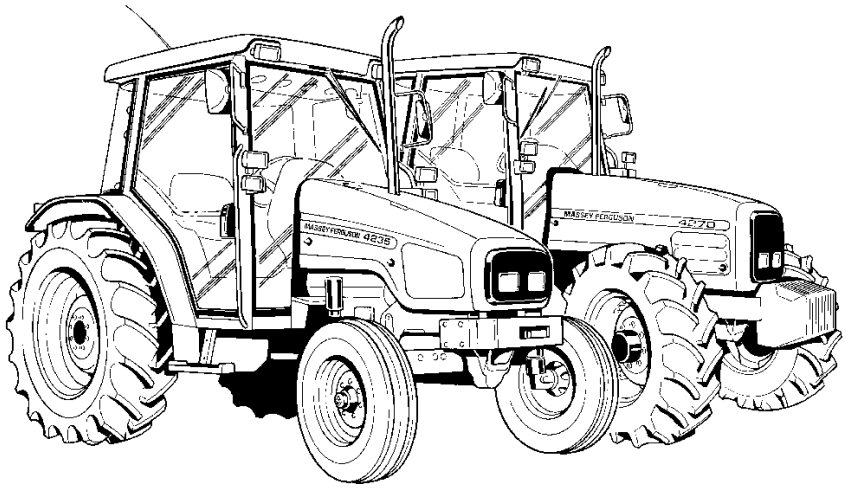
Tractor Manuals Scotland

4300 Series Tractor Workshop Manual

Publication No 1857 053 M4

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4200 Series Tractor Workshop Manual

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SECTION 1

Introduction and Safety

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Introduction and Safety in the Workshop

Section 1 - Part A

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Introduction and Safety in the Workshop

INTRODUCTION

The purpose of this manual is to assist Dealers and Distributors in the efficient repair and maintenance of Massey Ferguson farm machinery. Carrying out the procedures as detailed, together with the use of special tools where appropriate, will enable the operations to be completed within the time stated in the Repair Time Schedule.

To assist with locating information, each section of the manual is preceded by a contents page listing the operations. Each instruction within an operation has a sequence number, and to complete the operation in the minimum time it is essential that these instructions are performed in numerical sequence commencing at 1, unless otherwise stated.

When applicable, these sequence numbers identify the components in the appropriate illustration. Where an operation requires the use of a special tool, the tool number is quoted under the operation heading and is repeated in, or following, the instruction involving its use.

Indexing

For convenience the manual is divided into sections and parts, each page bearing a section and part number. The sections are subdivided into numbered operations. Example: 1-7A would be Operation 1 in Section 7, Part A. This simplifies cross referencing and enables the subject to be found easily.

Definition of Terms

The operation descriptions generally used throughout the schedules may be defined as follows:

Removal and Refitment - Remove and refit an original part or assembly, or a new part or assembly which does not involve additional operations or time.

Install - Install a part or component not previously fitted e.g., accessories.

Overhaul - Remove a part or assembly, dismantle, inspect and recondition, re-assemble, and re-install making all necessary adjustments.

Dis-assembly and Re-assembly - The terms `Dis-assembly' and `Re-assembly' indicate the orderly taking apart of an assembly into individual parts and rebuilding it into the original assembly.

Adjust - Make the necessary adjustments to restore specified setting or performance.

Check - Ascertain if a setting or condition is within the limits of acceptability, either as defined in the manufacturer's specifications or, where a dimension is not specified, in the judgement of the mechanic. The checking of fixings, e.g. nuts and bolts, includes tightening to the specified torque figures listed in this Manual.

Servicing - All technical work undertaken to maintain the machine in working order.

Special Tools

Where the use of a special tool is specified in an operation the tool number will be shown under the operation heading and also following the instruction requiring its use.

The use of the special tools mentioned in the text contributes to a safe, efficient and profitable repair. Some operations are impracticable without their use, for example, the refitment of the differential unit. Distributors and Dealers are therefore urged to check their tools against the list provided. Where necessary, tools may be ordered from: AGCO Limited. Product Reliability, Banner Lane, Coventry. CV4 9FG (Phone 44 (0) 1203 694400) (Fax 44 (0) 1203 852318).

For further details, refer to the special tool catalogue for this range of tractors, Publication No. 1856 550 M5, or Section 14 of this manual.

Repairs and Replacements

When service parts are required it is essential that only genuine Massey Ferguson replacements are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories:

Safety features embodied in the tractor may be impaired if other than genuine parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the tractor manufacturer's specification. Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices where specified must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The tractor warranty may be invalidated by the fitting of other than genuine Massey Ferguson parts. All Massey Ferguson replacements have the full backing of the manufacturer's warranty. Massey Ferguson Distributors and Dealers are obliged to supply only genuine service parts.

Repair of the Tractor

Follow these important points:

CLEAN THE TRACTOR AND DIAGNOSE THE FAULT BEFORE DIS-ASSEMBLY.

If possible, make a complete diagnosis to determine the extent of the repair required. Take precautions, as necessary, to prevent dirt or other foreign material entering the hydraulic, fuel or air systems.

DO NOT MIX PARTS.

Make particular note of special parts which should not be interchanged.

DURING DIS-ASSEMBLY, CLEAN PARTS THOROUGHLY AND INSPECT THEM FOR WEAR, DAMAGE, ETC.

LABEL PARTS. PROTECT PRECISION OR MACHINED SURFACES.

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Amendments

Under normal conditions revised pages are issued carrying the same number as the existing pages requiring amendment. The new pages are inserted in place of the existing ones. The old pages should then be destroyed.

The issue number is printed on the bottom of each page, e.g. Issue 1, 2 or 3 etc.

In some cases additional pages or completely new sections may be issued. These pages are to be inserted immediately following the page carrying the next lowest page number, or section number as appropriate.

Where new pages are required to be positioned between existing pages, the new page numbers will contain a suffix letter - example: New page number 7A-16a. This page is inserted after existing page number 7A-16 and before page number 7A-17. Correspondingly a further new page numbered 7A-16b would be positioned after 7A-16a but before 7A-17.

To ensure that a record of amendments to this manual is readily available, the list of amendments will be re-issued with each set of revised pages, quoting the amendment number, date of issue and appropriate instructions.

NOTE: *Service Bulletins and Amendment Sheets are issued to the Massey Ferguson Distributors and Dealers only and are not for general circulation.*

Amendment Status

Date	Issue	Page	Remarks
May 1997	M1	Issue 1 released	
August 1998	M2	New sections and issue 2 pages released.	Supplement S1/1857 053 M1 refers.
April 1999	M3	Sections 5J, 8D and 12C added. Issue 2 & 3 pages released.	Supplement 1857 053 S3 refers.
February 2000	M4	Section 10C added. Issue 2 & 3 pages released.	Supplement 1857 053 S4 refers.

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Introduction and Safety in the Workshop

SAFETY ALERT SYMBOL AND TERMS

This safety alert symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!



The safety alert symbol identifies important safety messages on machines, safety signs, in manuals, or elsewhere. When you see this symbol, be alert to the possibility of personal injury or death. Follow the instructions in the safety message.

Why is SAFETY important to you?

★ **ACCIDENTS DISABLE and KILL** ★

★ **ACCIDENTS are COSTLY** ★

★ **ACCIDENTS can be AVOIDED** ★

SAFETY in the WORKSHOP

This safety section of your Workshop Service manual is intended to point out some of the basic safety situations which may be encountered during the normal repair operations of the tractor, and to suggest possible ways of dealing with these situations.

Additional precautions may be necessary, depending on the type of repair and the conditions at the work site or in the workshop. Massey Ferguson has no direct control over the repair procedures, operation, inspection, lubrication or general maintenance. Therefore it is YOUR responsibility to use good safety practices in these areas.

SAFETY - A WORD to the MECHANIC

It is your responsibility to read and understand this safety section before carrying out repairs on Massey Ferguson equipment.

Remember that YOU are the key to safety. Good safety practices not only protect you, but also the people around you. Study the features in this section and the rest of the manual and make them a working part of your safety programme. Practice all other usual and customary safe working precautions, and above all – REMEMBER – SAFETY IS YOUR RESPONSIBILITY. YOU CAN PREVENT SERIOUS INJURY OR DEATH.

SAFETY - DANGER, WARNING and CAUTION

Whenever you see these signal words and symbol  used in this manual and on decals, you MUST take note of their instructions.



DANGER: The symbol and the word DANGER indicates an imminently hazardous situation which, if not avoided, will result in DEATH OR VERY SERIOUS INJURY.



WARNING: The symbol and the word WARNING indicates a potentially hazardous situation. If the instructions or procedures are not correctly followed it could result in PERSONAL INJURY, OR LOSS OF LIFE.



CAUTION: *The symbol and the word CAUTION is used to indicate a potentially hazardous situation that, if not avoided, may result in MINOR OR MODERATE INJURY.*

IMPORTANT: *The word IMPORTANT is used to identify special instructions which, if not observed, could result in damage to, or destruction of the machine, process or its surroundings.*

NOTE: *The word NOTE is used to indicate points of particular interest for more efficient and convenient repair or operation.*

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SAFETY DECALS



WARNING: DO NOT remove or obscure Danger, Warning or Instruction Decals.

Replace any Danger, Warning, Caution or Instruction Decals that are not readable, damaged or are missing.

GENERAL

Practically all service work involves the need to drive a tractor. The Operator Instruction Book, supplied with each tractor or implement, contains detailed safety precautions relating to driving, operating and servicing. These precautions are as applicable to the service mechanic as they are to the operator, and should be read, understood and practised by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or re-assembly operations, whether within a workshop facility or out 'in the field', consideration should be given to factors that may have an effect upon Safety, not only upon the mechanic carrying out the work, but also upon bystanders.

- DO NOT allow children or bystanders around or on the machine while it is being adjusted, serviced, repaired or operated.

PERSONAL CONSIDERATIONS

Clothing

- The wrong clothes or carelessness in dress can cause accidents. Check to see that you are suitably clothed. DO NOT wear loose clothing or long hair around equipment.

Some jobs require special protective equipment

Eye Protection

- The smallest eye injury may cause loss of vision. Injury can be avoided by wearing the proper eye protection when engaged in chiselling, grinding, discing, sanding, welding, painting etc.
- Wear safety goggles or safety glasses appropriate to the job in hand.

Breathing Protection

- Fumes, dust and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.

Hearing Protection

- Loud noise may damage your hearing and the greater the exposure the worse the damage. If you think the noise is excessive, wear ear protection.

Hand Protection

- It is advisable to use a protective barrier cream before work to prevent irritation and skin contamination. After work clean your hands in soap and water. Solvents such as white spirit, paraffin, etc., may harm the skin.
- Wear gloves when ever possible to protect your hands. DO NOT wear rings or wrist watches when working on machinery, as they could catch on moving parts and cause serious injury.

Foot Protection

- Substantial or protective footwear with reinforced toe-caps (safety shoes) will protect your feet from falling objects. Additionally, oil-resistant soles will help to avoid slipping.

Special Clothing

- For certain work it may be necessary to wear flame or acid-resistant clothing.

EQUIPMENT CONSIDERATIONS

Machine Guards

- Before using any machine, check to ensure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing coming in contact with the moving parts of the machine, but also ward off objects that might fly off the machine and cause injury. Ensure that missing guards are replaced.

Lifting Appliances

- Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes are thoroughly checked before use. If in doubt, select stronger equipment than is necessary.
- Never stand under a suspended load or raised implement.
- Avoid injury through incorrect handling of components. Make sure you are capable of lifting the object. If in doubt get help.

Jacking

- Select a jack strong enough to carry the load.
- Stabilise the tractor and chock the wheels.
- Put support stands under the tractor. Lower the jack and let the tractor rest on the stands.
- DO NOT go under a tractor supported by a chain hoist or jack.

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Compressed Air

- The pressure from a compressed air line is often as high as 7 bar (100 lbf/in²). It is perfectly safe if used correctly. Any misuse may cause injury.
- Never use compressed air to blow dust, filings, dirt etc., away from your work area unless the correct type of nozzle is fitted and eye protection is used.
- Compressed air is not a cleaning agent, it will only move dust, etc., from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears or skin.
- Used approved air guns, wear safety goggles, and use proper shielding to protect others in the work area.
- Never point an air nozzle at a persons body.

Hand Tools

- Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job, as this generally leads either to some injury, or to a poor job.
- Never use:–
  - A hammer with a loose head or split handle.
  - Spanners or wrenches with splayed or worn jaws.
  - Spanners or files as hammers; or drills, clevis pins or bolts as punches.
- Grind off mushroom heads from chisels. The sharp edges can tear your skin if the tool slips. And, when the tool is struck, chips could break off and fly into your eyes.
- Keep a handle on every file to prevent the tang from piercing your palm or wrist if the file should slip or catch.
- For removing or replacing hardened pins use a copper or brass drift rather than a hammer.
- For dismantling, overhauling and assembly of major components, always use Special Service Tools recommended.

  These will reduce the work effort, labour time and repair cost.
- Always keep tools clean and in good working order.

Electricity

- Electricity has become so familiar in day to day usage, that its potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.
- Before using any electrical equipment - particularly portable appliances - make a visual check to make sure that the cable is not worn or frayed and that the plugs, sockets, etc., are intact; make sure you know where the nearest isolating switch is located. Always use an earthed (grounded) 3 pin electrical cord.

GENERAL CONSIDERATIONS

Solvents

- Use only cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components such as seals, etc., and can cause skin irritation. Solvent labels should be checked that they are suitable not only for the cleaning of components and individual parts, but also that they DO NOT affect the personal safety of the user.

Housekeeping

- Many injuries result from tripping or slipping over or on, objects or material left lying around by a careless worker. Prevent these accidents from occurring. If you notice a hazard, don't ignore it - remove it.
- A clean, hazard-free place of work improves the surroundings and daily environment for everybody.
- Keep work organised and clean. Wipe up spills of any kind to minimise the possibility of a fall. Keep tools and parts off the floor to further reduce the possibility of tripping and causing serious injury.

Fire

- Fire has no respect for persons or property. The destruction that fire can cause is not always fully realised. Everyone must be constantly on guard.
  - Extinguish matches, cigars, cigarettes, etc., before throwing them away.
  - Work cleanly, disposing of waste material into proper containers.
  - Locate the fire extinguishers and find out how to operate them.
  - DO NOT allow or use open flame near the fuel tank, fuel lines, battery, hydraulic hoses or component parts
- When using a gas torch, always keep a fully charged fire extinguisher within reach.
- In the event of fire:
  - DO NOT panic - warn those near and raise the alarm.

First Aid

- In the type of work that mechanics are engaged in, dirt, grease, fine dust, etc. all settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may be found that an infection has formed within a short time. What appears at first to be trivial could become painful and injurious. It only takes a few minutes to have a fresh cut dressed, but it will take longer if you neglect it. Make sure you know where the First Aid box is located and that it is kept fully stocked at all times.

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OPERATIONAL CONSIDERATIONS

- Stop the engine, if at all possible, before performing any service.
- Place a warning sign on self propelled equipment which, due for service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended and remove the key.
- DO NOT attempt to start the engine while standing beside the tractor or attempt to by-pass the safety start switch. Make a practise of checking that neutral start switches are functioning correctly.
- Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.
- Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.
- Never work beneath a tractor which is on soft ground. Always take the unit to an area which has a hard level working surface - concrete is preferred.
- If it is found necessary to raise the equipment for ease of servicing or repair, make sure that safe and stable supports are installed, beneath axle housings, casings, etc., before commencing work.
- Certain repair or overhaul procedures may necessitate 'Separating the tractor', either at the engine gearbox or gearbox/rear axle locations. These operations are simplified by the use of the Tractor Splitting Kit/Stands (Use the Massey Ferguson MF.3012 Tractor Splitting Track, also available, MF.3013 Cab Stands). Should this equipment not be available, then every consideration must be given to stability, balance and weight of the components, especially if a cab is installed.
- Use footsteps or working platforms when servicing those areas that are not within easy reach.
- Cleanliness of the tractor hydraulic system is essential for optimum performance. When carrying out service and repairs plug all hose ends and component connections to prevent dirt entry.
- Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacement. Use of high pressure washer or steam cleaner is recommended.
- Before loosening any hoses or tubes connecting implements to remote control valves, etc., switch off the engine, remove all pressure in the lines by operating levers several times. This will remove the danger of personal injury by oil pressure.
- Prior to pressure testing, make sure all hoses and connectors not only of the equipment, but also those of the test equipment, are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or equipment, and to eliminate the possibility of personal injury.
- Hydraulic fluid escaping under pressure can have enough force to penetrate the human skin. To locate a leak under pressure, use a small piece of cardboard, never use your hands. If you are injected with hydraulic fluid seek medical help immediately.
- When equipment or implements are required to be attached to the hydraulic linkage, either for testing purposes or for transportation, the 'Position Control' should be used.
- Always lower equipment to the ground when leaving the tractor.
- If high lift attachments are installed on a tractor beware of overhead power, electric or telephone cables when travelling. Drop the attachment near to ground level to increase stability and minimise risks.
- DO NOT park or attempt to service the equipment on an incline. If unavoidable, take extra care and chock all wheels.
- Observe recommended precautions as indicated in this Service Manual when dismantling the air conditioning system as escaping refrigerant can cause frostbite.
- Prior to removing wheels and tyres from a tractor, check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly. Store the wheel so that they cannot fall over and cause injury.
- When inflating tyres beware of over inflation - constantly check the pressure. Over inflation can cause tyres to burst and result in personal injury.

Heed these safety precautions, and the ones found in this manual, and you will protect yourself accordingly. Disregard them and you may become injured for life.

SERVICING TECHNIQUES

Service Safety

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all farm machinery as well as the personal safety of the individual doing the work.

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This Service Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure that a thorough repair is successfully completed.

There are numerous variations in procedures, techniques, tools, and parts for servicing tractors, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Anyone who departs from the instructions provided in this Manual must realise that one compromises their personal safety and the tractor's integrity by the choice of repair methods, tools and/or parts.

Service Techniques

Clean the exterior of all components before carrying any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to 'O' rings and cause skin irritation. Check the label on Solvents to ensure that they are suitable for the cleaning of components and also that they DO NOT risk the personal safety of the user.

Replace 'O' rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or 'O' rings, regardless of condition. Always lubricate new seals and 'O' rings with hydraulic oil before installation.

When replacing component parts use the correct tool for the job.

Hoses and Tubes

Always replace hoses and tubes if their ends are damaged.

When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing or contact with other parts.

Before removing hoses or tubes make sure they are identified so that they can be correctly re-assembled.

Be sure any hose which has been installed is not kinked or twisted after it is tightened.

Bearings

Bearings which are considered suitable for further service should be cleaned in a suitable solvent and immersed in clean lubricating oil until required.

DO NOT spin bearings with compressed air. The centrifugal force could cause a ball or roller to fly outward with enough force to cause an injury.

Installation of a bearing can be classified in two ways: press fit on rotating parts such as shafts, and gears, and push fit into static locations such as reduction gear housings. Where possible, always install the bearing onto the rotating component first.

Always use pullers or a press to remove and/or install bearings, bushings and cylinder sleeves, etc. Use hammers, punches and chisels only when absolutely necessary and be sure to wear safety goggles.

Shims

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are re-installed.

Gaskets

Be sure the holes in the gasket correspond with the lubricant passages in the mating parts. If gaskets are to be made, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage - always renew gaskets prior to re-installation.

Lip Type Seals

Lubricate the lips of the lip-type seals before installation. Use petroleum jelly. DO NOT use grease. Ensure that the oil seal is fitted the right way round, the lip of the seal is placed next to the lubricant that is sealed. Some seals have a second auxiliary lip, which is used to prevent the ingress of dirt to the seal lip.

If, during installation, the seal lip must pass over a shaft that has splines, a keyway, rough surface or a sharp edge, the lip can be easily damaged. Always use a seal protector, when one is provided.

Use of Bolts in Blind Holes

Use bolts of the correct length. A bolt which is too long may 'bottom' before the head is tight against the part it is to hold. The threads can be damaged when a `long' bolt is removed. If a bolt is too short, there may not be enough threads engaged to hold the part securely.

Locking Devices

Lockwashers, flat metal locks or split pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head. Always install new locks.

Always fit new split pins/cotter pins and bend the ends round so that they will not catch in clothing and help to prevent cuts.

Cables and Wires

When removing or disconnecting a group of cables or wires, tag each one to assure proper re-assembly.

Always clip back wires and cable looms properly to prevent chafing, cable damage and possible damage by fire.

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Tractor Specification

Section 1 - Part B

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Tractor Specification

TRACTOR SPECIFICATION

Engine

Make	Perkins diesel to Massey Ferguson specification.
Type	Four stroke, water cooled, direct injection.
Models applicable - World-wide Cab:	Model ..... Perkins code
4215 - Low emission	903.27 ..... CP
4220 - Low emission - Turbocharged	903.27T ..... CR
4225 - Normal emission	4.41 ..... LM
4235 - Normal emission	4.41 ..... LM
4245 - Normal emission - Turbocharged	1004.40T ..... AH
4255 - Normal emission - Turbocharged	1004.40T ..... AH
4260 - Normal emission	1006.60 ..... YA
4270 - Normal emission	1006.60 ..... YA
Model applicable - North American Cab and Footstep:	
4225 - Low emission	1004.40 ..... AJ
4233 - Low emission	1004.42 ..... AK
4235 - Low emission - Turbocharged	1004.40T ..... AK
4243, 4245 - Low emission - Turbocharged	1004.40T ..... AK
4253, 4255 - Low emission - Turbocharged	1004.40T ..... AK
4263 - Low emission	1006.60 ..... YG
4270 - Low emission - Turbocharged	1006.60T ..... YH
Cylinders	3, 4 or 6.
Idle speed - all models	750 ± 25 rev/min.
Maximum rated speed - 4215, 4220	2250 ± 25 rev/min.
Maximum rated speed - all other models	2200 ± 25 rev/min.
Maximum no load speed - World-wide Cab:	
4215, 4220 - Normal emission	2420 ± 25 rev/min.
4225, 4235 - Normal emission	2350 ± 25 rev/min.
4245, 4255, 4260, 4270 - Normal emission	2310 ± 25 rev/min.
Maximum no load speed - North American Cab and Footstep:	
All models	2350 ± 25 rev/min.
Valve tip clearance:	
All tractors - Inlet (hot or cold)	0,20 mm (0.008 in).
All tractors - Exhaust (hot or cold)	0,45 mm (0.018 in).
Engine power and torque	Refer to Engine Section 3.

Cooling System

Type	Thermostat controlled with centrifugal pump to assist circulation multi-blade fan driven by a single or double belt from the crankshaft pulley.
Radiator pressure cap rating	0,75 bar (10 lbf/in²).
Fan belt(s) deflection	10 mm (3/8 in) or 35 N (8 lbf).
Air conditioner compressor belt deflection	15 mm (1/2 in).

Fuel System

Fuel lift pump	Mechanical, driven from camshaft, hand primed.
Fuel Filter	Lucas canister type filter.
Water sedimentor	Lucas with transparent sediment bowl.
Injection Pump	Lucas distributor type with mechanical governor.
Injectors	Lucas nozzles and holders.
Starting aid	Lucas thermostart.

Air System

Type	Two stage dry element with warning light. Removable main and secondary element.

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Clutch

Dry type:	
4215, 4220, 4225, 4233, 4235	305 mm (12 in) - Coil spring type.
4243 to 4270	330 mm (13 in) - Belleville spring type.
Clutch adjustment	No routine adjustment required.
Clutch pedal height:	
Lo-Profile cab	190-200 mm (7.7-7.9 in)
Standard cab	160-170 mm (6.3-6.7 in)
Footstep	160-170 mm (6.3-6.7 in)
Oil cooled type:	
Type	Multi-plate, oil cooled, mechanically operated.
Clutch adjustment	None.
Clutch pedal height:	
Lo-Profile cab	210-230 mm (8.3-9.0 in)
Standard cab	180-190 mm (7.0-7.5 in)
Footstep	180-190 mm (7.0-7.5 in)

Transmissions

8 x 2 Manual gearbox	The eight speed Manual gearbox has 8 forward and 2 reverse speeds. This is achieved by using a four forward and one reverse gearbox, no synchromesh is provided. This is compounded by a two speed range gearbox and controlled by centre shift levers. Reverse is available in high and low ratio.
Number of gears forward	8.
Number of gears reverse	2.
18 x 6 Speedshift gearbox	The 18 Speedshift gearbox has 18 forward and six reverse speeds. This is achieved by using a three forward and one reverse speed gearbox with synchromesh on all gears. This is compounded by a three speed range gearbox to give nine forward and three reverse speeds. At the front of the gearbox there is an electro/hydraulically operated Fast/Slow Speedshift unit which doubles the number of speeds to 18 forward and six reverse.
Number of gears forward	18.
Number of gears reverse	6.
12 x 12 Shuttle gearbox	The 12 x 12 Shuttle gearbox has twelve speeds forward and reverse. This is achieved by using a four-speed gearbox, compounded by a three-speed range gearbox to give twelve speeds. A forward/reverse unit is situated in front of the gearbox, all gears are synchromesh. A creeper attachment is available with this transmission with a reduction ratio of 4.7 : 1.
Number of gears forward	12.
Number of gears reverse	12.
12 speed shuttle creeper gearbox	The creeper reduction unit is a self contained set of gears mounted in the front section of the gearbox above the forward and reverse shuttle gears.
Application	Tractors fitted with 12 speed shuttle gearbox.
Speed reduction ratio	4.7 : 1.
Number of creeper speeds	4.

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12 x 4 Synchromesh gearbox	The 12 x 4 synchromesh gearbox has 12 forward and 4 reverse speeds. This is achieved by using a three forward and one reverse gearbox with synchromesh on all gears. This is compounded by a two speed range gearbox to give six speeds which is further doubled by a manual selector lever situated to the right of the drivers console. Reverse is available on all gears.
Number of gears forward	12.
Number of gears reverse	4.
8 x 8 Shuttle gearbox	The 8 x 8 Shuttle gearbox has eight speeds available forward and reverse. This is achieved by using a four speed gearbox compounded by a two speed range gearbox to give eight speeds. A shuttle lever to the left of the steering wheel provides easy forward to reverse gear changing.
Number of gears forward	8.
Number of gears reverse	8.
Range gearbox	The range gearbox is directly bolted to the rear of the main gearbox forming an integral unit. It is fitted with either a two or three speed unit. It also provides the drive to the front four-wheel drive axle.

Rear Axle

Rear axle maximum static load:	
4215 to 4220	4536 kgf (10000 lbf) - Narrow.
4225 to 4245	4536 kgf (10000 lbf) - Normal-duty.
4255 to 4270	5443 kgf (12000 lbf) - Heavy-duty.
Rear track - Pressed steel wheels:	
4215 to 4225	1425-1830 mm (56-72 in) - Narrow.
4225 to 4240	1425-2130 mm (56-84 in) - Normal-duty.
4245 to 4270	1525-2235 mm (60-88 in) - Heavy-duty.
Rear track - Cast centre wheels:	
4225 to 4240	1395-2210 mm (55-87 in) - Normal-duty.
4245 to 4270	1425-2130 mm (56-84 in) - Heavy-duty.
Rear track - PAVT wheels:	
4225 to 4245	1425-1930 mm (56-76 in) - Normal-duty axle.
4255 to 4270	1525-2130 mm (60-84 in) - Heavy-duty axle.
Rear track - PAVT wheels - dual ramp:	
4225 to 4245 and 4263	2030-2130 mm (80-84 in) - Normal-duty.
4260 and 4270	1830-2440 mm (72-96 in) - Heavy-duty.

Brakes

Type	Multi-disc oil immersed.
Model	T.S. brake (Tangential Slave).
Parking brake	Cable operated on both brakes independent of the foot brake.
Brake fluid	Mineral based (Green) - Massey Ferguson part No 3405 389 M1.

Power Take-off

Single-speed PTO:	
540 rev/min PTO speed	1789 engine rev/min.
Economy PTO:	
Standard 540 PTO	1979 engine rev/min.
Economy 540 (540E) PTO	1421 engine rev/min.
Two-speed PTO:	
540 rev/min PTO speed	1902 engine rev/min.
1000 rev/min PTO speed	2000 engine rev/min.

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Front mounted PTO:	
Speed	1000 rev/min at 2000 engine rev/min.
Rotation	Counter-clockwise.
Shaft type	540 rev/min type - 6 spline.
540 rev/min PTO shaft:	
No. of splines	6.
Outside diameter	34,93 mm (1.375 in).
1000 rev/min PTO shaft:	
No. of splines	21.
Outside diameter	34,93 mm (1.375 in).

Steering

Type	Hydrostatic power steering.
Pump	Transmission mounted gear pump drawing oil from the transmission case.
Turns lock to lock	4
Steering wheel	Tilt adjustable.

Front Axle - Two-wheel Drive

Type	Three section with telescopic outer arms.
4215 to 4225	Normal-duty.
4225 to 4255	Heavy-duty.
4243 to 4270	Extra heavy-duty.
4233 to 4270	Wide row crop.
Front track settings:	
Normal-duty	1245-1855 mm (49-73 in).
Heavy-duty and extra heavy-duty	1315-1820 mm (52-72 in).
Wide row crop	1830-2335 mm (72-96 in).
Static load:	
Normal-duty axles	2600 kgf (5732 lbf).
Heavy-duty axles	3460 kgf (7628 lbf).
Extra heavy-duty axles	4360 kgf (9612 lbf).
Front Wheel tow-in	0-5 mm (0-3/16 in) at wheel rim.
Turning circles - less brakes:	
4215 and 4220	6,8 metre (268 in).
4225 to 4255	8,0 metre (315 in).
4260 and 4270	9,5 metre (374 in).

Front Axle - Four-wheel Drive

Type ..... Centre drive, hydraulically engaged with Hydralock differential.

Tractor model:	Axle model - all centre drive	Width across hub flanges	Maximum static load
4215, 4220, 4225, 4233, 4235	AG 66 Narrow	1366 mm (53.82 in)	3000 kgf (6614 lbf)
4225, 4233, 4235	AG 66 Wide	1562 mm (61.54 in)	3000 kgf (6614 lbf)
4225 to 4263	AG 75	1669 mm (65.76 in)	4500 kgf (9921 lbf)
4225 to 4263	AG 85	1669 mm (65.76 in)	4500 kgf (9921 lbf)
4255, 4260, 4270	AG 105	1800 mm (70.92 in)	5000 kgf (11023 lbf)

Toe-in	0-4 mm (0-5/32 in).
Maximum turning angle	55°.

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Turning circles -less brakes:	
4215 and 4220	7,8 metre (307 in).
4225 to 4255	8,0 metre (315 in).
4260 and 4270	9,2 metre (362 in).
Front track settings:	
AG 66 narrow front axle	1423-1624 mm (56 in-64 in).
AG 66 wide front axle	1412-1820 mm (56 in-72 in).
AG 75 or AG 85 front axle	1407-1908 mm (55 in-75 in).
AG 105 front axle on 24 inch wheels	1557-2058 mm (61 in-81 in).
AG 105 front axle on 28 inch wheels	1451-2058 mm (57 in-81 in).

Wheel - Rim Nut and Bolt Torques

Front axle - two-wheel drive bolts	95 Nm (70 lbf ft).
Front axle - Four-wheel drive:	
Wheel nuts	270 Nm (200 lbf ft).
Rim to disc nuts	190 Nm (140 lbf ft).
Rear Wheels - Pressed steel:	
Wheel nuts	325 Nm (240 lbf ft).
Rim to disc nuts	240 Nm (177 lbf ft).
Rear wheels - Cast centre:	
Wheel nuts	325 Nm (240 lbf ft).
Rim clamp nuts (PAVT)	260 Nm (192 lbf ft).

Electrical System - 12 volt:

Battery:

Double battery installation	Type 372.	
Single battery installation	Type 665.	
	Type 372.	Type 665.
SAE rating	590A.	810A.
IEC rating	390A.	545A.
DIN rating	350A.	490A.
Ampere hour	120.	70.
Reserve capacity	110 min.	220 min.

Starter motor:

Type	Solenoid engaged pinion, safety start device operated by the gear shift lever and on the PTO.
Size	2,2 Kw.

Alternator:

	Cab tractor	Footstep tractor
Type	A127-70.	A127-45.
Size	70 amp.	45 amp.
Regulating voltage	14.2 volt.	14.2 volt

Light bulb sizes and part No.:

Head light	R2. - 45/40 W - Continental (white) - 961 866 M1.
Upper head light (Germany only)	H4. - 60/55 W - Halogen - 3713 341 M1.
Work light	H3. 55 W - Halogen - 1628 494 M1.
Side light	R. 5 W - Single contact - 1420 037 M1.
Stop and rear red light	P. 21/5 W - Double contact index - 908 543 M1.
Hazard and direction indicator light	P. 21 W - Single contact - 621 235 M1.
Number plate light	C. 5 W - Festoon - 621 234 M1.
Interior light	SV. 8.5 10 W - Festoon - 3385 821 M1.
Instrument panel lights	1,2 W - Capless - 3405 185 M1.
Instrument panel lights	2,0 W - Capless with holder - 3901 628 M91.
Rotating beacon	55 W - Halogen H1 - 3405 180 M1.

Fuses - Continental blade type:

Size and colour	2 amp (clear), 5 amp (tan), 7,5 amp (brown), 10 amp (red), 15 amp (blue), 20 amp (yellow), 25 amp (natural white), 30 amp (green).

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Lift Hydraulics

Hydraulic pump - Ferguson:	
Model	Mk. 3.
Type	Four cylinder, scotch yoke, driven from the PTO drive line.
Output at 2200 engine rev/min at normal working pressure:	
540 rev/min PTO (single speed)	17 litre/min (3.7 gal/min)(4.5 US gal/min).
540/540E rev/min PTO	22 litre/min (4.8 gal/min)(5.8 US gal/min).
540/1000 rev/min PTO	28 litre/min (6.2 gal/min)(7.4 US gal/min).
Pressure relief valve setting	227 bar (3292 lbf/in²).
Hydraulic pump - Electronic Lift Control:	
Type	Single element open type, transmission mounted.
Drive	Chain drive from PTO clutch housing.
Maximum pump flow 2200 rev/min at normal working pressure:	
Output	28 litre/min (6.2 gal/min)(7.4 US gal/min).
Maximum pressure	227 bar (3292 lbf/in²).

Auxiliary Hydraulics

Pump Type	Dual element gear type, transmission mounted.
Make	Sunstrand.
Drive	Chain drive from PTO clutch housing.
Maximum pump flow at 2200 engine rev/min at normal working pressure:	
Output	38 litre/min (8.4 gal/min)(10.0 US gal/min).
Maximum pressure	210 bar (3046 lbf/in²).
Oil strainer:	
Type	100 micron washable.
Location	Right-hand side of rear axle housing.
Oil Filter:	
Type	Centrifugal washable.
Location	Manifold block, right-hand side of rear axle housing.
Auxiliary hydraulic control valves:	
Type	Open centre.
Number of sections	1, 2, 3 or 4.
Type of sections available	Spring return to neutral (standard World-wide).
Optional	Detented with pressure kick-out. Detent with kickout plus float (standard North-America). Motor.
Combined Flow at quick release coupling at 2200 engine rev/min:	
Combined flow 540 PTO (single speed)	55 litre/min (12.1 gal/min)(14.5 US gal/min).
Combined flow 540/540E PTO	60 litre/min (13.2 gal/min)(15.8 US gal/min).
Combined flow 540/1000 PTO	66 litre/min (14.5 gal/min)(17.4 US gal/min).
Pressure at quick release coupling with combined flow at 2200 engine rev/min	210 bar (3046 lbf/in²) maximum.
Trailer brake valve:	
Make	Bosch.
Ratio	4:1.
Piston diameter	12 mm.
Maximum pressure to brakes	135 bar (1960 lbf/in^2).
Maximum oil flow to trailer brake	15 litre/min (3.3 gal/min)(4 US gal/min).

Drawbars

Standard:	
Maximum static load:	
Normal-duty:	
Inner position	775 kgf (1709 lbf).
Centre position	775 kgf (1709 lbf).
Fully extended position	775 kgf (1709 lbf).

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Heavy-duty:	
Inner position	1180 kgf (2601 lbf).
Centre position	1180 kgf (2601 lbf).
Fully extended position	1180 kgf (2601 lbf).
Distance to PTO shaft:	
Inner position	250 mm (10 in).
Centre position	350 mm (14 in).
Fully extended position	400 mm (16 in).
Drawbar face to centre of PTO shaft	200 mm (7.88 in).
Drawbar side swing from centre	221 mm (8.70 in).
Pintle-pin:	
Maximum static load	3000 kgf (6614 lbf).
Drawbar maximum static load	1180 kgf (2601 lbf).
Extended (North America):	
Maximum static load:	
Inner position	1180 kgf (2601 lbf).
Fully extended position	1180 kgf (2601 lbf).
Distance to PTO shaft (selected by PTO shaft):	
Fully extended position - (540 rpm)	350 mm (14 in).
Fully extended position - (1000 rpm)	400 mm (16 in).
Drawbar face to centre of PTO shaft	239 mm (9.4 in).
Drawbar side swing from centre	200 mm (7.9 in).

Pick-up Hitch

Normal-duty:	
Hook:	
Maximum static load	2243 kgf (4945 lbf).
Drawbar - distance to PTO shaft:	
Inner position	350 mm (14 in).
Fully extended position	400 mm (16 in).
Drawbar - maximum static load:	
Inner position	775 kgf (1709 lbf).
Fully extended position	775 kgf (1709 lbf).
Heavy-duty:	
Hook - maximum static load:	
Inner position	3058 kgf (6742 lbf).
Centre position	1180 kgf (2601 lbf).
Fully extended position	1180 kgf (2601 lbf).
Drawbar - distance to PTO shaft:	
Inner position	250 mm (10 in).
Centre position	350 mm (14 in).
Fully extended position	400 mm (16 in).
Drawbar - maximum static load:	
Inner position	1180 kgf (2601 lbf).
Centre position	1180 kgf (2601 lbf).
Fully extended position	1180 kgf (2601 lbf).

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Lift Linkage

Front linkage:	
Type	Hook ends - Category 2.
Lift capacity at link ends:	
Normal-duty	1800 kgf (3968 lbf).
Heavy-duty	2600 kgf (5732 lbf).
Rear linkage:	
Linkage types World-wide:	
4215, 4220, 4225, 4233, 4235, 4245	Interchangeable ball ends - Category 1 and 2.
4225, 4233, 4235, 4245	Normal-duty telescopic - Maximum capacity 3000 kgf (6614 lbf).
4245, 4255, 4260, 4270	Heavy-duty telescopic
4225, 4233, 4235, 4245, 4255, 4260, 4270	Fixed ball ends - Category 2.
4225, 4233, 4235, 4245, 4255, 4260, 4270	Hook ends - Category 2.
4225, 4233, 4235, 4245, 4255, 4260, 4270	Telescopic ends - Category 2.
Linkage types - North America:	
4225, 4233, 4235, 4243, 4245, 4253	Normal-duty telescopic ends - Category 2 - Maximum capacity 3000 kgf (6614 lbf).
4255, 4263, 4270 Tractors	Heavy-duty telescopic ends - Category 2.
Lift capacity at link ends with links horizontal - World-wide:	
4215, 4220	2200 kgf (4850 lbf).
4225, 4233, 4235	2600 kgf (5732 lbf).
4225, 4233, 4235, 4245	3000 kgf (6614 lbf) with 1 x 28 mm assistor cylinder.
4245, 4255, 4260	4000 kgf (8818 lbf) with 2 x 28 mm assistor cylinders.
4270	5000 kgf (11023 lbf) with 2 x 40 mm assistor cylinders.
Lift capacity at link ends with links horizontal - North America:	
4225, 4233, 4235,4243, 4245,4253	2600 kgf (5732 lbf).
4255, 4263	3000 kgf (6614 lbf).
Lift capacity at link ends with assistor cylinders - North America:	
4225, 4233, 4235,4243, 4245,4253	3000 kgf (6614 lbf).
4255, 4263	4000 kgf (8818 lbf).
4270	5000 kgf (11023 lbf).

Air Conditioning System

Refrigerant type	R134a.
Compressor type	SD7H15-7952.
Refrigerant oil type	PAG (SP-20).
Quantity of oil	190 cc (6.43 fl oz) - Total system capacity.
Drive belt deflection	12-15 mm (1/2-5/8 in).
Refrigerant capacity:	
4 Cylinder engines	1400 g (3.1 lb) (494 oz).
6 cylinder engines	1450 g (3.2 lb) (512 oz).

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Capacities

Fuel tanks Cab tractors:	
Lo-Profile Cab - 4215, 4220, 4225	84 litres (18.5 gal)(22 US gal).
Lo-Profile Cab - 4233, 4235, 4245, 4255	98 litres (22 gal)(26 US gal).
Standard Cab - Hi-Vis - 4233, 4235, 4245, 4255	127 litres (28 gal)(34 US gal).
Standard Cab - 4233, 4235, 4243, 4245, 4255:	
Single tank	127 litres (28 gal)(34 US gal).
Twin tanks	189 litres (42 gal)(50 US gal).
Standard Cab - 4260, 4263, 4270:	
Single tank	143 litres (31 gal)(38 US gal).
Twin tanks	205 litres (45 gal)(54 US gal).
Fuel tanks - Footstep tractors:	
Four cylinder engines - 'Lo Profile' sheet metal:	
Single tank	110 litres (29 US gal).
Four cylinder engines - Standard:	
Single tank	130 litres (34 US gal).
Twin tanks	200 litres (53 US gal).
Six cylinder engines:	
Single tank	130 litres (34 US gal).
Twin tanks	200 litres (53 US gal).
Engine oil:	
Three cylinder engines	5,7 litres (1.3 gal)(1.5 US gal).
Four cylinder engines	6,5 litres (1.4 gal)(1.7 US gal).
Six cylinder engines	13,5 litres (3.0 gal)(3.6 US gal).
Cooling system:	
Three cylinder engines	10,2 litres (2.3 gal)(2.7 US gal).
Four cylinder engines	17,5 litres (3.9 gal)(4.6 US gal).
Six cylinder engines	28,0 litres (6.2 gal)(7.4 US gal).
Transmission/hydraulics:	
Two- and four-wheel drive	50,0 litres (11.0 gal)(13.2 US gal).
Rear axle epicyclic hubs - heavy-duty only - each side	2,9 litres (5 pts)(5 US pts).
Front four-wheel drive axle:	
Oil capacity - epicyclic - each side:	
AG 66	0,8 litre (1.5 pt)(1.5 US pt).
AG 75 and AG 85	1,0 litre (1.8 pt)(1.8 US pt).
AG 105	1,2 litre (2 pt)(2 US pt).
Oil capacity - complete axle:	
AG 66, AG 75, AG 85	5,6 litre (1.2 gal)(1.5 US gal).
AG 105	7,6 litre (1.7 gal)(2 US gal).
Dual screen and rear window washer bottle:	
Capacity	2,5 litre (4 pt)(4 US pt).
Front PTO gearbox:	
Capacity	0,6 litre (1 pt)(1 US pt).

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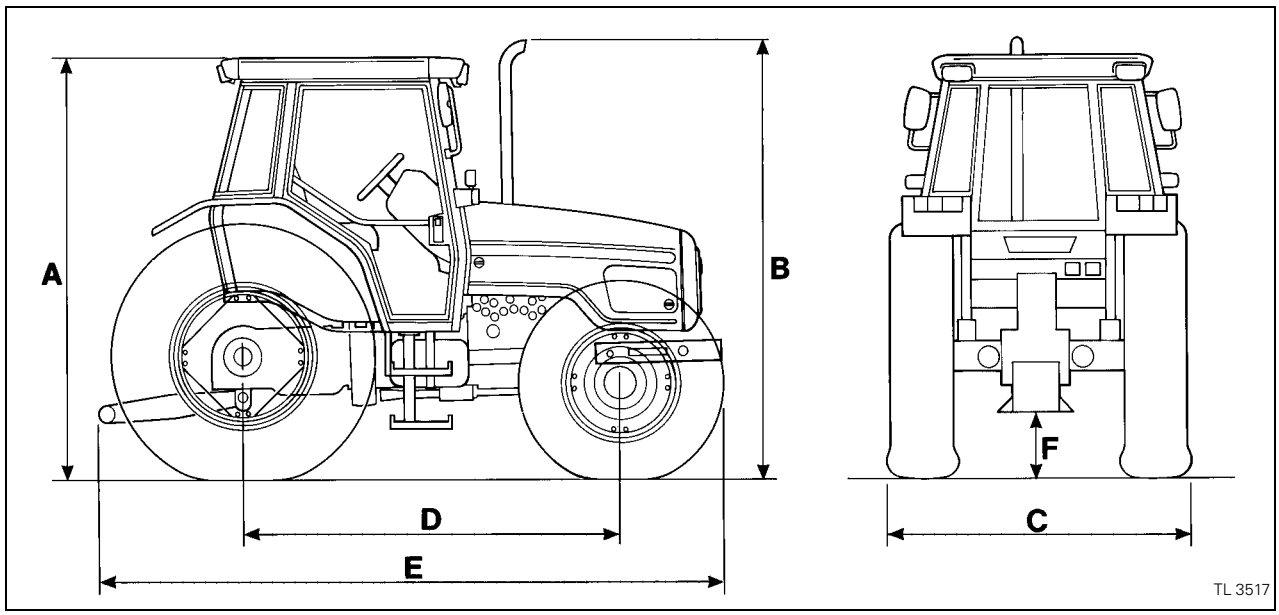
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Tractor Specification

TRACTOR DIMENSIONS AND WEIGHTS - CAB TRACTORS



Dimensions - mm (in)

Tractor model	4215	4220	4225	4233/35
Tyre size (rear)	14.9 - 28	14.9 - 28	16.9 - 30	16.9 - 34
Track setting	1525 (60)	1525 (60)	1525 (60)	1525 (60)
A. Overall height:				
Lo-Profile cab, flat roof	2360 (93)	2360 (93)	2365 (93)	–
Lo-Profile cab, standard roof	2450 (97)	2450 (97)	2455 (98)	–
Lo-Profile cab, flat roof	–	–	–	2445 (96)
Lo-Profile cab, standard roof	–	–	–	2535 (100)
Standard cab (flat floor), Hi-Vis, standard roof	–	–	2565 (101)	2615 (103)
Standard cab (flat floor), standard roof	–	–	–	2615 (103)
Standard cab (flat floor), standard roof	–	–	–	–
B. Height over exhaust	30-150 mm (1-6 in) above cab height			
C. Overall width	1900 (75)	1900 (75)	1955 (77)	1955 (77)
D. Wheel base:				
Two-wheel drive - normal-duty axle	2130 (84)	2130 (84)	2190 (86)	2190 (86)
Two-wheel drive - heavy- and extra heavy-duty axle	–	–	2350 (93)	2350 (93)
Four-wheel drive - AG 66 axle	2230 (88)	2230 (88)	2280 (90)	2280 (90)
Four-wheel drive - AG 75, AG 85 or AG 105 axle	-	-	2350 (93)	2350 (93)
E. Overall length:				
Two-wheel drive - without weights	3740 (147)	3740 (147)	3850 (152)	4010 (158)
Two-wheel drive - with weights	4075 (160)	4075 (160)	4185 (165)	4345 (171)
Four-wheel drive - without weights	3860 (152)	3860 (152)	3940 (155)	4050 (160)
Four-wheel drive - with weights	4192 (165)	4192 (165)	4277 (168)	4345 (171)
F. Minimum ground clearance (average)			340 (13)	340 (13)

continued

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TRACTOR DIMENSIONS and WEIGHTS - CAB TRACTORS *continued*

Dimensions - mm (in)

Tractor model	4243/4245	4253/4255	4260/4263	4270
Tyre size (rear)	16.9 - 34	16.9 - 34	16.9 - 38	18.4 - 38
Track setting	1625 (64)	1625 (64)	1625 (64)	1625 (64)
A. Overall height:				
Lo-Profile cab, flat roof	--	--	--	--
Lo-Profile cab, standard roof	--	--	--	--
Lo-Profile cab, flat roof	2445 (96)	2445 (96)	--	--
Lo-Profile cab, standard roof	2535 (100)	2535 (100)	--	--
Standard cab (flat floor), Hi-Vis, standard roof	2615 (103)	2640 (104)①	--	--
Standard cab (flat floor), standard roof	2615 (103)	2640 (104)①	--	--
Standard cab (flat floor), standard roof	-	-	2680 (106)	2740 (108)
B. Height over exhaust	30-150 mm (1-6 in) above cab height			
C. Overall width	2055 (81)	2055 (81)	2055 (81)	2095 (82)
D. Wheel base:				
Two-wheel drive - heavy-duty axle	--	--	--	--
Two-wheel drive - heavy- and extra heavy-duty axle	2350 (93)	2350 (93)	2610 (103)	2610 (103)
Four-wheel drive - AG 66 axle	2350 (93)	-	-	-
Four-wheel drive - AG 75, AG 85 or AG 105 axle	2280 (90)	2350 (93)	2610 (103)	2610 (103)
E. Overall length:				
Two-wheel drive - without weights	4010 (158)	4010 (158)	4322 (170)	4322 (170)
Two-wheel drive - with weights	4345 (171)	4345 (171)	4655 (183)	4655 (183)
Four-wheel drive - without weights	4050 (160)	4100 (161)	4412 (174)	4450 (175)
Four-wheel drive - with weights	4345 (171)	4345 (171)	4655 (183)	4655 (183)
F. Minimum ground clearance (average)	340 (13)	390 (15)	390 (15)	405 (16)

NOTE: *The word 'Hi-Vis' refers to the High Visibility type hood with small radiator grille.*

The weights and dimensions can vary, depending on the specification of tyres, optional equipment, size of fuel tank etc. The dimensions and weights quoted are based on a tractor with the most common build and tyre size, therefore a slight variation may be found between these figures and your tractor.

① on 16.9 - 38 tyres.

Weights - kg (lb)

Tractor model - Four-wheel drive	4215	4220	4225	4233, 4235
Front axle	1234 (2720)	1234 (2720)	1396 (3078)	1506 (3320)
Rear axle	1750 (3858)	1750 (3858)	2000 (4409)	2200 (4850)
Total	2984 (6579)	2984 (6579)	3396 (7497)	3706 (8170)
Tractor model - Four-wheel drive	4243, 4245	4253, 4255	4260, 4263	4270
Front axle	1533 (3380)	1533 (3380)	1700 (3748)	1700 (3748)
Rear axle	2226 (4907)	2226 (4907)	2421 (5337)	2421 (5337)
Total	3759 (8287)	3759 (8287)	4121 (9085)	4121 (9085)

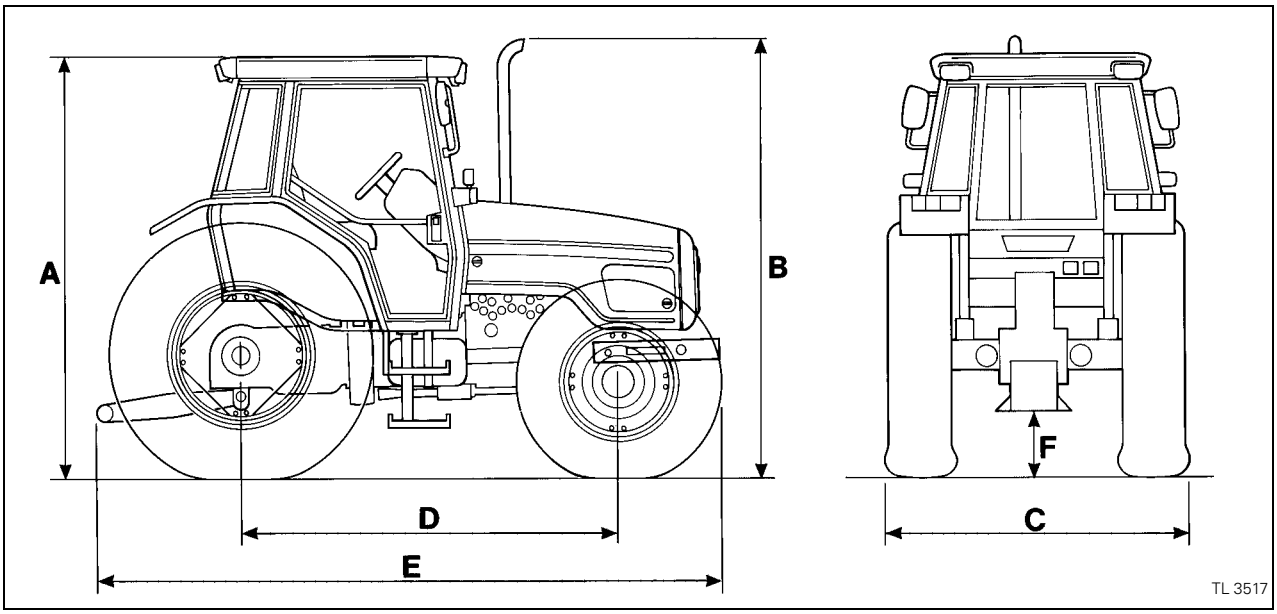
Tractor model - Two-wheel drive	4215	4220	4225	4233, 4235
Front axle	1020 (2249)	1020 (2249)	1146 (2526)	1256 (2769)
Rear axle	1750 (3858)	1750 (3858)	2000 (4409)	2200 (4850)
Total	2730 (6019)	2730 (6019)	3146 (6936)	3456 (7619)
Tractor model - Two-wheel drive	4243, 4245	4253, 4255	4260, 4263	4270
Front axle	1283 (2829)	1283 (2828)	1450 (3197)	1450 (3197)
Rear axle	2226 (4907)	2226 (4907)	2421 (5337)	2421 (5337)
Total	3509 (7736)	3509 (7736)	3871 (8534)	3871 (8534)

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Tractor Specification

TRACTOR DIMENSIONS AND WEIGHTS - NAO CAB TRACTORS



Dimensions - mm (in)

Tractor model	4225	4233/35	4243/45
Tire size (rear)'	16.9 - 30	16.9 - 30	18.4 - 30
Track setting	1525 (60)	1525 (60)	1625 (64)
A. Overall height:			
Lo-Profile cab, standard roof	2446 (96)	2446 (96)	2469 (97)
Standard cab (flat floor), standard roof	2526 (100)	2526 (100)	2549 (100)
B. Height over exhaust	30-150 mm (1-6 in) above cab height		
C. Overall width	1955 (77)	1955 (77)	2055 (81)
D. Wheel base:			
Two-wheel drive	2350 (93)	2350 (93)	2350 (93)
Four-wheel drive	2350 (93)	2350 (93)	2350 (93)
E. Overall length:			
Two-wheel drive - without weights	3850 (152)	4010 (158)	4010 (158)
Two-wheel drive - with weights	4185 (165)	4345 (171)	4345 (171)
Four-wheel drive - without weights	3940 (155)	4050 (160)	4050 (160)
Four-wheel drive - with weights	4277 (168)	4345 (171)	4345 (171)
F. Minimum ground clearance (average)	343 (14)	343 (14)	366 (14)

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TRACTOR DIMENSIONS AND WEIGHTS - NAO CAB TRACTORS CONTINUED

Dimensions - mm (in)

Tractor model	4253/55	4263	4270
Tire size (rear)	18.4 - 30	18.4 - 34	18.4 - 38
Track setting	1625 (64)	1625 (64)	1625 (64)
A. Overall height:			
Lo-Profile cab, standard roof	2469 (97)	–	–
Standard cab (flat floor), standard roof	2549 (100)	2640 (104)	2690 (106)
B. Height over exhaust	30-150 mm (1-6 in) above cab height		
C. Overall width	2055 (81)	2055 (81)	2095 (82)
D. Wheel base:			
Two-wheel drive	2350 (93)	2610 (103)	2610 (103)
Four-wheel drive	2350 (93)	2610 (103)	2610 (103)
E. Overall length:			
Two-wheel drive - without weights	4010 (158)	4322 (170)	4322 (170)
Two-wheel drive - with weights	4345 (171)	4655 (183)	4655 (183)
Four-wheel drive - without weights	4100 (161)	4412 (174)	4450 (175)
Four-wheel drive - with weights	4345 (171)	4655 (183)	4655 (183)
F. Minimum ground clearance (average)	366 (14)	417 (16)	467 (18)

NOTE: *The word 'Hi-Vis' refers to the High Visibility type hood with small radiator grille.*

The weights and dimensions can vary, depending on the specification of tires, optional equipment, size of fuel tank etc. The dimensions and weights quoted are based on a tractor with the most common build and tire size, therefore a slight variation may be found between these figures and your tractor.

Weights - kg (lb)

Tractor model - Four-wheel drive only	4225	4233/35	4243/45	4253/55	4263	4270
Front axle	1396 (3078)	1396 (3078)	1533 (3380)	1533 (3380)	1700 (3748)	1700 (3748)
Rear axle'	2000 (4409)	2000 (4409)	2226 (4907)	2226 (4907)	2421 (5337)	2421 (5337)
Total	3396 (7497)	3396 (7497)	3759 (8287)	3759 (8287)	4121 (9085)	4121 (9085)

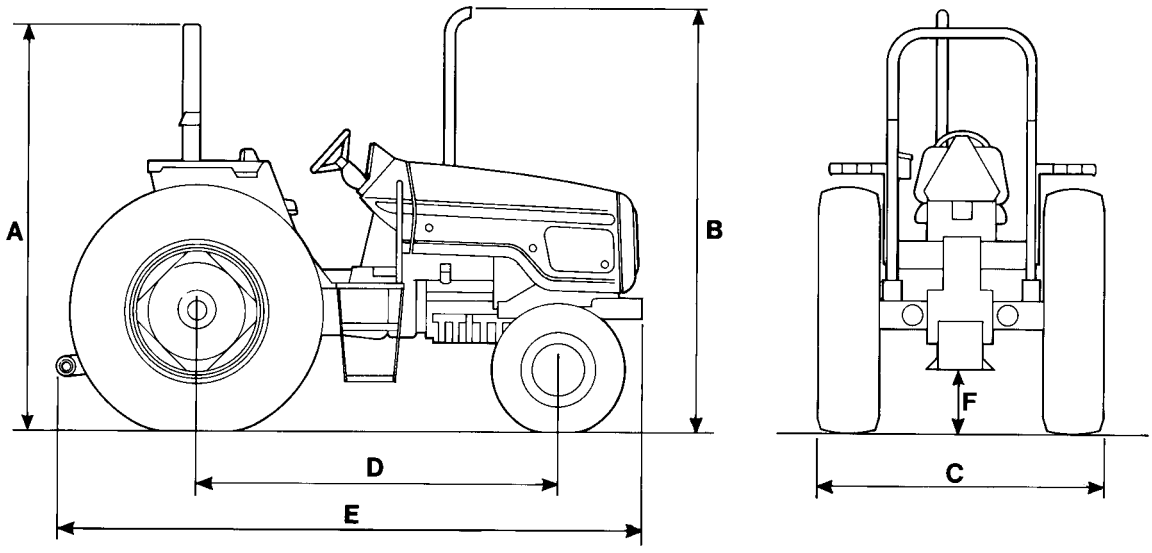
Tractor model - Two-wheel drive only	4225	4233/35	4243/45	4253/55	4260/63	4270
Front axle	1146 (2526)	1256 (2769)	1283 (2828)	1283 (2828)	1450 (3197)	1450 (3197)
Rear axle'	2000 (4409)	2200 (4850)	2226 (4907)	2226 (4907)	2421 (5337)	2421 (5337)
Total'	3146 (6936)	3456 (7619)	3509 (7736)	3509 (7736)	3871 (8534)	3871 (8534)

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Tractor Specification

TRACTOR DIMENSIONS AND WEIGHTS - FOOTSTEP TRACTORS



Dimensions - mm (in)

Tractor model	4 cylinder normal-duty	4 cylinder heavy-duty	6 cylinder normal-duty	6 cylinder heavy-duty
Tire size (rear)	16.9 - 30	16.9 - 34	18.4 - 30	18.4 - 38
Track setting	1640 (64)	1760 (68)	1640 (64)	1740 (68)
A.Height over ROPS	2610 (103)	2657 (104)	2690 (106)	2791 (110)
B.Height over exhaust	2630 (104)	2677 (105)	2740 (108)	2841 (112)
C.Overall width	2090 (82)	2100 (83)	2118 (83)	2220 (87)
D.Wheel base:				
Two-wheel drive	2350 (93)	2350 (93)	2610 (103)	2610 (103)
Four-wheel drive axle	2350 (93)	2350 (93)	2610 (103)	2610 (103)
E.Overall length:				
Two-wheel drive	3960 (156)	3960 (156)	4250 (167)	4250 (167)
Four-wheel drive axle	3960 (156)	3960 (156)	4250 (167)	4250 (167)
F. Minimum ground clearance (average)	340 (13)	340 (13)	400 (16)	400 (16)

The weights and dimensions can vary, depending on the specification of tires, optional equipment, size of fuel tank etc. The dimensions and weights quoted are based on a tractor with the most common build and tire size, therefore a slight variation may be found between these figures and your tractor.

Weights - kg (lb)

Tractor model - Two-wheel drive only	4 cylinder normal-duty	4 cylinder heavy-duty	6 cylinder normal-duty	6 cylinder heavy-duty
Front axle	1130 (2486)	1130 (2486)	1357(2992)	1357 (2992)
Rear axle	1750 (3850)	1763 (3879)	1528 (3369)	1541 (3397)
Total	2810 (6182)	2823 (6211)	3563 (7855)	3576 (7884)

Tractor model - Four-wheel drive only	4 cylinder normal-duty	4 cylinder heavy-duty	6 cylinder normal-duty	6 cylinder heavy-duty
Front axle	1390 (3058)	1390 (3058)	1560 (3439)	1560 (3439)
Rear axle	1950 (3900)	1963 (3926)	2127 (4689)	2140 (4718)
Total	3260 (6520)	3273 (6546)	3607 (7952)	3620 (7981)

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Tractor Specification

TRACTOR MOUNTING POINTS

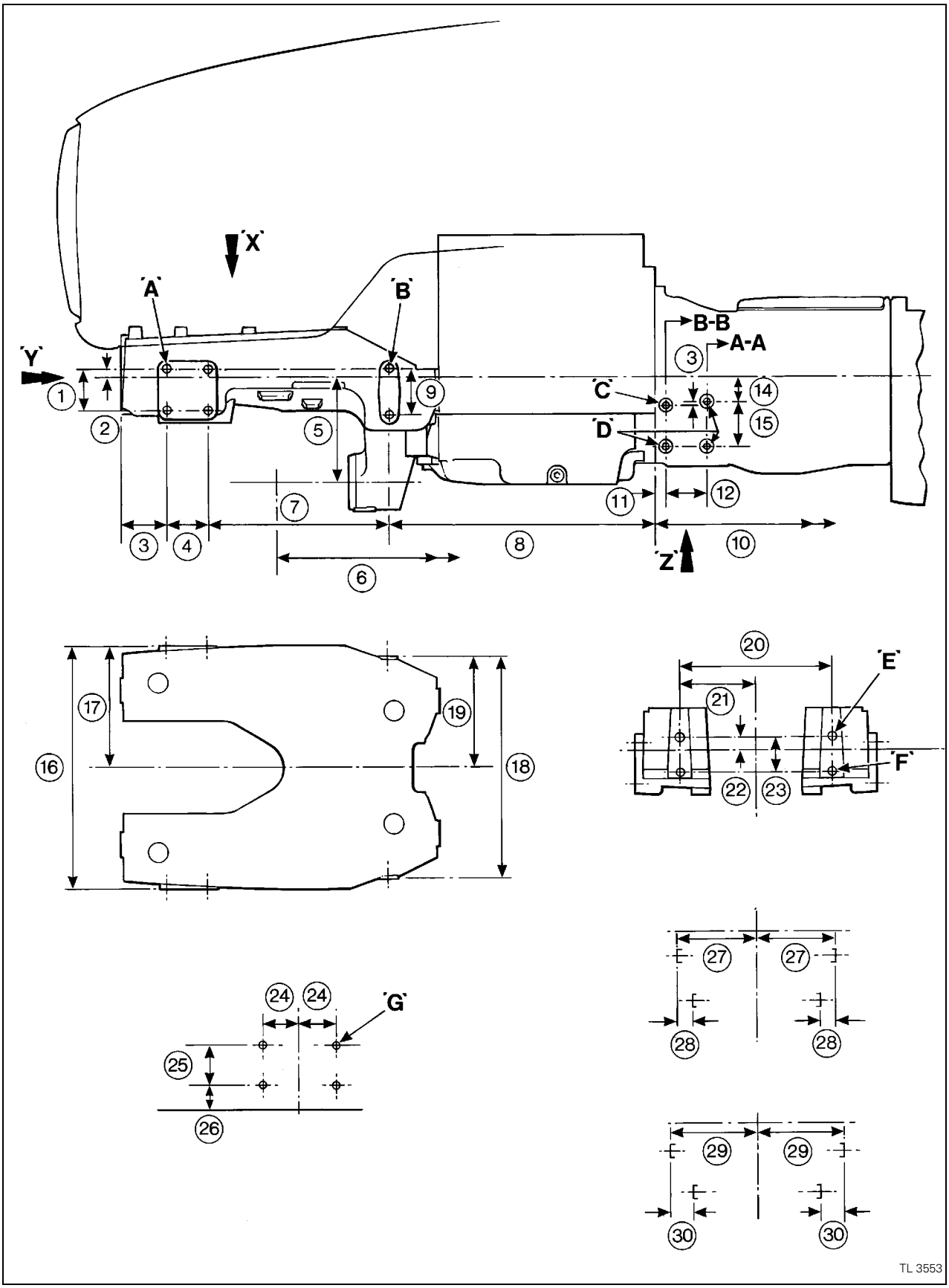


Fig. 1 Tractor front mounting points

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MOUNTING POINTS

Refer to Fig. 1 and Fig. 2.

Tractor Front (Fig. 1):

1. 101,6 mm (4 in).
2. 20 mm (0.788 in).
3. 60,4 mm (2.364 in) high visibility hood.
   115,4 mm (4.547 in) standard hood.
4. 101.6 mm (4 in).
5. 260 mm (10.244 in).

Wheelbase two-wheel drive:

6. 2133 mm (84.040 in) 3 cylinder engine tractor.
   2187 mm (86.168 in) 4 cylinder engine tractor *(see Note 1).*
   2350 mm (92.590 in) 4 cylinder engine tractor.
   2609 mm (102.795 in) 6 cylinder engine tractor.

Note 1: Tractors fitted with light weight front axle.

Wheelbase four-wheel drive:

2227 mm (87.744 in) 3 cylinder engine tractor.
2281 mm (89.871 in) 4 cylinder engine tractor *(see Note 2).*
2350 mm (92.590 in) 4 cylinder engine tractor *(see Note 3).*
2609 mm (102.795 in) 6 cylinder engine tractor.

Note 2: Tractors fitted with AG 66 type axle

Note 3: Tractors fitted with AG 75, 85 or 105 type axles.

7. 448 mm (17.651 in).
8. 612 mm (24.113 in) 3 cylinder engine tractor.
   664,75 mm (26.191 in) 4 cylinder engine tractor.
   908,22 mm (35.784 in) 6 cylinder engine tractor.
9. 114 mm (4.492 in).
10. 1406 mm (55.396 in) - to centre of rear axle.
11. 25.4 mm (1 in).
12. 101.6 mm (4 in).
13. 9,65 mm (0.380 in).
14. 60,45 mm (2.382 in).
15. 111,25 mm (4.383 in).

View arrow 'X':

16.600 mm (23.640 in).
17.300 mm (11.820 in).
18.550 mm (21.670 in).
19.275 mm (10.835 in).

View arrow 'Y':

20. 381 mm (15.011 in).
21. 190 mm (7.486 in).
22. 31,87 mm (1.256 in).
23. 86 mm (3.388 in).

View arrow 'Z':

24. 91,95 mm (3.623 in).
25. 101,6 mm (4 in).
26. 60,2 mm (2.372 in).

Section 'AA':

27. 197,61-196,09 mm (7.786-7.765 in).
28. 39,62-36,58 mm (1.561-1.441 in).

Section 'BB':

29. 216,28-215,52 mm (8.521-8.491 in).
30. 57,53-56,77 mm (2.267-2.238 in).

Hole sizes:

A. 4 holes M20 - 2,5 x 38 mm deep.
B. 2 holes M20 - 2,5 x 38 mm deep.
C. 1 hole 5/8 in - 11 UNC x 23,8 mm deep.
D. 3 holes 5/8 in - 11 UNC x 31,8 mm deep.
E. 2 holes 22,33/22,00 (0.867 in) diameter through.
F. 2 holes M20 - 2,5 through.
G. 4 holes 5/8 in - 11 UNC x 31,7 mm deep.

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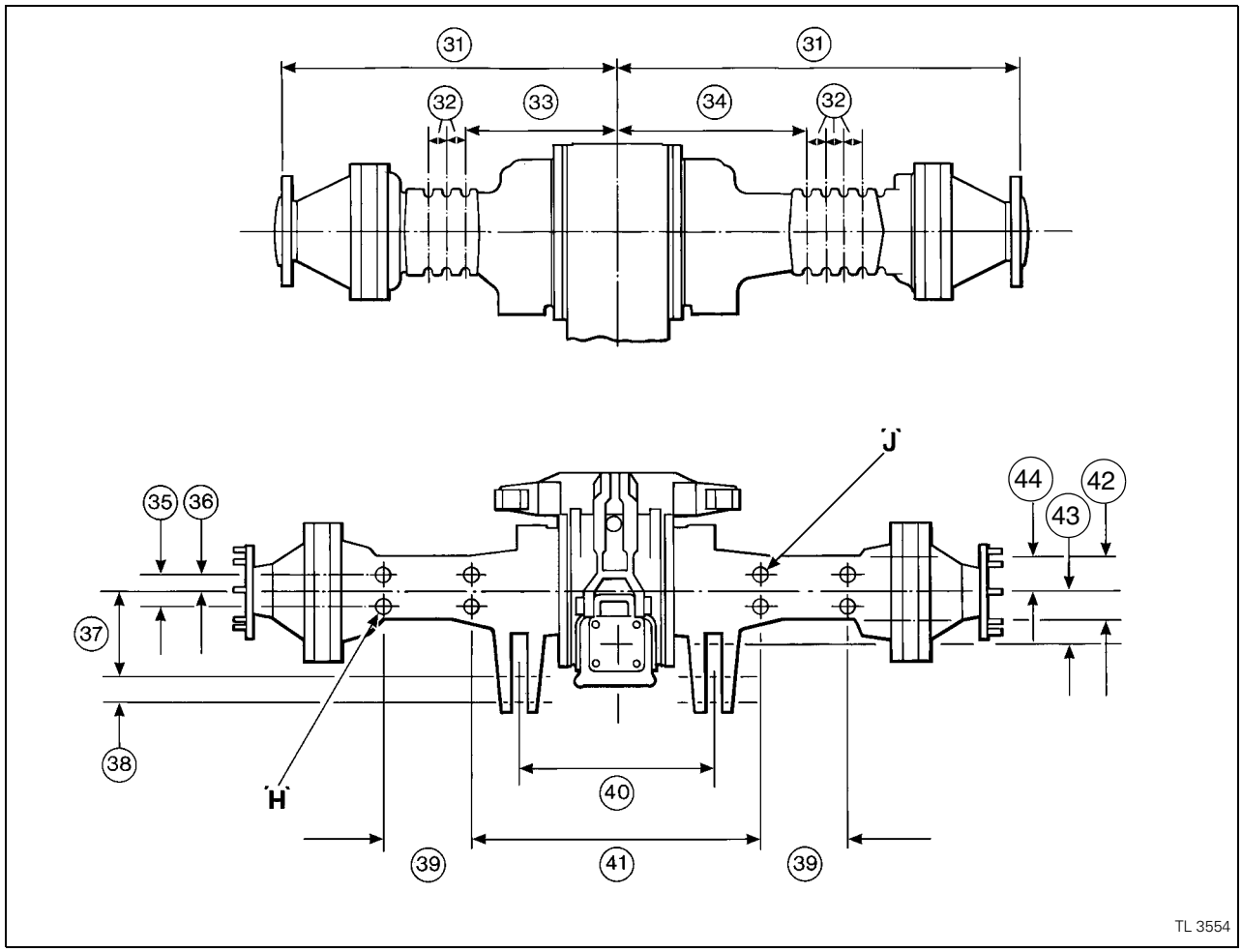


Fig. 2 Rear axle mounting points

Rear axle (Fig. 2):

31. 734 mm (28.20 in) narrow axle.
    885,5 mm (34.889 in) normal-duty axle.
    936,5 mm (36.898 in) heavy-duty axle
32. 41 mm (1.615 in).
33. 345,5 mm (13.613 in) narrow axle.
34. 428 mm (16.863 in) Normal- and heavy-duty axle.
35. 80 mm (3.152 in).
36. 40,8 mm (1.607 in).
37. 212,5 mm (8.373 in).
38. 67 mm (2.640 in) heavy-duty axle only.
39. 220 mm (8.668 in).
40. 492 mm (19.370 in).
41. 726 mm (28.580 in).
42. 161.5 mm (6.363 in).
43. 127 mm (5 in).
44. 90,2 mm (3.554 in).

Hole sizes:

H. 4 holes 5/8" - 11 UNC x 28 mm deep.

J. 4 holes 5/8" - 11 UNC x 30 mm deep.

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TRACTOR IDENTIFICATION

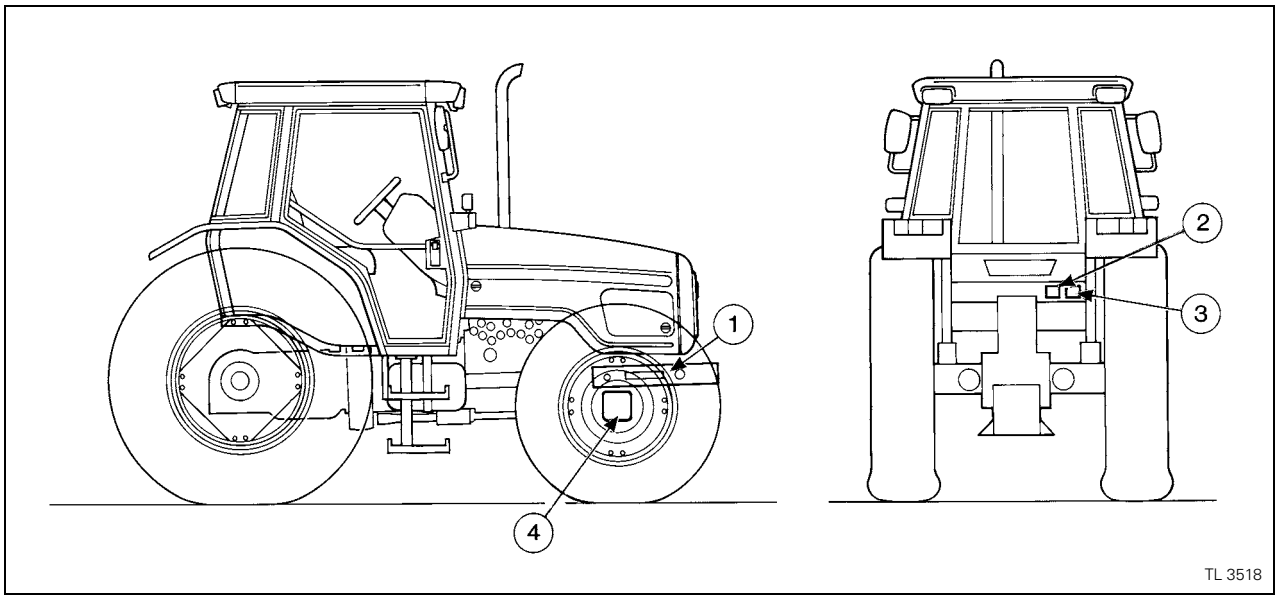


Fig. 3

SERIAL NUMBERS - TRACTOR

The serial number of the tractor forms a very important part in the identification of the tractor, when it was made and the components included in its build. The serial number MUST always be quoted when communicating with Massey Ferguson or the Dealer.

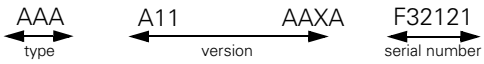
The location of serial numbers and serial number plates are shown in Fig. 3. The serial number is stamped on the right-hand side of the front support casting (1 Fig. 3) and detailed in Fig. 4. This information is repeated on a serial number plate located on the rear of the tractor (2 Fig. 3), and detailed in Fig. 5.

The cab compliance and serial number plate is located at the rear of the cab (3 Fig. 3). The front four-wheel drive axle serial number plate is fixed to the rear right-hand side of the axle (4 Fig. 3), and detailed in Fig. 7.

The tractors are numbered systematically and the number gives information on machine build, engine, transmission, when it was built and year of manufacture.

The serial number information is as follows:

Example:



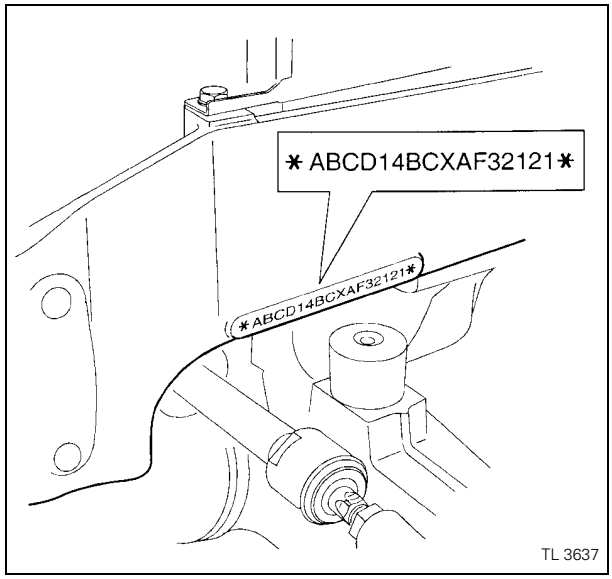


Fig. 4

Legend

Type

A	Family
A or 1	Engine (Directory Identity)
A	Nominal Power (Directory Identity

Version

A	Transmission
1	Notional road speed
1	Driving axles
A	Structure
A	ROPS mounts
X	Free
A	Brand

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Tractor Specification

Tractor Types Covered in Code

Family (digit 1):

A	Perkins (emissions compliant engine) Standard sheet metal
B	Perkins (non-emissions compliant engine) Standard sheet metal
C	Perkins (emissions compliant engine) Low sheet metal
D	Perkins (non-emissions compliant engine) Low sheet metal
W	Valmet (emissions compliant engine)
1	Cummins (emissions compliant engine)

Engine Directory (digit 2):

A	3 cylinder
B	4 cylinder
C	6 cylinder

Power Directory (digits 2 and 3):

AA	3 cylinder 52 DIN
AB	3 cylinder 60 DIN
BA	4 cylinder 65 DIN
BB	4 cylinder 75 DIN
BC	4 cylinder 85 DIN
BD	4 cylinder 105 DIN
BE	4 cylinder 95 DIN
BF	4 cylinder 80 DIN
BG	4 cylinder 70 DIN
BH	4 cylinder 100 DIN
CA	6 cylinder 100 DIN
CB	6 cylinder 110 DIN

Engine Type (digita 1, 2 and 3): 4200 family 'A' emissions complaint standard sheet metal

ABA	Perkins – 4 cylinder 65 DIN
ABB	Perkins – 4 cylinder 75 DIN
ABC	Perkins – 4 cylinder 85 DIN
ABD	Perkins – 4 cylinder 105 DIN
ABE	Perkins – 4 cylinder 95 DIN
ABF	Perkins – 4 cylinder 80 DIN
ACA	Perkins – 6 cylinder 100 DIN
ACB	Perkins – 6 cylinder 110 DIN

Engine Type (digita 1, 2 and 3): 4200 family 'B' non-emissions complaint standard sheet metal

BBA	Perkins – 4 cylinder 65 DIN
BBB	Perkins – 4 cylinder 75 DIN
BBC	Perkins – 4 cylinder 85 DIN
BBD	Perkins – 4 cylinder 105 DIN
BBE	Perkins – 4 cylinder 95 DIN
BBF	Perkins – 4 cylinder 80 DIN
BBH	Perkins – 4 cylinder 100 DIN
BCA	Perkins – 6 cylinder 100 DIN
BCB	Perkins – 6 cylinder 110 DIN

Engine Type (digita 1, 2 and 3): 4200 family 'C' emissions complaint low sheet metal

CAA	Perkins – 3 cylinder 52 DIN
CAB	Perkins – 3 cylinder 60 DIN
CBA	Perkins – 4 cylinder 65 DIN
CBB	Perkins – 4 cylinder 75 DIN
CBC	Perkins – 4 cylinder 85 DIN
CBD	Perkins – 4 cylinder 105 DIN
CBE	Perkins – 4 cylinder 95 DIN

Engine Type (digita 1, 2 and 3): 4200 family 'D' non-emissions complaint low sheet metal

DBA	Perkins – 4 cylinder 65 DIN
DBB	Perkins – 4 cylinder 75 DIN
DBC	Perkins – 4 cylinder 85 DIN
DBE	Perkins – 4 cylinder 95 DIN
DBF	Perkins – 4 cylinder 80 DIN
DBH	Perkins – 4 cylinder 100 DIN

Engine Type (digita 1, 2 and 3): 4200 family 'W' emissions complaint standard sheet metal

WBC	Valmet – 4 cylinder 85 DIN
WBG	Valmet – 4 cylinder 70 DIN
WBH	Valmet – 4 cylinder 100 DIN

Engine Type (digita 1, 2 and 3): 4200 family '1' emissions complaint standard sheet metal

1BC	Cummins - 4 cylinder 85 DIN
1BE	Cummins - 4 cylinder 95 DIN
1BF	Cummins - 4 cylinder 80 DIN
1BG	Cummins - 4 cylinder 70 DIN

Version Available for Each Type of Transmission (digit 4):

A	8 x 2
B	8 x 8
C	12 x 4
D	12 x 12
E	18 x 6
F	24 speed

Notional Road Speed (digit 5):

1	30 kph
2	40 kph
3	35 kph

Drive Axles (digit 6):

1	Two-wheel drive – short wheelbase
2	Two-wheel drive – long wheelbase
3	Four-wheel drive – short wheelbase
4	Four-wheel drive – long wheelbase
5	Four-wheel drive – Portal Axle

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Structure (digit 7):

A	CAB – Standard fixed screen (type 5001)
B	CAB – Lo-profile fixed screen (type 5003)
C	CAB – Versa cab (type 5002)
D	CAB – Lo-profile opening screen (type 5004)
E	CAB – Standard opening screen (type 5005)
F	CAB – Orchard (type 5006)
H	ROPS – 4 post, narrow rear axle (type 1800)
J	ROPS – 2 post field-folding, standard rear axle (type 1100)
K	ROPS – 4 post, standard rear axle (type 1900)
L	ROPS – 2 post transport-folding, standard rear axle (type 1101)
M	ROPS – 4 post, standard rear axle (type 1500)
N	ROPS – 4 post extra high, standard rear axle (type 1500 XH)
P	ROPS – 4 post, narrow rear axle (type 1700)
R	ROPS – 2 post field-folding, standard rear axle (type 1200)
X	LESS STRUCTURE

ROPS/Cab Mounts (digit 8):

A	High rear mount, type R21 (6 cylinder, standard rear axle)
B	High rear mount, type R19 (4 cylinder, standard rear axle)
C	Low rear mount, type R17 (4 cylinder, standard rear axle)
D	High rear mount, type R20 (4 cylinder, narrow rear axle)
E	Low rear mount, type R18 (4 cylinder, narrow rear axle)
F	Low rear mount, type R15 (3 cylinder, standard rear axle)
G	Low rear mount, type R16 (3 cylinder, narrow rear axle)
H	2/4 post ROPS (standard rear axle)
J	2/4 post ROPS (narrow rear axle)
K	High rear mount, type R22 (4 cylinder, standard rear axle) – Versa cab
X	Less mounts

Free (digit 9):

X	

Brand (digit 10):

A	Massey Ferguson
C	Massey Ferguson 'ES' (Spain)
E	Iseki
F	Massey Ferguson '3' range (North America)
G	Allis
H	White

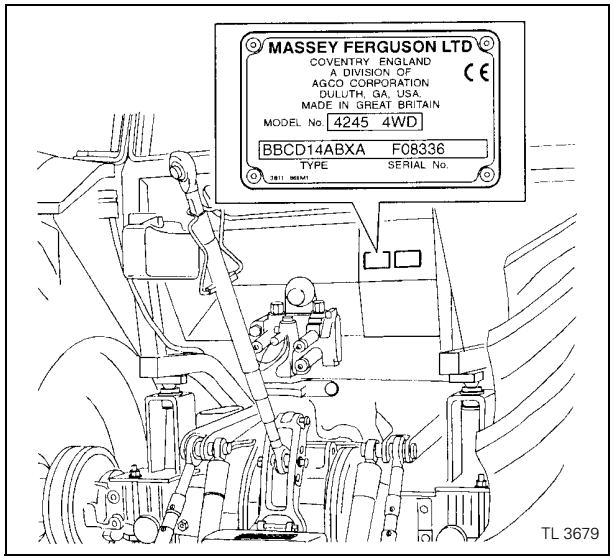


Fig. 5

Year Code Letter (digit 11):

F	1997 – January to December
G	1998 – January to December
H	1999 – January to December
J	2000 – January to December
K	2001 – January to December
L	2002 – January to December
M	2003 – January to December
T	2004 – January to December
W	2005 – January to December
X	2006 – January to December

End of alphabetical sequence.
I, O, Q and Z are not used.

Serial Number (digit 11 to 16):

F	Year of manufacture, see year code letter, (F = 1997 – as above).
32	Week of manufacture, 32nd week (week 1 = 1st week in January).
121	121st tractor built in that week.

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Tractor Specification

SERIAL NUMBERS - ENGINE

The engine numbering system (Fig. 6) consists of up to thirteen letters and numbers giving details of build code, country of origin, serial number and year of manufacture.

AK	Engine family code - 4.401T
31299	Build code
U	Country of manufacture
862894	Engine serial number
C	Year of manufacture

Engine family codes:

Engine	Engine family	Emission
903.27	CP	Low
903.27T	CR	Low
4.41	LM	Normal
4.401	AJ	Low
4.42	AR	Low
4.401T	AK	Low
1004-4THR2	AH	Normal
4.401TW	AM	Low
1006.6	YA	Normal
6.601	YG	Low
1006-6HR3	YA	Normal
6.601T	YH	Low

Country of manufacture:

B	Brazil.
F	France.
L	Italy.
P	Poland.
T	Turkey.
U	United Kingdom.

Year of manufacture:

B = 1996
C = 1997
D = 1998
E = 1st January 1999 to 31st March 1999
F = from 1st April 1999 to 31st December 1999
G = 2000
H = 2001
J = 2002
K = 2003
L = 2004
M = 2005
N = 2006
P = 2007

I, O, Q and Z are not used.
Two year letters are used during 1999, otherwise calendar year is used.

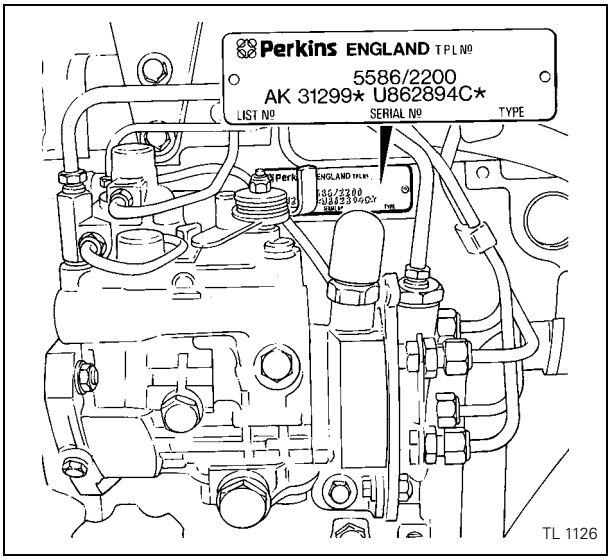


Fig. 6

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SERIAL NUMBERS - FRONT AXLE

The serial number plate for the four-wheel drive front axle (Fig. 7) is important, it identifies the model and size of the front axle fitted to the tractor because different axles can be fitted to many tractors. The plate is divided into five sections, each section giving information as follows:

1. Axle

AG 66 CD	Type 66 centre drive - narrow (Short Wheel Base) 4215, 4220, 4225, 4233, 4235, 4245 tractors.
AG 66 CD	Type 66 centre drive - wide (Short Wheel Base) 4225, 4233, 4235 tractors.
AG 66 CD	Type 66 centre drive - portal (Short Wheel Base) 4225, 4233, 4235, 4245 tractors.
AG 75 CD	Type 75 centre drive (Long Wheel Base) 4225, 4233, 4235, 4243 tractors.
AG 85 CD	Type 85 centre drive (Long Wheel Base) 4245, 4253, 4255, 4260, 4263 tractors.
AG 85 CD	Type 85 centre drive - portal (Long Wheel Base) 4255, 4260 tractors.
AG 105 CD	Type 105 centre drive (Long Wheel Base) 4245, 4255, 4260, 4270 tractors.

2. Differential

NS	No-spin (autolock).
ST	Standard (no differential lock).
HY	Hydrolock (hydraulic).

3. Total Ratio

This is the total ratio value of the axle from the input to the wheel.

4. Serial Number

Progressive serial number:

The last two letters of the number refer to the date of build.

The first letter denotes the month:

A	January.
B	February.
C	March.
D	April.
E	May.
F	June.
G	July.
H	August.
I	September.
L	October.
M	November.
N	December.

The second letter denotes the year:

F	1996.
G	1997.
H	1998.
J	1999.
K	2000.

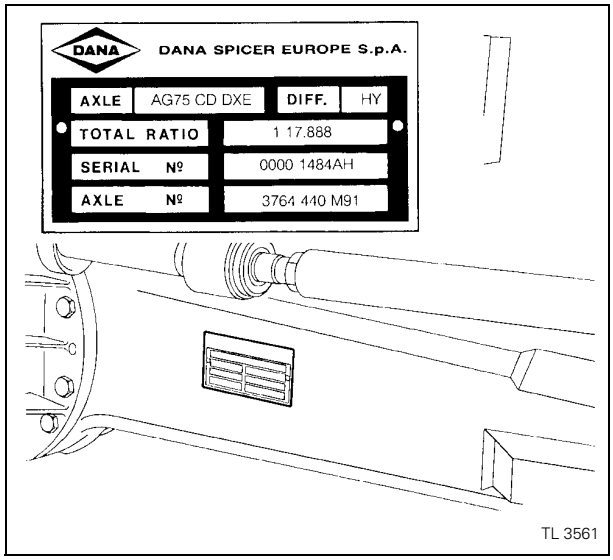


Fig. 7

5. Axle Number

Part numbers of axles:

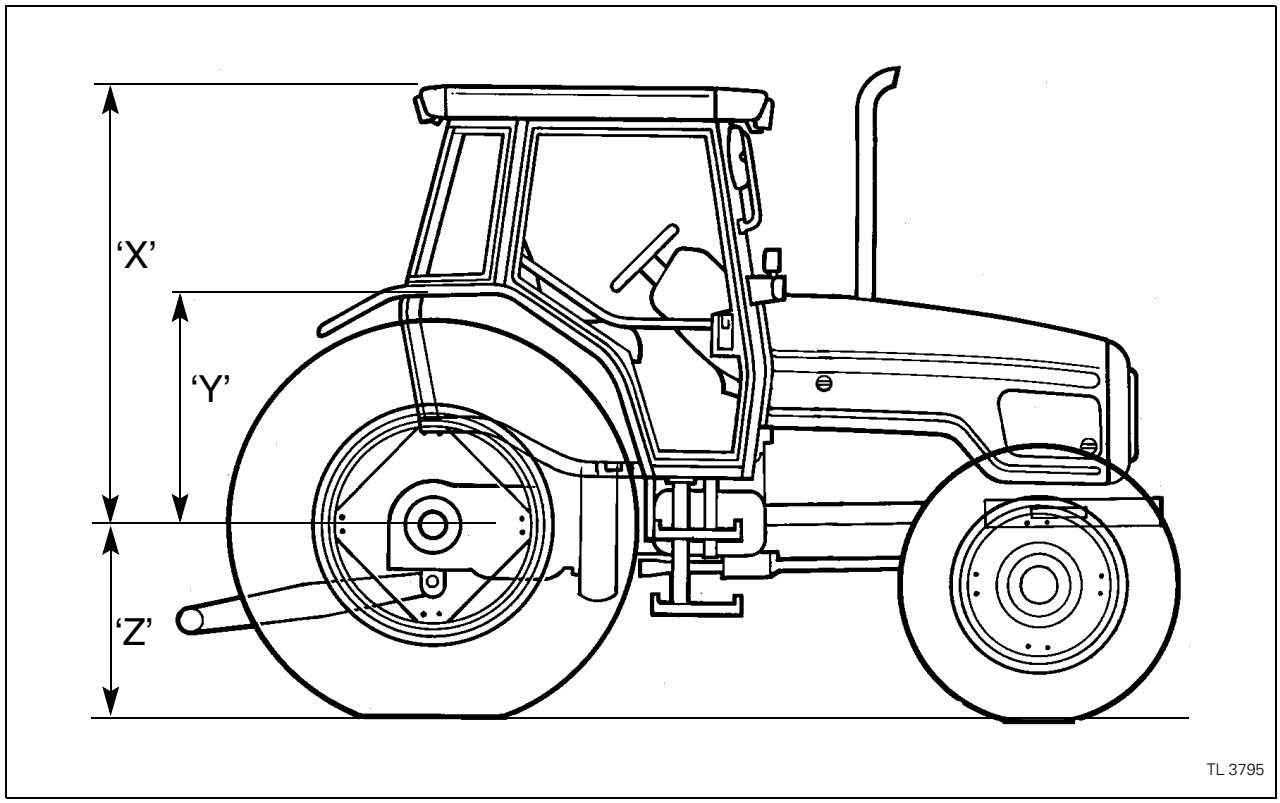
3808 857 M91	AG 66 - CD - Narrow - Hydralock.
3808 858 M91	AG 66 - CD - Wide - Hydralock.
3808 334 M91	AG 75 - CD - Hydralock.
3808 336 M91	AG 85 - CD - Hydralock.
3808 338 M91	AG105 - CD - Hydralock.

NOTE: *The above part numbers may change.*

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Tractor Specification



TRACTOR IDENTIFICATION AND HEIGHT – CAB TRACTORS

The 4200 series tractors come in various types starting with the 'Standard Tractor'. This has a standard cab with a flat floor and standard roof with the heating and ventilating system installed, the hood is a normal type and size. The cab is set at two heights depending on the model and size of the rear wheels. The basic structure of all the cabs are the same size from the six cylinder down to the three cylinder.

The next type is similar to the first with a sloping hood used for loader and front mounted implement work.

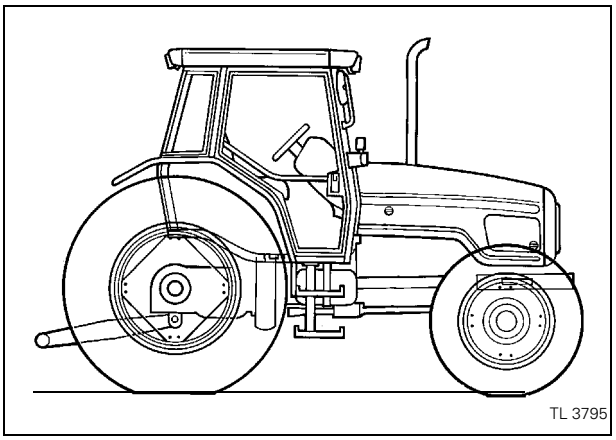
The third type is called 'Lo-Profile', the cab is set lower on the chassis and in the cab there is a tunnel around the transmission. This build only comes with a sloping hood. As an option, it can be fitted with a flat roof which further reduces the overall height of the tractor.

The last and fourth type is for tractors with three cylinder engines, it is only available with the Lo-Profile cab and sloping hood, the cab is set lower for the small wheels. It is also available with a four cylinder engine (4225). These models are available with a standard or flat roof cab for working in low buildings.

The following illustrations show the visual differences between the types of build and the changes in height depending on model and tyre size. The height of cab controls the size of fuel tank fitted.

4260, 4263 and 4270 Standard Tractors

6 cylinder engines.
Standard roof.
Standard cab with flat floor.
Standard hood.
Cab height 'X' = 1900 mm.
Mud guard height 'Y' = 990 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 205 litres (two tanks).

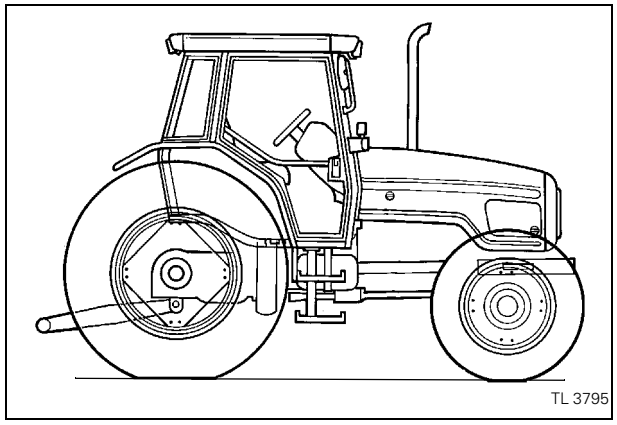


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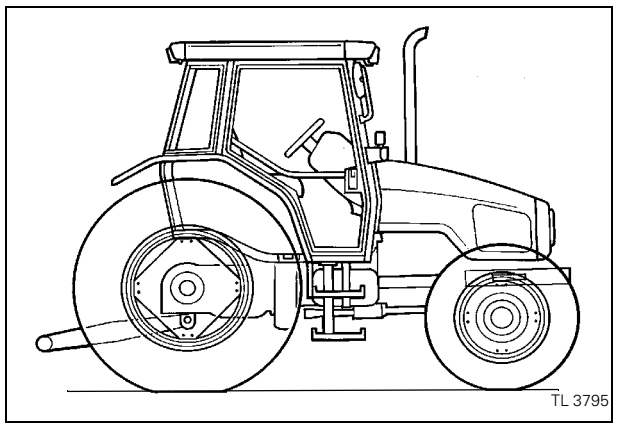
4225, 4233, 4235, 4243, 4245, 4253 and 4255 Standard Tractors

4 cylinder engines.
Standard roof.
Standard cab with flat floor.
Standard hood.
Cab height `X' = 1860 mm.
Mud guard height `Y' = 950 mm
'Z' = rolling radius of tyre.
Fuel tank capacity = 127 litres (single tank).



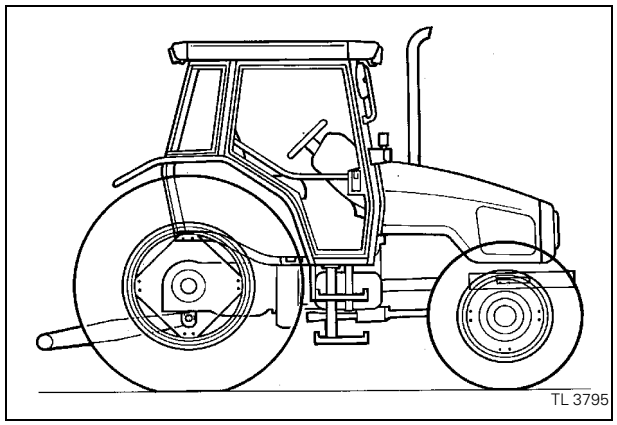
4225, 4233, 4235, 4243, 4245, 4253 and 4255 Standard Tractors

4 cylinder engines.
Standard roof.
Standard cab with flat floor.
Sloping hood.
Cab height 'X' = 1860 mm.
Mud guard height 'Y' = 950 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 127 litres (single tank).



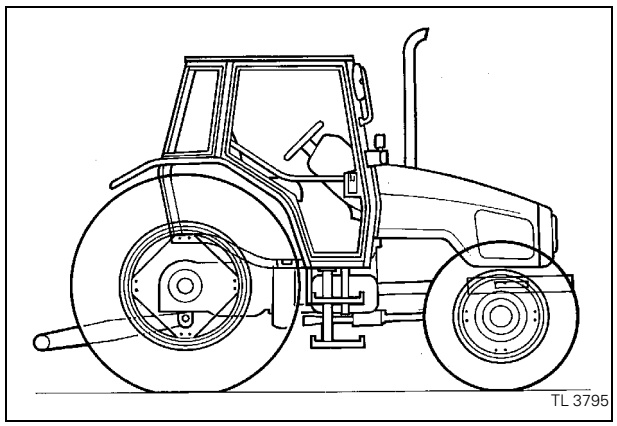
4233, 4235, 4243, 4245, 4253 and 4255 Lo-Profile Tractors

4 cylinder engines.
Standard roof.
Lo-Profile cab with tunnel floor.
Sloping hood.
Cab height 'X' = 1780 mm.
Mud guard height 'Y' = 870 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 98 litres (single tank).



4233, 4235, 4245, and 4255 Lo-Profile Tractors

4 cylinder engines.
Flat roof.
Lo-Profile cab with tunnel floor.
Sloping hood.
Cab height 'X' = 1780 mm.
Mud guard height 'Y' = 870 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 98 litres (single tank).



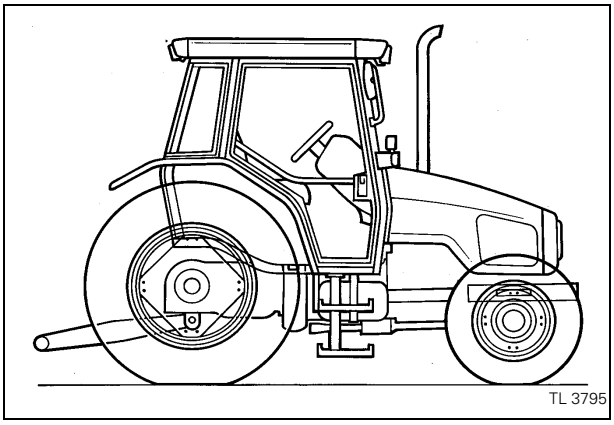
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Tractor Specification

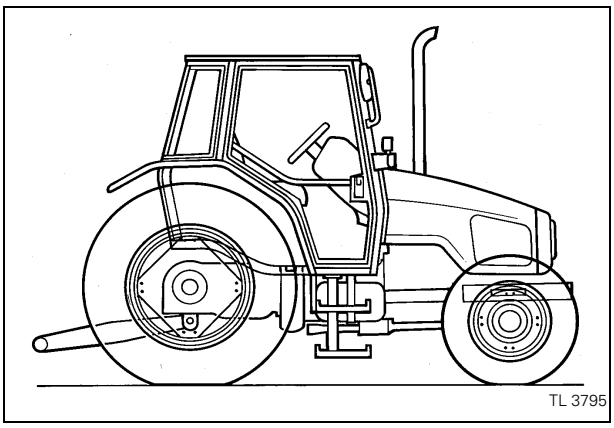
4215, 4220 and 4225 Lo-Profile Tractors

4215, 4220 - 3 cylinder engines.
4225 - 4 cylinder engine.
Standard roof.
Lo-Profile cab with tunnel floor.
Sloping hood.
Cab height 'X' = 1745 mm.
Mud guard height 'Y' = 835 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 84 litres.



4215, 4220 and 4225 Lo-Profile Tractors

4215, 4220 - 3 cylinder engines.
4225 - 4 cylinder engine.
Flat roof.
Lo-Profile cab with tunnel floor.
Sloping hood.
Cab height 'X' = 1665 mm.
Mud guard height 'Y' = 835 mm.
'Z' = rolling radius of tyre.
Fuel tank capacity = 84 litres.



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Miscellaneous Data

Section 1 - Part C

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Miscellaneous Data

BOLT TORQUE SPECIFICATIONS (GENERAL GUIDE FOR INCH FASTENERS)

Use the "Standard Torque" charts as a general guide when tightening fasteners that DO NOT HAVE SPECIFIC TIGHTENING RECOMMENDATIONS.

Inch Fasteners

Standard torque in Newton Metres (Foot Pounds)

* Inch bolt size	SAE grade 5 **mild steel below grade 5	SAE grade 8 ISO grade 8.8 BS grade S		ISO grade 10.9 BS grade V	
		*** Non-rigid joint	**** Rigid joint	*** Non-rigid joint	**** Rigid joint
1/4 inch	6-8 (4-6)	9-12 (7-9)	11-15 (8-11)	13-18 (10-13)	16-22 (12-16)
5/16 inch	12-16 (9-12)	18-24 (13-18)	22-30 (16-22)	25-34 (18-25)	31-43 (23-32)
3/8 inch	22-30 (16-22)	31-42 (23-31)	39-53 (29-39)	44-60 (32-44)	55-75 (41-55)
7/16 inch	35-47 (26-35)	51-69 (38-51)	64-86 (47-63)	72-96 (53-71)	90-120 (66-89)
1/2 inch	54-72 (40-53)	80-104 (59-77)	100-130 (74-96)	110-140 (81-103)	140-180 (103-133)
5/8 inch	110-140 (81-103)	160-210 (118-155)	200-260 (148-192)	220-300 (162-221)	280-370 (207-273)
3/4 inch	190-250 (140-184)	280-370 (207-273)	350-460 (258-339)	390-530 (287-391)	490-660 (361-487)
7/8 inch	310-410 (228-302)	450-610 (332-450)	560-760 (413-561)	640-850 (472-672)	800-1060 (590-782)
1 inch	460-620 (339-457)	670-900 (494-664)	840-1120 (620-826)	960-1280 (708-944)	1200-1600 (885-1180)

Key to table above:

* *NOTE: The size is the diameter of the shank - not the head width.*

** *NOTE: Mild steel torque values to be used for SAE Grade 5 bolts when weld nuts, or other low strength nuts are used.*

*** *NOTE: Use these values when any of the following conditions exist:*
1. Possible damage to the joined members of the assembly may occur.
2. Thick and/or highly compressible gaskets are used between members.
3. Non-flat unmachined seating surfaces for bolt head (or nut) occurs.
4. Non-flat or non-parallel joint faces are encountered.

**** *NOTE: Use these values when ALL of the following conditions exist:*
1. Damage will not occur to the joined members of the assembly.
2. It is desirable to use this higher clamping force to ensure tightness.
3. Fastener thread is not lubricated prior to assembly.

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BOLT TORQUE SPECIFICATIONS (GENERAL GUIDE FOR METRIC FASTENERS)

Use the "Standard Torque" charts as a general guide when tightening fasteners that DO NOT HAVE SPECIFIC TIGHTENING RECOMMENDATIONS

.

Metric Fasteners

Standard torque in Newton Metres (Foot Pounds)

* Metric bolt size	SAE grade 5 ** mild steel below grade 5	SAE grade 8 ISO grade 8.8 BS grade S		ISO grade 10.9 BS grade V	
		*** Non-rigid joint	**** Rigid joint	*** Non-rigid joint	**** Rigid joint
M6	4-5 (3-4)	8-11 (6-8)	10-14 (7-10)	12-16 (9-12)	14-20 (10-15)
M8	10-13 (7-10)	20-28 (15-21)	25-35 (18-26)	29-37 (21-27)	36-46 (27-34)
M10	19-25 (14-18)	40-56 (30-41)	50-70 (37-52)	57-77 (42-57)	72-96 (53-71)
M12	33-43 (24-32)	72-96 (53-71)	90-120 (66-89)	100-130 (74-96)	120-160 (89-118)
M16	84-110 (62-81)	160-210 (118-155)	200-260 (148-192)	240-320 (177-236)	300-400 (221-295)
M20	160-210 (118-155)	340-450 (251-332)	420-560 (310-413)	480-640 (354-472)	600-800 (443-590)

Key to table above:

* *NOTE: The size is the diameter of the shank - not the head width.*

** *NOTE: Mild steel torque values to be used for SAE Grade 5 bolts when weld nuts, or other low strength nuts are used.*

*** *NOTE: Use these values when any of the following conditions exist:*
1. Possible damage to the joined members of the assembly may occur.
2. Thick and/or highly compressible gaskets are used between members.
3. Non-flat unmachined seating surfaces for bolt head (or nut) occurs.
4. Non-flat or non-parallel joint faces are encountered.

**** *NOTE: Use these values when ALL of the following conditions exist:*
1. Damage will not occur to the joined members of the assembly.
2. It is desirable to use this higher clamping force to ensure tightness.
3. Fastener thread is not lubricated prior to assembly.

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Miscellaneous Data

CHEMICALS AND SEALANTS

The following chemicals and sealants quoted in this Workshop Service Manual are available from AGCO Parts Division..

Description	Quantity	Part No.
Hylomar ..... Jointing and sealing compound.	100 g tube	1447 390 M1
	280 g aerosol	3638 340 M91
High Strength Gasket ..... Loctite 509 - Specially prepared for AGCO to seal and prevent flexing of the lift cover to the rear axle casing. **This sealant must be used at all times.**	300 ml	3931 545 M1
Lock 'n' Seal ..... Loctite 222 - prevents small components from vibrating loose and provides an effective pipe thread seal against liquids or gases.	10 ml	3930 904 M1
Studlock ..... Loctite 270 - a heavy duty version of Lock 'n' Seal for larger components which need less frequent stripping down. Highly resistant to industrial fluids and gases.	10 ml	3405 352 M5
Crownwheel Retainer ..... Loctite 638 - for high strength retaining of close fitting parts. Designed to retain slip fitted or to strengthen press fitted parts, shafts bushes, pulleys etc.	6 ml	3930 274 M92
574 Multi-Gasket ..... Loctite 573 - forms a strong, flexible gasket which provides a gas-tight, water-tight, oil-tight seal up to 200° C (392° F). Does not shrink, crack, tear or perish.	50 ml	3900 613 M2
Super Lube ..... Multi-purpose synthetic lubricant containing Teflon®. Reduces friction and wear. Excellent dielectric properties, prevents tracking. Contains anti-oxidants and rust inhibitors, protects against moisture and corrosion.	7 gm Oiler	3931 224 M1
	357 ml aerosol	3931 225 M1
Cleaner and Degreaser ..... Loctite 7063 - a all-purpose solvent for removing grease and dirt.	400 ml aerosol	3930 907 M1
Cleaner and Degreaser ..... Loctite 7070 - cleaner and activator to be used to clean the lift cover and rear axle faces prior to application of Loctite 509.	400 ml aerosol	3931 549 M1
Super Glue ..... Instant bonding for metals, plastics, rubber and ceramics.	5g	3930 905 M1
Clear Silicone ..... A clear, tough, flexible and waterproof seal for metal, rubber, glass and plastics.	80g	3405 357 M5
	310 ml	3405 423 M2
Penetrating oil ..... A highly effective multi-purpose lubricant, moisture dispersant and dismantling spray.	330 ml aerosol	3930 850 M2
Gasket Remover ..... Dissolves gaskets for easy removal.	300 ml	3930 908 M1
Citrus Handcleaner ..... Works with or without water.	3 litre	3930 906 M1
Anti-freeze ..... Ethylene-glycol based, designed for protection down to minus 33° C (minus 27° F). Suitable for all types of engines, including those with aluminium cylinder heads.	1 litre	1894 799 M2
	5 litre	1891 780 M2
	25 litre	1891 781 M2
	205 litre	1891 782 M2
Brake Fluid (Green) ..... Specially developed for braking systems requiring a mineral fluid.	0,5 litre	3405 389 M1
Anti-Squawk Additive ..... Specially developed to be added to the transmission oil to prevent noise from wet brake installations.	1 litre	1889 891 M2
Protective Grease ..... Specially prepared grease for electrical components and connectors with dielectric properties, protects against moisture and corrosion. Long lasting, won't dry out.	Tin	3600 553 M1

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CONVERSION TABLES

Area	Multiply by
mm^2 to in^2	0.0015
in^2 to mm^2	645.16
m^2 to ft^2	10.764
ft^2 to m^2	0.0929
ha to acre	2.4711
acre to ha	0.4047

Capacity	Multiply by
ml to fluid oz	0.0351
fluid oz to ml	28.413
litre to gal	0.2200
gal to litre	4.5640
litre to US gal	0.2640
US gal to litre	3.7850
gal to US gal	1.2010
US gal to gal	0.8330

Length	Multiply by
mm to in	0.0394
in to mm	25.400
m to ft	3.2808
ft to m	0.3048
km to mile	0.6214
mile to km	1.6093

Power	Multiply by
ps to hp	0.9863
hp to ps	1.0139
kW to hp	1.3410
hp to kW	0.7457

Pressure	Multiply by
bar to lbf/in^2	14.504
lbf/in^2 to bar	0.0690

Speed	Multiply by
km/hr to mile/hr	0.6214
mile/hr to km/hr	1.6093

Torque	Multiply by
Nm to lbf ft	0.738
lbf ft to Nm	1.356

Volume	Multiply by
mm^3 to in^3	0.6102
in^3 to mm^3	163.87
m^3 to ft^3	35.315
ft^3 to m^3	0.0283

Weight	Multiply by
gram to oz	0.3530
oz to gram	28.350
kg to lb	2.2046
lb to kg	0.4536
kg to ton	0.0010
ton to kg	1016.1
tonne to ton	0.9842
ton to tonne	1.0160

Temperature	
°C to °F	1.8 x °C + 32
°F to °C	(°F - 32) ÷ 1.8

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Servicing the Tractor

Section 1 - Part D

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Servicing the Tractor

GENERAL

This section has been compiled to enable the reader to ascertain quickly what action is necessary to prepare a new tractor for sale, install it on the farm and carry out the 50 and 300 hour services, which should be rendered during the warranty period.

The timing of these two services has been calculated to provide maximum tractor efficiency throughout the warranty period thus safeguarding the subsequent life of the tractor.

Also detailed is the 'Running-in' procedure which will ensure that the engine will give a satisfactory performance throughout its life.

NOTE: *This is an optimum list of checks, instructions, etc., and may not apply to the tractor you are working on.*

PRE-DELIVERY INSPECTION

Check **1-1D**

Procedure

Before checking

1. Verify and record for future use the serial numbers of the tractor, engine, and four-wheel drive front axle.
2. Assemble all parts that have been removed for transport.

Checking levels

Check and adjust if necessary the following levels with their specific liquids:

3. Cooling system, water or anti-freeze.
4. Fuel tank.
5. Engine oil.
6. Transmission and rear axle.
7. Rear axle epicyclic hubs (heavy-duty only).
8. Four-wheel drive front axle.
9. Four-wheel drive front axle epicyclic hubs.
10. Battery.
11. Hydraulic brake reservoir.
12. Screen washer reservoir - cab only.

Lubrication

Lubricate the following points:

13. Lubricate all grease points as detailed in the Operator Instruction Book.
14. Lightly oil clutch linkage, hand and foot throttle linkage, all hinges, catches and door locks.

Adjustments

Check and adjust if necessary:

15. Battery condition, charge if necessary.
16. Tension of fan and air conditioner compressor belt(s).
17. Clutch pedal cable - height.
18. Brake pedal linkage - free pedal clearance.
19. Torque of all wheel and rim nuts and bolts.
20. Tyre pressures.

Checks before Road Test

Turn the starter switch to 'Auxiliary' position (ON) - check:

21. All warning lights - ON, warning buzzer sounds.
22. Lights - head, side, indicator, work, interior and panel.
23. Hazard warning lights and horn.
24. Cab heater and fresh air blower.
25. Remove all traces of oil, fuel and coolant from the tractor to permit a leak check after road test.

Start the Engine

Start the engine and carry out the following functional tests:

26. Safety start switches - transmission and PTO.
27. Air cleaner restriction indicator, momentarily blanking off the air intake.
28. Fuel cut-off.

Road Test

Restart the engine, warm up the tractor, drive forward - carry out the following checks:

29. Balance and operation of brakes.
30. Steering operation - lock to lock.
31. Operation in all gears.
32. Differential lock function.
33. Four-wheel drive function.
34. Operation of cab heater and fresh air blower.
35. Operation of all air conditioning.
36. Operation of all gauges and instruments.
37. Parking brake effectiveness.

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After Road Test

Hydraulic lift performance with 400 kg (900 lb) weight fitted to lower links - check operation:

38. Draft control.
39. Position control.
40. Transport - correctly positioned.
41. Pick-up hitch release, setting correctly positioned.
42. Response control effectiveness.
43. Selector valve - function.
44. Auxiliary control valve - function.
45. Trailer brake valve - function.

Electronic Systems

Check the operation of the following:

46. Electronic linkage control, if fitted.

Final Checks

With engine stopped, carry out the following:

47. Ensure that there are no oil, fuel or coolant leaks.
48. Clean off all preservatives and shipping labels.
49. Clean the tractor.
50. Ensure tool box contents and literature pack are to specification:
    a. Operator Instruction Book.
    b. Maintenance Chart.
    c. Tractor Service Record Book.
    d. Safety Book (North America only)

TRACTOR INSTALLATION

Instruction **2-1D**

Procedure

These instructions are to be given to the Owner and/or Operator of the tractor, all items must be fully explained and where applicable, performed. Emphasis must be given to all safety precautions in the operation and servicing of the tractor and its implements.

Installation Check List:

Use the Operator Instruction Book, Maintenance Chart and Tractor Service Record Book supplied with the tractor to explaining the following:

1. Location and significance of tractor, engine, cab and four-wheel drive front axle serial numbers.
2. Safety points and safety decals fitted to the tractor and highlighted in the Operator Instruction Book.
3. Use of all instruments and warning lights.
4. Running-in procedures.
5. Operation of the hand and foot throttles, use of the gear/travel and PTO speed chart.
6. Use and adjustment of the clutch pedal height.
7. Differential lock - engagement and disengagement.
8. Four-wheel drive - engagement and disengagement and four-wheel braking, when fitted.
9. Brake operation - latched and unlatched, method of adjustment.
10. Attachment of auxiliary hydraulic equipment.
11. Wheel width adjustment, front and rear. Correct settings for steering stops, front wheel alignment and tyre pressures.
12. Drawbar and pick-up hitch - operation and positions.
13. Servicing the tractor - routine maintenance procedures and service intervals as detailed in the Operator Instruction Book. Position of drain plugs, filler plugs and dipsticks, including hydraulic brake fluid reservoir.
14. Use of recommended Massey Ferguson lubricants and alternatives. Advice on engine fuel and oil filter replacement.
15. Instruct in the cleaning methods to be adopted for the hydraulic centrifuge filter and suction screens on the hydraulic system.
16. Cooling system - coolant level, frost precautions, adjustment of fan belt and cleaning the radiator, and oil cooler.
17. Maintenance of the engine and cab air filters.
18. Servicing of the air conditioning system. Adjustment of compressor belt, cleaning the condenser and operation during winter periods.
19. Connection and operation of trailers fitted with hydraulic brakes.
20. Use and power ratings of electrical output sockets for auxiliary equipment.
21. Operation and care of the radio cassette player. Care of cassettes in the tractor environment.

Demonstrate the following:

You will demonstrate the following points:

22. Engine starting and stopping procedures, when hot and cold.
23. Removal of air from the fuel system, the importance of using clean fuel.
24. Driving the tractor, starting and stopping, the use and sequence of gears, operation of clutches, especially those fitted with front end loaders and shuttle gearboxes.
25. Operation of the PTO, how to select the appropriate speed and how to change the PTO shaft.

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26. Use of the hydraulic lift system, how to make adjustments and attach implements. Use of stabilisers and pick-up hitch, if fitted.
27. Operation of cab heater, fresh air blower or air conditioning system.
28. Demonstrate the use and calibration of the Speedometer/Performance Monitor.
29. Operation of Front Three-point Linkage and PTO, if fitted.

Carry out the following:

To complete the Installation, you are required to:

30. Give separate instructions on the use of any implements or attachments supplied.
31. Enter all the tractor serial numbers in the Registration Data section of this Tractor Service Record Book.
32. Explain to the owner his Warrant entitlement and the services due during the warranty period.
33. Complete the Installation and Registration Certificate and request the owner's signature.

RUNNING-IN

Instruction **3-1D**

Procedure

1. Experience has shown that the first 50 hours of tractor operation have a significant effect on the performance and life of the engine. From new, the tractor should be engaged in work which will load the engine as near as possible to full working conditions, emphasis should be given on varying the load to assist in the running-in.

Full load should not be applied until the engine has reached a temperature of at least 60°C (140°F).

2. Use low gear when pulling heavy loads.
3. During the running in period, check frequently the tightness of all wheel nuts and bolts.
4. To ensure proper clutch life, care must be taken to bed-in the friction plates properly.

NOTE: *During the first 15 hours of the tractor's life, frequently, but carefully engage and disengage the clutch. After the first 50 hours operation it may be necessary to adjust the clutch pedal height to suit the driver.*

INITIAL 50 HOUR SERVICE

Servicing **4-1D**

Procedure

The following operations are to be carried out after 50 hours running to remove factory fill lubricants by the Dealer service engineer.

Engine

1. Change the engine oil.
2. Change the engine oil filter.
3. Check the tappets, and adjust if necessary

Fuel System and Air Cleaner

4. Change the primary fuel filter element.
5. Check the air cleaner, clean the filter if necessary.

Cooling System

6. Check the coolant level and replenish if necessary.
7. Check the alternator/fan belt tension and adjust if necessary.
8. Check the air conditioning compressor belt tension and adjust if necessary.

Electrical System and Instruments

9. Check battery electrolyte level.
10. Check tightness of battery connections.
11. Check safety start switches for correct operation.
12. Check function of all instruments and warning lights.
13. Check function and adjustment of all lights.
14. Check function of all electronic systems.

Front Axle and Steering

15. Check the front axle oil level (four-wheel drive only), top up if necessary.
16. Check the front axle epicyclic oil level (four-wheel drive only), top up if necessary.

Transmission and Hydraulics

17. Check the transmission oil level and top-up if necessary.
18. Check the oil in the rear epicyclic hubs and top-up if necessary (heavy-duty axles only).
19. Check the torque of all wheel and rim nuts and bolts.
20. Check the tyre pressures and adjust if necessary.

Clutch and Brakes

21. Check the clutch pedal height and adjust if driver requests.
22. Check the foot brakes and adjust if necessary.
23. Check the parking brake and adjust if necessary.
24. Check the brake fluid level and top up if necessary.

Cab

25. Check the screen washer bottle fluid level and replenish if necessary.
26. Check the cab air filter, and clean if necessary.

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General

27. Lubricate all grease points.
28. Lightly oil the clutch linkage, throttle linkage both hand and foot, hinges, catches, and door locks.
29. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
30. After the road test, check for leaks in the oil, coolant and fuel systems.
31. Enquire if any operational difficulties are being experienced by the Owner, correct or demonstrate as necessary.
32. Complete the 50 hour Service record card in the Tractor Service Record Book.

300 HOUR SERVICE

Servicing **5-1D**

Procedure

The following operations are to be carried out after 300 hours running or before the end of the warranty period which ever is first by the Dealer service engineer.

Engine

1. Change the engine oil.
2. Change the engine oil filter.

Fuel System and Air Cleaner

3. Check the air cleaner, clean the filter if necessary.

Cooling System

4. Check the coolant level and replenish if necessary.
5. Check the alternator/fan belt tension and adjust if necessary.
6. Check the air conditioning compressor belt tension and adjust if necessary.

Electrical System and Instruments

7. Check battery electrolyte level.
8. Check tightness of battery connections.
9. Check safety start switches for correct operation.
10. Check function of all instruments and warning lights.
11. Check function and adjustment of all lights.
12. Check function of all electronic systems.

Front Axle and Steering

13. Check the front axle oil level (four-wheel drive only), top up if necessary.
14. Check the front axle epicyclic oil level (four-wheel drive only), top up if necessary.

Transmission and Hydraulics

15. Check the transmission oil level top-up if necessary.
16. Check the oil in the rear epicyclic hubs and top-up if necessary (heavy-duty axles only).
17. Check the torque of all wheel and rim nuts and bolts.
18. Check the tyre pressures and adjust if necessary.

Clutch and Brakes

19. Check the clutch pedal height and adjust if driver requests.
20. Check the foot brakes and adjust if necessary.
21. Check the parking brake and adjust if necessary.
22. Check the brake fluid level and top up if necessary.

Cab

23. Check the screen washer bottle fluid level and replenish if necessary.
24. Clean the cab air filter.

General

25. Lubricate all grease points.
26. Lightly oil the clutch linkage, throttle linkage both hand and foot, hinges, catches, and door locks.
27. Road test the tractor, checking all instruments, lights and services for correct functioning, in the event of any fault being found this must be corrected.
28. After the road test, check for leaks in the oil, coolant and fuel systems.
29. Check that all safety guards are in place and all safety decals are fitted and readable.
30. Enquire if any operational difficulties are being experienced by the Owner, correct or demonstrate as necessary.
31. Complete the 300 hour Service record card in the Tractor Service Record Book.

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TRACTOR STORAGE

Instruction 6-1D

Procedure

General

When preparing a tractor for storage, comply with the following recommendations to ensure that the tractor is in good condition when required for use. Thoroughly clean the tractor, giving particular attention to the greasing points and oil filler plugs. Park the tractor in a dry, level and covered area away from the weather and livestock with easy exit in case of fire.

When the tractor has to be stored in the open air, park it on level ground in the shelter of a building or wall and completely cover it with a good tarpaulin.

Tyres

1. Jack up the tractor and position wooden blocks under the axles to relieve the tyres of all weight.
2. Inflate the tyres a little above the normal pressure and chalk that pressure on the tyre wall. Protect the tyres from direct sunlight.
3. When ballasted tyres are not filled with calcium chloride, deflate the tyres, empty out the water and re-inflate with air.
4. When wheel weights are fitted, remove, clean and paint any bare metal and refit.

Hydraulic Lift System

5. Check and replenish the transmission oil level in the centre housing to the high mark on the dipstick.
6. Using the tractor hydraulics, with the Response Control in FAST, raise and lower the linkage several times.
7. Engage the PTO for a short period to obtain the maximum circulation of transmission oil around the centre housing.
8. Raise the linkage to the Transport Position and support the two lift arms in this position with wooden chocks.
9. Leave the two quadrant levers in the Transport Position i.e., the Draft Control (outer) lever past the UP and the Position Control (inner) lever in Transport Position. DO NOT MOVE the quadrant control levers from these positions.
10. Clean and coat the exposed Assistor lift cylinder rod with grease, if fitted.

Steering

11. Clean and coat the exposed steering cylinder rod with grease.

Engine

12. Drain the engine sump oil, when hot if possible.
13. Change the filter element.
14. Refill the engine sump with an approved grade of oil.
15. Seal the crankcase breather, exhaust and air cleaner pipes with adhesive tape after running the engine.
16. Clean the dry air cleaner unit.

Cooling System

17. Drain the header tank, radiator and cylinder block, when hot if possible and leave the taps in the open position.
18. Rest the header tank cap on the filler neck.

Fuel System

19. Clean the fuel filter bowl(s), renew the elements and drain any sediment out of the fuel tank.
20. Top up the fuel tank completely to prevent condensation forming on the unfilled portion of the tank, thus resulting in water contaminating the fuel.
21. Remove the injectors and spray approximately 2 ml (0.65 fl oz) of engine oil into each cylinder bore. Using new joint washers, refit the injectors and slowly rotate the crankshaft one complete revolution. DO NOT bleed the fuel system of air.
22. Lubricate the foot and hand throttle control linkage.

Clutch

23. Fully depress the clutch pedal and hold down with a wooden chock. The clutch friction plates will then not bond themselves to the flywheel or pressure plates. NOT applicable to tractors fitted with Oil Cooled Clutch.

Battery

24. Remove the battery from the tractor.
25. Check the electrolyte level and top up as necessary.
26. Clean the battery top and coat the terminals with petroleum jelly.
27. Fully charge the battery from an external source.
28. Repeat the external charge every month during the storage period and top up the electrolyte as necessary.
29. Store the battery in a cool, dry, dust free location but not directly on a concrete or metal surface. There must be no possibility of freezing.

Alternator and Starter Motor

30. Remove any dust or dirt from the alternator.
31. Smear the starter motor and solenoid terminals with petroleum jelly.

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Sheet Metal

32. All rusty, scratched or bare patches of castings and/or sheet metal must be cleaned with abrasive papers and repainted. Matching colours are available for all Massey Ferguson tractors.
33. The bright metal components and surfaces must be cleaned and/or degreased and the protectives sprayed or brushed on.

TRACTOR WATERPROOFING

Instruction **7-1D**

Procedure

General

Before working in water, such as in paddy fields or flooded areas, certain waterproofing modifications must be made to the tractor.

In addition, two extra maintenance services are required.

Starter Motor and Solenoid Assembly

1. Remove the starter motor and solenoid assembly.
2. Thoroughly clean the exterior of the starter motor and solenoid assembly.
3. Blank off the drive end bracket.
4. Seal all the openings in the starter motor and solenoid assembly with suitable waterproof putty.
5. Apply a thick coating of grease to the starter motor and solenoid terminals and ensure that the drive end bracket is blanked off.
6. Coat the exterior of the starter motor and solenoid assembly with a water repellent spray.
7. Refit the starter motor and solenoid assembly to the engine.
8. Reconnect the wiring harness.

Battery

9. Clean the battery top and smear the battery terminals with petroleum jelly.

Engine Breather Pipe

NOTE: *The engine breather pipe is of a critical length and after modification it can be longer but NEVER shorter. When refitted it must point generally in a downward direction without 'U' bends or restrictions to trap liquid or dirt.*

10. Route the plastic breather pipe to the front of the engine and secure it to one of the timing case bolts with a suitable clip.

Engine Dipstick

11. Remove the engine dipstick and store in the tool box.
12. Fit a tapered rubber plug to the engine dipstick tube.

Clutch Housing Drain Hole

13. Discard the split pin in the drain hole in the clutch housing.
14. Enlarge the drain hole, tap and fit a screwed plug.

NOTE: *Procedures 13, 14 and 18 are not applicable to tractors fitted with Oil Cooled Clutches.*

PTO Shaft Cap

15. Remove the PTO cap.
16. Grease both threads
17. Refit the PTO cap and screw it fully home.

Extra Maintenance

Every 10 Hours or Daily

Charge all grease points with an approved grease until it exudes from the seals or shafts.

Every 50 Hours or Weekly

18. Remove the clutch housing drain plug, permit any water to drain away and refit the drain plug.
19. Ensure that the engine breather pipe is unobstructed.

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CLEANING THE TRACTOR

Instruction **8-1D**

Removing Protective Coating

WARNING: HEALTH and SAFETY CAUSES BURNS

- ***In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.***
- ***In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).***
- ***Avoid contact with skin and eyes.***
- ***Wear suitable protective clothing, gloves and eye/face protection.***

Tractors can be sprayed with a protective coating to preserve the paint work during shipment, this is removed using Tempro 70, the removal instructions are as follows:

AS A HOT REMOVER: Feed the product into the steam cleaning equipment or low pressure hot water sprayer to give a final solution of between 25 : 1 and 50 : 1 at the nozzle. A jet temperature of over 60° C (140°F) is recommended. Use a slow, steady passes of the lance. When removal is complete rinse thoroughly with clear water. DO NOT allow the product to dry before rinsing.

AS A COLD REMOVER: Dilute to between 5 : 1 and 9 : 1 with water. If surface is very dirty, rinse with water first. Apply a thick, even coat of the solution by brush, or low pressure sprayer. Leave to soak for 5 to 10 minutes, then rinse thoroughly with water. DO NOT allow the product to dry before rinsing.

CLEANING THE TRACTOR

Careful attention to the following will help to retain the value of your tractor and make the task of maintenance and adjustment quick and simple.

- Use plenty of water to soften dirt adhering to the surface. If you use a jet of water, try and keep it away from electrical components such as the alternator and starter motor.
- If it is found necessary to use detergents or high pressure hot water or steam cleaners, use care not to damage the paint work. Set the machine to the lower pressures and lower rates of detergent application.
- Car polishes can be used on the metal work to improve the appearance of the tractor.
- Aerosol tins of touch-up paint are available from your Massey Ferguson Dealer to repair chipped or damaged paint.
- Check that all the safety decals are in place. The actual location and part numbers of these safety decals are illustrated in the safety section of the Operator Instruction Book, replace any that have been lost or removed during cleaning.

Glass Cleaning

The windows should be washed with soapy water. Visibility is part of SAFETY.

Cleaning the Cab Interior

- When the soft trim material inside the cab becomes dirty, it should be wiped clean. Dip a cloth in warm water/detergent solution and wring out as much of the water as possible.
- The floor matting should be cleaned with a vacuum cleaner and/or a stiff brush. If necessary a damp cloth may be used to remove tough stains. If it is necessary to use a water hose pipe allow the matting to dry naturally and avoid getting water under the mat.
- Clean the seat belt by sponging with warm water and a non-detergent soap, allow to dry naturally.
- Cloth seats are cleaned using a stiff brush or vacuum cleaner. Plastic seats are cleaned using a damp cloth.

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Maintenance Chart		EVERY				
		Flex **	100 hours	300 hours	600 hours	1200 hours
GREASE POINTS	Grease four-wheel drive front axle universal joints.				1	
	Grease all other grease nipples.		2			
ENGINE	Check the engine oil level and top up if necessary.	3				
	Change the engine oil and filter.			4		
	Check the valve tip clearance and adjust if necessary.	(5) every 1200 hours - Dealer				
FUEL SYSTEM	Drain the sediment from the fuel filter bowl(s).	6				
	Change the fuel filter elements.				7	
	Clean the fuel lift pump sediment chamber and strainer.				9	
AIR CLEANER	Change the inner SECONDARY element.	(10) every 1200 hours				
	Change the dry air cleaner MAIN element.	11				
	Check and clean the dry air cleaner MAIN element.					12
COOLING SYSTEM	Check the radiator coolant level and top up if necessary.	13				
	Clean the radiator, condenser and oil cooler fins.	14				
	Drain, flush and refill the cooling system.					15
ELECTRICAL SYSTEM	Clean the battery(ies), smear the terminals with petroleum jelly and check the electrolyte level.			16		
	Check the tension of the alternator/fan and air compressor belt.			17		
STEERING	Check the front wheel hub adjustment (two-wheel drive).				18	
	Check the front wheel alignment (two-wheel drive).					19
CLUTCH	Change the clutch operating cable.	Every 3000 hours - Dealer				
	Adjust the clutch pedal cable.	20				
TRANSMISSION AND HYDRAULICS	Check the transmission/hydraulic oil level and top up if necessary.		21			
	Check the rear epicyclic hub oil level and top up (heavy-duty only).			22		
	Change the rear epicyclic oil (heavy-duty only).					23
	Change the transmission/hydraulic oil.					24
	Clean the auxiliary pump strainer.					25
	Clean the centrifugal filter.					26
	Clean the linkage pump oil strainer.					27
BRAKES	Check the brakes and adjust if necessary.			28		
	Check the hydraulic brake fluid level and top up.			29		
	Change the brake fluid and check the condition of the brake pipes.	(30) every 2400 hours - Dealer				
FOUR-WHEEL DRIVE FRONT AXLE	Check the front axle and epicyclic oil levels and top up.			31		
	Change the front axle and epicyclic oil.					32
WHEELS AND TYRES	Check all tyre pressures.		33			
	Check wheel nut tightness.			34		
CAB	Check the windscreen/rear window washer bottle and top up.	35				
	Remove and clean the cab air filter.	36				
	Change the cab air filter.					37
	Check operation of air-conditioning system.			38		
	Check air-conditioning compressor belt tension.				39	
GENERAL	Oil can lubrication.			40		

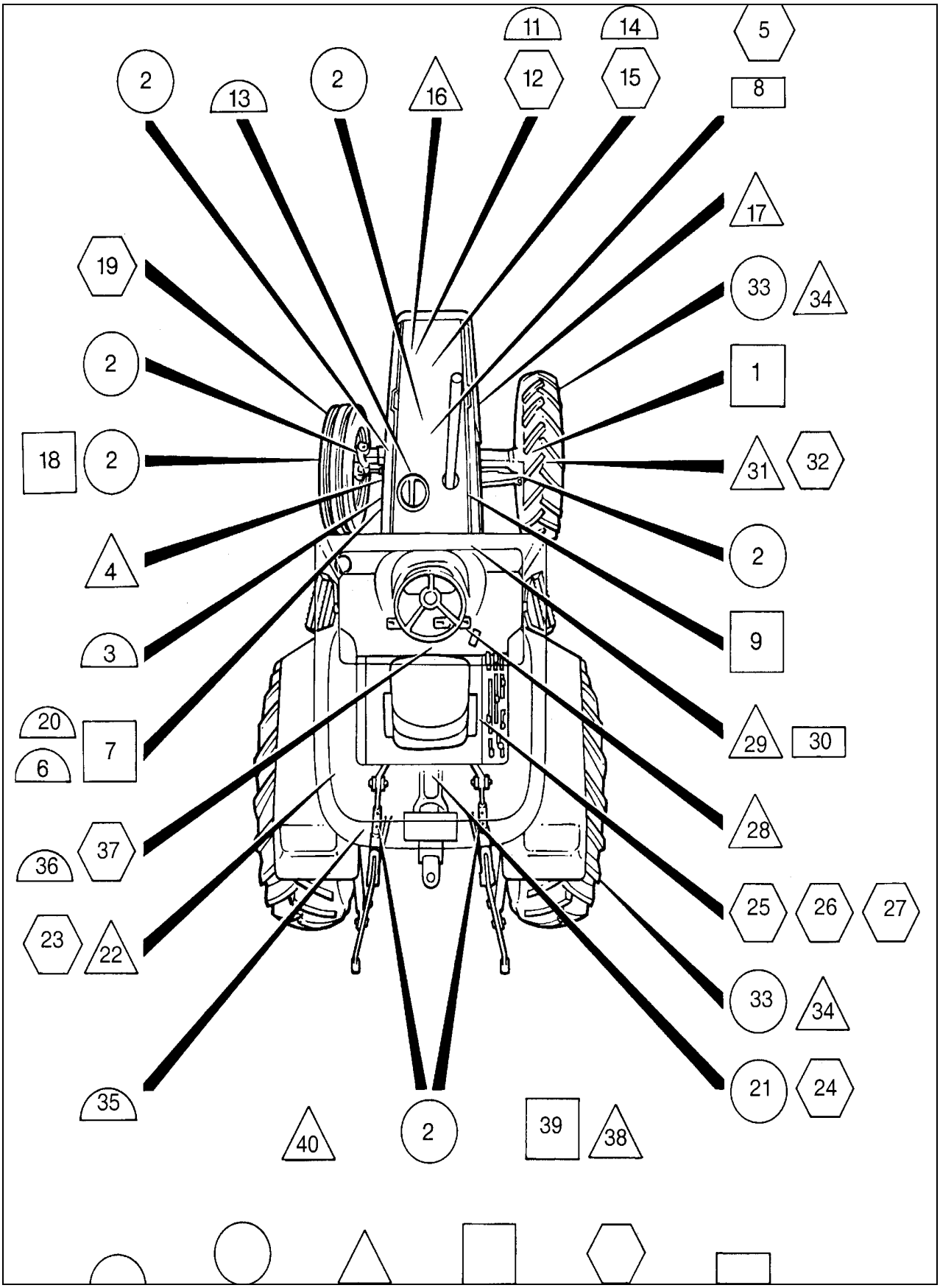
Table 1

Symbols and numbers cross refer to the tractor maintenance and lubrication chart, *(see page 1D-10)* for location purposes.

IMPORTANT: ***Flexible maintenance times vary according to individual conditions of operation. You must establish times for servicing flexible items. An average interval time for checking these items is at each fuel fill.*

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Tractor lubrication chart, *(see page 1D-9)*

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MASSEY FERGUSON RECOMMENDED LUBRICANTS

ENGINE

Specification:

Use Massey Ferguson Super Tractor Universal Oil 10W-30.

or

Massey Ferguson Super Premium Universal Oil 15W-30.

or

Super Tractor Universal Oil (STUO) covered by Massey Ferguson specification M1139 to one of the viscosities listed in Table 2 below.

or

Use MULTIGUARD ® 5W30 Motor Oil.

or:

MULTIGUARD ® 15W40 Motor Oil.

or:

MULTIGUARD ® 10W30 Motor Oil.

or:

MULTIGUARD ® Straight Weight Motor Oil.

or:

One of the alternative lubricants listed on page 1D-14

Capacity:

Three cylinder engine . . . . . .5,7 litres (1.3 gal)(1.5 US gal).
Four cylinder engine . . . . . .6,5 litres (1.4 gal)(1.7 US gal).
Six cylinder engine . . . . . .13,5 litres (3.0 gal)(3.6 US gal).

Requirements:

Oil must meet one of the following minimum specifications:

Naturally aspirated engines . . . . . API CC/CCMCD1
Turbocharged engines. . . . . API CD/CCMCD2

Viscosity:

Ambient temperature range			Oil viscosity - SAE number
	Degree F	Degree C	
Cold Temperate Hot	Below 41 25 to 81 Above 64	Below 5 -4 to +27 Above 18	10W. 10W/20 10W/30 10W/30. 20W. 15W/30. 20W/30. 10W/40. 15W/40. 20W/50. 15W/40. 20W/30. 20W/40. 20W/50. 30.

Table 2

TRANSMISSION and HYDRAULICS

Specification:

Use Massey Ferguson Super Tractor Universal Oil 10W-30

or

Massey Ferguson Super Premium Universal Oil 15W-30.

or

Super Tractor Universal Oil (STUO) M1139 or Universal Tractor Transmission Oil (UTTO) M1135 to one of the viscosities listed in Table 3

or

PERMATRAN III

or

One of the alternative lubricants listed on page 1D-14 or its equivalent.

Capacity:

All transmissions . . . . . 50,0 litres (11.0 gal)(13.2 US gal)

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Viscosity:

Ambient temperature range			Oil viscosity - SAE number
	Degree F	Degree C	
Cold Temperate Hot	Below 41 25 to 81 Above 64	Below 5 -4 to +27 Above 18	10W/20 10W/30. 10W/30. 15W/30. 20W/30. 10W/40. 15W/40. 20W/50. 15W/40. 20W/30. 20W/40. 20W/50.

Table 3

FRONT PTO GEARBOX

Specification:

One of the alternative lubricants listed on page 1D-14.

Capacity0,6 litres (1 pt)(1 US pt)

FOUR-WHEEL DRIVE FRONT AXLE

Specification:

Use Massey Ferguson Super Tractor Universal Oil 10W-30.

or

Massey Ferguson Super Premium Universal Oil 15W-30.

or

Massey Ferguson Universal Gear Oil EP 80W-90.

or

PERMATRAN III

or

One of the alternative lubricants listed on page 1D-14.

Capacity:

Axle (each side) - AG 66/75/85 (4215, 4220, 4225, 4235, 4243, 4245, 4255) . . . . . 5,6 litres (1.2 gal)(1.5 US gal).
Axle (each side) - AG 105 (4253, 4255, 4260, 4263, 4270) . . . . . 7,6 litres (1.7 gal)(2 US gal).

Epicyclic hub (each side) - AG 66 (4215, 4220, 4225, 4235) . . . . . 0,8 litres (1.5 pts)(1.5 US pts).
Epicyclic hub (each side) - AG 75/85 (4235, 4243, 4245, 4255) . . . . . 1,0 litres (1.8 pts)(1.8 US pts).
Epicyclic hub (each side) - AG 105 (4253, 4255, 4260, 4263, 4270) . . . . . 1,2 litres (2.0 pts)(2.0 US pts).

BRAKE FLUID

Use Massey Ferguson LHM Mineral Brake Fluid part number 3405 389 M1 (1 litre bottle).

or

Mineral type oil as specified in the alternative lubricants listed on page 1D-14.

DO NOT use vegetable type fluid. The correct fluid is colour coded GREEN.

DO NOT use DOT 3.

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GENERAL

Grease Points

Use Massey Ferguson Multi-Purpose Grease NLG1 EP2 or any multi-purpose lithium-based grease. Always clean the grease gun and fittings before and after use.

or:

Use HI TEMP EP2 GREASE.

or:

MULTI-PURPOSE LITHIUM #2.

Grease points are located as follows:

Two-wheel drive tractors

Front wheel hubs	2 points.
Front axle swivel pins	2 points.
Steering ram pivot pin	1 point.

Four-wheel drive tractors

Universal joints	2 points.
Front axle swivel pins	4 points

All tractors

Front axle pivot bearing	2 points.
Adjustable lift rods	4 points.
Lift assistor rams top bearing	2 points.
Pick-up hitch	2 points.
Front three-point linkage	2 points.

With an oil can lubricate throttle and control linkage every 250 hours.

IMPORTANT: *Severe working conditions.*
Where tractors are operating arduous work cycles, or when working in areas where there are dusty conditions, paddy fields, deep water etc, coupled with a lack of maintenance care and low specification fuel and oil, the intervals of service should be halved, particularly for oil and filter changes.

CAUTION: *Tractor lubricants and greases:*
No significant hazard when properly used and in the application for which they were designed. Frequent and/or prolonged skin contact may give rise to skin irritations. Emergency treatment of acute effects:

- Ingestion: DO NOT induce vomiting. Administer 250 ml (1/2 pint) milk or 50 ml olive oil. Seek medical advice.
- Skin Contact: Remove by wiping, wash with soap and water.
- Inhalation: Saturated vapour non-toxic at room temperature. - Remove from exposure.
- Eye contact: Wash with copious amounts of warm water.

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ALTERNATIVE LUBRICANTS

For engine oil viscosities and temperature - see tables on page 1D-8.

Unit	Temp.	BP	CALTEX	CASTROL	ESSO
Engine naturally aspirated	See page 1D-8	Vanellus M Terrac Extra	Delo 100 Delo 200 Delo 350 Delo 500 Super Tractor Oil Delo 350 Delo 500 Multigrade	Castrol Agri MP Castrol Agri MP Fortec Castrol CRF	Unifarm Super Tractor Oil Essolube DX-34+ Essolube MHX
Engine turbocharged	See page 1D-8	Vanellus C3 Terrac Extra BP Multigrade 15W-40	Delo 350 Delo 350 Multigrade Delo 500 Delo 500 Multigrade Super Tractor Oil Delo SMP Delo SMP Multigrade	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Trimax Castrol Agri Powermax Castrol RX Castrol RX Super Plus	Unifarm Super Tractor Oil Essolube MHX SAE 15W40 Essolube Cargo 15W40 Esso Super Diesel Oil TD
Transmission and hydraulics. Four-wheel drive front axle Rear axle epicyclic (Heavy-duty)	Cold	Tractran 9 Terrac Extra 10W30	RPM Tractor Hydraulic Fluid	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Power Trans Castrol Agri Multi Trans	Torque Fluid 56 Unifarm AL 3100
	Temperate	Terrac Extra 10W30 Terrac Extra 10W40 Terrac 15 Tractran 8	Super Tractor Oil TDH Fluid HT RPM Tractor Hydraulic Fluid	Castrol Agri MP Castrol Agri MP Fortec Castrol Agri Power Trans Castrol Agri Multi Trans Castrol Agri AS Super	Torque Fluid 56 Torque Fluid 62 Unifarm AL 3100 Super Tractor Oil
	Hot	Terrac Extra 10W40 Terrac 15 Tractran 8	Super Tractor Oil TDH Fluid HT	Castrol Agri MP Castrol Agri MR Fortec Castrol Agri Power Trans Castrol Agri Multi Trans Castrol Agri AS Super	Unifarm Torque Fluid 62 AL 3100 Super Tractor Oil
Front PTO	All temps.	Energear SGX 75W90	Synstar GL 75W90	Alpha Syn T150	GX 75W90
Brake fluid	All temps.	Hydraulic LHM	Rando HDZ 15	Castrol CHSMO Castrol LHM	LHM Fluid
	Over -20°C	Autran MBX Autran GM-MP Vanellus C3 10W	Rando HD 32 ATF HDA Delo 350 10W	Castrol TQ D Castrol RX Super 10 Castrol Agri ATF	Torque Fluid 10 ATF D ATF TAS A Essolube XD-3 SAE 10W
Grease	All temps.	Energrease LS-EP2	Molytex EP2	Castrol LM Castrol LMX	Esso Beacon 2 Esso Beacon EP2

Unit	Temp.	MOBIL	SHELL	TEXACO	TOTAL
Engine naturally aspirated	See page 1D-8	Mobil Super Universal Mobil Universal Delvac 1300 Delvac Super 1300	Rotella X Rimular X Rimular XT Harvella S Harvella TX Super Universal Farm Oil	Universal Tractor Oil Ursatex Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Rubia S Rubia XT Multagri TM Multagri Super
Engine turbocharged	See page 1D-8	Mobiland Super Universal Delvac 1300 Delvac Super 1300 Delvac XHP	Harvella S Harvilla TX Super Universal Farm Oil Rimula X Rimula XT Rotella TX	Ursa Super LA Ursa Super TD Texfarm Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Multagri Super Multagri TM Rubia XT
Transmission and hydraulics. Four-wheel drive front axle Rear axle epicyclic (Heavy-duty)	Cold	Mobiland Super Universal Mobilfluid 423	Donax TD Harvella TX	TDH Oil Texfarm 10W30	Multagri Super 10W30 Transmission MP
	Temperate	Mobiland Super Universal	Donax TT Harvella Harvella TX Super Universal Farm Oil Farmecon Universal Oil	Texfarm Super Universal Tractor Oil Super Universal Tractor Oil-Premium	Multagri Super Multagri TM Transmission MP
	Hot	Mobiland Super Universal	Harvella 10W40 Harvella TX Donax TT	Super Universal Tractor Oil	Multagri Super Multagri TM Transmission MP
Front PTO	All temps.	----------	Spirax X 75W90	Multigear 75W90R	Transmission TX 75W90
Brake fluid	All temps.	Mobil DET 11	Shell LHM.S	Rando HD 10	LHM Plus
	Over -20°C	Mobil ATF 200 Mobil ATF 220 Delvac 1310	Donax TA Donax TX Rimula X 10W Tellus T15	Texamatic 9226 Textran C3 Ursa Super LA 10W	Fluid ATX Azolla ZS 32 Robias 10W
Grease	All temps.	Mobilux EP2 Mobilgrease HP222	Farm Grease Universal Retinax LX	Multifak All Purpose EP2	Multis or Multis EP2

Table 4

NOTE: *All engine oils recommended for turbocharged engines are suitable for use in naturally-aspirated engines after running in.*

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SECTION 2

Splitting the Tractor

INDEX

2A SPLITTING THE CAB TRACTOR
2B SPLITTING THE FOOTSTEP TRACTOR

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Splitting the Cab Tractor

Section 2 - Part A

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4-2A	Between Gearbox and Rear Centre Housing, Withdrawing Rearwards - Removal and Refitment	2A–10

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Splitting the Cab Tractor

SPECIFICATION

Bolt Torques

Bolts and nuts front support casting to engine	280 Nm (205 lbf ft).
Bolts and nuts engine to gearbox	115 Nm (85 lbf ft).
Bolts gearbox to range gearbox	102 Nm (75 lbf ft).
Bolts and nuts range gearbox to centre housing	102 Nm (75 lbf ft).
Bolts and nuts cab rubber mounts	85 Nm (65 lbf ft).
Bolts front cab support bracket to gearbox	203 Nm (150 lbf ft).
Bolts rear cab support bracket to axle casing	200 Nm (148 lbf ft).
Bolts front torsion bar to flywheel housing	375 Nm (275 lbf ft).
Torsion bar tension	120-140 Nm (90-103 lbf ft).

Special Tools

MF.367B	Transmission torque wrench.
MF.3012	Tractor splitting track.
MF.3013	Cab stands.
3376 935 M1	Blanking plug and cap.

General Description

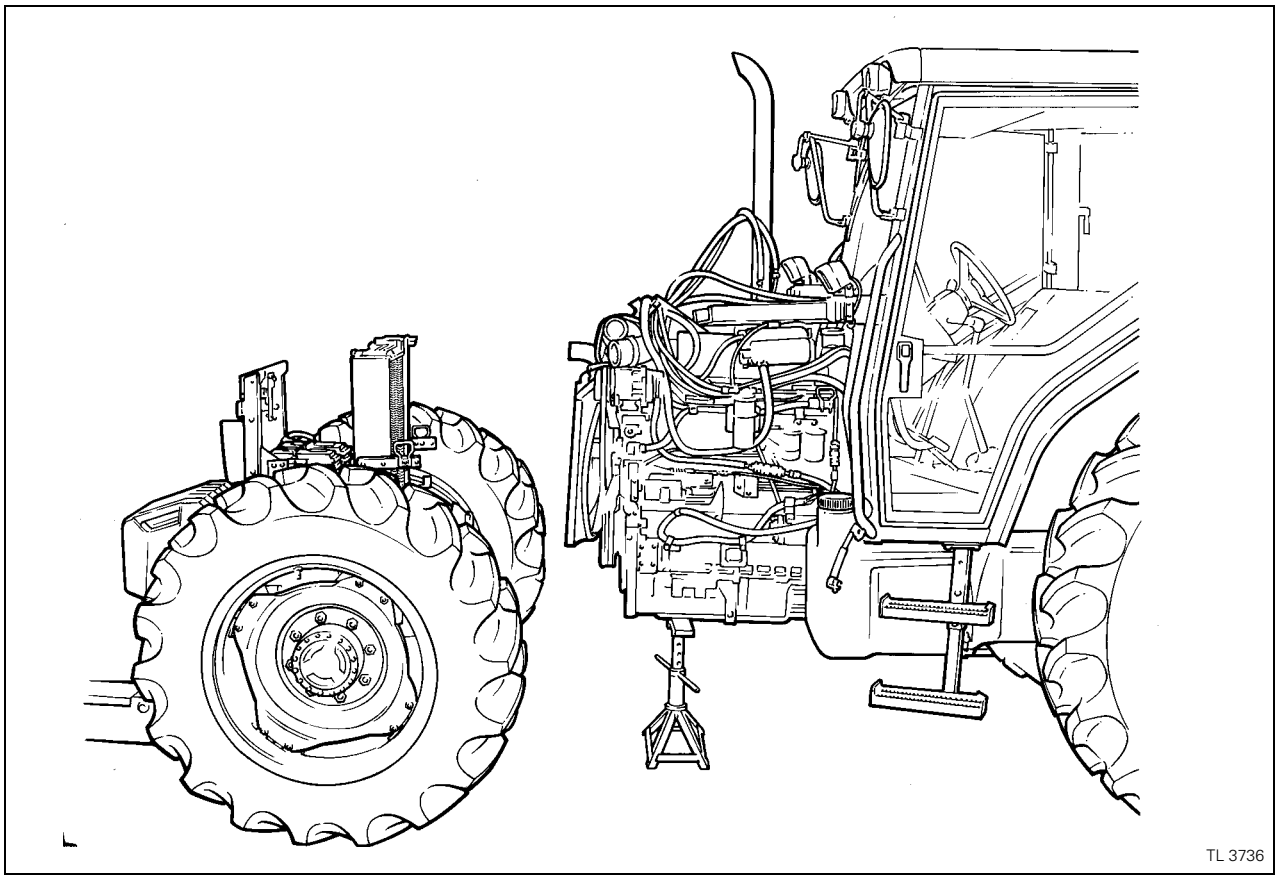
These instructions on splitting the tractor are given as a guide, you may find that your tractor does not contain some of the features shown or described. This is due to the large number of build variations; for example, height of cab, three, four or six cylinder engines, with or without air conditioning and the various types of gearbox.

The main differences are that standard cabs with flat floors give greater access around the transmission compared with Low Profile cabs. Tractors with Hi-visibility hoods have side mounted batteries behind the right-hand footstep. Tractors with six cylinder engines can have torsion bars across the top of the transmission case to increase the lift capacity.

When splitting the tractor, work safely, use a tractor splitting track and cab stands, DO NOT work under parts of the tractor which are only supported on a hydraulic jack.

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SPLITTING BETWEEN THE FRONT AXLE AND ENGINE

Special Tools:
MF.3012 Tractor Splitting Track

Removal and Refitment 1-2A

Removal

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. *(see operation 1-5E).*
2. Apply the tractor parking brake and fit blocks to hold the rear wheels.
3. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
4. Remove the exhaust pipe.
5. Remove the hood side panels, centre section and front grille *(see operation 1-12B).*
6. Remove the header tank cap and drain the cooling system via the drain tap on the front of the radiator bottom tank.
7. Disconnect the batteries.
8. If the tractor is fitted with front mounted batteries, disconnect the power cable at the starter motor.
9. Disconnect the wires to the headlights, horn, and air cleaner switch.
10. Disconnect the pipes to the steering cylinder in front of the radiator, marking with a felt tip pen which is left and right.
11. Disconnect the hose between the air cleaner and engine.

Oil Cooler/Air Conditioner Condenser

12. If the tractor is fitted with either an oil cooler or air conditioner condenser or both, they can be moved to one side without disconnecting the pipes.
13. Disconnect the oil cooler from the radiator frame.
14. Remove the top runner retaining the condenser to the radiator.
15. Disconnect the panel above the radiator through which all the pipes and hoses pass.
16. Lift the oil cooler, condenser and all the pipes up and over so that they rest on top of the engine.

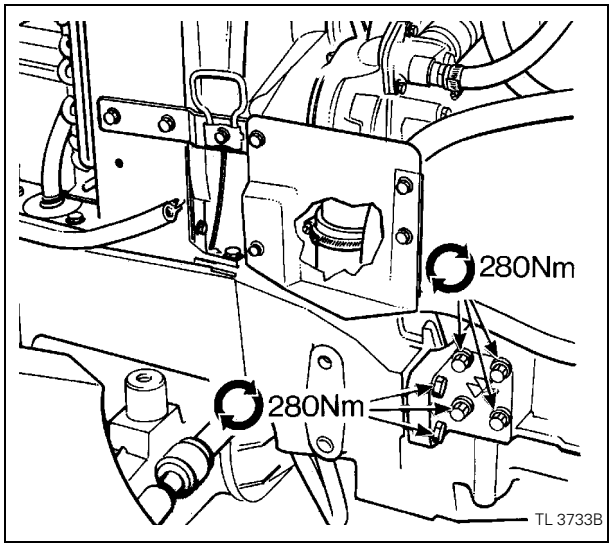
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Splitting the Cab Tractor

General

17. Remove the fan cowl and hang it over the fan.
18. Disconnect the radiator and header tank hoses.
19. Disconnect the differential lock pipe connection to the four-wheel drive front axle.
20. Support the tractor under the engine sump using the fixed stand part of MF.3012 Tractor Splitting Track, or a suitable jack, place wood between the jack and sump to prevent slippage.
21. To the front of the tractor fit a full set of weights to counter balance the weight of the front axle.
22. Place a suitable trolley jack under the weights.
23. Remove the bolts and nuts securing the front axle support casting to the engine, there are bolts and nuts inside and outside the support casting.
24. Carefully wheel the front assembly away from the engine on its wheels and the front trolley jack.

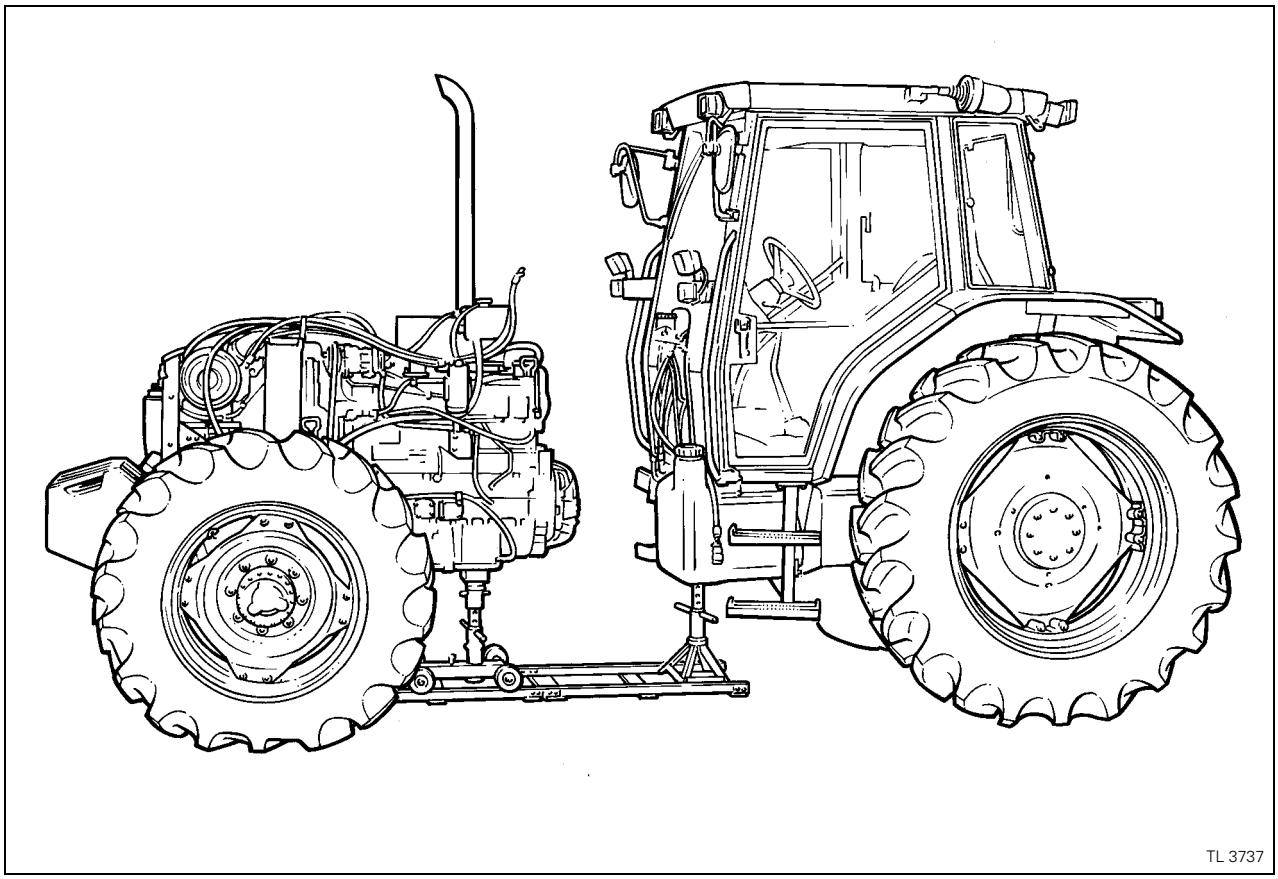


Refitment

25. Reverse procedures 1 to 24 except:
    a. Tighten the front axle support casting to engine bolts and nuts to a torque of 280 Nm (205 lbf ft).
    b. Fill the cooling system with a 50% anti-freeze/water solution.
    c. Check all oil levels and for leaks.

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SPLITTING BETWEEN THE ENGINE AND GEARBOX

Special Tools:
MF.3012 Tractor Splitting Track
3376 935 M1 Blanking Plug and Cap

Removal and Refitment 2-2A

Removal

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. Remove the drive shaft assembly *(see operation 1-5E)*.
2. Apply the tractor parking brake and fit blocks to hold the rear wheels.
3. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
4. Remove the exhaust pipe.
5. Remove the hood side panels, centre section and front grille, *(see operation 1-12B)*.
6. Disconnect the batteries.

Left-hand Side

7. Disconnect the main power cable and wires to the solenoid, remove the starter motor.
8. Disconnect the throttle cable.
9. Disconnect the stop control cable, if fitted.
10. Disconnect the two electrical multi-pin plugs in front of the cab bulkhead.
11. Disconnect the hydraulic pipes from the steering unit to the front axle, mark with a felt tip pen for refitment.
12. Disconnect the hydraulic pipe from steering unit to oil cooler, if fitted.
13. Disconnect the fuel leak-off pipe to tank at the fuel filter.
14. Disconnect the air conditioner couplings and fit blanking plug and cap, Massey Ferguson part number 3376 935 M1 to prevent the loss of refrigerant, if fitted.
15. Tractors with shuttle gearbox, remove the shift lever bracket fitted to the rear of the cylinder block.

Right-hand Side

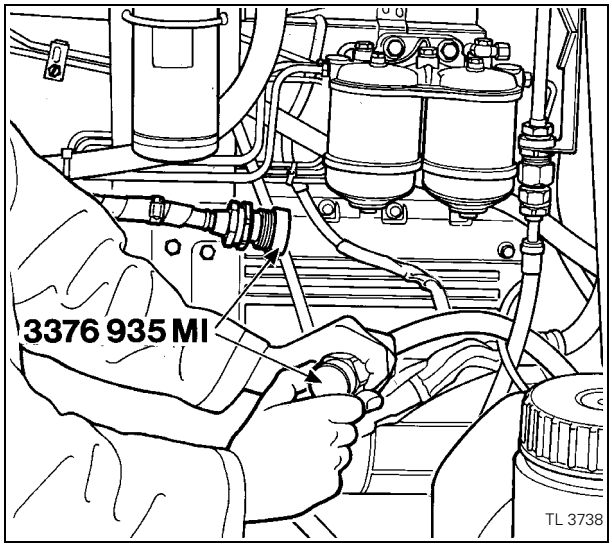
16. Remove the tool box.
17. Disconnect the four-wheel drive differential lock pipe.
18. Disconnect the hydraulic pipe from the oil cooler, if fitted.

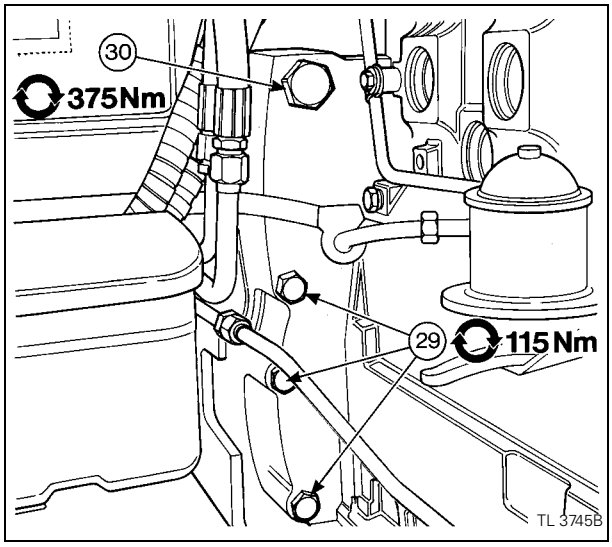
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Splitting the Cab Tractor

19. Disconnect the fuel pipe at the lift pump.
20. Clamp the two cab heater hoses at the base of the cab. Remove and drain off the coolant. Mark one of the pipes with tape to aid correct refitment.
21. Assemble the MF.3012 Tractor Splitting Kit, The stationary part is assembled under the gearbox, it must be placed on the end of the track to prevent the track from moving when parting the tractor. The trolley is placed under the engine sump. Wood should be place between the rear jacks and the tractor to prevent slipping. The two vertical side plates must be fitted each side of the engine sump to prevent side slippage.
22. On tractors with six cylinder engines fitted with torsion bars, the tension is released by removing the two large bolts on each side of the cylinder block at the rear of the engine. These bolts can be removed and refitted without having to re-tension the rods.
23. Remove the bolts and nuts holding the engine to the gearbox case. There is a 13 mm screw securing the top centre of the gearbox.
24. Check that all bolts have been removed, some fit front to back, others back to front.
25. Withdraw the engine and front axle forward.





Refitment

26. Ensure that the clutch release bearing is held back and wired in place, *(see operation 3-4A)*.
27. Align the engine with the gearbox. Two guide studs will assist its alignment. These should be approximately 100 mm (4 in) long x M12 with the non-threaded end tapered and slotted for a screwdriver.

    They should be placed in opposite holes from which the studs can easily be removed when the tractor is assembled.
28. Turn the flywheel through the starter motor aperture and, at the same time, push the engine and front axle towards the transmission.

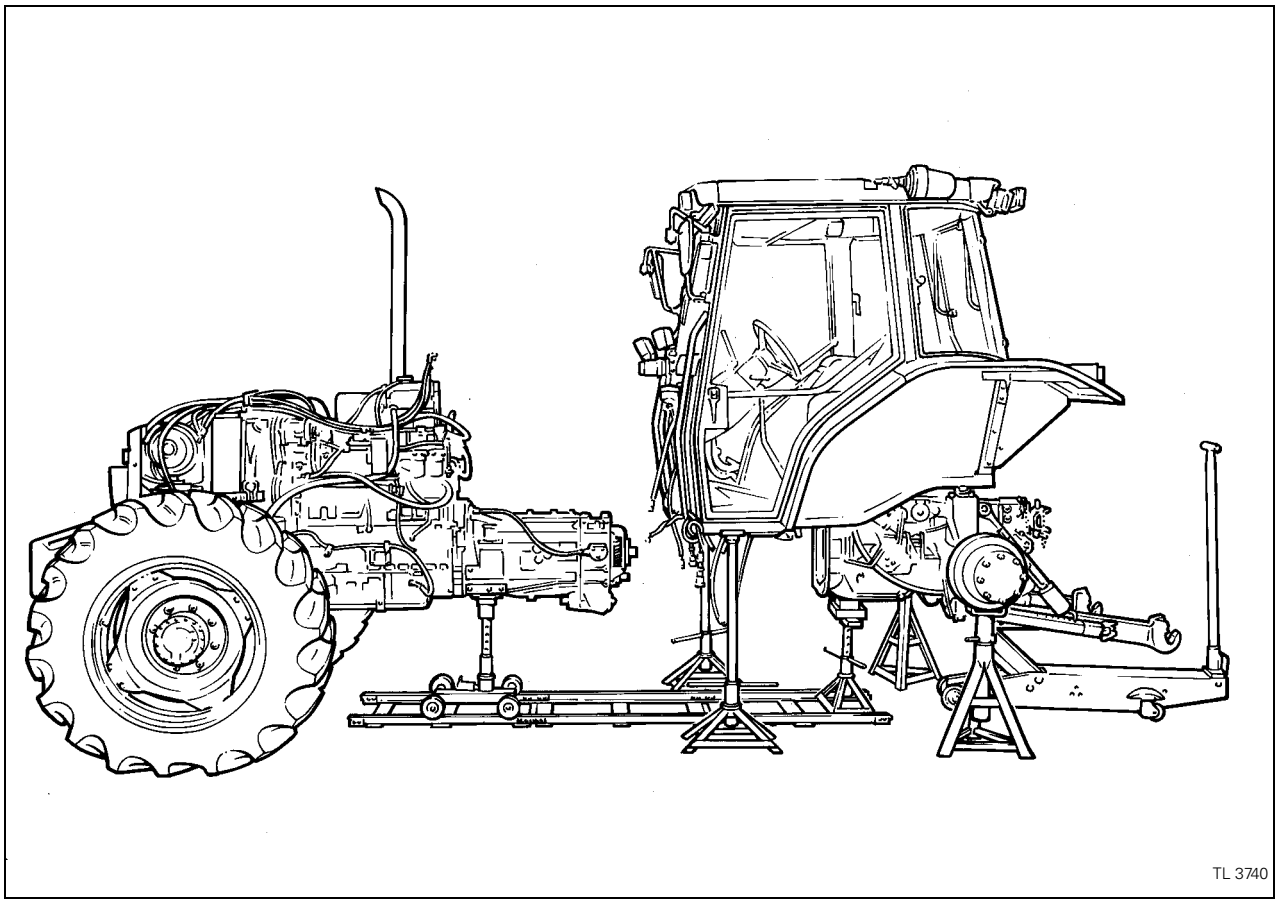
    Turning the flywheel will align the clutch plate splines with the gearbox and PTO input shaft. Continue pushing and turning until the engine flanges meet.

IMPORTANT: *DO NOT force, fit and tighten any bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.*

29. Fit some bolts, remove the guide studs if used, fit the remainder of the bolts and tighten them to a torque of 115 Nm (85 lbf ft).
30. On tractors with torsion bars tighten the bolts to a torque of 375 Nm (275 lbf ft).
31. Reverse procedures 1 to 21.
32. Test drive the tractor.
33. Check all oil and coolant levels and check for leaks.

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SPLITTING BETWEEN THE GEARBOX AND REAR CENTRE HOUSING

Special Tools:
MF.367B Transmission Torque Wrench
MF.3012 Tractor Splitting Track
MF.3013 Cab Stands

Removal and Refitment 3-2A

Removal

IMPORTANT: *DO NOT split the tractor between the range gearbox and the main gearbox.*

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. Remove the drive shaft assembly *(see operation 1-5E).*
2. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
3. Disconnect the batteries.
4. Drain the transmission oil via the drain plugs, you will require a container for 50 litres of oil.
5. Remove both rear wheels and place the axle housings on axle stands.
6. If the tractor has a six cylinder engine and torsion bars, release the two large bolts above the clutch housing.
7. Remove the cab floor mat and the central panel in the floor.
8. Disconnect the shift rod to the gearbox cover, if fitted.
9. Disconnect the safety start switch, if fitted.
10. Disconnect the return pipe to the top cover.
11. Tractors with side mounted batteries, Remove the batteries and carrier.
12. Remove the cab footsteps.

Left-hand Side

13. Disconnect the power and solenoid cables and remove the starter motor.
14. Disconnect the throttle cable.
15. Disconnect the stop control cable, if fitted.
16. Disconnect the two electrical multi-pin plugs in front of the cab bulkhead.
17. Disconnect the hydraulic pipes from the steering unit to the front axle, mark with a felt tip pen for refitment.

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Splitting the Cab Tractor

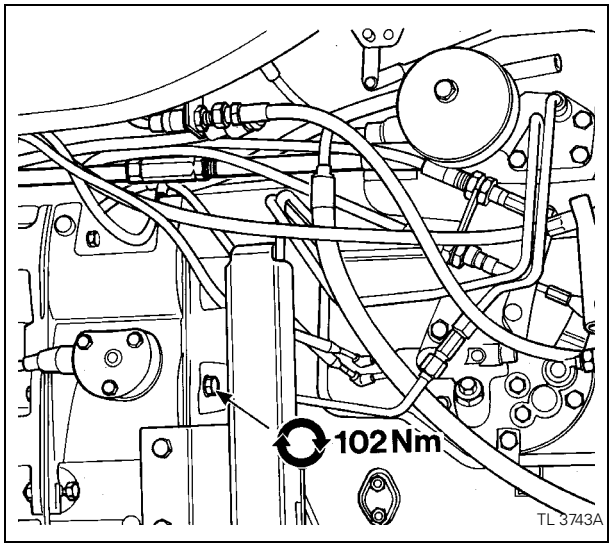
18. Disconnect the hydraulic pipe from steering unit to oil cooler, if fitted.
19. Disconnect the fuel leak-off pipe to tank at the fuel filter.
20. Disconnect the air conditioner couplings and fit blanking plug and cap, Massey Ferguson part number 3376 935 M1 to prevent the loss of refrigerant, if fitted.
21. Tractors with shuttle gearbox, remove the shift lever bracket fitted to the rear of the cylinder block.
22. Disconnect the fuel pipes and electrical connection to the fuel tank sender unit (the connection is in the cable NOT on the top of the tank).
23. Drain and remove the fuel tank(s), *(see operation 2-3C)*.
24. Remove the rear tank support.
25. Disconnect the wires to the PTO safety start switch, and range box indicator switch located in the cable.
26. Disconnect the clutch cable.

Right-hand Side

27. Clamp the two cab heater hoses at the base of the cab. Remove and drain off the coolant. Mark one of the pipes with tape to aid correct refitment.
28. Remove the gear lever.
29. Disconnect the hydraulic pipes from the manifold which run to the front of the tractor.
30. Disconnect the wires to the safety start switch on the gear lever housing, if fitted.

General

31. Remove the studs from the front cab mounts complete with large washers and nuts.
32. Assemble the MF.3012 Tractor Splitting Track, under the tractor. Place the stationary jack on the end of the track under the rear centre housing. Place the trolley under the gearbox placing wood between both jacks and the tractor. An additional length of track (three sections) will assist in splitting.
33. Place MF.3013 Cab Stands on each side of the cab. Screw up the stands so that the cab is lifted approximately 25 mm (1 in) clear of the mounts.
34. Remove the bolts and nuts around the range gearbox and centre housing flange.
35. Carefully withdraw the front axle, engine and gearbox forwards.
36. Discard the gasket.
37. Remove the drive shaft and PTO coupling.
38. The range gearbox or main gearbox can now be removed as required.



Refitment

39. Tension the fan belt tight so that the engine and transmission can be turned over using the fan.
40. Engage the main gear lever into high/3rd and the shuttle lever into forward.
41. Fit the drive shaft and PTO coupler.
42. Fit two guide studs to assist in alignment of the gearbox and centre housing.
43. Place a new gasket on the guide studs.
44. Push the front axle/engine/gearbox assembly towards the centre housing, align the guide studs in the range box with the corresponding holes in the centre housing. Turn the engine fan to align the splines and continue pushing until the two flanges meet.

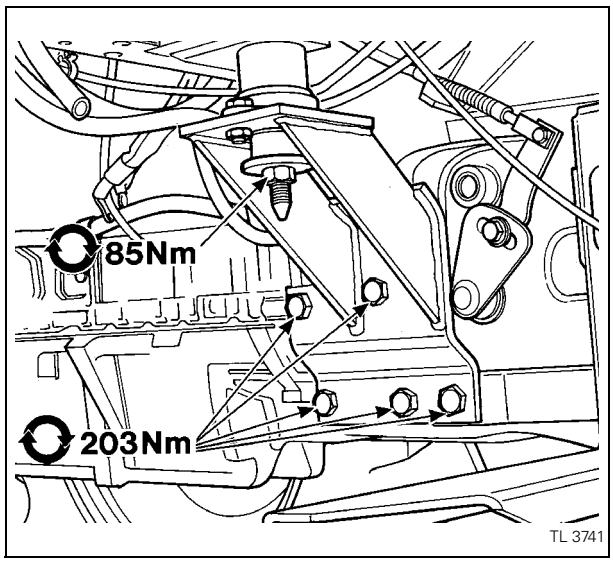
IMPORTANT: *DO NOT fit and tighten any bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the range box and centre housing flanges must be in alignment and parallel.*

45. Secure the two flanges with special bolts and nuts where fitted (dry), removing the guide studs. Use special tool MF.367B, Transmission Torque Wrench, using the 14 mm socket tighten to an initial torque of 50 Nm (35 lbf ft) working in sequence around the box.
46. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.

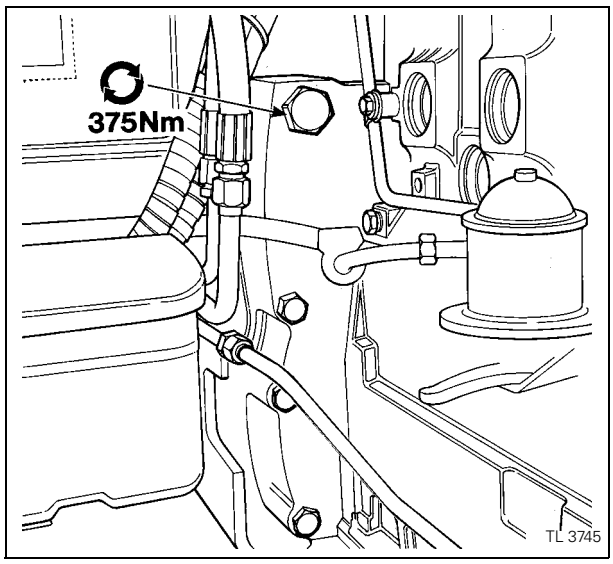
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47. Reverse procedures 1 to 24 except:
    a. Tighten the gearbox to engine bolts (clutch housing) to a torque of 115 Nm (85 lbf ft).
    b. If the front cab support brackets have been removed from the gearbox, apply Massey Ferguson Stud Lock (Loctite 270) and tighten the four bolts to a torque of 203 Nm (150 lbf ft).
    c. Tighten the cab mount stud nuts to a torque of 85 Nm (65 lbf ft).



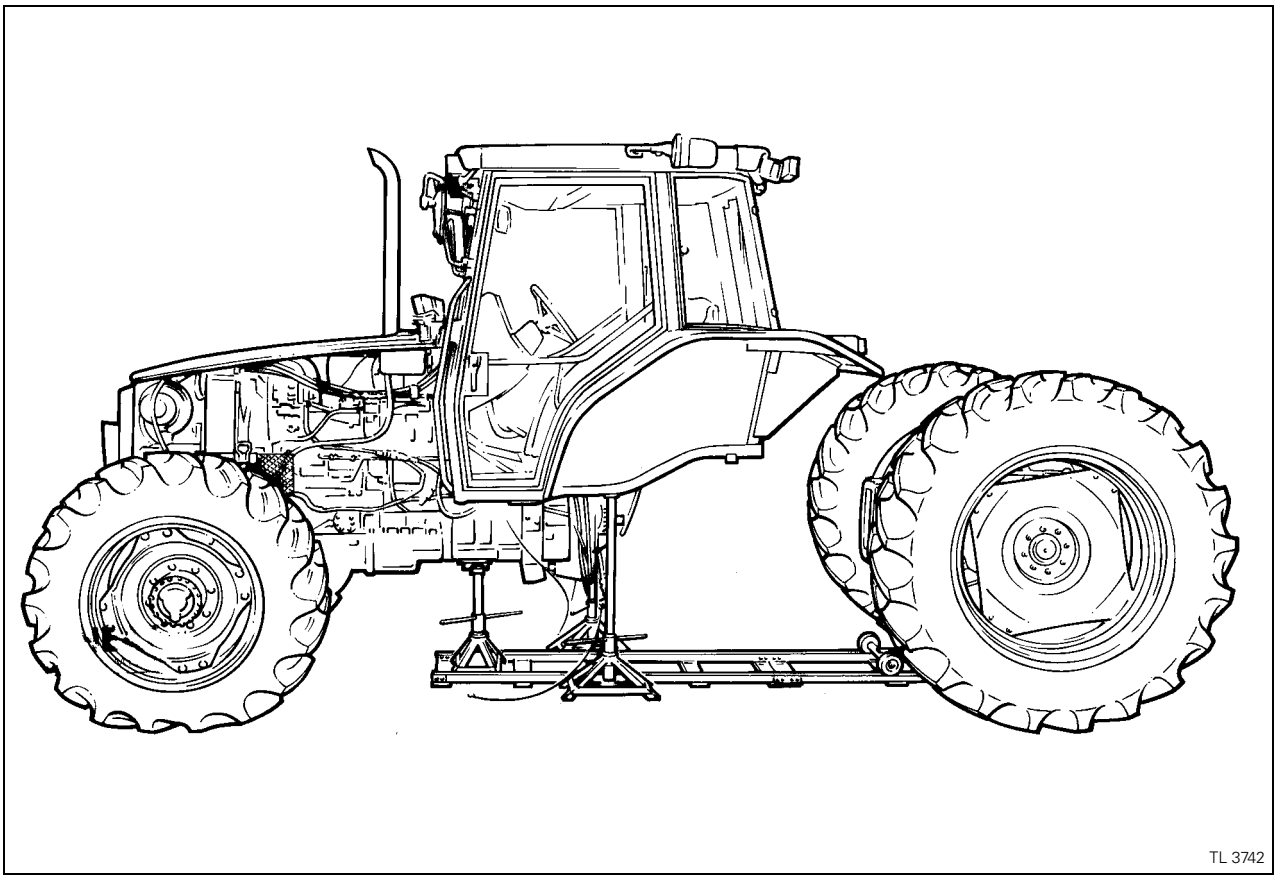
    d. Tighten the torsion bar bolts to a torque of 375 Nm (275 lbf ft).
    e. Adjust the clutch pedal height, *(see operation 1-4A)*.
    f. Refill the transmission with clean oil of the correct grade and top-up the cooling system.
    g. Finally road test the tractor.



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Splitting the Cab Tractor



SPLITTING BETWEEN THE GEARBOX AND REAR CENTRE HOUSING WITHDRAWING REARWARDS

Special Tools:
MF.367B Transmission Torque Wrench
MF.3012 Tractor Splitting Track
MF.3013 Cab Stands

Removal and Refitment **4-2A**

Removal

IMPORTANT: *DO NOT split the tractor between the range gearbox and the main gearbox.*

1. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
2. Disconnect the batteries.
3. Drain the transmission oil via the drain plugs, you will require a container for 50 litres of oil.
4. Remove both rear wheels and place the axle housings on axle stands.
5. If the tractor has a six cylinder engine and torsion bars, release the two large bolts above the clutch housing.

Left-hand Side

6. Disconnect the fuel pipes and electrical connection to the fuel tank sender unit (the connection is in the cable NOT on the top of the tank).
7. Remove the fuel tank, *(see operation 2-3C).*
8. Disconnect the PTO safety start switch wires.
9. Disconnect the PTO control cables.
10. Disconnect the hydraulic brake pipe to the slave cylinder, drain the fluid off and cap the end of the pipe.

Centre

11. Disconnect the rods to the auxiliary control valve.
12. Disconnect the pick-up hitch control cable, if fitted.
13. Remove the trailer socket from the bracket.
14. Disconnect the selector valve cable.

Right-hand Side

15. Disconnect the parking brake cable (both sides).
16. Disconnect the hydraulic brake pipe to the slave cylinder, drain the fluid off and cap the end of the pipe.
17. Disconnect the response cable.
18. Disconnect the position and draft control rods.

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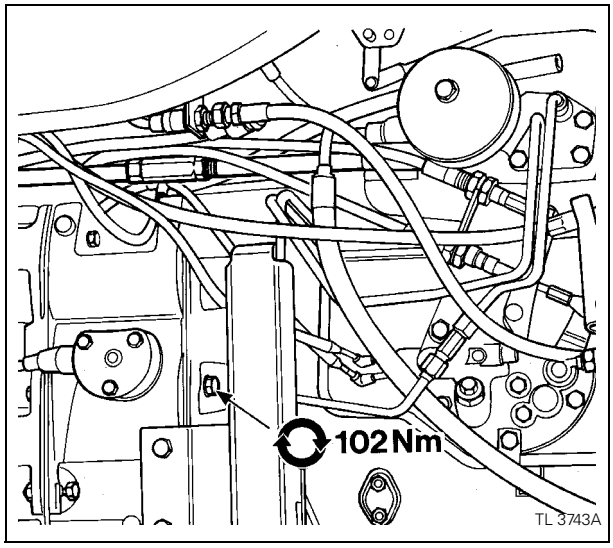
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19. Disconnect the wires from the differential lock and four-wheel drive solenoids, hydraulic pressure switch and safety start switch.
20. Disconnect and remove as necessary the hydraulic pipes going forward to the front of the tractor.
21. Disconnect the pipe to the four-wheel drive clutch.
22. Assemble the MF.3012 Tractor Splitting Track, under the tractor. Place the stationary jack on the end of the track under the range gearbox. Place the trolley jack part under the centre housing placing wood between both jacks and the tractor.
23. Remove the bolts from the rear cab mounts complete with the large washers.
24. Place MF.3013 Cab Stands on each side of the cab as far rearward as possible. Screw up the stands so that the cab is lifted approximately 25 mm (1 in) clear of the mounts.
25. The transmission can be in balance or slightly rear end heavy depending on the build and type of drawbar fitted. It is recommended that a trolley jack is placed under the drawbar to support any weight when removed.
26. Refit the rear wheels with them facing outwards to give maximum clearance between the wheel and transmission.
27. Remove the bolts and nuts holding the centre housing to the range gearbox.
28. Carefully withdraw the rear axle and centre housing rearwards.
29. Discard the gasket.
30. Remove the drive shaft and PTO coupling.

Refitment

31. Tension the fan belt tight so that the engine and transmission can be turned over using the fan.
32. Engage the main gear lever into high/3rd and the shuttle lever (if fitted) into forward.
33. Fit the drive shaft and PTO coupler.
34. Fit two guide studs to assist in alignment of the range gearbox and centre housing.
35. Place a new gasket on the guide studs.
36. Push centre housing assembly towards the range gearbox, align the guide studs in the range box with the corresponding holes in the centre housing. Turn the engine fan to align the splines and continue pushing until the two flanges meet.

IMPORTANT: *DO NOT fit and tighten any bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the range box and centre housing flanges must be in alignment and parallel.*



37. Secure the two flanges with special bolts and nuts where fitted (dry), removing the guide studs. Use special tool MF.367B, Transmission Torque Wrench, using the 14 mm socket tighten to an initial torque of 50 Nm (35 lbf ft) working in sequence around the box.
38. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.

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Splitting the Cab Tractor

39. If the setting of the torsion bars on tractors with six cylinder engines has been disturbed, it will be necessary to reset the tension:

    Couple up the two rods adjacent to the range gearbox, ensure that there is an equal amount of thread in each side of the turnbuckle, within half a turn. Tighten the two front bolts to a torque of 375 Nm (275 lbf ft). With a torque wrench and a 24 mm crowfoot open ended wrench, tighten the turnbuckle to a torque of 120-140 Nm (90-103 lbf ft). DO NOT over tighten. Tighten both sides, then re-check the first rod to ensure that both rods are set to the correct tension Hold the turnbuckle stationary and tighten the locknut to a torque of 130 Nm (95 lbf ft). The setting is now complete.

40. Reverse procedures 1 to 27 except:

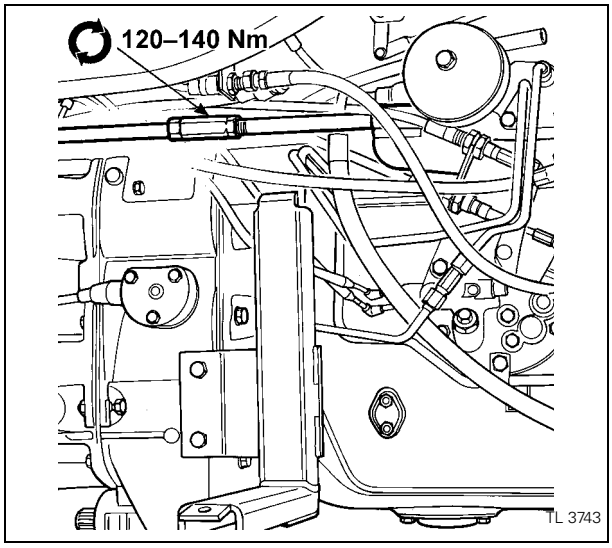
    a. Remove the air from the brake system before fitting the fuel tank, *(see operation 6-6A)*.

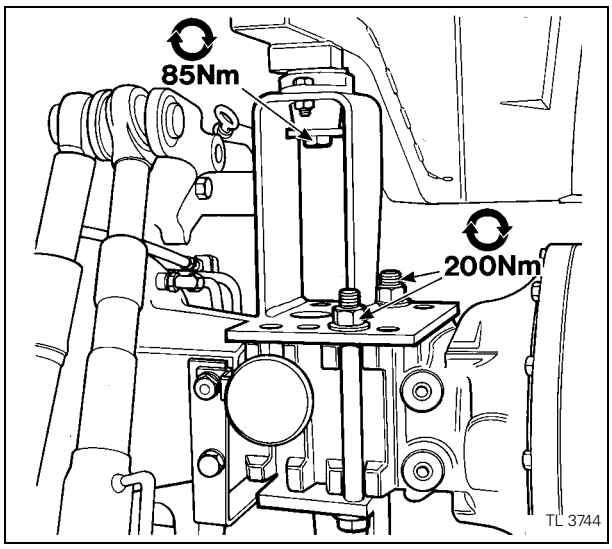
    b. If the rear cab supports have been removed tighten the main support bracket bolts to axle casing to a torque of 200 Nm (148 lbf ft). The central mounting bolt to a torque of 85 Nm (65 lbf ft).

    c. Check adjustment of all control cables and operating rods.

    d. Fill the transmission with the correct grade of clean oil.

    e. Road test the tractor.





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Tractor Manuals Scotland

Splitting the Footstep Tractor

Section 2 - Part B

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Splitting the Footstep Tractor

SPECIFICATION

Bolt Torques

Bolts and nuts front support casting to engine	280 Nm (205 lbf ft).
Bolts and nuts engine to gearbox	115 Nm (85 lbf ft).
Bolts gearbox to range gearbox	102 Nm (75 lbf ft).
Bolts and nuts range gearbox to centre housing	102 Nm (75 lbf ft).

Special Tools

MF.367B	Transmission torque wrench.
MF.3012	Tractor splitting track.

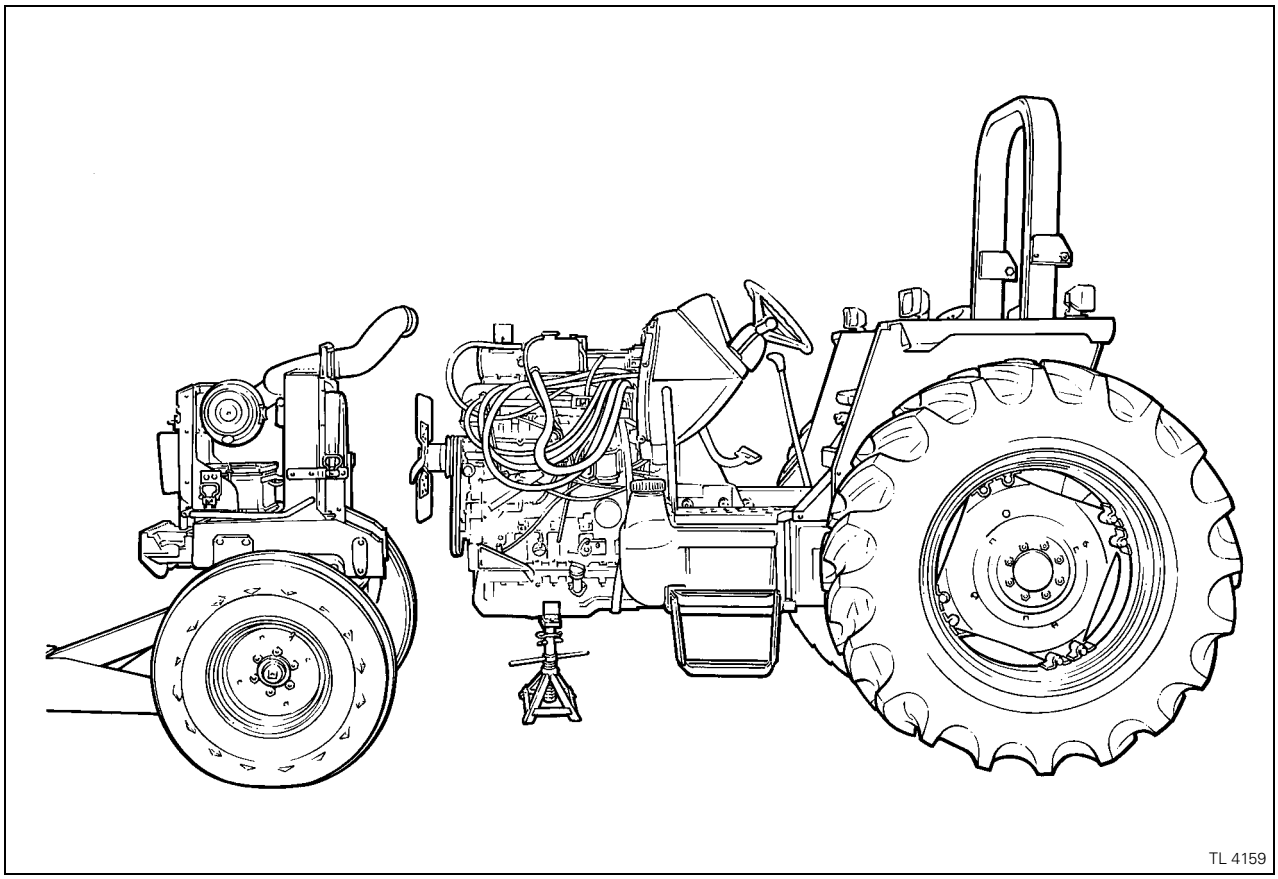
General Description

These instructions on splitting the tractor are given as a guide, you may find that your tractor does not contain some of the features shown or described.

WARNING: When splitting the tractor, work safely, use a tractor splitting track, DO NOT work under parts of the tractor which are only supported on a hydraulic jack.

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SPLITTING BETWEEN THE FRONT AXLE AND ENGINE

Special Tools:
MF.3012 Tractor Splitting Track

Removal and Refitment 1-2B

Removal

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. *(see operation 1-5E).*
2. Apply the tractor parking brake and fit blocks to hold the rear wheels.
3. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
4. Remove the exhaust pipe.
5. Remove the hood side panels, centre section and front grille, *(see operation 1-12B).*
6. Remove the header tank cap and drain the cooling system via the drain tap on the front of the radiator bottom tank.
7. Disconnect the batteries.
8. If the tractor is fitted with front mounted batteries, disconnect the power cable at the starter motor.
9. Disconnect the wires to the headlights, horn, and air cleaner switch.
10. Disconnect the pipes to the steering cylinder in front of the radiator, marking with a felt tip pen which is left and right.
11. Disconnect the hose between the air cleaner and engine.

Oil Cooler

12. If the tractor is fitted with an oil cooler it can be moved to one side without disconnecting the pipes.
13. Disconnect the oil cooler from the radiator frame.
14. Disconnect the panel above the radiator through which all the pipes and hoses pass.
15. Lift the oil cooler, and all the pipes up and over so that they rest on top of the engine.

General

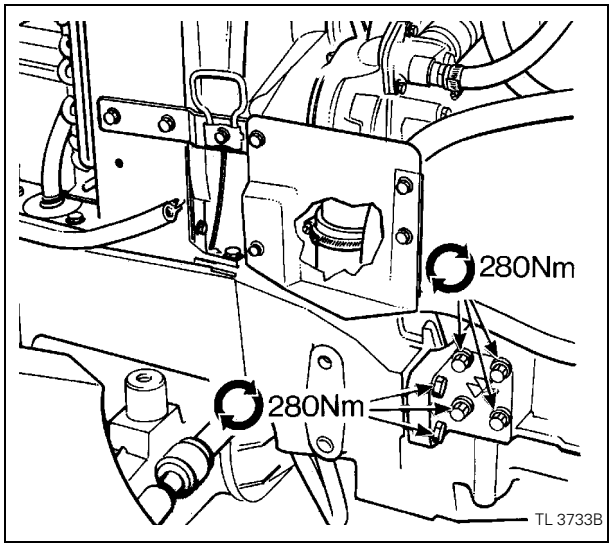
16. Remove the fan cowl and hang it over the fan.
17. Disconnect the radiator and header tank hoses.

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Splitting the Footstep Tractor

18. Disconnect the differential lock pipe connection to the four-wheel drive front axle.
19. Support the tractor under the engine sump using the fixed stand part of MF.3012 Tractor Splitting Track, or a suitable jack, place wood between the jack and sump to prevent slippage.
20. To the front of the tractor fit a full set of weights to counter balance the weight of the front axle.
21. Place a suitable trolley jack under the weights.
22. Remove the bolts and nuts securing the front axle support casting to the engine, there are bolts and nuts inside and outside the support casting.
23. Carefully wheel the front assembly away from the engine on its wheels and the front trolley jack.

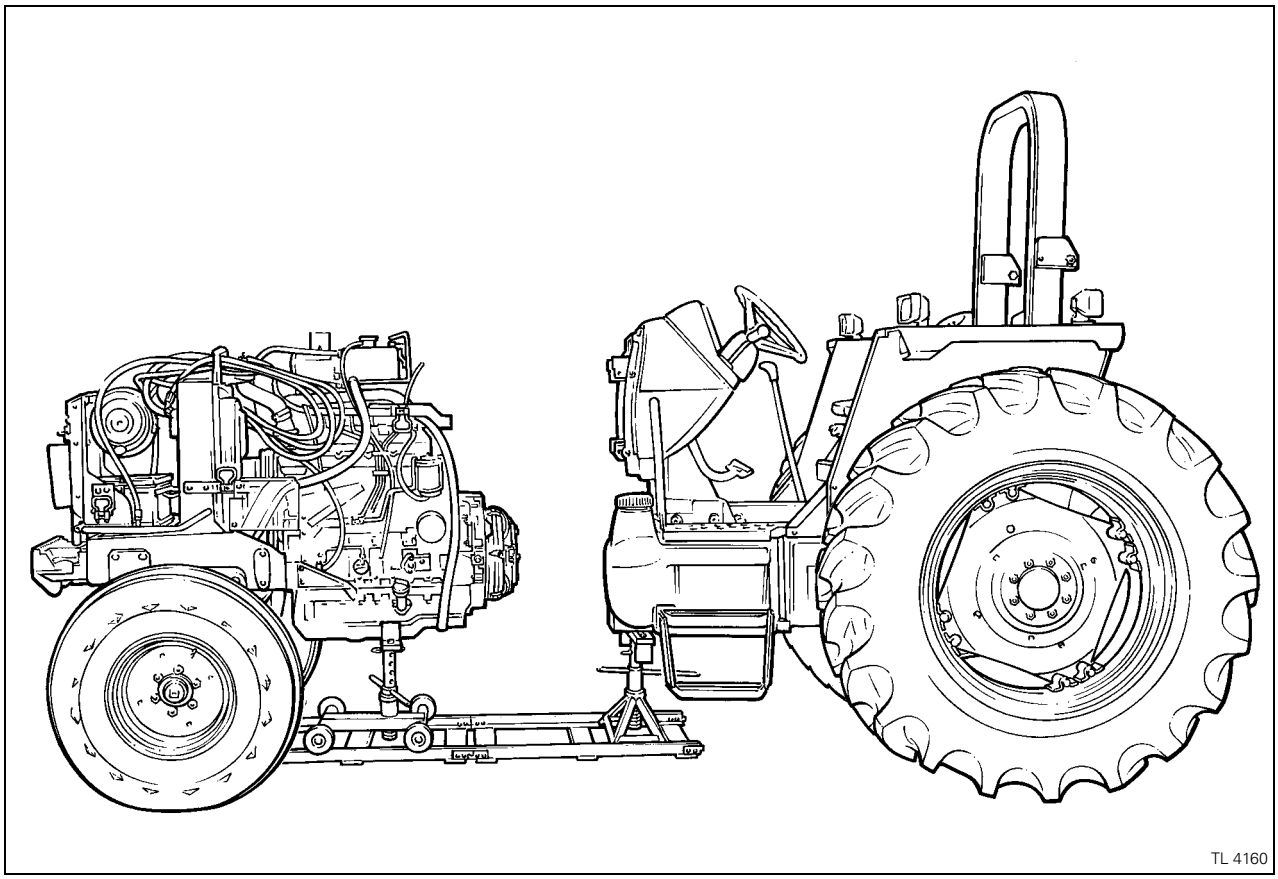


Refitment

24. Reverse procedures 1 to 24 except:
    a. Tighten the front axle support casting to engine bolts and nuts to a torque of 280 Nm (205 lbf ft).
    b. Fill the cooling system with a 50% anti-freeze/water solution.
    c. Check all oil levels and for leaks.
    d. Road test the tractor.

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SPLITTING BETWEEN the ENGINE and GEARBOX

(Clutch access)

Special Tools:
MF.3012 Tractor Splitting Track

Removal and Refitment 2-2B

Removal

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. Remove the drive shaft assembly *(see operation 1-5E)*.
2. Apply the tractor parking brake and fit blocks to hold the rear wheels.
3. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
4. Remove the exhaust pipe.
5. Remove the hood side panels, centre section and front grille, *(see operation 1-12B)*.
6. Disconnect the batteries.
7. Disconnect the cooling system header tank bracket from the bulkhead.

Left-hand Side

8. Disconnect the main power cable and wires to the solenoid, remove the starter motor.
9. Disconnect the throttle cable.
10. Disconnect the stop control cable, if fitted.
11. Disconnect the two electrical multi-pin plugs in front of the bulkhead.
12. Disconnect the hydraulic pipes from the steering unit to the front axle, mark with a felt tip pen for refitment.
13. Disconnect the hydraulic pipe from steering unit to oil cooler, if fitted.
14. Disconnect the fuel leak-off pipe to tank at the fuel filter.

Right-hand Side

15. Disconnect the four-wheel drive differential lock pipe.
16. Disconnect the hydraulic pipe from the oil cooler or steering unit.
17. Disconnect the fuel pipe at the lift pump.

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Splitting the Footstep Tractor

18. Assemble the MF.3012 Tractor Splitting Kit. The stationary part is assembled under the gearbox, it must be placed on the end of the track to prevent the track from moving when parting the tractor. The trolley is placed under the engine sump. Wood should be place between the rear jacks and the tractor to prevent slipping. The two vertical side plates must be fitted each side of the engine sump and the gearbox to prevent side slippage.
19. Remove the bolts and nuts holding the engine to the gearbox case. There is a 13 mm screw securing the top centre of the gearbox.
20. Check that all bolts have been removed, some fit front to back, others back to front.
21. Withdraw the engine and front axle forward.

Refitment

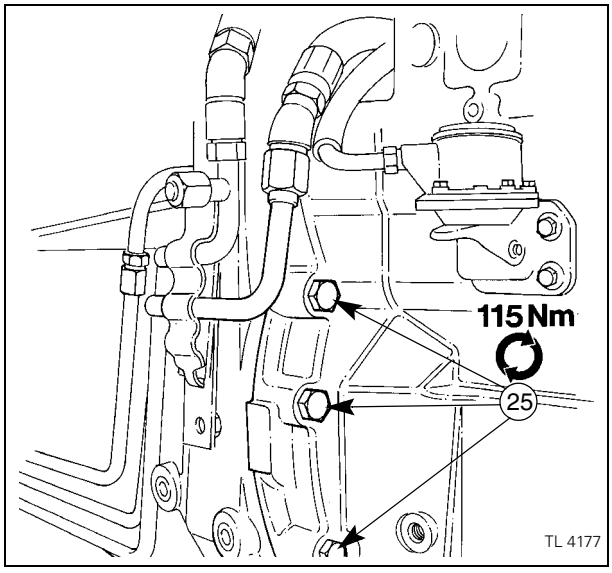
22. Ensure that the clutch release bearing is held back and wired in place, *(see operation 3-4A)*. Not necessary on tractors fitted with oil cooled clutch.
23. Align the engine with the gearbox. Two guide studs will assist its alignment. These should be approximately 100 mm (4 in) long x M12 with the non-threaded end tapered and slotted for a screwdriver.

    They should be placed in opposite holes from which the studs can easily be removed when the tractor is assembled.
24. Turn the flywheel through the starter motor aperture and, at the same time, push the engine and front axle towards the transmission.

    Turning the flywheel will align the clutch plate splines with the gearbox and PTO input shaft. Continue pushing and turning until the engine flanges meet.

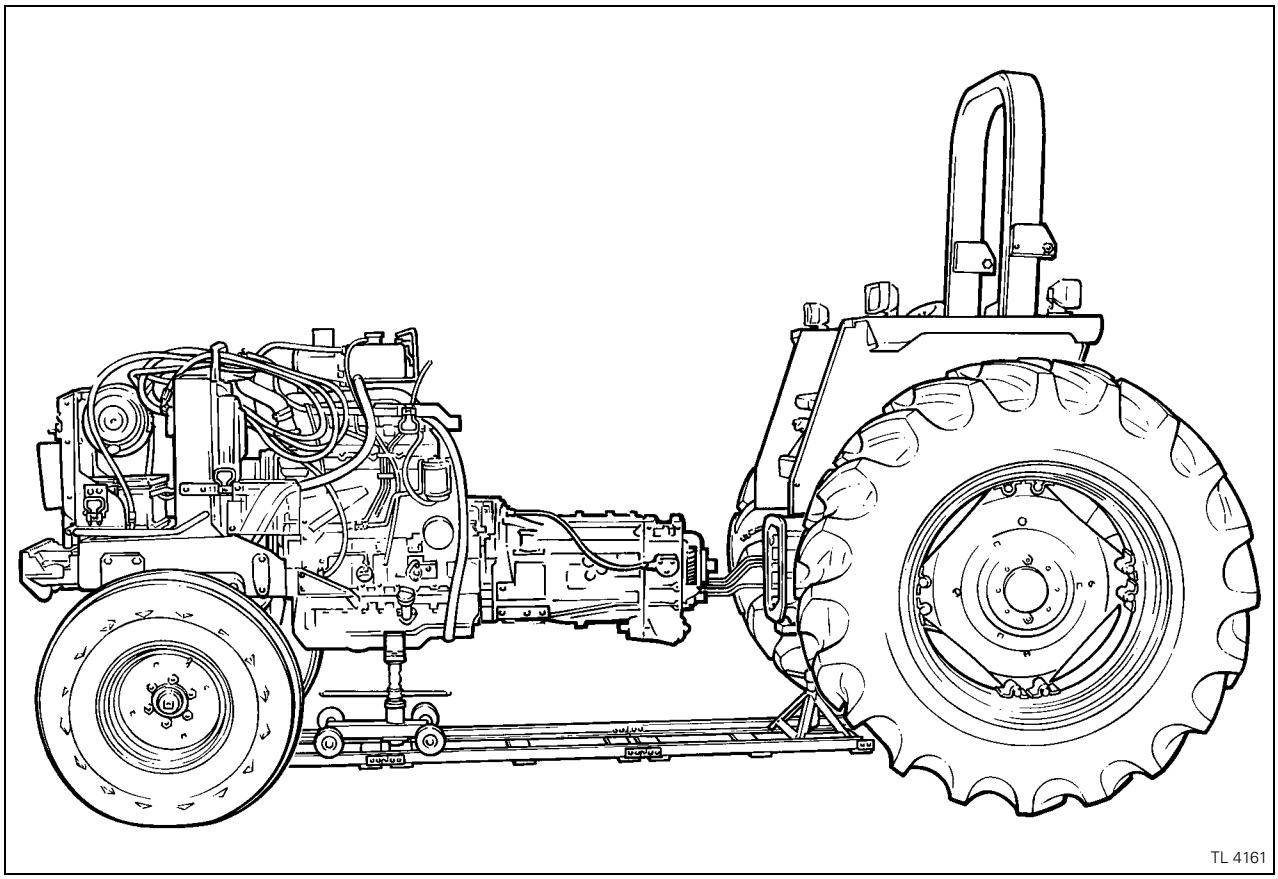
IMPORTANT: *DO NOT force, fit and tighten any bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.*

25. Fit some bolts, remove the guide studs if used, fit the remainder of the bolts and tighten them to a torque of 115 Nm (85 lbf ft).
26. Reverse procedures 1 to 18 except:
    a. Check and adjust if necessary the clutch pedal height, *(see operation 1-4A)*.
    b. Oil cooled clutch, check and adjust if necessary the oil supply control valve, *(see operation 6-4B)*.
    c. Check and adjust if necessary the hand/foot throttle adjustment, *(see operation 4-3C)*.
    d. Test drive the tractor.
    e. Check all oil and coolant levels and check for leaks.



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SPLITTING BETWEEN the GEARBOX and REAR CENTRE HOUSING
(Gearbox removal)

Special Tools:
MF.367B Transmission Torque Wrench
MF.3012 Tractor Splitting Track

Removal and Refitment **3-2B**

Removal

IMPORTANT: *DO NOT split the tractor between the range gearbox and the main gearbox.*

1. If the tractor is four-wheel drive, first disconnect the drive shaft at the front axle end. To turn the drive shaft to gain access to the coupling split pin it may be necessary to move the tractor under power. The shaft cannot be turned without the engine running. Remove the drive shaft assembly *(see operation 1-5E)*.
2. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
3. Disconnect the batteries.
4. Drain the transmission oil via the drain plugs, you will require a container for 50 litres of oil.
5. Remove the left-hand rear wheel and place the axle housings on an axle stand.
6. Disconnect the forward/reverse or high/low shift rod to the gearbox cover, if fitted.
7. Disconnect the safety start switch, if fitted.
8. Disconnect the hydraulic oil return pipe to the gearbox top cover.
9. Tractors with side mounted batteries. Remove the batteries and carrier.

Left-hand Side

10. Disconnect the power and solenoid cables and remove the starter motor.
11. Disconnect the throttle cable.
12. Disconnect the stop control cable, if fitted.
13. Disconnect the hydraulic pipes from the steering unit to the front axle, mark with a felt tip pen for refitment.

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Splitting the Footstep Tractor

14. Disconnect the hydraulic pipe from steering unit to oil cooler or rear hydraulics.
15. Disconnect the fuel leak-off pipe to tank at the fuel filter.
16. Drain and remove the fuel tank(s) and floor plates, *(see operation 5-3C)*.
17. Refit the rear wheel so that the tractor is level for splitting.
18. Disconnect both brake pipes and seal the ends to prevent the loss of brake fluid and the ingress of dirt.
19. Disconnect the wires to the PTO safety start switch, and range box indicator switch located in the cable.
20. Disconnect the clutch rod.

Right-hand Side

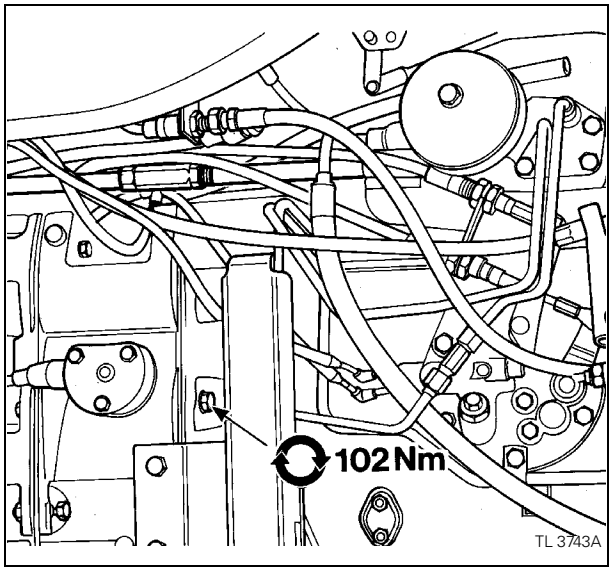
21. Disconnect the electrical multi-pin plugs at the base of the instrument panel.
22. Remove the side shift gear lever.
23. Remove the clamp and disconnect the hydraulic pipes at the front end and swing clear for splitting.
24. Disconnect the wires to the safety start switch on the gear lever housing, if fitted.

General

25. Disconnect the fuel tank vent pipe and attach end to the instrument panel.
26. Remove the bolts securing the instrument panel assembly to the top of the gearbox. With the aid of another person or crane, lift the instrument panel off the tractor.
27. Assemble the MF.3012 Tractor Splitting Track, under the tractor. Place the stationary jack on the end of the track under the rear centre housing. Place the trolley under the gearbox placing wood between both jacks and the tractor. An additional length of track (three sections) will assist in splitting.
28. Place a jack under the drawbar to prevent any tendency for the tractor to tip backwards.
29. Remove the bolts and nuts around the range gearbox and centre housing flange.
30. Carefully withdraw the front axle, engine and gearbox forwards.
31. Discard the gasket.
32. Remove the drive shaft and PTO coupling.
33. The range gearbox or main gearbox can now be removed as required.

Refitment

34. Tension the fan belt tight so that the engine and transmission can be turned over using the fan.
35. Engage the main gear lever into high/3rd and the shuttle lever into forward.
36. Fit the drive shaft and PTO coupler.



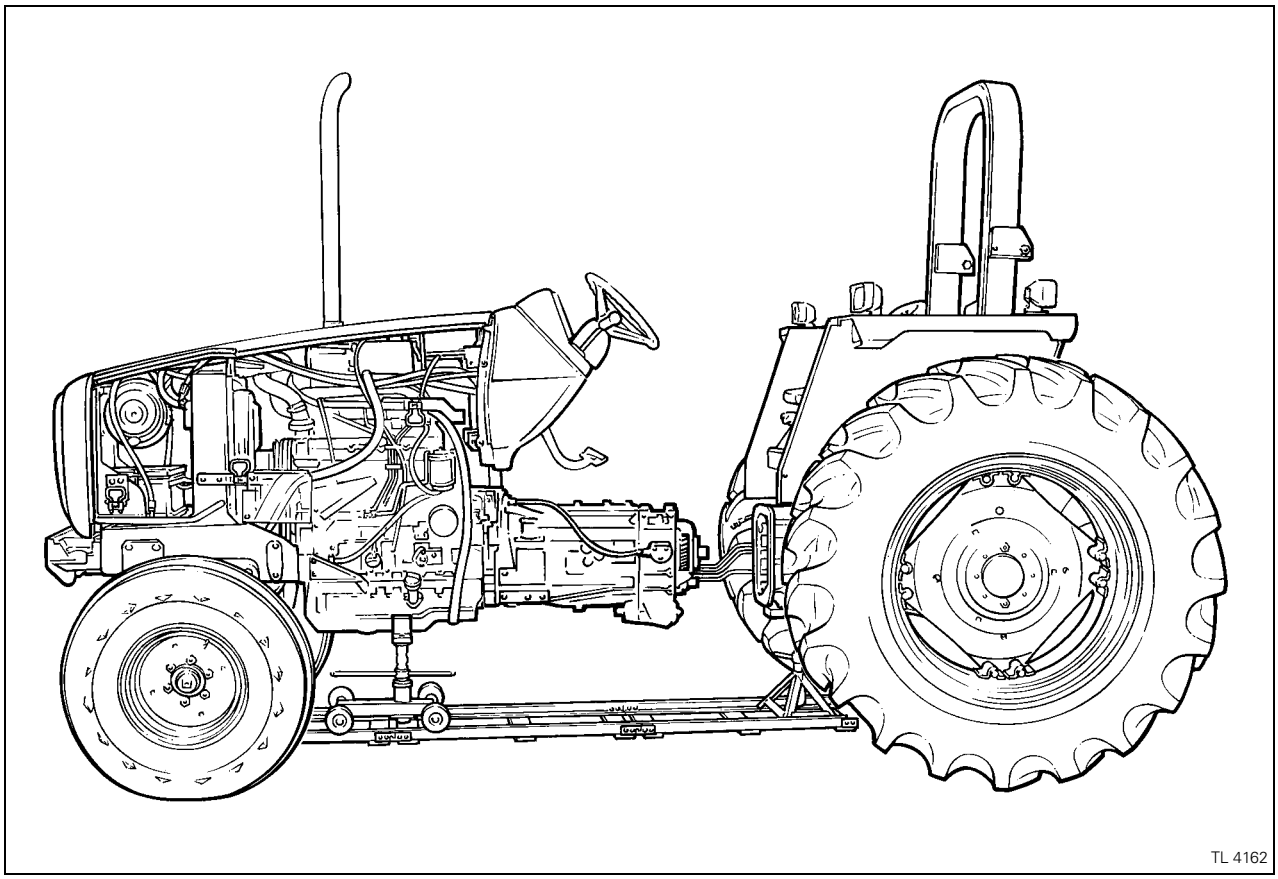
37. Fit two guide studs to assist in alignment of the gearbox and centre housing.
38. Place a new gasket on the guide studs.
39. Push the front axle/engine/gearbox assembly towards the centre housing, align the guide studs in the range box with the corresponding holes in the centre housing. Turn the engine fan to align the splines and continue pushing until the two flanges meet.

IMPORTANT: *DO NOT fit and tighten any bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the range box and centre housing flanges must be in alignment and parallel.*

40. Secure the two flanges with special bolts and nuts where fitted (dry), removing the guide studs. Use special tool MF.367B, Transmission Torque Wrench, using the 14 mm socket tighten to an initial torque of 50 Nm (35 lbf ft) working in sequence around the box.
41. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
42. Reverse procedures 1 to 24 except:
    a. Tighten the gearbox to engine bolts (clutch housing) to a torque of 115 Nm (85 lbf ft).
    b. Adjust the clutch pedal height, *(see operation 1-4A)*.
    c. Oil cooled clutch, check and adjust if necessary the oil supply control valve, *(see operation 6-4B)*.
    d. Check and adjust if necessary the hand/foot throttle adjustment, *(see operation 4-3C)*.
    e. Remove the air from the braking system, *(see operation 6-6A)*.
    f. Refill the transmission with clean oil of the correct grade.
    g. Finally road test the tractor.

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SPLITTING BETWEEN THE GEARBOX AND REAR AXLE

(Access to rear axle)

Special Tools:
MF.367B Transmission Torque Wrench
MF.3012 Tractor Splitting Track

Removal and Refitment 4-2B

Removal.

1. Apply the tractor parking brake and fit blocks to hold the rear wheels.
2. Fit hard wood wedges between the front axle support casting and axle beam on both sides to prevent the front assembly tilting during removal and refitment.
3. Remove the left-hand rear wheel and place it on an axle stand.
4. Remove the floor plates and fuel tank, *(see operation 5-3C).*
5. Disconnect the hand and foot throttle cables.
6. Drain the transmission oil via the drain plugs, you will require a container for 50 litres of oil.
7. Disconnect both brake pipes and seal the ends to prevent the loss of brake fluid and the ingress of dirt.
8. Disconnect the electrical harness on both sides of the tractor.
9. Disconnect both brake pipes and seal the ends to prevent the loss of brake fluid and ingress of dirt.
10. On the right-hand side, remove the pipe clamp and disconnect the hydraulic pipes at the front end and swing clear for splitting.
11. Disconnect the hydraulic pipe(s) to the gearbox top cover.
12. Assemble the MF.3012 Tractor Splitting Track, under the tractor. Place the stationary jack on the end of the track under the rear centre housing. Place the trolley under the gearbox placing wood between both jacks and the tractor. An additional length of track (three sections) will assist in splitting.
13. Place a jack under the drawbar to prevent any tendency for the tractor to tip backwards.
14. Remove the bolts and nuts around the range gearbox and centre housing flange.
15. Carefully withdraw the front axle, engine and gearbox forwards.
16. Discard the gasket.
17. Remove the drive shaft and PTO coupling.

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Splitting the Footstep Tractor

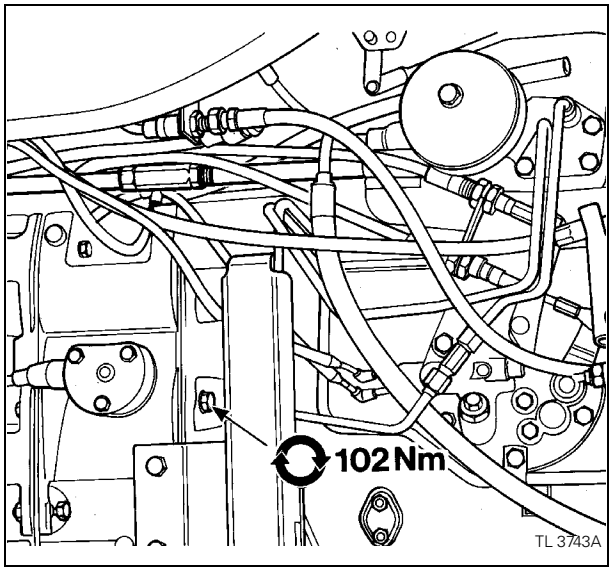
18. Work can now be carried out on the components of the rear axle.

Refitment

19. Tension the fan belt tight so that the engine and transmission can be turned over using the fan.
20. Engage the main gear lever into high/3rd and the shuttle lever into forward.
21. Fit the drive shaft and PTO coupler.
22. Fit two guide studs to assist in alignment of the gearbox and centre housing.
23. Place a new gasket on the guide studs.
24. Push the front axle/engine/gearbox assembly towards the centre housing, align the guide studs in the range box with the corresponding holes in the centre housing. Turn the engine fan to align the splines and continue pushing until the two flanges meet.

IMPORTANT: *DO NOT fit and tighten any bolts until the two flanges meet, or serious damage may occur to the PTO and main drive components. To facilitate easy reassembly, the range box and centre housing flanges must be in alignment and parallel.*

25. Secure the two flanges with special bolts and nuts where fitted (dry), removing the guide studs. Use special tool MF.367B, Transmission Torque Wrench, using the 14 mm socket tighten to an initial torque of 50 Nm (35 lbf ft) working in sequence around the box.
26. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
27. Reverse procedures 1 to 17 except:
    a. Remove the air from the braking system, *(see operation 6-6A).*
    b. Check and adjust if necessary the hand/foot throttle adjustment, *(see operation 4-3C).*
    c. Refill the transmission with clean oil of the correct grade.
    d. Finally road test the tractor.



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SECTION 3

Engine

INDEX

3A	ENGINE SPECIFICATIONS
3B	COOLING SYSTEM
3C	FUEL SYSTEM
3D	AIR SYSTEM

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Engine Specifications

Section 3 - Part A

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----	4.41 Engine Specifications	3A– 6
----	1000 Series Engine Specifications	3A–10
----	1000 Series Low Emission Engine Specifications	3A–16

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Engine Specifications

ENGINE POWER TESTING

When testing engines for power on the PTO the following considerations must be taken into account:

1. The power figures in this specification and all other Massey Ferguson literature are to the DIN Standard 70020 and the powers are quoted in metric horse power (ps) and Kilowatt (kW). To convert to Imperial horsepower multiply by 0.986.1 ps (Pferdestärke) = 1 cv (cheval vapeur)
2. All power ratings to the above standard have a tolerance of plus or minus 5%; for example, a 65 hp engine will be to specification between 61.8 and 68.3 horse power, this also applies to power ratings at the PTO.
3. The nominal power quoted at the PTO shaft is the manufacturers estimate and varies with specification; for example, type of gearbox, power take-off, auxiliary hydraulics fitted.
4. The test conditions will influence the result; for example, barometric pressure, ambient temperature, fuel inlet temperature, fuel grade, lubricating oil etc.
5. The engine will not develop full power until at least 200 hours hard work has been achieved, the minimum time before testing would be 100 hours, engines that are not run-in will exhibit different powers.
6. When testing a tractor fitted with a two speed PTO, test using the 1000 rev/min speed selection; on 540/540E PTO select 540E rev/min speed selection. This will give a more direct drive from the engine to PTO reducing transmission load.
7. Before testing, the engine and transmission must be thoroughly checked over to ensure that there are no restrictions; for example, blocked air filter, incorrect oil, faulty injectors, incorrect settings etc. Ensure that there is no electrical load, no hydraulic load and the air conditioner is switched OFF.

900 ENGINE SPECIFICATIONS

Engine:

Make	Perkins diesel - water cooled direct injection.
Engine model number:	
4215 tractor	903.27 Low Emission - naturally aspirated.
4220 tractor	903.27T Low Emission - turbocharged.
Engine build code letters:	
4215 tractor	CP.
4220 tractor	CR.
Nominal bore	95,0 mm (3.74 in).
Stroke	127 mm (5 in).
Cubic capacity	2,7 litres (164.76 in^3).
Number of cylinders	3.
Firing order	1, 2, 3.
Direction of rotation	Clockwise from the front.
Compression ratio	17.5:1

Power Ratings:

Ratings are DIN ±5%:

	PS	kW
4215 tractor:		
Engine power at flywheel	52	38.2.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):		
8 x 8 and 12 x 4 gearbox	44.8	32.9.
Maximum engine torque at 1200 rev/min	190 Nm (140 lbf ft).	
4220 tractor:	PS	kW
Engine power at flywheel	60	44.1
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):		
8 x 8 and 12 x 4 gearbox	52.2	38.4.
Maximum engine torque at 1400 rev/min	232 Nm (171 lbf ft).	

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Engine Speeds:

Low idle speed (nominal)	750 rev/min.
Rated speed	2250 rev/min.
Maximum no-load speed (nominal)	2420 rev/min.

Fuel Injection Pump:

4215 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644A409CN/2/2420.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4220 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644A406DN/2/2420
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.

Fuel Injectors:

4215 tractor:	
Make	Lucas.
Code	KL.
Set and reset pressures	300/300 ats (300 bar) (4351 lbf/in²).
4220 tractor:	
Make	Lucas.
Code	KS.
Set and reset pressures	294/294 ats (294 bar) (4264 lbf/in²).

Valve Tip Clearance:

Inlet (hot or cold)	0,20 mm (0.008 in).
Exhaust (hot or cold)	0,45 mm (0.018 in).

Valve Guides:

Protrusion above face of spring seat:	
Inlet and exhaust	11,10-11,40 mm (0.437-0.449 in).

Valves and Valve Seats Angles:

Angle of valve face - inlet	35°.
Angle of valve face - exhaust	45°.
Angle of valve seat - inlet	36°.
Angle of valve seat - exhaust	46°.

Valve Recession:

Depth of valve head below cylinder head face:	
Inlet - production limits	1,10-1,40 mm (0.042-0.055 in).
Exhaust - production limits	1,11-1,39 mm (0.044-0.055 in).
Inlet and exhaust - service limit	1,65 mm (0.065 in).
Valve seat inserts	It is permissible to fit valve seat inserts to both inlet and exhaust valve seats, *(see Perkins Engine Workshop Manual).*
Valve spring fitted length	38,0 mm (1.50 in).
Load at fitted length	22,3-24,6 kgf (49.12-54.29 lbf).
Valve spring - number of active coils	5.

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Engine Specifications

Cylinder Liners:	
Type	Not fitted to 900 series engines.
Pistons:	
Type	Re-entrant bowl, off set gudgeon pin.
Gudgeon pin	Fully floating.
Height of piston above top face of cylinder block	*See Perkins Engine Workshop Manual.*
Piston Ring Layout:	
Top compression ring	Barrel face, molybdenum insert.
Gap of top ring	0,20-0,48 mm (0.008-0.019 in).
Second compression ring	Taper face, cast iron, chamfer at inner bottom edge.
Gap of second ring	0,40-0,73 mm (0.016-0.029 in).
Third ring - oil control	Coil spring loaded, chromium faced.
Gap of third ring	0,30-0,68 mm (0.012-0.027 in).
Connecting Rods:	
Big end bearing regrind undersize	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Diameter of parent bore - small end	34,920-34,956 mm (1.3745-1.3762 in).
Crankshaft:	
Journals and crank pins regrind undersizes	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Method of hardening	No heat treatment, induction hardened or tuftrided.
End float - maximum permissible	0,51 mm (0.020 in).
Lubricating Oil Pressure:	
At maximum engine speed and normal engine temperature	3,5-4,5 bar (50-60 lbf/in²).
Cooling System:	
Type	Thermostat controlled - pump assisted.
Water pump	Centrifugal, belt driven.
Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity	1.
Type	Wax.
Opening temperature (nominal)	82° C (180° F).
Fully open temperature	96° C (205° F).
Radiator header tank cap rating	0,75 bar (10 lbf/in²).
Capacities:	
Engine cooling system	10,2 litre (2.3 gal) (2.7 US gal).
Engine sump	5,7 litre (1.3 gal) (1.5 US gal).

RECOMMENDED TORQUE TENSIONS

Cylinder Head Assembly:	
Setscrews - cylinder head	*See Perkins 900 Workshop Manual.*
Fasteners - rocker shaft brackets	44 Nm (32 lbf ft).
Cap nuts, rocker cover	20 Nm (15 lbf ft).
Setscrews, inlet manifold to cylinder head	22 Nm (16 lbf ft).
Nuts, exhaust manifold to cylinder head	22 Nm (16 lbf ft).
Setscrews, engine lift bracket	44 Nm (33 lbf ft).

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Piston and Connecting Rod Assembly:

Nuts, connecting rods	77 Nm (57 lbf ft).

Crankshaft Assembly:

Setscrews, main bearings	152 Nm (112 lbf ft).
Setscrews, crankshaft pulley	325 Nm (240 lbf ft).
Setscrews, rear oil seal housing	22 Nm (16 lbf ft).
Setscrew, balance weight to crankshaft	73 Nm (54 lbf ft).

Timing Case and Drive Assembly:

Setscrews, timing case to cylinder block	22 Nm (16 lbf ft).
Setscrews, bottom cover to timing case	22 Nm (16 lbf ft).
Setscrews, front cover to timing case	22 Nm (16 lbf ft).
Setscrews, front cover to timing case	9 Nm (7 lbf ft).
Setscrews, front cover to bridge piece, bottom cover	22 Nm (7 lbf ft).
Setscrews, camshaft gear	27 Nm (20 lbf ft).
Setscrews, idler gear - 1/2 UNF	65 Nm (48 lbf ft).
Setscrews, idler gear - M20	78 Nm (57 lbf ft).

Aspiration System:

Setscrews, inlet manifold to cylinder head	22 Nm (16 lbf ft).
Nuts, exhaust manifold to cylinder head	22 Nm (16 lbf ft).

Fuel System:

Nuts, high pressure fuel pipes	22 Nm (16 lbf ft).
Setscrews, fuel injectors	22 Nm (16 lbf ft).
Setscrews, fuel lift pump	22 Nm (16 lbf ft).
Setscrews, pump support bracket to cylinder block	22 Nm (16 lbf ft).
Nut, pump support bracket to fuel injection pump	22 Nm (16 lbf ft).
Nut, drive gear of fuel injection pump	80 Nm (59 lbf ft).
Nuts for flange of fuel injection pump	22 Nm (16 lbf ft).

Lubrication System:

Plug, lubricating oil sump	34 Nm (25 lbf ft).
Setscrews, oil pump to front bearing cap	22 Nm (16 lbf ft).
Setscrews, suction pipe to main bearing cap	9 Nm (7 lbf ft).
Nuts and setscrews, lubricating oil sump	22 Nm (16 lbf ft).
Setscrews, filter head	44 Nm (32 lbf ft).

Cooling System:

Setscrews, adaptor plate to timing case	22 Nm (16 lbf ft).
Setscrews and nuts, coolant pump to timing case, front cover and adaptor plate	22 Nm (16 lbf ft).
Setscrews, fan to coolant pulley	22 Nm (16 lbf ft).

Flywheel and Housing:

Setscrews, flywheel to crankshaft	105 Nm (77 lbf ft).
Setscrews, flywheel housing adaptor plate	44 Nm (32 lbf ft).

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4.41 ENGINE SPECIFICATIONS

Engine:

Make	Perkins diesel - naturally aspirated.
Type	Water cooled direct injection.
Engine type and build code letter:	
4225, 4235	4.41 - LM - 4 cylinder - Naturally aspirated.
Nominal bore	101 mm (3.98 in).
Stroke	127 mm (5.000 in).
Cubic capacity	407 litres (248 in^3).
Number of cylinders	4.
Firing order	1, 3, 4, 2.
Direction of rotation	Clockwise from the front.
Compression ratio	15.3:1

Power Ratings:

Ratings are DIN ± 5%:

	PS	kW
4225 tractor:		
Engine power at flywheel at 2200 rev/min	65	47,8.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):		
8 x 8, 12 x 4 and 12 x 12 gearbox	57.7	42.4.
18 x 6 gearbox	53.2	39.1.
Maximum engine torque at 1200 rev/min	255 Nm (188 lbf ft).	
4235 tractor:	PS	kW
Engine power at flywheel at 2200 rev/min	75	55.1.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):		
8 x 8, 12 x 4 and 12 x 12 gearbox	67.6	49.7.
18 x 6 gearbox	63.1	46.4.
Maximum engine torque at 1300 rev/min	281 Nm (207 lbf ft).	

Engine Speeds:

Low idle speed (nominal)	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed (nominal)	2350 rev/min.

Fuel Injection Pump:

4225 tractor:	
Make	Lucas.
Type	DPA.
Fuel pump code	2643C321AD/1/2350.
Pump rotation from drive end	Clockwise.
Outlet for No. 1 cylinder	W.
Engine checking angle at TDC	280.5°.
Fuel pump checking angle	291.0°.
Static timing BTDC	21°.
4235 tractor:	
Make	Lucas.
Type	DPA.
Fuel pump code	2643C316AD/3/2350.
Pump rotation from drive end	Clockwise.
Outlet for No. 1 cylinder	W.
Engine checking angle at TDC	280.5°.
Fuel pump checking angle	291.0°.
Static timing BTDC	21°.

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Fuel Injectors:

4225, 4235 tractor:

Make	Lucas.
Code	HL.
Set and reset pressures	230/230 ats (230 bar) (3336 lbf/in²).

Valve Tip Clearance:

Inlet (hot or cold)	0,20 mm (0.008 in).
Exhaust (hot or cold)	0,45 mm (0.018 in).

Valve Guides:

Protrusion from bottom of recess for valve spring:

Inlet and exhaust	15,10 mm (0.594 in).

Valves and Valve Seat Angles:

Angle of valve face - inlet	45°.
Angle of valve face - exhaust	45°.
Angle of valve seat - inlet	46°.
Angle of valve seat - exhaust	46°.

Valve Recession:

Depth of valve head below cylinder head face:

Inlet and exhaust - production limits	1,28-1,60 mm (0.050-0.063 in).
Inlet and exhaust - service limit	1,85 mm (0.073 in).
Valve seat inserts	It is permissible to fit valve seat inserts to both inlet and exhaust valve seats, *(see Perkins Engine Workshop Manual).*
Valve spring fitted length	40,0 mm (1.57 in).
Load at fitted length	31,8-35,1 kgf (70.1-77.3 lbf ft).
Valve spring - number of active coils	4.5.

Cylinder Liners:

Type - production	Dry, interference fit, flanged.
Type - service	Dry, transition fit, flanged.

Pistons:

Type	'Toroidal' combustion bowl, controlled expansion.
Gudgeon pin	Fully floating.
Height of piston above top face of cylinder block	*See Perkins Engine Workshop manual.*

Piston Ring Layout:

Top compression ring	Barrel face, molybdenum insert, internal top step.
Gap of top ring	0,41-0,86 mm (0.016-0.034 in).
Second compression ring	Taper face, cast iron.
Gap of second ring	0,41-0,86 mm (0.016-0.034 in).
Third ring - oil control	Coil spring loaded, chromium faced.
Gap of third ring	0,41-0,86 mm (0.016-0.034 in).

Connecting Rods:

Big end bearing regrind undersize	-0,25 mm (-0.010 in).
	-0,51 mm (-0.020 in).
	-0,76 mm (-0.030 in).
Diameter of parent bore - small end	38,89-38,92 mm (1.531-1.532 in).

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Engine Specifications

Crankshaft:

Journals and crank pins regrind undersizes	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Method of hardening	Induction hardened.
End float - maximum permissible	0,051 mm (0.020 in).

Lubricating Oil Pressure:

At maximum engine speed and normal engine temperature	3,5-4,5 bar (50-60 lbf in²).

Cooling System:

Type	Thermostat controlled - pump assisted.
Water pump	Centrifugal, belt driven.
Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity	1.
Type	Wax - by-pass blanking.
Opening temperature (nominal)	82° C (180° F).
Fully open temperature	96° C (205° F).
Radiator header tank cap rating	0,75 bar (10 lbf/in²).

Capacities:

Engine cooling system	17,5 litre (3.9 gal) (4.6 US gal).
Engine sump	6,5 litre (1.4 gal) (1.7 US gal).

RECOMMENDED TORQUE TENSIONS

Cylinder Head Assembly:

Setscrews - cylinder head	See Perkins 4.41 Workshop Manual.
Fasteners - rocker shaft brackets	75 Nm (55 lbf ft).
Cap nuts, rocker cover	20 Nm (15 lbf ft).
Setscrews, inlet manifold to cylinder head	44 Nm (33 lbf ft).
Nuts, exhaust manifold to cylinder head	44 Nm (33 lbf ft).

Piston and Connecting Rod Assembly:

Nuts, connecting rods	125 Nm (92 lbf ft).

Crankshaft Assembly:

Setscrews, main bearings	250 Nm (185 lbf ft).
Setscrews, crankshaft pulley	115 Nm (85 lbf ft).
Torxscrew, rear oil seal housing to cylinder block	22 Nm (16 lbf ft).
Cap screws, bridge piece to cylinder block	16 Nm (12 lbf ft).
Cap screws, rear oil seal housing to bridge piece	13 Nm (10 lbf ft).
Torxscrew, rear oil seal housing to bridge piece	18 Nm (13 lbf ft).
Setscrew, idler gear hub of balancer unit	93 Nm (68 lbf ft).
Nut, drive gear of balance weight	82 Nm (60 lbf ft).
Setscrews, rear cover of balancer frame	54 Nm (40 lbf ft).
Setscrews, oil transfer plate (balancer unit)	30 Nm (22 lbf ft).
Setscrews, oil pump to balancer frame	27 Nm (20 lbf ft).
Setscrews, balancer to cylinder block	54 Nm (40 lbf ft)

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Timing Case and Drive Assembly:

Setscrews, timing case to cylinder block - M8	22 Nm (16 lbf ft).
Setscrews, timing case to cylinder block - M10	44 Nm (33 lbf ft).
Bolt, hub of idler gear	44 Nm (33 lbf ft).
Setscrew, camshaft gear	78 Nm (58 lbf ft).
Setscrews, timing case cover to timing case and block idler gear	22 Nm (16 lbf ft).

Cylinder Block:

Setscrews, fitted instead of piston cooling jets	27 Nm (20 lbf ft).

Aspiration System:

Setscrew, breather pipe to head	22 Nm (16 lbf ft).

Fuel System:

Nuts, high pressure fuel pipes	22 Nm (16 lbf ft).
Setscrews, fuel injectors	12 Nm (9 lbf ft).
Setscrews, fuel lift pump	22 Nm (16 lbf ft).
Screws, for gear of fuel injection pump	27 Nm (20 lbf ft).
Nuts for flange of fuel injection pump	22 Nm (16 lbf ft).

Lubrication System:

Plug, lubricating oil sump	34 Nm (25 lbf ft).
Setscrews, oil pump to front bearing cap	22 Nm (16 lbf ft).
Setscrews, cover for oil pump	22 Nm (16 lbf ft).
Fasteners, lubricating oil sump	22 Nm (16 lbf ft).

Cooling System:

Setscrews, fan drive housing to timing case	44 Nm (33 lbf ft).
Setscrews, fan to pulley	22 Nm (16 lbf ft).
Connector, oil cooler to oil filter head	37 Nm (27 lbf ft).
Setscrews, coolant pump to cylinder block - M8	22 Nm (16 lbf ft).
Setscrews, coolant pump to cylinder block - M10	44 Nm (33 lbf ft).
Setscrews, coolant pump front body to rear body	44 Nm (33 lbf ft).

Flywheel and Housing:

Setscrews, flywheel to crankshaft	105 Nm (77 lbf ft).
Setscrews, cast iron flywheel housing to cylinder block	44 Nm (32 lbf ft).
Stamped 8.8 - M12	75 Nm (55 lbf ft).
Stamped 10.9 - M10	63 Nm (46 lbf ft).
Stamped 10.9 - M12	115 Nm (85 lbf ft).
Setscrews, flywheel housing to cylinder block (paper joint)	70 Nm (52 lbf ft).

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Engine Specifications

1000 SERIES ENGINE SPECIFICATIONS

Engine:

Make	Perkins diesel.
Type	Water cooled direct injection.
Engine type and build code letters:	
4243, 4245, 4253, 4255	1004.4T - AH - four cylinder - Turbocharged.
4260, 4270	1006.6 - YA - six cylinder - Naturally aspirated.
Nominal bore	100 mm (3.937 in).
Stroke	127 mm (5.000 in).
Cubic capacity four cylinder engines:	
4243, 4245, 4253 and 4255 tractors	4 litres (243 in³).
Cubic capacity six cylinder engines:	
4260,and 4270 tractors	6 litres (365 in³).
Firing order four cylinder engines:	
4243 4245, 4253 and 4255 tractors	1, 3, 4, 2.
Firing order six cylinder engines:	
4260 and 4270 tractors	1, 5, 3, 6, 2, 4.
Direction of rotation	Clockwise from the front.
Compression ratio	16.0:1.

Power Ratings:

Ratings are DIN ± 5%:	
4243 and 4245 tractors:	PS kW
Engine power at flywheel	85.....62.5.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
8 x 8, 12 x 4 and 12 x 12 gearboxes	75.8....55.7.
18 x 6 gearbox	71.3....52.4.
Maximum engine torque at 1500 rev/min	311 Nm (230 lbf ft).
4253 and 4255 tractors:	PS kW
Engine power at flywheel	95.....69.8.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	86.8....63.8.
18 x 6 gearbox	82.3....60.5.
Maximum engine torque at 1400 rev/min	374 Nm (276 lbf ft).
4260 tractor:	PS kW
Engine power at flywheel	100.....73.5
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	93.5....68.7.
18 x 6 gearbox	89.0....65.4.
Maximum engine torque at 1200 rev/min	388 Nm (286 lbf ft).
4270 tractor:	PS kW
Engine power at flywheel	110.....80.9.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 12 gearbox	99.2....72.9.
18 x 6 gearbox	94.7....69.6.
Maximum engine torque at 1200 rev/min	441 Nm (325 lbf ft).

Engine Speeds:

Low idle speed (nominal)	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed (nominal)	2310 rev/min.

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Fuel Injection Pump:

4243, 4245 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644C110DC/1/2310.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4253, 4255 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644C109BC/1/2310.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4260 tractor:	
Make	Lucas.
Type	DPA.
Fuel pump code	2643D629LK/5/2310.
Pump rotation from drive end	Clockwise.
Outlet for No. 1 cylinder	Y.
Engine checking angle at TDC	326°.
Fuel pump checking angle	337.5°.
Static timing BTDC	22°.
4270 tractor:	
Make	Lucas.
Type	DPA.
Fuel pump code	2643D806BF/2/2310.
Pump rotation from drive end	Clockwise.
Outlet for No. 1 cylinder	Y.
Engine checking angle at TDC	326°.
Fuel pump checking angle	334°.
Static timing BTDC	16°.

Fuel Injectors:

4243, 4245 tractor:	
Make	Lucas.
Code	JK.
Set and reset pressures	220/220 ats (220 bar) (3191 lbf/in²).
4253, 4255 tractor:	
Make	Lucas.
Code	JY.
Set and reset pressures	250/250 ats (250 bar) (3626 lbf/in²).
4260 tractor:	
Make	Lucas.
Code	JU.
Set and reset pressures	220/220 ats (220 bar) (3191 lbf/in²).
4270 tractor:	
Make	Lucas.
Code	JU.
Set and reset pressures	220/220 ats (220 bar) (3191 lbf/in²).

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Engine Specifications

Valve Tip Clearance:	
Inlet (hot or cold)	0,20 mm (0.008 in).
Exhaust (hot or cold)	0,45 mm (0.018 in).
Valve Guides:	
Protrusion above bottom of recess for valve spring:	
Inlet and exhaust	15,10 mm (0.594 in).
Valves and Valve Seat Angles:	
Angle of valve face - inlet:	
4225 to 4255	30°.
4260 to 4270	45°.
Angle of valve face - exhaust	45°.
Angle of valve seat - inlet:	
4225 to 4255	31°.
4260 to 4270	46°.
Angle of valve seat - exhaust	46°.
Valve Recession:	
inlet and exhaust	1,27-1,60 mm (0,050-0.063 in).
Service inlet and exhaust - limit	1,85 mm (.073 in).
Valve seat inserts	It is permissible to fit valve seat inserts to both inlet and exhaust valve seats of the 1000 series engines, *(see Perkins Engine Workshop Manual).*
Valve spring fitted length	40,0 mm (1.57 in).
Load at fitted length	31,8-35,1 kgf (70.1-77.3 lbf).
Valve spring - number of active coils	4.5.
Cylinder Liners:	
Type - production	Dry, interference fit, flanged.
Type - service	Dry, transition fit, flanged.
Note	Flame ring above the flange.
Pistons:	
Type:	
Naturally aspirated engines	'Quadram' combustion bowl, controlled expansion, inserted top ring groove.
Turbocharged engines	'Quadram' combustion bowl, controlled expansion, inserted top ring groove, reduced diameter top land.
Gudgeon pin	Fully floating.
Height of piston above top face of cylinder block	*See Perkins Engine Workshop Manual.*
Piston Ring Layout:	
Naturally aspirated engines:	
Top compression ring	Barrel face, molybdenum insert with a chamfer at the top of the inner face.
Gap of top ring	0,40-0,85 mm (0.016-0.033 in).
Second compression ring	Taper face, cast iron.
Gap of second ring	0,30-0,76 mm (0.012-0.030 in).
Third ring - oil control	Coil spring loaded, chromium faced.
Gap of third ring	0,38-0,84 mm (0.015-0.033 in).
Turbocharged engines:	
Top compression ring	Barrel face, molybdenum insert, wedge.
Gap of top ring	0,35-0,80 mm (0.014-0.031 in).
Gap of top ring with internal step	0,35-0,70 mm (0.014-0.028 in).
Second compression ring	Taper face, cast iron.

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Gap of second ring	0,30-0,76 mm (0.012-0.030 in).
Gap of second ring with external step	0,40-0,85 mm (0.016-0.033 in).
Third ring - oil control	Coil spring loaded, chromium faced.
Gap of third ring	0,38-0,84 mm (0.015-0.033 in).

Connecting Rods:

Big end bearing regrind undersize	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Diameter of parent bore - small end:	
Naturally engines	38,89-38,92 mm (1.531-1.532 in).
Turbocharged engines	42,07-42,09 mm (1.656-1.657 in).

Crankshaft:

Journals and crank pins regrind undersizes	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Method of hardening:	
4243 to 4255 - 4 cylinder engine	Nitro carburised.
4260 and 4270 - 6 cylinder engine	Induction hardened.
End float - maximum permissible	0,51 mm (0.020 in).

Lubricating Oil Pressure:

At maximum engine speed and normal engine temperature:	
Engines without piston cooling jets	3,4-4,5 bar (50-60 lbf/in²).
Engines with piston cooling jets	4,2-4,8 bar (60-68 lbf/in²).

Cooling System:

Type	Thermostat controlled - pump assisted.
Water pump	Centrifugal, belt driven.
Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity - four cylinder engines	1.
Quantity - six cylinder engines	2.
Type	Wax pellet, by-pass blanking.
Opening temperature (nominal)	82° C (180° F).
Fully open temperature	96° C (205° F).
Radiator header tank cap rating	0,75 bar (10 lbf/in²).

Capacities:

Engine cooling system - four cylinder	17,5 litre (3.9 gal)(4.6 US gal).
Engine cooling system - six cylinder	28,0 litre (6.2 gal)(7.4 US gal).
Engine sump - four cylinder	6,5 litre (1.4 gal)(1.7 US gal).
Engine sump - six cylinder	13,5 litre (3.0 gal)(3.6 US gal).

RECOMMENDED TORQUE TENSIONS

Cylinder Head Assembly:

Setscrews - cylinder head	See Perkins 1000 Workshop Manual.
Fasteners - rocker shaft brackets	75 Nm (55 lb ft)
Cap nuts, rocker cover	20 Nm (15 lbf ft).
Setscrews, inlet manifold to cylinder head	44 Nm (33 lbf ft).
Nuts (plated), exhaust manifold to cylinder head	44 Nm (33 lbf ft).
Nuts (non plated), exhaust manifold to cylinder head	50 Nm (37 lbf ft).

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Engine Specifications

Piston and Connecting Rod Assembly:

Nuts, connecting rods	125 Nm (92 lbf ft).
Setscrews, connecting rods	155 Nm (114 lbf ft).
Banjo bolts, piston cooling jets	20 Nm (15 lbf ft).

Crankshaft Assembly:

Setscrews, main bearings (four cylinder engines)	250 Nm (185 lbf ft).
Setscrews, main bearings (six cylinder engines)	265 Nm (196 lbf ft).
Setscrews, crankshaft pulley	115 Nm (85 lbf ft).
Setscrews, viscous damper to crankshaft pulley	75 Nm (55 lbf ft).
Capscrews, viscous damper to crankshaft pulley	35 Nm (26 lbf ft).
Capscrews, rubber bonded damper to crankshaft pulley	35 Nm (26 lbf ft).
Setscrews, rear oil seal housing to cylinder block	22 Nm (16 lbf ft).
Torxscrew, rear oil seal housing to cylinder block	22 Nm (16 lbf ft).
Cap screws, bridge piece to cylinder block	16 Nm (12 lbf ft).
Cap screws, rear oil seal housing to bridge piece - M6	18 Nm (13 lbf ft).
Cap screws, rear oil seal housing to bridge piece - M8	13 Nm (10 lbf ft).
Torxscrew, rear oil seal housing to bridge piece	18 Nm (13 lbf ft).
Setscrew, idler gear hub of balancer unit	93 Nm (68 lbf ft).
Nut, drive gear of balance weight	82 Nm (60 lbf ft).
Setscrews, rear cover of balancer frame	54 Nm (40 lbf ft).
Setscrews, oil transfer plate (balancer unit)	30 Nm (22 lbf ft).
Setscrews, oil pump to balancer frame	27 Nm (20 lbf ft).
Setscrews, balancer to cylinder block	54 Nm (40 lbf ft)

Timing Case and Drive Assembly:

Setscrews, timing case to cylinder block - M8	22 Nm (16 lbf ft).
Setscrews, timing case to cylinder block - M10	44 Nm (33 lbf ft).
Setscrews, hub of idler gear	44 Nm (33 lbf ft)
Setscrew, camshaft gear	78 Nm (58 lbf ft).
Setscrew, camshaft gear (6 cylinder engines with 45 mm long setscrew)	100 Nm (74 lbf ft).
Setscrews, timing case cover to timing case	22 Nm (16 lbf ft).
Nuts, timing case cover to timing case	22 Nm (16 lbf ft).

Cylinder Block:

Setscrews, fitted instead of piston cooling jets	27 Nm (20 lbf ft).

Aspiration System:

Nuts, Turbocharger to manifold	44 Nm (33 lbf ft).
Setscrew, breather cover	9 Nm (7 lbf ft).

Fuel Systems

Nuts, high pressure fuel pipes	22 Nm (16 lbf ft).
Setscrews, fuel injectors	12 Nm (9 lbf ft).
Setscrews, fuel lift pump	22 Nm (16 lbf ft).
Nut, for gear of fuel injection pump	80 Nm (59 lbf ft).
Nuts for flange of fuel injection pump	22 Nm (16 lbf ft).
Locking screw for DP 200 fuel injection pump shaft	10 Nm (16 lbf ft).

Lubrication System:

Plug, lubricating oil sump	34 Nm (25 lbf ft).
Setscrews, oil pump to front bearing cap	22 Nm (16 lbf ft).
Setscrews, cover for oil pump	28 Nm (21 lbf ft).
Fasteners, lubricating oil sump	22 Nm (16 lbf ft).

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Cooling System:

Setscrews, fan drive housing to timing case	44 Nm (33 lbf ft).
Setscrews, fan to pulley	22 Nm (16 lbf ft).
Connector, oil cooler to oil filter head	58 Nm (42 lbf ft).
Setscrews, coolant pump to timing case	22 Nm (16 lbf ft).
Nut, auxiliary coolant pump pulley	70 Nm (52 lbf ft).
Setscrew, inter cooler flange to inlet manifold	7 Nm (5 lbf ft).
Setscrew, inter cooler body to inlet manifold	22 Nm (16 lbf ft).

Flywheel and Housing:

Setscrews, flywheel to crankshaft	105 Nm (77 lbf ft).
Setscrews, cast iron flywheel housing to cylinder block	44 Nm (32 lbf ft).
Stamped 8.8 - M12	75 Nm (55 lbf ft).
Stamped 10.9 - M10	63 Nm (46 lbf ft).
Stamped 10.9 - M12	115 Nm (85 lbf ft).
Setscrews, flywheel housing to cylinder block (paper joint)	70 Nm (52 lbf ft).

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Engine Specifications

1000 SERIES LOW EMISSION ENGINE SPECIFICATIONS

Engine:

Make	Perkins diesel.
Type	Water cooled direct injection
Engine type and build code letters:	
4225 tractor	1004.40 - AJ - 4 cylinder - naturally aspirated.
4235, 4243, 4245, 4253, 4255 tractor	1004.40T - AK - 4 cylinder - Turbocharged.
4260, 4263 tractor	1006.60 - YG - 6 cylinder - Naturally aspirated.
4270 tractor	1006.60T - YH - 6 cylinder - Turbocharged.
Nominal bore	100 mm (3.937 in).
Stroke	127 mm (5.000 in).
Cubic capacity:	
4225, 4235, 4243, 4245, 4253 4255 tractors	4 litres (243 in^3)
4260, 4263, 4270 tractors	6 litres (365 in^3).
Firing order:	
Four cylinder engines	1, 3, 4, 2.
Six cylinder engines	1, 5, 3, 6, 2, 4.
Direction of rotation	Clockwise from the front.
Compression ratio	17.25:1

Power Ratings:

Ratings are DIN ± 5%:	
4225 tractor:	PS kW
Engine power at flywheel	65.....47.8.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	57.7....42.4.
18 x 6 gearbox	53.2....39.1.
Maximum engine torque at 1400 rev/min	261 Nm (193 lbf ft).
4235 tractor:	PS kW
Engine power at flywheel	75.....55.1.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	67.6....49.7.
18 x 6 gearbox	63.1....46.4.
Maximum engine torque at 1400 rev/min	319 Nm (235 lbf ft).
4243 and 4245 tractors:	PS kW
Engine power at flywheel	85.....62.5.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	75.8....55.7.
18 x 6 gearbox	71.3....52.4.
Maximum engine torque at 1400 rev/min	350 Nm (258 lbf ft).
4253 and 4255 tractors:	PS kW
Engine power at flywheel	95.....69.8.
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	86.8....63.8.
18 x 6 gearbox	82.3....60.5
Maximum engine torque at 1400 rev/min	388 Nm (286 lbf ft).
4260 and 4263 tractors:	PS kW
Engine power at flywheel	100.....73.5
Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	92.7....68.1.
18 x 6 gearbox	88.2....64.8.
Maximum engine torque at 1400 rev/min	388 Nm (286 lbf ft).
4270 tractor:	PS kW
Engine power at flywheel	110.....80.9

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Nominal power at PTO at engine rated speed (manufacturers estimate varies with specification):	
12 x 4 and 12 x 12 gearboxes	101.2..74.4.
18 x 6 gearbox	96.7....71.1.
Maximum engine torque at 1400 rev/min	453,5 Nm (335 lbf ft).

Engine Speeds:

Low idle speed (nominal)	750 rev/min.
Rated speed	2200 rev/min.
Maximum no-load speed (nominal)	2350 rev/min.

Fuel Injection Pump:

4225 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644F101JG/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4235 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644F001NG/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4243, 4245 tractors:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644C707CG/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4253, 4255 tractors:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644C705BG/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4263, 4260 tractors:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644D104CH/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.
4270 tractor:	
Make	Lucas.
Type	DP200.
Fuel pump code	2644C705AH/1/2350.
Pump rotation from drive end	Clockwise.
Engine timing	Pin timed at TDC.

Fuel Injectors:

4225 tractor:	
Make	Lucas.
Code	KE.
Set and reset pressures	290/290 ats (290 bar) (4206 lbf/in^2).
4235 tractor:	
Make	Lucas.
Code	KF.

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Engine Specifications

Set and reset pressures	295/295 ats (295 bar) (4279 lbf/in²).
4243, 4245 tractors:	
Make	Lucas.
Code	KF.
Set and reset pressures	295/295 ats (295 bar) (4279 lbf/in²).
4253, 4255 tractors:	
Make	Lucas.
Code	KN.
Set and reset pressures	290/290 ats (290 bar) (4206 lbf/in²).
4263, 4260 tractors:	
Make	Lucas.
Code	KE.
Set and reset pressures	290/290 ats (290 bar) (4206 lbf/in²).
4270 tractor:	
Make	Lucas.
Code	KG.
Set and reset pressures	300/300 ats (300 bar) (4351 lbf/in²).

Valve Tip Clearance:

Inlet (hot or cold)	0,20 mm (0.008 in).
Exhaust (hot or cold)	0,45 mm (0.018 in).

Valve Guides:

Protrusion above bottom of recess for valve spring:	
Inlet and exhaust	14,85-15,15 mm (0.585-0.596 in).

Valves and Valve Seat Angles:

Angle of valve face - inlet	30°.
Angle of valve face - exhaust	30°.
Angle of valve seat - inlet	31°.
Angle of valve seat - exhaust	31°.

Valve Recession:

Depth of inlet valve head below cylinder head face	1,40-1,70 mm (0,055-0.067 in).
Service inlet - limit	1,95 mm (.077 in).
Depth of exhaust valve head below cylinder head face	1,50-1,80 mm (0,059-0.071 in).
Service exhaust - limit	2,05 mm (.081 in).
Valve seat inserts	It is permissible to fit valve seat inserts to both inlet and exhaust valve seats of the 1000 series low emission engines, *(see Perkins Engine Workshop Manual).*
Valve spring fitted length	39,0 mm (1.54 in).
Load at fitted length	25,1-28,3 kgf (55.3-62.4 lbf).
Valve spring - number of active coils	3.73.

Cylinder Liners:

Type - production	Dry, interference fit, flanged with flame ring.
Type - service	Partially finished dry, transition fit, flanged with flame ring.

Pistons:

Type	'Fastram' combustion bowl, inserted top ring groove, graphite skirt.
Gudgeon pin	Fully floating.
Height of piston above top face of cylinder block	*See Perkins Engine Workshop Manual.*

Piston Ring Layout:

Top compression ring	Barrel face, molybdenum insert, wedge.
Gap of top ring	0,28-0,63 mm (0.011-0.025 in).
Second compression ring	Taper face, cast iron, outside bottom step.

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Gap of second ring	0,40-0,85 mm (0.016-0.034 in).
Third ring - oil control	Coil spring loaded, chromium faced.
Gap of third ring	0,25-0,75 mm (0.010-0.031 in).

Connecting Rods:

Big end bearing regrind undersize	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Diameter of parent bore - small end	43,01-43,04 mm (1.693-1.694 in).

Crankshaft:

Journals and crank pins regrind undersizes	-0,25 mm (-0.010 in). -0,51 mm (-0.020 in). -0,76 mm (-0.030 in).
Method of hardening:	
4225	Induction hardened.
4260 and 4263	Induction hardened.
4270	Nitro carburised.
End float - maximum permissible.	0,51 mm (0.020 in).

Lubricating Oil Pressure:

Minimum at maximum engine speed and normal engine temperature:	
Engines with piston cooling jets	2,8 bar (40 lbf/in²).
Engines without piston cooling jets	2,1 bar (30 lbf/in²).

Cooling System:

Type	Thermostat controlled - pump assisted.
Water pump	Centrifugal, belt driven.
Fan belt deflection	10 mm (3/8 in).
Thermostat:	
Quantity - four cylinder engines	1.
Quantity - six cylinder engines	2.
Type	Wax pellet, by-pass blanking.
Opening temperature (nominal)	82° C (180° F).
Fully open temperature	96° C (205° F).
Radiator header tank cap rating	0,75 bar (10 lbf/in²).

Capacities:

Engine cooling system - Four cylinder	17,5 litre (3.9 gal)(4.6 US gal).
Engine cooling system - Six cylinder	28,0 litre (6.2 gal)(7.4 US gal).
Engine sump - four cylinder	6,5 litre (1.4 gal)(1.7 US gal).
Engine sump - six cylinder	13,5 litre (3.0 gal)(3.6 US gal).

RECOMMENDED TORQUE TENSIONS

Cylinder Head Assembly:

Setscrews - cylinder head	See Perkins 1000 Workshop Manual.
Fasteners - rocker shaft brackets	75 Nm (55 lb ft)
Cap nuts, rocker cover	20 Nm (15 lbf ft).
Setscrews, inlet manifold to cylinder head	44 Nm (33 lbf ft).
Nuts (plated), exhaust manifold to cylinder head	44 Nm (33 lbf ft).
Nuts (non plated), exhaust manifold to cylinder head	50 Nm (37 lbf ft).

Piston and Connecting Rod Assembly:

Nuts, connecting rods	125 Nm (92 lbf ft).
Setscrews, connecting rods	155 Nm (114 lbf ft).
Banjo bolts, piston cooling jets	27 Nm (21 lbf ft).

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Engine Specifications

Crankshaft Assembly:

Setscrews, main bearings (four cylinder engines)	250 Nm (185 lbf ft).
Setscrews, main bearings (six cylinder engines)	265 Nm (196 lbf ft).
Setscrews, crankshaft pulley	115 Nm (85 lbf ft).
Setscrews, viscous damper to crankshaft pulley	75 Nm (55 lbf ft).
Capscrews, viscous damper to crankshaft pulley	35 Nm (26 lbf ft).
Capscrews, rubber bonded damper to crankshaft pulley	35 Nm (26 lbf ft).
Setscrews, rear oil seal housing to cylinder block	22 Nm (16 lbf ft).
Torxscrew, rear oil seal housing to cylinder block	22 Nm (16 lbf ft).
Cap screws, bridge piece to cylinder block	16 Nm (12 lbf ft).
Cap screws, rear oil seal housing to bridge piece - M6	18 Nm (13 lbf ft).
Cap screws, rear oil seal housing to bridge piece - M8	13 Nm (10 lbf ft).
Torxscrew, rear oil seal housing to bridge piece	18 Nm (13 lbf ft).
Setscrew, idler gear hub of balancer unit	93 Nm (68 lbf ft).
Nut, drive gear of balance weight	82 Nm (60 lbf ft).
Setscrews, rear cover of balancer frame	54 Nm (40 lbf ft).
Setscrews, oil transfer plate (balancer unit)	30 Nm (22 lbf ft).
Setscrews, oil pump to balancer frame	27 Nm (20 lbf ft).
Setscrews, balancer to cylinder block	54 Nm (40 lbf ft)

Timing Case and Drive Assembly:

Setscrews, timing case to cylinder block - M8	22 Nm (16 lbf ft).
Setscrews, timing case to cylinder block - M10	44 Nm (33 lbf ft).
Setscrews, hub of idler gear	44 Nm (33 lbf ft)
Setscrew, camshaft gear	95 Nm (74 lbf ft).
Setscrews, timing case cover to timing case	22 Nm (16 lbf ft).
Nuts, timing case cover to timing case	22 Nm (16 lbf ft).

Cylinder Block:

Setscrews, fitted instead of piston cooling jets	27 Nm (20 lbf ft).

Aspiration System:

Nuts, Turbocharger to manifold	44 Nm (33 lbf ft).

Fuel System:

Nuts, high pressure fuel pipes	22 Nm (16 lbf ft).
Bolt banjo, leak-off connection	9 Nm (7 lbf ft).
Gland nut, atomiser body	30 Nm (23 lbf ft).
Setscrews, fuel lift pump	22 Nm (16 lbf ft).
Setscrews for the gear of the fuel injection pump	28 Nm (20 lbf ft).
Nuts for flange of fuel injection pump	22 Nm (16 lbf ft).
Locking screw for DP 200 fuel injection pump shaft	10 Nm (16 lbf ft).

Lubrication System:

Plug, lubricating oil sump	34 Nm (25 lbf ft).
Setscrews, oil pump to front bearing cap	22 Nm (16 lbf ft).
Setscrews, cover for oil pump	28 Nm (21 lbf ft).
Fasteners, lubricating oil sump	22 Nm (16 lbf ft).

Cooling System:

Setscrews, fan drive housing to timing case	44 Nm (33 lbf ft).
Setscrews, fan to pulley	22 Nm (16 lbf ft).
Connector, oil cooler to oil filter head	58 Nm (42 lbf ft).
Setscrews, coolant pump to timing case	22 Nm (16 lbf ft).
Nut, auxiliary coolant pump pulley	70 Nm (52 lbf ft).

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Flywheel and Housing:

Setscrews, flywheel to crankshaft	105 Nm (77 lbf ft).
Setscrews, cast iron flywheel housing to cylinder block	44 Nm (32 lbf ft).
Stamped 8.8 - M12	75 Nm (55 lbf ft).
Stamped 10.9 - M10	63 Nm (46 lbf ft).
Stamped 10.9 - M12	115 Nm (85 lbf ft).
Setscrews, flywheel housing to cylinder block (paper joint)	70 Nm (52 lbf ft).

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Engine Specifications

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Cooling System

Section 3 - Part B

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Cooling System

SPECIFICATION

Capacities:	
Three cylinder engines	10,2 litre (2.3 gals)(2.7 US gals).
Four cylinder engines	17,5 litre (3.9 gals)(4.6 US gals).
Six cylinder engines	28,0 litre (6.2 gals)(7.4 US gals).
Radiator pressure cap rating	0,75 bar (10 lbf/in²).
Thermostat:	
Quantity - depending on tractor model	1 or 2.
Type	Bypass.
Opening temperature (nominal)	82°C (180°F).
Fan belt deflection	10 mm (3/8 in).

FAULT DIAGNOSIS

The faults listed are cooling system faults only and do not cover engine defects which may contribute towards overheating.

Fault	Possible cause	Suggested remedy
Overheating	Engine racing or pulling hard	Select the correct gear to suit the conditions.
	Radiator water level	Fill to the correct level, check for leaks at joints and hoses, rectify as necessary.
	Loose fan belt	Adjust the fan belt tension.
	Radiator cap leaking or valve spring defective	Replace the radiator cap.
	Radiator matrix blocked	Clean the radiator using a reverse flow of air or water
	Water flow restricted	Check the thermostat operation and replace if necessary, Reverse flush the cooling system. Service or renew the water pump.
Engine runs cool	Operating conditions (cold head winds)	Blank off a portion of the radiator.
	Thermostat stuck open	Replace the thermostat.

FROST PRECAUTIONS

There are three main methods of protecting the cooling system during frosty conditions:

1. *Draining the cooling system after each day's work.*

   This method leaves the system unprotected in the idle periods during the day, and in extreme conditions the cooling system may freeze while the engine is running. Erosion of the water pump impeller may be accelerated in hard water conditions due to the frequent draining and refilling of the system.

2. *Use of heated premises, engine or sump heaters.*

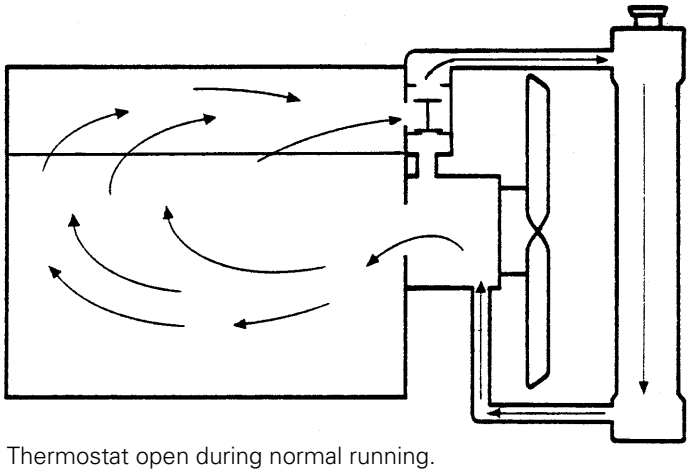
   This method also leaves the engine unprotected during the idle periods of the day and extremely cold conditions.

3. *Antifreeze Solutions.*

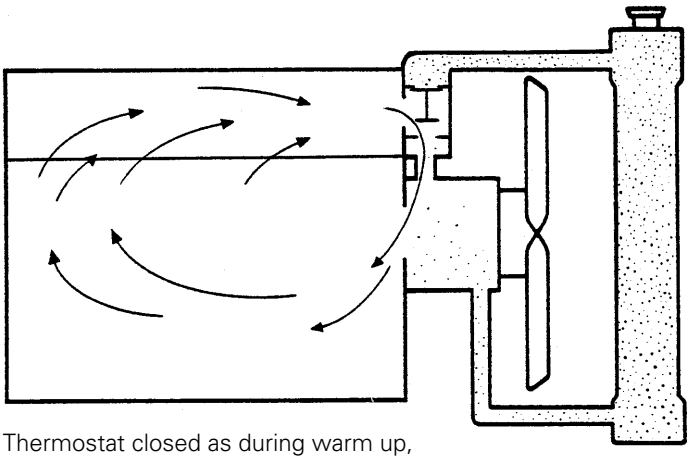
   Generally the most efficient method of protecting cooling systems but, due to the penetrating properties of the solution, all hoses and joints should be in good condition. A cooling system which is normally free of leaks may well develop them when filled with antifreeze. Leakage may not occur immediately after initial filling of the system but may develop shortly afterwards. This should be considered and the necessary checks carried out.

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Thermostat open during normal running.



Thermostat closed as during warm up, in cold ambients or under part load.

TL 480

GENERAL DESCRIPTION

The coolant is circulated by thermo-syphon action assisted by a centrifugal type pump. The system is controlled by a thermostat which prevents the coolant from flowing through the radiator until the correct working temperature has been achieved, and a pressure-sensitive radiator cap, which, by allowing the radiator to pressurise, raises the temperature at which the coolant will boil. A fan attached to the front of the engine assists cooling by drawing air through the radiator.

The water pump and cooling fan are driven by a belt, which is driven by a pulley splined to the front of the crankshaft.

The thermostat fitted to the engine is a by-pass blanking type. These can be identified by the valve disc at its base. This type of thermostat regulates the flow of water through the radiator or by-pass port.

When cold, the by-pass port is fully open and the connection to the radiator is closed; when hot, the by-pass port is closed and the connection to the radiator is open. If the blanking by-pass thermostat is removed, the greater water flow is through the by-pass and not the radiator, resulting in severe overheating and consequential damage. Do not run the engine without the thermostat.

Repair information on the water pump and thermostat will be found in the Engine Workshop Manual.

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COOLING SYSTEM

Servicing **1-3B**

WARNING: High-pressure steam and hot water. Remove the filler cap with extreme care. DO NOT check or fill while the engine is hot or running.

Antifreeze:

It is very important that you read the label on the container before you add antifreeze to the cooling system. The safety precautions are as follows:

- Keep locked up and out of reach of children.
- Keep only in the original container.
- Avoid contact with the skin and eyes.
- Wear suitable protective clothing and gloves.
- Harmful by inhalation and if swallowed.
- If swallowed, seek medical advice immediately and show the label or container.

NOTE: *It is advisable to use Massey Ferguson antifreeze, it contains inhibitors to protect your engine.*

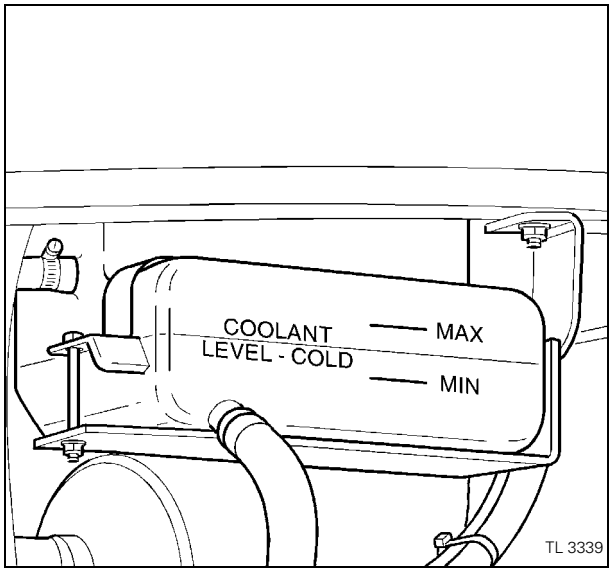
Coolant - Header Tank

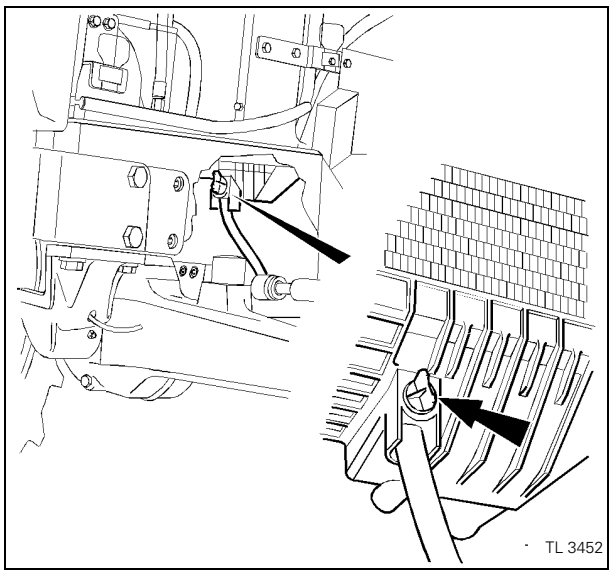
DO NOT use an antifreeze solution for more than two years (or 2000 hours) of operation. The heat generated by the diesel engine causes a natural change in the inhibitors in the coolant which results in loss of corrosion protection. The loss of the inhibitors may cause water pump cavitation and cylinder block erosion.

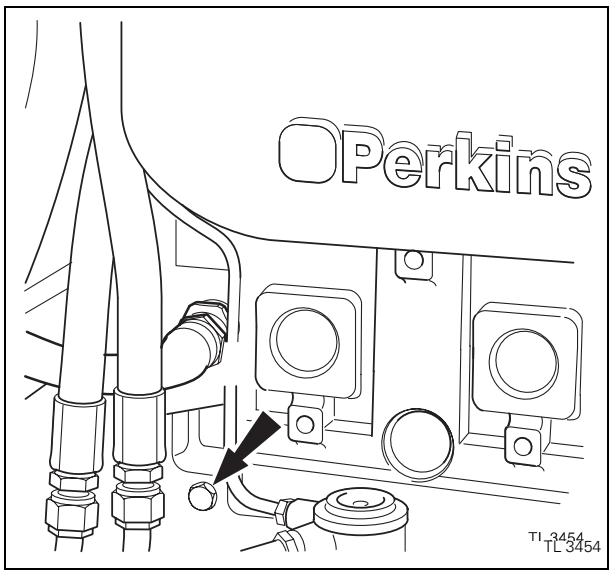
1. To check the coolant level first remove the header tank cap slowly to allow pressure to escape. DO NOT add cold coolant to a hot system.
2. The coolant level must be maintained between the level marks on the header tank. Top up with antifreeze solution of the correct strength.

Draining the Cooling System

1. To drain the cooling system remove the header tank cap slowly to allow any pressure to escape.
2. Open the drain tap at the bottom of the radiator. You will need to reach through the bottom casting to access the tap.
3. Remove the drain plug from the cylinder block. Make sure that the drain points do not become blocked during draining.







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4. On four cylinder turbocharged engines drain the oil cooler by disconnecting the hose on the cooler.
5. If the old coolant is very dirty, flush out the system with clean water.
6. Replace the plugs and reconnect the hose if removed. Refill the radiator with clean rain water, if available, with a minimum of 33 per cent antifreeze solution.
7. Run the engine for approximately five minutes to remove all air from the system. Check the coolant level and add coolant if needed. Check the hoses, radiator, pump and heat exchanger for leaks.

Frost Precautions (Cold Climate)

Antifreeze solutions must be added to the cooling system water. Use Massey Ferguson Universal Antifreeze, available from your local Massey Ferguson Dealer, who will advise you of the correct proportions of antifreeze mixture to suit your climatic conditions. The dry ice point in the following table can be regarded as the safe limit temperature for a given concentration of antifreeze/water solution.

DO NOT use more than 50 per cent antifreeze solution in the cooling system unless the ambient air temperature will be less than -35°C (-31°F). More than 50 per cent decreases heat transfer and will cause the engine surface temperature to be more than normal.

Antifreeze Concentration

Antifreeze concentration	Specific gravity	First crystal formation °C	Dry ice point °C
10	1.016	- 2.2	- 6
15	1.025	- 4	-11
20	1.034	- 7	-18
25	1.042	-11	-26
33	1.059	-17	-36
50	1.086	-36	-51

It should be remembered that an antifreeze solution not only prevents freezing, it also contains an anti-corrosion additive that protects the cooling system. The mixing of different makes of antifreeze can lead to the loss of corrosion protection and is therefore not recommended.

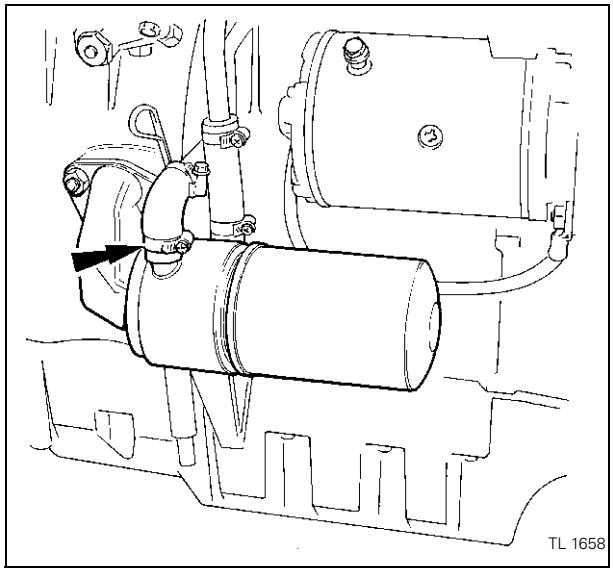
IMPORTANT: *If an antifreeze solution is not used during frosty weather, the coolant must be drained after work to prevent damage from freezing. Use the procedure under Draining the Cooling System.*

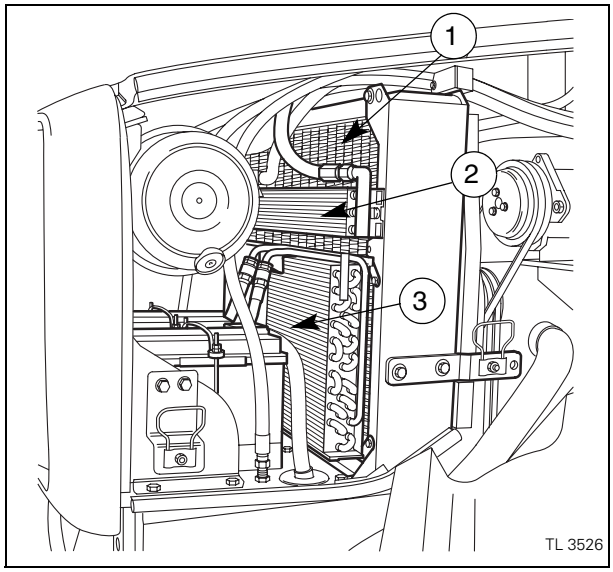
Radiator, Oil Cooler and Condenser

The radiator (1), oil cooler (2), and the air-conditioner condenser (3) fins must be checked for blockage. They can be cleaned by blowing with compressed air or a high-pressure washer not exceeding 7 bar (100 lbf/in²). Clean from the rear of the radiator and remove the side panels to allow debris to escape.

Fins blocked with oily substances may be cleaned with a detergent solution.

To remove and clean the oil cooler, turn the two thumb screws through 90° to release the cooler.





To remove and clean the condenser, unscrew the wing headed bolt from the right-hand side of the condenser and partially withdraw it.

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Cooling System

RADIATOR HEADER TANK

WARNING: High pressure steam and hot water. Remove the filler cap with extreme care.

Removal and Refitment 2-3B

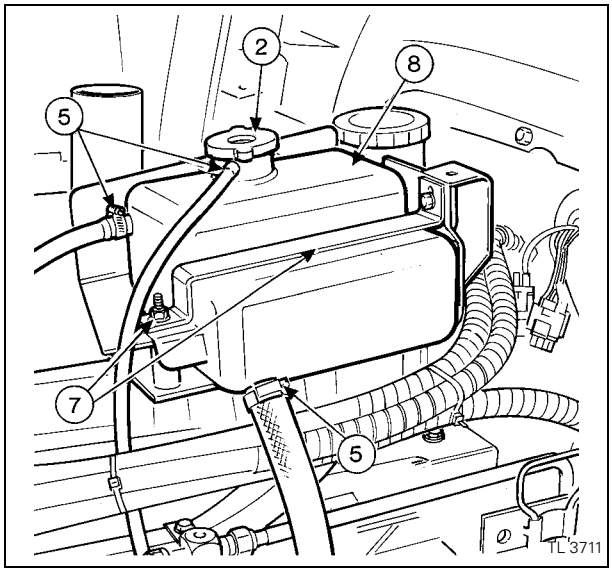
Removal

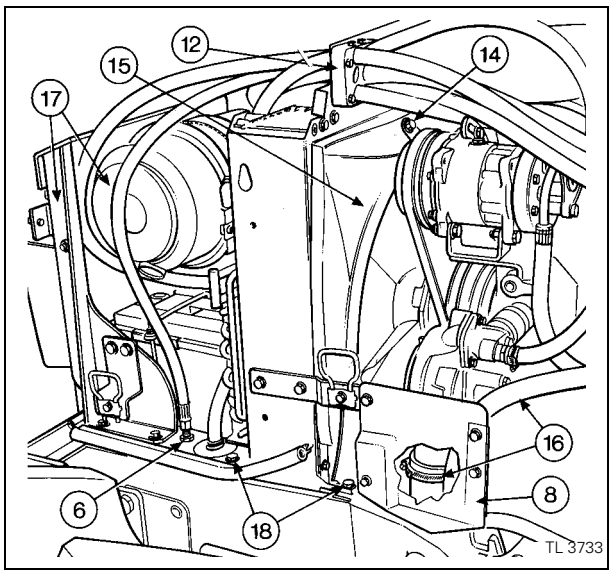
1. If hot, allow the system to cool.
2. Turn and lift out the rubber access cover and remove the header tank cap.
3. Drain down some of the coolant so that it is not visible in the header tank.
4. Remove the bonnet, front grille and side panels complete with the silencer and exhaust pipe, *(see operation 1-12B)*.
5. Disconnect the three hoses attached to the header tank at the header tank end. These three hoses are the feed and return to the radiator plus the overflow.
6. Support the detached hoses in an upright position, and cover the ends to prevent the spillage of coolant and the ingress of dirt.
7. Remove the two bolts holding the tank and bracket assembly in position.
8. Remove the tank assembly.

Refitment

9. Reverse procedures 1 to 7 above.

a. Fill the system to the required percentage with Massey Ferguson antifreeze.



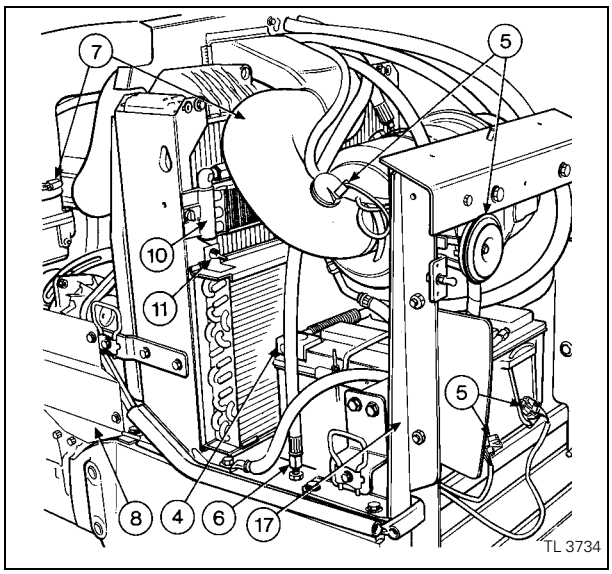


RADIATOR

Removal and Refitment 3-3B

Removal

1. Remove the exhaust pipe.
2. Remove the hood side panels, centre section and front grille, *(see operation 1-12B)*.
3. Remove the header tank cap and drain the cooling system via the drain tap on the front of the radiator bottom tank.
4. Disconnect the batteries, front mounted.
5. Disconnect the wires to the headlights, horn, and air cleaner switch and move to one side.
6. Disconnect the pipes to the steering cylinder on either side of the top plate marking with a felt tip pen which is left and right.
7. Disconnect the hose between the air cleaner and engine.
8. Remove the fan guards.



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Oil Cooler/Air Conditioner Condenser

9. If the tractor is fitted with either an oil cooler or air conditioner condenser or both, they can be moved to one side without disconnecting the pipes.
10. Disconnect the oil cooler from the radiator frame.
11. Remove the top runner retaining the condenser to the radiator.
12. Disconnect the panel above the radiator through which all the pipes and hoses pass.
13. Lift the oil cooler, condenser and all the pipes up and over so that they rest on top of the engine.

General

14. Disconnect the radiator stay.
15. Remove the fan cowl and hang it over the fan.
16. Disconnect the radiator and header tank hoses.
17. Remove the front hood support complete with air cleaner.
18. Remove the four radiator holding bolts.
19. Slide the battery tray or top plate, complete with batteries if fitted, forward to clear the radiator foot.
20. Lift out the radiator.

Refitment

21. Reverse procedures 1 to 20 except:
    a. Realign the hood latch frames on each side of the radiator.
    b. Fill the cooling system with a 50% antifreeze/water solution.
    c. Check for coolant leaks and level after a road test.

FAN BELT

Adjust **4-3B**

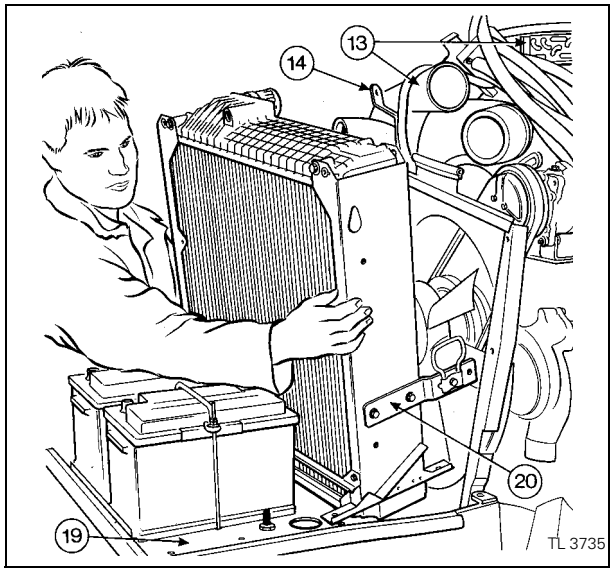
Procedure

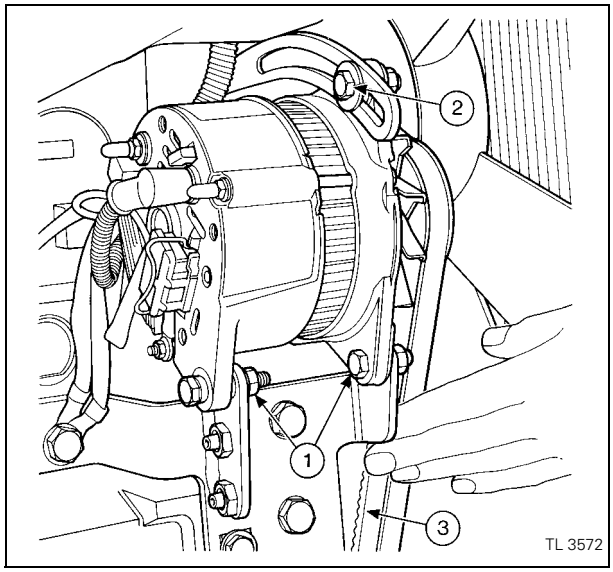
WARNING: If the lower side panel (safety guard) is removed or loosened whilst checking the belt tension, it must be refitted and secured before restarting the tractor.

The illustration gives a typical tractor installation of the alternator/fan belt arrangement; your tractor may differ slightly in the positioning of the adjustment link.

Renew the belt if it is worn or damaged. If twin belts are fitted, they must be renewed together.

To check the deflection, press down the belt with the thumb at the centre of the longest free length. With moderate thumb pressure the correct deflection of the belt is 10 mm (3/8 in).





If a belt tension gauge is available, the correct tension is 35 N (8 lbf), DO NOT allow the tension to fall below 22 N (5 lbf).

If twin belts are fitted, check/adjust the tension on the tighter belt.

To adjust the belt tension:

1. Loosen the alternator pivot bolts (1) and the adjustment link bolt (2).
2. Change the position of the alternator to give the correct tension and re-tighten the bolts.
3. Recheck the belt tension to ensure that it is still correct.

NOTE: *If a new belt(s) is fitted, check/adjust the tension again after 25 hours of operation.*

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Fuel System

Section 3 - Part C

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Fuel System

SPECIFICATION

Fuel Tank Capacity:

Lo-Profile Cab - 4215, 4220, 4225	84 litre (18.5 gal)(22 US gal).
Lo-Profile Cab - 4235, 4245, 4255	
Single tank	98 litre (22 gal)(26 US gal).
Standard Cab - Sloping hood - 4235, 4245, 4255	
Single tank	127 litre (28 gal)(34 US gal).
Standard Cab - 4235, 4245, 4255	
Single tank	127 litre (28 gal)(34 US gal).
Twin tanks	189 litre (42 gal)(50 US gal).
Standard Cab - Twin tanks - 4260, 4270	205 litre (45 gal)(54 US gal).
Lo-Profile Footstep - 4225-4255	110 litre (24 gal)(29 US gal).
Standard Footstep - Twin tanks - 4260, 4270	200 litre (44 gal)(53 US gal).

Special Tools:

3405 991 M1	Portapump.

GENERAL DESCRIPTION

The fuel tank(s) are mounted under the cab floor. The main tank on the left-hand side with the fuel filler in front of the cab for easy access. An auxiliary tank, when fitted, is mounted on the right-hand side with a balance pipe passing under the tractor behind the gearbox.

A vent pipe, which is fitted with a safety valve in the event of a turn-over, is located to the rear of the cab on the left-hand side behind the screen washer container. This is connected to both tanks.

The fuel transfer pump is a diaphragm-type pump, driven by the engine camshaft and attached to the left- or right-hand side of the tractor engine depending on model.

The pump can be manually operated, e.g. for removing air from the fuel system. Fuel is fed from the fuel tank through either a single or dual filter to the fuel injection pump.

The fuel filter(s) are equipped with a water trap below the filter element. A water drain plug is provided to drain off any water or sediment.

Tractors are equipped with 'Thermostart' starting aid. Pressurised fuel is taken off the fuel filter to the burner located in the intake manifold through a fuel line. A filament inside the burner receives current from the battery and a heat-sensitive valve which opens during the cold starting procedure. The thermostart is controlled by the key start switch when turned to the cold start or pre-heat position. By turning the key switch to the cold start position, the filament is heated, which, in turn, ignites the fuel, thus providing the engine with pre-heated air for easier starting.

The desired speed is selected by means of a hand or foot throttle. The position of these levers controls, through the governor on the fuel injection pump, the amount of fuel being injected into the cylinders.

The hand throttle handle on the quadrant has an adjustable stop so that the lever can be returned to a predetermined position. The stop position can be over ridden by moving the lever to the right.

Control cables are used to convey the movement of the hand and foot throttle.

With engine running at slow idle speed, the slow idle stop screw contacts the control lever. When the hand throttle is pulled back to its stop, the engine speed is increased to its maximum.

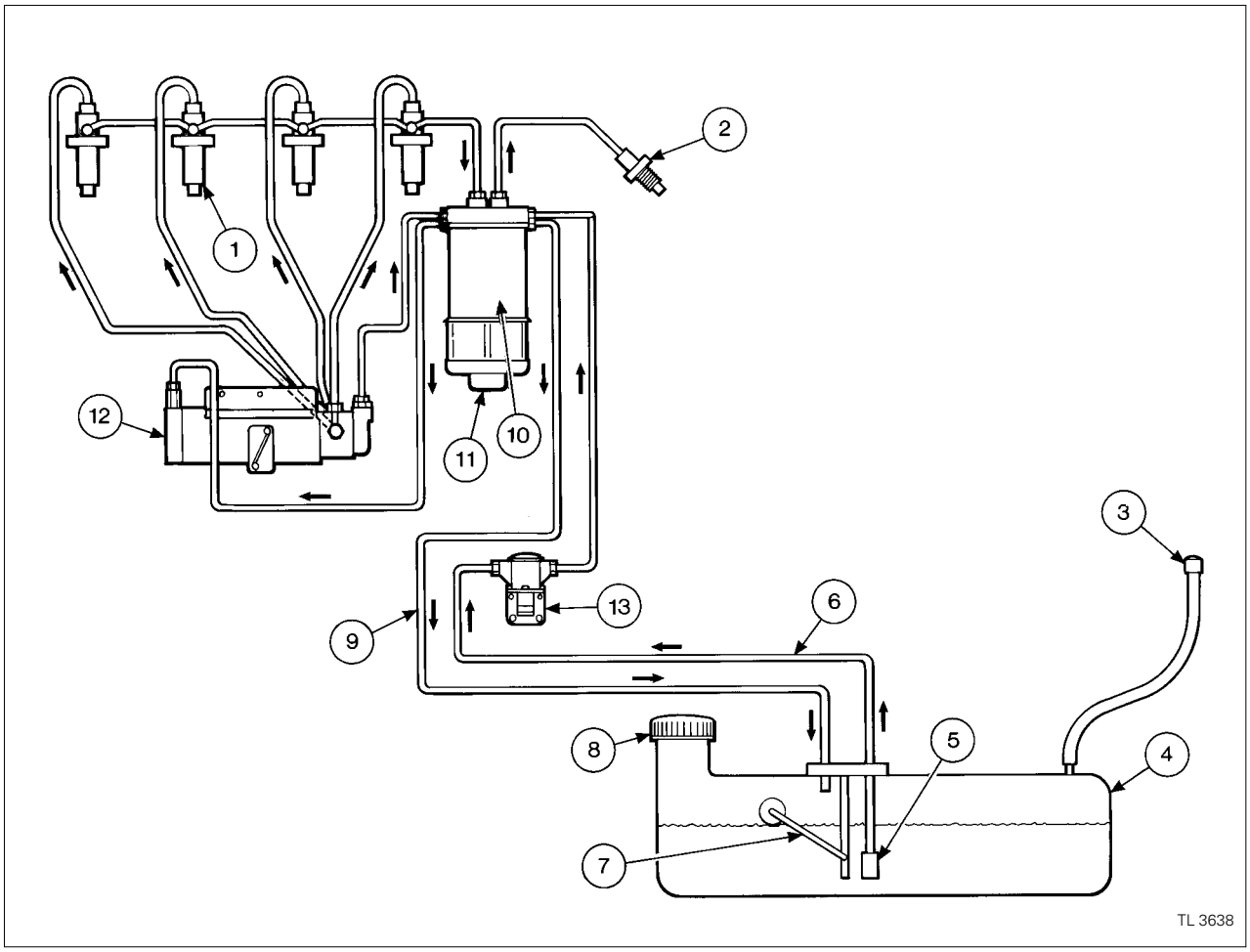
The engine is stopped on certain models by switching the key to the 'STOP' position.

or:

The engine is stopped on certain models by means of a shut off cable. One end of the cable is connected to the fuel injection pump stop lever, the other to a red knob on the tractor instrument panel. Pull to 'STOP'.

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Fuel system 4 cylinder engine – pictorial only

1. Fuel injectors.
2. Thermostart.
3. Vent pipe and safety valve.
4. Fuel tank.
5. Suction strainer.
6. Fuel supply pipe.
7. Fuel gauge sender unit.
8. Fuel filler cap.
9. Fuel return pipe.
10. Fuel filter element.
11. Water drain tap.
12. Fuel injection pump.
13. Fuel lift pump.

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FUEL FILTERS

Servicing 1-3C

Procedure

Depending on the model of tractor, the filter can have one or two elements. When twin elements are fitted, both of the elements must be renewed at the same time.

Water Separator (Fig.1)

A water separator (1) can be fitted into the fuel system when the tractor is working in very arduous conditions. It is designed to trap water and heavy particles of dirt. It does not have a filter element and no replacement parts are required.

1. Check for water or impurities in the glass sediment bowl.
2. If necessary, open the drain tap (2) to allow the water to escape.
3. Close the tap and then actuate the lift pump (3) to refill the water separator with fuel.

Fuel Filters (Fig.2 and Fig.3)

To drain water and other impurities from the fuel filters proceed as described in procedures 1 to 3.

4. Clean the outside of the filter assembly(ies).
5. Drain the filter(s) by unscrewing the tap(s) (2).
6. Hold the sediment bowl (2) and the filter element (3) and release the central bolt (1) through the filter head.
7. Remove the element(s) and the bowl(s) from the head and discard the element(s).
8. Clean the inside of the filter head and bowl(s).
9. Renew the seals (4) and reassemble with new filter element(s).

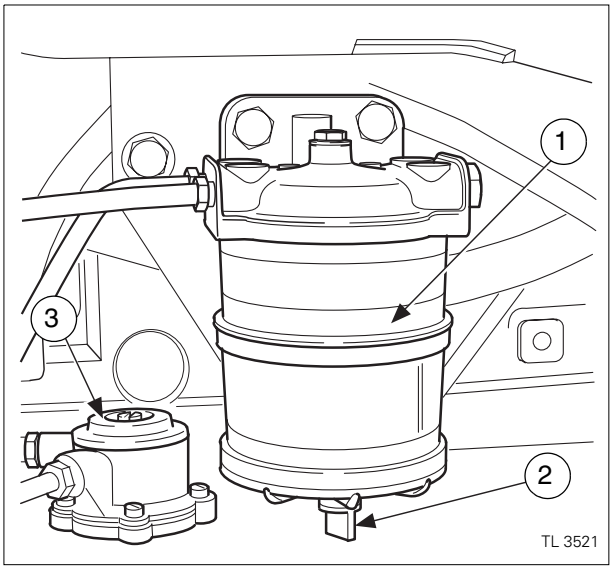


Fig.1

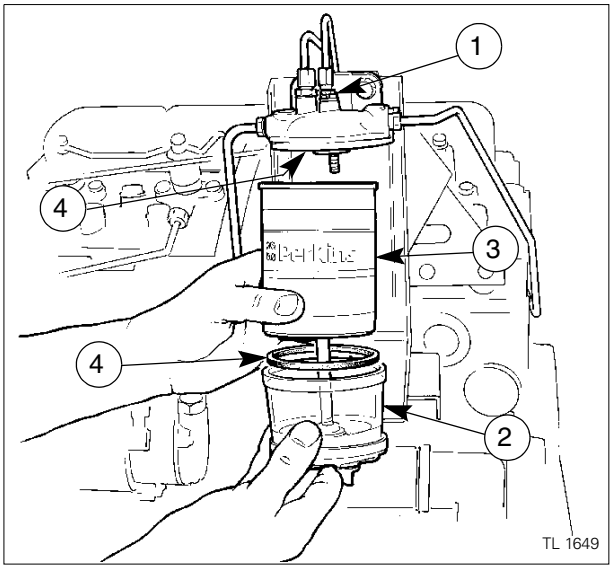


Fig.2

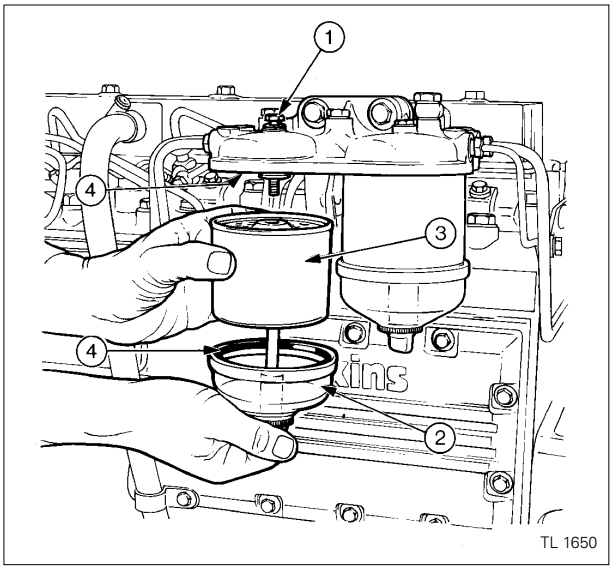


Fig.3

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Fuel Lift Pump (Fig.4)

10. Remove the cover and joint (1) from the top of the fuel lift pump (2).
11. Remove the gauze strainer (3).
12. Clean the gauze strainer, joint and cover.
13. Carefully wash all sediment from the lift pump body.
14. Reassemble the lift pump ensuring that the gauze strainer and joint are undamaged and fitted correctly to prevent air entering the system.

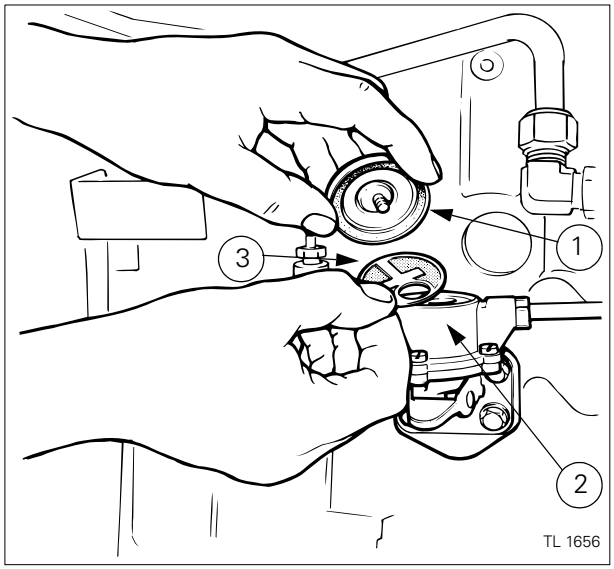


Fig.4

Removing Air from the System (Fig.5 to Fig.8)

If air enters the fuel system, it must be removed before the engine can be started.

Air can enter the system if:

- The fuel tank has been run dry or drained.
- One of the low pressure fuel pipes leaks during operation or disconnection.
- The fuel filters have been replaced.

The tractors are fitted with self-venting fuel injection pumps. There are no vent screws fitted to the pump, air will be removed automatically.

IMPORTANT: *Damage to the fuel injection pump, battery and starter motor can occur if the starter motor is used excessively to eliminate air from the system.*

To eliminate air from the system proceed as follows:

15. Loosen the thermostart fuel pipe nut (Fig.5) on top of the filter (single filter arrangement) or the vent plug (Fig.6) (double filter arrangement).

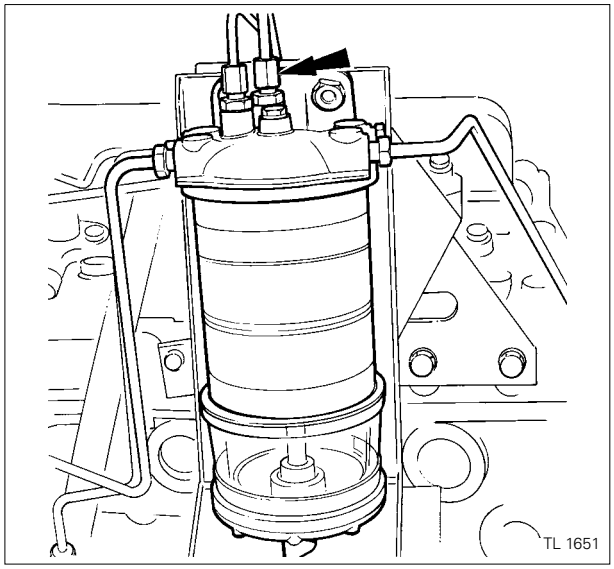


Fig.5

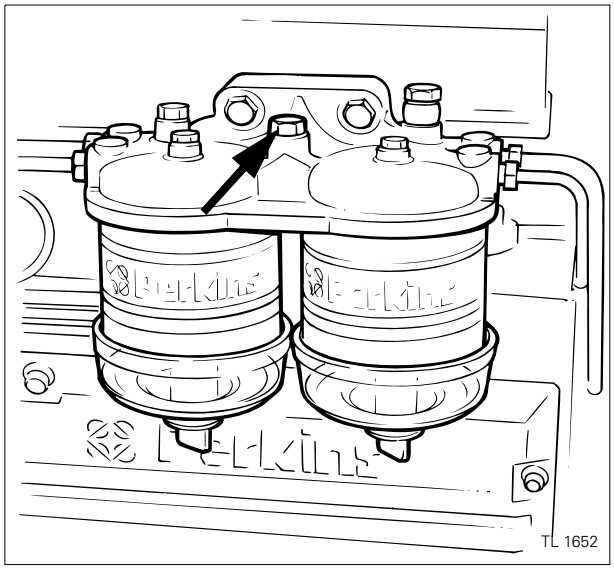


Fig.6

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16. Operate the priming lever on the fuel lift pump (Fig.7) until fuel, free of air, comes from the vent. Tighten the pipe or vent plug.

NOTE: *If the drive cam of the fuel lift pump is at the point of maximum lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be turned one revolution.*

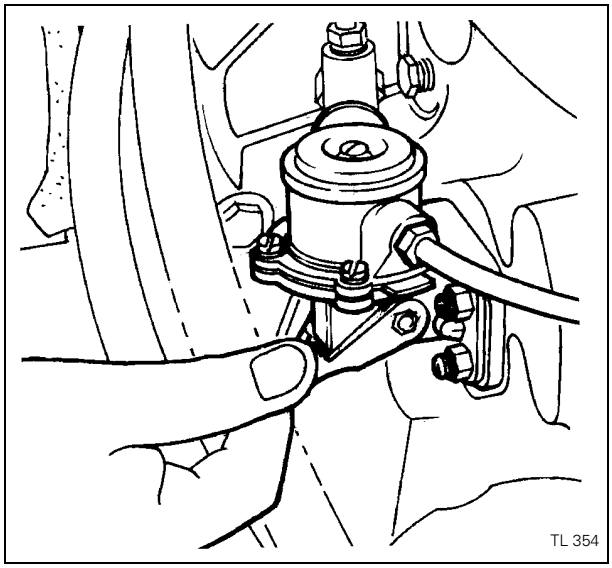


Fig.7

17. Loosen the fuel feed pipe at the thermostart (Fig.8) and operate the fuel lift pump until air free fuel emerges, then re-tighten the pipe.
18. The engine is now ready to start. Operate the engine slowly at first to allow any air in the pump to vent it's self and to prevent any internal damage.

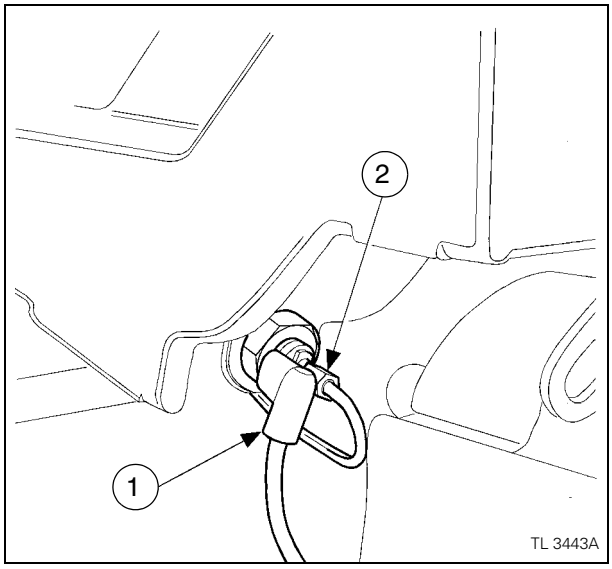


Fig.8

FUEL TANK(S) - CAB

Removal and Refitment **2-3C**

Special Tools:
3405 991 M1 Massey Ferguson Portapump

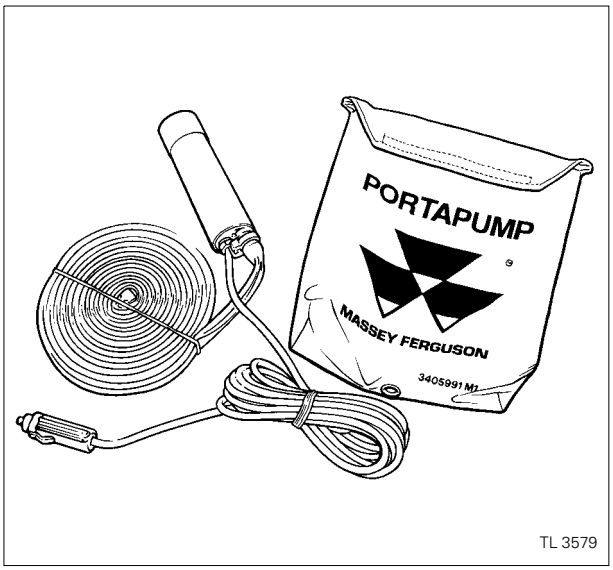
Removal

NOTE: *To gain access to the components behind the fuel tank it is not always necessary to drain the fuel from the tank. By releasing the tank retaining straps it is possible to move away from the transmission case so that access can be obtained to the range switch or PTO pressure test point.*

On the 4200 series tractor with two fuel tanks it can contain up to 202 litre (44 gal)(53 US gal) of fuel, On tractors with single tanks, the maximum is 127 litre (28 gal)(34 US gal). You will need to identify the capacity of the tractor and have to hand containers for the fuel to the required size.

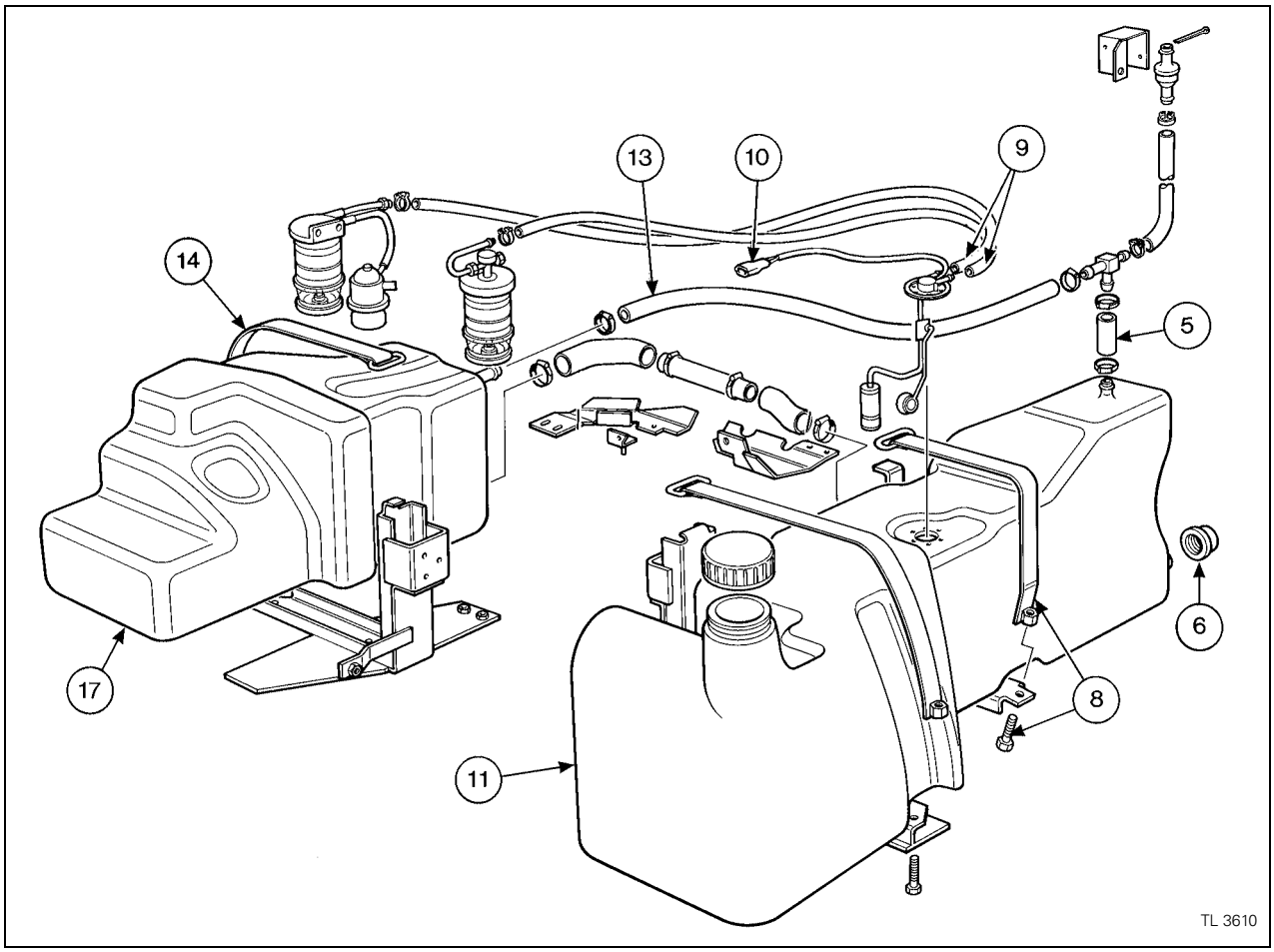
Fuel Removal

1. To remove the fuel you will require a portable pump, we recommend the Massey Ferguson Portapump, part number 3405 991 M1 (see illustration) obtainable from the Massey Ferguson Parts Division. This a submersible pump of 12 volt operation at 7 amp maximum, can be operated either from the service van or tractor electrics. It has a capacity of 18 litre/min (4 gal/min) removing 202 litre in approximately 12 minutes.



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Main Fuel Tank

2. Arrange the containers for the fuel in a suitable position, install the Portapump into the fuel tank through the filler and pump out the fuel. While this process is being undertaken:
3. Jack up the left-hand wheel and place the axle on an axle stand and remove the wheel.
4. Remove the left-hand footstep.
5. Disconnect the breather pipe at the back of the tractor, on top of the tank.
6. When the fuel has been drained down, unscrew the drain plug and remove the remainder of the fuel into a container.

NOTE: *When drained, the auxiliary tank can still contain a small quantity of fuel.*

7. If an auxiliary tank is fitted, disconnect the balance pipe on the right-hand side adjacent to the tank.
8. Remove the two bolts and disconnect the tank straps.
9. Remove the two pipe clips and disconnect the pipes from the top of the tank.
10. Disconnect the electrical plug to the sender unit.
11. Slide the fuel tank out from under the cab - pulling the balance pipe out of the guard.

Auxiliary Fuel Tank

12. Remove the right-hand footstep.
13. Disconnect the breather on the top of the tank.
14. Remove the bolt and release the tank strap.
15. Remove the balance pipe guards.
16. After the fuel has been drained, disconnect the balance pipe between the two tanks.
17. Withdraw the fuel tank out from under the cab.

Refitment

18. Reverse procedures 1 to 17 except:

a. Drain out any sediment in the fuel tank when it is removed.

b. Ensure that the drain cap is replaced and all hose clips are tight.

c. Ensure that the tank is securely clamped down to prevent movement.

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FUEL GAUGE SENDER UNIT

Removal and Refitment **3-3C**

Test

For test procedure of the electrical components of the sender unit, *(see operation 8-10A)* in the electrical section.

Removal

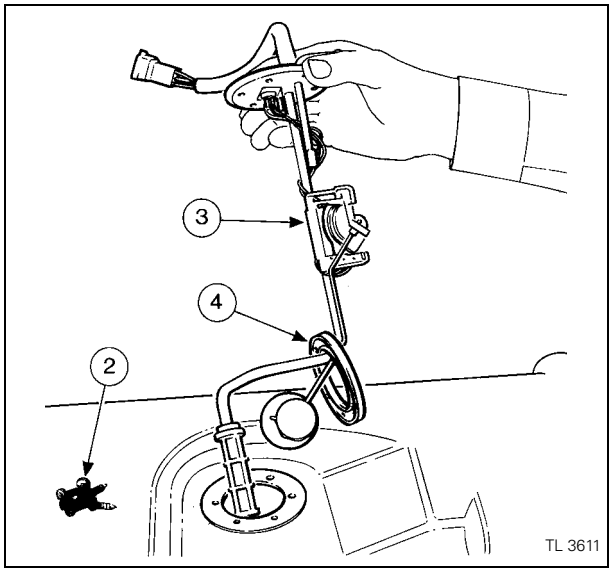
1. Remove the fuel tank from under the cab, *(see operation 2-3C)*.
2. Remove the six self-tapping screws.
3. Carefully lift out the sender unit.
4. Remove and discard the gasket.

Refitment

5. Replace the gasket.
6. Replace the sender unit, an arrow stamped on the top must face forward towards the filler, pipes to the rear.

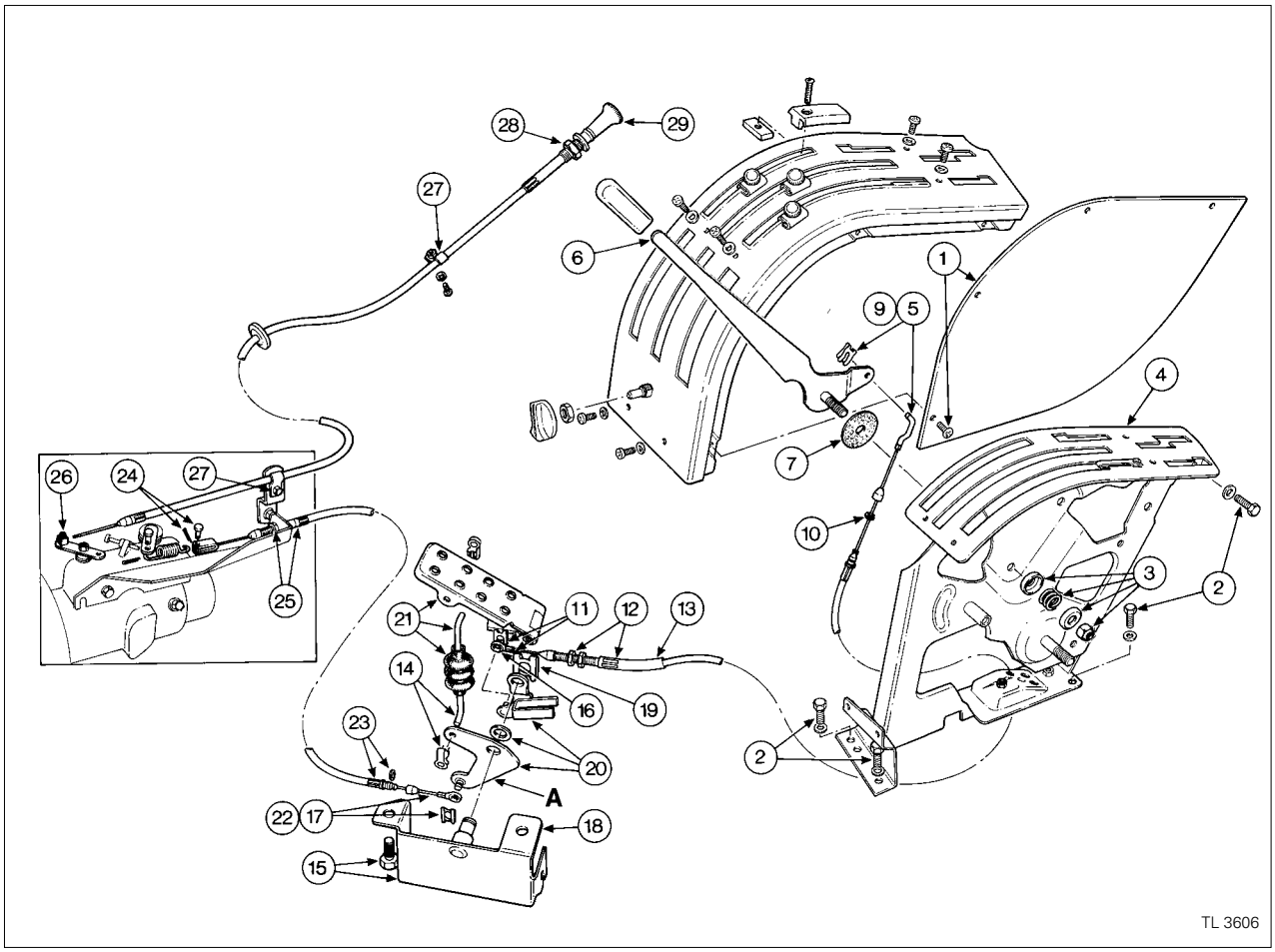
IMPORTANT: *The self-tapping screws screw directly into the plastic body of the tank. DO NOT over tighten, if the threads are stripped and you fit a larger screw, Ensure the screw is not longer than the original screw, otherwise you will puncture the tank which could lead to fuel leaks.*

7. Refit the screws.
8. Reinstall the tank.



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THROTTLE CONTROL

Removal and Refitment 4-3C

Removal

1. To gain access to the inside of the control assembly, remove the four cross head screws and the side panel.

Throttle Lever

2. Remove the mounting bolts.
3. Remove the Nyloc nut, cup washers and spring.
4. Tilt the console over to gain access to the outside.
5. Remove the clip and disconnect the cable.
6. Remove the throttle lever assembly from the frame.
7. Remove the friction washer.

Throttle Cable (Hand to Foot Pedal)

8. Remove the mounting bolts and tilt the console over to gain access to the throttle lever.
9. Remove the clip and disconnect the cable.
10. Remove the clip from the cable where is passes through the floor.
11. Remove the cable at the foot pedal end by removing the clip and disconnect the cable.
12. Remove the locknut and disconnect the cable from the foot pedal housing.
13. Pull the cable out from the tractor.

Foot Pedal Assembly

14. Remove the clip and disconnect the rod between the pedal and mechanism.
15. Remove the two bolts and lower the assembly away from the floor.
16. Disconnect the hand throttle cable.
17. Disconnect the engine throttle cable.
18. Remove the assembly to the bench.
19. Remove the clip.
20. Remove the two levers and washer.
21. If necessary, remove the foot pedal, rod and rubber cover.

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Throttle Cable (Foot Pedal to Engine)

22. Remove the clip and disconnect the cable at the foot pedal end.
23. Remove the clip and disconnect the cable from the housing.
24. Remove the split pin and clevis pin from the end of the cable at the fuel injection pump end.
25. Unscrew the locknut and remove the cable.

Stop Control

26. Unscrew the small grub screw on the fuel injection pump to release the cable.
27. Slacken the clamps around the cable so it can be drawn through.
28. Remove the nut on the back of the control.
29. Remove the control from the tractor.

Refitment

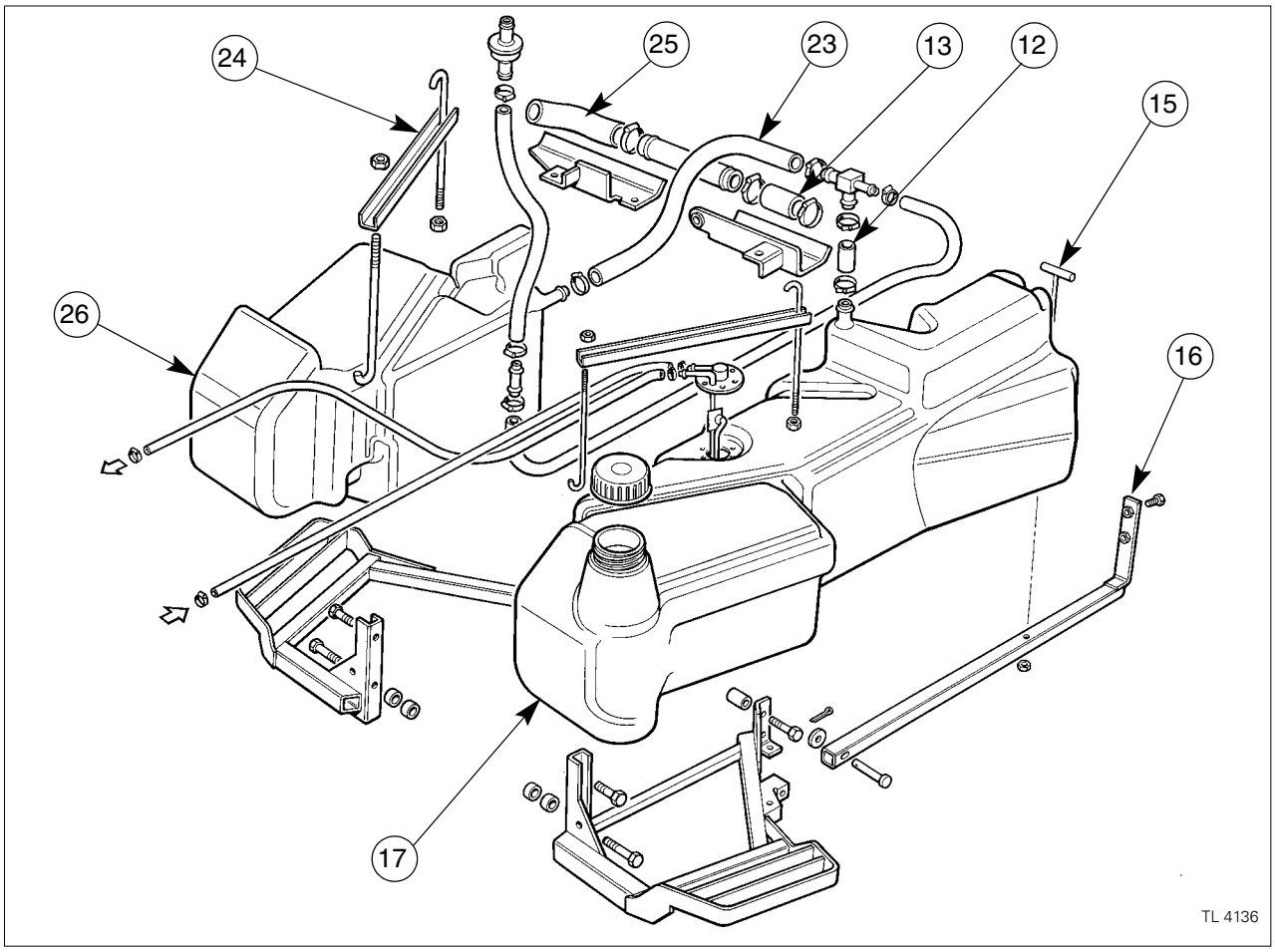
30. Reverse procedures applicable 1 to 29 except:
    a. When installing the cables, ensure that there are no tight bends and that the cables operate freely.
    b. Adjust the Nyloc nut on the hand throttle lever to allow smooth action without undue force.

Adjustment

31. Set the hand throttle to the maximum position.
32. Adjust the cable connecting the hand throttle to the foot pedal until lever 'A' just touches the floor.
33. Adjust the cable connecting the foot pedal to the fuel injection pump until the pump lever contacts it's maximum engine speed stop.
34. Return the hand throttle to 'slow' speed position until the cables are about to go slack.
35. Slide the hand throttle stop forward until it touches the lever, tighten the clamp screw.

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FUEL TANK(S) - FOOTSTEP

Removal and Refitment 5-3C

Removal

A tractor with two fuel tanks can contain up to 200 litres (44 gal) (53 US gal). On tractors with a single tank, the maximum is 130 litres (29 gal) (34 US gal). You will need to identify the capacity of the tractor and have to hand containers for the fuel to the required size.

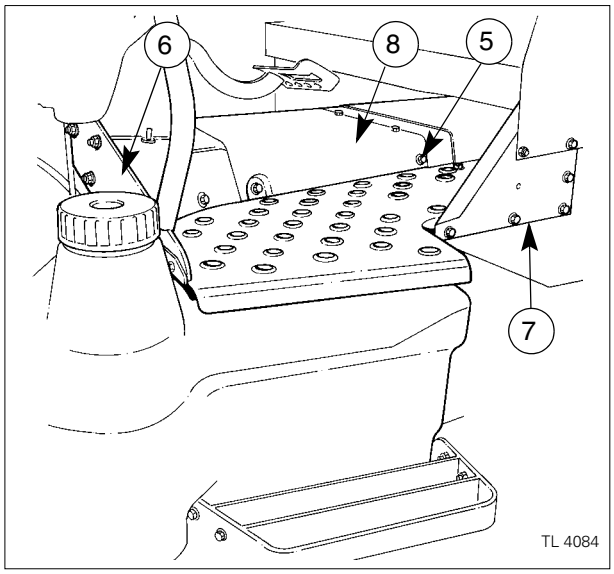
Fuel Removal

1. To remove the fuel you will require a portable pump, either hand, or 12 volt electrical, to pump the fuel into containers *(see operation 2-3C)*.

Main Fuel Tank

2. Arrange the containers for the fuel in a suitable position, install the pump into the fuel tank through the filler and pump out the fuel.
3. When the fuel has been drained, unscrew the drain plug and remove the remainder of the fuel into a drain pan.

NOTE: *When drained, the auxiliary tank can still contain a small quantity of fuel.*



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4. Remove the left-hand wheel and place the axle on a stand.
5. Remove the bolts around the left-hand foot plate.
6. Remove the hand-hold.
7. Remove the small fender valance.
8. Remove the centre bolts and lift up the central cover plate to allow removal of the foot plate.
9. Remove the left-hand foot plate.
10. Disconnect the fuel supply and return pipes.
11. Disconnect the electrical plug to the sender unit.
12. Disconnect the vent pipe on top of the tank.
13. If an auxiliary tank is fitted, disconnect the balance pipe on the left-hand side adjacent to the tank.
14. Remove the nuts from the hook bolts and remove the front retaining strap.
15. Remove the nut from the rear retainer and disconnect it from the tank.
16. Remove the bolts from the rear support and allow it to rest on the ground.
17. Lift up the front of the tank by about 15° and slid it out from under the fender pulling it out of the balance pipe.

Auxiliary Fuel Tank

18. Remove the bolts around the right-hand foot plate.
19. Remove the hand-hold.
20. Remove the small fender valance.
21. Remove the centre bolts and lift up the central cover plate to allow removal of the foot plate.
22. Remove the right-hand foot plate.
23. Disconnect the vent pipe on end of the tank.
24. Remove the nuts from the hook bolts and remove the retaining strap.
25. After draining, disconnect the balance pipe between the two tanks.
26. Withdraw the tank out from under the fender.

Refitment

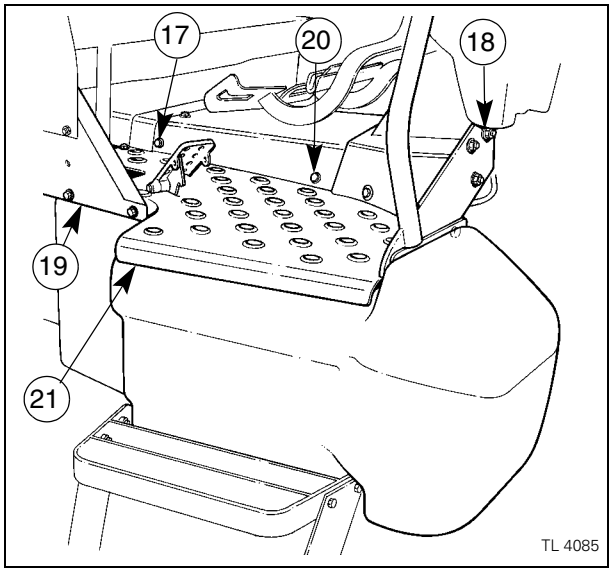
27. Reverse procedures 1 to 18 except:

a. Drain out any sediment in the fuel tank when it is removed.

b. The balance pipe is assembled and pushed in to place from the right-hand side. Before the left-hand tank is in its final position connect up the balance pipe. Connect up the right-hand tank when the left has been secured.

c. Ensure that the drain cap is replaced and all hose clips are tight.

d. Ensure that the tank(s) are securely clamped down (NOT over tightened) to prevent movement.



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Air System

Section 3 - Part D

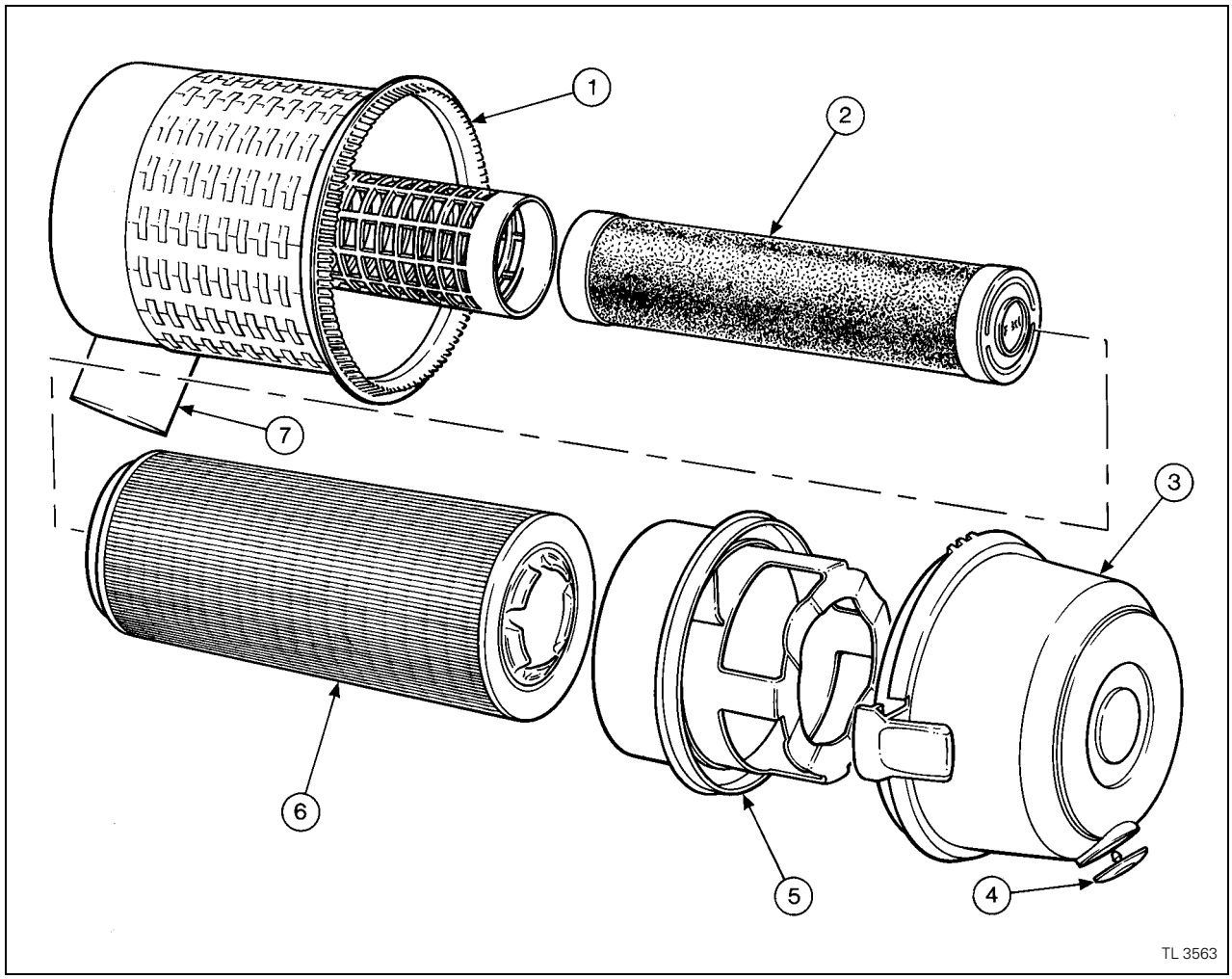
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2-3D	Secondary Element - Servicing	3D– 4
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Air System



1. Filter body.
2. Secondary filter element.
3. End cover.
4. Unloader valve.
5. Dust collector ring - turbocharged engines only.
6. Main filter element.
7. Air intake.

NOTE: *Air cleaners with yellow unloader valves (4) are fitted to naturally aspirated engines. Air cleaners with red unloader valves are fitted to turbocharged engines.*

GENERAL DESCRIPTION

The air intake system consists of a dry type air cleaner with a inner secondary element.

Air cleaner

Under the influence of the suction generated by the engine, the intake air flows through the intake pipe into the cleaner body. The air passes through the main filter element and a secondary element before being sucked in by the engine.

A restriction indicator switch, in conjunction with an air cleaner indicator light located in the instrument cluster, shows when the air cleaner element requires cleaning.

The main element may be cleaned up to a maximum of five times. ***The secondary element must not be washed.***

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AIR CLEANER

Servicing **1-3D**

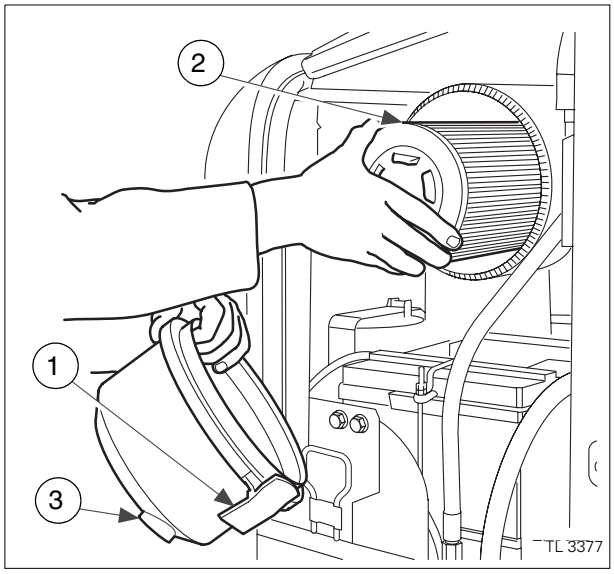
Procedure

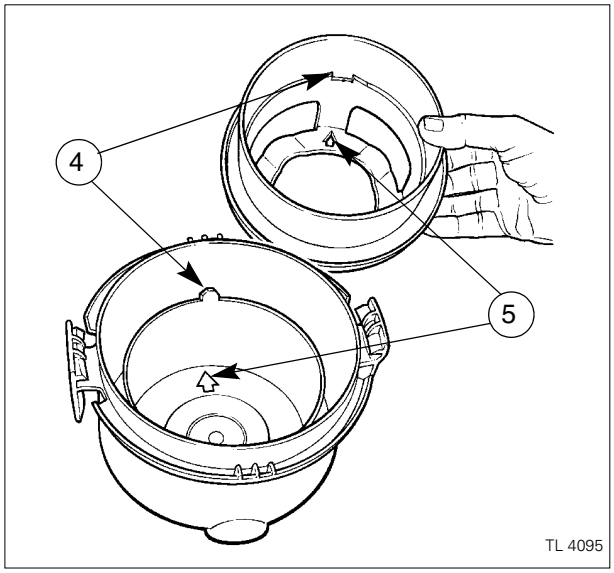
CAUTION: *Never use petrol (gasoline), paraffin or cleaning solvents to clean the elements.*

- *DO NOT attempt to blow the main element clean using the tractor exhaust gases.*
- *DO NOT attempt to clean the inner secondary element.*
- *NEVER add oil to the dry air cleaner.*
- *If servicing is not carried out when the warning light comes on the engine will lose power and damage could be caused.*

The air cleaner is situated in front of the radiator and is accessed by removing the left-hand hood cover. To service the main filter element proceed as follows:

1. Press the clips (1) on either side of the end cover. Remove the cover and withdraw the outer element (2).
2. If dust is present inside the element, it must be renewed. If satisfactory, clean the element by tapping both ends on the palm of the hand. DO NOT tap the element against a hard surface as it will become damaged or distorted.
3. Alternatively, to remove dust, compressed air, not exceeding 7 bar (100 lbf/in²) may be used. Insert the air line nozzle inside the element and blow the dust from the inside to the outside. Blow loose particles from the outside of the element by holding the nozzle at least 300 mm (12 in) from the element. Protect your eyes when carrying out this operation.
4. Clean the inside of the air cleaner casing with a damp lint-free cloth and refit the element ensuring that the rubber sealing ring on the end is secure.
5. Before refitting, the cleaned filter element must be checked for damage to its paper pleats and rubber seals. Cracks and holes in the paper pleats can be seen when shining a torch through the element. The Massey Ferguson replacement part number is marked on the bottom of the filter.
6. Carefully insert the filter element into housing. When replacing the end cover, the filter element will automatically be guided into its correct position.
7. Ensure that the unloader valve (3) is at the lowest point and both clips (1) are correctly in place. They will only fit properly if the filter end cover is properly in place.
8. Tractor engines with a turbocharger fitted have a dust collector ring in the end cover, remove to clean. Ensure it is correctly in place before replacing. The arrow head moulded into the outer cover (4) must engage with the slot in the collector ring, the two arrows (5) must align.





The filter element can be cleaned up to five times. At the latest it must be renewed after reaching its maximum operational life of two years. The number of times a filter element has been cleaned can be marked by a tick on the secondary filter element, using a ball or felt-tip pen.

On no account whatsoever continue to use a damaged filter element. If there is any doubt, replace with a new element.

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SECONDARY ELEMENT

Servicing 2-3D

Procedure

IMPORTANT: *The inner secondary filter element is NOT a serviceable item. It must be replaced at the appropriate servicing interval. The old element must be destroyed and not re-used under any circumstances.*

Remove the filter end cover and withdraw the main filter element.

Pierce seal of the secondary filter element with a suitable tool (e.g. a screwdriver) from inside to outside and pull up both handles.

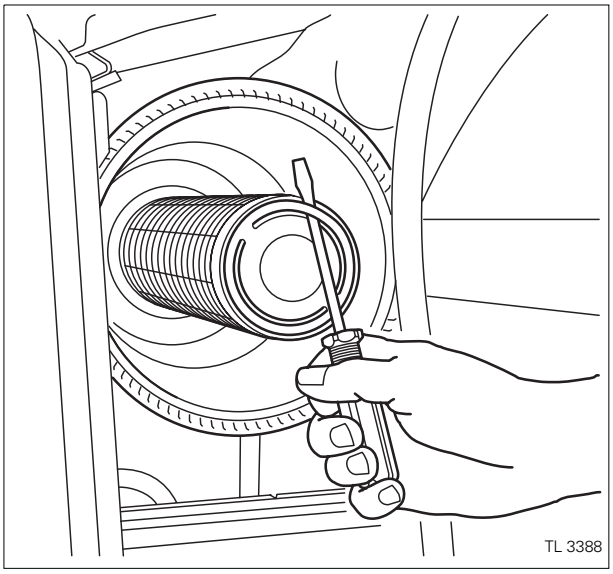
Take a grip on both handles and, slightly rotating it, withdraw the secondary filter element from the tube. Insert a new secondary filter element.

Re-assemble ensuring that all parts are securely in place.

Storage of Filter Elements

Protect stored filter elements against the effects of dust, humidity, and damage. It is best to store them in an upright position, using their original packaging.

All filter elements have their Massey Ferguson part number clearly marked on them.



AIR CLEANER

Removal and Refitment 3-3D

Removal

1. Remove the hood side access panels and front grille, *(see operation 1-12B)*.
2. Loosen the hose clip around the air cleaner hose.
3. Loosen the two bolts holding the cleaner to the front support frame.
4. Remove the air cleaner assembly, sliding down away from the bolts and out of the hose.
5. If necessary, remove the electrical plug and unscrew the air cleaner `blocked filter' switch.

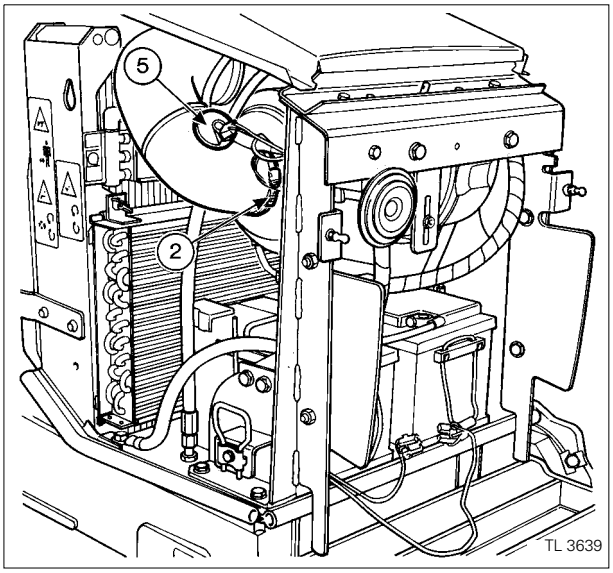
Refitment

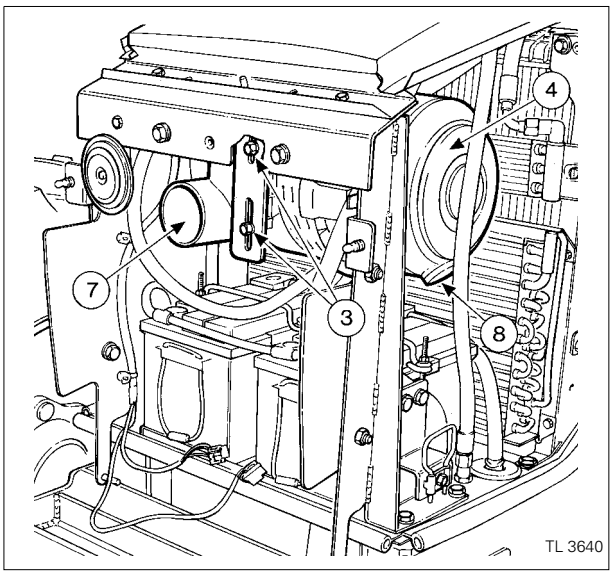
6. Reverse procedures 1 to 5 except:

a. Position the intake pipe (7) facing forward.

b. Arrange the end cover so that the unloader valve (8) is at the bottom.

c. Ensure that all rubber hoses are correctly fitted and that the hose clips are tight between the air cleaner and engine.





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SECTION 4

Clutch

INDEX

4A	SPLIT TORQUE CLUTCH
4B	OIL COOLED CLUTCH

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Split Torque Clutch

Section 4 - Part A

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Split Torque Clutch

SPECIFICATION

Type:	
305 mm (12 in) diameter clutch	Split torque coil spring.
330 mm (13 in) diameter clutch	Split torque belleville spring.
Clutch diameter:	
Coil spring	305 mm (12 in) - coil spring type.
Belleville spring	330 mm (13 in) - belleville spring type.
Pressure plate coil springs:	
305 mm (12 in) diameter clutch	12 red springs with clamp load of 664 kg (1464 lb).
Pressure plate belleville spring:	
330 mm (13 in) diameter clutch	885 kg (1950 lb) clamp load.
Release lever height:	
305 mm (12 in) clutch	82,31-82,55 mm (3.25-3.28 in).
330 mm (13 in) clutch	118,92-120,22 mm (4.682-4.733 in).
Routine clutch adjustment	None.
Flywheel machining limits	See page 4A-11.

Special Tools:

MF.159B	Clutch centraliser.
MF.314	Release lever height setting gauge 305 mm (12 in).
MF.446	Release lever height setting gauge 330 mm (13 in).
MF.479	Clutch release bearing installer.
MS.550	Universal handle.

Bolt Torques:

Clutch cover to flywheel (12 in)	30 Nm (23 lbf ft).
Clutch cover to flywheel (13 in)	45 Nm (33 lbf ft).
Release lever lock-nut	24 Nm (18 lbf ft).
PTO drive plate to clutch cover	45 Nm (33 lbf ft).
Flywheel to engine	105 Nm (77 lbf ft).
Cross shaft release lever adjusting screw	105 Nm (77 lbf ft).

GENERAL DESCRIPTION

The split torque clutch (Fig.1 and Fig.2) comprises two parts, the drive to the Ferguson linkage pump and power take-off (PTO) and the drive to the transmission. The drive to the linkage pump and PTO is always engaged when the engine is running and is taken from the clutch cover (14) by the PTO drive plate (7). An independent power take-off (IPTO) hydraulic clutch is employed to engage and disengage the PTO. The drive to the gearbox, rear axle and rear wheels is transmitted from either a 305 mm (12 in) clutch with coil springs (see Fig.1) or a 330 mm (13 in) clutch with a belleville type spring (see Fig.2)

The friction disc (10) is held engaged by the pressure plate (9) against the flywheel. Pressure plate movement is obtained by three release levers (5), pivoted on the clutch cover (14). Release lever movement operating against the twelve coil springs (12 Fig.1) or the belleville spring (12 Fig.2) moves the pressure plate rearwards and releases the friction disc (10). The clutch release levers (5) are operated by a release bearing (15) which is moved by the clutch pedal.

The clutch release bearing is operated from the clutch pedal by a flexible cable, cross shaft and fork. The release bearing is held in contact with the three release levers by a torsion spring on the cross shaft so that there is no need to carry out routine clutch adjustment. As the clutch friction plate wears there will be a need to readjust the clutch pedal height from the cab floor or footplate.

All the clutches are fitted with a six-blade type Cerametallic friction disc for its hard wearing and long life properties.

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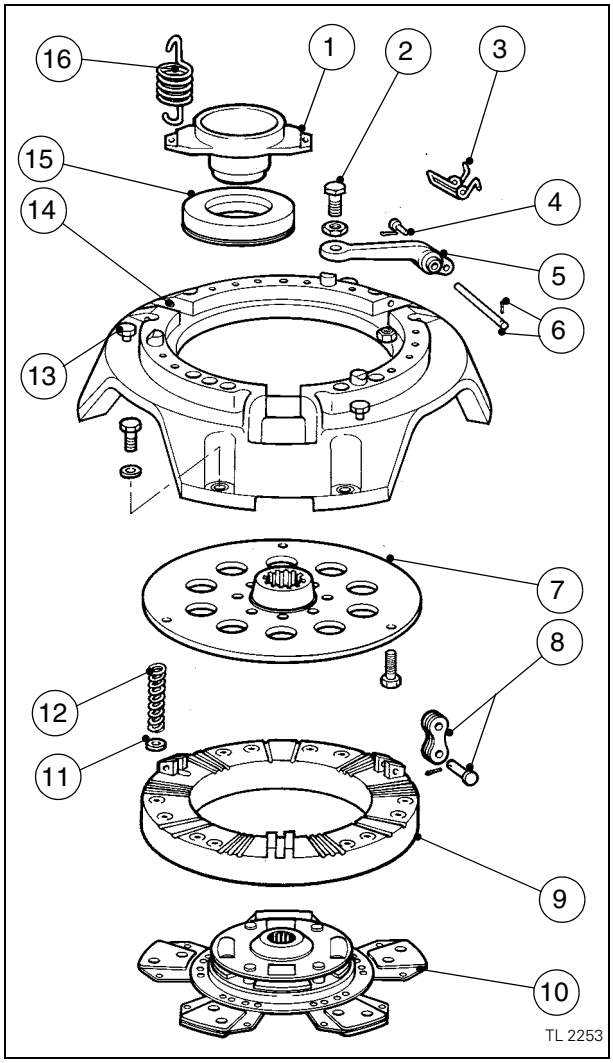


Fig.1 305 mm (12 in) Clutch.

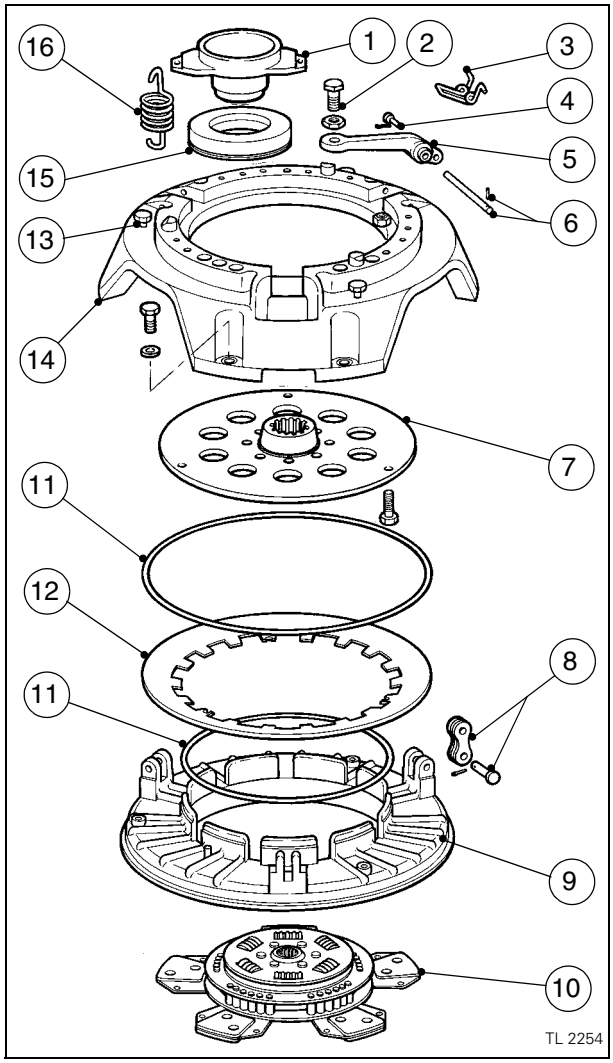


Fig.2 330 mm (13 in) Clutch.

Key to illustration (Fig.1)

1. Bearing carrier
2. Adjusting screw
3. Release lever spring
4. Link pivot pin and split pin
5. Release lever
6. Release lever pivot pin and roll pin
7. PTO drive plate
8. Link and pivot pin
9. Pressure plate
10. Friction disc
11. Fibre washer
12. Coil spring
13. Assembly slave bolts
14. Clutch cover
15. Release bearing
16. Retaining spring

Key to illustration (Fig.2)

1. Bearing carrier
2. Adjusting screw
3. Release lever spring
4. Link pivot pin and split pin
5. Release lever
6. Release lever pivot pin and roll pin
7. PTO drive plate
8. Link and pivot pin
9. Pressure plate
10. Friction disc
11. Pivot rings
12. Belleville spring
13. Assembly slave bolts
14. Clutch cover
15. Release bearing
16. Retaining spring

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Split Torque Clutch

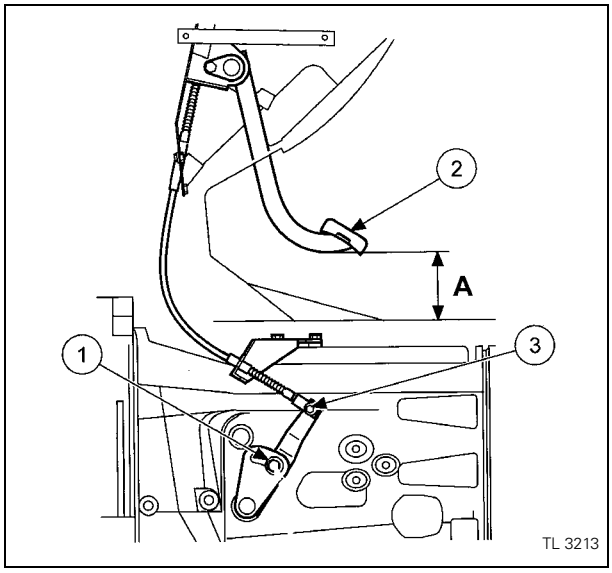
CLUTCH PEDAL HEIGHT

Adjust **1-4A**

Procedure

The tractor is fitted with a cable operated clutch with a constant running release bearing. This type of clutch does not require routine adjustment, the pedal will rise as the clutch wears. Occasionally, it will be necessary to readjust the clutch pedal cable to reset the pedal height when it becomes too high as follows:

1. Using the special spanner provided in the tool box, part number 3812 659 M1, slacken the adjusting screw (1) between the fuel tank and chassis.
2. Hold the pedal (2) off the flat part of the cab floor mat to a height of 155 mm (6.1/8 in) '**A**', place it on a block of wood.
3. Pull the clutch release lever (3) down until the cable is taught and re-tighten the adjusting screw.



CLUTCH PEDAL LINKAGE

Removal and Refitment **2-4A**

Massey Ferguson recommend that the clutch cable is renewed every 3000 hours.

Removal

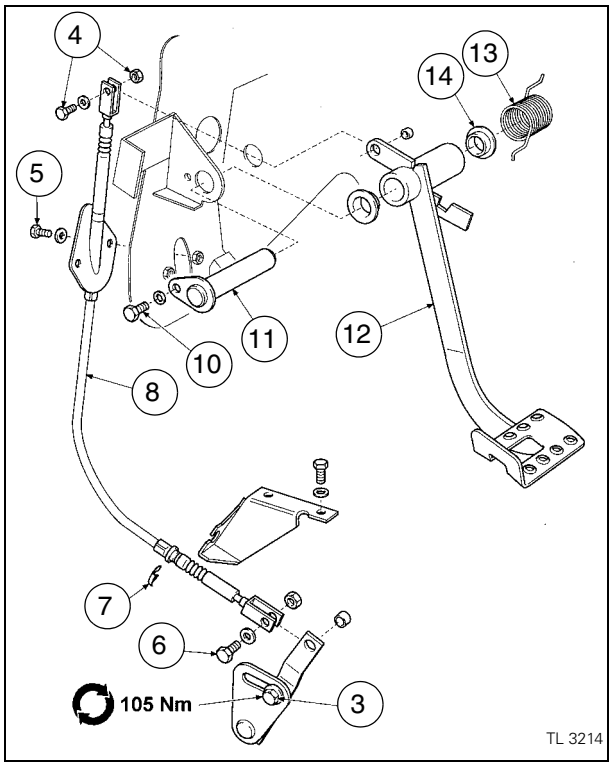
1. Remove the lower panel under the instrument panel to gain access to the clutch pedal shaft.
2. Open the left-hand hood panel.

Clutch cable

3. Slacken the clutch pedal adjusting bolt.
4. Remove the upper clutch cable nut, bolt, washer and spacer.
5. Remove the two bolts securing the cable to the front bulkhead.
6. Remove the lower cable nut, washer and spacer.
7. Remove the spring clip securing the cable to the lower bracket and disconnect the cable.
8. Remove the cable by pulling out from the front of the bulkhead.

Clutch pedal

9. Engage the forward gear to disconnect the interlock (shuttle transmissions).
10. Remove the bolt from the end of the pivot pin.
11. Withdraw the pivot pin.
12. Lift out the clutch pedal.
13. Remove the return spring.
14. If necessary, renew the clutch pedal bushes.



Refitment

15. Reverse procedures 1 to 12 except:
    a. Lubricate the pivot shaft and bushes with a lithium-based grease.
16. Adjust the clutch pedal height, *(see operation 1-4A)*.

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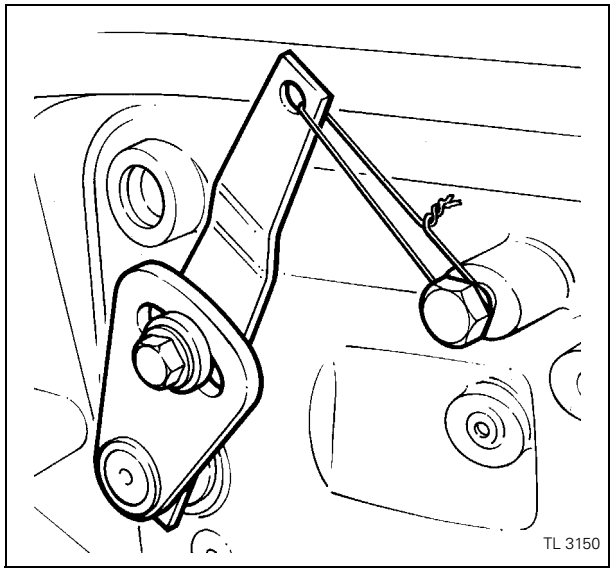
CLUTCH RELEASE BEARING

Removal and Refitment **3-4A**

Special Tools:
MF.479 Clutch Release Bearing Installer
MS.550 Universal Handle

Removal

1. Prior to splitting the tractor, disconnect the clutch cable at the lower end.
2. To prevent the cross shaft rotating against the tension of the torsion spring, the operating lever must be restrained with locking wire as shown in the illustration.
3. Split the tractor between the engine and gearbox, *(see operation 2-2A).*
4. Release the two retaining springs.
5. Remove the release bearing and carrier assembly.
6. Press the release bearing off the carrier.

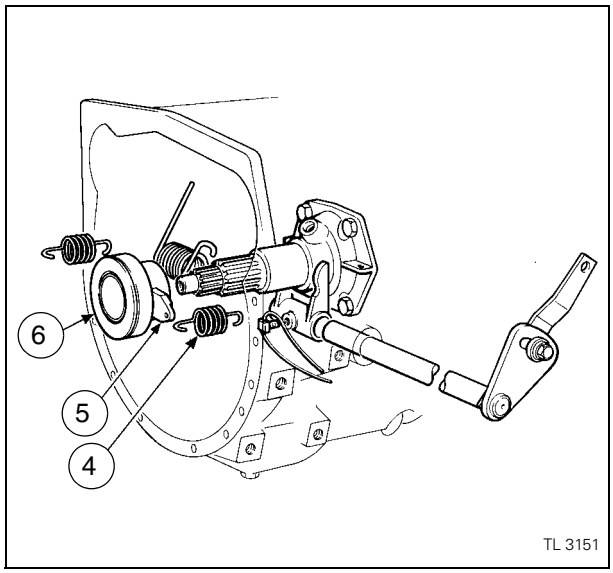

TL 3150

Refitment

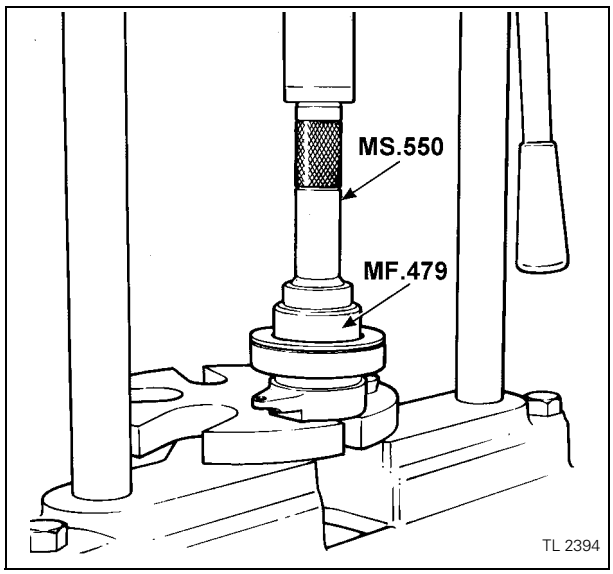
IMPORTANT: *Special service tool MF.479, must be used to install the clutch release bearing to the carrier. Failure to carry out this operation using the special tool will result in damage to the bearing and premature failure.*

- *The release bearing carrier must be re-fitted so that the small 'T' cast into the body, is assembled to the top. Failure to carry out this instruction will result in premature failure of the bearing.*

7. Replace the release bearing using special tool MF.479, Clutch Release Bearing Installer, and MS.550, Universal Handle, as shown in the illustration using a hand press.
8. Replace the release bearing and carrier assembly. Check that the small 'T' is on top.
9. Reverse procedures 1 to 6 except:
   a. Smear a light coating of lithium-based grease on the input shaft splines and the bore of the release bearing carrier.
   b. Ensure that the release fork is correctly located on the carrier.
   c. When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position *(see first illustration).*
   d. Release the cross shaft after the two halves of the tractor have been bolted together.
   e. Adjust the clutch pedal height, *(see operation 1-4A).*



TL 3151

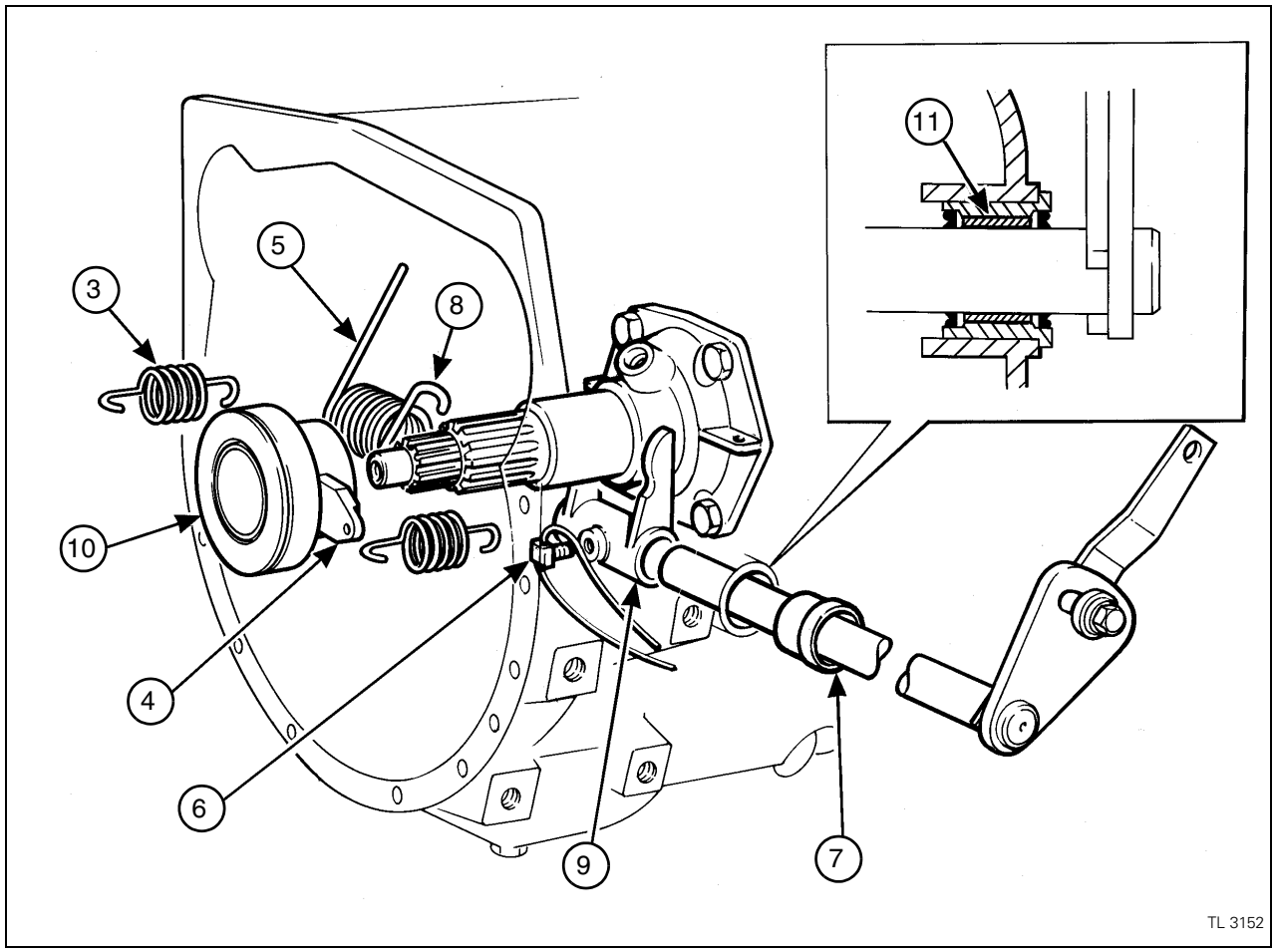


TL 2394

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Split Torque Clutch



CLUTCH RELEASE MECHANISM

Removal and Refitment 4-4A

Removal

1. Split the tractor between the engine and gearbox, (*see operation 2-2A*).
2. Support the cab and remove the left-hand cab support bracket.
3. Release the two retaining springs.
4. Remove the release bearing and carrier assembly.
5. Release the torsion spring from the release fork.
6. Remove the locking wire and locking screw from the release fork.
7. Withdraw the clutch cross shaft from the gearbox casing.
8. Remove the torsion spring.
9. Remove the release fork.
10. Remove the release bearing assembly, *(see operation 3-4A)*.
11. If necessary, remove the clutch cross shaft bearing and seal assemblies.

Refitment

12. Reverse procedures 1 to 11 except:
    - *a.* If the clutch cross shaft bushes have been removed, apply Massey Ferguson Studlock (Loctite 270) to the outside of the bearing.
    - *b.* Install the cross shaft seals in the bearing with the lip of the seal facing the bearing.
    - *c.* Smear a light coating of grease on the input shaft splines, cross shaft bushes and the release bearing carrier. Use a lithium-based grease.
    - *d.* Ensure that the locking screw is located in the hole in the cross shaft.
    - *e.* When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position.
    - *f.* Release the cross shaft after the two halves of the tractor have been bolted together.
13. Adjust the clutch pedal height, *(see operation 1-4A)*.

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CLUTCH ASSEMBLY

Removal and Refitment **5-4A**

Special Tools:
MF.159B Clutch Centraliser.
MF.314 Lever Height Setting Gauge
MF.446 Lever Height Setting Gauge

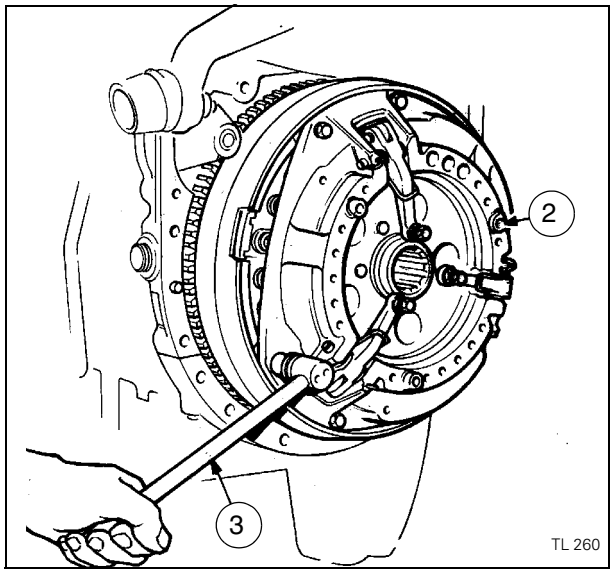
WARNING: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if the pressure is not released slowly and evenly.

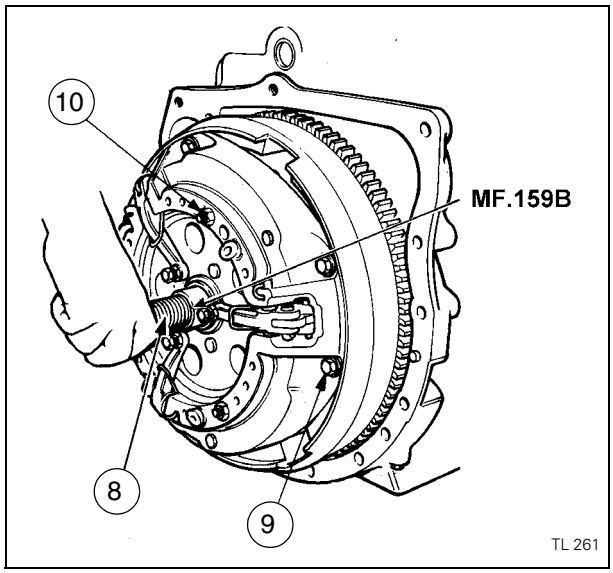
Removal

1. Split the tractor between the engine and the gearbox, *(see section 2A).*
2. Fit three slave bolts 1/4 UNC x 2.1/8 inches long to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts or cap screws and washers.
4. Lift the clutch assembly clear of the flywheel. The friction disc will remain separate from the clutch assembly.

Refitment

5. Lightly smear the splines of the friction disc with a Bentone-based grease (high melting point).
6. Locate the friction disc in the flywheel.
7. Position the clutch assembly onto the flywheel.
8. Using special tool MF.159B, Clutch Centraliser, centralize the clutch assembly and the friction disc.
9. Refit the six bolts or cap screws and washers. Tighten to the following torque:
   305 mm (12 in) clutch - 30 Nm (23 lbf ft).
   330 mm (13 in) clutch - 45 Nm (33 lbf ft).
10. Remove the three slave bolts.
11. Remove MF.159B.





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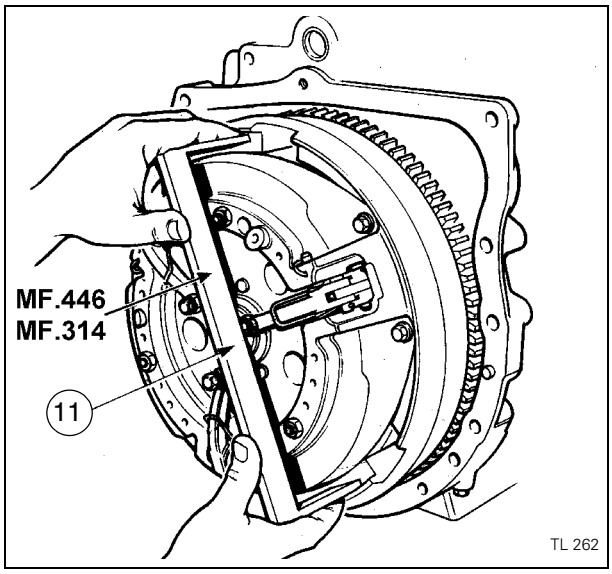
12. Using one of the following release lever setting gauges check the adjustment of each release lever:

    305 mm (12 in) clutch - MF.314, Lever Height Setting Gauge.

    330 mm (13 in) clutch - MF.446, Lever Height Setting Gauge.

The domed end of the release lever setscrew must be just touching the gauge. Apply Massey Ferguson Lock 'n' Seal (Loctite 222) to the threads of the screws and adjust the setscrews as required. Tighten the lock-nuts to a torque of 24 Nm (18 lbf ft).

13. Re-assemble the tractor except:
    a. When refitting the gearbox to engine, rotate the clutch cross shaft clockwise to hold the release bearing away from the clutch during assembly. Secure the operating lever in this position.
    b. Release the cross shaft after the two halves of the tractor have been bolted together.
14. Adjust the clutch pedal height, *(see operation 1-4A)*.



CLUTCH ASSEMBLY-305 mm (12 inch)

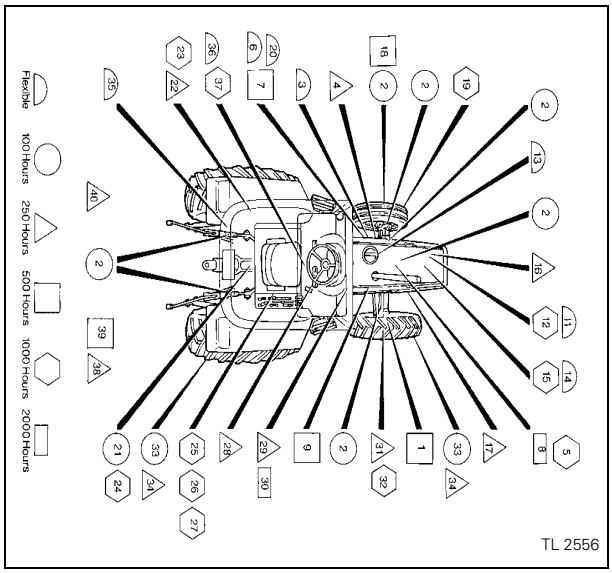
Overhaul 6-4A

Dis-assembly

1. Remove the clutch assembly and friction disc, *(see operation 5-4A)*.

WARNING: Ensure that the clutch is located under the press correctly, that the bar will not slip and that the press has sufficient travel to allow the spring pressure to come off. Release the pressure evenly and slowly.

2. Place the clutch assembly on the hydraulic press and locate a suitable bar across the top of the clutch cover.
3. Apply pressure until the three 1/4 inch bolts can be easily removed.
4. Drive out the roll pins from the pivot pins.
5. Remove the three pivot pins.
6. Remove the release lever springs.
7. Slowly release the pressure from the press until the springs are out of compression.
8. Lift off the cover plate assembly.
9. Remove the springs and fibre washers.
10. Remove the split pins and pivot pins.
11. Remove the release levers.
12. Remove the lower split pins and pivot pins.
13. Remove the links.



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14. Remove the three nuts and bolts.
15. Remove the PTO drive plate.

Examination

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. Check the coil springs against a new spring for loss of tension. If the flywheel is scored, skimming is possible, *(see operation 8-4A)* for details. Never, under any circumstance, skim the pressure plate, as this will severely impair its heat dissipation characteristics.

Re-assembly

16. Reverse procedures 1 to 13 except:
    a. Renew the springs and fibre washers.
    b. Renew all split pins and roll pins.
    c. Tighten the PTO drive plate nuts and bolts to a torque of 45 Nm (33 lbf ft).

CLUTCH ASSEMBLY-330 mm (13 inch)

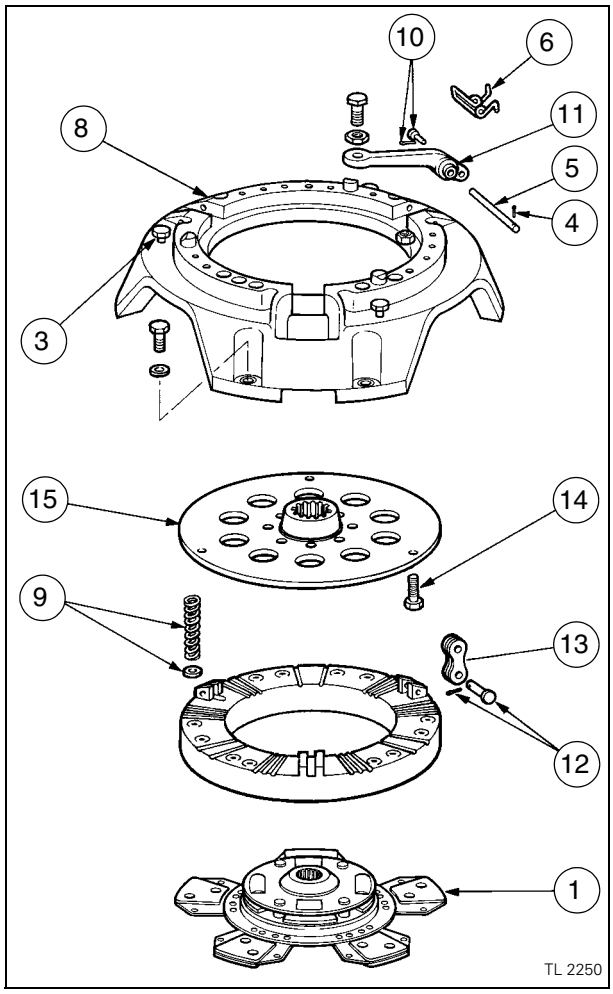
Overhaul 7-4A

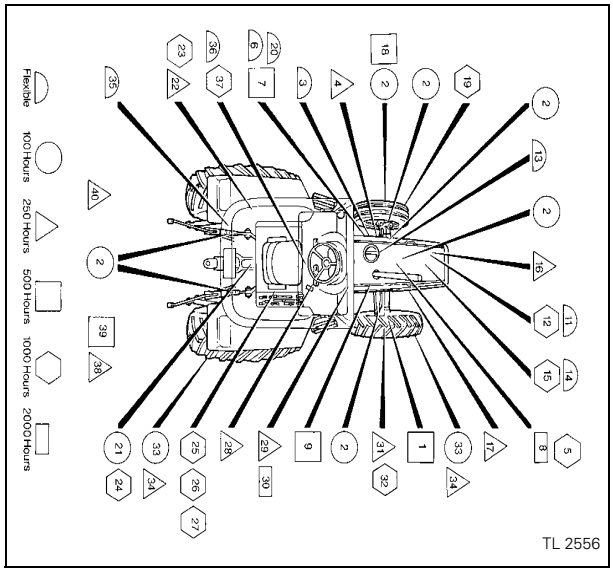
Dis-assembly

1. Remove the clutch assembly and friction disc, *(see operation 5-4A)*.

WARNING: Ensure that the clutch is located under the press correctly, that the bar will not slip and that the press has sufficient travel to allow the spring pressure to come off. Release the pressure evenly and slowly.

2. Place the clutch assembly on the hydraulic press and locate a suitable bar across the top of the clutch cover.
3. Apply pressure until the three 1/4 inch bolts can be easily removed.
4. Drive out the roll pins from the pivot pins.
5. Remove the three pivot pins.
6. Remove the release lever springs.
7. Slowly release the pressure from the press until the springs are out of compression.
8. Remove the clutch assembly from the press.
9. Lift off the cover plate assembly.
10. Remove the belleville spring and pivot rings.
11. Remove the split pins and pivot pins.
12. Remove the release levers.
13. Remove the lower split pins and pivot pins.





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Split Torque Clutch

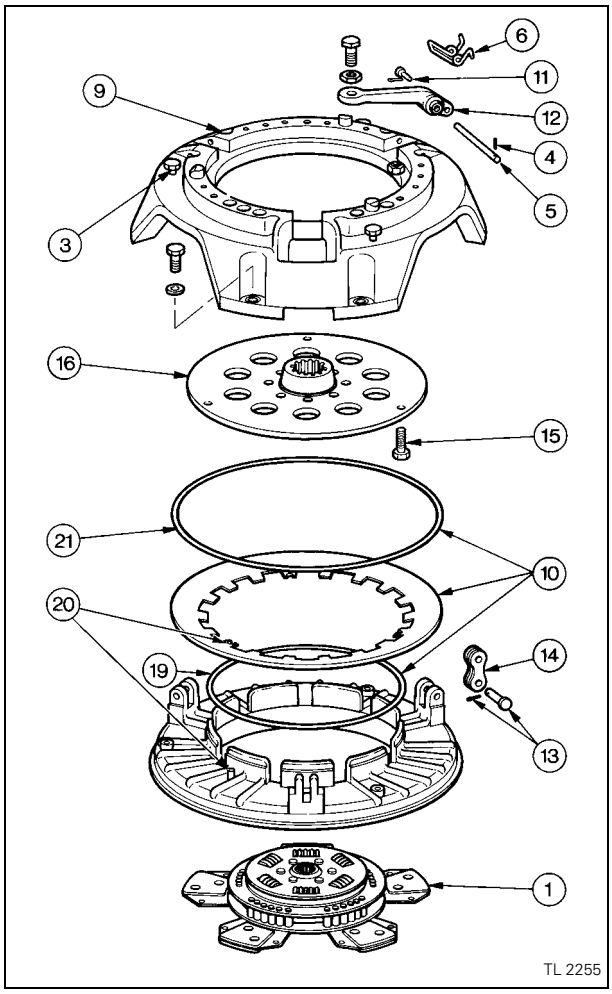
14. Remove the links.
15. If necessary, remove the three nuts and bolts.
16. Remove the PTO drive plate.

Examination

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. If the flywheel is scored, skimming is possible, *(see operation 8-4A)*. Never, under any circumstance, skim the pressure plate, as this will severely impair its heat dissipation characteristics.

Re-assembly

17. Replace the release levers, links and pivot pins.
18. If the PTO drive plate has been removed, replace it and tighten the nuts and bolts to a torque of 45 Nm (33 lbf ft).
19. Place the pressure plate on the bed of the hydraulic press. Position the smaller of the two pivot rings in the groove on the pressure plate locating the joint each side of the small roll pin.
20. Refit the belleville spring locating one of the small cut- outs in the fingers on the dowel pin in the pressure plate. The belleville spring is fitted with the dished-face upwards.
21. Position the larger of the two pivot rings in the groove in the cover plate.
22. Carefully place the cover plate over the pressure plate pulling the release levers through the holes in the cover. Ensure that pivot ring and belleville spring are correctly located.
23. Using the hydraulic press, bar and slave bolts re-assemble the clutch.
24. Refit the release lever pivot pins and springs and renew the roll pins and split pins.



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FLYWHEEL RECLAMATION

Procedure **8-4A**

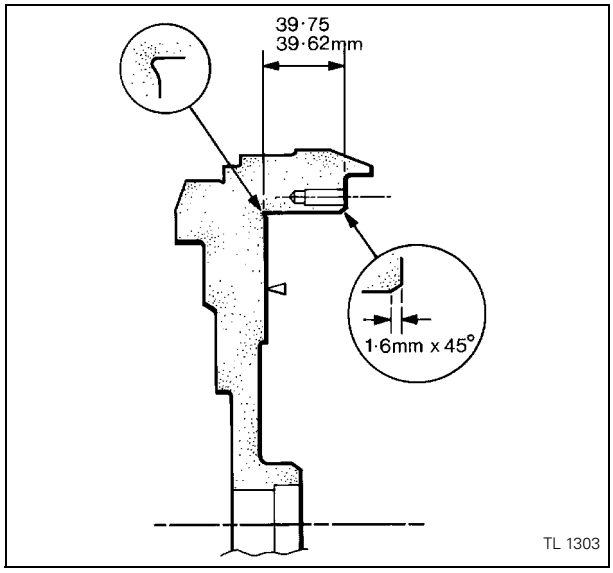
The clutch surface of flywheels can be reclaimed by skimming in 0,25 mm (0.010 in) increments to a maximum of 1 mm (0.040 in) deep.

The ledge to which the clutch cover is bolted must also be skimmed by the same amount to maintain the distance from the clutch face.

305 mm *(12 in) clutches*

The following dimensions must always be maintained:

39,75-39,62 mm (1.565-1.560 in) - see illustration on right.

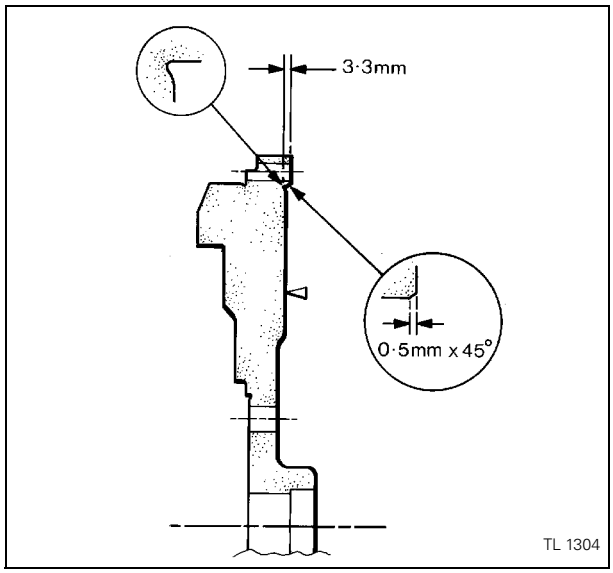


330 mm *(13 in) clutches*

The following dimensions must always be maintained:

3,3 mm (0.130 in) - see illustration on right.

IMPORTANT: *Never, under any circumstance, attempt to skim either the clutch pressure plate or the false flywheel, as this will adversely affect the heat dissipating properties of these clutch components.*



FLYWHEEL AND PILOT BEARING

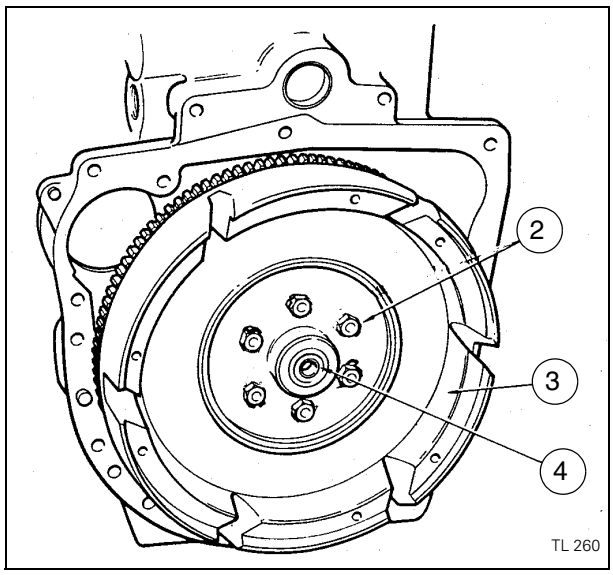
Removal and Refitment **9-4A**

Removal

1. Remove the clutch assembly, *(see operation 5-4A)*.
2. Remove the six bolts and washers.
3. Remove the flywheel.
4. Fill the pilot bearing bore with heavy grease, then insert a suitable length of 16,9 mm (0.668 in) diameter rod into the pilot bearing bore. Tap the rod sharply to hydraulically eject the bearing.

Refitment

5. Fit a new pilot bearing.
6. Locate the flywheel, aligning the untapped hole in the flange to the unused hole in the flywheel.
7. Fit the flywheel bolts and washers then tighten to a torque of 105 Nm (77 lbf ft).
8. Refit the clutch.



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Split Torque Clutch

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Oil Cooled Clutch

Section 4 - Part B

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For repair information on the input housing, the scavenge pump and PTO support bearing please refer to the relevant gearbox.

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Oil Cooled Clutch

SPECIFICATION

Type	Multi plate, oil cooled.
Size	190 mm (7.486 in) diameter.
No. friction plates	5.
No. steel plates	4.
Clutch spring	Diaphragm type.
Oil supply control valve setting	14,5 mm (0.571 in).
Low pressure relief valve setting	4,5 bar (65 lbf/in²).
Clutch pedal height from floor:	
Cab tractors:	
Standard cab - oil cooled clutch	180-190 mm (7.0-7.5 in).
Lo-Profile cab - oil cooled clutch	210-230 mm (8.3-9.1 in).
Footstep tractors:	
Oil cooled clutch	180-190 mm (7.0-7.5 in).

Special Tools

MF.512	Clutch centraliser.
MF.513	Input seal installer.
MF.514	valve setting gauge.
MS.550	Universal handle.

Bolt Torques

Clutch housing to gearbox casing bolts	24 Nm (18 lbf ft).
PTO bearing cover bolts	24 Nm (18 lbf ft).
Clutch cover bolts	24 Nm (18 lbf ft).
PTO shaft hexagon socket cap screw	84 Nm (62 lbf ft).
Clutch cover hexagon socket cap screws	14 Nm (10 lbf ft).
Clutch coupling to flywheel bolts	60 Nm (44 lbf ft).
Clutch release fork grub screw	43 Nm (32 lbf ft).
Control valve operating lever pinch bolt	24 Nm (18 lbf ft).

GENERAL DESCRIPTION

The oil cooled clutch is housed in a casing in front of the gearbox. It is driven from the flywheel of the engine through a spring coupling to reduce vibration and shock loads, a splined shaft is used to connect the coupling to the clutch and to allow the tractor to be split. An oil seal is used to retain the oil within the casing.

The clutch assembly is a multi-plate clutch with friction driver plates and steel driven plates all contained in a steel casing. A diaphragm type spring with release fingers is used to apply pressure and disengage the clutch; similar to that used in the automotive industry. The clutch is disengaged by a clutch release bearing which is operated from the clutch pedal by a flexible cable or rod, cross shaft and fork. When the clutch pedal is pressed down the release bearing presses on the fingers of the diaphragm which removes the clamping force on the plates. Small side springs around the clutch housing assist in separating the plates when the clutch disengages.

The oil supply for the clutch cooling is taken from the steering, PTO clutch, Power Front Axle hydraulic system. It passes through the centre of the input shaft and out through cross drillings in the middle of the clutch, flooding oil through the plates and dissipating the heat. To prevent clutch drag, and to allow gear changing, the oil supply is shut-off when disengaging by a control valve mounted on the right-hand side of the bell housing and operated by the cross shaft.

All the oil passing through the clutch collects in the bottom of the casing and is returned to the gearbox by a scavenge pump driven from the PTO shaft in the bottom of the gearbox.

The drive for the PTO is taken from a gear mounted on the front face of the main clutch housing to a gear supported by a bearing in the front cover and driving an extension of the PTO shaft which goes to the rear of the tractor.

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Oil Cooled Clutch

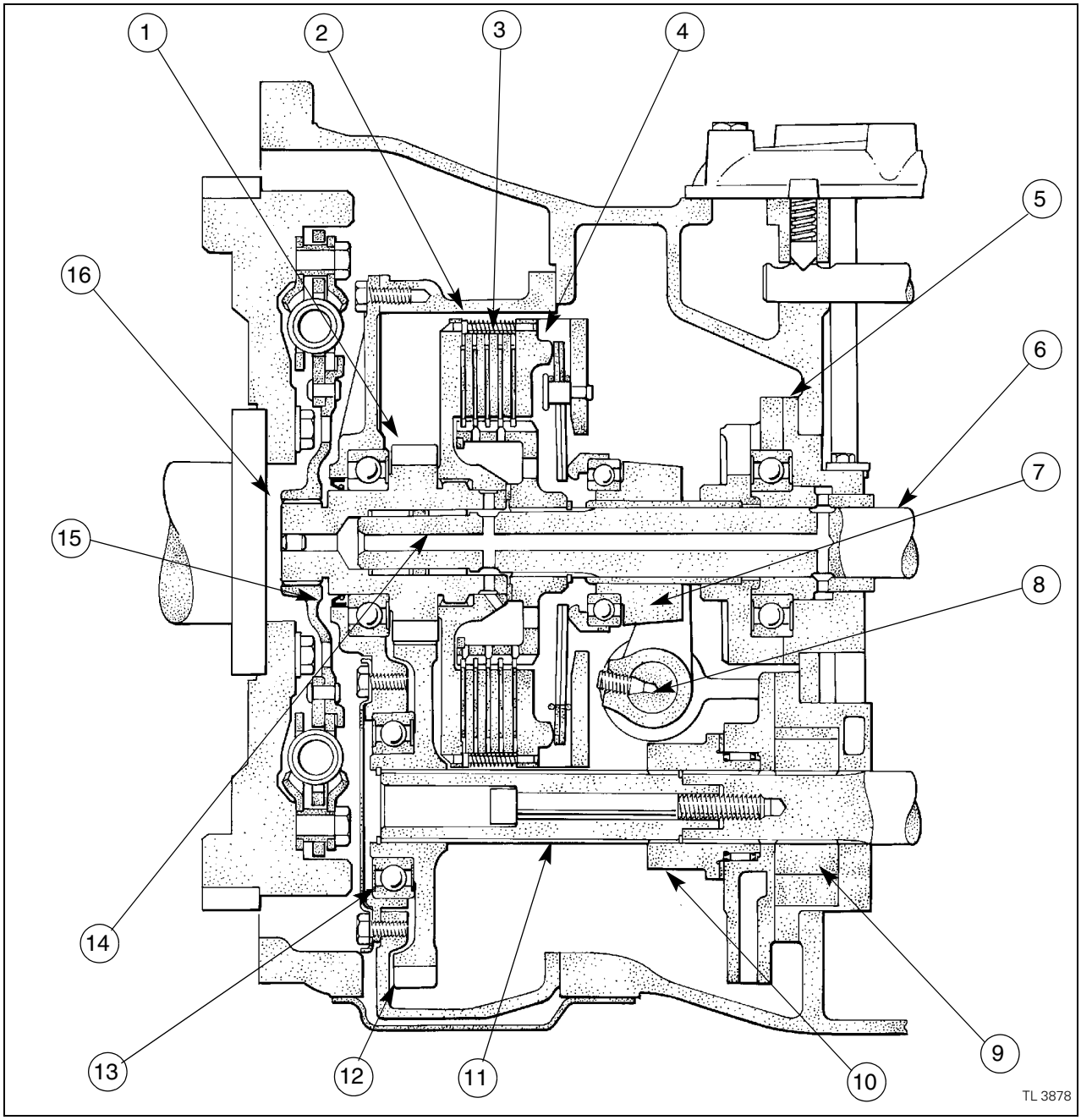


Fig.1 Oil cooled clutch

Key to Fig.1

9. PTO drive gear.
10. Clutch separation springs.
11. Friction and steel plates.
12. Diaphragm spring.
13. Input housing.
14. Input shaft.
15. Clutch release assembly.
16. Clutch cross shaft.
17. Scavenge pump.
18. PTO shaft coupling.
19. PTO shaft extension.
20. PTO driven gear.
21. PTO support bearing.
22. Cooling oil gallery.
23. Input seal.
24. Drive coupling.

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Oil Cooled Clutch

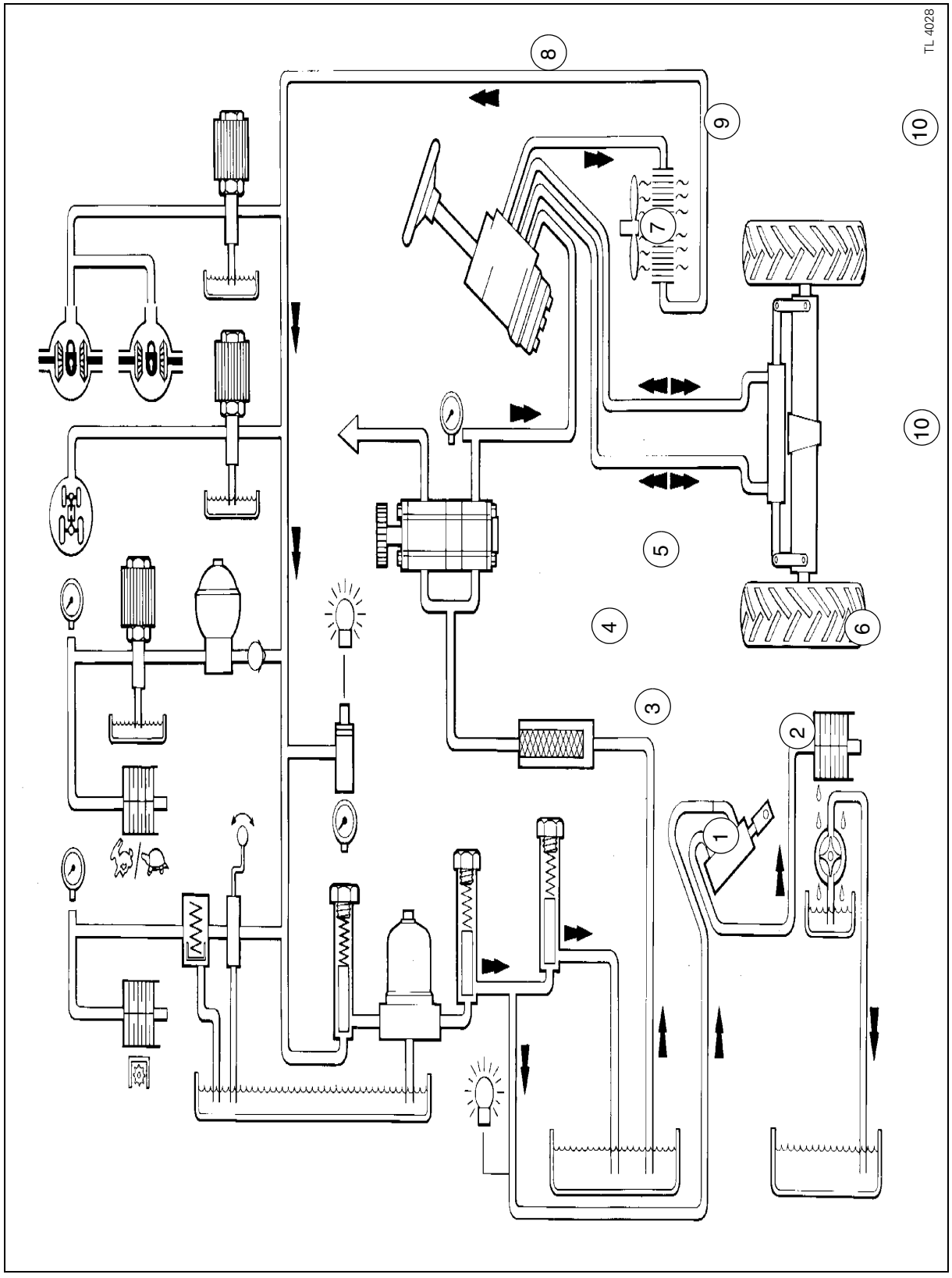


Fig.2 Hydraulic Circuit – Oil Cooled Clutch

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HYDRAULIC CIRCUIT

The illustration in (Fig.2) shows the complete hydraulic circuit which is fully described in the Auxiliary Hydraulic section of this manual. The addition of the Oil Cooled Clutch adds further pipework, control valve, scavenge pump and pressure relief valve.

When the system is working, oil flows from the steering pump at 25 litre/min supplying pressure to the differential lock, four-wheel drive, PTO and 18 x 6 Speedshift gearbox when fitted. Five litres of the excess oil from the Pressure Maintaining Valve (1) passes through the centrifugal filter (3) to the transmission. The remainder, approximately 20 litre/min, is used to cool the clutch. Pressure to operate the centrifugal filter is derived from the back pressure valve (4) set at 6 bar.

The pressure to the clutch is created by a low pressure relief valve (5) set at 4,5 bar located in the manifold block (Fig.3). This relief valve is non-adjustable and in the event of a failure it must be replaced as a complete assembly. When the clutch pedal is applied, the control valve (7) closes and the cooling oil is passed back to the transmission through the relief valve (5).

If there is a failure in the supply of cooling oil to the clutch, a pressure switch (6) in the supply pipe will light the low transmission oil pressure warning light in the instrument panel.

Cooling oil leaving the clutch collects in the bottom of the clutch housing, this is returned to the main transmission case by a scavenge pump (9) driven by the PTO shaft in the front of the gearbox.

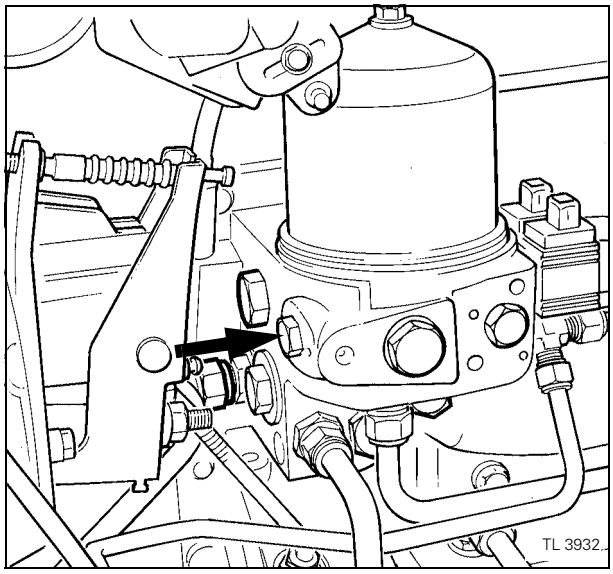


Fig.3

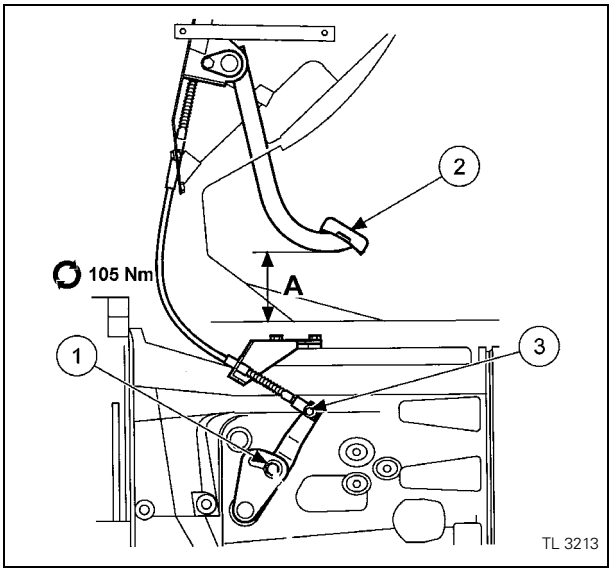
Key to Fig.2 - Oil Cooled Clutch Circuit.

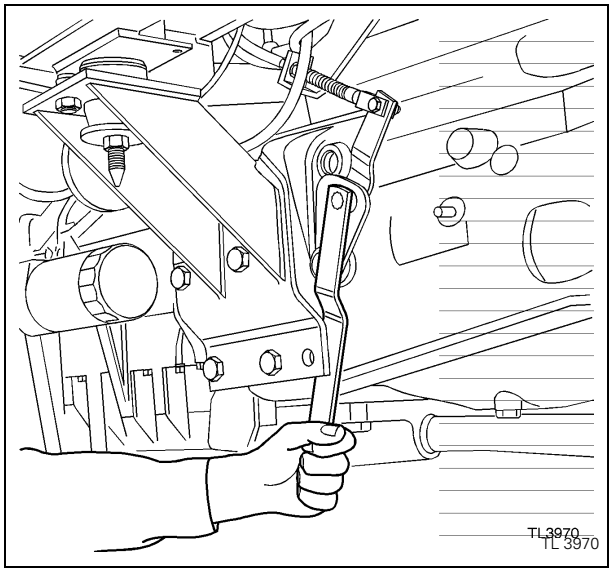
1. Pressure Maintaining Valve (PMV).
2. Manifold block.
3. Centrifugal filter.
4. Back pressure valve 6 bar.
5. Low pressure valve 4.5 bar (clutch).
6. Low clutch oil pressure warning light switch.
7. Clutch control valve.
8. Main transmission clutch.
9. Scavenge pump.
10. Transmission case

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Oil Cooled Clutch





Cab tractor

CLUTCH PEDAL HEIGHT

Adjust **1-4B**

Procedure

The tractor clutches are fitted with a constant running release bearing which is in continuous contact with the clutch. This type of clutch does not require routine adjustment. It will be necessary to readjust the foot pedal height when it has been dismantled or the cable stretches. Cab tractors are fitted with a cable operation, footstep tractors with rod operation. The resetting procedure is identical as follows:

1. Using a special spanner, which can be obtained from your Massey Ferguson Parts Store, part number 3812659 M1 will assist.
2. Slacken the adjusting screw (1) between the fuel tank and the chassis.
3. Hold the pedal (2) off the flat part of the cab floor or platform to the following height 'A' by placing it on a wooden block or using a ruler:

'A' = Cab tractors:

Standard cab - dry clutch 160-170 mm (6.3-6.7 in).

Oil cooled clutch..... 180-190 mm (7-7.5 in).

Lo-Profile cab - dry clutch 190-200 mm (7.5-7.9 in)

Oil cooled clutch..... 210-230 mm (8.3-9.1 in).

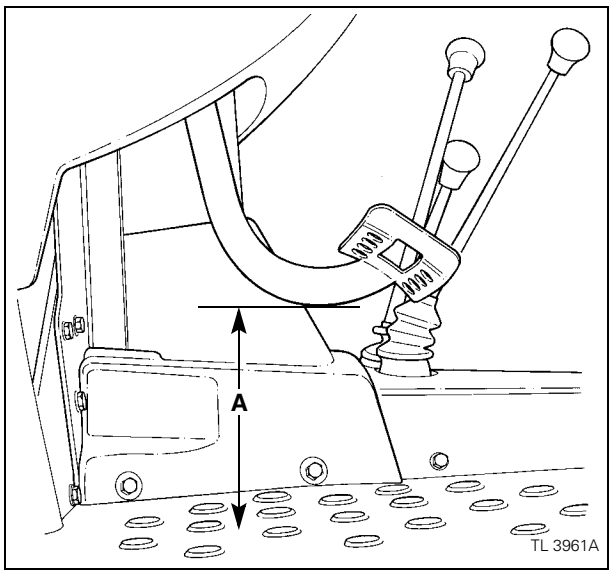
'A' = Footstep tractors:

Dry clutch..... 160-170 mm (6.3-6.7 in).

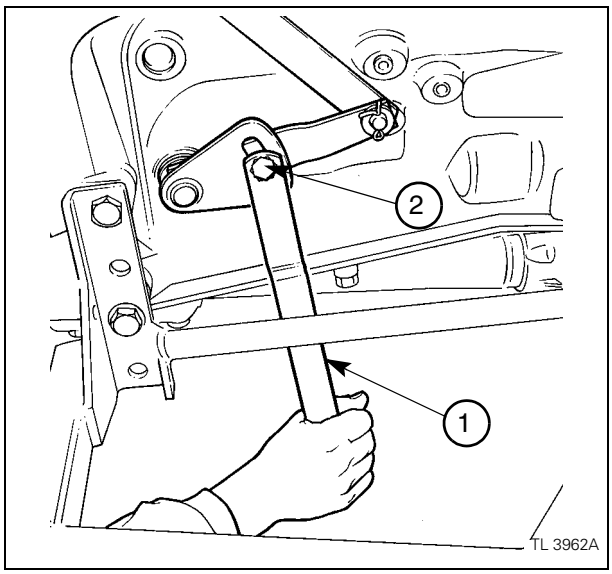
Oil cooled clutch..... 180-190 mm (7-7.5 in).

This dimension must be accurately set.

4. Pull the clutch release lever (3) down and to the right until the cable is taught, re-tighten the adjusting screw. Tighten to a torque of 105 Nm (75 lbf ft) if access can be obtained with a torque wrench.
5. Check the adjustment of the oil supply control valve *(see operation 6-4B)*.



Footstep tractor



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CLUTCH PEDAL LINKAGE CAB TRACTOR

Removal and Refitment 2-4B

Massey Ferguson recommend that the clutch cable is renewed every 3000 hours.

Removal

1. Remove the lower panel under the instrument panel to gain access to the clutch pedal shaft.
2. Open the left-hand hood panel.

Clutch cable

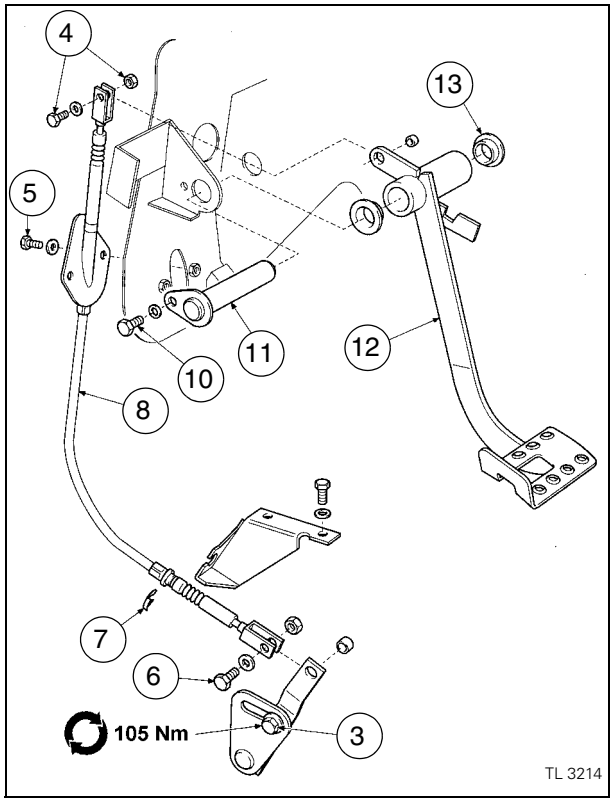
3. Slacken the clutch pedal adjusting bolt.
4. Remove the upper clutch cable nut, bolt, washer and spacer.
5. Remove the two bolts securing the cable to the front bulkhead.
6. Remove the lower cable nut, washer and spacer.
7. Remove the spring clip securing the cable to the lower bracket and disconnect the cable.
8. Remove the cable by pulling out from the front of the bulkhead.

Clutch pedal

9. Engage the forward gear to disconnect the interlock (shuttle transmission only).
10. Remove the bolt from the end of the pivot pin.
11. Withdraw the pivot pin.
12. Lift out the clutch pedal.
13. If necessary, renew the clutch pedal bushes.

Refitment

14. Reverse procedures 1 to 12 except:
    a. Lubricate the pivot shaft and bushes with a lithium-based grease.
15. Adjust the clutch pedal height, *(see operation 1-4B).*



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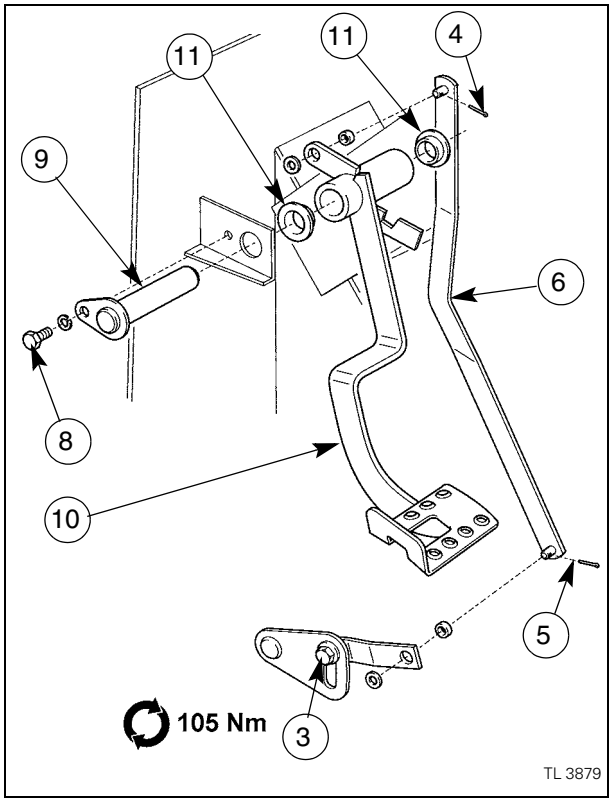
Oil Cooled Clutch

CLUTCH PEDAL LINKAGE FOOTSTEP TRACTOR

Removal and Refitment **3-4B**

Removal

1. Remove the cover around the Instrument panel.
2. Remove the foot plate and slide out the fuel tank to gain access to the clutch cross shaft and the end of the pull rod, *(see operation 5-3C)*.
3. Slacken the clutch pedal adjusting bolt.
4. Remove the upper clutch pull rod nut, bolt, washer and split pin.
5. Remove the lower clutch pull rod nut, bolt, washer and split pin.
6. Remove the pull rod.
7. Engage the forward gear to disconnect the interlock (shuttle gearbox only).
8. Remove the bolt from the end of the pivot pin.
9. Withdraw the pivot pin.
10. Lift out the clutch pedal.
11. If necessary, renew the clutch pedal bushes.

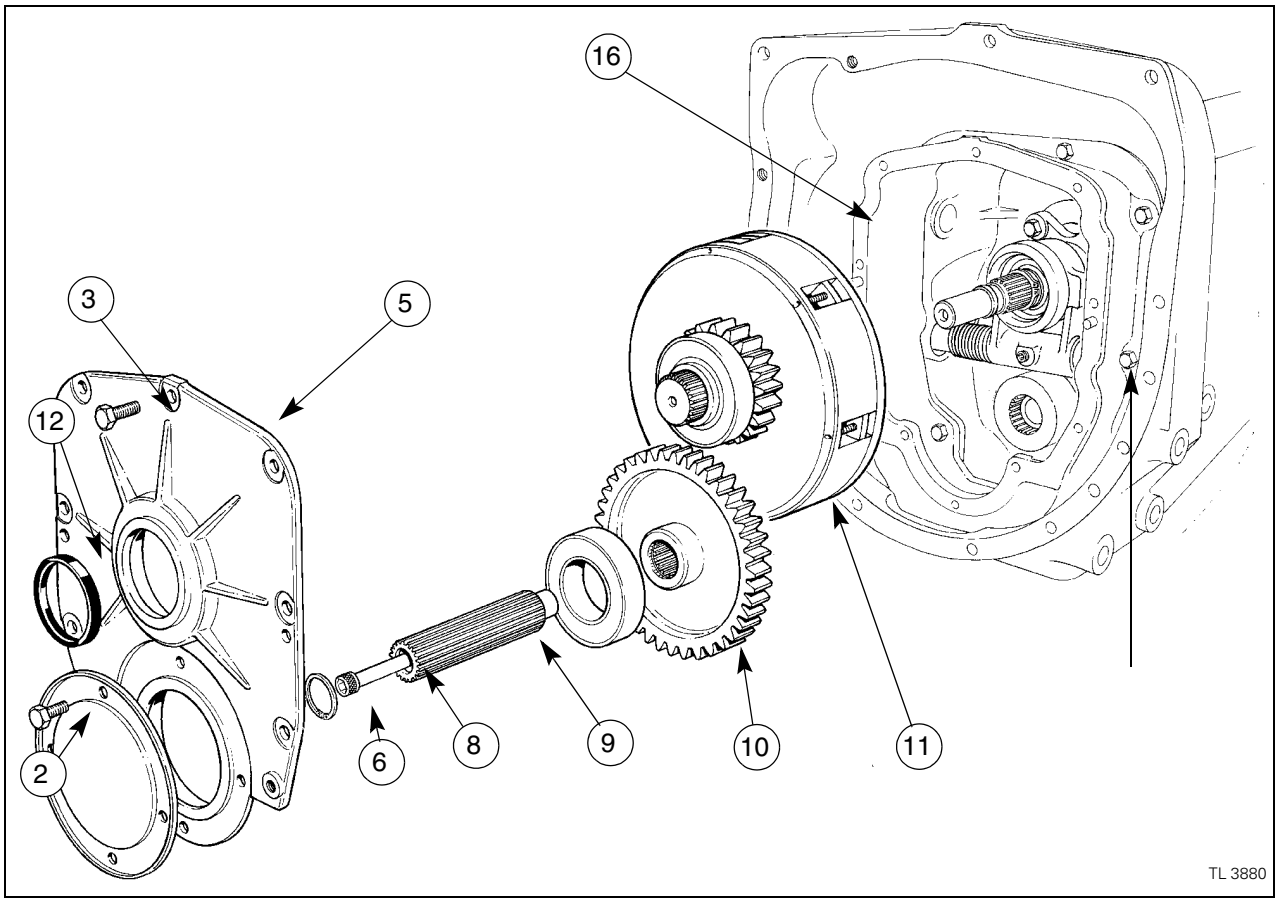


Refitment

12. Reverse procedures 1 to 11 except:
    a. Lubricate the pivot shaft and bushes with a lithium based grease.
    b. Adjust the pedal height, *(see operation 1-4B)*

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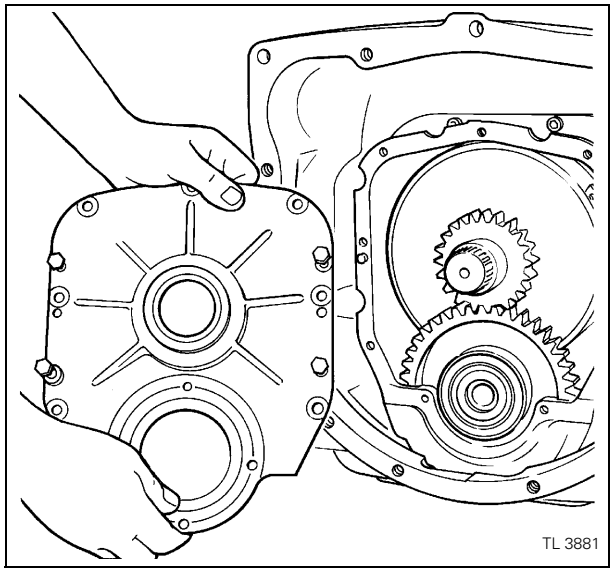
CLUTCH ASSEMBLY

Removal and Refitment **4-4B**

Special Tools:
MF.513 Input seal Installer
MF.550 Universal Handle

Removal

1. Split the tractor between the engine and gearbox, *(see operation 2-2A or 2-2B).*
2. Remove the PTO bearing cover.
3. Remove the seven cover bolts.
4. Insert four extraction bolts, M8 x 30 mm long,
5. Carefully remove the cover using the extraction bolts. The cover is located on dowels, cemented with liquid gasket and is a close fit to the PTO shaft outer bearing.
6. Remove the circlip from the PTO shaft.

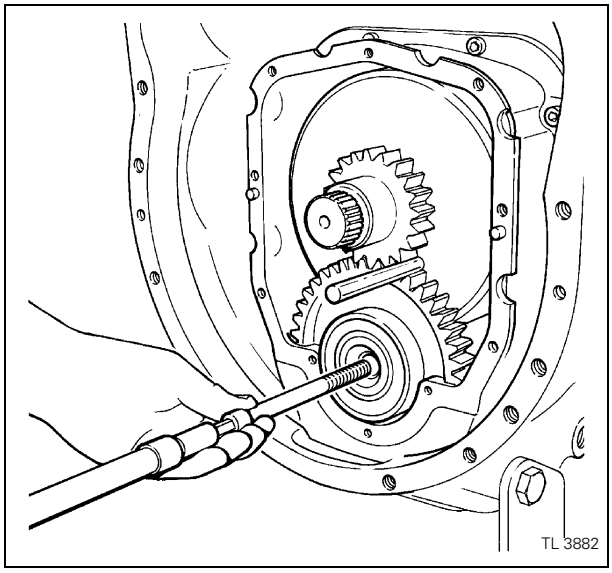


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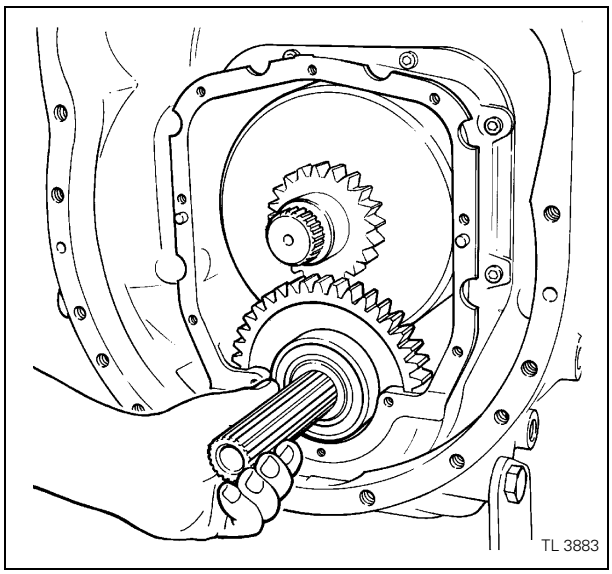
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Oil Cooled Clutch

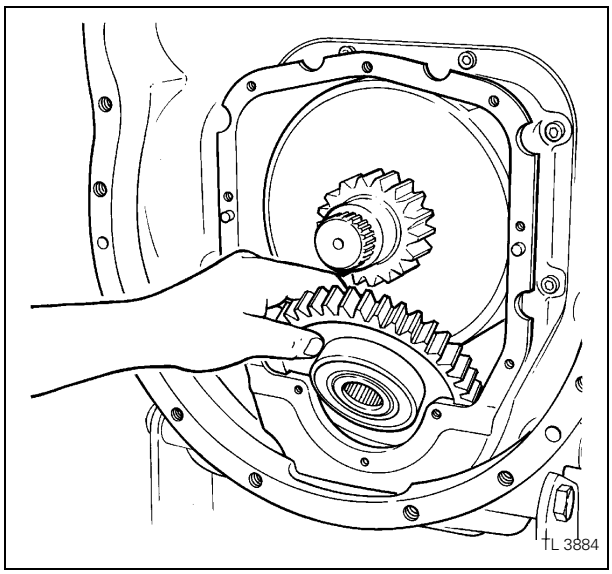
7. Place a small length of rod in between the teeth of the PTO gears to prevent rotation.
8. Using a 10 mm hexagon bit adaptor, remove the cap screw from inside the PTO shaft. It retains the PTO shaft extension.



9. To remove the PTO shaft extension push the clutch into the housing against the pressure of the clutch release bearing, and at the same time lifting it a little. Pull the shaft extension out of the internal coupling. You may need some kind of internal clamping device to be able to grip the shaft in the central hole to pull it out.



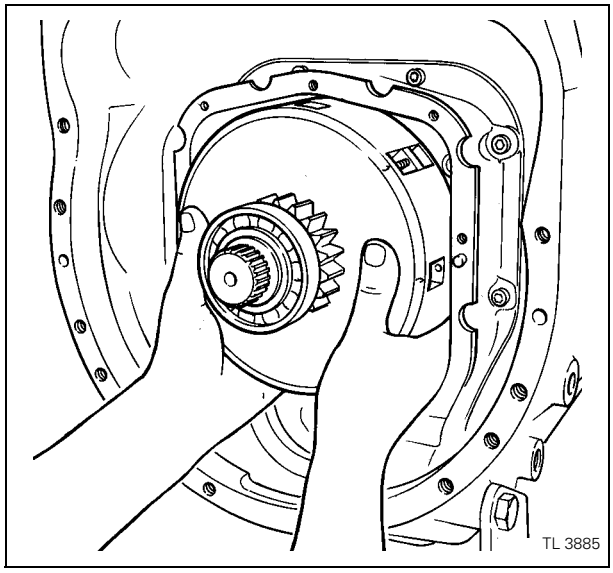
10. Remove the PTO shaft driven gear.



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11. Remove the clutch assembly by carefully pulling it off the input shaft.
12. Press the oil seal out of the cover.

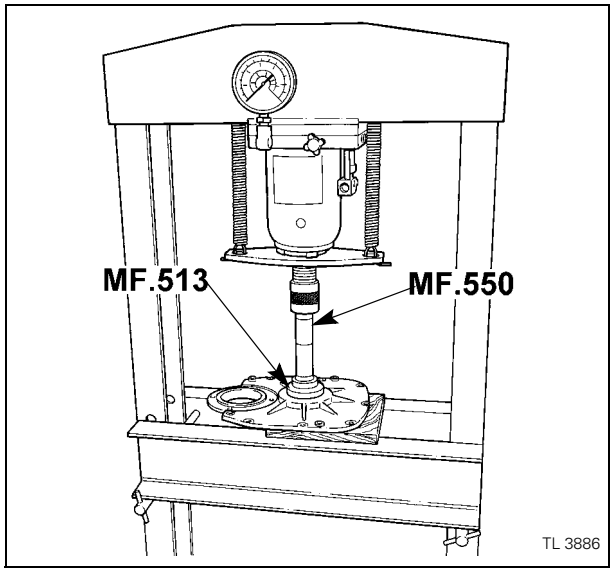


Examination

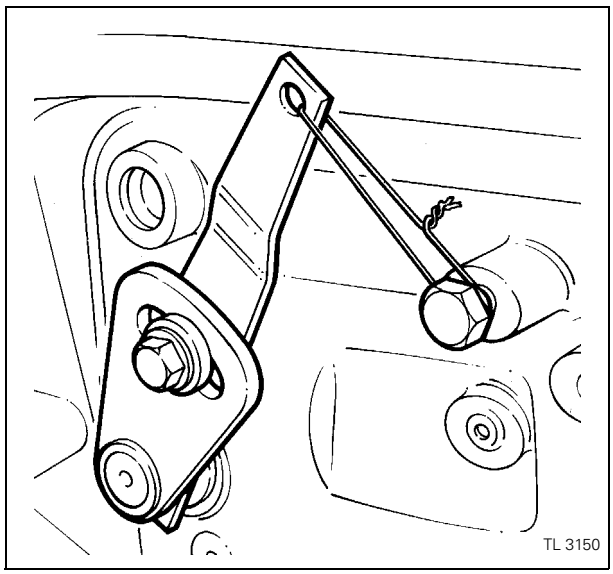
Clean all the components, remove all dirt and old oil from the bottom of the casing. Inspect the gears, shafts and bearings for wear or damage, replace any defective parts.

Refitment

13. Using special tool MF.513 Input Seal Installer and MF.550 Universal Handle, install a new seal in the cover with the lip of the seal facing inwards to retain the oil in the casing.



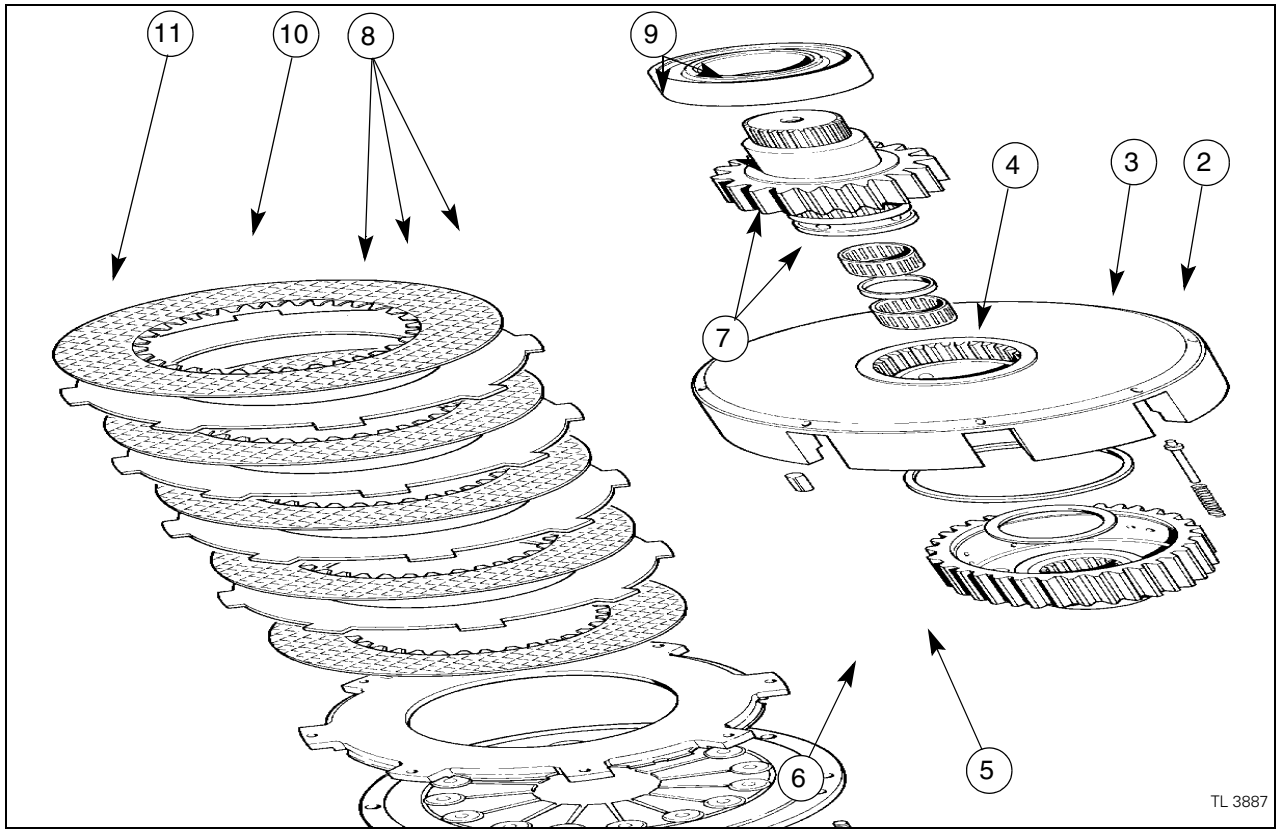
14. Tie back the clutch operating lever with some locking wire to keep the release bearing at back of the casing.
15. Reverse procedures 1 to 11 except:
    a. Tighten the PTO shaft extension hexagon socket cap screw to a torque of 84 Nm (62 lbf ft).
    b. Apply Multi Gasket (Loctite 573) to the bolting face of the casing and tighten the cover bolts to a torque of 24 Nm (18 lbf ft).
    c. Lubricate the seal in the cover with petroleum jelly, very carefully instal the cover over the PTO bearing and prevent damage to the seal.
    d. Apply Multi Gasket (Loctite 573) to the bolting face of the PTO bearing cover and tighten the bolts to a torque of 24 Nm (18 lbf ft).
    e. Apply a small quantity of Mobilplex 47 grease to the internal splines of the drive coupling.
16. If the internal casing *(see 16, page 4B-9)* is removed. Apply Multi Gasket (Loctite 573) to the bolting face and tighten the bolts to a torque of 24 Nm (18 lbf ft).



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Oil Cooled Clutch



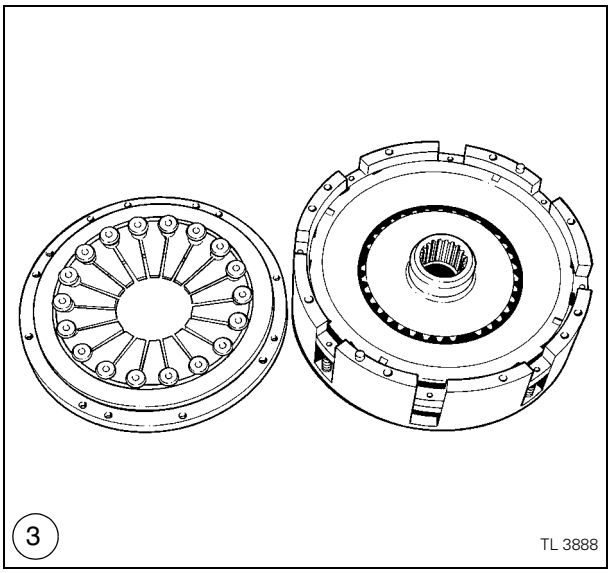
CLUTCH ASSEMBLY

Overhaul **5-4B**

Special Tools:
MF.512 Clutch Centraliser

Dis-assembly

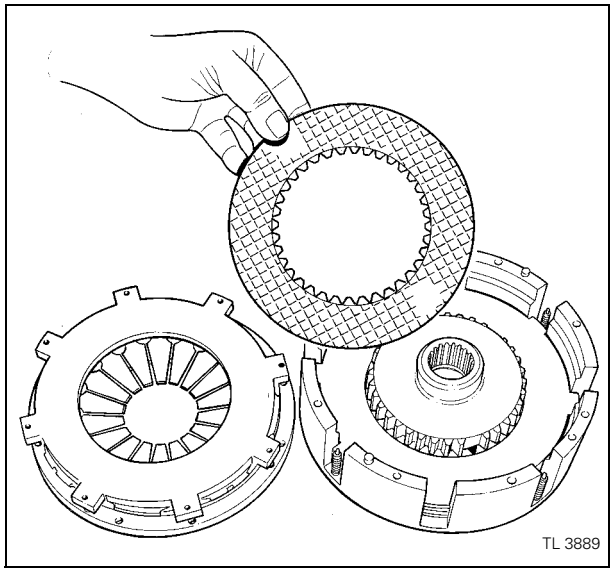
1. Remove the clutch assembly, *(see operation 4-4B)*.
2. Remove the eight cap screws from the cover.
3. Remove the cover and diaphragm assembly.
4. Lift off the pressure plate.



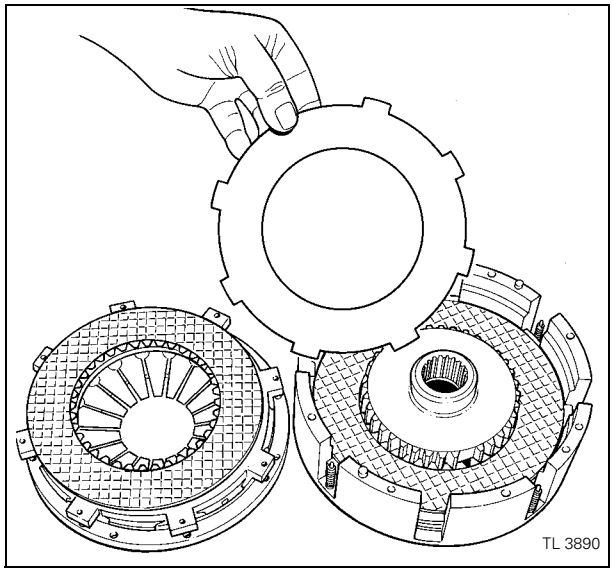
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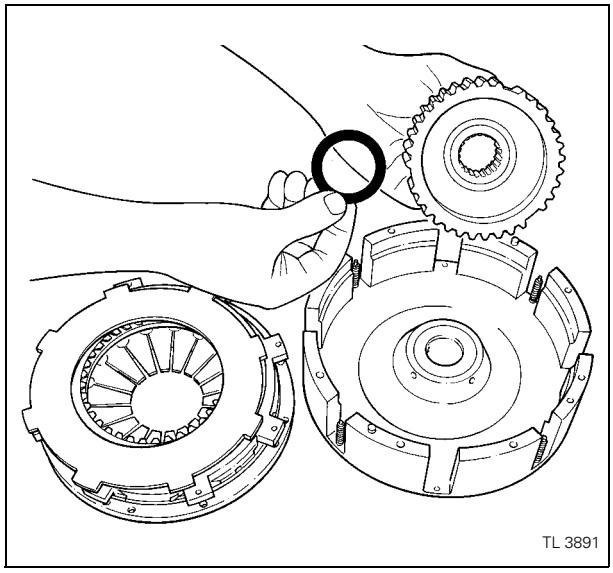
5. Remove the friction plates.



6. Remove the steel plates.



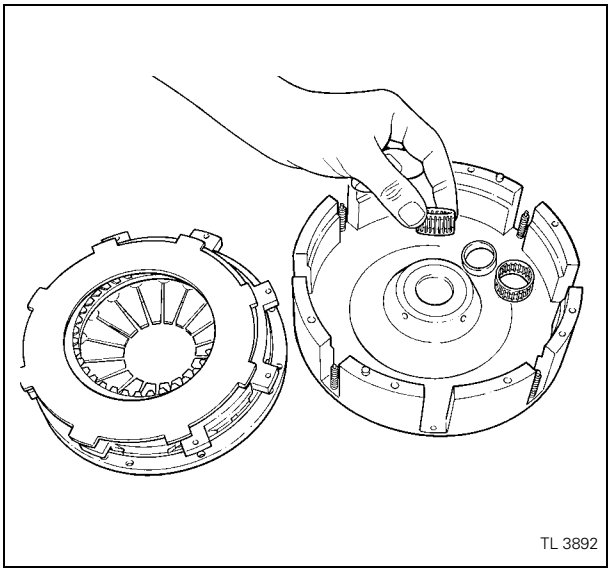
7. Remove the central hub and thrust washer.



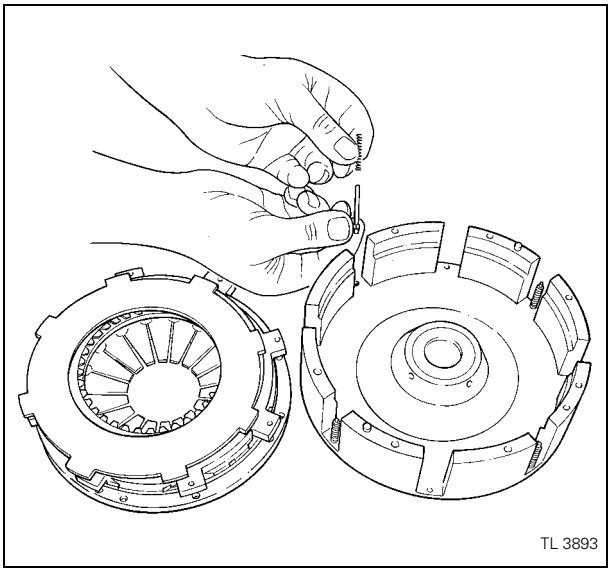
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8. Remove the needle roller bearings and spacer.


TL 3892

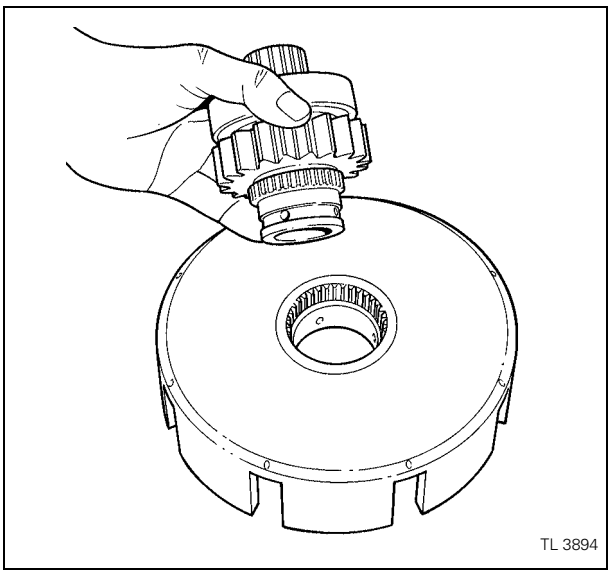
9. Remove the clutch separation springs and pins.


TL 3893

10. Remove the PTO drive gear and bearing assembly.
11. If necessary remove the bearing from the PTO gear.

Examination

Carefully inspect all the plates for damage, wear and distortion. Inspect the diaphragm for cracks. Replace any component that shows signs of serious wear or damage.

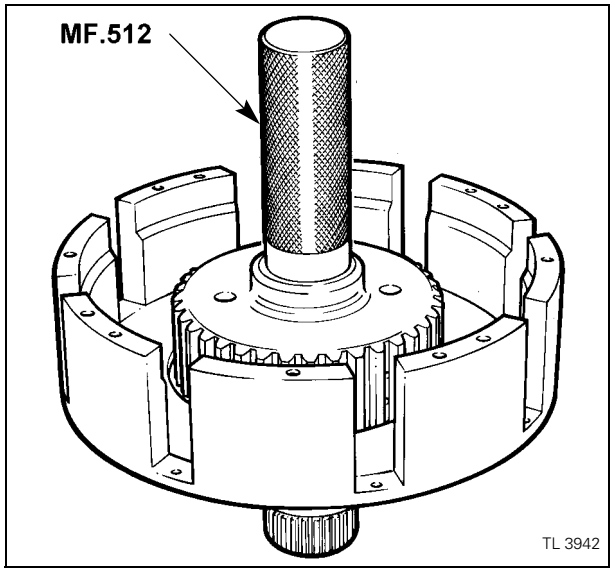

TL 3894

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Re-assembly

12. Replace any removed bearings.
13. Fit the PTO drive gear and bearing assembly.
14. Install the needle roller bearings and spacer in the drive gear and bearing assembly.
15. Using special tool MF.512 Clutch Centraliser, align the central hub and thrust washer assembly.
16. Soak the friction plates for at least 1 hour in clean transmission oil.
17. Hold the thrust washer (7) in place with some petroleum jelly.
18. Install all the friction and steel plates, starting with a friction plate.
19. Install the clutch separation springs and pins.
20. Re-fit the cover and tighten the hexagon socket cap screws to a torque of 14 Nm (12 lbf ft).



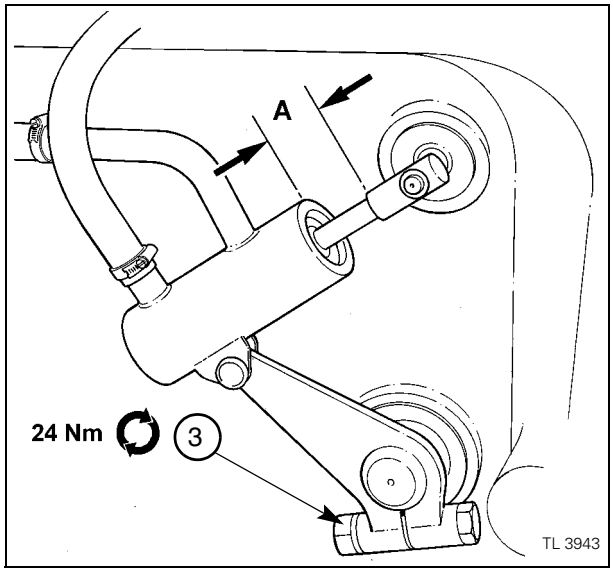
OIL SUPPLY CONTROL VALVE

Adjust **6-4B**

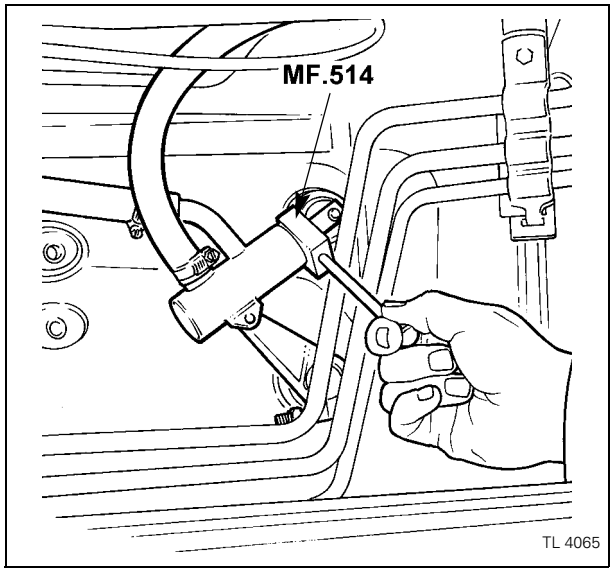
Special Tools:
MF.514 Valve Setting Gauge

Procedure

1. Ensure that the clutch cross shaft is free to rotate and that the clutch thrust bearing is in contact with the clutch.
2. Set the clutch pedal height, *(see operation 1-4B)*.
3. Slacken the pinch bolt on the operating lever so that it is free.
4. Check that the valve spindle is free to move in the valve.



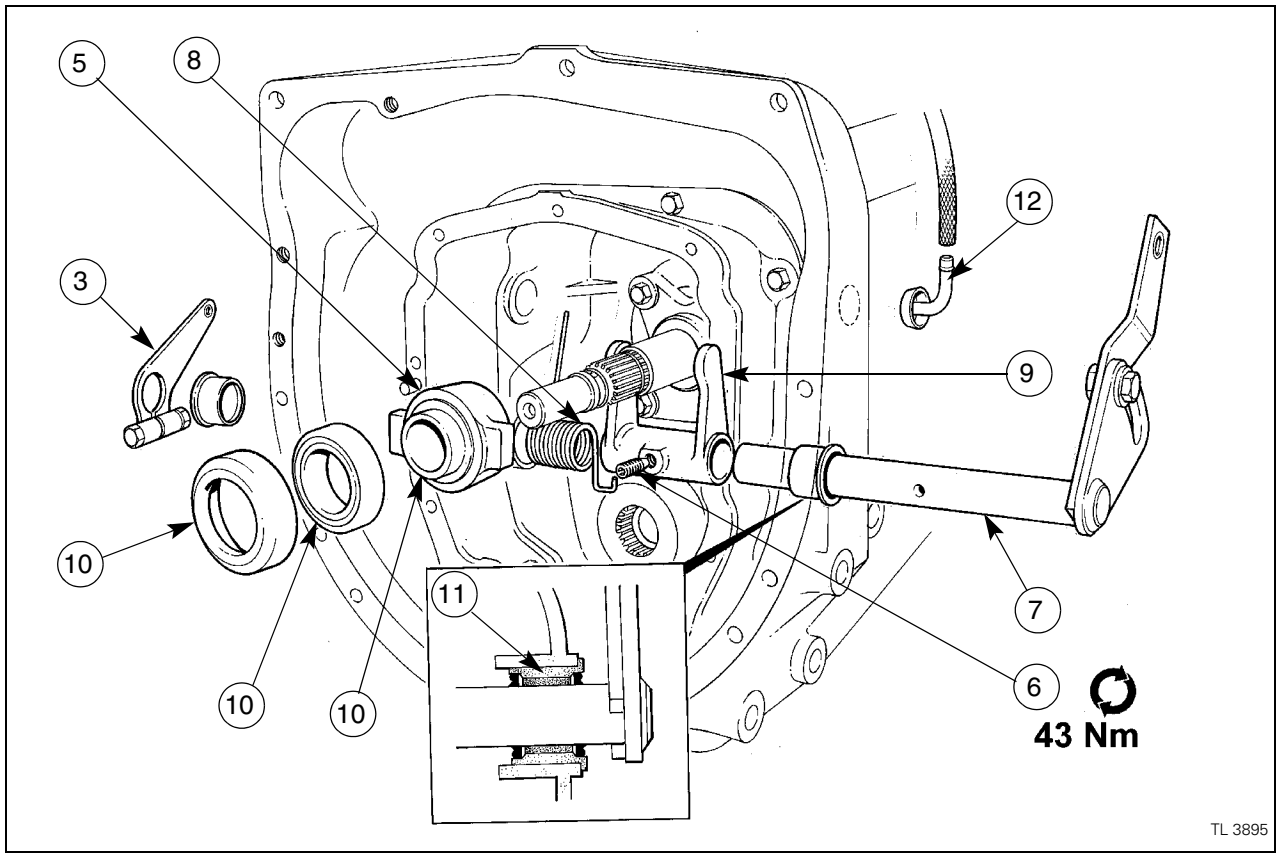
5. Adjust the position of the operating lever on the cross shaft. Using special tool MF.514 Valve Setting Gauge, set dimension ‘A’ between the cylinder and spindle end. If the tool is not available the dimension is 14,5 mm (0.571 in).
6. Tighten the pinch bolt to a torque of 24 Nm (18 lbf ft).



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Oil Cooled Clutch



CLUTCH RELEASE MECHANISM

Removal and Refitment 7-4B

Removal

IMPORTANT: *The clutch is fitted with a heavy duty release bearing and should not be a routine replacement.*

1. Remove the clutch assembly, *(see operation 4-4B).*
2. Remove or slide to one side the fuel tank(s), *(see operation 2-3C or 5-3C).*
3. Disconnect the control valve operating lever from the right-hand side of the cross shaft.
4. Disconnect the clutch operating cable or rod.
5. Remove the release bearing and carrier assembly.
6. Slacken the screw in the release fork, remember there is tension from the spring.
7. Withdraw the clutch cross shaft from the gearbox casing.
8. Remove the torsion spring.
9. Remove the release fork.
10. If necessary, dis-assemble the clutch release bearing assembly.
11. If necessary, remove the clutch cross shaft bearing and seal assemblies.
12. There is a small breather pipe between the clutch housing and the gearbox top cover to release pressure. This is pressed into the casing with a coating of sealant.

Refitment

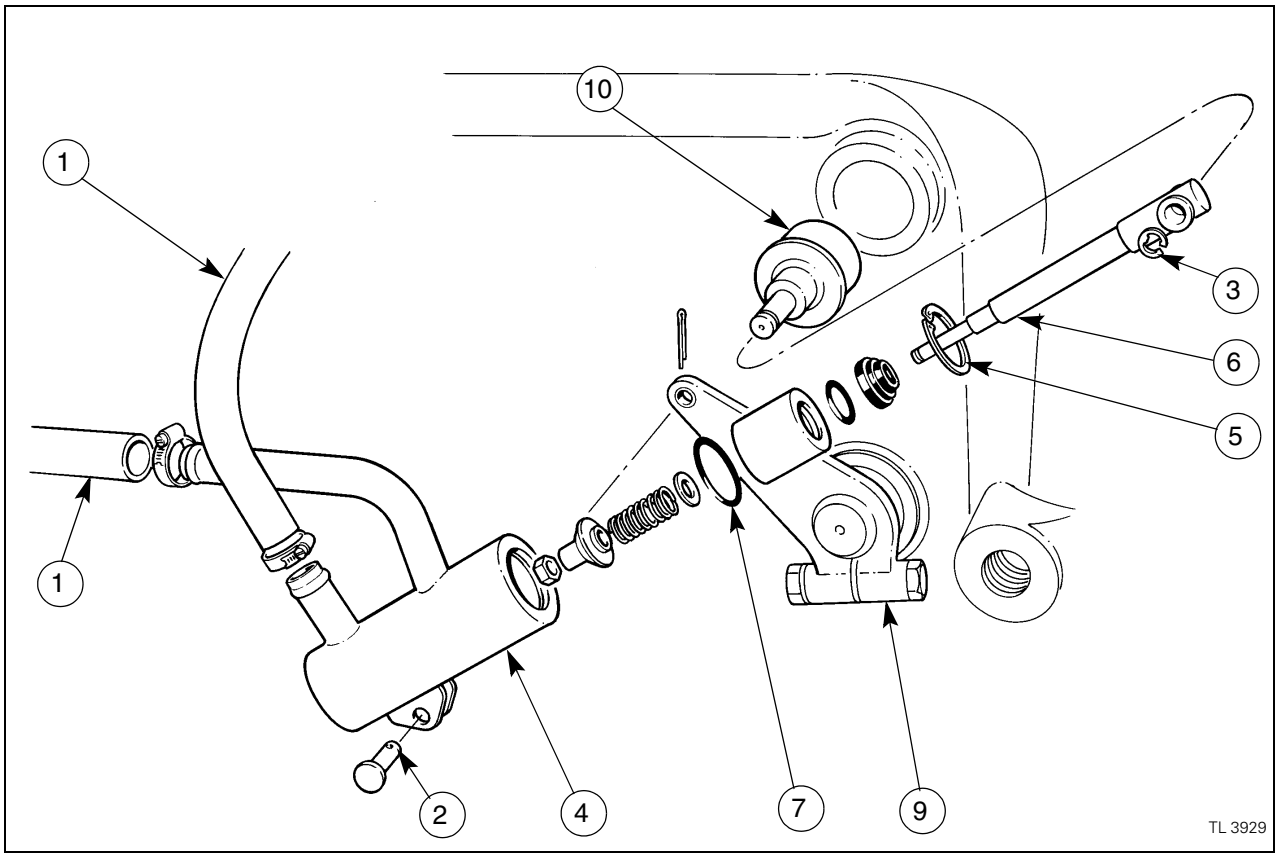
13. Replace the cross shaft bushes, if removed.

IMPORTANT: *DO NOT apply any load on the balls in the bearing when assembling.*

14. If the release bearing assembly has been dismantled, press the clutch thrust ring onto the bearing.
15. Press the bearing onto the carrier; press the bearing by applying force to the inner part of the race, otherwise you will damage the bearing.
16. Reverse procedures 1 to 9 except:
    a. Ensure that the locking screw is located in the hole in the cross shaft. Apply two drops of Stud Lock (Loctite 270) and tighten the screw to a torque of 43 Nm (32 lbf ft).
    b. Tie back the operating lever with wire to aid assembly of the clutch *(see page 4B-10).*
    c. Adjust the oil supply control valve, *(see operation 6-4B).*

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OIL SUPPLY CONTROL VALVE

Overhaul **8-4B**

Dis-assembly

1. Disconnect the two hydraulic hoses.
2. Remove the clevis pin - cylinder to operating lever.
3. Remove the spring clip from the valve spindle pivot.
4. Remove the cylinder assembly.
5. Remove the clip.
6. Pull the valve assembly out of the cylinder.
7. Remove and discard the 'O' ring in the cylinder body.

Examination

Clean all the components and check for wear replacing any worn components. Ensure that the valve seat in the cylinder and on the spindle is in good working condition. Check that the valve slides freely up and down the valve spindle.

NOTE: *The valve assembly can only be obtained as an assembly part number 3816 663 M91.*

8. Reverse procedures 1 to 7.
9. Adjust the oil supply control valve, *(see operation 6-4B).*
10. The pivot pin is held in the gearbox casing with an application of Loctite 601.

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Oil Cooled Clutch

CLUTCH DRIVE COUPLING

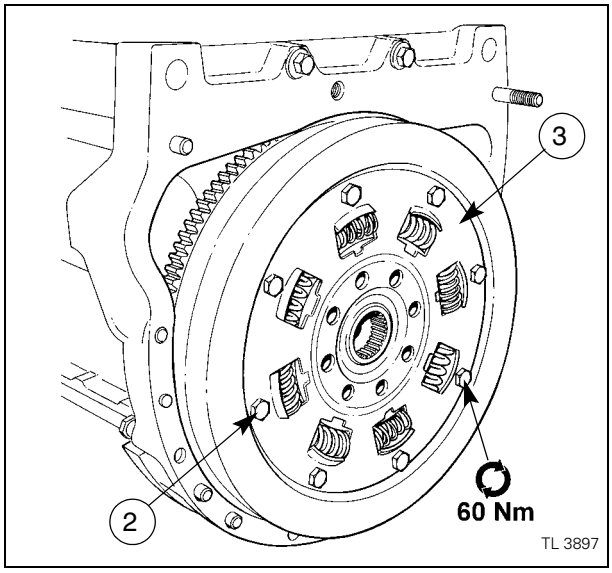
Removal and Refitment **9-4B**

Removal

1. Split the tractor, *(see operation 2-2A or 2-2B).*
2. Remove the eight bolts around the coupling.
3. Remove the coupling from the flywheel.

Refitment

4. Reverse procedures 1 to 3 and tighten the bolts to a torque of 60 Nm (44 lbf ft).
5. Apply a small quantity of Mobilplex 47 grease to the internal splines.



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SECTION 5

Gearbox

INDEX

5A	12 X 12 SHUTTLE GEARBOX
5B	12 X 12 CREEPER GEARBOX
5C	18 X 6 SPEEDSHIFT GEARBOX
5D	RANGE GEARBOX
5E	FOUR-WHEEL DRIVE SHAFT
5F	8 X 8 SHUTTLE GEARBOX
5G	12 X 4 MANUAL GEARBOX
5H	FOUR-WHEEL DRIVE GEARBOX
5J	POWER SHUTTLE GEARBOX

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12 x 12 Shuttle Gearbox

Section 5 - Part A

Table of Contents

Operation No.	Description	Page No.
----	Specification	5A– 2
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2-5A	Forward/Reverse Control Lever - Overhaul	5A– 7
3-5A	Main Gear Shift - Removal and Refitment	5A– 9
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12 x 12 Shuttle Gearbox

SPECIFICATION

Model	12 x 12 Shuttle gearbox.
Number of gears forward	12.
Number of gears reverse	12.
Synchromesh type	Strut type.
Settings required:	
Main shaft end float	0,08-0,03 mm (0.003-0.012 in).
Type of adjustment	Variable thickness thrust washer.
Synchromesh ring to coupler clearance - installed	0,8 mm (0.030 in).
Synchromesh ring to coupler clearance - removed	0,5 mm (0.020 in).
Synchromesh neutral setting	See procedure 5A-05.
Input shaft bearing dimension (oil cooled clutch)	179,70 - 179,60 mm (7.080 - 7.076 in).

Special Tools:

MF.177A	Input shaft oil seal protector.
MF.218B	PTO Bearing housing replacer.
MF.255B	PTO input shaft oil seal replacer.
MF.315A	Needle roller bearing remover/replacer.
MF.367B	Transmission torque wrench.
MF.414	Synchromesh setting pin.
MF.421	Needle roller bearing and seal replacer.
MF.422A	Bearing, sleeve and oil seal remover.
MF.3008	Circlip plier set.

Bolt Torques:

Gear lever 12 point cap screws	60 Nm (45 lbf ft).
Gearbox top cover	115 Nm (85 lbf ft).
Shifter fork locking screws	43 Nm (32 lbf ft).
Rear gear shift selector bracket	58 Nm (43 lbf ft).
Input shaft housing to gearbox	40 Nm (30 lbf ft).
PTO drive bearing housing	58 Nm (43 lbf ft).
Gearbox to range gearbox	102 Nm (75 lbf ft).
Input housing to gearbox - countersunk screw	40 Nm (30 lbf ft).
Scavenge pump housing	40 Nm (30 lbf ft).

GENERAL DESCRIPTION

The 12 x 12 shuttle gearbox has twelve forward and twelve reverse gears; the forward reverse selection being controlled by a lever on the instrument panel adjacent to the steering wheel. All speed gears are controlled by a single gear lever to the right of the driver. Full engine braking is provided on over-run and the tractor can be towed to start the engine.

Drive Arrangements

From the constructional view point the gearbox has three sections. The front section consists of the forward and reverse gears with a synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and one reverse speed. The rear section consists of a three speed range gearbox offering an alternative low range, medium range and high range. Synchromesh engagement is provided on all gears.

The four basic forward and reverse speeds are tripled by the ability of the range gearbox to provide the additional ratios. This feature, gives the gearbox the total of twelve forward speeds and twelve reverse.

The gearbox layshaft is located below the mainshaft which is of hollow construction to accept the Power Take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted into the front end of the mainshaft.

The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

There are two types of reverse idler fitted, the single gear type or a double idler gear type depending on the ratio and size of the rear tyre.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

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12 x 12 Shuttle Gearbox

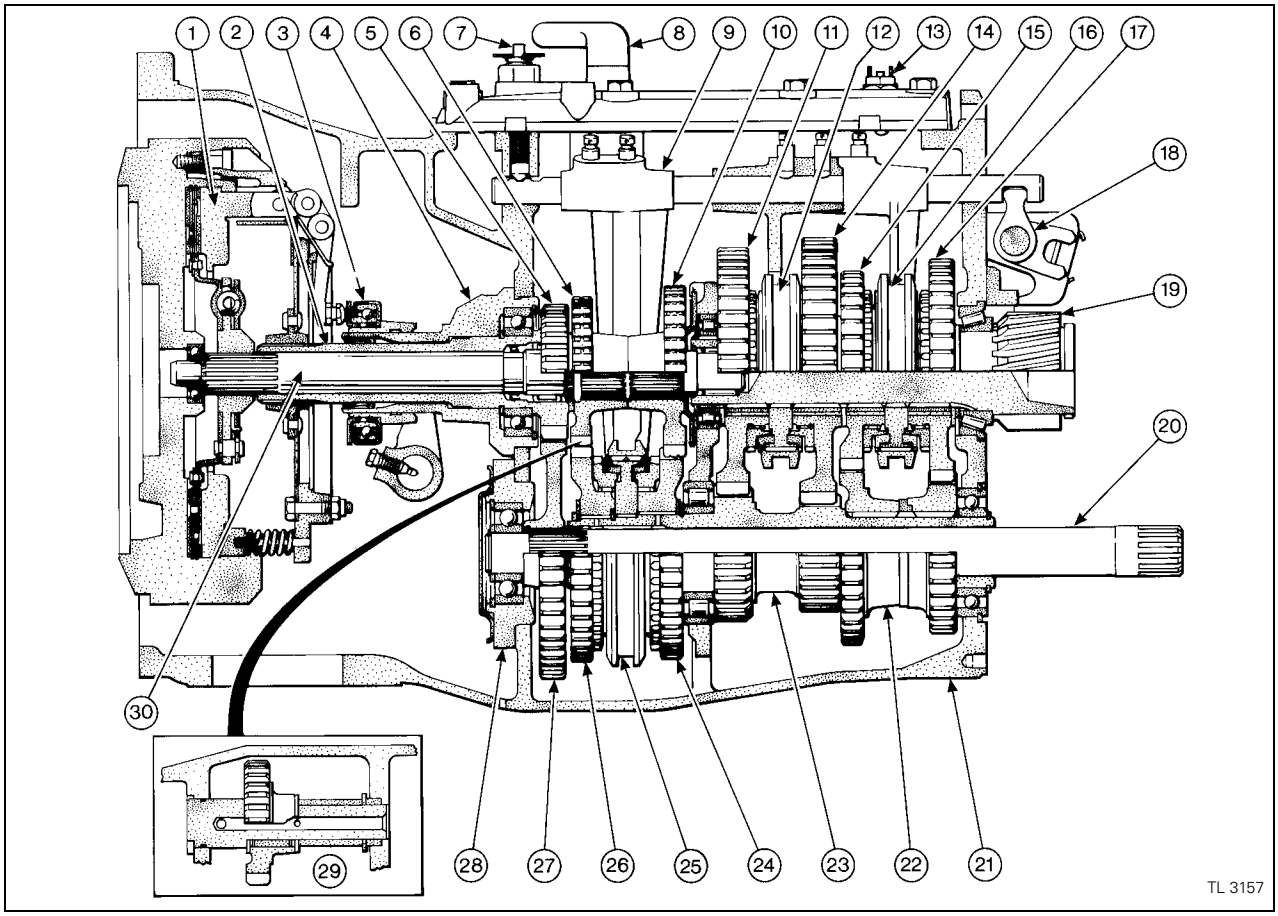


Fig.1 12 x 12 Shuttle Gearbox

Key to Fig.1

1. Main split-torque transmission clutch
2. PTO input shaft
3. Clutch release mechanism
4. Input housing
5. PTO drive gear
6. Reverse constant mesh gear
7. Safety start switch
8. Shift mechanism
9. Selector rails and forks
10. Forward constant mesh gears
11. 2nd gear
12. 1st/2nd synchromesh coupler
13. Switch - reverse bleeper
14. 1st gear
15. 4th gear
16. 3rd/4th synchromesh coupler
17. 3rd gear
18. Selector mechanism
19. Mainshaft
20. PTO drive shaft
21. Gearbox case
22. 3rd/4th gear
23. Layshaft
24. Forward constant mesh gear - layshaft
25. Forward/reverse synchromesh coupler
26. Reverse constant mesh gear - layshaft
27. PTO constant mesh gear - layshaft
28. PTO front bearing housing
29. Reverse idler gear
30. Transmission input shaft

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12 x 12 Shuttle Gearbox

The mainshaft carries four free-running gears, all of which are constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

All the gear sets are of the straight cut spur type, 1st and 2nd being wider than 3rd and 4th to cope with the higher torque that has to be transmitted.

Drive through the 1st, 2nd, 3rd and 4th ratio gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms part of the synchromesh engagement mechanism. Roller and taper roller bearings are used to support the mainshaft and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the forward or reverse gear set to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the range gearbox.

Synchromesh Mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Range Gearbox

The range gearbox is bolted directly to the rear of the main gearbox and forms an integral part of the main transmission assembly. Bolted to the right-hand side of the casing is the main gear shift lever, this single lever operates both sections of the gearbox excluding the forward/reverse mechanism which is operated from the lever adjacent to the steering wheel.

Gear Selection

The forward/reverse lever (1 Fig.2) is simple in operation, depress the clutch and move the lever forward to go forward, back for reverse from the central neutral position.

This operates the forward/reverse selector fork and coupler in the front of the gearbox. The lever can only be moved when the clutch is fully depressed and must be in the central neutral position to start the engine. A safety start switch prevents starting the engine if the lever is engaged.

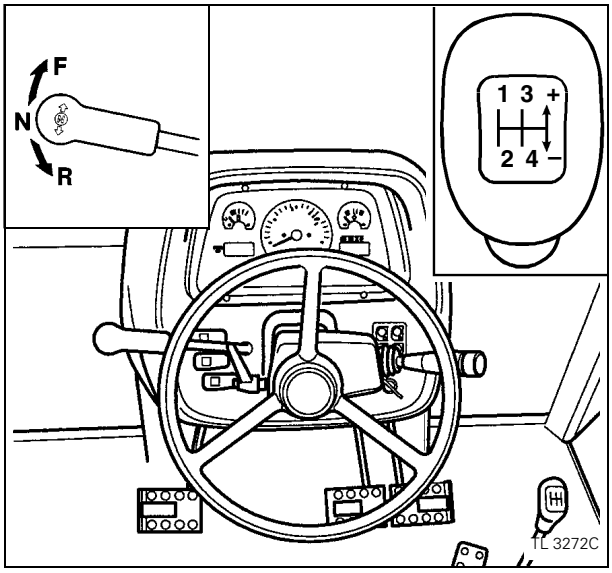


Fig.2 Gear shift positions

The 12 speeds are selected by a single lever (2 Fig.2), this lever operates the two sections of the gearbox. The first section contains four gears, 1st, 2nd, 3rd and 4th working in a gate as in any conventional gearbox, the lever is spring loaded when in neutral to be opposite 3rd and 4th gears. On the end of the gear lever cross shaft is a vertical lever which engages either of the two selector rails moving the selector fork and coupler.

The three speed range section is arranged in sequence from low (L) to medium (M) and high (H), and back through the range. The range selected is indicated by the appropriate indicator light on the instrument panel.

The range shift works on a ratchet system, moving the lever forward will select the next higher range and the lever will then return to the central position for selection of main gears, leaving the range selected.

Moving the lever back will select the next lower range and the lever will again return to the centre. If a double shift is required the lever must be moved in the appropriate direction twice.

The range gear is selected by moving the main gear lever fully to the right of the gate and moving it either forwards or backwards to its limit, depending whether a change up or down is being made. One movement of the lever changes one range.

After selection of the range gear the main gear lever is then used to select the required main gear.

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GEARBOX

Removal and Refitment 1-5A

Special Tools:
MF.367B Transmission Torque Wrench

Removal

IMPORTANT: *The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and range gearbox.*

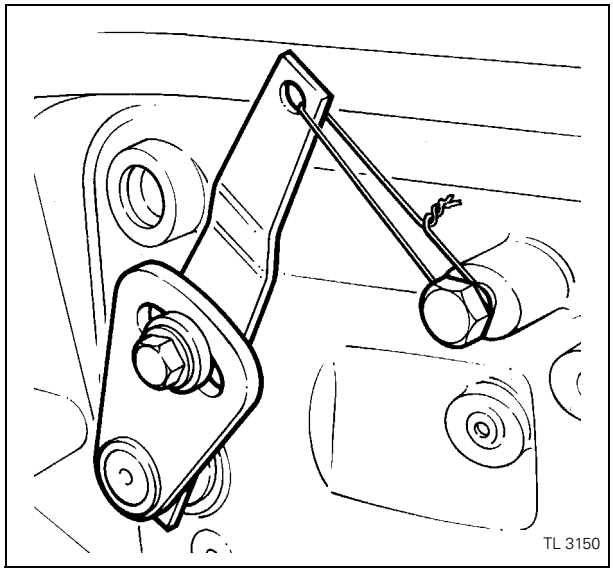
1. Split the tractor between the range gearbox and the rear axle *(see operation 3-2A)* in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the range gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Tie the clutch operating lever back with a piece of wire to retain the clutch release bearing.
6. Support the weight of the main gearbox on the hoist or crane. Position the crane so that the input shafts can be withdrawn out of the clutch.
7. Remove all the bolts around the clutch housing and remove the gearbox taking care not to damage any of the clutch components.
8. Place the gearbox on a suitable bench so that the repair work can be carried out.

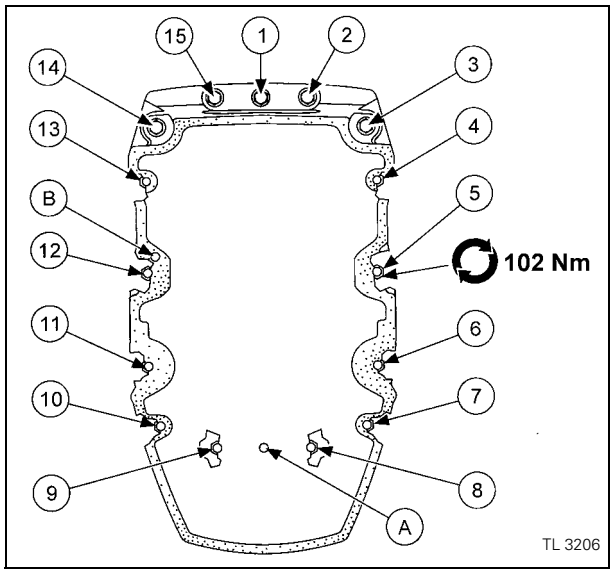
Refitment

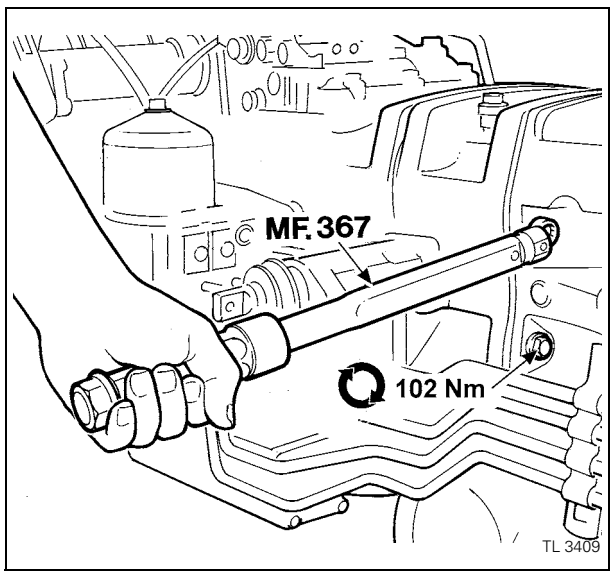
9. After repair, stand the gearbox vertically on the clutch housing face. Ensure that all gears are in neutral.
10. Ensure that the two dowels on the bottom and side of the range gearbox are in place.
11. Place a new gasket on the mounting face of the main gearbox.
12. Lower the range gearbox into position on the main gearbox. Check that range selector fork engages correctly with the rollers in the back of the cam plate. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure.*

13. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.



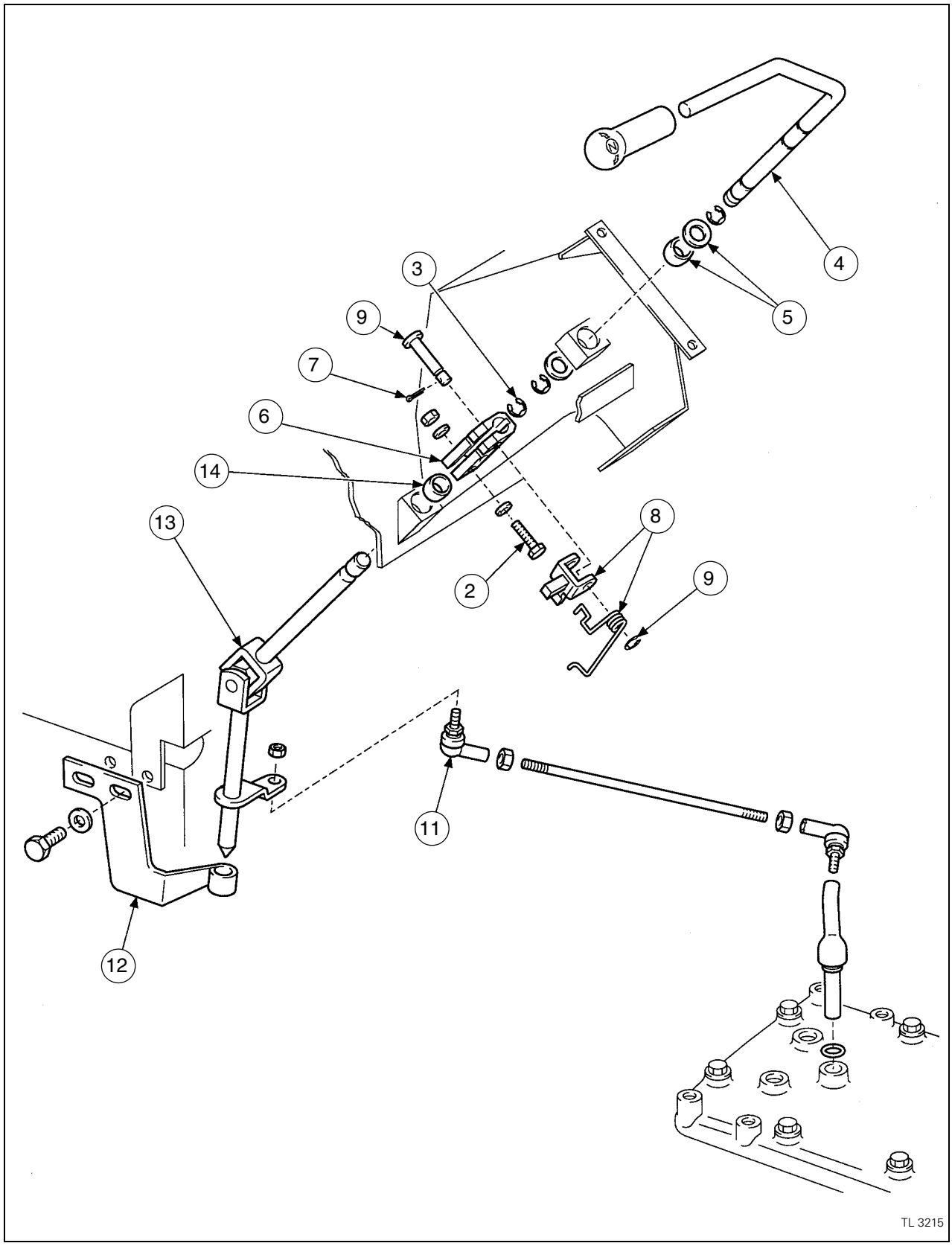




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12 x 12 Shuttle Gearbox



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14. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm socket.
15. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
16. Set the main shaft bearing pre-load, *(see operation 3-5D).*
17. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
18. Re-install the engine/gearbox assembly into the tractor.

FORWARD/REVERSE CONTROL LEVER

Overhaul 2-5A

Dis-assembly

NOTE: *The lower part of the shaft with the universal joint can only be removed when the tractor is split between the engine and clutch.*

1. Remove the lower panel under the instrument panel to gain access to the control mechanism.
2. Slacken the coupling bolts.
3. Remove the three 'C' clips on the upper part of the hand lever.
4. Withdraw the hand lever up out of the instrument panel.
5. Remove the washers and spherical bearing.
6. Remove the coupling complete with the clutch interlock.
7. Remove the split pin.
8. Remove the spring and interlock lever.
9. Remove the 'C' clip and pivot pin.
10. If removal of the lower part of the shaft is required, split the tractor between the engine and clutch, sufficiently to enable the shaft to be removed from the lower bearing and to clear the back of the cylinder block.
11. Disconnect the control rod ball joint.
12. Remove the lower bracket.
13. Remove the lower shaft and universal joint.
14. Remove the lower spherical bearing.

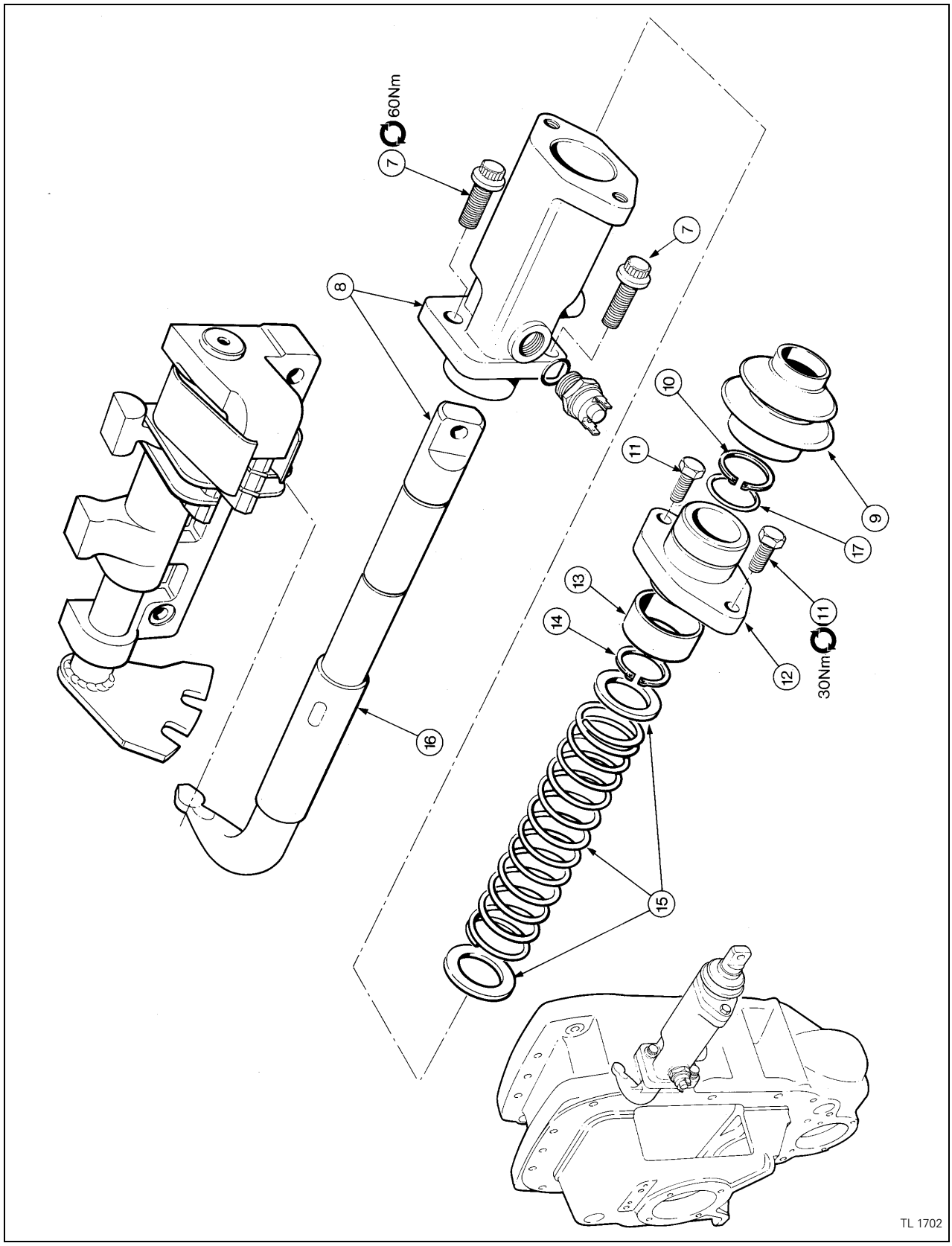
Re-assembly

15. Reverse procedures 1 to 14 except:
    a. Adjust the length of the control rod so that the interlock engages with the clutch pedal when the pedal is in its normal position.
    b. Lightly lubricate the spherical bearings.
    c. Set the hand lever to a nine o`clock position before tightening the coupling bolts.

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MAIN GEAR SHIFT LEVER

Removal and Refitment 3-5A

Removal

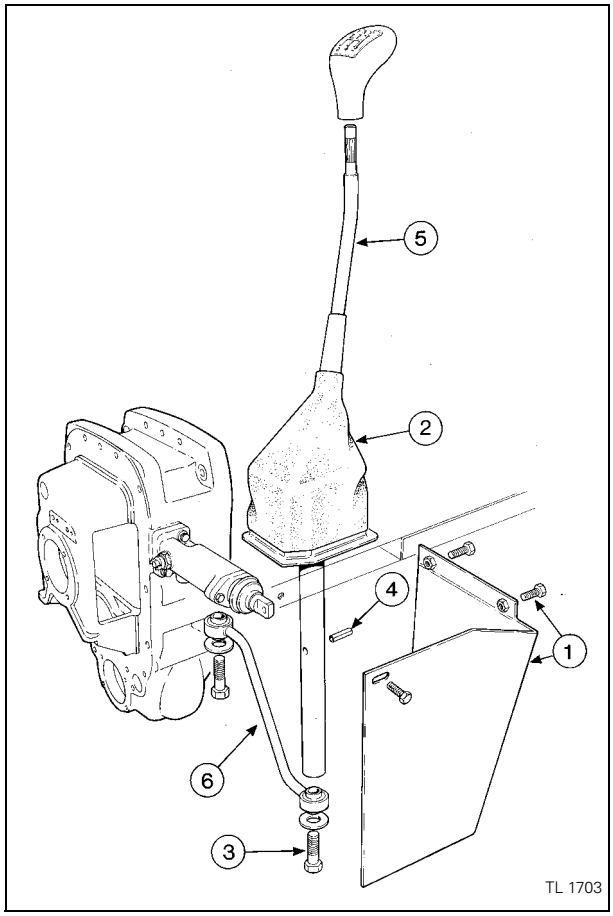
1. Remove the three bolts and the gear lever cover (tractors with single fuel tank only).
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the three 12 point cap screws holding the lever assembly to the range gearbox.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.

WARNING: Spring under compression.

14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.
17. Remove the 'O' ring.

Refitment

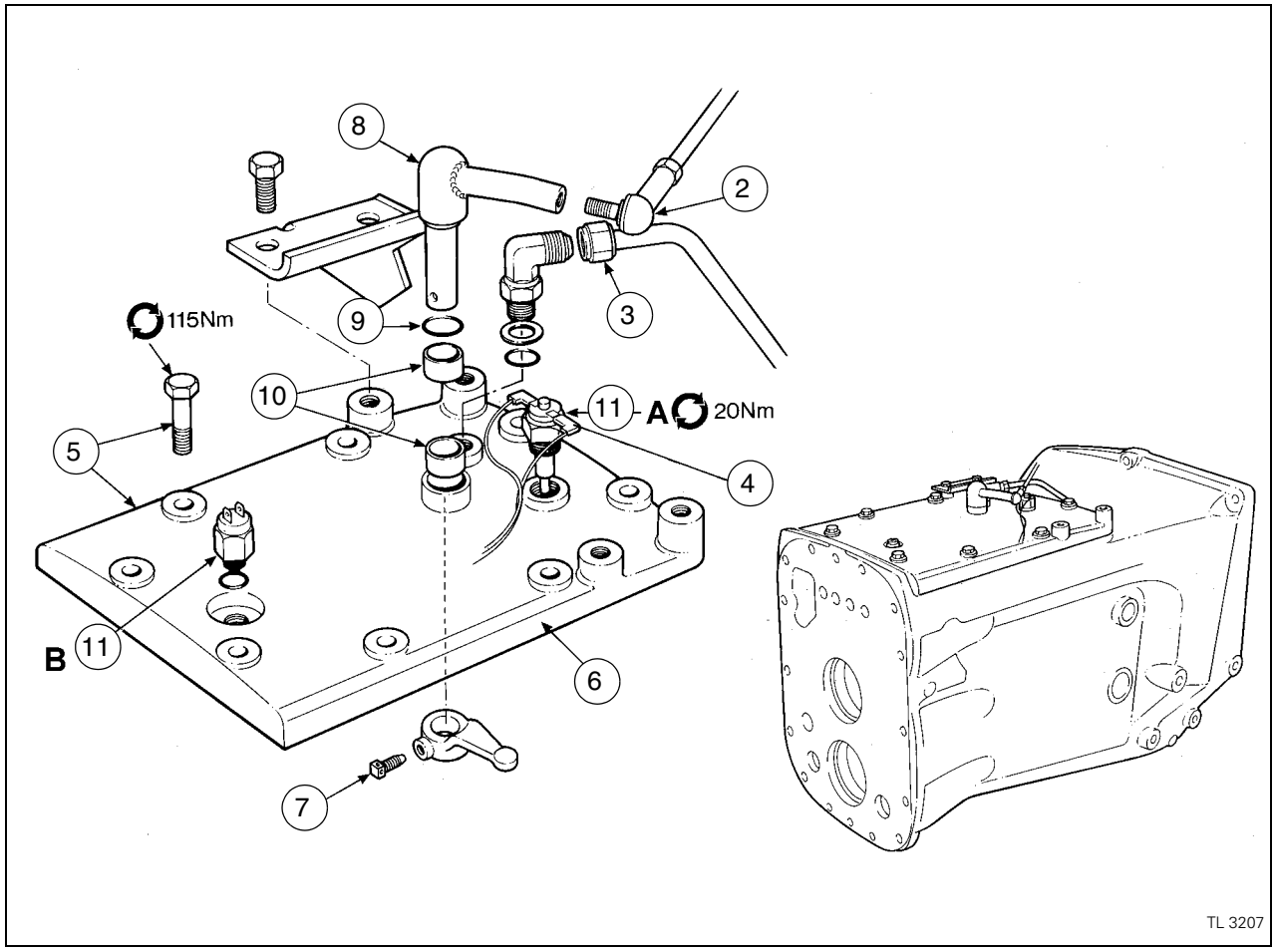
18. Reverse procedure 1 to 14, except:
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (25 lbf ft).
    f. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 60 Nm (45 lbf ft).



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12 x 12 Shuttle Gearbox



GEARBOX TOP COVER

Removal and Refitment **4-5A**

Removal

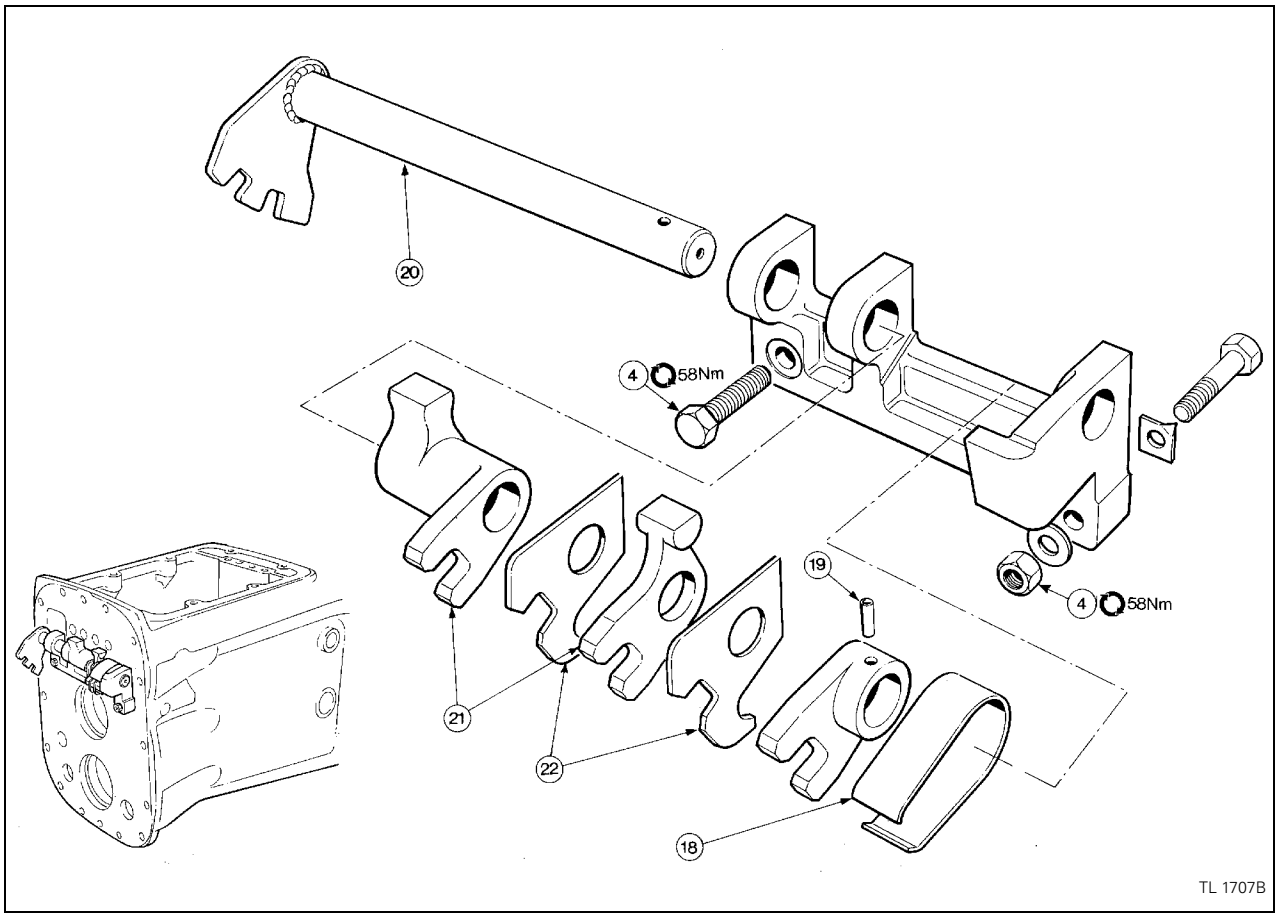
1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the wires to the switches ‘A’ and ‘B’.
5. Remove the bolts and clutch cable bracket.
6. Remove the top cover.
7. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
8. Withdraw the shaft from the cover.
9. Remove and discard the 'O' ring seal.
10. If necessary, remove and replace the bushes in the top cover.
11. Remove the safety start switch ‘A’, reverse bleeper switch ‘B’ to prevent damage to the switches.
12. Clean all components and remove dried gasket material from the machined faces.

Refitment

13. Reverse procedures except:
    a. Replace the shaft 'O' ring.
    b. Apply Massey Ferguson Studlock (Loctite 270) to the lever locking bolt (7).
    c. Lubricate the safety start switch with a small quantity of transmission oil or petroleum jelly before installation.
    d. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

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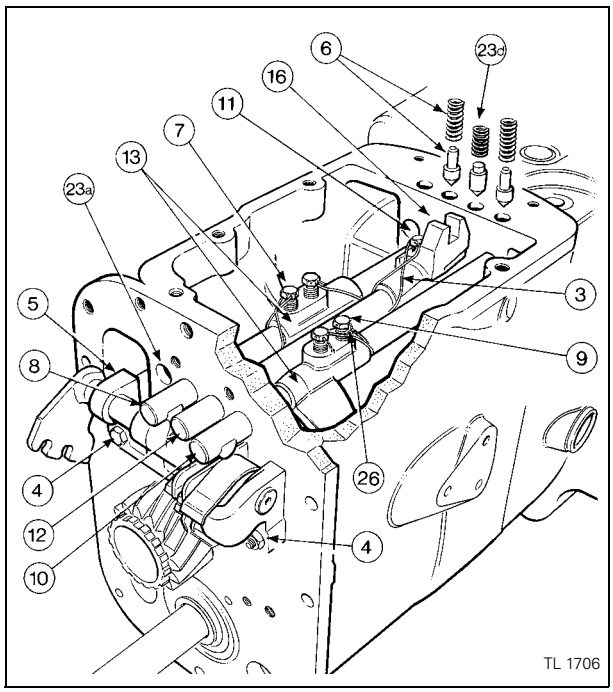
SELECTOR RAILS AND FORKS

Removal and Refitment **5-5A**

Special Tools:
MF.414 Synchromesh Setting Pin

Removal

1. Remove the gearbox assembly from the tractor, *(see operation 1-5A)*.
2. Remove the gearbox top cover, *(see operation 4-5A)*.
3. Release the locking wires.
4. Remove the bolt and nut from the rear selector mechanism.
5. Remove the selector mechanism assembly.
6. Lift out the detent springs and plungers.
7. Loosen the two locking screws.
8. Slide the 1st/2nd rail rearwards out of the housing.
9. Loosen the two locking screws.
10. Slide out the 3rd/4th rail rearwards out of the housing.
11. Loosen the two locking screws.



12. Slide the forward/reverse rail rearwards out of the housing.

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13. Remove 1st/2nd and 3rd/4th selector forks.

NOTE: *The forward/reverse selector fork can only be removed after removal of the input shaft and housing, and the reverse idler gear assembly.*

To remove the forward/reverse selector fork:

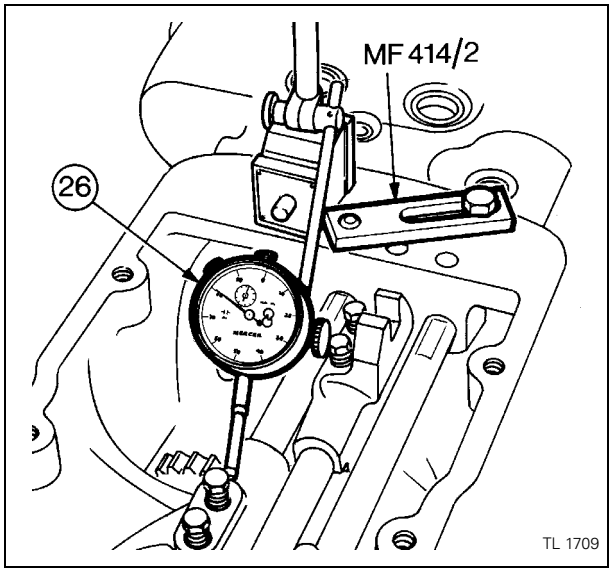
14. Remove the main input shaft, *(see operation 6-5A).*
15. Remove the reverse idler assembly, *(see operation 8-5A).*
16. Remove the forward/reverse synchromesh selector fork.
17. If necessary, dismantle the selector mechanism proceed as follows:
18. Remove the selector return spring.
19. Drive out the roll pin.
20. Withdraw the range selector shaft.
21. Remove the selector levers.
22. Remove the spacer plates.

Refitment

23. Reverse procedures 1 to 22 except:
    a. The first selector shaft hole, working from left to right, in the gearbox casing is not used.
    b. Tighten the selector mechanism bolt and nut to a torque of 58 Nm (43 lbf ft).
    c. Apply a few drops of oil to the selector rails before refitment.
    d. When refitting the detent springs and plungers, the light spring and special plunger is fitted to the central forward/reverse rail.

NOTE: *The selector fork adjustment can not be carried out until the range gearbox is bolted to the rear of the gearbox.*

24. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rails in place during the setting procedure using the plate and bolt MF.414/2 (part of tool MF.414 Synchromesh Setting Pin).
25. Set up magnetic base and dial indicator, as illustrated, with plunger located against the selector fork. With fingers pressure only slide the selector fork to the rear taking up any clearance. DO NOT engage gear. Zero the indicator gauge; slide the selector fork fully forward, taking up any clearance again and note the reading on the dial indicator.
    Halve the reading obtained and progressively lock up the two security screws on the selector fork to a torque of 43 Nm (32 lbf ft) ensuring that the selector fork is positioned to give the halve reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).
26. Wire lock all the security screws.
27. Re-assemble the gearbox.



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PTO DRIVE SHAFT FRONT BEARING

Removal and Refitment **6-5A**

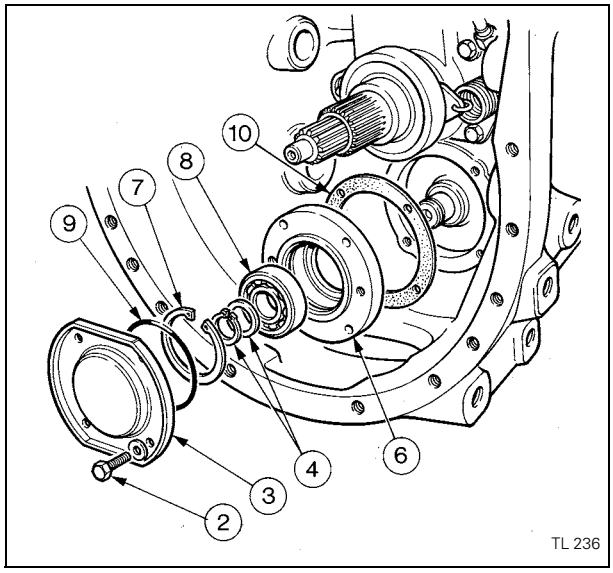
Special Tools:
MF.218B PTO Bearing Housing Replacer

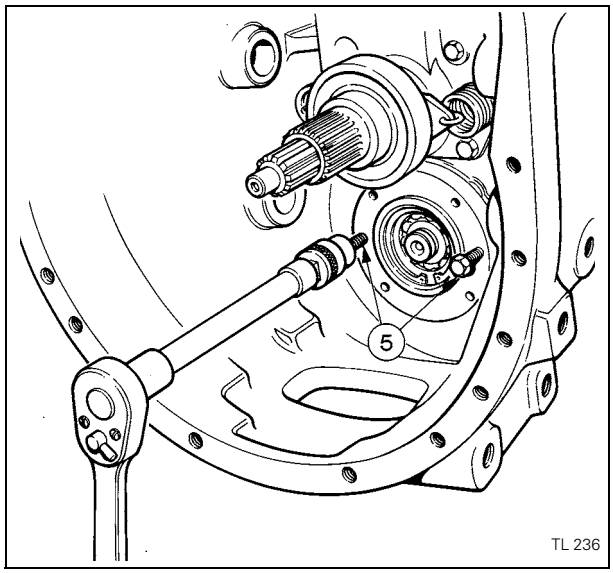
Removal

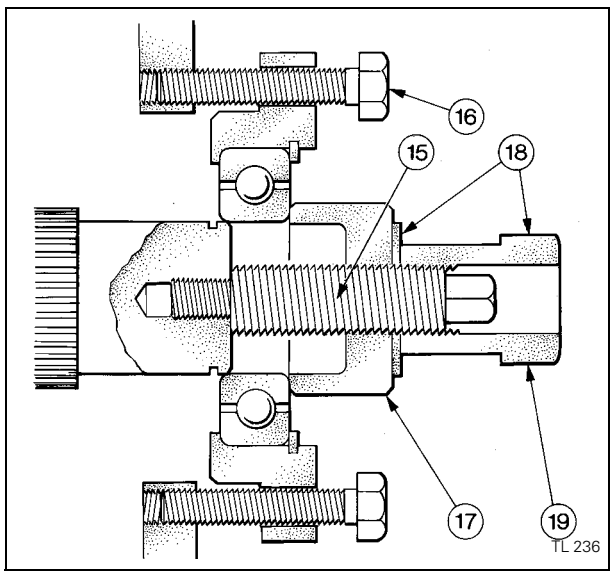
1. Remove the clutch cross-shaft and lever, *(see operation 4-4A)*.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x (75 mm) 3 inch bolts (part of special tool MF.218B) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove and discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 inch UNF bolt approximately 75-100 mm (3-4 inch long) into the shaft to protect it, and drive the shaft out of the PTO constant mesh gear.

Refitment

12. Lightly coat the new gasket with Hylomar sealant.
13. Using MF.218B, PTO Bearing Housing Replacer, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 inch across flats spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF.218B through the un-threaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and put on the nut.
19. Tighten the nut with a 1 1/8 inch across flats spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
20. Fit a new circlip and washer.
21. Replace the cover ensuring that a new 'O' ring is fitted.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 58 Nm (43 lbf ft).



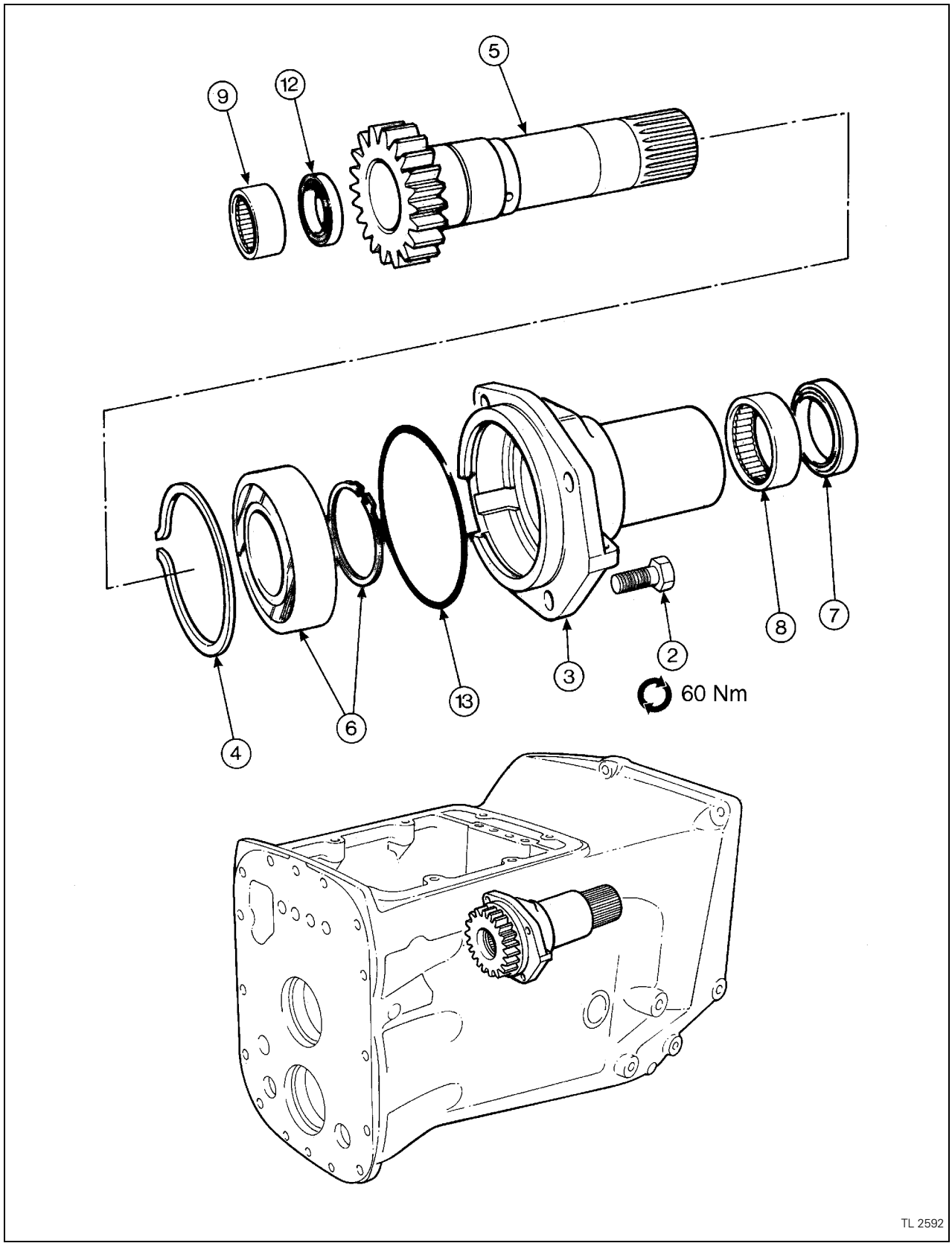




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12 x 12 Shuttle Gearbox



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INPUT SHAFTS AND HOUSING

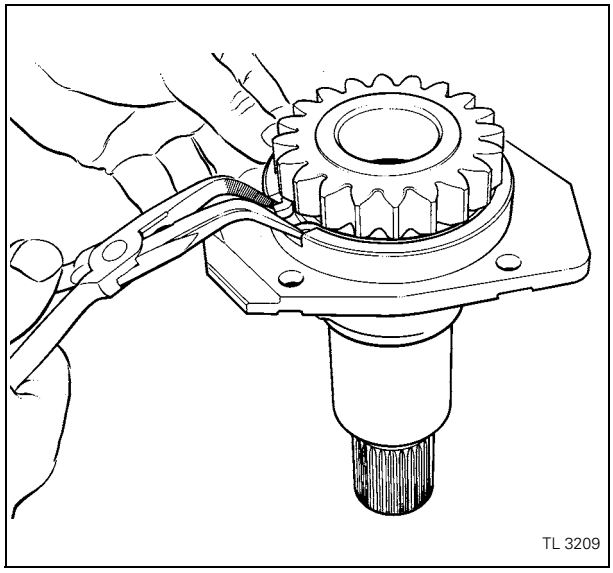
Removal and Refitment **7-5A**

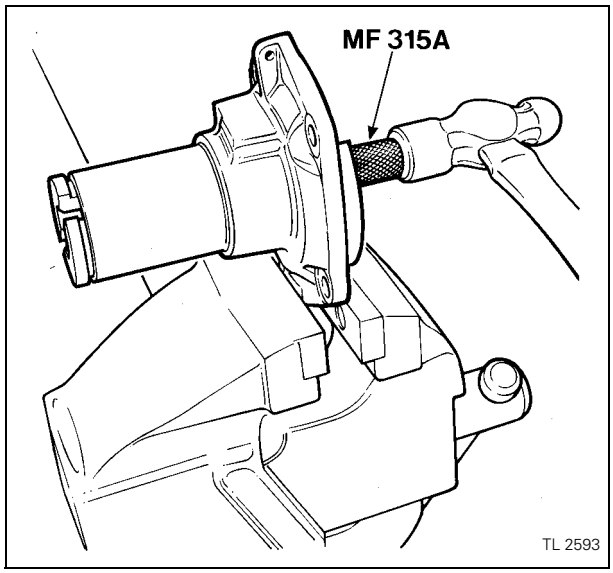
Special Tools:

MF.177A Input Shaft Oil Seal Protector
MF.255B PTO Input Shaft Oil Seal Replacer
MF.315A Needle Roller Bearing Remover/Replacer
MF.421 Needle Roller Bearing And Seal Replacer
MF.422A Bearing, Sleeve And Oil Seal Remover

Removal

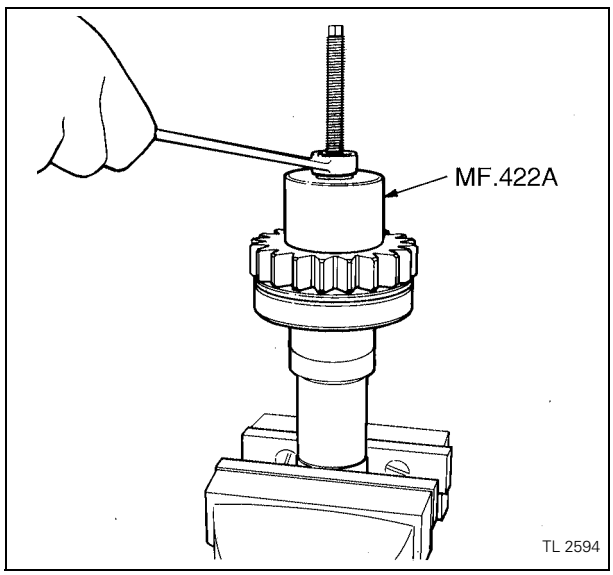
1. Remove the clutch mechanism, *(see operation 3-4A)*.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Open up the large circlip in its groove so that it is clear of the bearing.
5. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
6. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
7. Lever the seal out of the front of the housing.
8. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, drive the needle roller bearing out of the housing.


TL 3209



TL 2593

9. Using special tool MF.422A, Bearing Sleeve and Oil Seal Remover, remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
10. Fit the cap, lubricate the screw thread, fit the washer and nut.
11. Tighten the nut withdrawing the bearing from the shaft.
12. Repeat the operation using tool MF.422A to extract the oil seal. The step on the collets must be located fully behind the seal.
13. Remove and discard the 'O' ring.



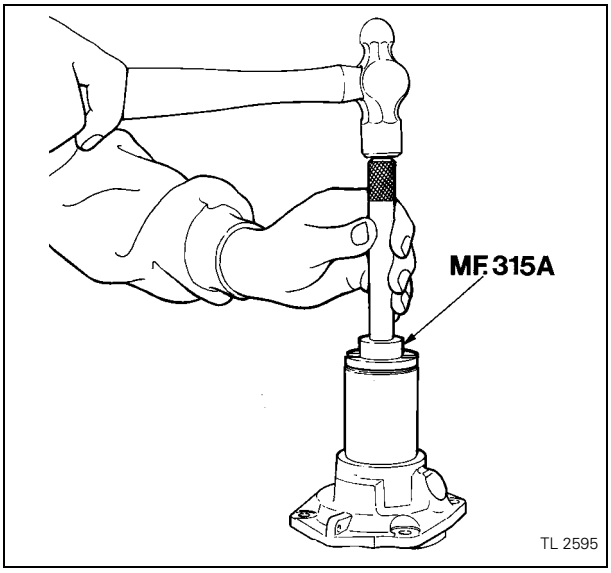
TL 2594

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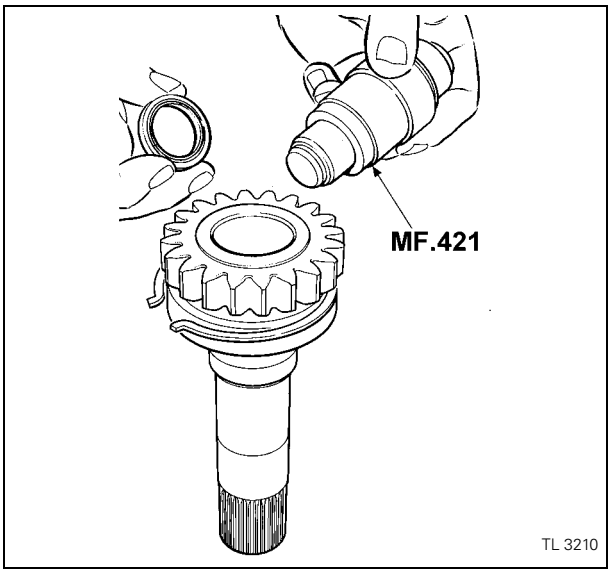
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Re-assembly

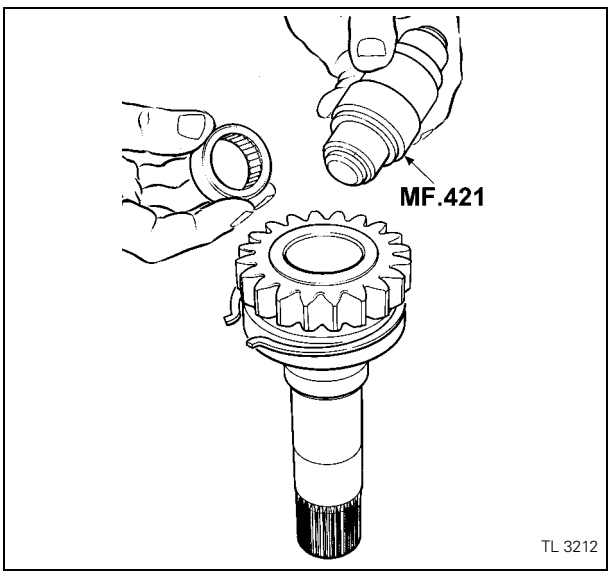
14. If the ball bearing has been removed from the PTO shaft, refit the bearing using a new circlip.
15. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.



16. Pack the cavity of the small input shaft seal with petroleum jelly.
17. Using special tool MF.421, Needle Roller Bearing and Seal Replacer, place the seal on the tool as shown in the illustration and press it into the PTO shaft until the flange on the tool touches the face of the gear.



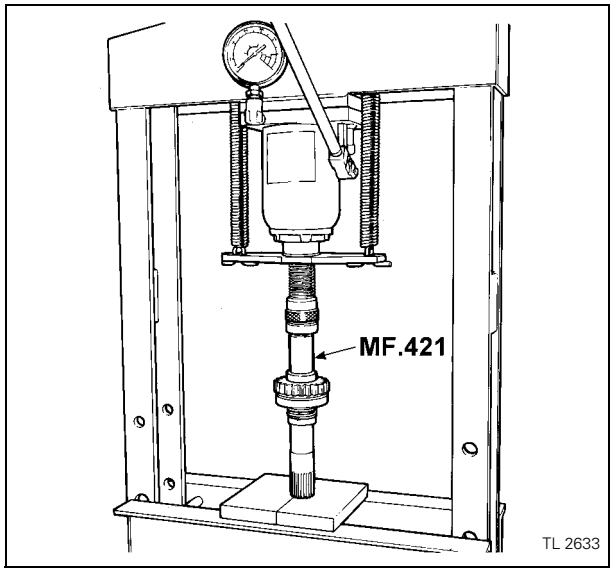
18. Place the needle roller bearing on the other end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.



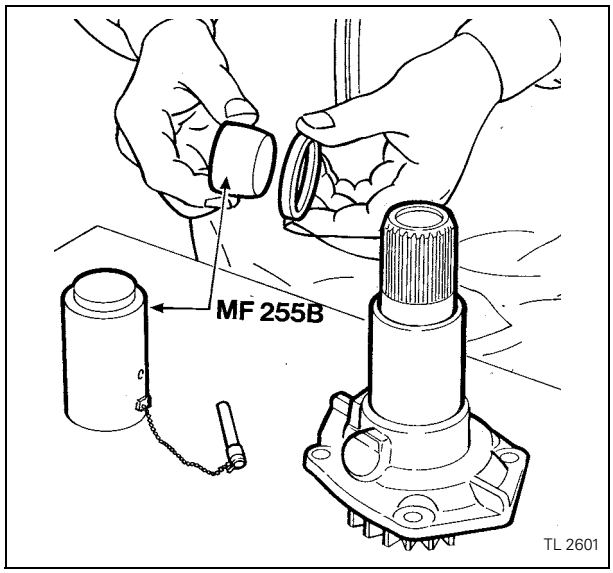
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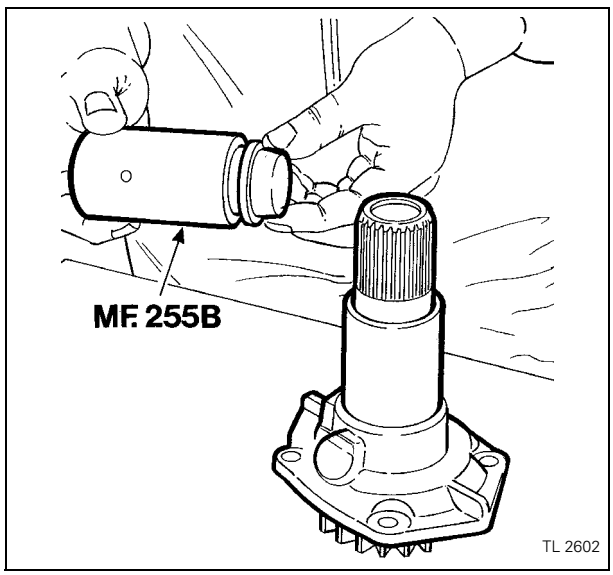
19. Press the bearing into position up to the flange on the tool.
20. Place the large circlip into the groove in the housing.
21. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.



22. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
23. Install the seal using special tool MF.255B, PTO Input Shaft Oil Seal Replacer, to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



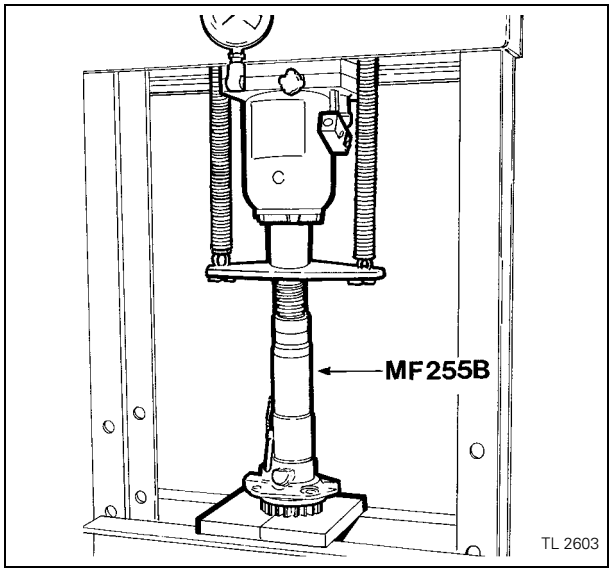
24. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



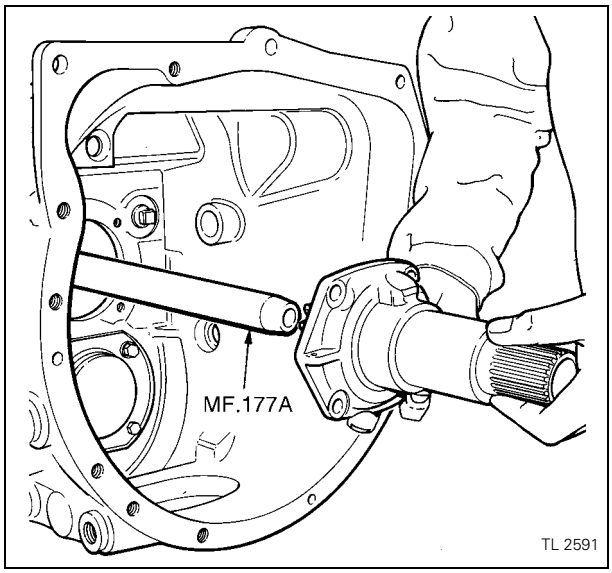
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25. Place the input housing under a light press, place the tool with seal over the PTO input shaft and press the seal into place.
26. Replace the large 'O' ring on the housing.



27. Place special tool MF.177A, Input Shaft Oil Seal Protector, over the main transmission input shaft on the gearbox. This is to protect the seal from the splines on the shaft and prevent seal leakage.
28. Lightly oil the sleeve.
29. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
30. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
31. Refit the clutch release mechanism, *(see operation 3-4A)*.



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LAYSHAFT, MAINSHAFT, PTO SHAFT AND GEARS

Overhaul **8-5A**

Special Tools:
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the gearbox and range gearbox assembly from the tractor, *(see operation 1-5A)*.
2. Split the transmission between the gearbox and range gearbox, *(see operation 1-5A)*.
3. Remove the clutch release mechanism, *(see operation 3-4A)*.
4. Remove the selector rails and forks, *(see operation 5-5A)*.

NOTE: *The layshaft selector fork (forward/reverse) cannot be removed at this stage.*

Input Shafts and Housing

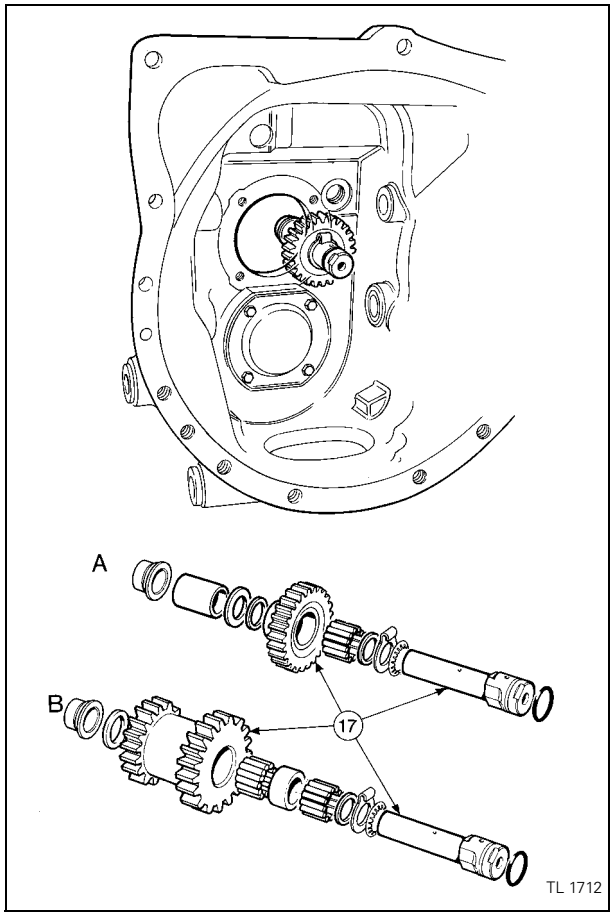
5. Remove the input shaft and housing assembly, *(see operation 7-5A)*.

NOTE: *There are two types of input shaft and reverse idler assembly that can be fitted to this gearbox, either with a double input shaft gear and a single reverse gear type 'A', Or a single input shaft gear and double reverse gear arrangement type 'B'. The type fitted depends on the ratio and rear tyre size.*

6. Withdraw the main input shaft and housing assembly leaving the forward gear in the gearbox.
7. Lift out the forward constant mesh gear.
8. Remove the main thrust washer, if necessary.
9. Remove the snap ring, thrust washer and reverse gear or spacer from the main input shaft, if necessary.
10. Remove the needle roller bearing from inside the mainshaft.

Mainshaft

11. Using one of the circlip pliers from the MF.3008 Circlip Pliers Set, remove the circlip from the front of the mainshaft.
12. Pull the mainshaft out of the gearbox to the rear with the rear thrust washer and spacer.
13. Lift out the 1st/2nd gear set and the measured thrust washer.
14. Lift out the rear 3rd/4th gear set assembly.
15. Remove the front roller bearing from the gearbox case.
16. Press the rear taper roller bearing off the mainshaft, if necessary.



Reverse Idler

17. Remove the reverse idler shaft by tapping the shaft forward from inside the gearbox and lifting out the gear, thrust washers and spacers. Be careful, the idler gear contains loose needle roller bearings. Retain the components in a clean container.

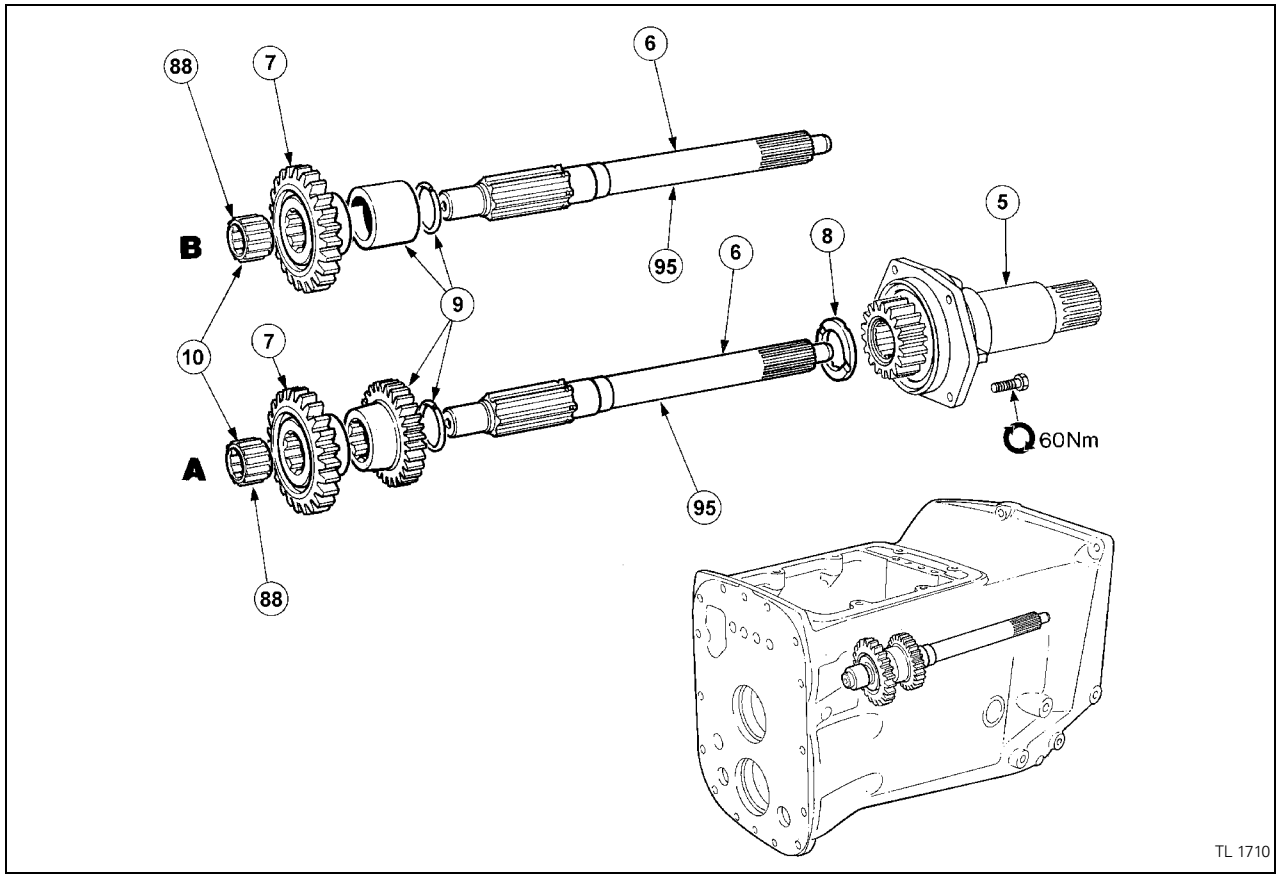
Layshaft

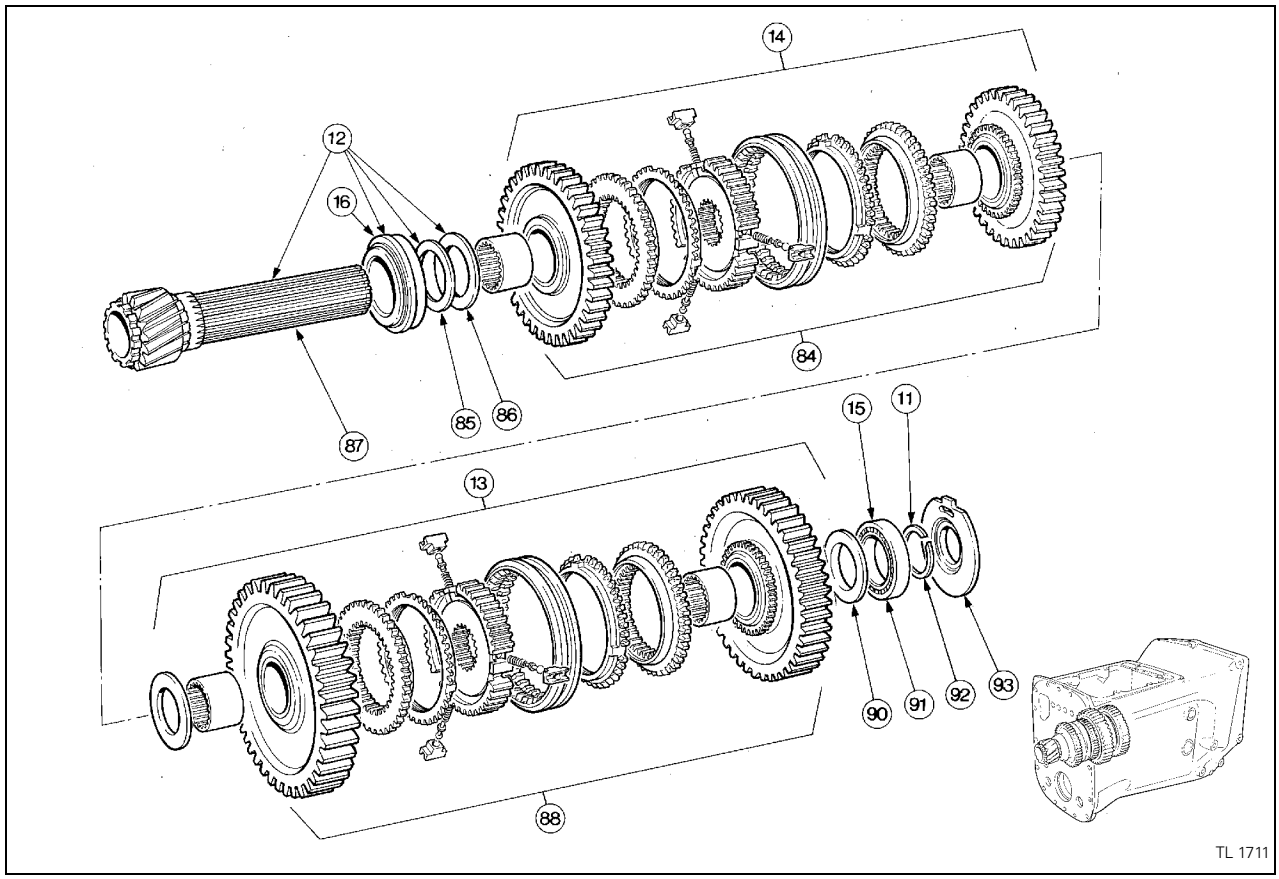
18. Remove the PTO drive shaft front bearing cover.
19. Remove the PTO shaft circlip and thrust washer.
20. Remove the PTO drive shaft front bearing, *(see operation 6-5A)*.
21. Screw a 7/16 inch UNF bolt approximately 75-100 mm (3-4 in) long into the end of the PTO shaft to protect it and drive it out of the PTO constant mesh gear and layshaft.
22. Lift out the PTO constant mesh gear.
23. Remove the snap ring from the rear of the layshaft.
24. Remove the spring ring from the rear layshaft bearing.

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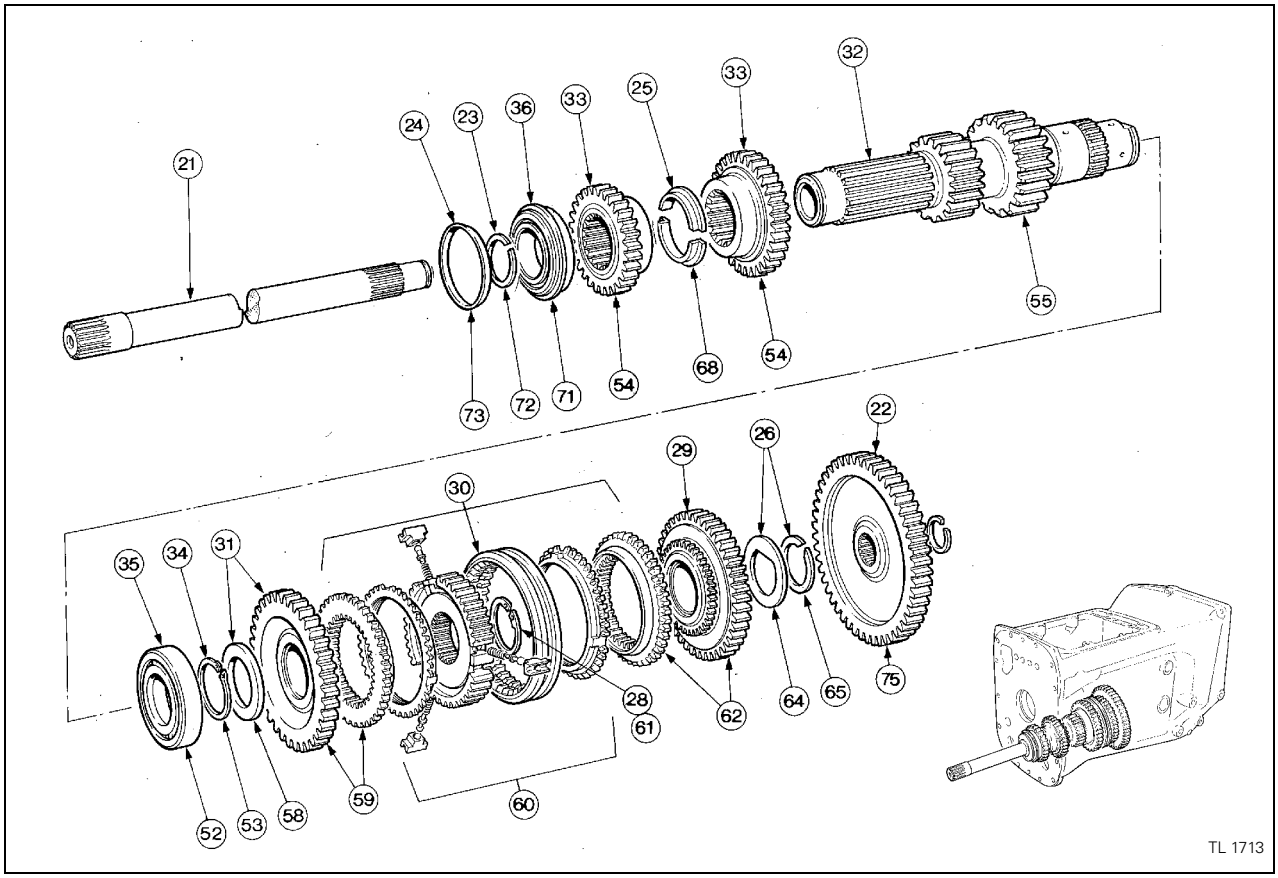
12 x 12 Shuttle Gearbox



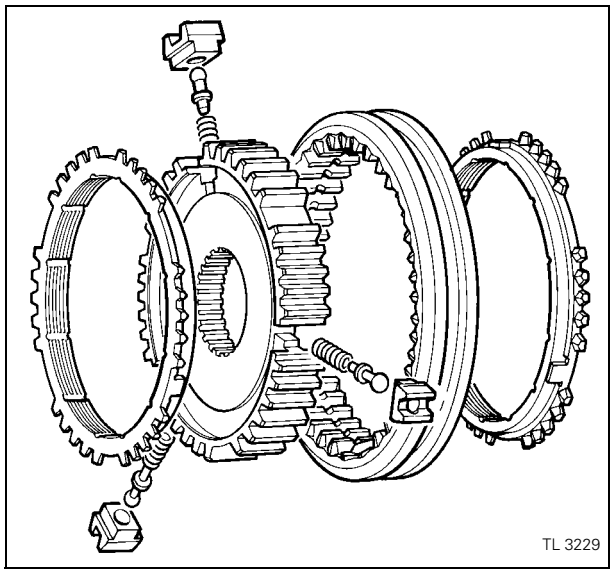


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25. Drive the layshaft forwards and remove the two split rings between 3rd and 4th gear.
26. Remove the snap ring and thrust washer from the front of the layshaft.
27. Push the layshaft rearwards as far as possible.
28. Slide the reverse constant mesh gear fully forward. Remove the circlip with a pair of right-angled circlip pliers from the front of the synchromesh hub. Slide the circlip as forward along the layshaft as possible.
29. Push the layshaft rearwards as far as it will go and lift the reverse gear out through the top of the gearbox leaving the brass baulk ring on the synchromesh hub.
30. Remove the circlip and the synchromesh hub assembly with two brass baulk rings.
31. Remove the forward gear and thrust washer.
32. Remove the layshaft by pushing it out through the front of the gearbox.
33. Lift out the 3rd and 4th gear.
34. Remove the circlip.
35. Press the front layshaft bearing off the shaft, if necessary.
36. Remove the rear bearing from the casing.



Synchromesh Hub Assemblies

37. Remove the two baulk rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, take care not to lose pressure springs, ball pins and blocks.
41. Remove the three pressure blocks.

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42. Remove the three ball pins.
43. Remove the three pressure springs.
44. Thoroughly clean all the components and check their condition.
45. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in) replace the brass baulk ring. If the clearance is checked with the gearbox assembled, replace the baulk ring if the clearance is found to be less than 0,8 mm (0.30 in).

Examination

46. Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, circlips and 'O' rings. When refitting ensure that they are correctly located in their grooves.

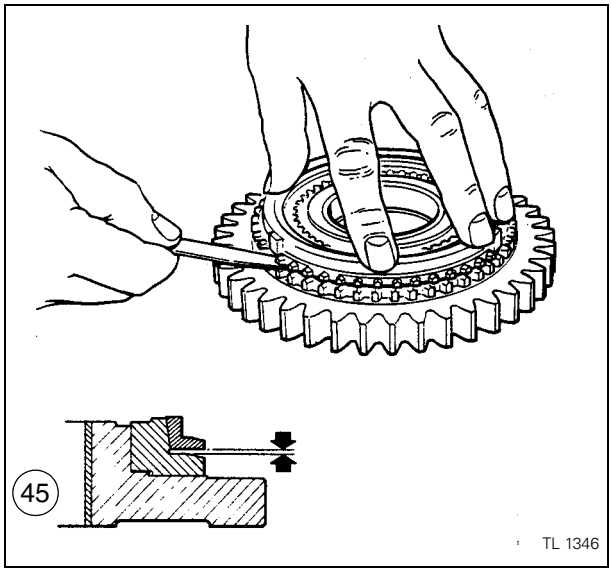
Re-assembly

Synchromesh Hub Assemblies

47. Reverse procedures 37 to 43.
48. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
49. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
50. Press the coupler down into place easing the spring-loaded blocks into position.
51. Position the baulk rings so that the locating blocks fit into the slots in the hub. Use petroleum jelly to retain the components in position.

Layshaft

52. Press the front roller bearing onto the shaft, if removed.
53. Fit the front roller bearing circlip.
54. Place the 3rd (28T) and 4th (33T) gears in the bottom of the gearbox, the smaller gear is fitted to the rear.
55. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
56. Fit the 4th and 3rd layshaft gears.
57. Push the layshaft rearwards so that the roller bearing is in the centre web and the shaft is fully rearwards.
58. Refit the thrust washer at the front of the shaft.
59. Refit the forward gear and synchromesh cone.
60. Refit the synchromesh hub complete with brass baulk rings.
61. Place the circlip on the non splined portion of the shaft close up to the synchromesh hub.



NOTE: *Circlips must be fitted the correct way round to aid in removal. The two holes in the clip are tapered, the small side must be on the outside.*

62. Refit the reverse gear and synchromesh cone.
63. Push the layshaft forward holding the reverse gear set so that it pushes the circlip between the reverse gear and hub into its groove.

IMPORTANT: *Check that the circlip between the reverse gear and the synchromesh hub is correctly seated in its groove.*

64. Refit the thrust washer locating the internal flat on the flat on the shaft.
65. Refit the thick snap ring.

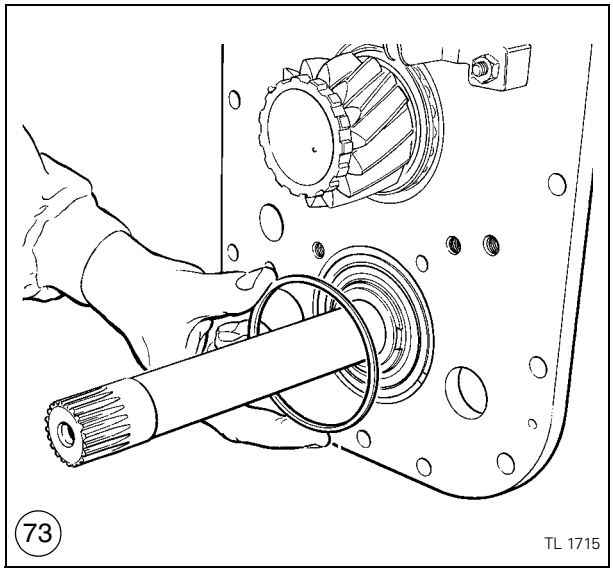
NOTE: *Snap rings must be fitted the correct way round to aid removal. The cut ends are tapered, the narrow gap must face outwards.*

66. Check that both forward and reverse gears are free to rotate.
67. Move the shaft forward.
68. Refit the two split rings between 3rd and 4th gears using some petroleum jelly to hold them in place.
69. Move the shaft rearwards.
70. Place a block of wood between the front of the layshaft and the gearbox casing.
71. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
72. Remove the block and replace the rear thin snap ring.

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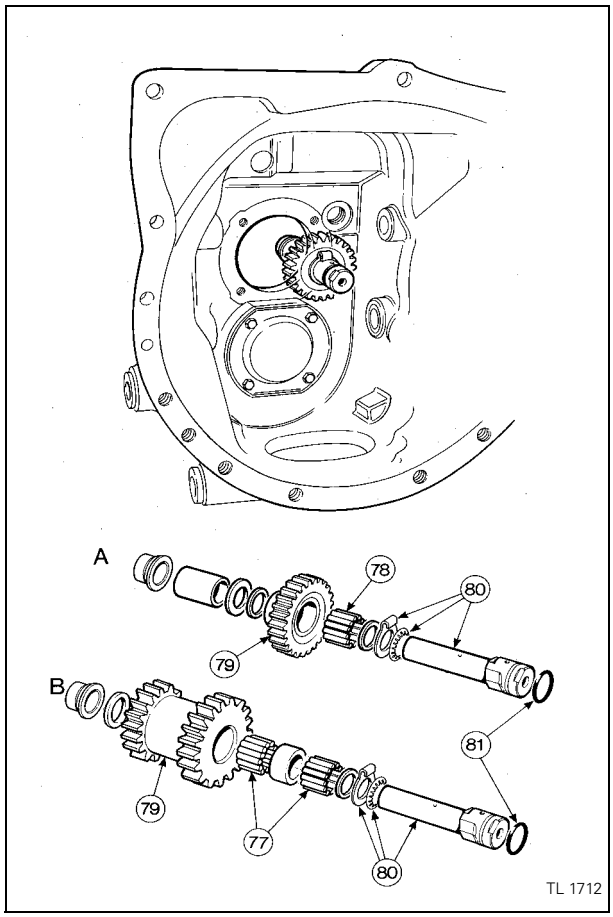
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73. Fit the rear bearing retainer spring ring.
74. Ensure that the shaft is fully forward and check that the layshaft turns freely.
75. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.
76. Refit the PTO front bearing housing, *(see operation 6-5A)*.
77. Locate the forward/reverse selector fork into the coupler of the layshaft synchromesh assembly.



Reverse Idler

78. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly (not grease) will help to retain them. There is a double row of 23 rollers with a spacer ring each side depending on the type of reverse idler fitted.
79. Refit the reverse idler into the gearbox with a thrust washer each side of the gear and a spacer in the case of the single gear arrangement.
80. Assemble the tabbed friction plate and slotted disc spring in front of the gear, ensure that the tab on the friction plate engages with the small flat on the shaft.
81. Renew the 'O' ring on the idler shaft and enter from the bell housing end, align the cut away portion on the front of the idler shaft to allow fitment of the input housing. The oil hole will be at the top visible inside the case.



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12 x 12 Shuttle Gearbox

Mainshaft

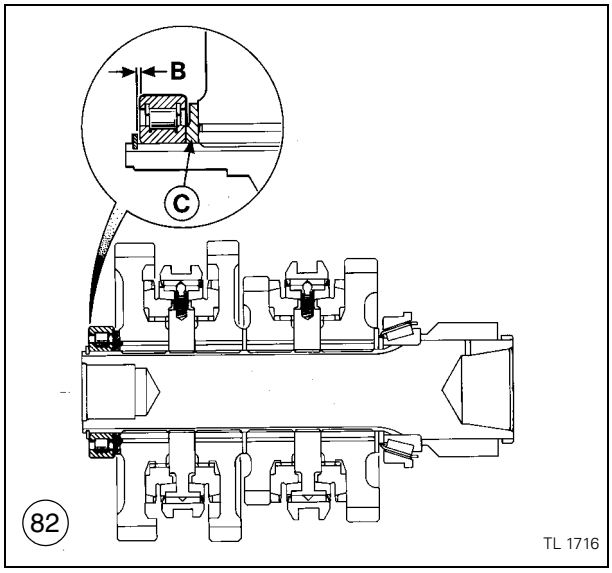
82. Assemble the mainshaft complete with all hubs, gears, bushes, bearings and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and 1st gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated thrust washer part numbers and sizes are as follows:

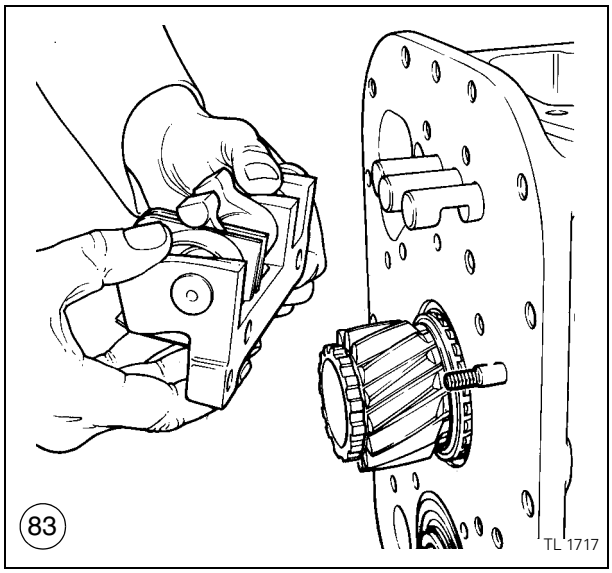
Thrust washer 'C' thickness chart		
Part No.	Metric	Imperial
3599 299 M1	3,4 mm	0.134 in
3598 644 M1	3.7 mm	0.146 in
3598 643 M1	3,9 mm	0.154 in
1671 888 M2	4,2 mm	0.164 in

83. Ensure that the selector mechanism dowel bolt is in place, use Loctite 222 to retain it.
84. Assemble the 3rd (40T) and 4th (36T) gear pack with the synchromesh hub and steel bushes, lower the assembly down into the box with the 3rd gear (largest) to the rear, rest the gear pack on the layshaft gears.
85. Place the steel spacer on the main shaft.
86. Place the thrust washer on the main shaft.
87. Slide the mainshaft through the rear of the gearbox and the 3rd/4th gear pack.
88. Assemble the 1st (49T) and 2nd (45T) gear pack with the synchromesh hub and steel bushes and lower the assembly down into the box with the 1st gear (largest) to the rear, rest the gear pack on the layshaft gear
89. Push the shaft right through the 1st/2nd gear pack.
90. Fit the pre-selected calibrated thrust washer with the large flat side towards 2nd gear.
91. Hold the mainshaft and drive the front roller bearing into position in the centre web of the gearbox.
92. Replace the circlip.
93. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forwards.

Input Shafts and Housing

94. Refit the needle roller bearing into the front of the mainshaft.
95. Hold the forward constant mesh gear in the gearbox and refit the transmission input shaft and housing assembly complete with reverse gear or spacer, *(see operation 7-5A)*.
96. Refit the selector fork and rails, *(see operation 5-5A)*.

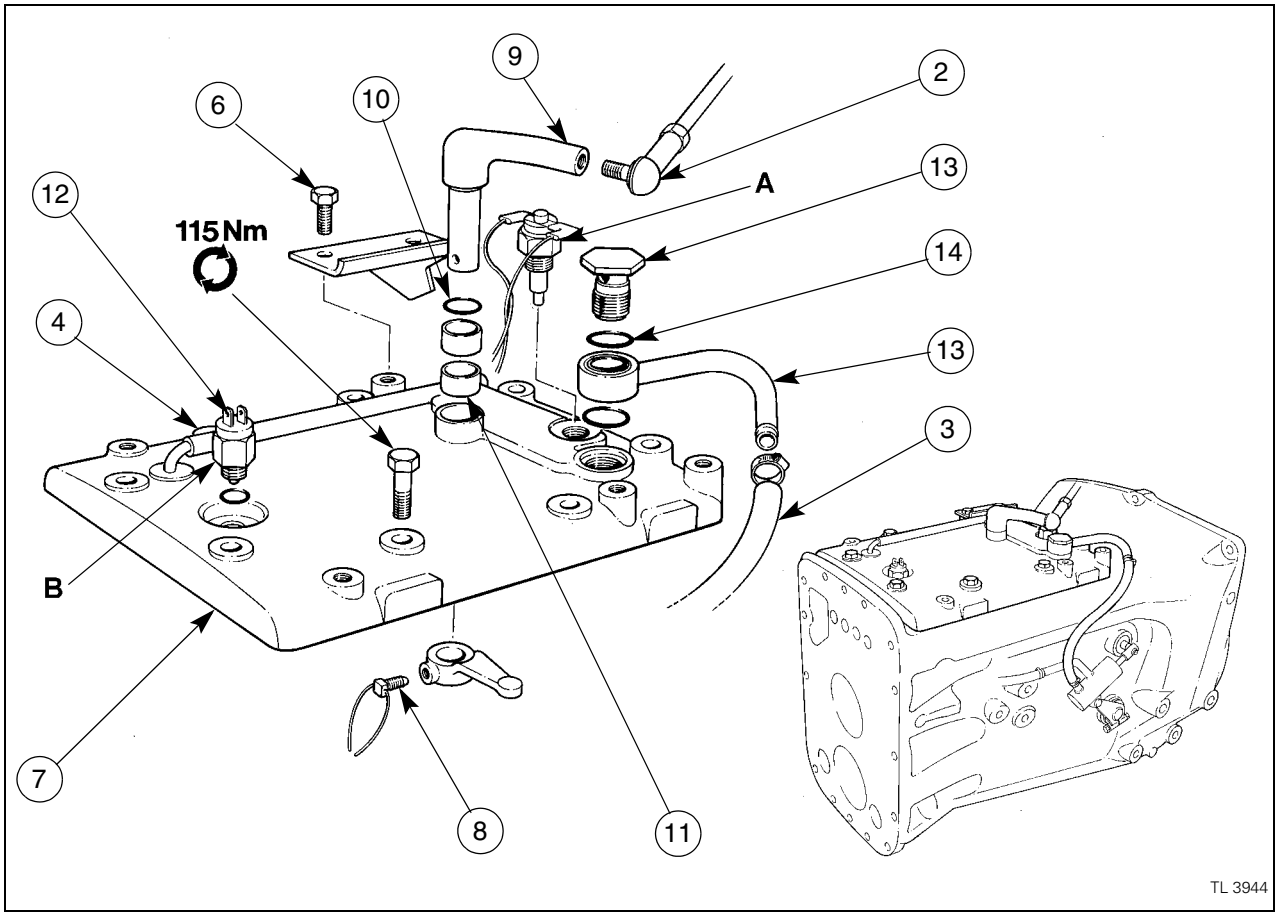




97. Refit the clutch release mechanism, *(see operation 3-4A)*.
98. Refit the range gearbox and set the selector forks and main shaft pre-load settings as necessary.
99. If the main shaft and/or rear taper roller bearing have been changed it will be necessary to reset the upper range gearbox bearing pre-load, *(see operation 3-5D)*.
100. Refit the gearbox to the tractor, *(see operation 1-5A)* and Splitting the Tractor.

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GEARBOX TOP COVER

Removal and Refitment 9-5A

Removal

1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the breather pipe.
5. Disconnect the wires to the switches 'A' and 'B' (if fitted).
6. Remove the bolts and clutch cable bracket (cab tractor only).
7. Remove the top cover.
8. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
9. Withdraw the shaft from the cover.
10. Remove and discard the 'O' ring seal.
11. If necessary, remove and replace the bushes in the top cover.
12. Remove the safety start switch 'A', reverse light/ bleeper switch 'B' to prevent damage to the switches.
13. Remove the banjo bolt and pipe.
14. Remove and discard the 'O' ring seals.
15. Clean all components and remove dried gasket material from the machined faces.

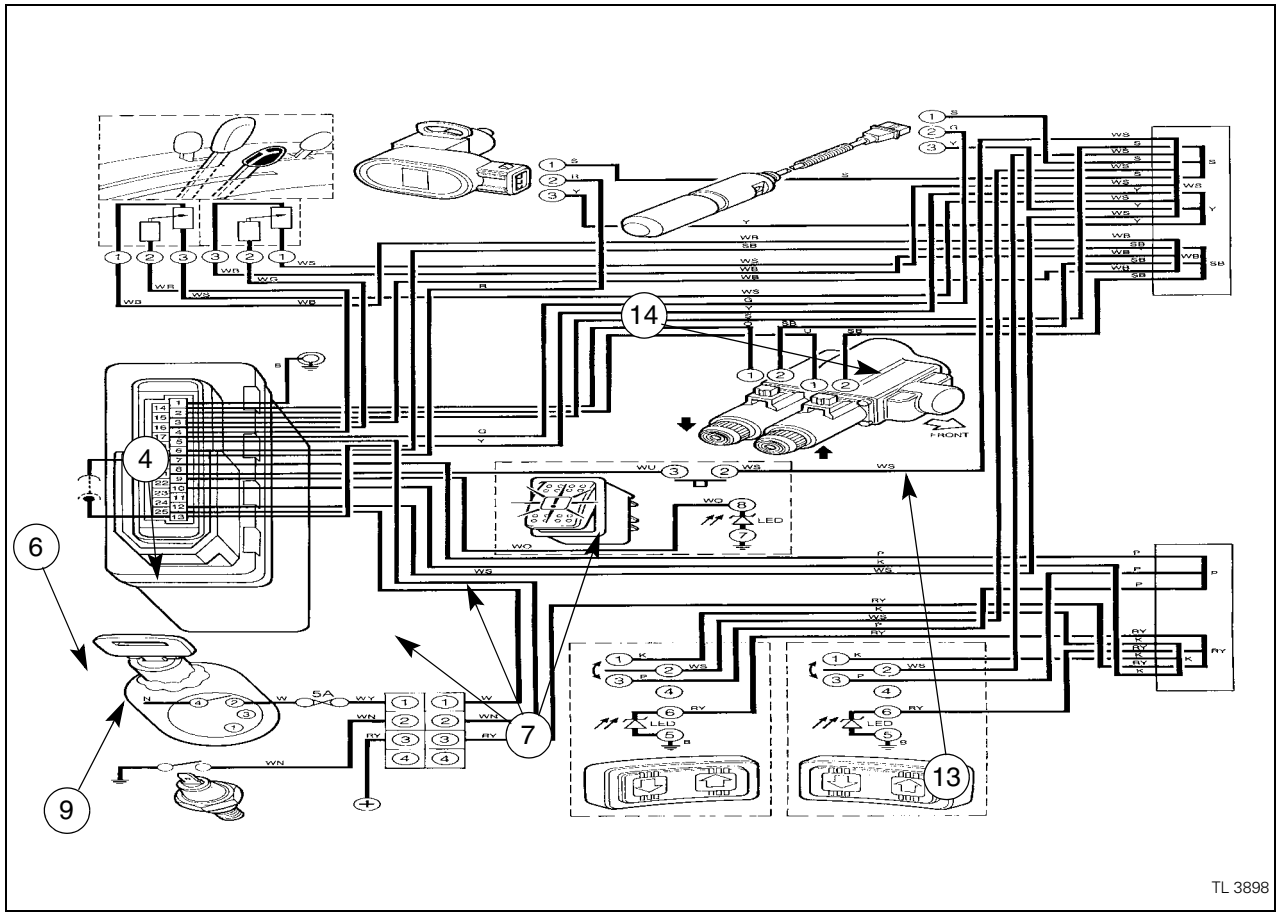
Refitment

16. Reverse procedures except:
    a. Replace the shaft, banjo bolt and 'O' rings.
    b. Apply Studlock (Loctite 270) to the lever locking bolt (8).
    c. Lubricate the safety start switch with a small quantity of transmission oil or petroleum jelly before installation.
    d. Apply Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115Nm (85 lbf ft).

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12 x 12 Shuttle Gearbox

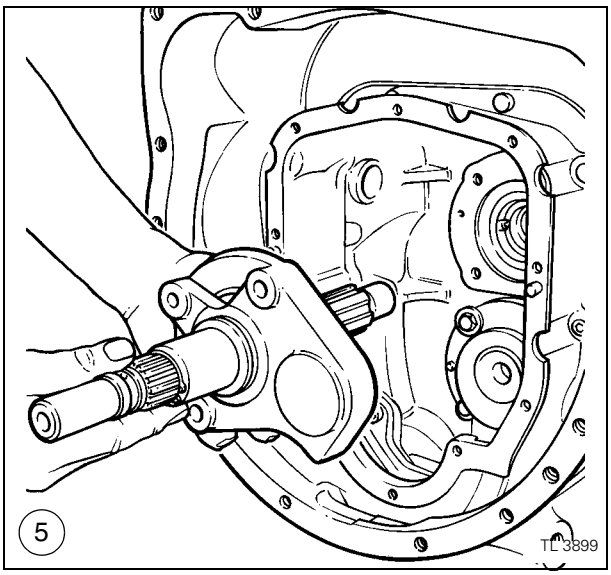


INPUT SHAFT AND HOUSING

Removal and Refitment **10-5A**

Removal

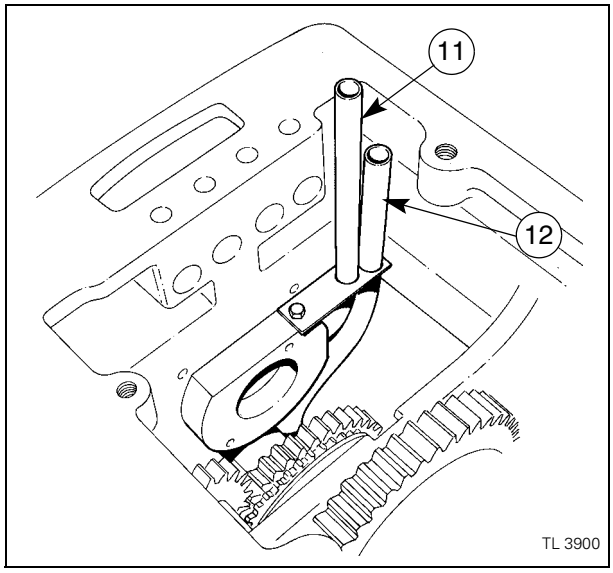
1. Remove the clutch assembly, *(see operation 4-4B)*.
2. Remove the clutch release mechanism, *(see operation 7-4B)*.
3. Remove the gearbox top cover, *(see operation 9-5A)*.
4. Remove the three bolts.
5. Withdraw the housing and shaft assembly from the gearbox, support the clutch pack to ease removal.
6. Remove the circlip.
7. Remove the shaft assembly from the outer housing.
8. Remove the gears and thrust washers from the gearbox.
9. The release bearing sleeve is a press fit into the housing and under normal conditions should not require replacement.



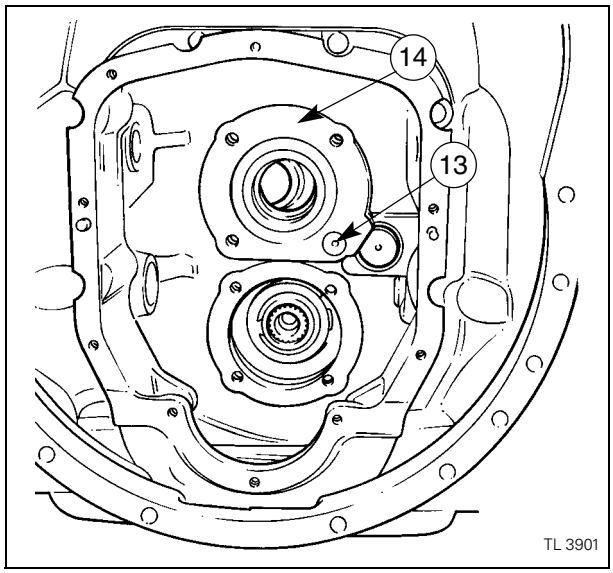
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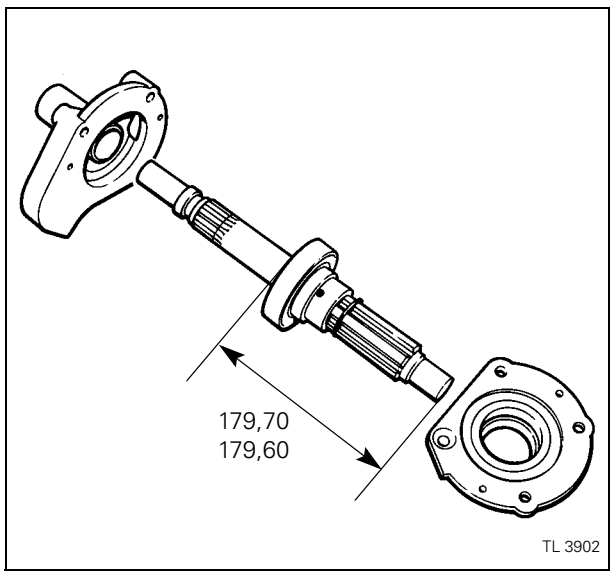
10. To remove the inner housing, remove the bolt, keep plate.
    Gearbox components have been removed for clarity.
11. Remove the oil feed pipe.
12. Remove the oil return pipes.



13. Remove the countersunk screw holding the housing.
14. Remove the inner housing.



IMPORTANT: *The input shaft has been accurately set in the factory and is only available as an assembly comprising of the shaft, carrier and bearing. DO NOT remove the carrier from the shaft. If the bearing is being replaced, the carrier must be supported during removal and refitment to prevent movement. When a new bearing has been fitted the dimension shown on the illustration (179,70-179,60* mm*(7.076-7.080 in) must be accurately checked and adjusted if incorrect. It is recommended that the assembly is always fitted.*



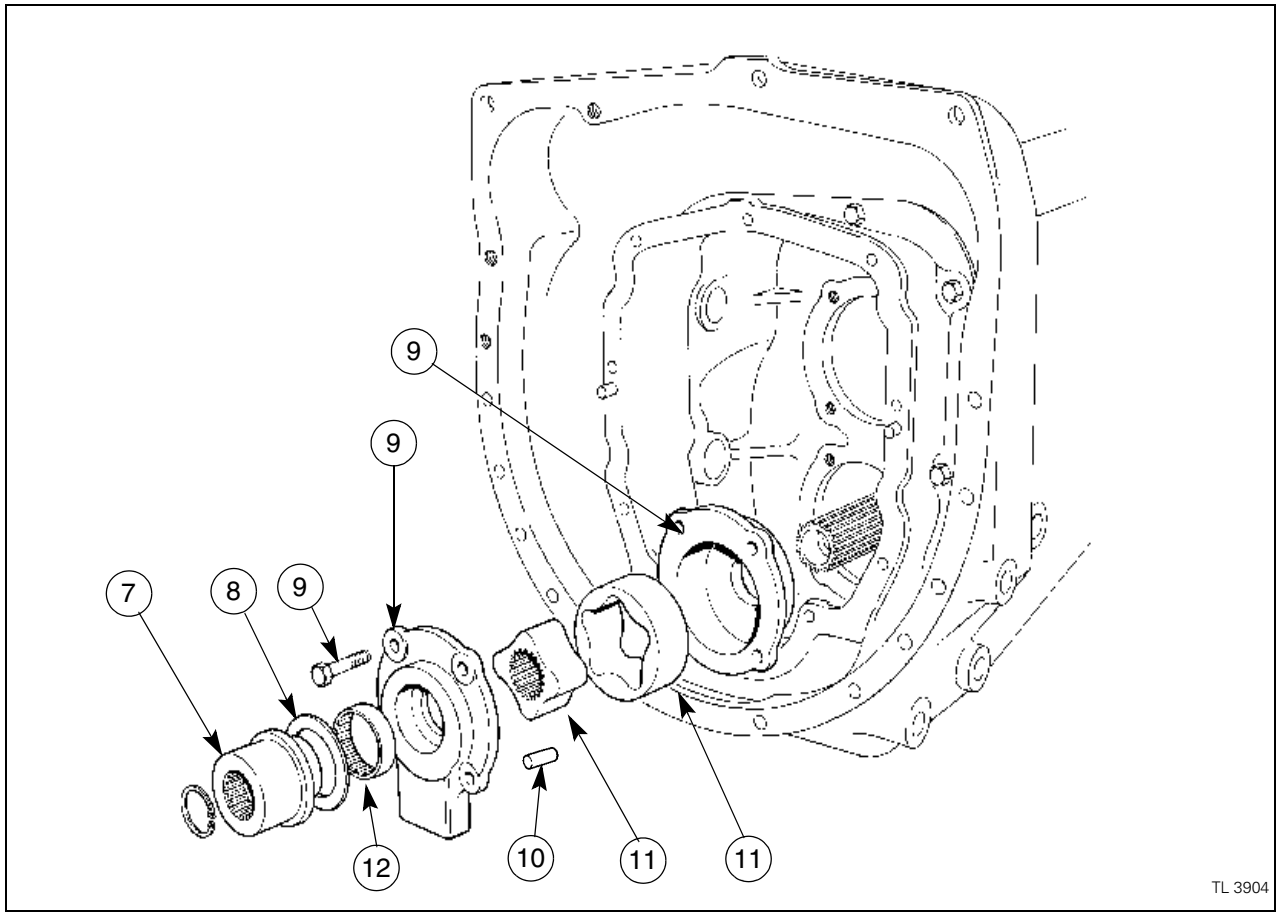
Refitment

15. Reverse procedures 1 to 14 except:
    a. Tighten the countersunk screw to a torque of 40 Nm (30lbf ft).
    b. Tighten the three bolts to a torque of 40 Nm (30 lbf ft).
    c. Apply Loctite 270 to the bolt (10) retaining the internal pipes.
16. The sleeve for the clutch thrust bearing is a press fit into the housing.

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12 x 12 Shuttle Gearbox

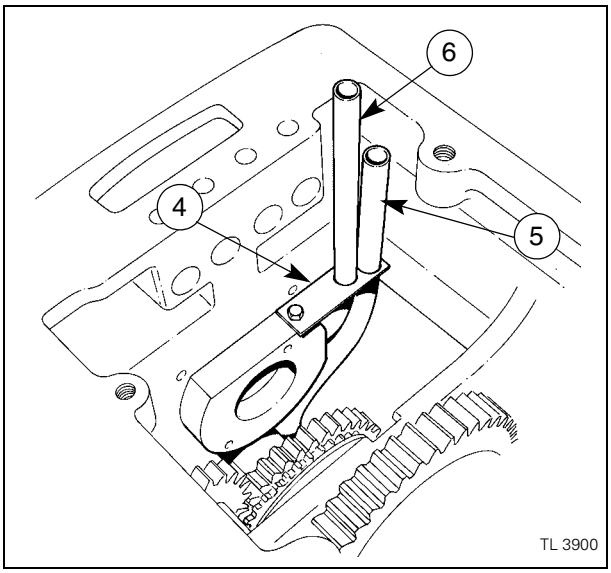


SCAVENGE PUMP

Removal and Refitment **11-5A**

Removal

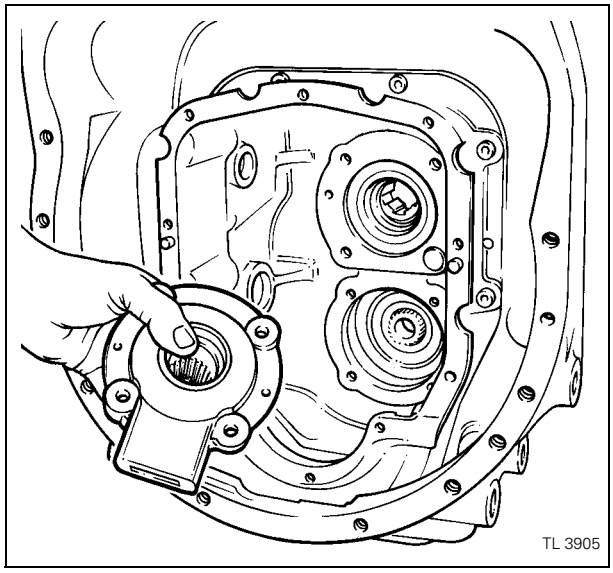
1. Remove the clutch assembly, *(see operation 4-5A)*.
2. Remove the clutch release bearing and cross shaft, *(see operation 7-4B)*.
3. Remove the gearbox top cover, *(see operation 9-5A)*.
4. Disconnect the internal pipes to the scavenge pump by removing the bolt and keep plate.
5. Remove the oil return pipe.
6. Remove the oil feed pipe.
7. Remove the PTO support bearing assembly.
8. Remove the thrust washer.



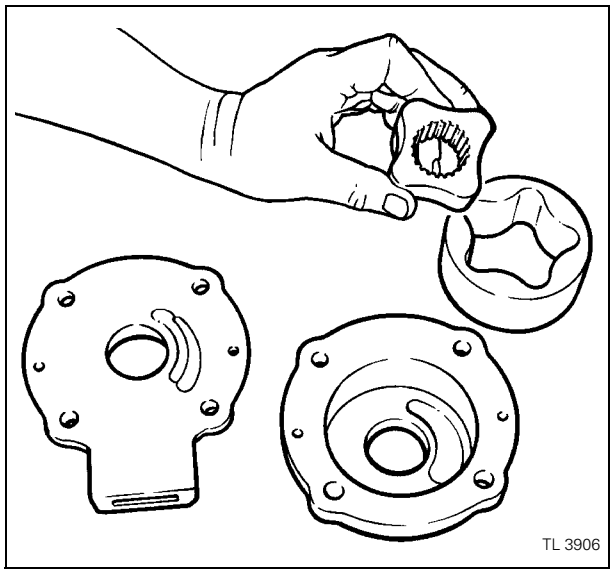
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9. Remove the four bolts and pull the scavenge pump assembly off the shaft and out of the housing.



10. Place the pump on a clean bench, drive out the two dowels and split the pump.
11. Remove the rotor and stator.
12. Only remove the needle roller bearing if replacement is required.



Examination

Carefully clean the components and the scavenge pump, especially the oil ways. There are no dimensional tolerances that need checking, the pump is low pressure, moving oil from the clutch casing to the transmission.

Inspect the rotor and stator for wear, scoring or damage on their working faces, if they appear to be in good condition they can be replaced.

Refitment

13. Lightly oil and reassemble the pump, it can only be assembled one way to line-up the bolt holes. Centralise the rotor in the stator so that it is in the centre of the bore.
14. Reverse procedures 1 to 10 except:
    a. Tighten the four pump retaining bolts to a torque of 40 Nm (30 lbf ft).
    b. Apply Loctite 270 to the bolt (4) retaining the internal pipes.

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12 x 12 Shuttle Gearbox

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12 x 12 Creeper Gearbox

Section 5 - Part B

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12 x 12 Creeper Gearbox

SPECIFICATION

Application	Tractors fitted with 12 speed shuttle gearbox.
Speed reduction ratio	4.7 : 1.
Number of creeper speeds	4.
Speed range	0,37-0.83 km/hr at 2200 engine rev/min.
Total number speed ranges obtainable:	
30 km/hr transmission	16 forward x 12 reverse.
40 km/hr transmission	16 forward x 16 reverse.

Bolt Torques:

Selector lever lock screws	8 Nm (6 lbf ft).
Lower shaft lock screws	8 Nm (6 lbf ft).
Selector lever pivot bolt	10 Nm (7 lbf ft).
Gearbox cover bolts	112 Nm (82 lbf ft).
Creeper cover bolts	112 Nm (82 lbf ft).
Creeper cover nuts	60 Nm (44 lbf ft).

GENERAL DESCRIPTION

The creeper reduction unit is a self contained set of gears mounted in the front section of the gearbox above the forward and reverse shuttle gears. It is only fitted to the 12 x 12 shuttle gearbox. Engagement of the creep gears is by means of a sliding gear in the creeper unit and a sliding collar on the input shaft operated by an interconnected selector fork. The selector fork is operated by an internal and external lever which in turn is connected by a control cable to the operating handle on the seat deck. A warning light on the tractor instrument panel indicates when the creeper gear is fully engaged. Built into the selector mechanism is an interlock device which prevents the creeper gears being selected in any range other than low. This protects the creeper gears from exposure to excessive loading in the higher speed ranges and prevents unnecessary duplication of speeds.

The creeper unit (see Fig.1 and Fig.2) consists of a simple train of five gears interposed between the input shaft and the main gearbox constant mesh gear to give a reduction of 4.7 : 1. The transmission input shaft assembly is different from the standard shaft fitted to this gearbox. In the centre of the shaft there is a sliding collar which connects to shaft with one of two gears. Moving the collar rearwards engages normal drive constant mesh gear. Moving it forwards engages creep.

There are two different types of reverse idler, simple or compound train that can be fitted to the gearbox. This results in two types of input shaft assembly. The simple train is shown in Fig.1 and it will be noted that there are two constant mesh gears. The front gear, reverse, meshing through the idler to the layshaft gears. The rear gear, forward, is meshed directly with the layshaft gear (this does not show on the illustration due to it being laid out flat). The compound train shown in Fig.2, there is only one input shaft constant mesh gear. This is engaged with both the reverse idler gear and the forward gear on the layshaft. The second gear on the reverse idle shaft engages with the layshaft reverse gear. Due to the different layout of reverse idler, tractors fitted with the simple gear train as shown in figure 1 will only have creep speeds in forward gear due to the reverse constant mesh gear being splined to the input shaft. With the compound gear train in figure 2, forward and reverse speeds are both taken off the rear constant mesh gear this results in creep speeds in both forward and reverse. Figure 3 shows the drive path through the gears for both types of gearbox.

When the creeper gear is engaged the transmission must first be placed in low range forward gear. The main engine clutch pedal is pressed down, the creep handle pulled up into the engaged position. Release the clutch pedal keeping pressure on the creep handle until the indicator light lights-up. Release the handle. Pulling the handle up into creep moves the sliding collar out of mesh with the main constant mesh gear (F) and into engagement with the first creep gear (A). At the same time the upper end of the selector lever engages gear (D) with gear (E) which is in mesh with the main constant mesh gear (F). The drive train is then completed through gears (A), (B), (C), (D) and (E). The constant mesh gears drive the forward and reverse shuttle gears and synchromesh units on the layshaft.

The creeper gearbox is available as a factory fit option only on two- and four-wheel drive tractors.

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12 x 12 Creeper Gearbox

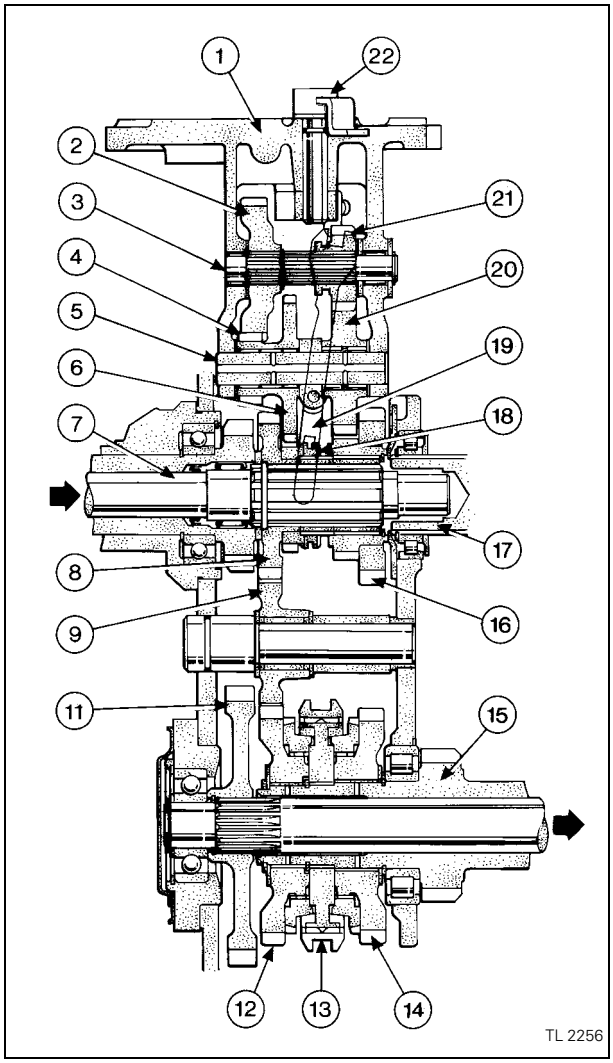


Fig.1 Creeper gearbox with simple reverse idler.

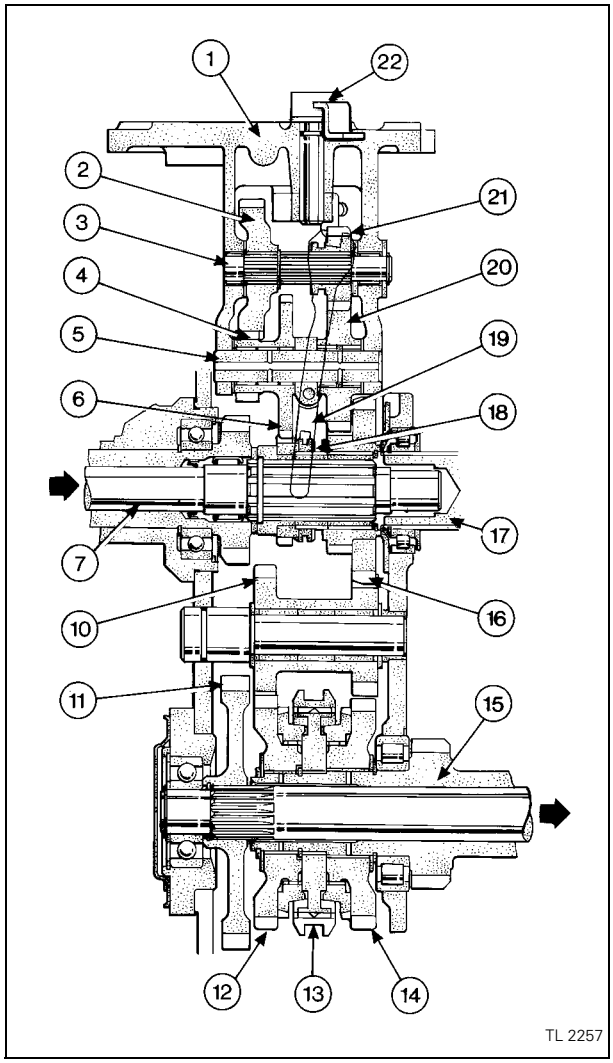


Fig.2 Creeper gearbox with compound reverse idler

1. Creeper gearbox.
2. Intermediate gear (C).
3. Upper shaft.
4. Input driven gear (B).
5. Lower shaft.
6. Input driver gear (A).
7. Input shaft.
8. Reverse constant mesh gear.
9. Reverse idler gear - simple.
10. Reverse idler gear - compound.
11. PTO gears.
12. Reverse gear.
13. Synchromesh coupler.
14. Forward gear.
15. Layshaft.
16. Forward constant mesh gear (F).
17. Main shaft.
18. Sliding collar.
19. Selector fork.
20. Output gear (E).
21. Sliding intermediate gear 18T (D).
22. Selector lever.

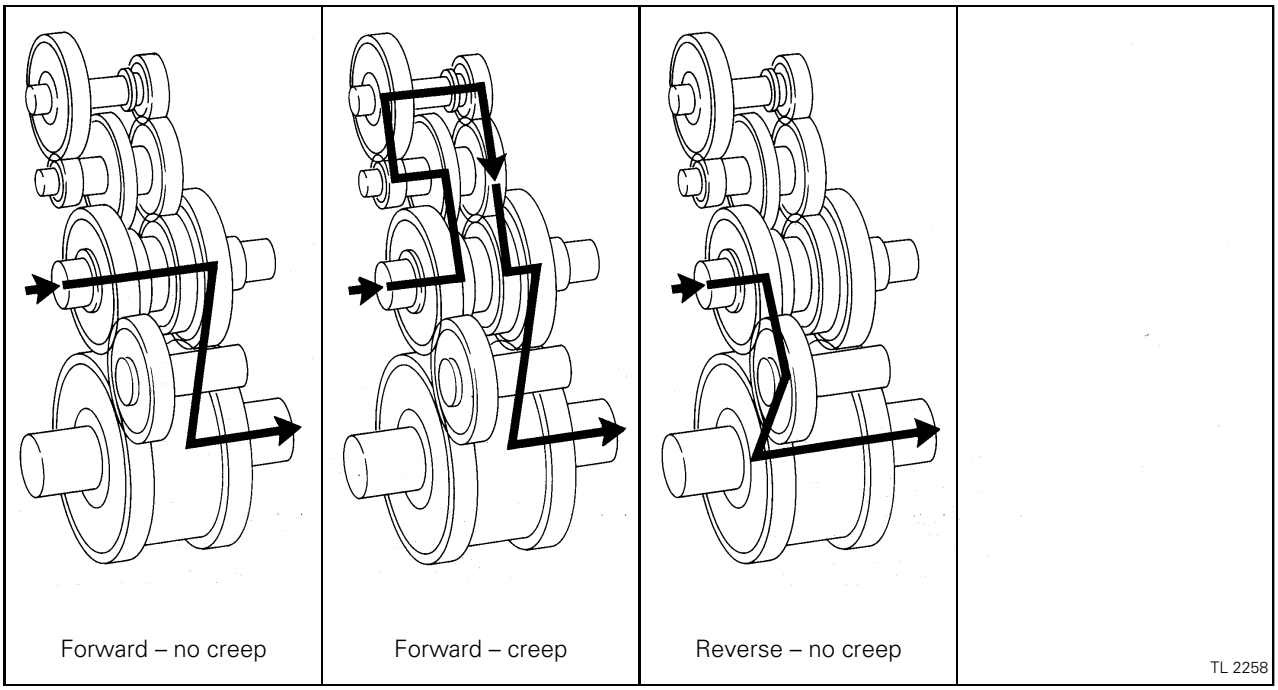
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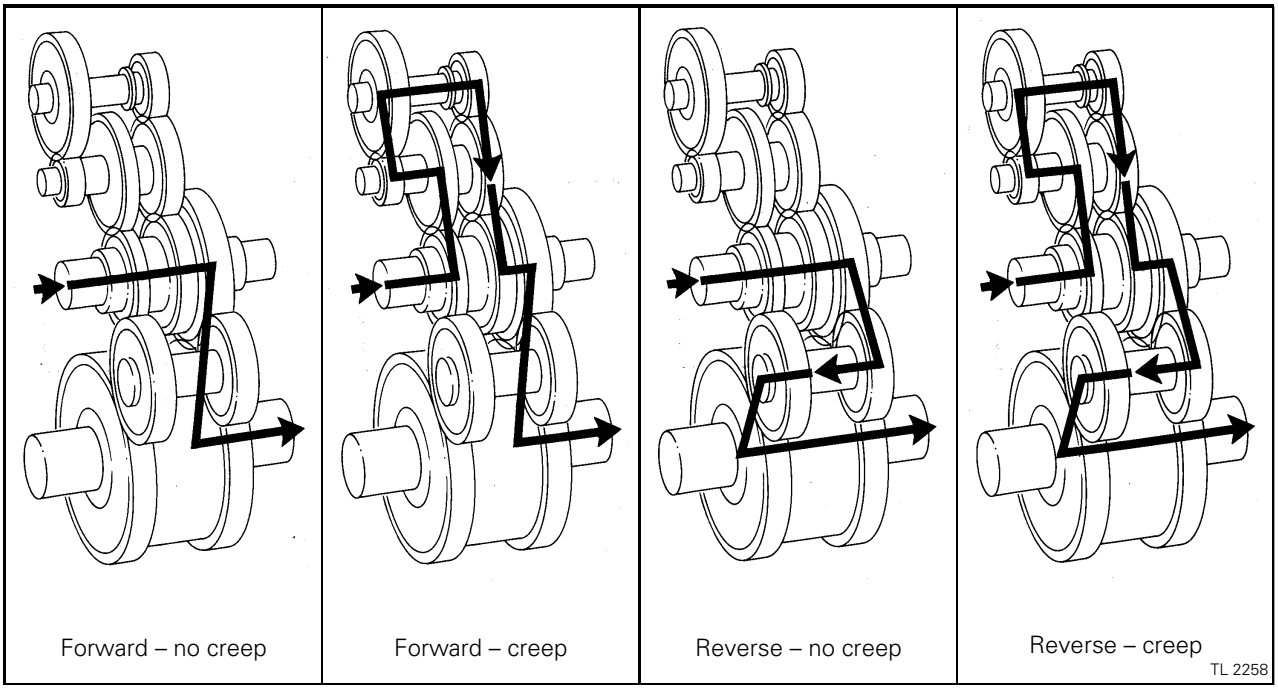
12 x 12 Creeper Gearbox

CREEPER UNIT GEAR TRAIN (Fig.3)

Simple reverse idler.

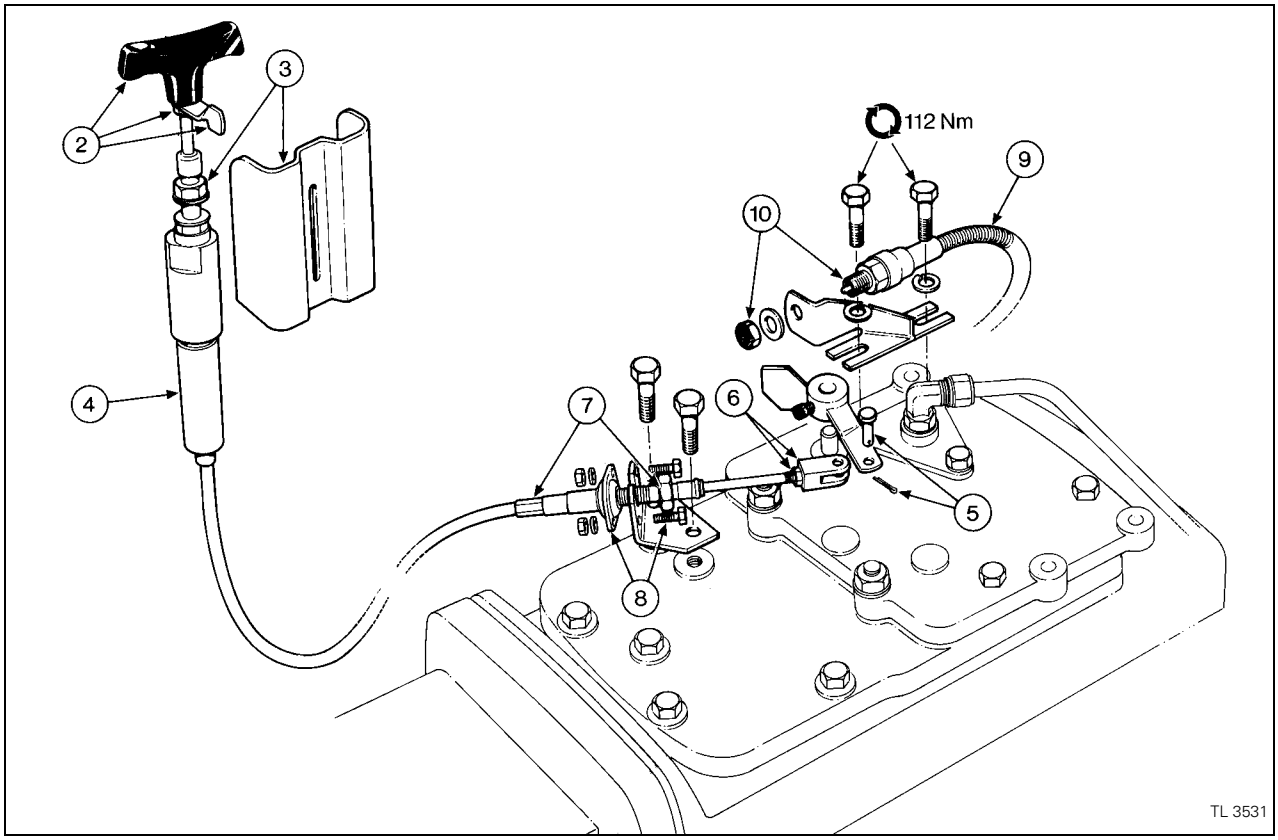


Compound reverse idler.



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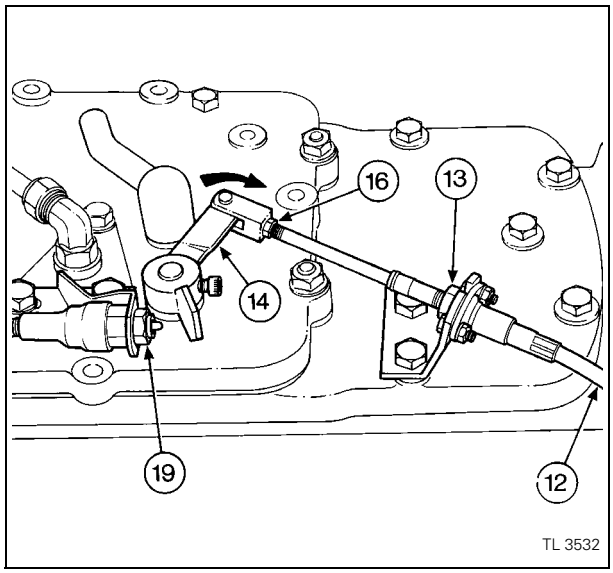


CREEPER CONTROL

Removal and Refitment 1-5B

Removal

1. Remove the floor mats and floor plates as necessary.
2. Slacken the locknut and remove the 'T' handle, guide plate and locknut.
3. Remove the locknut, plate and guard.
4. Remove the control cable from under the seat deck.
5. Remove the split pin and clevis pin from the lever on the gearbox, disconnect the cable end.
6. Slacken the locknut and remove the fork end and locknut.
7. Remove the locknut from the cable end and remove the cable from the swivel end, support bracket and tractor.
8. Remove the two nuts and bolts and the swivel joint, if necessary.
9. Disconnect the 'Engaged' light switch wiring at the plug.
10. Remove the nut and switch.



Refitment

11. Reverse procedures 1 to 10. Reset the linkage and light switch as follows:
12. Reinstall the control cable on the seat deck, ensure that the guide plate under the knob locates in the slot in the guard.
13. Pass the cable through the swivel joint and install the locknut.

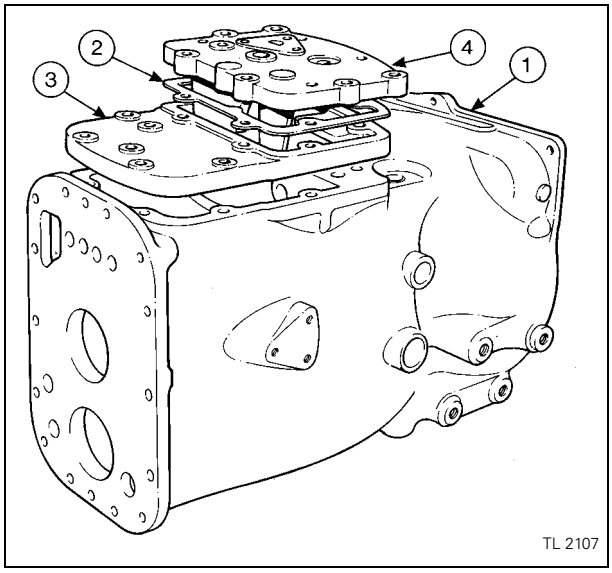
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14. Place the lever on the gearbox into the creep position by pulling the lever rearwards, (it may be necessary to rotate the gearbox to ensure full engagement).
15. Adjust the position of the 'T' handle so that there is 3 mm (1/8 in) clearance between the guide plate and the top of the slot when in the fully UP position.
16. With the 'T' handle UP, adjust the position of the clevis on the end of the cable so that when it is connected to the lever there is no strain on the cable.
17. Tighten all the locknuts on the fork end, swivel joint and 'T' handle.

NOTE: *The control cable is fitted with a spring loaded device to prevent overloading of the selector mechanism during engagement of the creeper drive.*

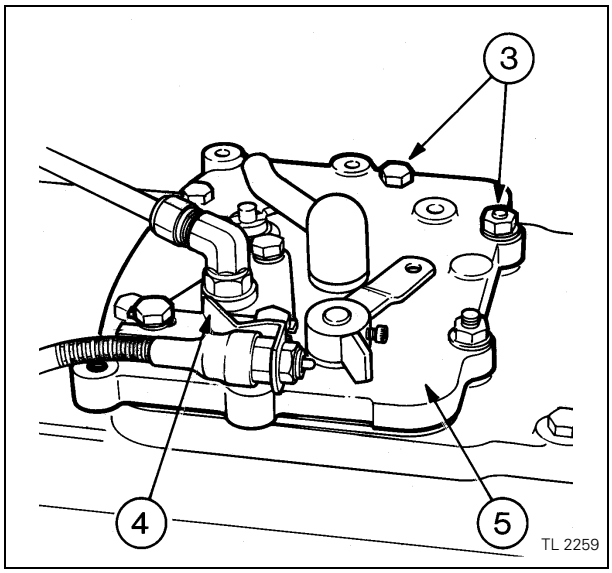
18. Check the engagement of the creeper gear. It may be necessary to run the engine to get engagement. When the 'T' handle is pulled fully UP to engage, or fully DOWN to disengage, ensure that the drive is selected correctly.
19. Check the adjustment of the creeper 'Engaged' light (snail). This should only illuminate on full engagement. If adjustment is required, slacken the two bracket bolts and move the switch until the indicator light on the instrument panel comes ON when the gear is fully engaged. Retighten the two bolts to a torque of 112 Nm (82 lbf ft).



CREEPER UNIT

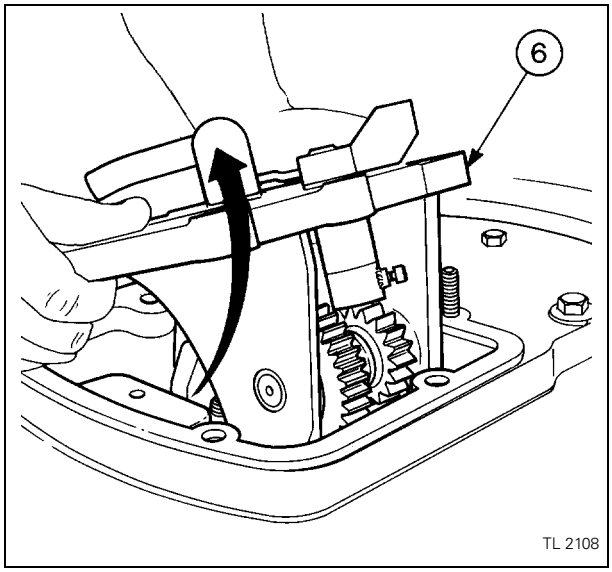
Removal and Refitment 2-5B

IMPORTANT: *The gearbox casing (1), steel shim (2) and gearbox cover (3) have been assembled in the factory as a matched set. They control the depth of mesh of the creeper unit gears with the gears on the input shaft. The steel shim (2) must NOT be changed or replaced when fitting a new creeper unit.*



Removal

1. Disconnect the creep control cable, wiring to the engaged light switch and safety start switch.
2. Remove the gearbox and range change unit from the tractor, *(see operation 1-5A)*.
3. Remove the four bolts and two nuts securing the creeper unit to the top cover.
4. Remove the engaged light switch bracket.
5. Break the joint between the creeper unit and the top cover by giving the cover a side tap with a hammer.
6. Standing on the right hand side of the gearbox lift the creeper unit up vertically then tilt it as shown in the illustration so that the selector fork clears the selector collar. Ease the unit out of the gearbox at an angle so that the lower gears clear the main gearbox selector rails.



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Refitment

7. Ensure that the range unit is in LOW range and a forward main gear selected so that the gearbox can be rotated to assist in re-assembly.
8. Press the interlock back so that it contacts the selector forks.
9. Move the creeper selector collar on the input shaft forwards into the engaged position.
10. Move the selector fork on the creeper unit into the engaged position i.e. the upper 18 tooth sliding gear is in mesh.
11. Ensure that the two small bronze pivoting pads on the selector fork are in the vertical position.
12. Apply Massey Ferguson Instant Multi-Gasket (Loctite 573) to the top of the cover and the steel shim. Install the steel shim as shown in the illustration.
13. Position the shuttle lever in relation to the hole that takes the safety start switch as shown in the illustration.
14. With care install the creeper unit. It will fit back into the gearbox the same way it came out by a rolling action passing the gears round under the selector rails and then down into position. As the unit is finally lowered into place it may be necessary to slightly move the shuttle lever so that it engages with the jaw in the selector fork.
15. Fit the two dowel bolts first. Refit the remaining bolts and nuts, don't forget the switch bracket and wiring clips.
16. Check that the creeper and shuttle levers have engaged correctly. Turn the gearbox over and engage all gears in turn to ensure that it is correctly assembled.

IMPORTANT: *This check and adjustment is very important. The creeper gear must only be allowed to be engaged in LOW range. Engagement in any other range will result in a very serious failure of the gearbox.*

17. Check the operation of the creeper interlock, this prevents engagement of the creeper gear in any other range except LOW range as follows:

Range change check:

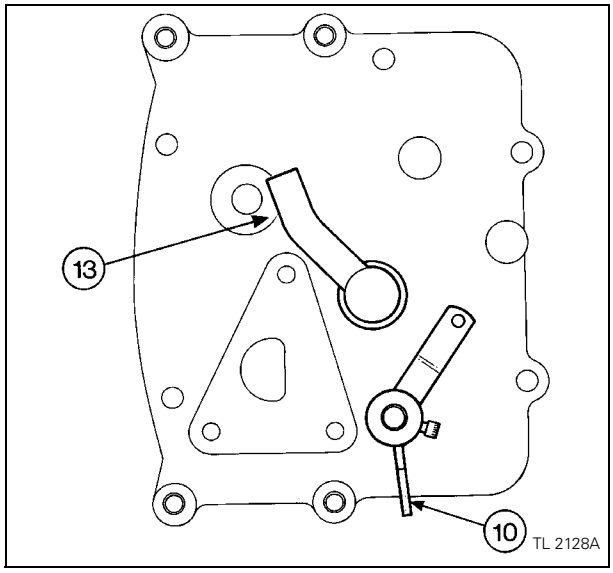
a. Select a LOW range.

b. Select 1st gear.

c. Select forward gear.

d. Engage creeper gear.

e. Move the range lever into MEDIUM range. The creeper gear should disengage. Check by rotating the gearbox input shaft. If disengagement does not take place the interlock rod length needs adjustment, *(see operation 3-5B procedures 68 to 71).*



Creep gear engagement check:

a. Select MEDIUM range.

b. Select 1st gear forward.

c. Creeper gear disengaged.

d. Try to select creeper or gear whilst rotating the input shaft. This must be prevented by the interlock. If engagement takes place the interlock rod length needs adjustment, *(see operation 3-5B procedures 68 to 71).*

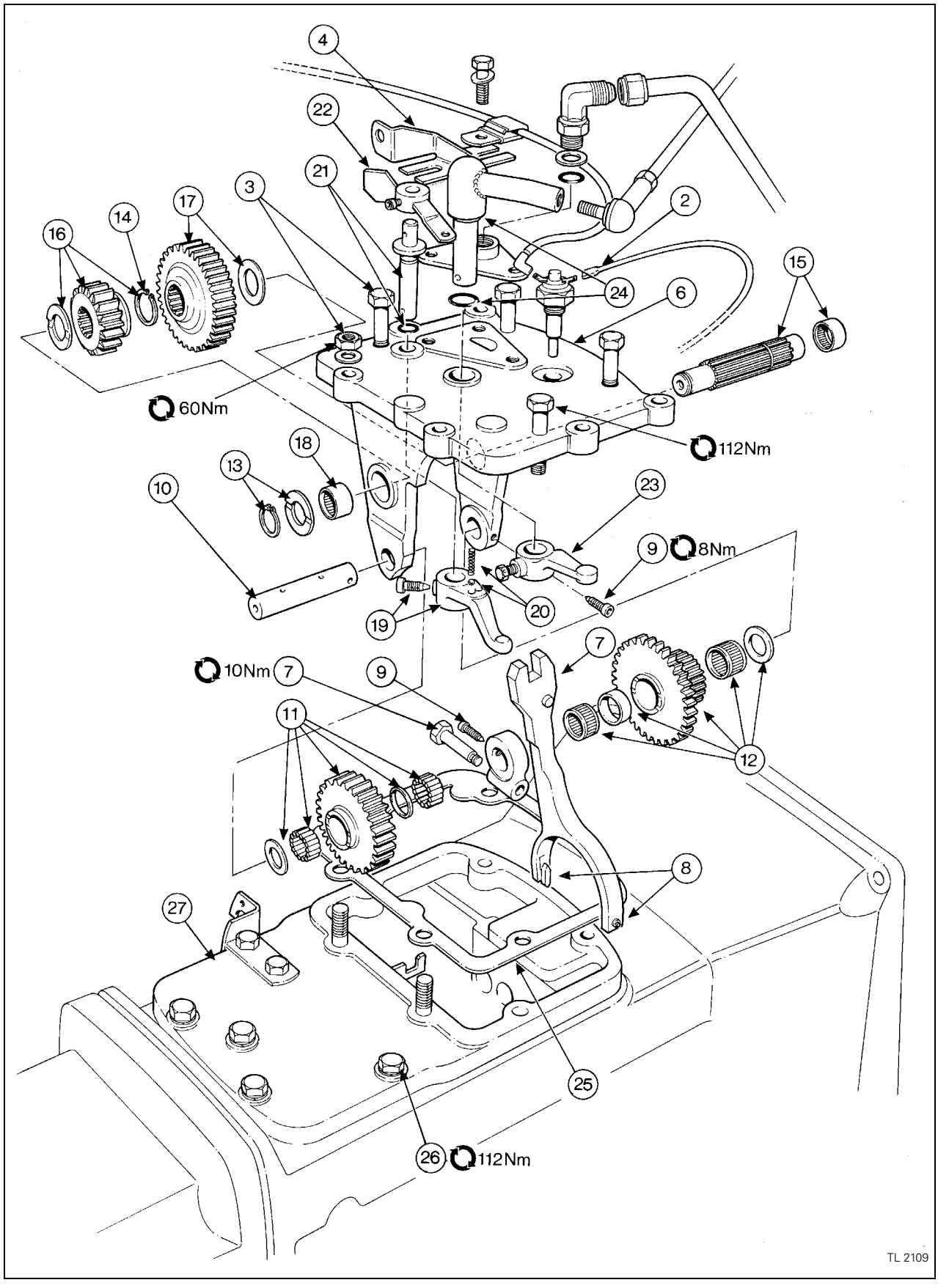
e. Repeat the above check with a HIGH range, forward gear selected.

18. Tighten all the creeper unit and gearbox cover bolts to a torque of 112 Nm (82 lbf ft). Nuts to a torque of 60 Nm (44 lbf ft)
19. Install the gearbox assembly back into the tractor.
20. Reconnect the creeper operating cable and adjust, *(see operation 1-5B).*

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12 x 12 Creeper Gearbox



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CREEPER UNIT

Overhaul 3-5B

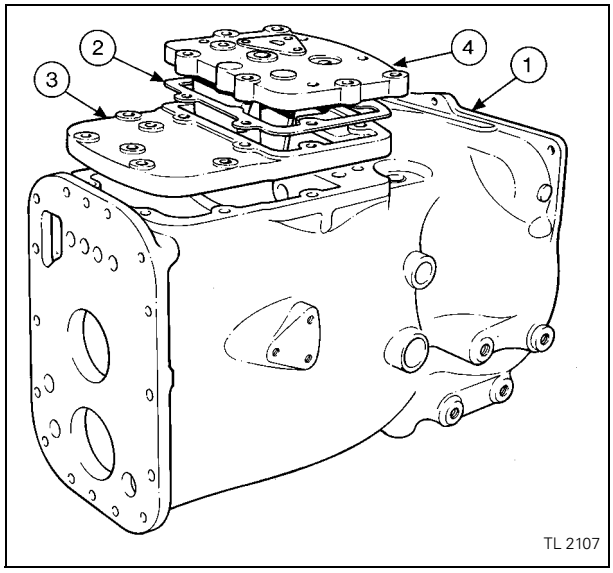
IMPORTANT: *The gearbox casing (1), steel shim (2) and gearbox cover (3) have been assembled in the factory as a matched set. They control the depth of mesh of the creeper unit gears with the gears on the input shaft. These three components must NOT be changed or replaced. In the event of a serious failure which involves the changing of the gearbox casing or the gearbox cover contact the Massey Ferguson Limited, Service Department, Banner Lane, Coventry, England, CV4 9GF, who will provide a matched set.*

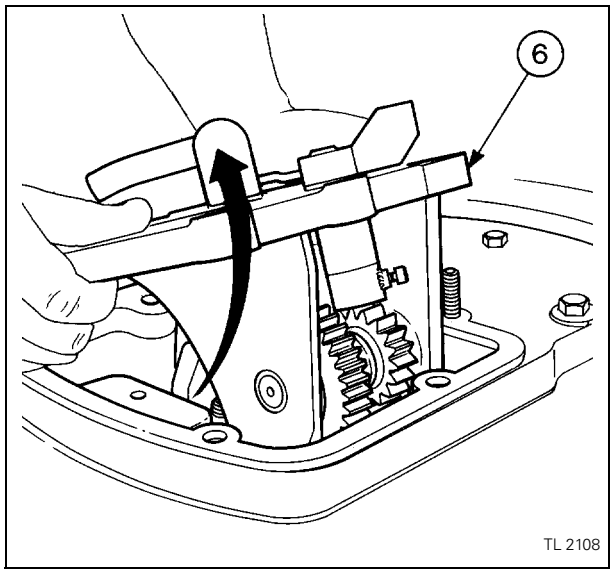
Dis-assembly

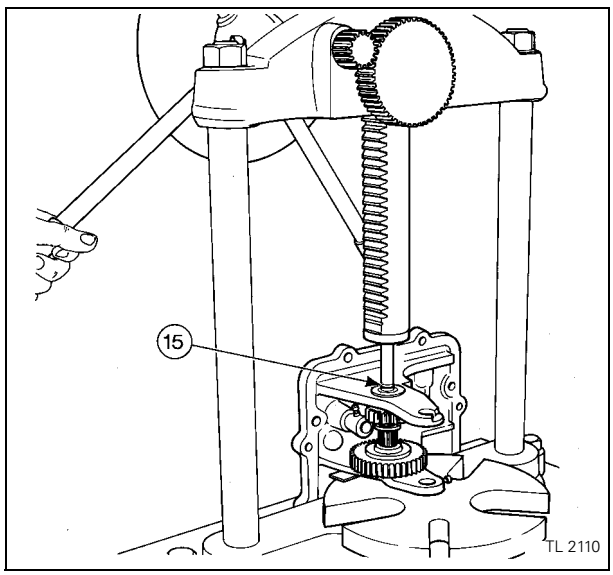
1. Remove the gearbox and range change unit from the tractor, *(see operation 1-5A)*.
2. Disconnect the creep control cable, wiring to the engaged light switch and safety start switch.

Creeper Unit

3. Remove the four bolts and two nuts securing the creeper unit to the top cover.
4. Remove the engaged light switch bracket.
5. Break the joint between the creeper unit and the top cover by giving the cover a side tap with a hammer.
6. Standing on the right hand side of the gearbox lift the creeper unit up vertically then tilt it as shown in the illustration so that the selector fork clears the selector collar. Ease the unit out of the gearbox at an angle so that the lower gears clear the main gearbox selector rails.
7. With the unit on a work bench, remove the selector fork pivot bolt and fork assembly.
8. If necessary, remove the two spring clips and the two bronze pivoting pads.
9. Remove the locking screws from the pivot bearing and casting.
10. Slide the lower shaft out of the gears, pivot bearing and housing. Carry out this task carefully, the single gear contains two sets of uncaged needle roller bearings.
11. Remove the output gear, bearings, spacer and thrust washer. Empty the washers and roller bearings into a clean container.
12. Remove the input gear, caged needle roller bearings, spacers and thrust washer.
13. Remove the intermediate shaft circlip and thrust washer.
14. Open-up the central circlip and slide it along the shaft towards the small sliding gear.



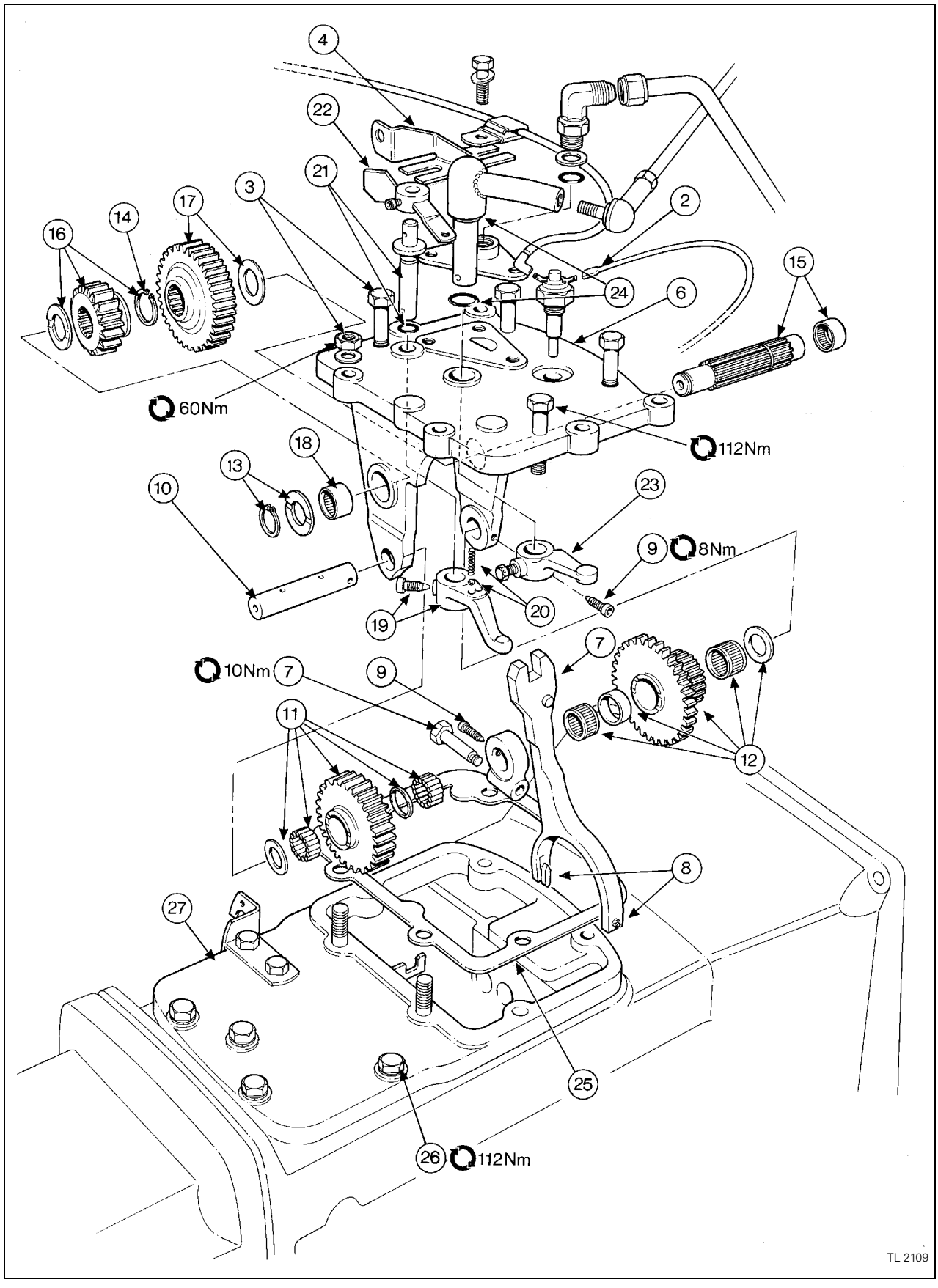




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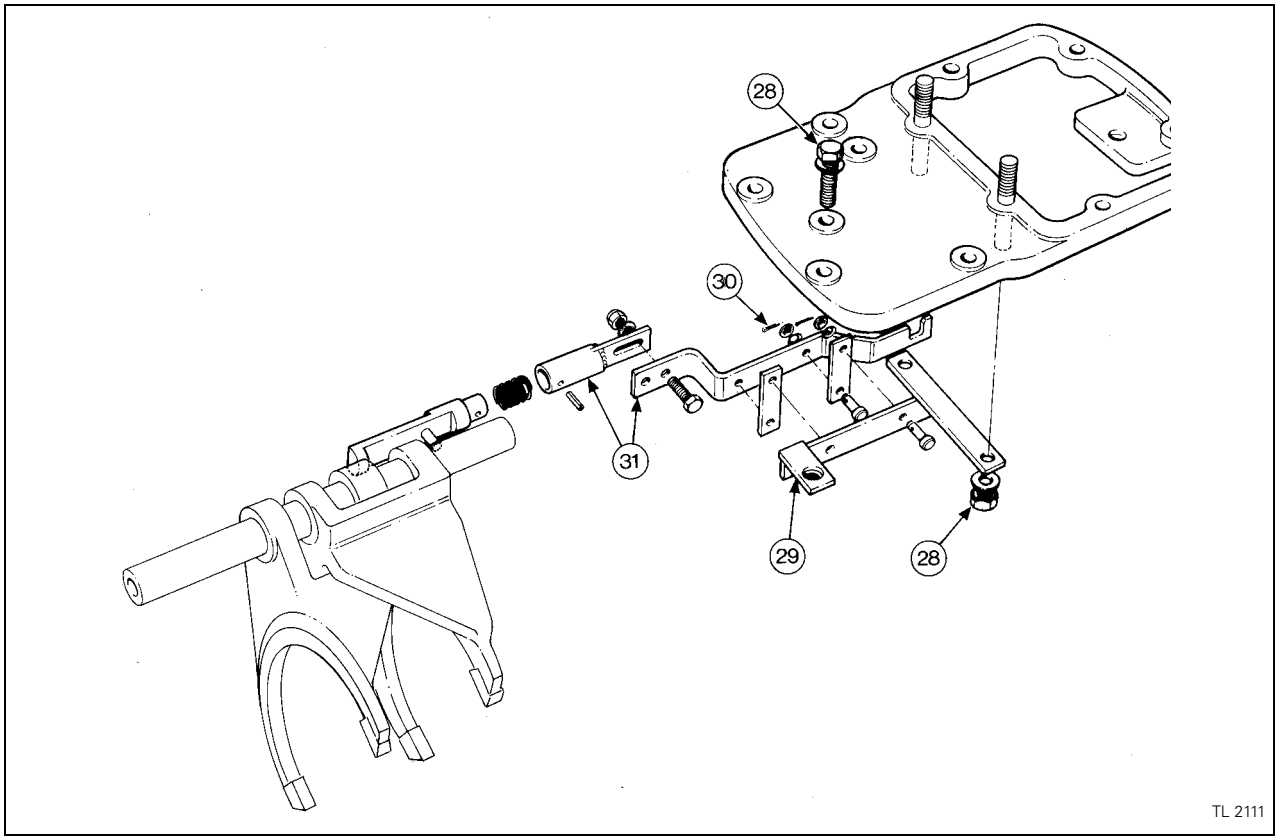
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12 x 12 Creeper Gearbox



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15. Place the creeper unit on its side under a hand press. Gently press the shaft from the back to the front (left to right looking at the illustration). This will enable the shaft to press the front caged needle roller bearing out of the casting. This bearing must be renewed on re-assembly.
16. Remove the sliding intermediate gear, thrust washer and circlip.
17. Remove the intermediate fixed gear and thrust washer.
18. If necessary, remove the rear needle roller bearing. If this bearing is removed it must be renewed on re-assembly.
19. Remove the lower selector lever lock screw and lever.
20. Remove the ball and spring.
21. Remove the creeper selector shaft and 'O' ring. Discard the 'O' ring.
22. If necessary, remove the upper selector lever lock screw and lever.
23. If necessary, remove the shuttle lever lock screw and lever.
24. Remove the selector shaft and 'O' ring. Discard the 'O' ring.

Gearbox Top Cover

25. Remove the steel shim and retain.
26. Remove the remaining top cover bolts.
27. Lift the cover up and forwards so that the interlock rod which passes into the range unit can be withdrawn.

Interlock

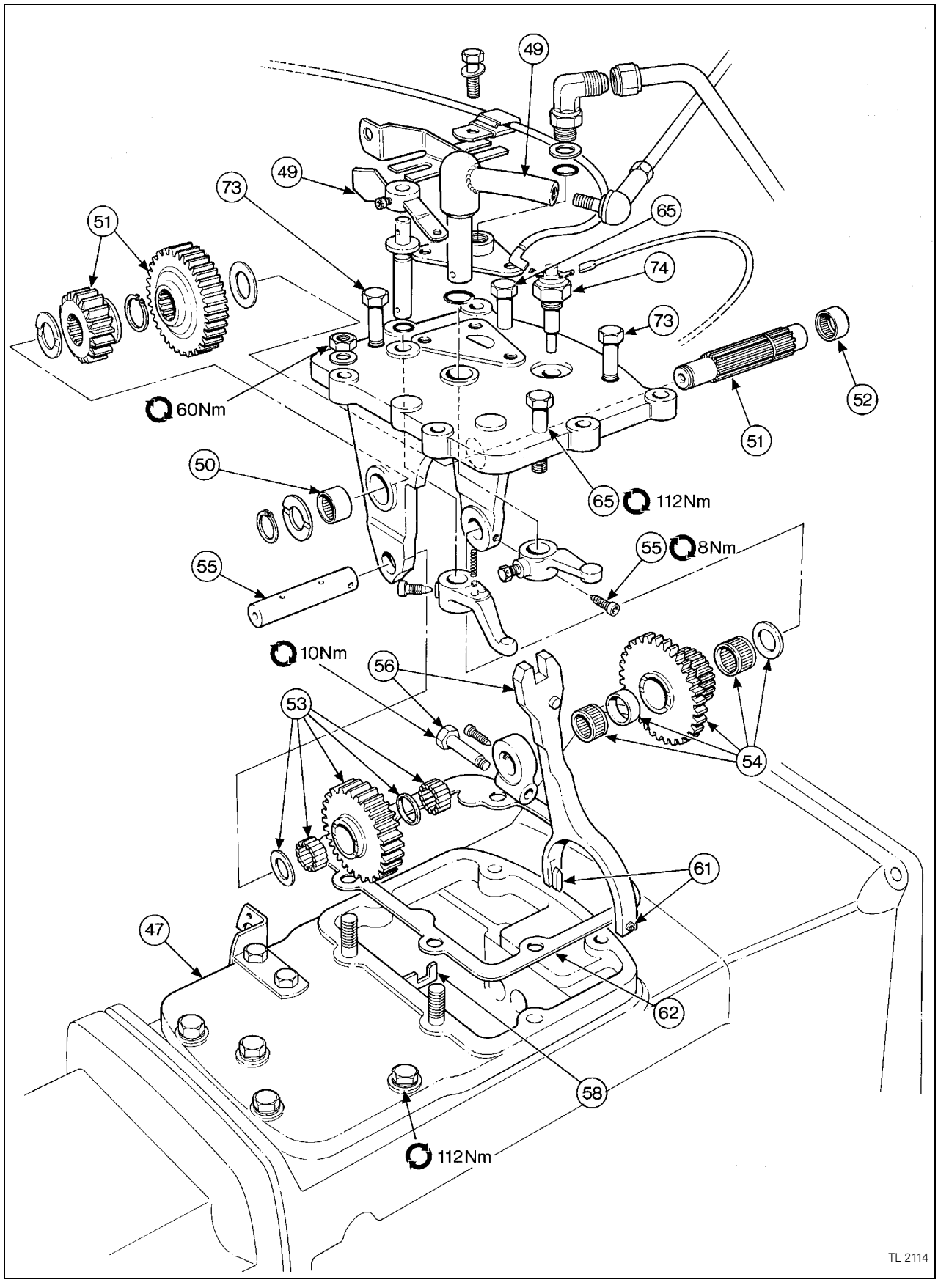
The interlock prevents the creeper unit being engaged in any other gear except LOW range. A rod passes from the creep selector fork to the range unit selector forks. This rod has been set in the factory and should not require any attention. DO NOT alter the length adjustment unless new parts are being fitted.

28. Remove the two nuts and washers, and the single bolt.
29. Remove the assembly from the cover.
30. If necessary, remove the split pins, plain washers, spring washers and clevis pins.
31. Dismantle the linkage.

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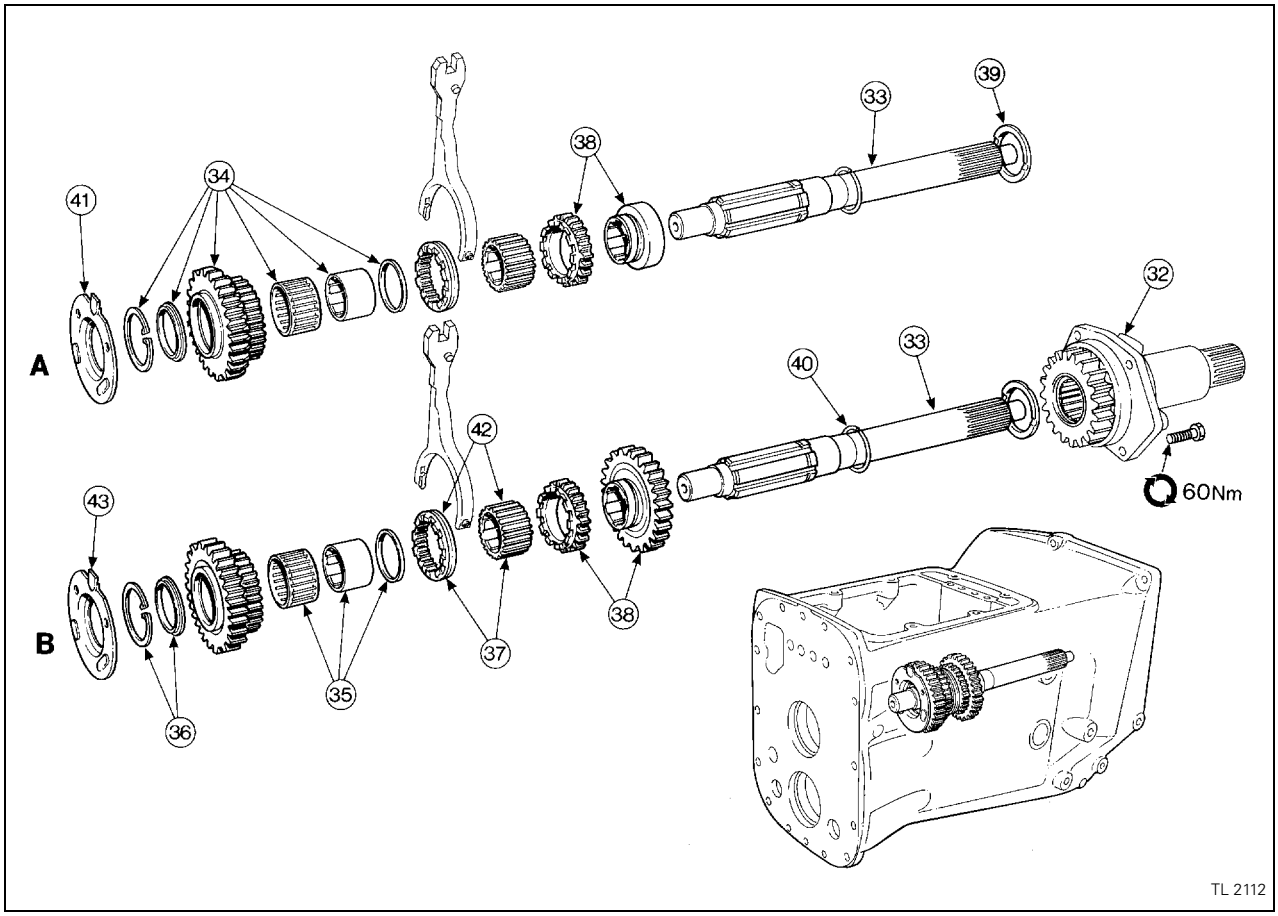
12 x 12 Creeper Gearbox



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12 x 12 Creeper Gearbox



Input Shaft

There are two types of input shaft. Type 'A' used with gearboxes with a compound reverse idler gear train. Type 'B' with a simple reverse idler gear train. The repair procedure is identical for both types.

32. Remove the input housing, *(see operation 6-5A)*.
33. Remove the input shaft by holding the input gears and lifting them out of the gearbox one at a time.
34. Remove the compound gear assembly complete with bearing. sleeve and washers.
35. Remove the needle roller bearing, sleeve and ring.
36. Remove the circlip and stepped ring.
37. Lift out the selector collar and splined sleeve.
38. Finally, lift out the drive gear and collar or reverse gear depending on the type of gearbox.
39. Remove the thrust washer.
40. If necessary, remove the snap ring.
41. Remove the main thrust washer.

Examination

Clean and carefully examine all the components, especially those subject to movement, and replace any that show signs of damage or wear. Renew all circlips, snap rings and 'O' rings. When re-assembling the gearbox ensure that all circlips are correctly located in their grooves.

Re-assembly

The re-assembly of the creeper unit is a reverse procedure of its dis-assembly. The following instructions are a further guide with details on any particular instructions that may apply.

Input Shaft

42. Ensure that the selector collar slides freely on the splined sleeve.
43. Hold the main thrust washer in place during assembly with petroleum jelly, NOT GREASE.
44. When refitting the input housing ensure that the machined flat on the reverse idler shaft locates correctly on the housing.

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Interlock

45. If the interlock, range change selector fork, creeper unit, input shaft (or its associated components) or range change unit output shaft components are being replaced or there is a need to re-adjust the interlock rod then proceed as follows. If this does not apply then replace the unaltered interlock assembly and continue on procedure 47.
46. Set the length of the rod to its minimum setting by making the adjustment at the slotted part of the linkage. This is the starting point and you may have to make further adjustments later when all the components of the creeper unit are assembled.
47. Install the gearbox cover and steel shim.
48. Replace the cover bolts but do not tighten, leave them loose so the cover can move.

Creeper Unit

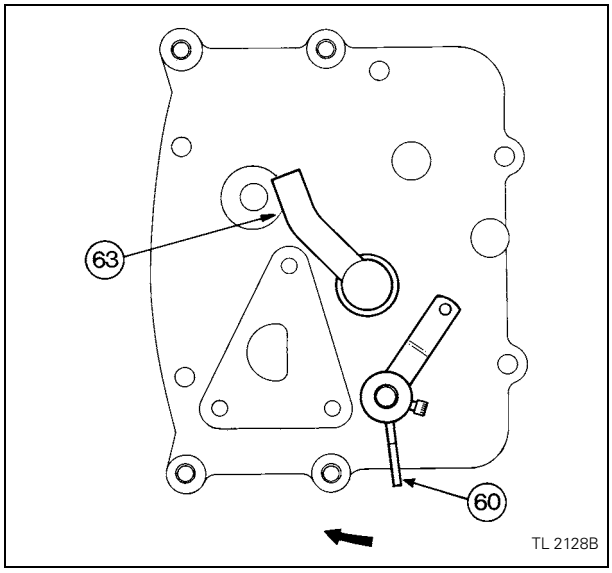
49. Install the shuttle and creeper levers with new 'O' rings, apply Massey Ferguson Studlock (Loctite 270) to the locking screws and tighten to a torque of 8 Nm (6 lbf ft). DO NOT forget the ball and spring on the creeper lever.
50. If the old bearing has been removed then press a new rear upper shaft needle roller bearing into the casting ensuring that it does not project on either side. DO NOT use a hammer to install, the bearings are susceptible to damage.

NOTE: *Press the bearing on the flat/part number end of the bearing cup, NOT the rounded end.*

51. Install the upper shaft, gears, thrust washers and circlips.
52. Press a new front needle roller bearing into place, pressing on the flat/part number end of the bearing cup.
53. Coat the inside of the output gear with petroleum jelly, NOT GREASE. Install the spacer and two rows of needle rollers, 21 rollers in each row.
54. Install the two needle roller bearings and spacer and thin thrust washers into the input gear. A little petroleum jelly will help to retain them.
55. Install the shaft, gears, thrust washers and selector fork pivot block. Apply Massey Ferguson Studlock (Loctite 270) to the lock screw in the casting and the pivot block. Tighten to a torque of 8 Nm (6 lbf ft).
56. Refit the selector fork ensuring the peg locates in the groove of the 18 tooth sliding gear, apply Massey Ferguson Studlock (Loctite 270) to the thread on the pivot bolt and tighten to a torque of 10 Nm (7 lbf ft).

Installing the Creeper Unit

57. Ensure that the range unit is in LOW range and a forward main gear selected so that the gearbox can be rotated to assist in re-assembly.
58. Press the interlock back so that it contacts the selector forks.



59. Move the creeper selector collar on the input shaft forwards into the engaged position.
60. Move the selector fork on the creeper unit into the engaged position i.e. the upper 18 tooth sliding gear is in mesh.
61. Ensure that the two small brass pivoting pads on the selector fork are in the vertical position.
62. Install the steel shim as shown in the illustration.
63. Position the shuttle lever in relation to the hole that takes the safety start switch as shown in the illustration.
64. With care install the creeper unit. It will fit back into the gearbox the same way it came out by a rolling action passing the gears round under the selector rails and then down into position. As the unit is finally lowered into place it may be necessary to slightly move the shuttle lever so that it engages with the jaw of the selector fork.
65. Fit the two dowel bolts first. Refit the other remaining bolts and nuts.
66. Check that the creeper and shuttle levers have engaged correctly. Turn the gearbox by the input shaft and engage all gears in turn to ensure that it is correctly assembled.

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Interlock Check

IMPORTANT: *This check and adjustment is very important. The creeper gear must only be allowed to be engaged in LOW range. Engagement in any other range will result in a very serious failure of the gearbox.*

67. Check the operation of the creeper interlock, this prevents engagement of the creeper gear in any other range except LOW range as follows:

    Range change check:

    a. Select a LOW range.

    b. Select 1st gear.

    c. Select forward gear.

    d. Engage creeper gear.

    e. Move the range lever into MEDIUM range. The creeper gear should disengage. Check by rotating the gearbox input shaft. If dis-engagement does not take place the interlock rod length needs adjustment, *(see procedures 68 to 71).*

    Creep gear engagement check:

    a. Select MEDIUM range.

    b. Select 1st gear forward.

    c. Creeper gear disengaged.

    d. Try to select creeper or gear whilst rotating the input shaft. This must be prevented by the interlock. If engagement takes place the interlock rod length needs adjustment, *(see procedures 68 to 71).*

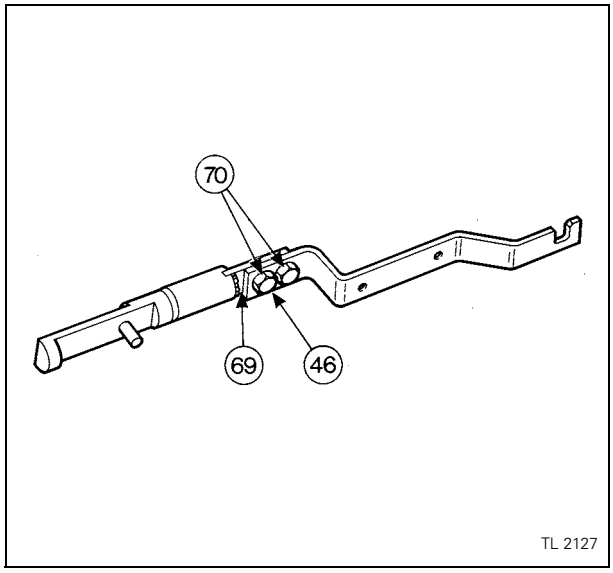
    e. Repeat the above check with a HIGH range, forward gear selected.

Interlock Adjustment

68. Remove the creeper unit, and top cover.
69. Scribe a line on the linkage at the end of the adjustable section as indicated in the illustration.
70. Slacken the two bolts and lengthen the rod by 2 mm, this should be sufficient to overcome the problem. Retighten the nuts and re-install the unit and check its operation as described in procedures 66 and 67.

NOTE: *This procedure must be followed as incorrect setting of the interlock rod could result in only partial engagement of the creeper gear.*

71. Repeat the adjustment procedure until the correct adjustment has been obtained.
72. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the joint between the gearbox cover, shim and creeper unit.
73. Tighten all the creeper unit and gearbox cover bolts to a torque of 112 Nm (82 lbf ft) and nuts to 60 Nm (44 lbf ft), don't forget the switch bracket, wiring clips and cable control bracket.
74. Refit the safety start switch and light switch.



75. Install the gearbox assembly back into the tractor.
76. Reconnect the creeper operating cable and light switch, adjust, *(see operation 1-5B).*

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12 x 12 Creeper Gearbox

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18 x 6 Speedshift Gearbox

Section 5 - Part C

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18 x 6 Speedshift Gearbox

SPECIFICATION

Model	18 Speedshift gearbox.
No of gears:	
Forward	18.
Reverse	6.
Synchromesh type	Strut type.

Settings Required:

Mainshaft end float	0,080-0,30 mm (0.003-0.012 in).
Type of adjustment	Variable thickness thrust washer.
Selector fork setting tolerance	0,25 mm (0.010 in).
Input shaft to clutch pack clearance	0,20-0,45 mm (0.008-0.018 in).
Type of adjustment	Variable thickness thrust washer.
Clutch pack clearance	0,30-0,45 mm (0.012-0.018 in).
Type of adjustment	Variable thickness thrust washer.
Speedshift clutch operating pressure (at 1200 engine rev/min)	22-24 bar (319-348 lbf in^2).
Input shaft bearing dimension (oil cooled clutch)	179,70 - 179,60 mm (7.080 - 7.076 in).

Special Tools:

MF.177A	Input shaft oil seal protector.
MF.218B	PTO bearing housing replacer.
MF.255B	PTO input shaft oil seal replacer.
MF.315A	Needle roller bearing remover/replacer.
MF.367B	Transmission torque wrench.
MF.414	Locating peg.
MF.422A	Bearing, sleeve and oil seal remover.
MF.489	Bearing, sleeve and oil seal replacer.
MF.3008	Circlip plier set.

Bolt Torques:

Range gearbox to gearbox bolts	102 Nm (75 lbf ft).
Rear selector mechanism bolt	60 Nm (44 lbf ft).
Rear selector mechanism nut	30 Nm (22 lbf ft).
Selector fork screws	43 Nm (32 lbf ft).
Safety start switch dummy rail screws	43 Nm (32 lbf ft).
Gear lever extension 12 point screw	60 Nm (44 lbf ft).
Gearbox top cover bolts	112 Nm (83 lbf ft).
Oil filler pipe bolts	60 Nm (44 lbf ft).
Input housing bolts	60 Nm (44 lbf ft).
PTO bearing housing bolts	60 Nm (44 lbf ft).
Gear lever knob screw	3 Nm (2 lbf ft).
Gear lever knob cover screw	12 Nm (9 lbf ft).
Input housing to gearbox - countersunk screw	40 Nm (30 lbf ft).
Scavenge pump housing	40 Nm (30 lbf ft).

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GENERAL DESCRIPTION

The 18 x 6 Speedshift gearbox has 18 forward speeds and six reverse. It is based on a three-speed gearbox with a three-speed range gearbox giving High, Medium and Low speeds. A hydraulic clutch pack is provided to give a Fast/ Slow powershift change-on-the-move facility.

The gearbox has three sections, the front section consists of the Speedshift hydraulic clutch pack and drive arrangement. The Power Take-Off (PTO) input drive is also contained within this section.

The centre section comprises constant mesh gear set giving three basic forward speeds and a single reverse, all fitted with synchromesh engagement.

The rear section, the range gearbox (see section 5D), comprises a three-speed unit giving High - transport speed, Medium - working speed and Low - special low speed for planting etc. The three speeds are again fitted with synchronized engagement.

The gears are all operated by a single gear lever within a gate designed to allow independent operation of the conventional gearbox or the range gearbox. A push button on the gear lever operates the Speedshift in sequence. An additional button is provided on cab tractors adjacent to the hydraulic lift quadrant.

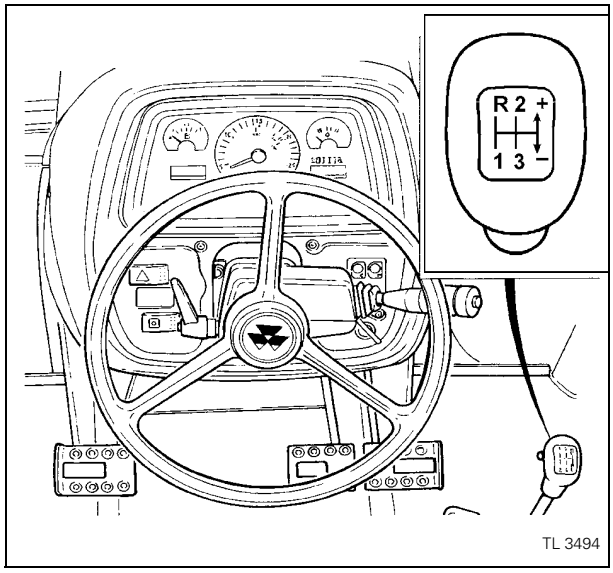
The gears from 1 to 18 have been arranged logically in three groups, 'Low', 'Medium' and 'High'. In each range there are six speeds 1st Slow/Fast, 2nd Slow/Fast and 3rd Slow/Fast.

To select a gear the lever is moved to the right of the gate and then firmly forward, or rearward to select the range required. The indicator light on the instrument panel will show which range has been selected. On releasing the gear lever it will position itself opposite 2nd and 3rd gear.

Depressing the clutch, 1st, 2nd or 3rd gear can then be selected. Speedshift can be selected at any time by pressing the button, an indicator light will show the speed selected 'Fast' or 'Slow'. Engine braking is provided in all gears, including Speedshift 'Fast' and 'Slow'. The tractor can be tow started.

The Speedshift clutch pack is hydraulically controlled by a solenoid valve located on a valve block situated on the left-hand side of the lift cover. When the clutch pack is in its non-energized condition, 'Fast' (high) speed is engaged by the pressure exerted by a large Belleville spring compressing the clutch plates.

When 'Slow' (low) speed is selected, hydraulic pressure is applied to the piston which overcomes the pressure of the large Belleville spring, this releases the 'Fast' speed clutch and engages the 'Slow' speed clutch. The clutch plates for both speeds are compressed through additional Belleville springs so as to control the rate to give a smooth engagement. The selection of 'Fast' speed shuts off the supply of oil, the large Belleville spring takes over releasing one clutch and engaging the other. Oil inside the clutch is returned to the transmission.



Gear shift positions

The hydraulic oil under pressure is regulated by a pressure maintaining valve to a pressure of 24 bar (348 lbf in²). It passes through a non-return valve to the solenoid valve operated by the push button. On the up-stream side of the non-return valve a 400 cc accumulator is fitted to maintain pressure to the Speedshift system during other demands on the hydraulic system i.e. engagement of the independent PTO.

The system is fitted with a low pressure cut-out switch. This protects the clutch from slippage when in slow speed, due to low hydraulic pressure. If low pressure occurs the clutch is automatically shifted to 'Fast' to prevent over-heating and damage.

The centre section, with the three forward and one reverse gear, is a conventional constant mesh gearbox with straight cut gears. Selection being through couplers and synchronizers.

The PTO drive is taken from the split torque clutch, through a set of constant mesh gears to the layshaft, here it passes to the rear of the tractor, lift pump and PTO shaft.

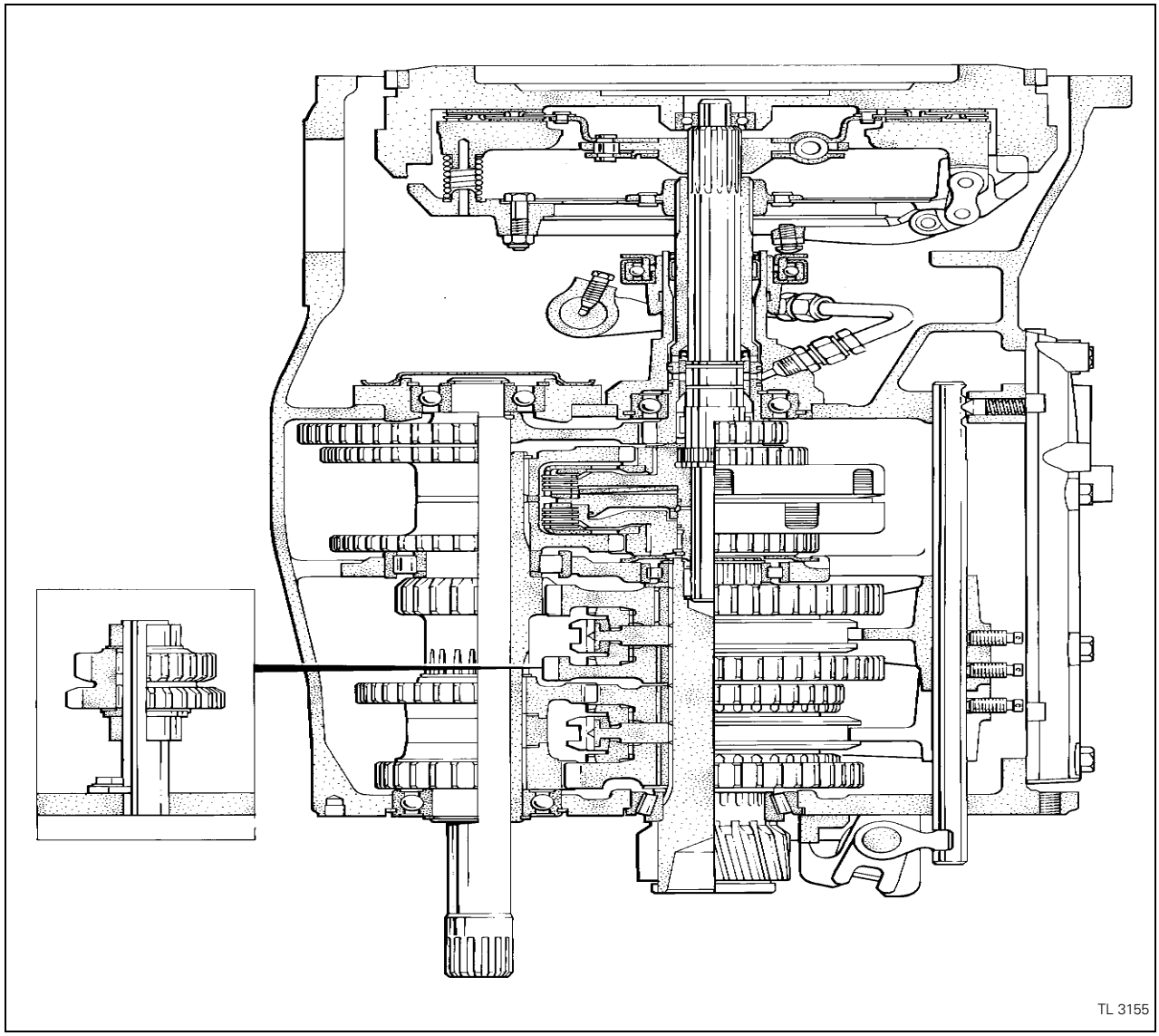
The range gearbox is directly bolted to the rear of the main gearbox forming an integral unit. It is identical to the unit fitted to the 12 x 12 shuttle gearbox. The unit is similar to a conventional gearbox with a main and lay shaft. Three gears provide a direct drive 'High' gear and reduction gears for 'Medium' and 'Low' through the layshaft. All gear selections are through synchromesh couplers.

The range change is selected by moving the main gear lever fully to the right of the gate and moving it forwards or backwards to its limit, depending whether a change up or down is being made. One movement of the lever changes one range. The range selected is indicated by the appropriate indicator light on the instrument panel.

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18 x 6 Speedshift Gearbox



General arrangement of 18 x 6 Speedshift gearbox

1. Main transmission clutch
2. PTO input shaft
3. Clutch release mechanism
4. PTO drive gear
5. Slow speed gear (low)
6. Speedshift clutch pack
7. Fast speed gear (high)
8. First gear (48T)
9. 1st/Rev synchromesh coupler
10. Reverse gear (49T)
11. Third gear (36T)
12. Selector rails and forks
13. 2nd/3rd synchromesh coupler
14. Second gear (42T)
15. Reverse idler
16. Layshaft
17. Fast speed - layshaft gear
18. Slow speed - layshaft gear
19. PTO constant mesh gear
20. PTO front bearing housing
21. Clutch release mechanism
22. Transmission input shaft

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DIAGNOSIS

The Speedshift hydraulic system is controlled by a valve block located on the left-hand side of the lift cover. Non-operation of the Speedshift can only result in three types of failure; mechanical, electrical or hydraulic. Before any repairs are made, either mechanical or hydraulic, tests should be carried out to determine the condition of the hydraulic system. Refer to Section 9C for system diagnosis

GEARBOX

Removal and Refitment 1-5C

Special Tools:
MF.367B Transmission Torque Wrench

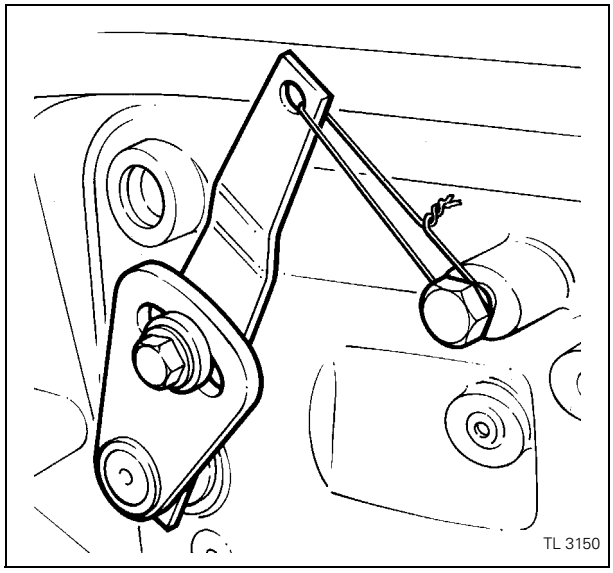
Removal

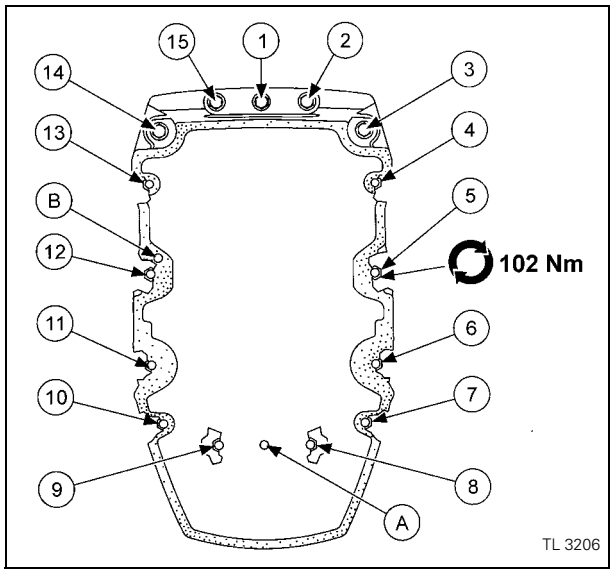
IMPORTANT: *The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and range gearbox.*

1. Split the tractor between the range gearbox and the rear axle *(see operation 3-2A)* in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed, ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the range gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Tie the clutch operating lever back with a piece of wire to retain the clutch release bearing.
6. Support the weight of the main gearbox on the hoist or crane. Position the crane so that the input shafts can be withdrawn out of the clutch.
7. Remove all the bolts around the clutch housing and remove the gearbox taking care not to damage any of the clutch components.
8. Place the gearbox on a suitable bench so that the repair work can be carried out.

Refitment

9. After repair, stand the gearbox vertically on the clutch housing face. Ensure that all gears are in neutral.
10. Ensure that the two dowels 'A' and 'B' on the bottom and side of the range gearbox are in place.
11. Place a new gasket on the mounting face of the main gearbox.





12. Lower the range gearbox into position on the main gearbox. Check that range selector fork engages correctly with the rollers in the back of the cam plate. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

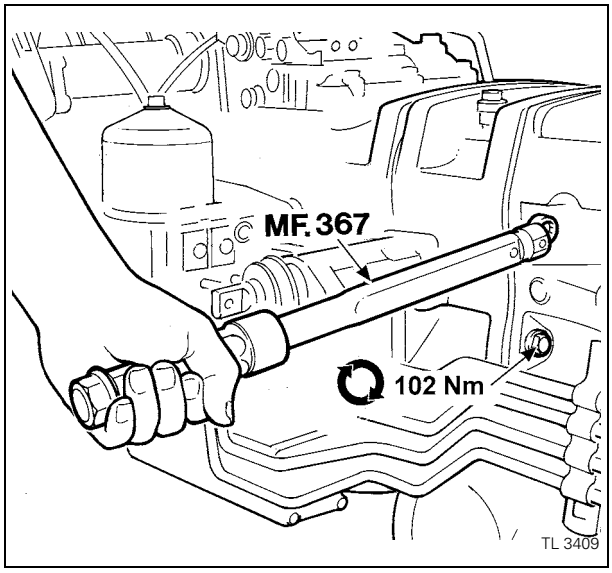
IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure:*

13. Apply Hylomar to the bottom two casing bolts (8 and 9). These are the two short bolts.

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14. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration on the previous page. Use special tool MF.367B, Transmission Torque Wrench, using the 14 mm socket.
15. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
16. Set the main shaft bearing pre-load, *(see operation 3-5D).*
17. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
18. Re-install the engine/gearbox assembly into the tractor.



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MAIN GEARSHIFT LEVER

Removal and Refitment **2-5C**

Removal

1. Remove the three bolts and the guard (Tractors with single fuel tank only).
2. Disconnect the wiring to the push button at the multi-plug connector.
3. Remove the floor mat (cab tractors).
4. Remove the strut bolt.
5. Remove the pivot roll pin.
6. Lift the gear lever up through the floor.

Push Switch

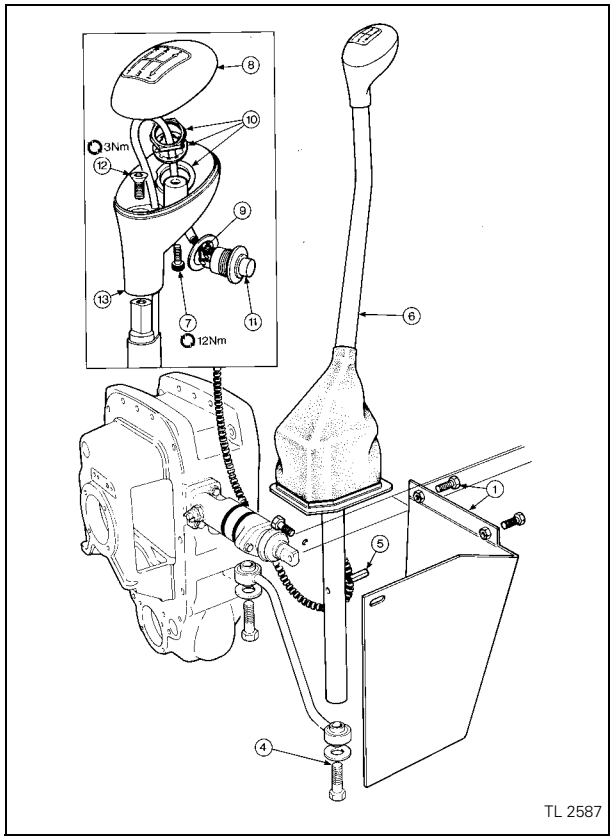
7. Using a 3 mm hexagon key, remove the screw under the gear lever knob.
8. Remove the cap.
9. With the aid of a small electric soldering iron remove the three wires from the push switch.
10. Unscrew the nut and remove the two washers.
11. Remove the switch.

Knob

12. Remove the countersunk screw with a 4 mm hexagon key.
13. Remove the knob.

Refitment

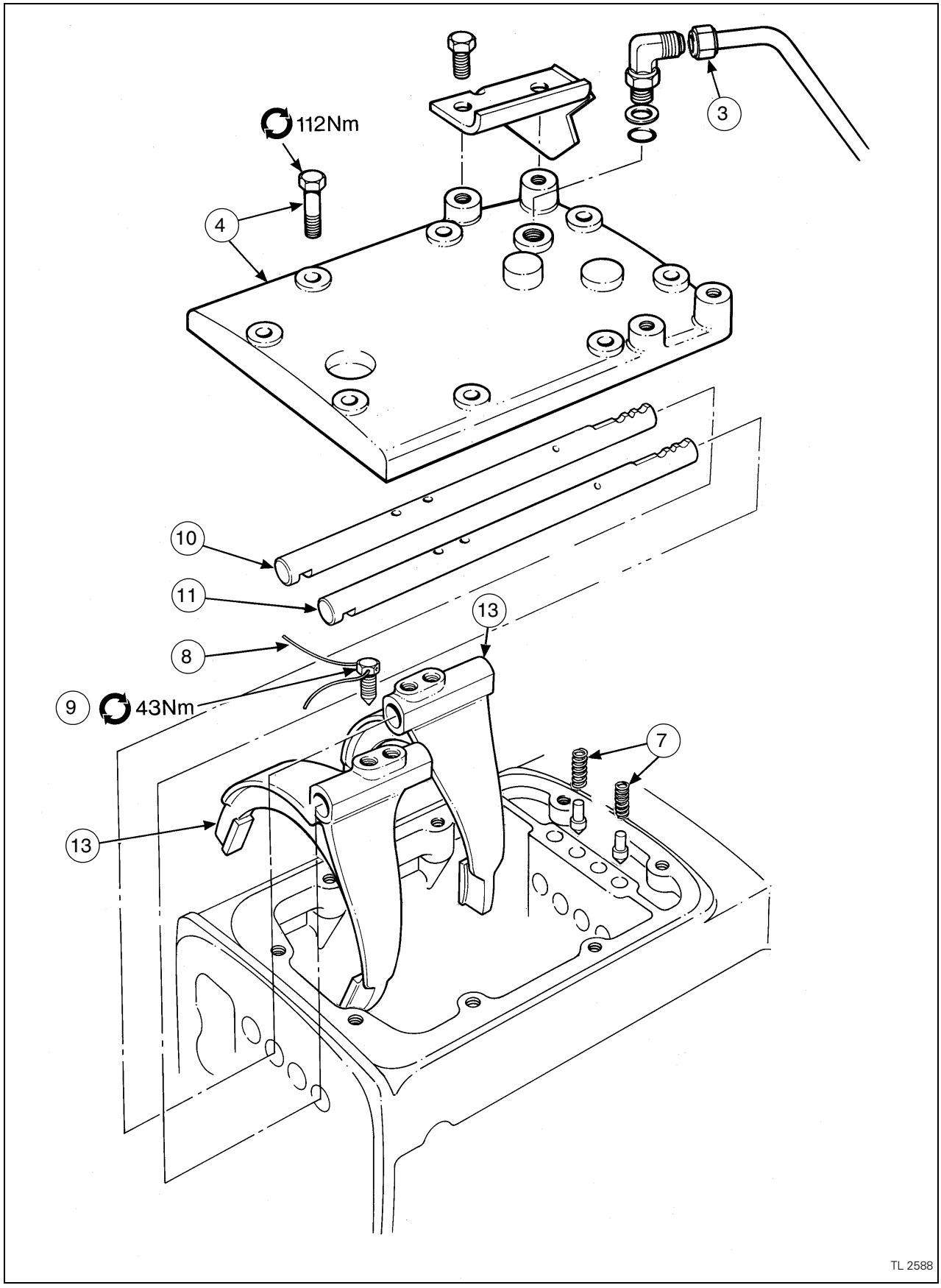
14. Replace the knob, apply two or three drops of Massey Ferguson Lock 'n' Seal (Loctite 222) to the threads of the screw and tighten to a torque of 3 Nm (2 lbf ft).
15. Fit the push switch, fitting the plain washer, lock washer and nut.
16. Pass the wires through the hole in the knob and solder them on to the terminals of the switch. The red wire must be soldered to the central terminal.
17. Pack the wires into the knob ensuring that there will not be a short circuit.
18. Replace the cover and tighten the screw to 12 Nm (9 lbf ft).
19. Reverse procedures 1 to 6 fitting a new roll pin.



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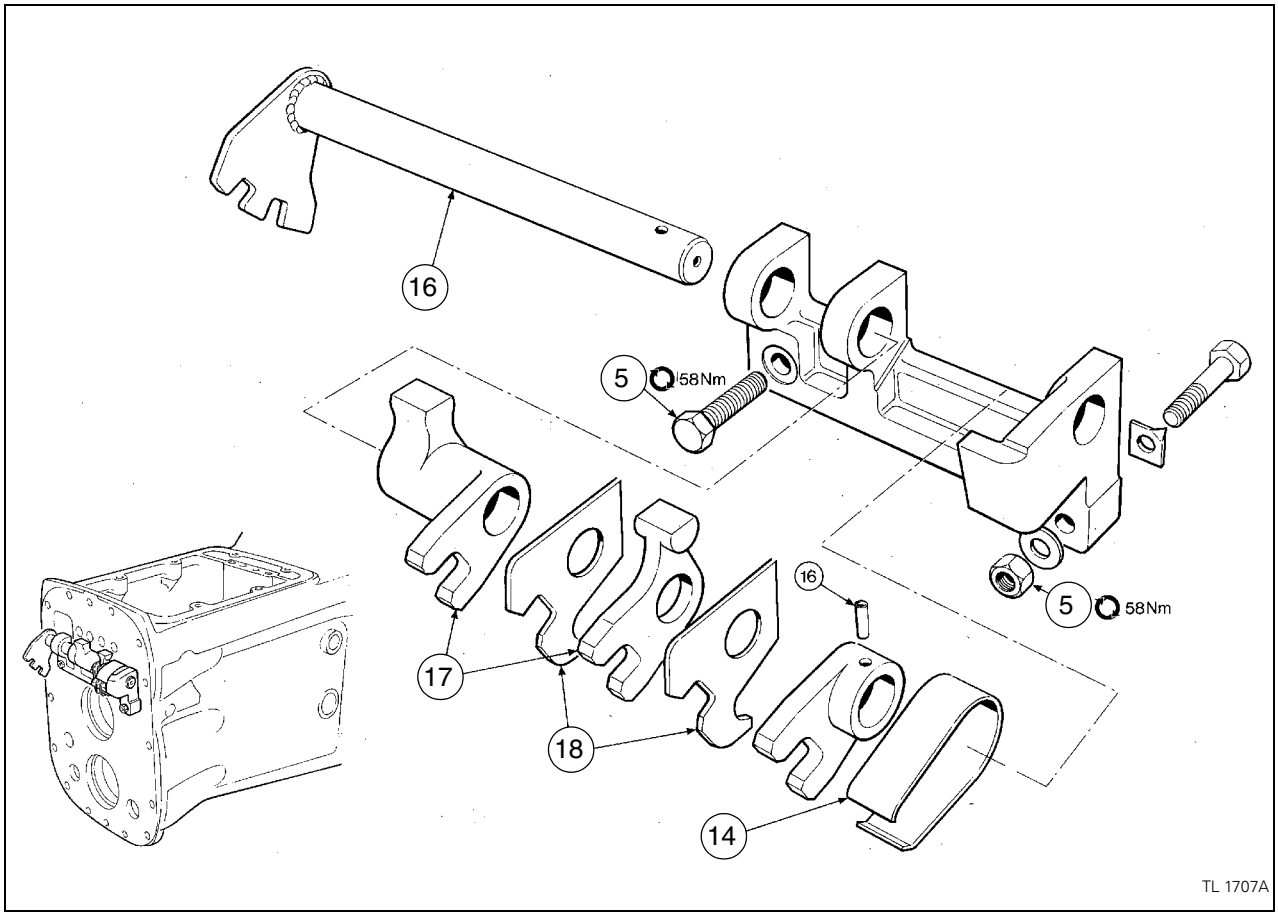
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18 x 6 Speedshift Gearbox



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GEARBOX COVER and SELECTORS

Removal and Refitment 3-5C

Removal

1. Remove the gearbox assembly from the tractor, *(see operation 3-2A)*.
2. Remove the range gearbox, *(see operation 2-5C)*.
3. Disconnect the lubrication pipe.
4. Remove the eight bolts and the gearbox top cover.
5. Remove the bolt and nut from the rear selector mechanism.
6. Remove the selector mechanism assembly.
7. Lift out the detent springs and plungers.
8. Cut and remove the locking wires.
9. Loosen the locking screws on the selector forks.
10. Slide out the 2nd/3rd rail rearwards and remove.
11. Slide out the 1st/reverse rail and remove.
12. Remove the 2nd/3rd selector fork.
13. Remove the 1st/reverse selector fork.

Rear Selector Mechanism

14. Remove the selector return spring.
15. Drive out the roll pin.
16. Withdraw the range selector shaft.
17. Remove the selector levers.
18. Remove the spacer plates.

Refitment

19. Reverse procedures 1 to 18 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. When refitting the detent springs and plungers, assemble them as shown in the illustration.

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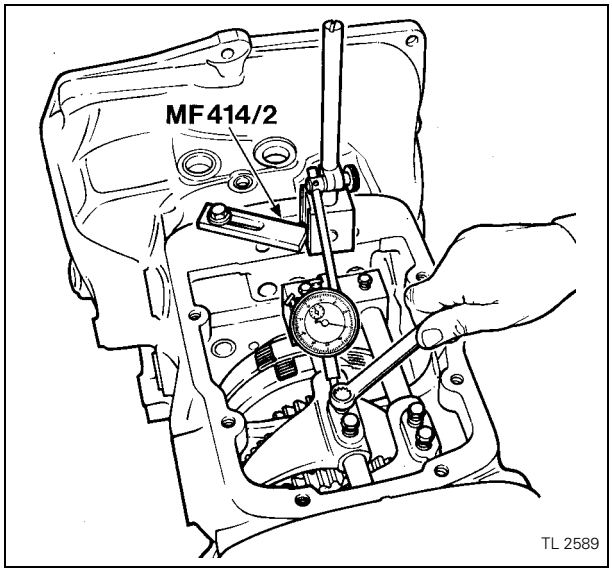
Selector Fork Adjustment

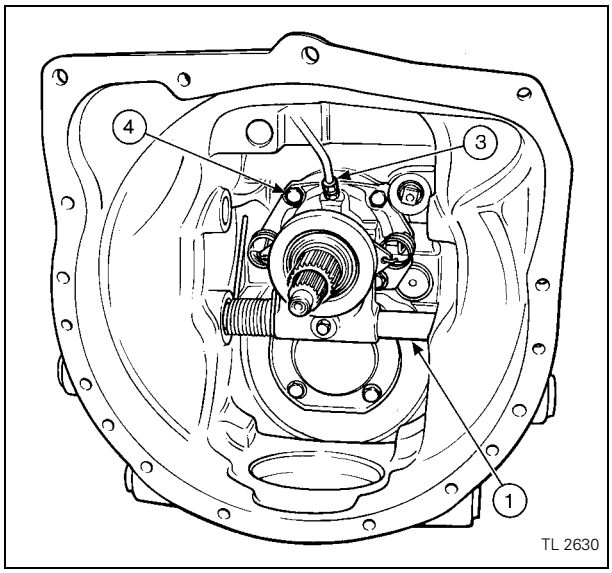
NOTE: *This procedure must be carried out with the range gearbox in place.*

20. Set each selector ring, selector fork and rail to the neutral position.
21. Lock the selector rail in place during the setting procedure using the plate and bolt MF.414/2 part of tool MF.414, Synchromesh Setting Pin.
22. Set up a magnetic base and dial indicator, as illustrated, with the plunger located against the selector fork.
23. Ensure that the locking screws are loose.
24. With finger pressure only, slide the selector fork to the rear taking up any clearance. DO NOT engage gear.
25. Zero the dial indicator and slide the fork fully forward taking up any clearance. Note the reading of movement on the dial indicator.
26. Halve the reading obtained and progressively tighten up the two locking screws to a torque of 43 Nm (32 lbf ft) ensuring that the selector fork is positioned to give the half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).

General

27. Wire-lock all locking screws.
28. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 112 Nm (83 lbf ft)





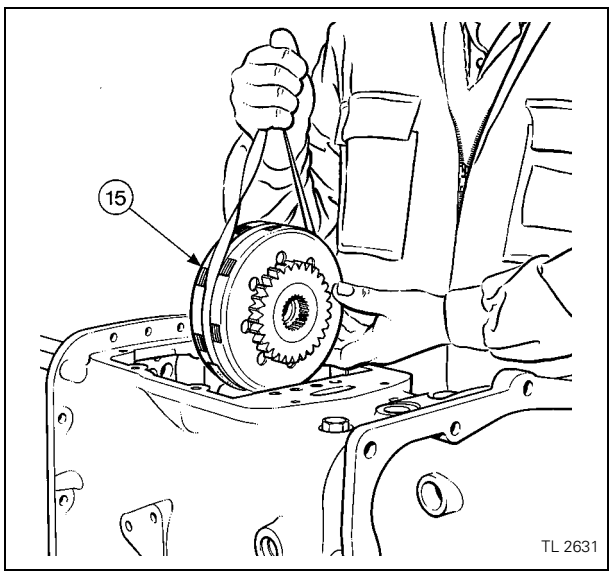
INPUT HOUSING AND CLUTCH PACK

Removal and Refitment **4-5C**

Special Tools:
MF.177A Input Shaft Oil Seal Protector

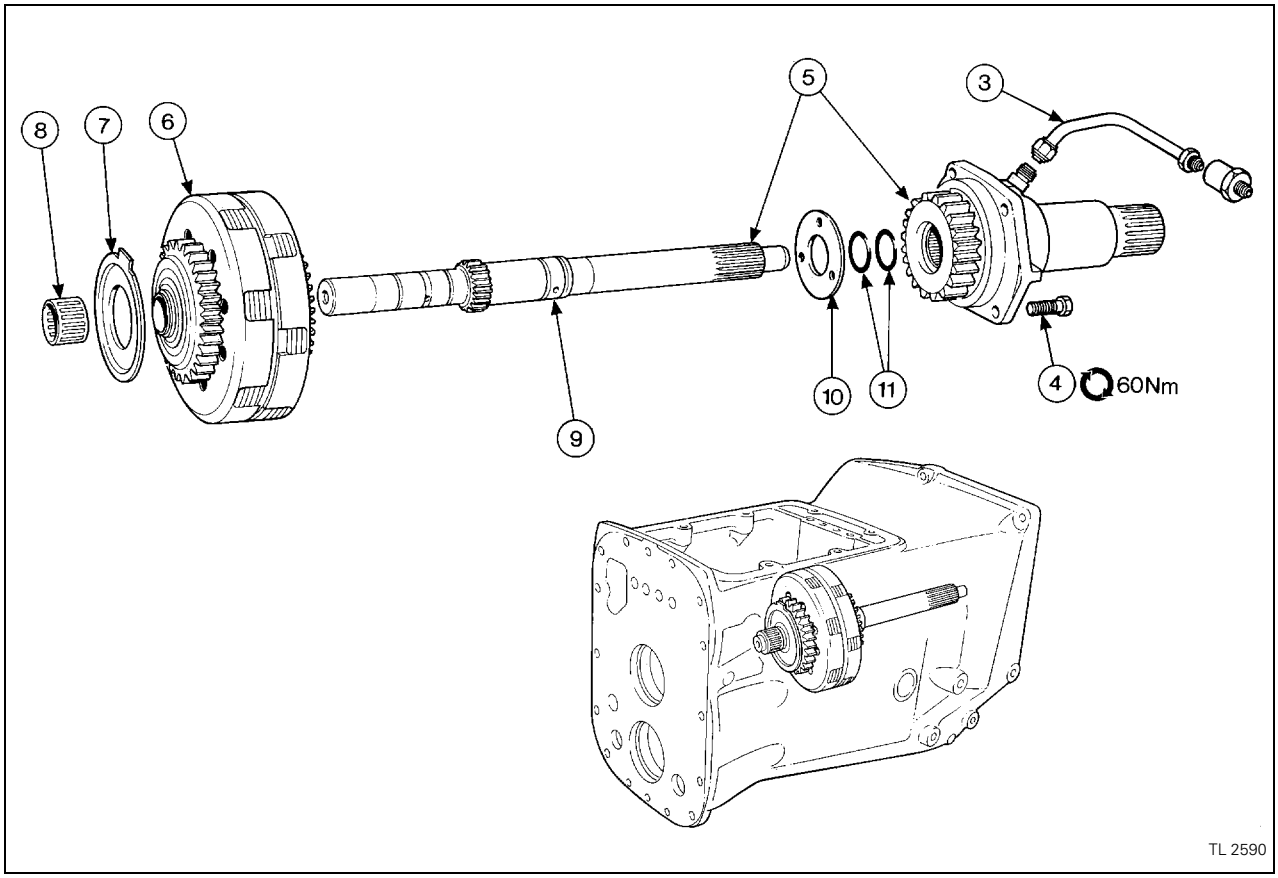
Removal

1. Remove the clutch release mechanism, *(see operation 4-4A)*.
2. Remove the gearbox top and selectors, *(see operation 3-5C)*.
3. Disconnect the oil supply pipe to the clutch pack.
4. Remove the four bolts.
5. Withdraw the input housing complete with the main input shaft.
6. Lift out the clutch pack assembly.
7. Remove the large thrust washer.
8. Remove the input shaft support bearing from inside the main shaft.
9. Remove the input shaft from the PTO pinion.
10. Remove the two sealing rings from the input shaft.
11. Remove the variable thrust washer from the input shaft.



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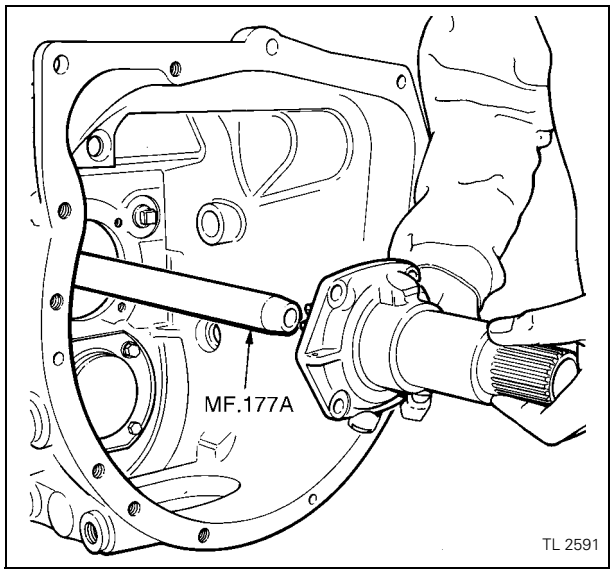
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Refitment

If all the original components are being refitted it is not necessary to carry out the input shaft end float adjustment. When new components are fitted the procedure detailed *(see operation 6-5C)* must be carried out.

12. Refit the needle roller bearing in the gearbox main shaft and the stepped thrust washer.
13. On to the input shaft fit the variable thrust washer with stepped face facing forward.
14. Fit two new seal rings to the shaft and lightly lubricate with clean transmission oil the rings and thrust washer.
15. Wrap some plastic banding around the clutch and lower into the gearbox. Install the thrust washers and input shaft.
16. Place special tool MF.177A, Input Shaft Oil Seal Protector, over the main transmission input shaft on the gearbox. This is to protect the seal inside the PTO pinion from the splines on the shaft and prevent seal leakage.
17. Lightly oil the sleeve.
18. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.

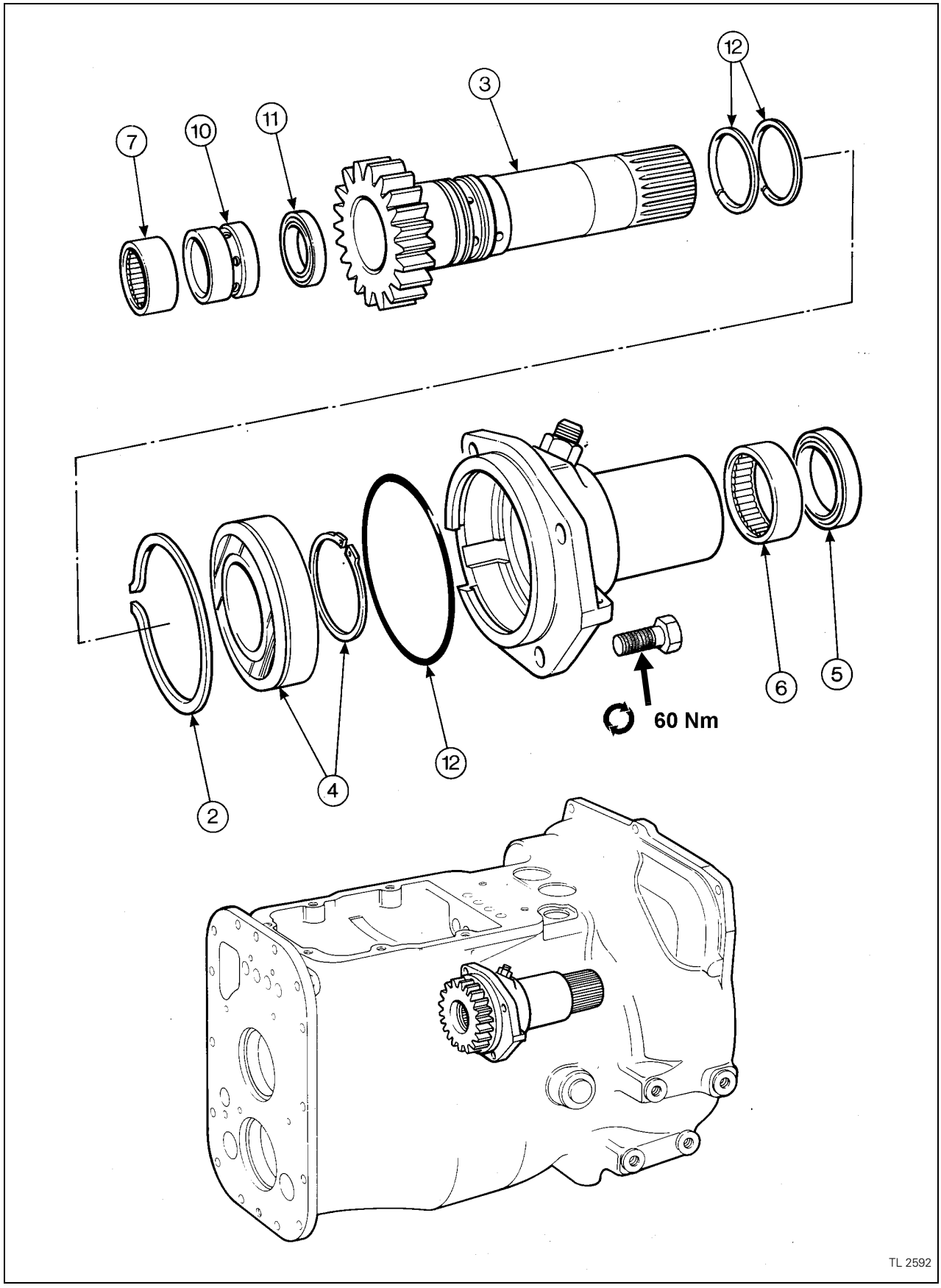


19. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (45 lbf ft).
20. Reconnect the oil feed pipe.
21. Refit the clutch release mechanism, *(see operation 4-4A)*.

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18 x 6 Speedshift Gearbox



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INPUT HOUSING

Overhaul **5-5C**

Special Tools:

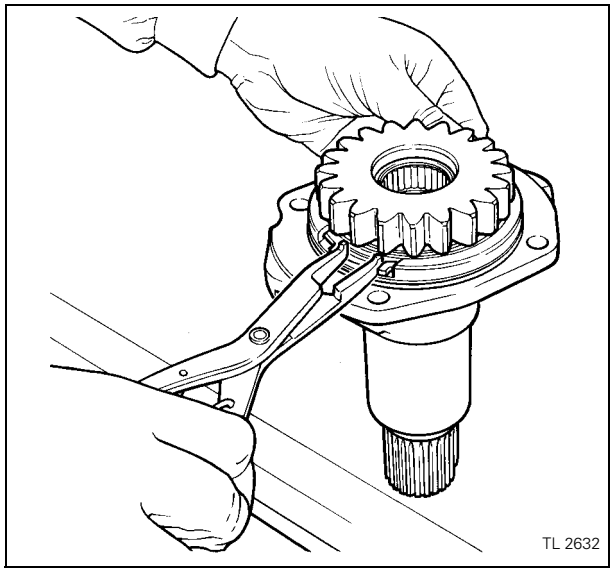
MF.177A Input Shaft Oil Seal Protector
MF.255B PTO Input Shaft Oil Seal Replacer
MF.315A Needle Roller BearingRemover/ Replacer
MF.422A Bearing, Sleeve and Oil Seal Remover
MF.489 Bearing, Sleeve and Oil Seal Replacer

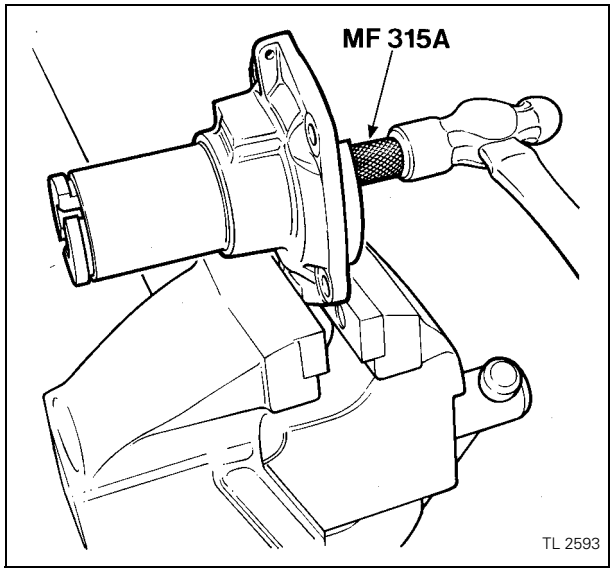
Dis-assembly

1. Remove the input housing, *(see operation 4-5C)*.
2. Open up the large circlip in its groove so that it is clear of the bearing.
3. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
4. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
5. Lever the seal out of the front of the housing.
6. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, drive the needle roller bearing out of the housing.
7. Using special tool MF.422A, Bearing, Sleeve and Oil Seal Remover, remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
8. Fit the cap, lubricate the screw thread, fit the washer and nut.
9. Tighten the nut withdrawing the bearing from the shaft.
10. Repeat the operation using tool MF.422A to extract the sleeve. The step on the collets must be located fully behind the sleeve.
11. Lever out the inner oil seal.
12. Remove and discard the two sealing rings.
13. Remove and discard the 'O' ring.

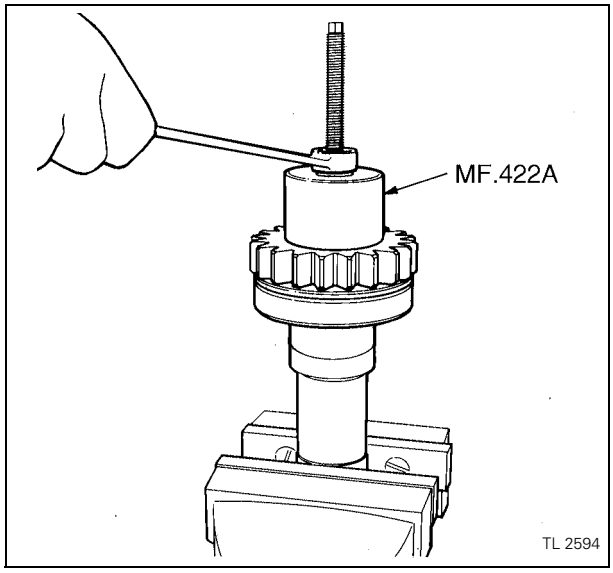
Re-assembly

14. If the ball-bearing has been removed from the PTO shaft, refit the bearing using a new circlip.


TL 2632



TL 2593



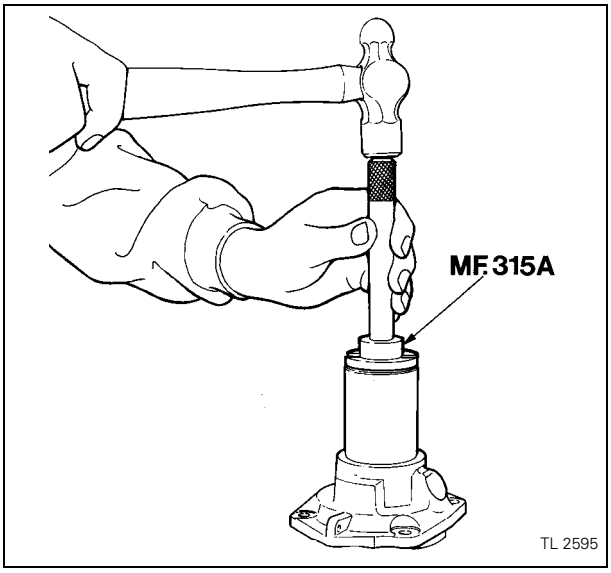
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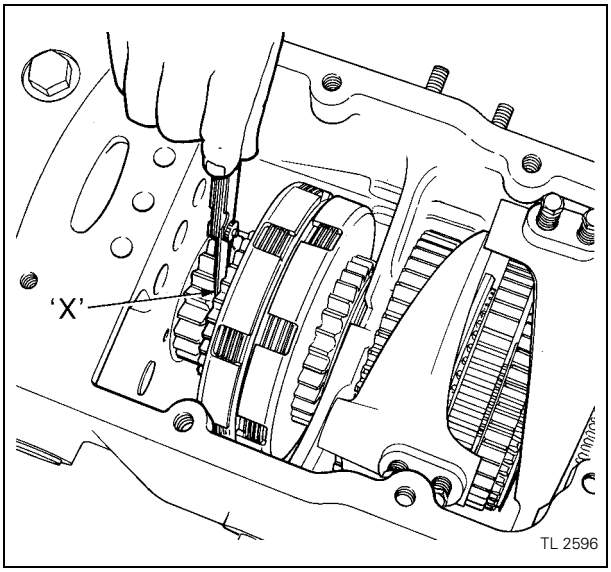
15. Using special tool MF.315A, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.
16. Fit new seals to the PTO input shaft, lightly lubricate with clean transmission oil.
17. Place the large circlip into the groove in the housing.
18. Take care in carrying out this operation to prevent damage to the seals. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.

NOTE: *If any of the major components of the input housing have been replaced, or the clutch pack has been overhauled, it will be necessary to carry out the following adjustment procedure:*

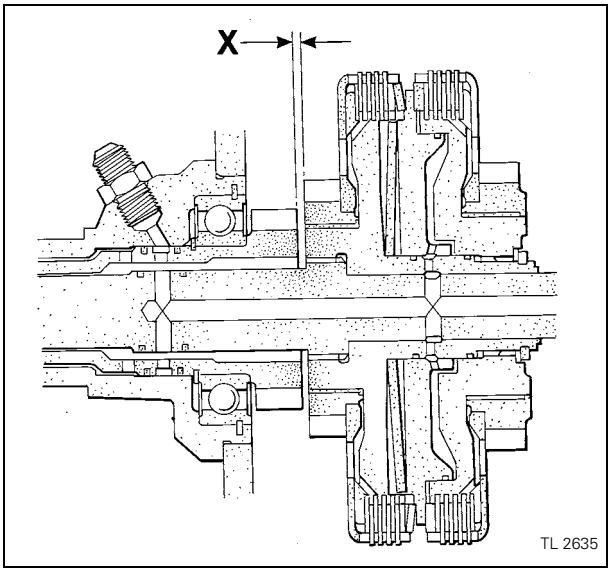


Input Shaft Adjustment

19. DO NOT install the inner seal, sleeve or needle roller bearing in the PTO input shaft.
20. Refit the needle roller bearing into the gearbox main shaft.
21. Install the large thrust washer between the clutch pack and main shaft.
22. Hold the clutch pack in position and refit the input shaft. DO NOT fit the seal rings or front thrust washer.
23. Refit the input shaft housing and bolt it into position.
24. Push the clutch pack rearward, push the PTO input shaft rearward.
25. With the aid of a set of feeler gauges, measure the gap between the face of the PTO pinion and the face of the hub on the clutch pack.
26. From the chart below select a shim to give clearance '**X**' of 0,2-0,45 mm (0.008-0.018 in).



Thrust washer thickness chart		
Part No.	Metric	Imperial
3697 855 M1	2,0 mm	0.079 in
3697 856 M1	2,3 mm	0.091 in
3697 857 M1	2,5 mm	0.099 in
3760 548 M1	2,8 mm	0.110 in
3760 549 M1	3,0 mm	0.118 in



General

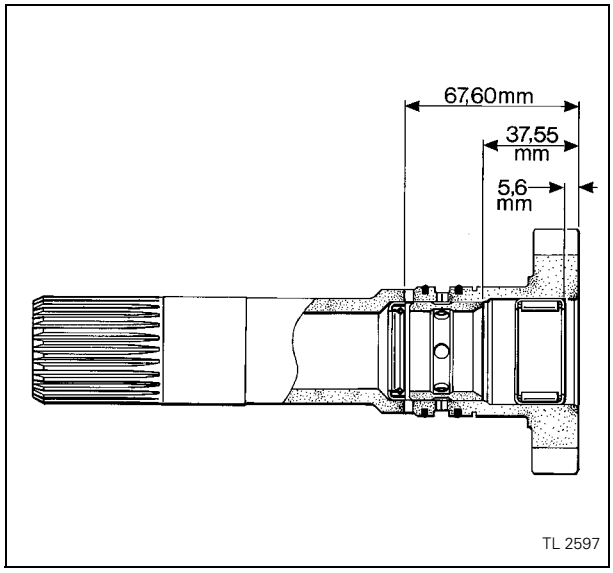
27. Remove the input housing and input shaft.
28. On to the input shaft fit the selected thrust washer with stepped face facing forward.
29. Fit two new seal rings to the shaft and lightly lubricate with clean transmission oil the rings and thrust washer.

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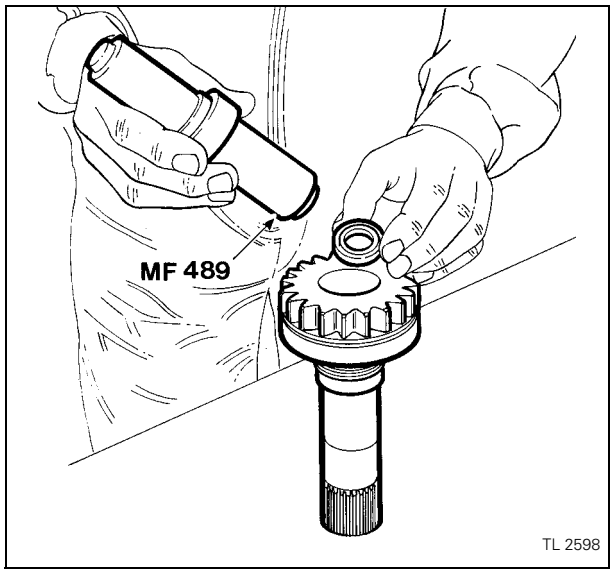
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30. Re-install the thrust washer and transmission input shaft into the gearbox.

IMPORTANT: *The oil seal, sleeve and needle roller bearing must be accurately positioned in the PTO input shaft. Special tool MF.489, Bearing, Sleeve, and oil seal replacer, has been designed to do this. In the event of a tool not being available set to the measurement given in the illustration.*



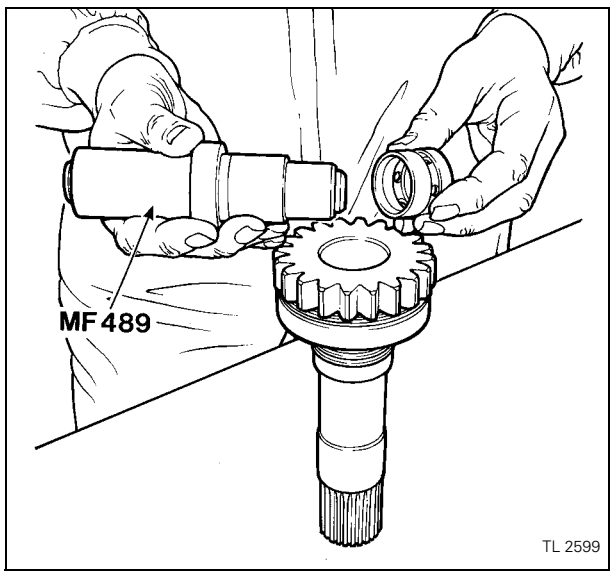
31. Pack the cavity of the small input shaft seal with petroleum jelly.
32. Using special tool MF.489, Bearing, Sleeve, and Oil Seal Replacer. place the seal in the PTO shaft as shown in the illustration and press it into position until the flange on the tool touches the face of the gear.



33. Turn the tool round, place the tool sleeve and the sleeve to be fitted on to the other end.

NOTE: *The sleeve must be fitted with the internal chamfer facing to the rear (gear end).*

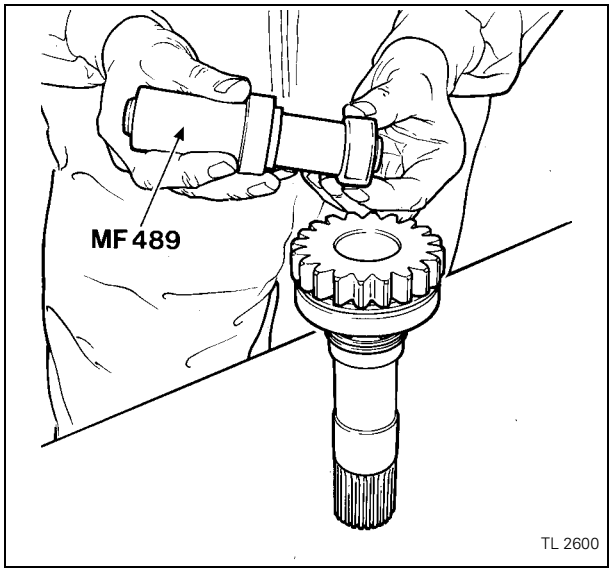
34. Press the sleeve into the PTO shaft until the flange on the tool touches the face of the gear.
35. Remove the tool and sleeve.



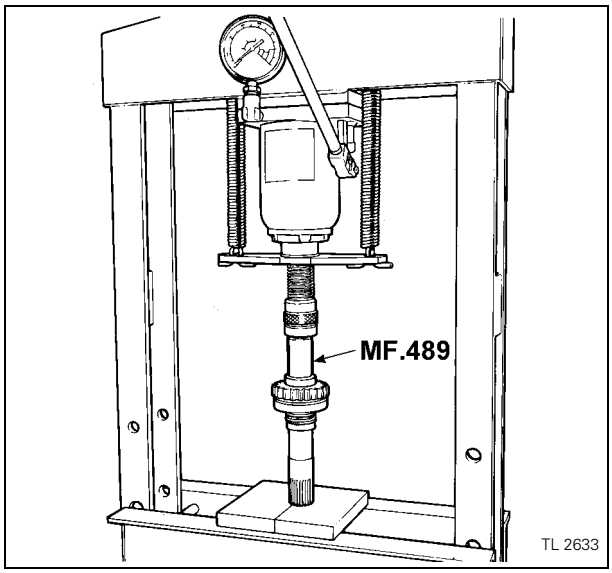
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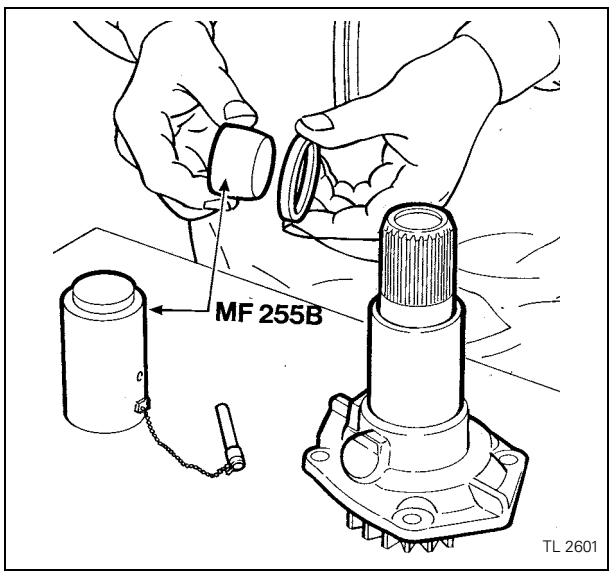
36. Place the needle roller bearing on the same end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.



37. Press the bearing into position up to the flange on the tool.



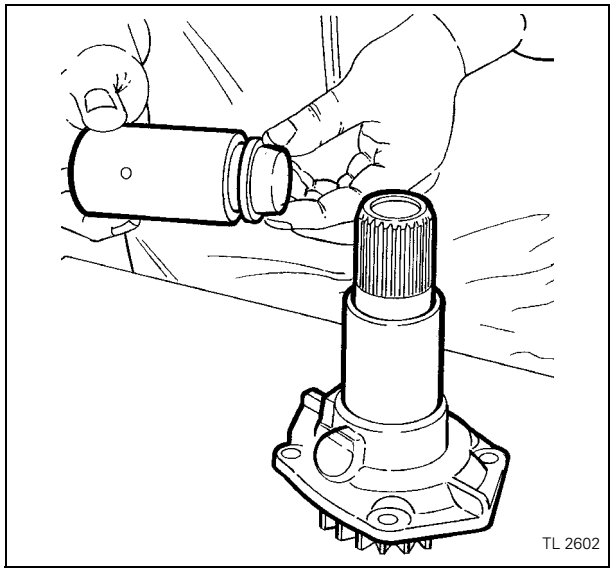
38. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
39. Install the seal using special tool MF.255B, PTO Input Shaft Oil Seal Replacer, to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



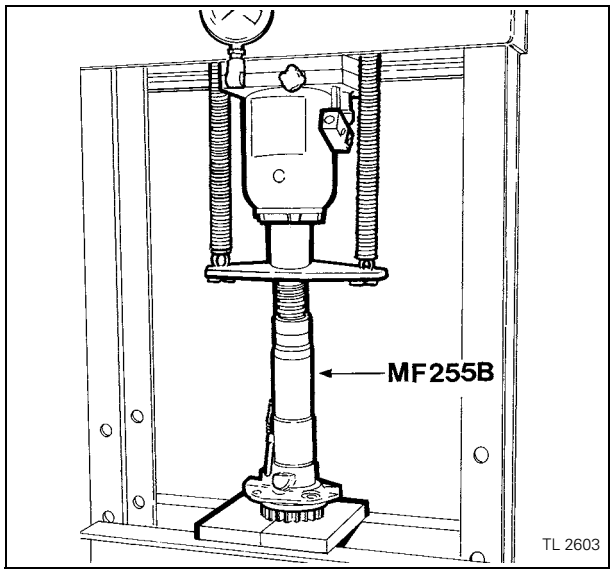
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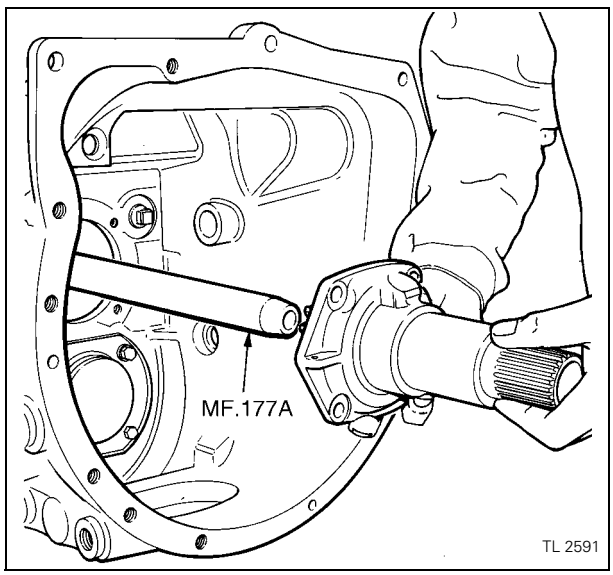
40. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



41. Place the input housing under a light press, place the tool with seal over the PTO input shaft and press the seal into place.
42. Replace the large 'O' ring on the housing.



43. Place special tool MF.177A, Input Shaft Oil Seal Protector, over the main transmission input shaft on the gear box. This is to protect the seal from the splines on the shaft and prevent seal leakage.
44. Lightly oil the sleeve.
45. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
46. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
47. Reconnect the oil feed pipe applying Massey Ferguson Studlock (Loctite 270) to the pipe threads.
48. Refit the clutch release mechanism, *(see operation 4-4A).*



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CLUTCH PACK ASSEMBLY

Overhaul 6-5C

Dis-assembly

1. Remove the clutch pack assembly, *(see operation 4-5C)*.
2. Manufacture a pressing tool as shown in the illustration.
3. Place the clutch pack under a hydraulic press with the rear face upwards.
4. Place the tool over the clutch resting on the face of the hub.
5. Apply hydraulic pressure so that the circlip inside the gear can be removed.
6. Release the pressure slowly, removing the shim.
7. Place the clutch on a clean work bench.
8. Lift off the fast speed gear, cover, piston and hub assembly and put to one side.
9. Remove the outer Belleville spring from the slow speed set.
10. Remove the inner Belleville spring.
11. Remove the cover and gear assembly from the hub.

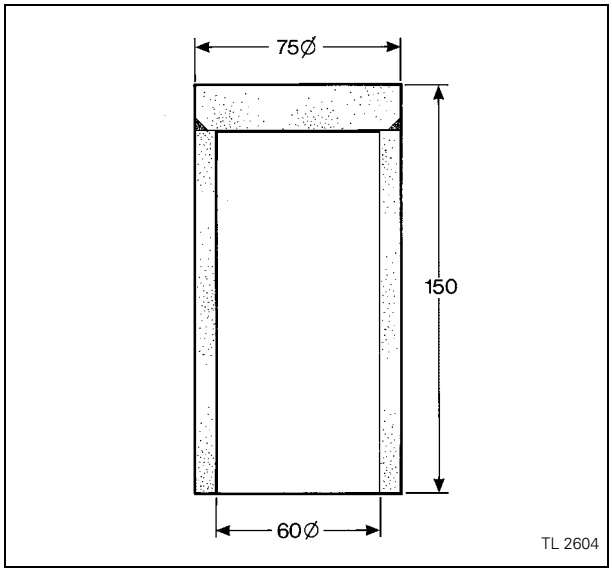
IMPORTANT: *If the clutch plates are to be refitted to the clutch they must be kept in their respective sets and sequence. Note that the last steel plate to be fitted in the set is thicker than the others.*

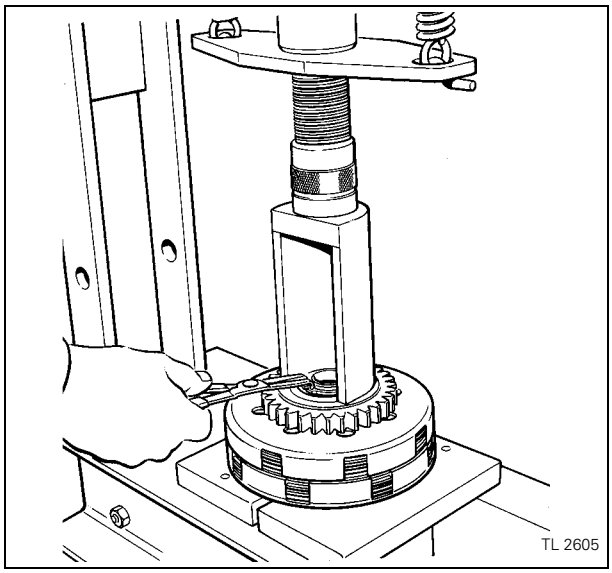
12. Remove the clutch plates.
13. Remove the two 'O' rings from the hub and discard.
14. Taking the fast speed set, carefully prise the piston out of the hub.
15. Remove and discard the 'O' ring.
16. Remove the outer Belleville spring.
17. Remove the cover and gear assembly from the hub.
18. Remove the clutch plates.

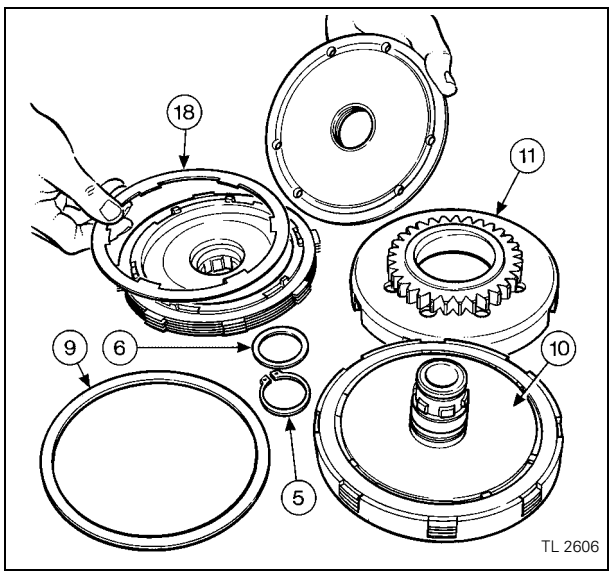
Examination

Examine all the components of the clutch, paying particular attention to the clutch plates. The plates should be flat, not deeply scored (light scuffing is acceptable) and the friction plates must show clear tangential oil grooves on their faces. Check the condition of the piston and its bore for signs of wear or damage.

Thoroughly clean all the components, lightly lubricate the parts during assembly. Replace all seal rings and circlips.

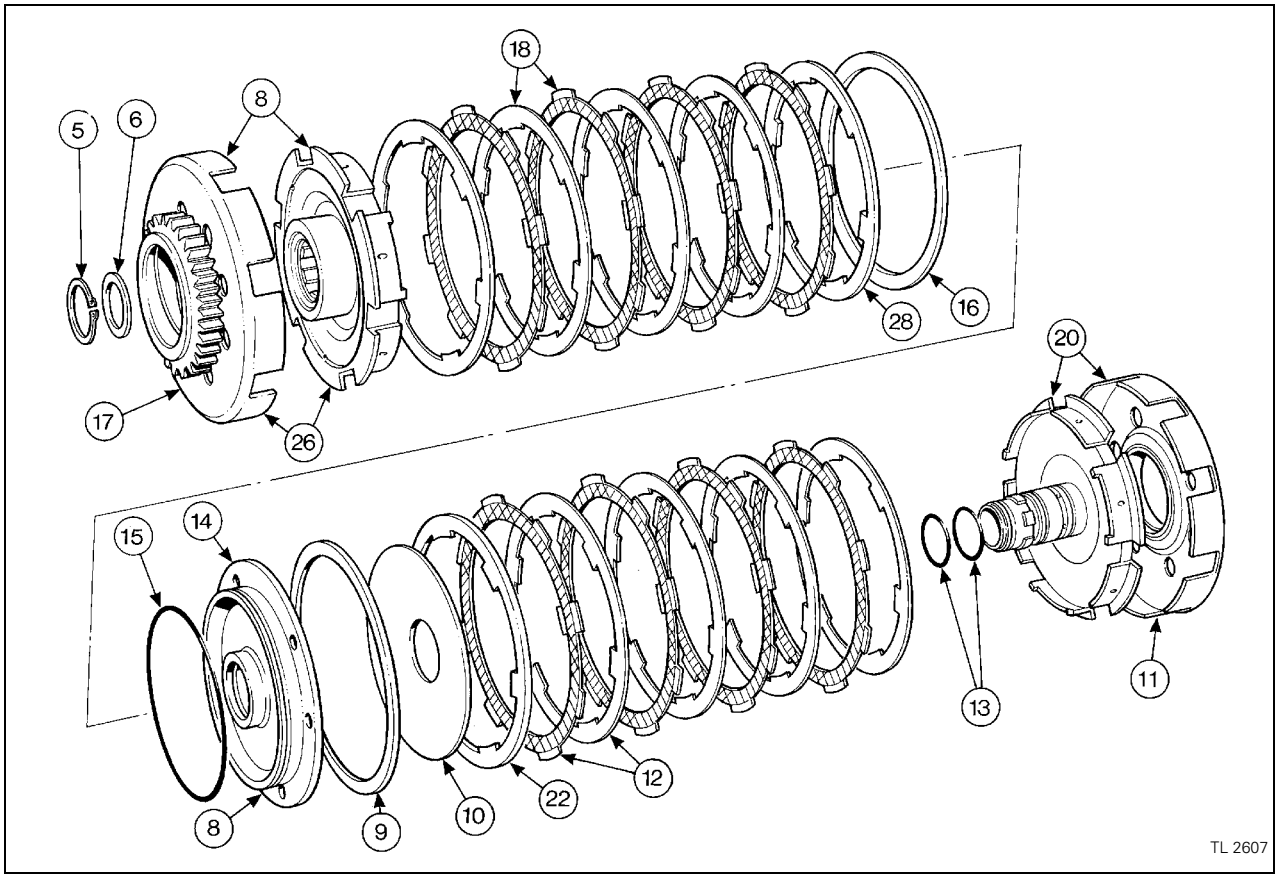






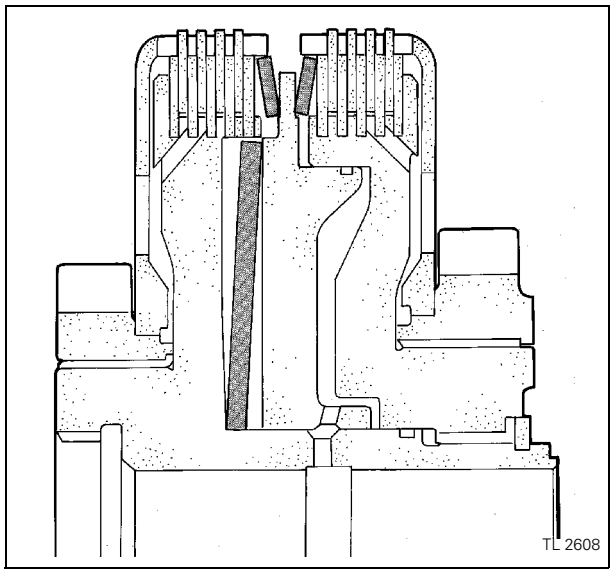
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Re-assembly

19. If new friction plates are to be fitted they should be immersed in transmission oil for 30 minutes before assembly.
20. Lubricate the bore of the front cover, slow speed (smallest gear) and fit the hub. Check that the face of the hub is proud of the gear.
21. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
22. Fit the final steel plate which is thicker.
23. Fit the inner Belleville spring with it resting on its inner edge.
24. Fit the outer Belleville spring with it resting on its outer edge.
25. Carefully fit two new sealing rings to the hub.
26. Taking the rear cover, fast speed (largest gear), lubricate the bore and fit the hub. Check that the hub is proud of the gear.
27. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
28. Fit the final steel plate which is thicker.



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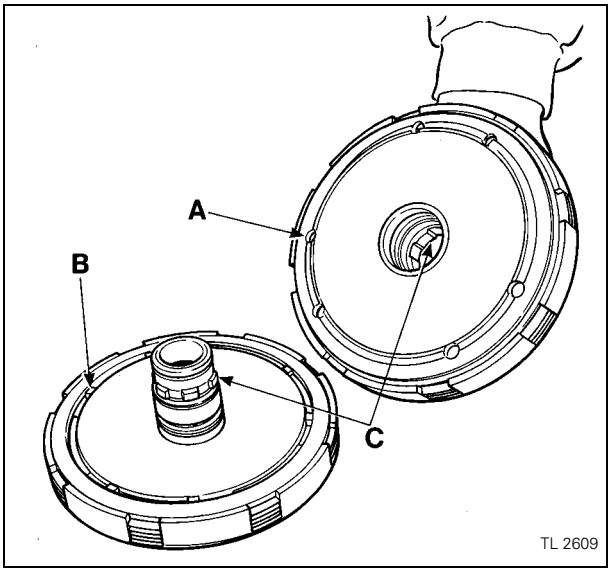
29. Fit the outer Belleville spring with it resting on its outer edge.
30. Replace the piston seal ring.
31. Lubricate the piston with clean transmission oil and locate the piston over the hub. The six projections on the hub must align with the six holes in the piston.
32. With hand pressure, press the piston down into the hub.
33. Lubricate the seals on the front hub with clean transmission oil.
34. Taking the rear clutch pack fit it to the front clutch pack by lowering over the hub. Take care not to damage the seals.
35. The six holes in the piston 'A' must again align with the six pins on the front hub 'B'. The hub has six splines 'C' and the six pins are in three groups of two, there are three positions where the pins will be in line and three positions where they will not.
36. Check that the clutch is located properly and rotates freely.
37. Place the clutch under the press and position the tool on the hub.
38. Press the hub down until the shim and circlip can be fitted.
39. Fit the shim removed as a starting point.
40. Replace the circlip. A new clip must be fitted and it must be fitted with the sharp edge facing outwards.

Clutch Adjustment

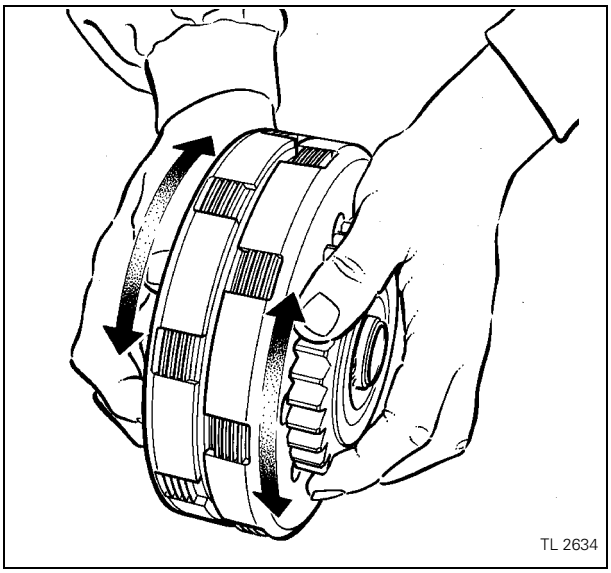
41. Remove the clutch from the press and check it for rotation.
42. Holding the clutch by the two gears try and rotate it. If the clutch is locked solid a thinner thrust washer is required.
43. If the clutch rotates freely a thicker thrust washer is required. The clutch should be able to be turned by hand, but it should be stiff. Thrust washers are available in the following sizes:

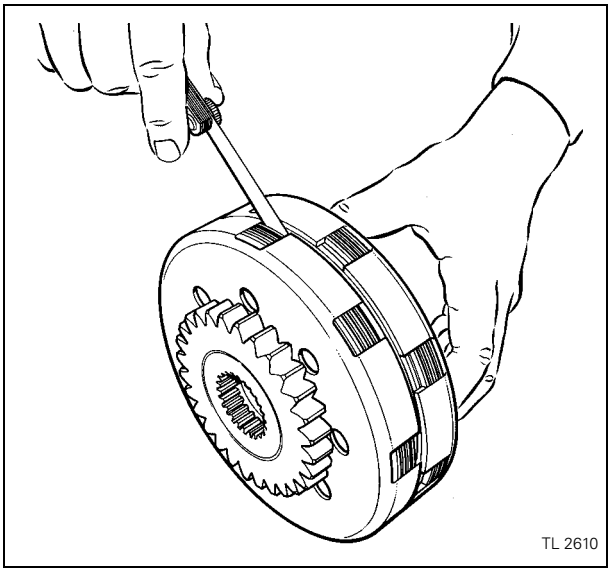
Thrust washer thickness chart		
Part No.	Metric	Imperial
3760 658 M2	1,70 mm	0.067 in
3760 659 M2	1,85 mm	0.073 in
3760 660 M2	2,0 mm	0.079 in
3760 661 M2	2,15 mm	0.085 in
3760 662 M2	2,30 mm	0.091 in

44. Check the clutch internal clearance by using a set of feeler gauges and measuring the gap between the outer Belleville spring and the first steel plate, dimension 'X'.



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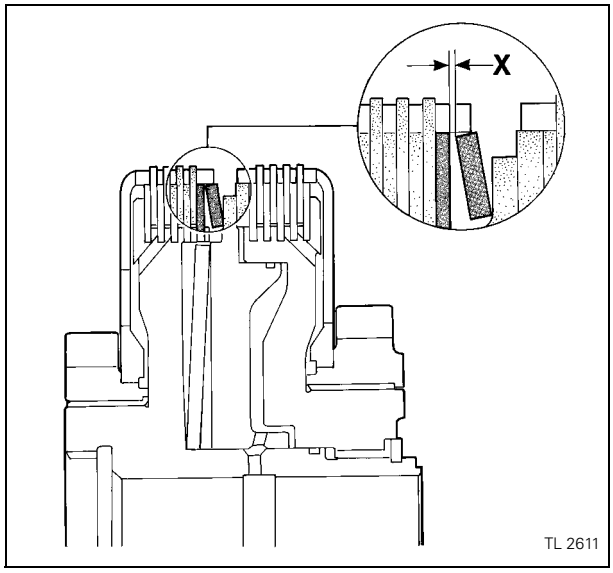

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TL 2610

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45. Check the clearance 'X' in at least eight positions around the clutch. Make a note of each reading, add the readings up and take an average. The average figure should be within 0,30-0,45 mm (0.012-0.018 in). If the reading is less than the tolerance a thinner shim is required, if greater a thicker one.
46. Re-install the clutch into the gearbox.



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PTO DRIVE SHAFT FRONT BEARING

Removal and Refitment **7-5C**

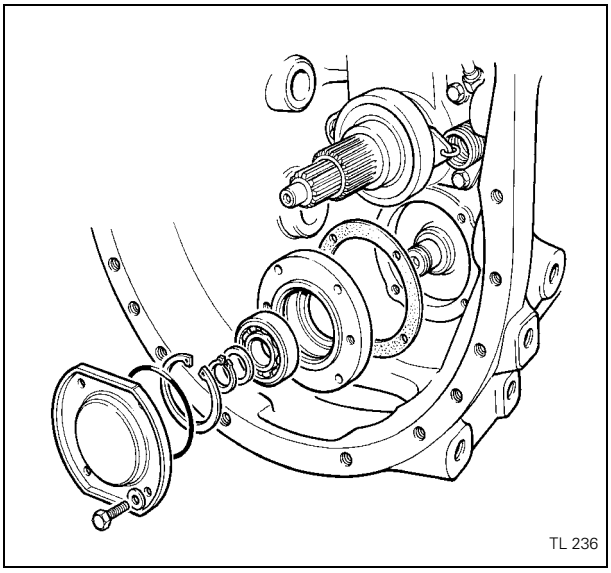
Special Tools:
MF.218B PTO Bearing Housing Replacer

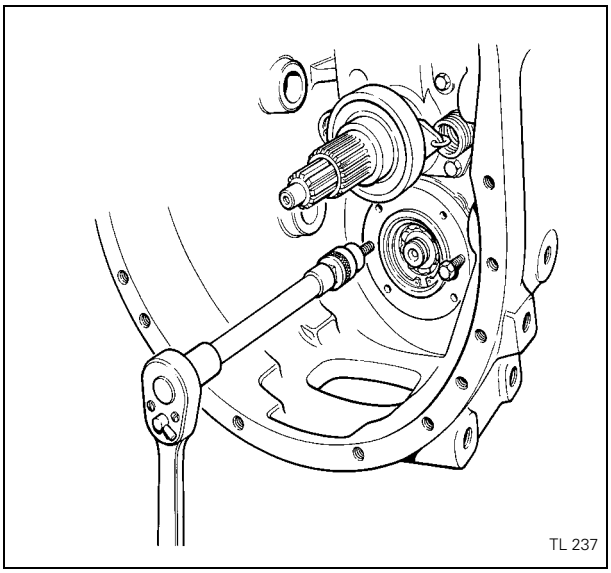
Removal

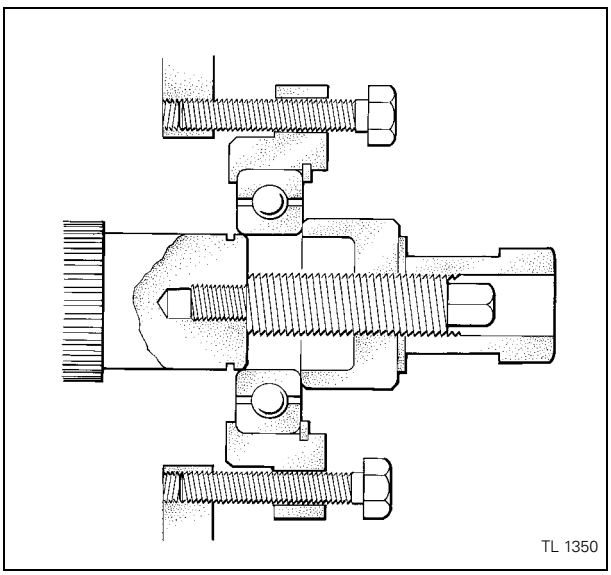
1. Remove the clutch release mechanism, *(see operation 4-4A)*.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 in UNC x 75 mm (3 in) bolts (part of Special Tool MF.218B, PTO Bearing Housing Replacer), into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Discard the internal circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed for overhaul and it is necessary to remove the PTO shaft; screw a 7/16 in UNF bolt approximately 75-100 mm (3-4 in) long into the end of the shaft. Drive the shaft out of the PTO constant mesh gear by striking the end of the bolt with a hammer.

Refitment

12. Lightly coat the gasket with Hylomar sealant.
13. Using special tool MF.218B, PTO Housing Replacer, pull the PTO shaft into the bearing and housing assembly as follows:
14. Check that the PTO shaft splines locate with those in the PTO constant mesh gear.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 in A/F spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft. Locate the housing with the two long bolts provided with MF.218B through the un-threaded holes.
17. Lubricate the thread of the tool and place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and screw on the nut
19. Tighten the nut with a 1,1/8 in A/F spanner until the housing is pushed home and the PTO shaft is drawn through the gear and ball-bearing up to the shoulder so that the washer and circlip can be fitted.
20. Fit the washer and a new circlip.

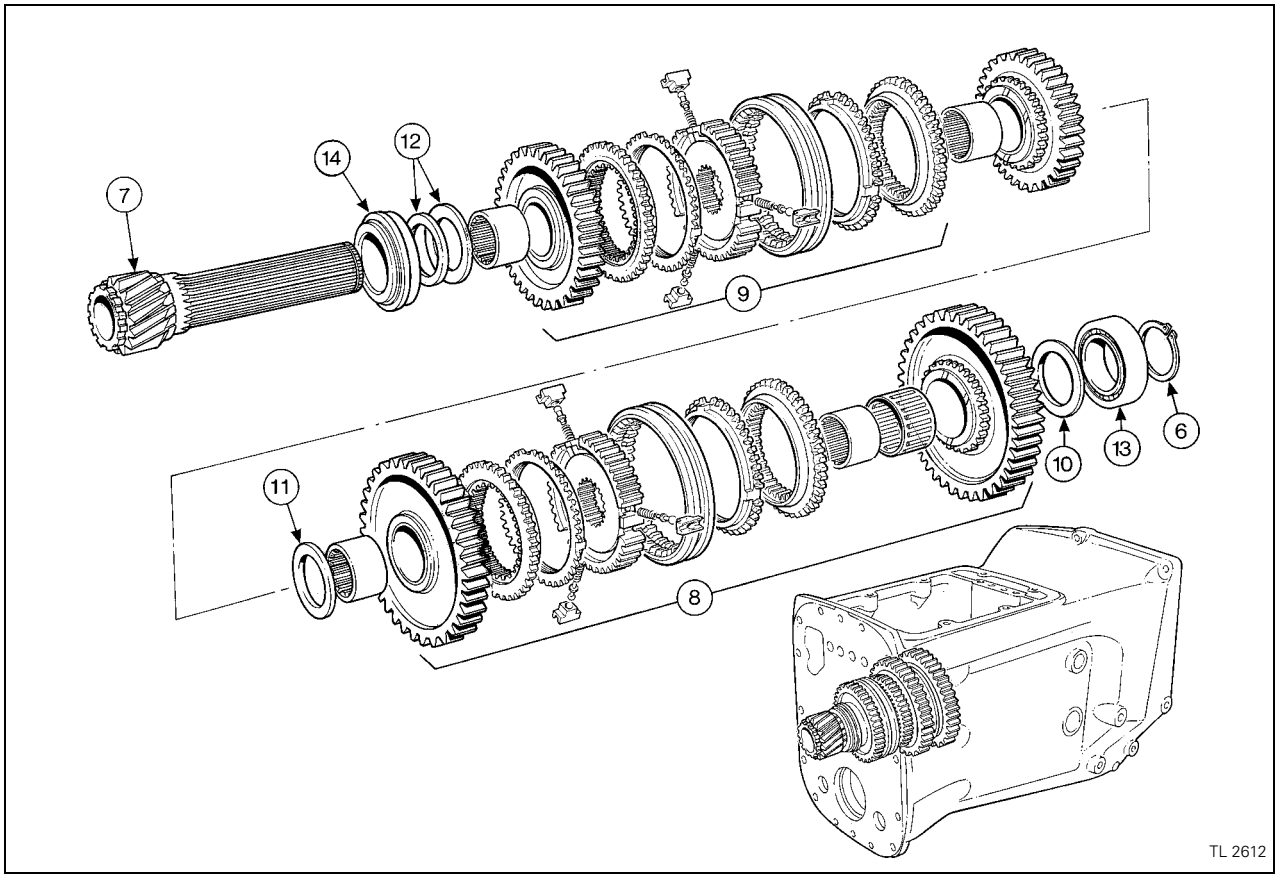

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21. Refit the cover with a new 'O' ring.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 60 Nm (44 lbf ft).

LAYSHAFT, MAINSHAFT, PTO and GEARS

Overhaul **8-5C**

Special Tools:
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the gearbox and range gearbox assembly from the tractor, *(see operation 1-5C)*.
2. Remove the range gearbox from the gearbox, *(see operation 1-5C)*.
3. Remove the clutch release mechanism, *(see operation 4-4A)*.
4. Remove the top cover and selector rails and forks, *(see operation 3-5C)*.
5. Remove the input housing and clutch pack assembly, *(see operation 4-5C)*.

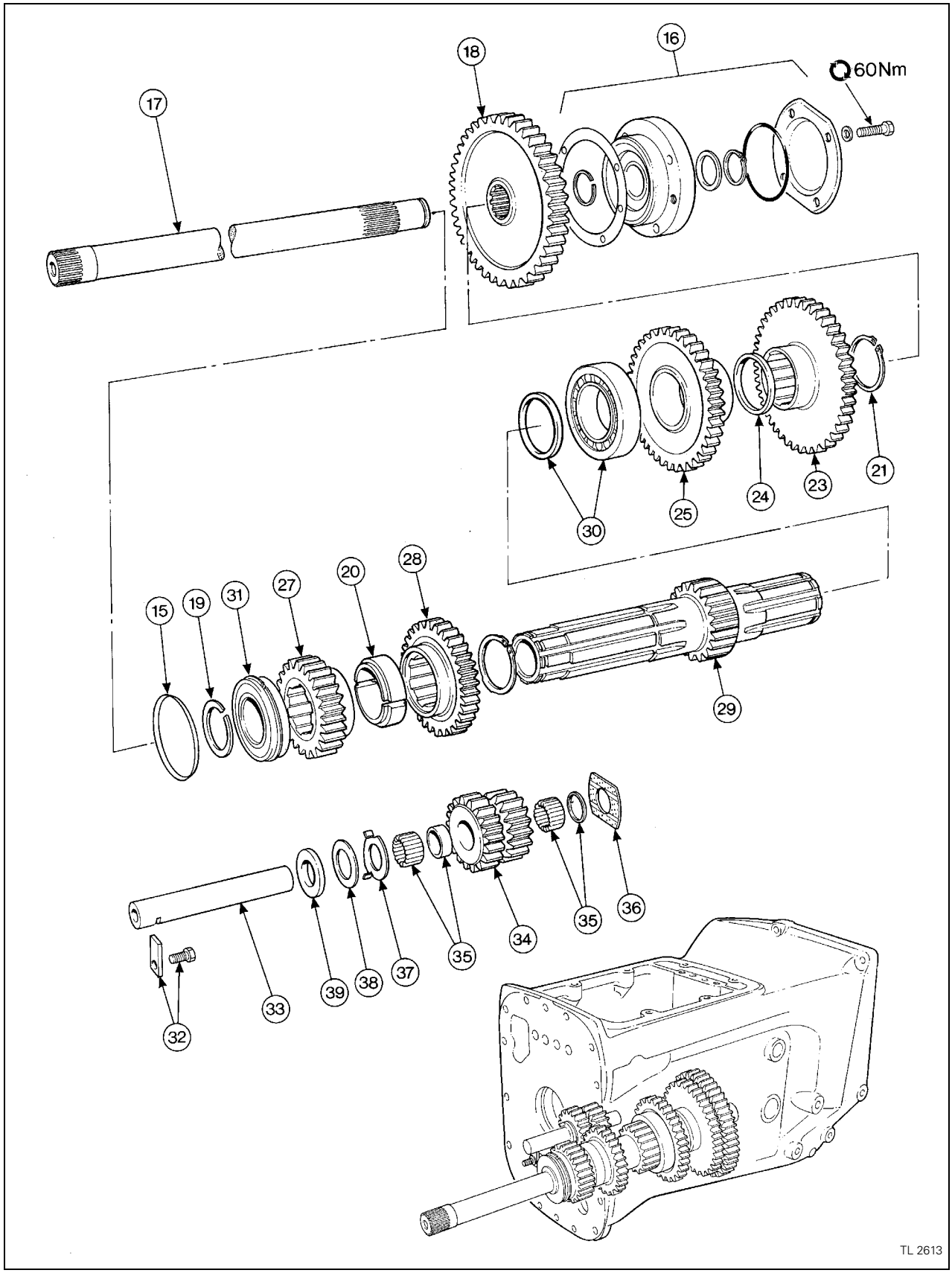
Mainshaft

6. Using one of the circlip pliers from the MF.3008 Circlip Plier Set, remove the circlip from the front of the main shaft.
7. Pull the main shaft out of the gearbox from the rear, complete with the rear thrust washer and spacer. Allow the gear sets to rest on the layshaft, the thrust washers will fall into the bottom of the box.
8. Lift out the 1st/reverse gear set.
9. Lift out the 2nd/3rd gear set.
10. Retrieve the measured thrust washer.
11. Retrieve the intermediate washer.
12. Remove the rear thrust washer and spacer.
13. Remove the front roller bearing from the gearbox casing.
14. If necessary, press the rear taper roller bearing off the mainshaft.

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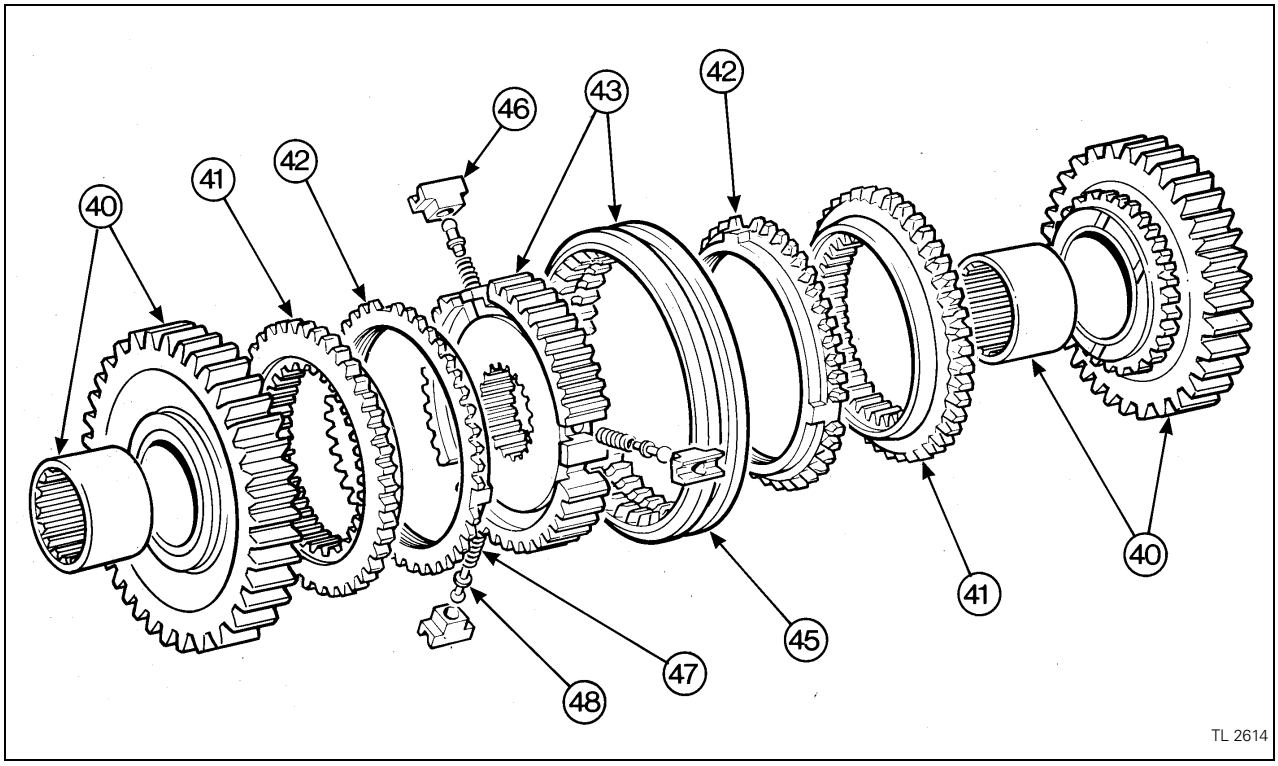
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18 x 6 Speedshift Gearbox



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Layshaft

15. Remove the compression ring from the rear bearing.
16. Remove the PTO drive shaft front bearing, *(see operation 7L-08)*.
17. Remove the PTO shaft.
18. Move the layshaft rearwards and lift out the PTO constant mesh gear.
19. Remove the rear circlip.
20. Drive the layshaft towards the front, separate 2nd and 3rd gear and lift out the two halves of the spacer.
21. Remove the front circlip.
22. Drive the layshaft to the rear to give sufficient clearance to lift out the Fast and Slow constant mesh gears.
23. Remove the slow speed gear.
24. Remove the spacer.
25. Remove the fast speed gear.
26. Drive the layshaft out of the gearbox casing from the rear.
27. Lift out 2nd gear.
28. Lift out 3rd gear.
29. Remove the shaft from the front of the box complete with the front roller bearing.
30. If necessary, remove the front bearing from the shaft with the spacer.
31. Remove the rear ball-bearing from the gearbox.

Reverse Idler

32. Remove the bolt and locking plate from the inside of the box.
33. Hold the gear cluster and carefully push out the shaft.
34. Remove the gear cluster.
35. Tip the 56 rollers and spacers into a clean container.
36. Remove the thrust washer.
37. Remove the tabbed thrust washer.
38. Remove the belleville spring washer.
39. Remove the collar.

Synchromesh Assemblies

40. Remove the two gears and sleeves. In the case of 1st gear, the needle roller bearing.
41. Remove the two synchromesh cones.
42. Remove the two baulk rings.
43. Remove the drive hub complete with sliding coupler.
44. Wrap the hub and coupler in a cloth.
45. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
46. Remove the three pressure blocks.
47. Remove the three pressure springs.
48. Remove the three ball pins.
49. Thoroughly clean all the components and check their condition.

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50. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in) replace the brass baulk ring.

Examination

51. Clean and thoroughly inspect all parts for signs of wear or damage and replace if necessary. Renew all snap rings, circlips and 'O' rings. When replacing snap rings and circlips ensure that they are correctly located in their grooves.

Re-assembly

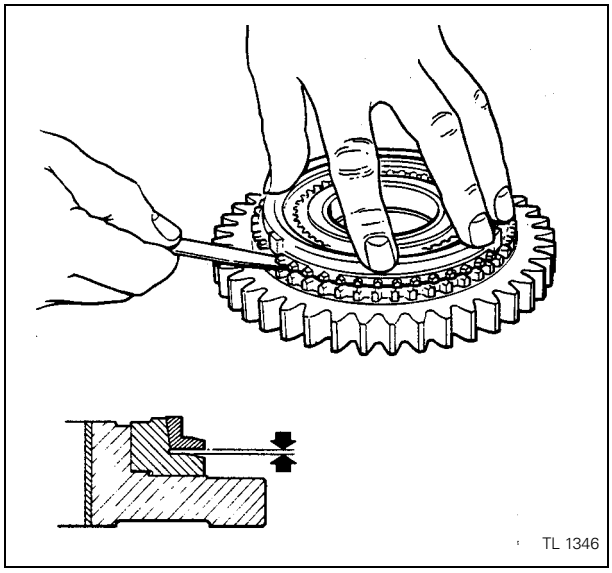
Synchromesh Hub Assemblies

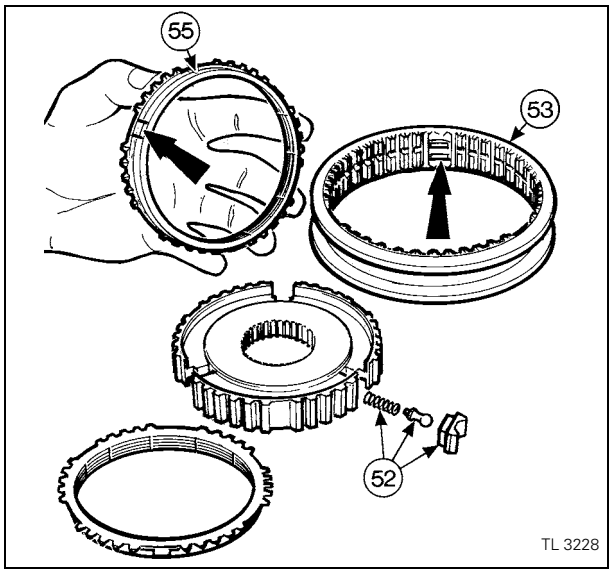
52. Place the hub on a work bench and insert the three springs, ball pins and pressure blocks.
53. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
54. Press the coupler down into place easing the spring-loaded blocks into position.
55. Position the baulk rings so that the locating blocks fit into the slots in the hub.
56. Fit the synchromesh cones to the 1st (48T), 2nd (42T), 3rd (36T) and reverse (49T) gears.
57. Fit the sleeves to the gears.
58. Complete the two synchromesh assemblies by placing the gears each side of the hubs (1st/Rev - 3rd/2nd) ready for installation.

NOTE: *1st/rev synchromesh has the smaller outside diameter sliding coupler (53).*

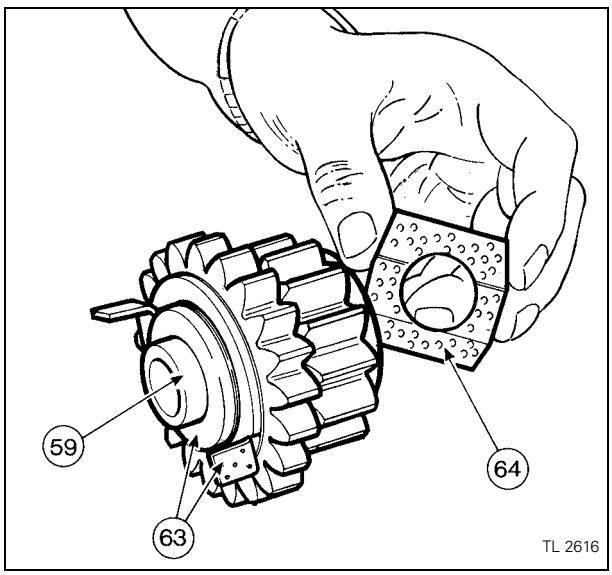
Reverse Idler

59. An assembly tool will greatly assist in fitting the reverse idler into the gearbox casing. Obtain a length of steel bar 25 mm diameter x 58 mm long. (1 in dia. x 2.5/16 in long).
60. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly (not grease) will help to retain them. There is a double row of 28 rollers with the wide spacer between them.
61. The narrow spacer is fitted to the front in line with the small gear.
62. Insert the assembly tool into the gear to hold all the rollers in place.
63. Fit the Belleville spring washer to the collar with the dished face facing the tabbed thrust washer and gear.
64. Fit the front thrust washer with the brass face facing the gear.
65. Insert the idler assembly into the gearbox casing. Refit the shaft pushing out the assembly tool in the process.


TL 1346



TL 3228



TL 2616

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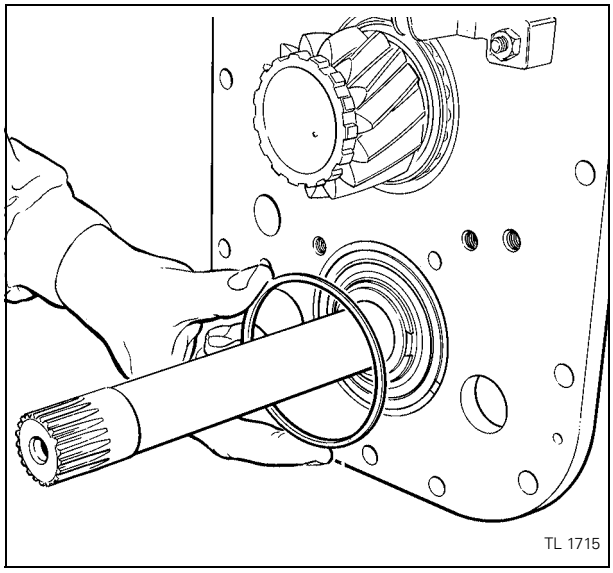
66. Apply two or three drops of Massey Ferguson Lock 'n' Seal (Loctite 222) to the retaining bolt and fit the lock plate and washers.

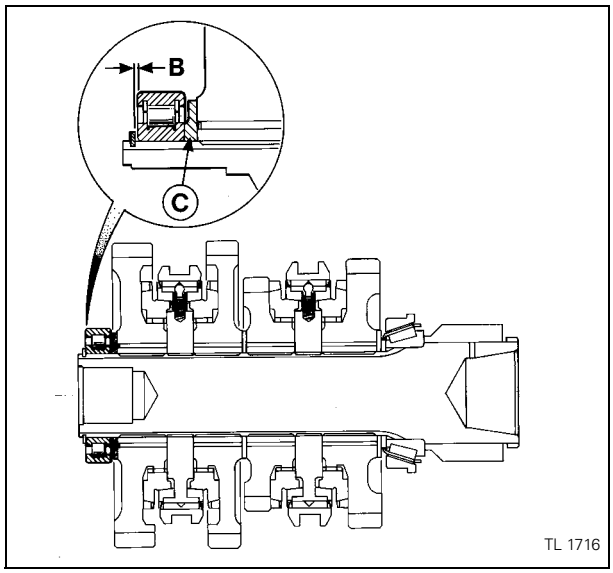
Layshaft

67. Replace the circlip in the centre of the shaft.
68. Fit the spacer (which is part of the bearing) to the shaft first. Press the front roller bearing onto the shaft, if removed.
69. Place the 2nd (27T) and 3rd (33T) gears in the bottom of the gearbox. The smaller gear to the rear.
70. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
71. Fit the 3rd and 2nd layshaft gears.
72. Push the layshaft rearwards so that the roller bearing is in the centre web and the shaft is fully rearwards.
73. Slide on the fast speed gear (the smallest of the two).
74. Fit the spacer.
75. Slide on the slow speed gear (the largest).
76. Replace the circlip on the front of the layshaft.
77. Move the layshaft forward so that the two gears 2nd and 3rd can be separated and the split spacer fitted.
78. Move the layshaft rearward again with the front roller bearing in its housing. Place a steel wedge, or suitable packing, between the front end of the layshaft and the inside of the gearbox casing.
79. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
80. Remove the wedge or material from the front of the gearbox.
81. Replace the rear snap ring and ensure that the layshaft is fully forward.
82. Ensure that the layshaft turns freely.
83. Place the PTO constant mesh gear in place in the front of the box.
84. Refit the PTO shaft and bearing housing, *(see operation 8-5C)*.
85. Fit the rear bearing retainer spring ring.

Mainshaft End Float Adjustment

86. Assemble the mainshaft complete with all hubs, gears bearings and thrust washers.
87. Refit the circlip.
88. Measure gap 'B' between the front bearing and the circlip. The gap (end float) should be 0,08-0,30 mm (0.003-0.012 in).
89. If your measurement falls outside these set limits replace the calibrated thrust washer 'C' which sits between the bearing and first gear.





90. Select a suitable thrust washer from the chart below.

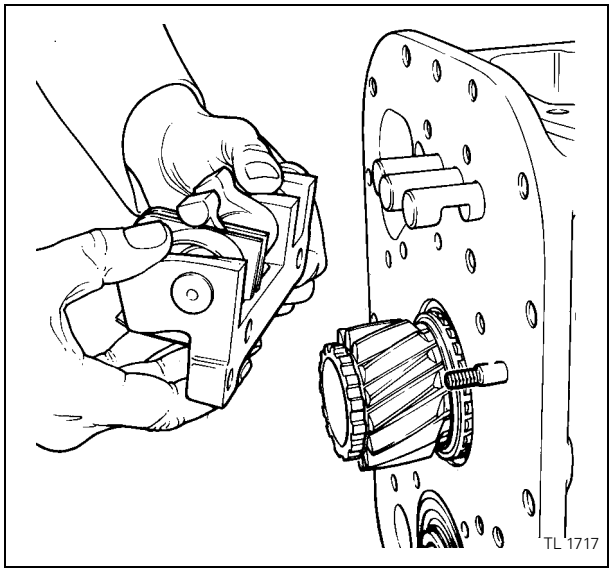
Thrust washer thickness chart		
Part No.	Metric	Imperial
3599 299 M1	3,4 mm	0.134 in
3598 644 M1	3.7 mm	0.146 in
3598 643 M1	3,9 mm	0.154 in
1671 888 M2	4,2 mm	0.164 in

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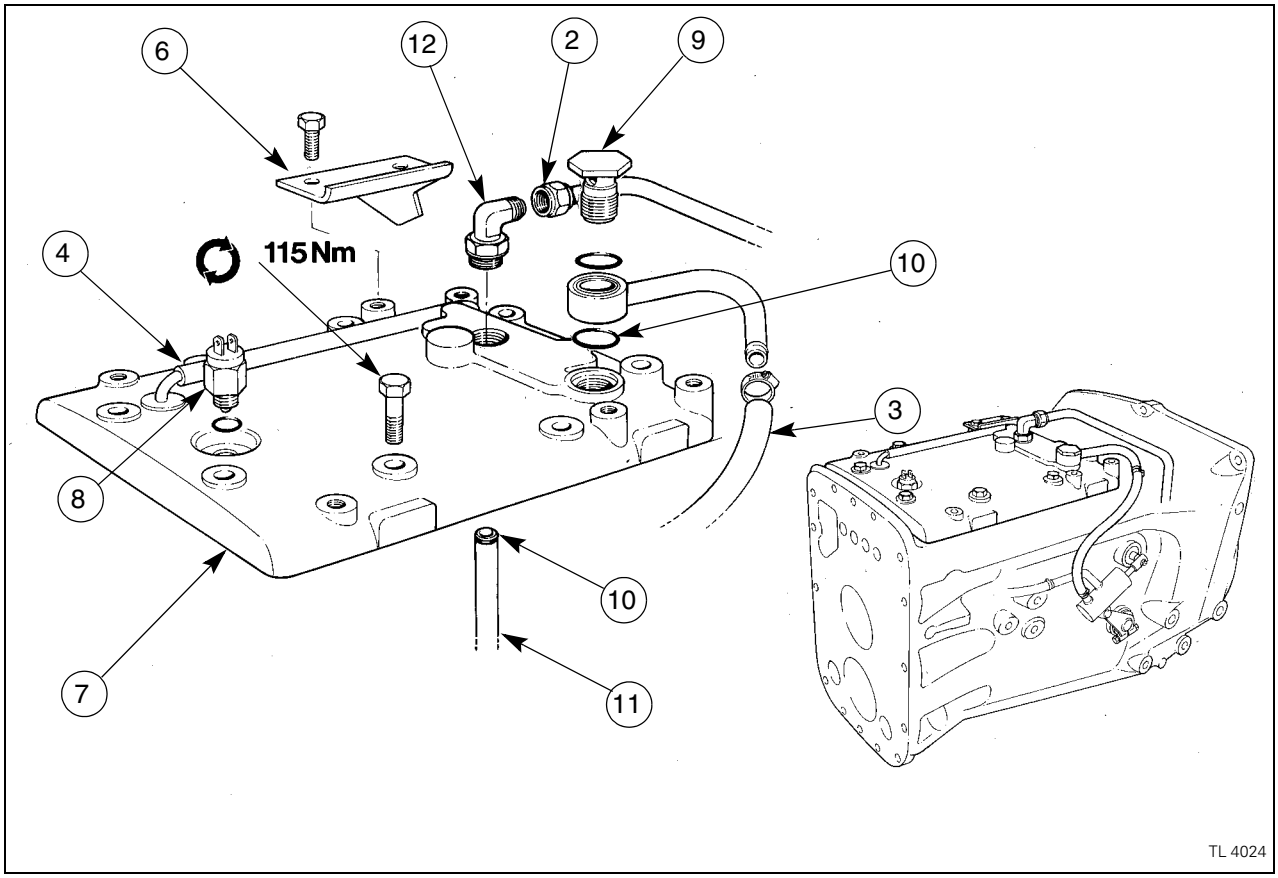
General

91. Slide the mainshaft, complete with spacer and thrust washer through the rear of the gearbox, progressively fitting in the following order:
    a. 2nd/3rd synchromesh hub assembly with 2nd gear (largest 42T) to the rear.
    b. Central thrust washer.
    c. 1st/reverse synchromesh hub assembly with reverse (largest 49T) to the rear.
    d. Calibrated thrust washer with the larger face to the rear.
    e. Roller bearing.
    f. Circlip.
92. Locate the tagged thrust washer in the gearbox centre web with the belled side facing forwards.
93. Ensure that the needle roller bearing is fitted into the centre of the mainshaft.
94. Refit the input housing and clutch pack, *(see operation 4-5C)*.
95. Refit the selector forks, rails and top cover, *(see operation 3-5C)*.
96. Refit the clutch release mechanism, *(see operation 4-4A)*.
97. Refit the range gearbox to the gearbox, *(see operation 1-5C)*. Carry out all necessary bearing pre-load adjustments.
98. Refit the gearbox to the tractor.



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GEARBOX TOP COVER

Removal and Refitment 9-5C

Removal

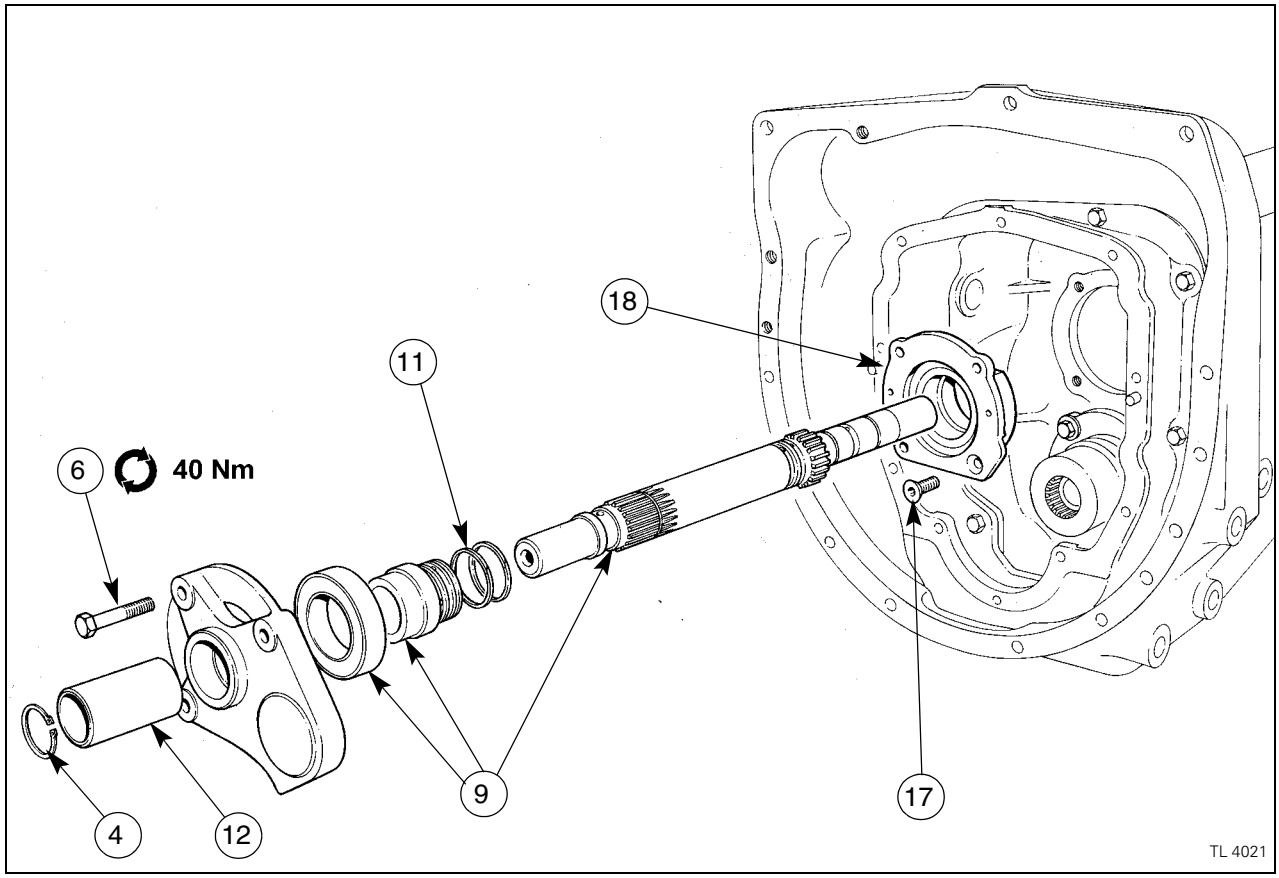
1. Remove the cab floor or footplates.
2. Disconnect the clutch pressure feed pipe.
3. Disconnect the lubrication oil pipe.
4. Disconnect the breather pipe.
5. Disconnect the wires to the reverse light/bleeper switch, (if fitted).
6. Remove the bolts and clutch cable bracket (cab tractor only).
7. Remove the top cover.
8. Remove the reverse light/bleeper switch to prevent damage to the switch (if fitted).
9. Remove the banjo bolt and pipe.
10. Remove and discard the 'O' ring seals.
11. Remove the gearbox oil feed pipe.
12. Clean all components and remove dried gasket material from the machined faces.
13. Remove the hydraulic elbow, if necessary.

Refitment

14. Reverse procedures 1 to 13 except:
    a. Apply Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115Nm (85 lbf ft).

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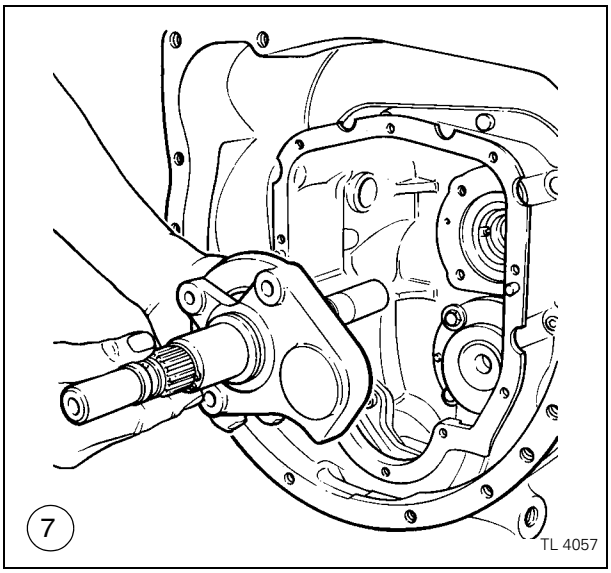


INPUT SHAFT AND HOUSING

Removal and Refitment **10-5C**

Removal

1. Remove the gearbox assembly, *(see operation 1-5C)*.
2. Remove the clutch assembly, *(see operation 4-4B)*.
3. Remove the clutch release mechanism, *(see operation 7-4B)*.
4. Remove the gearbox top cover, *(see operation 9-5C)*.
5. Remove the gear selectors, *(see operation 3-5C)*.
6. Remove the three bolts.
7. Withdraw the housing and shaft assembly from the gearbox, support the clutch pack to ease the removal.
8. Remove the circlip.
9. Remove the shaft assembly from the outer housing.
10. Remove the clutch pack and thrust washers from the gearbox, *(see operation 4-5C)*.
11. Remove the sealing rings, if necessary.

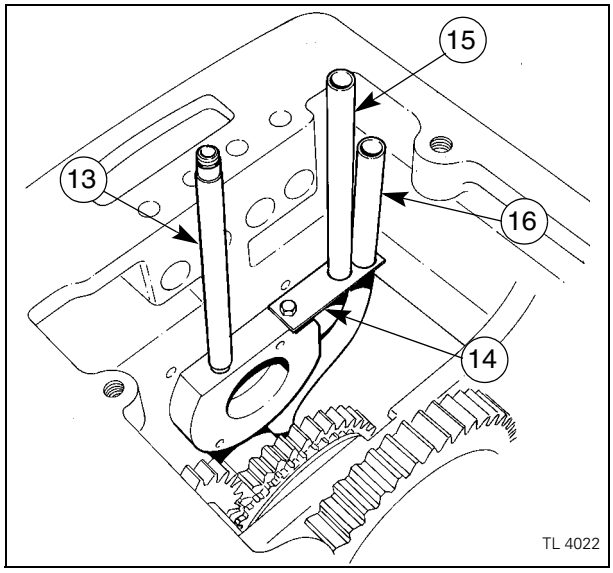


12. The release bearing sleeve is a press fit into the housing and under normal conditions should not require replacement.

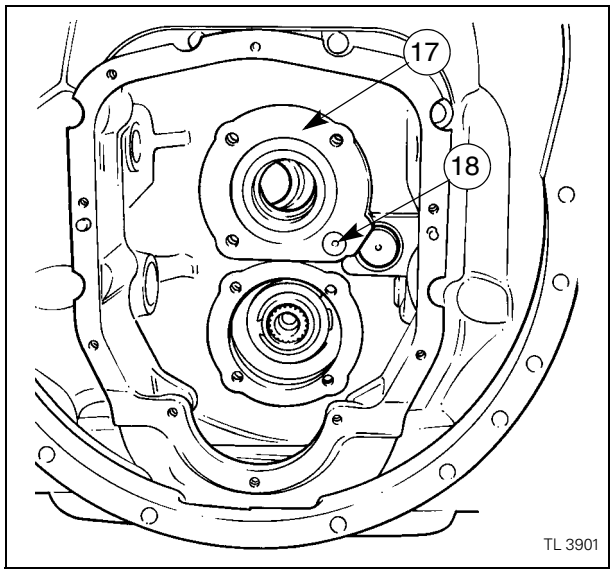
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13. Remove the pressure feed pipe.
14. Remove the bolt and keep plate.
15. Remove the oil feed pipe.
16. Remove the oil return pipe.

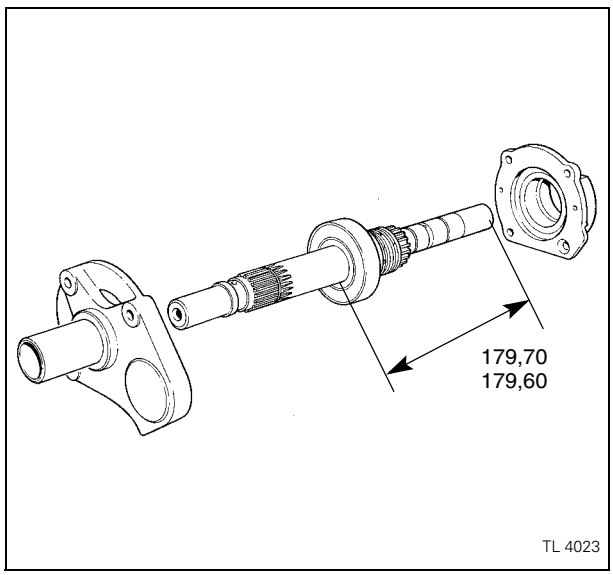


17. Remove the countersunk screw holding the housing.
18. Remove the inner housing.



Refitment

IMPORTANT: *The input shaft has been accurately set in the factory and is only available as an assembly comprising of the shaft, carrier and bearing. DO NOT remove the carrier from the shaft. If the bearing is being replaced, the carrier must be supported during removal and refitment to prevent movement. When a new bearing has been fitted the dimension shown on the illustration (179,70-179,60* mm*(7.076-7.080 in) must be accurately checked and adjusted if incorrect. It is recommended that the assembly is always fitted.*



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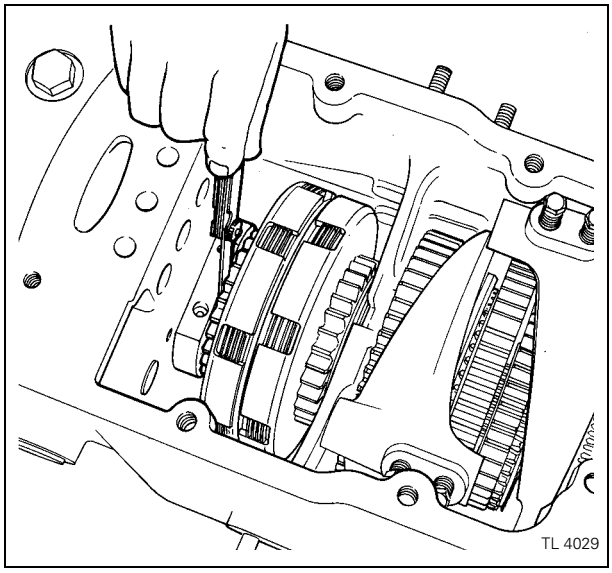
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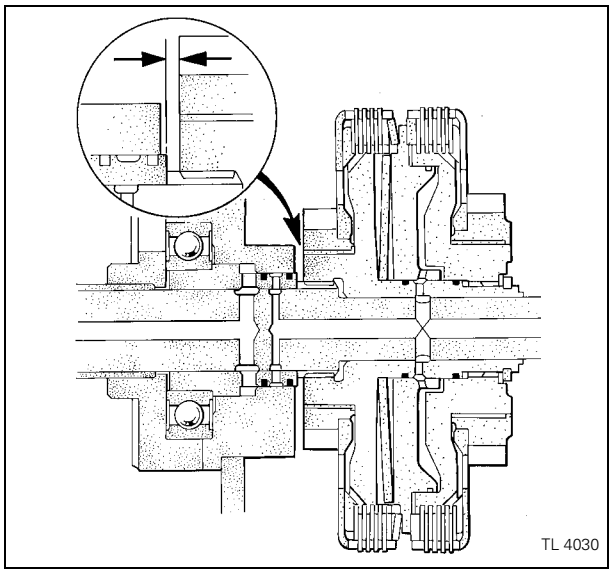
Input Shaft Adjustment

NOTE: *If any major components of the input housing have been replaced, or the clutch pack has been overhauled, it will be necessary to carry out the following adjustment procedure:*

19. Install the input housing and shaft assembly without the thrust washer between the housing and clutch pack.
20. Push the clutch pack rearward.
21. With the aid of a set of feeler gauges, measure the gap between the face of the housing and the face of the hub on the clutch pack.
22. From the chart below select a shim to give a clearance '**X**' of 0,20-0,45 mm (0.008-0.018in).

Thrust washer thickness chart - oil cooled clutch		
Part No.	Metric	Imperial
3815 222 M1	2,05-2,10	0.081-0.083
3815 223 M1	2,30-2,35	0.090-0.093
3815 224 M1	2,55-2,60	0.100-0.102
3815 225 M1	2,80-2,85	0.110-0.112
3815 226 M1	3,05-3,10	0.120-0.122


TL 4029

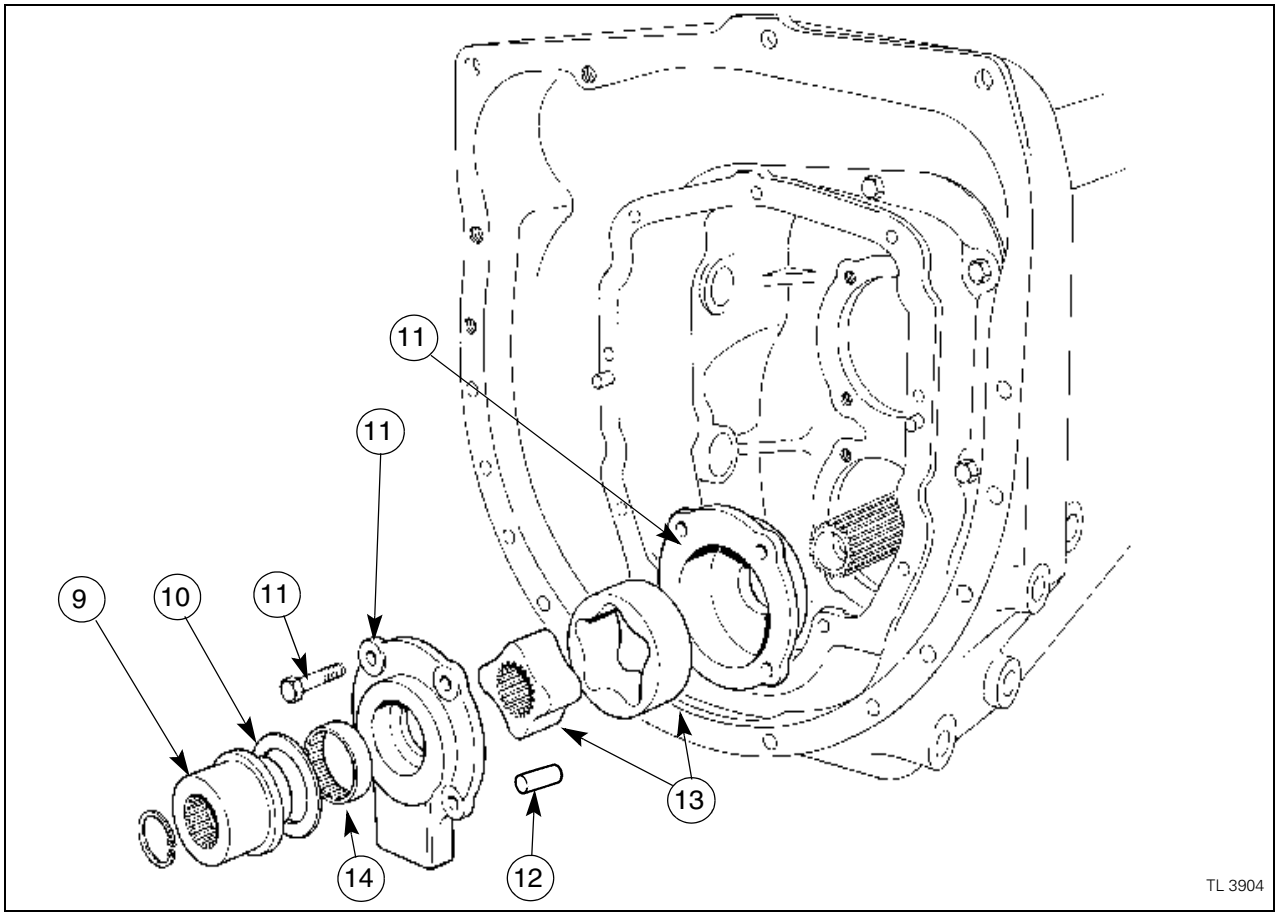

TL 4030

General

23. Reverse procedures 1 to 19 except:
    a. Tighten the countersunk screw to a torque of 40 Nm (30lbf ft).
    b. Tighten the three bolts to a torque of 40 Nm (30 lbf ft).
    c. Apply Loctite 270 to the bolt (6) retaining the internal pipes.
24. The sleeve for the clutch thrust bearing is a press fit into the housing.

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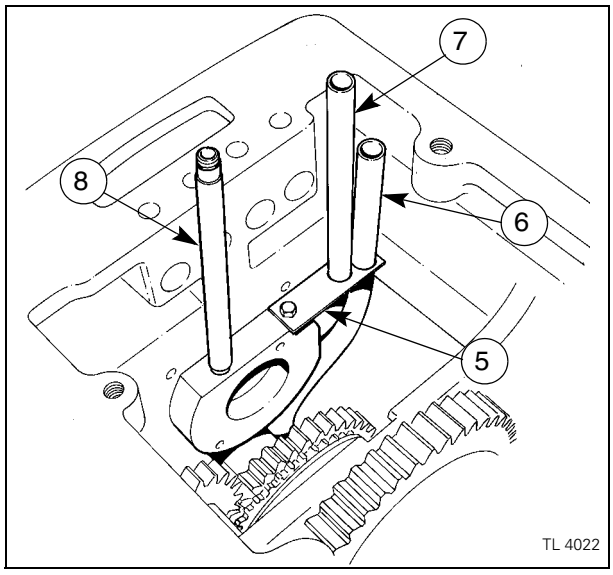


SCAVENGE PUMP

Removal and Refitment 11-5C

Removal

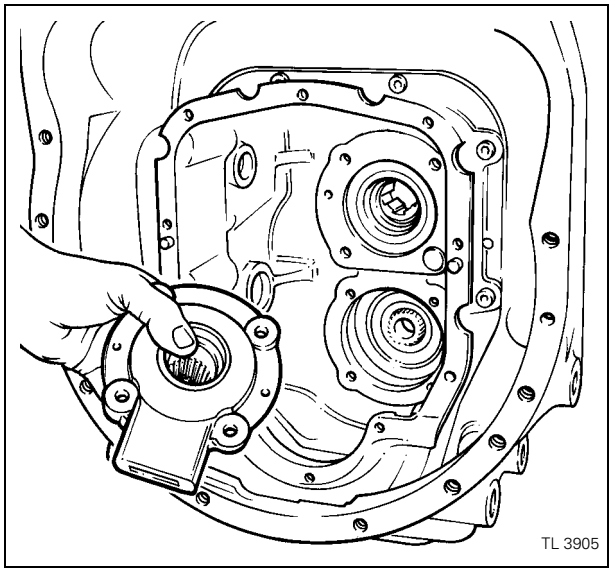
1. Remove the clutch assembly, *(see operation 4-4B)*.
2. Remove the clutch release bearing and cross shaft, *(see operation 7-4B)*.
3. Remove the gearbox top cover, *(see operation 9-5C)*.
4. Remove the Speedshift clutch assembly, *(see operation 4-5C)*.
5. Disconnect the internal pipes to the scavenge pump by removing the bolt and keep plate.
6. Remove the oil return pipe.
7. Remove the oil feed pipe.
8. Remove the pressure pipe.
9. Remove the PTO support bearing assembly.
10. Remove the thrust washer.



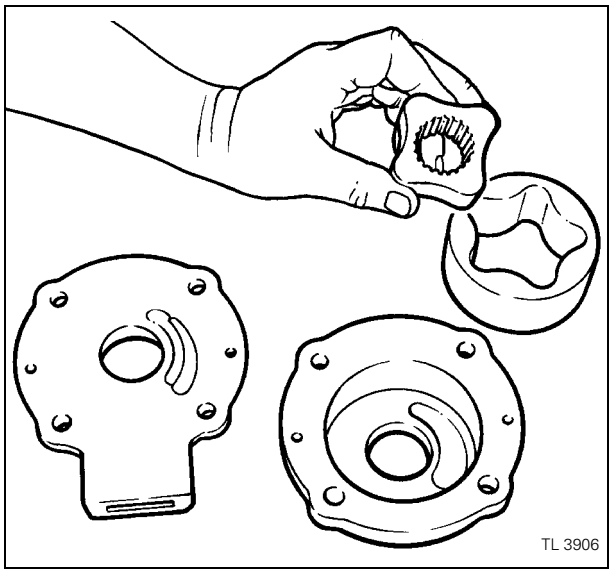
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11. Remove the four bolts and pull the scavenge pump assembly off the shaft and out of the housing.



12. Place the pump on a clean bench, drive out the two dowels and split the pump.
13. Remove the rotor and stator.
14. Only remove the needle roller bearing if replacement is required.



Examination

Care fully clean the components and the scavenge pump, especially the oil ways. There are no dimensional tolerances that need checking, the pump is low pressure, moving oil from the clutch casing to the transmission.

Inspect the rotor and stator for wear, scoring or damage on their working faces, if they appear to be in good condition they can be replaced.

Refitment

15. Lightly oil and reassemble the pump, it can only be assembled one way to line-up the bolt holes. Centralise the rotor in the stator so that it is in the centre of the bore.
16. Reverse procedures 1 to 14 except:
    a. Tighten the four pump retaining bolts to a torque of 40 Nm (30 lbf ft).
    b. Apply Loctite 270 to the bolt (4) retaining the internal pipes.

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Range Gearbox

Section 5 - Part D

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3-5D	Bearing Pre-load - Adjust	5D–23
4-5D	Drive Shaft Oil Seal - Removal and Refitment	5D–24
5-5D	Indicator Light Switch - Removal and Refitment	5D–25

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Range Gearbox

SPECIFICATION

Settings Required:

Top bearing pre-load	0,05-0,06 mm (0.002-0.0025 in).
Method of adjustment	Variable thickness spacer rings.
Drive shaft bearing pre-load	0,07 mm (0.003 in) - 200-900 grams (7-32 oz) pull.
Idler bearing pre-load	0-0,05 mm (0-.002 in) - see text for pull.
Drive shaft seal depth	7 mm (1/4 in) below recessed face.

Special Tools:

MF.476	Bearing remover/replacer.
MF.477	Gear set support tool.
MF.478	Bearing pre-load tool.
MF.499	Drive shaft seal installer.

Bolt Torques:

Range gearbox to gearbox bolts	102 Nm (75 lbf ft).
Selector fork rail support plate bolts	30 Nm (22 lbf ft).
Range selector detent spring plug	60 Nm (44 lbf ft).
Rear upper bearing housing bolts	30 Nm (22 lbf ft).
Rear lower bearing housing bolts	30 Nm (22 lbf ft).
Range selector switch housing bolts	30 Nm (22 lbf ft).
Shift casting to range housing bolts	30 Nm (22 lbf ft).
Idler shaft locknut.	18 Nm (13 lbf ft).

GENERAL DESCRIPTION

Range Gearbox

The range gearbox is directly bolted to the rear of the main gearbox forming an integral unit with either the 12 x 12, the 18 x 6 Speedshift or the Power Shuttle gearboxes. It can be fitted with a four-wheel drive unit to drive a front axle. The unit is similar to a conventional gearbox with a main and lay shaft. There is a direct drive 'High' gear and three gears provide a reduction gears for 'Medium' and 'Low' through the layshaft. All gear selections are through synchromesh couplers.

Moving the lever forward will select the next higher range and the lever will then return to the central position for selection of main gears, leaving the range selected.

The range gear is selected by moving the main gear lever fully to the right of the gate and moving it either forwards or backwards to its limit, depending whether a change up or down is being made. One movement of the lever changes one range.

When the main gear lever is moved to the right, the vertical lever on the end of the cross shaft engages with the range selector lever, this in turn rotates the cam plate through a ratchet system and moves the appropriate selector fork and coupler. Rotation of the cam operates a rotary switch to illuminate one of the indicator lights to show that the gear has been selected.

Moving the lever back will select the next lower range and the lever will again return to the centre. If a double shift is required the lever must be moved in the appropriate direction twice.

After selection of the range gear the main gear lever is then used to select the required main gear.

Four-wheel Drive

In the case of four-wheel drive gearboxes, the drive to the front axle is taken from the centre train of gears from the main drive shaft, through the layshaft to an intermediate gear located on the right-hand side of the gearbox.

The drive shaft in the bottom of the gearbox, contains the four-wheel drive clutch, it is driven from the intermediate gear which runs on a pair of pre-loaded taper roller bearings.

The drive shaft also runs on pre-loaded taper roller bearings and contains the hydraulically operated clutch for the disengagement of four-wheel drive. The clutch is spring loaded to the normally engaged position. A cassette type seal prevents loss of oil around the drive shaft.

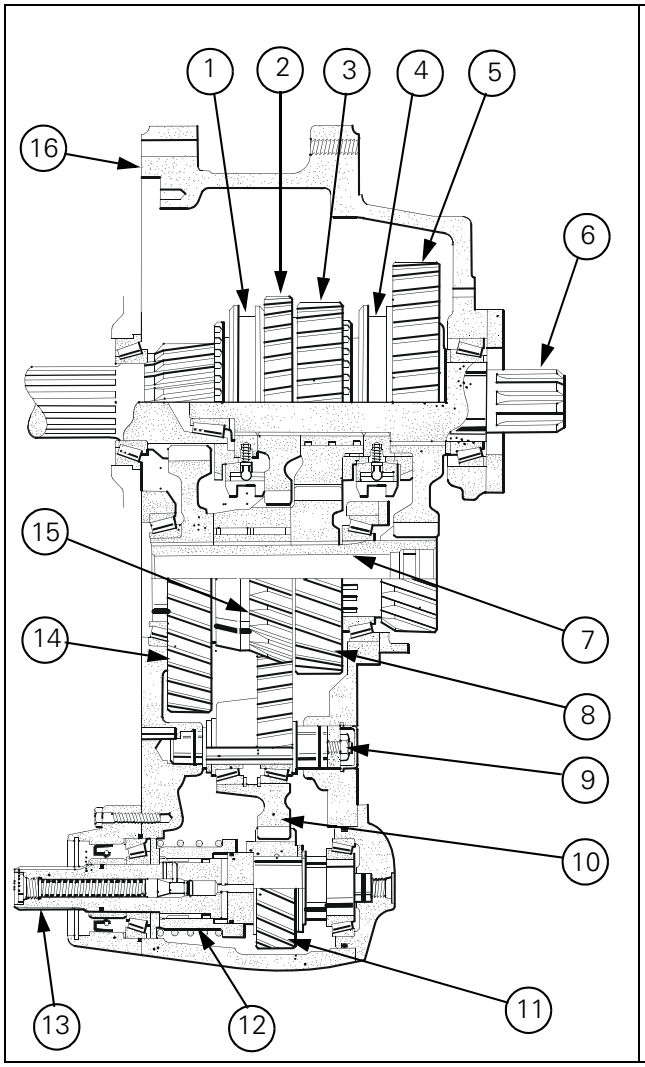
The clutch is controlled hydraulically through a solenoid valve which is controlled by the drivers switch.

Two-wheel Drive

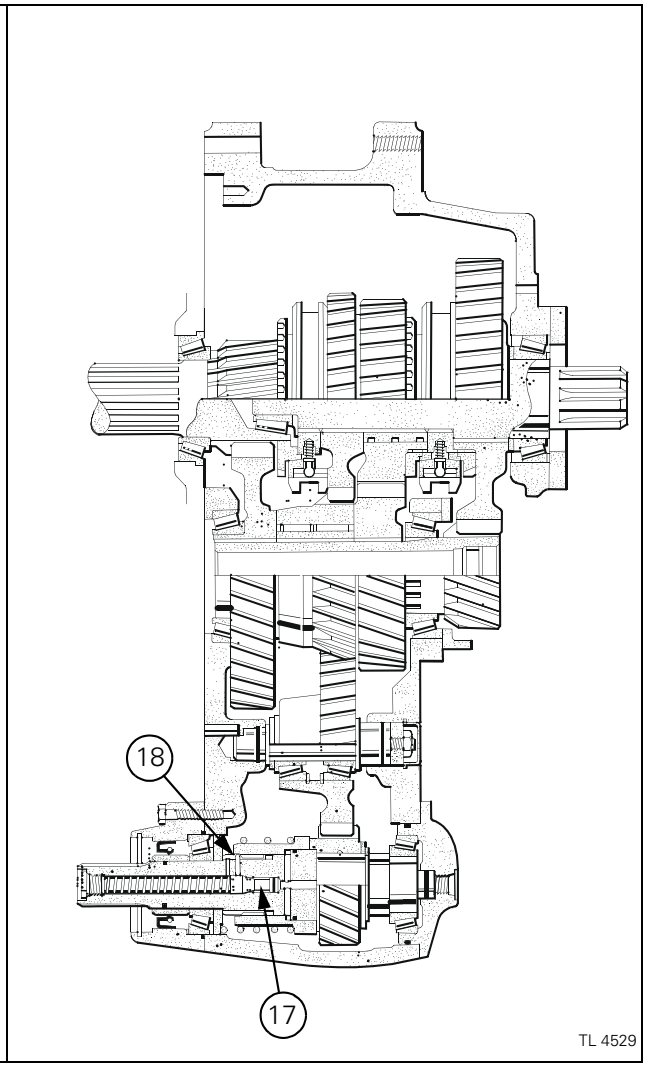
On tractor with two-wheel drive, a simple drive shaft is employed. No explanation is required.

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Range gear box in two-wheel drive position



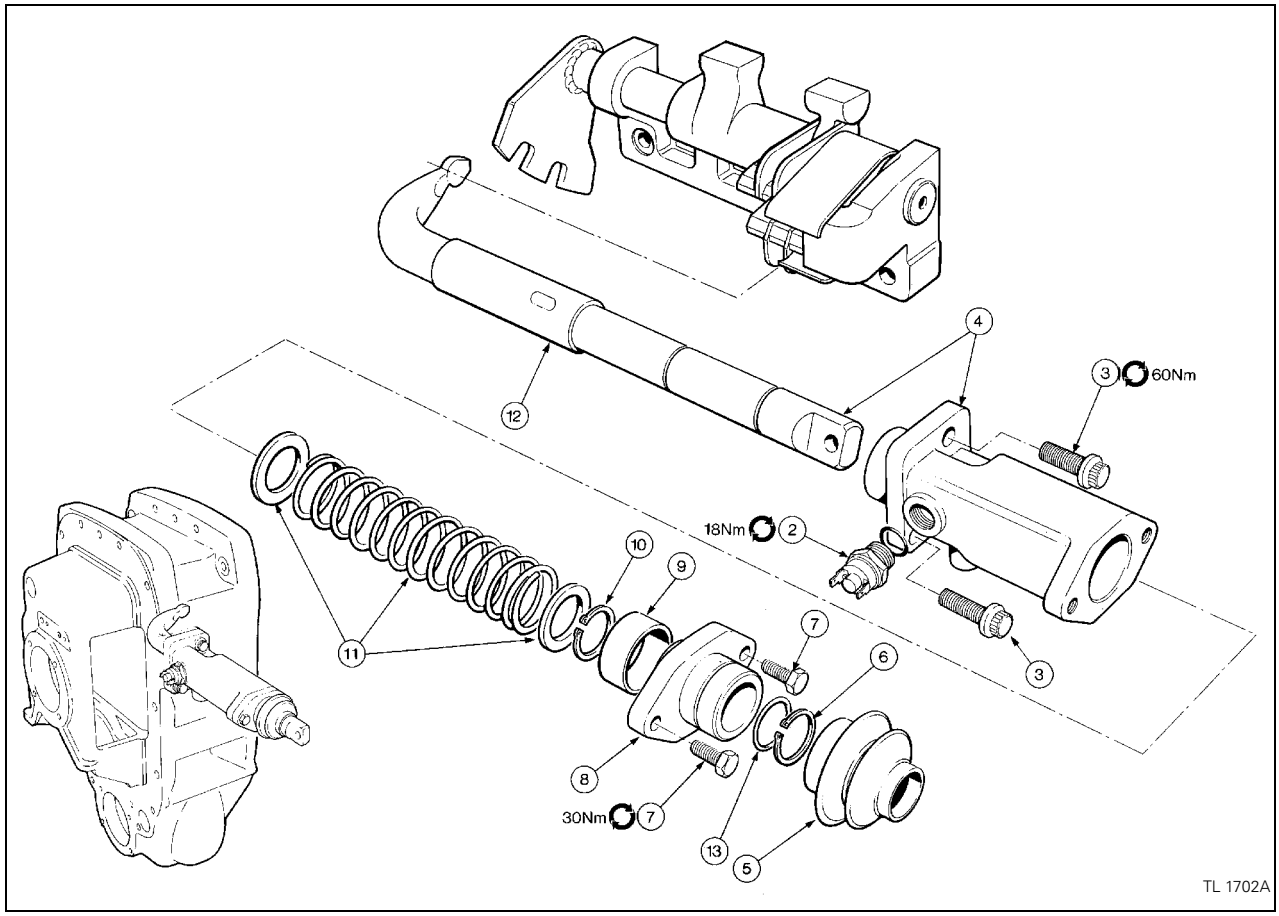
Range gearbox in four-wheel drive position

1. High range synchromesh coupler
2. Four-wheel drive gear (30 Teeth)
3. Medium range gear (27 Teeth)
4. Medium/low range synchromesh coupler
5. Low range gear (41 Teeth)
6. Main shaft - drive to rear axle
7. Layshaft
8. Medium range gear (26 Teeth)
9. Intermediate shaft
10. Four-wheel drive intermediate gear (27 Teeth)
11. Four-wheel drive shaft gear (18/16 Teeth)
12. Four-wheel drive clutch
13. Four-wheel drive shaft
14. Layshaft drive gear (39 Teeth)
15. Four-wheel drive intermediate gear (25 Teeth)
16. Four-wheel drive casing
17. Plunger
18. Locking pins

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Range Gearbox



GEAR SHIFT SELECTOR

Overhaul 1-5D

Dis-assembly

1. Remove the main gear shift lever assembly, *(see operation 3-5A or 3-5C).*
2. Remove the safety start switch (18 Speedshift gearbox only).
3. Remove the three twelve-point cap screws holding the lever assembly to the range gearbox.
4. Remove the lever assembly.
5. Remove the rubber boot.
6. Remove the circlip.
7. Unscrew the two bolts holding the end cover in place.
8. Remove the end cover.
9. Remove the spacer.

WARNING: Spring under compression.

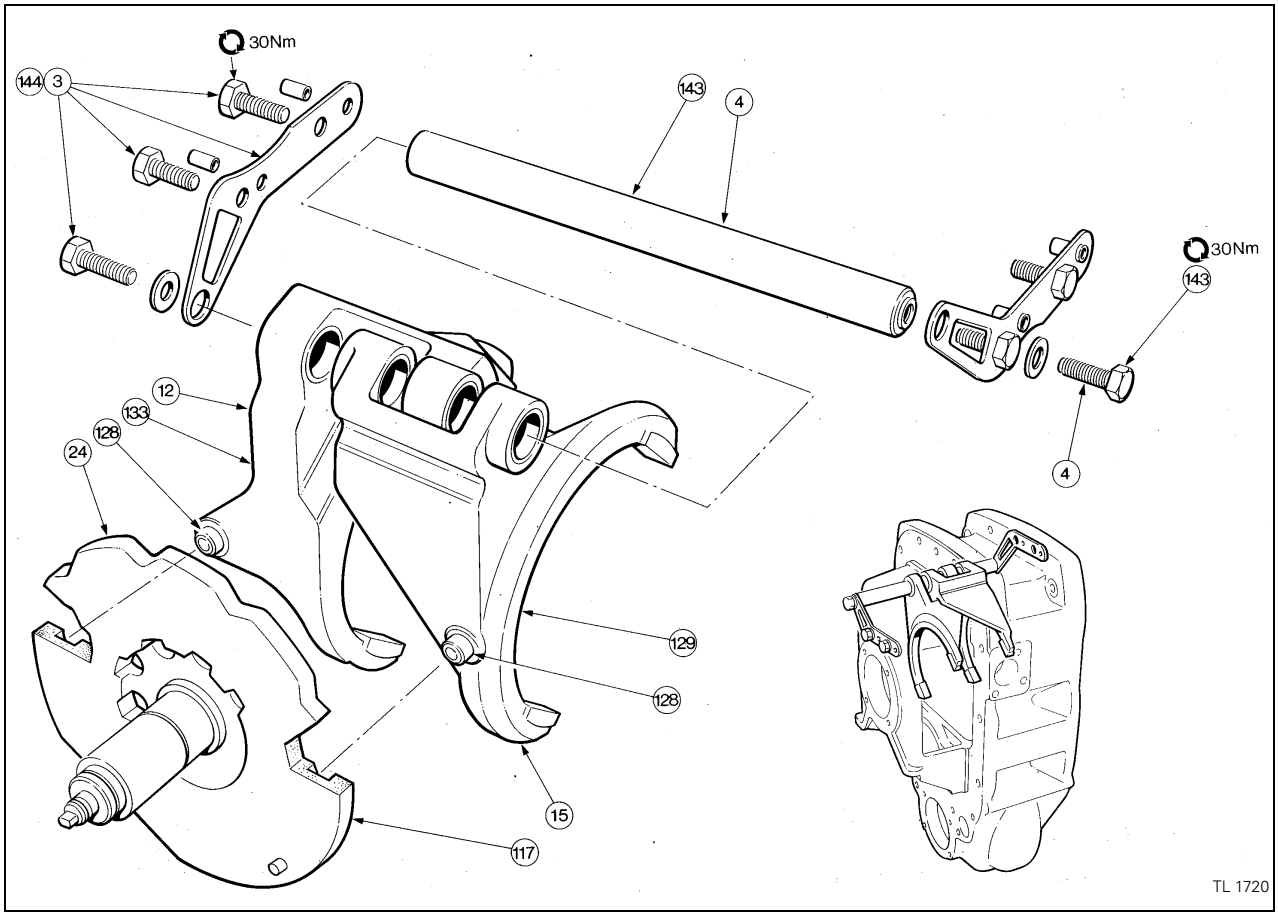
10. Remove the circlip.
11. Remove the two spacers and spring.
12. Remove the selector shaft from the housing.
13. Remove the 'O' ring.

Re-assembly

14. Reverse procedures 1 to 13 except:
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (22 lbf ft).
    f. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing and tighten the twelve-point cap screws to a torque of 60 Nm (45 lbf ft).

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SHAFTS and GEARS

Overhaul **2-5D**

Special Tools:

MF.476 Bearing Remover/Replacer
MF.477 Gear Set Support Tool
MF.499 Drive Shaft Oil Seal Installer
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the transmission gearbox assembly from the tractor, *(see operation 1-5A or 1-5C).*
2. Remove the range gearbox from the gearbox and place on a suitable workbench. It would be beneficial to make a small stand to support the gearbox approximately 380 mm (15 in) high, 460 mm (18 in) long and 222 mm (8 3/4 in) wide between the supports as shown in the illustration on the next page.

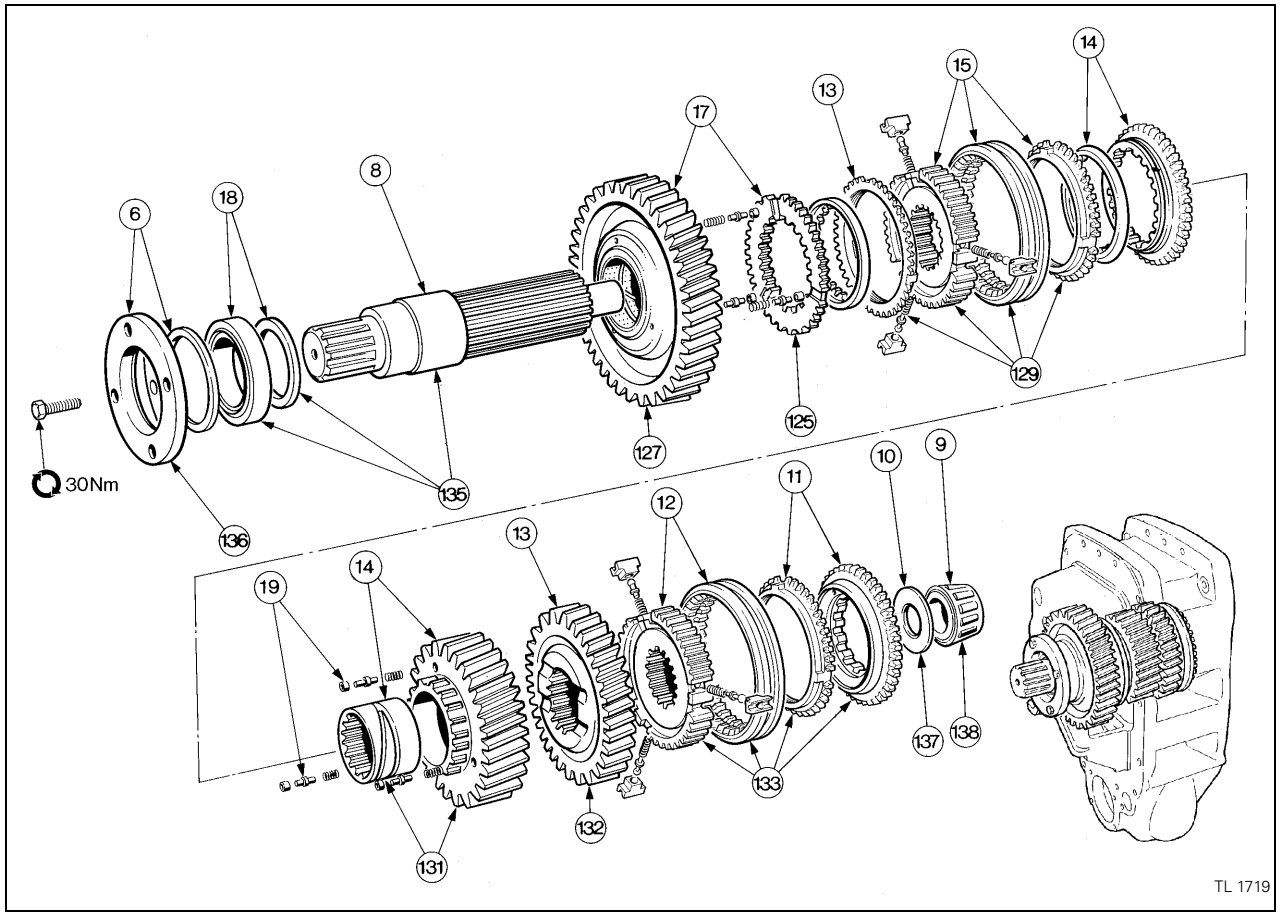
Main Shaft and Selector Forks

3. Remove the three bolts from the front selector rail support bracket and remove the bracket.
4. Remove the bolt from the rear of the selector rail and withdraw the rail from the selector forks.
5. Place special tool MF.477, Gear Set Support Tool, between the rear casing and low range gear on the main shaft. The tool will support the gears in their operating position and prevent damage to the selector fork roller and pin.
6. Remove the main shaft rear bearing cap and spacer ring.

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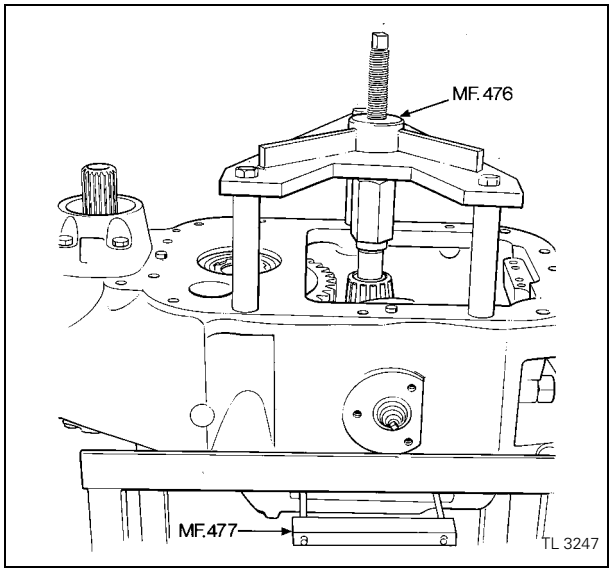
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Range Gearbox



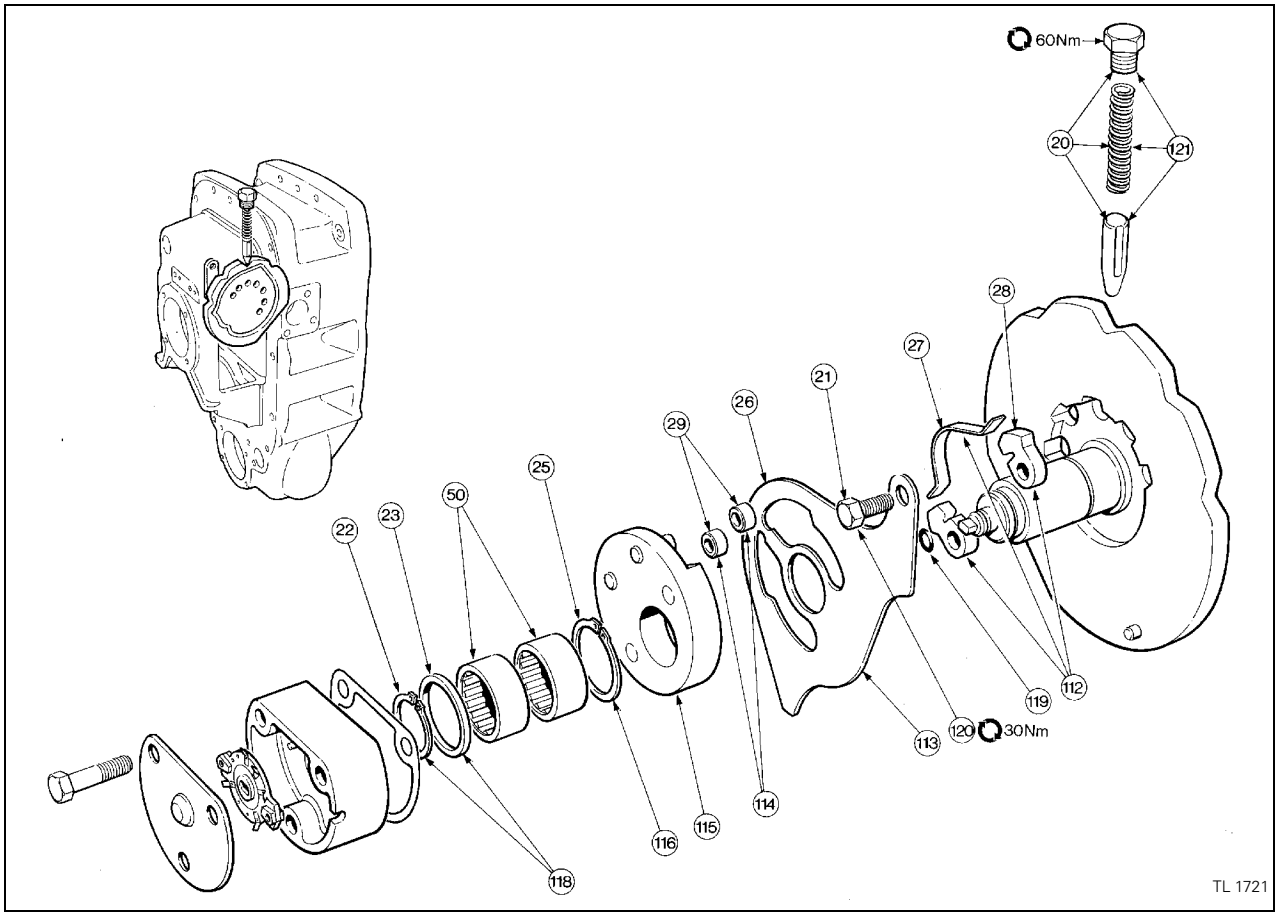
IMPORTANT: *Under no circumstances is the taper roller bearing, item 9, to be removed or fitted to the main shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components. Special tool MF.476, Bearing Remover/Replacer, has been developed to make the dismantling and assembly of the range gearbox safe, quick and easy.*

7. Bolt special tool MF.476, Bearing Remover/Replacer over the main shaft as shown in the illustration, a nut will be required on the front left-hand bolt.
8. Screw down the hand press onto the main shaft and press the shaft out of the small taper roller bearing. DO NOT allow the shaft to fall onto the floor.
9. Remove the taper roller bearing.
10. Remove the thrust washer.
11. Remove the high range synchromesh cone and baulk ring.
12. Remove the high range synchromesh hub assembly and selector fork complete with guide roller.
13. Remove the four-wheel drive pinion.
14. Remove the medium speed range gear complete with synchromesh cone and bush.



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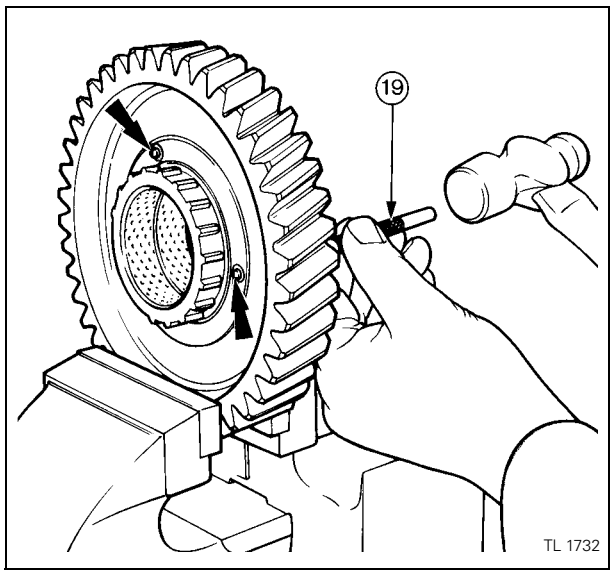
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15. Remove the low/medium range synchromesh hub assembly and selector fork complete with guide roller.
16. Remove special tool MF.477.
17. Remove the low range gear complete with synchromesh cone.
18. If necessary, the rear taper roller bearing and thrust washer can be pressed off the shaft.
19. Check the operation of the spring-loaded synchromesh cone alignment pins. If damaged, they can be removed with a hammer and punch through the rear face of the gear. This applies to both medium and low speed gears.

Selector Cam Assembly

20. Remove the cam plate detent plunger and spring.
21. Remove the bolt from the cam spring plate.
22. Remove the circlip.
23. Remove the thrust washer.
24. Remove the cam plate assembly from the inside of the box.
25. If necessary, remove the circlip and the cam ratchet assembly.

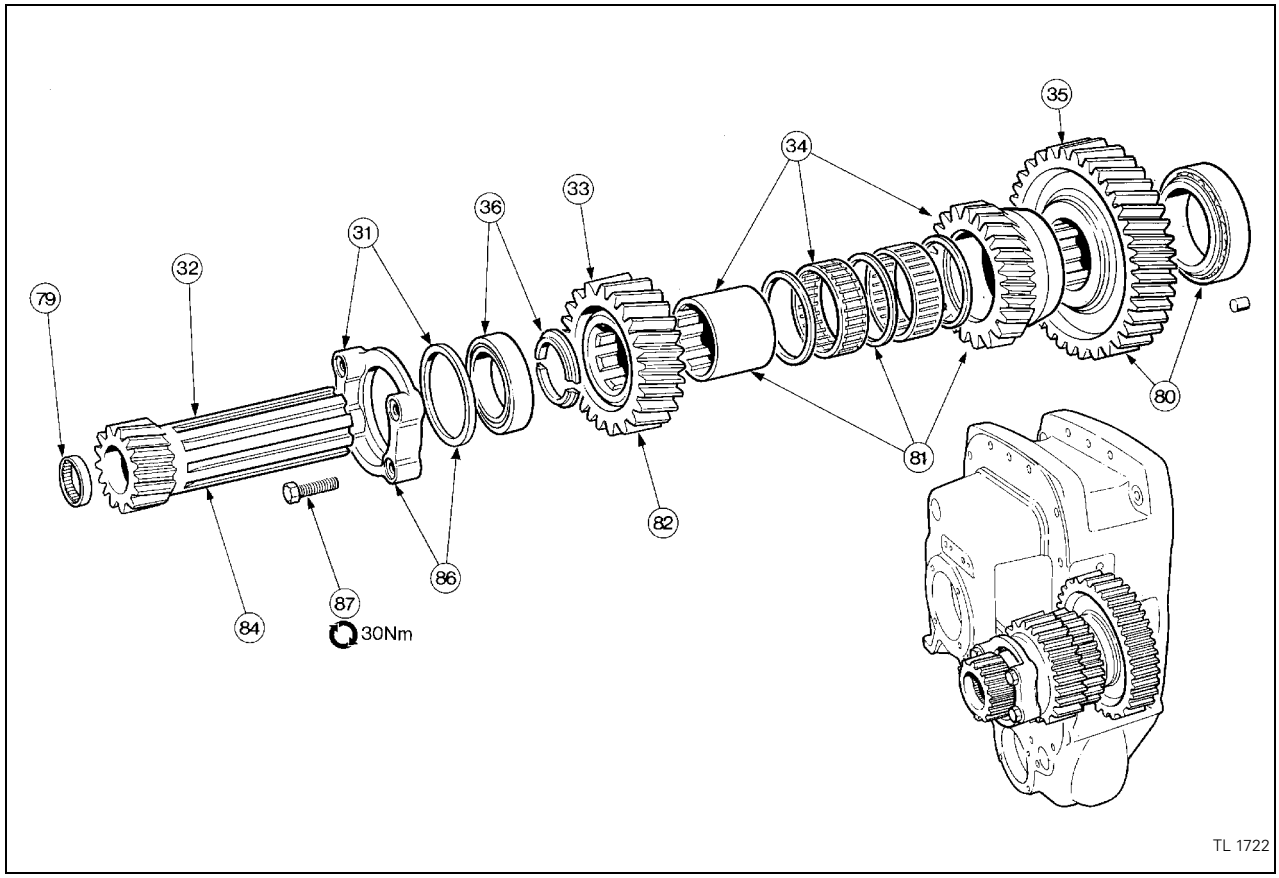


26. Remove the spring plate.
27. Remove the spring.
28. Remove the pawls.
29. Remove the selector lever rollers.

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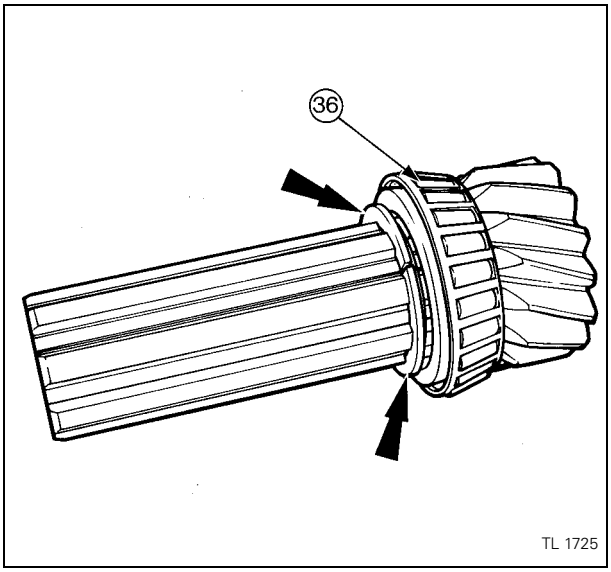
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Range Gearbox



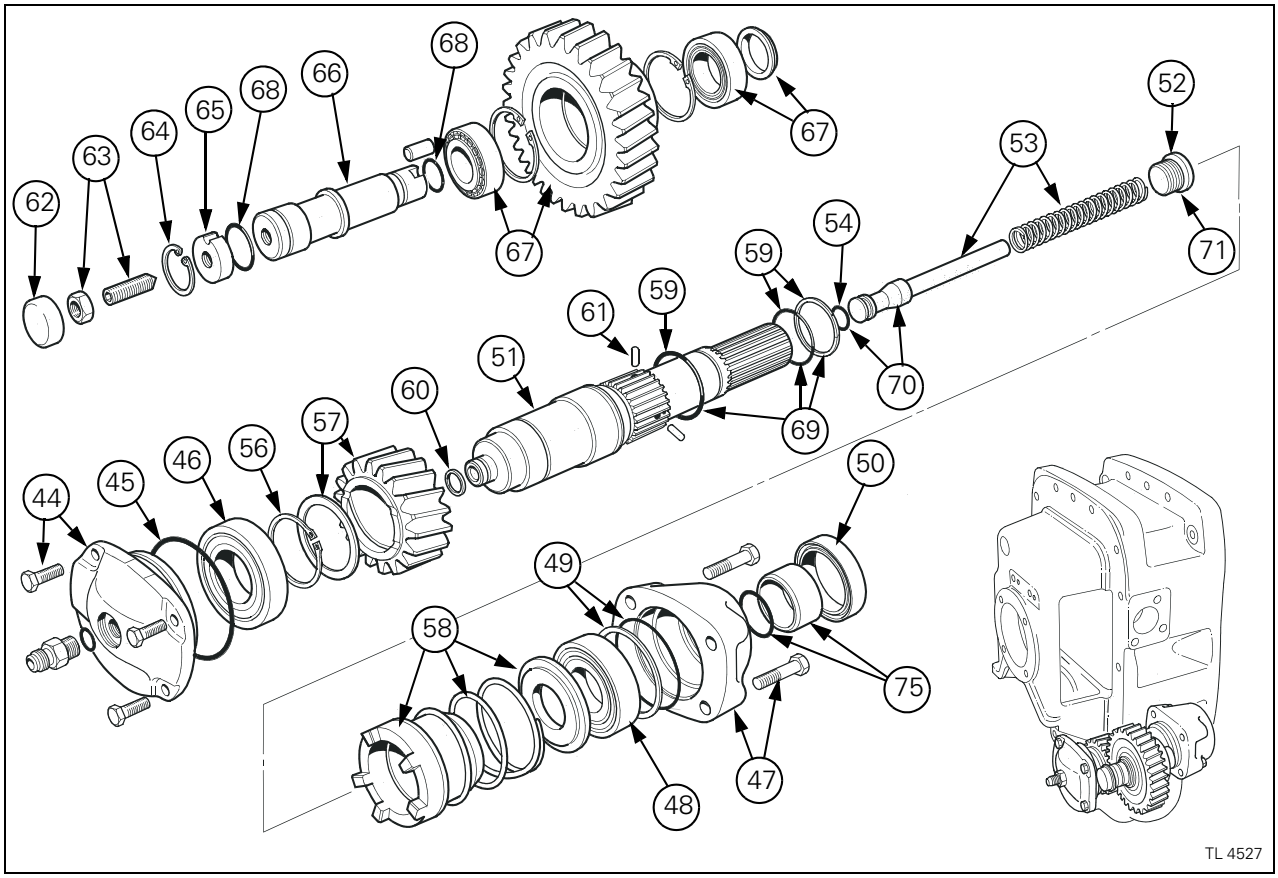
Layshaft

30. Turn the gearbox over.
31. Remove the layshaft bearing cap bolts, cap and spacer ring.
32. Pull the layshaft and thrust washer out of the gearbox.
33. Remove the medium range gear.
34. Remove the four-wheel drive gear; if fitted, complete with needle roller bearings and sleeve.
35. Remove the constant mesh gear.
36. Remove the taper and needle roller bearings as necessary. To remove the taper roller bearing behind the low range gear it will be necessary to press the bearing towards the gear to remove the two split retaining rings.



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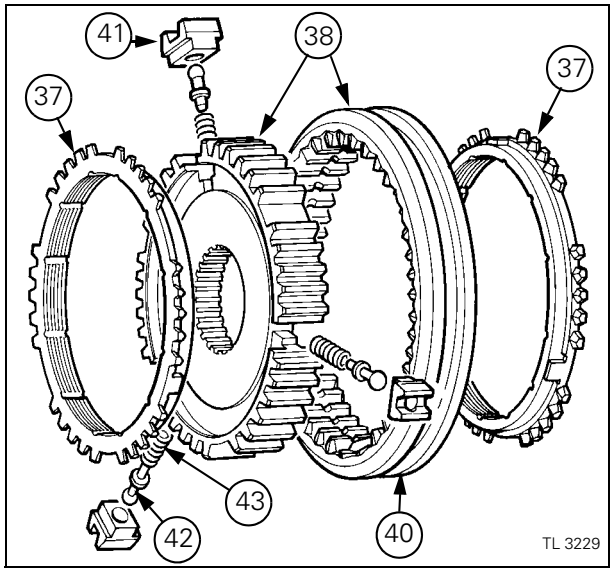


Synchromesh Hub Assemblies

37. Remove the two baulk rings.
38. Remove the drive hub complete with the sliding coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the sliding coupler, taking care not to lose pressure springs, ball pins and blocks.
41. Remove the three pressure blocks.
42. Remove the three ball pins.
43. Remove the three pressure springs.

Drive Shaft (Four-wheel Drive Only)

44. Remove the four bolts and the rear cover plate.
45. Remove and discard the 'O' ring.
46. Extract the taper roller bearing cup, if necessary.
47. Remove the four bolts and the front bearing housing.
48. Remove the bearing cup.
49. Remove and retain the shims for future use.
50. Press the oil seal out of the housing.

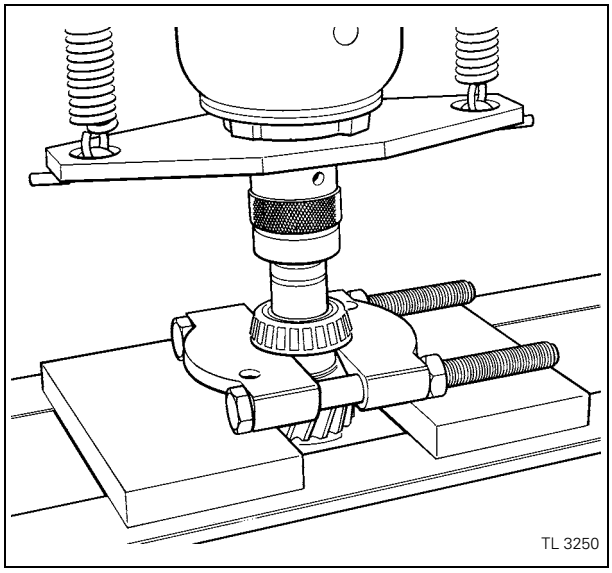


51. Remove the shaft assembly from the rear of the gearbox.

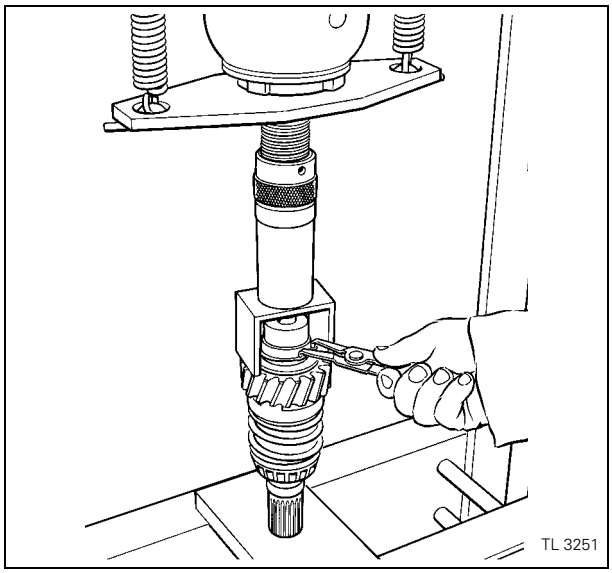
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52. Remove the plug.
53. Withdraw the spring and push the plunger out.
54. Remove and discard the ‘O’ ring.
55. On a press remove the rear taper roller bearing cone.

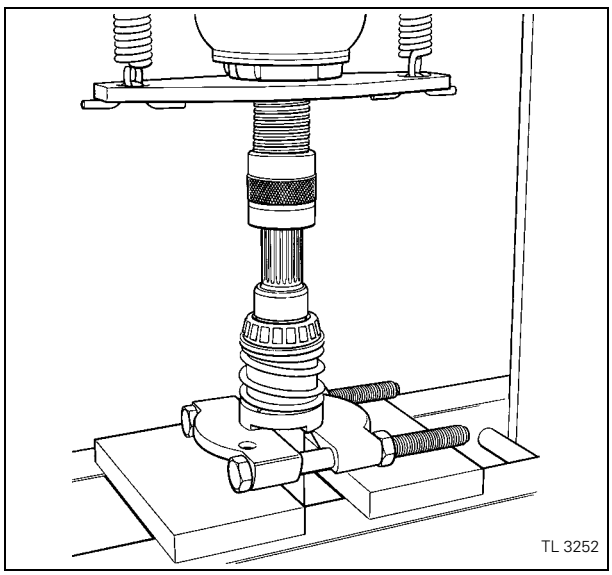

TL 3250

56. Spring pressure is being applied to the gear and circlip preventing its removal. Make a bridge piece as shown in the illustrations to depress the gear so that the circlip can be removed.
57. Remove the gear and thrust washer.


TL 3251

IMPORTANT: *The plunger must be removed prior to stage 58. Failure to do so will damage the drive shaft assembly beyond repair.*

58. Spring pressure is being applied to the clutch components on the shaft, **proceed with care**. Place the shaft assembly on a bearing separator plate under a hydraulic or hand press as shown in the illustration. Press the coupler, spring retainer, taper roller bearing and sleeve off the shaft.
59. Remove and discard the back-up ring and 'O' rings.
60. Remove and discard the rear seal ring.
61. Remove the locking pins.


TL 3252

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Idler Shaft (Four-wheel Drive Only)

62. With the aid of a sharp instrument, pierce the core plug and lever out of the casing.
63. Slacken the locknut and hexagon socket screw.
64. Remove the internal circlip.
65. Remove the disc, screw and locknut assembly.
66. Screw a 12 mm bolt into the end of the idler shaft, place your hand inside the box to contain the parts and pull the shaft out of the casing.
67. Remove the gear assembly and its thrust washers, and dowel from the idler bore. Dismantle further if necessary.
68. Remove and discard the 'O' rings.

Examination

Thoroughly clean and carefully examine all the components, replace any that show signs of damage or wear. Replace all 'O' rings, seals and circlips. Ensure that all circlips are fitted correctly in their grooves.

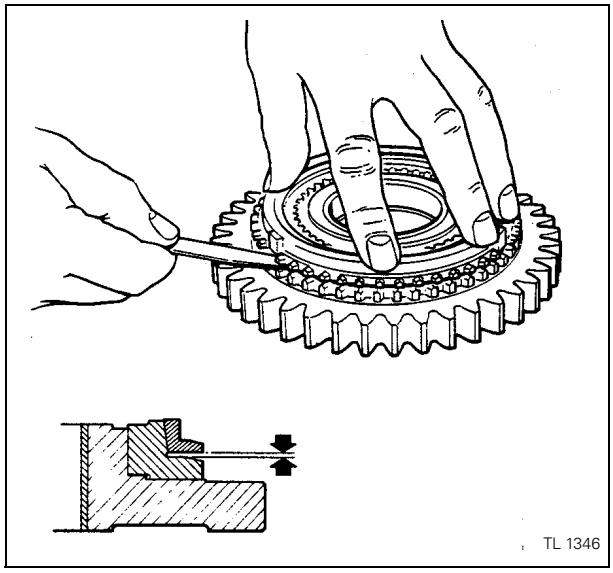
Synchromesh Inspection

Carefully inspect the ribbed face of the brass baulk ring for wear. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be centrally positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in), replace the baulk ring.

Re-assembly

Drive Shaft (Four-wheel Drive Only)

69. Re-assemble the drive shaft, by first fitting two new 'O' rings and the back-up ring to the centre of the shaft, lubricate the seals with oil. Ensure not to shear the back-up ring when fitting the coupler. The back-up ring is fitted to the front of the shaft.
70. Fit a new 'O' ring to the plunger and push the plunger into the shaft.
71. Fit the plug into the end of the shaft and push the plunger back until it contacts the plug.
72. Insert the three locking pins.
73. Fit the coupler, spring, and spring retainer.
74. Under a hydraulic press, press the front bearing cone into position.



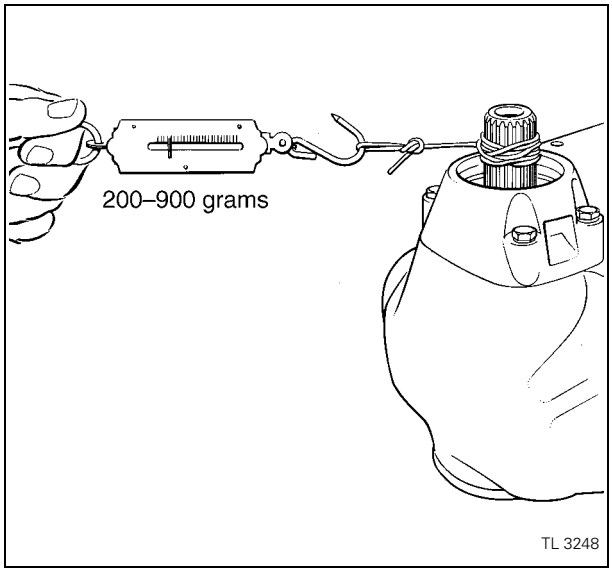
75. Fit a new 'O' ring to the front of the shaft and press into position the oil seal sleeve.
76. Fit the free running gear and thrust washer. The gear will need pressing down to install the circlip.
77. Remove the plug from the shaft, and refit the spring and the plug.
78. Install the rear bearing cone.
79. Assemble the shaft in the gearbox casing, fit the rear cover plate without the 'O' ring and tighten the bolts to a torque of 30 Nm (22 lbf ft).
80. Place the shims removed behind the bearing cup of the front housing and install the housing without the 'O' ring and seal.
81. Tighten the bolts to a torque of 30 Nm (22 lbf ft) and lightly tap the end of the shaft with a copper faced hammer to ensure that the bearings are seated correctly.

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Drive Shaft Pre-load (Four-wheel Drive Only)

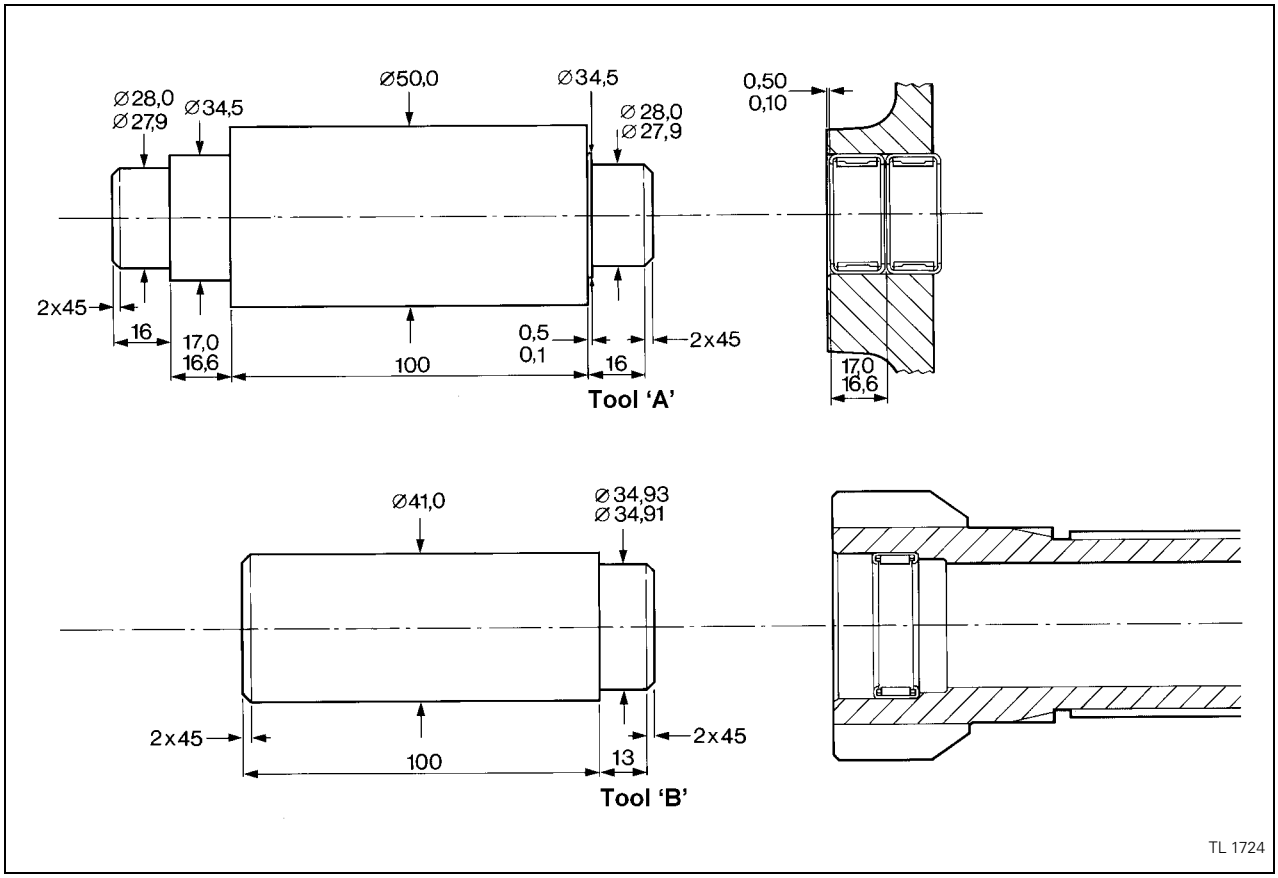
82. The correct bearing pre-load is 0,07 mm (0.003 in), this is obtained by adjusting the shim pack thickness between the bearing cup and the front bearing housing. Shims are available in the sizes listed in the table opposite.
83. Put some turns of string around the shaft and attach the end to a spring balance. Pull the spring balance and note the reading when the shaft is turning, this should be 200-900 grams (7-32 oz).
84. If the reading is incorrect adjust the thickness of the shim pack behind the front bearing cup accordingly.
85. Remove the drive shaft assembly from the gearbox and put to one side.



Drive shaft shims		
Part number	Metric	Imperial
3801 392 M1	1,00 mm	0.039 in
3801 393 M1	1.05 mm	0.041 in
3801 394 M1	1,10 mm	0.043 in
3801 395 M1	1,15 mm	0.045 in
3801 396 M1	1,20 mm	0.047 in
3801 397 M1	1,25 mm	0.049 in
3801 398 M1	1,30 mm	0.051 in
3801 399 M1	1,35 mm	0.053 in
3801 400 M1	1,40 mm	0.055 in
3801 401 M1	1,45 mm	0.057 in
3801 402 M1	1,50 mm	0.059 in
3801 403 M1	1,55 mm	0.061 in
3800 277 M1	1,60 mm	0.063 in
3800 278 M1	1,65 mm	0.065 in

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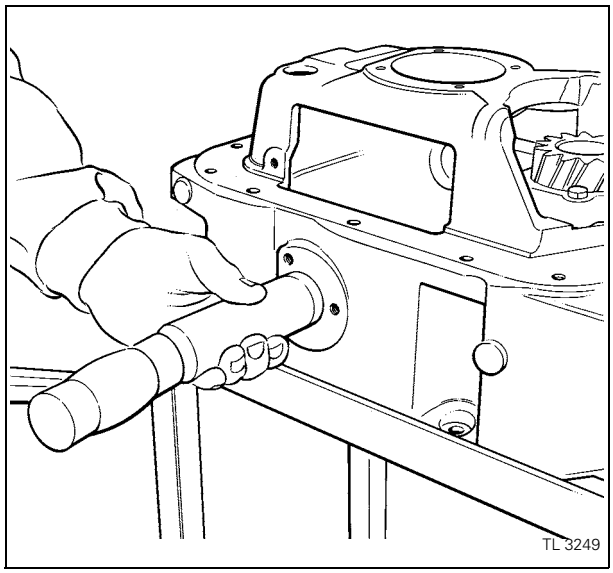


Layshaft

86. Place the range gearbox casing on the work stand, on its front face with the layshaft taper roller bearing cup in place.
87. Replace, if necessary, the needle roller bearings in the gearbox casing or the end of the layshaft. Make a tool as shown in the illustration to install the bearings.

Camshaft Bearing Installer - Tool **'A'**.

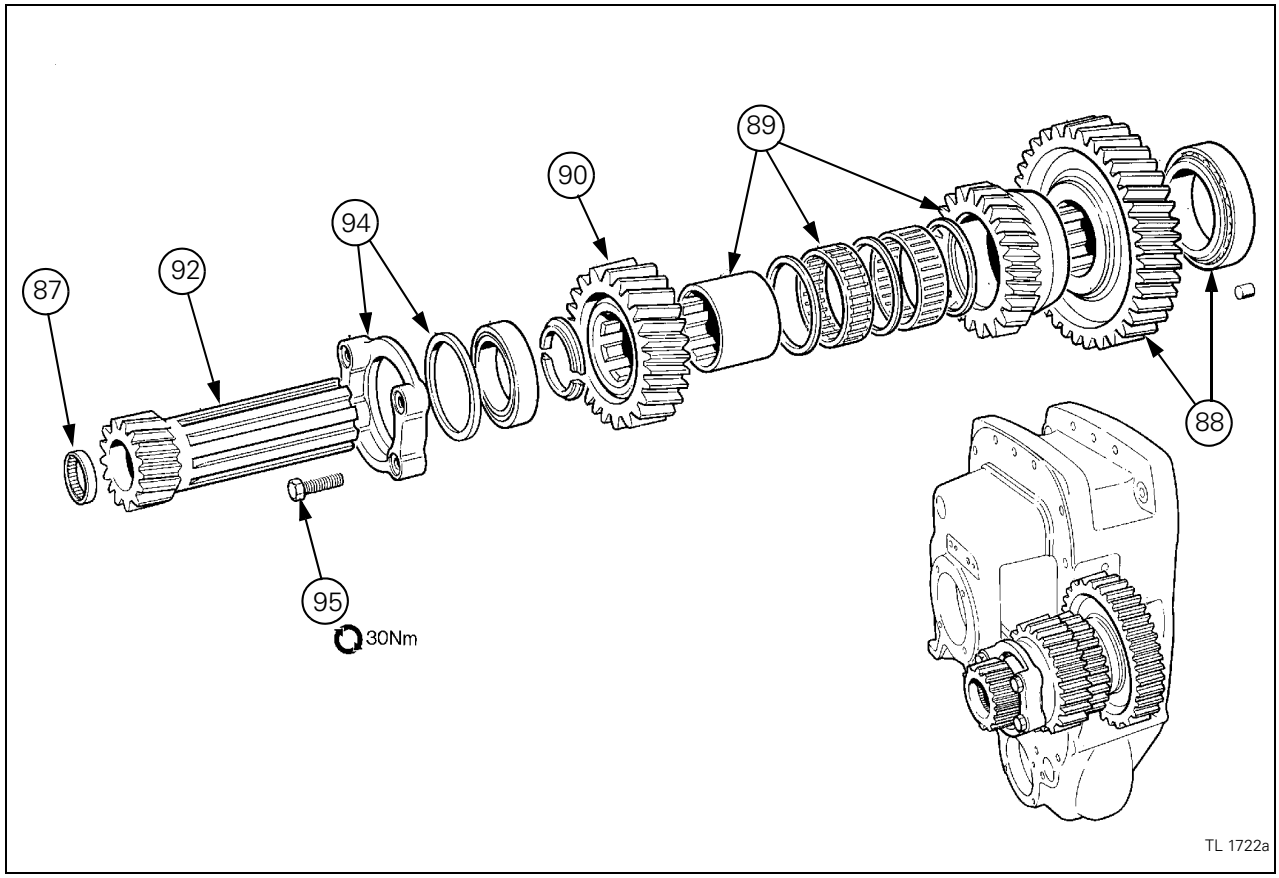
Layshaft Bearing Installer - Tool **'B'**.



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Range Gearbox



88. Place the constant mesh gear, complete with taper roller bearing, in position in the gearbox.
89. Replace the four-wheel drive gear assembly complete with needle roller bearings and steel bush with the thrust side facing down.
90. Position the medium range gear over the four-wheel drive gear with the thrust side facing downwards.
91. Carefully align the splines in all the gears.
92. Fit the layshaft complete with bearing, threading it through all the gears.
93. If all the original components are being refitted to the layshaft shaft there is no need to reset the bearing pre-load, ignore procedure 89.
94. Fit the bearing cap with the spacer ring that was removed on dis-assembly.
95. Fit the four cap bolts and tighten to a torque of 30 Nm (22 lbf ft).
96. Rotate the shaft and lightly tap each end to ensure that the bearings are fully seated and that it rotates freely.

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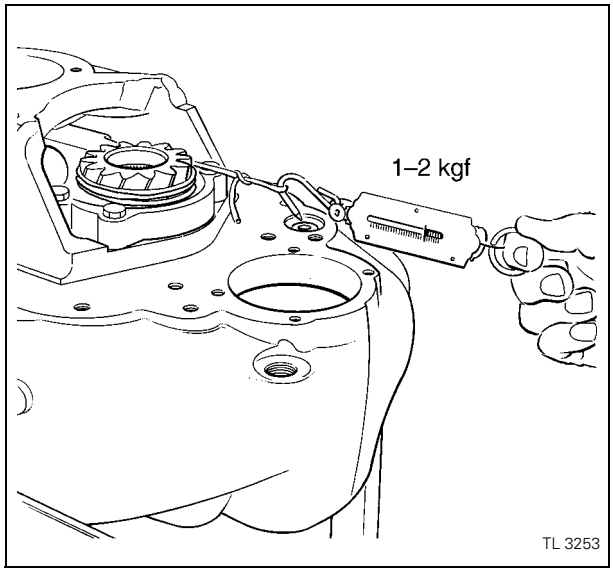
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Layshaft Pre-load

97. Wrap string around the gear and check with a spring balance that the load required to turn the gear is 1-2 kgf (2-4 lbf). This equals a taper roller bearing pre-load for both new and old bearings of 0,05 mm (0.002 in). If adjustment is required, spacer rings are available in the sizes listed in the chart opposite.
98. Remove the layshaft from the gearbox and put to one side.

Idler Shaft (Four-wheel Drive Only)

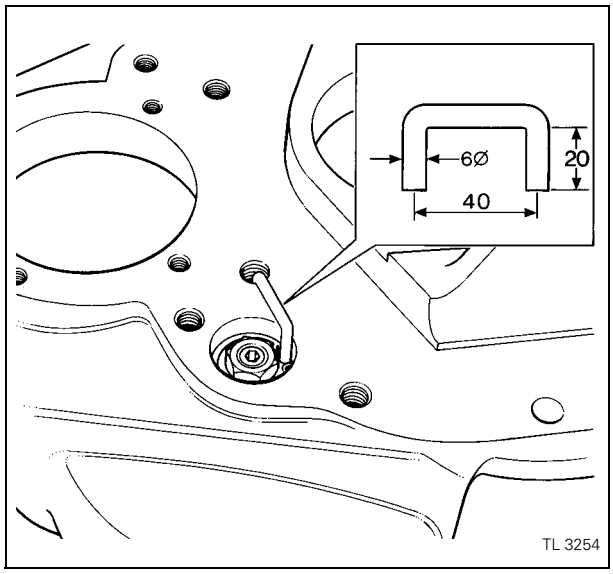
99. Re-assemble the idler gear assembly with the two taper roller bearings.
100. Fit new 'O' rings to the shaft.
101. Hold the gear assembly and the thrust washers up in place inside the gearbox.
102. Lubricate the shaft and 'O' rings with oil and push the shaft into the casing and through the gear assembly. A 12 mm bolt screwed into the end of the shaft will help with the installation.
103. Ensure that the shaft is fully home. Rotate the shaft to enable a loose fitting slave pin to be inserted in the dowel hole which will prevent the shaft from rotating.
104. Remove the 12 mm bolt.
105. Assemble the disc with the hexagon screw and lock nut.
106. Install the disc assembly and fit the circlip. At the other end withdraw the slave and install the dowel until flush with the rangebox face.



Spacer ring sizes		
Part number	Metric	Imperial
3697 520 M1	2,44 mm	0.096 in
3697 521 M1	2,48 mm	0.098 in
3697 522 M1	2,52 mm	0.099 in
3697 843 M1	2,56 mm	0.101 in
3697 844 M1	2,60 mm	0.102 in
3697 845 M1	2,64 mm	0.104 in
3697 846 M1	2,68 mm	0.106 in
3697 847 M1	2,72 mm	0.107 in
3697 848 M1	2,76 mm	0.109 in
3697 849 M1	2,80 mm	0.110 in
3697 850 M1	2,84 mm	0.112 in
3697 851 M1	2,88 mm	0.113 in
3697 852 M1	2,92 mm	0.115 in
3697 853 M1	2,96 mm	0.117 in

Idler Shaft Pre-load (Four-wheel Drive Only)

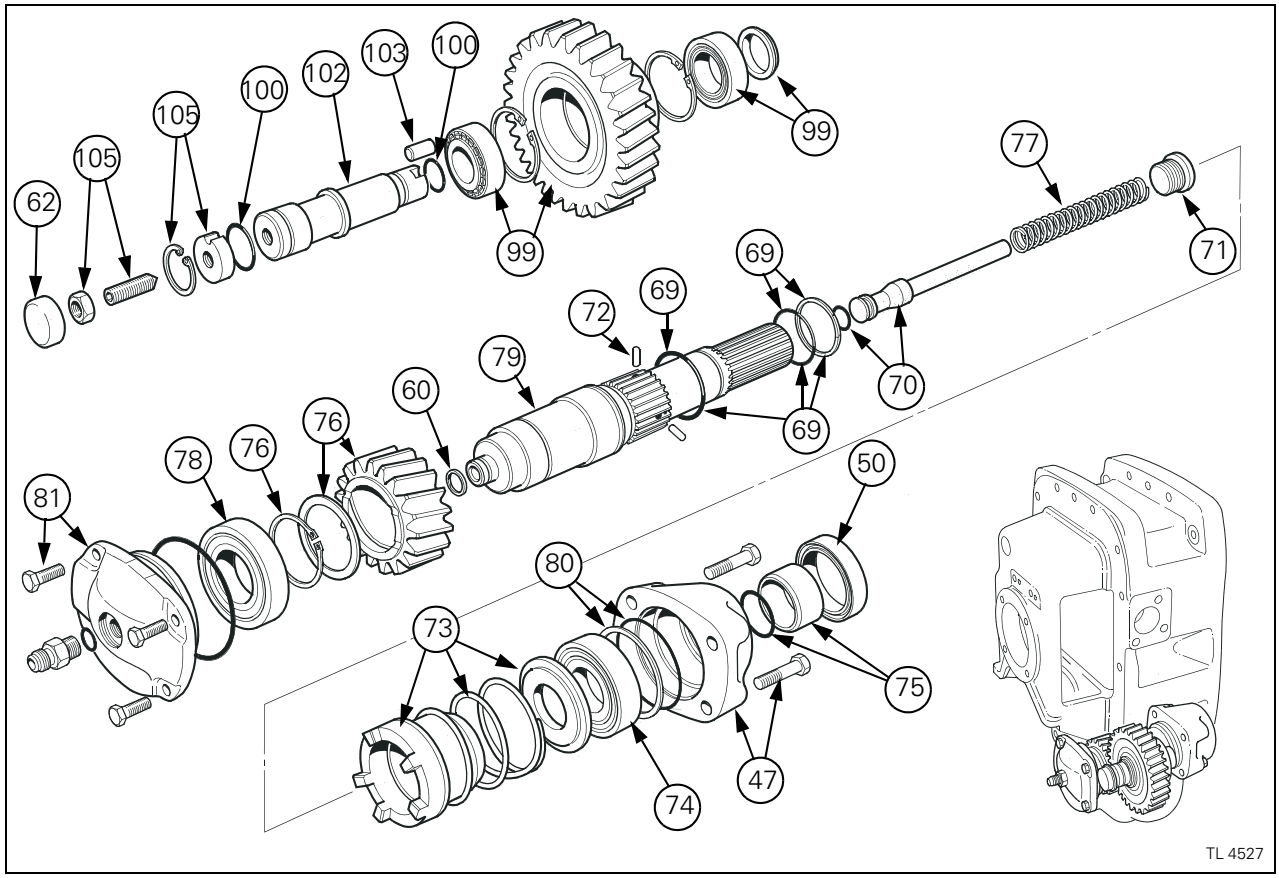
107. Make-up a small tool as shown in the illustration to prevent the disc from rotating during adjustment.
108. The correct pre-load is obtained by tightening up the hexagon screw and then locking in position with the locknut.
109. Fully tighten the hexagon screw until the gear is locked, this will ensure that the bearings are fully seated, then slacken off the screw.



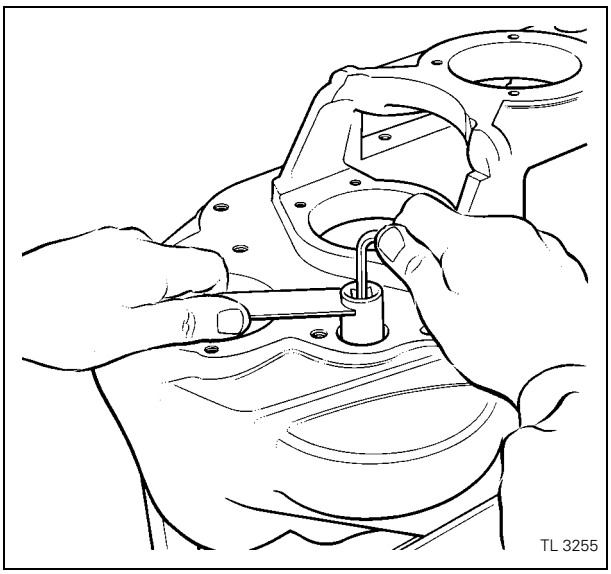
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Range Gearbox



110. Adjustment of the pre-load can be assisted by making a special wrench. Weld a handle to a 17mm across flats socket as shown in the illustration. This allows the hexagon wrench to hold the screw when tightening the locknut.
111. The correct pre-load for the idler shaft bearings is 0-0,05 mm (0-0.002 in). Tighten the screw carefully and slowly, rotating the gear. The pre-load should be correct when a slight resistance is felt when rotating the gear. To check that the pre-load is correct, repeat procedures 71 to 75. The reading should be 1200-2000 gm (42-71 oz) greater than with only the output shaft installed.
112. Apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the locknut. Hold the screw with a hexagon wrench and tighten the locknut with the special wrench to a torque of 18 Nm (13 lbf ft). Re-check the pre-load, re-adjust if not correct.
113. Remove the holding tool.
114. Fit a new core plug to the casing so that it is > 0,25 mm (0.010 in) below the machined face of the casing.



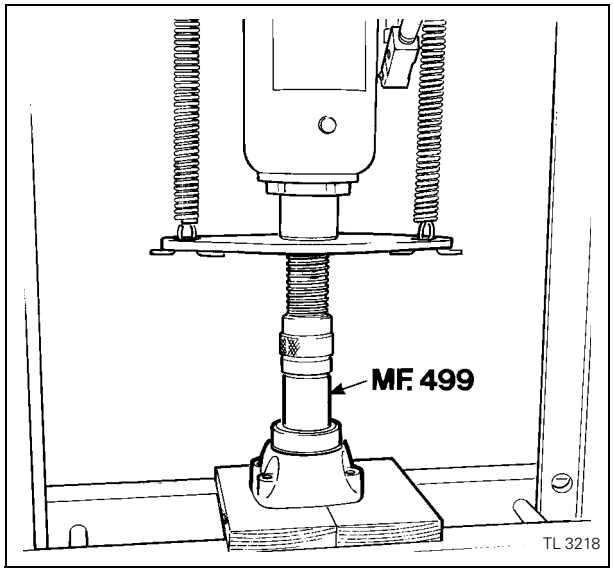
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Drive Shaft (Four-wheel Drive Only)

115. Using special tool MF.499, Drive Shaft Oil Seal Installer, fit a new seal, with the lip facing inwards, to the front bearing housing. The seal should be positioned 7 mm (1/4 in) below the internal recessed face, *(see page 5D-25)*. The tool ensures that the seal is correctly positioned. Lubricate the seal with petroleum jelly.
116. Install a new seal on the rear of the drive shaft assembly, lubricate with oil.
117. Fit new 'O' rings to the front bearing housing and rear cover.
118. Reinstall the drive shaft assembly and refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).

    Refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).

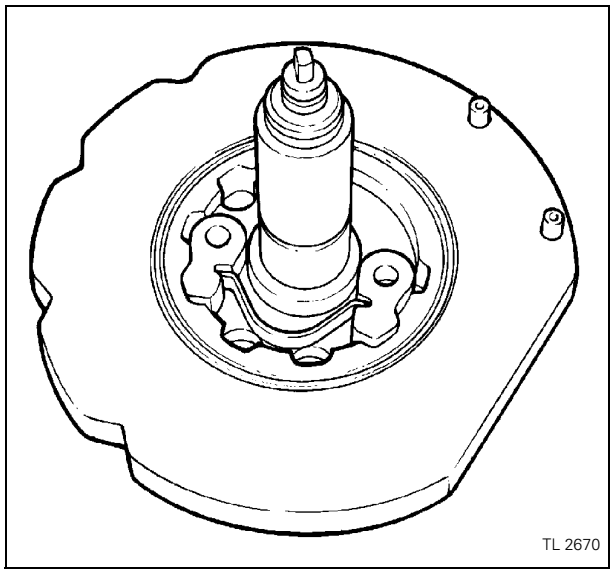


Layshaft

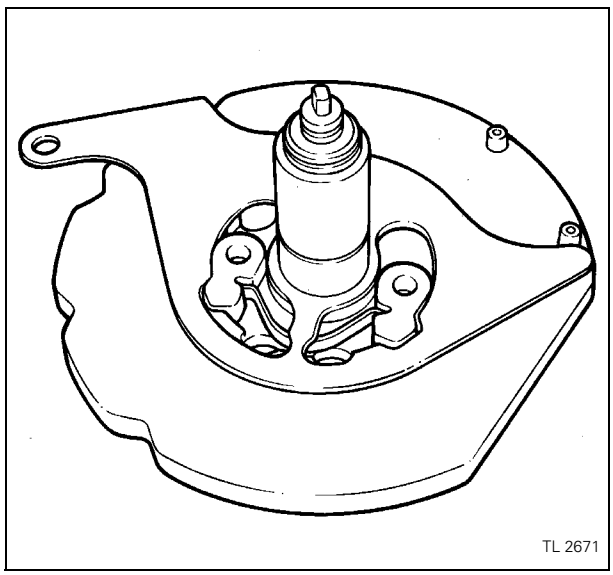
119. Reinstall the layshaft assembly and tighten the bolts to a torque of 30 Nm (22 lbf ft).

Selector Cam Assembly

120. Re-assemble the cam ratchet assembly, position the two pawls and spring in the cam plate as shown in the illustration.



121. Place the spring plate over the two pawls ensuring that they locate in the two semi-circular slots in the plate.



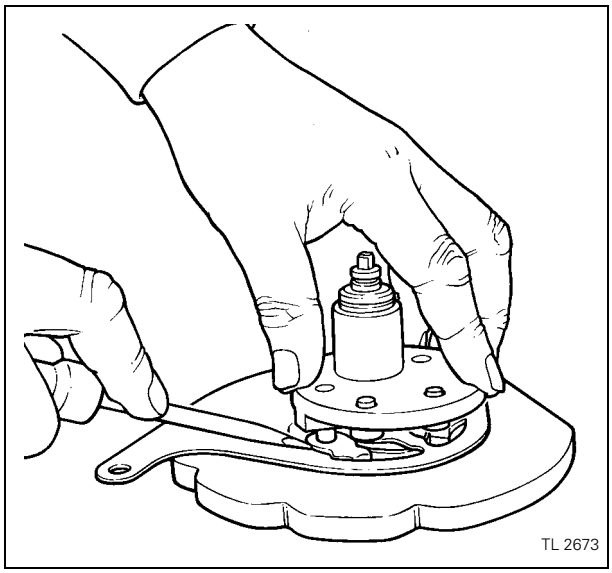
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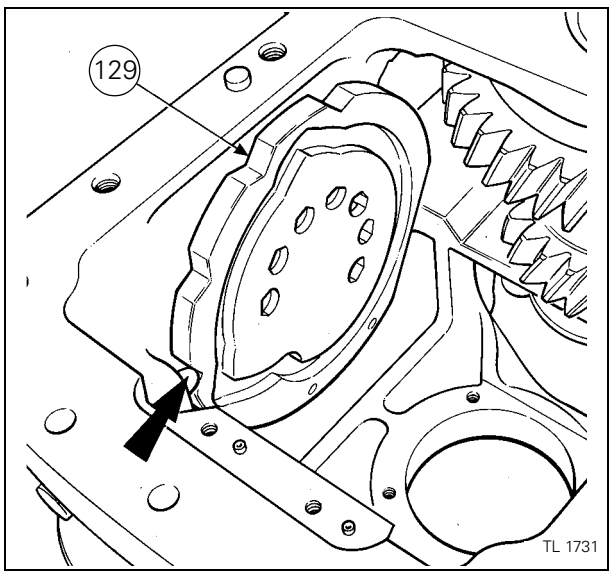
122. Position the two rollers on the pins of the cam block holding them in place with petroleum jelly.



123. Replace the cam block using a screwdriver to ease the pawls onto the pivot pins on the cam block.
124. Replace the circlip.
125. Refit the cam plate assembly to the gearbox in the high range position.
126. Replace the thrust washer and circlip.
127. Replace the seal ring.
128. Replace the bolt through the cam spring plate, apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten to a torque of 30 Nm (22 lbf ft).

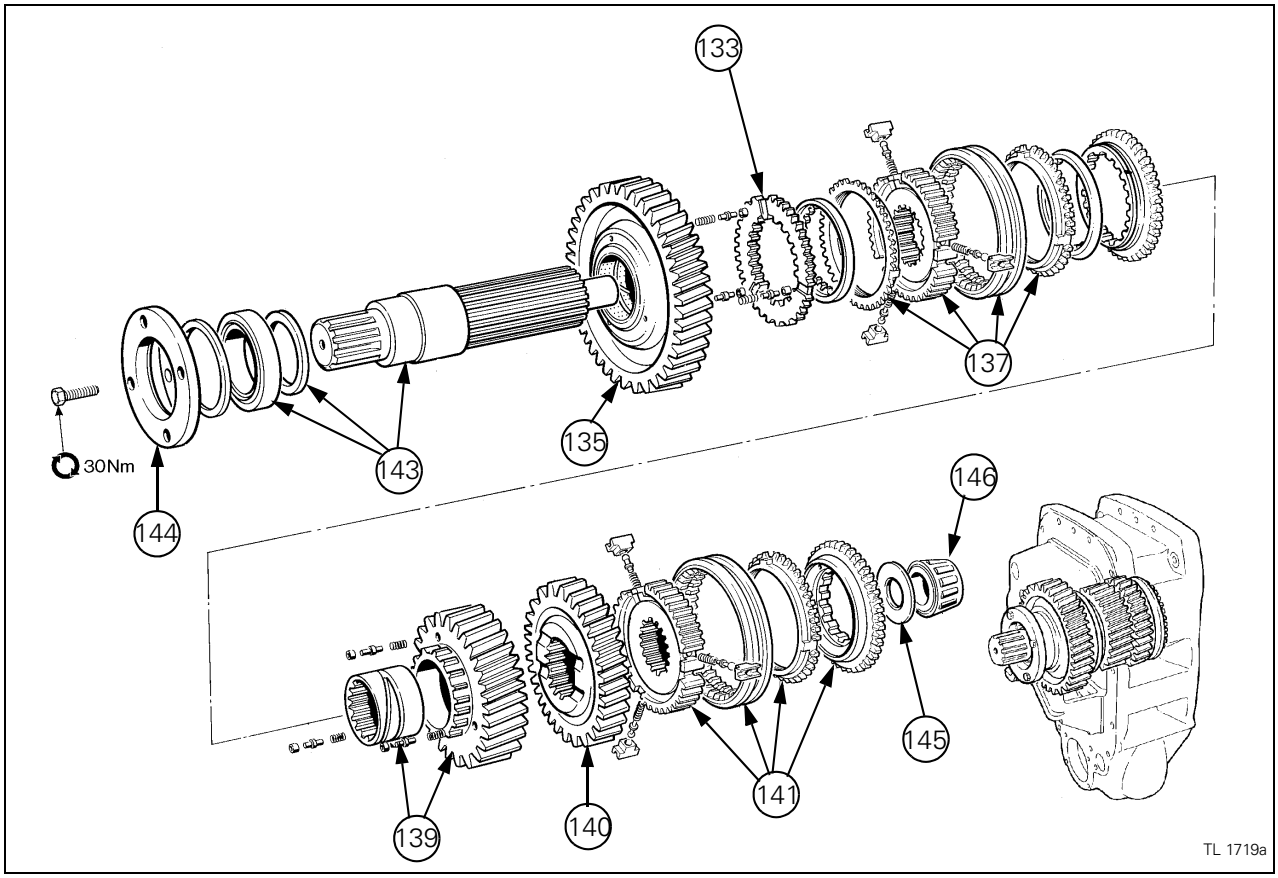


129. Replace the detent plunger and spring ensuring that the cam plate is in high range, *(see illustration),* tighten the plug to a torque of 60 Nm (44 lbf ft).



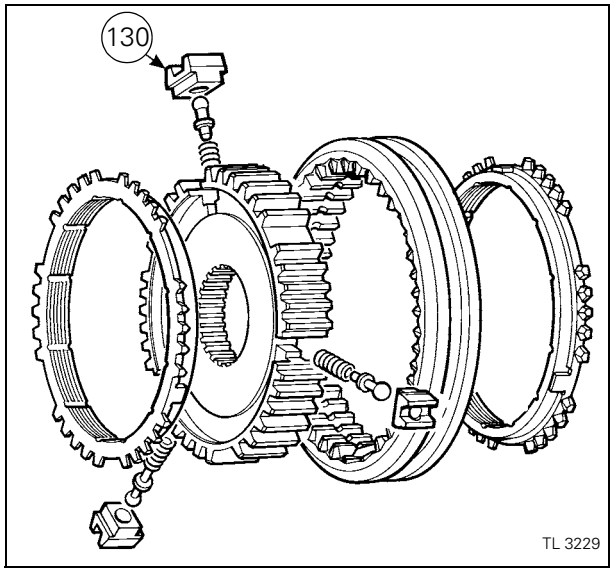
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Synchromesh Hub Assemblies

130. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
131. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
132. Press the coupler down into place easing the spring loaded blocks into position.



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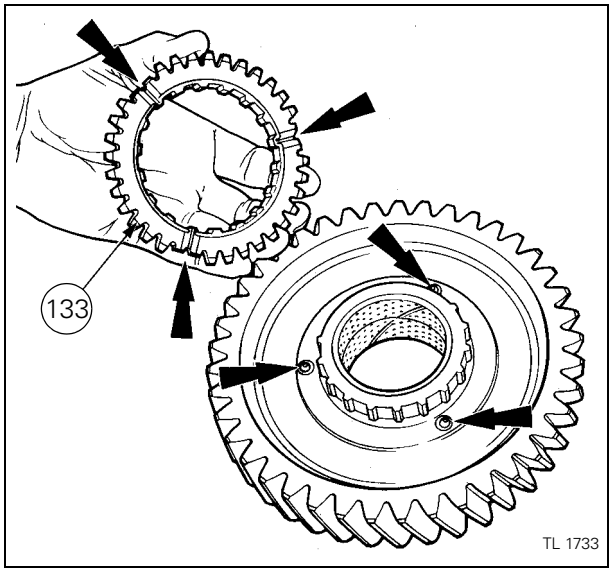
Main Shaft

133. Fit the synchromesh ring on first gear ensuring that the synchromesh alignment pins are opposite the `V' groove in the synchromesh cone hub.

NOTE: *Use petroleum jelly to hold all the synchromesh cones, baulk rings and hubs in place during the assembly process.*

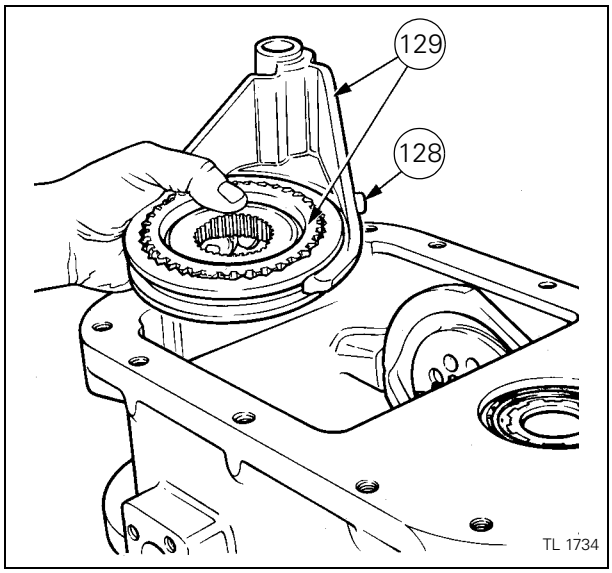
134. Place the special tool MF.477 on the inner face of the rear web of the box. This is to hold all the gears in their running position during assembly.

135. Place the low range gear in position with the synchromesh cone uppermost.



136. Fit the small rollers to the medium/low range and high range selector forks with some petroleum jelly.

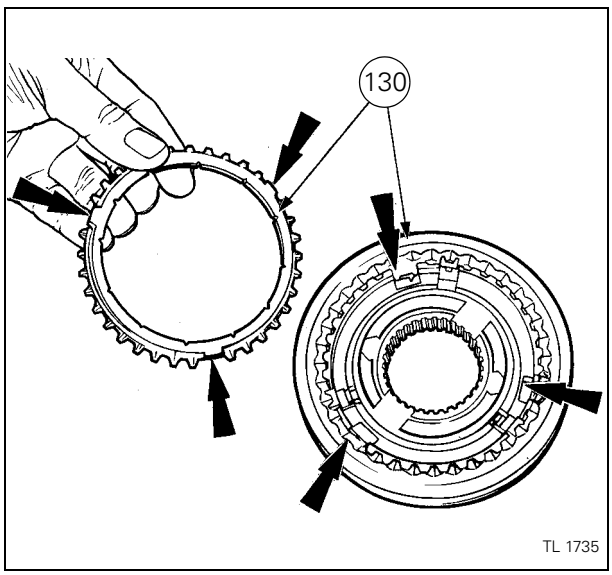
137. Fit the selector fork to the synchromesh hub assembly and lower it into position in the box, simultaneously engaging the selector fork roller in the cam track.



138. Ensure that the locating blocks on the low range baulk ring are engaged in the slots of the hub.

139. Refit the medium range gear ensuring that the spring loaded plungers locate in the 'V' grooves in the back of the synchromesh cone, as described for the first range gear.

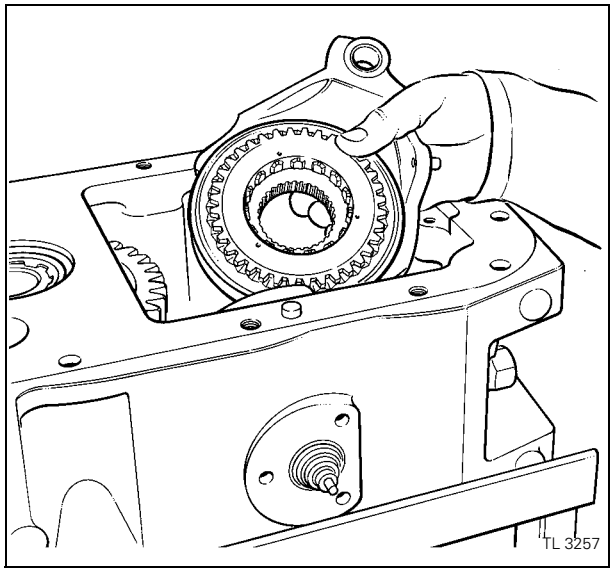
140. Replace the four-wheel drive gear with the grooved thrust face downwards.



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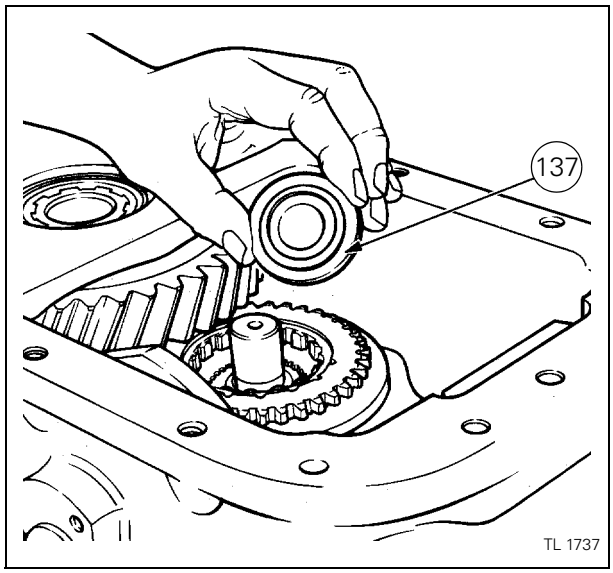
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141. Fit the selector fork to the synchromesh hub, complete with baulk ring and synchromesh cone. Pull the selector fork and coupler 'up' to engage High range with the baulk ring. Install with the flat face downwards, engaging the selector fork roller in the cam plate track.
142. Align the splines of all the gears and synchromesh hubs in the pack.
143. Take the main shaft with the taper roller bearing cone, sleeve and thrust washer fitted. Pass it up through the gear pack carefully fitting all the gears and synchromesh hubs.
144. Fit the bearing cap with the shims removed to hold the shaft in place.

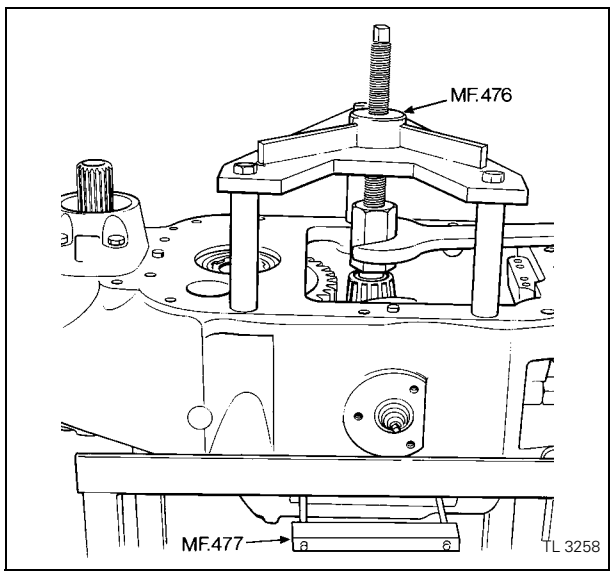


145. Place the thrust washer on the shaft with the reduced diameter facing upwards.

IMPORTANT: *Under no circumstance is the roller bearing, procedure 138, to be fitted to the main shaft with a hammer and punch. Damage to the bearing will result in a seizure of the gearbox and extensive failure of many of the components.*



146. Place the small taper roller bearing on the end of the screwed rod of special tool MF.476.
147. Fit special tool MF.476 over the main shaft. Screw down the central screw until it locates in the end of the shaft. Tighten the lock-nut.
148. Screw down the large hexagon nut on MF.476 to press the taper roller bearing into position.
149. Check that the bearing is pressed fully home by trying to turn the thrust washer under the bearing.
150. Remove special tools MF.476 and MF.477.
151. Replace the selector shaft, apply Massey Ferguson Studlock (Loctite 270) to the threads of the bolt and tighten to a torque of 30 Nm (22 lbf ft).
152. Replace the selector shaft support plate, apply Massey Ferguson Studlock (Loctite 270) to the threads of all the bolts and tighten to a torque of 30 Nm (22 lbf ft).
153. Rotate the shafts to ensure that all the gears are free to rotate.



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Re-installing the Range Gearbox

154. Stand the main gearbox up on end on its clutch housing. Ensure that all gears are in neutral.
155. Place the gasket on the mounting face of the main gearbox (only replace if damaged).
156. Ensure that the dowel on the bottom of the range gearbox is in place.
157. Lower the range gearbox into position on the main gearbox. Check that the range selector fork engages correctly with the rollers in the back of the cam plate.
158. Apply Hylomar to the bottom two bolts securing the range gearbox to the main gearbox.
159. Refit the transmission case bolts, range gearbox to gearbox, torque to 102 Nm (75 lbf ft).
160. Set the bearing pre-load setting.

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BEARING PRE-LOAD SETTING

Adjust **3-5D**

Special Tools:
MF.478 Bearing Pre-load Tool

Procedure

IMPORTANT: *The setting of the taper roller bearing pre-load is critical and MUST be carried out as described in this operation. Any deviation from the laid down procedure could have a serious effect on the performance of the gearbox.*

1. From an old shear tube coupling make up a turning handle as shown in the illustration.
2. Remove the bearing cap bolts and clean out the threaded holes in the casing with an M6 tap.
3. Install one of the thicker spacer rings between the cap and bearing so that when the cap is installed the gap between the cap and casing is minimal and easily measured with a feeler gauge.
4. Refit the bearing cap.
5. Install special tool MF.478, Bearing Pre-load Tool. Fit the four springs to the four bolts and screw into the housing so that the height of the four bolts from the top face of the cap to the top of the bolt is 55 mm (2.167 in). This will pre-load the taper roller bearings to approximately 45 kg (100 lbs).
6. Select medium range.
7. Rotate the main shaft at least 5 times both ways with the handle, tap the end of the shaft with a soft hammer to ensure that all the bearings are fully seated in their cups.
8. With two feeler gauge sets very carefully measure the gap between the underside of the bearing cap and the casing. Both feeler gauges must be set to the same thickness because there is a tendency for the cap to tilt.

NOTE: *This part of the operation is very critical, you must obtain the most accurate reading you can to 0,0025* mm *(0.001 in).*

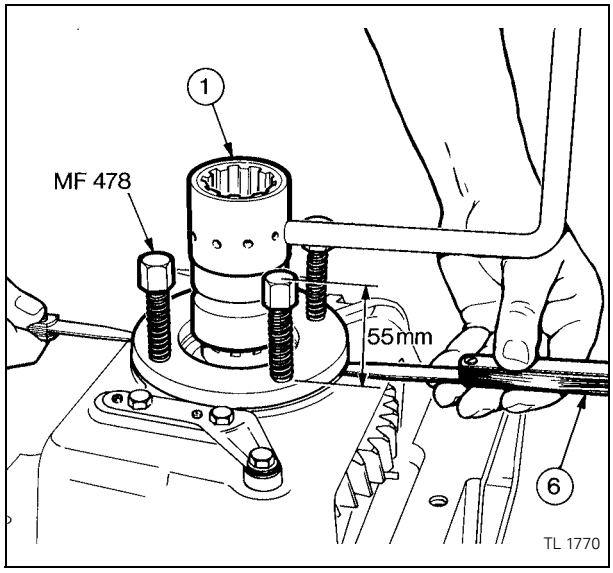
9. Check the clearance in two positions, 12 o'clock/6 o'clock and 3 o'clock/9 o'clock. When you are satisfied with the gauges selected, add up the value of one gauge set.
10. Calculate the spacer ring required as follows:

    The taper roller bearing pre-load for both new and old bearings is 0,05 mm (0.002 in).

    Spacer thickness = Thickness of spacer installed - gap measured + pre-load

    = 2,92 mm - 0,20 mm + 0,05 mm

    = 2,77 mm Use spacer ring 2,76 mm



Spacer ring sizes		
Part number	Metric	Imperial
3697 520 M1	2,44 mm	0.096 in
3697 521 M1	2,48 mm	0.098 in
3697 522 M1	2,52 mm	0.099 in
3697 843 M1	2,56 mm	0.101 in
3697 844 M1	2,60 mm	0.102 in
3697 845 M1	2,64 mm	0.104 in
3697 846 M1	2,68 mm	0.106 in
3697 847 M1	2,72 mm	0.107 in
3697 848 M1	2,76 mm	0.109 in
3697 849 M1	2,80 mm	0.110 in
3697 850 M1	2,84 mm	0.112 in
3697 851 M1	2,88 mm	0.113 in
3697 852 M1	2,92 mm	0.115 in
3697 853 M1	2,96 mm	0.117 in

Select a spacer ring that will give the closest reading to that calculated. In the case of used bearings a slightly lighter pre-load will be satisfactory because the bearings do not have to wear in.

11. Remove tool MF.478, the bearing cap and the spacer ring used as a gauge.
12. Re-assemble the bearing cap with the selected spacer ring and apply Massey Ferguson Studlock (Loctite 270) to the threads of the bolts. Tighten the bolts to a torque of 30 Nm (22 lbf ft).
13. Disengage the medium range gear and check the shafts for free rotation.

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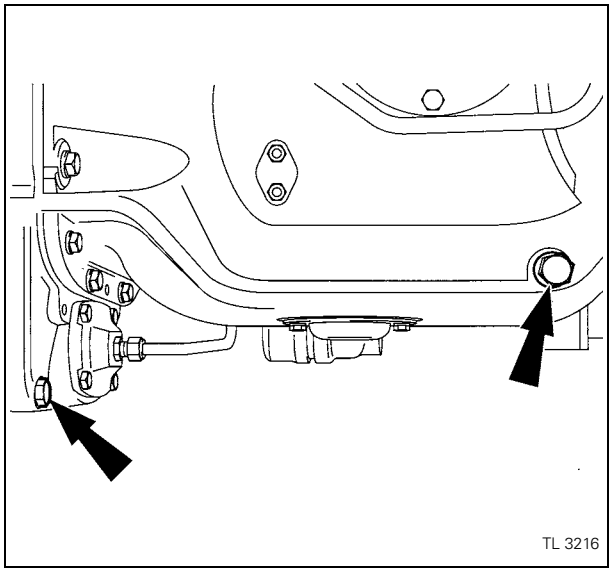
DRIVE SHAFT OIL SEAL

Removal and Refitment **4-5D**

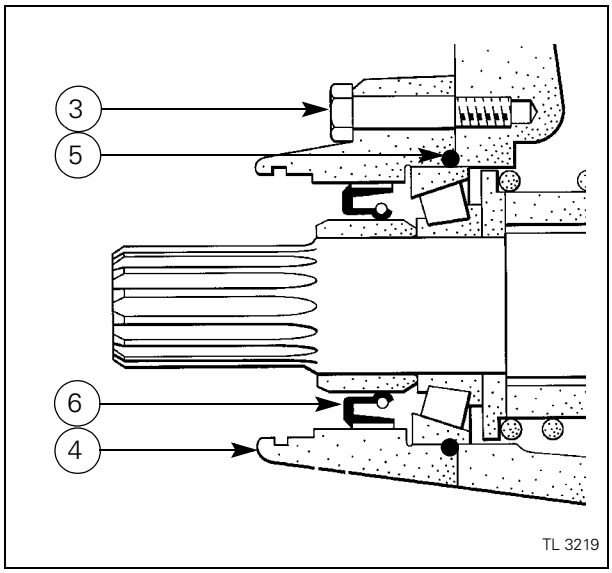
Special Tools:
MF.499 Drive Shaft Oil Seal Installer

Removal

1. Drain the oil from the transmission using the drain plug on the rear axle and range gearbox.


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2. Remove the drive shaft assembly, *(see operation 1-5E)*.
3. Remove the four bolts and the front bearing housing.
4. Remove the front bearing housing.
5. Remove and discard the 'O' ring.
6. Remove and discard the oil seal.



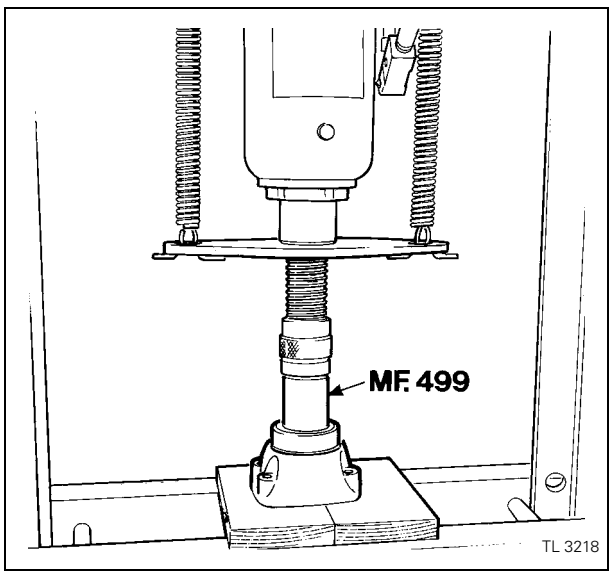
TL 3219

Refitment

7. Depending on the equipment available, using special tool MF.499 Drive Shaft Oil Seal Installer, place the housing under a press and press the seal into position with the lip of the seal facing inwards. The tool will position the seal correctly, if the tool is not available, set the seal 7 mm (0.276 in) below the recess in the cover, *(see illustration on next page)*.

or

8. Refit the housing to the gearbox with a new 'O' ring and apply 2-3 drops of Massey Ferguson Studlock (Loctite 270) to the bolts prior to tightening to a torque of 30 Nm (20 lbf ft).

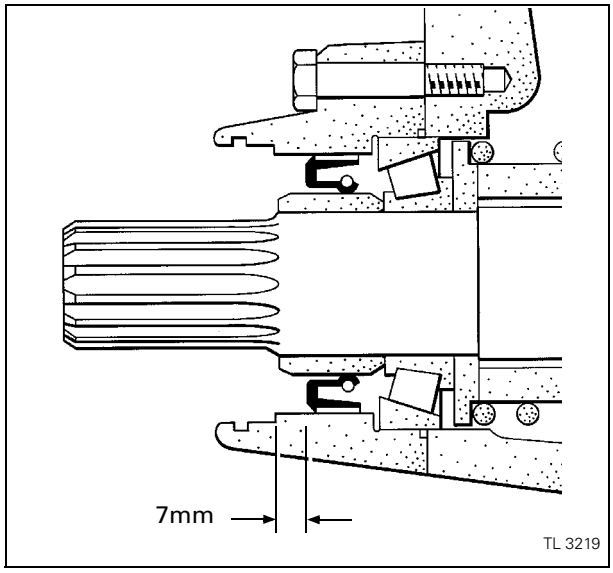


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9. Position the seal in the housing, using the special tool drive the seal into position. The tool will ensure that the seal is pressed in square and to the correct depth.
10. Refit the drive shaft assembly.
11. Refill the transmission with the correct grade of oil.



INDICATOR LIGHT SWITCH

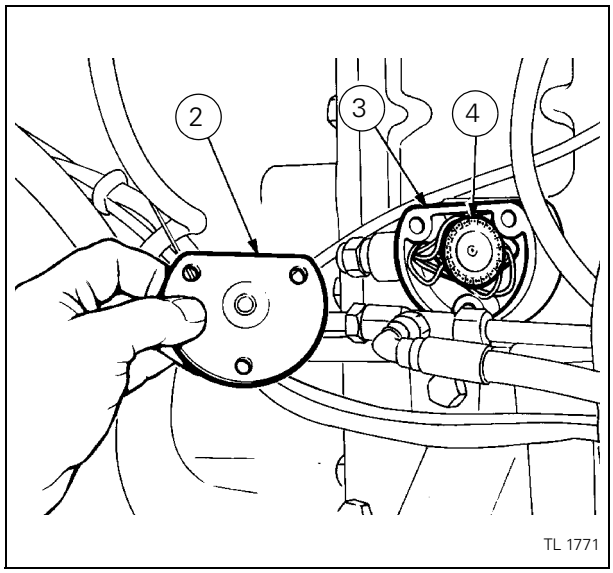
Removal and Refitment 5-5D

Removal

1. Drain the fuel and remove the left-hand fuel tank, *(see operation 2-3C)*.
2. Remove the three retaining screws and the cover.
3. Carefully remove the switch assembly; there may be a small loss of oil when the switch is removed.
4. If necessary, disconnect the wiring.
5. Remove the switch from the housing.

Refitment

6. Reverse procedures 1 to 5, except:
   a. Renew the seal on the switch shaft.
   b. Lightly oil the seal.
   c. Ensure that the cover seal is satisfactory.
   d. Replace the gasket between the switch housing and the range gearbox.



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Four-wheel Drive Shaft

Section 5 - Part E

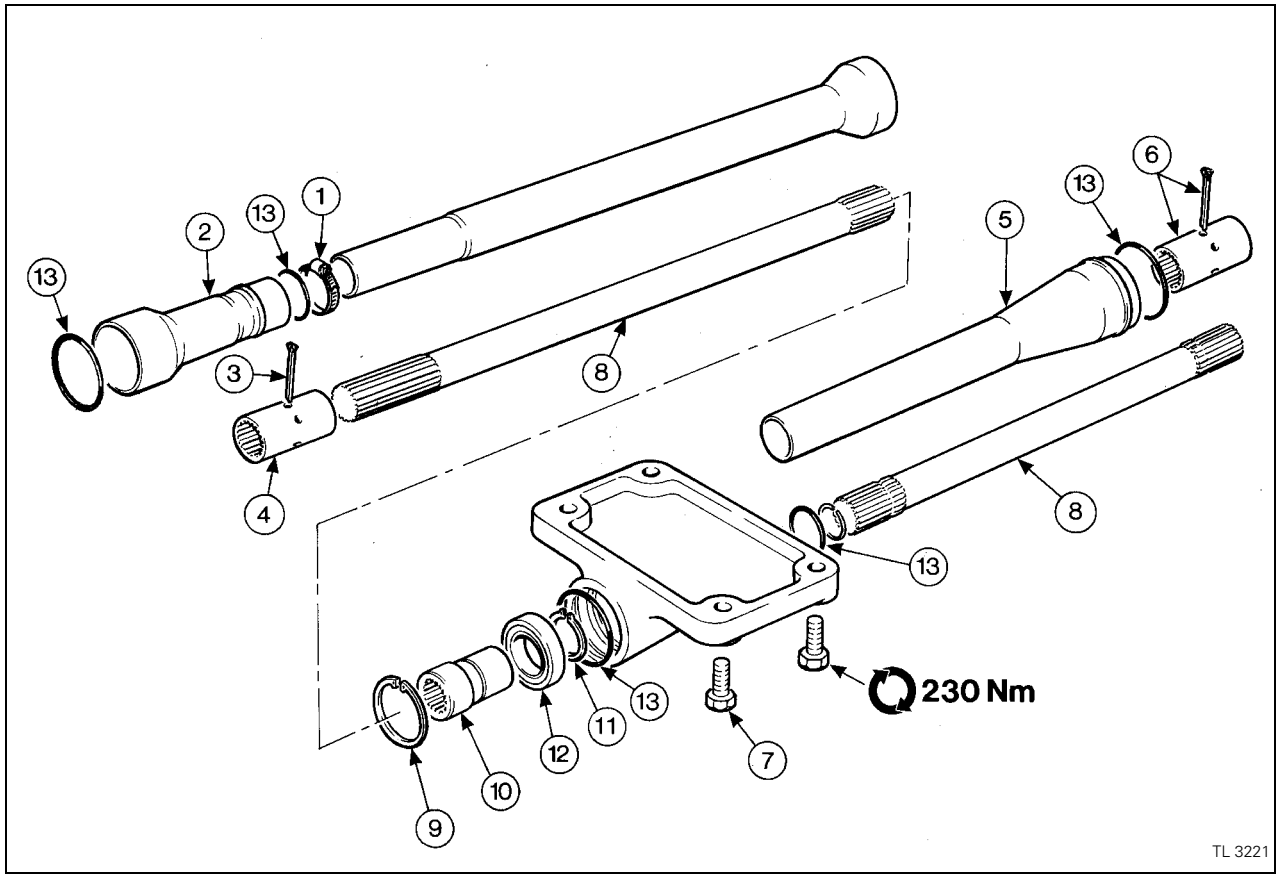
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Four-wheel Drive Shaft



FOUR-WHEEL DRIVE SHAFT

Removal and Refitment 1-5E

Removal

Disconnecting from Front Axle

1. Slacken the clip and slide down the guard tube.
2. Slide back the front section of the guard tube.
3. Remove the split pin.
4. Slide the coupler back along the drive shaft disconnecting the front axle.

NOTE: *If the tractor is being split between the engine and the gearbox, roll the engine forward and then remove the drive shaft and guard.*

Removal of the Drive Shaft Assembly

5. Slide the rear guard tube forward exposing the coupling to the range gearbox.
6. Remove the split pin and slide the coupling forward.
7. Remove the four bolts and the intermediate bearing assembly complete with the front and rear drive shafts.
8. Remove the drive shafts and guard tubes.

Intermediate Bearing Assembly

9. Remove the front circlip.
10. Drive the coupling and bearing assembly out of the front of the housing.
11. Remove the coupling circlip.
12. Remove the ball bearing from the coupling.

Examination

Carefully clean and examine all the components for wear especially the splines on the drive shafts and in the couplings. Replace any worn or suspect parts.

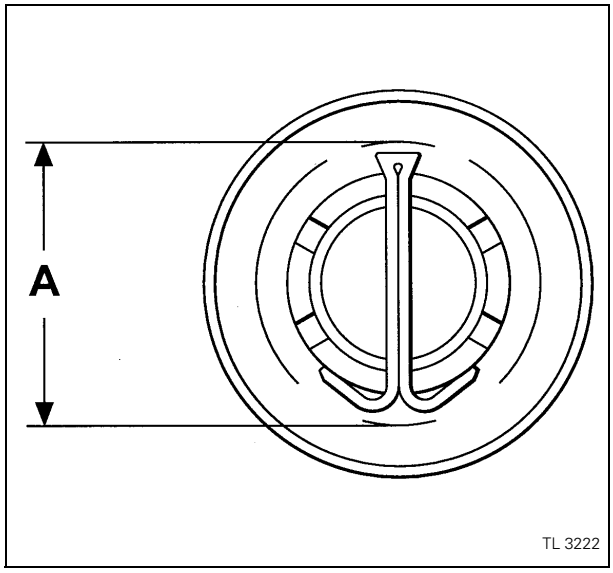
13. Inspect the condition of the 'O' ring seals, replace any that are split or damaged.

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Refitment

14. Re-assemble the intermediate bearing assembly, reverse procedures 9 to 12, except:
    a. Apply a medium amount of Mobilplex 47 or equivalent grease to the internal splines of the coupling.
15. Apply a small amount of lubricant to the guard tube 'O' rings to assist in re-assembly.
16. Re-assemble the drive shaft assembly, reverse procedures 5 to 8 except:
    a. The coupling split pin is a special split pin, part number 3810 097 M1, with a flat head to give clearance to the guard tube. The special split pin can be made by flattening the head of a standard pin as shown in the illustration. The overall dimension 'A' of the split pin must not exceed 50 mm (2 in).
    b. Apply a medium amount of Mobilplex 47 grease or equivalent to the internal splines of the couplings.
    c. Tighten the four housing bolts to a torque of 185 Nm (135 lbf ft)
17. Re-connect the drive to the front axle, reverse procedures 1 to 4. Ensure that the clip is correctly located and tight.



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8 x 8 Shuttle Gearbox

Section 5 - Part F

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8 x 8 Shuttle Gearbox

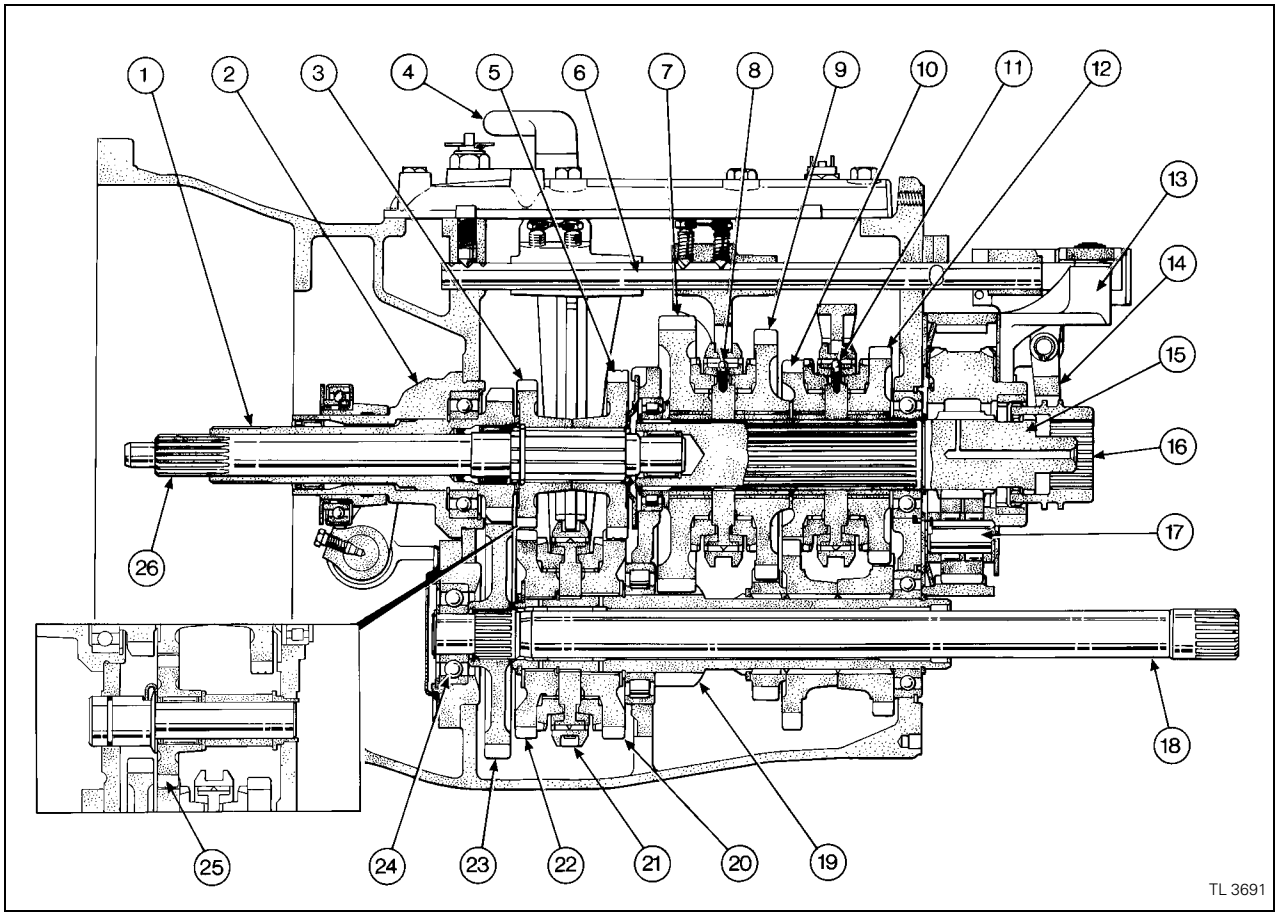
SPECIFICATION

Model	8 x 8 Shuttle gearbox.
No. of gears:	
Forward	8.
Reverse	8.
Epicyclic reduction unit:	
Type	Heavy-duty.
Reduction	4 : 1.
Mainshaft end float	0,080-0,30 mm (0.003-0.012 in).
Type of adjustment	Variable thickness thrust washer.
Synchromesh ring to coupler clearance - installed	0,8 mm (0.030 in).
Synchromesh ring to coupler clearance - removed	0,5 mm (0.020 in).
Special Tools	
MF.177A	Input shaft oil seal protector.
MF.218B	PTO bearing housing replacer.
MF.255B	PTO input shaft oil seal replacer.
MF.315A	Needle roller bearing remover/replacer.
MF.367B	Transmission torque wrench.
MF.414A	Synchromesh neutral setting tool.
MF.421	Needle roller bearing and seal replacer.
MF.422A	Bearing and seal remover.
MF.3008	Circlip plier set.
Bolt Torques	
Gear lever 12 point cap screws	60 Nm (45 lbf ft).
Gearbox top cover bolts	115 Nm (85 lbf ft).
Shifter fork locking screws	43 Nm (32 lbf ft).
Rear gear shift selector bracket	58 Nm (43 lbf ft).
Input shaft housing to gearbox	60 Nm (44 lbf ft).
PTO drive bearing housing	58 Nm (43 lbf ft).
Gearbox to range housing	102 Nm (75 lbf ft).
Gear shift housing bolts to four-wheel drive housing	30 Nm (25 lbf ft)
Epicyclic unit retaining bolts	43 Nm (32 lbf ft)
Selector mechanism support bracket bolts	43 Nm (32 lbf ft)

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8 x 8 Shuttle Gearbox



Eight speed shuttle gearbox

1. PTO input shaft and gear.
2. Input shaft housing.
3. Reverse constant mesh gear.
4. Forward/reverse selector lever.
5. Forward constant mesh gear.
6. Selector rail and forks.
7. First gear.
8. First/second synchromesh coupler.
9. Second gear.
10. Fourth gear.
11. Third/fourth synchromesh coupler.
12. Third gear.
13. Gear shift mechanism.
14. Epicyclic selector.
15. Mainshaft.
16. Sliding coupler.
17. Epicyclic reduction unit.
18. PTO shaft.
19. Layshaft.
20. Forward constant gear - layshaft.
21. Forward/reverse synchromesh coupler.
22. Reverse constant mesh gear.
23. PTO constant mesh gear.
24. PTO front bearing housing.
25. Reverse idler gear.
26. Transmission input shaft.

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8 x 8 Shuttle Gearbox

GENERAL DESCRIPTION

The 8 x 8 Speed Shuttle Gearbox has eight forward and eight reverse gears; the forward reverse (shuttle) selection being controlled by a lever on the instrument panel adjacent to the steering wheel. It provides full engine braking on over-run and enables the tractor to be towed to start the engine.

Drive Arrangements

From the construction viewpoint the gearbox has three sections. The front section consists of the forward and reverse gears with synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and reverse speeds with synchromesh engagement on all gears whilst the rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio for work in the field.

The four basic forward and reverse speeds are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, doubles the number of speeds available and gives the gearbox a total of eight forward speeds and eight reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the power take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted at its front end into the mainshaft. The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft.

The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

The mainshaft carries four free-running gears, all of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

The 2nd, 3rd and 4th ratio, forward and reverse gear sets are of the straight cut spur type. The 1st ratio gear set has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running.

Drive through the 1st, 2nd, 3rd and 4th ratio free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms part of the synchromesh engagement mechanism. Ball and roller bearings are used to support the main and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the forward or reverse gear set to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the epicyclic gear reduction unit in LOW range drive or directly in HIGH range.

Synchromesh Mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Epicyclic Gear Reduction Unit

The epicyclic gear reduction unit is at the rear of the gearbox. The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears, also in mesh with a fixed internal ring gear or 'annulus' forming the circumference of the working components. When the mainshaft rotates, the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the drive shaft to the final drive. When moved rearwards by its shift lever, it couples the mainshaft directly to the output shaft to establish high range drive, giving the gearbox an additional set of speed ratios 5th, 6th, 7th, 8th and high reverse.

When shifted fully forwards the external splines on the coupler engage corresponding splines on the planet carrier to establish low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving 1st, 2nd, 3rd and 4th speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox - a feature forming the basis of the Massey Ferguson safety starting arrangements.

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GEARBOX

Removal and Refitment 1-5F

Special Tools:
MF.367B Transmission Torque Wrench

Removal

IMPORTANT: *The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and four-wheel drive gearbox.*

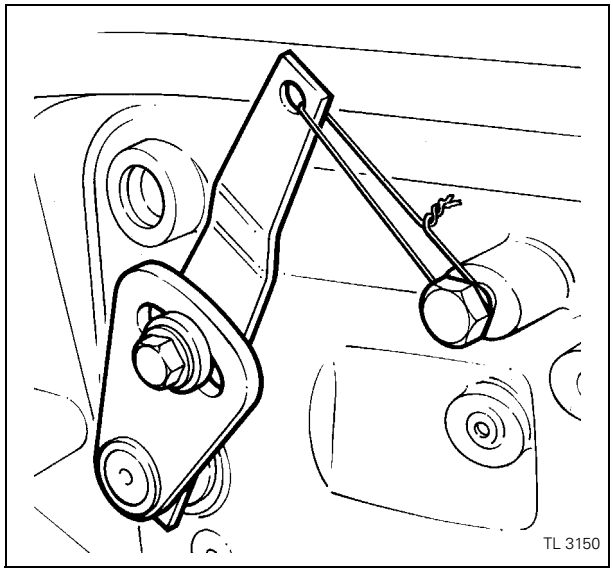
1. Split the tractor between the range gearbox and the rear axle *(see operation 3-2A)* in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the four-wheel drive gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Tie the clutch operating lever back with a piece of wire to retain the clutch release bearing.
6. Support the weight of the main gearbox on the hoist or crane. Position the crane so that the input shafts can be withdrawn out of the clutch.
7. Remove all the bolts around the clutch housing and remove the gearbox taking care not to damage any of the clutch components.
8. Place the gearbox on a suitable bench so that the repair work can be carried out.

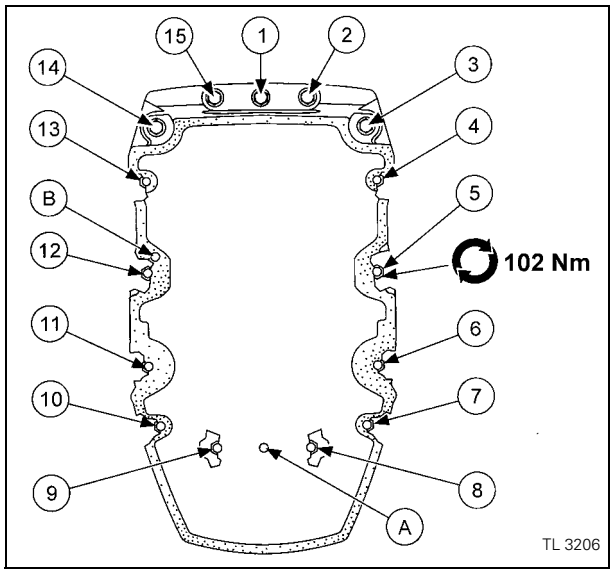
Refitment

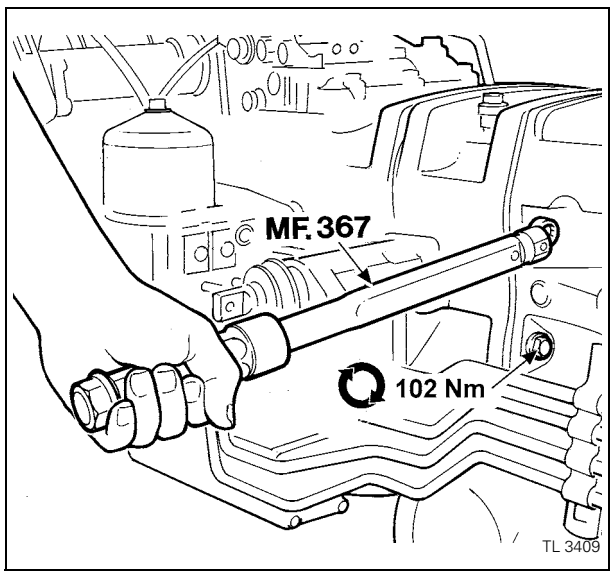
9. After repair, stand the gearbox vertically on the clutch housing face. Ensure that all gears are in neutral.
10. Ensure that the two dowels on the bottom and side of the range gearbox are in place.
11. Place a new gasket on the mounting face of the main gearbox.
12. Lower the four-wheel drive gearbox into position on the main gearbox. Check that the four-wheel drive gear, if fitted, engages correctly with the gearbox main shaft. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure.*

13. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.



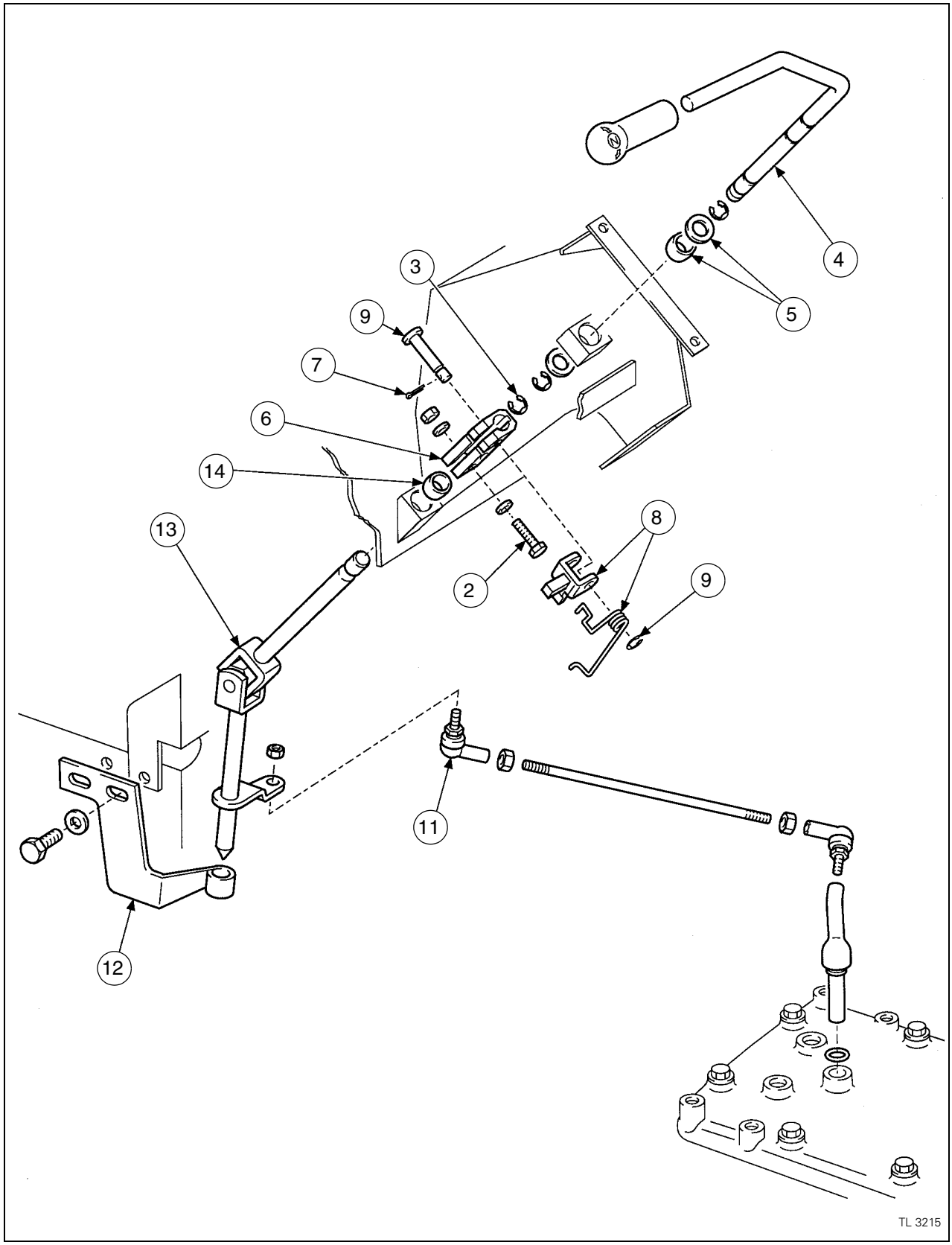




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8 x 8 Shuttle Gearbox



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14. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm socket.
15. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
16. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
17. Re-install the engine/gearbox assembly into the tractor.

FORWARD/REVERSE CONTROL LEVER

Overhaul 2-5F

Dis-assembly

NOTE: *The lower part of the shaft with the universal joint can only be removed when the tractor is split between the engine and clutch.*

1. Remove the lower panel under the instrument panel to gain access to the control mechanism.
2. Slacken the coupling bolts.
3. Remove the three 'C' clips on the upper part of the hand lever.
4. Withdraw the hand lever up out of the instrument panel.
5. Remove the washers and spherical bearing.
6. Remove the coupling complete with the clutch interlock.
7. Remove the split pin.
8. Remove the spring and interlock lever.
9. Remove the 'C' clip and pivot pin.
10. If removal of the lower part of the shaft is required, split the tractor between the engine and clutch, sufficiently to enable the shaft to be removed from the lower bearing and to clear the back of the cylinder block.
11. Disconnect the control rod ball joint.
12. Remove the lower bracket.
13. Remove the lower shaft and universal joint.
14. Remove the lower spherical bearing.

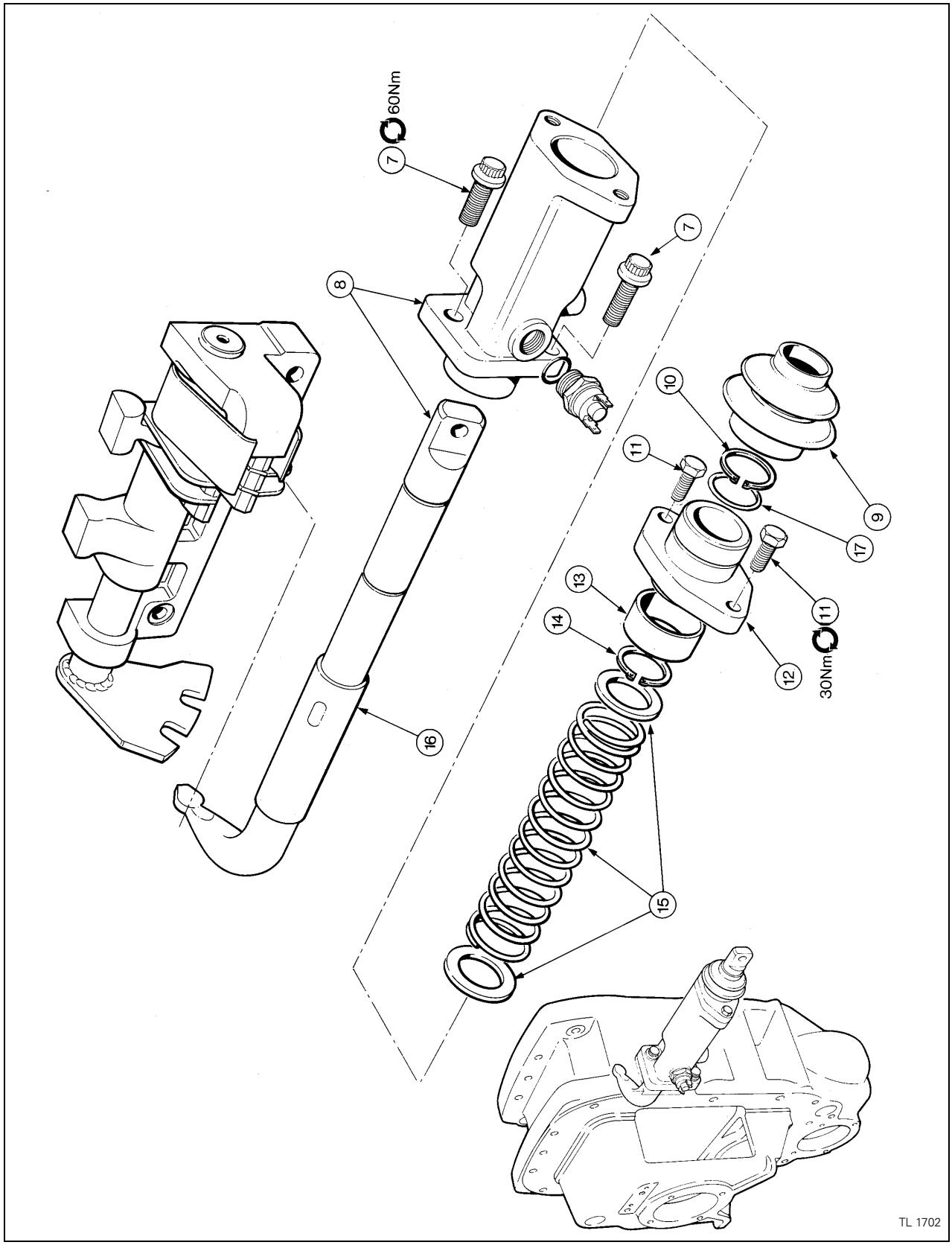
Re-assembly

15. Reverse procedures 1 to 14 except:
    a. Adjust the length of the control rod so that the interlock engages with the clutch pedal when the pedal is in its normal position.
    b. Lightly lubricate the spherical bearings.
    c. Set the hand lever to a nine o'clock position before tightening the coupling bolts.

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MAIN GEAR SHIFT LEVER

Removal and Refitment **3-5F**

Removal

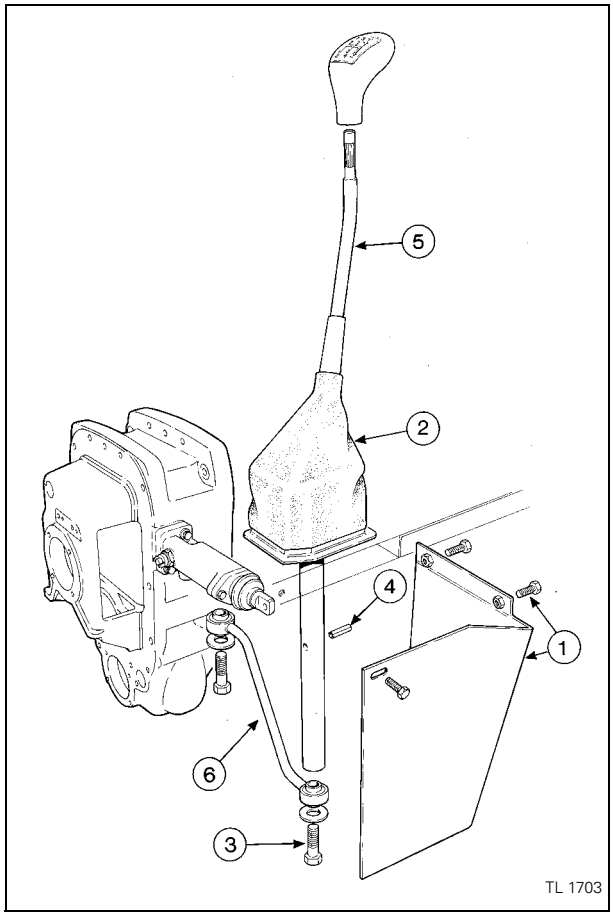
1. Remove the three bolts and the gear lever cover (tractors with single fuel tank only).
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the three 12 point cap screws holding the lever assembly to the four-wheel drive gearbox.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.

WARNING: Spring under compression.

14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.
17. Remove the 'O' ring.

Refitment

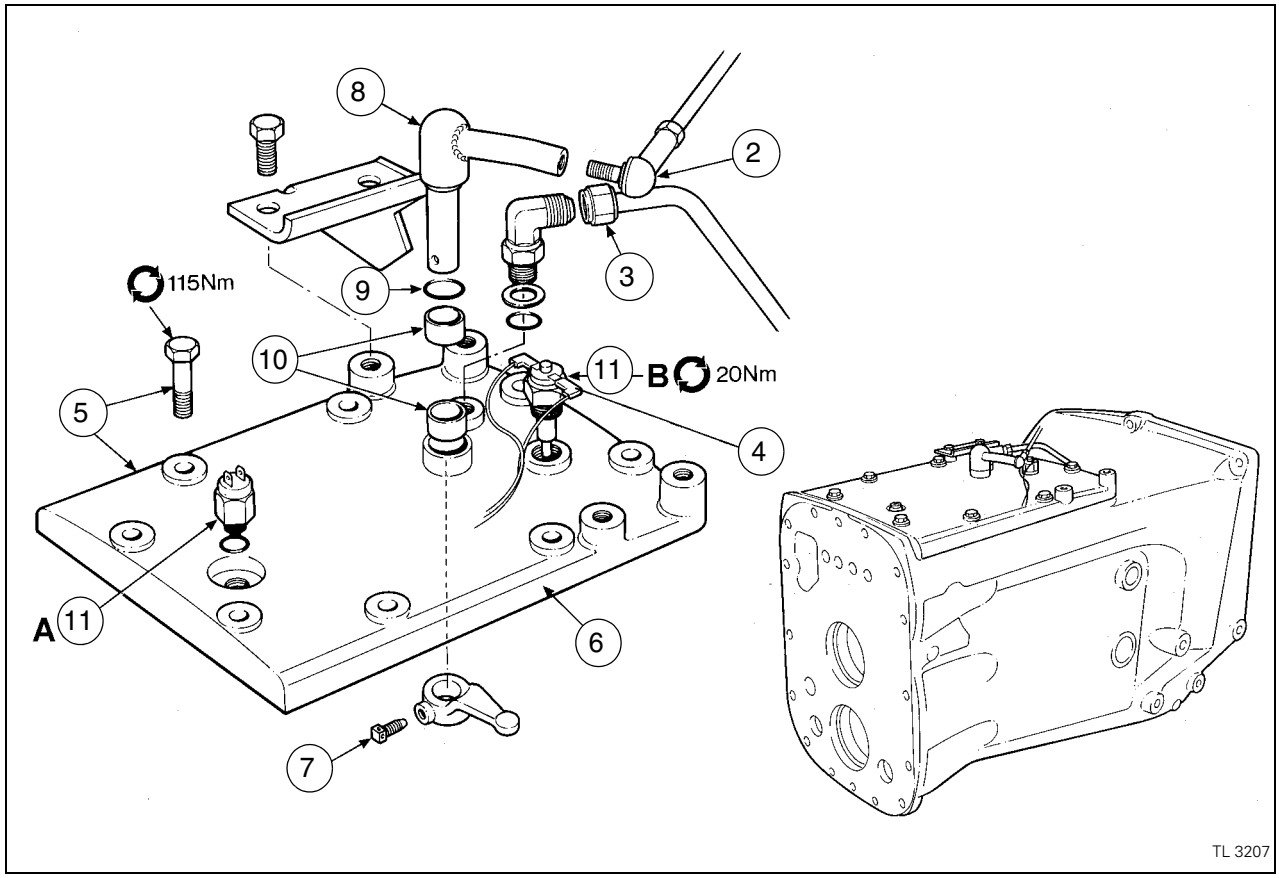
18. Reverse procedure 1 to 14, except:
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (25 lbf ft).
    f. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 60 Nm (45 lbf ft).



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8 x 8 Shuttle Gearbox



GEARBOX TOP COVER

Removal and Refitment 4-5F

Removal

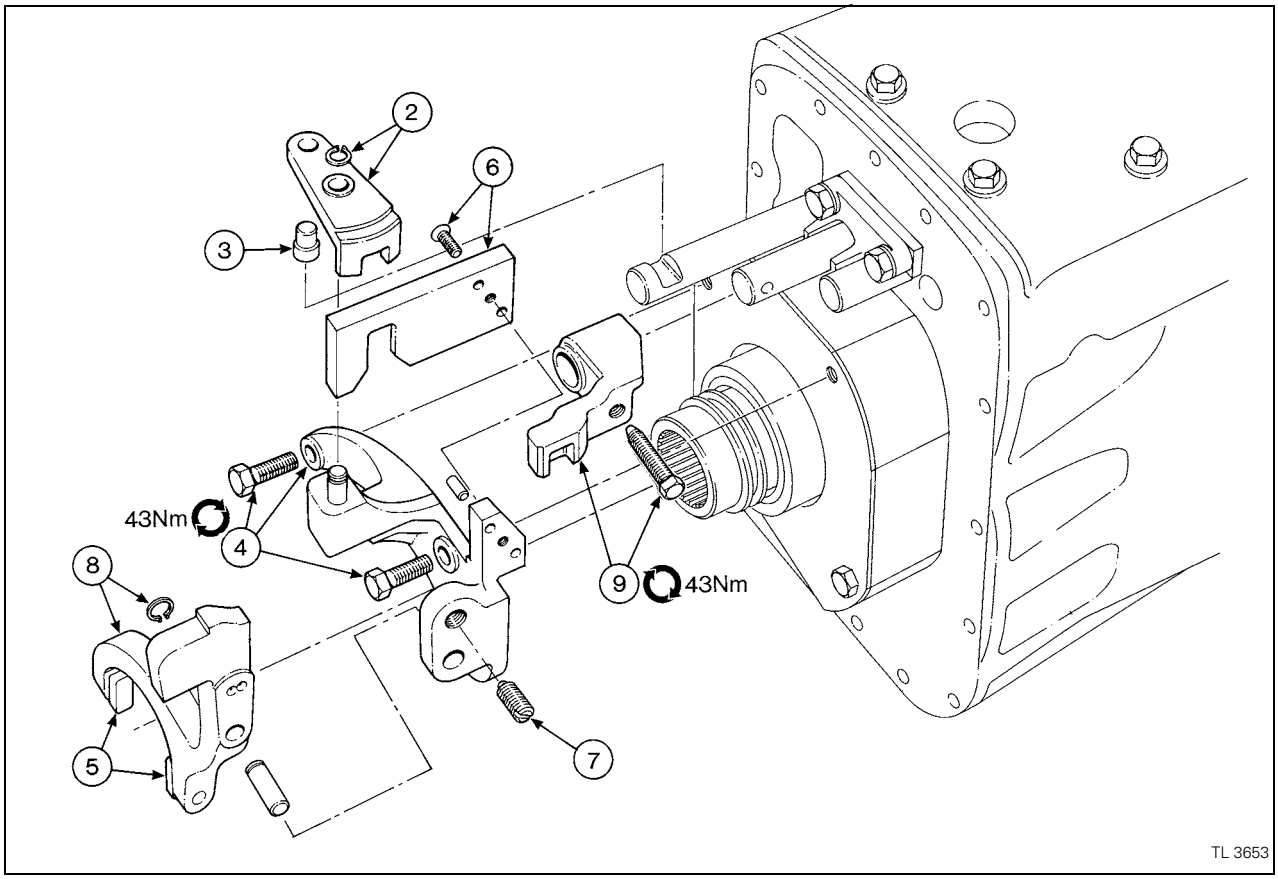
1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the wires to the switches 'A' and 'B'.
5. Remove the bolts and clutch cable bracket.
6. Remove the top cover.
7. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
8. Withdraw the shaft from the cover.
9. Remove and discard the 'O' ring seal.
10. If necessary, remove and replace the bushes in the top cover.
11. Remove the safety start switch 'A', reverse bleeper switch 'B' to prevent damage to the switches.
12. Clean all components and remove dried gasket material from the machined faces.

Refitment

13. Reverse procedures except:
    a. Replace the shaft 'O' ring.
    b. Apply Massey Ferguson Studlock (Loctite 270) to the lever locking bolt (7).
    c. Lubricate the safety start switch with a small quantity of transmission oil or petroleum jelly before installation.
    d. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

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SELECTOR MECHANISM

Removal and Refitment 5-5F

Removal

1. Remove the four-wheel drive gearbox assembly, *(see operation 1-5H);* or spacer on two-wheel drive tractors.
2. Remove the circlip and 3rd/4th selector lever.
3. Remove the selector pin.
4. Remove the two bolts and lift off the support assembly.
5. Remove the two pivot pads.
6. Remove the countersunk screw and the locking plate.
7. Unscrew the spring plunger.
8. Remove the circlip and the epicyclic selector fork.
9. Loosen the screw and remove the 1st/2nd selector jaw.

Refitment

10. Reverse procedures 1 to 9 except:

a. Tighten the two support assembly bolts to a torque of 43 Nm (32 lbf ft).

b. Tighten the 1st/2nd selector jaw screw to a torque of 43 Nm (32 lbf ft).

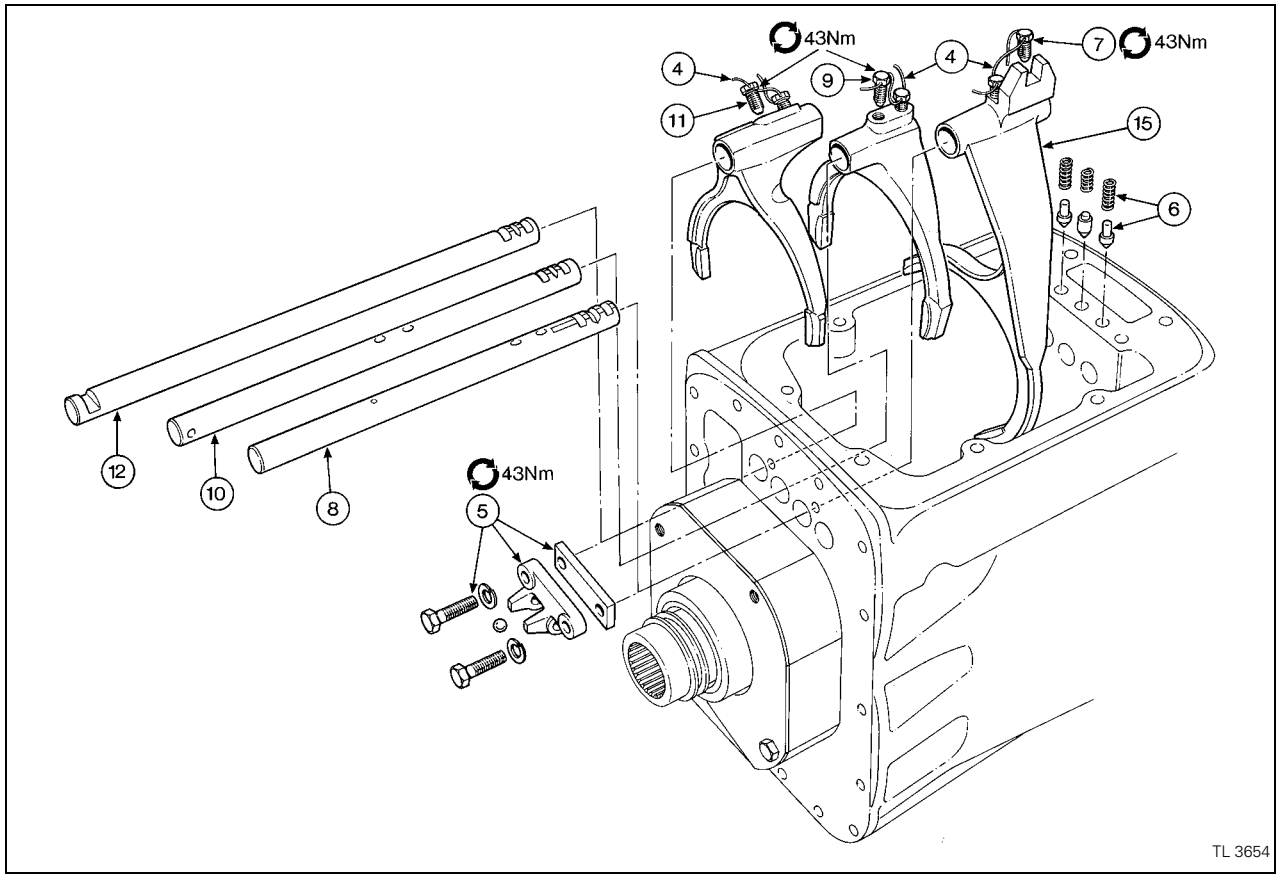
c. Apply 2-3 drops of Massey Ferguson Studlock (Loctite 270) to the threads of the spring plunger. Screw fully home and then undo 1/4 turn.

d. Lightly lubricate the mechanism and check for free movement, rectify any stiff operation.

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8 x 8 Shuttle Gearbox



SELECTOR RAILS AND FORKS

Removal and Refitment **6-5F**

Special Tools:
MF.414A Synchromesh Neutral Setting Tool

Removal

CAUTION: *Beware of sharp edges around the top of the gearbox case.*

1. Remove the gearbox, *(see operation 1-5F)*.
2. Remove the gearbox top cover *(see operation 4-5F)*.
3. Remove the selector mechanism, *(see operation 5-5F)*.
4. Remove all the locking wires and discard.
5. Remove the bolts, retainer, packing piece and ball, part of the gear shift interlock.
6. Lift out the detent springs and plungers.
7. Loosen the locking screws.
8. Slide the Forward/Reverse rail rearwards out of the housing and the selector fork.
9. Loosen the locking screw.
10. Slide the 1st/2nd rail rearwards out of the housing.
11. Loosen the locking screw.
12. Slide the 3rd/4th rail rearwards out of the housing.
13. Remove the 1st/2nd and 3rd/4th selector forks.
14. Remove main input shaft, *(see operation 10-5F)*.
15. Remove the Forward/Reverse synchromesh selector fork.

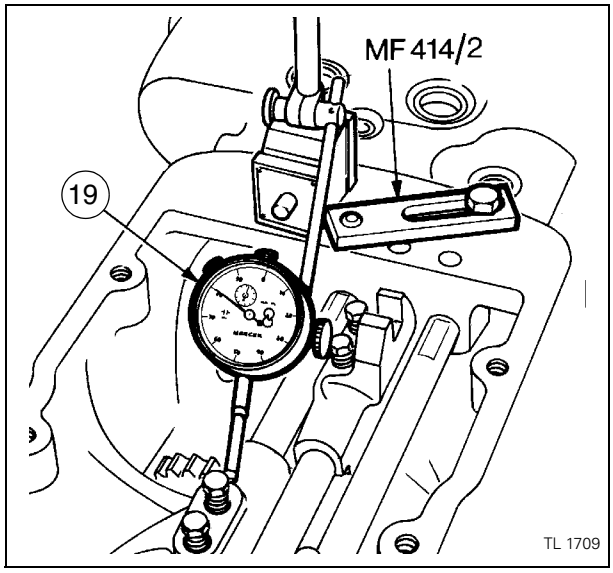
Refitment

16. Reverse procedures 1 to 14.
17. Set the Forward/Reverse, 1st/2nd and 3rd/4th selector forks to the selector rails as follows:
18. Using special tool MF.414A Synchromesh Neutral Setting Tool, lock the selector rail using the bolt MF414/2 and plate MF414/3.
19. Set up a magnetic base dial indicator, as illustrated, with the plunger located against the selector fork.
20. With finger pressure only, slide the selector fork to the rear taking up any clearance. DO NOT engage gear.

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21. Zero the indicator gauge; slide the selector fork fully forward, taking up the clearance again and note the reading on the dial indicator.
22. Half the reading obtained and progressively lock up the two screws on the selector fork to a torque of 43 Nm (32 lbf ft). Ensure that the selector fork is positioned to give half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).
23. Wire-lock all locking screws using new locking wire.
24. On completion of the refitting procedure, check operation and place all the gears in the neutral position.
25. Replace the gear shift interlock and torque the retaining bolts (5) to 43 Nm (32 lbf ft).

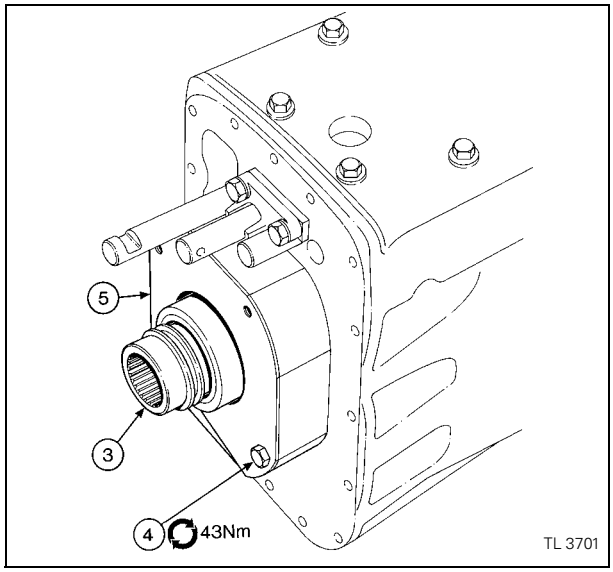


EPICYCLIC UNIT

Removal and Refitment 7-5F

Removal

1. Remove the four-wheel drive gearbox assembly, *(see operation 1-5H),* or Spacer unit on two-wheel drive tractors.
2. Remove the selector mechanism *(see operation 5-5F).*
3. Remove the coupling.
4. Remove the bolts.
5. Remove the complete assembly.



Refitment

6. Reverse procedures 1 to 5 except:

a. Ensure that the front and rear thrust rings are correctly located before refitment.

b. Ensure that the dowels are correctly located in the gearbox casing.

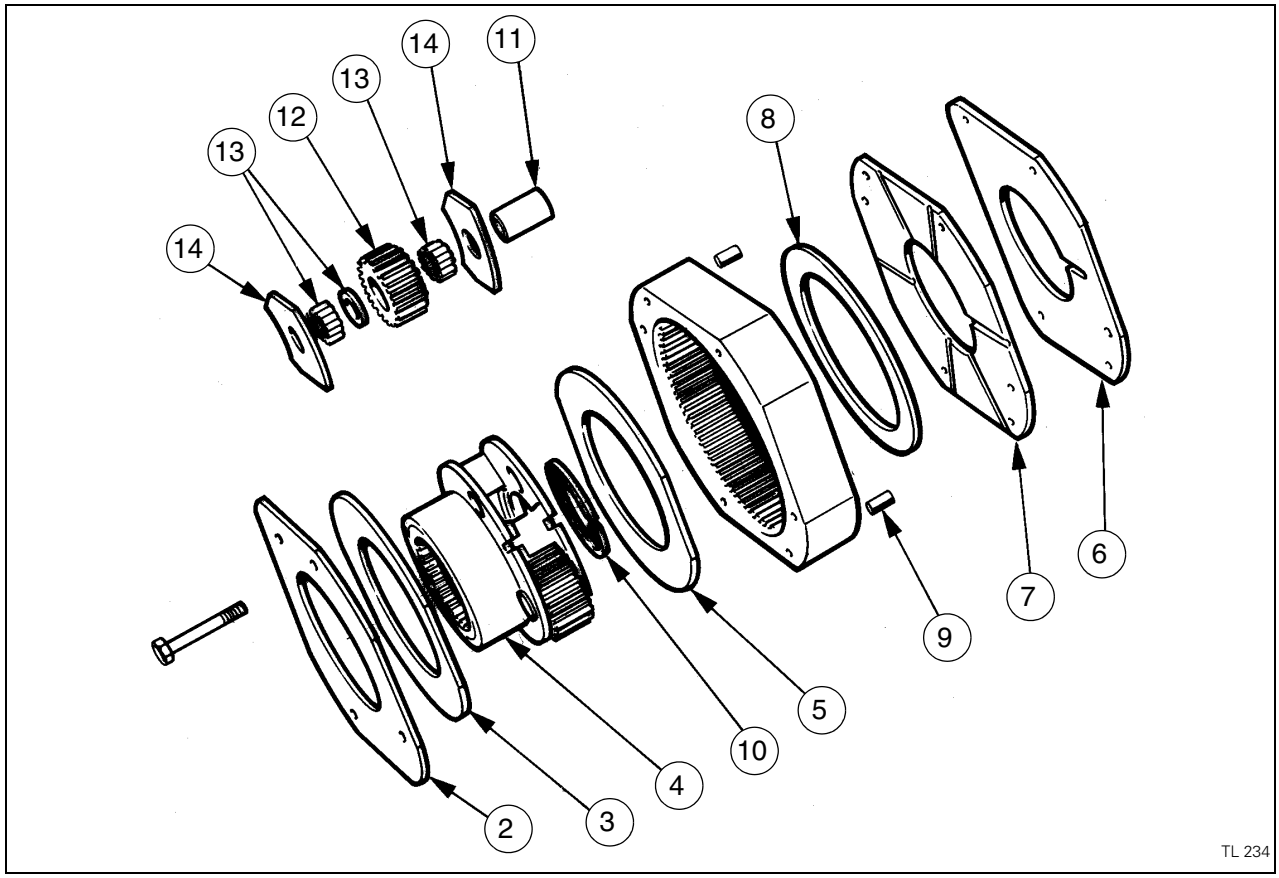
c. Locate the cover plate with the cut out, to the bottom left hand corner.

d. Tighten the retaining bolts progressively and evenly to a torque of 43 Nm (32 lbf ft).

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8 x 8 Shuttle Gearbox



EPICYCLIC UNIT

Overhaul 8-5F

Removal

Dis-assembly

1. Remove the gearbox epicyclic unit, *(see operation 7-5F)*.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Examination

Clean and carefully examine all the components, especially those subject to movement, and replace any items that show signs of damage or wear.

Re-assembly

15. Reverse procedures 1 to 14, except:
    a. When replacing the rollers in the pinions, a smear of petroleum jelly, NOT GREASE, will help retain them. Do not omit the spacer from between the two rows of rollers. Each row consists of 16 rollers.
    b. Ensure that the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    c. The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    d. Ensure that the gap of the snap ring is located midway between the planetary pinion shafts.
    e. To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly, NOT GREASE. Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the planetary pinion carrier.

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PTO DRIVE SHAFT FRONT BEARING

Removal and Refitment **9-5F**

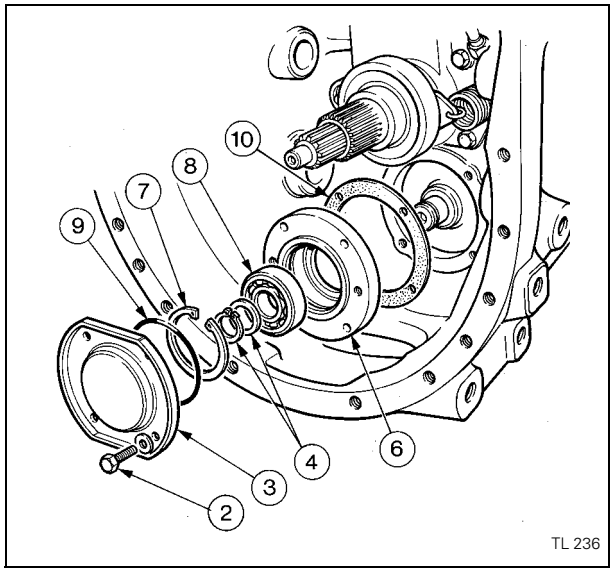
Special Tools:
MF.218B PTO Bearing Housing Replacer

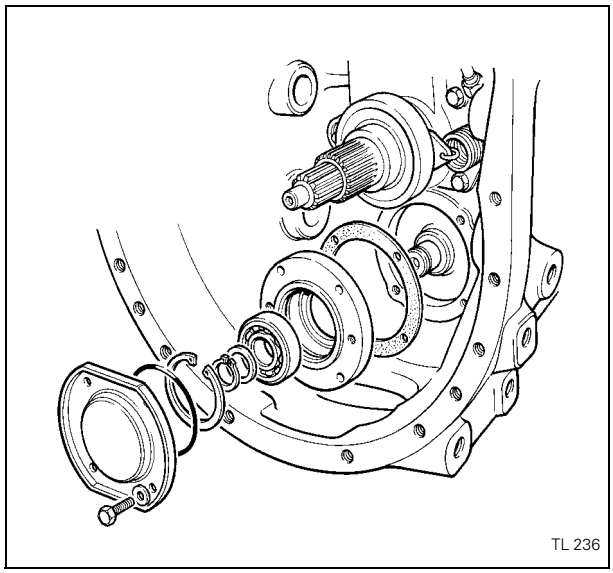
Removal

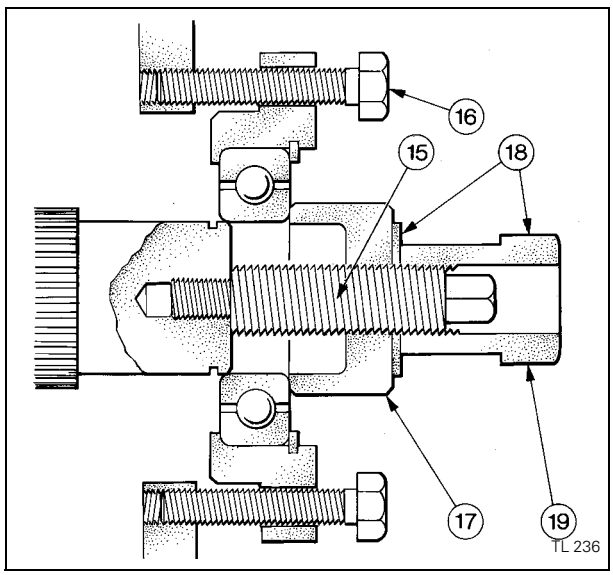
1. Remove the clutch cross-shaft and lever, *(see operation 4-4A)*.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x (75 mm) 3 inch bolts (part of special tool MF.218B) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove and discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 inch UNF bolt approximately 75-100 mm (3-4 inch long) into the shaft to protect it, and drive the shaft out of the PTO constant mesh gear.

Refitment

12. Lightly coat the new gasket with Hylomar sealant.
13. Using MF.218B, PTO Bearing Housing Replacer, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 inch across flats spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF.218B through the un-threaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and put on the nut.
19. Tighten the nut with a 1 1/8 inch across flats spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
20. Fit a new circlip and washer.
21. Replace the cover ensuring that a new 'O' ring is fitted.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 58 Nm (43 lbf ft).



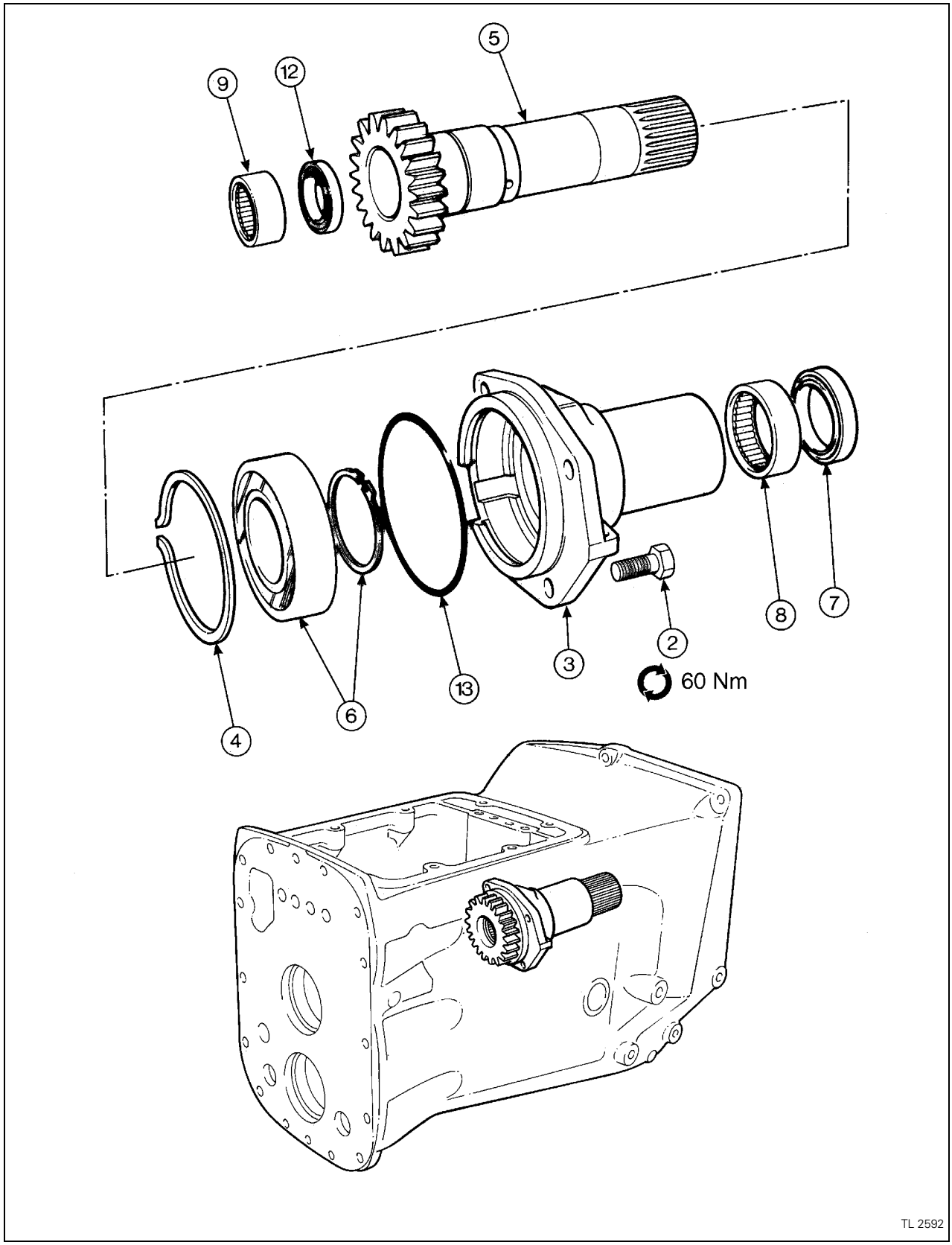




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8 x 8 Shuttle Gearbox



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INPUT SHAFTS AND HOUSING

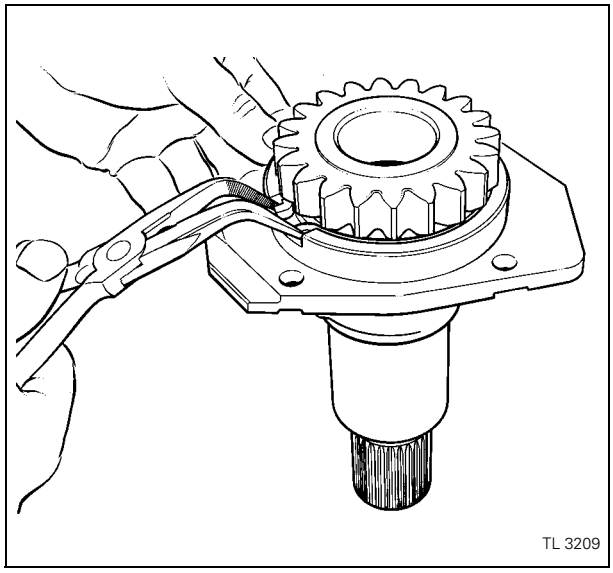
Removal and Refitment **10-5F**

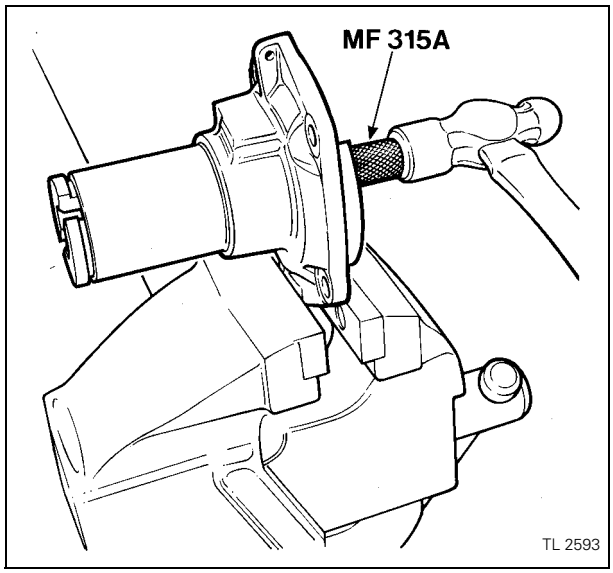
Special Tools:

MF.177A Input Shaft Oil Seal Protector
MF.255B PTO Input Shaft Oil Seal Replacer
MF.315A Needle Roller Bearing Remover/Replacer
MF.421 Needle Roller Bearing and Seal Replacer
MF.422A Bearing, and Seal Remover

Removal

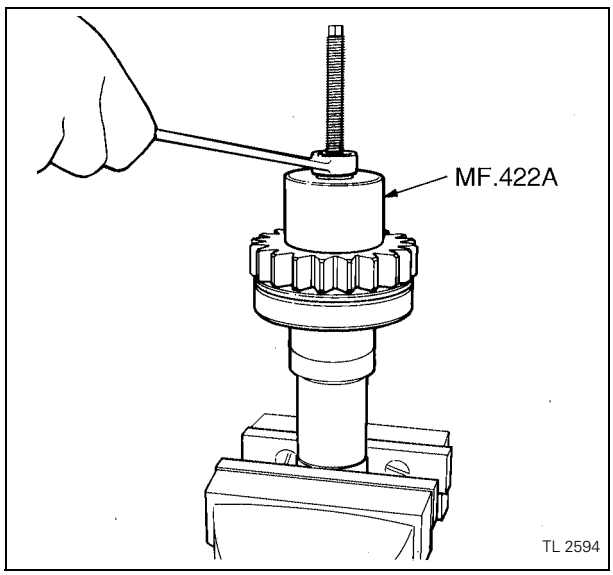
1. Remove the clutch mechanism, *(see operation 3-4A)*.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Open up the large circlip in its groove so that it is clear of the bearing.
5. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
6. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
7. Lever the seal out of the front of the housing.
8. Using special tool MF.315F, Needle Roller Bearing Remover/Replacer, drive the needle roller bearing out of the housing.


TL 3209



TL 2593

9. Using special tool MF.422A, Bearing and Seal Remover, remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
10. Fit the cap, lubricate the screw thread, fit the washer and nut.
11. Tighten the nut withdrawing the bearing from the shaft.
12. Repeat the operation using tool MF.422A to extract the oil seal. The step on the collets must be located fully behind the seal.
13. Remove and discard the 'O' ring.



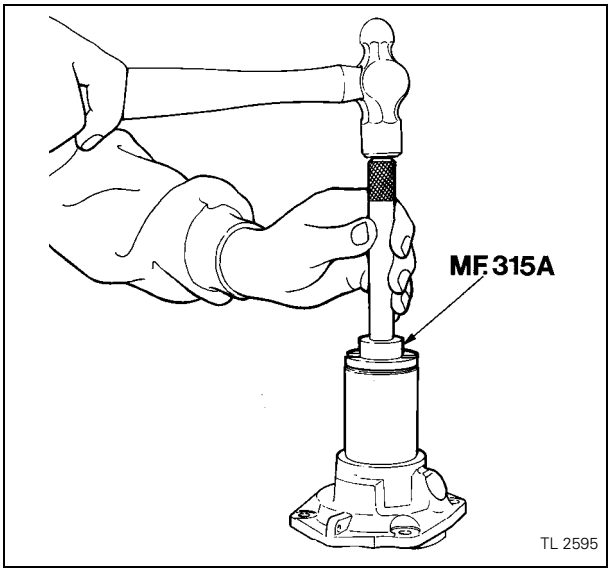
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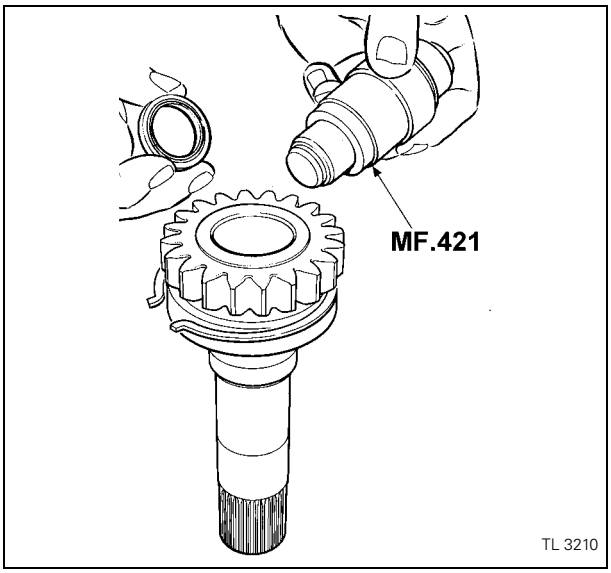
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Re-assembly

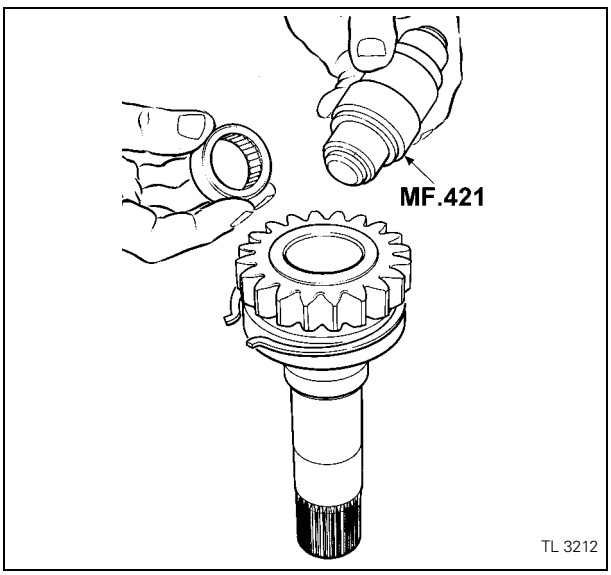
14. If the ball bearing has been removed from the PTO shaft, refit the bearing using a new circlip.
15. Using special tool MF.315F, Needle Roller Bearing Remover/Replacer, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.



16. Pack the cavity of the small input shaft seal with petroleum jelly.
17. Using special tool MF.421, Needle Roller Bearing and Seal Replacer, place the seal on the tool as shown in the illustration and press it into the PTO shaft until the flange on the tool touches the face of the gear.



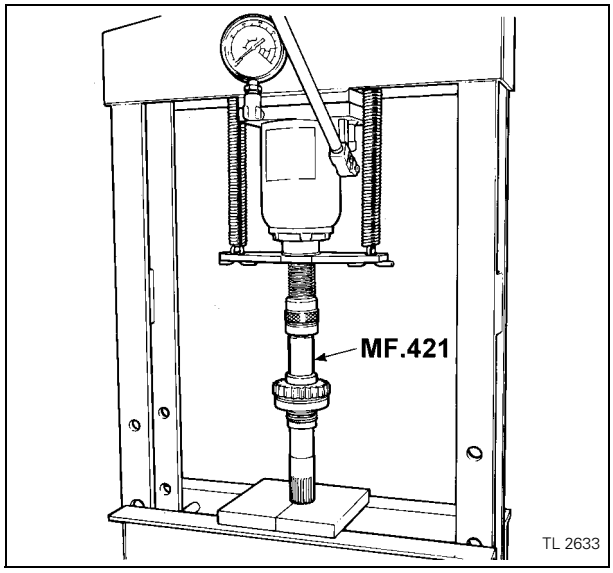
18. Place the needle roller bearing on the other end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.



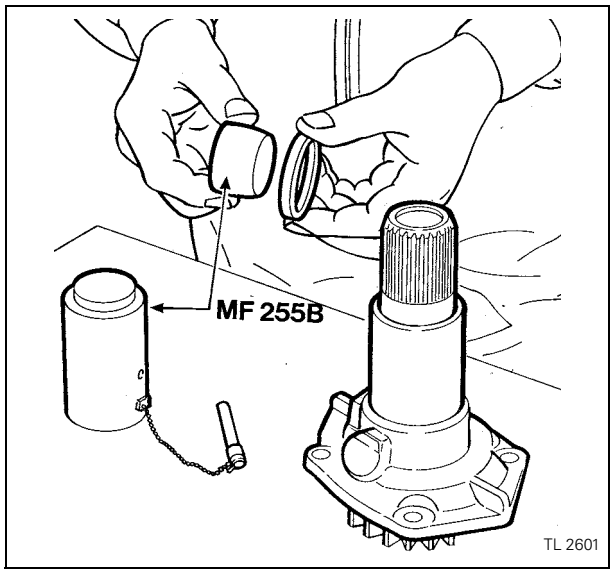
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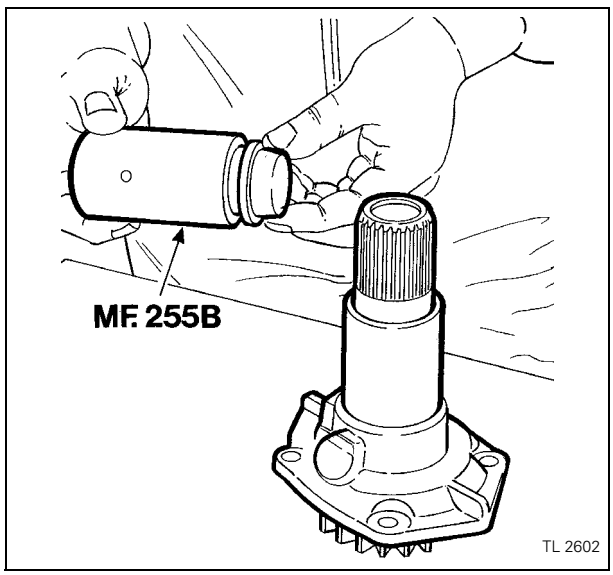
19. Press the bearing into position up to the flange on the tool.
20. Place the large circlip into the groove in the housing.
21. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.



22. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
23. Install the seal using special tool MF.255B, PTO Input Shaft Oil Seal Replacer, to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



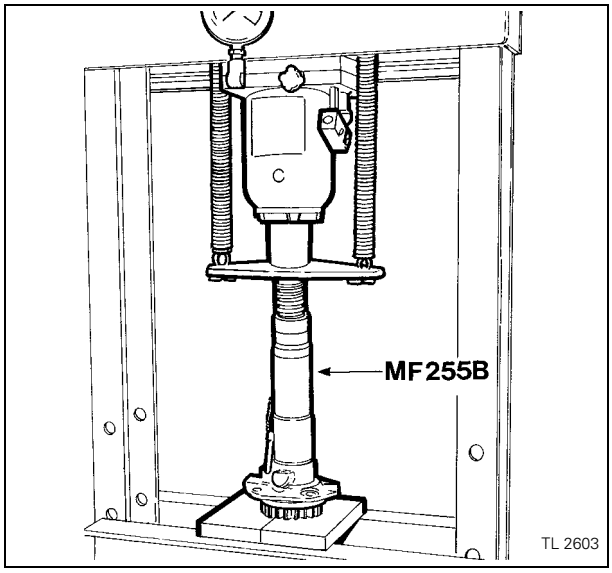
24. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



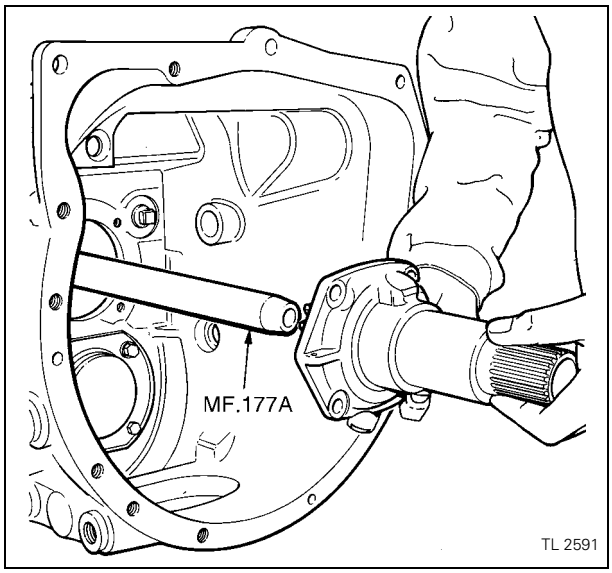
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25. Place the input housing under a light press, place the tool with seal over the PTO input shaft and press the seal into place.
26. Replace the large 'O' ring on the housing.

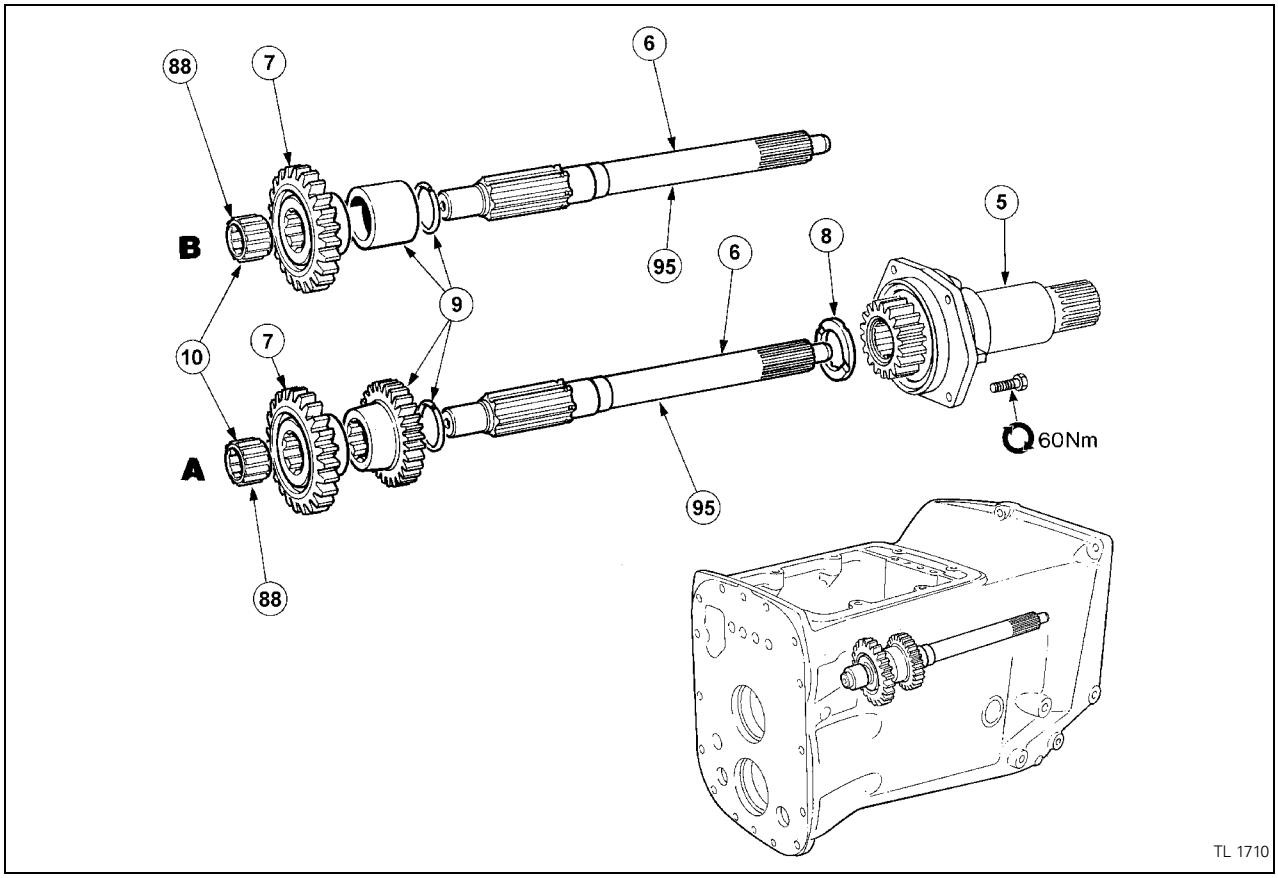


27. Place special tool MF.177A, Input Shaft Oil Seal Protector, over the main transmission input shaft on the gearbox. This is to protect the seal from the splines on the shaft and prevent seal leakage.
28. Lightly oil the sleeve.
29. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
30. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
31. Refit the clutch release mechanism, *(see operation 3-4A)*.



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LAYSHAFT, MAINSHAFT, PTO SHAFT AND GEARS

Overhaul **11-5F**

Special Tools:
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the gearbox from the tractor and top cover, *(see operations 1-5F and 4-5F).*
2. Remove the clutch release mechanism, *(see operation 3-4A).*
3. Remove the selector mechanism, *(see operation 5-5F).*
4. Remove the selector rails and forks, *(see operation 6-5F).*

NOTE: *The layshaft selector fork (forward/reverse) cannot be removed at this stage.*

Input Shafts and Housing

5. Remove the input shaft housing assembly, *(see operation 10-5F).*

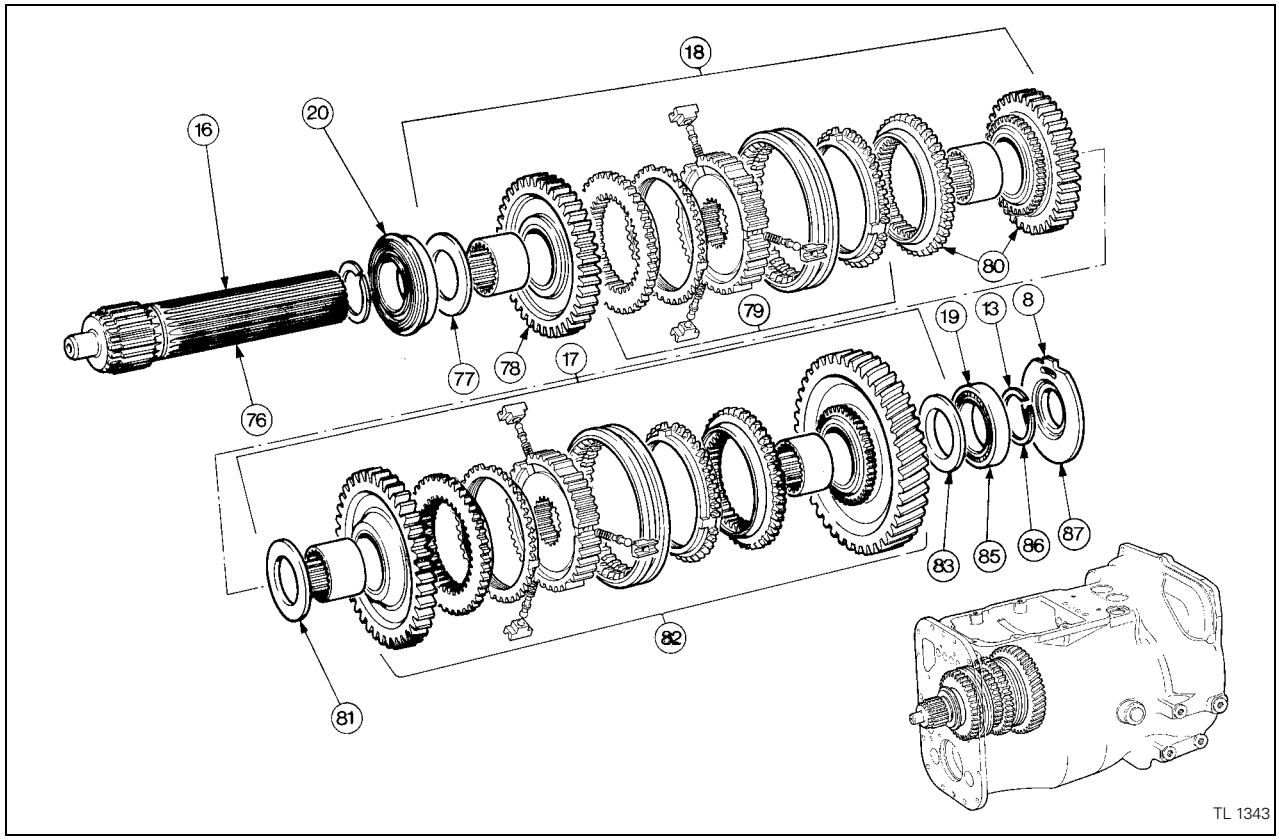
NOTE: *There are two types of input shaft and reverse idler assembly that can be fitted to this gearbox, either with a double input gear and a single reverse gear type 'A'. Or, a single input gear and a double reverse gear arrangement type 'B'. The type fitted depends on the ratio and rear tyre size.*

6. Withdraw the main input shaft leaving the forward gear in the gearbox.
7. Lift out the forward constant mesh gear.
8. Remove the main thrust washer, if necessary.
9. Remove the snap ring, thrust washer and reverse gear or spacer from the main input shaft, if necessary.
10. Remove the needle roller bearing from inside the mainshaft.

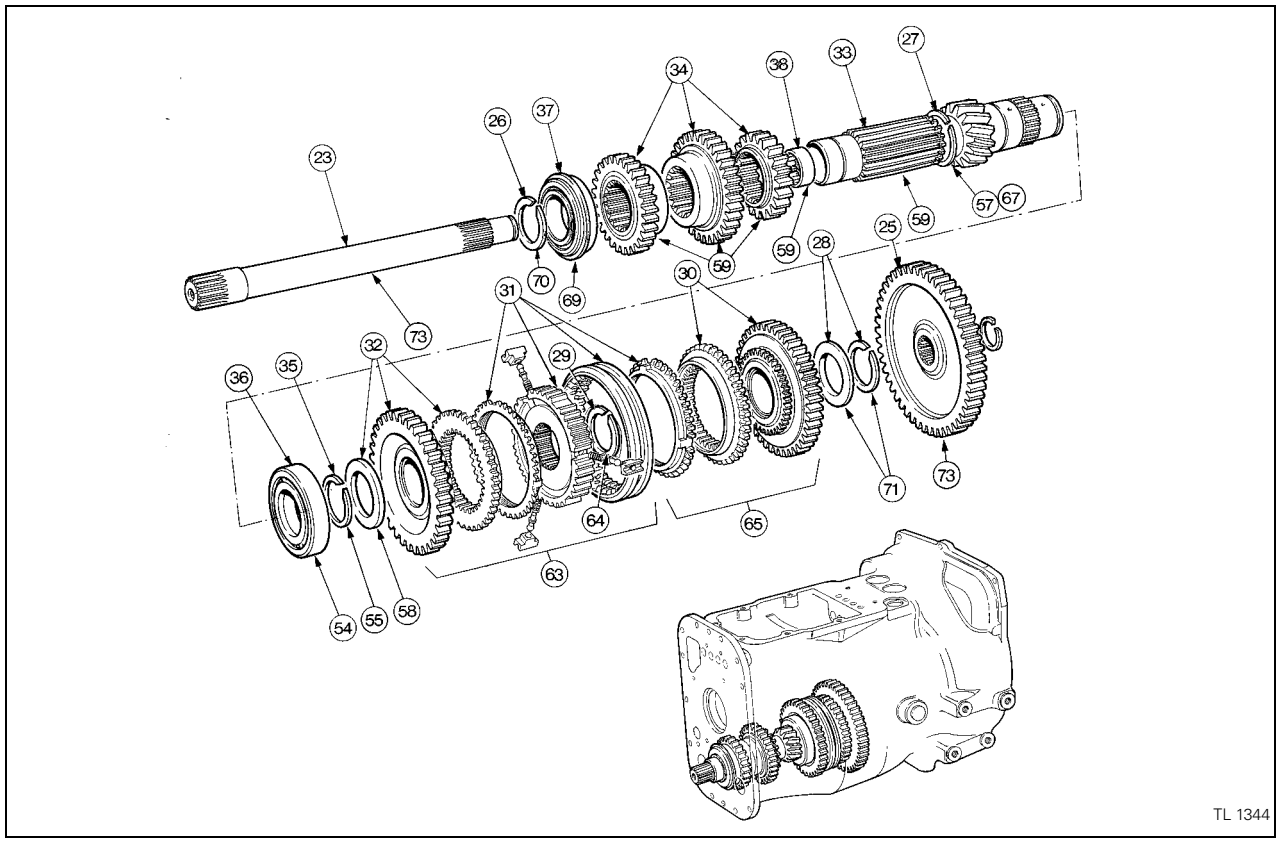
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8 x 8 Shuttle Gearbox



Mainshaft



Layshaft

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Reverse Idler

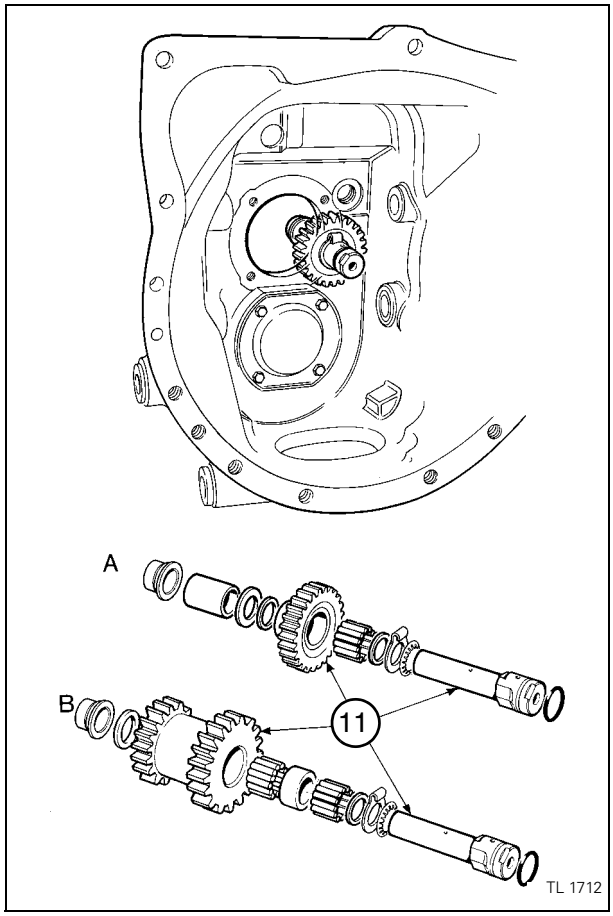
11. Remove the reverse idler shaft by tapping the shaft forward from the inside of the gearbox and lifting out the gear, thrust washer and spacers. Be careful, the idler gear contains loose needle roller bearings. Retain the components in a clean container.

Mainshaft

12. Lightly drive the front roller bearing to the rear with a punch to facilitate removal of the main shaft snap ring.
13. Remove the snap ring from the front of the mainshaft.
14. Remove the epicyclic reduction unit from the rear of the gearbox, *(see operation 7-5F).*
15. Push the front mainshaft bearing forward to give clearance to the 1st/2nd gear set assembly.
16. Pull the main shaft out of the gearbox to the rear.
17. Lift out the 1st gear and the measured thrust washer, then 2nd gear and the synchromesh hub.
18. Lift out the rear 3rd/4th gear set assembly and thrust washers.
19. Remove the front roller bearing from the gearbox case.
20. Press the rear ball bearing off the front of the shaft.

Layshaft

21. Remove the PTO drive shaft front bearing cover.
22. Remove the PTO shaft circlip and thrust washer.
23. Screw a 7/16 inch UNF bolt approximately 3-4 inch long into the end of the PTO shaft. Drive the shaft out of the bearing.
24. Remove the PTO drive shaft front bearing, *(see operation 9-5F).*
25. Lift out the PTO constant mesh gear.
26. Remove the snap ring from the rear of the layshaft.
27. Carefully drive the layshaft forward to ease removal of the snap ring in front of the 2nd gear, move it to the unsplined portion of the shaft.
28. Remove the snap ring and thrust washer from the front of the layshaft and then drive the layshaft fully rearwards.
29. Slide the reverse constant mesh gear fully forward. Remove the circlip with a pair of right angled circlip pliers from the front of the synchromesh hub. Slide the circlip as far forward along the layshaft as possible.
30. Drive the layshaft rearwards so that the roller bearing is in the rear section of the gearbox. Lift the reverse ratio gear out through the top of the gearbox.
31. Remove the circlip and the synchromesh hub assembly.
32. Remove the forward ratio gear and thrust washer.



33. Relocate the bearing in the centre web and drive the layshaft forward, remove it through the front of the gearbox.
34. Lift out the 2nd, 3rd and 4th gears.
35. Remove the snap ring.
36. Press the front layshaft bearing off the shaft.
37. Remove the rear bearing from the casing.
38. Remove the PTO rear support bearing, *(only fitted to two-wheel drive tractors).*

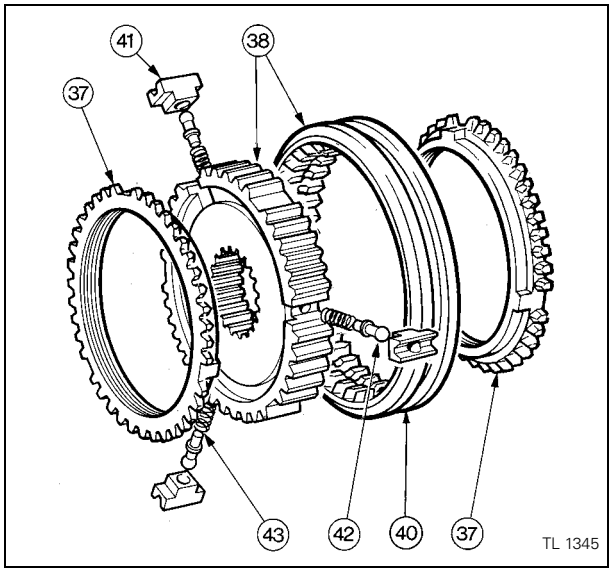
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8 x 8 Shuttle Gearbox

Synchromesh Hub Assemblies

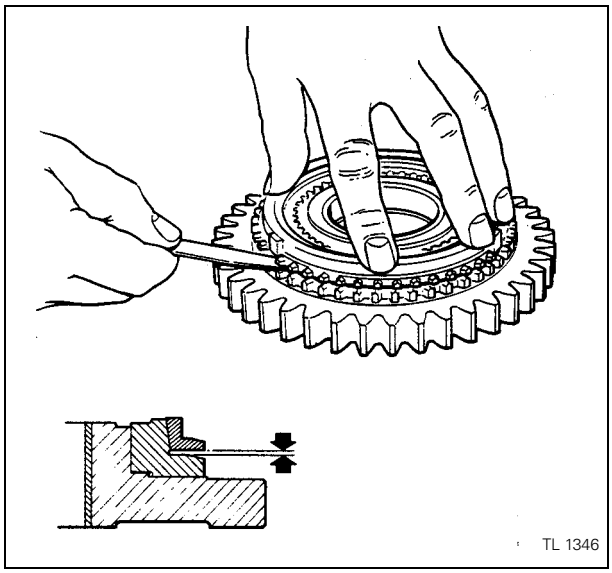
39. Remove the two baulk rings.
40. Remove the drive hub complete with the coupler.
41. Wrap the hub and coupler in a cloth.
42. Remove the coupler, taking care not to lose springs, ball pins and pressure blocks.
43. Remove the three pressure blocks.
44. Remove the three ball pins.
45. Remove the three springs.
46. Thoroughly clean all the components and check their condition.



47. Using a feeler gauge, measure the clearance between the ring and the synchromesh cone on the gear at several points. The baulk ring must be correctly positioned on the synchromesh cone. If the clearance is less than 0,5 mm (0.020 in), replace the baulk ring. If the clearance is checked with the gearbox assembled replace the baulk ring if the clearance is found to be less than 0,8 mm (0.030 in).

Examination

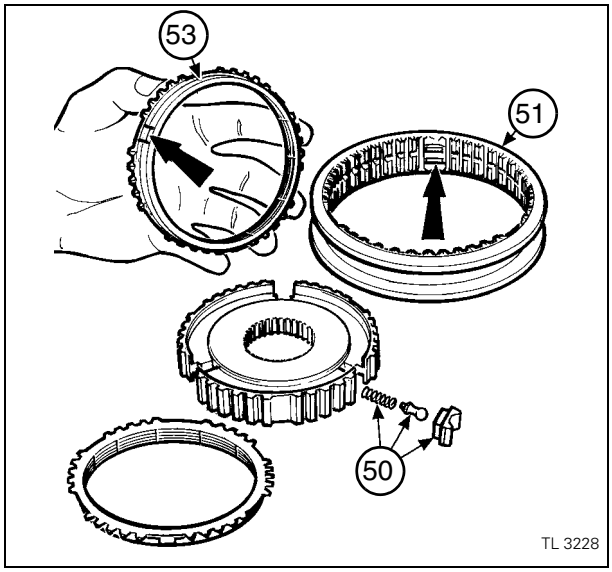
48. Clean and thoroughly inspect all parts for signs of wear or damage and renew if necessary. Renew all snap rings, when refitting ensure that they are correctly located in their grooves.



Re-assembly

Synchromesh Hub Assemblies

49. Reverse procedures 39 to 45.
50. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
51. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
52. Press the coupler down into place easing the spring-loaded blocks into place.
53. Position the baulk rings so that the locating blocks fit into the slots in the hub. Use petroleum jelly to retain the components in position.



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Layshaft

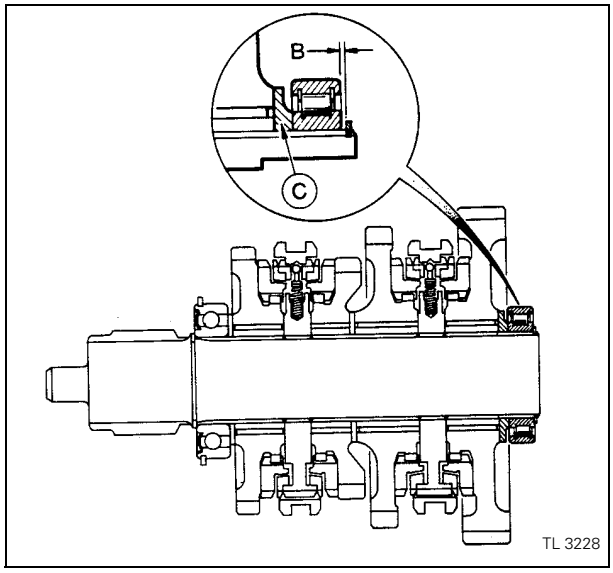
54. Press the front roller bearing onto the shaft.
55. Fit the roller bearing circlip.
56. Fit the rear PTO shaft support bearing, *(only fitted to two-wheel drive tractors).*
57. Place the circlip on the unsplined portion of the shaft.
58. Refit the thrust washer at the front of the shaft.
59. Place the 2nd (20T), 4th (29T) and 3rd (28T) gears in the bottom of the gearbox.
60. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.
61. Fit the layshaft gears in the above order.
62. Drive the layshaft rearwards so that the roller bearing is in the rear section.
63. Refit the forward gear and synchromesh hub assembly.
64. Place the circlip on the unsplined portion of the shaft close up to the synchromesh hub.
65. Refit the reverse gear assembly.
66. Enter the roller bearing into the centre web. Drive the layshaft forward holding the reverse gear set so that it pushes the circlip between the reverse gear and hub into its groove.

IMPORTANT: *Check that the circlip between the reverse gear and the synchromesh hub is correctly seated in its groove.*

67. Refit the circlip from the unsplined portion of the shaft into its groove in front of 2nd gear.
68. Place a block between the front of the layshaft and the gearbox casing in the front section.
69. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.
70. Remove the block and replace the rear snap ring.
71. Refit the thrust washer with the flat face towards the reverse gear and replace the snap ring.
72. Ensure that the shaft is fully forward and check that the layshaft turns freely.
73. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.
74. Refit the PTO drive shaft front bearing, *(see operation 9-5F).*

Mainshaft

75. Assemble the mainshaft complete with all hubs, gears, bushes, bearing and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip.



The gap (end float) should be between 0,080 mm (0.003 in) and 0,30 mm (0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated shims part numbers and sizes are shown below.

Part Number	Shim thickness	
	mm	inch
1671 888 M2	4,14-4,19	0.163-0.165
1671 889 M1	4,39-4,44	0.173-0.175
1671 890 M2	4,62-4,67	0.182-0.184
1671 891 M2	4,85-4,90	0.191-0.193

76. Slide the mainshaft through the rear of the gearbox, progressively fitting in the following order:
77. Steel thrust washer.
78. 3rd gear (35T) with steel bush and synchromesh cone.
79. Synchromesh hub assembly and baulk ring.
80. 4th gear (40T) with steel bush and synchromesh cone.
81. Steel thrust washer.
82. Assemble the 2nd (40T) and 1st (42T helical) gear pack with the synchromesh hub and steel bushes. Lower the assembly down into the box and slide the main shaft through the assembly.
83. Fit the pre-selected calibrated thrust washer with flat side towards first gear.
84. Refit the epicyclic reduction unit, *(see operation 7-5F).*
85. Drive the front roller bearing on to the mainshaft and into the centre web of the gearbox.
86. Replace the circlip.
87. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forwards.

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8 x 8 Shuttle Gearbox

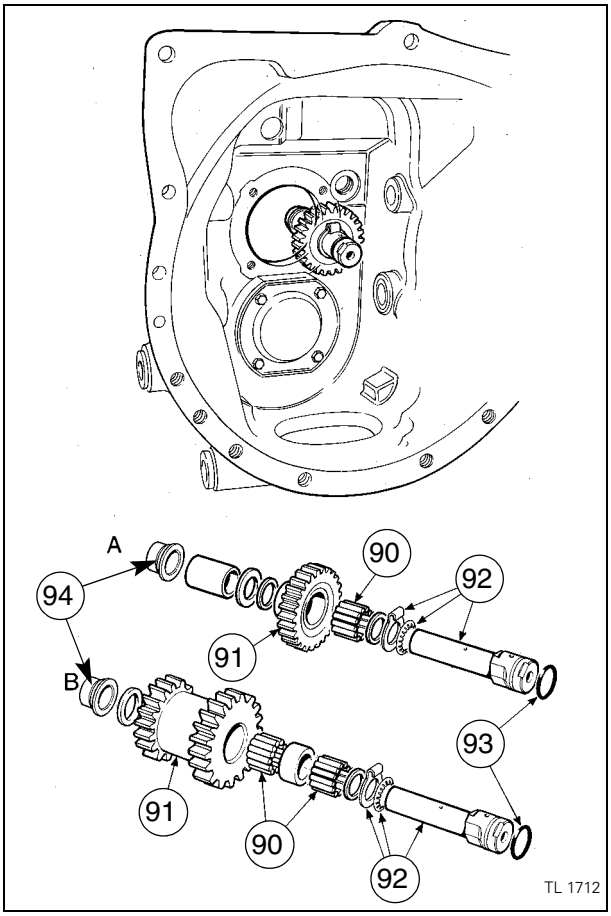
88. Refit the needle roller bearing into the front of the mainshaft.
89. Locate the forward/reverse selector fork into the coupler of the layshaft synchromesh assembly.

Reverse Idler

90. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly, NOT GREASE, will help retain them. There is a single row of 23 rollers with a spacer ring each side.
91. Refit the reverse idler into the gearbox with a thrust washer each side of the gear, and a spacer in the case of the single gear arrangement.
92. Assemble the tabbed friction plate and slotted disc spring in front of the gear, ensure that the tab on the friction plate engages with the small flat on the shaft.
93. Renew the 'O' ring on the idler shaft and enter from the bell housing end. Align the cut away portion on the front of the idler shaft to allow fitment of the input housing. The oil hole will be at the top visible inside the case.
94. If the internal bush in the casing is removed, it is retained with Loctite 601.

General

95. Hold the forward and reverse constant mesh gears in the gearbox and refit the transmission input shaft.
96. Refit reversible steel thrust washer to the front of the reverse ratio gear.
97. Refit the input housing assembly, *(see operation 10-5F).*
98. Refit the selector mechanism, selector rails and forks, *(see operations 5-5F and 6-5F).*
99. Refit the clutch release mechanism, *(see operation 4-4A),* and refit the gearbox to the tractor, *(see operations 1-5F and 4-5G).*



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12 x 4 Manual Gearbox

Section 5 - Part G

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12 x 4 Manual Gearbox

SPECIFICATION

Model	12 x 4 manual synchromesh gearbox.
No. of gears:	
Forward	12.
Reverse	4.
Epicyclic reduction unit:	
Type	Heavy-duty.
Reduction	4 : 1.
Mainshaft end float	0,080-0,30 mm (0.003-0.012 in).
Type of adjustment	Variable thickness thrust washer.
Synchromesh ring to coupler clearance - installed	0,8 mm (0.030 in).
Synchromesh ring to coupler clearance - removed	0,5 mm (0.020 in).
Input shaft bearing dimension (oil cooled clutch)	179,70 - 179,60 mm (7.080 - 7.076 in).

Special Tools

MF.177A	Input shaft oil seal protector.
MF.218B	PTO bearing housing replacer.
MF.255B	PTO input shaft oil seal replacer.
MF.315A	Needle roller bearing remover/replacer.
MF.367B	Transmission torque wrench.
MF.414A	Synchromesh neutral setting tool,
MF.421	Needle roller bearing and seal replacer.
MF.422A	Bearing and seal remover.
MF.3008	Circlip plier set.

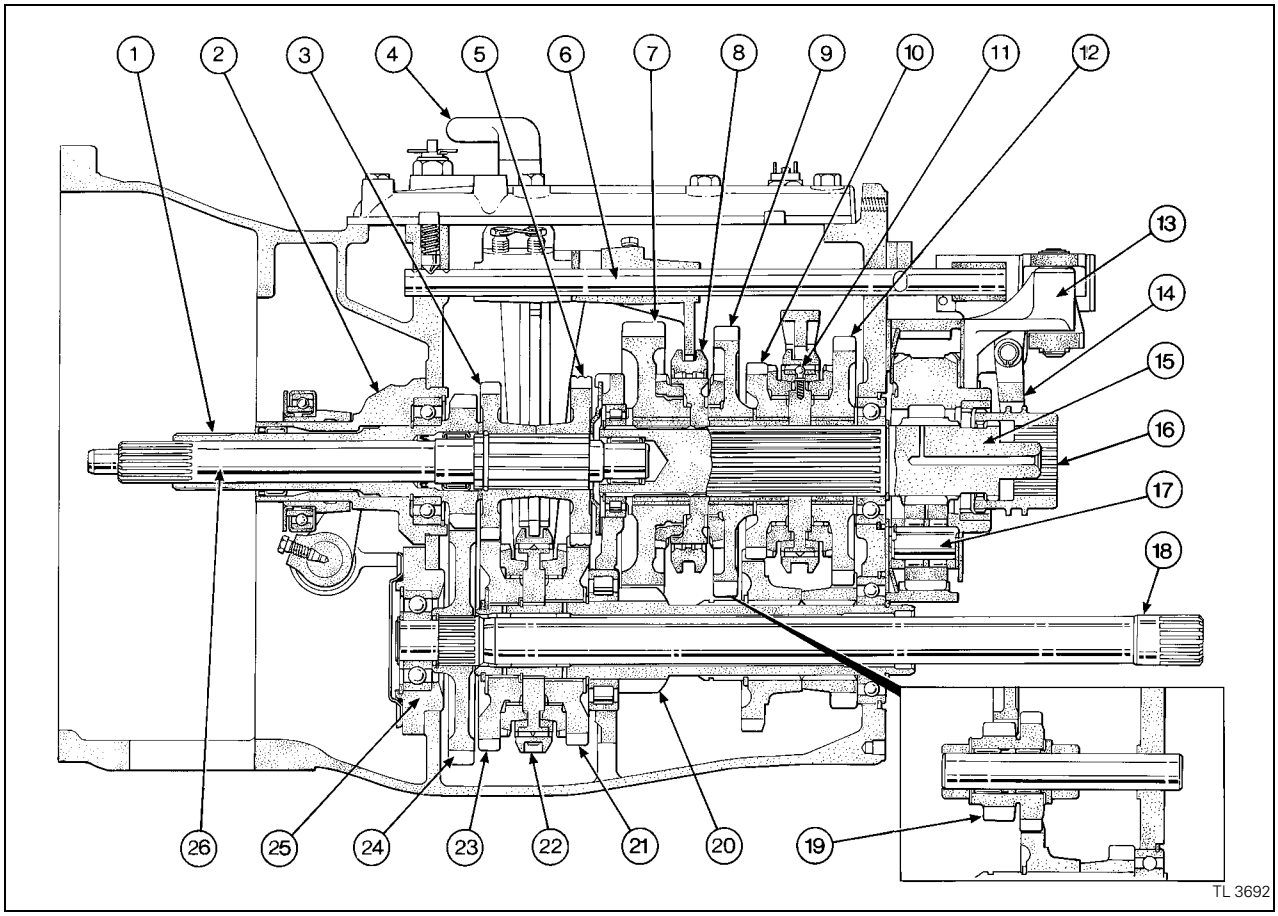
Bolt Torques

Gear lever 12 point cap screws	60 Nm (45 lbf ft).
Gearbox top cover bolts	115 Nm (85 lbf ft).
Shifter fork locking screws	43 Nm (32 lbf ft).
Rear gear shift selector bracket	58 Nm (43 lbf ft).
Input shaft housing to gearbox	60 Nm (44 lbf ft).
PTO drive bearing housing	58 Nm (43 lbf ft).
Gearbox to range housing	102 Nm (75 lbf ft).
Gear shift housing bolts to four-wheel drive housing	30 Nm (25 lbf ft)
Epicyclic unit retaining bolts	43 Nm (32 lbf ft)
Selector mechanism support bracket bolts	43 Nm (32 lbf ft)
Input housing to gearbox - countersunk screw	40 Nm (30 lbf ft).
Scavenge pump housing	60 Nm (44 lbf ft).

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12 x 4 Manual Gearbox



12 x 4 Manual Gearbox

1. PTO input shaft and gear.
2. Input shaft housing.
3. Low range constant mesh gear.
4. High/low range selector.
5. High range constant mesh gear.
6. Selector rail and forks.
7. First gear.
8. Sliding coupler.
9. Reverse gear.
10. Third gear.
11. Synchromesh and sliding coupler.
12. Second gear
13. Gear shift mechanism.
14. Epicyclic selector.
15. Mainshaft.
16. Sliding coupler.
17. Epicyclic reduction unit.
18. PTO shaft.
19. Reverse idler.
20. Layshaft.
21. High range constant mesh gear.
22. Synchromesh and sliding coupler.
23. Low range constant mesh gear.
24. PTO constant mesh gear.
25. PTO front bearing housing.
26. Transmission input shaft.

GENERAL DESCRIPTION

The 12 x 4 Manual Gearbox provides twelve forward gears. It provides full engine braking on over-run and enables the tractor to be towed to start the engine.

Drive arrangement

From the constructional view point the gearbox has three sections. The front section consists of the high and low ratio gears providing the choice of an alternative input ratio.

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12 x 4 Manual Gearbox

The centre section comprises constant mesh gearsets giving three basic forward speeds with synchromesh engagement for 2nd and 3rd ratios whilst the rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio.

The three basic forward speeds and single reverse are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, together with the alternative input ratio offered by the gears in the front section, which further doubles the number of speeds available, gives the gearbox a total of twelve forward speeds and four reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the power take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted at its front end into the mainshaft. The high and low ratio gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft.

Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

The mainshaft carries four free-running gears, three of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd and 3rd ratios. The remaining free-running gear gives reverse drive and is in constant mesh with a compound idler gear set permanently driven from the side of the layshaft 3rd ratio gear.

The 2nd and 3rd ratio and reverse gear sets are of the straight cut spur type. The 1st ratio gear set has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running.

Drive through the 1st, 2nd and 3rd ratio and reverse free-running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between 2nd and 3rd ratios forms part of the synchromesh engagement mechanism. Roller bearings are used to support the main and layshaft at their front ends.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the high or low ratio gear set to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the epicyclic gear reduction unit in LOW range drive or directly in HIGH range.

Synchromesh Mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Sliding Couplers

Sliding couplers have teeth specially shaped to give easier drive engagement. All the teeth on the coupler engage with corresponding teeth on the side of the appropriate gear at the same time. This means that any impact forces occurring during the process of initial engagement are distributed uniformly through all teeth, so minimising the risk of damage. Furthermore, in the unlikely event of damage being received it is restricted to the coupler area and in no way effects the smooth running and life of the gears themselves.

Epicyclic Gear Reduction Unit

The epicyclic gear reduction unit at the rear of the gearbox is of heavy duty design and incorporates a Belleville spring arrangement to absorb the end thrust imposed on the mainshaft by the first speed helical gear set.

The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears, also in mesh with a fixed internal ring gear or ‘annulus’ forming the circumference of the working components. When the mainshaft rotates, the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the gear shaft to the final drive. When moved rearwards by the gear lever, it couples the mainshaft directly to the output shaft to establish high range drive, giving the gearbox an additional set of speed ratios designated 4th, 5th and 6th and high reverse. When shifted fully forwards the external splines on the coupler engage corresponding splines on the planet carrier to establish low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving 1st, 2nd and 3rd speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox - a feature forming the basis of the Massey Ferguson safety starting arrangements.

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GEARBOX

Removal and Refitment 1-5G

Special Tools:
MF.367B Transmission Torque Wrench

Removal

IMPORTANT: *The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and four-wheel drive gearbox.*

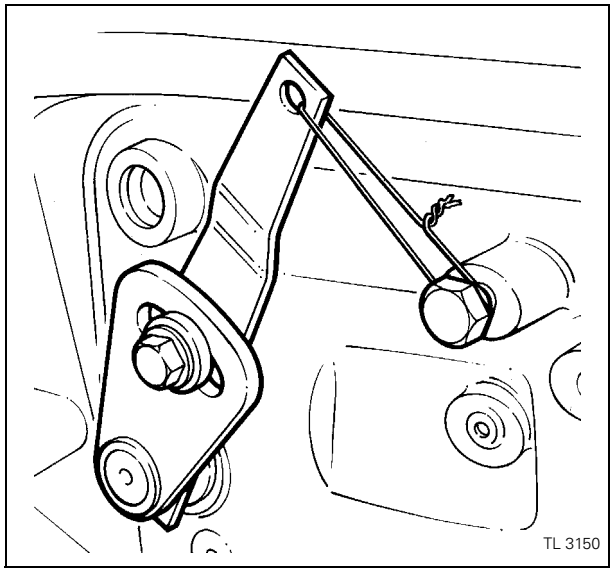
1. Split the tractor between the range gearbox and the rear axle (*see operation 3-2A*) in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the four-wheel drive gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Tie the clutch operating lever back with a piece of wire to retain the clutch release bearing.
6. Support the weight of the main gearbox on the hoist or crane. Position the crane so that the input shafts can be withdrawn out of the clutch.
7. Remove all the bolts around the clutch housing and remove the gearbox taking care not to damage any of the clutch components.
8. Place the gearbox on a suitable bench so that the repair work can be carried out.

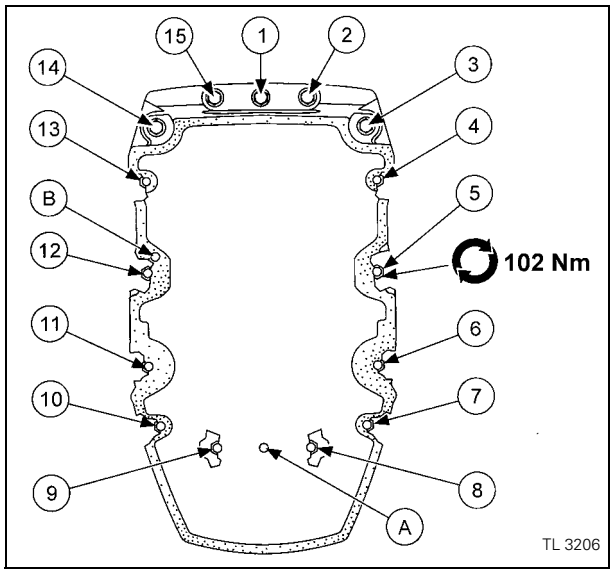
Refitment

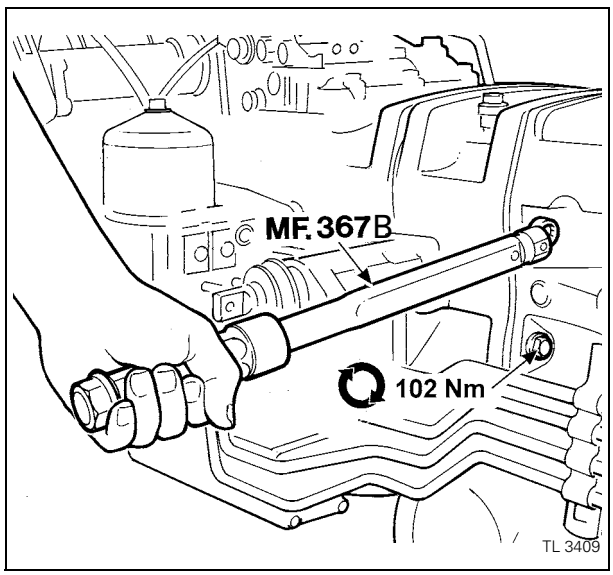
9. After repair, stand the gearbox vertically on the clutch housing face. Ensure that all gears are in neutral.
10. Ensure that the two dowels on the bottom and side of the range gearbox are in place.
11. Place a new gasket on the mounting face of the main gearbox.
12. Lower the four-wheel drive gearbox into position on the main gearbox. Check that the four-wheel drive gear, if fitted, engages correctly with the gearbox main shaft. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure.*

13. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.



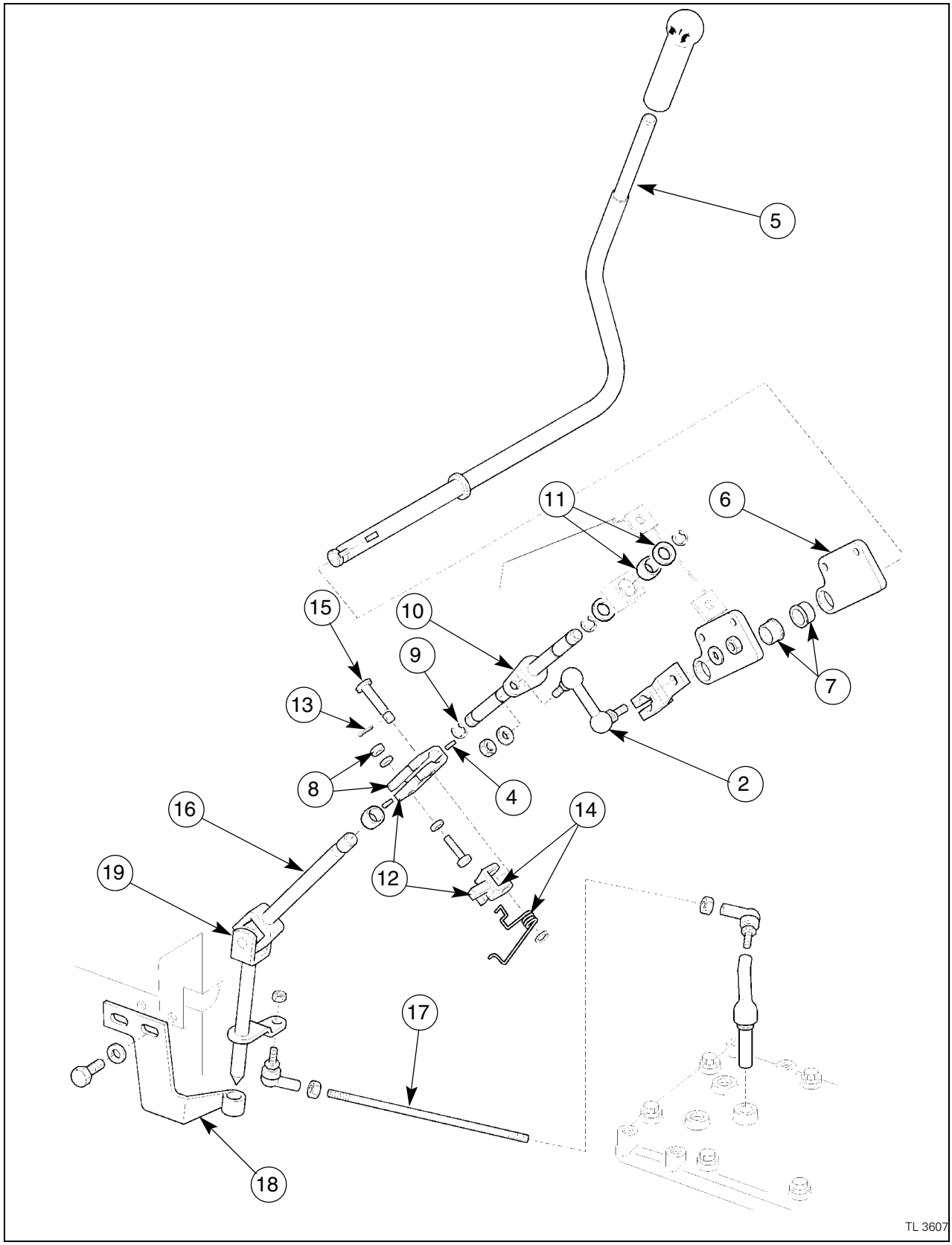




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12 x 4 Manual Gearbox



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14. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm socket.
15. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
16. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
17. Re-install the engine/gearbox assembly into the tractor.

SPEED SELECTOR LEVER

Overhaul 2-5G

Dis-assembly

NOTE: *The lower part of the shaft with the universal joint can only be removed when the tractor is split between the engine and clutch.*

1. Remove the lower panel under the instrument panel to gain access to the control mechanism.

Hand Lever

2. Remove the nuts and the short control rod.
3. Remove the nut and bolt and remove the lever.
4. Remove the woodruff key.
5. Slide the hand lever out of the support brackets.
6. If necessary, remove the four nuts and bolts and the support brackets.
7. Replace the two bushes.

Control Mechanism

8. Slacken the coupling bolts.
9. Remove the three 'C' clips on the upper part of the hand lever.
10. Withdraw the upper part of the shaft.
11. Remove the washers and spherical bearings.
12. Remove the coupling complete with the clutch interlock.
13. Remove the split pin.
14. Remove the spring and interlock lever.
15. Remove the 'C' clip and pivot pin.
16. If removal of the lower part of the shaft is required, split the tractor between the engine and clutch, sufficiently to enable the shaft to be removed from the lower bearing and to clear the back of the cylinder block.
17. Disconnect the lower control rod ball joint.
18. Remove the lower bracket.
19. Remove the lower shaft and universal joint.
20. Remove the lower spherical bearing.

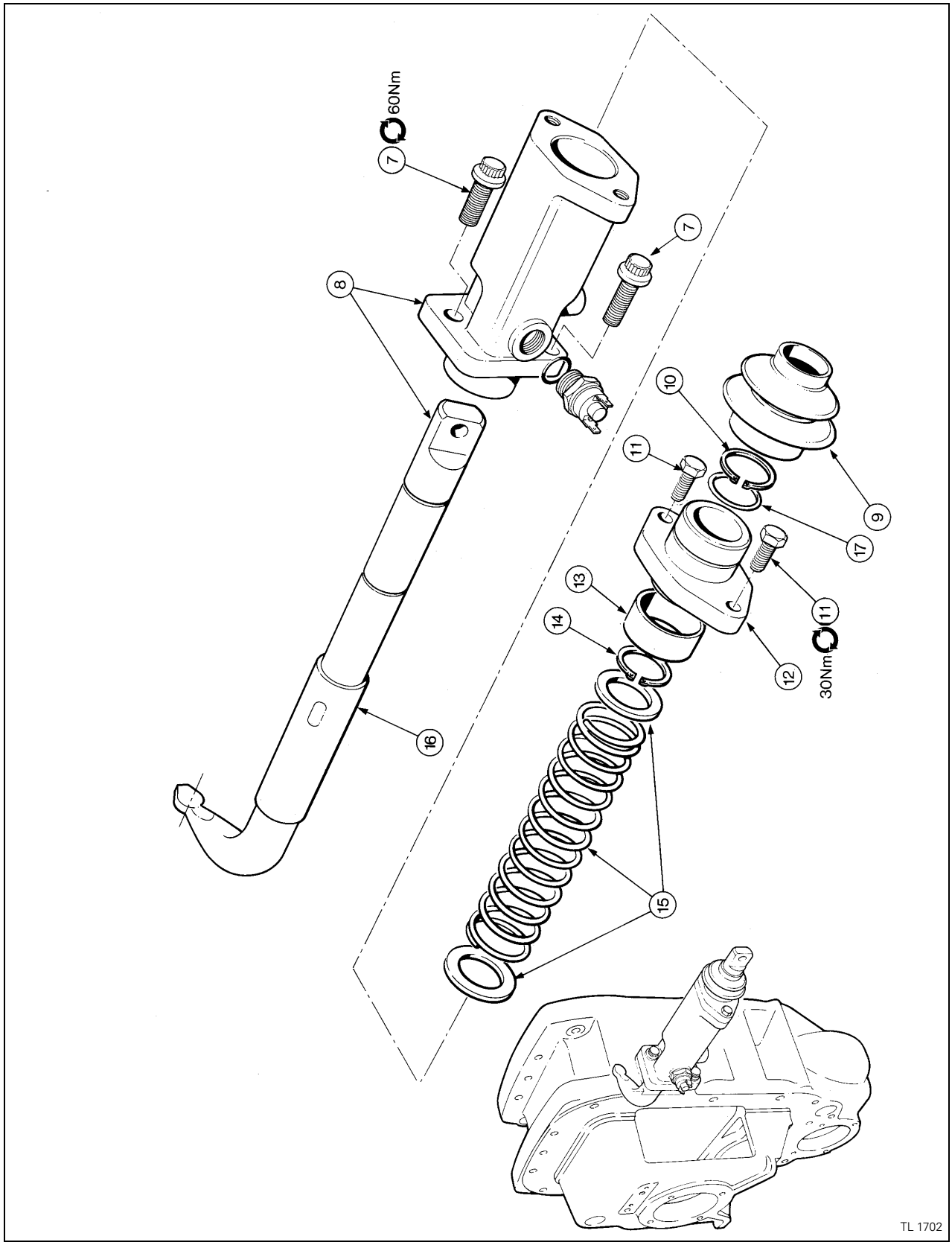
Re-assembly

21. Reverse procedures 1 to 20 except:
    a. Adjust the length of the lower control rod so that the interlock engages with the clutch pedal when the pedal is in its normal position.
    b. Lightly lubricate the spherical bearings and the hand lever bearings during assembly.
    c. Adjust the position of the lever on the end of the hand lever to eliminate end float.

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MAIN GEAR SHIFT LEVER

Removal and Refitment 3-5G

Removal

1. Remove the three bolts and the gear lever cover (tractors with single fuel tank only).
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the three 12 point cap screws holding the lever assembly to the four-wheel drive gearbox.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.

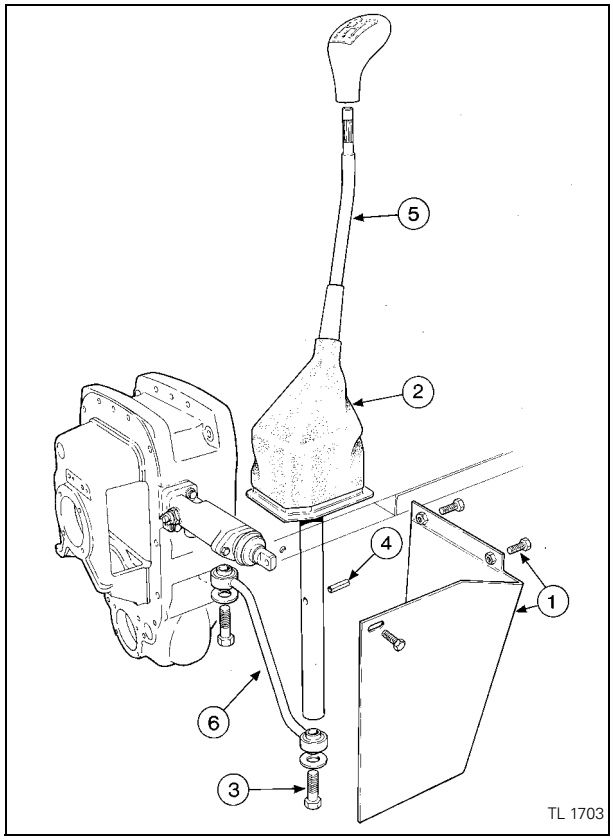


WARNING: Spring under compression.

14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.
17. Remove the 'O' ring.

Refitment

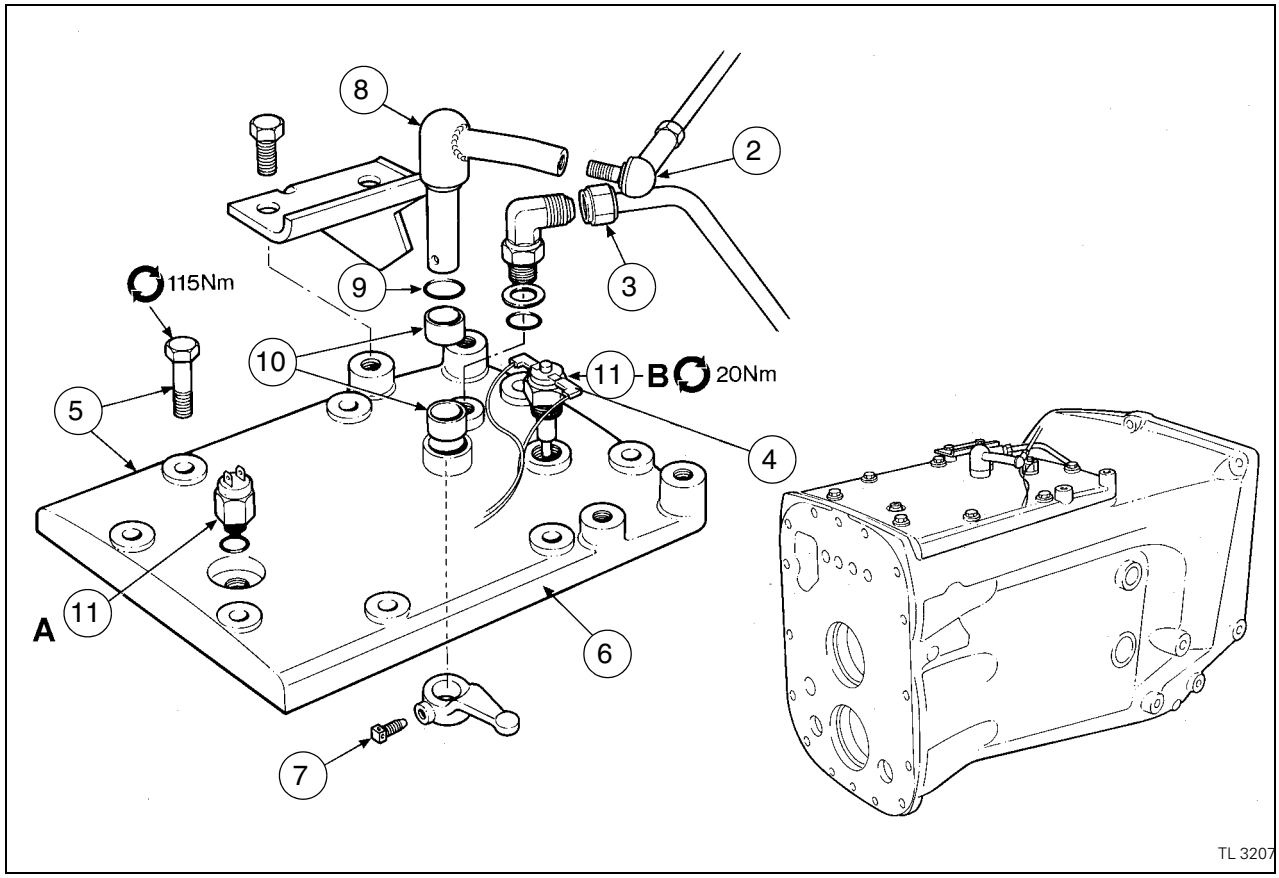
18. Reverse procedure 1 to 17, except:
    a. Replace the 'O' ring in the end cover.
    b. Replace all circlips.
    c. Lubricate the component parts during assembly with transmission oil.
    d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    e. Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (25 lbf ft).
    f. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 60 Nm (45 lbf ft).



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GEARBOX TOP COVER

Removal and Refitment 4-5G

Removal

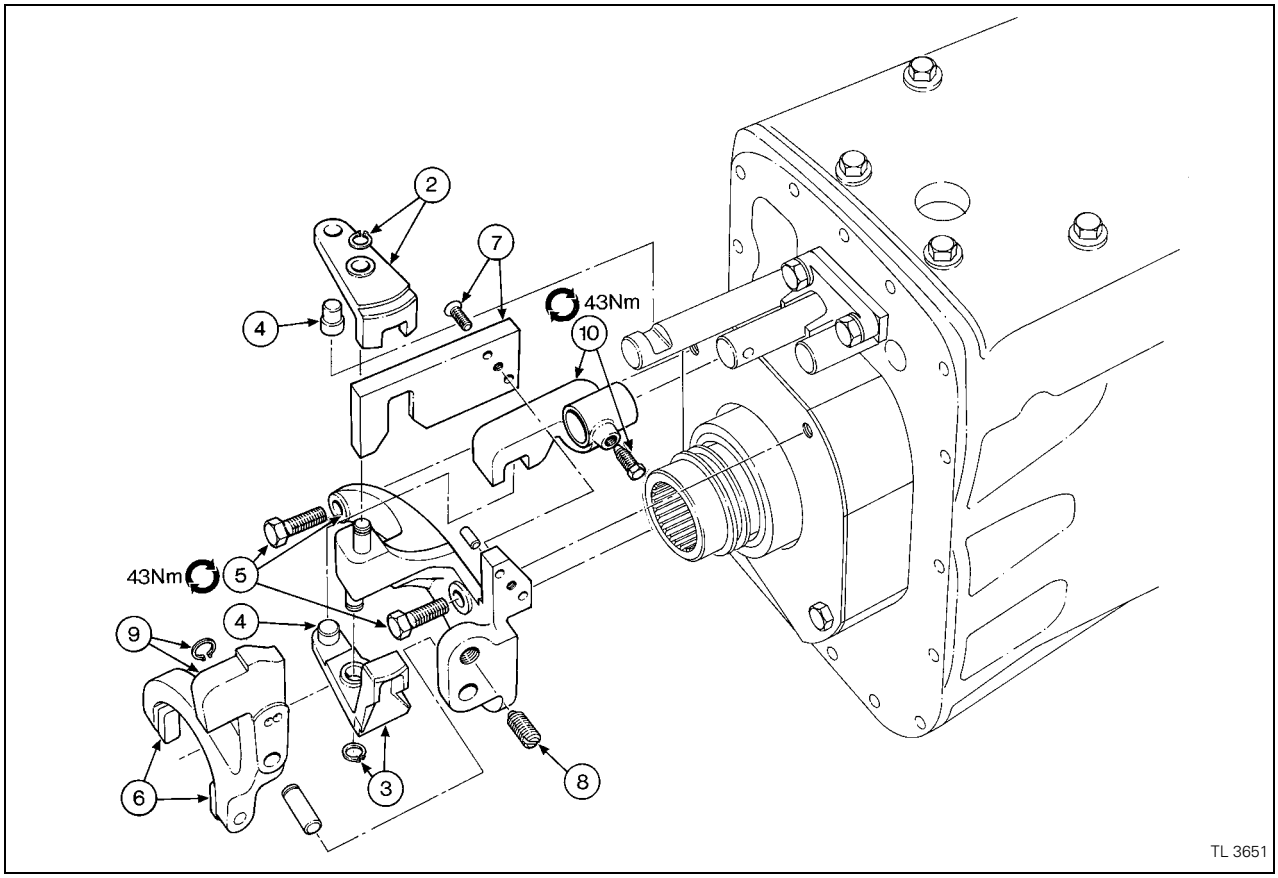
1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the wires to the switches 'A' and 'B'.
5. Remove the bolts and clutch cable bracket.
6. Remove the top cover.
7. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
8. Withdraw the shaft from the cover.
9. Remove and discard the 'O' ring seal.
10. If necessary, remove and replace the bushes in the top cover.
11. Remove the safety start switch 'A', reverse bleeper switch 'B' to prevent damage to the switches.
12. Clean all components and remove dried gasket material from the machined faces.

Refitment

13. Reverse procedures 1 to 12 except:
    a. Replace the shaft 'O' ring.
    b. Apply Massey Ferguson Studlock (Loctite 270) to the lever locking bolt (7).
    c. Lubricate the safety start switch with a small quantity of transmission oil or petroleum jelly before installation.
    d. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

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SELECTOR MECHANISM

Removal and Refitment 5-5G

Removal

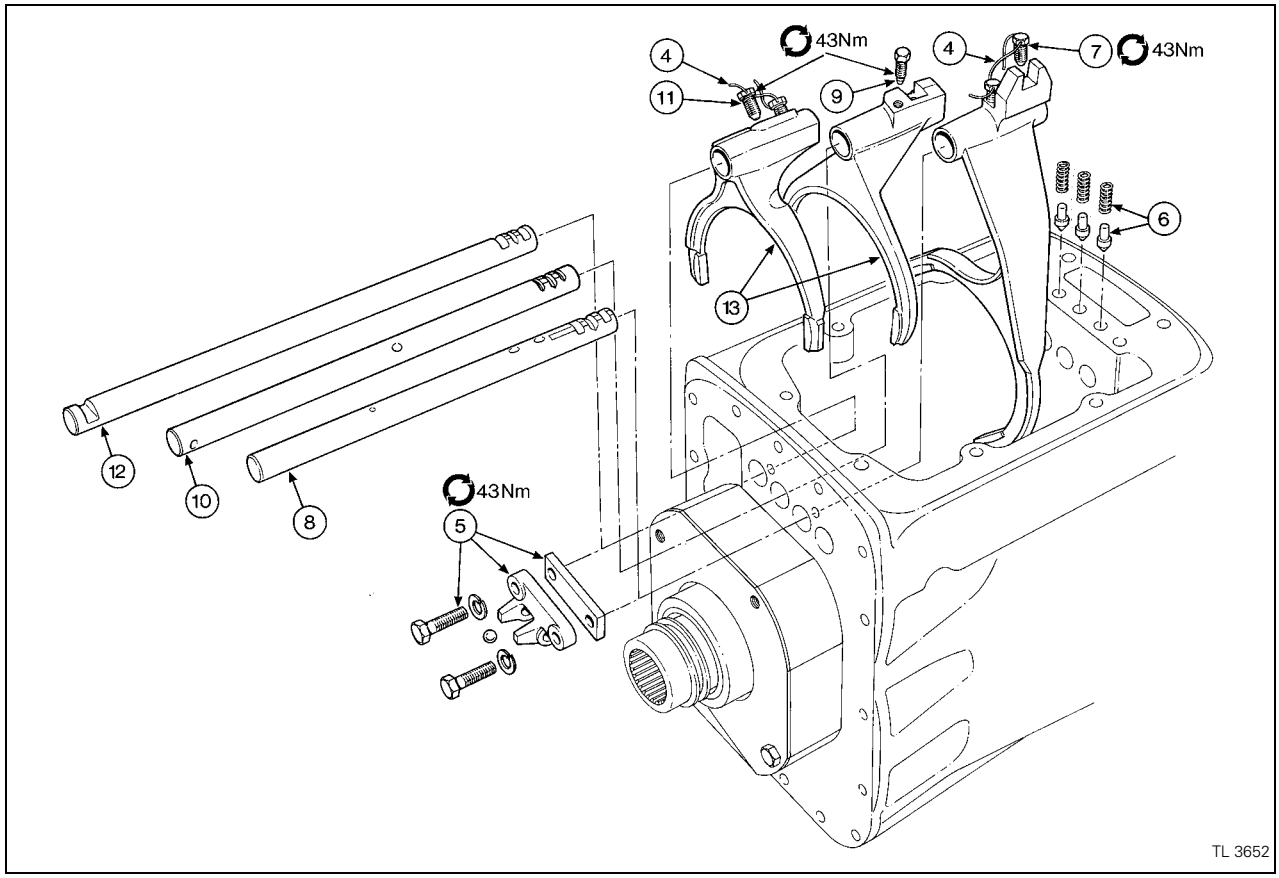
1. Remove the four-wheel drive gearbox assembly, *(see operation 1-5H);* or spacer on two-wheel drive tractors.
2. Remove the circlip and 2nd/3rd selector lever.
3. Remove the circlip and 1st/reverse selector lever.
4. Remove the two selector pins.
5. Remove the two bolts and lift off the support assembly.
6. Remove the two pivot pads.
7. Remove the countersunk screw and the locking plate.
8. Unscrew the spring plunger.
9. Remove the circlip and the epicyclic selector fork
10. Loosen the screw and remove the 1st/reverse selector jaw.

Refitment

11. Reverse procedures 1 to 10 except:
    a. Tighten the two support assembly bolts to a torque of 43 Nm (32 lbf ft).
    b. Tighten the 1st/reverse selector jaw screw to a torque of 43 Nm (32 lbf ft).
    c. Apply 2-3 drops of Massey Ferguson Studlock (Loctite 270) to the threads of the spring plunger. Screw fully home and then undo 1/4 turn.
    d. Lightly lubricate the mechanism and check for free movement, rectify any stiff operation.

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SELECTOR RAILS AND FORKS

Removal and Refitment **6-5G**

Special Tools:
MF.414A Synchromesh Neutral Setting Tool

Removal

CAUTION: *Beware of sharp edges around the top of the gearbox case.*

1. Remove the gearbox, *(see operation 1-5G).*
2. Remove the gearbox top cover *(see operation 4-5G).*
3. Remove the selector mechanism, *(see operation 5-5G).*
4. Remove all the locking wires and discard.
5. Remove the bolts, retainer, packing piece and ball, part of the gear shift interlock.
6. Lift out the detent springs and plungers.
7. Loosen the locking screws.
8. Slide the high/low rail rearwards out of the housing and the selector fork.
9. Loosen the locking screw.
10. Slide the 1st/reverse rail rearwards out of the housing.
11. Loosen the locking screw.
12. Slide the 2nd/3rd rail rearwards out of the housing.
13. Remove the 1st/reverse and 2nd/3rd selector forks.
14. Remove main input shaft, *(see operation 10-5G).*
15. Remove the high/low synchromesh selector fork.

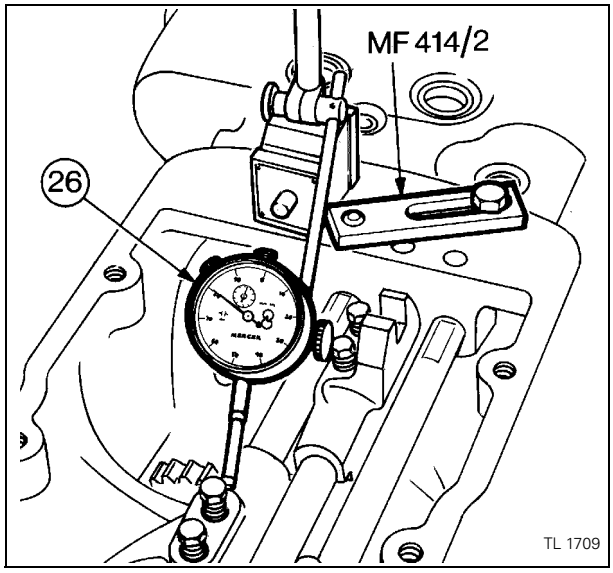
Refitment

16. Reverse procedures 1 to 15.
17. Set the high/low and 2nd/3rd selector forks to the selector rails as follows:
18. Using special tool MF.414A Synchromesh Neutral Setting Tool, lock the selector rail using the bolt MF414/2 and plate MF414/3.
19. Set up a magnetic base dial indicator, as illustrated, with the plunger located against the selector fork.
20. With finger pressure only, slide the selector fork to the rear taking up any clearance. DO NOT engage gear.

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21. Zero the indicator gauge; slide the selector fork fully forward, taking up the clearance again and note the reading on the dial indicator.
22. Half the reading obtained and progressively lock up the two screws on the selector fork to a torque of 43 Nm (32 lbf ft). Ensure that the selector fork is positioned to give half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).
23. Wire-lock all locking screws using new locking wire.
24. On completion of the refitting procedure, check operation and place all the gears in the neutral position.
25. Replace the gear shift interlock and torque the retaining bolts (5) to 43 Nm (32 lbf ft).

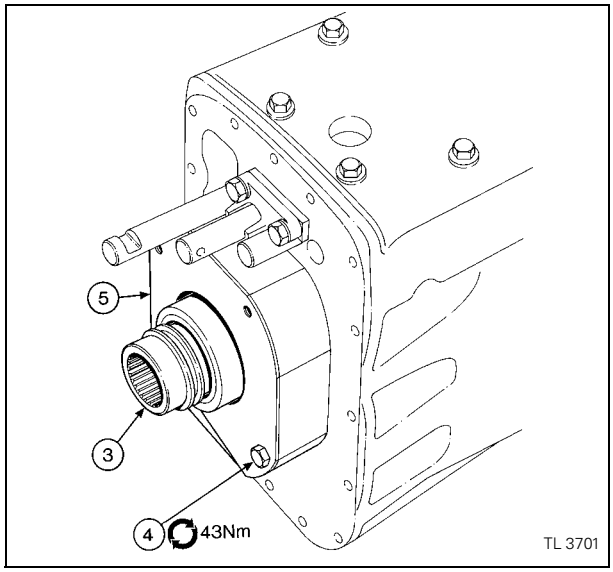


EPICYCLIC UNIT

Removal and Refitment 7-5G

Removal

1. Remove the four-wheel drive gearbox assembly, *(see operation 1-5H);* or spacer on two-wheel drive tractors.
2. Remove the selector mechanism, *(see operation 5-5G).*
3. Remove the coupling.
4. Remove the bolts.
5. Remove the complete assembly.



Refitment

6. Reverse procedures 1 to 5 except:

a. Ensure that the front and rear thrust rings are correctly located before refitment.

b. Ensure that the dowels are correctly located in the gearbox casing.

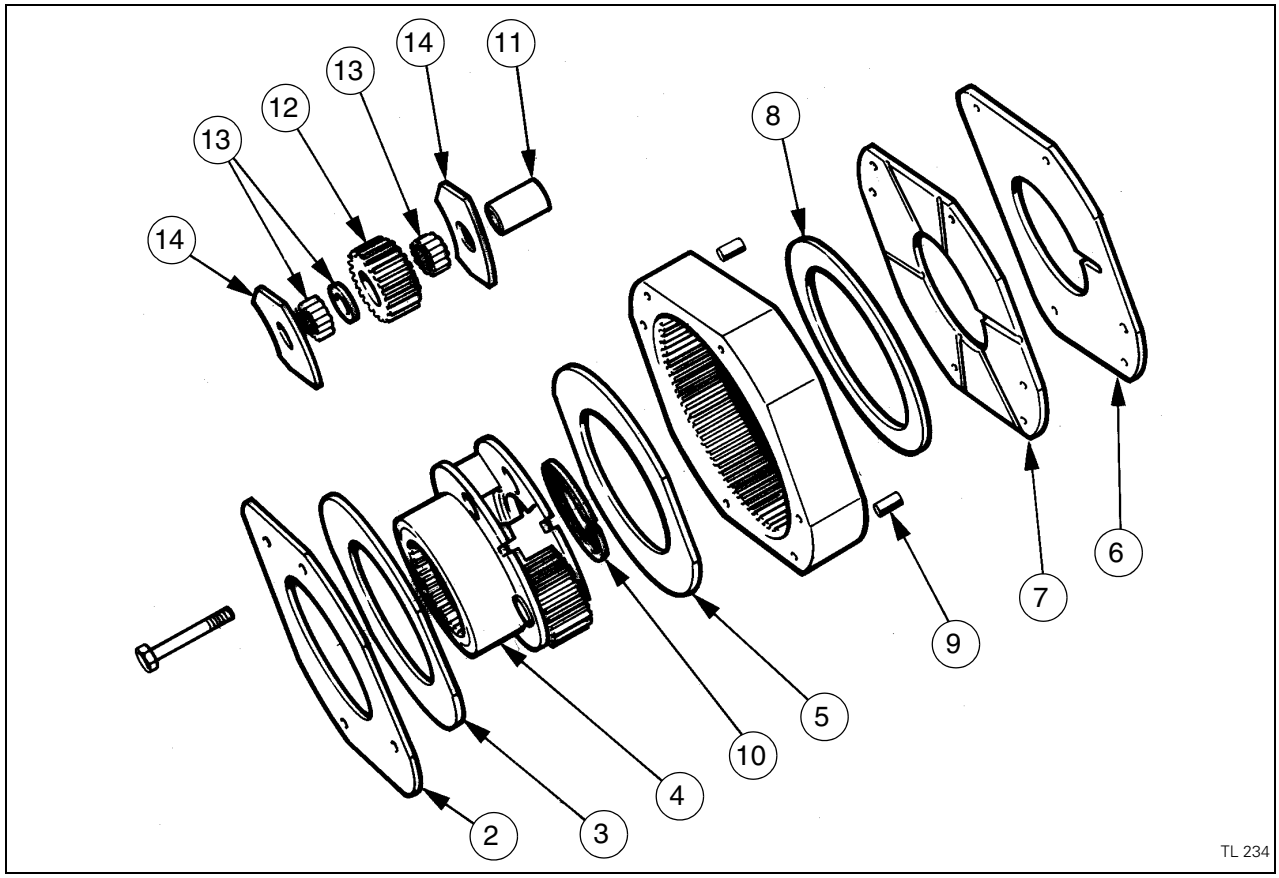
c. Locate the cover plate with the cut out, to the bottom left hand corner.

d. Tighten the retaining bolts progressively and evenly to a torque of 43 Nm (32 lbf ft).

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12 x 4 Manual Gearbox



EPICYCLIC UNIT

Overhaul **8-5G**

Removal

Dis-assembly

1. Remove the gearbox epicyclic unit, *(see operation 7-5G)*.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowels from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Examination

Clean and carefully examine all the components, especially those subject to movement, and replace any items that show signs of damage or wear.

Re-assembly

15. Reverse procedures 1 to 14, except:
    - *a.* When replacing the rollers in the pinions, a smear of petroleum jelly, NOT GREASE, will help retain them. Do not omit the spacer from between the two rows of rollers. Each row consists of 16 rollers.
    - *b.* Ensure that the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
    - *c.* The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
    - *d.* Ensure that the gap of the snap ring is located midway between the planetary pinion shafts.
    - *e.* To assist assembly of the front and rear thrust rings on the pinion carrier, smear them with petroleum jelly, NOT GREASE. Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the planetary pinion carrier.

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PTO DRIVE SHAFT FRONT BEARING

Removal and Refitment **9-5G**

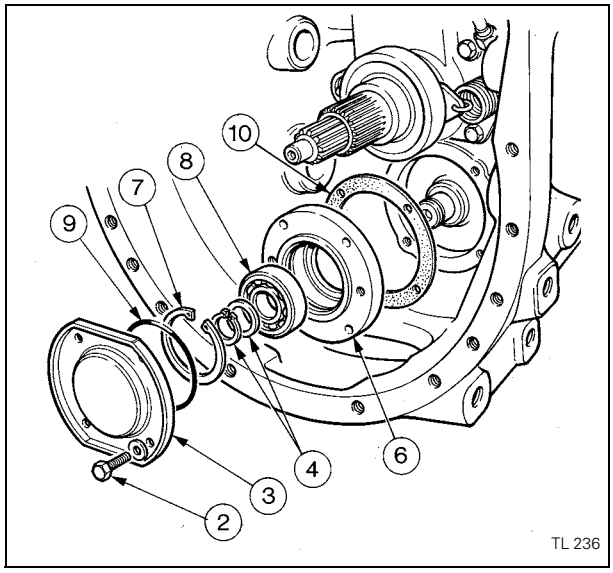
Special Tools:
MF.218B PTO Bearing Housing Replacer

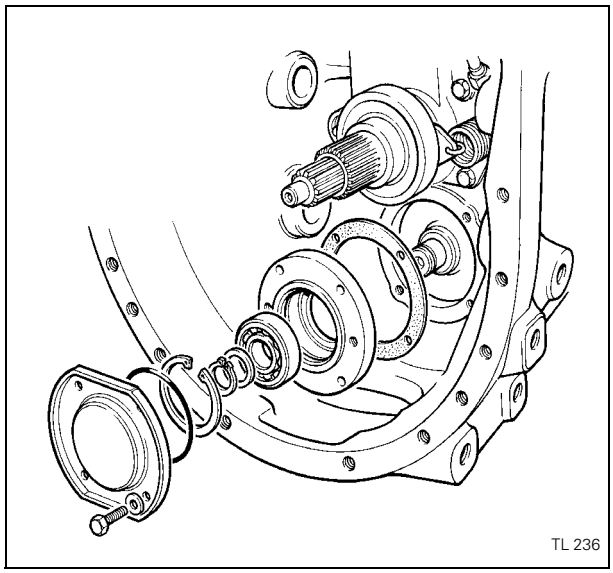
Removal

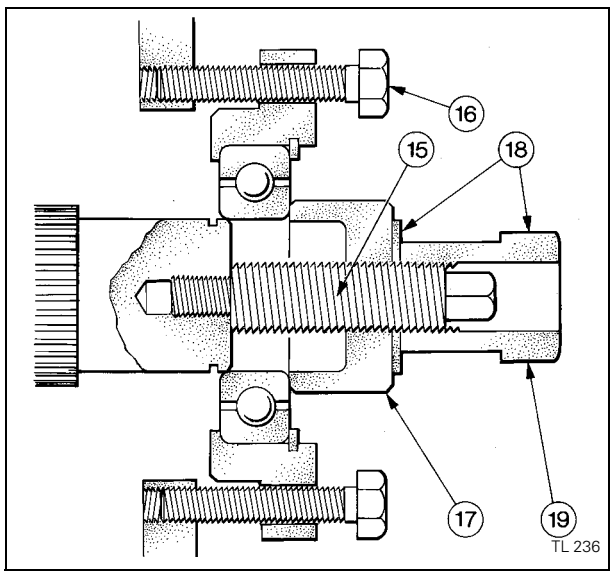
1. Remove the clutch cross-shaft and lever, *(see operation 4-4A)*.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x (75 mm) 3 inch bolts (part of special tool MF.218B) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove and discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 inch UNF bolt approximately 75-100 mm (3-4 inch long) into the shaft to protect it, and drive the shaft out of the PTO constant mesh gear.

Refitment

12. Lightly coat the new gasket with Hylomar sealant.
13. Using MF.218B, PTO Bearing Housing Replacer, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 inch across flats spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF.218B through the un-threaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and put on the nut.
19. Tighten the nut with a 1 1/8 inch across flats spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
20. Fit a new circlip and washer.
21. Replace the cover ensuring that a new 'O' ring is fitted.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 58 Nm (43 lbf ft).



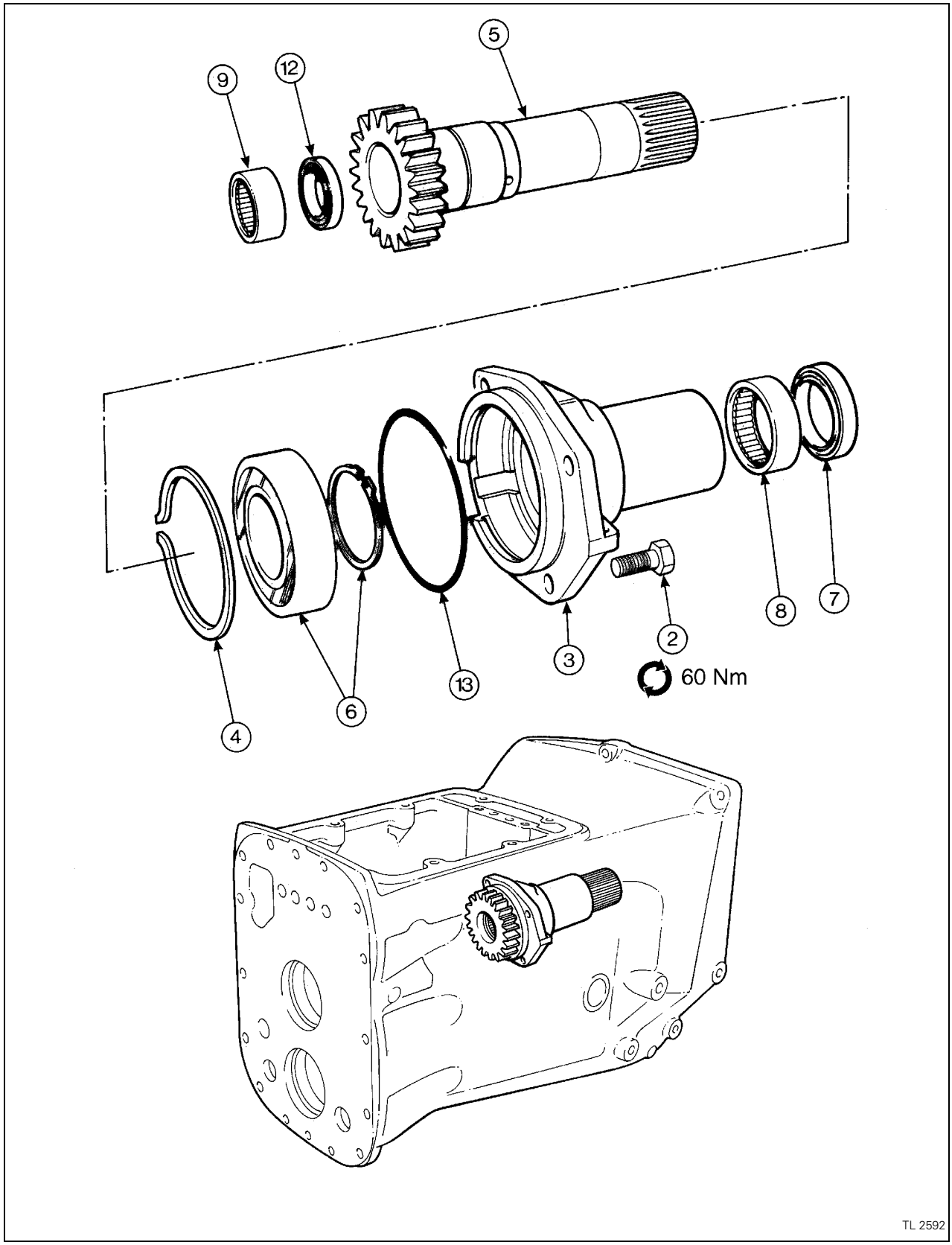




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INPUT SHAFTS AND HOUSING

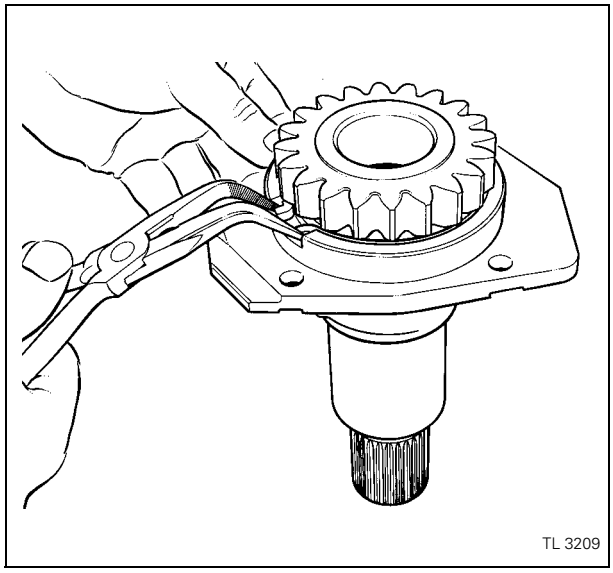
Removal and Refitment **10-5G**

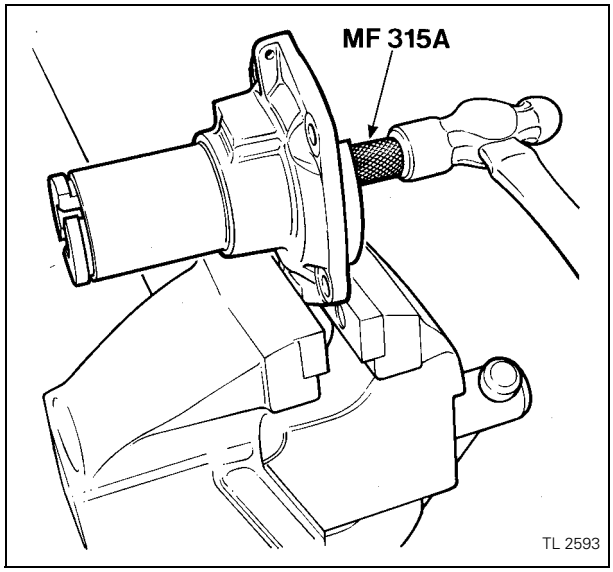
Special Tools:

MF.177A Input Shaft Oil Seal Protector
MF.255B PTO Input Shaft Oil Seal Replacer
MF.315A Needle Roller Bearing Remover/Replacer
MF.421 Needle Roller Bearing and Seal Replacer
MF.422A Bearing, and Seal Remover

Removal

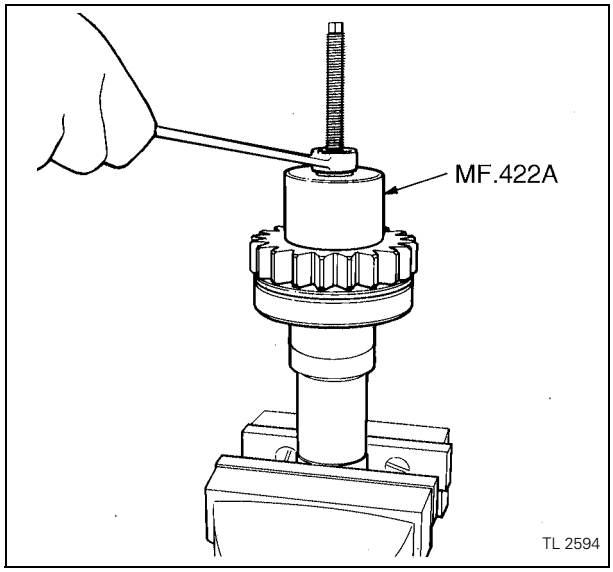
1. Remove the clutch mechanism, *(see operation 3-4A)*.
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Open up the large circlip in its groove so that it is clear of the bearing.
5. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
6. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
7. Lever the seal out of the front of the housing.
8. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, drive the needle roller bearing out of the housing.


TL 3209



TL 2593

9. Using special tool MF.422A, Bearing and Seal Remover, remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
10. Fit the cap, lubricate the screw thread, fit the washer and nut.
11. Tighten the nut withdrawing the bearing from the shaft.
12. Repeat the operation using tool MF.422A to extract the oil seal. The step on the collets must be located fully behind the seal.
13. Remove and discard the 'O' ring.



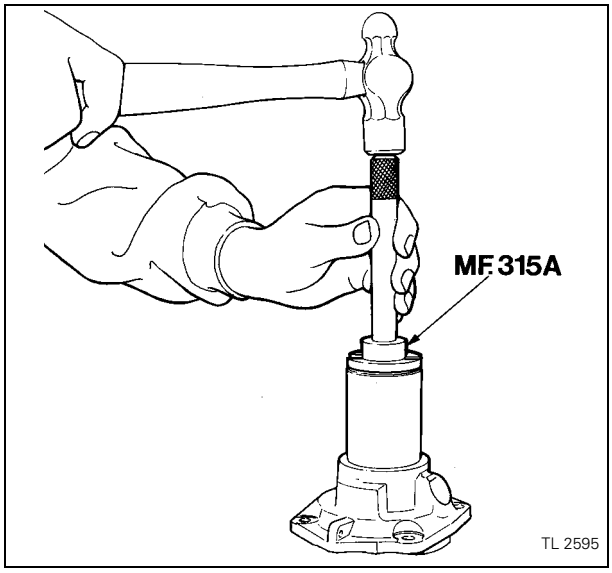
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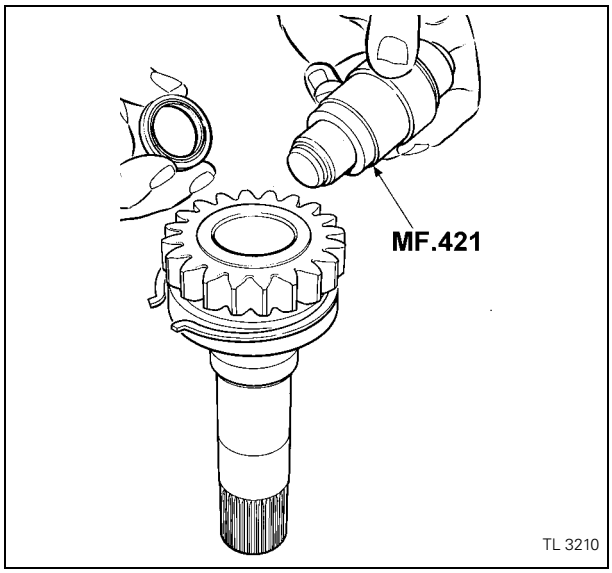
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Re-assembly

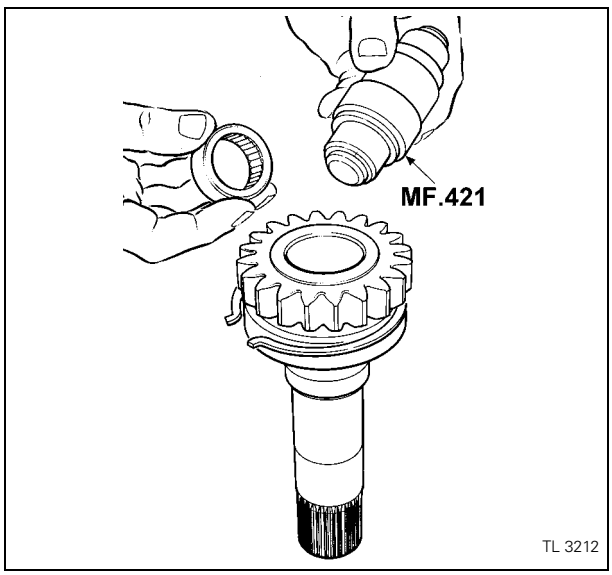
14. If the ball bearing has been removed from the PTO shaft, refit the bearing using a new circlip.
15. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.



16. Pack the cavity of the small input shaft seal with petroleum jelly.
17. Using special tool MF.421, Needle Roller Bearing and Seal Replacer, place the seal on the tool as shown in the illustration and press it into the PTO shaft until the flange on the tool touches the face of the gear.



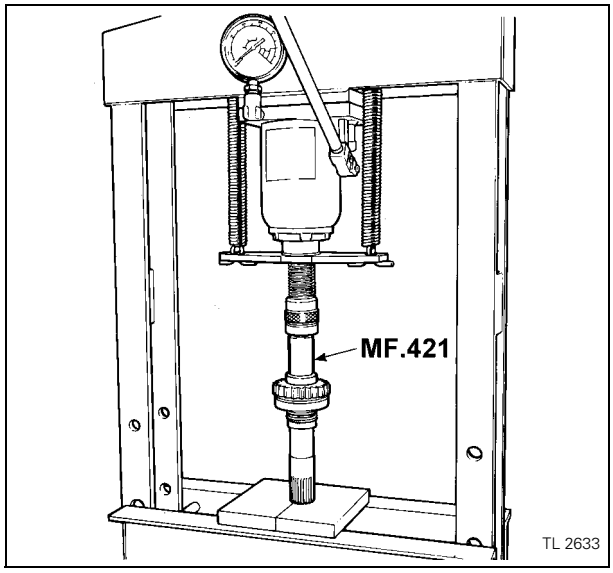
18. Place the needle roller bearing on the other end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.



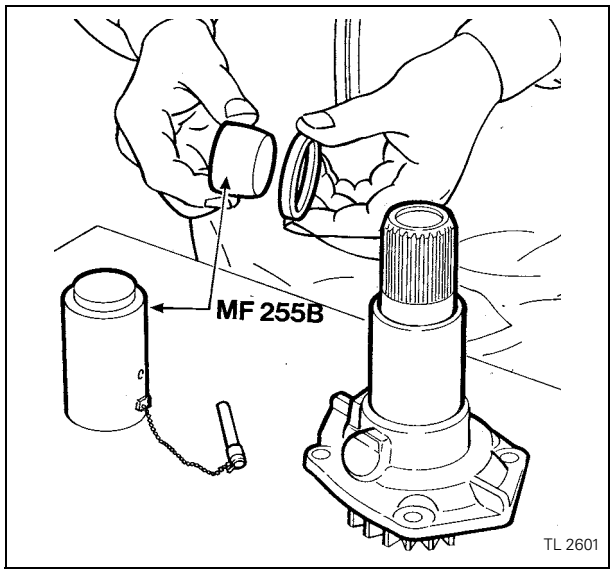
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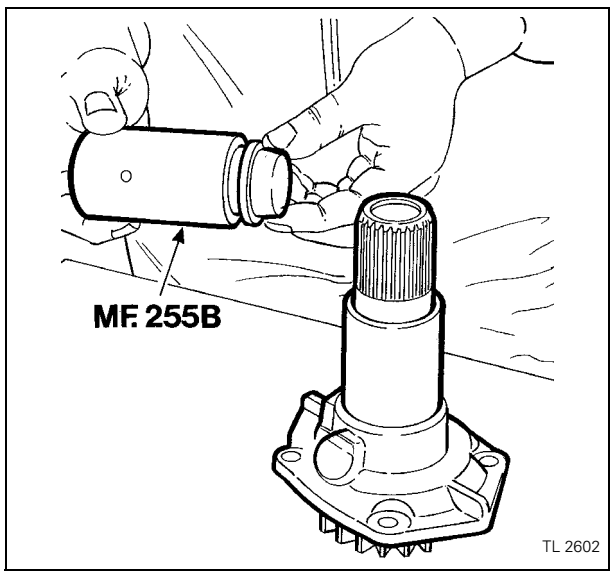
19. Press the bearing into position up to the flange on the tool.
20. Place the large circlip into the groove in the housing.
21. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.



22. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
23. Install the seal using special tool MF.255B, PTO Input Shaft Oil Seal Replacer, to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



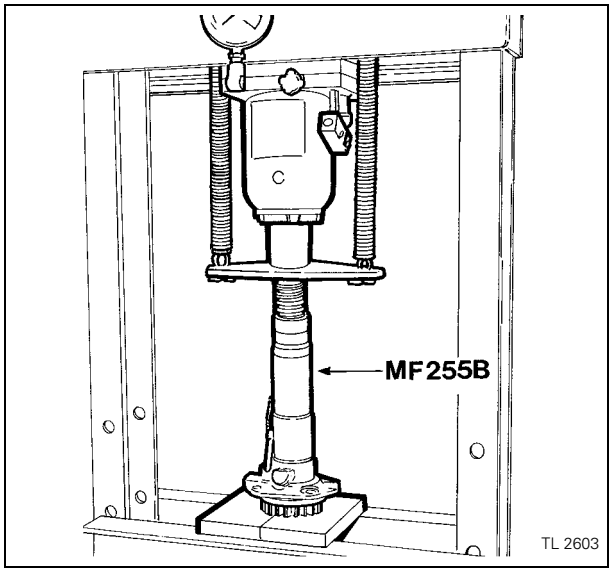
24. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



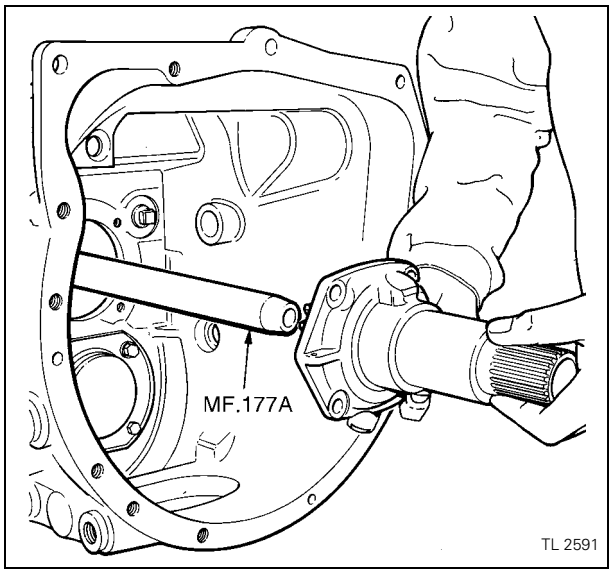
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25. Place the input housing under a light press, place the tool with seal over the PTO input shaft and press the seal into place.
26. Replace the large 'O' ring on the housing.



27. Place special tool MF.177A, Input Shaft Oil Seal Protector, over the main transmission input shaft on the gearbox. This is to protect the seal from the splines on the shaft and prevent seal leakage.
28. Lightly oil the sleeve.
29. Carefully refit the input housing sliding it over the sleeve. Withdraw the sleeve when the housing is in place.
30. Lightly coat the threads of the bolts with Hylomar sealant and tighten to a torque of 60 Nm (44 lbf ft).
31. Refit the clutch release mechanism, *(see operation 3-4A)*.



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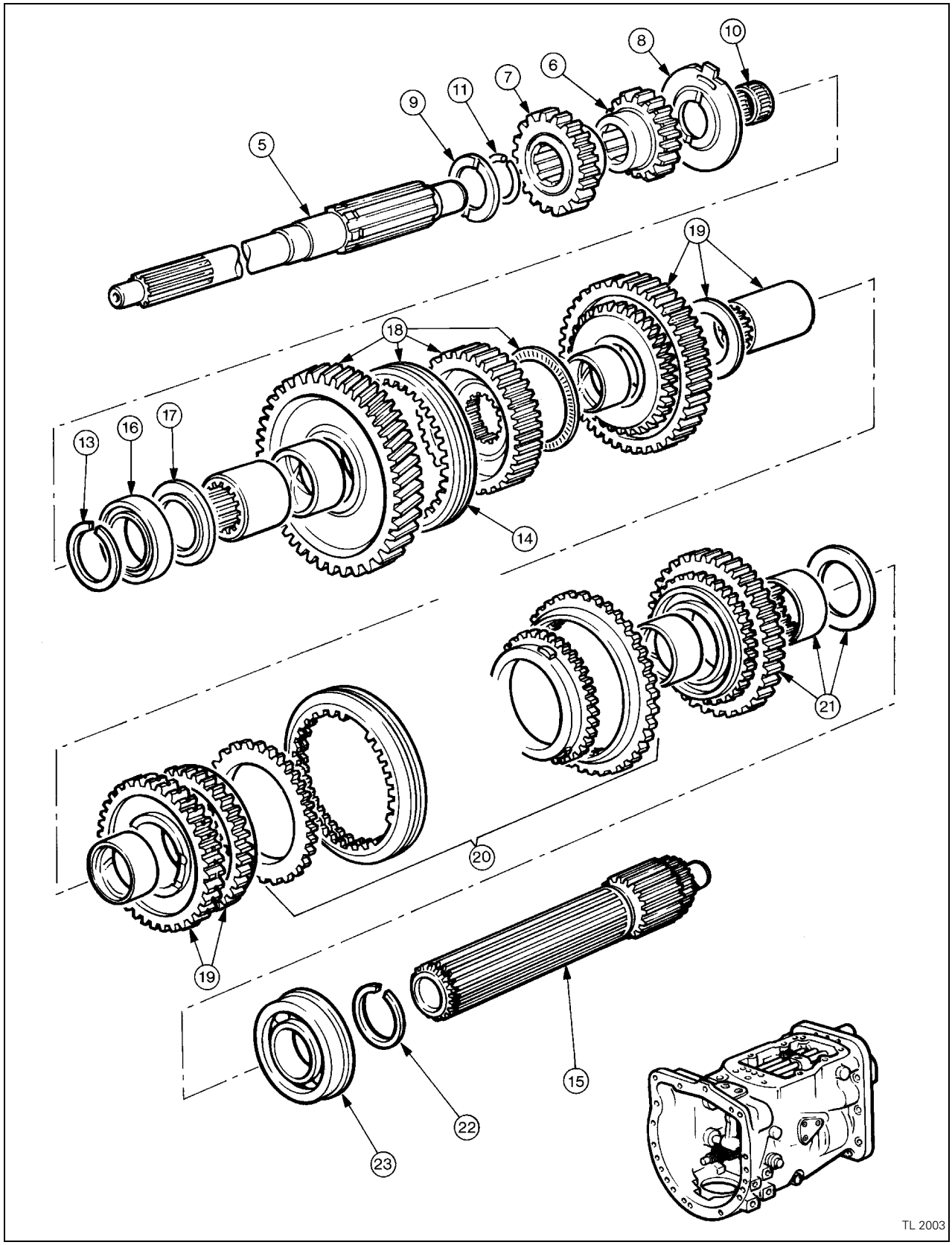
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12 x 4 Manual Gearbox



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LAYSHAFT, MAINSHAFT, PTO SHAFT AND GEARS

Overhaul **11-5G**

Special Tools:
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the gearbox from the tractor and the top cover, *(see operations 1-5G and 1-5G).*
2. Remove the clutch release mechanism, *(see operation 3-4A).*
3. Remove the selector mechanism, selector rails and forks, *(see operations 5-5G and 6-5G).*
4. Remove the input housing, *(see operation 10-5G).*

Input shaft

5. Remove the input shaft.
6. Lift out the low speed constant mesh gear.
7. Lift out the high speed constant mesh gear.
8. Remove the main thrust washer.
9. Remove the front thrust washer.
10. Remove the needle roller bearing.
11. Remove the snap ring from the input shaft if necessary.

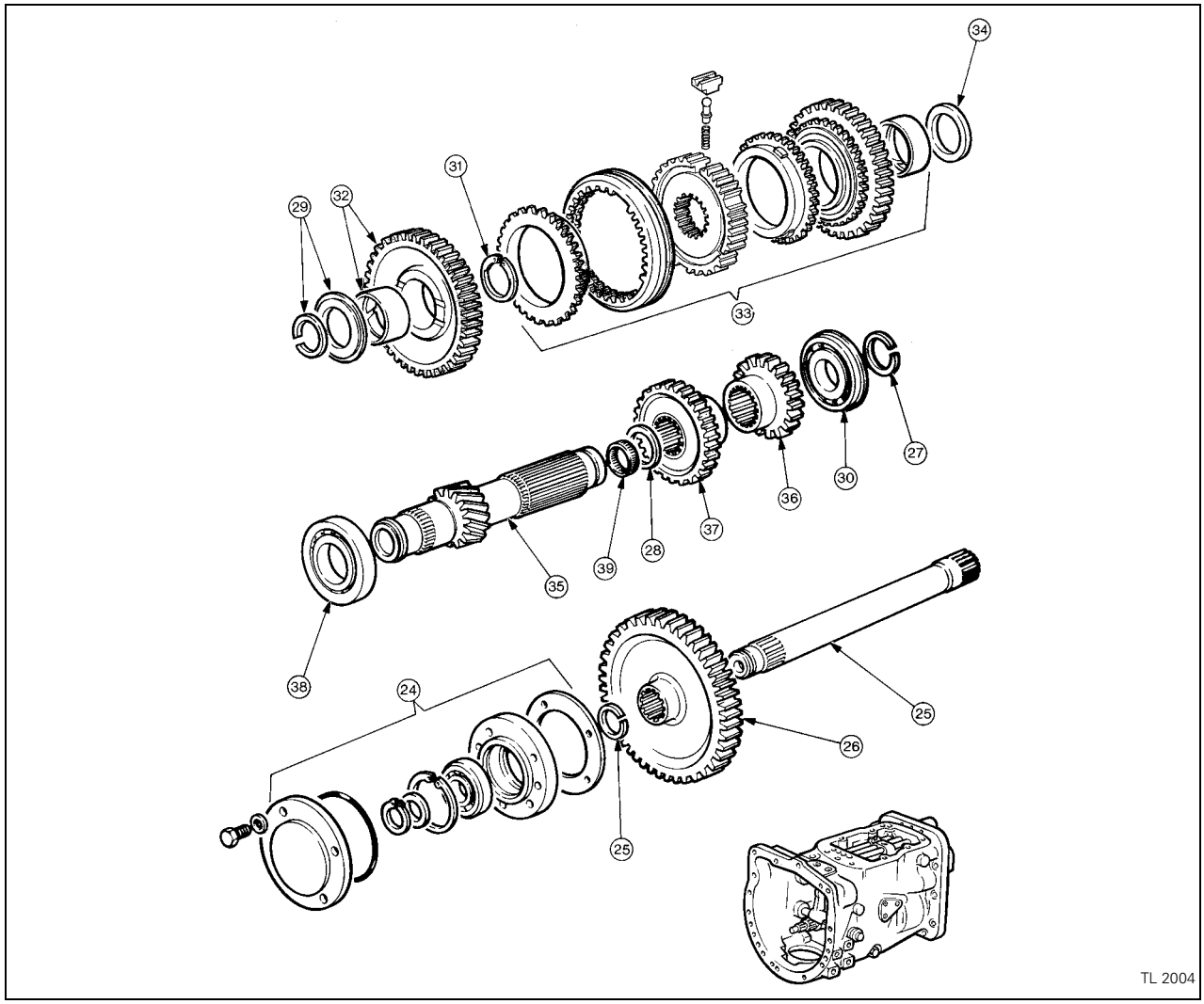
Mainshaft

12. Remove the epicyclic unit, *(see operation 7-5G).*
13. Remove the snap ring from the front of the main shaft.
14. Engage the coupler with first gear.
15. Withdraw the mainshaft through the rear of the gearbox.
16. Remove the roller bearing.
17. Remove the calibrated thrust washer.
18. Lift the 1st gear, coupler, hub and needle roller thrust race out as one unit out of the gearbox.
19. Lift out the reverse gear, sleeve, thrust washer and 3rd gear.
20. Lift out the synchromesh hub assembly complete with baulk rings.
21. Remove the 2nd gear, sleeve and thrust washer.
22. Remove the snap ring if necessary.
23. Remove the roller bearing from the shaft if necessary.

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12 x 4 Manual Gearbox

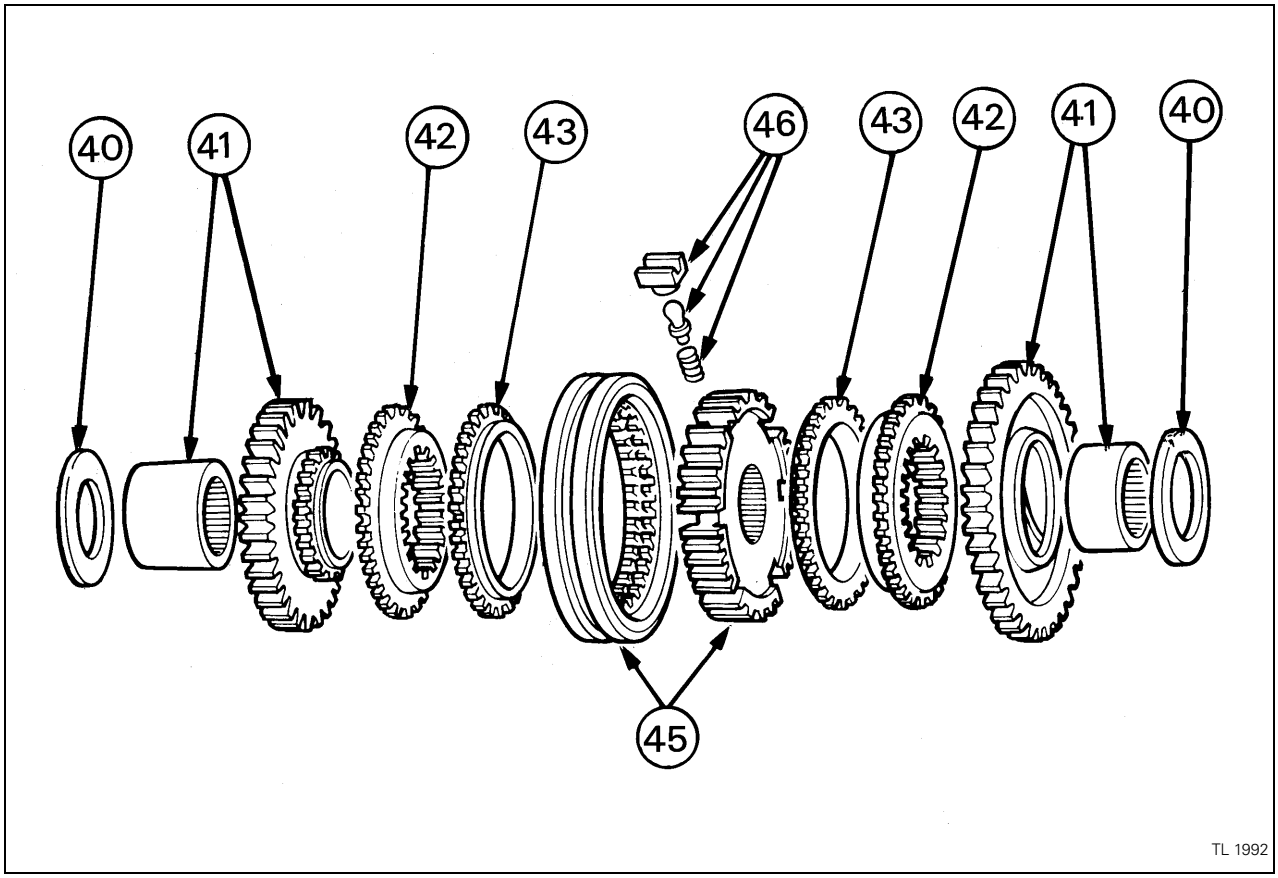


Layshaft

24. Remove the PTO drive shaft front bearing, *(see operation 9-5G).*
25. Remove the circlip and PTO shaft from the layshaft.
26. Lift out the PTO constant mesh gear.
27. Remove the snap ring from the rear of the layshaft.
28. Carefully drive the layshaft forward to uncover the snap ring in front of 3rd gear and move it to the un-splined portion of the shaft.
29. Drive the layshaft rearwards and remove the snap ring and thrust washer from the front of the shaft.
30. Remove the rear bearing.
31. Slide the low range gear forwards and remove the circlip from the front of the synchromesh hub. Move it as far forward along the shaft as possible.
32. Slide the layshaft rearwards and lift out the low range gear and sleeve.
33. Remove the circlip from the shaft and lift out the high range gear and synchromesh hub assembly.
34. Remove the thrust washer.
35. Remove the layshaft through the front of the gearbox.
36. Remove the 2nd gear.
37. Remove 3rd gear.
38. Remove the front ball bearing if necessary.
39. Remove the PTO needle roller bearing if necessary.

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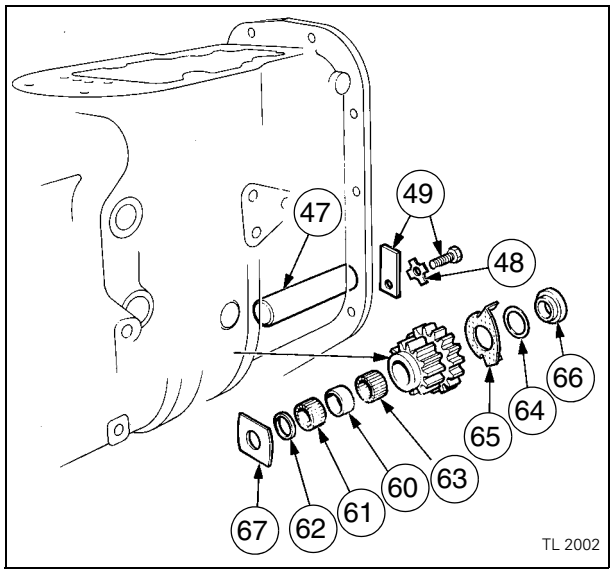


Synchromesh Hub Assemblies

40. Remove the two thrust washers.
41. Remove the 2nd and 3rd gears and sleeves.
42. Remove the two synchromesh cones.
43. Remove the two baulk rings.
44. Remove the hub assembly complete with coupler.
45. Wrap the assembly in a cloth and press the coupler off the hub with your fingers. This will prevent loss of the springs, ball pins and pressure blocks.
46. Remove the three pressure blocks, ball pins and springs.

Reverse idler

47. Obtain a length of steel bar 1 inch in diameter and 2 3/16 inch long to aid in removal of the idler shaft.
48. Release the locking washer.
49. Remove the bolt and locating tab.
50. Slide the steel bar in from the front of the reverse idler shaft towards the rear. This will push the shaft out of the case and prevent the needle roller bearings from dropping into the transmission case and allow the idler gear to be removed.



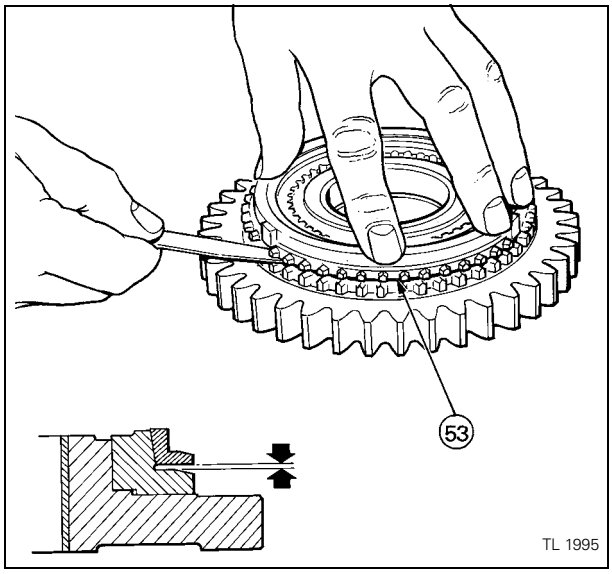
51. Remove the shaft and allow the needle roller bearings and spacers to drop into a clean container.

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Examination

52. Thoroughly clean all the components.
53. Check the condition of the synchromesh assembly by measuring the clearance between the baulk ring and synchromesh cone on the gear at several points. The baulk ring must be correctly positioned on the cone as shown in the illustration. If the clearance is less than 0,5 mm (0.020 in) replace the baulk ring. If the clearance is checked with the gearbox assembled, engage the gear and replace the baulk ring if the clearance is found to be less than 0,8 mm (0.030 in).

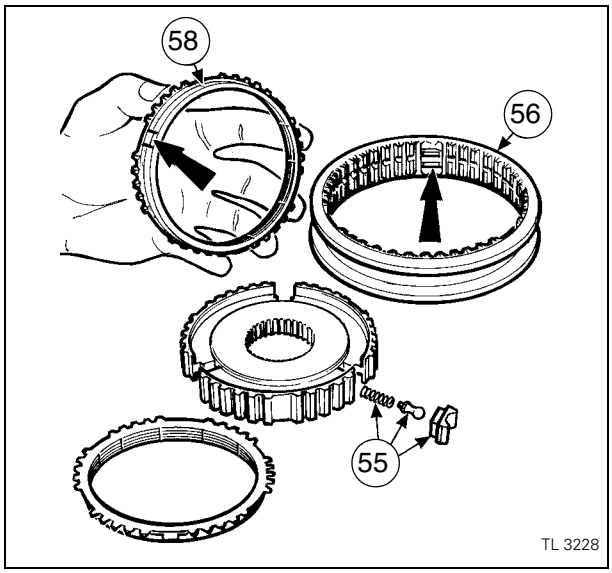


Re-assembly

NOTE: *All circlips and snap rings must be renewed. Ensure that they are all correctly located in their grooves.*

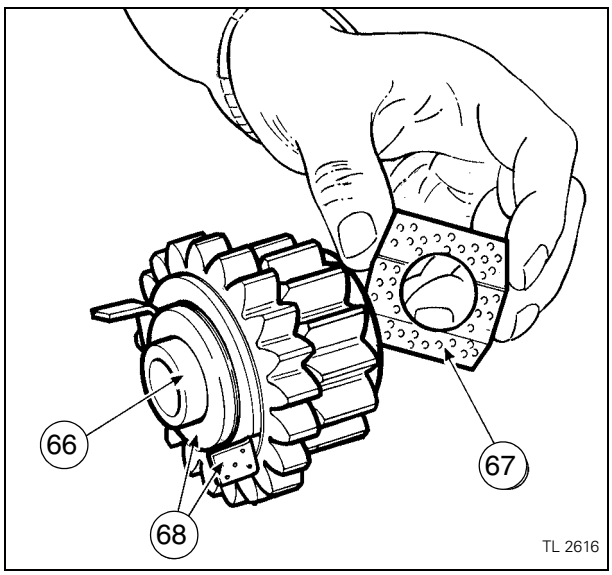
Synchromesh Hub Assembly

54. Reverse procedures 40 to 46.
55. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
56. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
57. Press the coupler down into place easing the spring-loaded blocks into place.
58. Position the baulk rings so that the locating blocks fit into the slots in the hub. Use petroleum jelly to retain the components in position.



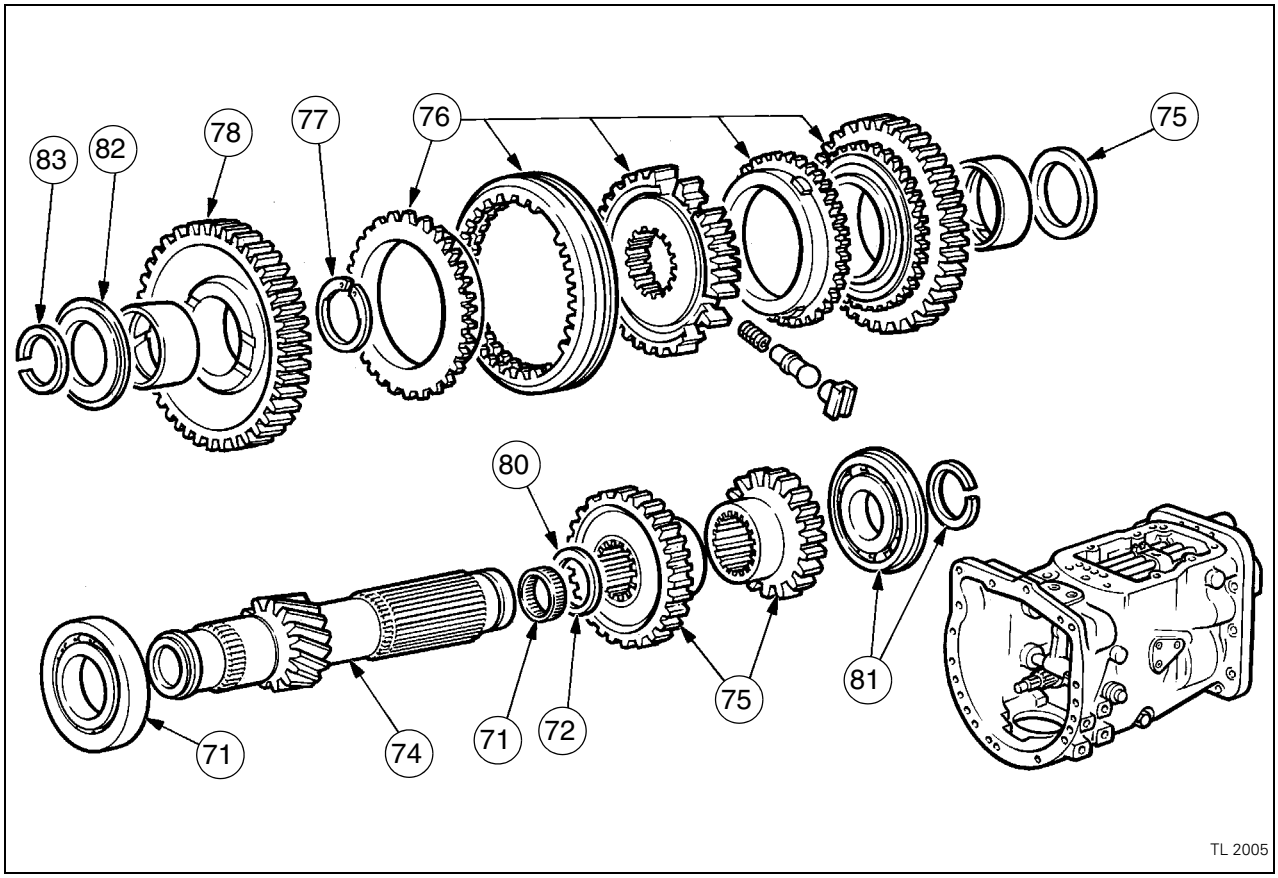
Reverse Idler Assembly (see page 5G-25)

59. Coat the inside of the reverse idler gear with petroleum jelly, NOT GREASE, to assist in assembly.
60. Refit the centre spacer.
61. Refit the first row of 28 rollers.
62. Refit the small spacer.
63. Refit the second set of rollers
64. Refit the spring washer to the collar with the concave side facing the gear.
65. Refit the friction washer to the collar with the brass face facing the gear.
66. Refit the collar assembly to the gear.
67. Place the thrust washer on the front face of the gear with the brass face facing the gear.
68. Squeeze the assembly together compressing the spring washer so that the reverse idler assembly will fit into the gearbox:
    a. Ensure that the two small lugs on the rear thrust washer locate each side of the casting.
    b. The curved edge of the front thrust washer must locate against the curved machined profile of the casting.
69. Carefully refit the reverse idler gear shaft.
70. Fit a new lock washer to lock the retaining bolt.



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Layshaft

71. If the front ball bearing and the needle roller bearings have been removed, refit them.
72. Place the snap ring onto the un-splined portion of the layshaft.
73. Place the 2nd (20T) and 3rd (33T) gears in the bottom of the gearbox with the 2nd gear to the rear.
74. Refit the layshaft through the front of the gearbox sliding on the 3rd and 2nd gears. Position the shaft fully rearward.
75. Refit the thrust washer to the front of the shaft with the step towards the bearing.
76. Refit the high range gear (smaller of the two) complete with the synchromesh hub and baulk rings as one assembly. Hold the synchromesh components in place with petroleum jelly.
77. Place the circlip on the shaft as far rearward as possible.
78. Refit the low range gear (larger gear).
79. Hold the low range gear in position and drive the layshaft forward so that the gear pushes the circlip into its groove.

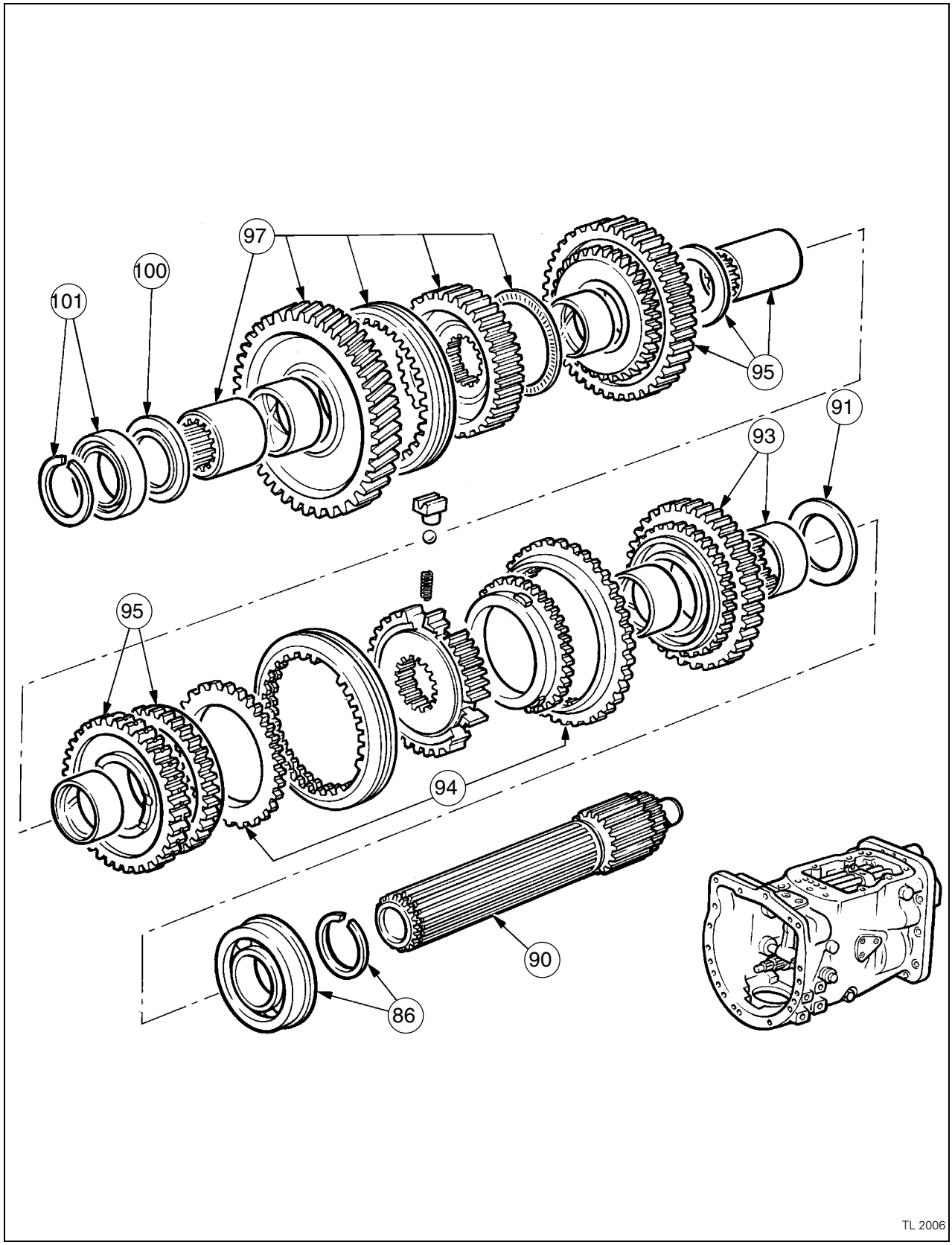
IMPORTANT: *Check that the circlip between the low range gear and synchromesh hub is correctly seated in its groove.*

80. Replace the snap ring in front of 3rd gear.
81. Place a piece of wood between the front of the layshaft and the front of the gearbox casting to prevent the shaft moving forward. Drive the rear bearing onto the shaft and into the casing. Replace the snap ring.
82. Refit the front thrust washer with the flat face towards the high range gear.
83. Replace the front snap ring.
84. Place the PTO constant mesh gear in the bottom of the gear box and refit the PTO shaft.
85. Refit the PTO front bearing housing, *(see operation 9-5G)*.

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12 x 4 Manual Gearbox



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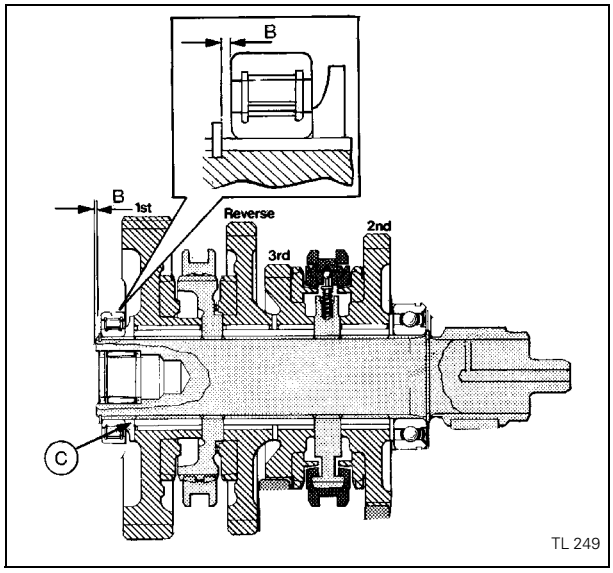
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Mainshaft

86. Assemble the mainshaft complete on the bench with all hubs, gears, bushes, bearings and thrust washers.
87. Refit the front circlip and measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0,08 and 0,30 mm (0.003 and 0.012 in).
88. If your measurement falls outside the set limits, replace the calibrated thrust washer 'C' which is positioned between the bearing and 1st gear. Use one of a choice of varying thickness of thrust washers to achieve the desired end float. The chart below lists the thickness and part number of the thrust washers available:

Part Number	Shim thickness	
	mm	inch
1671 888 M2	4,14-4,19	0.163-0.165
1671 889 M1	4,39-4,44	0.173-0.175
1671 890 M2	4,62-4,67	0.182-0.184
1671 891 M2	4,85-4,90	0.191-0.193

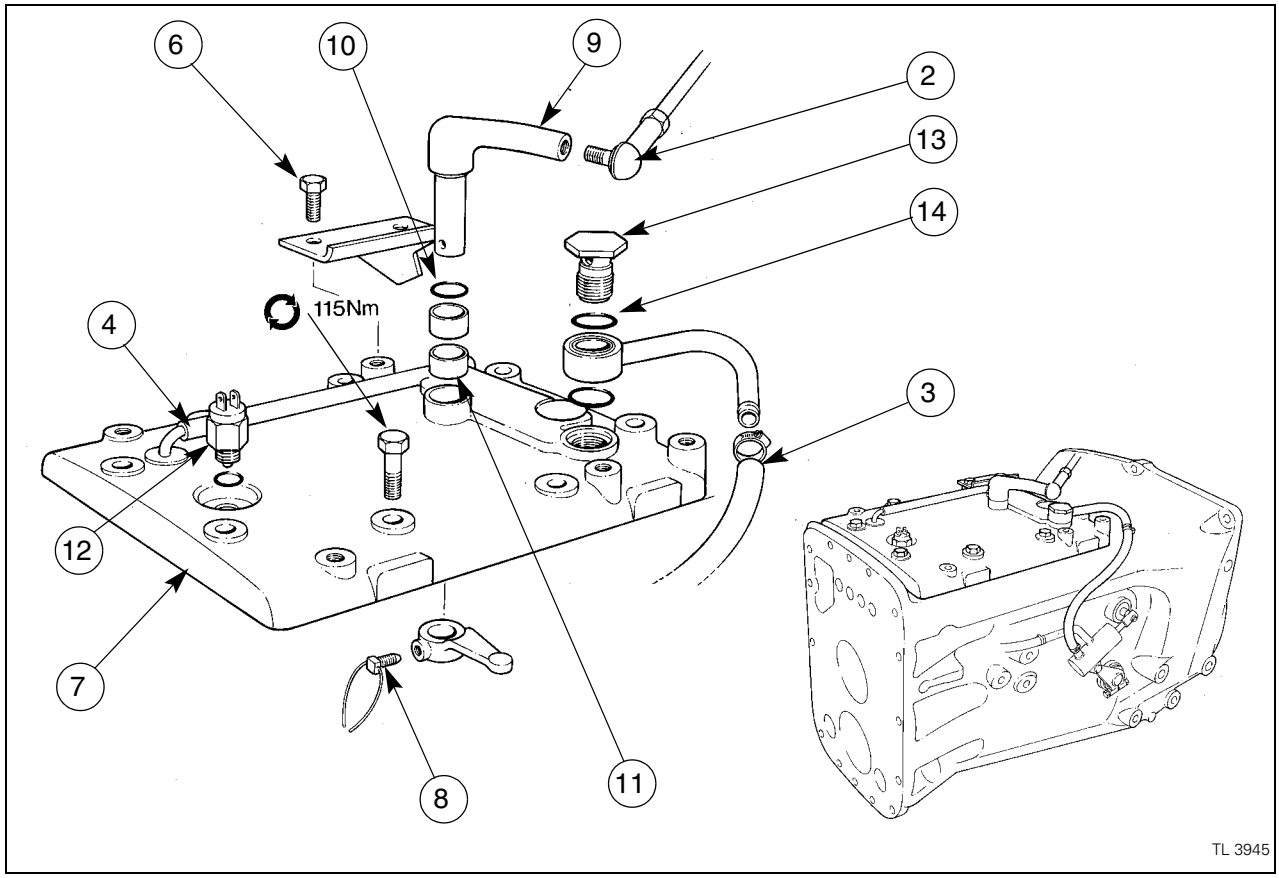
89. Dismantle the mainshaft so that it can be assembled into the gearbox with the rear ball bearing in position on the shaft.
90. Slide the mainshaft through the rear of the gearbox progressively fitting in order.
91. Steel reversible thrust washer.
92. Make the synchromesh hub up into an assembly using petroleum jelly to hold all the components together as follows:
93. 2nd gear (40T) with short sleeve.
94. 2nd/3rd synchromesh hub assembly with the two baulk rings.
95. Assemble 3rd gear (36T) and reverse gear (44T) on the long sleeve with a reversible thrust washer between the two gears.
96. Fit the above assembly into the box and slide the mainshaft through until it is flush with the front of the reverse gear.
97. Assemble the 1st gear (42T), coupler and hub. Engage the coupler with first gear. Fit the medium length bush to the 1st gear and locate the needle roller thrust race on to the rear of the hub using petroleum jelly.
98. Carefully lower the assembly into the gearbox and push the mainshaft fully forwards.
99. Refit the epicyclic unit, *(see operation 7-5G)*.
100. Fit the pre-selected calibrated thrust washer with the flat side towards 1st gear.
101. Refit the roller bearing and snap ring.
102. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forward, use petroleum jelly to hold it in place.



103. Refit the needle bearing into the front of the mainshaft.
104. Locate the high/low range selector fork into the coupler of the layshaft synchromesh assembly.
105. Pass the input shaft through the front of the gearbox and fit the high range gear (the larger of the two), the low range gear and locate it into the front of the mainshaft.
106. Refit the front thrust washer.
107. Refit the input housing assembly, *(see operation 10-5G)*.
108. Refit the selector mechanism, selector forks and rails, *(see operations 5-5G and 6-5G)*.
109. Refit the clutch release mechanism, *(see operation 3-4A)*.
110. Refit the gearbox to the tractor, *(see operations 1-5G and 4-5G)*.

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GEARBOX TOP COVER

Removal and Refitment 12-5G

Removal

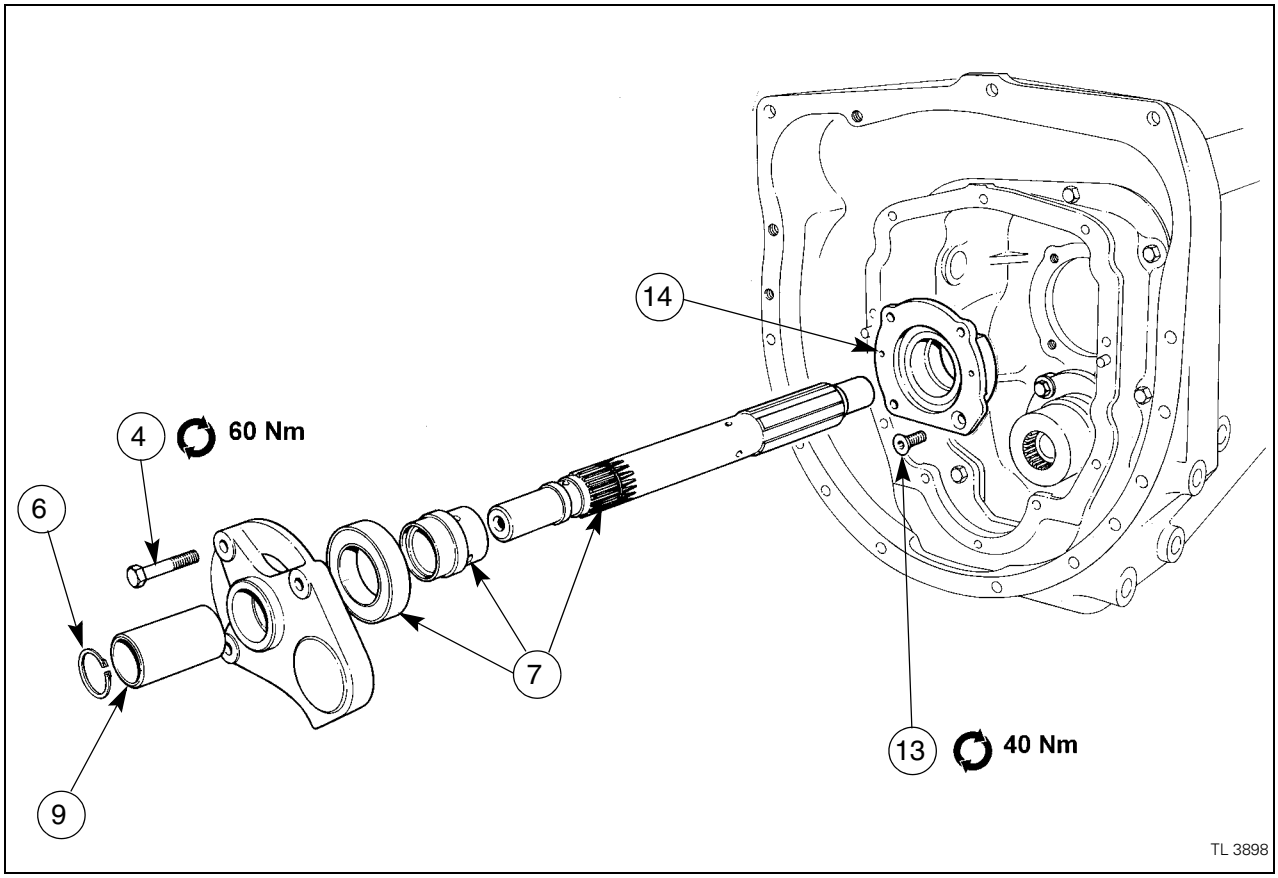
1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the breather pipe.
5. Disconnect the wires to the reverse light/bleeper switch, (if fitted).
6. Remove the bolts and clutch cable bracket (cab tractor only).
7. Remove the top cover.
8. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
9. Withdraw the shaft from the cover.
10. Remove and discard the 'O' ring seal.
11. If necessary, remove and replace the bushes in the top cover.
12. Remove the reverse light/bleeper switch to prevent damage to the switch (if fitted).
13. Remove the banjo bolt and pipe.
14. Remove and discard the 'O' ring seals.
15. Clean all components and remove dried gasket material from the machined faces.

Refitment

16. Reverse procedures 1 to 14 except:
    a. Replace the shaft and banjo 'O' rings.
    b. Apply Studlock (Loctite 270) to the lever locking bolt (7).
    c. Apply Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

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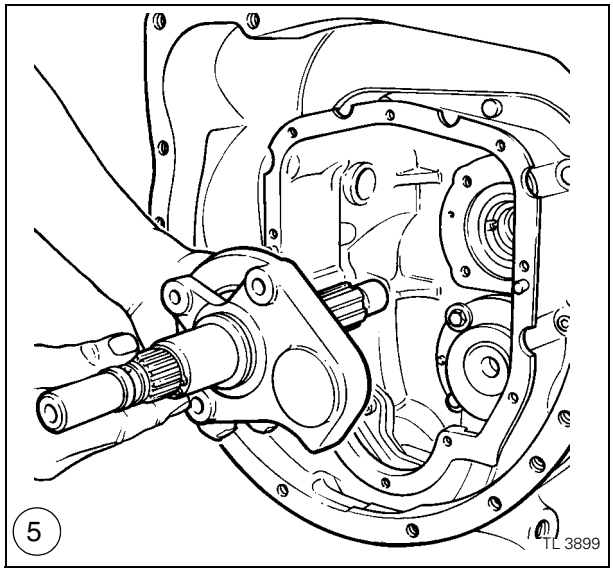


INPUT SHAFT AND HOUSING

Removal and Refitment **13-5G**

Removal

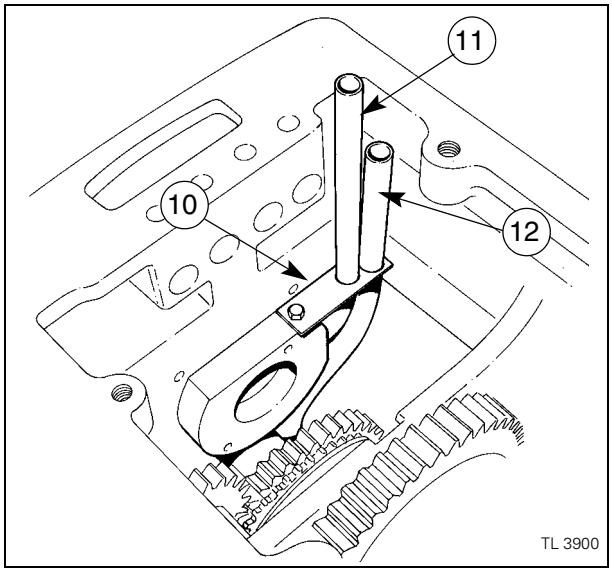
1. Remove the gearbox assembly, *(see operation 1-5G)*.
2. Remove the clutch release mechanism, *(see operation 8-4B)*.
3. Remove the gearbox top cover, *(see operation 12-5G)*.
4. Remove the three bolts.
5. Withdraw the housing and shaft assembly from the gearbox, support the clutch pack to ease the removal.
6. Remove the circlip.
7. Remove the shaft assembly from the outer housing.
8. Remove the gears and thrust washers from the gearbox.
9. The release bearing sleeve is a press fit into the housing and under normal conditions should not require replacement.



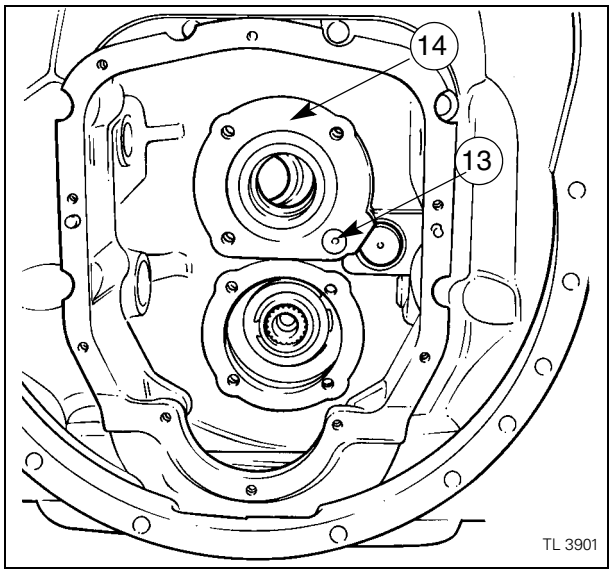
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10. To remove the inner housing, remove the bolt and keep plate. *Gearbox components have been removed for clarity.*
11. Remove the oil feed pipe.
12. Remove the oil return pipes.



13. Remove the countersunk screw holding the housing.
14. Remove the inner housing.

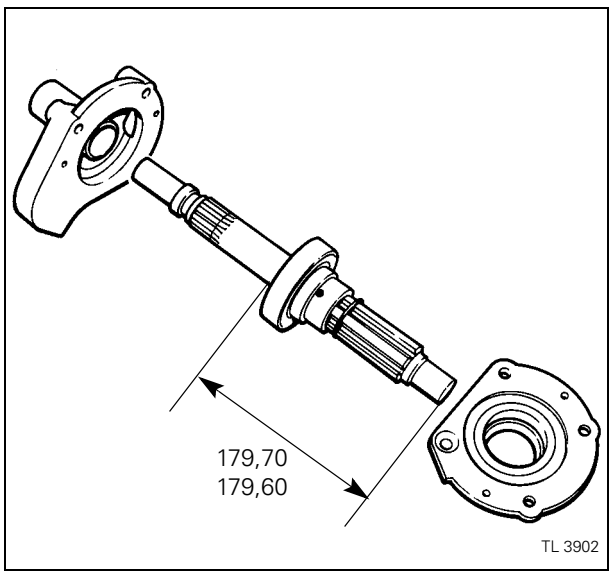


Refitment

IMPORTANT: *The input shaft has been accurately set in the factory and is only available as an assembly comprising of the shaft, carrier and bearing. DO NOT remove the carrier from the shaft. If the bearing is being replaced, the carrier must be supported during removal and refitment to prevent movement. When a new bearing has been fitted the dimension shown on the illustration (179,70-179,60* mm*(7.076-7.080 in) must be accurately checked and adjusted if incorrect. It is recommended that the assembly is always fitted.*

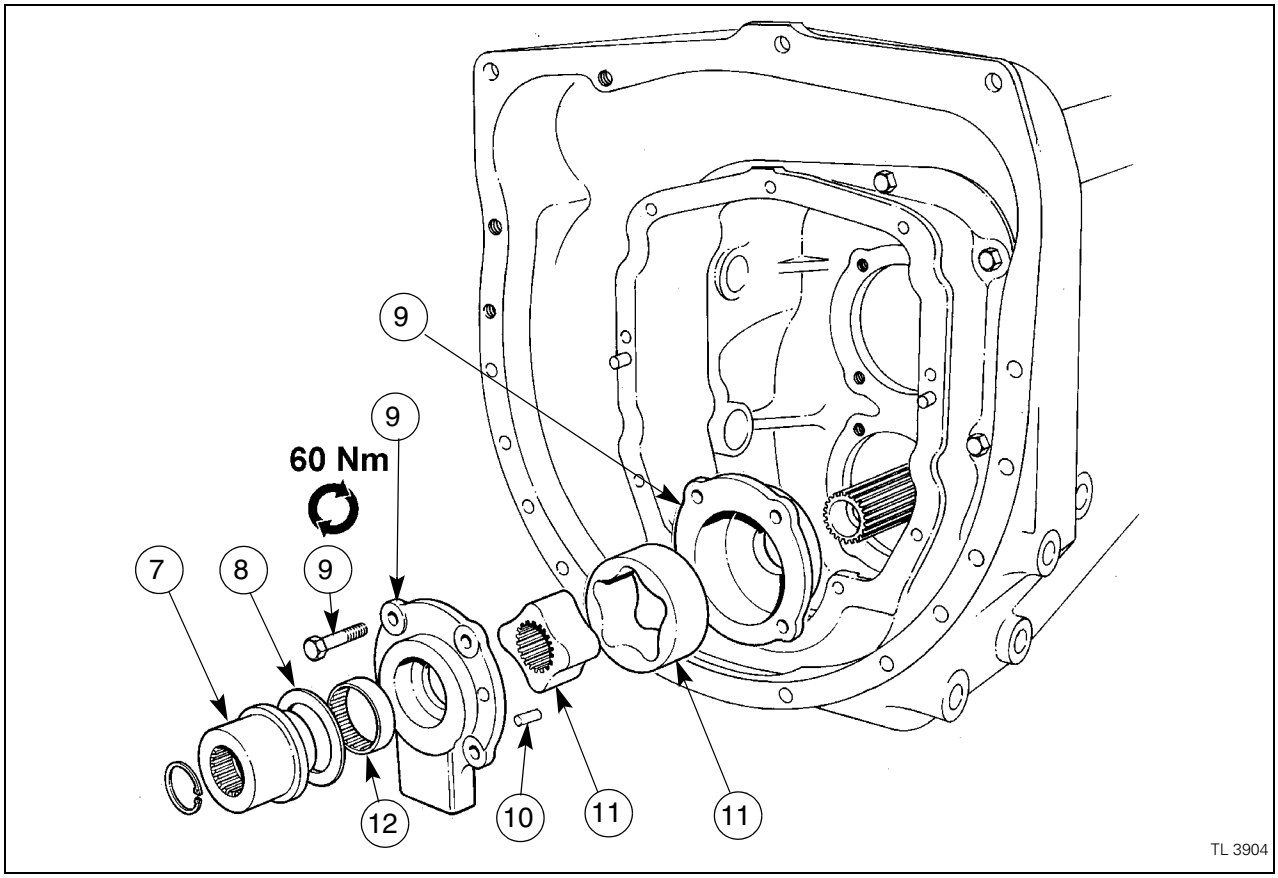
Refitment

15. Reverse procedures 1 to 14 except:
    a. Tighten the countersunk screw to a torque of 40 Nm (30lbf ft).
    b. Tighten the three bolts to a torque of 60 Nm (44 lbf ft).
    c. Apply Loctite 270 to the bolt (10) retaining the internal pipes.
16. The sleeve for the clutch thrust bearing is a press fit into the housing.



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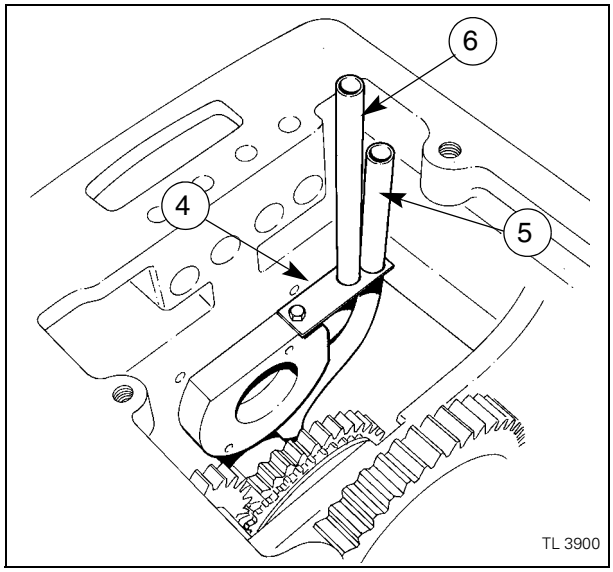


SCAVENGE PUMP

Removal and Refitment 14-5G

Removal

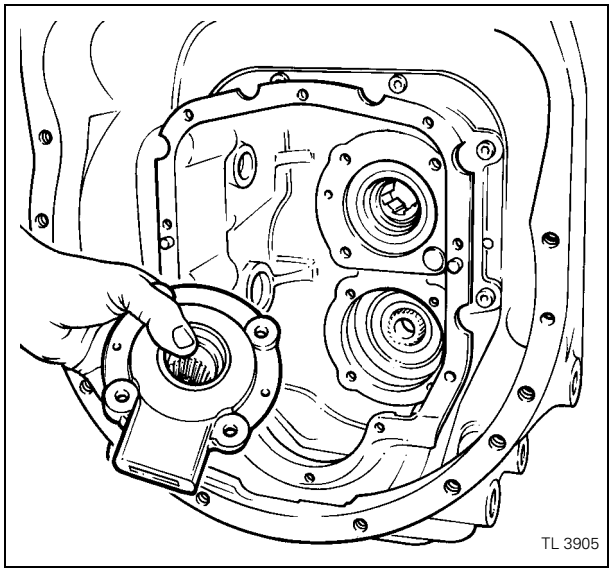
1. Remove the clutch assembly, *(see operation 4-4B)*.
2. Remove the clutch release bearing and cross shaft, *(see operation 7-4B)*.
3. Remove the gearbox top cover, *(see operation 12-5G)*.
4. Disconnect the internal pipes to the scavenge pump by removing the bolt and keep plate.
5. Remove the oil return pipe.
6. Remove the oil feed pipe.
7. Remove the PTO support bearing assembly.
8. Remove the thrust washer.



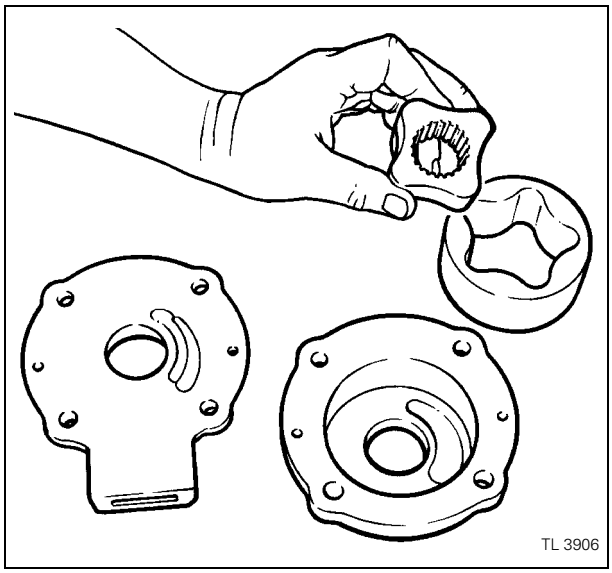
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9. Remove the four bolts and pull the scavenge pump assembly off the shaft and out of the housing.



10. Place the pump on a clean bench, drive out the two dowels and split the pump.
11. Remove the rotor and stator.
12. Only remove the needle roller bearing if replacement is required.



Examination

Care fully clean the components and the scavenge pump, especially the oil ways. There are no dimensional tolerances that need checking, the pump is low pressure, moving oil from the clutch casing to the transmission.

Inspect the rotor and stator for wear, scoring or damage on their working faces, if they appear to be in good condition they can be replaced.

Refitment

13. Lightly oil and reassemble the pump, it can only be assembled one way to line-up the bolt holes. Centralise the rotor in the stator so that it is in the centre of the bore.
14. Reverse procedures 1 to 10 except:
    a. Tighten the four pump retaining bolts to a torque of 60 Nm (44 lbf ft).
    b. Apply Loctite 270 to the bolt (4) retaining the internal pipes.

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Four-wheel Drive Gearbox

Section 5 - Part H

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–––––	General Description	5H– 2
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2-5H	Gearbox - Overhaul	5H– 7
3-5H	Drive Shaft Oil Seal - Removal and Refitment	5H–13

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Four-wheel Drive Gearbox

SPECIFICATION

Drive shaft bearing pre-load	0,07 mm (0.003 in) - 200-900 grams (7-32 oz) pull.
Idler bearing pre-load	0-0,05 mm (0-0.002 in) - see text for pull.
Drive shaft seal depth	7 mm (1/4 in) below recessed face.

Special Tools

MF.367B	Transmission torque wrench.
MF.499	Drive shaft oil seal installer.
MF.3008	Circlip plier set.

Bolt Torques

Four-wheel drive gearbox to gearbox bolts	102 Nm (75 lbf ft).
Bearing retainer plate bolts	30 Nm (22 lbf ft).
Bridge piece bolts	30 Nm (22 lbf ft).
Drive shaft bearing housing bolts	30 Nm (22 lbf ft).
Main gear shift lever assembly bolts	30 Nm (22 lbf ft).
Idler shaft locknut	18 Nm (13 lbf ft)

GENERAL DESCRIPTION

The four-wheel drive gearbox is directly bolted to the rear of the 12 x 4 manual or the 8 x 8 shuttle gearbox forming an integral unit. It contains the drive train of gears from the main output shaft of the gearbox to the drive shaft to the front axle.

The first motion shaft is mounted on a ball bearing within the rear casing, the front of the shaft is supported on an internal needle roller bearing supported on a spigot in the back of the gearbox drive shaft. Drive to the first motion shaft is selected by a sliding coupler which either engages with the epicyclic unit to give a reduced working speed; or direct to the drive shaft for a high transport speed.

The drive is then passed through a hollow second motion shaft which is supported on roller bearings. An internal needle roller bearing supports the PTO shaft which passes through it.

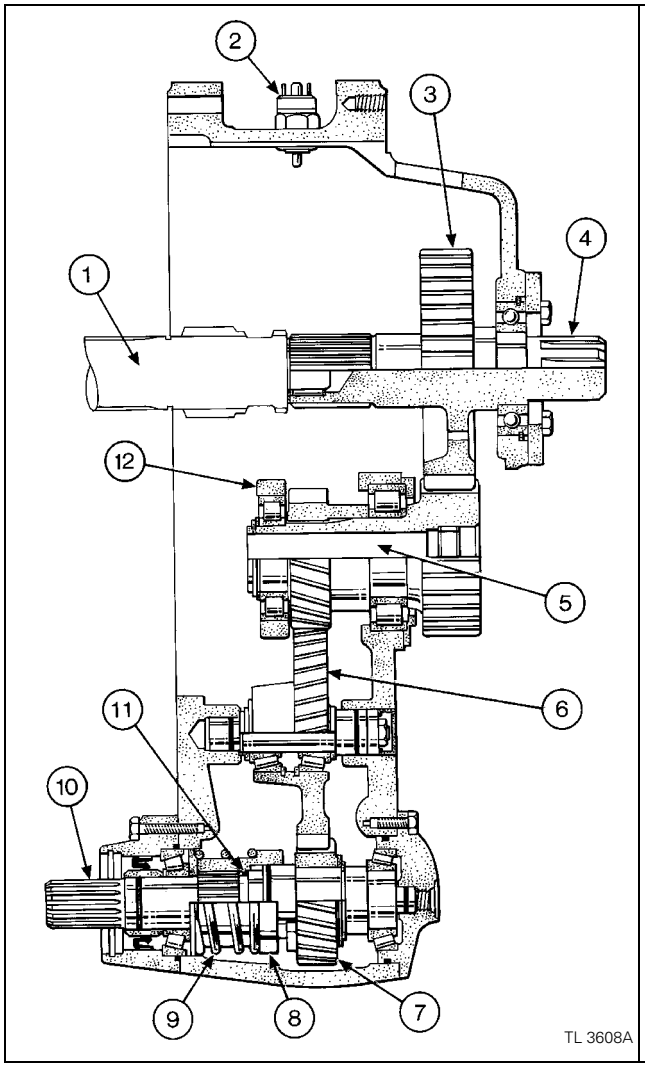
The drive shaft in the bottom of the gearbox, contains the four-wheel drive clutch, it is driven from the second motion shaft through an idler gear which runs on a pair of pre-loaded taper roller bearings.

The drive shaft also runs on pre-loaded taper roller bearings and contains the hydraulic clutch for the dis-engagement of four-wheel drive. The clutch is spring loaded to the engaged position.

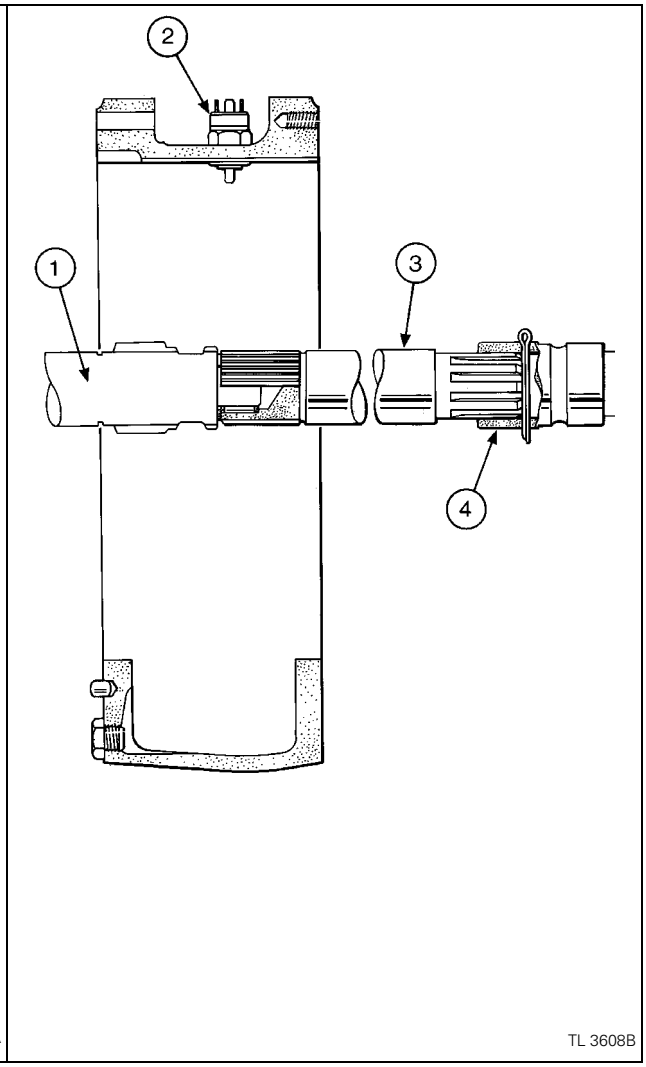
The clutch is controlled hydraulically through a solenoid valve which is controlled by the driver's switch.

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Four-wheel Drive Gearbox



Two-wheel Drive Spacer

Key to Four-wheel Drive Gearbox

1. Gearbox mainshaft.
2. High/Low range indicator switch.
3. Four-wheel drive gear.
4. Output shaft to rear axle.
5. Intermediate shaft and gear.
6. Idler shaft and gear.
7. Four-wheel drive idler gear.
8. Four-wheel drive clutch.
9. Return spring.
10. Drive shaft to front axle.
11. Hydraulic cylinder.
12. Intermediate shaft support bracket.

Key to Two-wheel Drive Spacer

1. Gearbox mainshaft.
2. High/Low range indicator switch.
3. Intermediate shaft.
4. Shear tube.

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GEARBOX

Removal and Refitment 1-5H

Special Tools:
MF.367B Transmission Torque Wrench

Removal

IMPORTANT: *The main gearbox and four-wheel drive gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and four-wheel drive gearbox.*

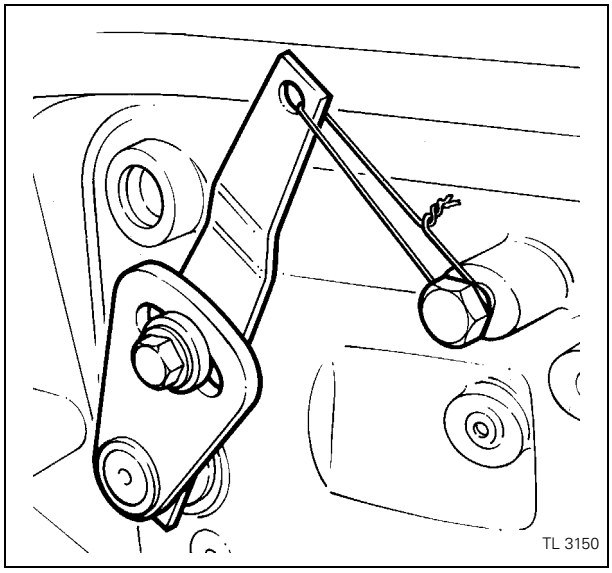
1. Split the tractor between the range gearbox and the rear axle as described, *(see operation 3-2A)* in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the main gearbox is securely supported so that it does not fall over when the gearbox is removed.
3. Remove the main gear shift lever assembly.
4. Slide back the rear drive shaft cover.
5. With the aid of a hoist or small crane support the weight of the four-wheel drive gearbox.
6. Remove all the bolts around the casing and lift clear.
7. Place the gearbox on a suitable bench so that the repair work can be carried out.

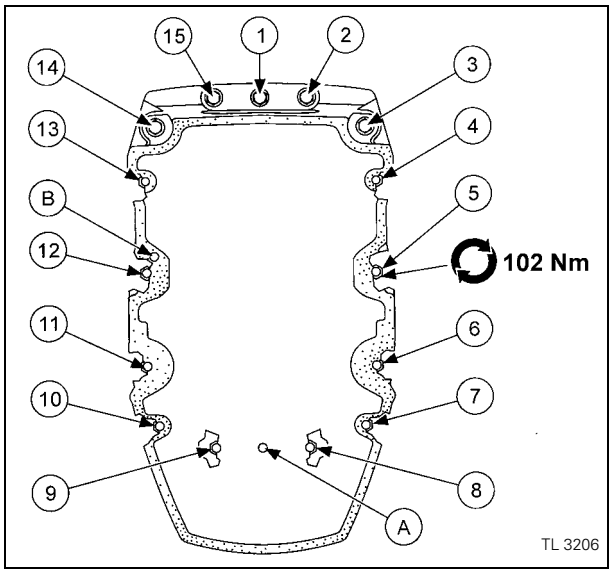
Refitment

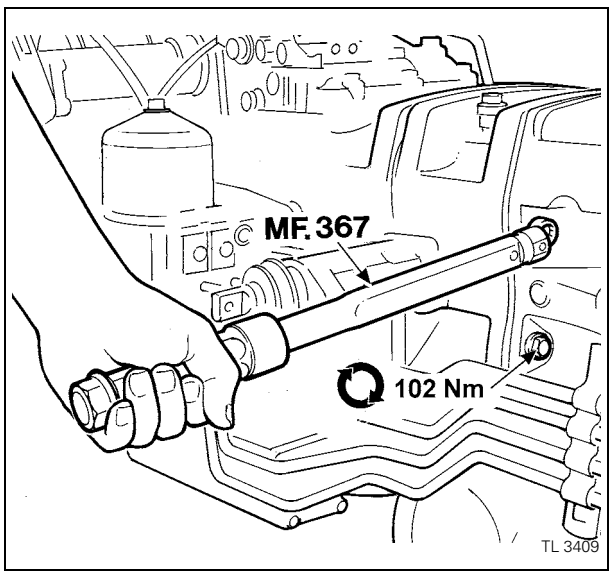
8. After repair, hang the gearbox from the hoist or crane so that it hangs vertical.
9. Ensure that the two dowels on the bottom and side of the gearbox are in place.
10. Place a new gasket on the mounting face of the main gearbox.
11. Lift the gearbox into position ensuring that the main shaft from the gearbox enters the first motion gear without damaging the needle roller bearing. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure.*

12. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.
13. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm wrench.







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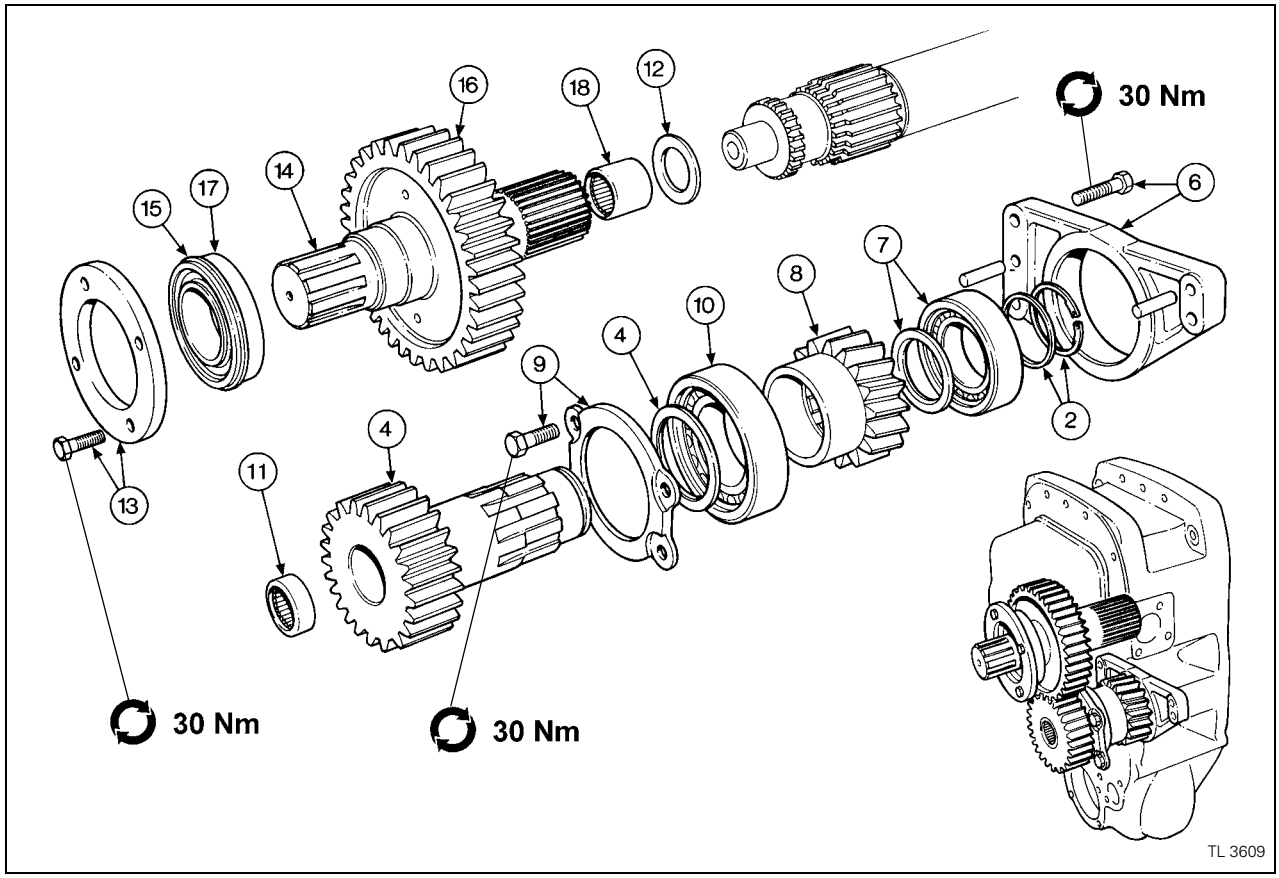
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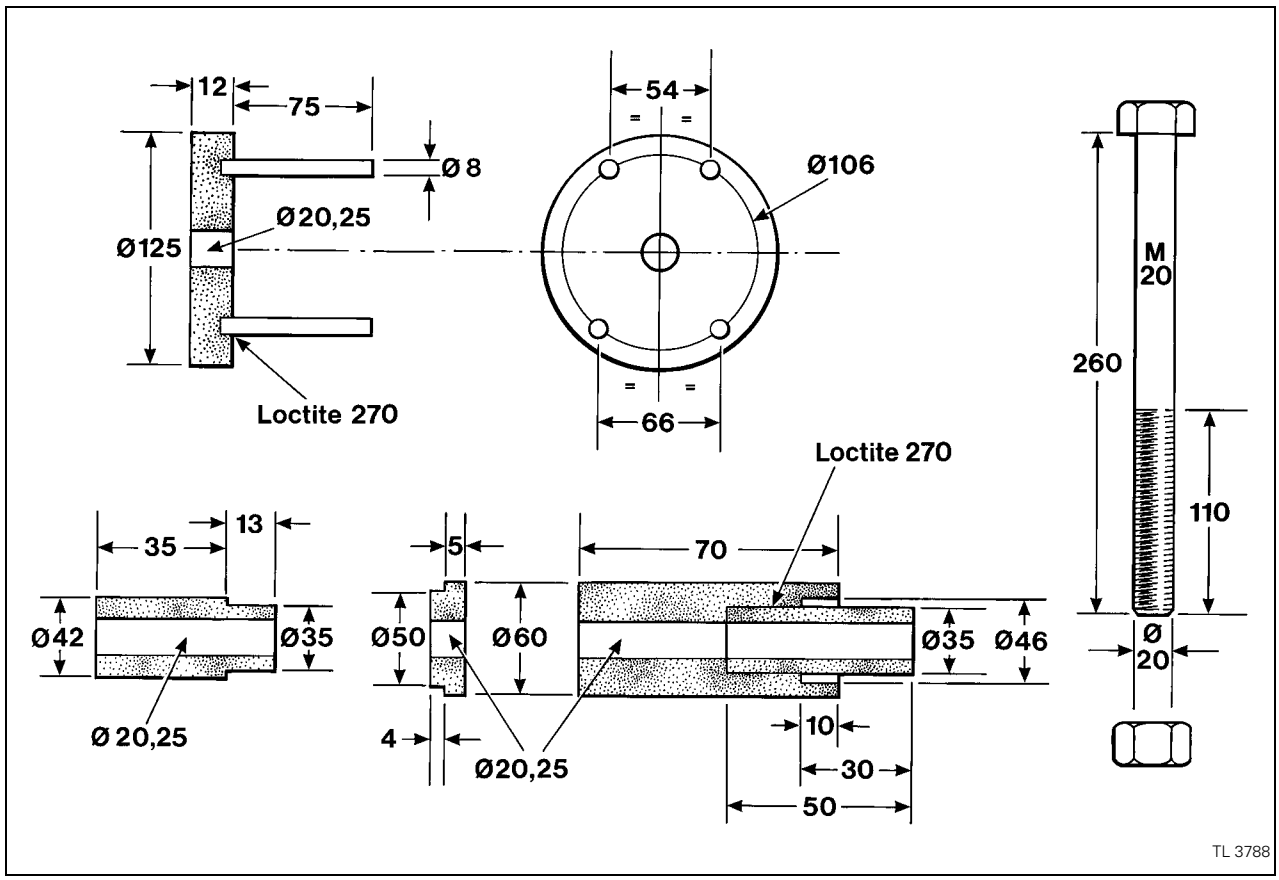
14. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
15. Re-engage the drive shaft and cover into the four-wheel drive gearbox.
16. Refit the main gear shift lever assembly, apply Massey Ferguson Studlock (Loctite 270) to the threads of the two M8 bolts and tighten to a torque of 30 Nm (22 lbf ft).
17. Re-install the engine/gearbox assembly into the tractor.

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Four-wheel Drive Gearbox





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GEARBOX

Overhaul **2-5H**

Special Tools:
MF.499 Drive Shaft Oil Seal Installer
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the four-wheel drive gearbox from the tractor, *(see operation 1-5H)*.

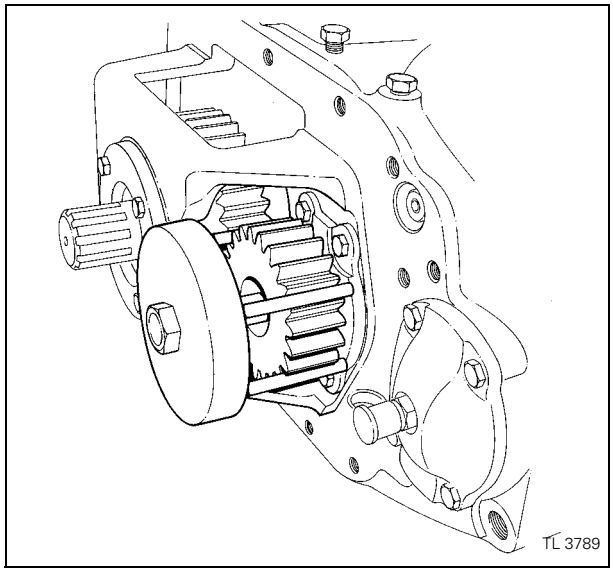
Intermediate Shaft

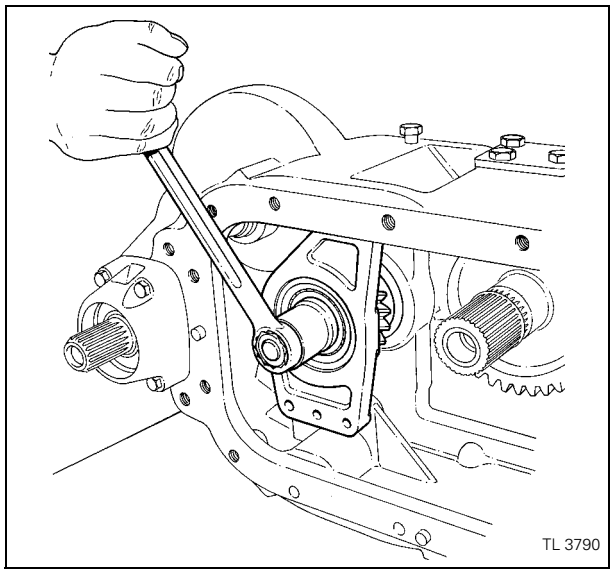
IMPORTANT: *The roller bearings fitted to this shaft are designed to take end thrust, they MUST NOT be removed or fitted using a hammer of any kind, you must use a puller. The drawing shows a simple puller which can be of local manufacture. Failure to carry out these simple instructions may result in a gearbox failure.*

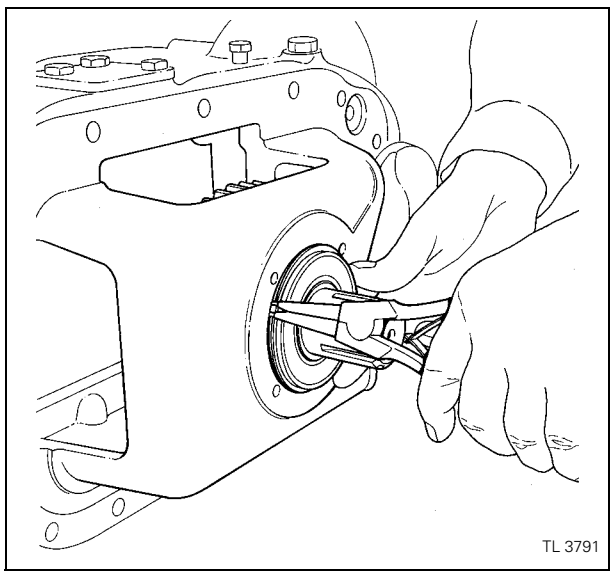
2. Remove the circlip and spacer.
3. Assemble your tool so that the legs of the plate straddle the gear and rest on the bearing retainer. This part of the tool prevents breakage of the retainer. Pass the bolt through the shaft from back to front with the large spacer behind the nut.
4. Fit the nut and tighten until the shaft is pulled through the front bearing and internal gear.
5. Remove the tool, gear and spacer.
6. Remove the three bolts and the bridge piece, it will be tight, it is dowelled to the housing.
7. Remove the bearing (if necessary) and spacer.
8. Remove the gear.
9. Remove the four bolts and the rear bearing retainer.
10. Remove the rear bearing, if necessary.
11. Remove the internal needle roller bearing, if necessary.

Main Shaft

12. Remove the thrust washer.
13. Remove the four bolts and the bearing retainer.
14. Pull the shaft rearwards to expose the snap ring, remove the snap ring around the bearing.
15. Remove the snap ring around the bearing.
16. Remove the shaft and bearing assembly forwards out of the housing, twisting it slightly so as to clear the centre casting.
17. Remove the bearing on a hydraulic press, if necessary.
18. Remove the internal needle roller bearing, if necessary.


TL 3789


TL 3790


TL 3791

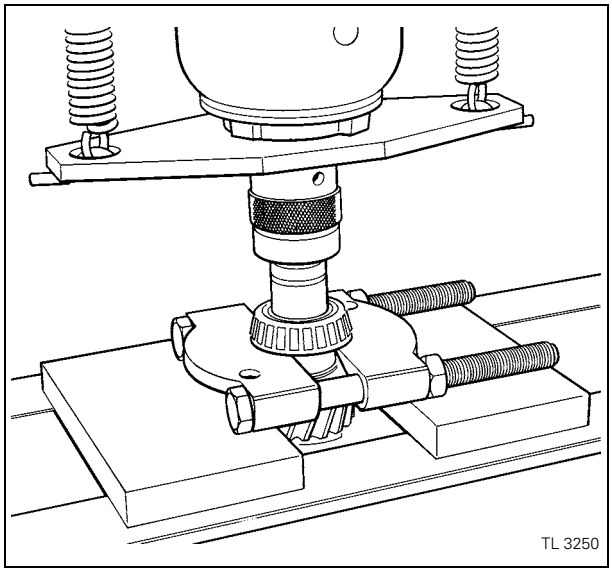
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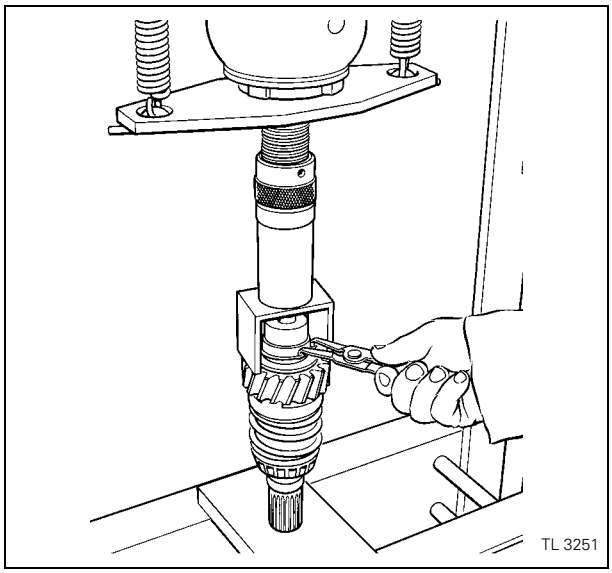
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Drive Shaft

NOTE: *Removal and Refitment of the Drive Shaft can be carried out without the removal of the gearbox.*

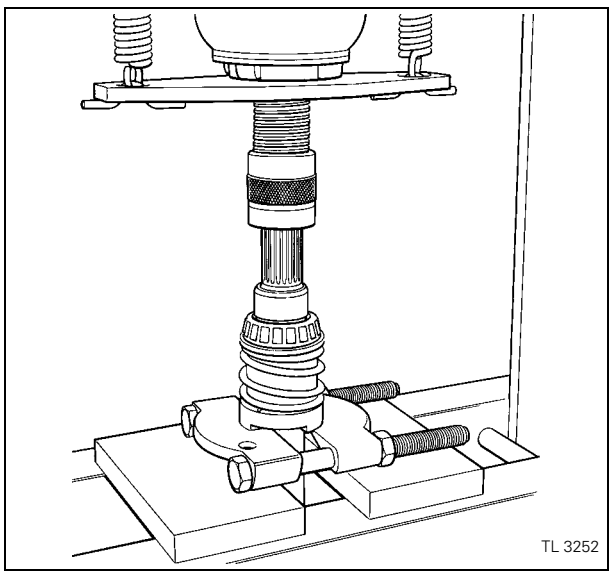
19. Remove the four bolts and the rear cover plate.
20. Remove and discard the 'O' ring.
21. Extract the taper roller bearing cup, if necessary.
22. Remove the four bolts and the front bearing housing.
23. Remove the bearing cup.
24. Remove and retain the shims for future use.
25. Press the oil seal out of the housing.
26. Remove the shaft assembly from the rear of the gearbox.
27. Remove the plug.
28. Withdraw the spring and push the plunger out.
29. Remove and discard the 'O' ring.
30. On a press remove the rear taper roller bearing cone.
31. Spring pressure is being applied to the gear and circlip preventing its removal. Make a bridge piece as shown in the illustrations to depress the gear so that the circlip can be removed.
32. Remove the gear and thrust washer.


TL 3250


TL 3251

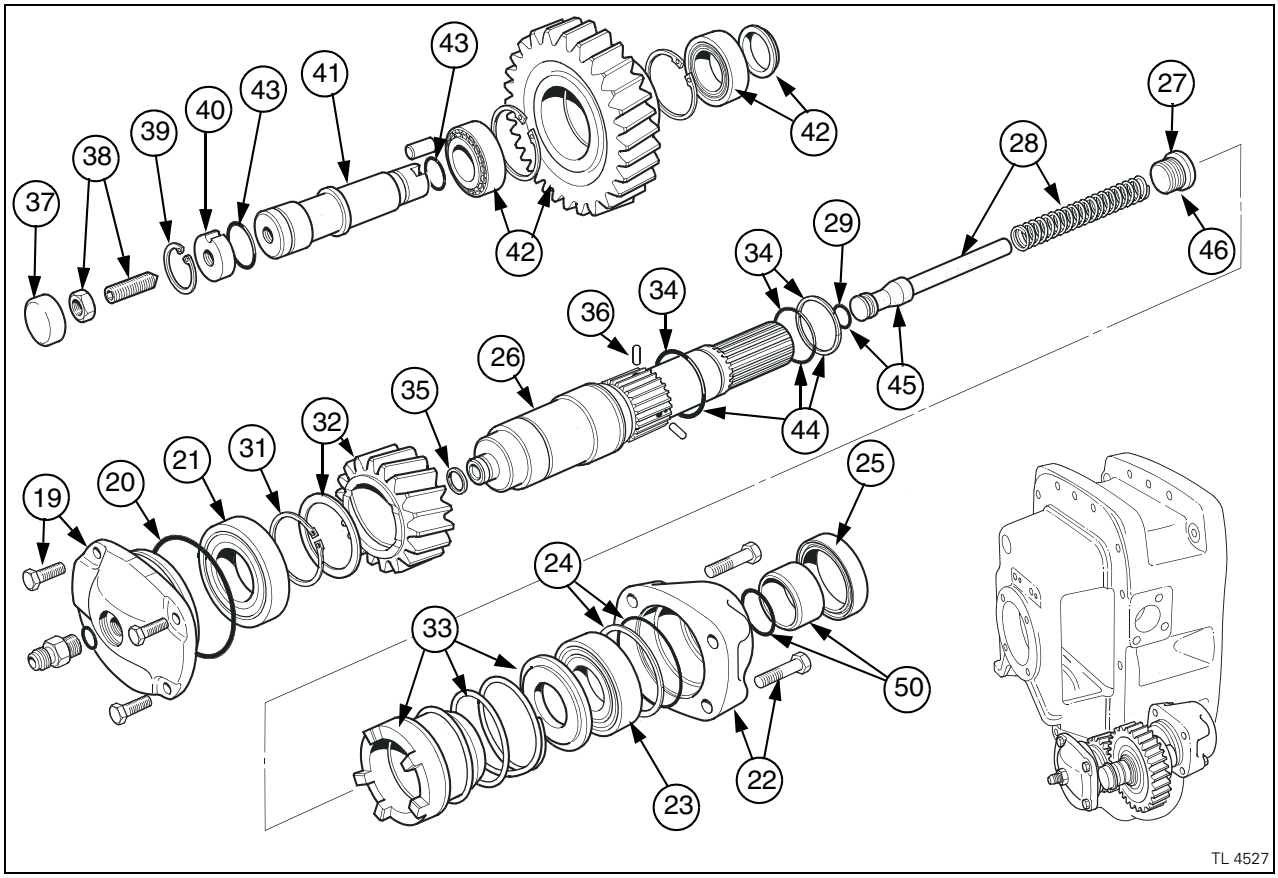
IMPORTANT: *The plunger must be removed prior to stage 33. Failure to do so will damage the drive shaft assembly beyond repair.*

33. Spring pressure is being applied to the clutch components on the shaft, **proceed with care**. Place the shaft assembly on a bearing separator plate under a hydraulic or hand press as shown in the illustration. Press the coupler, spring retainer, taper roller bearing and sleeve off the shaft.
34. Remove and discard the back-up ring and 'O' rings.
35. Remove and discard the rear seal ring.
36. Remove the locking pins.


TL 3252

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Idler Shaft

37. With the aid of a sharp instrument, pierce the core plug and lever out of the casing.
38. Slacken the locknut and hexagon socket screw.
39. Remove the internal circlip.
40. Remove the disc, screw and locknut assembly.
41. Screw a 12 mm bolt into the end of the idler shaft, place your hand inside the box to contain the parts and pull the shaft out of the casing.
42. Remove the gear assembly and its thrust washers, and dowel from the idler bore. Dismantle further if necessary.
43. Remove and discard the 'O' rings.

Examination

Thoroughly clean and carefully examine all the components, replace any that show signs of damage or wear. Replace all 'O' rings, seals and circlips. Ensure that all circlips are fitted correctly in their grooves.

Re-assembly

Drive Shaft

44. Re-assemble the drive shaft, by first fitting two new 'O' rings and the back-up ring to the centre of the shaft, lubricate the seals with oil. Ensure not to shear the back-up ring when fitting the coupler. The back-up ring is fitted to the front of the shaft.
45. Fit a new 'O' ring to the plunger and push the plunger into the shaft.
46. Fit the plug into the end of the shaft and push the plunger back until it contacts the plug.
47. Insert the three locking pins.

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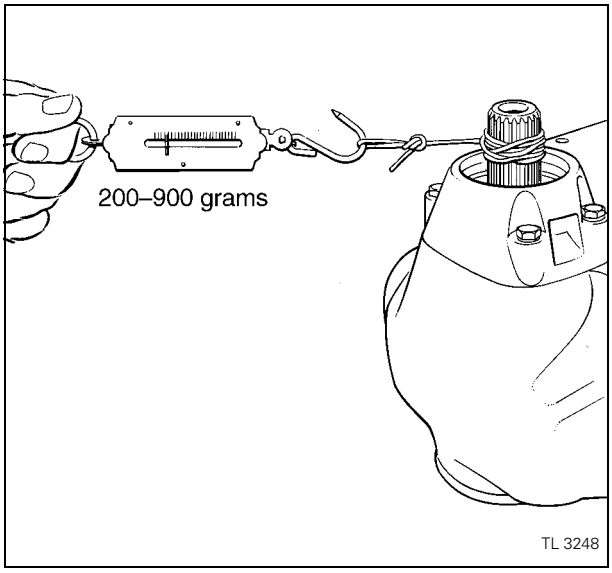
48. Fit the coupler, spring, and spring retainer.
49. Under a hydraulic press, press the front bearing cone into position.
50. Fit a new 'O' ring to the front of the shaft and press the oil seal sleeve into position.
51. Fit the free running gear and thrust washer. The gear will need pressing down to install the circlip.
52. Remove the plug from the shaft, and refit the spring and the plug.
53. Install the rear bearing cone.
54. Assemble the shaft in the gearbox casing, fit the rear cover plate without the 'O' ring and tighten the bolts to a torque of 30 Nm (22 lbf ft).
55. Place the shims removed behind the bearing cup of the front housing and install the housing without the 'O' ring and seal.
56. Tighten the bolts to a torque of 30 Nm (22 lbf ft) and lightly tap the end of the shaft with a copper faced hammer to ensure that the bearings are seated correctly.

Drive Shaft Pre-Load

57. The correct bearing pre-load is 0,07 mm (0.003 in), this is obtained by adjusting the shim pack thickness between the bearing cup and the front bearing housing. Shims are available in the sizes listed in the table opposite.
58. Put some turns of string around the shaft and attach the end to a spring balance. Pull the spring balance and note the reading when the shaft is turning, this should be 200-900 grams (7-32 oz).
59. If the reading is incorrect adjust the thickness of the shim pack behind the front bearing cup accordingly.
60. Remove the drive shaft assembly from the gearbox and put to one side.

Idler Shaft

61. Re-assemble the idler gear assembly with the two taper roller bearings.
62. Fit new 'O' rings to the shaft.
63. Hold the gear assembly and the thrust washers up in place inside the gearbox.
64. Lubricate the shaft and 'O' rings with oil and push the shaft into the casing and through the gear assembly. A 12 mm bolt screwed into the end of the shaft will help with the installation.
65. Ensure that the shaft is fully home. Rotate the shaft to enable a loose fitting slave pin to be inserted in the dowel hole which will prevent the shaft from rotating.
66. Remove the 12 mm bolt.
67. Assemble the disc with the hexagon screw and lock nut.



Drive shaft shims		
Part number	Metric	Imperial
3801 392 M1	1,00 mm	0.039 in
3801 393 M1	1.05 mm	0.041 in
3801 394 M1	1,10 mm	0.043 in
3801 395 M1	1,15 mm	0.045 in
3801 396 M1	1,20 mm	0.047 in
3801 397 M1	1,25 mm	0.049 in
3801 398 M1	1,30 mm	0.051 in
3801 399 M1	1,35 mm	0.053 in
3801 400 M1	1,40 mm	0.055 in
3801 401 M1	1,45 mm	0.057 in
3801 402 M1	1,50 mm	0.059 in
3801 403 M1	1,55 mm	0.061 in
3800 277 M1	1,60 mm	0.063 in
3800 278 M1	1,65 mm	0.065 in

68. Install the disc assembly and fit the circlip. At the other end withdraw the slave and install the dowel until flush with the gearbox face.

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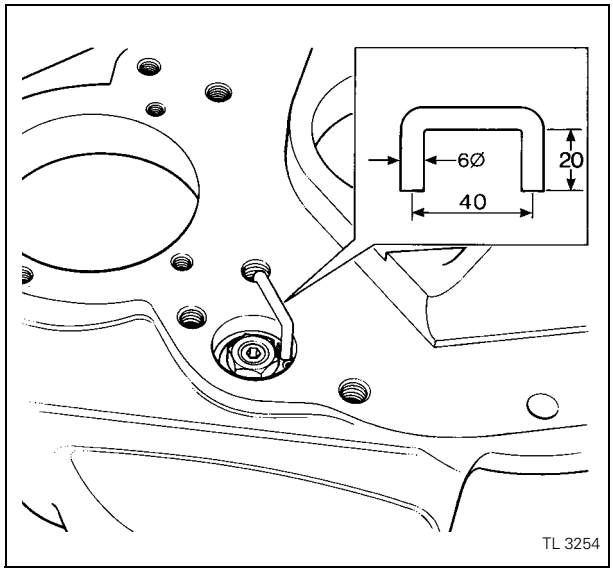
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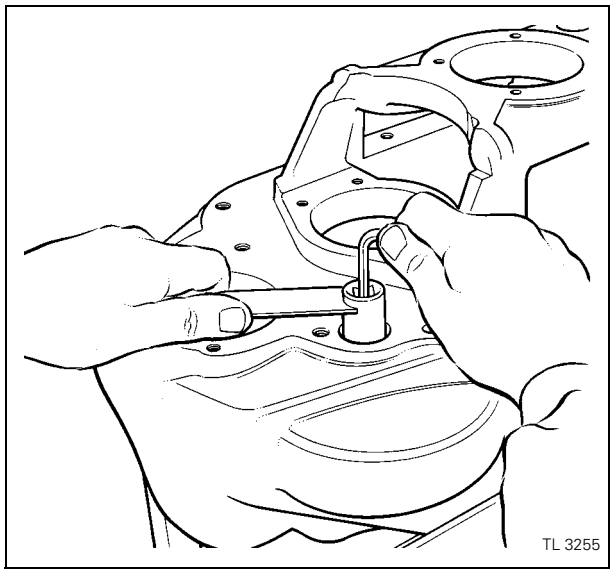
Idler Shaft Pre-Load

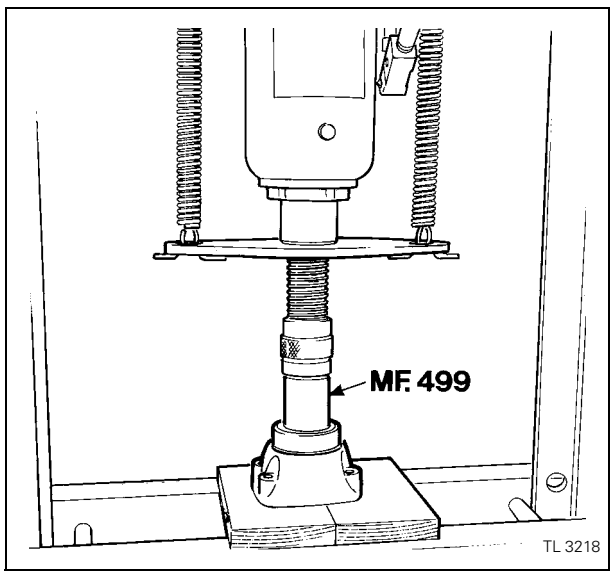
69. Make-up a small tool as shown in the illustration to prevent the disc from rotating during adjustment.
70. The correct pre-load is obtained by tightening up the hexagon screw and then locking in position with the locknut.
71. Fully tighten the hexagon screw until the gear is locked, this will ensure that the bearings are fully seated, then slacken off the screw.
72. Adjustment of the pre-load can be assisted by making a special wrench. Weld a handle to a 17mm across flats socket as shown in the illustration. This allows the hexagon wrench to hold the screw when tightening the locknut.
73. The correct pre-load for the idler shaft bearings is 0-0,05 mm. Tighten the screw carefully and slowly, rotating the gear. The pre-load should be correct when a slight resistance is felt when rotating the gear. To check that the pre-load is correct, repeat procedures 71 to 75. The reading should be 1200-2000 gm greater than with only the output shaft installed.
74. Apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the locknut. Hold the screw with a hexagon wrench and tighten the locknut with the special wrench to a torque of 18 Nm (13 lbf ft). Re-check the pre-load, re-adjust if not correct.
75. Remove the holding tool.
76. Fit a new core plug to the casing so that it is > 0,25 mm (0.010 in) below the machined face of the casing.

Drive Shaft

77. Using special tool MF.499, Drive Shaft Oil Seal Installer, fit a new seal, with the lip facing inwards, to the front bearing housing. The seal should be positioned 7 mm (1/4 in) below the internal recessed face, *(see page 5D-25)*. The tool ensures that the seal is correctly positioned. Lubricate the seal with petroleum jelly.
78. Install a new seal on the rear of the drive shaft assembly, lubricate with oil.
79. Fit new 'O' rings to the front bearing housing and rear cover.
80. Reinstall the drive shaft assembly and refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).
81. Refit the bearing cap with the selected spacer ring, apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).







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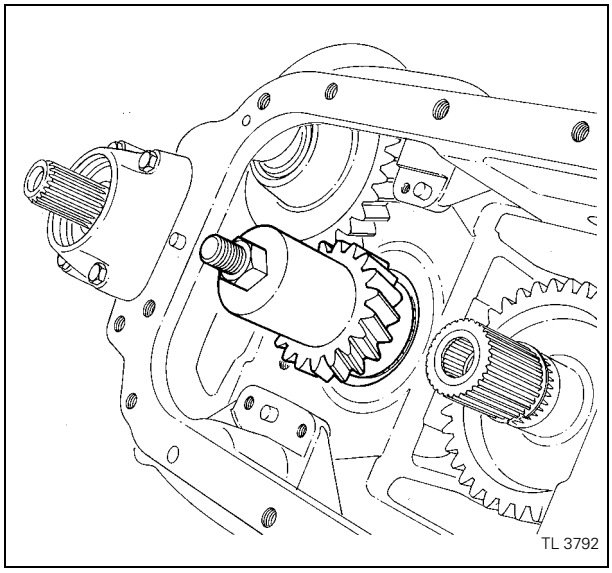
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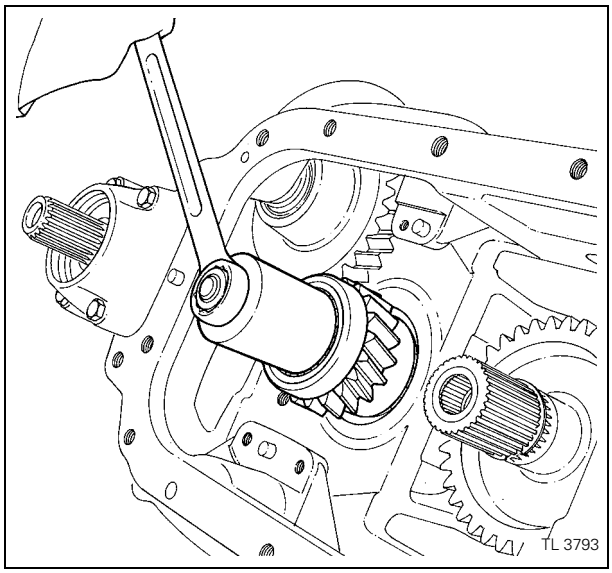
Main Shaft.

82. Reverse procedures 12 to 18 except:
    a. Install the internal needle roller bearing so it is flush with the end of the shaft, if removed.
    b. Apply Massey Ferguson Studlock (Loctite 270) to the bearing retainer bolts and tighten to a torque of 30 Nm (22 lbf ft).

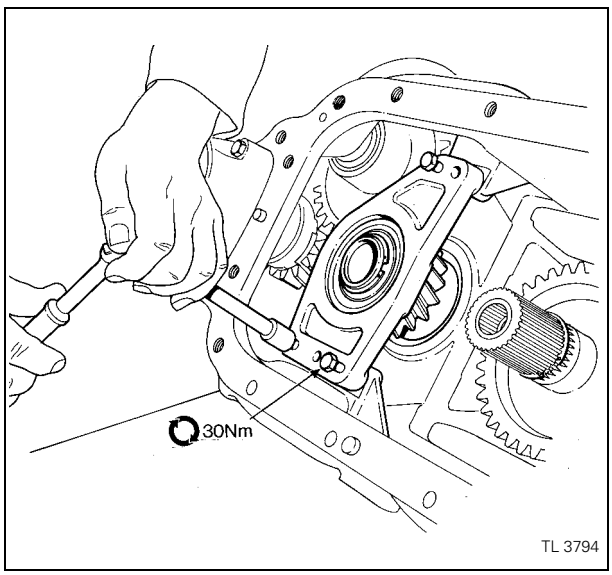
Intermediate Shaft

83. Install the internal needle roller bearing to the shoulder if it has been removed.
84. Install the rear roller bearing, the recess in the bearing faces to the rear to accommodate the spacer.
85. Fit the bearing retainer and apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).
86. Fit the bearing spacer to the shaft, the inner chamfered edge faces the gear,
87. Install the gear through the bearing and inner gear.
88. Assemble the tool and pull the shaft approximately 3 mm (1/8 in) into the rear bearing.
89. Remove the end of the tool and place the other bearing spacer on the shaft, the inner chamfered edge faces the gear,
90. Fit the front roller bearing, the recessed end facing the spacer.
91. Reassemble the tool and pull the assembly up tight.
92. Remove the tool and replace the spacer and circlip.





93. Fit the bridge piece and apply Massey Ferguson Studlock (Loctite 270) to the bolts and tighten to a torque of 30 Nm (22 lbf ft).
94. Check the gearbox for free running and reinstall on the tractor.



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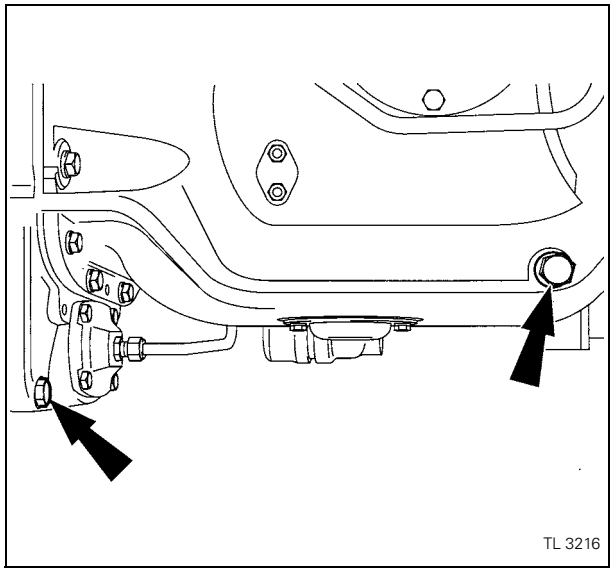
DRIVE SHAFT OIL SEAL

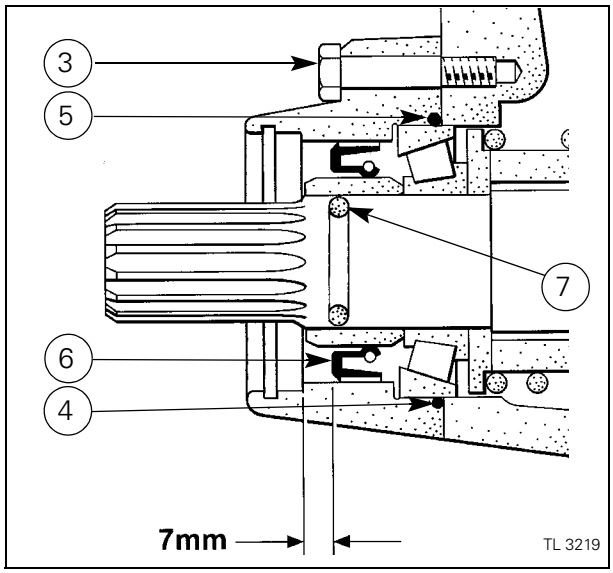
Removal and Refitment **3-5H**

Special Tools:
MF.499 Drive Shaft Oil Seal Installer

Removal

1. Drain the oil from the transmission using the drain plug on the rear axle and four-wheel drive gearbox.
2. Remove the drive shaft assembly, *(see operation 1-5E)*.
3. Remove the four bolts and the front bearing housing.
4. Remove the front bearing housing.
5. Remove and discard the 'O' ring.
6. Remove and discard the oil seal.
7. Slide the oil seal sleeve off the shaft and replace the 'O' ring.



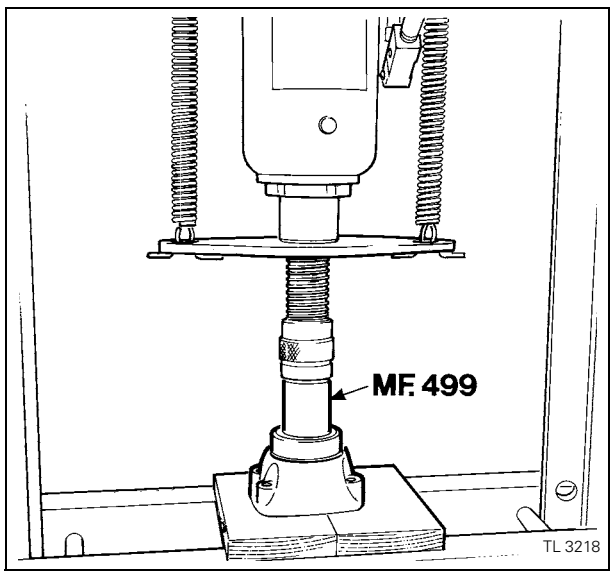


Refitment

8. Depending on the equipment available, using special tool MF.499 Drive Shaft Oil Seal Installer, place the housing under a press and press the seal into position with the lip of the seal facing inwards. The tool will position the seal correctly.

or:

See next page



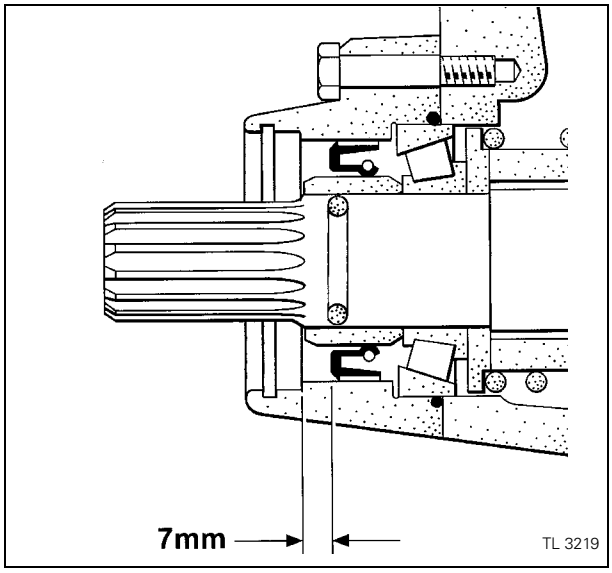
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Four-wheel Drive Gearbox

If the tool is not available, set the seal 7 mm (0.076 in) below the recess in the cover, *(see illustration opposite).*

9. Refit the housing to the gearbox with a new 'O' ring and apply 2-3 drops of Massey Ferguson Studlock (Loctite 270) to the housing bolts prior to tightening to a torque of 30 Nm (22 lbf ft).
10. Position the seal in the housing, using the special tool, drive the seal into position. The tool will ensure that the seal is pressed in square and to the correct depth.
11. Refit the drive shaft assembly.
12. Refill the transmission with the correct grade of oil.



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Power Shuttle Gearbox

(12 and 24 Speed)
Section 5 - Part J

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Power Shuttle Gearbox

SPECIFICATION

Model	12 or 24 speed Power shuttle gearbox.
Number of gears forward	12 or 24.
Number of gears reverse	12 or 24.
Power Shuttle:	
Control	Electronic control with microproessor.
Operation	Hydraulic engaged clutch packs, forward and reverse.
Type	Multi-plate, oil cooled
Size	190 mm (7.486 in).
No. friction plates (each clutch)	5.
No. steel plates (each clutch)	4.
Retainer ring torque	150 Nm (110 lbf ft).
Clearance between forward and reverse clutches	1,5 mm (0.060 in).
Cooling oil pressure	4,5 bar (65 lbf/in²).
Cooling oil pressure switch	2 - 4 bar (29 - 58 lbf/in²).
24 Speed (Fast/Slow speed):	
Control	Switch and electrically controlled solenoid valve.
Operation	Hydraulic operated clutch pack into Slow, spring return to Fast.
Type	Multi-plate clutch.
Size	176 mm (6.93 in).
No. friction plates (each clutch)	4.
No. steel plates (each clutch)	5.
Clutch pack clearance	0,30-0,45 mm (0.012-0.018 in).
Type of adjustment	Variable thickness thrust washer.
Clutch pack operating pressure (at 1200 engine rev/min)	22-24 bar (319-348 lbf/in²).
Main section:	
Synchromesh type	Strut type.
Synchromesh neutral setting	See procedure 12-5J.
Mainshaft end float	0,08-0,03 mm (0.003-0.012 in).
Type of adjustment	Variable thickness thrust washer.
Selector fork setting tolerance	0,25 mm (0.010 in).
Synchromesh ring to coupler clearance - installed	0,8 mm (0.030 in).
Synchromesh ring to coupler clearance - removed	0,5 mm (0.020 in).

Special Tools:

MF.367B	Transmission torque wrench.
MF.414	Selector setting pin.
MF.513	Input seal installer.
MF.515	Clutch plate retaining wedges.
MF.516	Clutch pack wrench.
MF.517	Spring support remover/replacer.
MF.518	Diagnostic lead.
MS.550	Universal handle.
MF.3008	Circlip plier set.
MF.3021	Diagnostic software.
MF.3025	Filter Kit.
MF.3026	Seal installer kit.

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Bolt Torques:

Inner housing to gearbox casing bolts	24 Nm (18 lbf ft).
PTO bearing cover bolts	24 Nm (18 lbf ft).
Power Shuttle cover bolts	24 Nm (18 lbf ft).
PTO shaft hexagon socket cap screw	84 Nm (62 lbf ft).
Input shaft housing to gearbox - bolts	55 Nm (40 lbf ft).
Input housing to gearbox - Hexagon socket capscrew	65 Nm (50 lbf ft).
Reverse idler counter sunk screw	55 Nm (40 lbf ft).
Scavenge pump housing bolts	44 Nm (33 lbf ft).
Gear lever 12 point cap screws	60 Nm (45 lbf ft).
Gearbox top cover	115 Nm (85 lbf ft).
Shifter fork locking screws	44 Nm (33 lbf ft).
Rear gear shift selector bracket bolt	58 Nm (43 lbf ft).
Rear gear shift selector bracket nut	30 Nm (22 lbf ft).
Gearbox to range gearbox bolts	102 Nm (75 lbf ft).
Cooling oil banjo bolt	25 Nm (18 lbf ft).
Solenoid cartridge	18 Nm (13 lbf ft).
Solenoid coil	7 Nm (5 lbf ft).

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Power Shuttle Gearbox

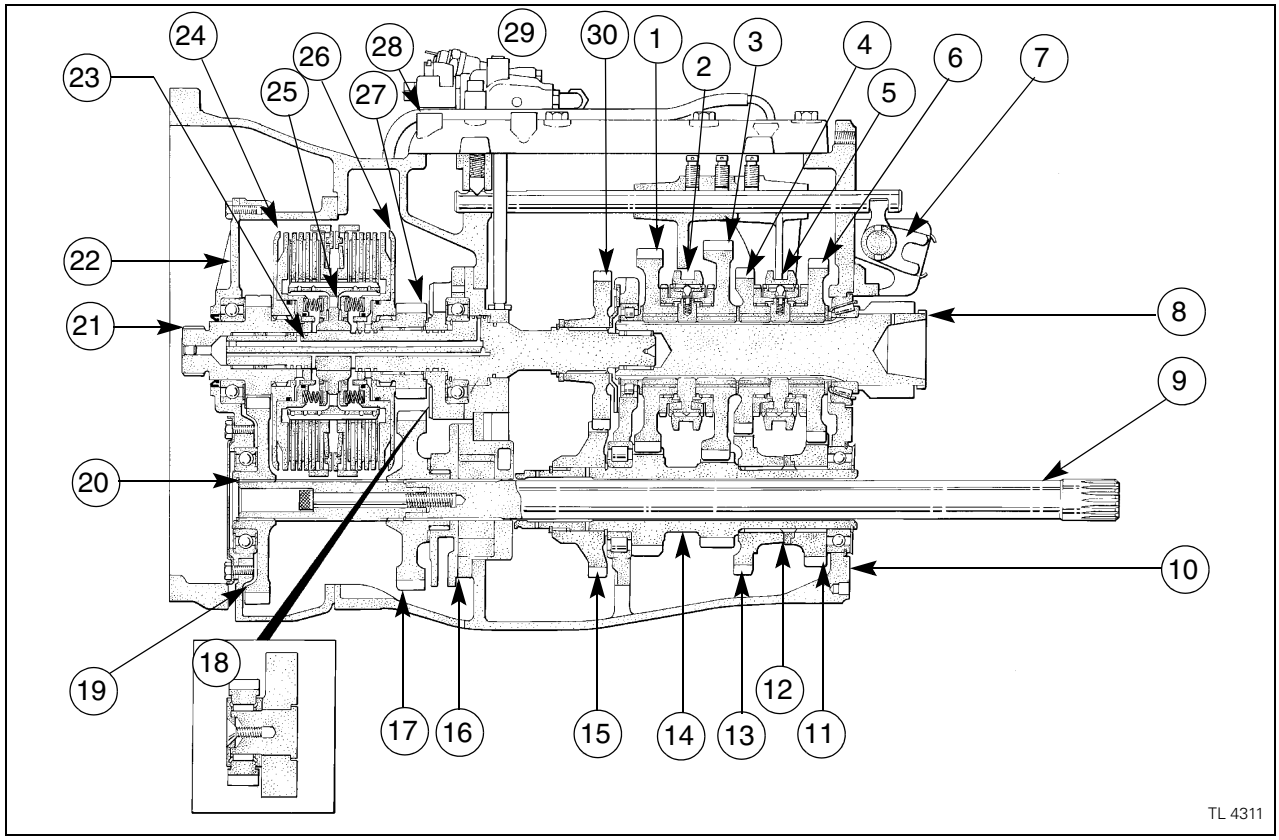


Fig.1 General Arrangement – 12 speed Power Shuttle Gearbox

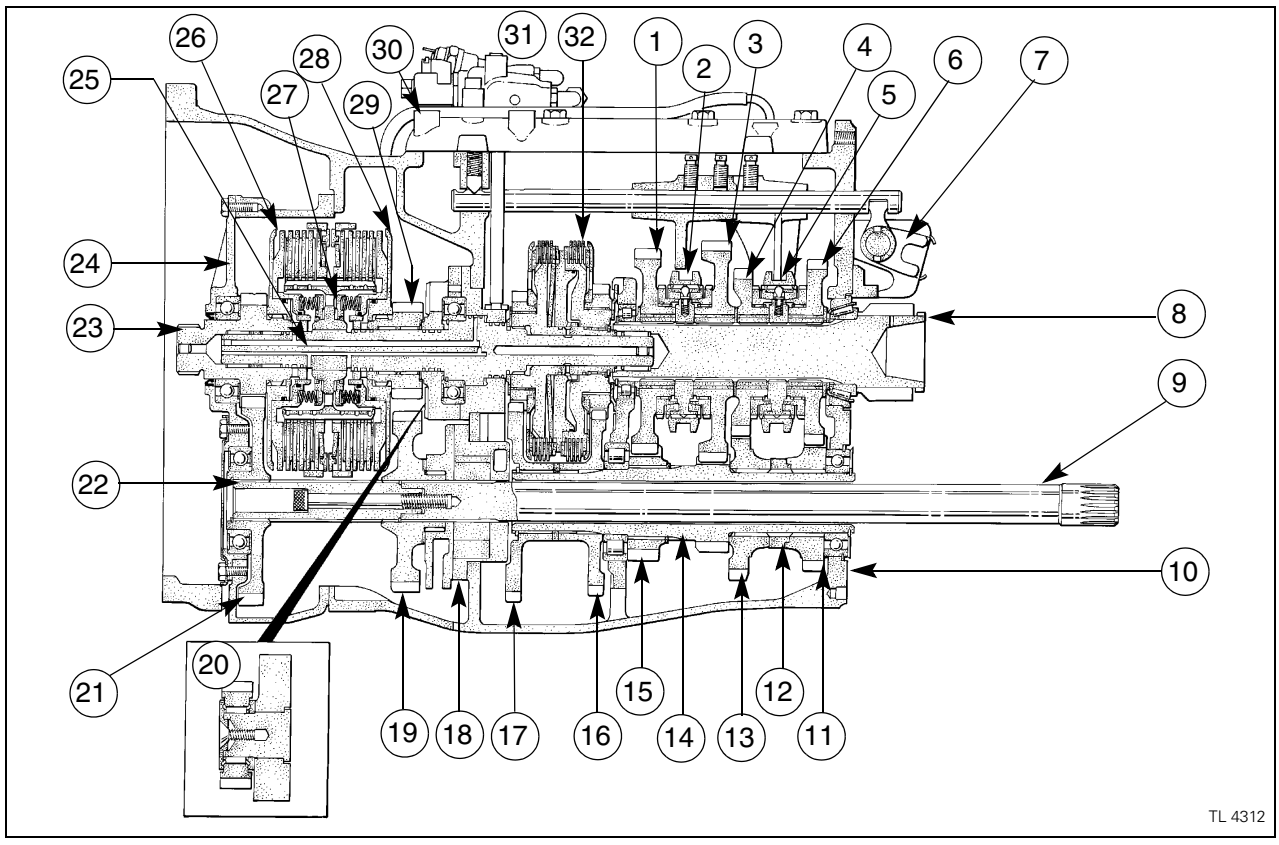


Fig.2 General Arrangement – 24 speed Power Shuttle Gearbox

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Key to numbering - Fig.1.

1. 2nd gear.
2. 1st/2nd synchromesh coupler.
3. 1st gear.
4. 4th gear.
5. 3rd/4th synchromesh coupler
6. 3rd gear.
7. Selector mechanism.
8. Mainshaft.
9. PTO drive shaft.
10. Gearbox case.
11. 3rd gear.
12. Spacer.
13. 4th gear.
14. Layshaft.
15. Constant mesh gear - layshaft.
16. Scavenge pump.
17. Reverse constant mesh gear.
18. Reverse idler gear.
19. PTO constant mesh gear.
20. PTO shaft extension.
21. Input pinion.
22. Cover.
23. Input shaft.
24. Forward clutch pack.
25. Hub.
26. Reverse clutch pack.
27. Reverse constant mesh gear.
28. Gearbox top cover.
29. Valve block.
30. Constant mesh gear - mainshaft.

Key to numbering - Fig.2.

1. 2nd gear.
2. 1st/2nd synchromesh coupler.
3. 1st gear.
4. 4th gear.
5. 3rd/4th synchromesh coupler
6. 3rd gear.
7. Selector mechanism.
8. Mainshaft.
9. PTO drive shaft.
10. Gearbox case.
11. 3rd gear.
12. Spacer.
13. 4th gear.
14. Layshaft.
15. 2nd gear.
16. Fast speed - layshaft gear.
17. Slow speed - layshaft gear.
18. Scavenge pump.
19. Reverse constant mesh gear.
20. Reverse idler gear.
21. PTO constant mesh gear.
22. PTO shaft extension.
23. Input pinion.
24. Cover.
25. Input shaft.
26. Forward clutch pack.
27. Hub.
28. Reverse clutch pack.
29. Reverse constant mesh gear.
30. Gearbox top cover.
31. Valve block
32. Speedshift clutch pack.

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Power Shuttle Gearbox

GENERAL DESCRIPTION

The Power Shuttle gearbox comes in two versions, 12 x 12 (Fig.1) or 24 x 24 (Fig.2) speeds, forward and reverse. The forward and reverse is controlled by two hydraulic clutch packs, one gives forward speed, the other reverse. The hydraulic pressure for the clutches is controlled by a pilot operated proportional solenoid valves which are controlled by a microprocessor. The microprocessor is programmed to ensure smooth engagement for pulling away or changing direction, without requiring skill from the driver. The 24 speed box is basically a 12 speed box with the addition of a hydraulic controlled clutch pack which gives two speeds for each gear, doubling up the 12 to 24 speed.

Controls

Power Shuttle Lever

The shift lever is exactly the same as used in a mechanical system; for example, the 12 x 12 shuttle, except it operates a 3-position switch with a central neutral position (Forward-Neutral-Reverse). This provides an input signal to the microprocessor.

The shuttle lever incorporates mechanical safety features to avoid accidental operation:

- There is a fixed guard around the lever to prevent accidental movement.
- The lever moves in a 'T' shaped gate so that it must be lifted up out of the 'Neutral' slot before it can be moved into either 'Forward' or 'Reverse'.
- The engine can be started when the shuttle lever is in any position, (the main gear lever must be in neutral to allow the engine to start). The tractor will not move unless the lever is shifted to neutral and the direction selected; alternatively, pressing the clutch pedal down will engage the direction of travel the lever is in.

Two Speed Range Fast/Slow

The two speed range, fast/slow on 24 speed, is controlled by push-buttons, one on the gear lever, the other on the right-hand side panel. This clutch is identical to the 18 x 6 Speedshift clutch both in construction and control.

Clutch Pedal

The clutch pedal looks the same as a conventional clutch pedal and its function is the same. There is no direct mechanical actuation of the clutches, the position of the clutch pedal provides an input signal to the microprocessor which will control the engagement of the selected clutch. An additional switch is fitted, when the pedal is pressed fully down (in the case of an emergency) the Power Shuttle is immediately placed in neutral.

Comfort Control

A small rotateable knob is located close to the Shuttle Lever, this allows the driver to choose the rate of engagement of the clutches according to the operating conditions (aggressive for loader work, more gentle for transport). The comfort control is another component which provides a signal into the microprocessor.

The microprocessor also knows which range gear is selected (L, M or H), it modulates the engagement of the clutches accordingly.

Microprocessor

The microprocessor controls the engagement of the Forward and Reverse clutches according o a pre-set logic, and the following input signals from the drivers controls.

- The rate of engagement is modulated according to the operating conditions, so that the engagement is always smooth and predictable. The clutch is engaged quickly during a uni-directional gear change, but much more slowly when pulling away in Forward or Reverse. It is also engaged more quickly in the 'Low' and 'Medium' ranges than in 'High'.
- The change between Forward and Reverse is inhibited if the tractors speed is too high, 17 km/hour (10.4 mile/hr) in High range. This avoids damage due to accidental or careless operation. If the shuttle lever is moved at too high a speed, the transmission will be shifted into 'Neutral' by the microprocessor.

However, if the driver needs to change direction at high speed (perhaps in an emergency situation), the change can be forced by pressing and then releasing the clutch pedal. The violence of the change can be controlled by the pedal as with any standard gearbox.

- Direct operation of the clutch by the driver (via the clutch pedal) is possible at any time. The forward/reverse clutches are still controlled by the microprocessor, but follows the position of the clutch pedal rather than the pre-set logic. The 'feel' of the clutch pedal closely approximates to the feel of a conventional clutch.
- The operation of the whole system is continuously monitored, so the driver can be warned of any malfunction before damage occurs. A warning light on the instrument panel will flash if there is any problem. A diagnostic light installed in the fuse area flashes with a code and the pattern of the flashes indicates the nature of the malfunction.

Drive Arrangement

From a constructional view point, the gearbox has four sections. The front section contains the forward and reverse clutch packs, reverse gears, PTO drive gears and cooling oil scavenge pump.

The second section on 12 speed gear boxes contains a set of constant mesh gears driving the layshaft in the third section. On the 24 speed gearbox it contains the fast/slow range clutch pack which is in place of a set of constant gears driving the lay shaft. The third section contains the constant mesh gear sets with synchromesh giving four basic forward speeds. The last section is the range gearbox giving a low range, medium range and high range. Synchromesh engagement is provided on all gears.

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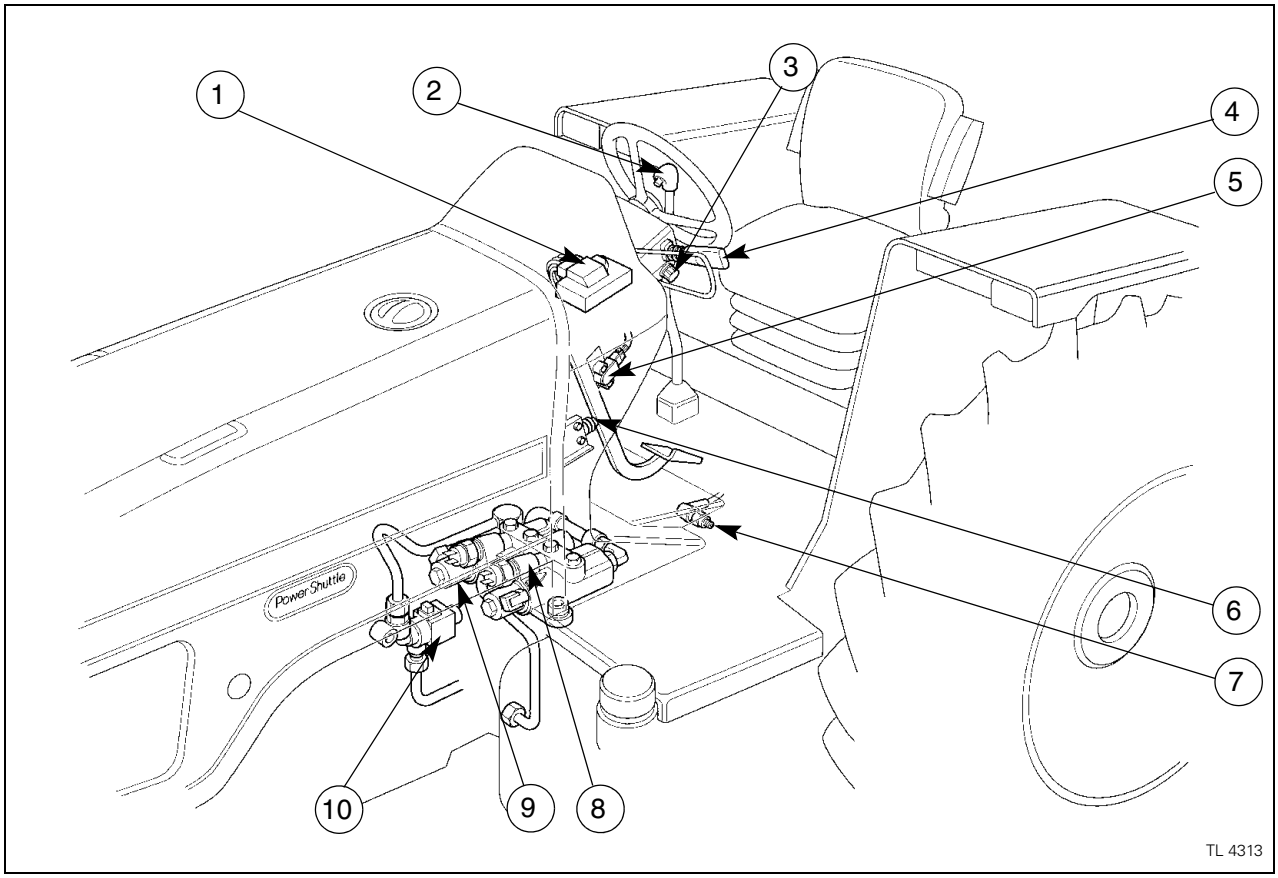


Fig.3 Hydraulic and Electrical Components

Key to numbering - Fig.3.

1. Microprocessor.
2. Speedshift switch.
3. Comfort control.
4. Forward/reverse switch.
5. Clutch pedal sensor.
6. Safety switch.
7. Cooling flow pressure switch.
8. Forward/reverse pressure switches.
9. Forward/reverse solenoid valves.
10. Cooling flow solenoid valve.

Forward/Reverse

The front section contains the forward/reverse clutch packs, these are mounted on the input shaft of the gearbox. The forward clutch pack housing is driven from the engine flywheel through a flexible coupling, when engaged it drives the input shaft and the rest of the gearbox.

In front of the forward clutch pack a set of gears drive the lower PTO shaft, this drive is also used for reverse gear, it drives the housing of the reverse clutch pack through an idler gear mounted on the input housing. When the reverse clutch pack is energised the reverse drive is taken from the PTO shaft, through the clutch to the input shaft.

The two clutch packs are supplied with oil from a control valve on top of the gearbox top cover. The oil is fed down pipes into the input shaft housing, along drillings in the shaft to the clutch packs. When the clutches are engaged, cooling oil is fed through the plates. This oil is collected in the bottom of the gear case and returned to the main section of the gearbox by the scavenge pump which is located on the PTO shaft.

The cooling oil flow is controlled by a solenoid valve on the right-hand side of the bell housing. This shuts off the oil supply when the clutch packs are disengaged to prevent clutch drag during engagement.

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Power Shuttle Gearbox

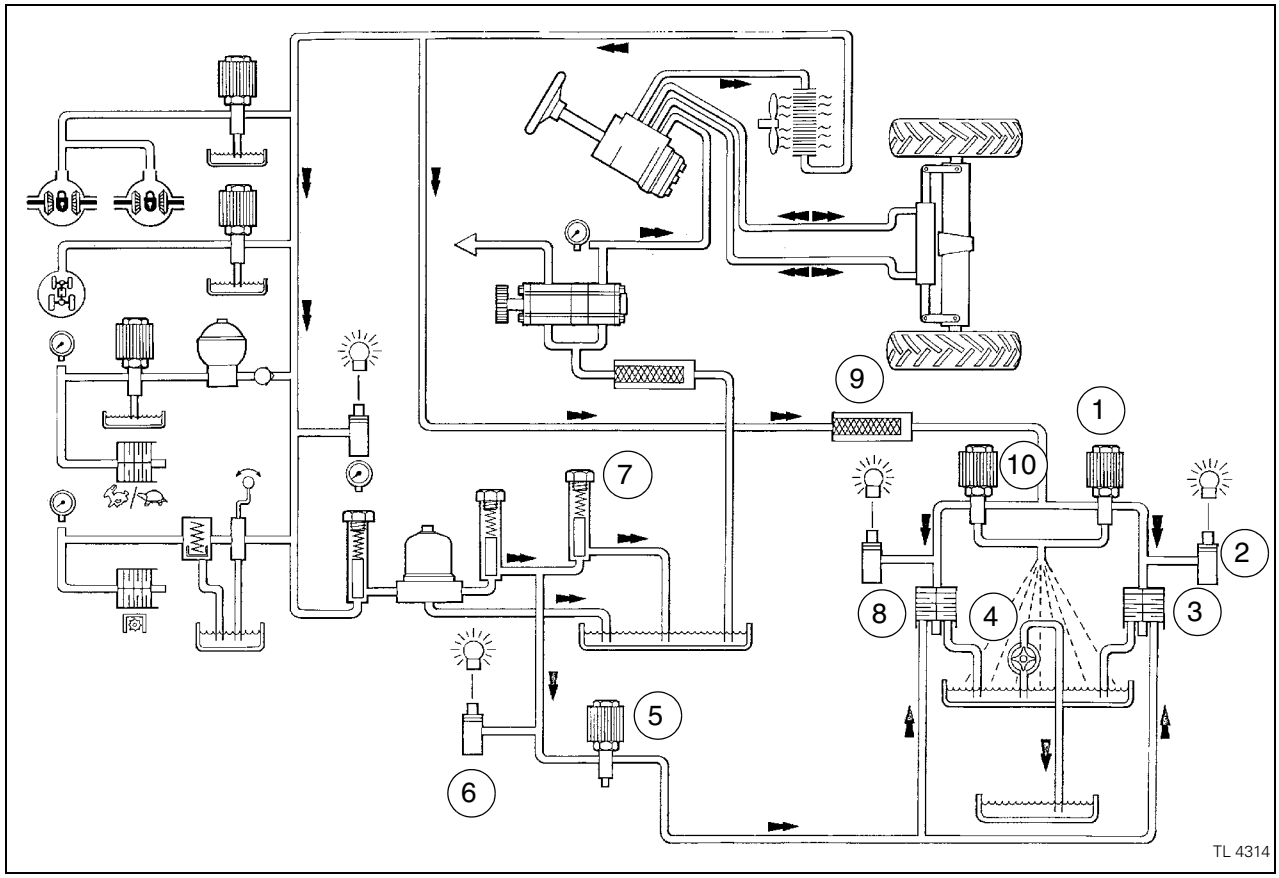


Fig.4 Hydraulic Circuit

Key to numbering - Fig.4.

1. Forward solenoid valve.
2. Forward clutch pack pressure switch.
3. Forward clutch pack.
4. Scavenge pump.
5. Cooling oil solenoid valve.
6. Cooling oil pressure switch.
7. 4,5 bar pressure maintaining valve.
8. Reverse clutch pack.
9. 150 micron filter.
10. Reverse solenoid valve.

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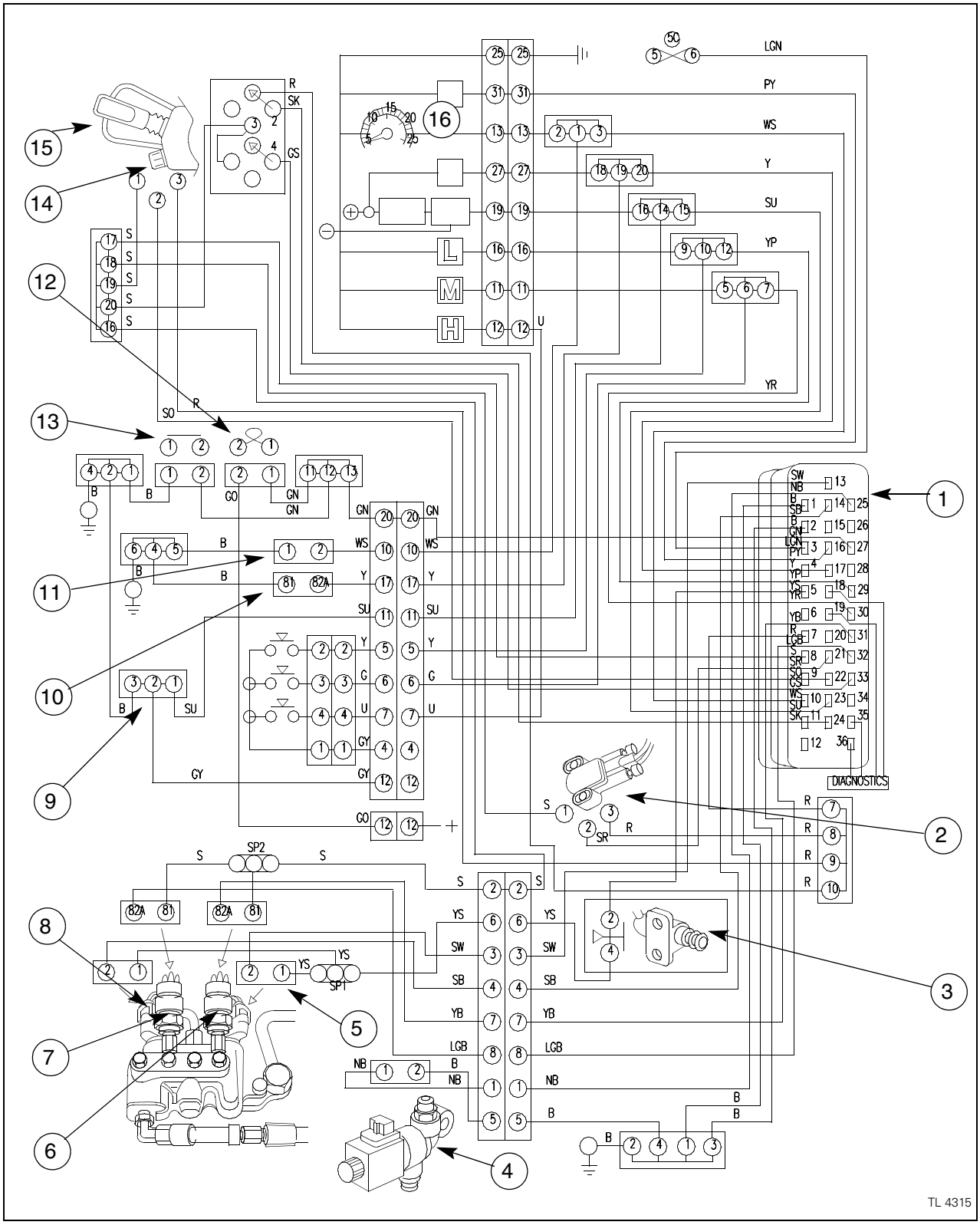


Fig.5 Electrical Wiring diagrams – cab tractors

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Power Shuttle Gearbox

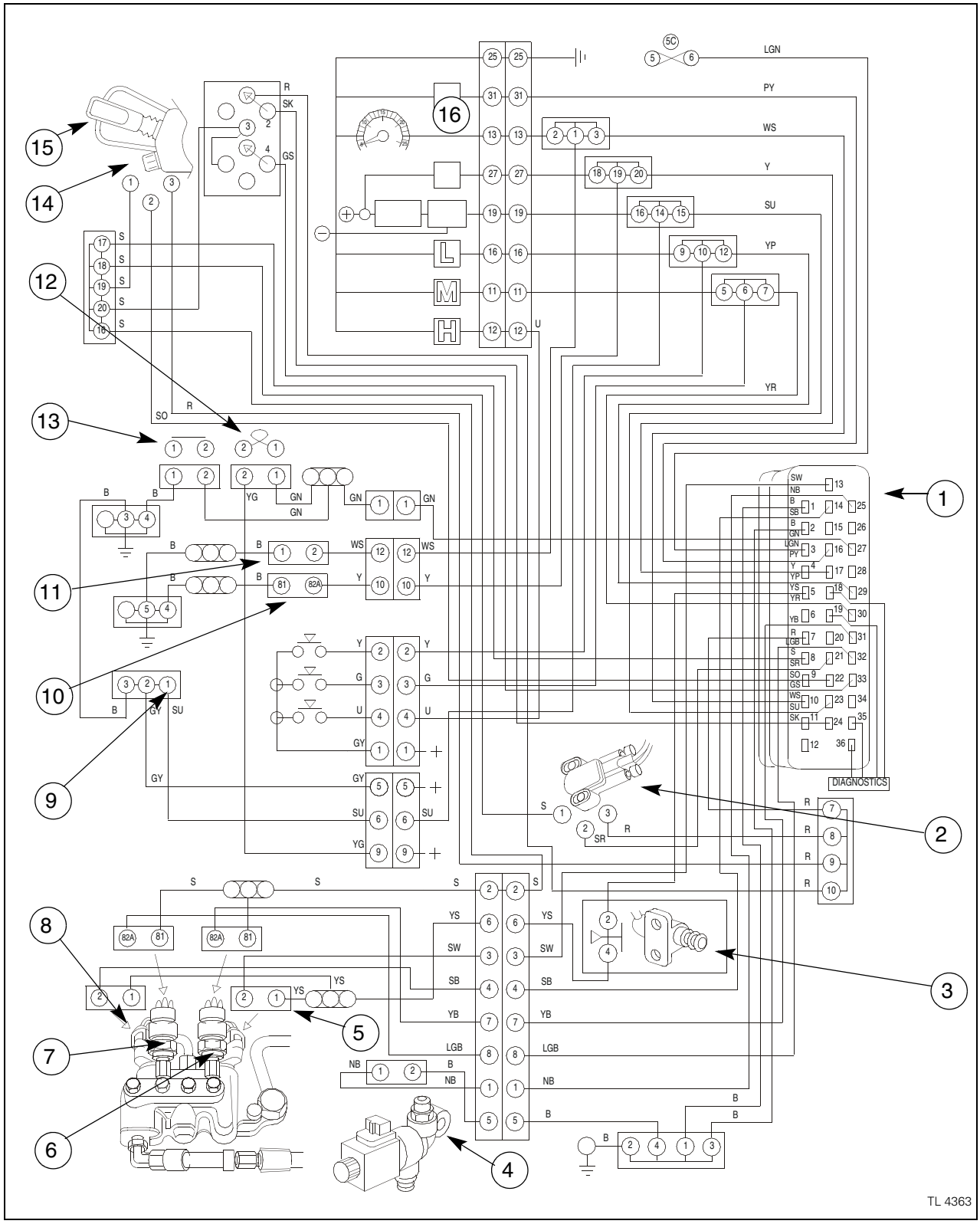


Fig.6 Electrical Wiring diagram – footstep tractors

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Key to numbering - Fig.5.

1. Connector to microprocessor.
2. Clutch position sensor.
3. Clutch safety switch.
4. Cooling flow solenoid valve.
5. Forward solenoid valve.
6. Forward pressure switch.
7. Reverse pressure switch.
8. Reverse solenoid valve.
9. Ground speed sensor.
10. Cooling flow pressure switch.
11. Engine speed sensor.
12. Reverse light (option).
13. Reverse light switch.
14. Comfort control.
15. Forward/reverse switch.
16. Instrument panel.

Key to numbering - Fig.6.

1. Connector to microprocessor.
2. Clutch position sensor.
3. Clutch safety switch.
4. Cooling flow solenoid valve.
5. Forward solenoid valve.
6. Forward pressure switch.
7. Reverse pressure switch.
8. Reverse solenoid valve.
9. Ground speed sensor.
10. Cooling flow pressure switch.
11. Engine speed sensor.
12. Reverse light (option).
13. Reverse light switch.
14. Comfort control.
15. Forward/reverse switch.
16. Instrument panel.

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Power Shuttle Gearbox

Fast/Slow Range

On 24 speed gearboxes only, there is a clutch pack in the second section of the gearbox in place of a set of constant mesh gears which gives a 'Fast' and 'Slow' gear. It can be selected at any time by pressing the button on the gear lever, an indicator light will show the speed selected. It is not connected in any way to the Power Shuttle and its microprocessor. The clutch is the same unit used in the 18 x 6 gearbox.

The Fast/Slow clutch pack is hydraulically controlled by a solenoid valve located on a valve block situated on the left-hand side of the lift cover. When the clutch pack is in its non-energised condition, 'Fast' (high) speed is engaged by pressure exerted by a large Belleville spring compressing the clutch plates.

When 'Slow' (low) speed is selected, hydraulic pressure is applied to the piston which overcomes the pressure of the Belleville spring, this releases the 'Fast' speed clutch and engages the 'Slow' speed clutch. The clutch plates for both speeds are compressed through an additional Belleville spring so as to control the rate to give a smooth engagement. The selection of 'Fast' speed shuts off the supply of oil, the large Belleville spring takes over releasing one clutch and engaging the other. Oil inside the clutch is returned to the transmission. A different ratio constant mesh gear on each side of the clutch meshes with constant mesh gears on the layshaft.

The hydraulic oil under pressure is regulated by the Pressure Maintaining Valve to a pressure of 24 bar (348 lb/in²). It passes through a non-return valve to the solenoid valve which is operated by the push button on the gear shift lever. On the up-stream side of the non-return valve a 400 cc accumulator is fitted to maintain pressure to the 24 speed system during other demands on the hydraulic system; for example, engagement of the independent PTO.

The system is fitted with a low pressure cut-out switch. This protects the clutch from slippage when in slow speed, due to low hydraulic pressure. If low pressure occurs the clutch is automatically shifted to 'Fast' to prevent over-heating and damage.

Main Section

The main section of the gearbox has four forward gears, it is a conventional constant mesh box with straight cut gears and selection through couplers and synchronizers. The layshaft is located below the mainshaft which is of hollow construction to accept the PTO drive shaft which runs within it. Gear selection is made through the main gear lever.

Power Take-off Drive

The PTO drive is taken from the drive coupling mounted on the engine flywheel, through a set of constant mesh gears to a shaft which passes right through the gearbox to the PTO at the rear of the tractor.

Three Speed Range Gearbox

The range gearbox is directly bolted to the rear of the main gearbox forming an integral unit. It is identical to the unit fitted to the 12 x 12 and 18 x 6 gearboxes. The unit is similar to a conventional gearbox with a main- and layshaft. Three gears provide a direct drive 'High' gear and reduction gears for 'Medium' and 'Low' through a layshaft. All gear selections are through synchromesh couplers.

The range change is selected by moving the main gear lever fully to the right of the gate and moving it forwards or backwards to its limit, depending on whether a change up or down is being made. One movement of the lever changes one range. The range selected is indicated by the appropriate indicator light on the instrument panel. After selection of the range gear the main lever is then used to select the required main gear.

The drive to the front axle on four-wheel drive tractors is taken and controlled from this gearbox.

Hydraulic System

To operate the Power Shuttle system, it is connected into the hydraulic circuit supplying the four-wheel drive, differential lock and PTO, the operating pressure is 22-24 bar (319-348 lbf/in²). The take-off point is in the hydraulic pipe between the manifold block and the PTO side cover. The supply is taken to a control valve mounted on the front of the gearbox top cover. On the entry side there is a 150 micron wire mesh filter to protect the solenoid valves, sealing rings and other precision components from damage.

The control valve contains a pilot operated proportional solenoid valve and pressure switch for the forward and reverse clutch packs. At the rear of the valve there is a connection for the 'Fast/Slow' range clutch when 24 speed is installed. On the top face of the valve there is a series of plugged holes which allow pressure tests to be carried out for diagnosis purposes. On the underside of the valve there are ports for the feed pipes into the input housing and the clutch packs.

Surplus oil from the pilot operated proportional solenoid valve passes into the front clutch compartment for lubrication of the PTO gears at a rate of 1/2 to 1 litre/min. The reverse gears are lubricated by ‘splash feed’ from oil contained in the bottom of the case and picked up by the drive gear.

Cooling oil is fed into the clutch packs to keep them cool, this supply of low pressure oil is taken from the manifold block at a pressure of 4.5 bar (65 lbf/in²). A pressure regulating valve maintains this pressure. The oil flow passes through a solenoid valve which shuts off the oil flow when the clutches are disengaged to prevent clutch drag during changing of the main gears. The solenoid valve is controlled by the microprocessor.

The additional clutch pack used for 24 speed receives its oil supply from the same source. A solenoid valve, non-return valve and accumulator are mounted on the left-hand side of the lift cover. The oil supply is taken from the PTO supply at the same pressure as the rest of the system. Operation of the clutch is by the push button on the gear lever or side console.

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Electronic Control System

The microprocessor is the heart of the Power Shuttle control system and it is connected to or monitors signals from the following components:

- Shuttle lever, forward/reverse/neutral.
- Comfort control.
- Proportional solenoid valves.
- Pressure switches.
- Clutch pedal sensor and neutral switch.
- Cooling oil control valve.
- Range Speed Selection (high, medium and low).
- Travel Speed sensor.
- Engine speed sensor.
- Engine oil pressure switch.

Shuttle Lever

The shuttle lever has three positions (forward-neutral-reverse), the switch is in open circuit when in neutral. When forward or reverse is selected the proportional solenoid valve is energised engaging the clutch according to the setting of the comfort control or "speed of use" of the clutch pedal.

Comfort Control

This is a simple potentiometer mounted on the steering column. It determines, through the microprocessor, the rate of engagement and disengagement of the clutches when the clutch pedal is not used. There is a minimum and maximum time for each gear range, (high, medium and low).

Pilot Operated Proportional Solenoid Valves

The proportional solenoid valves control the rate of flow and pressure of the hydraulic oil entering the clutch pack. When the driver operates the shuttle lever an increasing pulse of current is delivered to the appropriate valve. As the current increases so the valve opens more, allowing a greater flow and pressure of hydraulic oil to enter and engage the clutch. The rate of engagement is controlled by the microprocessor. This pulse is not applied when using the clutch.

Pressure Switches

The pressure switches monitor the pressure in the clutch packs, they are open circuit when under pressure They generate a warning when the following conditions occur:

When both clutch pack switches are pressurised for longer than 1 second.

When the proportional valve is fully open and the pressure switch does not open within a set time.

When a pressure switch closes for more than 2 seconds after a proportional valve when the valve is set to maximum current and the pressure switch has been detected as open.

Clutch Pedal Sensor and Neutral Switch

The clutch pedal and sensor, when used, over-rides the setting of the comfort control and the programmed engagement of the microprocessor. The proportional solenoids will engage or disengage the clutch selected by the shuttle lever at the rate that the pedal is released or depressed. The clutch sensor has an operating range, at the bottom of the range the clutch is fully disengaged, at the top of the range the clutch is fully engaged.

Depressing the pedal fully actuates the neutral switch which overrides the the microprocessor and puts the clutches into neutral.

Cooling Oil Control Valve

The cooling oil flow control valve is open when either of the two clutch packs are engaged. This allows oil to flow through the clutch packs and keep them cool. The oil is shut off on disengagement to prevent clutch drag,and to assist in the shifting of the main and the range gearbox. It is controlled by the microprocessor.

Range Speed Selection

The range speed (high-medium-low) selection rotary switch in the side of the transmission is connected into the microprocessor. This changes reaction time depending on the range selected, fast in low range, slow in high range.

Travel Speed Sensor

The microprocessor monitors the travel speed of the tractor. It will not allow change of direction over a speed of 17 km/hr (10.4 mile/hr), except in the case of emergency when the clutch pedal is used.

Engine Speed Sensor

In the event of a failure of the travel speed sensor the microprocessor will monitor the engine speed and it will not allow a change of travel speed over 1700 engine rev/min, except in the case of emergency when the clutch pedal is used.

Reverse Light/Bleeper

An output is provided from the microprocessor to operate a reverse light or bleeper if required.

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Warnings

The warning system consists of illuminating the transmission oil pressure warning light, audible warning and indicating the failure on the error code light. The warning is removed when the fault is cleared. The warning is also cleared when the microprocessor is switched off. Each failure has an associated error code that is transmitted via the error code light on the instrument panel or an LED on the microprocessor. A count is kept of each failure in the system, this count can be interrogated by the dealer mechanic through a lap top computer.

The error code consists of two numbers, the first number represents the component that has failed. The second digit indicates the problem with the component. The component identity are listed below:

1. System (microprocessor).
2. Clutch pedal sensor.
3. Shuttle lever.
4. Clutch pack (proportional valves, pressure switches).
5. Cooling valve.
6. Speed detectors (travel speed and engine).
7. Other (gear range and comfort control).

The error code light indicates the error number by flashing a number of times to represent the first and second digit. The inter-digit delay is nominally 3 seconds. The inter-code delay is nominally 10 seconds.

A full list of the codes will be found on page 5J-20.

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HYDRAULIC DIAGNOSIS

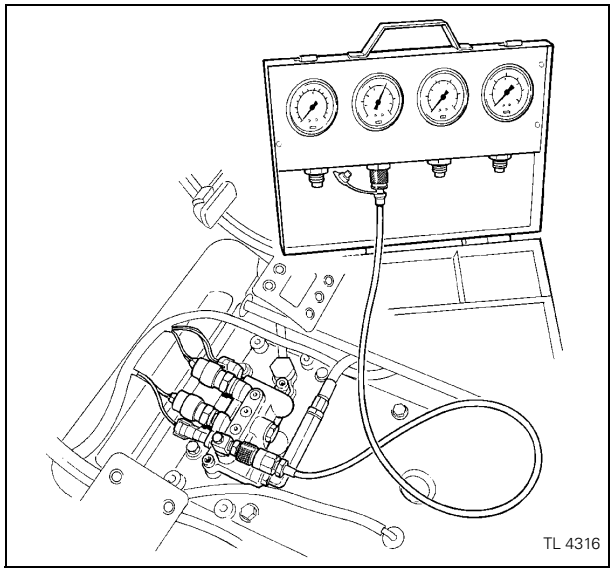
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Special Tools:
MF.3001A Pressure Test Kit
MF.3011 Pressure Test Point

The following procedures should be adopted to diagnose faults in the hydraulic system. The use of Massey Ferguson test equipment will greatly assist in the speedy diagnosis of faults.

TEST 1. System Hydraulic Pressure

1. Remove the cab floor, or platform covers to gain access to the gearbox top cover.
2. The system pressure is measured by removing the first test port on the left.
3. Remove the test port plug on the control valve block and install special test adaptor MF.3011 Pressure Test Point.
4. Using MF.3001A Pressure Test Kit, connect one of the centre gauges (0-35 bar) to the test port.
5. Start up the engine and warm up the hydraulic system, the oil temperature must be 50-60°C (120-140°F).
6. Set the engine speed to 1200-1250 rev/min.
7. Note the pressure reading on the gauge. The system pressure should be 22-24 bar (319-348 lbf/in²).



Diagnosis

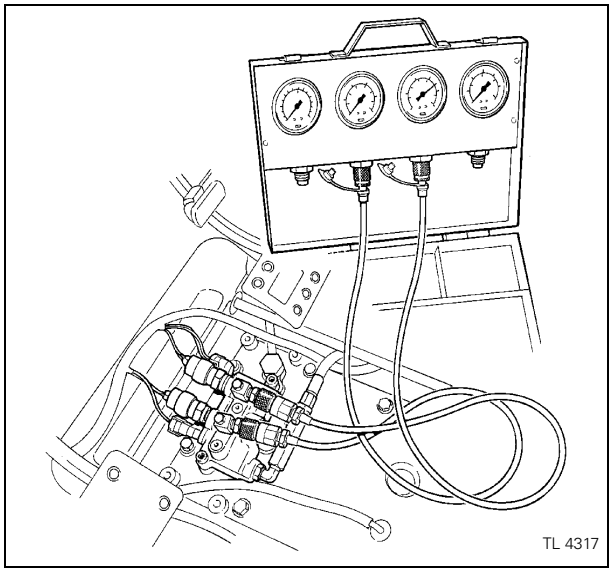
Symptom - Pressure LOW		
Cause	Action	Operation No.
Inline filter blocked	Clean filter element	12-5J
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
Loss of pressure in another circuit: 1. PTO 2. Four-wheel drive 3. Differential lock 4. Fast/slow range	Carry out an investigation as detailed in the Auxiliary Hydraulics section of this manual	2-9C to 6-9C
Loss of pressure in Power Shuttle Control valve	Remove and check valve	7-5J

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TEST 2. Clutch Pack Pressure Test

1. Remove the cab floor, or platform covers to gain access to the gearbox top cover.
2. The system pressure is measured by removing the second test port on the left for the reverse clutch pack, the fourth from the left for the forward pack.
3. Remove the test port plug from the selected ports on the control valve block and install two special test adaptors MF.3011 Pressure Test Point.
4. Using MF.3001A Pressure Test Kit, connect the two centre gauges (0-35 bar) to the test ports.
5. Sit in the drivers seat with the pressure gauges secured in a readable position.
6. Start up the engine and warm up the hydraulic system, the oil temperature must be 50-60°C (120-140°F).
7. Set the engine speed to 1200-1250 rev/min.
8. The gauge should read zero.
9. Shift the Power Shuttle lever forward and check the pressure.
10. The pressure reading on the gauge should build up to a system pressure of 22-24 bar (319-348 lbf/in²).
11. Check the pressure reading in reverse gear.



Diagnosis

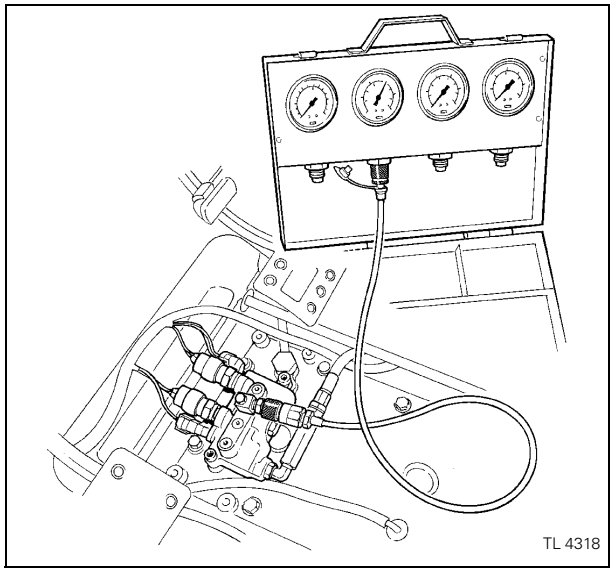
Symptom - Pressure LOW		
Cause	Action	Operation No.
System pressure low	Refer to Test 1.	---
Inline filter blocked	Clean filter element	21-5J
Forward or reverse clutch pack faulty	Overhaul clutch pack	6-5J
Input shaft seals leaking	Replace seals	8-5J
Solenoid valve faulty	Test and replace	7-5J
Electronic control system failure	See error codes and diagnosis	2-5J

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TEST 3. 24 Speed Fast/Slow Range Clutch Pack Pressure Test

1. Remove the cab floor, or platform covers to gain access to the gearbox top cover.
2. The system pressure is measured by removing the third test port on the left.
3. Remove the test port plug on the control valve block and install special test adaptor MF.3011 Pressure Test Point.
4. Using MF.3001A Pressure Test Kit, connect one of the centre gauges (0-35 bar) to the test port.
5. Start up the engine and warm up the hydraulic system, the oil temperature must be 50-60ºC (120-140ºF).
6. Set the engine speed to 1200-1250 rev/min.
7. With the main transmission in neutral, press the button on the gear lever and select Slow range (tortoise).
8. Note the pressure reading on the gauge. The system pressure should be 22-24 bar (319-348 lbf/in²).
9. To check the accumulator pressure, with the pressure gauge installed, turn the key switch to stop the engine and immediately turn the key to the auxiliary/run position (engine stopped). With slow speed still selected the pressure gauge will indicate the accumulator pressure. This pressure will slowly fall due to leakage through the clutch pack. It will give an indication that the accumulator is charged and the non-return valve seated.



Diagnosis

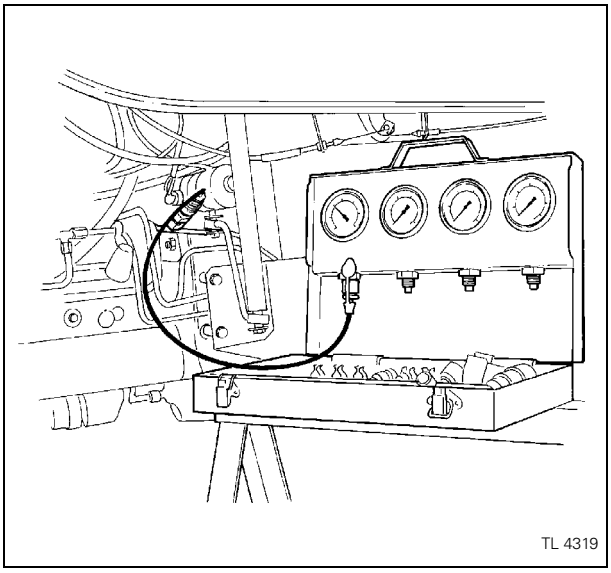
Symptom - Pressure LOW		
Cause	Action	Operation No.
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
Solenoid valve faulty	Replace solenoid valve	15-5J
Fast/Slow clutch pack piston seals worn	Remove and re-seal	11-5J
Input shaft seals worn	Replace faulty com-ponents	8-5J

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Test 4. Cooling Oil Pressure Test

1. Remove the cooling oil pressure switch on the right-hand side of the transmission case.
2. Using MF.3001A Pressure Test Kit, connect the low pressure gauge (0-10 bar) using the 1/4 NPT adaptor in the set to the pressure port.
3. Start up the engine and warm up the hydraulic system, the oil temperature must be 50-60°C (120-140°F).
4. Set the engine speed to 1200-1250 rev/min.
5. Note the pressure reading on the gauge with the forward and reverse clutches disengaged. The system pressure should be approximately 4,5 bar (65 lbf/in²).


TL 4319

Diagnosis

Symptom - Pressure LOW		
Cause	Action	Operation No.
Low pressure valve faulty	Replace valve	17-5J
Steering pump worn	Flow check pump	2-9C
Loss of pressure in another circuit: 1. PTO 2. Four-wheel drive 3. Differential lock 4. Fast/slow range	Carry out an investigation as detailed in the Auxiliary Hydraulics section of this manual	2-9C to 6-9C

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ELECTRONIC DIAGNOSIS

Check **2-5J**

Procedure

The electronic system in the microprocessor is constantly monitoring the system for faults. Any faults occurring are indicated by the illumination of the flashing warning triangle, sounding of an audible bleeper, illumination of the low transmission oil pressure warning light and the flashing of the error code light. The error codes are displayed as a double series of flashes emitted by the error code light. The first number represents the component that has failed. The second indicates the problem with the component. The component identity is listed below:

1. System (microprocessor).
2. Clutch pedal sensor.
3. Shuttle lever.
4. Clutch pack (solenoid valves, pressure switches).
5. Cooling valve.
6. Speed detectors (travel and engine).
7. Other (gear range and comfort control).

Example: In the event of a clutch sensor failure the error code 2 + 2 is indicated by the following sequence of flashes:

2 + 2 = long pause - **two flashes**-short pause-**two flashes**

The first two flashes indicates it is a clutch sensor problem, the second two flashes indicates sensor failure.

Refer to the error code listing for details of the codes, cause and action to be taken.

Microprocessor

Testing the microprocessor requires specialist equipment which is only available at the factory where they are made. The decision to replace the unit can only be made on elimination and based on the error codes 1 + 1, 1 + 2 and 1 + 3.

Before replacing the unit ensure that all the appropriate tests have been carried out.

WIRING AND CONNECTORS

Check **3-5J**

Procedure

IMPORTANT: *The operating voltages used in this system are less than battery voltage. The use of test lights, jumper wires etc. will seriously damage the microprocessor. DO NOT use these tools.*

The electrical system harness connections are of the sealed/water proof type and as such are not readily accessible to normal testing methods. Some individual units can be tested for continuity and short circuit. We would recommend the use of an accurate voltmeter, preferably high impedance digital multimeter; for example, the MF.3005 Digital Multimeter which will also perform continuity tests.

Initial Checks

The electronic components used in the system are very reliable; in some cases the microprocessor is unable to distinguish between a component failure and a poor connection. Before carrying out any extensive diagnosis or dismantling the following checks may be of some use:

1. The battery is in a satisfactory working condition and properly connected to the tractor.
2. The Power Shuttle electronic system is properly earthed to the tractor chassis.
3. The most common cause of failure or intermittent operation is loose or corroded cable connectors. Massey Ferguson markets a number of products that will assist you with this problem;

   3931 225 M1 – Super Lube – Aerosol

   This is a multi-purpose lubricant containing Teflon®. It has excellent dielectric properties, prevents tracking and protects against moisture and corrosion. Ideal for application by spray into the plugs and sockets.
4. The error code will give you an indication where to start.
5. Solenoid coils can be checked when switched ON with the aid of a ferrous screwdriver or spanner, test the top of the coil core for magnetism. DO NOT apply an external voltage.
6. Test pressure switches with your multimeter, they are closed circuit with no pressure, open circuit when pressure is applied.

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Power Shuttle Gearbox

Power Shuttle Error Codes

Code	Failure detected by microprocessor	Cause	Action	Operation No.
System (microprocessor)				
On all the time	Sensor supply out of range	Wiring or 5V sensor fault	Check wiring and connectors	3-5J
1 + 1	Microprocessor failure	Internal component failure	Replace microprocessor	22-5J
1 + 2	Sensor shorted to ground	Wiring fault	Check wiring and connectors	3-5J
Clutch Pedal Sensor				
2 + 1	Clutch sensor out of range	Sensor failure or dislodged sensor or wiring fault	Re-adjust clutch pedal sensor	18-5J
Shuttle Lever				
3 + 1	Shuttle lever switch inoperative	Switch or wiring fault	Check wiring and connectors Replace switch	3-5J 20-5J
Clutch Pack (solenoid valve, pressure switches)				
4 + 1	Both clutch packs pressurised at the same time	Solenoid valve stuck, wiring fault or pressure switch fault	Replace solenoid valve Check wiring and connectors Check pressure switches	7-5J 3-5J 7-5J
4 + 2	Solenoid valve at maximum current and pressure switch not activated	Low hydraulic pressure, solenoid valve failure, pressure switch or wiring fault	Check hydraulic pressure Check solenoid valve Check pressure switch Check wiring and connectors	1-5J 7-5J 7-5J 3-5J
4 + 3	Clutch pack switch closed for 2 seconds after the solenoid valve at maximum current and pressure switch open	Low hydraulic pressure, solenoid valve failure, pressure switch or wiring fault	Check hydraulic pressure Replace solenoid valve coil Replace pressure switch Check wiring and connectors	1-5J 7-5J 7-5J 3-5J
4 + 4	Solenoid valve current does not correspond to setting	Solenoid valve supply open circuit	Check wiring and connectors	3-5J
4 + 5	Wrong pressure switch operates when the solenoid valve is operated.	Solenoid valve or pressure switch incorrectly connected	Connect solenoid and pressure switches correctly	3-5J
4 + 6	Solenoid valves shorted to ground	Wiring fault	Check wiring and connectors	3-5J
Cooling Valve				
5 + 1	Cooling valve open circuit	Cooling solenoid or wiring fault	Check solenoid Check wiring and connectors	7-5J 3-5J
5 + 2	Cooling valve short circuit	Wiring fault	Check wiring and connectors	3-5J
Speed Detectors (travel and engine)				
6 + 1	Engine speed zero or out of range	Engine speed sensor failure, out of adjustment or wiring fault	Re-set sensor Replace sensor Check wiring and connectors	14-10A 14-10A 3-5J
6 + 2	Travel speed zero or out of range	Travel speed sensor failure, out of adjustment or wiring fault	Check setting of travel sensor Check wiring and connectors	3-11A 3-5J
Other (gear range and comfort control)				
7 + 1	Range gear not indicated	Range gear switch faulty or wiring fault	Replace range switch Check wiring and connectors	5-5D 3-5J
7 + 2	Comfort control out of range	Comfort control potentiometer failure or wiring fault	Replace potentiometer Check wiring and connectors	21-5J 3-5J
Other (transmission oil light is not illuminated)				
8 + 1	Microprocessor failure	Internal component failure	Replace microprocessor	22-5J
8 + 2	Engine stalls	Error code not activated	Restart engine	

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GEARBOX

Removal and Refitment 4-5J

Special Tools:
MF.367B Transmission Torque Wrench

Removal

IMPORTANT: *The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and range gearbox.*

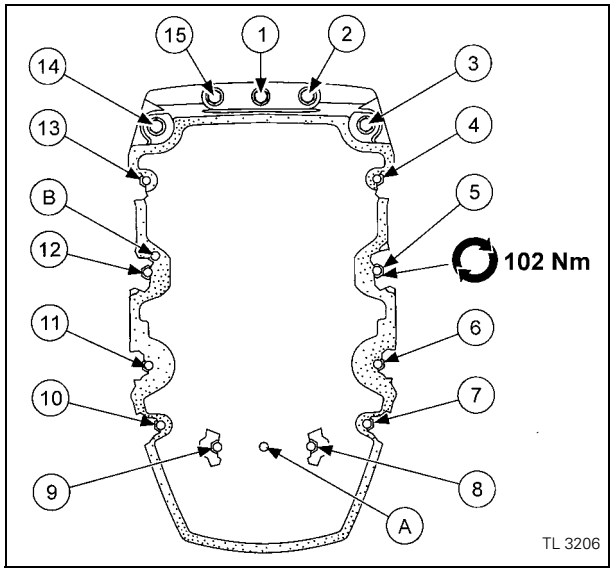
1. Split the tractor between the range gearbox and the rear axle *(see Section 2A or 2B)* Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the range gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Support the weight of the main gearbox on the hoist or crane.
6. Remove all the bolts around the bell housing and remove the gearbox taking care not to damage the drive coupling.
7. Place the gearbox on a suitable bench so that the repair work can be carried out.

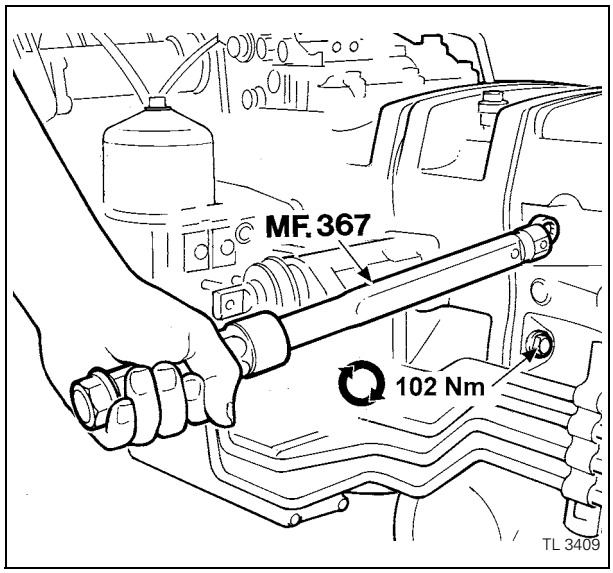
Refitment

8. After repair, stand the gearbox vertically on the bell housing face. Ensure that all gears are in neutral.
9. Ensure that the two dowels on the bottom and side of the range gearbox are in place.
10. Place a new gasket on the mounting face of the main gearbox.
11. Lower the range gearbox into position on the main gearbox. Check that range selector fork engages correctly with the rollers in the back of the cam plate. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels **'A'** and **'B'** have located through the gasket into the main gearbox.

IMPORTANT: *To prevent damage to the transmission the securing bolts must be tightened using the following procedure.*

12. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.
13. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm socket.



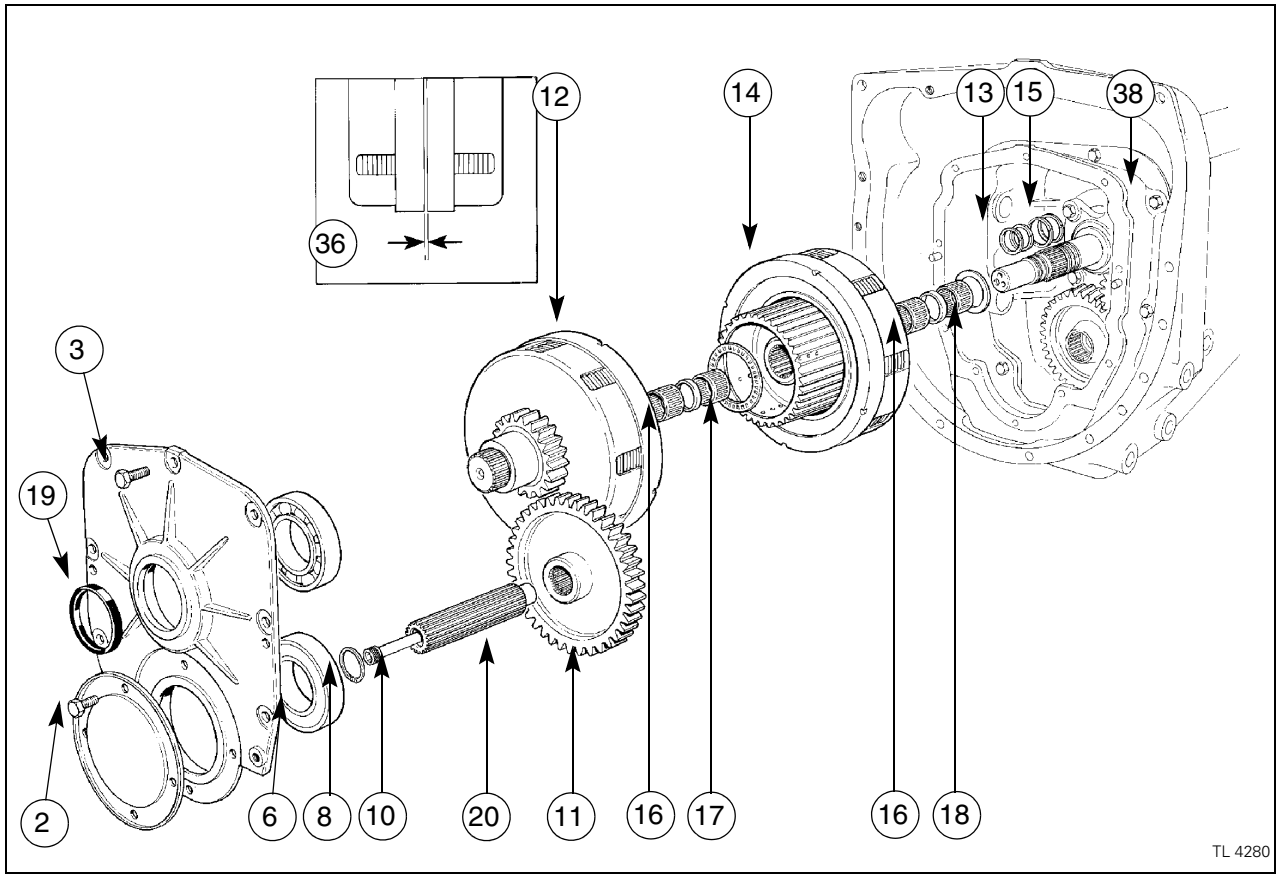


14. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
15. Set the main shaft bearing pre-load, *(see operation 3-5D).*
16. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
17. Re-install the engine/gearbox assembly into the tractor.

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Power Shuttle Gearbox



POWER SHUTTLE CLUTCH

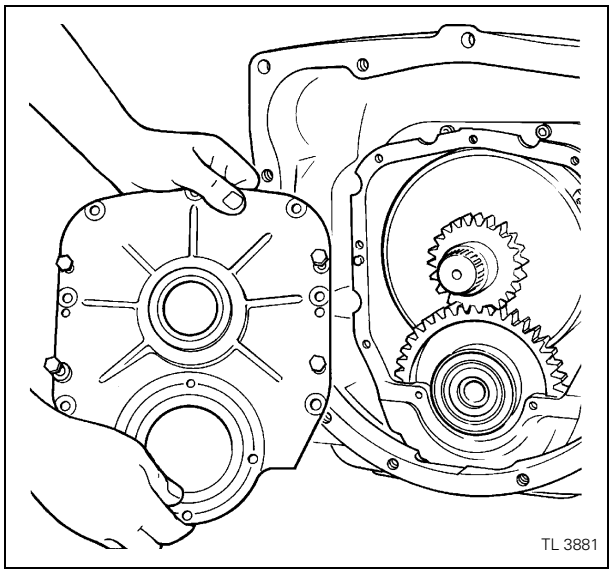
Removal and Refitment **5-5J**

Special Tools:

MF.513 Input seal Installer
MF.515 Clutch Plate Retaining Wedges
MS.550 Universal Handle

Removal

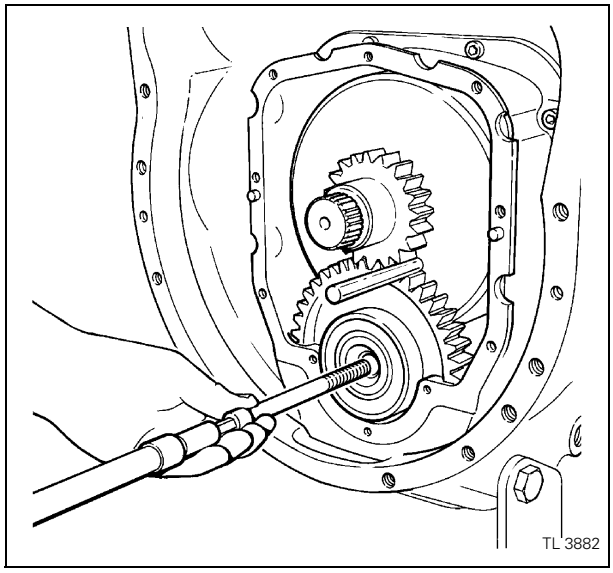
1. Split the tractor between the engine and gearbox, *(see operations 2-2A or 2-2B).*
2. Remove the four bolts and PTO bearing cover.
3. Remove the seven cover bolts.
4. Insert four extraction bolts, M8 x 30 mm long, in the threaded cover holes.
5. Carefully remove the cover using the extraction bolts. The cover is located on dowels, cemented with liquid gasket and is a close fit on the two bearings.
6. Remove the circlip from the inside of the PTO gear.



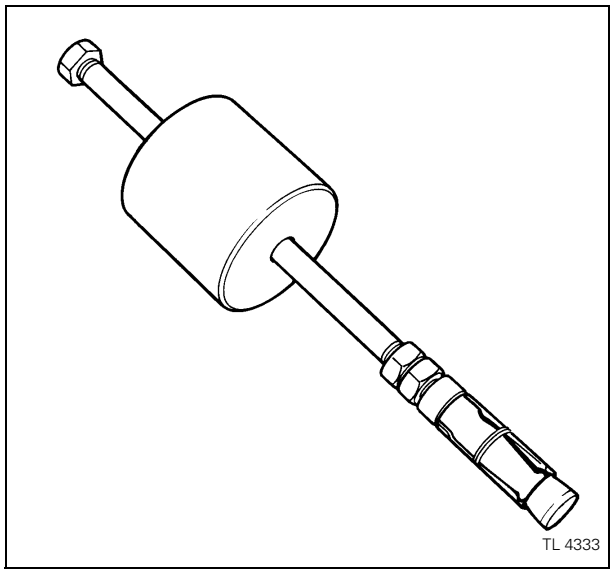
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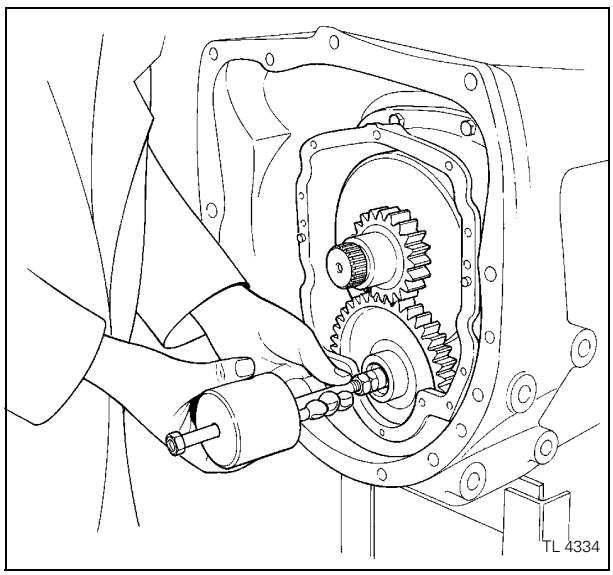
7. Place a small length of rod in between the teeth of the PTO gears to prevent rotation.
8. Using an 8 mm hexagon bit adaptor, remove the cap screw from inside the PTO shaft. It retains the PTO shaft extension.



9. To remove the PTO shaft extension, it may be necessary to make up a special tool. The shaft can be tight and there is only a small amount of shaft to grip. Obtain from your local store a 20 mm masonry bolt, to the head weld an extension rod and make up a slide hammer as shown in the illustration.



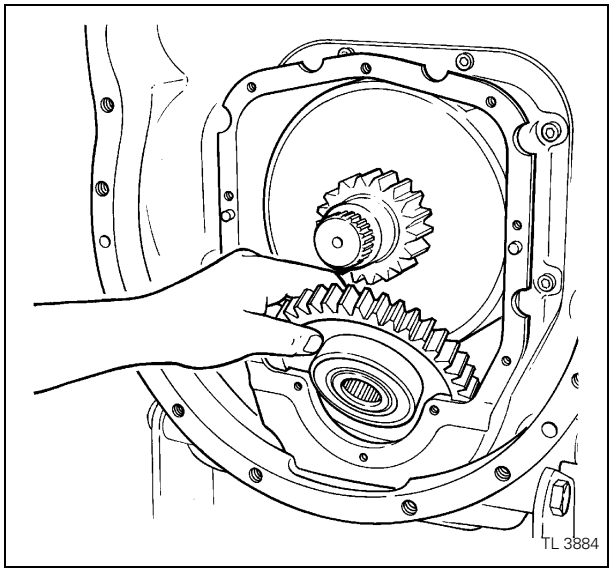
10. Insert the tool into the hollow shaft, expand it until it grips. Use the slide hammer and remove the shaft. It may be necessary to lift the clutch sightly to take the load off the gear inside.



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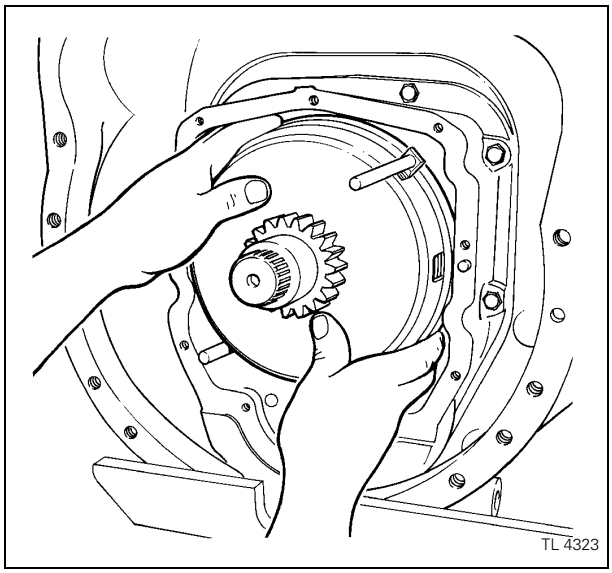
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11. Remove the PTO shaft driven gear.

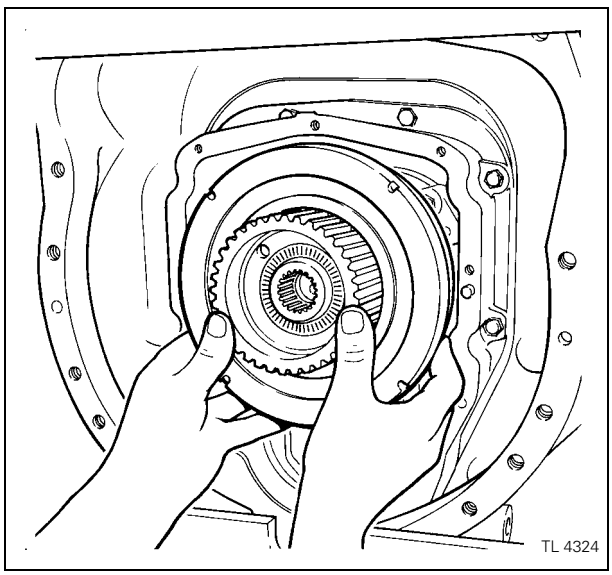


12. Remove the forward clutch first by carefully pulling it off the input shaft and clutch hub.

IMPORTANT: *Take care, there are a number of sealing rings on the input shaft, DO NOT force, if it sticks rotate it slightly.*



13. Remove the forward clutch sealing rings from the shaft.
14. Remove the reverse clutch and hub by carefully pulling it off the shaft, the same caution applies.
15. Remove the other set of sealing rings from the shaft.
16. Remove the needle roller bearings and spacers from both clutches.
17. Remove the two needle roller thrust races from the hub.
18. Remove the thrust washer from the input shaft.
19. Press the oil seal out of the cover.
20. Remove the PTO shaft ball bearing.



Examination

Clean all components, remove all dirt and old oil from the bottom of the casing. Inspect the gears, shafts and bearings for wear or damage, replace any defective parts.

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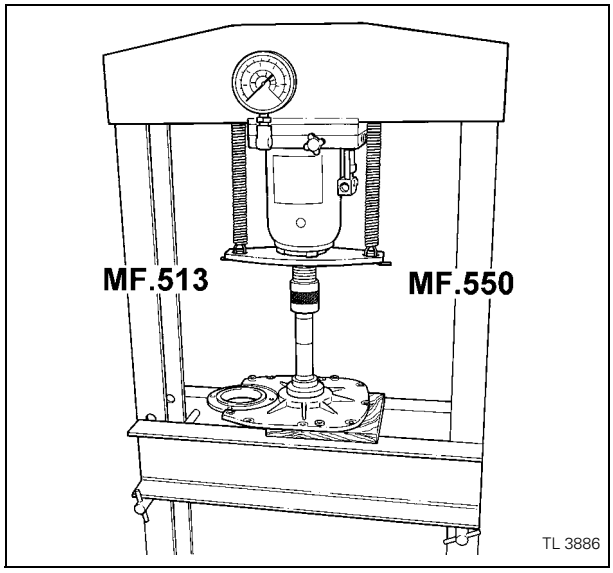
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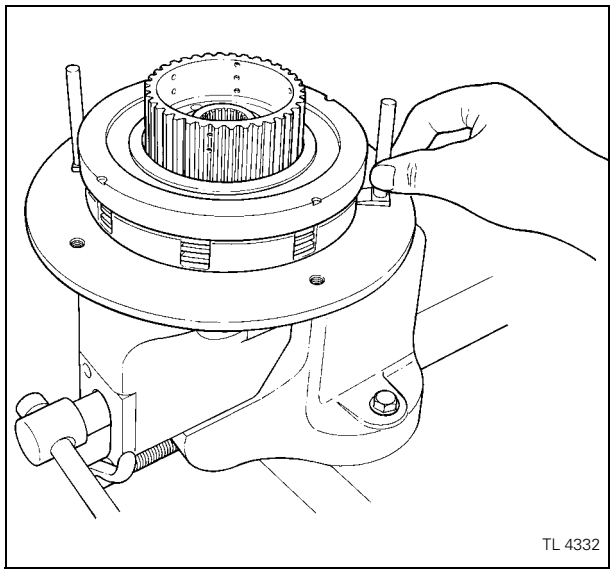
Refitment

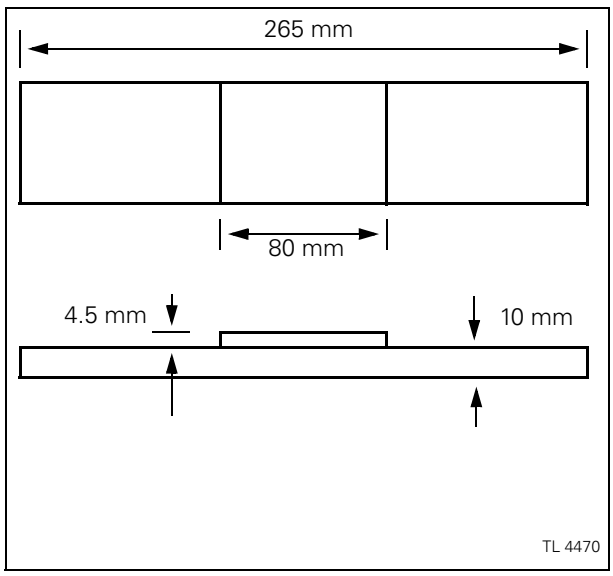
21. Using special tool MF.513 Input Seal Installer and MS.550 Universal Handle, install a new seal in the cover with the lip of the seal facing inwards to retain the oil in the casing.
22. Place the forward clutch on a clean bench top with the hub side facing upwards.
23. Install the hub working it down through the friction plates aligning them to the splines.
24. Using special tool MF.515 Clutch Plate Retaining Wedges, insert a wedge at 2 o'clock and 7 o'clock between the piston and the first plate. This will hold all the plates in position and prevent them from dropping during assembly.
25. When the plates are secure, carefully remove the hub and put the forward clutch to one side.
26. Install the needle roller thrust race onto the reverse clutch side of the hub, hold it in place with a little petroleum jelly.
27. Assemble the reverse clutch onto the hub aligning all the plates.
28. Assemble the clutch packs one on top of the other. Measure the gap between the retaining rings. It should be 0.9 mm (0.036 in) or greater.
29. Install the needle roller bearings and spacers into the forward and reverse clutches.
30. Install the needle roller thrust race onto the forward clutch side of the hub, hold it in place with a little petroleum jelly.
31. Install the thrust washer onto the input shaft, it locates between the housing and reverse gear.
32. Check that the reverse gear on the PTO shaft is in place and the plastic thrust washer is correctly located.
33. Install two new sealing rings in the input shaft for the reverse clutch.
34. Lubricate the shaft and seals and slide the reverse clutch and hub into place engaging the input shaft splines and reverse idler gear in the back of the housing. Ensure that the assembly is pushed fully home (input shaft splines visible next to the hub).

NOTE: *If resistance is felt when the gears are sliding over the seals, remove the assembly and reseat the seals.*

35. Install two new sealing rings in the input shaft for the forward clutch.
36. Lubricate the shaft and seals and slide the forward clutch onto the shaft and onto the hub. The same instruction above applies if resistance is felt.
37. Make a tool to the dimensions shown.



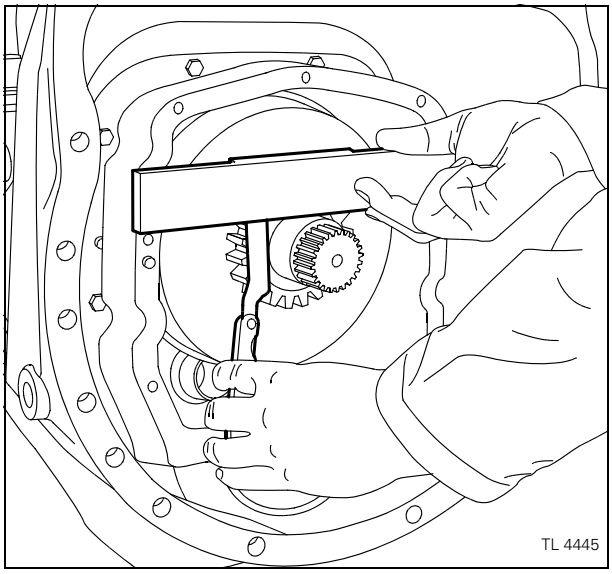


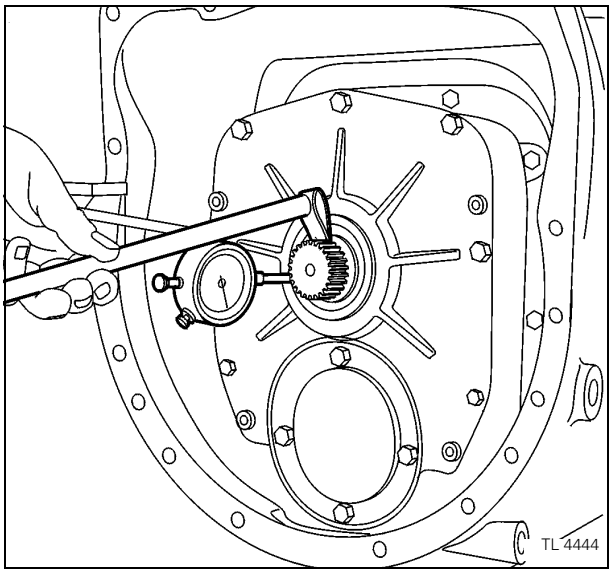


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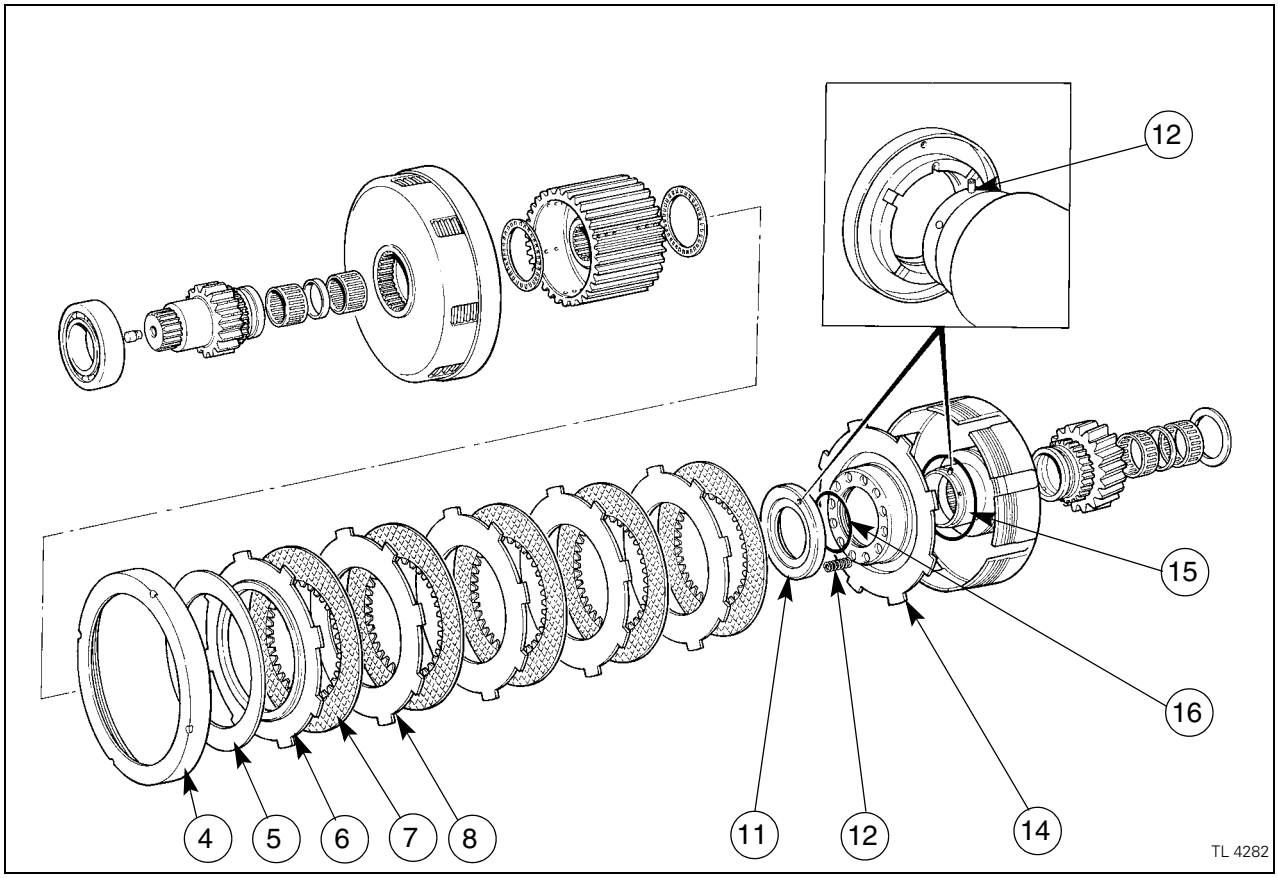
38. Remove all traces of sealant from gearbox flange. Using the special tool measure the gap between the input gear face and the special tool, (top and bottom). The gap should be 0.2 mm (0.008 in).
39. Remove the two wedges from the clutch.
40. Reverse procedures 1 to 11 except:
    a. Tighten the PTO shaft extension hexagon socket cap screw to a torque of 84 Nm (62 lbf ft).
    b. Lubricate the oil seal in the cover with petroleum jelly, very carefully install the cover over the two bearings to prevent damage to the seal.
    c. Apply Multi Gasket (Loctite 573) to the bolting face of the casing and tighten the cover bolts evenly to a torque of 24 Nm (18 lbf ft).
    d. Apply Multi Gasket (Loctite 573) to the bolting face of the PTO cover and tighten the cover bolts evenly to a torque of 24 Nm (18 lbf ft).
    e. Apply a small quantity of Mobilplex 47 grease to the internal splines of the drive coupling.
41. If the internal casing is removed. Apply Multi Gasket (Loctite 573) to the bolting face and tighten the bolts evenly to a torque of 24 Nm (18 lbf ft).
42. Rotate the input shaft counter clockwise to seat the bearings and seals. Using a dial guage, measure the end float of the input shaft. The end float should be between 0.18 mm and 0.76 mm (0.007 in to 0.030 in).





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POWER SHUTTLE CLUTCH

Overhaul **6-5J**

Special Tools:

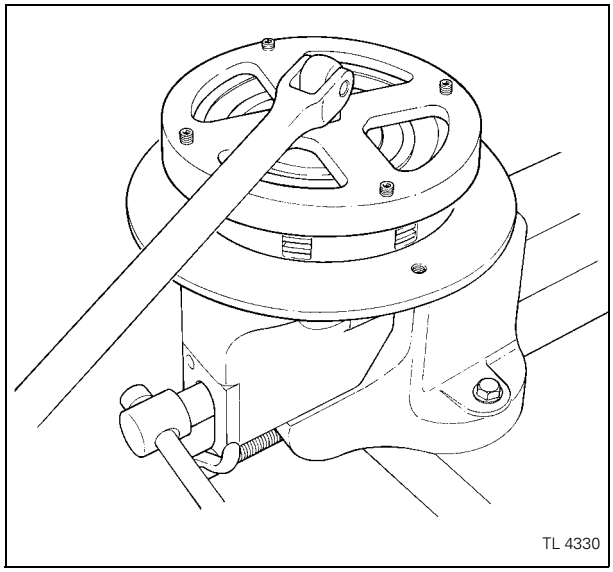
MF.516 Clutch Pack Wrench
MF.517 Clutch Pack Holding Fixture
MS.550 Universal Handle

Dis-assembly

1. Remove the Power Shuttle clutch pack, *(see operation 5-5J)*.
2. Place the clutch under a press, well supported, and press out the PTO drive gear or the reverse gear.
3. Place special tool MF.517 Clutch Pack Holding Fixture in a mechanics vice. Place the clutch onto the fixture locating it by the splines.
4. Using special tool MF.516 Clutch Pack Wrench, locate the pins in the retaining ring, apply downward pressure to hold the pins in place, unscrew the ring and remove.

NOTE: *The ring has a right-hand thread and can be very tight. The job is made easier by using two people, one to hold the wrench down, the other to turn the ring.*

5. Remove the Belleville spring.
6. Remove the pressure plate.
7. Remove the friction plates.
8. Remove the steel interplates.



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9. To remove the piston, seals and springs, you will require a small three leg puller. The spring support plate is a press fit onto the housing.
10. With the clutch and piston assembly in the MF.517 Fixture, install the four clamps so that they hold the assembly down by applying pressure to the piston assembly. DO NOT use any force on the clamp screws greater than finger tight.
11. Place the three legs of the puller around the spring support plate, the screw of the puller in the centre of MF.517 and pull the support off the housing.
12. Remove the 12 springs.
13. Remove the small spirol pin.
14. Pull the piston out of the housing.
15. Remove the sealing ring in the housing.
16. Remove the internal sealing ring in the piston.

Examination

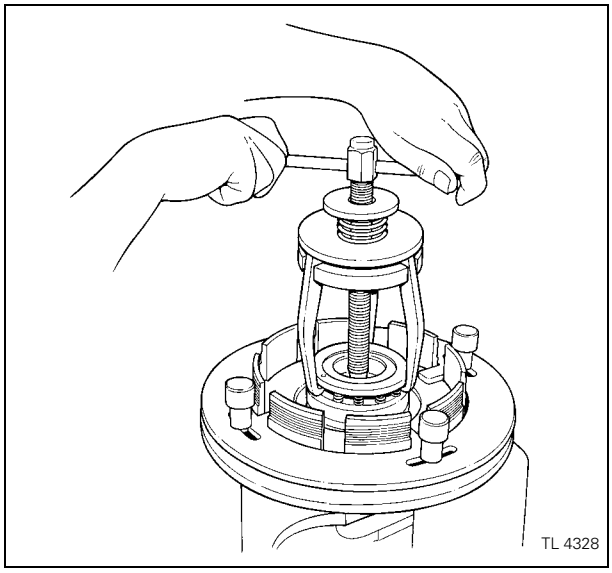
Carefully inspect all the plates for damage, wear and distortion. Inspect all wearing surfaces for wear, grooving and general damage. Replace any components that show signs of wear, damage or distortion.

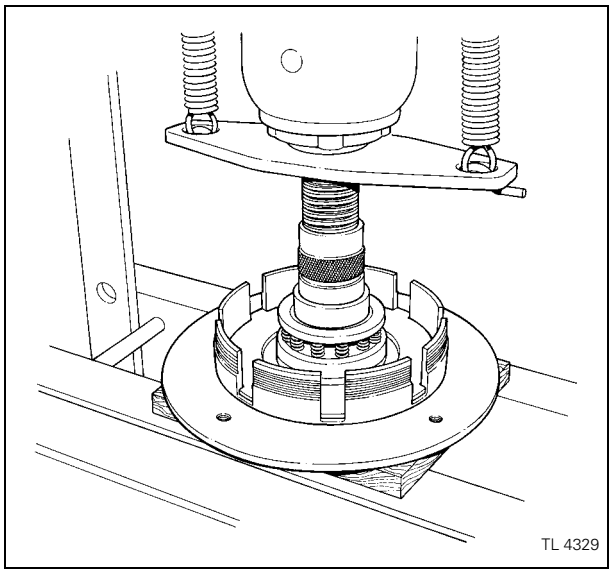
The clutch plates must be replaced as a set since their overall height is pre-set.

Remember, cleanliness is very important when dealing with these components, clean bench, clean tools clean environment.

Re-assembly

17. Soak the friction plates in clean transmission oil.
18. Install new sealing rings in the piston and housing and lubricate with clean oil.
19. Install the piston taking great care not to damage the seals. Ensure the piston moves freely.
20. Install a new spirol pin flush with the bore.
21. Place the housing and piston assembly into MF.517 Fixture and place it under a light press.
22. Place the 12 springs into position.
23. The sleeve spring support is located by a spirol pin in the housing. This ensures the correct relationship between the housing and support, there is a small hole in the face of the spring support to indicate the position of the location.
24. Locate the spring support on the sleeve, part of MF.517, and place it in the fixture.
25. Press the spring support onto the housing.
26. Place the housing on its back and load the plates, friction first, then a steel, ending with a friction. Centre the friction plates the best you can to aid assembly of the hub later on.
27. Replace the end plate and Belleville spring. The outer edge of the Belleville spring faces outwards.

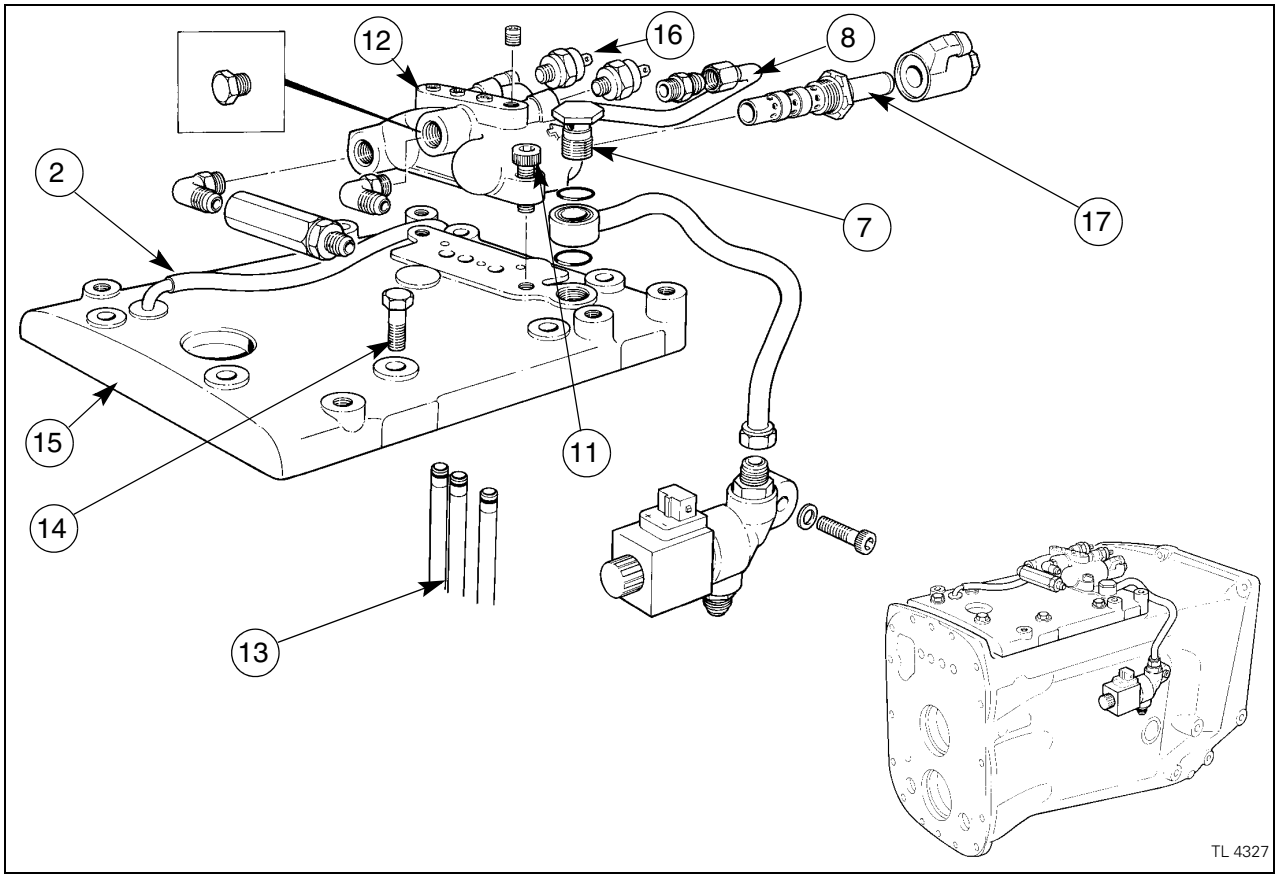




28. Return the clutch pack and fixture to the vice as you did in operation 3.
29. De-grease the housing and retainer ring threads, use loctite 7063.
30. Apply two drops of Studlock (Loctite 270) in four places. Using special tool MF.516 tighten the retainer ring to a torque of 150 Nm (110 lbf ft).
31. Repeat the operations for the other clutch.
32. Replace the clutches as described in operation 5-5J.

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GEARBOX TOP COVER AND CONTROL VALVE

Removal and Refitment 7-5J

Removal

1. Remove the cab floor or platform cover plates.
2. Disconnect the gearbox breather pipe.

NOTE: *When disconnecting cable plugs and pipes, make a note of their position so that they can be re-connected in correct position. There is a red band around the reverse solenoid and switch harness. Arrows are cast into the control valve casing to indicate forward and reverse.*

3. Disconnect the reverse solenoid valve plug.
4. Disconnect the reverse pressure switch plug.
5. Disconnect the forward pressure switch plug.
6. Disconnect the forward solenoid valve plug.
7. Disconnect the banjo and pipe from the cooling oil solenoid valve.
8. Disconnect the lubrication pipe.
9. Disconnect the pressure pipe to the control valve.
10. *24 Speed,* disconnect the pressure pipe to the Fast/ Slow range clutch.
11. Remove the two hexagon cap screws.
12. Remove the control valve assembly.
13. Remove the two (three - 24 speed) stack pipes.
14. Remove the eight cover bolts.
15. Remove the gearbox top cover. Lift with care, there are two vertical pipes under the cover.

Control Valve

16. Remove the pressure switches.
17. Remove the solenoid valve assemblies.

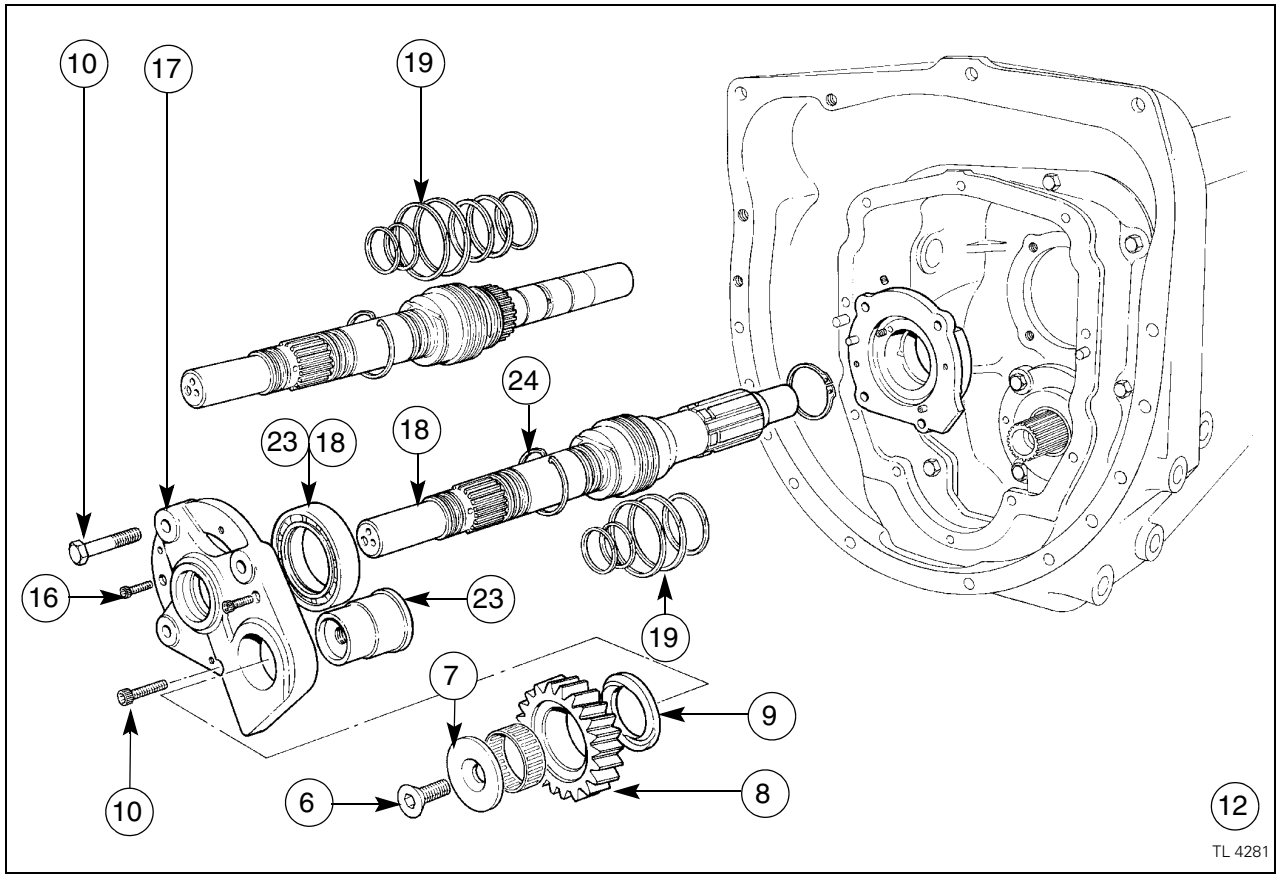
Refitment

18. Reverse procedure except:
    a. Replace the 'O' rings on the stack pipes.
    b. Replace the 'O' rings on the banjo bolt.
    c. Tighten the banjo bolt to a torque of 25 Nm (18 lbf ft).
    d. Tighten the solenoid cartridge to a torque of 18 Nm (13 lbf ft).
    e. Tighten the solenoid coil to a torque of 7 Nm (5 lbf ft).
    f. Apply Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

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Power Shuttle Gearbox



INPUT SHAFT AND HOUSING

Removal and Refitment **8-5J**

Removal

1. Remove the Power Shuttle Clutch, *(see operation 5-5J).*
2. Remove the Gearbox top cover, *(see operation 7-5J).*
3. Remove the pressure feed pipes to the clutch packs.
4. Remove the bolt, locating plate and two cooling oil pipes.
5. Remove the reverse gear on the PTO shaft complete with the plastic thrust washer.
6. Remove the countersunk screw in the reverse idler gear.
7. Remove the retaining plate.
8. Remove the reverse gear and bearing.
9. Remove the thrust washer.
10. Remove the three bolts and one cap screw securing the input housing.

NOTE: *The input shaft can be removed without the removal of the selector shafts and forks, it just requires careful dismantling.*

11. Carefully pull the shaft and housing out of the casing, you will need to supporting the constant mesh gear.
12. Remove the constant mesh gear and thrust washers in the centre section.

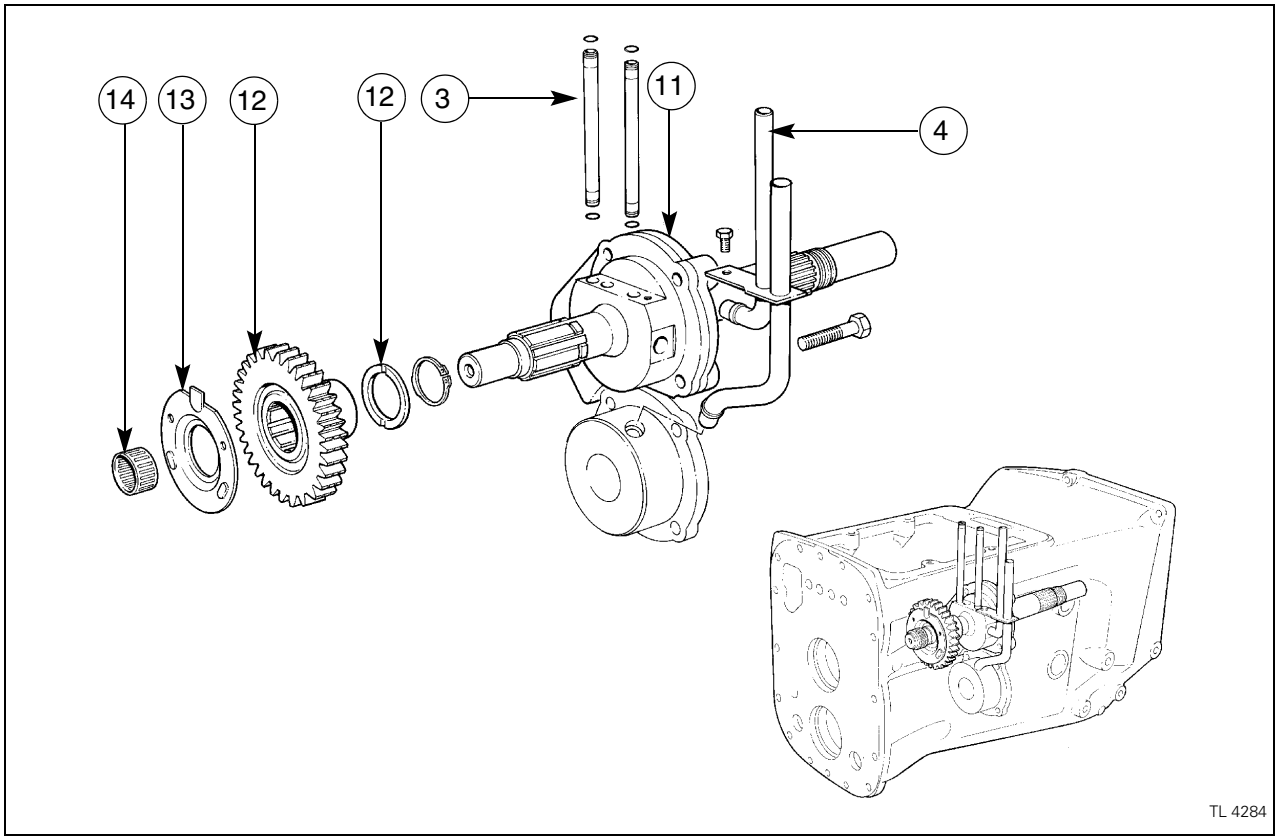
    On 24 speed gearboxes you will need to support the Fast/Slow range clutch pack. There is a thrust washer between the clutch pack and input housing, this could drop down into the bottom of the gearbox.
13. If necessary, remove the large tabbed thrust washer, (not possible on 24 speed with clutch in place).
14. If necessary, remove the input shaft support bearing from inside the mainshaft, (not possible on 24 speed with clutch in place).
15. Place the input shaft assembly in a vice.

Bearing Housing

16. Remove the two hexagon head cap screws that retain the two halves of the housing. There are two location dowels, one hollow located in an oil way.
17. Split the two halves by using two jacking bolts (M6) in the threaded holes provided.
18. Remove the input shaft and bearing.
19. Remove all sealing rings.
20. If necessary, remove the ball bearing from the shaft,

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21. Place the shaft under a press. With a pair of right-angled circlip pliers compress the retaining ring so that it is out of the groove in the bearing and into the groove in the shaft and hold.
22. Operate the press and press the shaft out of the bearing.
23. Remove the ball race.
24. Remove the retaining ring.
25. If it is necessary to replace the reverse idler shaft, this can be pressed out of, and into the input housing. The minimum projection of the shaft is 25,15 mm (0.9909 in) from the face of the input housing, the shaft must be fully pressed against the shoulder.

Examination

Cleanliness is one of the most important tasks when carrying out repairs to these components. Inspect the shaft sealing ring grooves and inside the housing for wear, blow out all passageways and replace any parts which are worn or damaged.

If the inner housing with all the drillings is replaced, ensure that all sealing plugs are in place, this can be checked by comparison with the old unit.

Refitment

26. Replace the ball bearing, if removed.

IMPORTANT: *DO NOT apply any force to the balls in the ball bearing when assembling. Always apply pressure on the inner track of the bearing.*

27. Place the retainer ring around the shaft in its groove and close up the ring.
28. Place the bearing and shaft under a light press.
29. Press the shaft into bearing and release the retaining ring.
30. Check that the ring is correctly located in the groove in the bearing.
31. If any of the plugging screws are to be fitted, apply two drops of Studlock (Loctite 270) to the threads on assembly. Ensure that screw does not protrude into a cross drilling blocking or restricting the oil flow.

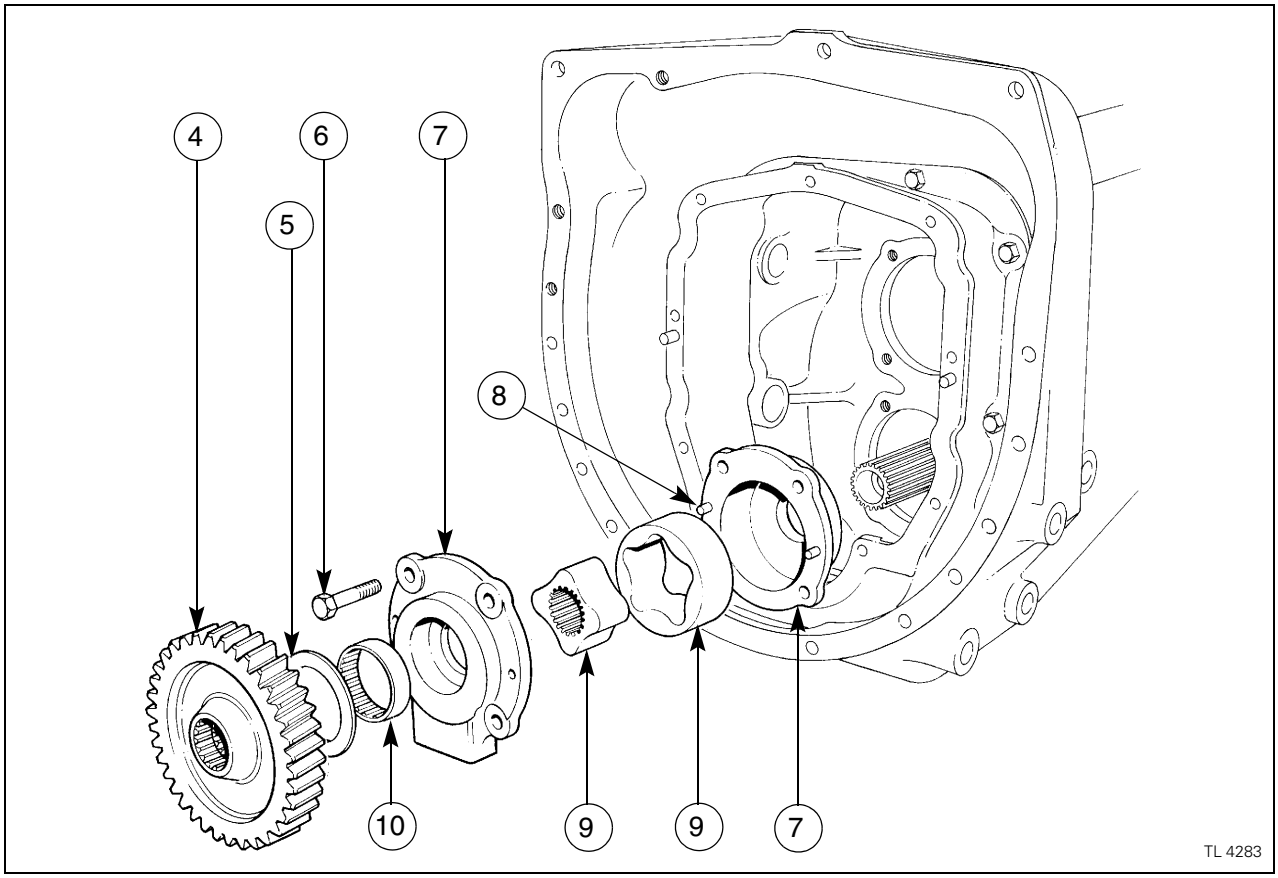
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32. Replace all the sealing rings and lubricate with clean transmission oil.
33. Reinstall the shaft into the housing taking care not to damage any of the sealing rings, if they are tight, remove the shaft and re-seat the rings.
34. Tighten the housing hexagon capscrews to a torque of 6 Nm (4.5 lbf ft).
35. Refit the needle roller bearing in the main shaft, if removed.
36. Apply a coat of petroleum jelly to the face of the large tabbed thrust washer and place it in the recess.
37. Reverse procedures 1 to 13 except:
    a. Tighten the input housing bolts to a torque of 60 Nm (44 lbf ft).
    b. Tighten the input housing hexagon socket cap screw to a torque of 65 Nm (50 lbf ft).
    c. When assembling the reverse idler, the oil groove on the face of the retainer plate and thrust washer face the gear.
    d. Apply Studlock (Loctite 270) and tighten the reverse idler counter sunk screw to a torque of 55 Nm (40 lbf ft).

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SCAVENGE PUMP AND PTO SHAFT

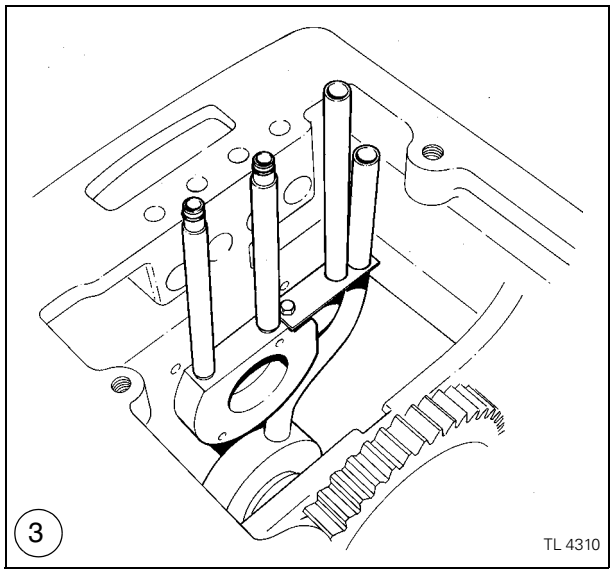
Removal and Refitment 9-5J

Removal

1. Remove the Power Shuttle Clutch, *(see operation 5-5J)*.
2. Remove the Gearbox top cover, *(see operation 7-5J)*.
3. Remove the cooling flow pipe, pump outlet pipe and locating plate.

NOTE: *It can be removed and replaced without removing the selector rails and forks. Improved access to the outlet pipe may be gained by removing the input shaft and housing,* (*see operation 8-5J*).

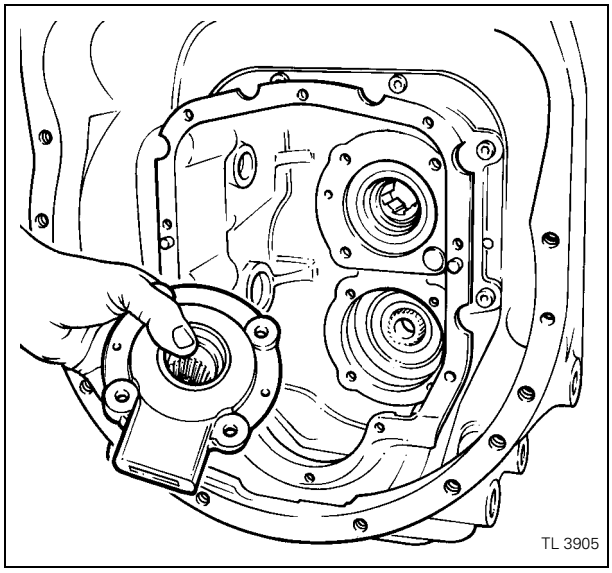
4. Remove the reverse gear.
5. Remove the plastic thrust washer.
6. Remove the four bolts.



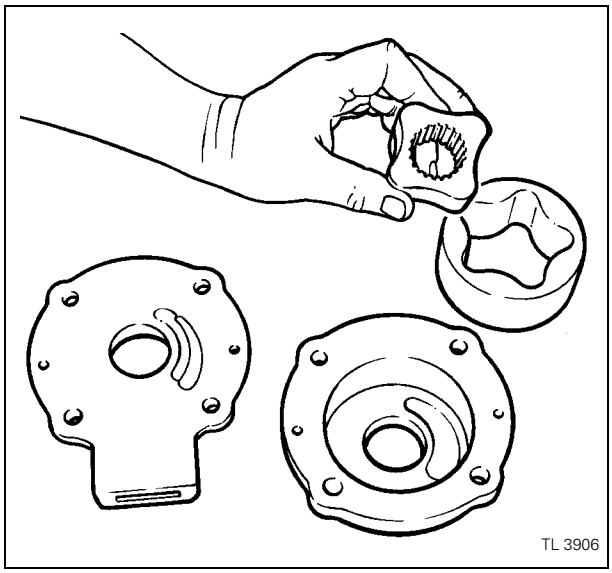
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7. Pull the scavenge pump assembly off the PTO shaft and out of the housing.
8. Place the pump on a clean bench, drive out the two dowels and split the pump.


TL 3905

9. Remove the rotor and stator.
10. Only remove the needle roller bearing if replacement is required.


TL 3906

Examination

Carefully clean the components and the scavenge pump, especially the oil passages. There are no dimensional tolerances that need checking, the pump is low pressure, moving oil from the clutch casing to the transmission.

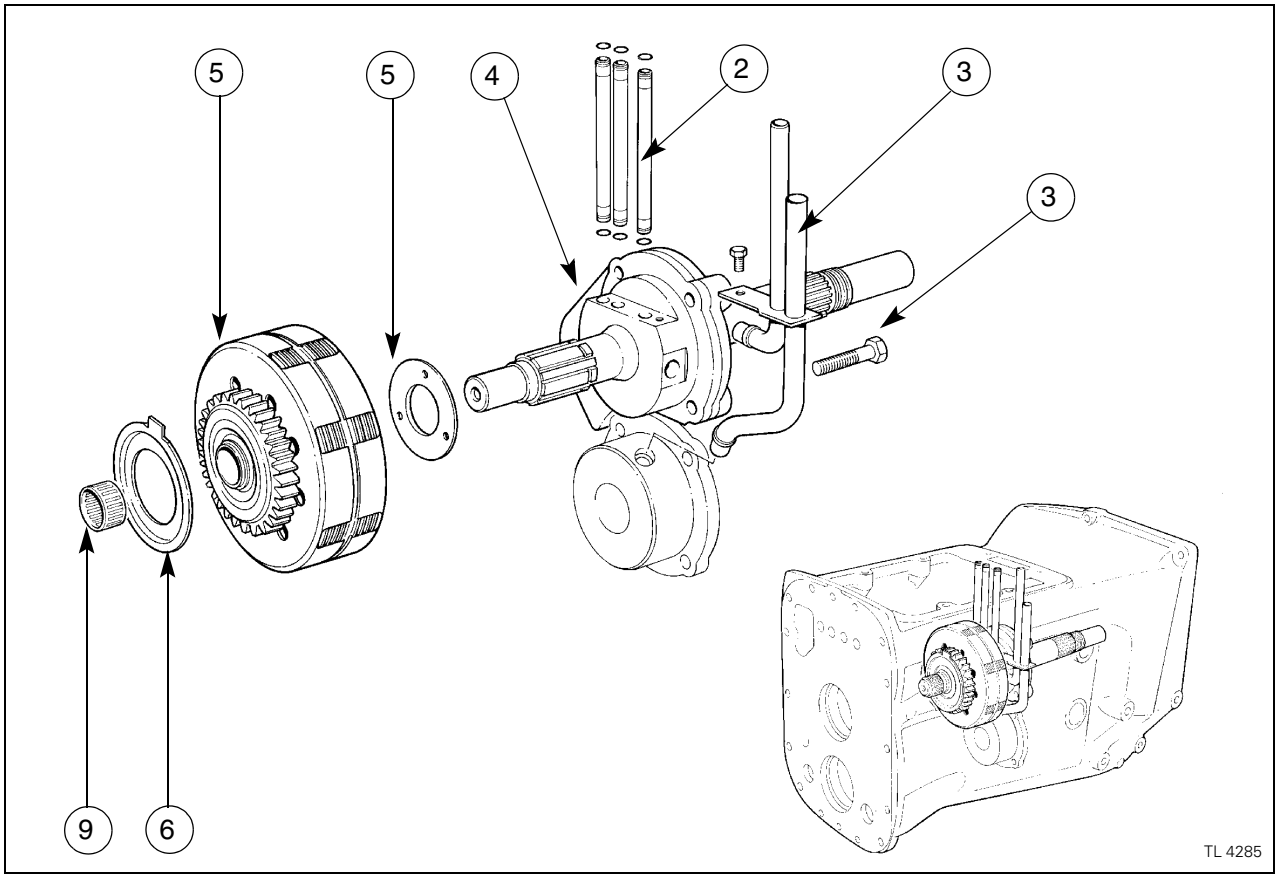
Inspect the rotor and stator for wear, scoring or damage on their working faces, if they appear to be in good condition they can be reused.

Refitment

11. Lightly oil and reassemble the pump, it can only be assembled one way to line-up the bolt holes. Centralise the rotor in the stator so that it is in the centre of the bore.
12. Reverse procedures 1 to 7 except:
    a. Tighten the four pump retaining bolts evenly to a torque of 44 Nm (33 lbf ft).

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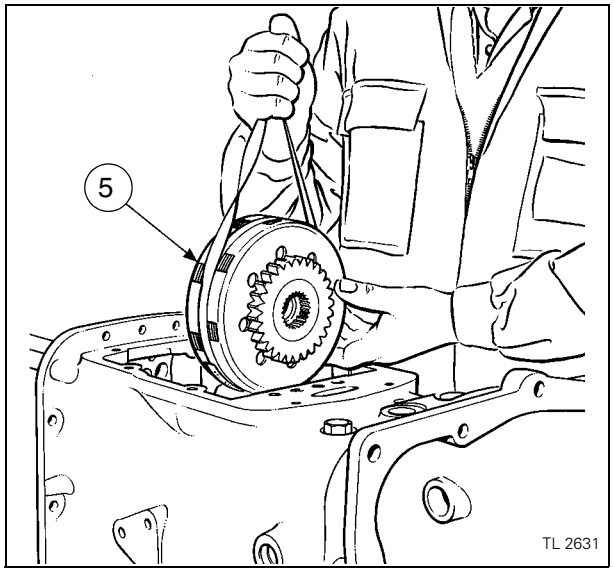


FAST/SLOW RANGE CLUTCH PACK

Removal and Refitment 10-5J

Removal

1. Remove the selector rails and forks, *(see operation 12-5J)*.
2. Remove the pressure feed pipes to the clutch packs.
3. Remove the bolt, locating plate and two cooling oil pipes.
4. Remove the Input shaft and housing, *(see operation 8-5J)*.
5. Lift out the clutch pack assembly. There is a thrust washer between the clutch pack and input housing, this could drop down into the bottom of the gearbox.
6. If necessary, remove the large tabbed thrust washer in front of the main shaft.
7. Remove the variable thrust washer from the input shaft.
8. If necessary, remove the input shaft support bearing from inside the main shaft.



Refitment

9. Refit the needle roller bearing in the main shaft.
10. Apply a coat of petroleum jelly to the face of the large tabbed thrust washer and place it in the recess.

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Power Shuttle Gearbox

Input Shaft Adjustment

NOTE: *If any major components of input shaft assembly or clutch pack have been replaced, it will be necessary to carry out the following adjustment procedure:*

11. Install the input shaft assembly without the variable thrust washer.

    alternatively:

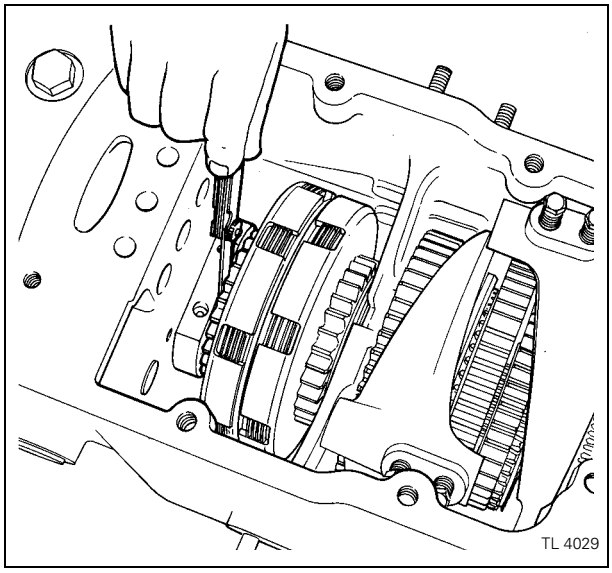
    Install the thinnest thrust washer part number 3815 222 M1 to reduce the measuring width.

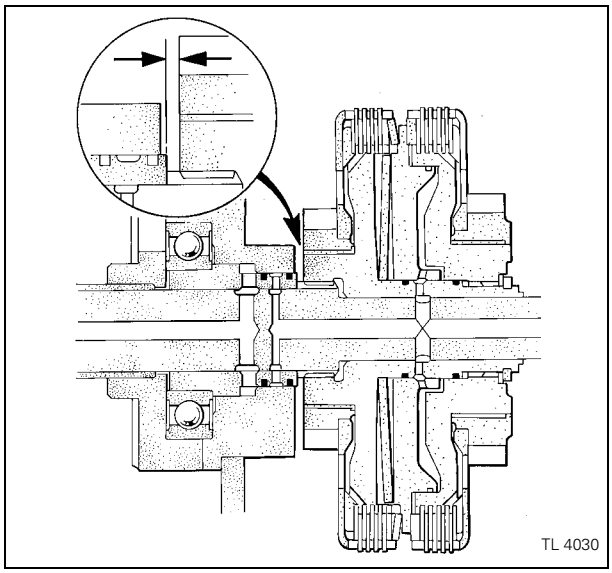
12. Tighten the input housing bolts and push the clutch pack rearwards.
13. With the aid of a set of feeler gauges, measure the gap between the face of the housing and the face of the hub on the clutch pack.
14. From the chart below select a thrust washer to give a clearance **'X'** of 0,20-0,45 mm (0.008-0.018).

Thrust washer thickness chart		
Part No.	Metric	Imperial
3815 222 M1	2,05-2,10	0.081-0.083
3815 223 M1	2,30-2,35	0.090-0.093
3815 224 M1	2,55-2,60	0.100-0.102
3815 225 M1	2,80-2,85	0.110-0.112
3815 226 M1	3,05-3,10	0.120-0.122

General

15. Place the thrust washer on the input shaft - stepped face away from the clutch pack.
16. If removed, refit the needle roller bearing in the main shaft and relocate the large tabbed thrust washer.
17. Wrap some plastic banding around the clutch and lower it into the gearbox.
18. Carefully slide the input shaft into position.
19. Complete re-assembly of the gearbox.


TL 4029


TL 4030

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FAST/SLOW RANGE CLUTCH PACK

Overhaul 11-5J

Dis-assembly

1. Remove the Fast/Slow range clutch pack assembly, *(see operation 10-5J)*.
2. Manufacture a pressing tool as shown in the illustration.
3. Place the clutch pack under a hydraulic press with the rear face upwards.
4. Place the tool over the clutch resting on the face of the hub.
5. Apply hydraulic pressure so that the circlip inside the gear can be removed.
6. Release the pressure slowly, removing the shim.
7. Place the clutch on a clean work bench.
8. Lift off the fast speed gear, cover, piston and hub assembly and put to one side.
9. Remove the outer Belleville spring from the slow speed set.
10. Remove the inner Belleville spring.
11. Remove the cover and gear assembly from the hub.

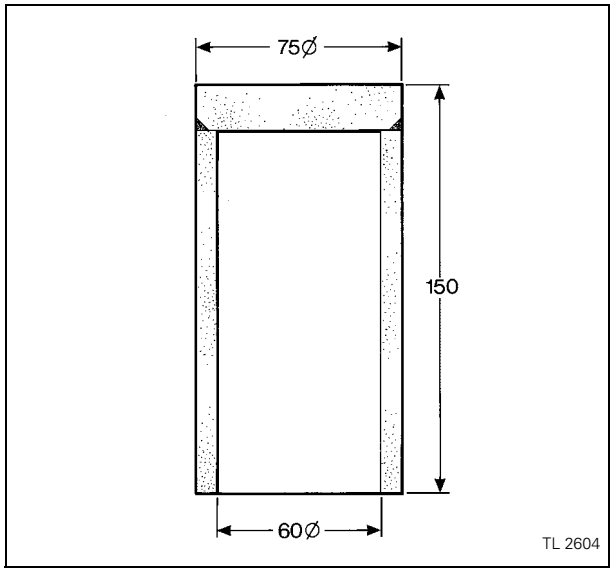
IMPORTANT: *If the clutch plates are to be refitted to the clutch they must be kept in their respective sets and sequence. Note that the last steel plate to be fitted in the set is thicker than the others.*

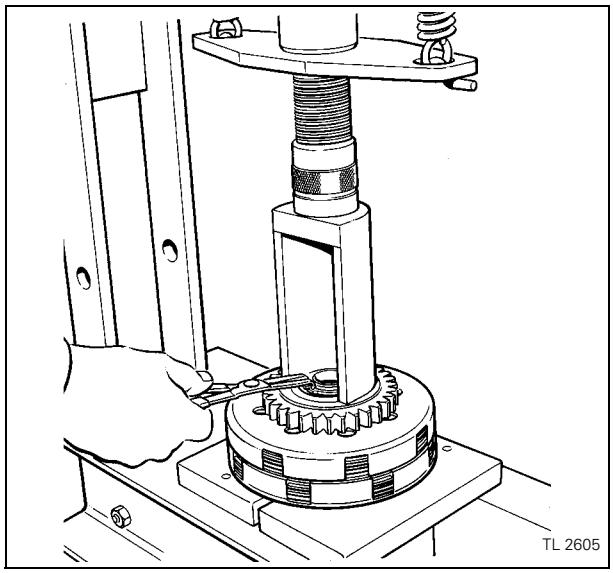
12. Remove the clutch plates.
13. Remove the two 'O' rings from the hub and discard.
14. Taking the fast speed set, carefully prise the piston out of the hub.
15. Remove and discard the 'O' ring.
16. Remove the outer Belleville spring.
17. Remove the cover and gear assembly from the hub.
18. Remove the clutch plates.

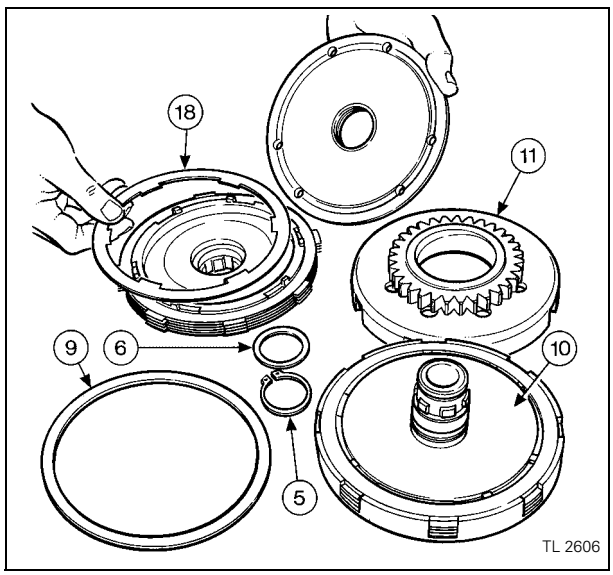
Examination

Examine all the components of the clutch, paying particular attention to the clutch plates. The plates should be flat, not deeply scored (light scuffing is acceptable) and the friction plates must show clear tangential oil grooves on their faces. Check the condition of the piston and its bore for signs of wear or damage.

Thoroughly clean all the components, lightly lubricate the parts during assembly. Replace all seal rings and circlips.



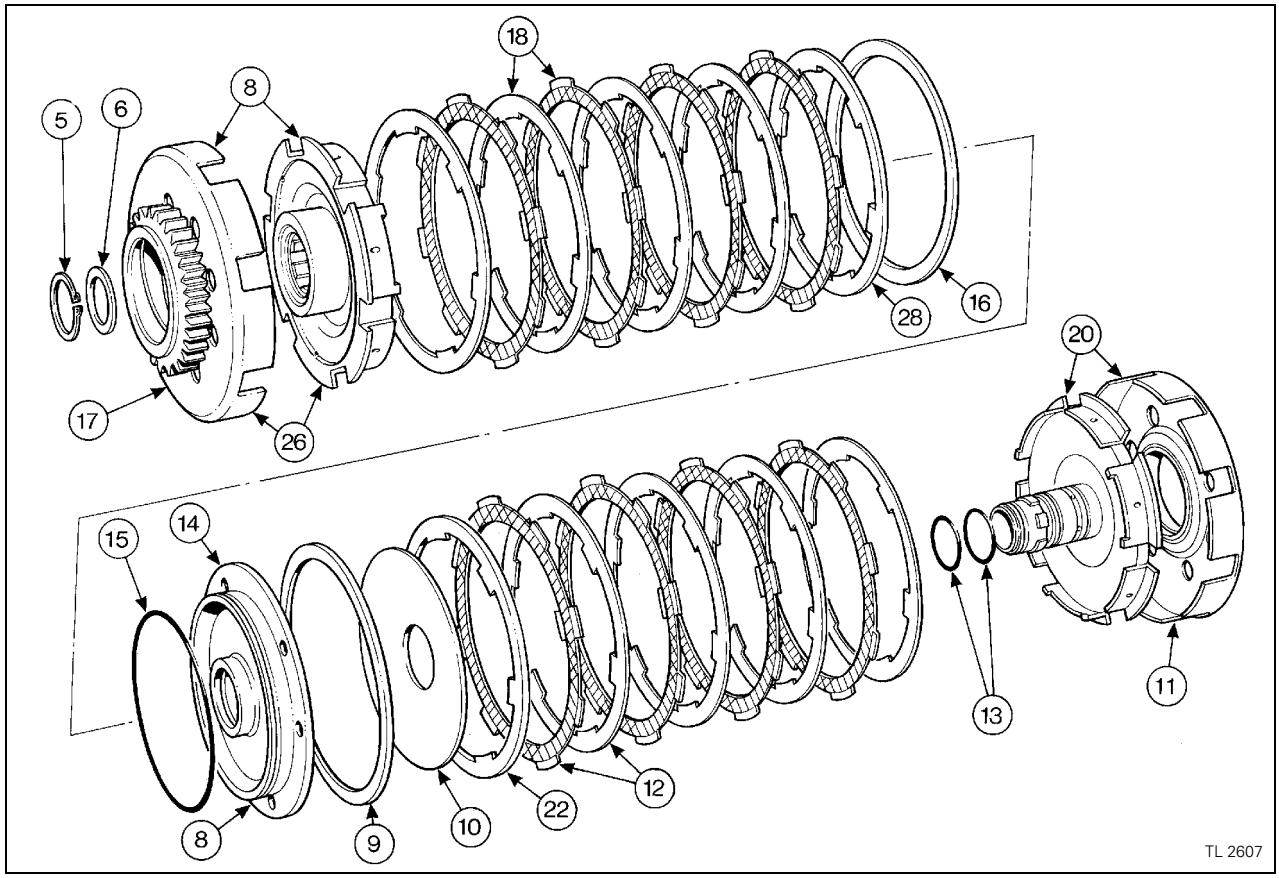




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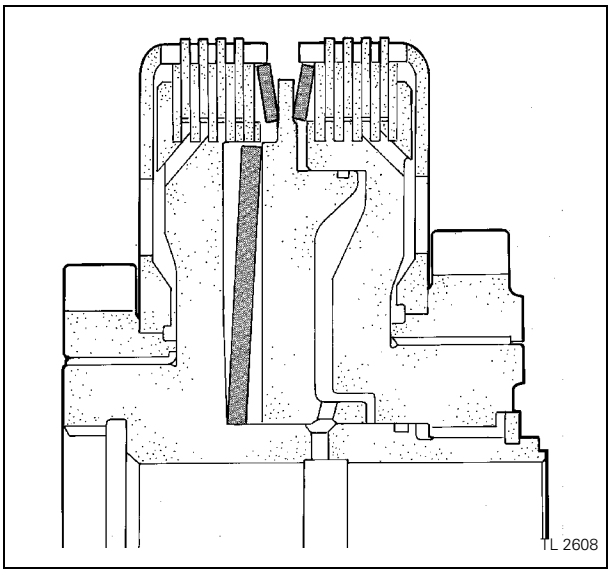
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Power Shuttle Gearbox



Re-assembly

19. If new friction plates are to be fitted they should be immersed in transmission oil for 30 minutes before assembly.
20. Lubricate the bore of the front cover, slow speed (smallest gear) and fit the hub. Check that the face of the hub is proud of the gear.
21. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
22. Fit the final steel plate which is thicker.
23. Fit the inner Belleville spring with it resting on its inner edge.
24. Fit the outer Belleville spring with it resting on its outer edge.
25. Carefully fit two new sealing rings to the hub.
26. Taking the rear cover, fast speed (largest gear), lubricate the bore and fit the hub. Check that the hub is proud of the gear.
27. Assemble the clutch plates starting with a steel plate, then friction until four sets have been fitted.
28. Fit the final steel plate which is thicker.



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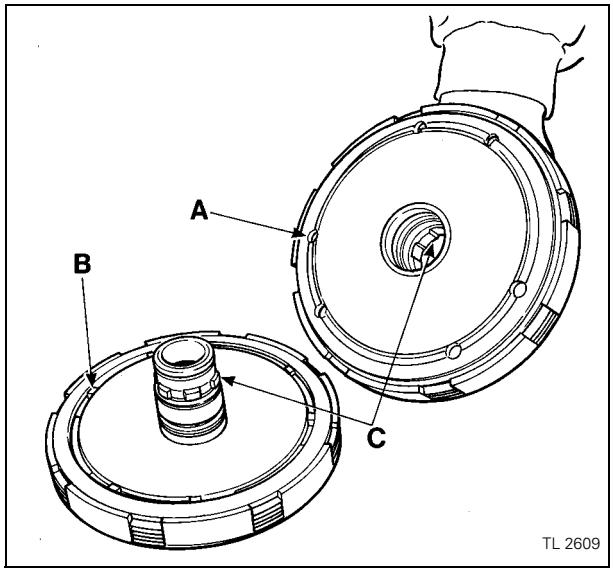
29. Fit the outer Belleville spring with it resting on its outer edge.
30. Replace the piston seal ring.
31. Lubricate the piston with clean transmission oil and locate the piston over the hub. The six projections on the hub must align with the six holes in the piston.
32. With hand pressure, press the piston down into the hub.
33. Lubricate the seals on the front hub with clean transmission oil.
34. Taking the rear clutch pack fit it to the front clutch pack by lowering over the hub. Take care not to damage the seals.
35. The six holes in the piston **'A'** must again align with the six pins on the front hub **'B'**. The hub has six splines **'C'** and the six pins are in three groups of two, there are three positions where the pins will be in line and three positions where they will not.
36. Check that the clutch is located properly and rotates freely.
37. Place the clutch under the press and position the tool on the hub.
38. Press the hub down until the shim and circlip can be fitted.
39. Fit the shim removed as a starting point.
40. Replace the circlip. A new clip must be fitted and it must be fitted with the sharp edge facing outwards.

Clutch Adjustment

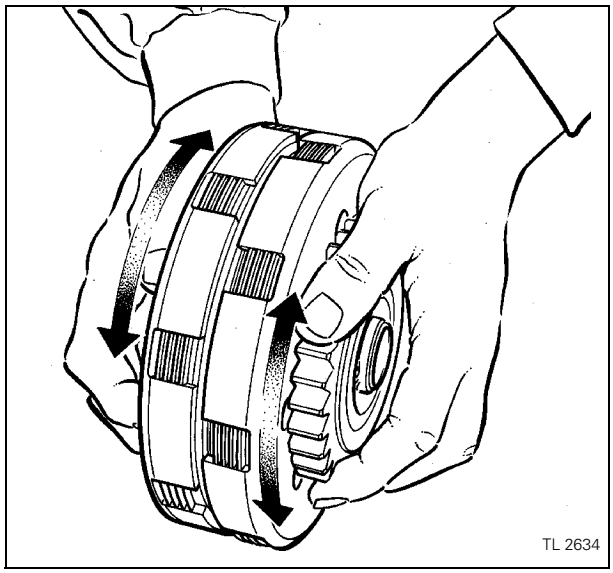
41. Remove the clutch from the press and check it for rotation.
42. Holding the clutch by the two gears try and rotate it. If the clutch is locked solid a thinner thrust washer is required.
43. If the clutch rotates freely a thicker thrust washer is required. The clutch should be able to be turned by hand, but it should be stiff. Thrust washers are available in the following sizes:

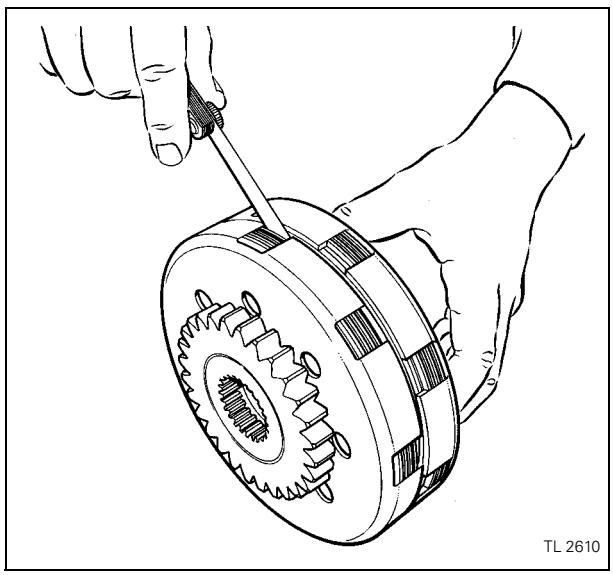
Thrust washer thickness chart		
Part No.	Metric	Imperial
3760 658 M2	1,70 mm	0.067 in
3760 659 M2	1,85 mm	0.073 in
3760 660 M2	2,0 mm	0.079 in
3760 661 M2	2,15 mm	0.085 in
3760 662 M2	2,30 mm	0.091 in

44. Check the clutch internal clearance by using a set of feeler gauges and measuring the gap between the outer Belleville spring and the first steel plate, dimension **'X'**.



TL 2609

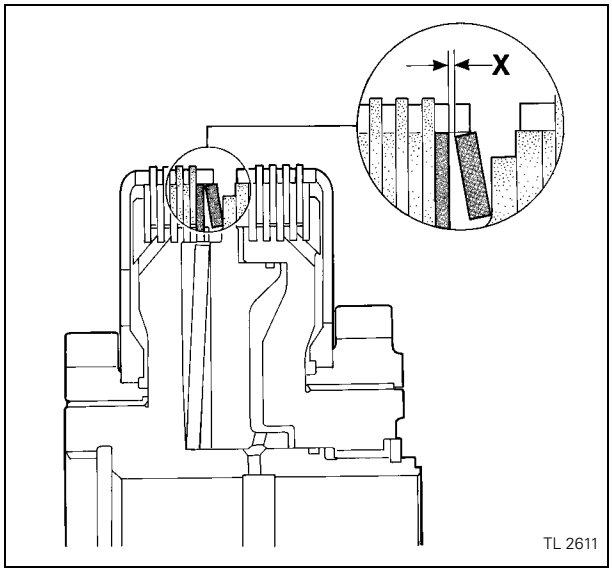

TL 2634


TL 2610

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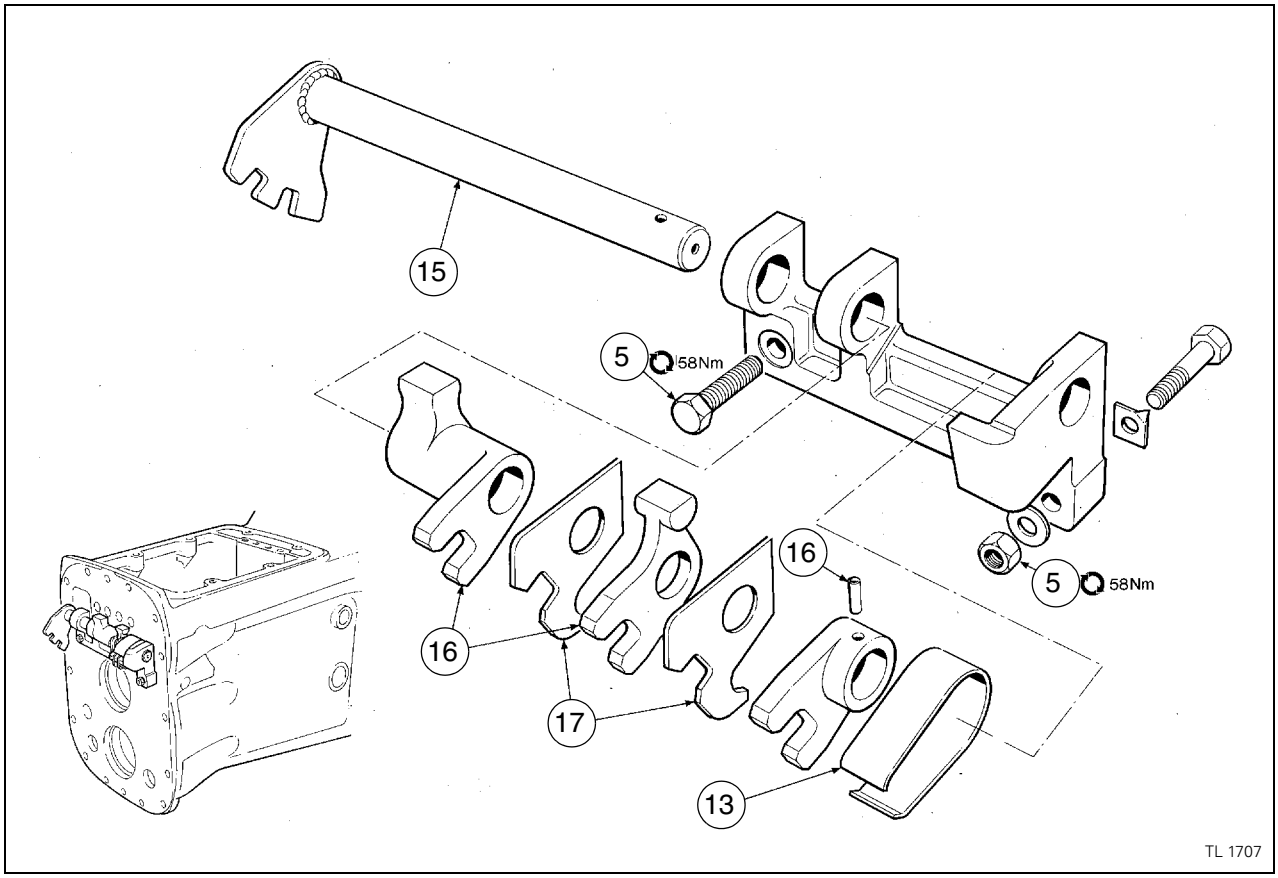
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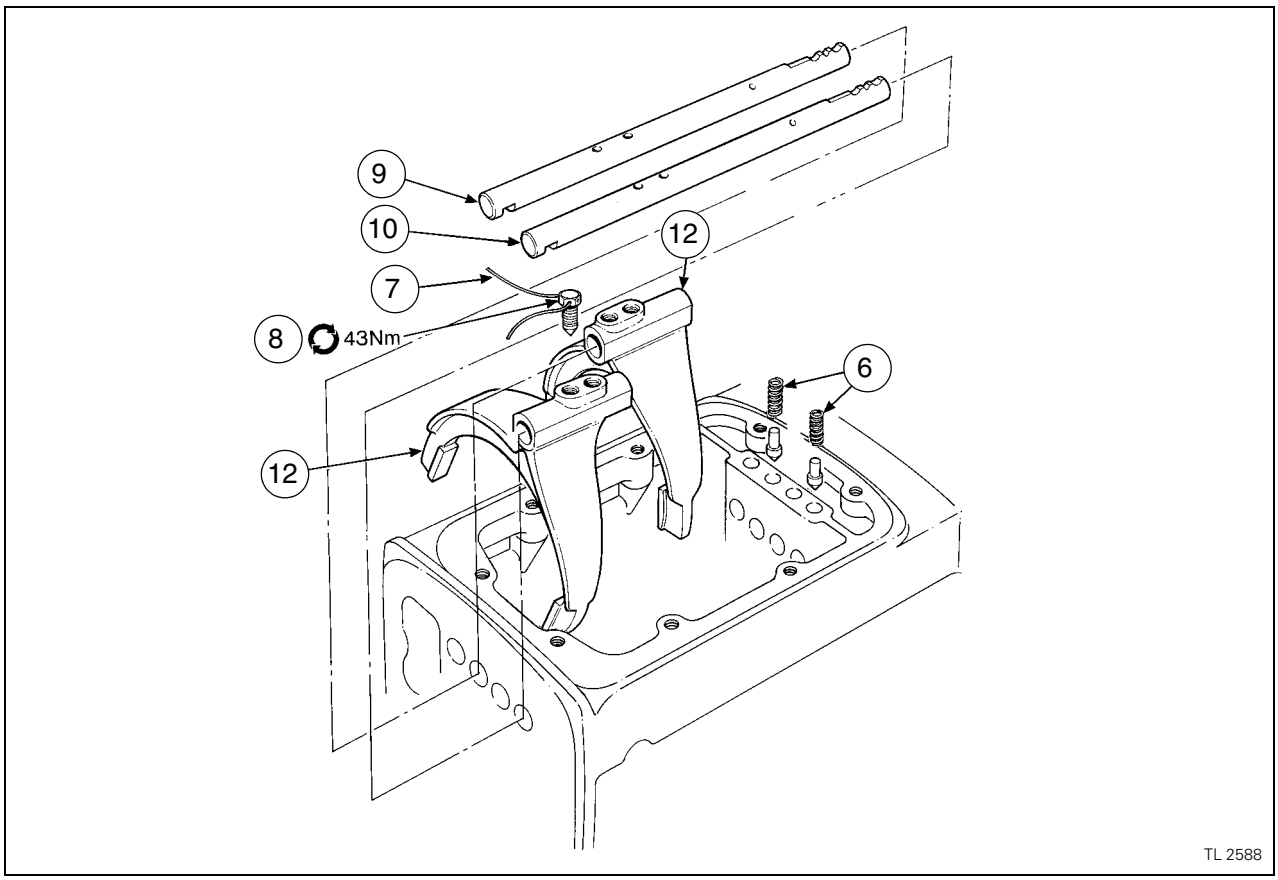
45. Check the clearance **'X'** in at least eight positions around the clutch. Make a note of each reading, add the readings up and take an average. The average figure should be within 0,30-0,45 mm (0.012-0.018 in). If the reading is less than the tolerance a thinner shim is required, if greater a thicker one.
46. Re-install the clutch into the gearbox.



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SELECTORS, RAILS AND FORKS

Removal and Refitment 12-5J

Special Tools:
MF.414 Selector Setting Pin

Removal

1. Remove the gearbox assembly and three speed range gearbox, *(see operation 4-5J)*.
2. Remove the main gear shift lever, *(see operation 14-5J)*.
3. Remove the gearbox top cover, *(see operation 7-5J)*.
4. Remove the bolt and nut from the rear selector mechanism.
5. Remove the selector mechanism assembly.
6. Lift out the detent springs and plungers from the front of the gearbox.
7. Cut and remove the locking wires.
8. Loosen the locking screws on the selector forks.
9. Slide out the 3rd/4th rail rearwards and remove.
10. Slide out the 1st/2nd rail rearwards and remove.
11. Remove the 3rd/4th selector fork.
12. Remove the 1st/2nd selector fork.

Rear Selector Mechanism

13. Remove the selector return spring.
14. Drive out the roll pin.
15. Withdraw the range selector shaft.
16. Remove the selector levers.
17. Remove the spacer plates.

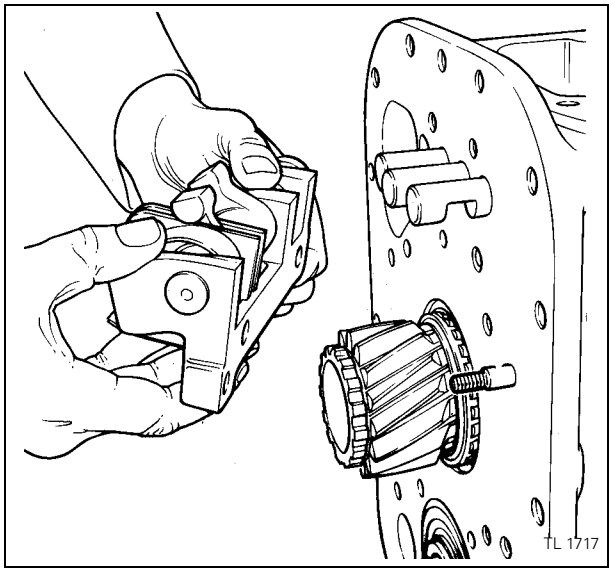
Refitment

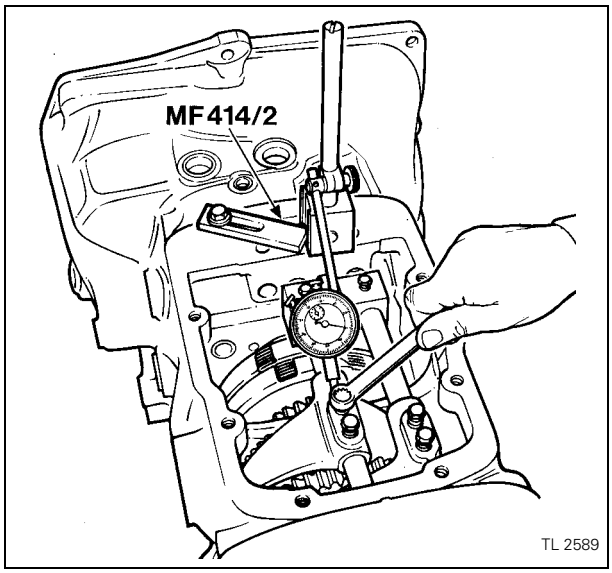
18. Reverse procedures 4 to 17 except:
    a. Apply a few drops of oil to the selector rails before refitment.
    b. Apply Studlock (Loctite 270) to the nut and bolt threads that retains the rear selector mechanism, tighten the bolts to a torque of 58 Nm (43 lbf ft), the nut to a torque of 30 Nm (22 lbf ft).

Selector Fork Adjustment

NOTE: *This procedure must be carried out with a correctly shimmed speed range gearbox in place.*

19. Set each selector ring, selector fork and rail in the neutral position.
20. Lock the selector rail in the neutral position during the setting procedure by using the plate and bolt MF.414/2 (part of MF.414 Synchromesh Setting Pin).
21. Set up a magnetic base and dial indicator as shown in the illustration with the plunger located against the selector fork.





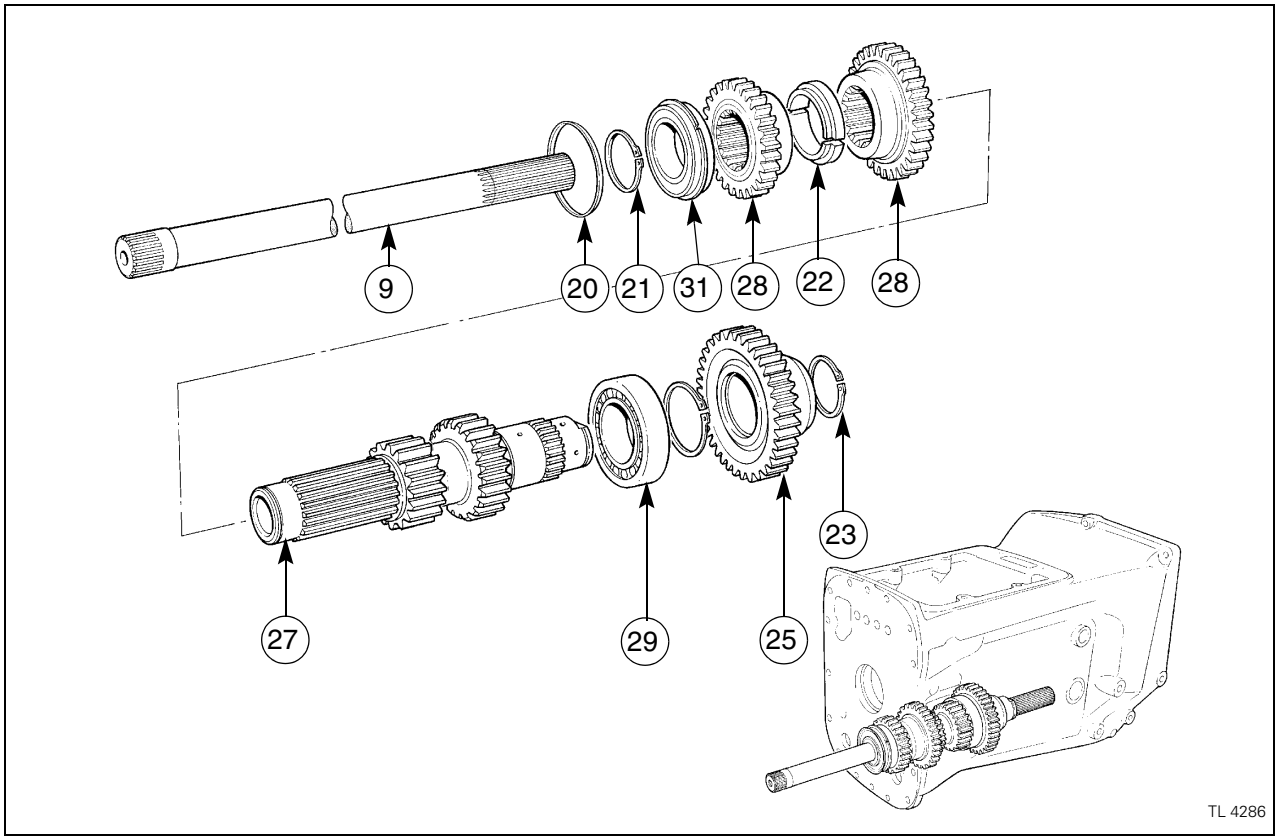
22. Ensure that the locking screws are loose.
23. With finger pressure only, slide the selector fork to the rear taking up any clearance. DO NOT engage gear.
24. Zero the dial indicator and slide the fork fully forward taking up the clearance. Note the reading of the movement on the dial indicator.
25. Halve the reading obtained and progressively tighten up the two locking screws to a torque of 43 Nm (32 lbf ft) ensuring that the selector fork is positioned to give the half reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).

General

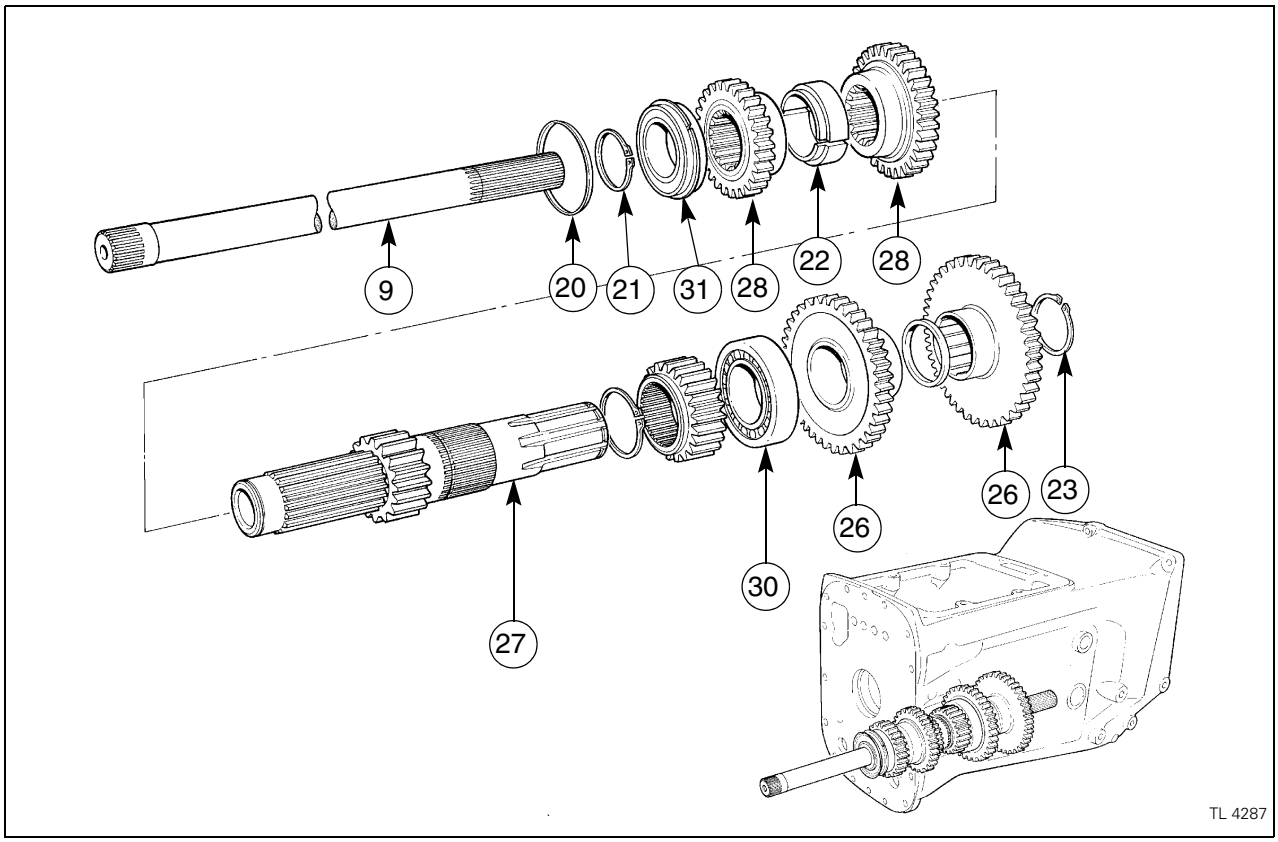
26. Wire-lock all locking screws.
27. Continue to re-assemble the gearbox reversing operations 7-5J, 14-5J and 4-5J.

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Layshaft – 12 speed Gearbox

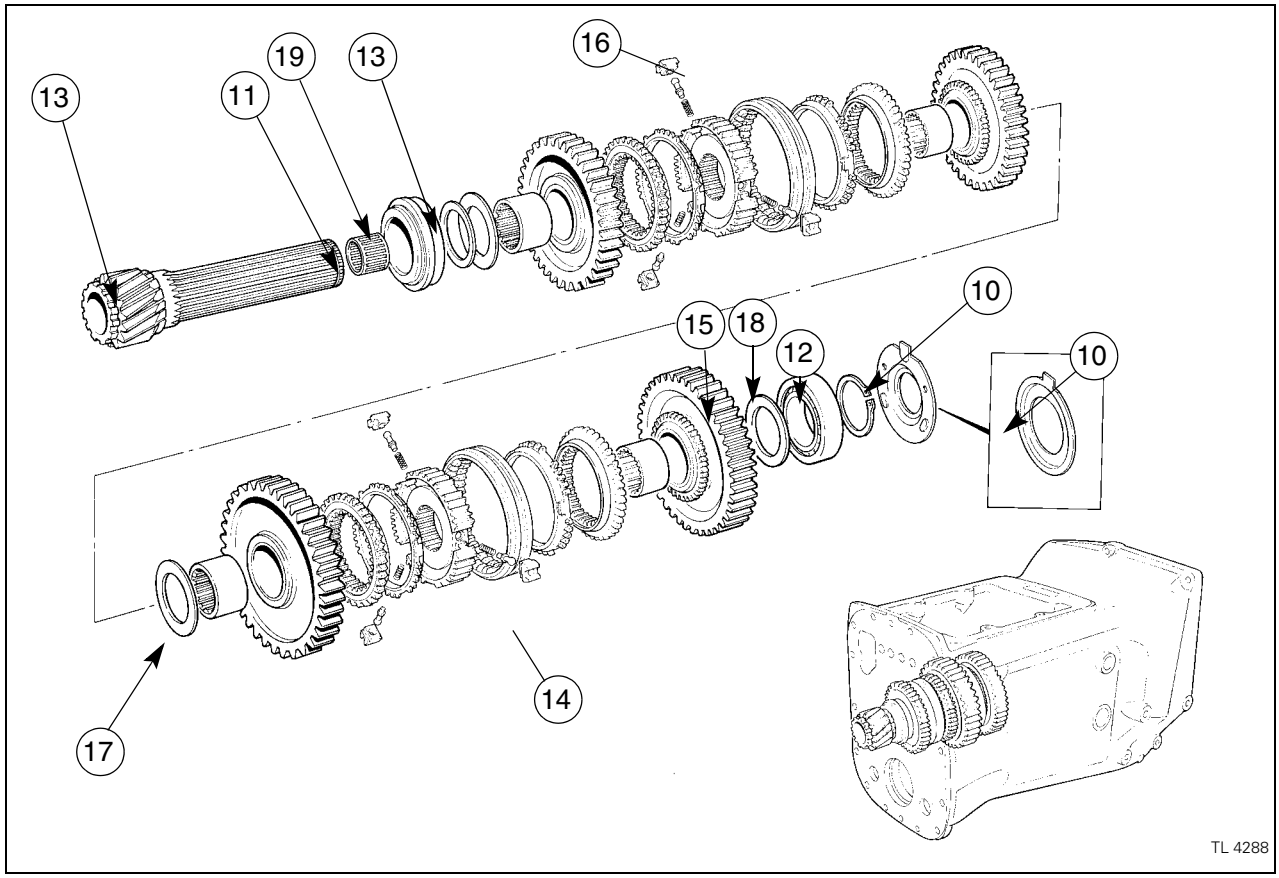


Layshaft – 24 speed Gearbox

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Power Shuttle Gearbox



Mainshaft

LAYSHAFT, MAINSHAFT PTO SHAFT AND GEARS

Overhaul **13-5J**

Special Tools:
MF.3008 Circlip Plier Set

Dis-assembly

1. Remove the gearbox and range gearbox assembly from the tractor, *(see operation 4-5J).*
2. Split the transmission between the gearbox and range gearbox, *(see operation 4-5J).*
3. Remove the Power Shuttle clutch packs, *(see operation 5-5J).*
4. Remove the gearbox top cover, (see operation 7-5J).
5. Remove the selector rails and forks, *(see operation 12-5J).*
6. Remove the input shaft and housing, *(see operation 8-5J).*
7. Remove the 24 speed Fast/Slow range clutch, if fitted, *(see operation 10-5J).*
8. Remove the scavenge pump, *(see operation 9-5J).*

Mainshaft

9. Remove the PTO shaft from inside the layshaft.
10. Remove the large tabbed thrust washer.
11. Remove the needle roller bearing from inside the mainshaft.
12. Using one of the circlip pliers from the MF.3008 Circlip Plier Set, remove the circlip from the front of the mainshaft.
13. Pull the mainshaft out of the gearbox to the rear with the rear thrust washer and spacer.
14. Lift out the 1st/2nd gear set and the measured thrust washer.
15. Remove the measured thrust washer.
16. Lift out the rear 3rd/4th gear set assembly.
17. Remove the thrust washer between the two gear sets.
18. Remove the front roller bearing from the gearbox.
19. If necessary, press the rear taper roller bearing off the mainshaft.

Layshaft

20. Remove the rear layshaft bearing retainer ring.
21. Remove the snap ring from the rear of the layshaft.
22. Drive the layshaft forwards and remove the two split rings between 3rd and 4th gear.
23. Remove the snap ring from the front of the layshaft.
24. Push the layshaft rearwards as far as possible

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25. *12 Speed*, remove the constant mesh gear in the front section.
26. *24 Speed*, remove the two constant mesh gears and the spacer in the front section.
27. Remove the lay shaft by pushing it out through the front of the gearbox.
28. Remove 3rd and 4th gear.
29. *12 Speed,* if necessary, remove the circlip and front roller bearing
30. *24 Speed*, if necessary, remove the roller bearing, 2nd speed gear and circlip.
31. Remove the rear ball bearing from the casing.

Synchromesh Hub Assemblies

32. Remove the two baulk rings.
33. Remove the drive hub complete with the sliding coupler.
34. Wrap the hub and coupler in a cloth.
35. Remove the sliding coupler, take care not to lose the pressure springs, ball pins and blocks.
36. Remove the three pressure blocks.
37. Remove the three ball pins
38. Remove the three pressure springs.

Examination

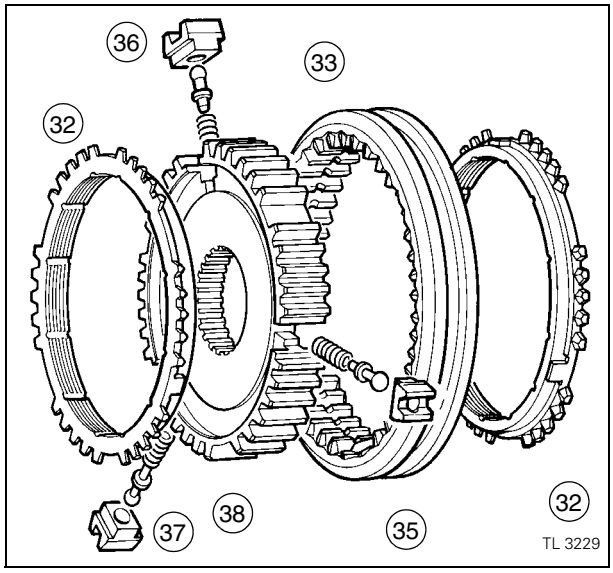
39. Thoroughly clean all the components of the synchromesh and check their condition.
40. Using a feeler gauge, measure the clearance between the baulk ring and the synchromesh cone at several points. The baulk ring must be correctly positioned on the tapered part of the synchromesh cone. If the average clearance is less than 0,5 mm (0.020 in) replace the baulk ring. If the clearance is checked with the gearbox assembled, replace the baulk ring if the clearance is found to be less than 0,8 mm (0.030 in).

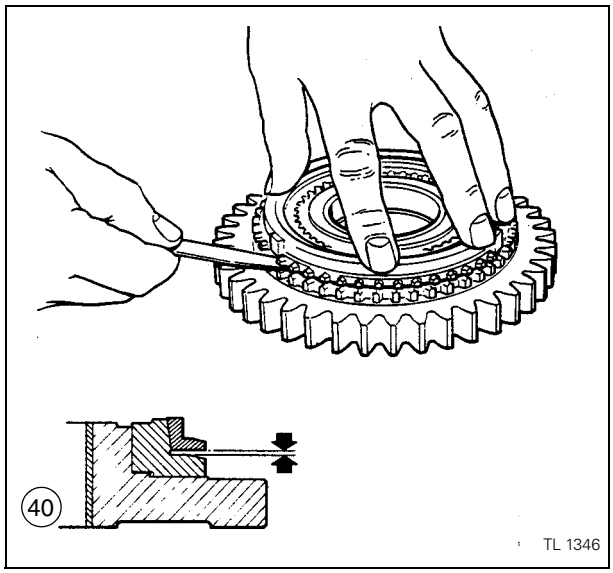
Clean and thoroughly inspect all parts for signs of wear and damage and replace if necessary. Renew all snap rings and circlips; when fitting ensure that they are correctly located in their grooves.

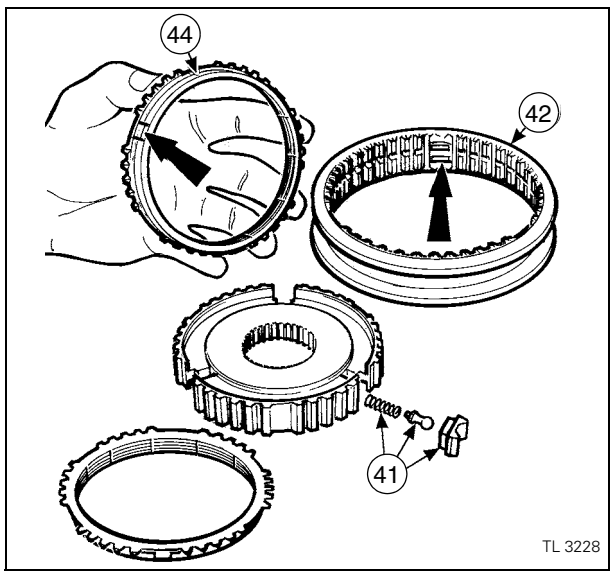
Re-assembly

Synchromesh Hub Assemblies

41. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.
42. Place the sliding coupler over the hub ensuring that the double width splines in the coupler are opposite the slots in the hub.
43. Press the coupler down into place easing the spring loaded blocks into position.
44. Position the baulk rings so that the locating blocks fit into the slots in the hub. Use petroleum jelly (NOT grease) to retain the components in position.







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45. Put the assemblies to one side until the main shaft is ready to be assembled.

Layshaft

46. Press the front roller bearing onto the shaft if it has been removed.
47. Replace the front roller bearing circlip (12 speed only).
48. Place 3rd and 4th gear in the bottom of the gearbox, 4th gear is the larger gear.
49. Pass the lay shaft through the front of the gearbox fitting 4th gear and 3rd gear.
50. Continue pushing the shaft rearwards until you can fit the constant mesh gear(s) in the front.
51. 12 Speed, fit the constant mesh gear.
52. 24 Speed, fit the smaller gear (Fast) first, then the spacer and larger gear (Slow).
53. Now push the shaft fully forward so you can install the two split rings.
54. Push the shaft back to its correct position in the gearbox and place a block of wood between the front of the layshaft and the gearbox casing.
55. Drive the rear roller bearing onto the end of the shaft and into the casing, (take care, drive on the inner and outer part of the race together.
56. Remove the block of wood and replace the snap rings at both ends of the shaft.
57. Ensure that the shaft is fully forward and check that the layshaft turns freely.
58. Check that the inside of the gearbox is clean.

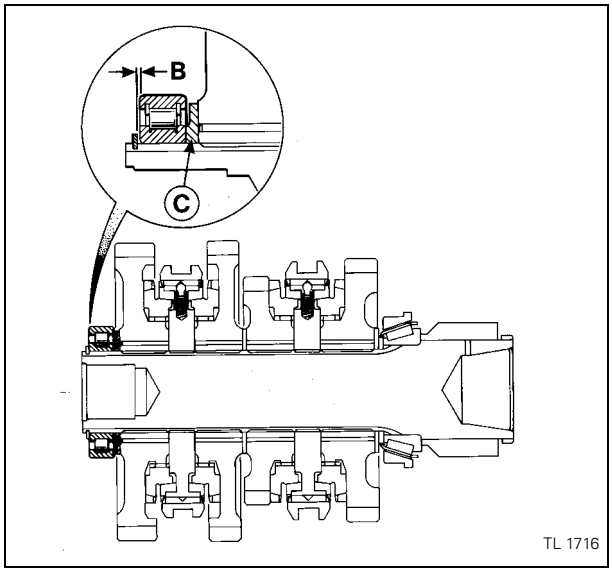
Mainshaft

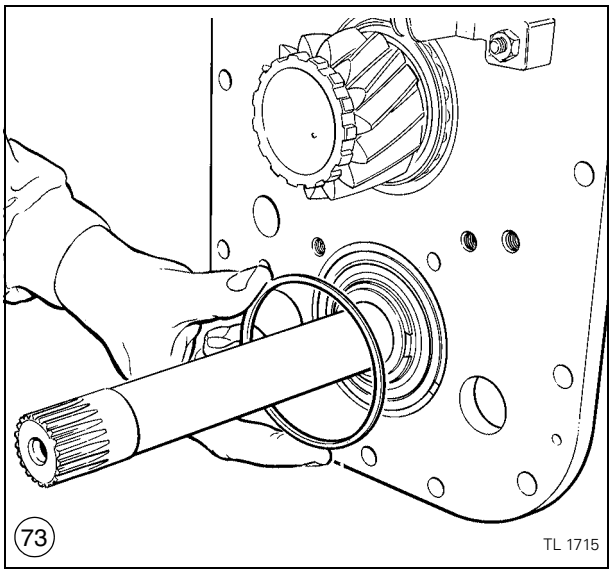
If any of the components on the mainshaft have been replaced it will be necessary to carry out a running clearance check as follows:

59. Assemble the main shaft on the bench complete with all hubs, gears, bushes, bearings and thrust washers. Refit the circlip and measure gap 'B' between the front bearing and the circlip. The gap (end float) should be 0,080-0,30 mm (0.003-0.012 in). If your measurement falls outside the set limits, replace the calibrated thrust washer 'C' which sits between the bearing and 1st gear. Select a washer from the chart below to give the desired end float.

Thrust washer 'C' thickness chart		
Part No.	Metric	Imperial
3599 299 M1	3,4 mm	0.134 in
3598 644 M1	3,7 mm	0.146 in
3598 643 M1	3,9 mm	0.154 in
1671 888 M1	4,2 mm	0.164 in

60. Dismantle the mainshaft for assembly into the gearbox.





61. Ensure that the selector mechanism dowel bolt is in place before installation of the mainshaft. Use a drop of Lock 'n' Seal (Loctite 222) to retain it.
62. Make-up the mainshaft with the taper roller bearing, steel spacer and thrust washer.
63. Assemble the 3rd and 4th gear pack with the synchromesh hub and steel bushes.
64. Slide the mainshaft through the rear of the gearbox.
65. Lower the assembly down into the box with the 3rd gear (largest) to the rear, rest it on the lay shaft gears.
66. Pass the shaft through the 3rd/4th gear pack.
67. Install the thrust washer between the two sets of gears and the synchromesh units.
68. Assemble the 1st and 2nd gear pack with the synchromesh hub and steel bushes.

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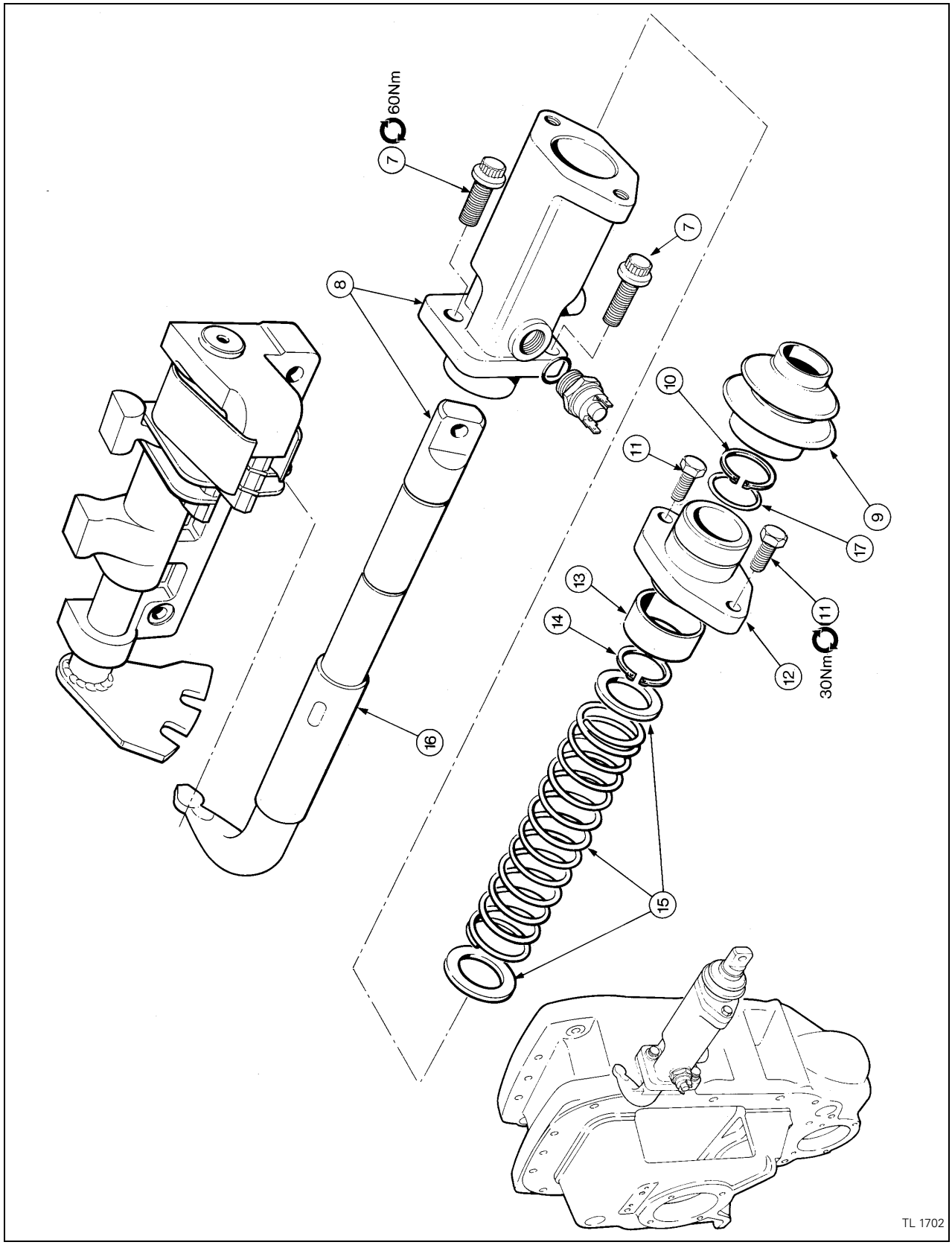
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69. Lower the assembly down into the box with the 1st gear (largest) to the rear, rest it on the lay shaft gears.
70. Slide the mainshaft through the 1st/2nd gear pack.
71. Fit the pre-selected thrust washer 'C' with the large flat side towards 2nd gear.
72. Hold the mainshaft and drive the front roller bearing into position in the centre web of the gearbox, (see care point in paragraph 55).
73. Replace the front circlip.
74. Check that the shafts in the gearbox rotate freely.
75. Fit the rear layshaft bearing retainer ring.
76. Install the PTO shaft.
77. Re-build the rest of the gearbox using procedures detailed in this manual.

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Power Shuttle Gearbox



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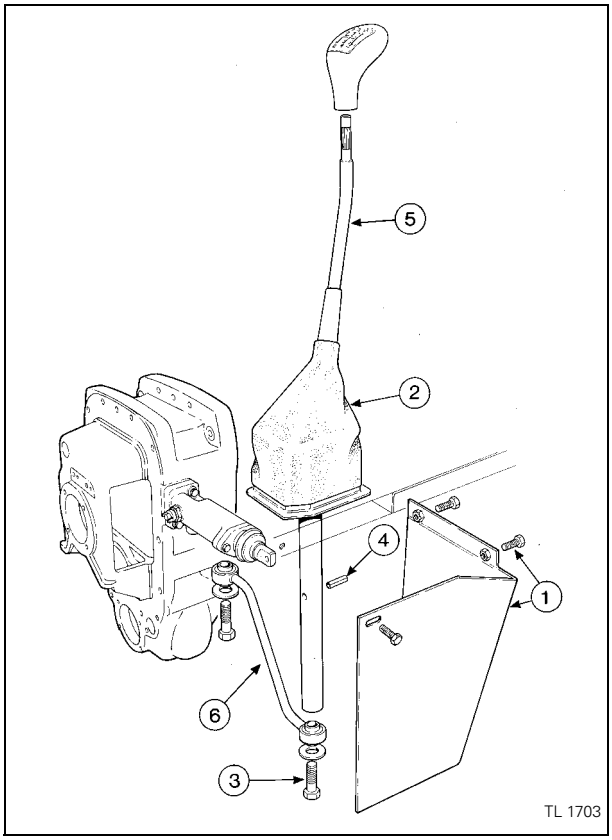
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MAIN GEARSHIFT LEVER

Removal and Refitment 14-5J

Removal

1. Remove the three bolts and the gear lever cover (tractors with single fuel tank only).
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the three 12 point cap screws holding the lever assembly to the range gearbox.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.



WARNING: Spring under compression.

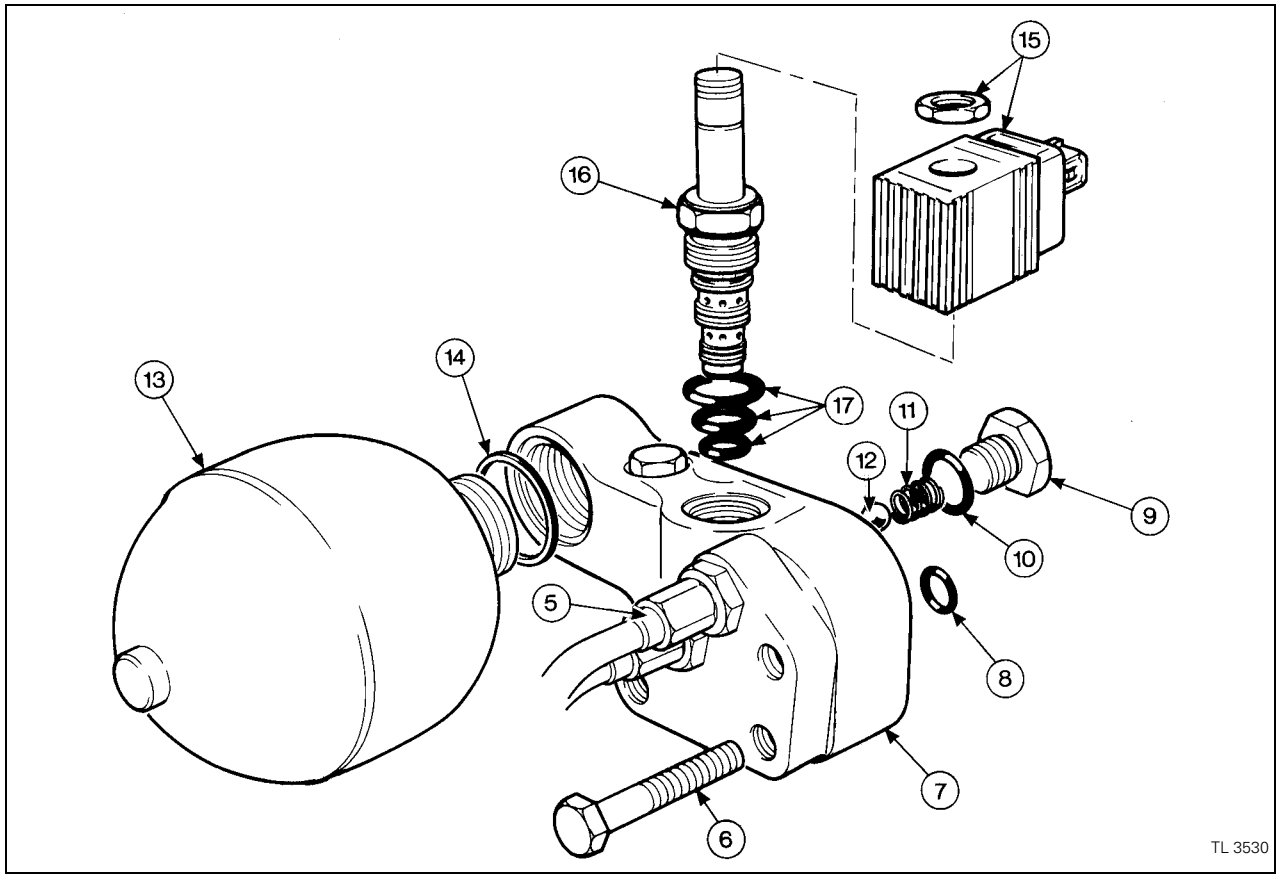
14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.
17. Remove the 'O' ring.

Refitment

18. Reverse procedure 1 to 14, except:
    - *a.* Replace the 'O' ring in the end cover.
    - *b.* Replace all circlips.
    - *c.* Lubricate the component parts during assembly with transmission oil.
    - *d.* Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
    - *e.* Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (25 lbf ft).
    - *f.* Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 60 Nm (45 lbf ft)

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24 SPEED CONTROL VALVE

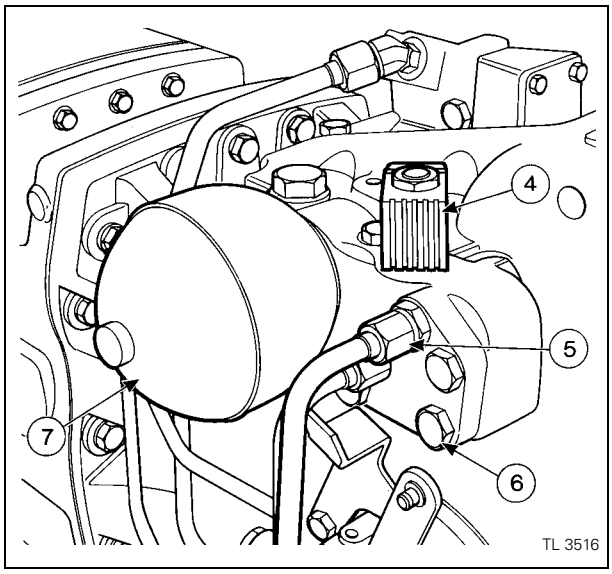
Overhaul **15-5J**

Dis-assembly

The 24 speed Power Shuttle Fast/Slow control valve is located on the left-hand side of the lift cover above the PTO control levers behind the fuel tank.

WARNING: Before working on the hydraulic system, exhaust the pressure from the hydraulic accumulator. Hydraulic oil pressure could cause personal injury.

1. Stop the engine.
2. With the ignition turned 'ON' operate the Speedshift button three times to exhaust any hydraulic pressure between the accumulator and the solenoid valve.
3. Turn 'OFF' the tractor ignition switch.
4. Disconnect the solenoid valve wiring.
5. Disconnect the hydraulic pipes.
6. Remove the three bolts.
7. Remove the valve assembly and place in a vice.



8. Remove and discard the 'O' ring between the valve block and lift cover.

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Check Valve

9. Remove the plug.
10. Remove the 'O' ring and discard.
11. Remove the spring.
12. Remove the check valve ball.

Accumulator

13. Unscrew the accumulator.
14. Remove the sealing ring from the valve block and discard.

Solenoid Valve

15. Unscrew the top nut and remove the coil.
16. Unscrew the valve from the block.
17. Remove and discard all 'O' rings.

Examination

Examine all components and replace any that are damaged or worn. Thoroughly clean all components and re-assemble using a small quantity of transmission oil.

Re-assembly

18. Reverse procedures 1 to 17 except:
    a. Before fitting the accumulator install a new sealing ring into the valve body.
    b. Tighten the solenoid valve body to a torque of 10 Nm (7 lbf ft). This is to prevent distortion of the valve body.
    c. When installing the coil, apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the nut (15) to prevent it vibrating loose and tighten only finger tight.
    d. Tighten the three valve body bolts to a torque of 60 Nm (45 lbf ft).
19. After the valve assembly has been installed, start the engine and check for operation and oil leaks.

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COOLING OIL CONTROL VALVE

Removal and Refitment **16-5J**

The Cooling Oil Control Valve is located on the right-hand side of the gearbox.

On tractors fitted with a high visibility hood, the battery carrier needs to be swung out from under the tractor to gain access.

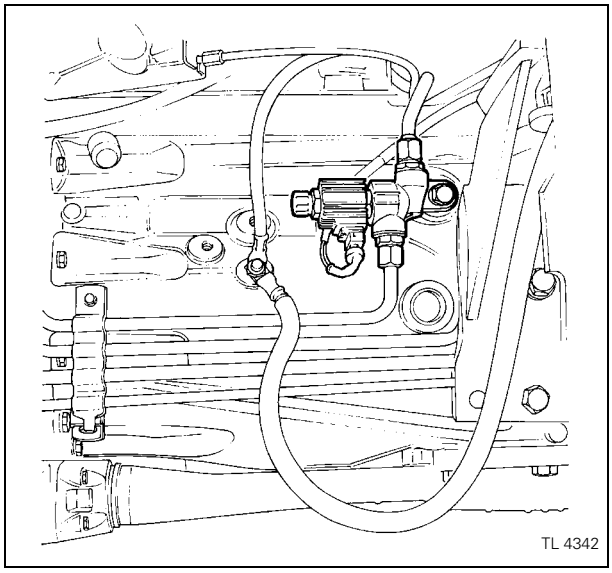
On tractors fitted with an auxiliary fuel tank, the tank needs to be slid out slightly from under the tractor to gain access.

Removal

1. Disconnect the electrical plug from the solenoid.
2. Disconnect the pipes from the valve.
3. Remove the capscrew and withdraw the Cooling Oil Control Valve.

Refitment

4. Reverse procedures 1 to 3.


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COOLING OIL RELIEF VALVE

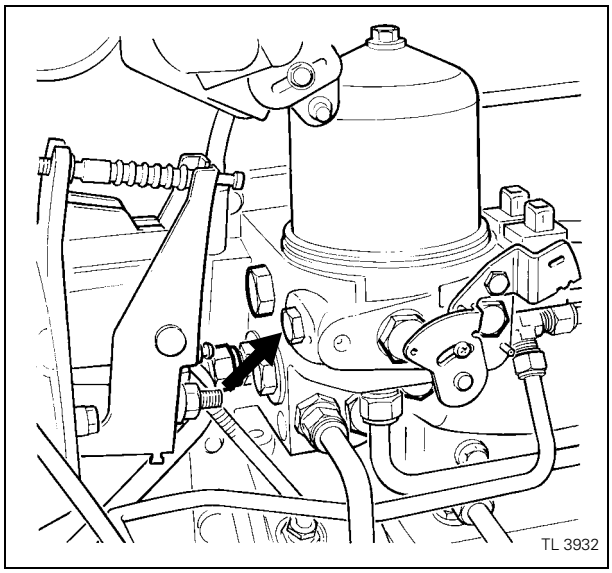
Removal and Refitment **17-5J**

Removal

1. Remove the valve from the auxiliary system manifold.
2. Examine the 'O' rings for damage. Renew if necessary.

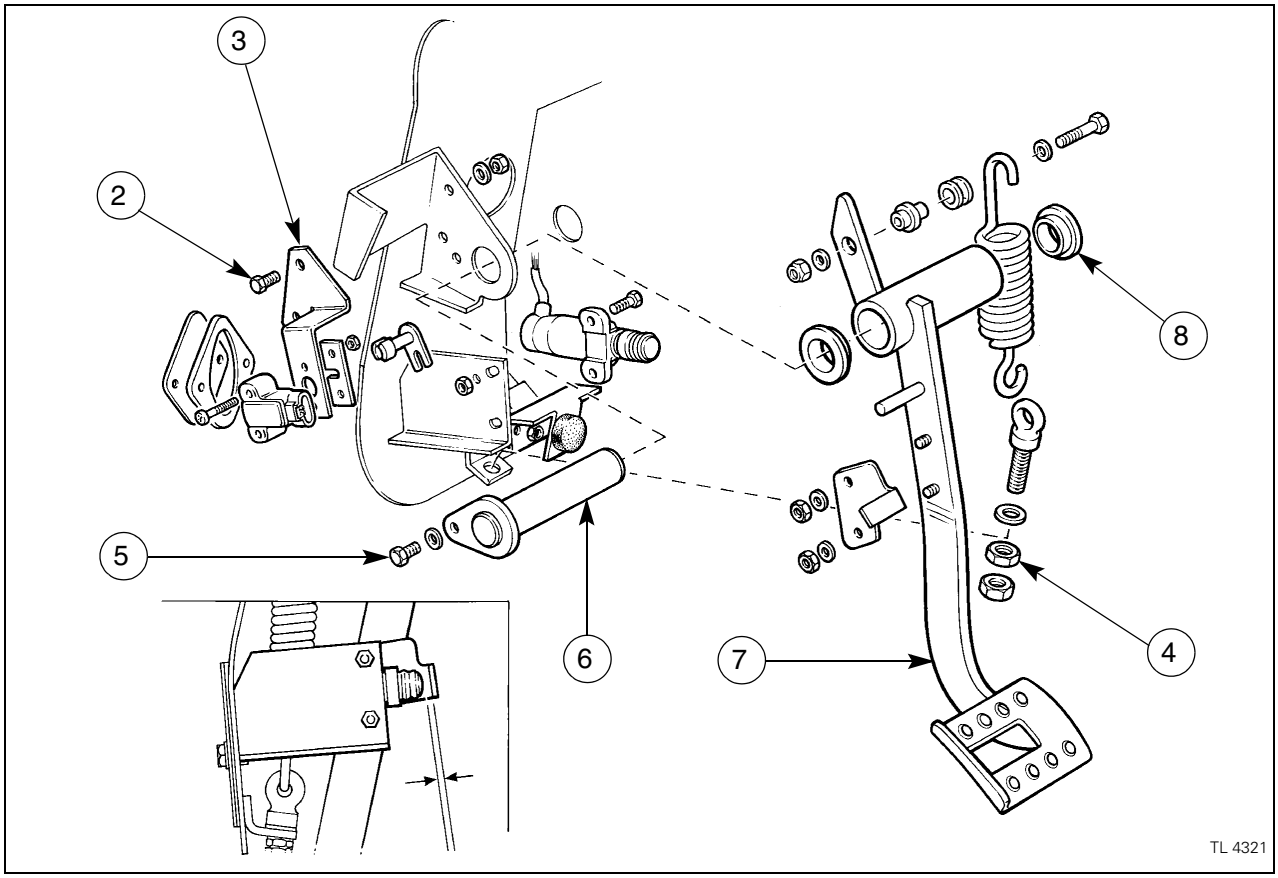
Refitment

3. Reverse procedures 1 and 2, except:
   a. Tighten the cooling oil relief valve to a torque of 50 Nm (37 lbf ft).


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CLUTCH PEDAL ASSEMBLY

Removal and Refitment **18-5J**

Special Tools:
MF.518 Diagnostic Lead
MF.3021 Diagnostic Software

Removal

1. Remove the lower panel under the instrument panel.
2. Remove the two screws, washers and nuts.
3. Disconnect the plug and remove the bracket complete with the sensor.
4. Remove the two nuts from the eyebolt and remove the spring.
5. Remove the bolt from the end of the pivot pin.
6. Withdraw the pivot pin.
7. Lift out the clutch pedal.
8. If necessary, renew the clutch pedal bushes.

Refitment

9. Reverse procedures 1 to 8 except:
   a. Lubricate the pivot shaft and bushes with a lithium-based grease.
   b. The gap between the coils of the clutch spring should be 1.60 mm (0.065 in).
10. Input the clutch pedal settings to the diagnostic software *(see operation 24-5J)*.

SAFETY SWITCH

Removal and Refitment **19-5J**

Removal

1. Remove the lower panel under the instrument panel.
2. Remove the two screws and nuts securing the safety switch.
3. Disconnect the plug and remove the safety switch.

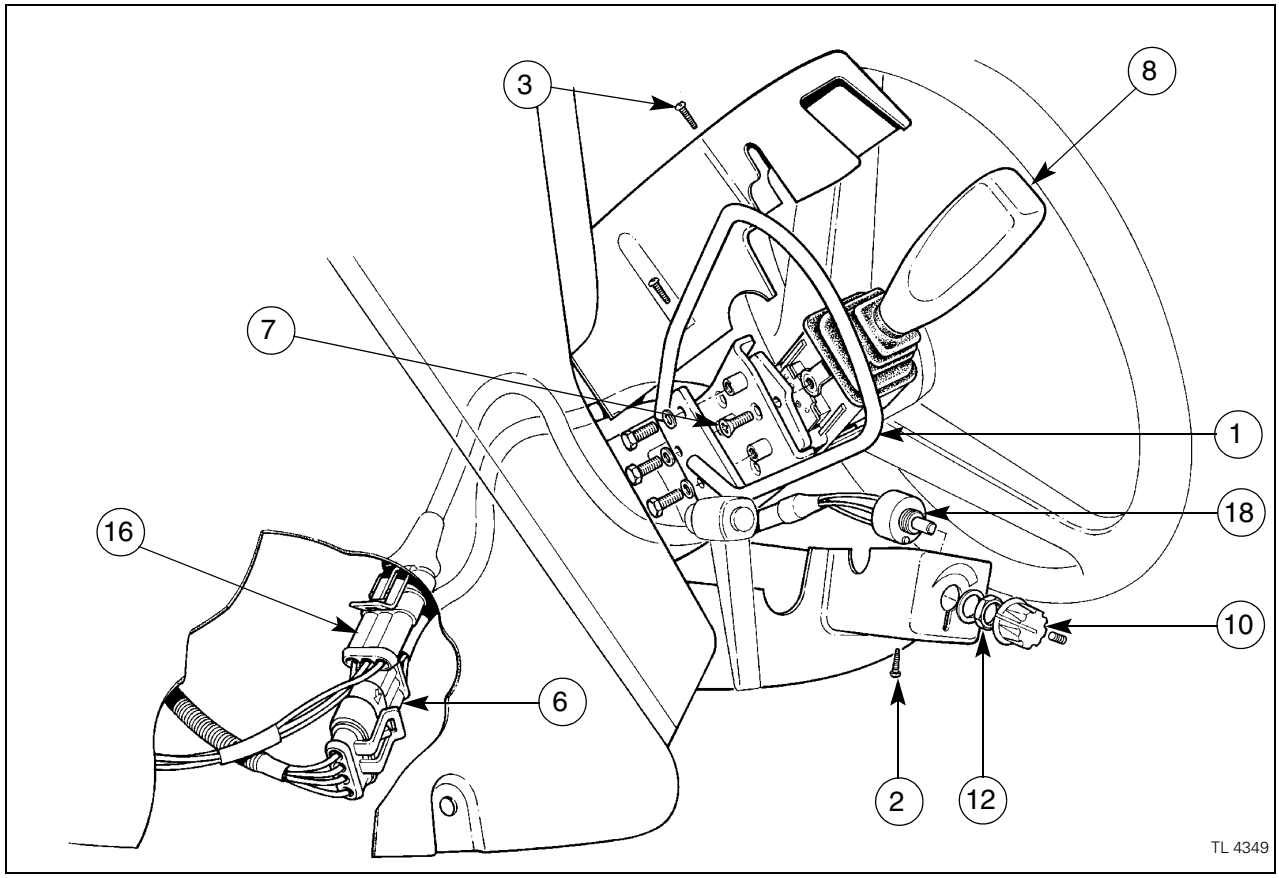
Refitment

4. Reverse procedures 1 to 3 except:
   a. With the clutch pedal fully down and the safety switch pressed fully in, the gap between the safety switch and the clutch pedal should be 2.00 mm (0.079in).

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Power Shuttle Gearbox



FORWARD/REVERSE SHIFT LEVER

Removal and Refitment 20-5J

Removal

1. Remove the guard.
2. Remove the five self tapping screws and the lower steering column cover.
3. Remove the two self tapping screws and the upper steering column cover.
4. Remove the instrument panel *(see operation 11-10A)*.
5. Remove the lower, left hand panel under the instrument panel.
6. Disconnect the plug.
7. Remove the three screws securing the switch to the bracket.
8. Remove the switch, pulling the cable out from the panel.

Refitment

9. Reverse procedures 1 to 8 ensuring that the insulator is fitted between the switch and the bracket.

COMFORT CONTROL

Removal and Refitment 21-5J

Removal

10. Unscrew the locking screw and remove the Comfort Control knob.
11. Remove the five self tapping screws and the lower steering column cover.
12. Unscrew the nut from the Comfort Control.
13. Remove the two self tapping screws and the upper steering column cover.
14. Remove the instrument panel (*see operation 11-10A*).
15. Remove the lower, left hand panel under the instrument panel.
16. Locate the plug at the end of the Comfort Control wiring harness.
17. Disconnect the plug.
18. Remove the Comfort Control, pulling the cable out from the panel.

Replacement

19. Reverse procedures 10 to 18.
    Ensure that all plugs are correctly fitted.

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MICROPROCESSOR

Removal and Refitment 22-5J

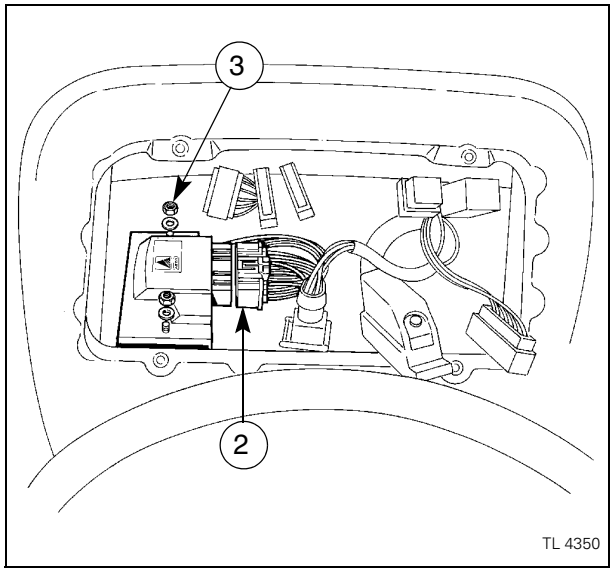
Removal

1. Remove the instrument panel *(see operation 11-10A)*.
2. Disconnect the plug on the microprocessor.
3. Remove the two nuts and washers and withdraw the microprocessor.

Refitment

4. Reverse procedures 1 to 3.
   Ensure that the plug in the microprocessor and the three plugs in the back of the instrument panel are correctly fitted.

NOTE: *If the microprocessor is renewed the diagnostic software must be used to set the system parameters (see operation 24-5J).*



TRANSMISSION OIL

Cleaning 23-5J

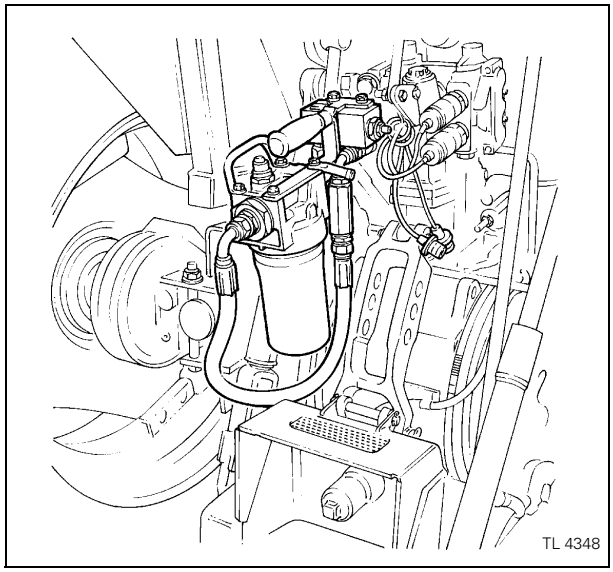
Special Tools:
MF.3025 Filter Kit

After any work has been carried out on the transmission it is important that the transmission oil is cleaned thoroughly. To clean the oil the following procedure should be adopted:

1. Fit special tool MF.3025 Filter Kit to the tractor.
2. Start the tractor engine and run at 1000 rev/min.
3. Push the hydraulic control lever marked '1' and '2' forward for five minutes to let oil flow through the filter.
4. With the lever still held forward, drive the tractor around if possible for at least another ten minutes.

NOTE: *While driving it is advisable to make sharp turns.*

5. After a minimum of fifteen minutes filtering the oil, stop the engine.
6. Relieve the hydraulic pressure.
7. Remove MF.3025 from the tractor.



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DIAGNOSTIC SOFTWARE

Check **24-5J**

Special Tools:
MF.518 Adapter Harness
MF.3021 Diagnostic Software Computer

NOTE: *To install the MF.3021 Diagnostic Software on your computer please refer to the instructions supplied with the software.*

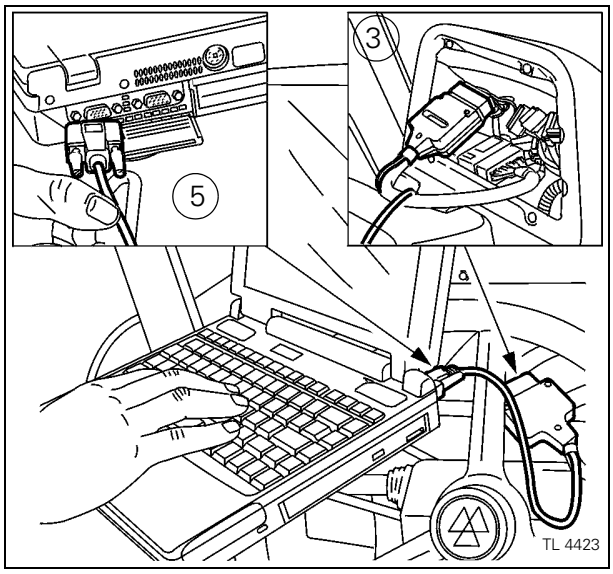
1. Remove the instrument panel *(see operation 11-10A)*.
2. Disconnect the harness from the microprocessor.
3. Connect MF.518 between the tractor wiring harness and the microprocessor.
4. Make sure that the computer is switched 'OFF'
5. Connect the other end of MF.518 to the RS232 connector on your computer.
6. Switch on the computer.
7. Switch on the tractor's ignition.
8. Select 'START' then 'PROGRAMS' then 'MFSHELL' from the computer's taskbar.
9. The MF.3021 software will now be launched.

Setting the Clutch Pedal Position.

10. Start the MF.3021 software.
11. Select 'SERVICE' from the software menu.
12. Select 'SET THE CLUTCH PEDAL POSITION'
13. Depress the clutch pedal fully down. With the clutch pedal fully down click the 'OK' button.
14. Let the clutch pedal come up to its fully raised position. Now click the 'OK' button again.
15. Cancel the request to set the tyre size.

Setting the Tyre Size.

16. Start the MF.3021 software.
17. Select 'SERVICE' from the software menu.
18. Select 'SET THE TYRE SIZE'.
19. Type in the speedometer constant for the tyres fitted to the tractor. *(see page 11A-3)* and click the 'OK' button.
20. Type in the rolling radius of the tyres. This is found by measuring from the centre of the rear axle to the ground. The figure must be in millimetres. Click the 'OK' button.
21. The tyre size is now set.



Viewing the Error Log.

22. Start the MF.3021 software.
23. Select 'VIEW' then 'VIEW THE ERROR LOG' from the menu.
24. A list of the error codes and the number of occurences of each is now displayed. The error log can be cleared if required by clicking the 'CLEAR ERROR LOG' button, then the 'YES' button.

NOTE: *The error log only shows the last 255 errors.*

Checking the Switch and Solenoid Status.

NOTE: This feature is not available on microprocessors fitted with Version 3 software.

25. Start the MF.3021 software.
26. Select 'PROBE' from the menu.
27. Click to check the status of the solenoids and the clutch pedal down switch.

NOTE: The status of the solenoids and the clutch pedal down switch are not monitored continuosly.

28. The status of the solenoids and the clutch pedal down switch can now be viewed.
29. The forward and reverse pressure switches are continuosly monitored and their status will be shown.

NOTE: *The engine must be running, with the main gear lever in neutral to check if these switches operate correctly.*

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SECTION 6

Rear Axle

INDEX

6A	BRAKES
6B	CROWNWHEEL AND PINION
6C	REAR AXLE
6D	DRAWBAR AND LINKAGE
6E	WHEELS AND TYRES

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Brakes

Section 6 - Part A

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2-6A	Parking Brake Hand Lever - Removal and Refitment	6A– 6
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Brakes

SPECIFICATION

Type	Multi-disc oil immersed.
Model	T.S. brake (Tangential Slave).
Diameter	222,4 mm (8.75 in).
No. of plates:	
All models	4 friction, 2 steel each side.
Lining material	Sintered bronze.
Depth of groove	0,3 mm (0.012 in) new.
Operation	Hydraulic independent.
Parking brake	Cable operated on both brakes independent of the foot brake.
Master cylinders:	
Type	C.C.V. Binocular master cylinder.
Quantity	2 - one serving each rear wheel.
Piston diameter	15,9 mm (0.620 in).
Push- rod to piston clearance	1 mm (0.040 in).
Pedal movement to obtain clearance	5-10 mm (0.2-0.4 in).
Slave cylinders:	
Type	Hydro-mechanical.
Quantity	2 - one in each rear axle.
Brake fluid:	
Type	Mineral based (Green).
Massey Ferguson part number	3405 389 M1.

Special Tools:

MF.467'	Brake pull rod seal protector.
MF.468	Dust cover replacer.
MF.3001	Pressure test kit.

Bolt Torques:

Bleed nipple	19 Nm (14 lbf ft).
Brake cover plate to axle housing	14 Nm (10 lbf ft).
Brake pipes	22 Nm (16 lbf ft).
Balance brake pipe	10 Nm (7 lbf ft).
Slave cylinder to cover plate	26 Nm (20 lbf ft).

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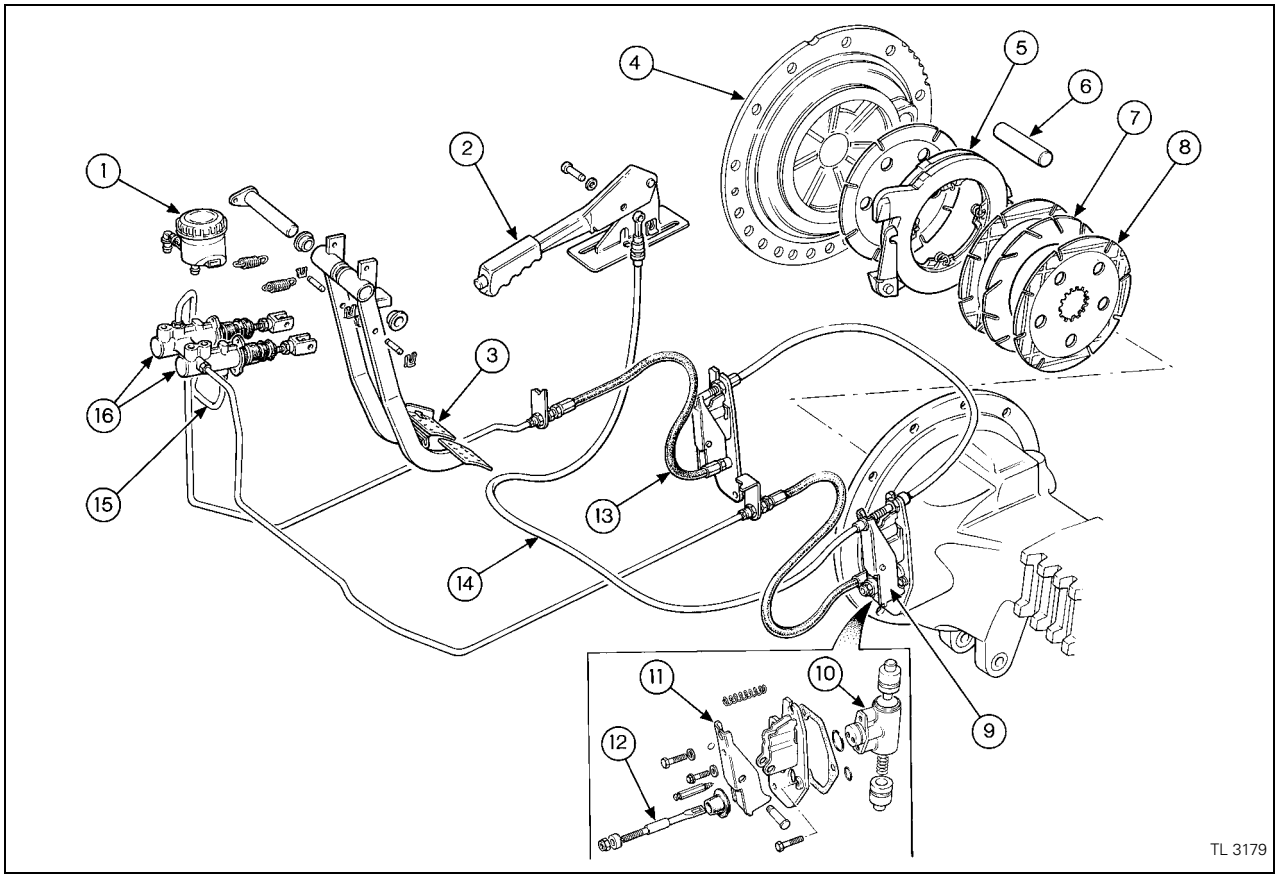


Fig.1 Braking System

1. Brake fluid reservoir.
2. Parking brake.
3. Independent brake pedals.
4. Carrier plate.
5. Actuator unit.
6. Reaction pin
7. Fixed steel plates.
8. Rotating friction plates.
9. Brake unit.
10. Slave cylinder.
11. Parking brake lever.
12. Pull rod.
13. Flexible brake pipes.
14. Parking brake cable.
15. Balance pipe.
16. Master cylinders.

GENERAL DESCRIPTION

The tractor is fitted with multi-disc, oil cooled brakes fitted in the axle housing between the differential carrier plates and the epicyclic unit.

The brakes are foot operated by two independent hydraulic master cylinders located in front of the instrument panel. They pressurise slave cylinders mounted inside the rear axle.

The right-hand pedal operates the right-hand brake and the left-hand pedal operates the left-hand brake to assist turning when working in the field. For highway use the brakes are used together by operating an interlocking latch which joins the two pedals together.

Pressure on the brake pedal applies hydraulic pressure to the slave cylinders which operate an actuator unit in the rear axle. The brakes comprise of rotating middle (friction) discs splined to each half shaft, these in turn contact the fixed steel friction faces of the axle housing and carrier plate and steel intermediate plates held stationary by a reaction pin.

The actuator unit consists of two cast iron actuator plates, held together by tension springs and separated by steel balls located in inclined ramps. The slave cylinder (1, Fig.2) is mounted between two lugs (2), one on each disc (3). When pressure is applied to the cylinder the two lugs are pushed apart, this rotates one of the discs relative to the other, and the steel balls (4) ride up their inclined seats and so spread the discs apart. These come into contact with the rotating (friction) discs, which are splined to the half shaft being braked.

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The actuator unit will move slightly in the direction of rotation until the torque ear of one of the discs comes in contact with the reaction pin (5) in the housing. The other disc tends to rotate further, increasing the angular displacement between the discs, and assisting the braking action. When the brake pedal is released, the tension springs cause the discs to return to their normal position.

A parking brake is provided which operates both brakes together, independent of the foot brakes, mechanically through a single cable control (14, Fig.1). When the parking brake is applied the lever (6, Fig.2) pulls the pull rod (7) which in turn operates the bellcrank (8) on one of the actuator plates. As the bellcrank pivots it rotates the actuator plate, the balls roll up the inclined seats and the brake is applied.

Adjustment is made by altering the effective length of the pull rod (7) with the nyloc nut (9).

Master Cylinder

Two master cylinders are employed on the tractor, one operating the right-hand brake (1, Fig.3), the other the left-hand brake (2), each having an independent pedal which can be mechanically linked together. The cylinders are fed from a single fluid reservoir (3) and are interconnected hydraulically by a bridge pipe (4). When the brake pedals are locked together the compensating valves are opened, allowing fluid to transfer from one cylinder to the other through a balance pipe (5) thus equalising pressures to each slave cylinder, thus preventing the tractor to pull to one side. Under single pedal braking the valve in the non operating cylinder will be flow closed thus preventing fluid transfer.

The basic operating principle of the unit, ignoring the compensating valve arrangements, is similar to that of a standard master cylinder.

Trailer Brakes

A hydraulic trailer braking system is available on the 4200 Series Tractors and offers simultaneous operation of the tractor and trailer brakes controlled by the movement of the tractor brake pedals.

This system eliminates the need for a separate mechanical or hydraulic trailer braking mechanism and enables the tractor and trailer to be braked safely as one unit.

Hydraulic oil for the trailer brake system is taken from the auxiliary hydraulic system before it passes to the main control valve. The trailer brake valve takes priority over the auxiliary control valve.

The trailer brake valve regulates the flow and pressure of oil to the trailer brakes and is fully automatic in operation when the operator presses or releases the tractor brakes. the hydraulic sensing of the brake circuit is carried out by a pipe between the right-hand brake slave cylinder and the tractor brake valve.

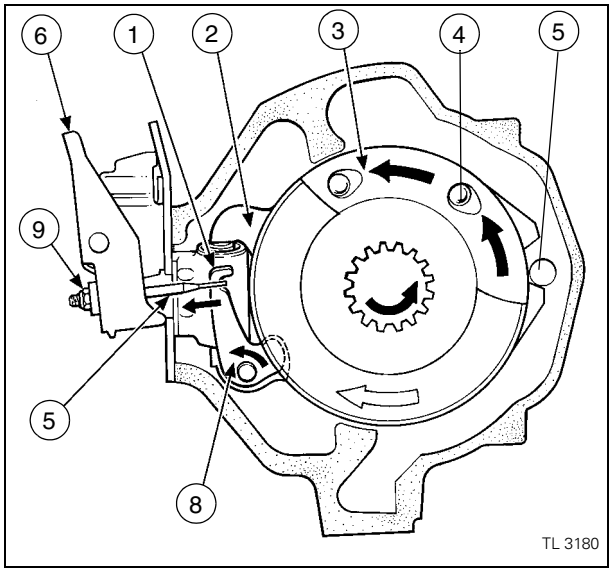


Fig.2

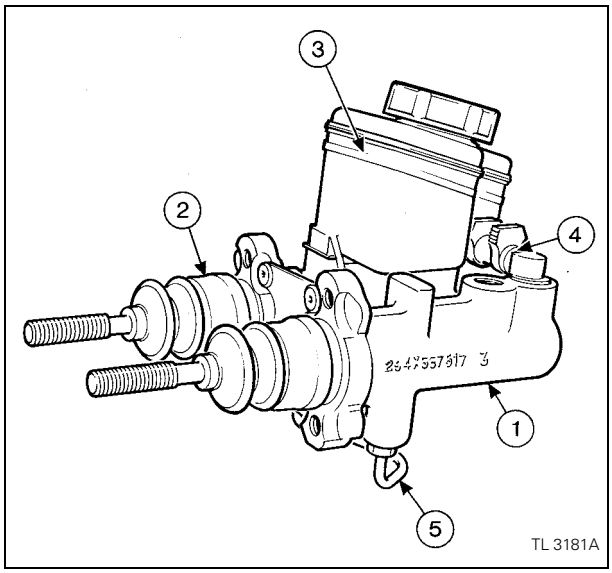


Fig.3

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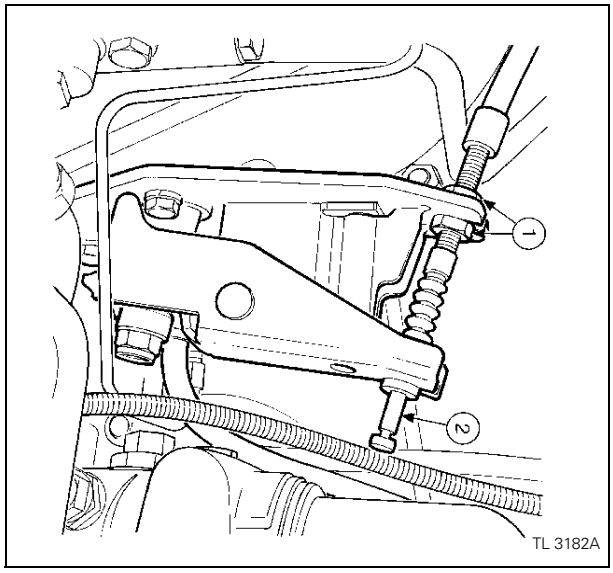
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PARKING BRAKE CABLE

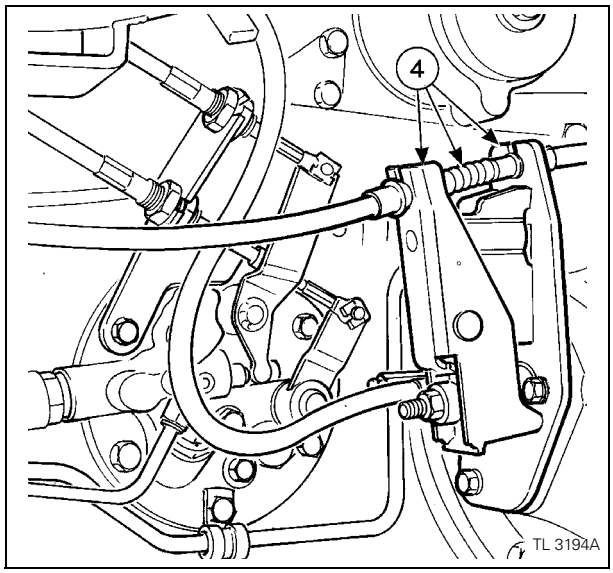
Removal and Refitment 1-6A

Removal

1. On the right-hand brake cover plate assembly, slacken the two cable adjusting nuts to the left so that the inner cable can be unhooked from the lever.
2. Unhook the outer cable from the cover plate assembly.
3. From the rear of the tractor pull the cable out from the right-hand side.



4. Disconnect the cable from the left-hand brake cover plate and lever.
5. From the right-hand side of the tractor pull the brake cable from over the transmission.



6. On the parking brake lever remove the spring clip and disconnect the end of the brake cable.
7. Remove the cable from the tractor.

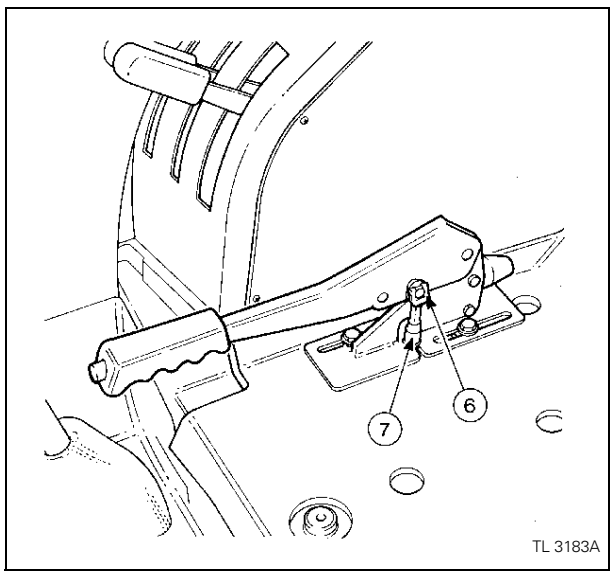
Refitment

8. Reverse procedures 1 to 7 except:

a. Route the brake cable over the transmission, through the left-hand brake cover plate, to the right-hand cover plate. At the rear of the tractor the cable passes under the lip of the top cover. Ensure that there are no sharp bends.

b. Check that the brake cable operates freely and that the warning light on the panel illuminates when applied.

c. Adjust the brakes, *(see operation 7-6A)*.



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PARKING BRAKE HAND LEVER

Removal and Refitment 2-6A

Removal

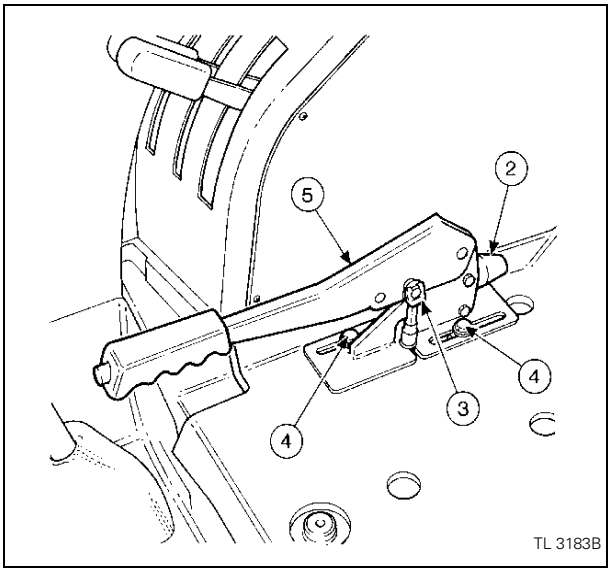
1. Slacken the brake cable adjusting nuts, *(see operation 1-6A)*.
2. Disconnect the plug from the warning light switch.
3. Remove the spring clip and slide the cable off the clevis pin.
4. Remove the two bolts securing the parking brake assembly to the floor.
5. Remove the parking brake assembly leaving the cable protruding through the hole.
6. Remove the switch from the bracket.

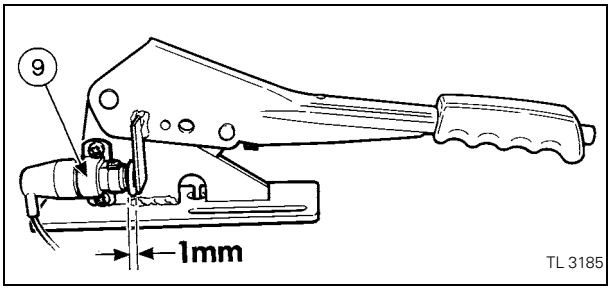
Refitment

7. Reverse procedures 1 to 6.
8. Ensure that the brakes operate freely.

Brake Switch Adjustment

9. Adjust the warning light switch. This is important, on four-wheel drive tractors, it operates four-wheel engagement to give four-wheel braking. Adjust as follows:
10. With the parking brake in the OFF position.
11. Press the brake switch plunger in.
12. Check the clearance between the plunger and the hand lever, it should be 1 mm (0.039 in).
13. If adjustment is required, slacken the two screws and re-set the position of the switch.
14. Adjust the brakes, *(see operation 7-6A)*.



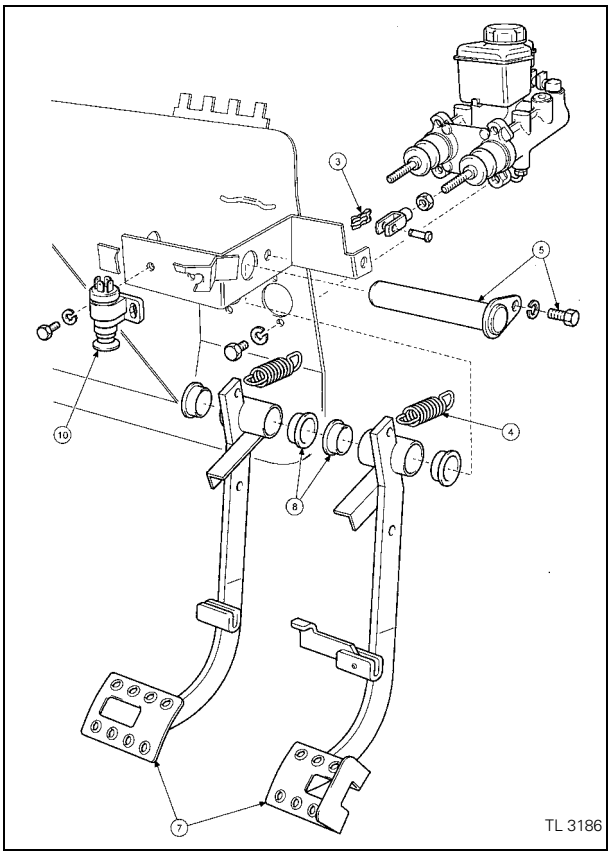


BRAKE PEDALS

Removal and Refitment 3-6A

Removal

1. Remove the panel under the instrument panel.
2. Remove the upper instrument panel cover.
3. Remove the two spring clips and clevis pins from the brake pedals.
4. Remove the two return springs.
5. Remove the bolt and pivot pin.
6. Withdraw both brake pedals from the support bracket.
7. If necessary, remove the bushes from the pedals.



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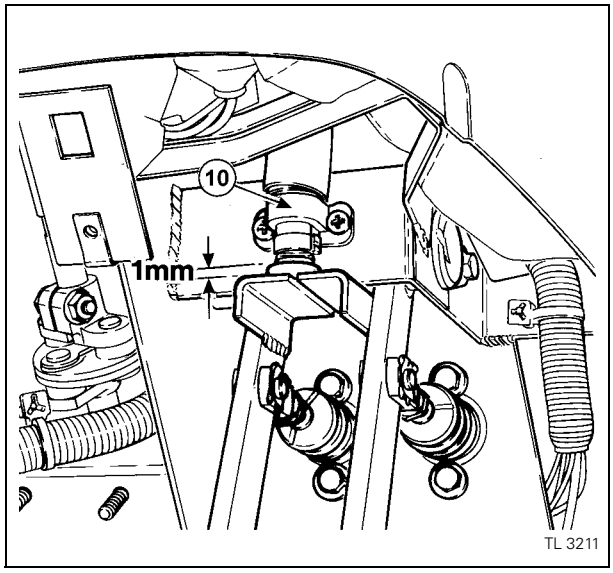
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Refitment

8. Lightly lubricate the pivot shaft and bushes with a lithium based grease.
9. Reverse procedures 1 to 7.

Brake Switch Adjustment

10. Adjust the warning light switch. This is important, on four-wheel drive tractors, it operates four-wheel drive engagement to give four-wheel braking. Adjust as follows:
11. With the foot brake pedals in the OFF position.
12. Press the brake switch plunger IN.
13. Check the clearance between the plunger and the brake pedal, it should be 1 mm (0.039 in).
14. If adjustment is required, slacken the two screws and re-set the position of the switch.



BRAKE MASTER CYLINDER

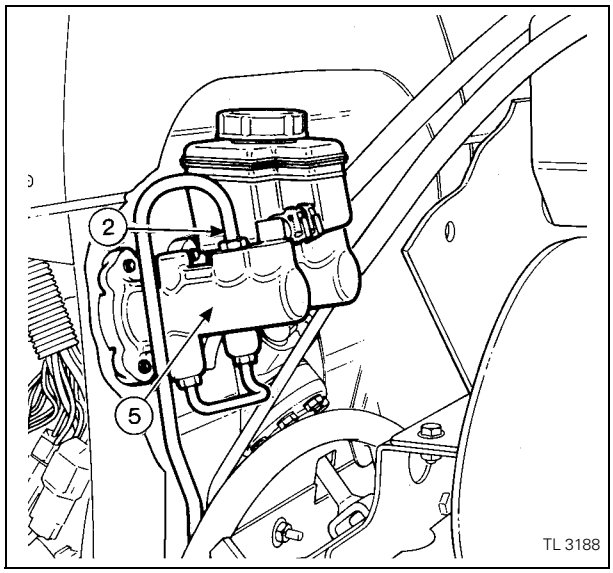
Removal and Refitment 4-6A

Removal

1. Remove the panel under the instrument panel.

NOTE: *The two master cylinders are assembled as one unit, they must be removed, repaired and refitted as one unit.*

2. Disconnect the two pressure pipes from the master cylinders.
3. Remove the spring clip and clevis pins from the foot pedals.
4. Unscrew the four bolts holding the master cylinders to the bulkhead.
5. Remove the master cylinder assembly.

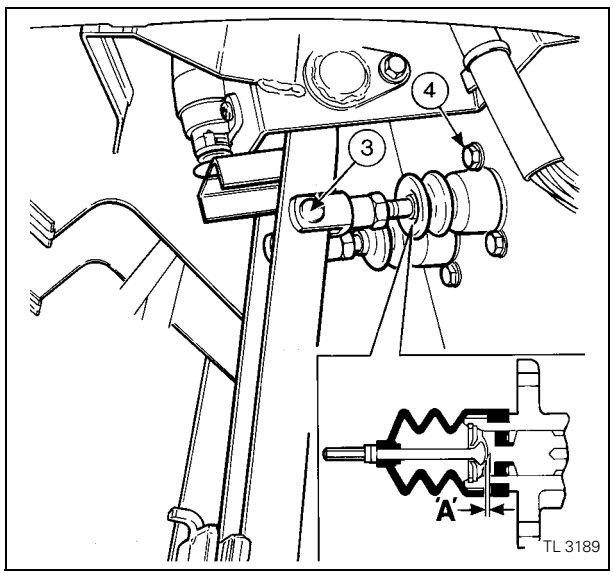


Refitment

6. Reverse procedures 1 to 5 except:

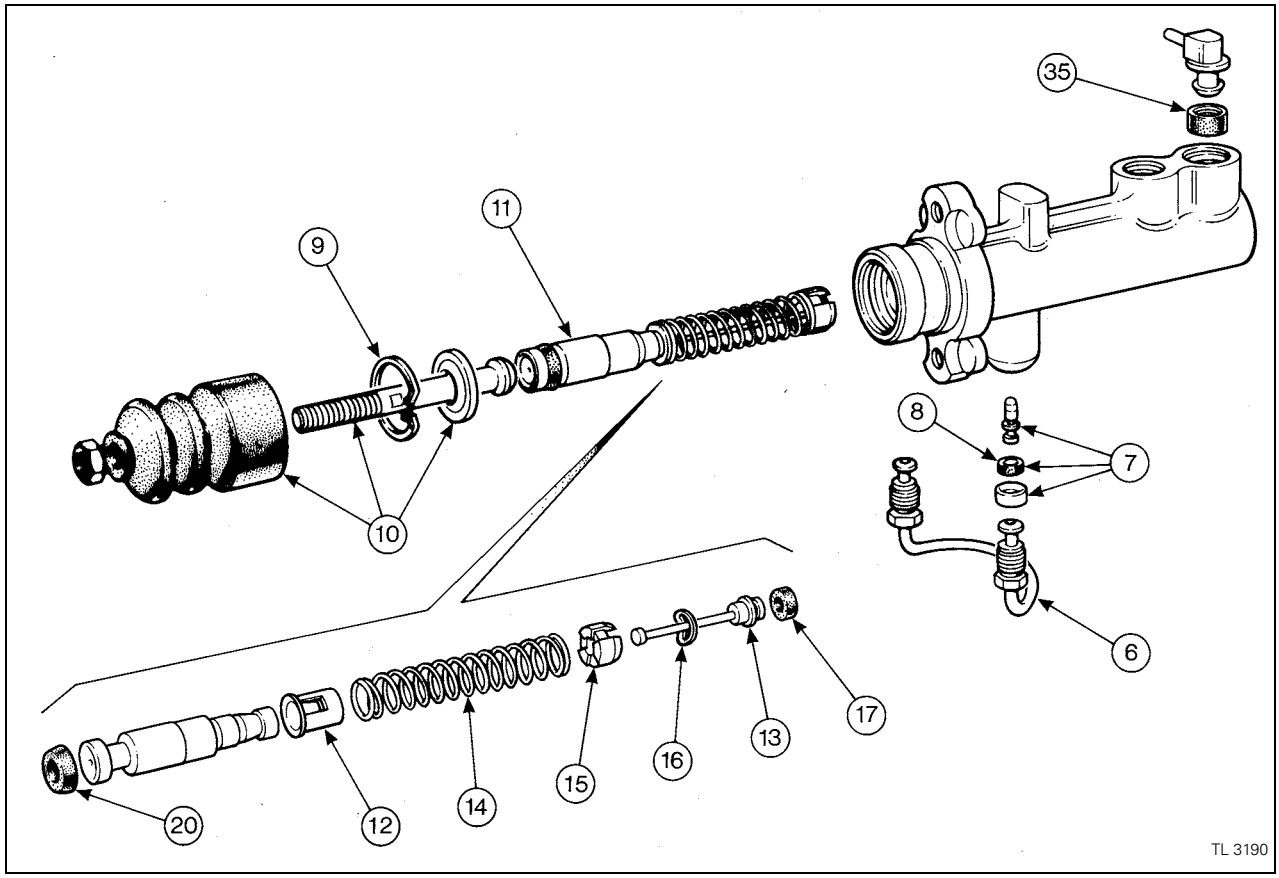
IMPORTANT: *Push rod to plunger clearance is critical and must be set as follows:*

7. Depress the foot brake pedal to stroke the master cylinder and allow the pedal and plunger to return freely.
8. Adjust the push rod to plunger clearance dimension '**A**' to 0,6-1,3 mm (0.025-0.050 in). This clearance is inaccessible but it can be assumed as correct when the movement of the foot pedal travel is approximately 5-10 mm (1/4 to 3/8 in).
9. Remove the air from the system, *(see operation 6-6A).*
10. Balance and adjust the brakes, *(see operation 7-6A).*



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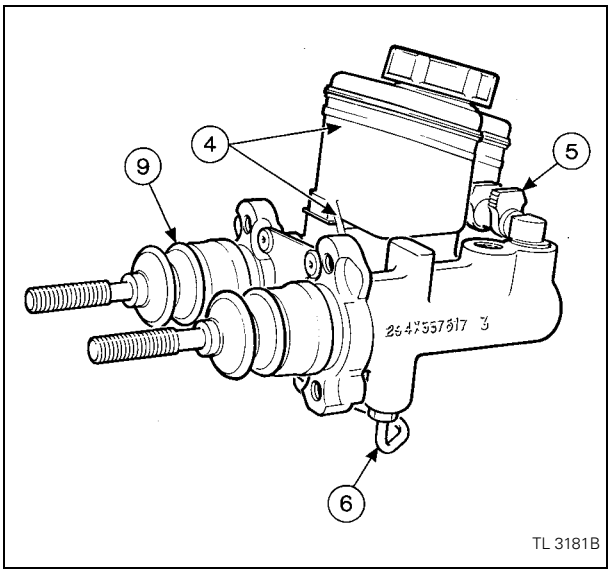


BRAKE MASTER CYLINDER

Overhaul 5-6A

Dis-assembly

1. Remove the master cylinder assembly, *(see operation 4-6A)*.
2. Drain out any surplus fluid.
3. Secure the cylinder assembly in a bench vice but do not clamp with excessive force.
4. If necessary, remove the fluid reservoir by cutting the plastic tie and prising the inter-connecting elbow and reservoir from the master cylinder bodies. They are sealed with rubber rings.
5. Remove the two hose clips and bridge pipe.
6. Remove the cylinder from the vice and invert, remove the balance pipe.
7. Remove the pipe insert and flow valve assembly.
8. Remove the flow valve seal.
9. Pull back the rubber dust cover and remove the circlip with a pair of long-nosed pliers.
10. Remove the rubber cover, retaining washer and push rod.



11. The plunger assembly can now be removed either by shaking the cylinder or gently applying compressed air to the inlet port, whilst blocking off the remaining ports.

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12. Lift the leaf **'A'** of the spring retainer and remove the spring assembly from the plunger.
13. Compress the spring to free the valve stem from the key hole of the spring retainer, thus releasing the tension of the spring.
14. Remove the spring.
15. Remove the valve spacer.
16. Remove the curved washer.
17. Remove the valve seal from the valve head.
18. Select a small screwdriver and round off and highly polish the end of the blade.

NOTE: *This is most important, for if the surface of the plunger is damaged in any way, a new master cylinder must be fitted.*

19. Squeeze the seal until the polished blade of the screwdriver can be inserted.
20. Lever up the seal as shown and remove from the plunger by pressing the seal off the plunger.

Examination

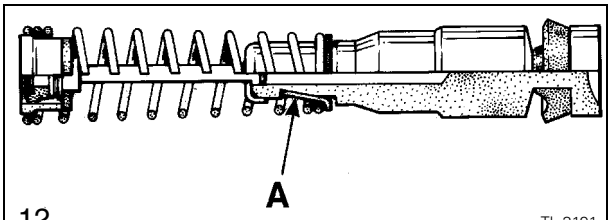
If the seals are loose on the plungers and appear oversize suspect contamination. If contamination is suspected, the system must be thoroughly flushed out and all seals in the master cylinders, slave cylinders and hoses changed without delay.

Examine the plunger and cylinder bore for visible score marks, ridges and corrosion. Check that the bore is smooth to the touch. If there is the slightest doubt as to the condition of the part, a new master cylinder must be fitted. Inspect all other components to see that they are in good condition.

Re-assembly

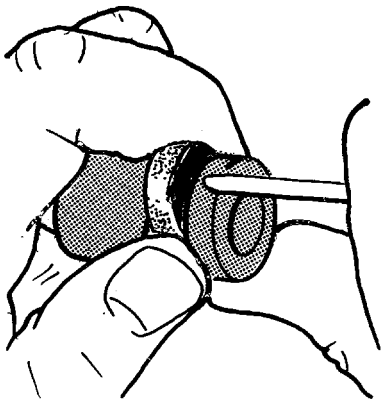
WARNING: The brake system contains special synthetic rubber components requiring petroleum (mineral) based oil (colour green), use only the brake oil recommended in the specification part of this section.

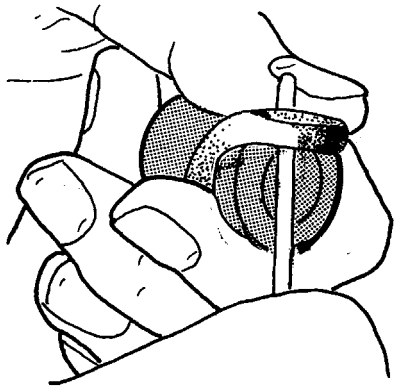
21. Use the new parts from the repair kit when re-assembling.
22. Lubricate the inner diameter of the new plunger seal with unused brake fluid and fit the seal to the plunger as shown.

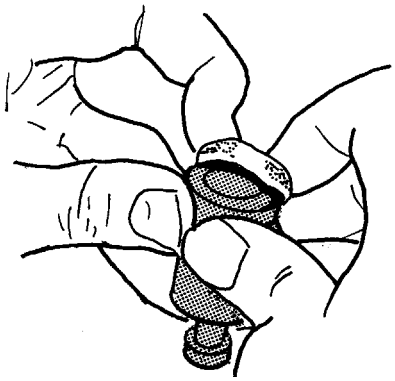


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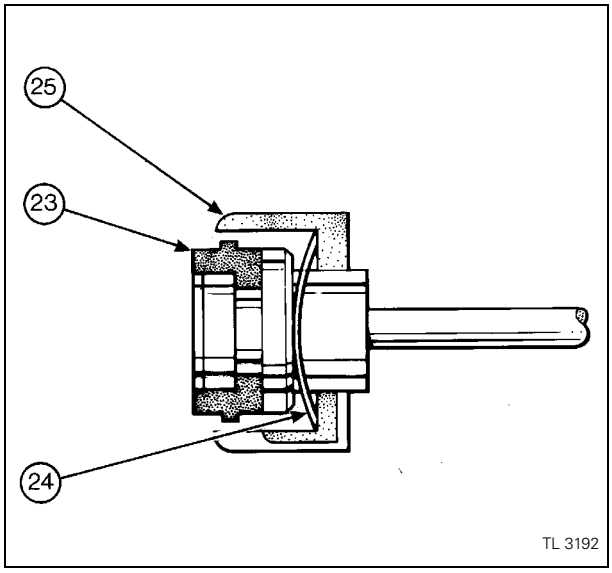

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23. Fit the valve seal, smallest diameter leading, onto the valve head.
24. Position the curved washer on the valve stem so that it 'flares' away from the valve stem shoulder as illustrated.
25. Fit the valve spacer, legs first, and spring.
26. Fit the spring retainer to the spring and compress the spring until the valve stem passes through the keyhole in the spring retainer and engages in the centre.
27. Fit the spring sub-assembly to the plunger and press home the leaf of the spring retainer to secure.
28. Liberally lubricate the plunger seal and cylinder bore with unused brake fluid.
29. Insert the plunger assembly fully into the cylinder, valve end leading, easing the entrance of the plunger seal.
30. Position the push rod and retaining washer and fit the circlip.
31. Smear the sealing areas of the rubber dust cover with rubber grease. The remainder of the grease in the repair kit should be used to pack the dust cover.
32. Position the dust cover on the cylinder body.
33. Insert the new flow valve into the flow valve port and position centrally so that the push rod protrudes into the central hole.
34. Install the pipe insert, fit the balance pipe and tighten the nuts to a torque of 107 Nm (10 lbf ft).
35. Fit new adaptor seals to the reservoir and elbow ensuring that the lip on the reservoir and elbow pipe locates in the bottom of the seal.
36. Refit the hose and clamps, the clamps must only be finger tight.
37. Retain the reservoir with a new plastic tie.
38. Refit the nut and clevis ends to the push rod.
39. Reinstall the brake master cylinder assembly.
40. Remove the air from the system, *(see operation 6-6A)*.
41. Adjust and balance the brakes, *(see operation 7-6A)*.



REMOVING AIR FROM THE SYSTEM

Adjust **6-6A**

Procedure

WARNING: The brake system contains special synthetic rubber components requiring petroleum (mineral) based oil (colour green), use only the brake oil recommended in the specification part of this section.

To remove the air from the system the following procedure must be followed:

1. Attach a plastic drain pipe to each air vent screw and immerse the open ends in a clean jar containing a small quantity of new clean brake fluid.
2. If the tractor is fitted with a trailer brake valve on the right-hand side, connect the pipe to the vent screw on the valve.
3. Open both vent screws 1/4 to 1/2 turn, depress and release the coupled brake pedals several times, topping-up the reservoir as necessary, until all the air has been expelled.
4. With both pedals held down, close both vent screws.
5. Open the left-hand screw 1/4 to 1/2 turn and hold the left-hand pedal at approximately 1/4 of its travel.
6. Fully depress the right-hand pedal, close the left-hand vent screw and release the right-hand pedal.
7. Check for sponginess by operating the pedal. Repeat operations 1 to 6 if the brakes are unsatisfactory.
8. Adjust and balance the brakes, *(see operation 7-6A)*.

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ADJUST AND BALANCE BRAKES

Adjust **7-6A**

Procedure

1. Ensure that all the air is removed from the hydraulic brake system.
2. Check the brake fluid level in the reservoir, top-up if necessary.
3. Place the tractor on level ground.

Initial Foot Brake Setting

4. With the rear wheels attached, jack up the rear of the tractor and place it on axle stands with the wheels clear of the ground.
5. Slacken off the parking brake cable on the right-hand side of the tractor.
6. With the aid of an assistant, rotate one of the wheels slowly, at the same time tighten the adjuster nut until the wheel just locks. It is important to always rotate the wheel forwards.
7. The brake expander clearance is adjusted by unscrewing the adjuster nut a number of flats back-off related to the number of friction plates fitted to one side of the axle, see table below:

Tractor model	No. of friction plates	Minimum No. of flats of nut back-off
4215, 4220	3	5
All other models	4	9

8. Carry out the same operation on the left-hand side of the tractor.

Parking Brake

Re-adjust the parking brake as follows:

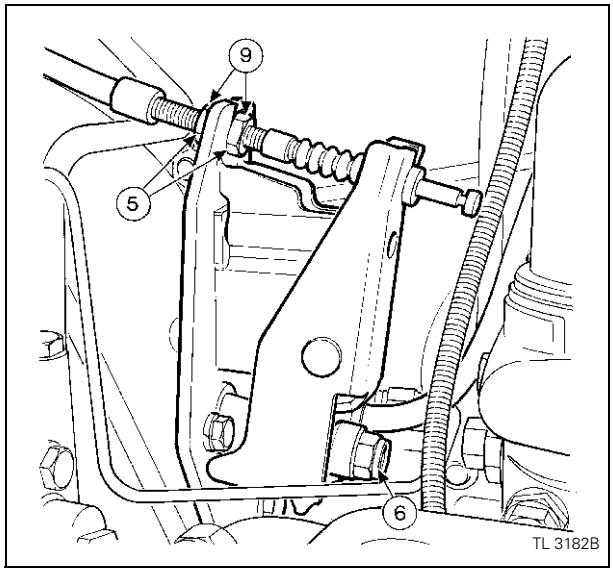
9. On the right-hand side, adjust the two cable nuts on either side of the bracket until the slack has been taken up in the inner cable.
10. Operate the parking brake several times to centralise the cable between the two brakes and re-check the adjustment. The parking brake should be fully applied within four to five clicks of the ratchet on the handle.

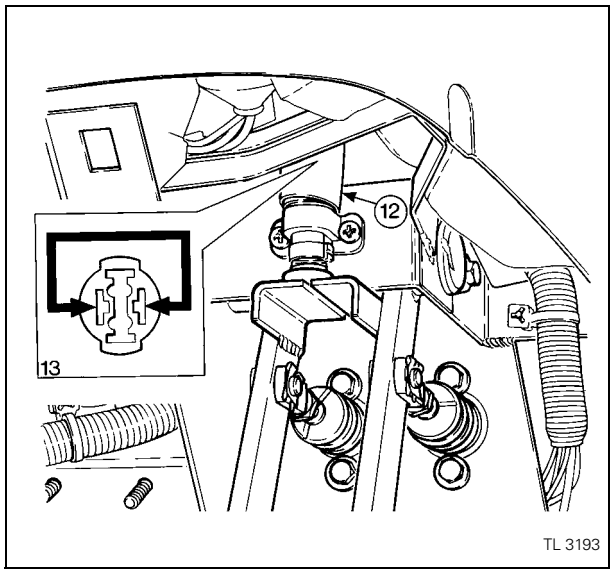
Road Testing

NOTE: *Tractors with four-wheel drive have automatic four-wheel drive engagement when the brakes are applied or the tractor is shut down. This must be disconnected to enable the brakes to be balanced during a road test.*

Proceed as follows:

11. Remove the lower instrument panel to gain access to the brake light switch mounted above the foot brake pedals.





12. Remove the electrical connector from the brake switch.
13. With the aid of a short piece of wire with a male connector on each end connect the two terminals together as shown in the illustration.
14. Switch the four-wheel drive system OFF.
15. Road test the tractor, check the brakes for binding or pulling to one side. Any tendency to pull to one side should be counteracted by slackening off the adjuster nut on the side to which the tractor pulls.
16. Finally, check the parking brake adjustment, check the system for leaks and fluid level, make any further adjustments that may be needed.
17. Re-connect the connector to the brake switch and replace the lower instrument panel

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COVER PLATE ASSEMBLY

Removal and Refitment **8-6A**

Special Tools:
MF.467 Brake Pull Rod Seal Protector
MF.468 Dust Cover Replacer

Removal

1. Drain the transmission oil.
2. Jack up the tractor and place an axle stand under the axle. Remove the rear wheel.
3. Disconnect the parking brake cable.
4. Remove any hydraulic pipes that will prevent the actuator being withdrawn from the axle housing.

NOTE: *The right-hand cover plate assembly can be removed without removing the hydraulic filter assembly. To make the task easy, remove the lever connecting pin, and return spring.*

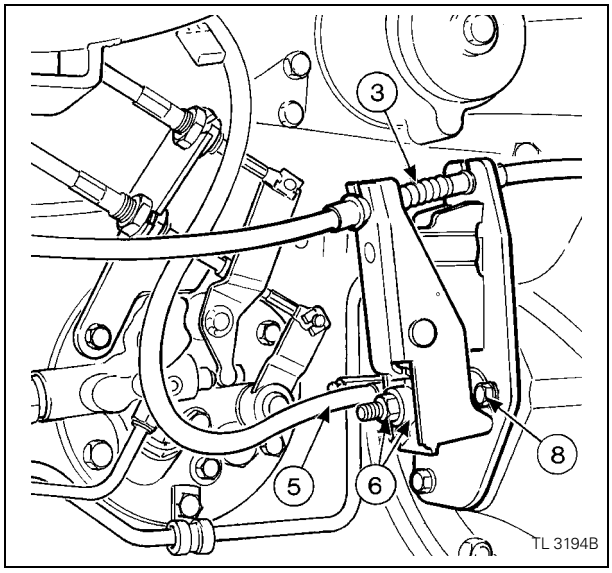
5. Disconnect the flexible brake pipe from the steel pipe, then disconnect from the slave cylinder. Drain the fluid into a container. Mask or plug the pipe to prevent dirt ingress.
6. Remove the brake adjusting nyloc nut, spherical bearing and plastic sleeve. Discard the nyloc nut.
7. Screw another bleed nipple (part number 1694 259 M1) into the brake pipe port and tighten. Check that the other bleed nipple is tight. This is to prevent the slave cylinder pistons being forced out of the brake cylinder by the internal spring when being removed from the axle housing.
8. Remove the three bolts securing the cover plate assembly to the axle housing.
9. Carefully slide the cover plate forward off the pull rod.
10. Remove and discard the gasket.
11. Carefully drift the dust cover from the cover plate and discard.

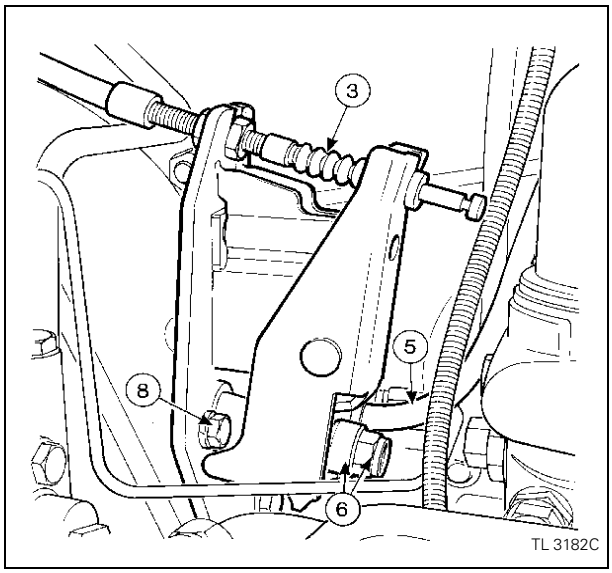
Examination

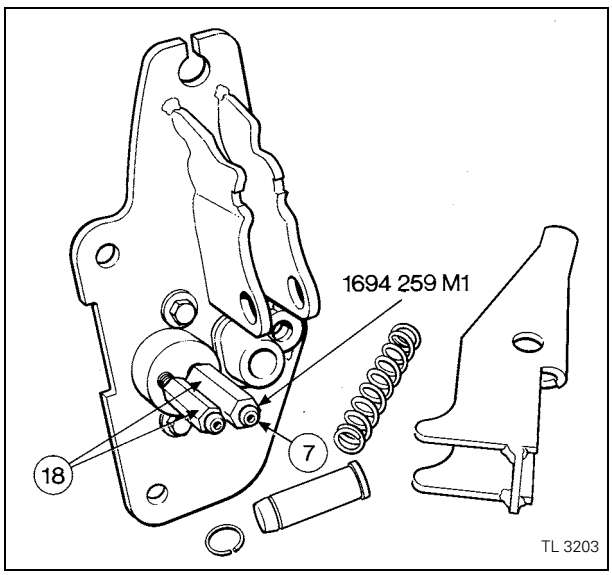
Examine the operating lever and the bracket for signs of damage or wear. Pay particular attention to the pivot pin. The surface that bolts to the axle housing must be flat and clean across its mounting face to ensure a good seal.

Ensure that the threads on the pull rod are undamaged and that the face of the spherical bearing is not worn or pitted. Replace any worn components.

Always fit a dust cover and ensure that the wrap spring is in place around the hole for the pull rod.







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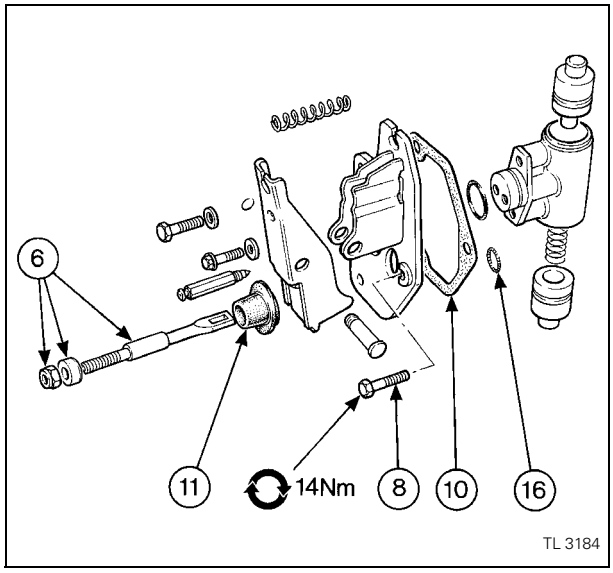
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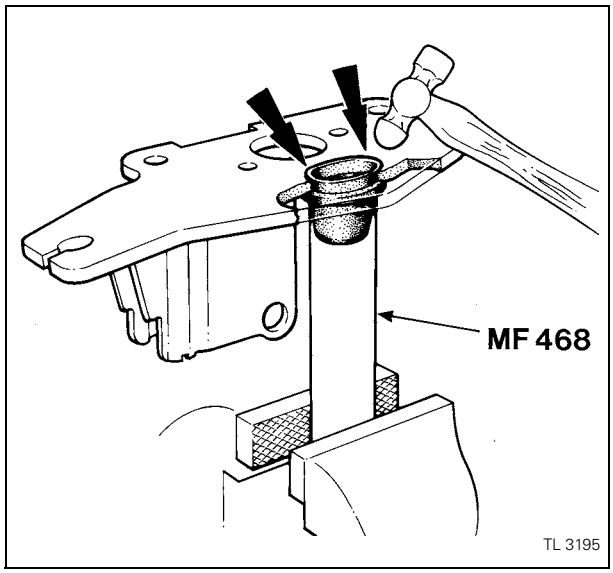
Refitment

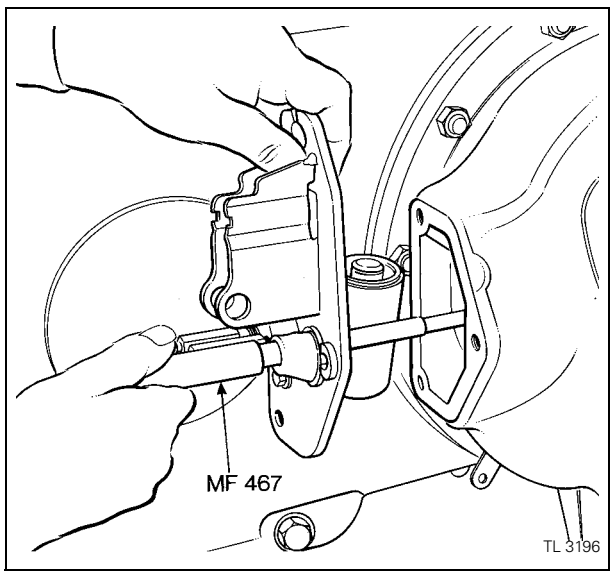
12. Remove the retaining ring, connecting pin, lever and return spring from the cover plate.
13. To assemble a new dust cover, apply a smear of Hylomar sealant on the sealing face of the dust cover.
14. Locate the dust cover in the plate then invert the assembly and rest the flange of the dust cover on special tool MF.468 Dust Cover Replacer, secured in a vice.
15. Hold the plate down tightly on the dust cover, peen over the tabs each end until the dust cover is held securely.
16. Fit the wrap spring into its groove on the inside of the dust cover.

NOTE: *The flange of the dust cover must lay flat on the face of the cover plate.*

17. Fit a new gasket to the axle housing, hold it in place with some petroleum jelly.
18. Refit the two bleed nipples to the brake slave cylinder and tighten one.
19. Press the two slave pistons right into the cylinder and tighten the second nipple to retain the piston in place.
20. Using special tool MF.467, Brake Pull Rod Seal Protector, slide the pointed guide pilot over the thread of the pull rod.
21. Slide the cover plate assembly on to the guide pilot, push the rubber seal and the cover plate down the pilot with the other part of the tool, the sleeve.
22. Ease the slave cylinder into the jaws of the expander unit, at the same time pushing the seal off the end of the guide pilot. The rubber seal is now correctly positioned.
23. Remove the special tool MF.467, refit the three retaining bolts and tighten to a torque of 14 Nm (10 lbf ft).
24. Remove the bleed nipple from the pipe port in the slave cylinder.
25. Refit the connecting pin, lever and return spring to the actuator.
26. Reverse procedures 1 to 10.
27. Remove air from the system, *(see operation 6-6A)*.
28. Balance and adjust the brakes, *(see operation 7-6A)*.







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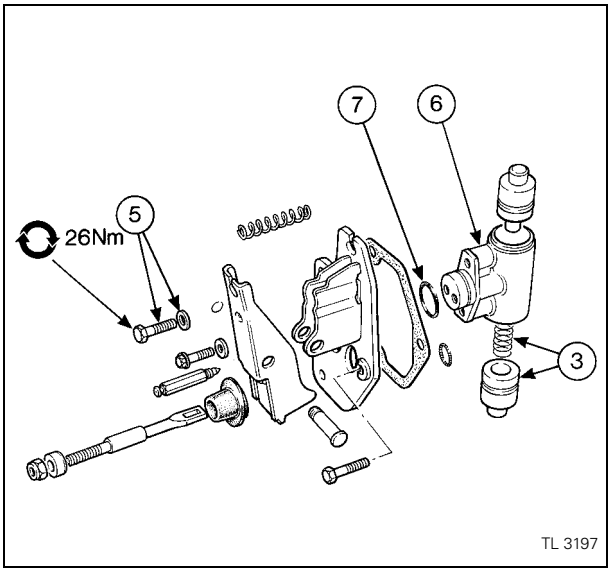
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BRAKE SLAVE CYLINDER

Overhaul 9-6A

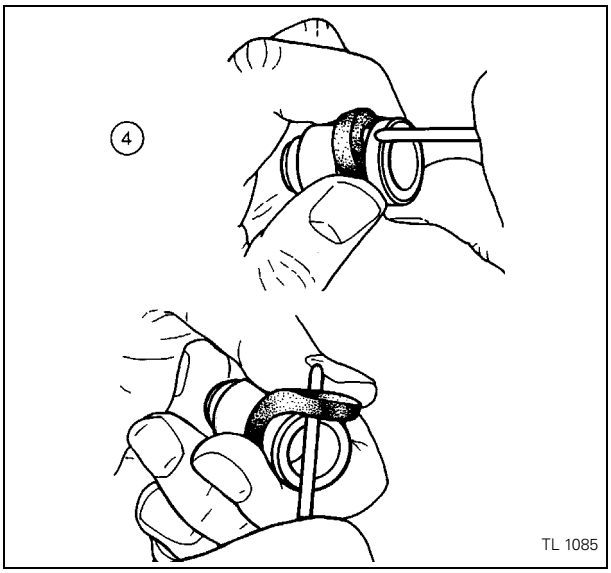
Dis-assembly

1. Remove the cover plate assembly, *(see operation 8-6A)*.
2. Unscrew one of the air bleed nipples allowing air into the cylinder, this will release the pistons in the slave cylinder.
3. Remove the pistons and spring from the bore of the cylinder.
4. Remove the seals from the pistons using a screwdriver, the tip of which has been rounded and polished to avoid scratching the piston seal groove.
5. Remove the two setscrews and sealing washers securing the slave cylinder to the cover plate.
6. Remove the slave cylinder.
7. Remove the 'O' ring seal from the cylinder turret.



Examination

Thoroughly clean all parts by washing in a suitable fluid and drying with compressed air. Inspect the inside of the cylinder bore and the piston for any signs of scoring, abrasion or corrosion. No attempt must be made to clean up damaged or corroded parts.

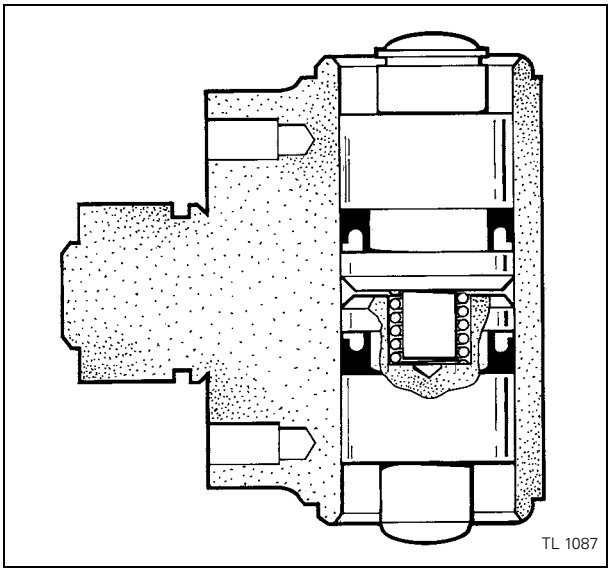


Re-assembly

8. Fit a new 'O' ring seal to the slave cylinder turret, ensure that it is located correctly in its groove.
9. Assemble the slave cylinder to the cover plate and replace the two seals, tighten the setscrews to a torque 26 Nm (20 lbf ft).
10. Lubricate the inside of the slave cylinder, piston and seals with new clean mineral type brake fluid.
11. Fit the new seals from the service kit to the pistons taking care not to damage the seal lips.

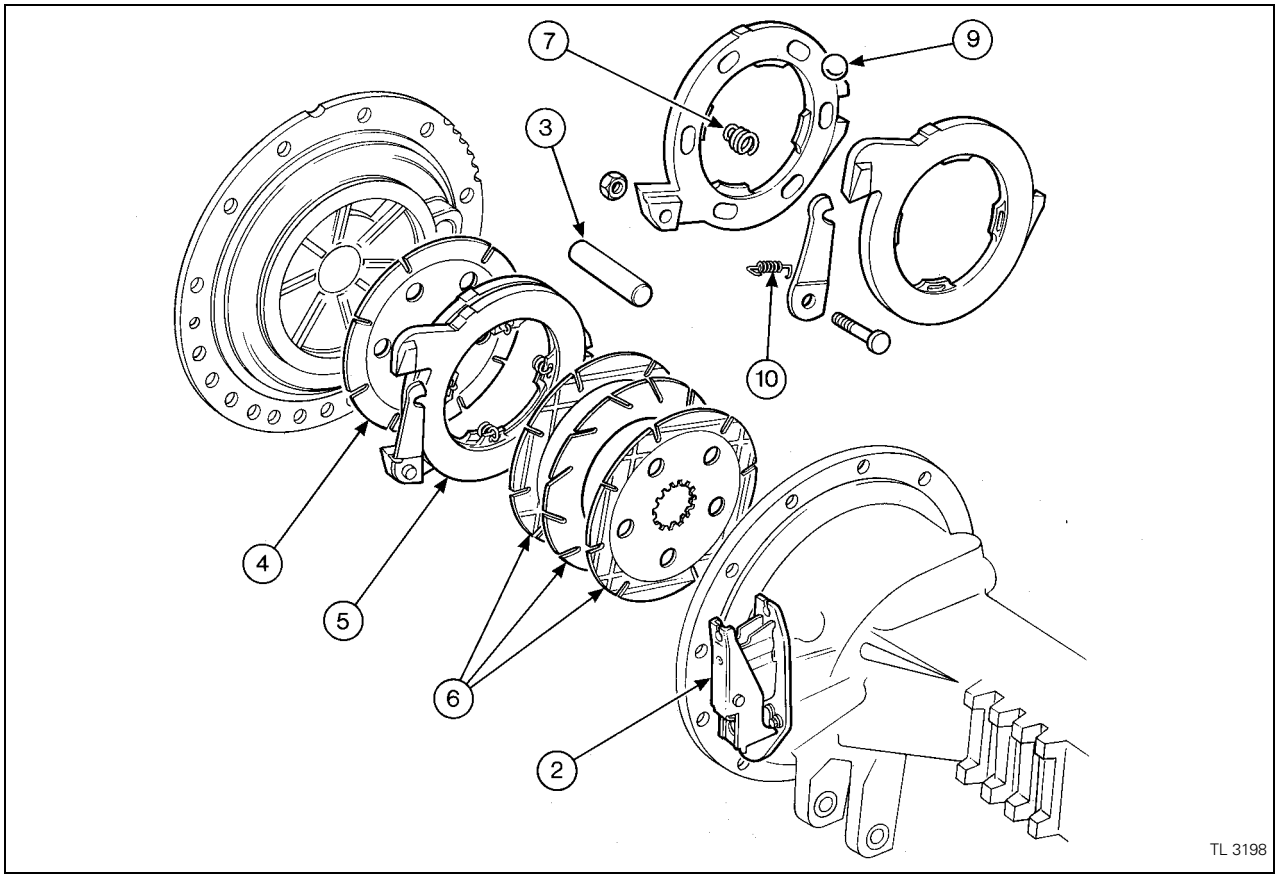
NOTE: *The lip of the seal must face the narrow land on the piston.*

12. Ease the two piston and seal assemblies into the cylinder with the piston with the male locating spigot at the top, and the spring between the two pistons (see the illustration).
13. Press the two pistons fully into the cylinder, fit two bleed nipples into the ports and tighten (maximum torque 19 Nm (14 lbf ft). This will hold the pistons in so that the cylinder will fit into the jaws of the expander unit.
14. Refit the brake cover plate assembly, *(see operation 8-6A)*.



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RIGHT- AND LEFT-HAND BRAKES

Removal and Refitment 10-6A

Removal

1. Remove the rear axle housing and carrier plate, *(see operation 1-6B)*.
2. Remove the brake cover plate assembly, *(see operation 8-6A)*.
3. Remove the brake reaction pin from the housing.
4. Remove the friction disc.
5. Remove the actuator unit.
6. Remove the brake plates, turning each plate over stacking in reverse order to ensure correct refitment.
7. Release the four springs.
8. Remove the pull rod.
9. Remove the six balls
10. Remove the bellcrank return spring.

Examination

Friction Plates

These have a minimum groove depth of 0,3 mm (0.012 in) when new. When the grooves begin to disappear, the plates must be replaced. Ensure that the splines are not duly worn. Check that the discs slide easily over the length of the spline.

Steel Plates

The steel plates can generally be refitted, but should be replaced either when badly scored or worn more than 0,13 mm (0.005 in) per face. The steel plates should also be replaced when the friction plates are renewed.

Check all plates for signs of severe overheating or distortion.

IMPORTANT: *Never attempt to reclaim friction plates or steel plates by lapping or grinding.*

Actuator Unit

The actuator plates do not normally need replacing, but should be checked for severe scoring.

Ensure that the threads on the pull rod are undamaged and that the slot in the opposite end shows no sign of excessive wear.

General

Thoroughly clean out the brake housing and remove any burrs on the carrier plates or inside the axle housing.

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Refitment

11. Lay the other actuator plate on top, ball seats downwards and with the lug on which the slave cylinder operates above the corresponding lug on the other plate. The illustration shows the correct assembly for the left-hand brake. The right-hand side will be the opposite hand.
12. Ensure that the balls are seated in the uppermost actuator plate and both plates will then be correctly located in relation to one another.
13. Attach the pull rod to the bellcrank.
14. Hook on new pull-off springs.
15. Fit a new bellcrank return spring to the actuator assembly. To do this hook it onto the actuator casting, twist then hook the other end over the bellcrank lever.
16. Reverse procedures 1 to 4 except:

a. Dip each friction plate, steel plate, and actuator unit in clean transmission oil before fitting them into the housing. IT IS VERY IMPORTANT to refit all plates in the order in which they were originally assembled.

b. If the brake plates have been mixed up or are being replaced, they are fitted into the axle housing in the following order:

All other tractors
4 friction discs per half axle
Friction plate
Steel plate
Friction plate
Expander unit
Friction plate
Steel plate
Friction plate
Carrier plate

c. Fit the actuator unit to the axle with the pull rod and bellcrank facing towards the tractor wheel.

d. Check that the small return spring is fitted between the bellcrank and the actuator plate.

17. Refit the axle housing and carrier plate, *(see operation 6-6C).*
18. Refit the brake cover plate assembly, *(see operation 8-6A).*
19. Remove air from the brake system, *(see operation 6-6A).*
20. Adjust and balance the brakes, *(see operation 7-6A).*

GENERAL MAINTENANCE

Servicing **11-6A**

Procedure

Hydraulic fluid

This fluid change should be carried out every 2000 hours or three years which ever comes first.

NOTE: *If the following procedure is adhered to, air will not enter the system and the time taken to change the fluid will be kept to a minimum.*

1. Proceed in the same manner and order as for removing air from the system, *(see operation 6-6A),* and attach a clear plastic tube together with a glass bottle to a bleed screw.
2. Pump out most, but not all, of the fluid in the reservoir.

NOTE: *DO NOT allow the reservoir to empty.*

3. Top up the reservoir with new unused fluid of the recommended type.
4. Ensure the reservoir is kept topped up and pump out the system until the old and discoloured fluid is ejected and the new fluid can be seen in the plastic tube.
5. Repeat the procedure for the other brake.
6. Top up the reservoir and road test the tractor.

Brake Pipes and Flexible Hoses

This inspection should be carried out every 2000 hours or three years which ever comes first.

Periodically examine the brake pipes and flexible hoses for signs of fretting, damage and corrosion. Renew the parts as deemed necessary and take action to prevent any fretting or damage recurring.

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Crownwheel and Pinion

Section 6 - Part B

Table of Contents

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----	General Description	6B– 2
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3-6B	Crownwheel and Pinion - Overhaul	6B– 6
4-6B	Differential Pre-Load - Check	6B–12

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Crownwheel and Pinion

SPECIFICATION

Crownwheel and pinion ratio	3.454 : 1 - 11 x 38 teeth.
Except 4270 with 12 x 4 gearbox	3.889 : 1 - 9 x 35 teeth.
Pinion bearing pre-load	24-30 Nm (18-22 lbf ft).
Differential bearing pre-load	Determined using special tool MF.245D.
Tighten MF.245D clamp bar	27 Nm (20 lbf ft).
Massey Ferguson Stud Lock - part No	3405 352 M4.
Massey Ferguson High Strength Retainer - part No	3930 274 M91.

Special Tools:

MF.245D	Differential bearing pre-load gauge.
MF.245D-1	Straight edge.
FT.4062A	Bearing pre-load gauge.

Bolt Torques:

Differential case bolts	108 Nm (80 lbf ft).
Crownwheel bolts	160 Nm (120 lbf ft).
Axle housing bolts	130 Nm (96 lbf ft).
Pinion housing to centre housing	108 Nm (80 lbf ft).

GENERAL DESCRIPTION

The drive from the transmission gearbox is transmitted through the rear drive shaft to a spiral bevel gear driving the crownwheel and differential, then through the axle half shafts to the epicyclic reduction units and the rear wheels.

The driving pinion is supported in the centre housing by a pilot bearing and a housing assembly carrying two pre-loaded taper roller bearings.

The crownwheel is attached to the split differential case, which is supported each side by a taper roller bearing. The differential pinions run on a cross joint and the thrust is taken by thrust washers behind the pinions. Side gears driven by the differential pinions are located on each side of the differential and the thrust is taken by thrust washers between the gear and case. The side gears are splined to the half shafts.

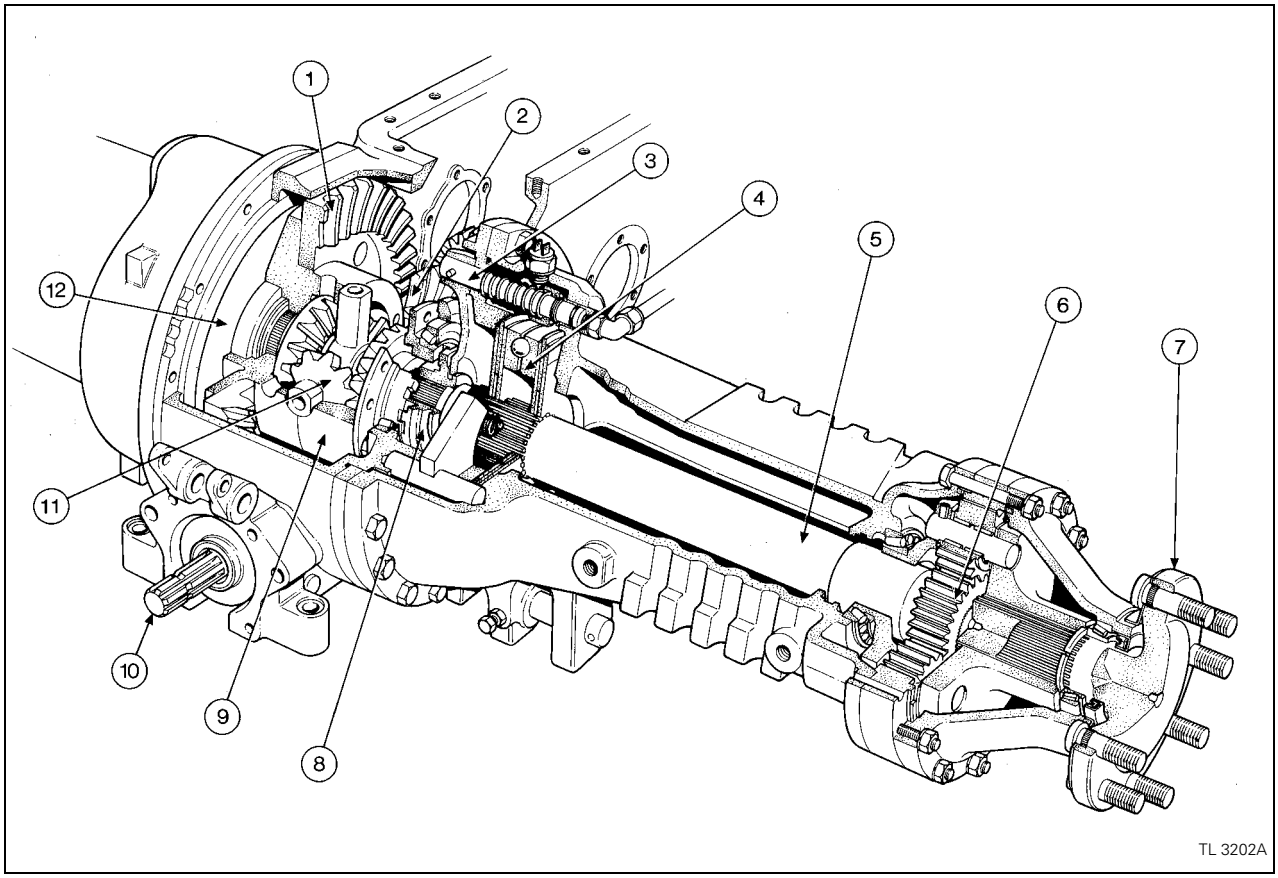
A differential lock is fitted to the right-hand axle housing. When engaged, a sliding coupler locks the right-hand half shaft to the differential casing, thus locking the differential.

The pinion pre-load is set by tightening a screwed locking ring behind the two taper roller bearings. The differential bearing pre-load is set with the aid of a special tool and variable thickness bearing chip shield which is fitted behind the bearing cup of the right-hand carrier plate.

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Crownwheel and Pinion



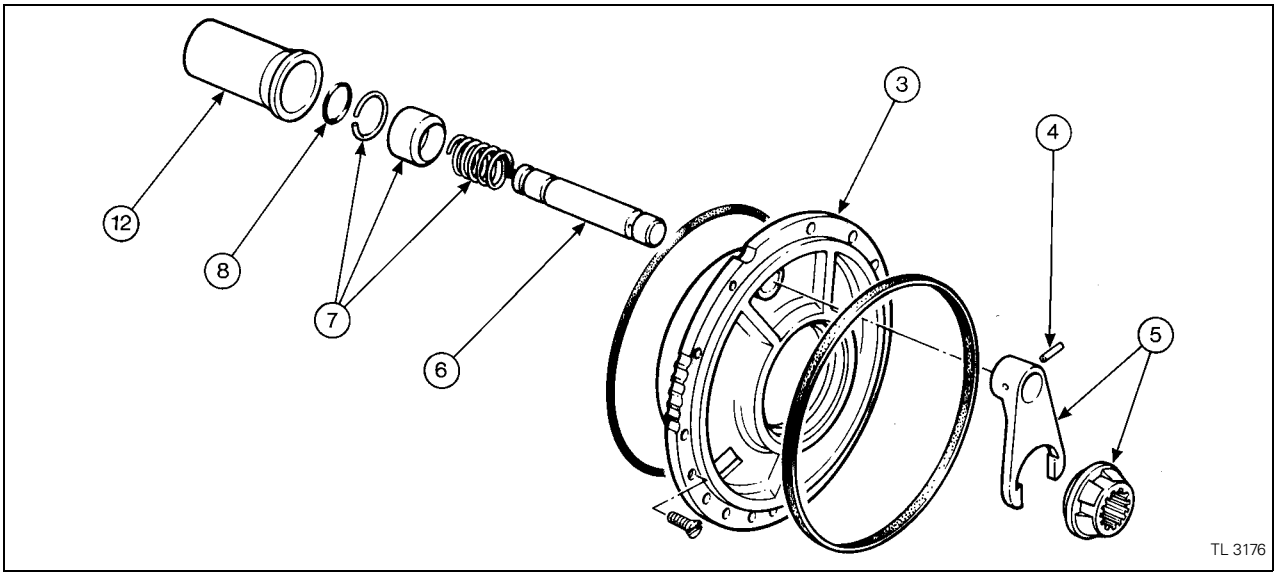
Crownwheel, Pinion and Differential Assembly

1. Crownwheel
2. Pinion
3. Differential lock
4. Brakes
5. Axle half shaft
6. Epicyclic reduction unit
7. Axle shaft
8. Differential lock coupler
9. Differential case
10. PTO shaft
11. Differential pinions
12. Carrier plate

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Crownwheel and Pinion



DIFFERENTIAL LOCK

Removal and Refitment 1-6B

Removal

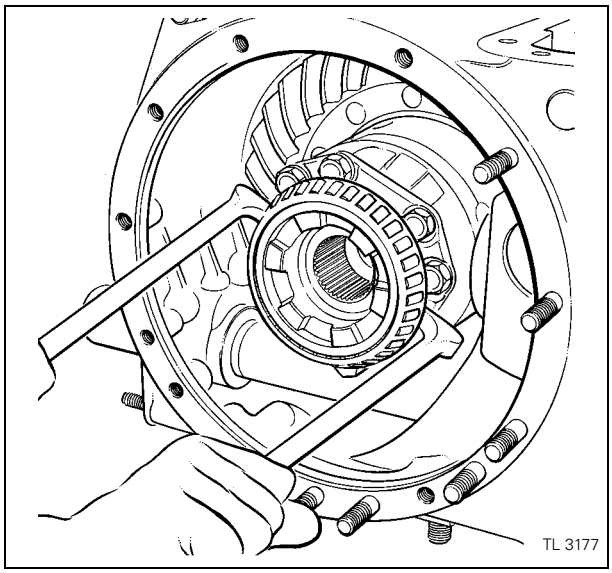
1. Remove the right-hand axle housing, *(see operation 6-6C).*
2. Remove the differential lock warning switch.
3. Remove the carrier plate.
4. Drive the roll pin out of the fork.
5. Remove the fork and coupler.
6. Remove the shaft assembly.
7. If necessary, remove the spring, switch actuator and spring clip.
8. Remove and discard the piston seal 'O' ring.
9. Using two pry bars lever the taper roller bearing cone off the differential housing.
10. Remove the eight bolts.
11. Prise off the differential lock cap, taking care not to dislodge the case which would allow the differential gears to fall out.
12. If necessary, remove the differential lock cylinder, it is retained with Loctite.

Examination

Examine the coupler, fork, cap and operating shaft for wear or scoring. Replace any worn parts.

Refitment

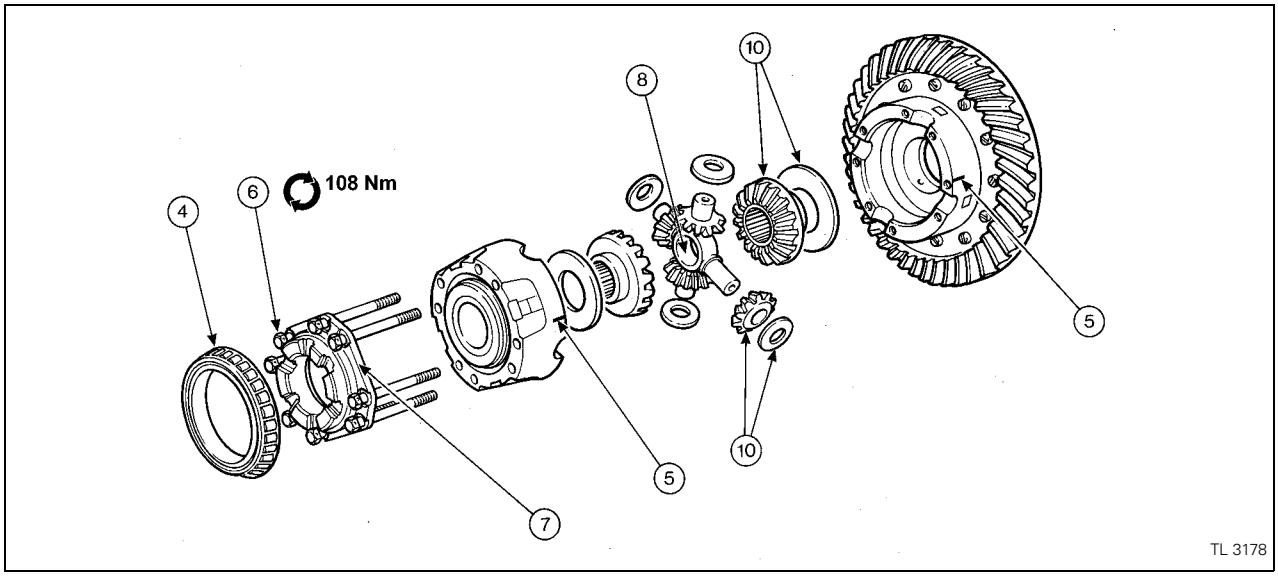
13. Fit a new differential lock cap.



14. Insert and hand tighten the eight bolts.
15. Tighten the eight bolts progressively and evenly to a torque of 108 Nm (80 lbf ft).
16. Refit the bearing cone, ensure that it is fully seated.
17. Fit a new piston seal 'O' ring.
18. Refit the shaft assembly and pin the fork to the shaft with a new pin.
19. Place the coupler in the fork and pin the fork to the shaft with a new pin.
20. Refit the carrier plate to the axle housing.
21. Refit the axle housing, *(see operation 6-6C).*

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DIFFERENTIAL UNIT

Overhaul 2-6B

Dis-assembly

1. Remove the left-hand axle housing, *(see operation 6-6C).*

CAUTION: *The differential assembly is heavy and awkward to handle. Take care when removing and refitting.*

2. Manoeuvre the differential assembly out of the centre housing.
3. Place the differential on a stand or in a vice.
4. Using two pry bars lever the right-hand taper roller bearing cone off the differential housing.
5. Mark the two halves of the differential case to enable them to be assembled in the same relative positions.
6. Remove the eight bolts.
7. Remove the coupler cap and the right-hand half of the differential case.
8. Remove the cross and pinion assembly complete with the thrust washers.
9. Remove the differential gears and their thrust washers.
10. Remove the two side gears and their thrust washers.

Examination

Examine all of the differential components and replace any that show signs of wear or are damaged.

If any of the differential gears are worn, a full set of four new gears and thrust washers must be fitted. In such circumstances, the side gears should also be replaced.

Re-assembly

11. Reverse procedures 1 to 10 except:
    a. Refit the right-hand differential case with the differential lock cap and the markings aligned.
    b. Tighten the eight bolts (6) progressively and evenly to a torque of 108 Nm (80 lbf ft).
    c. Refit the right-hand cone bearing.
    d. Refit the differential assembly into the centre housing with care, engaging the splines on the right-hand half shaft.

IMPORTANT: *If the differential bearings or case have been replaced, the bearing pre-load must be checked, (see operation 4-6B).*

12. Refit the left-hand axle housing, *(see operation 6-6C).*

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Crownwheel and Pinion

CROWNWHEEL and PINION

Overhaul **3-6B**

Special Tools:
FT.4062A Bearing Pre-load Gauge

Dis-assembly

NOTE: *The replacement crownwheel and pinion kit comprises of one pinion, one crownwheel, 12 nuts and bolts and a tube of Retainer Compound and Studlock.*

1. Split the tractor between the centre housing and the range box and remove the transmission from the rear of the tractor, *(see operation 4-2A).*
2. Remove the lift cover, *(see operation 4-9A).*
3. Remove the lift pump and PTO clutch assembly, *(see operation 4-7A).*
4. On tractors with two speed PTO, remove the reduction gears, *(see operation 5-7A).*
5. Remove the differential assembly, *(see operation 2-6B).*

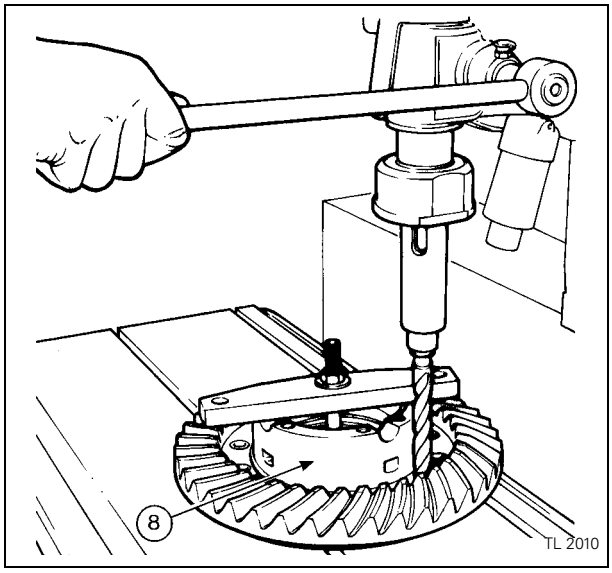
Crownwheel

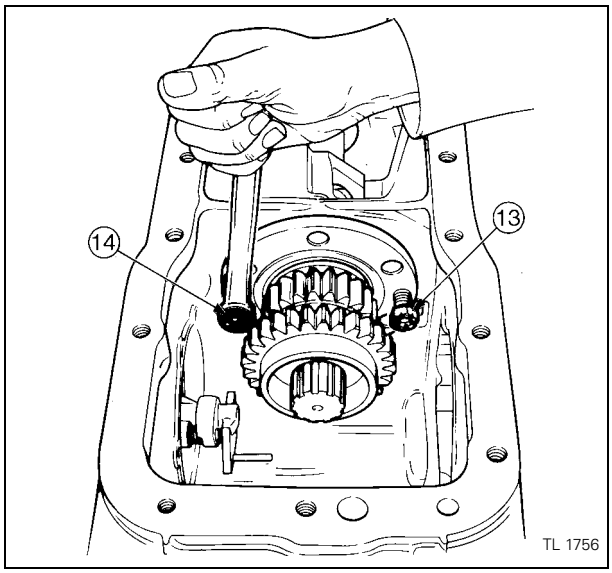
6. Split the differential case as detailed, *(see operation 3-6B).*
7. Centre punch each of the rivet heads centrally.
8. Using a 13 mm (1/2 in) drill, drill out each of the rivet heads until they become detached from their shanks.
9. Drive out the rivets.
10. Drive the crownwheel off the differential case.

All Models

NOTE: *The crownwheel and pinion is supplied as a matched set, therefore when fitting a new crownwheel, the pinion must also be replaced.*

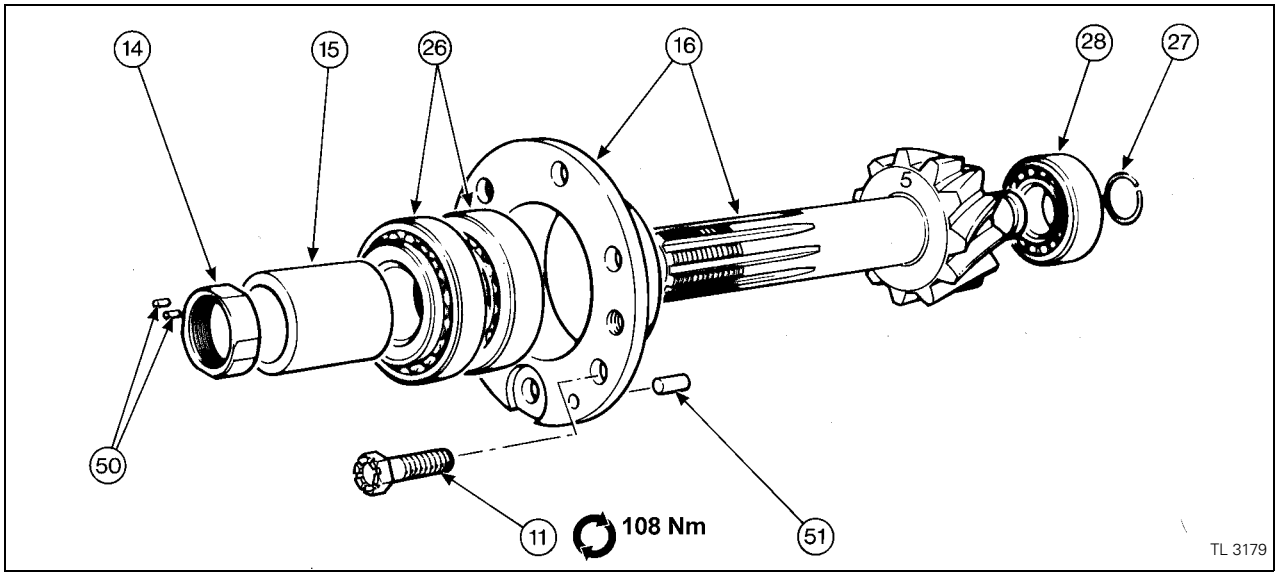
11. Remove the six bolts.
12. Screw one of the bolts into each of the two tapped holes.
13. Tighten the bolts, thus withdrawing the pinion assembly.





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Pinion - Single Speed

14. Remove the locking ring as follows:

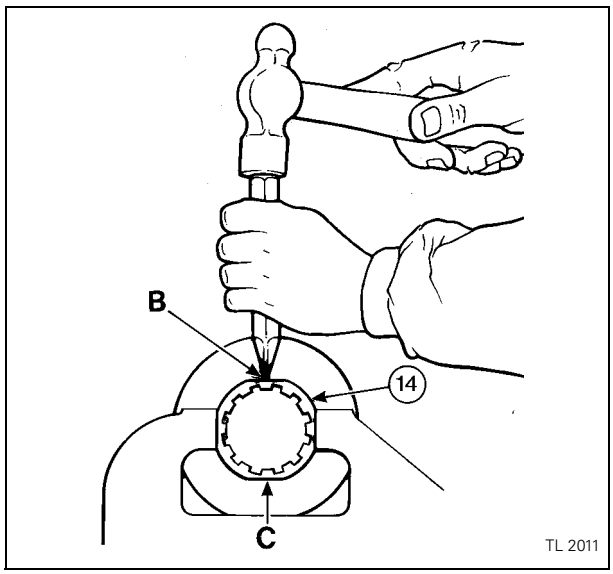
WARNING: Eye protection goggles must be worn during the following operation.

a. Place the pinion in a vice, holding the flats of the locking ring adjacent to the locking rollers.

b. Using a cold chisel, cut one half to two thirds into the retaining nut at points 'B' and 'C'.

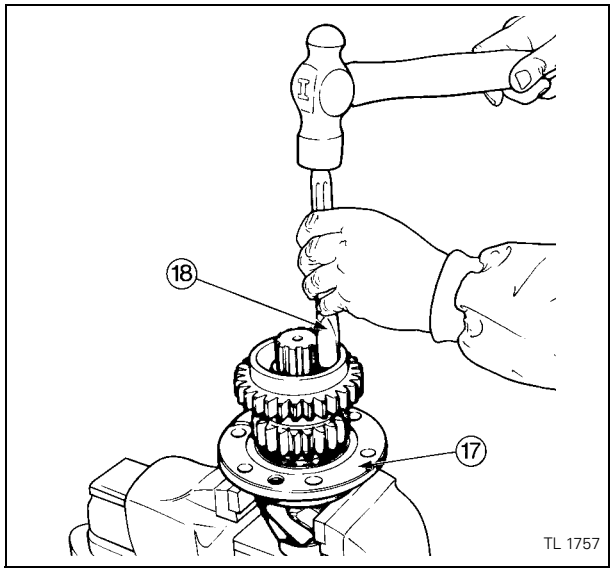
c. Re-position the pinion in the vice and chisel down the splines into the cuts made at points 'B' and 'C'. A few hefty blows will fracture the locking ring enabling it to be removed.

15. Remove the sleeve.
16. Remove the housing, pinion and bearing assembly.



Pinion - Two Speed

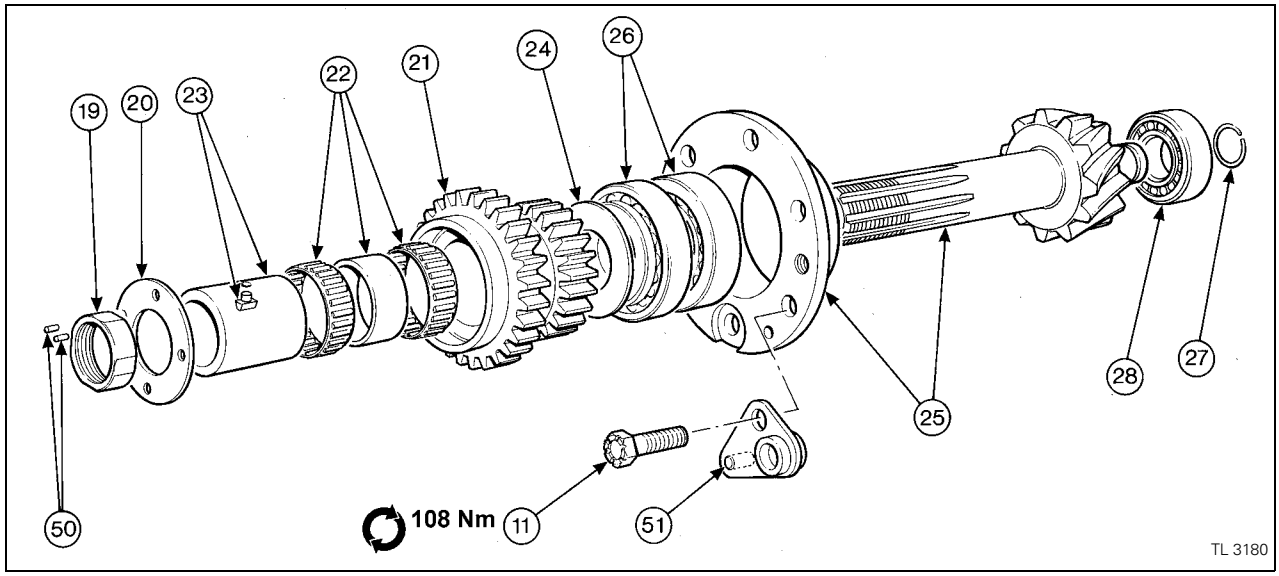
17. Place the pinion assembly in a vice holding it in the vertical position.
18. Using a cold chisel cut down through the locking ring adjacent to one of the flats and the two locking rollers.
19. A few hefty blows will fracture the ring enabling it and the rollers to be removed.
20. Remove the thrust washer.
21. Remove the intermediate gear cluster.
22. Remove the needle roller bearings and spacer.
23. Remove the sleeve and sleeve keeper.
24. Remove the thrust washer.
25. Remove the housing, pinion and bearing assembly.



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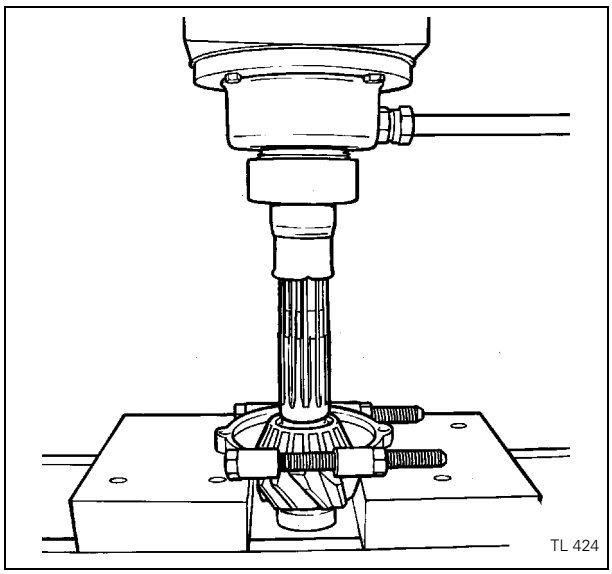
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Crownwheel and Pinion



All Models

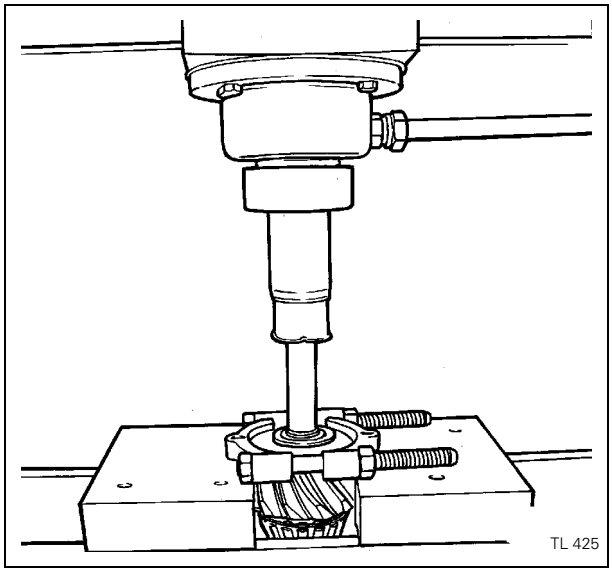
26. Use a hand or hydraulic press and a bearing seperator, remove the two taper roller bearings.



27. Remove the snap ring securing the pilot bearing to the pinion.
28. Remove the pilot bearing in a press.
29. Remove the two bearing cups from the housing.

Examination

Examine all the components for wear, scoring or pitting. Any faulty parts and snap rings should be replaced

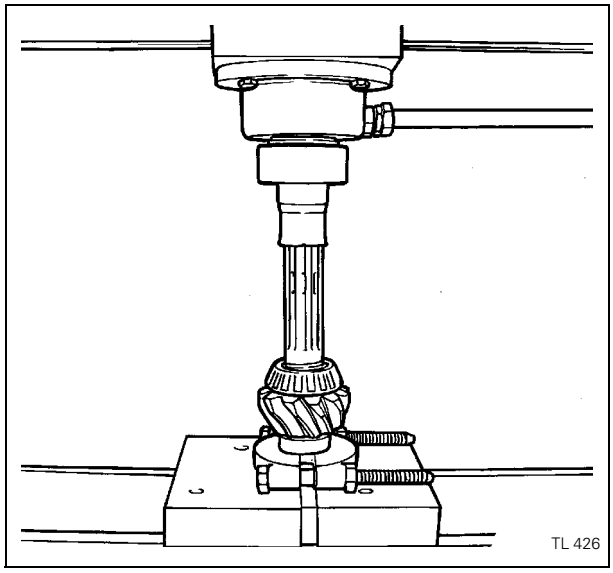


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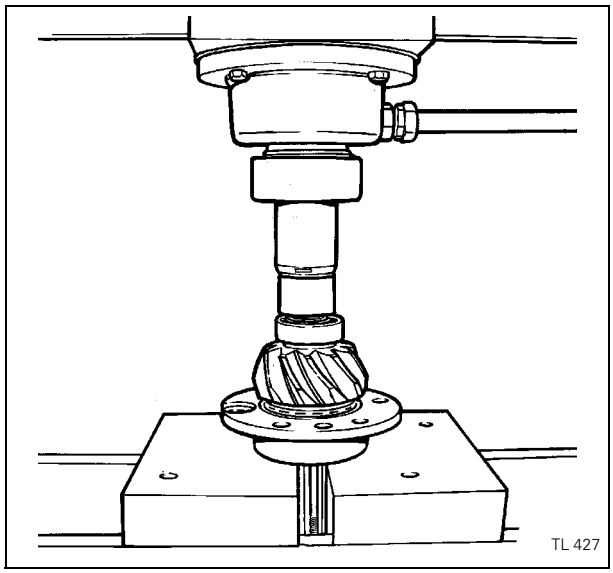
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Re-assembly

30. Press the pilot bearing onto the pinion. The face of the bearing with the manufacturer's name must be adjacent to the teeth of the pinion.
31. Secure the pilot bearing with a new snap ring.



32. Press the taper roller bearing onto the pinion.
33. Press two bearing cones into the housing.
34. Locate the pinion into its housing and fit the front bearing.

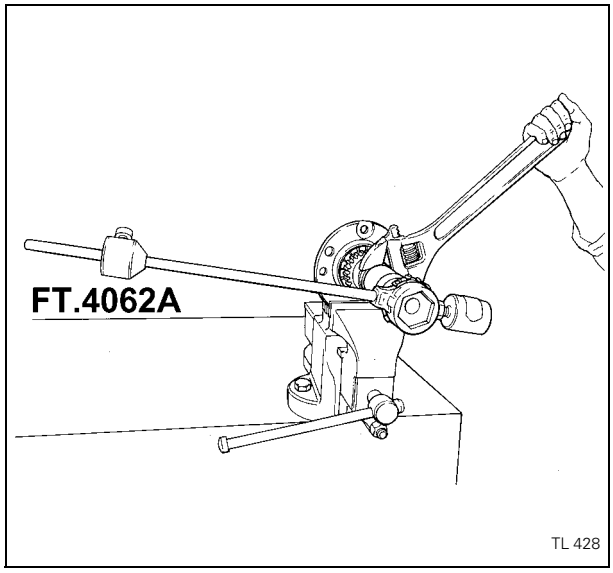


Pinion - Single Speed

35. Hold the pinion housing in a vice.
36. Refit the sleeve and a new locking ring, hand tighten until some resistance is felt.
37. Tap the pinion firmly to centralise and seat the bearings in the housing.
38. Fit Special Tool FT.4062A, Bearing Pre-Load Gauge, to the pinion and tighten the locking ring to give a pre-load reading of 2-2,5 Nm (18-22 in lbf). Set the weight to the 20 mark on the bar.

    If a pre-load gauge is not available, wrap some string around the pinion shaft and attach the end to a spring balance. Pull the spring balance away from the shaft. the rolling resistance must be 10-11 kg (21-25 lbf) when the shaft is rotating.

    Adjust the tension by tightening or loosening the locking ring. Set to the lower reading, when the locking rollers are fitted the tension will slightly increase.



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Crownwheel and Pinion

Pinion - Two Speed

39. Hold the pinion housing in a vice.
40. Refit the thrust washer with the oil grooves and chamfered side of the lubrication holes facing towards the gear cluster.
41. Refit the sleeve with the sleeve keeper installed inside.
42. Refit the needle roller bearing, spacer, needle roller bearing and lightly lubricate with oil.
43. Slide the gear cluster over the bearings.
44. Install the thrust washer with the oil groove side facing the gear cluster.
45. Fit a new locking ring, hand tighten until some resistance is felt.
46. Tap the pinion firmly to centralise and seat the bearings in the housing.
47. Make a box spanner with four flats 51 mm (2.1/16 in) A/F out of a piece of 55 mm (2.1/8 in) internal diameter tube x 80 mm (3 in) long as shown in the illustration
48. Fit Special Tool FT.4062A, Bearing Pre-Load Gauge, to the pinion and tighten the locking ring to give a pre-load reading of 2-2,5 Nm (18-22 in lbf). Set the weight to the 20 mark on the bar.

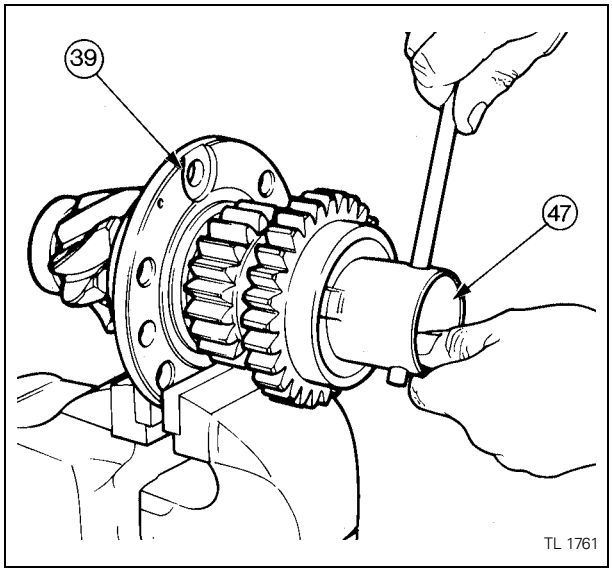
If a pre-load gauge is not available, wrap some string around the pinion shaft and attach the end to a spring balance. Pull the spring balance away from the shaft. the rolling resistance must be 10-11 kg (21-25 lbf) when the shaft is rotating.

Adjust the tension by tightening or loosening the locking ring. Set to the lower reading, when the locking rollers are fitted the tension will slightly increase.

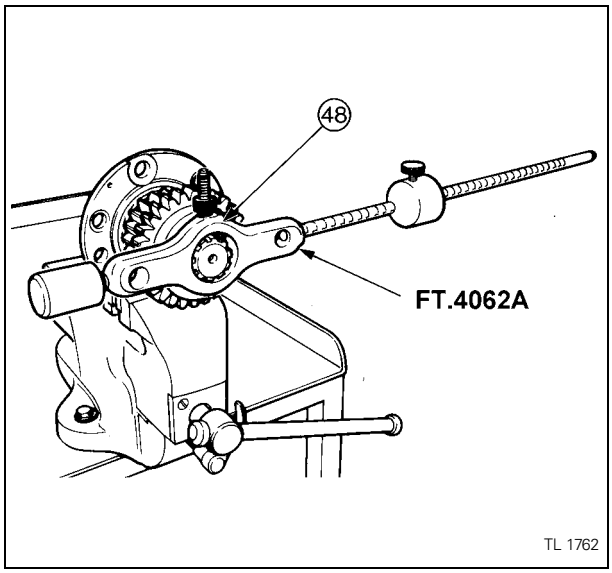
49. Check that the intermediate gear cluster is free to rotate, there should be a 0,10 mm (0.004 in) clearance between the gear and the thrust washer.

All Models

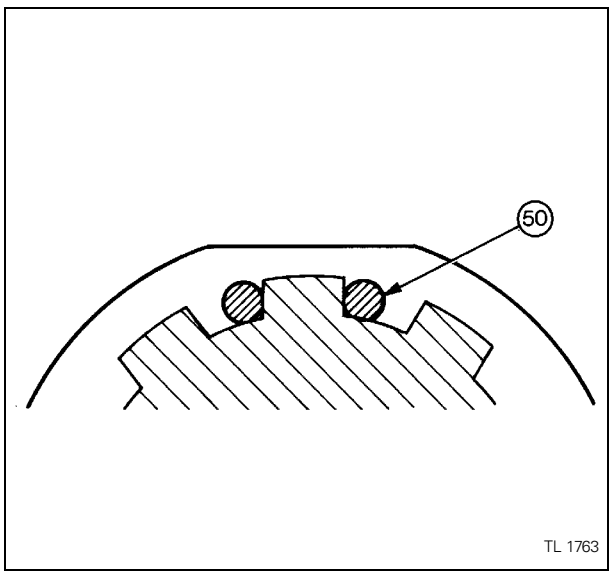
50. Secure the locking ring by driving a locking roller down either side of one of the pinion splines adjacent to one of the flats. The locking rollers must be driven flush with the locking ring.
51. Refit the pinion assembly in the centre housing ensuring that the locating pin in the back of the flange is correctly aligned. The recessed bolt hole in the flange is fitted at six o'clock.
52. Tighten the six pinion housing retaining bolts to a torque of 108 Nm (80 lbf ft).



TL 1761



TL 1762



TL 1763

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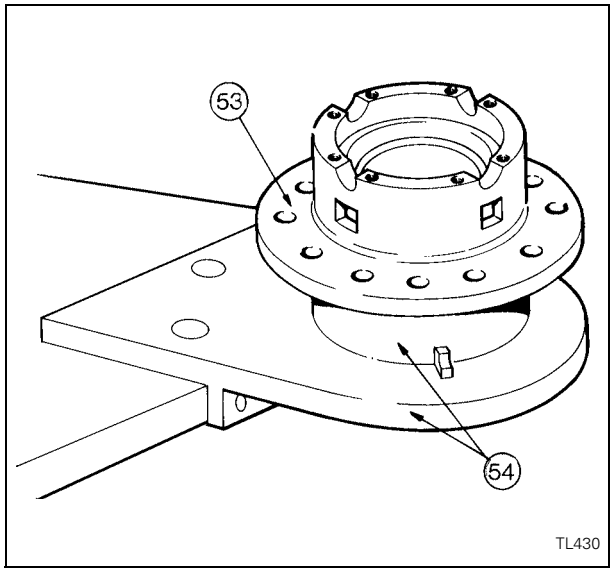
Crownwheel

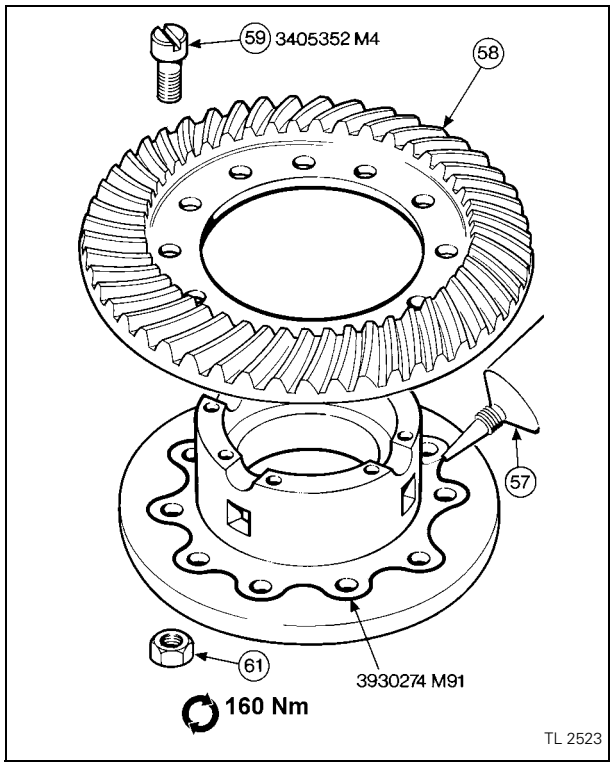
53. Ensure that the mating faces of the differential and the new crownwheel are perfectly flat and clean.
54. Position the left-hand differential case, with the mating face upwards, in a stand or vice.
55. Degrease the crownwheel, left-hand differential case and the crownwheel retaining nuts and bolts. Use Massey Ferguson Superclean Solvent or equivalent.
56. Collect together all the items required for the assembly of the crownwheel to the differential case, the items are:

- A torque wrench.
- 3/4 in across flats socket.
- Massey Ferguson Crownwheel Retainer (Loctite 638) part number 3930 274 M92.
- Massey Ferguson Studlock (Loctite 270) part number 3405 352 M5.

NOTE: *Procedures 58 to 62 must be completed without delay due to the curing of the Retainer and Studlock compound.*

57. Apply the entire contents of the 3 ml tube of Massey Ferguson High Strength Retainer evenly in a single bead to the flange of the differential case. DO NOT spread over the whole surface (see illustration).
58. Press the differential case onto the crownwheel. These two components are an interference fit and must have their bolt holes aligned accurately before being fitted together.
59. Fit the 12 bolts with their heads nearest the crownwheel teeth.
60. Apply two drops of Massey Ferguson Studlock (Loctite 270) to the first thread of each bolt.
61. Fit the nuts and tighten them progressively and evenly to a torque of 160 Nm (120 lbf ft).
62. Refit the differential components. *(see operation 2-6B).*
63. Press on the right-hand differential bearing cone.
64. Press on the left-hand bearing cup.
65. Refit the differential assembly.
66. Set the differential bearing pre-load, *(see operation 4-6B).*
67. Reverse procedures 1 to 5.





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DIFFERENTIAL PRE-LOAD

Check **4-6B**

Special Tools:
MF.245D Pre-Load Gauge
MF.245D-1 Straight Edge

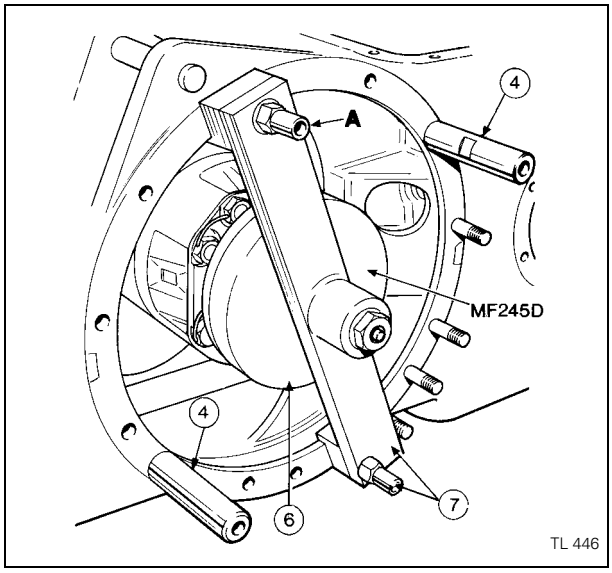
IMPORTANT: *This check must be carried out whenever the differential is dismantled, or if the bearings have been replaced.*

Procedure

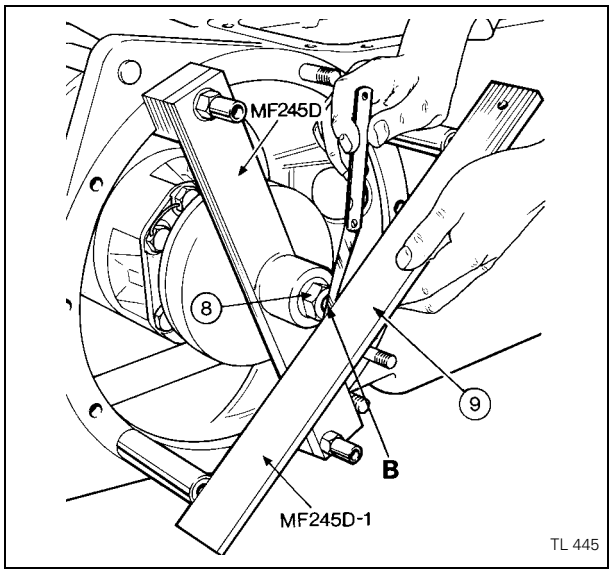
1. The pre-load check can only be made on the right-hand side.
2. Assemble the left-hand side axle housing complete.
3. DO NOT fit the bearing cup to the right-hand carrier plate, remove it and the chip shield.
4. Screw a setting block (part of special tool MF.245D, Pre-Load Gauge), to two diametrically opposite studs. Remove one stud from an adjacent location to fit the upper block.
5. Remove another stud from the centre housing and fit it in the taped hole at position 'A'.
6. Place the bearing cup on the bearing cone and fit the centraliser.
7. Position the clamp bar and secure it with the two tube nuts.
8. Torque the clamp bar nut to 27 Nm (20 lbf ft) whilst using a lever to turn the differential assembly. This will ensure correct seating and location of the bearings.
9. Place the straight edge, MF.245D-1, in position across the two setting blocks, and measure the gap 'B' using a feeler gauge.
10. Using the table below, determine the correct chip shield to be fitted behind the bearing cup. Usually, the chip shield required is either a two dot or a three dot.

Feeler gauge gap (equals shield thickness)		Means of identification	Part number
mm	in		
0,45-0,53	0.019-0.021	Eight dots	168 054 M1
0,61-0,66	0.024-0.026	Seven dots	521 401 M1
0,74-0,79	0.029-0.031	No dot	187 689 M1
0,86-0,91	0.034-0.036	One dot	892 173 M1
0,99-1,04	0.034-0.041	Two dots	892 172 M1
1,12-1,17	0.044-0.046	Three dots	892 171 M1
1,25-1,30	0.049-0.051	Four dots	892 170 M1
1,37-1,42	0.054-0.056	Five dots	191 124 M1

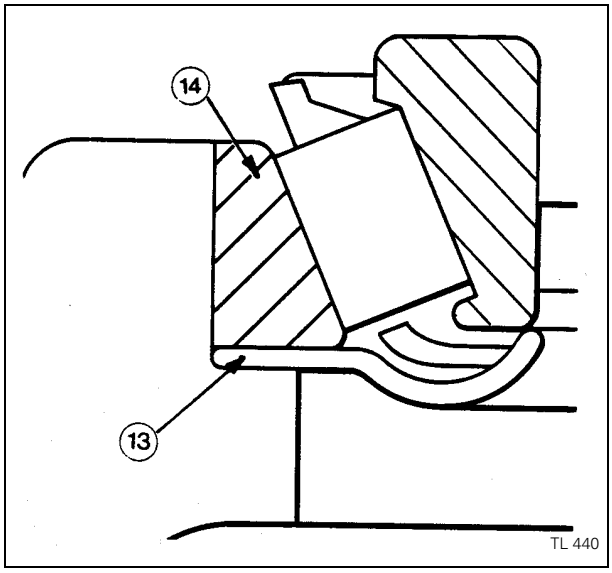
11. Remove MF.245D, tube nuts, clamp bar, centraliser and setting blocks.
12. Replace the two studs in there correct holes.
13. Place a new chip shield in the carrier plate, with the concave face towards the differential.
14. Refit the bearing cup, ensuring that it is fully seated.
15. Refit the carrier plate and axle housing.



TL 446



TL 445



TL 440

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Rear Axle

Section 6 - Part C

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3-6C	Epicyclic Planets and Sun Gear - Overhaul	6C– 5
4-6C	Epicyclic Unit - Overhaul	6C– 7
5-6C	Epicyclic Pre-Load - Check	6C– 9
6-6C	Axle Housing and Carrier Plate - Removal and Refitment	6C–10

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Rear Axle

SPECIFICATION

Normal-duty epicyclic rear axle:	
Tractor models:	
Normal-duty - narrow	4215, 4220, 4225, 4235, 4245, 4255.
Normal-duty - wide	4225, 4235, 4243, 4245, 4253, 4255, 4260, 4263
Heavy-duty - wide	4245, 4255, 4260, 4270.
Epicyclic ratio	3.75 : 1.
Axle shaft oil seal	Fit 2 mm (0.080 in) proud of casting.
Axle shaft end float	0 to 0,025 mm (0 to 0.001 in).
Method of adjustment	Graduated half ring.
Heavy-duty epicyclic rear axle:	
Tractor models	See above.
Epicyclic ratio	4.80:1.
Axle shaft oil seal	Press to shoulder.
Epicyclic carrier bearing pre-load	0,05 to 0,2 mm (0.002 to 0.008 in).
Method of adjustment	Shims.

Special Tools:

MF.265C	Epicyclic planetary carrier remover.
MF.267A	Epicyclic pre-load gauge.
MF.267-1	Sleeve - normal-duty axle.
MF.267-2	Sleeve - heavy-duty axle.
MF.366	PAVT wheel guide pegs.
MS.1713	30 tonne hydraulic puller.

Bolt Torques:

Epicyclic unit housing bolts - normal-duty	70 Nm (55 lbf ft).
Epicyclic unit housing bolts - heavy-duty	105 Nm (75 lbf ft).
Rear wheel nuts - pressed steel	325 Nm (240 lbf ft).
Axle housing to centre housing	130 Nm (95 lbf ft).
Cab/fender/stabiliser bracket bolts	230 Nm (170 lbf ft).
Bolts - front torsion bar to flywheel housing	375 Nm (275 lbf ft).
Cab/fender bracket bolts	130 Nm (95 lbf ft).

GENERAL DESCRIPTION

There are two versions of the indirect drive epicyclic rear axle, normal- and heavy-duty depending on the size of the tractor. The rear axles are fitted to each side of the centre housing which contains a bevel tooth crownwheel and pinion, driving through a differential unit to two fully floating half shafts with outboard epicyclic final speed reduction units. All these components run in a common transmission oil.

The heavy-duty versions of the standard axle use larger epicyclic final speed reduction units. They have an increased reduction ratio to lessen the transmission torque loads. These axles have their own self-contained oil supply for the final speed reduction units separated from the rest of the axle components by lip-type oil seals.

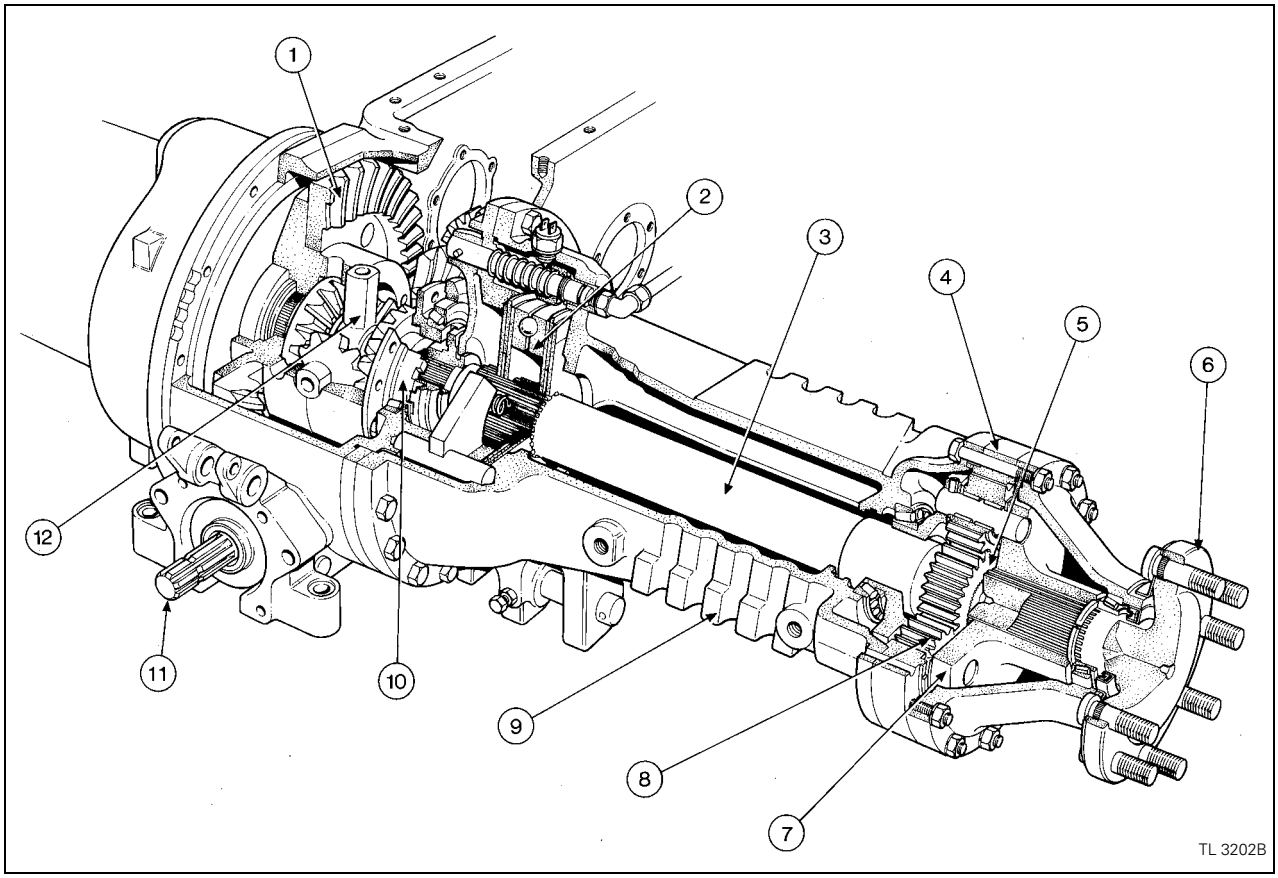
The half shafts are splined into the differential gears, and the outer ends are splined into the sun gear of the epicyclic unit.

The wheel axle is splined to the epicyclic carrier which is driven by the sun gear and planetary pinions.

The pre-load on the epicyclic taper roller bearings is set by the use of a special tool and fitting a shim behind the bearing cup in the axle housing.

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Rear Axle Assembly

1. Crownwheel and pinion
2. Brakes
3. Axle half shaft
4. Planetary ring gear
5. Sun gear
6. Axle shaft
7. Planetary carrier
8. Planetary gears
9. Axle housing
10. Differential lock
11. PTO shaft
12. Differential

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REAR WHEEL STUD

Removal and Refitment **1-6C**

Special Tools:
MF.366 Guide Sleeves (PAVT wheels only)

Removal

1. Apply the parking brake and chock the wheels. Jack up the tractor and place an axle stand under the axle housing.
2. Remove the rear wheel.

CAUTION: *PAVT wheels are extremely heavy and should only be removed with the assistance of a crane.*

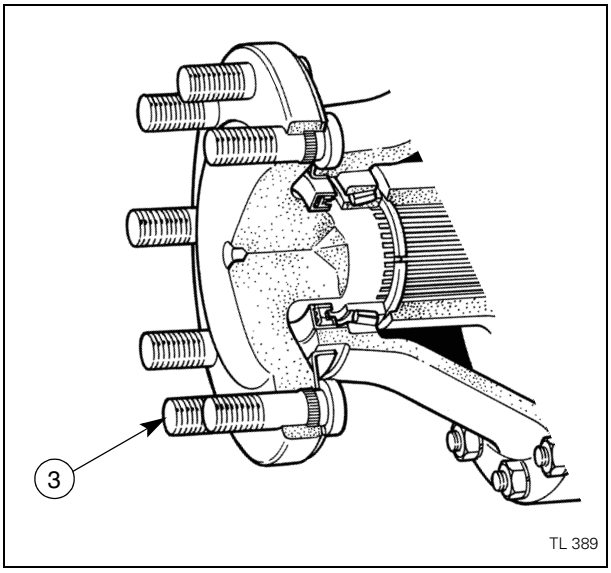
3. Drive out the damaged stud.

Examination

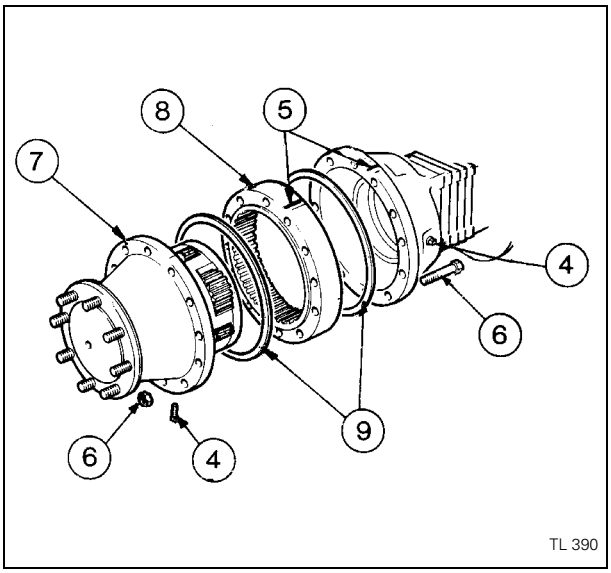
Examine the stud, hole, the other studs and the wheel disc for signs of fretting or damage.

Refitment

4. Locate the new stud in the wheel axle.
5. Tap the stud gently to locate the splines.
6. Fit a new wheel nut, with the flat side against the axle and pull the stud through the axle to its correct position.
7. Remove the nut.
8. PAVT wheels only, fit MF.366 Guide Sleeves to two opposed wheel studs to prevent damage to the threads.
9. Oil the threads of the wheel studs.
10. Refit the rear wheel and nuts and tighten progressively and evenly to a torque of 325 Nm (240 lbf ft).
11. Remove the axle stand.



TL 389



TL 390

EPICYCLIC UNIT AND RING GEAR

Removal and Refitment **2-6C**

Removal

1. Apply the parking brake and chock the wheels.
2. Jack up the tractor and place an axle stand under the axle housing.
3. Remove the rear wheel.
4. Normal-duty axles, drain down some of the transmission oil to below the axle housing.
5. Heavy-duty axle only, remove the drain and level plugs and drain the oil from the epicyclic unit.
6. Scribe a mark across the outer housing, ring gear, and axle housing to facilitate refitment.
7. Remove the nuts and bolts.
8. Remove the outer housing and ring gear assembly.
9. Remove the ring gear.

NOTE: *DO NOT withdraw the axle shaft, this would release all the brake plates.*

10. Remove and discard the two rubber seals around the housings.

Examination

Clean the recess in which the ring gear spigots are located and check that there are no burrs or deformity which could cause leakage.

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Refitment

11. Reverse procedures 1 to 9 except:
    a. Fit new rubber seals to each housing, fit carefully and press them down firmly in the groove.
    b. Ensure that the scribe marks are correctly aligned.
    c. Ensure that the teeth of the ring gear are in full engagement.
    d. Tighten the nuts and bolts to a torque of:
    Normal-duty axle 70 Nm (55 lbf ft).
    Heavy-duty axle 105 Nm (75 lbf ft).
    e. Normal-duty axles, top-up the transmission with the recommended lubricant.
    f. Heavy-duty axle, refill to the correct level with the recommended lubricant.

EPICYCLIC PLANETS AND SUN GEAR

Overhaul 3-6C

Dis-assembly

1. Remove the epicyclic unit, *(see operation 2-6C)*.

NOTE: *To service the sun gear, it is only necessary to remove one of the planet gears. One aperture is wider than the other two to allow the sun gear to pass through.*

2. Drive out and discard the roll pin.
3. Fit a 3/8 inch UNF bolt into the planet gear shaft.
4. Withdraw the shaft trying not to dislodge the needle rollers.
5. Remove the 3/8 inch bolt.
6. Remove the thrust washers and the planet gear. Repeat procedures 2 to 5 only if the epicyclic hub is to be completely overhauled.
7. Withdraw the sun gear.

Examination

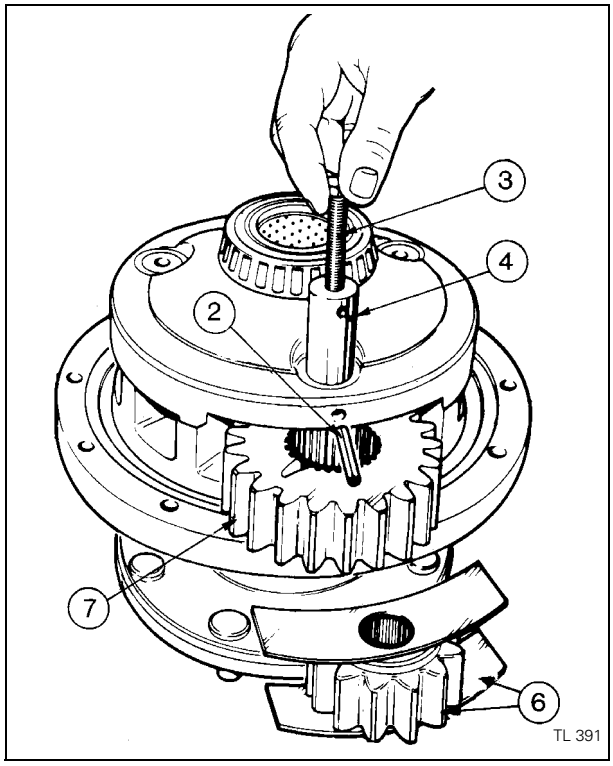
Inspect all parts and replace any which show signs of wear or damage.

Re-assembly

8. If the needle rollers were dislodged, refit them using petroleum jelly, NOT grease. Assemble as follows:

   Normal-duty axle - There are 58 needle rollers per planet gear - two rows of 29 rollers plus a spacer washer.

   Heavy-duty axle - There are 44 needle rollers per planet gear - two rows of 22 plus a spacer washer.

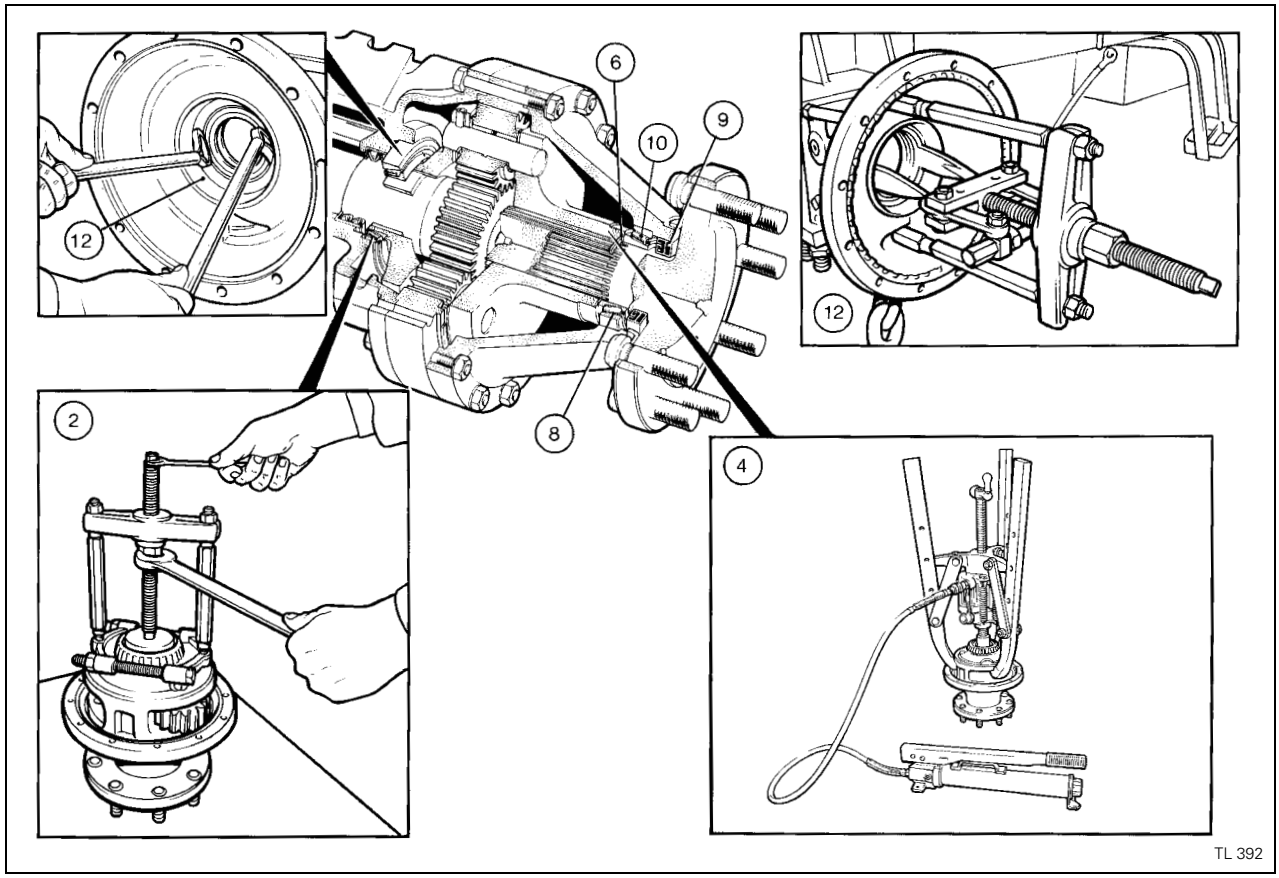


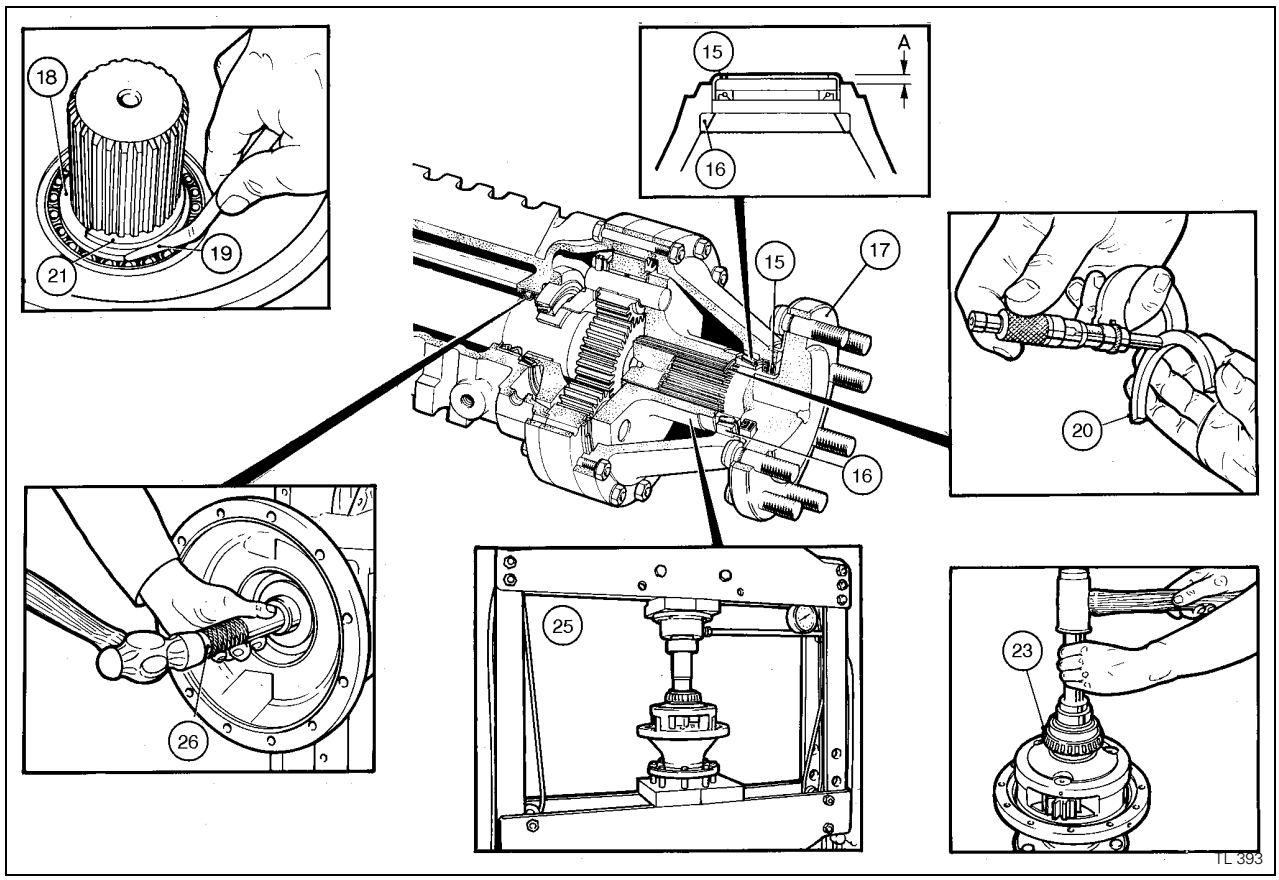
9. Reverse procedures 1 to 7, except:
   a. The wide aperture for removal of the sun gear has special wide thrust washers, ensure that they are fitted to the correct planet gear.
   b. DO NOT forget to place the sun gear inside the carrier before fitting the planet gear.
   c. On normal-duty axles, fit the planet gears with the large shoulder facing the centre of the tractor.
   d. Ensure that the holes in the casting, thrust washer and gear are in line before fitting the shaft.
   e. Fit new roll pins.

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Rear Axle





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EPICYCLIC UNIT

Overhaul **4-6C**

Special Tools:

30 tonne Hydraulic Press
or
MS.1713 30 tonne Hydraulic Puller

Dis-assembly

1. Remove the planetary gears and sun gear, *(see operation 3-6C)*.
2. Remove the bearing cone using an external bearing puller.
3. There are two methods of removing the epicyclic carrier from the axle shaft. Using a hydraulic puller or a hydraulic press, these must have a minimum capacity of 30 tonne. It will require a pressure of approximately 20 to 25 ton to remove the carrier.
4. Hydraulic puller, position the MS.1713 puller so that the central rod is located in the centre of the axle shaft. It will take two pulls to remove due to the length of spline engaged.
5. Hydraulic press, the illustration shows clearly the method of removal, it is recommended that the three pillars which support the cross bars are welded to a base plate. Allow a 100 mm (4 in) minimum clearance under the axle shaft for removal.
6. Remove the two half rings on normal-duty axles, snap ring on heavy-duty axles.
7. Press the axle shaft out of the bearing and housing.
8. Lift out the bearing cone.
9. Remove the oil seal.
10. If necessary, remove the bearing cup.
11. To remove the half shaft, fully apply the parking brake to lock all the brake plates in position. Pull the half shaft out of the housing.
12. Using pry bars or an internal bearing puller, remove the inner bearing cup and shim.
13. Heavy-duty axles, remove the inner oil seal from the axle housing.

Examination

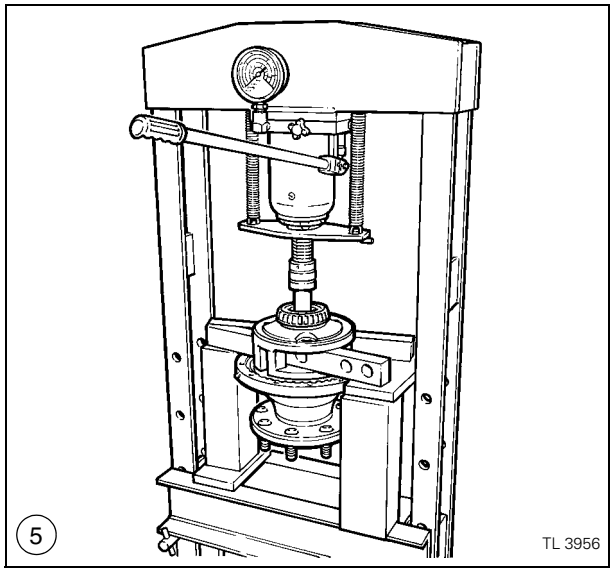
Inspect all parts and replace any which show signs of wear or damage. Replace all seals, gaskets and circlips.

Re-assembly

14. Refit the bearing cup, making sure it is fully seated.
15. Place the axle housing under a hydraulic press and position the outer seal with the lip facing inwards.

Normal-duty Axle up to serial number G13373:

Press the seal into the housing until it is 2 mm (0.080 in) proud of the housing (dimension 'A').



Clearances and half rings					
Half ring + feeler gap		Half ring thickness		Part No.	Ring No.
mm	in	mm	in		
5,92 5,94	0.233 0.234	5,84 5,89	0.230 0.232	882 601 M1	0
5,95 5,99	0.234 0.236	5,90 5,94	0.230 0.234	882 602 M1	1
6,00 6,04	0.236 0.238	5,95 5,99	0.234 0.236	882 603 M1	2
6,05 6,09	0.238 0.240	6,00 6,04	0.236 0.238	882 604 M1	3
6,10 6,15	0.240 0.242	6,05 6,09	0.238 0.240	882 605 M1	4
6,15 6,19	0.242 0.244	6,10 6,14	0.240 0.242	882 606 M1	5
6,20 6,24	0.244 0.246	6,15 6,19	0.242 0.244	882 607 M1	6
6,25 6,30	0.246 0.248	6,20 6,24	0.244 0.246	882 608 M1	7
6,30 6,35	0.248 0.250	6,25 6,30	0.246 0.248	882 609 M1	8

Normal-duty Axle serial number G13374 onwards and Heavy-duty Axles:

Press the seal into the housing so that the seal is flush with the housing.

16. Refit the bearing cup, making sure it is fully seated.
17. Lubricate the inside of the seal with engine oil, carefully insert the wheel axle shaft through the outer seal.
18. Drive the bearing cone down the shaft seating the rollers in the cup.

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Normal-duty Axles

19. Refit the half rings removed and check the clearance with a feeler gauge between the half ring and the bearing which should be 0,00 to 0,025 mm (0.000 to 0.001 in). The ring most used is Ring No. 2, part number 882 603 M1.
20. If adjustment is required proceed as follows:
    a. Using a micrometer, check the thickness of the half ring you have used to check the clearance.
    b. To this measurement add the thickness of the feeler gauge measurement.
    c. From the chart select the correct ring to be fitted to the shaft.

For example:

No. '2' measures 6,00 mm + feeler gauge thickness 0,10 mm = 6,1 mm

From chart select half ring No. 4 part number 882 605 M1, half ring + feeler gap = 6,10 mm

21. Fit the two half rings selected, ensuring that they are fully seated in the groove.

Heavy-duty Axles

22. Fit a new snap ring. Using a suitable puller, pull the housing assembly and bearing back tightly onto the snap ring. No shims or setting is required.

Both Types of Axles

23. Refit the bearing cone onto the spigot on the epicyclic carrier.
24. Reassemble the planet gears and the sun gear in the epicyclic hub, *(see operation 3-6C)*.
25. Using the hydraulic press, drive the epicyclic carrier on to the axle shaft.
26. Apply a thin coating of Hylomar sealant to the bore of the axle housing, then fit a new inner seal. The open side of the seal faces outwards. Smear the lips of the seal with petroleum jelly.
27. Refit the axle half shaft.
28. Check the epicyclic pre-load, *(see operation 5-6C)*.
29. Fit the selected shim(s) in the bearing cavity in the axle housing.
30. Refit the inner bearing cup.
31. Refit the ring gear and housing assembly, *(see operation 2-6C)*.

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EPICYCLIC PRE-LOAD

Check **5-6C**

Special Tools:
MF.267A Epicyclic Pre-load Gauge
MF.267-1 Sleeve - Normal-duty Axle
MF.267-2 Sleeve - Heavy-duty Axle

Procedure

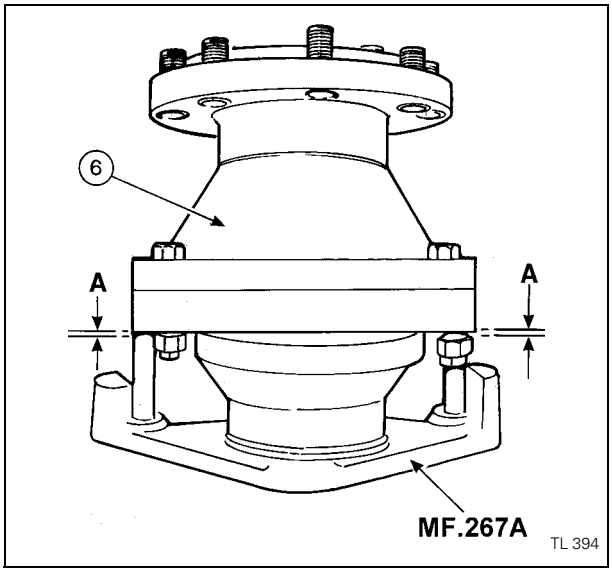
Before refitting the epicyclic unit, check the bearing pre-load as follows:

1. The inner bearing cup in the axle housing will have to be removed to enable the pre-load to be determined.
2. Remove the old shim(s) behind the bearing cup.
3. Bolt the ring gear to the outer housing using four bolts from the epicyclic unit with four wheel nuts as spacers. These bolts should be equally spaced around the ring gear.
4. Using special tool MF.267A, Epicyclic Pre-load Gauge, set the tool for either normal- or heavy-duty axle as follows:

a. Normal-duty - fit sleeve MF.267-1 on the central locating pin and screw the two gauge posts into the inner positions.

b. Heavy-duty - fit sleeve MF.267-2 on the central locating pin and screw the two gauge posts into the outer positions.

5. Place the bearing cup over the central locating pin on the gauge. DO NOT fit the shim(s).
6. Place the epicyclic unit on MF.267A so that the bearing cone fits the bearing cup and measure the gap at points 'A' using two sets of feeler gauges.
7. Note the clearance, which must be equal at both sides, then select a shim or shims from the table opposite.
8. Fit the shims into the cavity behind the bearing in the axle housing.
9. Refit the inner bearing cup, ensuring that it is fully seated.
10. Rebuild the axle as described *(see operation 4-6C)*.



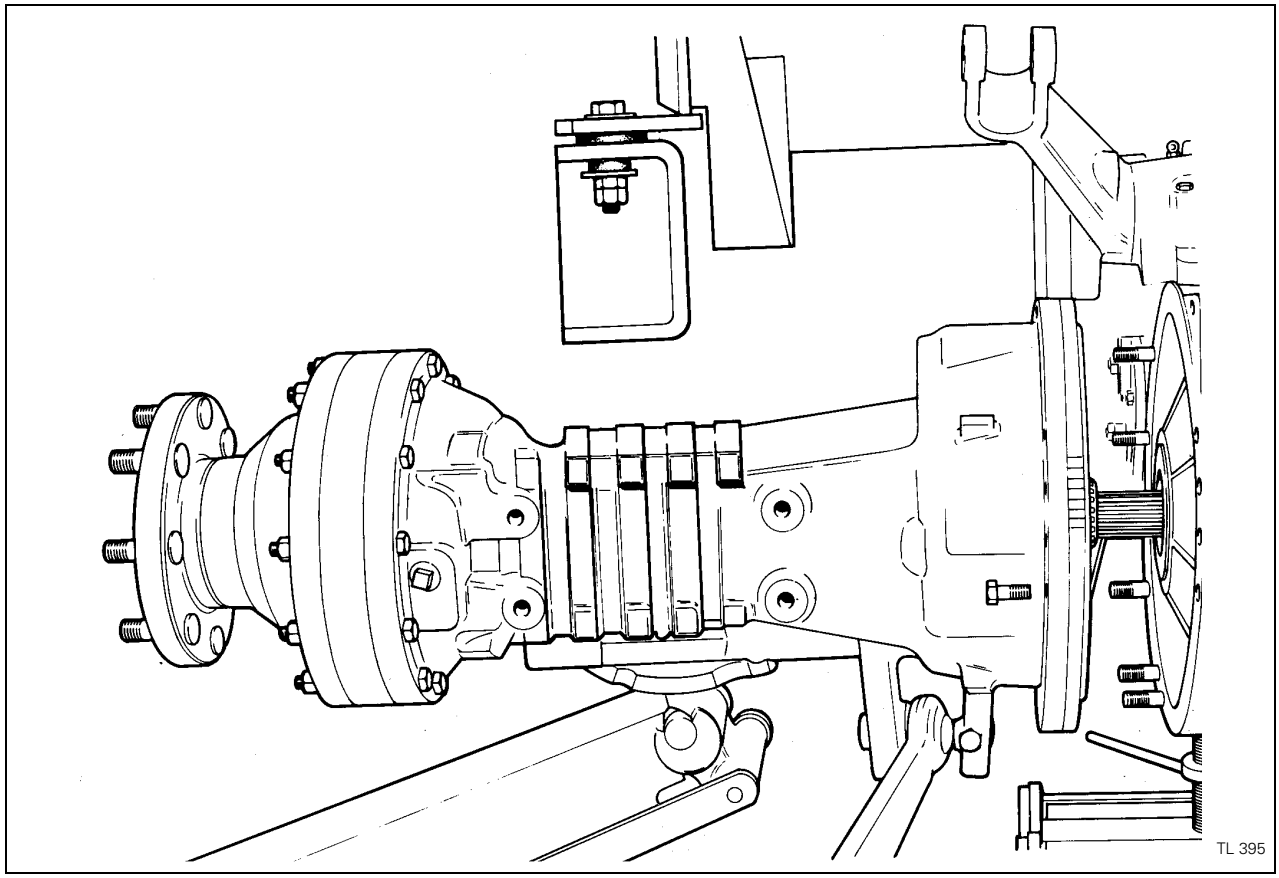
Epicyclic pre-load table			
Gap measured by feeler gauges (both sides)		Shim thickness required	
mm	in	mm	in
0,025-0,127	0.001-0.005	0,889	0.035
0,152-0,254	0.006-0.010	0,762	0.030
0,279-0,381	0.011-0.015	0,635	0.025
0,406-0,508	0.016-0.020	0,508	0.020
0,533-0,635	0.021-0.025	0,381	0.015
0,660-0,762	0.026-0.030	0,254	0.010
0,787-0,889	0.031-0.035	0,127	0.005
0,914-1,016	0.036-0.040	0,000	0.000

Shims available		
Shim thickness		Part number
mm	in	
0,13	0.005	894 757 M1
0,25	0.010	894 758 M1
0,38	0.015	894 759 M1

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Rear Axle



AXLE HOUSING AND CARRIER PLATE

Removal and Refitment 6-6C

Removal

1. Drain the transmission oil.
2. Disconnect the hydraulic brake feed pipe to the brake slave cylinder and drain the fluid into a clean receptacle. Mask-off the pipes and unions with suitable plugs or masking tape to prevent dirt ingress.
3. Disconnect the lift rod from the lift arm and assistor lift cylinder if fitted.
4. Disconnect the stabiliser.
5. Remove the stabiliser bracket under the axle housing.
6. Disconnect the forward end of the lower link from the axle housing.
7. Remove the lift arm and lower link assembly complete.
8. Disconnect the parking brake cable.
9. Chock the wheels and jack up the tractor under the axle housing.
10. Remove the rear wheel.
11. Place a substantial stand or support under the centre housing and lower the tractor onto the support.

On cab tractors, support the cab on an MF.3013 Cab Stand. Jack up the cab and remove the cab support bracket.

12. On tractors with six cylinder engines and fitted with a transmission case torsion bar, release the tension by releasing the bolt adjacent to the clutch housing, *(see operation 2-2A).*

Right-hand Side

13. Disconnect the hydraulic pipe to the differential lock.
14. Disconnect the differential lock switch.
15. If fitted, disconnect the trailer brake pipe from the slave cylinder, mask the connections, disconnect the hydraulic pipes and remove the valve assembly from the axle housing.

CAUTION: *The axle housing is heavy and awkward to handle. Take extra care when both removing and refitting it.*

Both sides

16. Place a substantial trolley jack, or use part of a tractor splitting track, under the axle housing.

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17. Remove all of the nuts and bolts securing the axle housing to the centre housing. Pull the axle housing away from the centre housing far enough for the half shaft to clear the differential housing.
18. Lower the axle housing to clear the cab or fender.
19. Manoeuvre the axle housing off the trolley jack or splitting track and stand it on end.

Left-hand Carrier Plate

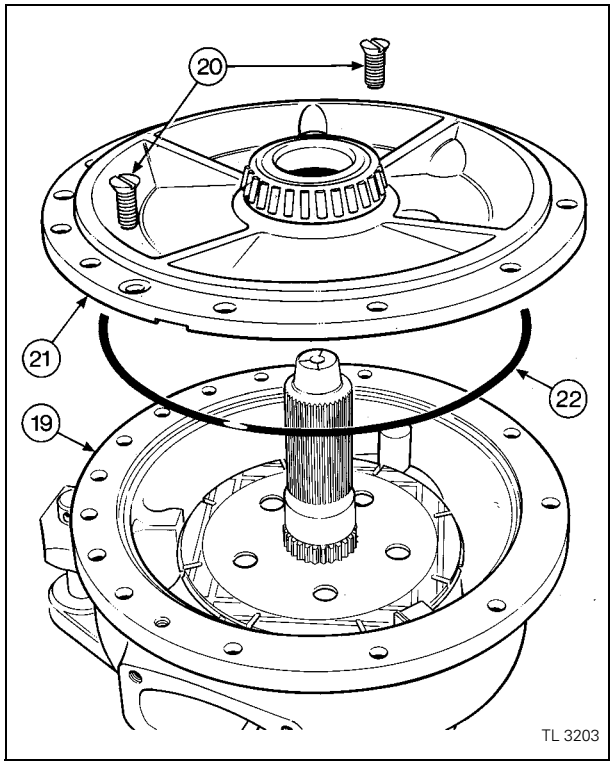
20. Remove the two countersunk screws.
21. Withdraw the carrier plate from the axle housing.
22. Remove and discard the inner 'O' ring.

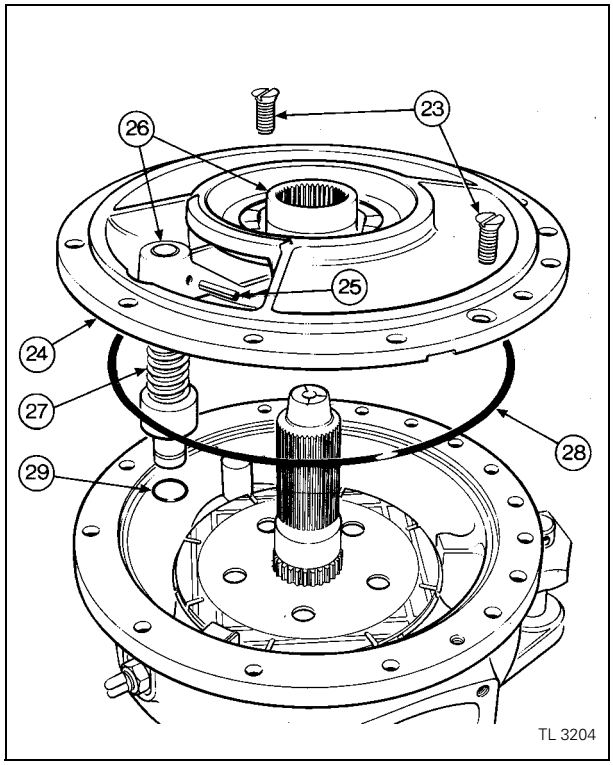
Right-hand Carrier Plate

23. Remove the two countersunk screws.
24. Remove the carrier plate complete with the differential lock coupler, fork and shaft assembly.
25. Remove the roll pin.
26. Remove the selector fork and coupling.
27. Remove the selector shaft and spring.
28. Remove and discard the inner 'O' ring.
29. Remove and discard the 'O' ring seal on the differential lock piston.

Refitment

30. Reverse procedures 1 to 29 except:
    a. Fit a new seal to the differential lock piston.
    b. Fit a new roll pin into the differential mechanism.
    c. Place a new 'O' ring in the recess in the axle housing using a smear of petroleum jelly for location. DO NOT attempt to fit the 'O' ring to the carrier plate.
    d. When manoeuvring the axle housing assembly back into position, take care to align the half shaft splines in the differential unit and the studs with the holes in the axle housing.
    e. Tighten the axle housing nuts and bolts to a torque of 130 Nm (95 lbf ft).
    f. Tighten the cab/fender mounting bracket bolts to a torque of 230 Nm (170 lbf ft).
    g. Oil the threads of the wheel studs.
    h. Refit the rear wheel and nuts and tighten progressively and evenly to a torque of 325 Nm (240 lbf ft).
    i. Refill the transmission with oil.
    j. Remove the air from the brake system, *(see operation 7-6A)*.
    k. Adjust and balance the brakes, *(see operation 8-6A)*.





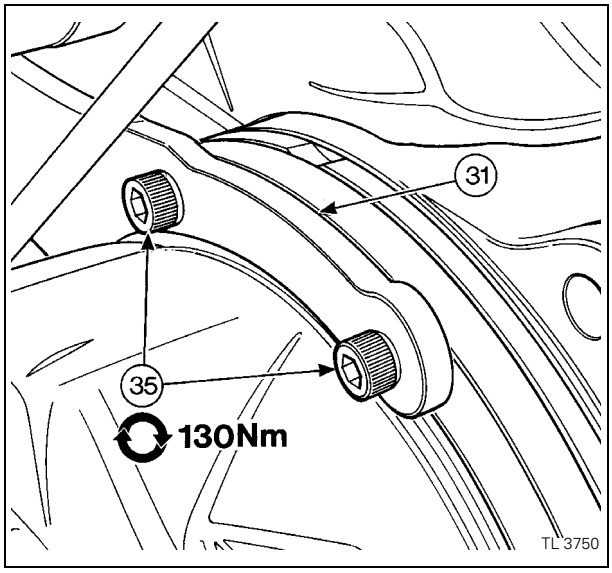
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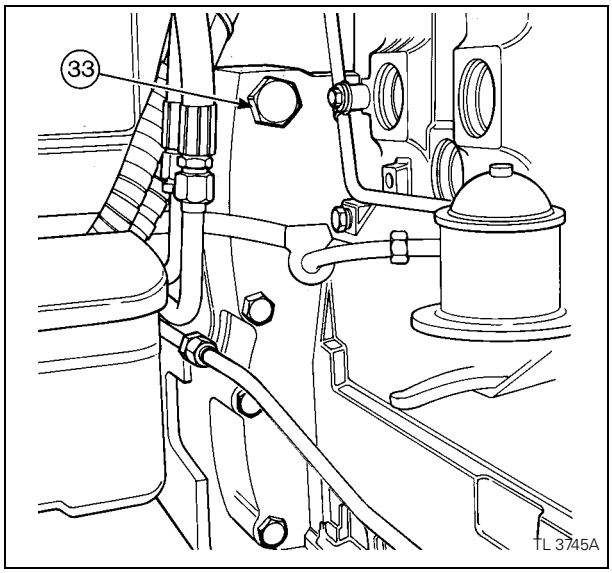
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Torsion Bars

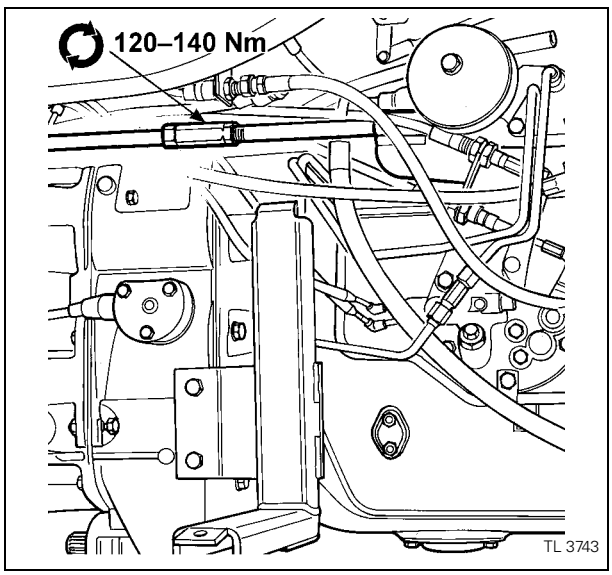
Tractors with six cylinder engines can be fitted with torsion bars across the top of the transmission case from front to rear. They are attached to a special bracket above the clutch housing at the front and a curved bracket around the top of the axle housing at the rear. These bars are tensioned to 130 Nm and must be released by slackening the front bolts before removing the axle housing bolts. There is a central turnbuckle to reinstall the tension. The tension is reset as follows:

31. Ensure that the bolting faces of the rear torsion bar bracket and the axle housing are clean.
32. With the axle in position and the torsion bar bracket hexagon socket cap screws loose, Couple up the two rods adjacent to the range gearbox, ensure that there is an equal amount of thread in each side of the adjuster, within half a turn.
33. Tighten the front bolt adjacent the clutch housing to a torque of 375 Nm (275 lbf ft).
34. Screw up the turnbuckle to apply a small amount of tension in the rods to take-up any slack in the bolt holes.
35. Tighten the hexagon socket cap screws (a 10 mm male hexagon bit adaptor will be required) to a torque of 130 Nm (95 lbf ft).





36. With a torque wrench and a 24 mm crowfoot open ended wrench, tighten the turnbuckle nut to a torque of 120-140 Nm (90-103 lbf ft). DO NOT over tighten. Check the torque in the other rod (if only one rod has been disturbed), Both rods must have the same tension and both rods must be checked. Hold the turnbuckle stationary and tighten the locknut to a torque of 130 Nm (95 lbf ft). The setting is now complete.



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Drawbar and Linkage

Section 6 - Part D

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3–6D	Haulage Drawbar - Removal and Refitment	6D–11
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Drawbar and Linkage

SPECIFICATION

Linkage

Linkage types:	
4215, 4220, 4225, 4235, 4245 tractors	Interchangeable ball ends category 1 and 2.
4225, 4235, 4243, 4245, 4253	Normal-duty telescopic - Maximum capacity 3000 kgf (6614 lbf).
4245, 4255, 4260, 4263, 4270	Heavy-duty telescopic - category 2.
4225, 4235, 4245, 4255, 4260, 4270	Fixed ball ends - category 2.
4225, 4235, 4245, 4255, 4260, 4270	Quick attach hook ends - category 2.
Lift capacity at link ends with links horizontal:	
Tractors with no assistor cylinders	2600 kgf (5732 lbf).
Tractors with 1 x 28 mm assistor cylinder	3000 kgf (6614 lbf).
Tractors with 2 x 28 mm assistor cylinders	4000 kgf (8818 lbf).
Tractors with 2 x 40 mm assistor cylinders	5000 kgf (11023 lbf).

Drawbar

Standard

Maximum static load:	
Normal-duty:	
Inner position	775 kgf (1709 lbf).
Centre position	775 kgf (1709 lbf).
Outer position	775 kgf (1709 lbf).
Heavy-duty:	
Inner position	1180 kgf (2601 lbf).
Centre position	1180 kgf (2601 lbf).
Outer position	1180 kgf (2601 lbf).
Haulage:	
Inner position	2500 kgf (5510 lbf).
Outer position	2500 kgf (5510 lbf).
Distance to PTO shaft:	
Inner position	250 mm (10 in).
Centre position (Haulage drawbar outer position)	350 mm (14 in).
Outer position	400 mm (16 in).
Drawbar face to centre of PTO shaft	200 mm (7.88 in).
Drawbar side swing from centre	221 mm (8.70 in).
Pintle pin:	
Maximum static load	3000 kgf (6614 lbf).
Drawbar maximum static load	1180 kgf (2601 lbf).

Pick-Up Hitch

Normal-Duty:	
Hook	
Maximum static load	2243 kgf (4945 lbf).
Drawbar - distance to PTO shaft:	
Inner position	350 mm (14 in).
Outer position	400 mm (16 in).
Drawbar - maximum static load:	
Inner position	775 kgf (1709 lbf).
Outer position	775 kgf (1709 lbf).

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Heavy-duty:

Hook - maximum static load:	
Inner position	3058 kgf (6742 lbf).
Centre position	1180 kgf (2601 lbf).
Outer position	1180 kgf (2601 lbf).
Drawbar - distance to PTO shaft:	
Inner position	250 mm (10 in).
Centre position	350 mm (14 in).
Outer position	400 mm (16 in).
Drawbar - maximum static load:	
Inner position	1180 kgf (2601 lbf).
Centre position	1180 kgf (2601 lbf).
Outer position	1180 kgf (2601 lbf).

Bolt Torques

Drawbar front frame to rear axle casing bolts	325 Nm (240 lbf ft)
Pick-up Hitch frame to rear axle casing nuts	375 Nm (276 lbf ft).
Two horizontal bolts into rear axle casing	230 Nm (170 lbf ft).
Four horizontal bolts into rear axle casing	115 Nm (85 lbf ft).
Two vertical bolts into PTO frame to drawbar frame	185 Nm (135 lbf ft).

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Drawbar and Linkage

GENERAL DESCRIPTION

The three point linkage controls the vertical movement of the mounted or semi-mounted implements *(see pages 6D-5, 6D-6 and 6D-7)*.

The three point linkage consists of:

1. Top link.
2. Two lift rods.
3. Two lower links.
4. Two telescopic stabilisers.
5. Control beam.

Top Link

The top link transmits the draft reaction forces from the soil engaging implements to the control spring and plunger assembly in the lift cover.

The top link consists of three main components:

Top ball end (tractor end).

Turnbuckle barrel and spring locking clip.

Bottom ball end (implement end).

The top link is adjustable for length, there are two witness holes in the turnbuckle barrel to ensure that there is sufficient engagement of thread. The turnbuckle is prevented from rotating by the spring locking clip at its top end.

Lift Rods

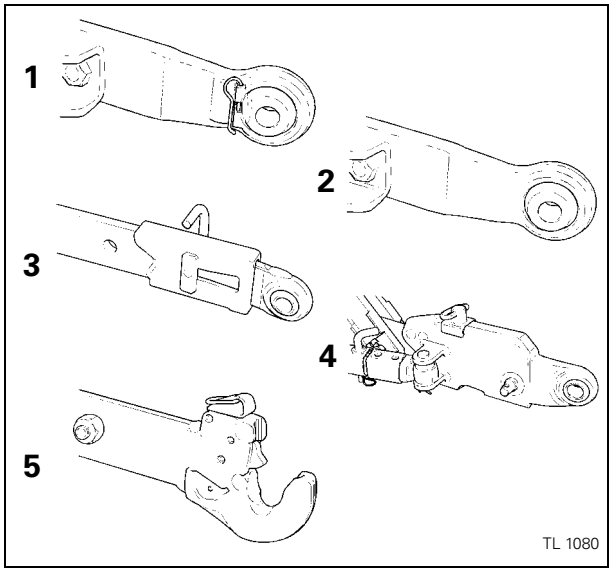
The two lift rods connect the lift arms to the lower links having a ball type joint at the top end with the link arms and a pivot pin at the bottom end with the lower links. The lift rod consists of three main components, ball joint, turnbuckle and lower fork.

The lift rod lengths can be adjusted for attachment to the implement by lifting the tube handle and rotating the turnbuckle. Allowing the tube to locate in the lowest position with the handles in the fore and aft position locks the lift rod and prevents rotation.

The lower fork section of both lift rods have elongated lower link attachment holes. This will permit lift rod float when working with wide implements. In this instant one lift rod lower pivot pin is released and the locking plate rotated 90^{o} to allow the lower link to float. The pin is then locked in position.

The lift rod has a nominal length between centres of 660 mm (26 in) for the 4215 and 4220 tractors and 745 mm (29. 3/8 in) on all other models.

Two grease nipples are provided on each lift rod to lubricate the screw threads.



Lower Links

Five types of lower link ends can be fitted to these tractors. *(see picture above)*.

1. Interchangeable ball ends- category 1 or 2.
2. Fixed ball ends- category 2.
3. Normal-duty telescopic ball ends- category 2.
4. Heavy-duty telescopic ball ends- category 2.
5. Hook type ball ends - category 2.

   Cables can be provided for operation of the hook ends from the cab as an optional accessory.

Telescopic Stabilisers

Two telescopic stabilisers are provided to restrict the sideways movement of the lower links to prevent them or the implement fouling the inside walls of the rear tyres. They can be fixed or set to allow a small amount of sideways movement when the implement is in the fully raised (transport) position.

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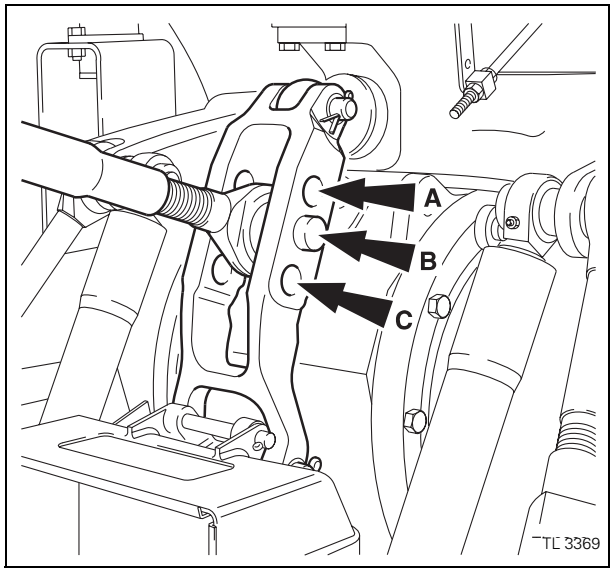
Control Beam

The control beam connects the top link to the control spring of the tractor hydraulic lift system when draft control is in use. It governs the action of the implement and is provided with three positions:

The top hole **'A'** is used for light draft implements for maximum depth control in shallow work.

The middle hole **'B'** is for heavy draft implements in deep work.

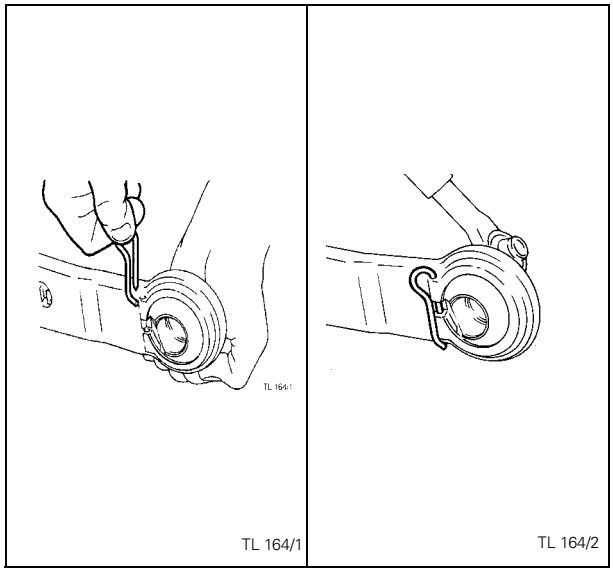
The lower hole **'C'** is used when it is necessary to reduce the effect of extreme compression and tension loads using very heavy equipment.



Interchangeable Ball Ends

The interchangeable ball ends are only fitted to the 4215 and 4220 tractor; they are fitted to the rear ends of the two lower links, thus category 1 and 2 implements can be used. Normally category 1 ball ends are stowed in the tool box.

The ball ends are changed by pulling up a spring wire clip, laying the ball ends flat and aligning the cut-out of the ball end with the slot in the lower link and sliding it out. The replacement ball is fitted by reversing the removal procedure.



LIFT LINKAGE

Removal and Refitment **1-6D**

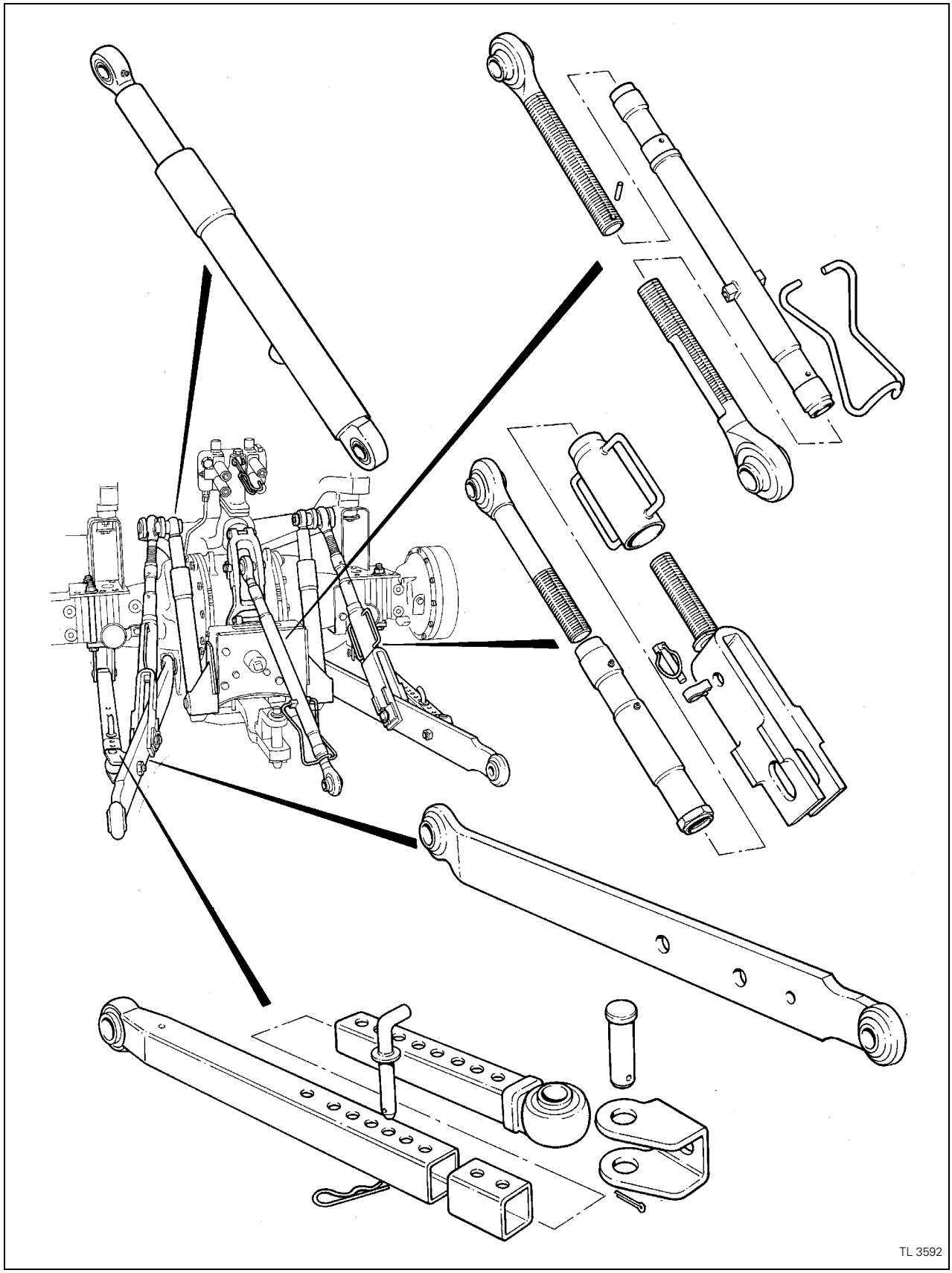
The lift linkage fitted to the rear of the tractor is extremely simple and removal and refitment and arrangement of the parts can be clearly seen in the following *pages 6D-6, 6D-7 and 6D-9*.

No repair sequence will be given.

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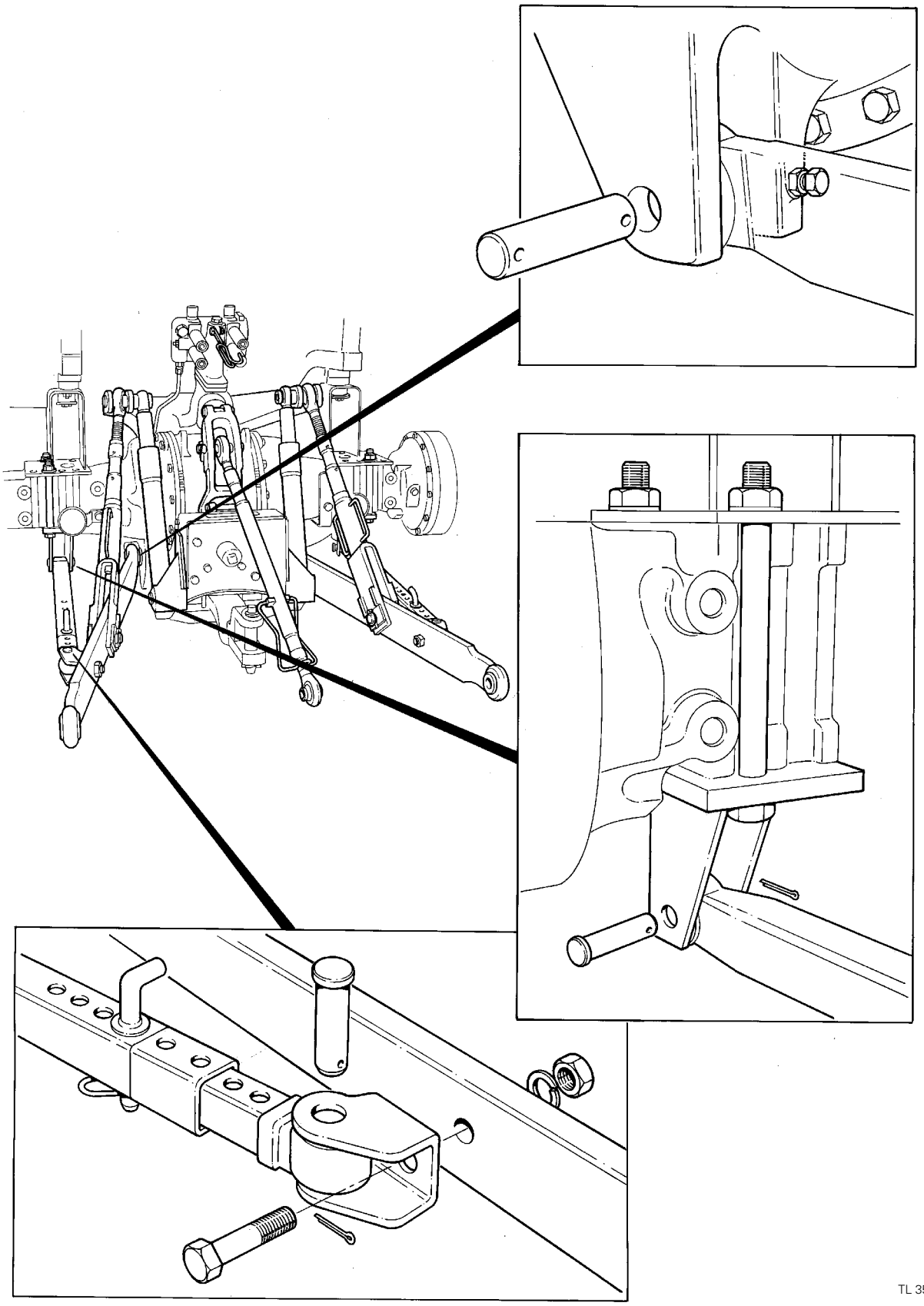
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Drawbar and Linkage



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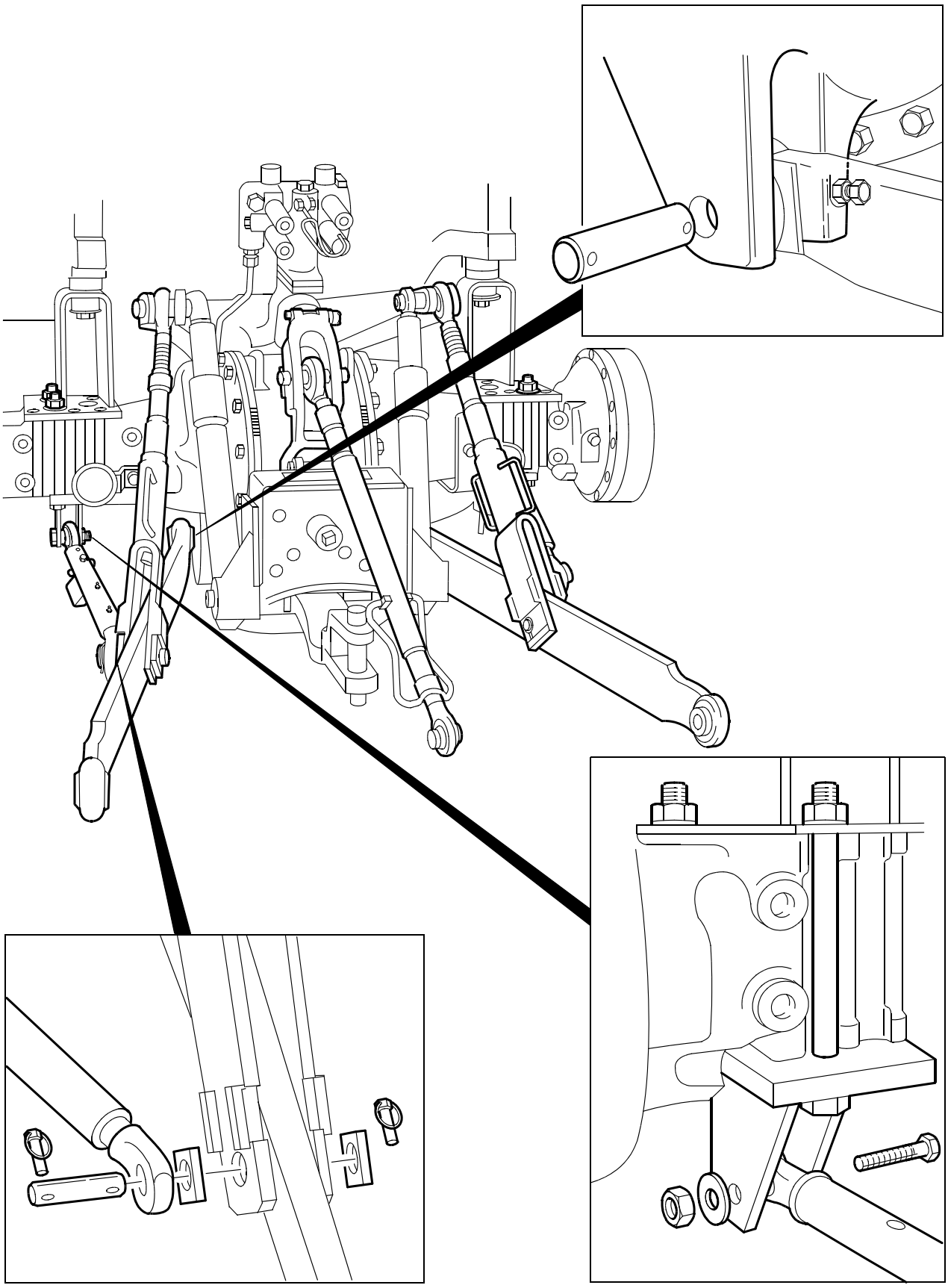


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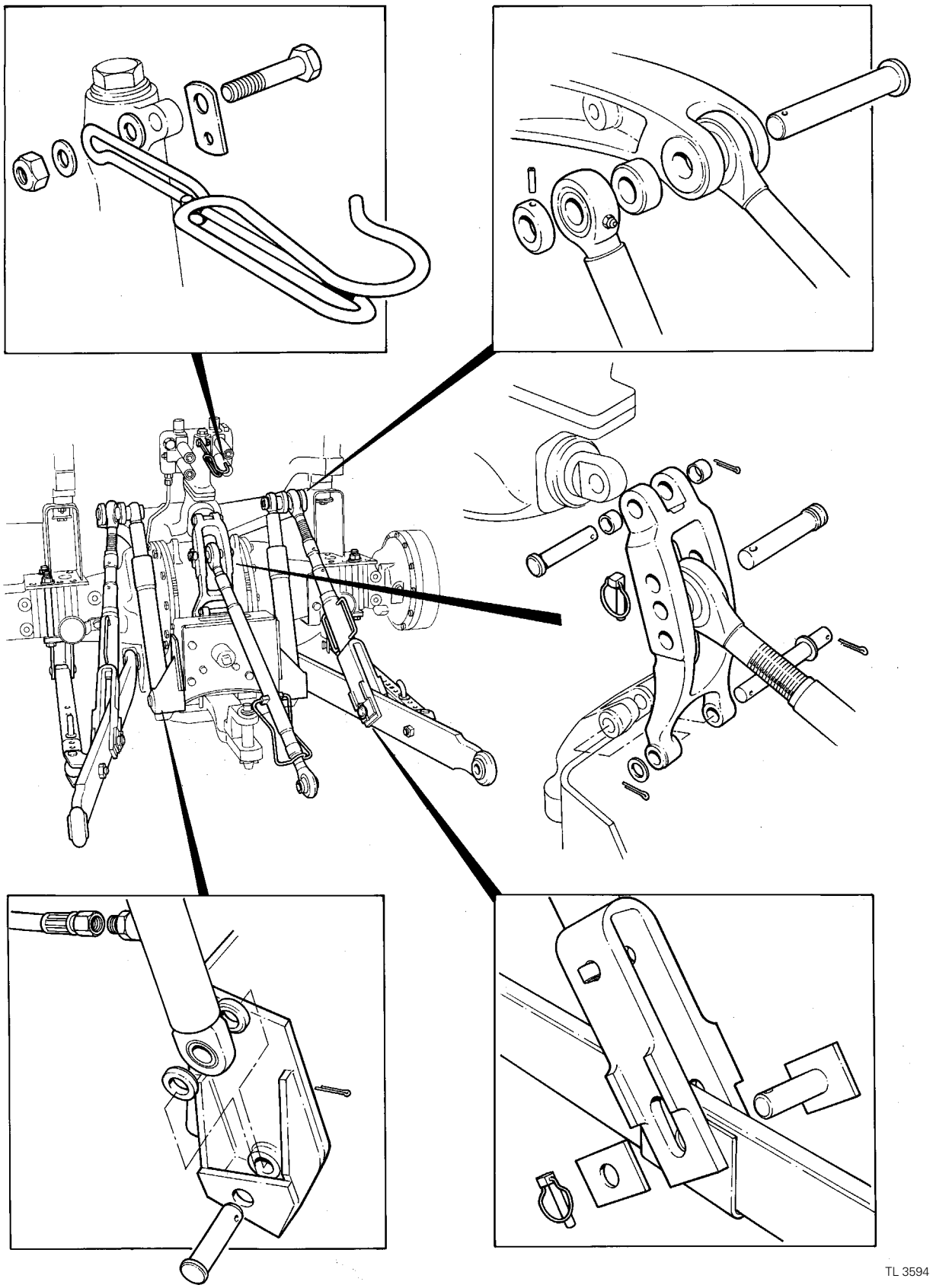
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Drawbar and Linkage



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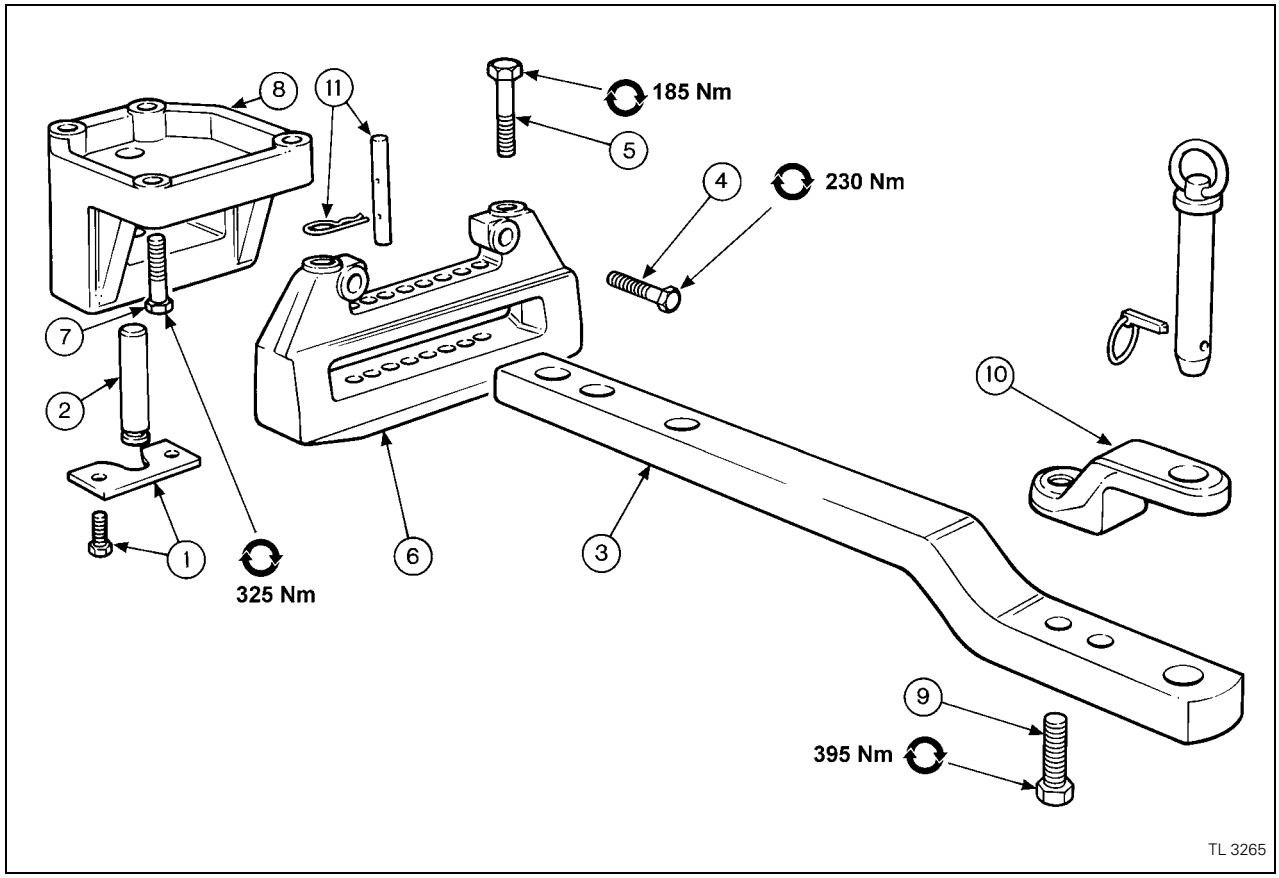


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Drawbar and Linkage



STANDARD DRAWBAR

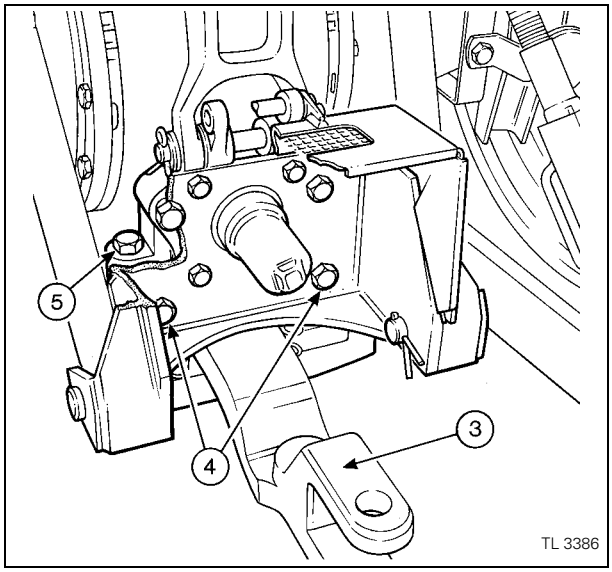
Removal and Refitment 2-6D

Removal

1. Remove the two bolts and the locking plate.
2. Remove the drawbar pivot pin.
3. Withdraw the drawbar rearwards from the drawbar frame.
4. Remove the two lower horizontal bolts adjacent to the PTO shaft. Slacken the other bolts.
5. Remove the two vertical bolts.
6. Lower the frame to the ground.
7. Remove the four bolts from the front support bracket.
8. Remove the front support bracket.
9. Remove the two bolts.
10. Remove the clevis.
11. If necessary, remove the 'R' clips and limit pins.

Refitment

12. Reverse procedures 1 to 11 except:
    a. Apply Massey Ferguson Studlock (Loctite 270) to all bolts.



b. Tighten the four front support bracket bolts to a torque of 325 Nm (240 lbf ft).

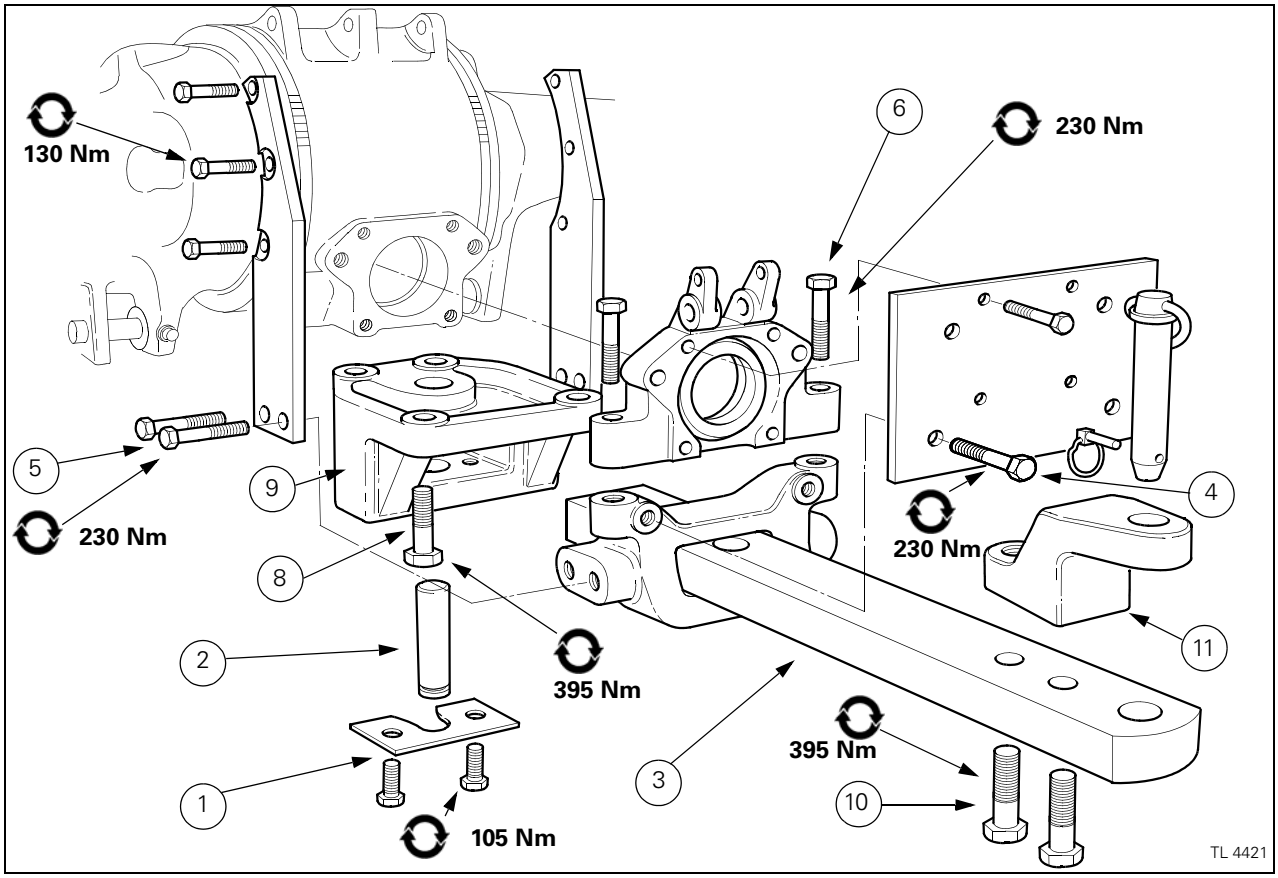
c. Tighten the two vertical bolts to a torque of 185 Nm (135 lbf ft).

d. Tighten the two horizontal bolts to a torque of 230 Nm (170 lbf ft).

e. Tighten the two clevis bolts to a torque of 395 Nm (290 lbf ft).

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HAULAGE DRAWBAR

Removal and Refitment 3-6D

Removal

1. Remove the two bolts and the locking plate.
2. Remove the drawbar pivot pin.
3. Withdraw the drawbar rearwards from the drawbar frame.
4. Remove the two lower horizontal bolts.
5. Remove the two bolts from each side.
6. Remove the two vertical bolts.
7. Lower the frame to the ground.
8. Remove the four bolts from the front support bracket.
9. Remove the front support bracket.
10. Remove the two bolts.
11. Remove the clevis.

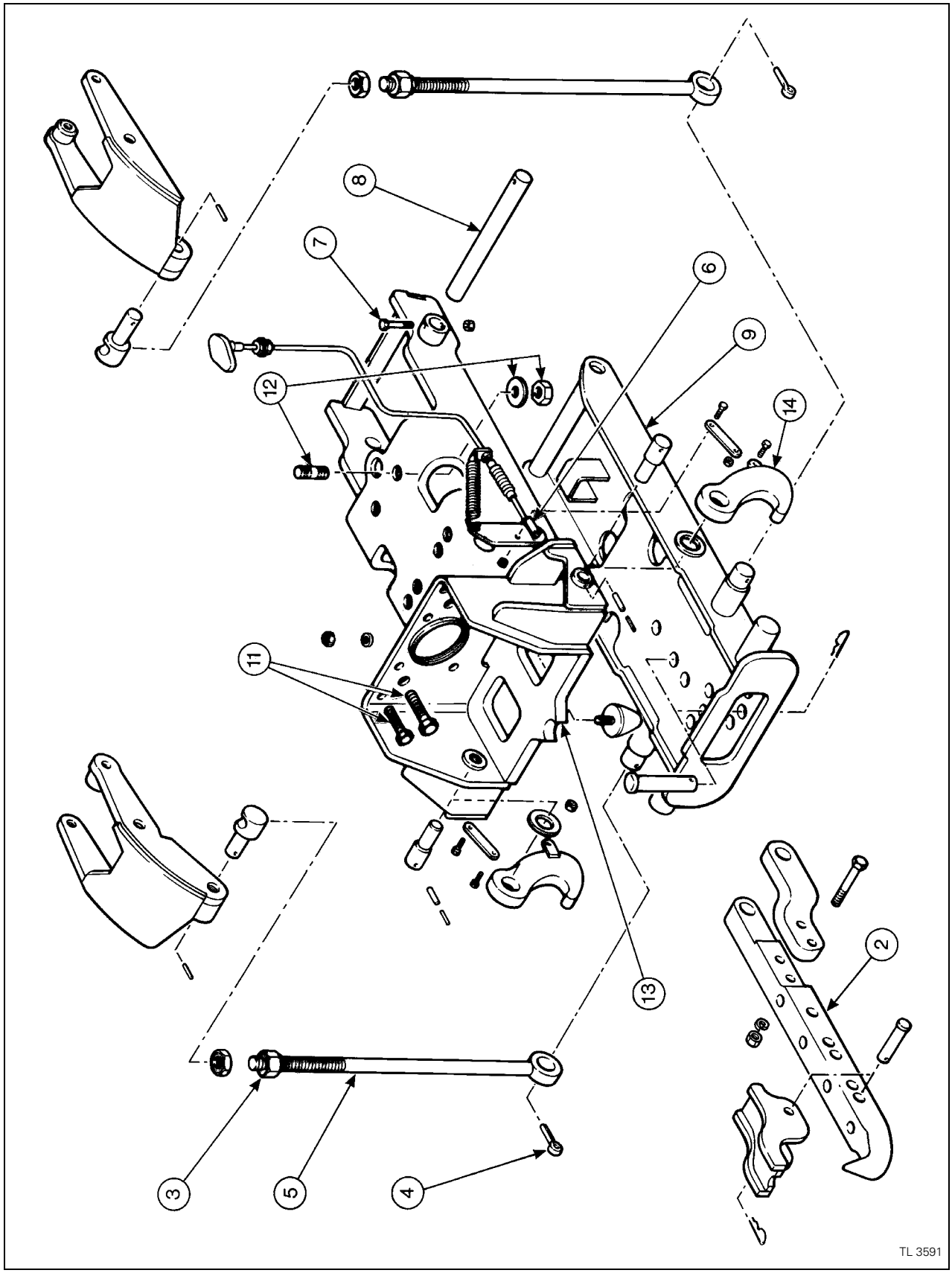
Refitment

12. Reverse procedures 1 to 11 except:
    a. Apply Massey Ferguson Studlock (Loctite 270) to all bolts.
    b. Tighten the four front support bracket bolts to a torque of 395 Nm (290 lbf ft).
    c. Tighten the two vertical bolts to a torque of 230 Nm (170 lbf ft).
    d. Tighten the horizontal bolts (4 and 5) to a torque of 230 Nm (170 lbf ft).
    e. Tighten the two clevis bolts to a torque of 395 Nm (290 lbf ft).
    f. Tighten the two locking plate bolts to a torque of 105 Nm (78 lbf ft)

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Drawbar and Linkage



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PICK-UP HITCH

Removal and Refitment 4-6D

The two pick-up hitches, normal- and heavy-duty are very similar in construction and design. For the purpose of this repair procedure we have only shown the heavy-duty version. Much of the work is of a very simple nature and the illustration will convey more information than can be put into words. The following will act as a guide:

Removal

1. Lower the frame.
2. Remove the drawbar/hook.
3. Remove the two nuts on top of the lift rods.
4. Remove the bolts at the base of the lift rods.
5. Remove the lift rods.
6. Disconnect the release cable.
7. Remove the bolt securing the rear pivot pin.
8. Remove the rear pivot pin.
9. Remove the drawbar frame.
10. Remove the assistor lift cylinders (not illustrated), if fitted.
11. Support the hitch sub-frame and remove the six horizontal bolts in the frame around the PTO shaft.
12. Remove the nuts and washers securing the sub-frame to the under side of the rear axle casing.
13. Remove the frame from the tractor.
14. Remove the latch linkage if required.

Refitment

15. Reverse procedures 1 to 14 except:
    a. Grease the rear pivot pin prior to installing.
    b. Ensure that the release cable operates freely.
    c. Tighten the nuts securing the sub-frame to the chassis to a torque of 375 Nm (276 lbf ft).
    d. Tighten the two large horizontal bolts to a torque of 230 Nm (170 lbf ft).
    e. Tighten the four small horizontal bolts to a torque of 115 Nm (85 lbf ft).

Adjustment

16. Adjust the control cable so there is no slack in the cable when the handle is down and the latches engaged.
17. Re-set the lift rod length to the previous setting.
18. With the hitch raised, place the Position Control in the Transport position.
19. Adjust the length of the lift rods so that they are just tight without taking the weight of the frame off the latches. Tighten the locknuts.
20. Check the operation of the release catches, move the Position control lever to the pick-up Hitch release position.
21. Pull the release handle, there should be approximately 3 mm (1/8 in) clearance between the latch and pin which will allow the frame to drop.

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Wheels and Tyres

Section 6 - Part E

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Wheels and Tyres

WHEEL NUT AND BOLT TORQUES

Three Cylinder Tractors:

Front wheels - Two-wheel drive:	
Wheel nuts	95 Nm (70 lbf ft).
Wheel screws	108 Nm (80 lbf ft).
Front wheels - Four-wheel drive:	
Wheel to hub screws	270 Nm (200 lbf ft).
Rim to disc nuts	190 Nm (140 lbf ft).
Rear wheels - Standard:	
Wheel to hub nuts	325 Nm (240 lbf ft).
Rim to disc nuts	240 Nm (178 lbf ft).
Rear wheels - PAVT:	
Wheel to hub nuts	325 Nm (240 lbf ft).
Clamp nuts - stage 1	70 Nm (52 lbf ft).
Clamp nuts - stage 2	140 Nm (105 lbf ft).
Clamp nuts - stage 3	260 Nm (192 lbf ft).

Four and Six Cylinder Tractors:

Front wheels - Two-wheel drive with pressed wheels:	
Wheel nuts	95 Nm (70 lbf ft).
Wheel screws	140 Nm (105 lbf ft).
Front wheels - Two-wheel drive with disc wheels:	
Wheel nuts	125 Nm (95 lbf ft).
Wheel screws	205 Nm (150 lbf ft).
Front wheels - Four-wheel drive:	
Wheel to hub screws	270 Nm (200 lbf ft).
Rim to disc nuts	190 Nm (140 lbf ft).
Rear wheels - Standard:	
Wheel to hub nuts	325 Nm (240 lbf ft).
Rim to disc nuts	190 Nm (140 lbf ft).
Rear wheels - PAVT:	
Wheel to hub nuts	325 Nm (240 lbf ft).
Clamp nuts - stage 1	70 Nm (52 lbf ft).
Clamp nuts - stage 2	140 Nm (105 lbf ft).
Clamp nuts - stage 3	260 Nm (192 lbf ft).

Special tools:

MF.366	PAVT wheel guide pilots.

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SAFETY

WARNING: Tyre fitting should be carried out by properly trained personnel - it can be very DANGEROUS. If you do not have this skill call in a qualified repair service.

Observe the following safety points:

1. Always use a safety cage.
2. Do not stand over the tyre.
3. Use a clip-on chuck and extension hose when inflating a tyre and stand clear.
4. Do not hit a tyre or rim with a hammer when the assembly is inflated.
5. Do not re-inflate a tyre that has been run flat or badly under-inflated without first removing it from the wheel and checking for damage. Any damage should be professionally repaired.
6. Never use a tube in a tyre larger - or smaller - than the one for which it was designed.
7. Never install tubes that have buckled or creased.
8. Never re-work, weld, heat or braze damaged rims.
9. Do not inflate above the maximum recommended pressure.
10. Tighten all nuts and bolts to the recommended torques stated in the specification section.

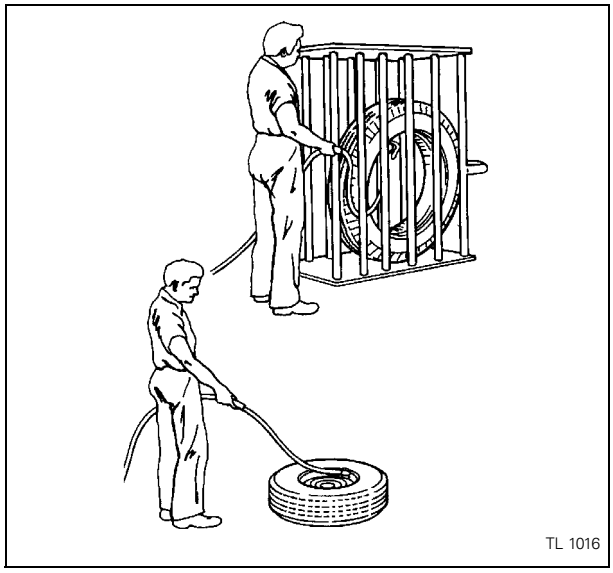


Fig.1

CAST CENTRE WHEELS

Adjust 1-6E

Special Tools:
MF366 PAVT Wheel Guide Pilots

Procedure

Power adjusted, variable track (PAVT) rear wheels are available on these tractors. They come in two sizes and provide an easily adjusted track width, ranging from:

Normal-duty rear axle	1395-2110 mm (55-83 in). (4225-4245 tractors).
Heavy-duty rear axle	1525-2440 mm (60-96 in). (4255-4270 tractors).

NOTE: *The widest track settings are obtained by reversing the cast centre of the PAVT wheels.*

The track settings are shown in the table at the end of this section, and are adjusted as follows:

1. Remove the two pins (1 Fig.2) from the rim stops.

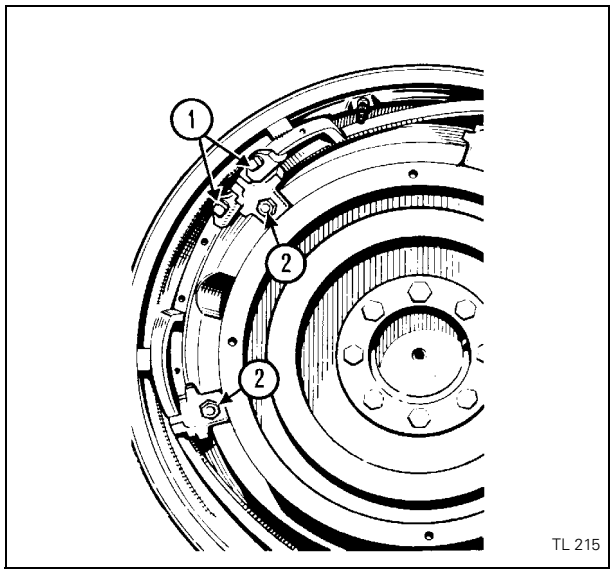


Fig.2

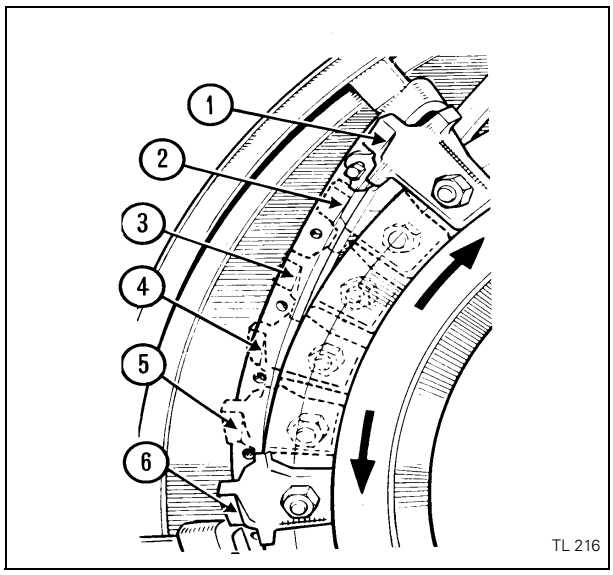


Fig.3

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2. Move the rim stop to required track setting position (Fig.3) and secure it with the pin. If the wheel has two sets of stops, set one stop on each rail to same setting. Check which direction the wheel has to be turned to adjust the setting.
3. Remove rim clamp nuts (2 Fig.2) individually, oil threads and refit leaving slack by approximately three turns.
4. Start the tractor engine and using independent brakes, apply the brake opposite to the wheel being adjusted. Select a gear either forward or reverse as required (see procedure 2).
5. Release the clutch sharply and let the wheel run until the rim clamp comes up against the stop.
6. Stop the engine.
7. Refit the other rim stop against the clamp.

NOTE: *If the Maximum or Minimum setting is required then the spare rim clamp stop can be fitted to any convenient hole.*

8. Oil the ramps on the rim clamps and wheel disc.
9. Using diagonal selection, starting with the nut nearest to the bottom of the wheel tighten the clamp nuts (2) evenly to a torque of 70 Nm (52 lbf ft).
10. Drive the tractor slowly forward approximately three revolutions of the rear wheels and reverse the same amount.
11. Using diagonal selection, starting with the nut nearest the bottom of the wheel, tighten the clamp nuts (2) evenly to a torque of 140 Nm (103 lbf ft).
12. Using diagonal selection, starting with the nuts nearest the bottom of the wheel, tighten the clamp nuts evenly to a torque of 260 Nm (192 lbf ft).

NOTE: *If the wheels run-out after making the above adjustments proceed as follows:*

Drive the tractor forward or backward until the maximum wheel run-out is at the top, using the fender as a guide. Stop the engine and slacken the three lower clamp bolts by two turns. Retorque the remaining clamp bolts to 260 Nm (192 lbf ft) thus pulling the wheel towards the centre line of the tractor. Retorque the three lower clamp bolts to 260 Nm (192 lbf ft). Check the run-out again by driving the tractor. Repeat the adjustment if necessary.

NOTE: *Minimum track setting cannot be obtained on tractors fitted with wide tyres.*

Track Settings

Track setting	Wheel type	
	Normal-duty	Heavy-duty
1	1425 mm (56 in)	1525 mm (60 in)
2	1525 mm (60 in)	1625 mm (64 in)
3	1625 mm (64 in)	1725 mm (68 in)
4	1725 mm (68 in)	1830 mm (72 in)
5	1830 mm (72 in)	1930 mm (76 in)
6	1930 mm (76 in)	2030 mm (80 in)
7		2130 mm (84 in)

Table 1

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TYRE

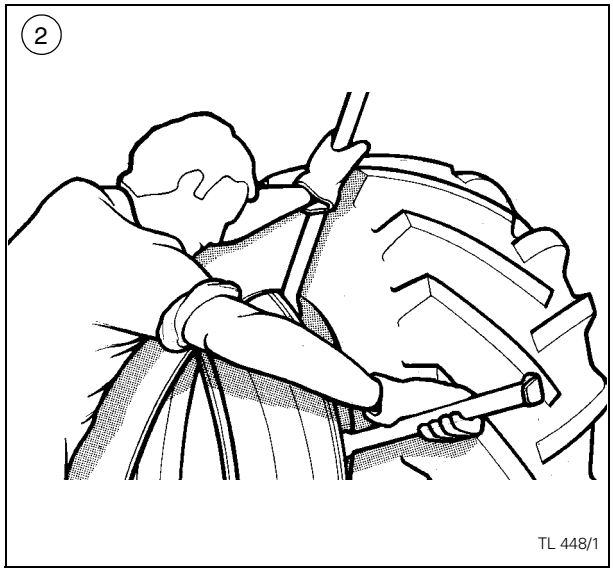
Removal and Refitment **2-6E**

Special Tools:
Bead-breaking Tool
3 lb Hammer
Tyre Levers

Removal

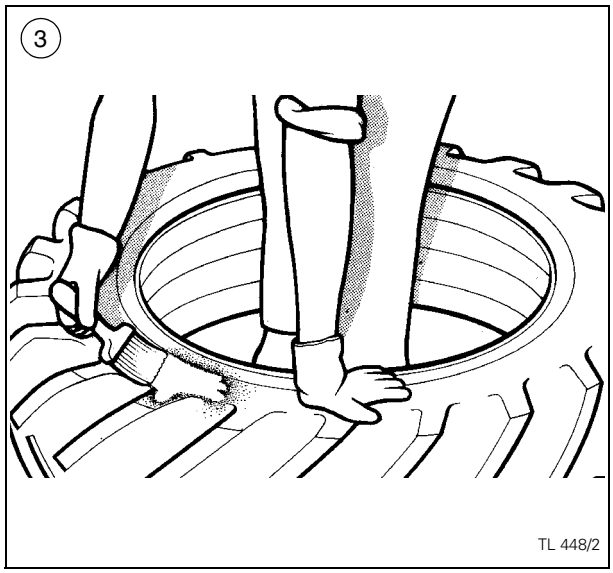
1. Remove inner tube as stated *(see operation 3-6E).*
2. With the wheel in a vertical position, pry off the tyre taking small bites with the tyre levers. A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help removal.

NOTE: *Never use petroleum or silicone based greases.*

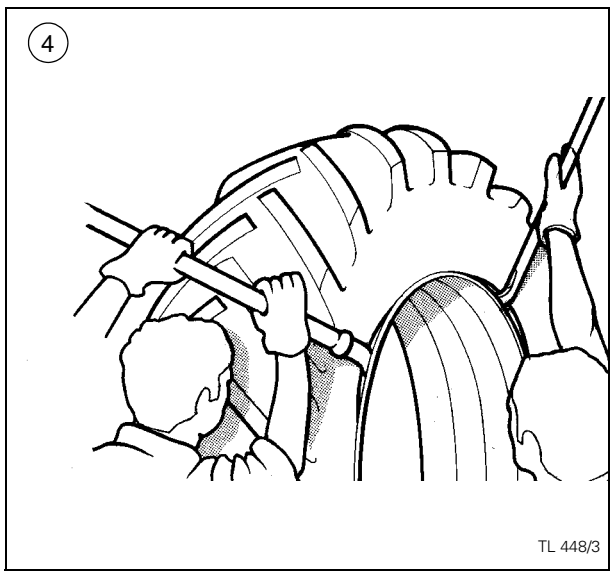


Refitment

3. Place the rim on the ground. Lubricate the bead and rim and place the tyre on rim.



4. Refit the tyre to the rim using long tyre levers.
5. Refit the inner tube.



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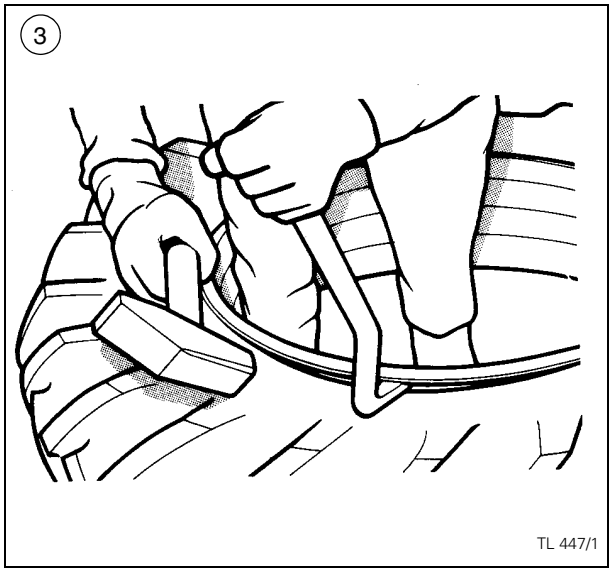
INNER TUBE

Removal and Refitment **3-6E**

Special Tools:
Bead-breaking tool
3 lb Hammer
Tyre Levers

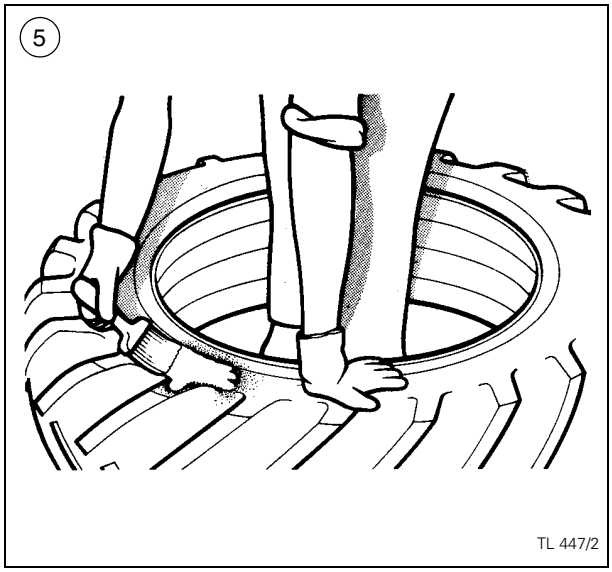
Removal

1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat item 3.

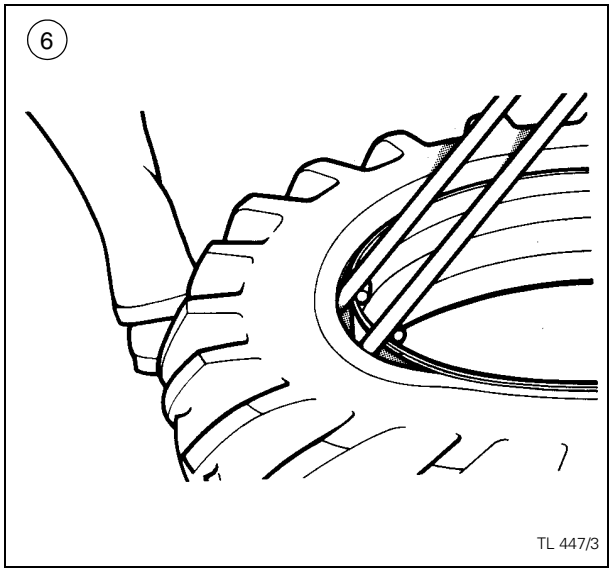


5. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

NOTE: *Never use petroleum or silicone base greases.*



6. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.



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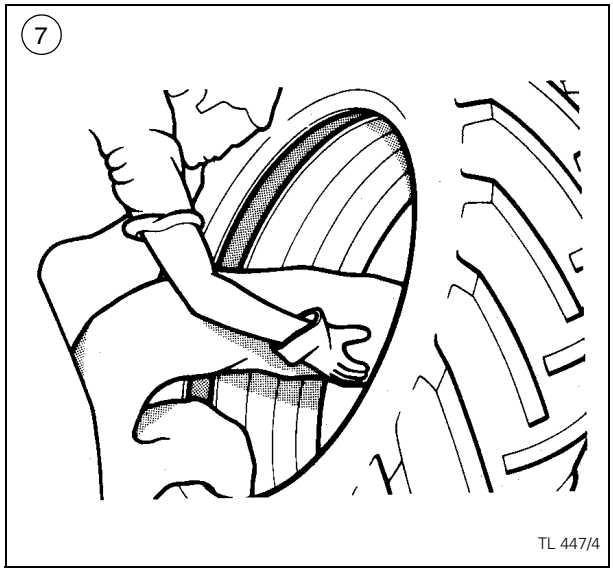
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7. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

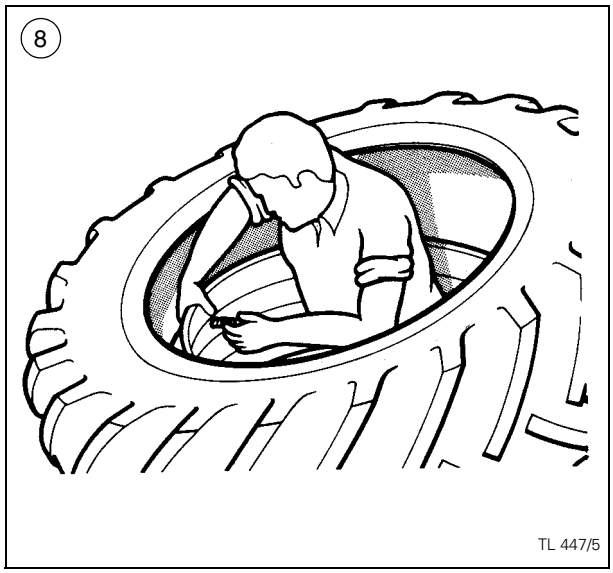
Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.

Refitment

WARNING: Never stand over the assembly when inflating. Remote control inflation equipment should be used, *(see Safety Instructions on page 6E-3).*



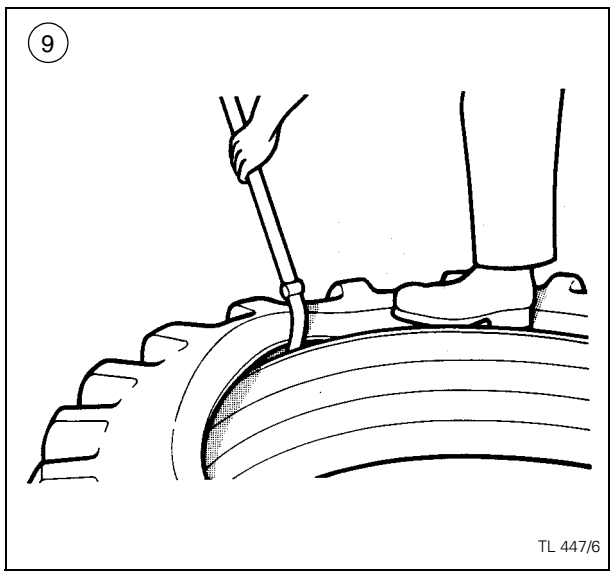
8. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.



9. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help refitment.

NOTE: *Care must be taken not to pinch the tube when fitting.*

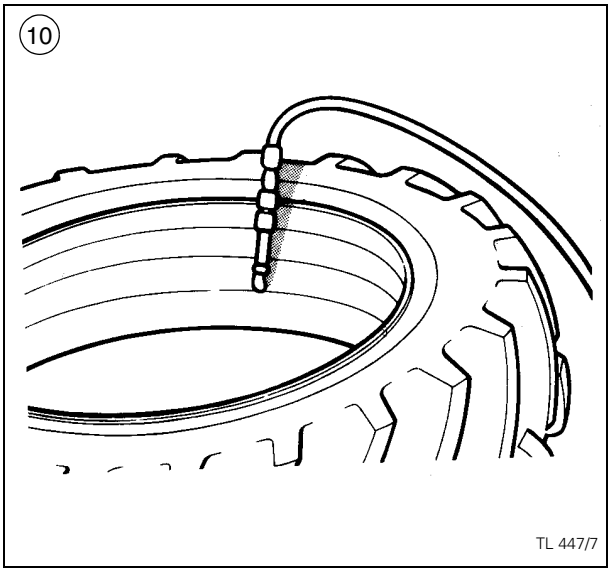


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10. Centre the tyre on the rim and inflate to approximately 2,4 bar (35 lbs/in²).
11. Remove the valve core and completely deflate the tyre.
12. Refit the valve core and inflate to recommended pressure.

CAUTION: *If beads fail to seat at 2,4 bar (35 lbf/in²) the tube may be pinched, do not increase the pressure but remove the valve core and release the tyre from the rim. Lubricate tyre, bead and rim and re-inflate to 2,4 bar (35 lbf/in²). Repeat process until both beads are properly seated. Adjust pressure to that recommended for tyre size and tractor.*



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SECTION 7

Power Take-Off

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7B	TWO-SPEED POWER TAKE-OFF
7C	FRONT POWER TAKE-OFF

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Single-speed Power Take-Off

Section 7 - Part A

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Single-speed Power Take-Off

SPECIFICATION

Engine to PTO shaft ratio	3.313:1.
Engine speed 540 PTO	1789 rev/min.
PTO shaft:	
Outside diameter	34,93 mm (1.375 in).
No. of splines	6.
PTO clutch:	
Type	Multiplate.
Size	127 mm (5 in).
Operation	Hydraulic.
No. of friction discs	7.
Thickness (new)	1,45-1,55 mm (0.057-0.061 in).
Max. permissible dish	0,127 mm (0.005 in).
Groove depth	0,152-0,227 mm (0.006-0.009 in).
No. of steel plates	7.
Thickness new	1,35-1,45 mm (0.053-0.057 in).
Max. permissible dish	0,127 mm (0.005 in).
No. return springs	1.
Type	Coil.
Free length	74 mm (2.9 in).
Working length	26,7-33,8 mm (1.052-1.332 in).
Load at working length	100 kgf (45 lbf).
Clutch retainer plate clearance	3,5-4,0 mm (0.138-0.157 in).
Checking load	5 kgf (11 lbf).
PTO drive hub support bearings:	
Depth of first bearing	59-60 mm (2.352-2.364 in).
Depth of second bearing	1-2 mm (0.040-0.080 in).
Spacer clearance	0,25 mm (0.010 in).

Special tools

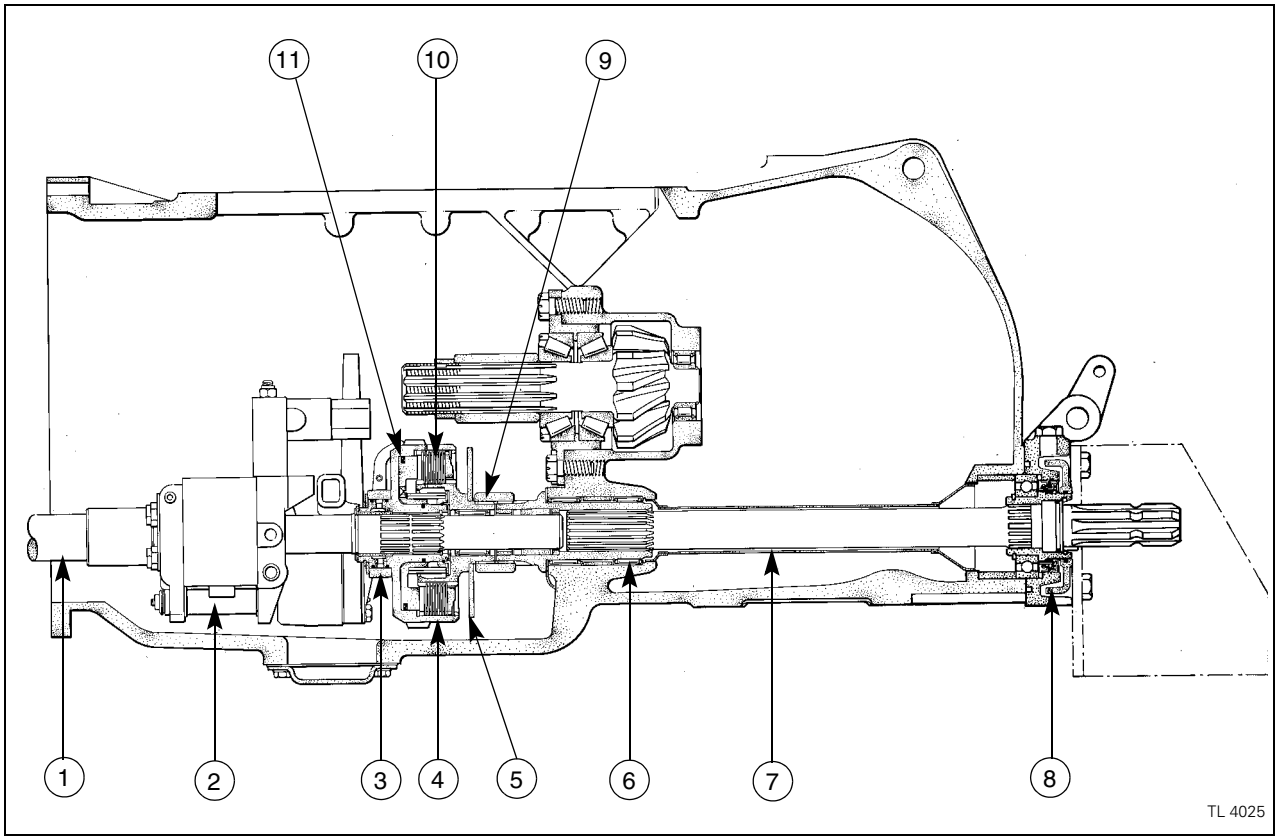
MF.195C	Bearing remover/replacer - main tool.
MF.195-5A/2	Extension rod.
MF.195-6A/1	PTO needle bearing remover.
MF.195-6A/4	PTO needle bearing replacer.
MF.501	Cassette seal installer.
MS.550	Universal handle.

Bolt torques

Two vertical extension housing bolts	185 Nm (136 lbf ft).
Two horizontal extension housing bolts (large)	230 Nm (170 lbf ft).
Four horizontal extension housing bolts (small)	115 Nm (85 lbf ft).

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Single-speed PTO

1. PTO input from transmission.
2. Hydraulic lift pump.
3. Feed ring.
4. PTO clutch.
5. PTO brake disc.
6. PTO shaft support bearing.
7. PTO shaft.
8. PTO bearing and seal assembly.
9. PTO shaft spigot bearing.
10. Multi-plate clutch.
11. Piston.

GENERAL DESCRIPTION

The PTO drive is taken from the hydraulic lift pump running at a speed of 540 rev/min giving a hydraulic flow of 16.7 litre/min (3.7 gal/min) (4.4 US gal/min) at an engine speed of 1789 rev/min.

The principal components of the single-speed PTO comprise a hydraulically-operated multi-plate clutch, and a spool-type control valve and linkage operated by hand lever.

The PTO clutch is located immediately to the rear of the linkage pump and is driven from an extension of the linkage pump drive shaft. This shaft is driven from the cover of the split torque transmission clutch, through the PTO reduction gears and drive shaft to the pump.

The rear extension shaft of the linkage pump is splined into the housing of the PTO clutch. Five steel interplates are splined into the casing of the clutch. Five corresponding sintered friction plates are splined to a central hub and brake disc. A large central spring holds the clutch in the disengaged position.

The PTO clutch is connected to the rear PTO shaft through an intermediate support bearing which takes the loads imposed by the chain drive to the auxiliary pump. The intermediate bearing is connected to the clutch by a splined coupler, to the PTO shaft by an internal spline.

Rotation of the PTO shaft is controlled by the hydraulic clutch. It occurs when the driving (steel) plates and the driven (friction) plates are forced into engagement by the piston, this is operated by oil pressure from the left-hand side cover and auxiliary hydraulic system.

The spool-type control valve is located on the outside of the left-hand side cover and has two positions selected by the hand lever adjacent to the driver. Moving the lever to the engaged position allows the control valve to direct oil into the back of the piston, overcome the pressure of the return spring and engage the clutch. A small jet is positioned in the face of the piston to direct oil at 0,5 litre/min (1 pt/min) onto the friction plates, particularly at the time of engagement, to cool the plates. Holes are provided in the periphery of the clutch casing to vent oil from between the plates.

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Single-speed Power Take-Off

Moving the lever to the disengaged position shifts the control valve spool allowing oil to return from behind the piston and thereby disengaging the clutch. At the same time the safety start switch is engaged. The large return spring located behind the piston ensures a fast return oil flow and a rapid disengagement of the clutch. Return oil from behind the piston returns directly through a port in the side cover to the transmission case.

When the clutch is in the disengaged position, the oil pressure is directed to the brake piston. This force operates through linkage to a calliper-type brake which holds the PTO shaft stationary.

The hydraulic system is fitted with a modulating valve assembly which controls the rate of engagement of the clutch, it comprises two valves mounted in the left-hand side cover. They control the flow of oil into the clutch pack so that the engagement time is approximately 1.5 seconds, this prevents the clutch taking up the drive suddenly which could result in damage to the tractor or the implement. The clutch pack pressure is controlled by the pressure maintaining valve adjacent to the engine. A safety pressure relief valve is fitted to the larger of the modulating valves to prevent damage to the clutch pack. These valves are factory set and non-adjustable.

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DIAGNOSIS

The Power Take-off hydraulic system is controlled by a valve block located on the left-hand transmission side cover and the hydraulic pump on the right-hand side. Before any repairs are made tests should be carried out to determine the condition of the hydraulic system. Refer to Section 9C for system diagnosis.

LEFT-HAND SIDE COVER

Removal and Refitment 1-7A

Removal

1. Remove the left-hand fuel tank, *(see operation 2-3C).*
2. Drain the transmission below the LOW mark on the dipstick.
3. Disconnect the auxiliary and/or PTO hydraulic pipes from the side cover and remove as necessary.
4. Disconnect the PTO selector cable from the operating lever.
5. Remove the two bolts holding the brake and selector rail support bracket.
6. Disconnect the wires from the safety start switch.
7. Make from 3 mm (1/8 in) diameter wire a hook as illustrated.
8. Insert the hook into the end of the transfer pipe engaging it in the cross drilled hole, withdraw the pipe from the PTO clutch and side cover.
9. Remove the side cover bolts.
10. Remove the PTO cable anchor bracket.
11. 1Remove the side cover by lifting it vertically so that the selector arm clears the selector rail.

Refitment

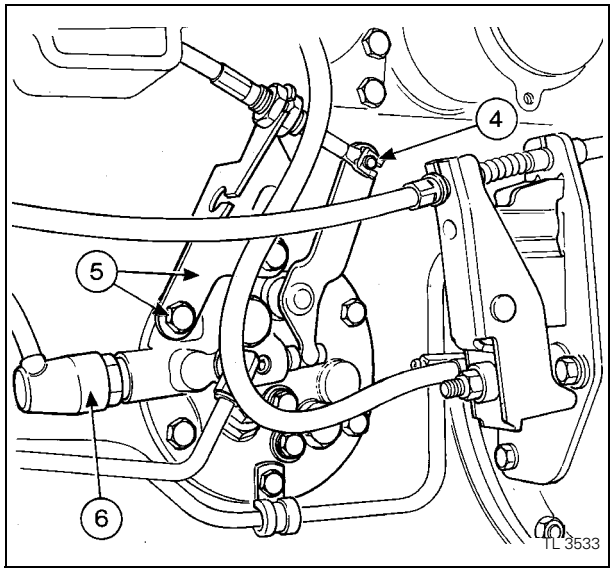
12. Clean the mating faces between the side cover and the transmission.
13. Reverse procedures 1 to 11 except:

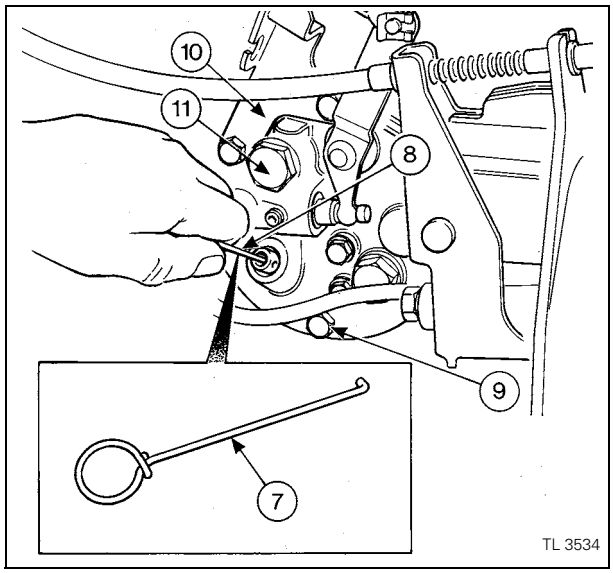
a. Replace the 'O' rings on the transfer pipe and the bolts holding the brake and selector rail bracket to the side cover.

b. Insert the transfer pipe with the cross drilled hole uppermost. Ensure that the pipe is pressed fully home.

c. Apply Massey Ferguson Multi-Gasket (Loctite 573 instant gasket to the face of the side cover.

d. Seal the six side cover bolts with Hylomar sealant.

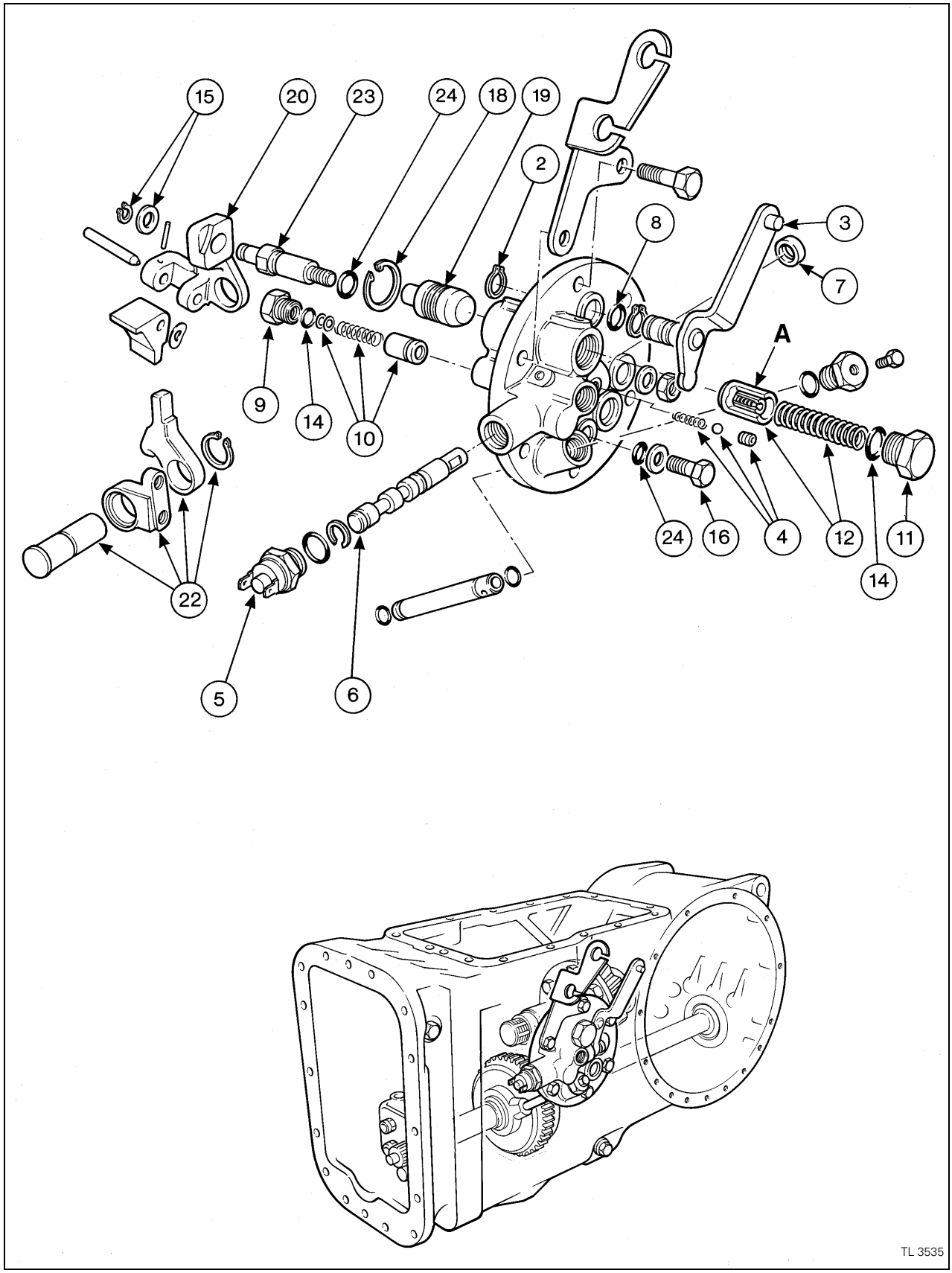




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Single-speed Power Take-Off



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LEFT-HAND SIDE COVER

Overhaul 2-7A

Dis-assembly

1. Remove the left-hand side cover, *(see operation 1-7A)*.

Control Valve Spool

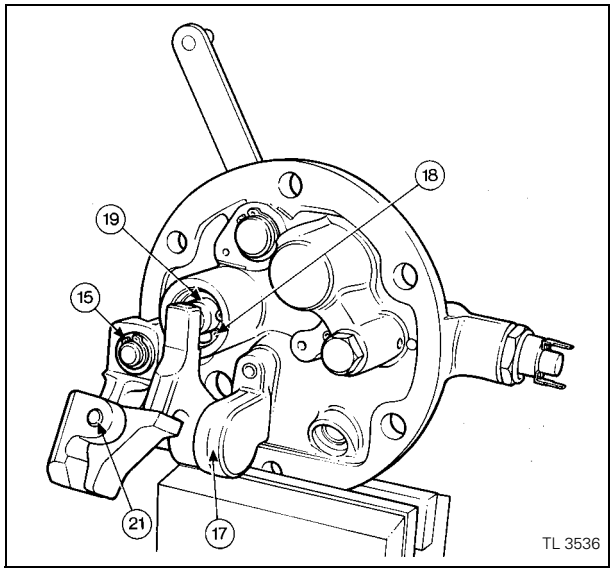
2. Remove the circlip.
3. Remove the selector lever.
4. Remove the detent ball and spring.
5. Remove the safety start switch.
6. Withdraw the valve spool.
7. Remove the oil/dirt seal.
8. Discard all 'O' rings.

Flow Modulating Valves

9. Remove the 1st modulating valve cap.
10. Withdraw the valve, spring and shims.
11. 1Remove the 2nd modulating valve cap.
12. Withdraw the valve and spring.
13. Check the condition of the valves, clean the small orifice in end of the 1st modulating valve (A). The modulating valves and pressure relief valve must not be adjusted, they are factory set for the correct flow and pressure.
14. Discard all 'O' rings.

Brake

15. Remove the circlip and washer.
16. Remove the two bolts and sealing washers from the front of the cover.
17. Remove the brake assembly.
18. Remove the circlip.
19. Withdraw the brake piston from the side cover. The brake piston has no sealing rings, it relies on a precision fit for sealing.
20. Remove the brake calliper.
21. 2Split the brake calliper into two parts by removing the roll pin and pivot pin.
22. Remove the external circlip and brake actuating lever and shaft.
23. If necessary, remove the nut, 'O' ring and brake support shaft.
24. Remove and discard the 'O' rings.



Re-assembly

25. Clean all components and lightly lubricate parts with clean oil when reassembling.
26. Reverse procedures 1 to 24 except:
    a. Fit new 'O' rings and gaskets.
    b. The spool valve seal (7) is fitted to prevent ingress of dirt and the loss of oil.
    c. Reassemble the 1st modulating valve with the original shims removed.
27. Test the PTO clutch pack pressure, *(see operation 4-9C)*.
28. Ensure that the pressure maintaining valve is correctly set, 22-24 bar (319-348 lbf/in²) and that there is no mechanical reason for loss of pressure before making any adjustments to the maintaining valve.

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PTO CLUTCH UNIT

Removal and Refitment 3-7A

1. Split the tractor between the rear centre housing and the range change unit, four-wheel drive drop box or spacer, *(see operation 4-2A or 4-2B).*
2. Remove the lift cover, *(see operation 2-9A).*
3. Remove the left-hand side cover, *(see operation 1-7A).*
4. Remove the main drive shaft.
5. Remove the access plate, the hydraulic lift pump filter and stud extension.
6. Remove the two nuts and dowel pin on the left-hand side of the transmission case holding the lift pump. Remove the strainer housing on the right-hand side, *(see operation 14-9C).*

NOTE: *The following procedure must be carefully followed otherwise extreme difficulty will be experienced in removing the pump.*

7. The lift pump and PTO clutch pack must be held together and removed as one unit.
8. The PTO clutch pack hub and brake disc must not be allowed to move away from the clutch pack.
9. Carrying out the instructions in procedures 7 and 8, hold the lift pump and PTO clutch pack assembly, manoeuvre the assembly forwards out of the centre housing.
10. Slide the clutch pack assembly off the lift pump drive shaft.

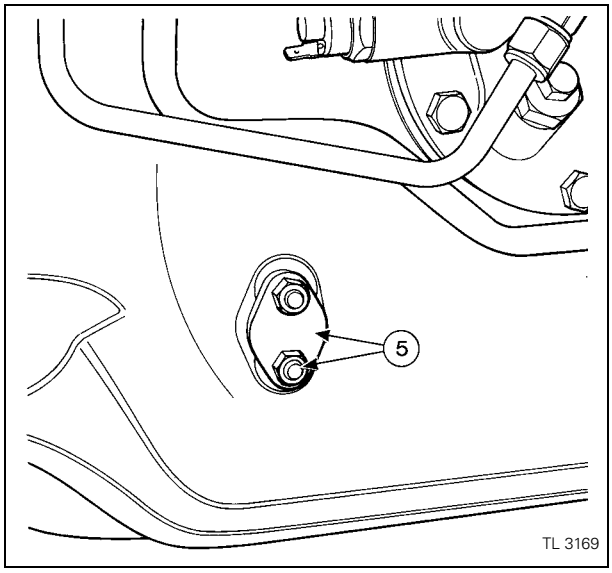
Refitment

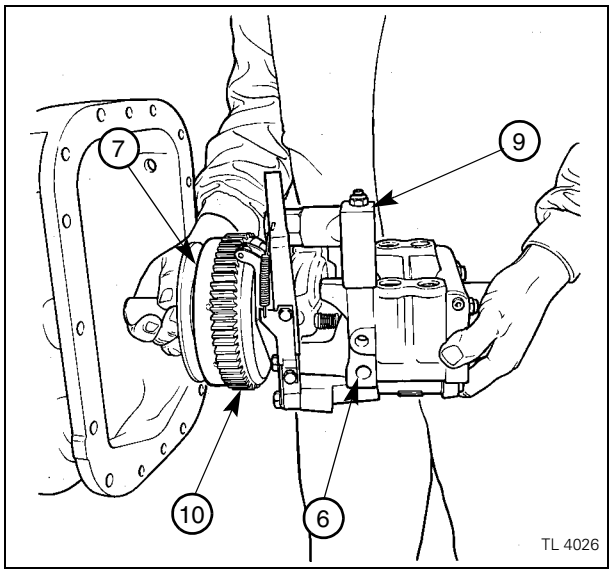
11. Refit the clutch assembly to the lift pump.
12. Ensure that the fork on the feed ring is correctly engaged on the pin on the lift pump.
13. Reverse procedures 1 to 10 except:

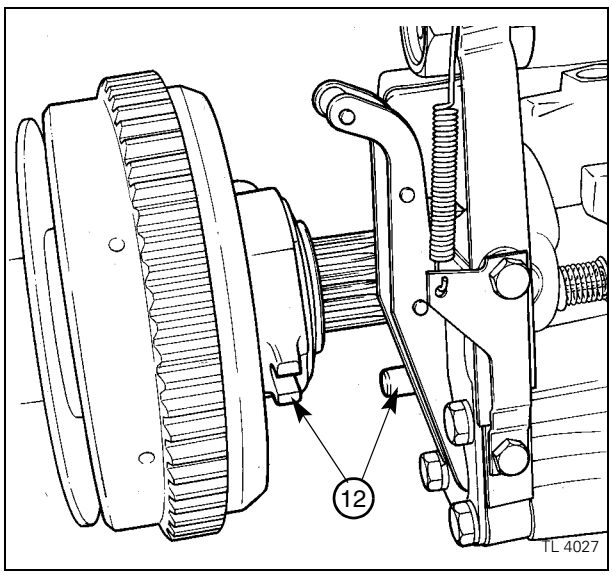
a. Fit new 'O' rings, gaskets and split pins.

b. Ensure that the PTO clutch hub and brake disc does not move away from the clutch pack assembly during reassembly.

c. DO NOT tighten the two lift pump dowel nuts (5) until the transmission has been completely reassembled.

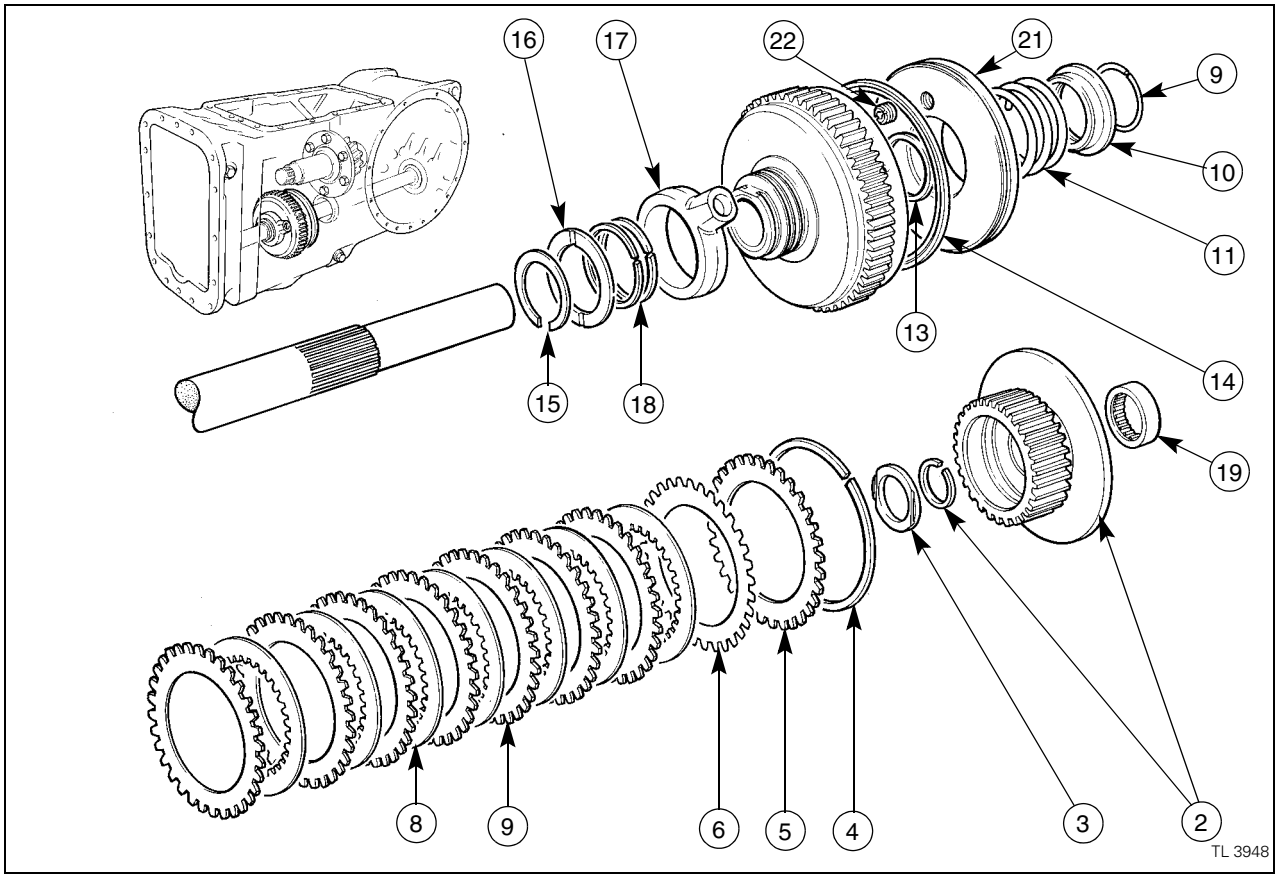






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PTO CLUTCH UNIT

Overhaul **4-7A**

Dis-assembly

1. Remove the PTO clutch assembly, *(see operation 3-7A)*.
2. Remove the hub, brake disc and internal circlip.
3. Remove the thrust washer.
4. Remove the spring ring.
5. Remove the retainer plate.
6. Remove the shim plate.
7. Remove the steel plates.
8. Remove the friction plates.
9. Make up a bridge piece as shown in the illustration on the next page and place the clutch under a hydraulic press. Apply pressure to the retaining ring to compress the spring and remove the spring clip.
10. Remove the retainer ring.
11. Remove the spring.

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Single-speed Power Take-Off

WARNING: Be very careful when using compressed air to remove the piston, DO NOT stand over the clutch assembly, for safety, the piston and the open end of the clutch must face away from you, use a piece of cloth to cover the assembly to prevent the piston flying out.

12. Remove the piston, it may be necessary to use compressed air applied to the feed ring. Heed the warning, only apply enough air to move the piston out of the casing.
13. Remove the internal iron piston seal.
14. Remove the external rubber piston seal.
15. Remove the snap ring.
16. Remove the thrust washer.
17. Remove the feed ring.
18. Remove the PTFE sealing rings.
19. If necessary remove the needle roller bearing.

Examination

20. Check the condition of all the components for signs of wear, scoring, damage or distortion due to over heating. Check all the friction and steel plates against the following new dimensional tolerances for wear:

Friction plates:

Thickness - 1,45-1,55 mm (0.057-0.061 in).

Maximum permissible distortion - 0,127 mm (0.005 in).

Steel plates:

Thickness - 1,35-1,45 mm (0.053-0.057 in).

Maximum permissible distortion - 0,127 mm (0.005 in).

Coil spring:

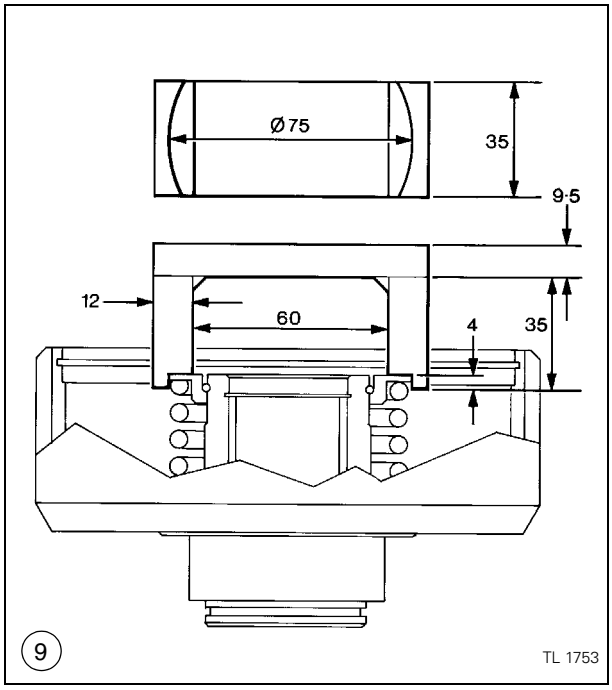
Free length - 74 mm (2.9 in).

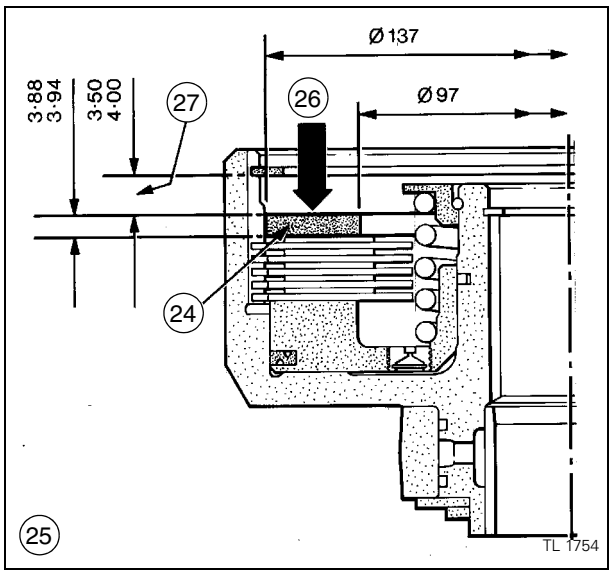
Working length - 26,7-33,8 mm (1.052-1.332 in).

Load at working length - 100 kgf (45 lbf).

Re-assembly

21. Replace any worn or damaged components as required.
22. Check that the lubrication jet in the piston is not blocked, use compressed air to clear it.
23. Fit new internal and external piston rings, lubricate the piston with clean transmission oil and reassemble into the clutch housing.
24. Make a steel ring as shown in the illustration to replace the retainer plate for checking the clutch plate clearance.
25. Assemble all the clutch plates, friction and steel, into the clutch housing, fit the tool described in procedure 24 and replace the spring ring. There are seven friction and seven steel plates.
26. Apply a pressure of approximately 5 kgf (11 lbf) to the clutch pack to compress all the plates.





27. Using a feeler gauge measure the gap between the plate and the underside of the spring ring. The distance should be 3,50-4,00 mm (0.138-0.157 in), if the gap is not correct add one or more shims between the discs and the retainer plate depending on the gap.

Shims are available in the following sizes:

Clutch shim plates		
Part No.	Metric	Imperial
1870 010 M1	0,51 mm	0.020 in
1870 011 M1	0,76 mm	0.030 in

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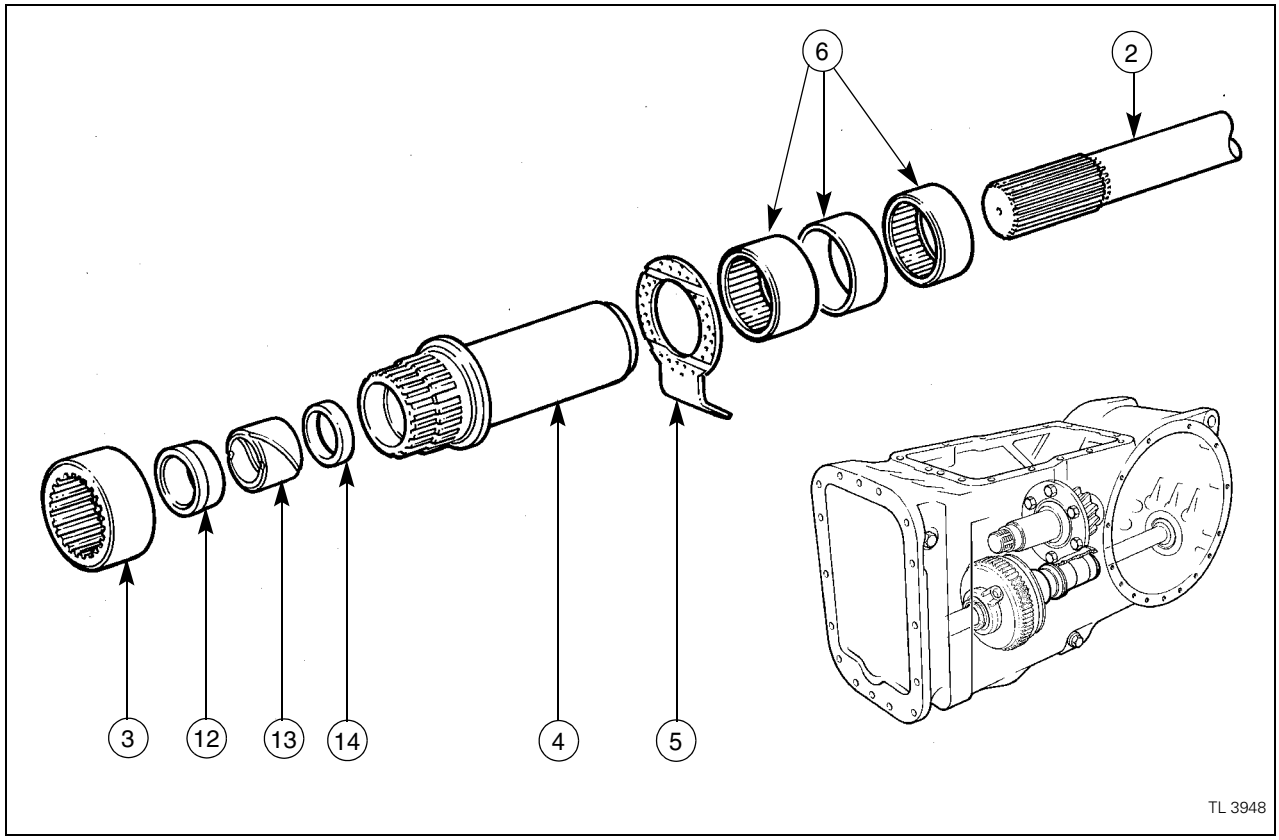
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28. Remove the spring ring, checking ring and clutch plates.
29. Refit the spring and retainer ring.
30. Place the clutch assembly under a hydraulic press and using the bridge piece compress the spring and replace the snap ring.
31. If new friction plates are being used they should be soaked in clean transmission oil for a minimum period of 30 minutes before assembly.
32. Reassemble the plates starting with a steel plate, alternating with a friction plate, and finally fitting the shim plate(s).
33. Refit the retainer plate and spring ring.
34. Fit new PTFE sealing rings to the feed ring.
35. Reassemble the feed ring, thrust washer and snap ring.
36. If necessary, replace the needle roller bearing in the gear hub.
37. With the aid of some petroleum jelly retain the thrust washer inside the hub and brake disc.
38. Check that the spring ring (4), retaining the clutch plates, is fully seated in its groove.
39. With the aid of two lengths of 3 mm (1/8 in) diameter rod, carefully align and centre all the internal teeth of the friction discs.
40. With the aid of an air line pressurize the clutch pack so that all the plates are clamped tight.
41. Whilst still holding the pressure on the clutch pack insert the hub and brake disc so that it passes down through the pack of plates. When fully installed the gear will be within approximately 6 mm (1/4 in) of the clutch housing.
42. If the clutch is not being fitted immediately it is recommended that some form of security band is placed around the clutch to retain the hub and brake disc in place.
43. Refit the clutch assembly.

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Single-speed Power Take-Off



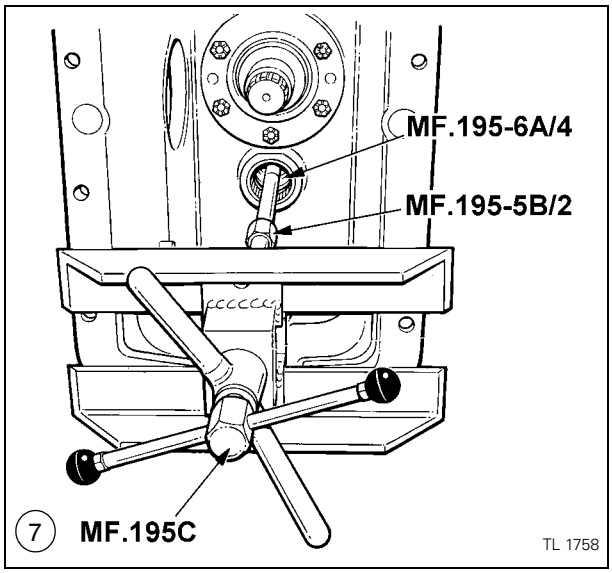
PTO SUPPORT BEARING

Removal and Refitment **5-7A**

Special Tools:
MF.159C Puller, Main Tool
MF.195-5B/2 Extension Rod
MF.195-6A/1 Needle Bearing Remover
MF.195-6A/4 Needle Bearing Replacer

Removal

1. Remove the PTO clutch unit, *(see operation 3-7A)*.
2. Remove the PTO shaft, *(see operation 6-7A)*.
3. Remove the coupler.
4. Remove the shaft assembly.
5. Remove the thrust washer.
6. Remove the two needle roller bearings and spacer using special tool MF.195C Bearing Puller Main Tool, MF.195-5B/2 Extension Rod, MF.195-6A/1 Needle Bearing Remover and two pieces of angle iron.
7. Place MF.195-6A/1 remover, comprising of two collets, through the open end of the needle roller bearing and engage the flange of the remover behind the second bearing, this will enable the two bearings and the spacer to be withdrawn in one operation.



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8. Screw the extension rod MF.195-5B/2 into the remover until the end protrudes through. Attach the extension rod to the main puller MF.195C. Locate the two pieces of angle iron as shown in the illustration.
9. Ensure that the flange of the remover MF.195-6A/1 is still secure behind the bearing.
10. Hold the 'T' bar of the main tool and turn the wing nut to withdraw the needle roller bearings and spacer.

Shaft Assembly

11. The shaft assembly is fitted with an internal bronze support bearing. This is retained by an inner and outer spacer which are pressed into the shaft. If removal is required proceed as follows:
12. Extract the outer spacer.
13. Remove the bronze bush.
14. The inner spacer should not require removing.

Refitment

15. Manufacture a bearing replace for special tool MF.195C Puller, Main Tool and MF.195-5B/2 Extension Rod as shown in the illustration.
16. Using the puller through the rear PTO attach the manufactured replacer to the extension rod and place a new **narrow** bearing onto the replacer. Feed the extension rod through the bearing housing and attach it to the main puller.
17. Ensure the needle roller bearing is square to the housing face and bore, Hold the 'T' bar and turn the wing nut until the bearing is drawn home; this will be when the collar on the replacer contacts the face of the bearing housing.

    If you do not have the special tool, pull or push the bearing to a depth of 59-60 mm (2.325-2.364 in).
18. Refit the spacer.
19. Unscrew the replacer and exchange it for the short end of MF.195-6A/4 Needle Bearing Replacer. Fit a new **wide** bearing and pull it into position using the same procedure as described in paragraph 17. Check that the spacer between the bearings has free movement.

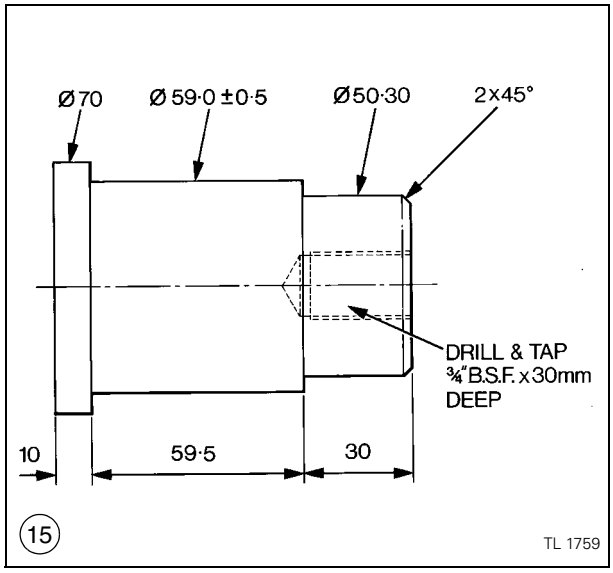
    If you do not have the special tool there must be a clearance of 0,25 mm (0.010 in) between the spacer and the second bearing. The bearing must be 1-2 mm (0.040-0.080 in) below the front face of the centre housing to prevent it touching the thrust washer.

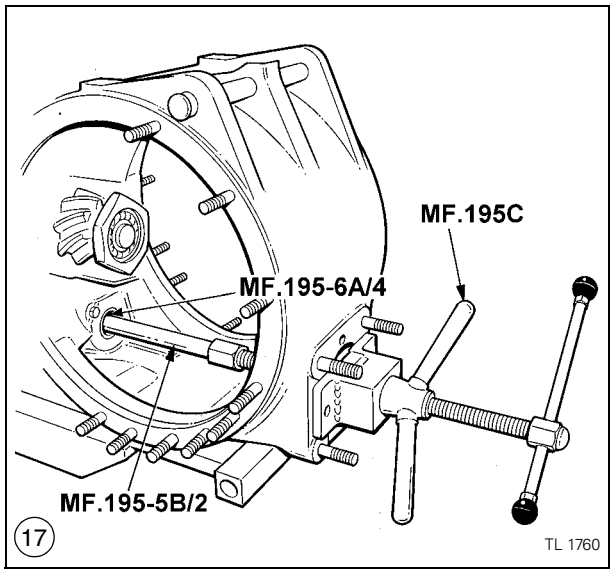
Shaft Assembly

20. Replace the bronze bush.
21. Press in the outer spacer, the stepped end of the spacer to outside face.

Installing the Shaft

22. Refit the thrust washer ensuring the split tag locates on the web in the centre housing. Some grease will hold it in place.
23. Reverse procedures 1 to 4.

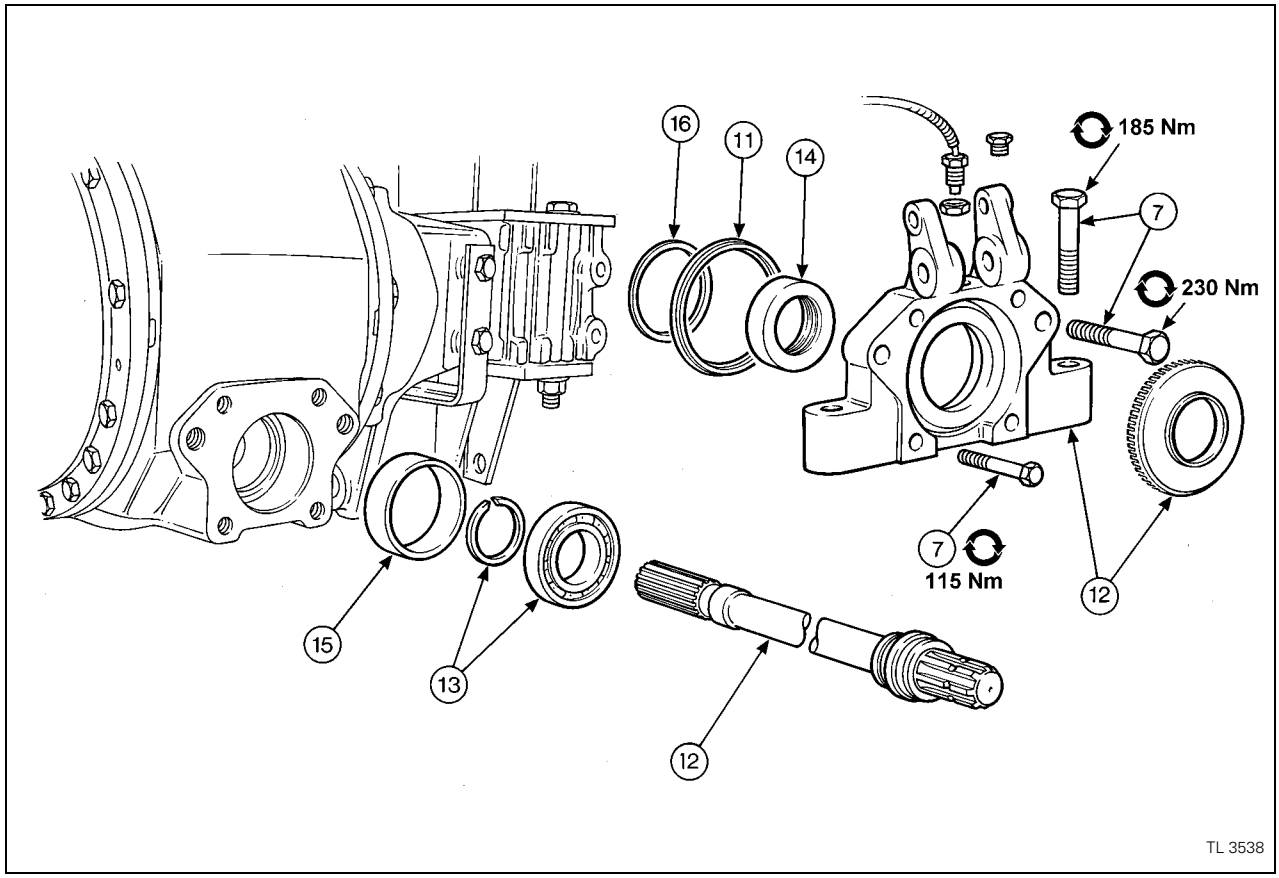




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Single-speed Power Take-Off



PTO SHAFT AND OIL SEAL

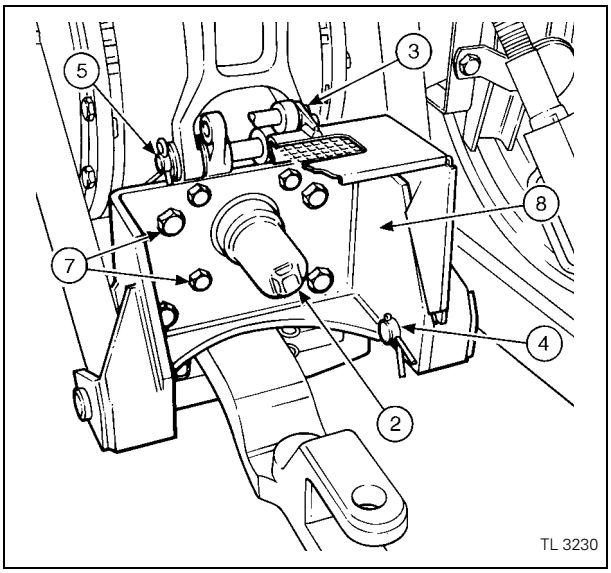
Removal and Refitment **6-7A**

Special Tools:
MF.501 PTO Cassette Seal Installer
MS.550 Universal Handle

Removal

IMPORTANT: *To ensure a leak-proof installation of the rear PTO seal, special service tool MF.501 MUST be used to install the seal.*

1. Place a drip tray under the rear PTO.
2. Remove the PTO cap
3. Remove the split pin, pivot pin and PTO guard.
4. Remove the split pins and the lower assistor lift cylinder pivot pins, if fitted.
5. Remove the split pin and pivot pin from the control beam.
6. Disconnect the PTO speed sensor.
7. Remove the bolts from the rear bracket and the two vertical bolts into the lower drawbar support casting.
8. Remove the rear bracket.



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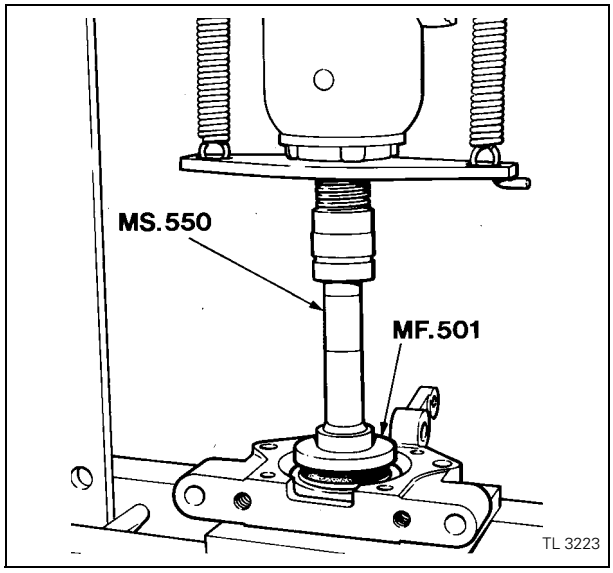
9. Holding the PTO shaft and extension housing, pull the PTO shaft assembly out of the rear of the tractor.
10. Unscrew and remove the PTO speed sensor, if fitted.
11. 1Remove and discard the seal ring in the extension housing.
12. Carefully push the PTO shaft out of the extension housing from back to front pushing the toothed count wheel off the shaft.
13. Remove the front circlip and press the ball bearing off the PTO shaft.
14. Remove the cassette seal from the extension housing.
15. Remove the bearing spacer.
16. Remove the crush washer.

Examination

Thoroughly clean and inspect all parts, discard removed 'O' rings and circlips and replace with new. Replace any parts that are worn or damaged.

Refitment

17. Using special tools MF.501 Cassette Seal Installer and MS.550 Universal Handle. Place the extension housing under a press and press the seal into the housing flush with the rear face.
18. Press the ball bearing onto the PTO shaft.
19. Replace the crush washer into the housing. This washer only requires to be replaced if a new extension housing is being fitted.
20. Refit the bearing spacer into the rear axle housing.
21. Slide the PTO shaft assembly into the rear axle, taking care to keep it horizontal to align the internal splines. Locate the ball bearing in the housing.
22. Fit a new 'O' ring to the extension housing and liberally apply petroleum jelly to the internal ribs of the seal.
23. Very carefully refit the extension housing sliding the seal onto the bearing retainer and locating the housing onto the ball bearing.
24. Locate the housing with two of the smaller bolts, DO NOT tighten.
25. Press the toothed sensing wheel onto the bearing retainer, ensure that there is clearance between the housing.
26. Lift up the drawbar support casting and locate the two vertical bolts.



27. Reverse procedures 1 to 10 except:
    a. Tighten the large horizontal bolts to a torque of 230 Nm (170 lbf ft).
    b. Tighten the four small horizontal bolts to a torque of 115 Nm (85 lbf ft).
    c. Tighten the two large vertical drawbar bolts to a torque of 185 Nm (136 lbf ft).
    d. Screw the PTO speed sensor into the extension housing until it bottoms on the toothed wheel, then back-off by half a turn. Tighten the lock-nut. The correct clearance is 0,6 mm (0.025 in).

PTO CONTROLS

Overhaul 7-7A

These instructions apply to both Single-speed and Two-speed PTO. *(see page 7B-20)* - Two-speed PTO for repair details.

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Tractor Manuals Scotland

Two-speed Power Take-Off

Section 7 - Part B

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Two-speed Power Take-Off

SPECIFICATION

Two-speed PTO:	
540 rev/min PTO speed	1902 engine rev/min.
1000 rev/min PTO speed	2000 engine rev/min.
Economy PTO:	
Standard 540 PTO	1979 engine rev/min.
Economy 540 PTO	1421 engine rev/min.
540 rev/min PTO shaft:	
No. of splines	6.
Outside diameter	34,93 mm (1.375 in).
1000 rev/min PTO shaft	
No. of splines	21.
Outside diameter	34,93 mm (1.375 in).
PTO clutch:	
Type	Multi-plate.
Size	127 mm (5 in).
Operation	Hydraulic.
No. of friction plates:	
All models	5.
4360/4370 tractor	7.
Thickness (new)	2,41-2,54 mm (0.095-0.100 in).
Max. permissible dish	0,127 mm (0.005 in).
Groove depth	0,152-0,227 mm (0.006-0.009 in).
No. of steel plates:	
All models	5.
4360/4370 tractor	7.
Thickness (new)	1,35-1,45 mm (0.053-0.057 in).
Max. permissible dish	0,127 mm (0.005 in).
No. of return springs	1.
Type	Coil.
Free length	74 mm (2.9 in).
Working length	26,7-33,8 mm (1.052-1.332 in).
Load at working length	100 kgf (45 lbf).
Clutch retainer plate clearance	3,5-4,0 mm (0.138-0.157 in).
Checking load	5 kgf (11 lbf).
Clutch pressures:	
Engine speed	1500 rev/min.
Oil temperature	50-60°C (120-140°F).
Clutch operating pressure	22-24 bar (319-348 lbf/in²).
Min. permissible pressure	20,7 bar (300 lbf/in²).
Main PTO support bearings:	
Depth of first bearing	59-60 mm (2.352-2.364 in).
Depth of second bearing	1-2 mm (0.040-0.080 in).
Spacer clearance	0,25 mm (0.010 in).
Intermediate gear clearance	0,10 mm (0.004 in).
Pinion bearing pre-load	2,0-2,5 Nm (18-22 lbf in).

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Special Tools:

MF.195C	Bearing remover/replacer - main tool.
MF.195-5B	PTO needle bearing remover.
MF.195-6B	PTO needle bearing replacer.
MF.501	PTO Cassette seal installer.
MS.550	Universal handle.
FT.4062A	Bearing pre-load gauge.

Bolt Torques:

Two vertical extension housing bolts	185 Nm (136 lbf ft).
Two horizontal extension housing bolts	230 Nm (170 lbf ft).
Four horizontal extension housing bolts	115 Nm (85 lbf ft).
Pinion bearing assembly bolts	108 Nm (80 lbf ft).
Selector fork bolt	35 Nm (25 lbf ft).
Two vertical drawbar bolts (extended PTO)	185 Nm (135 lbf ft).
PTO shaft retaining nut (heavy-duty PTO)	40 Nm (30 lbf ft).

GENERAL DESCRIPTION

The PTO shaft that projects from the rear of the tractor is supported at the rear by a ball-bearing and at the front by the main PTO transmission shaft which runs in a pair of needle roller bearings in the centre housing. Two separate PTO shafts are provided, one with the 540 rev/min six spline and another with the 1000 rev/min 21 spline, either shaft can be fitted. A tube in the centre housing prevents loss of oil during shaft changes.

The two-speed power take-off (PTO) allows the operator to select 540 or 1000 rev/min PTO from the driving position by using a simple shift lever with an additional neutral position. A second shift lever operates the hydraulic control valve which controls the PTO clutch pack.

An alternative shaft arrangement is available (used in North America) which contains an internal lockout which prevents 1000 rev/min speed being selected when the 540 speed shaft is fitted. It comprises of a simple spring loaded pin which prevents the shift coupler being moved forward to 1000 speed position when the longer 540 speed shaft is installed.

The principal components of the two-speed PTO comprise of a hydraulically operated multi-plate clutch, a spool type control valve and linkage, a reduction intermediate gear mounted on the rear axle pinion shaft and a selector mechanism for 540 or 1000 rev/min and linkage operated by hand lever.

The PTO clutch is located immediately to the rear of the linkage pump and is driven from an extension of the linkage pump drive shaft. This shaft is driven from the cover of the split torque transmission clutch, through the PTO reduction gears and drive shaft to the pump.

The rear extension shaft of the linkage pump is splined into the housing of the PTO clutch, five steel interplates are splined into the casing of the clutch. Five corresponding sintered friction plates are splined to a central hub and drive gear. A large central spring holds the clutch in the disengaged position.

The main PTO transmission shaft is splined to the rear PTO shaft and carries the selector coupler and 540 driven gear. The lower PTO shaft and linkage pump run at 1000 rev/min at approximately 2000 engine rev/min, when the selector coupler is moved forward by the selector lever the PTO shaft is directly coupled through the hydraulic clutch giving a speed of 1000 rev/min.

When the selector coupler is moved rearwards it engages with the 540 driven gear giving a speed of 540 rev/min. The speed reduction is obtained by the driven gear on the clutch hub driving an intermediate reduction gear cluster on the pinion shaft, which in turn drives the 540 driven gear on the transmission shaft.

Rotation of the PTO shaft is controlled by the hydraulic clutch, it occurs when the driving (steel) plates and driven (friction) plates are forced into engagement by the piston, operated by oil pressure from the left-hand side cover and auxiliary hydraulic system.

The solenoid valve is located on the outside of the left-hand side cover and is energised by a switch adjacent to the driver.

Energising the solenoid allows oil into the back of the piston, overcome the pressure of the return spring and engage the clutch. A small jet is positioned in the face of the piston to direct oil at 0,5 litre/min (1 pt/min) onto the friction plates, particularly at the time of engagement to cool the plates. Holes are provided in the in the periphery of the clutch casing to vent oil from between the plates.

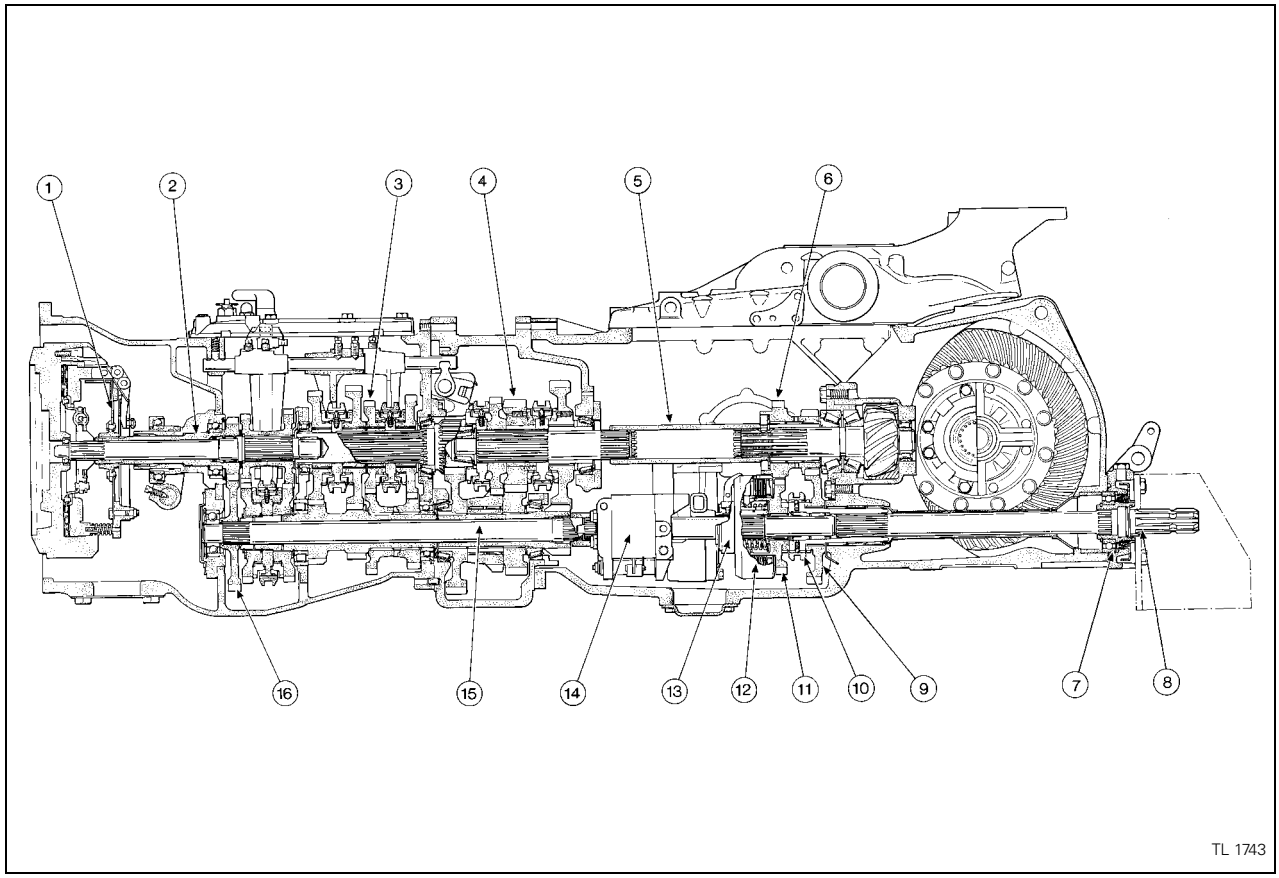
De-energising the solenoid allows oil to return from behind the piston and thereby disengaging the clutch. The large return spring located behind the piston ensures a fast return oil flow and rapid disengagement of the clutch. Return oil from behind the piston returns directly through a port to the transmission case.

Continued overleaf

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Two-speed Power Take-Off



Two-speed PTO

1. PTO drive plate
2. PTO input shaft
3. Main gearbox
4. Range change gearbox
5. Rear axle drive shaft
6. 540 Intermediate gear cluster
7. PTO rear bearing and oil seal assembly
8. Rear PTO shaft
9. 540 speed driven gear
10. Speed selector coupler
11. 540 speed drive gear
12. PTO clutch assembly
13. Hydraulic feed ring
14. Linkage pump
15. PTO layshaft
16. PTO constant mesh gears

GENERAL DESCRIPTION *continued*

The hydraulic system is fitted with a modulating valve assembly which controls the rate of engagement of the clutch, it comprises of two valves mounted in the left-hand side cover. They control the flow of oil into the clutch pack so that the engagement time is approximately 1.5 seconds, this prevents the clutch taking up the drive suddenly which could result in damage to the tractor or the implement. A pressure relief valve is built into the modulating valve in the event of any excess pressure. The clutch pack pressure is controlled by the pressure maintaining valve in the auxiliary system manifold.

Economy PTO arrangement is identical to the two-speed arrangement, except that the tractor is fitted with a low speed PTO (540 rev/min) at 1979 engine rev/min and the gear ratios are different to provide economy 540 at 1421 engine rev/min. Moving the selector coupler forward selects standard 540 speed, moving the selector coupler to the rear selects economy PTO speed through the reduction gears.

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DIAGNOSIS

The Power Take-off hydraulic system is controlled by a valve block located on the left-hand transmission side cover and the hydraulic pump on the right-hand side. Before any repairs are made tests should be carried out to determine the condition of the hydraulic system. Refer to Section 9C for system diagnosis.

LEFT-HAND SIDE COVER

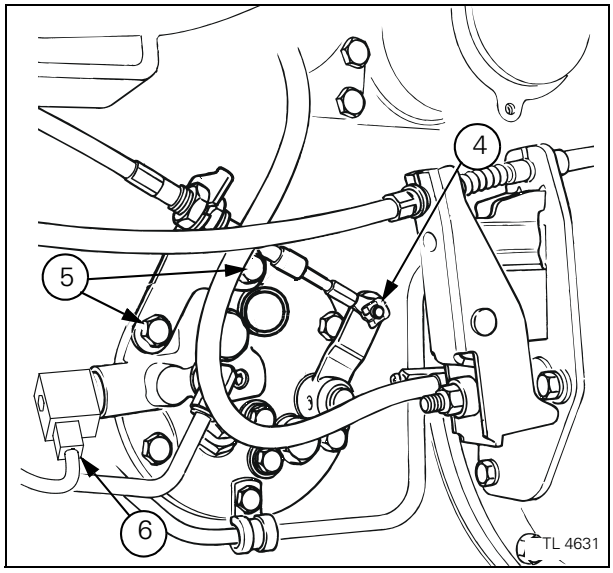
Removal and Refitment 1-7B

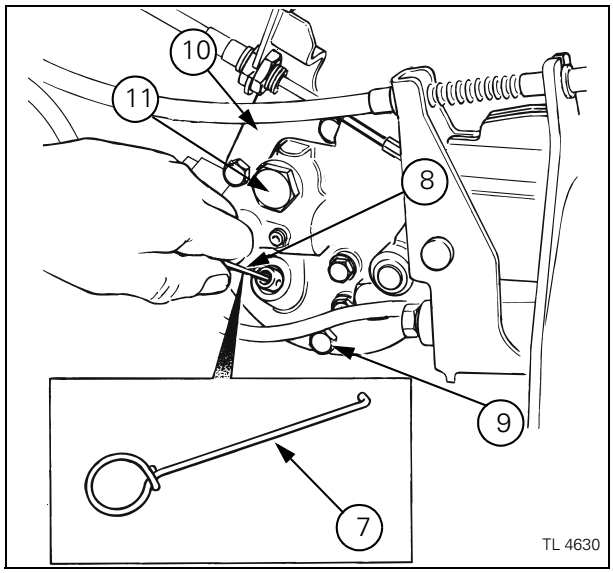
Removal

1. Remove the left-hand fuel tank, *(see operation 2-3C)*.
2. Drain the transmission below the LOW mark on the dipstick.
3. Disconnect the auxiliary and/or PTO hydraulic pipes from the side cover and remove as necessary.
4. Disconnect the PTO selector cables from the operating levers.
5. Remove the two bolts holding the brake and selector rail support bracket.
6. Disconnect the wires from the solenoid.
7. Make from 3 mm (1/8 in) diameter wire a hook as illustrated.
8. Insert the hook into the end of the transfer pipe engaging it in the cross drilled hole, withdraw the pipe from the PTO clutch and side cover.
9. Remove the side cover bolts.
10. Remove the PTO cable anchor bracket.
11. Remove the side cover by lifting it vertically so that the selector arm clears the selector rail.

Refitment

12. Clean the mating faces between the side cover and the transmission.
13. Reverse procedures 1 to 11 except:
    - *a.* Replace the 'O' rings on the transfer pipe and the bolts holding the brake and selector rail bracket to the side cover.
    - *b.* Insert the transfer pipe with the cross drilled hole uppermost. Ensure that the pipe is pressed fully home.
    - *c.* Apply Massey Ferguson Multi-Gasket (Loctite 573) instant gasket to the face of the side cover.
    - *d.* Seal the six side cover bolts with Hylomar sealant.

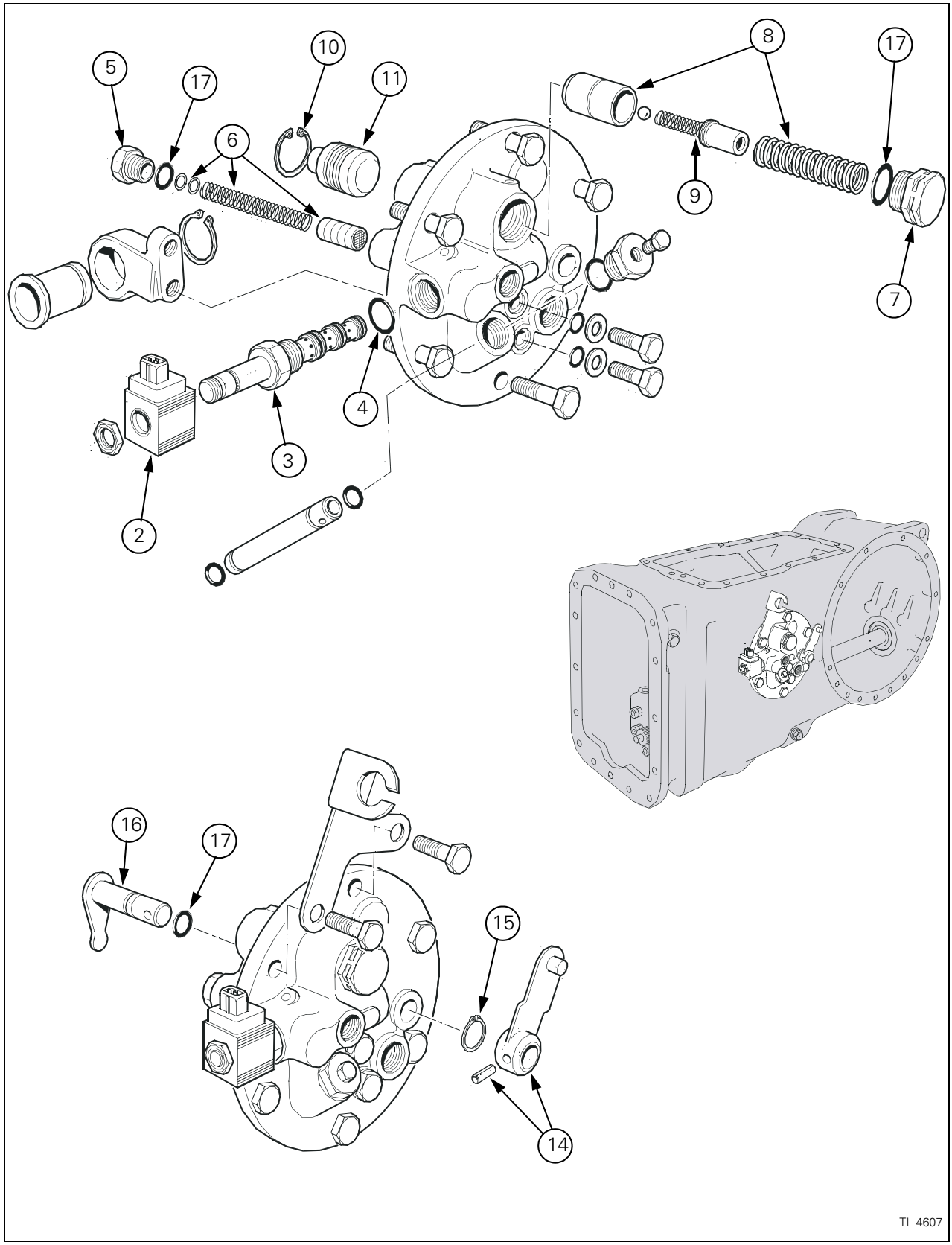




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Two-speed Power Take-Off



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LEFT-HAND SIDE COVER

Overhaul **2-7B**

Dis-assembly

1. Remove the left-hand side cover, *(see operation 1-7B).*

Solenoid Valve

2. Remove the coil from the solenoid valve.
3. Remove the solenoid valve.
4. Remove the 'O' ring.

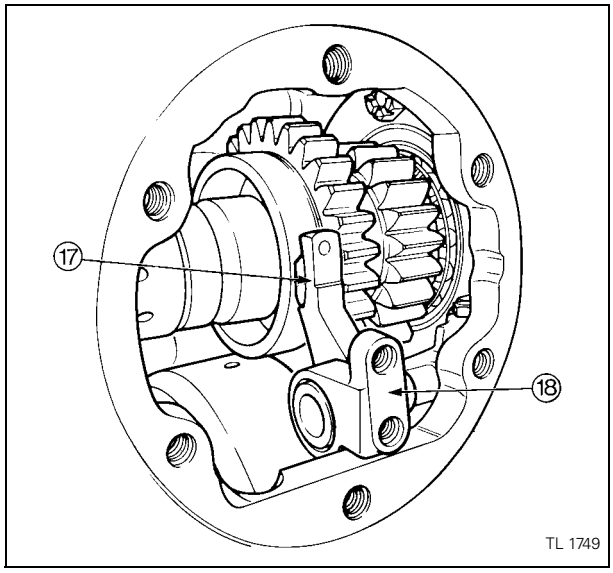
Flow Modulating Valves

5. Remove the flow modulating valve cap.
6. Withdraw the valve, spring and shims.
7. Remove the second modulating valve cap.
8. Withdraw the valve and spring.
9. Check the condition of the valves, clean the small orifice in the end of the first modulating valve.

The modulating valves must not be adjusted, they are factory set for the correct flow. Discard all 'O', rings.

Brake

10. Remove the circlip.
11. Withdraw the brake piston from the side cover. The brake system has no sealing rings, it relies on a precision fit for sealing.
12. The brake shoe can be removed from inside the transmission case by sliding it off the selector rail.
13. Remove the circlip and brake shoe off the bearing assembly.
14. Remove the roll pin and speed selector lever.
15. Remove the circlip.
16. Remove the selector lever and shaft.
17. Discard all 'O' rings.



Re-assembly

Brake

18. Clean all components and lightly lubricate parts with clean oil when re-assembling.
19. Reverse procedures 1 to 17 except:
    a. Re-assemble the first modulating valve with the original shims removed.
20. Test the PTO clutch pack pressure, *(see operation 4-9C).*
21. Ensure that the pressure maintaining valve is correctly set, at 22-24 bar (319-348 lbf/in²) and that there is no mechanical reason for loss of pressure before making any adjustments to the maintaining valve.

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PTO CLUTCH UNIT

Removal and Refitment 3-7B

Removal

1. Split the tractor between the rear centre housing and the range gearbox, *(see operation 3-2A)*.
2. Remove the lift cover, *(see operation 2-9A)*.
3. Remove the left-hand side cover, *(see operation 1-7B)*.
4. Remove the main drive shaft.
5. Remove the two nuts and dowel pin on the left-hand side of the transmission case holding the lift pump. Remove the strainer housing on the right-hand side, *(see operation 13-9C)*.

NOTE: *The following procedure must be carefully followed otherwise extreme difficulty will be experienced in removing the pump.*

6. The lift pump and PTO clutch pack must be held together and removed as one unit.
7. The PTO clutch pack hub and drive gear must not be allowed to move away from the clutch pack.
8. The two speed selector coupler, shaft and gears must stay at the back of the box and not allowed to come forward.
9. Carrying out the instructions in procedures 6, 7 and 8; disengage the hydraulic pump drive, take hold the lift pump and PTO clutch pack assembly, manoeuvre the assembly forwards and up out of the centre housing.
10. Slide the clutch pack assembly off the lift pump drive shaft.

NOTE: *In the event of the lift pump/clutch pack assembly becoming jammed in the centre housing it will be necessary to dismantle the pinion shaft assembly in position to gain the extra space for removal.*

Refitment

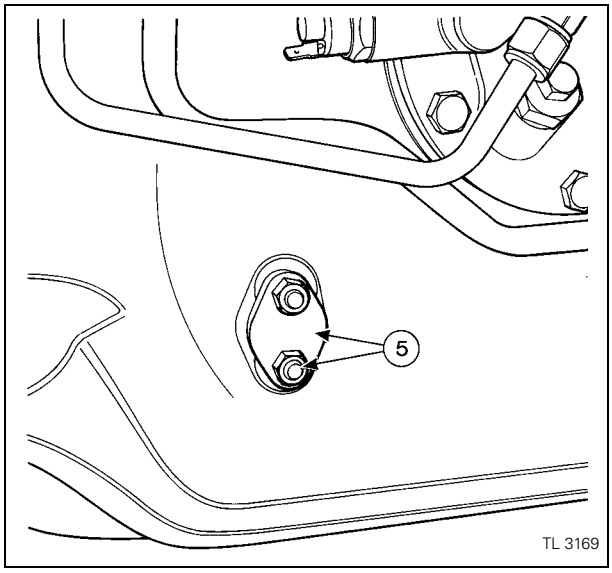
11. Refit the clutch assembly to the lift pump.
12. Ensure that the fork on the manifold is correctly engaged with the pin on the lift pump.
13. Reverse procedures 1 to 10 except:

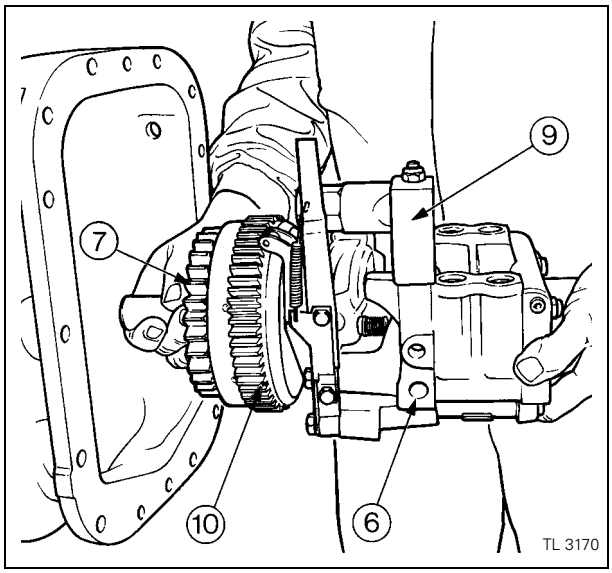
a. Fit new 'O' rings, gaskets and split pins.

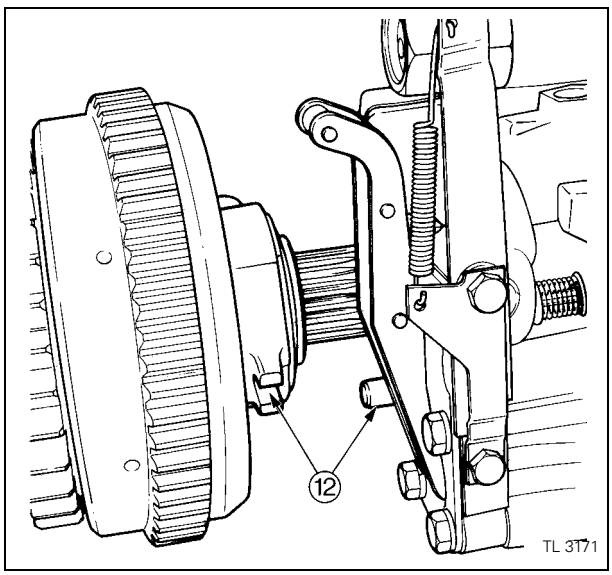
b. DO NOT forget to locate the chain drive before installing the lift pump and clutch pack.

c. Ensure that the PTO clutch gear and hub does not move away from the clutch pack assembly during re-assembly.

d. DO NOT tighten the two lift pump dowel nuts (5) until the transmission has been completely re-assembled.







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PTO CLUTCH UNIT

Overhaul 4-7B

Dis-assembly

1. Remove the PTO clutch assembly, *(see operation 3-7B).*
2. Remove the hub and drive gear.
3. Remove the thrust washer.
4. Remove the spring ring.
5. Remove the retainer plate.
6. Remove the shim plate.
7. Remove the steel plates.
8. Remove the friction plates.
9. Make up a bridge piece as shown in the illustration and place the clutch under a hydraulic press. Apply pressure to the retaining ring to compress the spring and remove the spring clip.
10. Remove the retainer ring.
11. Remove the spring.

WARNING: Be very careful when using compressed air to remove the piston, DO NOT stand over the clutch assembly, for safety, the piston and the open end of the clutch must face away from you, use a piece of cloth to cover the assembly to prevent the piston flying out.

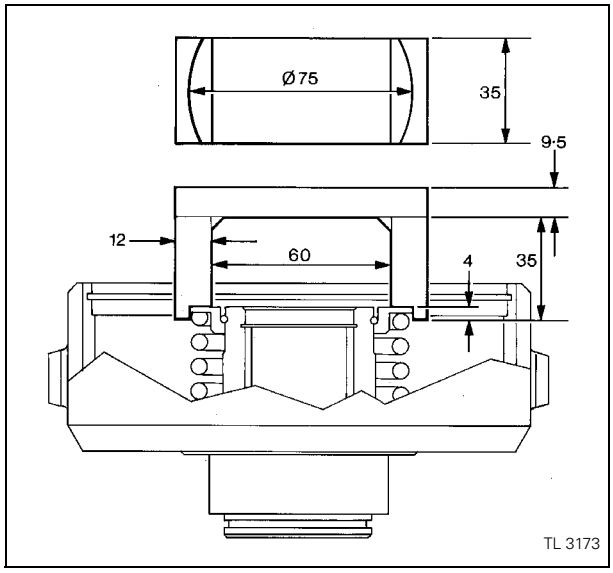
12. Remove the piston, it may be necessary to use compressed air applied to the feed ring. Heed the warning, only apply enough air to move the piston out of the casing.
13. Remove the internal iron piston seal.
14. Remove the external rubber piston seal.
15. Remove the snap ring.
16. Remove the thrust washer.
17. Remove the feed ring.
18. Remove the PTFE sealing rings.
19. Remove the internal circlip and needle roller bearing, if necessary.

Examination

Check the condition of all the components for signs of wear, scoring, damage or distortion due to overheating. Check all the friction and steel plates against the following new dimensional tolerances for wear:

Friction plates:

Thickness . . . . . 2,41 to 2,54 mm (0.095 to 0,100 in).
Max. distortion . . . . . 0,127 mm (0.005 in).



Steel plates:

Thickness . . . . . 1,35 to 1,45 mm (0.053 to 0.057 in).
Max. distortion . . 0,127 mm (0.005 in).

Coil spring:

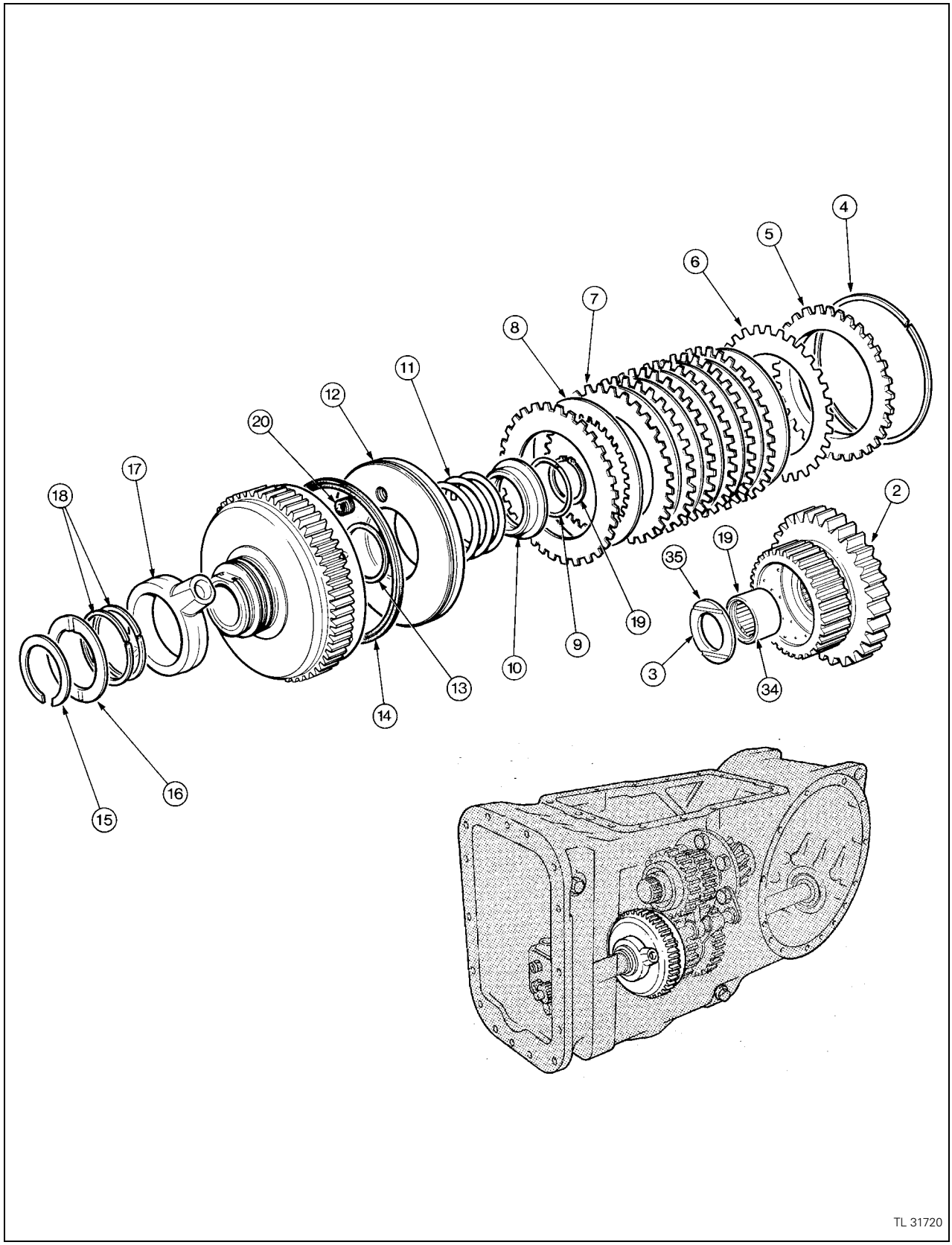
Free length . . . . . 74 mm (2.9 in)
Working length . . 26,7 to 33,8 mm (1.052 to 1.332)
Load at working length . . . . . 100 kgf (45 lbf).

Replace any worn or damaged components as required.

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Two-speed Power Take-Off



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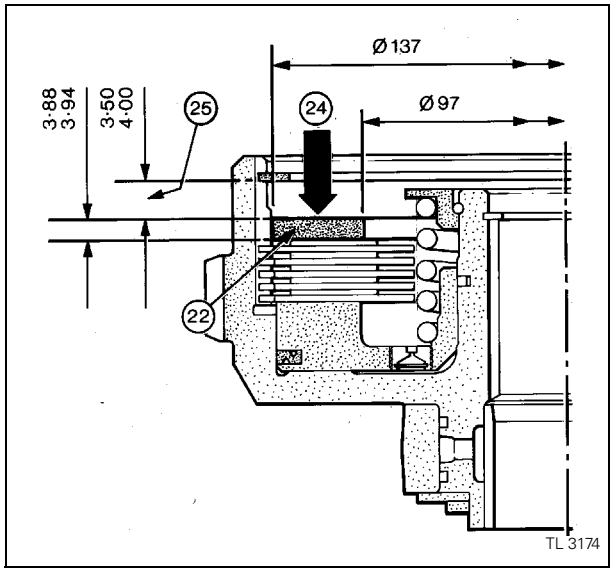
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Re-assembly

20. Check that the lubrication jet in the piston is not blocked, use compressed air to clear it.
21. Fit new internal and external piston rings, lubricate the piston with clean transmission oil and re-assemble into the clutch housing.
22. Make a steel ring as shown in the illustration to replace the retainer plate for checking the clutch plate clearance.
23. Assemble all the clutch plates, friction and steel, into the clutch housing, fit the tool described in procedure 22 and replace the spring ring. There are five friction and five steel plates, except 4260 and 4270 tractors, they have seven friction and seven steel.
24. Apply a pressure of approximately 5 kgf (11 lbf) to the clutch pack to compress all the plates.
25. Using a feeler gauge measure the gap between the plate and the underside of the spring ring. The distance should be 3,50-4,00 mm (0.138-0.157 in). If the gap is not correct add one or more shims between the discs and the retainer plate depending on the gap. Shims are available in the following sizes:

Clutch shim plates		
Part number	Metric	Imperial
1870 010 M1	0,51 mm	0.020 in
1870 011 M1	0,76 mm	0.030 in

26. Remove the spring ring, checking ring and clutch plates.
27. Refit the spring and retainer ring.
28. Place the clutch assembly under a hydraulic press and using the bridge piece compress the spring and replace the snap ring.
29. If new friction plates are being used they should be soaked in clean transmission oil for a minimum period of 30 minutes before assembly.
30. Re-assemble the plates starting with a steel plate, alternating with a friction plate, finally fitting the shim plate(s).
31. Refit the retainer plate and spring ring.
32. Fit new PTFE sealing rings to the feed ring.
33. Re-assemble the feed ring, thrust washer and snap ring.
34. If necessary, replace the needle roller bearing in the gear hub.
35. With the aid of some petroleum jelly retain the thrust washer inside the gear and hub.
36. Check that the spring ring (4) retaining the clutch plates is fully seated in its groove.

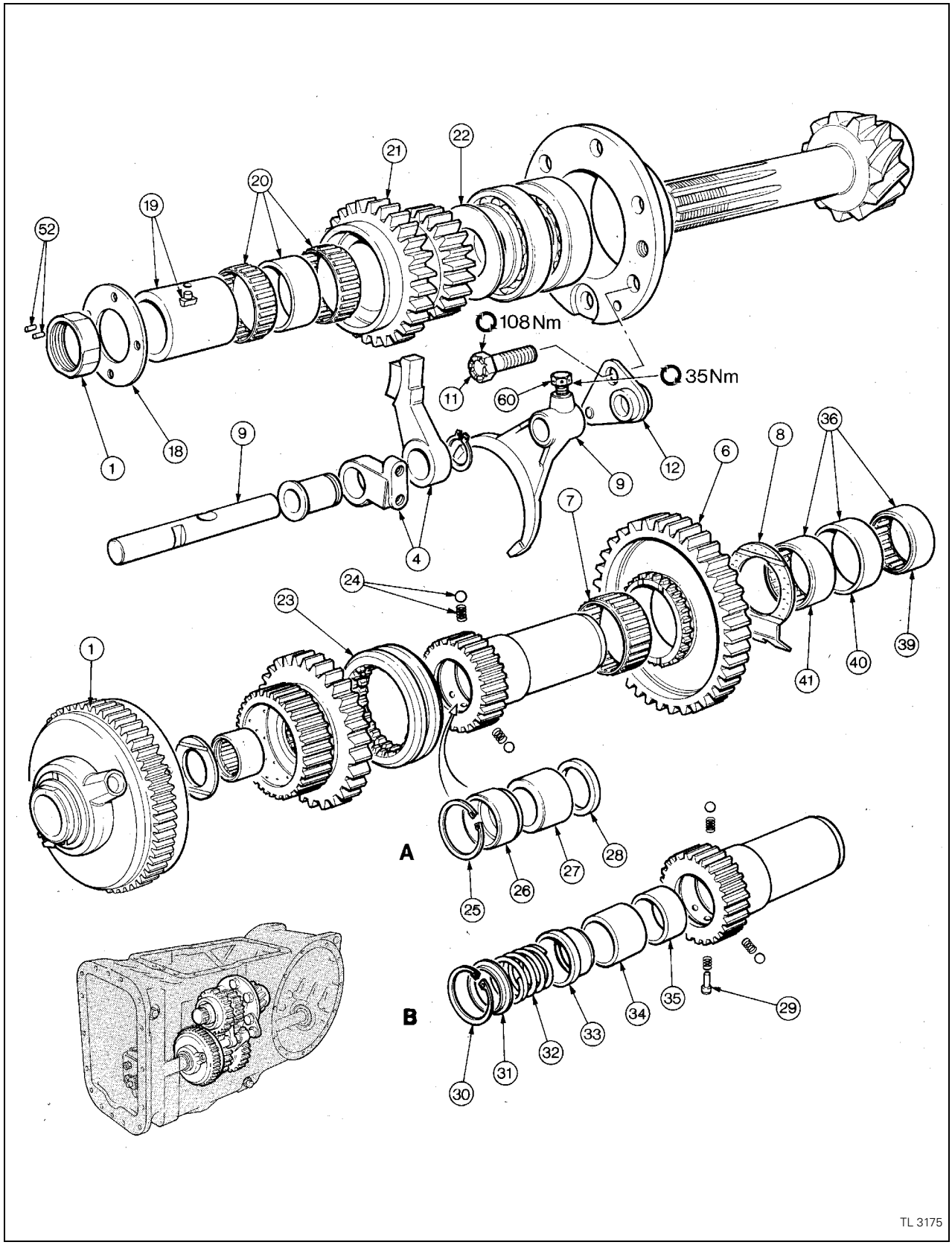


37. With the aid of two lengths of 3 mm (1/8 in) diameter rod carefully align and centre all the internal teeth of the friction discs.
38. With the aid of an air line pressurise the clutch pack so that all the plates are clamped tight.
39. Whilst still holding the pressure on the clutch pack insert the hub and drive gear so that it passes down through the pack of plates. When fully installed the gear will be within approximately 3 mm (1/8 in) of the clutch housing.
40. If the clutch is not being fitted immediately it is recommended that some form of security band is placed around the clutch to retain the hub and drive gear in place.
41. Refit the clutch assembly.

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Two-speed Power Take-Off



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REDUCTION GEARS AND BEARINGS

Overhaul **5-7B**

Special Tools:
MF.195C Bearing Puller Main Tool
MF.195-5B PTO Needle Bearing Remover
MF.195-6B PTO Needle Bearing Replacer
FT.4062A Bearing Pre-load Gauge

Dis-assembly

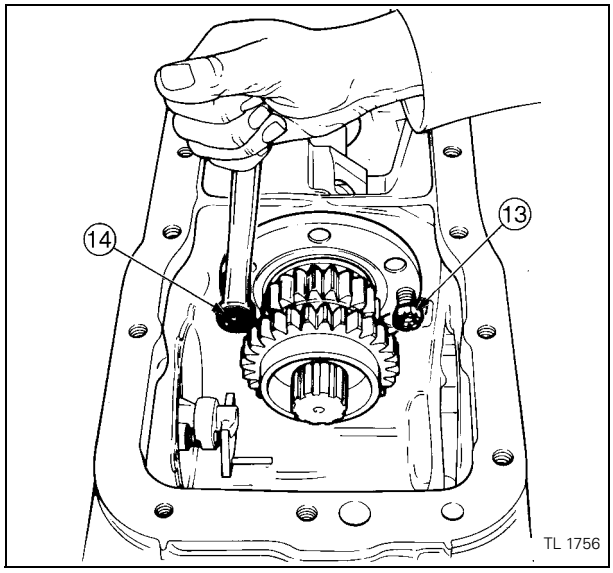
1. Remove the PTO clutch assembly, *(see operation 4-7B)*.
2. Remove the left-hand side cover assembly, *(see operation 1-7B)*.
3. Remove the PTO shaft, *(see operation 8-7B)*.
4. Remove the brake shoe and bearing assembly off the selector rail.

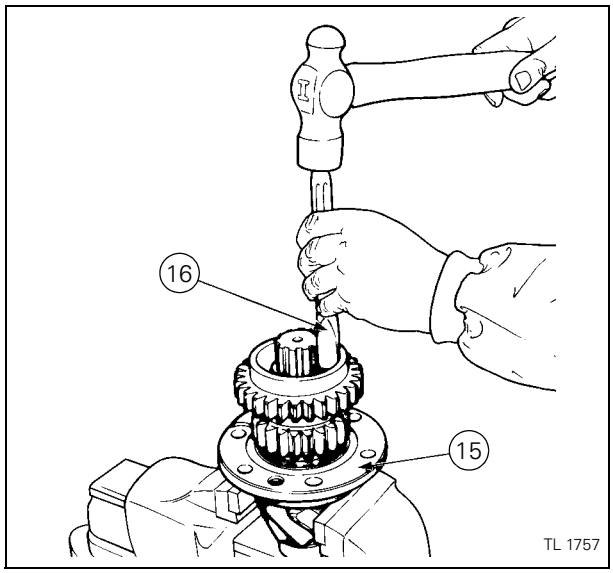
Lower PTO Shaft

5. Keeping the 540 driven gear (6), needle roller bearing (7) and thrust washer (8) to the rear of the box. Pull the selector coupler, shaft and selector fork assembly out of the rear casing.
6. Remove the 540 driven gear.
7. Remove the needle roller bearing.
8. Remove the thrust washer.
9. Remove the selector fork and rail.
10. Remove the selector fork from the selector rail, if necessary.

Pinion Shaft

11. Remove the six pinion housing retaining bolts.
12. Remove the brake and selector rail support bracket.
13. Screw one of the pinion housing retaining bolts into each of the two tapped holes in the flange.
14. Tighten the bolts thus withdrawing the pinion assembly.
15. Place the pinion assembly in a vice with soft jaws holding it in a vertical position.
16. Using a cold chisel cut down through the nut adjacent to one of the flats and the two locking rollers (52).
17. A few hefty blows will fracture it enabling the rollers and nut to be removed.
18. Remove the thrust washer.
19. Remove the sleeve and sleeve keeper.
20. Remove the needle roller bearings and spacer.
21. Remove the intermediate gear cluster.
22. Remove the thrust washer.





Selector Shaft Assembly

NOTE: *There are two types of selector shaft fitted. Type '**A**' is fitted to all models where 540 and 1000 rev/min speed can be selected with either type of splined PTO shaft fitted (540/1000).*
*Type '**B**' is fitted when 1000 rev/min speed can only be selected when a 1000 speed shaft is installed. There is a locking device in the front end of the PTO transmission shaft, this consisting of a spring loaded lockout pin which prevents the selector coupler being moved forwards to the 1000 speed position when the 540 shaft is in place.*

23. Slide the selector coupler off the shaft.
24. Retain the three detent balls and springs.

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Shaft type 'A'

25. Remove the circlip.
26. Remove the sleeve.
27. Remove the bush.
28. Remove the spacer.

Shaft type 'B'

29. Remove the lockout pin and spring.
30. Remove the circlip.
31. Remove the washer.
32. Remove the spring.
33. Remove the retainer.
34. Remove the bush.
35. Remove the sleeve.

Support Bearings

36. To remove the two bearings and spacer in the centre housing it will be necessary to remove the PTO shaft assembly, *(see operation 8-7B)*, PTO shaft guide tube and left hand trumpet housing, *(see operation 6-6C)*.
37. Using special tool MF.195C Bearing Puller Main Tool, MF.195-5B/2 extension rod, MF.195-6/4 collet and two pieces of angle iron., pull out the two needle bearings and spacer from the centre housing.

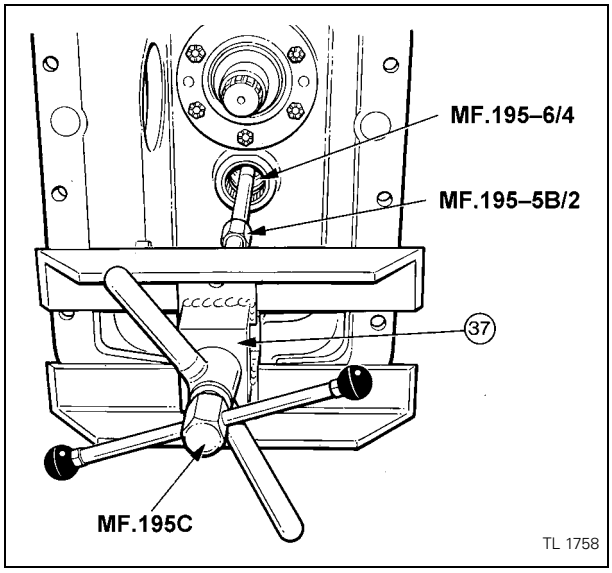
Re-assembly

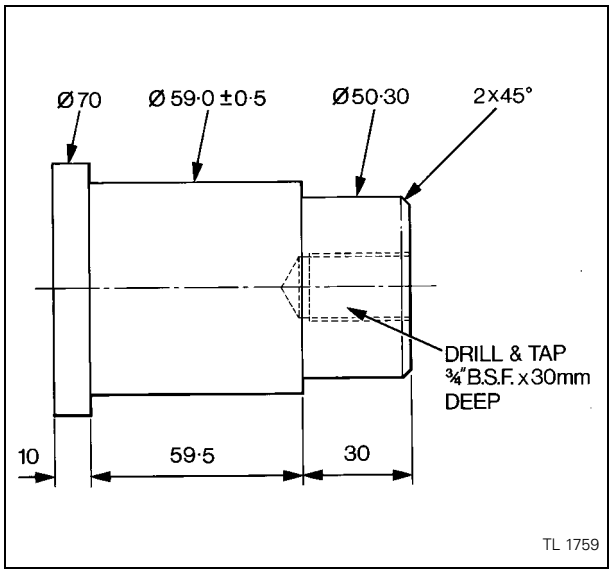
Support Bearings

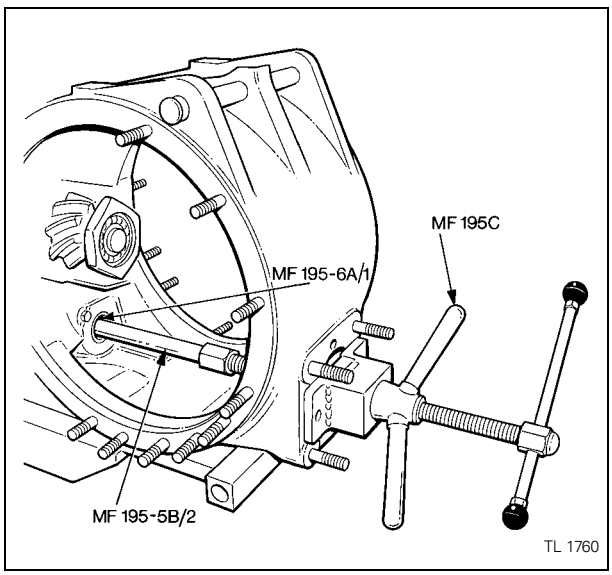
38. Special tool MF.195-6/4 is not suitable for fitting the first bearing in the centre housing. Make a bearing replacer as shown in the illustration.
39. Using MF.195B puller, MF.195-5B/2 extension and the tool described in procedure 38, pull the first bearing into the centre housing. The bearing must be fitted in the centre housing with the face containing the part number printed on it facing forward. If you do not have the special tool pull the bearing in to a depth of 59-60 mm (2.325-2.364 in).
40. Replace the spacer.
41. Using the short end of bearing replacer MF.195-6/4 pull the second bearing into the centre housing. If you do not have the special tool there must be a clearance of 0,25 mm (0.010 in) between the spacer and bearing, the second bearing must be between 1-2 mm (0.040-0.080 in) below the front face of the centre housing.
42. Press the PTO shaft guide tube into the centre housing until its rear end is more than 1,5 mm (0.060 in) below the shaft bearing recess.

Selector Shaft Assembly

43. Reverse procedures 23 to 35.





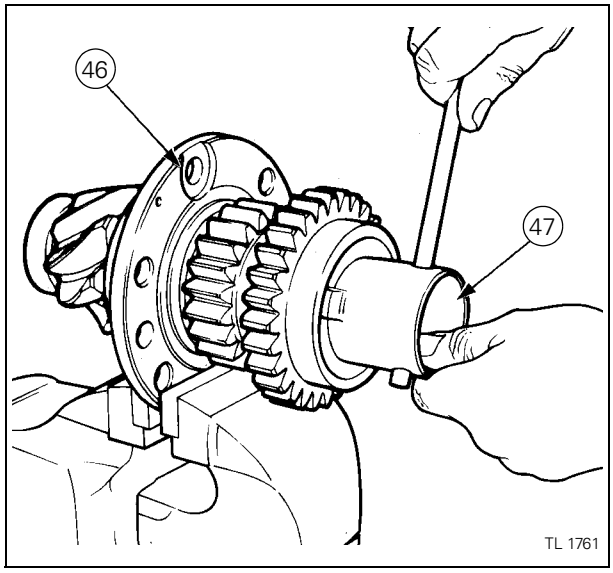


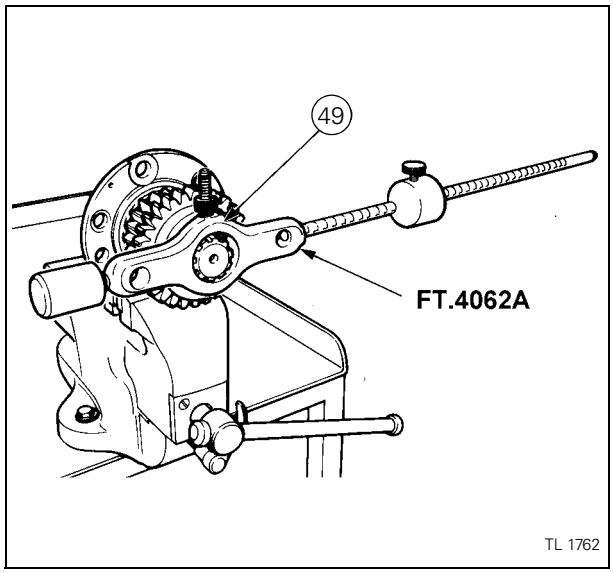
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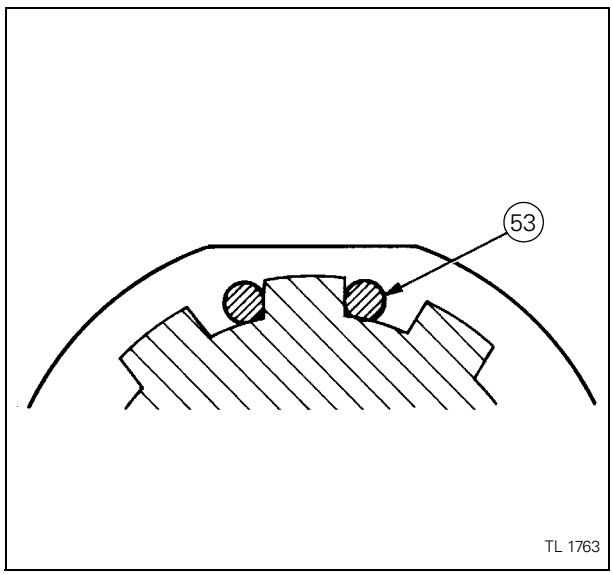
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Pinion Shaft

44. Reverse procedures 18 to 22 except:
    a. Ensure that the thrust washers (18 and 22) are fitted with the oil grooves and chamfered side of the lubrication holes face towards the intermediate gear cluster.
    b. DO NOT forget to fit the sleeve keeper inside the sleeve (19), engaging in one of the pinion splines.
    c. Lightly lubricate the bearings and thrust washers with clean transmission oil.
45. Due to the pinion bearing pre-load being lost it will be necessary to reset this in the following manner:
46. Hold the pinion housing in a vice.
47. Make a box spanner with four flats 51 mm (2.1/16 in) across flats out of a piece of 55 mm (2.1/8 in) internal diameter tube x 80 mm (3 in) long as shown in the illustration.
48. Tighten the new nut until some resistance is felt. The correct pre-load is 2,0-2,5 Nm (18-22 lbf in).
49. Check the pre-load by fitting gauge FT.4062A to the end of the shaft. When the correct setting is obtained the gauge should just turn under its own weight when weight is set 20 mark on the bar.
50. If a pre-load gauge is not available, wrap some string around the pinion shaft and attach the end to a spring balance. Pull the spring balance away from the shaft, the rolling resistance must be 10-11 kgf (21-25 lbf) when the shaft is rotating.
51. Re-adjust the nut if necessary, tap the pinion firmly to centralise the bearings, then re-check the pre-load.
52. Check that the intermediate gear cluster on the pinion shaft rotates freely, there should be a 0,10 mm (0.004 in) clearance between the gear and the thrust washers.
53. Secure the nut by driving a locking roller down each side of one of the pinion splines as shown in the illustration. The locking rollers must be driven flush with the locking ring.
54. Refit the pinion assembly in the centre housing ensuring that the locating pin is correctly aligned.
55. Replace the selector rail support bearing on one of the bolts locating the dowel pin in the pinion housing.
56. Tighten the six pinion housing retaining bolts to a torque of 108 Nm (80 lbf ft).





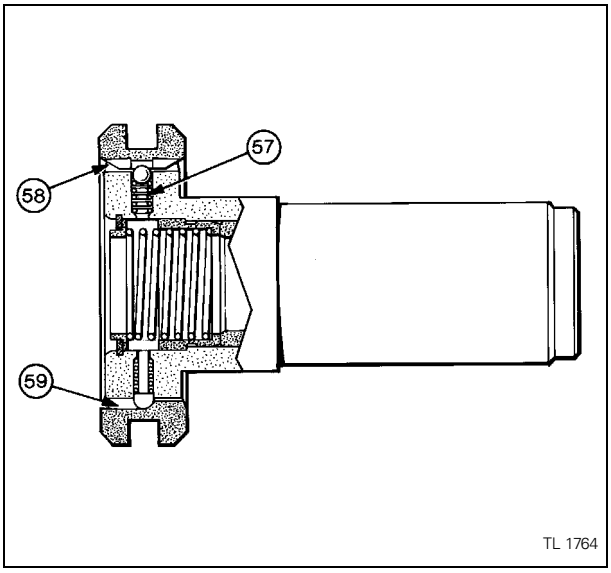


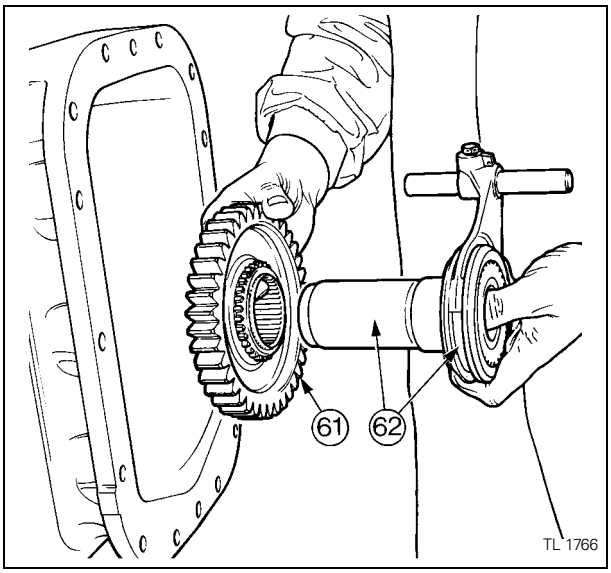
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Lower PTO Shaft

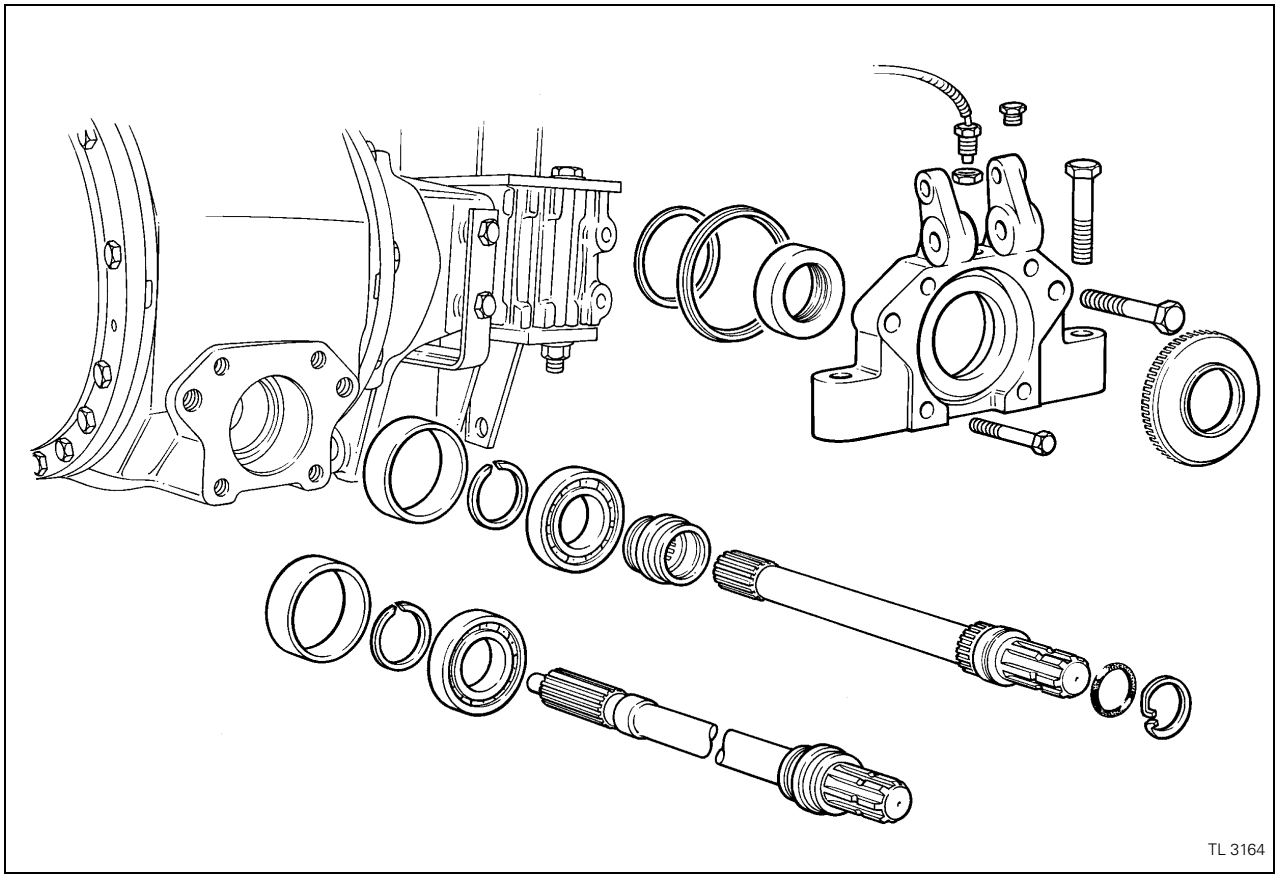
57. Re-assemble the selector coupler to the PTO transmission shaft, fitting the three detent springs and balls.
58. The selector coupler must be correctly fitted, the three detent springs and balls are equally positioned around the hub. The selector coupler has three special internal splines with 30° entry ramps to accommodate the balls. These three special splines must be assembled opposite the three balls.
59. In the case of type 'B' shaft with a 1000 speed lock-out device, it will be noted that one of the splines in the selector coupler has a cut-away tooth. This tooth must be assembled in line with the lockout pin facing the clutch.
60. Fit the selector fork to the selector rail, if removed, tighten the locking bolt to a torque of 35 Nm (25 lbf ft).
61. Hold the gear (6) with the needle roller bearing (7) and thrust washer (8) in place behind the intermediate gear cluster.
62. Fit the PTO transmission shaft through the 540 driven gear assembly into the centre housing simultaneously fitting the selector fork and rail in the selector ring and support bearing.
63. Ensure that the gear and shaft assembly goes fully back to the housing and that the thrust washer (8) is correctly located on the web in the housing.
64. Reverse procedures 1 to 4.





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PTO SHAFT and OIL SEAL

Removal and Refitment **6-7B**

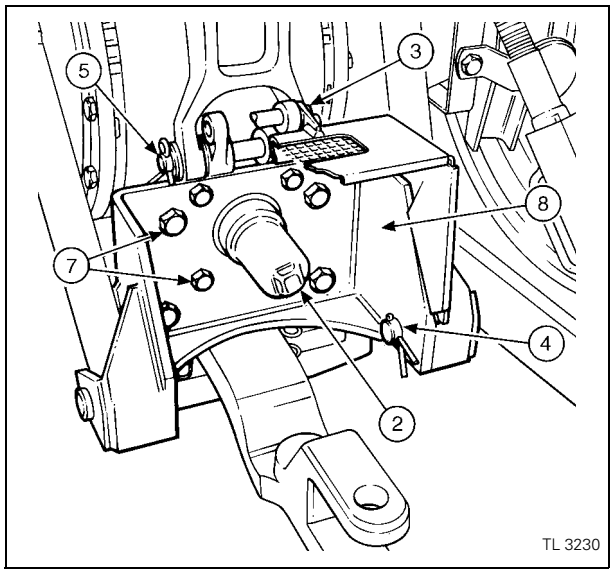
Special Tools:
MF.501 PTO Cassette Seal Installer
MS.550 Universal Handle

Removal

IMPORTANT: *To ensure a leak-proof installation of the rear PTO seal, special service tool MF.501 MUST be used to install the seal.*

There are two types of PTO shaft, single speed, 540/540E and two speed 540/1000 rev/min. On tractors with single speed PTO it will be necessary to drain the oil from the transmission case before removing the PTO shaft.

1. Place a drip tray under the rear PTO.
2. Remove the PTO cap.
3. Remove the split pin, pivot pin and PTO guard.
4. Remove the split pins and the lower assistor lift cylinder pivot pins, if fitted.
5. Remove the split pin and pivot pin from the control beam.



6. Disconnect the PTO speed sensor.
7. Remove the bolts from the rear bracket and the two vertical bolts into the lower drawbar support casting.
8. Remove the rear bracket.

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9. Holding the PTO shaft and extension housing, pull the PTO shaft assembly out of the rear of the tractor.
10. Unscrew and remove the PTO speed sensor, if fitted.
11. Remove and discard the seal ring in the extension housing.
12. Carefully push the PTO shaft out of the extension housing from back to front pushing the toothed count wheel off the shaft.

540/1000 Speed PTO

13. Remove the circlip.
14. Remove the PTO shaft from the retainer.
15. Remove the 'O' ring seal and discard.
16. Remove the front circlip and press the ball bearing off the retainer.

540/540E Speed PTO

17. Remove the front circlip and press the ball bearing off the PTO shaft.

All Models

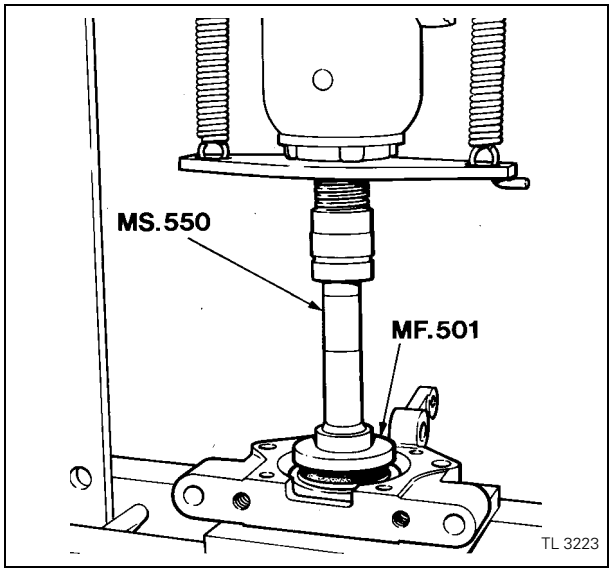
18. Remove the cassette seal from the extension housing.
19. Remove the bearing spacer.
20. Remove the crush washer.

Examination

Thoroughly clean and inspect all parts, discard removed 'O' rings and circlips and replace with new. Replace any parts that are worn or damaged.

Refitment

21. Using special tools MF.501 Cassette Seal Installer and MS.550 Universal Handle. Place the extension housing under a press and press the seal into the housing flush with the rear face.
22. Press the ball bearing onto the retainer on two-speed PTO. Onto the PTO shaft on single-speed PTO. Replace the circlip.
23. Replace the crush washer into the housing. This washer only requires to be replaced if a new extension housing is being fitted.
24. Refit the bearing spacer into the rear axle housing.
25. On two speed PTO, refit the PTO shaft to the bearing retainer.
26. Slide the PTO shaft assembly into the rear axle, taking care to keep it horizontal to align the internal splines. Locate the ball bearing in the housing.
27. Fit a new 'O' ring to the extension housing and liberally apply petroleum jelly to the internal ribs of the seal.



28. Very carefully refit the extension housing sliding the seal onto the bearing retainer and locating the housing onto the ball bearing.
29. Locate the housing with two of the smaller bolts, DO NOT tighten.
30. Press the toothed sensing wheel onto the bearing retainer, ensure that there is clearance between the housing.
31. Lift up the drawbar support casting and locate the two vertical bolts.
32. Reverse procedures 1 to 10 except:
    a. Tighten the two large horizontal bolts to a torque of 230 Nm (170 lbf ft).
    b. Tighten the four small horizontal bolts to a torque of 115 Nm (85 lbf ft).
    c. Tighten the two large vertical drawbar bolts to a torque of 185 Nm (136 lbf ft).
    d. Screw the PTO speed sensor into the extension housing until it bottoms on the toothed wheel, then back-off by half a turn. Tighten the lock-nut. The correct clearance is 0,6 mm (0.025 in).

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CHANGING the PTO SHAFT 540/1000

Removal and Refitment 7-7B

Removal

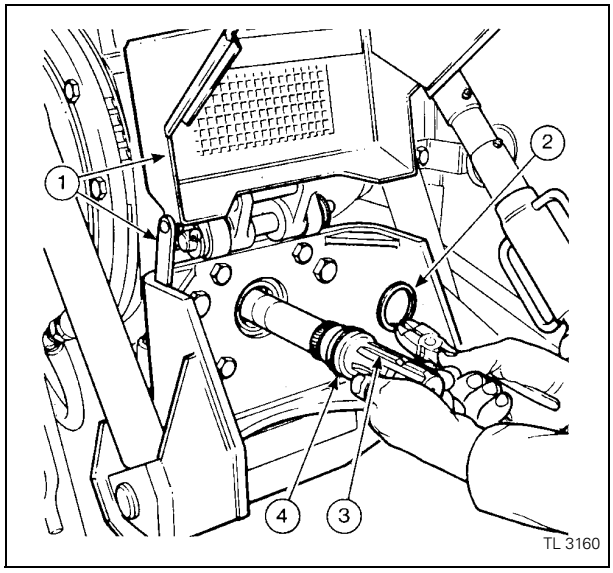
To change the PTO shaft from a five spline shaft (540) to a 21 spline shaft (1000), or 1000 to 540, proceed as follows:

NOTE: *There may be a small loss of oil when the PTO shaft is removed.*

1. Lift up the PTO guard, there is a small strut which can be lowered to retain it in the raised position.
2. Remove the cap and with the aid of a pair of pliers remove the circlip securing the PTO shaft.
3. Withdraw the shaft from the rear of the tractor.

Refitment

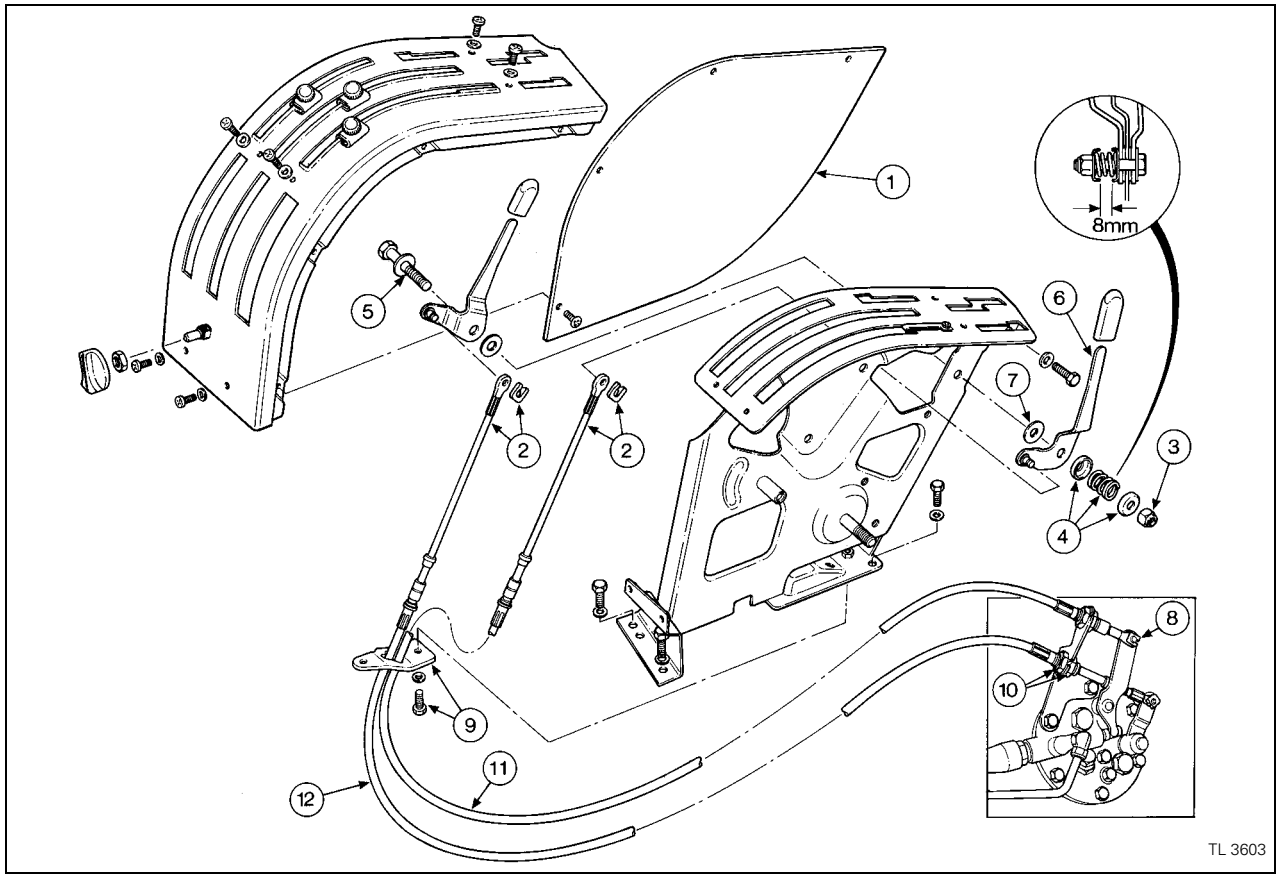
4. Before installing the replacement shaft check the condition of the 'O' ring seal, if replacement is required fit a new seal, part number 3008 359 X1.
5. Grease the 'O' ring and spline.
6. Slide the shaft into the tractor, DO NOT force the shaft in, but carefully align the internal splines.
7. Refit the circlip ensuring that it locates correctly in its groove.
8. Lower the PTO guard and refit the cap.



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Two-speed Power Take-Off



PTO CONTROLS

Overhaul 8-7B

These instructions apply to both Single-Speed and Two-Speed PTO.

Dis-assembly

1. To gain access to the inside of the control assembly, remove the four cross head screws and the side panel.

Hand Levers

NOTE: *If it is necessary to remove the speed selector lever, the console frame will have to be un-bolted to gain access to the back of the frame.*

2. Remove the spring clip and un-hook the cable from the hand lever.
3. Remove the Nyloc nut.
4. Remove the two cup washers and spring.
5. To remove the hand lever, it will be necessary to slide the bolt to the right.
6. Remove the hand lever up through the slot in the quadrant frame.
7. Remove the friction washer.

Cable

8. Remove the spring clips and disconnect the cable at the PTO side cover end.
9. Underneath the cab, remove the two bolts and the cable clamp.
10. Unscrew the cable adjusting nut.
11. Remove the cable, passing it through the cable clamp.
12. The same procedure applies to the other operating cable.

Re-assembly

13. Reverse procedures 1 to 12 except:

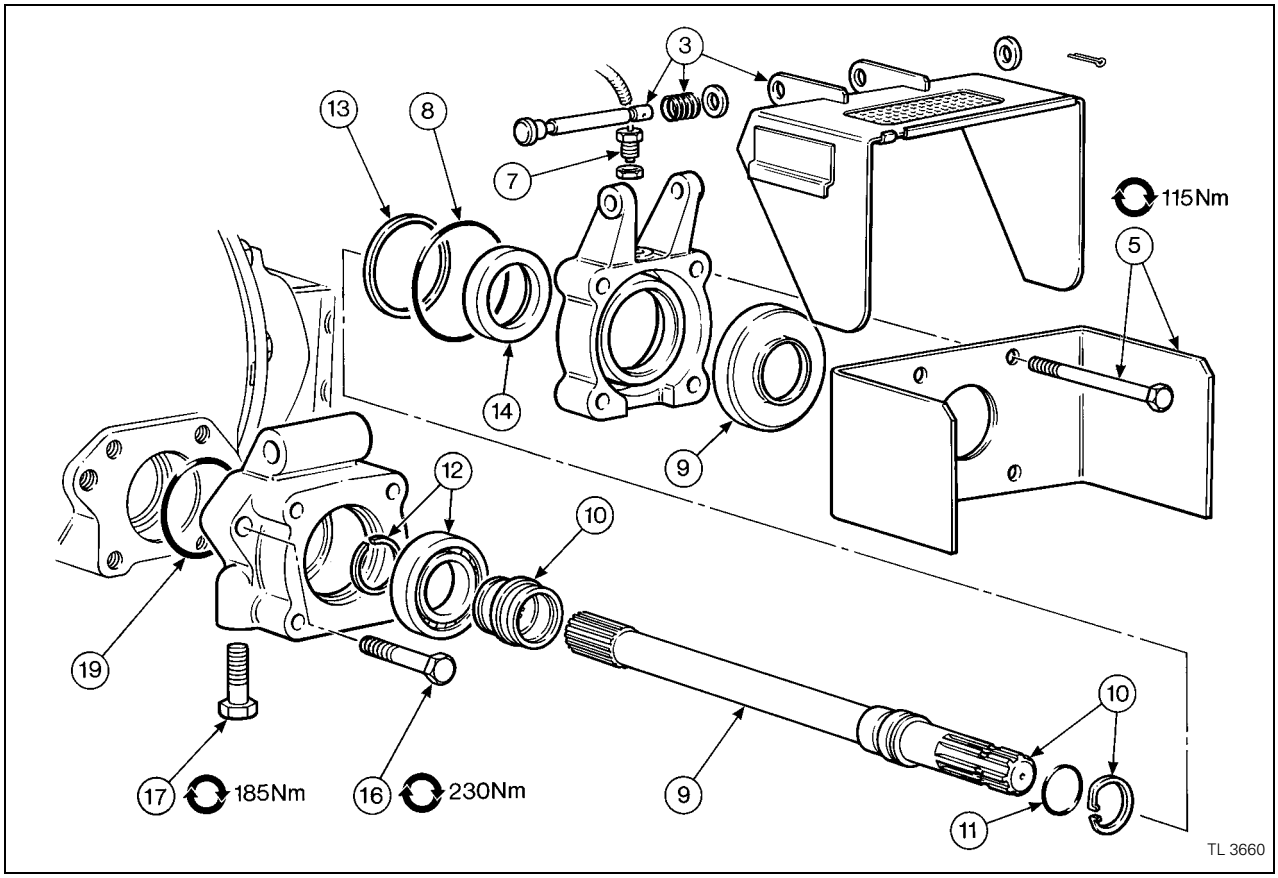
a. Adjust the Nyloc nut (14) until the two cup washers are 8 mm (5/16. in) apart.

b. Speed Control - With the PTO speed lever in neutral position on the quadrant and the lever on the side cover in neutral, adjust the cable to suit.

c. On/Off Control - With the PTO speed lever in the OFF position on the quadrant and the lever on the side cover in OFF, adjust the cable to suit.

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EXTENDED PTO SHAFT and OIL SEAL

Removal and Refitment **9-7B**

Special Tools:
MF.501 PTO Cassette Seal Installer
MS.550 Universal Handle

Removal

IMPORTANT: *To ensure a leak-proof installation the rear PTO seal, special service tool MF.484 MUST be used to install the seal.*

1. Place a drip tray under the rear PTO.
2. Remove the PTO cap.
3. Remove the split pin, pivot pin, spring, washers and PTO guard lid.
4. Disconnect the PTO speed sensor.
5. Remove the four horizontal bolts and the PTO guard.
6. Pull the PTO shaft assembly out of the rear of the tractor complete with the outer housing.
7. Remove the PTO speed sensor, if fitted.
8. Remove and discard the 'O' ring.
9. Carefully push the PTO shaft assembly out of the housing from back to front pushing the toothed count wheel off the shaft.
10. Remove the circlip and remove the PTO shaft from the retainer.
11. Remove the 'O' ring seal and discard.
12. Remove the front circlip and press the ball bearing off the retainer.
13. Remove the crush washer.
14. Remove the cassette seal from the housing.

Extension Housing

15. Remove the split pin, pin and disconnect the control beam.
16. Remove the two large horizontal bolts.
17. Remove the two vertical bolts through the drawbar bracket into the extension housing.
18. Remove the extension housing.
19. Remove the 'O' ring seal and discard.

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Two-speed Power Take-Off

Examination

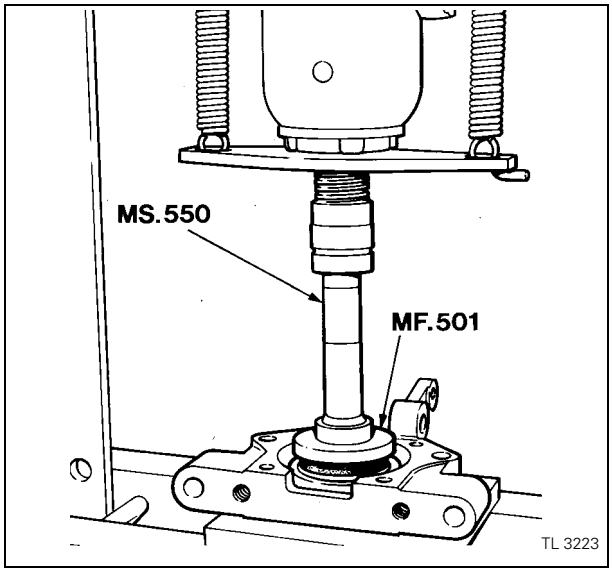
Thoroughly clean and inspect all parts, discard removed 'O' rings and circlips and replace with new. Replace any parts that are worn or damaged.

Refitment

20. Using special tools MF.501 Cassette Seal Installer and MS.550 Universal Handle. Place the housing under a press and press the seal into the housing flush with the rear face.
21. Press the ball bearing onto the retainer. Replace the circlip.
22. Replace the crush washer into the housing. This washer only requires replacing if new housings are being fitted.
23. Refit the extension housing with a new 'O' ring and tighten the two bolts through the drawbar to a torque of 185 Nm (135 lbf ft). Tighten the two large horizontal bolts to a torque of 230 Nm (115 lbf ft).
24. Refit the PTO shaft to the bearing retainer.
25. Slide the PTO shaft assembly into the rear axle, taking care to keep it horizontal to align the internal splines. Locate the ball bearing in the housing.
26. Fit a new 'O' ring to the extension housing and liberally apply petroleum jelly to the internal ribs of the seal.
27. Very carefully refit the extension housing sliding the seal onto the bearing retainer and locating the housing onto the ball bearing.
28. Locate the housing with two of the bolts.
29. Press the sensing wheel onto the bearing retainer, ensure that there is clearance between the housing.
30. Reverse procedures 1 to 5 except:

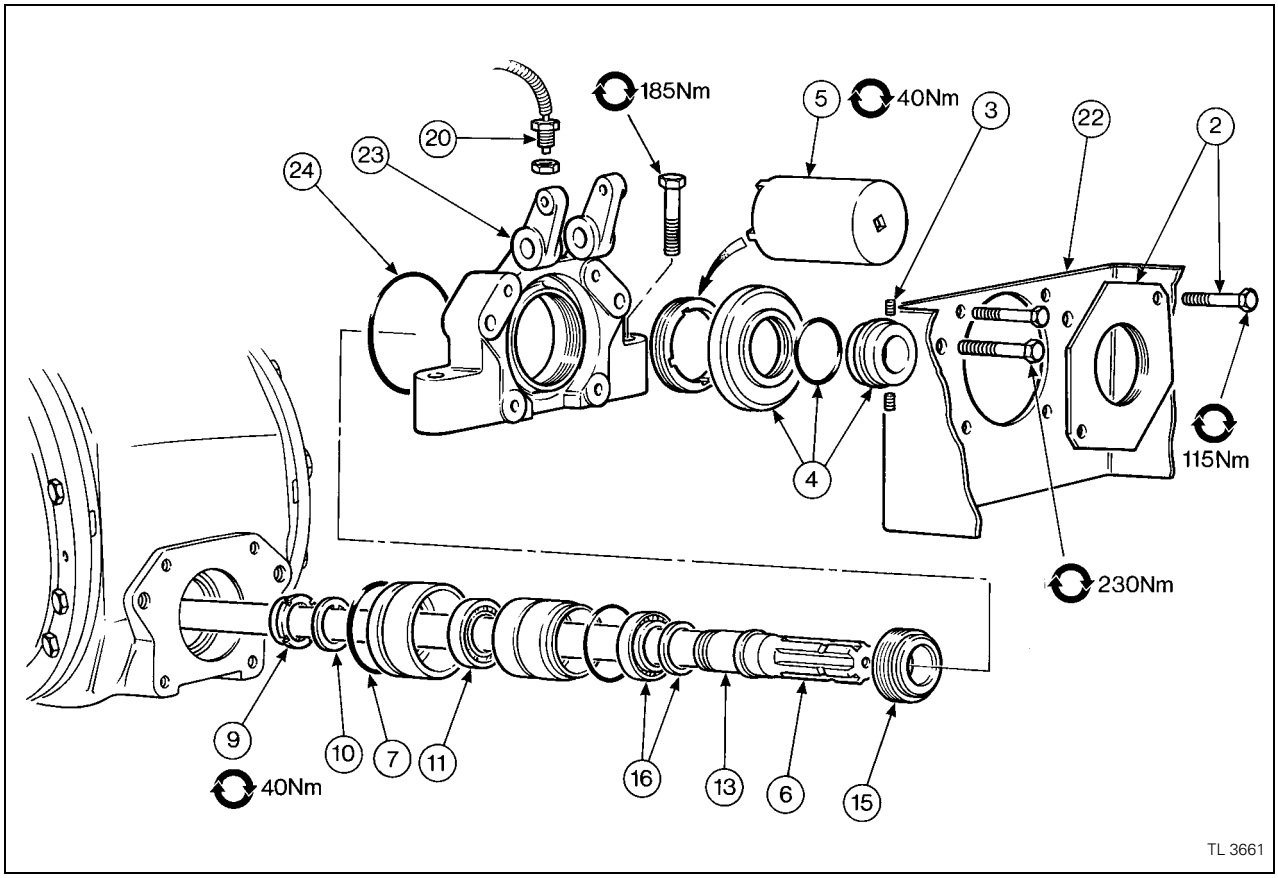
a. Tighten the four horizontal bolts to a torque of 115 Nm (85 lbf ft).

b. Screw the PTO speed sensor into the extension housing until it bottoms on the toothed wheel, then back-off by half a turn. Tighten the lock-nut. The correct clearance is 0,6 mm (0.025 in).



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TL 3661

HEAVY DUTY PTO SHAFT and SEAL

Removal and Refitment 10-7B

Removal

The heavy duty PTO shaft and seal is used in adverse conditions such as paddy fields. It contains two taper roller bearings for shaft support and a face-type seal to prevent the ingress of dirt into the transmission.

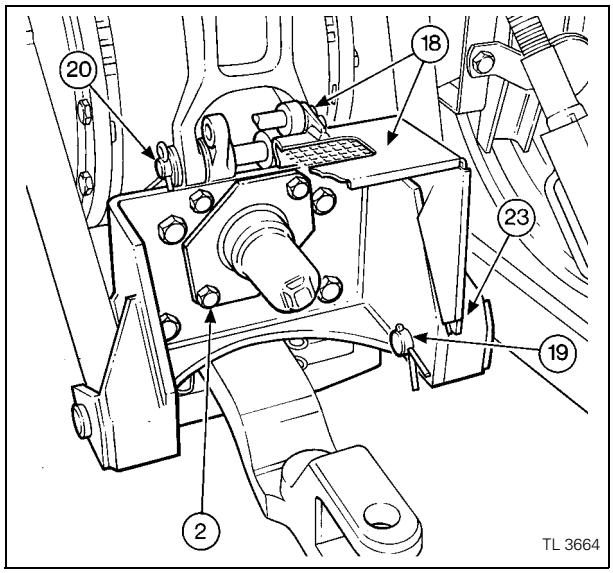
Special Tools

To ensure that the bearing and seal assembly is correctly dismantled and re-assembled it will be necessary to manufacture the two special Massey Ferguson Tools, 3762 193 C01 Split Ring and 3759 801 C02 Face Seal Installer. These two tools are made out of mild steel to the dimensions given in the illustration. In addition you will require spanner part No. 3811 090 M91, supplied with the tractor or obtainable from your Massey Ferguson Dealer.

Dis-assembly

Shaft Assembly

1. Place a drip tray under the rear PTO.
2. Remove the two bolts holding the PTO cap and support in place.



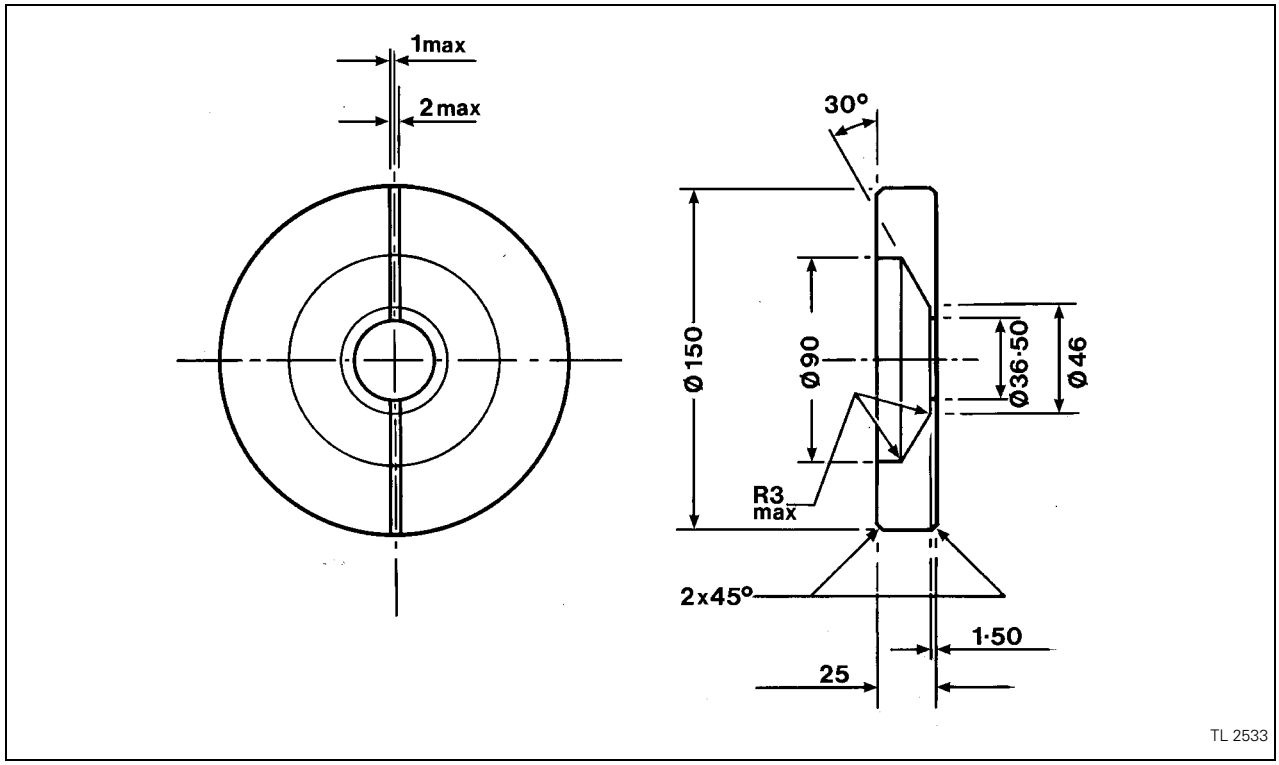
TL 3664

3. Remove the two grub screws.
4. Slide the hub and PTO speed count wheel off the PTO shaft.
5. With the aid of special box spanner 3811 090 M91, unscrew the ring nut retaining the bearing assembly.

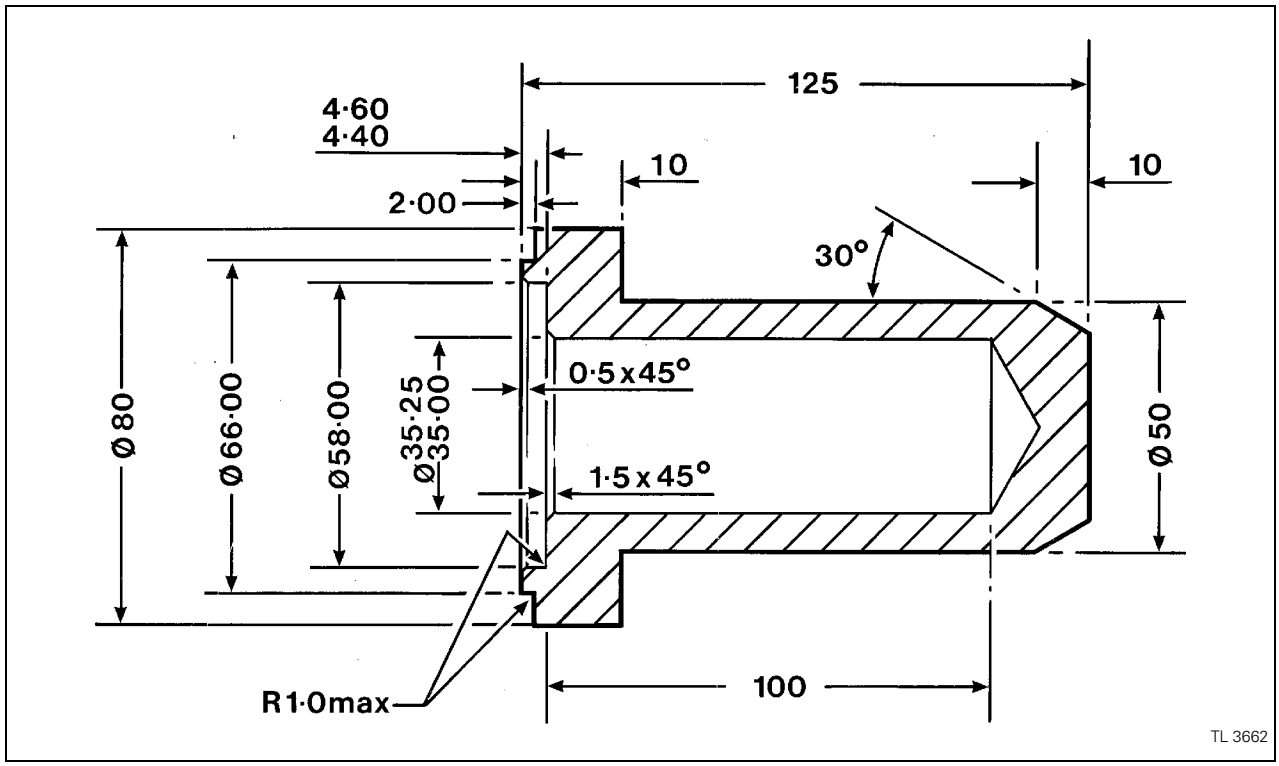
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Two-speed Power Take-Off



Split Ring Tool 3762 193 C01

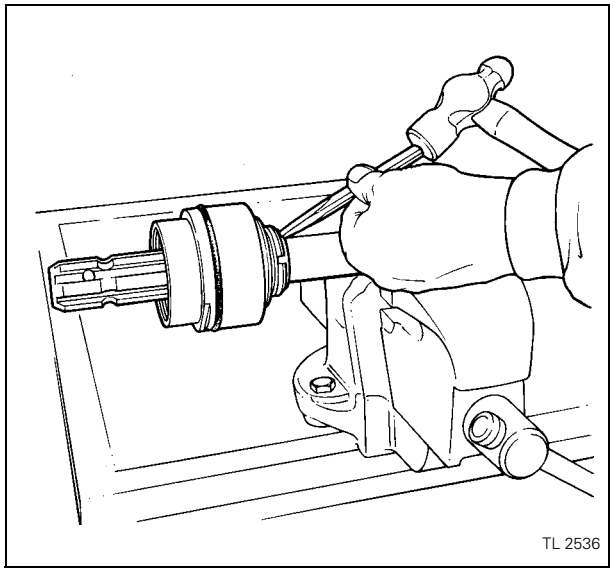


Face Seal Installer 3759 801 C02

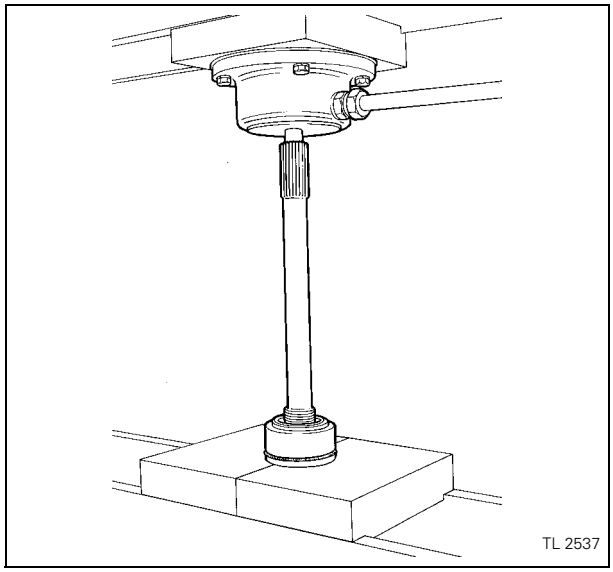
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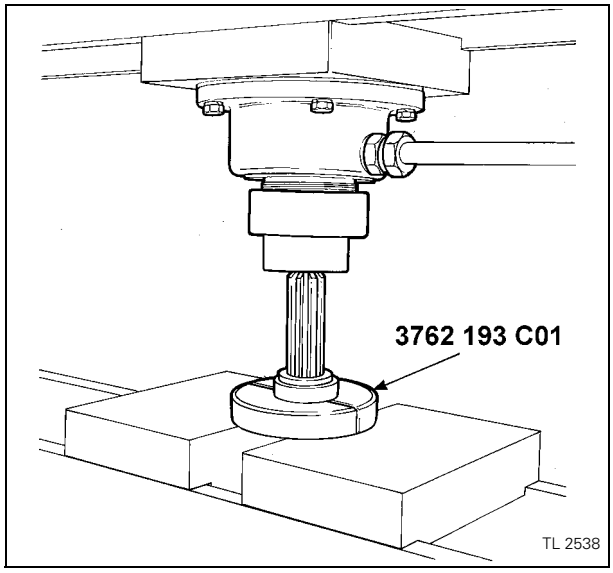
6. Remove the PTO shaft and bearing assembly by pulling it out of the centre housing.
7. Remove and discard the 'O' ring.
8. Using a sharp narrow chisel, lift the staking up out of the slot.
9. Remove the retaining nut. A 50 mm (2 in) 'C' spanner will assist in the removal and refitment.
10. Remove the tab washer.
11. Remove the bearing cone.


TL 2536

12. Place the shaft in a press, threaded end upwards and resting on the sleeve.
13. Press the shaft and seal out of the bearing sleeve.


TL 2537

14. Slide the Split Ring Tool (3762 193 C01) between the seal and the shoulder on the shaft.
15. Place the shaft in a press and remove the seal.
16. Remove the components of the taper roller bearings and spacer if necessary.



TL 2538

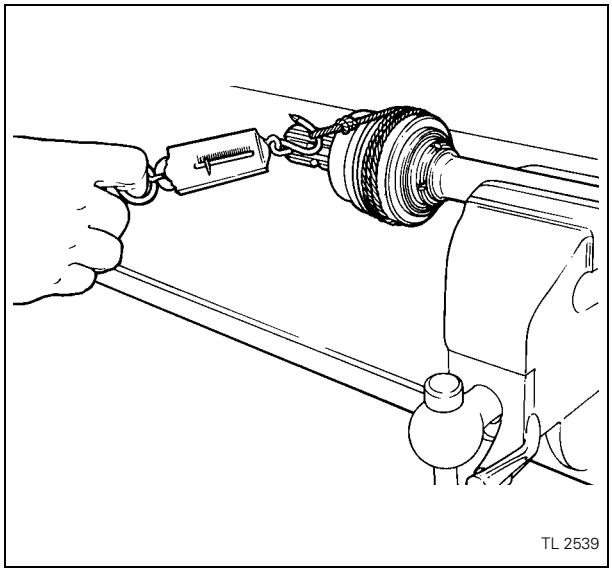
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Housing

If it is necessary to remove the housing proceed as follows:

17. Remove the split pin, pivot pin and PTO guard.
18. Remove the split pins and lower assistor lift cylinder pivot pins, if fitted.
19. Remove the split pin and pivot pin from the control beam.
20. Disconnect the PTO speed sensor.
21. Remove the bolts from the rear bracket and the two vertical bolts into the lower drawbar support casting.
22. Remove the rear bracket.
23. Remove the extension housing.
24. Remove and discard the 'O' ring.
25. Remove the sleeve from the rear axle housing and discard the 'O' ring.

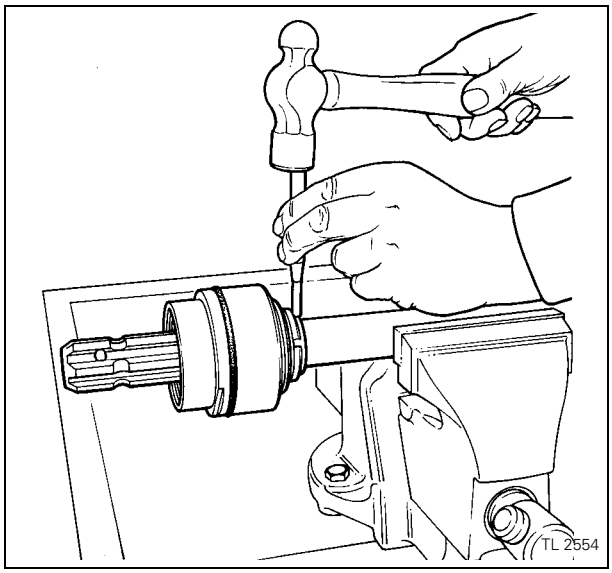

TL 2539

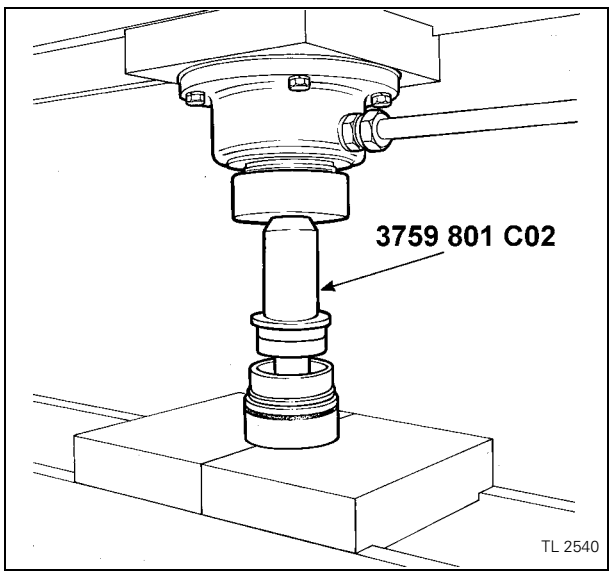
Re-assembly

26. Re-assemble the housing, reversing procedures 18 to 26.
27. Re-assemble the shaft in the bearing sleeve and reverse procedures 10 to 12.
28. Apply Massey Ferguson Lock 'n' Seal (Loctite 242) to the thread on the shaft, screw on the nut and tighten to give a rolling torque on the bearings of 1.0-1.7 Nm (0.7-1.3 lbf ft).
29. To obtain the rolling torque, place the PTO shaft in a vice. Wrap string around the bearing sleeve and attach to a spring balance. Pull the spring balance away from the sleeve, the setting is correct when the reading on the spring balance is 3 kg (6.5 lb) when the sleeve is rotating.
30. Firmly stake the nut into the slot.

IMPORTANT: *The shaft, housing and seal assembly MUST be free of oil and grease during assembly.*

31. Ensure that the shaft and housing are free of oil and grease in the area adjacent to the seal. Using the Face Seal Installer (3759 801 C02), press the new seal onto the shaft and into the sleeve with the stepped end facing the tool.


TL 2554

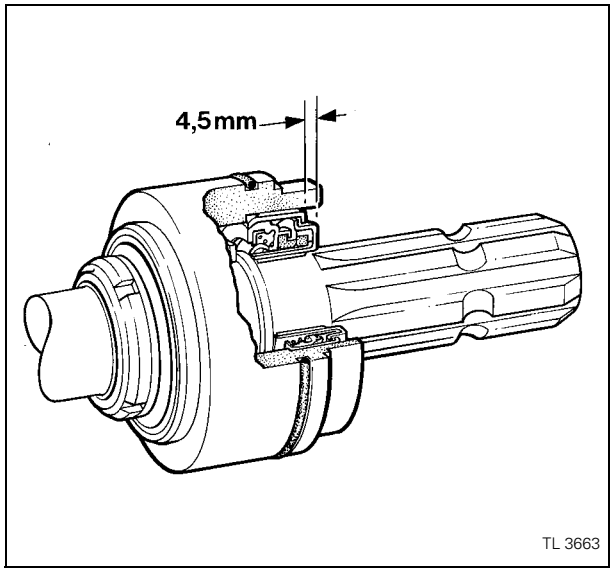


TL 2540

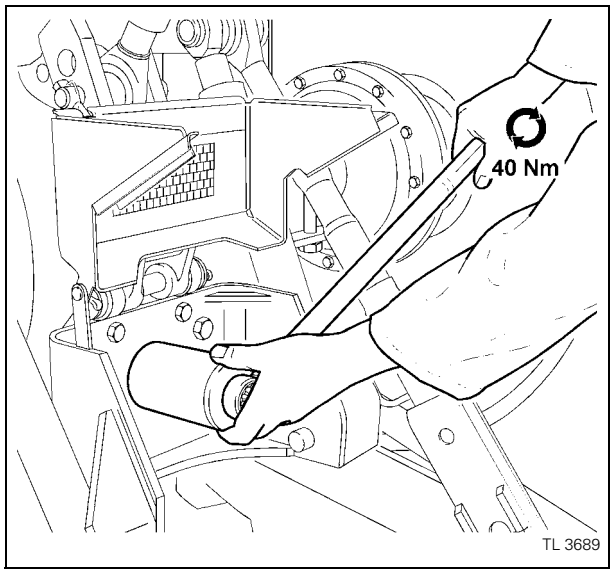
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32. The tool will ensure that the edge of the seal is installed 2,0 mm below the bearing sleeve.
33. Slide the PTO shaft assembly into the centre housing, taking care to keep it horizontal, to align the internal splines and to keep the two flats vertical.



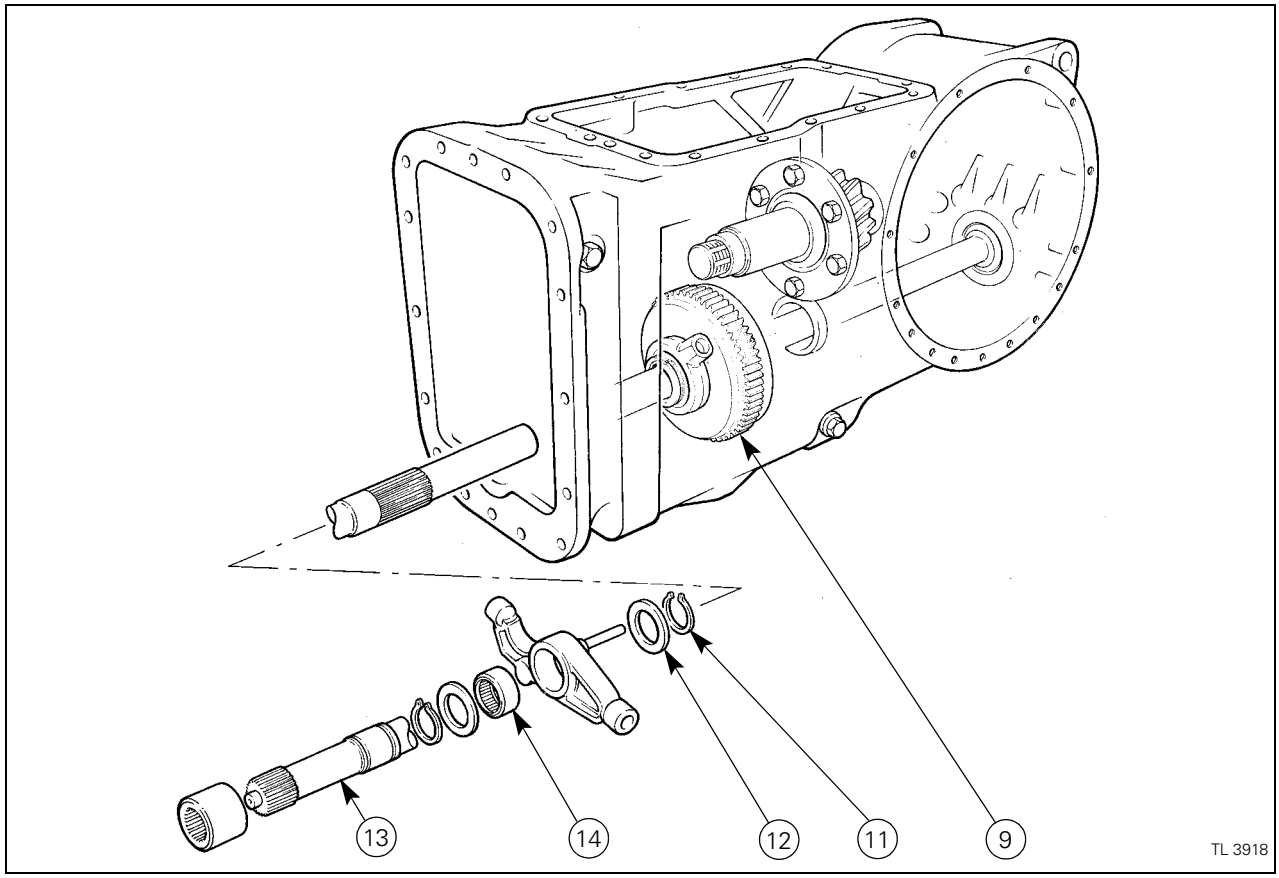
34. Reverse procedures 1 to 6 except:
    a. Tighten the PTO shaft and bearing assembly nut to a torque of 40 Nm (30 lbf ft) with the special box spanner.
    b. Tighten the four horizontal bolts to a torque of 115 Nm (85 lbf ft).
    c. Tighten the two large horizontal bolts to a torque of 230 Nm (170 lbf ft).
    d. Tighten the two large vertical drawbar bolts to a torque of 185 Nm (135 lbf ft).



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Two-speed Power Take-Off



PTO CLUTCH UNIT and SUPPORT BEARING

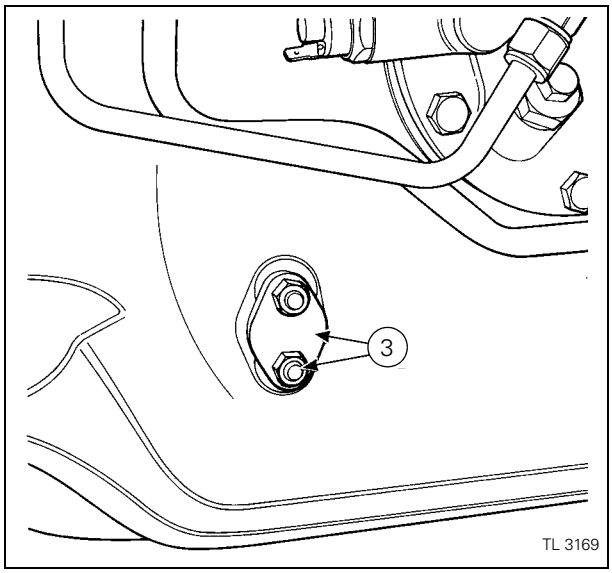
Removal and Refitment 11-7B

Removal

1. Split the tractor between the rear centre housing and the range gearbox, *(see operation 4-2A or 4-2B).*
2. Remove the left-hand side cover, *(see operation 1-7B).*
3. Remove the two nuts and the dowel pin on the left-hand side of the transmission case holding the PTO shaft support bearing.
4. Remove the strainer housing on the right-hand side, *(see operation 13-9C).*
5. Remove the auxiliary pump and drive to allow the drive chain to be removed from around the clutch.

NOTE: *The following procedure is important to prevent the components becoming dislodged.*

6. To remove the PTO clutch assembly carry out the following instructions:
7. The clutch hub and drive gear MUST NOT be allowed to move away from the clutch pack.



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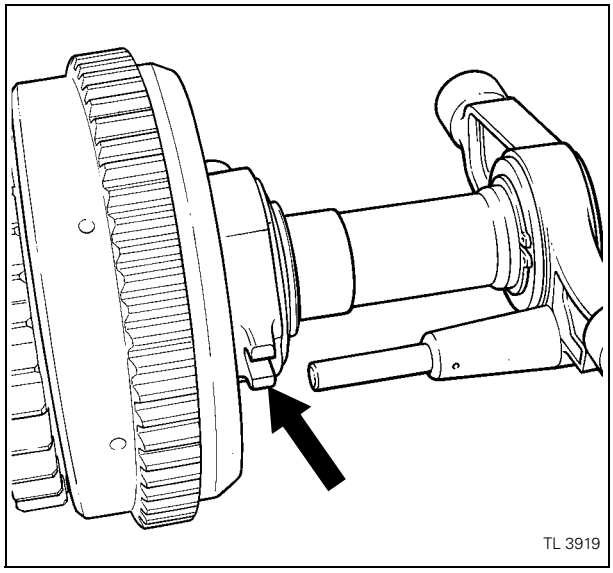
8. The two speed selector coupler, shaft and gears MUST stay at the back of the centre housing and NOT allowed to come forward.
9. Remove the PTO clutch assembly and support bearing from the centre housing as one unit.
10. Slide the clutch pack off the PTO shaft.

Support Bearing

11. Remove the circlips.
12. Remove the washers.
13. Remove the shaft.
14. If necessary, remove the needle roller bearing from inside the housing.

Refitment

15. Reverse procedures 11 to 14.
16. Refit the clutch unit onto the PTO shaft.
17. Ensure that the fork on the manifold is correctly engaged with the pin on the support bearing.
18. Ensure that all the components are correctly located in the centre housing.
19. Ensure that the clutch pack hub and drive gear are correctly located.
20. Reverse procedures 1 to 9. except:
    a. Renew all 'O' rings.
    b. DO NOT forget to locate the chain before installing 5the clutch and support bearing.
    c. Keep all the components of the clutch together during assembly.
    d. DO NOT tighten the two dowel nuts (3) until the transmission has been completely re-assembled.



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Two-speed Power Take-Off

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Front Power Take-Off

Section 7 - Part C

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Front Power Take-Off

SPECIFICATION

Front PTO speed	1000 rev/min @ 2000 engine rev/min.
Rotation	Counter-clockwise.
Gearbox reduction	2 : 1
Shaft type	540 rev/min type - 6 spline.
Gearbox bearing pre-load	0,03-0,05 mm (0.001-0.002 in).
Shim pack part number (bearing pre-load)	11 898 106.
Engagement	Electro hydraulic multi plate clutch.
Number of plates:	
Steel plates	8.
Friction	9.
Operating pressure	22-24 bar (319-348 lbf/in^2).

Bolt Torques

Front support plate to gearbox nuts	87 Nm (65 lbf ft).
Front support plate to front support casting bolts	395 Nm (290 lbf ft).
Front linkage top support bolts	180 Nm (135 lbf ft).
Gearbox casing	50 Nm (35 lbf ft).
Shaft hexagon cap screw M12	87 Nm (65 lbf ft).
Hexagon cap screws M5	7 Nm (5 lbf ft).
Hexagon cap screws M6	10 Nm (7 lbf ft).
Hexagon cap screws crankshaft adaptor plate	52 Nm (40 lbf ft).
Hexagon cap screws drive coupling	90 Nm (65 lbf ft).
Solenoid valve body	10 Nm (7lbf ft).
Solenoid valve coil	Finger tight.

General Description

The PTO gearbox is bolted to the front of the front support casting and is driven from the engine crankshaft through a drive shaft with a flexible coupling and clutch.

The gearbox contains a simple set of reduction gears with a ratio of 2 : 1, the PTO running at half engine speed. On the input side of the gearbox there is a multi-plate, hydraulically operated clutch. This is under the control of the driver through a switch and solenoid operated control valve.

The hydraulic system receives hydraulic pressure from a connection on the oil cooler between the steering unit and the pressure maintaining valve, this gives an operating pressure of 23 bar. Oil from the system is returned to the transmission case through the gearbox top cover.

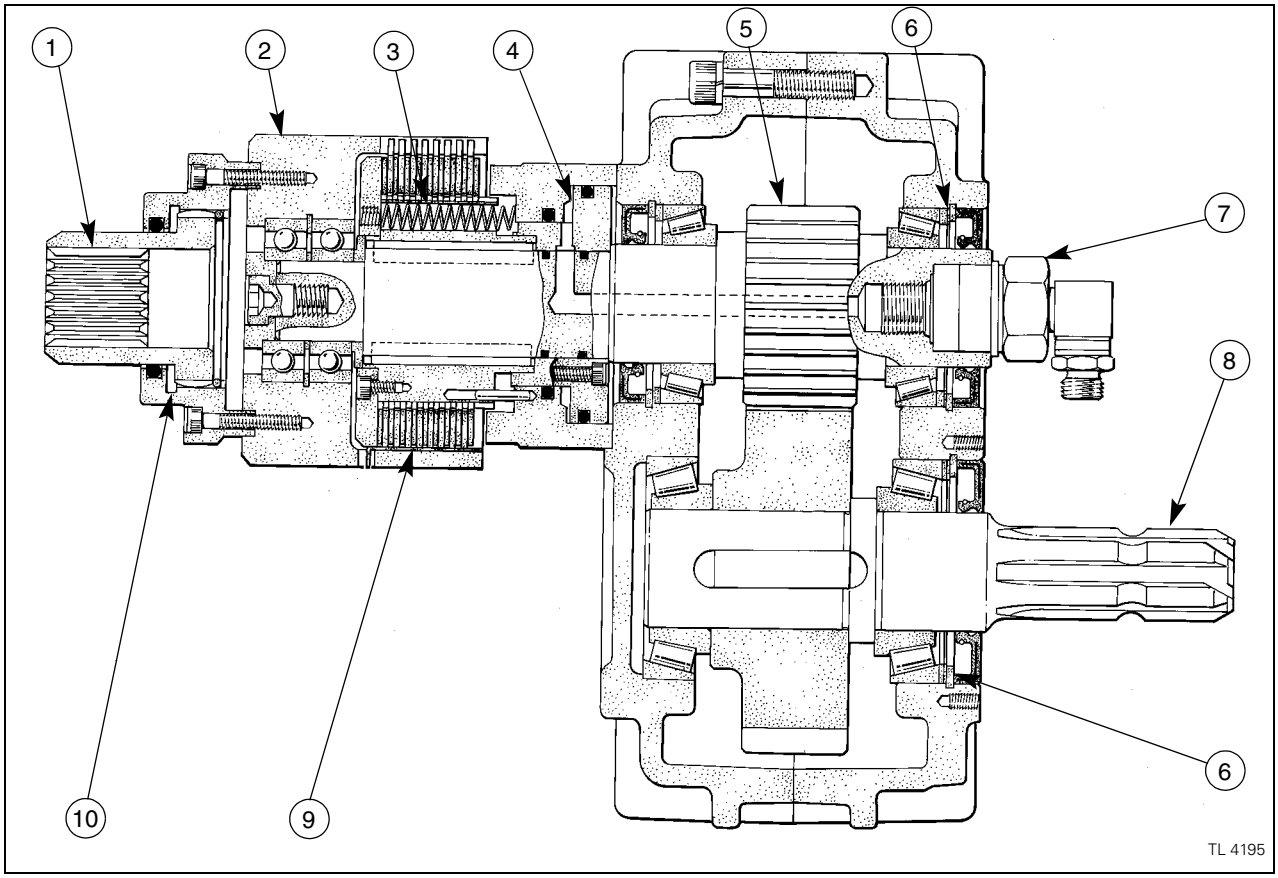
The hydraulic control valve is located under the battery support plate on the front support casting. It comprises of a solenoid valve, accumulator and a regulating orifice. The solenoid is energised to engage and the rate of engagement is controlled by the regulating orifice and accumulator. This is to give a controlled and smooth engagement.

Pressure from the system is taken into the clutch through a rotary coupling, down the centre of the shaft and into a cavity behind the clutch piston. When energised the piston moves forward and clamps the steel and friction plates together engaging the gearbox and PTO shaft. Six springs disengage the drive when the pressure is removed, a flat spring plate over the clutch plates prevent clutch plate rattle.

The front PTO is used in conjunction with the front three-point linkage.

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Front PTO Clutch and Gearbox

1. Input shaft coupling.
2. Clutch body.
3. Return springs.
4. Hydraulic cylinder.
5. Reduction gears.
6. Bearing pre-load shims.
7. Hydraulic rotating coupling.
8. PTO shaft.
9. Clutch friction and steel plates.
10. Clutch body bearing assembly.

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GEARBOX AND CLUTCH ASSEMBLY

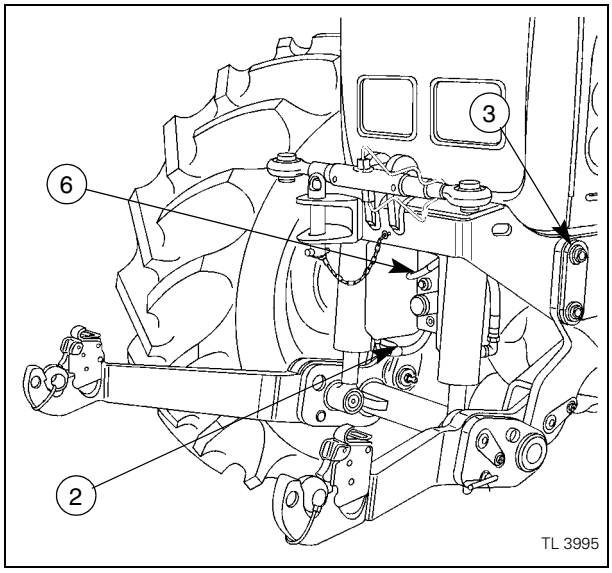
Removal and Refitment 1-7C

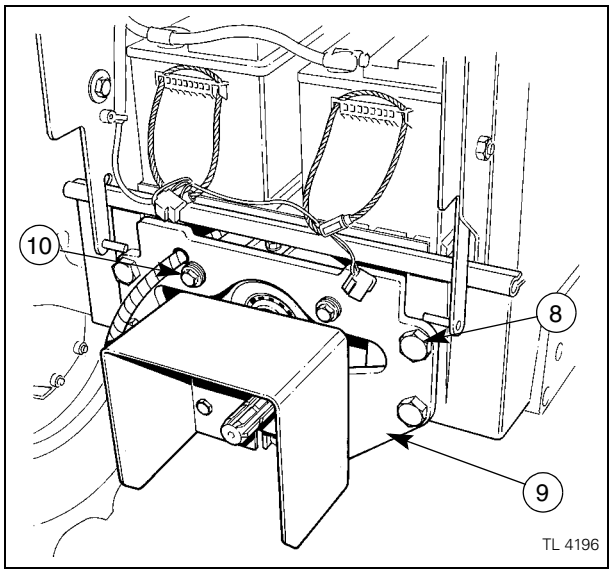
Removal

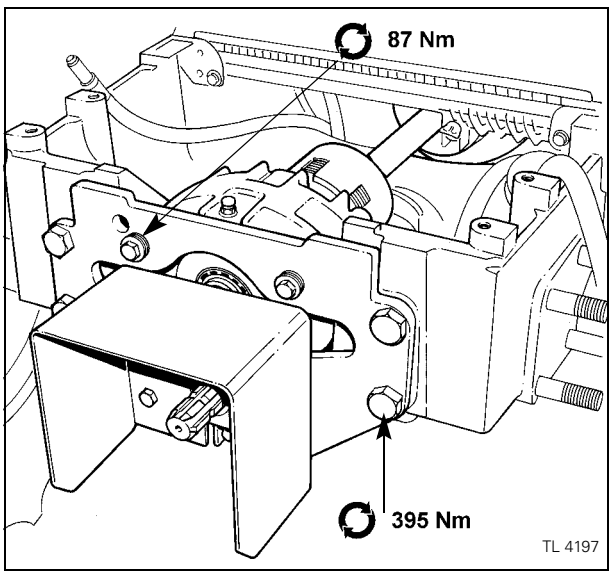
1. Remove the front grille.
2. Disconnect the hoses to the front linkage hydraulic cylinders.
3. Remove the four bolts and two dowel plates.
4. Swing the front linkage top support down to give clearance to remove the PTO gearbox.
5. Remove the PTO guard.
6. Disconnect the hydraulic hose the PTO clutch.
7. Remove the breather on top of the gearbox and replace it with a lifting eye. Take the weight of the box on a small crane.
8. Remove the four large bolts securing the gearbox support to the front casting.
9. Remove the front PTO gearbox assembly by pulling it forward off the drive shaft and away from the tractor.
10. If necessary, remove the four nuts and the front support plate

Refitment

11. Reverse procedures 1 to 10 except:
    - *a.* Apply a small amount of grease to the drive shaft spline.
    - *b.* Tighten the four nuts, front support plate to gearbox, to a torque of 87 Nm (65 lbf ft).
    - *c.* Tighten the four bolts, front support plate to front support casting, to a torque of 395 Nm (290 lbf ft).
    - *d.* Tighten the four bolts, front linkage top support, to a torque of 180 Nm (135 lbf ft).

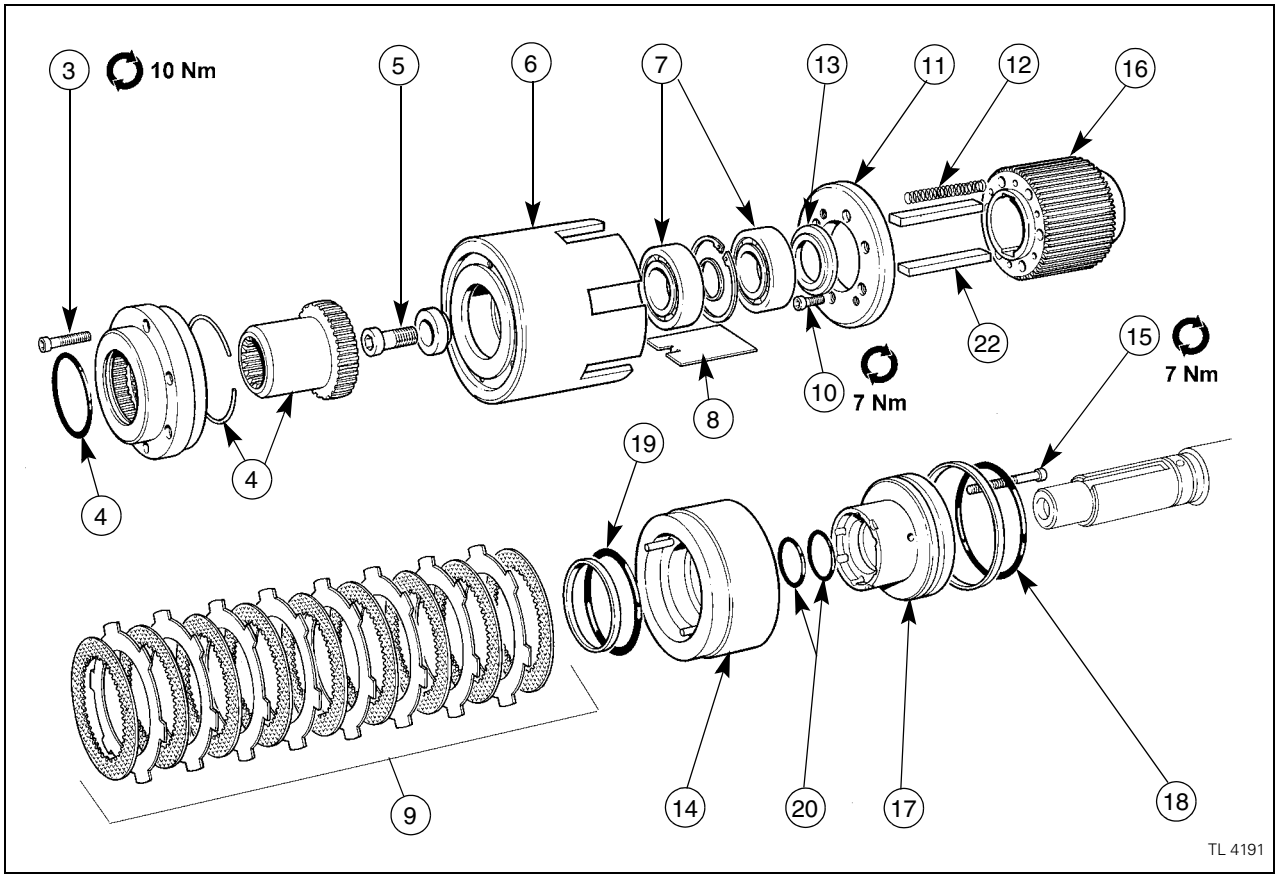






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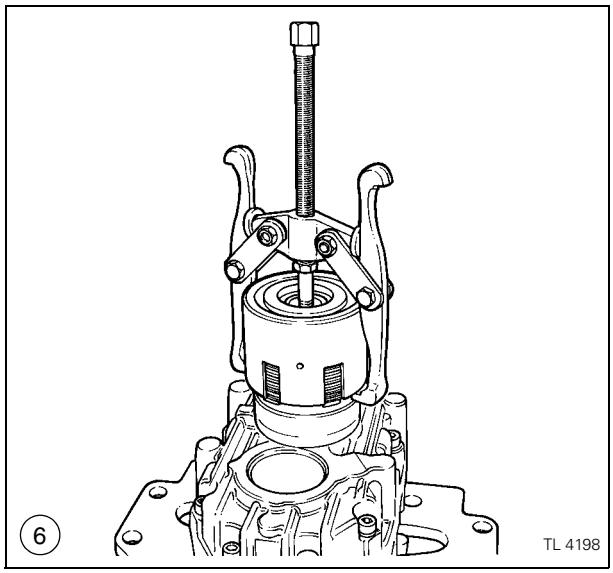


CLUTCH

Overhaul 2-7C

Disassembly

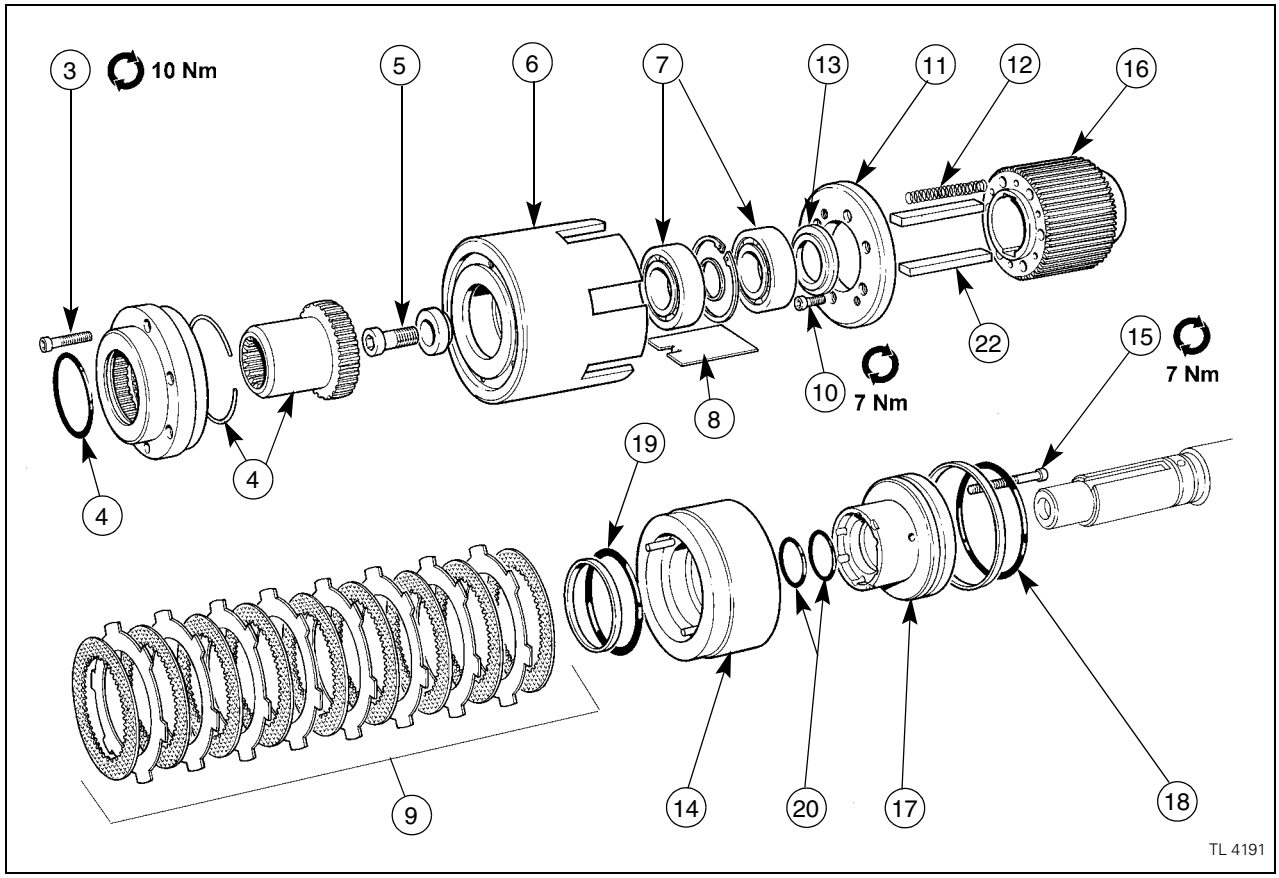
1. Remove the clutch and gearbox assembly, *(see operation 1-7C)*.
2. Stand the gearbox assembly up on end standing on the PTO guard.
3. Remove the six hexagon cap screws and the drive coupling.
4. If the splined coupler needs replacing, remove the clip, coupler and seal ring.
5. Remove the large hexagon cap screw, the washer will remain in the housing.
6. Screw a long bolt into the end of the shaft for the puller to push against. With the aid of a puller, remove the clutch body.
7. If necessary, remove and replace the two bearings in the clutch body.
8. Remove the spring plate.
9. Remove the set of steel and friction plates.
10. Remove the six capscrews.



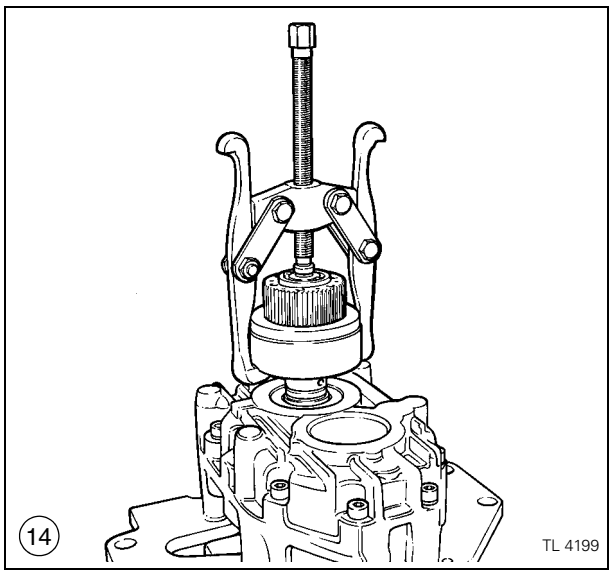
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Front Power Take-Off



11. Remove the end plate, there are springs under tension.
12. Remove the springs.
13. Remove the shim washer.
14. With the aid of a puller, pull the piston and cylinder assembly off the shaft.
15. Remove the six capscrews.
16. Remove the disk carrier.
17. Press the piston out of the cylinder.
18. Remove the seal and O-ring from the piston.
19. Remove the seal and O-ring from the cylinder.
20. Remove the seal rings from the shaft.
21. There should be no need to remove the guide pins.
22. Remove the two keys from the shaft, if necessary.



Examination

Carefully clean all the components, the clutch plates should be kept dry. Inspect all wearing parts and replace as necessary. Reassemble with new seals and O-rings.

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Reassembly

23. Reverse procedures 1 to 21 carrying out the following procedures:

Internal Seal Assembly Instructions

NOTE: *The plastic sealing rings can be expanded much more easily (and recover their shape much better afterwards), if they are heated to about 80°-120°C (176°-248°F) in oil or water. Follow the following precautions:*

- *All sharp edges must be removed.*
- *Clean all components, no dust, dirt, splinters or other foreign particles.*
- *DO NOT use tools with sharp edges.*
- *Before assembly the seals and housings must be oiled*

Internal Seal Assembly Instructions

24. Insert the 'O' ring into the internal groove.
25. Warm the sealing ring.
26. Squeeze the sealing ring together ensuring that there are no kinks (see illustration).
27. Place the sealing ring in the squeezed state over the 'O' ring and press it into the groove in the direction of the arrow.
28. Press the sealing ring into the groove.
29. Carefully insert the piston to size the internal sealing ring.

External Seal Assembly Instructions

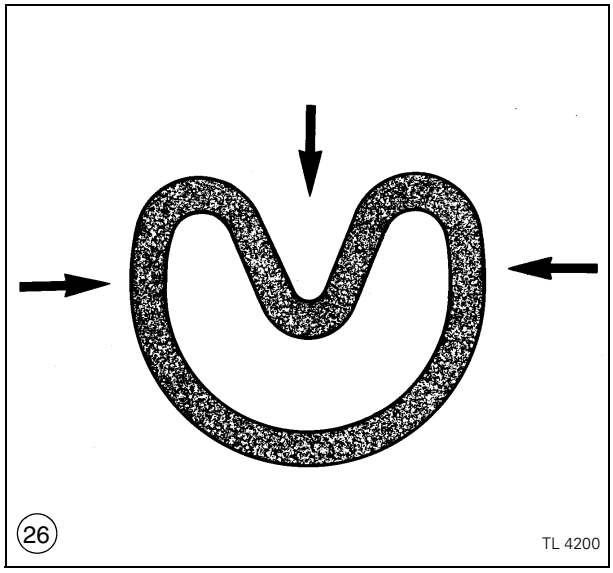
The Note above applies to external seals.

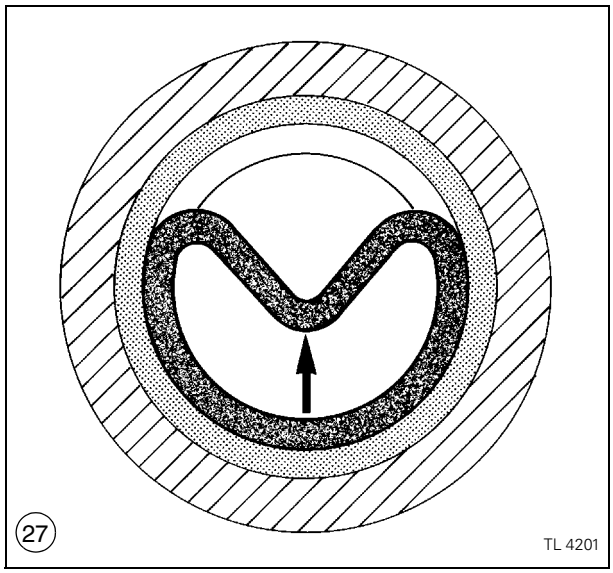
30. Remove the piston.
31. Insert the 'O' ring into the external groove.
32. Warm the sealing ring and very carefully expand it and slide it over the piston.
33. The expanded ring will snap into position in the groove but will protrude slightly outwards.
34. Press the sealing ring into the groove.

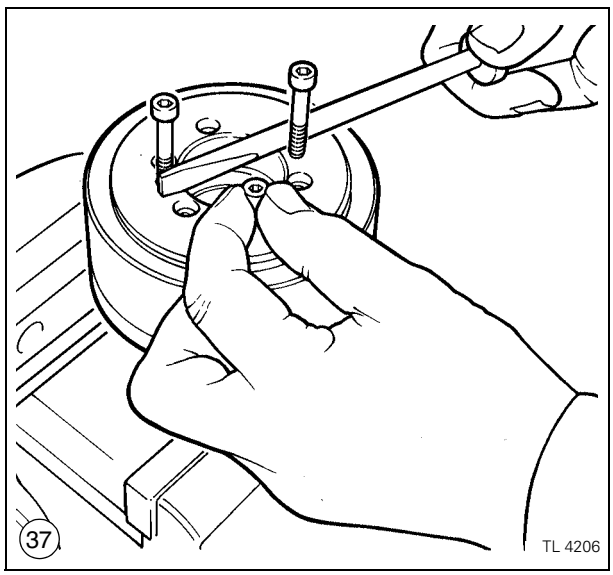
Assembling the Piston and Housing

The piston must now be installed into the housing sizing the outer sealing ring at the same time.

35. Lubricate both seals with clean transmission oil.
36. Carefully install the piston into the housing allowing the chamfer to size the ring. Check that the internal seal is satisfactory.
37. Align the capscrew holes in the piston and hub by inserting two screws in the tapped holes and turn the piston until they are in line.





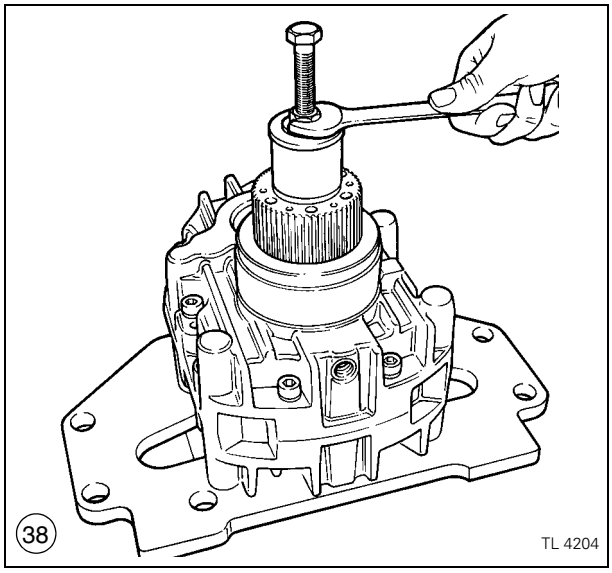


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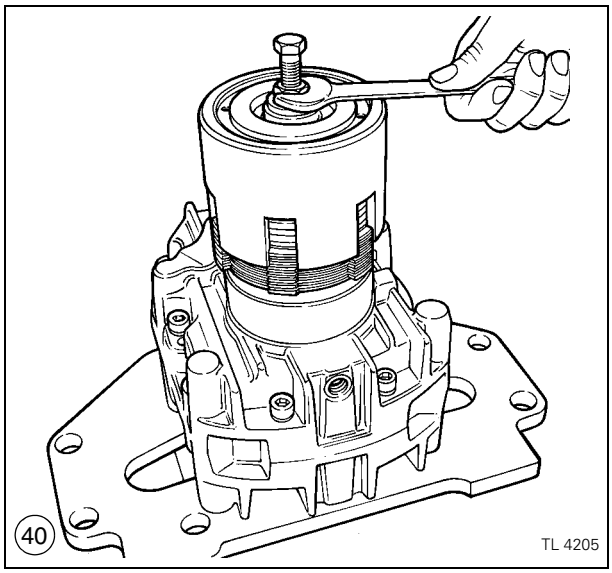
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General

38. Refit the clutch cylinder and hub assembly by making a puller with a long M12 bolt, nut, washer and tube screwed into the end of the shaft. Lubricate the thread of the bolt with engine oil. Tighten down the nut pushing the assembly into position.
39. Ensure that the two keys are down into the keyways, and re-fit the thrust washer (13).

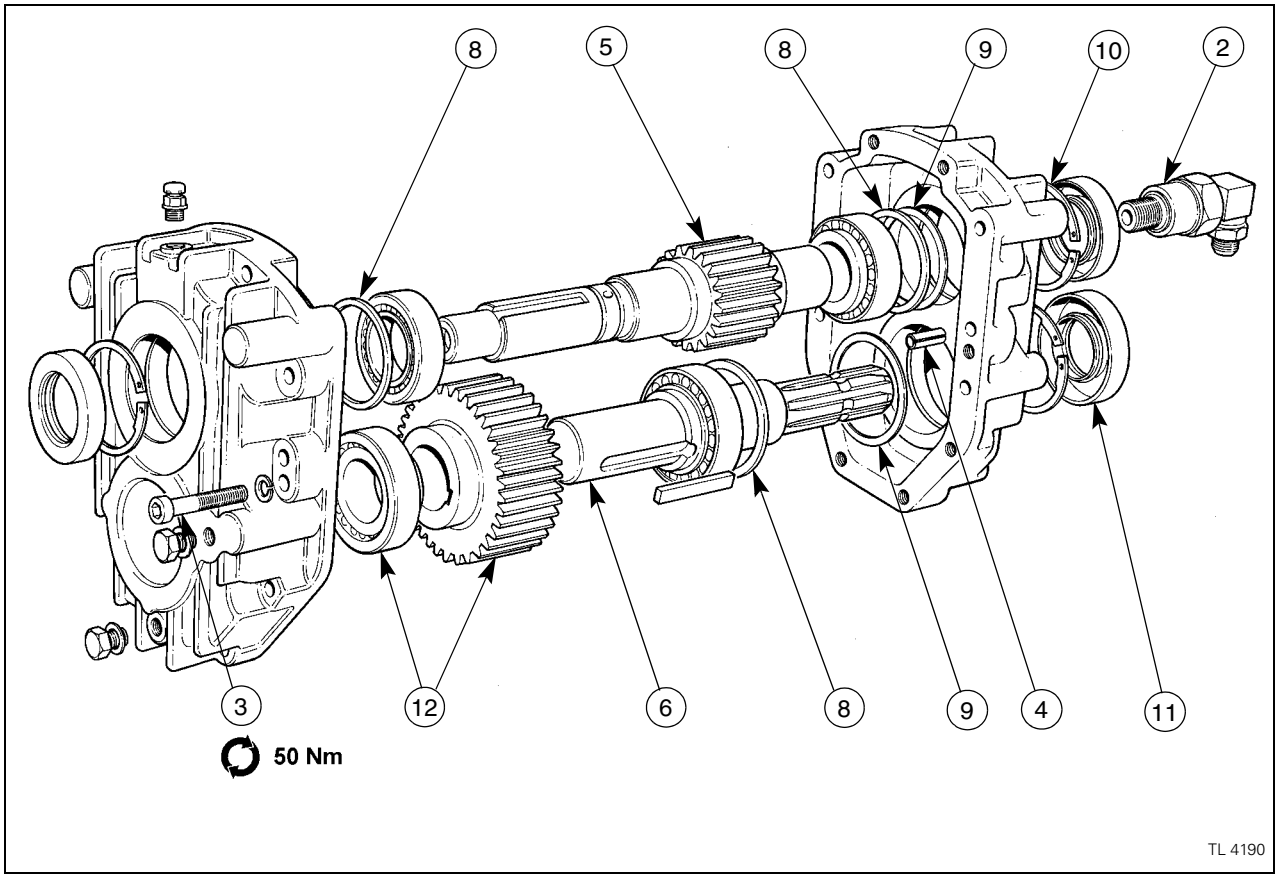


40. Refit the clutch body, again using the tool in procedure 37 without the tube. Lubricate the thread of the bolt with engine oil. Tighten down on the nut pushing body into position.
41. Assemble the clutch, the following points should be observed:
    a. Apply a small amount of grease to the shaft and keys to aid assembly.
    b. Apply Massey Ferguson Lock 'n' Seal (Loctite 222) and tighten all M5 hexagon cap screws to a torque of 7 Nm (5 lbf ft).
    c. Apply Massey Ferguson Lock 'n' Seal (Loctite 222) and tighten all M6 hexagon cap screws to a torque of 10 Nm (7 lbf ft).
    d. Apply Massey Ferguson Studlock (Loctite 270) and tighten the M12 hexagon cap screw (5) to a torque of 87 Nm (65 lbf ft).



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GEARBOX

Overhaul 3-7C

Disassembly

1. Remove the clutch, sealing rings and keys, *(see operation 2-7C)*.
2. Remove the rotating coupler.
3. Remove the ten hexagon cap screws around the casing.
4. Prise the case apart, there are two roll pins acting as dowels, one each side locating the two halves.
5. Pull the top shaft out of the casings.
6. Pull the bottom shaft out of the casings.
7. Remove the taper roller bearing cups.
8. Remove the bearing spacers.
9. Remove the shims.
10. Remove the circlips as necessary.
11. Press out the oil seals.
12. Remove the taper roller bearings and gear from the shafts, if necessary.

Examination

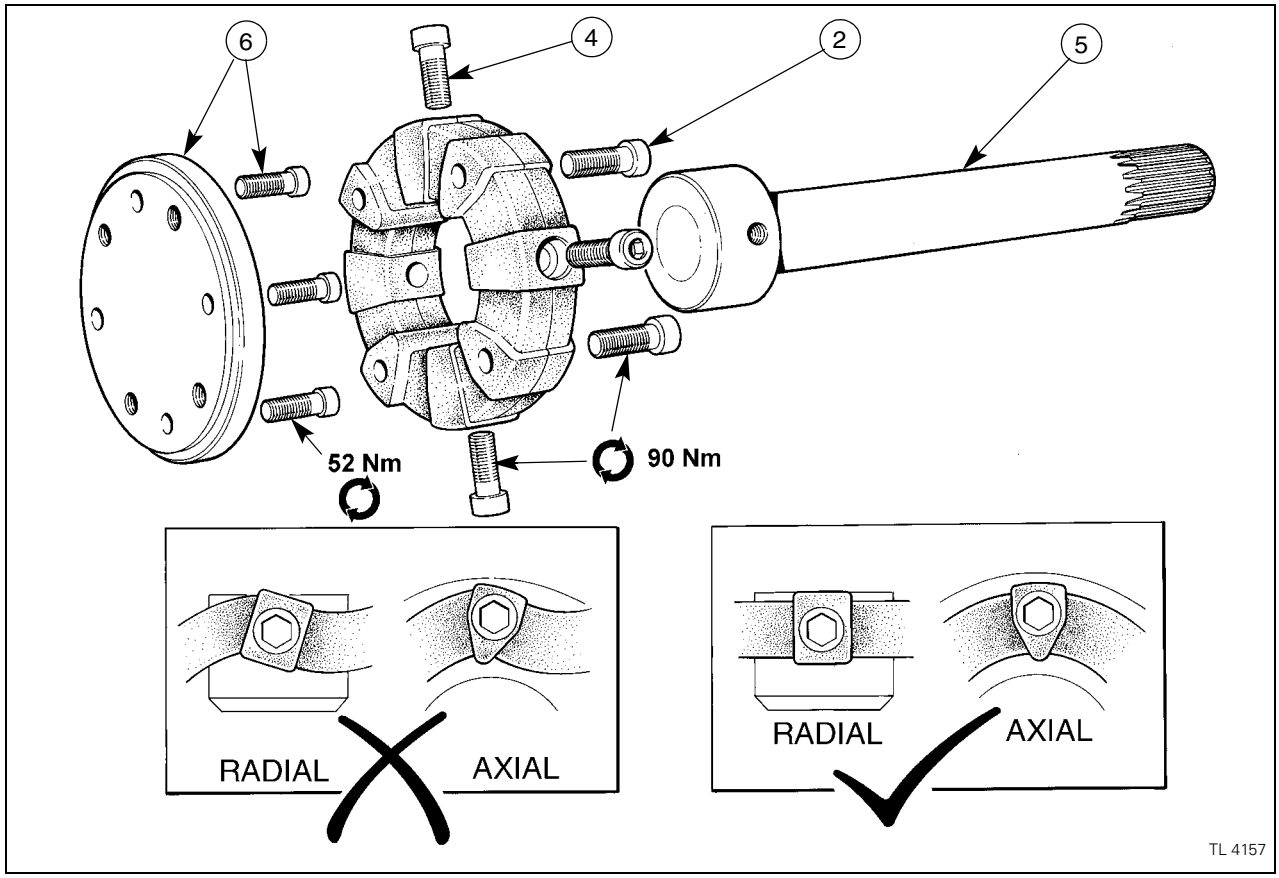
13. Clean all the components and examine for wear and damage and replace any faulty parts. Renew all oil seals.

Reassembly

14. If the bearings or shafts have been replaced it will be necessary to reset the pre-load on the taper roller bearings. This is accomplished by shims (9) between the bearing spacer (8) and the circlip on the front of the box only. The shims are available in a sets of three - part number 11 898 106.
15. Adjust the pre-load to 0,03-0,05 mm (0.001-0.002 in).
16. Reverse procedures 1 to 9 except;
    a. Apply petroleum jelly to the oil seal lips.
    b. Apply Massey Ferguson 574 Multi-Gasket (Loctite 574) to the faces of the casing.
    c. Tighten the ten hexagon cap screws to a torque of 50 Nm (35 lbf ft).
    d. Refill the gearbox with an approved oil, *(see page 1D-13)*, to the level plug.

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DRIVE SHAFT

Removal and Refitment 4-7C

Removal

1. Remove the front PTO gearbox, *(see operation 1-7C).*
2. Remove the four axial hexagon capscrews through the coupling into the engine pulley adaptor.
3. Remove the drive shaft assembly.
4. Remove the four radial hexagon cap screws.
5. Remove the drive shaft from the coupling.
6. If necessary, remove the four hexagon cap screws and the engine pulley adaptor.

Refitment

IMPORTANT: *The radial and axial cap screws connecting the rubber element to the hub and adaptor plate must all be tightened to the torque given using a torque wrench.*

Ensure that on tightening the hexagon capscrews the aluminium bushes in the rubber part are not twisted, but sit straight. Apply grease under the head of the screw and apply counter pressure on the element to prevent twisting of the rubber part during tightening of the screws. This is particularly important with the radial screws, refer to the illustration.

7. Refit the pulley adaptor, if removed, apply Massey Ferguson Stud Lock (Loctite 270) and tighten the cap screws to a torque of 52 Nm (40 lbf ft).

NOTE: *On tractors with six cylinder engines, the adaptor plate will only fit in one position on the pulley. The set of threaded holes are not all at 90°.*

8. Slide the drive shaft into the coupling, apply a small amount of grease under the head of the radial capscrews and a drop of Massey Ferguson Stud Lock (Loctite 270) to the thread. Tighten to a torque of 90 Nm (65 lbf ft). It will be necessary to use a clamp to squeeze up the blocks to insert the screws.
9. Fit the coupling to the pulley adaptor by means of the axial capscrews.
10. Apply a small amount of grease under the head of the capscrews and a drop of Massey Ferguson Stud Lock (Loctite 270) to the thread. Tighten to a torque of 90 Nm (65 lbf ft).
11. Reverse the removal process applying a small amount of grease to the spline.

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HYDRAULIC CONTROL VALVE

Removal and Refitment 5-7C

Removal

The control valve is located behind the grille under the battery support plate in the front of the tractor. The only replaceable part is the accumulator, solenoid valve and coil.

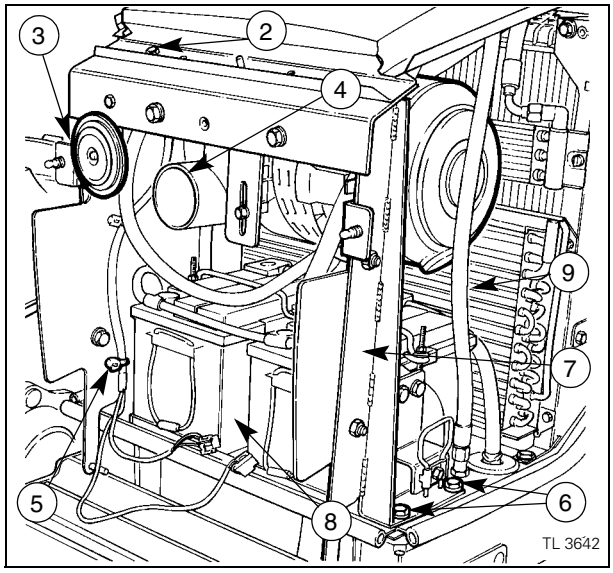
1. Remove the side panels and front grille.
2. Remove the bolts from the centre section of the hood to front support.
3. Disconnect the horn.
4. Disconnect the air cleaner hose to engine.
5. Disconnect the wiring harness from clips as required.
6. Remove the two bolts each side.
7. Lift off the front support.
8. Disconnect and remove the battery(s).
9. Disconnect the the steering hoses on both side of the tractor.
10. Mark the position of the of the two front PTO hoses for reassembly. Disconnect the hoses.
11. Disconnect the electrical supply to the solenoid valve.
12. Remove the two front radiator mounting bolts.
13. Lift up the battery support plate and disconnect the two nuts holding the steering hoses to the plate.
14. Remove the support plate from the tractor complete with the control valve.
15. The control valve can be removed by unscrewing the two retaining nuts and feeding the cable through the grommet.

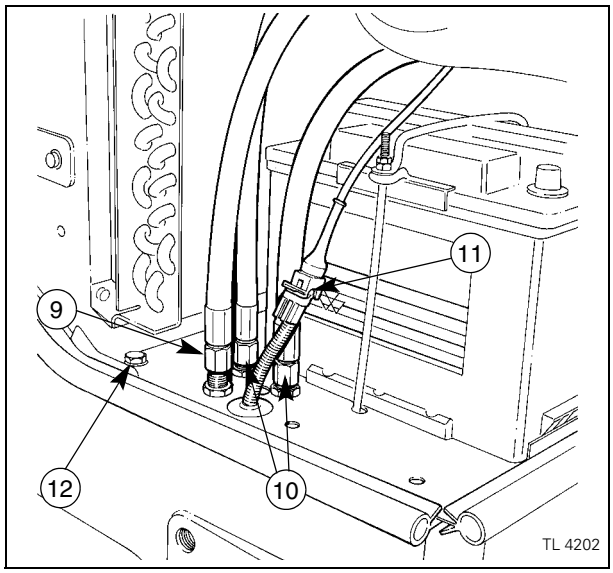
Refitment

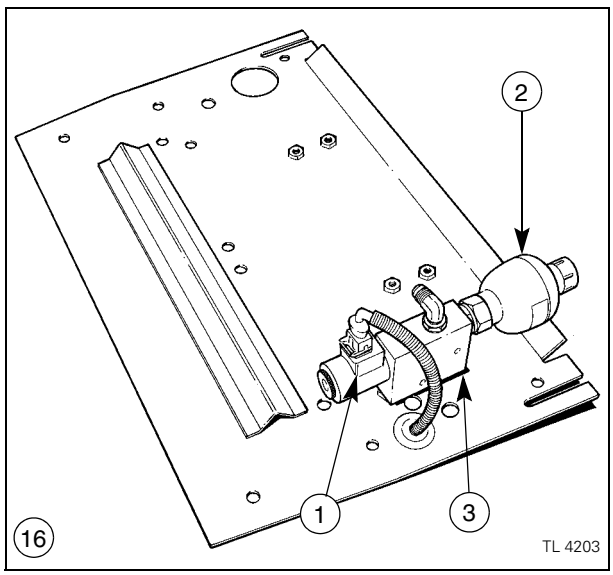
16. The components of the control valve are as follows:
    1. Solenoid valve.
    2. Accumulator.
    3. Control valve.
17. Reverse procedures 1 to 15 except:

a. Tighten the solenoid valve body to a torque of 10 Nm (7lbf ft).

b. When installing the coil, apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the nut to prevent it vibrating loose and tighten only finger tight.







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SECTION 8

Front Axle

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8B	TWO-WHEEL DRIVE FRONT AXLE – 2
8C	FOUR-WHEEL DRIVE FRONT AXLE
8D	FOUR-WHEEL DRIVE FRONT PORTAL AXLE

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Two-wheel Drive Front Axle – 1 (Normal-duty)

Section 8 - Part A

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––––	General Description	8A– 2
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Two-wheel Drive Front Axle – 1

SPECIFICATION

Model application	4215, 4220, 4225 and 4235.
Maximum static load	2600 kgf (5732 lbf).
Track settings	1245-1855 mm (49-73 in).
Track setting increments	101 mm (4 in).
Wheel camber angle	5°.
Wheel caster angle'	4° 56'.
Spindle angle	9° 30'.
Front wheel toe-in	0-5 mm (0-3/16 in) at wheel rim.
Axle beam to support casting clearance	0,05-0,25 mm (0.002-0.010 in).
Steering arm to spindle housing clearance	0-0,05 mm (0-0.002 in).

Special Tools

MF.263A	Bearing remover - main tool.
MF.263-2	Bush remover and replacer (1.1/2 in diameter).
MF.264	Bush reamer and pilot - main tool.
MF.264-1	Bush reamer and pilot (1.1/2 in diameter).
MF.264-2	Bush reamer and pilot (1.7/8 in diameter).
MF.444	Pivot pin remover.
MS.550	Universal handle.

Bolt Torques

Track rod ball joint to steering arm	90 Nm (65 lbf ft) maximum torque to split pin 100 Nm.
Steering ram to steering arm	85 Nm (125 lbf ft).
Wheel hub nut	80 Nm (60 lbf ft).
Wheel bolts	110 Nm (80 lbf ft).
Steering arm to spindle bolt	145 Nm (105 lbf ft).
Track rod clamp bolts	50 Nm (40 lbf ft).
Spindle housing to axle beam bolts	205 Nm (150 lbf ft).

GENERAL DESCRIPTION

The normal-duty front axle is fitted to all tractors with three cylinder engines - 4215 and 4220. It can also be fitted to the 4225 and 4235 with four cylinder engines.

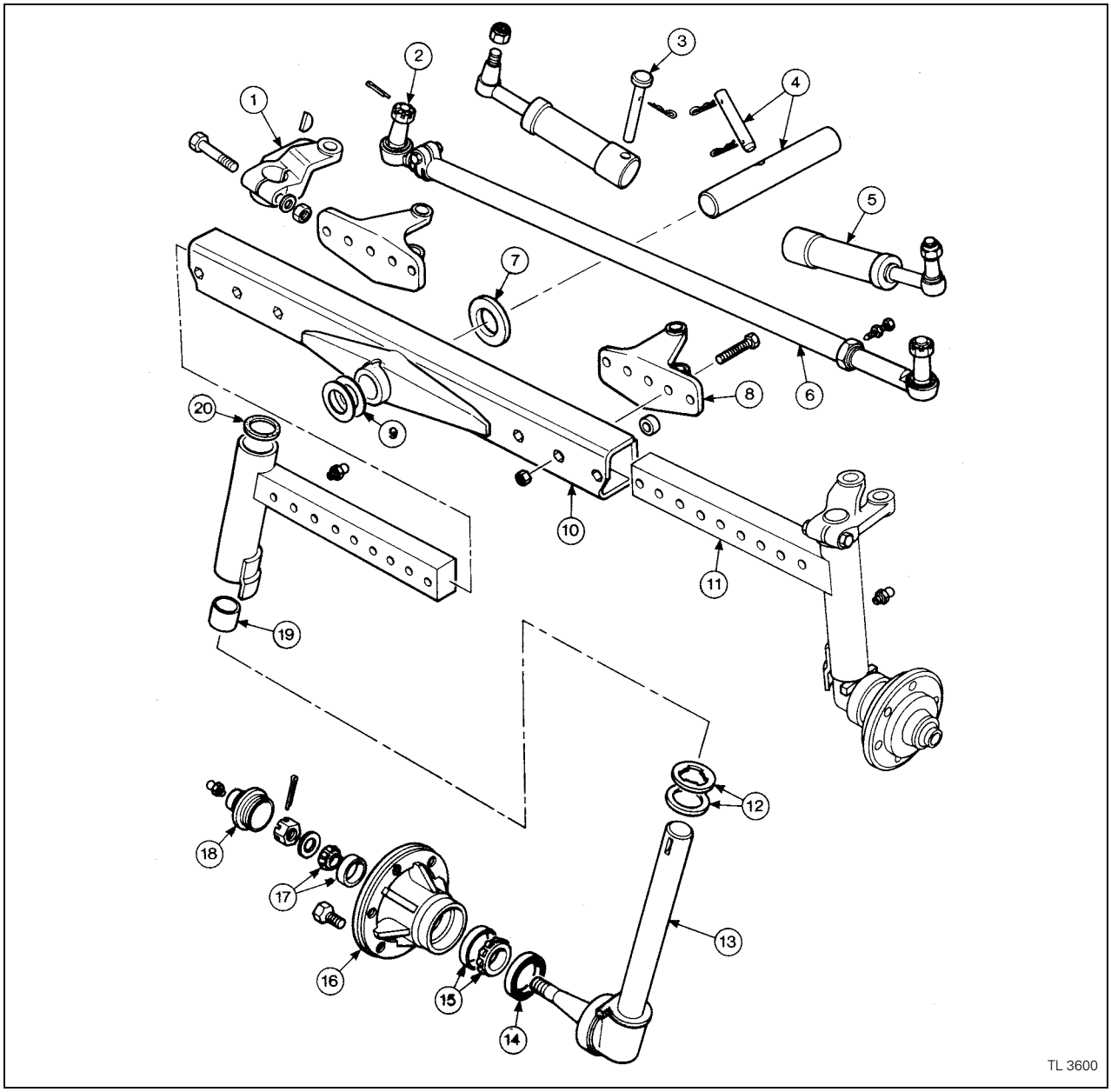
The axle assembly consists of an axle beam and two adjustable spindle housings, these can be bolted to the beam various positions to give a variable track of 1227 mm (48 in) to 1837 (72 in) in 101 (4 in) increments. The track rod is also adjustable to correspond with the axle beam.

The axle beam pivots on a pin which is locked to the beam and pivots in bushes in the support casting, grease lubrication is provided. The wheels are turned by two steering cylinders mounted on each end of the axle beam, they are positioned in accordance with the track setting.

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Two-wheel Drive Front Axle – 1



Normal-duty Front Axle Assembly

1. Steering arm.
2. Track rod ball joint.
3. Steering cylinder pivot pin.
4. Axle pivot pin.
5. Steering cylinder.
6. Track rod.
7. Thrust washer.
8. Steering cylinder bracket.
9. Locking pin and 'R' clips.
10. Axle beam.
11. Spindle housing.
12. Dirt seal.
13. Spindle.
14. Oil seal shield
15. Outer taper roller bearing.
16. Wheel hub.
17. Inner taper roller bearing.
18. Hub cap.
19. Spindle bush.
20. Felt seal.

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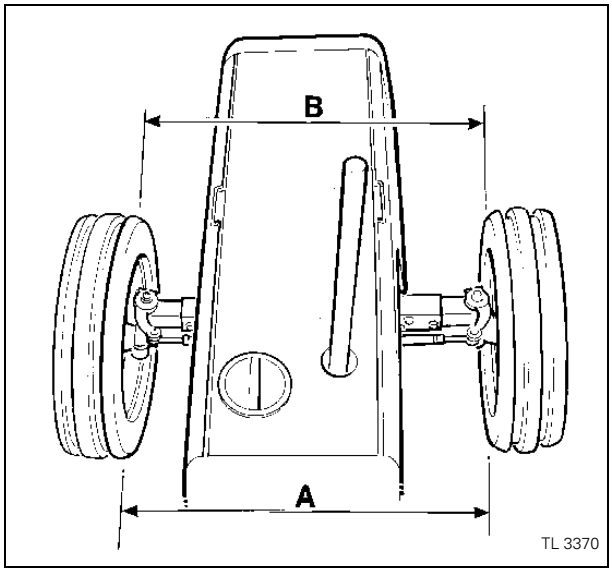
Two-wheel Drive Front Axle – 1

FRONT WHEEL ALIGNMENT

Adjust **1-8A**

Procedure

1. Place the tractor on firm level ground and put the front wheels in the straight ahead position.
2. To check the toe-in, see illustration. Distance 'A' must be 0-5 mm (0-3/16 in) greater than distance 'B' measured on the centre line of the axle at the wheel rim.
3. If adjustment is necessary proceed as follows:
4. Loosen the track rod clamp bolt.
5. Slacken the track rod setting bolt.
6. Screw out the track rod tube to increase toe-in, screw in to decrease the toe-in.
7. Locate the track rod setting bolt in its correct hole in the rod and tighten to a torque of 50 Nm (40 lbf ft).
8. Retighten the clamp nut and bolt to a torque of 50 Nm (40 lbf ft).

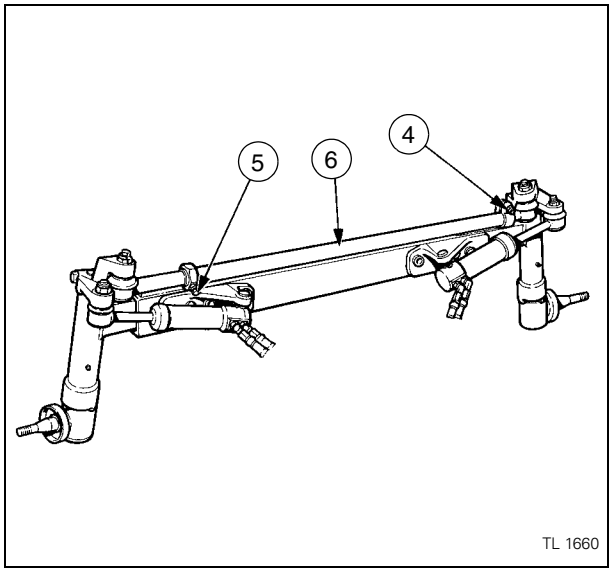


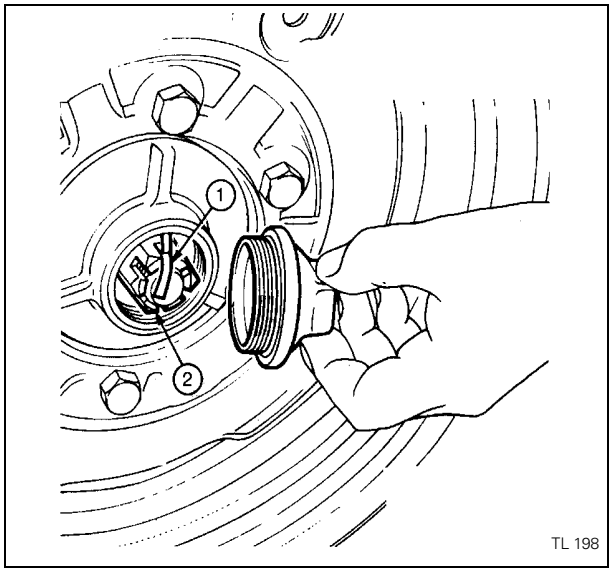
FRONT WHEEL HUB

Adjust **2-8A**

Procedure

9. Place the tractor on hard level ground.
10. Raise the front wheels off the ground and check the wheel bearing for wear. If movement is found, adjust the bearing pre-load as follows:
11. Unscrew the hub cap.
12. Remove and discard the split pin.
13. Tighten the slotted nut to a torque of 80 Nm (60 lbf ft) then slacken off the nut to the nearest split pin hole to give the correct end float.
14. Fit a new split pin.
15. Refit the hub cap.
16. Grease the hub until clean grease appears from the seal at the back of the hub.





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FRONT HUB

Overhaul 3-8A

Dis-assembly

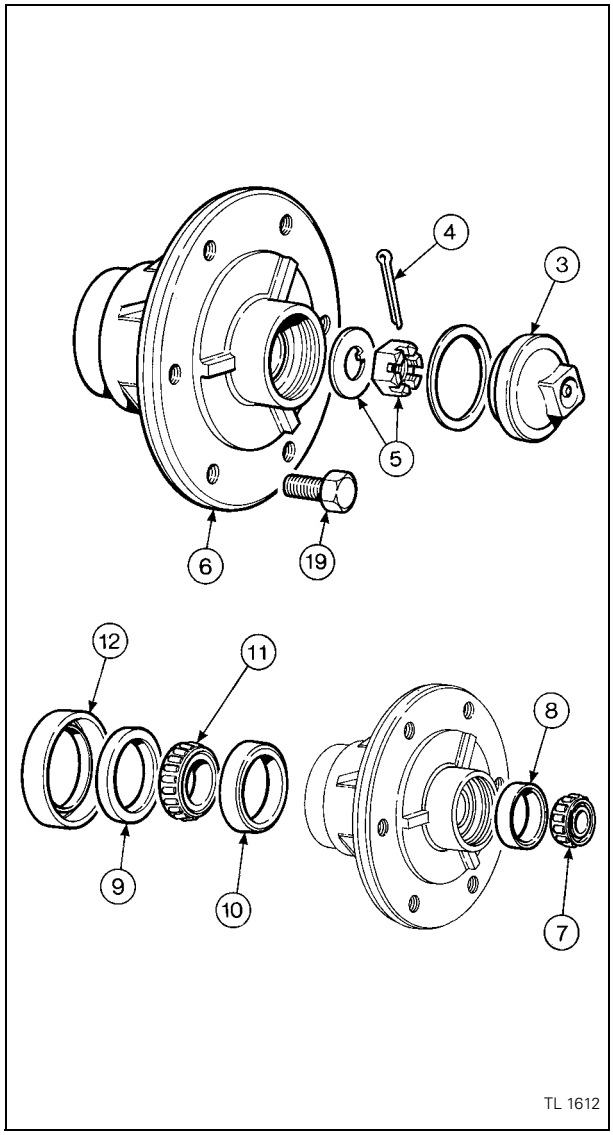
1. Raise the front of the tractor.
2. Remove the wheel.
3. Remove the hub cap.
4. Remove and discard the split pin.
5. Remove the slotted nut and washer.
6. Remove the hub assembly complete with bearing and seal from the spindle housing assembly.
7. Remove the outer bearing cone.
8. Tap out the outer bearing cup.
9. Remove the seal.
10. Drive out the inner bearing cup.
11. Remove the bearing cone.
12. Remove the dust shield.

Examination

13. Completely clean the hub components using paraffin and check the condition of the hub, spindle and bearings. Any worn or damaged components should be replaced. Always fit a new seal with the lip facing outward and fit the seal right into the recess of the hub.

Re-assembly

14. Reverse procedures 1 to 12.
15. Pack the bearings with an approved grease during assembly.
16. Tighten the slotted nut to 80 Nm (60 lbf ft) then slacken off the nut to the nearest split pin hole to give the correct end float.
17. Refit the hub cap.
18. Grease the hub until grease appears from the seal at the back of the hub.
19. Tighten the wheel bolts to a torque of 110 Nm (80 lbf ft).



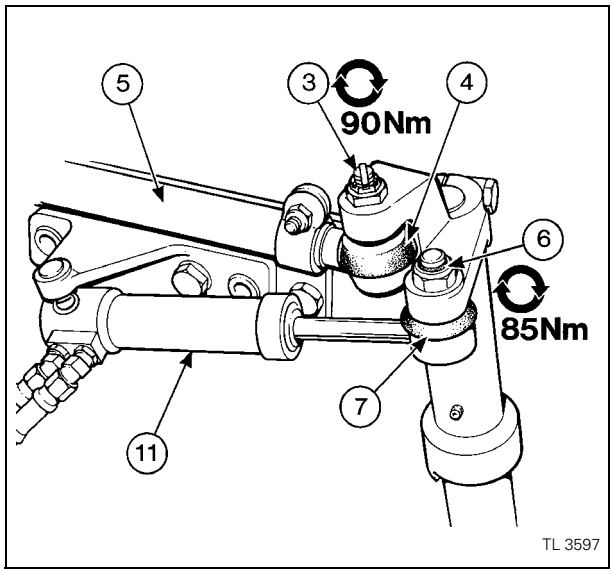
SPINDLE SHAFT AND HOUSING

Removal and Refitment 4-8A

Removal

Removal of Housing Assembly

1. Jack-up the axle on the side to be worked and remove the wheel.
2. Remove the front hub, *(see operation 3-8A)*.
3. Remove the nut and split pin.



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4. Disconnect the ball joint.
5. Move the track rod to one side.
6. Remove the steering cylinder nut.
7. Disconnect the steering cylinder.
8. Remove the steering arm nut and bolt.
9. Lift the steering arm off the spindle.
10. Remove the bolts securing the spindle housing to the axle beam.
11. Move the steering cylinder and bracket to one side and support.

    or:

    Disconnect the steering hoses and remove the cylinder assembly.
12. Withdraw the spindle housing assembly.

Dismantling Housing Assembly

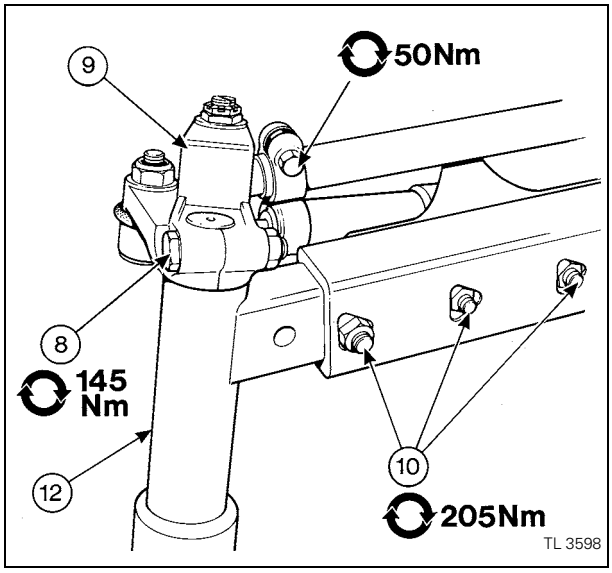
13. Remove the woodruff key.
14. Remove the dust seal.
15. Remove the spindle shaft from the housing.
16. Remove the spacer and thrust washer from the spindle.

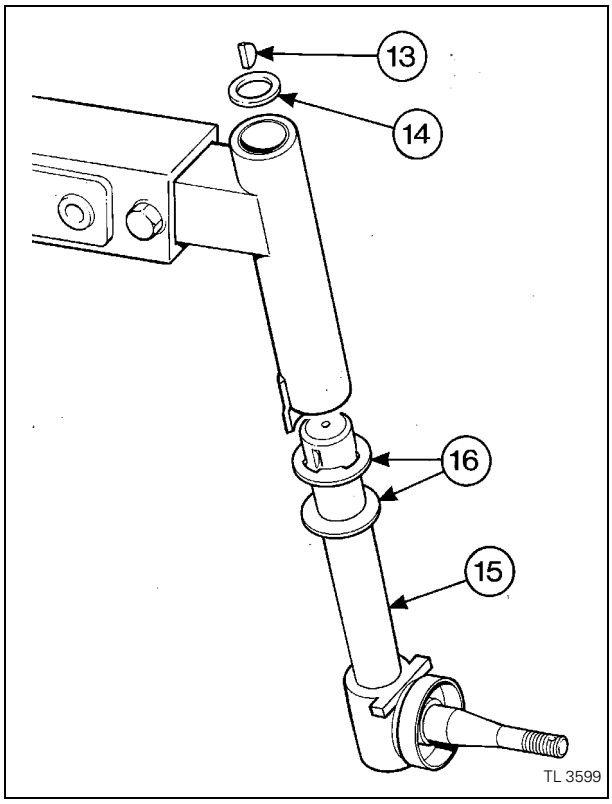
Examination

Examine the spindle, thrust bearings for damage or wear and replace if necessary. Thoroughly clean all components and remove all traces of old grease.

Refitment

17. Liberally lubricate the thrust washer and spacer with an approved grease before assembly.
18. Fit the spacer.
19. Fit the thrust washer to the spindle with the indentations in the bronze face facing downwards.
20. Refit the spindle to the housing.
21. Renew the felt seal.
22. Refit the steering arm.
23. With the hub and spindle assembly held firmly in place against the thrust bearing, measure the gap between the steering arm and the spindle housing using feeler gauges. The gap must not exceed 0,05 mm (0.002 in).
24. When the correct setting has been obtained tighten the steering arm nut to a torque of 145 Nm (105 lbf ft).
25. Thoroughly grease the spindle before the wheel is fitted and lowered to the ground. Ensure that the grease comes out of the lower bearing.
26. Refit the spindle housing to the axle beam selecting the required track setting and locate the steering cylinder.





27. Tighten the spindle housing to axle beam bolts to a torque of 205 Nm (150 lbf ft).
28. Refit and tighten the track rod ball joint to a torque of 90 Nm (65 lbf ft) do not exceed 100 Nm (75 lbf ft) to align the split pin.
29. Refit the steering cylinder and tighten the nut to a torque of 85 Nm (125 lbf ft).
30. Tighten the track rod setscrews to a torque of 50 Nm (40 lbf ft).

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SPINDLE HOUSING

Overhaul **5-8A**

Special Tools:
MF.263A Bush Remover - Main Tool
MF.263-2 Bush Remover and Replacer
MF.264 Bush Reamer and Pilot - Main Tool
MF.264-1 Bush Reamer and Pilot
MS.550 Universal Handle

Dis-assembly

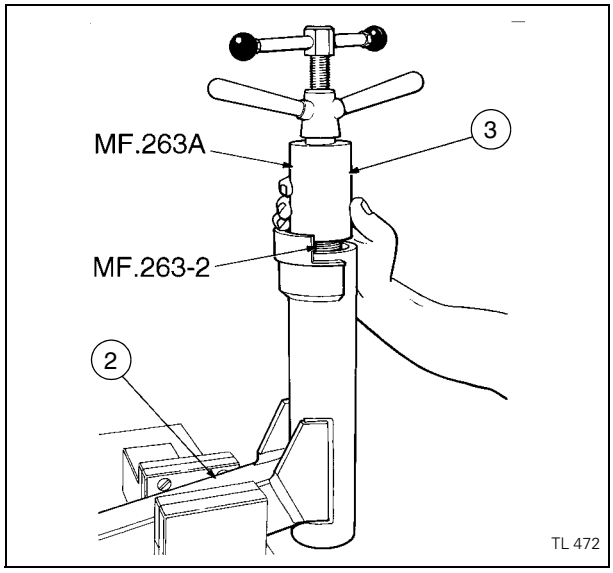
1. Remove the spindle housing and spindle, *(see operation 4-8A)*.
2. Secure the housing in a vice.
3. Using special tool MF.263A Bush Remover - Main Tool and MF.263-2 Bush Remover. Remove the bush by screwing the threaded extractor into the bush with the upper handle. Withdraw the bush by turning the lower handle.
4. Invert the housing and remove the lower bush.

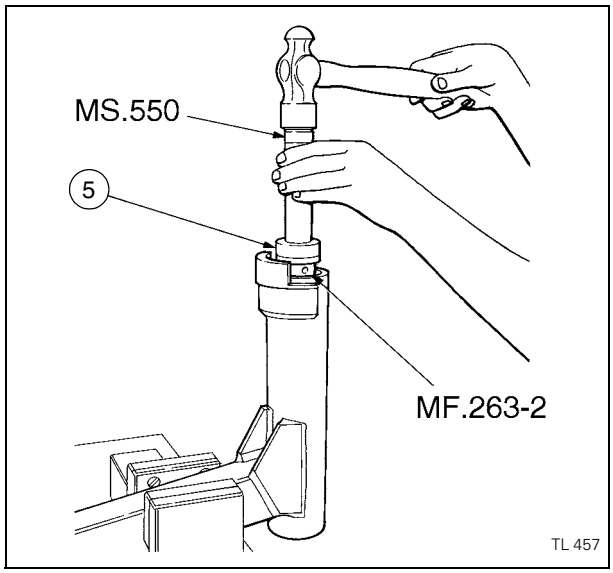
Examination

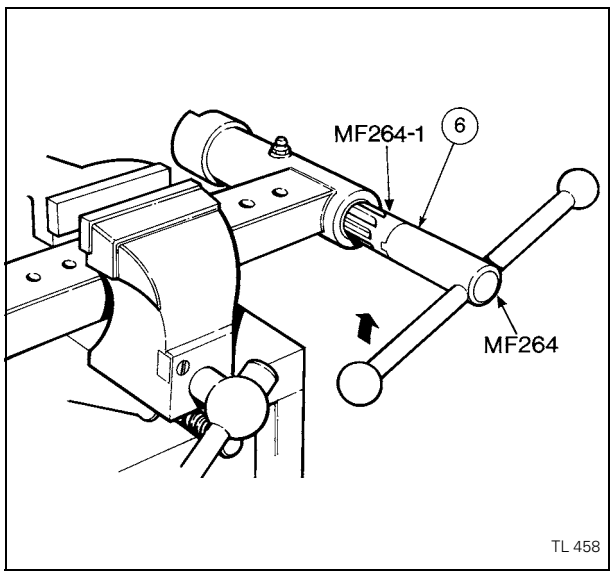
Clean all components and replace the spindle and bushes if there are signs of wear.

Re-assembly

5. Using special tools MS.550 Universal Handle and MF.263-2 Bush Replacer, drive a new bush into each side of the housing.
6. Using special tools MF.264 Reamer Handle - Main Tool and MF.264-1 Reamer and Pilot. With the reamer and handle assembled, pass the guide bar through the housing. Fit the reamer pilot onto the guide bar and into the housing. This will ensure that the bush is reamed parallel.
7. Ream the upper bush to size.
8. Turn the equipment over and ream the lower bush to size.
9. Remove all swarf from the housing and ensure the grease nipple hole is clear of dirt.
10. Thoroughly grease parts before and after assembly.
11. Refit the spindle shaft, *(see operation 4-8A)*.







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AXLE BEAM ASSEMBLY

Removal and Refitment **6-8A**

Special Tools:
MF.264 Bush Reamer and Pilot - Main Tool
MF.264-2 Bush Reamer and Pilot
MF.444 Pivot Pin Remover

Removal

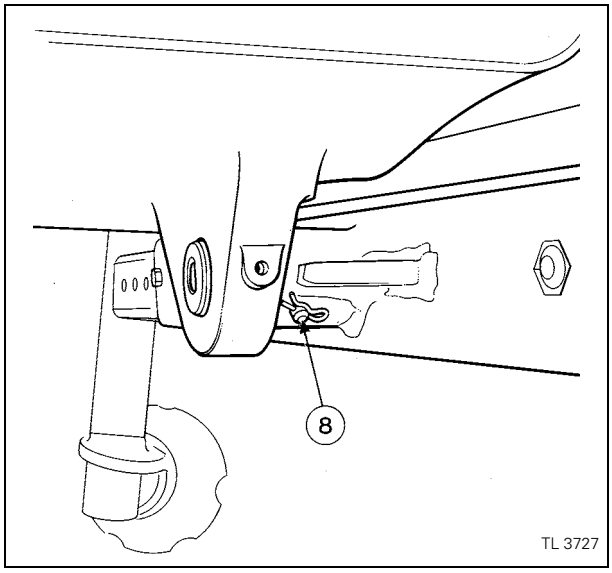
1. Block both rear wheels of the tractor and apply the parking brake.
2. Place a trolley jack under the engine sump and take the weight off the front of the tractor. DO NOT lift the front wheels off the ground.
3. Remove the front tractor weights, if fitted, and remove the front weight frame.
4. Disconnect the steering cylinder hoses at the cylinder end. Cap the ends of the pipes to prevent the ingress of dirt.
5. Remove the front wheels.

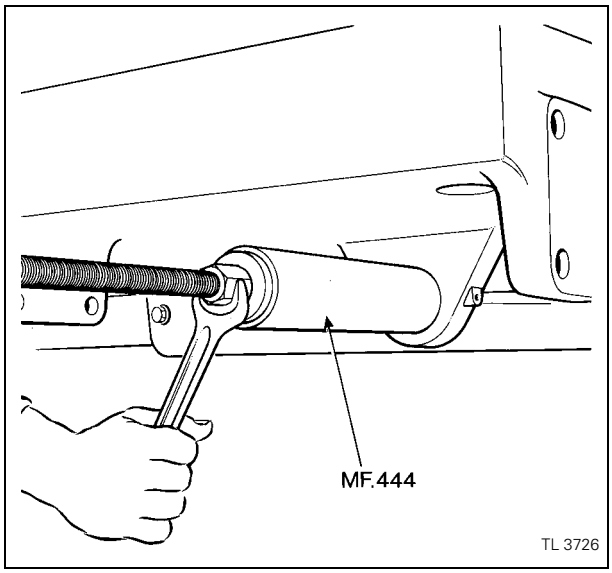
WARNING: Prevent the axle from tilting forwards or backwards, or rotating about the wheels if the axle is wheeled from under the tractor on its wheels. It could fall over and cause injury if precautions are not taken.

6. Place the axle in slings from an overhead crane.
7. Remove the plug from the end of the pivot shaft.
8. Remove one of the 'R' clips from the locking pin on the axle beam and pull it out of the axle.
9. Install special tool MF.444 Pivot Pin Remover, using the 7/16 inch UNC adaptor to extract the pivot pin from the axle and housing.
10. Lower the axle, remove it from the tractor and place it on two axle stands.
11. Remove shim washers and thrust washer between the axle and support casting.
12. Using a suitable drift remove the two bushes in the support casting.

Examination

Check the end face of the axle beam boss, the pivot pin and thrust washer for wear. Examine all surfaces for wear or damage. In the event of accident damage, check the beam for bending or twisting. If the beam has been deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the beam may have been dangerously weakened due to straining of the welded seams.





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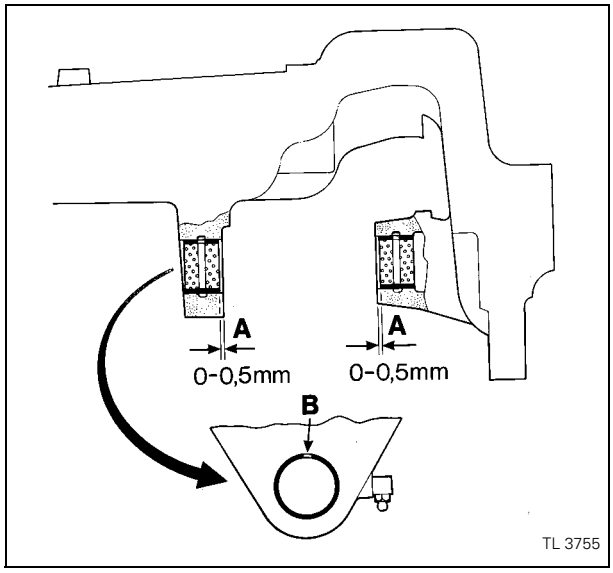
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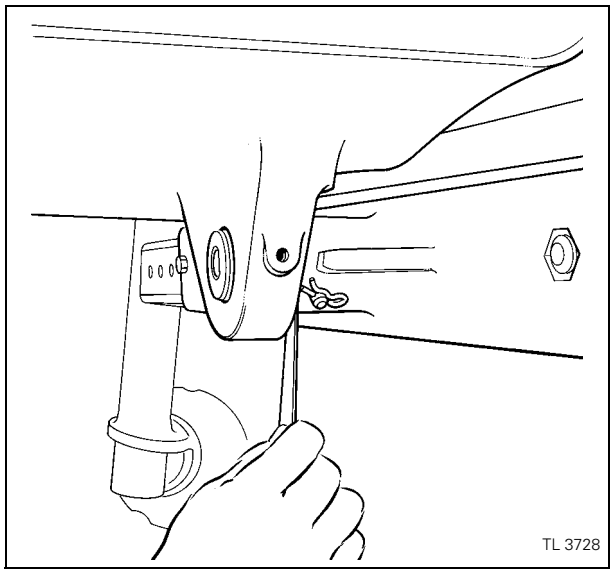
Refitment

13. Install two new bushes in the support casting.
14. The bushes must be 0-0,5 mm (0-0.020 in) below the faces in the support casting adjacent to the axle beam 'A'.
15. When fitting the bush, the grease hole in the bush must be positioned at 12 o'clock 'B'.
16. The pivot pin should be free to rotate in the bushes; if tight, use special tool MF.264 Bush Reamer and Pilot - Main Tool, and MF. 264-2 Bush Reamer, and pass through the two bushes to clean out to size.
17. With the aid of an overhead crane sling the axle so that it is horizontal in both directions.
18. Lift the axle up into place, DO NOT use your fingers to locate the axle.
19. Reinstall the shim washer(s) to the front of the axle; Install the shims removed, the thrust washer to the rear of the axle.
20. Refit the pivot pin.
21. Check the clearance between the axle beam and the support casting, it should not exceed 0,05-0,25 mm (0.002-0.010 in). If adjustment is required, select suitable shims from the following chart:

Part number	Shim thickness	
	mm	Inch
898 018 M1	0,74	0.029
898 019 M1	0,89	0.035
3759 455 M1	0,53	0.021

22. Refit the pivot pin aligning the locking pin holes.
23. Refit the locking pin and 'R' clip.
24. Reinstall the plug in the end of the pivot shaft.
25. Grease the axle pivot until clean grease appears at both the front and back of the axle beam.





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STEERING CYLINDER

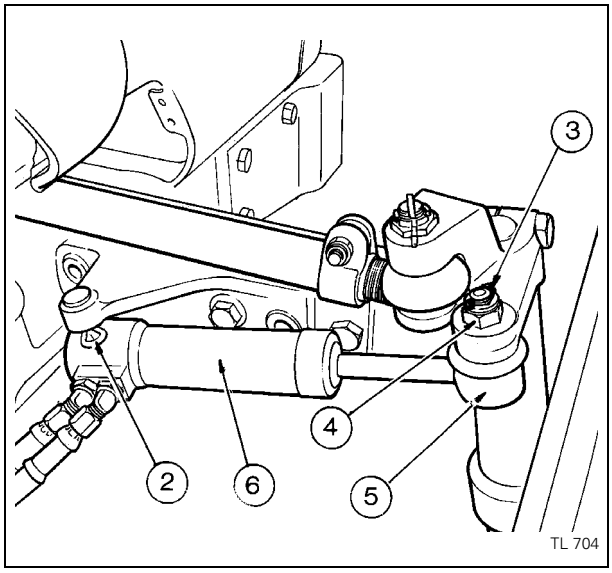
Removal and Refitment **7-8A**

Removal

1. Disconnect both hydraulic pipes to the steering cylinder. Cap the ends of the pipes to prevent the ingress of dirt.
2. Remove the 'R' clip from the inner pivot pin.
3. Remove the split pin.
4. Remove the slotted nut.
5. Drive the ball joint taper out of the steering arm.
6. Remove the steering cylinder.

Refitment

7. Reverse procedures 1 to 6 except:
   a. Tighten the ball joint nut to a torque of 85 Nm (125 lbf ft).

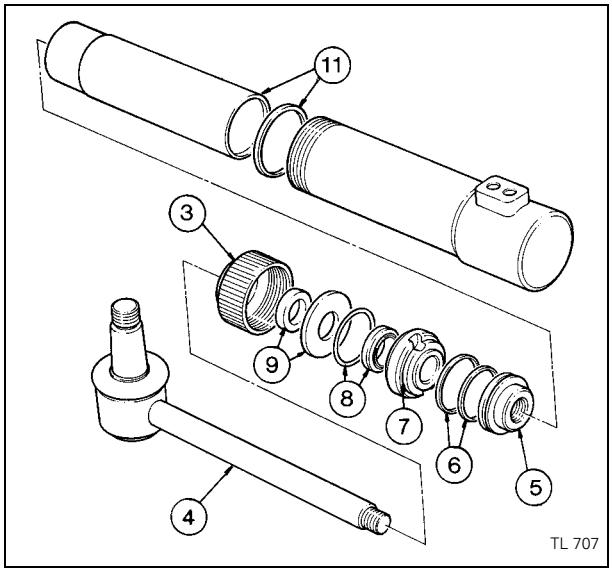


STEERING CYLINDER

Overhaul **8-8A**

Dis-assembly

1. Remove the steering cylinder, *(see operation 7-8A)*.
2. Place the steering cylinder in a vice.
3. Unscrew the end cap.
4. Withdraw the piston assembly from the cylinder.
5. Unscrew the piston from the rod.
6. Remove the sealing ring and 'O' ring from the piston.
7. Remove the end housing from the rod.
8. Remove the pressure seal and 'O' ring.
9. Remove the washer and dust seal.
10. Remove the end cap (3).
11. Remove the cylinder and sealing ring from the ram tube.



Examination

Clean and inspect all parts. Replace all seals and 'O' rings. Lubricate all parts with transmission oil.

Re-assembly

12. Reverse procedure 1 to 11 except:
    a. Apply Massey Ferguson Studlock (Loctite 270) to the thread on the end of the piston rod.
    b. Tighten the piston on the end of the piston rod and centre punch the thread to prevent it unscrewing.

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Two-wheel Drive Front Axle – 2 (Heavy-/Extra Heavy-duty)

Section 8 - Part B

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Two-wheel Drive Front Axle – 2

SPECIFICATION

Model application:	
Heavy-duty	4225 to 4270.
Extra heavy-duty	4243 to 4270.
Maximum static load:	
Heavy-duty	3460 kgf (7628 lbf).
Extra heavy-duty	4360 kgf (9612 lbf).
Track settings	1315 mm (52 in) to 1820 mm (72 in).
Wheel camber angle	2.1/2°.
Wheel caster angle	0°.
Spindle angle	12°.
Front wheel toe-in	0-5 mm (0-3/16 in) at wheel rim.
Axle beam to support casting clearance	0,10-0,25 mm (0.004-0.010 in).
Steering arm to spindle housing clearance	0-0,05 mm (0-002 in).
Steering cylinder pivot to axle beam clearance	0,05-0,25 mm (0.002-0.010 in).

Special Tools:

MF.195C	Bearing puller - main tool.
MF.263A	Bush remover - main tool.
MF.263-5	Bush remover and replacer (1.3/4 in diameter).
MF.264	Bush reamer and pilot - main tool.
MF.264-8	Bush reamer and pilot (1.3/4 in diameter).
MF.500	Front axle bearing replacer.
MF.504	Steering pivot nut wrench.
MF.505	Steering cylinder wrench.
MF.509	Steering ball joint wrench.
MS.550	Universal handle.

Bolt Torques:

Track rod ball joint	100 Nm (75 lbf ft) maximum torque to split pin 120 Nm.
Track rod to ball joint clamp	45 Nm (35 lbf ft).
Track rod to steering cylinder clamp	140 Nm (105 lbf ft).
Steering arm clamp	408 Nm (300 lbf ft).
Steering cylinder ball joint nut	110 Nm (80 lbf ft) maximum torque to split pin 120 Nm.
Steering cylinder ball joint to cylinder	210 Nm (155 lbf ft).
Spindle housing to axle beam	395 Nm (290 lbf ft).
Wheel hub nut	80 Nm (60 lbf ft).
Wheel nuts	95 Nm (140 lbf ft).
Front axle trunnion bearing bolts	560 Nm (415 lbf ft).
Pivot lock nut to stop nut	200 Nm (148 lbf ft).

GENERAL DESCRIPTION

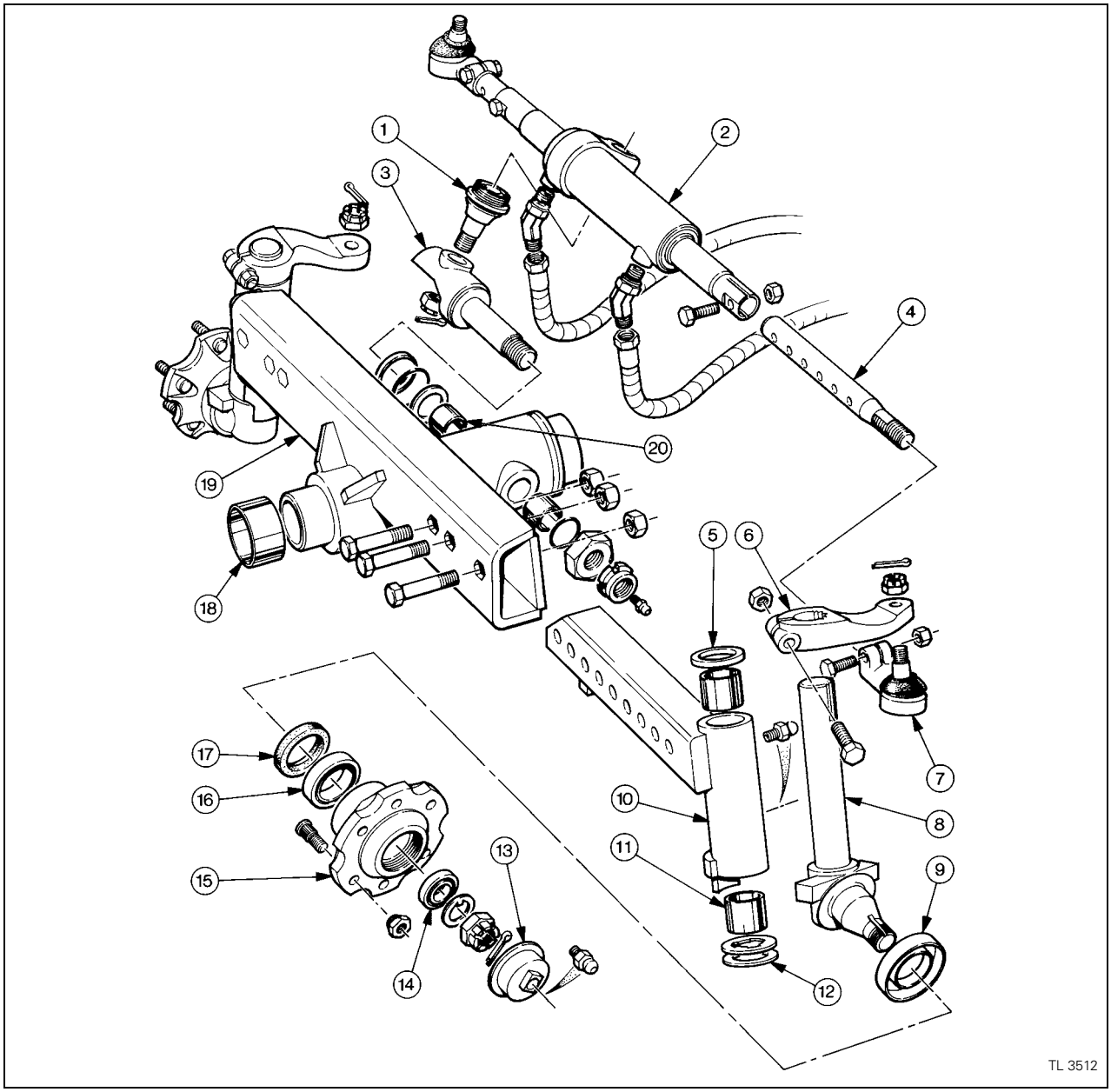
The front axle assembly consists of an axle beam and two spindle housing assemblies. The axle beam pivots on two bushes in the support casting and a front trunnion bearing block. The spindle housing assemblies can be bolted in alternative positions to provide front track adjustment.

The steering system is operated by an orbitrol hydrostatic steering unit controlling a double ended steering cylinder. The steering cylinder is centrally mounted behind the axle beam and is directly connected to each steering arm by a short adjustable track rod. The cylinder is mounted on a pivot pin and ball joint to allow alignment during turning. The short adjustable track rod is to allow adjustment of the front track

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Two-wheel Drive Front Axle – 2



Heavy-/Extra heavy duty Front Axle Assembly

1. Steering cylinder ball joint.
2. Steering cylinder.
3. Steering cylinder pivot.
4. Adjustable track rod.
5. Dirt seal.
6. Steering arm.
7. Track rod ball joint.
8. Spindle.
9. Oil seal shield.
10. Spindle housing.
11. Spindle bush.
12. Thrust washers.
13. Hub cap.
14. Outer taper roller bearing.
15. Wheel hub.
16. Inner taper roller bearing.
17. Oil seal.
18. Axle beam pivot bush.
19. Axle beam.
20. Steering cylinder pivot bushes.

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Two-wheel Drive Front Axle – 2

FRONT WHEEL ALIGNMENT

Adjust **1-8B**

Procedure

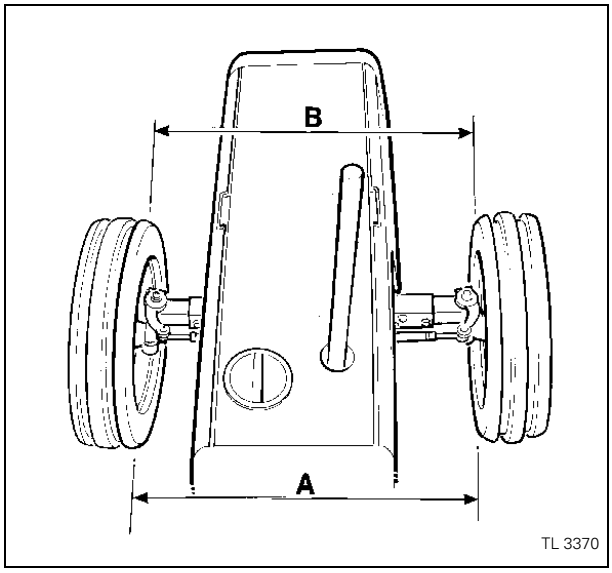
1. Place the tractor on firm level ground and put the front wheels in the straight ahead position.
2. To check the toe-in, see illustration. Distance 'A' must be 0-5 mm (0-3/16 in) greater than distance 'B' measured on the centre line of the axle at the wheel rim.
3. If adjustment is necessary proceed as follows:

NOTE: *Small adjustments can be carried out on one side only. Major adjustment after an extensive repair must be made on both sides to ensure that there is an equal amount of thread in each ball joint.*

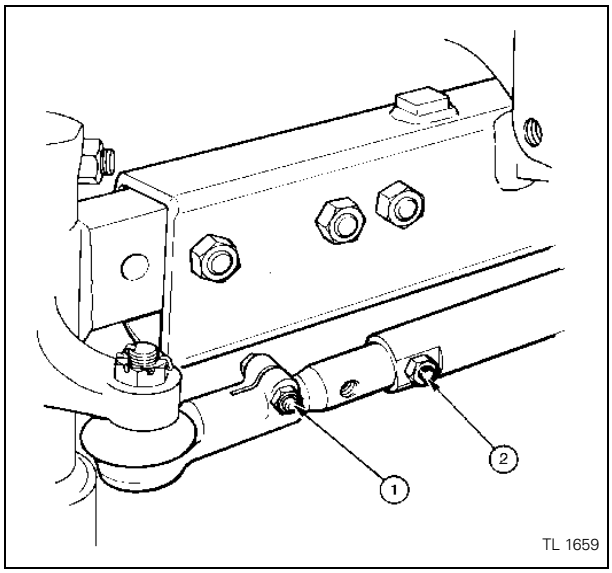
4. Slacken the ball joint clamp bolt (1) on each end of the track rods.
5. Remove the pinch bolt (2) from each end of the steering cylinder.
6. Rotate the track rod (3) by only half a turn at a time. It is important to keep the amount of thread in both ball joints equal. Screwing out the track rod will increase the tow-in, screwing in will decrease the toe-in.
7. Refit the pinch bolts and nuts (2) and tighten to a torque of 140 Nm (105 lbf ft).

IMPORTANT: *Pinch bolt (2) must be set in the horizontal position as shown in the illustration.*

8. Set pinch bolt (2) in the horizontal position and check the toe-in; if acceptable, tighten the two ball joint clamp bolts (1) to a torque of 45 Nm (35 lbf ft).



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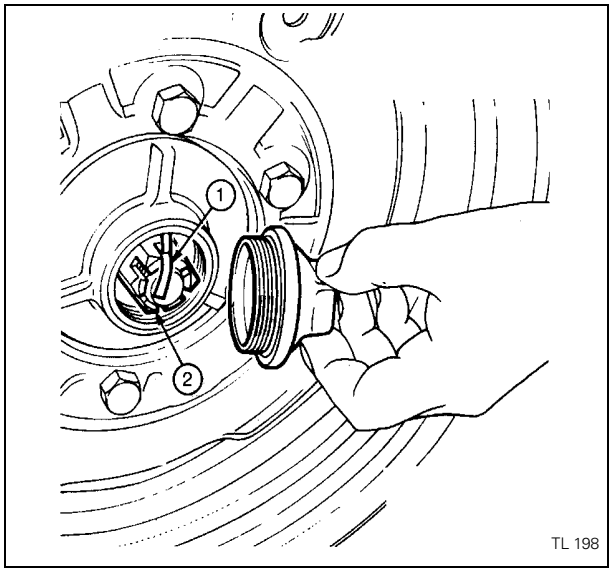
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FRONT WHEEL HUB

Adjust **2-8B**

Procedure

1. Place the tractor on hard level ground.
2. Raise the front wheels off the ground and check the wheel bearing for wear. If movement is found, adjust the bearing pre-load as follows:
3. Unscrew the hub cap.
4. Remove and discard the split pin.
5. Tighten the slotted nut to a torque of 80 Nm (60 lbf ft) then slacken off the nut to the nearest split pin hole to give the correct end float.
6. Fit a new split pin.
7. Refit the hub cap.
8. Grease the hub until clean grease appears from the seal at the back of the hub.



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FRONT HUB

Overhaul **3-8B**

Dis-assembly

1. Raise the front of the tractor and remove the wheel.
2. Unscrew the hub cap.
3. Remove and discard the split pin.
4. Remove the slotted nut and washer.
5. Remove the hub complete with bearings and seal from the axle spindle.
6. Remove the outer bearing cup.
7. Remove the seal.
8. Remove the inner bearing cup and cone.
9. If necessary, remove the dust shield.

Examination

Thoroughly wash out the old grease and dirt from the hub and components using clean paraffin, and check the condition of the hub spindle and bearings. Any worn or damaged components must be replaced.

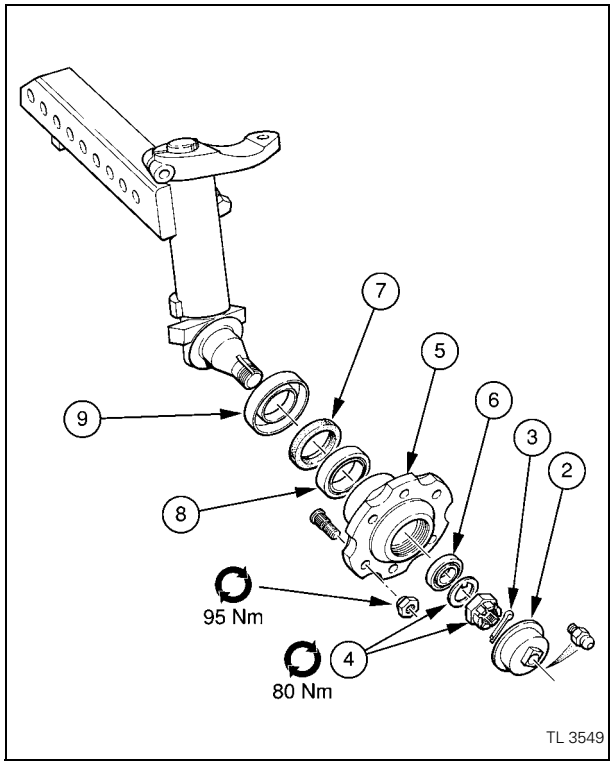
Re-assembly

10. Reverse procedures 1 to 9 except:

IMPORTANT: *The oil seal is fitted with the lip facing outwards to prevent the dirt getting in, and to allow the grease to get out.*

a. Pack the bearings with an approved grease during assembly.

b. Adjust and grease the bearings, *(see operation 2-8B).*



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Two-wheel Drive Front Axle – 2

SPINDLE and HOUSING

Removal and Refitment 4-8B

Removal

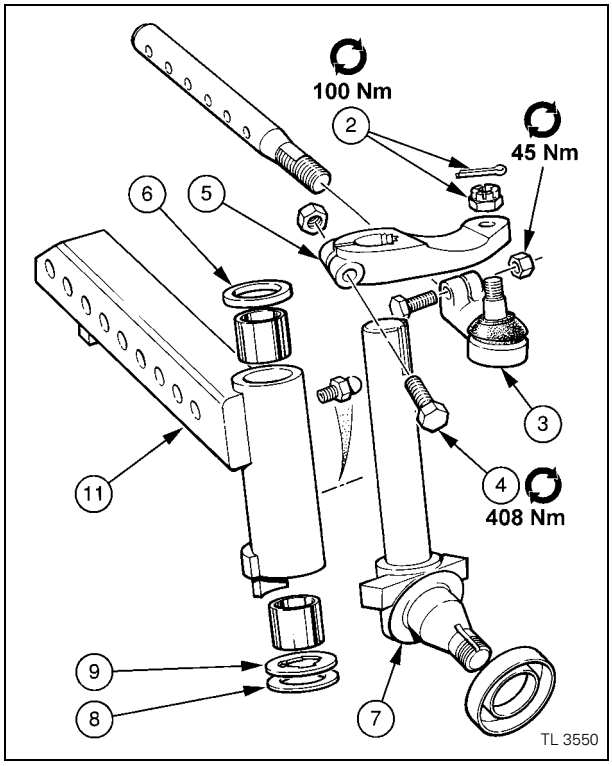
1. Remove the front hub, *(see operation 3-8B)*.
2. Remove the nut and split pin.
3. Disconnect the ball joint.
4. Slacken the steering arm nut and bolt.
5. Remove the steering arm.
6. Remove the dust seal.
7. Lower the spindle from the housing.
8. Remove the spacer from the spindle.
9. Remove the thrust washer from the spindle.
10. Remove the bolts securing the spindle housing to the axle beam.
11. Remove the axle housing.

Examination

Examine the spindle thrust bearings for damage or wear and replace if necessary. Thoroughly clean all components and remove all traces of old grease.

Refitment

12. Liberally lubricate the thrust washer and spacer with an approved grease before assembly.
13. Fit the thrust washer to the spindle with the indentations in the bronze face facing downwards.
14. Fit the spacer.
15. Refit the spindle to the housing.
16. Renew the felt seal.
17. Refit the steering arm.
18. With the hub and spindle assembly held firmly in place against the thrust bearing, measure the gap between the steering arm and the spindle housing using feeler gauges. The gap must not exceed 0,05 mm (0.002 in).
19. When the correct setting has been obtained tighten the steering arm nut to a torque of 408 Nm (300 lbf ft).
20. Thoroughly grease the spindle before the wheel is fitted and lowered to the ground. Ensure that the grease comes out of the lower bearing.
21. Refit and tighten the ball joint to a torque of 100 Nm (75 lbf ft) do not exceed 120 Nm (90 lbf ft) to align the split pin.
22. Tighten the spindle housing to axle beam bolts to a torque of 395 Nm (290 lbf ft).



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SPINDLE HOUSING

Overhaul **5-8B**

Special Tools:
MF.263A Bush Remover - Main Tool
MF.263-5 Bush Remover and Replacer
MF.264 Reamer Handle - Main Tool
MF.264-8 Reamer and Pilot
MS.550 Universal Handle

Dis-assembly

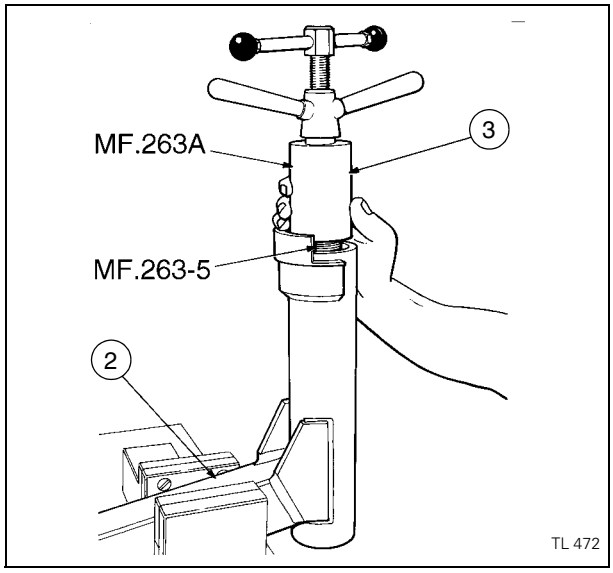
1. Remove the spindle housing and spindle, *(see operation 4-8B)*.
2. Secure the housing in a vice.
3. Using special tool MF.263A Bush Remover, Main Tool and MF.263-5 Bush Remover. Remove the bush by screwing the threaded extractor into the bush with the upper handle. Withdraw the bush by turning the lower handle.
4. Invert the housing and remove the lower bush.

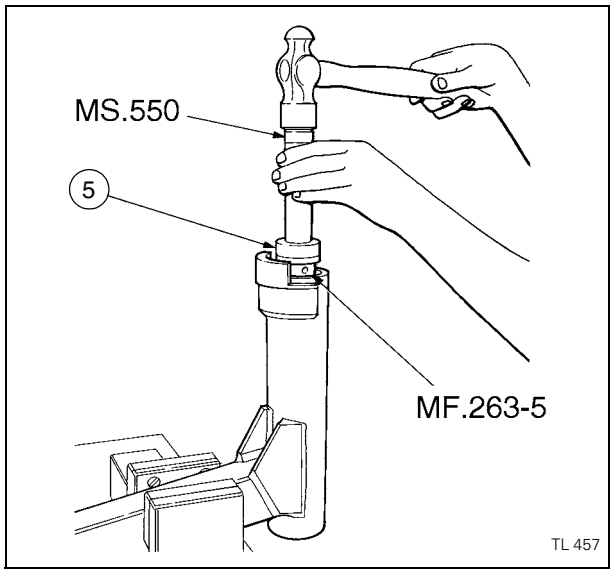
Examination

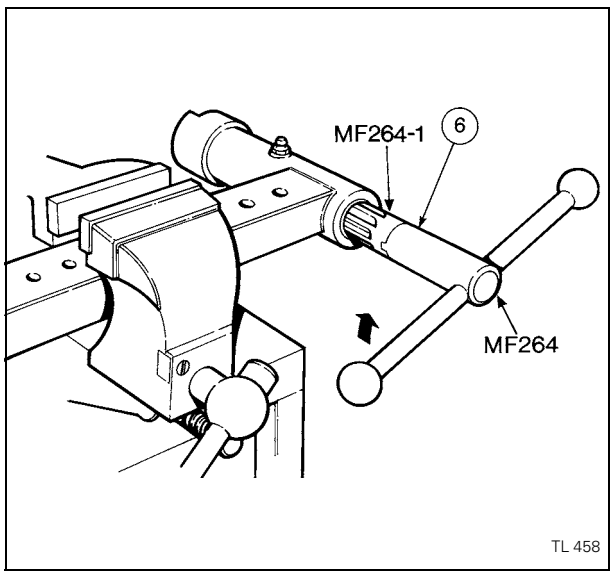
Clean all components and replace the spindle if there are signs of wear.

Re-assembly

5. Using special tools MS.550 Universal Handle and MF.263-5 Bush Replacer, drive a new bush into each side of the housing.
6. Using special tools MF.264 Reamer Handle - Main Tool and MF.264-8 Reamer and Pilot. With the reamer and handle assembled, pass the guide bar through the housing. Fit the reamer pilot onto the guide bar and into the housing. This will ensure that the bush is reamed parallel.
7. Ream the upper bush to size.
8. Turn the equipment over and ream the lower bush to size.
9. Remove all swarf from the housing and ensure the grease nipple hole is clear of dirt.
10. Thoroughly grease parts before and after assembly.
11. Refit the spindle shaft, *(see operation 4-8B)*.







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Two-wheel Drive Front Axle – 2

AXLE BEAM ASSEMBLY

Removal and Refitment 6-8B

Removal

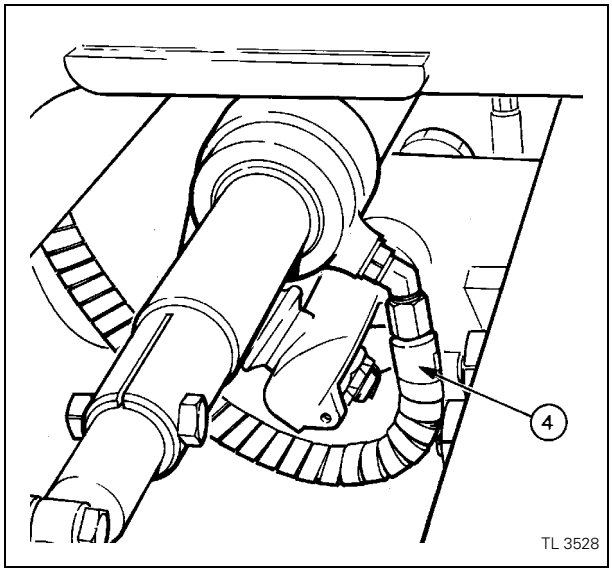
1. Block both rear wheels of the tractor and apply the parking brake.
2. Place a trolley jack under the engine sump and take the weight off the front of the tractor. DO NOT lift the front wheels off the ground.
3. Remove the front tractor weights, if fitted, and remove the front weight frame.
4. Disconnect the steering cylinder hoses at the cylinder end. Cap the ends of the pipes to prevent the ingress of dirt.
5. Remove the front wheels.

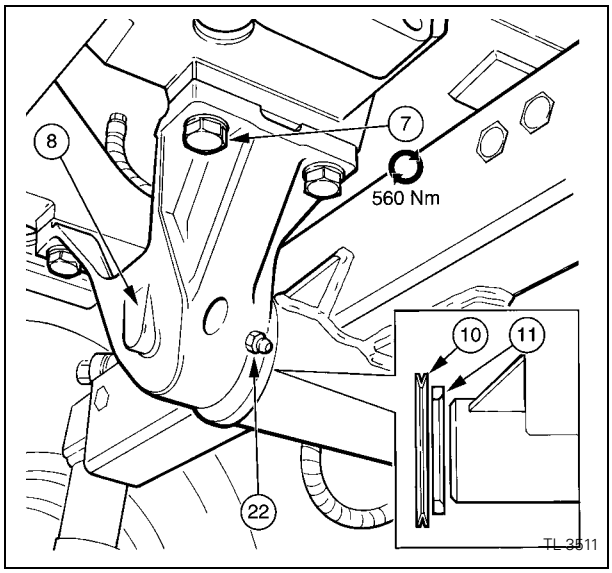
WARNING: Prevent the axle from tilting forwards or backwards, or rotating about the wheels if the axle is wheeled from under the tractor with its wheels still attached. It could cause injury if precautions are not taken.

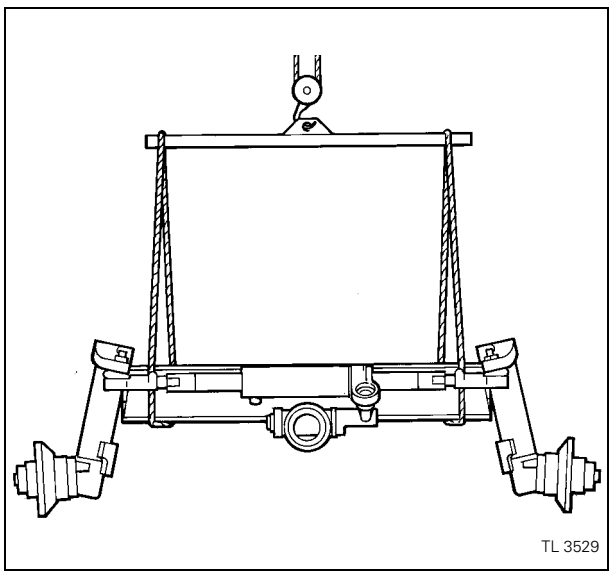
6. Place the axle in slings from an overhead crane.
7. Remove the bolts from the front trunnion.
8. Remove the trunnion.
9. Slide the axle forwards, disengaging it from its rear bearing housing and place it on two axle stands.
10. Remove the 'V' seals.
11. If necessary, remove the two chamfered washers.
12. Remove the quad seal.

Refitment

13. With the aid of an overhead crane sling the axle so that it is horizontal in both directions.
14. Fit a new quad sealing ring.
15. Reinstall the two thrust washers with the internal chamfered face facing the axle.
16. Fit new 'V' rings.
17. Place the axle under the front support casting and engage the rear support bearing, move the axle rearwards so that it is fully engaged.
18. Refit the front trunnion bearing and adjust its position until there is a clearance of 0,1-0,25 mm (0.004-0.010 in) between the axle and the housing.
19. Tighten the trunnion bearing bolts to a torque of 560 Nm (415 lbf ft).
20. Re-check the axle clearance, re-adjust if necessary.
21. Reverse procedures 1 to 5.
22. Grease both the front and rear bearings until grease shows between the bearing and axle.

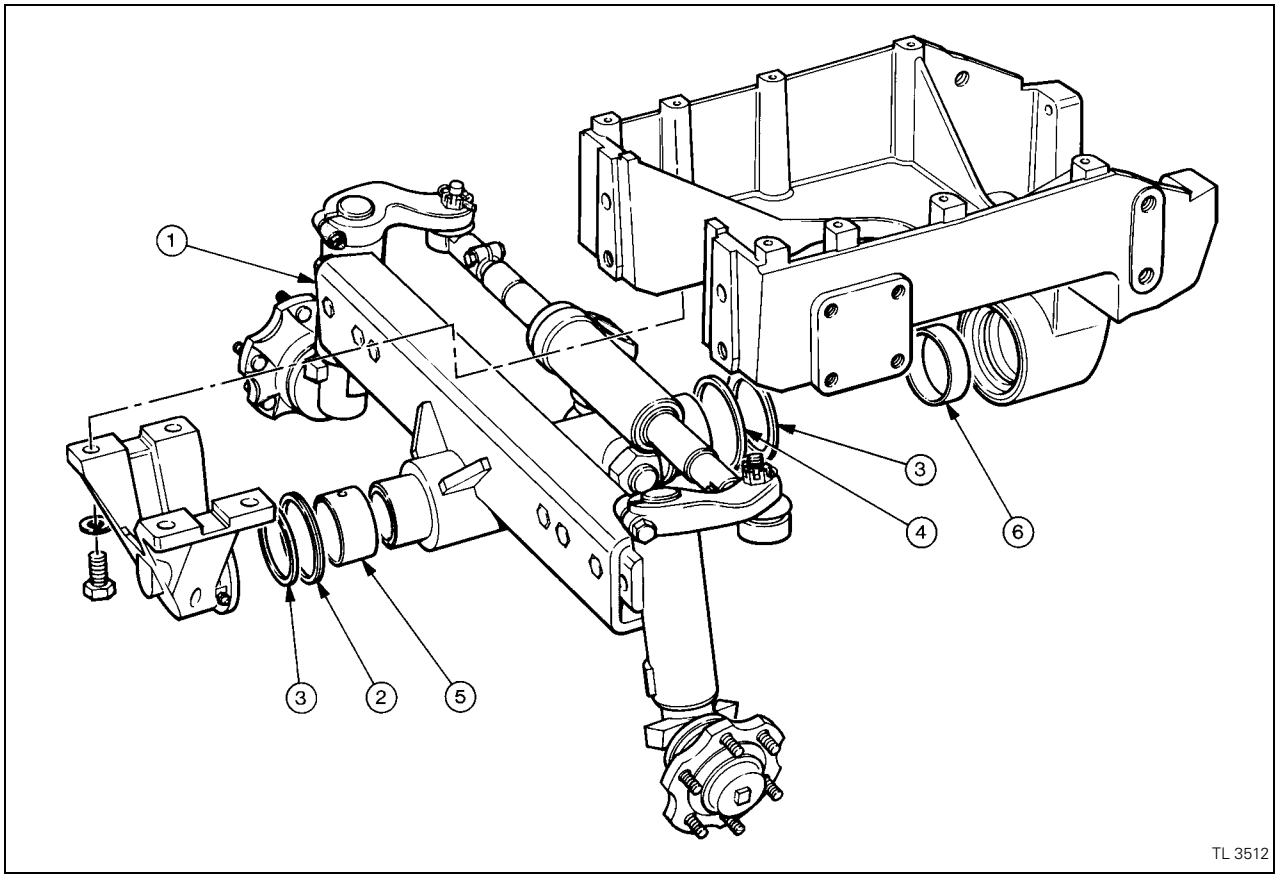






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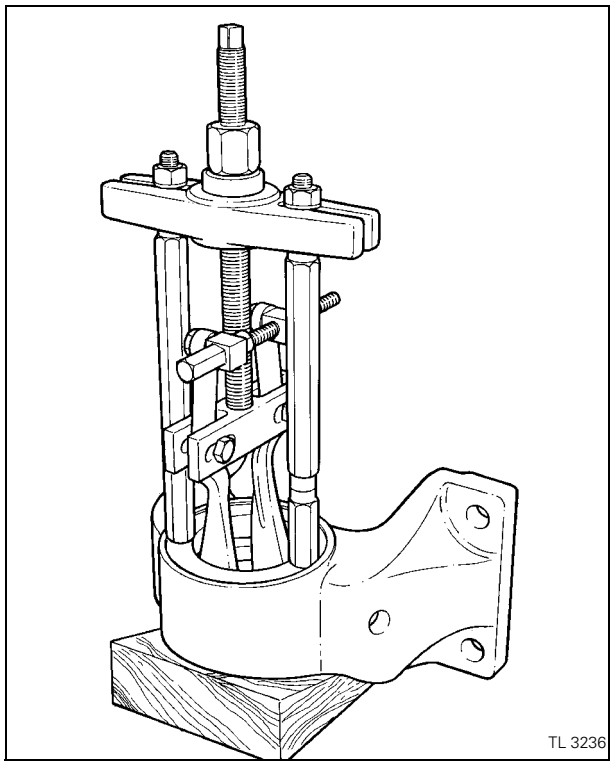
AXLE BEAM ASSEMBLY

Overhaul **7-8B**

Special Tools:
MF.500 Front Axle Bearing Installer
MS.550 Universal Handle

Dis-assembly

1. Remove the front axle, *(see operation 6-8B)*.
2. Remove the two 'V' ring seals.
3. Remove the two thrust washers.
4. Remove the quad seal from the axle pivot.
5. With the aid of an internal bearing extractor (see illustration) remove the bush from the front bearing housing.
6. Repeat the same operation and extract the bearing from the rear bearing housing.



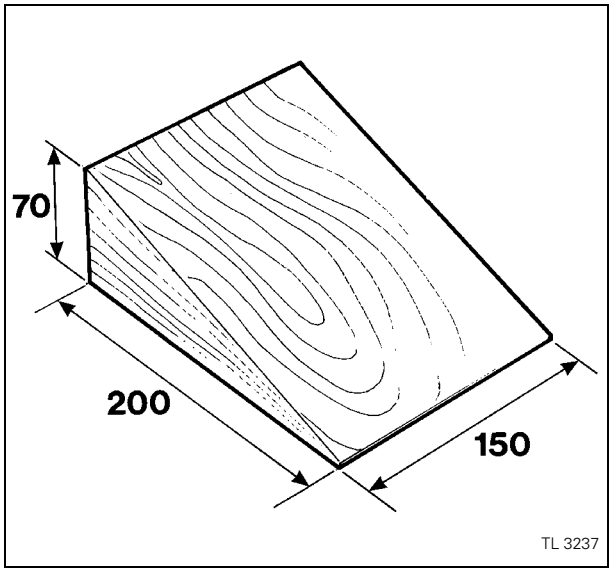
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Two-wheel Drive Front Axle – 2

Re-assembly

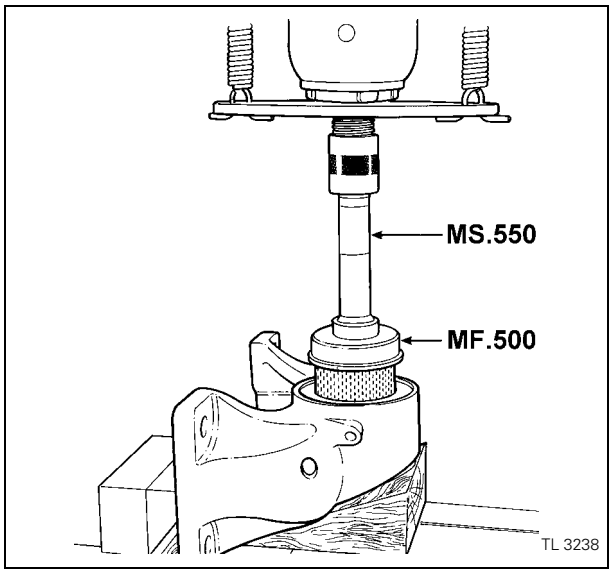
7. To replace the front bearing, make a wooden wedge to the dimensions shown in the illustration.



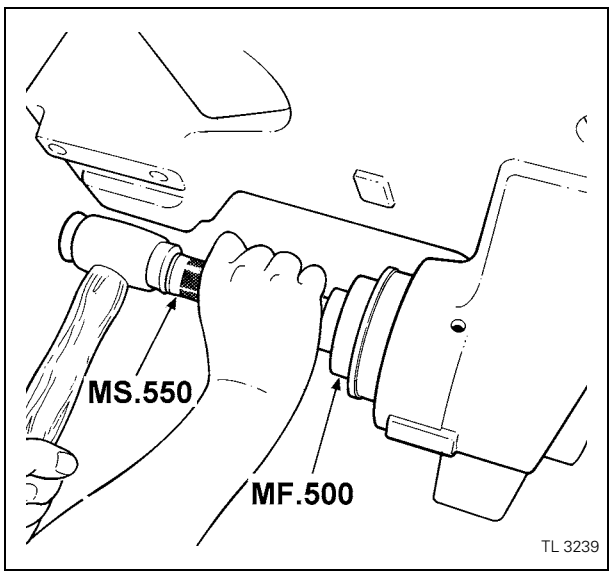
8. Place the bearing housing under a press on the wooden wedge.

IMPORTANT: *Both bushes, front and rear, must be assembled with the grease hole to the top.*

9. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal Handle, press the bush into the housing until it is 0,5-1,5 mm (0.020-0.060 in) below the rear face, the tool will position the bush correctly.

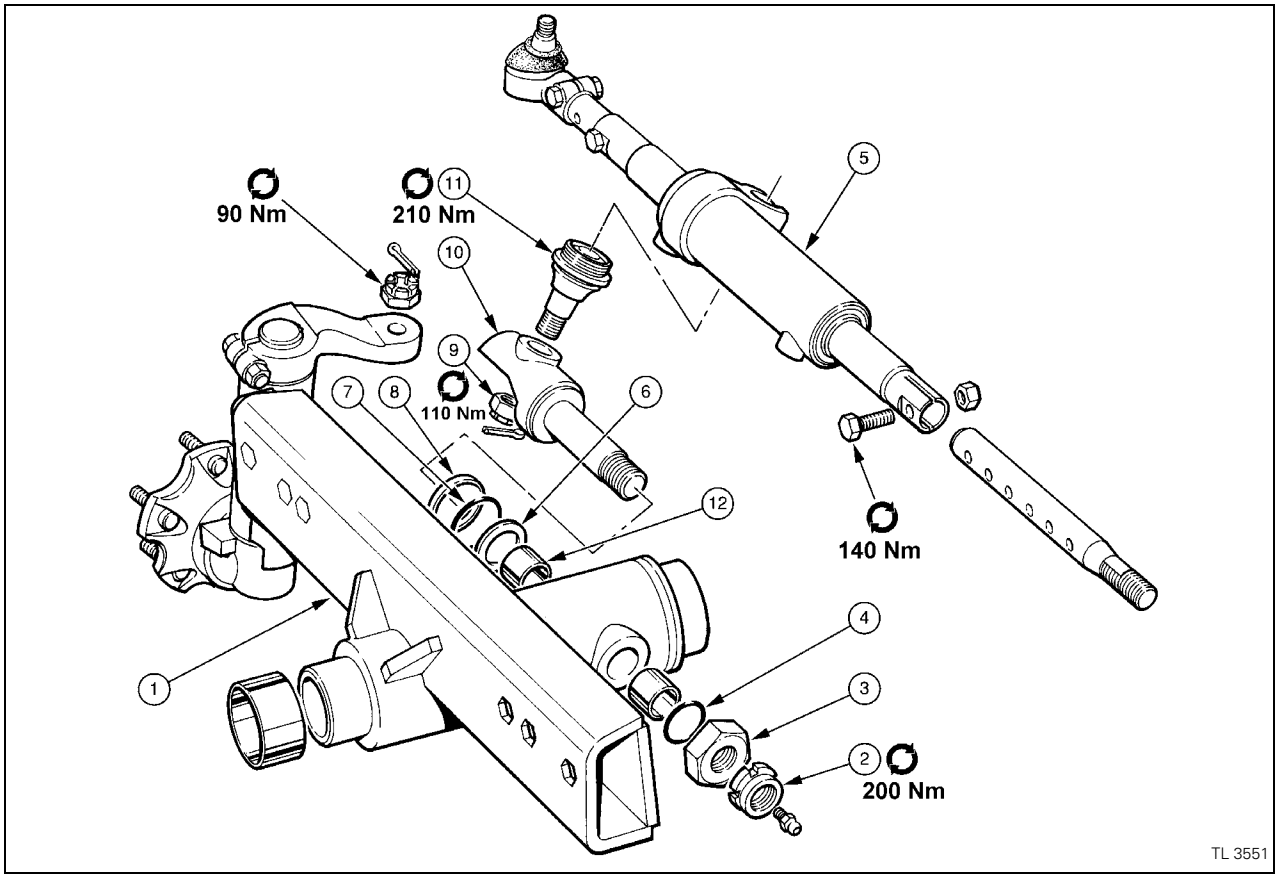


10. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal handle, drive the rear bush in until it is 0,1-0,5 mm (0.004-0.020 in) below the front face, the tool will position the bush correctly.
11. Reverse procedures 1 to 4 except:
    a. Renew the two 'V' ring seals.
    b. Renew the quad seal ring.
    c. Lubricate the seals and bushes prior to assembly with a general purpose grease.



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STEERING CYLINDER and PIVOT

Removal and Refitment **8-8B**

Special Tools:
MF.504 Steering Pivot Nut Wrench
MF.509 Steering Ball Joint Wrench

Removal

1. Remove the axle beam, *(see operation 6-8B)*.
2. Using special tool MF.504 Steering Pivot Nut Wrench, remove the locknut.
3. Unscrew the stop nut.
4. Remove the 'O' ring.
5. Withdraw the steering cylinder from the axle beam.
6. Remove the thrust washer.
7. Remove the 'O' ring.
8. Remove the seal protector ring.

Pivot Pin and Ball Joint

9. Remove the split pin and nut.
10. Remove the pivot pin from the cylinder ball joint.
11. With special tool MF.509 Steering Ball Joint Wrench, remove the large ball joint from the cylinder.

Examination

Thoroughly clean all components. Examine for wear or damage and replace any faulty components. Discard and replace all 'O' rings, seals and tab washer.

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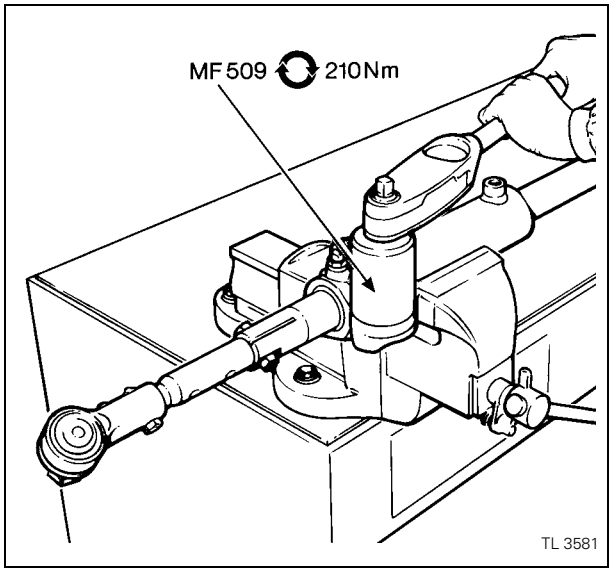
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Two-wheel Drive Front Axle – 2

Refitment

12. Reverse procedures 1 to 11 except:

a. Apply Massey Ferguson Studlock (Loctite 270) and using MF.509 tighten the ball joint into the cylinder to a torque of 210 Nm (155 lbf ft).



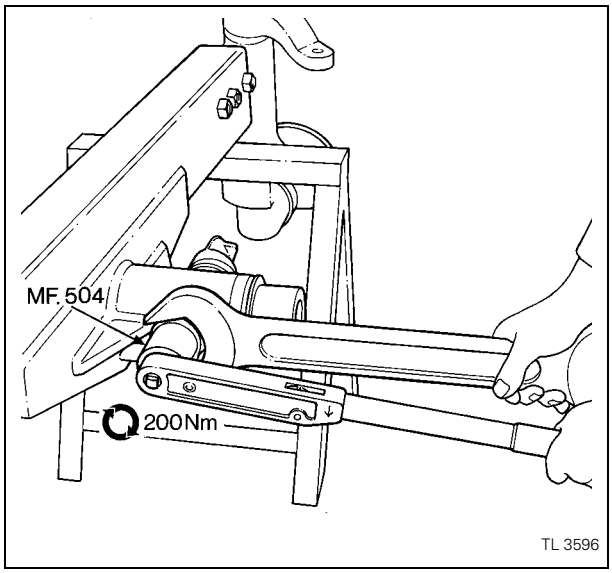
b. Set the running clearance of the cylinder pivot pin to 0,05-0,25 mm (0.002-0.010 in); to achieve this, tighten the stop nut and turn back by one flat.

c. Tighten the lock nut against the stop nut using MF.504 to a torque of 200 Nm (148 lbf ft).

d. Tighten the steering cylinder ball joint nut to a torque of 110 Nm (80 lbf ft), tighten further to align the split pin hole, DO NOT exceed a torque of 120 Nm (88 lbf ft) to align the split pin.

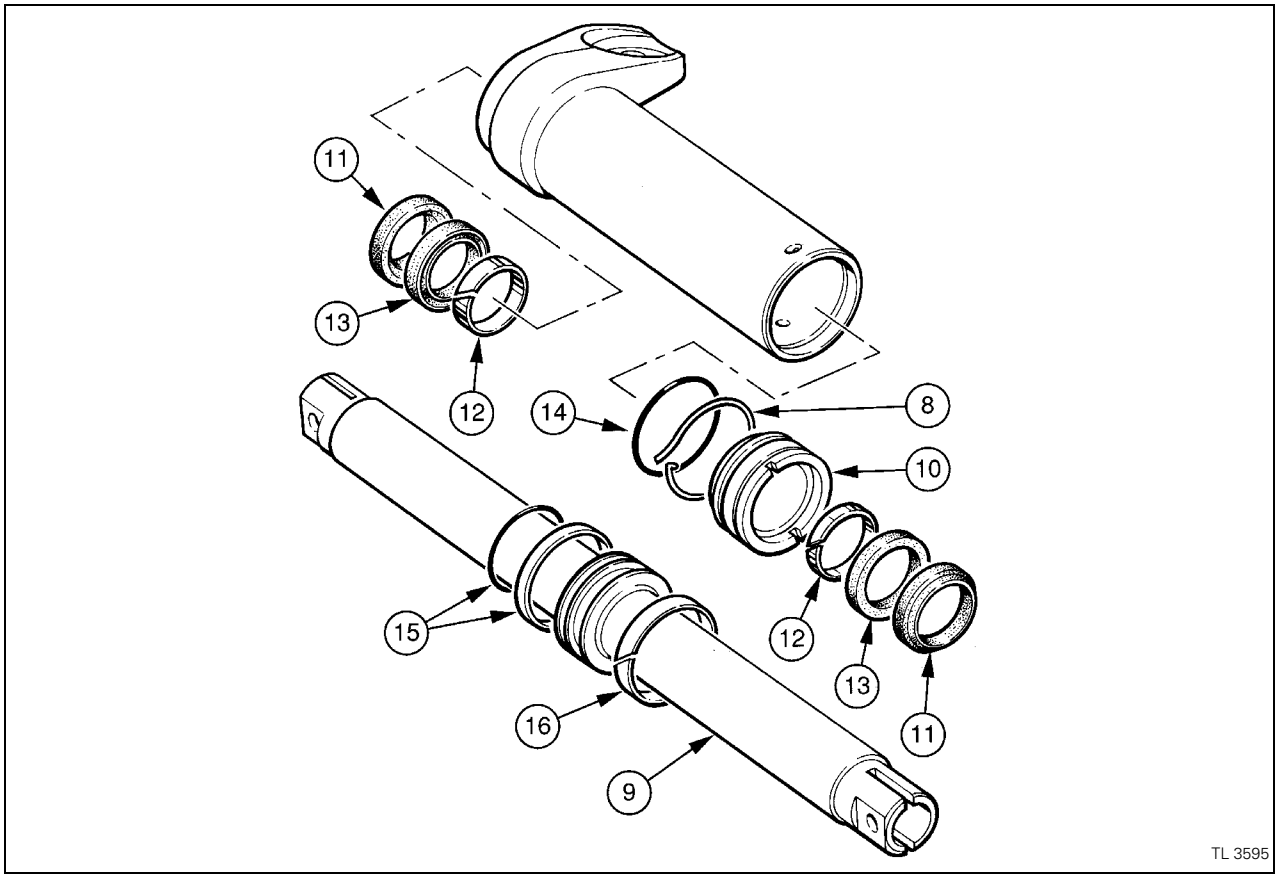
e. Tighten the piston rod clamp bolt to a torque of 140 Nm (105 lbf ft).

f. Tighten the track rod ball joint to a torque of 100 Nm (75 lbf ft). DO NOT exceed 120 Nm (90 lbf ft) to align the split pin.



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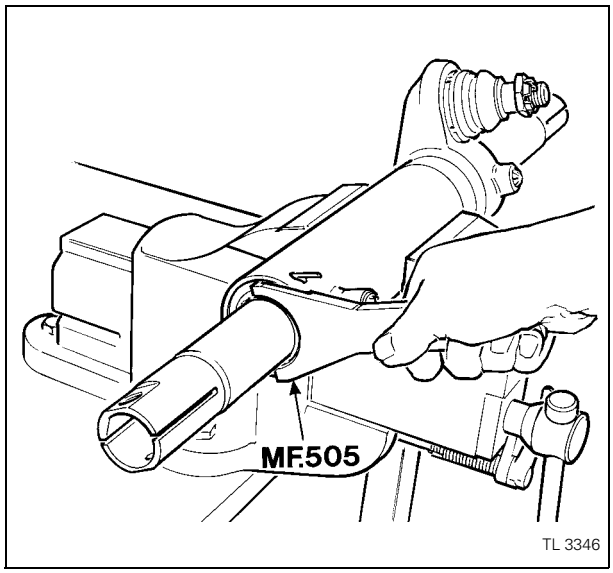
STEERING CYLINDER

Overhaul **9-8B**

Special Tools:
MF.505 Steering Cylinder Wrench

Dis-assembly

1. Remove the steering cylinder, *(see operation 8-8B)*.
2. Remove any sealing plugs and drain out any oil in the cylinder by moving the piston from one end of the cylinder to the other. Hold the cylinder over a container during this operation.
3. Hold the cylinder in a vice.
4. Remove the sealing compound in the elongated hole at the end opposite to the ball joint.
5. Using special tool MF.505 Steering Cylinder Wrench, engage the end of the wrench in the two slots in the cap. Rotate the cap until the chamfered end of the retaining wire can be seen in the elongated hole.
6. With the aid of a screwdriver, turn the end cap and prise the end of the wire up out of the hole.
7. Continue turning the cap and wind the rest of the wire out through the hole.



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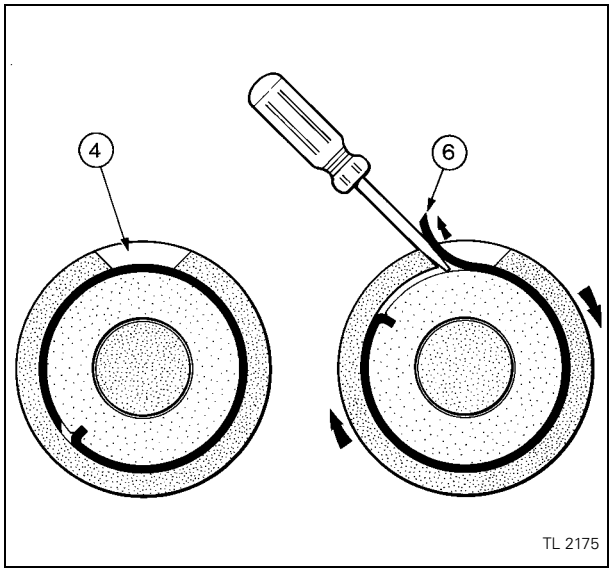
8. The end of the wire has a right angle bend which locates in a hole in the groove of the end cap, remove the wire from the cylinder.
9. Withdraw the piston assembly from the cylinder with the end cap.
10. Remove the end cap.
11. Remove the wiper seal.
12. Remove the wear ring
13. Remove the pressure seal.
14. Remove the 'O' ring.
15. Remove the piston seal assembly.
16. Remove the piston wear ring.

Examination

Thoroughly clean all components and inspect for wear and damage, remove all sharp edges that could cause damage to seals during assembly. Renew all seals, wear rings and 'O' rings.

Re-assembly

17. Fit a new set of seals to the ball joint end of the cylinder.
18. Fit a new set of seals to the piston.
19. Lubricate all the seals with clean transmission oil. Carefully re-install the piston into the cylinder taking care not to damage any of the seals.
20. Renew the seals in the end cap.
21. Slide the end cap down the piston rod into the cylinder.
22. Using the cylinder wrench, rotate the end cap until the hole in the wire groove is visible through the elongated hole in the cylinder wall.
23. Insert a new wire so that the bent end locates in the hole in the wire groove. Ensure that the two grooves in the cylinder wall and end cap are in line.
24. Rotate the end cap so that it draws the wire round the end cap inside the cylinder. Rotate until all the wire is in the cylinder.
25. Seal the elongated hole in the cylinder wall with a non-setting type sealing compound. This sealing is important to prevent ingress of water and the resultant rusting of the end cap and retaining wire.
26. Checks that the piston rod moves up and down the cylinder correctly.
27. Refit the steering cylinder to the tractor.



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Four-wheel Drive Front Axle

Section 8 - Part C

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Four-wheel Drive Front Axle

SPECIFICATION:

Axle type:	
4215, 4220, 4225, 4235, 4245	AG 66 CD - Narrow (1366 mm wide).
4225, 4235	AG 66 CD - Wide - (1562 mm wide).
4225, 4235, 4243	AG 75 CD - (1669 mm wide).
4245, 4253, 4255, 4260, 4263	AG 85 CD - (1669 mm wide).
4245, 4255, 4260, 4270	AG 105 CD - (1800 mm wide).
Camber angle	1°.
Castor angle	5° 30'.
Width across hub flanges:	
AG 66 narrow	1366 mm (53.82 in).
AG 66 wide	1562 mm (61.54 in).
AG 75 and AG 85	1669 mm (65.76 in).
AG 105	1800 mm (70.92 in).
Toe-in	0-4 mm (0-5/32 in).
Maximum turning angle	55°.
Maximum static load:	
AG 66	3000 kgf (6614 lbf).
AG 75 and 85	4500 kgf (9921 lbf).
AG 105	5000 kgf (11023 lbf).
Number of differential pinions:	
AG 66	4.
AG 75, AG 85, AG 105	2.
Type of differential lock	Hydralock.
Axle reduction ratio:	
Crownwheel and pinion - AG 66	No. of teeth = 9 x 35. Ratio = 3.888:1.
Crownwheel and pinion - AG 75 and AG 85	No. of teeth = 9 x 35. Ratio = 3.888:1.
Crownwheel and pinion - AG 105	No. of teeth = 8 x 36. Ratio = 4.500:1.
Epicyclic reduction ratio:	
AG 66 axle	4.6 : 1.
AG 75, 85 and 105 axle	4.6 : 1.
Overall reduction ratio:	
AG 66 axle	17.888 : 1.
AG 75 and 85 axle	17.888 : 1.
AG 105 axle	20.700 : 1.
Pinion setting dimension - AG 66	91 ± 0,10 mm.
Pinion setting dimension - AG 75, AG 85, AG 105	118 ± 0,10 mm.
Pinion bearing pre-load	2-4 Nm (1.5-3 lbf ft).
Differential bearing pre-load	With zero end float tighten bearing nut three notches.
Crownwheel and pinion back-lash:	
AG 66 axle	0,15-0,20 mm (0.006-0.008 in).
AG 75, 85 and 105 axle	0,18-0,23 mm (0.005-0.007 in).
Swivel pin pre-load - all axles	0,15-0,25 mm (0.006-0.010 in).
Oil capacity - hub each side:	
AG 66	0,8 litre (1.5 pt) (1.5 US pt).
AG 75, AG 85 and AG 105	1 litre (1.8 pt) (1.8 US pt).
Oil capacity - axle:	
AG 66, AG 75, AG 85	5,6 litre (1.2 gal) (1.5 US gal).
AG 105	7,6 litre (1.7 gal) (2 US gal).

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Special Tools:

MF.195C	Bearing puller.
MF.451B	Steering pin bearing remover.
MF.471A	Hydralock spring compressor.
MF.482	Steering cylinder wrench.
MF.483	Hub nut wrench (AG 66).
MF.487	Hub nut wrench.
MF.488	Hub puller.
MF.493	Hub seal installer (AG 66).
MF.494	Hub seal installer.
MF.495	Planetary ring gear replacer (AG 66).
MF.496	Wear ring installer (AG 66).
MF.497	Wear ring installer.
MF.498	Planetary ring gear replacer.
MF.502	Pinion nut wrench.
MF.503	Pinion oil seal installer.
MF.520/1	Seal installer.
MF.520/2	Bush installer.
MF.521	Hub seal installer.
FT.4062A	Pinion pre-load gauge.

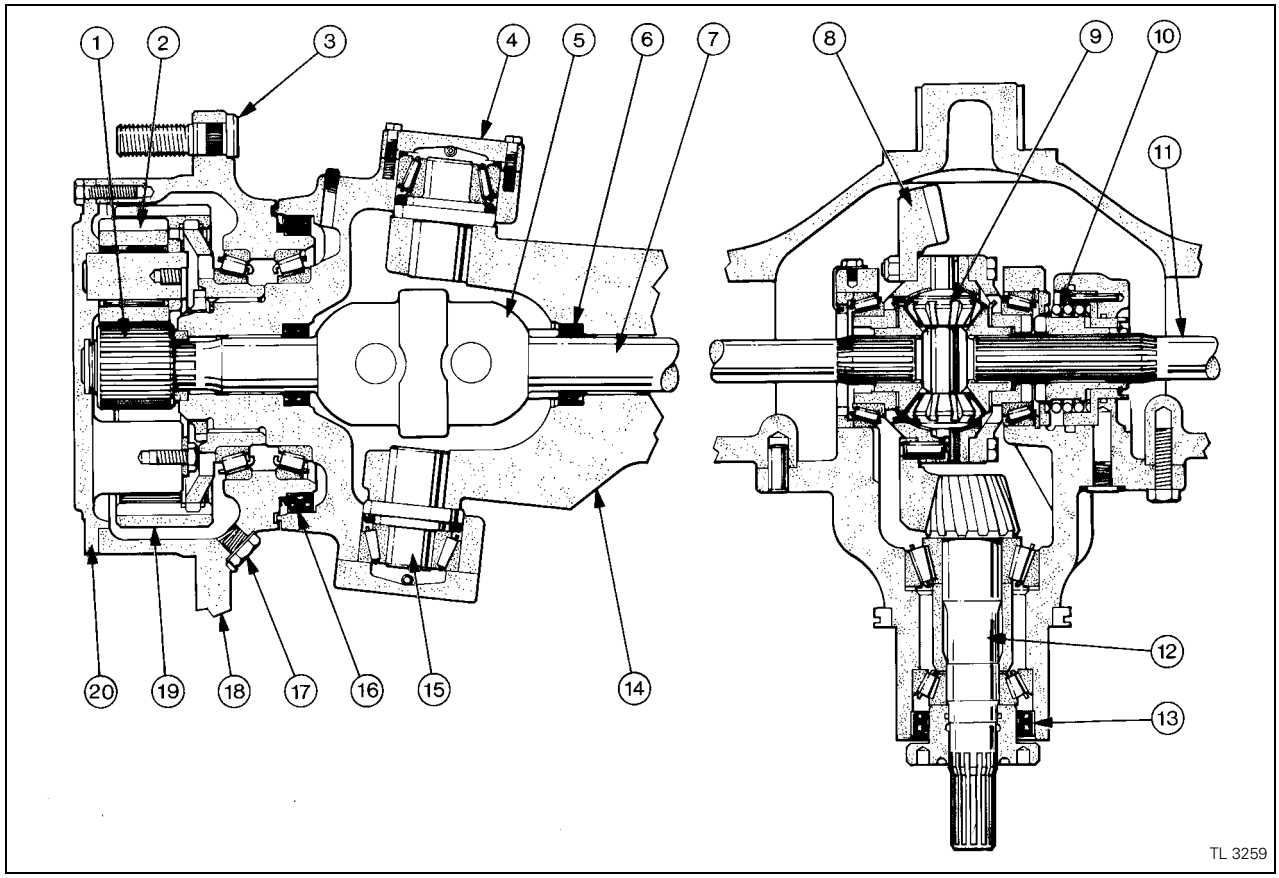
Bolt Torques:

Track rod lock-nuts	135 Nm (100 lbf ft).
Steering cylinder ball joints	135 Nm (100 lbf ft).
Ball joint nuts:	
AG 66 axle	105 Nm (80 lbf ft) Maximum torque 130 Nm (95 lbf ft).
AG 75, AG 85, AG 105 axle	125 Nm (90 lbf ft) Maximum torque 160 Nm (118 lbf ft).
Wheel nuts	270 Nm (200 lbf ft).
Planetary carrier cap screws	80 Nm (60 lbf ft).
Hub retaining nuts	425 Nm (315 lbf ft).
Pivot pin cap bolts:	
AG 66 axle	80 Nm (95 lbf ft).
AG 75, AG 85, AG 105 axle	130 Nm (95 lbf ft).
Pinion nut	380 Nm (280 lbf ft).
Differential case bolts	135 Nm (100 lbf ft).
Crownwheel bolts	85 Nm (65 lbf ft).
Differential bearing cap bolts	
AG 66 axle	140 Nm (103 lbf ft).
AG 75, AG 85, AG 105 axle	130 Nm (95 lbf ft).
Steering cylinder cap screws:	
AG 66 axle	120 Nm (90 lbf ft).
AG 75, AG 85, AG 105 axle	190 Nm (140 lbf ft).
Bearing lock tab bolt	20 Nm (15 lbf ft).
Front axle to front support bolt	560 Nm (413 lbf ft).

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Four-wheel Drive Front Axle



Four-wheel Drive Hydralock Front Axle

1. Sun gears.
2. Planetary gear.
3. Wheel studs.
4. Pivot housing.
5. Universal joint.
6. Oil seal.
7. Drive shaft.
8. Crownwheel.
9. Differential unit.
10. Hydralock differential.
11. Drive shaft.
12. Pinion.
13. Pinion oil seal.
14. Axle housing.
15. Pivot pin.
16. Hub oil seal.
17. Oil filler/drain plug.
18. Wheel hub.
19. Ring gear.
20. Planetary carrier.

GENERAL DESCRIPTION

The Massey Ferguson AG Series front axle is driven by a drive shaft along the centre of the tractor from a range gearbox bolted between the main gearbox and centre housing. The range gearbox contains the reduction gears and clutch to control the engagement and disengagement of the front axle.

The front axle has the crownwheel, pinion and differential mounted on the centre line of the axle to align with the drive shaft making it a Centre-Drive (CD) arrangement. The drive is taken through a standard crownwheel, pinion and differential arrangement. The differential contains a cross with four differential bevel gears, or a single pin with two gears. These mesh with two side bevel gears to which the inner ends of the drive shafts are splined.

The internal drive shafts transmit the power through double universal joints at the steering pivot to the epicyclic reduction units in the front wheels. The front axle is attached to the front support casting by means of a centre pivot pin.

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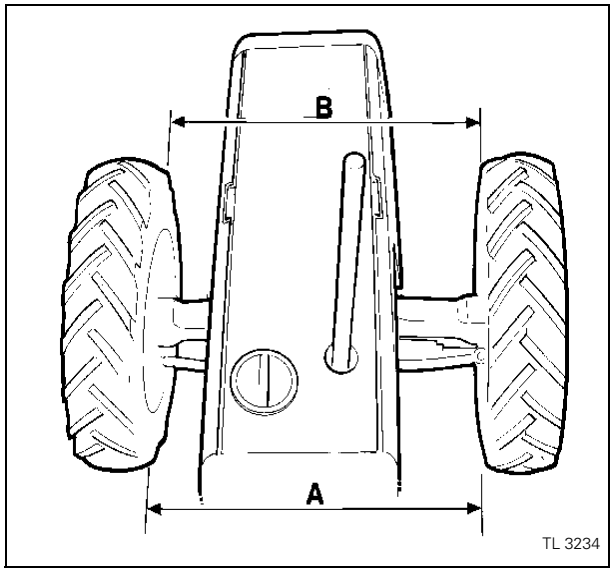
WHEEL ALIGNMENT and STEERING STOPS

Adjust **1-8C**

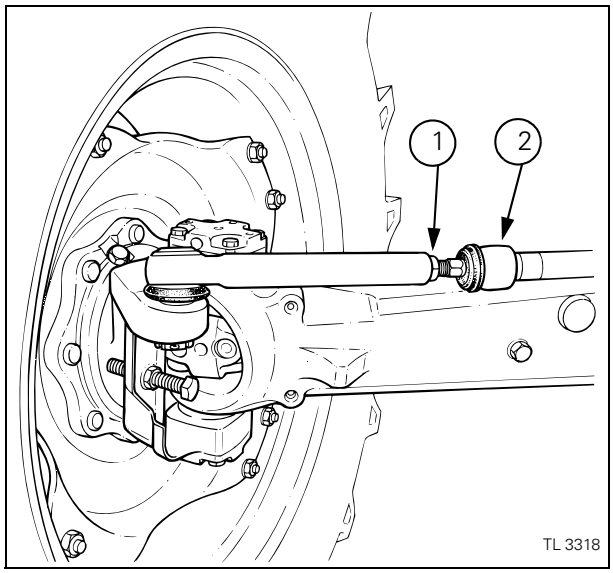
Procedure

Wheel Alignment

1. Drive the tractor onto firm level ground and put the front wheels in the straight ahead position.
2. Check the wheel toe-in measured on the centre line of the axle at the wheel rim. Distance **'A'** must be 0-5 mm (0-3/16 in) greater than distance **'B'**.



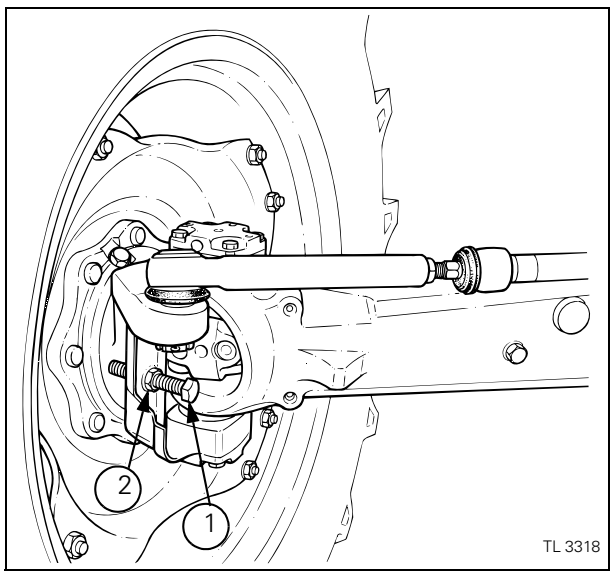
3. If adjustment is necessary, slacken the lock-nut (1) on the track rod on one side.
4. Rotate the inner steering ball joint (2) to either increase or decrease the track rod length to obtain the correct setting.
5. Apply Massey Ferguson Studlock (Loctite 270) and tighten the track rod lock-nut to a torque of 135 Nm (100 lbf ft). Ensure that both track rods are the same length.



Steering Stops

CAUTION: *At the smaller track settings, a foul condition may occur between the tyre and tractor or loader, if fitted, when the wheels are turned to the full lock position. To avoid this condition you must check by turning the wheels to full lock and adjusting the steering stops as necessary.*

6. Place the jack under the engine sump and raise the tractor enough to allow the axle to swing from one stop to the other.
7. Turn the front wheels to full lock and check that the inside edge of the tyre does not foul the tractor.
8. Carry out the same check on the other lock.
9. If necessary, adjust the length of the steering stops (1) on both sides so that a foul condition will not occur. Tighten the lock-nuts (2) after adjustment.



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TRACK ROD and BALL JOINT

Removal and Refitment 2-8C

Removal

1. Remove the split pin and nut from the ball joint.
2. Remove the ball joint from the housing by using an extractor or by striking the housing with a hammer adjacent to the ball joint to release the taper.
3. Slacken the lock-nut and unscrew the ball joint from the inner joint.
4. To remove the inner joint, hold the end of the steering cylinder piston rod with a spanner and unscrew the joint.

Refitment

5. Reverse procedures 1 to 4 except:

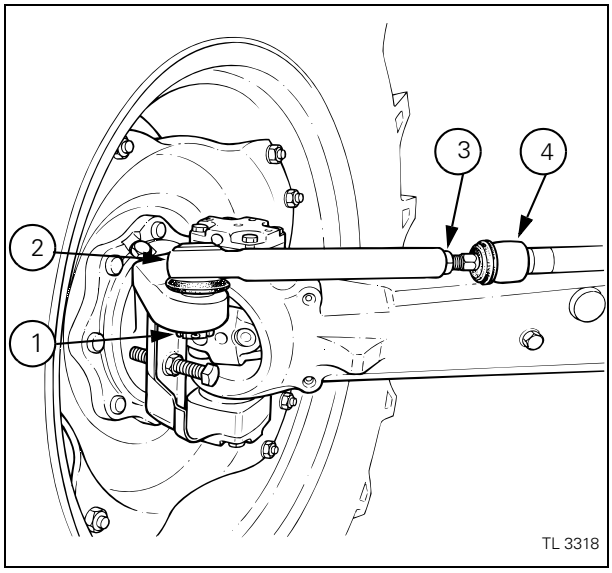
a. Ensure that the same amount of thread is screwed into each ball joint.

b. Apply Massey Ferguson Studlock (Loctite 270) to the threads of inner joint (4) and screw it into the end of the steering cylinder piston rod.

c. Set the wheel alignment as described, *(see operation 1-8C)*.

d. Tighten the lock-nut (3) to a torque of 135 Nm (100 lbf ft).

e. Apply lubricating oil to the thread and tighten the ball joint nut (1) to a torque of 105 Nm (80 lbf ft) on AG66 axles and 125 Nm (90 lbf ft) on other axles. Then tighten further as required to align the nut for the split pin (maximum torque 130 Nm (95 lbf ft) on AG66 axles and 160 Nm (118 lbf ft) on other axles. Renew the split pin.



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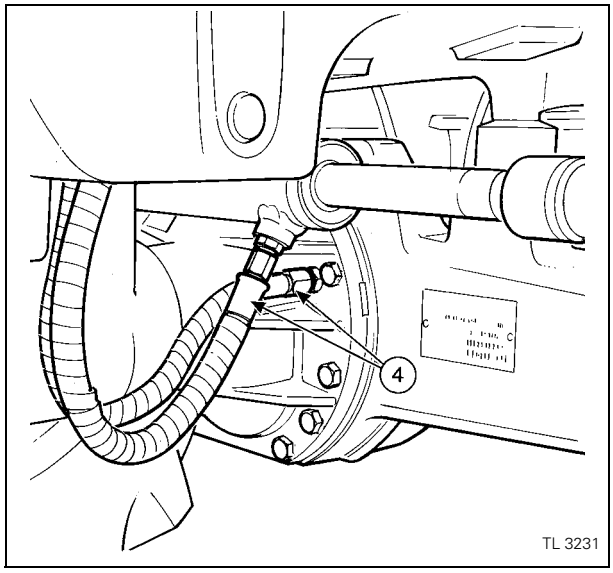
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FRONT AXLE

Removal and Refitment 3-8C

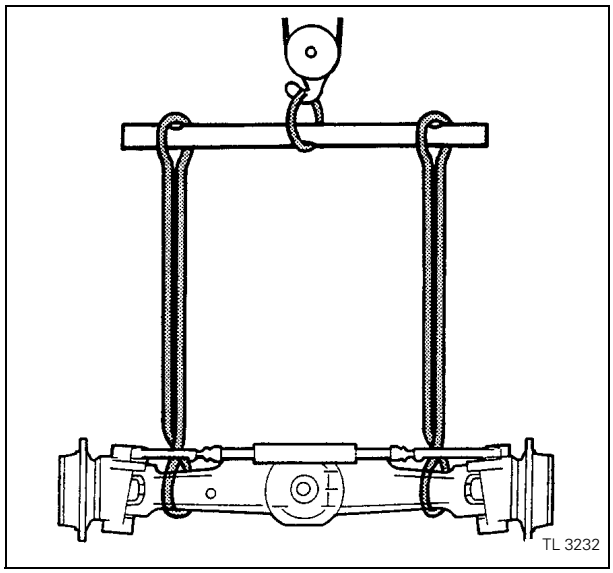
Removal

1. Block both rear wheels of the tractor and apply the parking brake.
2. Place a trolley jack under the engine sump and take the weight off the front of the tractor. DO NOT lift the front wheels off the ground.
3. Remove the front tractor weights, if fitted, and remove the front weight frame.
4. Disconnect the steering cylinder hoses at the cylinder end and disconnect the Hydralock pipe. Cap the ends of all pipes and hoses to prevent the ingress of dirt.
5. Disconnect the front axle four-wheel drive shaft guard and disconnect the four-wheel drive shaft, *(see operation 1-5E)*.



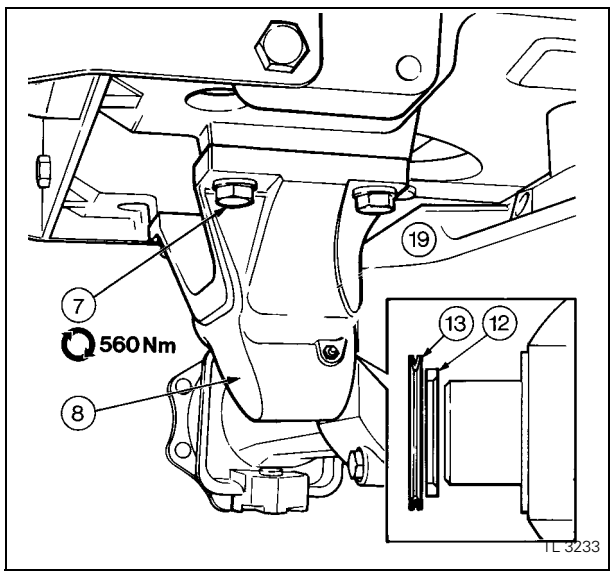
WARNING: Prevent the axle from tilting forwards or backwards, or rotating about the wheels if the axle is wheeled from under the tractor with its wheels still attached. It could cause injury if precautions are not taken.

6. Place the front axle in slings.
7. Remove the bolts from the front trunnion.
8. Remove the trunnion.
9. Remove the axle forwards, disengaging it from its rear bearing housing and place it on two axle stands.
10. If necessary remove the two chamfered washers.



Refitment

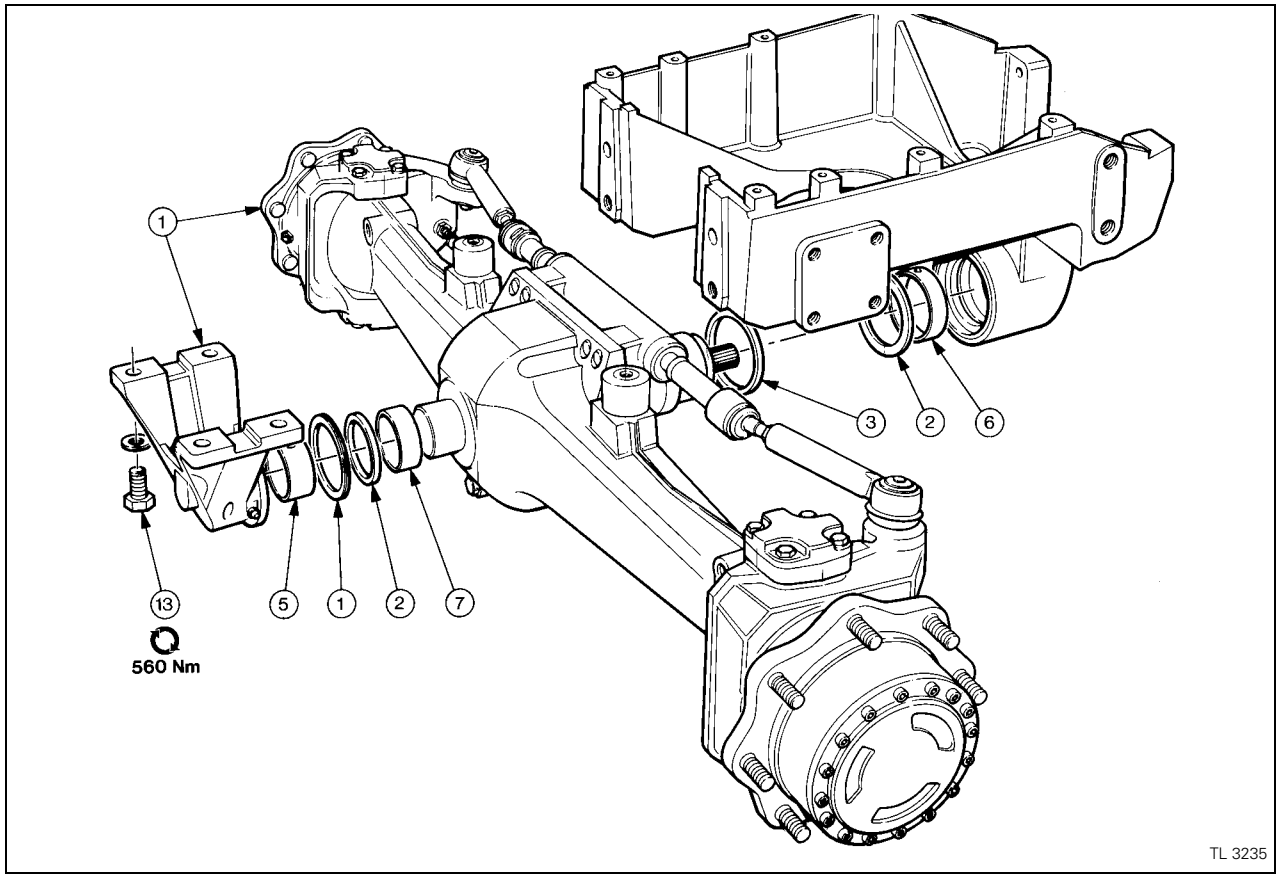
11. With the aid of an overhead crane sling the axle so that it is horizontal in both directions.
12. Reinstall the two thrust washers with the internal chamfered face facing the axle.
13. Fit new 'V' ring seals.
14. Place the axle under the front support casting and engage the rear support bearing, move the axle rearwards so that it is fully engaged.
15. Refit the front trunnion bearing and adjust its position until there is a clearance of 0,1-0,25 mm (0.004-0.010 in) between the axle and housing.
16. Tighten the trunnion bearing bolts to a torque of 560 Nm (415 lbf ft).
17. Re-check the axle clearance, re-adjust if necessary.
18. Reverse procedures 1 to 5.
19. Grease both the front and rear bearing until grease shows between the bearing and axle.



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Four-wheel Drive Front Axle



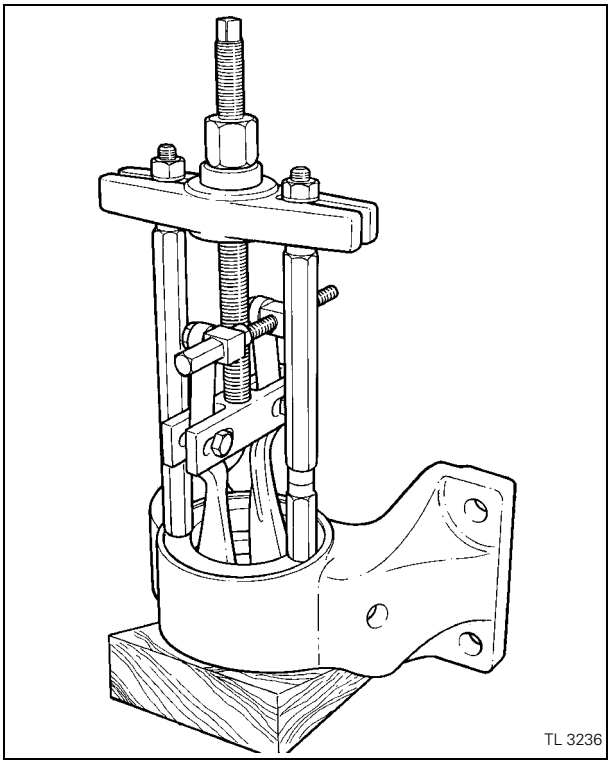
FRONT AXLE PIVOT PIN BEARINGS

Overhaul **4-8C**

Special Tools:
MF.500 Front Axle Bearing Installer
MS.550 Universal Handle

Dis-assembly

1. Remove the front axle, *(see operation 3-8C)*.
2. Remove the 'V' ring seal.
3. Remove the two thrust washers.
4. Remove the quad seal from the axle pinion housing.
5. With the aid of an internal bearing extractor (see illustration) remove the bush from the front bearing housing.
6. Repeat the procedure and extract the bearing from the rear bearing housing.
7. If necessary, remove the steel bearing from the front of the axle casing.

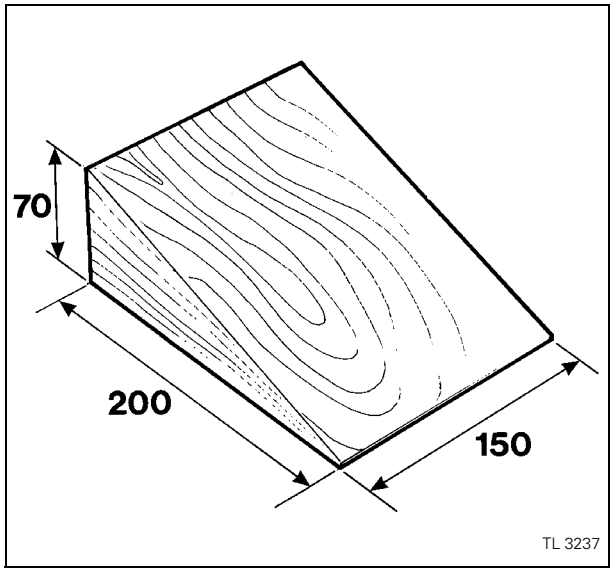


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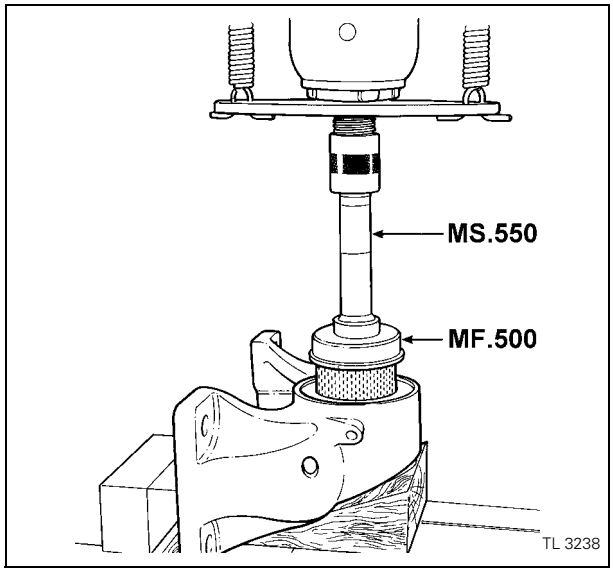
Re-assembly

8. To replace the front bearing, make a wooden wedge to the dimensions shown in the illustration.

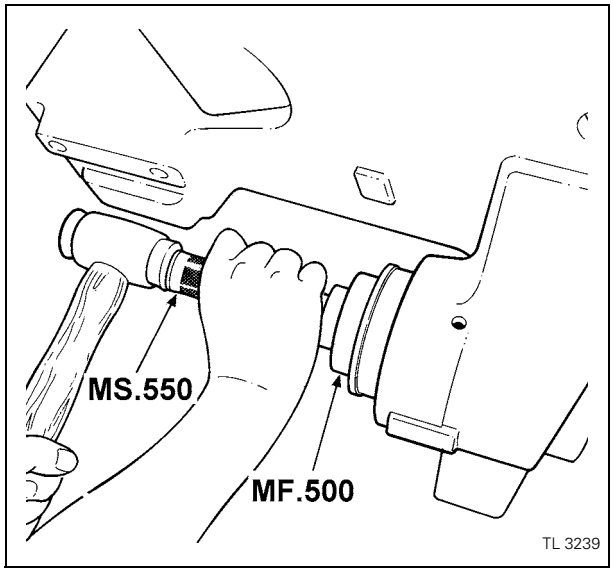


9. Place the bearing housing under a press on the wooden wedge.
10. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal Handle, press the bush into the housing until it is 0,5-1,5 mm (0.020-0.060 in) below the rear face, the tool will position the bush correctly.

IMPORTANT: *Both bushes, front and rear, must be assembled with the grease hole to the top.*



11. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal Handle, drive the rear bush in until it is 0,1-0,5 mm (0.004-0.020 in) below the front face, the tool will position the bush correctly.
12. If removed, replace the front steel bush on the axle housing.
13. Reverse procedures 1 to 4 except:
    a. Renew the two 'V' ring seals.
    b. Renew the quad seal ring.
    c. Lubricate the seals and bushes prior to assembly with a general purpose grease.
    d. Tighten the four front support bolts to a torque of 560 Nm (413 lbf ft).



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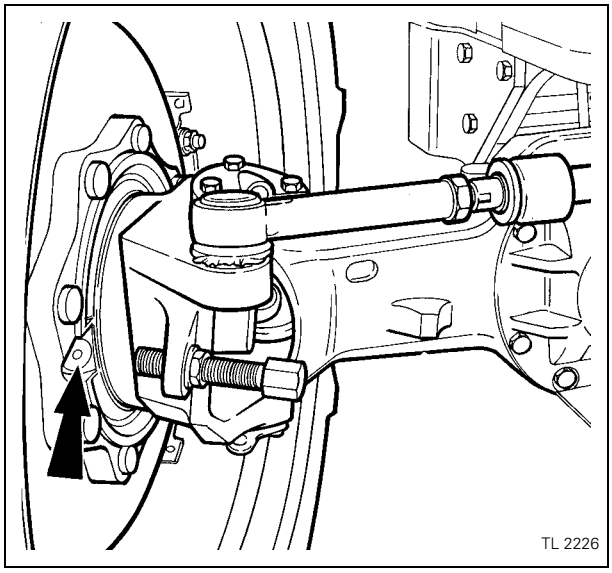
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PLANETARY CARRIER

Removal and Refitment 5-8C

Removal

1. Apply the parking brake and secure the rear wheels.
2. Raise the tractor under the side of the axle to be worked on, then support the axle on an axle stand.
3. Disconnect the drive shaft, *(see operation 1-5E)*.
4. Rotate the hub until the plug is at the bottom. Remove the wheel and the plug (8 mm hexagon key will be required) and drain the oil from the hub.
5. Mark the position of the planetary carrier in relation to hub to assist alignment during refitment.
6. Remove the 16 cap screws (8 mm hexagon key will be required) in the cover plate.
7. Remove the planetary cover plate.



Refitment

8. Reverse procedures 1 to 7 except:

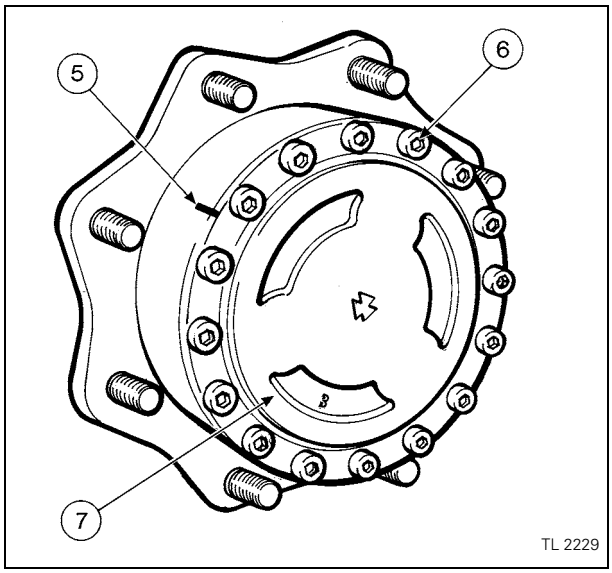
a. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the hub face.

b. Apply a light coating of lubricating oil to the planetary carrier bolts or cap screws. Tighten the bolts to a torque of 80 Nm (60 lbf ft).

c. Rotate the wheel so that the plug is horizontal. Fill the hub to this level with an approved oil and refit the plug.

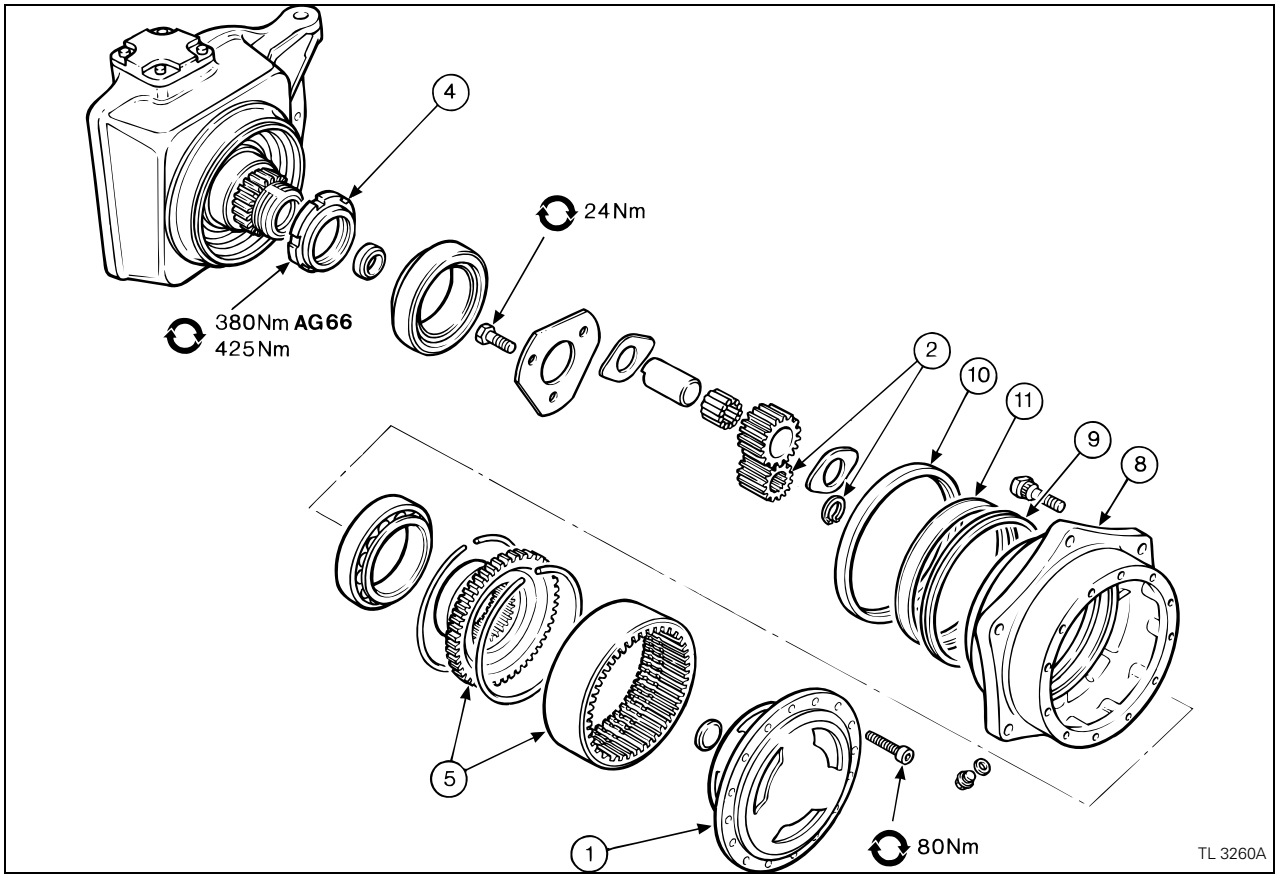
d. Tighten the wheel nuts to a torque of 270 Nm (200 lbf ft).

e. Reconnect the drive shaft.



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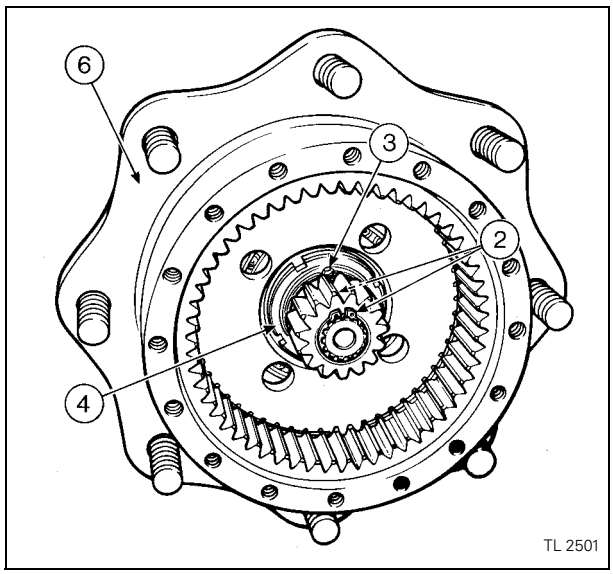


HUB OIL SEAL

Removal and Refitment **6-8C**

Special Tools:

MF.483 Hub Nut Wrench (AG 66)
MF.487 Hub Nut Wrench
MF.488 Hub Puller
MF.493 Hub Seal Installer (AG 66)
MF.494 Hub Seal Installer
MF.495 Planetary Ring Gear Replacer (AG 66)
MF.496 Wear Ring Installer (AG 66)
MF.497 Wear Ring Installer
MF.498 Planetary Ring Gear Replacer



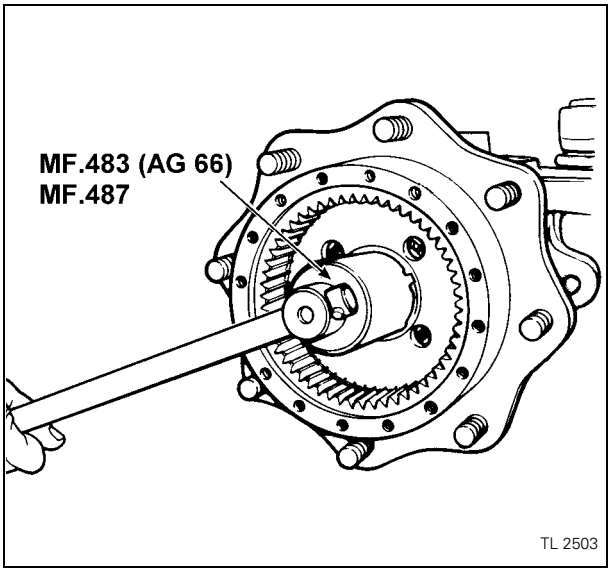
Removal

1. Remove the planetary carrier, *(see operation 5-8C)*.
2. Remove the circlip and sun gear.
3. With a narrow cold chisel and hammer carefully unstake the hub retaining nut where the lip has been driven down into the slot.

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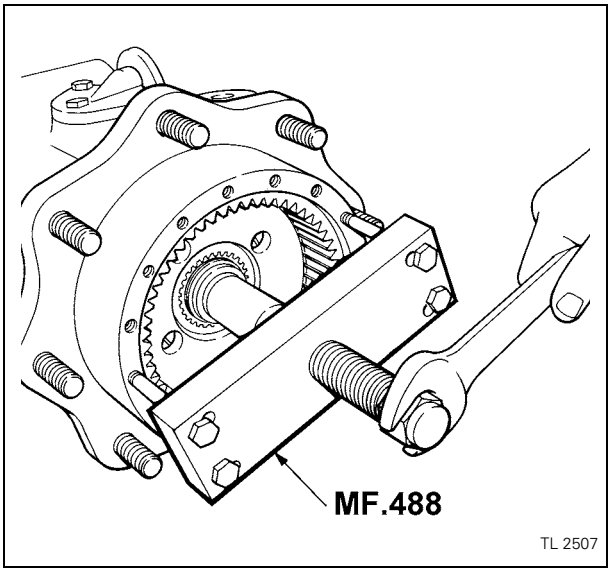
4. Using special tool MF.483 (AG 66) or MF.487 Hub Nut Wrench, unscrew the retaining nut.



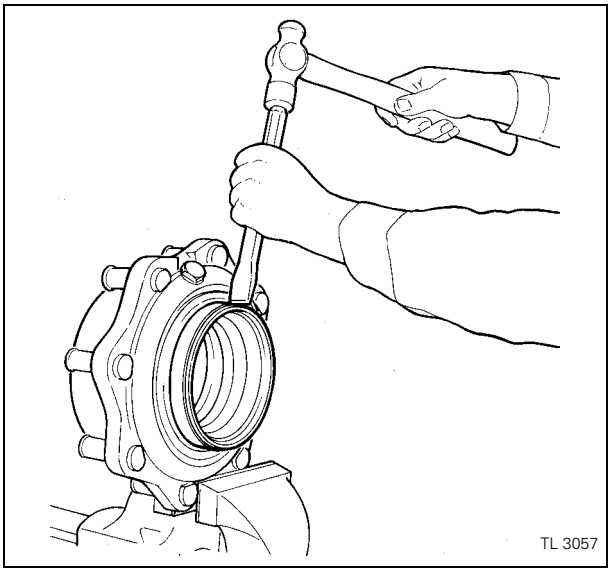
5. With the aid of the special tool MF.488 Hub Puller, pull the planetary ring gear and hub.
6. Place the cap over the end of the drive shaft. Bolt MF.488 across the face of the hub so that the forcing screw locates in the dimple in the cap. Adjust the length of the bolts so that they are all of equal length.

IMPORTANT: *Lubricate all the threads of the forcing screw.*

7. Tighten the screw so that the hub and ring gear are drawn off the shaft.
8. Remove the wheel hub and ring gear from the tool.
9. Remove the dirt seal from the back of the hub.
10. With a cold chisel split the large oil seal and remove from the housing. Be careful not to damage the taper roller bearing.



11. If necessary, remove the oil seal wear ring. With a cold chisel split the ring on the hub and remove.
12. Clean all components for re-assembly.

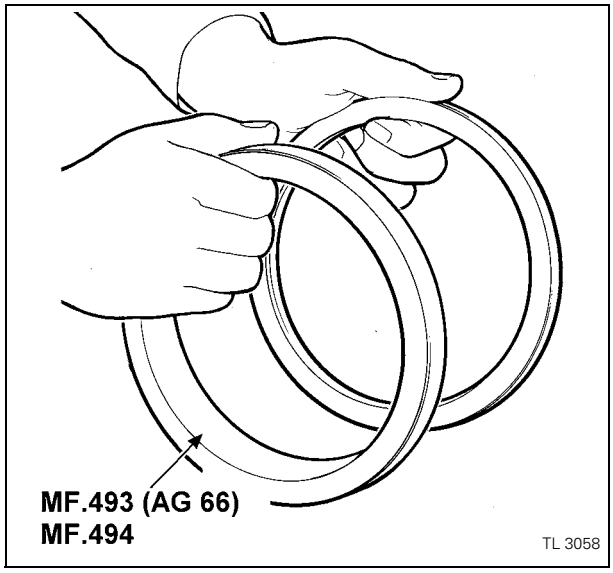


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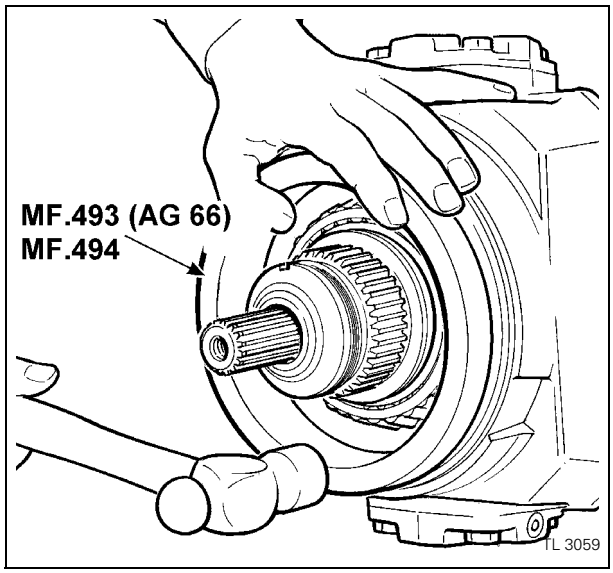
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Refitment

13. Using special tool MF.493 (AG 66) or MF.494 Hub Seal Installer fit a new oil seal. Place the seal on the tool with the lip facing outwards.



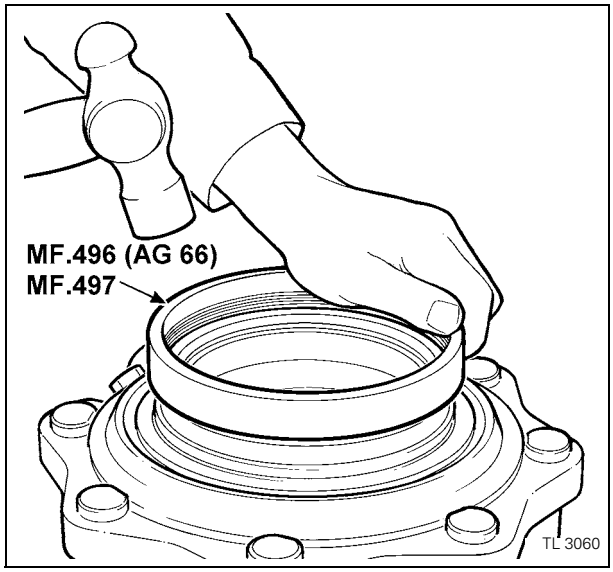
14. Offer the seal and tool assembly up to the swivel housing, with a hammer, gently drive the seal into the housing. Work around the seal driving in a small part at a time until it is fully home.



15. Fit the a new oil seal wear ring using special tool MF.496 (AG 66) or MF.497 Wear Ring Installer and a light hammer. Drive the wear ring down onto the hub using the same method when fitting the oil seal.

NOTE: *The radius edge of the wear ring must face outwards.*

16. Renew the dirt lip seal on the back of the hub.
17. Fill the space between the dirt seal and the lip seal with general purpose grease. It must be 30 to 50% full. Also apply generous application of grease to the lips of the seal.
18. Replace the hub.
19. Replace the planetary ring gear carrier using special tool MF.495 (AG 66) or MF.498 Planetary Ring Gear Replacer.



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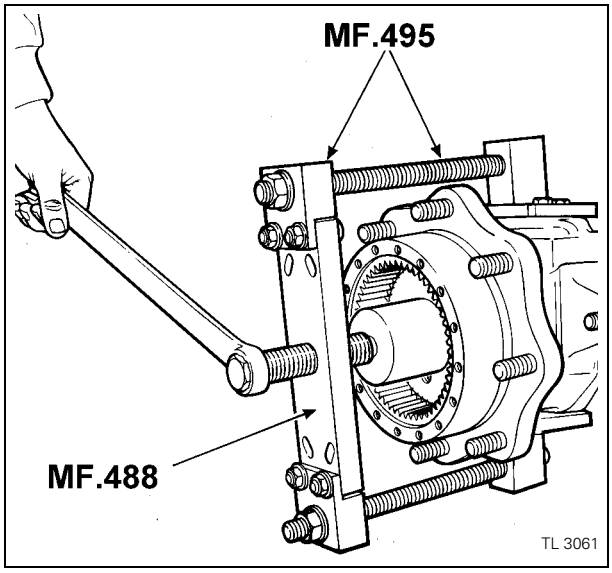
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AG 66 Axles

20. Replace the planetary ring gear carrier using special tool MF.495 Planetary Ring Gear Replacer.
21. To special tool MF.488 add the two extensions (part of MF.495) ensuring that the bolts are tight as shown in the illustration. It is important that they are fitted with the overlapping part to the outside.
22. Remove the top and bottom swivel pin caps and fit the two blocks complete with the threaded studs.
23. Suspend MF.488 on the studs and fit the nuts and washers.
24. Position the ring gear carrier so that the splines are in alignment. Place the cap over the end of the shaft and locate the forcing screw in the end of the cap.

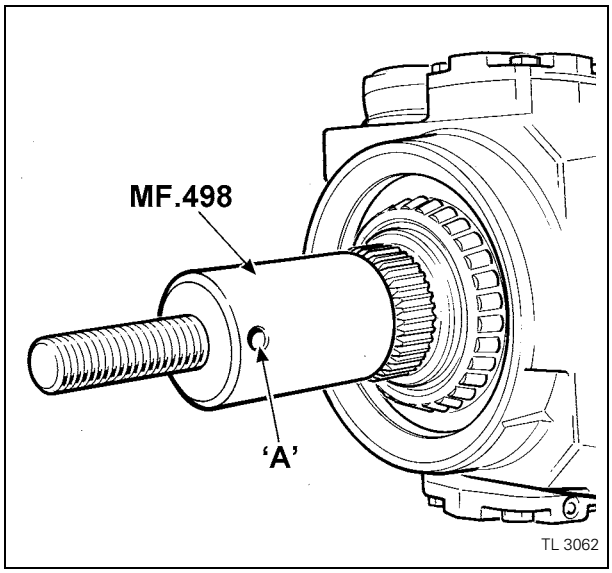
IMPORTANT: *Lubricate all the threads of the forcing screw.*

25. Lubricate the forcing screw, then tighten the screw until the carrier is pressed full home. DO NOT put excessive loads on the tool. Check by turning the hub to determine when the fitting has been completed.
26. Remove the special tool, MF.488, and replace the caps ensuring that the one with the shims is fitted on the top.

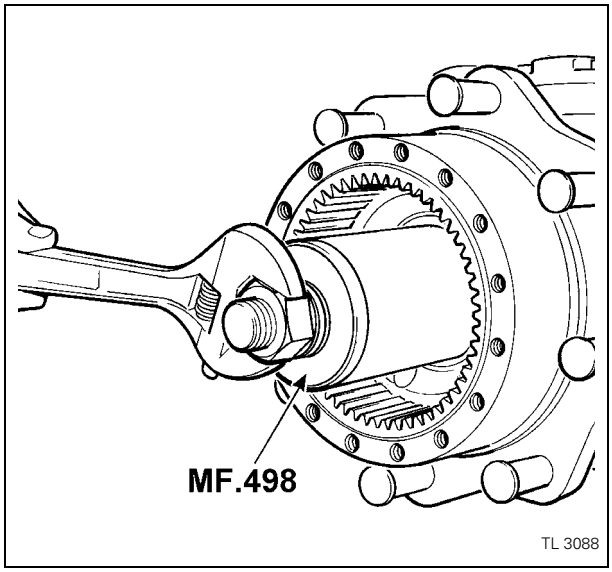


AG 75, AG 85 and AG 105 Axles

27. Screw the main part of the tool onto the thread of the stub axle. DO NOT tighten.
28. Slide the wheel hub and planetary ring gear carrier assembly into position.
29. Push the wheel hub into the oil seal.
30. Lubricate the forcing screw, fit the tube, cap, thrust bearing and nut.



31. Locate the splines in the carrier with the spline on the stub shaft.
32. With a 46 mm A/F spanner tighten the forcing nut until the carrier is pressed full home. DO NOT put excessive loads on the tool. Check by turning the hub to determine when the fitting has been completed.
33. Remove the special tool, MF.498. A 12 mm (1/2 in) diameter hole **'A'** is provided in the body of the tool to aid in removal.

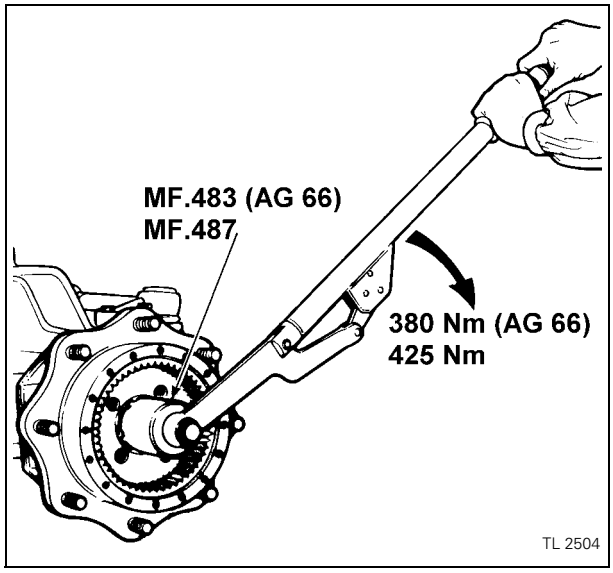


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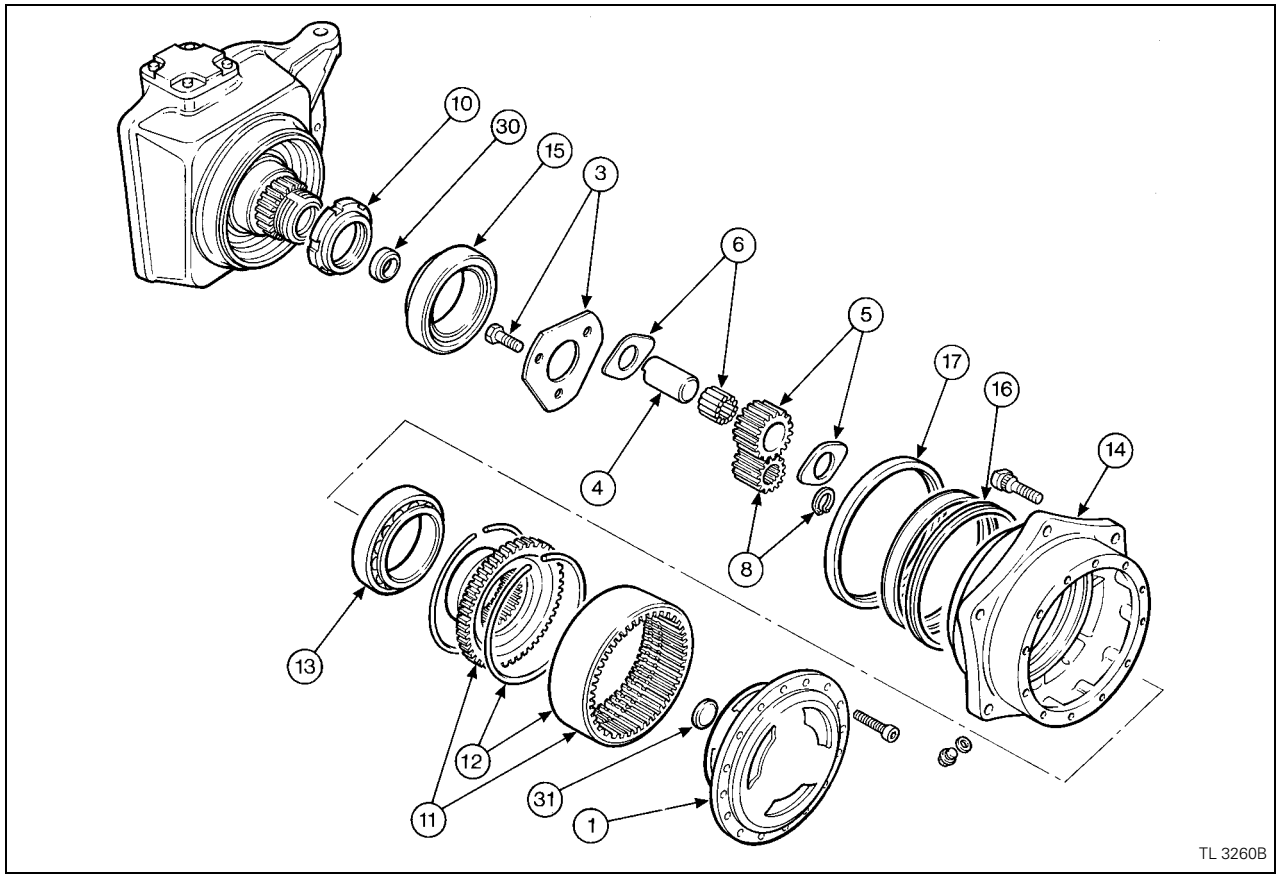
All Axles

34. Renew the ring gear retaining nut and tighten dry to a torque of 380 Nm (280 lbf ft) on the AG 66 axle using special tool MF.483. Tighten to a torque of 425 Nm (315 lbf ft) on all other axles using special tool MF.487.
35. Hammer the lip of the nut down into the slot.
36. Replace the sun gear and circlip.
37. Replace the planetary carrier.



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PLANETARY CARRIER and HUB

Overhaul **7-8C**

Special Tools:
MF.483 Hub Nut Wrench (AG 66)
MF.487 Hub Nut Wrench
MF.488 Hub Puller
MF.498 Planetary Ring Gear Replacer

Dis-assembly

1. Remove the planetary carrier, *(see operation 5-8C).*
2. Place the planetary carrier on the bench.
3. Remove the bolts and retainer ring.
4. Screw an 8 mm bolt (one of the retaining ring bolts) into the end of the shaft and withdraw the planetary gear shaft.
5. Carefully remove the planetary gear and thrust washers taking care not to dislodge the needle roller bearings.
6. Remove the needle rollers and thrust washers by emptying them into a clean container.
7. Repeat procedures 3 to 6 for the remaining two planetary gears.
8. Remove the circlip and sun gear.
9. With a narrow cold chisel and hammer carefully unstake the hub retaining nut where the lip has been driven down into the slot.
10. Using special tool MF.483 (AG 66) or MF.487 Hub Nut Wrench, unscrew the retaining nut.
11. With the aid of MF.488 Hub Puller, remove the ring gear and hub from the splined shaft complete with bearing, *(see operation 6-8C, procedures 5 to 8).*
12. If necessary, remove the circlips and the ring gear.
13. Remove the planetary ring gear taper roller bearing cone with a hammer and punch through the holes in the flange.
14. Remove the wheel hub.
15. If necessary, remove the two bearing cones.
16. If necessary, remove the dirt lip seal from the back of the hub.
17. If necessary, remove the large inner seal from the housing.

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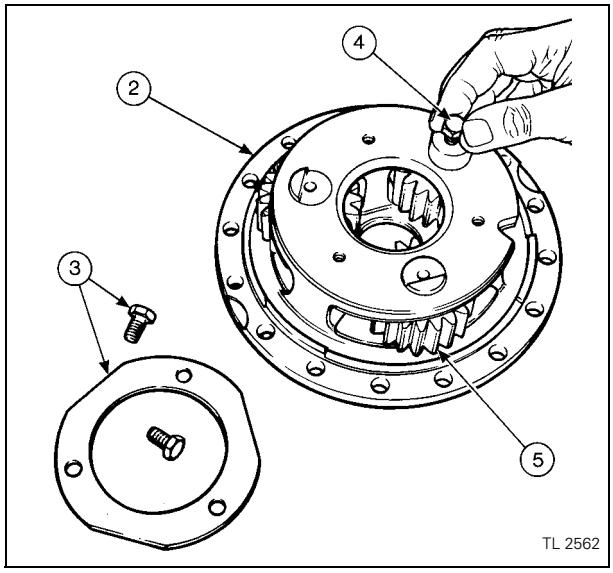
18. Remove the inner bearing cone. If this is necessary the cage will have to be broken, and the rollers removed. To remove the inner track, heat it with a gas torch until it expands and can be removed with a pry bar.

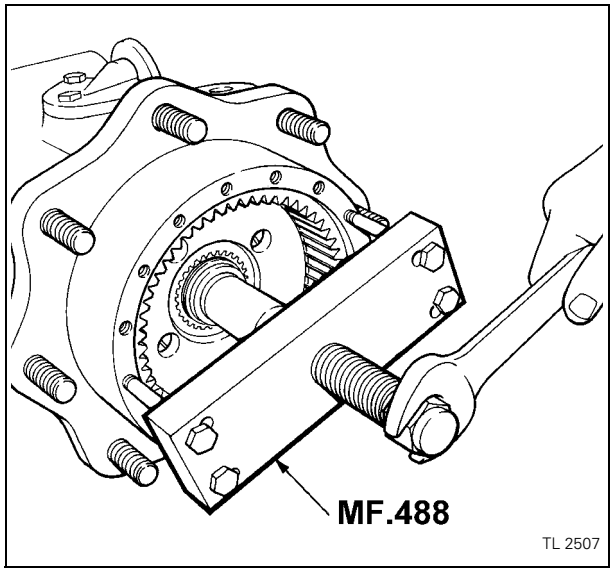
Examination

Thoroughly clean and inspect all components and renew any that are worn or damaged. Renew all 'O' rings and seals.

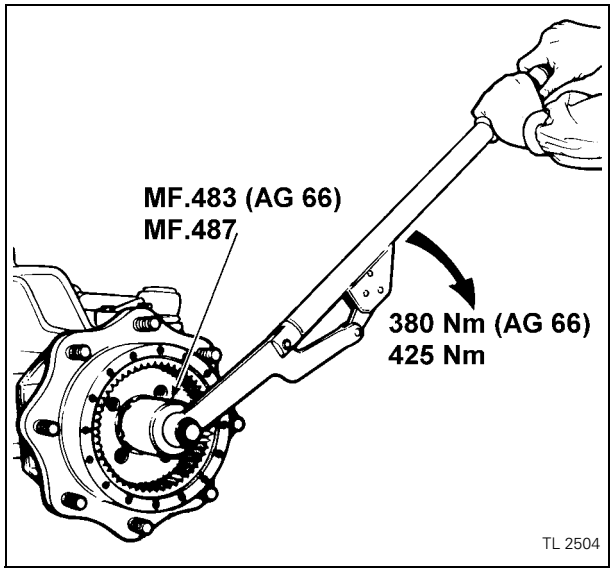
Re-assembly

19. Fit the inner taper roller bearing cone.
20. Fit a new lip seal (10) into the housing. *(see operation 6-8C, procedures 13 and 14).*
21. Fit the two taper roller bearing cups to the hub.
22. Renew the dirt lip seal on the back of the hub.
23. Fit the taper roller bearing cone to the planetary ring gear.
24. Re-assemble the ring gear, fitting the two circlips and gear.
25. Fill the space between the dirt seal and the lip seal with general purpose grease. It must be 30 to 50% full. Also apply grease to the lips of the seal.
26. Replace the hub.
27. Replace the planetary ring gear. *(see operation 6-8C, procedures 19 to 25).*



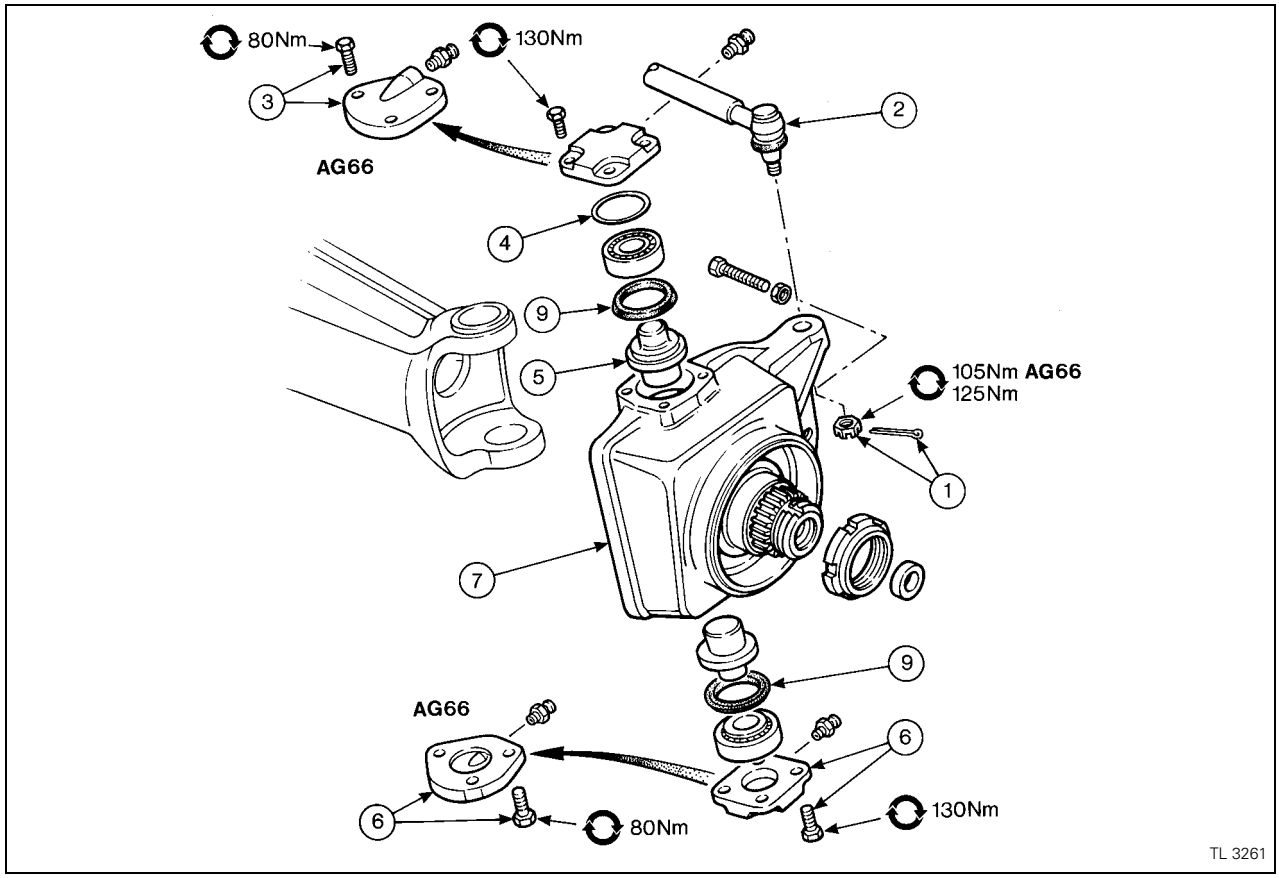


28. Renew the ring gear retaining nut and tighten dry to a torque of 380 Nm (280 lbf ft) on the AG 66 axle using special tool MF.483. Tighten to a torque of 425 Nm (315 lbf ft) on all other axles using special tool MF.487.
29. Hammer the lip of the nut down into the slot.
30. If the thrust ring has been removed it is retained in the housing with Massey Ferguson Studlock (Loctite 270).
31. If the drive shaft thrust pad has been removed it is retained in the cover with Massey Ferguson Studlock (Loctite 270).
32. Refit the sun gear and circlip.
33. Re-assemble the planet gears. Use petroleum jelly, NOT grease, to hold the needle rollers and thrust washers in place during assembly. Each planetary gear contains 19 needle rollers.
34. Refit the gears to the planetary carrier, apply Massey Ferguson Studlock (Loctite 270) to the retaining ring bolts and tighten to a torque of 24 Nm (18 lbf ft).
35. Refit the planetary carrier.



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SWIVEL HOUSING and PINS

Removal and Refitment **8-8C**

Special Tools:
MF.195C Bearing Puller - Main Tool
MF.451B Steering Pin Bearing Remover

Removal

1. Remove the split pin and steering ball joint nut.
2. Release the steering ball joint from the housing.
3. Remove the bolts and the upper cap.
4. Remove the shims and bearing cup.
5. Using special tool MF.195C Bearing Puller - Main Tool and MF.451B Steering Pin Bearing Remover, extract the upper pivot pin. Screw the 14 mm adaptor into the pin and onto the main puller. Remove the pin from the housing.

IMPORTANT: *Lubricate all the threads of the forcing screw.*

6. Remove the bolts and cap from the lower bearing and repeat the extraction of the pivot pin.
7. The housing can now be removed from the axle complete with the drive shaft.
8. This procedure can now be repeated on the other side if the crownwheel and pinion assembly is to be removed.

Examination

Thoroughly clean and inspect all components and renew any that are worn or damaged. Renew all 'O' rings and seals.

Refitment

9. Renew the seals on the pivot pins. Ensure that the seal is fitted to allow the grease to get out.
10. Fit the bearing cones to the pivot pins. DO NOT grease the bearings at this stage.
11. Coat the pivot pins and holes with a light application of grease or anti-seize compound.

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12. Hold the housing in position and partly fit the upper pivot pin to locate the assembly.
13. Refit the lower pivot pin, bearing cup, cap and bolts. NO shims are fitted to the lower cap.
14. Tighten the bolts evenly and in sequence to pull the lower pivot pin into the housing. Tighten the bolts to a torque of 80 Nm (60 lbf ft) on the AG 66 axle, and to a torque of 130 Nm (95 lbf ft) on all other axles.
15. Fit the upper bearing cup, shims, cap and bolts. Add additional shims to ensure that the pivot pins are seated on the axle casing. Tighten two opposing bolts evenly and in sequence to press the pivot pin into the housing.
16. Check that both pivot pins are fully seated onto the axle casing.
17. Remove the upper cap and shims.
18. Replace the cap and tighten the bolts to a torque of 80 Nm (60 lbf ft) on the AG 66 axle, and to a torque of 130 Nm (95 lbf ft) on all other axles.
19. Using a dial indicator gauge and lever as shown in the illustration, determine the end float of the two pivot bearings.

    When lifting the housing up and down with the lever ensure that you get the maximum reading on the dial indicator gauge. The correct bearing pre-load is 0,15-0,25 mm (0.006-0.010 in).
20. Select the required shims by the following method:

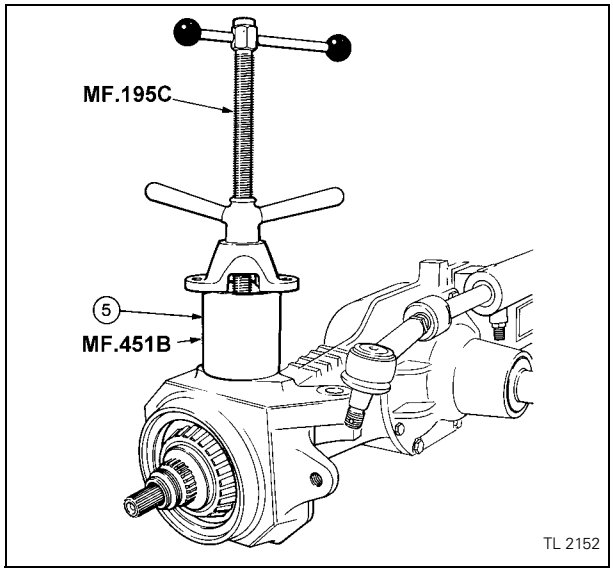
    Shims required = End float + Pre-load

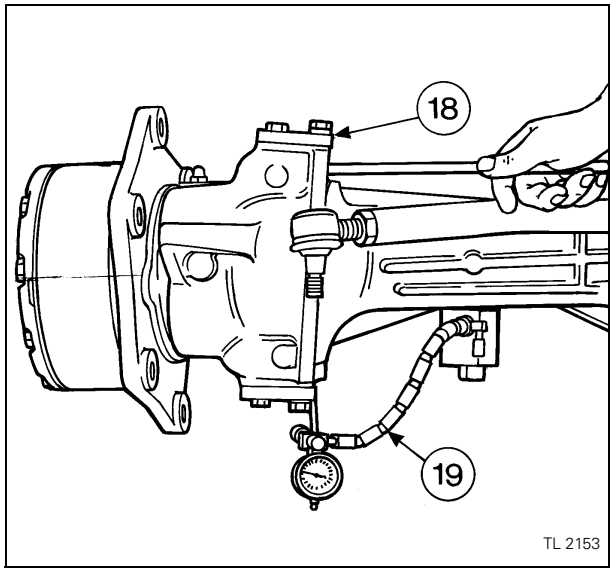
    Select shims from the following chart:

AG 66 axle only - thickness		
Part number	mm	inch
3427 190 M1	0,10	0.004
3427 191 M1	0,15	0.006
3427 192 M1	0,30	0.012
3427 193 M1	0,50	0.020
3427 194 M1	0,70	0.028
3427 195 M1	1,00	0.040

All other axles - thickness		
Part number	mm	inch
3426 234 M1	0,10	0.004
3426 233 M1	0,15	0.006
3426 232 M1	0,30	0.012
3426 231 M1	0,50	0.020
3426 230 M1	1,00	0.040

21. Remove the upper cap and bearing cup. Fill the bearing with grease, fit the correct number of shims, replace the cap.
22. Apply lubricating oil to the threads of the bolts and tighten to a torque of 80 Nm (60 lbf ft) on the AG 66 axle, and to a torque of 130 Nm (95 lbf ft) on all other axles.



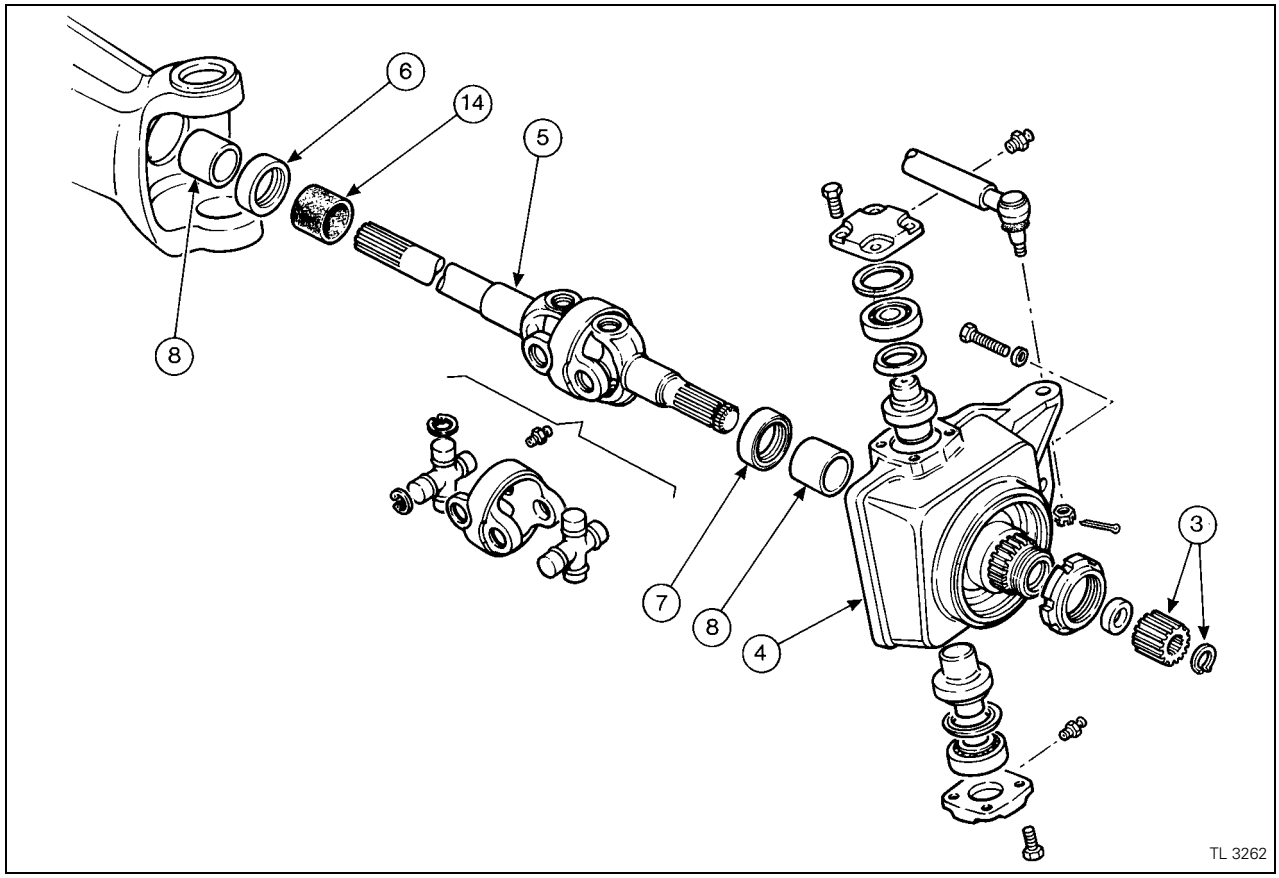


23. Remove the lower bearing cap and cup and fill the bearing with grease. Tighten the bolts as described in procedure 22.
24. Grease both bearings with a grease gun, ensure that the grease appears inside the housing.
25. Apply lubricating oil to the thread and tighten the ball joint nut to a torque of 105 Nm (80 lbf ft) on the AG 66 axle, and to a torque of 125 Nm (90 lbf ft) on all axles. Then tighten further as required to align the nut for the split pin - maximum torque 130 Nm (95 lbf ft) on the AG 66 axle, and to a maximum torque 160 Nm (118 lbf ft) on all other axles. Renew the split pin.

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Four-wheel Drive Front Axle



DRIVE SHAFT and OIL SEALS

Removal and Refitment 9-8C

Removal

1. Drain some of the oil from the axle casing.
2. Remove the planetary carrier, *(see operation 5-8C)*.
3. Remove the circlip and sun gear.
4. Remove the swivel housing, *(see operation 8-8C)*.
5. Remove the drive shaft from axle casing.
6. Lever the seal out of the axle casing.
7. Lever the seal out of the pivot housing.
8. Using an internal bearing puller, extract the bushes in the axle casing and swivel housing.

Examination

Carefully inspect the universal joints in the drive shaft, if there is any sign of wear renew the joints or fit new shafts. Inspect the condition of the drive shaft bushes, renew if necessary.

Refitment

9. To install new bushes and oil seals it will be necessary to make some service tools. This will ensure that the components are correctly fitted.
10. Manufacture the tools required for the size of axle being worked on. Installation of the outer bush in the swivel housing of an AG 66 axle requires a special tool, see first illustration.
11. Place the bush on the special tool and drive it into the housing. The bushes must be fitted with the split line at three o'clock, see illustration, and installed to a depth **'A'** of 2 mm (0.080 in) behind the oil seal face with the exception of the AG 66 axle swivel housing bush. This bush must be installed 3 mm (0.076 in) behind the sloping face of the housing with the split line at three o'clock.

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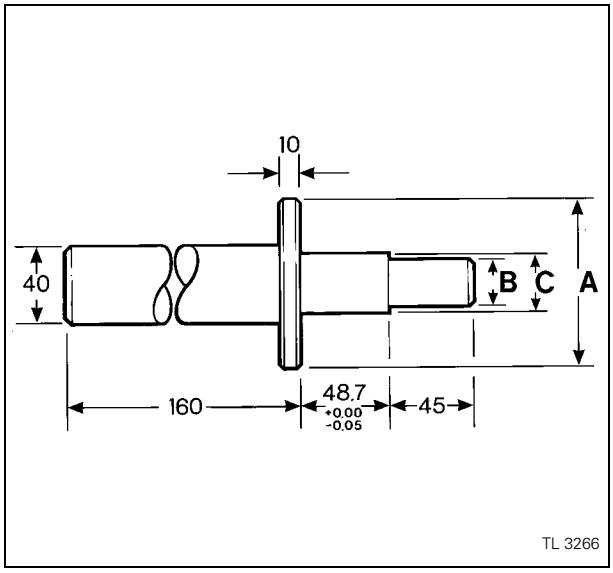


Fig.1 Outer Bush Tool – AG 66 Axle

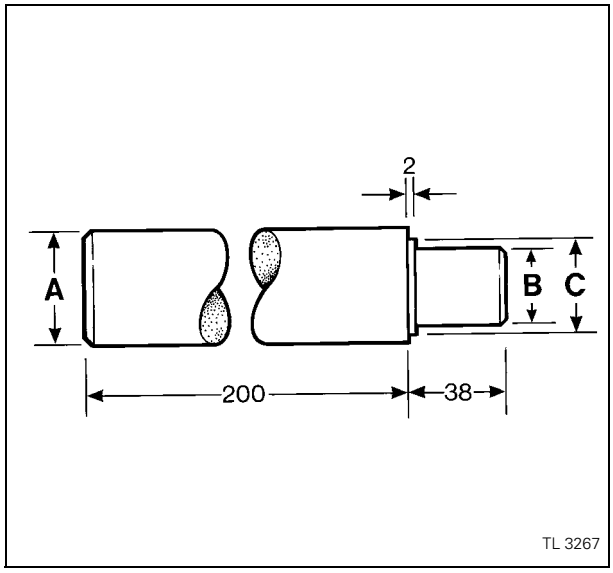


Fig.2 Bush Tool

Bush Installing Tool			
Axle Type	Dimension **'A'** diameter	Dimension **'B'** diameter	Dimension **'C'** diameter
AG 66 Outer bush Fig.1	89 mm ± 0,10	30 mm ± 0,10	26,5 mm +0,20 +0,10
AG 66 Inner bush Fig.2	43 mm ± 0,10	25 mm ± 0,10	33,5 mm +0,20 +0,10
AG 75, 85 & 105 Inner & outer bushes Fig.2	50 mm ± 0,10	35 mm ± 0,10	38,5 mm +0,20 +0,10

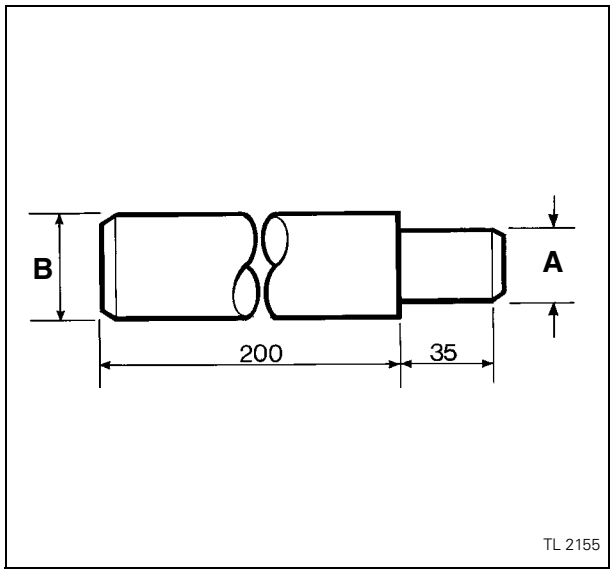


Fig.3 Oil Seal Tool

Oil Seal Installing Tool		
Component	Dimension **'A'**	Dimension **'B'**
AG 66 Fig.3	30 mm dia. +0,000 -0,033	42 mm dia.
AG 75, 85, & 105 Fig.3	35 mm dia. +0,000 -0,033	50 mm dia.

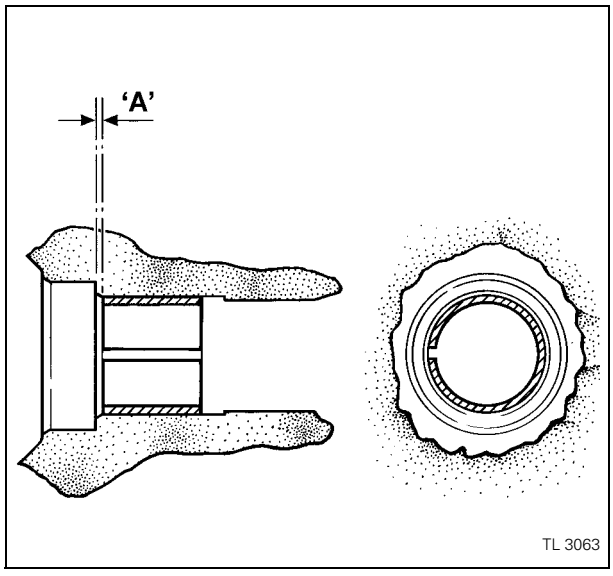


Fig.4 Bush Position

12. Manufacture a tool to install the seal according to the axle being worked on. Place the oil seal on the tool with the lip of the seal facing the inside of the casing or swivel housing. Drive the seal carefully to the bottom of the recess.
13. Fill the seal cavity with a general purpose grease.
14. Fit a new dust seal to the crownwheel side of the drive shaft.
15. Refit the drive shaft into the axle casing taking care not to damage the oil seal when locating the splines.
16. Refit the swivel housings and planetary gears.
17. Refill both the axle and planetary carrier to the correct level with an approved oil. Grease the drive shafts and swivel bearing caps.

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DRIVE SHAFT

Overhaul 10-8C

Dis-assembly

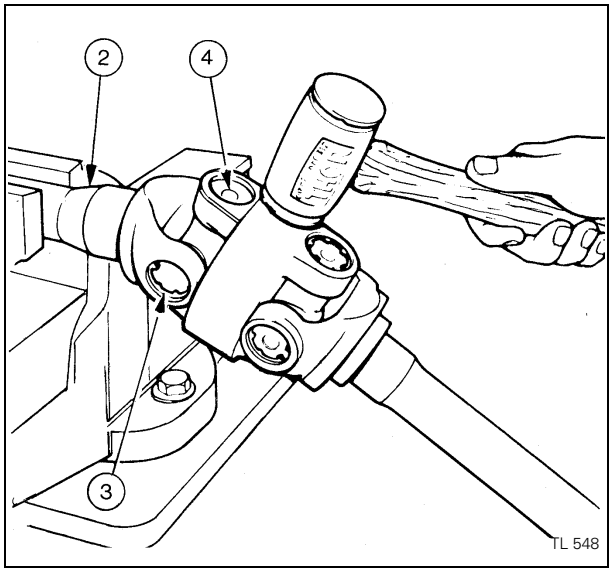
1. Remove the drive shaft, *(see operation 9-8C)*.
2. Hold the inner section of the drive shaft in a soft faced vice.
3. Remove the four circlips from each end of the universal joint.
4. Using a hammer, drive the central yoke downwards until the bearing sleeve protrudes.
5. Clamp the bearing sleeve in a vice and tap the central yoke from the bearing.
6. Remove the opposing bearing sleeve in the same way and remove the outer section of the shaft.
7. Turn the shaft assembly through 90°, then repeat procedures 4 to 6 to free the other universal joint from the shaft.
8. Grip the outer section of the drive shaft in a vice and repeat procedures 2 to 7.

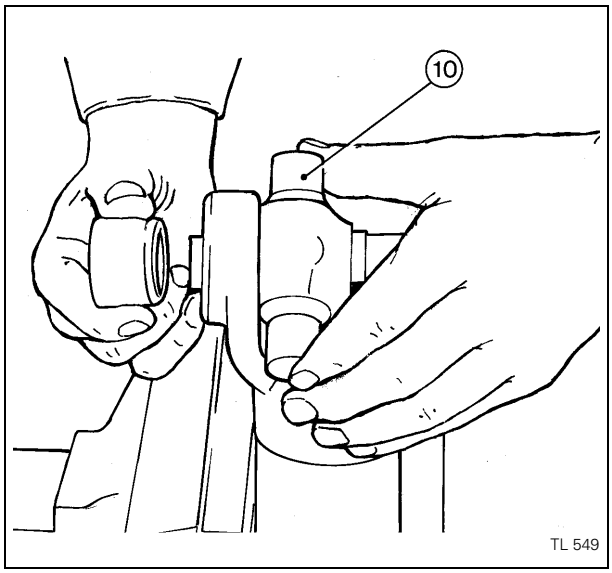
Examination

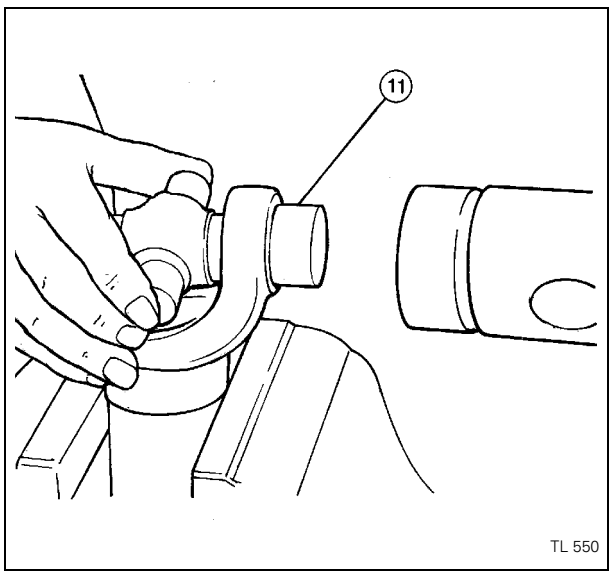
Pay particular attention to the axle shaft splines. Inspect all components and renew any which show signs of wear or damage. Always renew the universal joint as an assembly including the joint, bearings, caps, circlips and seals.

Re-assembly

9. Ensure that the needle rollers are held in place with a little grease in the bearing sleeve.
10. Position the cross within the yoke and move it sideways as far as possible to provide a guide for the needle rollers in the bearing sleeve when being refitted.
11. Slide the bearing sleeve onto the cross and drive the bearing into the yoke deep enough to permit the insertion of the circlip.
12. Assemble the remaining sleeves and universal joint in a similar method.
13. Thoroughly lubricate the universal joint with a grease gun after completing assembly and before fitting to the axle.
14. Refit the drive shaft to the axle.







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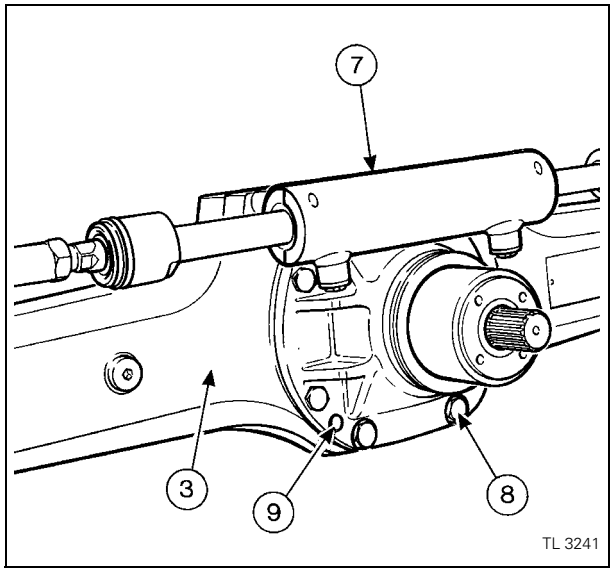
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DIFFERENTIAL ASSEMBLY

Removal and Refitment 11-8C

Removal

1. Secure the tractor by applying the parking brake.
2. Jack up the front of the tractor and support under the engine.
3. Remove the axle from the tractor, *(see operation 3-8C)*.
4. Remove both front wheels.
5. Drain the oil from the axle casing.
6. Remove both swivel housings, *(see operation 8-8C)*. It is not necessary to dismantle the planetary hubs.
7. Remove the steering cylinder, *(see operation 14-8C)*.
8. Remove the eight bolts holding the differential case to the axle casing.



WARNING: Take care when removing the differential assembly, it is awkward and heavy to handle.

9. The differential is located by dowels in the axle casing. Carefully prise it away from the casing supporting the weight at all times.

Refitment

10. Reverse procedures 1 to 9 except:

a. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the joint face of the differential case.

b. Apply lubricating oil to the differential case bolts and tighten them to a torque of 135 Nm (100 lbf ft).

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DIFFERENTIAL ASSEMBLY

Overhaul **12-8C**

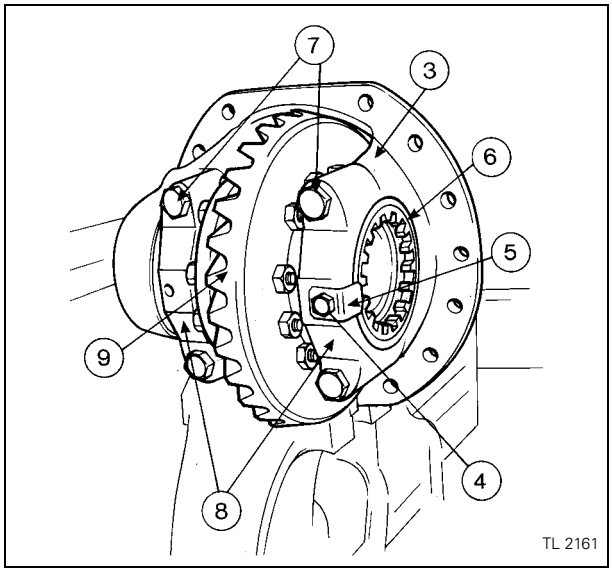
Special Tools:
MF.471A Hydralock Spring Compressor

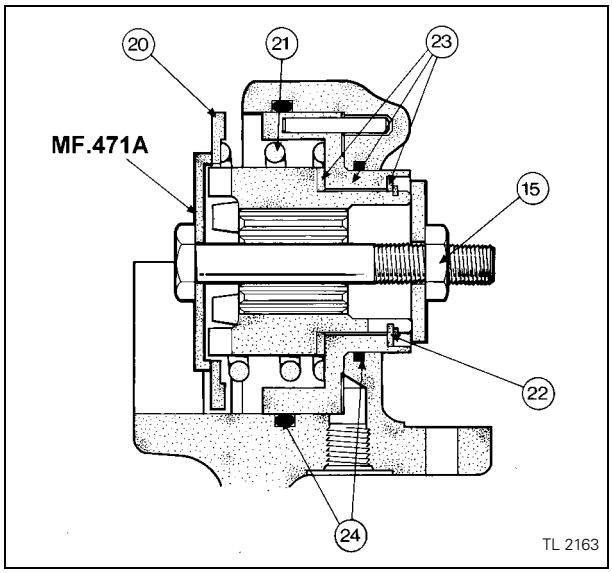
Dis-assembly

1. Remove the differential assembly, *(see operation 11-8C).*
2. Hold the differential assembly in the jaws of a vice.
3. Mark the end caps and casting to aid re-assembly.
4. Remove the securing bolts.
5. Remove the locking tabs.
6. Unscrew the bearing adjustment ring nut.
7. Remove the cap bolts.
8. Remove the end caps.
9. Lift the differential assembly out of the casing.
10. Remove the bearing cups.
11. Check that the two **'X'** marks are stamped on the differential case to ensure alignment during assembly. If these marks cannot be found, mark the two halves of the case.
12. Place the crownwheel and differential unit in the vice and remove the eight nuts and bolts.
13. Split the differential case and remove the differential gears, cross or shaft and thrust washers.

WARNING: Spring under compression, use special tool MF.471A. Failure to use the special tool or some other restraining means when removing the Hydralock assembly can cause injury.

14. Remove the bearing shims and retain for re-assembly.
15. Fit the Hydralock Spring Compressor MF.471A. Carefully centralize the two washers.
16. Tighten the spring compressor until the spring tension has been taken off the retaining ring.
17. Remove the retaining ring.
18. Slide the hydralock assembly out of the housing. It may need a tap with a hammer if the seals are tight.
19. Dismantle the hydralock unit by loosening and then removing the spring compressor.
20. Remove the spring guide plate.
21. Remove the coil spring.

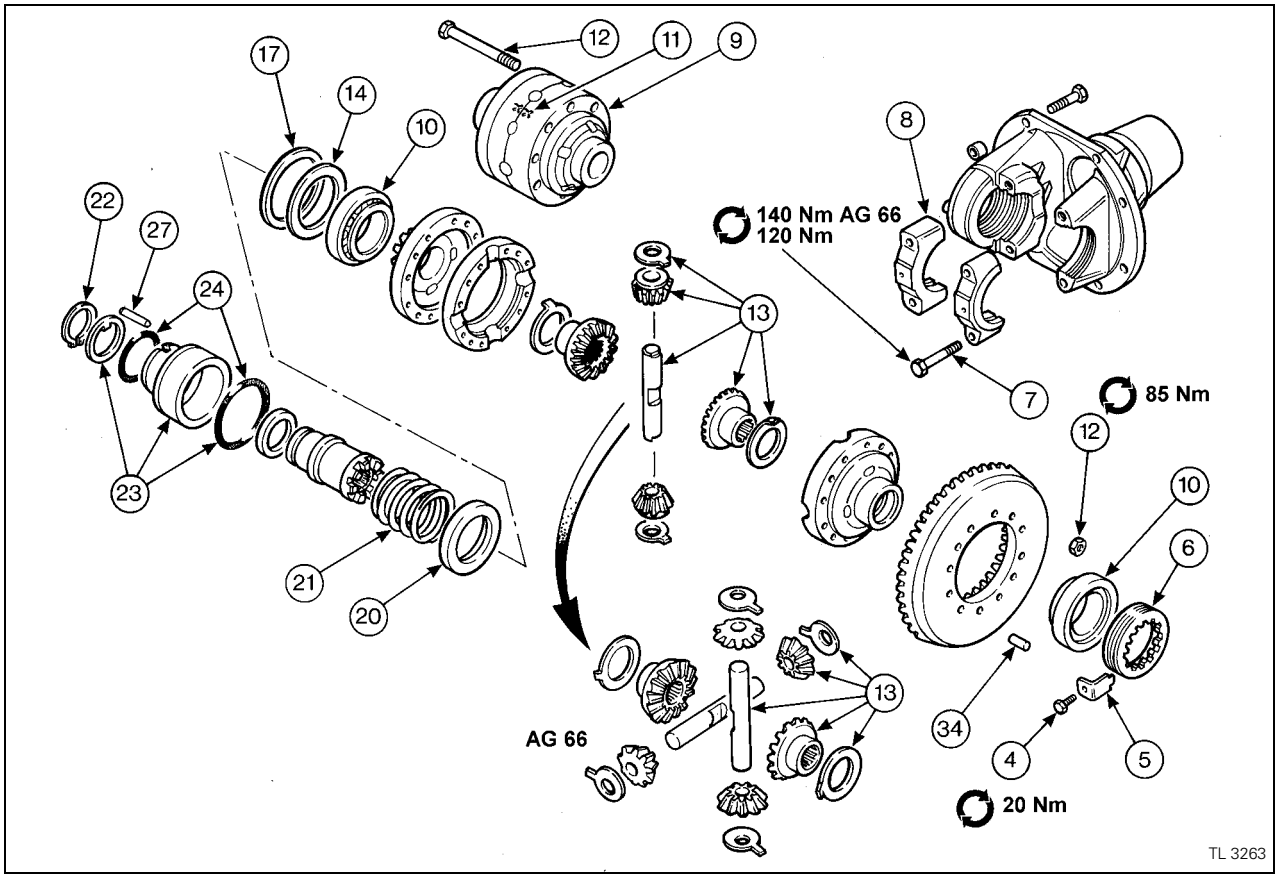




22. Remove the circlip.
23. Remove the piston and two thrust washers.
24. Remove the two seals from the housing.

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Examination

Thoroughly clean and inspect all components. Any parts showing signs of wear or damage must be renewed. Renew all 'O' rings, seals and circlips.

Re-assembly

25. Re-assemble the piston and coupler with the two thrust washers and circlip.
26. Fit two new seals into the housing ensuring that they are both correctly positioned and well lubricated.
27. Tap the piston and coupler assembly into the housing ensuring that it locates on the internal peg.
28. Refit the spring, guide plate and special tool MF.471A.
29. Tighten the spring compressor until the retaining clip can be inserted into its groove.
30. Slowly release the spring compressor and remove it.
31. Refit the removed shims.

Crownwheel and Differential

32. Refit or renew the taper roller bearing cones if they have been removed.
33. Refit the differential gears, cross and thrust washers into the case. AG 66 axles are fitted with four pinions, AG 75, 85 and 105 axles are fitted with two pinions. Ensure that the tabs on the thrust washers are correctly located in the holes in the differential case.
34. Align the marks on the case and locate the crownwheel on the two dowels. Refit the bolts, apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten the nuts to a torque of 85 Nm (65 lbf ft).
35. Refit the bearing cups and refit the crownwheel and differential assembly. The crownwheel is mounted on the left side of the differential.
36. Refit the bearing caps and lightly tighten the bolts.

Bearing Pre-load

37. Tighten the adjuster ring to take up the backlash between the taper roller bearings.

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38. Finally, turn the adjuster ring a further three notches until the slot is aligned with the locking plate to apply the correct pre-load.

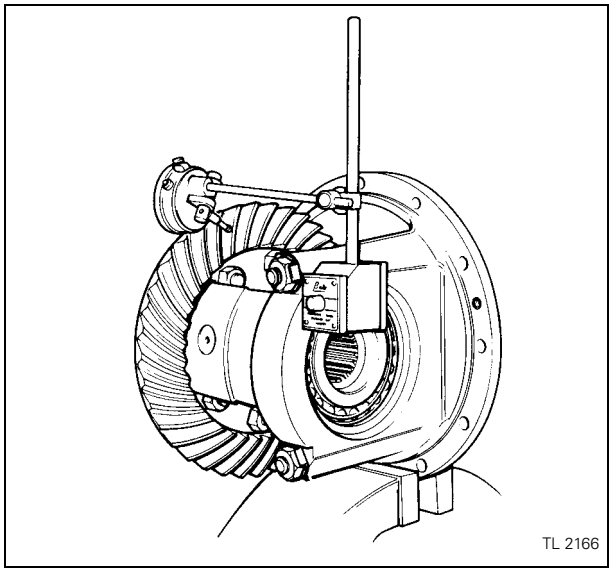
Crownwheel and Pinion Backlash

39. With a dial indicator gauge check the backlash between the crownwheel and the pinion. Fit the indicator gauge as shown in the illustration, the clearance should be:

    AG 66 axle - 0,15-0,20 mm (0.006-0.008 in).

    AG 75/85/105 axle - 0,18-0,23 mm (0.005-0.007 in).

40. If the reading is too high or too low it will be necessary to remove the crownwheel and differential assembly and adjust the thickness of the shim pack behind the right-hand bearing. Reduce the thickness of the shim pack if the clearance is too high, add if the clearance is low. Shims are available in the following sizes:


TL 2166

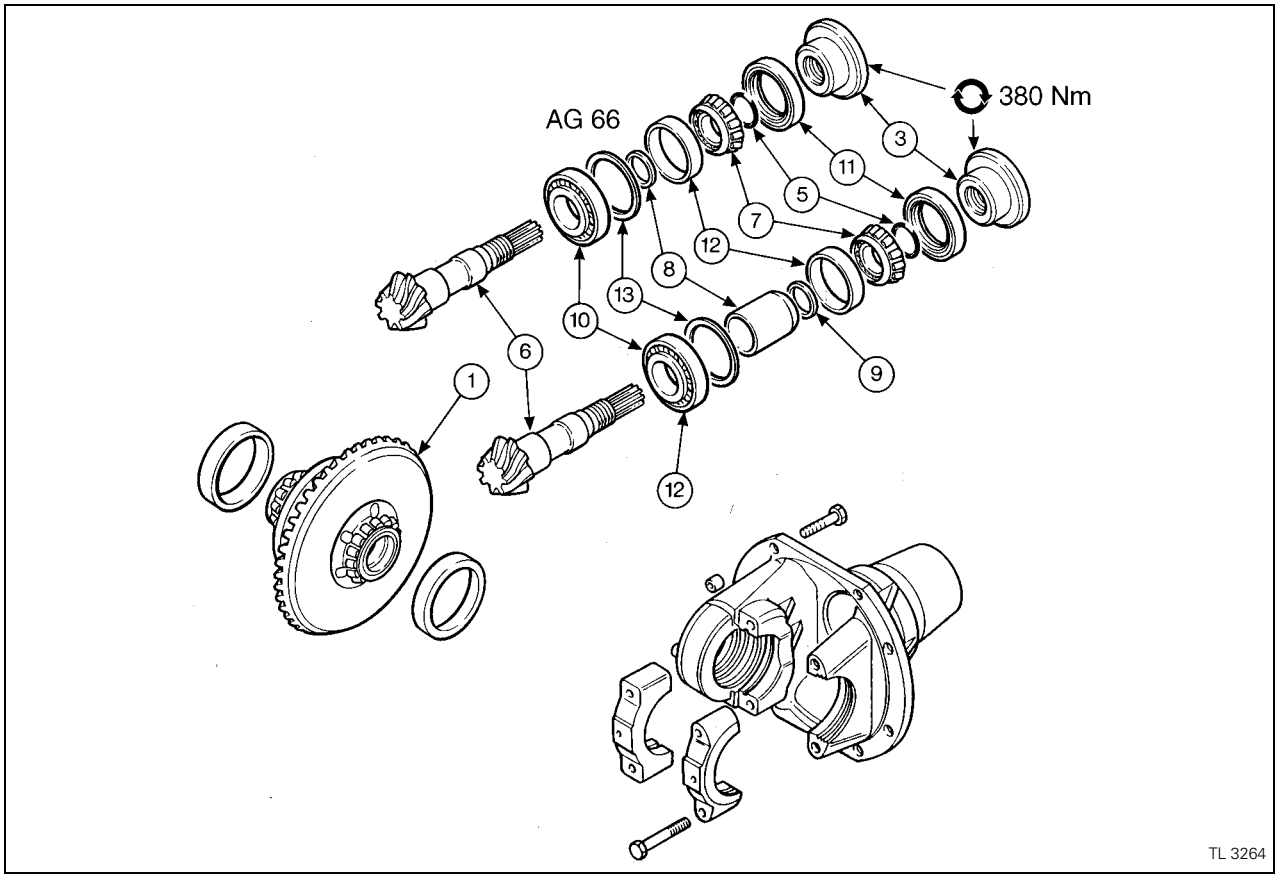
Shim thickness chart - AG 66 Axles		
Part number	mm	inch
3429 077 M1	0,10	0.004
3429 078 M1	0,15	0.006
3429 079 M1	0,30	0.012
3429 080 M1	0,50	0.020
3429 081 M1	0,70	0.028
3429 082 M1	1,00	0.040

Shim thickness chart - AG 75/85/105 Axle		
Part number	mm	inch
3427 281 M1	0,10	0.004
3427 282 M1	0,15	0.006
3427 283 M1	0,30	0.012
3427 284 M1	0,50	0.020
3427 285 M1	0,70	0.028
3427 286 M1	1,00	0.040

41. When the setting is correct remove each cap bolt in turn and apply Massey Ferguson Studlock (Loctite 270) to the thread. Tighten the bolts to a torque of 140 Nm (103 lbf ft) for AG 66 axle and 130 Nm (95 lbf ft) for all other axles.
42. Replace the locking tab, apply Massey Ferguson Studlock (Loctite 270) and tighten the bolt to a torque of 20 Nm (15 lbf ft).
43. Check the rotation of the crownwheel and pinion to ensure satisfactory operation.
44. Refit the differential unit to the axle casing.

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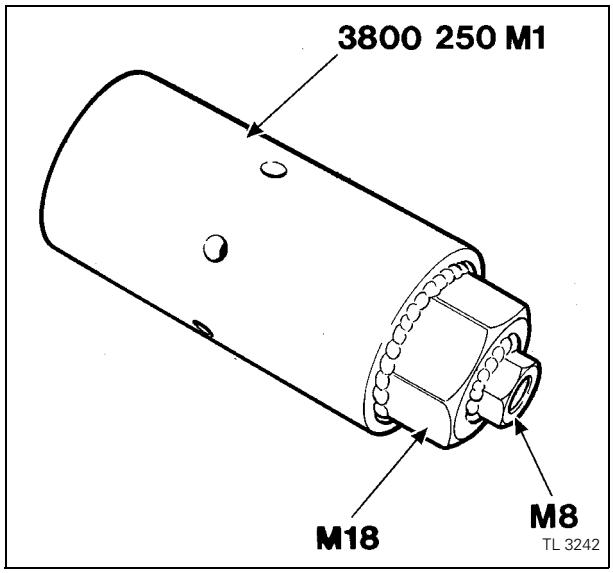
CROWNWHEEL and PINION

Overhaul **13-8C**

Special Tools:
MF.502 Pinion Nut Wrench
MF.503 Pinion Oil Seal Installer
FT.4062A Pinion Pre-load Gauge
Straight Edge

Dis-assembly

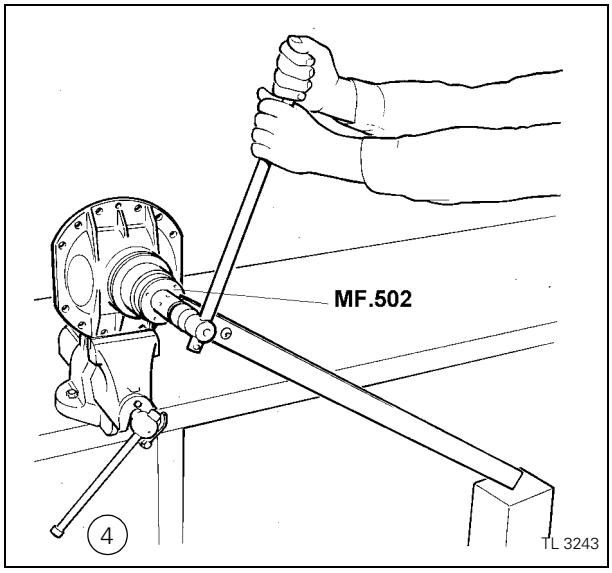
1. Remove and dismantle the crownwheel and differential assembly, *(see operation 11-8C)*.
2. With a narrow cold chisel and hammer carefully unstake the pinion nut securing it to the pinion shaft.
3. To remove the pinion nut you will need to locally manufacture a special sleeve. Obtain coupler number 3800 250 M1 and to one end weld an M18 nut and a M8 nut as shown in the illustration.
4. Using special tool MF.502 Pinion Nut Wrench, add an extension bar (section 45 x 5mm), length to suit mechanic, to the handle as shown in the illustration, use 2 off 14mm bolts at a 85 mm pitch. Remove the pinion nut.



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5. Remove the 'O' ring inside the nut and discard.
6. With the aid of a soft faced hammer or press remove the pinion with bearings from the case.
7. Remove the outer bearing cone.
8. Remove the spacer (calibrated spacer on AG 66 axle only).
9. Remove the bearing pre-load shims and retain for re-assembly (AG 75, 85 and 105 axles only).
10. Remove the inner bearing cone with a bearing separator plate and press.
11. Remove the oil seal.
12. Remove the inner and outer bearing cups.
13. Remove the pinion depth of mesh shims.



Examination

Thoroughly clean and inspect all components. Any parts showing signs of wear or damage must be renewed. Renew all 'O' rings, seals and circlips. Ensure that all parts are free from dents or damage.

Re-assembly

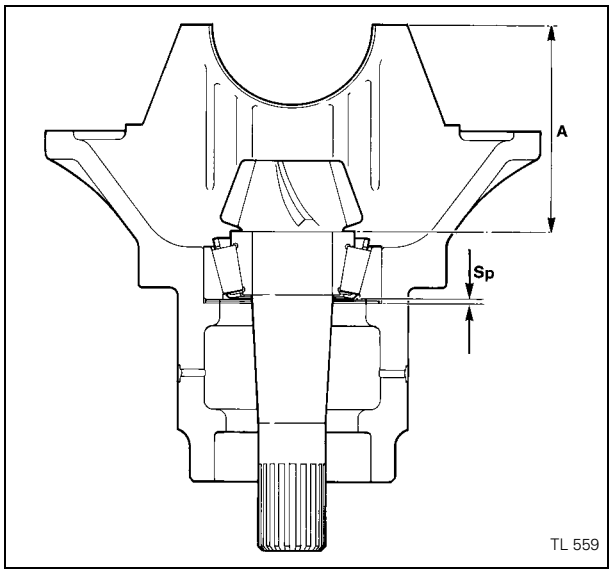
The crownwheel and pinion are only available as a matched set. If the crownwheel and pinion are not to be replaced the following instructions on setting the pinion may be disregarded. The two sets of shims must be retained for re-assembly.

It is necessary to carry out a series of measurements, calculations and procedures to establish the exact position of the pinion in relation to the crownwheel and the pinion bearing pre-load. It is recommended that you work in the metric system for ease of calculation.

Pinion Settings - Depth of Mesh

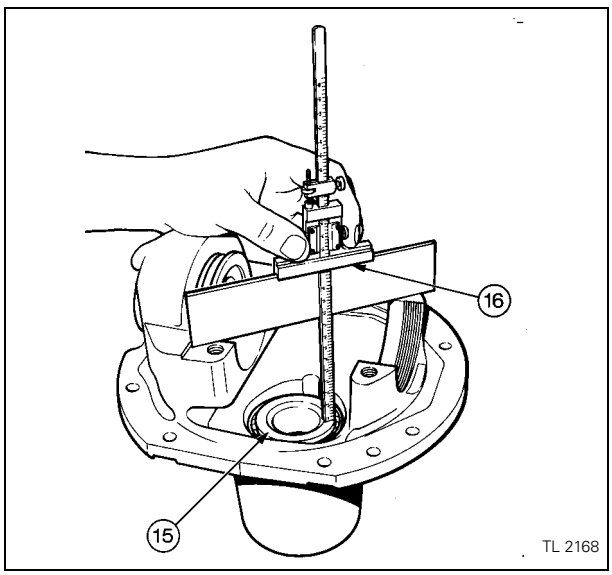
14. The height of the pinion is adjusted by shims under the taper roller bearing to obtain dimension **'A'**. The shims required are calculated in accordance with the following formula:

Sp	=	A- (D + R)
Sp	=	Shim thickness.
A	=	Actual dimension from centre line of crownwheel to the top of the taper roller bearing without shims.
D	=	Nominal dimension of 91 or 118 mm.
R	=	Actual tolerance of dimension **'D'** etched on the bevel pinion. This value may be a positive (+) or a negative (-) to be added or subtracted from the nominal dimension **'D'**.



For the next series of procedures you will require a precession depth gauge and straight edge.

15. Fit the upper taper roller bearing cup and cone into the housing without shims.



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16. Place the housing in the vertical position on the bench. Place a straight edge across the bearing cap faces and measure from the top of the straight edge to the top of the bearing. You may find it easier to place a small piece of plate over the bearing and measure from the centre of the bearing.

    Subtract the width of the straight edge and add the thickness of the plate if used, from your reading and record dimension **'A'**.
17. Dimension **'D'** is a fixed dimension of 91 mm (AG 66) and 118 mm on the other sizes of axles which must always be adhered to.
18. Inspect the end of the pinion and record tolerance 'R', plus or minus.
19. Using the figures you have obtained above and the formula calculate the shim thickness required.

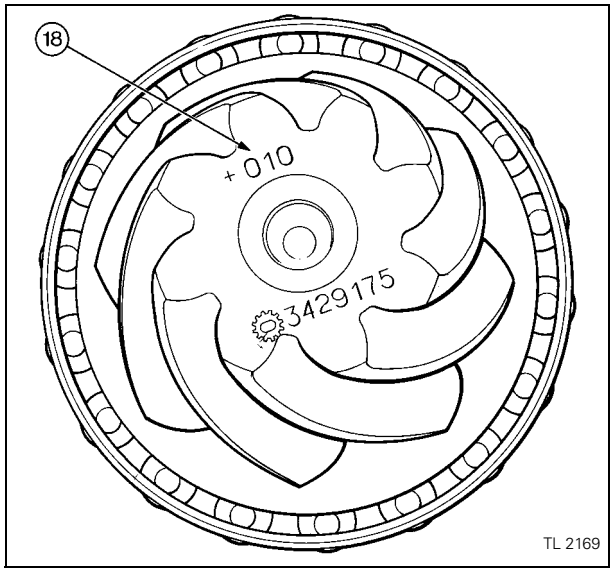
Example AG 66 only - others similar:

Where	A	=	91,96 mm	(measured).
	D	=	91 mm	(nominal).
	R	=	+ 0,010 mm	(tolerance).
	Sp	=	91,96 less (91 plus 0,010).	
	Sp	=	0,95 mm.	

Shims required: 1 x 0,15, 1 x 0,3 and 1 x 0,5.

Check the thickness of the pack with a micrometer. It may be necessary to round-off to the nearest value that can be made into a shim pack. Select the higher value if new bearings are being fitted. Shims are available in the sizes shown in the tables opposite.

20. Remove the bearing, place the shim pack into the housing and fit the inner taper roller bearing cup.
21. Fit the outer taper roller bearing cup.
22. Press the inner taper roller bearing cone on to the pinion.
23. Replace the bearing spacer with the chamfered end facing the splined end.
24. Replace the spacer or shims that were removed on dis-assembly as a starting point, then the bearing cone and a new nut. DO NOT fit the oil seal.
25. Tighten the nut dry to a torque of 380 Nm (280 lbf ft). Tap the pinion in both directions to ensure that the bearings are fully seated. See procedures 36 and 37 for further details on tightening the pinion nut.
26. Lightly lubricate the bearings.



AG 66 Axles	Thickness	
Part number	mm	inch
3428 722 M1	0,10	0.004
3428 723 M1	0,15	0.006
3428 724 M1	0,30	0.012
3428 725 M1	0,50	0.020
3428 726 M1	0,70	0.028
3428 727 M1	1,00	0.040

AG 75 and 85 Axles	Thickness	
Part number	mm	inch
3429 077 M1	0,10	0.004
3429 078 M1	0,15	0.006
3429 079 M1	0,30	0.012
3429 080 M1	0,50	0.020
3429 081 M1	0,70	0.028
3429 082 M1	1,00	0.040

AG 105 Axles	Thickness	
Part number	mm	inch
3428 923 M1	0,10	0.004
3428 924 M1	0,15	0.006
3428 925 M1	0,30	0.012
3428 926 M1	0,50	0.020
3428 927 M1	0,70	0.028
3428 928 M1	1,00	0.040

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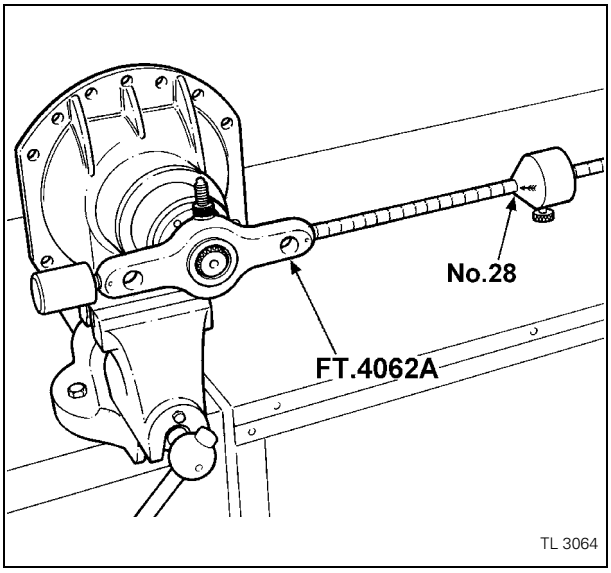
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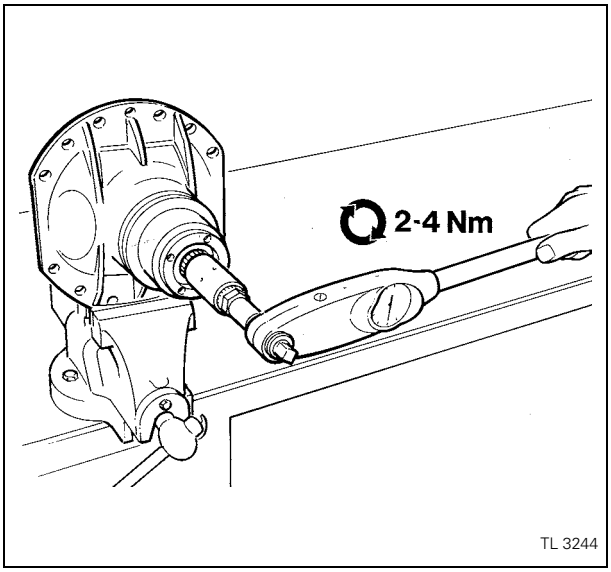
Pinion Bearing Pre-load

27. It is now necessary to set the taper roller bearing pre-load by selecting the correct spacer (AG 66 axle or shims to be placed between the spacer and outer bearing. The correct rotational torque is 2-4 Nm. This can be set by using special tool FT.4062A or using the special sleeve and a torque wrench.
28. Special tool FT.4062A is calibrated in inch pounds (in lb). Moving the weight to the 28 in. mark on the rod represents 3 Nm.
29. Attach special tool FT.4062A to the pinion spline and set the weight to the 28 mark.
30. The setting is correct when you touch the weight end of the tool and it slowly rotates from the horizontal to the vertical position.
31. Alternatively, using the special sleeve and a dial reading torque wrench. Rotate the pinion through a few turns using the torque wrench noting the reading on the dial, it is correct when a rotational torque of 2-4 Nm (18-35 in lb) is obtained.

To obtain this condition it may be necessary to adjust the spacer or shim thickness several times. Spacers and shims are available in the following thicknesses:

AG 66 Axles	Spacer thickness	
	mm	inch
3764 551 M1	11,15	0.439
3764 552 M1	11,20	0.441
3764 553 M1	11,25	0.443
3764 554 M1	11,30	0.445
3764 555 M1	11,35	0.447
3764 556 M1	11,40	0.449
3764 557 M1	11,45	0.451
3764 558 M1	11,50	0.453
3764 559 M1	11,55	0.455
3764 560 M1	11,60	0.457
3764 561 M1	11,65	0.459
3764 562 M1	11,70	0.461
3764 563 M1	11,75	0.463
3764 564 M1	11,80	0.465
3764 565 M1	11,85	0.467
3764 566 M1	11,90	0.469
3764 567 M1	11,95	0.471
3764 568 M1	12,00	0.473
3764 569 M1	12,30	0.485





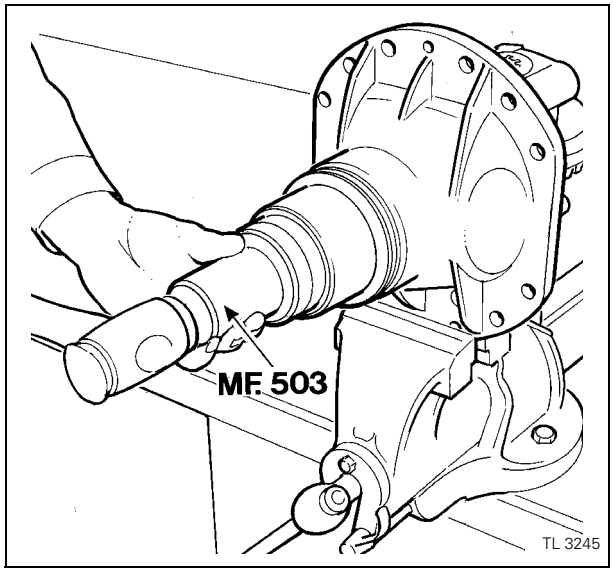
AG 75 & 85 Axles	Shim thickness	
	mm	inch
3428 253 M1	0,10	0.004
3428 254 M1	0,15	0.006
3428 255 M1	0,30	0.012
3428 256 M1	0,50	0.020
3428 257 M1	0,70	0.028
3428 258 M1	1,00	0.040

AG 105 Axles	Shim thickness	
	mm	inch
3428 289 M1	0,10	0.004
3428 290 M1	0,15	0.006
3428 291 M1	0,30	0.012
3428 292 M1	0,50	0.020
3428 293 M1	0,70	0.028
3428 294 M1	1,00	0.040

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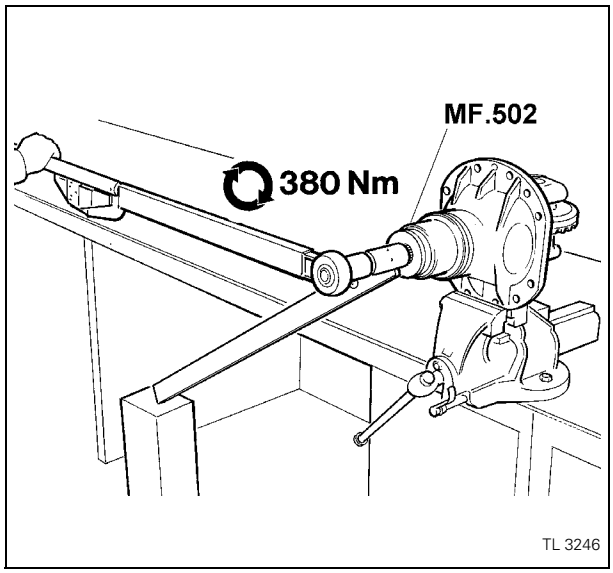
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32. Remove the pinion nut and pinion assembly.
33. Using special tool MF.503 Pinion Oil Seal Installer, press a new oil seal into the housing.
34. Renew the 'O' ring in the nut.
35. Apply general purpose grease to the cavity of the oil seal.



36. Apply Massey Ferguson Studlock (Loctite 270) to the thread and replace the pinion nut.
37. The special tool, MF.502 Pinion Nut Wrench, can be used in two ways:

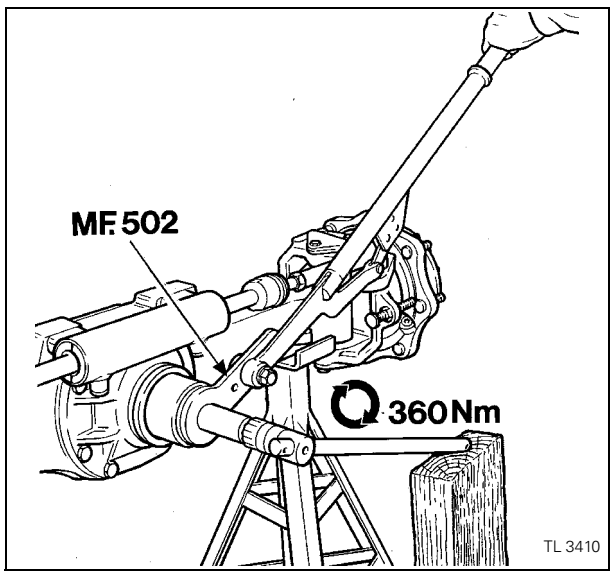
Attach the extension handle to the wrench and use it to hold the nut. Turn the pinion using a torque wrench and the special sleeve described on pages 8C-27 and 8C-28, the nut is tightened to a torque of 380 Nm (280 lbf ft).



Or alternatively:

If the axle is in an assembled condition, it is not possible to turn the pinion; for example, when replacing the oil seal. In this case, fit the torque wrench to MF.502 using the 3/4 inch square drive hole. Hold the pinion with a socket and bar, and tighten the nut. Because the torque wrench is not in the centre of the nut, set the torque wrench to 360 Nm (265 lbf ft) to achieve the correct torque.

38. With the aid of a hammer and punch, drive the lip of the nut into two opposite slots on the shaft to lock it.
39. Replace the crownwheel and differential assembly setting the clearance as described, *(see operation 12-8C).*
40. Rebuild the axle and refit to the tractor.



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STEERING CYLINDER

Removal and Refitment 14-8C

Removal.

1. Remove the front axle assembly, *(see operation 3-8C)*.
2. Remove the split pins and disconnect both steering ball joints.
3. Holding the ends of the steering cylinder piston rod with a spanner unscrew both track rods.
4. Remove the four hexagon cap screws (8 mm hexagon wrench will be required) and the steering cylinder.

Refitment

5. Reverse procedure except:

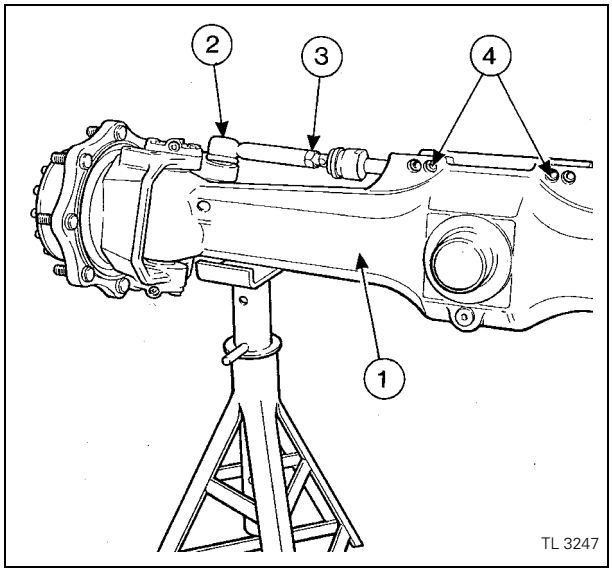
a. Apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten the four cap screws to a torque of 120 Nm (90 lbf ft) on AG 66 axles and 190 Nm (140 lbf ft) on other axles.

b. Tighten the steering rod ball joints to a torque of 135 Nm (100 lbf ft).

c. Apply lubricating oil to the thread and tighten the ball joint nut to a torque of 105 Nm (80lbf ft) on AG66 axles and 125 Nm (90 lbf ft) on other axles. Then tighten further as required to align the nut for the split pin (maximum torque 130 Nm (95 lbf ft) on AG66 axles and 160 Nm (118 lbf ft) on other axles. Renew the split pin.

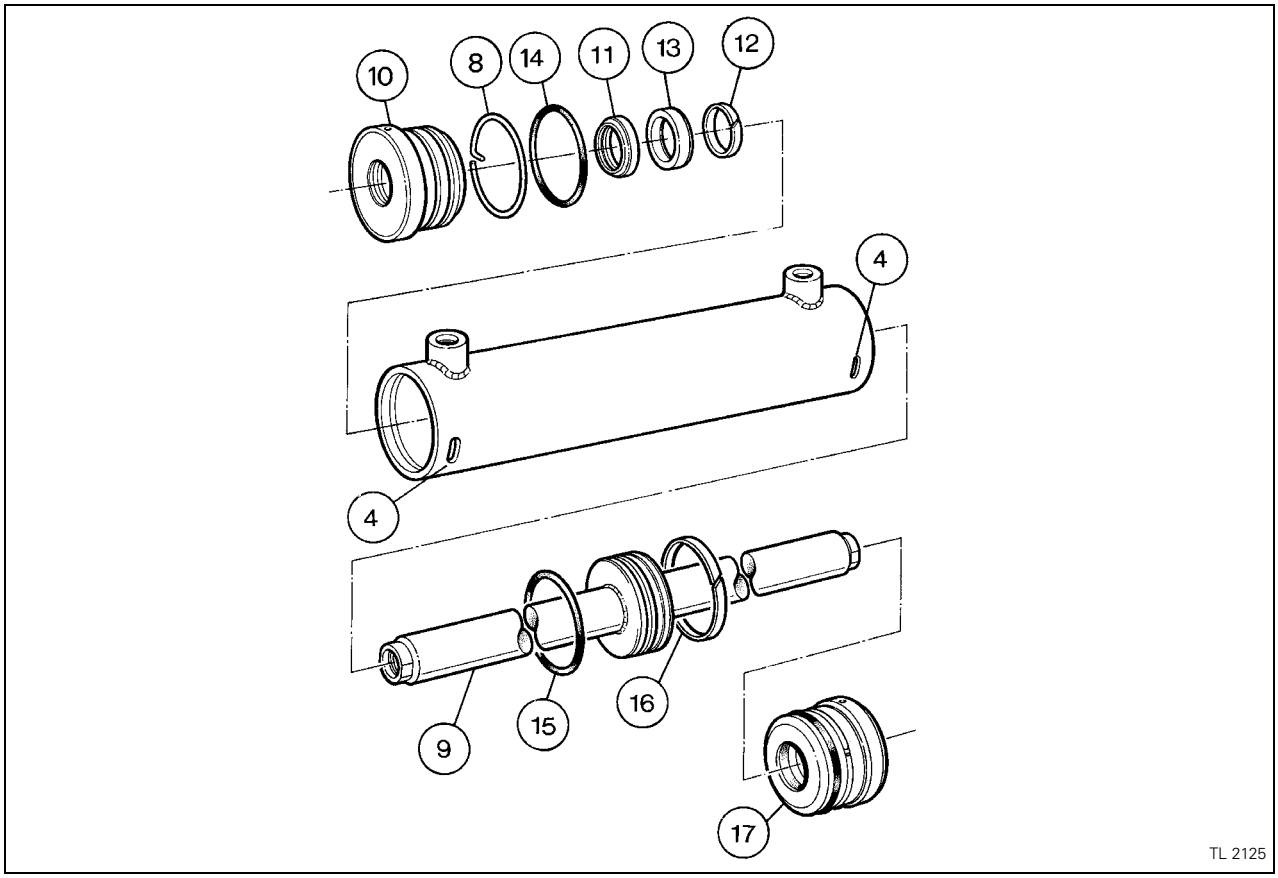
d. Check the wheel alignment, *(see operation 1-8C)*.

e. Use new split pins when refitting the steering ball joints.



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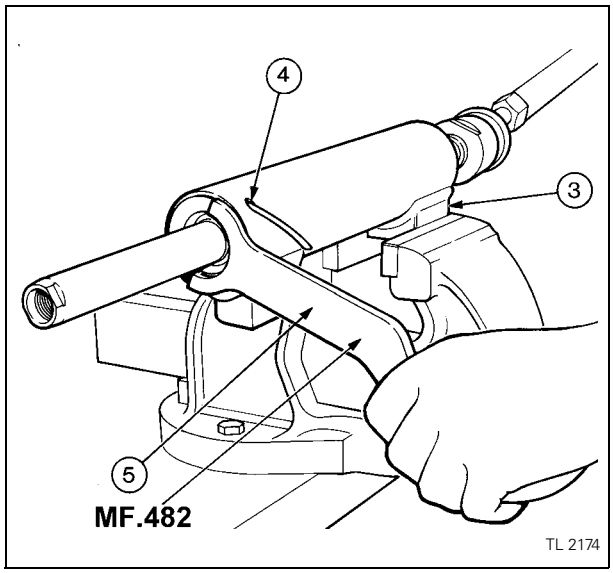
STEERING CYLINDER

Overhaul **15-8C**

Special Tools:
MF.482 Steering Cylinder Wrench

Dis-assembly

1. Remove the steering cylinder, *(see operation 14-8C)*.
2. Remove any sealing plugs and drain out any oil in the cylinder by moving the piston from one end of the cylinder to the other. Hold the cylinder over a container during this procedure.
3. Hold the cylinder in a vice by one of the mounting bosses.
4. Remove the sealing compound in the elongated holes at each end of the cylinder.
5. Using special tool MF.482 Steering Cylinder Wrench, rotate the cap until the chamfered end of the retaining wire can be seen in the elongated hole.



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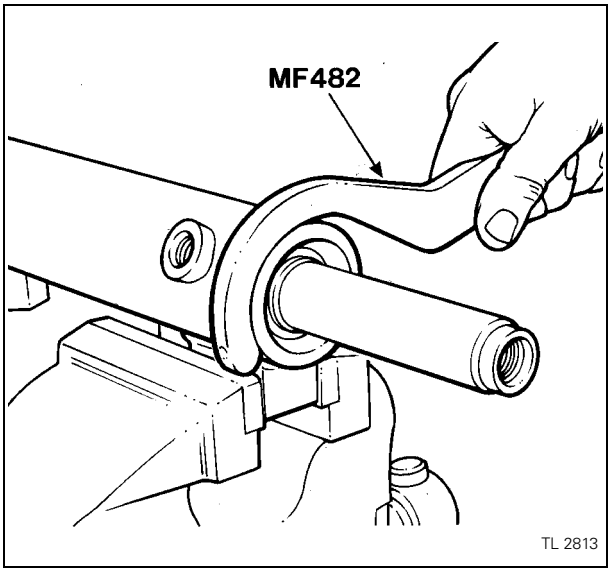
6. With the aid of a screwdriver, turn the end cap and prise the end of the wire up out of the hole.
7. Continue turning the cap and wind the rest of the wire out through the hole.
8. The end of the wire has a right angle bend which locates in a hole in the groove of the end cap, remove the wire from the cylinder.
9. Withdraw the piston assembly from the cylinder with the end cap.
10. Remove the end cap.
11. Remove the wiper seal.
12. Remove the wear ring.
13. Remove the pressure seal.
14. Remove the 'O' ring.
15. Remove the piston seal.
16. Remove the piston wear ring.
17. Remove the end cap from the other end of the cylinder following procedures 5 to 14.

Examination

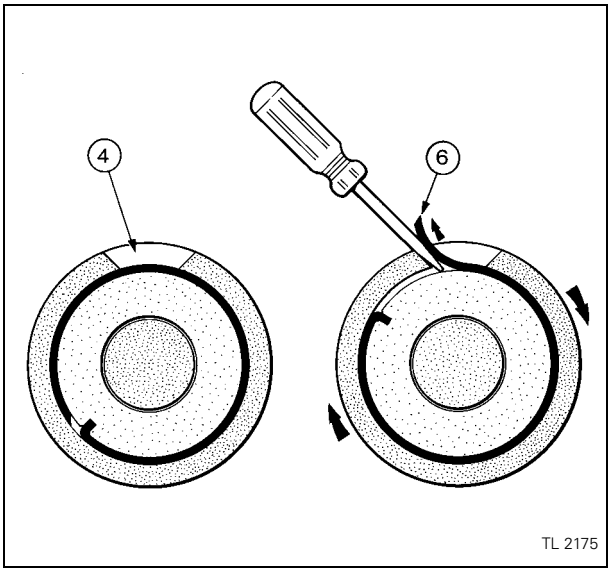
Clean and inspect all parts, renew any that are worn or damaged. Renew all seals, wear rings and 'O' rings.

Re-assembly

18. Fit a new set of seals in one of the end caps and lubricate them with transmission oil.
19. Renew the seal and wear ring on the piston and lubricate.
20. Refit the piston to the cylinder and slide the cap down into the cylinder.
21. Using special tool MF.482 Steering Cylinder Wrench, rotate the end cap until the hole in the wire groove is visible through the hole in the side of the cylinder.
22. Insert a new wire so that the bent end locates in the hole in the end cap. Ensure that the two grooves in the cylinder and end cap are in line.
23. Rotate the end cap so that it draws the wire round the end cap inside the cylinder. Rotate until all the wire is in the cylinder.
24. Seal the elongated hole in the cylinder with a non-setting type sealing compound. This sealing procedure is important to prevent the ingress of water and the resultant rusting of the end cap and retaining wire.
25. Repeat the procedures 20 to 24 for the other end cap.
26. Check that the piston rod moves up and down the cylinder correctly.
27. Refit the steering cylinder to the tractor.



AG 75, 85 and 105 axles



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Four-wheel Drive Front Portal Axle

Section 8 - Part D

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Four-wheel Drive Front Portal Axle

SPECIFICATION

Axle type:	
4225, 4235, 4245, T75, T85	AG 66 CD Portal
4245, 4255, 4260, T95	AG 85 CD Portal
Camber angle	1°.
Caster angle	5° 30'.
Width across hub flanges:	
AG 66 axle	1511 mm (59.53 in).
AG 85 axle	1611 mm (63.47 in).
Toe-in	0-4 mm (0-5/32 in).
Maximum turning angle	55°.
Maximum static load:	
AG 66 axle	3000 kgf (6614 lbf).
AG 85 axle	4500 kgf (9921 lbf).
Number of differential pinions:	
AG 66 axle	4.
AG 85 axle	2.
Type of differential lock	Hydralock.
Axle reduction ratio:	
Crown wheel and pinion - AG 66 axle	No. of teeth = 17 x 37.
Crown wheel and pinion - AG 85 axle	No. of teeth = 17 x 37.
Pinion setting dimension:	
AG 66 axle	91± 0,10 mm.
AG 85 axle	118± 0,10 mm.
Pinion bearing pre-load	2-4 Nm (1.5-3 lbf ft).
Differential bearing pre-load	With zero end float tighten bearing nut three notches.
Crown wheel and pinion back-lash:	
AG 66 axle	0,15-0,20 mm (0.006-0.008 in).
AG 85 axle	0,18-0,23 mm (0.005-0.007 in).
Oil capacity:	
Axle casing AG 66	7 litre (1.5 gal) (1.8 US gal).
Axle casing AG 85	10.6 litre (2.3 gal) (2.8 US gal).
Epicyclic housing (one side) both axles	2.7 litre (0.6 gal) (0.7 US gal).

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Four-wheel Drive Front Portal Axle

Special Tools

MF.471A	Hydralock spring compressor.
MF.482	Steering cylinder wrench.
MF.500	Front axle bearing installer.
MF.502	Pinion nut wrench.
MF.503	Pinion oil seal installer.
MS.550	Universal handle.
FT.4062A	Pinion pre-load gauge.

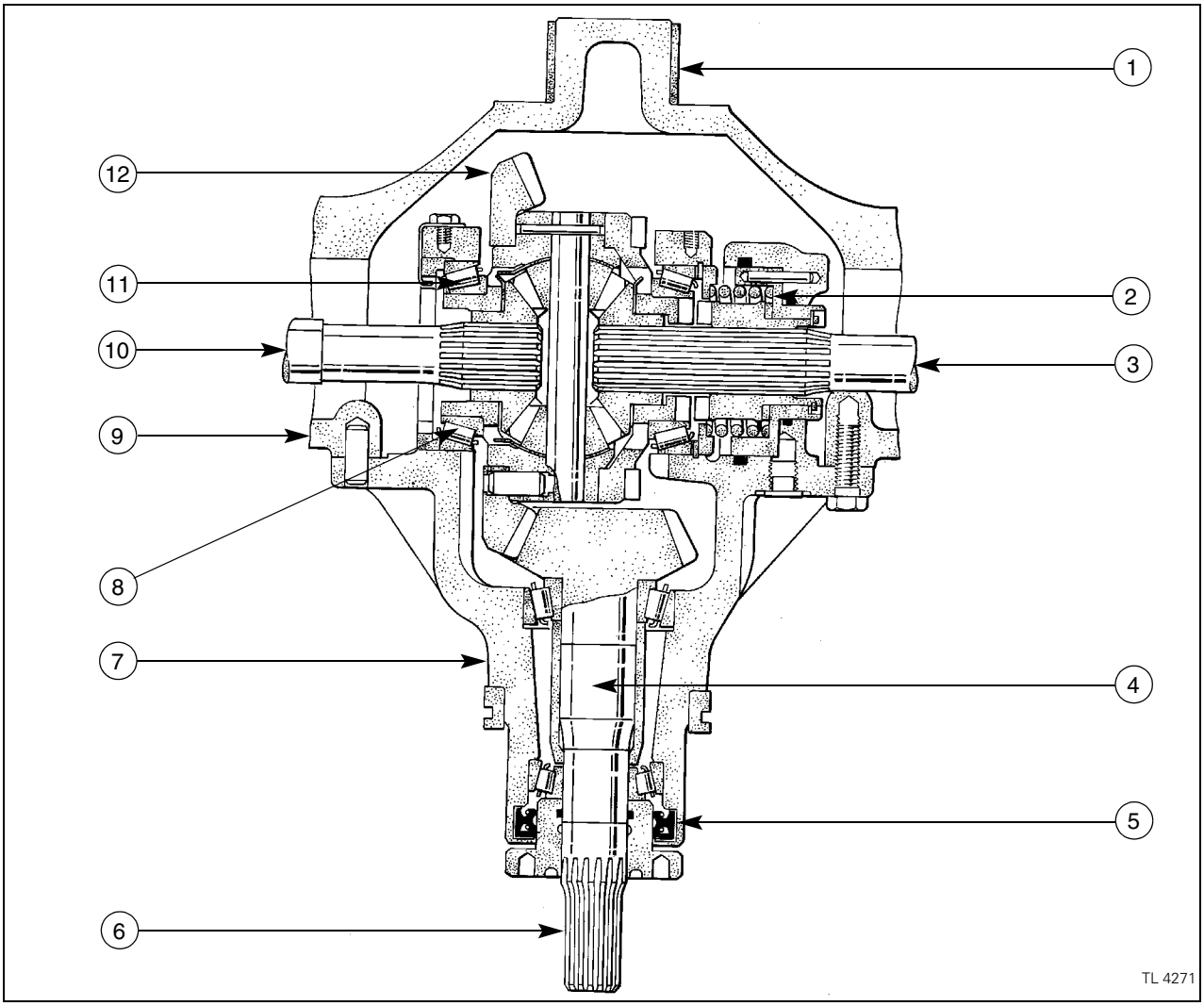
Bolt Toques

Track rod locknuts	135 Nm (100 lbf ft).
Steering cylinder ball joints	135 Nm (100 lbf ft).
Ball joint nuts	125 Nm (95 lbf ft) Maximum torque 160 Nm (120 lbf ft).
Steering cylinder cap screws	190 Nm (140 lbf ft).
AG 66 axle	120 Nm (90 lbf ft).
AG 85 axle	190 Nm (140 lbf ft).
Pinion nut	380 Nm (280 lbf ft).
Differential case bolts	135 Nm (100 lbf ft).
Crown wheel/differential case bolts	85 Nm (65 lbf ft).
Differential bearing cap bolts:	
AG 66 axle	140 Nm (105 lbf ft).
AG 85 axle	125 Nm (90 lbf ft).
Bearing lock tab bolt	20 Nm (15 lbf ft).
Axle casing to final drive units	130 Nm (95 lbf ft).
Axle shaft nut	425 Nm (315 lbf ft).
Ring gear bolts	66 Nm (50 lbf ft).
Planet shaft retainer plate bolts	23 Nm (18 lbf ft).
Epicyclic unit cover bolts	66 Nm (50 lbf ft).
Upper bearing cap bolts	66 Nm (50 lbf ft).
Upper steering arm bolts	110 Nm (80 lbf ft).

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Four-wheel Drive Front Portal Axle



Four-wheel Drive Portal Front Axle – Differential Assembly

1. Axle pivot bearing.
2. Hydralock differential.
3. Drive shaft to right-hand axle.
4. Pinion.
5. Pinion oil seal.
6. Couple to drive shaft.
7. Differential housing.
8. Differential.
9. Axle housing.
10. Drive shaft to left-hand wheel.
11. Differential bearings.
12. Crownwheel.

GENERAL DESCRIPTION

The Massey Ferguson AG series of portal front axles are driven from the range gearbox by a drive shaft down the centre of the tractor under the gearbox and engine. The range gearbox contains the reduction gears and clutch to control the engagement and disengagement of the front axle.

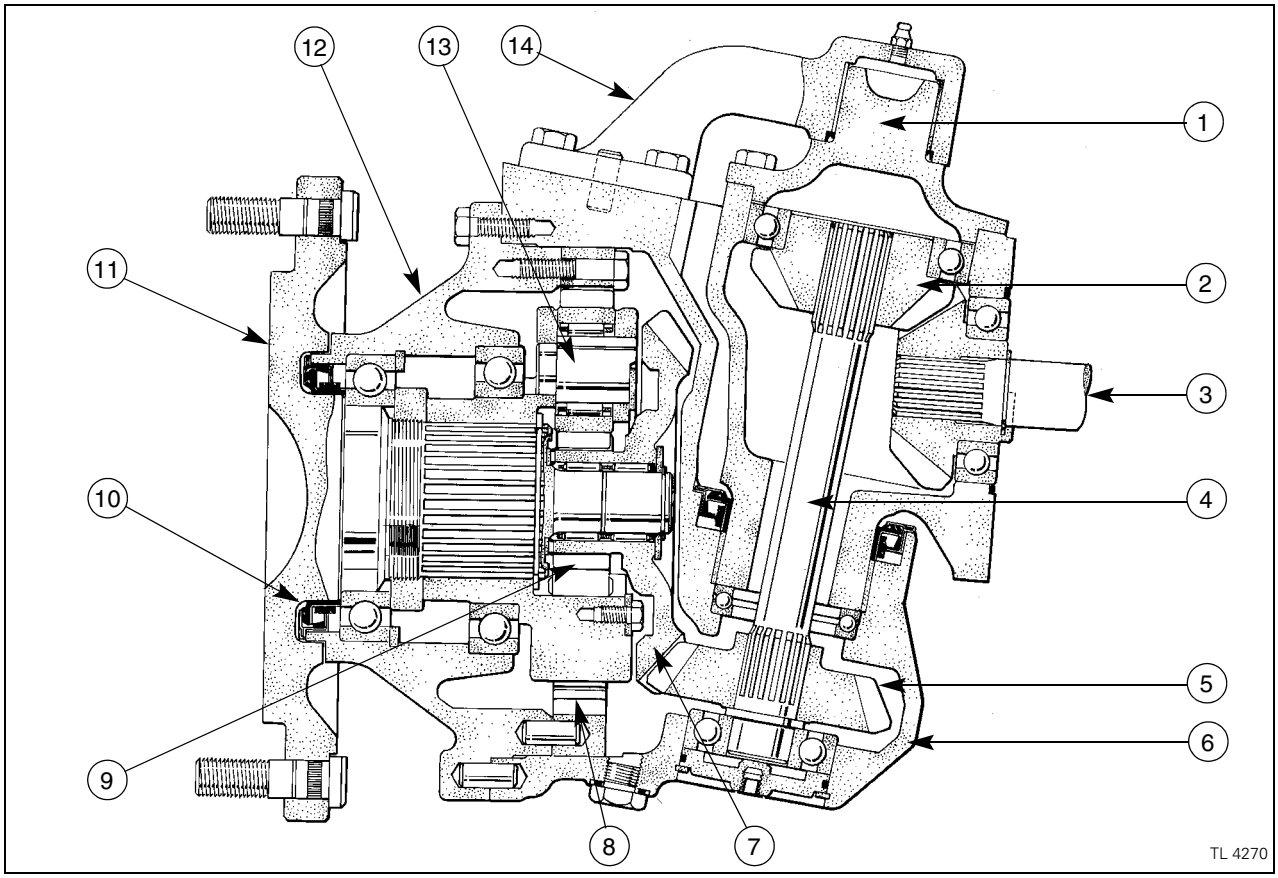
The crownwheel, pinion and differential are mounted in the centre of the axle to align with the drive shaft from the range gearbox, the axle also pivots on the centre line of the pinion. This is described as a Centre Drive (CD) arrangement.

The drive from the drive shaft is taken through a standard crownwheel and pinion and differential arrangement. The AG 66 axle is fitted with a four pinion differential and the AG 85 axle with a two pinion. The bevel gears mesh with two side gears to which the inner ends of the drive shafts to the wheels are splined.

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Four-wheel Drive Front Portal Axle



Four-wheel Drive Portal Axle – Epicyclic Reduction Unit

1. Upper bearing cap.
2. Upper bevel gear.
3. Drive shaft from differential.
4. Vertical shaft.
5. Lower bevel gear.
6. Swivel housing.
7. Axle shaft bevel gear.
8. Ring gear.
9. Sun gear.
10. Axle shaft oil seal.
11. Axle shaft.
12. Epicyclic housing.
13. Planet gears.
14. Upper arm.

The differential is equipped with a 'Hydrolock' differential lock which can be engaged by the driver or automatically when the brakes are applied. It comprises of a simple mechanical clutch which is engaged hydraulically and disengaged by a compression spring when the pressure is removed.

The drive from the differential comes into the swivel housing through a pair of upper bevel gears. The swivel housing is mounted on the axle housing by two bushes and supported by a ball thrust race, the dirt is kept out and the oil in by a cassette type oil seal.

A vertical shaft, lower bevel gear and ball race take the drive down to the bottom of the swivel housing, it then meshes with a large bevel gear on the epicyclic reduction unit.

The epicyclic unit comprises of a sun gear, three planets and a ring gear. The carrier containing the planets is splined to the axle shaft, the sun gear is splined to the large bevel gear. A large cassette seal is mounted behind the flange of the axle shaft to prevent the loss of oil and ingress of dirt.

Adjustment of the bevel gears is carried out by either shims or variable thickness thrust washers. The axle has a common oil reservoir with drain plugs on the centre casing and the reduction units, level plugs are also provided.

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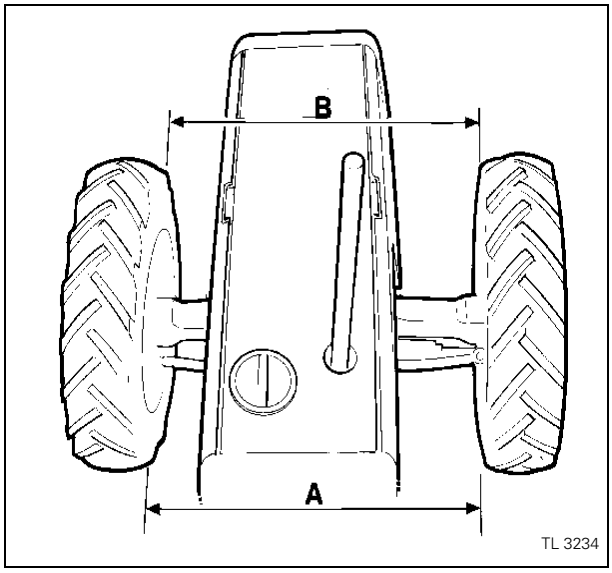
WHEEL ALIGNMENT and STEERING STOPS

Adjust **1-8D**

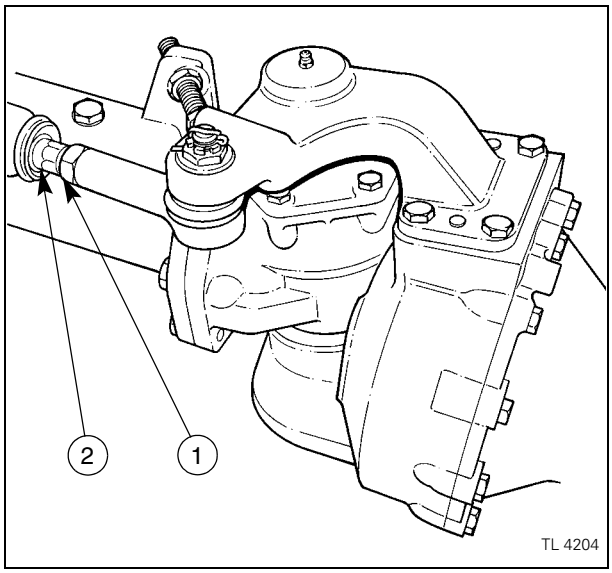
Procedure

Wheel Alignment

1. Drive the tractor onto firm level ground and put the front wheels in the straight ahead position.
2. Check the wheel toe-in measured on the centre line of the axle at the wheel rim. Distance **'A'** must be 0-5 mm (0-3/16 in) greater than distance **'B'**.



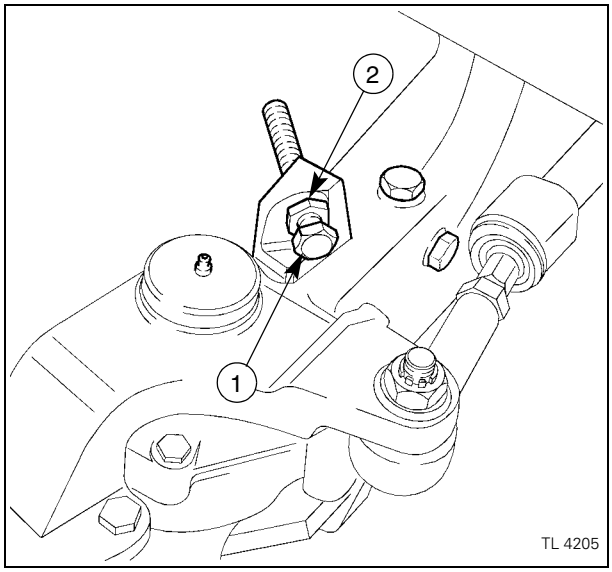
3. If adjustment is necessary, slacken the lock-nut (1) on the track rod on one side.
4. Rotate the inner steering ball joint (2) to either increase or decrease the track rod length to obtain the correct setting.
5. Apply Massey Ferguson Studlock (Loctite 270) and tighten the track rod lock-nut to a torque of 135 Nm (100 lbf ft). Ensure that both track rods are the same length.



Steering Stops

CAUTION: *At the smaller track settings, a foul condition may occur between the tyre and tractor or loader, if fitted, when the wheels are turned to the full lock position. To avoid this condition you must check by turning the wheels to full lock and adjusting the steering stops as necessary.*

6. Place the jack under the engine sump and raise the tractor enough to allow the axle to swing from one stop to the other.
7. Turn the front wheels to full lock and check that the inside edge of the tyre does not foul the tractor.
8. Carry out the same check on the other lock.
9. If necessary, adjust the length of the steering stops (1) on both sides so that a foul condition will not occur. Tighten the lock-nuts (2) after adjustment.



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TRACK ROD and BALL JOINT

Removal and Refitment 2-8D

Removal

1. Remove the split pin and nut from the ball joint.
2. Remove the ball joint from the housing by using an extractor or by striking the housing with a hammer adjacent to the ball joint to release the taper.
3. Slacken the lock-nut and unscrew the ball joint from the inner joint.
4. To remove the inner joint, hold the end of the steering cylinder piston rod with a spanner and unscrew the joint.

Refitment

5. Reverse procedures 1 to 4 except:

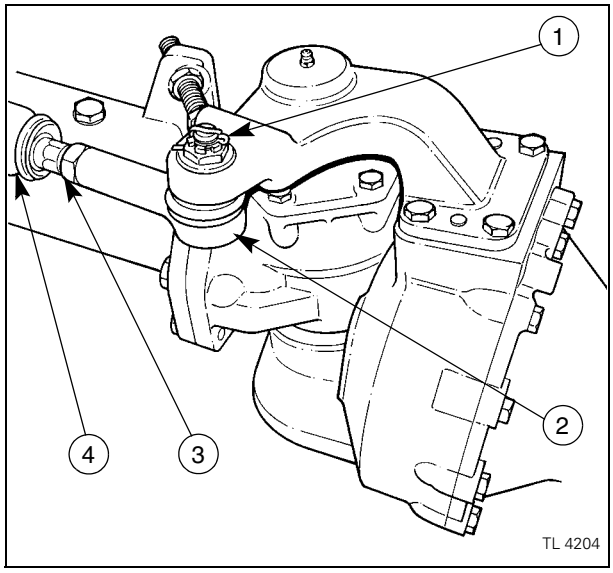
a. Ensure that the same amount of thread is screwed into each ball joint.

b. Apply Massey Ferguson Studlock (Loctite 270) to the threads of inner joint (4) and screw it into the end of the steering cylinder piston rod.

c. Set the wheel alignment as described, *(see operation 1-8D)*.

d. Tighten the lock-nut (3) to a torque of 135 Nm (100 lbf ft).

e. Apply lubricating oil to the thread and tighten the ball joint nut (1) to a torque of 125 Nm (90 lbf ft). Then tighten further as required to align the nut for the split pin (maximum torque 160 Nm (118 lbf ft). Renew the split pin.



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Four-wheel Drive Front Portal Axle

FRONT AXLE OIL LEVEL

Service **3-8D**

Procedure

The front axle has one common reservoir including both epicyclic units and the central differential. Time has to be allowed for the oil to penetrate down each epicyclic unit. To reduce the time taken to fill the axle, the two epicyclics and the centre section can be filled as separate units.

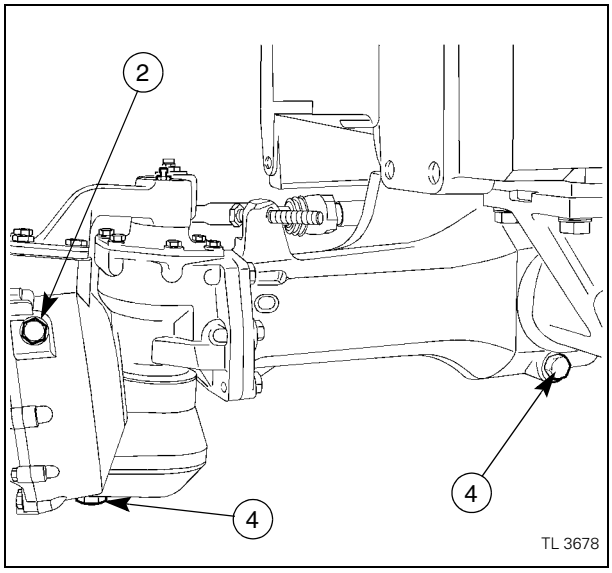
1. Stand the tractor on level ground.
2. Remove the two oil level plugs.
3. Place a drain pan beneath each epicyclic unit and centre housing.
4. Remove the two drain plugs.
5. Allow all the oil to drain.

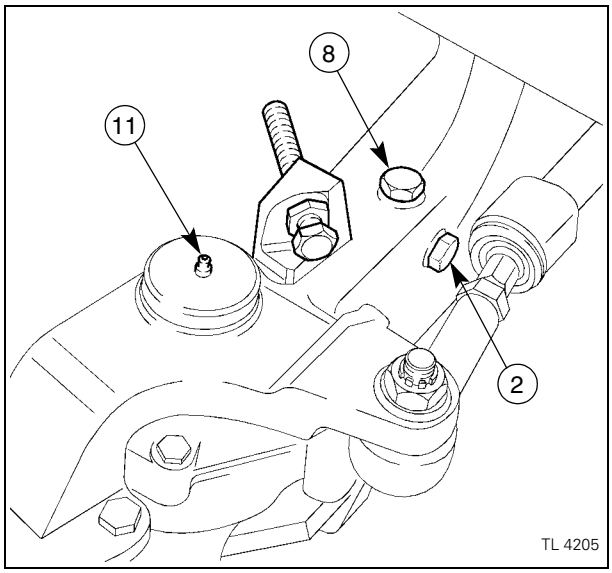
Re-fill

6. Replace the two drain plugs.
7. Fill both epicyclic units to the bottom of the fill/level plug hole with an approved oil.
8. Refill the central axle casing through the filler plug to the bottom of the oil level plug hole. Refit the plugs.
9. Drive the tractor around so that the oil completely levels itself across the axle.
10. Check the oil level in all sections and top up as necessary. If over full, drain out some of the oil.

Greasing

11. Grease the upper swivel bearing on both sides of the axle until grease is visible under the steering arm.





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FRONT AXLE

Removal and Refitment 4-8D

Removal

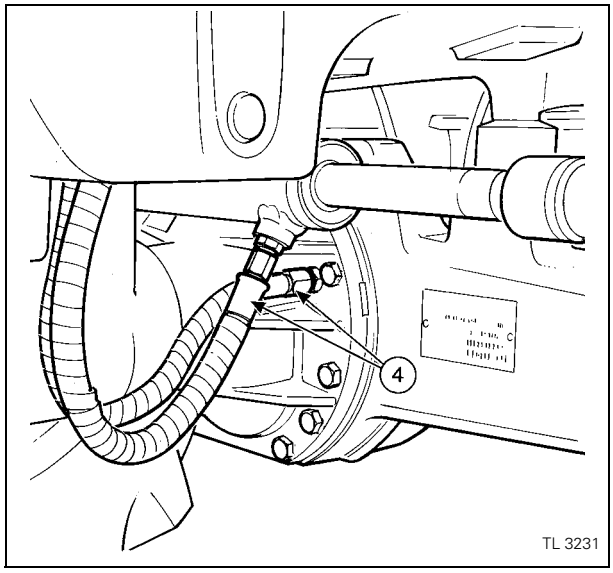
1. Block both rear wheels of the tractor and apply the parking brake.
2. Place a trolley jack under the engine sump and take the weight off the front of the tractor. DO NOT lift the front wheels off the ground.
3. Remove the front tractor weights, if fitted, and remove the front weight frame.
4. Disconnect the steering cylinder hoses at the cylinder end and disconnect the Hydralock pipe. Cap the ends of all pipes and hoses to prevent the ingress of dirt.
5. Disconnect the front axle four-wheel drive shaft guard and disconnect the four-wheel drive shaft, *(see operation 1-5E)*.

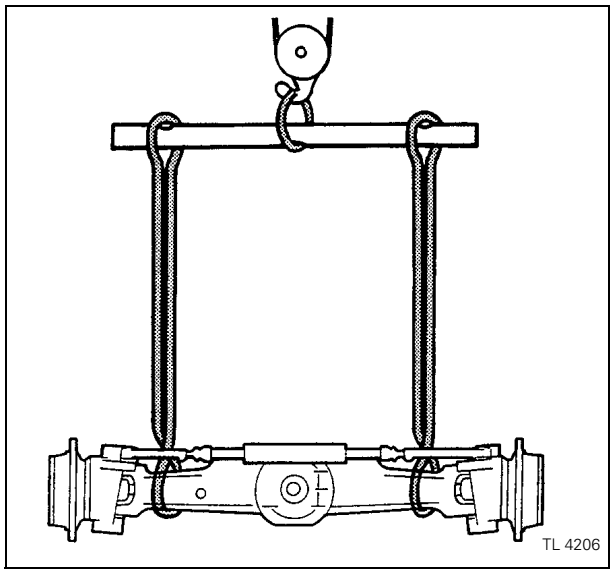
WARNING: Prevent the axle from tilting forwards or backwards, or rotating about the wheels if the axle is wheeled from under the tractor with its wheels still attached. It could cause injury if precautions are not taken.

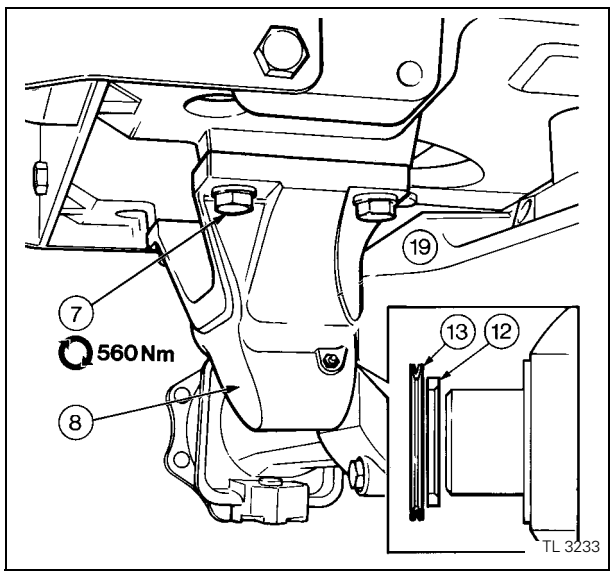
6. Place the front axle in slings.
7. Remove the bolts from the front trunnion.
8. Remove the trunnion.
9. Remove the axle forwards, disengaging it from its rear bearing housing and place it on two axle stands.
10. If necessary remove the two chamfered washers.

Refitment

11. With the aid of an overhead crane sling the axle so that it is horizontal in both directions.
12. Reinstall the two thrust washers with the internal chamfered face facing the axle.
13. Fit new 'V' ring seals.
14. Place the axle under the front support casting and engage the rear support bearing, move the axle rearwards so that it is fully engaged.
15. Refit the front trunnion bearing and adjust its position until there is a clearance of 0,1-0,25 mm (0.004-0.010 in) between the axle and housing.
16. Tighten the trunnion bearing bolts to a torque of 560Nm (415 lbf ft).
17. Re-check the axle clearance, re-adjust if necessary.
18. Reverse procedures 1 to 5.
19. Grease both the front and rear bearing until grease shows between the bearing and axle.



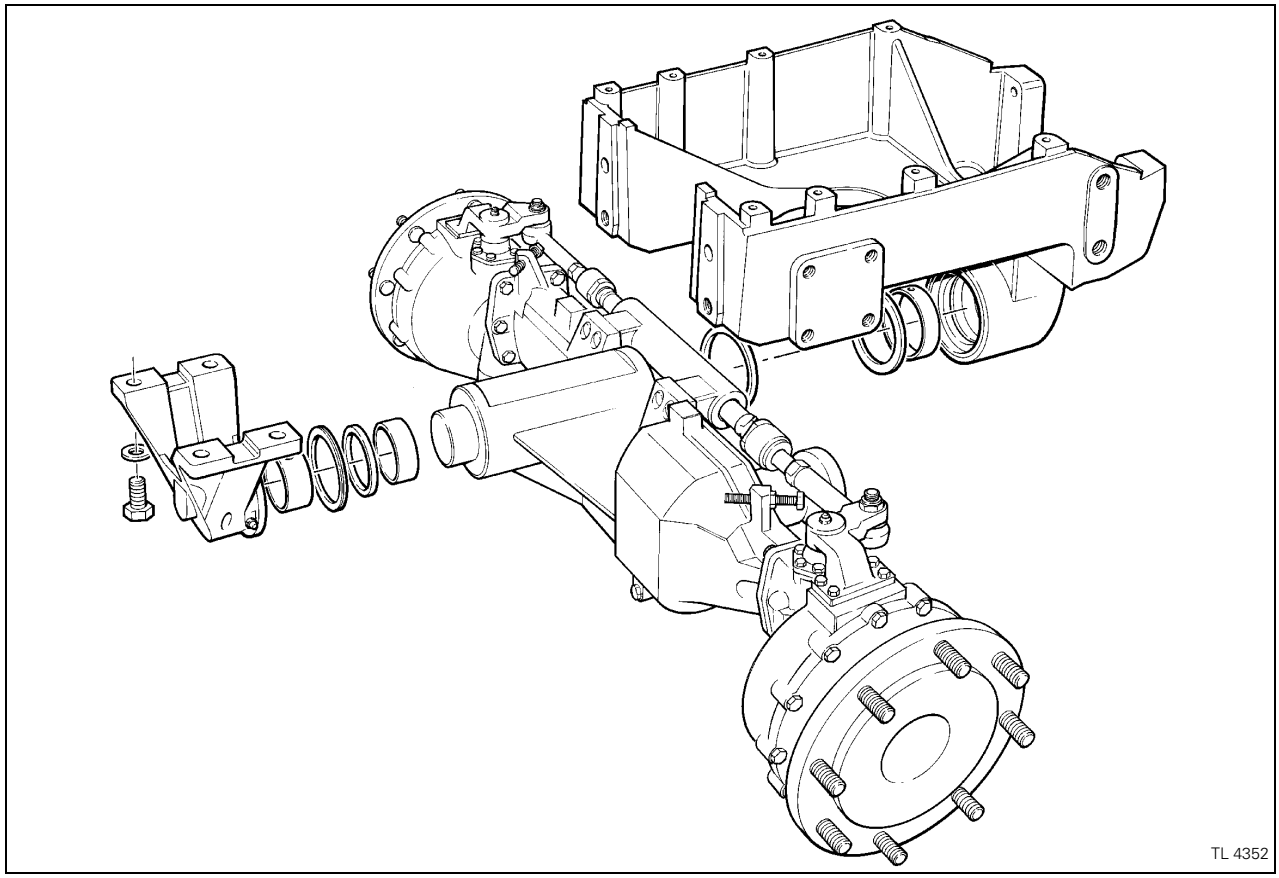




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Four-wheel Drive Front Portal Axle



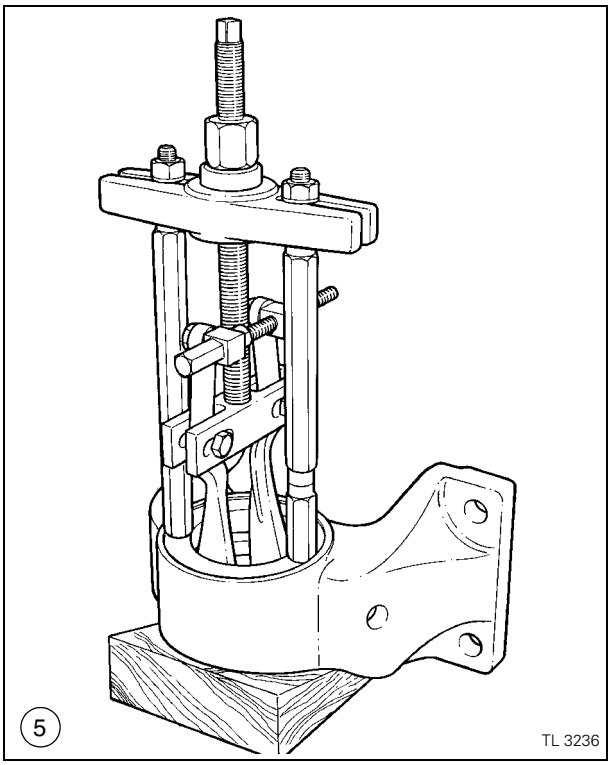
FRONT AXLE PIVOT PIN BEARINGS

Overhaul **5-8D**

Special Tools:
MF.500 Front Axle Bearing Installer
MS.550 Universal Handle

Dis-assembly

1. Remove the front axle, *(see operation 4-8D)*.
2. Remove the 'V' ring seal.
3. Remove the two thrust washers.
4. Remove the quad seal from the axle pinion housing.
5. With the aid of an internal bearing extractor (see illustration) remove the bush from the front bearing housing.
6. Repeat the procedure and extract the bearing from the rear bearing housing.
7. If necessary, remove the steel bearing from the front of the axle casing.

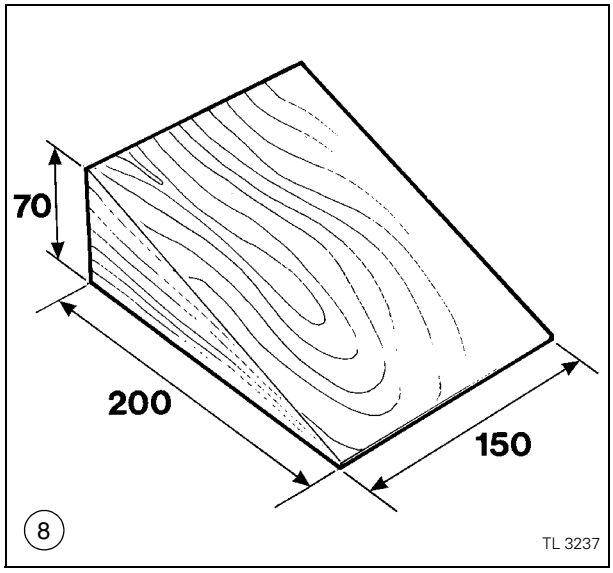


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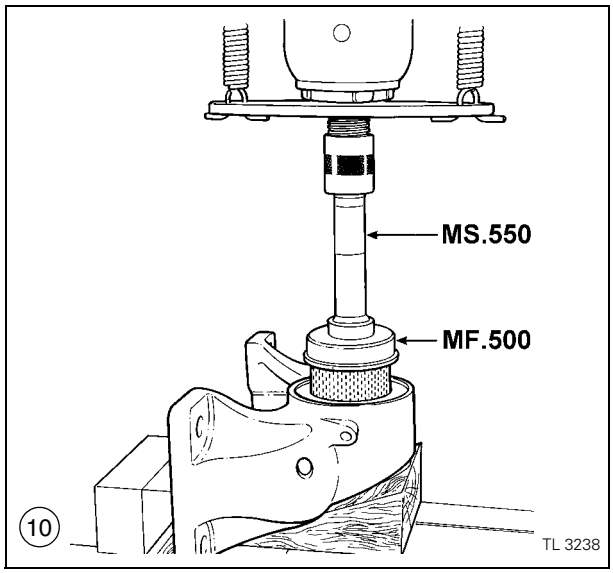
Re-assembly

8. To replace the front bearing, make a wooden wedge to the dimensions shown in the illustration.

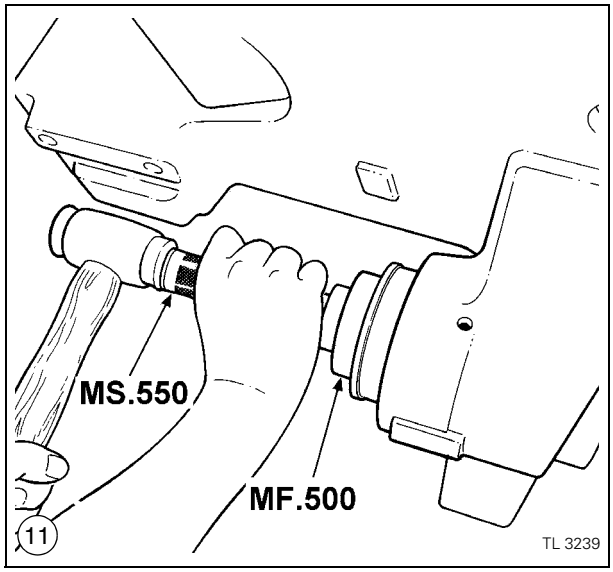


9. Place the bearing housing under a press on the wooden wedge.
10. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal Handle, press the bush into the housing until it is 0,5-1,5 mm (0.020-0.060 in) below the rear face, the tool will position the bush correctly.

IMPORTANT: *Both bushes, front and rear, must be assembled with the grease hole to the top.*



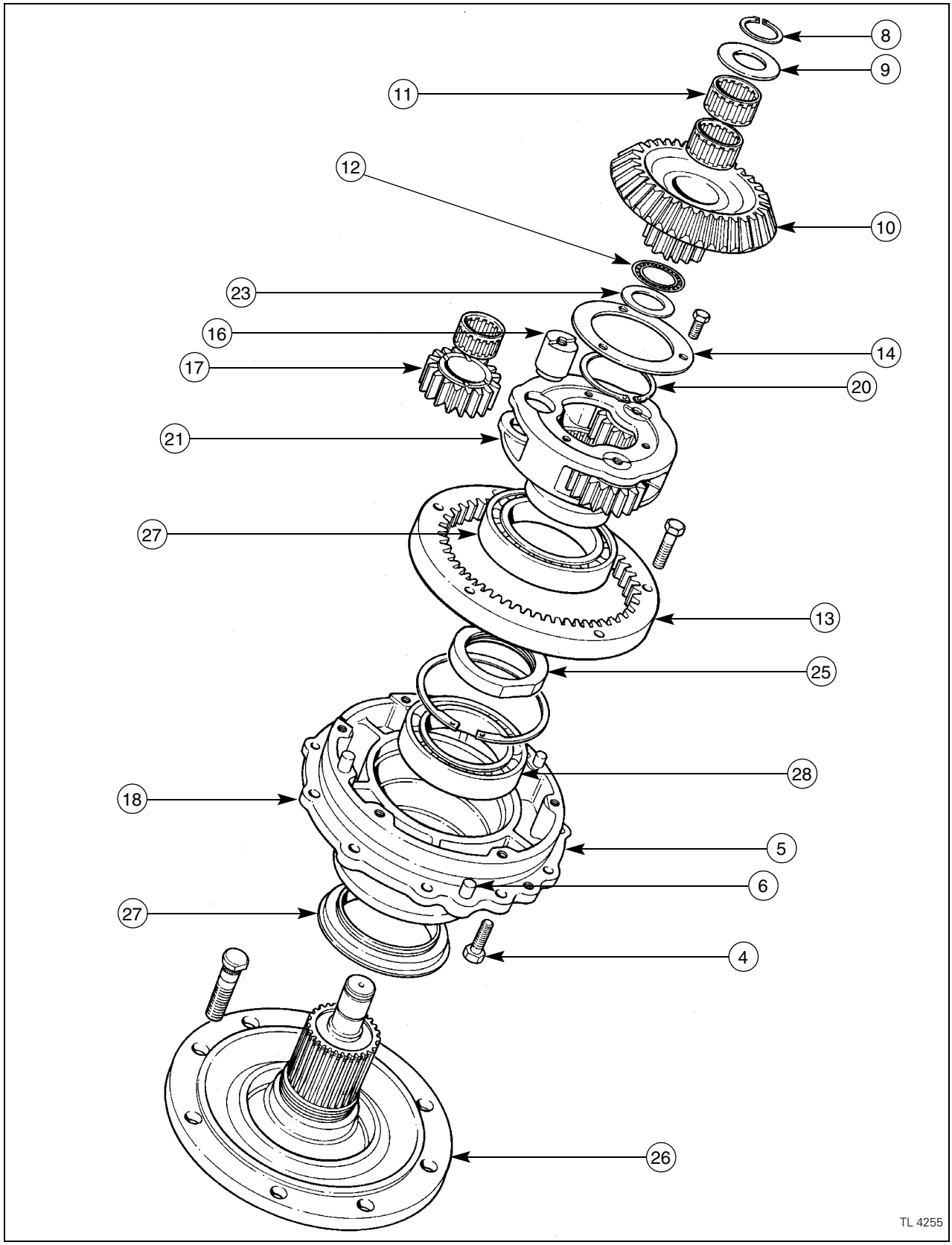
11. Using special tool MF.500 Front Axle Bearing Installer and MS.550 Universal Handle, drive the rear bush in until it is 0,1-0,5 mm (0.004-0.020 in) below the front face, the tool will position the bush correctly.
12. If removed, replace the front steel bush on the axle housing.
13. Reverse procedures 1 to 4 except:
    a. Renew the two 'V' ring seals.
    b. Renew the quad seal ring.
    c. Lubricate the seals and bushes prior to assembly with a general purpose grease.
    d. Tighten the four front support bolts to a torque of 560Nm (413 lbf ft).



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Four-wheel Drive Front Portal Axle



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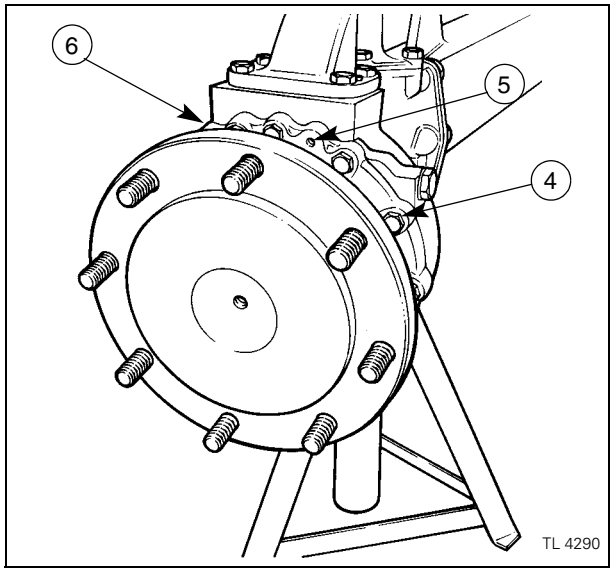
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EPICYCLIC REDUCTION UNIT and OIL SEAL

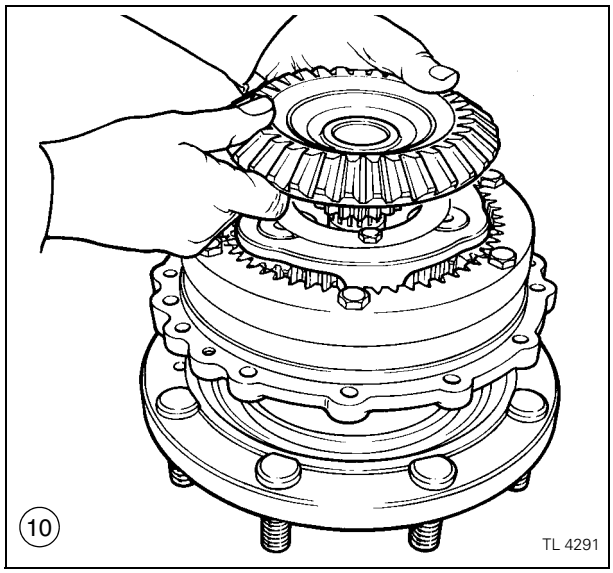
Removal and Refitment 6-8D

Removal

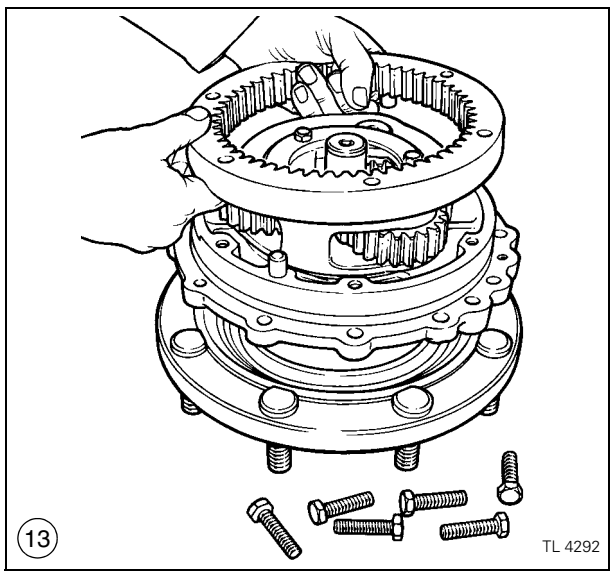
1. Place the tractor on level ground, apply the hand brake and jack up the tractor on the side to be worked on. Place the axle on a axle stand.
2. Drain the oil from the epicyclic unit and the main section of the axle, they are inter-connected.
3. Remove the wheel.



4. Remove the twelve cover retaining bolts.
5. Remove the cover by inserting M8 bolts in the two holes provide and jack the cover off the dowel pins.
6. The dowel pins are located close to the jacking holes.
7. Place the assembly on a bench.
8. Remove the circlip on the end of the axle shaft.
9. Remove the thrust washer.
10. Remove the bevel and sun gear.
11. Remove the two needle roller bearings.
12. Remove the needle thrust race.



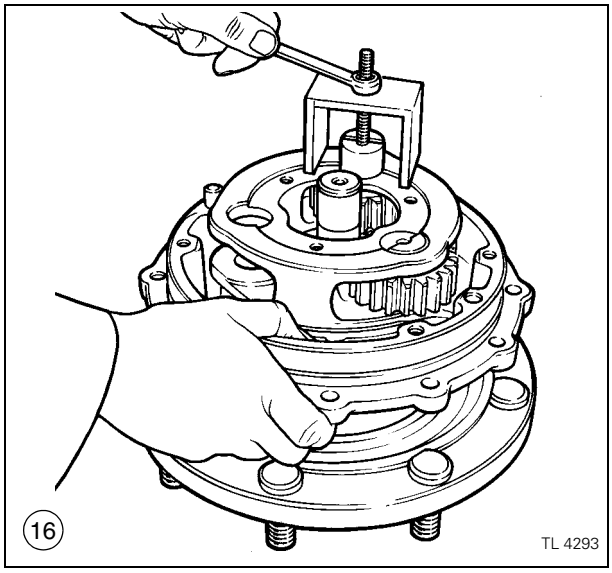
13. Remove the six blots and the ring gear.
14. Remove the three bolts and the retainer plate.



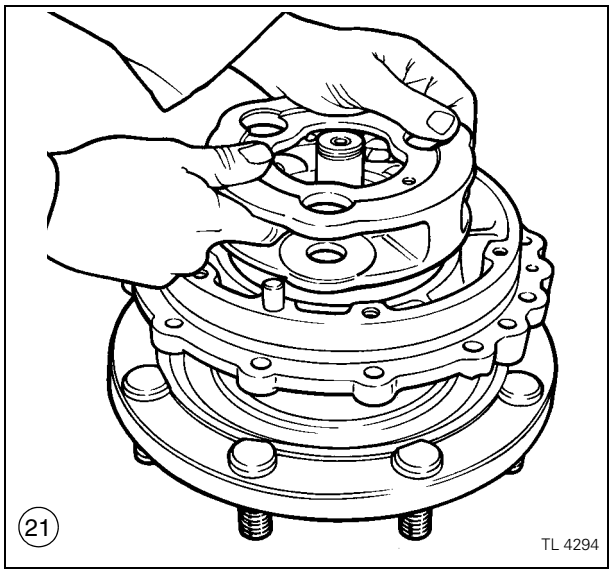
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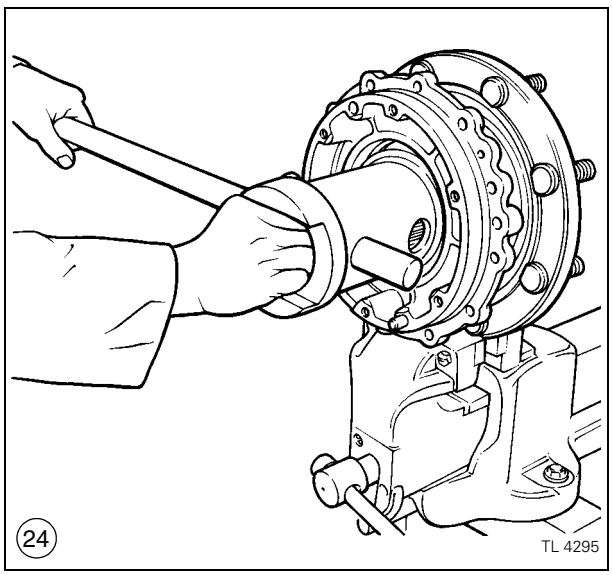
15. Manufacture a simple extractor using some steel strip, M8 studding and M8 nut and washer as shown in the illustration.
16. Using the above tool extract the planet gear shaft from the carrier.
17. Slide each gear and needle roller bearing out of the carrier.
18. The cover casting is relieved in one position to allow removal of the gears.
19. Repeat the operation for the other two shafts and gears.



20. Remove the large circlip inside the carrier.
21. Pull the carrier off the axle shaft,
22. If necessary, remove the ball bearing.
23. Remove the variable thickness thrust washer.



24. To remove the axle shaft from the cover it will be necessary to manufacture a special wrench to remove the large nut. The wrench must be capable of sustaining a force of up to 500 Nm (370 lbf ft). Dimensions are given in the illustration on pages 8D-33 and 34 at the end of the section.
25. Remove the nut.
26. Press the axle shaft out of the cover.
27. Remove and discard the oil seal.
28. If necessary, remove the large circlip and ball bearing.



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Refitment

29. Install a new oil seal. Take great care not to damage it, you may have to make up a tool to assist in installation. Lubricate the seal inside and out with clean transmission oil before fitting. Reassemble the axle shaft, ball bearing and circlip.
30. Apply Massey Ferguson Studlock (Loctite 270) to the large locknut and tighten to a torque of 425 Nm (315 lbf ft).

Re-positioning the Bevel Gear

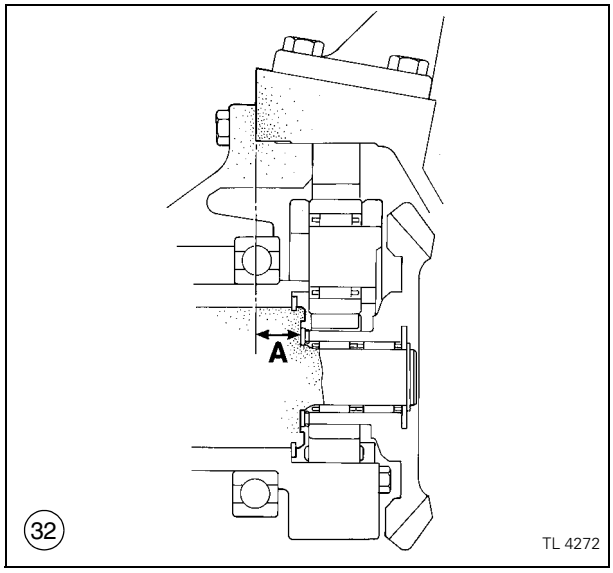
31. If any of the components have been replaced which affect the position of the bevel gear; for example, axle shaft or cover, the position of the bevel gear must be re-set. This is accomplished by changing the variable thickness thrust washer (22).
32. Measure the distance between the bolting face of the cover and the face on the axle shaft which locates the variable thickness thrust washer, dimension '**A**'. You may have to arrange for your local engineering company to perform this task for you if you do not have the precision measuring equipment required.
33. Calculate the washer thickness '**B**' using the following formula:

    B = A + 123 + 2

    For example:

    B = 25,46 + 123 + 2

    B = 150,46
34. From the table select the correct adjustable thrust washer. In the example this will be 1,50 mm thick part number 3764 472 M1.
35. Reverse procedures 1 to 22 except:
    a. Apply Massey Ferguson Studlock (Loctite 270) to the six ring gear bolts and tighten to a torque of 66 Nm (50 lbf ft).
    b. Apply Massey Ferguson Studlock (Loctite 270) to the three planet gear shaft retaining plate bolts and tighten to a torque of 23 Nm (18 lbf ft).
    c. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the cover bolting face.
    d. Tighten the twelve cover bolts to a torque of 66 Nm (50 lbf ft)



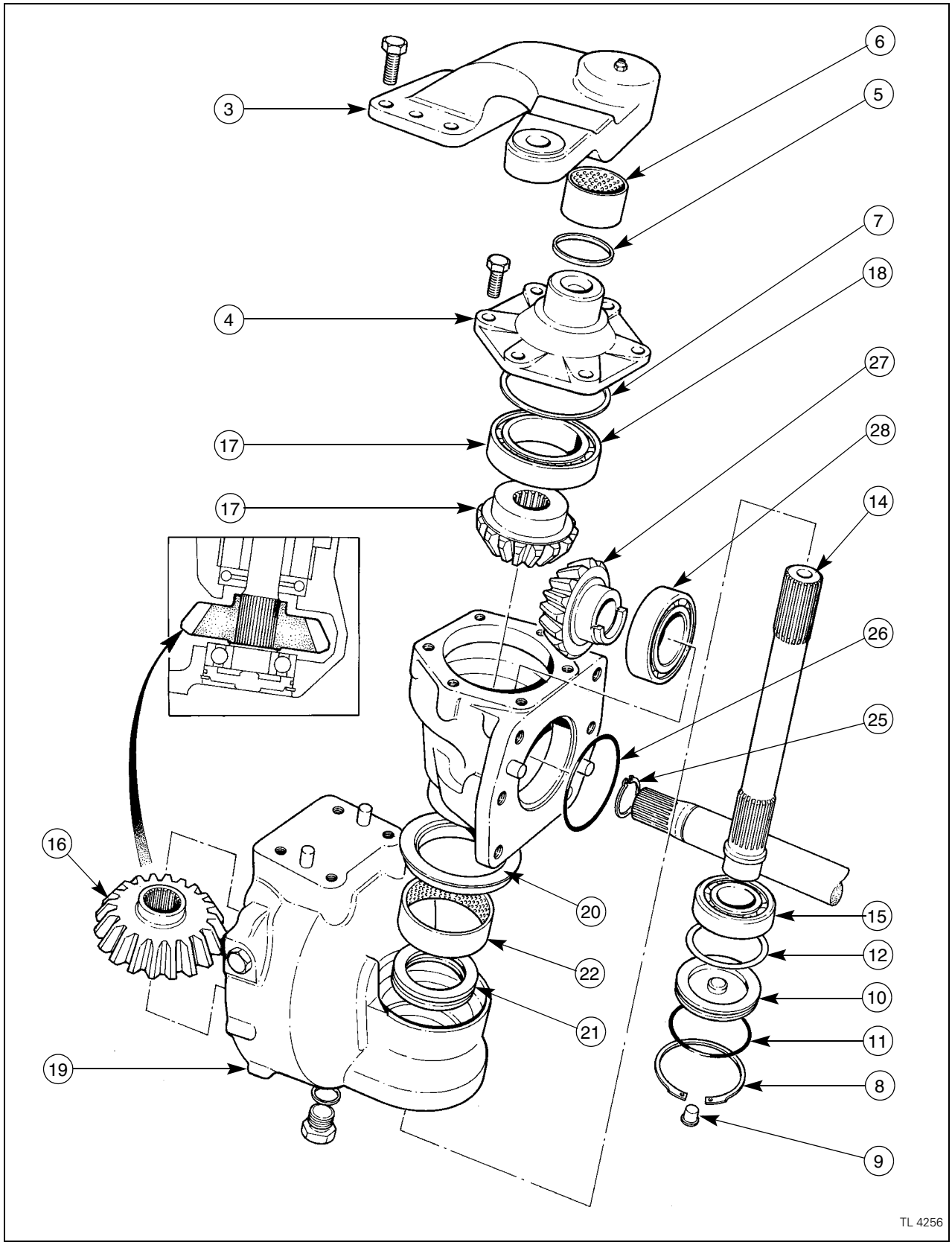
.

Variable Thrust Washer		
Value '**B**' (mm)	Shim thickness (mm)	Part number
150,65 150,56	1,40	3764 471 M1
150,55 150,46	1,50	3764 472 M1
150,45 150,36	1,60	3764 473 M1
150,35 150,26	1,70	3764 474 M1
150,25 150,16	1,80	3764 475 M1
150,15 150,05	1,90	3764 476 M1

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Four-wheel Drive Front Portal Axle



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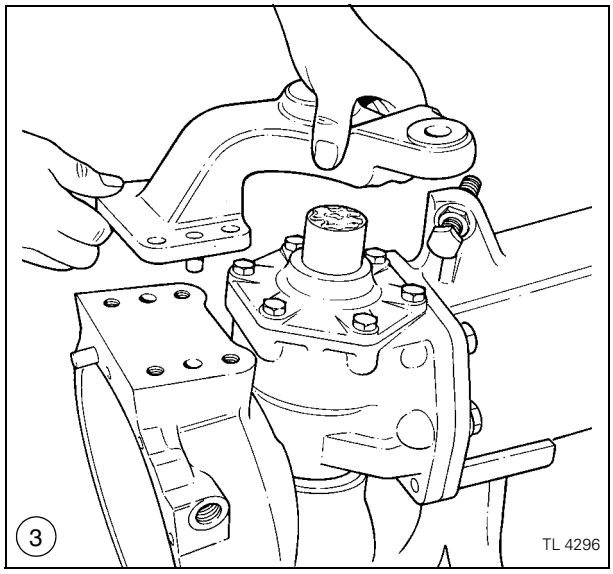
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SWIVEL HOUSING

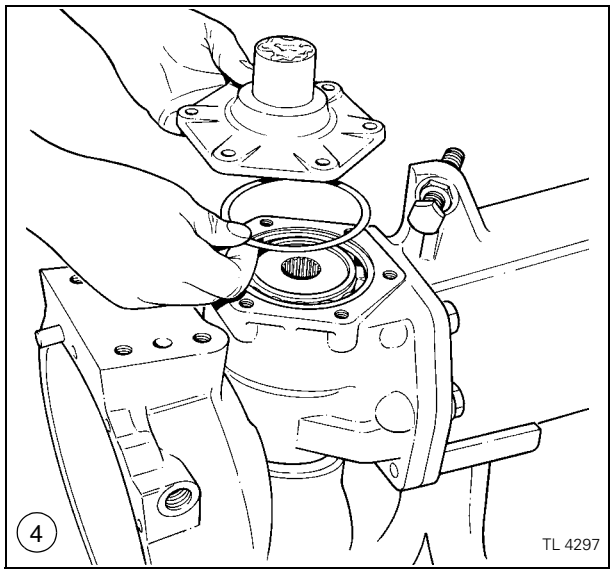
Removal and Refitment 7-8D

Removal

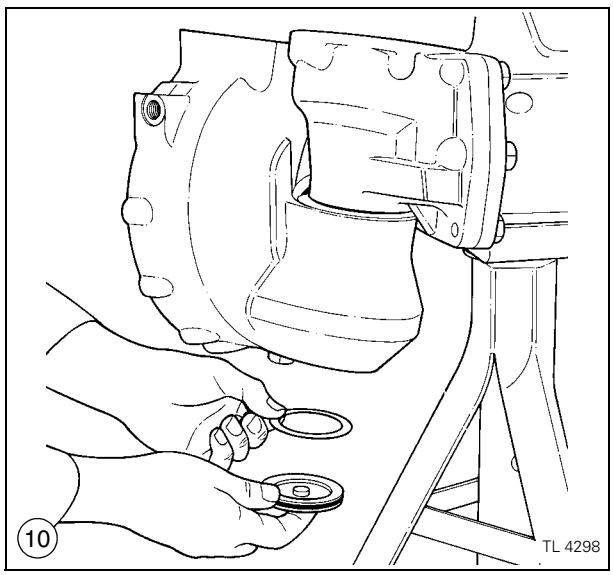
1. Remove the epicyclic reduction unit, *(see operation 4-8D)*.
2. Remove the split pin and nut and disconnect the track rod.
3. Remove the four bolts and the upper steering arm.



4. Remove the six bolts and the swivel housing cap.
5. Remove and discard the dirt seal.
6. If necessary, remove the bush.
7. Remove the shim on top of the bearing.



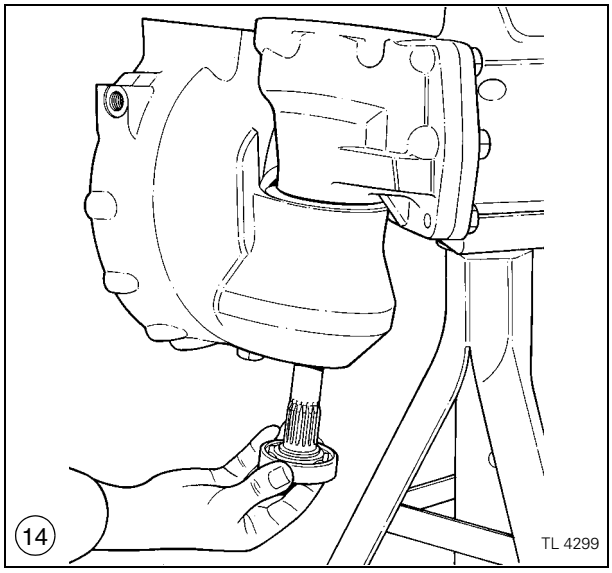
8. Remove the lower circlip.
9. Remove the plastic plug.
10. Insert a M10 bolt into the threaded hole in the lower cap and pull it out of the housing.
11. Remove and discard the 'O' ring.
12. Remove the shim between the lower cap and bearing.



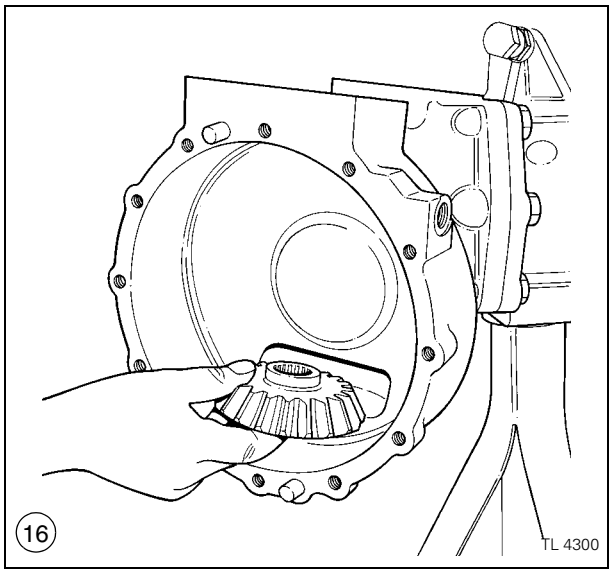
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13. Lightly drive the shaft downwards out of the upper bevel gear.
14. Remove the shaft from the lower bevel complete with bearing.
15. If necessary, remove the ball bearing from the shaft.



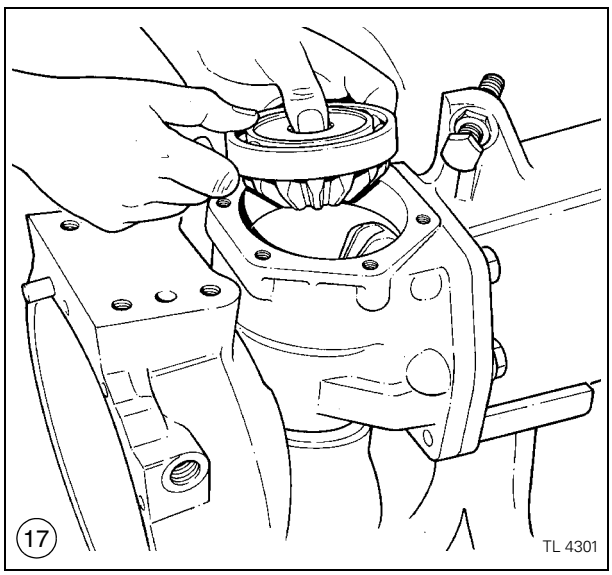
16. Remove the lower bevel gear.



17. Remove the upper bevel gear and bearing by driving it out of the housing from below.
18. If necessary, remove the ball bearing.
19. Remove the swivel housing by driving it downwards. It is held in position by a close fitting oil seal.
20. Remove and discard the oil seal.
21. If necessary, remove the ball thrust bearing.
22. If necessary, remove the lower bush.

Upper Drive Bevel Gear.

23. If it is necessary to remove the upper bevel gear (27), split the axle by removing the six large bolts and removing the housing complete with drive shaft.
24. Open-up the snap ring and pull the drive shaft out of the bevel gear.
25. Remove the snap ring.



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26. Remove and discard the 'O' ring.
27. Push the bevel gear and bearing into the housing and remove through the top.
28. If necessary, remove the ball bearing.

Refitment

Setting Procedure for Bevel Gears

There are three stages to setting the two sets of bevel gears. This setting procedure is only required if components are changed which effect the relative position of the gears; for example, new bevel gears, shafts and housings. The measurement and calculation is to determine the thickness of the shims to be fitted to obtain the correct bevel gear backlash.

29. Stage 1, ensure that the large bevel gear on the epicyclic carrier is correctly set.
30. Install the lower bevel gear, shaft and bearing.
31. Install the epicyclic reduction unit, *(see operation 6-8D)*.
32. Stage 2, install the upper bevel gear and bearing to locate the vertical shaft in its correct position.
33. Measure the thickness of the circlip (8) with a micrometer and record, this is dimension 'D'.
34. Measure the thickness of the lower cap where it presses onto the bearing, this is dimension 'E'.
35. Install the circlip in its groove.
36. Force the vertical shaft upwards so that the bevel gear is in tight mesh with the large bevel gear.
37. Measure the distance from the circlip to the ball bearing, this is dimension 'C'.
38. From the following formula calculate the thickness of the shim to be fitted between the cap and bearing, this is dimension 'Sp 1'.

    Sp 1 = C - (D + E)

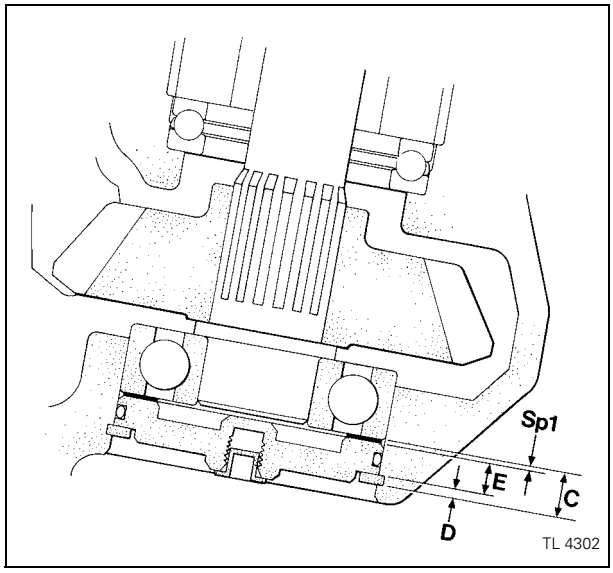
    For example:

    Sp 1 = 11,30 mm - (2,50 mm + 8,50 mm).

    Sp 1 = 0,30 mm.

From the following table select the required shim:

The shims, part number 3764 479 M1 are 0,10 mm (0.004 in) thick. In this example three shims will be required.



39. Install the shim(s), cap with new 'O' ring and circlip. Press the drive shaft downwards so that the bearing is tight against the shim and cap. The backlash between the lower bevel and the large bevel should be 0,15-0,25 mm (0.006-0.010 in), if it is not to specification the shim thickness will have to be adjusted.
40. Refit the plastic plug in the cap.

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Four-wheel Drive Front Portal Axle

41. Stage 3,The swivel housing must be bolted to the main axle housing. A new 'O' ring must be fitted and the six bolts tightened to a torque of 130 Nm (95 lbf ft).

Check that the bevel gear and bearing (27 & 28) is in contact with the main axle housing.

42. Check the installation of the upper bearing and bevel gear. Press the assembly down so there is no backlash between the two gears.
43. Measure the depth of the bearing from the top face of the housing, this is dimension 'X'.
44. Measure the depth of the bearing cap, this is dimension 'Y'.
45. From the following formula calculate the thickness of the shim to be fitted between the cap and bearing, this is dimension 'Sp 2'.

    Sp 2 = x - y - 0,20

    For example:

    Sp 2 = 7,78 - 7,43 - 0,20

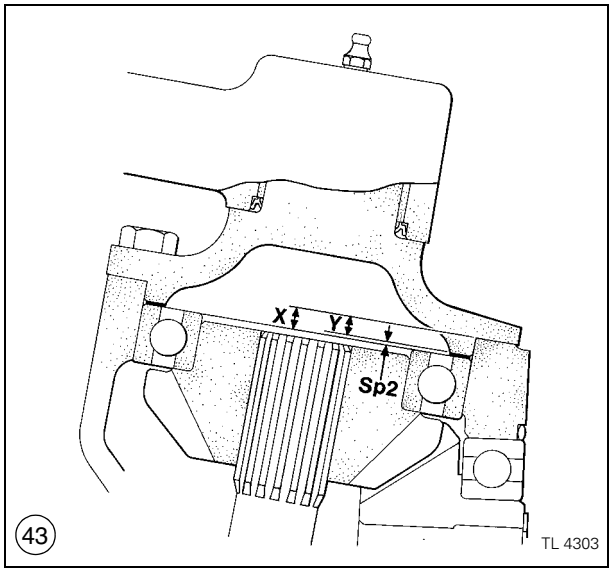
    Sp 2 = 0,15 mm

    Use shim 3428 488 M1

    From the following table select the required shim you require from your own calculation:

Shim thickness	Part number
0,10 mm	3428 487 M1
0,15 mm	3428 488 M1
0,30 mm	3428 489 M1

46. Install the shim and cap and tighten the bolts to a torque of 66 Nm (50 lbf ft).
47. Install the upper steering arm locating it on the dowel pins. Tighten the bolts to a torque of 110 Nm (80 lbf ft).
48. Grease the upper pivot bearing until grease shows around the joint.
49. Apply lubricating oil to the thread and tighten the ball joint nut to a torque of 125 Nm (90 lbf ft). Then tighten further as required to align the nut for the split pin (maximum torque 160 Nm (118 lbf ft). Renew the split pin.
50. Re-fill the axle with clean lubricating oil of the correct grade.



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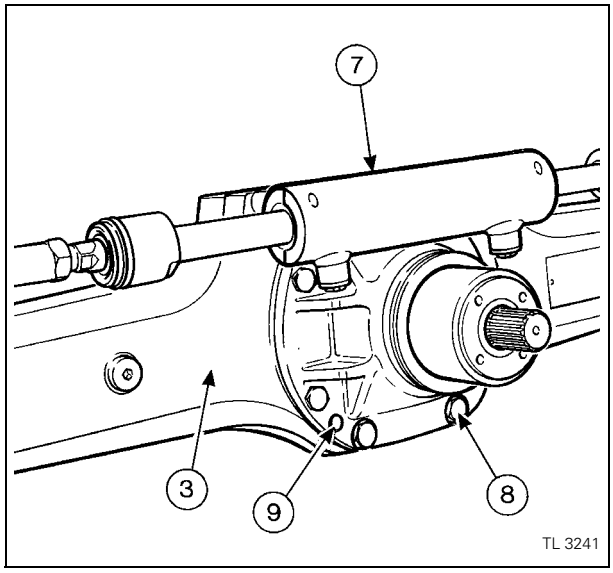
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DIFFERENTIAL ASSEMBLY

Removal and Refitment 8-8D

Removal

1. Secure the tractor by applying the parking brake.
2. Jack up the front of the tractor and support under the engine.
3. Remove the axle from the tractor, *(see operation 4-8D)*.
4. Remove both front wheels.
5. Drain the oil from the axle casing.
6. Remove both swivel housings, *(see operation 7-8D)*. It is not necessary to dismantle the epicyclic hubs.
7. Remove the steering cylinder, *(see operation 11-8D)*.
8. Remove the eight bolts holding the differential case to the axle casing.



WARNING: Take care when removing the differential assembly, it is awkward and heavy to handle.

9. The differential is located by dowels in the axle casing. Carefully prise it away from the casing supporting the weight at all times.

Refitment

10. Reverse procedures 1 to 9 except:

a. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the joint face of the differential case.

b. Apply lubricating oil to the differential case bolts and tighten them to a torque of 135 Nm (100 lbf ft).

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DIFFERENTIAL ASSEMBLY

Overhaul **9-8D**

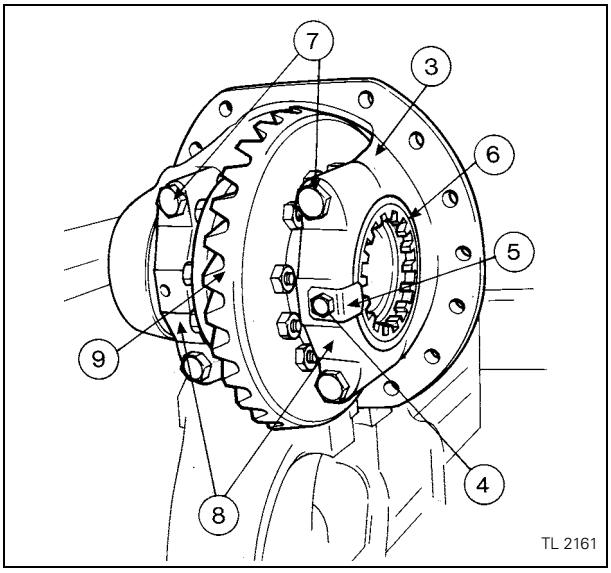
Special Tools:
MF.471A Hydralock Spring Compressor

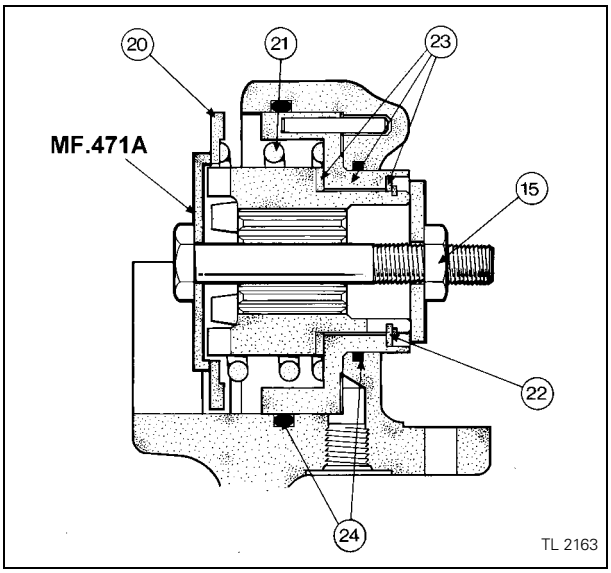
Dis-assembly

1. Remove the differential assembly, *(see operation 6-8D)*.
2. Hold the differential assembly in the jaws of a vice.
3. Mark the end caps and casting to aid re-assembly.
4. Remove the securing bolts.
5. Remove the locking tabs.
6. Unscrew the bearing adjustment ring nut.
7. Remove the cap bolts.
8. Remove the end caps.
9. Lift the differential assembly out of the casing.
10. Remove the bearing cups.
11. Check that the two **'X'** marks are stamped on the differential case to ensure alignment during assembly. If these marks cannot be found, mark the two halves of the case.
12. Place the crownwheel and differential unit in the vice and remove the eight nuts and bolts.
13. Split the differential case and remove the differential gears, cross or shaft and thrust washers.

WARNING: Spring under compression, use special tool MF.471A. Failure to use the special tool or some other restraining means when removing the Hydralock assembly can cause injury.

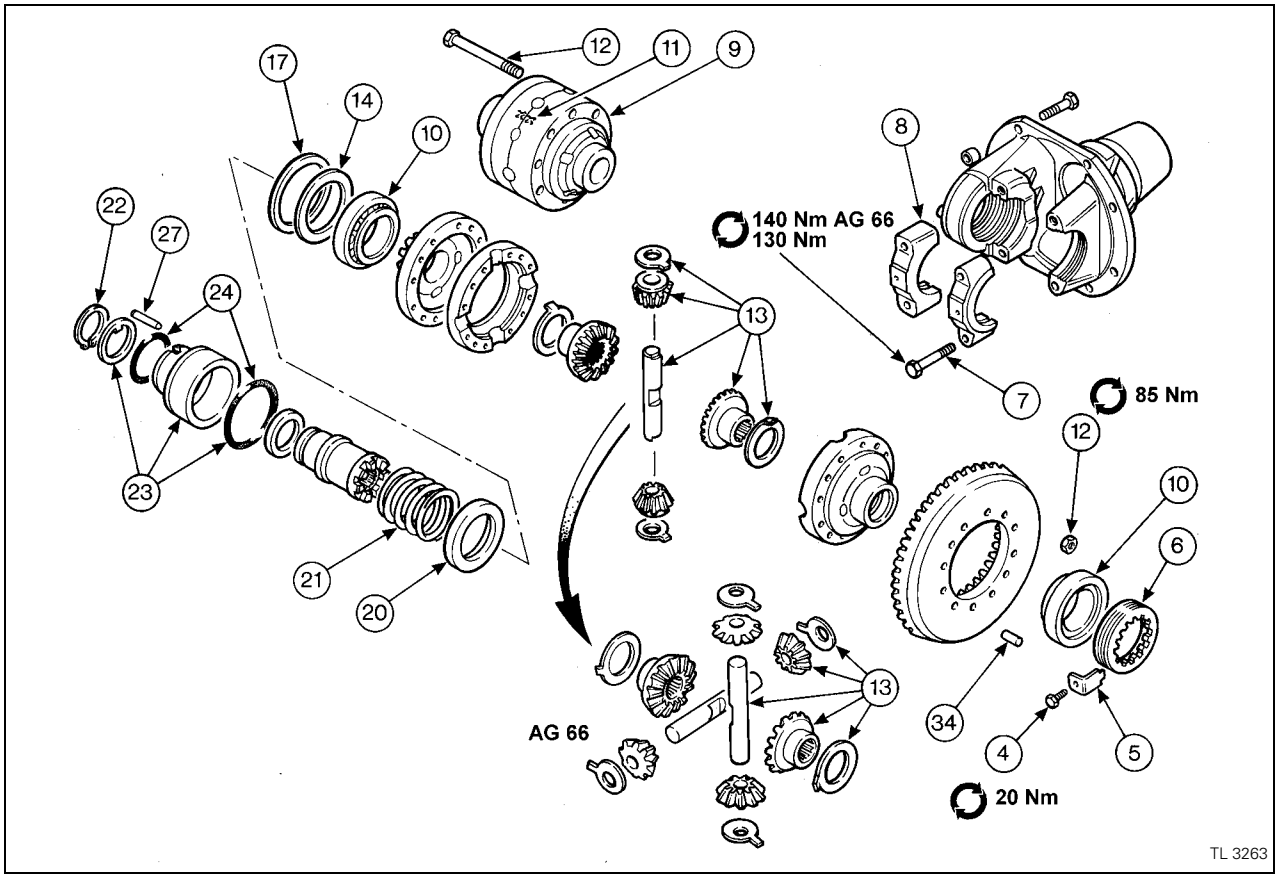
14. Remove the bearing shims and retain for re-assembly.
15. Fit the Hydralock Spring Compressor MF.471A. Carefully centralise the two washers.
16. Tighten the spring compressor until the spring tension has been taken off the retaining ring.
17. Remove the retaining ring.
18. Slide the hydralock assembly out of the housing. It may need a tap with a hammer if the seals are tight.
19. Dismantle the hydralock unit by loosening and then removing the spring compressor.
20. Remove the spring guide plate.
21. Remove the coil spring.
22. Remove the circlip.
23. Remove the piston and two thrust washers.
24. Remove the two seals from the housing.





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Examination

Thoroughly clean and inspect all components. Any parts showing signs of wear or damage must be renewed. Renew all 'O' rings, seals and circlips.

Re-assembly

25. Re-assemble the piston and coupler with the two thrust washers and circlip.
26. Fit two new seals into the housing ensuring that they are both correctly positioned and well lubricated.
27. Tap the piston and coupler assembly into the housing ensuring that it locates on the internal peg.
28. Refit the spring, guide plate and special tool MF.471A.
29. Tighten the spring compressor until the retaining clip can be inserted into its groove.
30. Slowly release the spring compressor and remove it.
31. Refit the removed shims.

Crownwheel and Differential

32. Refit or renew the taper roller bearing cones if they have been removed.
33. Refit the differential gears, cross and thrust washers into the case. AG 66 axles are fitted with four pinions, AG 85 axles are fitted with two pinions. Ensure that the tabs on the thrust washers are correctly located in the holes in the differential case.
34. Align the marks on the case and locate the crownwheel on the two dowels. Refit the bolts, apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten the nuts to a torque of 85 Nm (65 lbf ft).
35. Refit the bearing cups and refit the crownwheel and differential assembly. The crownwheel is mounted on the left side of the differential.
36. Refit the bearing caps and lightly tighten the bolts.

Bearing Pre-load

37. Tighten the adjuster ring to take up the backlash between the taper roller bearings.

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38. Finally, turn the adjuster ring a further three notches until the slot is aligned with the locking plate to apply the correct pre-load.

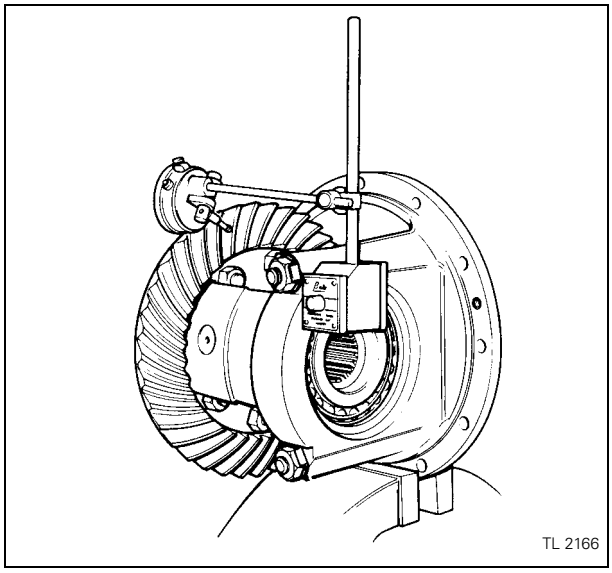
Crownwheel and Pinion Backlash

39. With a dial indicator gauge check the backlash between the crownwheel and the pinion. Fit the indicator gauge as shown in the illustration, the clearance should be:

    AG 66 axle - 0,15-0,20 mm (0.006-0.008 in).

    AG 85 axle - 0,18-0,23 mm (0.005-0.007 in).

40. If the reading is too high or too low it will be necessary to remove the crownwheel and differential assembly and adjust the thickness of the shim pack behind the right-hand bearing. Reduce the thickness of the shim pack if the clearance is too high, add if the clearance is low. Shims are available in the following sizes:


TL 2166

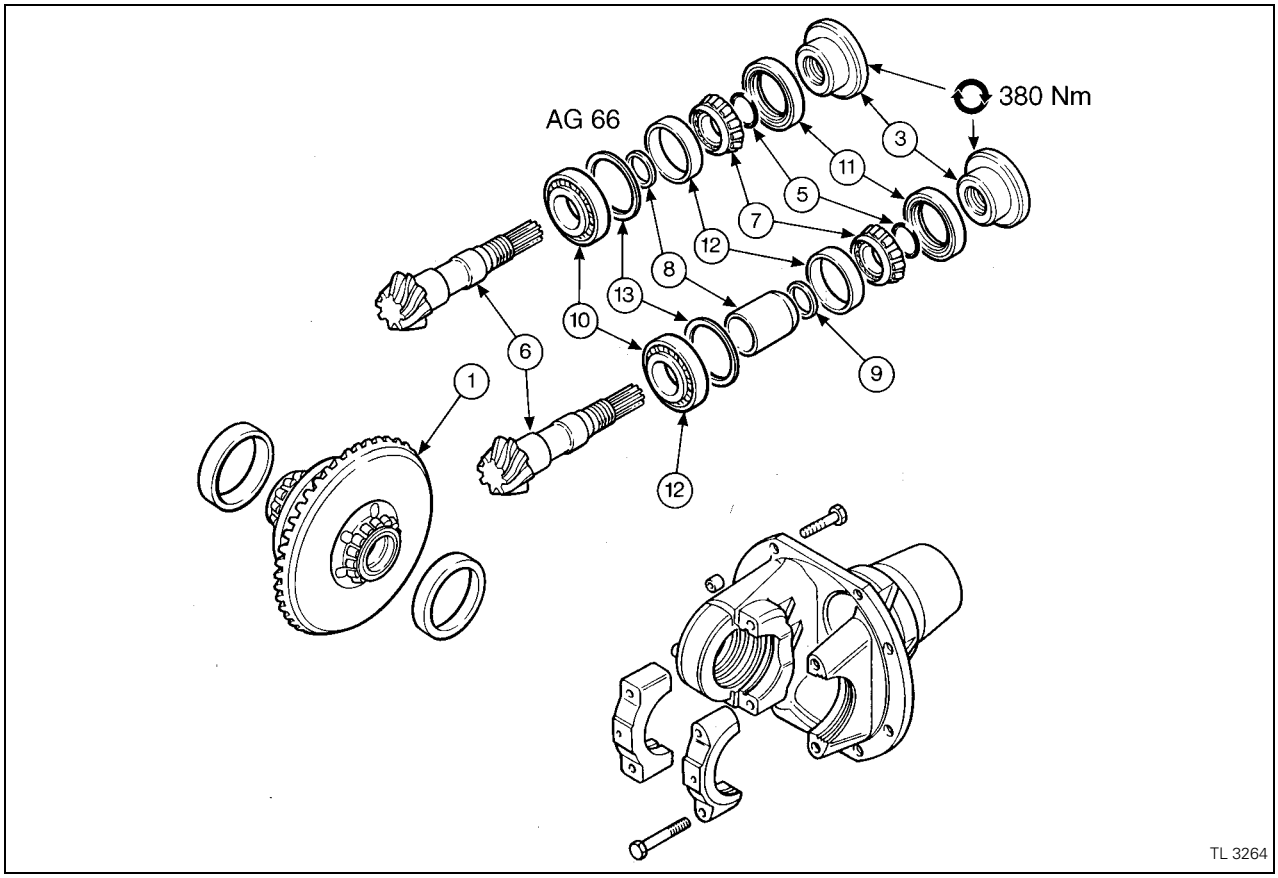
Shim thickness chart - AG 66 Axle		
Part number	mm	inch
3429 077 M1	0,10	0.004
3429 078 M1	0,15	0.006
3429 079 M1	0,30	0.012
3429 080 M1	0,50	0.020
3429 081 M1	0,70	0.028
3429 082 M1	1,00	0.040

Shim thickness chart - AG 85 Axle		
Part number	mm	inch
3427 281 M1	0,10	0.004
3427 282 M1	0,15	0.006
3427 283 M1	0,30	0.012
3427 284 M1	0,50	0.020
3427 285 M1	0,70	0.028
3427 286 M1	1,00	0.040

41. When the setting is correct remove each cap bolt in turn and apply Massey Ferguson Studlock (Loctite 270) to the thread. Tighten the bolts to a torque of 140Nm (103 lbf ft) for AG 66 axle and 130 Nm (95 lbf ft) for AG 85 axle.
42. Replace the locking tab, apply Massey Ferguson Studlock (Loctite 270) and tighten the bolt to a torque of 20 Nm (15 lbf ft).
43. Check the rotation of the crownwheel and pinion to ensure satisfactory operation.
44. Refit the differential unit to the axle casing.

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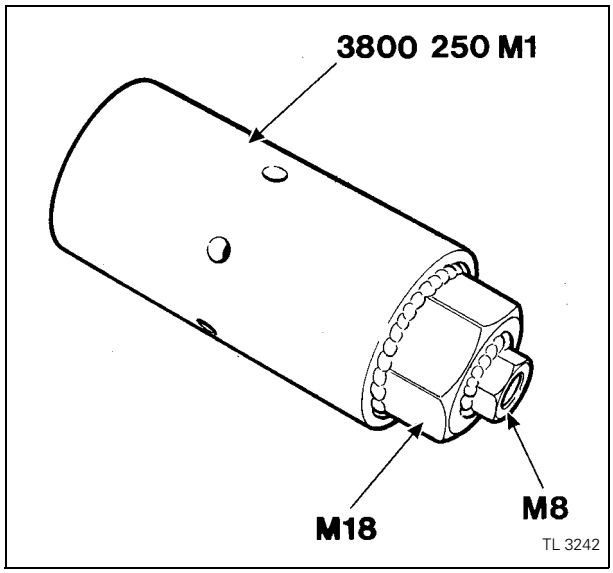
CROWNWHEEL AND PINION

Overhaul **10-8D**

Special Tools:
MF.502 Pinion Nut Wrench
MF.503 Pinion Oil Seal Installer
FT.4062A Pinion Pre-load Gauge
Straight Edge

Dis-assembly

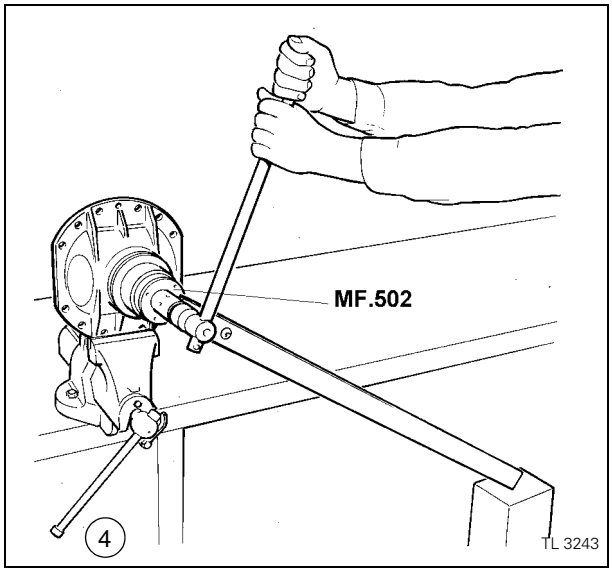
1. Remove and dismantle the crownwheel and differential assembly, *(see operation 8-8D)*.
2. With a narrow cold chisel and hammer carefully unstake the pinion nut securing it to the pinion shaft.
3. To remove the pinion nut you will need to locally manufacture a special sleeve. Obtain coupler number 3800 250 M1 and to one end weld an M18 nut and a M8 nut as shown in the illustration.
4. Using special tool MF.502 Pinion Nut Wrench, add an extension bar (section 45 x 5mm), length to suit mechanic, to the handle as shown in the illustration, use 2 off 14mm bolts at a 85 mm pitch. Remove the pinion nut.



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5. Remove the 'O' ring inside the nut and discard.
6. With the aid of a soft faced hammer or press remove the pinion with bearings from the case.
7. Remove the outer bearing cone.
8. Remove the spacer (calibrated spacer on AG 66 axle only).
9. Remove the bearing pre-load shims and retain for re-assembly (AG 85 axle only).
10. Remove the inner bearing cone with a bearing separator plate and press.
11. Remove the oil seal.
12. Remove the inner and outer bearing cups.
13. Remove the pinion depth of mesh shims.



Examination

Thoroughly clean and inspect all components. Any parts showing signs of wear or damage must be renewed. Renew all 'O' rings, seals and circlips. Ensure that all parts are free from dents or damage.

Re-assembly

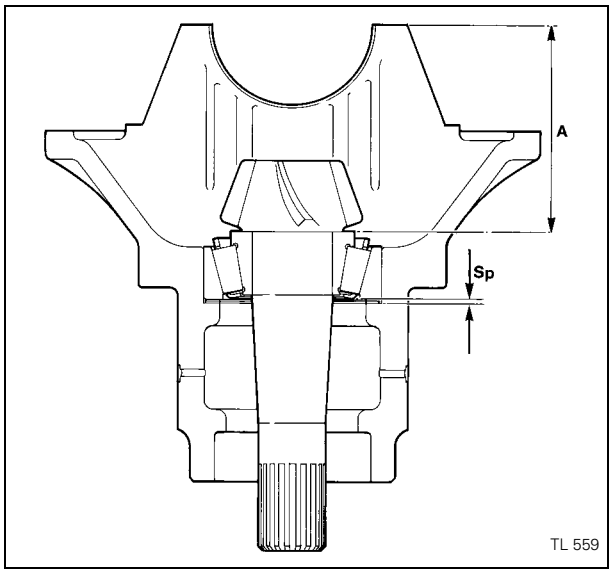
The crownwheel and pinion are only available as a matched set. If the crownwheel and pinion are not to be replaced the following instructions on setting the pinion may be disregarded. The two sets of shims must be retained for re-assembly.

It is necessary to carry out a series of measurements, calculations and procedures to establish the exact position of the pinion in relation to the crownwheel and the pinion bearing pre-load. It is recommended that you work in the metric system for ease of calculation.

Pinion Settings - Depth of Mesh

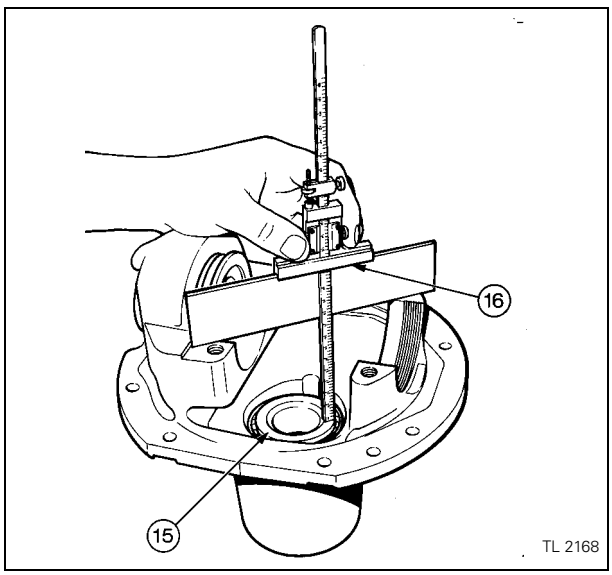
14. The height of the pinion is adjusted by shims under the taper roller bearing to obtain dimension **'A'**. The shims required are calculated in accordance with the following formula:

Sp	=	A- (D ± R)
Sp	=	Shim thickness.
A	=	Actual dimension from centre line of crownwheel to the top of the taper roller bearing without shims.
D	=	Nominal dimension of 91 or 118 mm.
R	=	Actual tolerance of dimension **'D'** etched on the bevel pinion. This value may be a positive (+) or a negative (-) to be added or subtracted from the nominal dimension **'D'**.



For the next series of procedures you will require a precession depth gauge and straight edge.

15. Fit the upper taper roller bearing cup and cone into the housing without shims.



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16. Place the housing in the vertical position on the bench. Place a straight edge across the bearing cap faces and measure from the top of the straight edge to the top of the bearing. You may find it easier to place a small piece of plate over the bearing and measure from the centre of the bearing.

    Subtract the width of the straight edge and add the thickness of the plate if used, from your reading and record dimension **'A'**.

17. Dimension **'D'** is a fixed dimension of 91 mm (AG 66) and 118 mm on the AG85 axle which must always be adhered to.

18. Inspect the end of the pinion and record tolerance 'R', plus or minus.

19. Using the figures you have obtained above and the formula calculate the shim thickness required.

Example AG 66 only - other axle similar:

Where	A	=	91,96 mm	(measured).
	D	=	91 mm	(nominal).
	R	=	+ 0,010 mm	(tolerance).
	Sp	=	91,96 less (91 plus 0,010).	
	Sp	=	0,95 mm.	

Shims required: 1 x 0,15, 1 x 0,3 and 1 x 0,5.

Check the thickness of the pack with a micrometer. It may be necessary to round-off to the nearest value that can be made into a shim pack. Select the higher value if new bearings are being fitted. Shims are available in the sizes shown in the tables opposite.

20. Remove the bearing, place the shim pack into the housing and fit the inner taper roller bearing cup.

21. Fit the outer taper roller bearing cup.

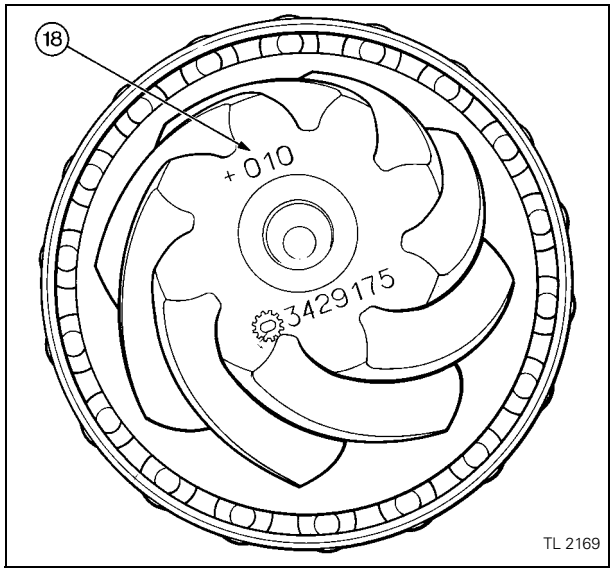
22. Press the inner taper roller bearing cone on to the pinion.

23. Replace the bearing spacer with the chamfered end facing the splined end.

24. Replace the spacer or shims that were removed on dis-assembly as a starting point, then the bearing cone and a new nut. DO NOT fit the oil seal.

25. Tighten the nut dry to a torque of 380 Nm (280 lbf ft). Tap the pinion in both directions to ensure that the bearings are fully seated. See procedures 36 and 37 for further details on tightening the pinion nut.

26. Lightly lubricate the bearings



.

AG 66 Axle	Thickness	
Part number	mm	inch
3428 722 M1	0,10	0.004
3428 723 M1	0,15	0.006
3428 724 M1	0,30	0.012
3428 725 M1	0,50	0.020
3428 726 M1	0,70	0.028
3428 727 M1	1,00	0.040

AG 85 Axle	Thickness	
Part number	mm	inch
3429 077 M1	0,10	0.004
3429 078 M1	0,15	0.006
3429 079 M1	0,30	0.012
3429 080 M1	0,50	0.020
3429 081 M1	0,70	0.028
3429 082 M1	1,00	0.040

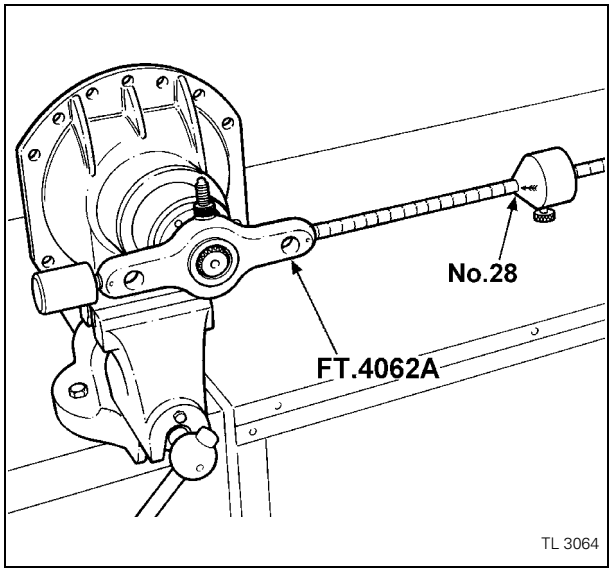
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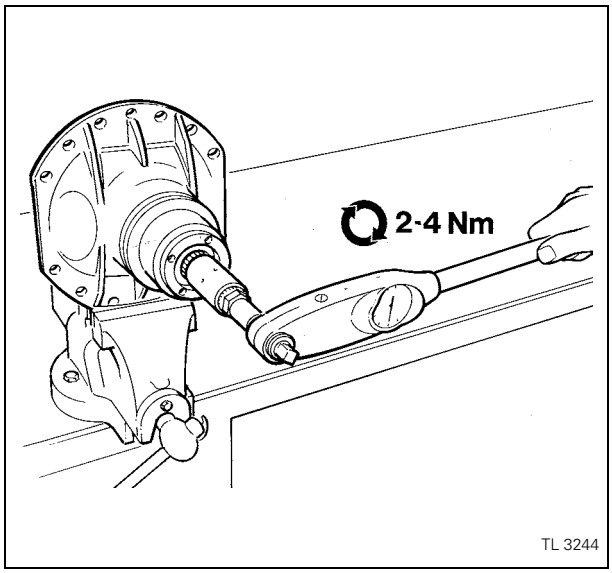
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Pinion Bearing Pre-load

27. It is now necessary to set the taper roller bearing pre-load by selecting the correct spacer (AG 66 axle or shims to be placed between the spacer and outer bearing. The correct rotational torque is 2-4 Nm. This can be set by using special tool FT.4062A or using the special sleeve and a torque wrench.
28. Special tool FT.4062A is calibrated in inch pounds (in lb). Moving the weight to the 28 in. mark on the rod represents 3 Nm.
29. Attach special tool FT.4062A to the pinion spline and set the weight to the 28 mark.
30. The setting is correct when you touch the weight end of the tool and it slowly rotates from the horizontal to the vertical position.
31. Alternatively, using the special sleeve and a dial reading torque wrench. Rotate the pinion through a few turns using the torque wrench noting the reading on the dial, it is correct when a rotational torque of 2-4 Nm (18-35 in lb) is obtained.

To obtain this condition it may be necessary to adjust the spacer or shim thickness several times. Spacers and shims are available in the following thicknesses:





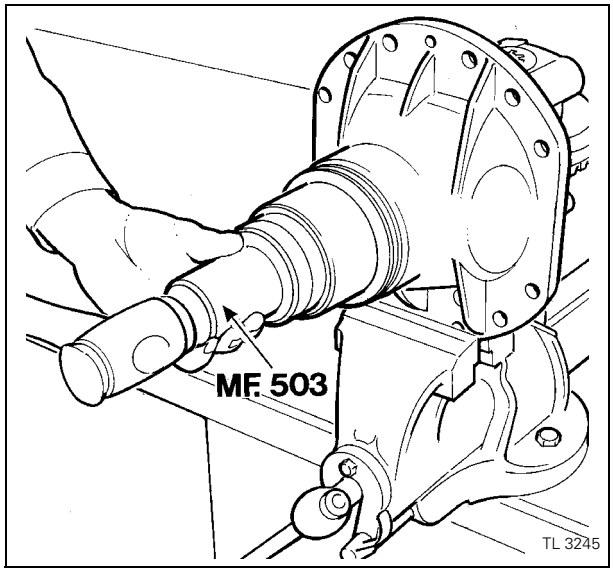
AG 66 Axle	Spacer thickness	
	mm	inch
3764 551 M1	11,15	0.439
3764 552 M1	11,20	0.441
3764 553 M1	11,25	0.443
3764 554 M1	11,30	0.445
3764 555 M1	11,35	0.447
3764 556 M1	11,40	0.449
3764 557 M1	11,45	0.451
3764 558 M1	11,50	0.453
3764 559 M1	11,55	0.455
3764 560 M1	11,60	0.457
3764 561 M1	11,65	0.459
3764 562 M1	11,70	0.461
3764 563 M1	11,75	0.463
3764 564 M1	11,80	0.465
3764 565 M1	11,85	0.467
3764 566 M1	11,90	0.469
3764 567 M1	11,95	0.471
3764 568 M1	12,00	0.473
3764 569 M1	12,30	0.485

AG 85 Axle	Shim thickness	
	mm	inch
3428 253 M1	0,10	0.004
3428 254 M1	0,15	0.006
3428 255 M1	0,30	0.012
3428 256 M1	0,50	0.020
3428 257 M1	0,70	0.028
3428 258 M1	1,00	0.040

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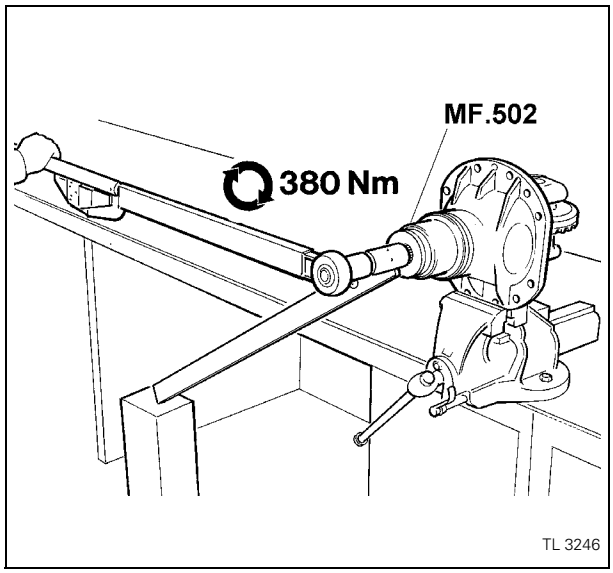
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32. Remove the pinion nut and pinion assembly.
33. Using special tool MF.503 Pinion Oil Seal Installer, press a new oil seal into the housing.
34. Renew the 'O' ring in the nut.
35. Apply general purpose grease to the cavity of the oil seal.



36. Apply Massey Ferguson Studlock (Loctite 270) to the thread and replace the pinion nut.
37. The special tool, MF.502 Pinion Nut Wrench, can be used in two ways:

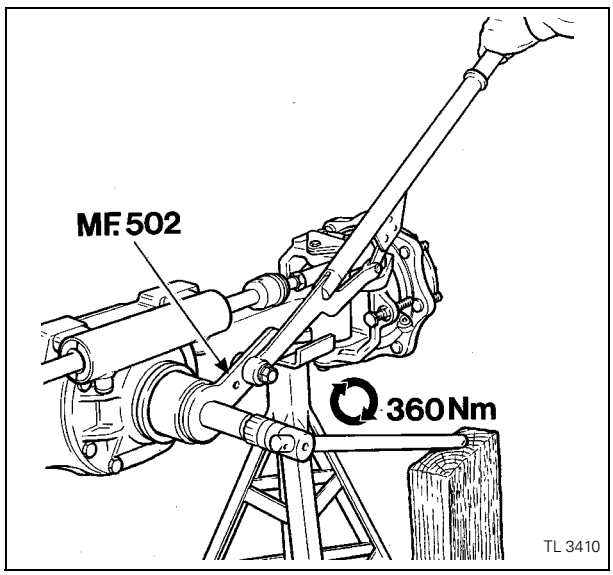
    Attach the extension handle to the wrench and use it to hold the nut. Turn the pinion using a torque wrench and the special sleeve described on pages 8D-25 and 8D-26, the nut is tightened to a torque of 380 Nm (280 lbf ft).



Or alternatively:

If the axle is in an assembled condition, it is not possible to turn the pinion; for example, when replacing the oil seal. In this case, fit the torque wrench to MF.502 using the 3/4 inch square drive hole. Hold the pinion with a socket and bar, and tighten the nut. Because the torque wrench is not in the centre of the nut, set the torque wrench to 360 Nm (265 lbf ft) to achieve the correct torque.

38. With the aid of a hammer and punch, drive the lip of the nut into two opposite slots on the shaft to lock it.
39. Replace the crownwheel and differential assembly setting the clearance as described, *(see operation 10-8D)*.
40. Rebuild the axle and refit to the tractor.



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STEERING CYLINDER

Removal and Refitment 11-8D

Removal.

1. Remove the front axle assembly, *(see operation 4-8D)*.
2. Remove the split pins and disconnect both steering ball joints.
3. Holding the ends of the steering cylinder piston rod with a spanner unscrew both track rods.
4. Remove the four hexagon cap screws (8 mm hexagon wrench will be required) and the steering cylinder.

Refitment

5. Reverse procedure except:

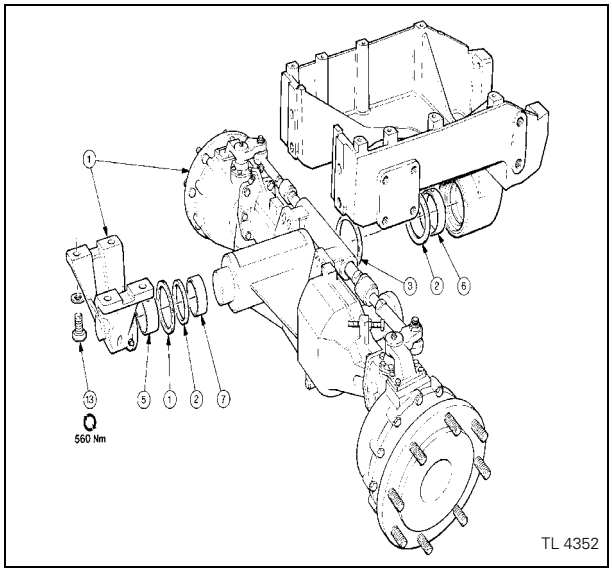
a. Apply Massey Ferguson Studlock (Loctite 270) to the threads and tighten the four cap screws to a torque of 120 Nm (90 lbf ft) on the AG 66 axle and 190 Nm (140 lbf ft) on the AG 85 axle.

b. Tighten the steering rod ball joints to a torque of 135 Nm (100 lbf ft).

c. Apply lubricating oil to the thread and tighten the ball joint nut to a torque of 125 Nm (90 lbf ft). Then tighten further as required to align the nut for the split pin (maximum torque 160 Nm (118 lbf ft). Renew the split pin.

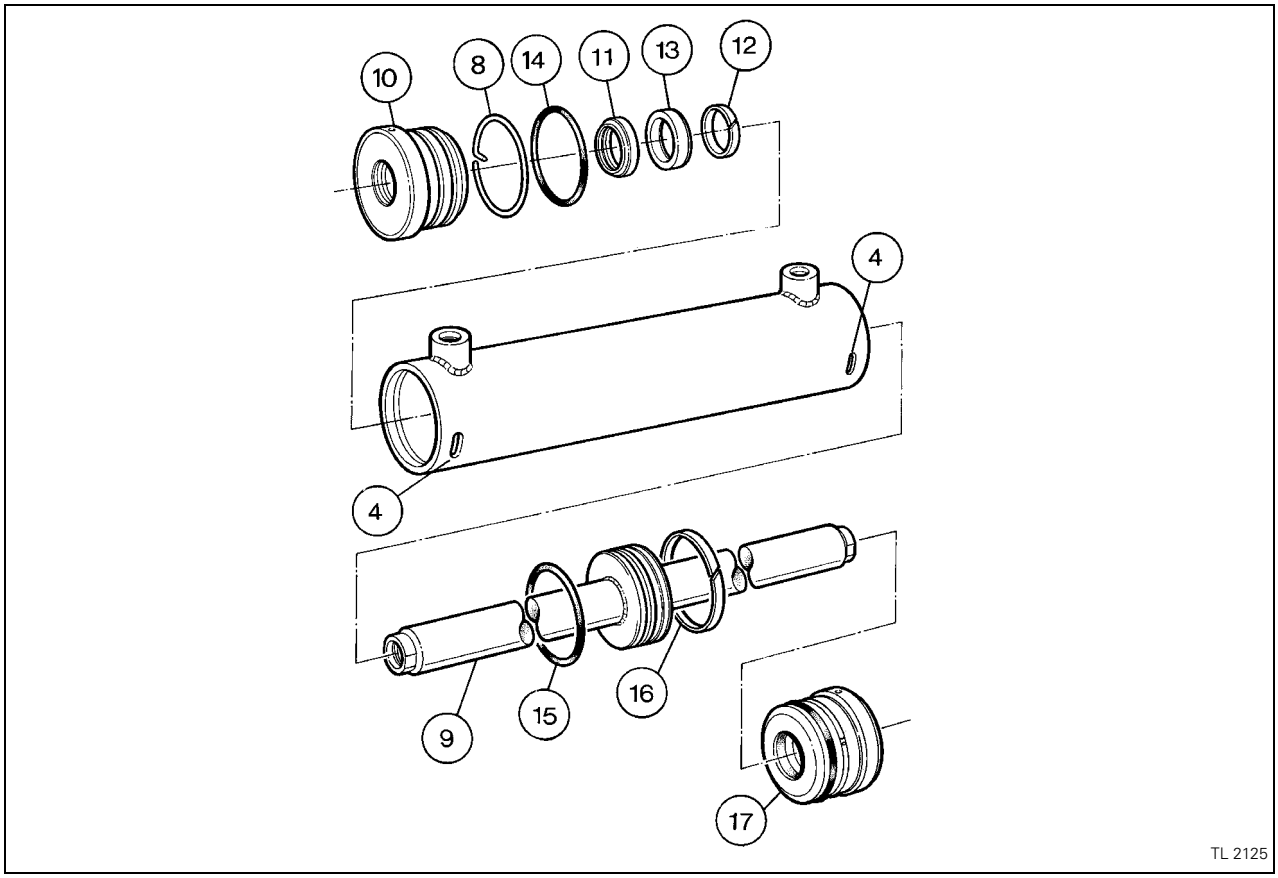
d. Check the wheel alignment, *(see operation 1-8D)*.

e. Use new split pins when refitting the steering ball joints.



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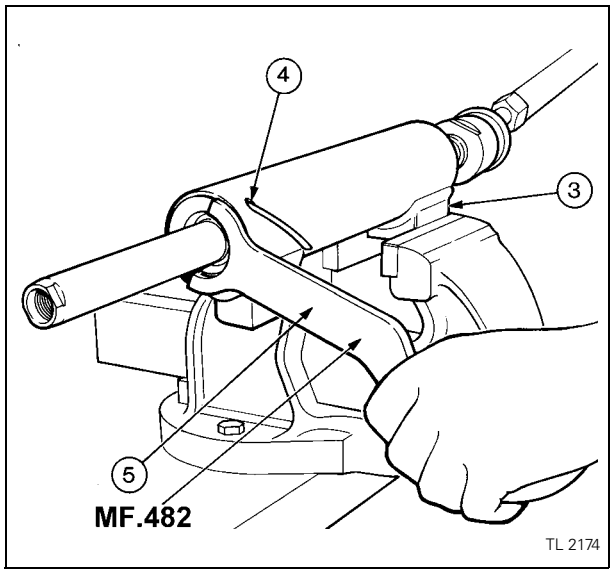
STEERING CYLINDER

Overhaul **12-8D**

Special Tools:
MF.482 Steering Cylinder Wrench

Dis-assembly

1. Remove the steering cylinder, *(see operation 11-8D)*.
2. Remove any sealing plugs and drain out any oil in the cylinder by moving the piston from one end of the cylinder to the other. Hold the cylinder over a container during this procedure.
3. Hold the cylinder in a vice by one of the mounting bosses.
4. Remove the sealing compound in the elongated holes at each end of the cylinder.
5. Using special tool MF.482 Steering Cylinder Wrench, rotate the cap until the chamfered end of the retaining wire can be seen in the elongated hole.



AG 66 Axle

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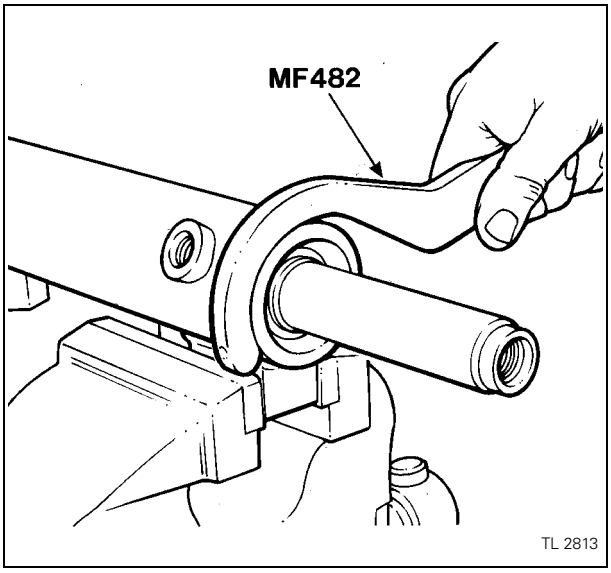
6. With the aid of a screwdriver, turn the end cap and prise the end of the wire up out of the hole.
7. Continue turning the cap and wind the rest of the wire out through the hole.
8. The end of the wire has a right angle bend which locates in a hole in the groove of the end cap, remove the wire from the cylinder.
9. Withdraw the piston assembly from the cylinder with the end cap.
10. Remove the end cap.
11. Remove the wiper seal.
12. Remove the wear ring.
13. Remove the pressure seal.
14. Remove the 'O' ring.
15. Remove the piston seal.
16. Remove the piston wear ring.
17. Remove the end cap from the other end of the cylinder following procedures 5 to 14.

Examination

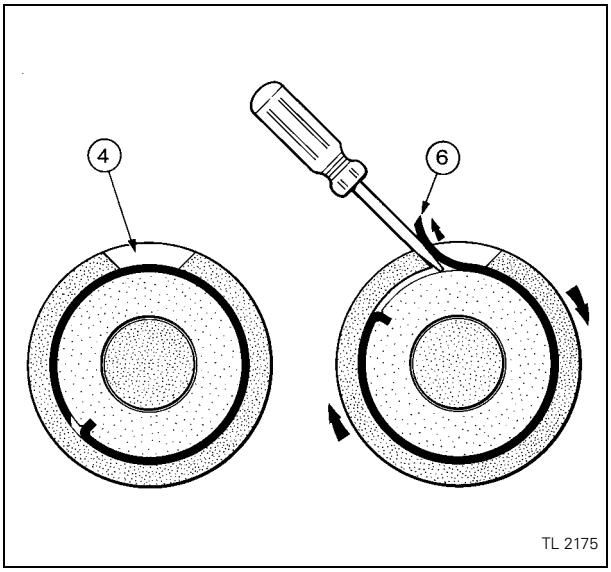
Clean and inspect all parts, renew any that are worn or damaged. Renew all seals, wear rings and 'O' rings.

Re-assembly

18. Fit a new set of seals in one of the end caps and lubricate them with transmission oil.
19. Renew the seal and wear ring on the piston and lubricate.
20. Refit the piston to the cylinder and slide the cap down into the cylinder.
21. Using special tool MF.482 Steering Cylinder Wrench, rotate the end cap until the hole in the wire groove is visible through the hole in the side of the cylinder.
22. Insert a new wire so that the bent end locates in the hole in the end cap. Ensure that the two grooves in the cylinder and end cap are in line.
23. Rotate the end cap so that it draws the wire round the end cap inside the cylinder. Rotate until all the wire is in the cylinder.
24. Seal the elongated hole in the cylinder with a non-setting type sealing compound. This sealing procedure is important to prevent the ingress of water and the resultant rusting of the end cap and retaining wire.
25. Repeat the procedures 20 to 24 for the other end cap.
26. Check that the piston rod moves up and down the cylinder correctly.
27. Refit the steering cylinder to the tractor.

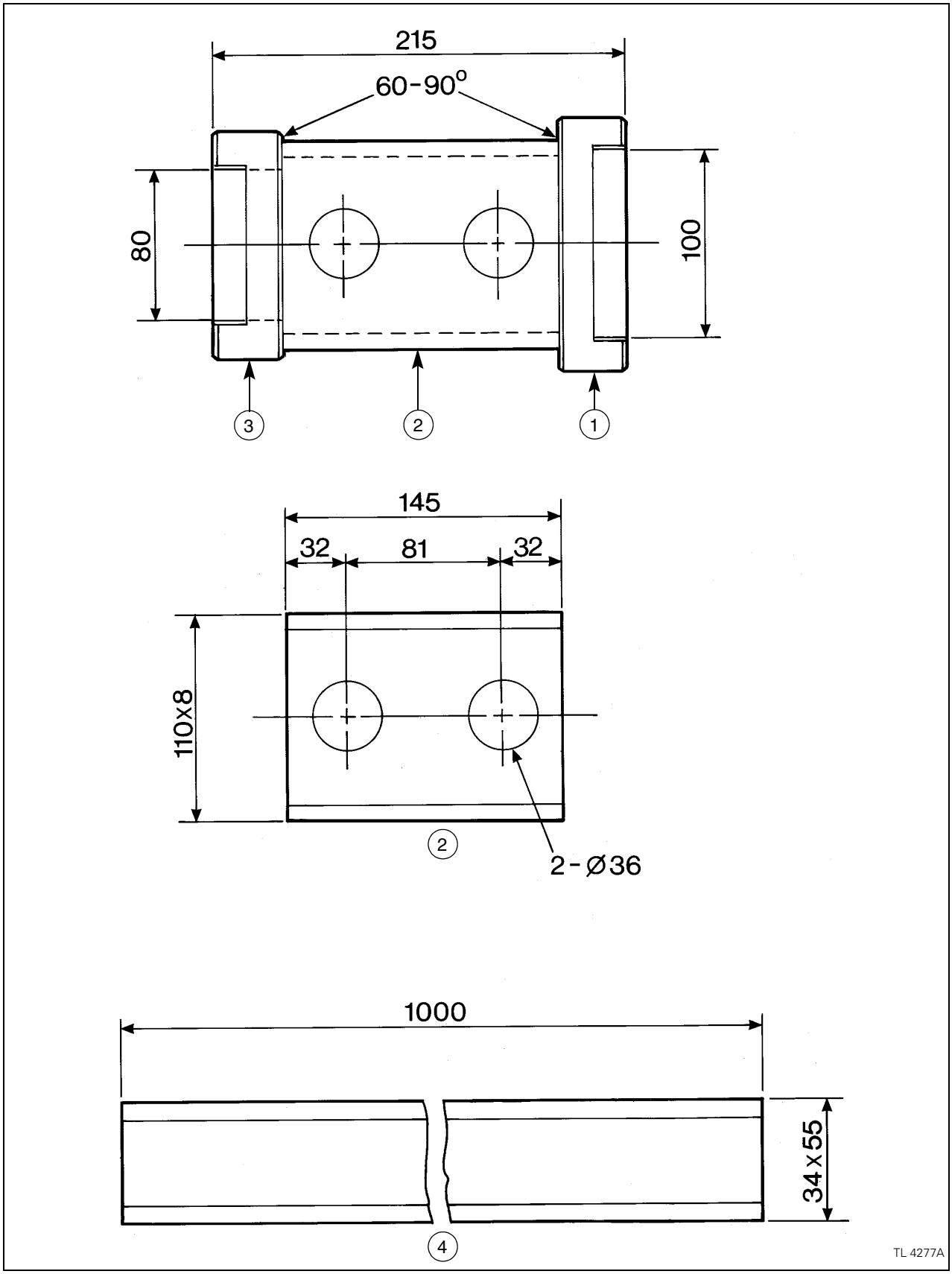


AG 85 axles



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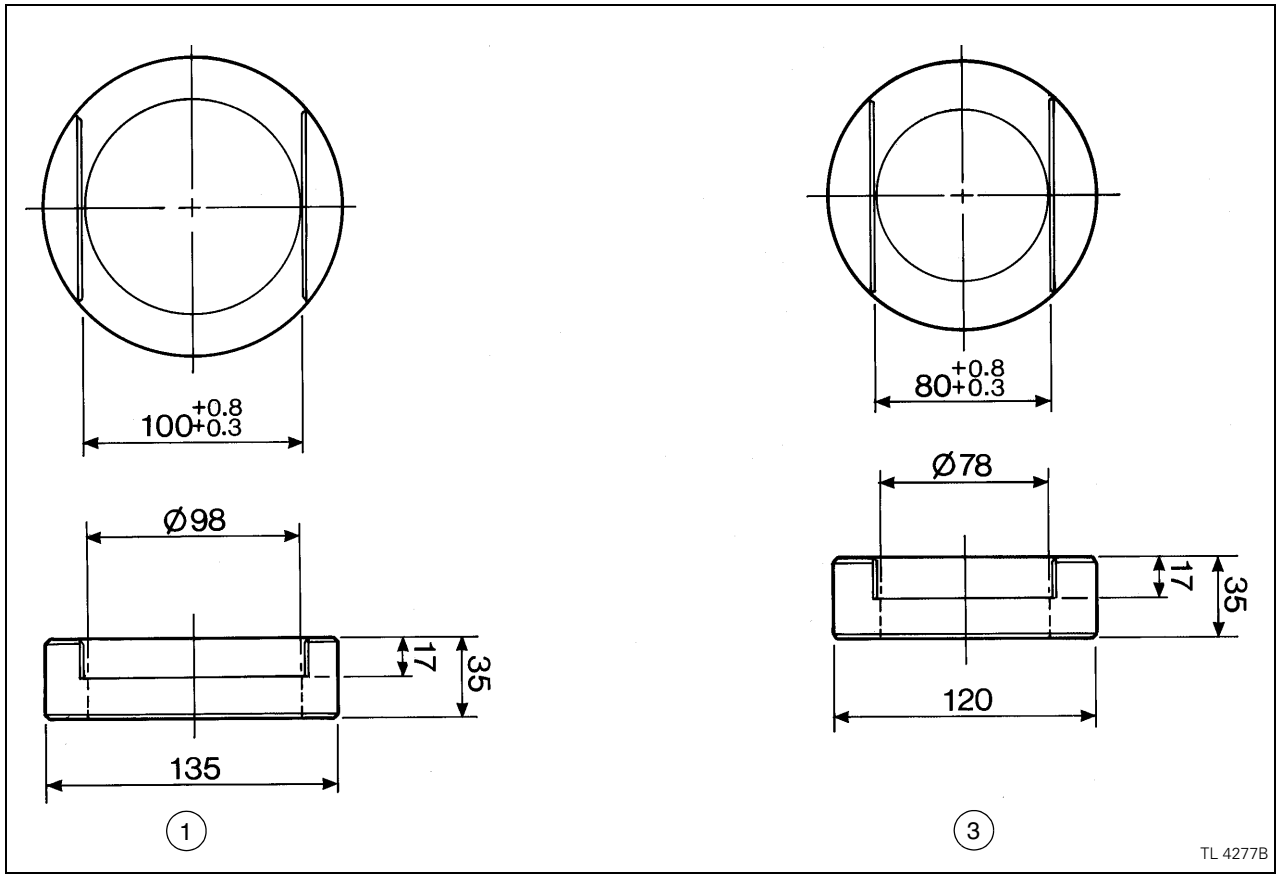
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Four-wheel Drive Front Portal Axle



SPECIAL WRENCH

Manufacture the special wrench in accordance with the drawings. The AG66 and AG85 axles fitted to the 4200 series tractors have nuts which are 100 mm across flats (1). The 80 mm across flat end (3) is for smaller axles and can be manufactured if required for other tractors. Weld the components together using a 6 mm x 90° fillet. Manufacture a handle (4) from tube to dimensions given in the drawing.

Material List

1. Bar 135 mm x 35 mm.
2. Tube 145 mm x 110 mm x 94 mm.
3. Bar 120 mm x 35 mm.
4. Tube 1000 mm x 55 mm x 34 mm.

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SECTION 9

Hydraulics

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9B	HYDRAULIC STEERING
9C	AUXILIARY HYDRAULICS

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Lift Hydraulics

Section 9 - Part A

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Lift Hydraulics

SPECIFICATION

Hydraulic pump - model	Mk. 3 - Four cylinder, scotch yoke, driven from the PTO drive line.
Output at 2000 engine rev/min at 138 bar (2000 lbf/in²):	
Low flow (540 rev/min PTO)	15 litre/min (3.3 gal/min)(4.0 US gal/min).
Intermediate flow (540/540E rev/min PTO)	18,8 litre/min (4.1 gal/min)(5.0 US gal/min).
High flow (540/1000 rev/min PTO)	24,3 litre/min (5.3 gal/min)(6.4 US gal/min).
Pressure relief valve setting:	
Flow condition - (1200 rev/min)	214-240 bar (3104-3481 lbf/in²).
Static condition	205-210 bar (2973-3046 lbf/in²).
Selector valve shock valve pressure setting	260-275 bar (3800-4000 lbf/in²).
Functions	Draft Control, Position Control, Response Control, Constant Pumping.
Lift cylinder size	93,6 mm (3.688 in).
Draft control rod clearance	5,8 mm (0.230 in).
Vertical lever applied load	1,3 kg (3 lb).
Linkage load for running adjustments	450 kg (1000 lb).
Lift arm rotation - transport setting	3 mm (1/8 in).
Hydraulic pump - Electronic Lift Control:	
Pressure at 1200/1500 engine rev/min)	214-240 bar (3104-3481 lbf/in²).
Pump flow at 140 bar - 2000 engine rev/min:	
New pump	28 litre/min (6.2 gal/min)(7.4 US gal/min).
Minimum	25 litre/min (5.5 gal/min)(6.6 US gal/min).

Special Tools:

MF.163	Spring retainer wrench.
MF.273A	Control lever setting arm.
MF.333	Draft control rod gauge.
MF.355	Lift pump overhaul kit comprising six items:
MF.349	Valve face cutter and coining tool set.
MF.350	Valve chamber circlip replacer.
MF.351	Valve chamber plug remover.
MF.352	Control valve spring retainer clip.
MF.353	Control valve body ‘O’ ring guide.
MF.354	Control Valve body replacer.
MF.356E	Position and Draft control setting gauge.
MF.418A	Lift cover remover/replacer.
MF.453	Hydraulic piston seal replacer.
MF.455	Pressure relief valve test capsule.
MF.506	Ram arm gauge - Position.
MF.507	Ram arm gauge - Draft.
MF.3001A	Pressure test kit.

Bolt Torques:

Control spring screw	7 Nm (5 lbf ft).
Lift cover bolts	95 Nm (70 lbf ft).
Front lift cylinder nuts	220 Nm (165 lbf ft).
Rear lift cylinder nuts	305 Nm (225 lbf ft).
Pump body retainer nuts	40 Nm (30 lbf ft).
Vertical lever end plate bolts	20 Nm (15 lbf ft).
Pressure relief valve assembly	110 Nm (80 lbf ft).
Pressure relief valve manifold nut	28 Nm (20 lbf ft).
Selector valve retaining screws	45 Nm (35 lbf ft).
Lift arm retaining bolts	230 Nm (170 lbf ft).
Cam pivot shaft grub screw	15 Nm (11 lbf ft).
Intake housing cover plate bolts	20 Nm (15 lbf ft).
Intake housing cover plate screws	12 Nm (10 lbf ft).
Solenoid valve retaining screws	24 Nm (18 lbf ft).

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GENERAL DESCRIPTION

General (Fig.1)

The Ferguson hydraulic system comprises a four cylinder scotch yoke pump (1) which delivers oil, through a vertical pipe (2) to the lift cylinder (3).

A connecting rod (4) from the cylinder piston (5) engages in the ram arm (6) which is splined on to the lift shaft (7) which carries the linkage lift arms.

When oil, under pressure from the pump is delivered to the ram cylinder (3), the piston is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

Conversely, when the oil is allowed out of the cylinder, the piston moves back under load of the lift arms.

The hydraulic pump is driven by the PTO drive from the main clutch, via the constant mesh gears and the PTO drive shaft. It is therefore rotating whenever the engine is running.

Oil flow from the pump is controlled by an integral control valve on the suction side of the pump.

The pump control valve is moved by the quadrant levers, forces down the top link, or the cam on the cross shaft.

The lower speed of the linkage (when the control valve is in the discharge position) is controlled by the response unit.

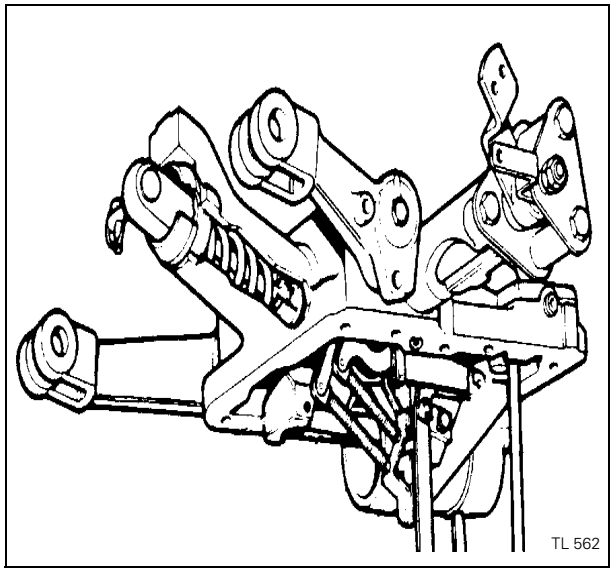


Fig.1

Hydraulic Linkage Pump (Fig.2)

All 4200 series tractors fitted with the Ferguson Lift system and the linkage pump as shown. The linkage pump is driven by its own drive shaft which forms part of the PTO drive line.

At normal operating pressure the pump operates at:

- A low flow of 17 litre/min with a 540 PTO.
- A intermediate flow of 22 litre/min with a 540/540E PTO.
- A high flow of 28 litre/min when fitted with a 540/1000 rev/min PTO

The pressure relief valve is set at 227 bar.

The pump consists of two piston yokes (1) which ride on cam blocks located on eccentrics on a camshaft (2). The pistons reciprocate in opposed valve chambers (3), each housing two inlet (4) and outlet valves (5) and springs. A sealing plug and snap ring secure the valves in the chambers.

Front and rear pump body castings incorporate the oil galleries connecting the valve chambers, and house the control valve (6) and the control valve oscillator.

Attached to the rear body is the Response Control (7) and strainer housing (8) and also the pressure relief valve (9).

The pressure relief valve is adjustable and connected to the outlet port of the pump to the lift cylinder.

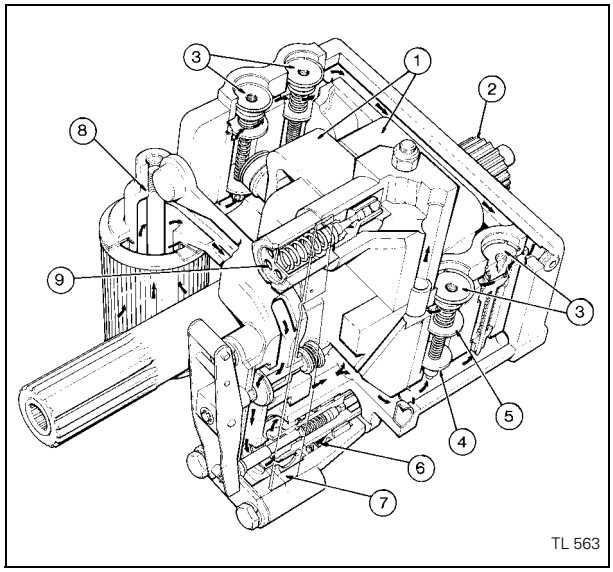


Fig.2

As each of the pump pistons moves in its cylinder it creates suction which lifts the inlet valve from its seat and draws in oil past the control valve (if open) along the intake gallery into the cylinder. During this inlet stroke the outlet valve is held closed by the spring acting on it. When the piston reaches the end of its inlet stroke, the suction ceases with the cylinder now full of oil, allowing the inlet valve to be closed by the inlet valve spring.

As the piston begins its compression stroke, the resultant pressure in the oil keeps the inlet valve closed and lifts the outlet valve, forcing the oil past the outlet valve into the high pressure gallery and up the stand pipe to the lift cylinder.

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Lift Hydraulics

Pump Control Valve (Fig.3 - Fig.5)

The function of the pump control valve is to control the oil flow to and from the hydraulic system. In order to carry out this function, it has 3 positions: 'Intake' (raise), 'Neutral' (stationary) and 'Discharge' (lower).

The main advantage of the Ferguson System is that the pump gives a variable flow by controlling the degree of opening of the intake and discharge slots in the control valve assembly giving complete controlability across the full range.

The control valve has intake and discharge slots at either end and is moved into its various operating positions by a vertical lever controlled by the linkage arrangements within the top cover assembly. It is spring loaded to the intake position. The valve is oscillated to prevent it sticking. It slides within a sleeve which has ports leading to the intake and pressure sides of the pump.

In Fig.3, the vertical lever has moved to allow the valve to move to the intake position under the influence of the spring. This allows oil to be drawn through the intake slots into the pump. In this position, the lift arms would be rising.

Fig.4, shows the valve in its neutral position, the intake and discharge slots being outside the ports in the sleeve. In this position, the lift arms would be stationary.

In Fig.5, the valve is in its discharge position. The discharge slots are open to the pressure chamber allowing oil to flow from the ram cylinder back to sump. In this position, the lift arms would be lowering.

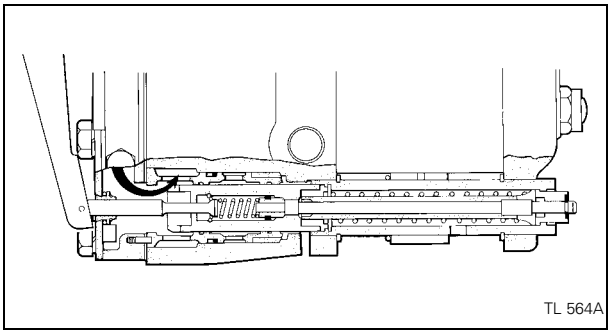


Fig.3

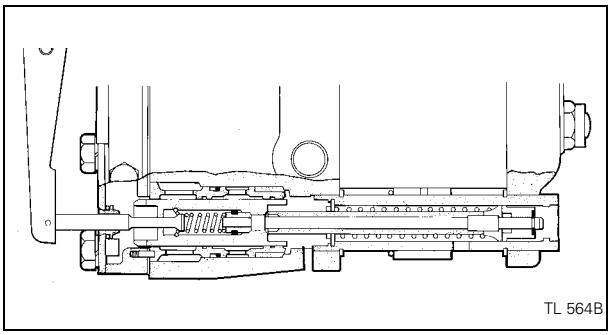


Fig.4

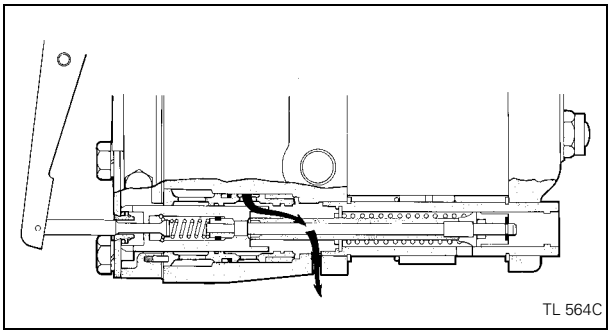


Fig.5

Response Control (Fig.6)

The principle components of the Response Control mechanism are a non-return valve within the pump intake gallery and an oil discharge orifice, the effective size of which is varied by a slide valve.

Whenever the pump control valve moves to the discharge position it displaces oil from the intake gallery (1). The oil is prevented from returning through the intake filter by the non-return valve (2) and is therefore forced to escape through the orifice (3). Altering the Response Control setting moves the slide valve (4) which varies the size of the orifice and consequently the rate of oil discharge from the gallery. This, in turn, determines the speed at which the control valve moves to discharge and the rate at which the implement lowers.

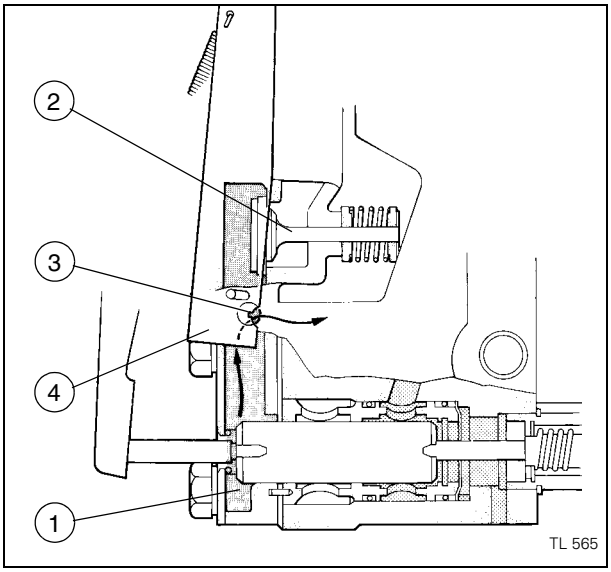


Fig.6

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Operation

Draft Control - Implement Lowering (Fig.7)

To lower the implement, place the Position Control lever in the Transport position, and move the Draft Control lever down the quadrant. This action presses the eccentric roller (1), on the end of the Draft Control lever shaft, down onto the upper cam face of the Draft Control cam (2), causing the lower face of the cam (2) to be forced downwards into contact with the roller (3) on the Draft Control linkage. The cam (2) is then moved rearward causing the vertical lever (4) to pivot and move the pump control valve, via the lever (5), into the discharge position against the influence of the control valve spring. The Draft Control linkage will move because the force from the control valve is less than the breakout spring (6) force.

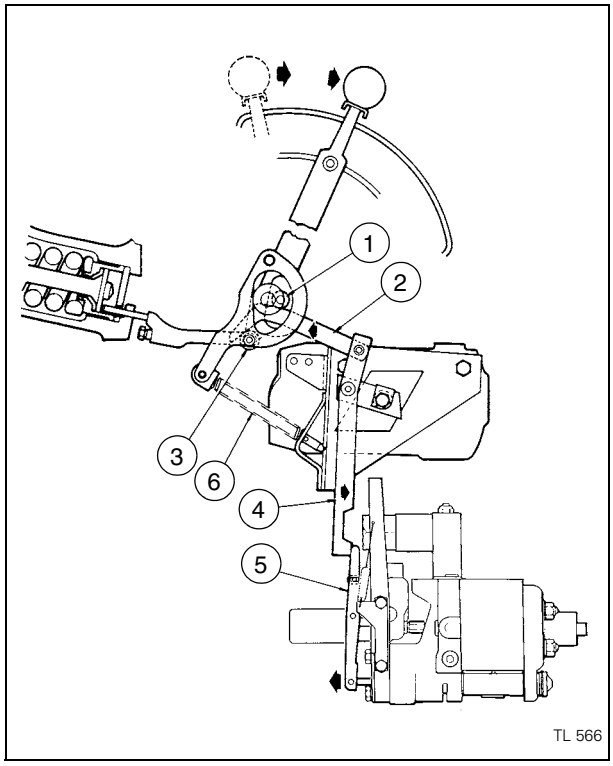


Fig.7

Draft Control - Compression Force in the Top Link (Fig.8).

When the control valve is in the full discharge position, and with further downward movement of the Draft Control lever, the eccentric roller (3) acting on the upper cam face of the Draft Control cam (4), forces the lower cam face of the Draft Control cam (4) to move the roller (5) forwards.

Forward movement of the roller (5) leaves a gap between the Draft Control rod (2) and the Draft Control spring plunger and simultaneously compresses the breakout spring on the guide rod (7).

Forward movement of the tractor will cause an implement to gain depth because the control valve is in the discharge position.

This will continue until the resultant implement draft reaction compression forces, applied through the top link, deflect the control spring.

This causes the Draft Control spring plunger to contact the Draft Control rod (2), and move the Draft Control linkage forwards, acting under the influence of the control valve spring and limited by the position of the roller (5), until the control valve reaches the neutral position.

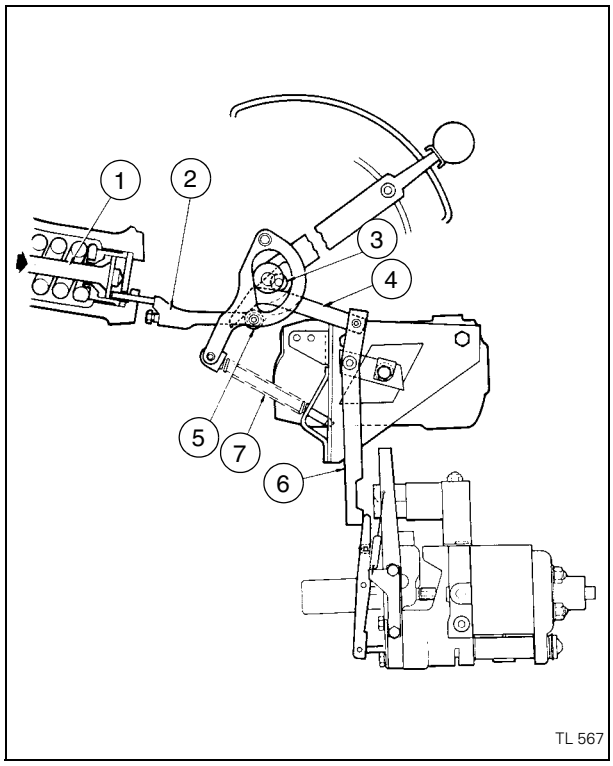


Fig.8

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Lift Hydraulics

Draft Control - Tension Force in the Top Link (Fig.9)

Variations in ground conditions will cause fluctuations in the draft force in the top link. If the draft force decreases, the compression force in the control spring decreases.

The Draft Control linkage follows the control spring plunger under the influence of the breakout spring in the guide rod (7), and moves the Draft Control link rearwards. The vertical lever (4) pivots and moves the pump control valve, via the lever (5), towards discharge. When the correct depth is obtained, the valve is restored to neutral. An increase of draft force in the top link will have the opposite effect.

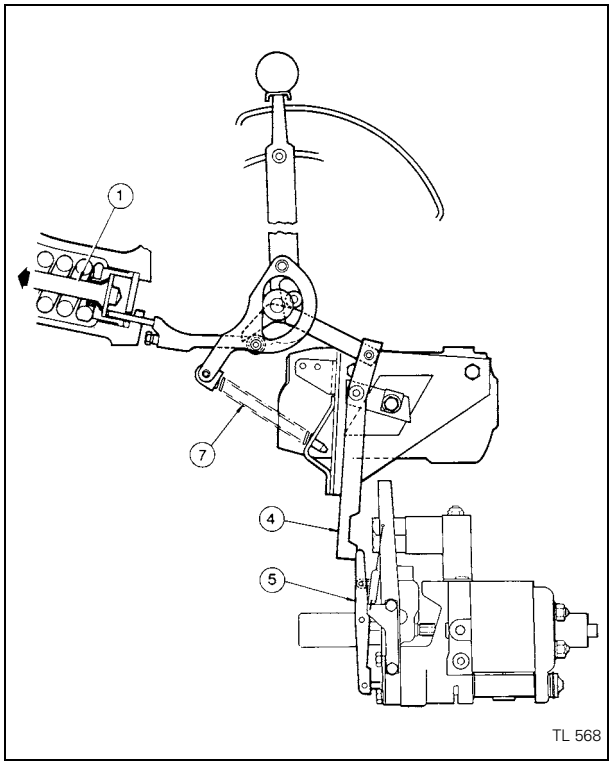


Fig.9

Position Control - Implement Lowering (Fig.10)

With the Draft Control in the fully UP position, downward movement of the Position Control Lever causes the eccentric roller (2) to force the cam (3) downwards. The breakout spring pushes the Position Control link (1) to maintain contact between the roller (8) and the eccentric cam on the cross shaft (9), and the front roller (6) moves the cam (3) rearwards, causing the vertical lever to pivot and move the pump control valve, via the lever (5) into the discharge position.

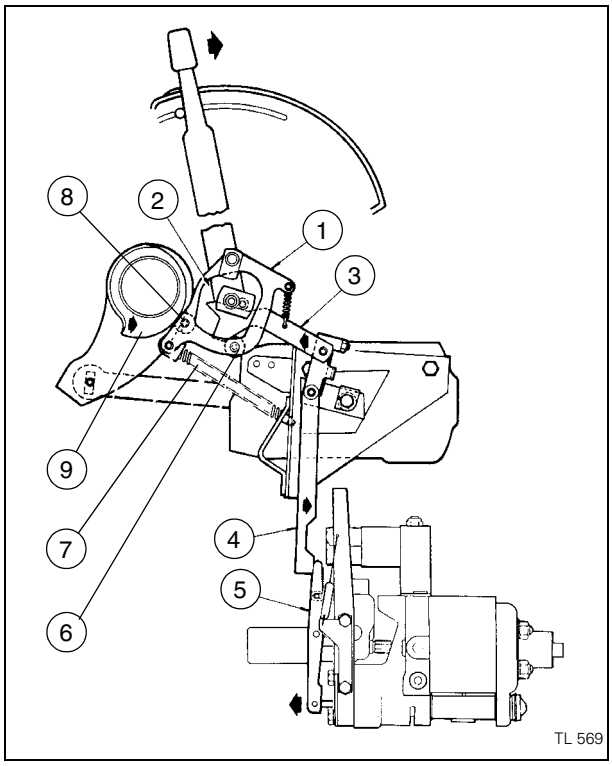


Fig.10

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Position Control - Implement Raising (Fig.11)

Release of oil from the ram cylinder allows the eccentric cam on the cross shaft (5) to rotate and force the rear roller (4), mounted on the Position Control link (1), forward. This action allows the pump control valve spring to move the Position Control cam (2), which is in contact with the front roller (3), forward, until the control valve reaches the neutral position, which has been determined by the Position Control lever.

For every position that the Position Control lever is moved to, there is a position where the cam moves the control valve to neutral.

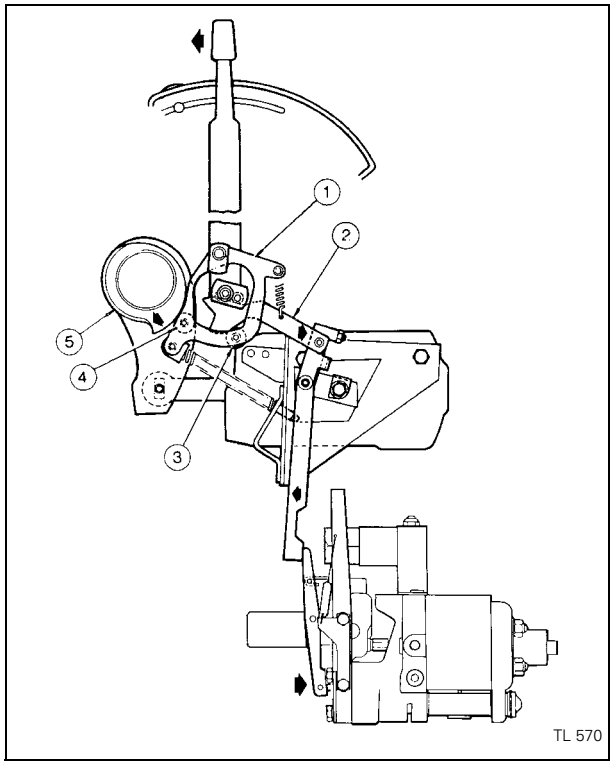


Fig.11

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Lift Hydraulics

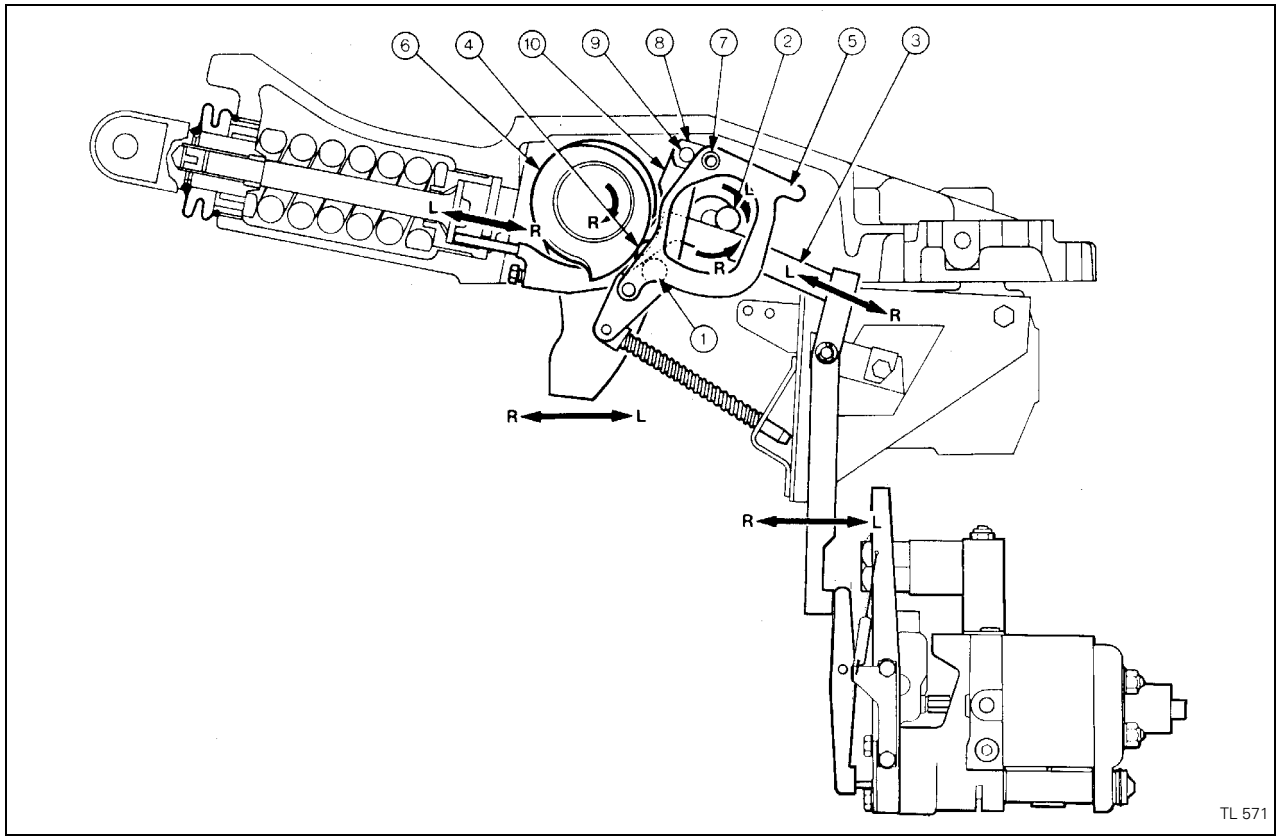


Fig.12

Intermix (Fig.12)

As the size of the tractor and implement increases, a system of Draft Control that relies only on changes in draft force for its reactions, can have limitations, in its ability to provide adequate control. Large changes in draft force will result in excessive linkage movement, a problem often associated with very wide (heavy draft) shallow cultivating implements or implements working soils with bands of different consistency.

For these reasons, the 4260 and 4270 tractors are fitted with an Intermix system. The result of this is that the linkage will move less for the same change in draft force allowing a closer control of depth to be attained.

The intermix feature has been achieved by altering the pivot position for the internal draft linkage. The Draft linkage is attached to the Position linkage by a connecting link. As the cross shaft rotates, the Position linkage moves and so also will the Draft linkage. This means that the Draft linkage and therefore pump control valve can be affected by the movement of the cross-shaft. This results in reduced cross-shaft rotation as the pump control valve remains in an intake or discharge position for less time. The linkage arrangement causes the pump to be quickly brought back to the neutral position.

The draft lever sets the depth of the implement draft required. This alters the distance between the roller (1) and roller (2), this sets the Draft control cam (3) in a given position. The control valve is now in the central position, allowing the lift arms to be lowered.

As the lift arms lower, the cam roller (4) on the position control link (5) rolls along the cam on the cross shaft (which rotates counter-clockwise). The Position control link (5) (also rotates counter-clockwise) about the pivot point (7).

The connecting link (8) which is fixed to the Position control link (5) also rotates counter-clockwise, about pivot point (7).

As the other end of the link (8) forms the pivot point (9) of the Draft control link (10) the Draft control link moves to the right.

When the Draft control cam (3) is moved to the right, by a bias spring (not shown), the control valve moves into the “raise” position, limiting the maximum depth the implement penetrates.

The minimum depth of implement penetration is controlled, as the lift arms rise, The roller (4) on the Position control link (5) follows the cross shaft (6). The Position control link (5) moves to the left, causing the Draft control link (10) to move upwards. This moves the Draft control cam (3) to the left, the control spool moves to the “lower” position, to maintain a minimum implement depth.

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Selector Valve and Combined Flow (Fig.13 - Fig.14)

The selector valve(1) is mounted on top of the lift cover and is under control of the driver through a hand lever and control cable (2). The valve controls the flow of oil from the linkage pump to either the lift cylinder or to the auxiliary control valve at the rear of the tractor for Combined Flow. It also automatically places the linkage pump into Constant Pumping when supplying oil (3) to the auxiliary control valve. This is achieved by means of internal linkage (4) which moves the linkage pump control valve into full intake. This action makes the tractor Draft and Position levers inoperative since they have no influence over the position of the pump control valve until the operating lever is returned to the linkage position.

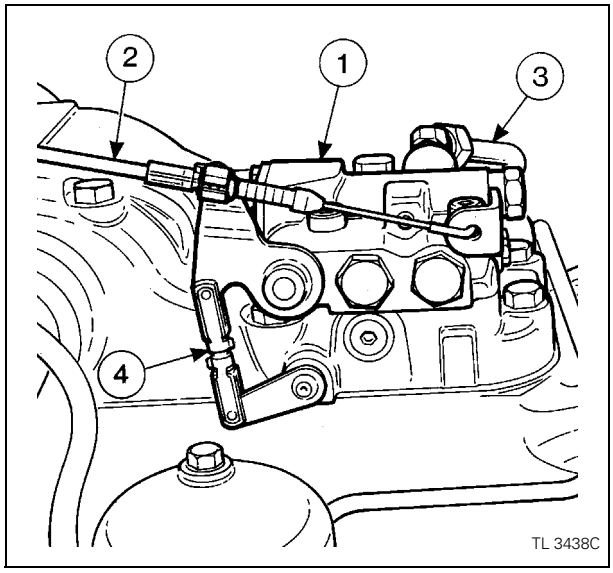


Fig.13

The selector valve incorporates a spool (1) having two alternative positions. In one position, it diverts the linkage pump flow to the linkage ram cylinder through port (2), in the other position, to the external supply port (3) to the auxiliary control valve.

The selector valve contains a shock valve (4) which protects the ram cylinder from damage by shock pressures, when the oil flow to the control valve is selected, since in this situation, the lift cylinder is isolated from the pump relief valve.

The lift cylinder piston is fitted with a zero-leak seal, there is no appreciable oil leakage past the piston or through the valve so the linkage will stay in the position selected when the selector valve is moved to the combined flow position.

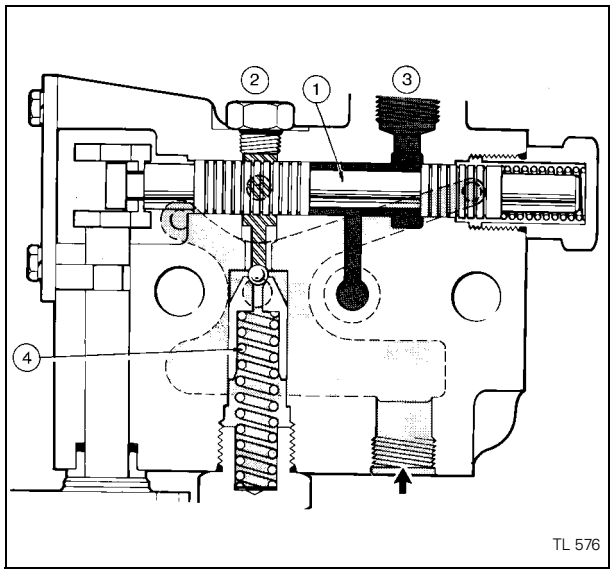
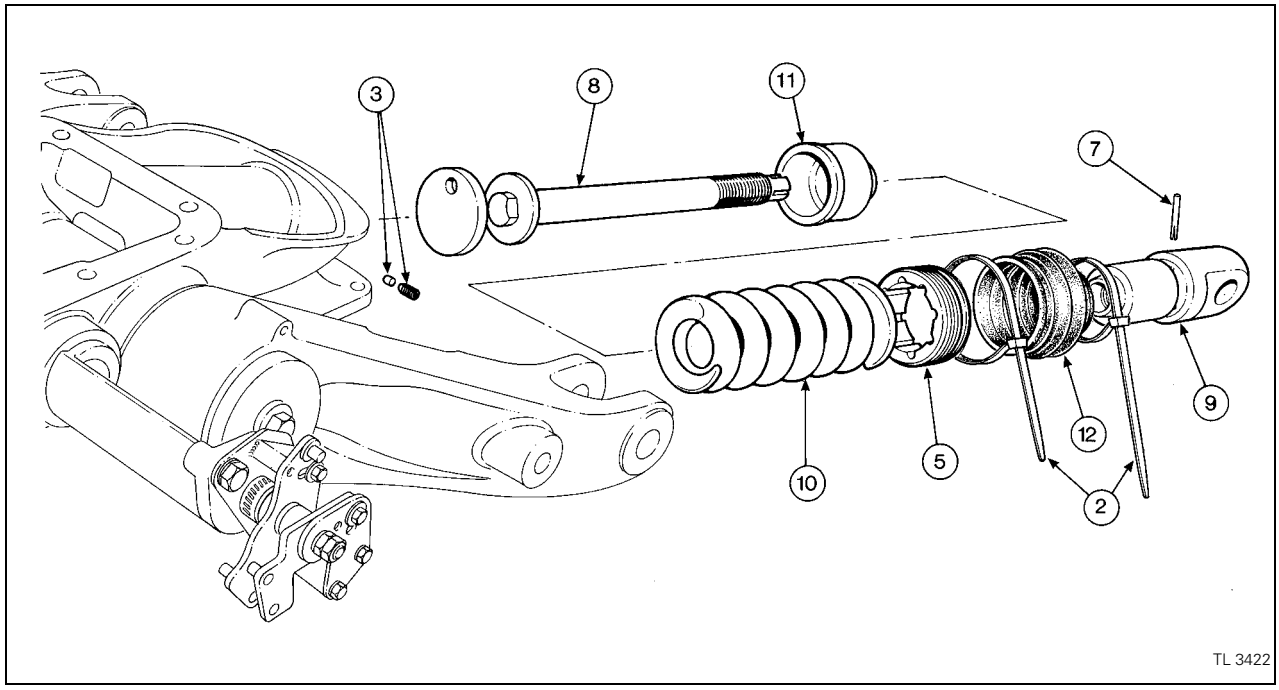


Fig.14

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CONTROL SPRING ASSEMBLY

Overhaul **1-9A**

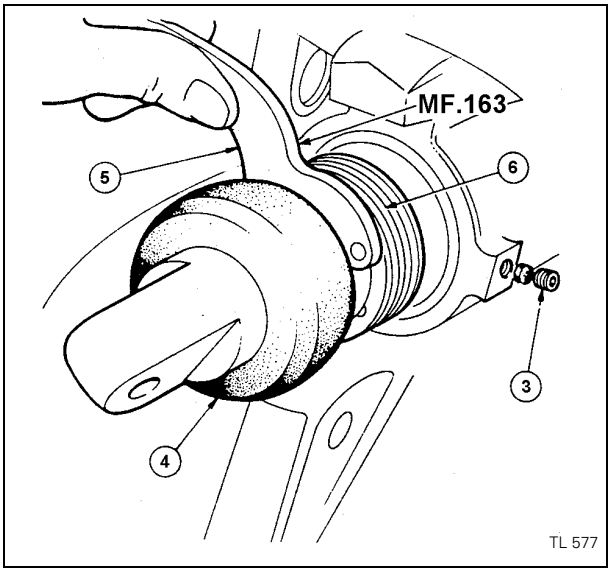
Special Tools:
MF.163 Spring Retainer Wrench

Dis-assembly

1. Remove the control beam.
2. Remove the two plastic ties.
3. Remove the hexagon screw and nylon plug.
4. Pull back the rubber boot.
5. Using special tool MF.163 Spring Retainer Wrench, unscrew the retainer from the lift cover.
6. Withdraw the control spring assembly from the lift cover.
7. Drive out the pin.
8. Unscrew the plunger.
9. Remove the retainer.
10. Remove the spring.
11. Remove the spring seat.
12. Remove the rubber boot.

Re-assembly

13. Reverse procedures 1 to 12 except:
    a. Screw the plunger into the head until the end-float is eliminated and the spring is tight to turn by hand.
    b. Fit a new pin.



    c. If the lift cover is fitted, move the Draft Control lever to the fully DOWN position. Position Control in Transport position.
    d. Screw the control spring assembly into the lift cover and tighten the retainer until the end float is eliminated. DO NOT over tighten, otherwise the end float will reappear.
    e. Renew the two plastic ties.
    f. Fit a new nylon plug.
    g. Tighten the hexagon socket screw to a torque of 7 Nm (5 lbf ft).

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HYDRAULIC LIFT COVER

Removal and Refitment **2-9A**

Special Tools:
MF.418A Lift Cover Remover/Replacer

Removal

1. Remove the driver's seat.
2. Remove the bolts from the parking brake bracket.
3. Remove the trim panel from under the seat.
4. Remove the bolts securing the hydraulic control shaft brackets to the removable panel.
5. Remove the panel in the seat deck.

Rear of the Tractor

6. Disconnect the lift linkage and assistor cylinders, if fitted, from the lift arms.
7. Disconnect the control beam.
8. Remove the auxiliary hydraulic control rods between the control shafts and valve.
9. Disconnect, and remove where necessary, the hydraulic control valve pipes.
10. Remove the four bolts and lift off the control valve assembly.
11. Remove the trailer electrical socket.

Left-hand side of the Tractor

12. Disconnect the assistor cylinder pipes.
13. Disconnect and remove the selector valve pipes.

Right-hand side of the Tractor

14. Disconnect the selector valve control cable.
15. Disconnect the selector valve linkage and remove the selector valve and vertical pipe.
16. Disconnect the dipstick from the quadrant control housing.
17. Disconnect the Draft and Position Control rods at the lift cover end.
18. Disconnect the remote Position Control.
19. Disconnect the hydraulic trailer brake connector bracket and move the pipe away.
20. Remove all the bolts around the lift cover.
21. Fit special tool MF.418A Lift Cover Remover/ Replacer, to the top of the lift cover.
22. Couple-up a small portable jib crane to MF.418A, coupling as close as possible.
23. Place the Draft Control in the Sector (neutral) position, Position Control in Transport position, located with the aid of a rod in the location holes. Lock in position with two 6 mm screws.
24. Carefully lift up the lift cover keeping it horizontal until the vertical lever is clear of the transmission casing.
25. Remove the lift cover to a suitable work bench.

Refitment

26. Reverse procedures 1 to 25 except:

IMPORTANT: *To maintain the strength of the tractor chassis and lift cover this Massey Ferguson sealant must be used.*

a. Apply Massey Ferguson High Flex Gasket (3931 226M1) to the face of the centre housing and the control valve housing.

b. DO NOT forget to fit the vertical stand pipe between the hydraulic lift pump and the lift cover.

c. The use of two guide studs (7/16 in - 14 UNC) fitted on each side of the transmission casing will help in locating the cover in the correct place.

d. Lock the Draft and Position controls in Sector (neutral) and Transport positions.

e. Take care when lowering the lift cover down into place. Don't allow the vertical lever to foul any of the internal components.

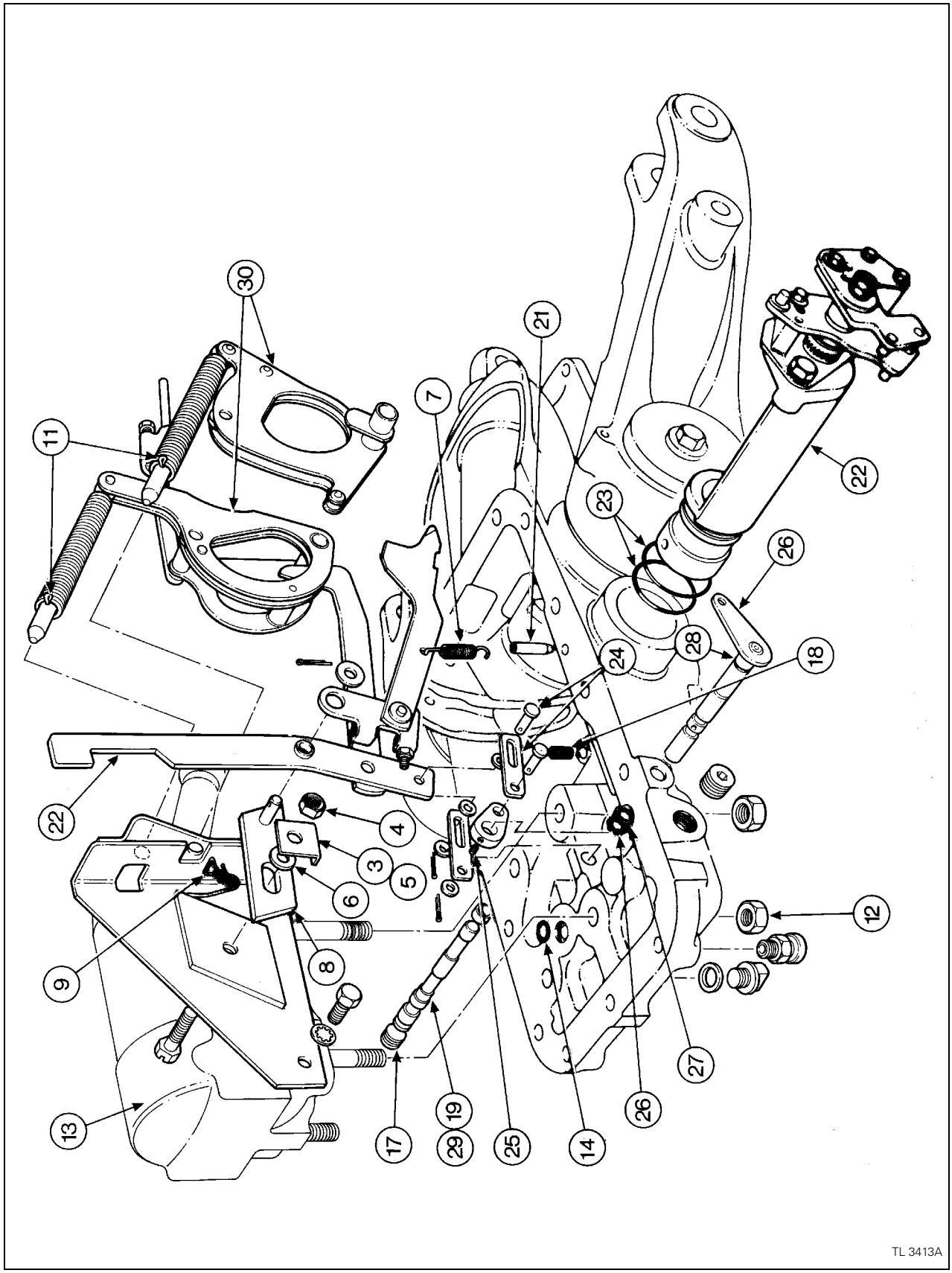
f. Tighten the lift cover bolts to a torque of 95 Nm (70 lbf ft).

g. Carry out external (running) adjustments, *(see operation 8-9A).*

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Tractor Manuals Scotland

Lift Hydraulics



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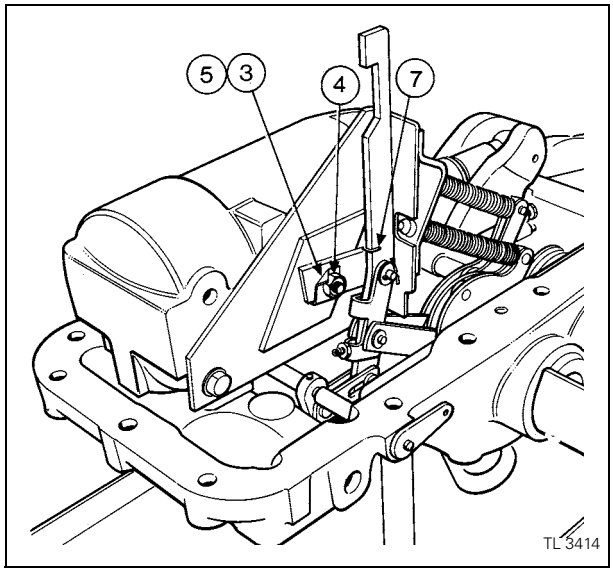
HYDRAULIC LIFT COVER

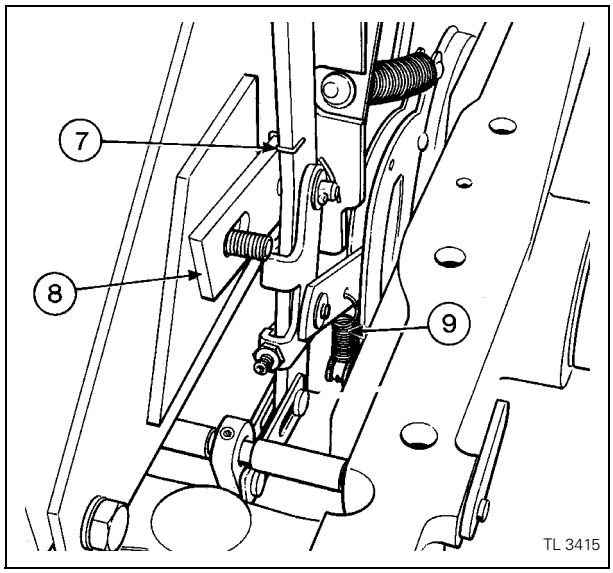
Overhaul 3-9A

NOTE: *The illustration of the lift cover assembly is shown upside down: how it will be viewed when under repair.*

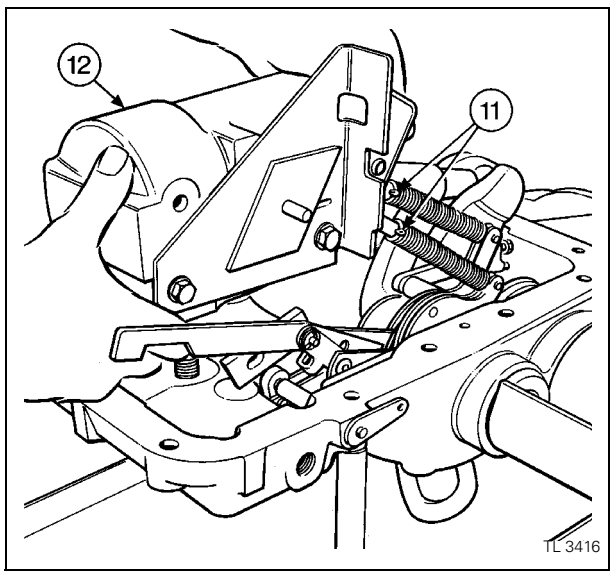
Dis-assembly

1. Remove the lift cover, *(see operation 2-9A)*.
2. Turn the lift cover over so that it is upside down and place it on a bench.
3. Release the tab washer.
4. Remove the nut.
5. Remove the tab washer.
6. Remove the spacer.
7. Release the spring.
8. Release the sliding pivot from the bolt.
9. Remove the spring.





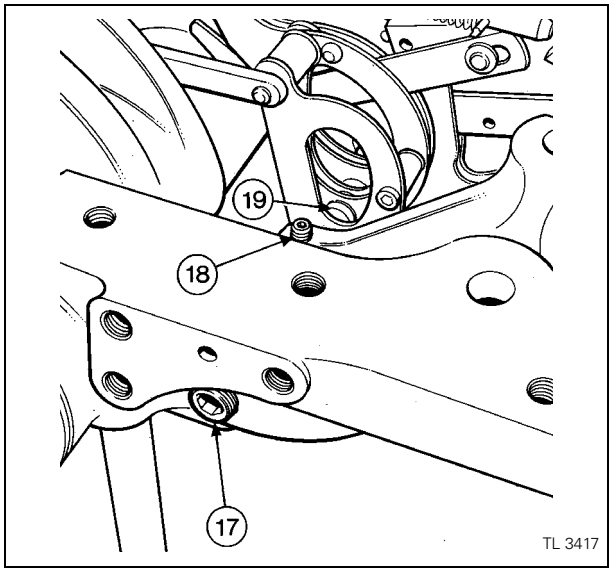
10. Select two new 3/32 in diameter split pins.
11. Compress the two springs and fit the pair of split pins to retain the springs. DO NOT open out.
12. Remove the four nuts securing the lift cylinder to the lift cover.
13. Remove the lift cylinder.
14. Remove and discard the 'O' ring between the cylinder and lift cover.



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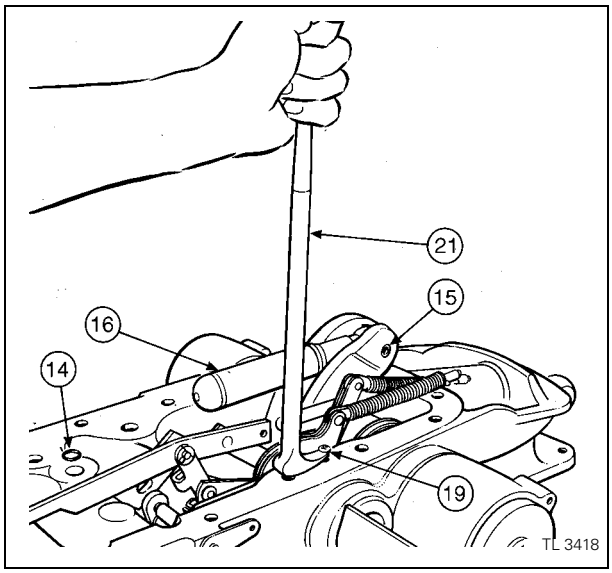
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15. Drive the roll pin out of the connecting rod and ram arm.
16. Remove the connecting rod.
17. Remove the hexagon socket plug from the side of the lift cover.
18. Slacken the hexagon socket screw.
19. Remove the pivot shaft from the Draft and Position control linkage.

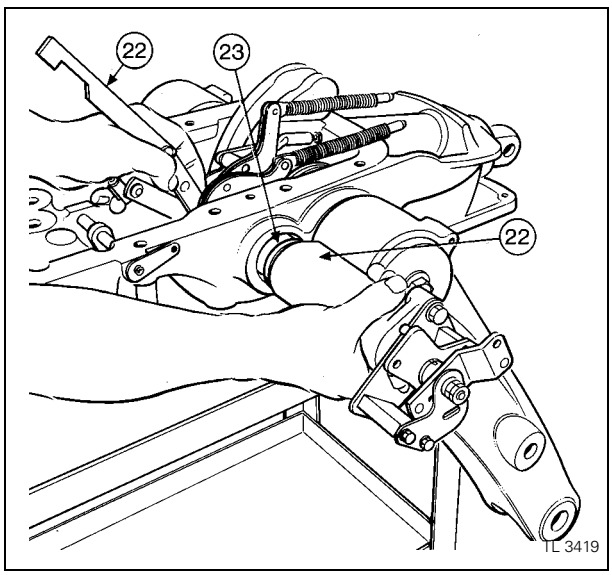


20. Screw a number 10-32 UNF bolt into the dowel which secures the quadrant control support to the lift cover.
21. With the aid of a pry bar, extract the dowel.

NOTE: *To aid re-assembly, make a visual note of how the Draft and Position cams, and the quadrant control fit into the Draft and Position Control linkage.*



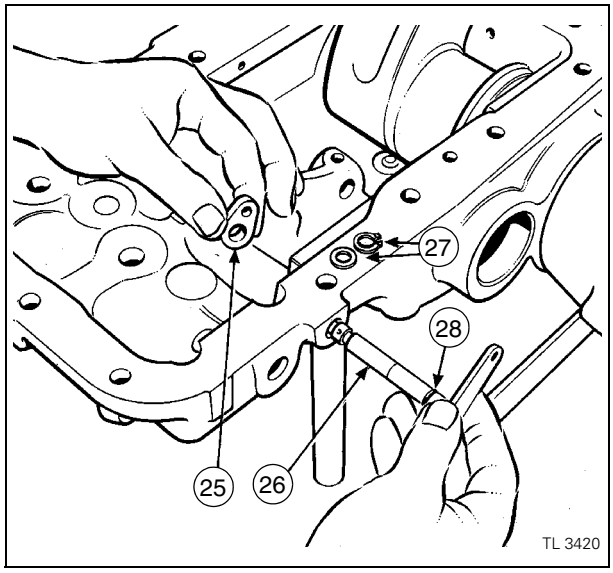
22. Withdraw the quadrant control support assembly, simultaneously lifting out the vertical lever.
23. Remove and discard the two 'O' rings on the quadrant control support.



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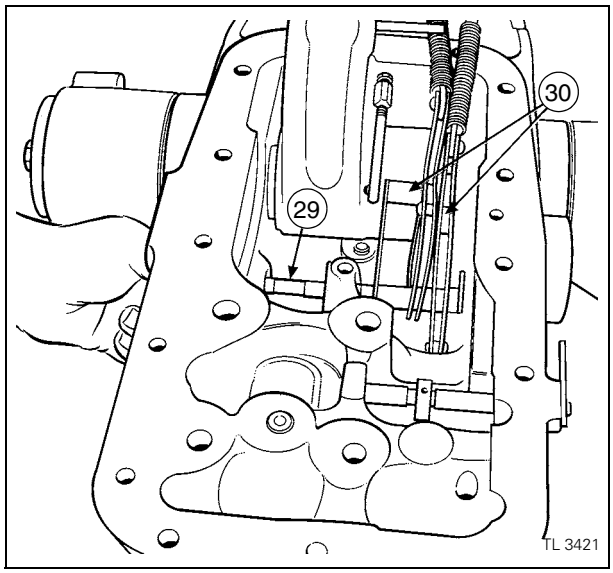
24. Disconnect the Constant Pumping control linkage at the base of the vertical lever.
25. Slacken the grub screw on the Constant Pumping control lever
26. Open-up the circlip and pull the shaft and lever assembly out of the lift cover.
27. Remove the washer and circlip.
28. Remove and discard the 'O' ring.



29. Withdraw the pivot shaft.
30. Lift out the Draft and Position control linkage.

Examination

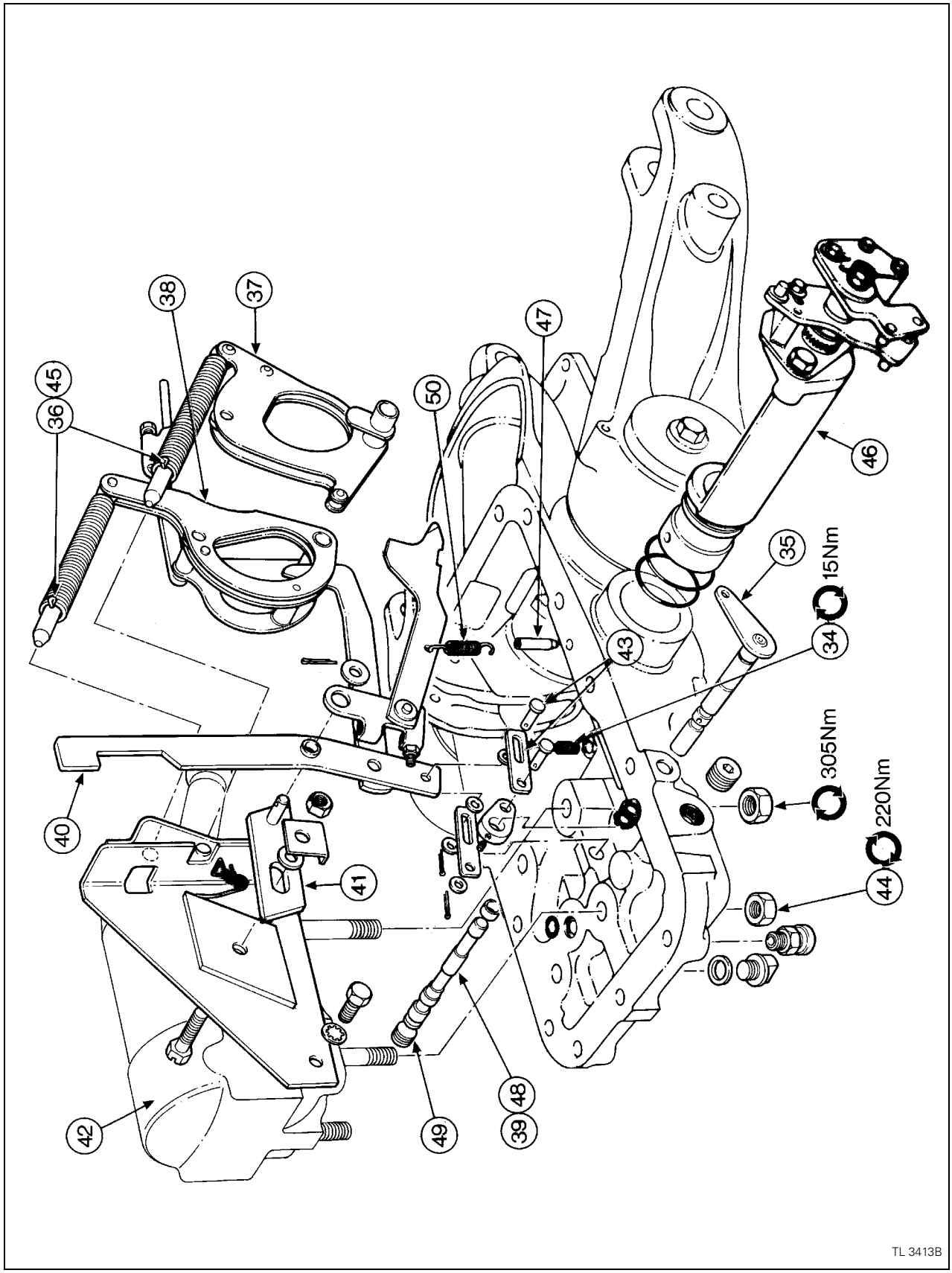
Carefully clean all components, check for wear and distortion of components. Replace any item that is not up to standard.



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Lift Hydraulics



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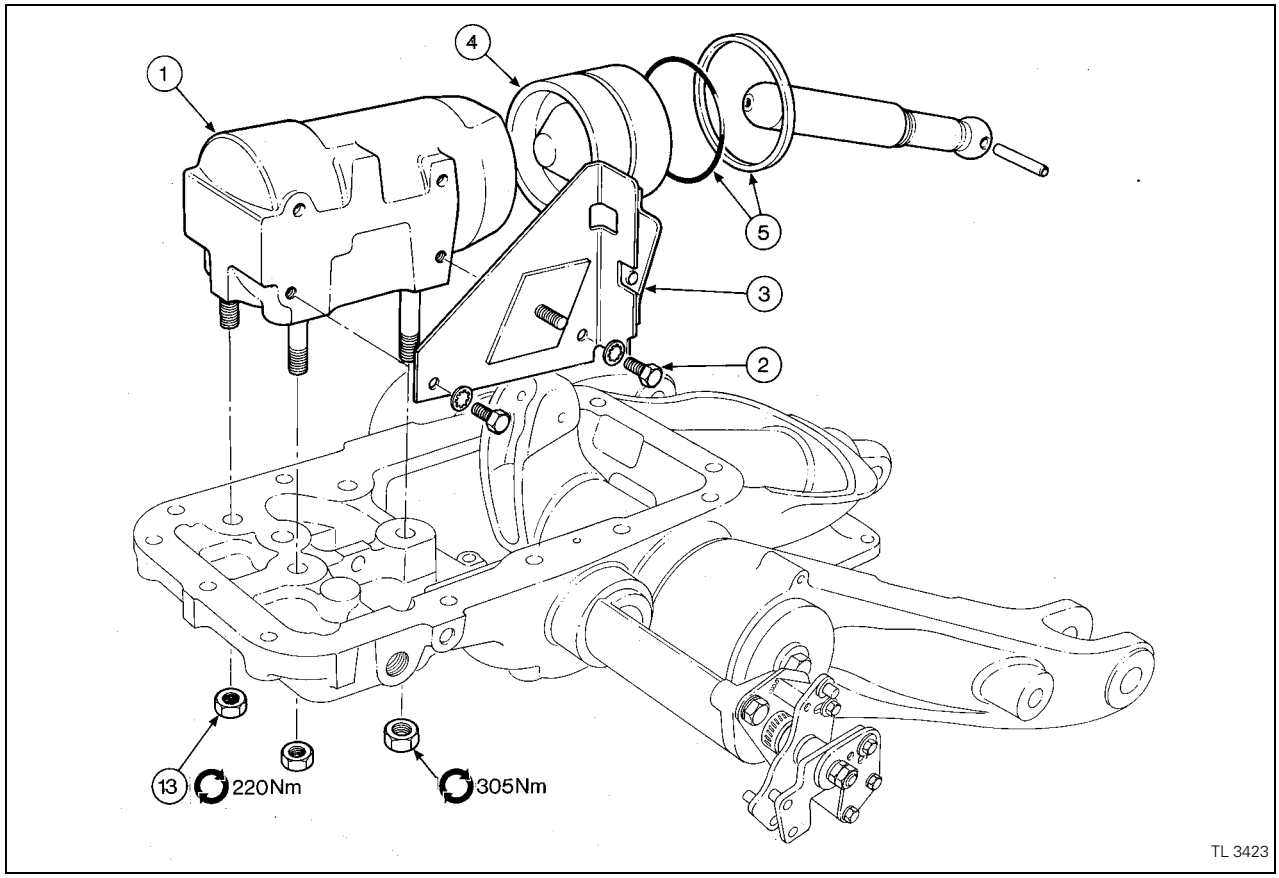
Re-assembly

Re-assembly is a reversal of the dismantling procedure, the following is a guide to the correct procedure:

31. Replace the control spring assembly, *(see operation 1-9A)*.
32. Replace the cross shaft assembly, *(see operation 6-9A)*.
33. Lightly lubricate the small pivot shaft with petroleum jelly and fit it and the spacer into the bottom of the lift cover.
34. Fit the grub screw into the central boss.
35. Refit the Constant Pumping control lever and links.
36. Fit the compression spring to the Draft and Position control linkage assemblies, retaining them with split pins, DO NOT open out the split pin.
37. Place the Position control linkage assembly into the lift cover entering the pivot tube into the lift cover casting.
38. Enter the draft control rod of the Draft control linkage assembly into the hole at the rear of the cover adjacent to the control spring assembly.
39. Position the Draft control linkage assembly and push the pivot shaft through both sets of levers. DO NOT tighten the grub screw.
40. Re-assemble the vertical lever and Position control cam assembly to the sliding pivot,
41. Fit the vertical lever assembly to the lift cylinder using a new tab washer
42. Refit the lift cylinder, lower the cylinder to within approximately 25 mm (1 in) of the lift cover. At the same time enter the Draft and Position control cams on the end of the vertical lever into the Draft and Position control linkage.
43. Connect the Constant Pumping linkage to the vertical lever.
44. Push the lift cylinder fully down and fit the nuts. Tighten the front nuts to a torque of 220 Nm (165 lbf ft), the rear nuts to a torque of 305 Nm (225 lbf ft).
45. Pull the two split pins out of the rods releasing the springs.
46. Refit the control quadrant. Lift the Draft and Position cams to allow the quadrant to push home.
47. Fit the dowel pin to locate the quadrant.
48. Push the small pivot shaft fully home and tighten the grub screw to a torque of 15 Nm (11 lbf ft).
49. Refit the plug in the side of the lift cover.
50. Fit the spring between the Position control linkage and the Position control cam on the vertical lever.
51. Carry out hydraulic static adjustments, *(see operation 7-9A)*.

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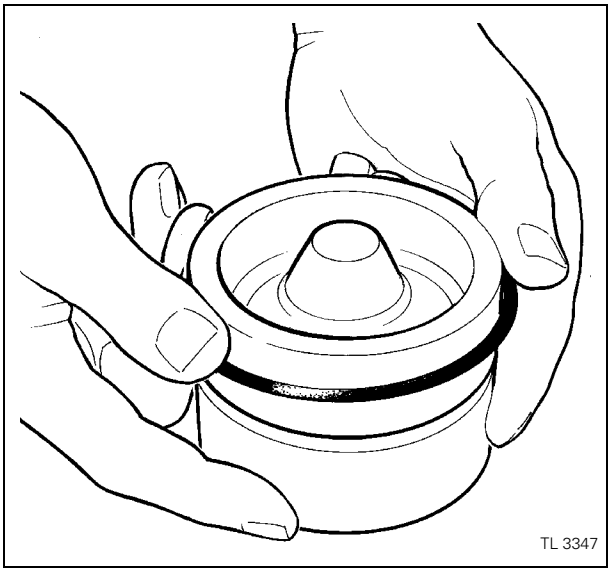
HYDRAULIC LIFT CYLINDER

Overhaul **4-9A**

Special Tools:
MF.453 Hydraulic Piston Seal Replacer

Dis-assembly

1. Remove the lift cylinder assembly, *(see operation 3-9A, procedures 1 to 13).*
2. Remove the two bolts.
3. Remove the support bracket.
4. Withdraw the piston from the cylinder.
5. Remove the piston seal and 'O' ring.



Examination

Thoroughly clean and examine all components for wear or scoring on the piston or in the cylinder bore. Replace the piston seals.

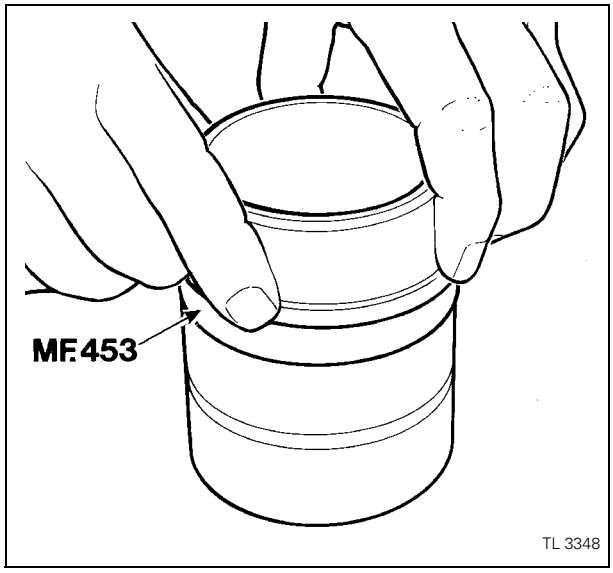
Re-assembly

6. Place the piston on the work bench and slide the 'O' ring over the piston and into the bottom of the piston seal groove.

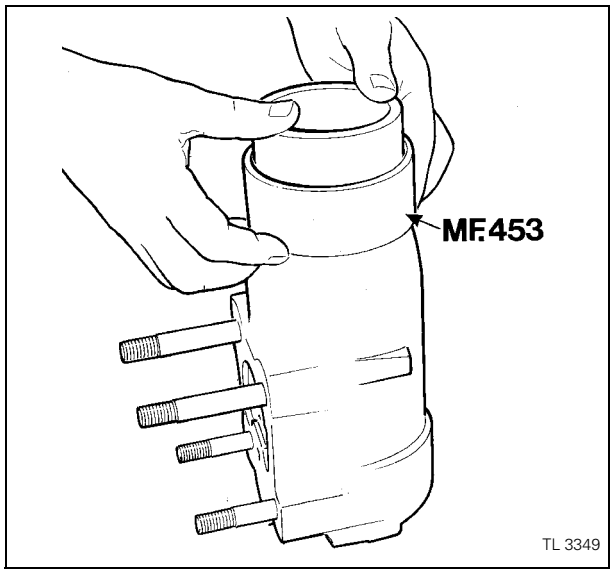
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7. Using special tool MF.453 Hydraulic Piston Seal Replacer, lubricate the outside of the tapered guide with transmission oil.
8. Place the seal on the guide.
9. Locate the guide on the piston and push the seal down the guide onto the piston and into the groove on top of the 'O' ring.

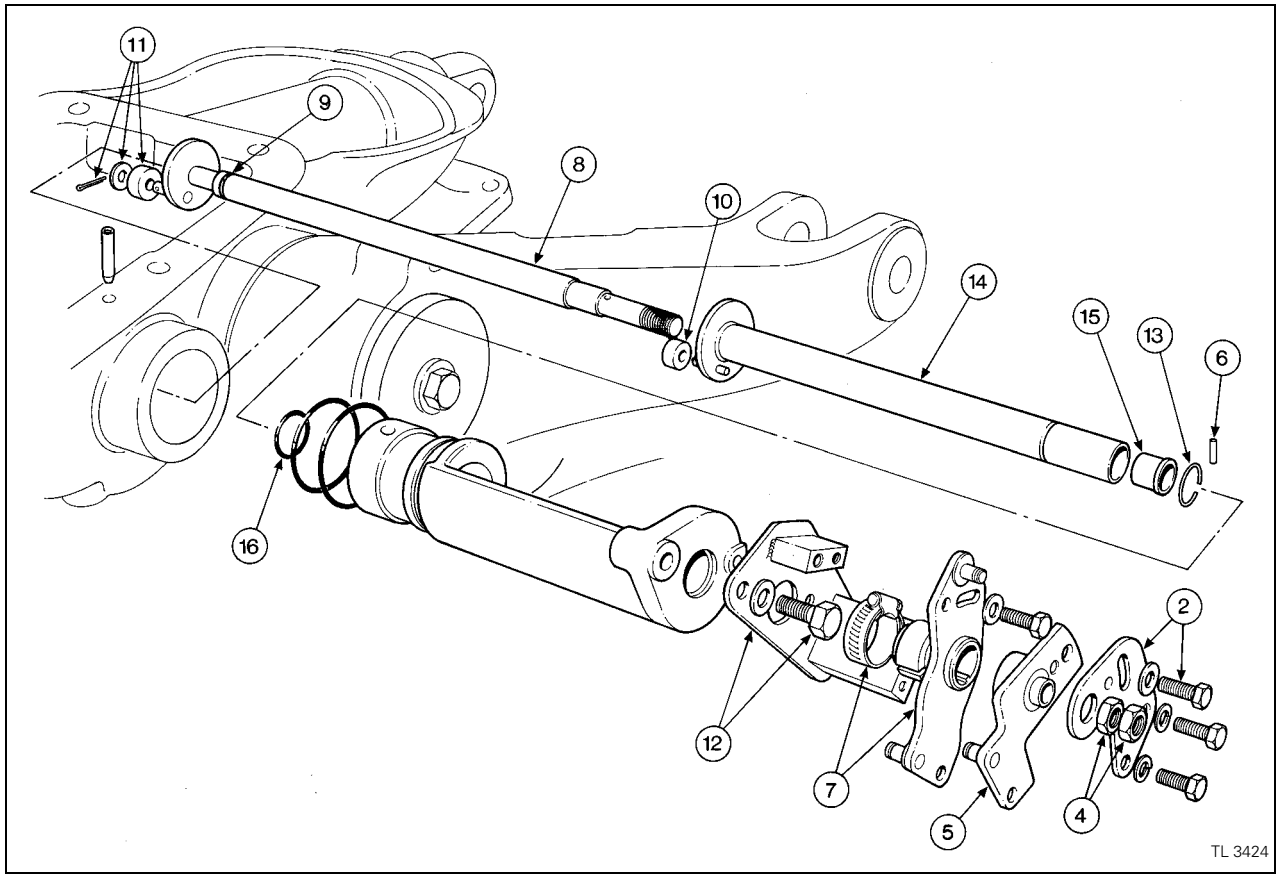


10. The seal must now be sized so that it will fit the cylinder bore. Push the piston into the wide end of the sizing ring (part of MF.453). Push it through until approximately 12 mm (1/2 in) of the piston protrudes out of the tool.
11. Lubricate the bore of the cylinder with transmission oil, then locate the protruding part of the piston in the mouth of the cylinder bore.
12. Push the piston through the sizing ring and into the cylinder. Push the piston to the bottom of the bore.
13. Reverse procedures 1 to 13, *(see operation 3-9A)*, except:
    a. Fit a new 'O' ring between the cylinder and lift cover.
    b. Tighten the lift cylinder front nuts to a torque of 220 Nm (165 lbf ft). Tighten the rear nuts to a torque of 305 Nm (225 lbf ft).



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QUADRANT CONTROL SHAFT

Overhaul **5-9A**

Dis-assembly

1. Remove the internal linkage from the lift cover, *(see operation 3-9A, procedures 1 to 12 and 17 to 23)*.
2. Remove the bolts and the outer support plate.
3. Align the two rollers and scribe a line across the Draft and Position levers to ensure alignment with the rollers during reassembly.
4. Remove the locknut and nut from the end of the shaft.
5. Remove the Draft Control lever.
6. Drive out the pin.
7. Remove the Position Control lever and the hose clip.
8. Withdraw the Draft Control shaft.
9. Remove and discard the 'O' ring.
10. Remove the Position control roller.
11. If necessary, remove the split pin, washer and roller from the Draft Control shaft.
12. Remove the bolt and the back plate.
13. Remove the snap ring.
14. Withdraw the Position control shaft.
15. If necessary, remove the bush.
16. Remove and discard the internal 'O' ring.

Examination

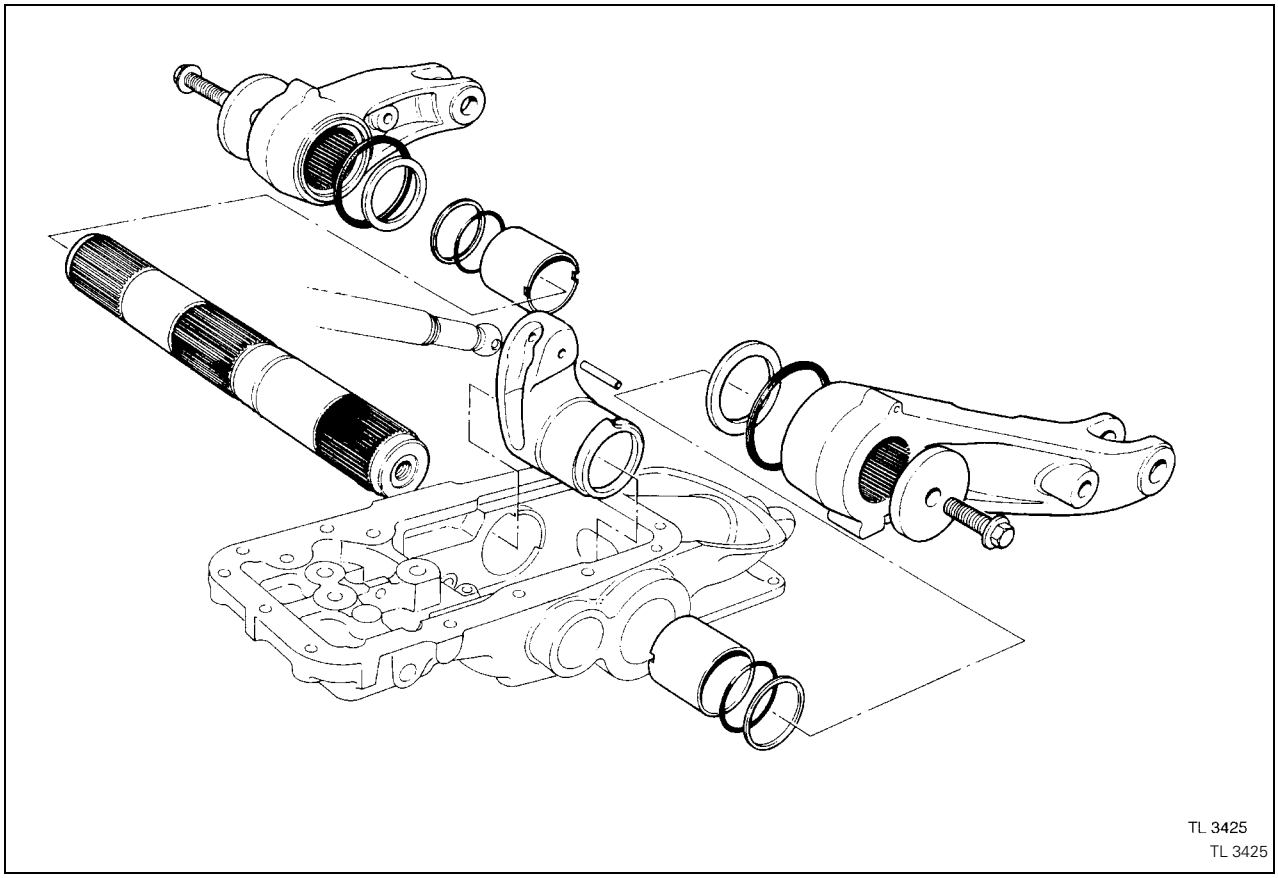
Clean all components, inspect for wear and replace any worn parts.

Re-assembly

17. Reverse procedures 1 to 16 except:
    a. Fit a new split pin and 'O' rings.
    b. Install pin (item 6) to a height of 13 mm (1/2 in) as shown in the illustration.
    c. DO NOT over tighten the Draft control shaft locknuts (item 4).
    d. Lubricate all 'O' rings and bushes on assembly.
    e. Check that all parts and rollers rotate freely.

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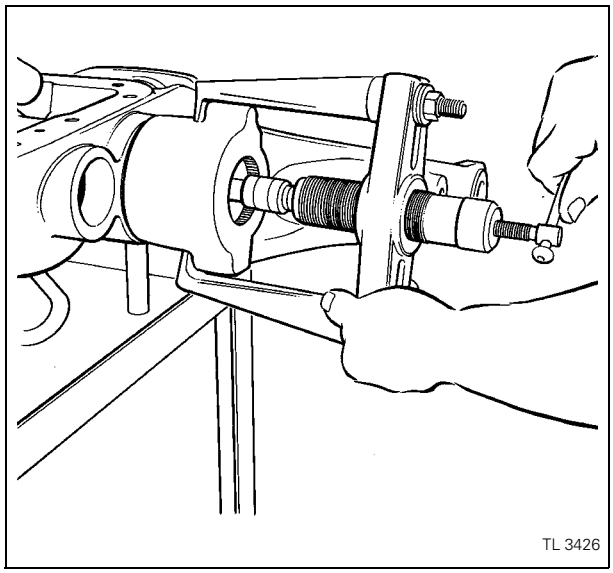
TL 3425
TL 3425

CROSS SHAFT ASSEMBLY

Overhaul 6-9A

Dis-assembly

1. Remove the lift cover assembly, *(see operation 2-9A)*.
2. Turn the lift cover upside down on a bench.
3. Drive the roll pin out of the ram arm securing the connecting rod.
4. Remove the two bolts.
5. Remove the two washers.
6. With the aid of a heavy duty puller remove the lift arms from the cross shaft.
7. Remove the 'V' ring seal.
8. Remove the plastic rings from the shaft.
9. Drive the cross shaft out of the lift cover and ram arm from right to left (from the quadrant side). This will remove the bush, 'O' ring and nylon ring on the left side.
10. Remove the ram arm.
11. Remove the nylon ring.
12. Remove and discard the 'O' rings.



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13. Remove the remaining bush. If the bushes are being replaced, retain the old bushes to help fit the new ones.

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Examination

Examine all components for wear and replace as necessary. Replace all 'O' rings.

Re-assembly

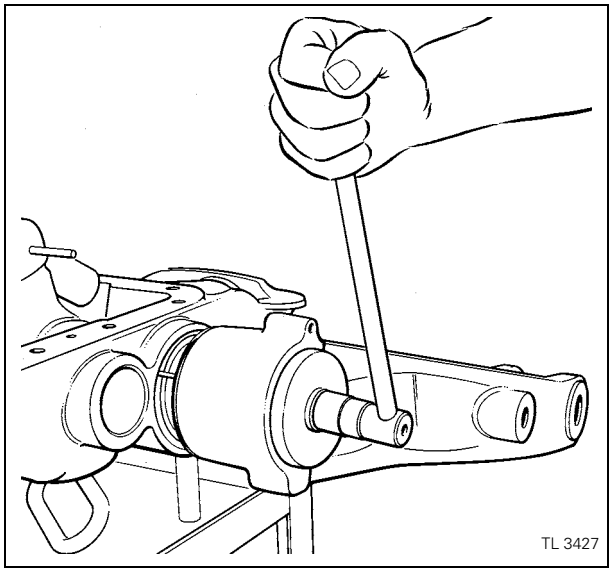
14. Place the ram arm inside the lift cover.
15. Apply a light coat of approved grease, Mobilplex 47 to the three splines of the cross shaft.

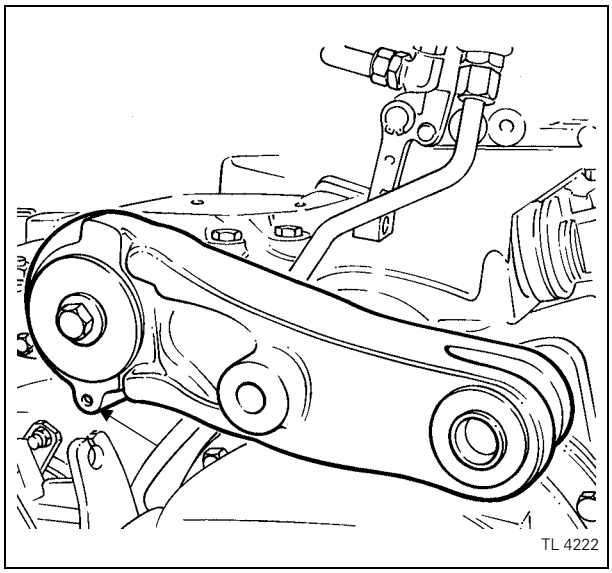
IMPORTANT: *The cross shaft must be fitted the correct way round. The end with the machined recess (indicated by an arrow on the illustration on page 21) must be fitted to the right-hand side, the quadrant side.*

16. Install the cross shaft, fitting it from left to right. There is a blind spline to ensure that ram arm and the two lift arms are in line.
17. Lubricate the bushes, 'O' rings and nylon ring with lubricating oil before assembly, either SAE 80 or 90 grade.
18. Lift the shaft and install the two bushes, the bush is installed with the small cut-out towards the centre of the lift cover. Use one of the old ones to drive in the new, they are a tight fit. Push the bush in until it touches the ram arm.
19. Install new 'O' rings and the two nylon rings.
20. Fit the two plastic rings to the cross shaft.
21. Fit new 'V' rings to the lift arms.
22. Fit the two lift arms. Check that the blind splines are in line. The lift arms will be tight on the spline, it may be necessary to fit a long M16 stud into the end of the cross shaft, fit a nut and plain washer and pull the arm on to the shaft until the correct bolts can be fitted. Apply Massey Ferguson Studlock (Loctite 270) to the thread in the cross shaft approximately half way down. NOT the bolt. Tighten the bolts to a torque of 230 Nm (170 lbf ft).

IMPORTANT: *The lift arms must be assembled the correct way round. The illustration shows the lift arms fitted to the lift cover which is assembled to the rear axle casing. Note that the small threaded hole on the lift arm is at the bottom, this applies to both sides.*

23. Check the cross shaft for free rotation.
24. Refit the connecting rod, using a new roll pin.
25. Replace the lift cover.


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HYDRAULIC STATIC ADJUSTMENTS

Adjust **7-9A**

Special Tools:

MF.163 Spring Retainer Wrench
MF.273A Control Lever Setting Arm
MF.333 Draft Control Rod Gauge
MF.356E Position & Draft Control Gauge
MF.506 Ram Arm Gauge - Position
MF.507 Ram Arm Gauge - Draft

Procedure

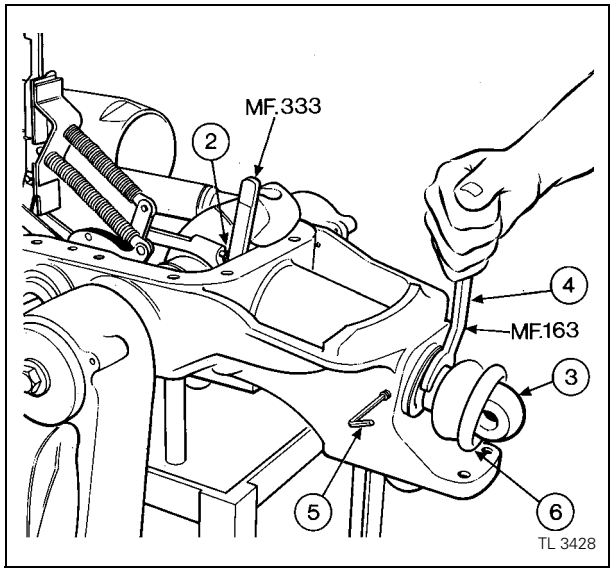
Control Spring External End Float

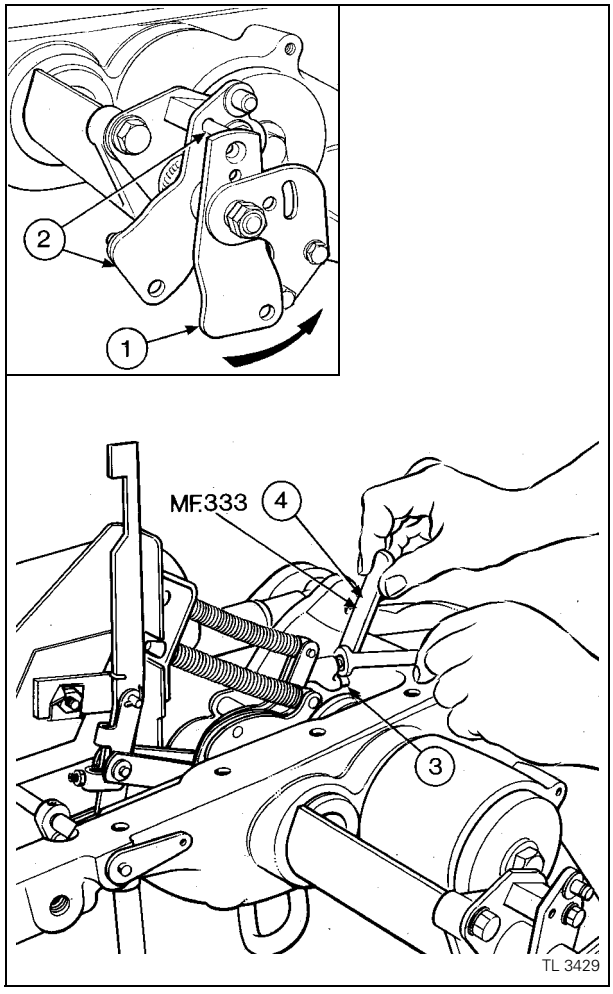
1. Set the control spring internal end float, *(see operation 1-9A)*.
2. Ensure that the Draft Control rod cannot obstruct the control spring plunger. Use special tool MF.333 Draft Control Gauge. Fit it on its side, as shown in the illustration, between the draft rod adjusting bolt and the lift cover casting.
3. Refit the spring assembly into the lift cover housing.
4. Using special tool MF.163 Spring Retainer Wrench, tighten the retaining nut until the end float in the spring assembly has been removed. DO NOT over tighten as this will compress the spring and cause the end float to return.
5. Tighten the hexagon socket screw to a torque of 7 Nm (5 lbf ft).
6. Refit the rubber boot to prevent the ingress of water.
7. Remove the tool MF.333 from the control spring plunger.

Draft Control Rod Adjustment

8. Set the Draft Control link to the fully UP position; rotate the control lever in a counter-clockwise direction.
9. Set the Position Control to the Transport position using a 6,4 mm (1/4 in) diameter pin.
10. Ensure that the Draft Control rod is held against the control spring plunger under the influence of the linkage return spring.
11. Using special tool MF.333 Draft Control Gauge, adjust the set screw on the Draft Control rod to obtain a clearance of 5,8 mm (0.230 in) between the setscrew and the lift cover casting.

NOTE: *If adjustment to the Central Spring is being made with the lift cover installed, it will be necessary to modify Special Tool MF.163 (See page 9A-39).*





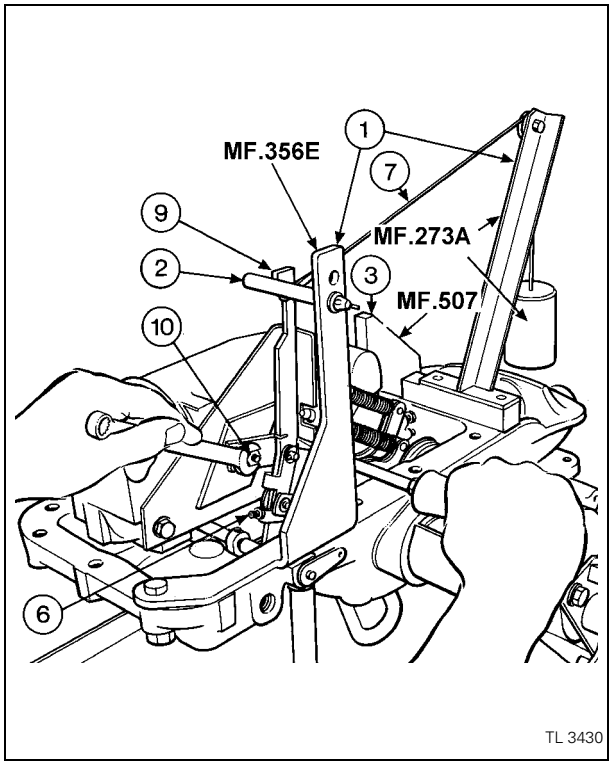
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Draft Control Neutral Setting

NOTE: *These instructions also apply to tractors fitted with 'Intermix'*

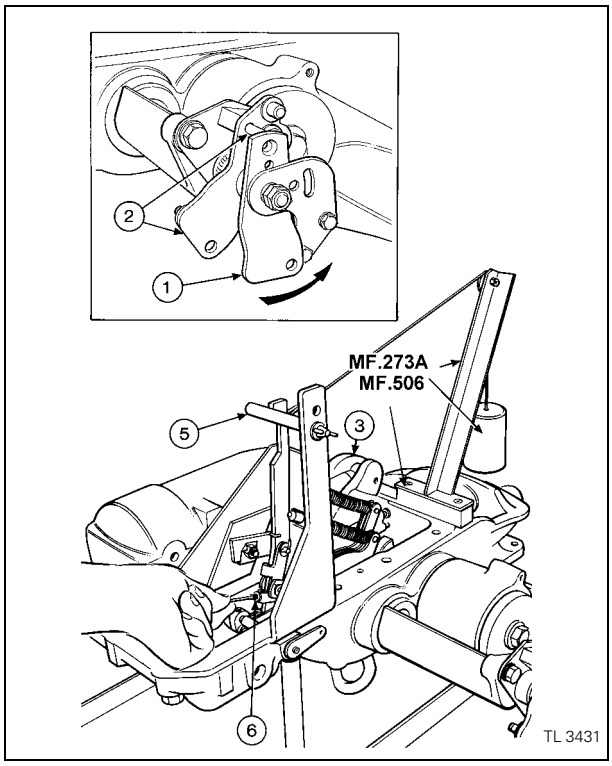
1. Assemble special tools MF.356E Position and Draft Control Setting Gauge, MF.273A Control Lever Setting Arm, and MF.507 Ram Arm Gauge - Draft, as shown in the Illustration.
2. Ensure that the gauge pin is in the lower hole on MF.356E.
3. Rest the ram arm against the tool MF.507.
4. Set the Draft Control lever to the Sector position and locate using a 6,4 mm (1/4 in) diameter pin in the hole.
5. Set the Position Control to the Transport position, again using a 6,4 mm (1/4 in) diameter pin.
6. Slacken the hexagon socket screw and locknut on the vertical lever to the end of its thread. This will ensure that no interference from the Position Control linkage takes place.
7. Hook the string and weight (part of MF.273A), 1,3 kg (3 lb), over the vertical lever and the pulley on MF.273. This simulates the force of the linkage pump control valve spring.
8. The vertical lever must now be set to its correct neutral position for the Draft Control in the Sector marks and Position Control in the Transport position.
9. With the clamping nut released sufficiently to permit the pin bracket to slide, with the aid of a screwdriver adjust the position of the vertical lever pivot pin until the lever just contacts the horizontal pin on MF.356E.
10. Tighten the pivot pin bracket nut.
11. Re-check the vertical lever position by moving the Draft Control lever through its full movement, and returning it to the Sector position.
12. Secure the nut with the locking tab after the setting has been proved.



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Position Control Neutral (Transport) Setting

1. Set the Draft Control link to the fully UP position, as shown (no pin hole is available for this position).
2. Set the Position Control link to the Transport position with the locating pin as shown.
3. Remove ram arm gauge MF.507 and install MF.506 Ram Arm Gauge - Position. This will simulate the Transport position of the lift arms and place the eccentric cam on the cross shaft in the correct position.
4. Apply the load to the end of the vertical lever using the string and weight of MF.273A.
5. Adjust the vertical lever hexagon screw (6) until the lever just contacts the horizontal pin on MF.356E.
6. Tighten the locknut.



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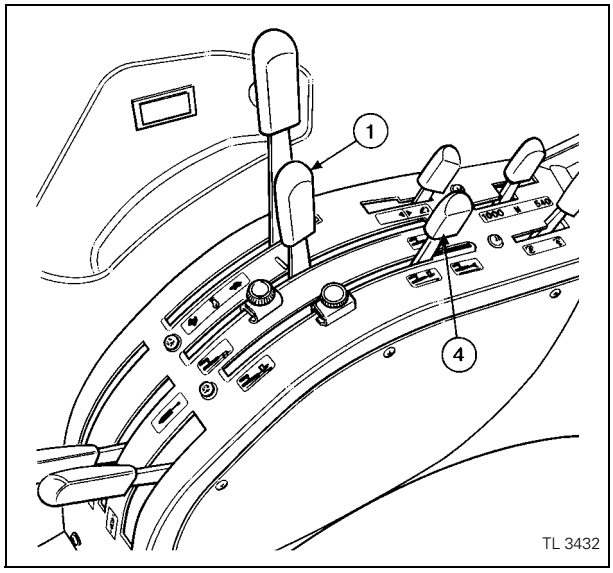
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7. Recheck the vertical lever position by moving the Position Control lever to the Constant Pumping position (rotate clockwise) and back again to the pin location.
8. Readjust if found necessary.

General

9. On completion of the settings, remove the service tools.
10. With two M6 screws and washers lock the Draft and Position levers in the Sector and Transport positions. Remove the two locating pins.



HYDRAULIC EXTERNAL ADJUSTMENTS

Adjust **8-9A**

Procedure

Refit the lift cover to the tractor and connect up all the services and fill the tractor transmission with the correct grade of oil.

Draft Control

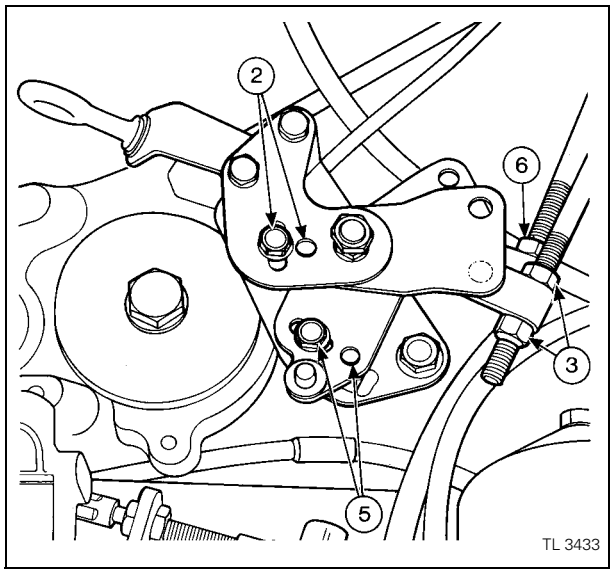
1. Place the Draft Control lever in the cab between the Sector marks on the control lever assembly.
2. Ensure that the location pin holes are in line and the lever is locked in position.
3. Adjust the length of the operating rod so it will engage with the pin on the quadrant lever. Reinstall the clip.

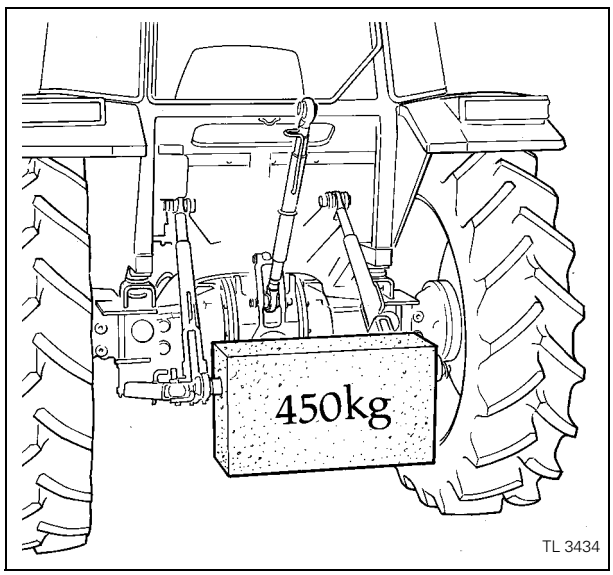
Position Control

4. Place the Position Control lever in the Transport position on the control lever assembly.
5. Ensure that the location pin holes are in line and the lever is locked in position.
6. Adjust the length of the operating rod so it will engage with the pin on the quadrant lever. Reinstall the clip.

Testing

7. Attach a weight of at least 450 kg (1000 lb) to the lower links.
8. Start the engine and expel any air in the hydraulic system by operating the linkage at least six times throughout its Position range
9. All the following adjustments must be carried out at 1200 engine rev/min and at a transmission oil temperature of 50-60°C (122-140°F).
10. Check that the system pressure is 214-240 bar (3100-3480 lbf/in²), *(see operation 14-9A)*.





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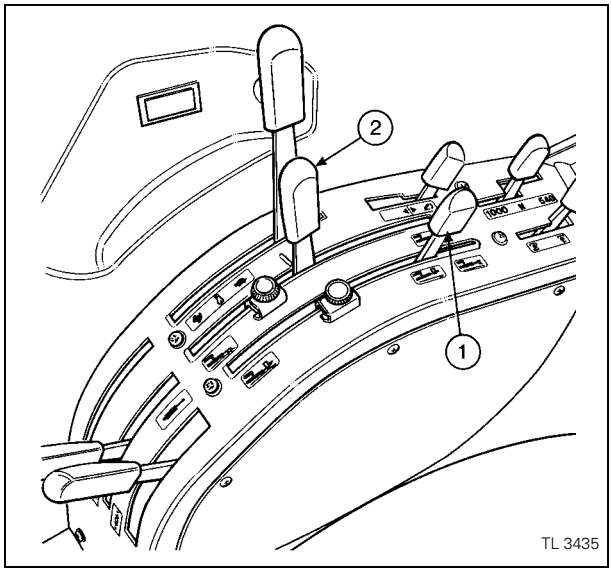
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Lift Hydraulics

Draft Control Lever Neutral Setting

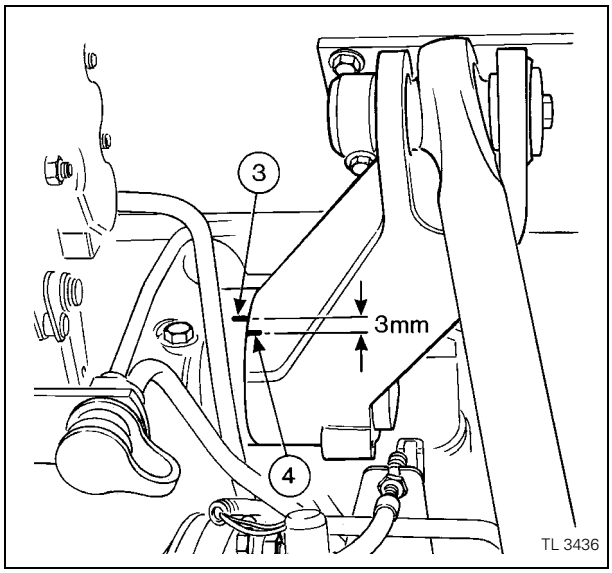
NOTE: *The top link must not be attached when carrying out this adjustment.*

1. Place the Position Control lever in Transport position.
2. Place the Draft Control lever between the Sector marks.
3. Check the position of the lower links, they should be held in a horizontal position level with the ground.
4. If adjustment is required, either lengthen or shorten the rod between the hand lever and the control lever on the quadrant to obtain the correct position.



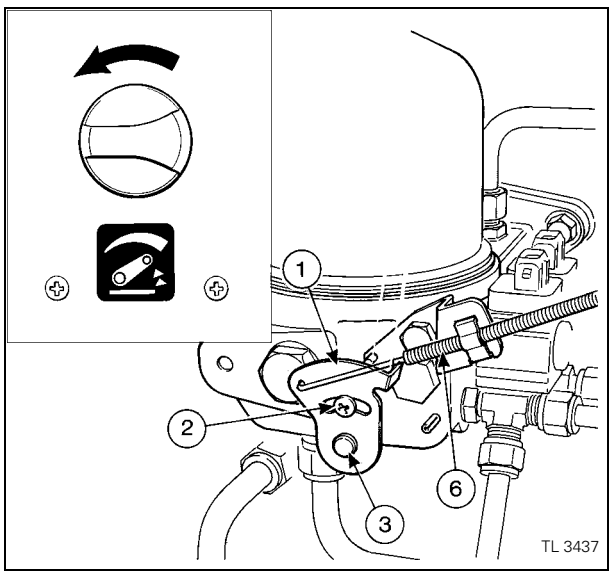
Position Control Transport Setting

1. Place the Draft Control lever in the fully UP position.
2. Place the Position Control lever in the Pick-up Hitch release position.
3. Scribe a line from the lift cover to the lift arm.
4. Move the Position Control lever into Transport position. The lift arms should lower so that the mark on the lift arm is 3 mm (1/8 in) away from the mark on the cover.
5. If adjustment is required, either lengthen or shorten the rod between the hand lever and the control lever on the quadrant to obtain the correct movement.



Response Control Setting

1. Place the Response lever so that it is against the stop pin in the SLOW position.
2. Slacken the screw.
3. Rotate the inner cam clockwise by moving the locking screw until it just contacts the Response lever on the hydraulic pump.
4. Tighten the locking screw.
5. Place the Response Control in the cab to the SLOW position.
6. Move the lever to the SLOW position and re-connect the cable control and adjust if necessary.
7. Finally, check the operation of the Response Control system

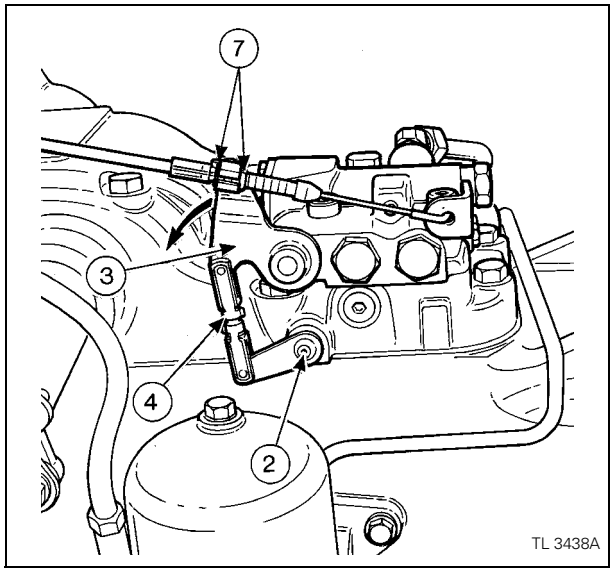


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Selector Valve Setting

1. Place the Draft Control and the Position Control in the fully DOWN position.
2. Rotate the constant pumping lever on the side of the lift cover in a clockwise direction until internal resistance is felt.
3. Rotate the selector valve lever fully counter-clockwise.
4. Adjust the length of the rod until the clevis pin fits freely.
5. Remove the pin and unscrew the clevis one turn, for example, lengthen the rod.
6. Refit the clevis.
7. Place the hand lever in the cab to the Linkage position, adjust the operating cable length by fitting the clips in the appropriate groove on the outer cable.



SELECTOR VALVE

Removal and Refitment 9-9A

Removal

1. Disconnect the control rod between the selector valve and the Constant Pumping lever.
2. Disconnect the control cable.
3. Disconnect the combined flow pipe.
4. Remove the two hexagon socket screws securing the selector valve to the lift cover.
5. Lift the valve clear taking care not to damage the stand pipe from the pump to selector valve.
6. Discard the 'O' ring and Gasket.

Refitment

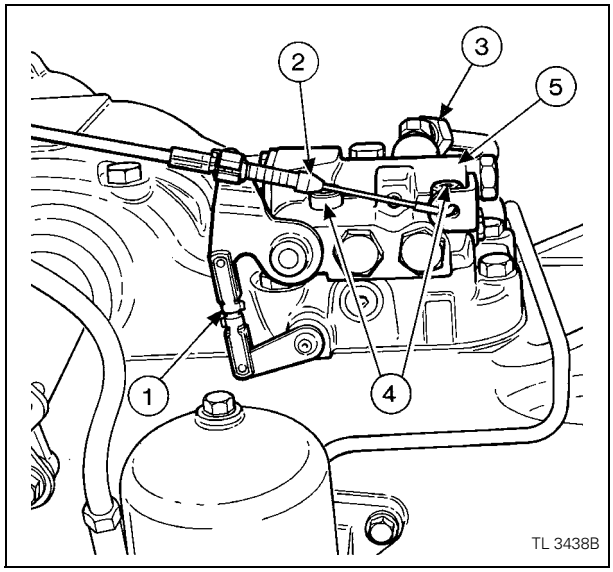
7. Reverse procedures 1 to 5 except:

a. Replace the 'O' ring and gasket.

b. Check that the stand pipe is located in the hydraulic pump.

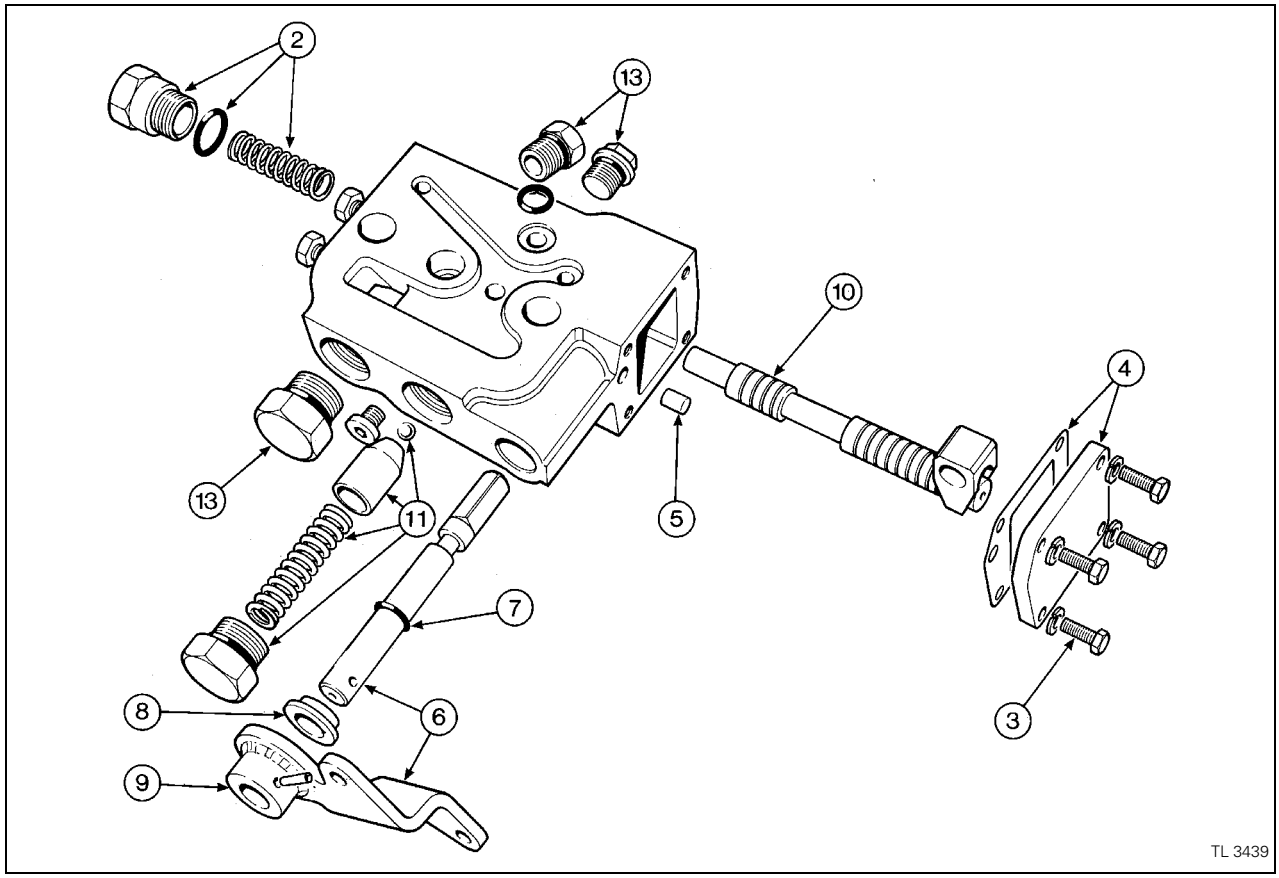
c. Tighten both hexagon socket screws to a torque of 45 Nm (65 lbf ft).

d. Selector valve setting, *(see operation 8-9A).*



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SELECTOR VALVE

Overhaul 10-9A

Dis-assembly

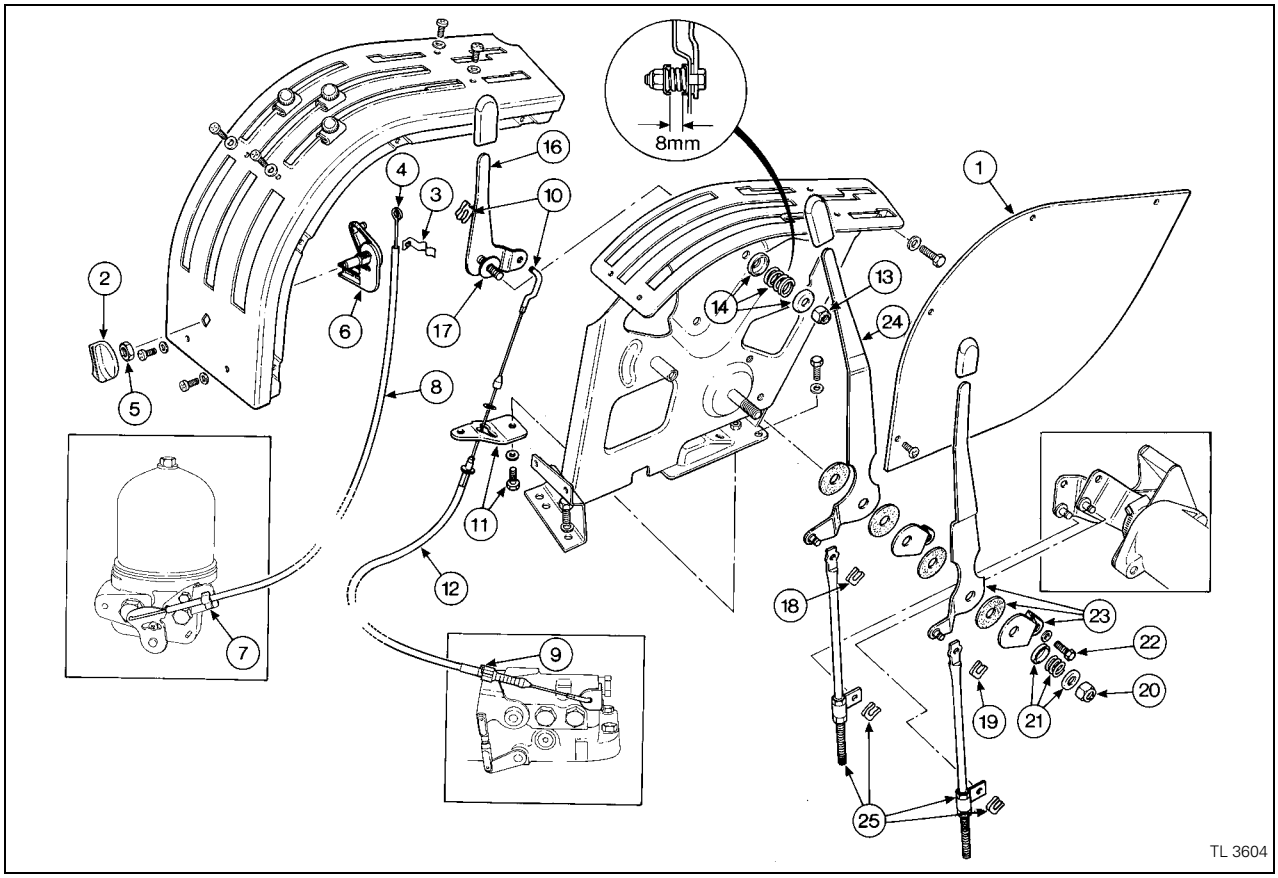
1. Remove the selector valve, *(see operation 9-9A)*.
2. Remove the plug and spring, discard the 'O' ring.
3. Remove the four screws.
4. Remove the cover plate and discard the gasket.
5. Remove the dowel.
6. Pull the operating lever and spindle out of the bore.
7. Discard the 'O' ring.
8. Remove the seal retaining collar.
9. Remove the control lever if necessary.
10. Remove the spool valve.
11. Remove the plug, spring, plunger and steel ball. Discard the 'O' ring.
12. Retain the pressure control shims for re-assembly.
13. Remove the remaining adaptors, plugs and 'O' rings as necessary.

Re-assembly

14. Thoroughly clean all components, using compressed air to clear the oil galleries.
15. Reverse procedures 1 to 13.
16. The shock valve pressure setting is 260-275 bar (3800-4000 lbf/in² in).

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HYDRAULIC QUADRANT CONTROLS

Overhaul 11-9A

Dis-assembly

1. To gain access to the inside of the control assembly, remove the four cross head screws and the side panel.

Response Control

2. Pull the knob off the spindle.
3. Release the spring clip.
4. Remove the cable.
5. Remove the nut.
6. Remove the control assembly.
7. Remove the clip and disconnect the cable at the response control end.
8. Remove the cable.

Selector Control

9. Remove the 'C' clips and disconnect the cable at the selector valve end.
10. Remove the spring clip and un-hook the cable from the hand lever.
11. Underneath the cab, remove the two bolts and the cable clamp.
12. Remove the cable.
13. Remove the Nyloc nut.
14. Remove the two cup washers and spring.
15. To remove the hand lever, it will be necessary to remove the frame mounting bolts and tilt the frame over to gain access behind.
16. Remove the hand lever up through the slot in the quadrant frame.
17. Remove the friction washer.

Draft and Position Controls

18. Remove the spring clips.
19. Disconnect the rods to the lift cover.
20. Remove the Nyloc nut.
21. Remove the two cup washers and spring.
22. Remove the bolt and washer.
23. Remove the fixed plates, friction washers and hand levers.
24. Remove the hand levers up through the slot in the quadrant frame.
25. Remove the spring clips from the bottom end of the rods and carefully lower them through the seal.

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Re-assembly

26. Reverse procedures 1 to 25 except:
    a. Response Control - Adjust the cable as described, *(see 9A-26).*
    b. Selector Control - Adjust the Nyloc nut (14) until the two cup washers are 8 mm (5/16. in) apart.
    c. Selector Control - Adjust the cable as described, *(see 9A-27).*
    d. Draft and Position Control - Adjust the Nyloc nut (21) to allow smooth action of the levers without being too stiff.
    e. Draft and Position Controls - Adjust the control rod length as described, *(see 9A-25).*

HYDRAULIC LIFT PUMP

Removal and Refitment 12-9A

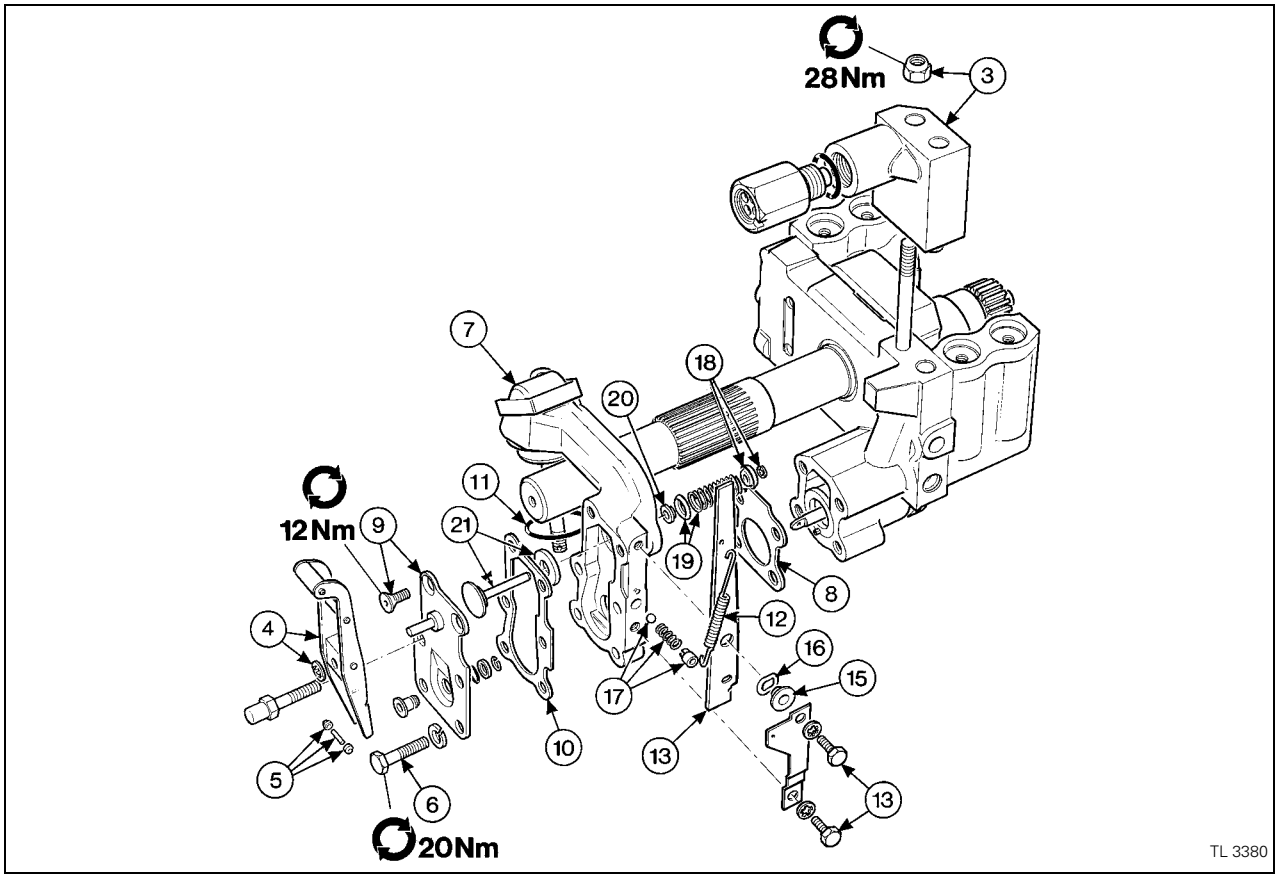
1. Split the tractor between the range gearbox and the rear axle housing, *(see operation 3-2A).*
2. Remove the lift cover, *(see operation 2-9A).*
3. Remove the auxiliary pump drive, *(see operation 14-9C).*
4. Remove the strainer housing assembly, *(see operation 13-9C).*
5. Remove the lift pump strainer, *(see operation 14-9A).*
6. Remove the lift pump complete with the independent PTO clutch pack, *(see operation 3-7A or 3-7B).*
7. Remove the independent PTO clutch pack from the pump shaft.

Refitment

8. Reverse procedures 1 to 7 except:
    a. Carefully re-fit the clutch pack to the pump shaft.
    b. Refit the strainer housing assembly and then the left-hand dowel pin. DO NOT tighten the left-hand dowel pin bolts until the tractor has been reassembled. This procedure ensures that the PTO and pump shafts are in line.

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HYDRAULIC LIFT PUMP

Overhaul **13-9A**

Special Tools:

MF.349 Valve Seat Forming Tool
MF.350 Valve Circlip Replacer
MF.351 Valve Plug Remover/Replacer
MF.352 Control Valve Spring Retainer
MF.353 Control Valve Body 'O' Ring Guide
MF.354 Control Valve Body Replacer

Dis-assembly

1. Remove the hydraulic lift pump, *(see operation 12-9A).*
2. Clean the outside of the pump.
3. Remove the nut, washer and pressure relief valve assembly.

Intake Housing

4. Remove the clip and control valve lever.
5. Remove the two rollers and the pin.
6. Remove the four lower bolts and washers.
7. Remove the intake housing.
8. Remove the gasket and discard it.
9. Remove the two hexagon socket screws (4mm hexagon) and the end plate.
10. Remove the gasket and discard it.
11. Remove the strainer 'O' ring and discard.

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Response Control

12. Remove the Response lever spring.
13. Remove the two bolts, washers and the Response lever assembly.
14. Remove the retainer.
15. Remove the shoulder bush.
16. Remove the wavy spring.
17. Remove the bush, spring and ball.

Non-Return Valve

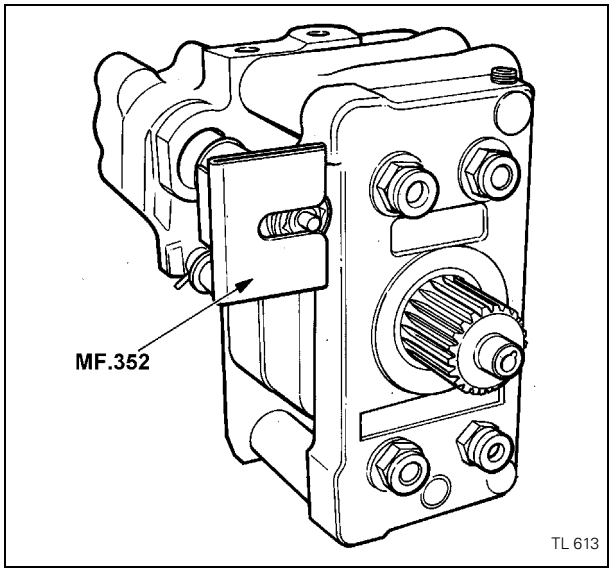
18. Remove the circlip and cap.
19. Remove the spring and retainer.
20. Remove the seal and discard it.
21. Remove the valve and sealing washer.

Control Valve Spring

22. Using special tool MF.352 Control Valve Spring Retainer, slide it into position to hold back the spring tension.
23. Remove and discard the retaining ring.
24. Withdraw the control valve spool out from the rear of the pump.
25. Remove the balancer tube.

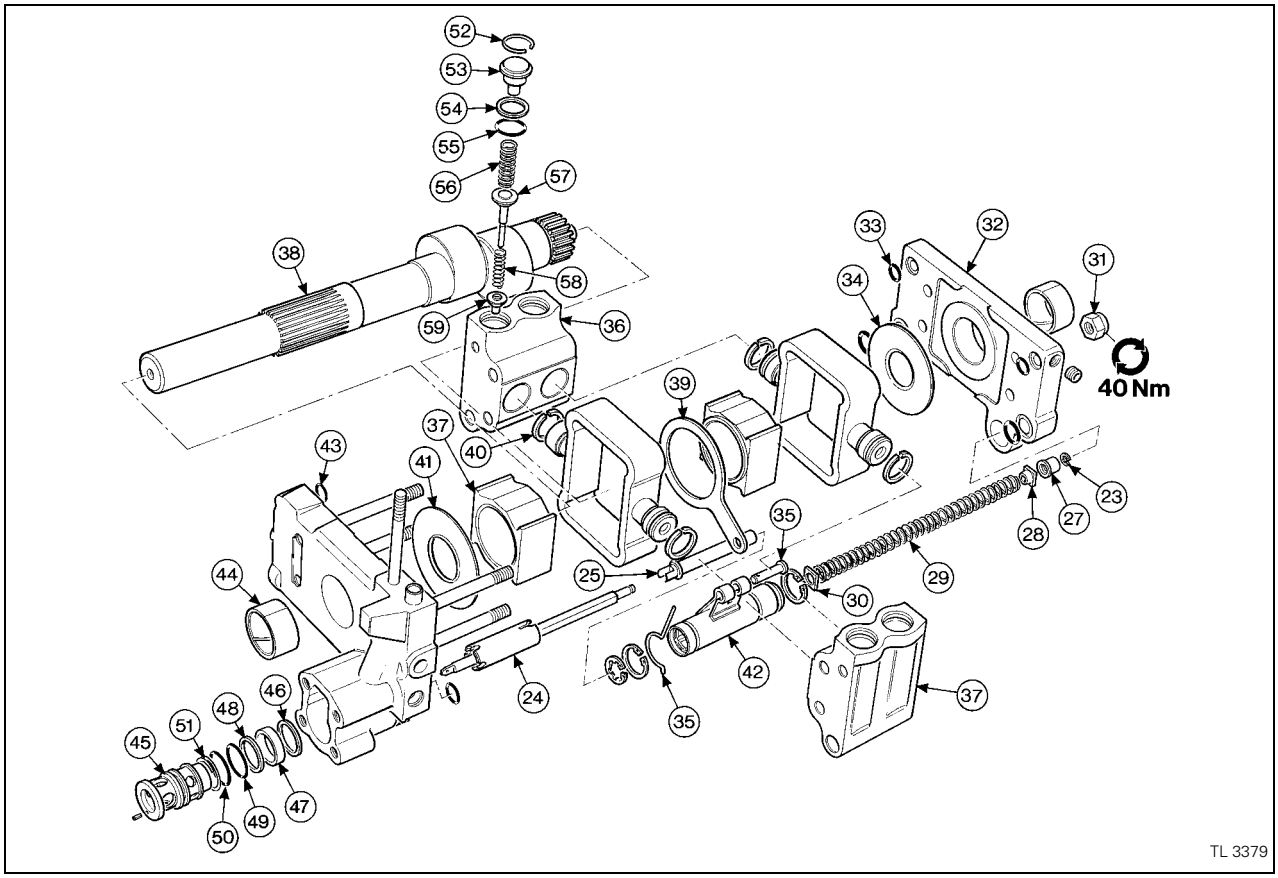
CAUTION: *Spring under compression, DO NOT stand over the pump when removing the tool and spring. Cover with a cloth to protect your face.*

26. Taking care that the spring is not ejected suddenly, remove the tool MF.352 and allow the spring to slowly extend.
27. Remove the collar.
28. Remove the square guide.
29. Remove the spring.
30. Remove the square disc.



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Pump Body

31. Remove the four main pump body nuts.
32. Detach the front body.
33. Remove and discard the 'O' rings between the front body and the valve chambers.
34. Remove the thrust washer.
35. Remove the oscillator retainer clip and pin, cutting off the bent end of the clip.
36. Withdraw the two valve chambers off the studs from the rear body, complete with the camshaft, cam blocks, pistons and cam follower.
37. Separate the valve chambers from the pistons.
38. Remove the cam blocks from the pistons and withdraw the camshaft.
39. Remove the cam follower.
40. Remove the piston rings.
41. Remove the thrust washer.
42. Remove the oscillator tube.
43. Remove and discard the 'O' rings between the rear body and the valve chambers.
44. If necessary, remove the camshaft bushes for replacement.

Control Valve

45. Carefully drive out the control valve body from the rear housing.
46. Remove the washer.
47. Remove the spacer ring.
48. Remove and discard the nylon ring.
49. Remove and discard the 'O' ring.
50. Remove and discard the 'O' ring.
51. Remove and discard the back-up washer.

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Valve Chambers

52. Remove and discard the circlip.
53. Using special tool MF.351 Valve Plug Remover/ Replacer, screw it into the plug and pull it out of the housing.
54. Remove and discard the back-up washer.
55. Remove and discard the 'O' ring.
56. Remove the outlet spring.
57. Remove the outlet valve.
58. Remove the intake spring.
59. Remove the intake valve.
60. Repeat procedures 52 to 59 for the other three valves.

Examination

IMPORTANT: *Cleanliness is the most important feature of carrying out repairs to the lift pump. Thoroughly clean all the components, the bench, your hands and any other containers.*

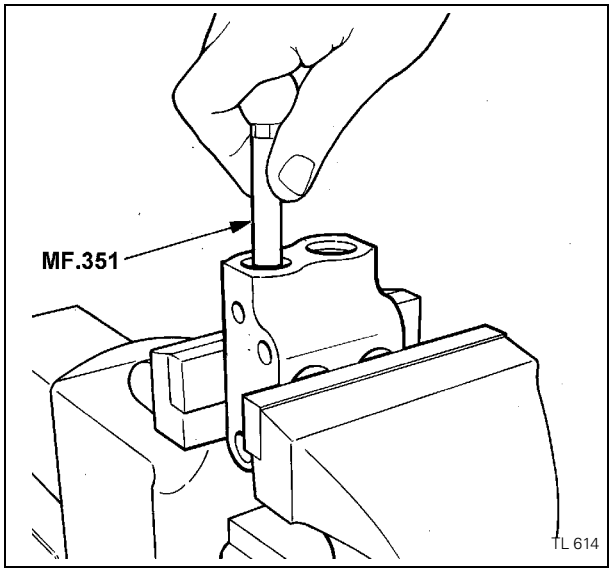
Check the condition of all the components for wear and damage, paying particular attention to the control valve assembly. This is a precision piece of engineering and must work smoothly without any sticking. When assembled, check that the control valve rod, square guides etc. move up and down the oscillator tube freely without sticking. if replacement of the control valve is necessary it must be replaced as an assembly, spool and sleeve.

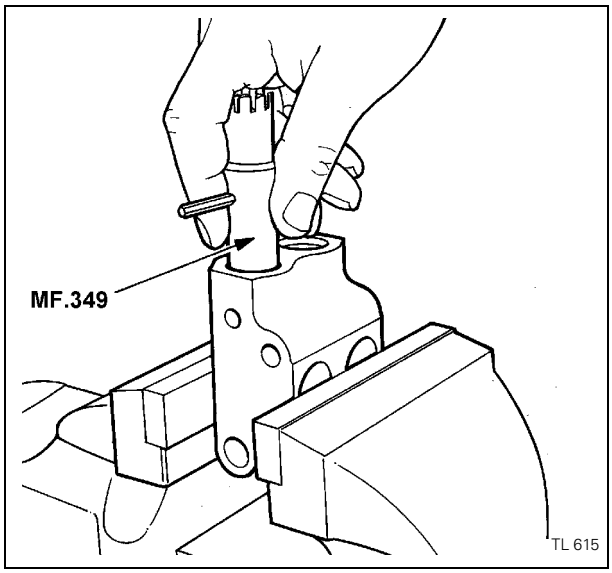
Always replace 'O' rings, back-up washers, gaskets and circlips. During assembly lightly oil the components with clean transmission oil.

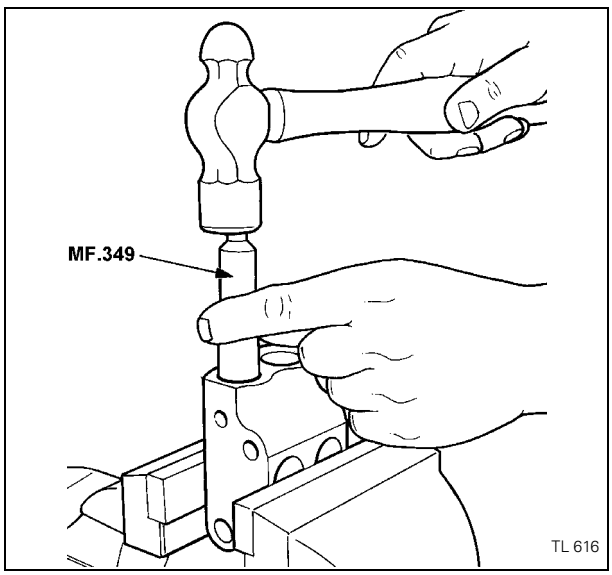
Re-assembly

Forming New Valve Seats

61. If necessary, form new valve seats; using special tool MF.349 Valve Seat Forming Tool, follow the following sequence:
62. Cut the top seat first in the valve chamber using the large end of the cutter and the tommy bar provided.
63. When a satisfactory seat has been formed remove the tool and fit the sleeve to the small end of the cutter.
64. Insert the small end of the cutter, and carefully rotate it to remove the burr around the top seat.
65. Remove the cutter and sleeve; re-insert and cut the bottom seat until a satisfactory result has been obtained. The cutter has been designed to ensure the correct depth of the bottom seat.
66. Using the seat forming tool (part of MF.349), form a new bottom seat. Insert the tool, small end first, hold it tight against the seat and strike the tool with a hammer once to form a conical seat.







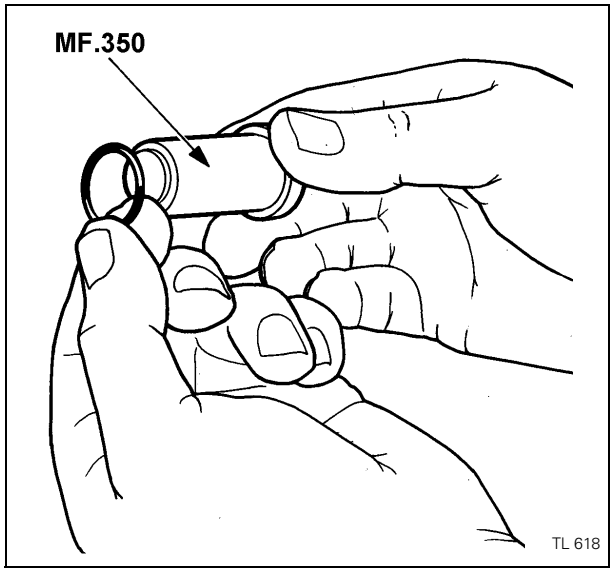
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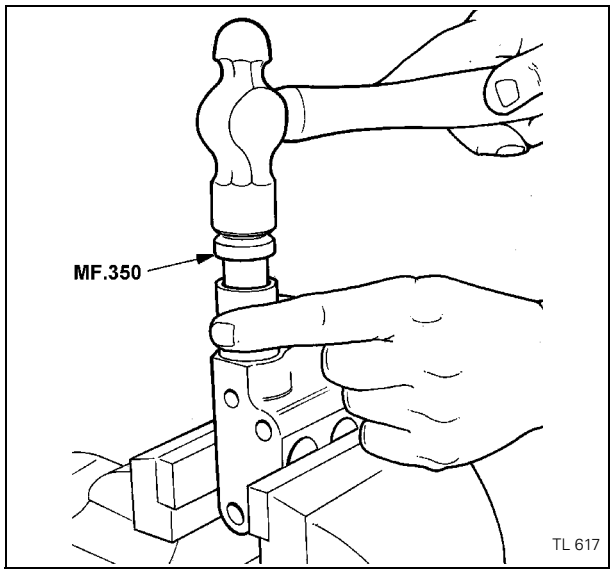
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67. Invert the tool and carry out the same process on the top seat.
68. Repeat procedures 62 to 67 on the other three chambers.
69. Thoroughly clean all the valve chambers.

Valve Chambers

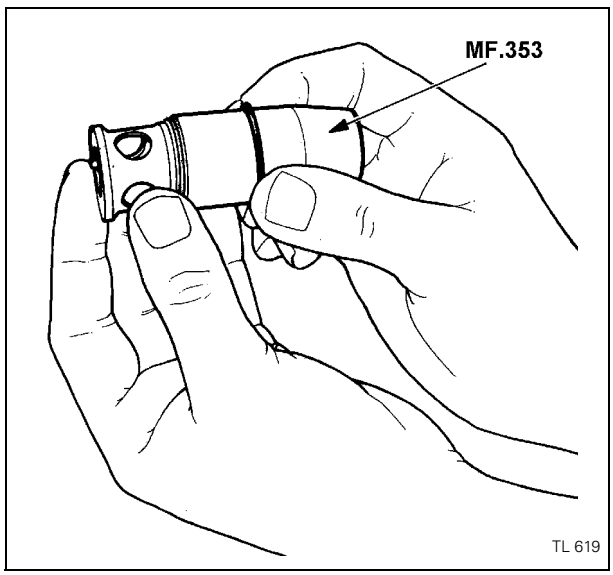
70. Reverse procedures 54 to 60.
71. Using special tool MF.351 Valve Plug Remover/ Replacer, push the plug into the valve chamber until the circlip groove can just be seen.
72. Using special tool MF.350 Valve Circlip Replacer, position a new circlip on the end of the tool.
73. Place the tool in the sleeve (part of MF.350), locate it on the valve chamber and with the aid of a hammer drive the clip down into position.
74. Using tool MF.351, pull the plug back into position.
75. Repeat procedures 70 to 74 on the other three valves.





Control Valve

76. Using special tool MF.353 Control Valve Body 'O' Ring Guide, locate the guide onto the body and slide a new back-up washer up the tool and into the central groove.
77. Using the same tool and method, slide a new 'O' ring into position.
78. Place in the rear body for the control valve the washer, spacer ring, a new nylon ring and 'O' ring.



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79. Using special tool MF.354 Control Valve Body Replacer, carefully drive the control valve body into the rear housing, align the pin at six o'clock.

Pump Body

80. If necessary, replace the bushes in the front and rear bodies.
81. To the rear part of the camshaft (the long shaft side) fit the rear cam block and thrust washer, the chamfered side of the thrust washer faces the cam block.
82. Install the camshaft into the rear housing.
83. Replace the 'O' rings in the rear housing.
84. Fit new rings to the pistons and fit the pistons to the valve chambers.
85. Place the cam follower between the pistons.
86. Lower the piston/valve chamber assembly over the shaft sliding the studs through the valve chambers. Align the cam block with the piston.
87. Fit the front cam block (with track for cam follower) to the piston, engage the cam follower.
88. Replace the front thrust washer.
89. Install the oscillator tube.
90. Connect up the cam follower to the oscillator tube with the pin install the clip in the pin and around the oscillator tube. bend the end of the clip over to prevent loss from the pin.
91. Replace the 'O' rings in the front housing.
92. Refit the front body.
93. Lubricate the studs with transmission oil, refit the four nuts and tighten to a torque of 40 Nm (30 lbf ft) ensuring at all times that the camshaft rotates and the pistons move freely.

Control Valve Spring

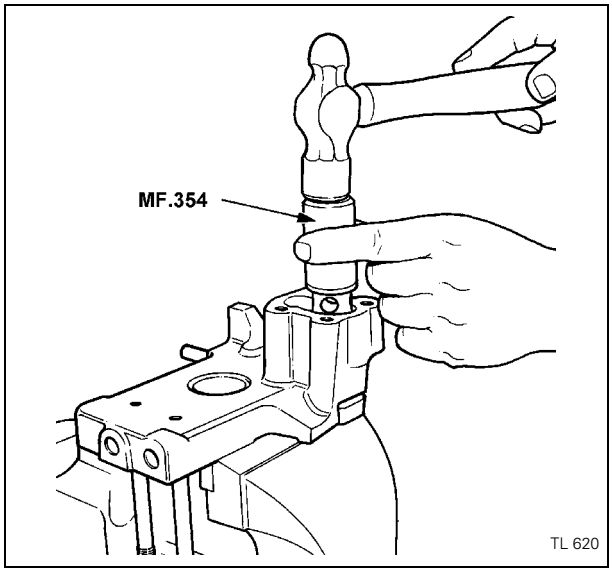
94. Reinstall the control valve spool, passing the square rod through the balancer tube and oscillator.
95. Fit the square washer, compress the spring, and fit the square guide and collar.
96. Hold all the oscillator tube components in place with MF.352 and replace the clip.

Non-Return Valve

97. Replace the rubber valve on the valve head. Ensure that the valve rubber lies flat.
98. Fit a new seal, the retainer with the large hole, spring, retainer with small hole, cap and circlip.

Response Control

99. Fit the retainer with the lower bolt loose.
100. Install the ball, spring and bush.



101. Assemble the Response lever, shoulder bush and wave spring.
102. Install the top bolt through the retainer, lever, securing the bush, spring and ball.
103. Tighten both retainer bolts.
104. Install the spring and check operation.

Intake Housing

105. Install a new 'O' ring for the strainer on the intake housing.
106. Replace the outer gasket, fit the end plate and secure with the two top hexagon socket screws, DO NOT tighten.
107. Replace the inner gasket and fit the intake housing to the pump securing with the four lower bolts. Ensure that the pin on the control valve body locates in the hole in the intake housing. The special bolt with the turned end is fitted in the top left-hand corner.
108. Tighten the four bolts to a torque of 20 Nm (15 lbf ft), tighten the two hexagon socket screws to a torque of 12 Nm (10 lbf ft).
109. Insert the pin through the end of the control valve rod and fit the two rollers with the chamfered side facing outwards.
110. Place the control lever behind the two rollers and on to the central pivot and fit the clip.

NOTE: *It is recommended that the pressure relief valve is tested and the setting verified before the pump is re-installed in the tractor. Adjustment after the tractor has been assembled involves removing the lift cover, (see operation 15-9A).*

111. Reinstall the pressure relief valve assembly and tighten the nut to a torque of 28 Nm (20 lbf ft).
112. Check over the pump and reinstall in the tractor.

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HYDRAULIC PRESSURE TEST

Check **14-9A**

Special Tools:
MF.3001A Pressure Test Kit

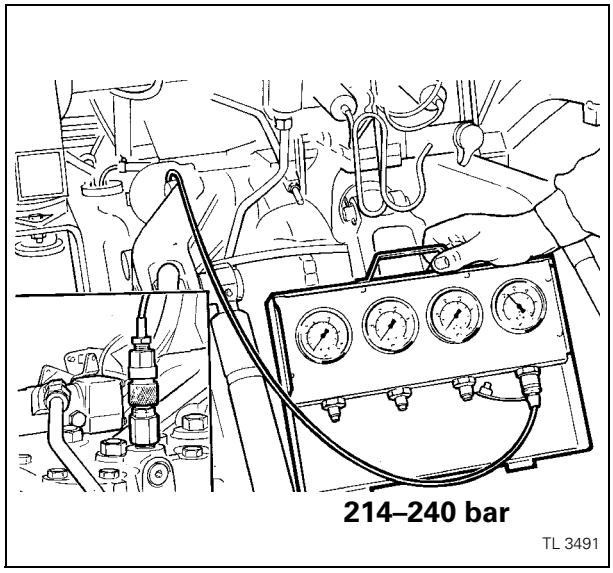
Procedure

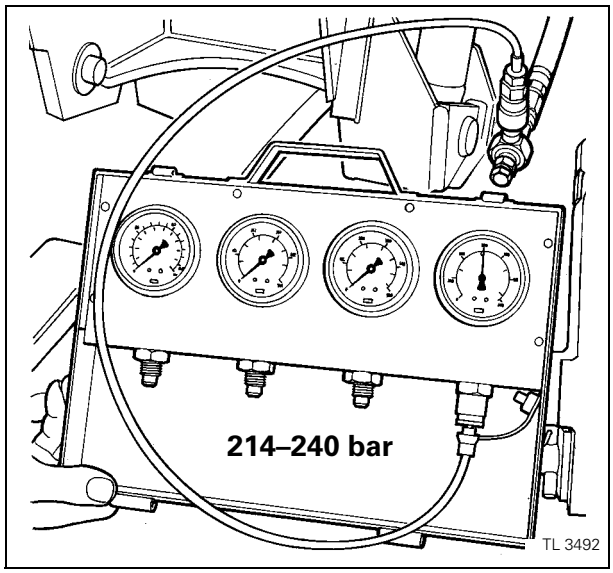
There are two ways of accessing the hydraulic system to test the pressure, through the port on the left-hand side of the lift cover, see first illustration; or by making a connection to the assistor cylinder pipe, see second illustration.

1. Using special tool MF.3001A Pressure Test Kit, remove the plug from the top of the lift cover and install an adaptor with the quick release diagnostic coupling.

Or alternatively:

2. Disconnect the hose at the cylinder end on one of the lift assistor cylinders.
3. With the tee and a cap from the test kit connect the quick release diagnostic coupling to the end of the hose.
4. Connect the high pressure gauge to the quick release coupling.
5. Move the selector valve to the Linkage position.
6. Move the Draft Control lever to UP and the Position Control lever to Transport.
7. Start the engine and run at 1200 rev/min. The transmission oil temperature must be 50-60°C (122-140°F).
8. When the system is at operating temperature, move the Position Control to Constant Pumping.
9. The system pressure should be 214-240 bar (3103-3480 lbf/in²)
10. If the pressure is incorrect, adjust the pressure relief valve, *(see operation 15-9A)*.





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Lift Hydraulics

HYDRAULIC PRESSURE RELIEF VALVE

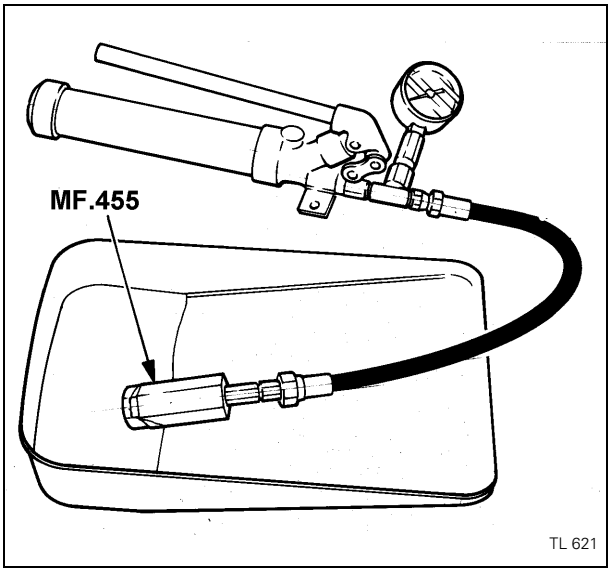
Adjust **15-9A**

Special Tools:
MF.455 Pressure Relief Valve Test Capsule

NOTE: *It is advisable to check the pressure relief valve when the hydraulic pump is being repaired, to gain access it is necessary to remove the lift cover.*

Procedure

1. Remove the relief valve from the manifold and using special tool MF.455 Pressure Relief Valve Test Capsule, screw the relief valve into capsule.
2. Connect the capsule up to an injector tester or hydraulic pump (illustrated), the thread size is M14-1,5.
3. Pressurise the relief valve and check the pressure which should be 205-210 bar (2972-3045 lbf/in²) in this 'static' or 'no flow' condition.
4. If the pressure is incorrect, release the staking of the end cap, then adjust by screwing in the end cap to increase the pressure, or screw out to decrease the pressure setting.
5. Lock the cap after adjustment by staking the edge of the cap into one of the slots in the body.
6. Replace the valve into the manifold and tighten to a torque of 110 Nm (80 lbf ft).



TL 621

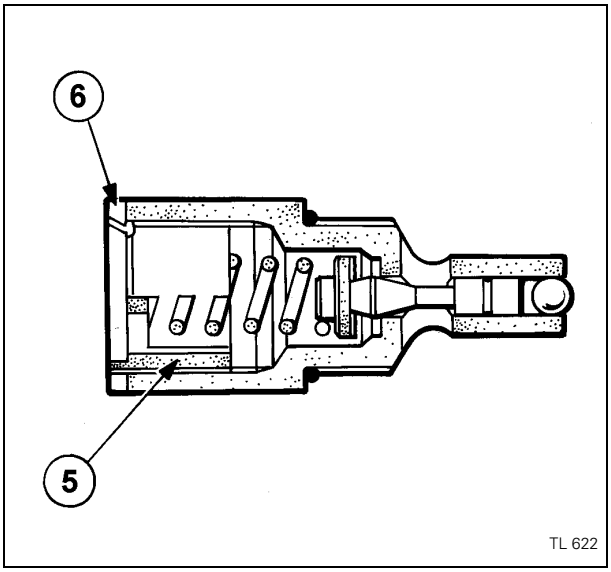
HYDRAULIC PUMP OIL STRAINER

Service **16-9A**

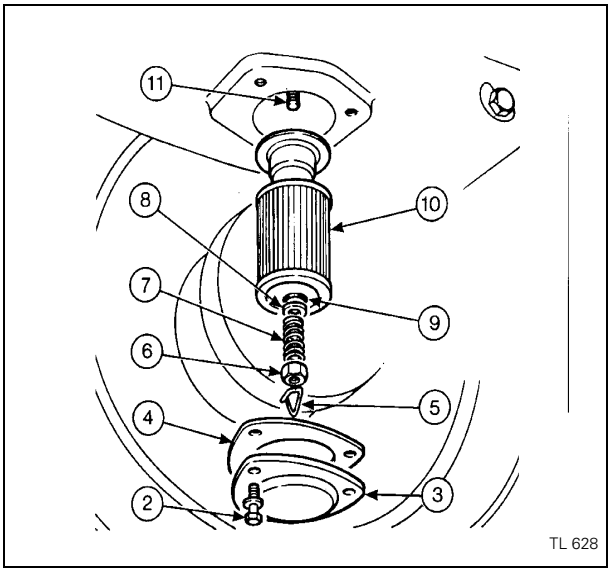
Procedure

1. Drain the oil from the transmission case.
2. Remove the three bolts and washers securing the cover plate.
3. Remove the cover plate.
4. Remove and discard the gasket.
5. Remove the clip.
6. Remove the nut.
7. Remove the spring.
8. Remove the washer.
9. Remove the 'O' ring.
10. Remove the strainer.
11. Thoroughly clean the strainer in paraffin with a suitable brush. Remove all particles of debris from the folds of the filter.
12. Carry out an inspection of the filter material, discard and replace the strainer if any damage is detected.
13. To reassemble reverse procedures 1 to 10 except:

a. Fit a new 'O' ring and cover plate gasket.



TL 622



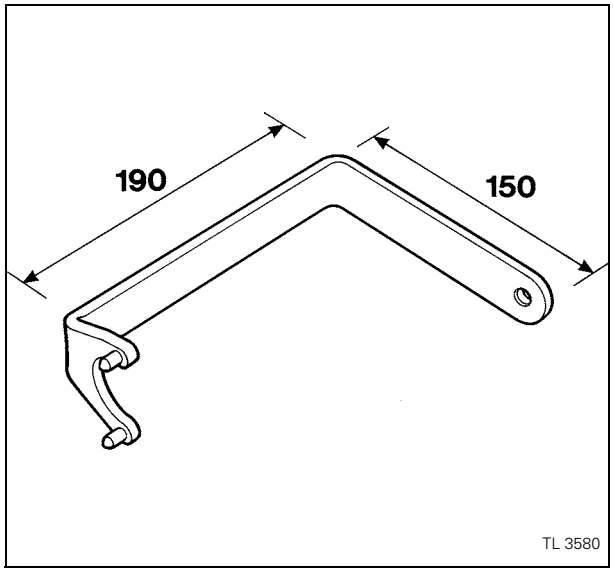
TL 628

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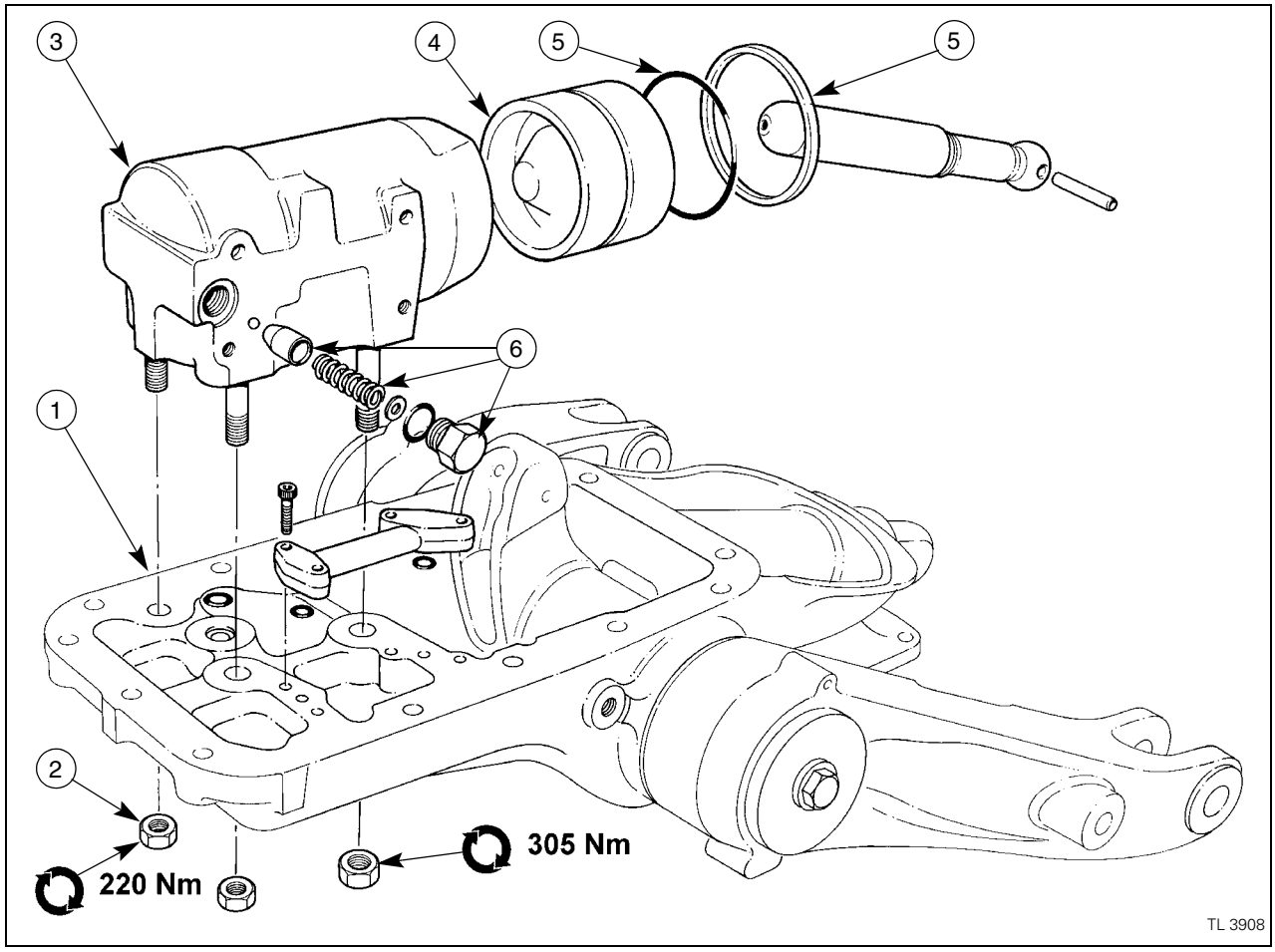
MODIFICATION TO TOOL MF.163

If special tool MF.163 is to be used with the lift cover installed, it will be necessary to modify the tool as shown in the illustration. The handle welded to the existing end is made from 30 x 5 mm steel strip x 340 mm long.



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HYDRAULIC LIFT CYLINDER

Overhaul **17-9A**

Special Tools:
MF.453 Hydraulic Piston Seal Replacer

Dis-assembly

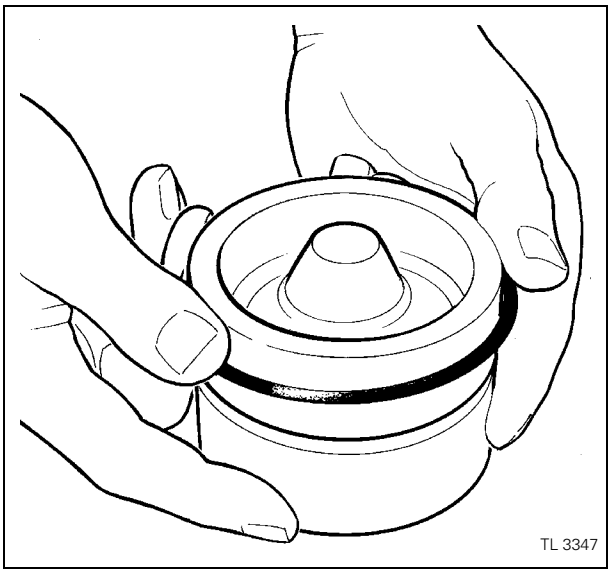
1. Remove the lift cover assembly, *(see operation 2-9A)*.
2. Remove the four nuts.
3. Remove the lift cylinder.
4. Withdraw the piston from the cylinder.
5. Remove the piston seal and 'O' ring.

Examination

Thoroughly clean and examine all components for wear or scoring on the piston or in the cylinder bore. Replace the piston seals.

Re-assembly

6. If necessary, remove the plug, spring and pressure relief valve.



7. Place the piston on the work bench and slide the 'O' ring over the piston and into the bottom of the piston seal groove.

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8. Using special tool MF.453 Hydraulic Piston Seal Replacer, lubricate the outside of the tapered guide with transmission oil.
9. Place the seal on the guide.
10. Locate the guide on the piston and push the seal down the guide onto the piston and into the groove on top of the 'O' ring.
11. The seal must now be sized so that it will fit the cylinder bore. Push the piston into the wide end of the sizing ring (part of MF.453). Push it through until approximately 12 mm (1/2 in) of the piston protrudes out of the tool.
12. Lubricate the bore of the cylinder with transmission oil, then locate the protruding part of the piston in the mouth of the cylinder bore.
13. Push the piston through the sizing ring and into the cylinder. Push the piston to the bottom of the bore.

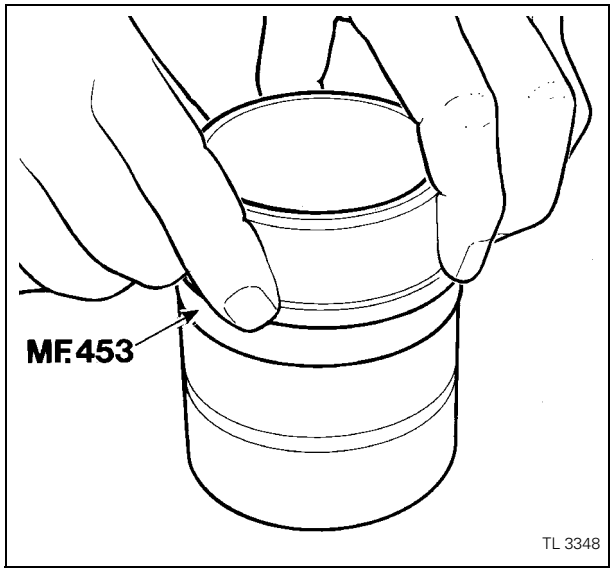
Pressure Relief Valve

14. Clean all components and check the valve seat.
15. Replace or refit the ball.
16. Refit the spool.
17. Refit the spring.
18. The pressure adjustment shims come in three thicknesses.

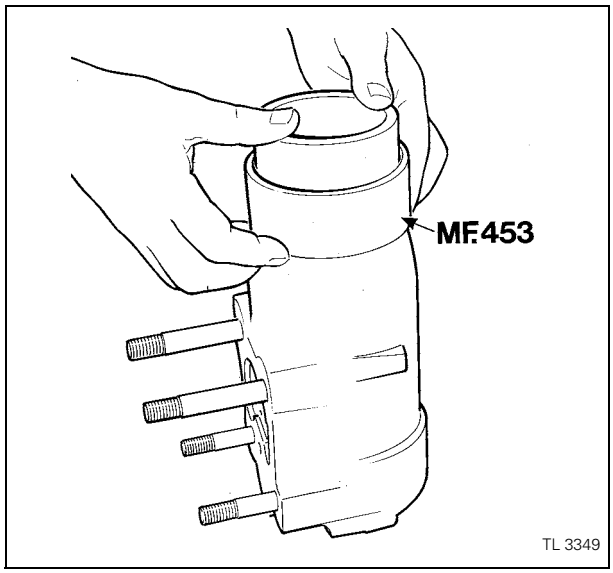
1679 210 M1	0,25 mm shim
1679 211 M1	0,50 mm shim
1679 212 M1	1,00 mm shim

Adjust pressure to 260-275 bar (3800-4000 lbf/in²).

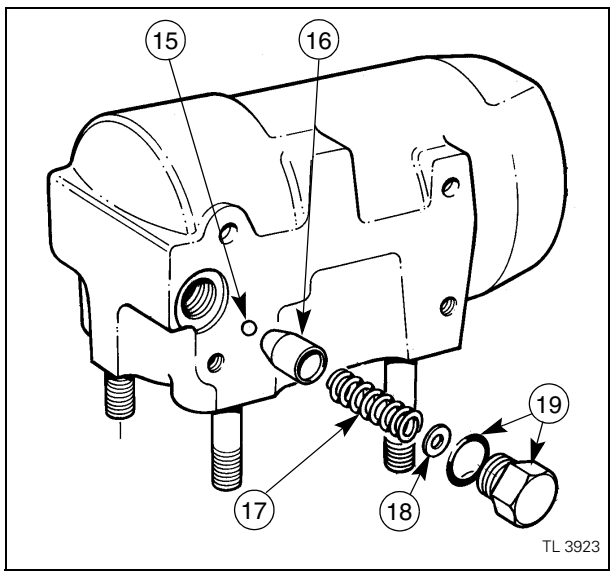
19. Refit the plug and tighten to a torque of 20 Nm (15 lbf ft).
20. Reverse procedures 1 to 5, except:
    a. Fit a new 'O' ring between the cylinder and lift cover.
    b. Tighten the lift cylinder front nuts to a torque of 220 Nm (165 lbf ft). Tighten the rear nuts to a torque of 305 Nm (225 lbf ft).



TL 3348



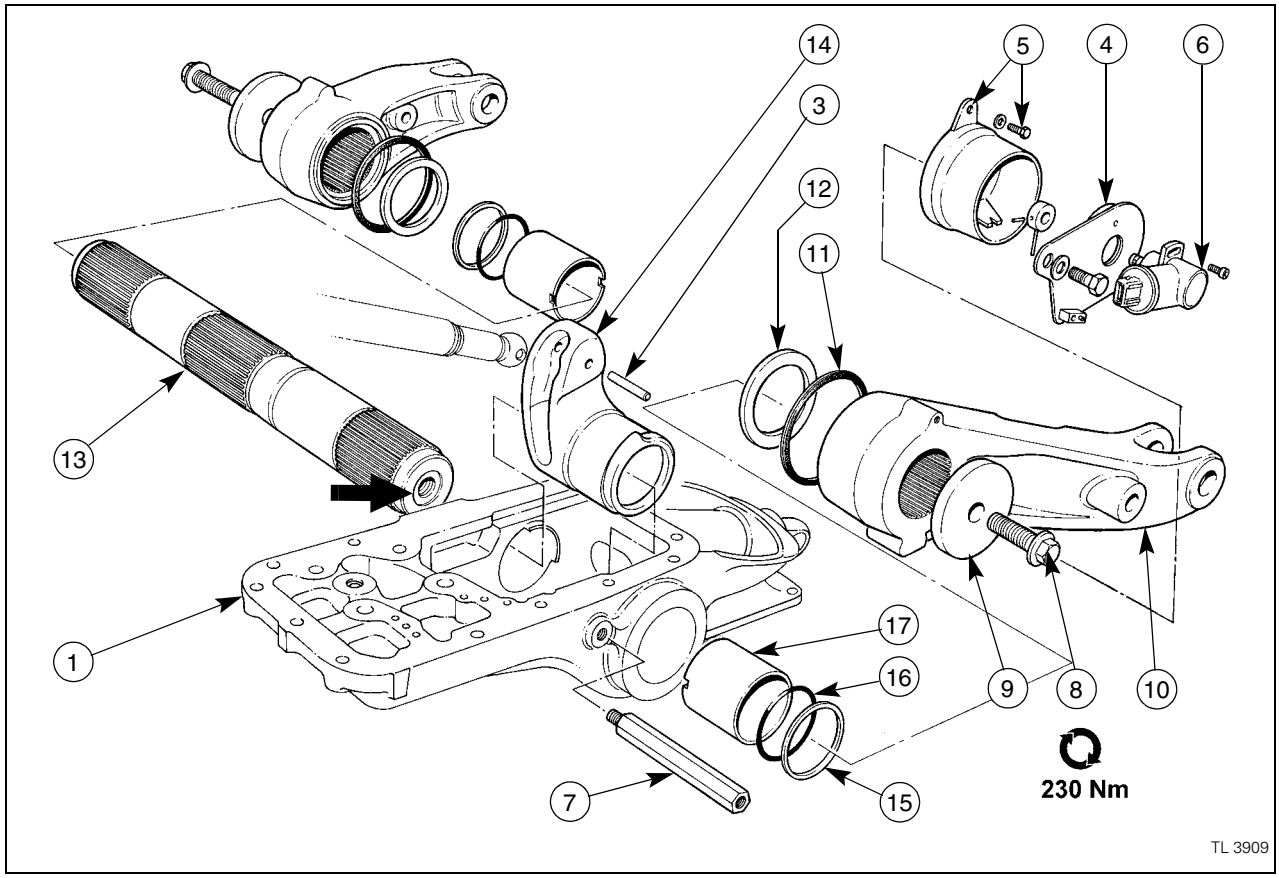
TL 3349



TL 3923

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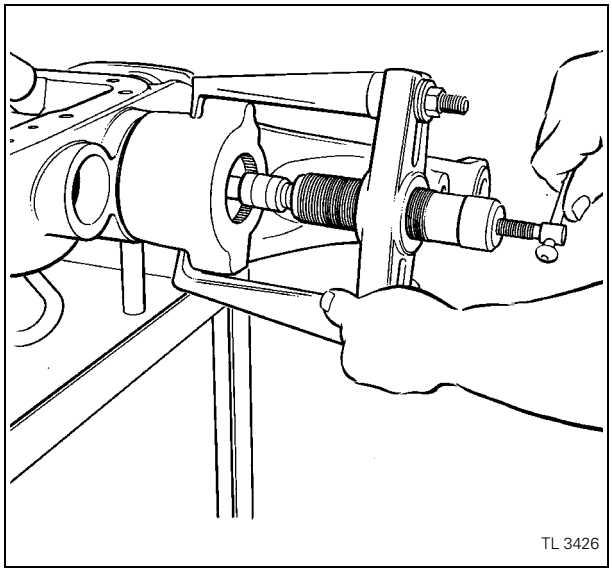


CROSS SHAFT ASSEMBLY

Overhaul **18-9A**

Dis-assembly

1. Remove the lift cover assembly, *(see operation 2-9A)*.
2. Turn the lift cover upside down on a bench.
3. Drive the roll pin out of the ram arm securing the connecting rod.
4. Remove the bracket complete with the Position Sensor.
5. Remove the inner cover.
6. If necessary, remove the position sensor.
7. If necessary, remove the bracket support.
8. Remove the two bolts.
9. Remove the two washers.
10. With the aid of a heavy duty puller remove the lift arms from the cross shaft.
11. Remove the 'V' ring seal.
12. Remove the plastic rings from the shaft.
13. Drive the cross shaft out of the lift cover and ram arm from right to left (from the quadrant side). This will remove the bush, 'O' ring and nylon ring on the left side.



14. Remove the ram arm.
15. Remove the nylon ring.
16. Remove and discard the 'O' rings.
17. Remove the remaining bush. If the bushes are being replaced, retain the old bushes to help fit the new ones.

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Examination

Examine all components for wear and replace as necessary. Replace all 'O' rings.

Re-assembly

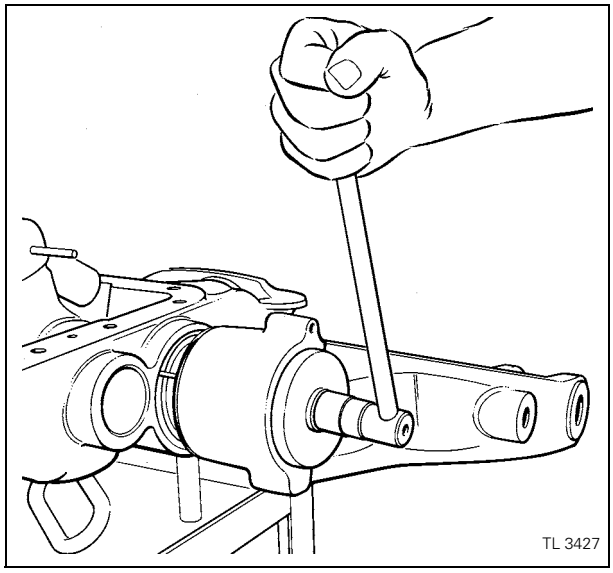
18. Place the ram arm inside the lift cover.
19. Apply a light coat of approved grease, Mobilplex 47 to the three splines of the cross shaft.

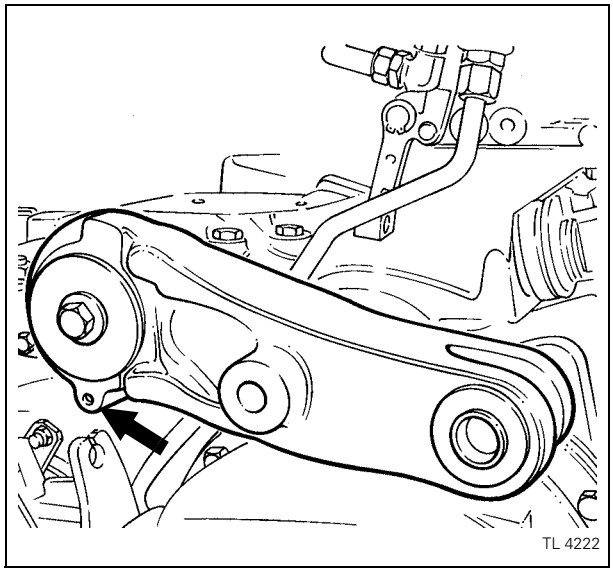
IMPORTANT: *The cross shaft must be fitted the correct way round. The end with the machined recess (indicated by an arrow on the illustration on previous page) must be fitted to the right-hand side.*

20. Install the cross shaft, fitting it from left to right. There is a blind spline to ensure that ram arm and the two lift arms are in line.
21. Lubricate the bushes, 'O' rings and nylon ring with lubricating oil before assembly, either SAE 80 or 90 grade.
22. Lift the shaft and install the two bushes, the bush is installed with the small cut-out towards the centre of the lift cover. Use one of the old ones to drive in the new, they are a tight fit. Push the bush in until it touches the ram arm.
23. Install new 'O' rings and the two nylon rings.
24. Fit the two plastic rings to the cross shaft.
25. Fit new 'V' rings to the lift arms.
26. Fit the two lift arms. Check that the blind splines are in line. The lift arms will be tight on the spline, it may be necessary to fit a long M16 stud into the end of the cross shaft, fit a nut and plain washer and pull the arm on to the shaft until the correct bolts can be fitted. Apply Studlock (Loctite 270) to the thread in the cross shaft approximately half way down, NOT the bolt. Tighten the bolts to a torque of 230 Nm (170 lbf ft).

IMPORTANT: *The lift arms must be assembled the correct way round. The illustration shows the lift arms fitted to the lift cover which is assembled to the rear axle casing. Note that the small threaded hole on the lift arm is at the bottom, this applies to both sides.*

27. Check the cross shaft for free rotation.
28. Refit the connecting rod, using a new roll pin.
29. Refit the components of the Position Sensor; take great care in fitting the sensor to the inner cover, the small lever on the sensor locates in a slot in the inside of the casting.
30. Replace the lift cover.
31. Re-set the adjustment of the Position Sensor, *(see operation 11-11B).*


TL 3427


TL 4222

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HYDRAULIC PUMP

Removal and Refitment 19-9A

Removal

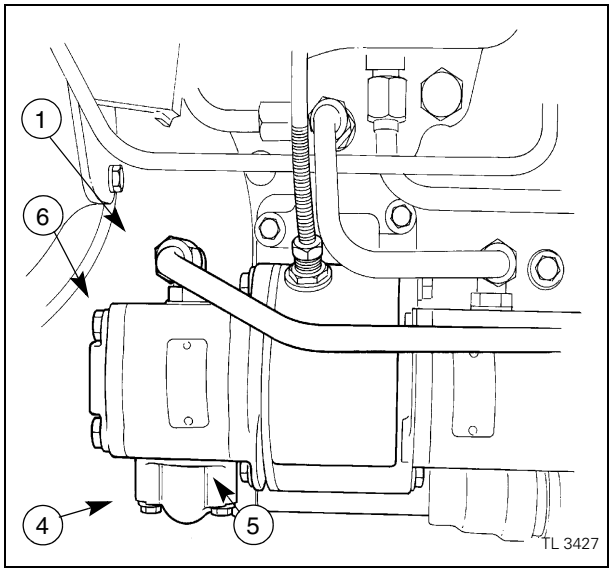
1. Drain the transmission of oil.
2. Place a container under the pump to catch surplus oil.
3. Disconnect the pressure pipe on top of the pump.
4. Remove the two bolts and slide out to the rear the oil manifold.
5. Remove the two bolts securing the pump.
6. Pull the pump to the rear, removing it from the housing and the manifold under the pump.
7. Inspect all 'O' rings, discard and replace if not suitable for replacement.

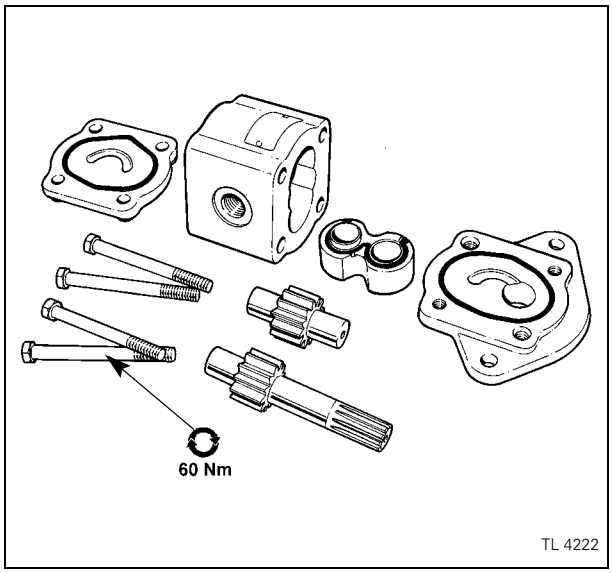
Refitment

8. Reverse procedures 1 to 6 except:

c. Tighten the pump retaining bolts to a torque of 60 Nm (45 lbf ft).

d. Prime the pump at slow engine speed, then check all connections and joints for leakage.





HYDRAULIC PUMP

Overhaul 20-9A

Dis-assembly

The hydraulic pump is a precision made component and Massey Ferguson do not recommend that repairs are carried out except for the replacement of the shaft seal. Specialist equipment is required for the testing and running-in of the pump after manufacture or repair.

To replace the shaft seal proceed as follows:

IMPORTANT: *Maximum cleanliness is essential. The work bench, tools, cleaning materials and hands must be free from dirt and swarf. Removed parts must be protected form any kind of damage, DO NOT drop or knock any of the parts.*

1. Remove the hydraulic pump, *(see operation 19-9A).*
2. Thoroughly clean the outside of the pump.
3. Use a sharp tool to scribe a mark across each section of the pump. This will assure proper re-assembly.
4. Place the pump on the bench and remove the four bolts.

NOTE: *The sections are dowelled together with two tubular dowels at each joint, excluding the end covers. The dowels are located on two through bolts.*

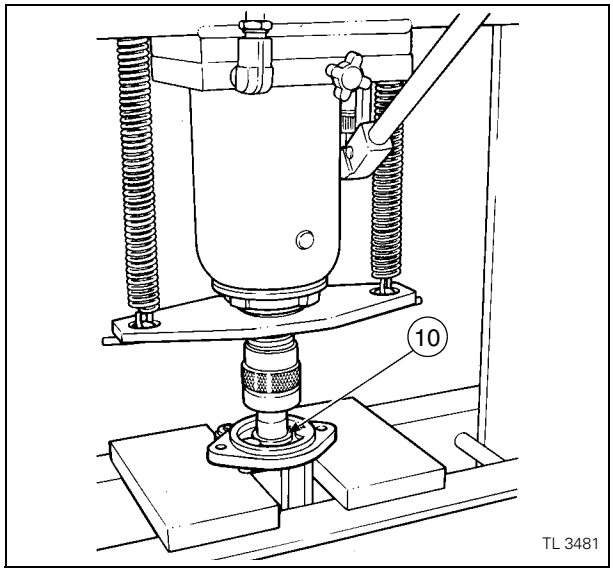
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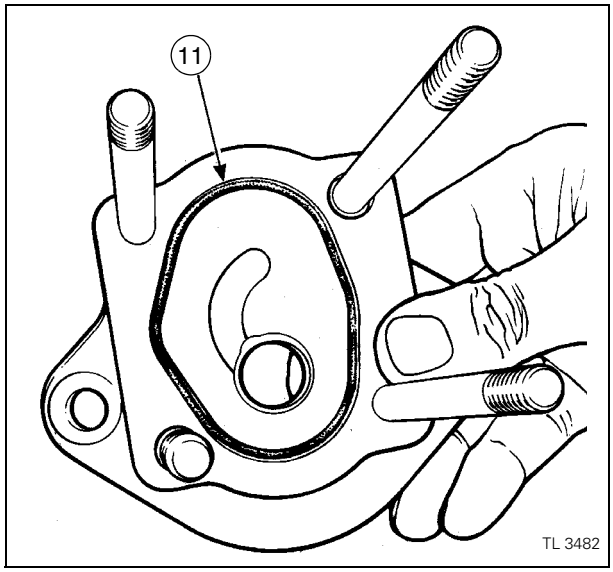
5. Remove the end cover.
6. Very carefully split the pump between the drive end flange and the body. When separating, keep the drive shaft and bearing in the pump body.
7. Remove and discard the seals from the end cover and flange.
8. Remove and discard the seal on the bearing.
9. Remove and discard the shaft seal.

Re-assembly

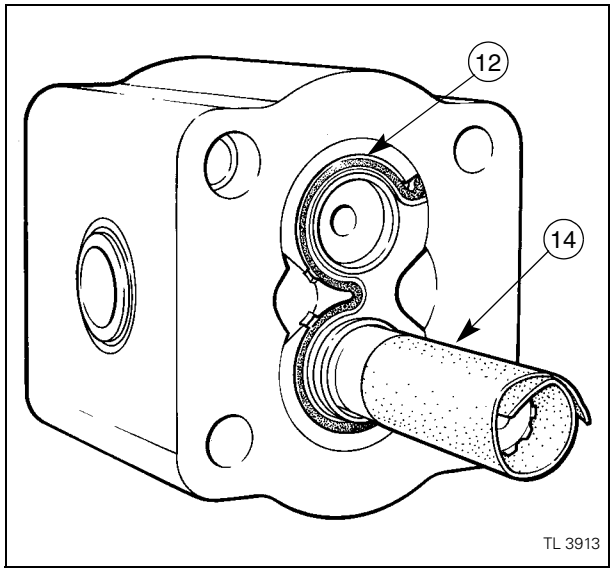
10. Fit a new shaft seal to the pump flange; press in squarely with a little grease and the spring side innermost.



11. Fit a new sealing ring to the flange end and end cover.



12. Fit a new pressure loading seal and backing strip, a little grease in the grooves will help to retain all the seals. Ensure that the seals are fitted as shown in the illustration.
13. Ensure that the pump sections are still all together with the gears and bearings in place.
14. Fit a protective sleeve over the gear shaft with thin tape to protect the seal.
15. Lightly lubricate the shafts and seal with lubricating oil, then slide the flange onto the drive shaft, locating the dowels and fitting the nuts.
16. Remove the tape or sleeve from the drive shaft.
17. Tighten the pump body nuts to a torque of 60 Nm (45 lbf ft).
18. Check the pump for free rotation.
19. Refit the pump, *(see operation 19-9A)*.



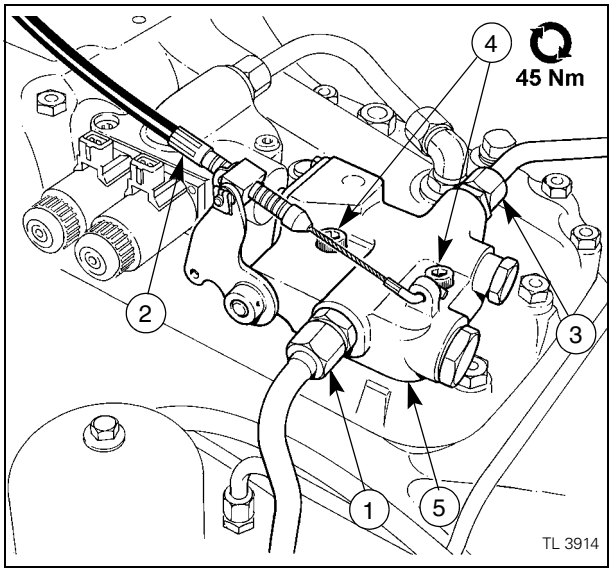
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SELECTOR VALVE

Removal and Refitment 21-9A

NOTE: *Components and assemblies have been removed to show more clearly the installation of the solenoid valve.*



Removal

1. Remove the pipe from the hydraulic pump.
2. Disconnect the control cable.
3. Disconnect the combined flow pipe.
4. Remove the two hexagon socket screws securing the selector valve to the lift cylinder.
5. Remove the valve assembly.
6. Discard the 'O' rings between the valve and the lift cover.

Refitment

7. Reverse procedures 1 to 5 except:

a. Replace the 'O' rings.

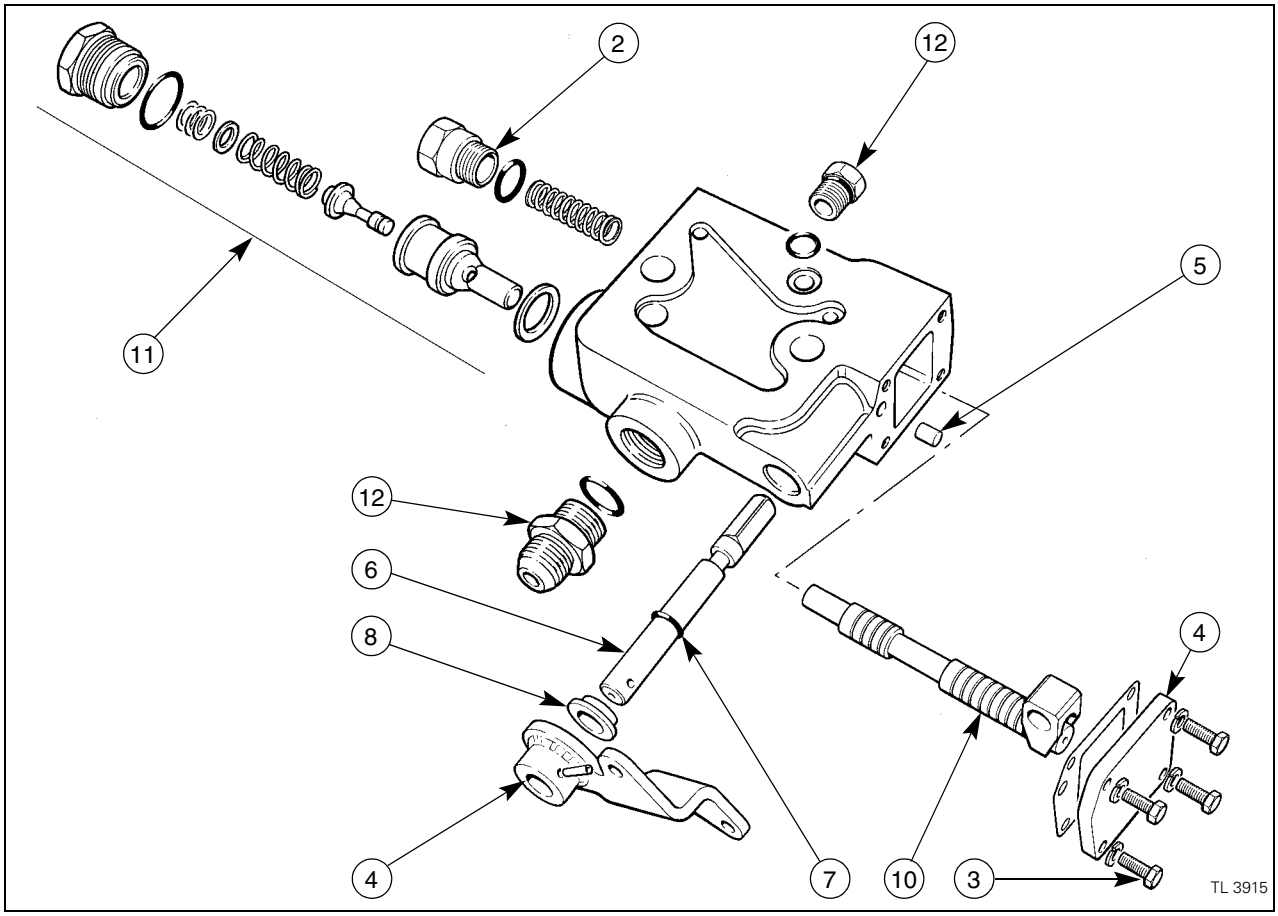
b. Tighten both hexagon socket screws to a torque of 45 Nm (65 lbf ft).

Selector Valve Cable Setting

8. Rotate the selector valve lever fully counter-clockwise.
9. Place the lever in the cab in the linkage position.
10. Pull the outer cable lightly to the left, install a clip in the outer groove.

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SELECTOR VALVE

Overhaul 22-9A

Dis-assembly

NOTE: *The valve is shown upside down to indicate the position of the 'O' ring on the underside.*

1. Remove the selector valve, *(see operation 21-9A)*.
2. Remove the plug and spring, discard the 'O' ring.
3. Remove the four screws.
4. Remove the cover plate and discard the gasket.
5. Remove the dowel.
6. Pull the operating lever and spindle out of the bore.
7. Discard the 'O' ring.
8. Remove the seal retaining collar.
9. If necessary, remove the control lever.
10. Remove the spool valve.
11. Remove the pressure relief valve assembly; it is made up of the following components reading from left to right:

    Cap with 'O' ring seal.

    Shims - to adjust the pressure setting.

    Washer.

    Spring.

    Valve.

    Body with sealing ring.
12. Remove the remaining adaptors, plugs and 'O' rings as necessary.

Re-assembly

13. Thoroughly clean all components, using compressed air to clear the oil galleries.
14. Reverse procedures 1 to 12.
15. Check the pressure relief valve setting, *(see operation 23-9A)*

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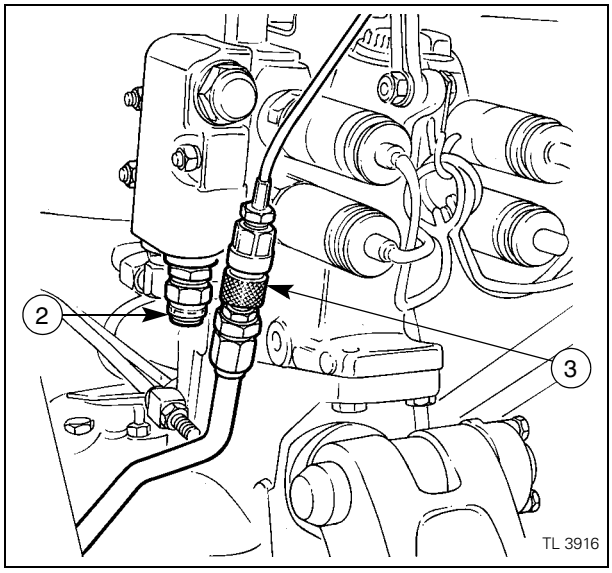
HYDRAULIC PRESSURE TEST
(Tractors with Electronic Lift Control)

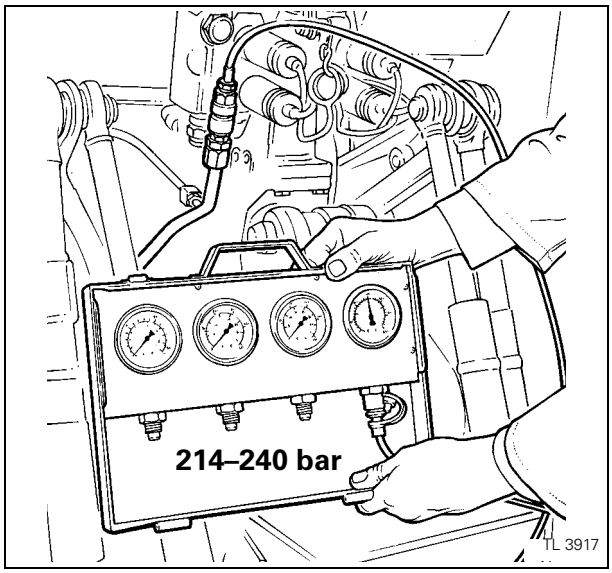
Check **23-9A**

Special Tools:
MF.3001A Pressure Test Kit

Procedure

1. At the rear of the tractor, disconnect the combined flow pipe from the selector valve to the auxiliary control valve at the control valve end.
2. To the male connector on the auxiliary control valve fit a 3/4-18 JIC cap to prevent loss of oil during test.
3. Using MF.3001A Pressure Test Kit, connect the high pressure gauge to the combined flow pipe using a suitable adaptor for the M14 male quick release coupling from the test kit.
4. Place the selector valve in the linkage position.
5. Start the engine and run at 1200 rev/min. The transmission oil temperature must be 50-60°C (122-140°F).
6. When the system is at operating temperature, move the selector valve to the combined flow position.
7. The system pressure should be 214-240 bar (3103-3480 lbf/in²).
8. If the pressure is incorrect, the valve in the selector valve must be replaced with a new assembly. Repair parts are NOT available.





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SOLENOID VALVE

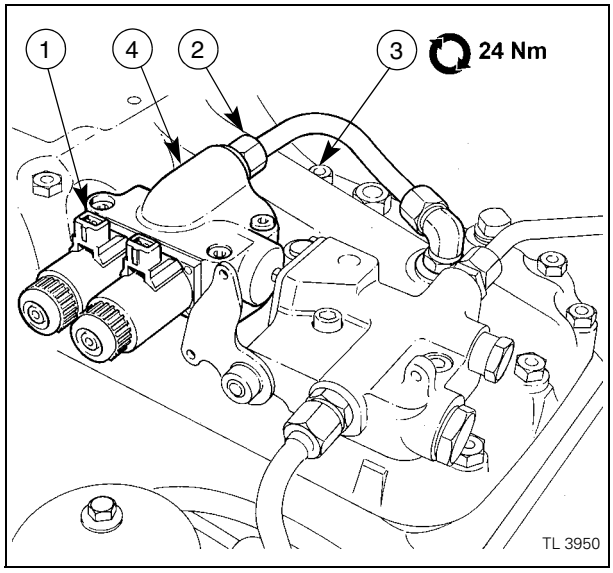
Removal and Refitment **24-9A**

Removal

NOTE: *Components and assemblies have been removed to show more clearly the installation of the solenoid valve.*

Valve Assembly

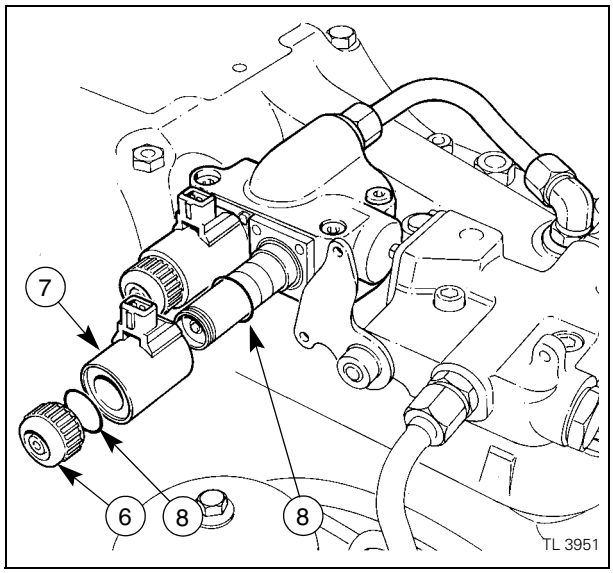
1. Disconnect the electrical connections.
2. Disconnect the pipe between the solenoid valve and the lift cover.
3. Remove the three cap screws.
4. Remove the valve assembly.
5. Discard the 'O' rings between the valve and lift cover.



Solenoid Coils

NOTE: *The front coil is the 'Lift' and the rear is the 'Lower'. Only the coils can be replaced.*

6. Unscrew the serrated end caps.
7. Slide the coil off the armature.
8. Capture the two thin 'O' rings each side of the coil.



Refitment

9. Reverse procedures 1 to 5 as applicable except:

a. Replace the 'O' rings.

b. Tighten the coil retaining cap hand tight.

c. Tighten the cap screws to a torque of 24 Nm (18 lbf ft).

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Hydraulic Steering

Section 9 - Part B

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----	Specification	9B– 2
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Hydraulic Steering

SPECIFICATION

Hydrostatic steering unit:

Make	Danfoss.
Type code	OSPC 100 ON.
Nominal displacement	100 cm^3/rev (6.1 in^3/rev).
Pressure settings at 1200 engine rev/min:	
Pressure relief valve setting	130-150 bar (1885-2175 lbf/in^2).
Shock valve pressure setting	200 bar (2900 lbf/in^2).

Special Tools:

MS.63	Centring spring fitting tool.
MS.1667	Shaft seal fitting tool.

Bolt Torques:

Steering wheel nut	40 Nm (30 lbf ft).
Steering unit mounting bolts	22 Nm (16 lbf ft).
Steering column mounting bolts	35 Nm (25 lbf ft).
Steering unit body bolts	30 Nm (25 lbf ft).
Steering unit relief valve plug	50 Nm (37 lbf ft).
Steering column flexible coupling clamp bolt	24 Nm (18 lbf ft).

GENERAL DESCRIPTION

The 4200 series tractors employ an open centre hydrostatic power steering system. Hydrostatic steering is a full power steering system with no mechanical connection between the steering wheel and the tractors front road wheels.

Hydraulic oil is delivered from the steering section of the main hydraulic pump to the hydrostatic steering control unit, which when the steering wheel is turned, directs oil flow to the appropriate side of the steering cylinder. When the wheel is stationary the unit allows the supply oil to pass on to the next service in the circuit. As no mechanical linkages are used in this arrangement, the steering unit is given the ability to act as a steering wheel operated hand pump to maintain steering control should, for instance, the engine run out of fuel and the oil supply from the pump cease.

The steering unit is splined onto the end of the steering column. Hydraulic pipes connect the unit to the steering cylinder and the hydraulic pump. Oil from the steering unit is fed to the appropriate side of the steering cylinder, determined by the steering wheel movement. The hydraulic force turns the road wheels in the direction required, excess oil from the steering cylinder and steering unit is passed on to the four-wheel drive, Speedshift and differential lock solenoids and the PTO engagement for use when required.

The action of the steering unit is as follows:

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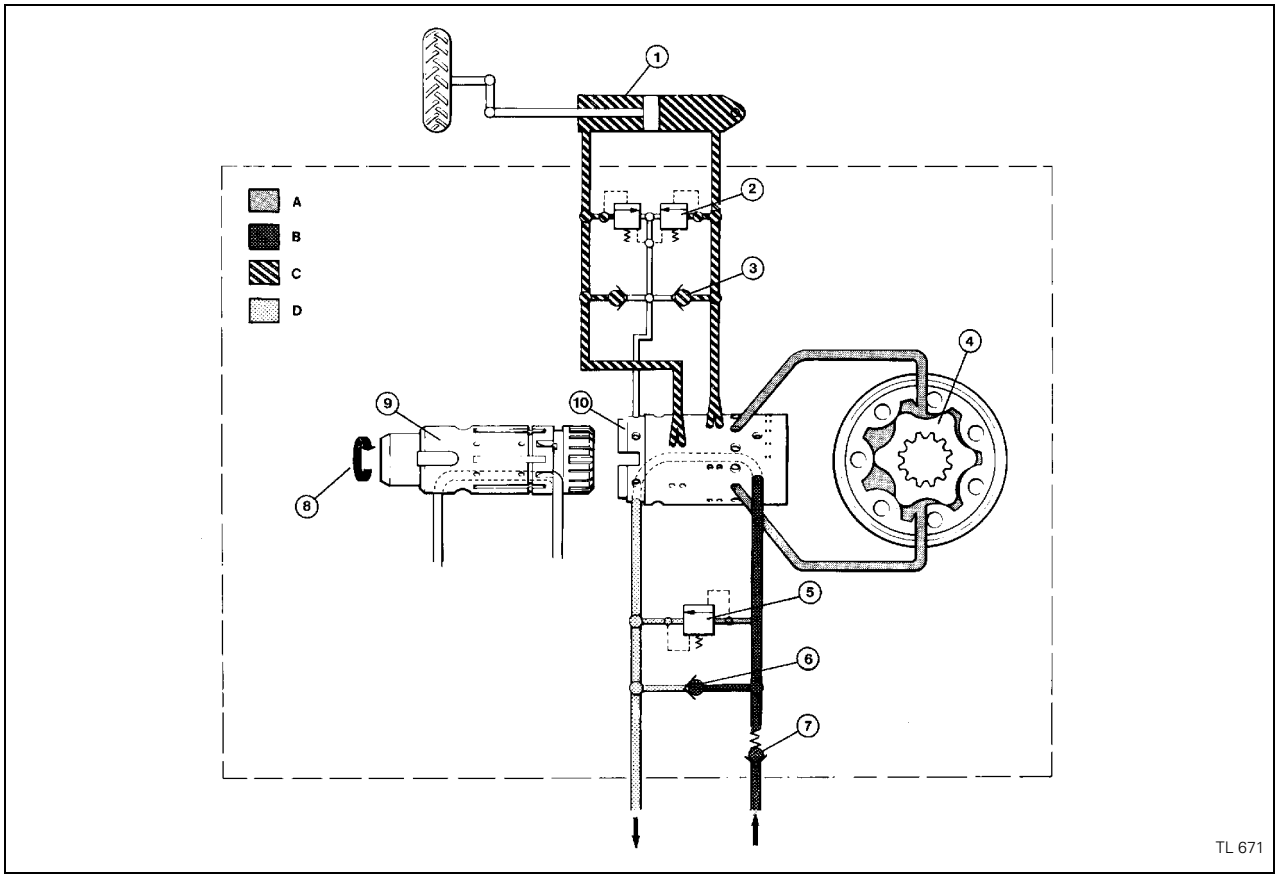


Fig.1 Hydrostatic steering unit circuit – Neutral flow

Key to Fig.1

1. Steering cylinder
2. Shock valves
3. Suction valves
4. Metering valve
5. Relief valve
6. Non return valve
7. Check valve
8. Steering wheel connection
9. Spool valve
10. Sleeve valve

A. Metering valve - static oil

B. Pressure line

C. Steering line - static oil

D. Return oil

Steering Unit Neutral Flow. Fig.1

In the neutral position oil flows from the hydraulic pump to the steering unit. The holes in the spool align with holes in the sleeve to direct the oil through the centre of the valve into the return flow circuit. The hydraulic lines to the steering cylinder are isolated.

Two shock valves and two suction valves are fitted internally to the left and right outlet ports. The shock valve will protect the system between the cylinder and the steering unit. The suction valve will then allow the other side of the system to compensate for any lack of oil.

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Hydraulic Steering

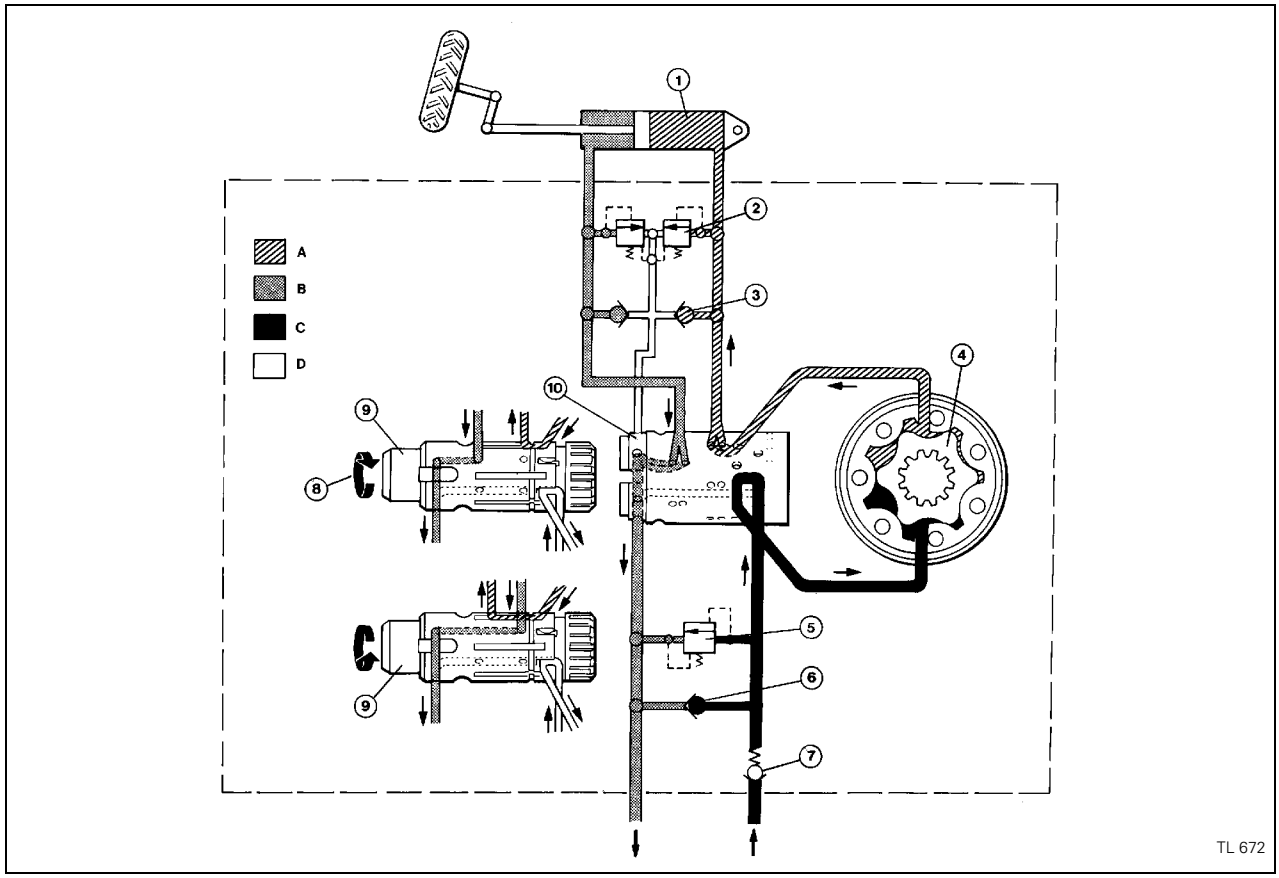


Fig.2 Hydrostatic steering unit circuit – Wheel turning with engine running

Key to Fig.2

1. Steering cylinder
2. Shock valves
3. Suction valves
4. Metering valve
5. Relief valve
6. Non return valve
7. Check valve
8. Steering wheel connection
9. Spool valve
10. Sleeve valve

A. Suction line

B. Steering line

C. Return oil

D. Return oil

Wheel Turning with Engine Running. Fig.2

First movement of the steering wheel moves the spool against the leaf springs. This opens the closed centre pressure port and aligns slots in the spool with holes in the sleeve, allowing oil to pass to the metering valve. Further movement of the steering wheel continues to turn the metering valve, sleeve and wheel. Simultaneously the metering valve meters the oil flow and directs it back into the sleeve and spool. The oil re-entering is then directed by slots in the spool which align with holes in the sleeve, to direct oil to the head side or road side of the steering cylinder (the direction is controlled by the steering wheel movement). The oil returning from the steering cylinder is directed, (by the slots in the spool valve aligning with holes in the sleeve) into the return line.

In the line between the inlet and the spool valve situated internally in the steering unit, is a relief valve. Its function is to protect the pump from excessive pressures. For example, when on full lock, or when the road wheels are against an obstruction.

A check valve is fitted in the steering unit in the path of the oil entering from the pump. This is a one way valve preventing induced peak pressure generated from the road wheels returning to the main pump when steering.

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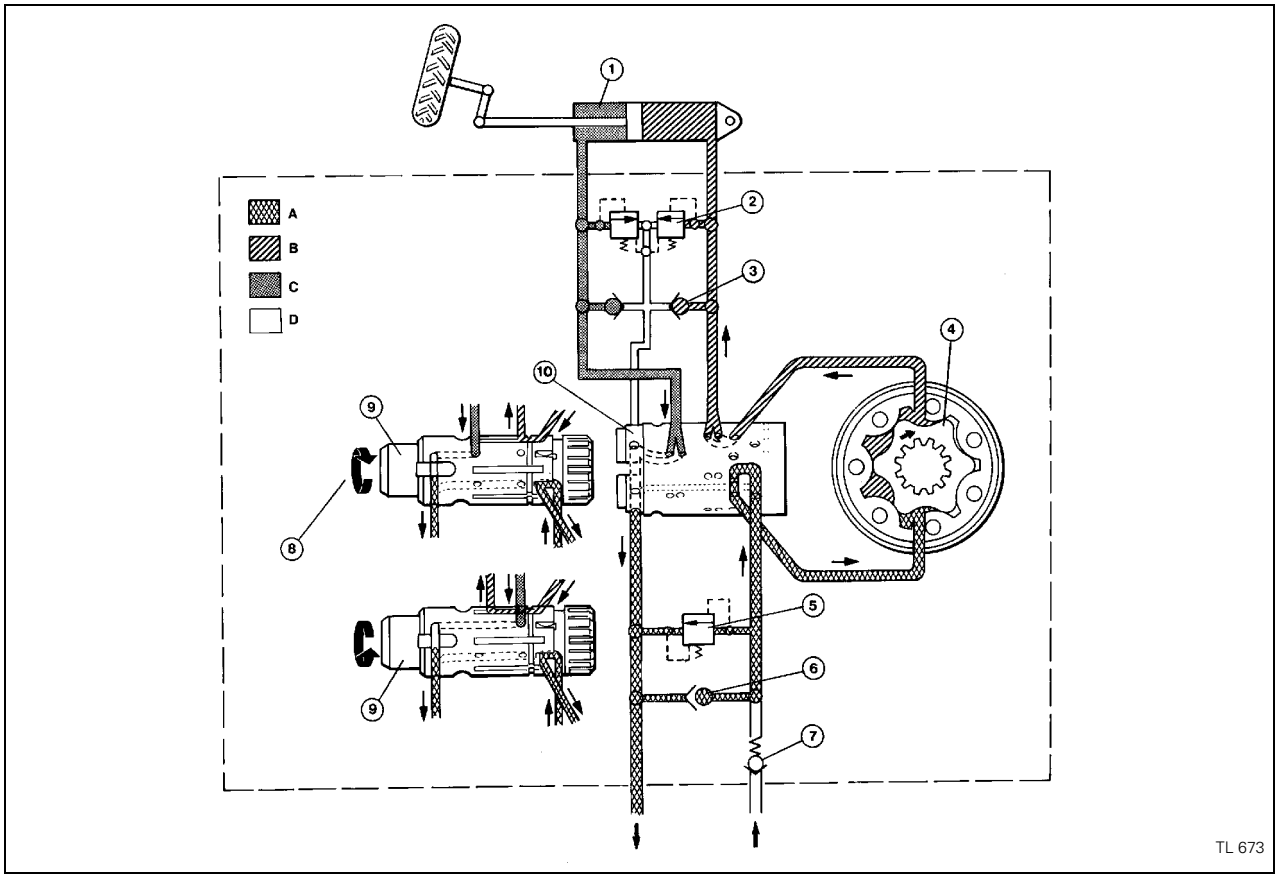


Fig.3 Hydrostatic steering unit circuit – Wheel turning with engine stopped

Key to Fig.3

1. Steering cylinder
2. Shock valves
3. Suction valves
4. Metering valve
5. Relief valve
6. Non return valve
7. Check valve
8. Steering wheel connection
9. Spool valve
10. Sleeve valve

A. Suction line

B. Steering line

C. Return oil

D. Return oil

Wheel Turning with Engine Stopped. Fig.3

Should the pressure from the hydraulic pump cease, it is important that the steering should still be maintained. For this reason a by-pass valve is situated between the inlet and the return galleries inside the steering unit assembly.

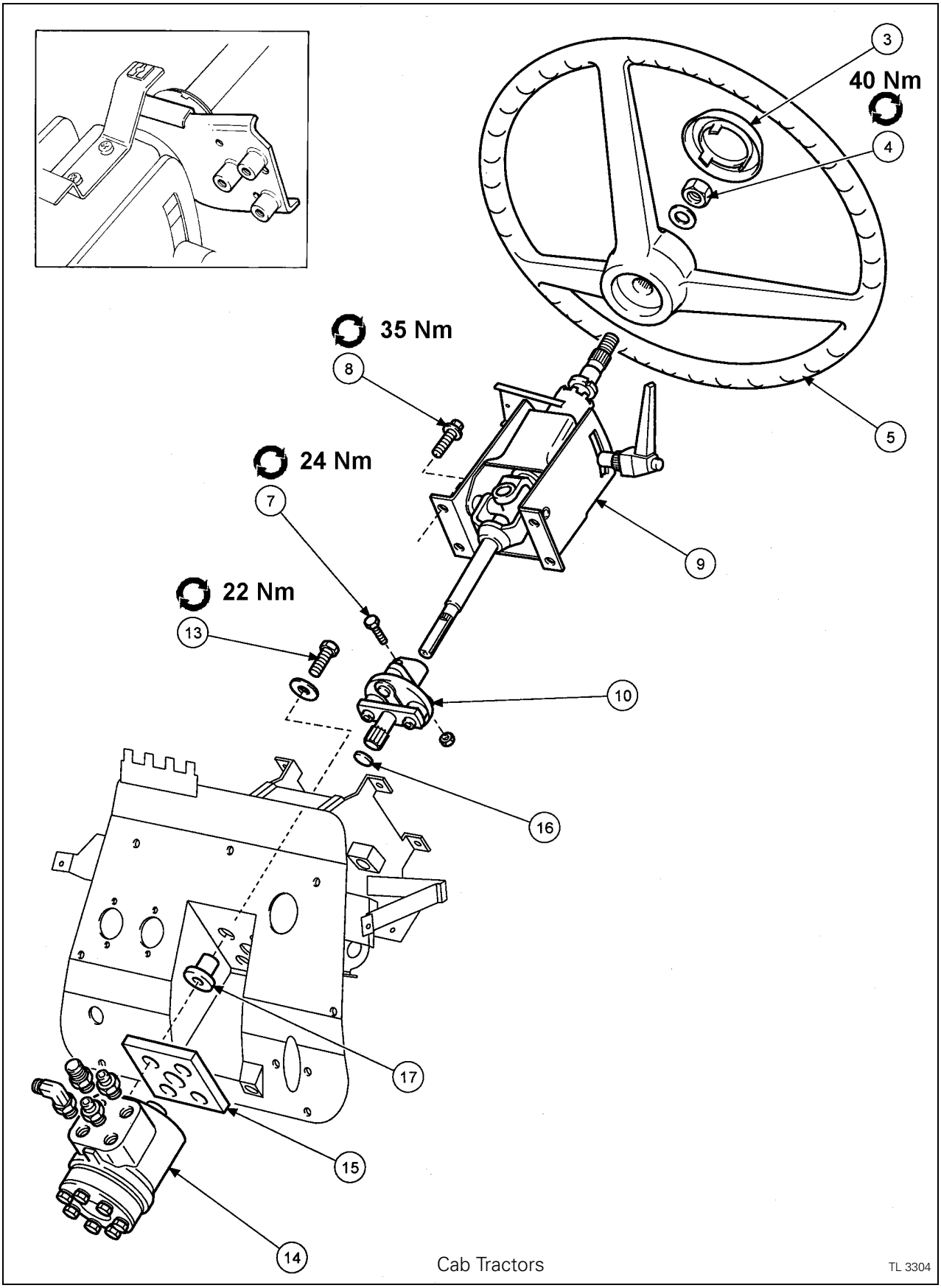
When the hydraulic pump is functioning normally, the by-pass valve is held on its seat by oil pressure, allowing the oil to pass into the spool valve.

When the pressure from the hydraulic pump drops, the oil returning from the steering cylinder is allowed to pass the by-pass valve to the inlet side of the spool valve, enabling oil to be passed from one side of the steering cylinder to the other. In this way steering control is maintained at all times.

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Hydraulic Steering



Cab Tractors

TL 3304

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STEERING COLUMN and STEERING UNIT - CAB TRACTORS

Removal and Refitment 1-9B

Removal

Steering Column

1. Remove the plastic surround at the top of the steering column.
2. Remove the lower instrument panel to gain access to the lower part of the column.
3. Remove the plastic cap.
4. Remove the steering wheel nut and washer.
5. Remove the steering wheel. A sharp tap with a soft faced hammer will release it from its taper.
6. Remove the direction indicator switch from the support bracket. (On power shuttle tractors remove the forward/reverse switch from the support bracket)
7. Slacken the clamp bolt on the flexible coupling.
8. Remove the four steering column retaining bolts.
9. Remove the column from the tractor.
10. Remove the coupling.

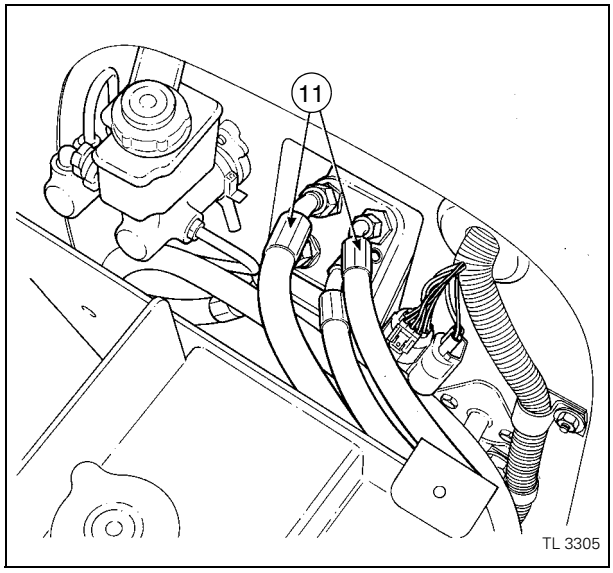
NOTE: *The steering column assembly is not available in separate parts. If any components fail or are in need of replacement, the whole unit must be replaced.*

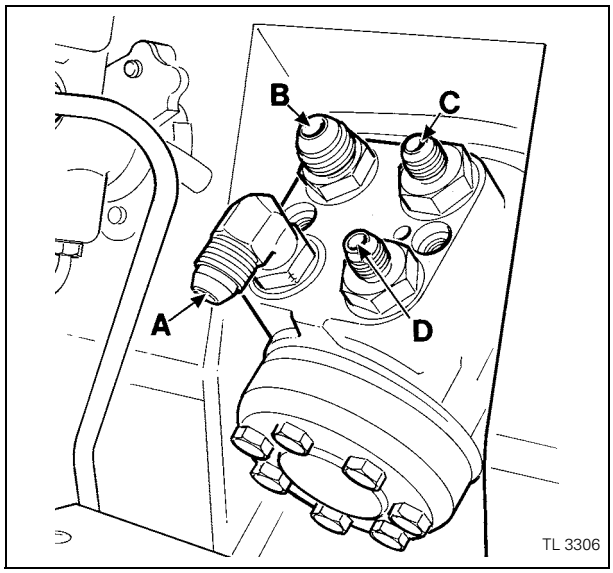
Steering Unit

11. Disconnect the steering hoses from the steering unit.
12. Cap the ends of the hoses and the steering unit to prevent the ingress of dirt.
13. Remove the four bolts and washers.
14. Remove the steering unit from the front of the bulkhead.
15. Remove the sound deadening material.
16. Remove the cork washer in the bottom of the spline in the drive shaft.
17. Remove the four rubber mounts.

Refitment

18. Reverse procedures 1 to 14 except:
    a. Tighten the four steering unit bolts to a torque of 22 Nm (16 lbf ft).
    b. When installing the steering unit, ensure that the cork washer (14) is in place at the bottom of the spline. Allow the coupling to lightly sit on the cork washer, DO NOT force in.
    c. Tighten the steering column bolts to a torque of 35 Nm (25 lbf ft).
    d. Tighten the flexible coupling clamp bolt to a torque of 24 Nm (18 lbf ft).





e. Tighten the steering wheel nut to a torque of 40 Nm (30 lbf ft).
f. Ensure that the two metal clips are in place on the plastic cap (3), replace the cap.
g. Ensure that the hydraulic hoses are fitted to their original positions on the steering unit. The connections are as follows:

A - From steering pump.

B - Return to transmission.

C - To steering cylinder - Left.

D - To steering cylinder - Right.

Start-up Procedure

IMPORTANT: *The steering unit will not tolerate dirt ingress under operational conditions. It is necessary to flush the system to remove any impurities after a new or repaired steering unit has been fitted as follows:*

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19. After installation, start the engine and under NO circumstance turn the steering wheel for 10 minutes.
20. Run the engine at a good throttle opening to ensure a high flow of hydraulic oil through the steering unit, filter and associated pipe work to effect a good flushing action.
21. Commence the steering action after 10 minutes warm-up taking the steering wheel to full lock in each direction. Complete at least 10 operations of the steering wheel to ensure the cylinder and cylinder lines are flushed.
22. A further two operations should then be undertaken taking the steering cylinder to its fullest extent and holding the steering wheel a full minute in this position so that flow occurs under full relief valve pressure.
23. On completion, check the steering wheel takes up the neutral position, check that the steering wheel neither moves to the left or right in the hands-off position.

STEERING UNIT

Overhaul **2-9B**

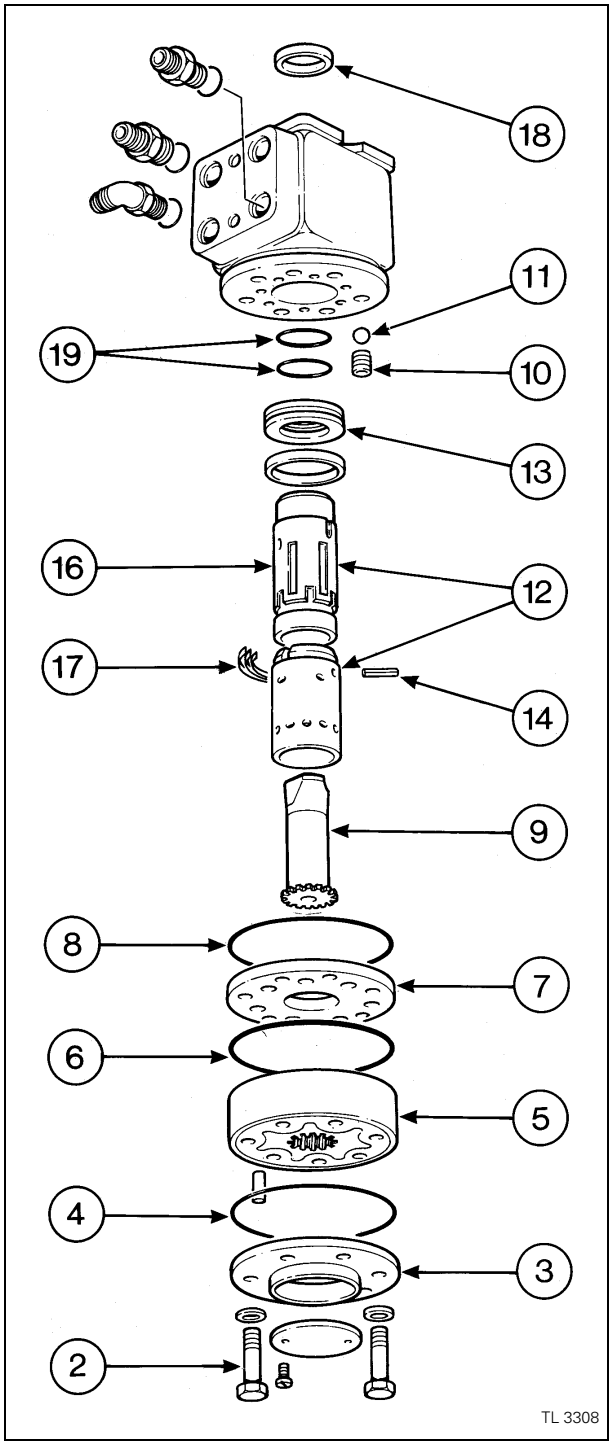
Special Tools:
MS.63 Centring Spring Fitting Tool
MS.1667 Shaft Seal Fitting Tool

Dis-assembly

1. Remove the Steering unit, *(see operation 1-9B).*
2. Remove the seven bolts.
3. Lift off the end cover.
4. Remove the 'O' ring.
5. Lift off the stator and rotor.
6. Remove the 'O' ring.
7. Remove the distributor plate.
8. Remove the 'O' ring.
9. Remove the drive shaft.
10. Unscrew and remove the threaded bushing in the bore of the check valve.
11. Shake out the ball check valve.
12. Remove the outer and inner spools with rings, bearing races and needle bearings from the housing. This is achieved by pressing the inner spool from the steering column end.

NOTE: *The cross pin (14) in the sleeve and spool must be kept horizontal. The pin can be seen through the open end of the inner spool.*

13. Remove the outer bearing race, needle bearing and inner bearing race from the spool and sleeve. The outer (thin) bearing race can sometimes 'stick' in the housing, therefore check that it has come out.
14. Press out the cross pin, use the special bolt from the end cover.



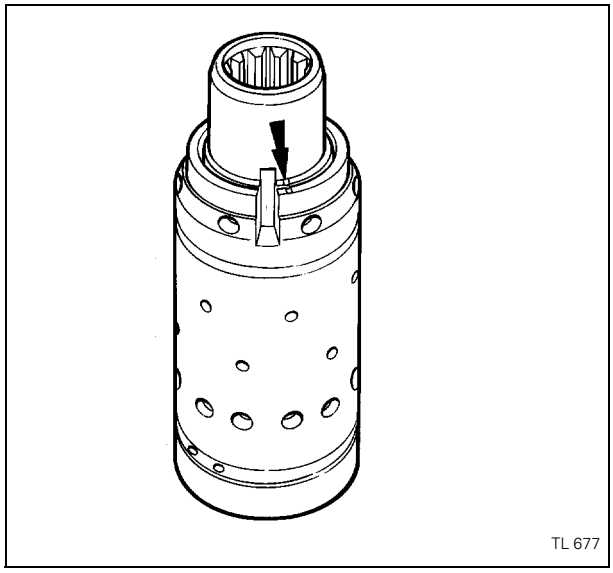
15. A small mark *(see procedure 20 and the illustration)* has been made with a pumice stone on both spool and sleeve close to one of the slots for the neutral position springs. If the mark is not visible, remember to leave a mark of your own on the sleeve and spool before the neutral position springs are dismantled.

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16. Carefully press the inner spool out of the outer sleeve.
17. Press the neutral position springs out of their slot in the inner spool.
18. Lever out the dust seal.
19. Remove the shaft seal.

NOTE: *It is not recommended that the shock and pressure relief valves are removed. It is very difficult to re-set the pressures without a test bench.*


TL 677

Examination

Cleanliness is the most important part of repairing this unit. Clean your hands, the work bench and all the tools and containers that will be used during repair.

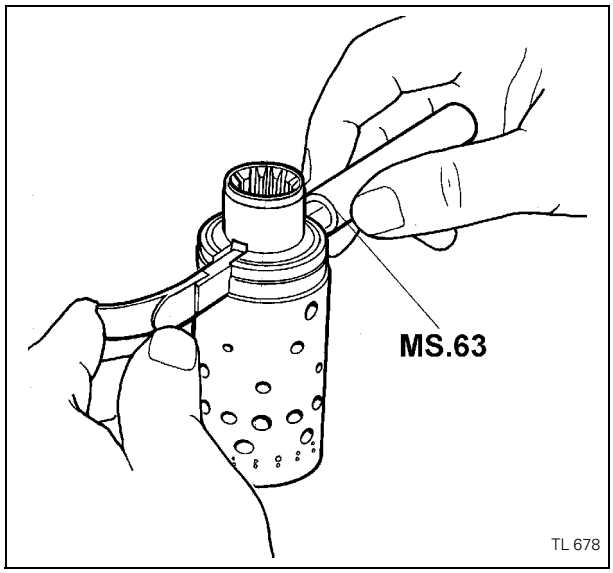
Check all parts carefully and replace parts as necessary. All seals, washers and neutral position springs must be replaced.

Clean all parts before assembly, lubricate all items with clean hydraulic oil.

Re-assembly

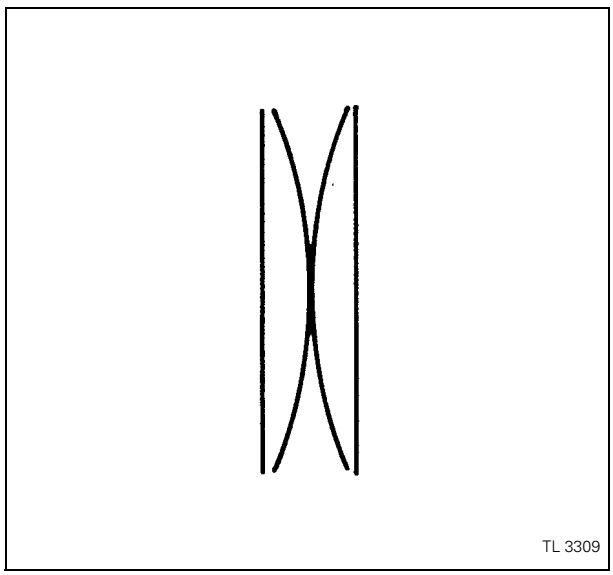
NOTE: *During assembly, try not to excessively handle the inner spool and sleeve, warming of the components with the hands will result in difficult assembly due to the very fine fit.*

20. Carefully slide the inner spool into the sleeve with the two marks aligned as shown and ensure that the slots for the neutral position springs are opposite each other.
21. Push special tool MS.63 Centring Spring Fitting Tool, right through the slot in the spools.
22. Place the springs in the tool.



TL 678

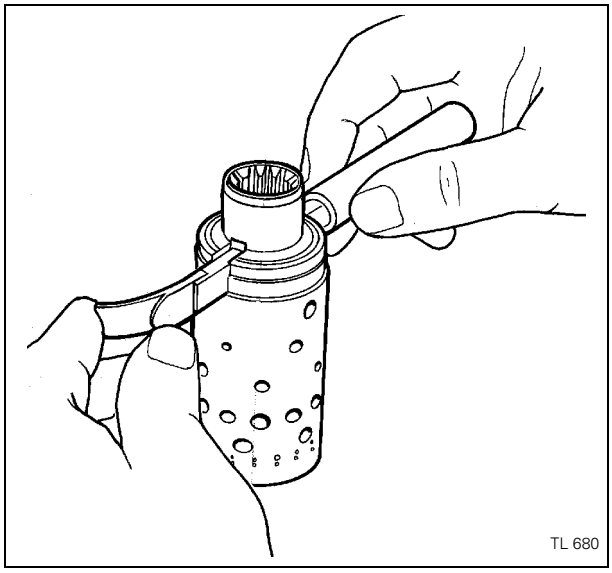
23. The springs are placed in the order shown in the illustration.


TL 3309

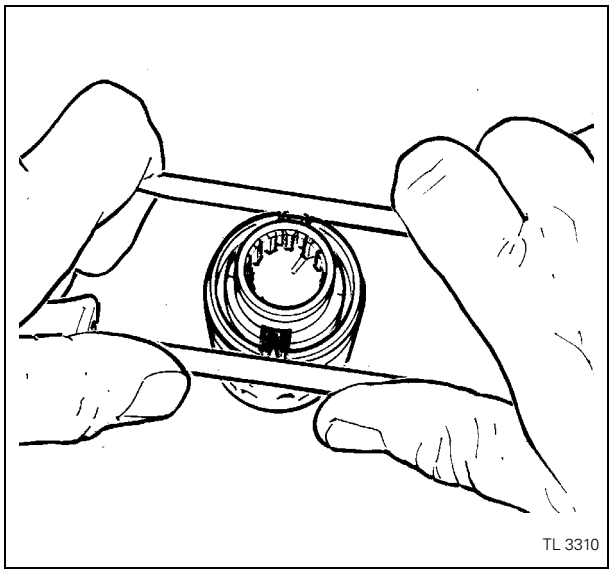
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Tractor Manuals Scotland

24. Press all the neutral position springs together into place, using the tool as a guide, remove the assembly tool.

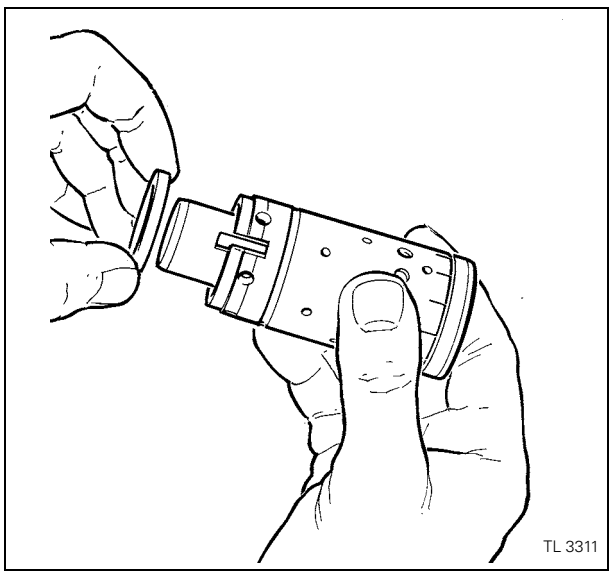


25. Line-up the springs and centre them.



26. Guide the ring down over the sleeve.

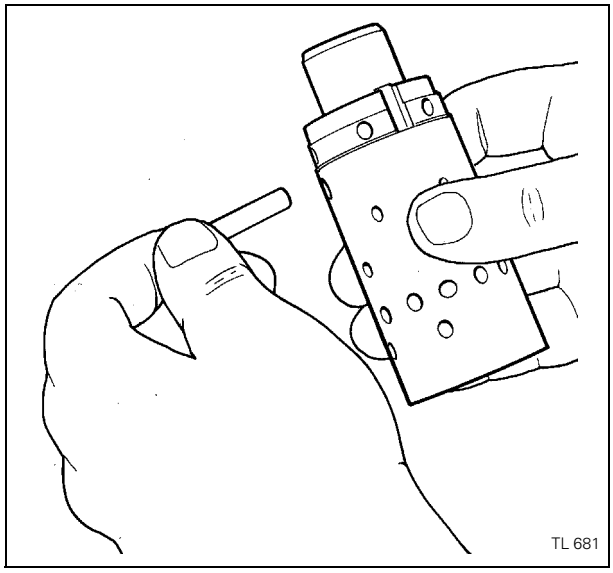
NOTE: *The ring should be able to rotate free of the springs.*



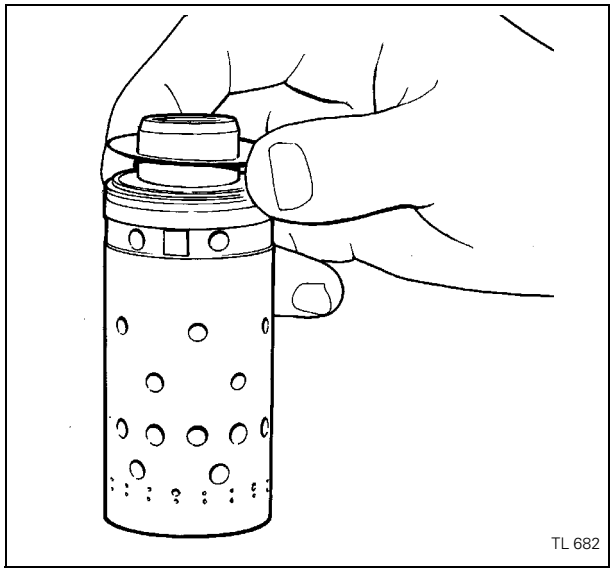
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27. Insert the cross pin.



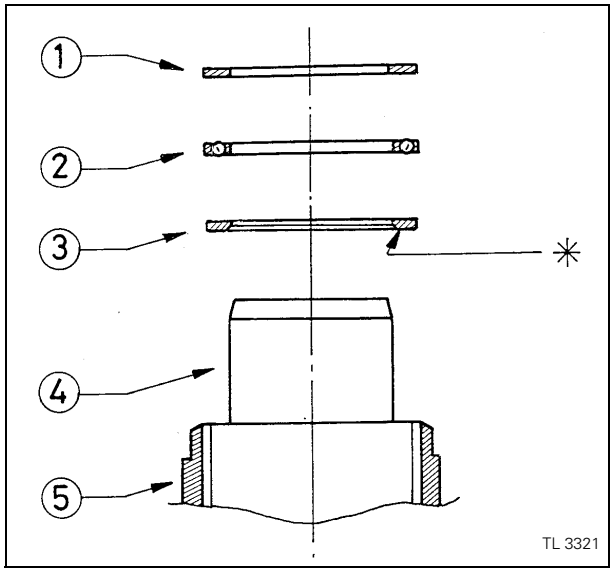
28. Fit the bearing races and needle bearing as shown in the illustration.



* The inside chamfer on the inner bearing race must face the inner spool.

Assembly pattern:

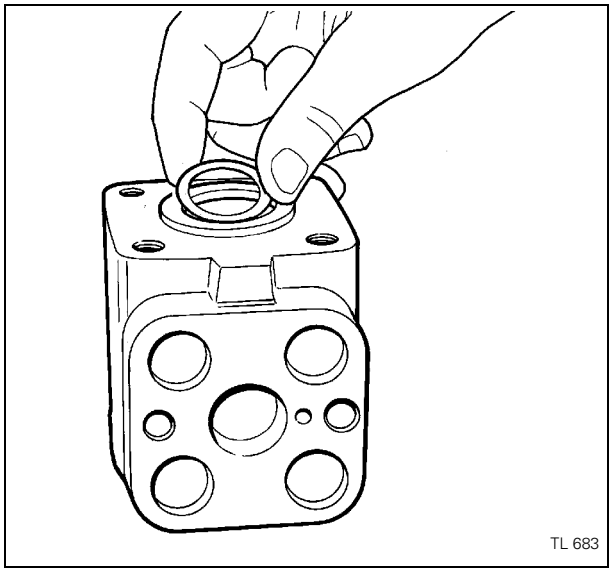
1. Outer bearing race
2. Needle bearing
3. Inner bearing race
4. Spool
5. Sleeve



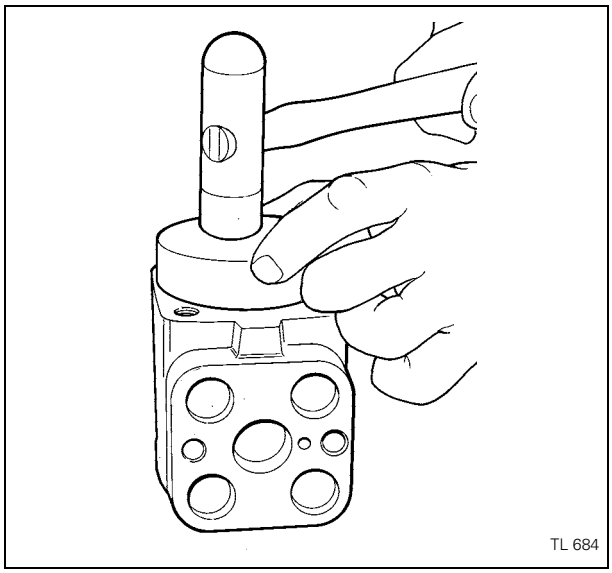
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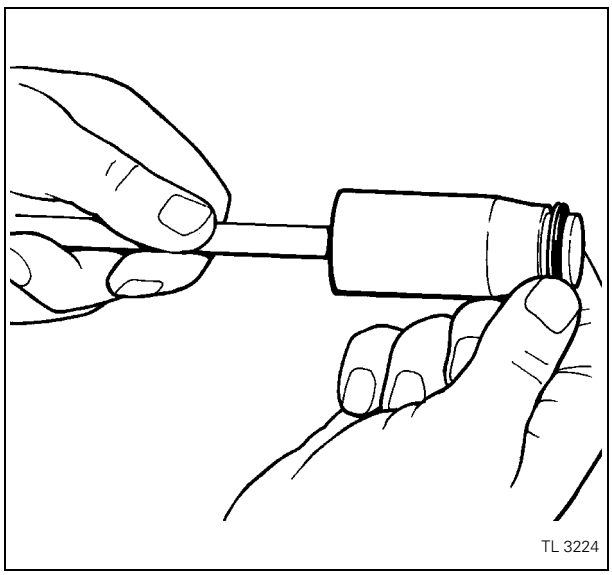
29. Place the dust seal in the groove of the housing.


TL 683

30. Place a flat steel block over the seal, and hammering it lightly to drive it into place.


TL 684

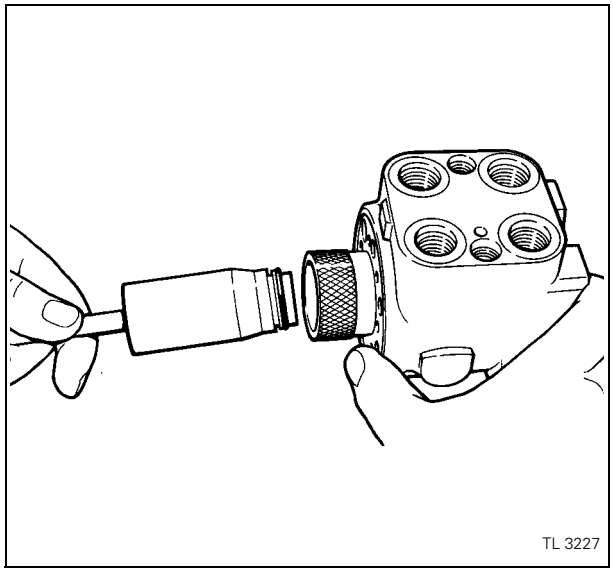
31. Using special tool MS.1667 Shaft Seal Fitting Tool, lubricate the seal ring with hydraulic oil and place it on the white plastic guide.


TL 3224

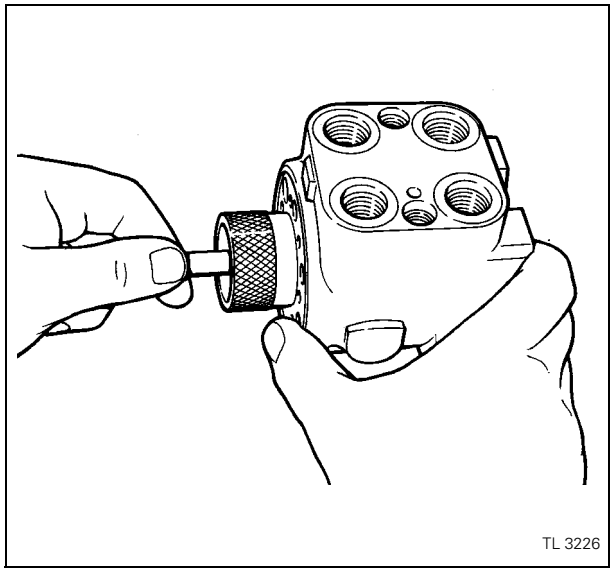
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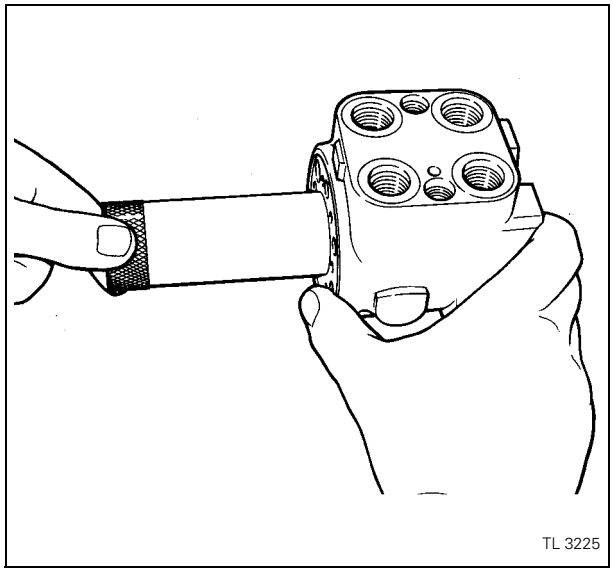
32. Slide the outer part of the tool to the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.


TL 3227

33. Press and turn the seal ring in the bottom of the housing.


TL 3226

34. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide in the inner part in the bore.

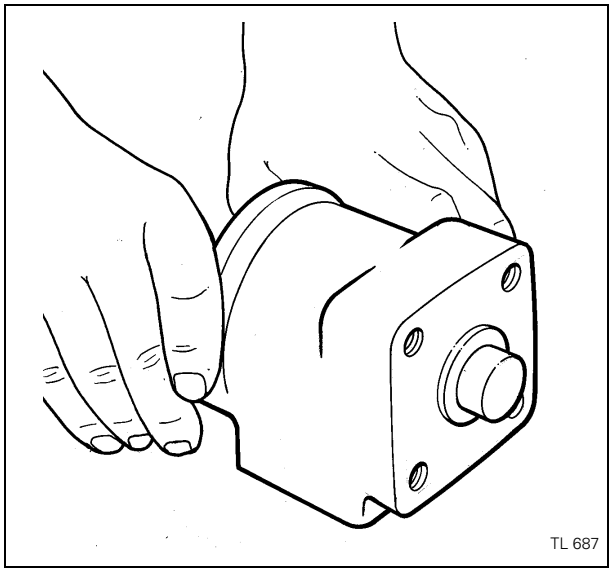

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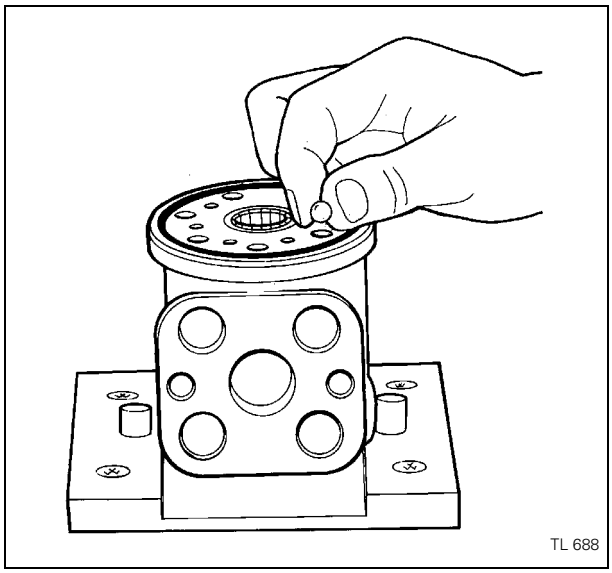
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NOTE: *Fit the spool set holding the cross pin horizontal.*

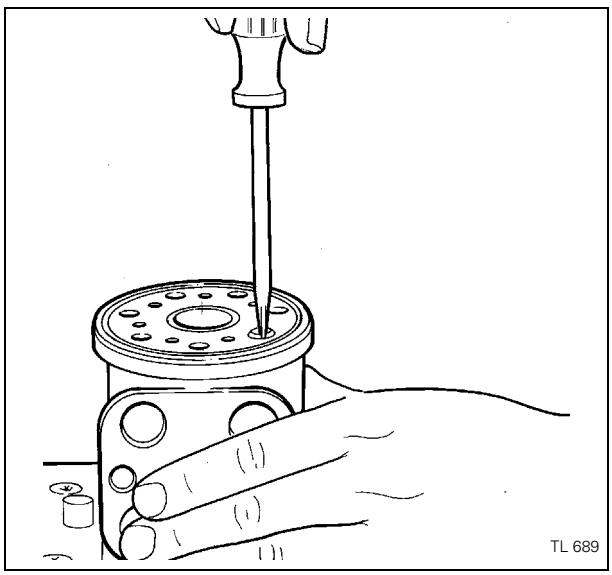
35. With a light turning movement, guide the spool and sleeve into the bore.
36. Push the spool and sleeve assembly so that it ejects the white plastic guide leaving the 'O' ring in place.


TL 687

37. Place the ball check valve in the hole.


TL 688

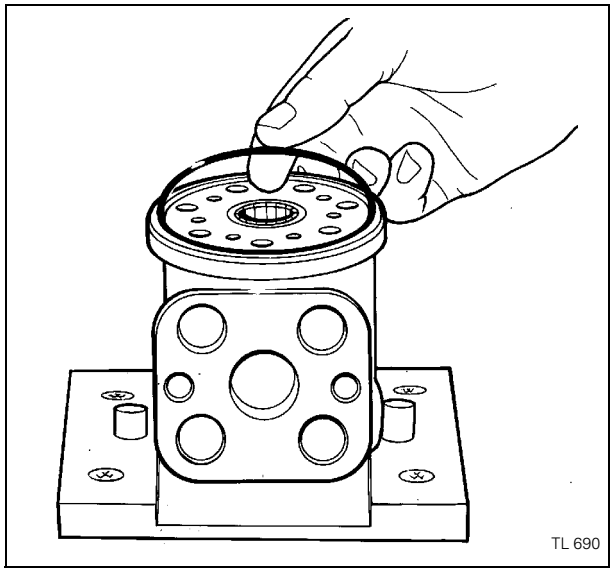
38. Lightly screw in the threaded bushing in the check valve bore. The top of the bush must lie just below the surface of the housing.


TL 689

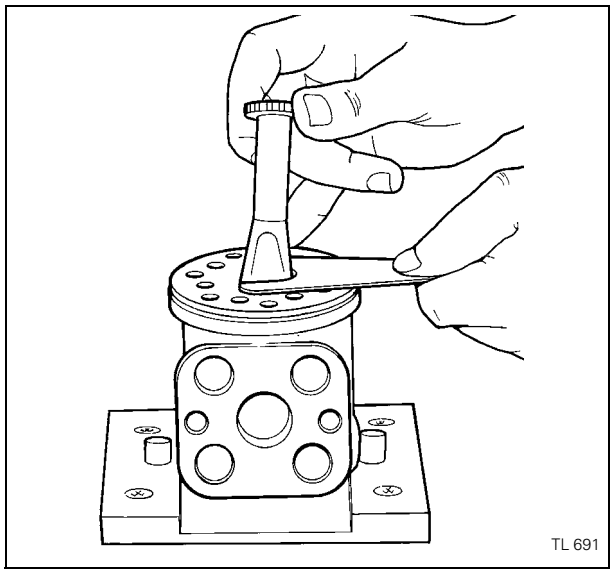
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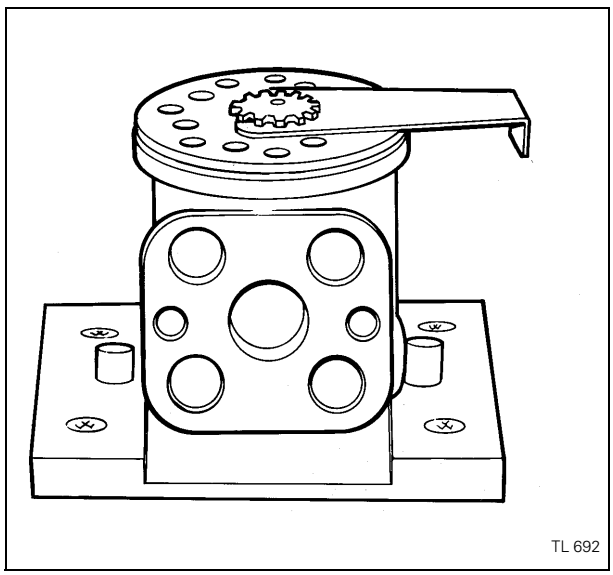
39. Lubricate the 'O' ring with petroleum jelly and place it in its groove.
40. Place the distributor plate so that the channel holes match the holes in the housing.


TL 690

41. Fit the drive shaft down into the bore so that the slot is parallel with the connection flange.


TL 691

42. Position the drive shaft as shown, make up a thin mounting fork as shown to hold it in position.
43. Grease the two 'O' rings with petroleum jelly and place them in the two grooves in the stator. Fit the rotor and stator to the drive shaft.

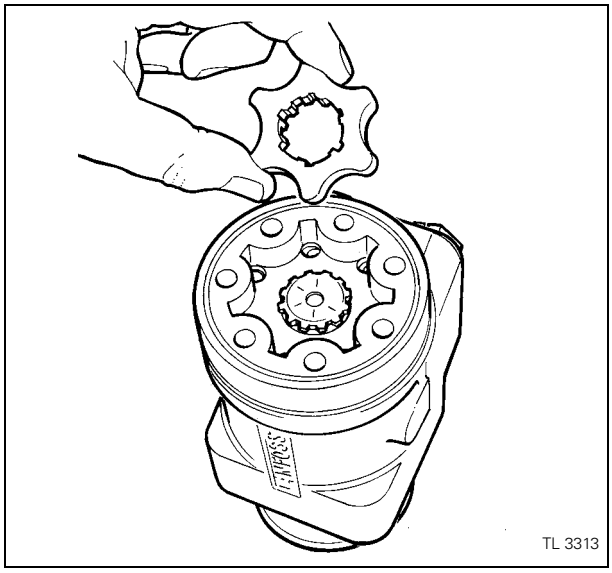

TL 692

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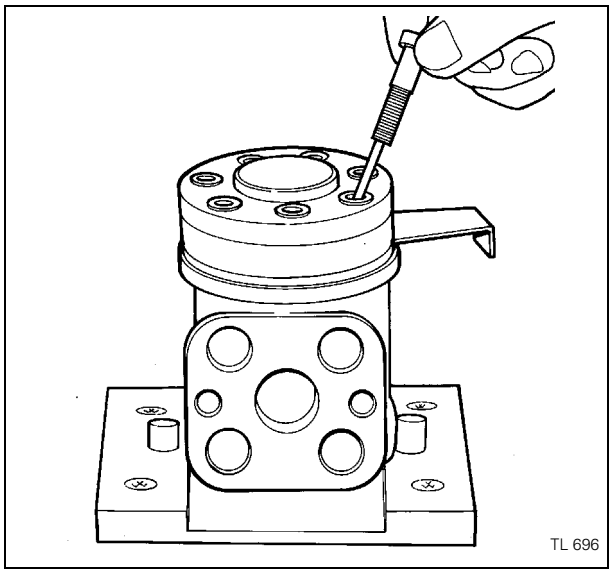
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NOTE: *The rotor and the drive shaft can only be assembled in one position, check the splines on the shaft and in the rotor.*

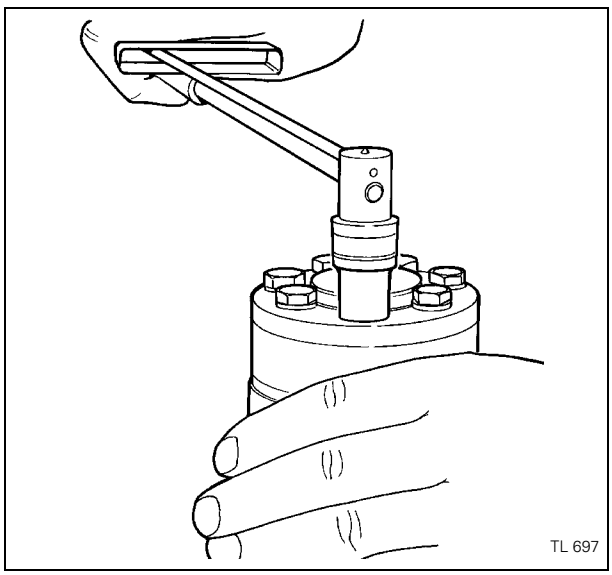
44. Turn the rim of the stator in such a way that the seven holes for the bolts match corresponding seven holes in the housing.
45. Fit the end cover (3).


TL 3313

46. Fit to the special bolt (with pin) and washer, screw it into the hole with the threaded bushing and check valve ball.


TL 696

47. Put the washers on the remaining six bolts and fit them. Withdraw the drive shaft holding tool and tighten the seven bolts to a torque of 30 Nm (25 lbf ft).

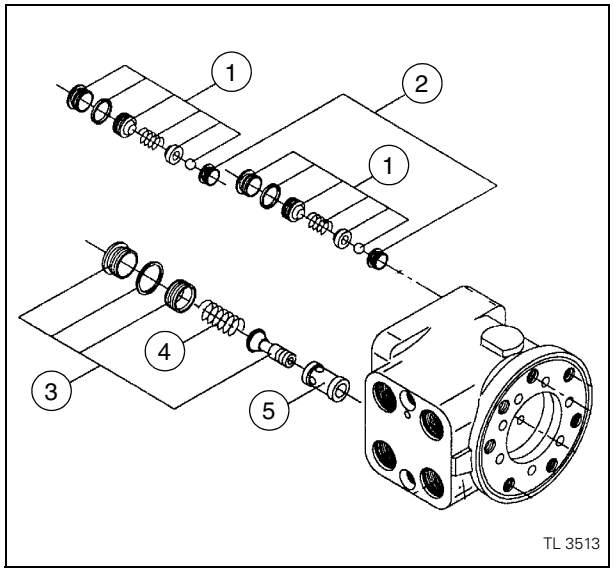

TL 697

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NOTE: *The steering unit is fitted with two shock valves (1) one to each port and a pressure relief valve (3). Massey Ferguson recommend that these valves are not removed from the steering unit. A special hydraulic test bench is required to re-set the valves, they are not accessible when fitted to the tractor. Under certain circumstances adjustment of the pressure relief valve may be required, proceed as follows:*

48. On top of the steering unit port face is the pressure relief valve. Adjustment is effected by removing the 8 mm hexagon plug and sealing washer. To obtain the correct pressure of 140 bar (2030 lbf/in²). Turn the internal 8 mm setting screw inwards to increase or outwards to decrease the pressure setting.
49. Refit the valve cover plug and sealing washer and tighten to a torque of 50 Nm (37 lbf ft).

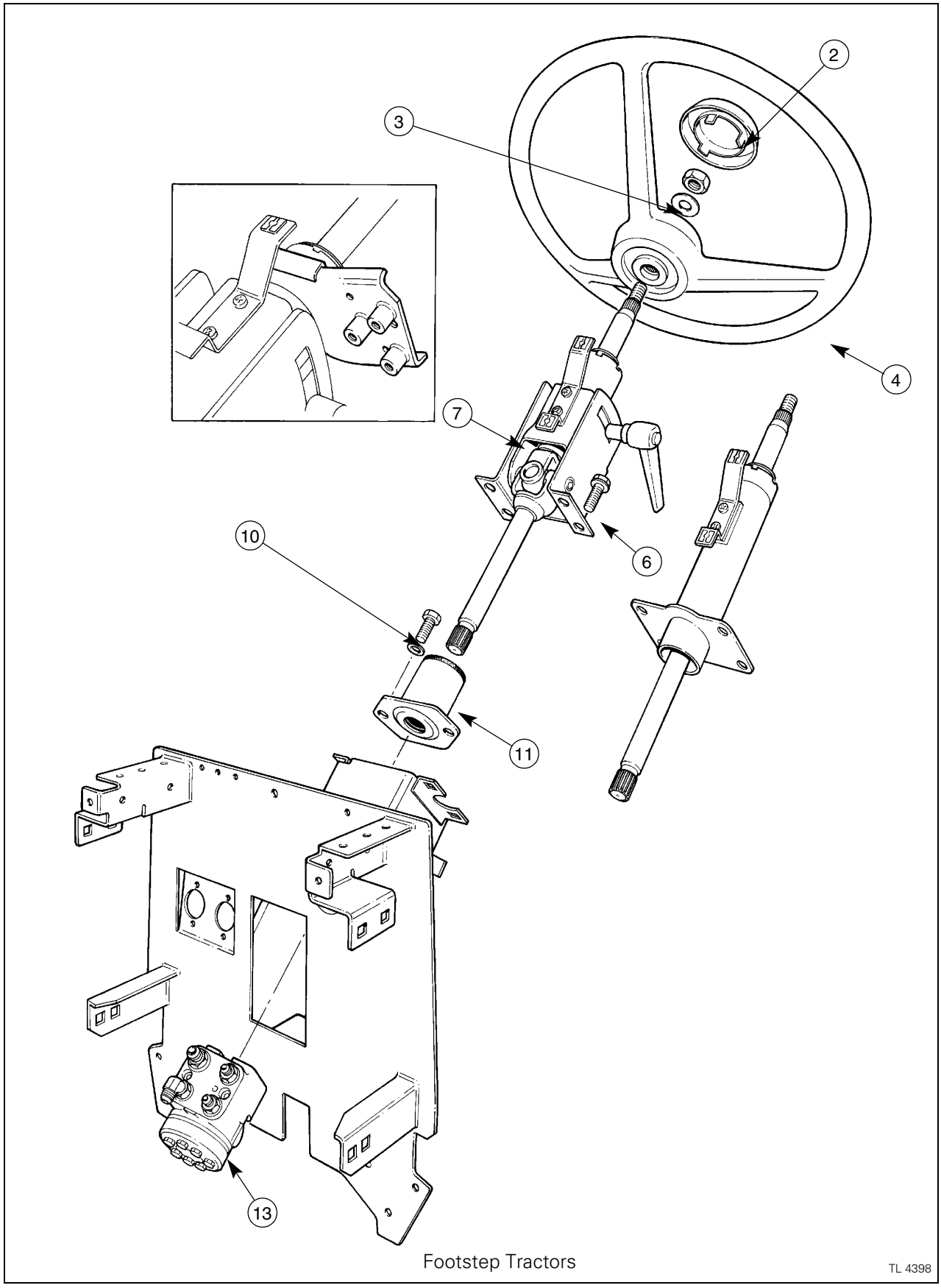


1.Shock valve.
2.Shock valve seat.
3.Pressure relief valve.
4.Pressure relief valve spring.
5.Pressure relief valve seat.

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Hydraulic Steering



Footstep Tractors

TL 4398

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STEERING COLUMN and STEERING UNIT - FOOTSTEP TRACTORS

Removal and Refitment 3-9B

Removal

Steering Column

1. Remove the plastic surround at the top of the steering column.
2. Remove the plastic cap.
3. Remove the steering wheel nut and washer.
4. Remove the steering wheel. A sharp tap with a soft faced hammer will release it from its taper.
5. On Power Shuttle tractors remove the forward/ reverse switch from the support bracket.
6. Remove the four steering column retaining bolts.
7. Remove the column from the tractor.

NOTE: *The steering column assembly is not available in separate parts. If any components fail or are in need of replacement, the whole unit must be replaced.*

Steering Unit

8. Disconnect the steering hoses from the steering unit.
9. Cap the ends of the hoses and the steering unit to prevent the ingress of dirt.
10. Remove the two bolts and washers.
11. Remove the dust seal.
12. Remove the two bolts and washers.
13. Remove the steering unit from the front of the bulkhead.

Refitment

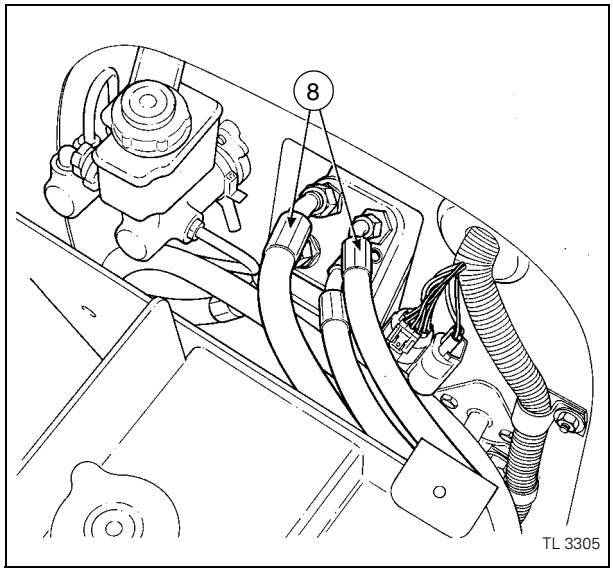
14. Reverse procedures 1 to 13 except:
    a. Tighten the four steering unit bolts to a torque of 22 Nm (16 lbf ft).

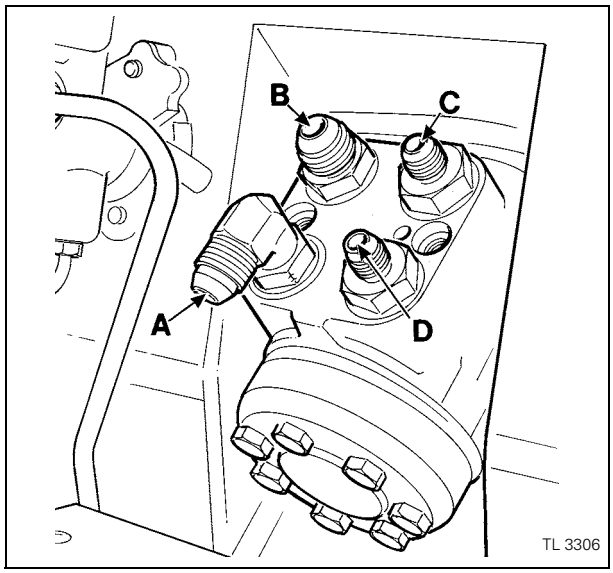
CAUTION: *When installing the steering column ensure that the splines of the shaft are correctly located in the steering unit before tightening the steering column bolts i.e. the steering column flanges should be flush with the bulkhead.*

b. Tighten the steering column bolts to a torque of 35 Nm (25 lbf ft).

c. Tighten the steering wheel nut to a torque of 40 Nm (30 lbf ft).

d. Ensure that the two metal clips are in place on the plastic cap (2), replace the cap.





e. Ensure that the hydraulic hoses are fitted to their original positions on the steering unit. The connections are as follows:

A - From steering pump.

B - Return to transmission.

C - To steering cylinder - Left.

D - To steering cylinder - Right.

Start-up Procedure

IMPORTANT: *The steering unit will not tolerate dirt ingress under operational conditions. It is necessary to flush the system to remove any impurities after a new or repaired steering unit has been fitted as follows:*

15. After installation, start the engine and under NO circumstance turn the steering wheel for 10 minutes.
16. Run the engine at a good throttle opening to ensure a high flow of hydraulic oil through the steering unit, filter and associated pipe work to effect a good flushing action.

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17. Commence the steering action after 10 minutes warm-up taking the steering wheel to full lock in each direction. Complete at least 10 operations of the steering wheel to ensure the cylinder and cylinder lines are flushed.
18. A further two operations should then be undertaken taking the steering cylinder to its fullest extent and holding the steering wheel a full minute in this position so that flow occurs under full relief valve pressure.
19. On completion, check the steering wheel takes up the neutral position, check that the steering wheel neither moves to the left or right in the hands-off position.

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Auxiliary Hydraulics

Section 9 - Part C

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Auxiliary Hydraulics

SPECIFICATION

Pump Type	Dual element gear type.
Location	Right-hand side of rear axle housing.
Make	Bosch (Sunstrand fitted to early tractors).
Drive	Chain drive from PTO clutch housing.

Test Data

Steering section:	
Pump flow at 140 bar, 2000 engine rev/min:	
New pump	25 litre/min (5.5 gal/min)(6.6 US gal/min).
Minimum	18 litre/min (4 gal/min)(4.8 US gal/min).
Pressure at 1200/1250 engine rev/min	130-150 bar (1886-2176 lbf/in²).
Pressure relief valve location	Built in the steering unit.
Cross line relief valve setting	196-220 bar (2842-3191 lbf/in²).
Cross line relief valve location	Built in the steering unit.
Auxiliary section:	
Pump flow at 140 bar, 2000 engine rev/min:	
New pump	34 litre/min (7.5 gal/min)(9 US gal/min).
Minimum	27 litre/min (5.9 gal/min)(7.1 US gal/min).
Pressure at 1200/1250 engine rev/min (At quick release coupling)	200-220 bar (2900-3190 lbf/in^2).
Pressure relief valve location	Manifold block, right-hand side of rear axle housing.
Pressure maintaining valve (PMV):	
Pressure setting at 1200/1250 engine rev/min	22-24 bar (319-348 lbf/in²).
Warning light pressure switch:	
Open	18 bar (260 lbf/in²) maximum.
Closed	14 bar (210 lbf/in²) maximum.
Pressure maintaining valve location	Manifold block, right-hand side of rear axle housing.
Back pressure valve:	
Pressure setting at 1200/1250 engine rev/min	5,5-6 bar (80-87 lbf/in²).
Back pressure valve location	Manifold block, right-hand side of rear axle housing.
Oil strainer:	
Type	100 micron washable.
Location	Right-hand side of rear axle housing.
Centrifugal oil filter:	
Type	Centrifugal washable.
Location	Manifold block, right-hand side of rear axle housing.
System pressures at 1200/1250 engine rev/min:	
Four-wheel drive	22-24 bar (319-348 lbf/in²).
Shiftable PTO (pressure at side cover test point) (Pressure 2 bar less than PMV)	20-22 bar (290-319 lbf/in²).
Differential lock	22-24 bar (319-348 lbf/in²).
18 x 6 Speedshift gearbox	22-24 bar (319-348 lbf/in²).

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Auxiliary hydraulic control valves:	
Make	Kontak.
Type	Open centre.
Number of sections	1, 2, 3 or 4.
Type of sections available	Spring return to neutral. Detented with pressure kick-out. Detent with kickout plus float. Motor.
Kick-out pressure setting	172 bar (2500 lbf/in²).
Combined Flow at quick release coupling at 2000 engine rev/min, 140 bar (2031 lbf/in²) pressure:	
Combined flow 540 PTO (single speed)	49 litre/min (10.7 gal/min)(12.9 US gal/min).
Combined flow 540/540E PTO	53 litre/min (11.6 gal/min)(13.9 US gal/min).
Combined flow 540/1000 PTO	58 litre/min (12.8 gal/min)(15.3 US gal/min).
Pressure at quick release coupling with combined flow at 1200 engine rev/min	200-220 bar (2900-3190 lbf/in²) maximum.
Trailer brake valve:	
Make	Bosch.
Ratio	4:1.
Piston diameter	12 mm.
Location	Right-hand axle housing.
Oil supply	First priority from auxiliary pump.
Maximum pressure to brakes	135 bar (1960 lbf/in²).
Maximum oil flow to trailer brake	15 litre/min (3.3 gal/min)(4 US gal/min).

Special Tools:

MF.508	Pump drive sprocket remover.
MF.510	Back pressure test adaptor.
MF.3001A	Hydraulic pressure test kit.
MF.3002	Hydraulic flow meter hose kit.
MF.3003	Hydraulic flow meter.
MF.3011	PTO hydraulic test point.

Bolt Torques:

Hydraulic pump drive housing to rear axle casing	60 Nm (45 lbf ft).
Hydraulic pump to drive housing	60 Nm (45 lbf ft).
Strainer housing to rear axle casing	60 Nm (45 lbf ft).
Auxiliary system manifold	60 Nm (45 lbf ft).
Centrifugal filter central bolt	16 Nm (12 lbf ft).
Hydraulic pump body bolts	60 Nm (45 lbf ft).
Hydraulic control valve tie rods	20 Nm (15 lbf ft).
Hydraulic control valve screws	7 Nm (5 lbf ft).
Control valve tie rod nuts	20 Nm (15 lbf ft).
Control valve change over valve	22 Nm (17 lbf ft).
Control valve shoulder screw	7 Nm (5 lbf ft).
Control valve seal plate screws	7 Nm (5 lbf ft).
Solenoid valve body	10 Nm (7 lbf ft).
Solenoid valve coil	Finger tight.
Speedshift control valve bolts	60 Nm (45 lbf ft).

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Auxiliary Hydraulics

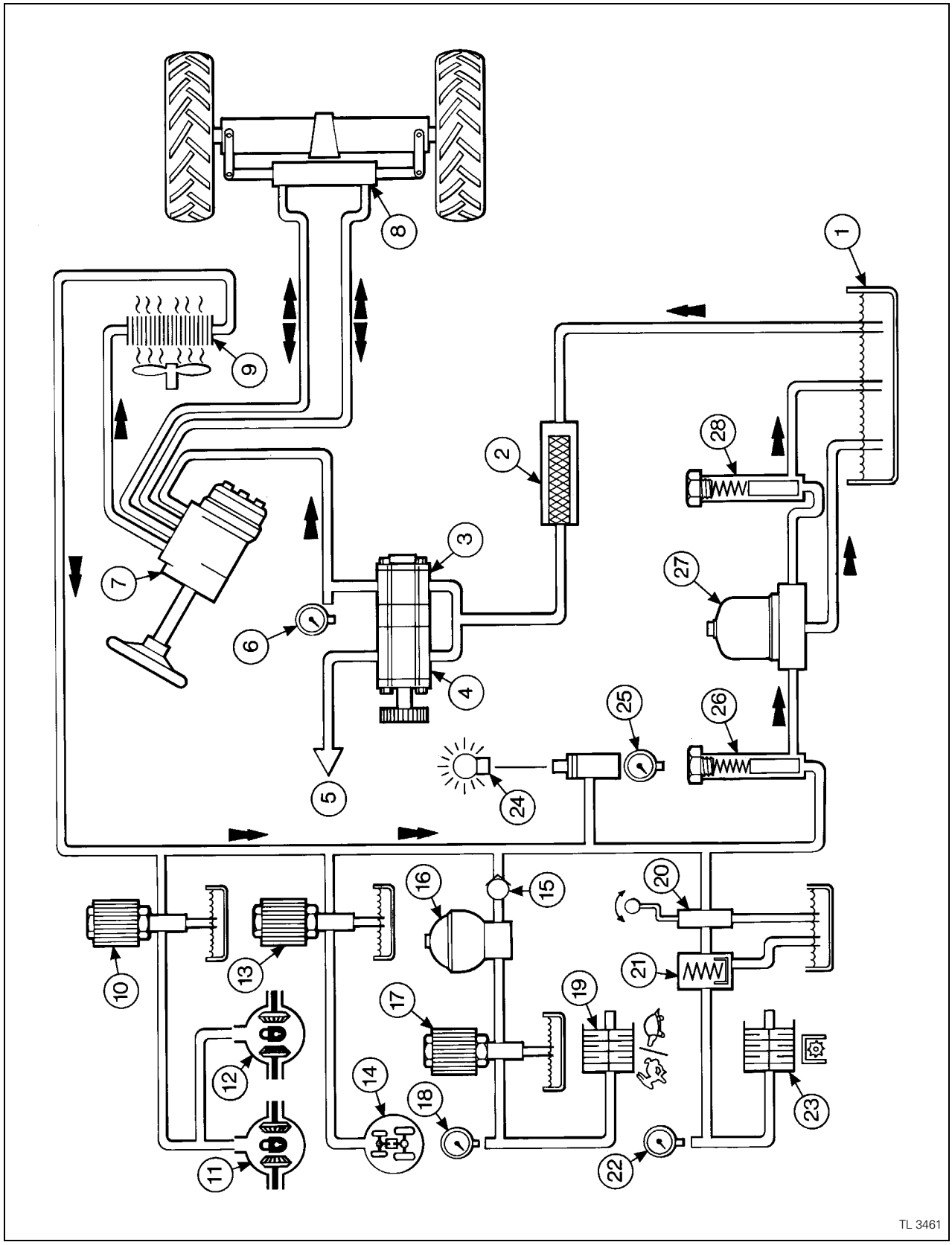


Fig.1 Steering and Auxiliary Hydraulic Circuit

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GENERAL DESCRIPTION

The auxiliary hydraulic system is in two parts, steering and auxiliary. A dual element gear type pump is mounted externally on the right-hand side of the rear axle casing. The schematic diagram (Fig.1) shows the oil flow through all the circuits.

Key to Fig.1 - Steering and Auxiliary Hydraulic Circuit

1. Transmission case - oil reservoir.
2. Oil strainer.
3. Hydraulic pump - steering section.
4. Hydraulic pump - auxiliary section.
5. Supply to auxiliary control valve.
6. Hydraulic test point - steering.
7. Steering unit.
8. Steering cylinder.
9. Oil cooler, if fitted.
10. Differential lock solenoid valve.
11. Front axle differential lock.
12. Rear axle differential lock.
13. Four-wheel drive solenoid valve.
14. Four-wheel drive clutch.
15. Speedshift non-return valve
16. Speedshift accumulator.
17. Speedshift solenoid valve.
18. Hydraulic test point - Speedshift.
19. Speedshift clutch.
20. PTO control valve.
21. PTO modulating valve.
22. Hydraulic test point - PTO
23. PTO clutch.
24. Low hydraulic oil pressure warning light.
25. Hydraulic test point - pressure maintaining valve
26. Pressure maintaining valve.
27. Centrifugal filter.
28. Back pressure valve.

The steering pump circuit provides oil to the following services:

- Steering.
- Power take-off.
- Four-wheel drive engagement.
- Differential lock engagement.
- Speedshift engagement.

The auxiliary section of the pump provides oil to the following services:

- Auxiliary control valve.
- Trailer brake valve.

Dual Element Hydraulic Pump

The dual element hydraulic pump is mounted on a housing on the right-hand side of the rear axle casing replacing the right-hand side cover. The pump is driven by an inverted tooth chain drive from a sprocket built-in to the power take-off (PTO) clutch housing. The PTO, clutch housing and pump are driven all the time the engine is running.

Because there are three different PTO shaft speeds in the transmission, depending on the type of PTO fitted, the size of the pump varies so that the hydraulic output in litre/min is identical on all models of tractor.

The three PTO's, transmission speed and output are as follows:

- 540 Single speed PTO - low speed, high output pump.
- 540/540E PTO - medium speed, medium output pump.
- 540/1000 PTO - high speed, low output pump.

The gearbox and rear axle housing form a common reservoir for all the hydraulic services, one grade of oil being used throughout for simplified maintenance.

The hydraulic pumps receive oil from the transmission through a 100 micron in-line strainer to a common port on the pump which feeds both sections of the pump through an internal port.

STEERING CIRCUIT

The steering pump section provides oil at 30 litre/min direct to the steering unit. The steering unit takes priority over all other circuits and contains its own pressure relief valve set at 140 bar. When the steering is employed, a proportion of the oil is diverted to the steering ram. Excess oil not required for steering passes through an oil cooler (optional) to the pressure maintaining valve in the manifold block.

Steering Unit

The tractor is fitted with an open centre hydrostatic steering unit. Hydrostatic steering is a full power steering system with no mechanical connection between the steering wheel and the road wheels.

The steering unit controls the amount of oil supplied to either side of the steering cylinder depending on the direction and the amount of rotation of the steering wheel. Further details on the operation of the steering unit will be found in the Steering Section page 9B-2.

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Manifold Block

The manifold block (1, Fig.2) is mounted on the right-hand side of the rear axle casing over the right-hand side cover aperture. It receives oil direct from the steering unit via an oil cooler, if fitted. It contains the following components:

- Pressure maintaining valve.
- Four-wheel drive and differential lock solenoids.
- Centrifugal filter.
- Back-up pressure regulating valve.
- Low pressure maintaining valve oil warning light switch.
- Auxiliary hydraulic pressure relief valve.

Pressure Maintaining Valve

The Pressure Maintaining Valve (PMV) (2, Fig.2) is situated in the back of the manifold block. It comprises of a spring loaded piston which remains seated until the required pressure of 23 bar is reached. The PMV supplies the differential lock and four-wheel drive through two electrically operated solenoid valves. The PTO and Speedshift gearbox are supplied by external piping to their own control valves.

The circuit is provided with a pressure switch and warning light on the instrument panel which will illuminate when the pressure falls below 16 bar. A test port is provided to determine the PMV pressure setting.

Four-wheel Drive and Differential Lock

These two circuits are controlled by two solenoid valves screwed into the front of the manifold block (3, Fig.2) four-wheel drive and (4, Fig.2) Differential lock, controlled by switches on the right-hand console. The oil pressure regulated by the PMV at 23 bar is supplied to each solenoid. The solenoid valves are normally closed, requiring power to operate the circuit. When closed, return oil is discharged to the transmission case.

The four-wheel drive is normally engaged, to give four wheel braking when operating or standing still. Operation of the solenoid disconnects the drive to the front axle. Operation of the foot brake or parking brake will also disconnect the electrical supply to the solenoid, engaging four-wheel drive, overriding any switch position.

Centrifugal Filter

The centrifugal filter (5, Fig.2) is built-in to the top of the manifold block and consists of an outer casing cover (1, Fig.3) and a central spindle (2) around which a rotor (3) spins at high speed.

Oil at 6 bar pressure enters the centrifuge body and continues to the cleaning chamber (4) of the rotor via the centre spindle. Having passed through the cleaning chamber, the oil exits at the base of the rotor via two tangentially opposed nozzles (5). The oil exiting from the nozzles causes the rotor to spin at high speed.

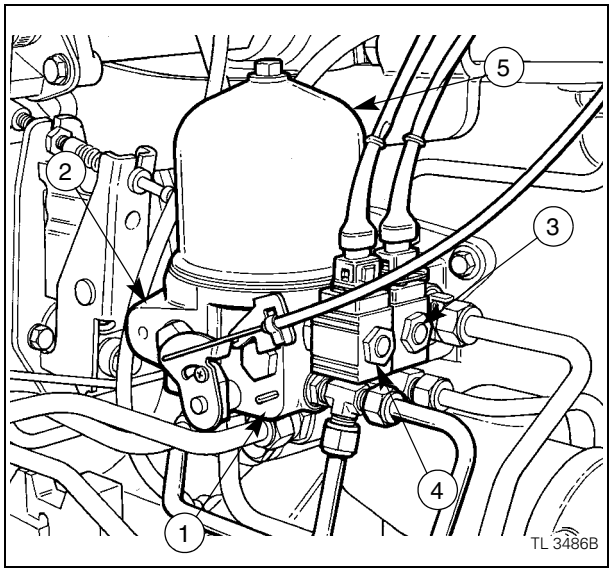


Fig.2

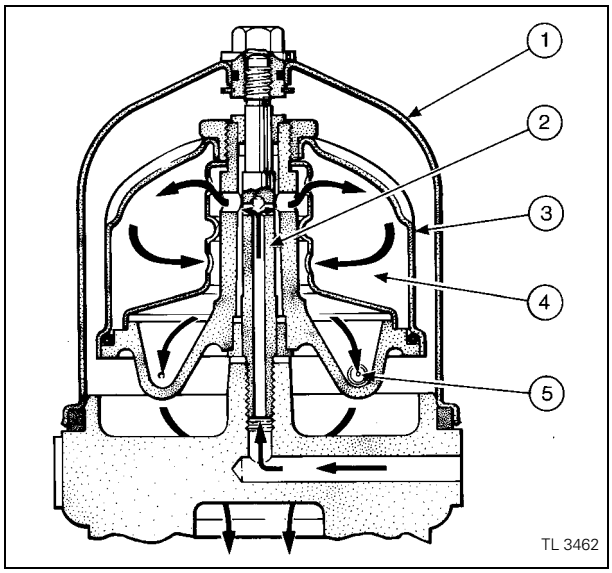


Fig.3

The resultant centrifugal force causes particles of contaminant to migrate outwards where they form a dense 'cake' on the inner wall of the rotor. The compacted dirt may be removed simply with a spatula and wash clean easily.

The centrifuge collects the tiny sub-micron particles present in a hydraulic system and isolates them to give greater protection than the normal by-pass filter. In addition, unlike conventional by-pass filters does not become blocked and provides additional protection.

The centrifuge filters oil at the rate of 5 litre/min, the excess oil passes through a 6 bar back-up pressure regulating valve to the transmission. The pressure back-up regulating valve ensures that there is hydraulic oil pressure to drive the rotor.

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Speedshift Gearbox

This circuit takes its oil supply from the main manifold block to a secondary manifold mounted on the side of the lift cover on the left-hand side of the tractor (Fig.4). This manifold comprises of the following components:

- Speedshift solenoid (1).
- Speedshift hydraulic accumulator (2).
- Non return valve (3).

The oil supply flows through a simple spring-loaded, ball-type, check valve into a gallery between the check valve and solenoid valve. Into this gallery is connected a hydraulic accumulator which holds a reserve of hydraulic pressure should the speed shift be operated when the pressure on the other side of the check valve is low. This low pressure could be due to the simultaneous operation of another service; for example, engagement of the differential lock. This reserve of hydraulic power ensures correct operation of the clutch, reduced slippage and smooth operation.

The speedshift clutch is normally in 'Fast' speed and is pressurised into 'Slow' speed. When the clutch is de-pressurised the oil behind the clutch piston is exhausted through the solenoid valve and back into the transmission case through an internal port in the manifold.

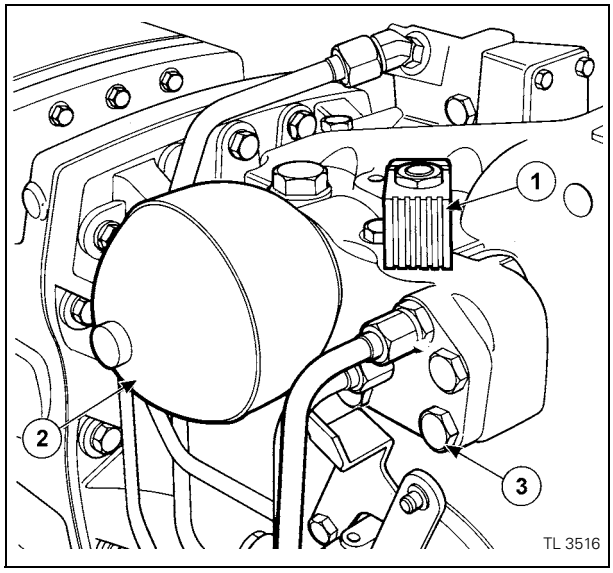


Fig.4

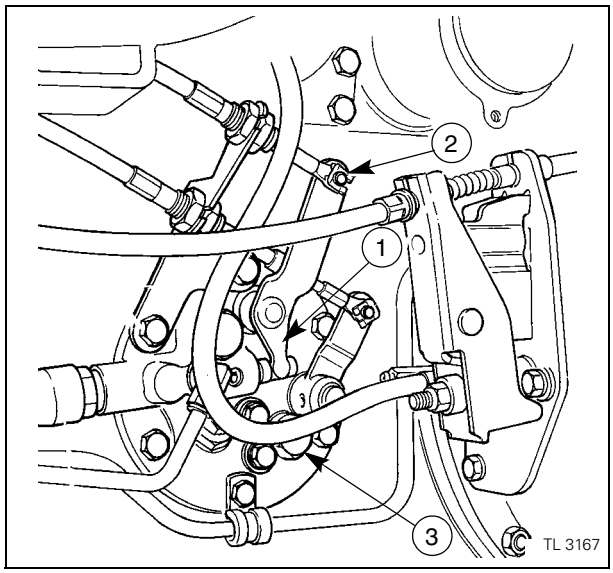


Fig.5

Power Take-off

The Power Take-off (PTO), similar to the Speedshift, takes its oil supply from the gallery in the manifold block regulated at 23 bar.

Rotation of the PTO shaft is controlled by a hydraulic clutch, engaged by pressurising the clutch. A spool type control valve is located on the outside of the left-hand side cover (1, Fig.5), has two positions, engaged and disengaged, selected by the driver. Moving the lever (2) to the engaged position allows the control valve to direct oil into the back of piston, overcome the pressure of the return spring and engage the clutch.

Moving the lever to the disengaged position, the control valve allows oil to return from behind the piston and thereby disengage the clutch. The large return spring located behind the piston ensures a fast return of oil and a rapid disengagement of the clutch. Return oil from behind the piston returns directly through a port to the transmission case.

When the clutch is in the disengaged position, the hydraulic pressure is diverted by the control valve to a brake cylinder, this operates on a brake drum on one of the reduction gears and holds the PTO shaft stationary when not in use.

The rate of engagement of the PTO clutch is controlled by a modulating valve (3), it comprises of two valves mounted in the left-hand side cover. They control the flow of oil into the clutch pack so that the engagement time is approximately 1.5 seconds, this prevents the clutch taking up the drive suddenly which could result in damage to the tractor or implement. The modulating valve also contains a maximum pressure relief valve which is set to relieve any excess pressure build-up and so protect the clutch pack.

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Auxiliary Hydraulics

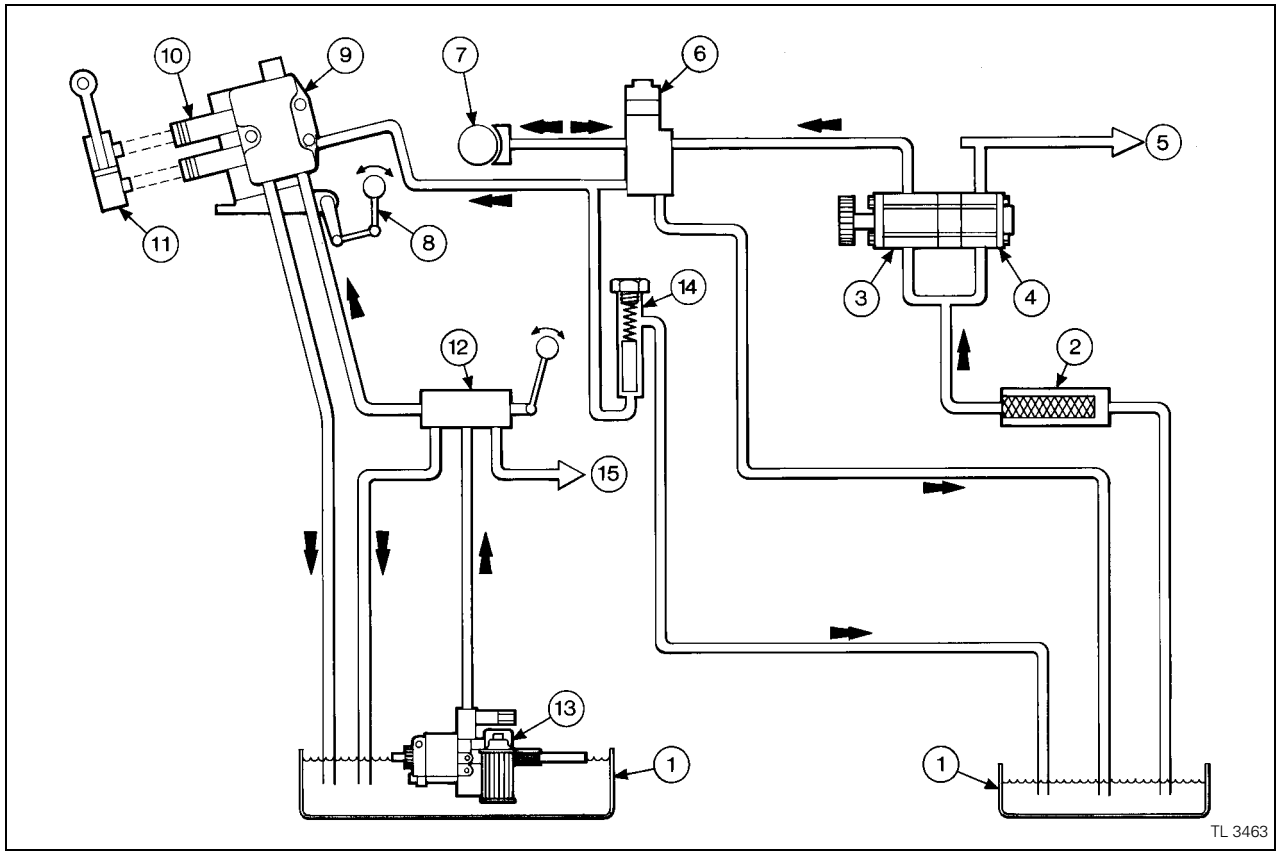


Fig.6 Auxiliary External Hydraulic Circuit

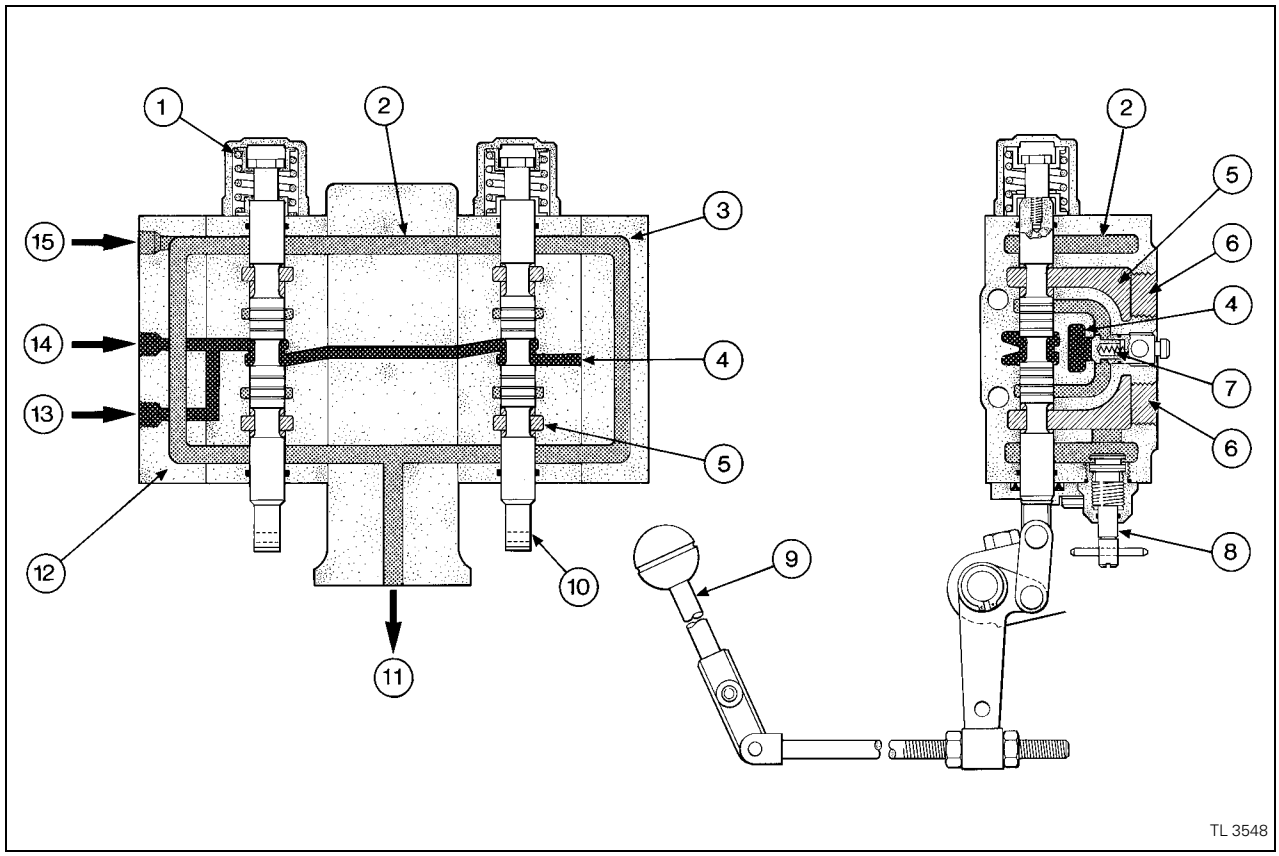


Fig.7 Hydraulic Control Valve

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Key to Fig.6 – Auxiliary External Hydraulic Circuit

1. Transmission case - oil reservoir.
2. Oil strainer.
3. Hydraulic pump - auxiliary section.
4. Hydraulic pump - steering section.
5. Supply to steering section.
6. Trailer brake valve.
7. Trailer brake coupling.
8. Control valve operation lever
9. Auxiliary control valve.
10. Quick release couplings.
11. External hydraulic service.
12. Selector valve to give combined flow.
13. Linkage pump.
14. Auxiliary pressure relief valve.
15. Supply to linkage lift cylinder.

Key to Fig.7 – Hydraulic Control Valve

1. Spool spring return cap.
2. Oil return gallery transmission case.
3. Right-hand end cap.
4. Oil pressure gallery.
5. Gallery to quick release coupling.
6. Screwed connection to quick release coupling.
7. Check valve.
8. Change-over valve.
9. Operator control lever.
10. Control valve spool.
11. Oil return port.
12. Left-hand end cap.
13. Oil supply from linkage pump - combined flow.
14. Oil supply from auxiliary pump.
15. Special port for return oil.

AUXILIARY CIRCUIT

Hydraulic oil at 38 litre/min from the auxiliary section of the dual element pump passes into the manifold block. The oil then passes to the trailer brake valve, when fitted, back to the manifold block and across a pressure relief valve set at 210 bar. then on to the auxiliary control valve mounted on the rear of the tractor. If a combined flow facility is provided, oil from the lift pump can be diverted by the selector valve to the auxiliary system to increase the oil flow by 17-28 litre/min.

Auxiliary Control Valve

The auxiliary control valve is located at the rear of the tractor and is mechanically controlled by levers positioned on the right-hand side of the driver

Four types of control valve can be fitted to the rear of the tractor:

- Three position valve, spring return to neutral.
- Three position valve, pressure kickout to neutral.
- Four position valve, with float and pressure kickout to neutral.
- Three position valve for hydraulic motors.

The tractor can be fitted with any combination of valve types and with any number of valve sections between one and four depending on the requirements of the owner.

All the control valve sections are of the open centre type (Fig.7) and are fitted with a change-over valve (8) situated on the bottom of each valve section to convert from single to double acting. To operate a single acting cylinder the change over valve must be screwed fully out.

A check valve (7) is provided within the valve section on the pressure side from the pump, which will not open until the pump pressure is greater than the line pressure to the cylinder. This prevents an external cylinder from dropping at the moment before lifting. It also prevents the cylinder from dropping if the control valve is moved to the lift position with the engine stopped.

A port (15) on the left-hand side of the valve is provided to give an unrestricted return flow for oil if required; for example, high output motors. This has a thread size of M27 x 2 metric 'O' ring port to ISO 6149. There is a reducing adaptor to 7/8 in-14 JIC male available - part number 3019 698 X91.

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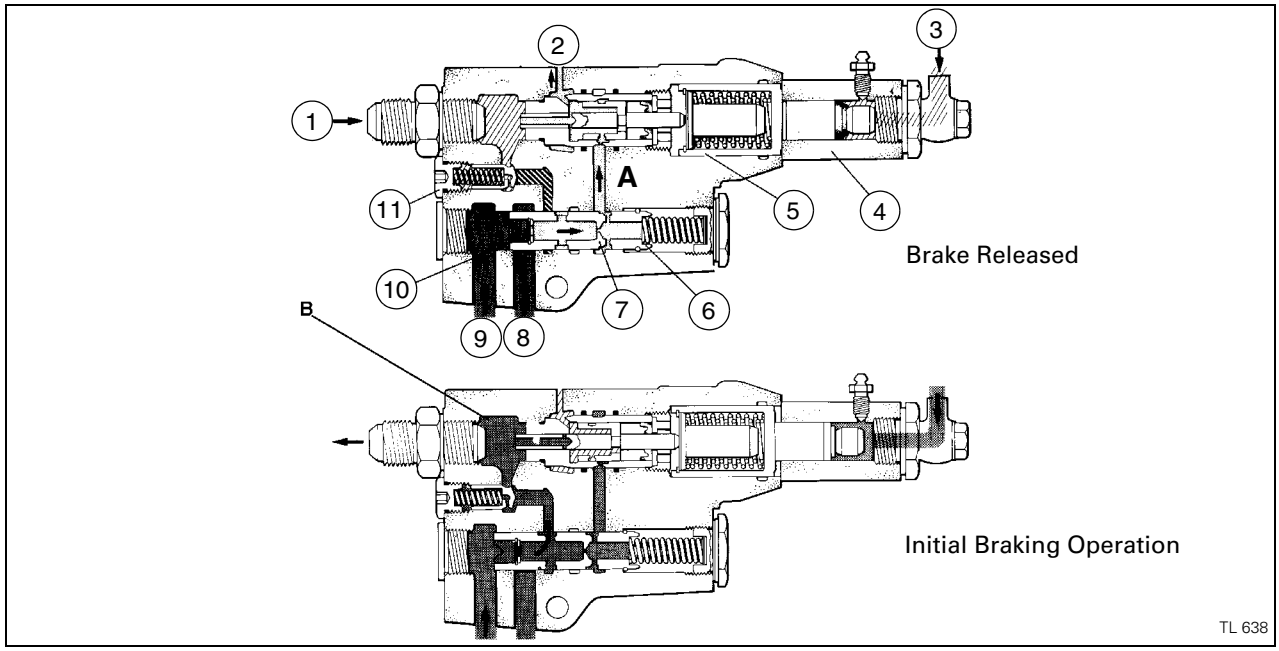


Fig.8 Trailer Brake valve – Released and Operating

1. From trailer brake.
2. Return to transmission case.
3. Sensing line from tractor brake circuit.
4. Control head with servo piston.
5. Pressure relief cartridge.
6. Flow control valve
7. Orifice.
8. Supply to manifold block relief valve.
9. Supply from auxiliary pump.
10. Restrictor.
11. Check valve.

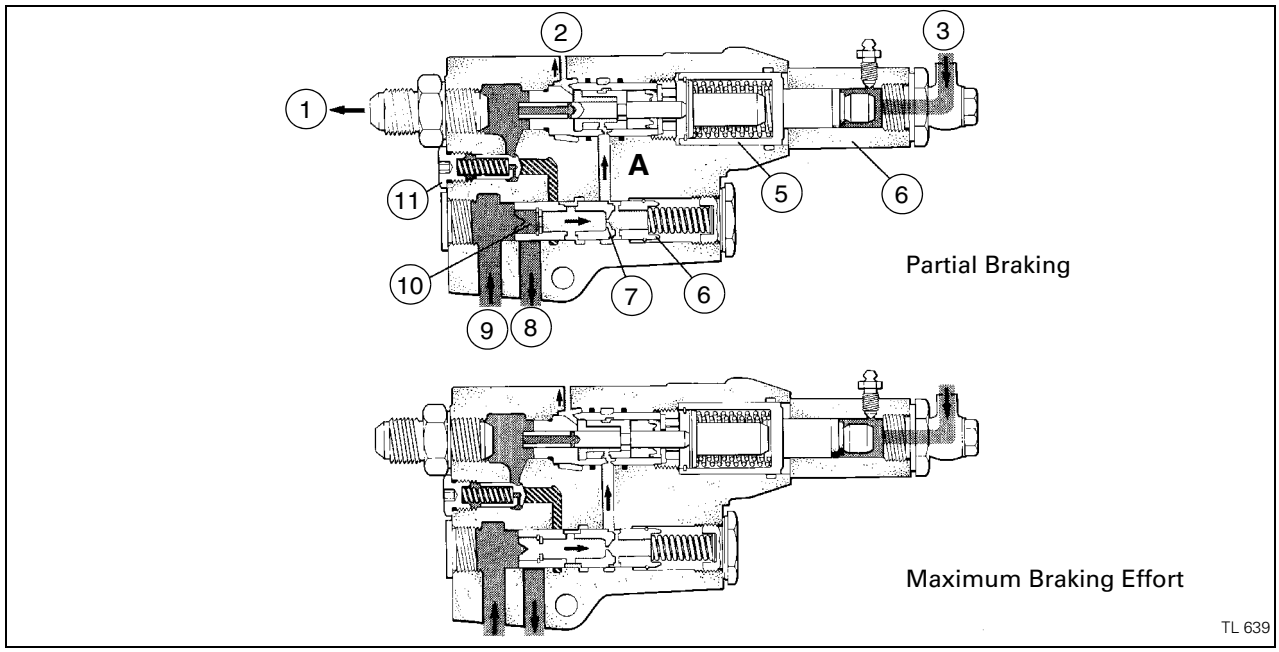


Fig.9 Trailer Brake valve – Partial and Maximum Braking

1. To trailer brake.
2. Return to transmission case.
3. Sensing line from tractor brake circuit.
4. Control head with servo piston.
5. Pressure relief cartridge.
6. Flow control valve.
7. Orifice.
8. Supply to manifold block relief valve.
9. Supply from auxiliary pump.
10. Restrictor.
11. Check valve.

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Trailer Brake Valve

The trailer brake valve is situated between the pump and manifold block, when fitted, it has priority on the oil supply to the auxiliary control valve. The brake valve has the following main components:

- Flow Control Valve - to regulate oil flow to the trailer brake.
- Control Spool - to change the position of the flow control valve and regulate the trailer brake pressure.
- Pressure Relief Cartridge - to limit the maximum brake pressure.
- Control Head and Servo Piston - to operate the control spool via a sensing line from the trailer brake system.
- Check Valve - to prevent back flow of oil from the trailer brake

1. Trailer Brake Released (Fig.8)

When the trailer brake is released pressure is dissipated in the sensing line. Residual pressure in the brake line acts on the head of the control spool to move it to the right allowing brake oil to dump to sump through the spool centre and sleeve. A pilot flow of oil from the pump approximately 0,6 litre/min flows through the restructure, orifice and gallery 'A' to sump. Consequently, there is a pressure drop at the right-hand end of the valve allowing it to be held fully open by the incoming oil so opening the outlet gallery.

2. Initial Brake Operation (Fig.8)

When the brake pedal is depressed slightly, pressure is transmitted through the brake pipe to the control head. The servo piston within the head pushes the control spool to the left isolating the brake return port and gallery 'A' from the reservoir. The flow control valve is now moved to the left by its spring because the pilot oil gallery is blanked off. A metered amount of oil, 15 litre/min is therefore allowed through the restrictor in the valve, past the check valve and out to the trailer brake.

Pressure builds up in the brake line, and acts on the control spool piston surface, 'B'.

3. Partial Braking (Fig.9)

If a moderate pressure is being applied to the pedal, the pressure build-up on the head of the control spool, mentioned in 1, equalises with the sensing line pressure acting on the servo piston. Consequently the spool moves to the right slightly to a position where the brake return port is cut-off and gallery 'A' is open to sump. The flow control valve can now move to the right and ceases to regulate the flow.

4. Maximum Braking Effort (Fig.9)

If the operator applies the brake pedal fully, pressure in the trailer brake line will build-up to a maximum of 100-150 bar. This pressure is controlled by the pressure relief cartridge. If the pressure in the sensing line rises above the maximum, the relief cartridge will be pushed to the left against its springs, without affecting the spool position.

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DIAGNOSIS

The following procedures should be adopted to diagnose faults in the auxiliary hydraulic system. The use of Massey Ferguson test equipment will greatly assist in the speedy diagnosis of faults. The following test kits contain all the necessary fitting to enable entry into the systems:

MF.3001A Pressure Test Kit

This universal hydraulic pressure test kit Fig.10 is supplied in a metal case with a removable lid, complete with four special hydraulic gauges - calibrated in graduations to cover the following ranges:

- 0-10 bar (0-50 lbf/in²).
- 0-35 bar (0-500 lbf/in²) quantity two.
- 0-420 bar (0-6000 lbf/in²).

Two, two metre test hoses and a set of special fittings are supplied to assist in connection into the hydraulic system.

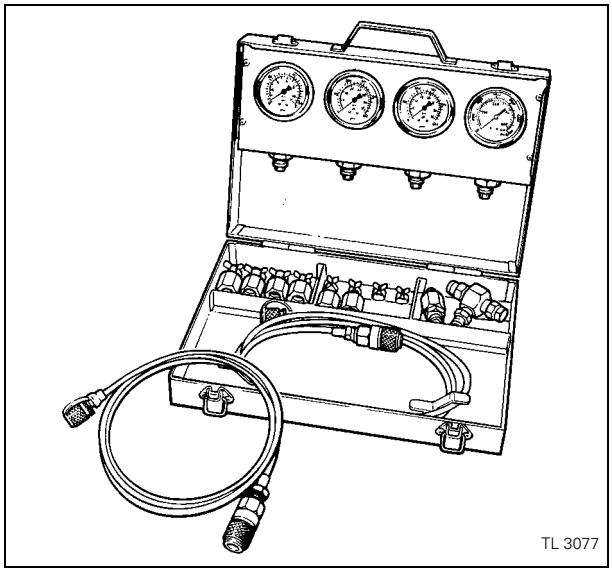


Fig.10

MF.3002 Hose Kit - Use with MF.3003

This hose kit Fig.11 comes with all the hoses and fittings you need to connect the MF.3003 hydraulic flow meter into the relevant circuits to test pump performance.

A metal case is provided for the neat storage of hoses and fittings.

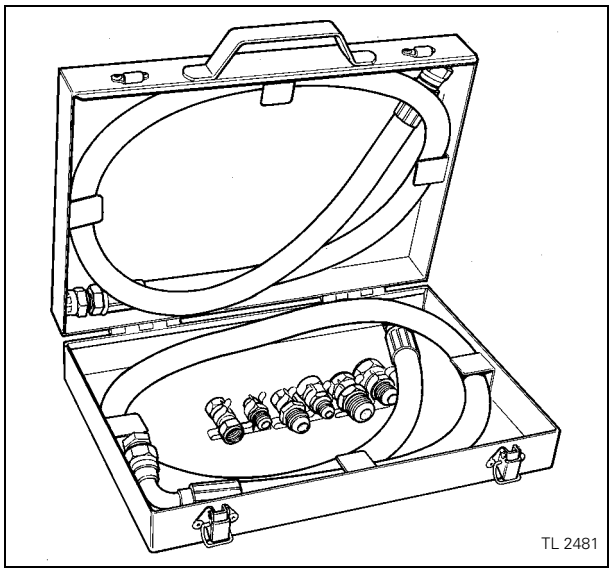


Fig.11

MF.3003 Hydraulic Flow Meter

The hydraulic flow meter Fig.12 is mounted in a strong steel case with a removable lid. It features a direct reading flow meter measuring from 3 to 60 litre/min (0.8 to 14 gal/min), built-in thermometer, loading valve and pressure test point. Hydraulic pressure readings are obtained by connecting the MF.3001A pressure test kit to the pressure test point.

This meter is used with the MF.3002 Hose Kit.

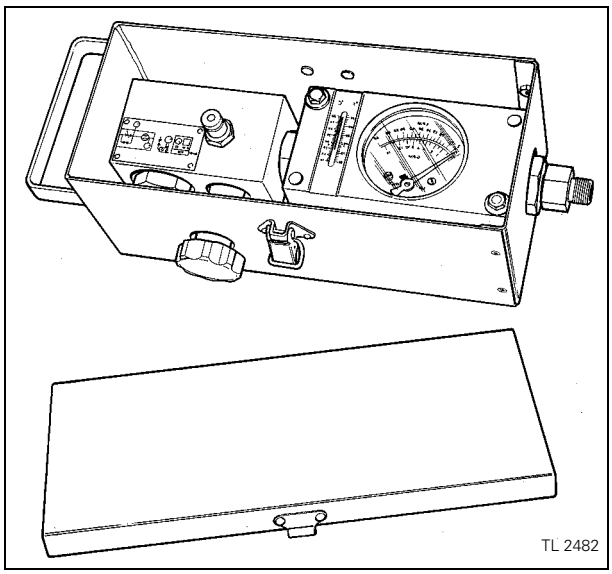
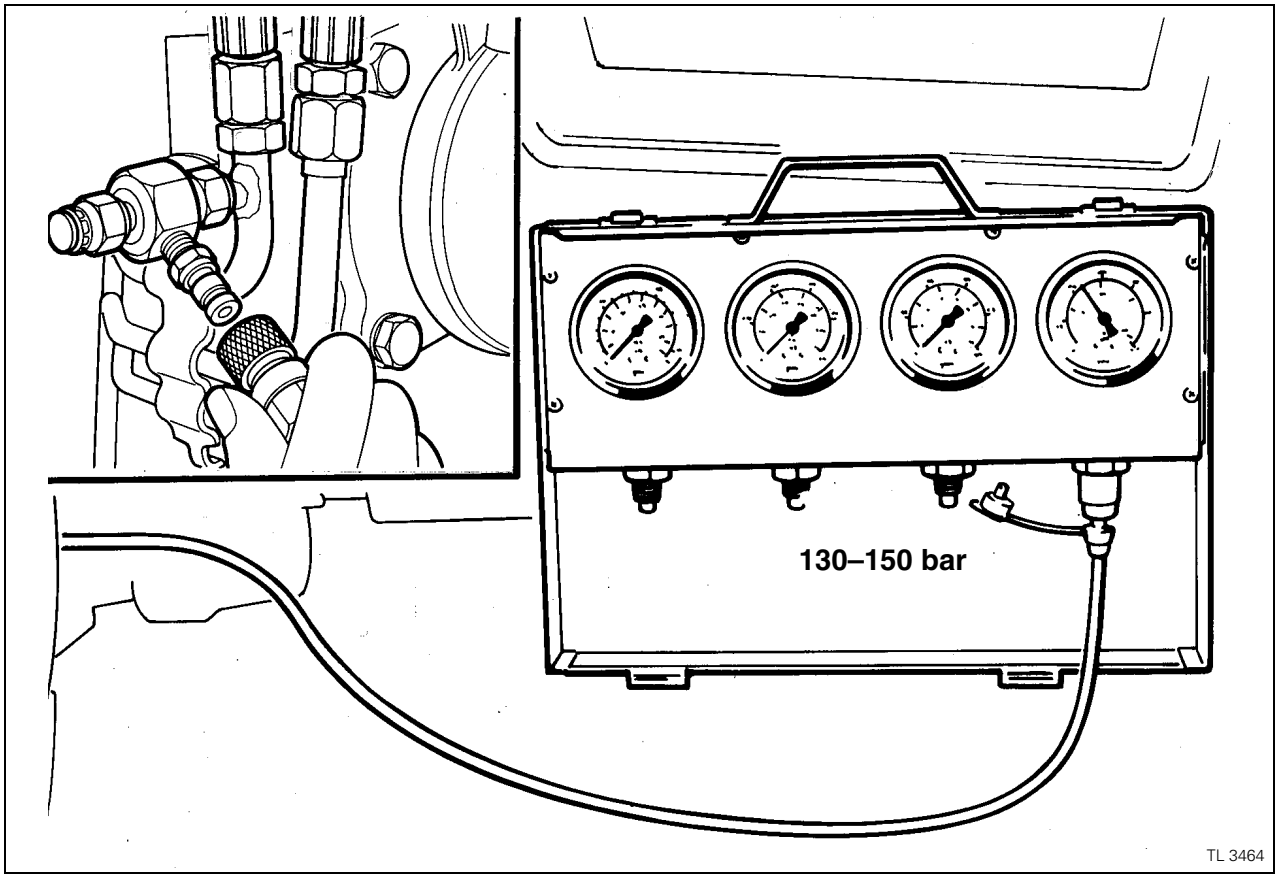


Fig.12

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STEERING SYSTEM PRESSURE TEST

Check **1-9C**

Special Tools:
MF.3001A Pressure Test Kit
MF.3002 Hose Kit

Procedure

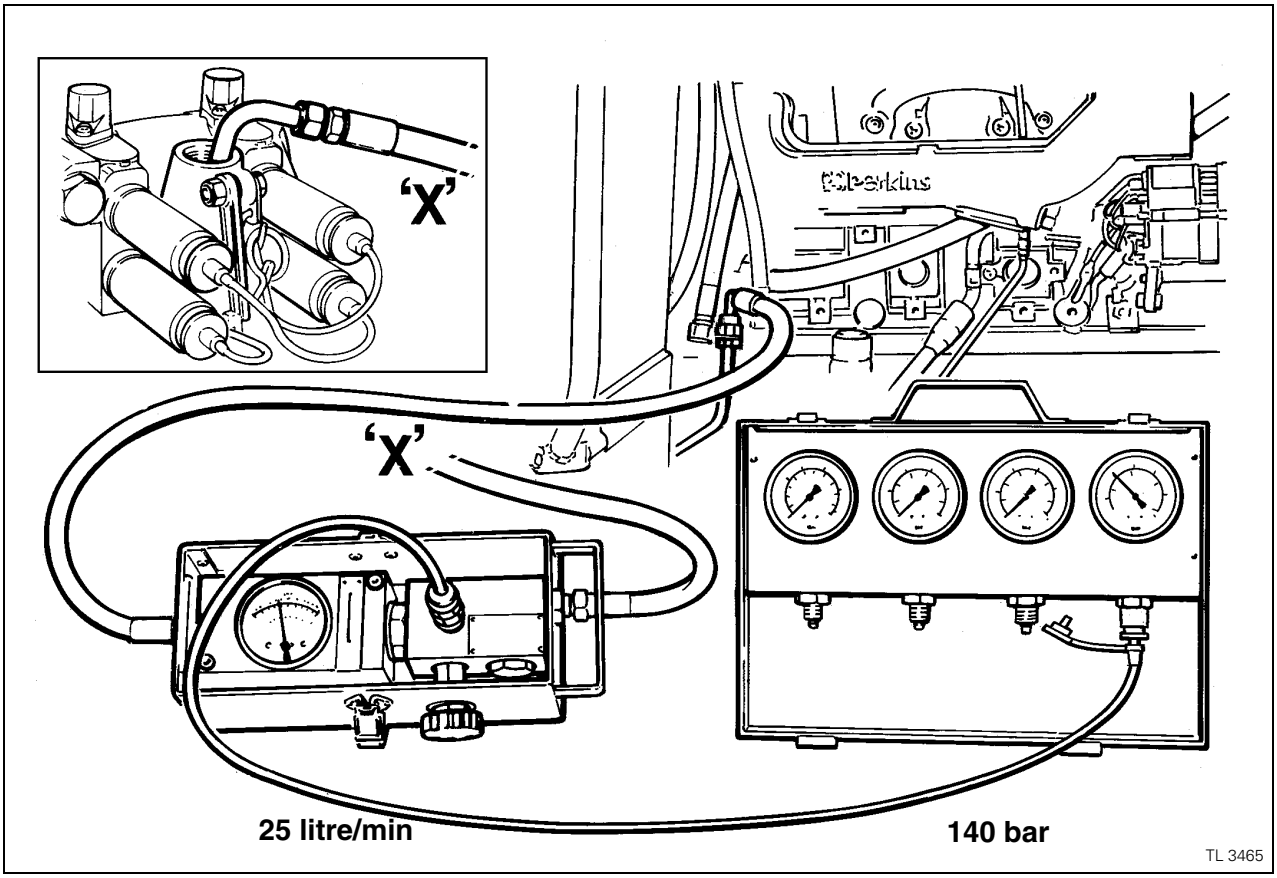
1. Remove the plug from the tee on the right-hand side of the tractor in front of the cab.
2. Install the test tee and a cap from the test kit.
3. Connect the high reading pressure gauge in the MF.3001A Pressure Test Kit.
4. Start up the engine and warm up the hydraulic system. The oil temperature must be 50-60°C (120-140°F).
5. Set the engine speed to 1200-1250 rev/min.
6. Make a note of the back pressure on the gauge.
7. Turn the steering to full lock, the relief valve will open, make a note of the maximum pressure reading.
8. Take the back pressure reading from the maximum pressure reading. The result is the system pressure, this should be 130-150 bar (1886-2175 lbf/in²).

Diagnosis

Symptom - Steering Pressure LOW		
Cause	Action	Operation No.
Steering pump performance down	Flow check pump	2-9C
Worn steering unit	Overhaul or replace steering unit	1-9B 2-9B
Relief valve faulty	Overhaul or replace steering unit	1-9B 2-9B
Shock valves faulty	Overhaul or replace steering unit	1-9B 2-9B
Leakage across steering cylinder	Overhaul steering cylinder	12-8A 15-8B

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STEERING SYSTEM FLOW TEST

Check **2-9C**

Special Tools:
MF.3001A Pressure Test Kit
MF.3002 Hose Kit
MF.3003 Hydraulic Flow Meter

Procedure

1. Disconnect the pressure pipe from the hydraulic pump to the steering unit on the right-hand side of the tractor adjacent to the clutch housing.
2. Connect the inlet side of the MF.3003 Hydraulic Flow Meter to the steel pipe from the pump, ensuring that flow through the meter is from left to right.
3. The outlet hose from the flow meter must be returned to the transmission, NOT through the steering valve. A hose extension will be required with a short length of steel pipe so that it can be hooked over the transmission filler, *(see insert on the illustration above).*
4. Connect the high pressure gauge in the MF.3001A Pressure Test Kit to the flow meter.
5. Ensure that the loading valve on the flow meter is fully OPEN.
6. Ensure that the PTO, 18 x 6 Speedshift, differential lock and four-wheel drive are switched OFF.
7. Start up the engine and warm up the hydraulic system. The temperature must be 50-60°C (120-140°F).
8. Set the engine speed to 2000 rev/min.
9. Screw in the flow meter loading valve until a pressure of 140 bar (2030 lbf/in²) is obtained.

IMPORTANT: *Care must be taken when applying the back pressure on the pump with the loading valve on the flow meter. The pump does not have a pressure relief valve for protection.*

10. Pump performance:

    New pump . . . . . 25 litre/min (5.5 gal/min) (6.6 US gal/min)

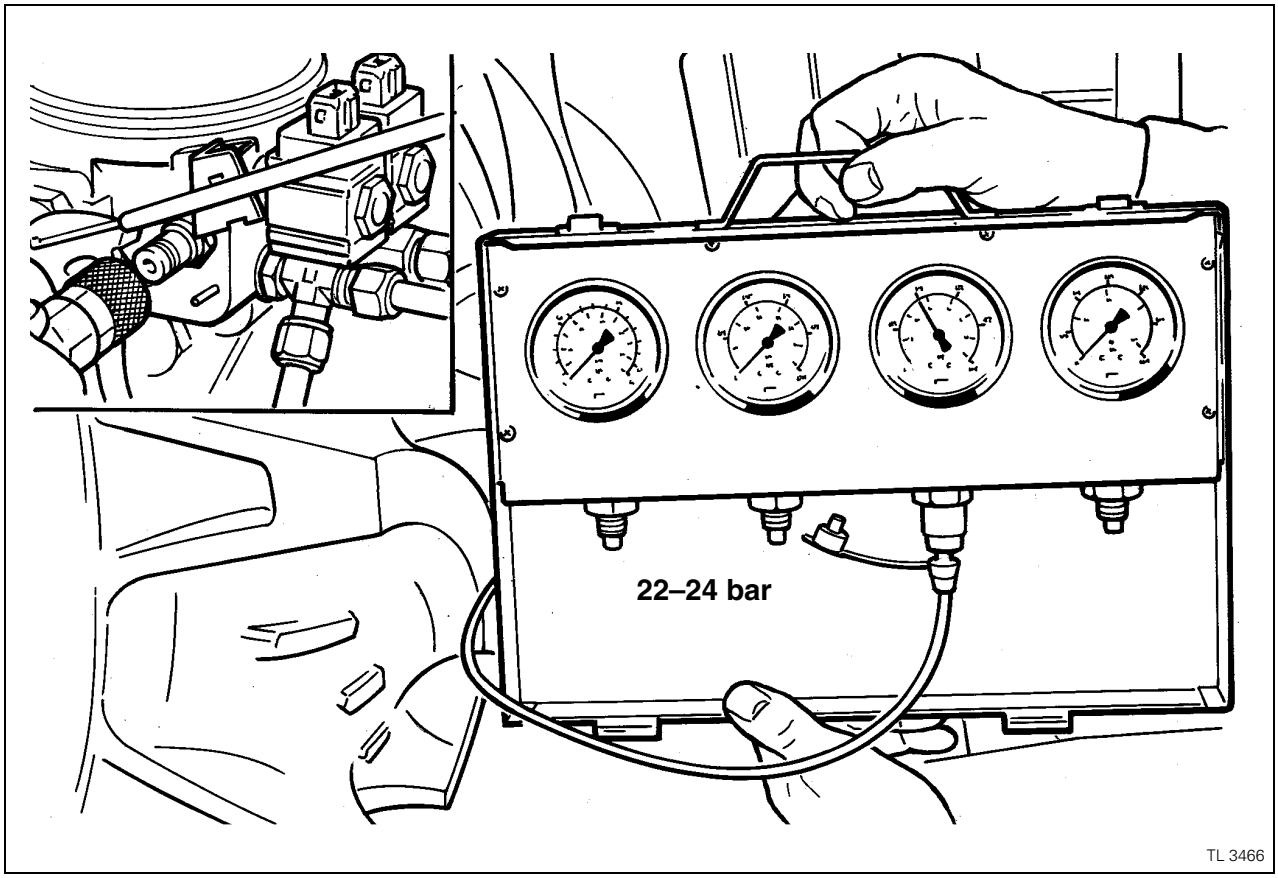
    Minimum flow to give acceptable performance. . 18 litre/min (4 gal/min) (4.7 US gal/min)

Diagnosis

Symptom - Steering Pump Flow LOW		
Cause	Action	Operation
Steering pump worn	Replace pump	12-9C
Suction strainer blocked	Clean strainer	11-9C
Insufficient transmission oil.	Fill to level	11-9C

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PRESSURE MAINTAINING VALVE PRESSURE TEST

Check **3-9C**

Special Tools:
MF.3001A Pressure Test Kit

Procedure

To test the pressure of the Pressure Maintaining Valve (PMV) proceed as follows:

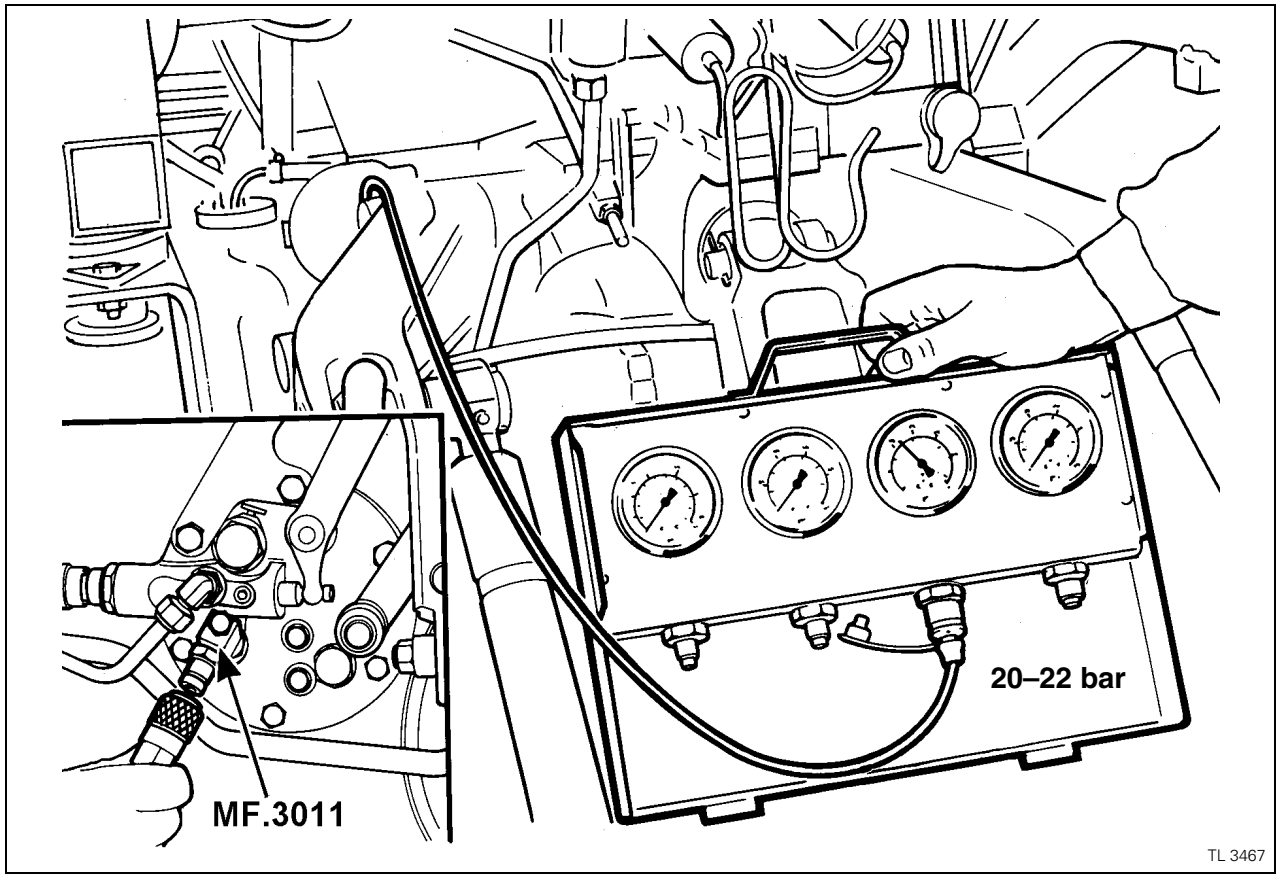
1. Remove the test point plug on the manifold block and install the M14 male quick release coupling from the test kit.
2. Using MF.3001A Pressure Test Kit, connect one of the centre gauges (0-35 bar) to the test point.
3. Start up the engine and warm up the hydraulic system. the oil temperature must be 50-60°C (120-140°F).
4. Set the engine speed to 1200-1250 rev/min.
5. Note the pressure reading on the gauge. The system pressure should be 22-24 bar (319-348 lbf/in²).

Diagnosis

Symptom —PMV Pressure LOW		
Cause	Action	Operation No.
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
PTO hydraulic control faulty	Check pressure in PTO clutch	4-9C
18 x 6 Speedshift control faulty	Check Speedshift system	5-9C
Symptom – PMV Pressure HIGH		
Back pressure valve blocked	Remove and clean valve	17-9C

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PTO PRESSURE TEST

Check **4-9C**

Special Tools:
MF.3001A Pressure Test Kit
MF.3011 Pressure Test Point

Procedure

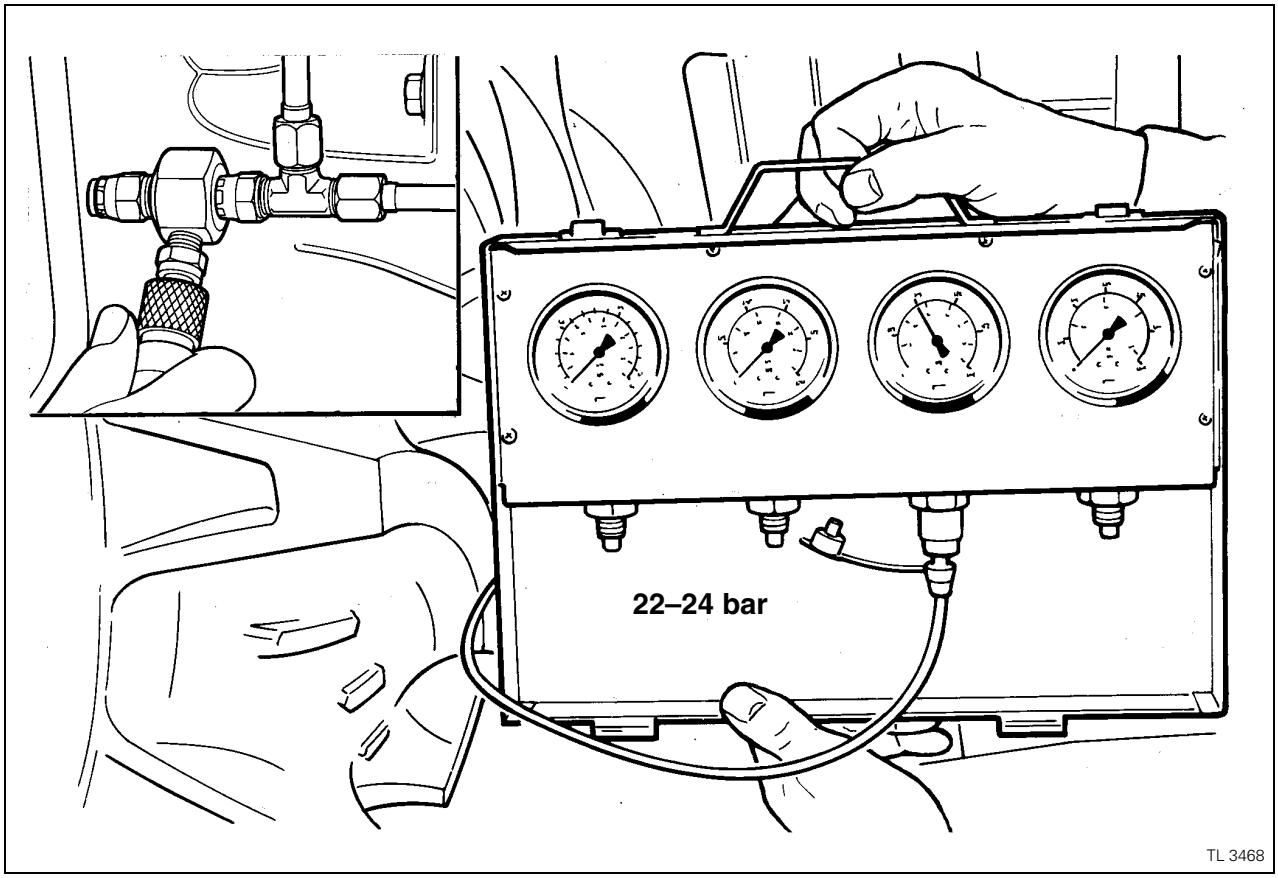
1. Start up the engine and warm up the transmission oil to a temperature of 50-60°C (120-140°F) by running the hydraulic system under load.
2. Stop the engine and locate the test point on the left-hand side of the transmission behind the fuel tank.
3. Remove the small plug and fit the MF.3011 Pressure Test Point.
4. Using MF.3001A Pressure Test Kit, connect one of the 35 bar gauges to the quick release coupling.
5. Restart the engine, engage the PTO and increase the speed to 1200-1250 rev/min.
6. With the transmission oil at the specified temperature, the pressure reading should build up to 20-22 bar (290-319 lbf/in²) over approximately 1.5 seconds. The pump pressure should not be below 20 bar (290 lbf/in²).

Diagnosis

Symptom -PTO Pressure LOW		
Cause	Action	Operation No.
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
PTO modulating valves faulty	Investigate cause in side cover	2-7A
PTO clutch pack piston seals worn	Remove and re-seal	4-7A
PTO clutch feed ring worn	Replace faulty components	4-7A
Leaking transfer pipe to clutch pack	Remove and re-seal	1-7A

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SPEEDSHIFT GEARBOX PRESSURE TEST

Check **5-9C**

Special Tools:
MF.3001A Pressure Test Kit

Procedure

1. A test point plug is provided in the feed pipe between the control block and gearbox on the right-hand side of the transmission.
2. Start up the engine and warm up the transmission oil to a temperature of 50-60°C (120-140°F) by running the hydraulic system under load.
3. Stop the engine and locate the test point, remove the plug and install an M14 quick release male coupling.
4. Using MF.3001A Pressure Test Kit, connect one of the 35 bar gauges to the quick release coupling.
5. Restart the engine and increase the speed to 1200-1500 rev/min.
6. Press the Speedshift button and select SLOW speed.
7. Note the pressure reading on the gauge. The system pressure should be 22-24 bar (319-348 lbf/in²).

Accumulator Pressure

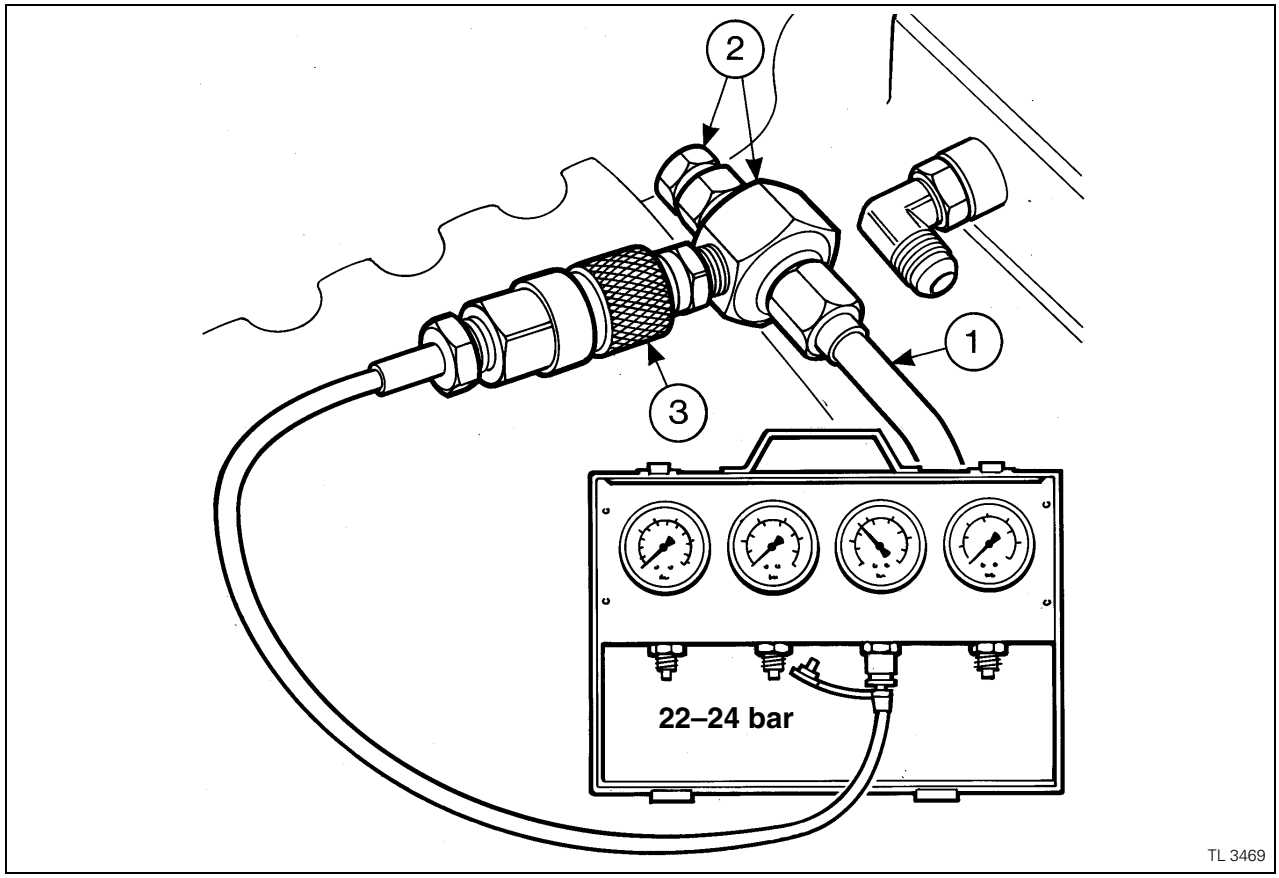
8. To check the accumulator pressure, with the pressure gauge installed, turn the key switch to stop the engine and immediately turn the key to the auxiliary position (engine stopped). With SLOW speed selected the pressure gauge will indicate the accumulator pressure. This pressure will slowly fall due to leakage through the clutch pack, but it will give indication that the accumulator is charged and the non-return valve is seated.

Diagnosis

Symptom -Speedshift Pressure LOW		
Cause	Action	Operation No.
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
Solenoid valve faulty	Replace solenoid valve	20-9C
Speedshift clutch pack piston seals worn	Remove and re-seal	6-5C
Input housing seals worn	Replace faulty components	4-9C

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DIFFERENTIAL LOCK & FOUR-WHEEL DRIVE PRESSURE TEST

Check **6-9C**

Special Tools:
MF.3001A Pressure Test Kit
MF.3002 Hose Kit

These test are extremely simple, the pressure gauge can either be installed direct to the end of the line, 'In-line Test' or it can be connected into the circuit using a Tee, 'Tee Test''

In the first case, connecting in-line, energising the solenoid valve will give direct reading of the PMV pressure and will confirm operation of the solenoid valve and PMV pressure.

In the second case, using a Tee, energising the solenoid valve will confirm the pressure and will also indicate if the piston seals in the differential lock or four-wheel drive are leaking.

A pressure comparison should be made with the PMV test, *(see operation 2-9C)* and the pressure readings obtained in the Tee test to ascertain seal leakage.

The illustration and procedure given in these operations on the rear differential lock are typical, the procedure also applies to the four-wheel drive differential lock and four-wheel drive engagement.

Procedure

1. Disconnect the pressure pipe from the elbow on the differential lock, move the end of the pipe away from the fitting.

In-line Test

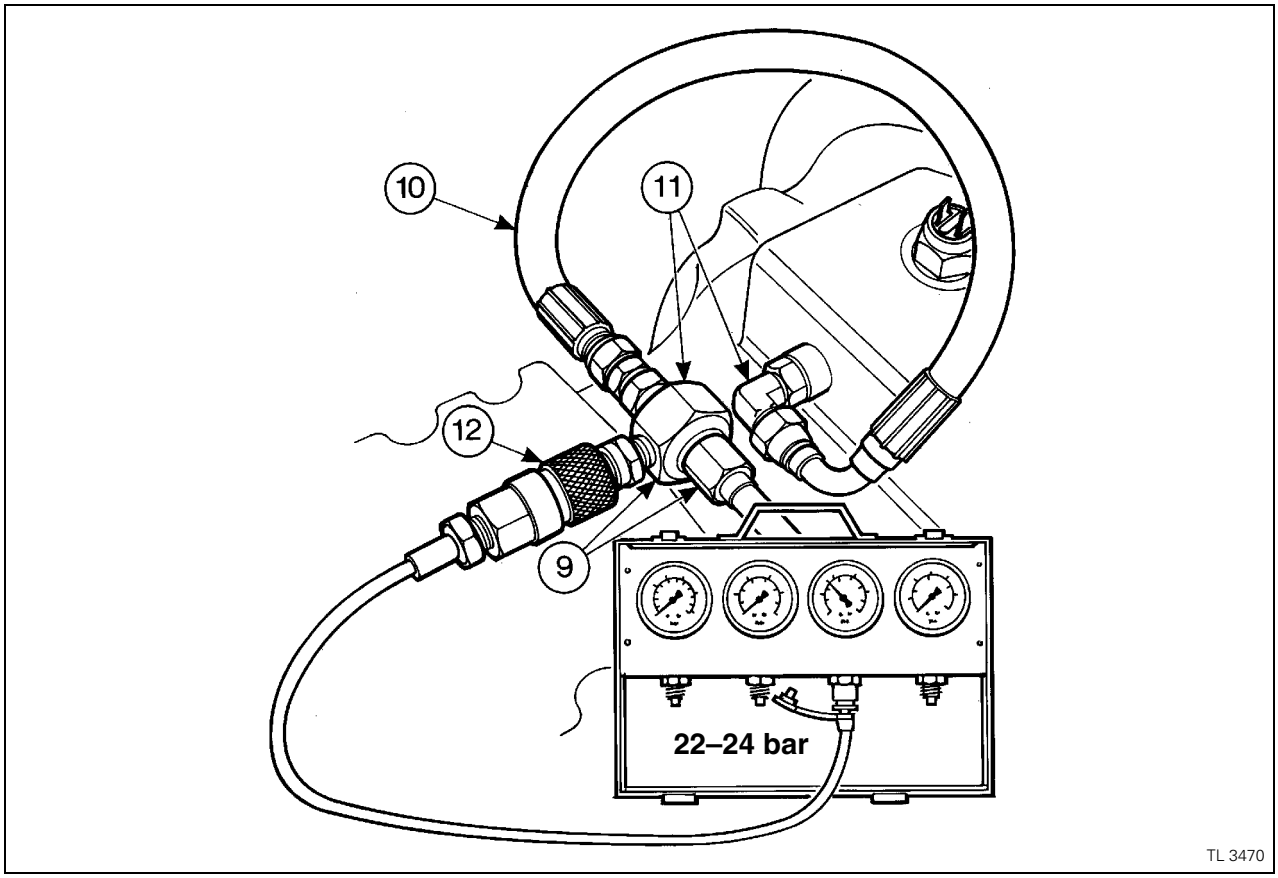
2. From the MF.3001A Pressure Test Kit, select the 9/16 in. J.I.C. tee and fit a plug to the female end.
3. Connect the tee piece to the end of the pressure pipe.
4. Connect the 35 bar gauge in the MF.3001A Pressure Test Kit to the tee.
5. Start up the engine and warm up the hydraulic system. The oil temperature must be 50-60°C (120-140°F).
6. Set the engine speed to 1200-1250 rev/min.
7. Disengage the four-wheel drive by energising the solenoid valve.

When testing the differential lock, press the switch to engage.

8. Note the pressure reading on the gauge. The system pressure should be the same as the PMV 22-24 bar (319-348 lbf/in²).

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Tee Test

9. From the MF.3001A Pressure Test Kit, select the 9/16 in. J.I.C. tee and screw it onto the end of the steel pipe or hose.
10. A short length of hose with 9/16-18 JIC fittings each end will make entry into the system easy.
11. Connect the tee piece to the housing using fittings in the MF.3002 Hose Kit.
12. Connect the 35 bar gauge in the MF.3001A Pressure Test Kit to the tee.
13. Start up the engine and warm up the hydraulic system. The oil temperature must be 50-60°C (120-140°F).
14. Set the engine speed to 1200-1250 rev/min.
15. Operate the switch to disengage the four-wheel drive, or to engage differential lock.
16. Note the pressure reading on the gauge. The system pressure should be 22-24 bar (319-348 lbf/in²).

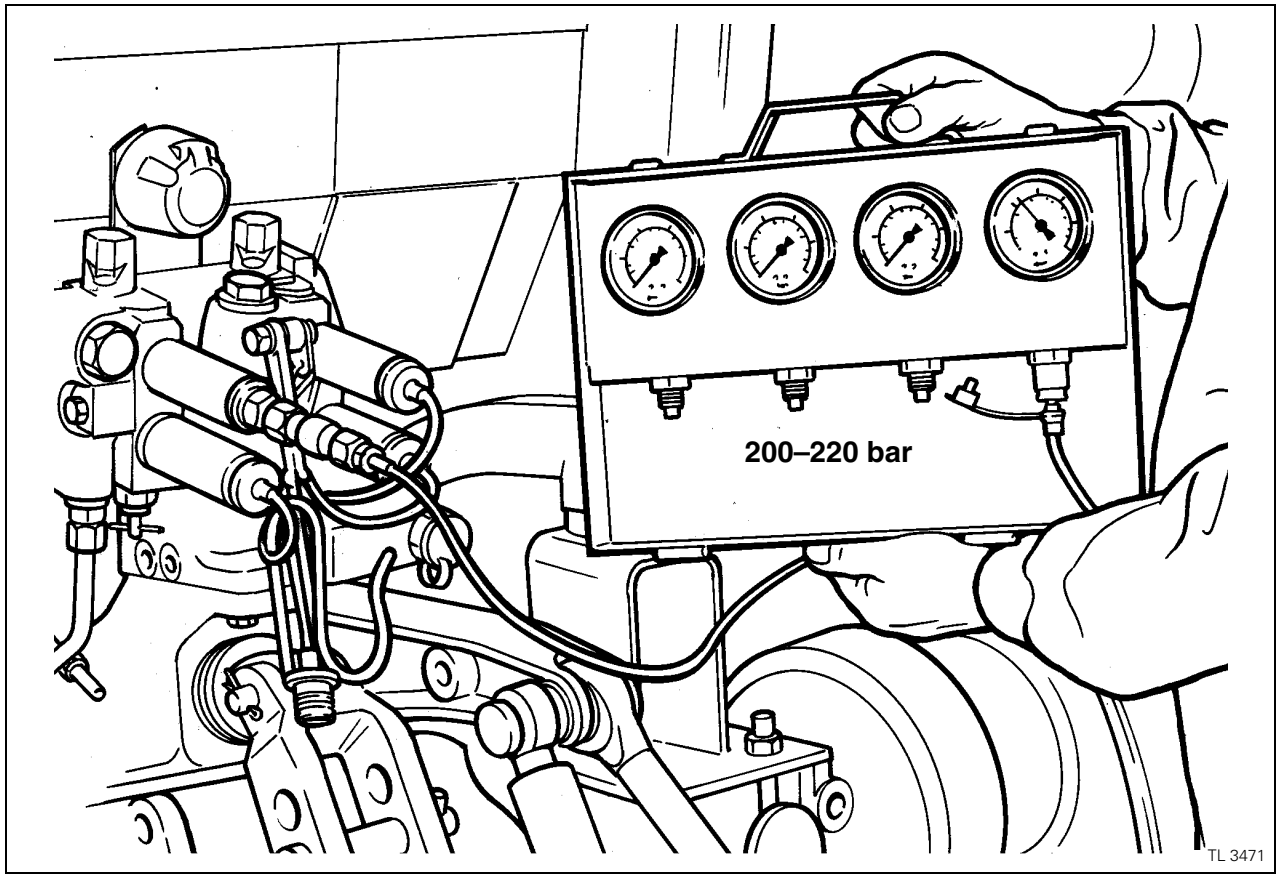
Any loss in pressure when compared with the in-line test or a pressure reading obtained, *(see operation 2-9C)* will indicate seal leakage.

Diagnosis

Symptom – Speedshift Pressure LOW		
Cause	Action	Operation No.
PMV faulty	Replace valve	17-9C
Steering pump worn	Flow check pump	2-9C
Solenoid valve faulty	Replace solenoid valve	17-9C
Piston seal leakage	Remove component and re-seal	1-5D 1-6C 12-8B

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AUXILIARY CIRCUIT PRESSURE TEST

Check **7-9C**

Special Tools:
MF.3001A Pressure Test Kit

Procedure

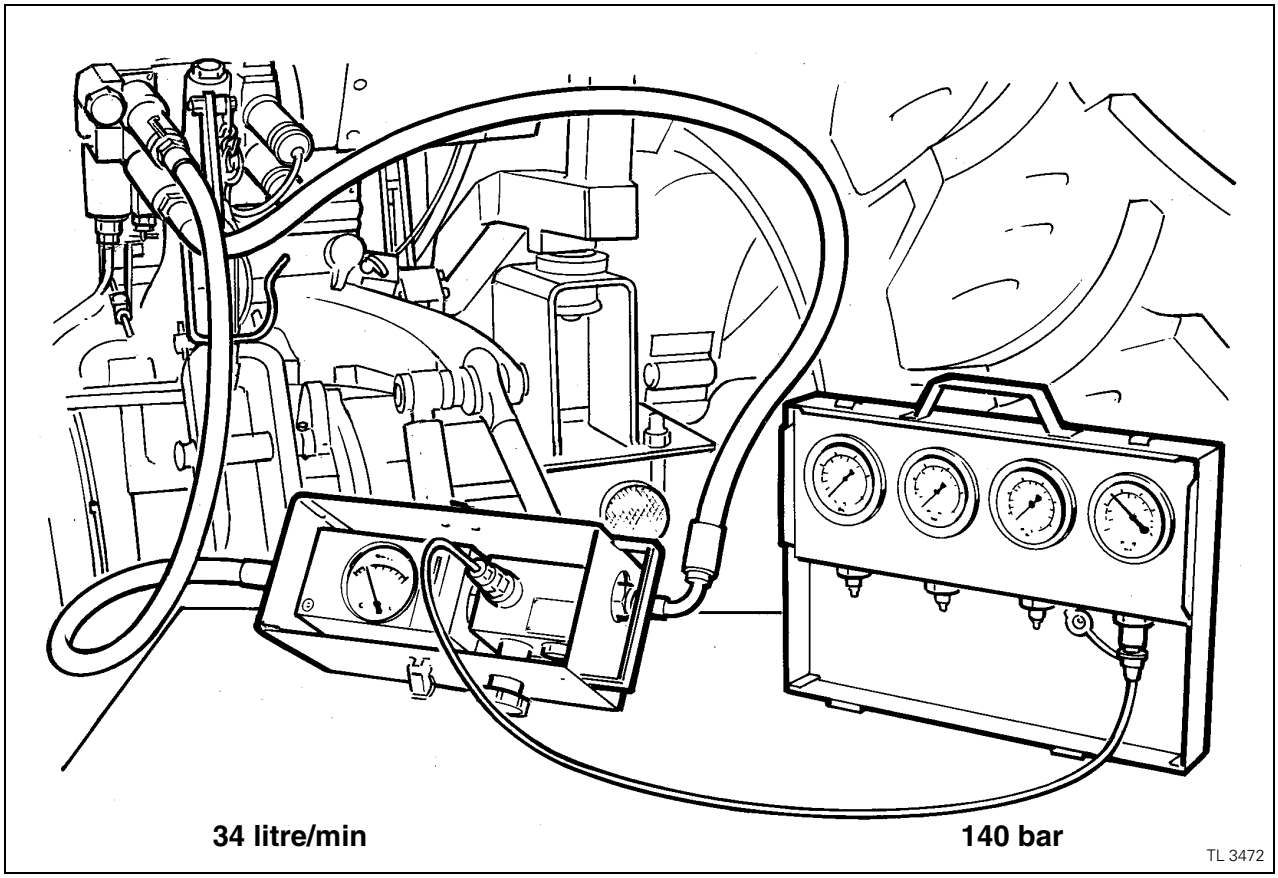
1. Using a quick release coupling part No. 1684 473 M1, make up a test adaptor using one of the connectors and the M14 quick release coupling from the test kit.
2. Using MF.3001A Pressure Test Kit, connect the high pressure gauge (0-420 bar) to the test point.
3. Connect it to the top left-hand coupling on the control valve at the rear of the tractor.
4. Ensure that the selector control lever is in the Linkage position.
5. Start up the engine and warm up the hydraulic system. the oil temperature must be 50-60°C (120-140°F).
6. Set the engine speed to 1200-1250 rev/min.
7. Pull back to the Lift position the first auxiliary control valve lever
8. Note the pressure reading on the gauge. The system pressure should be 200-220 bar (2900-3190 lbf/in²).

Diagnosis

Symptom – Auxiliary Pressure LOW		
Cause	Action	Operation No.
Auxiliary pump worn	Flow check pump	8-9C
Relief valve faulty	Replace or re-set relief valve	17-9C
Internal leakage in trailer brake valve	Overhaul or replace brake valve	21-9C
Internal leakage in control valve	Overhaul control valve	18-9C

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AUXILIARY SYSTEM FLOW TEST

Check **8-9C**

Special Tools:
MF.3001A Pressure Test Kit
MF.3002 Hose Kit
MF.3003 Hydraulic Flow Meter

Procedure

1. Obtain two auxiliary valve quick release couplings part No. 1684 473 M1, and fit these to the ends of the hoses in the MF.3002 Hose Kit.
2. Connect the intake hose to the top connection of the hydraulic control valve and the left-hand side of the MF.3003 Flow Meter. Connect the outlet hose to the bottom connection on the control valve.
3. Connect the high pressure gauge (420 bar) in the MF.3001A Pressure Test Kit to the flow meter.
4. Ensure that the loading valve on the flow meter is fully OPEN.
5. Start up the engine and warm up the hydraulic system. the oil temperature must be 50-60°C (120-140°F).
6. Set the engine speed to 2000 rev/min.
7. With the aid of an assistant, pull back and hold the first control lever in the cab.
8. Screw in the flow meter loading valve until a pressure of 140 bar (2030 lbf/in²) is obtained.
9. Pump performance:

   New pump . . . . . 34 litre/min (7.5 gal/min) (9 US gal/min)

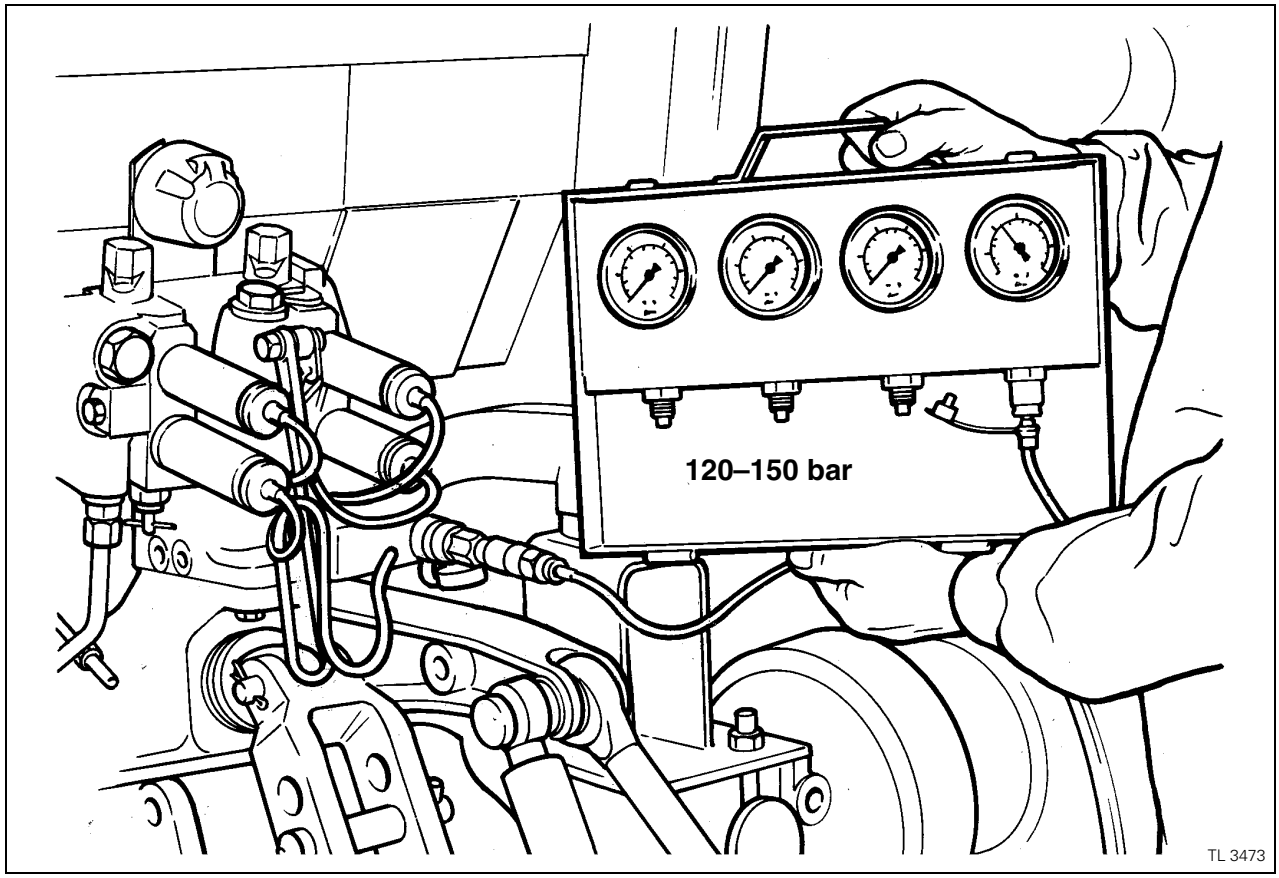
   Minimum flow to give acceptable performance. . 27 litre/min (5.9 gal/min) (7.1 US gal/min)

Diagnosis

Symptom - Auxiliary Pump Flow LOW		
Cause	Action	Operation No.
Auxiliary pump worn	Replace pump	12-9C
Suction strainer blocked	Clean strainer	11-9C
Insufficient oil in transmission.	Fill to level	11-9C

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TRAILER BRAKE VALVE TEST

Check **9-9C**

Special Tools:
MF.3001A Pressure Test Kit

Procedure

1. Check and ensure that the brakes are in a satisfactory operating condition. Make any adjustments that may be necessary.
2. Attach the MF.3001A Pressure Test Kit to the trailer brake outlet coupling at the rear of the tractor.
3. Use the high pressure gauge (420 bar).
4. Start the tractor and set the engine to 1200-1250 rev/min. Warm up the hydraulic/transmission oil to a working temperature of 50-60°C (120-140°F).
5. Unlatch the brake pedals.
6. From the seat press the right-hand pedal fully. Pressure in the system will build up to the maximum pressure of 120-150 bar (1740-2175 lbf/in²).

NOTE: *With the engine running and the brake pedal depressed a slight rhythmic oscillation of the pedal may be felt. This is due to pressure equalisation of the valve and is quite normal.*

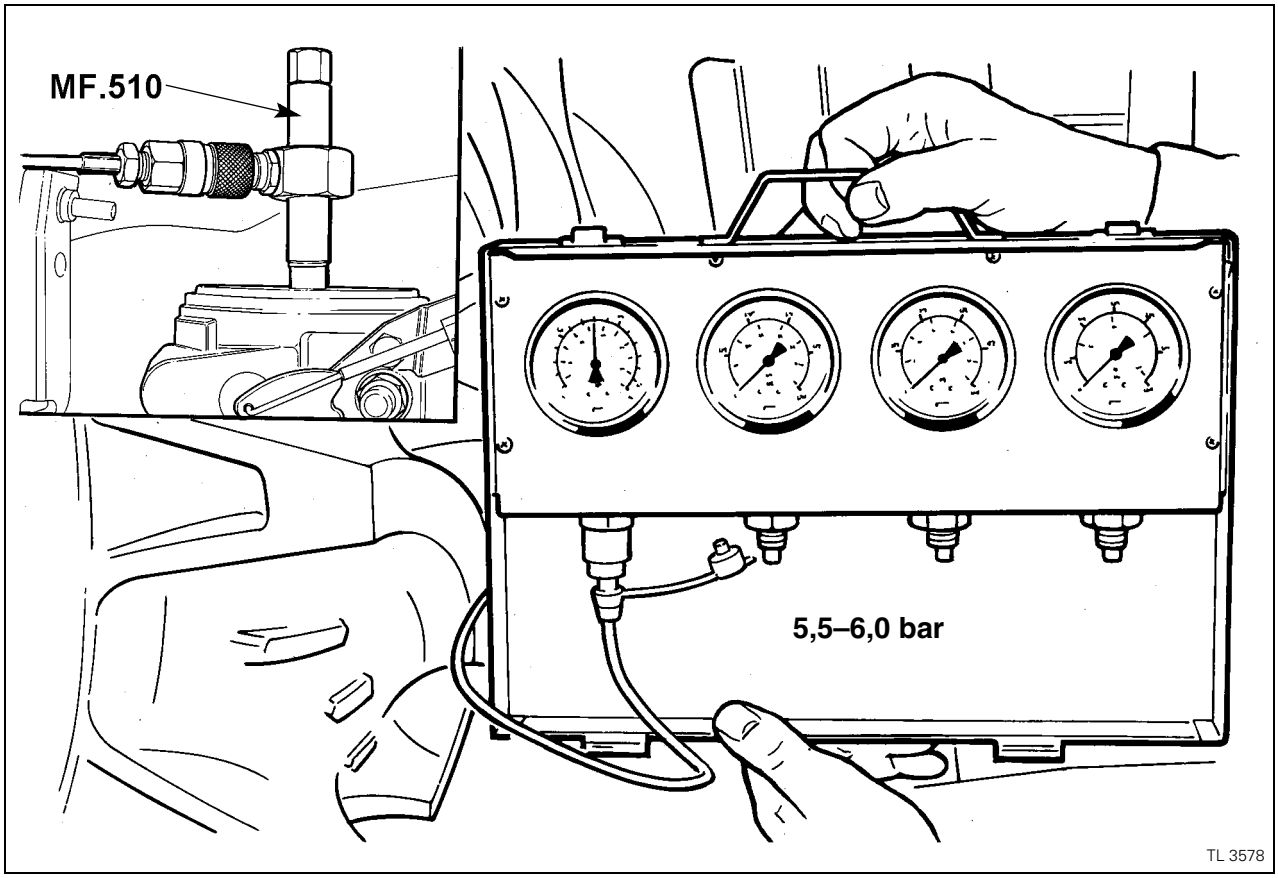
7. Latch the pedals together and retest the brake pressure.

Diagnosis

Symptom - Trailer brake valve pressure LOW		
Cause	Action	Operation No.
Auxiliary pump worn	Flow check pump	8-9C
Suction strainer blocked	Clean strainer	11-9C
Trailer brake valve faulty	Repair or replace valve	21-9C
Insufficient oil in transmission.	Fill to level	11-9C
Air in the brake system	Remove air from the system	6-6A
Brake pedal adjustment	Adjust brake pedal	4-6A
Brake adjustment	Adjust brakes	7-6A

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BACK PRESSURE VALVE TEST

Check **10-9C**

Special Tools:
MF.510 Back Pressure Test Adaptor
MF.3001A Pressure Test Kit

Procedure

NOTE: *Check the Pressure Maintaining Valve pressure first before undertaking this test.*

1. Start the tractor and set the engine to 1200-1250 rev/min. Warm up the hydraulic/transmission oil to a working temperature of 50-60°C (120-140°F).
2. After shutting the engine down, stand the tractor for a while to allow the oil in the hydraulics to drain back into the transmission.
3. Remove the housing and rotor from the centrifugal filter.
4. Install special tool MF.510 Back Pressure Test Adaptor over the spindle of the centrifugal filter. Ensure that the 'O' rings are in place on the special tool.
5. Screw into the side of the special tool a male M14 quick release coupling from the MF.3001A Pressure Test Kit.
6. Couple up to the low pressure gauge (11 bar) in the test kit.
7. Re-start the engine and run at 1200-1250 rev/min.
8. The pressure gauge should read 5,5-6,0 bar (80-87 lbf/in²).

Diagnosis

Symptom - back pressure LOW		
Cause	Action	Operation No.
Back pressure valve stuck open	Replace relief valve	17-9C
Back pressure relief valve setting low	Re-set relief valve	17-9C

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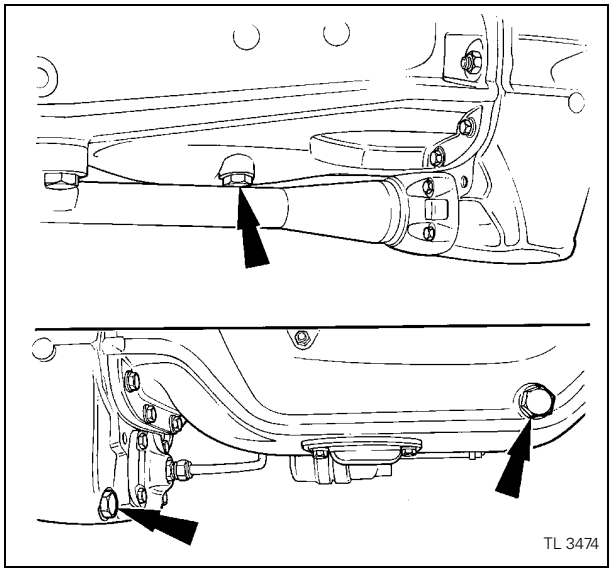
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HYDRAULIC OIL FILTERS

Servicing **11-9C**

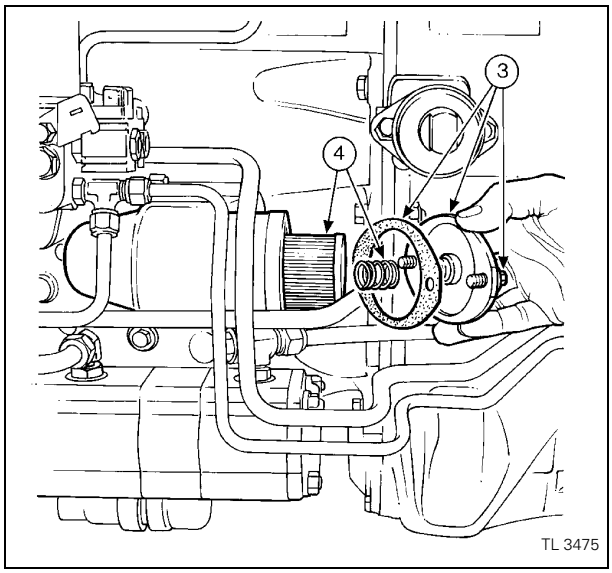
Procedure

1. Drain the transmission oil, it contains 50 litre (11 gal)(13 US gal) of oil. There are three drain plugs, *(see illustration).*



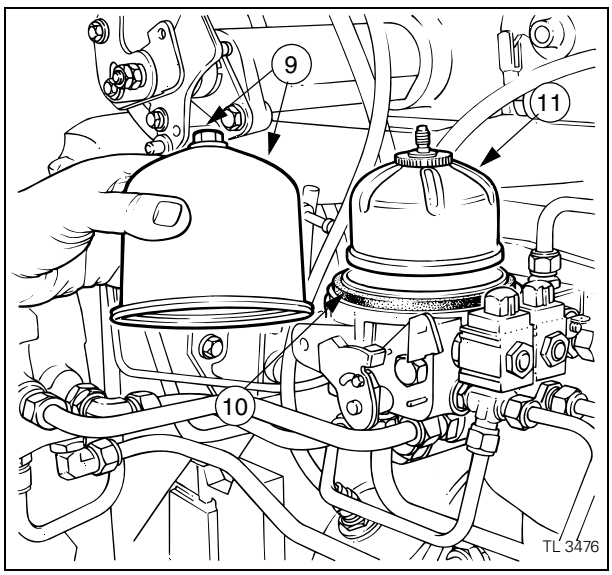
Oil Strainer

2. Place a container under the strainer housing to catch the surplus oil.
3. Remove the two bolts, cover plate and gasket.
4. Withdraw the strainer and spring.
5. Thoroughly clean the strainer with a paint brush and a container of paraffin. Remove all particles of debris from the folds of the filter material.
6. Carry out an inspection of the filter material, discard and replace the strainer if any damage is detected.
7. Inspect the gasket, discard and replace if not suitable for replacement.
8. Refit the strainer, spring, gasket and cover plate, tighten the bolts securely.



Centrifugal Filter

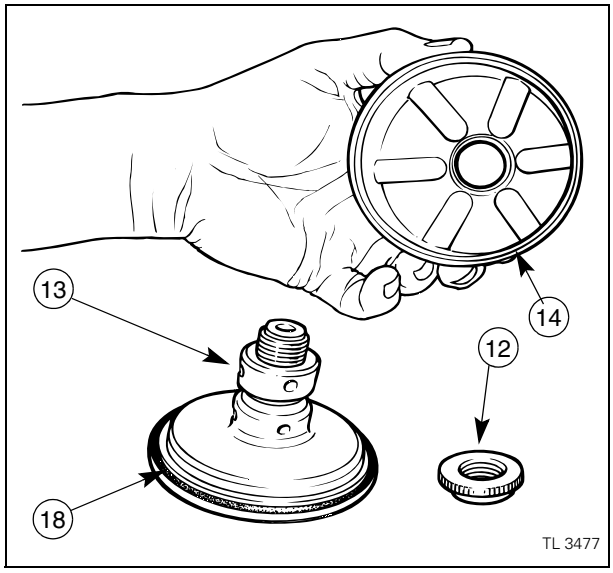
9. Unscrew the cover nut and lift off the filter cover.
10. Examine the body seal for damage, renew if necessary.
11. Withdraw the rotor assembly from the spindle and allow oil to drain from the nozzles.



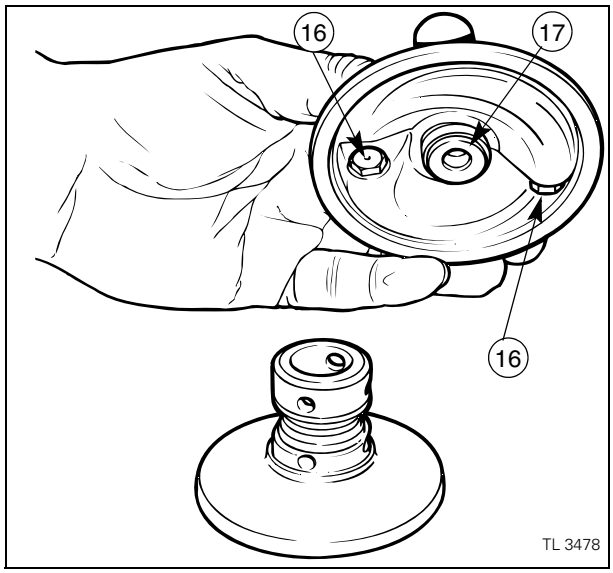
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12. Hold the rotor body and remove the cover nut. Separate the rotor cover from the rotor body.
13. Remove the central stand tube.
14. Remove the sludge from inside of the rotor cover by means of a wooden spatula and wash clean.
15. Clean and wash out the central stand tube ensuring that the strainer holes are not blocked.

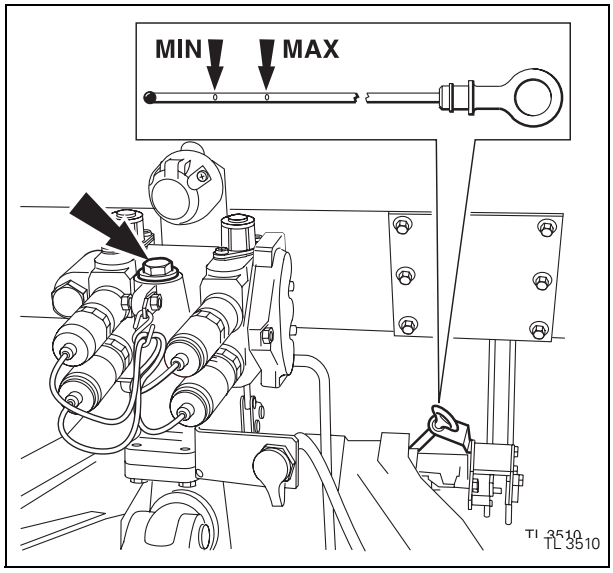


16. Clean out the nozzles with a brass or copper wire to ensure free passage of oil.
17. Examine the top and bottom bearings in the rotor body to ensure that they are free from damage or excessive wear.
18. Examine the 'O' ring for damage. Renew if necessary.
19. Re-assemble the rotor complete. Ensure that the rotor and housing 'O' ring seals are correctly and fully captivated.
20. Examine the central stand pipe to ensure that it is free from damage or excessive wear.
21. Re-assemble the filter complete, checking that the rotor assembly is free to rotate.
22. Replace the filter cover and tighten the cover nut by hand until resistance is felt. DO NOT exceed 16 Nm (12 lbf ft).



General

23. Refill the transmission with clean oil of the correct grade.
24. Start the engine and run at approximately 750/ 1000 rev/min until the hydraulic pumps have primed and oil is circulating.
25. Increase the speed and check all connections and joints for leakage.
26. When the centrifuge is operating correctly it can it can be heard slowing down after the tractor engine has been stopped. Rotation can also be felt if the hand is placed on the housing.



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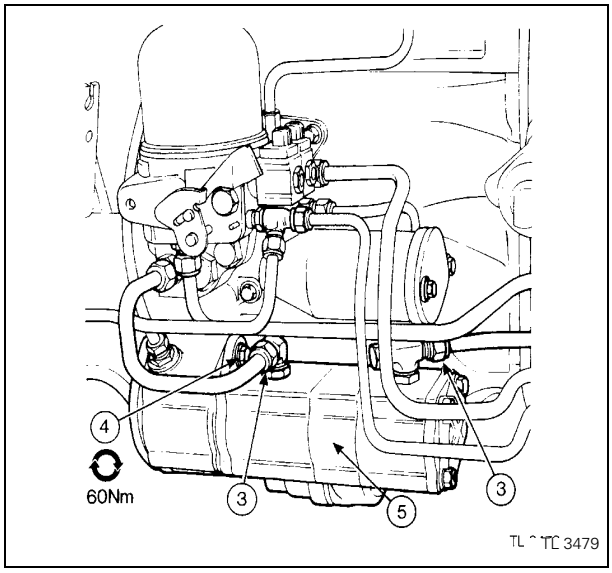
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HYDRAULIC PUMP

Removal and Refitment **12-9C**

Removal

1. Drain the transmission of oil.
2. Place a container under the pump to catch surplus oil.
3. Disconnect the two pressure pipes to the steering and auxiliary circuits.
4. Remove the two bolts securing the pump.
5. Pull the pump forward removing it from the housing and the suction manifold under the pump.
6. Inspect the 'O' ring, discard and replace if not suitable for replacement.
7. Examine the manifold 'O' rings for damage. Renew if necessary.



Replacement

8. Reverse procedures 1 to 8 except:

a. Tighten the pump retaining bolts to a torque of 60 Nm (45 lbf ft).

b. Prime the pump at slow engine speed, then check all connections and joints for leakage.

HYDRAULIC PUMP

Overhaul **13-9C**

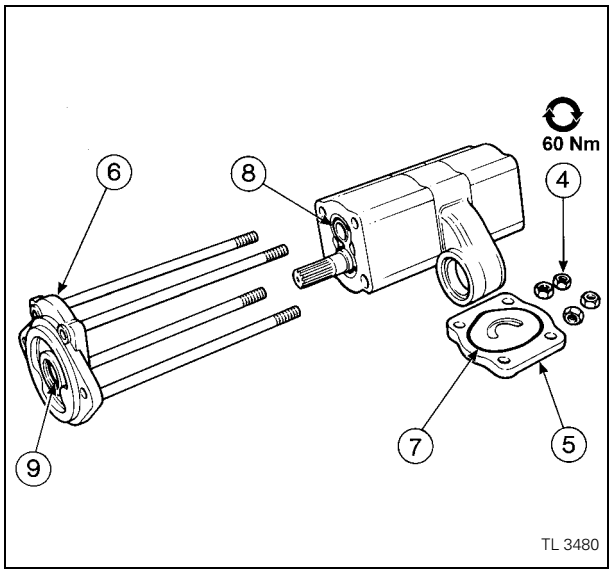
Dis-assembly

The hydraulic pump is a precision made component and Massey Ferguson do not recommend that repairs are carried out except for the replacement of the shaft seal. Specialist equipment is required for the testing and running-in of the pump after manufacture or repair.

To replace the shaft seal proceed as follows:

IMPORTANT: *Maximum cleanliness is essential. The work bench, tools, cleaning materials and hands must be free from dirt and swarf. Removed parts must be protected form any kind of damage, DO NOT drop or knock any of the parts.*

1. Remove the hydraulic pump, *(see operation 12-9C).*
2. Thoroughly clean the outside of the pump.
3. Use a sharp tool to scribe a mark across each section of the pump. This will assure proper re-assembly.
4. Place the pump on the bench and remove the four nuts on the ends of the tie rods.



NOTE: *The sections are dowelled together with two tubular dowels at each joint, excluding the end covers. The dowels are located on two through bolts.*

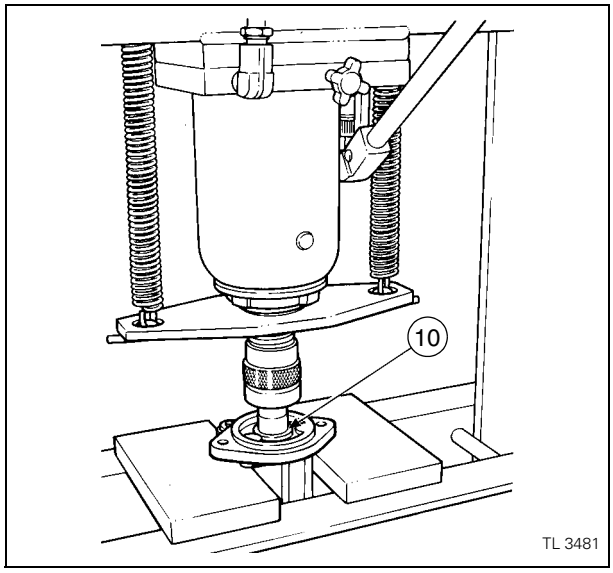
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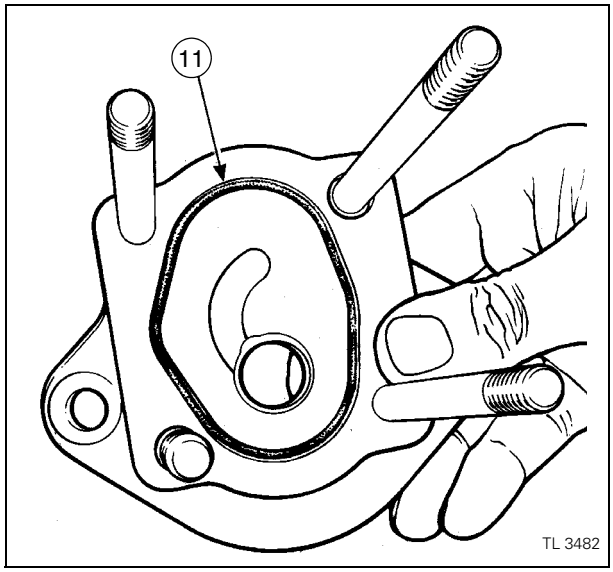
5. Remove the end cover.
6. Very carefully split the pump between the drive end flange and the body. When separating, keep the drive shaft and bearing in the pump body.
7. Remove and discard the seals from the end cover and flange.
8. Remove and discard the seal on the bearing.
9. Remove and discard the shaft seal.

Re-assembly

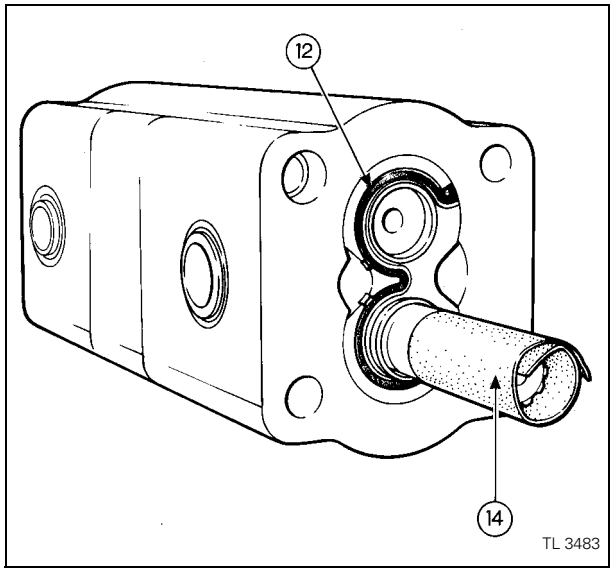
10. Fit a new shaft seal to the pump flange; press in squarely with a little grease and the spring side innermost.



11. Fit a new sealing ring to the flange end and end cover.

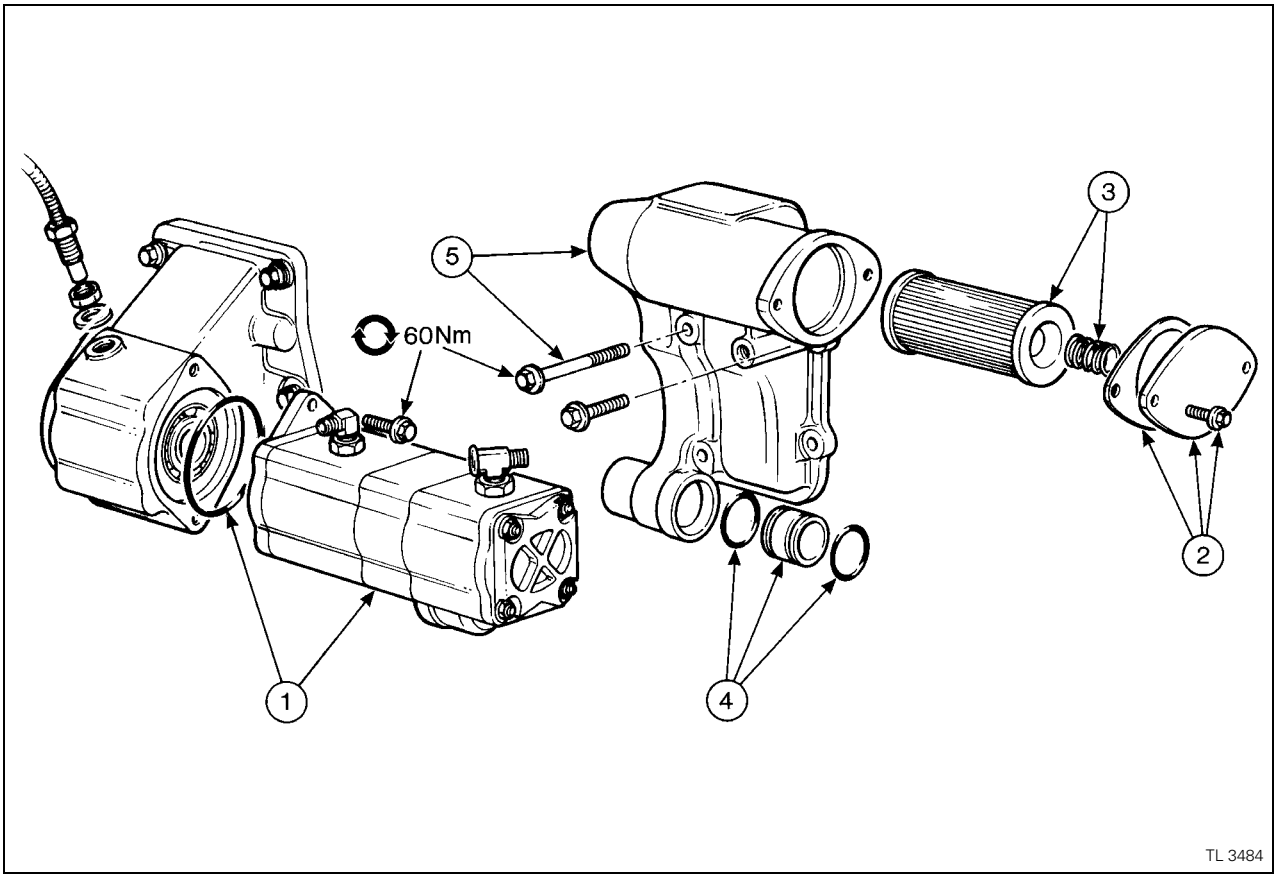


12. Fit a new pressure loading seal and backing strip, a little grease in the grooves will help to retain all the seals. Ensure that the seals are fitted as shown in the illustration.
13. Ensure that the pump sections are still all together with the gears and bearings in place.
14. Fit a protective sleeve over the gear shaft with thin tape to protect the seal.
15. Lightly lubricate the shafts and seal with lubricating oil, then slide the flange onto the drive shaft, locating the dowels and fitting the nuts.
16. Remove the tape or sleeve from the drive shaft.
17. Tighten the pump body nuts to a torque of 60 Nm (45 lbf ft).
18. Check the pump for free rotation.
19. Refit the pump, *(see operation 12-9C)*.



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STRAINER HOUSING

Removal and Refitment 14-9C

NOTE: *The strainer housing contains the lift pump location dowel and must be removed too when the lift pump is to be removed.*

Removal

1. Remove the hydraulic pump, *(see operation 12-9C)*.
2. Remove the two bolts and the cover plate and gasket.
3. Remove the filter screen and spring.
4. Remove the connector between the strainer housing and pump. Examine the 'O' rings for damage, renew if necessary.
5. Remove the six bolts and the manifold from the rear axle casing.

Refitment

6. Reverse procedures 1 to 5, except:

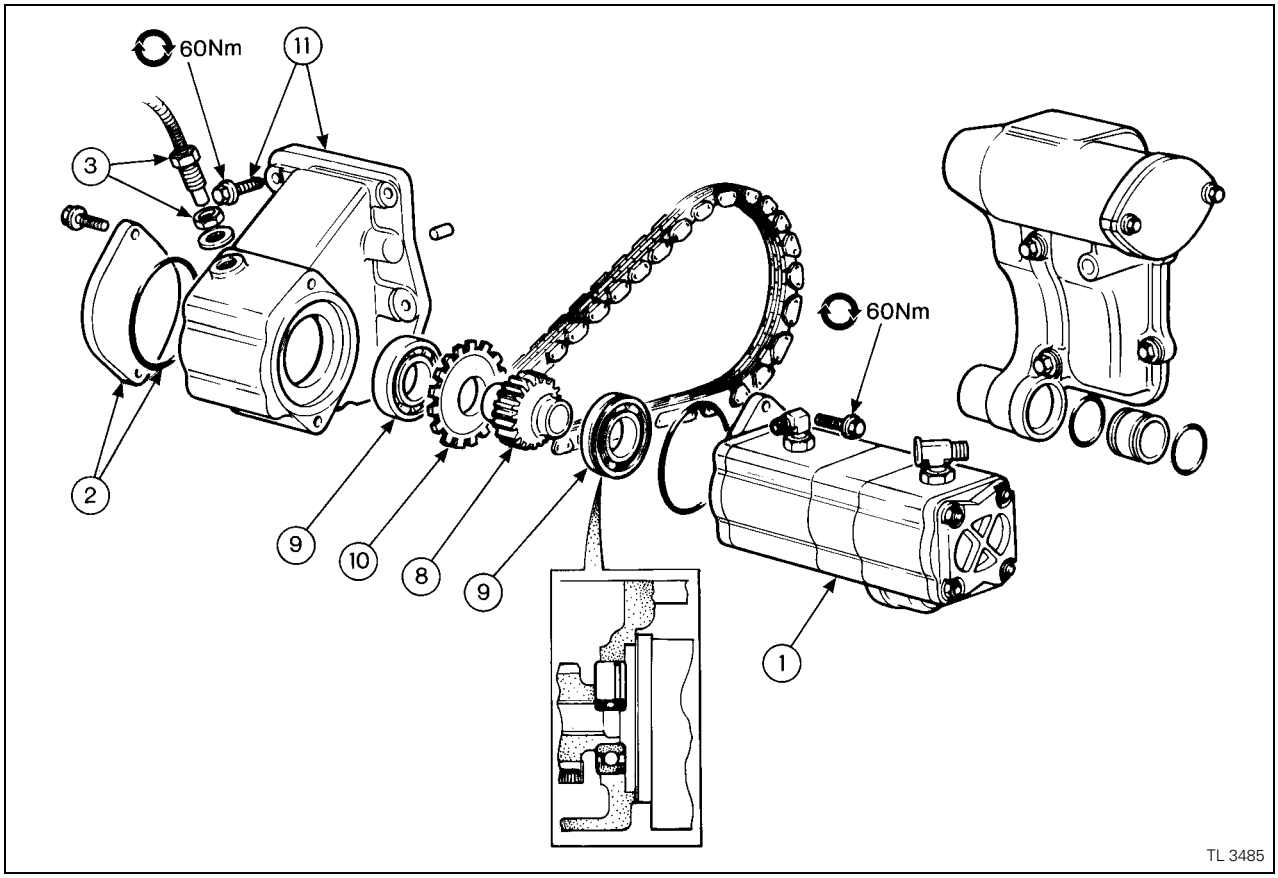
a. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the strainer housing.

b. Tighten the six bolts to a torque of 60 Nm (45 lbf ft).

c. Lubricate the 'O' rings with transmission oil.

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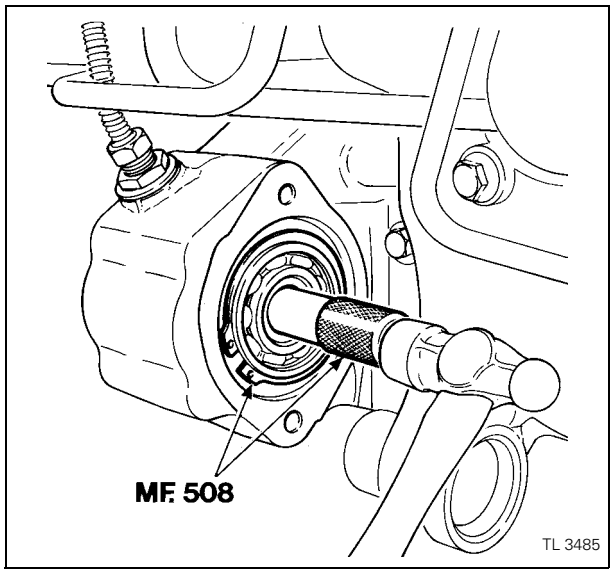
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HYDRAULIC PUMP DRIVE

Removal and Refitment **15-9C**

Special Tools:
MF.508 Pump Drive Sprocket Remover



Removal

1. Remove the hydraulic pump, *(see operation 12-9C)*.
2. Remove the two bolts and the rear cover. Examine the 'O' ring for damage, renew if necessary.
3. Slacken the locknut and unscrew the speed sensor.
4. Using special tool MF.508 Pump Drive Sprocket Remover, insert the tool into the drive sprocket from the rear. Lightly drive the sprocket forward until the groove in the front ball bearing can be seen.
5. Install the circlip (part of MF.508) into the groove.
6. Insert the tool into the front of the sprocket and drive the sprocket back towards the rear. When the circlip comes in contact with the face of the housing the sprocket will now be driven out of the bearing.
7. When the sprocket is free, unhook the chain and use a piece of metal to prevent the chain going back into the transmission case.

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8. Remove the sprocket and bearing.
9. Remove the bearings if necessary.
10. Remove the speed sensor wheel if necessary.
11. Remove the six bolts and the housing. Dowels are used to locate the housing to the rear axle casing.

Refitment

12. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the housing face and tighten the bolts to a torque of 60 Nm (45 lbf ft).
13. Reinstall the speed sensor wheel and bearing on the rear of the sprocket if removed.
14. Place the sprocket in the chain and fit the rear cover to hold the sprocket and chain in position.

IMPORTANT: *The front ball bearing MUST be fitted with the groove to the front, or the bearing shield to the inside, otherwise it will not be possible to remove the bearing and sprocket assembly at a later date if required.*

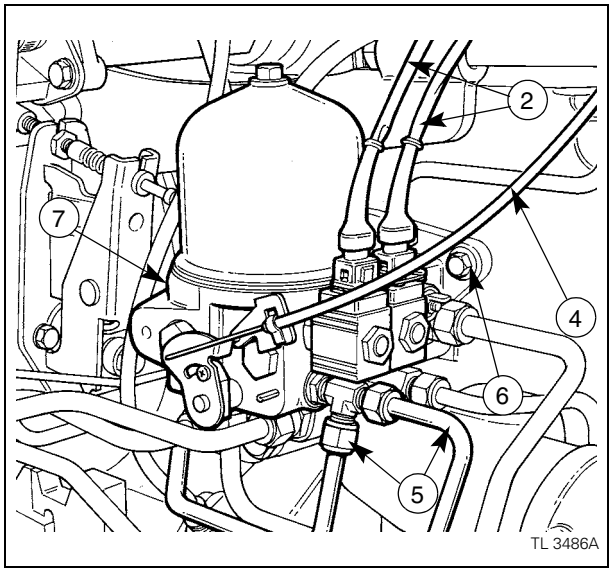
15. Fit the front ball bearing installing it onto the sprocket and into the housing.
16. Screw the speed sensor into the housing until it touches the toothed wheel, then back-off by half a turn. Tighten the locknut.
17. Refit the hydraulic pump, *(see operation 12-9C).*

AUXILIARY SYSTEM MANIFOLD

Removal and Refitment **16-9C**

Removal

1. Place a container under the hydraulics to catch surplus oil leaking from pipes.
2. Disconnect the electrical cables from the solenoid valves, mark the cables to ensure their correct re-connection.
3. Disconnect the transmission dipstick.
4. Disconnect the Response control cable.
5. Disconnect all the steel pipes connecting to the manifold.
6. Remove the four bolts holding the manifold to the rear axle case.
7. Very carefully remove the manifold, taking care not to damage the response control system on the inside of the housing.



Refitment

8. Reverse procedures 1 to 7, except:

a. Apply Massey Ferguson Multi-Gasket (Loctite 573) to bolting face of the manifold and tighten the bolts to a torque of 60 Nm (45 lbf ft).

b. Re-adjust the Response control, *(see operation 8-9A).*

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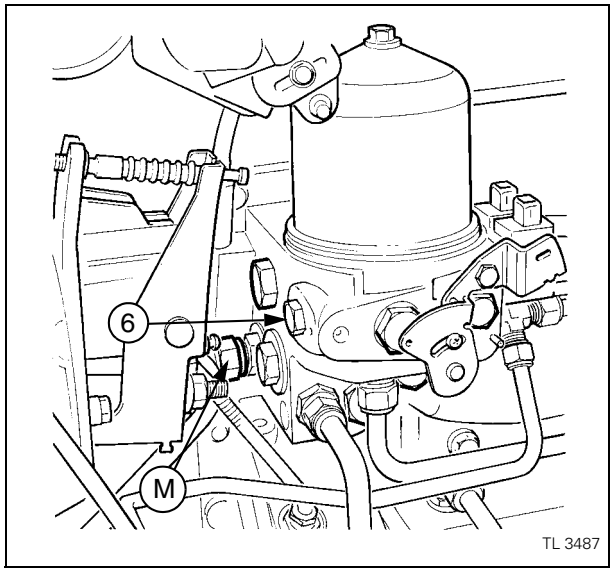
AUXILIARY SYSTEM MANIFOLD

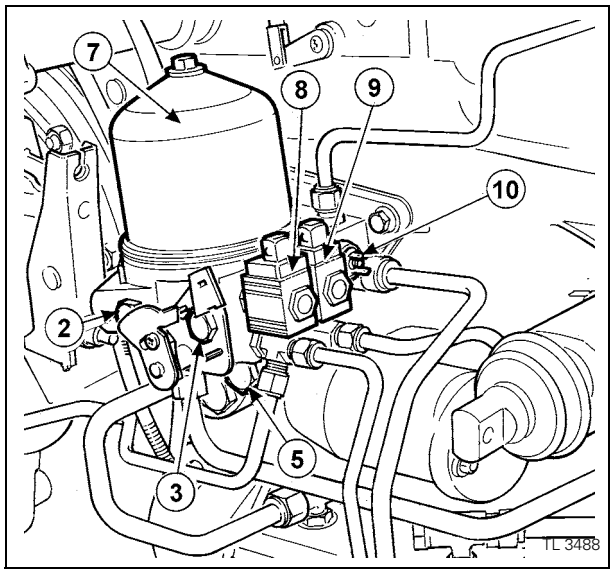
Overhaul 17-9C

Many of the components of the auxiliary system manifold can be serviced without removing the manifold assembly. For recognition purposes valves are numbered and pipes identified by letters, *(see illustrations):*

Manifold Components

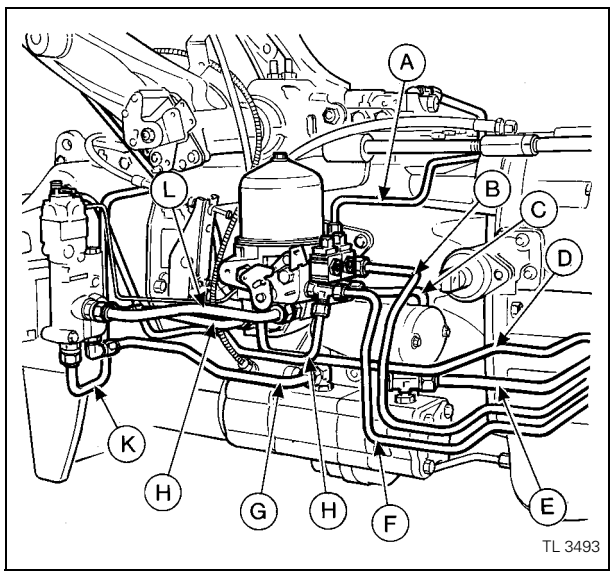
1. Pressure Maintaining Valve (PMV).
2. Back pressure valve 6 bar.
3. Pressure test point.
4. Return port from trailer brake valve when fitted.
5. Auxiliary pressure relief valve.
6. Pressure relief valve 4,5 bar (Power Shuttle and Oil Cooled clutch).
7. Centrifugal filter.
8. Differential lock solenoid.
9. Four-wheel drive solenoid.
10. Low pressure warning light switch.





Pipes and Connections

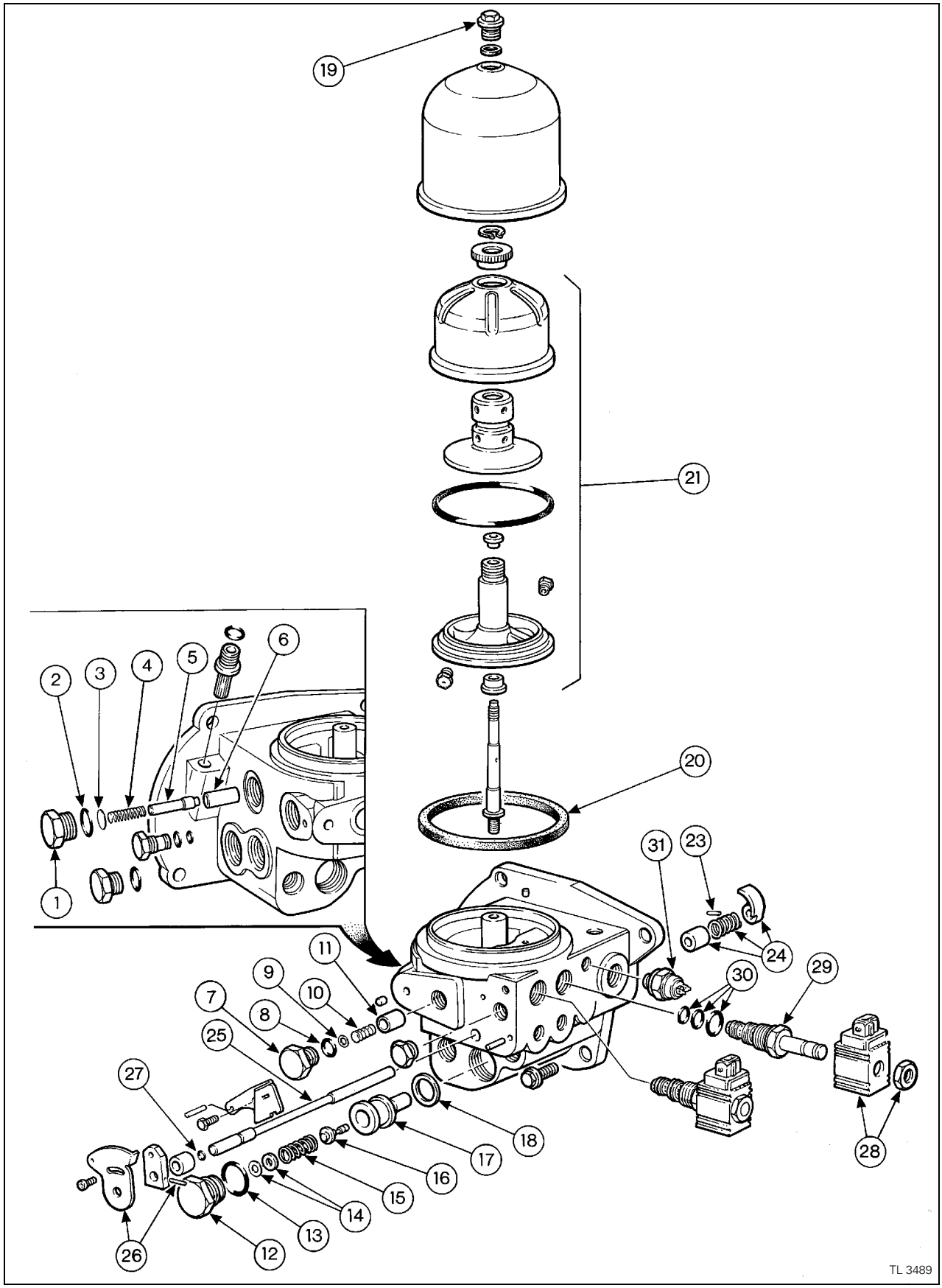
A. Power take-off engagement.
B. Return from steering unit and oil cooler.
C. Four-wheel drive engagement.
D. Return oil to transmission.
E. Steering unit supply.
F. Differential lock - four-wheel drive.
G. Pump to trailer brake valve.
H. Rear differential lock.
J. Trailer brake valve to control valve via relief valve.
K. Trailer brake coupling.
L. Return to transmission from trailer brake valve.
M. Auxiliary control valve.



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Auxiliary Hydraulics



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Dis-assembly

Pressure Maintaining Valve

1. Remove the plug.
2. Examine the 'O' ring for damage. Renew if necessary.
3. Remove the shims.
4. Remove the spring.
5. Remove the spool.
6. Remove the shroud.

Back Pressure Valve

7. Remove the plug.
8. Examine the 'O' ring for damage. Renew if necessary.
9. Remove the shims.
10. Remove the spring.
11. Remove the poppet valve.

Auxiliary Relief Valve

12. Remove the Plug.
13. Examine the 'O' ring for damage. Renew if necessary.
14. Remove the shims.
15. Remove the spring.
16. Remove the poppet valve.
17. Remove the cage.
18. Examine the sealing ring for damage. Renew if necessary.

Centrifugal Filter

19. Unscrew the cover nut and lift off the filter cover.
20. Examine the body seal for damage, renew if necessary.
21. Withdraw the rotor assembly from the spindle and allow oil to drain from the nozzles.
22. For servicing instructions, *(see operation 11-9C).*

Response Control

23. Drive out the roll pin.
24. Remove the cam, spring and spacer.
25. Withdraw the spindle and lever assembly from the manifold.
26. Drive out the roll pin, remove the screw and dismantle the lever.
27. Remove and discard the 'O' ring.

Solenoid Valve

28. Unscrew the top nut and remove the coil.
29. Unscrew the valve from the block.
30. Remove and discard the 'O' rings.
31. Remove, if necessary, low pressure warning light switch.

Examination

The components of the manifold assembly are made to very fine limits, The work bench, hands and cleaning equipment must be very clean, even the smallest particle of dirt can affect the working of the valves.

Clean all or any of the components, inspect for wear and scoring, pay particular attention to the valve seats. Renew any components that are worn or suspect.

Re-assembly

32. Reverse the procedures for dis-assembly depending on the extent of the repair, except:

a. To adjust the pressure of the Pressure Maintaining Valve and Back Pressure Valve the following shims are available:

Part No.	Metric	Imperial
1679 210 M1	0,25	0.010
1679 211 M1	0,50	0.020
1679 212 M1	1,00	0.039

b. To adjust the pressure of the Auxiliary Pressure Relief Valve the following shims are available:

Part No.	Metric	Imperial
3001 843 X1	0,10	0.004
3009 049 X1	0,20	0.008
3008 449 X1	0,50	0.020

c. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the transmission housing.

d. Apply Hylomar to the threads of the bolts securing the manifold to the transmission case and tighten to a torque of 60 Nm (45 lbf ft).

e. Tighten the solenoid valve body to a torque of 10 Nm (7 lbf ft) and the solenoid valve coil nut to a torque of 4 Nm (3 lbf ft).

f. Tighten the auxiliary relief valve plug to a torque of 90 Nm (65 lbf ft).

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AUXILIARY CONTROL VALVE

Overhaul **18-9C**

Dis-assembly

The control valve can be dismantled in two ways, either by removing the whole assembly, or by removing the retaining studs and dismantling the unit on the tractor. Whichever method is used cleanliness must be of prime importance.

1. Disconnect the control rods at the base of the control valve.
2. Remove the trailer socket and bracket from the top of the valve.
3. Remove the trailer brake quick release coupling and bracket from the right-hand side of the valve.
4. Remove the top link hook.
5. Disconnect the combined flow and supply pipes on left-hand side of the valve.

Removal of the Valve Assembly

6. Remove the four bolts at the base of the valve assembly and lift off the valve.

Removal of Valve Sections

This operation can be carried out on the tractor or bench.

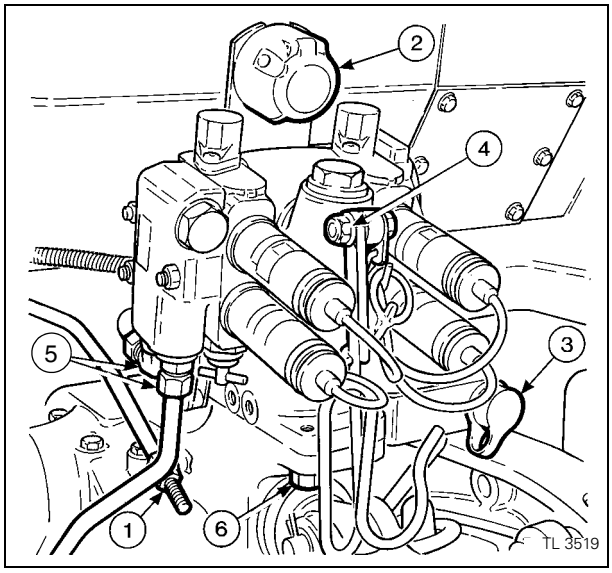
7. Mask off any open ports and clean the external surfaces so that they are free of all loose dirt, paint etc.
8. Remove the three nuts and washers on one end from the tie rods that pass through the valve
9. Note the order in which the sections are fitted so that they can be replaced in their original positions.
10. Slide each section off the tie rods in turn.
11. Remove and discard the 'O' rings fitted between each section.

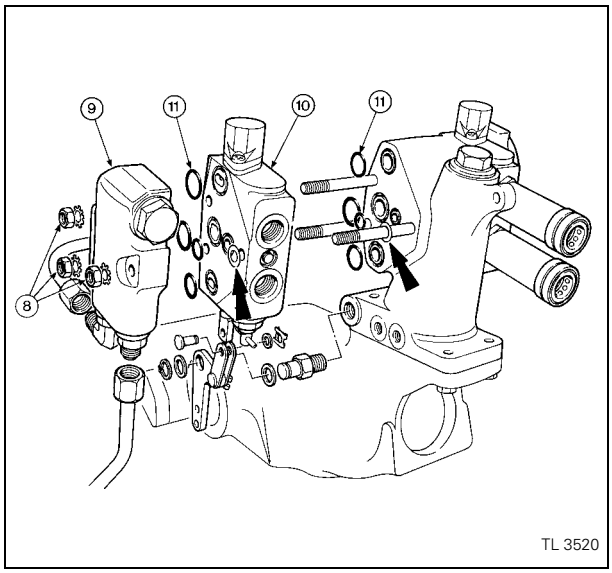
NOTE: *There is a green shim washer fitted between each section, located by the tie rod to the rear, (see arrows on illustration).*

Load Check Valve

The load check valve is retained by the rear tie rod, this must be removed first.

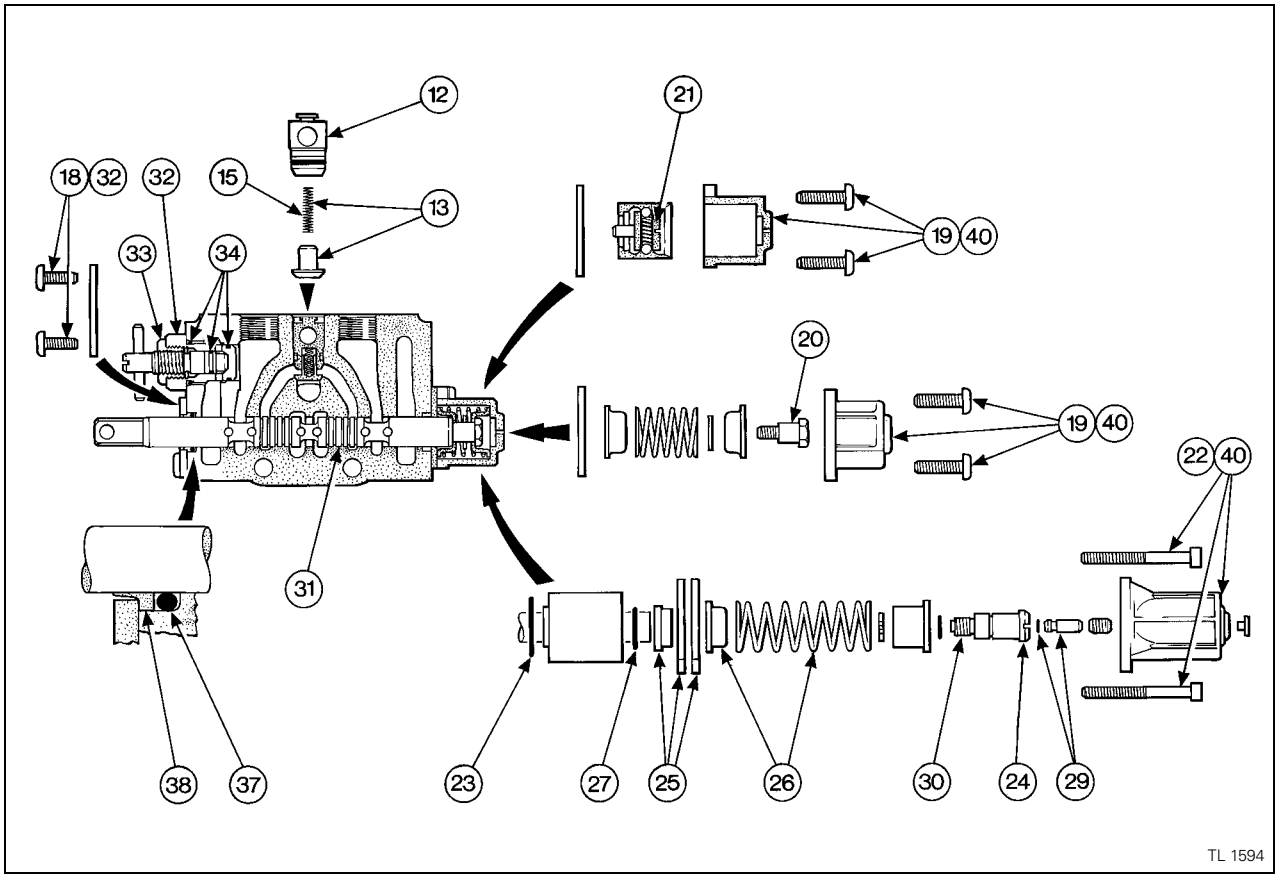
12. Use a large flat blade screwdriver to lever under the flanged head of the check valve guide and withdraw it from the body.
13. Remove the spring and poppet from the body with a pair of long nosed pliers.
14. Inspect all components for signs of deterioration or damage. The poppet and seat should show signs of an even ring around its ground conical seat, and damage will not allow the check valve to function correctly.





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15. The spring should be undamaged and be approximately 20 mm (0.8 in) long.

Spool 'O' Rings

16. Remove any lever mechanism still attached to the valve.
17. Hold the valve section in a vice with adequate jaw guards and grip around the area of the bottom tie rod holes so that the intersection sealing areas are not damaged.
18. Remove the two Posidrive screws from the bottom of the valve and remove the seal plate.
19. Remove the two Posidrive screws from the top of the valve and remove the end cap.

Spring Return Cap

20. Using a socket and bar through the spool hole to prevent rotation, loosen and remove the shoulder bolt from the top of the spool to release the spring, cups and seal plate.

Three Position Detent Cap

21. After removal of the end cap use a large flat blade screwdriver to remove the detent assembly and seal plate from the spool. DO NOT dismantle the detent assembly.

Detent with Kick Out and Float

22. Remove the two socket head cap screws and the cap, withdraw the spool from the top of the body ensuring that the detent mechanism stays in the neutral position.
23. Remove the 'O' ring between the detent housing and the body.
24. Hold the spool with the spade end down, support the detent housing to prevent movement and with a wide blade screwdriver remove the shoulder screw in the end of the spool.
25. Remove the two retainer plates and alloy retaining ring.
26. Remove the spring cup and spring.
27. Move the detent housing backwards and forwards by a small amount to ease out the 'O' ring in the end of the housing.
28. Remove the grub screw from the end of the shoulder screw.
29. Remove the piston and discard the 'O' ring.
30. Remove all traces of Loctite from the thread of the shoulder screw.

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Spool Seals

IMPORTANT: *Valve assemblies are manufactured with spools and bodies as matched set to control internal leakage. DO NOT mix bodies and spools.*

31. Pull the spool out of the boar. When pulled out one 'O' ring and wiper seal should come with the spool. Remove these and the other 'O' ring and wiper seal which would still be in position in the valve and discard.

Change Over Valve

32. Unscrew the change over valve assembly.
33. Unscrew the end cap and withdraw the valve.
34. Remove and discard the 'O' rings.

Examination

Clean all components and check their condition, replace all seals and ensure that all 'O' ring grooves are clean and their mating faces are free from any damage. Lubricate all parts with clean transmission oil during assembly.

Re-assembly

Detent with Kickout and Float

35. Reverse procedures 21 to 30 except:
    a. Apply Massey Ferguson Lock 'n' Seal (Loctite 242) to the thread of the shoulder screw.
    b. Tighten the shoulder screw to a torque of 7 Nm (5 lbf ft).
    c. When the valve is refitted to the tractor reset the kickout pressure setting, *(see operation 19-9C)*.

All Models

36. Refit the spool to the body and position it in the neutral position.
37. Onto each end of the spool fit a new 'O' ring seal.
38. Fit a new wiper seal.
39. Using a seal plate fitted over the spool, push the 'O' ring and wiper seal home in turn.

NOTE: *Take great care to ensure that the spool remains in the neutral position. If it moves either way too far then a land edge on the spool could pass over the 'O' ring and cause damage which may result in a leakage.*

40. Refit the action mechanism and seal plate, ensure that the threads of the screws and holes are clean and dry, apply two or three drops of Massey Ferguson Screw Lock (Loctite 222) and torque to 7 Nm (5 lbf ft).
41. Reverse procedures 25 to 27, 20 to 23 and 12 to 15 except:
    a. Tighten the change over valve assembly to a torque of 22 Nm (17 lbf ft).

IMPORTANT: *Take great care to ensure there is no contamination on the underside of the section and that the 'O' rings are fitted completely in their grooves, otherwise they may become trapped or damaged.*

42. With the nuts and washers fitted to one end of the tie rods, fit the tie rods through the plain end cover and stand on end so that the tie rods are vertical.
43. Fit new 'O' rings and green washer to the end cover and slide on the next section over the tie rods and down onto the cover.

    The green washer is fitted between every section and the central support on centre tie rod (rearmost when fitted to the tractor).
44. Continue fitting the sections and central support until all the sections are fitted.
45. Fit the inlet/outlet cover, three washers and nuts which should be lightly tightened with the valve still in the vertical position.
46. Return the valve to the rear of the tractor, Apply Massey Ferguson Multi Gasket (Loctite 573) to the mating face between the central support and the lift cover.
47. Evenly tighten the three tie rod nuts finishing with a torque of 20 Nm (15 lbf ft).
48. Reconnect the pipework, control rods and other components removed.
49. Start up the tractor and test for operation and leaks.

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CONTROL VALVE KICKOUT RELIEF VALVE

Adjust **19-9C**

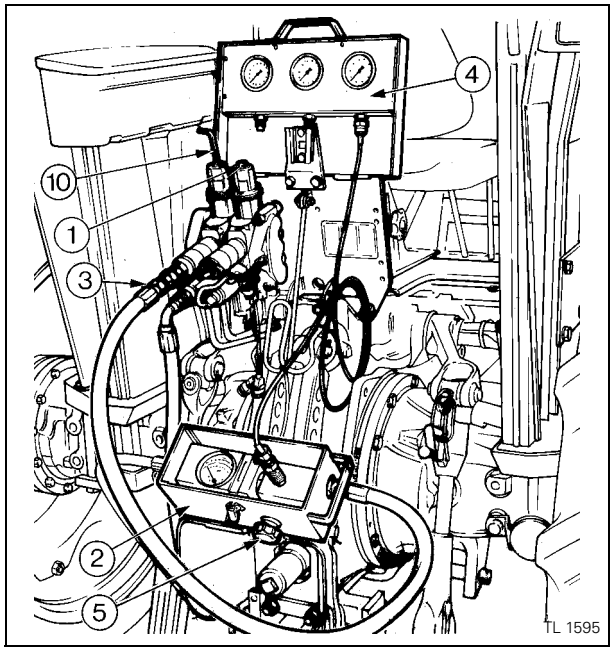
Special Tools:
MF.3001A Pressure Test Kit
MF.3002 Hose Kit
MF.3003 Hydraulic Flow Meter

Procedure

1. Remove the plastic plug from the end of the spring cap for access to the relief valve adjusting screw.
2. Fit the MF.3002 Hose Kit to the MF.3003 Hydraulic Flow Meter and fit two auxiliary male quick release couplings to each end of the hoses.
3. Connect the outlet side (right side) of the flow meter to the top port (No. 1) and the inlet (left side) to the bottom port (No. 2) on the control valve.
4. Connect the high pressure reading gauge in the MF.3001A Pressure Test Kit to the flow meter.
5. Open fully the loading valve on the flow meter.
6. Start the engine and run at 2000 rev/min, move the hydraulic control lever marked '1' and '2' forward into the locked position.
7. Slowly close the loading valve on the flow meter in order to raise the pressure on the service port. The pressure gauge will register the pressure on that service port.
8. The kickout pressure can be read from the pressure gauge at the moment of kickout, this should be at 172 bar (2500 lbf/in²).
9. If the mechanism will not hold in detent, kickout at a very low pressure, or it will not kickout at all, then it is likely that the relief valve setting needs adjusting.
10. Using a 5/32 inch A/F hexagon socket key through the hole in the spring cap, the adjusting screw can be located. Turn the screw clockwise to increase pressure, counter clockwise to decrease. DO NOT turn more than 1/4 turn without rechecking the setting.

NOTE: *Each 10° turn of the screw will change the pressure setting by approximately 2 bar (30* lbf*/in²).*

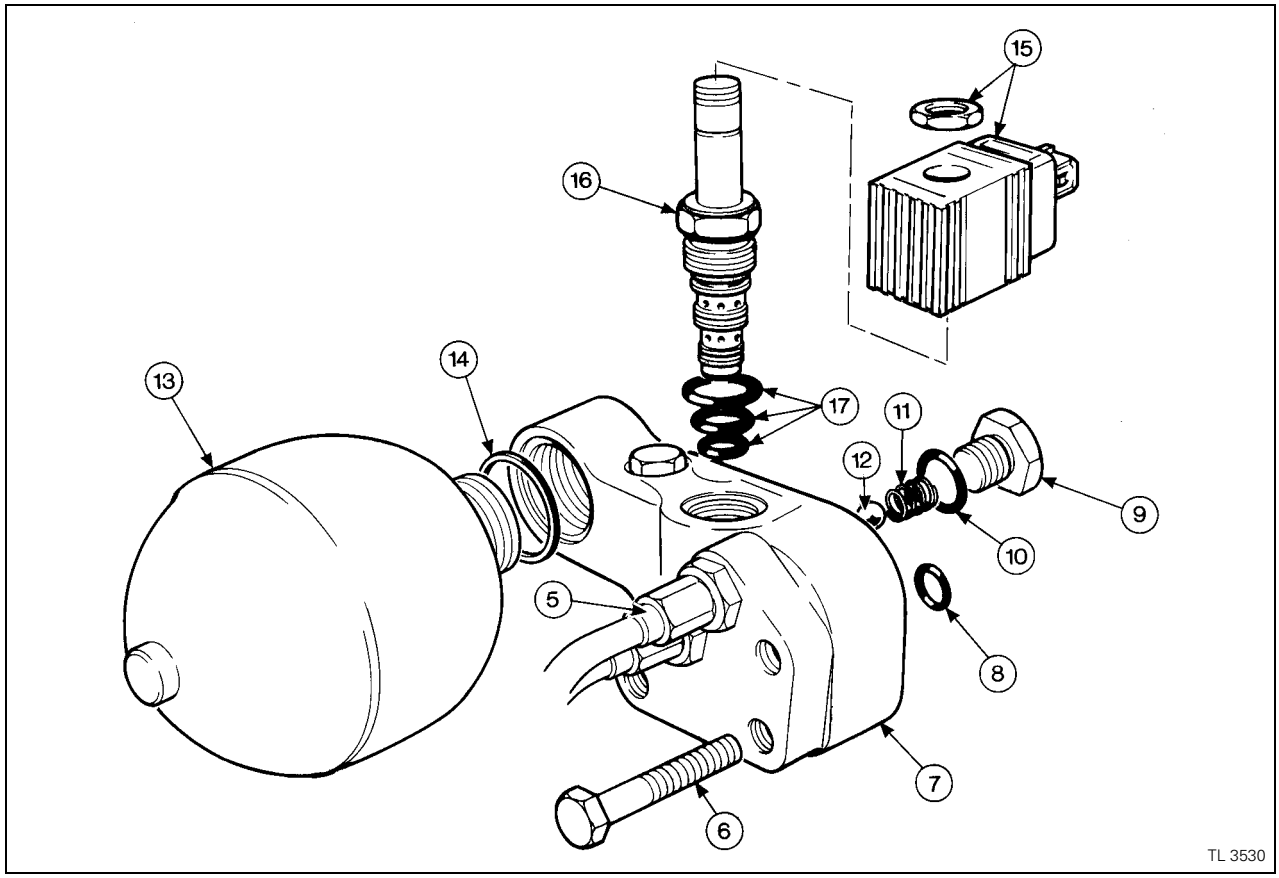
11. When the setting is achieved, recheck the setting using the loading valve on the flow meter five times to check repeatability.
12. Replace the plastic plug in the end cap and remove the hydraulic test equipment.



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Auxiliary Hydraulics



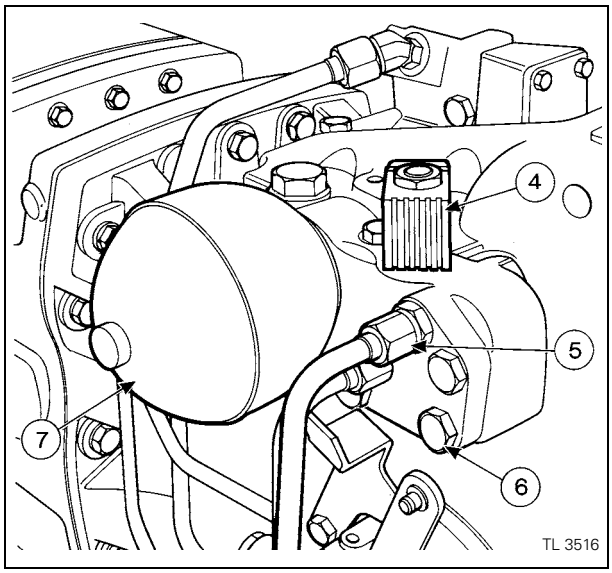
SPEEDSHIFT CONTROL VALVE

Overhaul 20-9C

The 18 x 6 Speedshift gearbox control valve is located on the left-hand side of the lift cover above the PTO control levers behind the fuel tank.

WARNING: Before working on the hydraulic system, exhaust the pressure from the hydraulic accumulator. Hydraulic oil pressure could cause personal injury.

1. Stop the engine.
2. With the ignition turned 'ON' operate the Speedshift button three times to exhaust any hydraulic pressure between the accumulator and the solenoid valve.
3. Turn 'OFF' the tractor ignition switch.
4. Disconnect the solenoid valve wiring.
5. Disconnect the hydraulic pipes.
6. Remove the three bolts.
7. Remove the valve assembly and place in a vice.
8. Remove and discard the 'O' ring between the valve block and lift cover.



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Check Valve

9. Remove the plug.
10. Remove the 'O' ring and discard.
11. Remove the spring.
12. Remove the check valve ball.

Accumulator

13. Unscrew the accumulator.
14. Remove the sealing ring from the valve block and discard.

Solenoid Valve

15. Unscrew the top nut and remove the coil.
16. Unscrew the valve from the block.
17. Remove and discard all 'O' rings.

Examination

Examine all components and replace any that are damaged or worn. Thoroughly clean all components and re-assemble using a small quantity of transmission oil.

Re-assembly

18. Reverse procedures 1 to 17 except:
    a. Before fitting the accumulator install a new sealing ring into the valve body.
    b. Tighten the solenoid valve body to a torque of 10 Nm (7 lbf ft). This is to prevent distortion of the valve body.
    c. When installing the coil, apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the nut (15) to prevent it vibrating loose and tighten only finger tight.
    d. Tighten the three valve body bolts to a torque of 60 Nm (45 lbf ft).
19. After the valve assembly has been installed, start the engine and check for operation and oil leaks.

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TRAILER BRAKE VALVE

Overhaul 21-9C

NOTE: *The main body of the trailer brake valve is not serviceable and replacement parts are not supplied. Components can only be obtained for the pilot flow valve, a seal kit is also available.*

Dis-assembly

1. Disconnect the brake fluid pipe, mask or plug the end to prevent ingress of dirt.
2. Disconnect the four hydraulic pipes.
3. Remove the securing bolts and the valve assembly.
4. Clean the outside of the valve and carry out the repair on a clean bench.
5. Remove the two hexagon socket screws.
6. Remove the cap and bleed screw.
7. Remove the pilot flow housing.
8. Remove and discard the gasket.
9. Remove and discard the 'O' ring.
10. The piston can now be pushed out of the housing.
11. Remove and discard the piston seal.

Examination

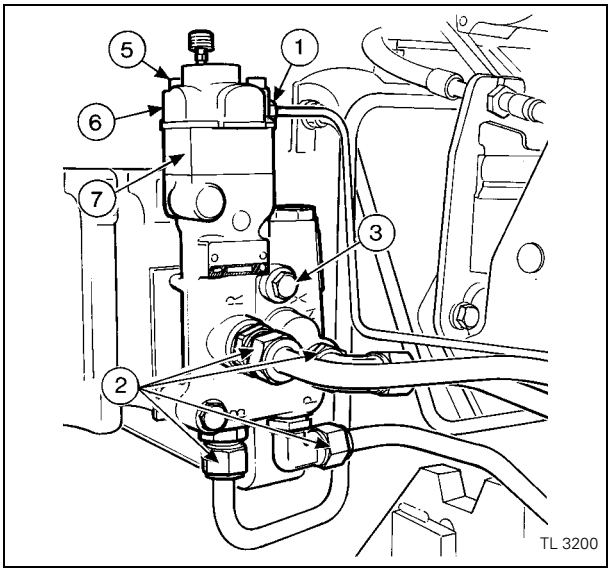
Thoroughly clean all parts by washing in a suitable fluid and drying with compressed air. Inspect the inside of the cylinder bore and the piston for any signs of scoring, abrasion or corrosion. No attempt must be made to clean up damaged or corroded parts.

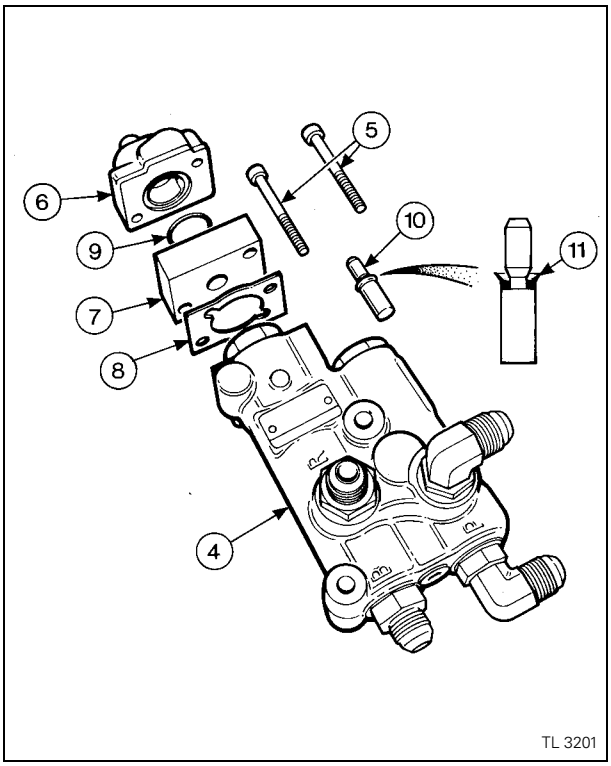
Re-assembly

12. Lubricate the inside of the cylinder, piston and seals with new clean mineral type brake fluid.
13. Fit the new seal from the service kit to the pistons taking care not to damage the seal lip.

NOTE: *The lip of the seal must face the turned down end of the piston.*

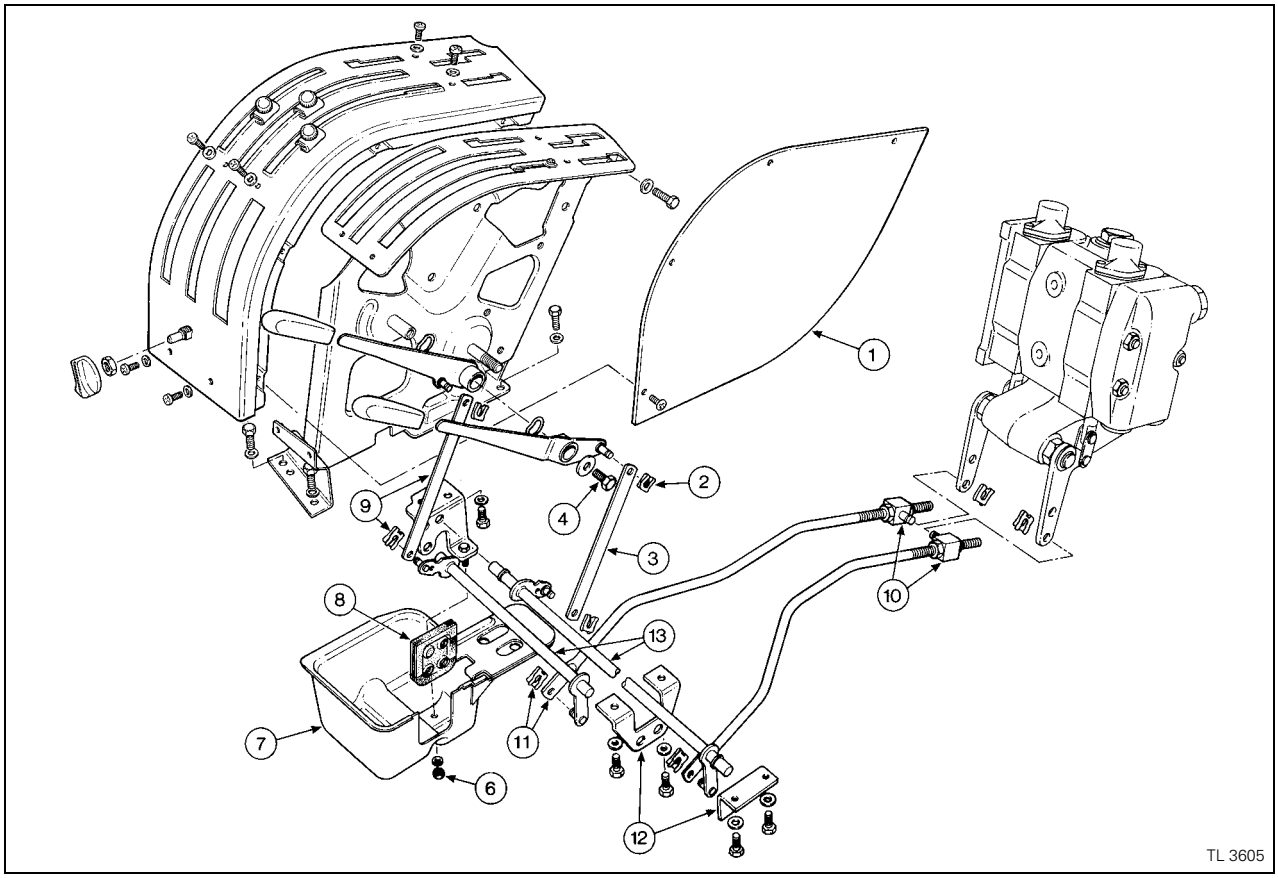
14. Ease the piston and seal assembly into the cylinder.
15. Refit the pilot flow housing using a new gasket.
16. Replace the 'O' ring on the cap.
17. Reverse procedures 1 to 5.
18. Remove air from the system, *(see operation 6-6A)*.





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HYDRAULIC CONTROLS

Overhaul 22-9C

Dis-assembly

1. To gain access to the inside of the control assembly, remove the four cross head screws and the side panel.

Hand Levers

2. Remove the spring clips.
3. Disconnect the control rods.
4. Remove the retaining bolt and washer.
5. Remove both levers and the wavy spring washers.

NOTE: *If it is necessary to remove the 3rd and 4th control valve levers, it will be necessary to remove the mounting bolts so that the frame can be tipped over to assist in extracting the levers.*

Control Rods

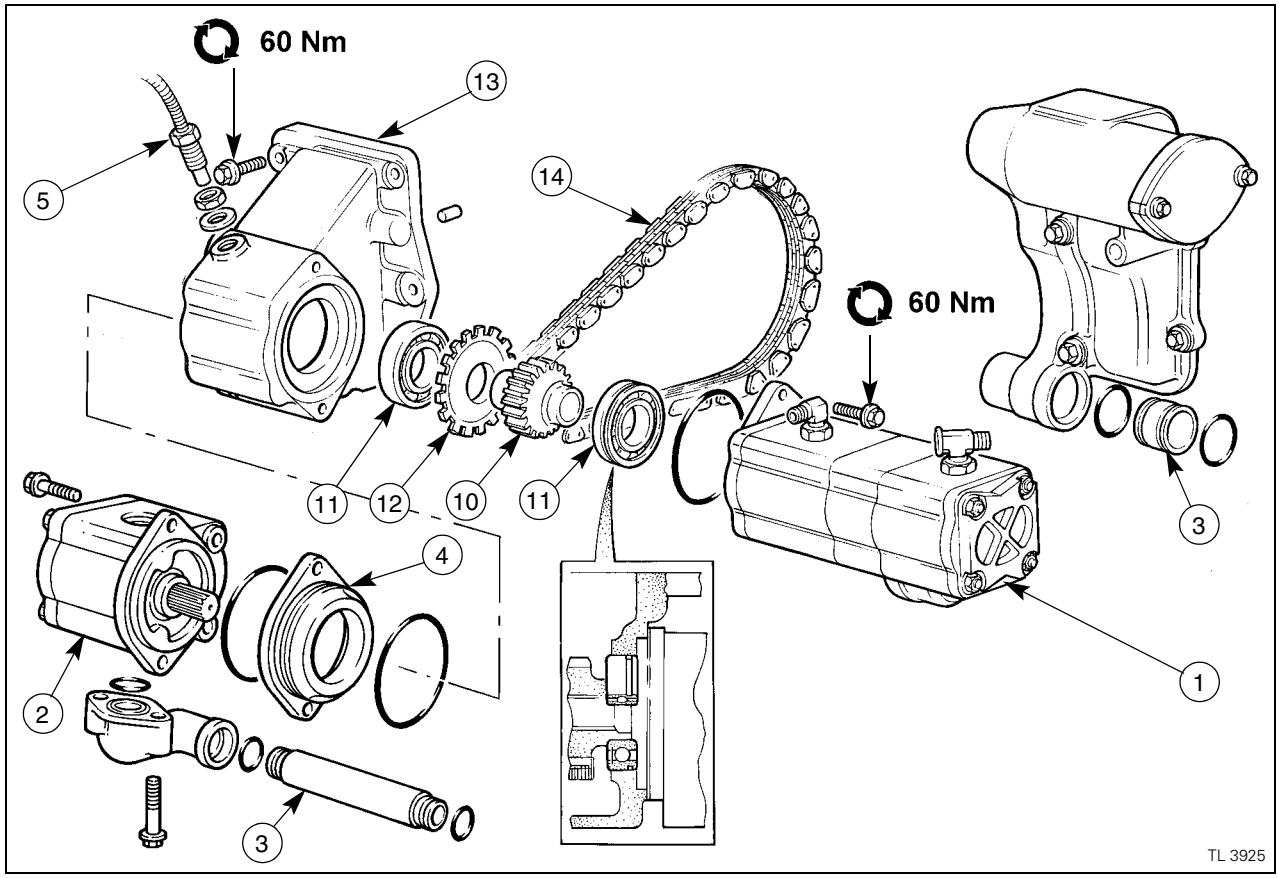
6. Remove the nut and washer.
7. Lower the cover down the draft and position control rods, sliding it out of the rubber seal.
8. Remove the rubber seal, cuts are provided in the rubber so it can be prised off the cross shafts.
9. Remove the spring clips and the control rods.
10. Disconnect the control rods at the control valve end by removing the spring clips.
11. Disconnect the control rods at the cross shaft end by removing the spring clips, remove the rods
12. Remove the bolts and the two mounting brackets.
13. Remove the cross shafts.

Re-assembly

14. Reverse procedures 1 to 13 except:
    a. Ensure that the rubber seal (8) is fitted correctly around the cross shafts and into the cover (7).
    b. Ensure that the wavy spring are in good condition and able to apply tension between the levers to prevent vibration.
    c. Adjust the control rods at the control valve end so that the lever on the console is in the centre of the slot when the valve is in neutral. Also, ensure that both levers are in line.

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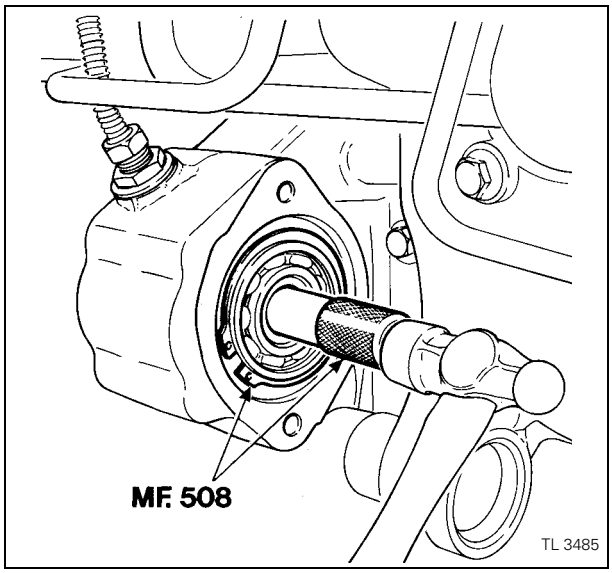
HYDRAULIC PUMP DRIVE

Removal and Refitment **23-9C**

Special Tools:
MF.508 Pump Drive Sprocket Remover

Removal

1. Remove the auxiliary hydraulic pump, *(see operation 11-9C).*
2. Remove the hydraulic lift pump, *(see operation 19-9A).*
3. Remove the connector between the two pumps and strainer housing. Examine the 'O' rings for damage, renew if necessary.
4. Remove the adaptor plate. Examine the 'O' rings for damage, renew if necessary.
5. Slacken the locknut and unscrew the speed sensor.
6. Using special tool MF.508 Pump Drive Sprocket Remover, insert the tool into the drive sprocket from the rear. Lightly drive the sprocket forward until the groove in the front ball bearing can be seen.
7. Install the circlip (part of MF.508) into the groove.

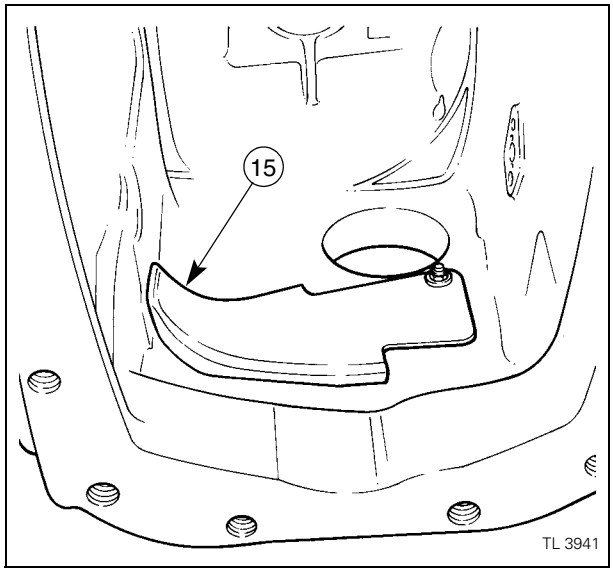


8. Insert the tool into the front of the sprocket and drive the sprocket back towards the rear. When the circlip comes in contact with the face of the housing the sprocket will now be driven out of the bearing.
9. When the sprocket is free, unhook the chain and use a piece of metal to prevent the chain going back into the transmission case.

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10. Remove the sprocket and bearing.
11. Remove the bearings if necessary.
12. Remove the speed sensor wheel if necessary.
13. Remove the six bolts and the housing. Dowels are used to locate the housing to the rear axle casing.
14. The drive chain will be retained by the PTO clutch. To remove the chain, *(see operation 3-7A)* in the PTO section.
15. Inside the transmission case there is a deflector fitted to the oil intake to the suction strainer. This prevents air laden oil being taken into the hydraulic pumps.



Refitment

16. Apply Multi-Gasket (Loctite 573) to the housing face and tighten the bolts to a torque of 60 Nm (45 lbf ft).
17. Reinstall the speed sensor wheel and bearing on the rear of the sprocket if removed.
18. Place the sprocket in the chain and fit the rear cover to hold the sprocket and chain in position.

IMPORTANT: *The front ball bearing MUST be fitted with the groove to the front, or the bearing shield to the inside, otherwise it will not be possible to remove the bearing and sprocket assembly at a later date if required, (see inset in illustration).*

19. Fit the front ball bearing installing it onto the sprocket and into the housing.
20. Screw the speed sensor into the housing until it touches the toothed wheel, then back-off by half a turn. Tighten the locknut.
21. Refit the hydraulic pumps *(see operation 19-9A and 12-9C).*

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SECTION 10

Electrical System

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10A	ELECTRICAL SYSTEM
10B	CAB WIRING DIAGRAMS
10C	FOOTSTEP WIRING DIAGRAMS

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Electrical System

Section 10 - Part A

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Electrical System

SPECIFICATION

Voltage	12 volt negative earth.
Battery:	
Make	Exide
Type:	
Single battery installation	Type 665.
SAE rating	775A.
IEC rating	505A.
DIN rating	480A.
Ampere hours	105
Reserve capacity	180 mins
Size	341 x 175 x 233 high.
Terminals	Standard post.
Bench charging rate	10.5 amps.
Double battery installation	Type 672.
SAE rating	590A.
IEC rating	420A.
DIN rating	400A.
Ampere hour	70.
Reserve capacity	120 min.
Size	277 x 175 x 195 high.
Terminals	Standard Post.
Bench charging rate	7 amps.
Maximum charging voltage	15 volts.
Battery test data with Multimeter:	
Fully charged	12.7 volts +.
50% charged	12.4 volts.
Discharged	12.0 volts.
Battery test data with Hydrometer:	
Fully charged	Below 25°C = 1.270-1.290. Above 25°C = 1.210-1.230.
70% charged	Below 25°C = 1.230-1.250. Above 25°C = 1.170-1.190.
Discharged	Below 25°C = 1.110-1.130. Above 25°C = 1.050-1.070.
Starter motor:	
Make	Iskra
Model	AZF 4520 4x6 cylinder, AZJ 3 cyl
Type	Solenoid engaged pinion, safety start device operated by the gear shift lever and PTO.
Size	3 Kw.
Alternator:	
Make	Iskra
Model - Cab tractor	AAK-80 External Fan, AAK-120 Internal Fan
Maximum output - Cab tractor	80 amp.
Model - Footstep tractor	A127-45.
Maximum output - Footstep tractor	45 amp.
Regulating voltage	13.6-14.2 volts.
Belt tension	10 mm (3/8 in) or 350 Nm (80 lbf).

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Fuses:	
Type	Continental blade.
Application	See fuse chart.
Sizes and colour:	
2 amp	Clear.
5 amp	Tan.
7,5 amp	Brown.
10 amp	Red.
15 amp	Blue.
20 amp	Yellow.
25 amp	Natural white.
30 amp	Green.

Light Bulbs - Type and Part Number

Application	Watts	Type	Massey Ferguson Part No.
Headlight	60/55	Continental UEC	916 866 M1.
Side light	5	Single contact SCC	963 333 M1.
Rear and stop light	5/21	Double contact index SBC	908 543 M1.
Direction indicator light	21	Single contact SCC	621 235 M1.
Number plate light	5	Festoon	621 234 M1.
Work light	55	Halogen H3	1628 494 M1.
Interior light	5	Festoon	621 234 M1.
Instrument panel warning lights	2.2	Integral bulb and holder	
Instrument illumination lights	1.2	LED	3405 185 M1
Rotating beacon	55	Halogen H1	3405 180 M1

Test Data

Relay coil resistance	85 ohms approximately.
Speed sensors	350 ohms approximately.
Speed sensor clearance	0,6 mm (0.025 in).
Solenoid coil resistance	9-10 ohms.

Test Equipment

MF.3005	Digital Multimeter
	Battery Hydrometer.
	Test Kit with DC Volt and Ammeter.

Bolt Torques

Starter motor main terminal	38 Nm (28 lbf ft).
Solenoid valve coil body	10 Nm (7 lbf ft).
Solenoid valve coil nut	Finger tight.

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Electrical System

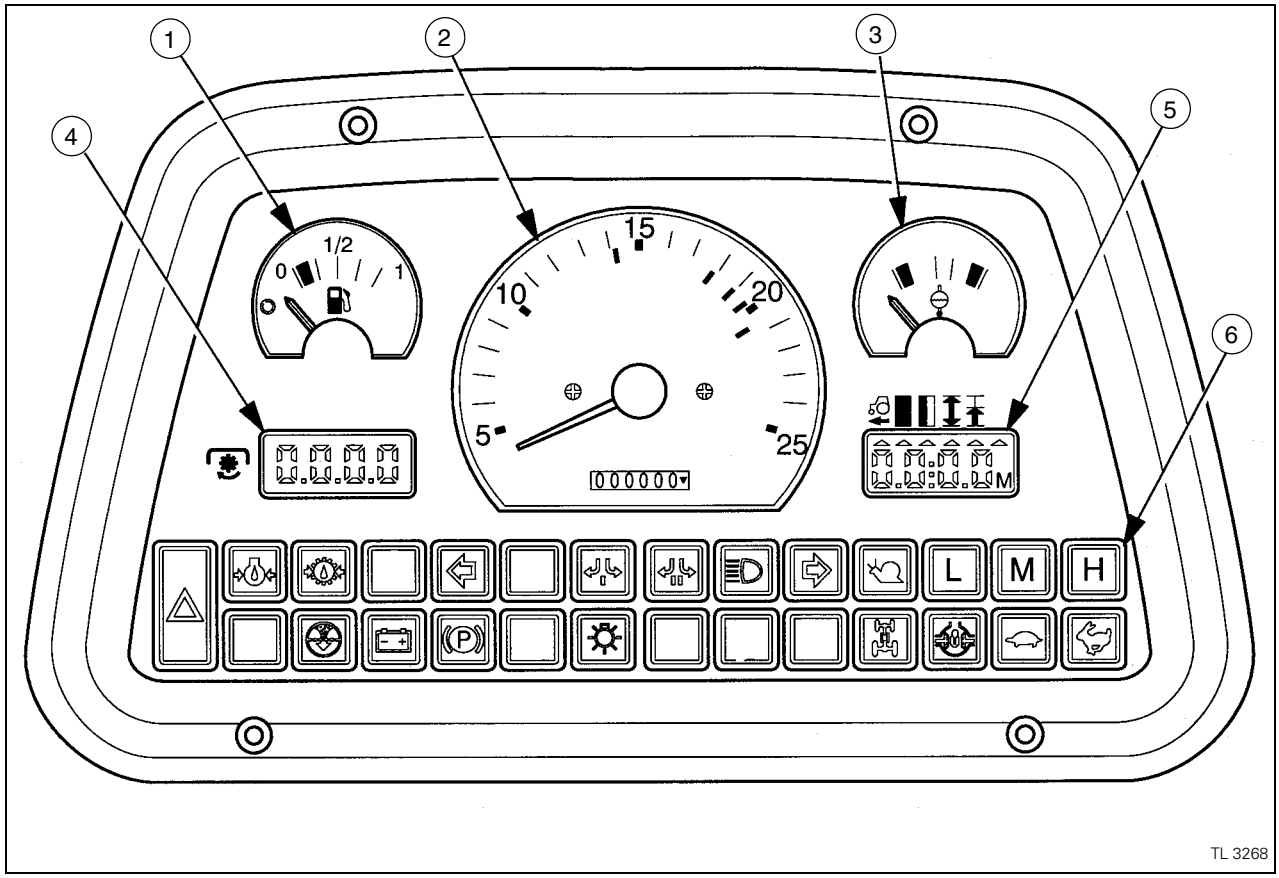


Fig.1 Instrument Panel

GENERAL DESCRIPTION

The electrical system on the 4200 series tractors comprises of a 12 volt negative earth system, charged by a 70 ampere alternator. The alternator has an integral rectifier and regulator and the charging control is machine sensed. The alternator is mounted on the right-hand side of the engine and is driven by a V-belt from the crankshaft pulley. Adjustment of the V-belt tension is provided for with a slotted link and clamp bolts on the alternator.

The starter motor is a pre-engaged type mounted on the left-hand side of the engine. Neutral safety start switches are fitted to the transmission gear levers and the PTO control lever. This renders the starter motor inoperative until both the levers are in the neutral or disengaged position.

The tractors can be supplied with one or two 12 volt batteries mounted in front of the radiator, access is made by removing the front grille. On tractors with a high visibility hood the batteries are mounted behind the right-hand footstep, access is made by swinging the battery carrier out from under the tractor.

The console is of similar layout on all 4200 series tractors comprising of an integral instrument panel and warning lights. Switches are provided for the main lights and hazard warning; rotary switch for engine starting and a control stalk for horn, direction indicators and headlight flash. The main fuse board is mounted behind a cover below the steering wheel, relays behind the instrument panel.

The roof of the cab contains the environment conditioning equipment, heating, cooling and air conditioning when installed. Switches for the work lights, windscreen wash/wipe, rotating beacon. It can also equipped with a clock, radio and rear window wash/wipe. the fuses and relays for the cab are mounted behind covers in the door pillars.

In addition to the fuses, the electrical system is protected by fusible links at the power supply point on the starter motor. In the event of a major short circuit in the wiring harness one of the fusible links will blow. The fusible link in not replaceable, the harness must be replaced.

Instrument Panel (Fig.1)

The instrument panel is supplied from a variety of sender units and switches, these senders are all basically electrical in design, therefore the panel receives no mechanical inputs.

The instrument panel has a number of displays and warning lights as follows:

1. Fuel Gauge - Shows the amount of fuel in the tank, equipped with a small orange low fuel warning light.
2. Tachometer - Showing engine revolutions and hour meter.

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3. Temperature Gauge - Shows the temperature of the coolant in the engine.
4. PTO Speed Indicator - Optional accessory, shows the rotational speed of the PTO shaft at the rear of the tractor.
5. Speed Indicator - Optional accessory, this instrument comes in two forms; as a speed indicator showing the forward speed of the tractor; or as a Performance Monitor indicating:
   - Forward speed.
   - Total distance.
   - Trip distance.
   - Total area cultivated.
   - Trip area covered.
6. Instrument warning lights - These lights give warning of system problems or indication of engaged services. The lights are as follows starting with the top row from the left:
   - Warning light and buzzer - Stop and Investigate.
   - Engine oil pressure - Warning.
   - Hydraulic oil pressure - Warning.
   - Left-hand direction indicator - Indication.
   - Single trailer direction indicator - Indication.
   - Double trailer direction indicator - Indication.
   - Main headlight beam - Indication.
   - Right-hand direction indicator - Indication.
   - Creeper gear engaged - Indication.
   - L, M, H range gearbox - Indication.

Bottom row (left to right):

- Engine air filter blocked - Warning.
- Battery not charging - Warning.
- Parking brake applied - Indication.
- Main lights ON - Indication.
- Four-wheel drive engaged - Indication.
- Differential lock engaged - Indication.
- Speedshift SLOW engaged - Indication.
- Speedshift FAST engaged - Indication.

When the starter switch is turned on all the warning lights will come on and a warning buzzer will sound briefly, this is an automatic check of the system. After seven seconds the lights will go out. Only the lights giving a warning will remain lit. In the event of a problem with one of the circuits monitored by a warning light, the buzzer will sound and the warning light will illuminate to indicate to the driver to stop and attend.

When the main lights are switched on, a dimmer comes into operation reducing the light level to the indicator lights; for example, four-wheel drive, differential lock etc. this is to prevent dazzle during night driving.

The tachometer is driven by a magnetic pick-up sensor over a toothed wheel in the auxiliary pump drive housing. The pulses drive the tachometer through an electronic interface which is set to suit the transmission to give accurate engine speed.

The power take-off speed display is also driven by a magnetic sensor over a toothed wheel, this is situated at the rear of the tractor in the extension housing between the rear axle and the power take-off guard.

The Speed Indicator and Performance Monitor is driven by a sensor behind the rear wheel hub flange.

On four-wheel drive tractors, the four-wheel braking system is electrically controlled. The four-wheel drive is normally engaged, requiring hydraulic power to disengage which is controlled by a solenoid valve. Both the parking brake and the foot brake have double pole switches, one part operating the indicator lights and rear stop lights, the other part disconnecting the electrical supply to the solenoid, thus engaging the four-wheel drive, giving four wheel braking.

The differential lock is also engaged and disengaged by a switch and solenoid valve.

Various sender units, or transmitters, are used to control the instruments and lights as follows:

- Low pressure switch - Engine oil pressure and hydraulic oil pressure.
- Vacuum switch - Air cleaner blocked.
- Push switch - PTO and transmission safety start.
- Variable resistance - fuel tank level.
- Temperature sensor resistor - engine coolant.

The wiring to all electrical services is an insulated earth return system, the earth wire (-) is colour coded black and is connected to the chassis at various point around the tractor.

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FAULT DIAGNOSIS

Fault diagnosis is the method of locating faults while the electrical equipment is still in position. In the interests of efficiency and economy, the diagnosis must be accurate and must be carried out in the shortest time using the minimum amount of equipment.

Massey Ferguson considers that the following is the minimum equipment necessary to carry out full diagnosis and to restore and maintain battery condition:

1. MF.3005 Digital Multimeter (Fig.2).

AC volts	0 - 750.
DC volts	0 - 1000.
Ohms	0 - 32M.
AC amps	0 - 10.
DC amps	0 - 10.

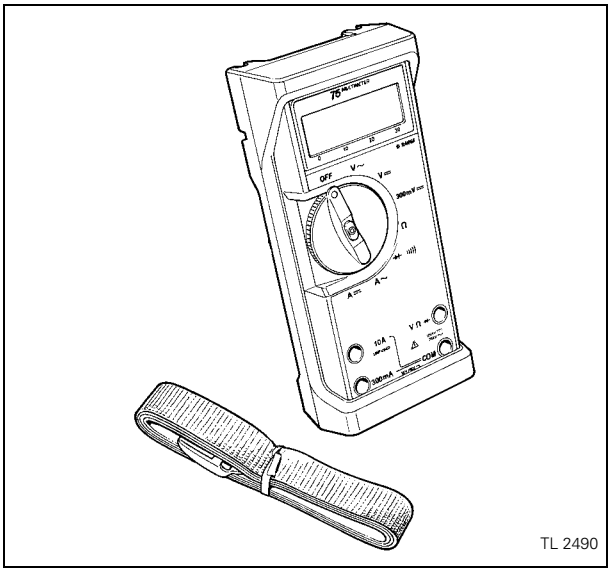


Fig.2

or alternatively:

2. Test kit comprising of a moving coil DC voltmeter (0-50 volts) and ammeter (10-0-100 amps) (Fig.3).

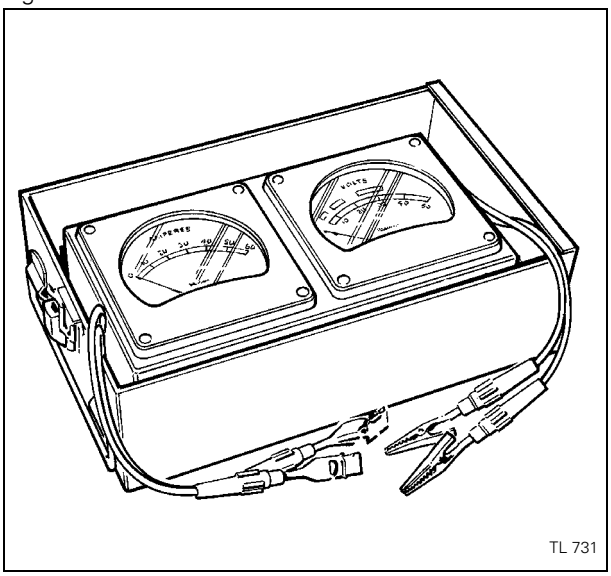


Fig.3

3. Battery hydrometer (Fig.4).

This equipment will be used in the diagnostic procedures shown in this Workshop Service Manual.

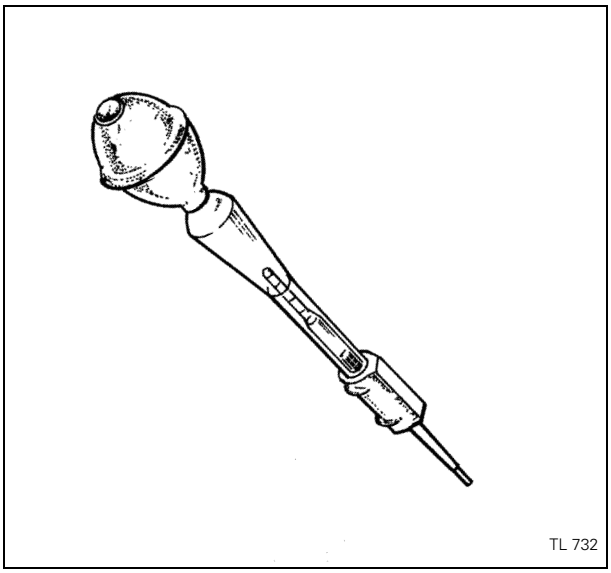


Fig.4

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FUSES and RELAYS

Check 1-10A

Fuses and relays are situated in five places as follows:

- Console fuse panel under the steering wheel.
- Left-hand cab door pillar.
- Right-hand cab door pillar.
- Air conditioner unit in cab roof - relays only.
- Behind the instrument panel - relays only.

The fuses installed in the fuse boxes and relays will depend upon the model specification.

Console Fuses

The fuses are in a hinge down panel in the console below the steering wheel. Turn the two screw heads (1, Fig.1) until the slots are vertical and hinge open. To close, turn the screw heads through 90° and push firmly in place. Identification of each fuse is as follows (Fig.2):

Fuse	amps	Description
A1	10	Left-hand main beam.
B1	10	Right-hand main beam.
C1	10	Left-hand dip beam.
D1	10	Right-hand dip beam.
E1	10	Non ignition switch auxiliary supply.
F1	20	Hazard warning lights.
A2	25	Thermostart.
B2	10	Upper roof main beam left - Germany only.
C2	10	Upper roof main beam right - Germany only.
D2	10	Upper roof dip beam left - Germany only.
E2	10	Upper roof dip beam right - Germany only.
F2	25	Auxiliary power socket.
A3	10	Ignition switch for auxiliary power.
B3	5	Differential lock & fast/slow lights
C3	5	Ignition relay.
D3	10	Air seat supply.
E3	5	Four-wheel drive.
F3	5	Lift control lock out - Japan only.
A4	5	Instrument console and warning lights/ range change/ground speed.
B4	15	Stop light - including trailer.
C4	5	Ignition fuel cutoff (engine stop).
D4	15	Direction indicator lights.
E4	–	Unused on this model.
F4	10	Horn.
A5	5	Electronic lift control.
B5	5	Reversing light and reversing horn - Japan only.
C5	15	Heater fan (floor mounted).
D5	10	Right trailer lights.
E5	10	Left trailer lights.
F5	5	Instrument panel illumination.

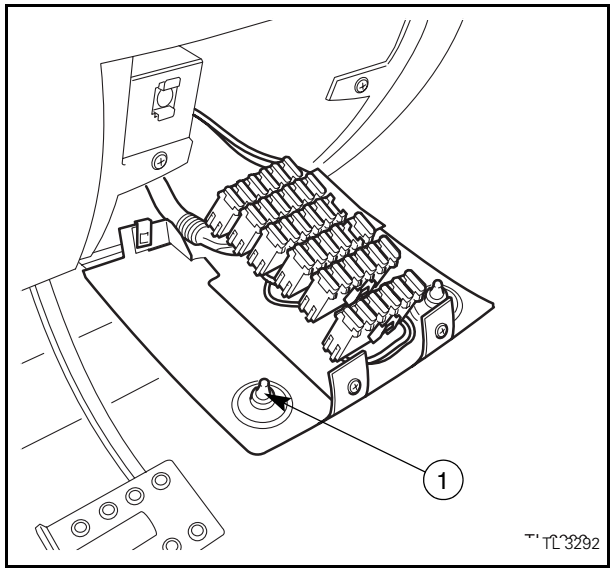


Fig.1

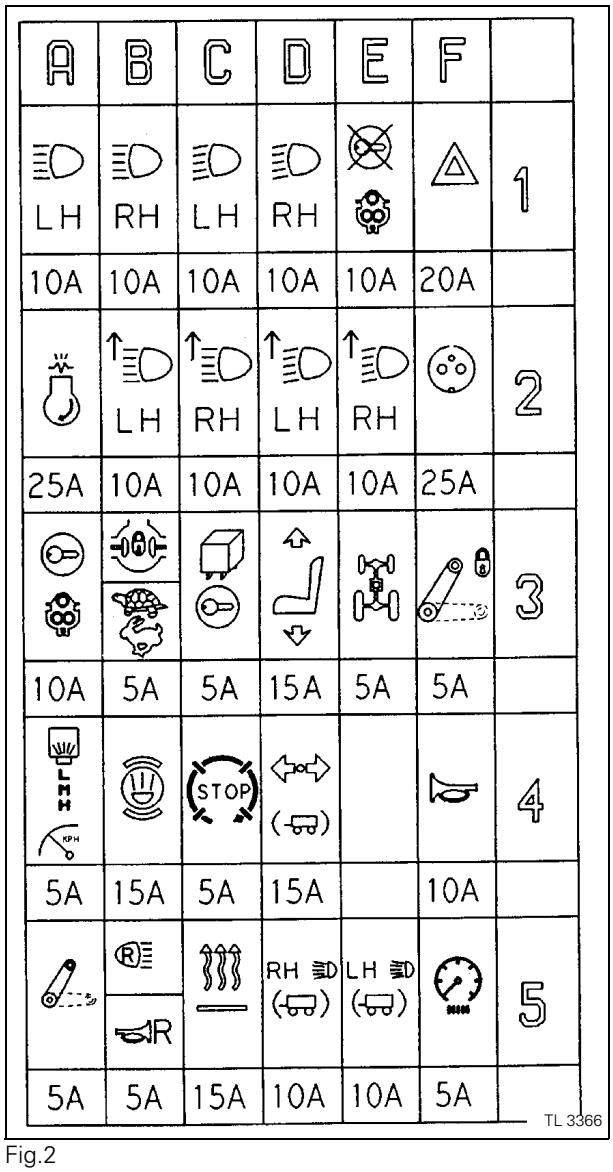


Fig.2

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Fuse ratings and colour codes:

Rating (amps)	Identification colour
5	Tan.
7.5	Brown.
10	Red.
15	Blue.
20	Yellow.
25	Natural (white).
30	Green.

Left-hand Door Pillar

The fuses and relays are situated behind the covers in both rear door pillars in cab tractors. Turn the screws (1, Fig.3) until the slots are vertical and pull the cover away to gain access:

Fuse ratings and location, (Fig.4).

Fuse	Rating (amps)	Description
A6	30	Rear work lights.
B6	-	Unused.
C6	-	Unused.
D6	15	Low level front work lights.
E6	-	Unused.
F6	15	Front work lights.

Relay

The relay (Fig.4) controls all work lights and is rated at 70 amps.

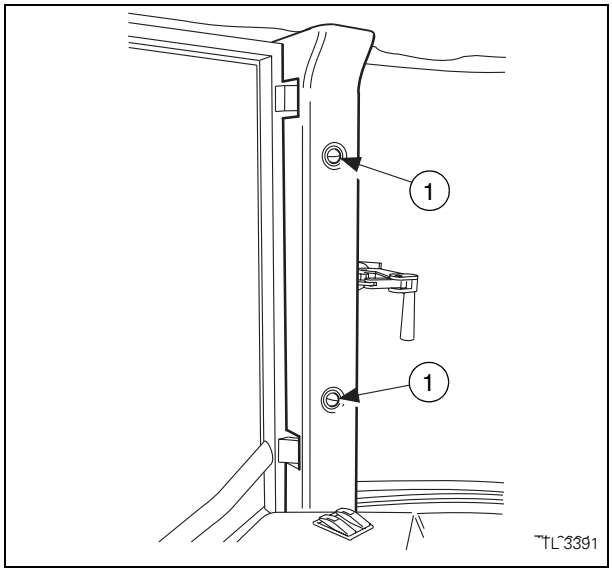


Fig.3

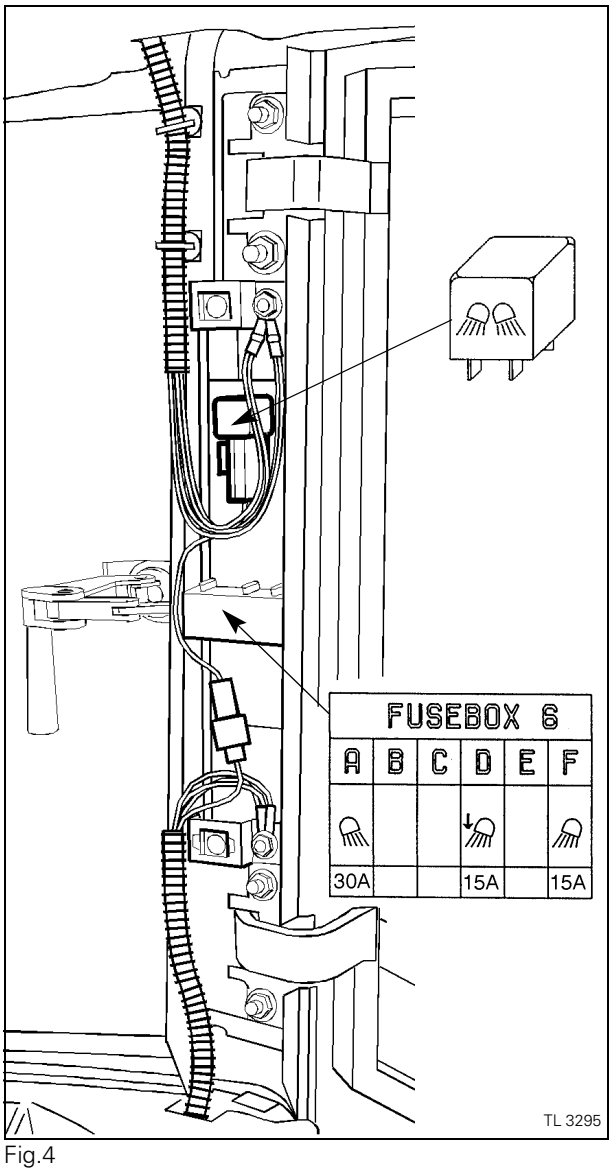


Fig.4

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Right-hand Door Pillar

Further fuses and relay is situated behind the cover of the right-hand door pillar, access is obtained in the same way as the left-hand side.

Fuse ratings and location, (Fig.5).

Fuse	Rating (amps)	Description
A7	10	Air conditioner clutch.
B7	10	Rotating beacon.
C7	5	Interior light and clock.
D7	10	Rear wash/wipe.
E7	10	Front wash/wipe.
F7	5	Blower motor/air conditioning.

Relay

The relay (Fig.5) controls all services in the cab roof supplied by the ignition switch and are inactive when the switch is turned OFF. It is rated at 40 amp.

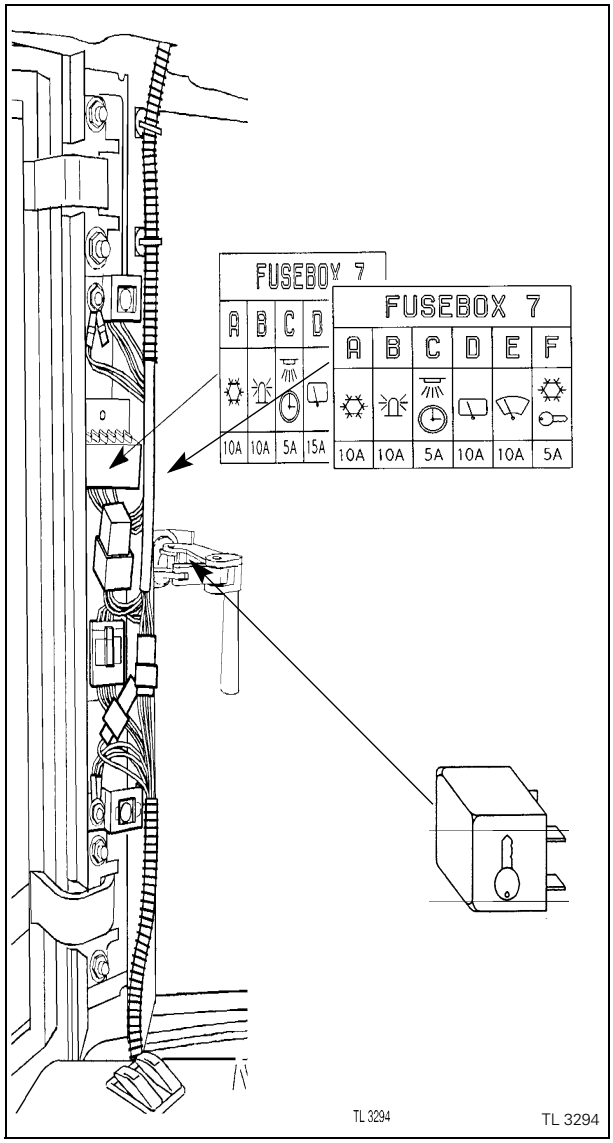


Fig.5

Air Conditioning Fuse and Relay

The fuse (1) and relay (2, Fig.6) servicing the air conditioner (optional) is situated under the front hatch on the cab, located on the right-hand side.

Fuse rating 30 amp (green). Relay is rated at 40 amp.

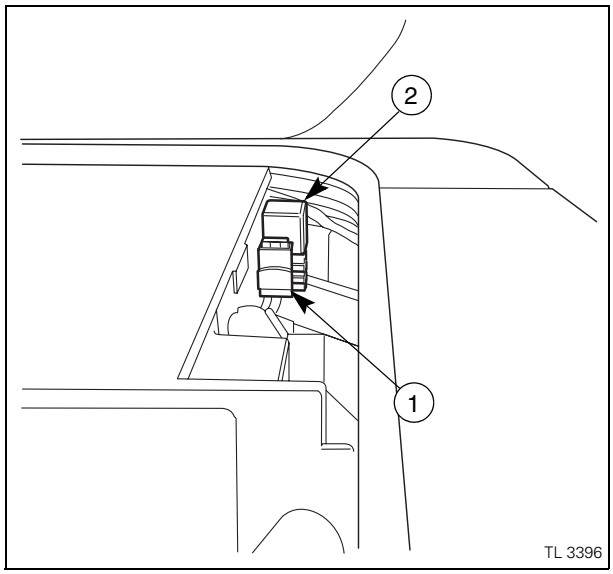


Fig.6

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Ignition Relay and Direction Indicator Flasher Unit

Mounted behind the instrument panel is the ignition relay (1, Fig.7), this controls all circuits which are supplied with power through the ignition switch and are inactive when the key switch is OFF; for example, differential lock, four-wheel drive, warning systems etc.

The direction indicator flasher unit (2, red) is also mounted behind the panel.

For removal of the instrument panel, *(see operation 9-10A).*

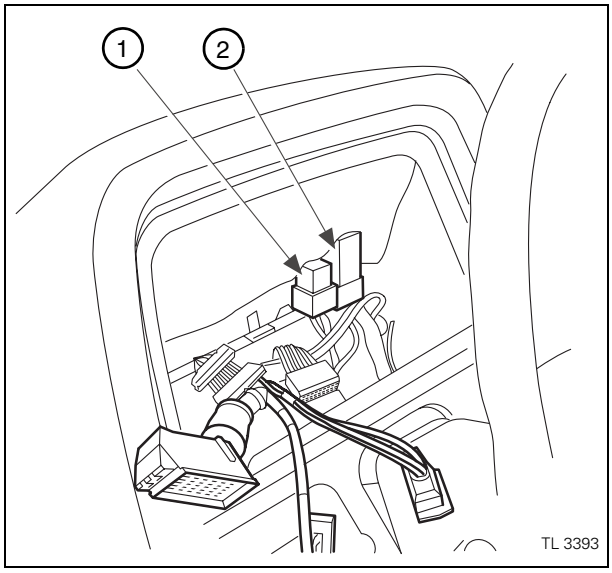
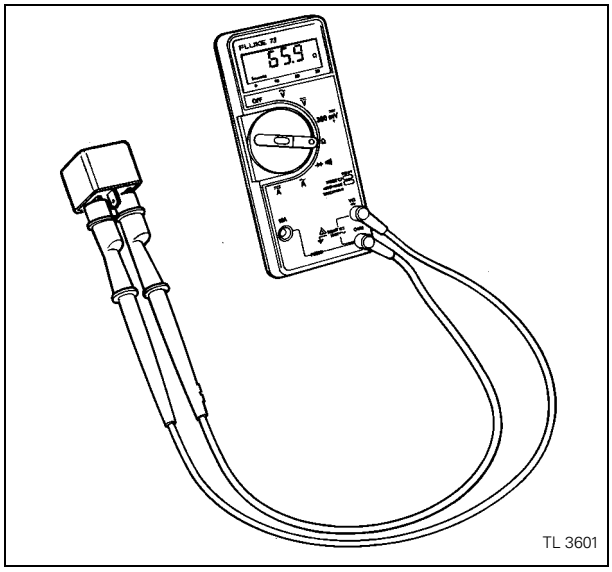


Fig.7

RELAYS

Removal and Refitment 2-10A

Test Equipment:
MF.3005 Digital Multimeter

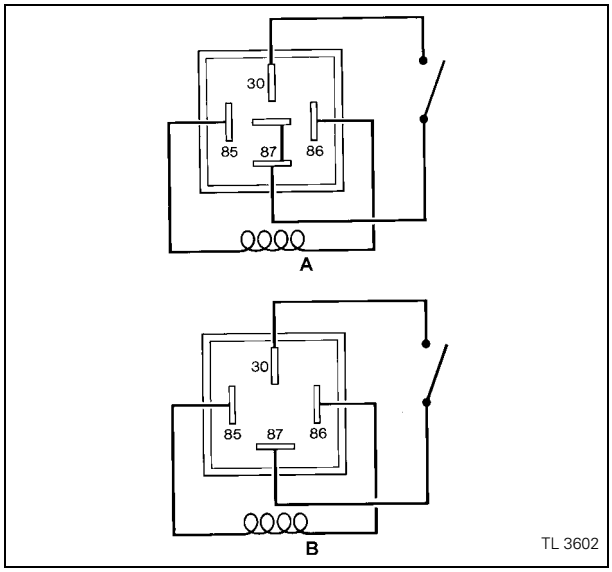


Test

Electrical relays are provided in the following services:

- Ignition relay - behind the instrument panel supplying all circuits around the instrument panel and engine and controlled by the key start switch. Relay type 'A' in illustration.
- Work lights relay - located behind the cover on the right-hand door pillar. Supplies all work lights around the cab roof and lower lights on the front cab posts. Relay type 'B'.
- Cab roof relay - Located behind the left-hand door pillar cover. Supplies all services, other than work lights, in the cab roof which are controlled by the key start switch. Relay type 'A'.
- Air conditioning relay - this relay will be found under the top roof hatch adjacent to the cab air filter housing. This controls the air conditioner magnetic clutch mounted on the compressor by the engine. Relay type 'A'.

The illustration shows the two types of relay used on the tractor, the pin lay-out, terminal numbers, and diagrammatically, the switch and coil connections. On relay type 'A' (40 amp) the centre pin and pin 87 are connected together. Relay type 'B', work lights, is rated at 70 amp.



Removal

1. Access and remove the suspect relay, *(see operation 1-10A).*
2. Test the coil between terminals 85 and 86 with the MF.3005 Digital Multimeter set on ohms.
3. The reading should be approximately 85 ohms.
4. Terminals 30 and 87 is the switch which is normally open, closed when the coil is energised.

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BATTERIES

Check **3-10A**

Test Equipment:
MF.3005 Digital Multimeter
Battery Hydrometer

Procedure

The batteries fitted to the 4200 Series Tractors are specified as 'maintenance-free', but are not 'maintenance impossible' as there is an access panel in the top cover which can be removed for inspection and 'topping-up' due to evaporation or caused by an overcharging fault occurring.

Maintenance-free batteries are rated to a standard specified by the International Electrotechnical Commission (IEC), which demands that certain, ampere output is available at a temperature of -18°C for a period of one minute under continuous cranking conditions. This output is defined as the Cold Cranking Ampere (CCA) capacity of the battery. Full specifications of the batteries is given *(on page 10A-2)*.

Safety Precautions

Observe the following safety precautions when handling batteries, your personal safety is at risk:

1. Take care when fitting batteries as they contain sulphuric acid. If splashed on skin or eyes, wash the affected parts immediately in water. Seek medical help immediately.
2. When mixing acid always ADD ACID TO WATER SLOWLY, NOT WATER TO ACID (Fig.1).
3. Explosive gases are given off when charging the battery. Keep the top well ventilated and away from flames or sparks.
4. Switch off the charger before disconnecting the charger leads.
5. When putting the battery into service on a tractor. Connect the earth lead (-) last and when removing the battery, disconnect the earth lead first.
6. Keep the battery away from children.
7. DO NOT smoke when handling or checking batteries.

Routine Maintenance

Routine maintenance is limited to the following points:

1. Keep the top of the battery clean and dry, wipe away spillage during top-up.
2. If the battery requires topping-up because of loss of electrolyte due to over charging or evaporation, use only distilled or ionised water.
3. Coat the terminals with petroleum jelly to prevent corrosion.

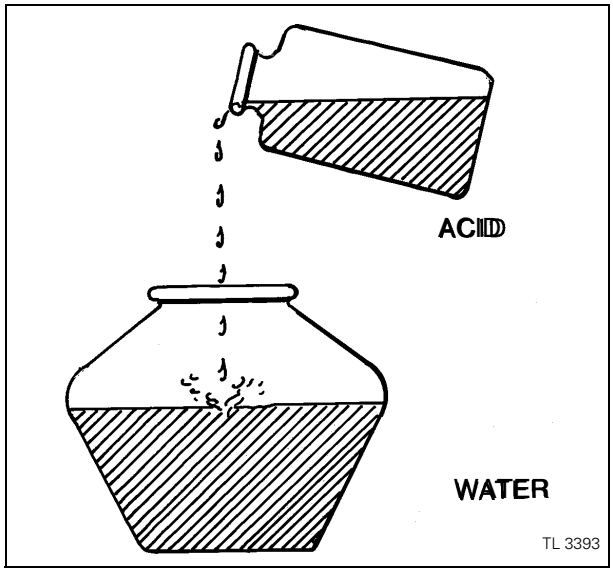


Fig.1

4. DO NOT allow the battery to fall below 70% state of charge.
5. DO NOT store a battery in a discharged state.
6. Ensure the battery is stowed correctly in the tractor.

Battery Charging

The boost charging of batteries is not advised at any time, but recharging as necessary should be carried out at a specific current, and a determined period of time according to the model and the tested voltage of the battery.

The ideal method of charging batteries is to use an automatic charger designed for the charging of low maintenance batteries and charged one at a time. If this equipment is not available the following instructions should be observed:

1. When more than one battery is to be charged at the same time must be:

a. Separated by model - DO NOT mix sizes; for example, models 372 and 665.

b. Separated by test voltage - use the voltage bands in Table 1.

c. Batteries must be connected in parallel.

NOTE: *The mixing of battery types, size and voltage bands will result in a number of the batteries not being fully charged.*

2. Test the battery with a digital multimeter; for example the Massey Ferguson MF.3005 Digital Multimeter, and note the reading.
3. Connect up the battery or batteries in parallel.
4. Switch ON the battery charger.

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5. Set the battery charger output in amps according to the size of the battery being charged. Nothing will be gained by putting up the charge rate, a damaged battery will result.
6. The output voltage of the charger should not exceed 15 volts across any one 12 volt battery.
7. Massey Ferguson battery charge rates:

   Model 372 battery- 7 amps

   Model 665 battery - 9 amps
8. Charge the battery for a period of time listed in Table 1 according to its voltage reading:

Battery charging times	
Battery voltage	Length of charge
Above 12.6 volts	4 Hours
12.4 to 12.59 volts	6 Hours
12.2 to 12.39 volts	10 Hours
12.19 & below	16 Hours

Table 1

9. Check the charger reading after 15 minutes and adjust the ampere if necessary.
10. Check and reset the charger after 2 hours.
11. Leave until the end of the charge period.
12. Switch OFF.
13. Leave the battery for 8 hours, then check the voltage which should be:

    12.7 volts or more for new batteries.

    12.5 volts or more for batteries which have been in service.

Putting into Service

When fitting the battery into the tractor ensure that it is properly secured by the hold down devices, and that the terminals and cables are clean and correctly and securely connected to the battery terminals. The connectors and terminals should be lightly smeared with petroleum jelly after they have been fitted.

Battery Storage

The storage life of a new charged battery providing it is maintained in accordance with the following instructions is approximately 18 months.

Wet charged batteries in storage or installed on tractors waiting to be sold should be fully charged and inspected every month by testing with a accurate digital multimeter:

If the voltage is above 12.4 volts - No action.

If voltage is below 12.39 volts - Remove and recharge.

It is important that the battery receives a freshening charge every 12 weeks (8 weeks in tropical climates).

Prior to delivery of a new tractor the voltage should be over 12.59 volts, if not, remove and recharge.

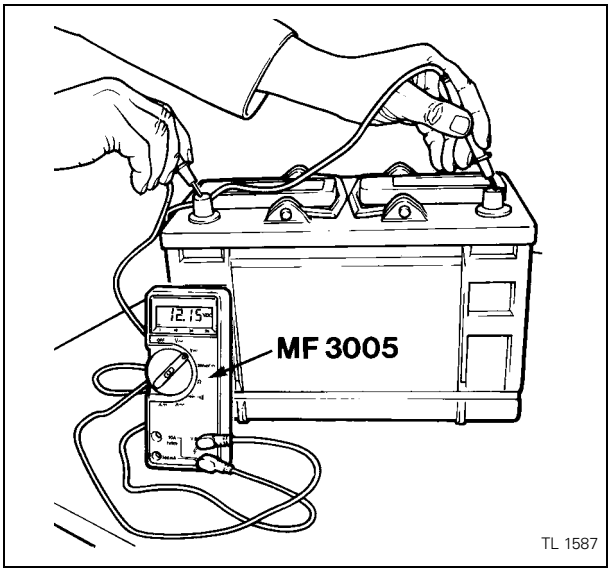


Fig.2

Battery Testing - Multimeter (Fig.2)

In order to obtain the best results from the battery, it must be maintained in the highest possible state of charge. This is best checked by measuring the open circuit voltage:

12.7 volts + Fully charged

12.4 volts 50% charged

12.0 volts Discharged

The voltage should be measured with a digital multimeter such as the Massey Ferguson MF.3005.

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Battery Testing - Hydrometer (Fig.3)

There is a relationship between the state of the battery charge and the strength of the electrolyte. As the battery becomes discharged, the specific gravity (S.G.) of the electrolyte becomes lower. The S.G. of the electrolyte is measured by means of an hydrometer.

From the specific gravity (S.G.) readings, a fairly accurate indication of the state of the battery charge can be obtained.

State of charge	Specific gravity readings	
	Climates normally below 25°C (77°F)	Climates normally above 25°C (77°F)
Fully charged	1.270 - 1.290	1.210 - 1.230
70% charged	1.230 - 1.250	1.170 - 1.190
Discharged	1.110 - 1.130	1.050 - 1.070

NOTE: *The hydrometer readings should not be taken if the battery has only just been topped up. it should be charged for 1 to 2 hours before taking a reading.*

BATTERY

Removal and Refitment 4-10A

The tractor can be fitted with either one or two batteries, behind the front grille or under the right-hand cab footstep.

Removal

Front Mounting (Fig.4 and Fig.5)

1. Remove the front grille.
2. Disconnect the NEGATIVE (earth) cables (1) from both batteries, if two are fitted.
3. Disconnect the POSITIVE (red) cable (2) from the battery.
4. Remove the nuts (3).
5. Remove battery securing clamp (4).
6. Remove the battery(ies) from the tractor.
7. To fit a new or recharged battery, carry out procedures 1 to 6 in reverse order and re-connect the positive (red) cable first. DO NOT over tighten the clamp nuts.

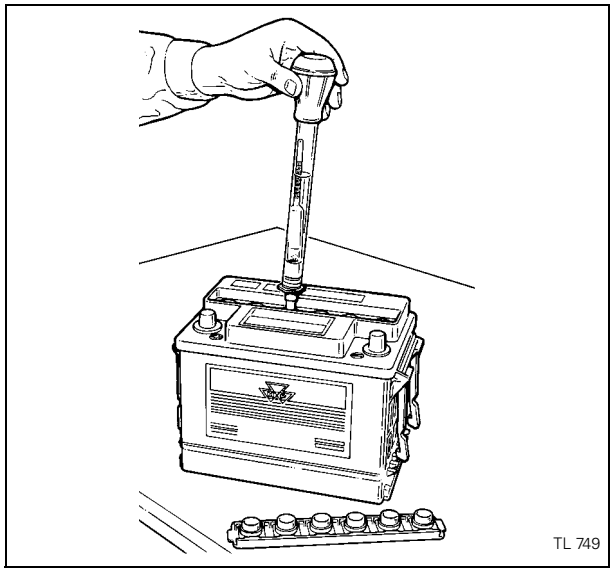


Fig.3

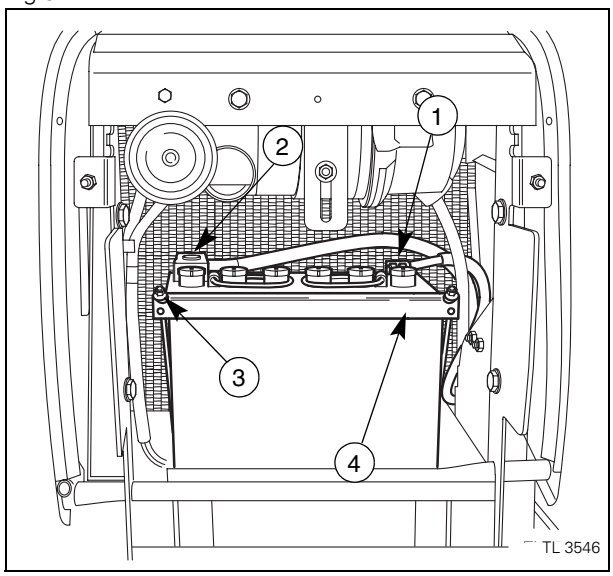


Fig.4 Single battery installation

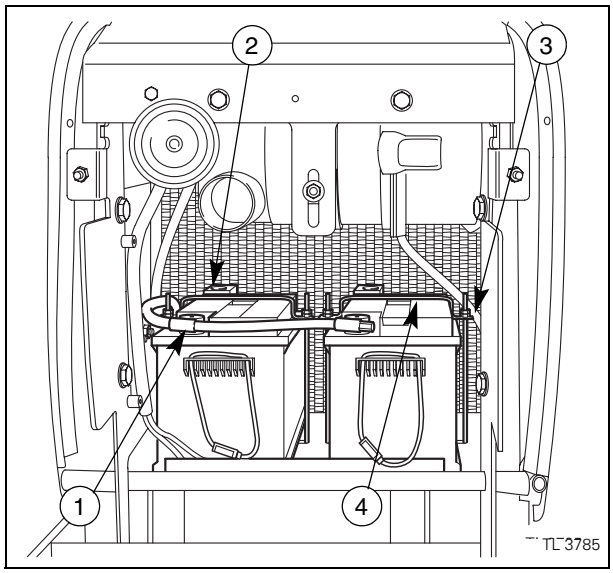


Fig.5 Double battery installation

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Footstep Mounting (Fig.6)

8. Remove the pin box.
9. Remove the 'R' clip and pin from the battery carrier (1) and swing it out to gain access.
10. Disconnect the NEGATIVE (earth) cables (2) from the battery.
11. Disconnect the POSITIVE (red) cable (3) from the battery.
12. Remove the two nuts (4).
13. Remove battery securing clamp (5).
14. Remove the battery from the tractor.
15. To fit a new or recharged battery, carry out procedures 1 to 7 in reverse order and re-connect the positive (red) cable first. DO NOT over tighten the clamp nuts.

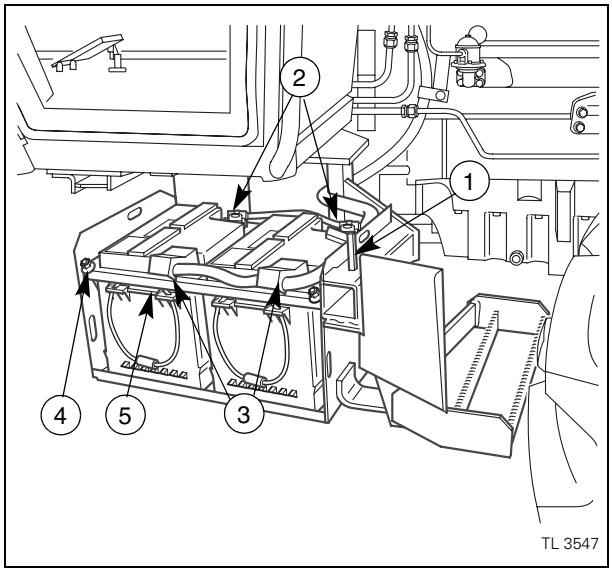


Fig.6

STARTER MOTOR

Check **5-10A**

Test Equipment:
MF.3005 Digital Multimeter
Battery Hydrometer
Ammeter/Voltmeter Test Kit

Procedure

The starter is a motor which converts electrical energy, supplied by the battery, into mechanical energy for the purpose of cranking the engine.

The 4200 series of tractors uses the pre-engaged type which is fitted with a solenoid which engages the starter pinion with the flywheel ring gear before the starter is energised. After engagement the pinion is retained in mesh for as long as is necessary to start the engine. When the engine is firing and the pinion is being driven at high speed by the flywheel, the armature is protected against over speeding by the flywheel action of an inbuilt clutch.

In the event of a problem with the starter motor or circuit the following procedure should be adopted:

TEST 1. Checking Battery Condition (Fig.1 and Fig.2)

Measure the open circuit voltage of the battery with the MF.3005 Digital Multimeter to establish the state of charge (Fig.1).

Diagnosis

Result	Action
12.0 volts	Discharged battery recharge or replace
12.4 volts	50% charged recharge
12.7 + volts	Fully charged

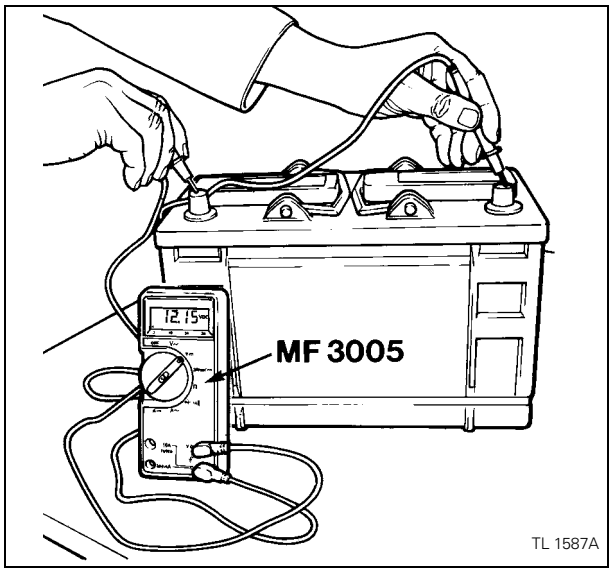


Fig.1

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Alternative Test

Take the hydrometer reading of the battery cells to establish the state of charge (Fig.2).

Diagnosis

Result	Action
Reading below 1.230	Discharged battery recharge or replace
Reading 1.230 to 1.290	Proceed to Test 2

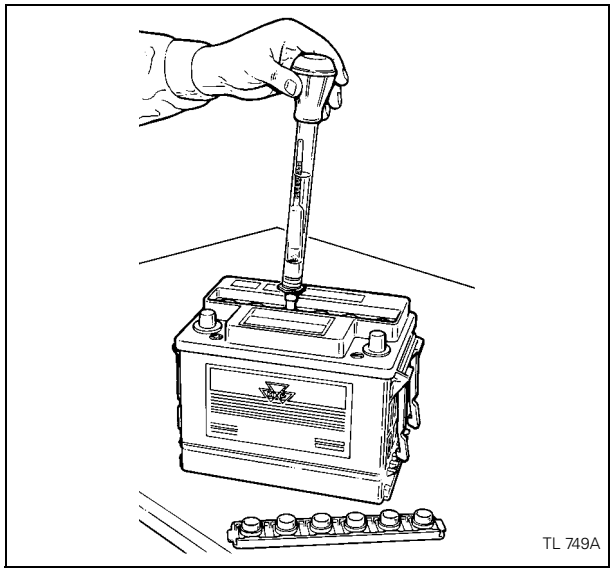


Fig.2

TEST 2. Checking Connections

Check all battery, earth, starter motor and solenoid connections are clean and tight.

Diagnosis

Result	Action
Loose and/or dirty	Rectify
Satisfactory	Proceed to Test 3

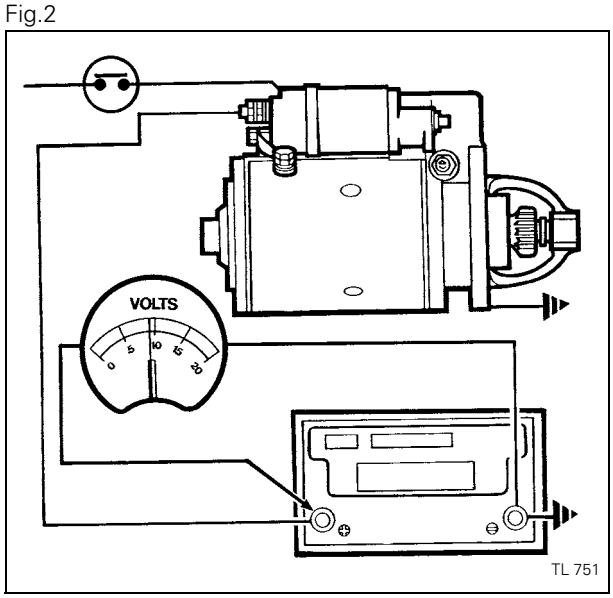


Fig.3

TEST 3. Checking Battery Voltage on Load (Fig.3 and Fig.4)

Connect a voltmeter across the terminals of the battery, as shown in Fig.3, stop control out, or, remove the electrical plug from the fuel injection pump, operate the starter switch.

Diagnosis

Result	Action
Reading below 9.0 volts	Remove starter motor for bench testing
Reading above 9.0 volts	Proceed to Test 4

NOTE: *If the solenoid operates intermittently during the test or the engine is cranked at a low or irregular speed, there may be insufficient voltage at the solenoid operating terminal or the solenoid is faulty.*

To check the circuit for high resistance (poor connections) connect the voltmeter between the solenoid operating terminal and earth (commutator end cover) as shown in Fig.4. When the switch contacts are closed, the reading on the voltmeter should be slightly less than the reading in Test 1. A satisfactory reading indicates a negligible voltage drop in the circuit and consequently the fault may be in the solenoid.

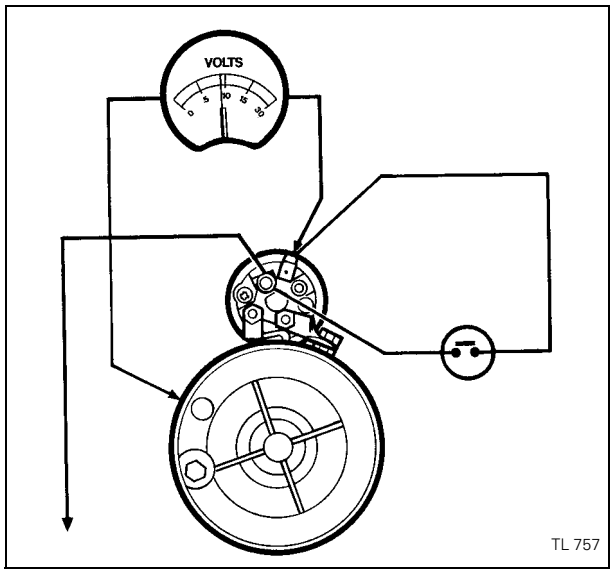


Fig.4

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TEST 4. Checking the Starter Terminal Voltage Under Load Conditions (Fig.5)

Connect the voltmeter between the starter input terminal and earth (commutator end cover) as shown in Fig.5, stop control out, or, plug removed, operate the starter switch.

Diagnosis

Result	Action
Difference in reading in Test 3 of 0.5 volts	Check all connections
Same as in Test 3	Proceed to Test 5

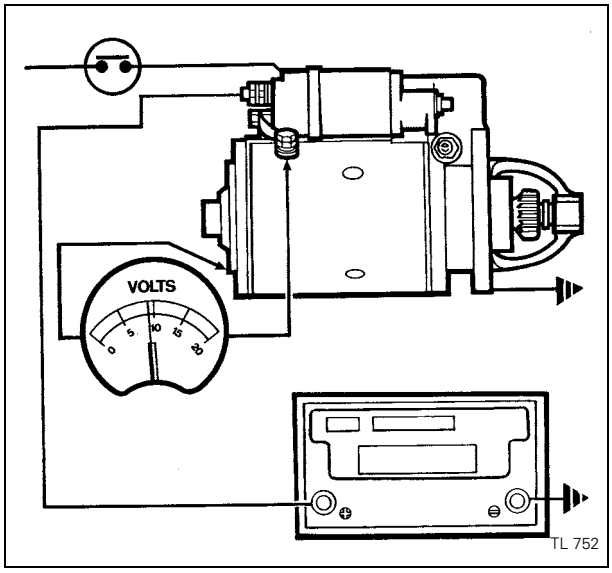


Fig.5

TEST 5. Checking the Voltage Drop on the Insulated Line. (Fig.6)

Connect the voltmeter between the starter input terminal and the battery positive (+) terminal as shown in Fig.6.

When the starter switch is open the voltmeter should register battery voltage. Stop control out, or, plug removed, operate the starter switch.

Diagnosis

Result	Action
High voltage reading	Rectify faulty or dirty connections
Voltage reading practically zero	Proceed to Test 6

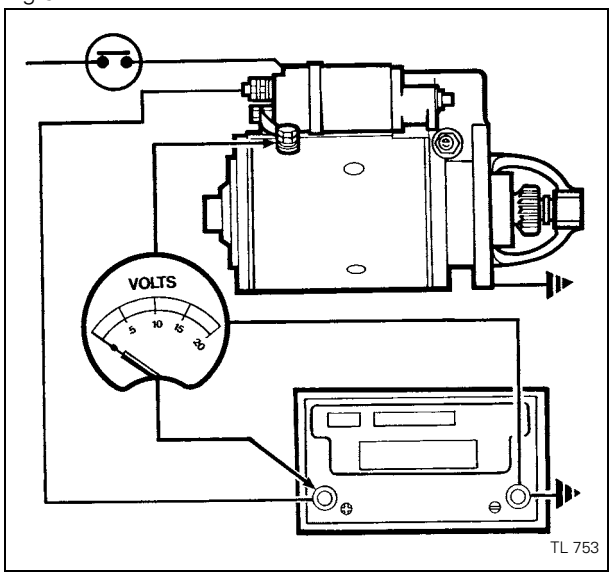


Fig.6

TEST 6. Checking the Voltage Drop Across the Solenoid Contacts (Fig.7)

Connect the voltmeter between the two main solenoid terminals as shown in Fig.7. When the starter switch is open the voltmeter should register battery voltage. Stop control out, or, plug removed, operate the starter switch.

Diagnosis

Result	Action
High voltage reading (similar to Test 5)	Faulty solenoid, replace
Voltage reading practically zero	Solenoid satisfactory proceed to Test 7

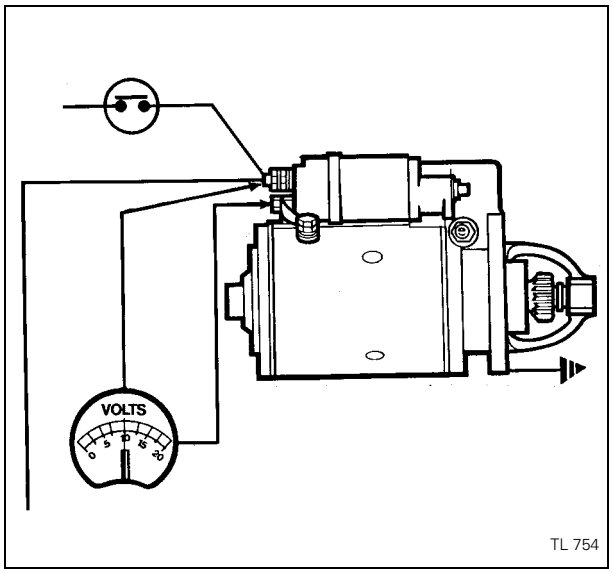


Fig.7

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TEST 7. Checking the Voltage Drop on the Earth Line (Fig.8)

Finally check the voltage drop on the earth line. Connect the voltmeter between the battery earth terminal (line 4), as shown in (Fig.8), at the following points:

1. Starter motor commutator end cover.
2. Starter motor body.
3. Engine.

Stop control out, or, plug removed, operate the starter switch.

Diagnosis

Result	Action
Above 0.5 volts	Check all earth connections between the battery and starter motor
Approximately zero voltage	Earth lines satisfactory

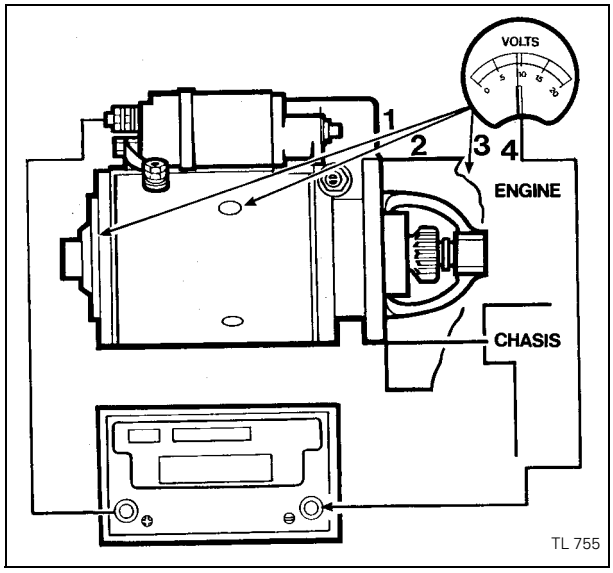


Fig.8

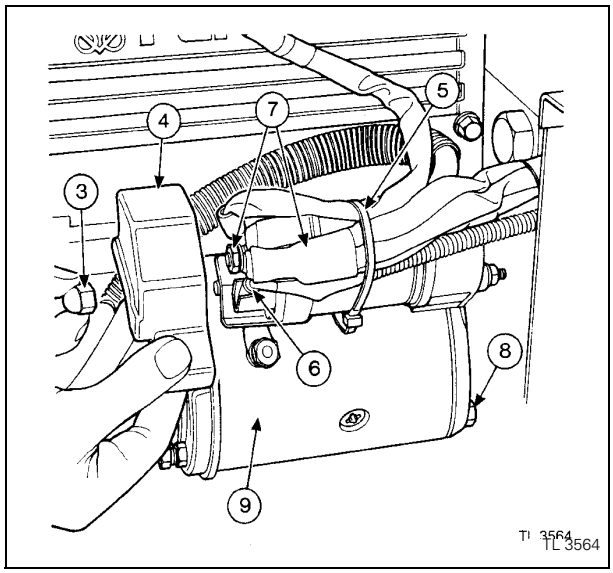
STARTER MOTOR

Removal and Refitment 6-10A

Removal

NOTE: *The starter motor on tractors with three cylinder engines is fitted on the right-hand side. The following instructions still apply:*

1. Remove the front grille.
2. Disconnect the negative cable (black) from the battery.
3. Remove the plastic dome nut from the terminal cover.
4. Remove the terminal cover.
5. Remove the plastic tie.
6. Pull the solenoid cable off its terminal.
7. Remove the nut and disconnect the three cables from the main starter terminal.
8. Remove the three bolts holding the starter motor. One of the bolts is behind the starter, a long extension will be required to remove.
9. Remove the starter motor.



Refitment

10. Reverse procedures 1 to 9 except:

a. Tighten the main starter terminal to a torque of 38 Nm (28 lbf ft).

b. DO NOT over tighten the plastic dome nut when replacing the terminal cover.

c. All the cables above the starter motor, including the return of the main battery cable, must be held together with a cable tie to keep them clear of the engine block.

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ALTERNATOR

Check **7-10A**

Test Equipment:
MF.3005 Digital Multimeter
Battery Hydrometer
Ammeter/Voltmeter Test Kit

Procedure

The alternator produces alternating current which is converted to direct current before being connected to the tractor electrical system. The alternator is provided to supply a source of electrical power used to charge the battery after starting and to operate all the tractor electrical services whilst the tractor is running.

Routine maintenance

Routine maintenance is limited to wiping away any oil or dirt from around the apertures on the alternator and cleaning any dust or chaff that has accumulated internally with a soft brush or air line.

Precautions in Service

Various precautions should be taken to avoid damage to the semi-conductor components within the alternator.

1. DO NOT connect or disconnect any part of the charging circuit, including battery, while the engine is running.
2. When using a slave battery, or battery charger always observe correct polarity (positive to positive, negative to negative).

Alternator Testing (Fig.1)

The following test will check for normal operation of the alternator by taking voltage and ampere readings at selected point in the circuit.

The alternator back cover has a plastic plug and socket. The small terminal is the indicator (IND) (3) connection from the charging warning light on the instrument panel. The two remaining terminals are the positive (+) (4) connections which are not used in this application. The positive supply is taken from a large separate terminal (2).

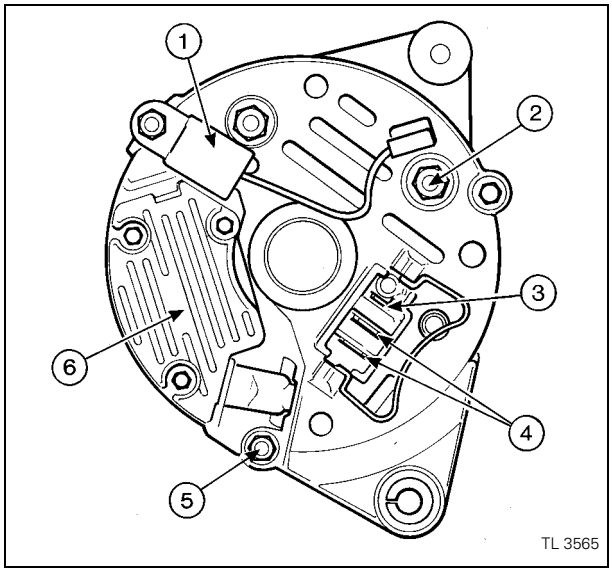


Fig.1

1.Radio interference suppressor.
2.Main positive terminal (+).
3.Indicator terminal (IND).
4.Positive terminals (not used).
5.Earth terminal.
6.Voltage regulator.

TEST 1. Battery Testing (Fig.2 and Fig.3)

Measure the open circuit voltage of the battery with the MF.3005 Digital Multimeter to establish the state of charge (Fig.2).

Diagnosis

Result	Action
12.0 volts	Discharged battery re-charge or replace
12.4 volts	50% charged recharge
12.7 + volts	Fully charged

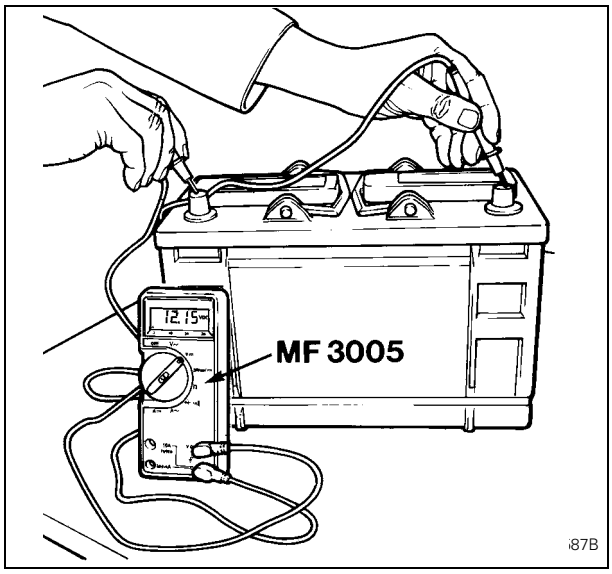


Fig.2

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Alternative Test

Take the hydrometer reading of the battery cells to establish the state of charge (Fig.3).

Diagnosis

Result	Action
Reading below 1.230	Discharged battery recharge or replace
Reading 1.230 to 1.290	Proceed to Test 2

A battery fault or low charge can have an adverse effect on the charging system.

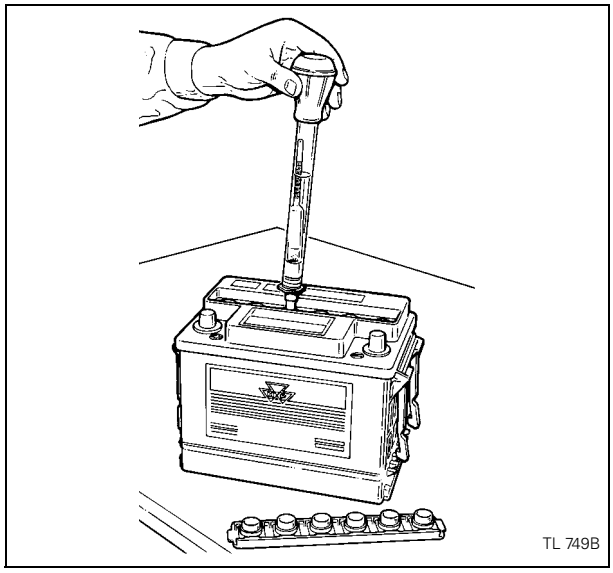


Fig.3

TEST 2. Drive Belt Tension (Fig.4)

Allow 10 mm (3/8 in) deflection, when moderate finger pressure is applied to the longest run at the belt, see 'A' Fig.4.

The alternator will not charge the battery if the belt is too slack. On the other hand, an excessively tight belt may damage the bearings.

If the belt is worn or oily, it must be replaced with a new belt.

Diagnosis

Result	Action
Belt slack	Adjust
Belt worn	Replace and adjust
Belt satisfactory	Proceed to Test 3

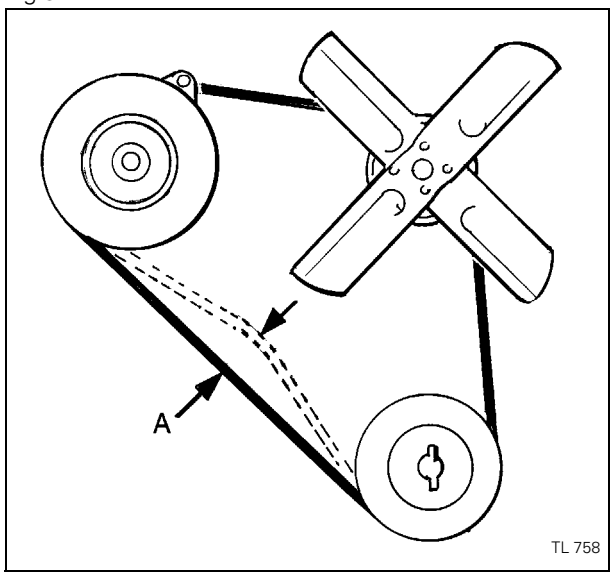


Fig.4

TEST 3. Alternator Connections (Fig.5)

Ensure that all wires are in position and that the connections are clean and tight.

Diagnosis

Result	Action
Loose and/or dirty	Rectify
Clean and tight	Proceed to Test 4

Key - Fig.5 to Fig.9

1.Alternator warning light.
2.Starter switch.
3.Starter solenoid.
4.Battery.

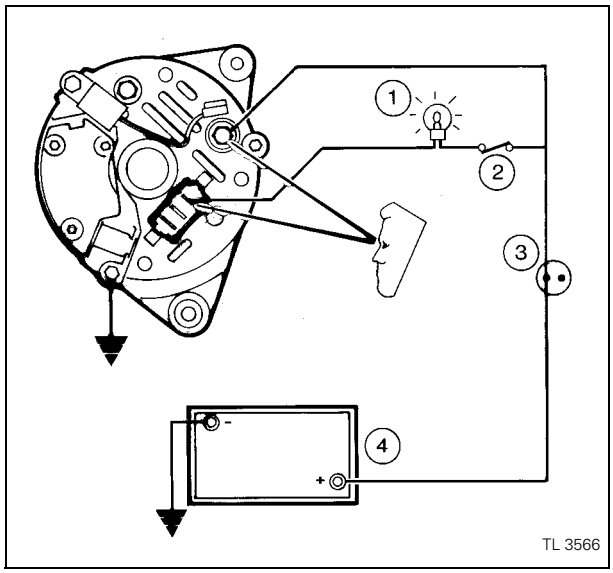


Fig.5

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TEST 4. Cable Continuity (Fig.6)

Remove the main cable (brown) from the alternator and connect the negative lead of the voltmeter (V_1) to the battery earth, then connect the other lead to the main cable.

Next, remove the plastic plug and connect the lead to the small IND terminal, the starter switch must be ON (NOT engine cranking).

The voltmeter should read battery voltage, if a zero reading is obtained on the small terminal (IND) check for a faulty bulb in the charging indicator light in the instrument panel, third bottom row.

Diagnosis

Result	Action
Readings below battery voltage	Check all wiring and connections
Readings of battery volt age	Proceed to Test 5

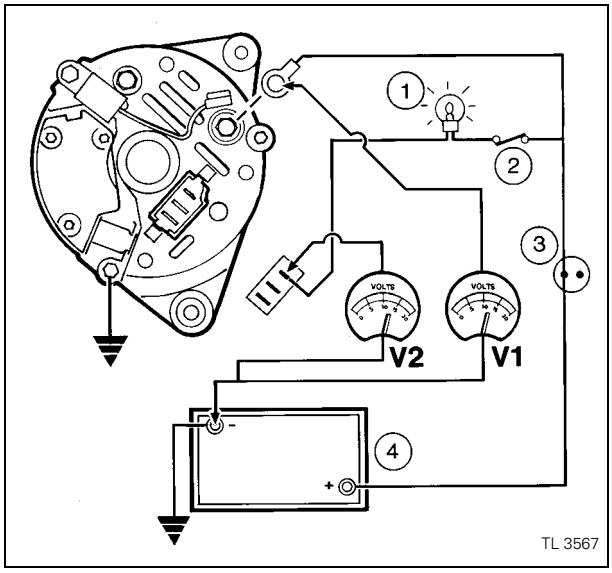


Fig.6

TEST 5. Alternator Output (Fig.7)

The alternator should be run for a few minutes to ensure that the tests are carried out at normal operating temperature. Then stop the engine.

1. Switch ON all lights and cab blower motor (except wipers) to create a load and discharge the battery for one minute.
2. Remove the main cable (Brown) from the back of the alternator.
3. Connect the ammeter between the large terminal and the brown cable. You will require an ammeter of at least 100 amp capacity.

IMPORTANT: *The clips or test probes on the ammeter MUST NOT touch the alternator casing before or during the test. A short circuit will result which will damage the alternator.*

4. Switch ON, check that the charge warning light comes ON.

NOTE: *There is a resistor built into the circuit across the charge warning light. In the event of a bulb failure, the alternator will still charge.*

5. Start the engine and slowly increase to maximum rated speed, the ammeter reading should equal the maximum rated output of the alternator of 70 amps

NOTE: *As the state of charge of the battery increases so the output of the alternator will decrease. The rated output of the alternator should be checked quickly.*

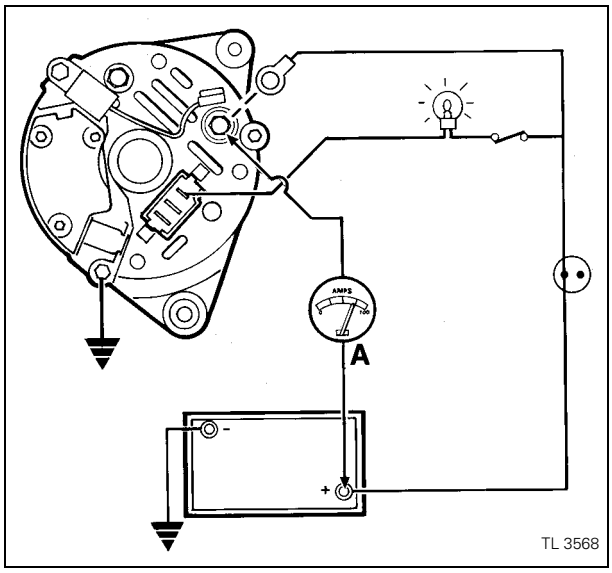


Fig.7

Diagnosis

Result	Action
Ammeter reading low	Replace or repair alternator *(see operation 9-10A).*
Ammeter reading 65-70 amp.	Proceed to Test 6

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TEST 6. Circuit Charging Voltage Drop (Fig.8)

Use a voltmeter to check for high resistance (poor connections) in the charging circuit.

1. Connect a voltmeter (V_1) between the battery positive terminal (+) and the alternator main output terminal.
2. Switch ON all lights to create a load. Start the engine and increase to maximum rated speed. The voltmeter should not exceed 0.5 volts.
3. Transfer the voltmeter (V_2) connections to the battery earth (-) terminal and the alternator body.
4. Start and run the engine as in (2). The voltmeter reading should not exceed 0.25 volts.

Diagnosis

Result	Action
2. Reading above 0.5 volts	Check all wiring for loose connections
4. Reading below 0.5 volts.	Satisfactory Proceed to Test 7

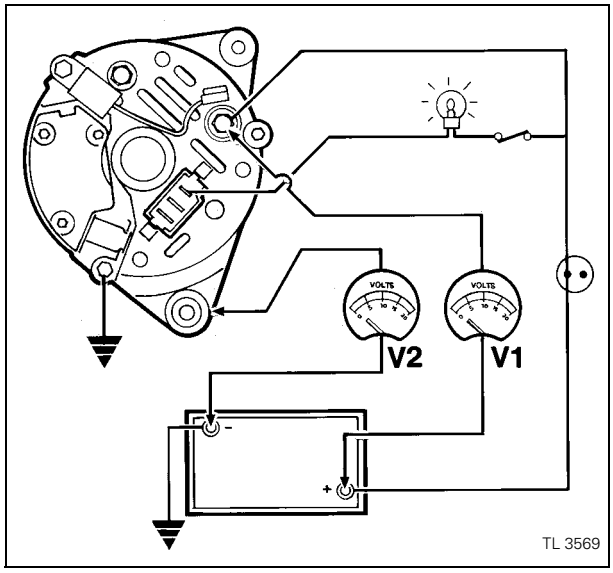


Fig.8

TEST 7. Alternator Voltage Regulator Setting (Fig.9)

Before checking the voltage regulator setting, it is essential that the tractor battery is in a well charged condition.

1. Disconnect the main cable from the rear cover of the alternator.
2. Connect an ammeter between the starter solenoid terminal and the alternator terminal.
3. Connect a voltmeter across the battery terminals.
4. Start the engine and increase the speed until the ammeter reading is less than 10 amperes.
5. The voltmeter reading should be within the limits of 13.6 - 14.4 volts.

Diagnosis

Result	Action
Reading is unstable or outside specified limits	Voltage regulator faulty, replace *(see operation 9-10A).*
Reading 13.6 - 14.4 volts	Regulator satisfactory

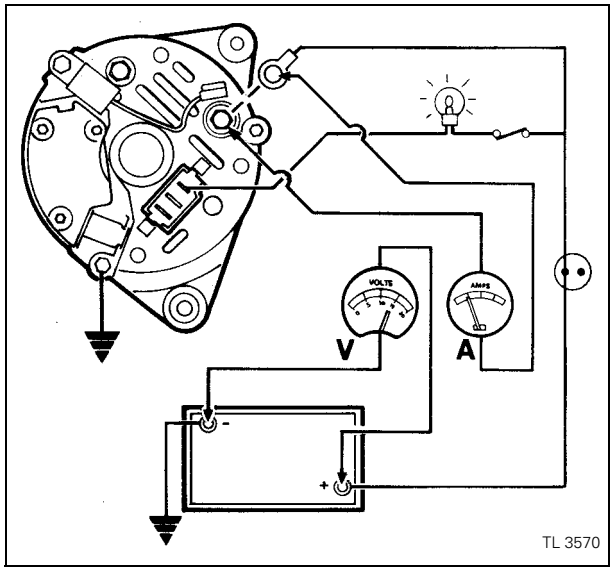


Fig.9

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ALTERNATOR

Removal and Refitment 8-10A

Removal

WARNING: If the mesh guard is removed or loosened whilst changing the alternator, it must be refitted and secured before re-starting the tractor.

1. Remove the front grille.
2. Disconnect the negative (black) cable from the battery.
3. Remove the right-hand engine side panel.
4. Remove the guard around the alternator.
5. Slacken the three bolts and remove the fan/ alternator belt.
6. Disconnect the three sets of wires from the back of the alternator:

a. Positive cable.

b. IND cable.

c. Earth.

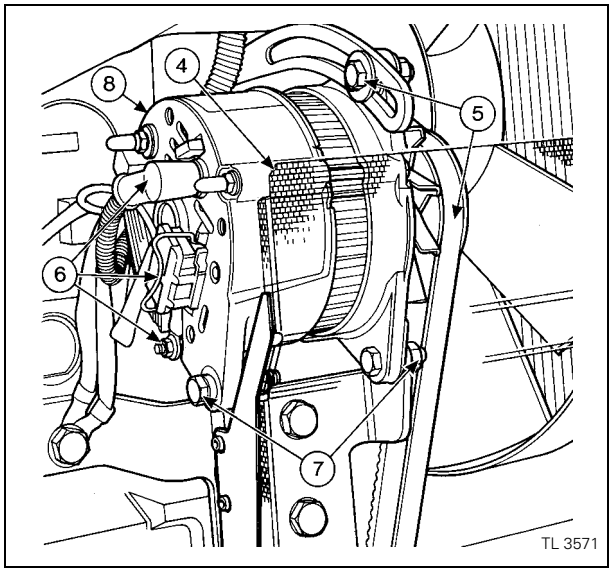
7. Remove the three nuts and bolts.
8. Remove the alternator.

Refitment

9. Reverse procedures 1 to 8 except:

a. Adjust the belt to a tension of 10 mm (3/8 in), *(see operation 10-10A).*

b. Replace the guard, if removed.



ALTERNATOR

Overhaul 9-10A

Dis-assembly

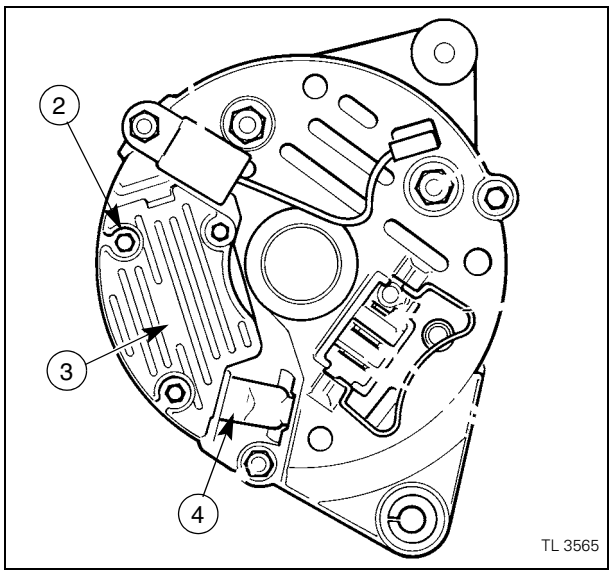
A small amount of repair can easily be carried out on the alternator without any special tools or bench test equipment. Cleaning out dust, replacement of the voltage regulator/brush assembly. The most common causes of alternator failure are:

Brushes worn out.

Regulator failure.

Radio interference suppressor failure.

Contamination from dust and dirt.



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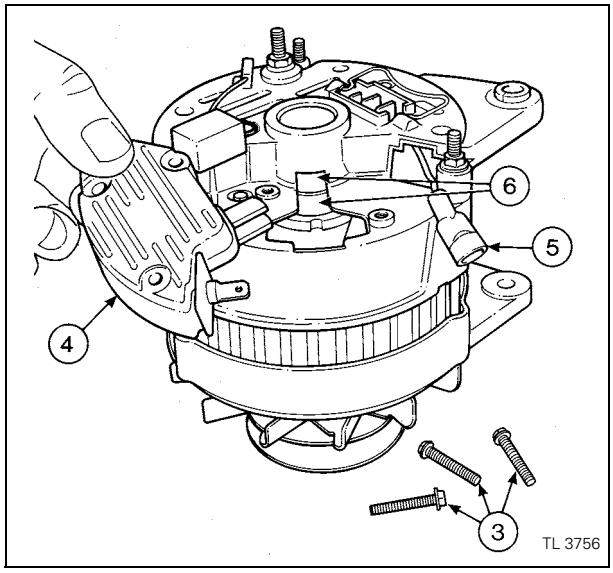
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To rectify these problems proceed as follows:

1. Remove the alternator from the tractor, *(see operation 8-10A).*
2. Remove the three bolts.
3. Remove the voltage regulator/brush assembly. Lift out carefully, the brushes extend horizontally into the casing.
4. Disconnect the wire connector.

Re-assembly

5. Blow out all the dust and dirt from the inside of the alternator with compressed air.
6. Clean the armature slip ring with a suitable electrical cleaner.
7. The regulator/brush assembly comes as a complete unit, not as individual parts. Replace the assembly.
8. Tighten the three bolts, refit the alternator and test.



ALTERNATOR/FAN BELT

Adjust **10-10A**

Procedure

WARNING: If the mesh guard is removed or loosened whilst checking the belt tension, it must be refitted and secured before re-starting the tractor.

The picture gives a typical illustration of the alternator/fan belt arrangement; your tractor may differ slightly in the positioning of the adjustment link and pivot bolts.

Renew the belt if it is worn or damaged. If twin belts are fitted, they must be renewed together; check/adjust the tension on the tighter belt.

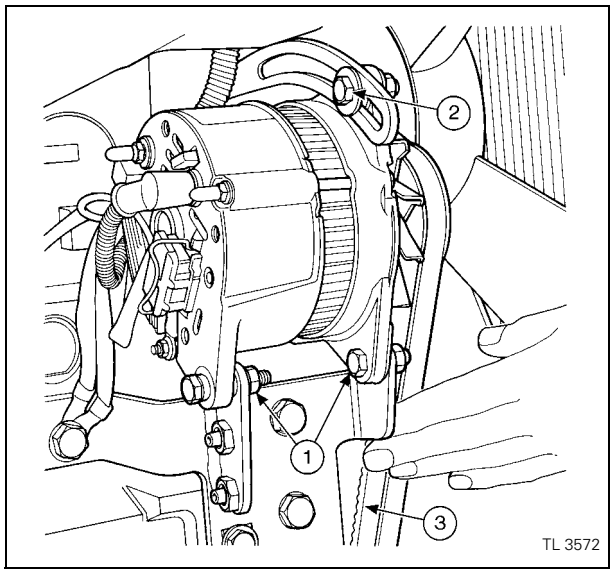
To check the deflection, press down the belt with the thumb at the centre of the longest free length. With moderate thumb pressure the correct deflection of the belt is 10 mm (3/8 in).

If a belt tension gauge is available, the correct tension is 35 N (8 lbf), DO NOT allow the tension to fall below 22 N (5 lbf).

To adjust the belt tension:

1. Loosen the alternator pivot bolts.
2. Loosen the adjustment link bolt.
3. Change the position of the alternator to give the correct tension and re-tighten the bolts.
4. Re-check the belt tension to ensure that it is still correct.
5. Replace the guard, if removed.

NOTE: *If a new belt(s) is fitted, check/adjust the tension again after 25 hours operation.*



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INSTRUMENT PANEL

Removal and Refitment **11-10A**

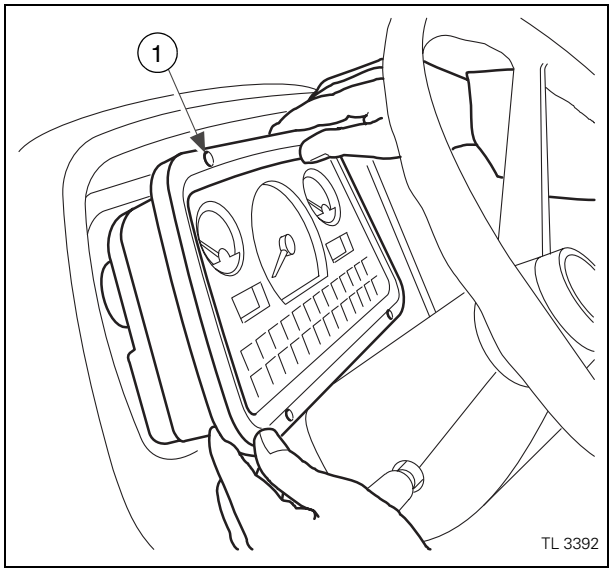
Removal

1. Unscrew the four securing screws.
2. Carefully withdraw the panel from the console.
3. Disconnect the three plugs

Refitment

4. Reverse procedures 1 to 3.

   Ensure that the three plugs in the back of the instrument panel are correctly fitted.



INSTRUMENT PANEL

Overhaul **12-10A**

Dis-assembly

The dismantled instrument panel is a delicate instrument, take care when handling the components, fitting the printed circuit and removing and re-fitting the retaining nuts.

NOTE: *The later type of instrument panel is fitted with Light Emitting Diodes (LED) for all warning lights and instrument illumination. These LED's will give a life-time of service and cannot be replaced.*

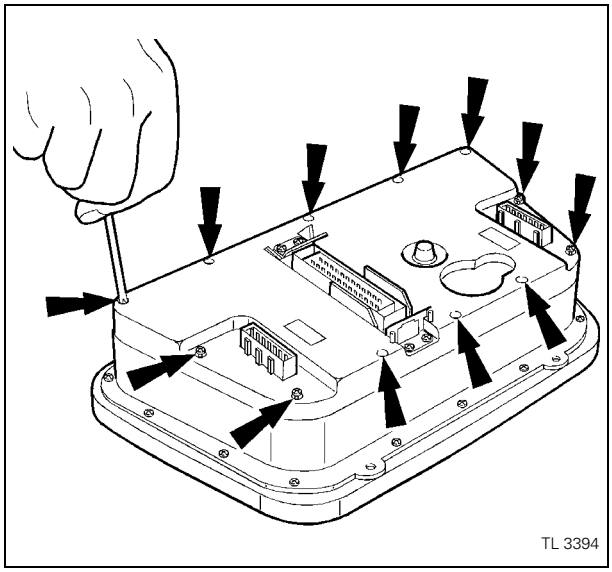
1. Remove the instrument panel, *(see operation 11-10A).*
2. Lay the instrument panel face down on a clean cloth on a clean bench, preferably in the office to prevent the ingress of damp and dust. Use the correct size spanner and a Phillips cross-head screwdriver.

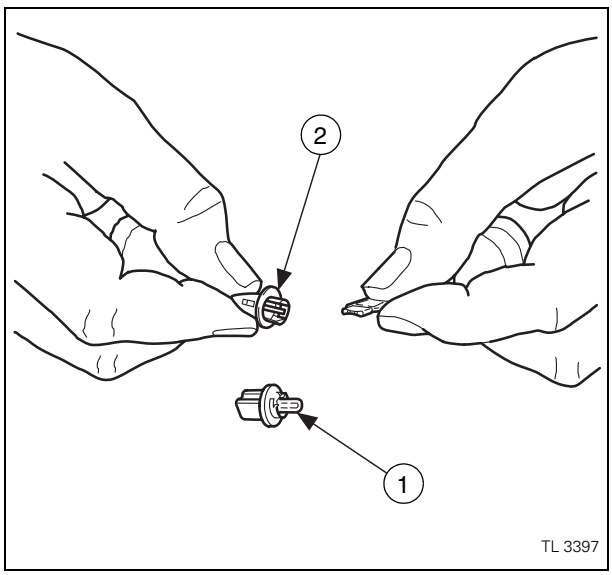
Warning and Illumination Bulbs

3. Unscrew the 12 screws indicated.
4. Carefully lift off the back taking care not to stretch the 'O' ring seal.
5. Turn the appropriate bulb holder a quarter turn and remove.
6. Green bulb holders (1) have 2.2 watt bulbs which are an integral bulb and holder, they are fitted in the following positions:

   Alternator Warning.
   Four-wheel drive.
   Differential lock.
   Speedshift Low (Tortoise).
   Speedshift High (Hare).
   Creep (Snail).
   L - Low.
   M - Medium.
   H - High.

The remainder are black (2) and fitted with a 1,2 watt capless bulb which can be removed from the holder for replacement.





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FUSIBLE LINKS

Check **13-10A**

Procedure

The tractor electrical system is fitted with a final protection device, a set of fusible links. These fusible links are situated in the cables adjacent to the starter motor, see illustration. They are designed to protect the wiring loom in the event of a major circuit failure and installed between the power supply (starter motor) and the fuse boxes and alternator.

Check

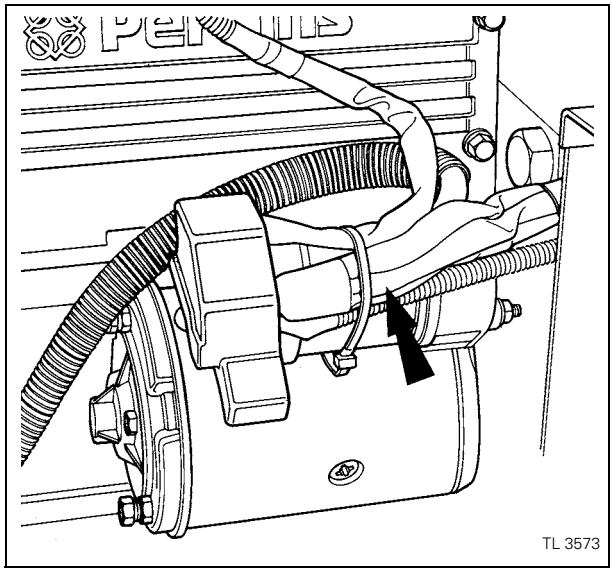
In the unlikely event of a failure of one of the links, it can normally be recognised by a discolouration of the protective sleeve over the fusible link. If this is not visible, it will be necessary to remove the plastic tie and feel along the length of each wire to determine if one of them has parted.

It is important not to connect the battery the wrong way round. This will result in a failure of the front engine harness fusible link feeding the alternator.

Action

IMPORTANT: *DO NOT under any circumstance bridge the failed fusible link with another cable. It will result in a more serious failure, possibly setting fire to the tractor.*

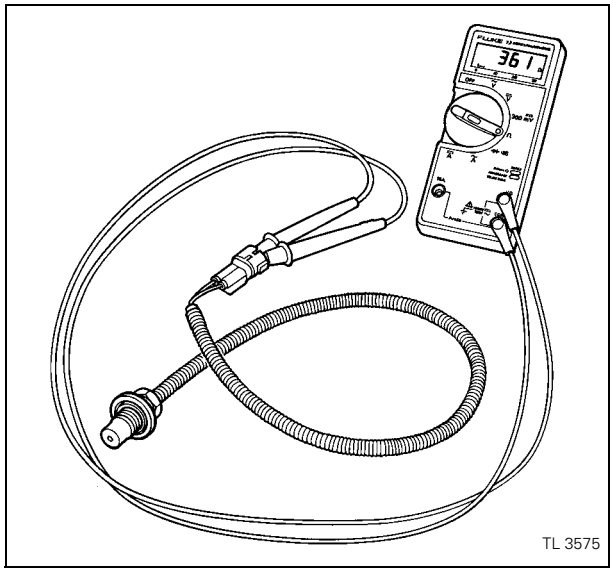
The fusible link must not be replaced, it will be necessary to replace the failed wiring harness complete.


TL 3573

SPEED SENSORS – TACHOMETER AND PTO

Removal and Refitment **14-10A**

Special Tools:
MF.3005 Digital Multimeter


TL 3575

Removal

The power take-off and tachometer sensors are similar in design, the power take-off is mounted in the top of the PTO shaft extension housing. The tachometer sensor in the auxiliary hydraulic pump drive housing.

1. Disconnect the wire from the harness.
2. Slacken the locknut and unscrew the sensor.

Diagnosis

3. Check the sensor for open circuit with the MF.3005 Digital Multimeter. The reading should be approximately 350 ohms plus/minus 50 ohms.

Refitment

4. The correct clearance between the sensor and the magnetic wheel is 0,6 mm (0.025 in).
5. Set the sensor by lightly screwing it in until it bottoms on the wheel, DO NOT force. Back off the sensor by half a turn and tighten the locknut. If the sensor is screwed in too far it will be damaged.
6. Re-connect the wiring.

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SOLENOID VALVE COILS

Removal and Refitment 15-10A

Removal

When performing fault finding work on the hydraulic solenoids associated with the differential lock, 18 x 6 Speedshift and four-wheel drive. Great care must be exercised when connecting an alternative electrical supply; for example, testing the valve.

These solenoids incorporate an integral suppressor diode and correct polarity MUST be observed. The diode is fitted to preserve the associated switch components.

1. Disconnect the wiring.
2. Unscrew the top nut and remove the coil.
3. Unscrew the valve body, if necessary.

Testing

There are three methods of testing the solenoids:

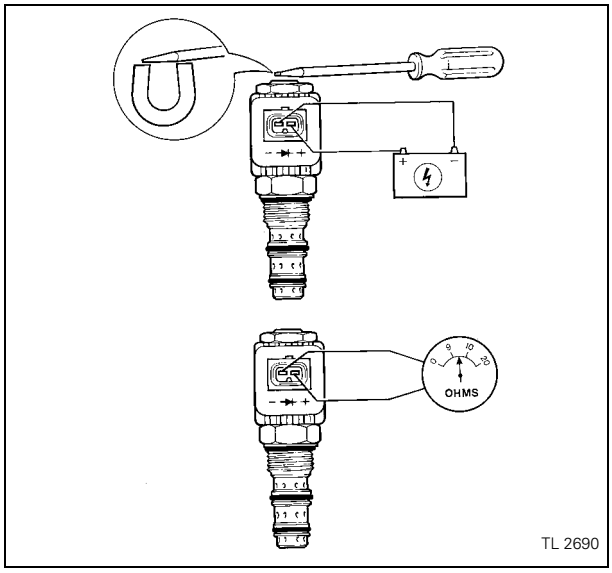
4. With the coil connected to the tractor electrical system, switch ON the service. With the aid of a ferrous spanner or screwdriver test the top of the coil core for magnetism.

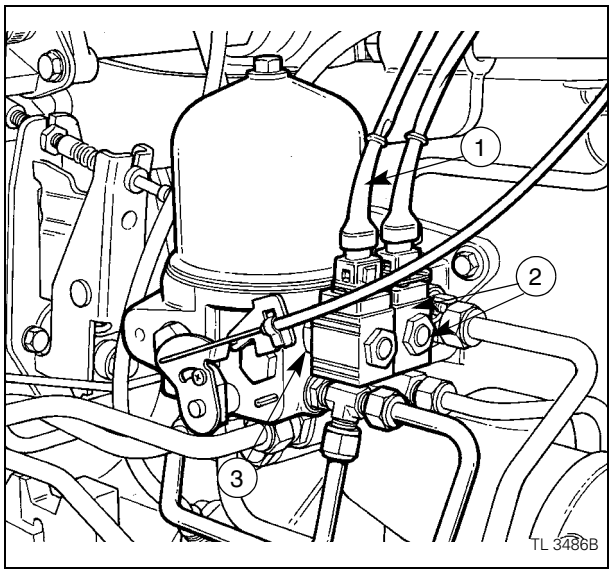
IMPORTANT: *Observe coil polarity.*

5. Test the coil with an outside source of power (12 volt battery). connect the battery across the two terminals, observe the polarity of the coil. Test for magnetism, or you will feel the valve being pulled in.
6. Test the coil winding for continuity with a multimeter, you should obtain a reading of approximately 9 - 10 ohms.

Refitment

7. Refit or replace the valve body, if removed. Tighten to a torque of 10 Nm (7 lbf ft).
8. Refit or replace the coil. Apply a drop of Massey Ferguson Lock 'n' Seal (Loctite 222) to the threads and tighten only finger tight.





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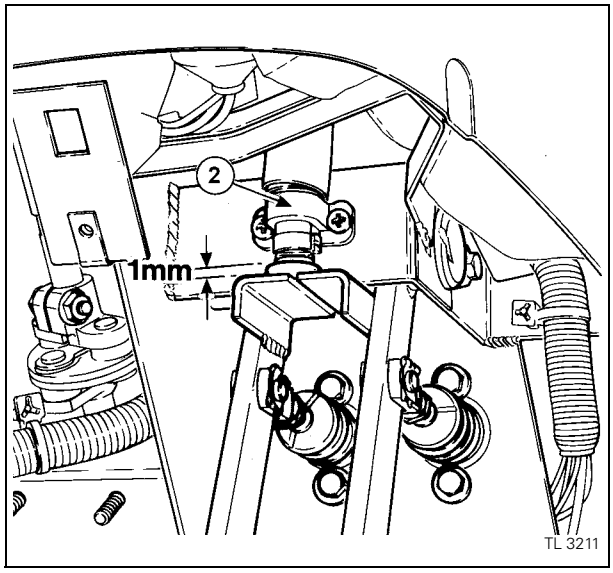
BRAKE SWITCHES

Removal and Refitment 16-10A

Removal

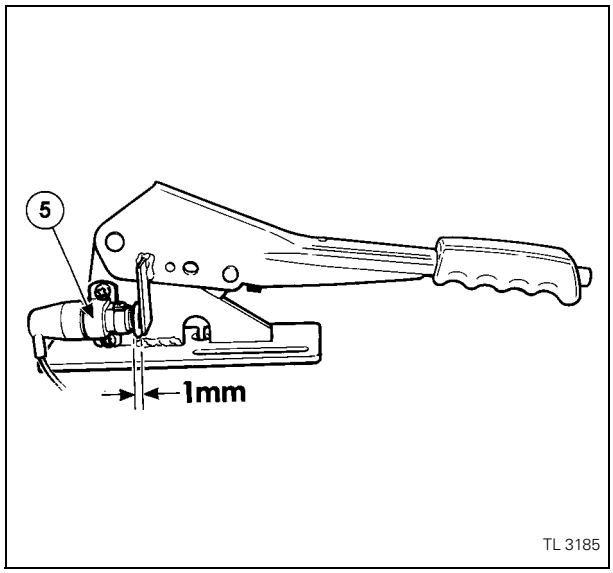
Foot Brake Switch

1. Remove the panel under the instrument panel.
2. Disconnect the electrical plug from the switch.
3. Remove the two screws.
4. Remove the switch.



Parking Brake Switch

5. Disconnect the electrical plug from the switch.
6. Remove the two screws.
7. Remove the switch.



Refitment

8. Reverse procedures 1 to 4 or 5 to 7 except:

a. With the foot brake or the parking brake in the OFF position:

b. Press the brake switch plunger IN.

c. Check the clearance between the plunger and the brake pedal or lever, it should be 1 mm (0.039 in).

d. If adjustment is required, slacken the two screws and re-set the position of the switch, or, slightly bend the operating lever.

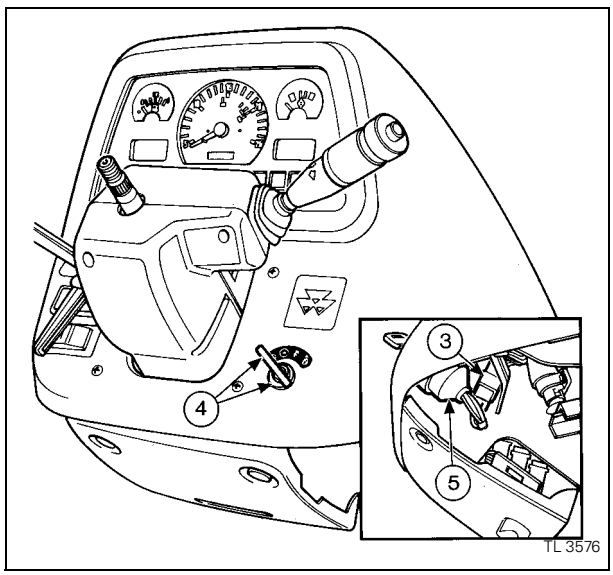
STARTER SWITCH

Removal and Refitment 17-10A

Removal

NOTE: *The steering wheel has been removed for clarity.*

1. Disconnect the battery negative lead (-).
2. Remove the lower right-hand console cover.
3. Behind the switch, disconnect the electrical plug.
4. Remove the key and unscrew the ring nut.
5. Remove the switch.



Refitment

6. Reverse procedures 1 to 4.
7. Ensure that the flat on the side of the thread is correctly located in the hole in the console.

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DIRECTION INDICATOR SWITCH

Removal and Refitment **18-10A**

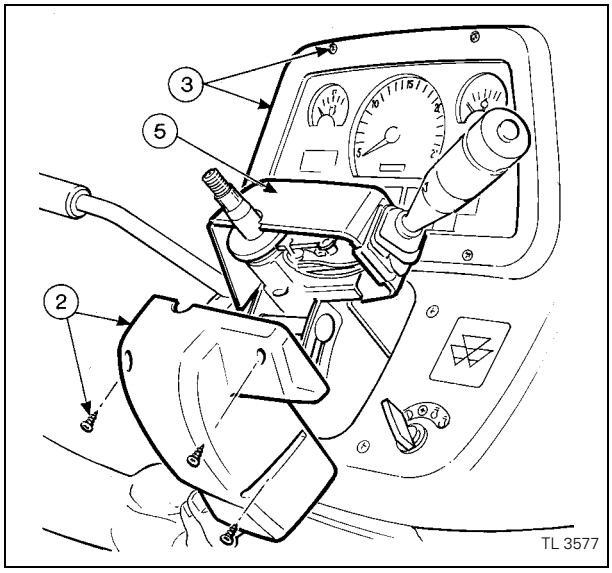
Removal

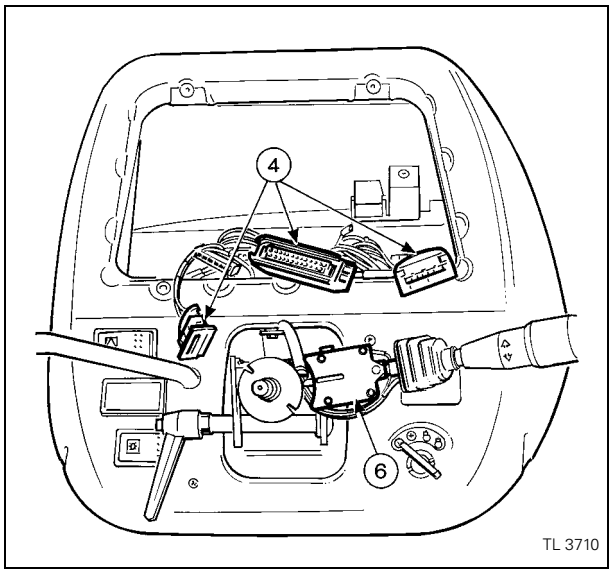
NOTE: *The steering wheel has been removed for clarity.*

1. Disconnect the battery negative lead (-).
2. Remove the four self tapping screws and the lower steering column cover.
3. Remove the four screws and the instrument panel.
4. Disconnect the three electrical plugs on the back of the instrument panel.
5. Remove the three self tapping screws and the upper cover.
6. Through the instrument panel aperture, disconnect the two electrical plugs.
7. Remove the three self tapping screws securing the switch to the bracket. The screws are located on the panel side of the bracket.
8. Remove the switch, pulling the cable out from the panel.

Refitment

9. Reverse procedures 1 to 7.
10. The electrical plugs to the instrument panel are connected with the large plug in the centre, the grey plug on the left, black on the right.





FUEL TANK SENDER UNIT

Check **19-10A**

Test Equipment:
MF.3005 Digital Multimeter

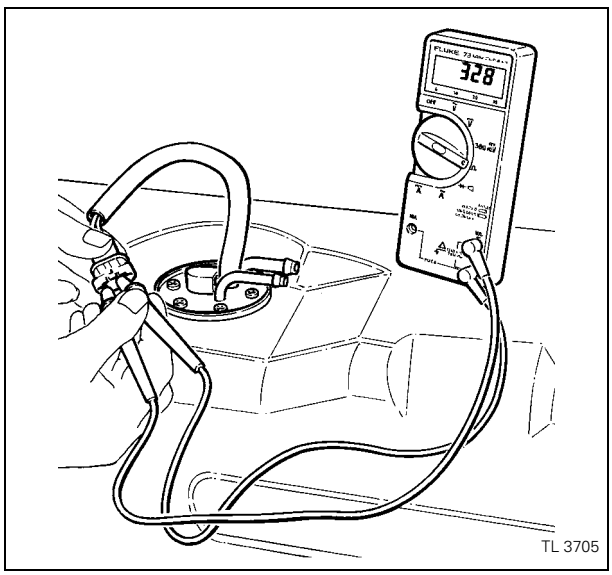
Procedure

1. Disconnect the plug to the fuel tank sender unit.
2. Connect the MF.3005 Digital Multimeter between terminals 1 and 2.

   Terminal 3 is the connection for the 'Low fuel' warning light.
3. Check the contents of the fuel tank.
4. The approximate resistance reading should be as follows:

Tank contents	Meter reading
Full	6-8 ohms
Three quarter full	58-62 ohms
Half full	115-119 ohms
Quarter full	172-178 ohms
Low fuel light ON	234-240 ohms
Empty	322-332 ohms

5. This test will give an indication if there is a fault with the sender unit.



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HEADLIGHT ALIGNMENT

Adjust 20-10A

Procedure (not North America)

To adjust the alignment of the headlights, screw the three screws (Fig.1) IN or OUT as required, this will deflect the beam up, down or sideways. To adjust the beam:

1. Position the tractor facing a wall or screen, 2 m (6 ft) away (Fig.2)
2. Mark a point on the wall or screen by sighting down the hood centre line.
3. Draw a vertical line (1) through the point.
4. Draw a horizontal line (2) through the vertical line (1) at headlight height (4).
5. Mark two points (3) on the horizontal line representing the distance between the two headlights (230 mm), spaced equally either side of the vertical line (1).
6. Adjust each headlight (Fig.1), on main beam, individually by obscuring the other, so that the points (3) marked on the wall or screen are in the centre of the beam. The centre of the headlight beam may be found by marking the extremities of the beam both vertically and horizontally, and dividing by two.

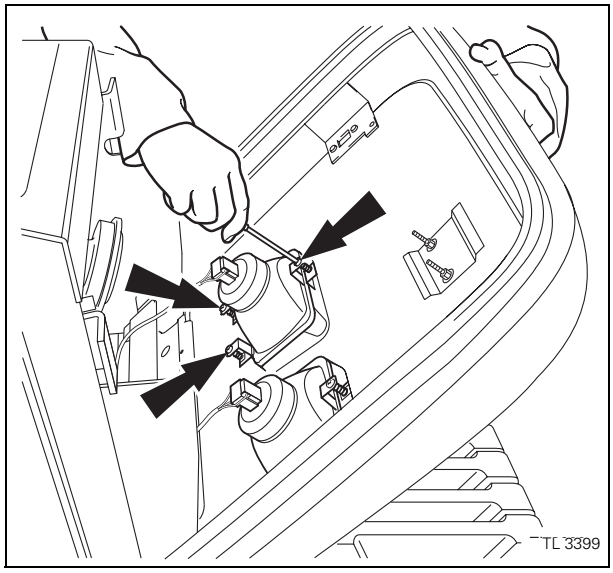


Fig.1

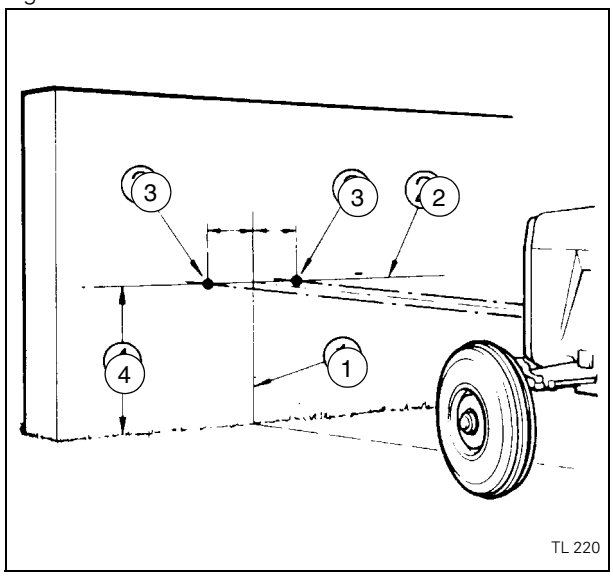


Fig.2

Procedure (North America only)

To adjust the beam (Fig.3):

1. Position the tractor facing a wall or screen 7,5 m (25 ft) away, distance (A).
2. Draw a horizontal line on the wall or screen (1) the same as the centre height of the headlights from the ground (B).
3. Draw two vertical lines (2), the same as the horizontal centre to centre distance between the headlights (C), (230 mm).
4. Draw a second horizontal line (3) at a distance (D) below and parallel to line (1). Distance (D) is calculated by multiplying distance (B) by 0.1; for example, headlight height 1130 mm x 0.1 = 113 mm.
5. Adjust each headlight, on main beam, individually by covering the opposite one and aligning the upper edge of the illuminated zone to line (3).

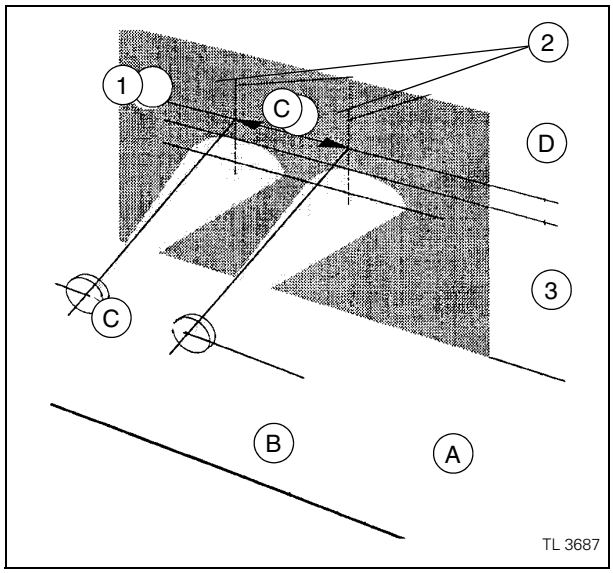


Fig.3

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BULB REPLACEMENT

Removal and Replacement **21-10A**

Procedure

Headlight Bulb (Fig.1):

1. Switch off the headlight.
2. Remove the front grille.
3. Remove the headlight wiring plug (1).
4. Carefully remove the rubber surround (2).
5. Release the spring clip and remove the failed bulb (3).
6. Fit a new 40/45 watt bulb.
7. Reassemble the light unit and test.

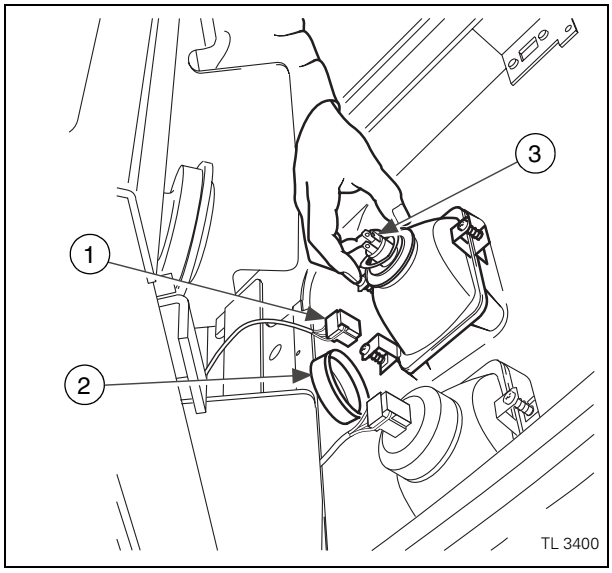


Fig.1

Interior Light (Fig.2):

1. Hold the lens as shown.
2. Rotate counter clockwise (1) until the end of its travel is reached.
3. Push upwards, and rotate further (2).
4. The lens can now be taken away from the fitting exposing the 5 watt festoon bulb.
5. Replace the lens ensuring that the tongues on the lens locate into the fitting, it will click into place when pushed up and turned clockwise.

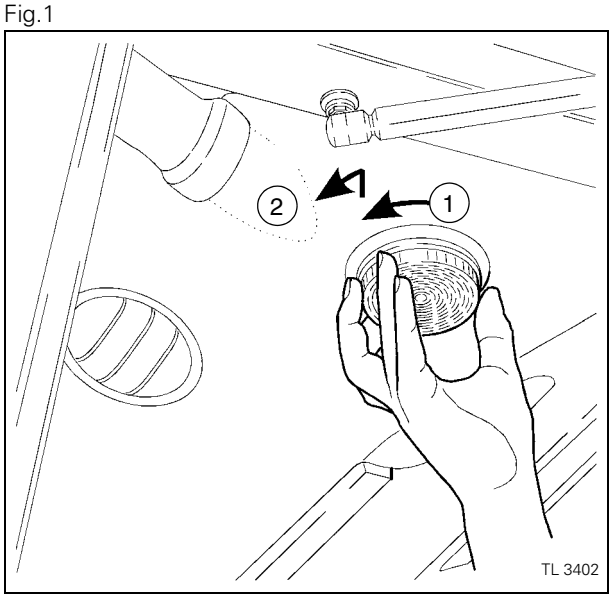


Fig.2

Rotating Beacon (Fig.3)

IMPORTANT: *DO NOT touch the new halogen bulb with your fingers. Natural moisture in the skin will cause the bulb to burn out when the light is switched on. Always use a clean cloth or tissue when handling halogen bulbs.*

To renew the bulb:

1. Remove the security screw (1), press down the plastic catch and rotate the lens (2) counter clockwise and remove.
2. Squeeze the clip (3) together and remove the clip and bulb (4).
3. Replace the 55 watt halogen bulb.
4. Replace the clip, lens and screws.

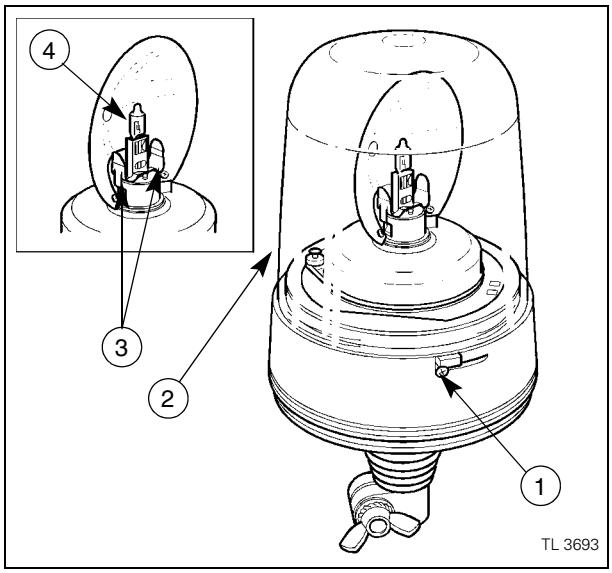


Fig.3

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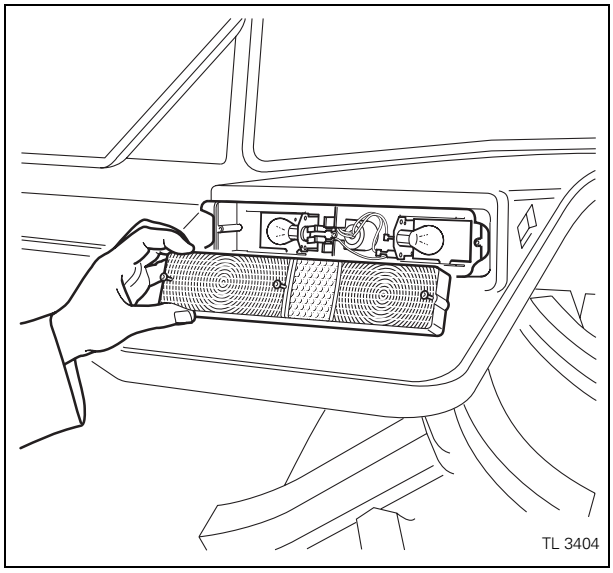


Fig.4 Rear and direction indicator light.

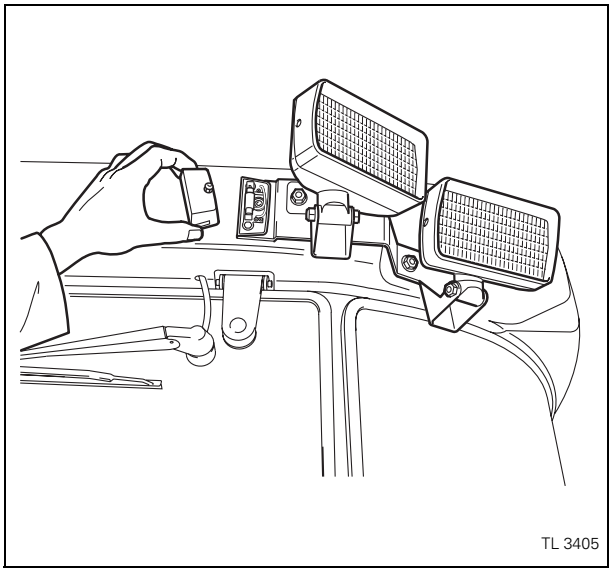


Fig.6 Number plate light.

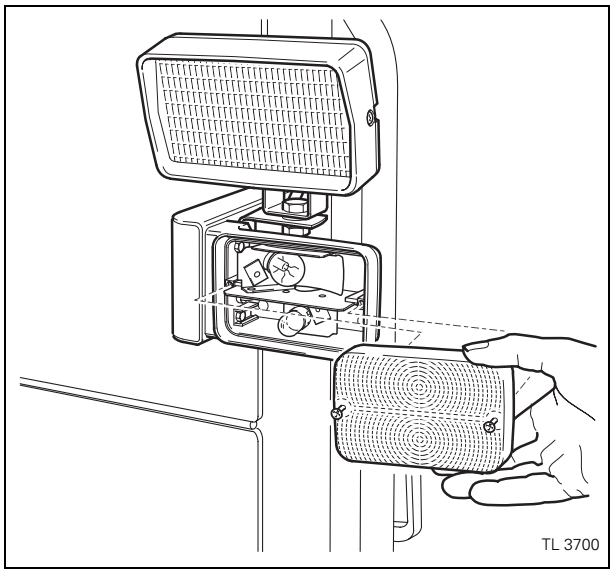


Fig.5 Side and direction indicator light.

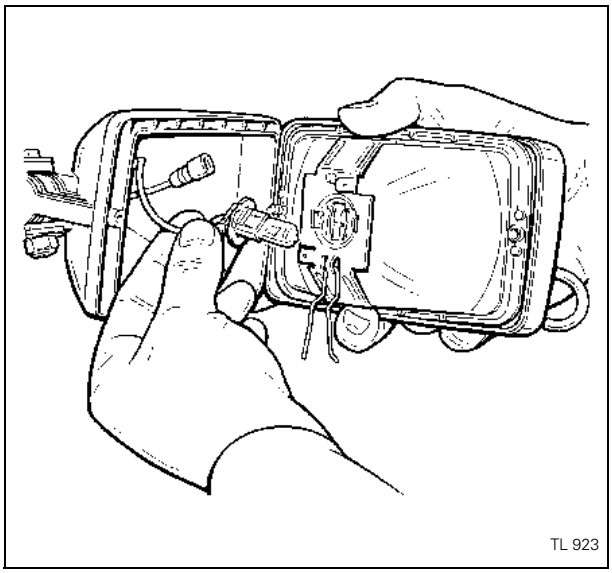


Fig.7 Work light.

Driving and Work Light Bulbs

The series of four illustrations show the replacement of the driving and work light bulbs:

Rear and direction indicator light (Fig.4):

Rear/stop light 5/21 watt - offset pin.

Direction indicator light 21 watt - standard pin,

Side light and direction indicator (Fig.5):

Side light 5 watt - standard pin.

Direction indicator 21 watt - standard pin.

Number plate light (Fig.6):

Festoon 5 watt.

Work lights (Fig.7):

Halogen 55 watt.

IMPORTANT: *The work lights have halogen bulbs. Never touch a halogen bulb with the fingers. Natural moisture in the skin will cause the bulb to burn out when the light is switched on. Always use a clean cloth or tissue when handling halogen bulbs.*

To change a bulb:

1. Switch off the respective light switch.
2. Loosen the two screws and remove the cover or lens.
3. Remove the bulb from its fitting.
4. Fit a new bulb of the correct wattage, refit the cover or lens and tighten the screws.

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SEVEN PIN TRAILER SOCKETS

Wiring Connections 22-10A

Two types of trailer socket can be fitted to the rear of the tractor for additional lighting on a mounted implement if this conceals the rear lights of the tractor, or on towed trailers etc. Suitable plugs can be obtained from your Massey Ferguson Dealer. The connections are as follows:

NOTE: *The letters and numbers in the connection column are marked on the rear of the socket and plug, next to each terminal.*

European Type

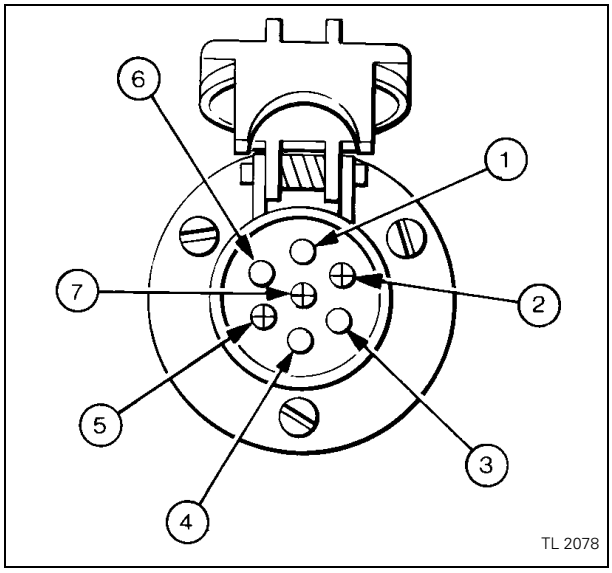
Connection	Function
1. L	Left-hand rear direction indicator.
2. 54G	Not used.
3. 31	Negative (earth).
4. R	Right-hand rear direction indicator.
5. 58R	Right-hand rear light.
6. 54	Right- and left-hand brake stop lights.
7. 58L	Left-hand rear light & number plate light.

Use male trailer connection part No. 3405 168 M1.

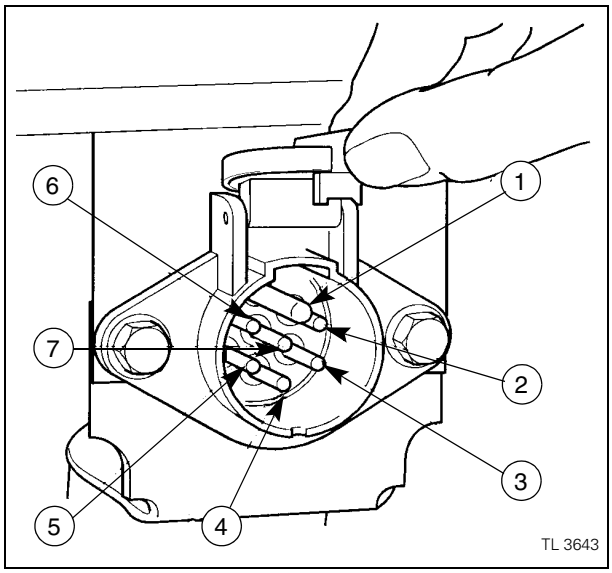
North American Type

Connection	Function
1. 31	Negative (ground).
2. 58L	Not used.
3. L	Left-hand flashing and turn signal.
4. 54	Not used.
5. R	Right-hand flashing and turn signal.
6. 54G	Rear lights.
7. 58R	Not used.

Use male trailer connection part No. 22 076 A91.



European



North American

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POWER SOCKETS

Wiring Connections 23-10A

Procedure

The tractor is fitted with three power sockets; main power socket on the right-hand side at the rear of the cab. Single pole socket for use with a rotating beacon adjacent to the main power socket. The auxiliary socket is located by the main fuse box.

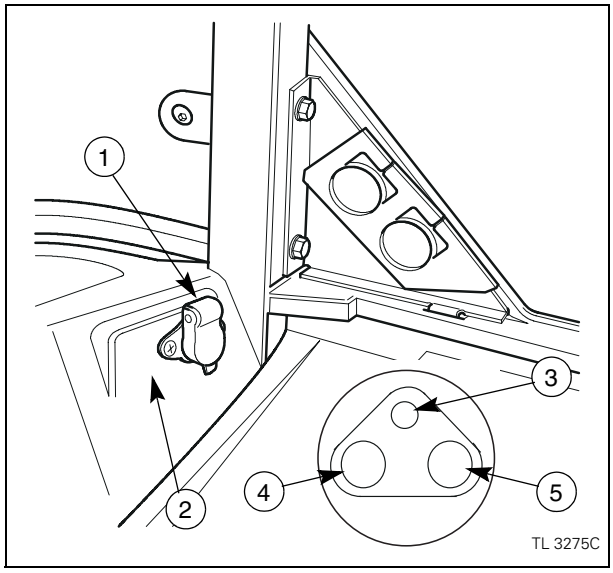
Main Power Socket (1)

For heavy power use, the 25 amp fused socket is live all the time and protected by fuse F2 in the main fuse box. A plug is available part No. 3760 032 M1. The terminal connections, looking from the front, are as follows:

3. - not used.

4. - positive, 12 volt live all the time.

5 - negative, earth.



Single Pole Socket (2)

This single pole socket is intended for use with a rotating beacon, it is protected by a 10 amp fuse 7B in the right-hand door pillar. It is controlled by the switch in the cab roof console.

A plug is available part No. 3760 031 M1.

Auxiliary Instrument Socket

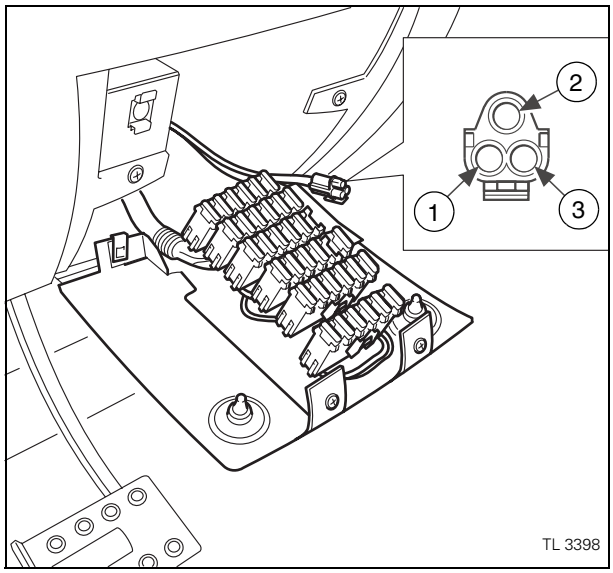
This socket is located by the main fuse box, it may be tucked behind the lower cover. It is rated at 10 amps protected by fuses E1 and A3 in the main fuse box. It is intended for auxiliary instruments; for example, mobile telephone charger.

This plug has three wires. The connections, looking from the front, are as follows;

1. Black - negative (earth).
2. Purple - positive, live all the time - fuse E1
3. White/Green stripe - positive, live when ignition switched ON - fuse A3.

A meter long cable, complete with plug, is available part No. 3760 036 M1

NOTE: *This plug is provided for low consumption items. The main power socket should be used whenever possible for implement electrics.*



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Cab Wiring Diagrams

Section 10 - Part B

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General Description	10B - 2
Circuit Wiring Diagram Index	10B - 3

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Cab Wiring Diagrams

GENERAL DESCRIPTION

The electrical system is divided into five main harnesses, engine, console, hydraulic (left-hand side), cab (right-hand side) and cab roof.

The engine harness serves all components in front of the cab and is connected to the console harness by two connectors behind the engine cylinder block.

The console harness is situated behind the instrument panel and contains the main fuse box, instruments and switches. It is connected to the left-hand hydraulic harness and the right-hand cab harness. These connections will be found on the left- and right-hand side of the console at the base. The cables then pass under the floor mats.

The hydraulic harness serves the left-hand side of the tractor and all components around the transmission on the left- and right-hand side. It is also connected to the roof through the fuse box in the left-hand door pillar, this fuse box controls the work lights.

The cab harness is connected to all the components on the right-hand side of the cab, switches, power socket, speedshift etc. and is connected to the roof harness through the fuse box in the right-hand door pillar, this fuse box serves all components in the roof except work lights.

The roof harness is connected to the fuse boxes in the left- and right-hand door pillars and is routed around the roof serving all switches, lights and the cab heating, ventilating and air conditioner.

The schematic illustration in Figs. 1 and 2 shows the layout of the harnesses and all their connectors and components.

Circuit Diagrams

The wiring system has been broken down into individual circuits to make it easy to trace faults which may develop with any component. The circuits are all listed in the alphabetical circuit wiring diagram index on page 10B-3. Every connector, header joint, switch and relay is identified by a number prefixed with a letter, they are all illustrated on pages 10B-16 to 10B-19 for identification of the individual pin connectors. Identification of the components is as follows:

C = Connector, this can be a connector between two harnesses or a connector to a component, when it is connected to a component it also identifies the component; for example, C67 Parking brake switch.

or:

C9 Engine harness to console harness.

S = Switch, this identifies all switches and the plug pin layout; for example, S3 master light switch side/ head.

R = Relay, this identifies all relays and flasher unit; for example, R4 work light relay left-hand door pillar.

FB= Fuse boxes, there are four fuse boxes located below the instrument panel, behind the cover on the left- and right-hand door pillars and in the cab roof under the cab air filter access panel. They are numbered; for example, FB6 left-hand door pillar.

HJ= Header joints, these are common soldered connectors within the harness and are used to connect a number of wires together.

SJ= Soldered joint, this indicates a single soldered joint within the harness.

Terminal Identification

When reading the circuit diagram it will be noted that each connector terminal is identified by a number in a circle, this is the pin number, it will be found stamped on the plug or socket and shown on the illustration of the connector on pages 10B-16 to 19.

In the description the number of pins and colour of the connector are given to aid identification.

Diagnosis

When dealing with electrical problems, have to hand simple test equipment so that you can test the continuity of the circuit from source to the component. Remember that the most common fault is a loose connection, first check that all the connectors in the circuit are tight. Don't forget the earth connections.

Wiring Colour Codes

The following colour codes to international standard are used to identify all the wires:

B	Black.
G	Green.
K	Pink.
LG	Light green.
LU	Light blue.
N	Brown.
O	Orange.
P	Purple.
R	Red.
S	Grey.
U	Blue.
W	White.
Y	Yellow.

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Cab Wiring Diagrams

.The table below gives a cross reference to all circuits.

Key to diagrams							
Connector Number	Description	Connector Number	Description	Connector Number	Description	Connector Number	Description
C1	RHS Head Light	C37	Cab Rear Beacon	C73	RH Front work light	C109	Fan LHS
C2	LHS Head Light	C38	Hydraulic/Roof (4 Way)	C74	Front wiper	C110	Clock illum
C3	Air Cleaner	C39	Hydraulic/Roof (1 Way)	C75	LH Front work light	C111	Gearbox safety start switch
C4	Horn	C40	LH B Post Earth	C76	LH IND side work in roof	C112	Starter sol
C5	Alternator	C41	Alternator Body	C77	LH work LT	C113	Rear wiper
C6	Compressor HP/LP Switch Switch	C42	LH Rear Lamps	C78	LH side and IND conn Front A Post	C114	Roof head LT
C7	Compressor 1	C43	Ground Speed sensor	C79	H VAC Conn - Roof/Air con	C115	Roof head LT
C8	Starter Positive	C44	Reverse Light/Bleeper	C80	Radio 1	C116	Water temp sender
C9	Engine/Console (14 Way)	C45	Front Wash Pump	C81	Radio 2	C117	Thermostat conn
C10	Engine/Console (2 Way)	C46	Rear Wash Pump	C82	Radio Earth (Screen)	C118	Oil pressure switch (Japan only)
C11		C47	Shaft Encoder	C83	Clock	C119	Hydraulic lock solenoid
C12		C48	Power Shift Sol Hyd	C84	Interior Light	C120	Lower heater conn
C13		C49	Fuel Tank Sender	C85	Door switch	C121	Engine stop switch
C14	Key Pad 1	C50	Gear Lever	C86	Roof/LH side fender number plate	C122	PTO module/PTO engine conn (4 way)
C15	Ignition Switch	C51	Engine Speed Sensor	C87	Power shift sol	C123	PTO module/Console conn (4 way)
C16	Column Switch 1	C52	Diff Lock Solenoid	C88	-	C124	PTO module/PTO switch (4 way)
C17	Column Switch 2	C53	4WD Solenoid	C89	LH side B post earth (Roof)	C125	PTO engine/PTO solenoid harness (2 way)
C18	Console/Cab (20 Way)	C54	Trans Oil Press Switch	C90	Rear RH upper work LT switch	C126	PTO solenoid
C19	Console/Cab (8 Way)	C55	PTO Speed Sensor	C91	Rear RH lower work LT conn	C127	PTO switch
C20	Console/Cab (3 Way)	C56	Trailer	C92	Number plate 1	C128	Starter sol
C21	Console/Cab (1 Way)	C57	Dif Lock Switch	C93	Number plate 2	C129	Thermal switch (green engines)
C22	Console/Hydraulic (20 Way)	C58	Reverse Light Switch	C94	Rear RH lower work LT	C130	LHS Rear - Engine Timing Control (Green engines)
C23	Console/Hydraulic (12 Way)	C59	Oil Press Switch	C95	Rear LH upper work LT	C131	Roof earth stud
C24	Console/Hydraulic (4 Way)	C60	Fuel Pump	C96	RH/LH speaker conn 2	C132	Front work LT 1
C25	Console/Hydraulic (1Way)	C61	Creep Switch	C97	Roof earth (screen)	C133	Front work LT 2
C26	Console Earth	C62	LO WNG LT (18 Speed)	C98	Roof/RHS fender number plate	C134	Rear work LT single RH side (F. Roof & HI VIS)
C27	Cab/Roof (10 Way)	C63	HI WNG LT (18 Speed)	C99	PTO safety start switch	C135	Rear work LT single LH side (F. Roof & HI VIS)
C28	Cab/Roof (17 Way)	C64	Foot Brake Switch	C100	RHS IND/Lights (F.Roof)	C136	Dual work LT1 & 2 LHS HI VIS Roof
C29	Cab/Roof (1 Way)	C65	Aux Power Socket	C101	LHS IND/Lights (F.Roof)	C137	Dual work LT1 & 2 LHS HI VIS Roof
C30	RH B Post Earth	C66	Key Pad 2	C102	RH B Post earth (Roof)	C138	Fender number plate LHS
C31	Alternator Earth	C67	Hand Brake Switch	C103	RH/LH speaker	C139	Fender number plate RHS
C32	Power Socker	C68	Field Conn Alternator	C104	Beacon 1	C140	RH number plate terminals HI VIS Roof only
C33	RH Rear Lamps	C69	Starter Positive	C105	Beacon 2	C141	LH number plate terminals HI VIS Roof only
C34	ELC	C70	RH Side and Ind LT Front A Post	C106	3 speed fan	C142	Compressor conn
C35	Cab Heater	C71	RH Work LT	C107	Thermostat	C143	Sensor conn
C36	Power Seat	C72	RH Ind Side Work in Roof	C108	Fan RHS	C144	New instrument panel

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Key to diagrams							
Connector Number	Description	Connector Number	Description	Connector Number	Description	Connector Number	Description
C145	Power shuttle ECU	C181	-	HJ1	Console (Green)	S3	Master light sw
C146	Comfort control	C182	PTO harness interconnect	HJ2	Console (Blue)	S4	Diff lock sw
C147	Clutch pedal pot	C183	-	HJ3	Console (Orange)	S5	Not fitted
C148	Forward/Reverse switch	C184	Air con control pod	HJ4	Console (Orange)	S6	4WD sw
C149	Clutch safety switch connector	C185	Orchard blower inter connect	HJ5	Console (Slate)	S7	Beacon
C150	Control valve	C186	Orchard air con control module	HJ6	Console (Black)	S8	Rear wiper
C151	Forward pressure switch	C187	Orchard earth	HJ7	Console (Slate)	S9	Not fitted
C152	Reverse pressure switch	C188	-	HJ8	Console (Orange)	S10	Rear work lights
C153	Forward solenoid	C189	Orchard blower distribution	HJ9	Console (Slate)	S11	Side work lights
C154	Reverse solenoid	C190	Orchard blower pressure	HJ10	Standard roof (Blue)	S12	Front work lights
C155	Cooling flow solenoid	C191	LH indicator Orchard	HJ11	Standard roof (Slate)	S13	Engine stop
C156	Wet clutch switch	C192	RH indicator Orchard	HJ12	Standard roof (Slate)	S14	4WD sw (Cab)
C157	Aux power socket (NAO only)	C193	PTO	HJ13	Console (Orange) up to 2002	S15	Not fitted
C158	Beacon link	C194	Console/Hydraulic conn 6	HJ14	ELC (Green)	S16	Remore lift/lower
C159	Beacon supply	C195	Temp switch	HJ15	ELC (Slate)	S17	Front PTO
C160	-	C196	Filter blocked switch	HJ16	ELC (Black)	S18	Rear PTO
C161	ELC RH / Remote lift/lower	C197	Instrument panel conn 0.2Km/h creep	HJ17	Orchard roof (Blue)	S19	Arm lift/Lower
C162	ELC LH / Remote lift/lower	C198	0.2Km/h creep solenoid conn	HJ18	Console (Black)	S20	Rotary draft control
C163	-	C199	Interconnect Fieldstar - Ins panel	HJ19	Flat roof (Blue)	S21	HVAC orchard distribution
C164	-	C200	Fieldstar panel conn	HJ20	Flat roof (Green)	S22	HVAC orchard pressure
C165	Draft sensor			HJ21	HI VIS Roof (Green)	S23	HVAC orchard on/off
C166	Gain control			HJ22	HI VIS Roof (Slate)	S24	HVAC orchard comfort switch
C167	ELC control unit			HJ23	Orchard HVAC (Slate)	R1	Flasher unit
C168	ELC earth			HJ24	Hydraulic (Orange)	R2	Ignition supply relay console
C169	ELC posotion sensor					R3	Ignition supply relay roof
C170	Lower solenoid			FB1	Console lower dash LHS	R4	Work light relay
C171	Lift solenoid			FB2	Console lower dash RHS	R5	Air con isolation relay
C172	ELC switch panel			FB6	Roof B post LHS	R6	Work light isol relay - flat roof
C173	Radar			FB7	Roof B post RHS	R7	Hydra lock relay
C174	-			FB8	HVAC roof (by HVAC unit)	R8	Fuel solenoid relay
C175	-			FB9	Not fitted	R9	Starter relay
C176	-			FB10	Orchard control pod	R10, 11, 12	HVAC orchard
C177	-			FB11	Orchard control pod	R13	Air con relay HVAC orchard
C178	-			FB12	Orchard control pod	R14	LH indicator relay
C179	-			S1	Hazard	R15	RH indicator relay
C180	-			S2	Roof headlights (German only)	R16	Auto diff lock relay

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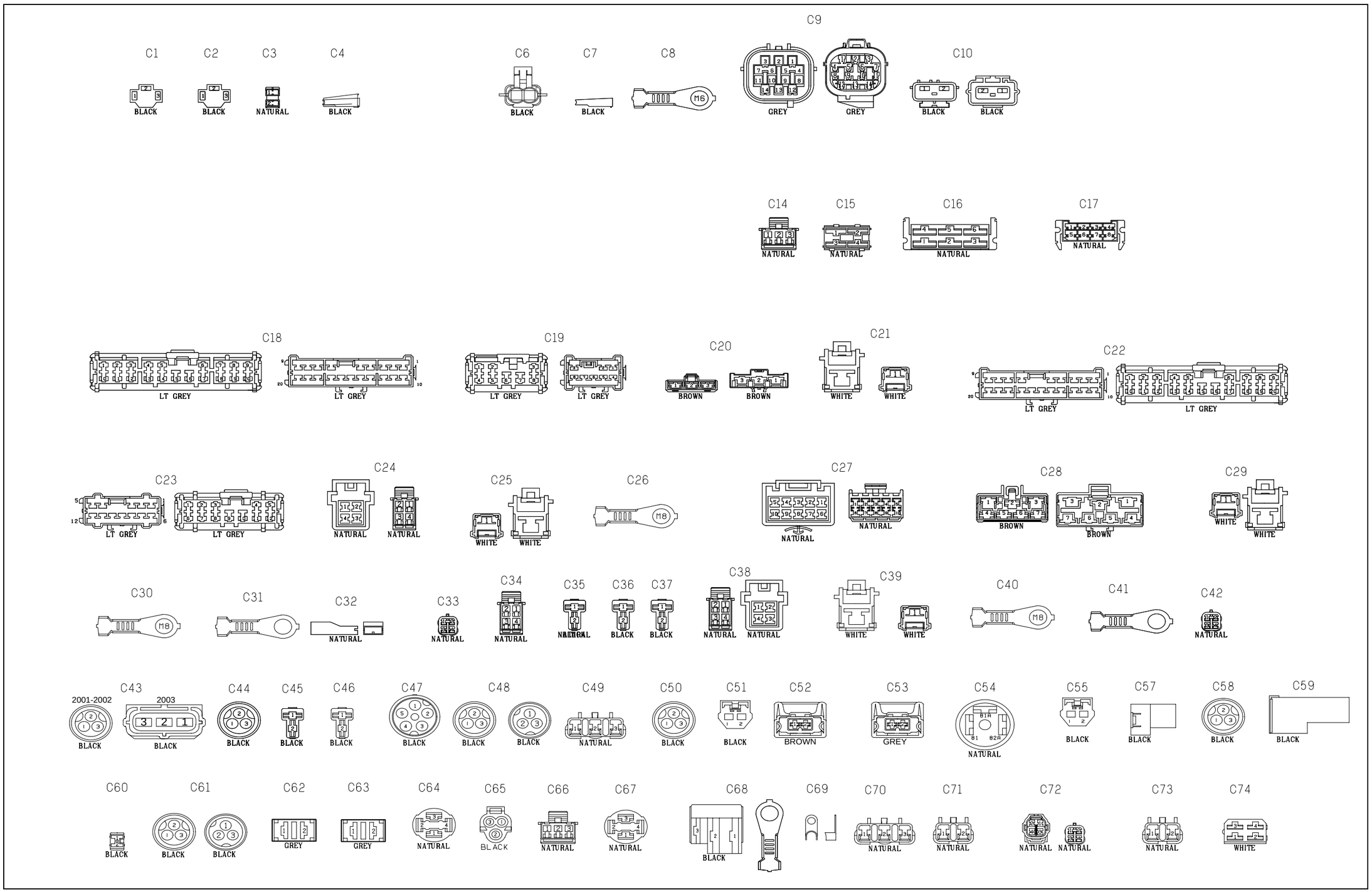


Figure 1

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Figure 1

Connectors, header Joints and plugs

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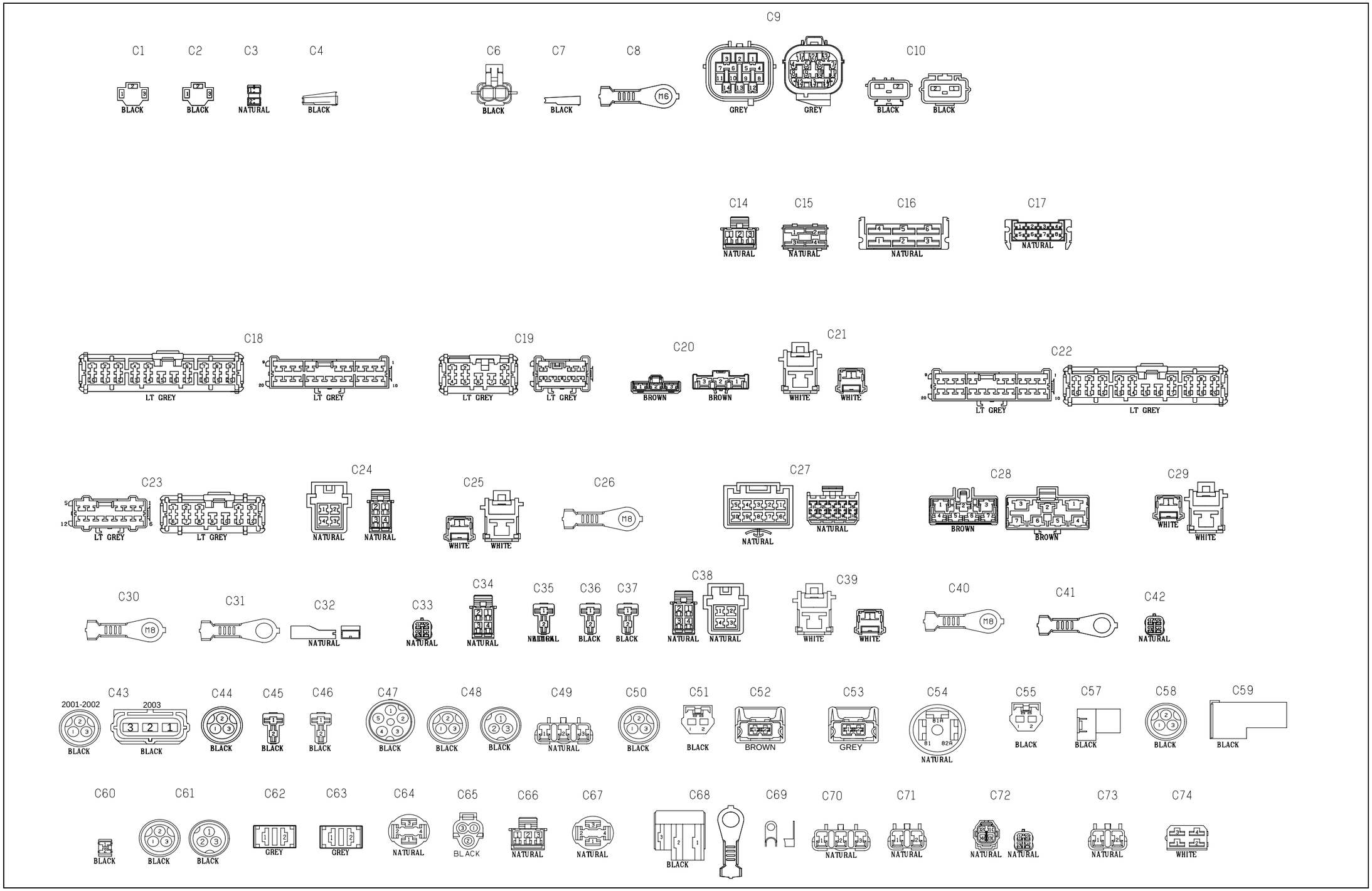


Figure 2

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Figure 2
Connectors, header Joints and plugs

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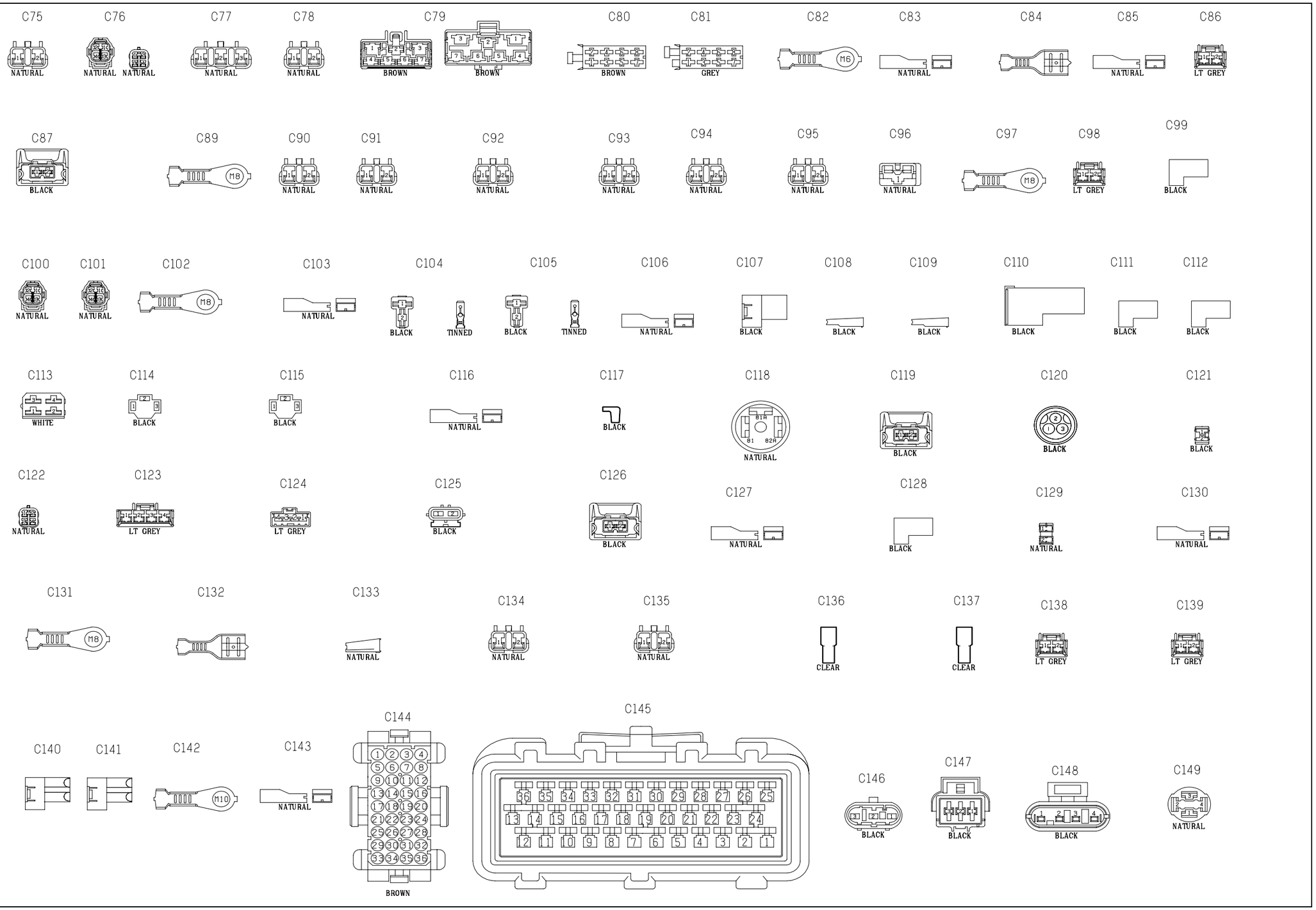


Figure 3

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Figure 3
Connectors, header Joints and plugs

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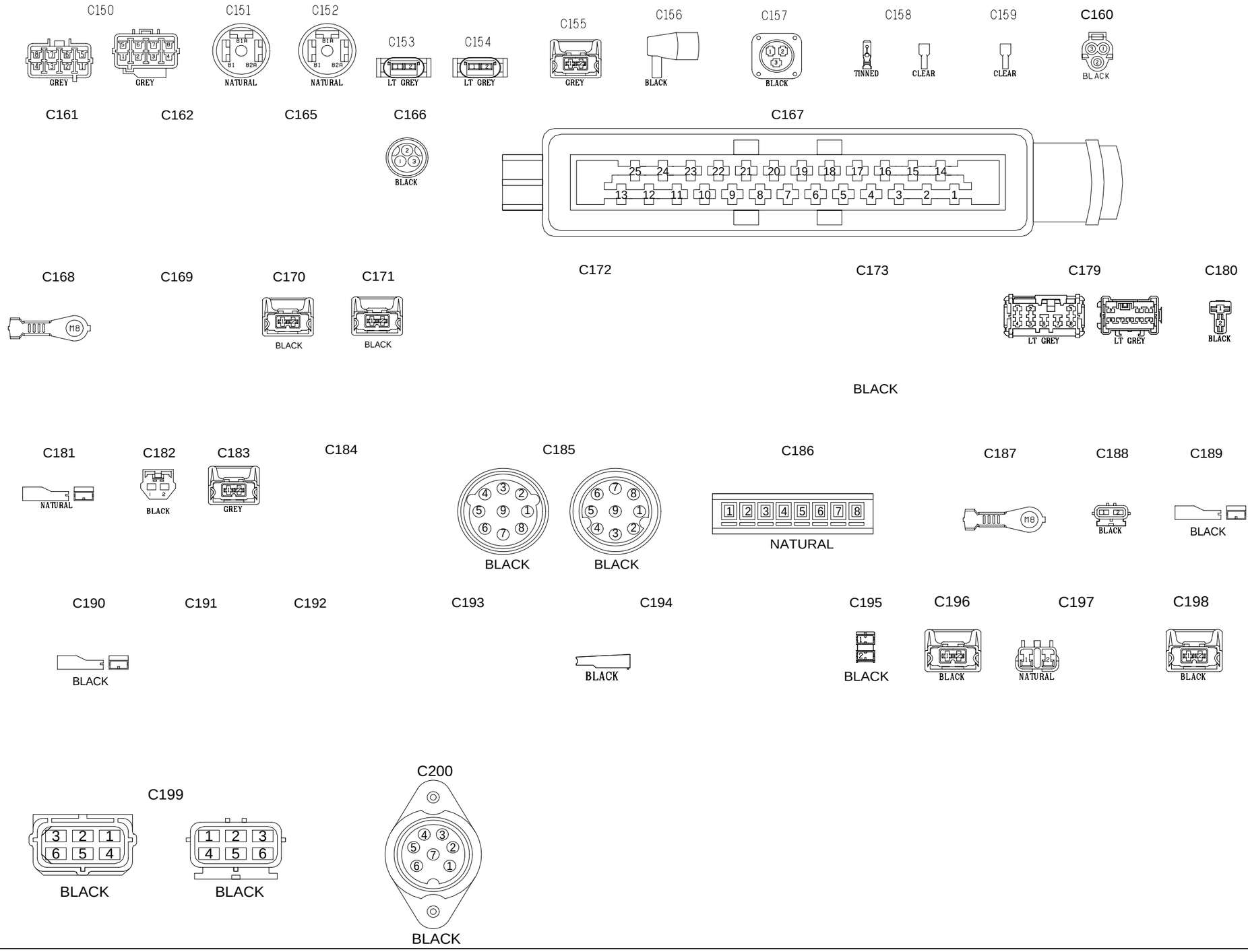


Figure 4

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Figure 4
Connectors, header Joints and plugs

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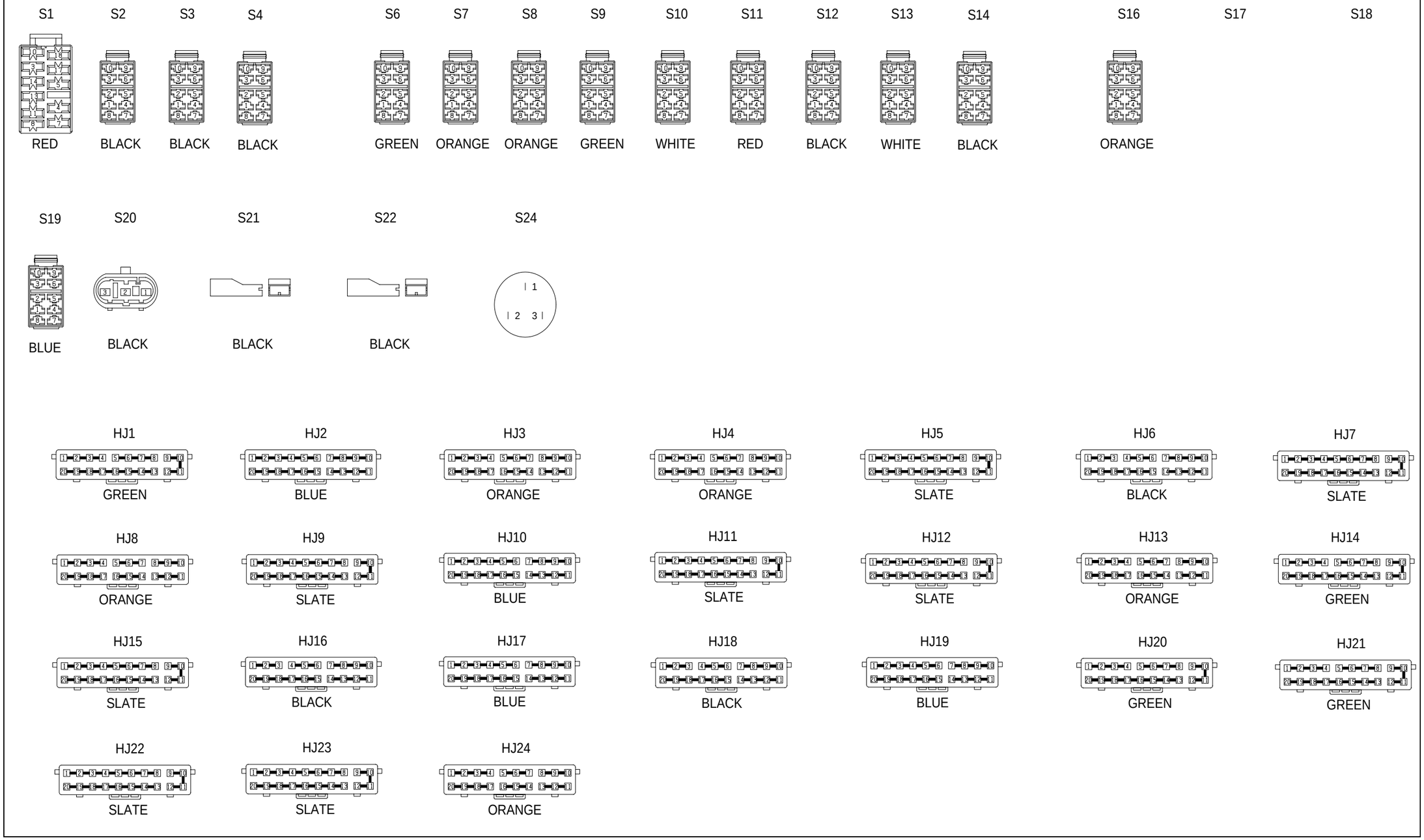


Figure 5

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Figure 5
Connectors, header Joints and plugs

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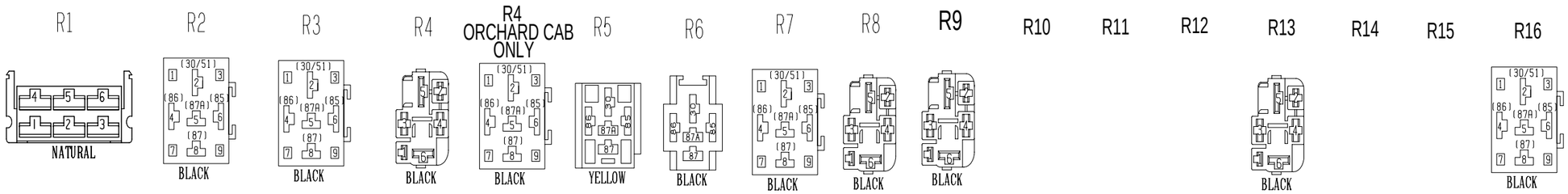


Figure 6

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Figure 6
Connectors, header Joints and plugs

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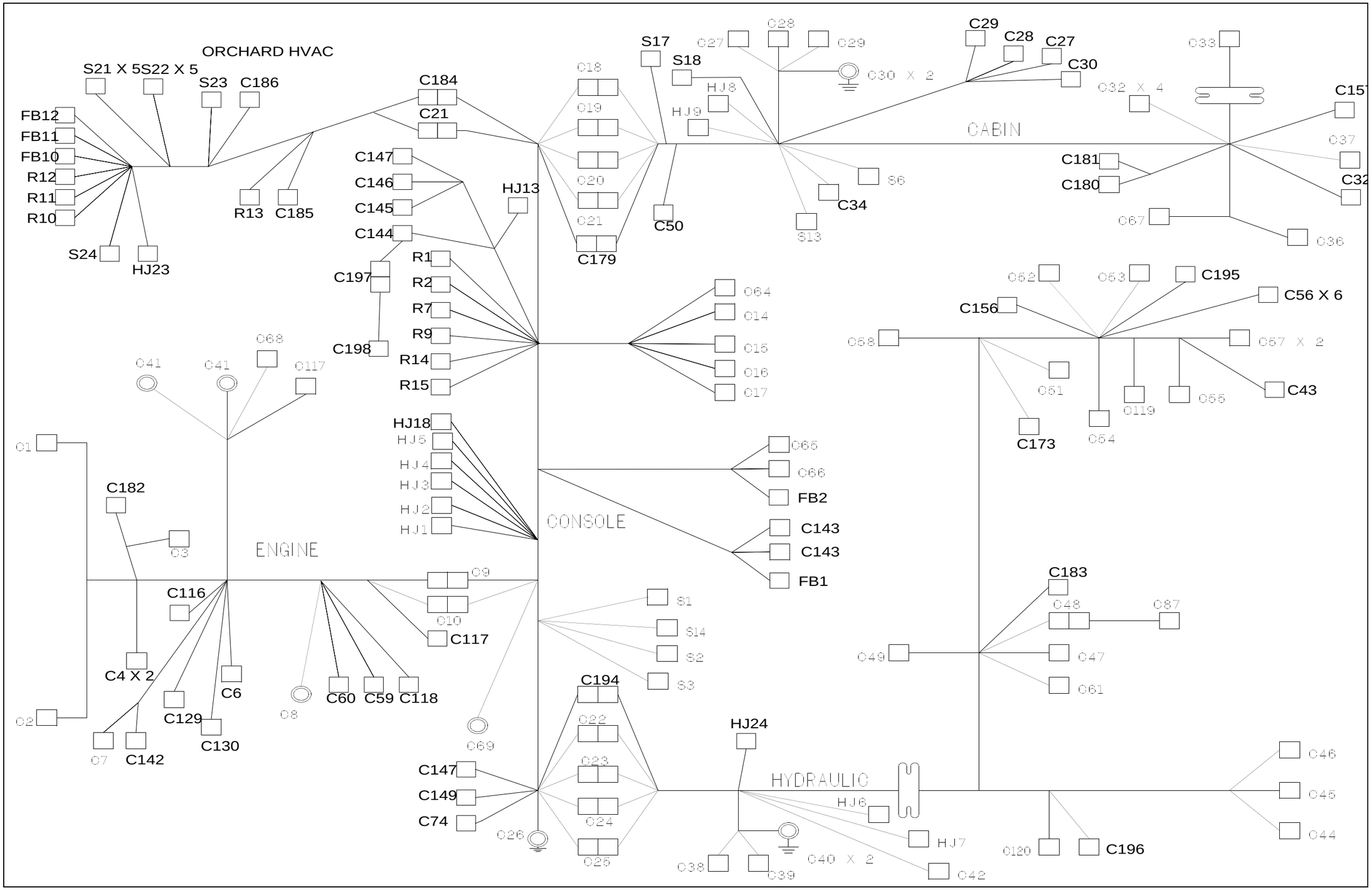


Figure 7 - Harness layout Engine - Console - Hydraulic 2001/2002

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Figure 7
Harness Layout Engine Console
Hydraulic 2001/2002

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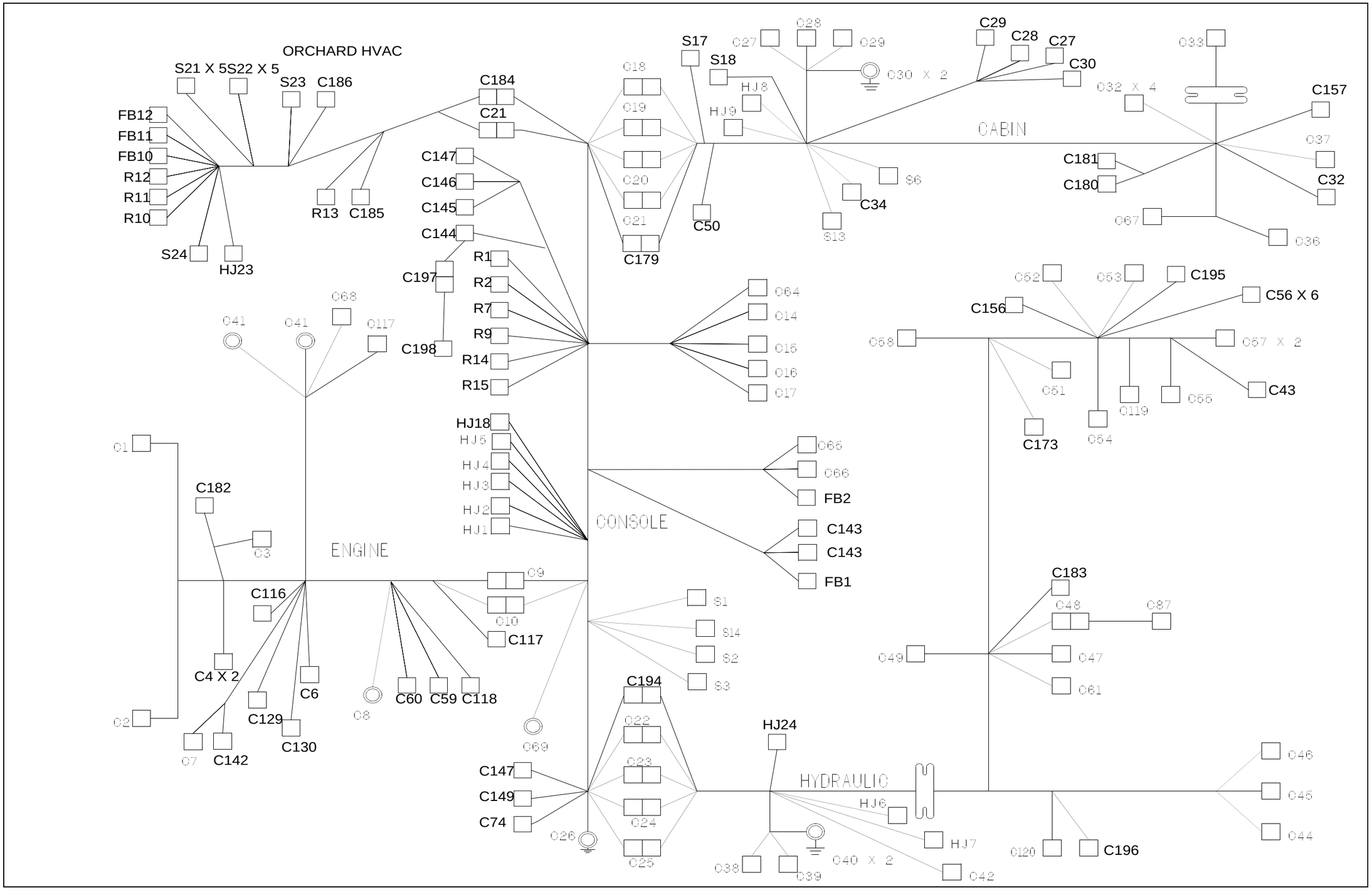


Figure 8 - Harness layout Engine-Console-Cab-Hydraulic 2003

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Figure 8

Harness layout Engine Console

Cab-Hydraulic 2003

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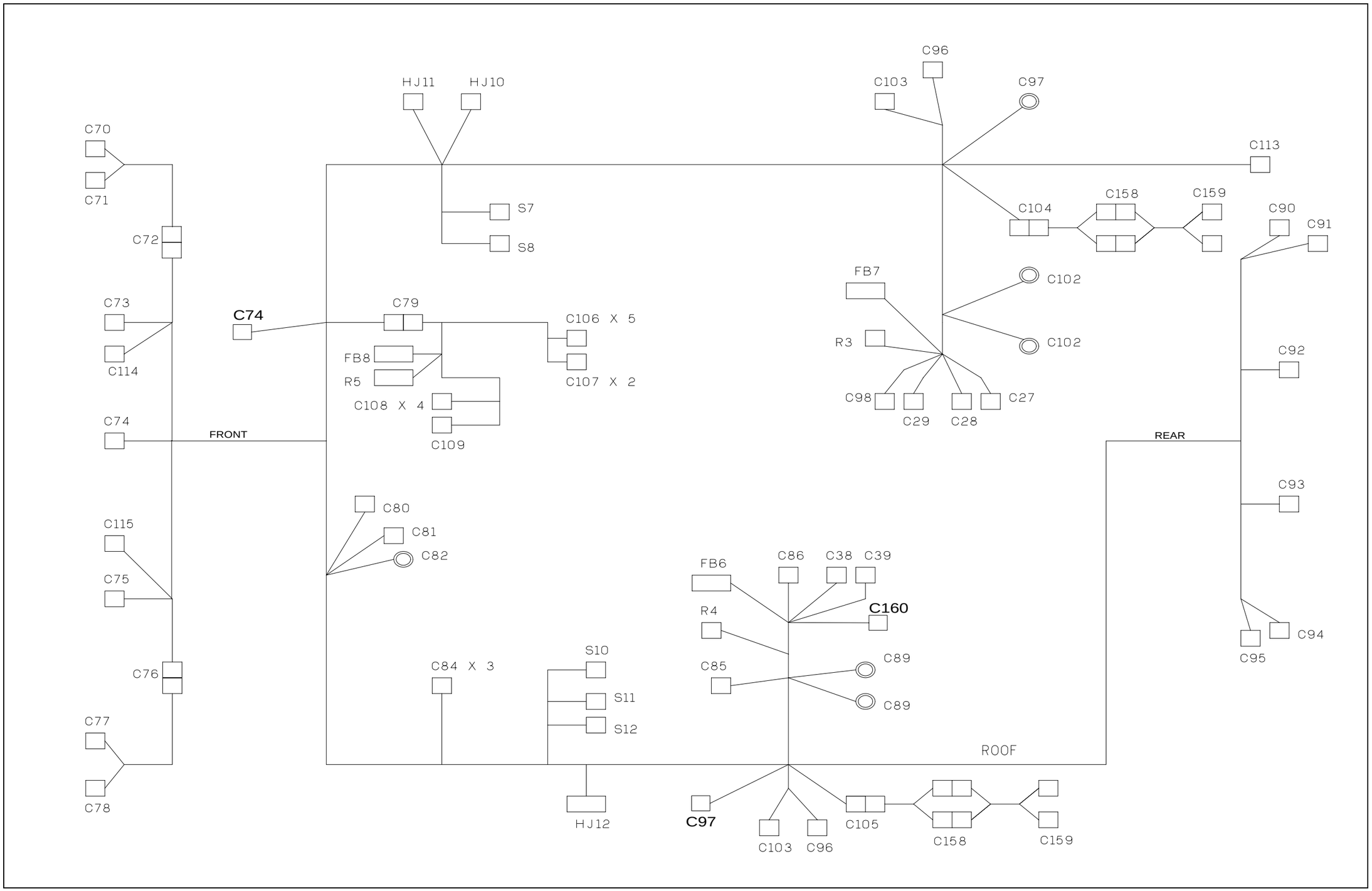


Figure 9 - Harness Cab Layout - Standard Roof

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Figure 9
Harness Cab Layout - Standard Roof

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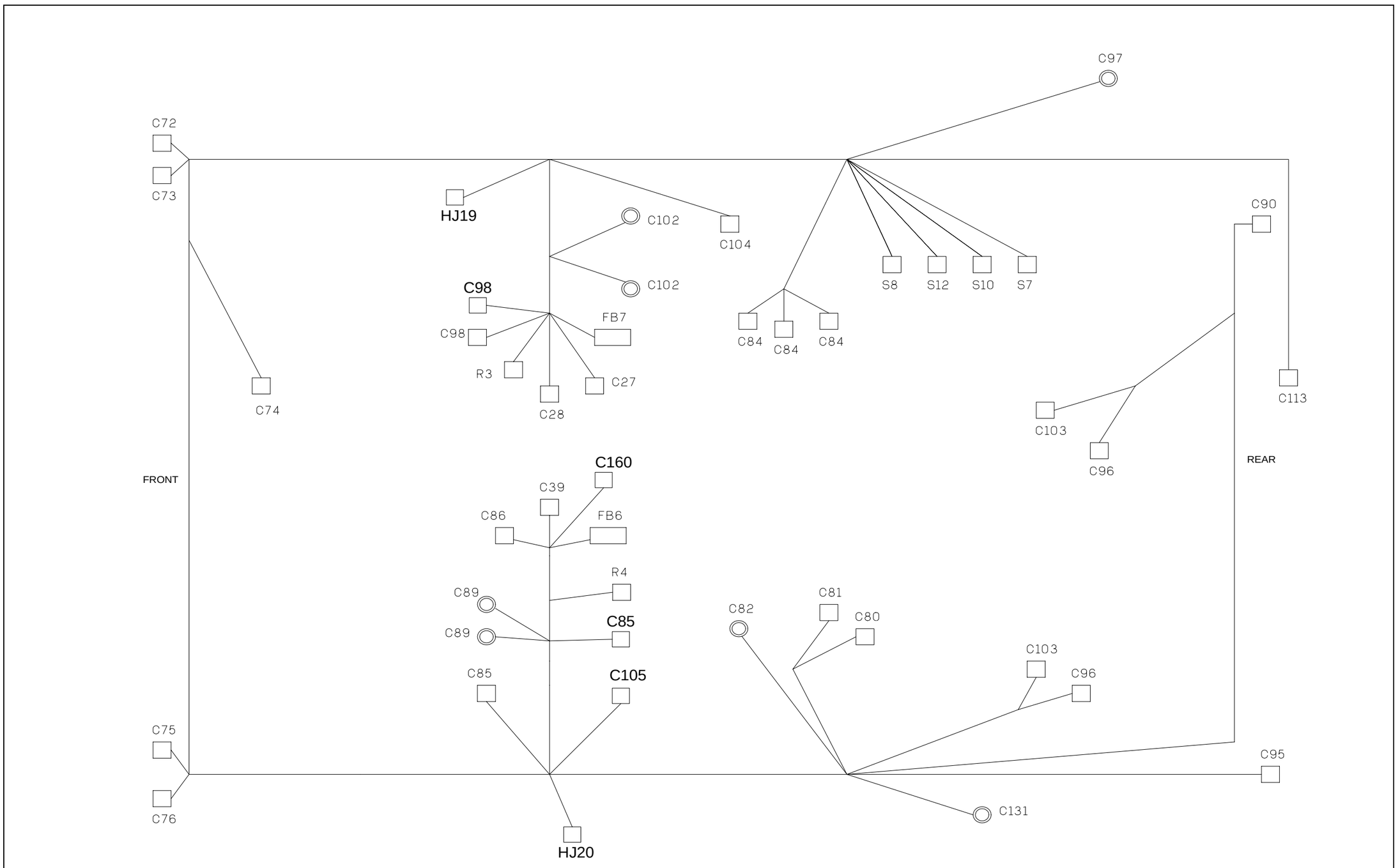


Figure 10 - Harness Cab Layout - Flat Roof

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Figure 10
Harness Cab Layout - Flat Roof

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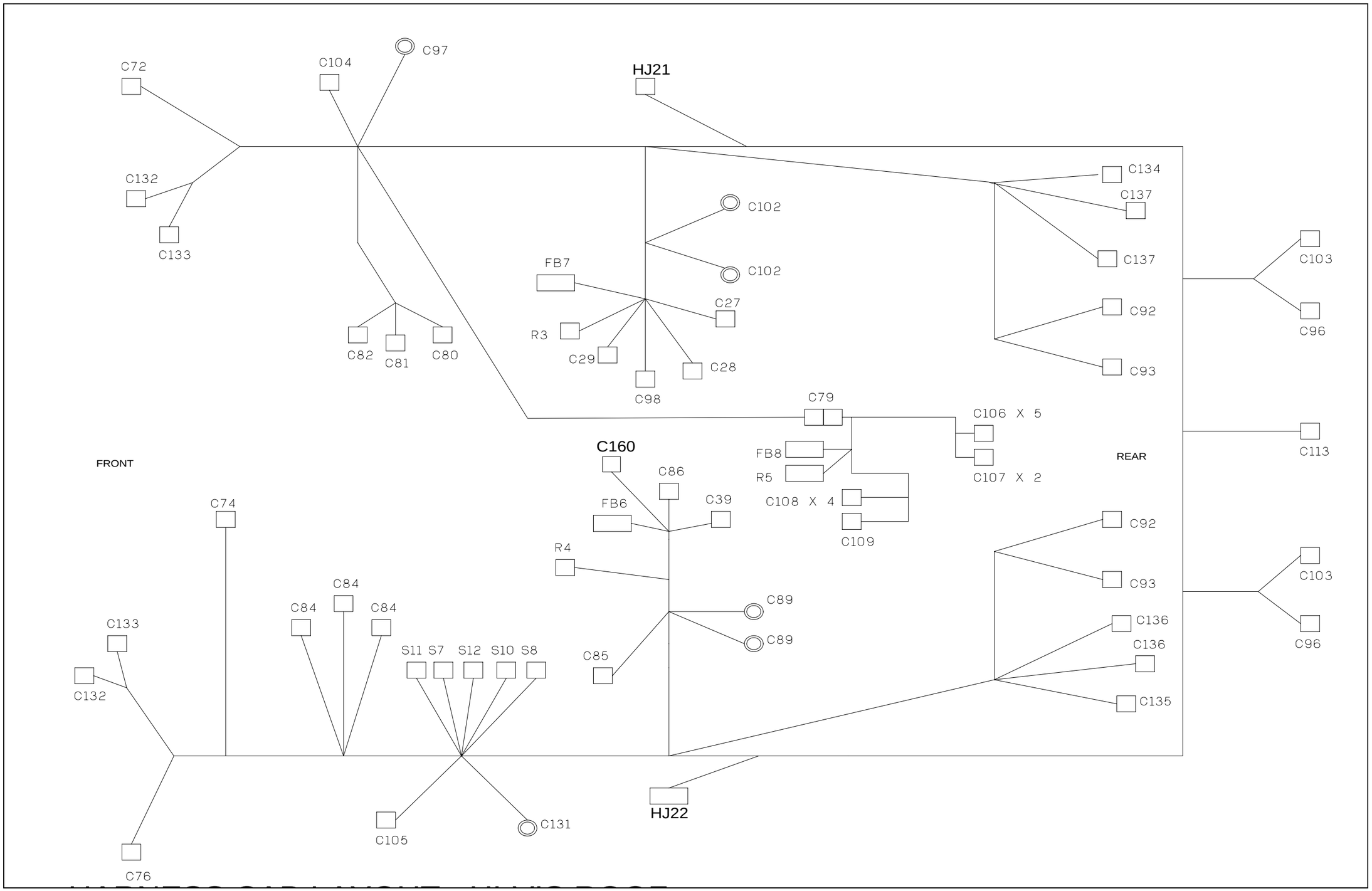


Figure 11 - Harness Cab Layout - HI VIS Roof

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Figure 11
Harness Cab Layout - HI VIS Roof

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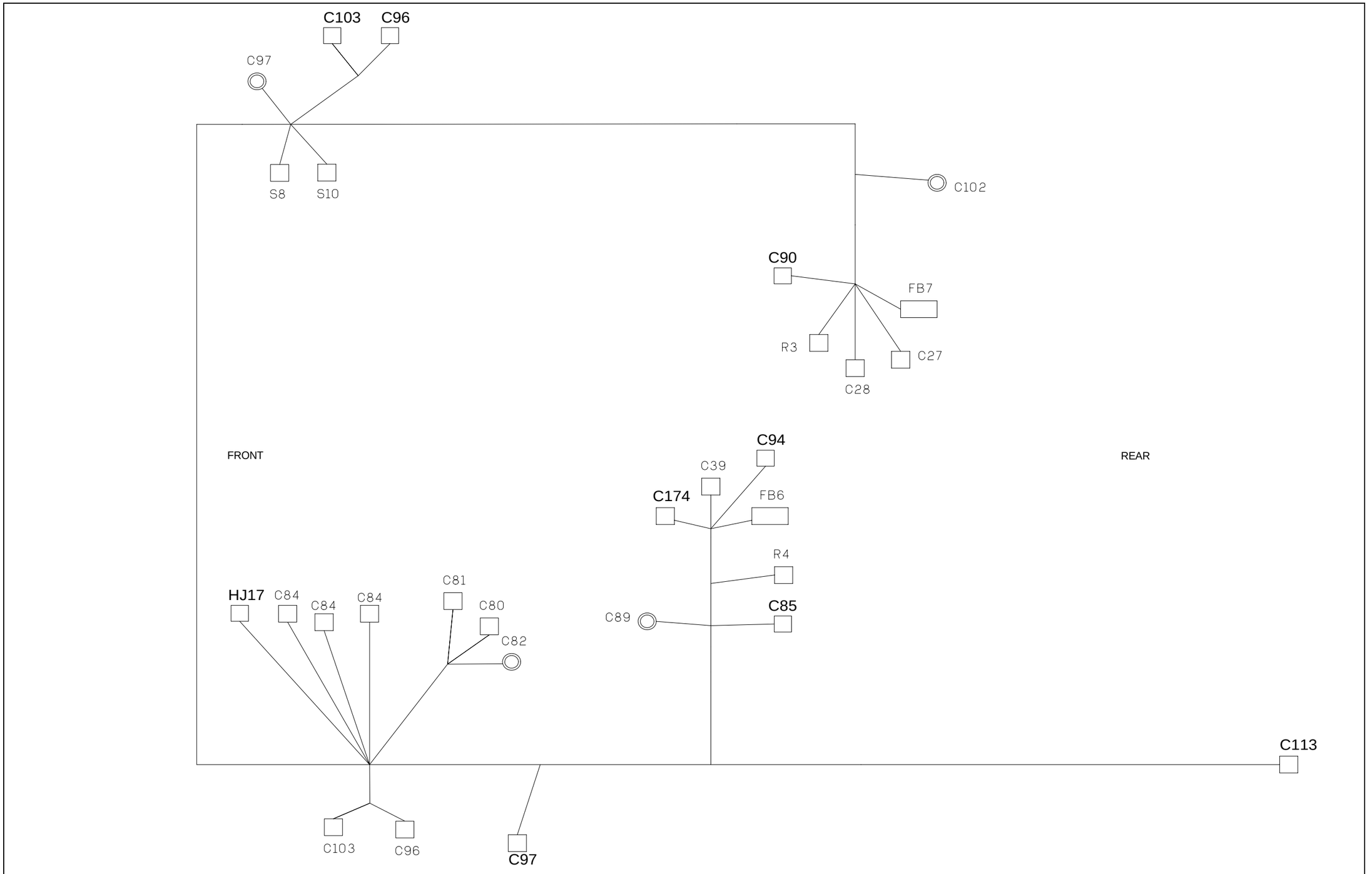


Figure 12 - Harness Cab Layout - Orchard Roof

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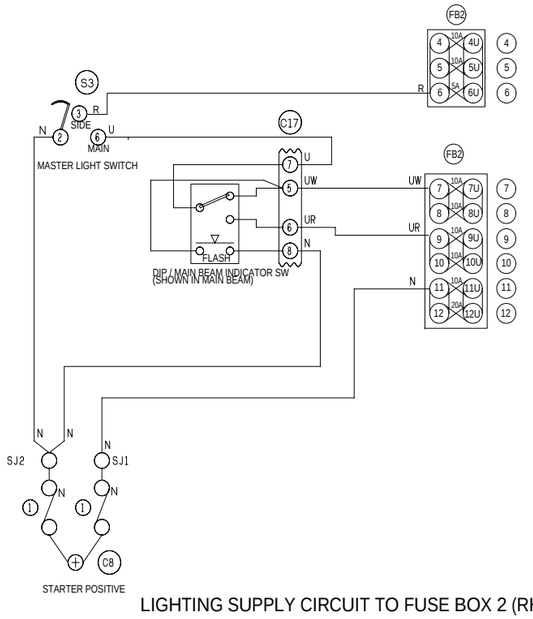
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Figure 12
Harness Cab Layout - Orchard Roof

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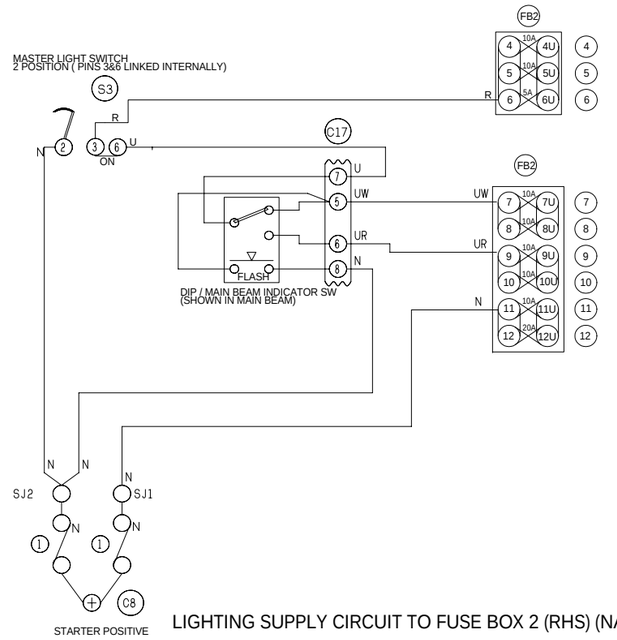
Tractor Manuals Scotland

A



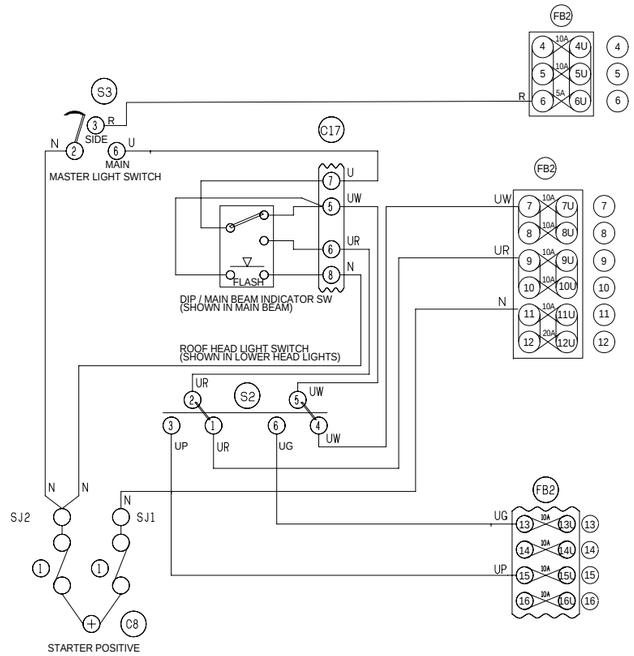
LIGHTING SUPPLY CIRCUIT TO FUSE BOX 2 (RHS) (WEO NON GERMAN)

B



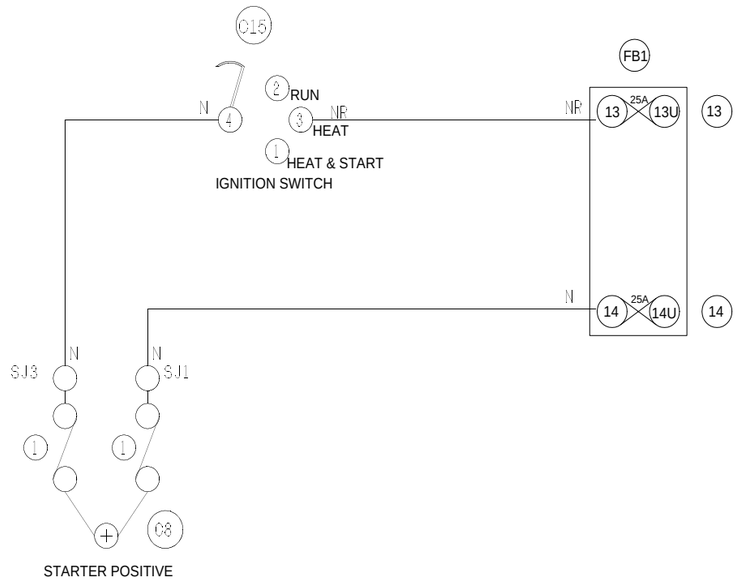
LIGHTING SUPPLY CIRCUIT TO FUSE BOX 2 (RHS) (NAO)

C



LIGHTING SUPPLY CIRCUIT TO FUSE BOX 2 (RHS) (GERMAN HIGH SPEC)

D



IGNITION SWITCH SUPPLY CIRCUIT TO FUSE BOX 1 (LHS)

Figure 13

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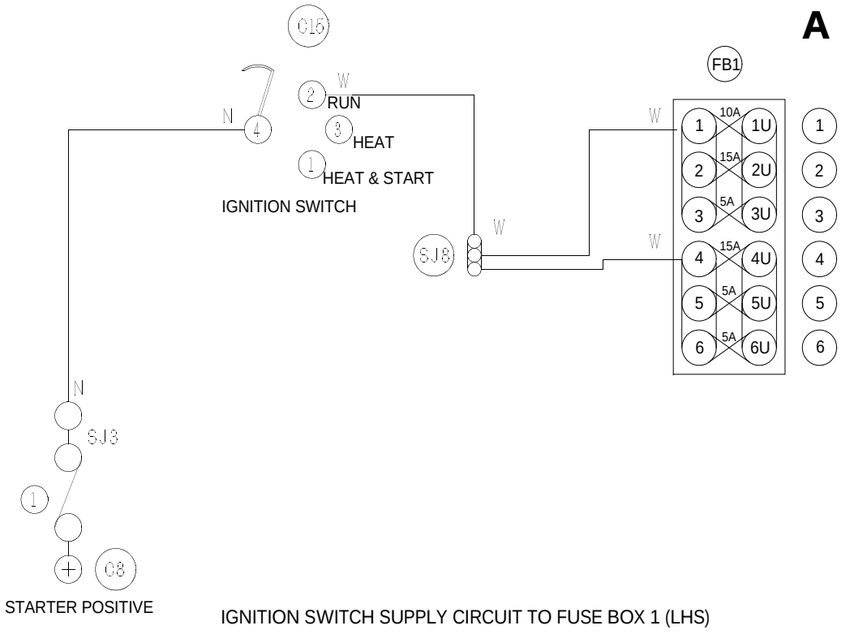
Figure 13

A - Lighting supply circuit to fuse box 2 (RHS) (WEO NON German)
B - Lighting supply circuit to fuse box 2 (RHS) (NAO)
C - Lighting supply circuit to fuse box 2 (RHS) (German High spec)
D - Ignition switch supply circuit to fuse box 1 (LHS)

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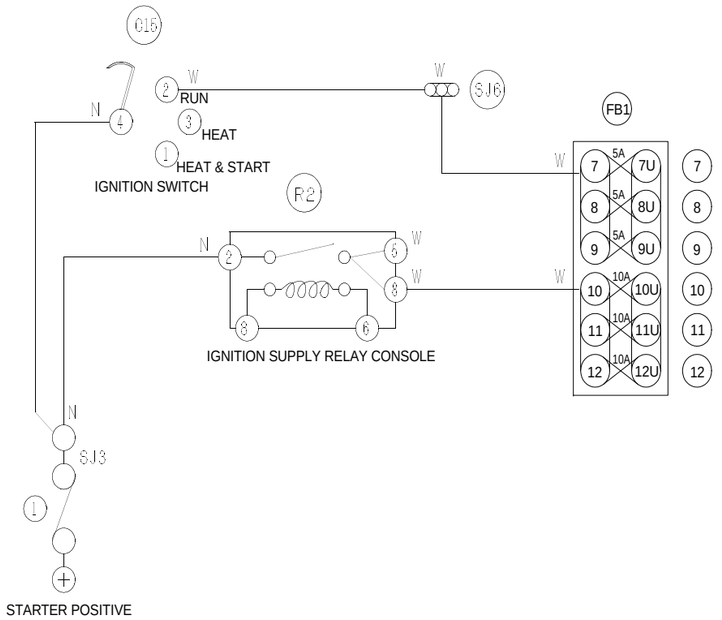
Tractor Manuals Scotland

A



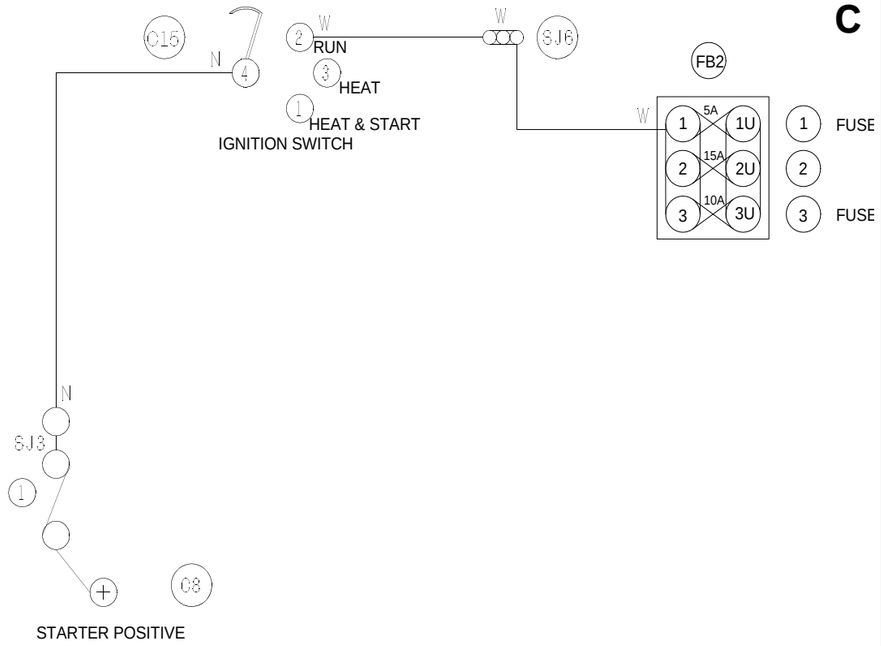
IGNITION SWITCH SUPPLY CIRCUIT TO FUSE BOX 1 (LHS)

B



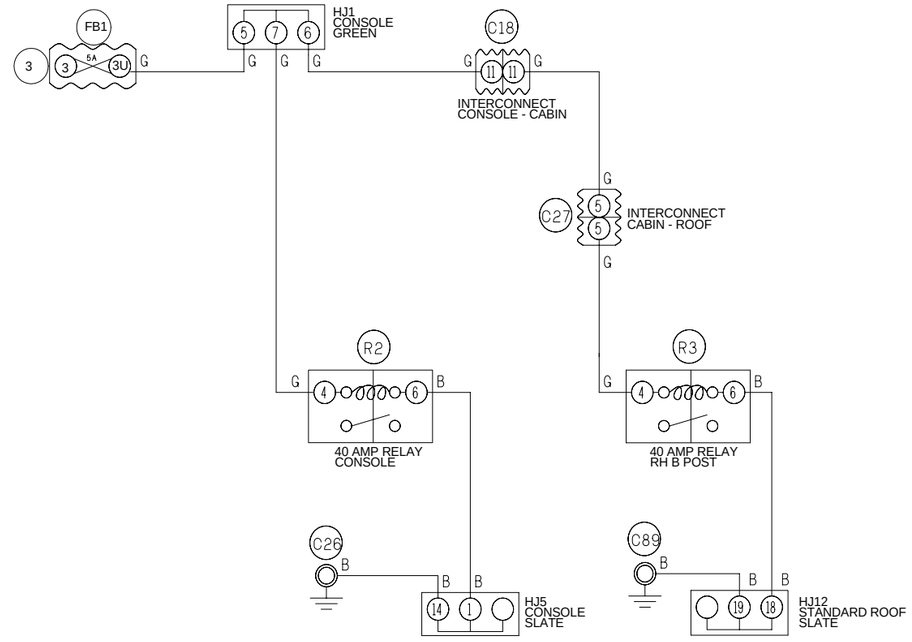
IGNITION SWITCH SUPPLY CIRCUIT VIA CONSOLE RELAY (R2) TO FUSE BOX 1 (LHS)

C



IGNITION SWITCH SUPPLY CIRCUIT TO FUSE BOX 2 (RHS)

D



IGNITION SWITCHED RELAYS CIRCUIT

Figure 14

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Figure 14

A - Ignition switch supply circuit to fuse box 1 (LHS)
B - Ignition switch supply circuit via console relay (R2) to fuse box 1 (LHS
C - Ignition switch supply circuit to fuse box 2 (RHS)
D - Ignition switched relays circuit

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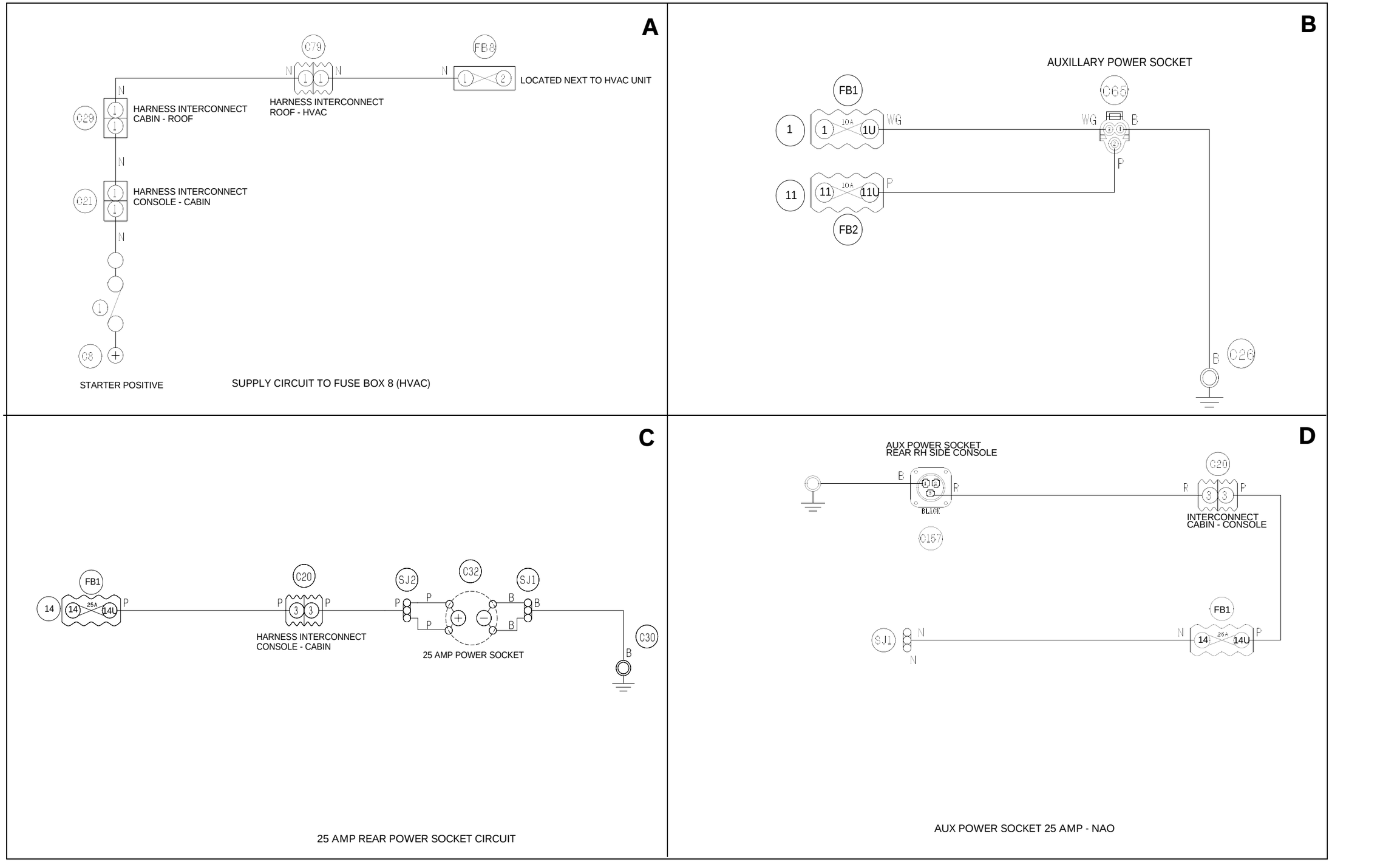


Figure 15

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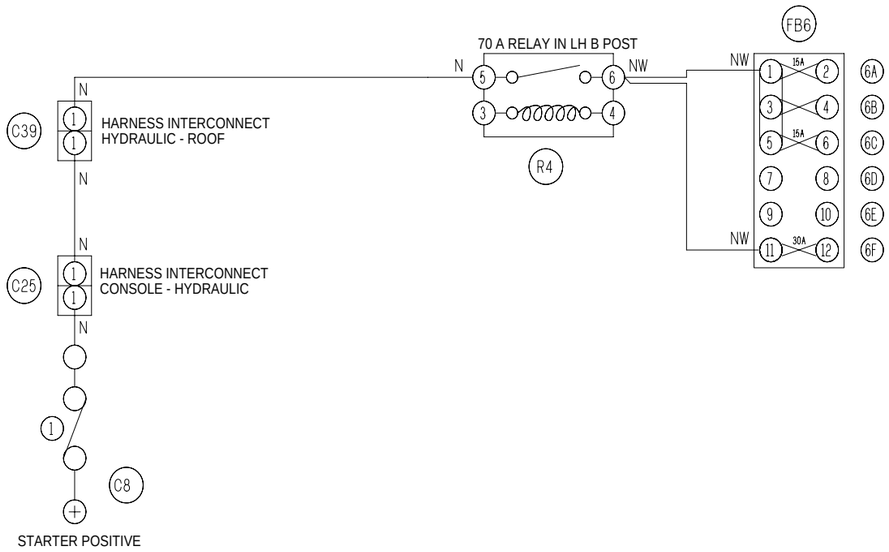
Tractor Manuals Scotland

Figure 15

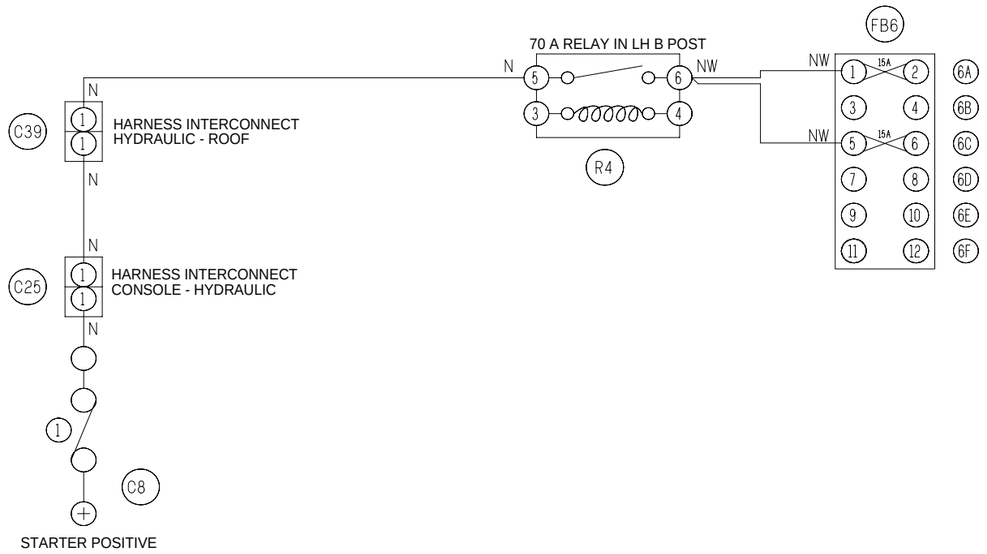
A - Supply circuit to fuse box 8 (HVAC)
B - Auxiliary power socket
C - 25 AMP rear power socket circuit
D - Aux power socket 25 AMP - NAO

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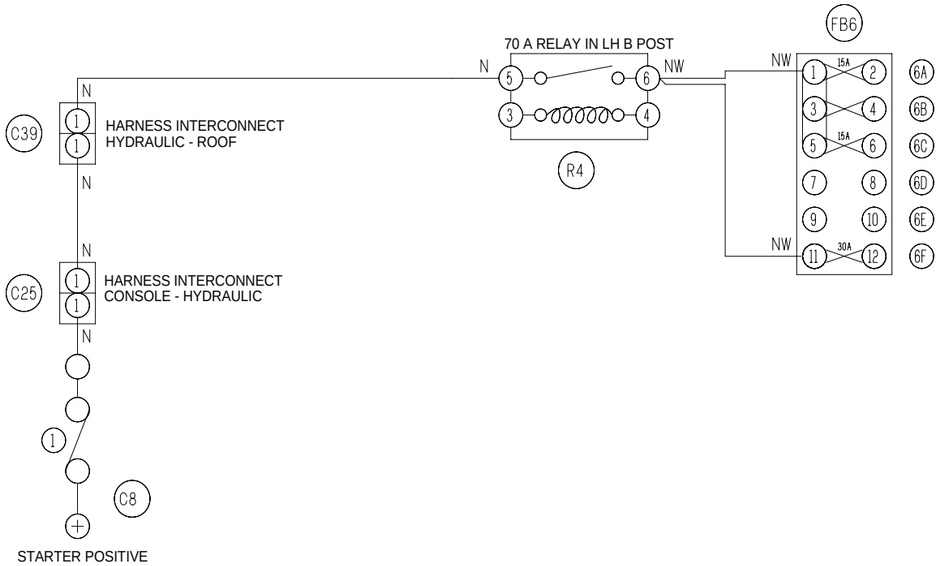
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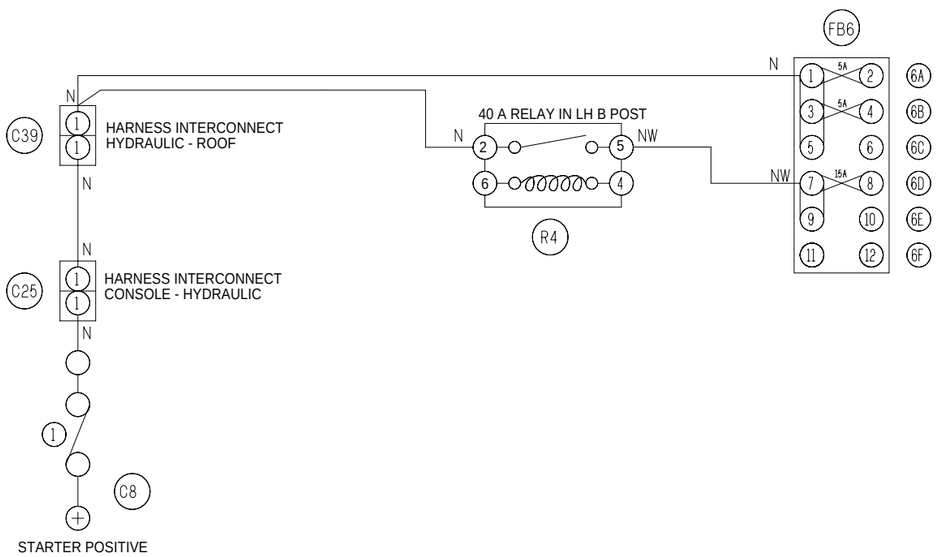
WORK LIGHT SUPPLY TO FUSE BOX 6 (LH B POST) - STANDARD ROOF



WORK LIGHT SUPPLY TO FUSE BOX 6 (LH B POST) - FLAT ROOF



WORK LIGHT SUPPLY TO FUSE BOX 6 (LH B POST) - HI VIS ROOF



WORK LIGHT SUPPLY TO FUSE BOX 6 (LH B POST) - ORCHARD CAB ROOF

Figure 16

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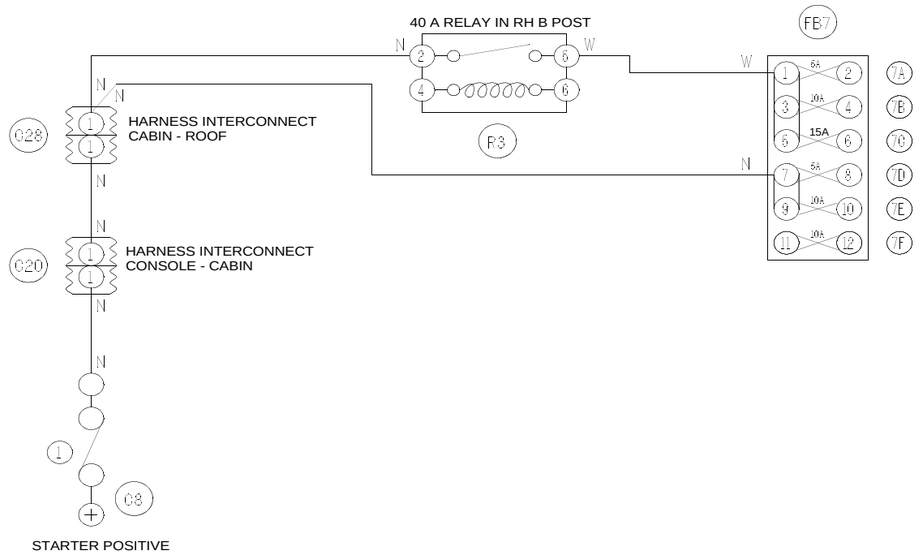
Figure 16

A - Work light supply to fuse box 6 (LH B POST) - Standard roof
B - Work light supply to fuse box 6 (LH B POST) - Flat roof
C - Work light supply to fuse box 6 (LH B POST) - HI VIS Roof
D - Work light supply to fuse box 6 (LH B POST) - Orchard cab roof

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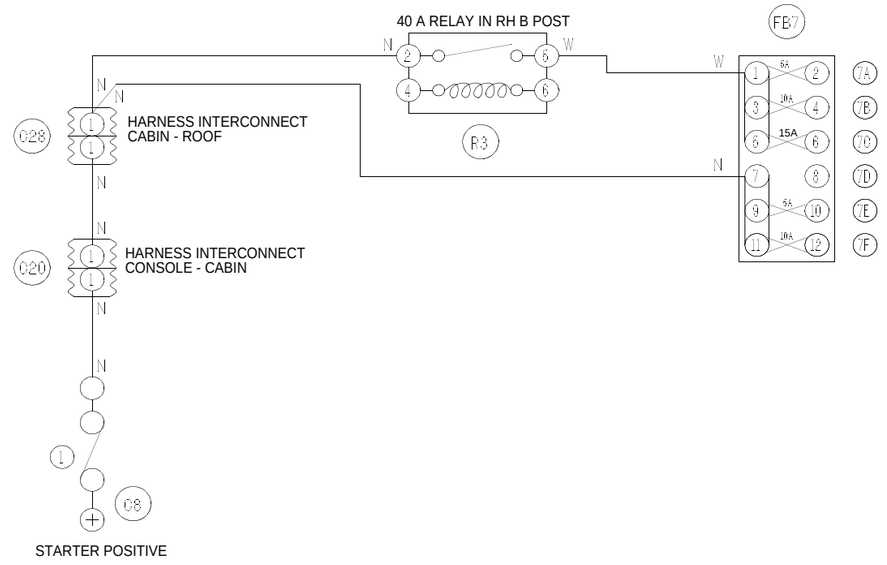
Tractor Manuals Scotland

A



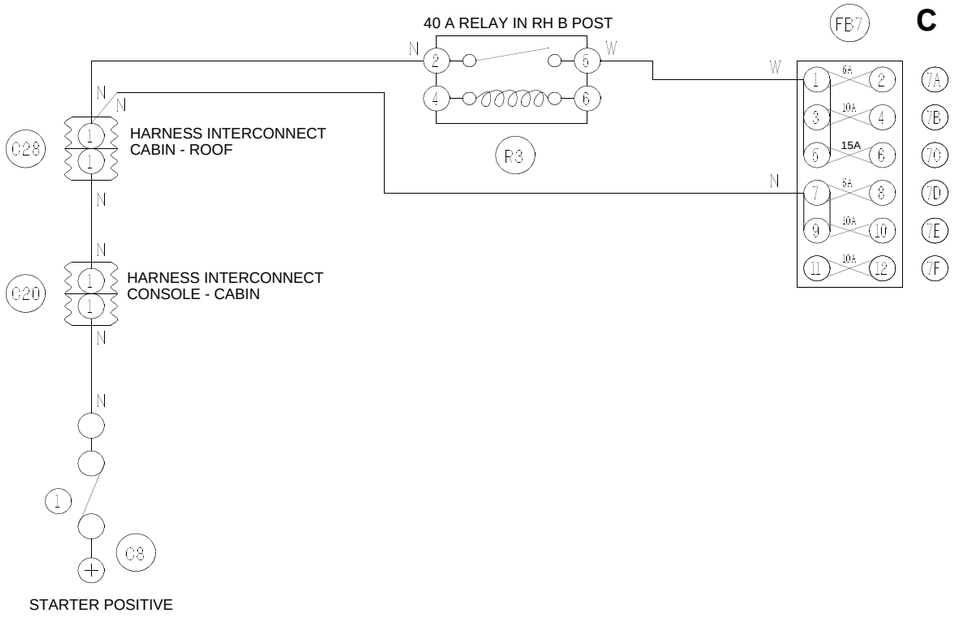
ROOF IGNITION SWITCHED SUPPLY TO FUSE BOX 7 (RH B POST) - STANDARD ROOF

B



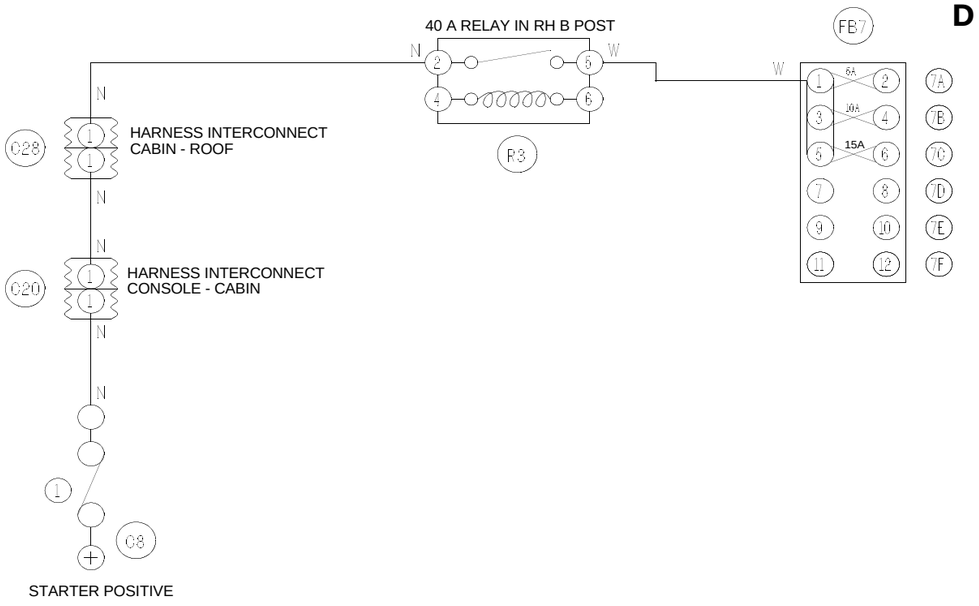
ROOF IGNITION SWITCHED SUPPLY TO FUSE BOX 7 (RH B POST) - FLAT ROOF

C



ROOF IGNTION SWITCHED SUPPLY TO FUSE BOX 7 (RHS B POST) - HI VIS ROOF

D



ROOF IGNITION SWITCHED SUPPLY TO FUSE BOX 7 (RH B POST) - ORCHARD CAB ROOF

Figure 17

Tractor Manuals Scotland - Please Do Not Copy

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Figure 17

A - Roof ignition switched supply to fuse box 7 (RH B POST) - Standard roof

B - Roof ignition switched supply to fuse box 7 (RH B POST) - Flat roof

C - Roof ignition switched supply to fuse box 7 (RHS B POST) - HI VIS roof

D - Roof ignition switched supply to fuse box 7 (RH B POST) - Orchard cab roof

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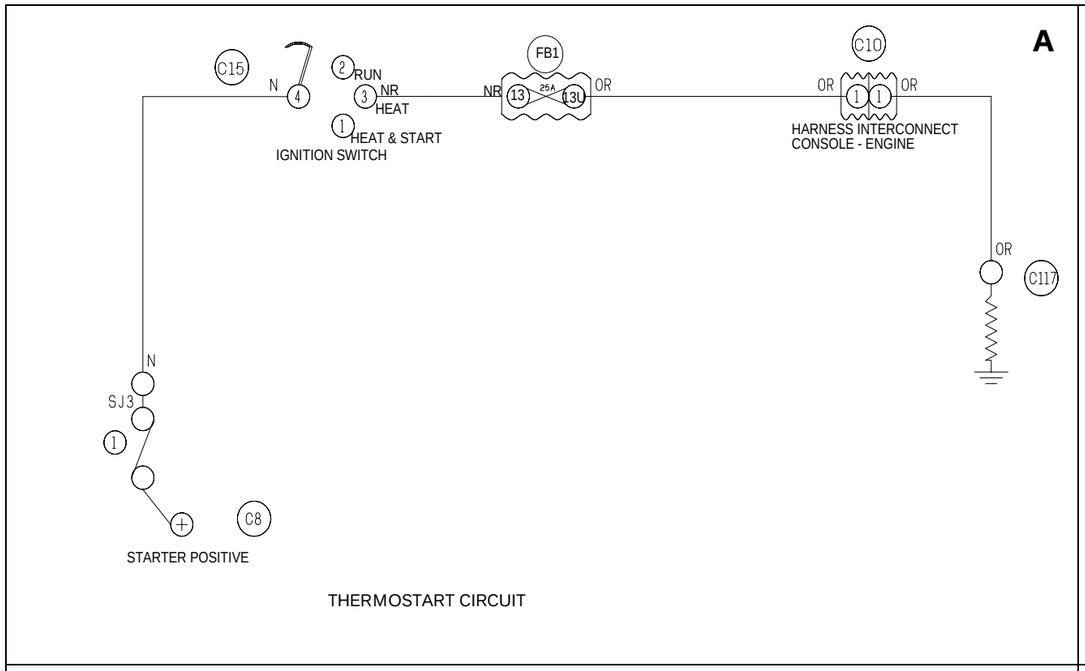


Figure 18

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Figure 18

A - Thermostart circuit
B - Electric seat
C - Supply to instrument panel
D - Range change circuit non power shuttle

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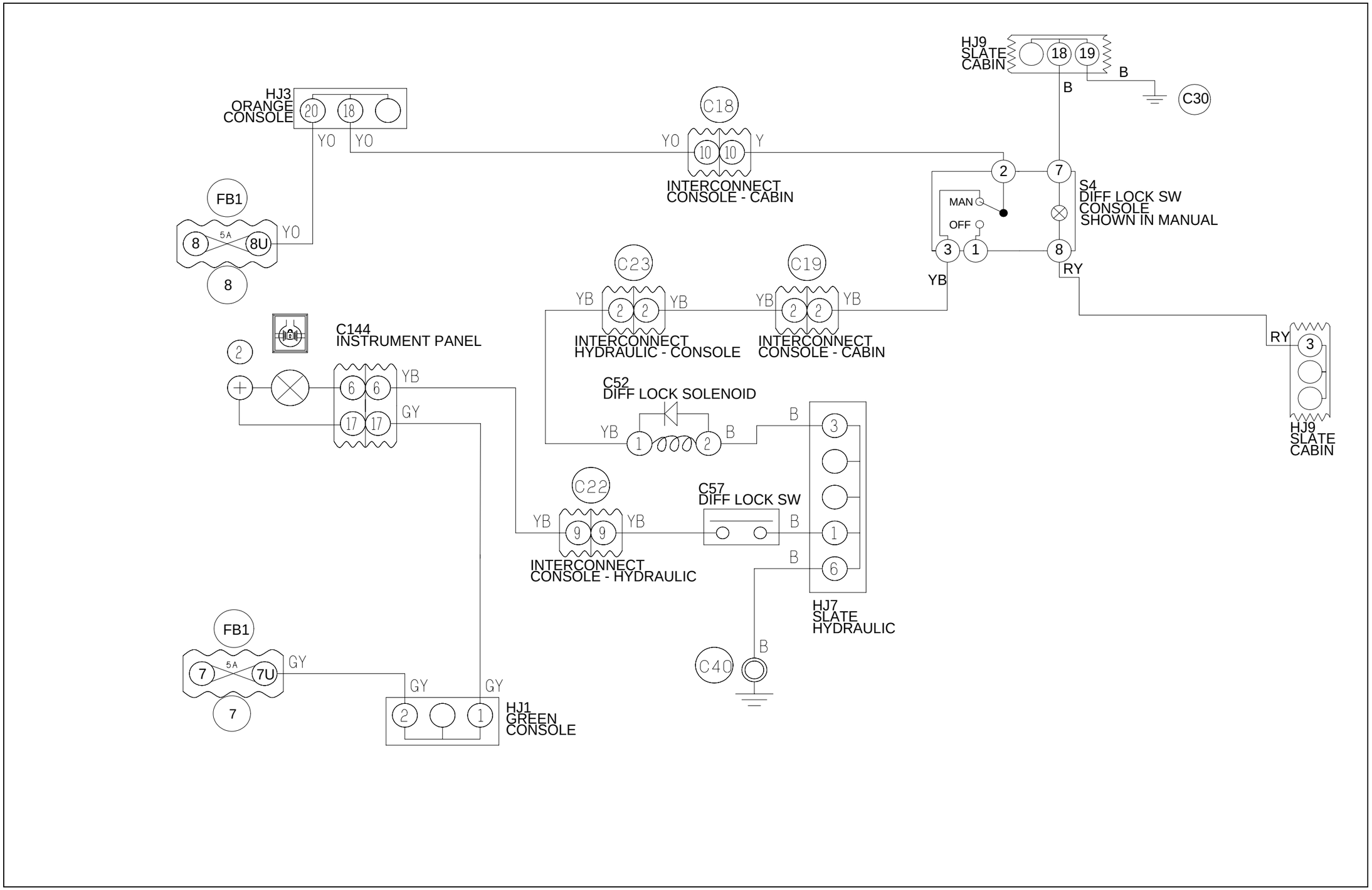


Figure 19 - Manual Diff Lock

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Figure 19
Manual Diff Lock

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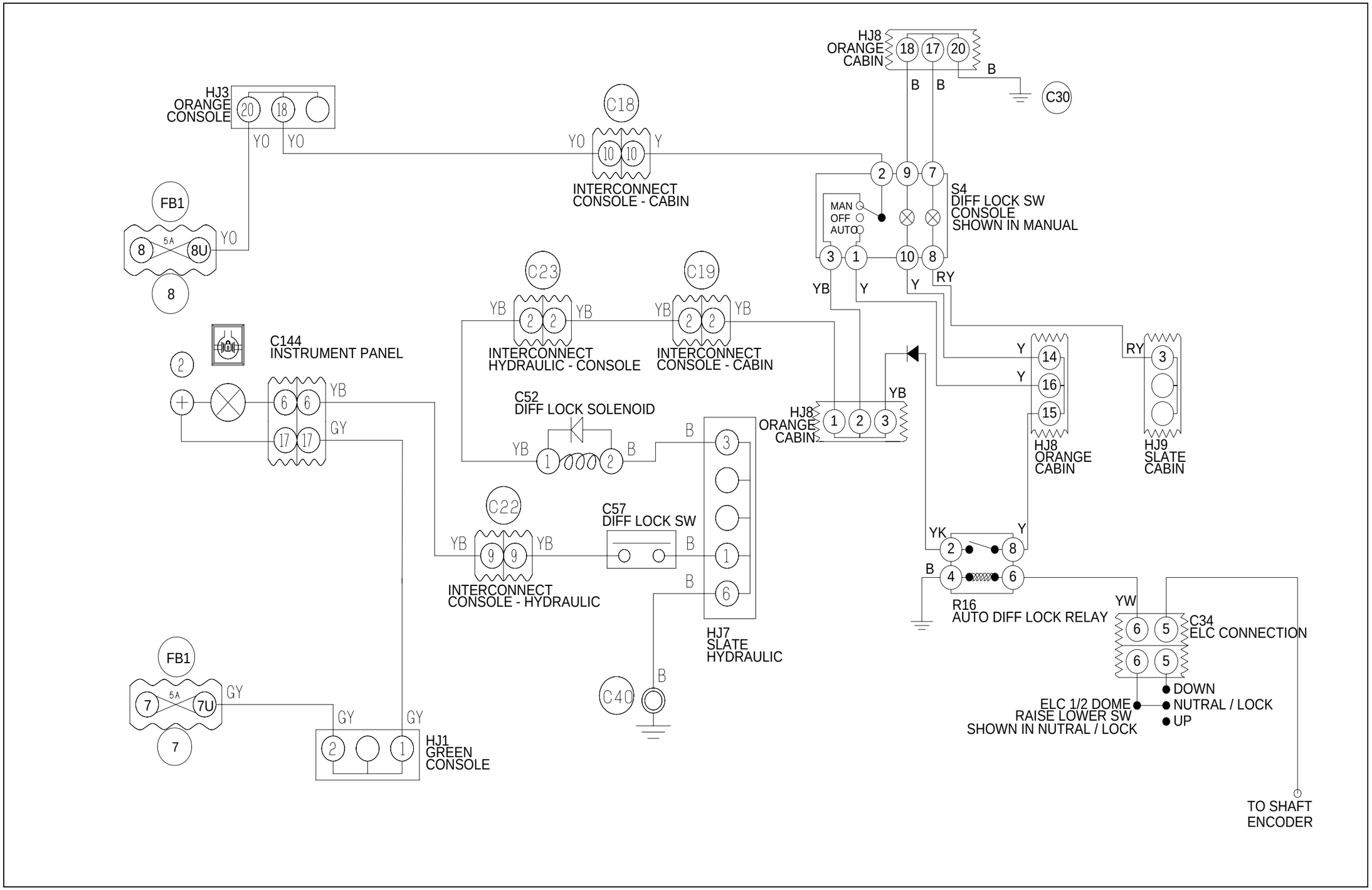


Figure 20 - Auto Diff Lock - Late 2002 Onwards

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Figure 20
Auto Diff Lock - Late 2002 Onwards

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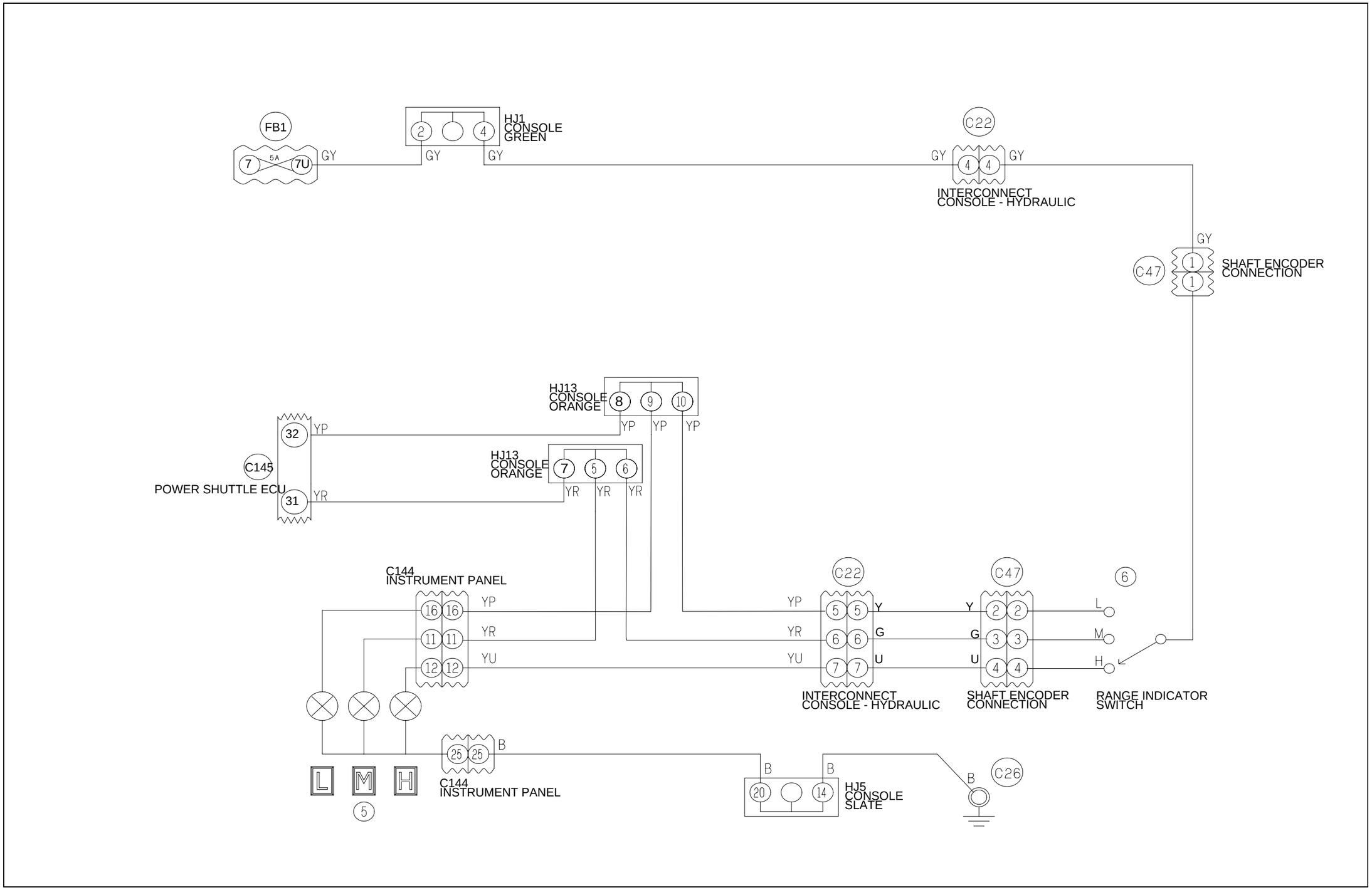


Figure 21 - Range Change Power Shuttle 2001/2002

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Figure 21
Range Change Power Shuttle 2001/2002

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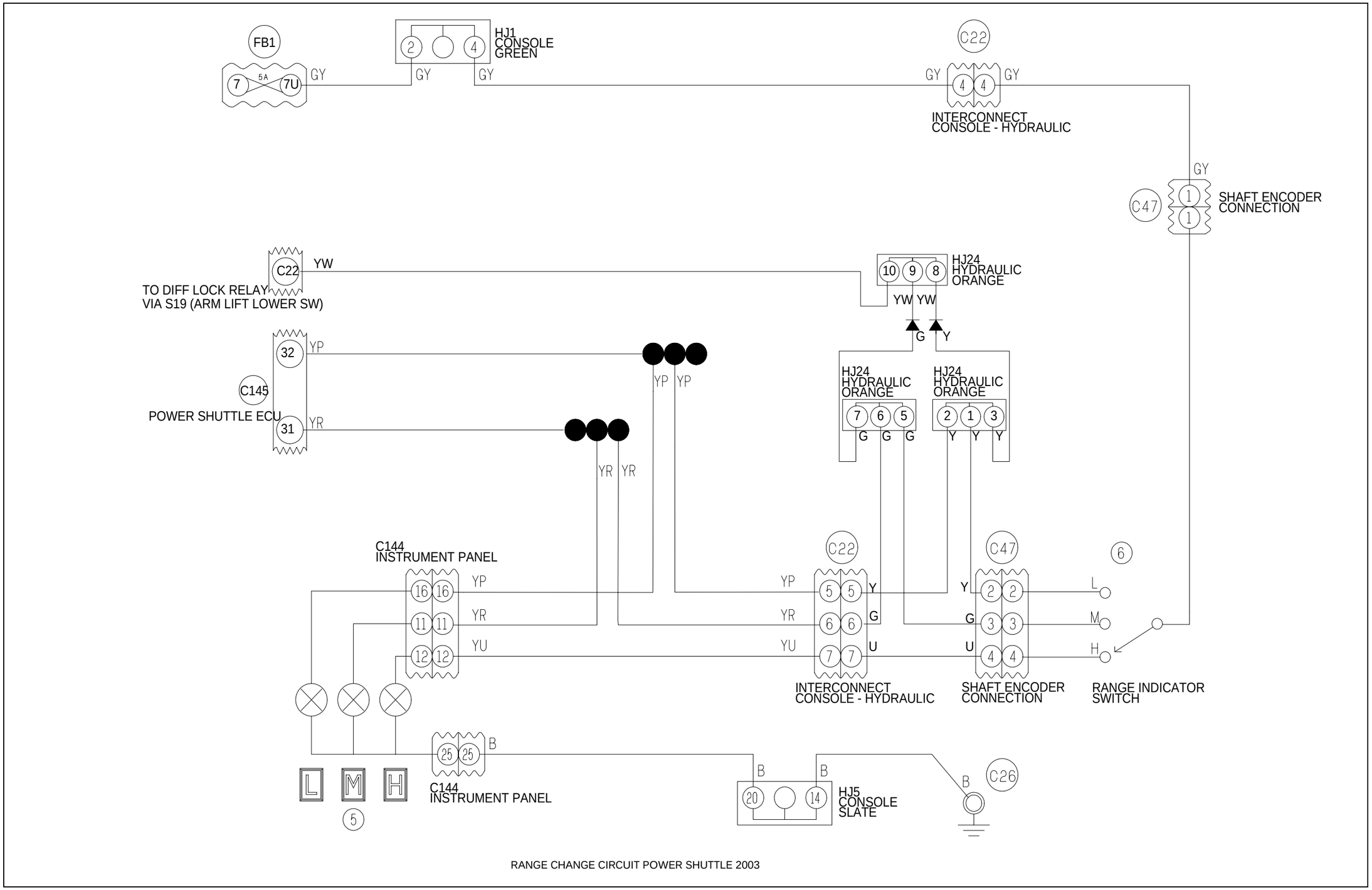


Figure 22 - Range change circuit power shuttle 2003

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Figure 22
Range Change Circuit Power Shuttle 2003

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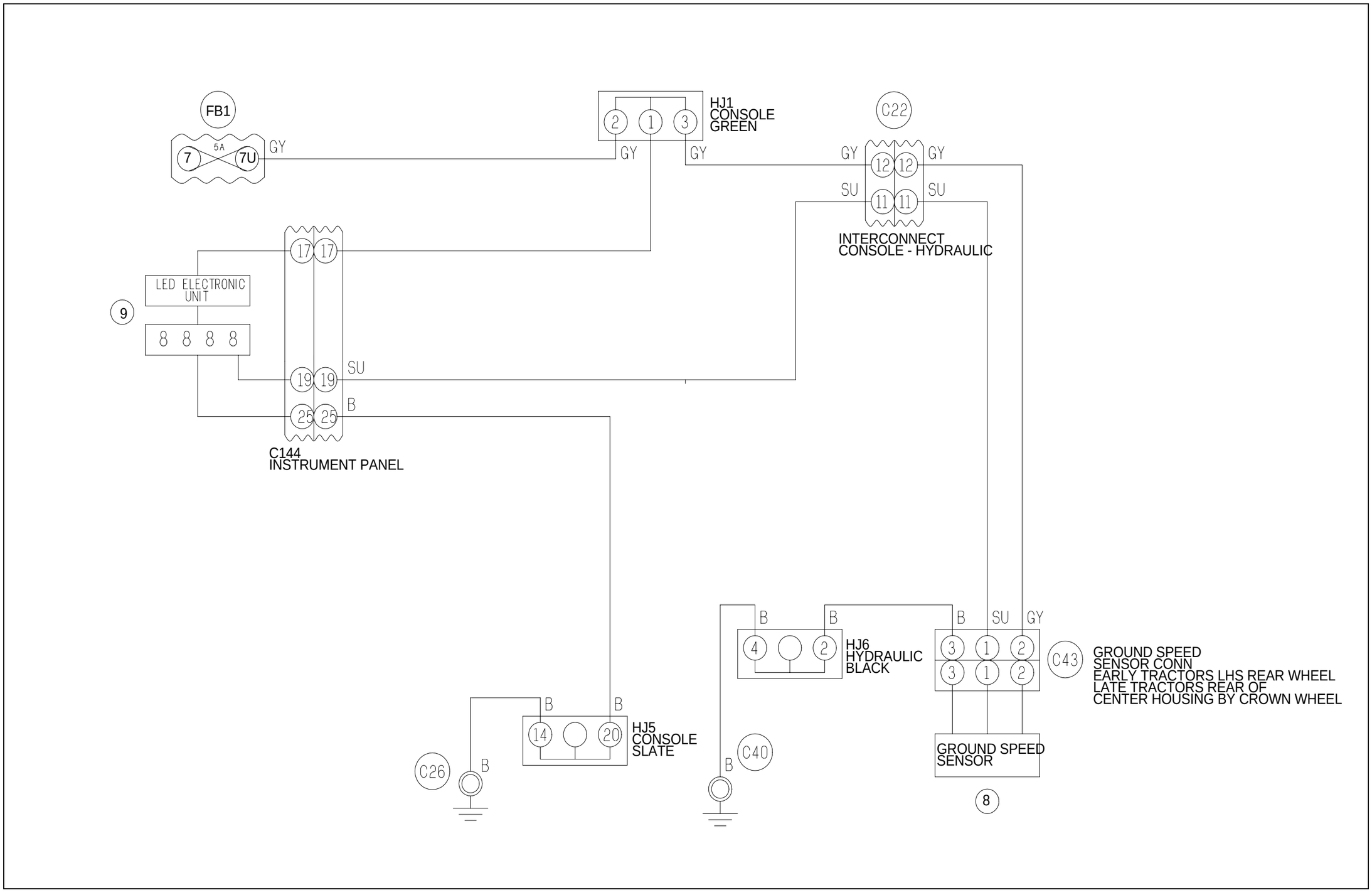


Figure 23 - Ground Speed Circuit Non Power Shuttle

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Figure 23
Ground Speed Circuit Non Power Shuttle

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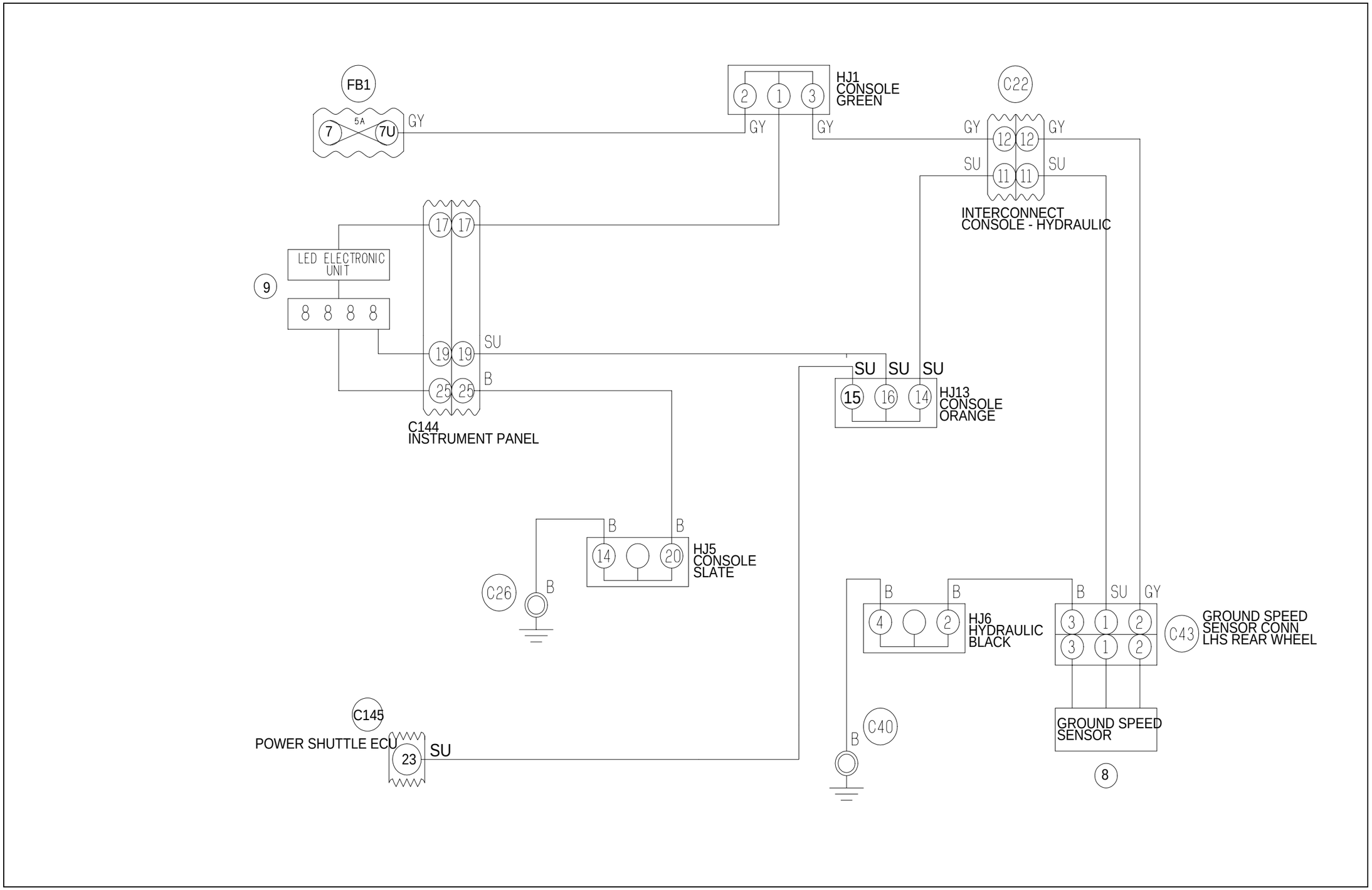


Figure 24 - Ground Speed Circuit Power Shuttle 2001/2002

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Figure 24
Ground Speed Circuit Power Shuttle 2001/2002

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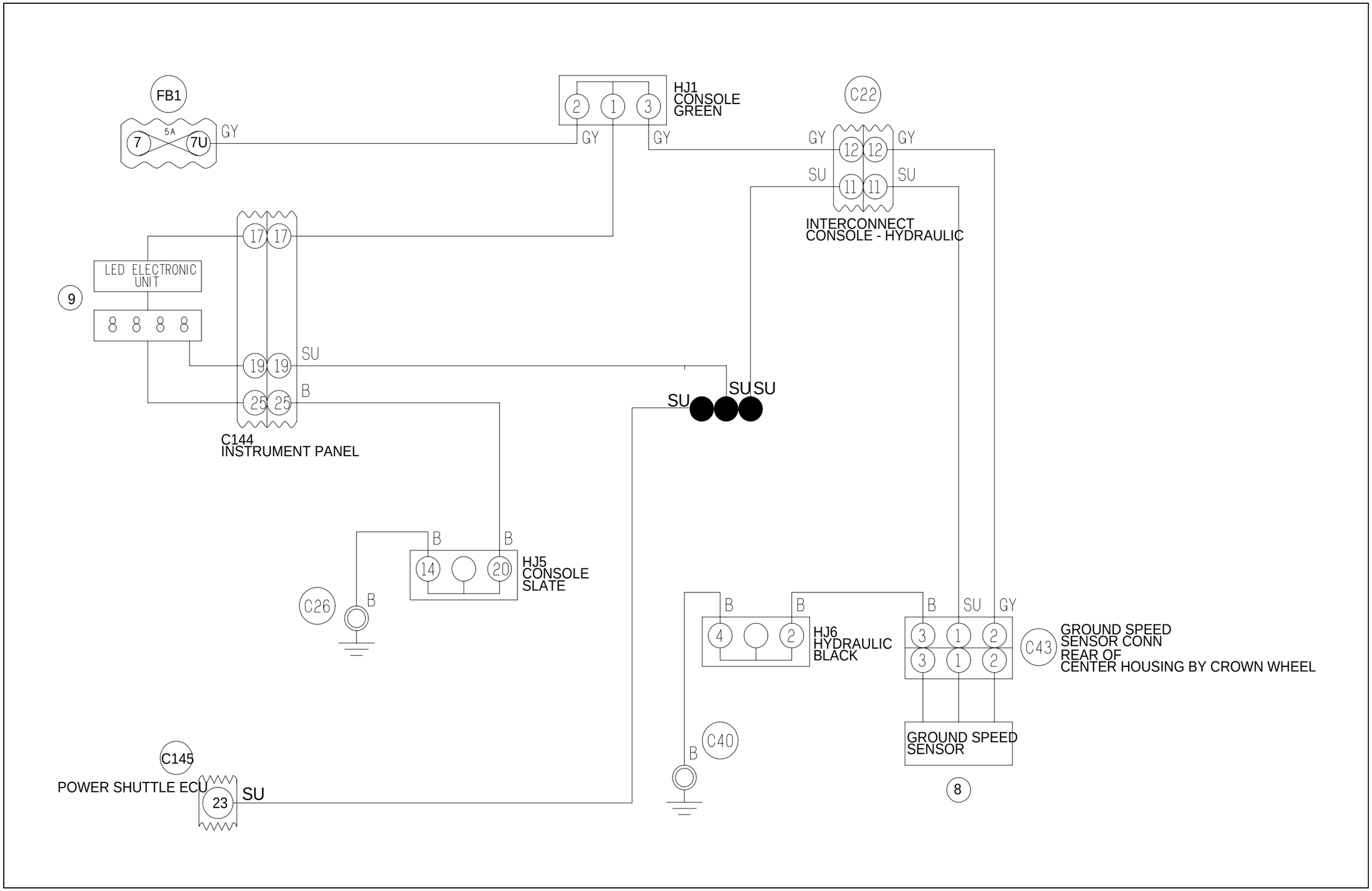


Figure 25 - Ground Speed Circuit Power Shuttle 2003

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Figure 25
Ground Speed Circuit Power Shuttle 2003

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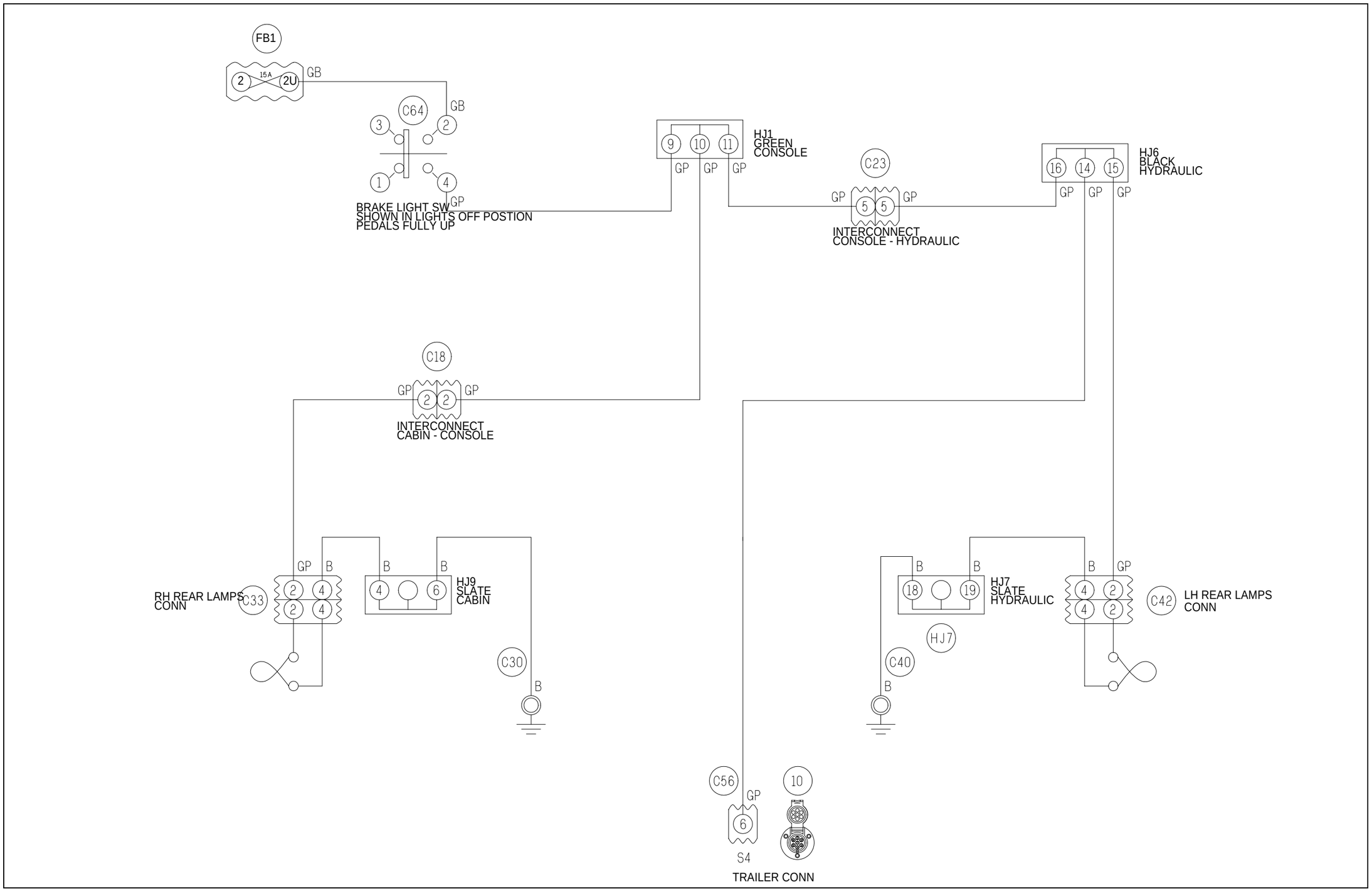


Figure 26 - Brake Lights Circuit

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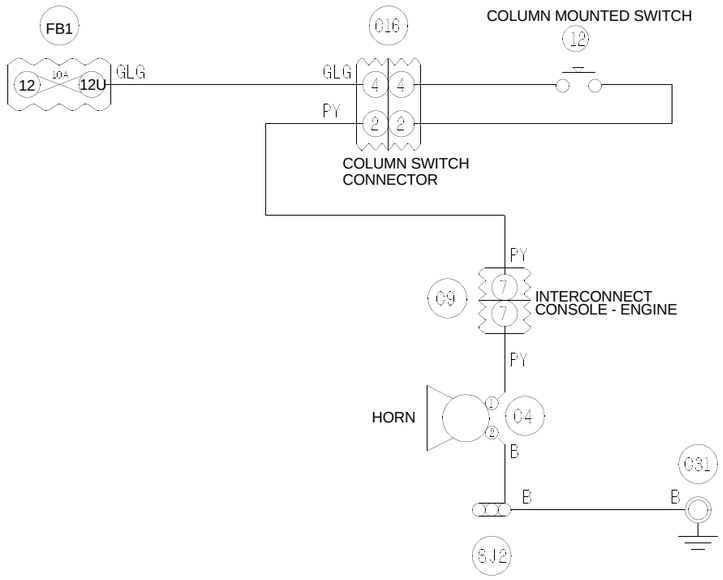
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Figure 26
Brake Light Circuits

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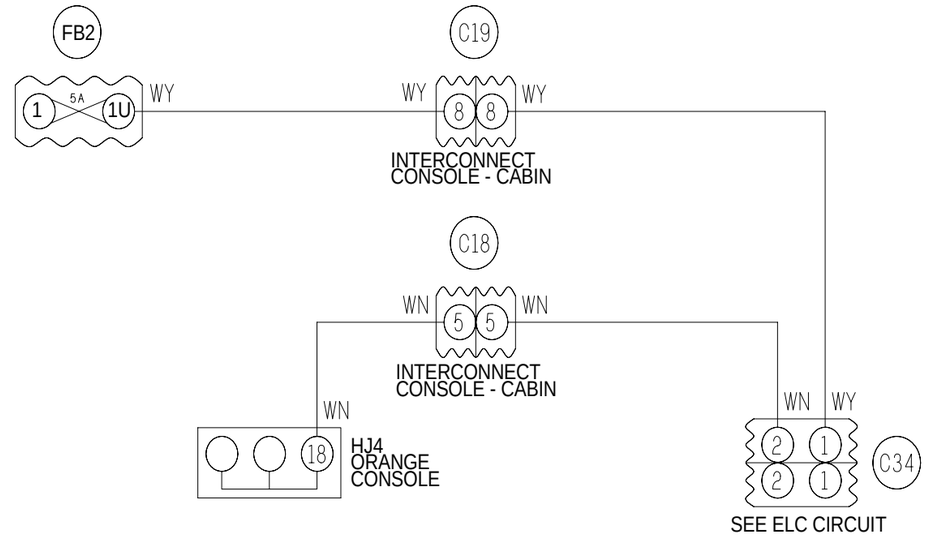
Tractor Manuals Scotland

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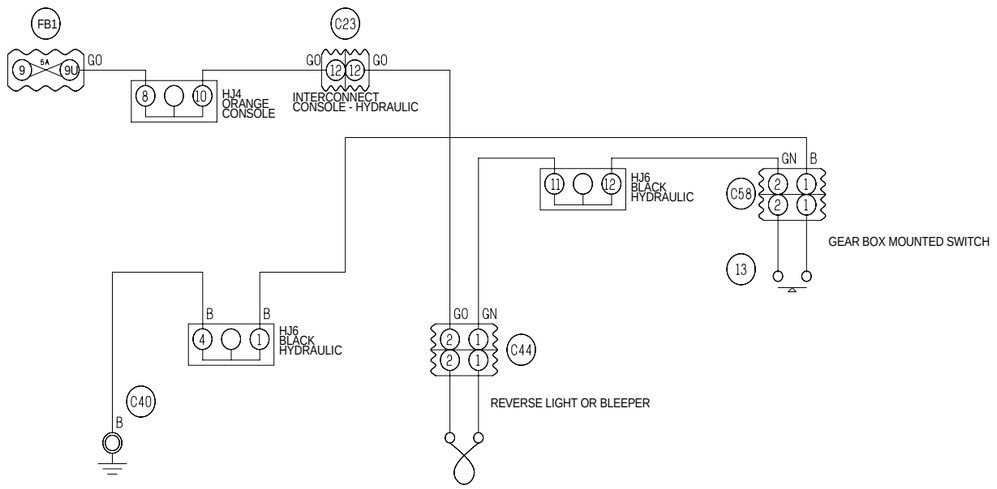
HORN CIRCUIT

B



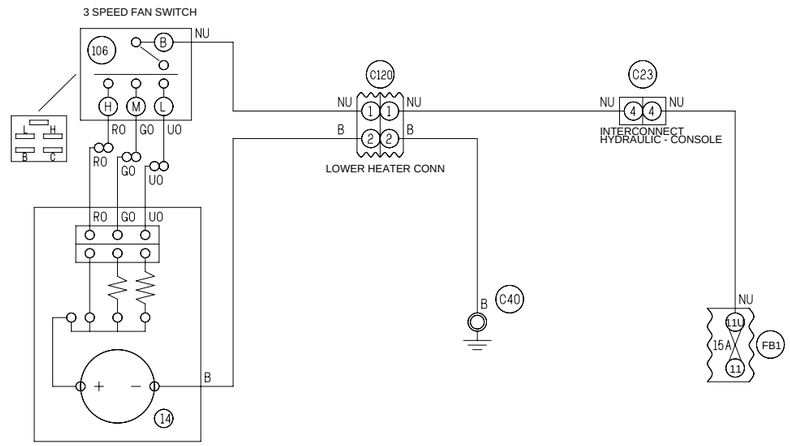
ELECTRONIC LIFT CONTROL SUPPLY

C



REVERSE LIGHT/BLEEPER CIRCUIT (NON POWER SHUTTLE)

D



LOWER HEATER CICUIT - FLAT ROOF

Figure 27

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Figure 27

A - Horn circuit
B - Electronic lift control supply
C - Reverse light/bleeper circuit (NON POWER SHUTTLE)
D - Lower heater circuit - flat roof

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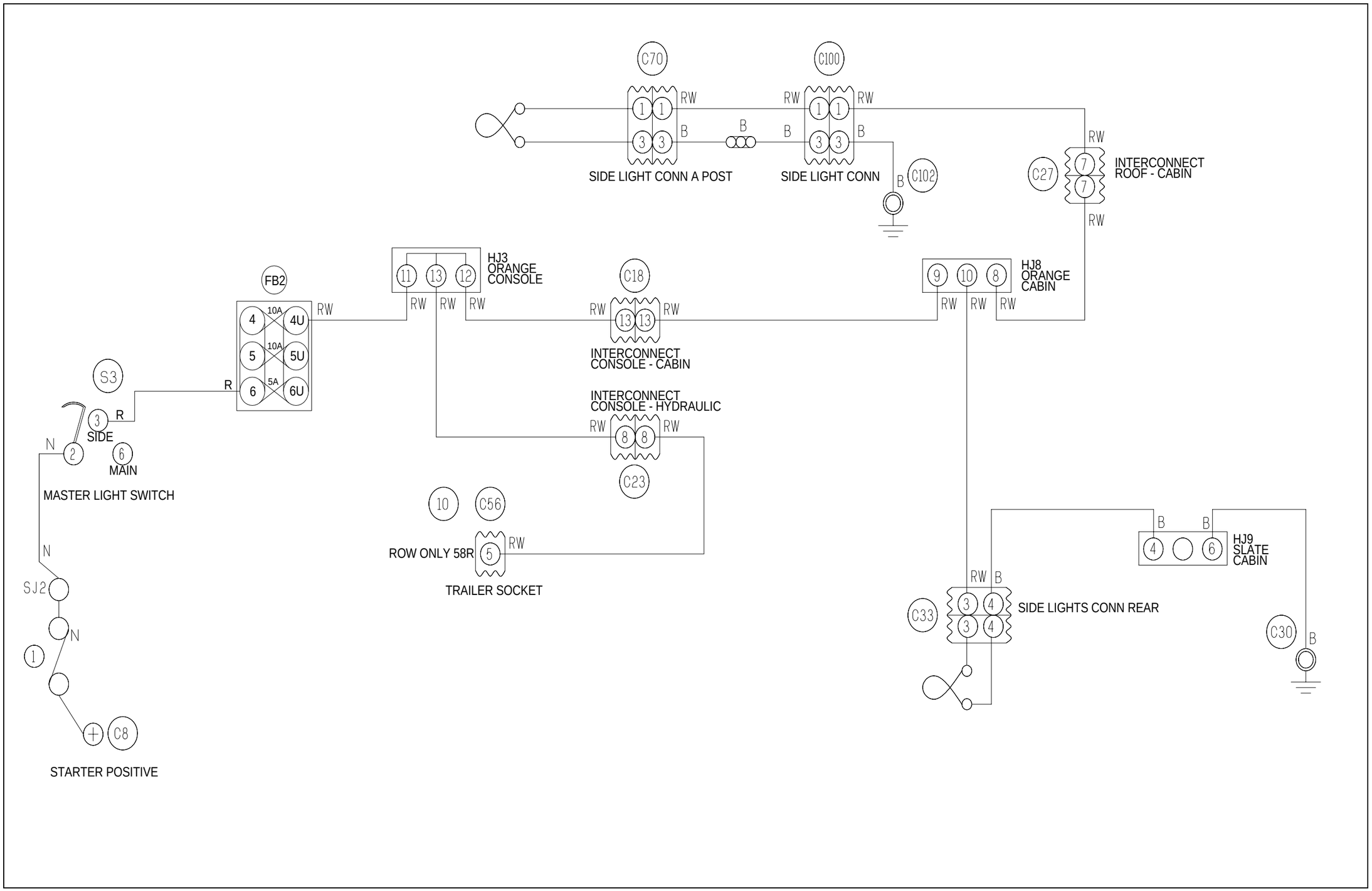


Figure 28 - RHS Position Lights (ROW)

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Tractor Manuals Scotland

Figure 28
RHS Position Lights (ROW)

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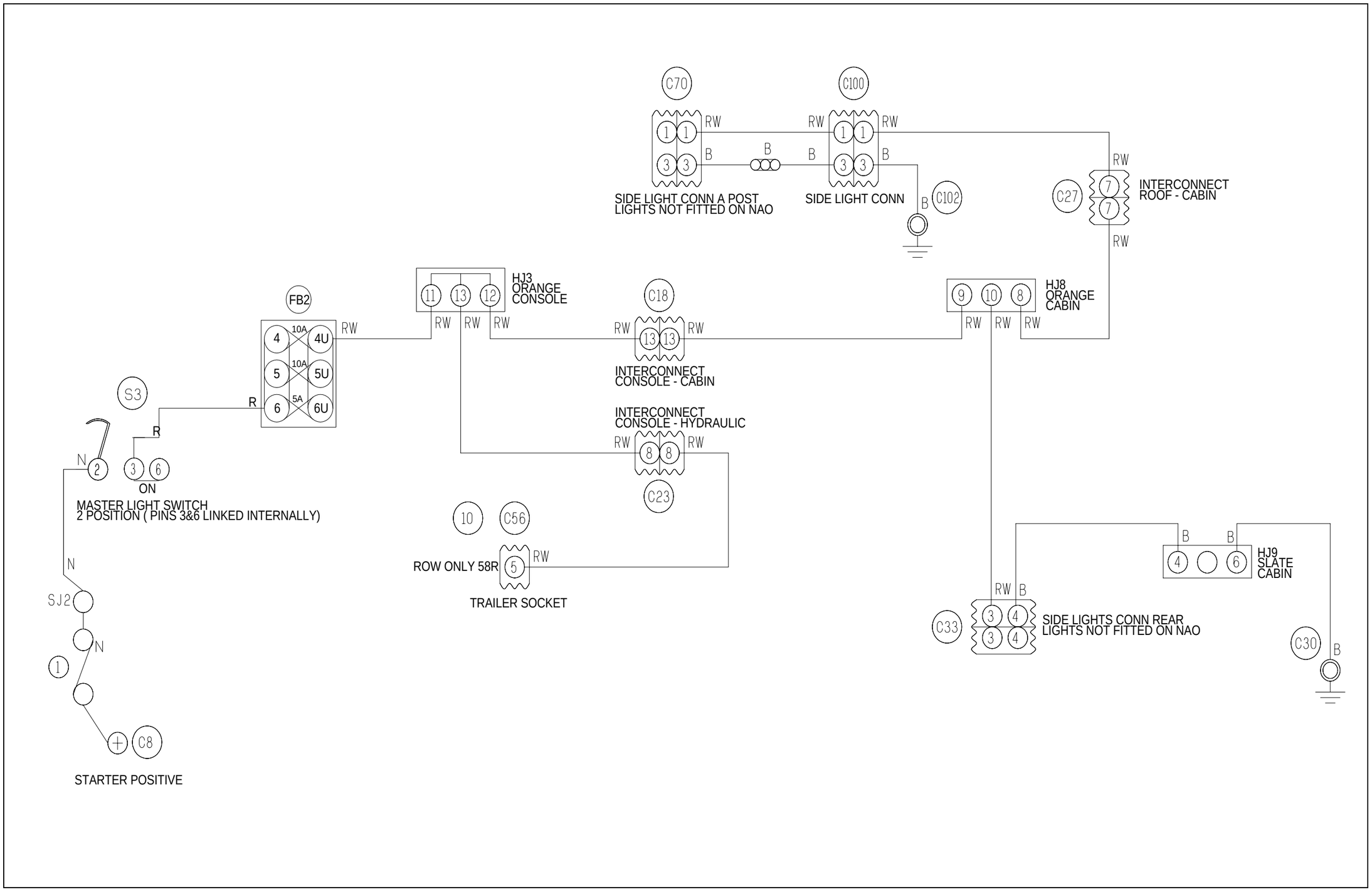


Figure 29 - RHS Position Lights (NAO)

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Figure 29
RHS Position Lights (NAO)

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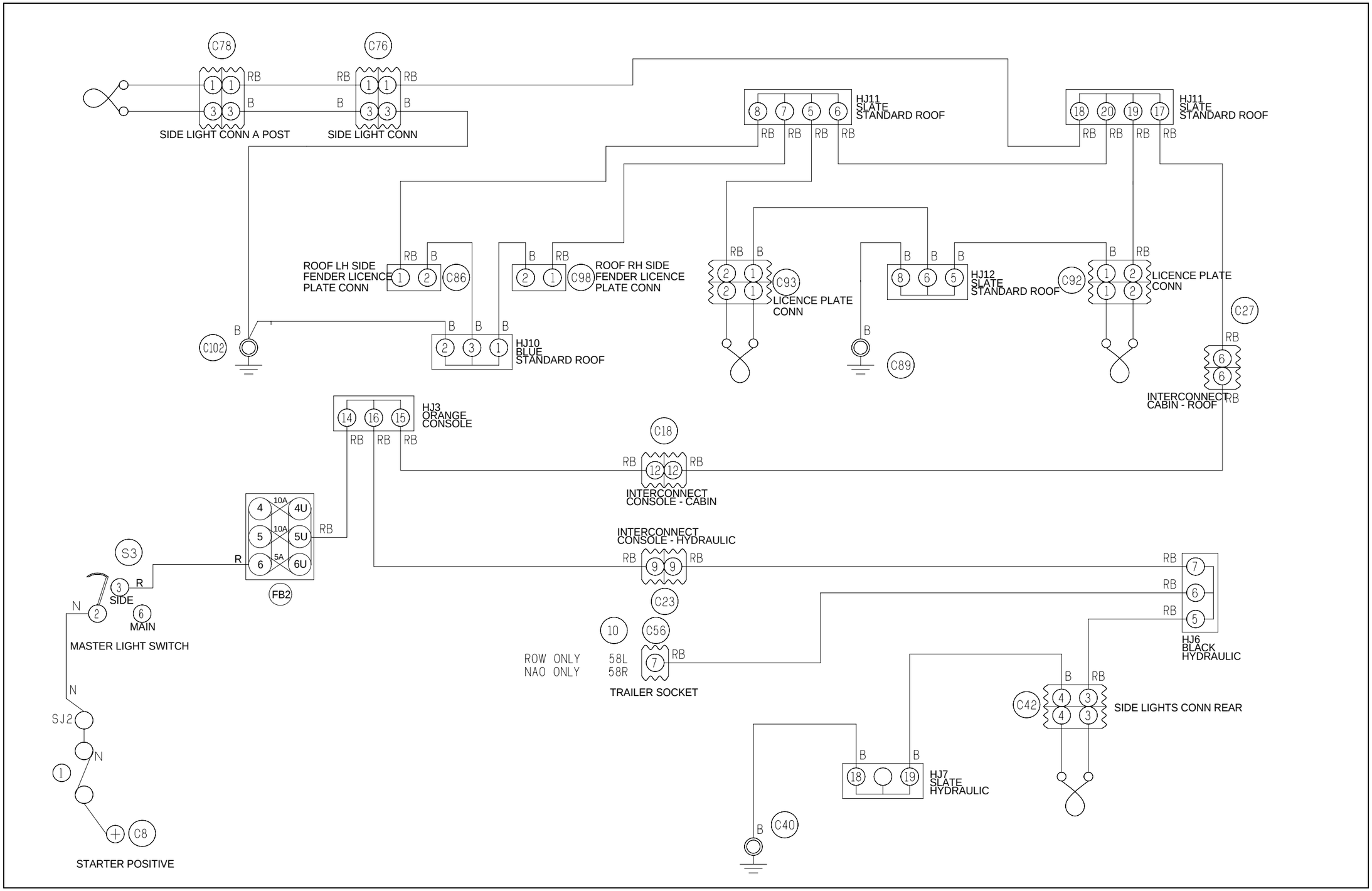


Figure 30 - LHS Position and Licence plate Lights (Standard Roof) (ROW)

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Tractor Manuals Scotland

Figure 30
LHS Position and Licence plate Lights (Standard Roof) (ROW)

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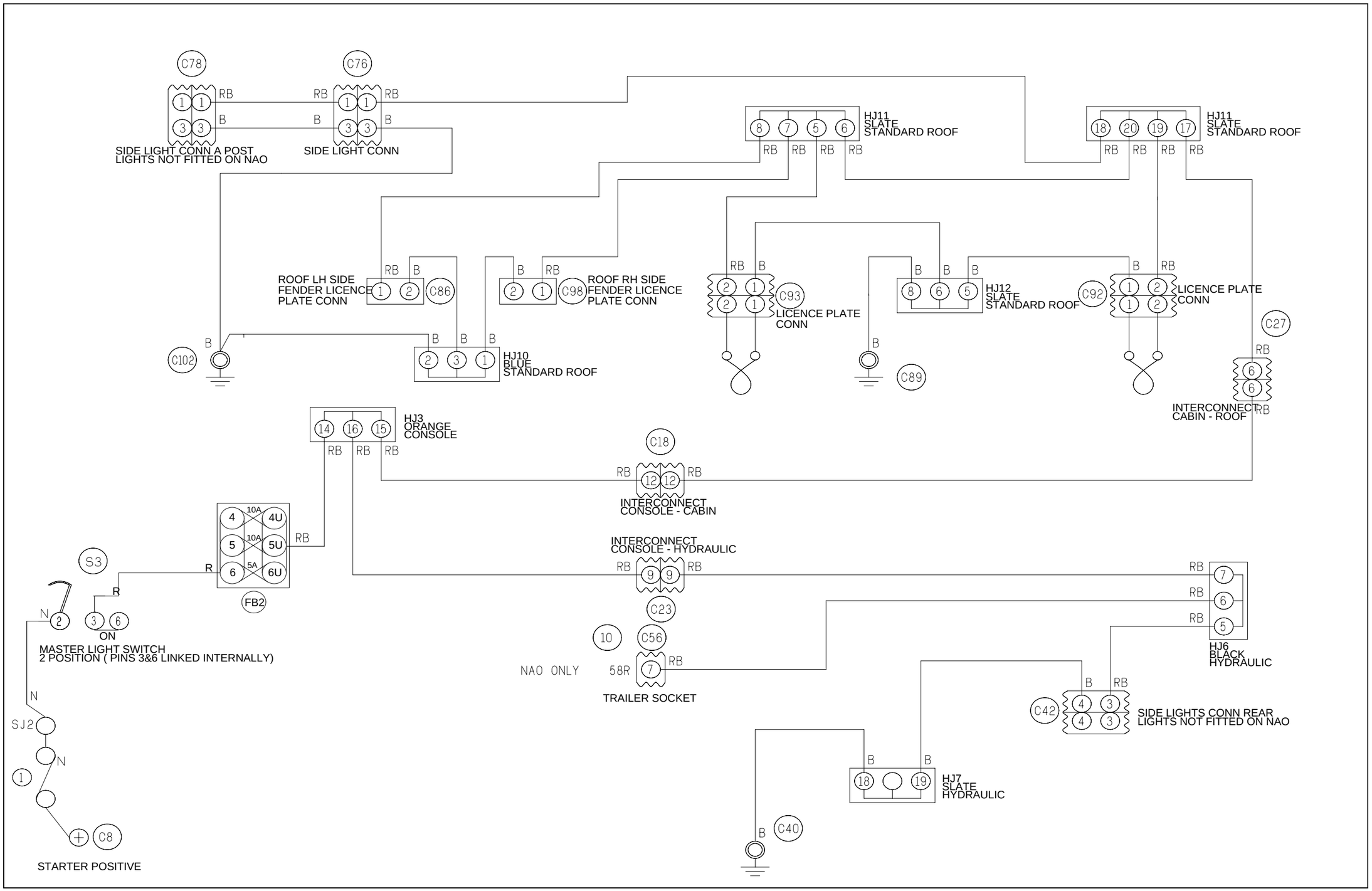


Figure 31 - LHS Positionand Licence Plate Lights (Standard Roof) (NAO)

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Figure 31
LHS Position and Licence Plate Lights (Standard Roof) (NAO)

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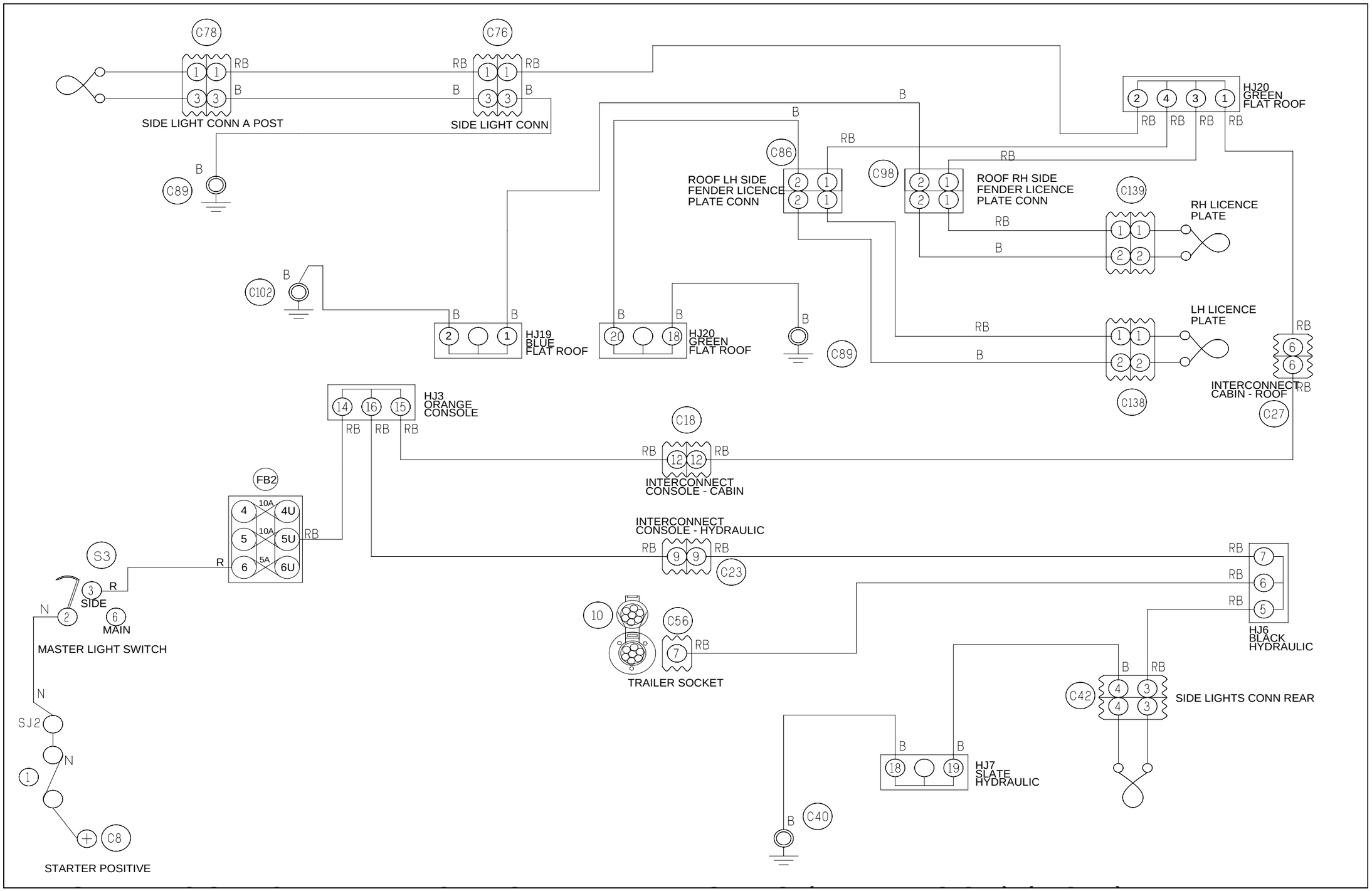


Figure 32 - LHS Position and Licence Plate Lights (Flat Roof, ROW)

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Figure 32
LHS Position and Licence Plate Lights (Flat Roof, ROW)

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Tractor Manuals Scotland

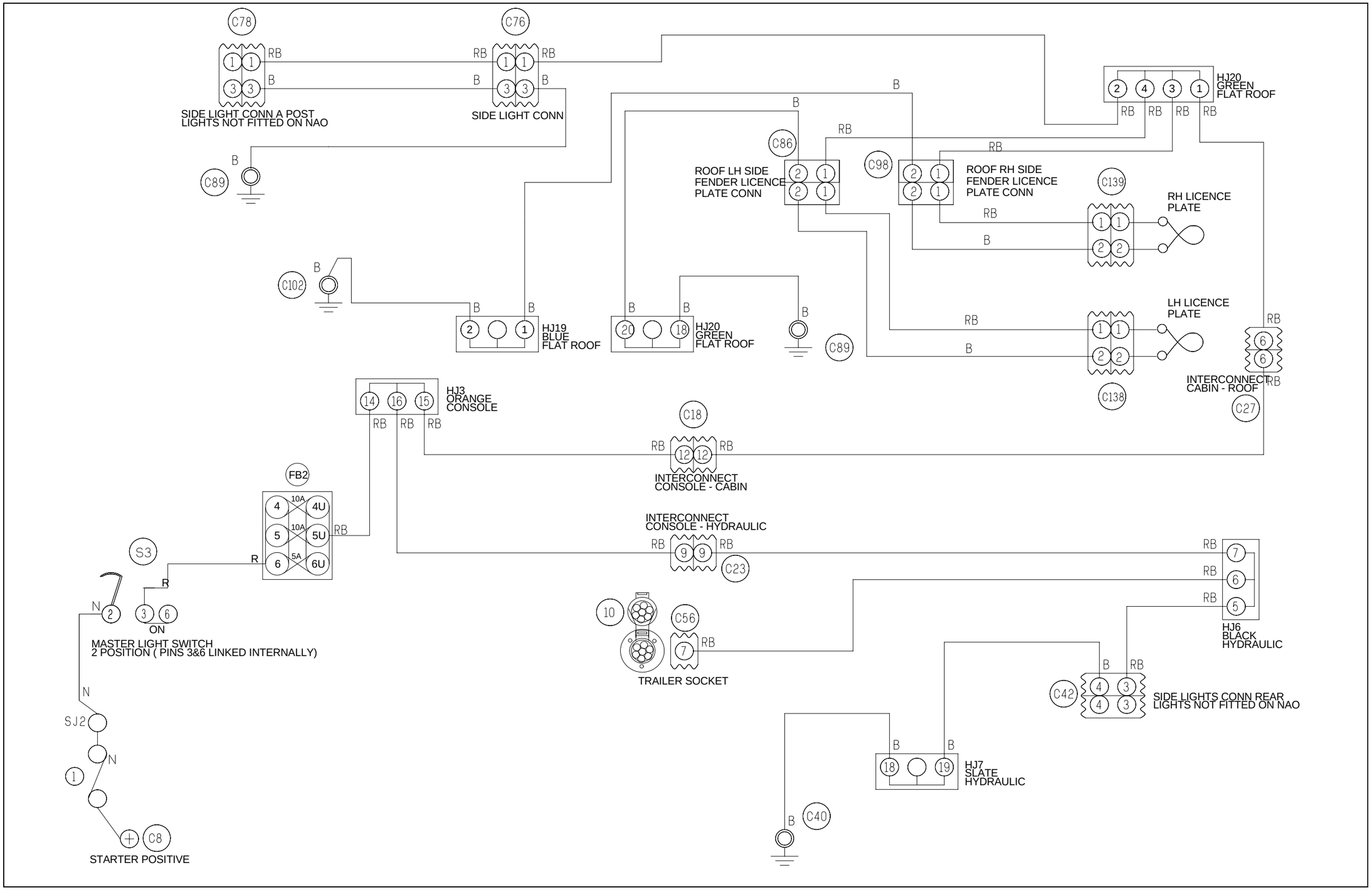


Figure 33 - LHS Position and Licence Plate Lights (Flat Roof NAO)

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Figure 33
LHS Position and Licence Plate Lights (Flat Roof NAO)

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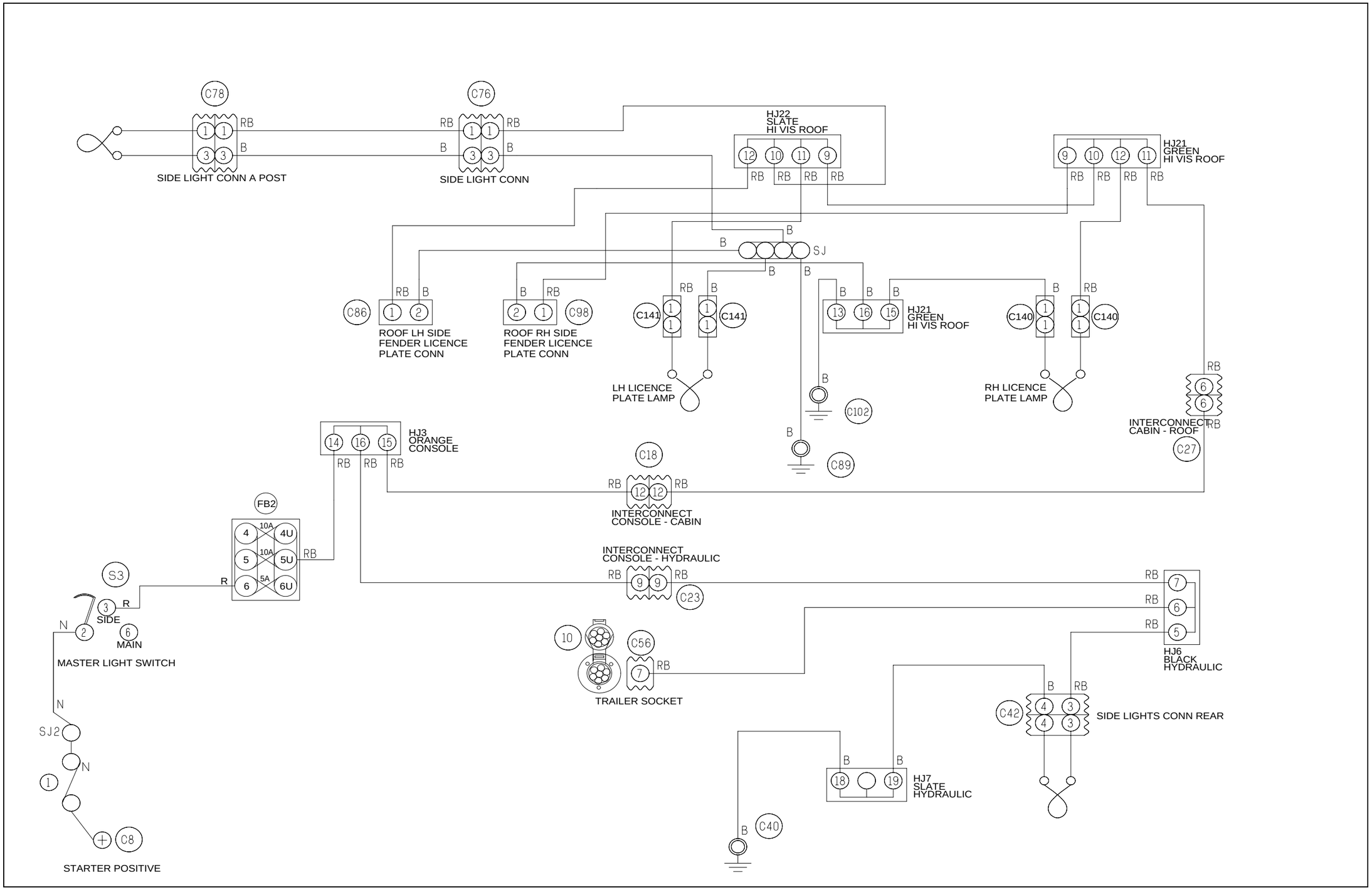


Figure 34 - LHS Position and Licence Plate Lights (HI VIS Roof, ROW)

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Figure 34
LHS Position and Licence Plate Lights (HI VIS Roof, ROW)

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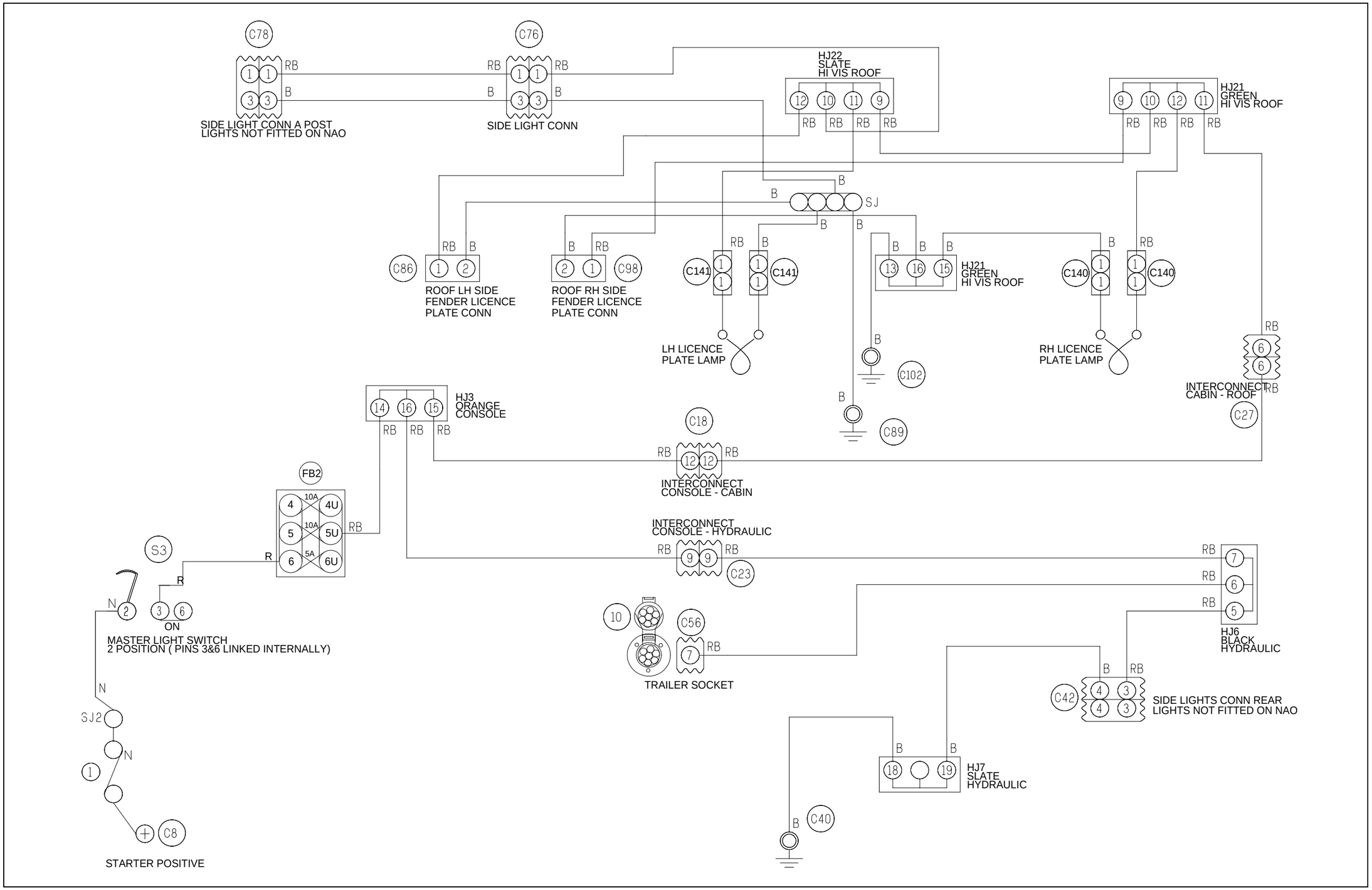


Figure 35 - LH Side position and licence plate lights (HI VIS ROOF) (NAO)

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Figure 35
LH Side position and licence plate lights (HI VIS ROOF) (NAO)

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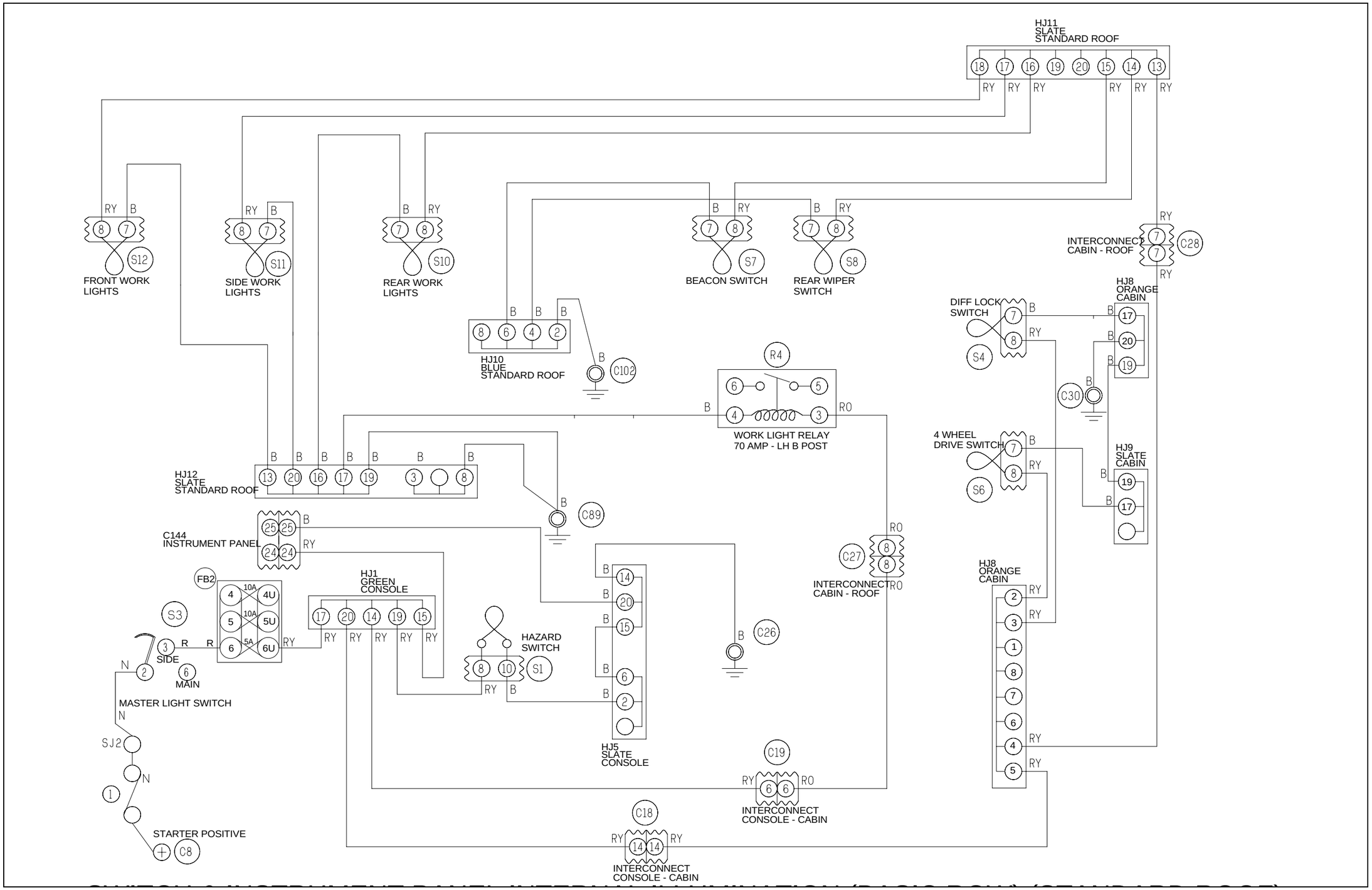


Figure 36 - Switch & Instrument panel internal illumination (Basic row) (Standard roof)

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Tractor Manuals Scotland

Figure 36
Switch & Instrument panel internal illumination (Basic ROW) (Standard roof)

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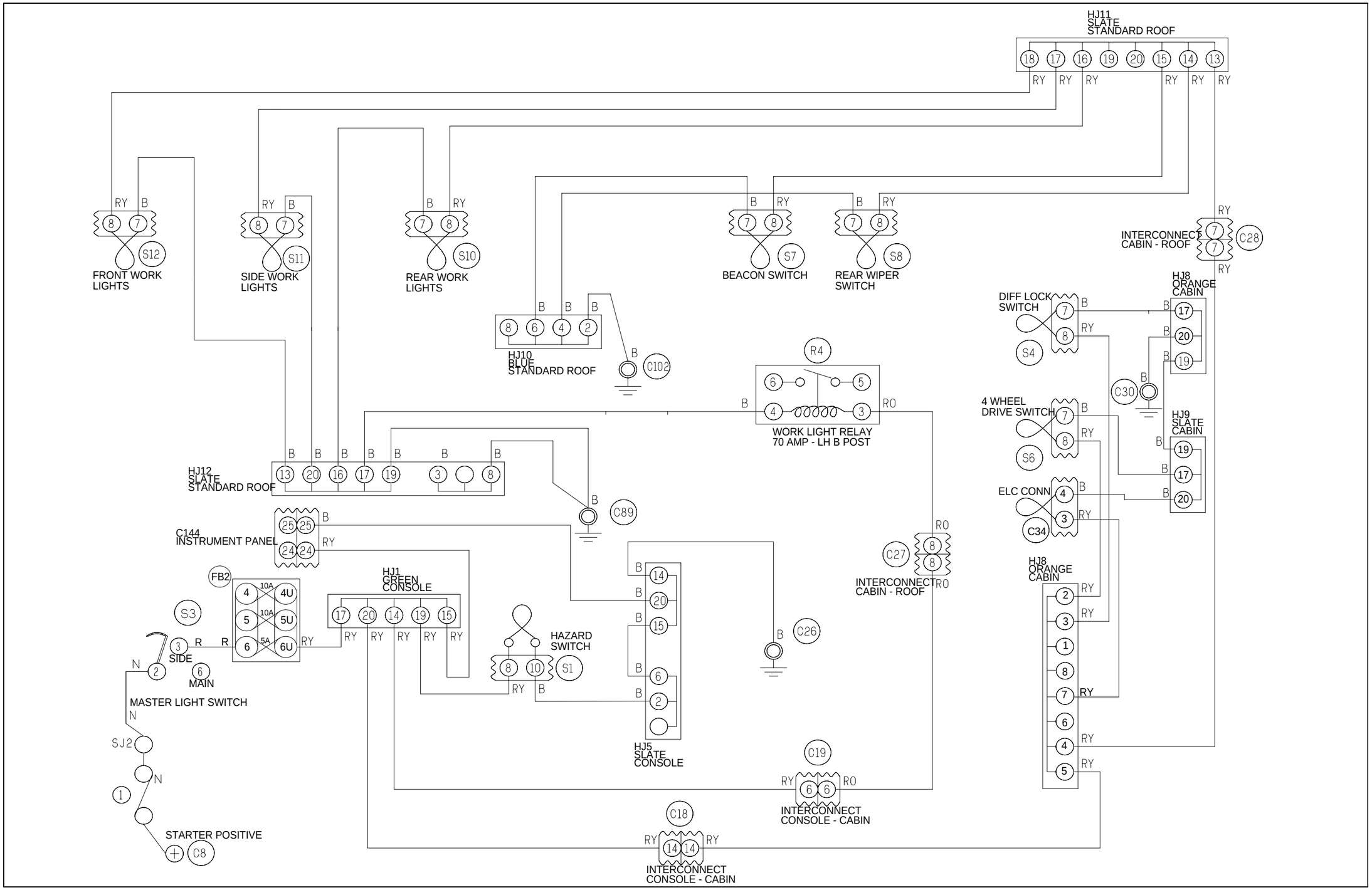


Figure 37 - Switch & Instrument panel internal illumination (High spec row) (Standard Roof)

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Tractor Manuals Scotland

Figure 37
Switch & Instrument panel internal illumination (High spec ROW)
(Standard Roof)

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Tractor Manuals Scotland

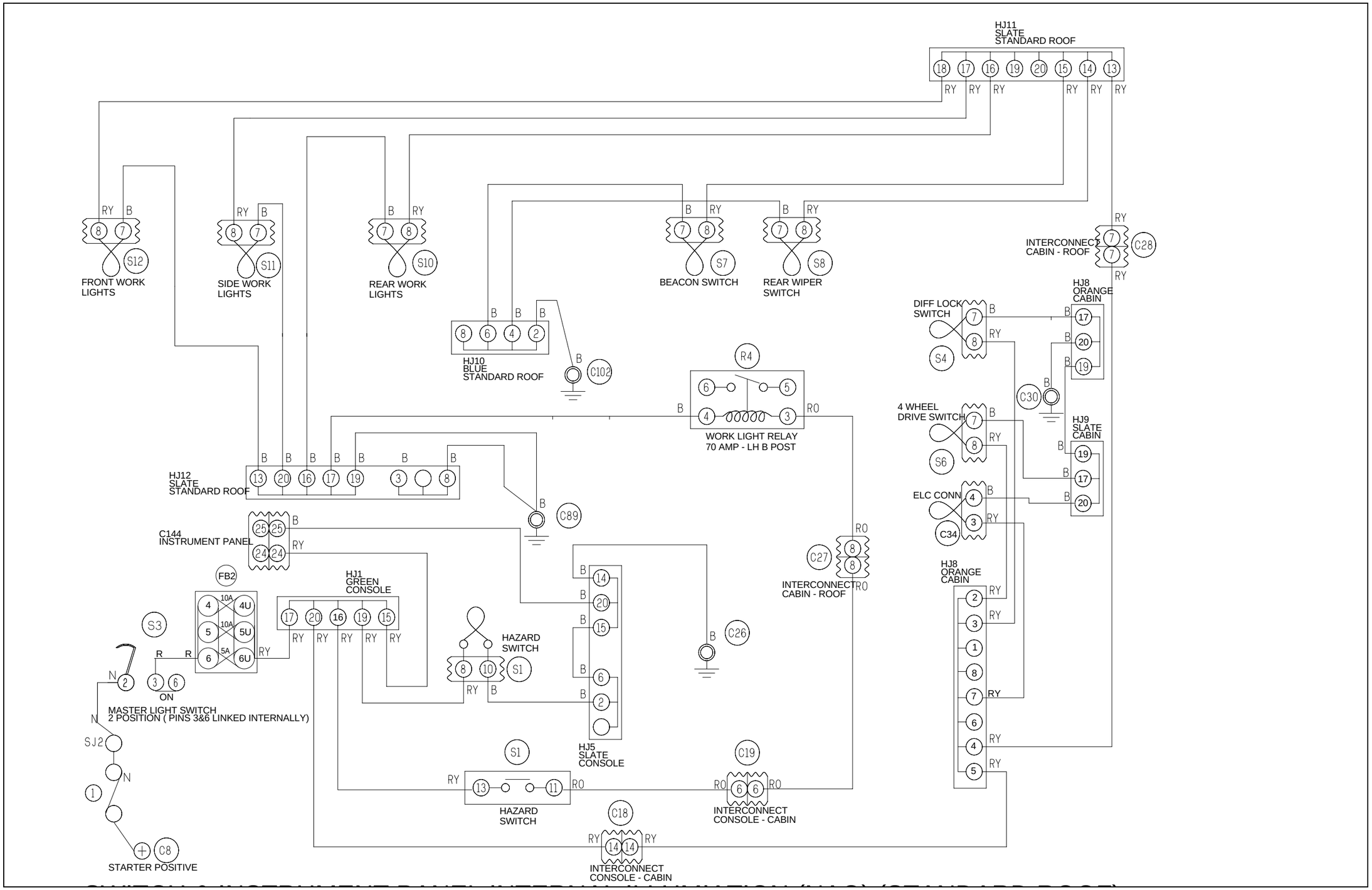


Figure 38 - Switch & Instrument panel internal illumination (NAO) (Standard roof)

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Tractor Manuals Scotland

Figure 38

Switch & Instrument panel internal illumination (NAO) (Standard roof)

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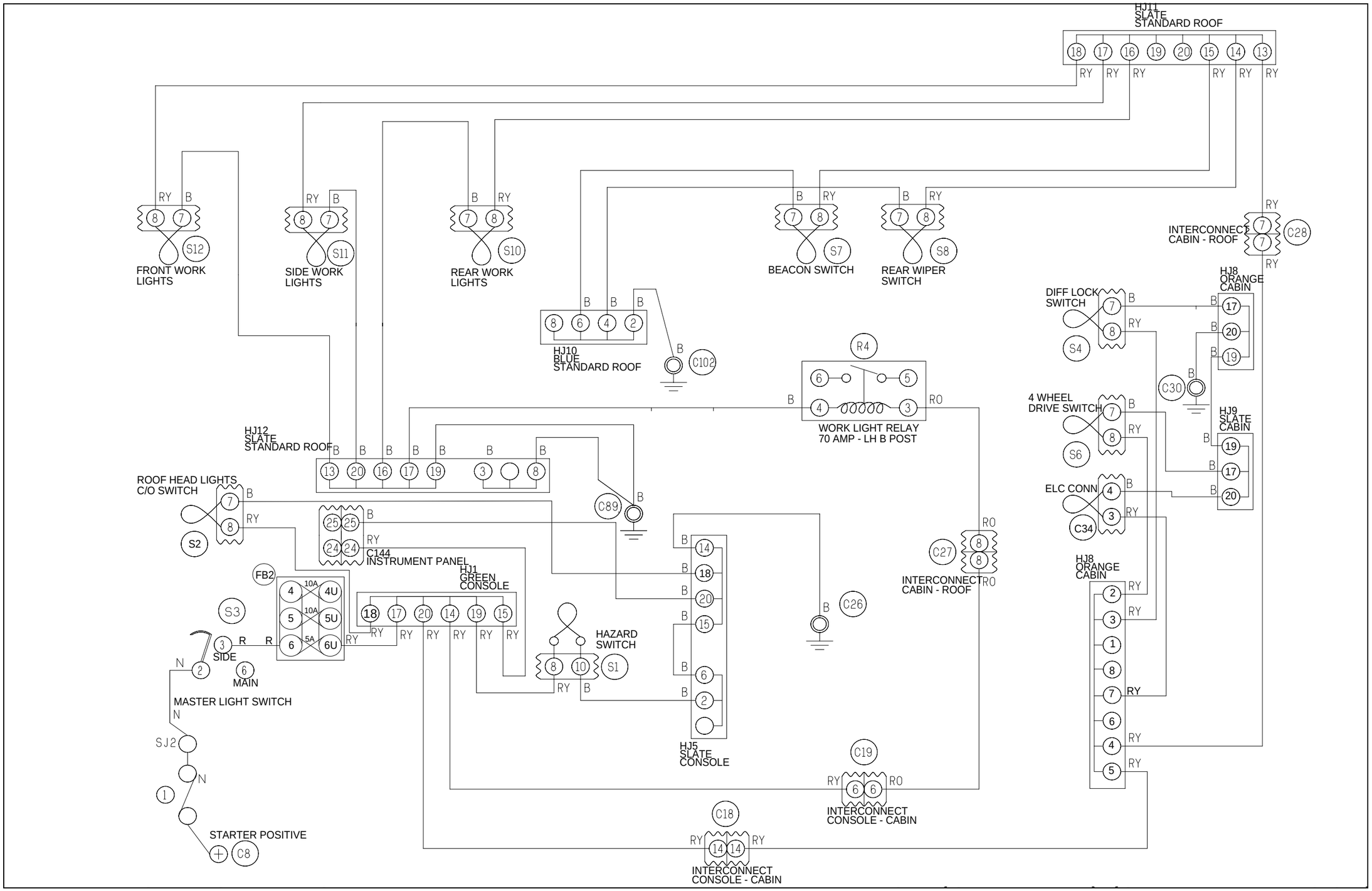


Figure 39 - Switch & Instrument panel internal illumination (Germany) (Standard roof)

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Figure 39
Switch & Instrument panel internal illumination (Germany) (Standard roof)

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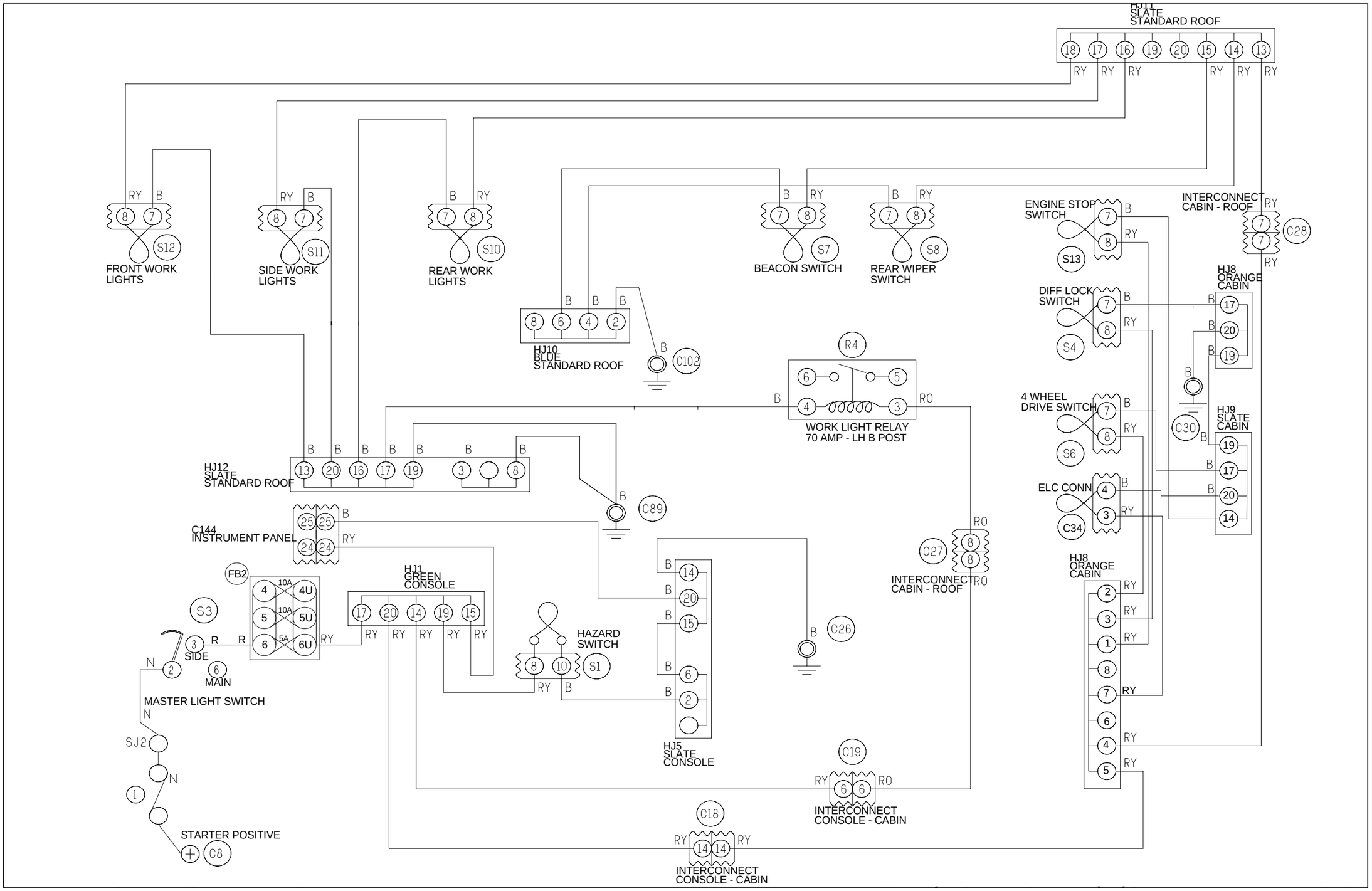


Figure 40 - Switch & Instrument panel internal illumination (Forestry) (Standard roof)

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Figure 40
Switch & Instrument panel internal illumination (Forestry) (Standard roof)

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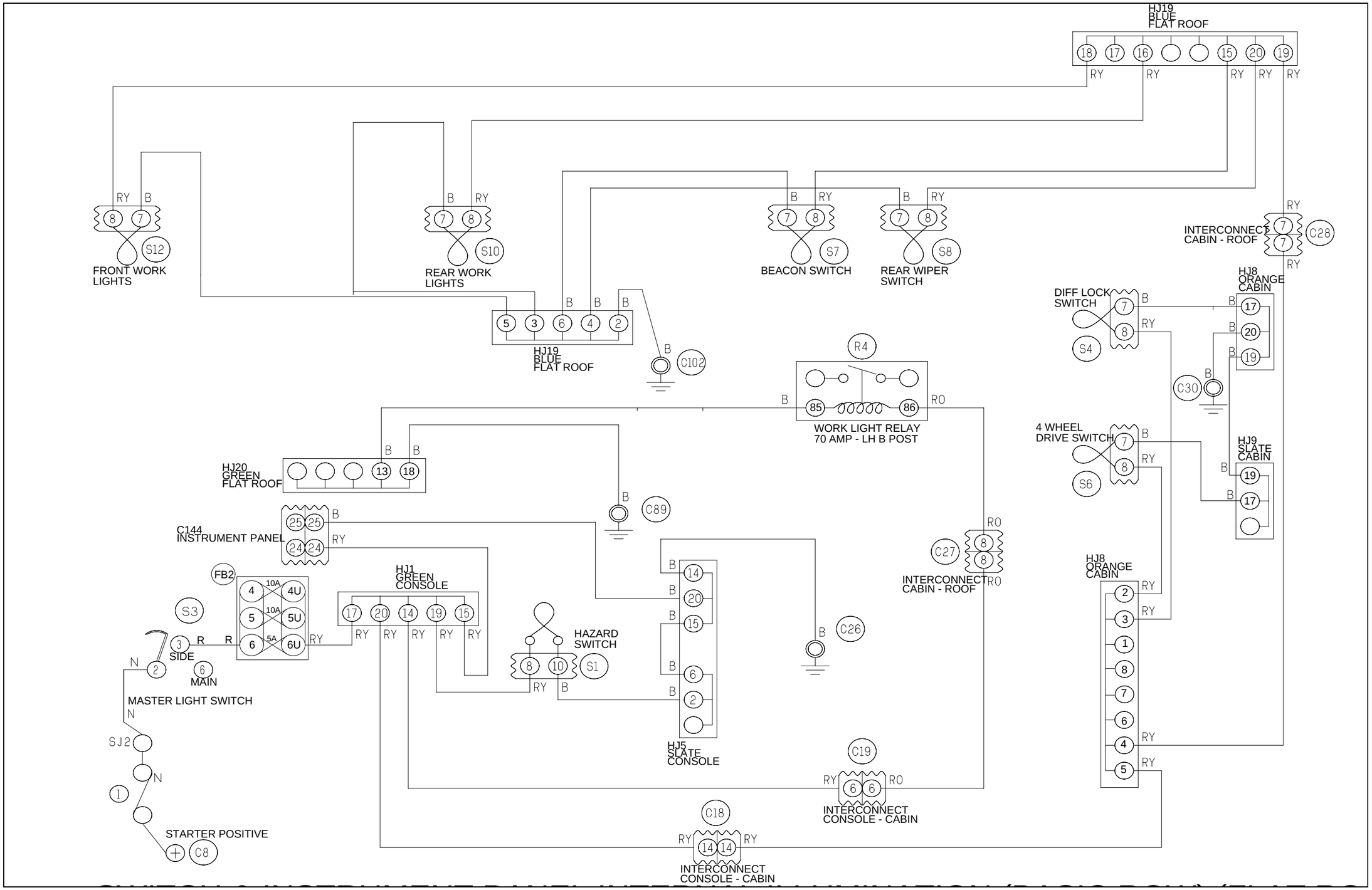


Figure 41 - Switch & Instrument panel internal illumination (Basic row) (Flat roof)

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Tractor Manuals Scotland

Figure 41
Switch & Instrument panel internal illumination (Basic ROW) (Flat roof)

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Tractor Manuals Scotland

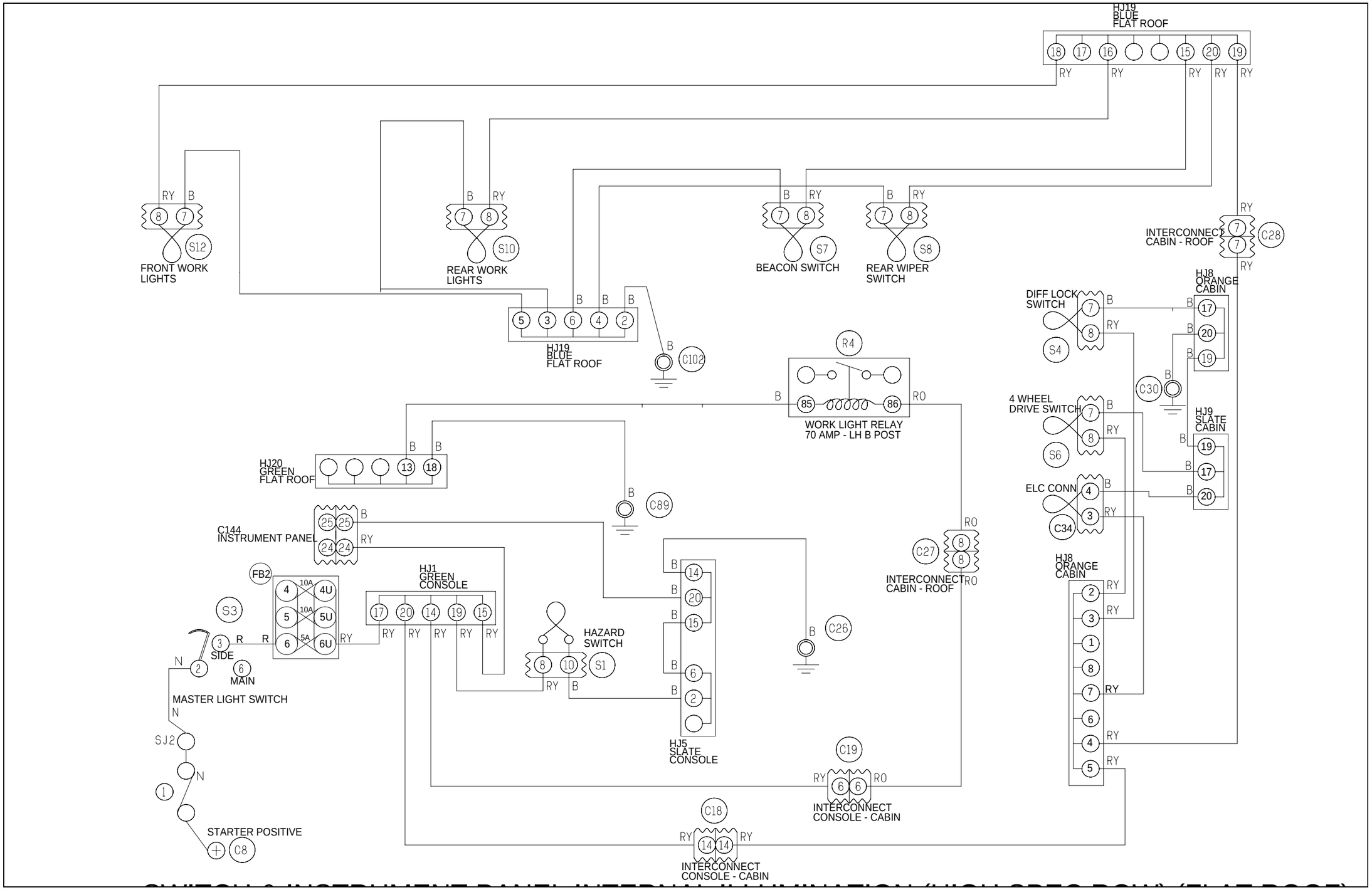


Figure 42 - Switch & Instrument panel internal illumination (High spec row) (Flat roof)

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Figure 42
Switch & Instrument panel internal illumination (High spec ROW) (Flat roof)

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Tractor Manuals Scotland

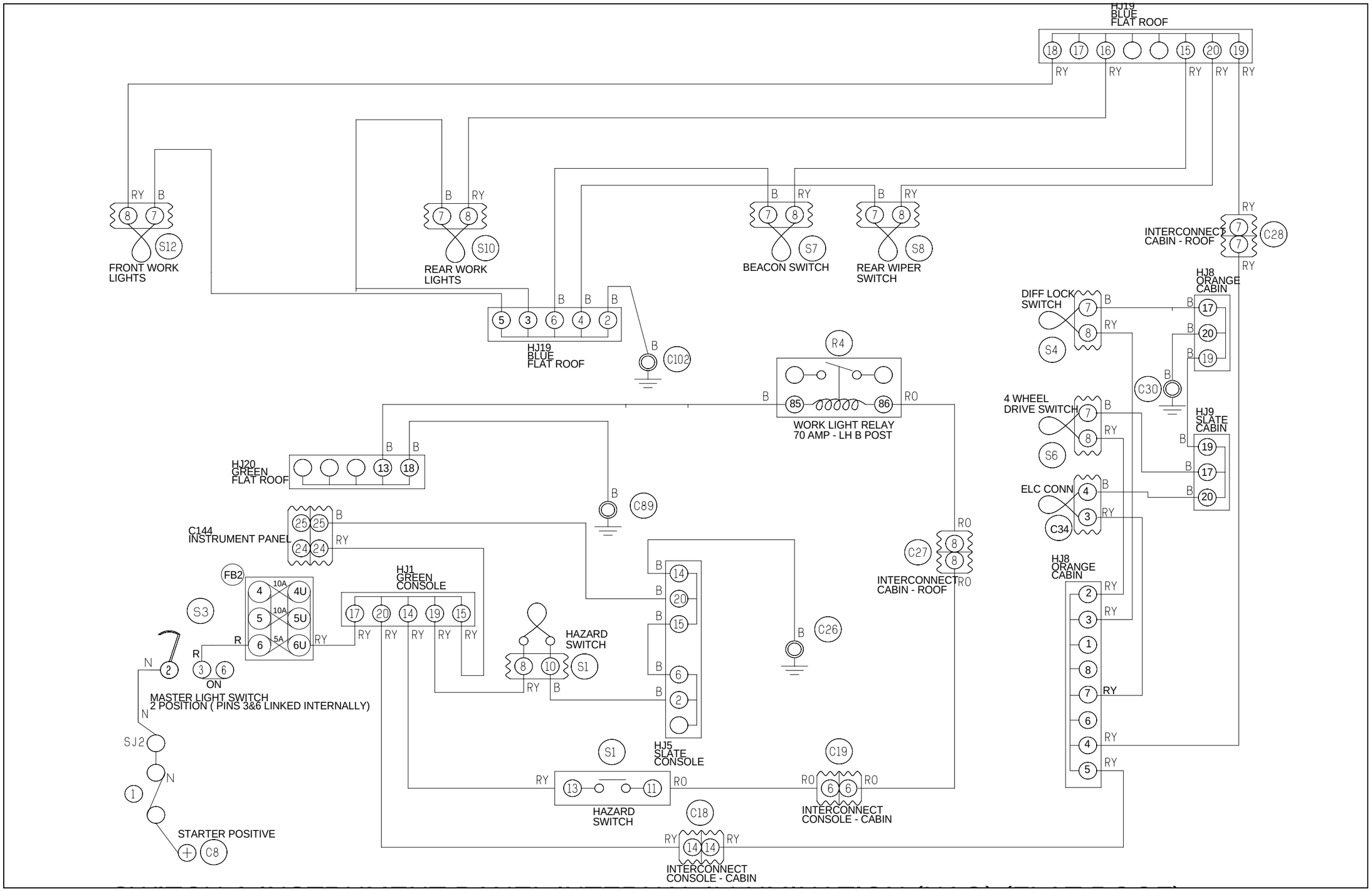


Figure 43 - Switch & Instrument panel internal illumination (NAO) (Flat roof)

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Tractor Manuals Scotland

Figure 43
Switch & Instrument panel internal illumination (High spec ROW) (Flat roof)

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Tractor Manuals Scotland

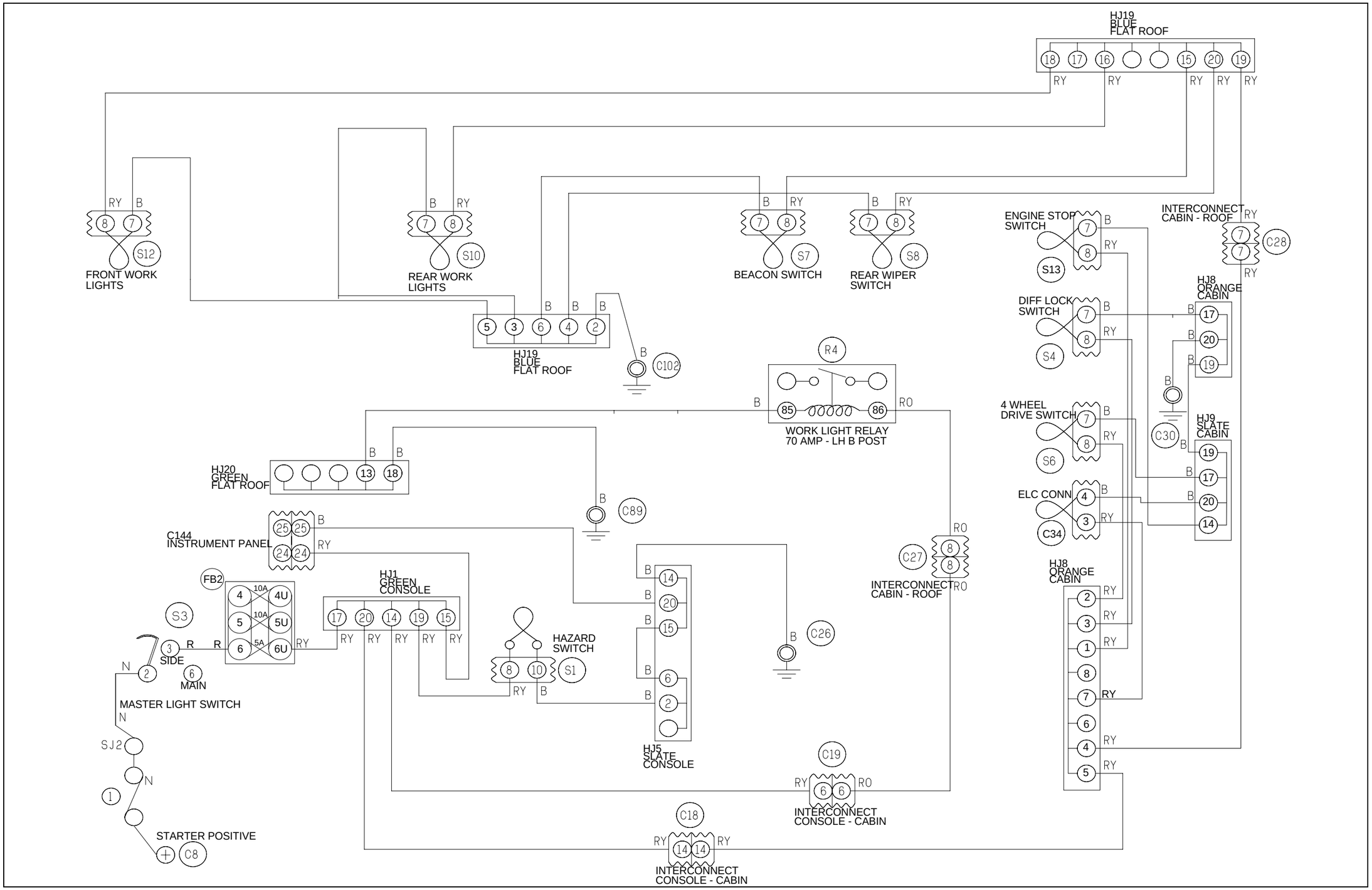


Figure 44 - Switch & Instrument panel internal illumination (Forestry) (Flat roof)

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Tractor Manuals Scotland

Figure 44
Switch & Instrument panel internal illumination (Forestry) (Flat roof)

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Tractor Manuals Scotland

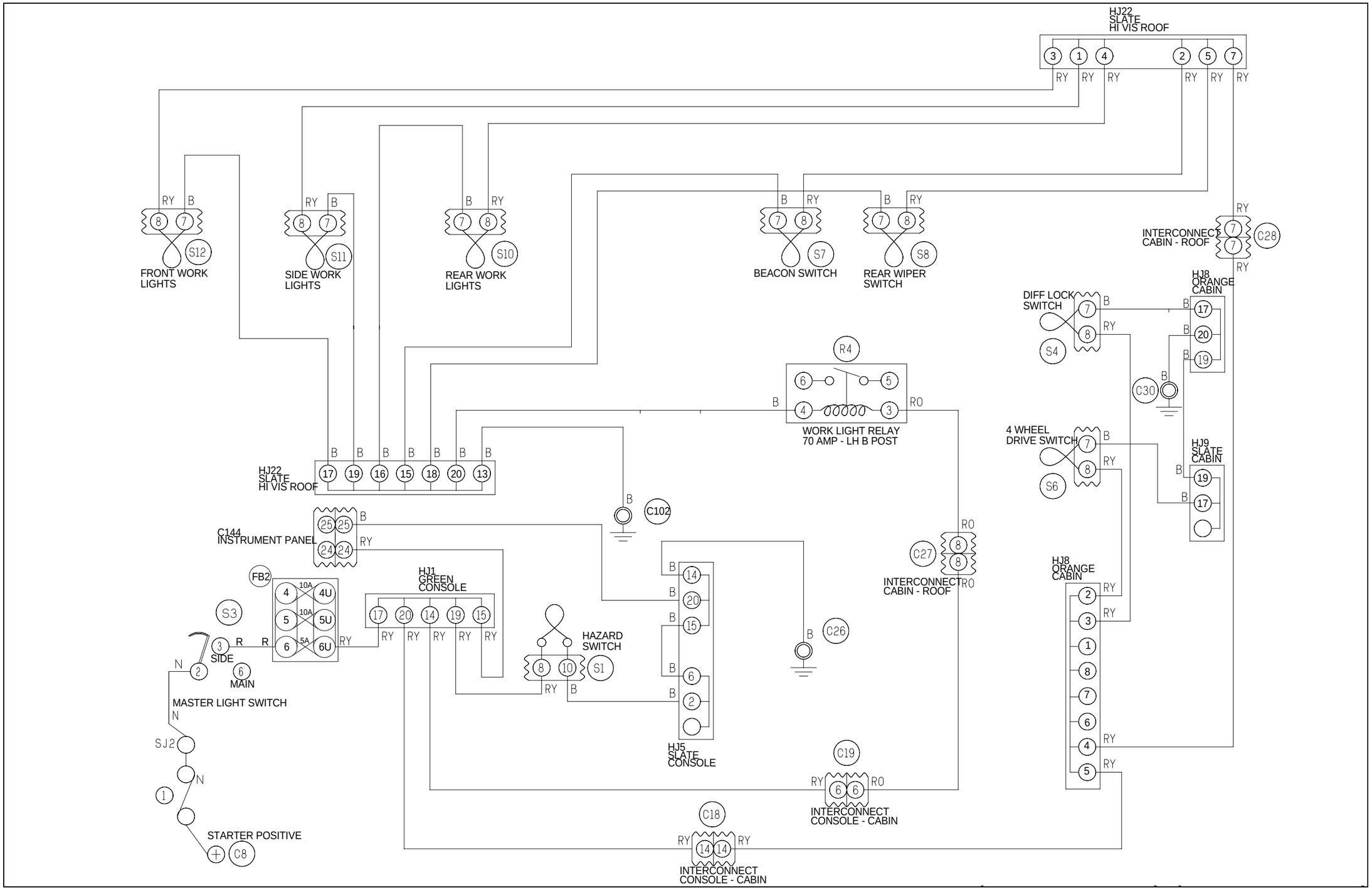


Figure 45 - Switch & Instrument panel internal illumination (Basic row) (HI VIS Roof)

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Tractor Manuals Scotland

Figure 45
Switch & Instrument panel internal illumination (Basic ROW) (HI VIS Roof)

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Tractor Manuals Scotland

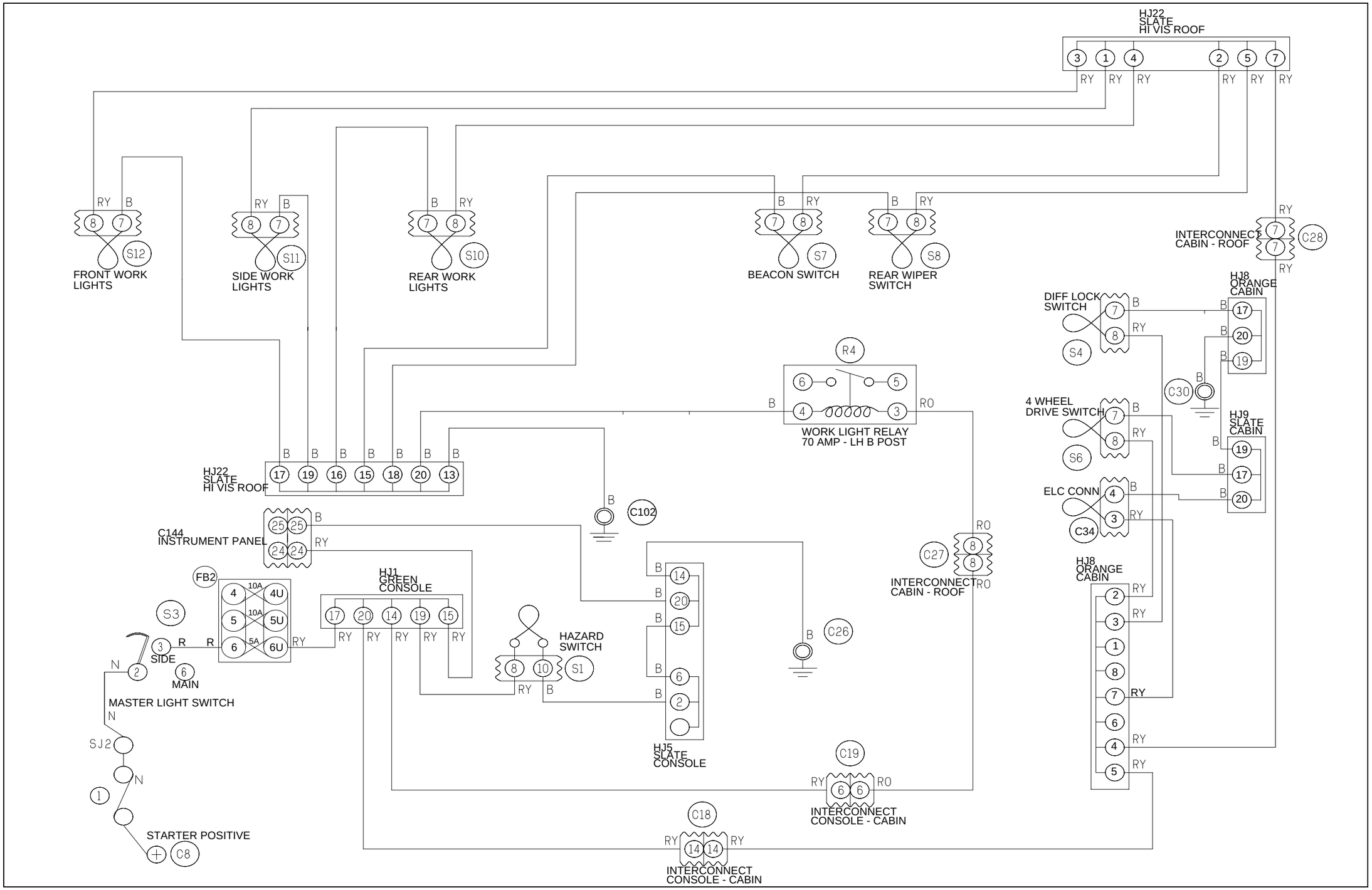


Figure 46 - Switch & Instrument panel internal illumination (High spec row) (HI VIS Roof)

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Tractor Manuals Scotland

Figure 46
Switch & Instrument panel internal illumination (High spec ROW) (HI VIS Roof)

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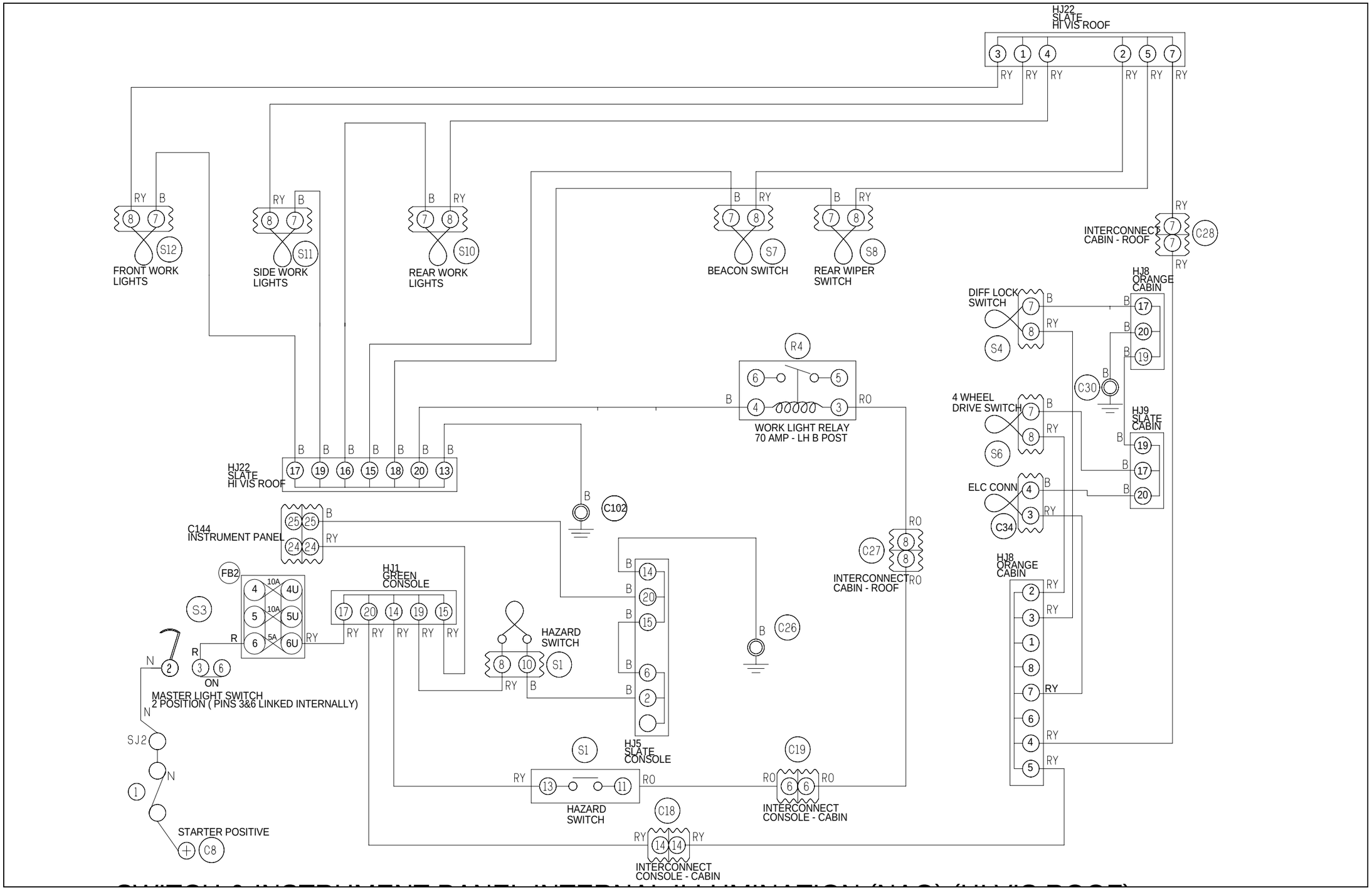


Figure 47 - Switch & Instrument panel internal illumination (NAO) (HI VIS Roof)

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Tractor Manuals Scotland

Figure 47
Switch & Instrument panel internal illumination (NAO) (HI VIS Roof)

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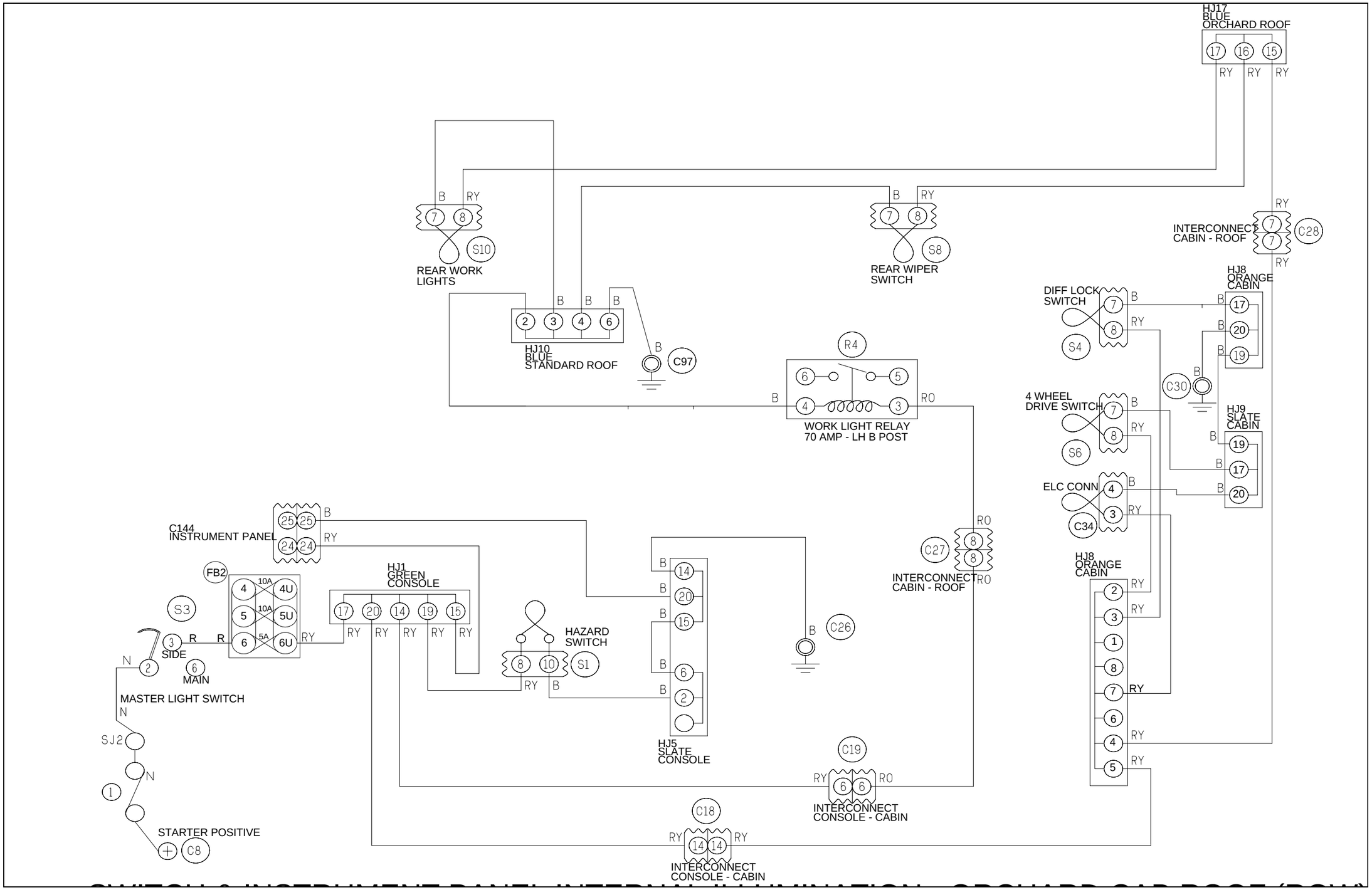


Figure 48 - Switch & Instrument panel internal illumination - Orchard cab roof (Row)

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Tractor Manuals Scotland

Figure 48

Switch & Instrument panel internal illumination - Orchard cab roof (Row)

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Tractor Manuals Scotland

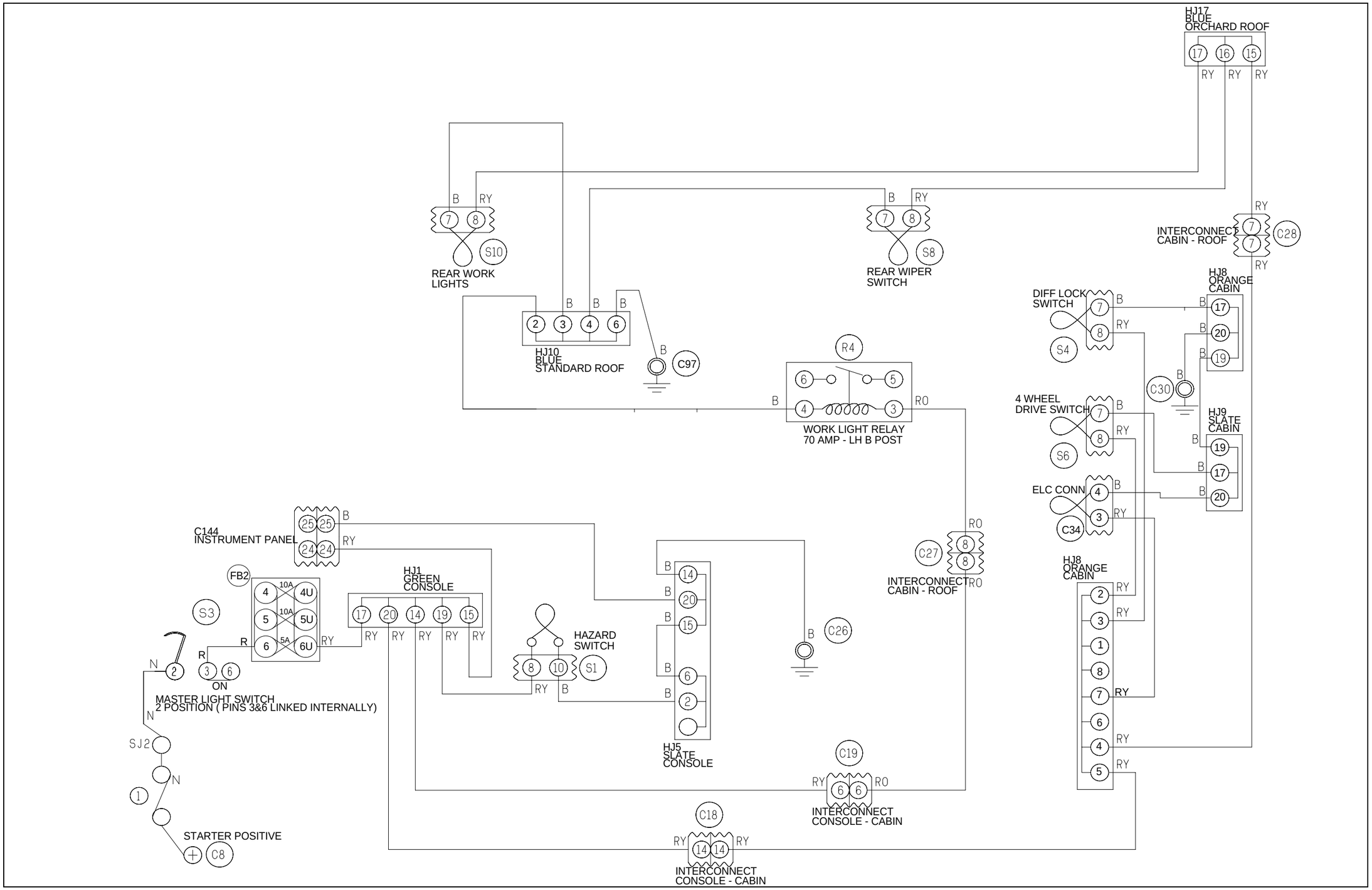


Figure 49 - Switch & Instrument panel internal illumination - Orchard Cab Roof (NAO)

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Tractor Manuals Scotland

Figure 49
Switch & Instrument panel internal illumination - Orchard Cab Roof (NAO)

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Tractor Manuals Scotland

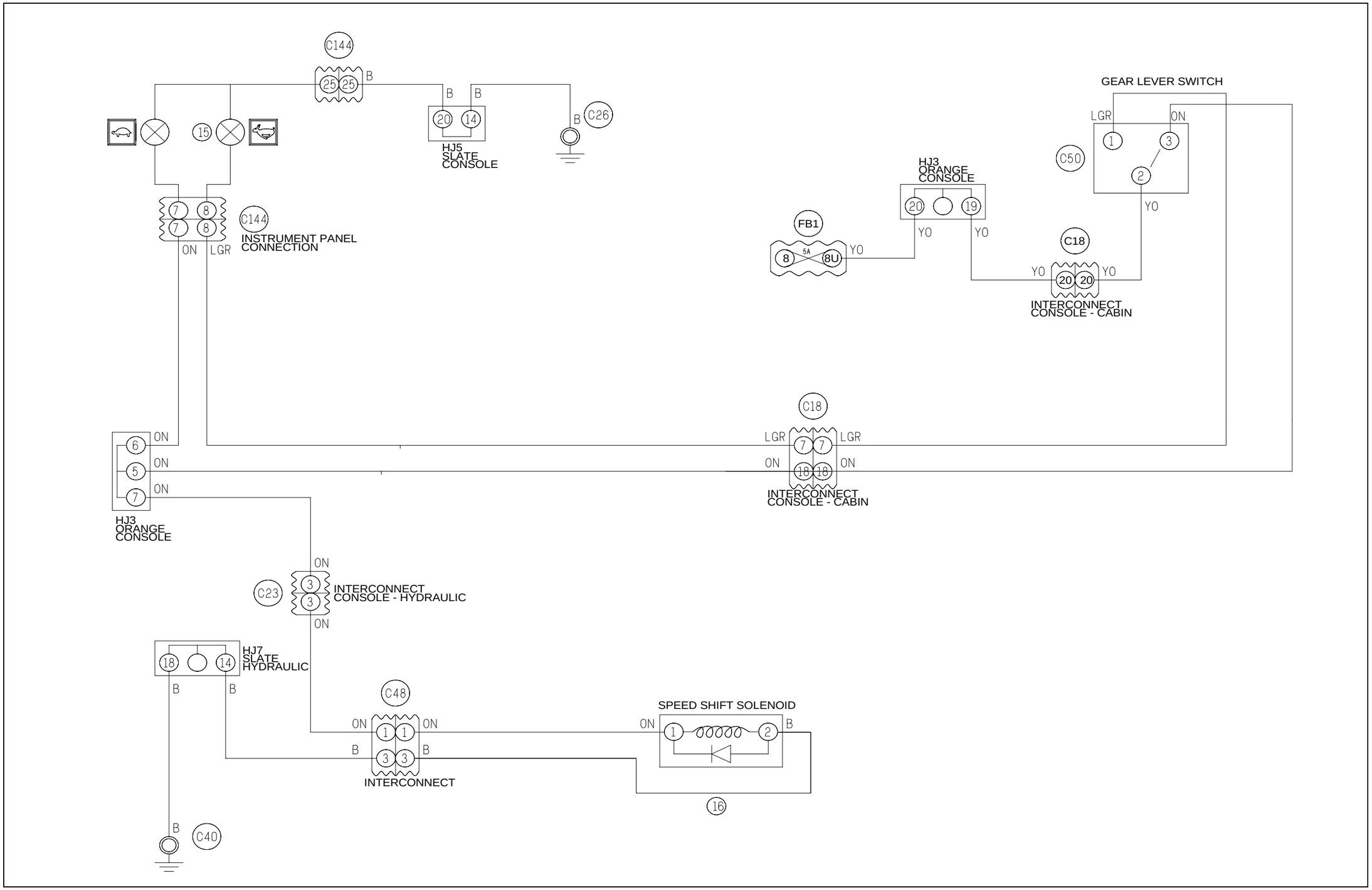


Figure 50 - Speed shift control circuit

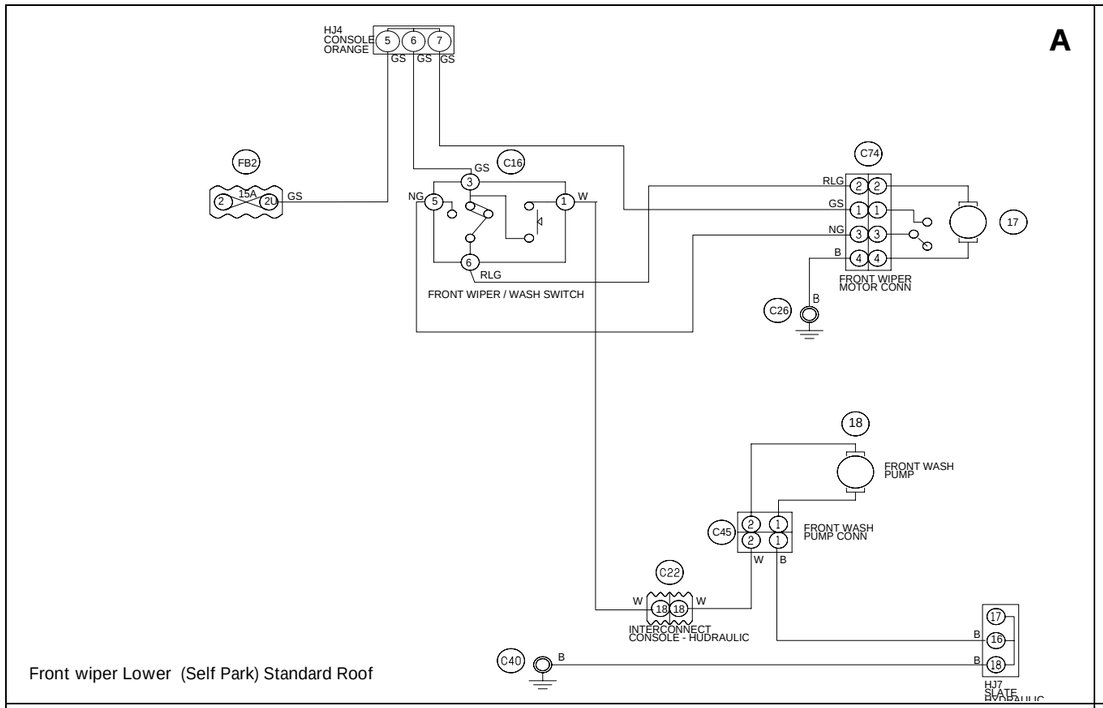
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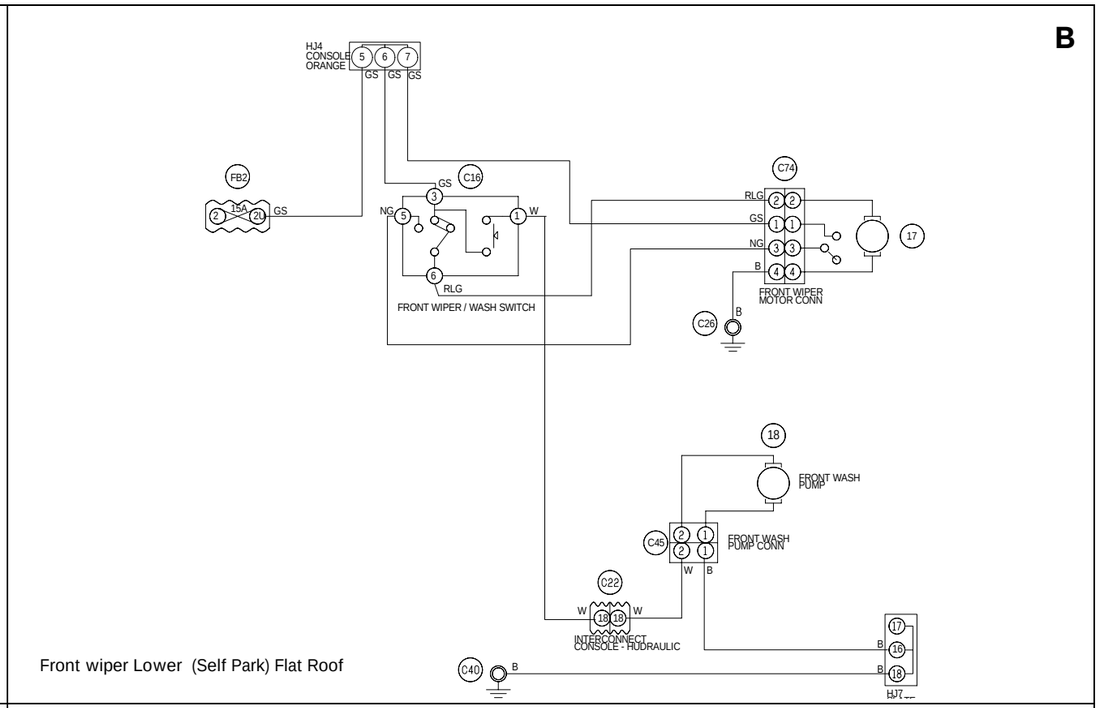
Tractor Manuals Scotland

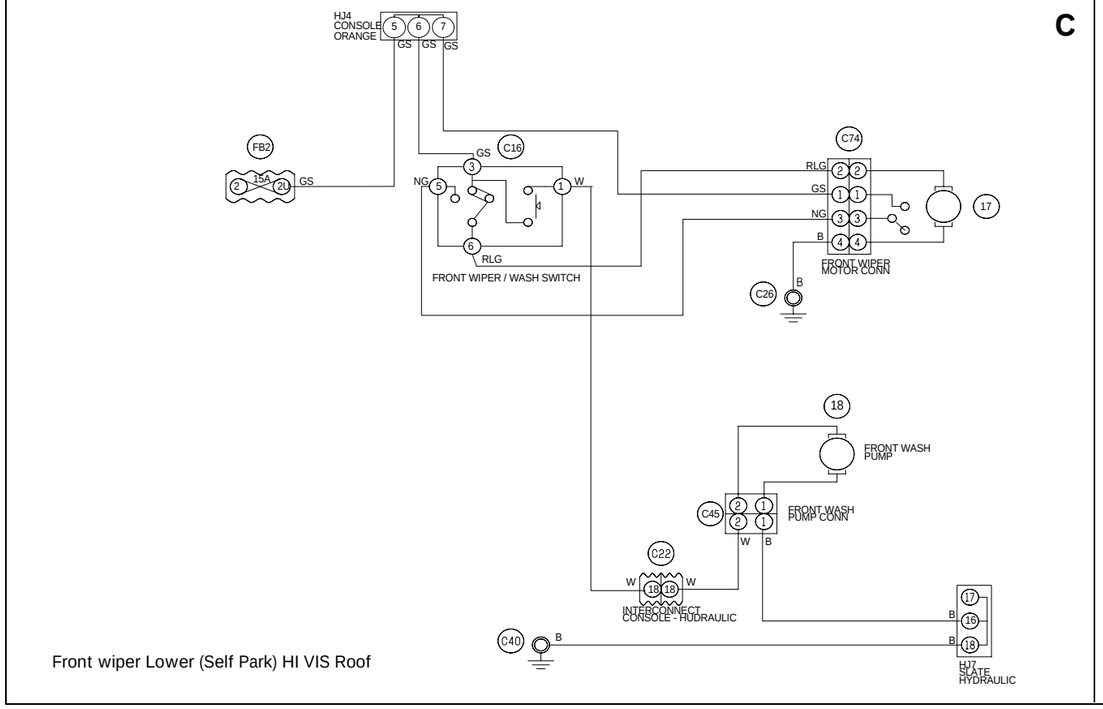
Figure 50
Speed shift control circuit

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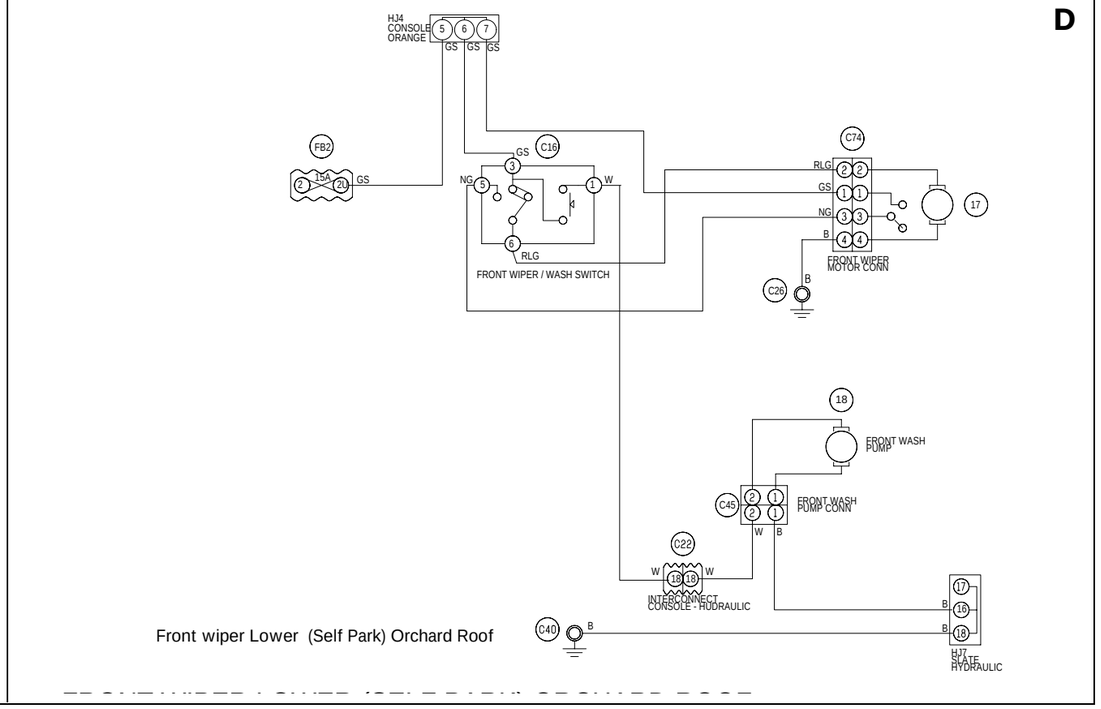


Figure 51

Tractor Manuals Scotland - Please Do Not Copy

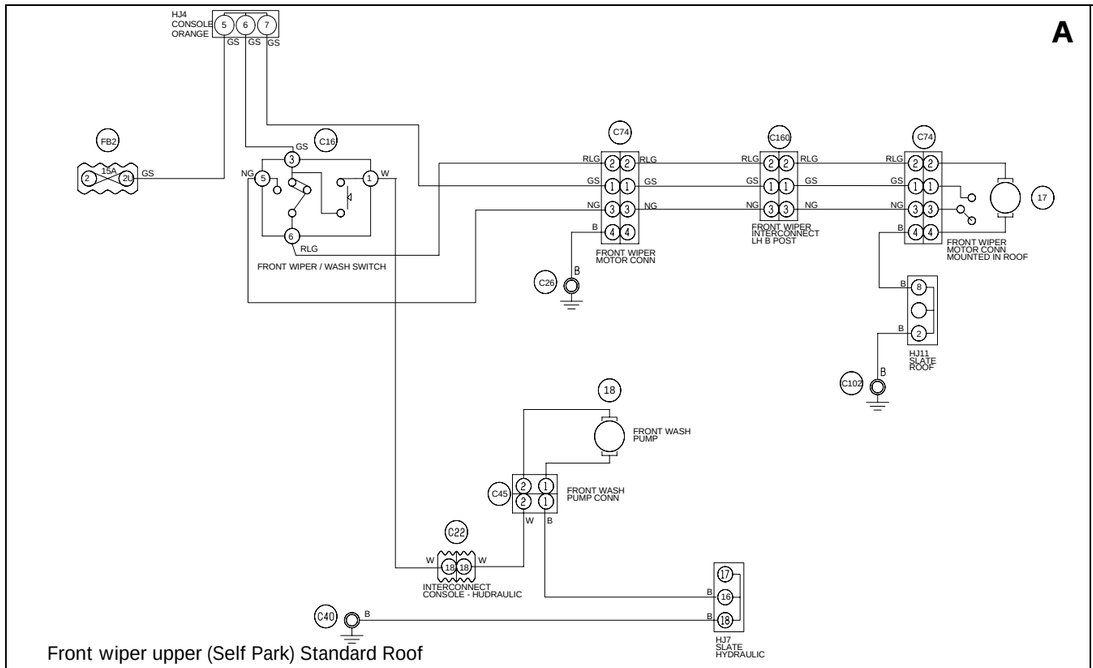
Tractor Manuals Scotland

Figure 51

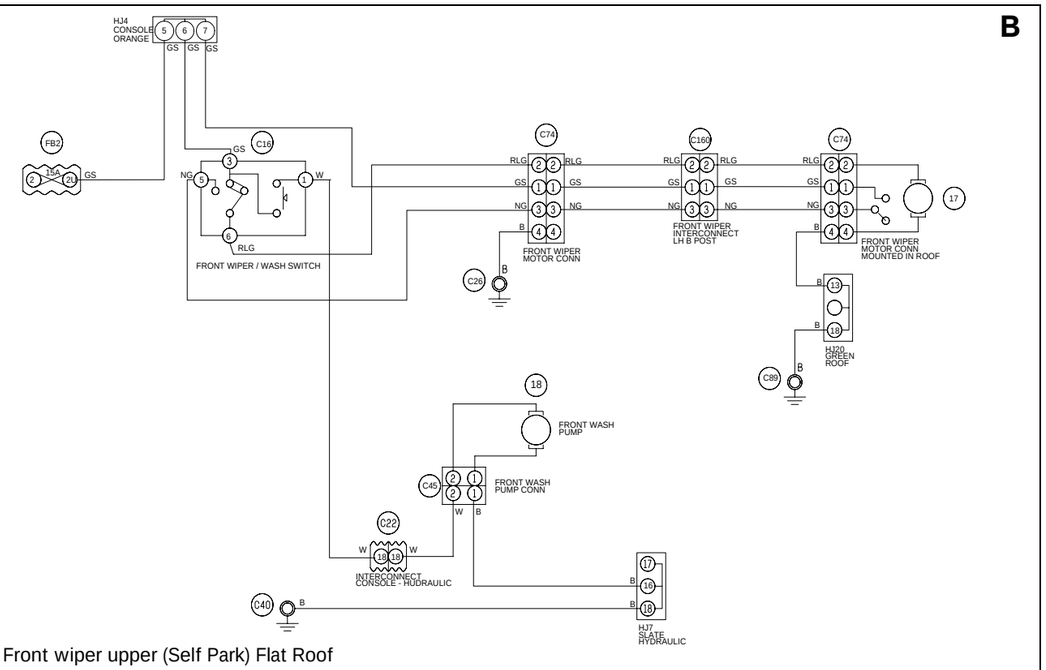
A - Front wiper Lower (Self Park) Standard Roof
B - Front wiper Lower (Self Park) Flat Roof
C - Front wiper Lower (Self Park) HI VIS Roof
D - Front wiper Lower (Self Park) Orchard Roof

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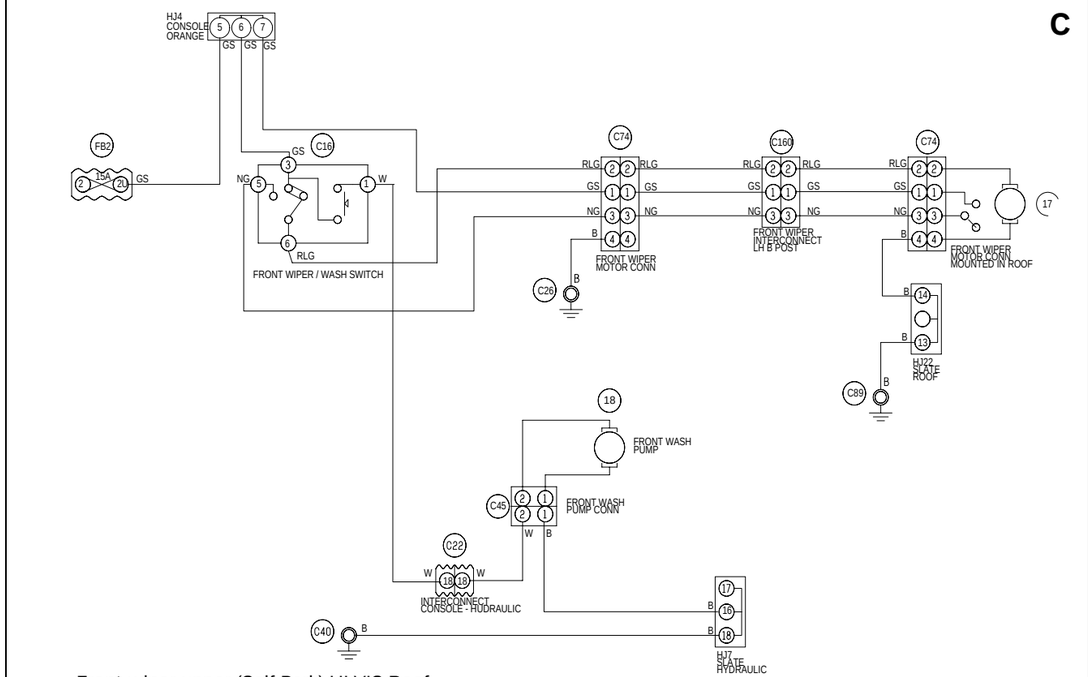
Tractor Manuals Scotland



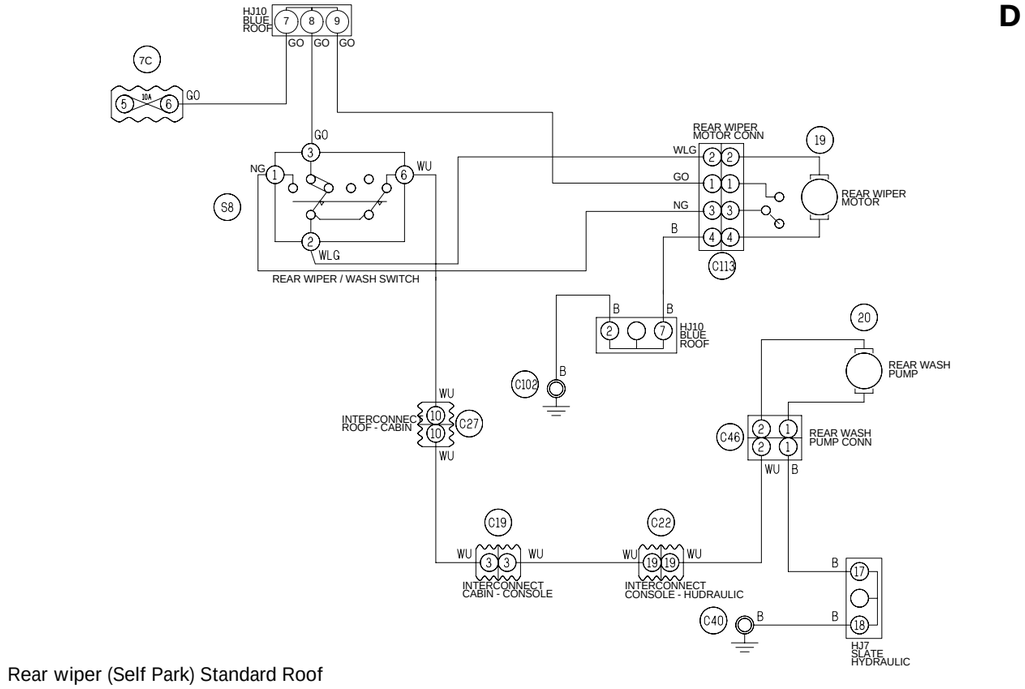
Front wiper upper (Self Park) Standard Roof



Front wiper upper (Self Park) Flat Roof



Front wiper upper (Self Park) HI VIS Roof



Rear wiper (Self Park) Standard Roof

Figure 52

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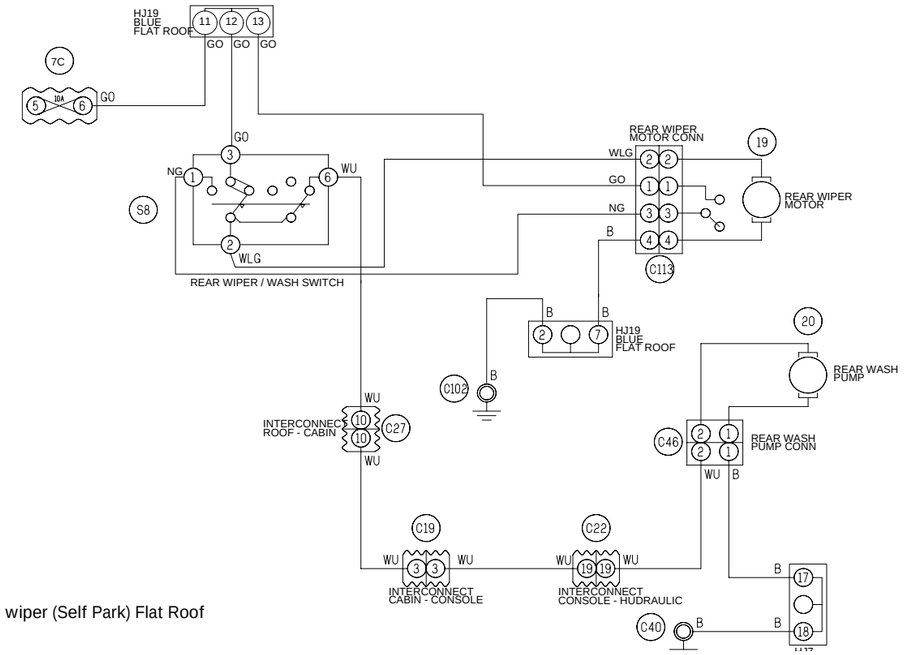
Figure 52

A - Front wiper upper (Self Park) Standard Roof
B - Front wiper upper (Self Park) Flat Roof
C - Front wiper upper (Self Park) HI VIS Roof
D - Rear wiper (Self Park) Standard Roof

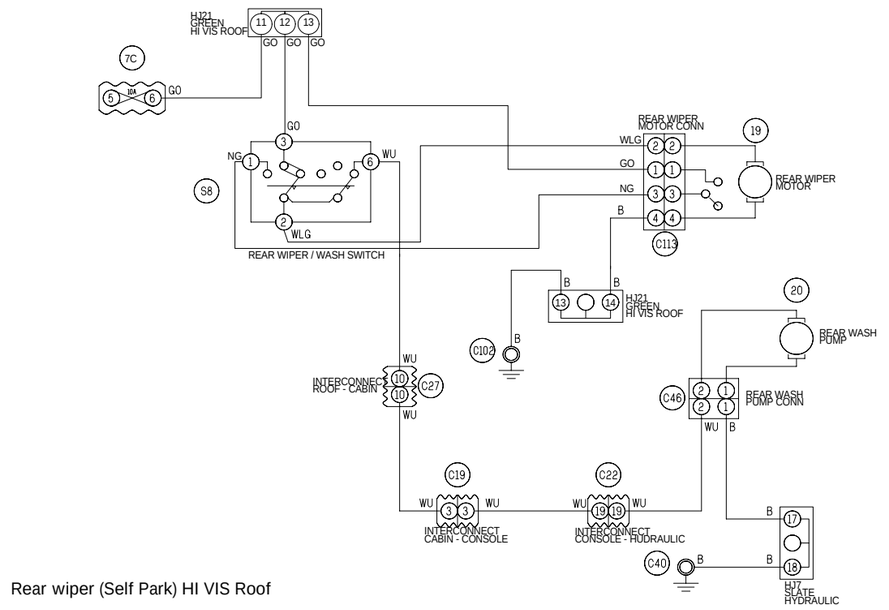
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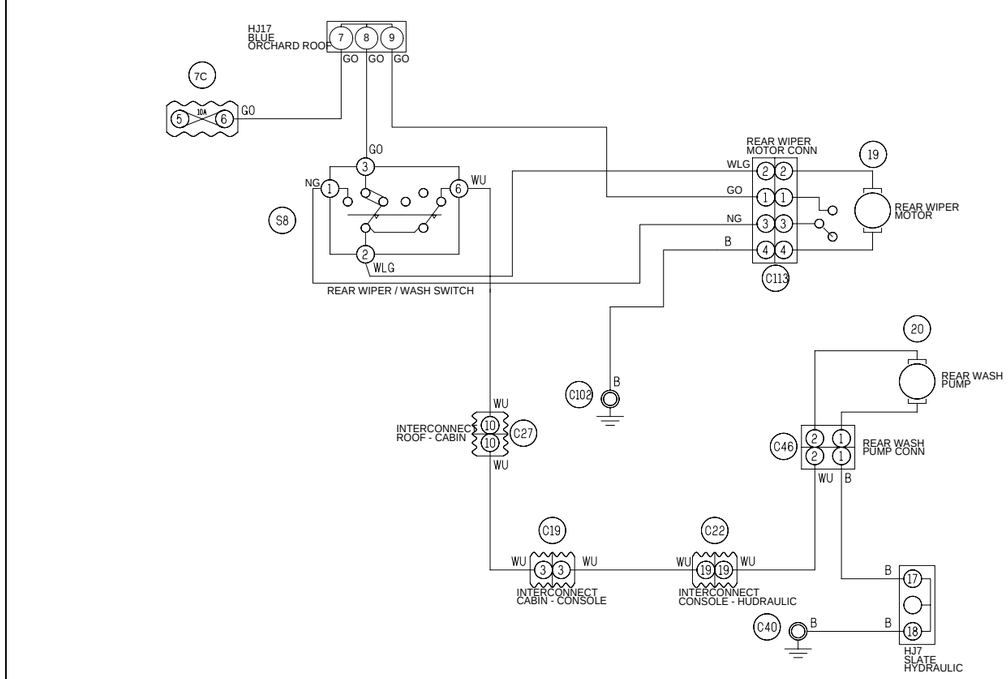
Cab Wiring Diagrams



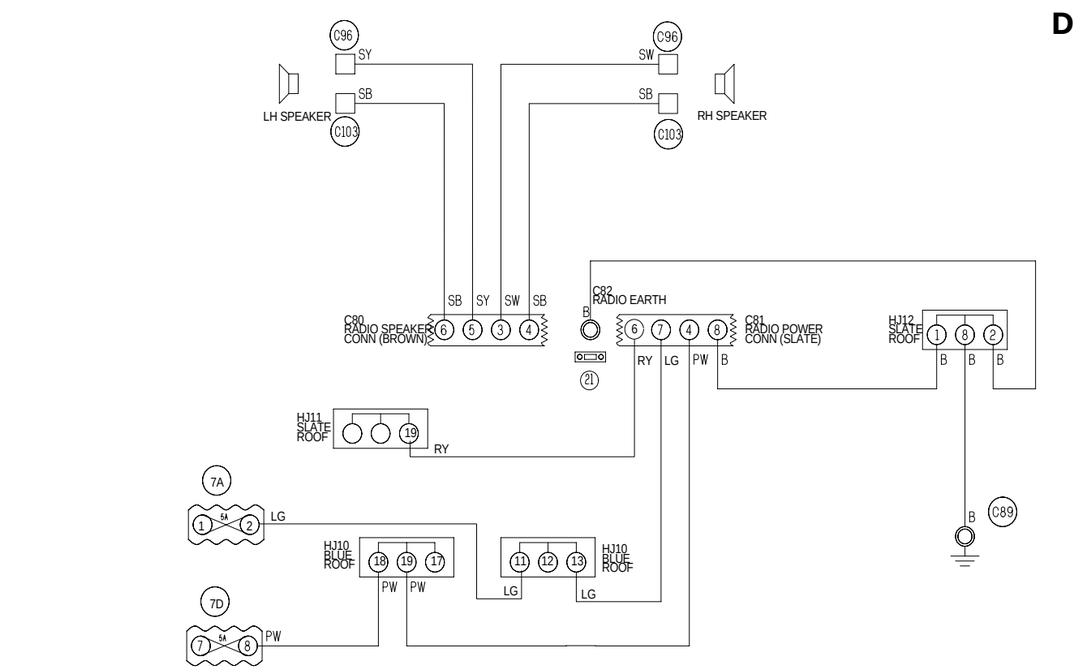
Rear wiper (Self Park) Flat Roof



Rear wiper (Self Park) HI VIS Roof



Rear wiper (Self Park) Orchard Cab Roof



Radio Cassette - Standard Roof

Figure 53

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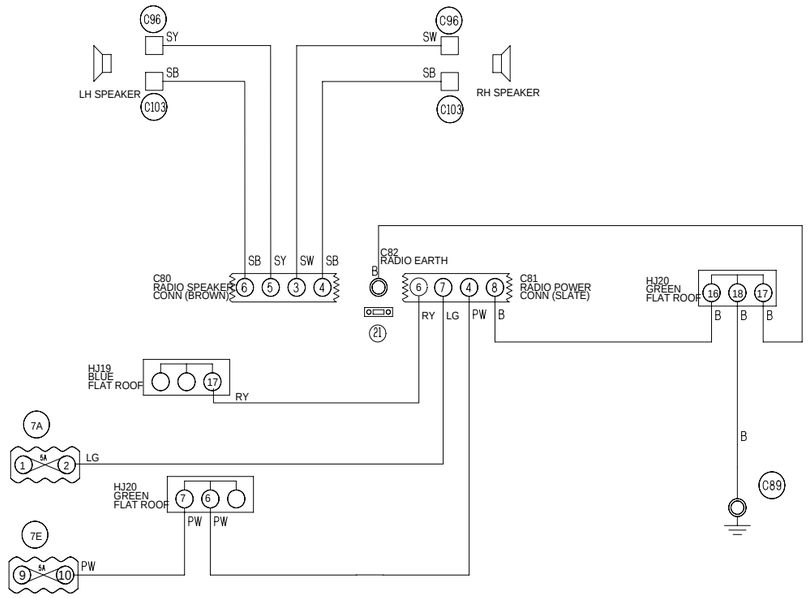
Figure 53

A - Rear wiper (Self Park) Flat Roof
B - Rear wiper (Self Park) HI VIS Roof
C - Rear wiper (Self Park) Orchard Cab Roof
D - Radio Cassette - Standard Roof

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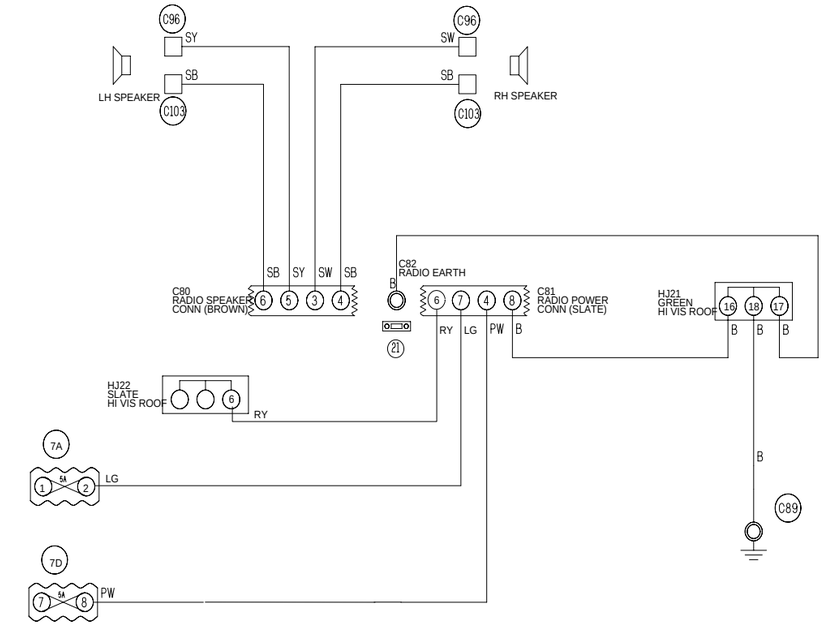
Tractor Manuals Scotland

A



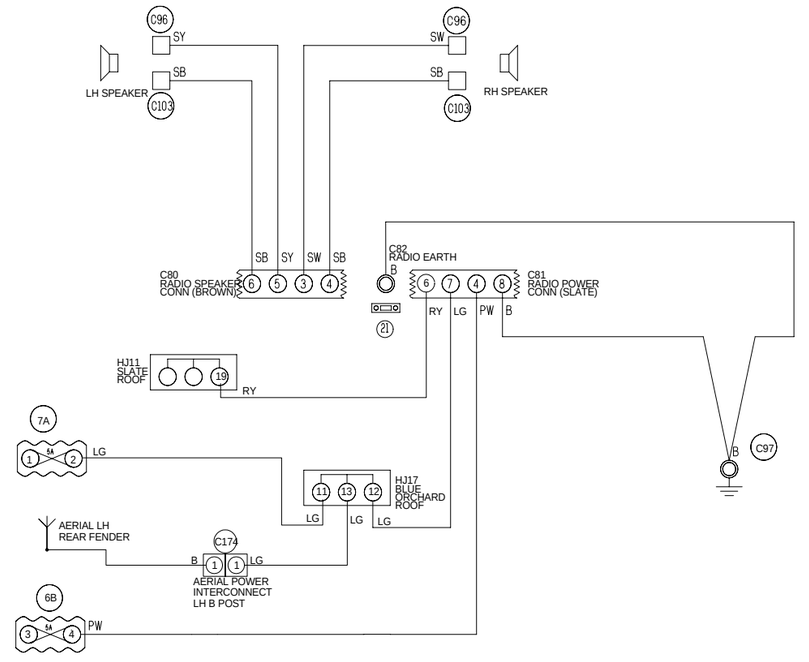
Radio Cassette - Flat Roof

B



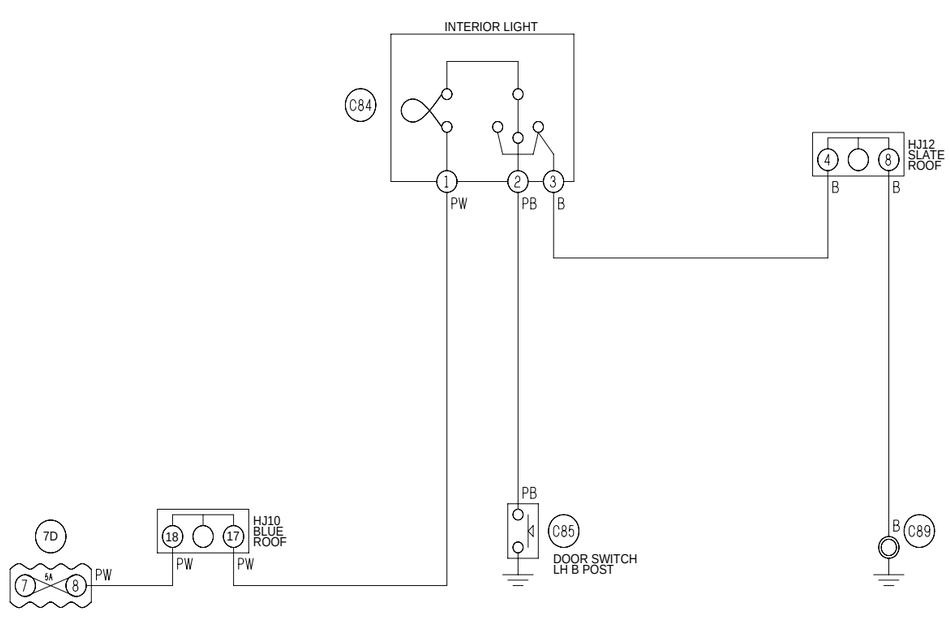
Radio Cassette - HI VIS Roof

C



Radio Cassette - Orchard Roof

D



Interior Light - Standard Roof

Figure 54

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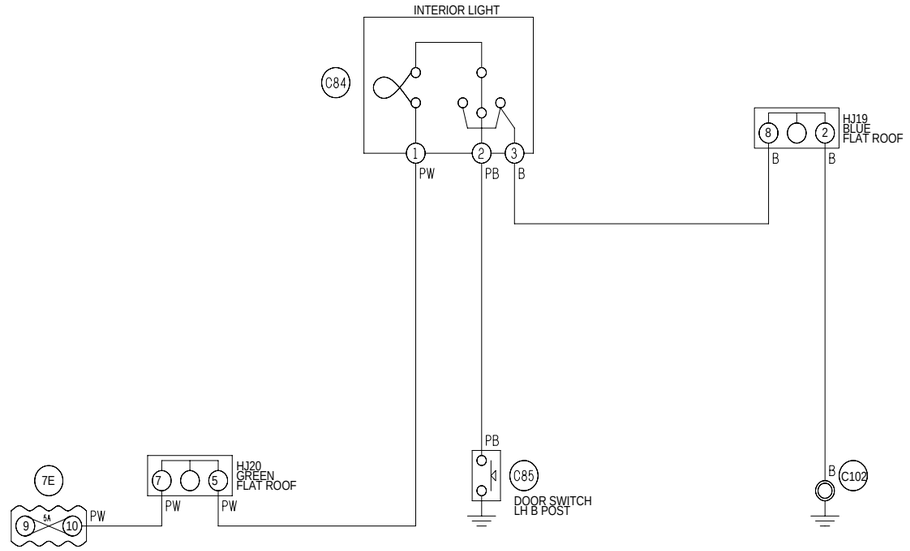
Figure 54

A - Radio Cassette - Flat Roof
B - Radio Cassette - HI VIS Roof
C - Radio Cassette - Orchard Roof
D - Interior Light - Standard Roof

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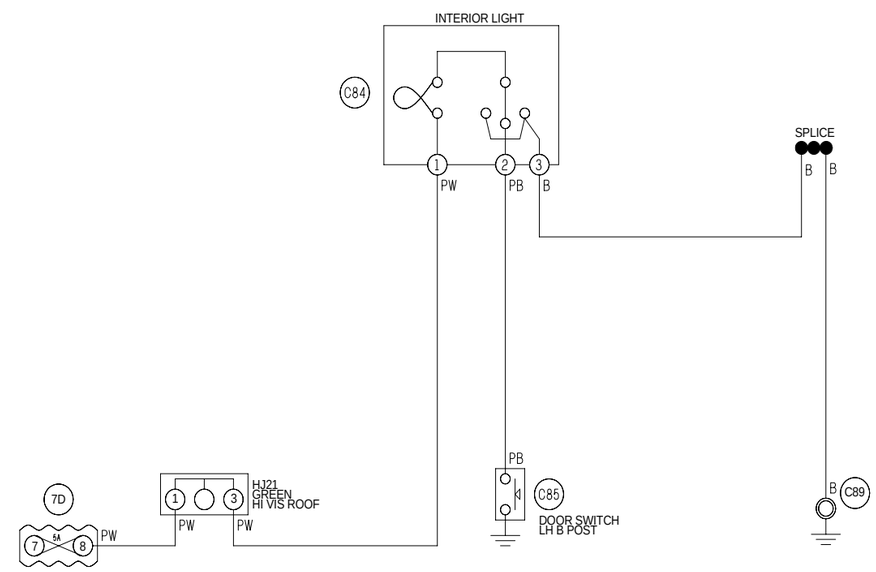
Tractor Manuals Scotland

A



Interior Light - Flat Roof

B



Interior Light - HI VIS Roof

C

Interior Light - Orchard Roof

D

Beacon circuit - Standard Roof

Figure 55

Tractor Manuals Scotland - Please Do Not Copy

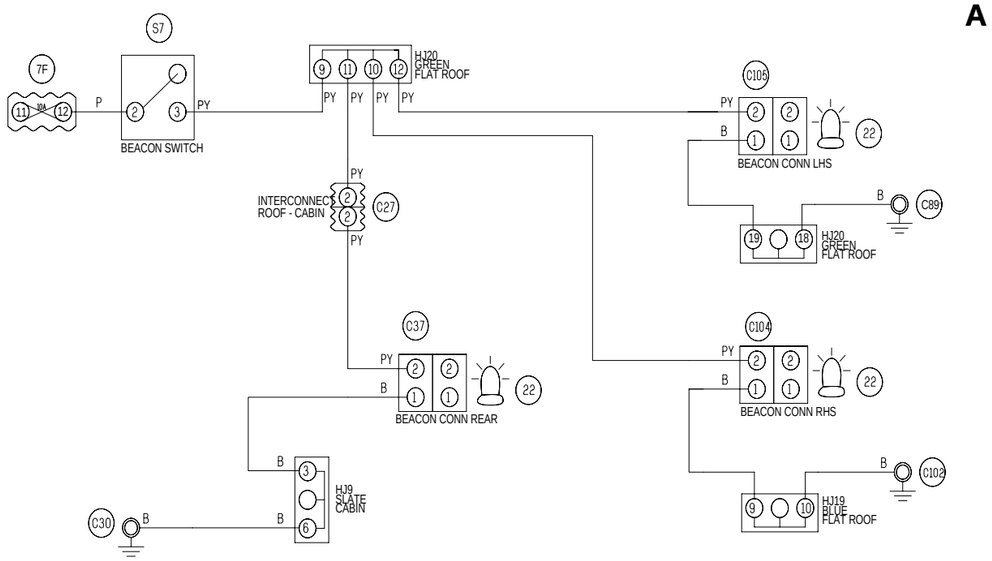
Tractor Manuals Scotland

Figure 55

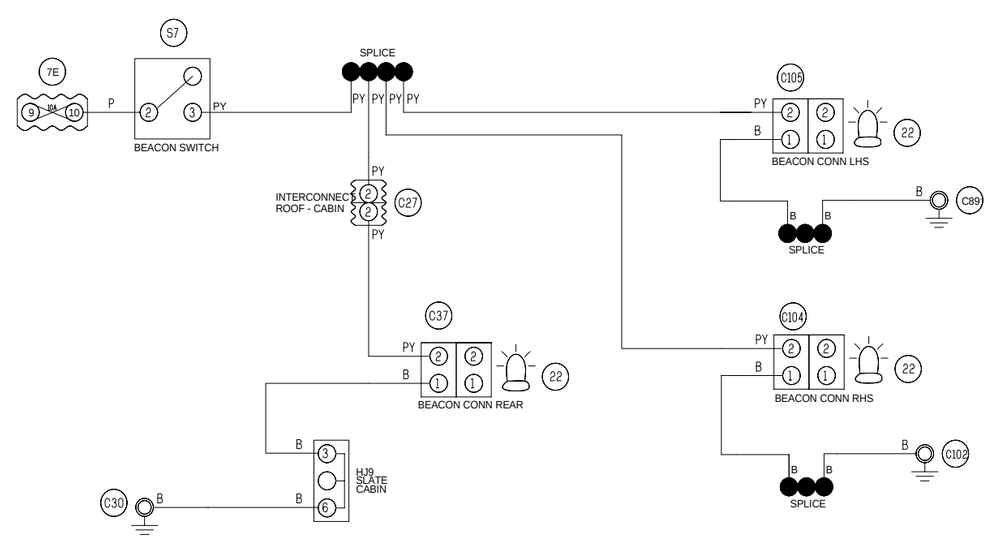
A - Interior Light - Flat Roof
B - Interior Light - HI VIS Roof
C - Interior Light - Orchard Roof
D - Beacon circuit - Standard Roof

Tractor Manuals Scotland - Please Do Not Copy

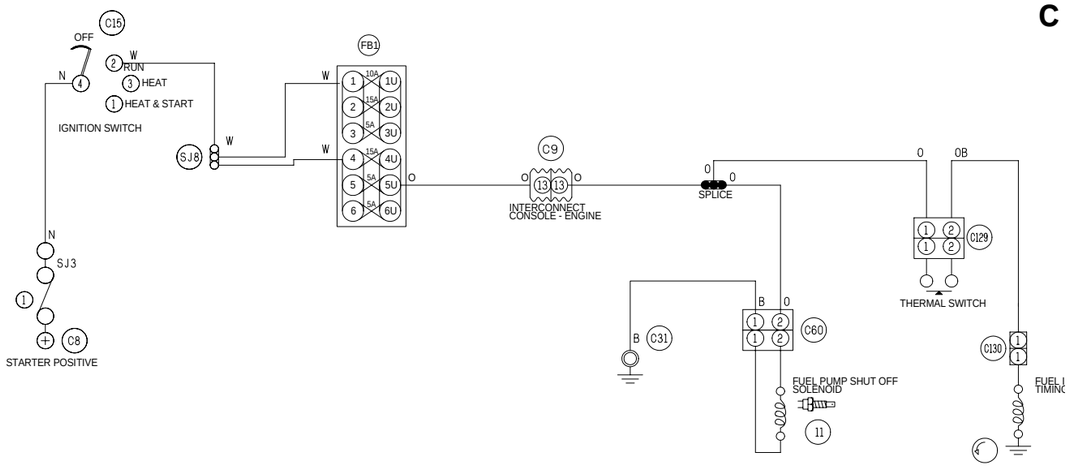
Tractor Manuals Scotland



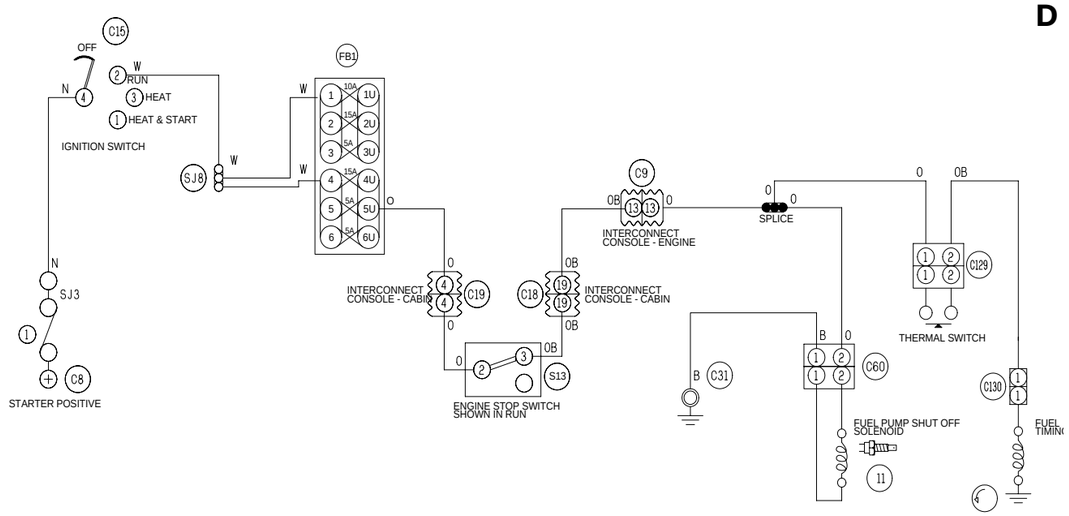
Beacon circuit - Flat Roof



Beacon circuit - HI VIS Roof



Fuel injection pump stop solenoid



Engine stop solenoid circuit - Forestry cab only

Figure 56

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Tractor Manuals Scotland

Figure 56

A - Beacon circuit - Flat Roof
B - Beacon circuit - HI VIS Roof
C - Fuel injection pump stop solenoid
D - Engine stop solenoid circuit - Forestry cab only

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Tractor Manuals Scotland

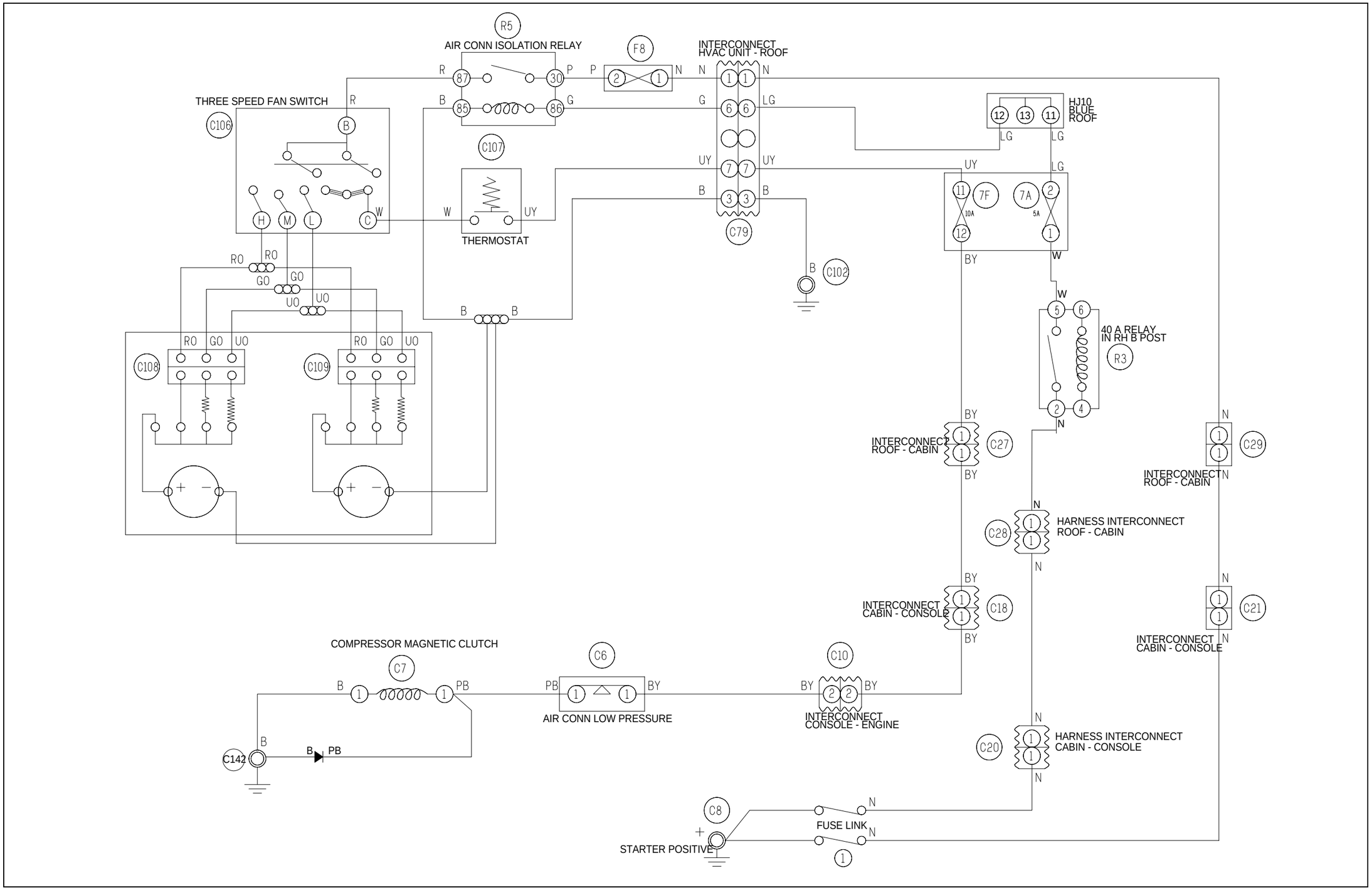


Figure 57 - HVAC unit - Standard Roof

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Tractor Manuals Scotland

Figure 57
HVAC unit - Standard Roof

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Tractor Manuals Scotland

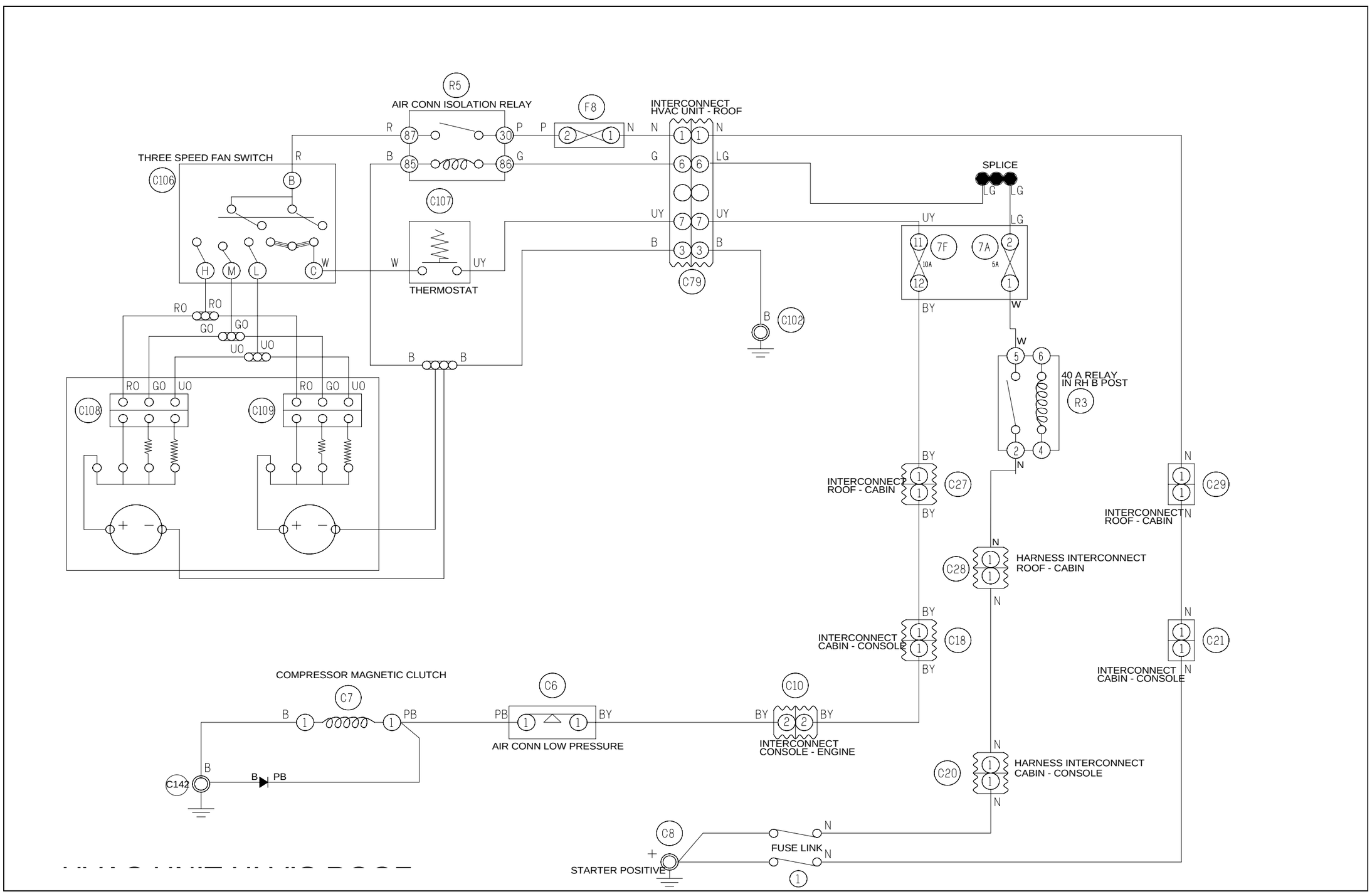


Figure 58 - HVAC Unit HI VIS Roof

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Tractor Manuals Scotland

Figure 58
HVAC Unit HI VIS Roof

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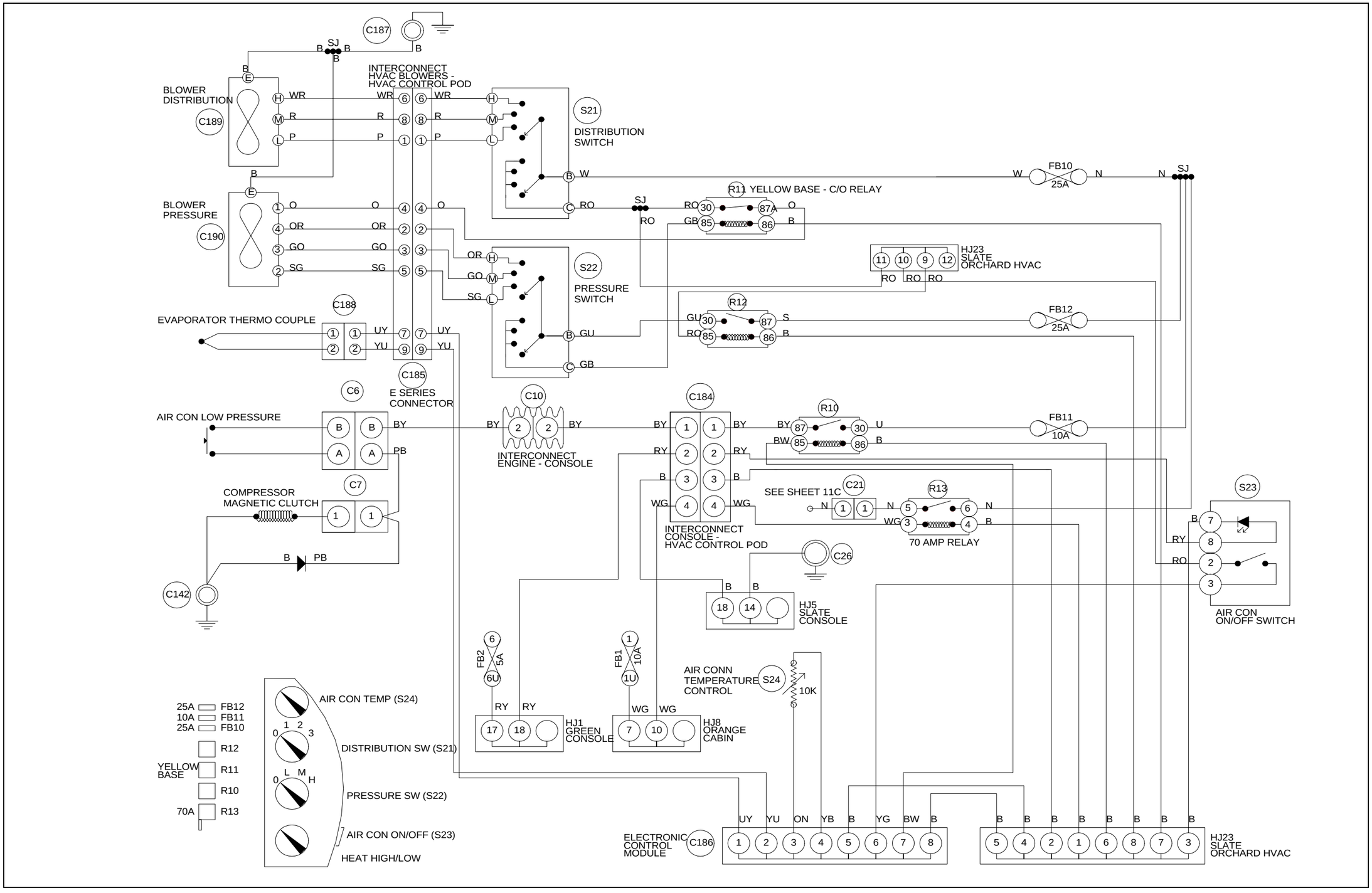


Figure 59 - HVAC Unit - Control pod and blower box circuit - Orchard cab

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Tractor Manuals Scotland

Figure 59
HVAC Unit - Control pod and blower box circuit - Orchard cab

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Tractor Manuals Scotland

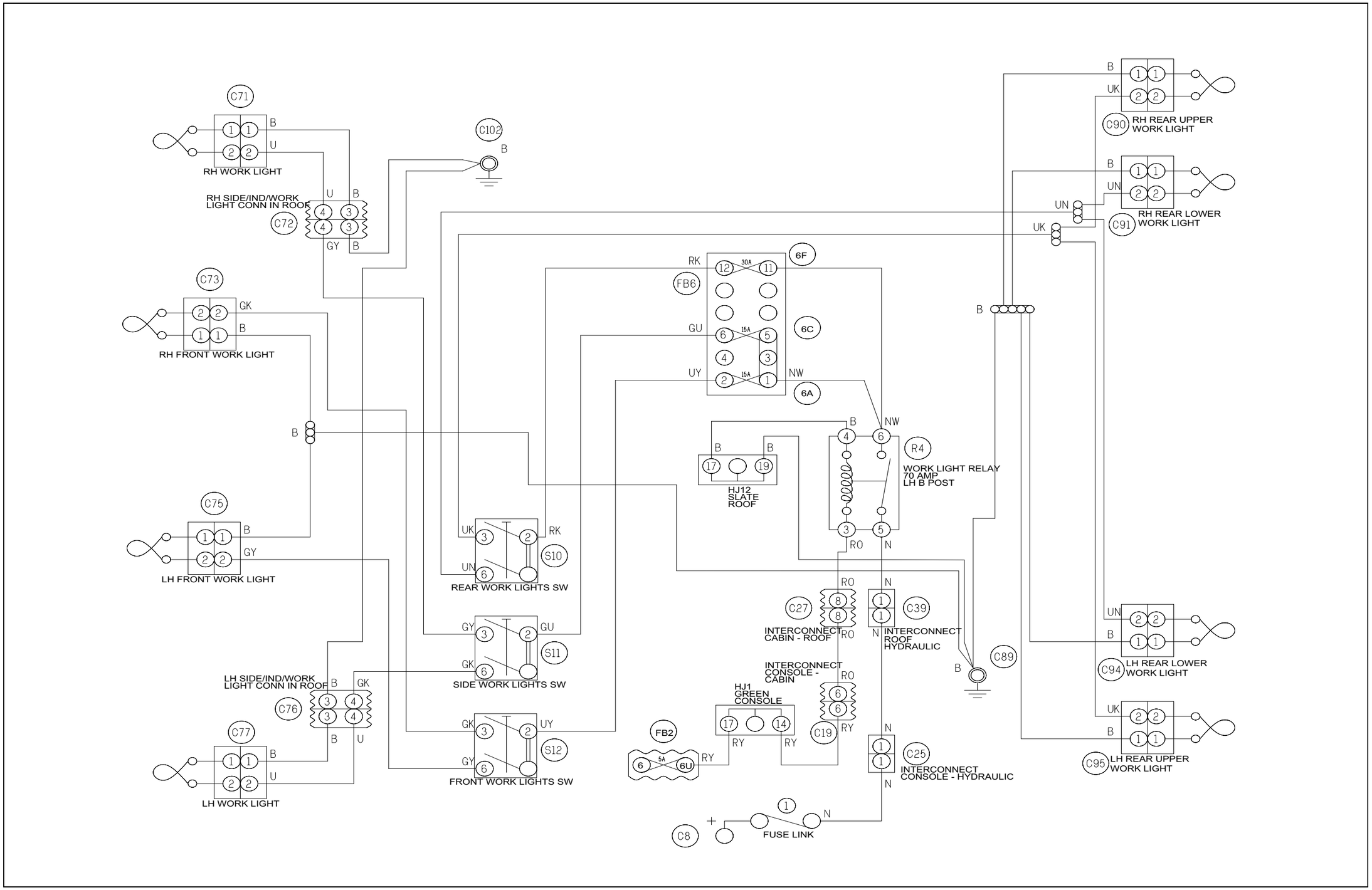


Figure 60 - Work lights - Row - Standard Cab

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Tractor Manuals Scotland

Figure 60
Work lights - Row - Standard Cab

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Tractor Manuals Scotland

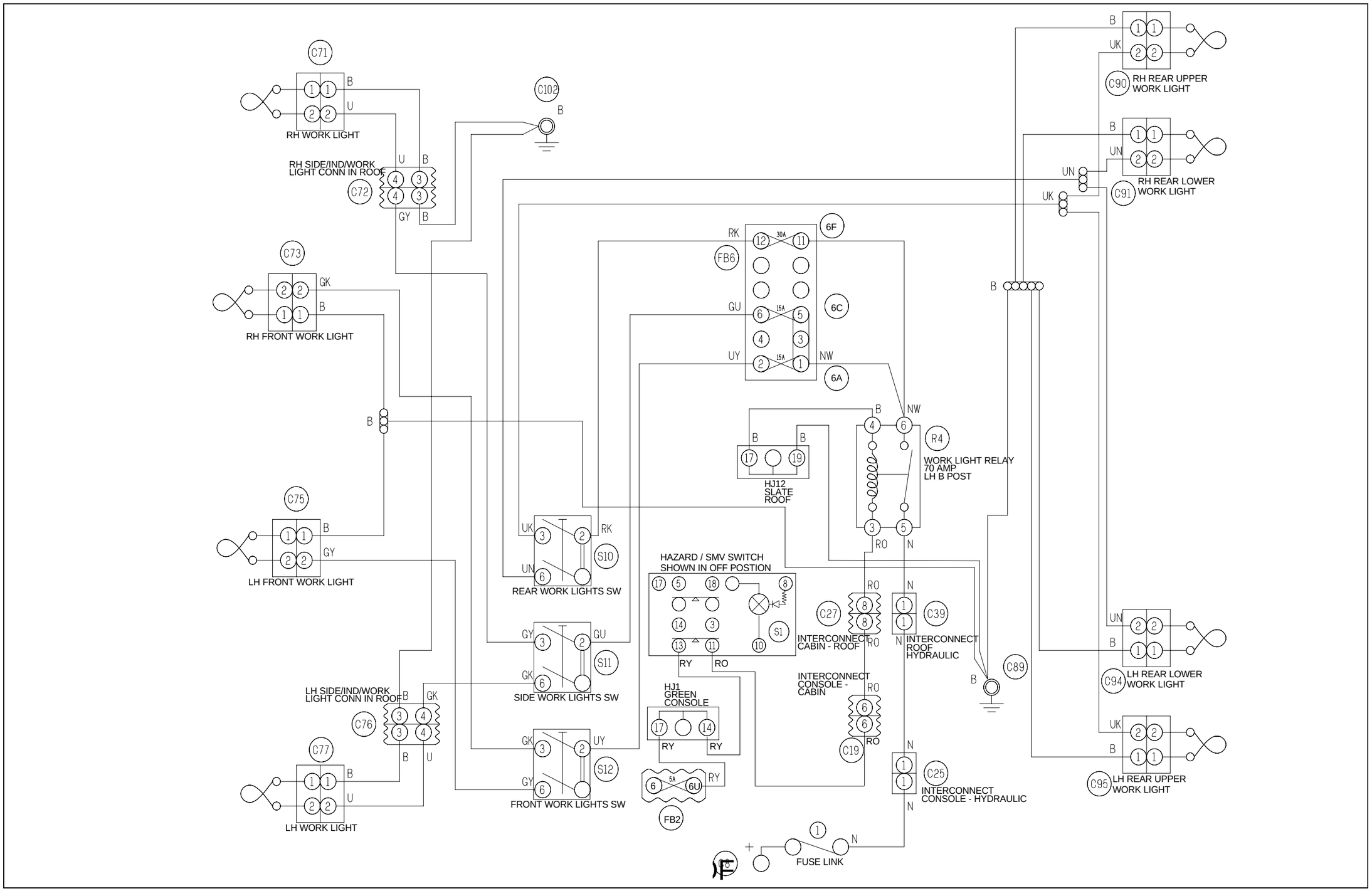


Figure 61 - Work lights NAO - Standard Roof

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Tractor Manuals Scotland

Figure 61
Work lights NAO - Standard Roof

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Tractor Manuals Scotland

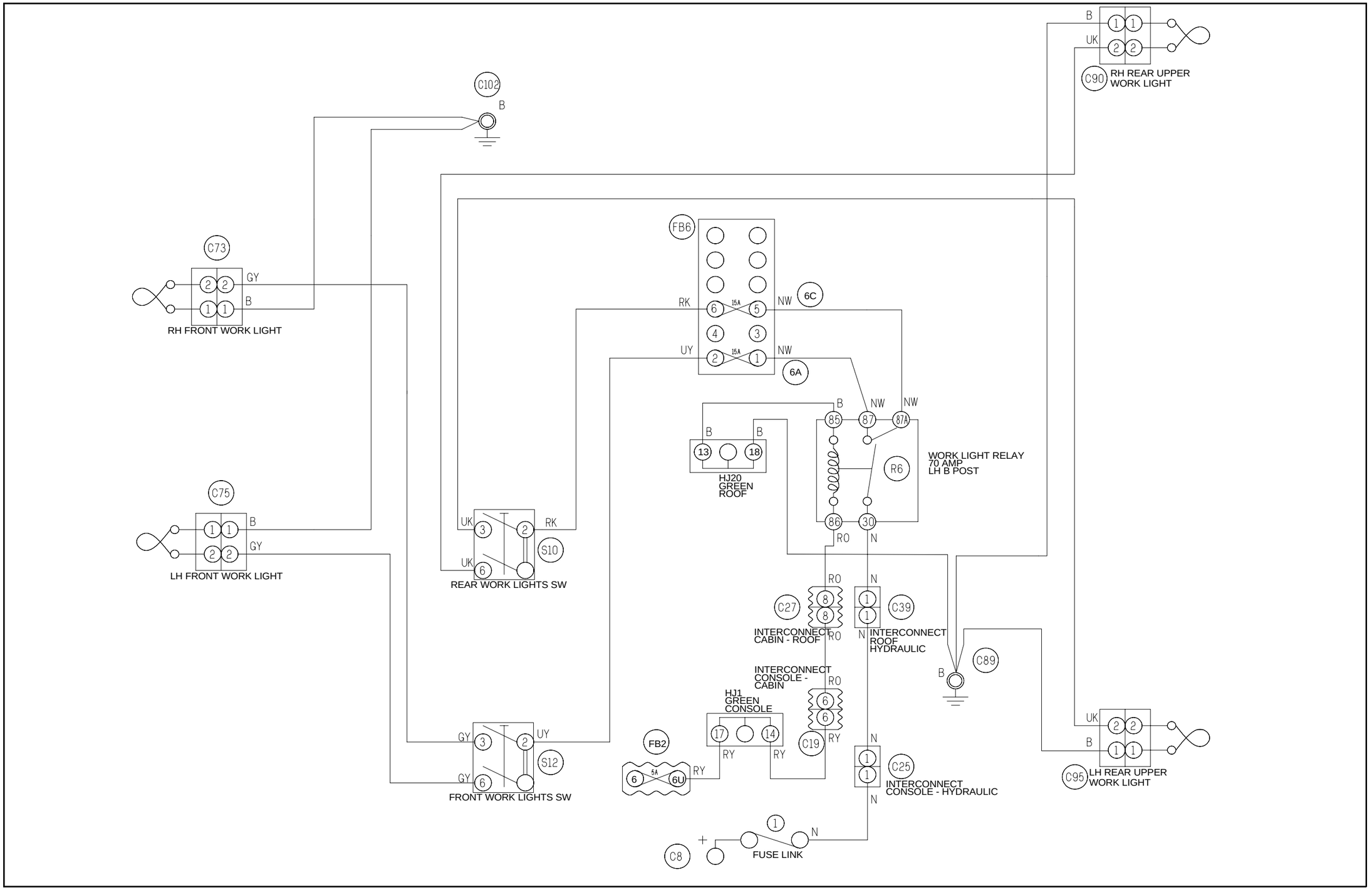


Figure 62 - Work lights - Row - Flat Roof

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 62
Work lights - Row - Flat Roof

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

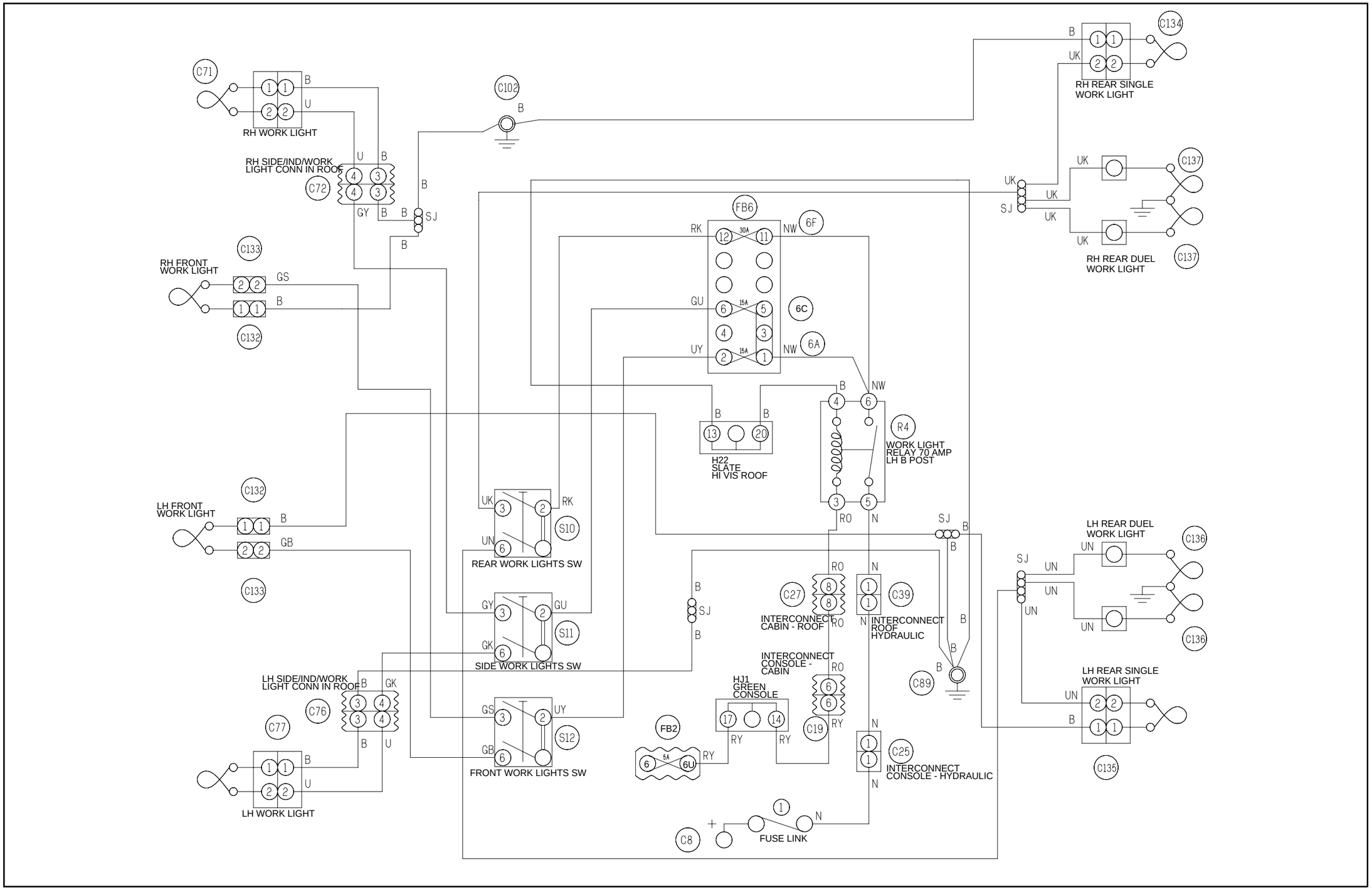


Figure 63 - Work lights - Row - HI VIS Roof

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 63
Work lights - Row - HI VIS Roof

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Tractor Manuals Scotland

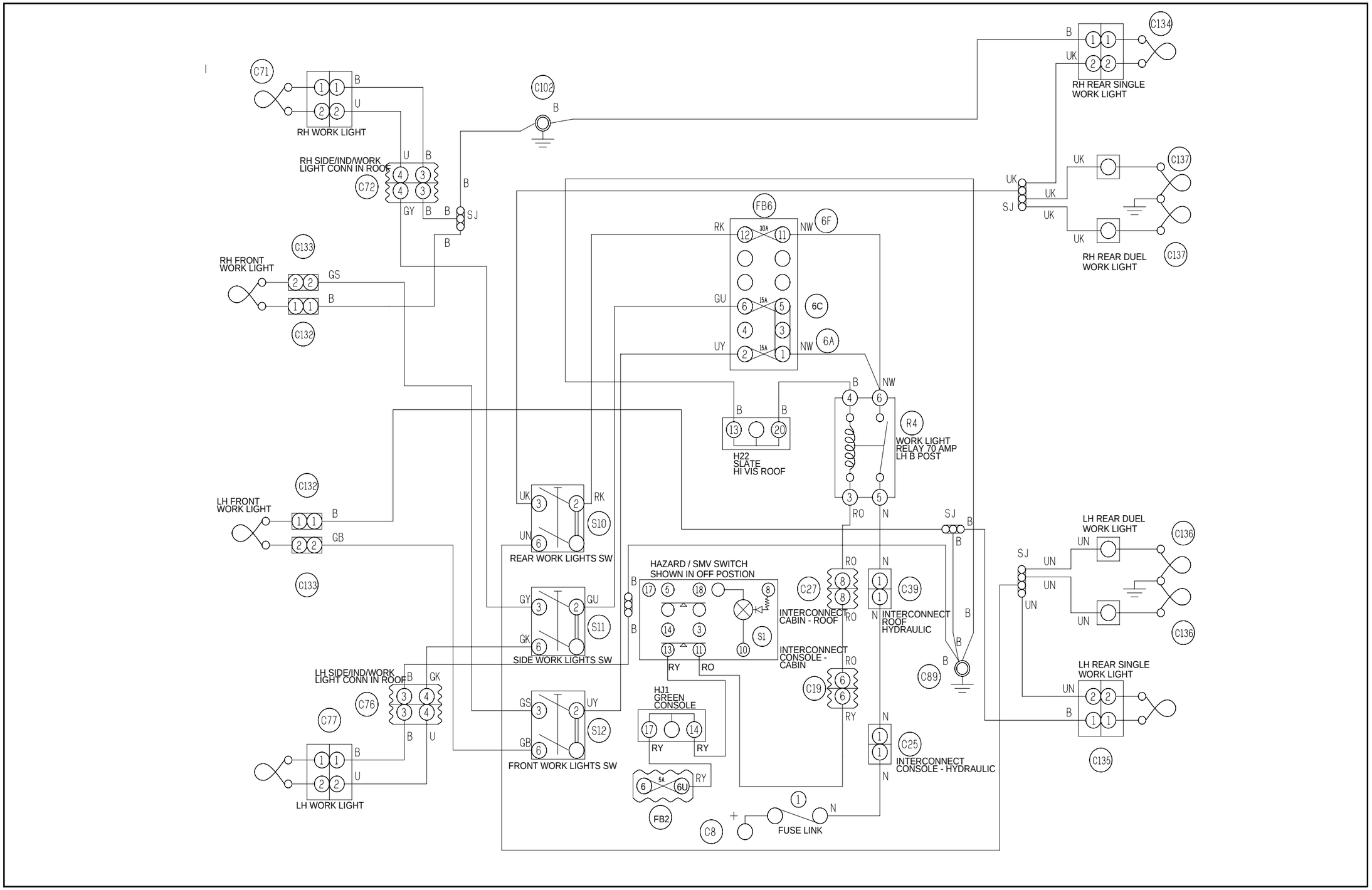


Figure 64 - Work lights - NAO - HI VIS Roof

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Tractor Manuals Scotland

Figure 64
Work lights - NAO - HI VIS Roof

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Tractor Manuals Scotland

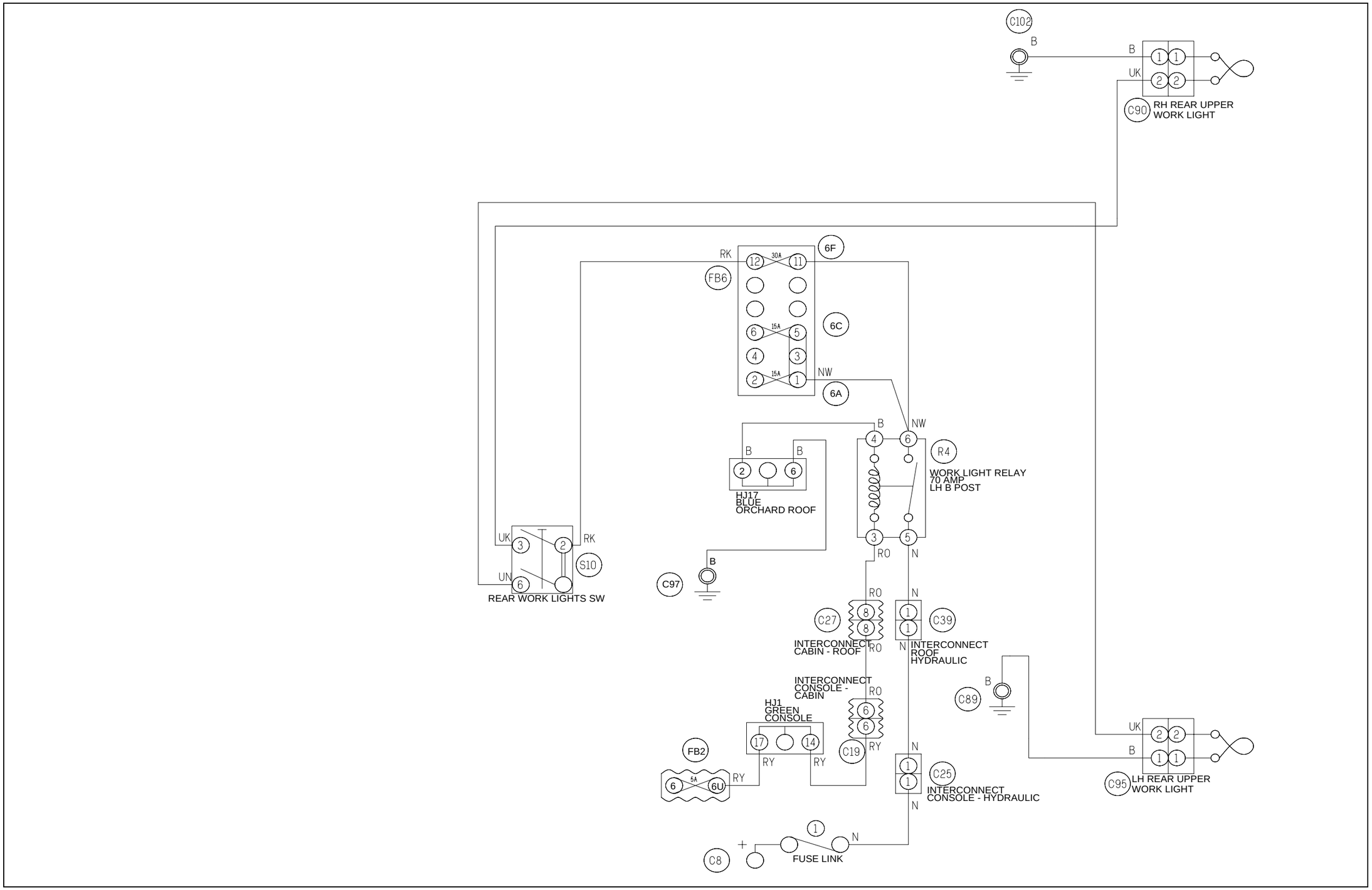


Figure 65 - Work lights - Orchard Cab Roof

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Tractor Manuals Scotland

Figure 65
Work lights - Orchard Cab Roof

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

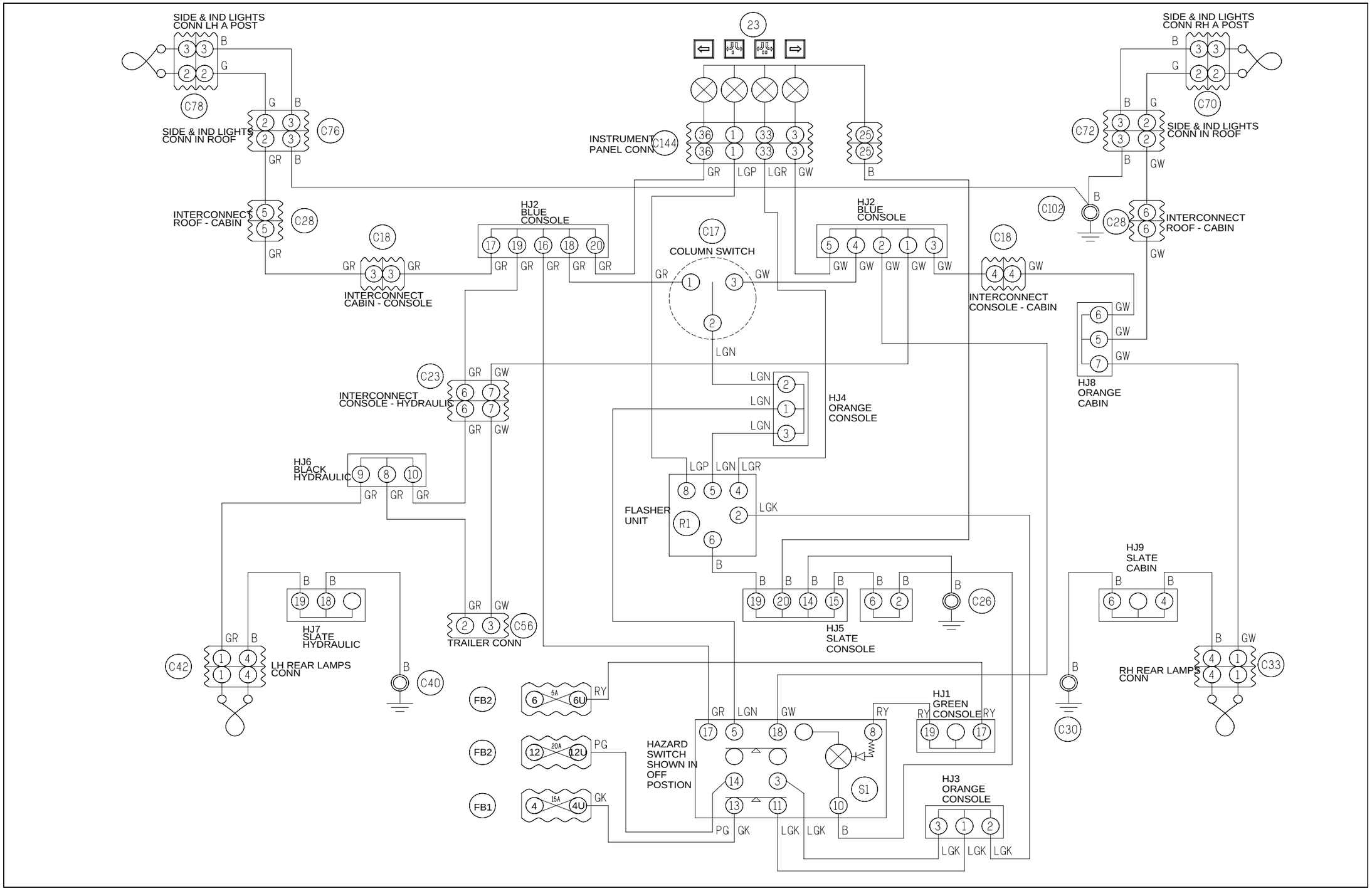


Figure 66 - Direction Indicators & Hazards - WEO Standard Roof

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Figure 66
Direction Indicators & Hazards - WEO Standard Roof

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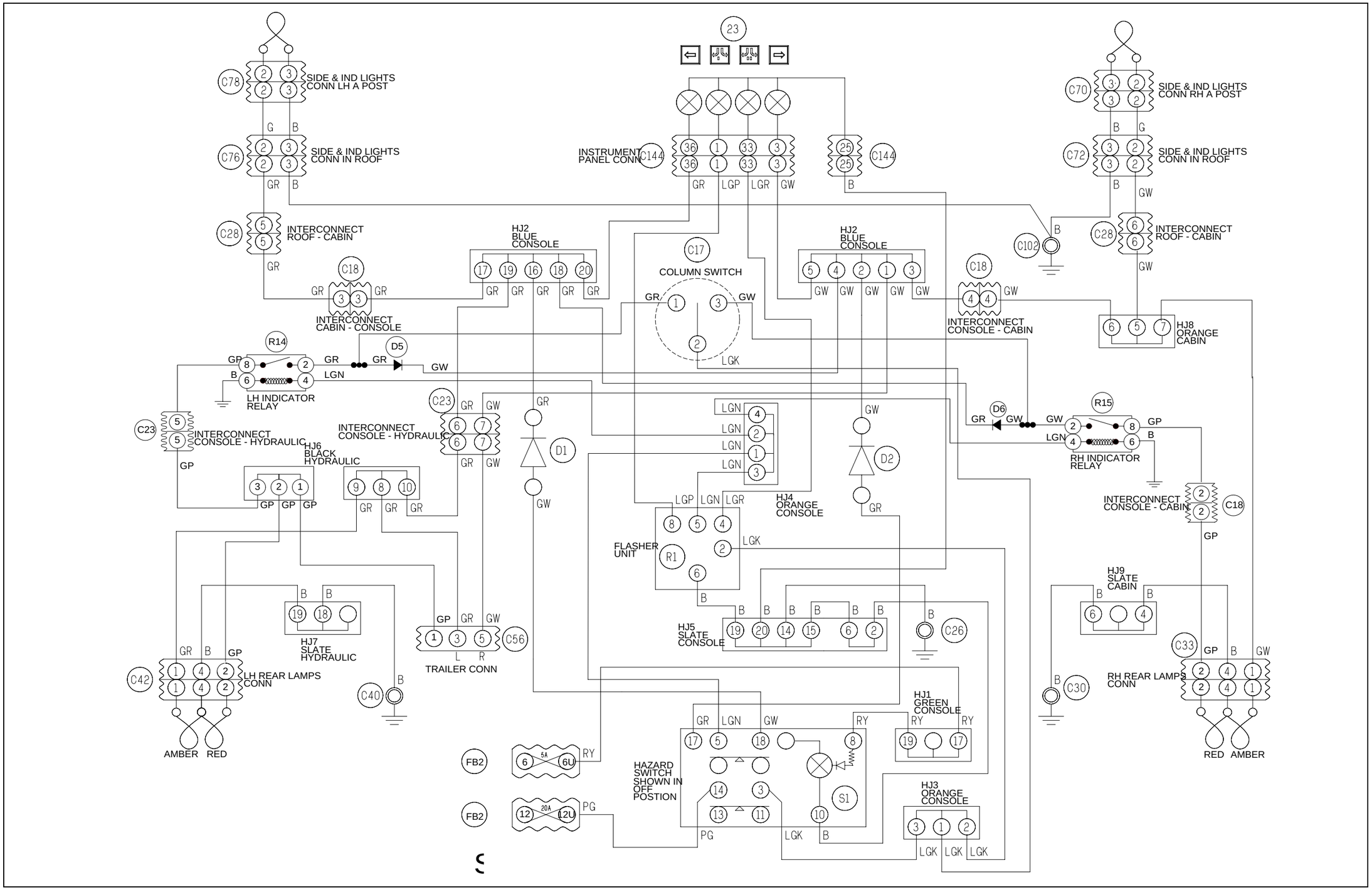


Figure 67 - Direction Indicators & SMV Hazards - NAO Standard Roof

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Figure 67
Direction Indicators & SMV Hazards - NAO Standard Roof

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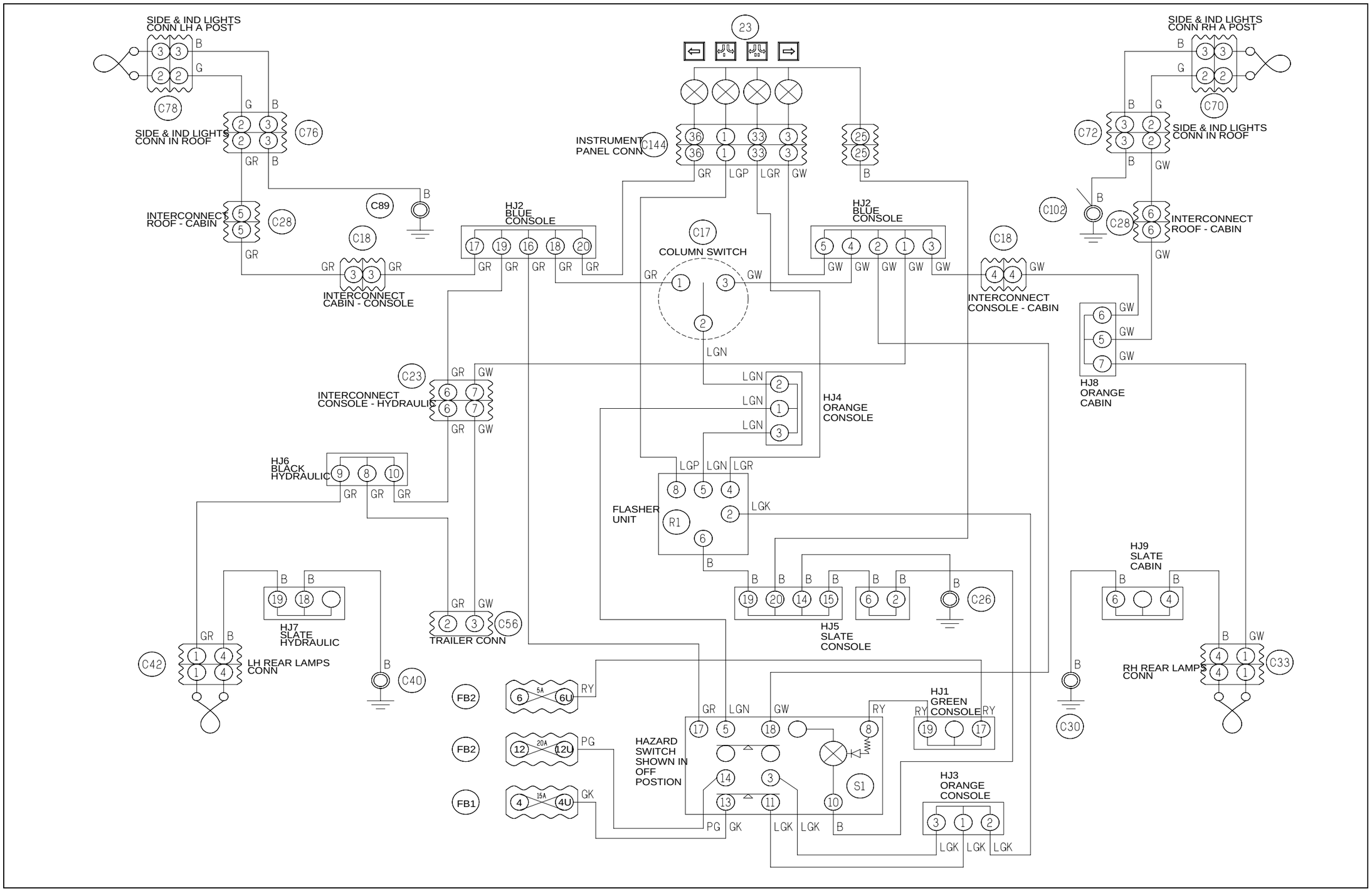


Figure 68 - Direction indicators & hazards - WEO - Flat Roof

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Figure 68
Direction indicators & hazards - WEO - Flat Roof

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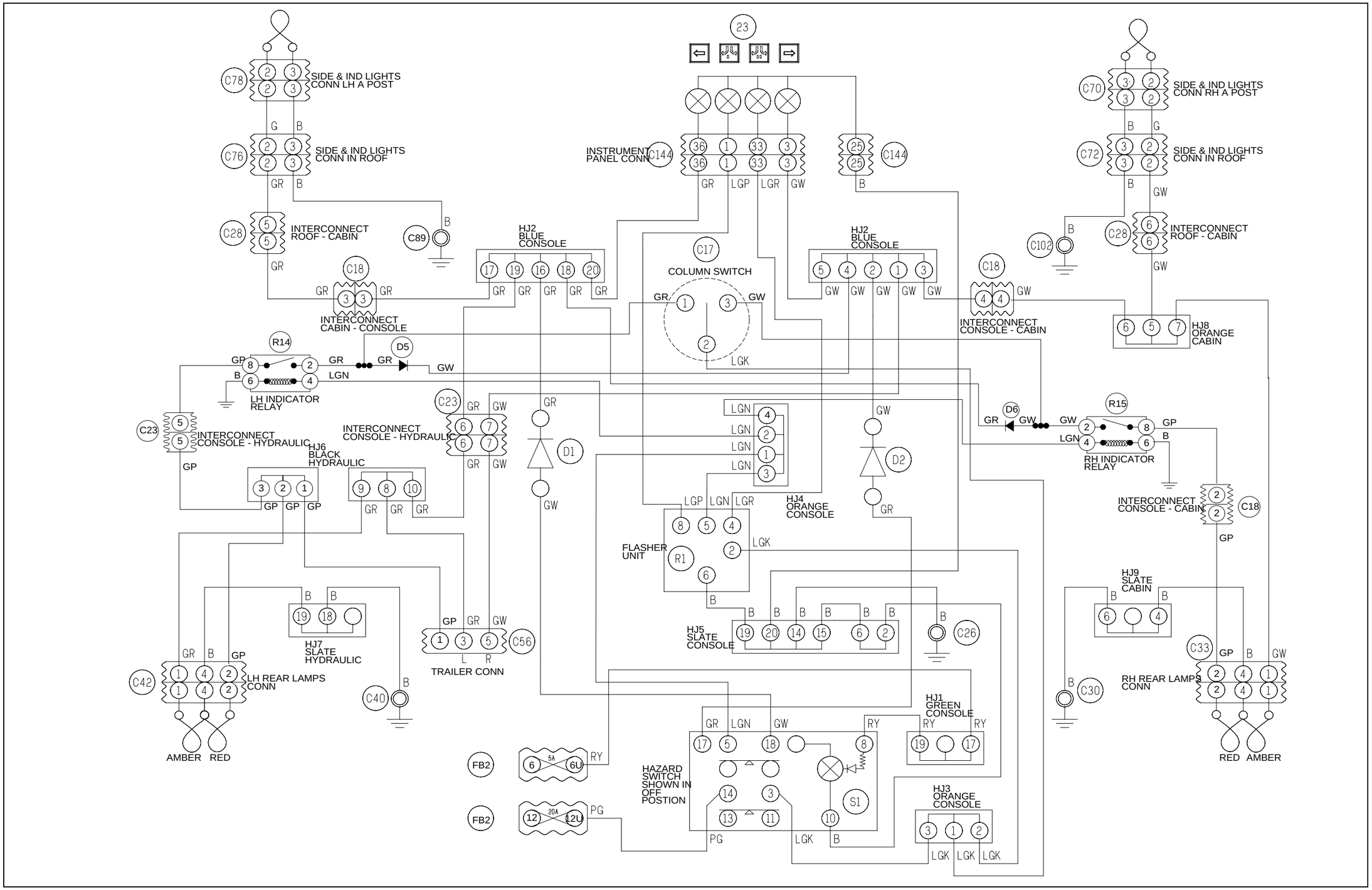


Figure 69 - Direction Indicators & SMV Hazards - NAO - Flat Roof

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Figure 69
Direction Indicators & SMV Hazards - NAO - Flat Roof

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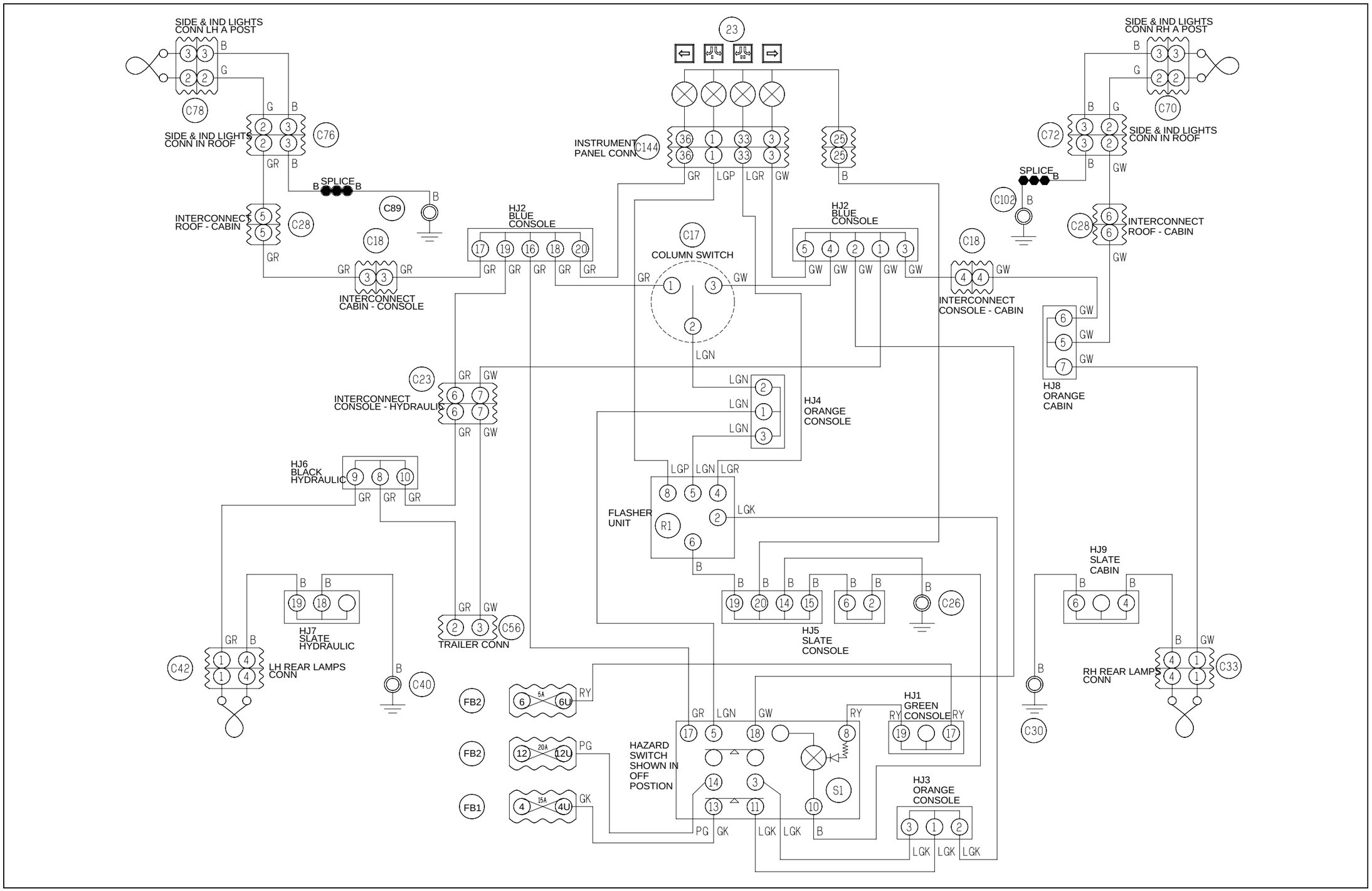


Figure 70 - Direction indicators & hazards - WEO - HI VIS Roof

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Figure 70
Direction indicators & hazards - WEO - HI VIS Roof

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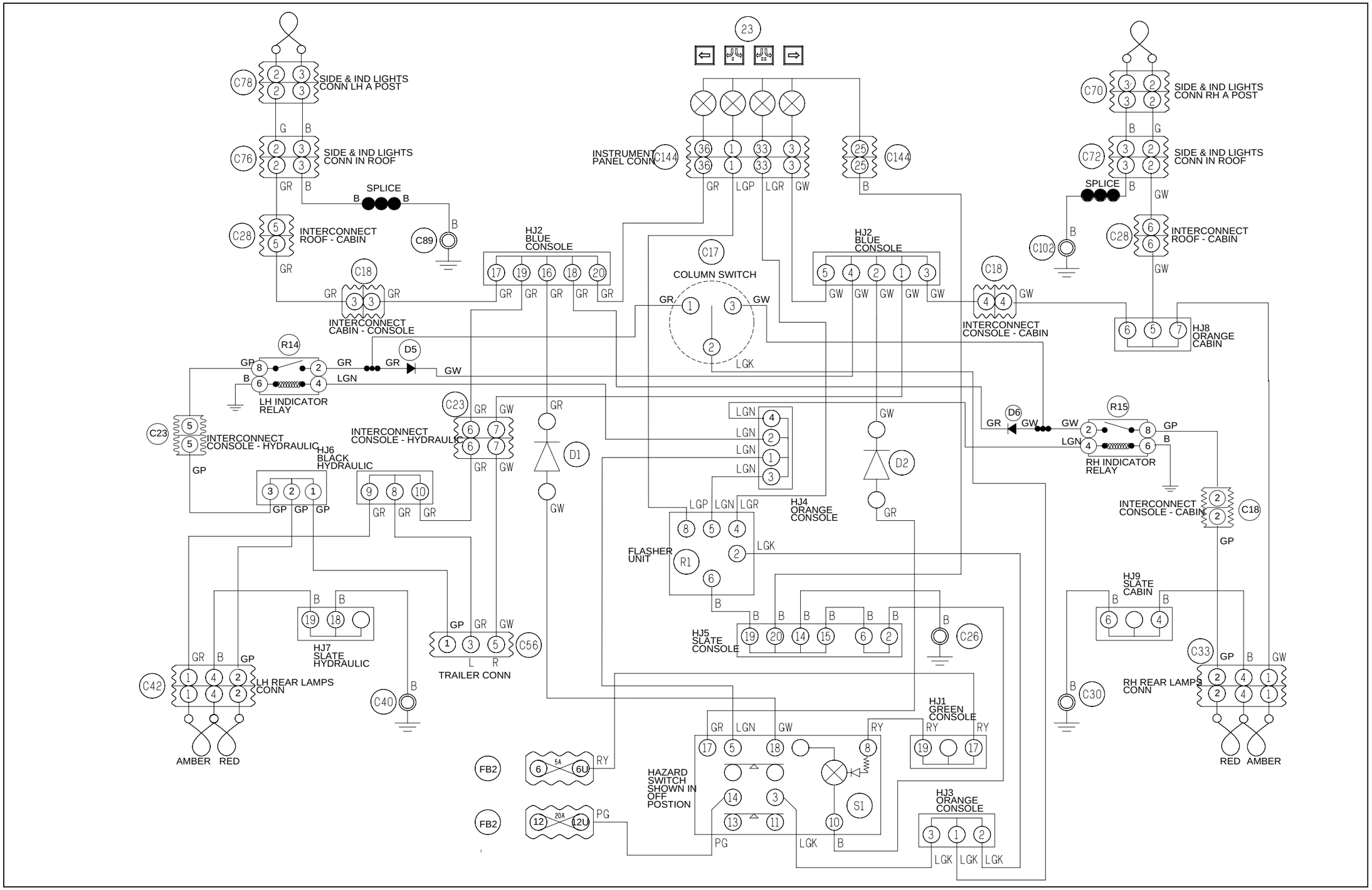


Figure 71 - Direction indicators & SMV hazards - NAO - HI VIS Roof

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Figure 71

Direction indicators & SMV hazards - NAO - HI VIS Roof

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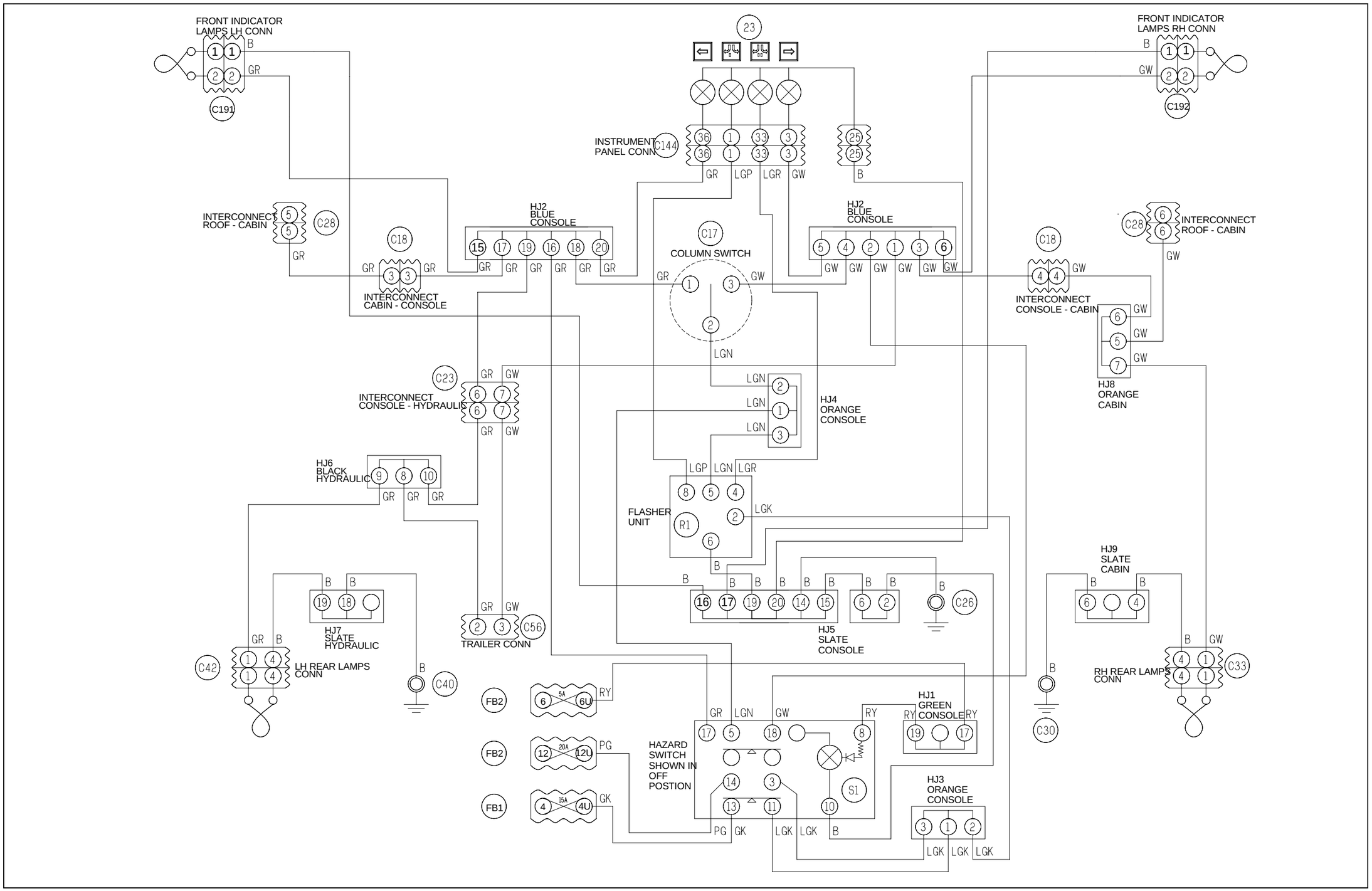


Figure 72 - Direction indicators & hazards - WEO - Orchard Cab Roof

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Figure 72
Direction indicators & hazards - WEO - Orchard Cab Roof

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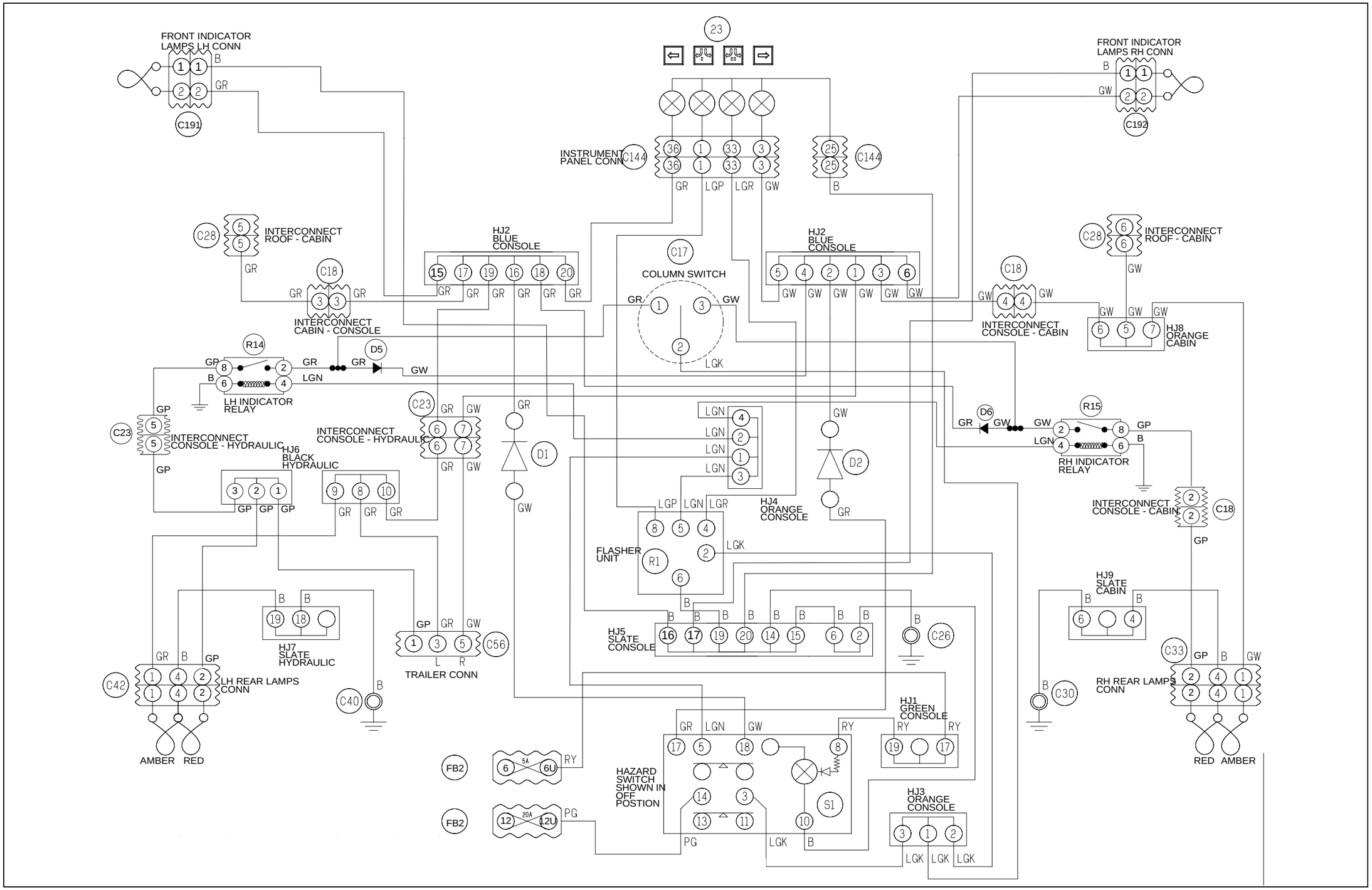


Figure 73 - Direction indicators & SMV hazards - NAO - Orchard Cab Roof

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Figure 73
Direction indicators & SMV hazards - NAO - Orchard Cab Roof

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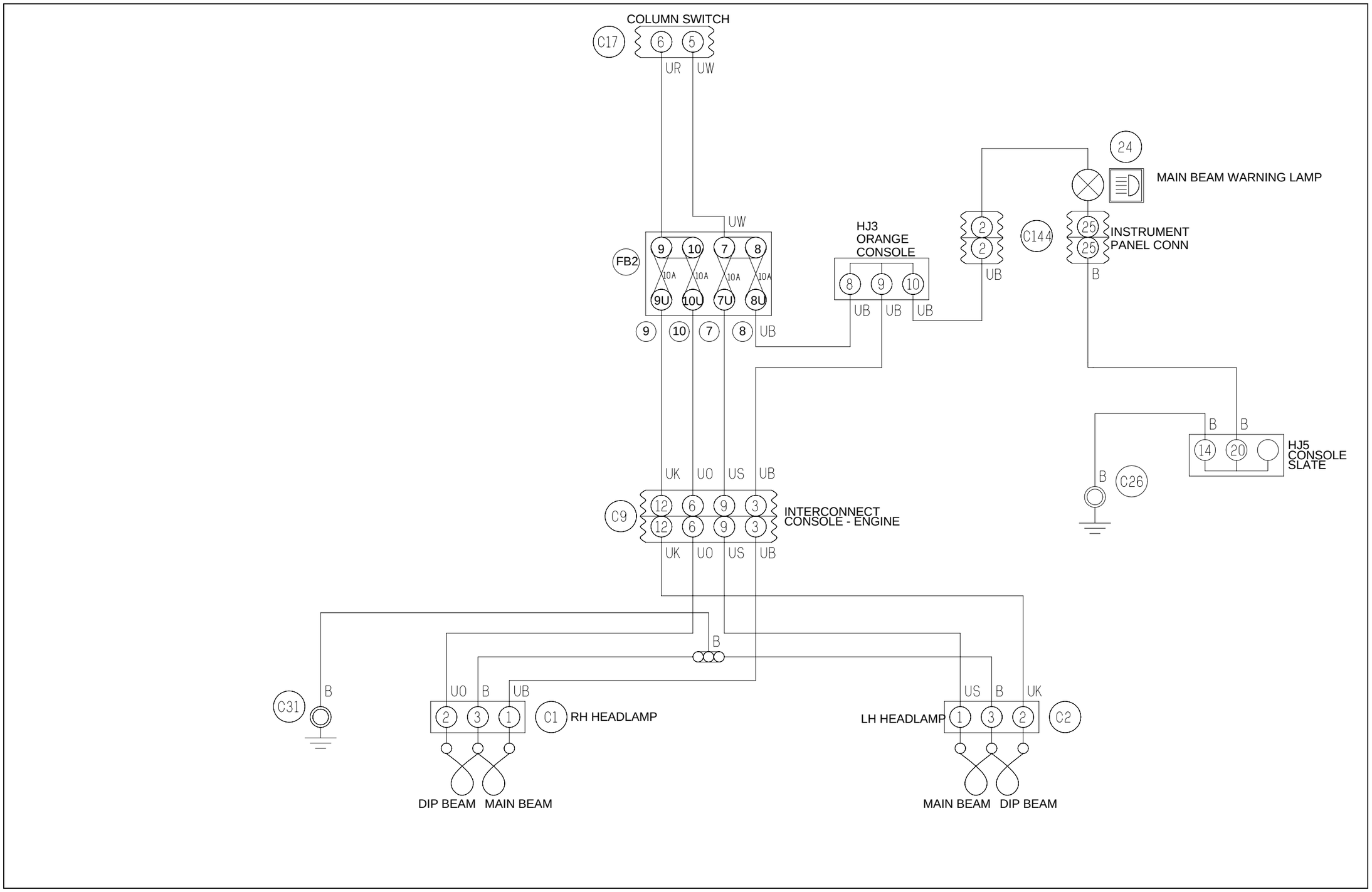


Figure 74 - Head lamp circuit

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Figure 74
Head Lamp Circuit

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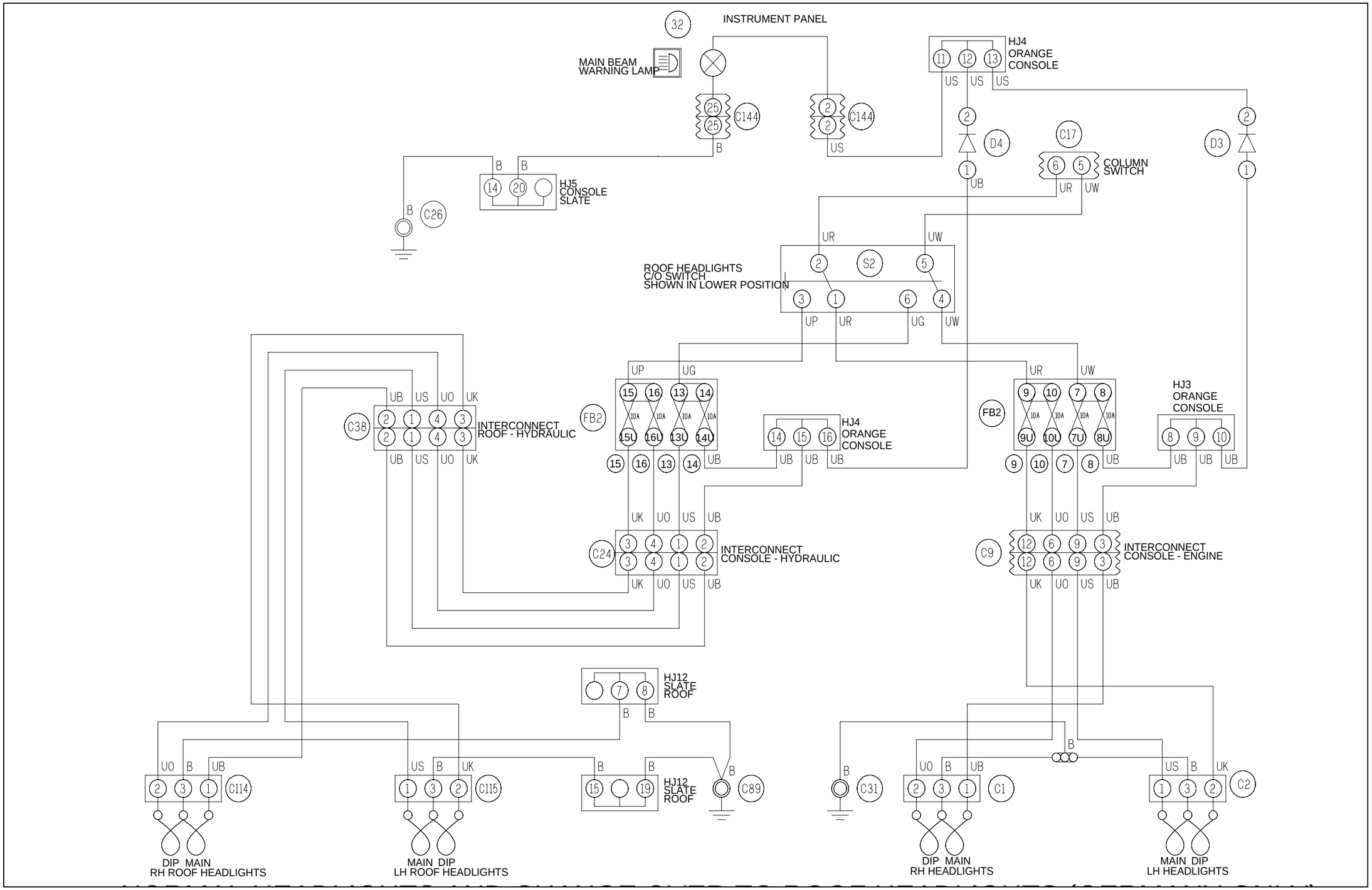


Figure 75 - Normal headlights and change over to roof headlights (Germany Only)

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Figure 75
Normal headlights and change over to roof headlights (Germany Only)

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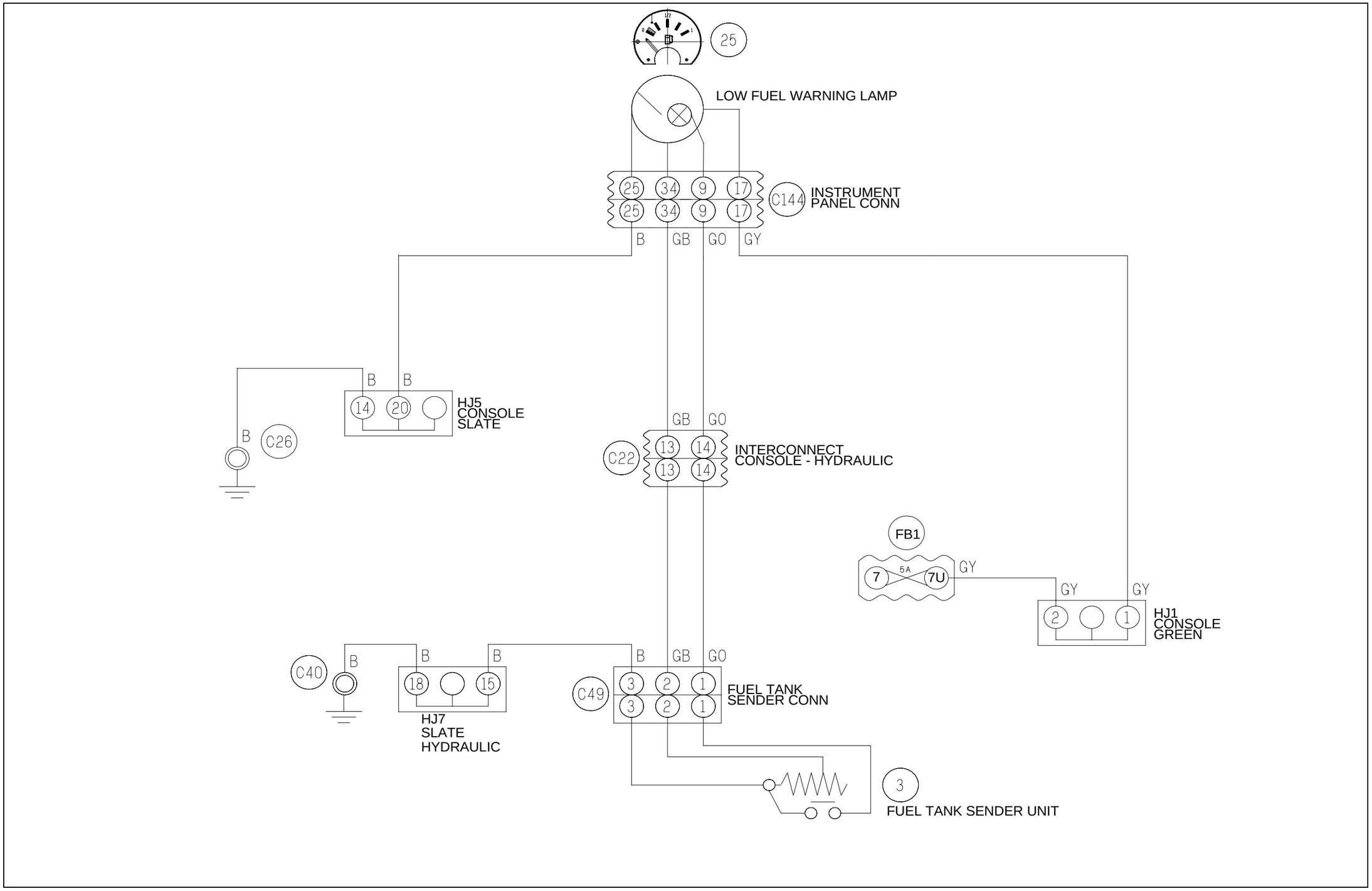


Figure 76 - Instrument fuel gauge and low fuel warning light panel

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Figure 76
Instrument fuel gauge and low fuel warning light panel

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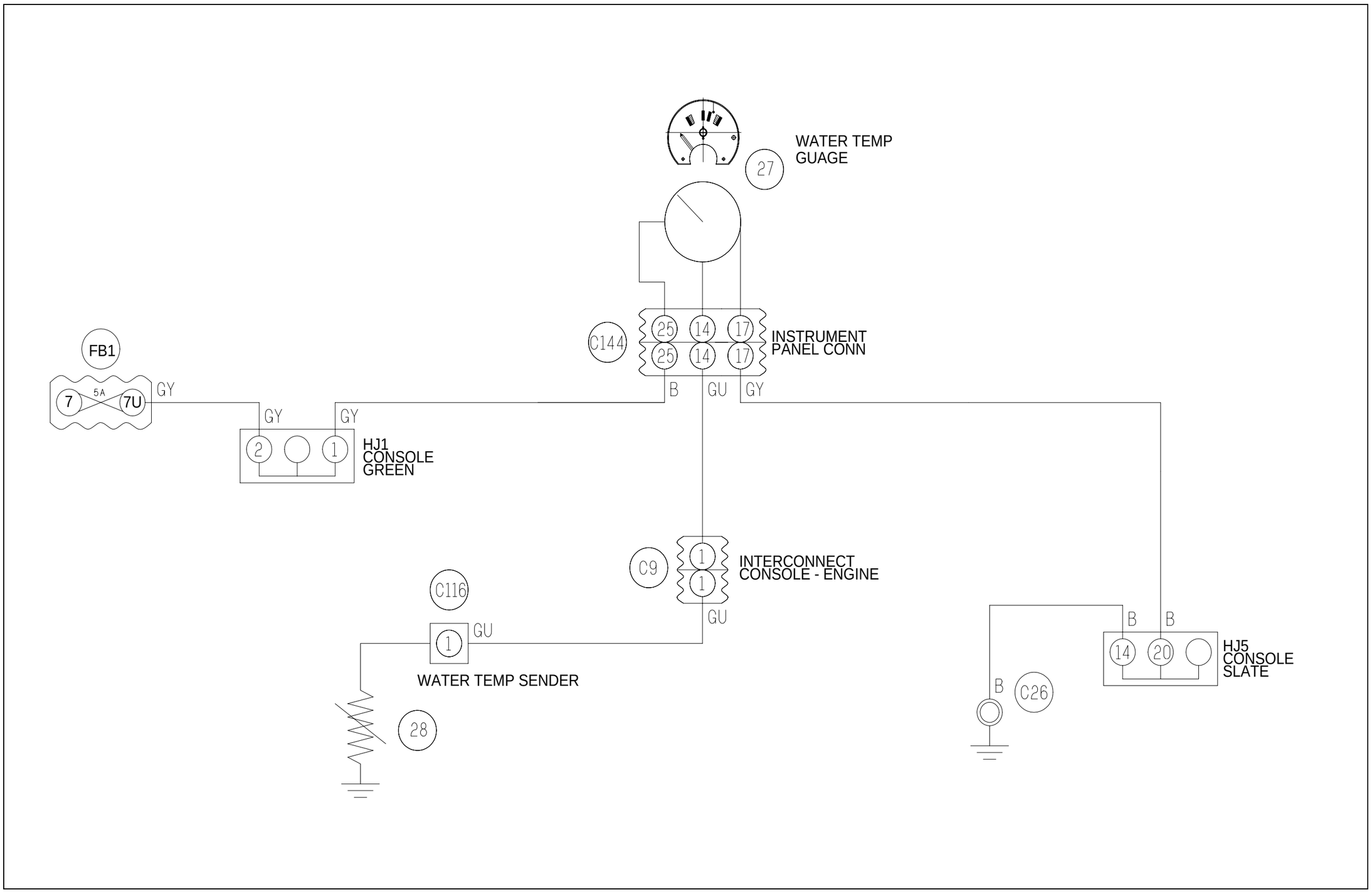


Figure 77 - Instrument panel water temp gauge

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Figure 77
Instrument panel water temp gauge

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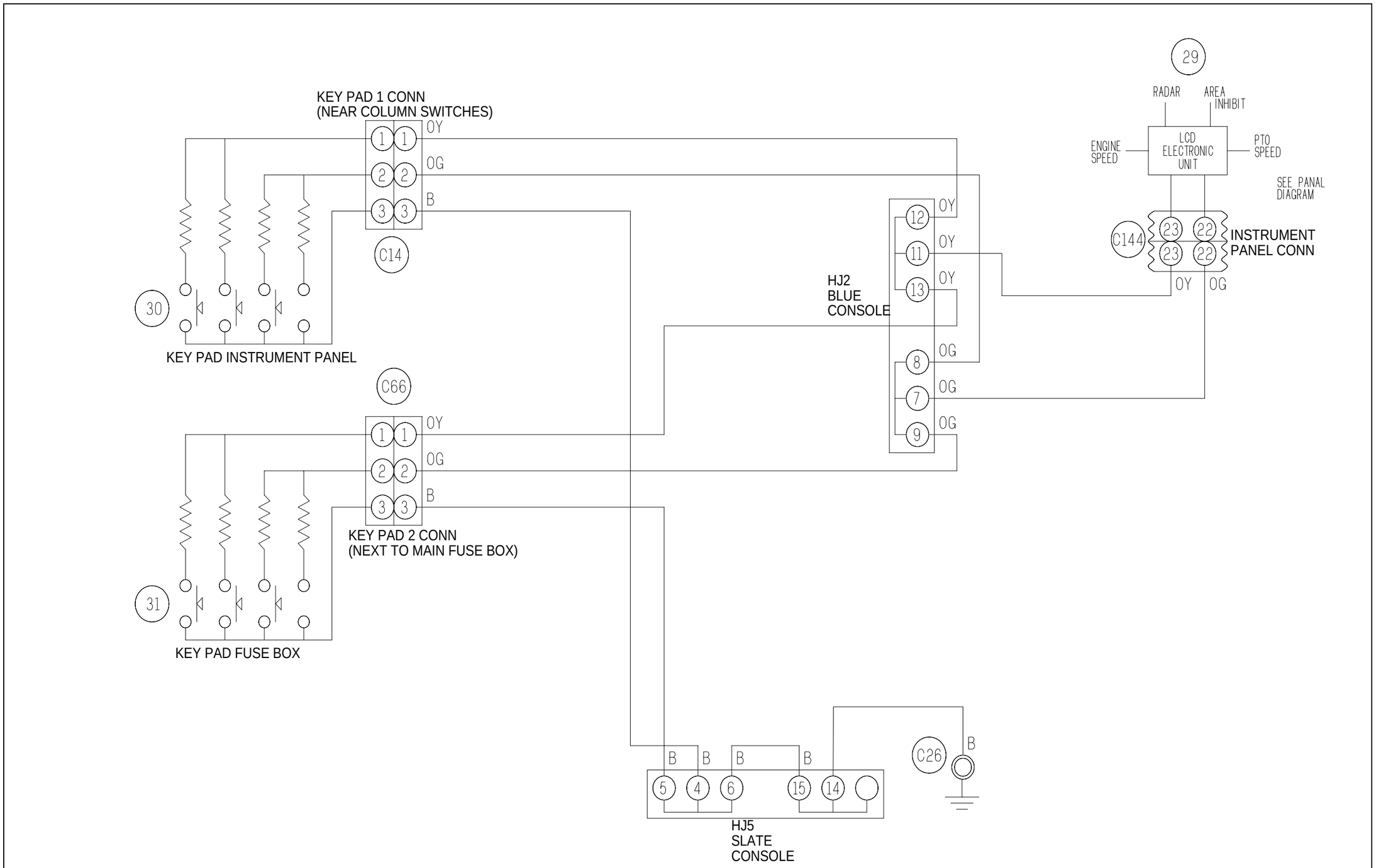


Figure 78 - Instrument panel performance monitor key pad

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Figure 78
Instrument panel performance monitor key pad

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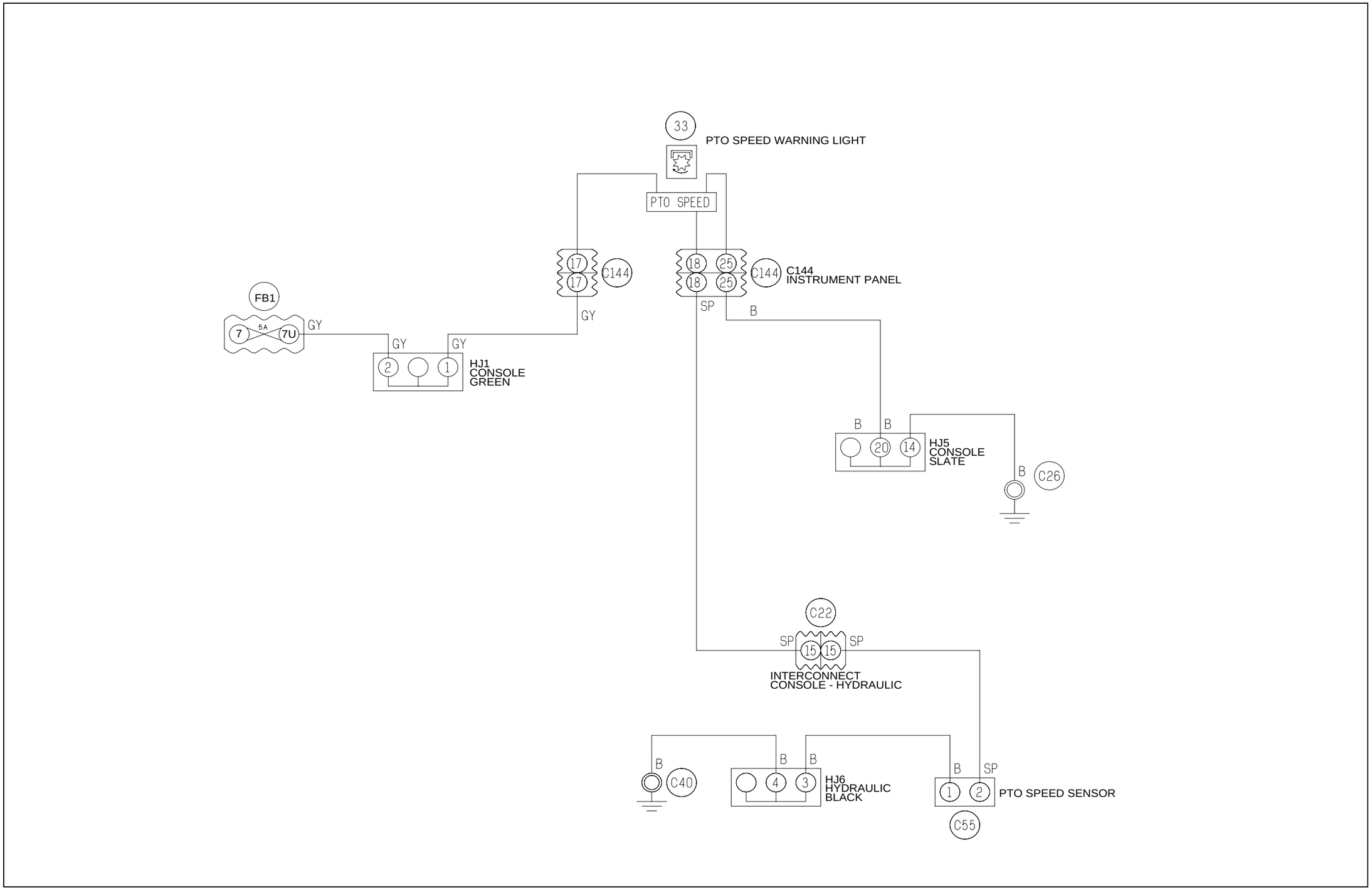


Figure 79 - Rear PTO speed sensor

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Figure 79
Rear PTO speed sensor

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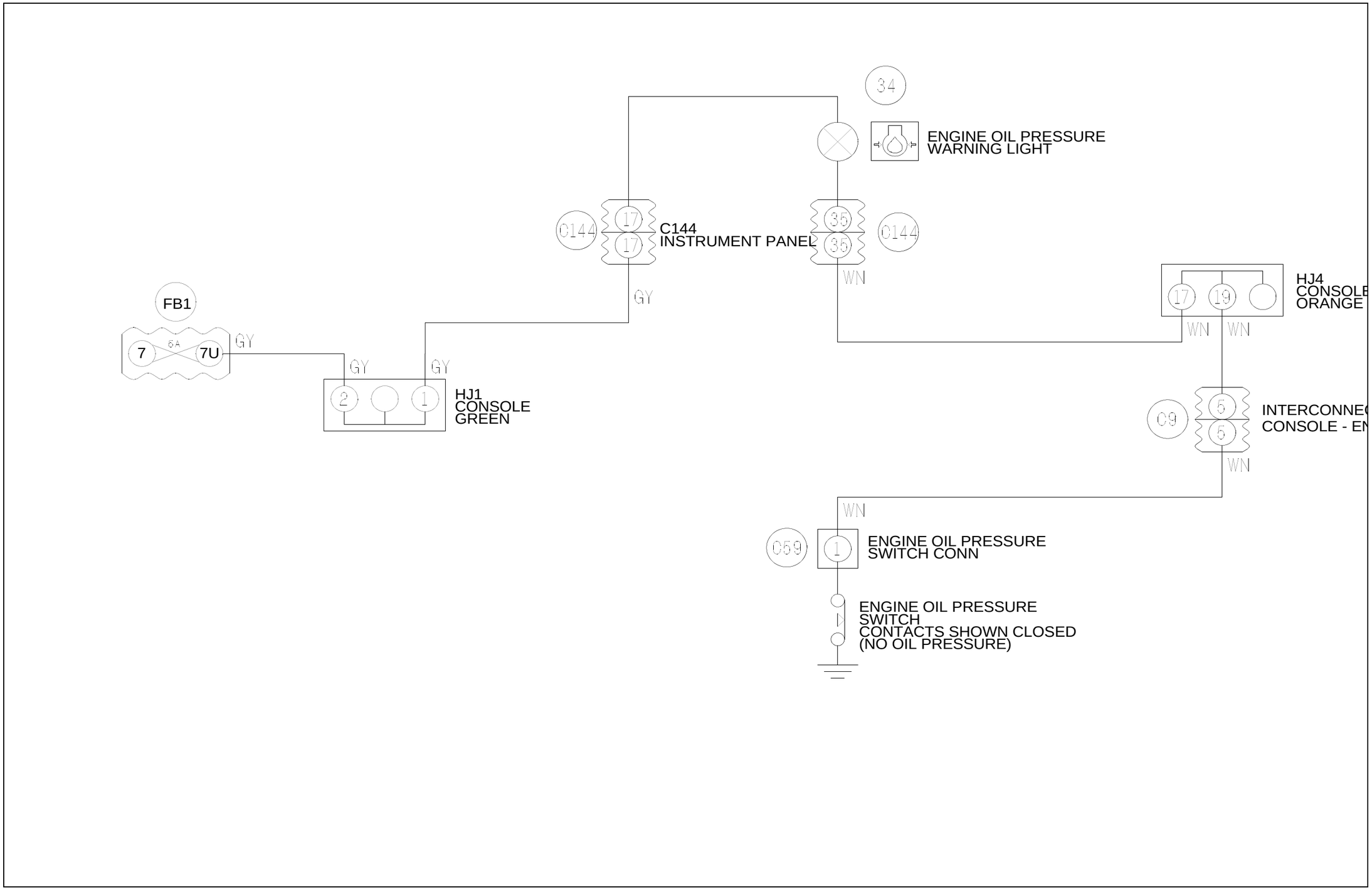


Figure 80 - Engine oil pressure instrument panel warning light

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Figure 80
Engine oil pressure instrument panel warning light

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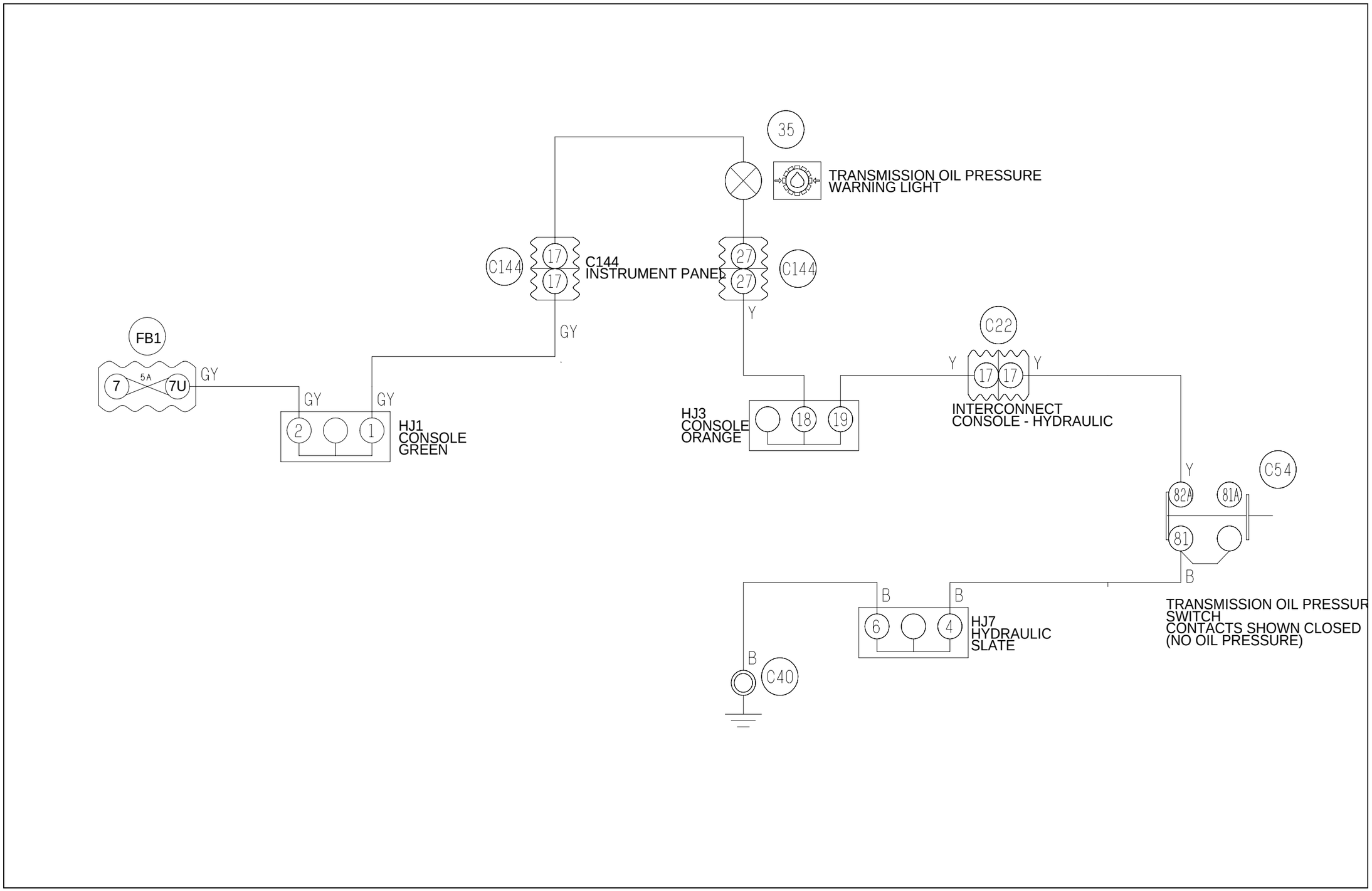


Figure 81 - Transmission oil pressure instrument panel warning light - Power shuttle

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Figure 81
Transmission oil pressure instrument panel warning light - Power shuttle

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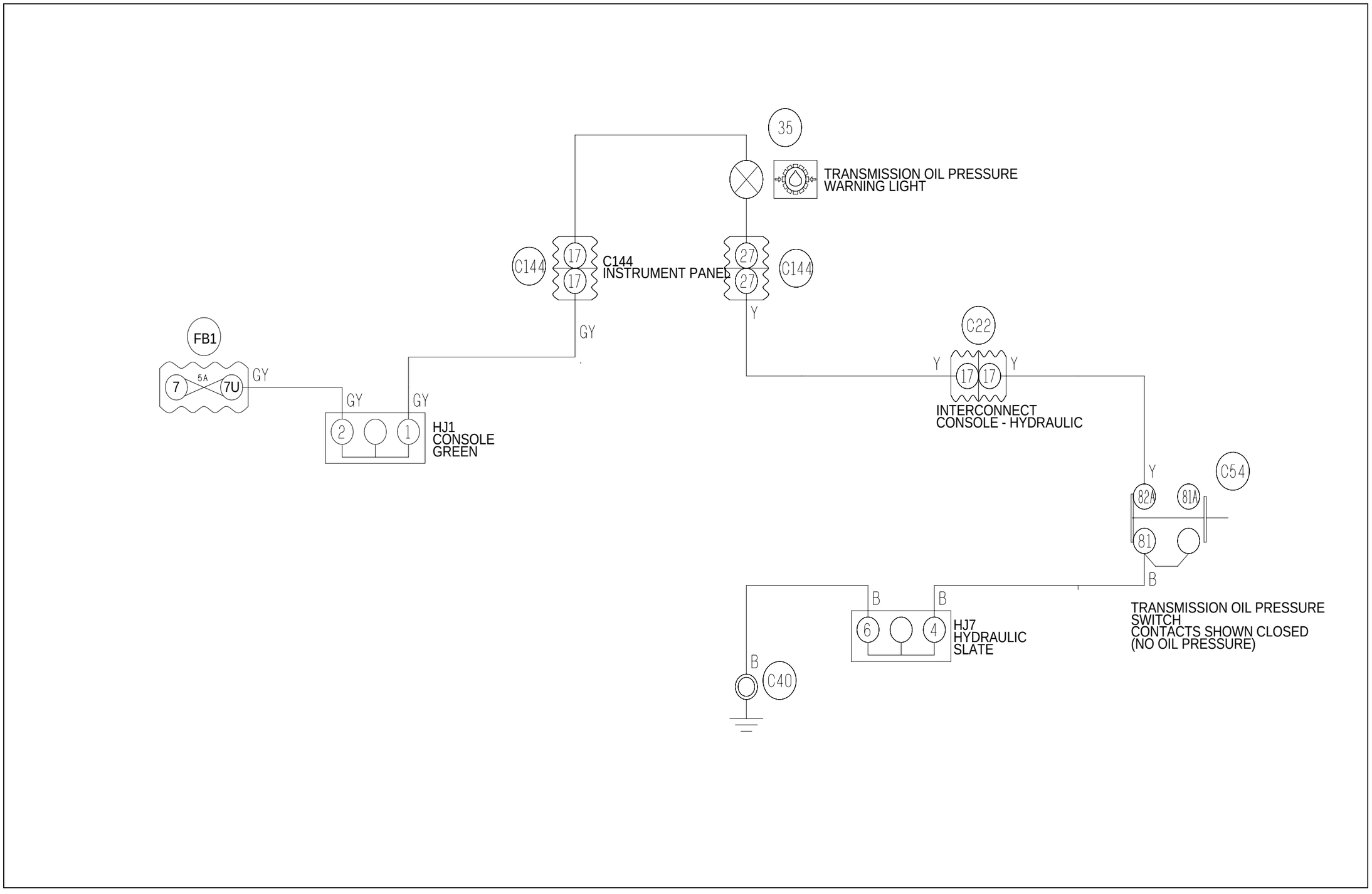


Figure 82 - Transmission oil pressure instrument panel warning light - Non power shuttle

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Figure 82
Transmission oil pressure instrument panel warning light - Non power shuttle

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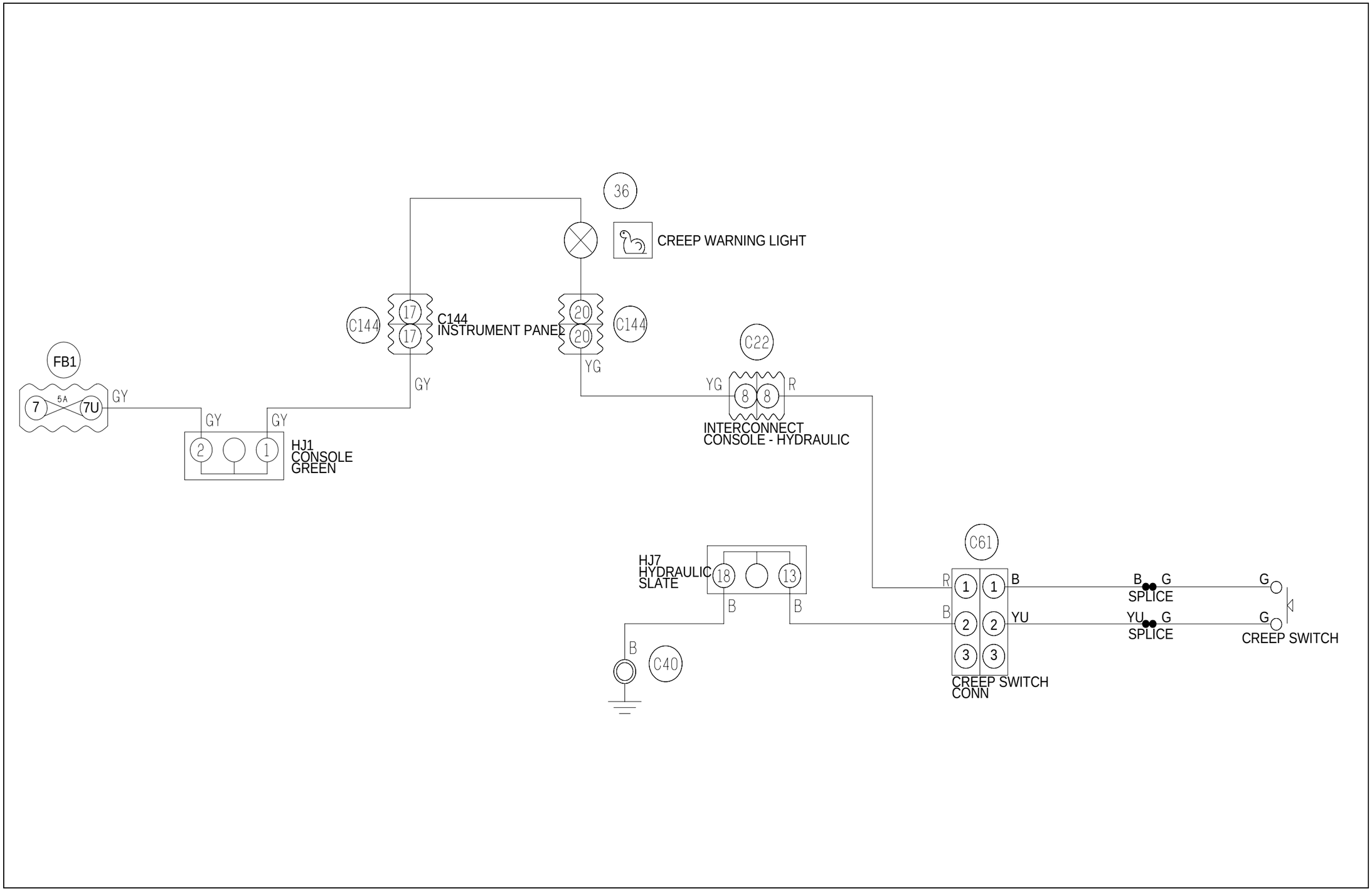


Figure 83 - Instrument panel creep warning light

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Figure 83
Instrument panel creep warning light

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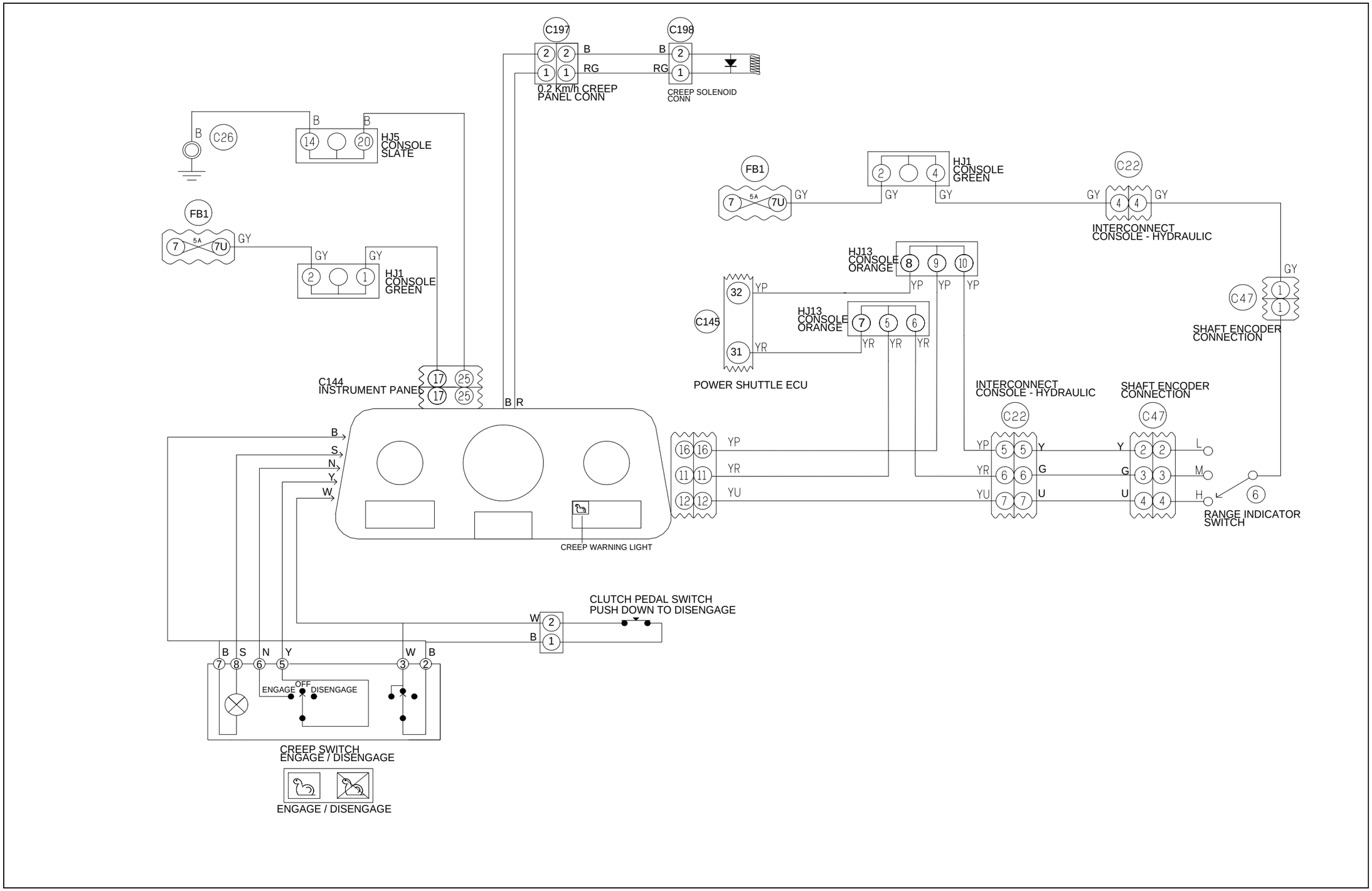


Figure 84 - 0.2 Km/h Super creep - 2001/2002 Only for 3821 850 M92 Instrument panels

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Figure 84

0.2 Km/h Super creep - 2001/2002 Only for 3821 850 M92 Instrument panels

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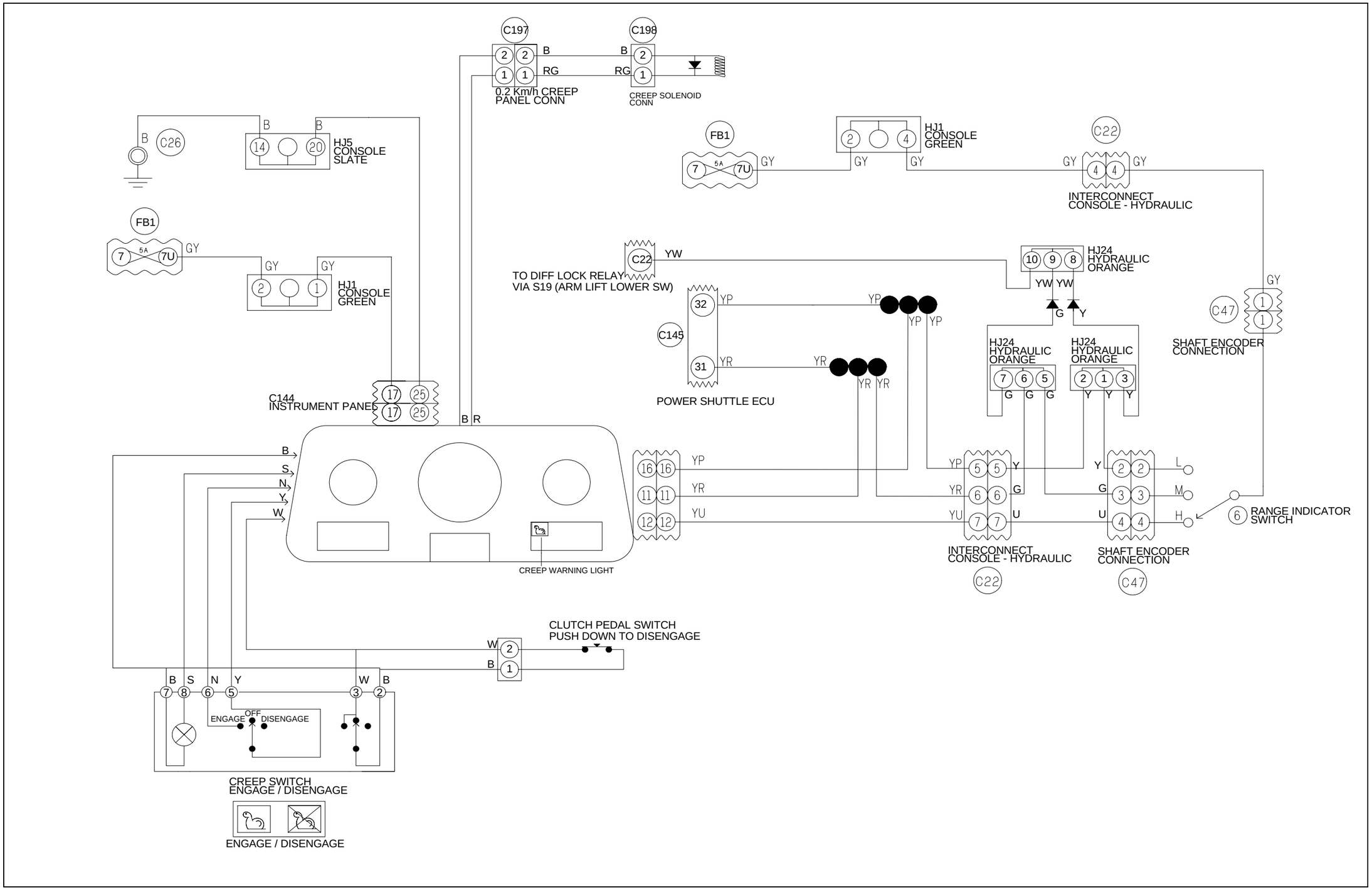


Figure 85 - 0.2 Km/h Super creep 2003 - Only for 3821 850 M92 Instrument panels

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Figure 85
0.2 Km/h Super creep 2003 - Only for 3821 850 M92 Instrument panels

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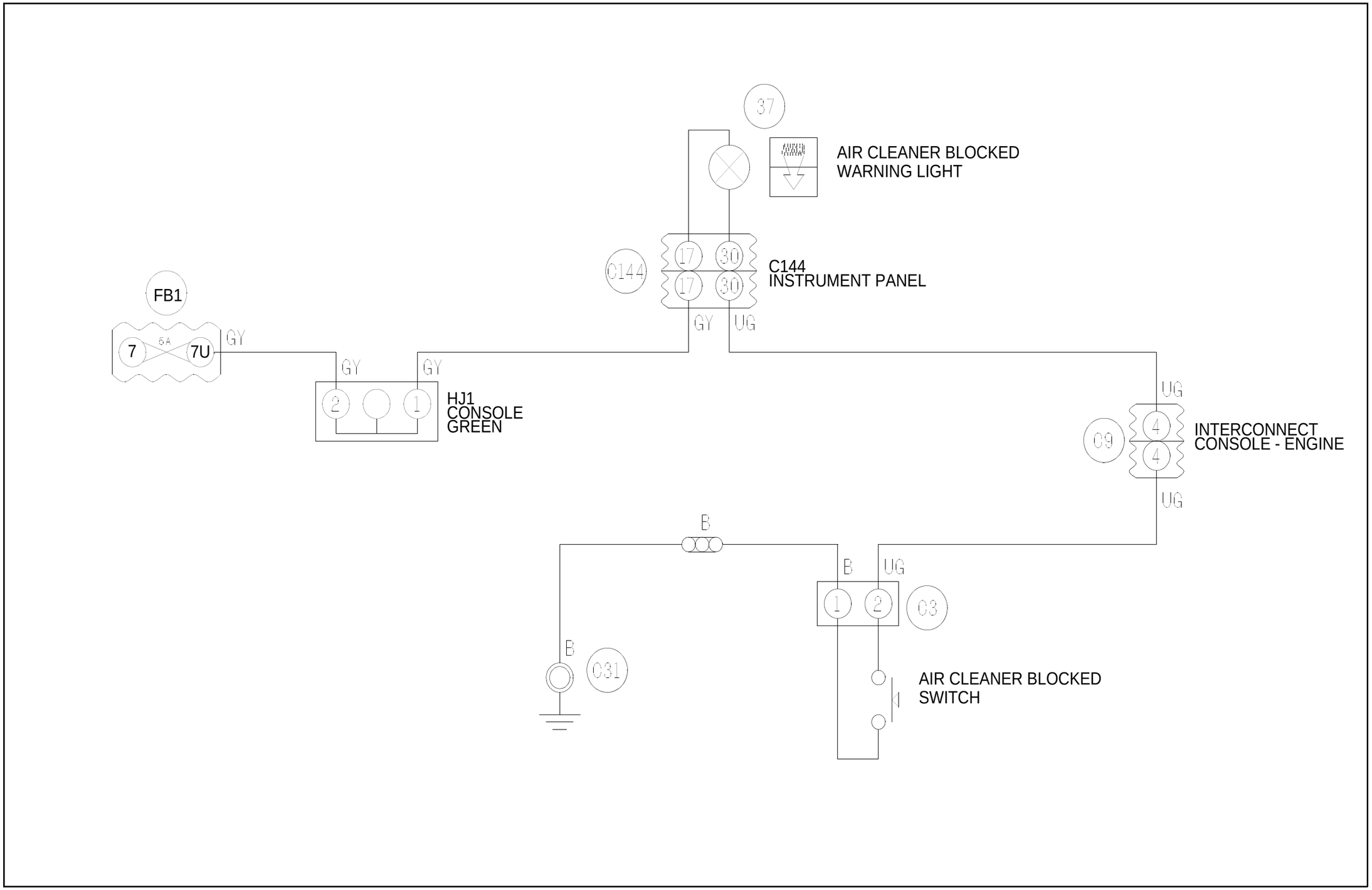


Figure 86 - Air cleaner blocked instrument panel warning light

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Figure 86
Air cleaner blocked instrument panel warning light

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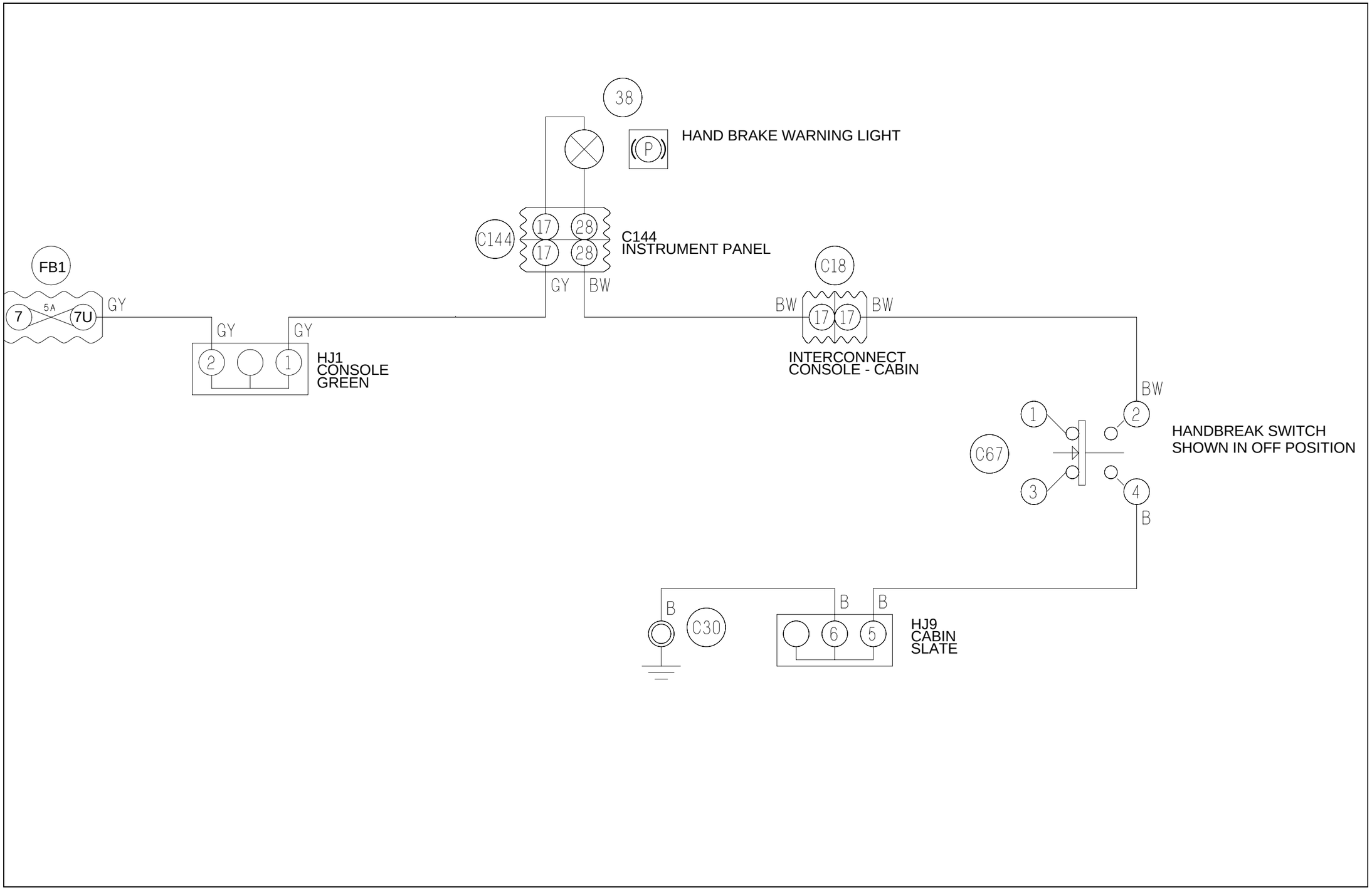


Figure 87 - Hand brake instrument panel warning light

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Figure 87
Hand brake instrument panel warning light

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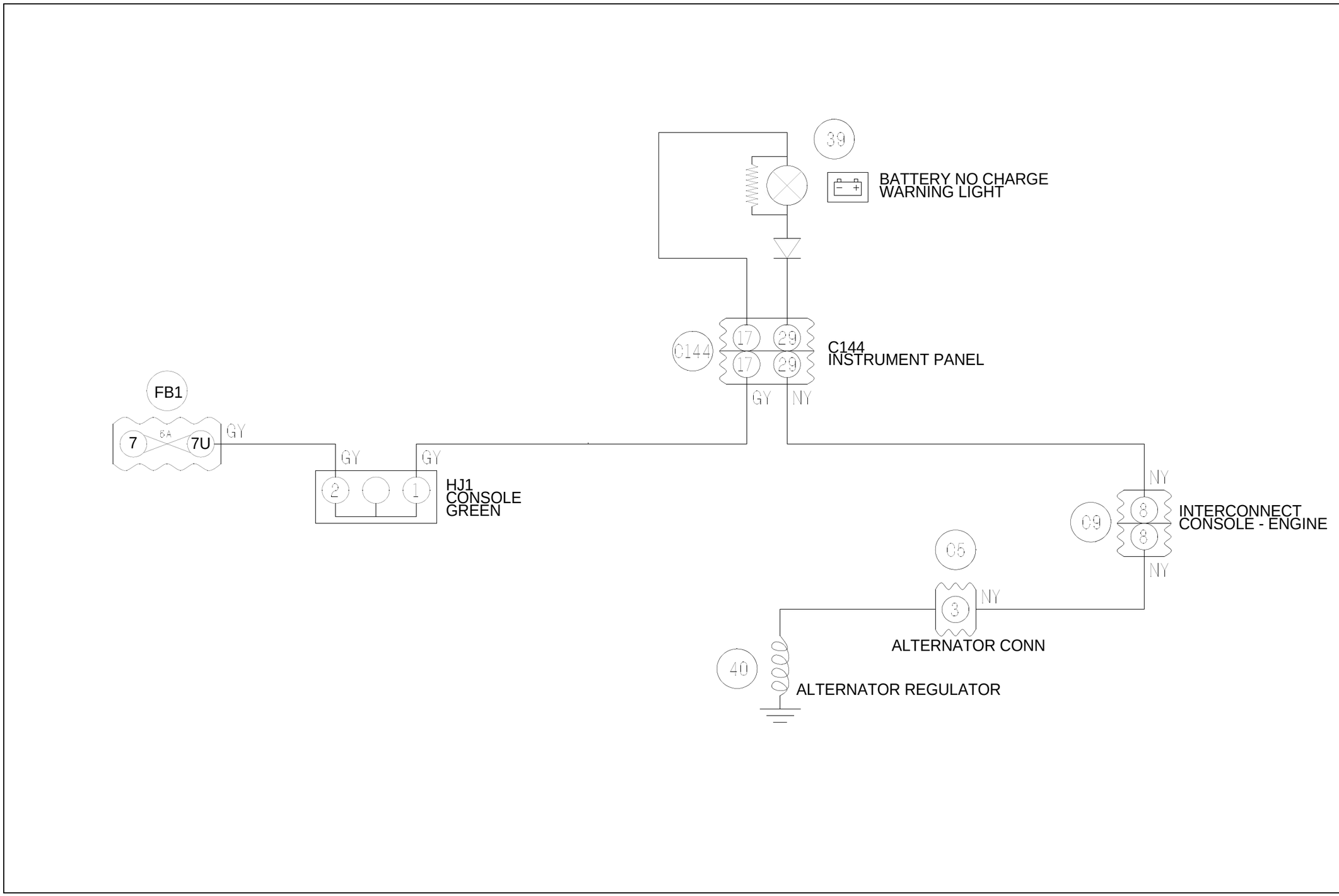


Figure 88 - Alternator no charge instrument panel warning light

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Figure 88
Alternator no charge instrument panel warning light

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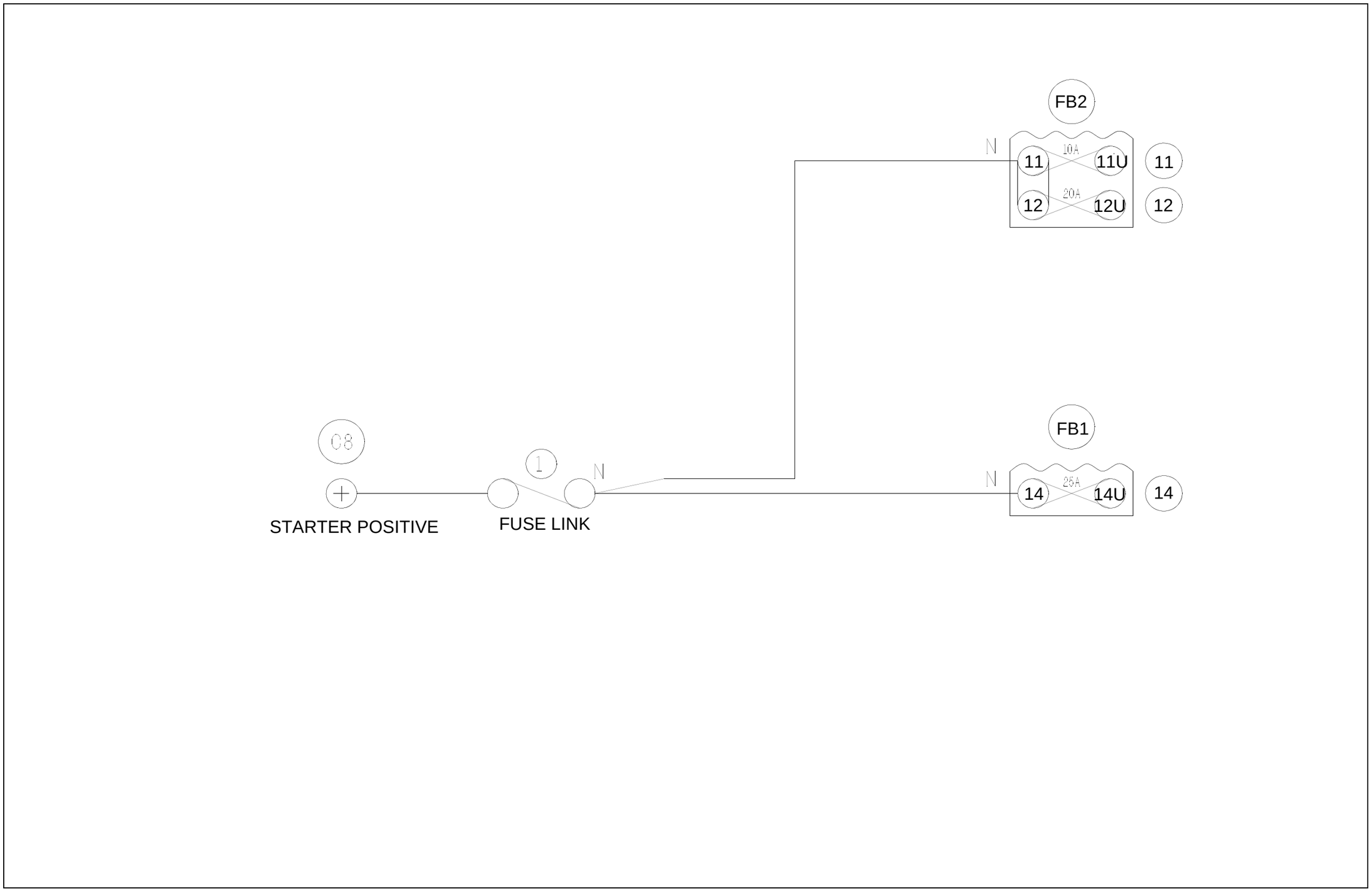


Figure 89 - Fuse link 1 circuit

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Figure 89
Fuse link 1 circuit

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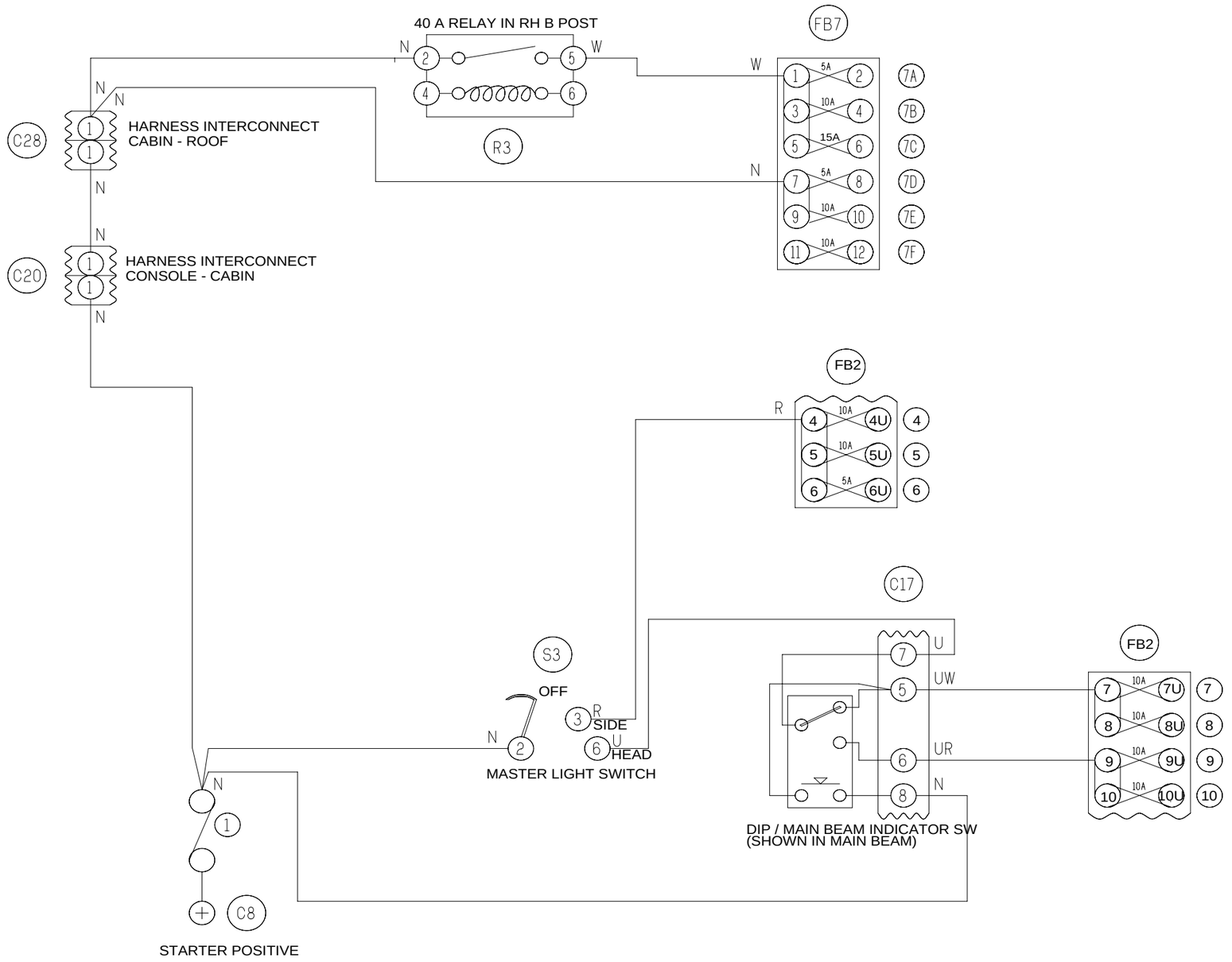


Figure 90 - Fuse link 2 circuit - Row standard roof

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Figure 90
Fuse link 2 circuit - Row standard roof

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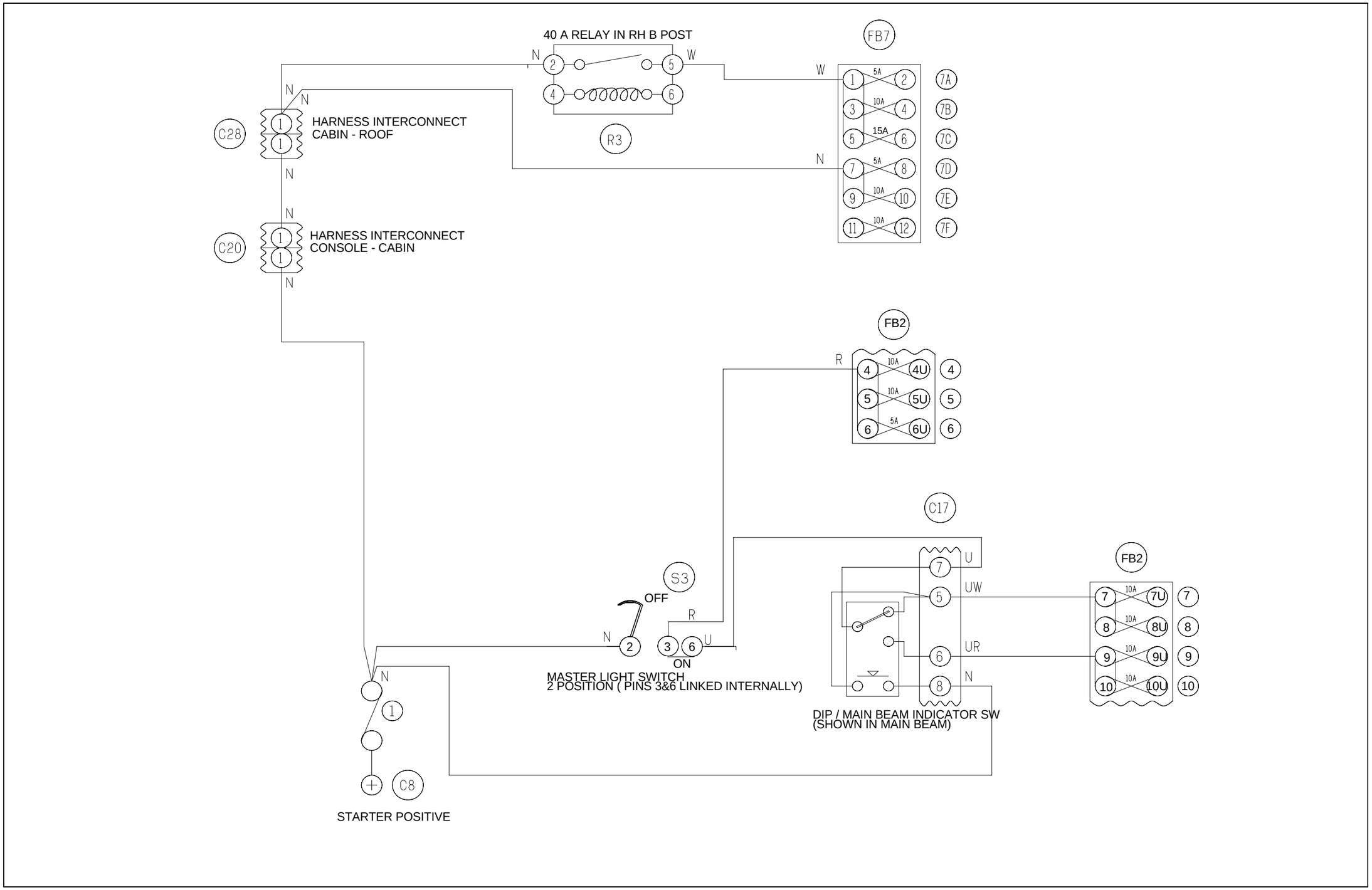


Figure 91 - Fuse link 2 circuit - NAO Standard roof

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Figure 91
Fuse link 2 circuit - NAO Standard roof

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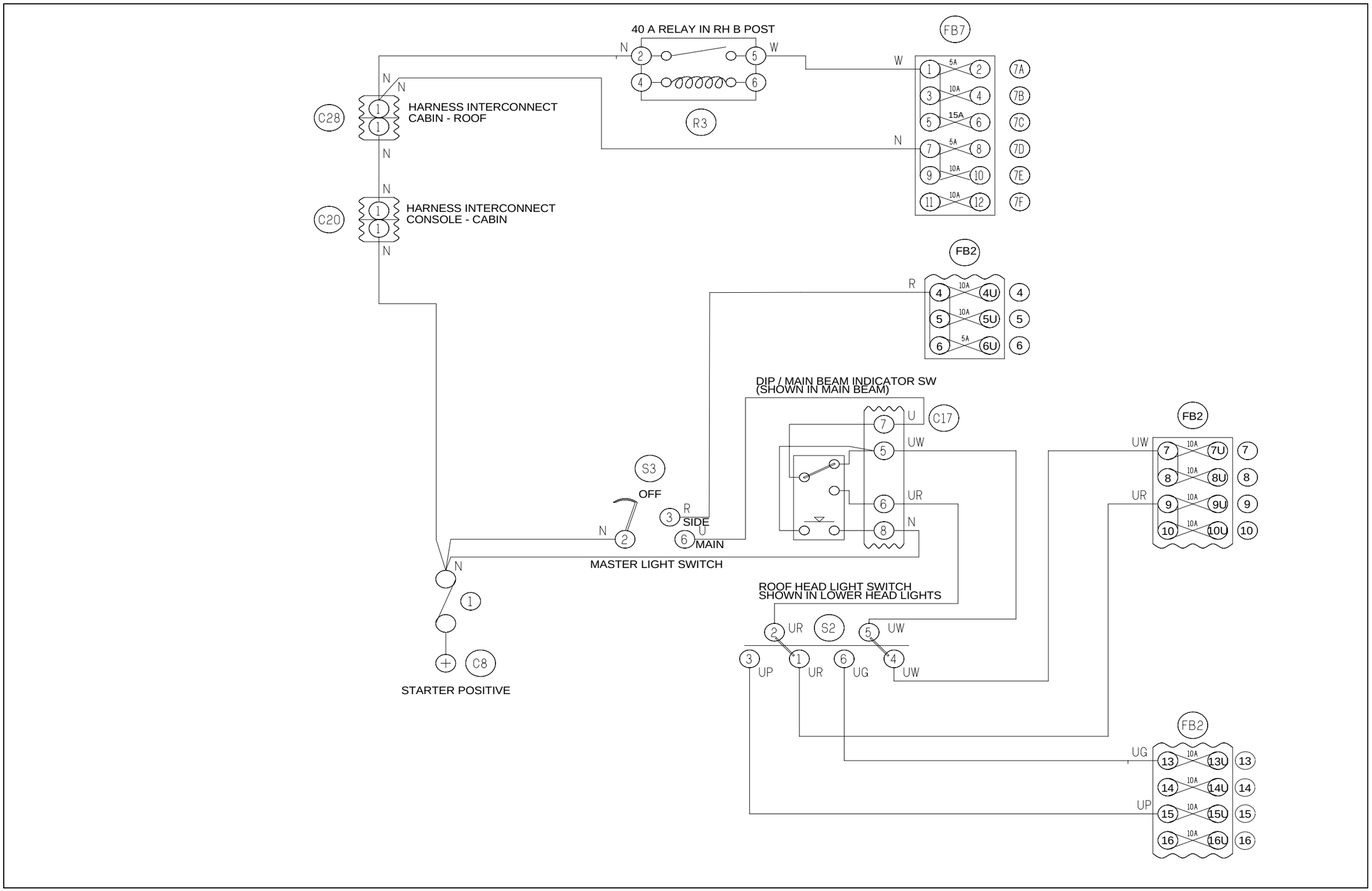


Figure 92 - Fuse link 2 circuit - German roof headlights - Standard roof

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Figure 92
Fuse link 2 circuit - German roof headlights - Standard roof

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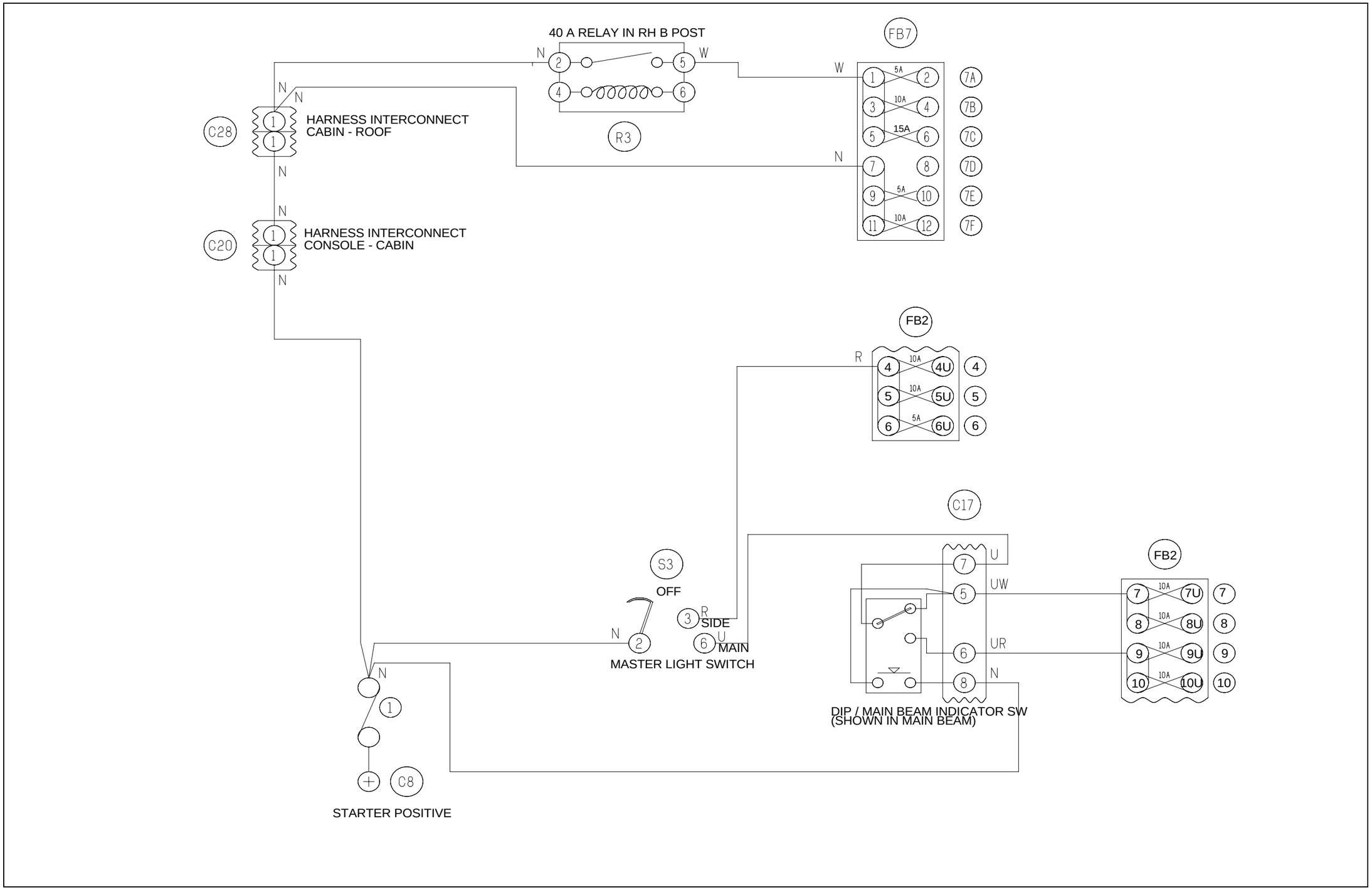


Figure 93 - Fuse link 2 circuit - Row flat roof

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Figure 93
Fuse link 2 circuit - Row flat roof

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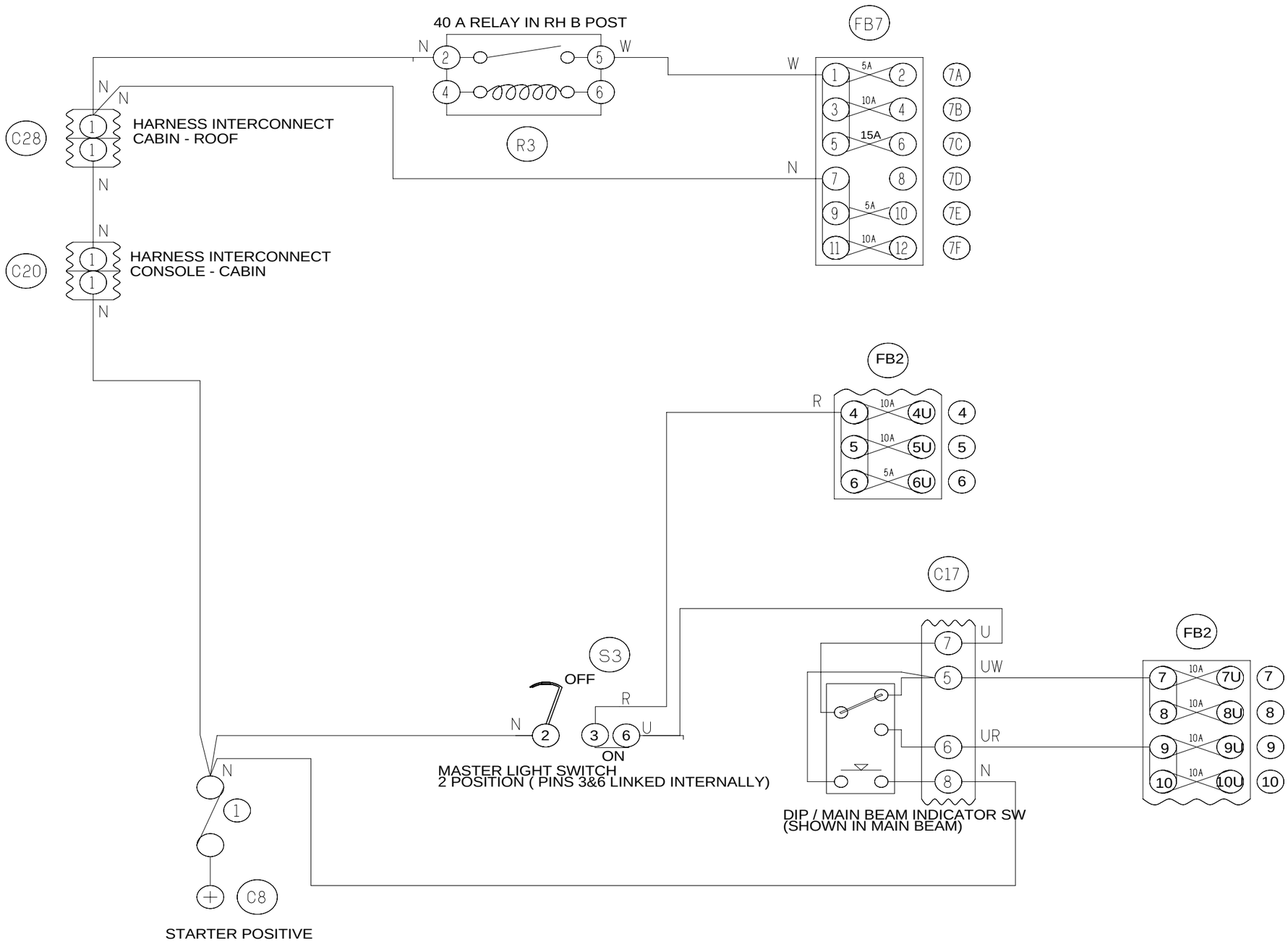


Figure 94 - Fuse link 2 circuit - NAO Flat roof

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Figure 94
Fuse link 2 circuit - NAO Flat roof

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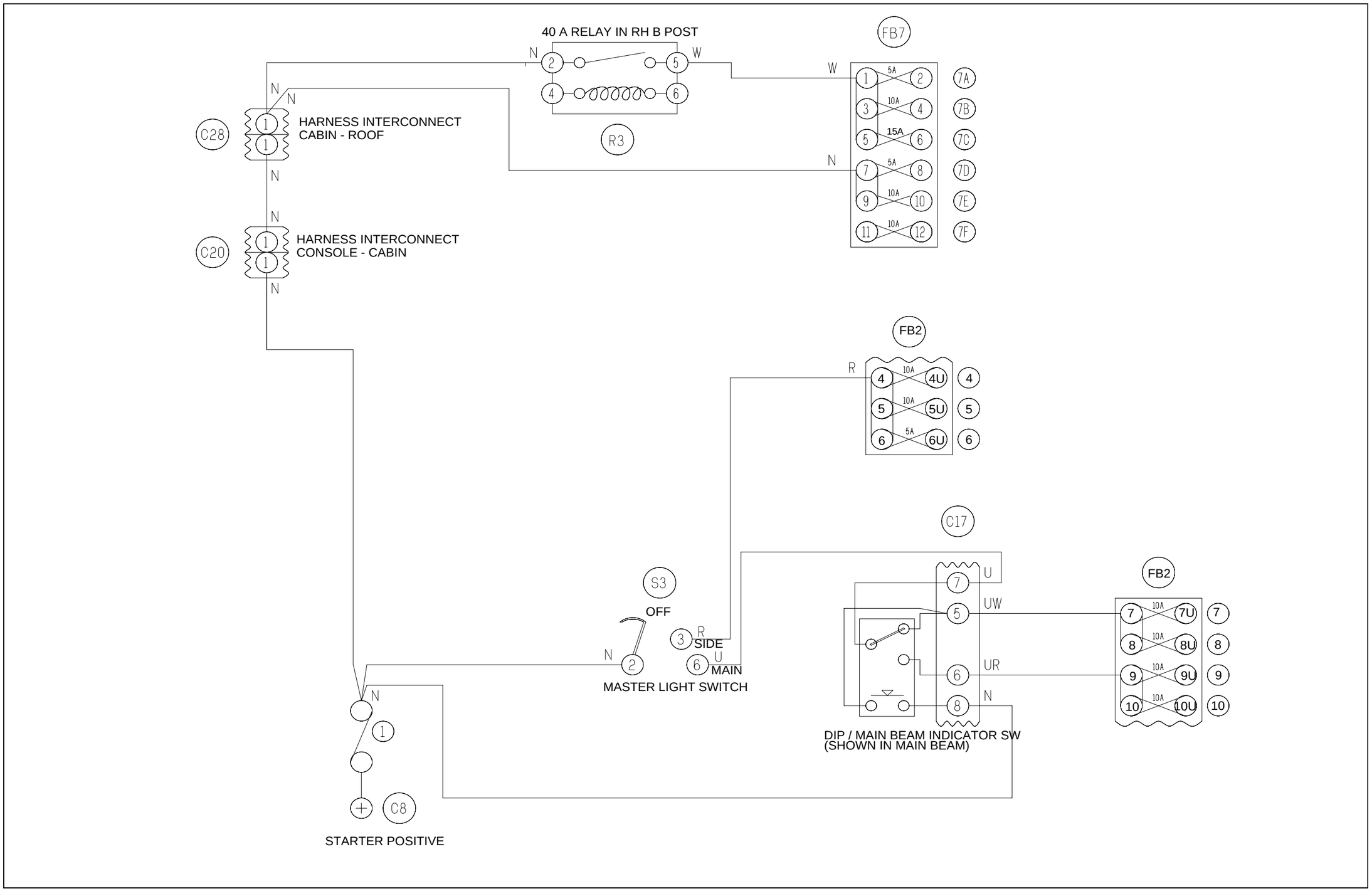


Figure 95 - Fuse link 2 circuit - Row HI VIS Roof

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Figure 95
Fuse link 2 circuit - Row HI VIS Roof

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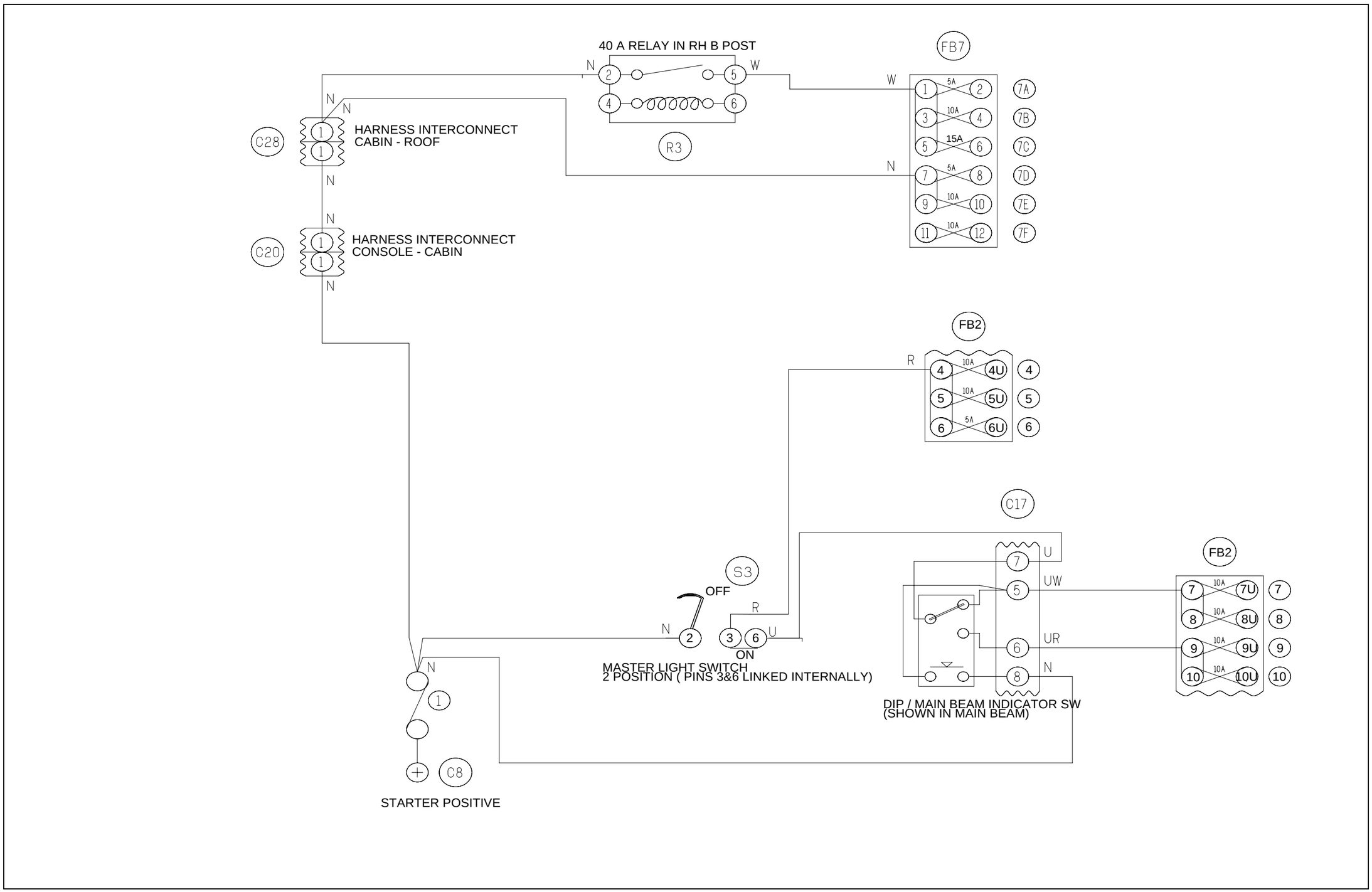


Figure 96 - Fuse link 2 circuit - NAO HI VIS Roof

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Figure 96
Fuse link 2 circuit - NAO HI VIS Roof

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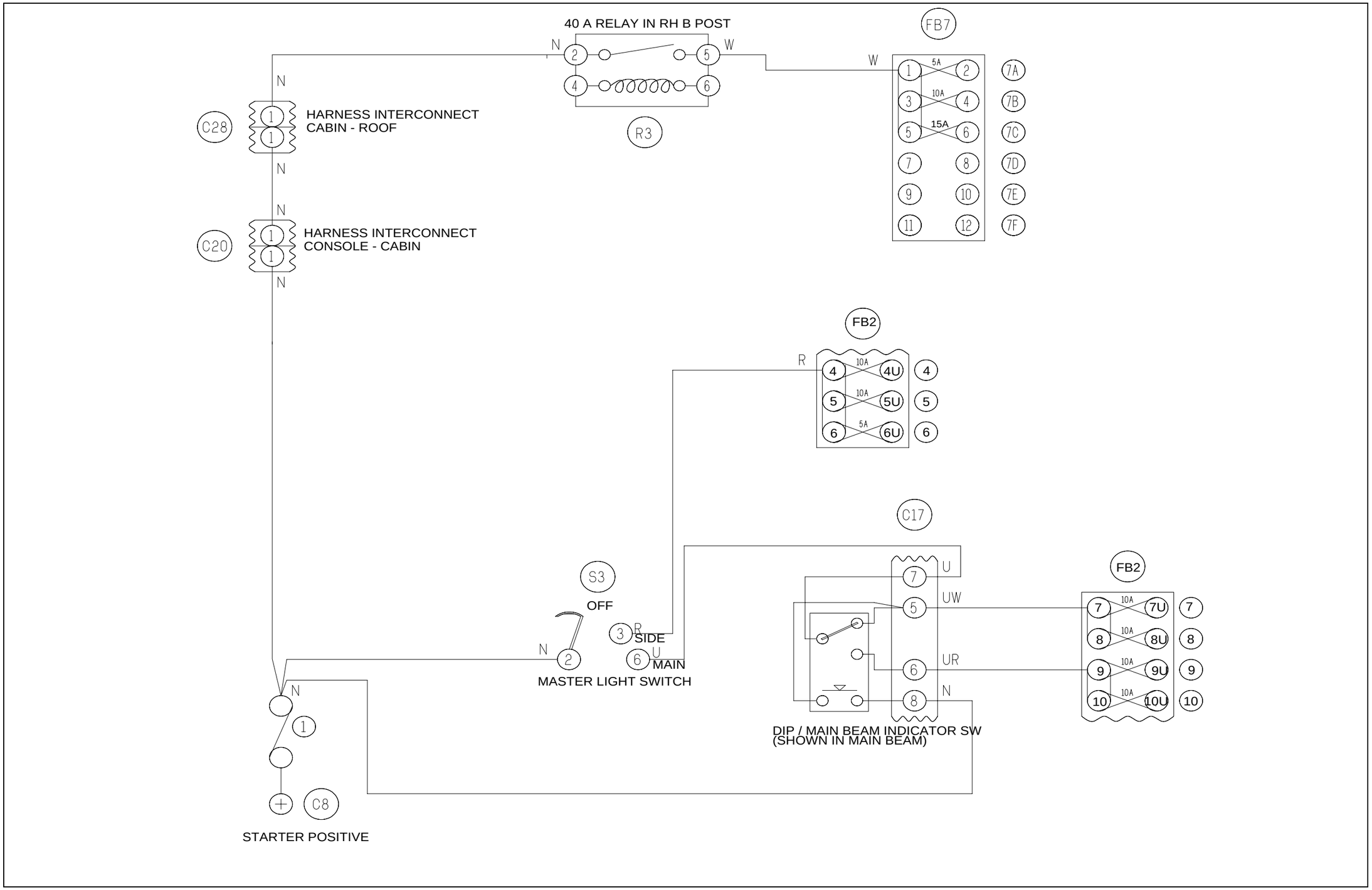


Figure 97 - Fuse link 2 circuit - Row Orchard Cab Roof

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Figure 97
Fuse link 2 circuit - Row Orchard Cab Roof

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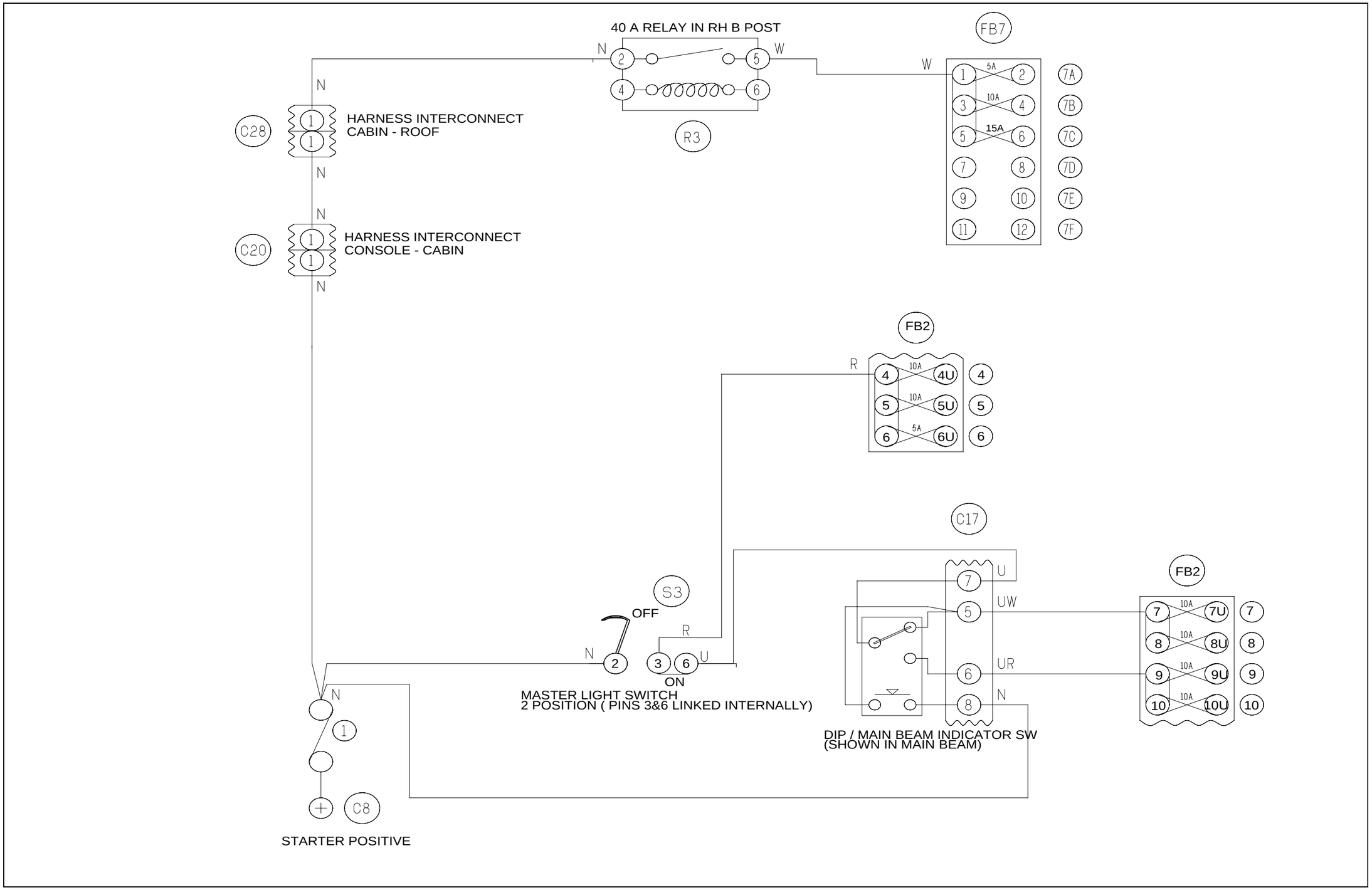


Figure 98 - Fuse link 2 circuit - NAO Orchard Cab Roof

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Figure 98
Fuse link 2 circuit - NAO Orchard Cab Roof

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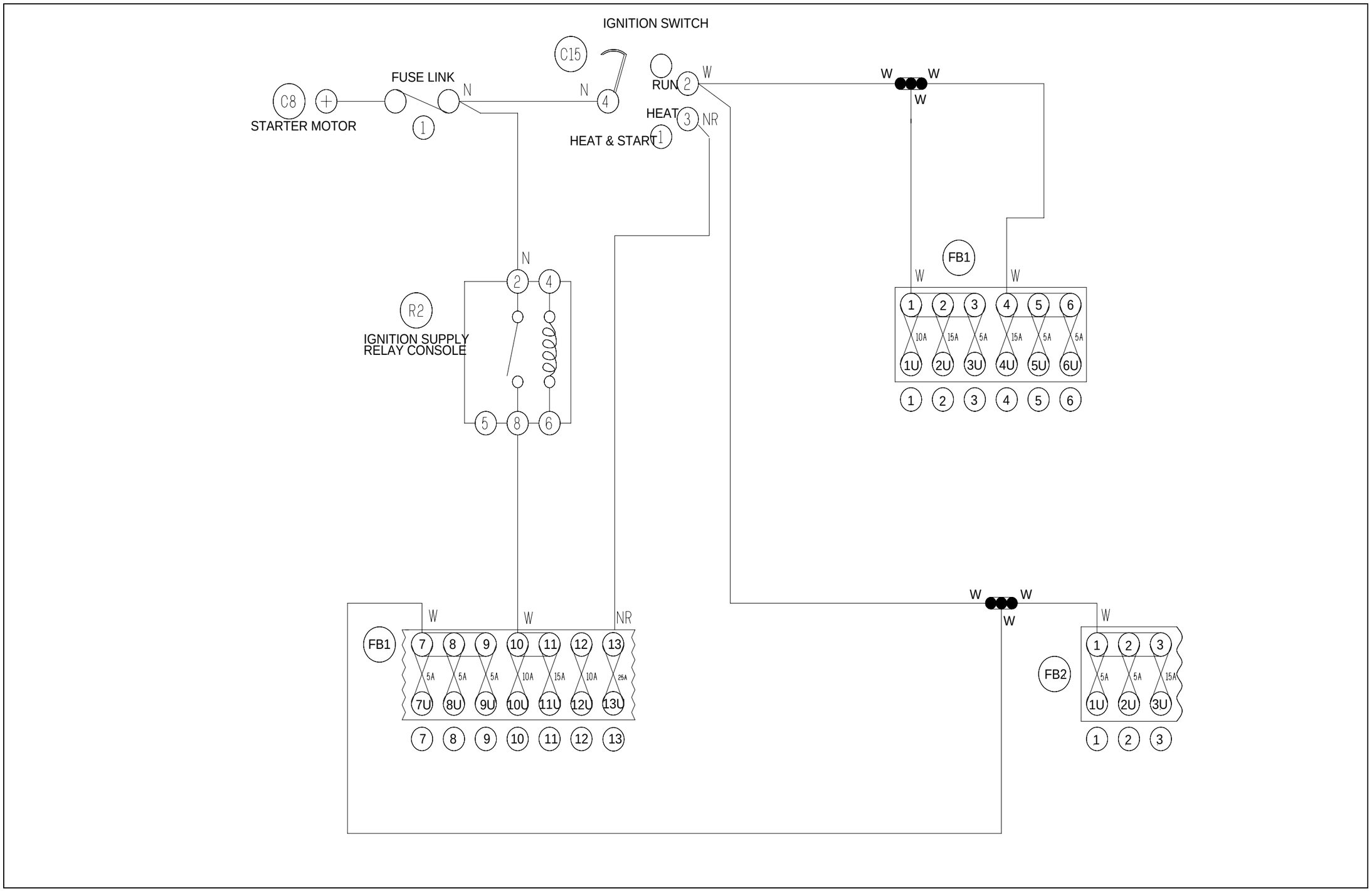


Figure 99 - Fuse link 3 circuit

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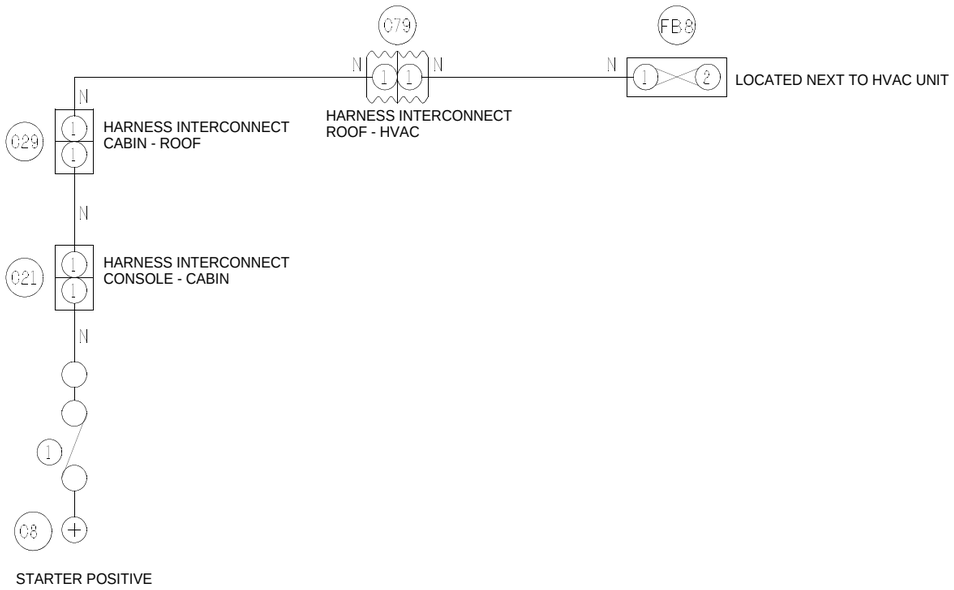
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Figure 99
Fuse link 3 circuit

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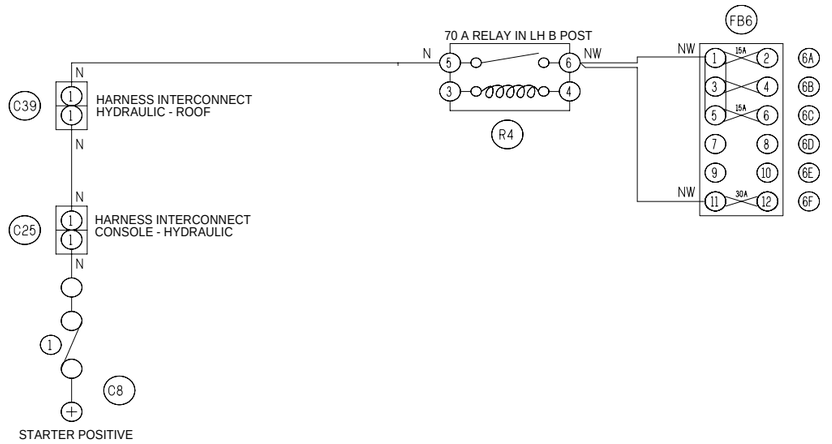
Tractor Manuals Scotland

A



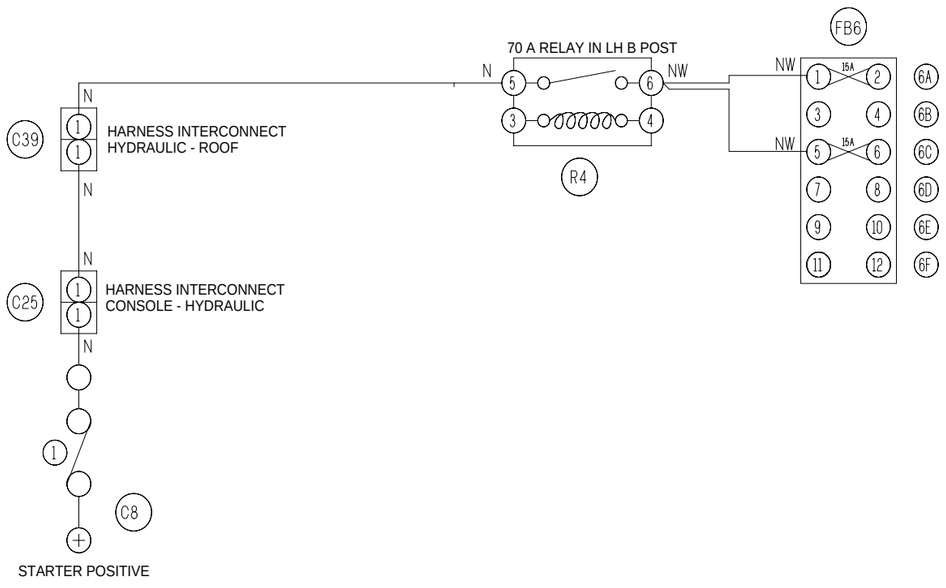
Fuse link 4 circuit

B



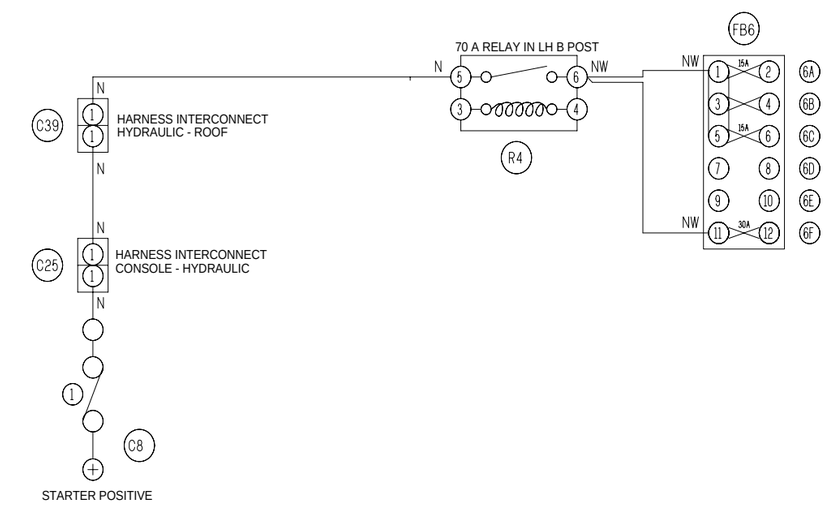
Fuse link 5 - Standard Roof

C



Fuse link 5 - Flat Roof

D



Fuse link 5 - HI VIS Roof

Figure 100

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Figure 100

A - Fuse link 4 circuit
B - Fuse link 5 - Standard Roof
C - Fuse link 5 - Flat Roof
D - Fuse link 5 - HI VIS Roof

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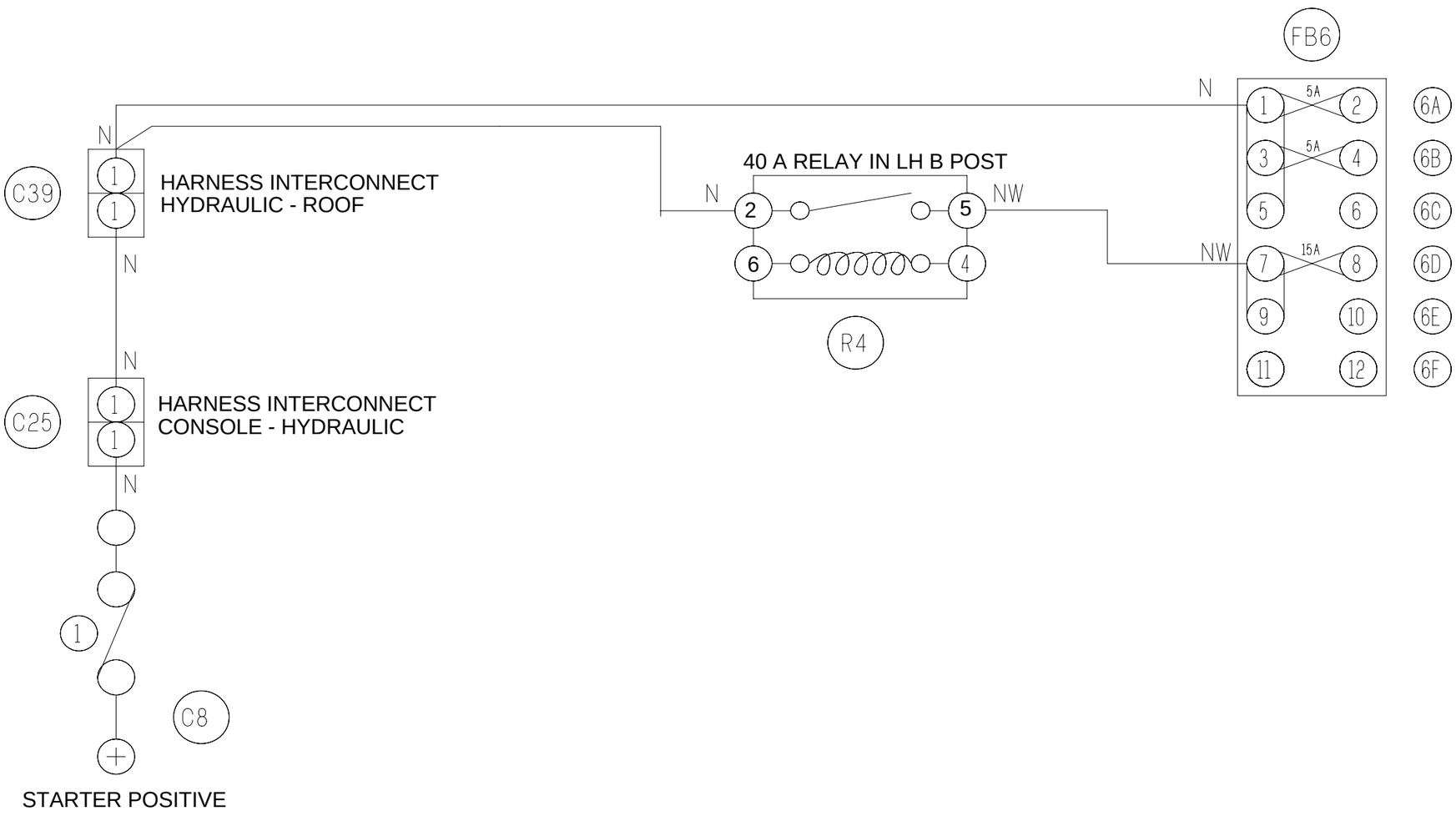


Figure 101 - Fuse link 5 - Orchard Cab Roof

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Figure 101
Fuse link 5 - Orchard Cab Roof

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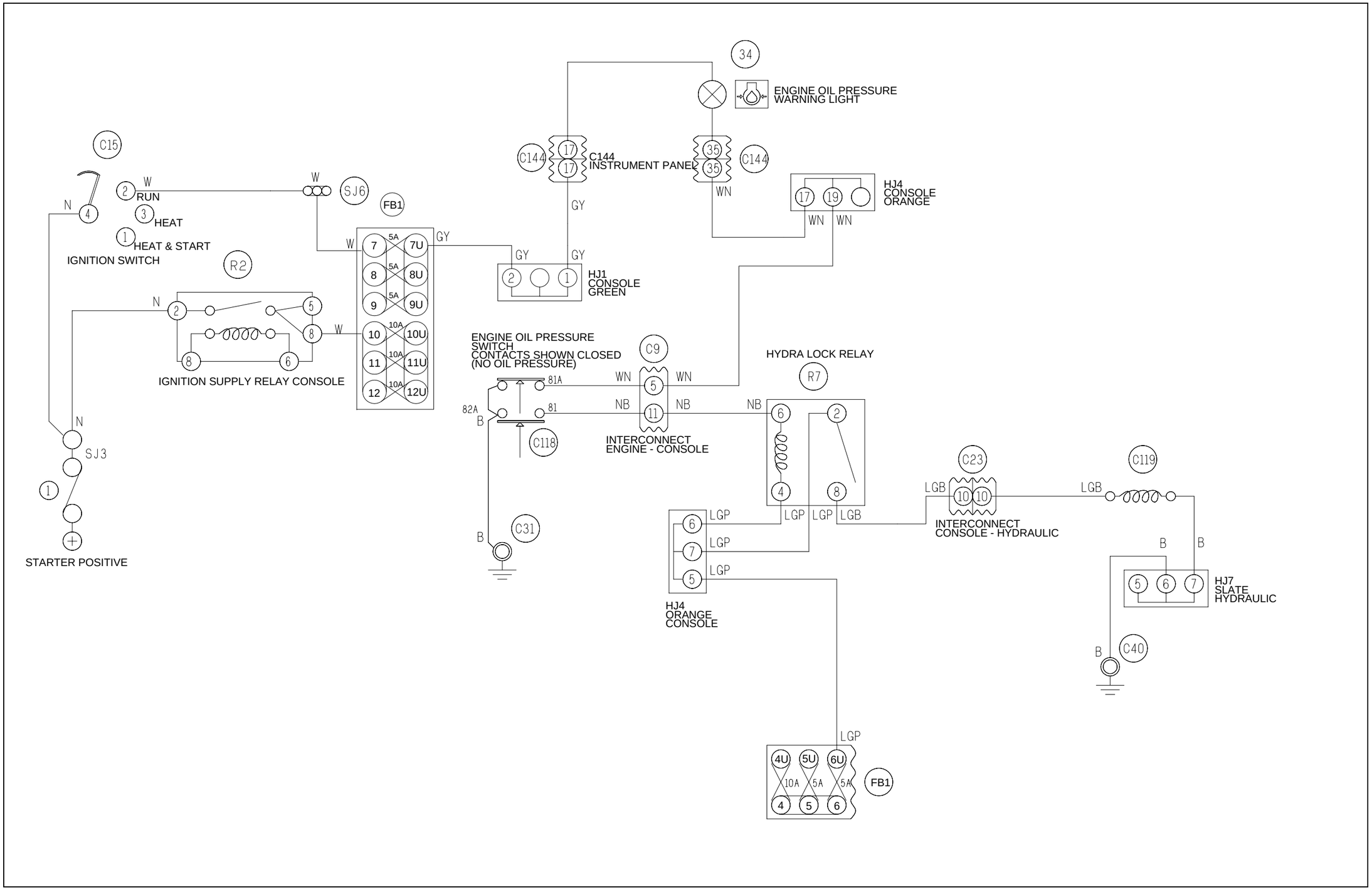


Figure 102 - Hydraulic lift system lock - Japan only

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Figure 102
Hydraulic lift system lock - Japan only

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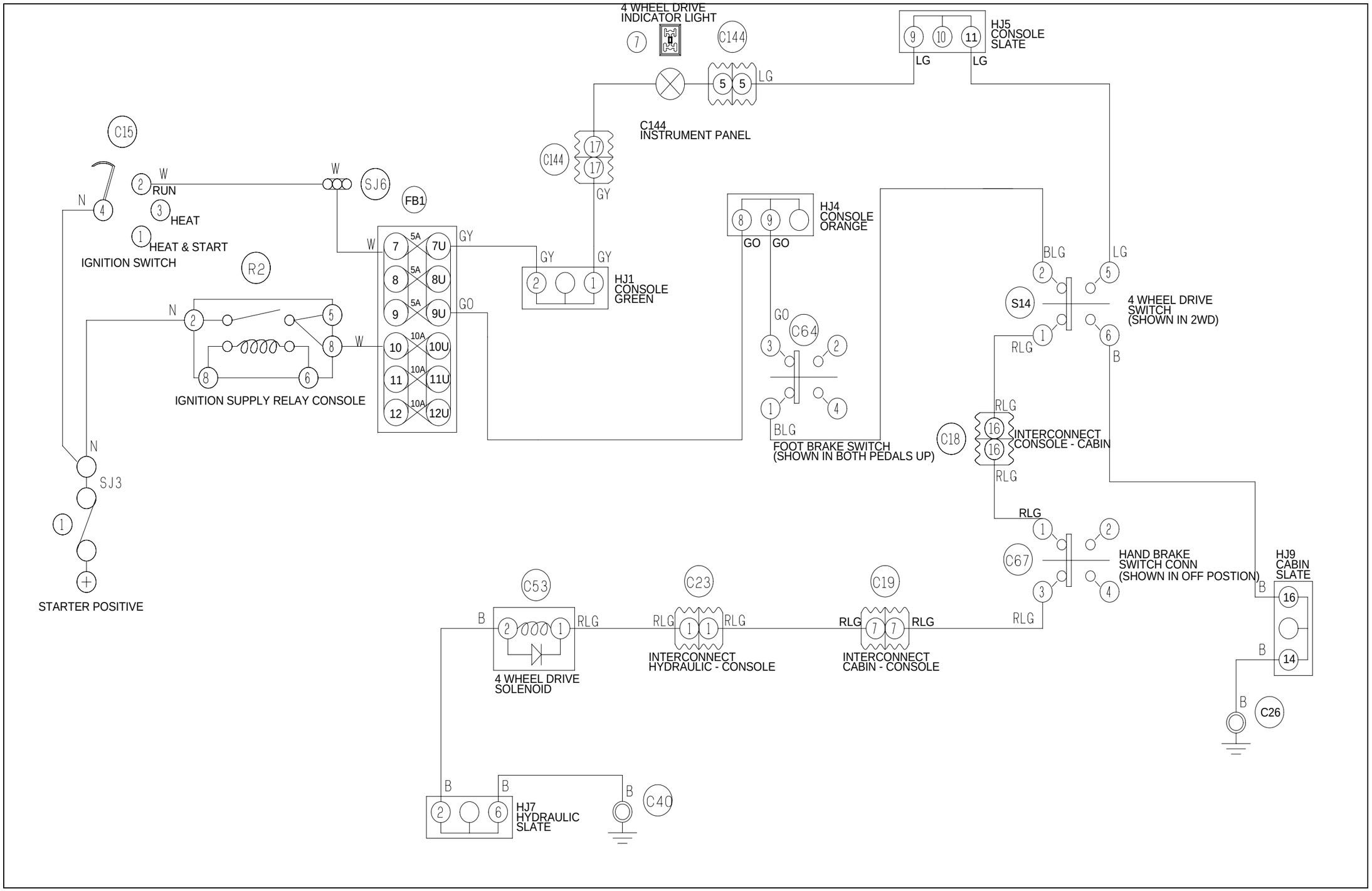


Figure 103 - Centre console mounted 4 WD switch - Japan only

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Figure 103
Centre console mounted 4 WD switch - Japan only

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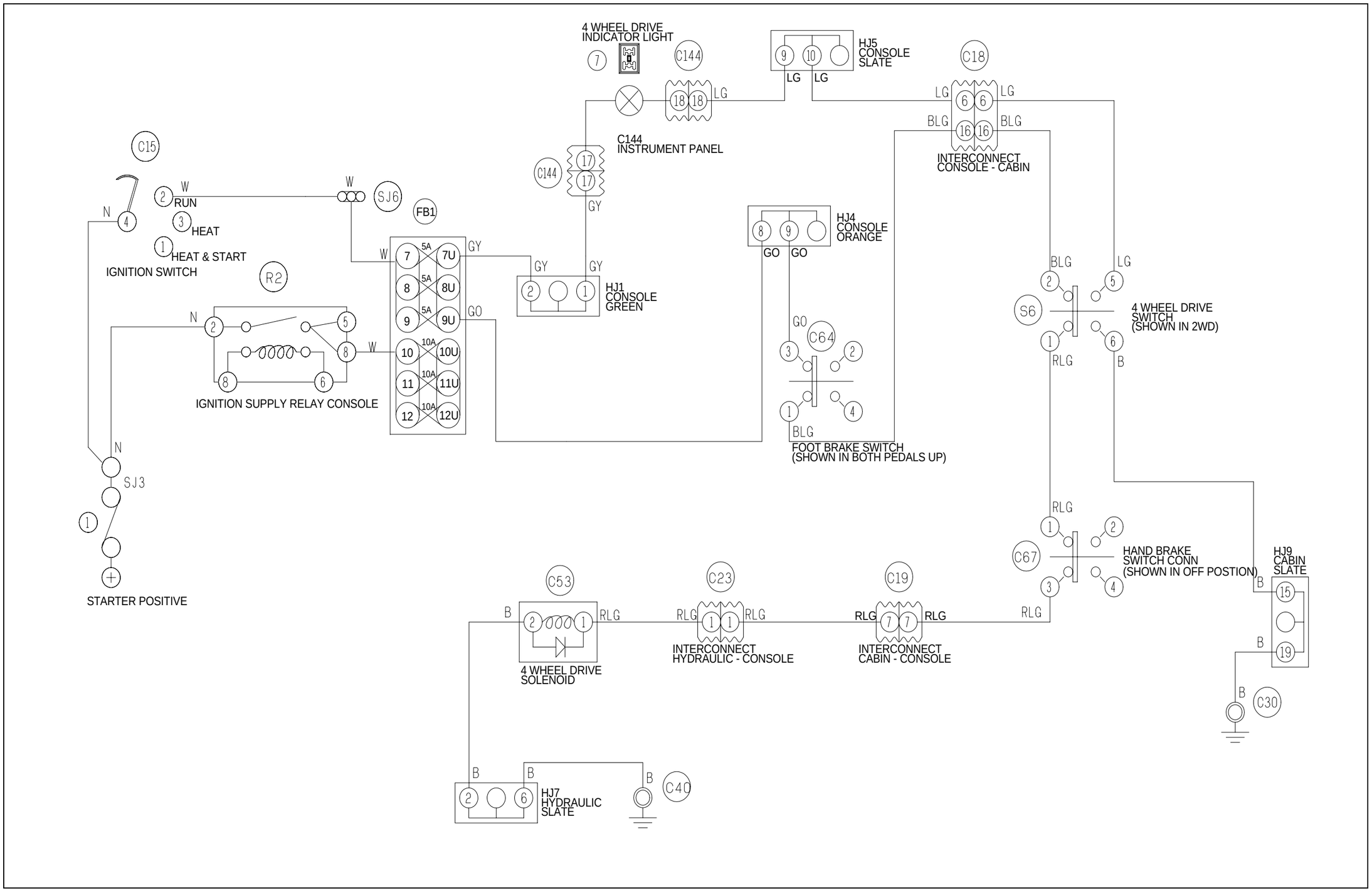


Figure 104 - RHS Side Console Mounted 4WD Switch - NAO & ROW

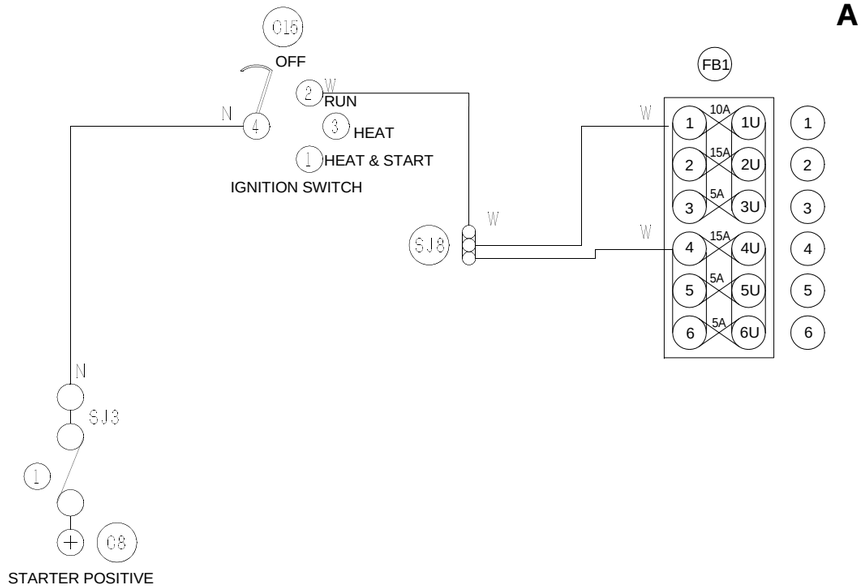
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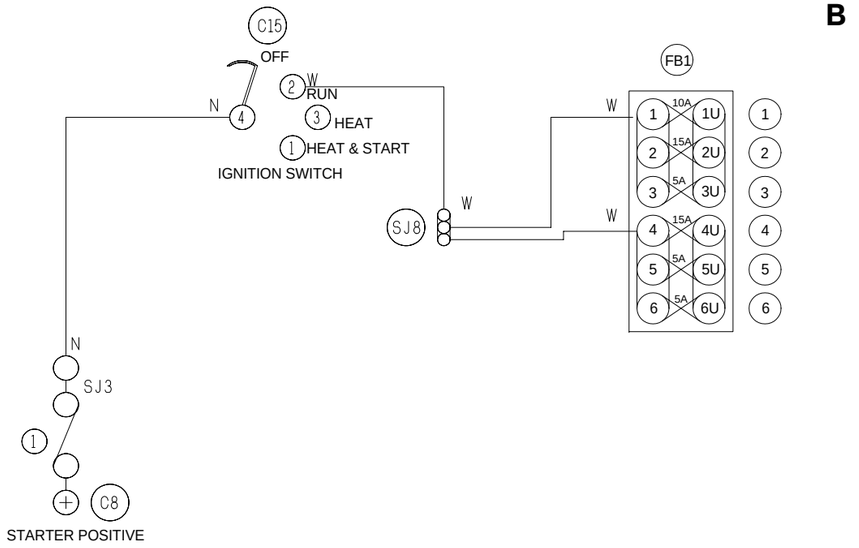
Figure 104
RHS Side Console Mounted 4WD Switch - NAO & ROW

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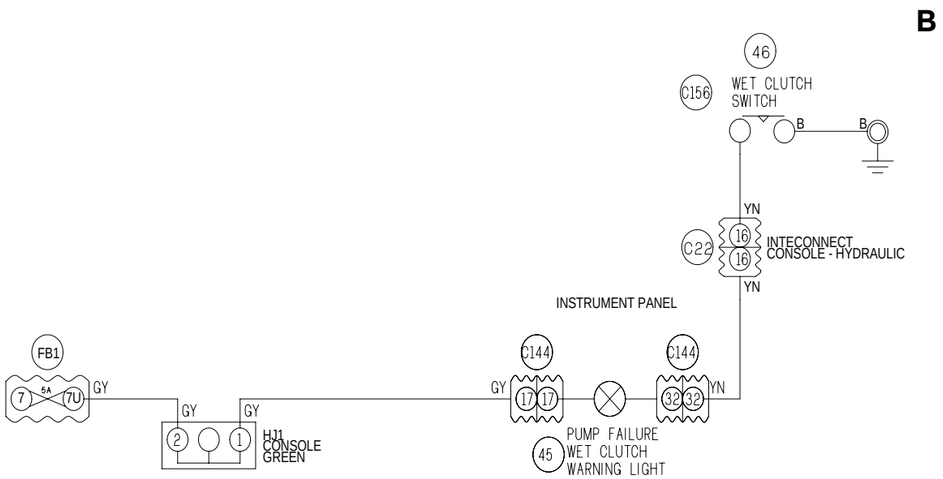
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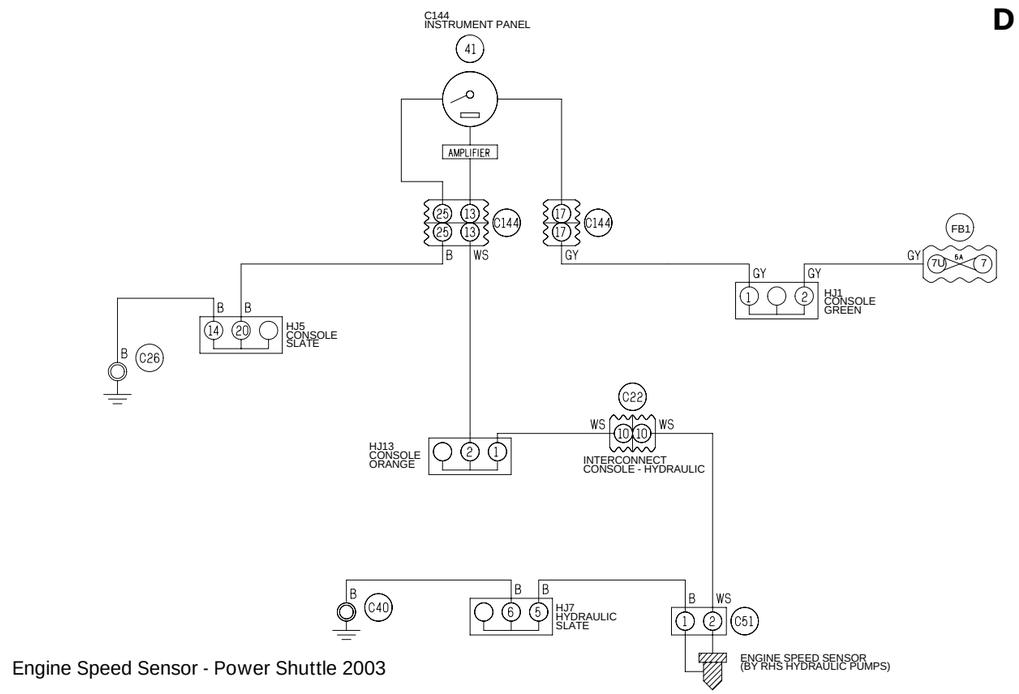
Ignition Switch Supply Circuit To Fuse Box 1 (LHS) Japan



Ignition Switch Supply Circuit To Fuse Box 1 (LHS) NAO



Wet Clutch/Power shuttle low cooling flow oil pressure



Engine Speed Sensor - Power Shuttle 2003

Figure 105

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Figure 105

A - Ignition Switch Supply Circuit To Fuse Box 1 (LHS) Japan
B - Ignition Switch Supply Circuit To Fuse Box 1 (LHS) Japan
C - Wet Clutch/Power shuttle low cooling flow oil pressure
D - Engine Speed Sensor - Power Shuttle 2003

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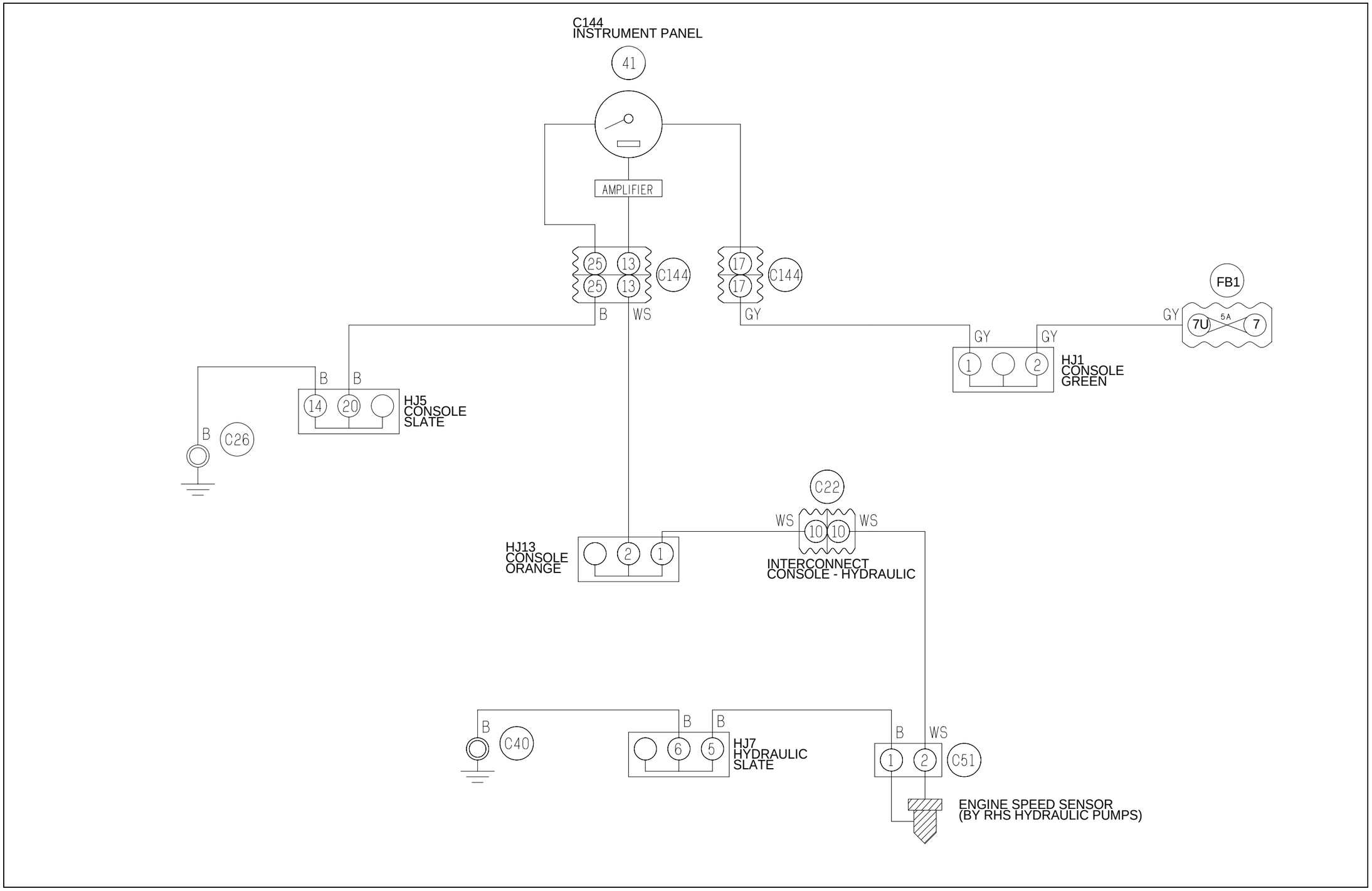


Figure 106 - Engine Speed Sensor - Non Power Shuttle

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Figure 106
Engine Speed Sensor - Non Power Shuttle

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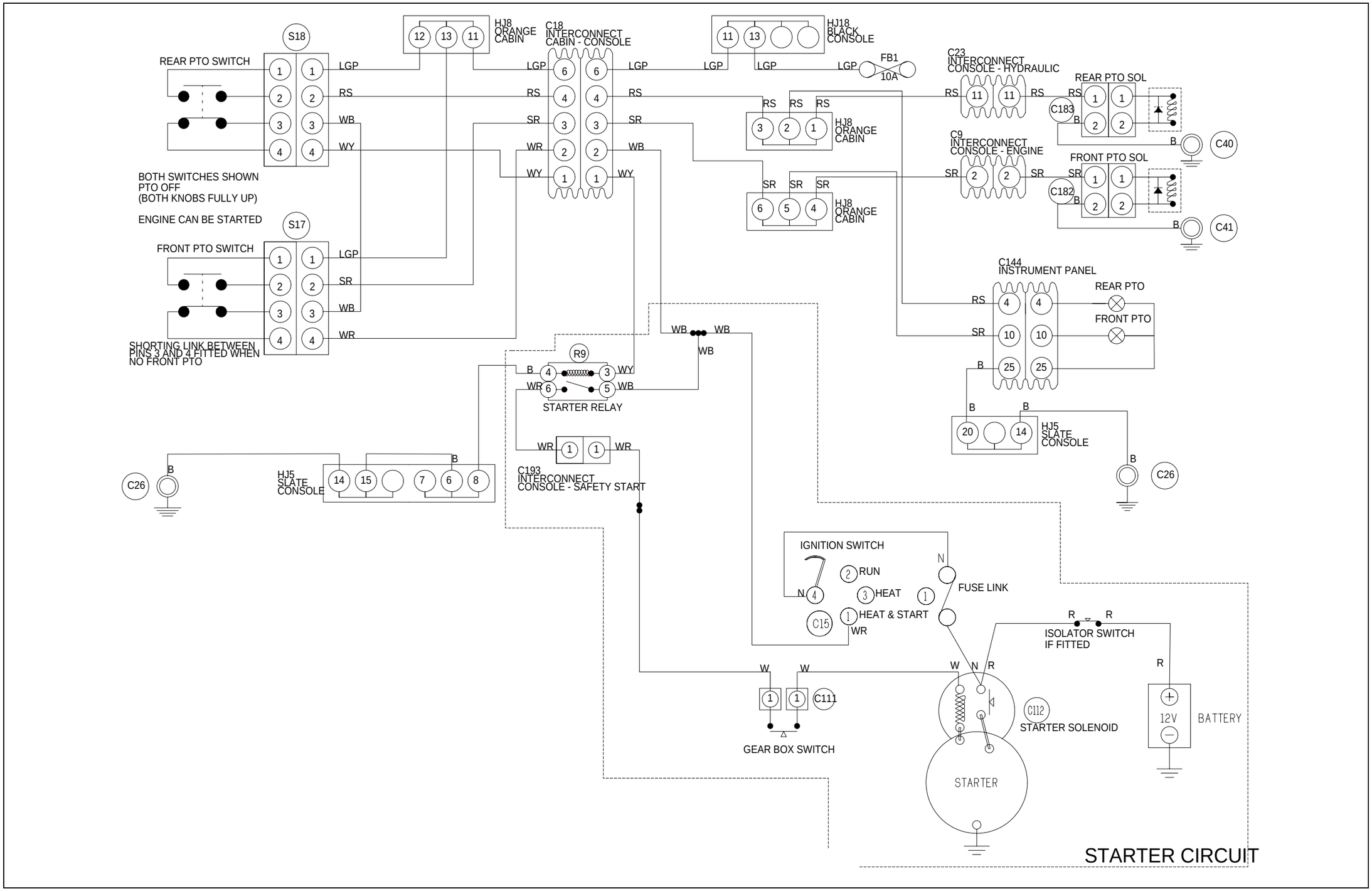


Figure 107 - Safety start/PTO interlock/Starter circuit

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Figure 107
Safety start/PTO interlock/Starter circuit

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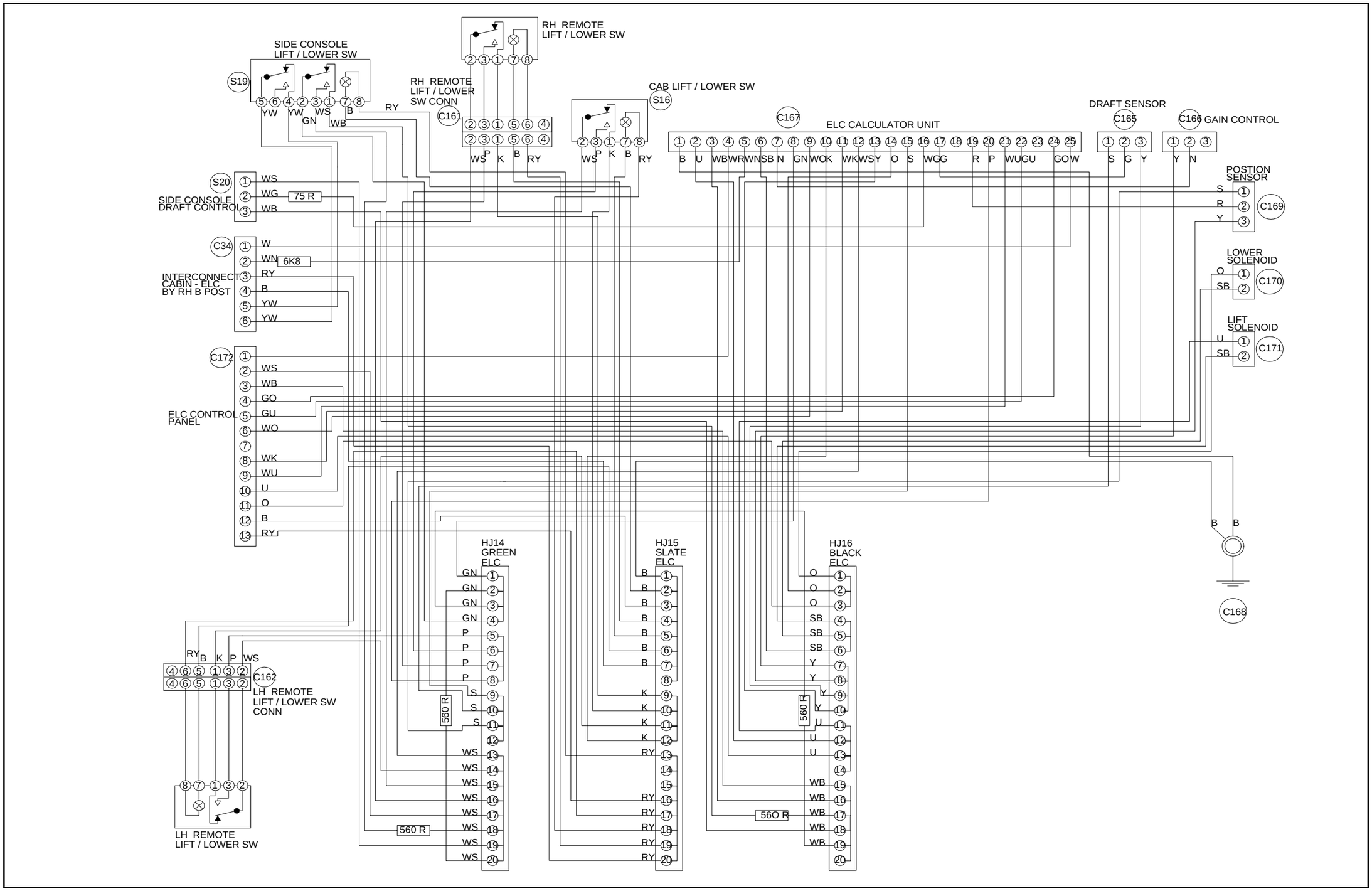


Figure 108 - ELC Circuit

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Figure 108
ELC Circuit

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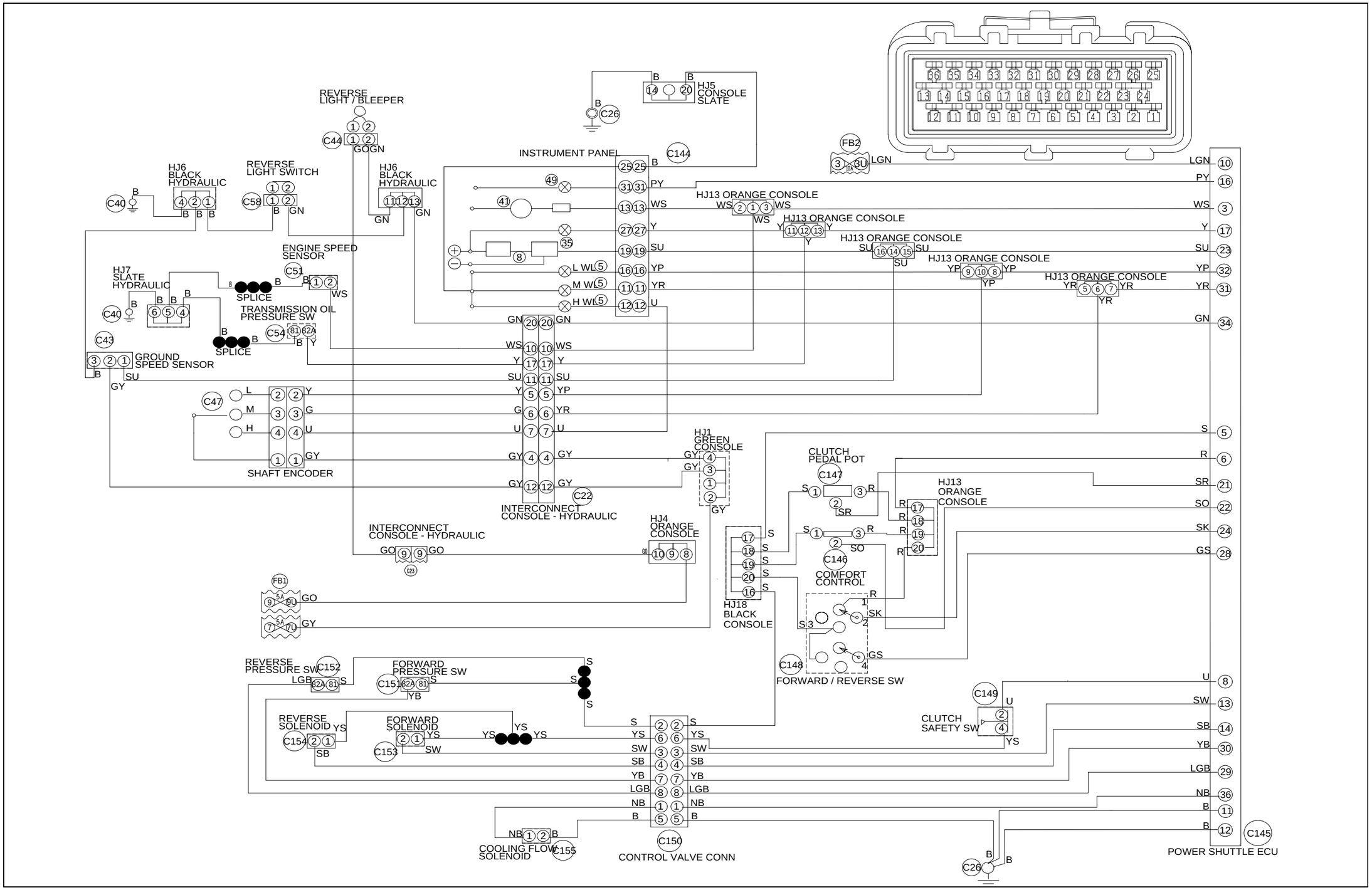


Figure 109 - Power Shuttle 2002

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Figure 109
Power Shuttle 2002

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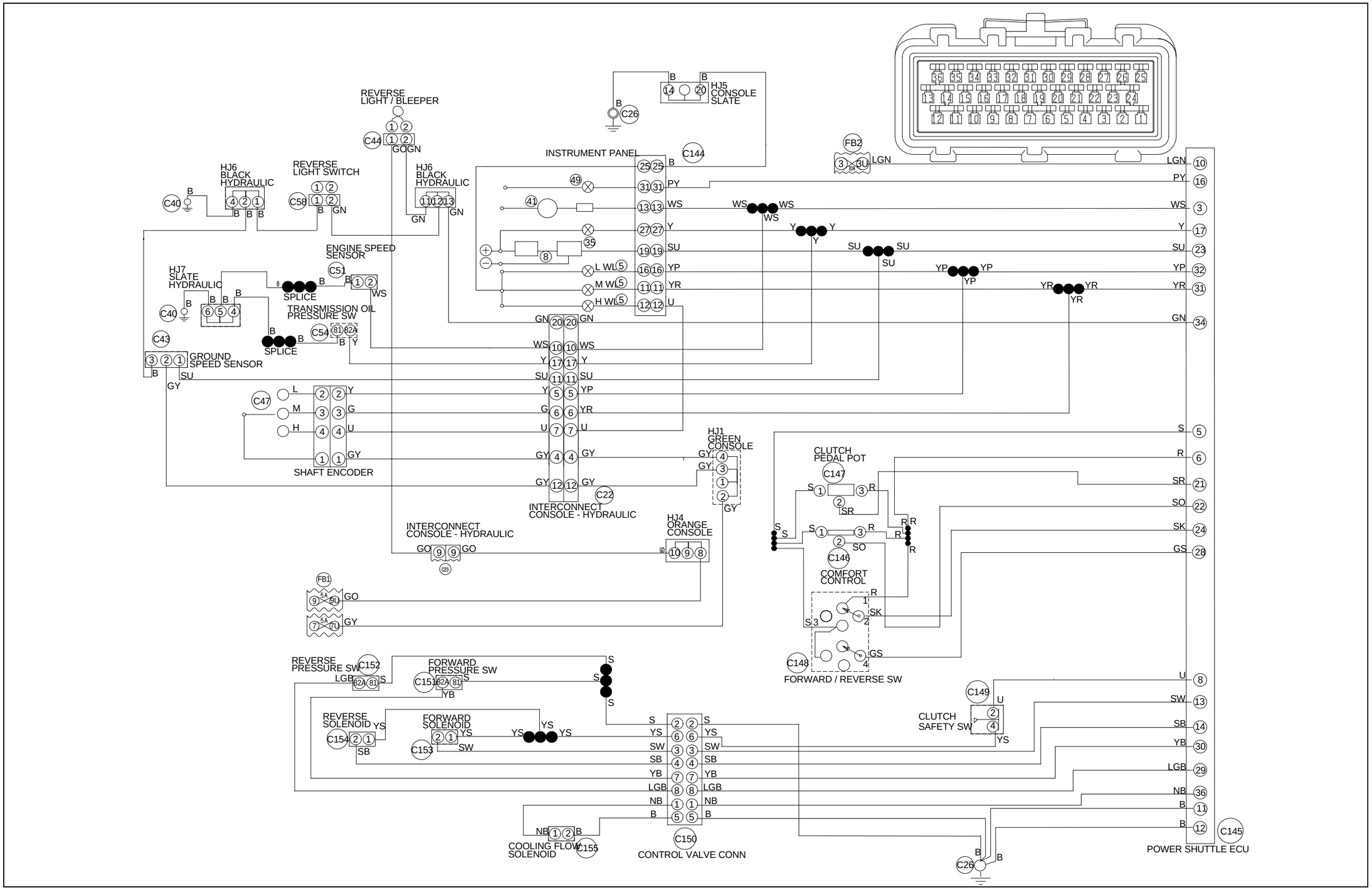


Figure 110 - Power shuttle 2003

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Figure 110
Power shuttle 2003

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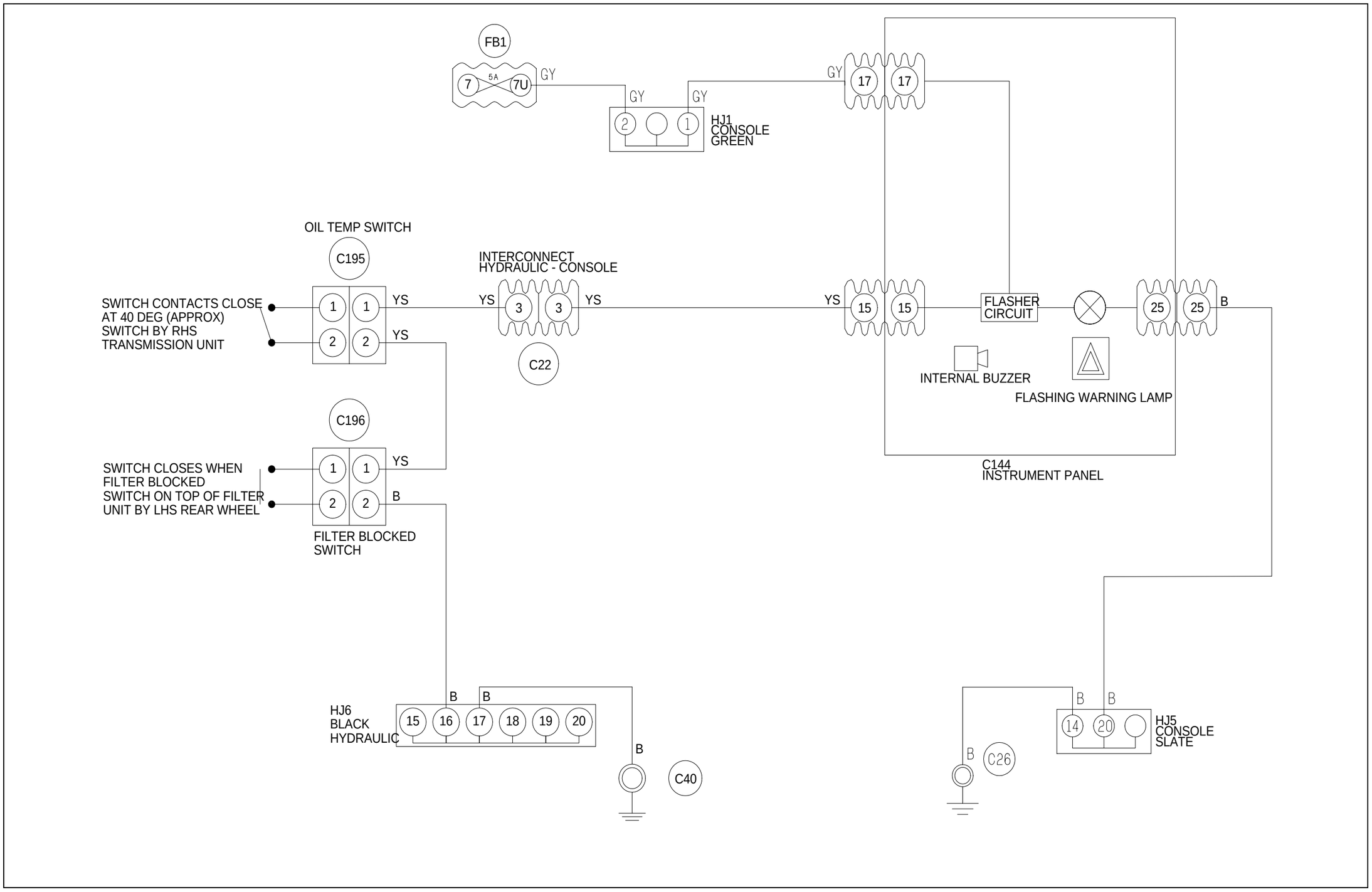


Figure 111 - Transmission Oil Filter Blocked Warning Lamp - Power Shuttle

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Figure 111
Transmission Oil Filter Blocked Warning Lamp - Power Shuttle

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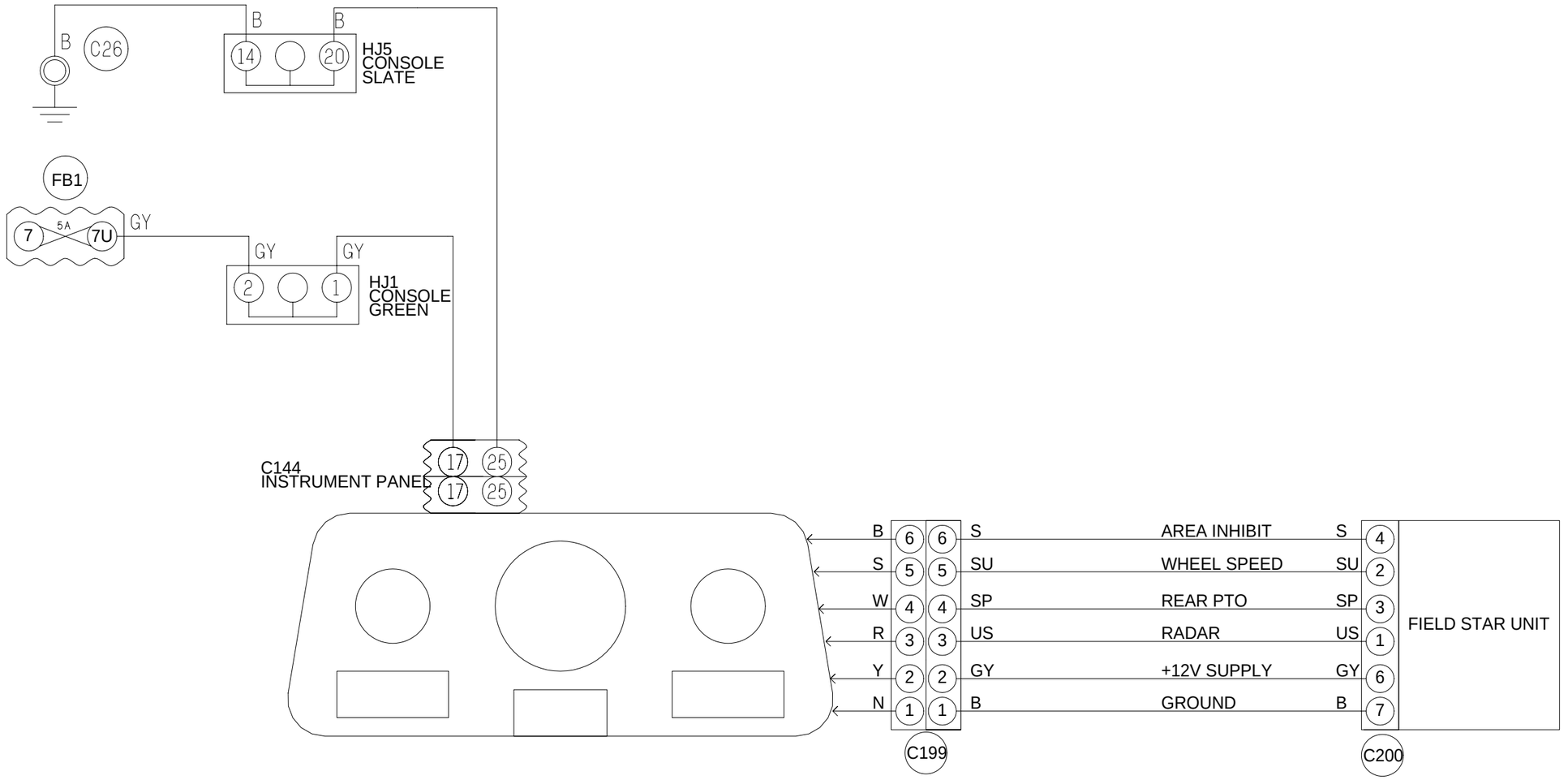


Figure 112 - FieldStar Only for 3821 850 M92 Instrument Panels

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Figure 112
FieldStar Only for 3821 850 M92 Instrument Panels

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Footstep Wiring Diagrams

Section 10 - Part C

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Footstep Wiring Diagrams

GENERAL DESCRIPTION

The electrical system is divided into five main harnesses, engine, console, hydraulic (left-hand side), cab (right-hand side) and cab roof.

The engine harness serves all components in front of the cab and is connected to the console harness by two connectors behind the engine cylinder block.

The console harness is situated behind the instrument panel and contains the main fuse box, instruments and switches. It is connected to the left-hand hydraulic harness and the right-hand cab harness. These connections will be found on the left- and right-hand side of the console at the base. The cables then pass under the floor mats.

The hydraulic harness serves the left-hand side of the tractor and all components around the transmission on the left- and right-hand side. It is also connected to the roof through the fuse box in the left-hand door pillar, this fuse box controls the work lights.

The cab harness is connected to all the components on the right-hand side of the cab, switches, power socket, speedshift etc. and is connected to the roof harness through the fuse box in the right-hand door pillar, this fuse box serves all components in the roof except work lights.

The roof harness is connected to the fuse boxes in the left- and right-hand door pillars and is routed around the roof serving all switches, lights and the cab heating, ventilating and air conditioner.

The schematic illustration in Figs. 1 and 2 shows the layout of the harnesses and all their connectors and components.

Circuit Diagrams

The wiring system has been broken down into individual circuits to make it easy to trace faults which may develop with any component. The circuits are all listed in the alphabetical circuit wiring diagram index on page 10B-3. Every connector, header joint, switch and relay is identified by a number prefixed with a letter, they are all illustrated on pages 10B-16 to 10B-19 for identification of the individual pin connectors. Identification of the components is as follows:

C = Connector, this can be a connector between two harnesses or a connector to a component, when it is connected to a component it also identifies the component; for example, C67 Parking brake switch.

or:

C9 Engine harness to console harness.

S = Switch, this identifies all switches and the plug pin layout; for example, S3 master light switch side/head.

R = Relay, this identifies all relays and flasher unit; for example, R4 work light relay left-hand door pillar.

FB= Fuse boxes, there are four fuse boxes located below the instrument panel, behind the cover on the left- and right-hand door pillars and in the cab roof under the cab air filter access panel. They are numbered; for example, FB6 left-hand door pillar.

HJ= Header joints, these are common soldered connectors within the harness and are used to connect a number of wires together.

SJ = Soldered joint, this indicates a single soldered joint within the harness.

Terminal Identification

When reading the circuit diagram it will be noted that each connector terminal is identified by a number in a circle, this is the pin number, it will be found stamped on the plug or socket and shown on the illustration of the connector on pages 10B-16 to 19.

In the description the number of pins and colour of the connector are given to aid identification.

Diagnosis

When dealing with electrical problems, have to hand simple test equipment so that you can test the continuity of the circuit from source to the component. Remember that the most common fault is a loose connection, first check that all the connectors in the circuit are tight. Don't forget the earth connections.

Wiring Colour Codes

The following colour codes to international standard are used to identify all the wires:

B	Black.
G	Green.
K	Pink.
LG	Light green.
LU	Light blue.
N	Brown.
O	Orange.
P	Purple.
R	Red.
S	Grey.
U	Blue.
W	White.
Y	Yellow.

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Footstep Wiring Diagrams

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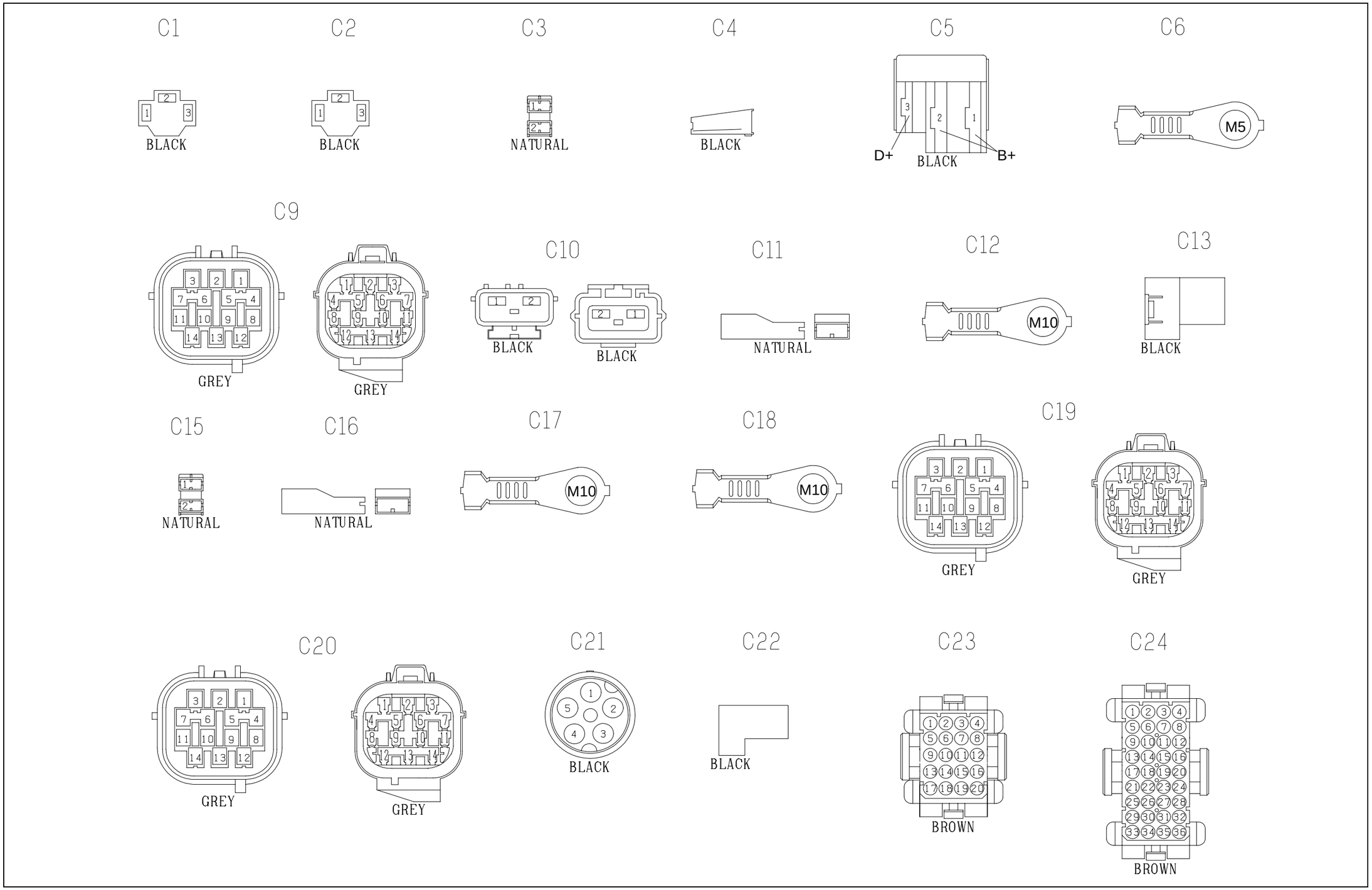


Figure 1

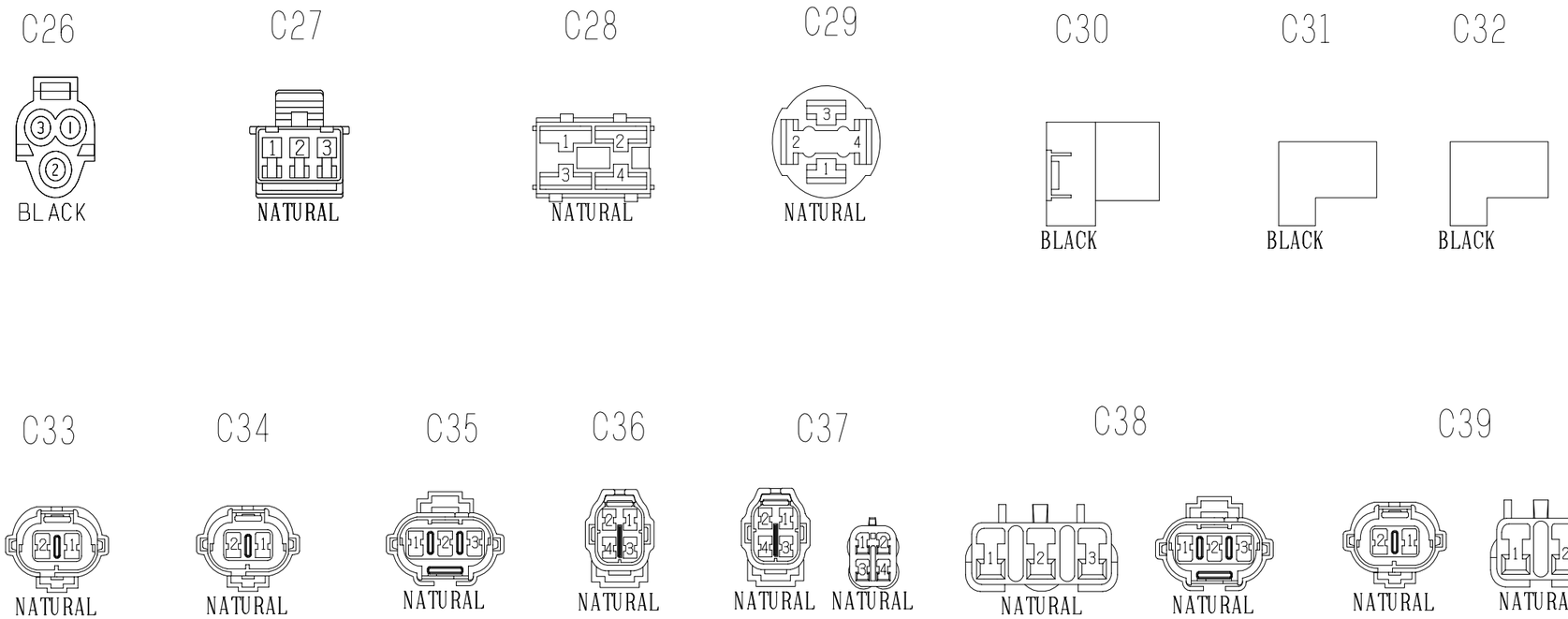
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Figure 1
Connectors, Header joints and Plugs

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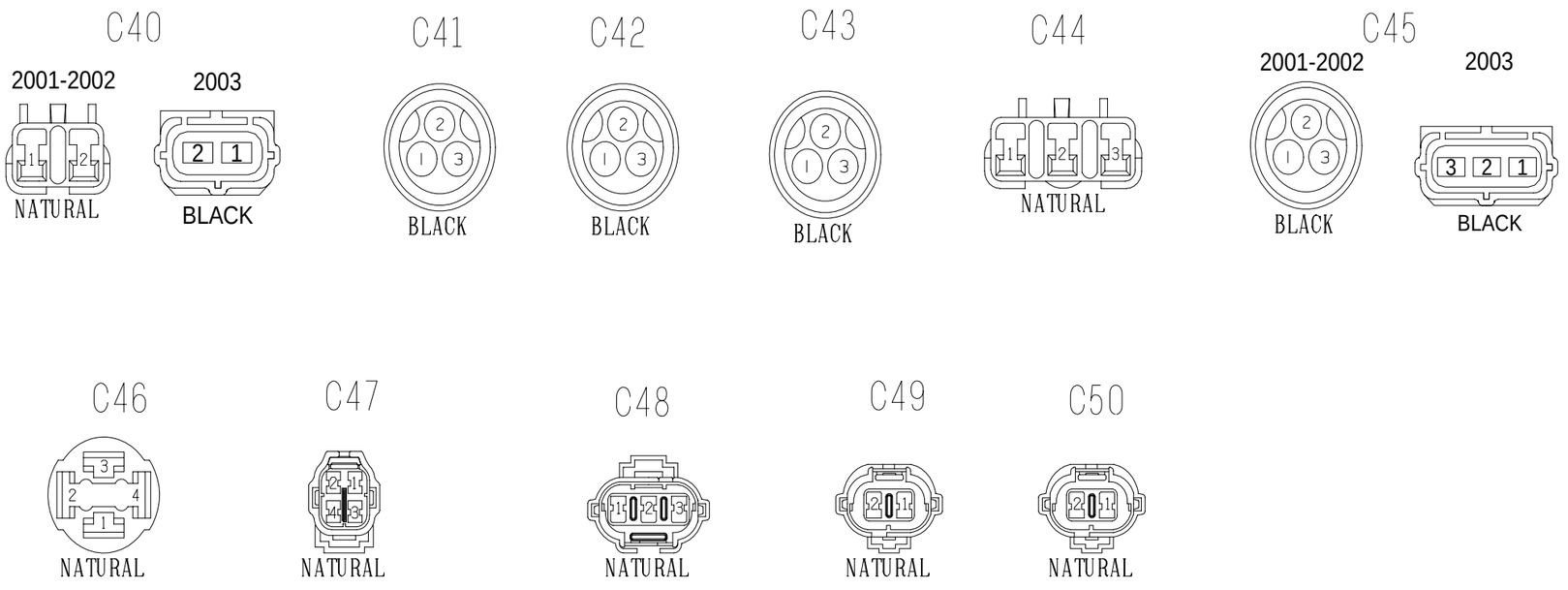


Figure 2

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Figure 2
Connectors, Header joints and Plugs

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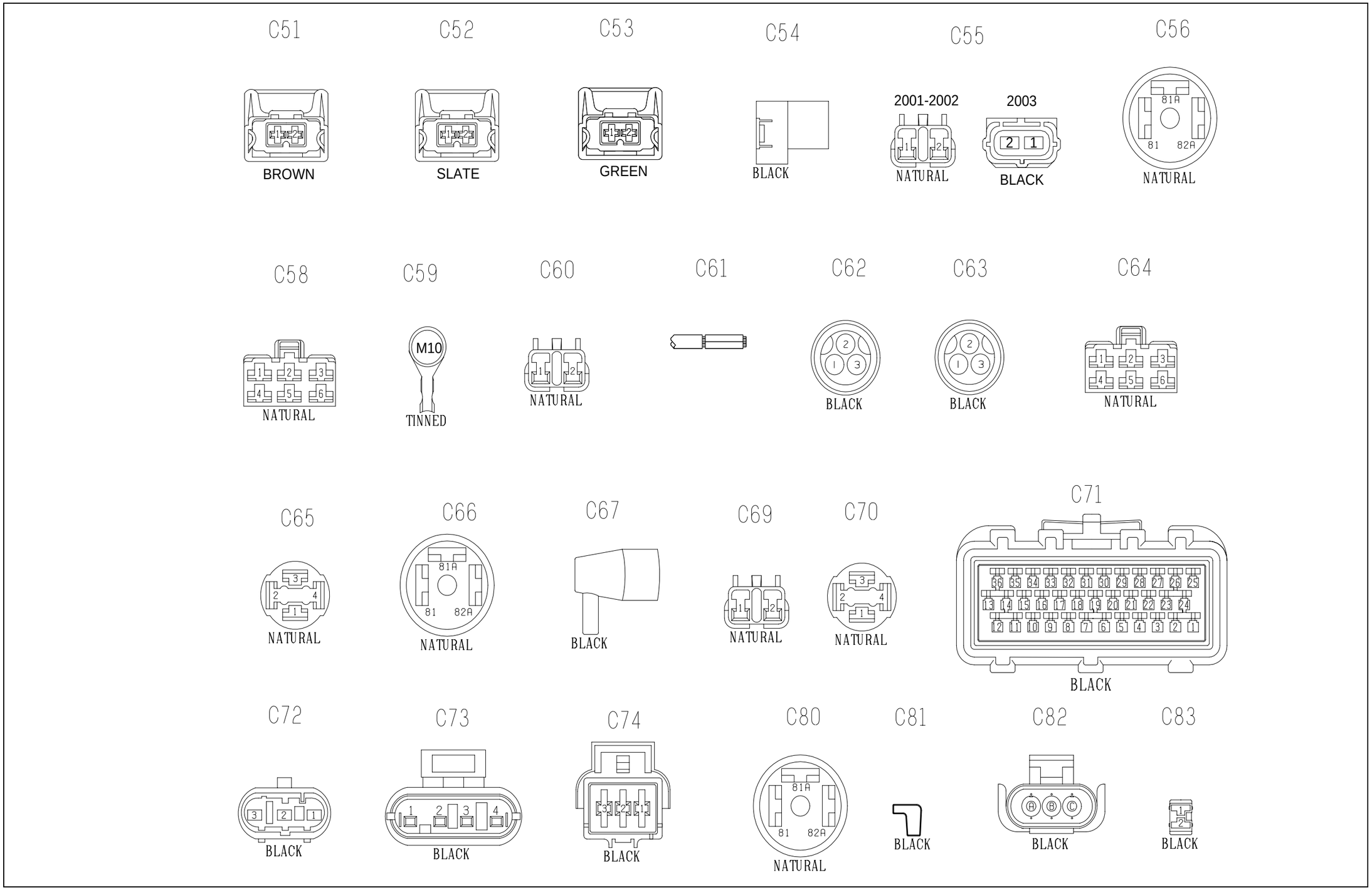


Figure 3

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Figure 3
Connectors, Header joints and Plugs

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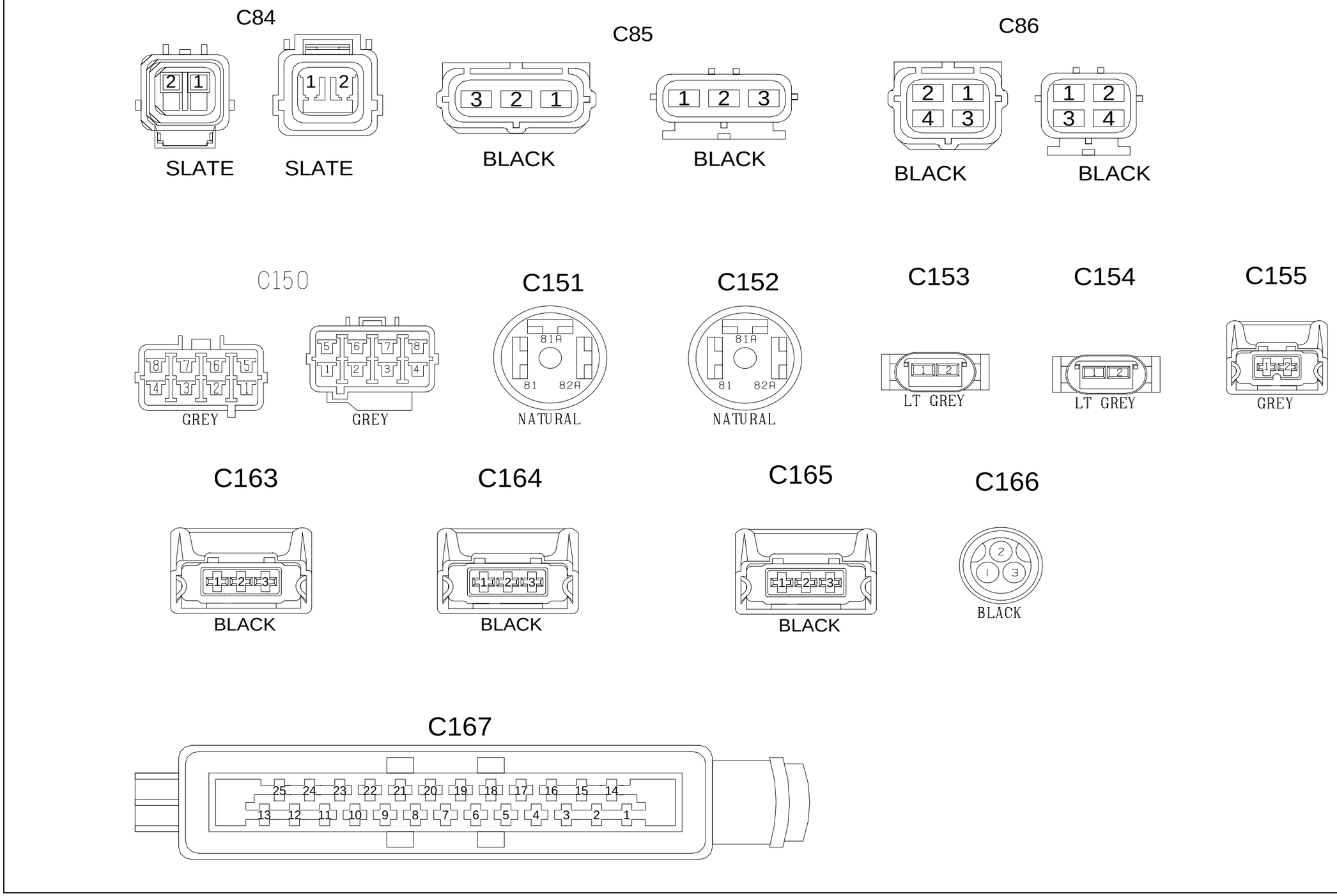


Figure 4

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Figure 4
Connectors, Header joints and Plugs

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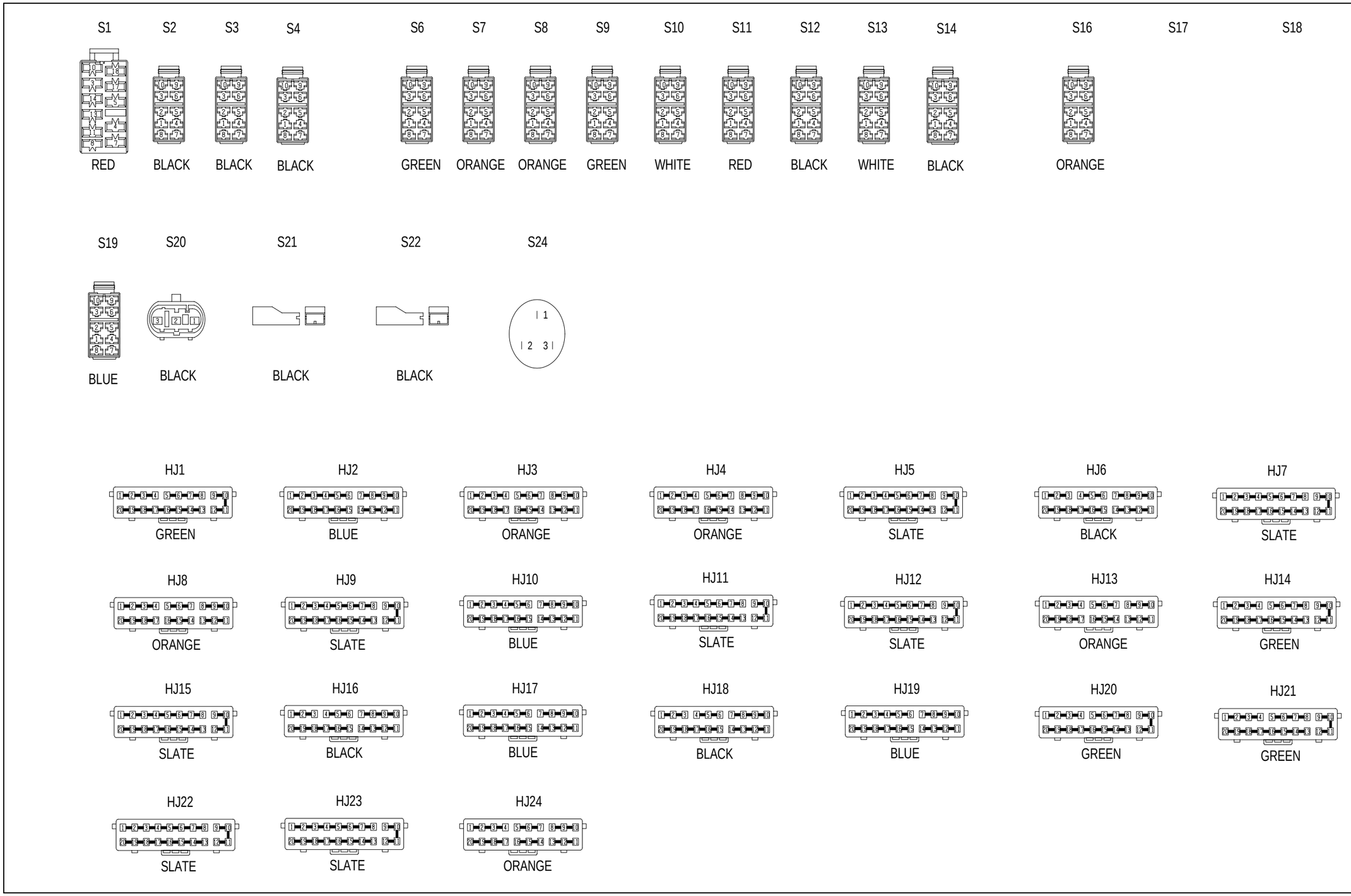


Figure 5

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Figure 5
Connectors, Header joints and Plugs

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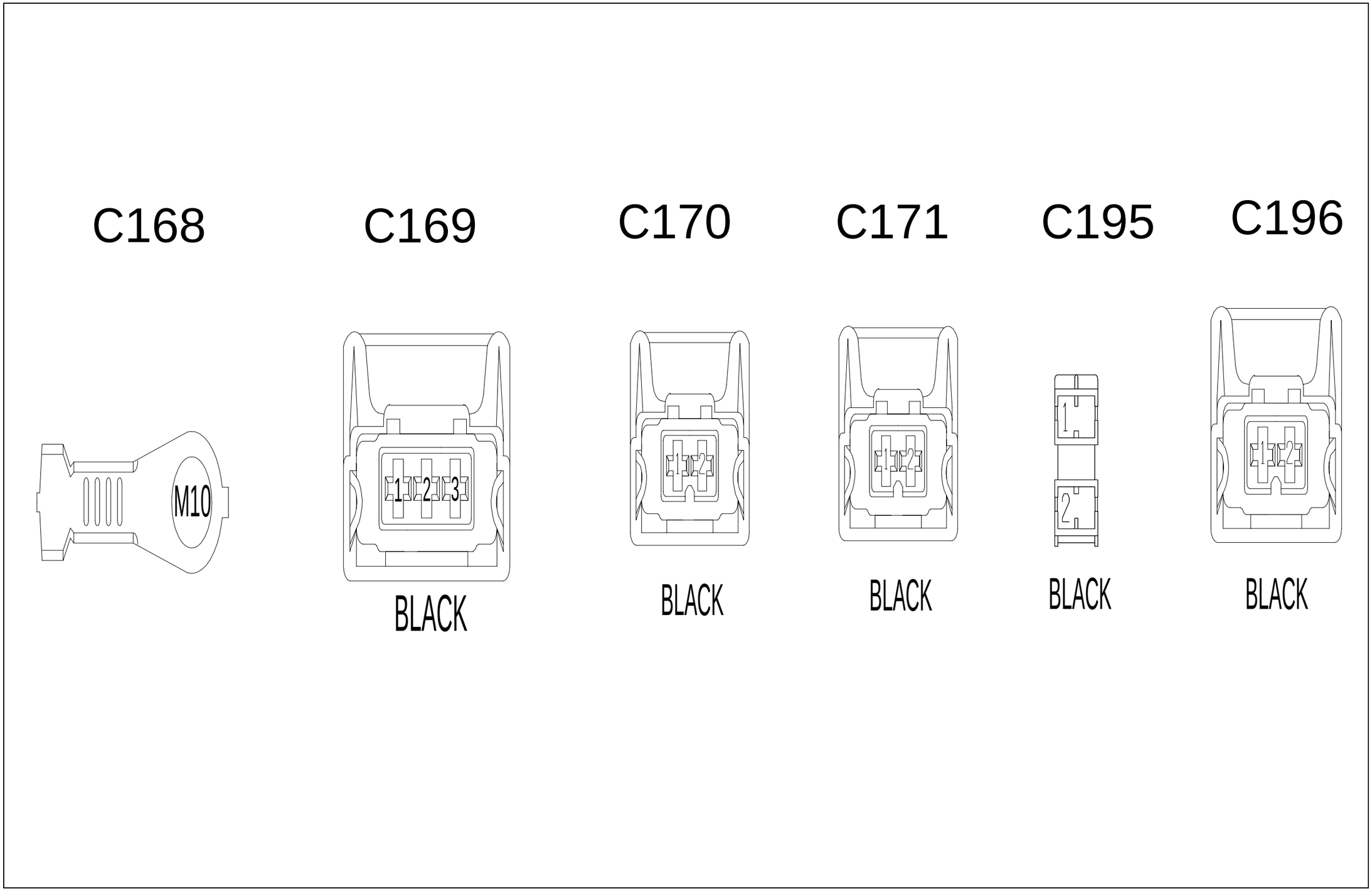


Figure 6

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Figure 6
Connectors, Header joints and Plugs

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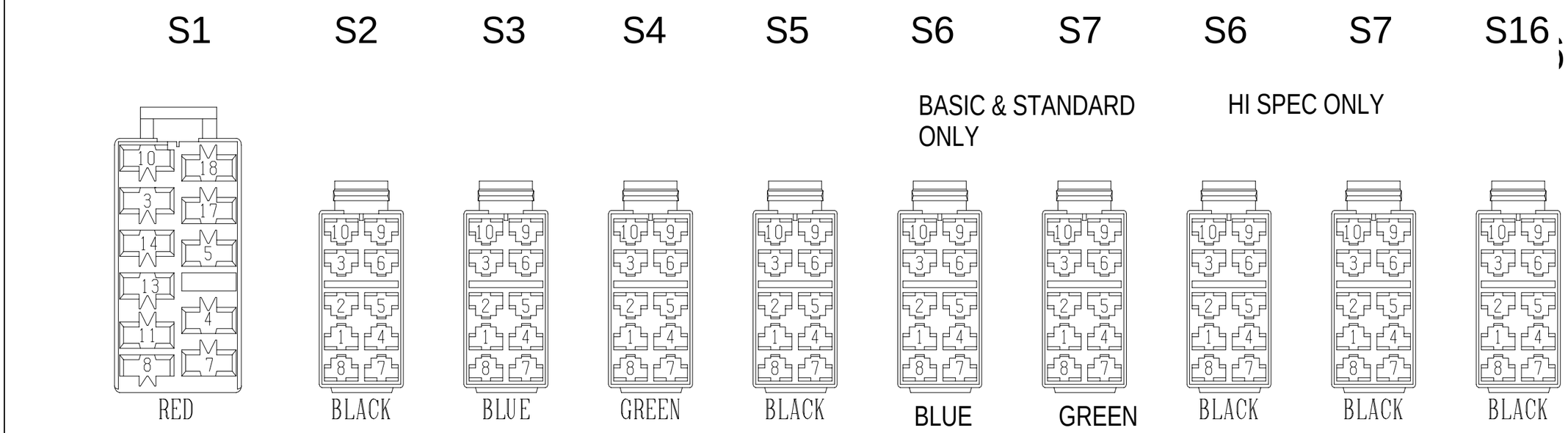


Figure 7

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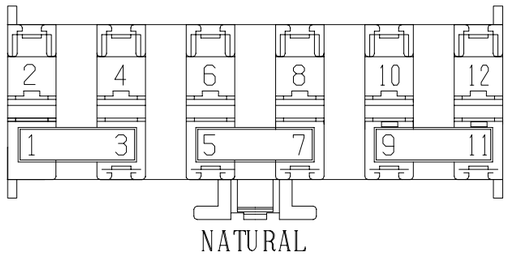
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Figure 7
Connectors, Header joints and Plugs

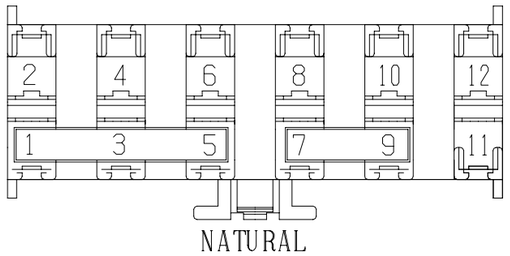
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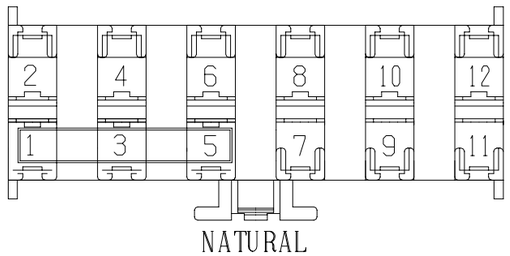
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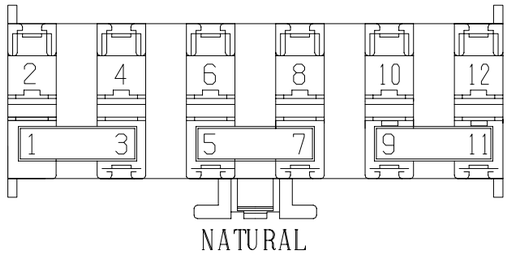
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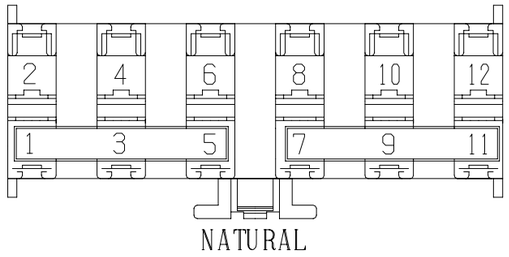
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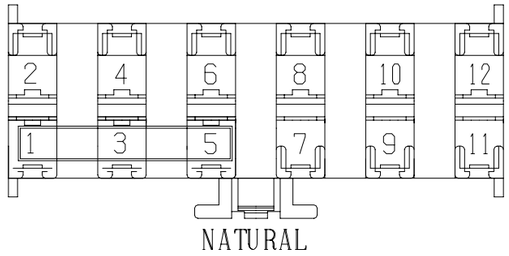
FB4



FB5



FB6



FB7

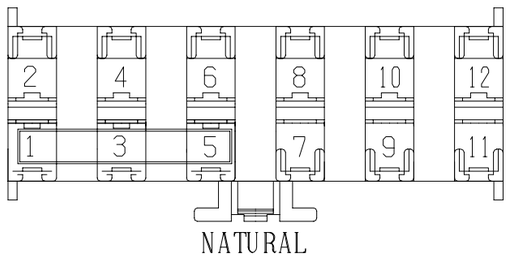


Figure 8

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Figure 8
Connectors, Header joints and Plugs

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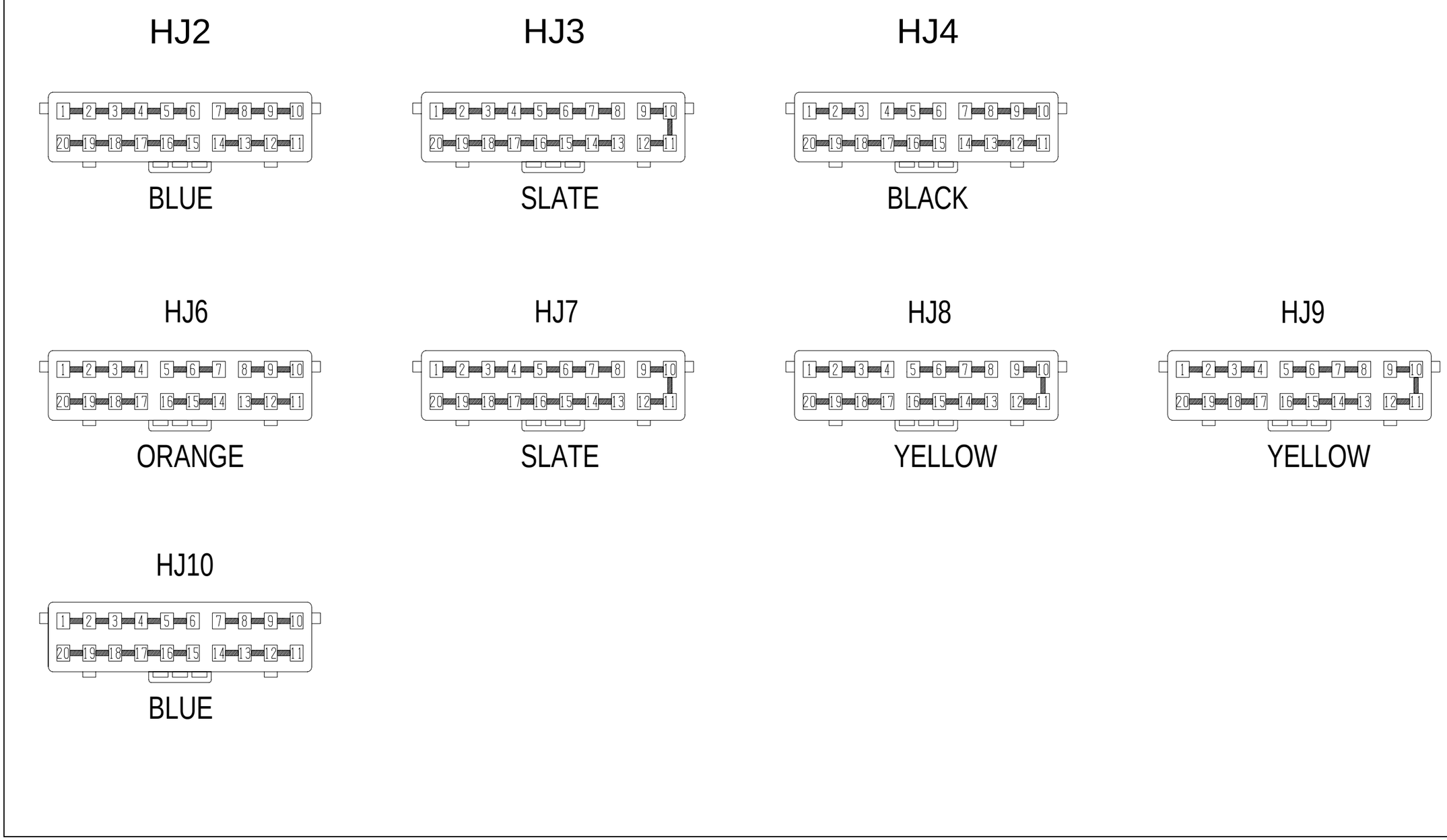


Figure 9

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Footstep Wiring Diagrams

Harness Layout Fig. 10

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B - Harness Layout Basic WEO Mechanical Diff Lock

C - Harness Layout Basic WEO Electrical Diff Lock

D - Harness Layout NAO

Figure 9

Connectors, Header joints and Plugs

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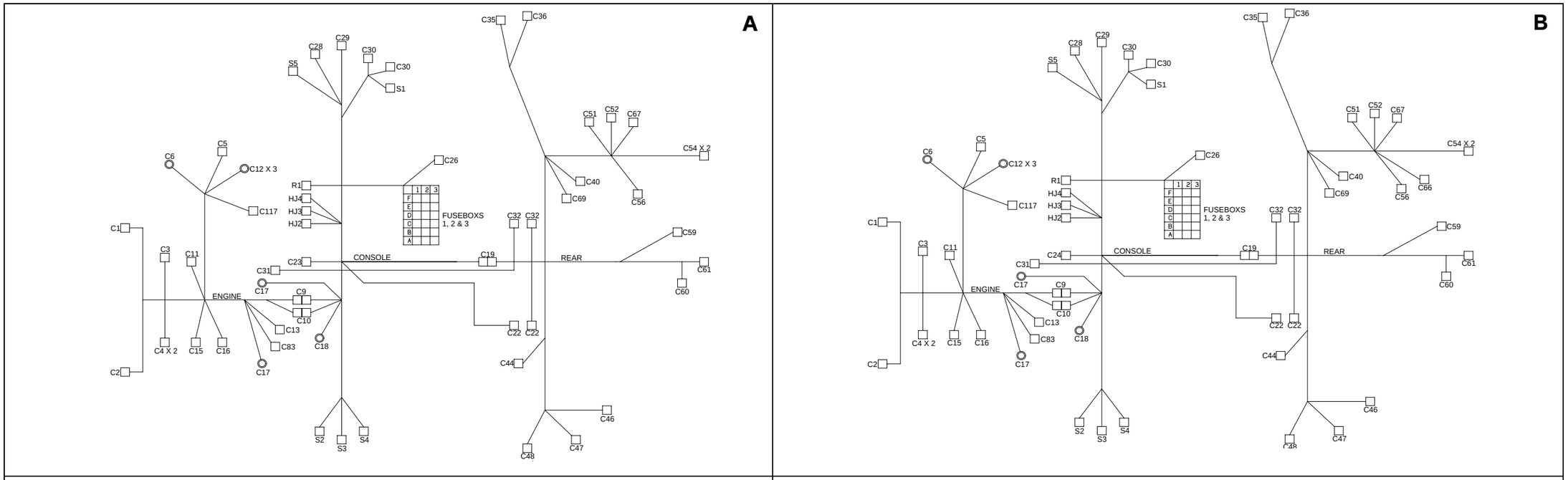


Figure 10

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Footstep Wiring Diagrams

Figure 11

A - Harness Layout Basic WEO Electrical Diff Lock 2003
B - Harness Layout HI Spec WEO Non Power Shuttle 2001-2002
C - Harness Layout HI Spec WEO Power Shuttle 2001-2002
D - Harness Layout HI Spec Japan Non Power Shuttle 2001-2002

Figure 10

Harness Layout

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Footstep Wiring Diagrams

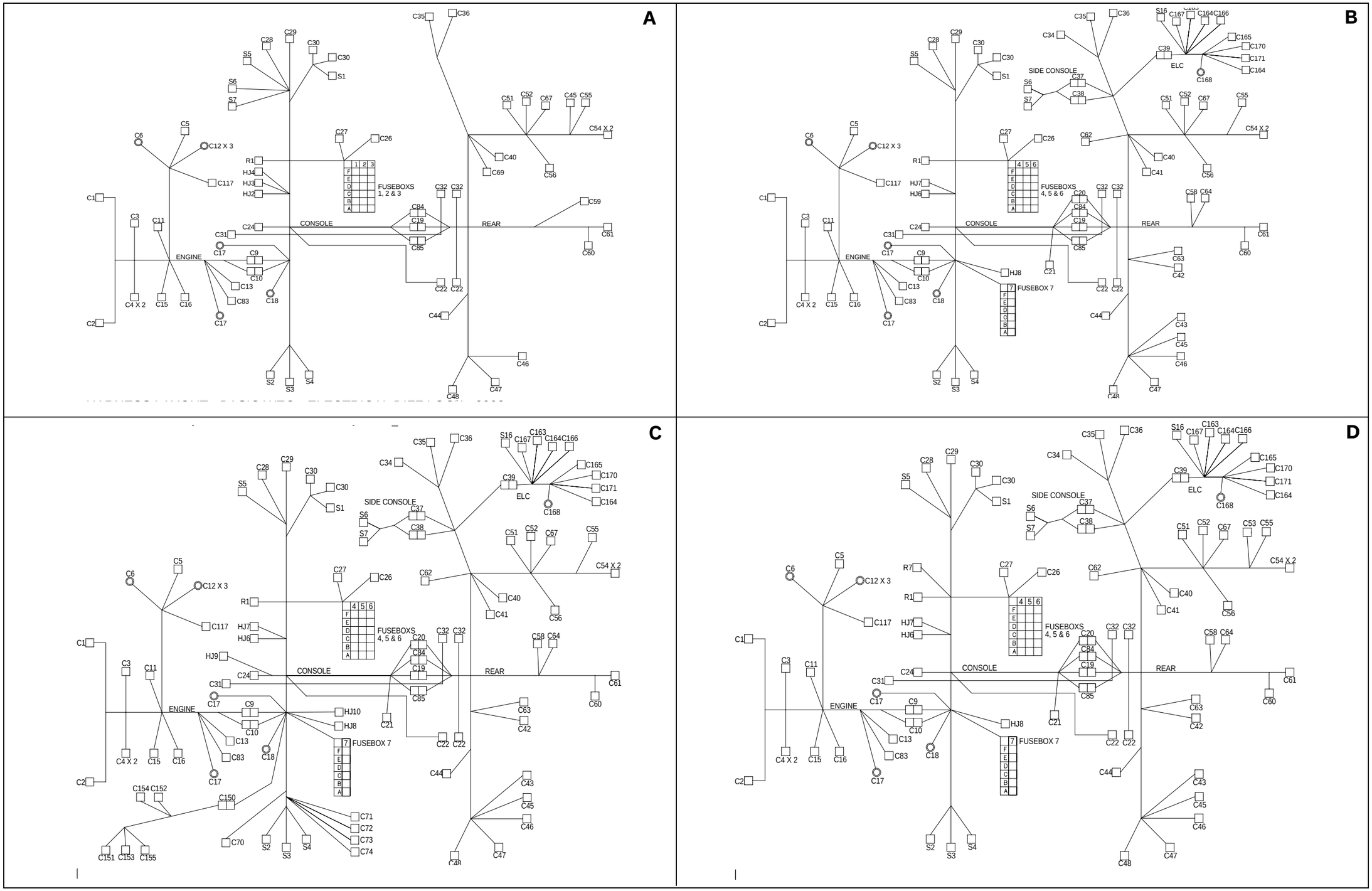


Figure 11

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Figure 11
Harness Layout

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C - Harness Layout HI Spec NAO Power Shuttle 2001 - 2002
D - Harness Layout HI Spec AGCO Cummins Engine Power Shuttle 2001 - 2002

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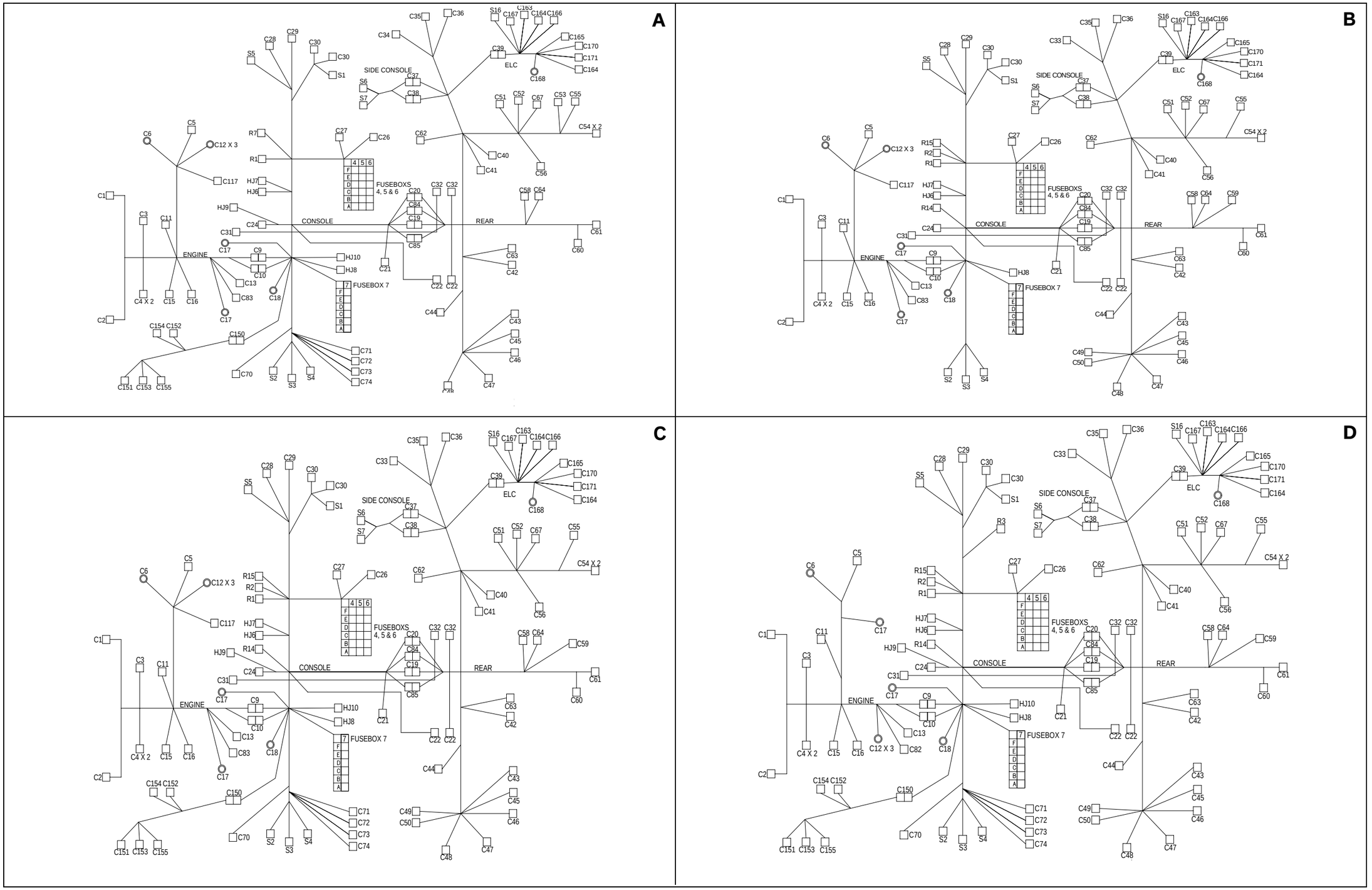


Figure 12

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Figure 13

A - Harness Layout HI Spec WEO Non Power Shuttle 2003
B - Harness Layout HI Spec WEO Power Shuttle 2003
C - Harness Layout HI Spec Japan Non Power Shuttle 2003
D - Harness Layout HI Spec Japan Power Shuttle 2003

Figure 12

Harness Layout

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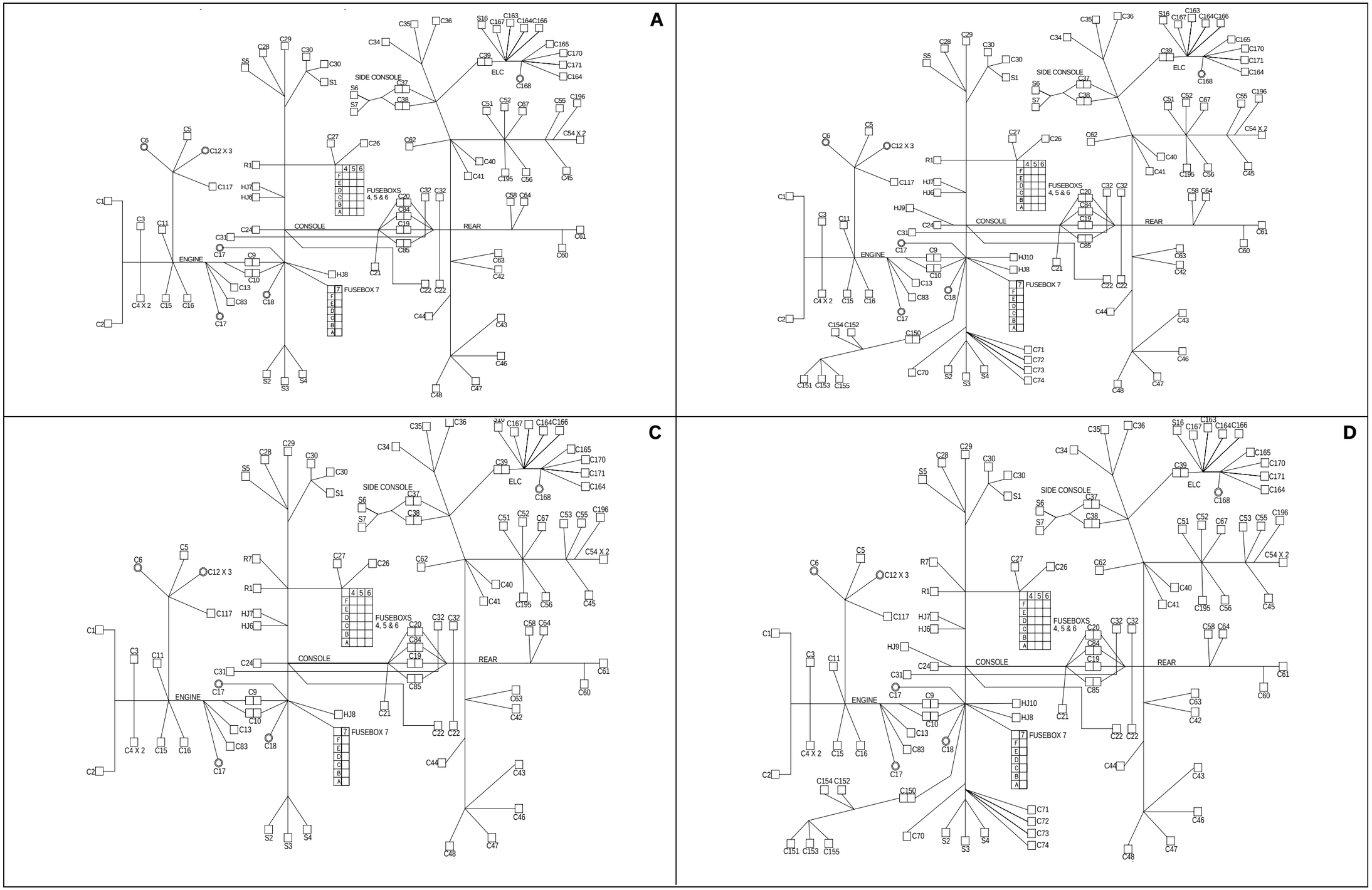


Figure 13

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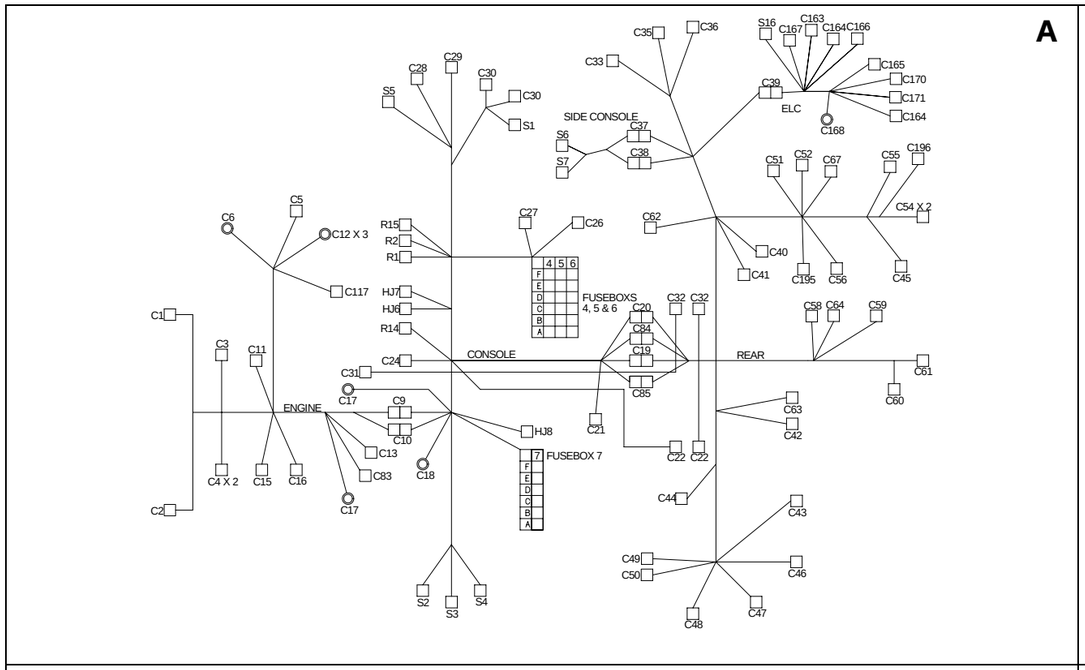
Figure 13
Harness Layout

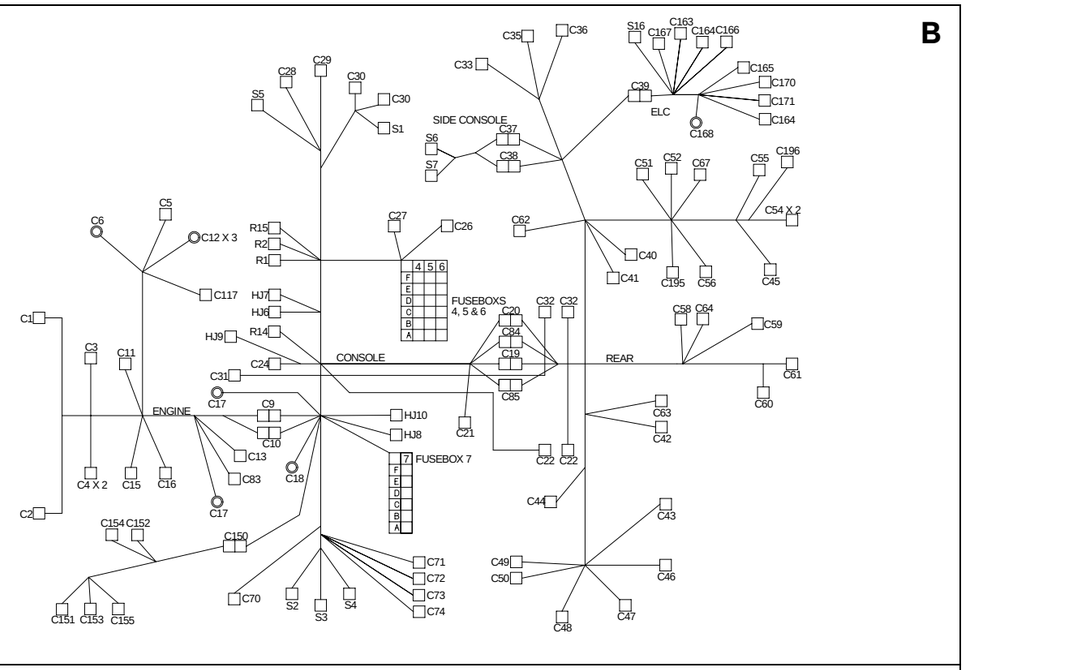
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B - Harness Layout HI Spec NAO Power Shuttle 2003
C - Harness Layout HI Spec AGCO Cummins Power Shuttle 2003
D - Lighting Supply Circuit to Fuse Box Standard WEO

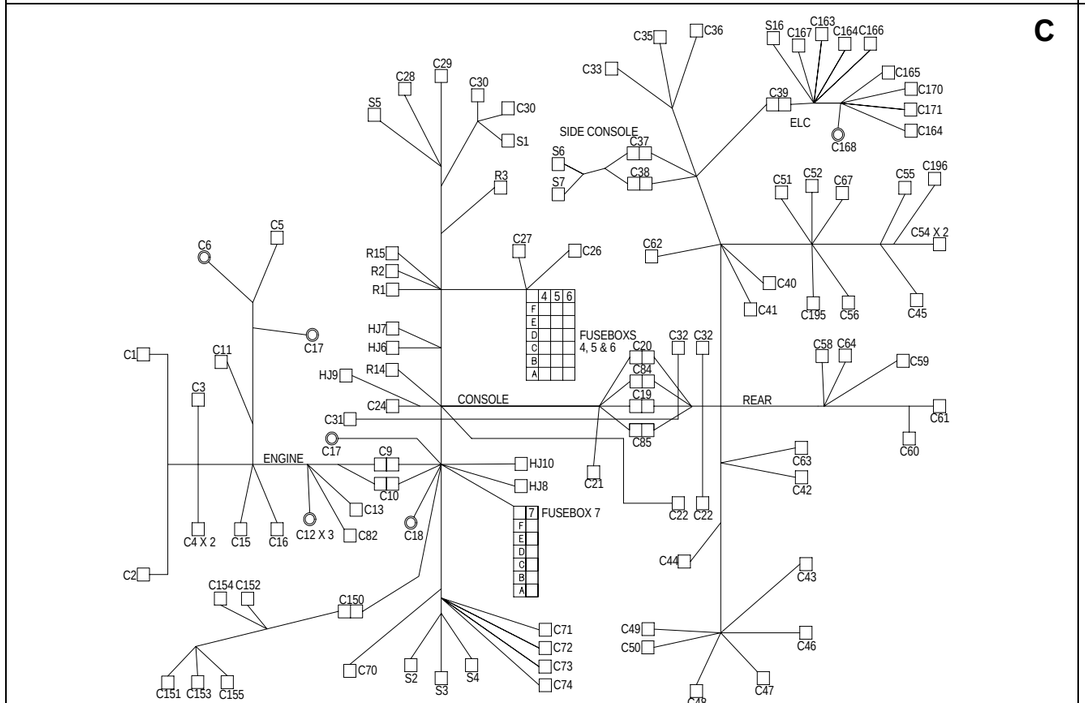
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Footstep Wiring Diagrams







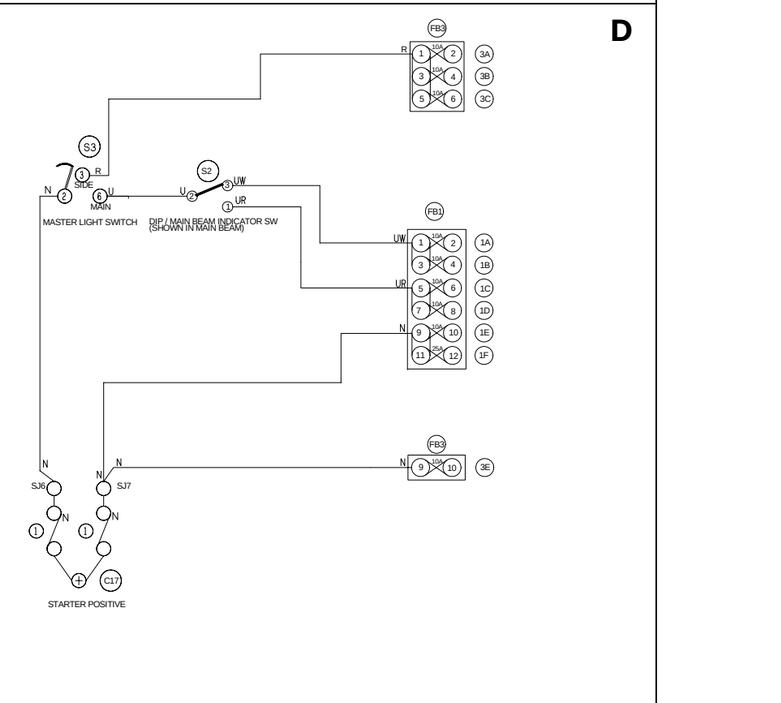


Figure 14

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Figure 15

A - Lighting Supply Circuit to Fuse Box Basic WEO
B - Lighting Supply Circuit to Fuse Box Basic NAO
C - Lighting Supply Circuit to Fuse Box HI Spec WEO Non Power Shuttle
D - Lighting Supply Circuit to Fuse Box HI Spec WEO Power Shuttle

Figure 14

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Tractor Manuals Scotland

Footstep Wiring Diagrams

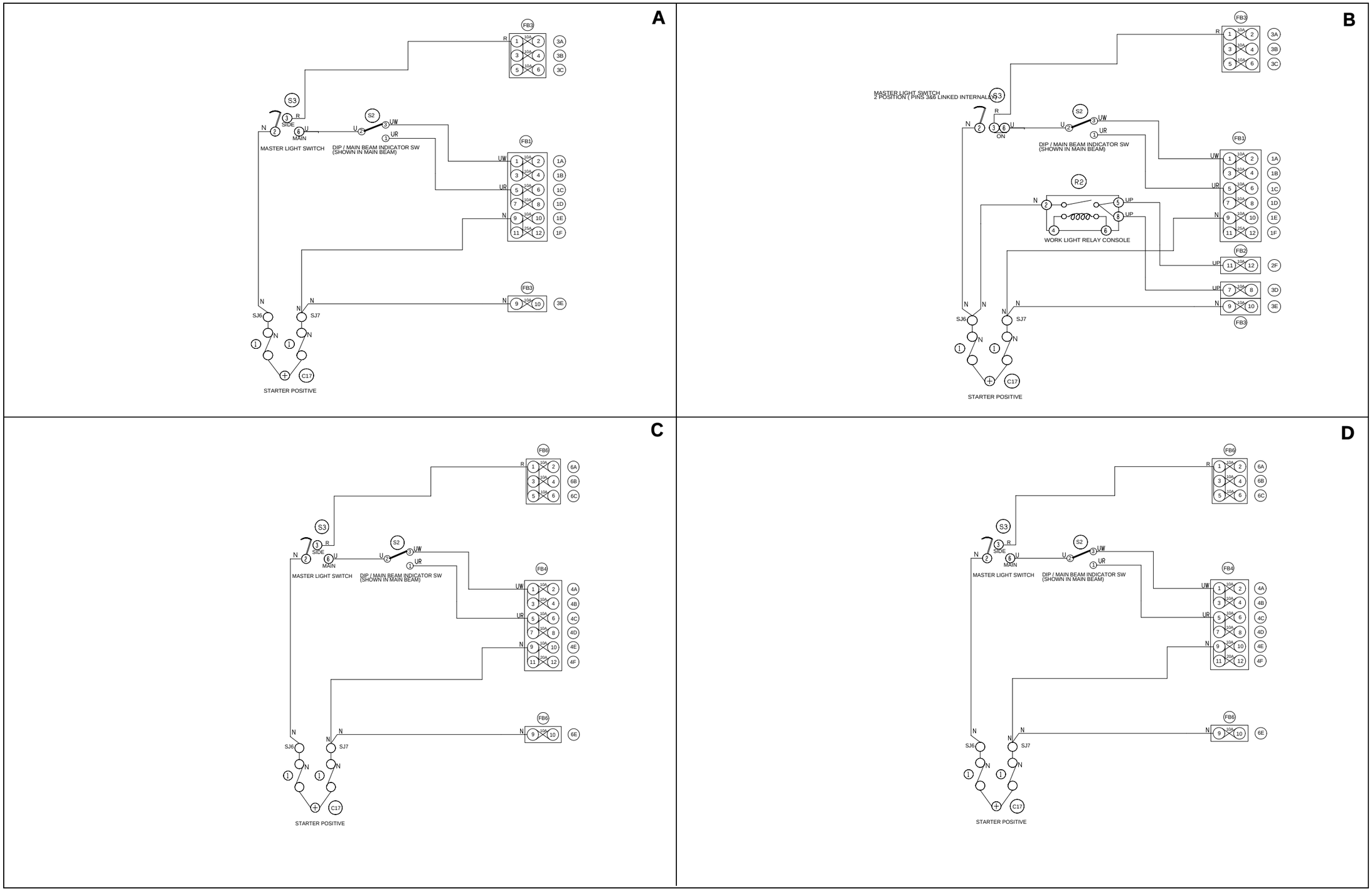


Figure 15

Tractor Manuals Scotland - Please Do Not Copy

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Figure 16

A - Lighting Supply Circuit to Fuse Box HI Spec Japan Non Powershuttle
B - Lighting Supply Circuit to Fuse Box HI Spec Japan Powershuttle
C - Lighting Supply Circuit to Fuse Box HI Spec NAO Non Powershuttle
D - Lighting Supply Circuit to Fuse Box HI Spec NAO Powershuttle

Figure 15

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Tractor Manuals Scotland

Footstep Wiring Diagrams

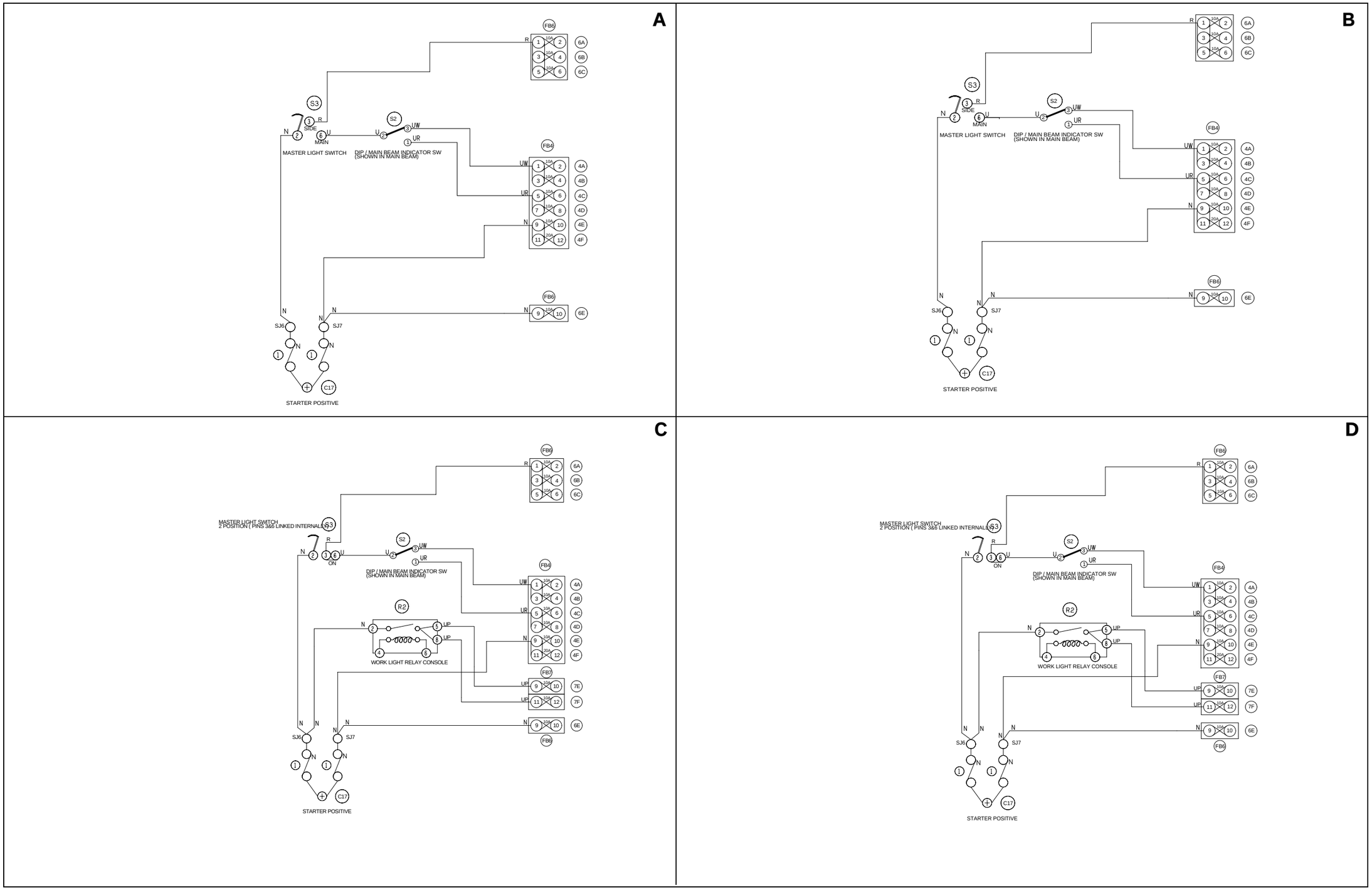


Figure 16

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Footstep Wiring Diagrams

Figure 17

A - Lighting Supply Circuit to Fuse Box

B - Ignition Switch Supply Circuit to Fuse Box Standard WEO

C - Ignition Switch Supply Circuit to Fuse Box Basic WEO

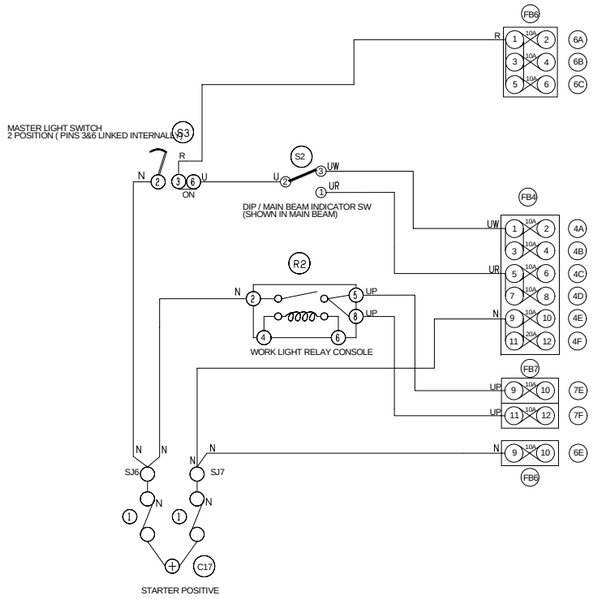
D - Ignition Switch Supply Circuit to Fuse Box Basic NAO

Figure 16

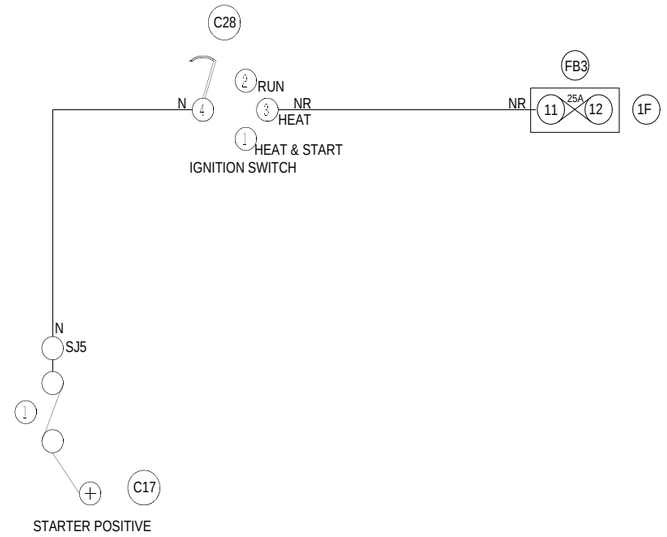
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Tractor Manuals Scotland

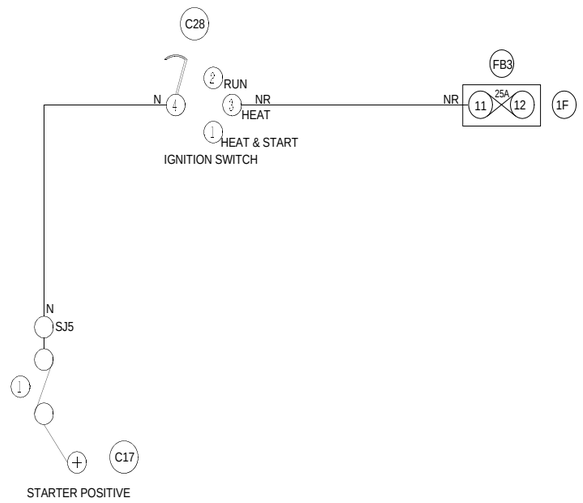
A



B



C



D

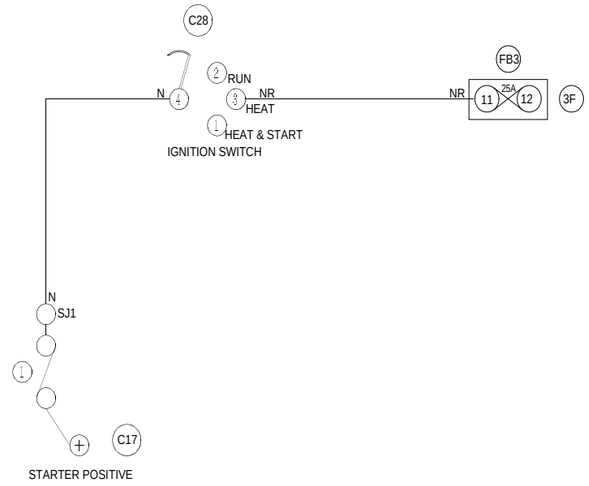


Figure 17

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 18

A - Lighting Supply Circuit to Fuse Box HI Spec WEO Non Power Shuttle
B - Lighting Supply Circuit to Fuse Box HI Spec WEO Power Shuttle
C - Lighting Supply Circuit to Fuse Box HI Spec Japan Non Power Shuttle
D - Lighting Supply Circuit to Fuse Box HI Spec Japan Power Shuttle

Figure 17

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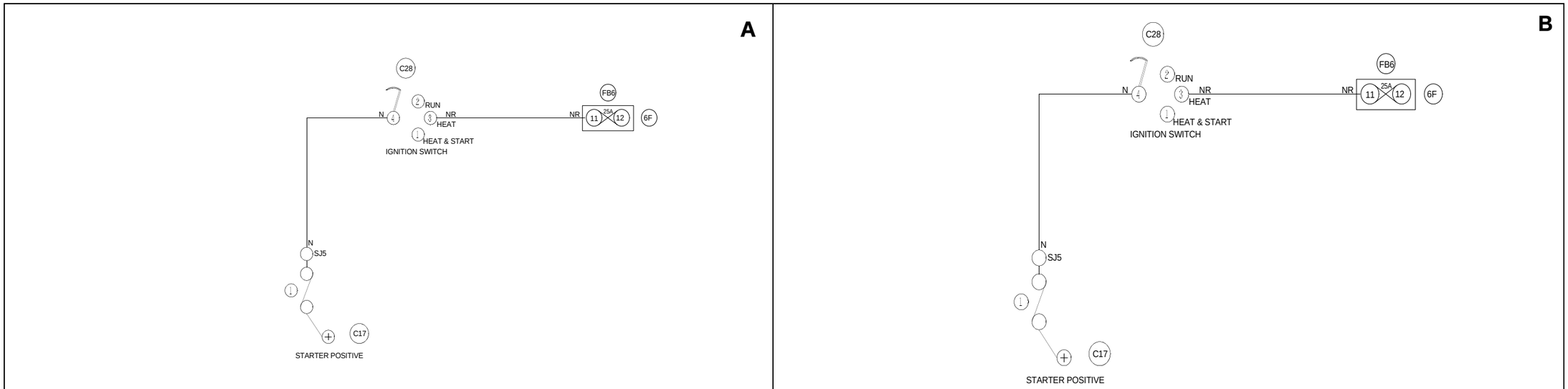


Figure 18

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 19

A - Iginition Switch Supply Circuit to Fuse Box HI Spec NAO Non Power Shuttle
B - Iginition Switch Supply Circuit to Fuse Box HI Spec NAO Power Shuttle
C - Iginition Switch Supply Circuit to Fuse Box HI Spec AGCO Cummins Engine Power Shuttle
D - Iginition Switch Supply Circuit to Fuse Box Standard WEO

Figure 18

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Footstep Wiring Diagrams

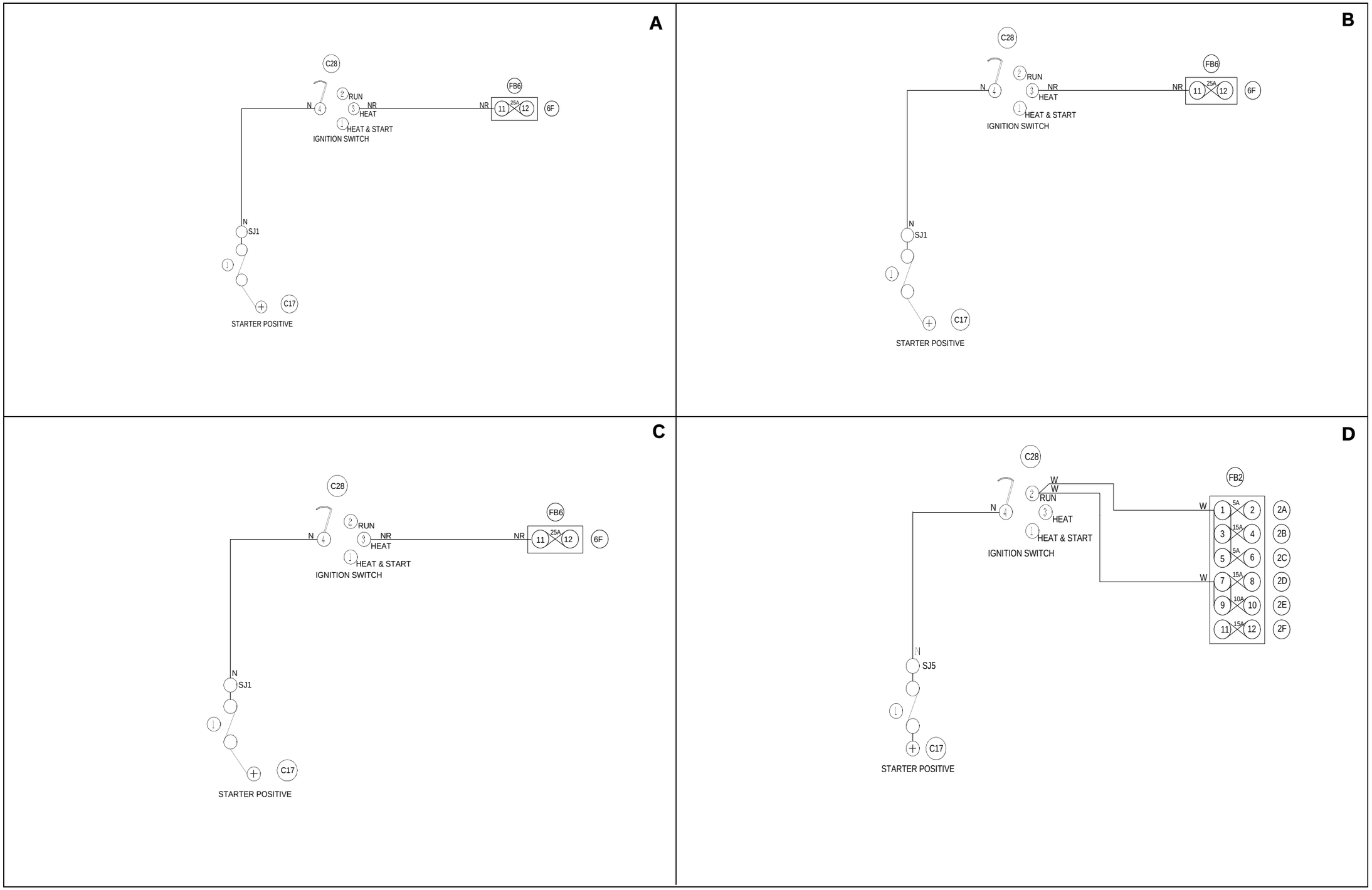


Figure 19

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Figure 19

Figure 20

A - Ignition Switch Supply Circuit to Fuse Box Basic WEO

B - Ignition Switch Supply Circuit to Fuse Box Basic NAO

C - Ignition Switch Supply Circuit to Fuse Box HI Spec WEO Non Power Shuttle

D - Ignition Switch Supply Circuit to Fuse Box HI Spec WEO Power Shuttle

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Tractor Manuals Scotland

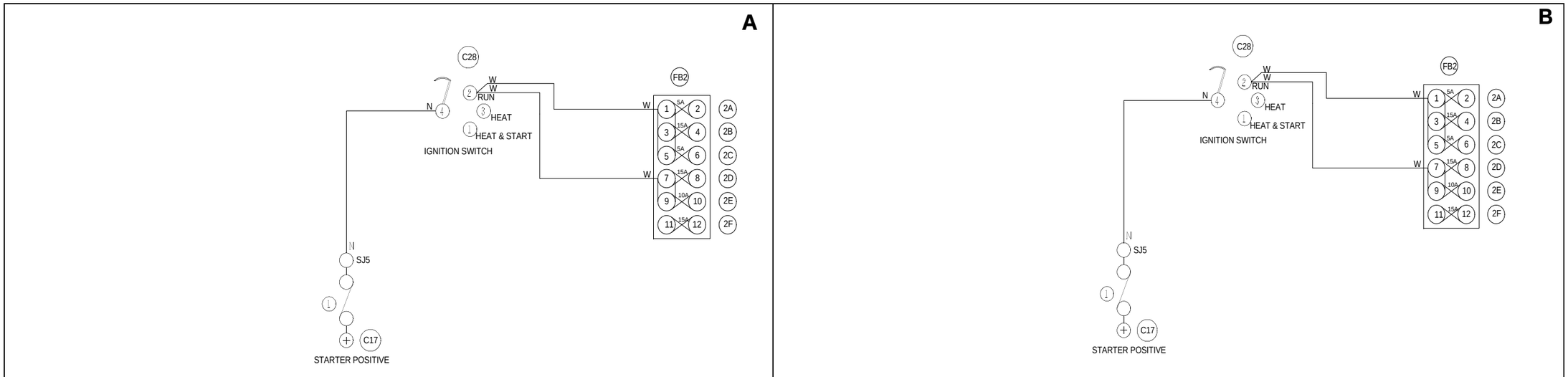


Figure 20

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Figure 20

Figure 21

A - Ignition Switch Supply Circuit to Fuse Box HI Spec Japan Non Power Shuttle
B - Ignition Switch Supply Circuit to Fuse Box HI Spec Japan Power Shuttle
C - Ignition Switch Supply Circuit to Fuse Box HI Spec NAO Non Power Shuttle
D - Ignition Switch Supply Circuit to Fuse Box HI Spec NAO Power Shuttle

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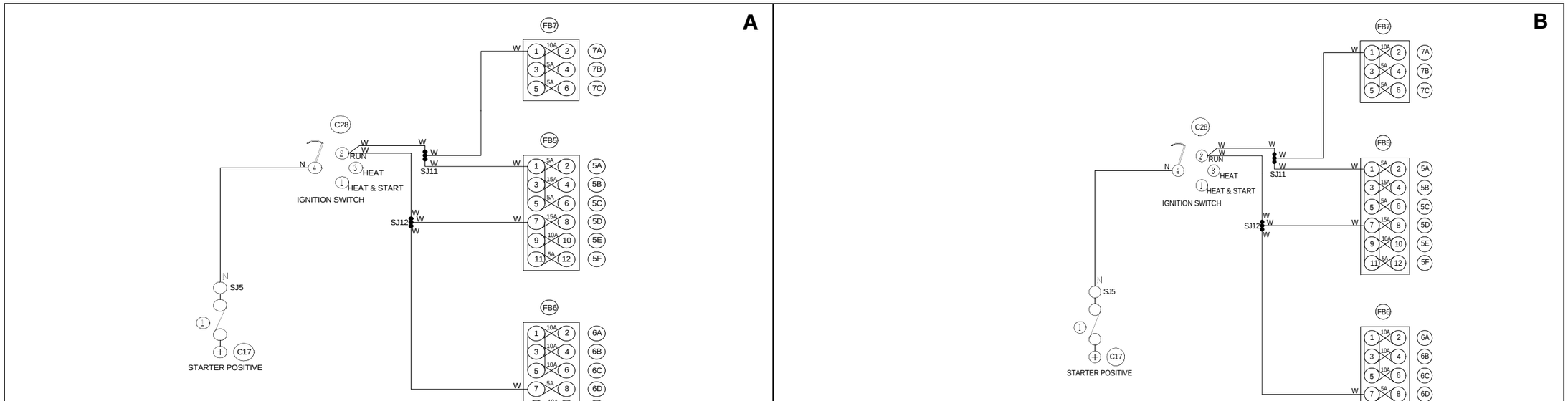


Figure 21 -

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Tractor Manuals Scotland

Figure 22

A - Ignition Switch Supply Circuit to Fuse Box HI Spec AGCO Cummins Engine Power Shuttle
B - Console Fuse Box Mounted Auxillary Power Supply Standard and Basic WEO, NAO and AGCO Cummins Engine
C - Console Fuse Box Mounted Auxillary Power Supply HI Spec WEO, NAO and AGCO Cummins Engine
D - Thermostart Circuit Standard WEO

Figure 21

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Footstep Wiring Diagrams

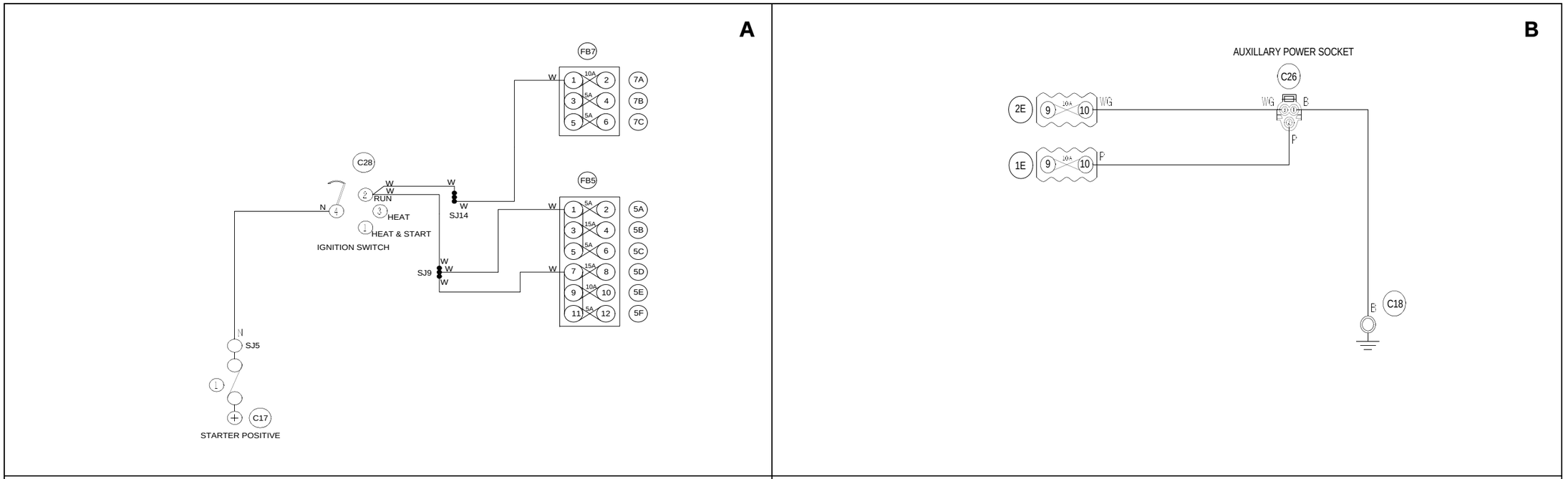


Figure 22

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Tractor Manuals Scotland

Figure 23

A - Thermostart circuit Basic WEO
B - Thermostart circuit Basic NAO
C - Thermostart circuit HI SPEC WEO
D - Thermostart Circuit HI SPEC Japan

Figure 22

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Footstep Wiring Diagrams

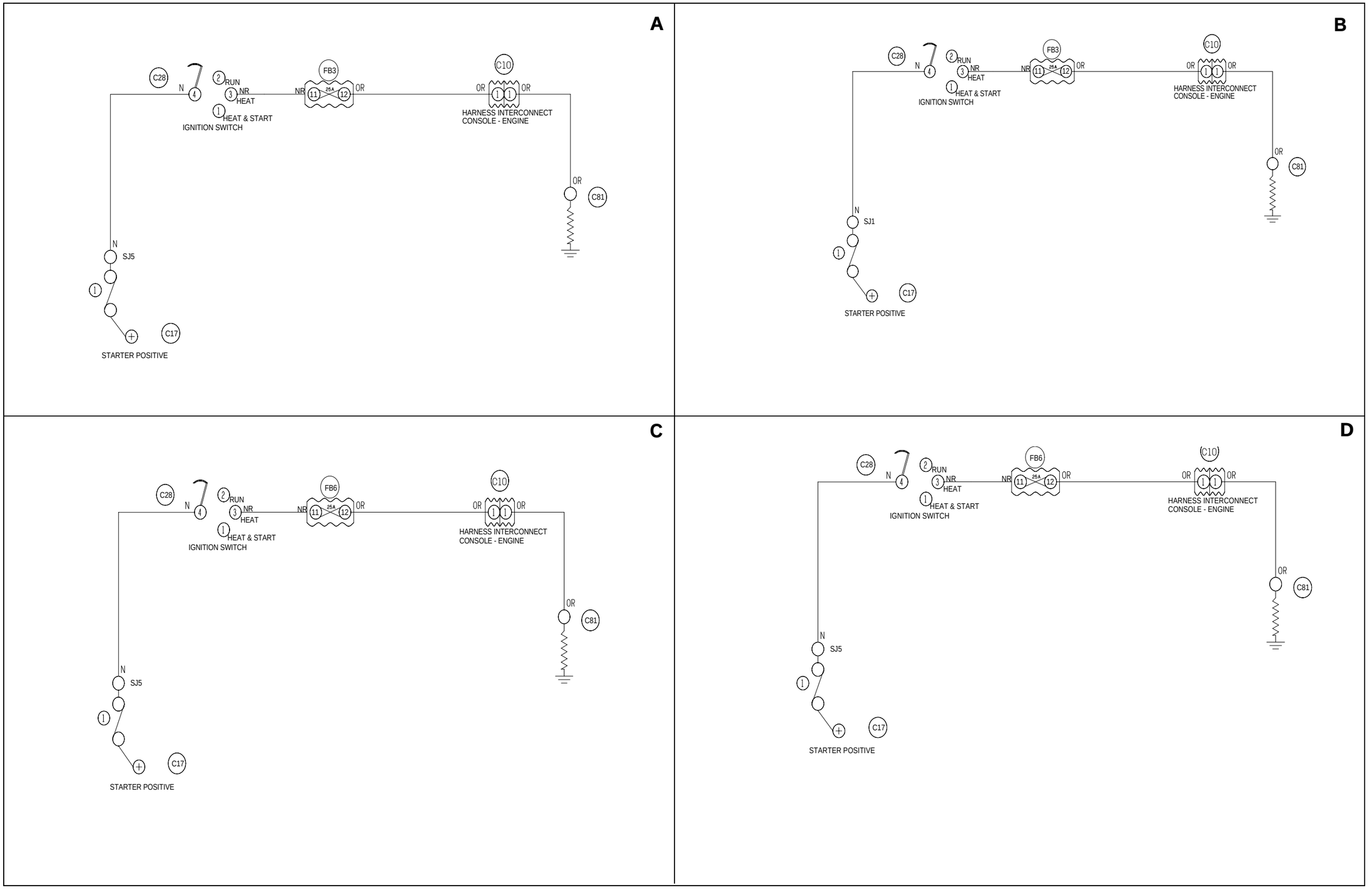


Figure 23

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Figure 24

A - Thermostart circuit HI SPEC NAO
B - Mechanical Diff Lock Standard WEO
C - Electrical Diff Lock Basic WEO
D - Electrical Diff Lock Basic NAO

Figure 23

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Tractor Manuals Scotland

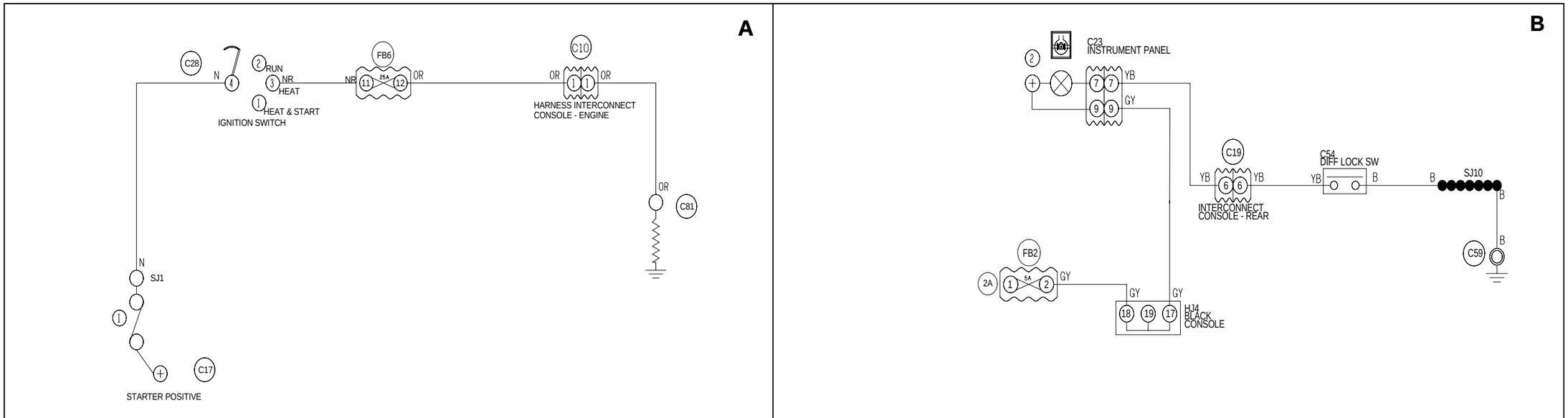


Figure 24

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Tractor Manuals Scotland

Figure 25

A - Electrical Diff Lock HI SPEC WEO

B - Electrical Diff Lock HI SPEC Japan

C - Electrical Diff Lock HI SPEC NAO

D - Electrical Diff Lock HI SPEC AGCO Cummins Engine

Figure 24

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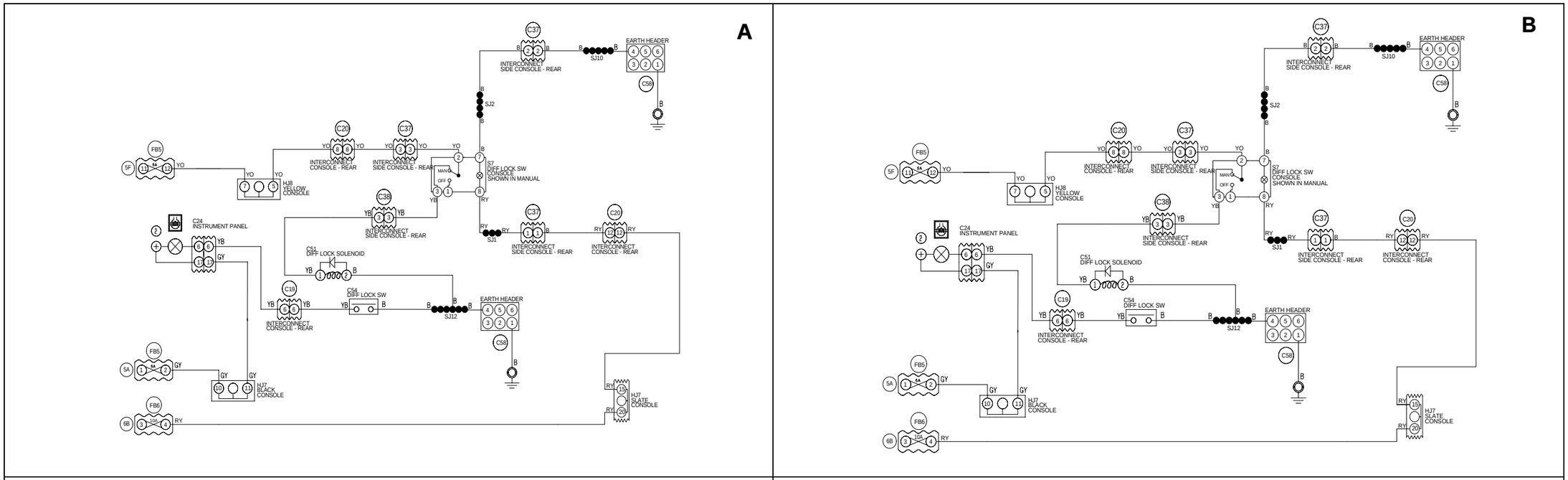


Figure 25

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 26

A - Electrically Operated 4WD Switch - Standard WEO
B - Electrically Operated 4WD Switch - Standard NAO
C - Electrically Operated Side Console Mounted 4 WD Switch HI SPEC WEO
D - Electrically Operated Side Console Mounted 4 WD Switch HI SPEC Japan

Figure 25

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Tractor Manuals Scotland

Footstep Wiring Diagrams

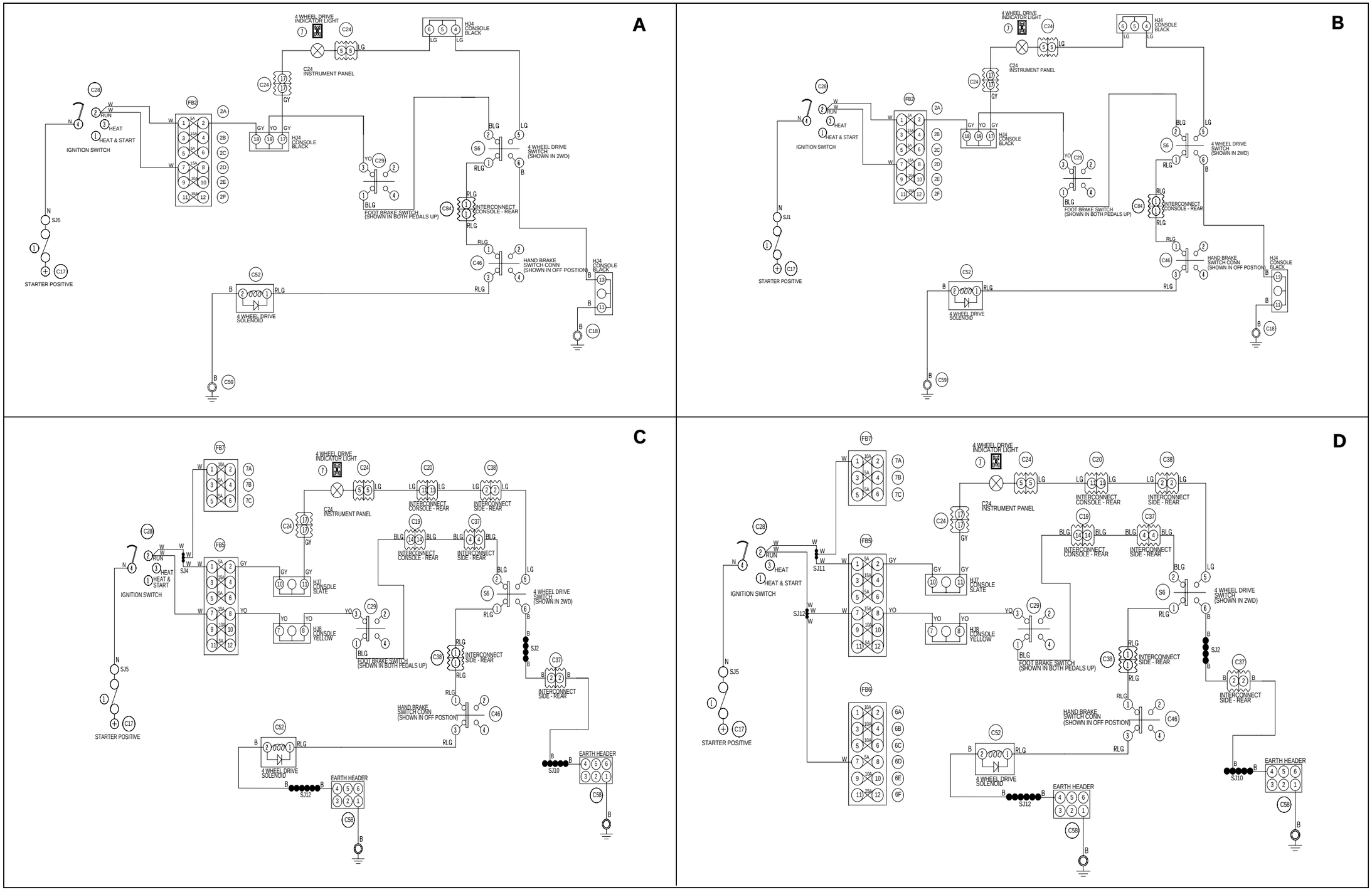


Figure 26

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 27

A - Electrically Operated Side Console Mounted 4WD Switch HI SPEC NAO
B - Electrically Operated Side Console Mounted 4WD Switch HI SPEC AGCO Cummins Engine
C - Supply to Instrument Panel
D - Supply to Instrument Panel Basic WEO

Figure 26

Tractor Manuals Scotland - Please Do Not Copy

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Footstep Wiring Diagrams

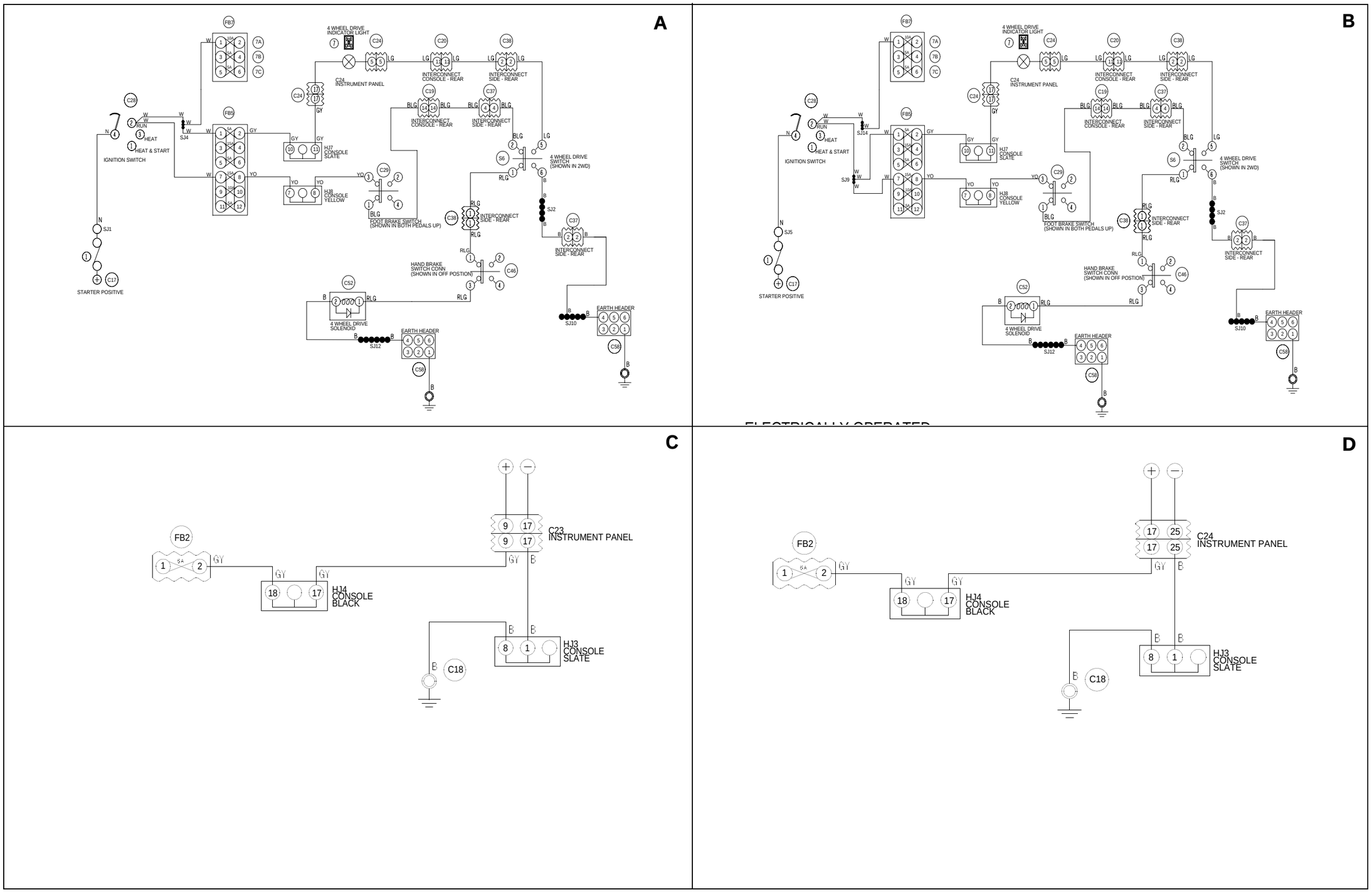


Figure 27

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Tractor Manuals Scotland

Figure 28

A - Supply to Instrument Panel Basic NAO
B - Supply to Instrument Panel HI SPEC WEO
C - Supply to Instrument Panel HI SPEC Japan
D - Supply to Instrument Panel HI SPEC NAO

Figure 27

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Tractor Manuals Scotland

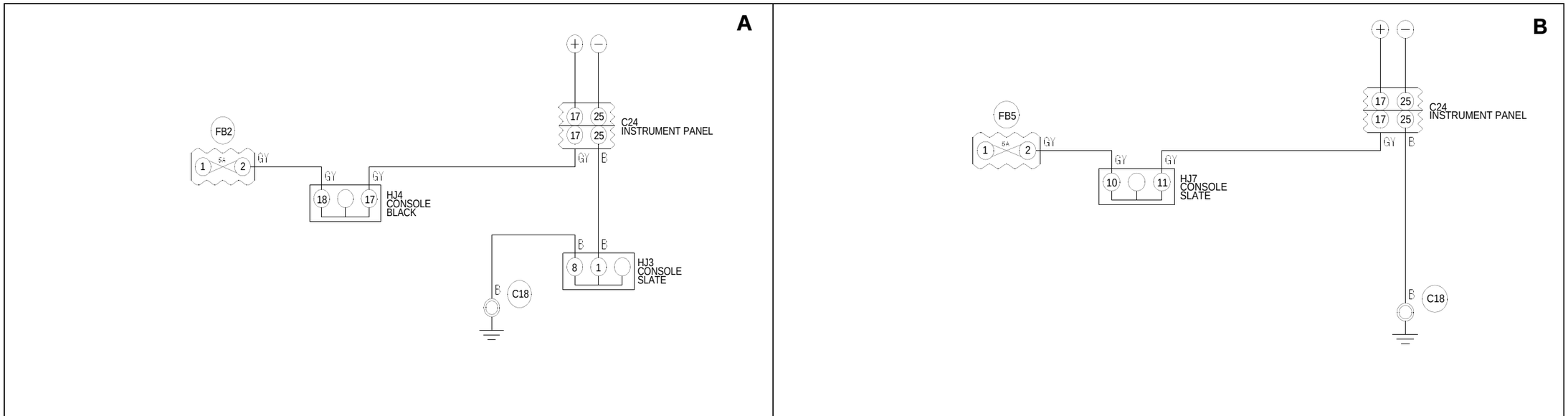


Figure 28

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 29

A - Supply to Instrument Panel HI SPEC AGCO Cummins Engine
B - Range Change 2 Speed Circuit Non Power Shuttle HI SPEC WEO
C - Range Change 2 Speed Circuit Non Power Shuttle HI SPEC NAO and AGCO Cummins Engine
D - Range Change 3 Speed Circuit Non Power Shuttle HI SPEC WEO

Figure 28

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Tractor Manuals Scotland

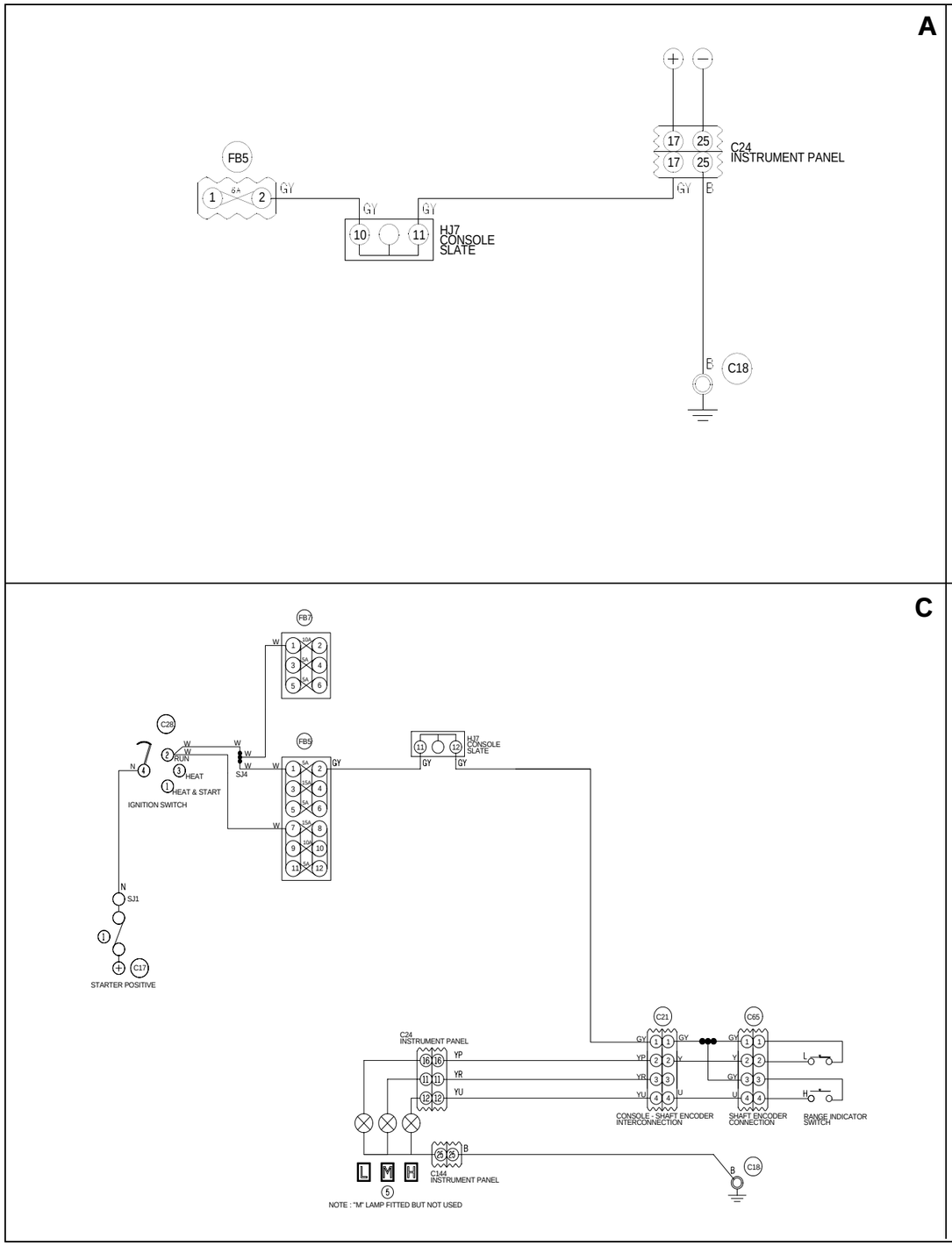


Figure 29

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 30
A - Range Change 3 Speed Circuit Power Shuttle HI SPEC WEO 2001-2002
B - Range Change 3 Speed Circuit Non Power Shuttle HI SPEC Japan
C - Range Change 3 Speed Circuit Power Shuttle HI SPEC Japan
D - Range Change 3 Speed Circuit Non Power Shuttle HI SPEC NAO

Figure 29

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Tractor Manuals Scotland

Footstep Wiring Diagrams

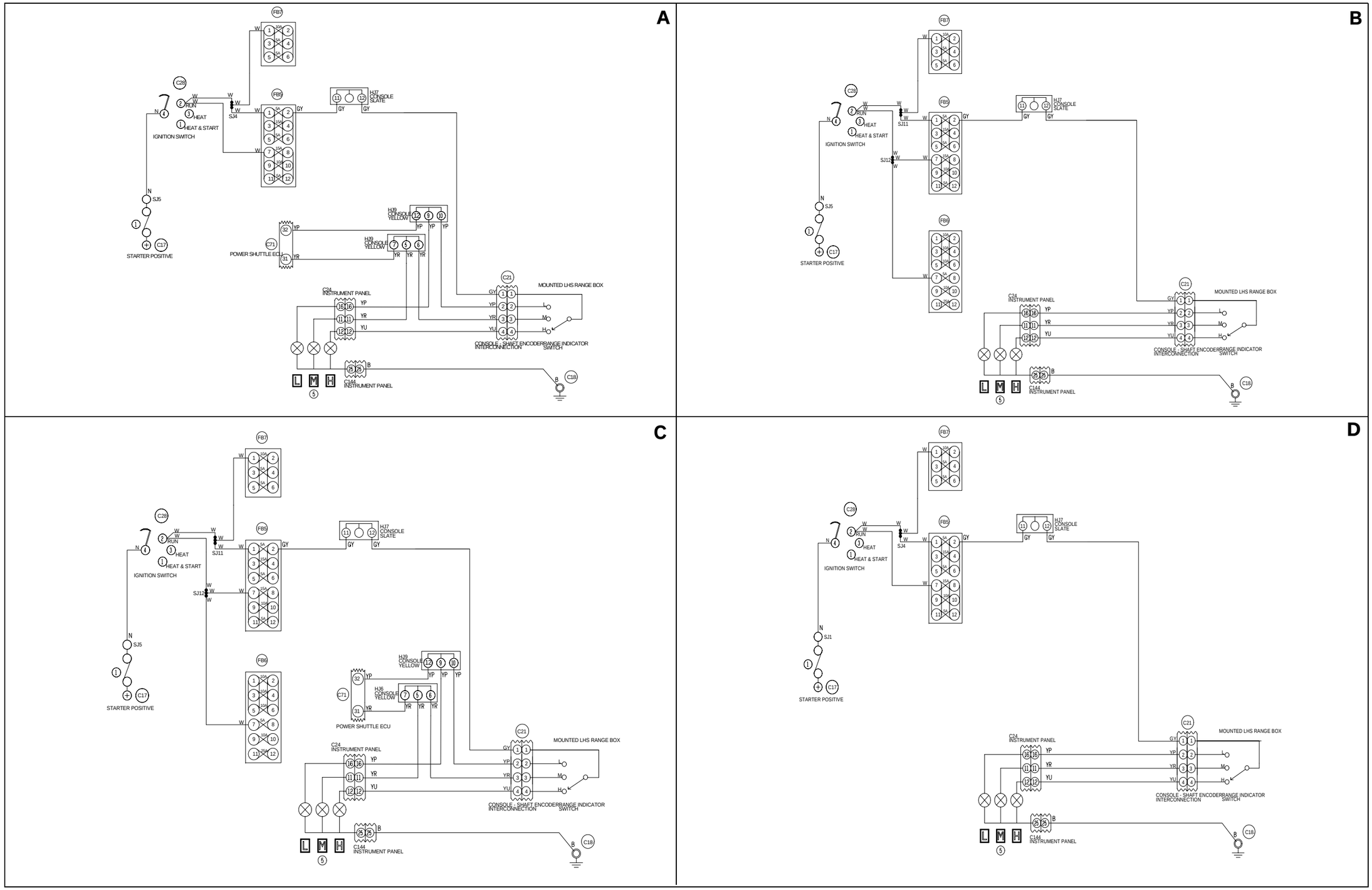


Figure 30

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 31

A - Range Change 3 Speed Circuit Power Shuttle HI SPEC NAO 2001-2002

B - Range Change 3 Speed Circuit Power Shuttle HI SPEC AGCO Cummins Engine 2001-2002

C - Range Change 3 Speed Circuit Power Shuttle HI SPEC WEO 2003

D - Range Change 3 Speed Circuit Power Shuttle HI SPEC Japan 2003

Figure 30

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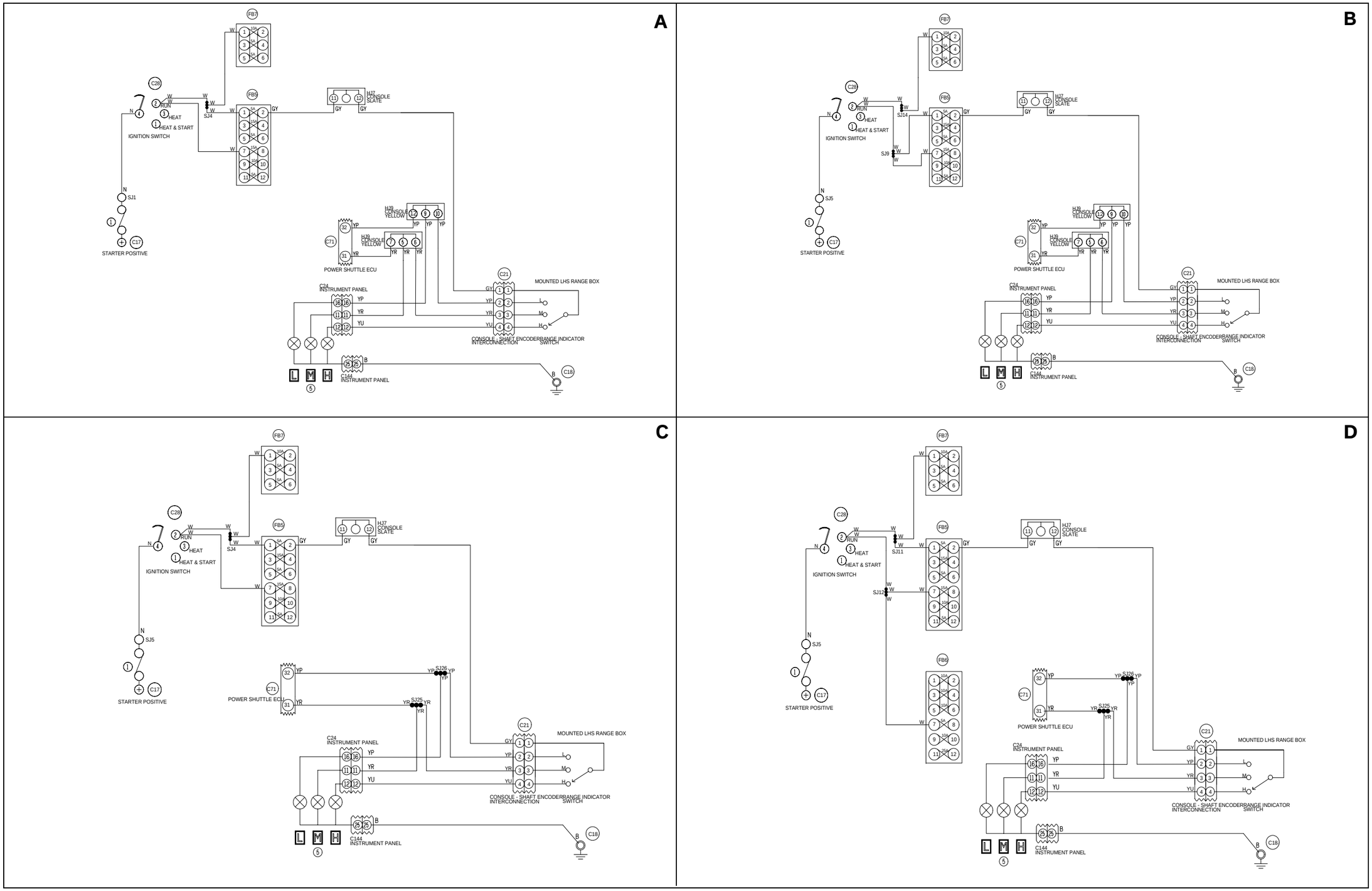


Figure 31

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 32

A - Range Change 3 Speed Circuit Power Shuttle HI SPEC NAO2003

B - Range Change 3 Speed Circuit Power Shuttle HI SPEC AGCO Cummins Engine 2003

C - Ground Speed Circuit Basic WEO 2001-2002

D - Ground Speed Circuit Basic NAO 2001-2002

Figure 31

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Tractor Manuals Scotland

Footstep Wiring Diagrams

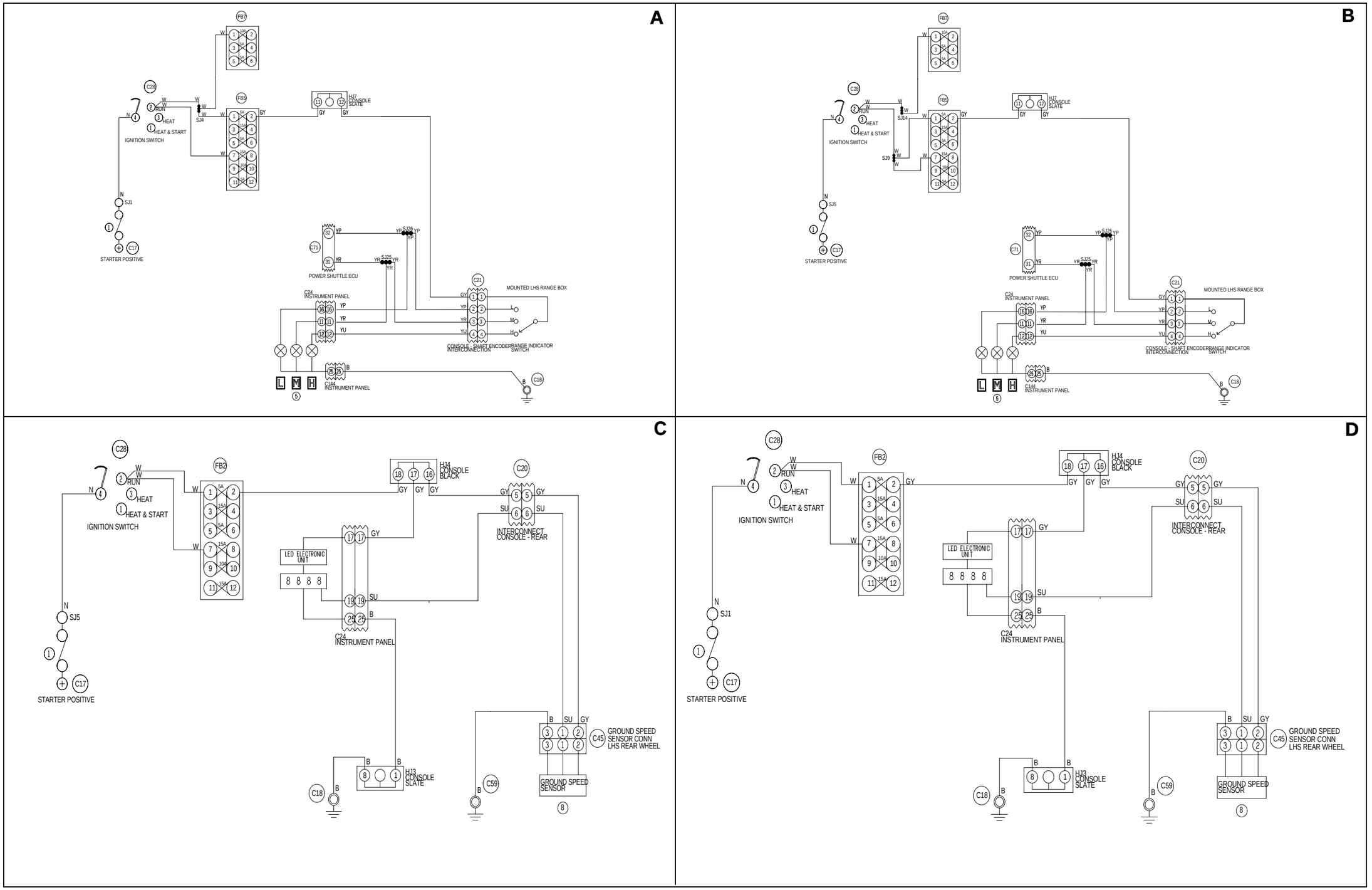


Figure 32

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Tractor Manuals Scotland

Figure 33

A - Ground Speed Circuit HI SPEC WEO Non Power Shuttle 2001-2002
B - Ground Speed Circuit HI SPEC WEO Power Shuttle 2001-2002
C - Ground Speed Circuit HI SPEC Japan Non Power Shuttle 2001-2002
D - Ground Speed Circuit HI SPEC Japan Power Shuttle 2001-2002

Figure 32

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Tractor Manuals Scotland

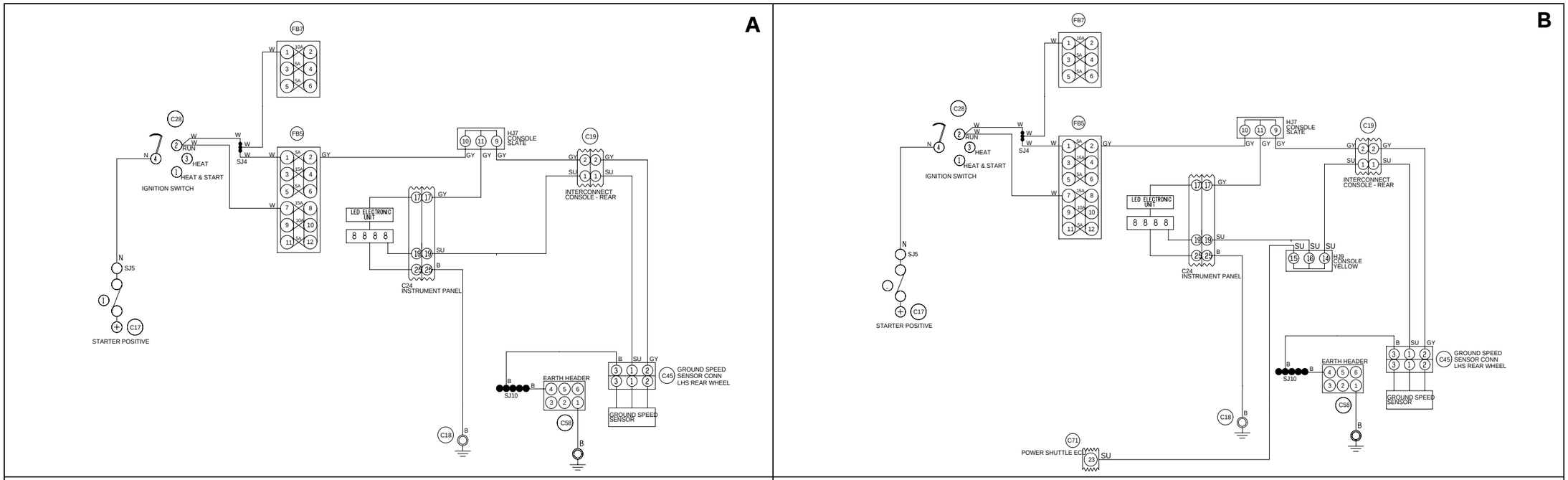


Figure 33

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 34

A - Ground Speed Circuit HI SPEC NAO Non Power Shuttle 2001-2002
B - Ground Speed Circuit HI SPEC NAO Power Shuttle 2001-2002
C - Ground Speed Circuit HI SPEC AGCO Cummins Engine Power Shuttle
D - Ground Speed Circuit Basic WEO 2003

Figure 33

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Footstep Wiring Diagrams

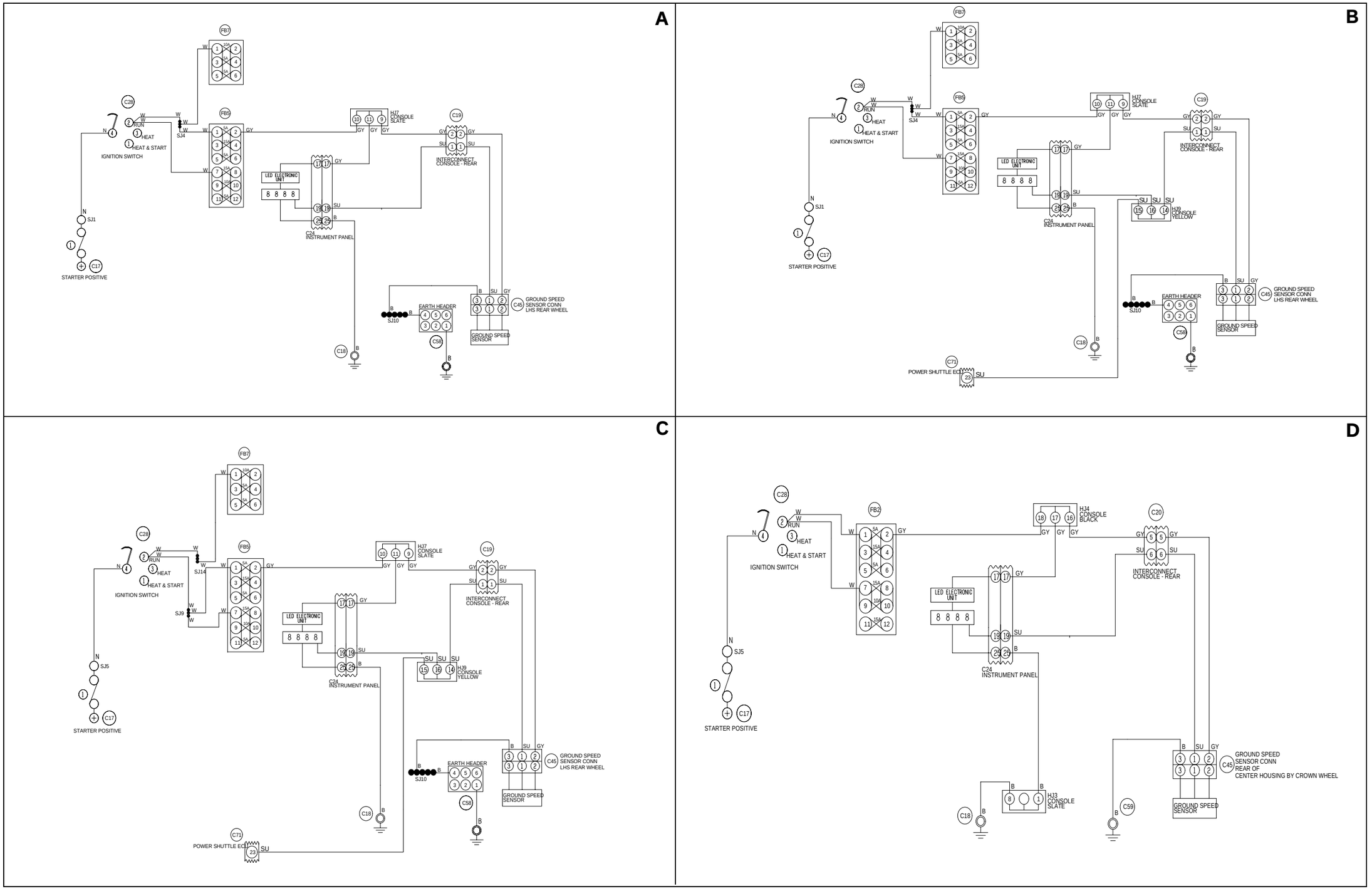


Figure 34

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 35

A - Ground Speed Circuit Basic NAO 2003

B - Ground Speed Circuit HI SPEC WEO Non Power Shuttle 2003

C - Ground Speed Circuit HI SPEC WEO Power Shuttle 2003

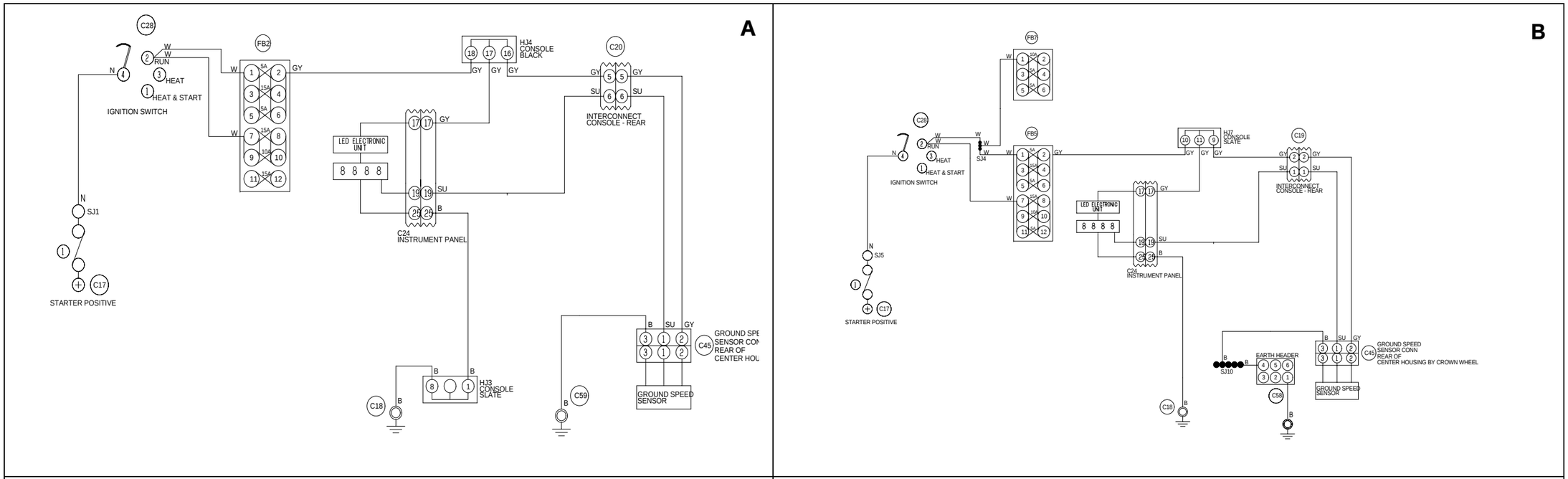
D - Ground Speed Circuit HI SPEC Japan Non Power Shuttle 2003

Figure 34

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Footstep Wiring Diagrams



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Tractor Manuals Scotland

Figure 36

A - Ground Speed Circuit HI SPEC Japan Power Shuttle 2003

B - Ground Speed Circuit HI SPEC NAO Non Power Shuttle 2003

C - Ground Speed Circuit HI SPEC NAO Power Shuttle 2003

D - Ground Speed Circuit HI SPEC AGCO Cummins Engine 2003

Figure 35

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Tractor Manuals Scotland

Footstep Wiring Diagrams

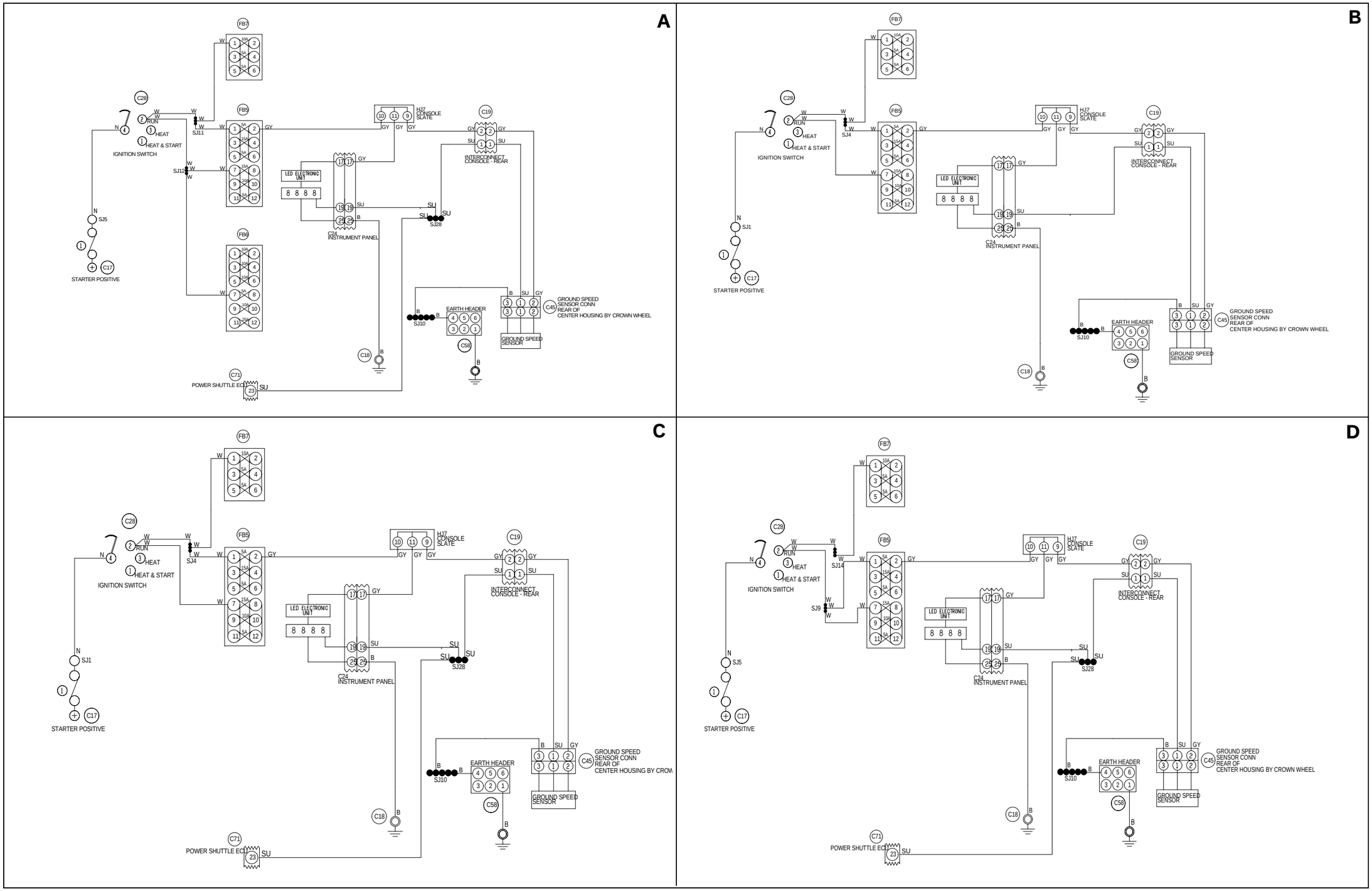


Figure 36

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Footstep Wiring Diagrams

Figure 37

A - Brake Lights Circuit Basic and Standard WEO

B - Brake Lights Circuit HI SPEC WEO and Japan

C - Horn Circuit Standard and Basic

D - Horn Circuit HI SPEC

Figure 36

Tractor Manuals Scotland - Please Do Not Copy

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Footstep Wiring Diagrams

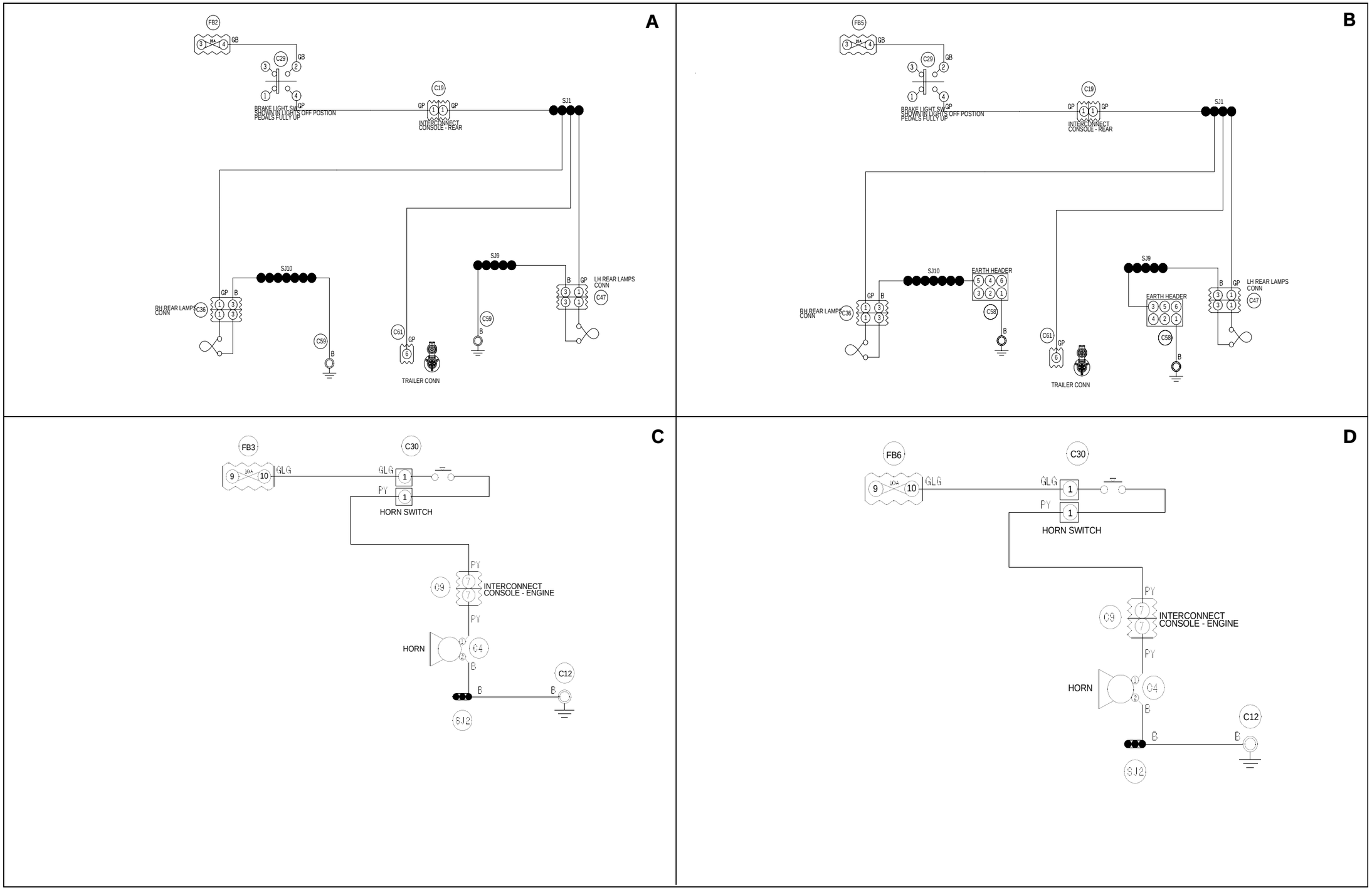


Figure 37

Tractor Manuals Scotland - Please Do Not Copy

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Figure 38

A - Electronic Lift Control Supply HI SPEC WEO
B - Electronic Lift Control Supply HI SPEC Japan
C - Electronic Lift Control Supply HI SPEC NAO
D - Electronic Lift Control Supply HI SPEC AGCO Cummins Engine

Figure 37

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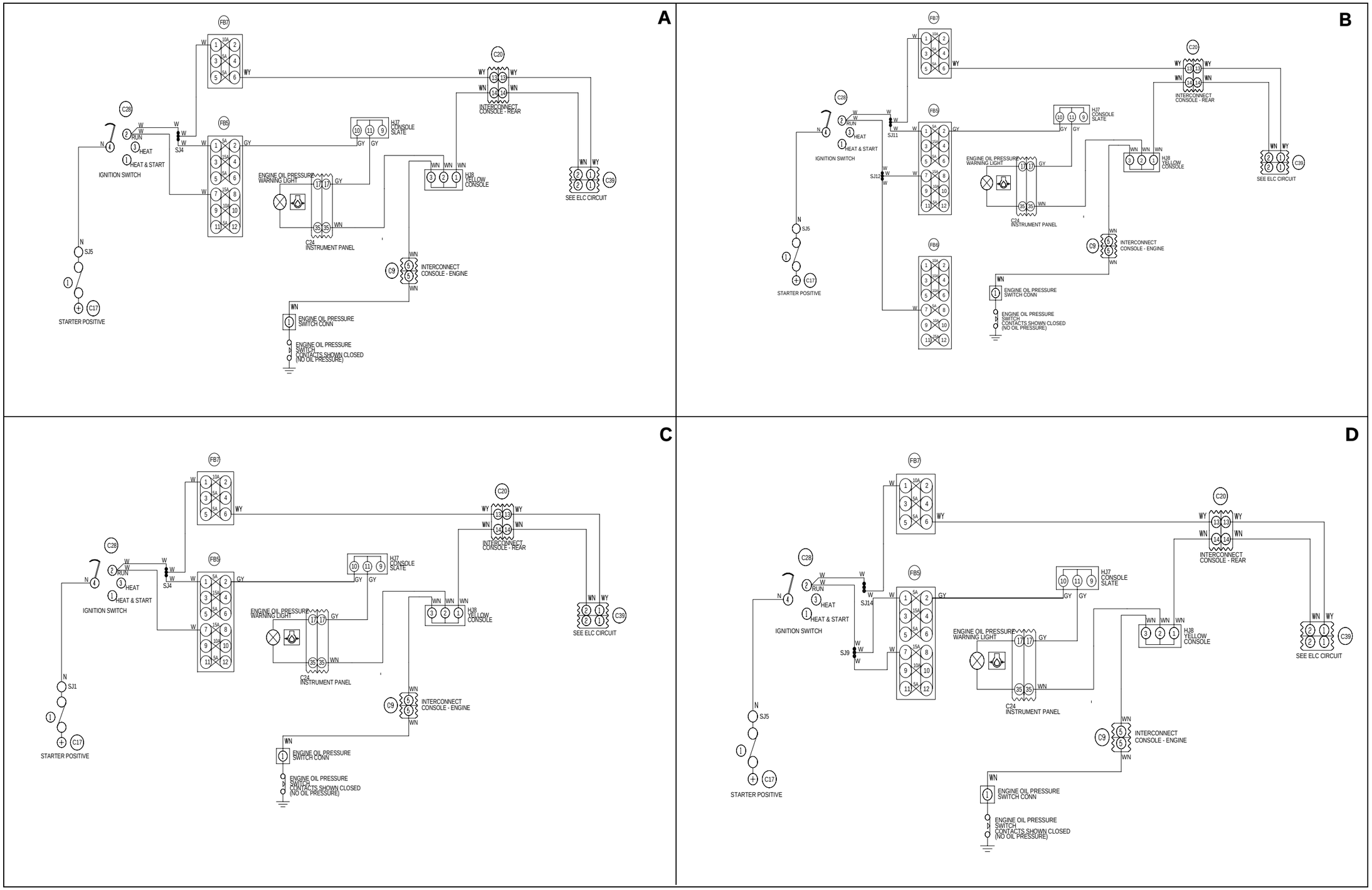


Figure 38

Tractor Manuals Scotland - Please Do Not Copy

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Figure 38

Figure 39

A - Reverse Light/ Bleeper Circuit HI SPEC WEO Non Power Shuttle
B - Reverse Light/ Bleeper Circuit HI SPEC WEO Power Shuttle
C - Reverse Light/ Bleeper Circuit HI SPEC Japan Non Power Shuttle
D - Reverse Light/ Bleeper Circuit HI SPEC Japan Power Shuttle

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Tractor Manuals Scotland

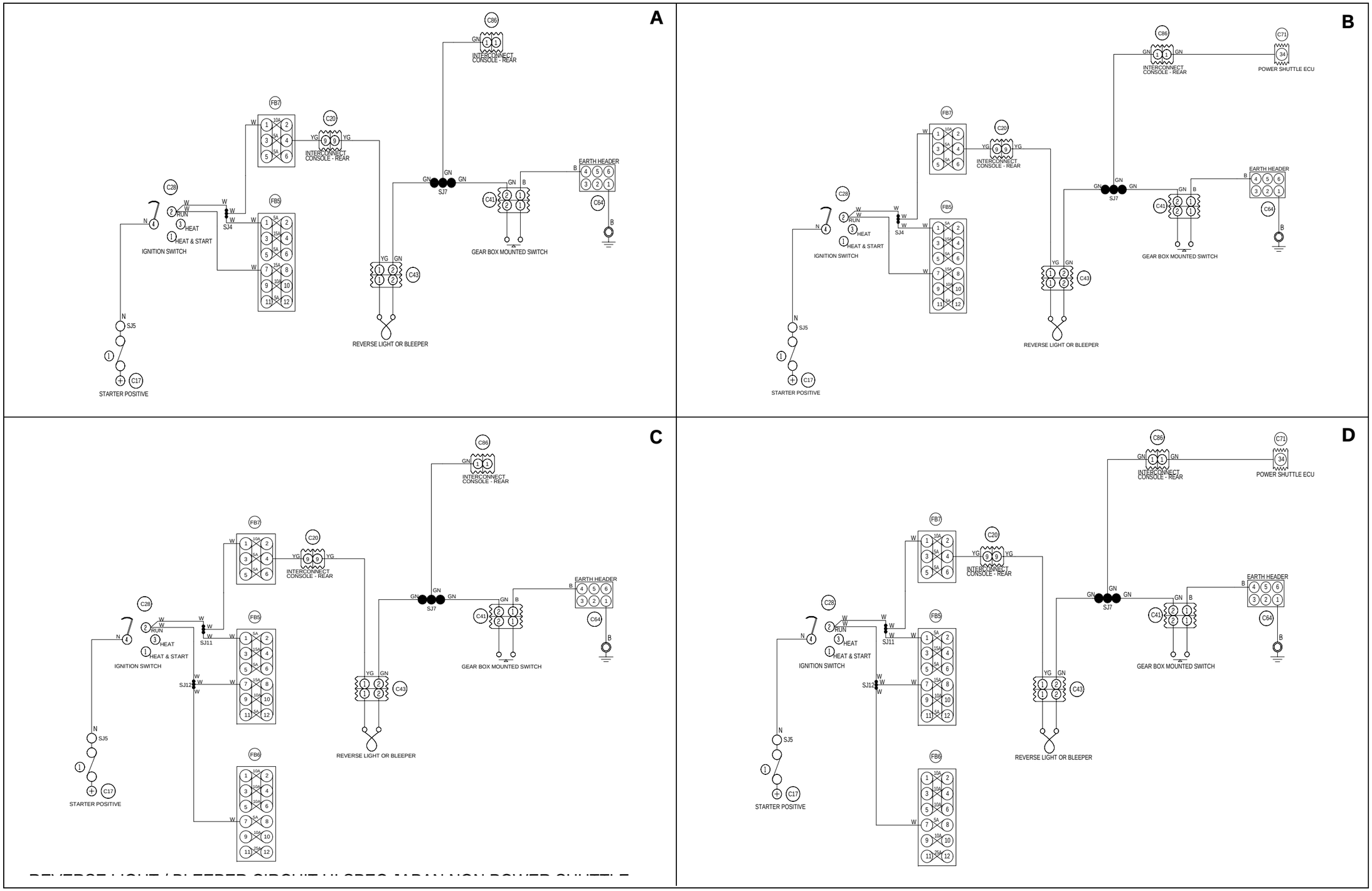


Figure 39

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 40

A - Reverse Light/ Bleeper Circuit HI SPEC WEO Non Power Shuttle
B - Reverse Light/ Bleeper Circuit HI SPEC NAO Power Shuttle
C - Reverse Light/ Bleeper Circuit HI SPEC AGCO Cummins Engine
D - RHS Side Position Lights Standard WEO

Figure 39

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Footstep Wiring Diagrams

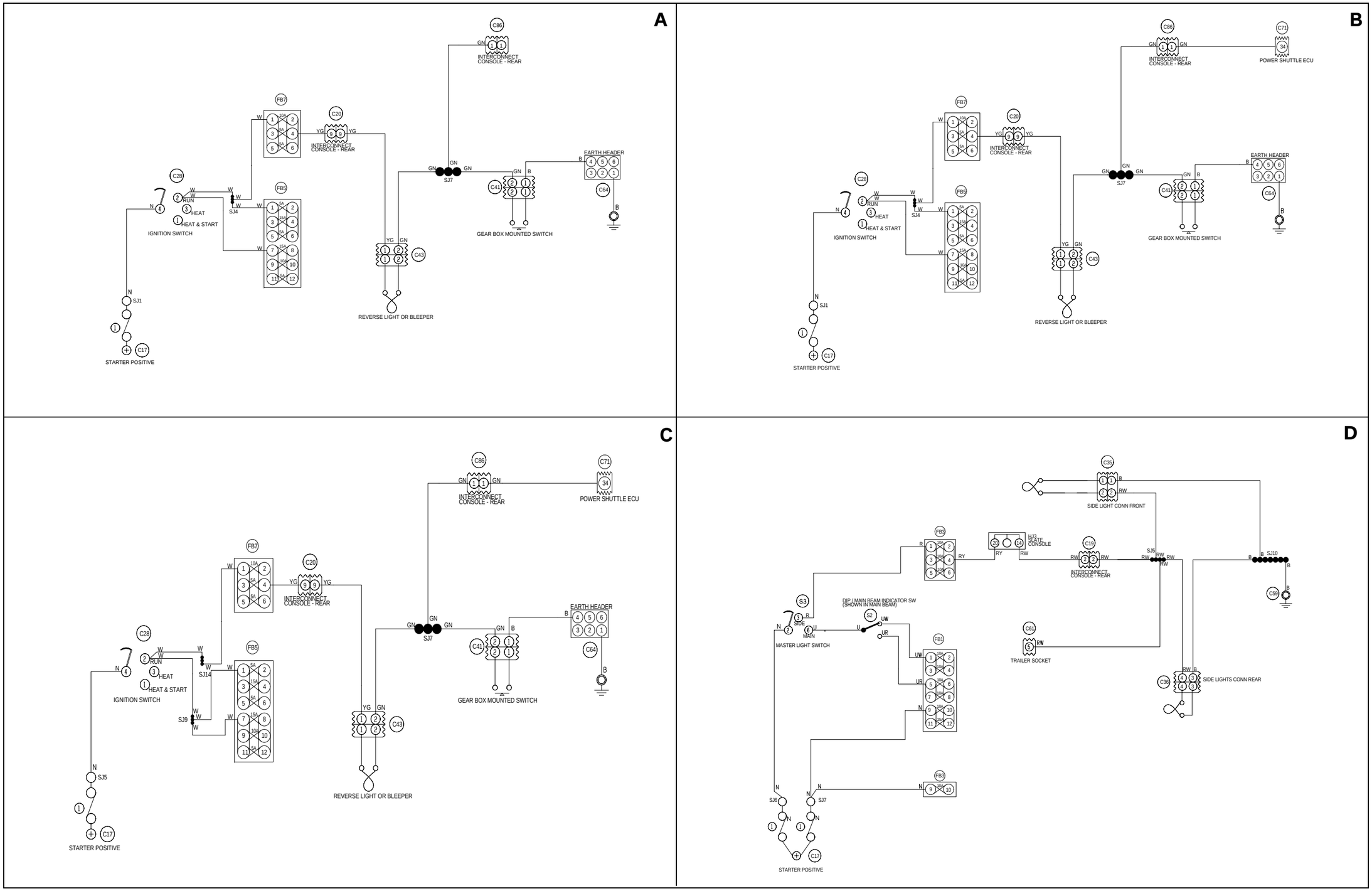


Figure 40

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Footstep Wiring Diagrams

Figure 41
A - RHS Side Position Lights Basic WEO
B - RHS Side Position Lights Basic NAO
C - RHS Side Position Lights HI SPEC WEO
D - RHS Side Position LightsHI SPEC Japan

Figure 40

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Tractor Manuals Scotland

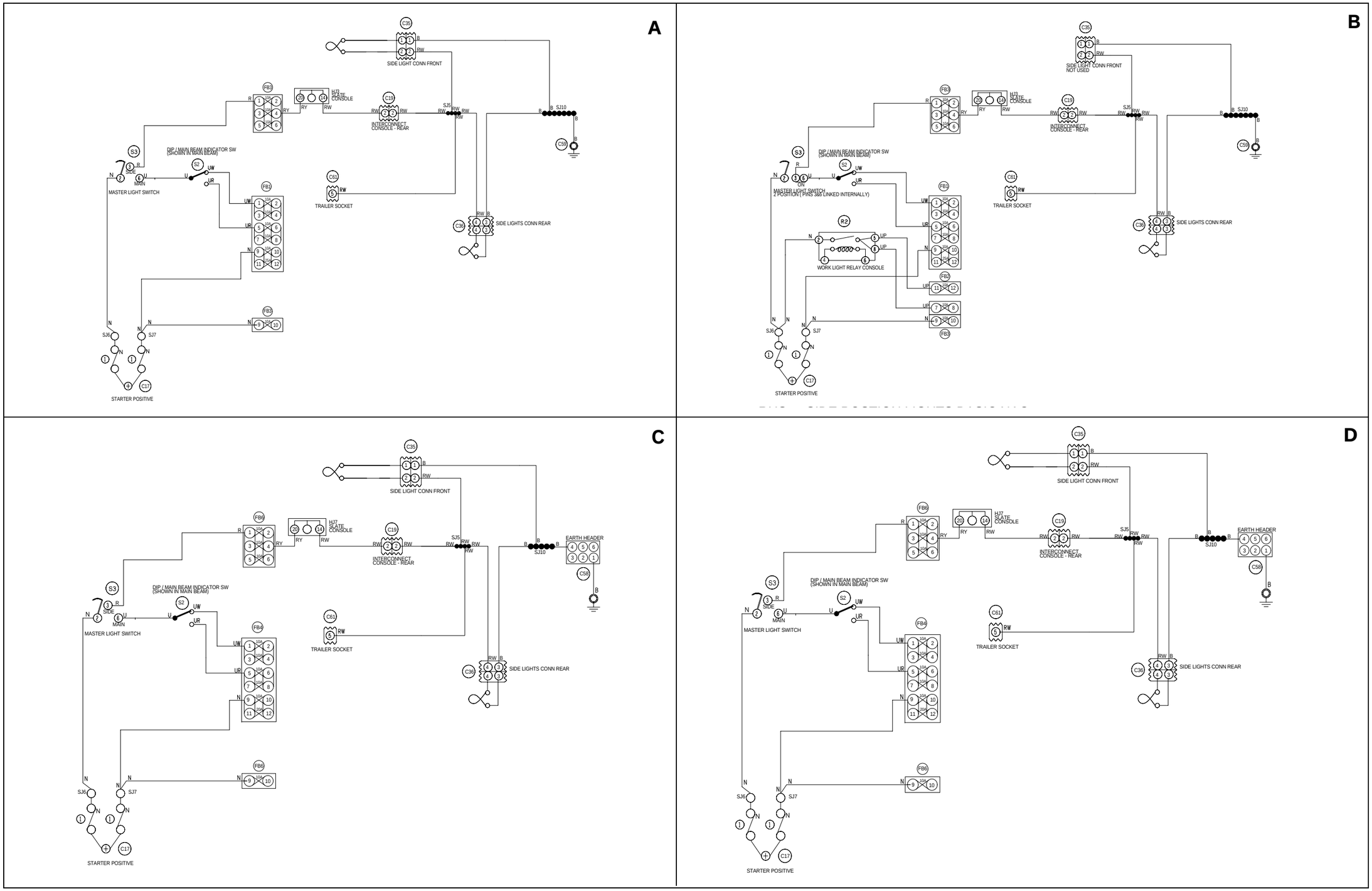


Figure 41

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Tractor Manuals Scotland

Figure 42

A - RHS Side Position Lights HI SPEC NAO

B - RHS Side Position Lights HI SPEC AGCO Cummins Engine

C - RHS Side Position Lights and Number Plate Light Standard WEO

D - RHS Side Position Lights and Number Plate Light Basic WEO

Figure 41

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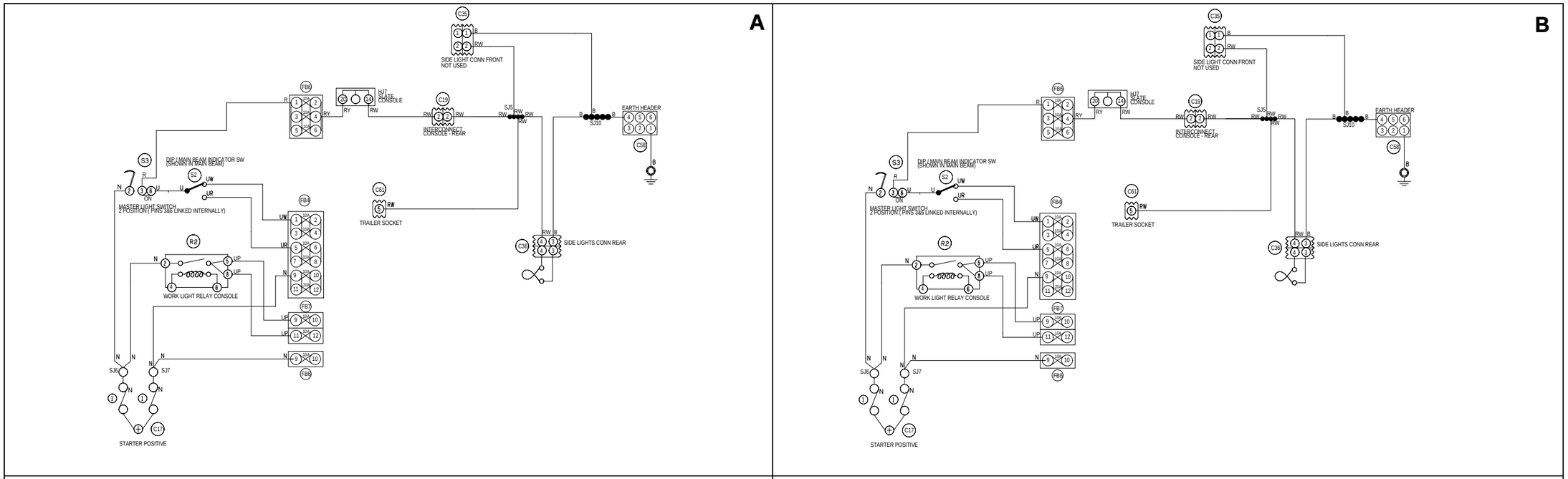


Figure 42

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 43

A - RHS Side Position Lights and Number Plate Light Basic NAO

B - RHS Side Position Lights and Number Plate Light HI SPEC WEO

C - RHS Side Position Lights and Number Plate Light HI Japan

D - RHS Side Position Lights and Number Plate Light HI SPEC NAO

Figure 42

Tractor Manuals Scotland - Please Do Not Copy

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Footstep Wiring Diagrams

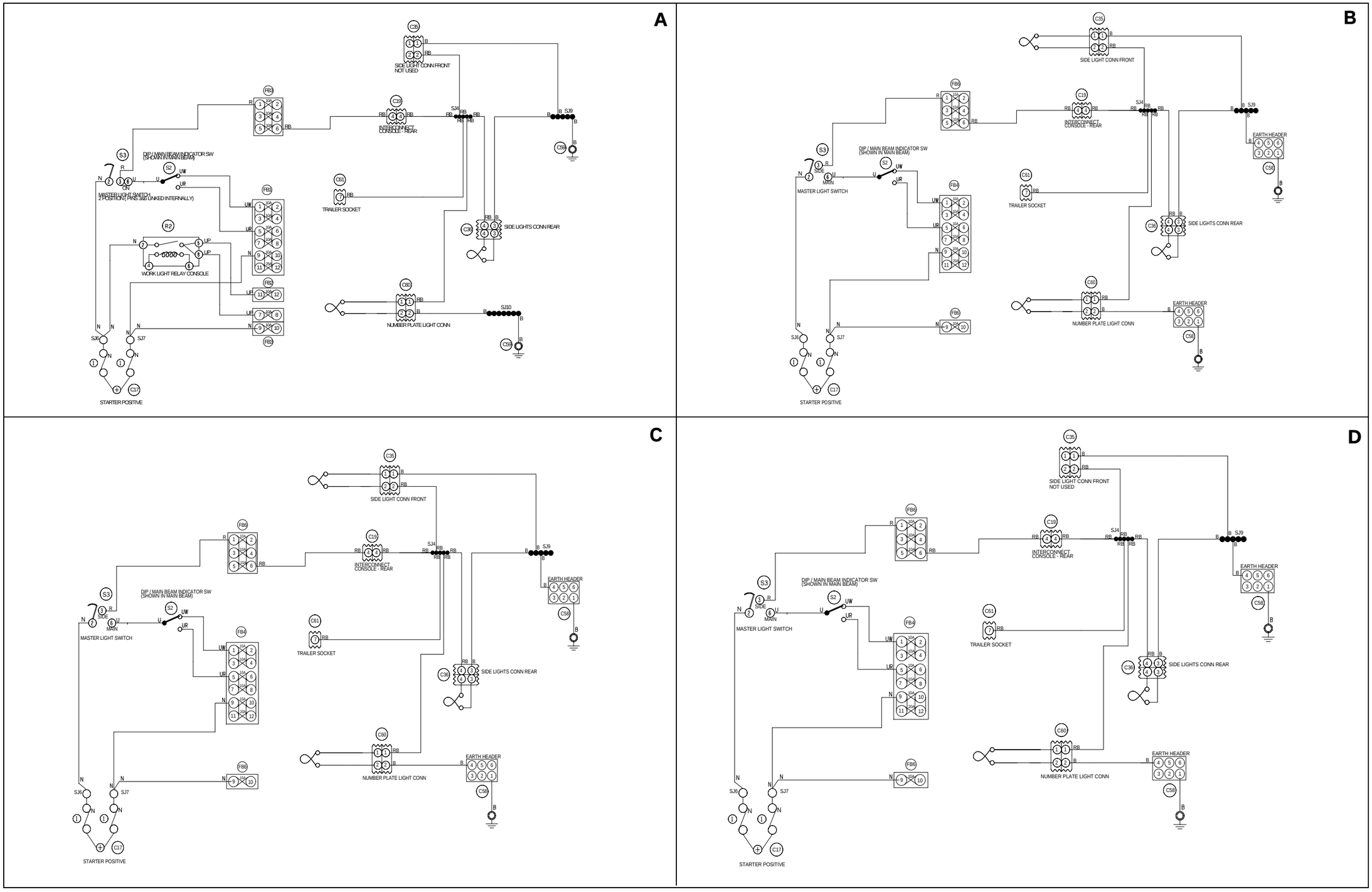


Figure 43

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

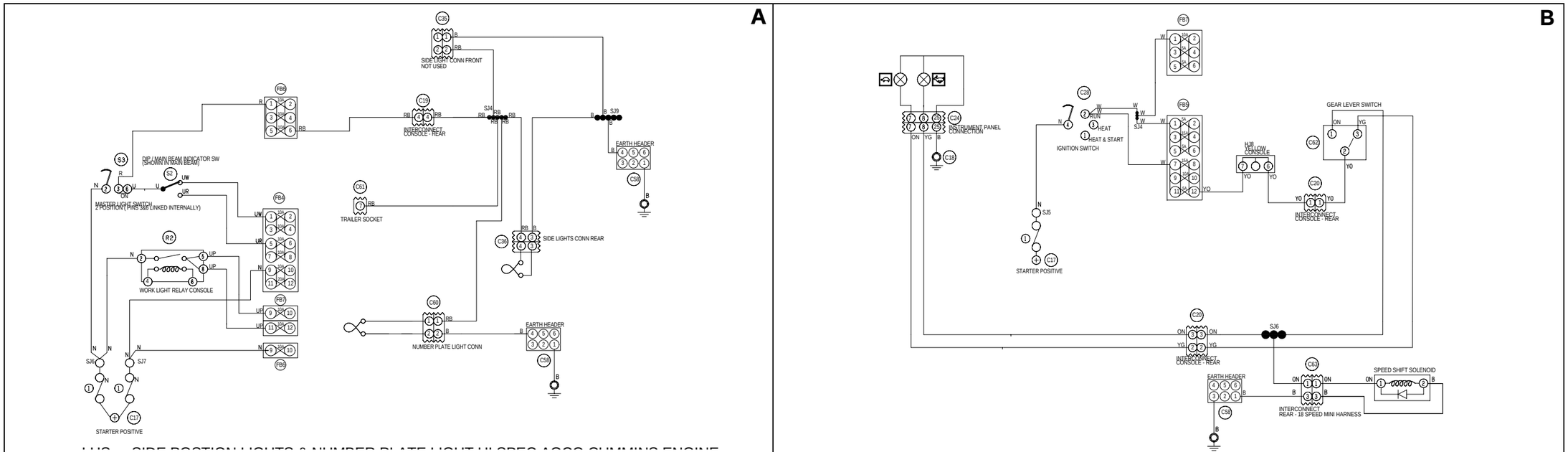
Figure 44

A - RHS Side Position Lights and Number Plate Light HI SPEC AGCO Cummins Engine
B - Speed Shift Control Circuit HI SPEC WEO
C - Speed Shift Control Circuit HI SPEC Japan
D - RHS Side Position Lights and Number Plate Light HI SPEC NAO

Figure 43

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SPEED SHIFT CONTROL CIRCUIT - HI SPEC NAO

Figure 44

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Figure 45

A - Speed Shift Control Circuit HI SPEC AGCO Cummins Engine
B - Fuel Injection Pump Stop Solenoid Standard WEO
C - Fuel Injection Pump Stop Solenoid Basic WEO
D - Fuel Injection Pump Stop Solenoid Basic NAO

Figure 44

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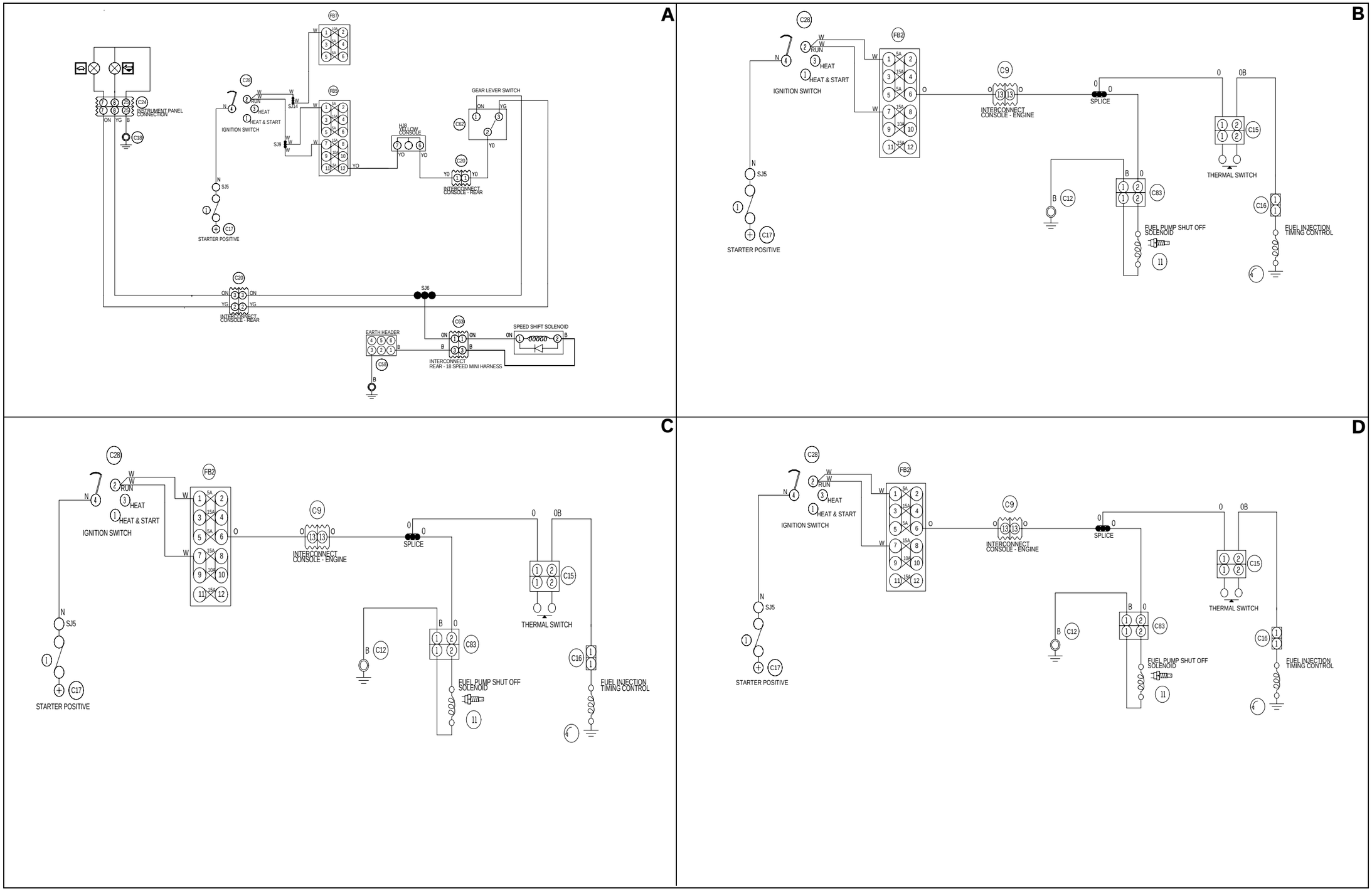


Figure 45

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 46

A - Fuel Injection Pump Stop Solenoid HI SPEC WEO
B - Fuel Injection Pump Stop Solenoid HI SPEC Japan
C - Fuel Injection Pump Stop Solenoid HI SPEC NAO
D - Fuel Pump Circuit HI SPEC AGCO Cummins Engine

Figure 45

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Tractor Manuals Scotland

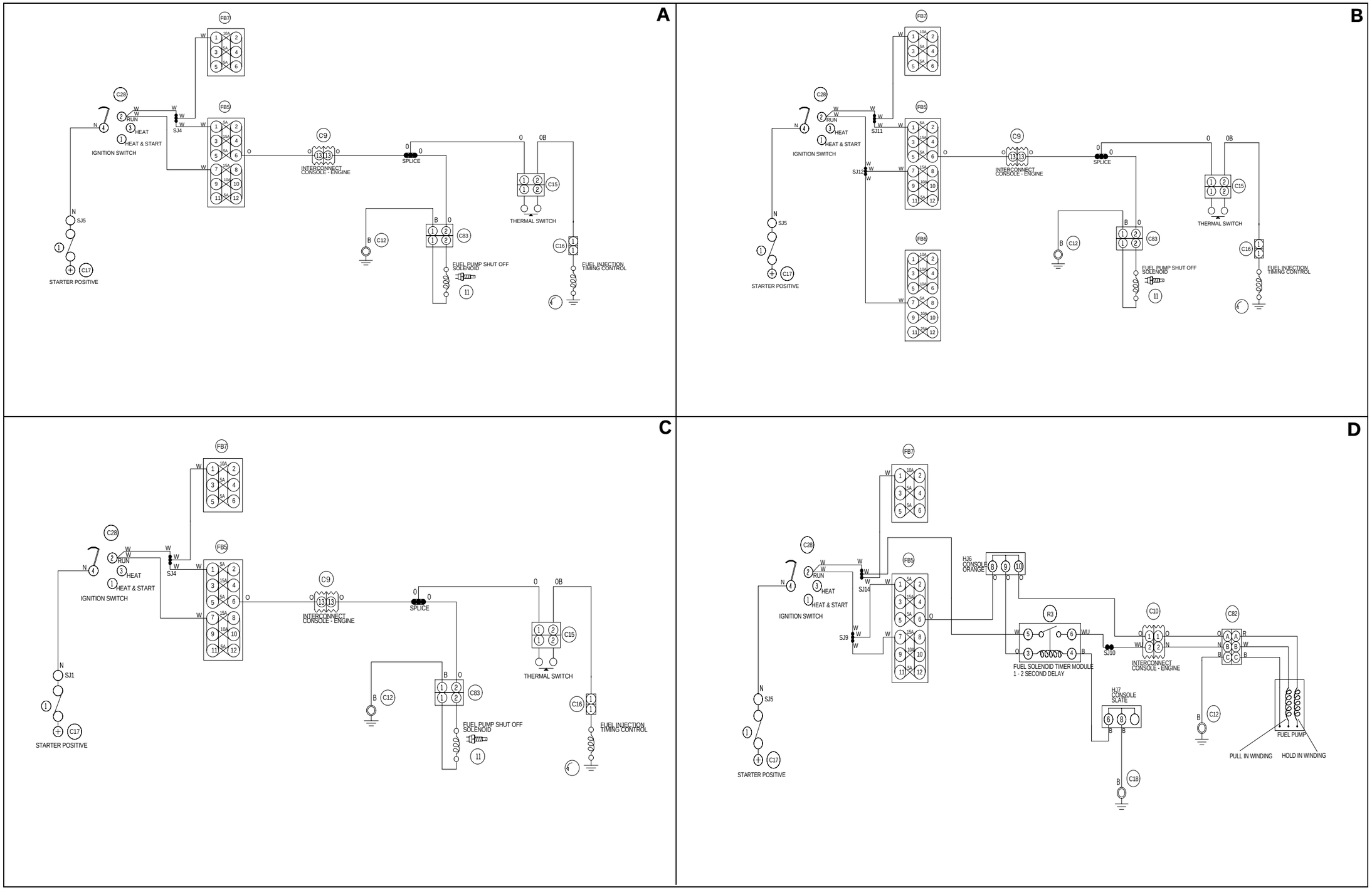


Figure 46

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 47

A - Work Lights Standard WEO

B - Work Lights Basic WEO

C - Work Lights Basic NAO

D - Work Lights Basic HI SPEC WEO

Figure 46

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Footstep Wiring Diagrams

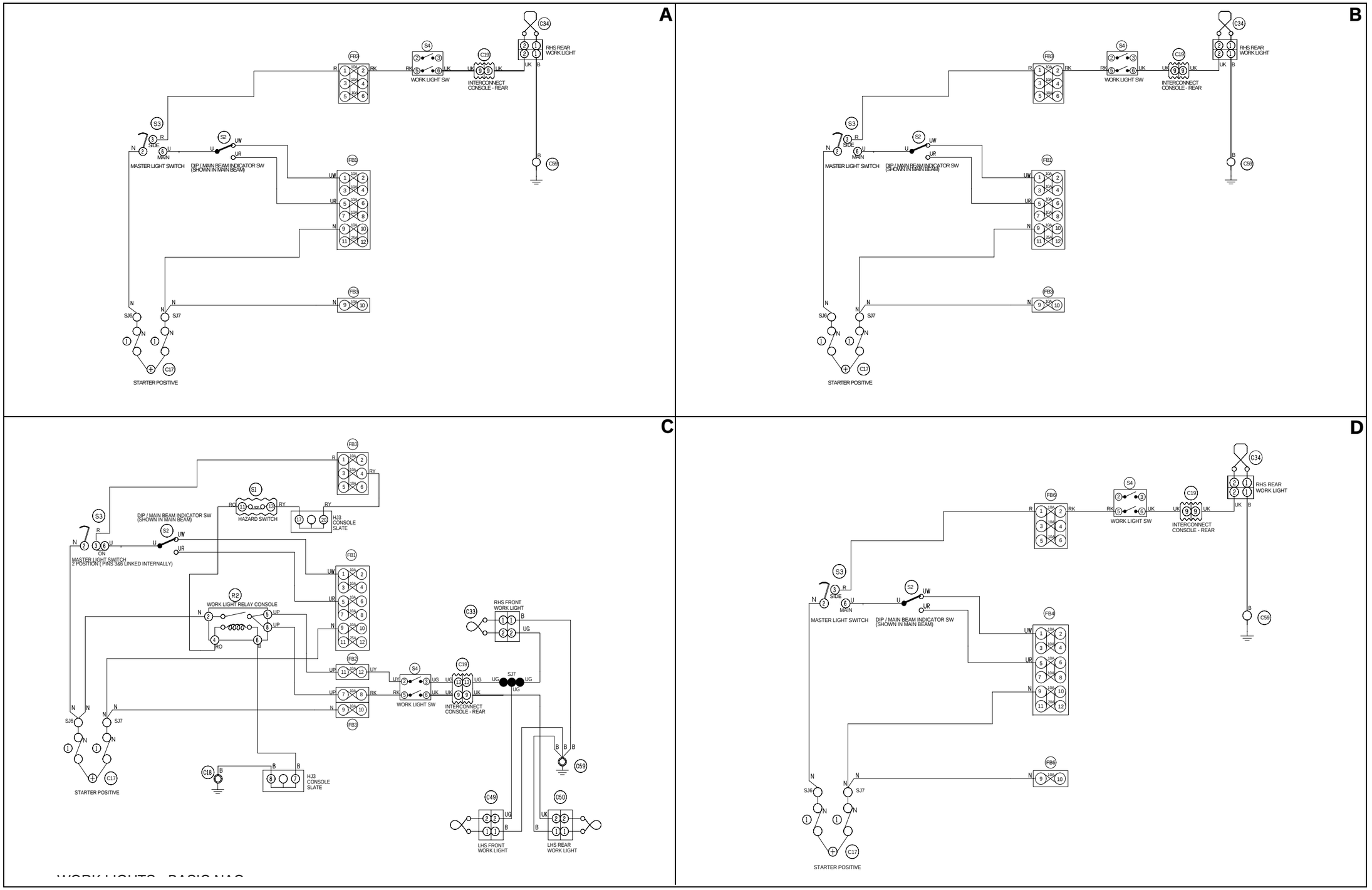


Figure 47

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 48

A - Work Lights HI SPEC Japan

B - Work Lights HI SPEC NAO

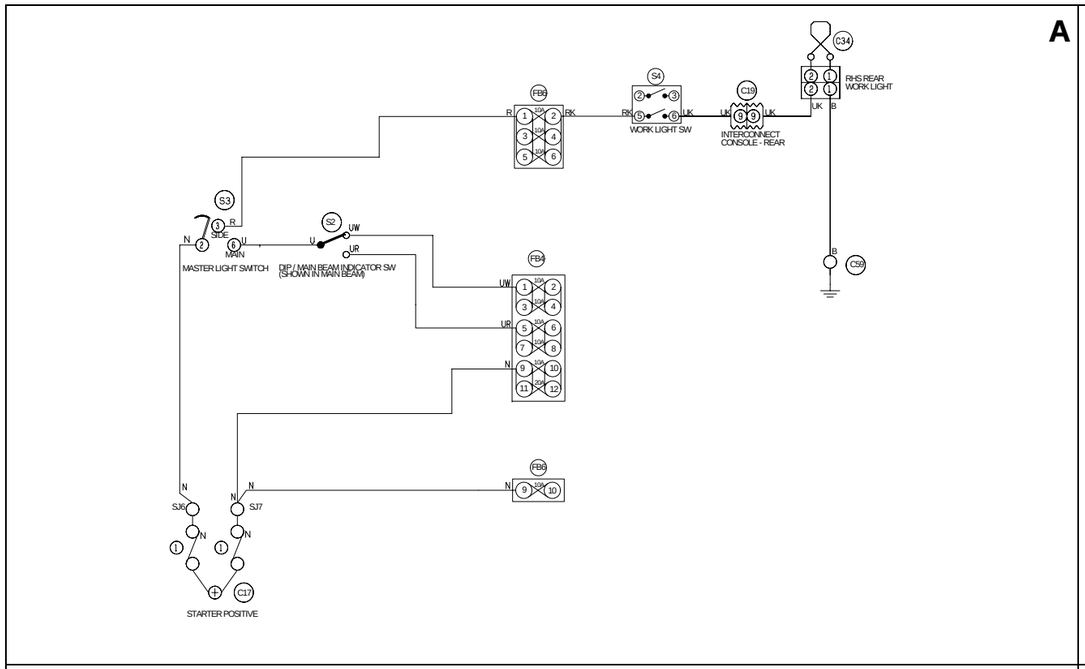
C - Work Lights HI SPEC AGCO Cummins Engine

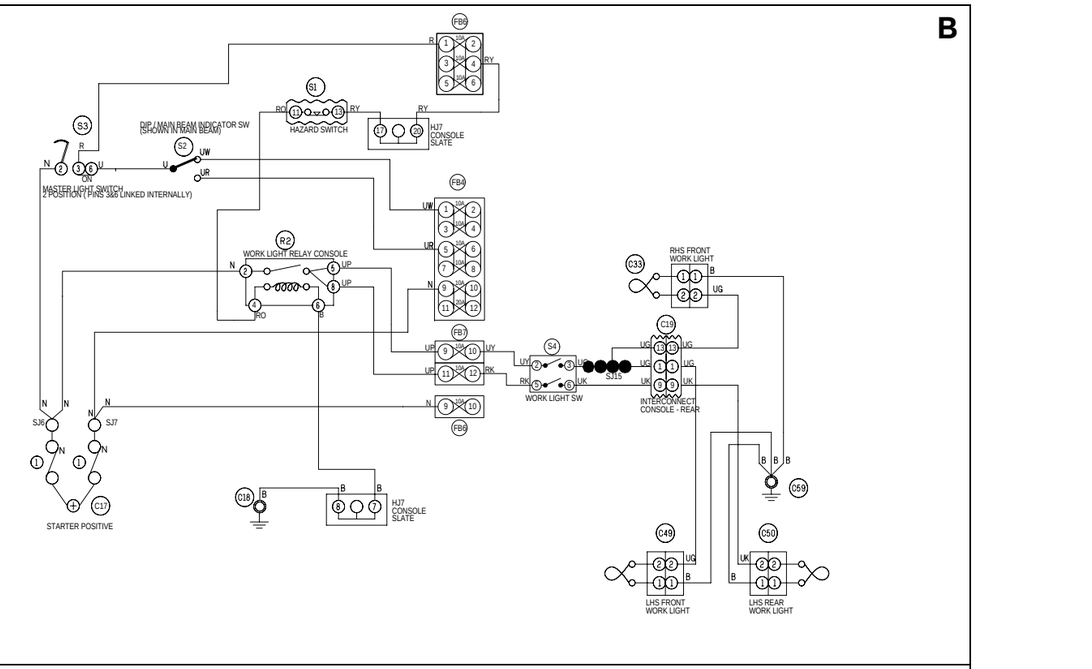
Figure 47

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Footstep Wiring Diagrams





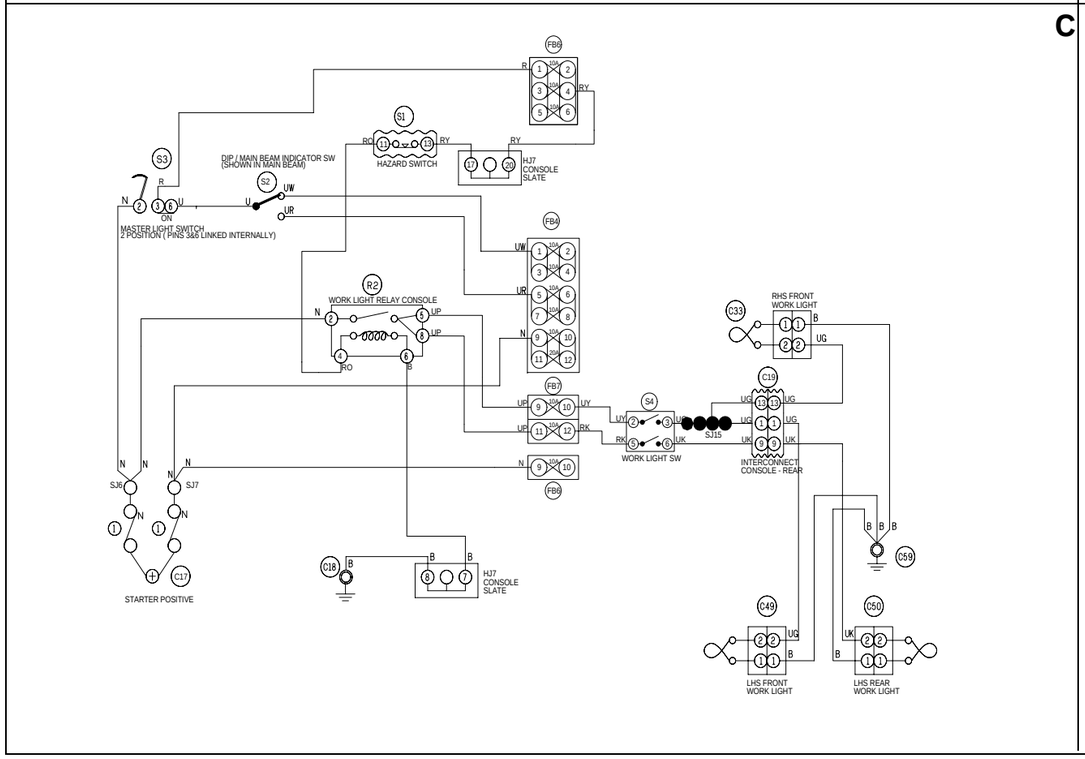


Figure 48

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 48

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

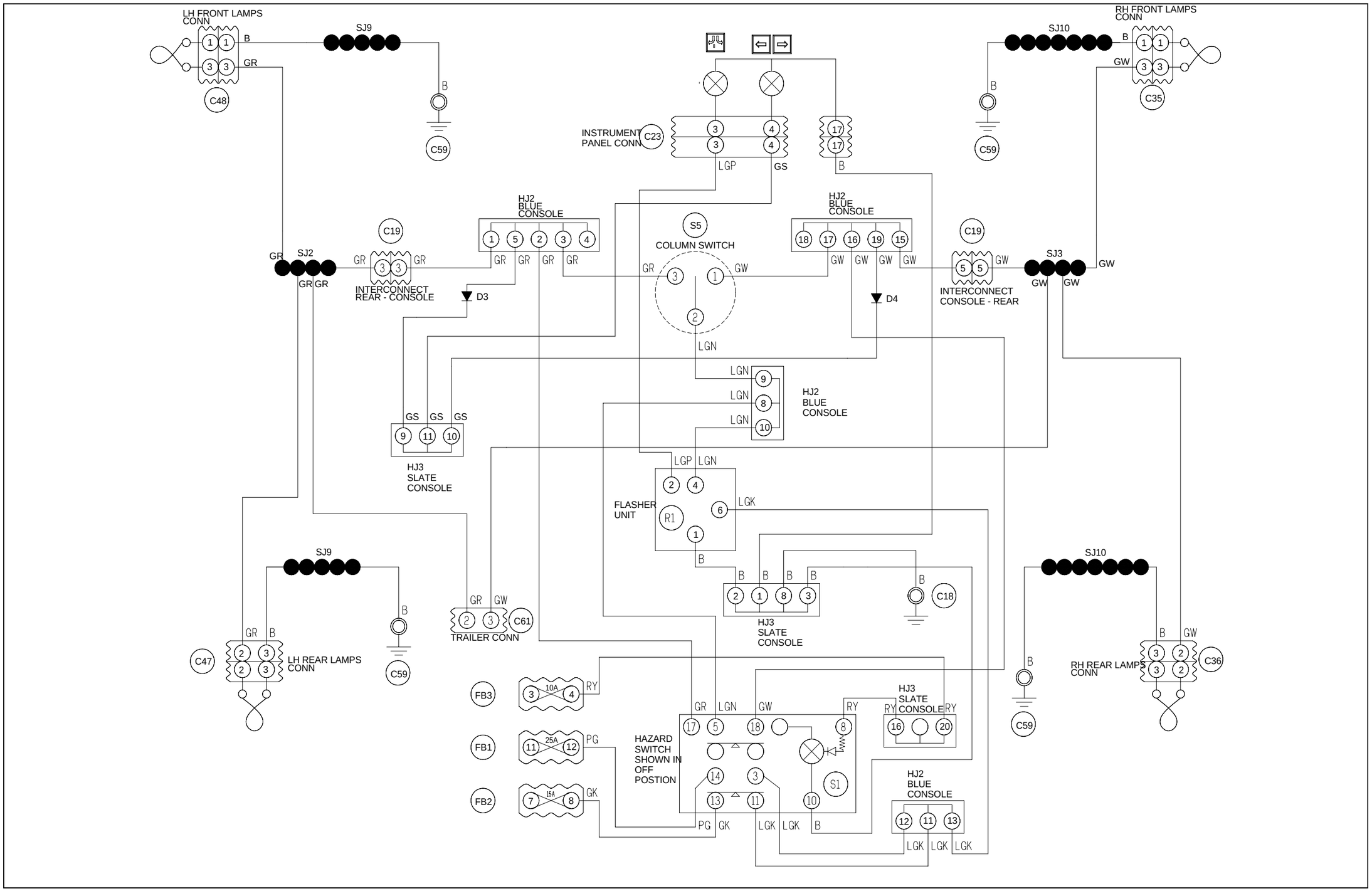


Figure 49

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 49
Direction Indicators and Hazards - Standard WEO

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Tractor Manuals Scotland

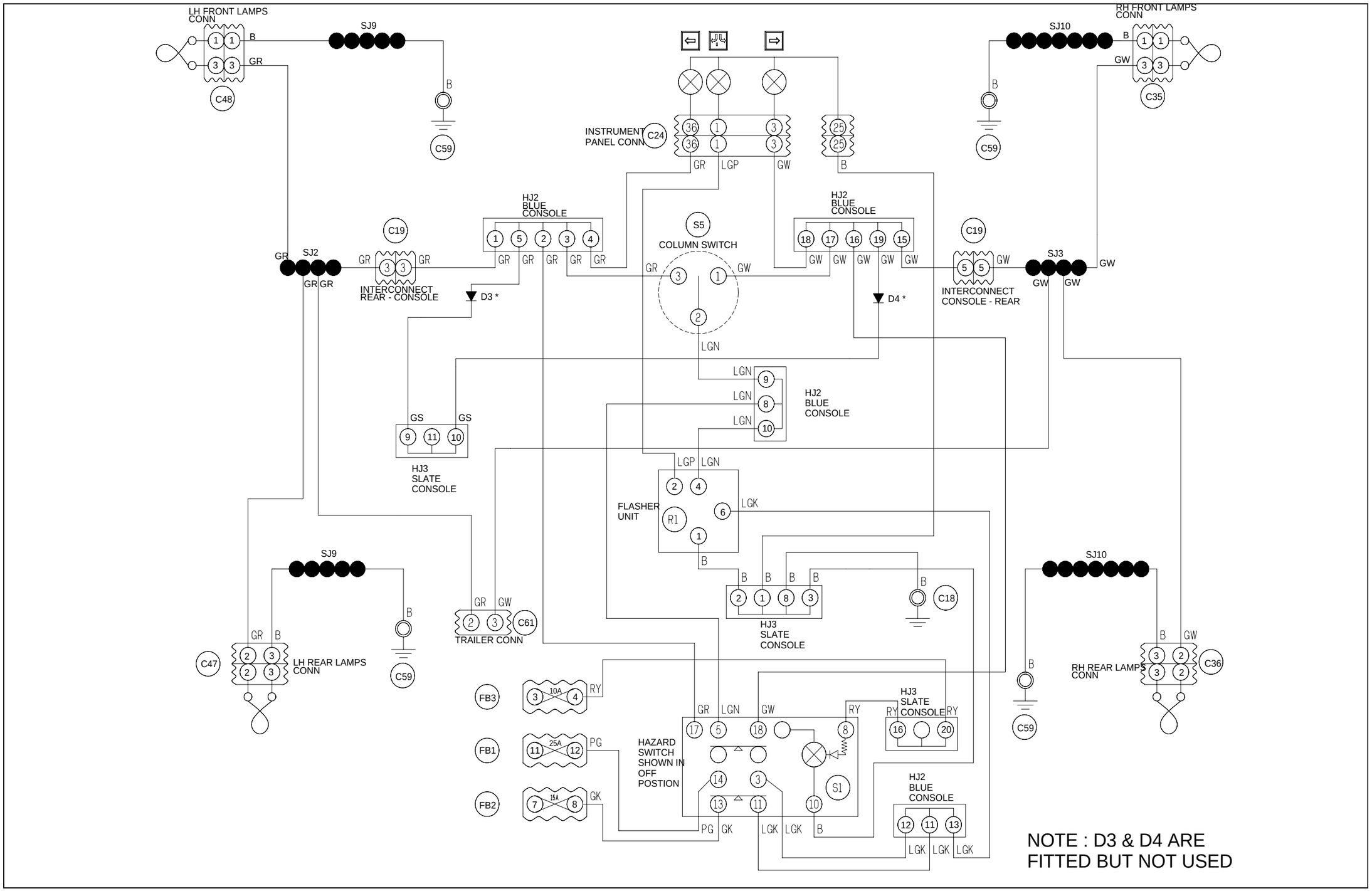


Figure 50 - Speed shift control circuit

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Tractor Manuals Scotland

Figure 50
Direction Indicators and Hazards - Basic WEO

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Tractor Manuals Scotland

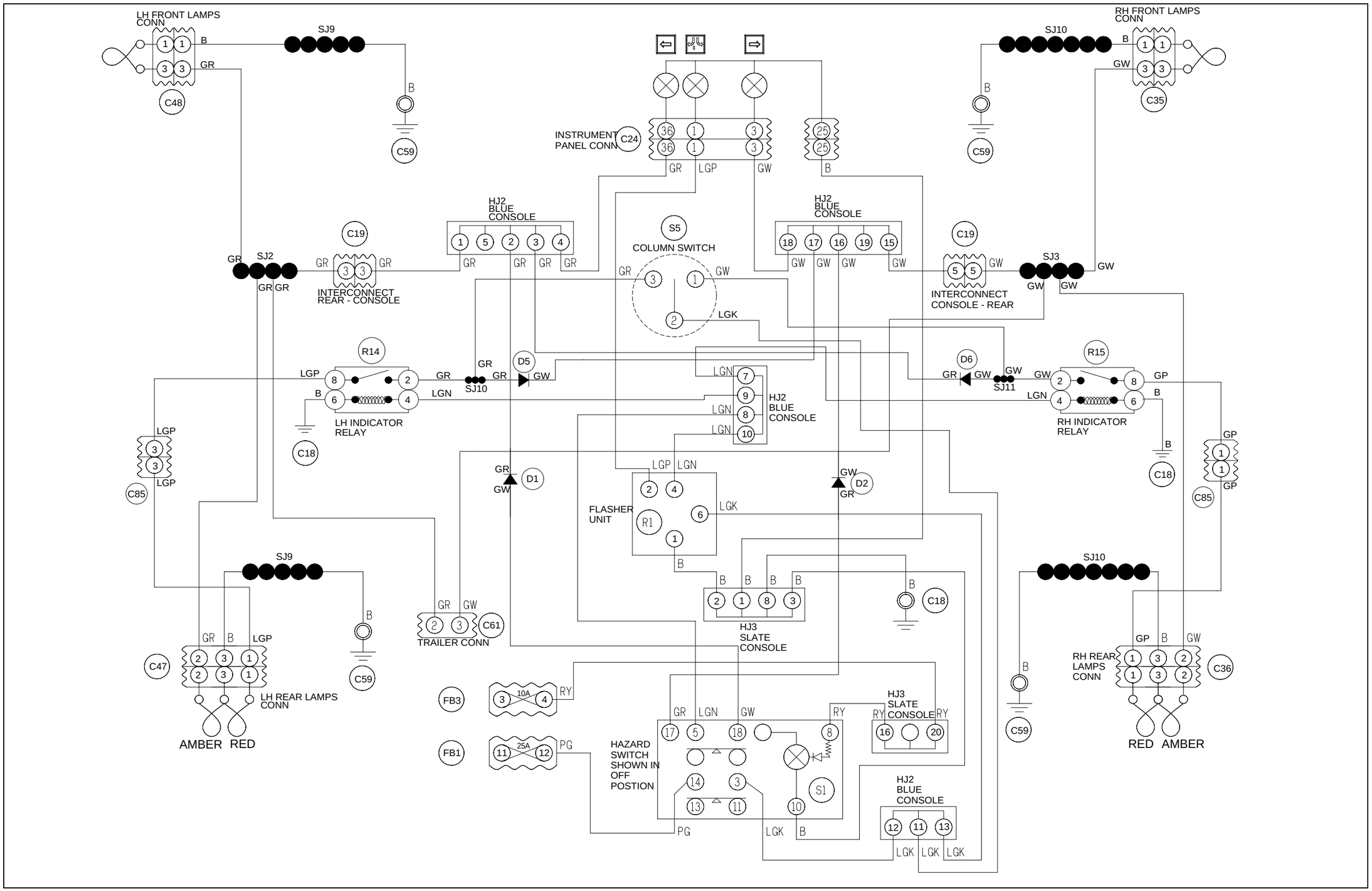


Figure 51

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 51
Direction Indicators and SMV Basic NAO

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

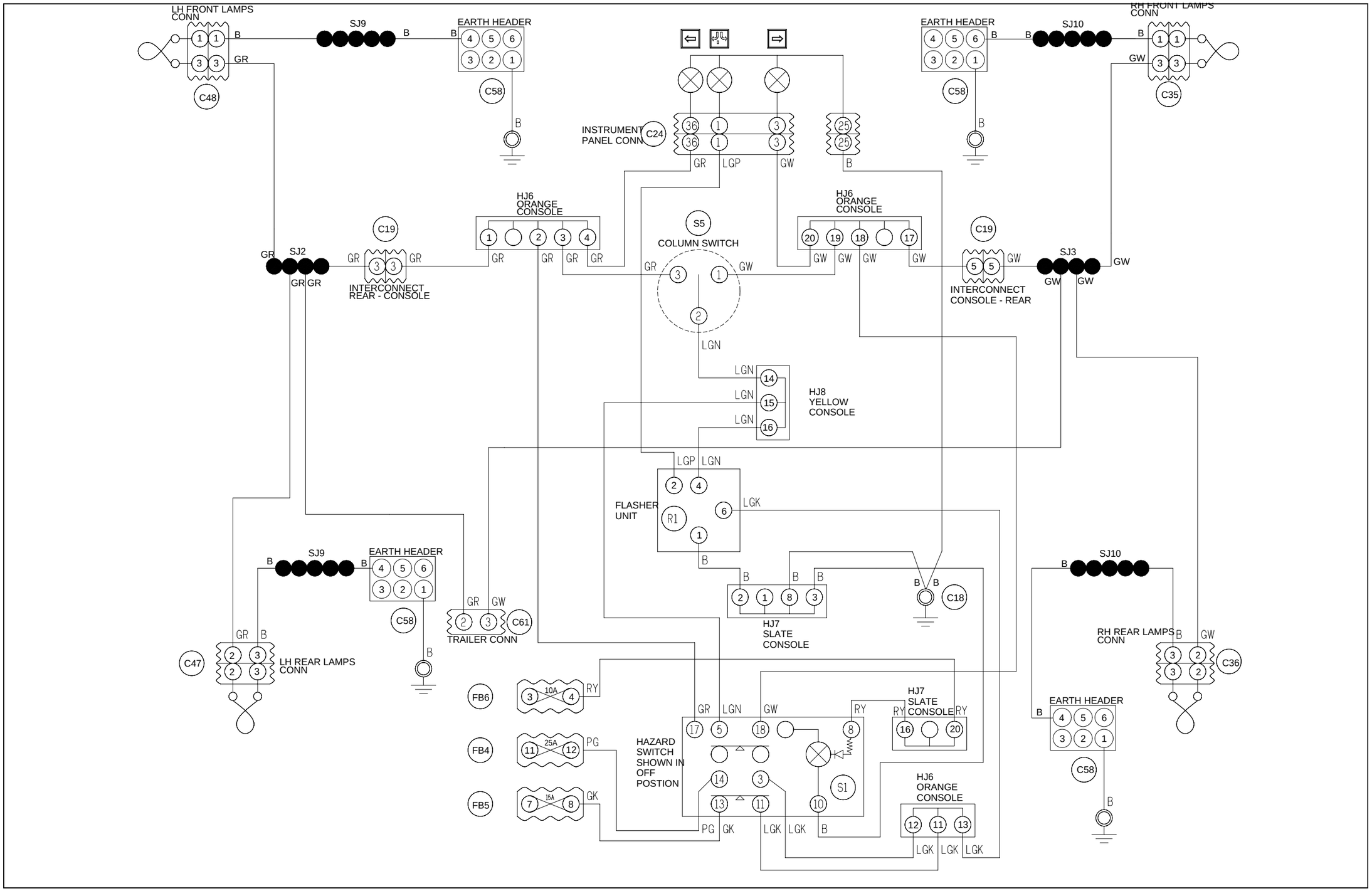


Figure 52

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 52
Direction Indicators and Hazards HI SPEC WEO

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

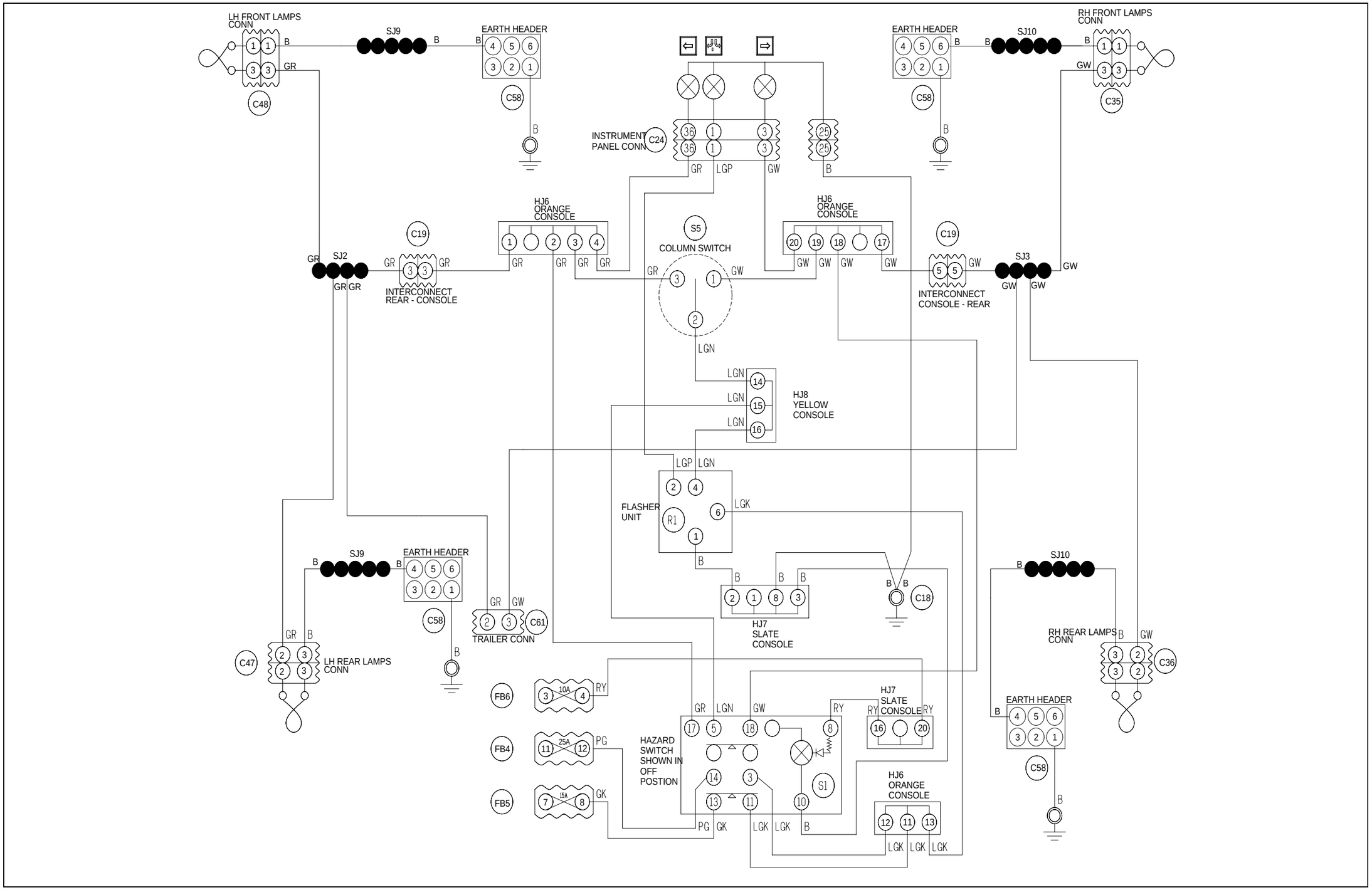


Figure 53

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 53
Direction Indicators and Hazards HI SPEC Japan

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Tractor Manuals Scotland

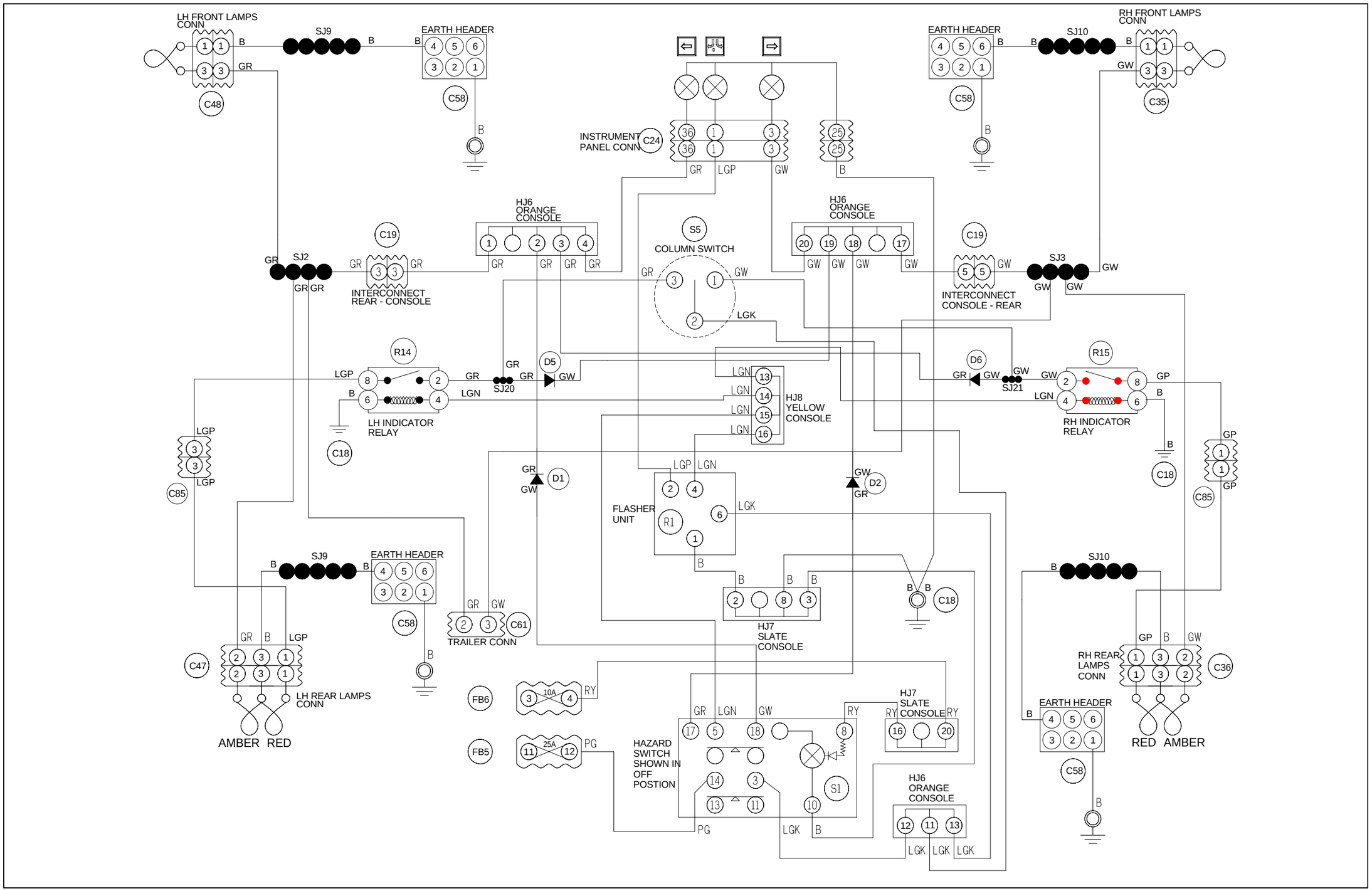


Figure 54

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 54
Direction Indicators and SMV HI SPEC NAO

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Tractor Manuals Scotland

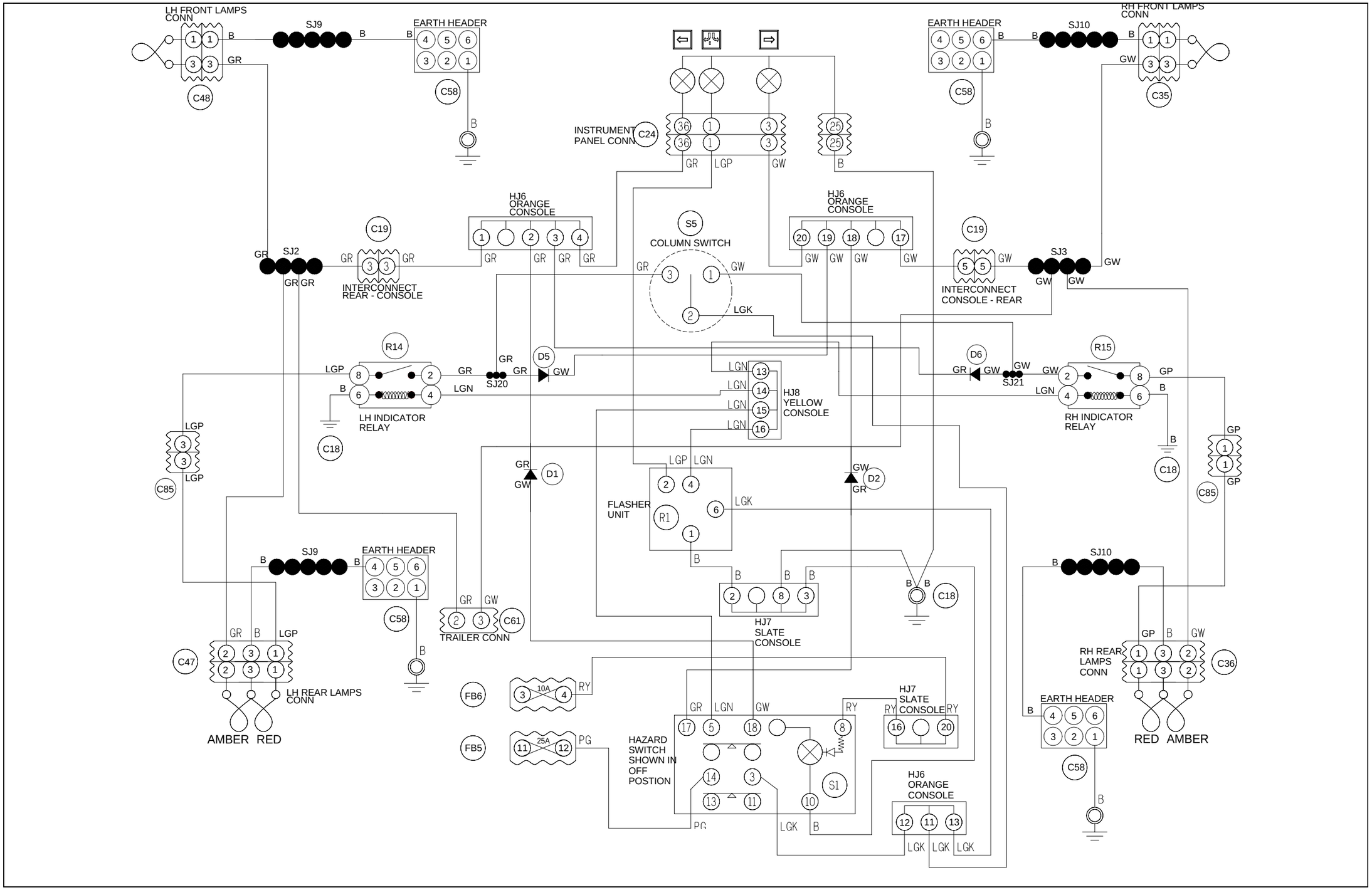


Figure 55

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Tractor Manuals Scotland

Figure 55
Direction Indicators and SMV HI SPEC AGCO Cummins Engine

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Tractor Manuals Scotland

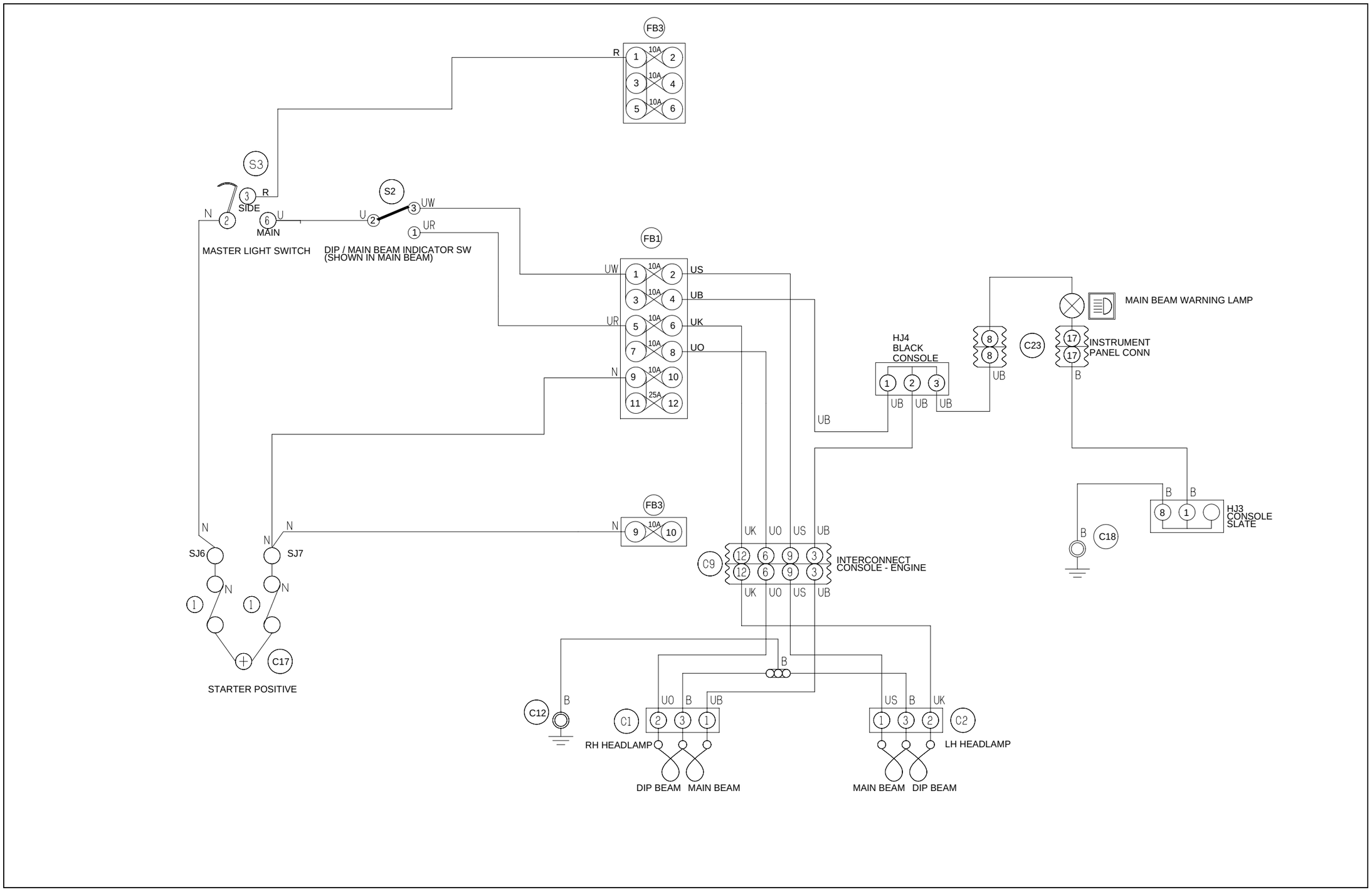


Figure 56

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 56
Head Lamp Circuit Standard WEO

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Tractor Manuals Scotland

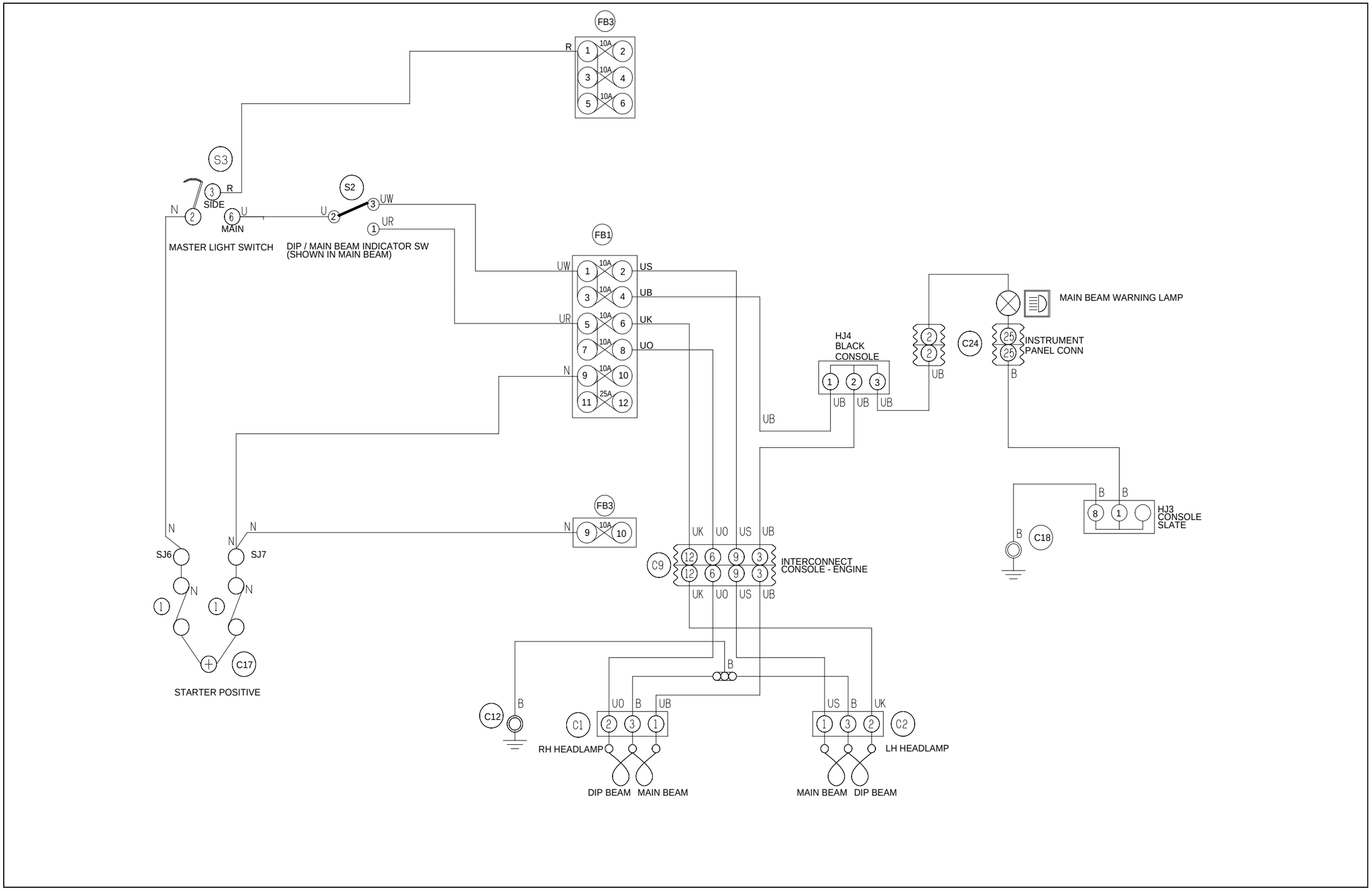


Figure 57

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 57
Head Lamp Circuit Basic WEO

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

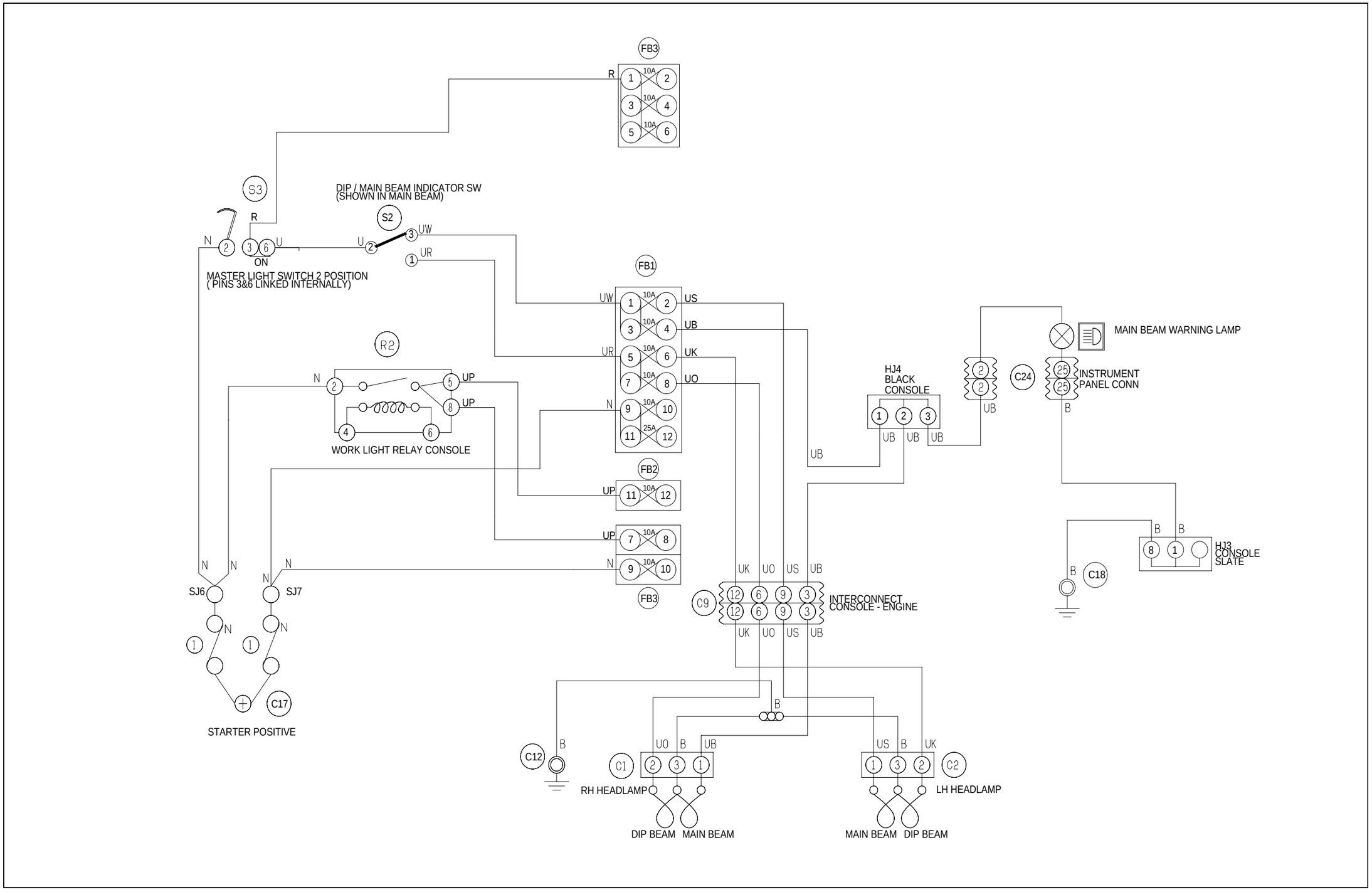


Figure 58

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 58
Head Lamp Circuit Basic NAO

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

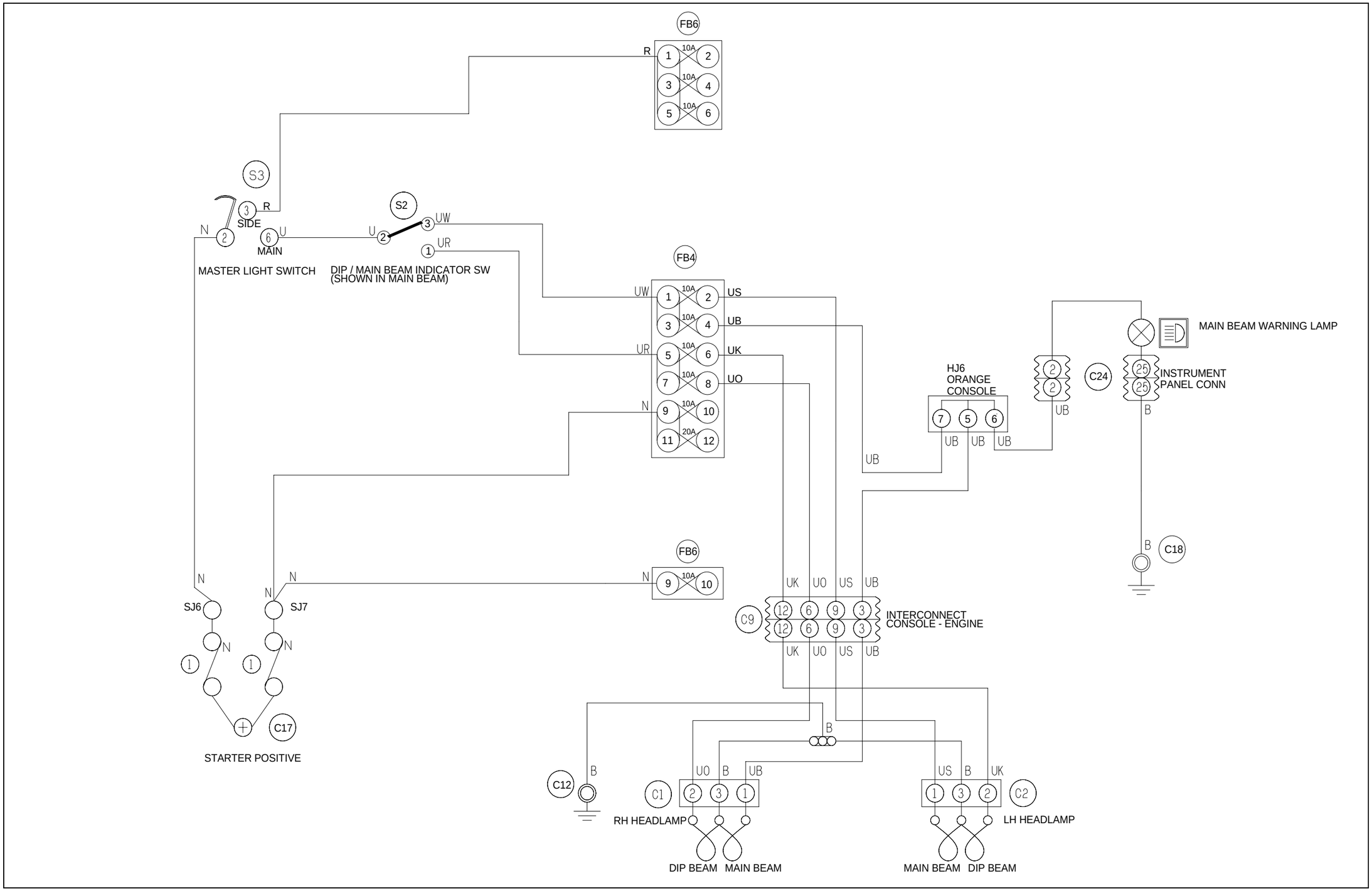


Figure 59

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 59
Head Lamp Circuit HI SPEC WEO

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

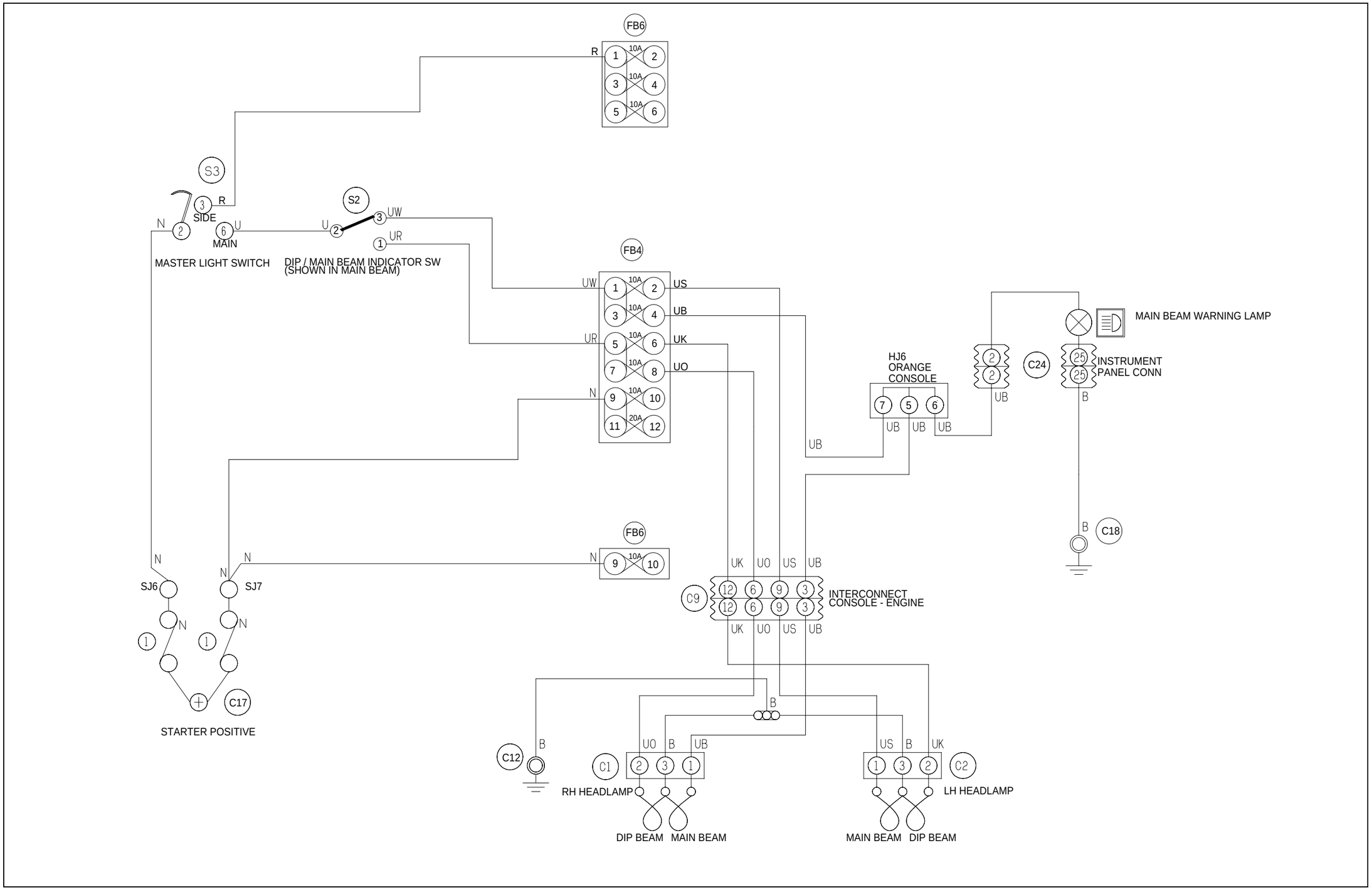


Figure 60

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Tractor Manuals Scotland

Figure 60
Head Lamp Circuit HI SPEC Japan

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Tractor Manuals Scotland

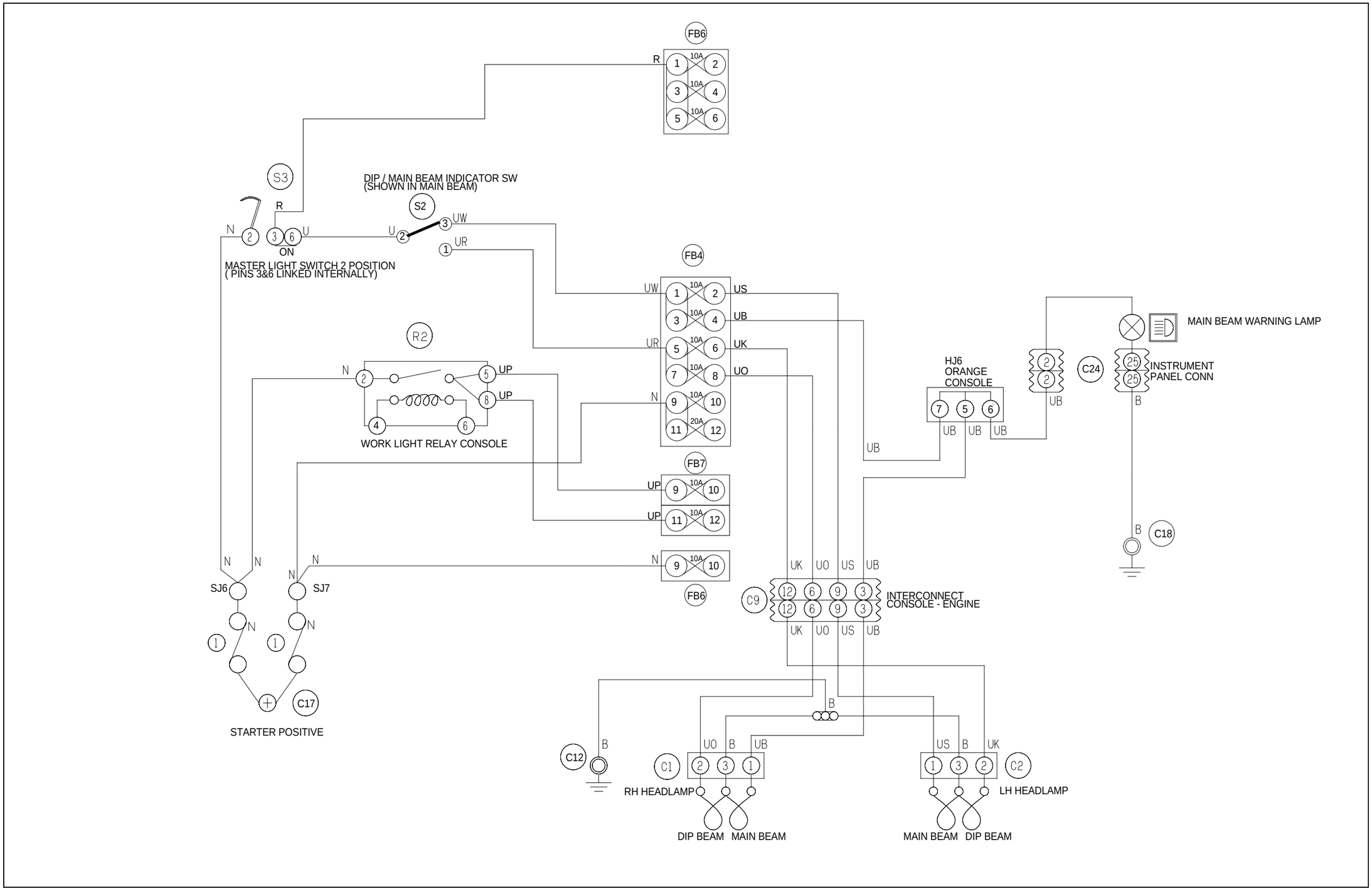


Figure 61

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Tractor Manuals Scotland

Figure 61
Head Lamp Circuit HI SPEC NAO

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Tractor Manuals Scotland

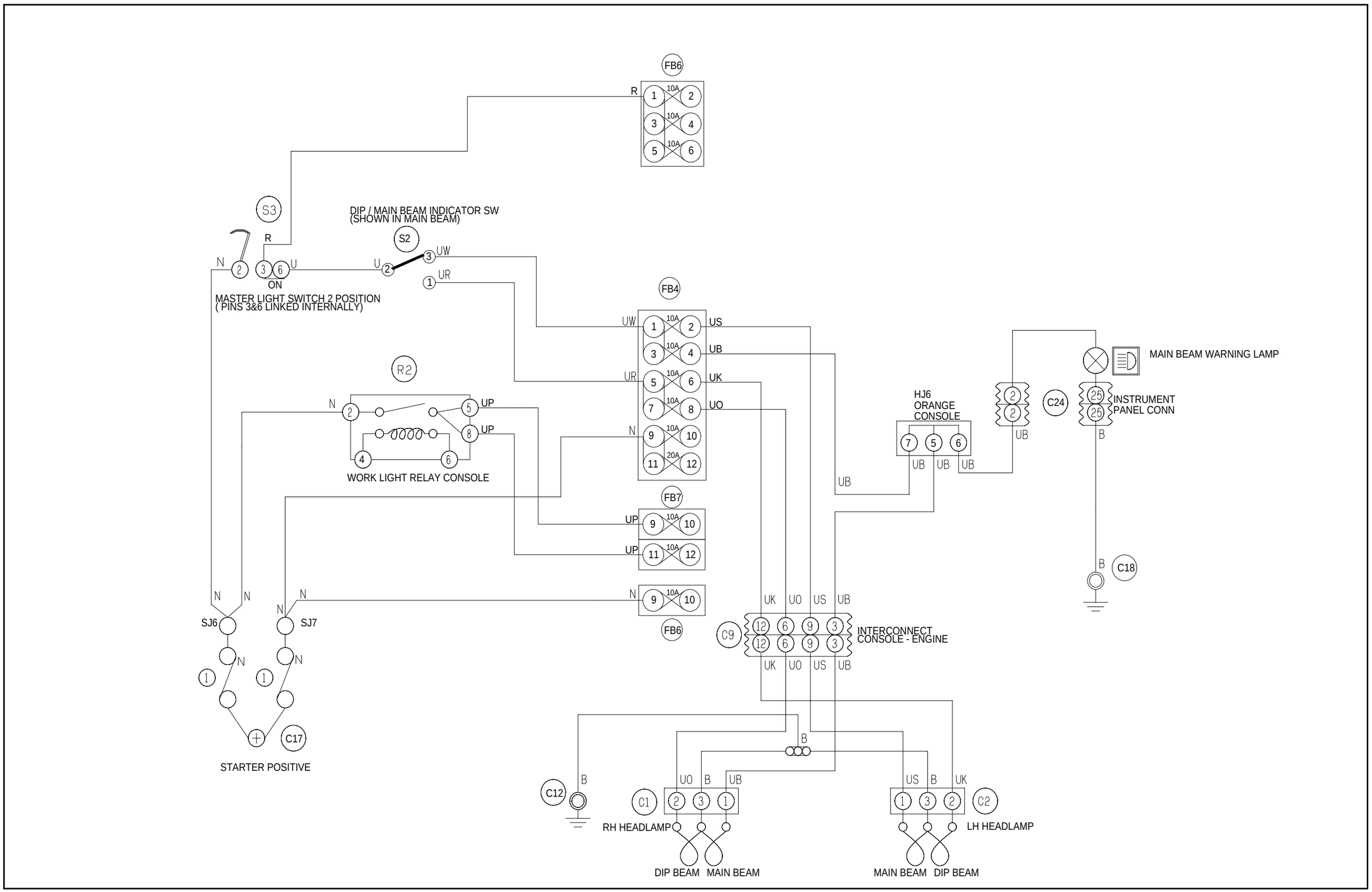


Figure 62

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Tractor Manuals Scotland

Figure 63
A - Instrument Fuel Gauge Standard WEO
B - Instrument Fuel Gauge Basic WEO
C - Instrument Fuel Gauge and Low Fuel Warning Light Basic NAO
D - Instrument Fuel Gauge and Low Fuel Warning Light HI SPEC WEO

Figure 62
Head Lamp Circuit HI SPEC AGCO Cummins Engine

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Footstep Wiring Diagrams

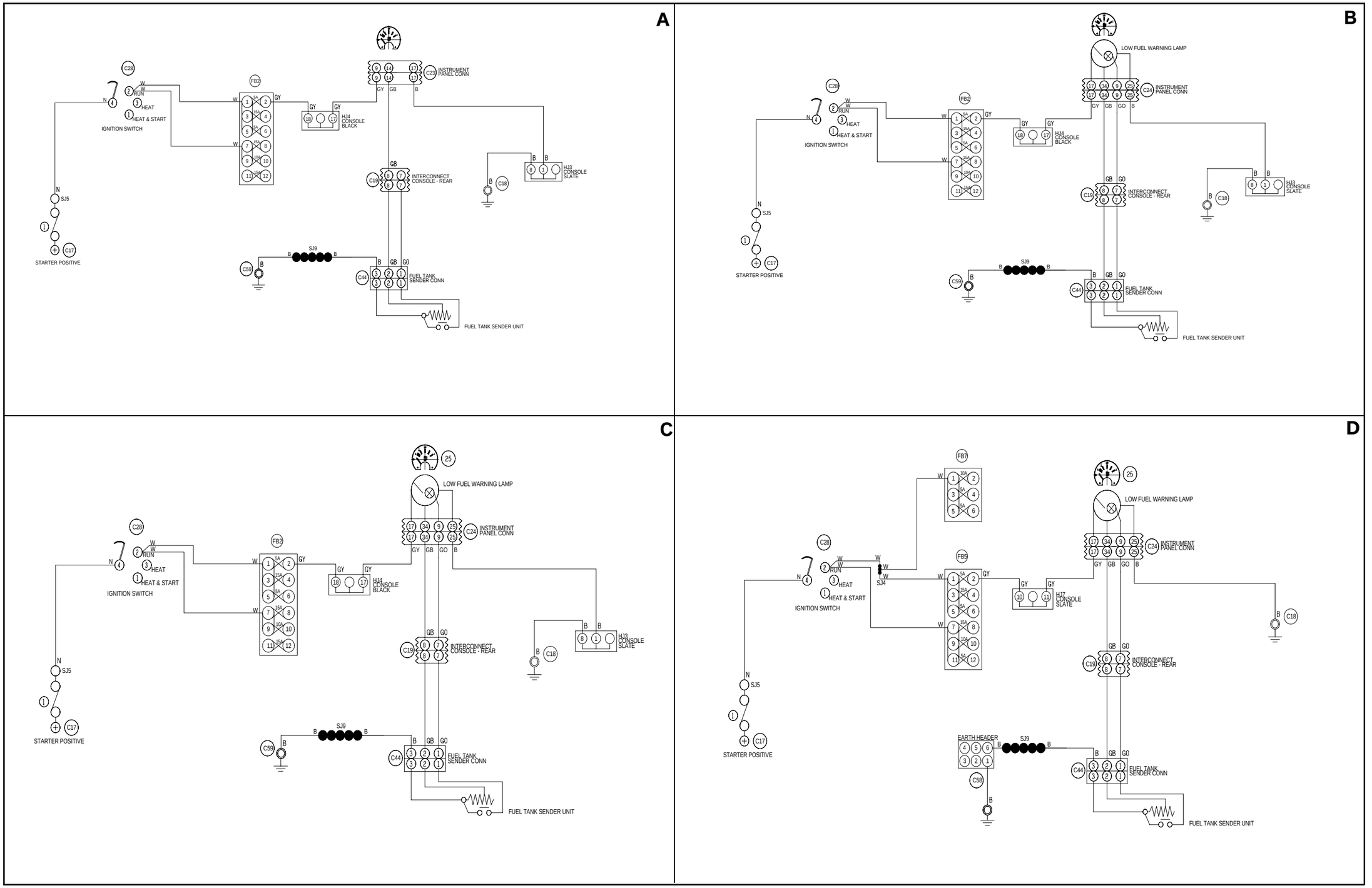


Figure 63

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 64

A - Instrument Fuel Gauge and Low Fuel Warning Light HI SPEC Japan
B - Instrument Fuel Gauge and Low Fuel Warning Light HI SPEC NAO
C - Instrument Fuel Gauge and Low Fuel Warning Light HI SPEC AGCO Cummins Engine
D - Instrument Panel Water Temperature Gauge Standard WEO

Figure 63

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Tractor Manuals Scotland

Footstep Wiring Diagrams

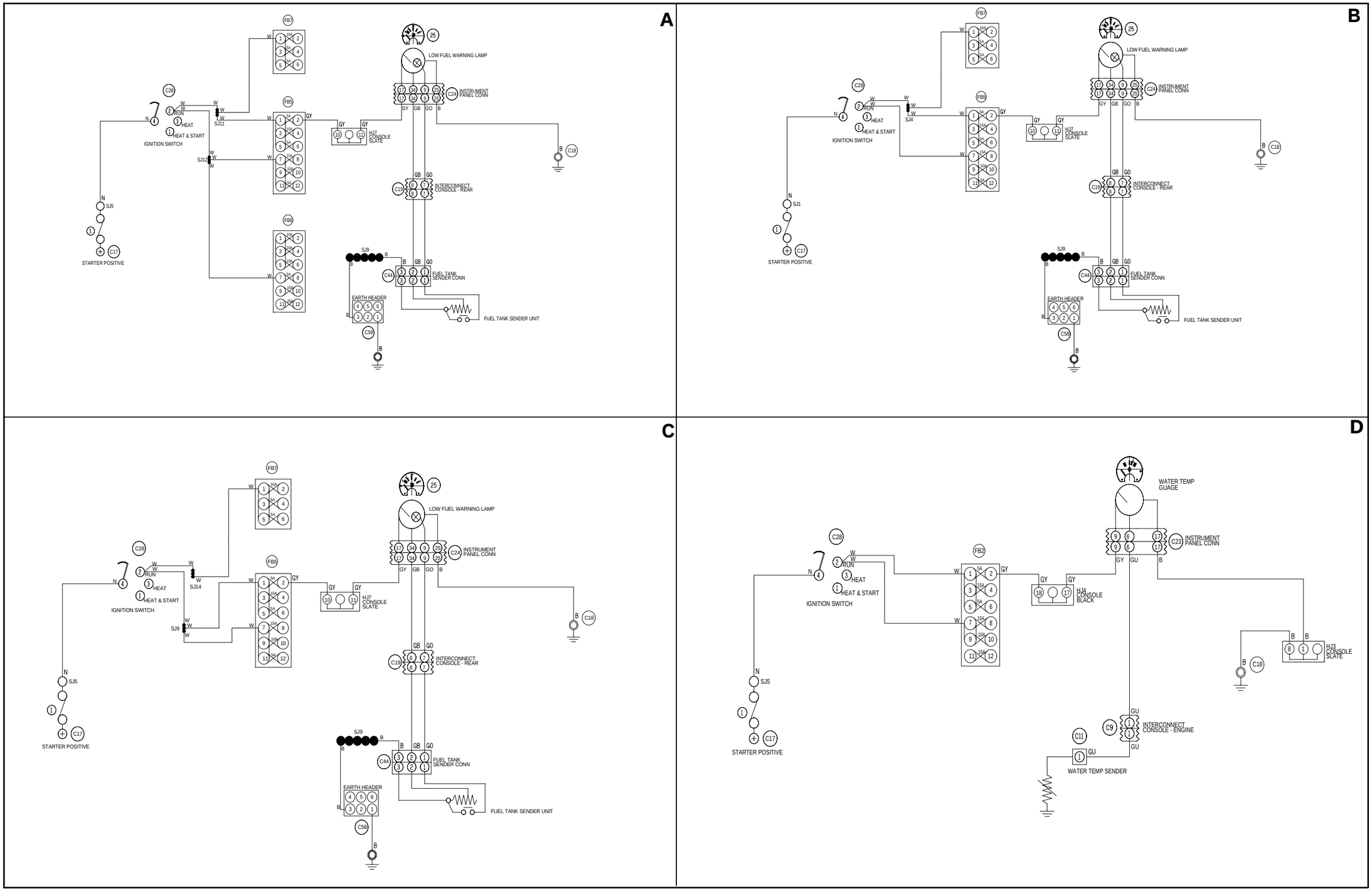


Figure 64

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Tractor Manuals Scotland

Figure 65

A - Instrument Panel Water Temp Gauge Basic WEO
B - Instrument Panel Water Temp Gauge Basic NAO
C - Instrument Panel Water Temp Gauge HI SPEC WEO
D - Instrument Panel Water Temp Gauge HI SPEC Japan

Figure 64

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Tractor Manuals Scotland

Footstep Wiring Diagrams

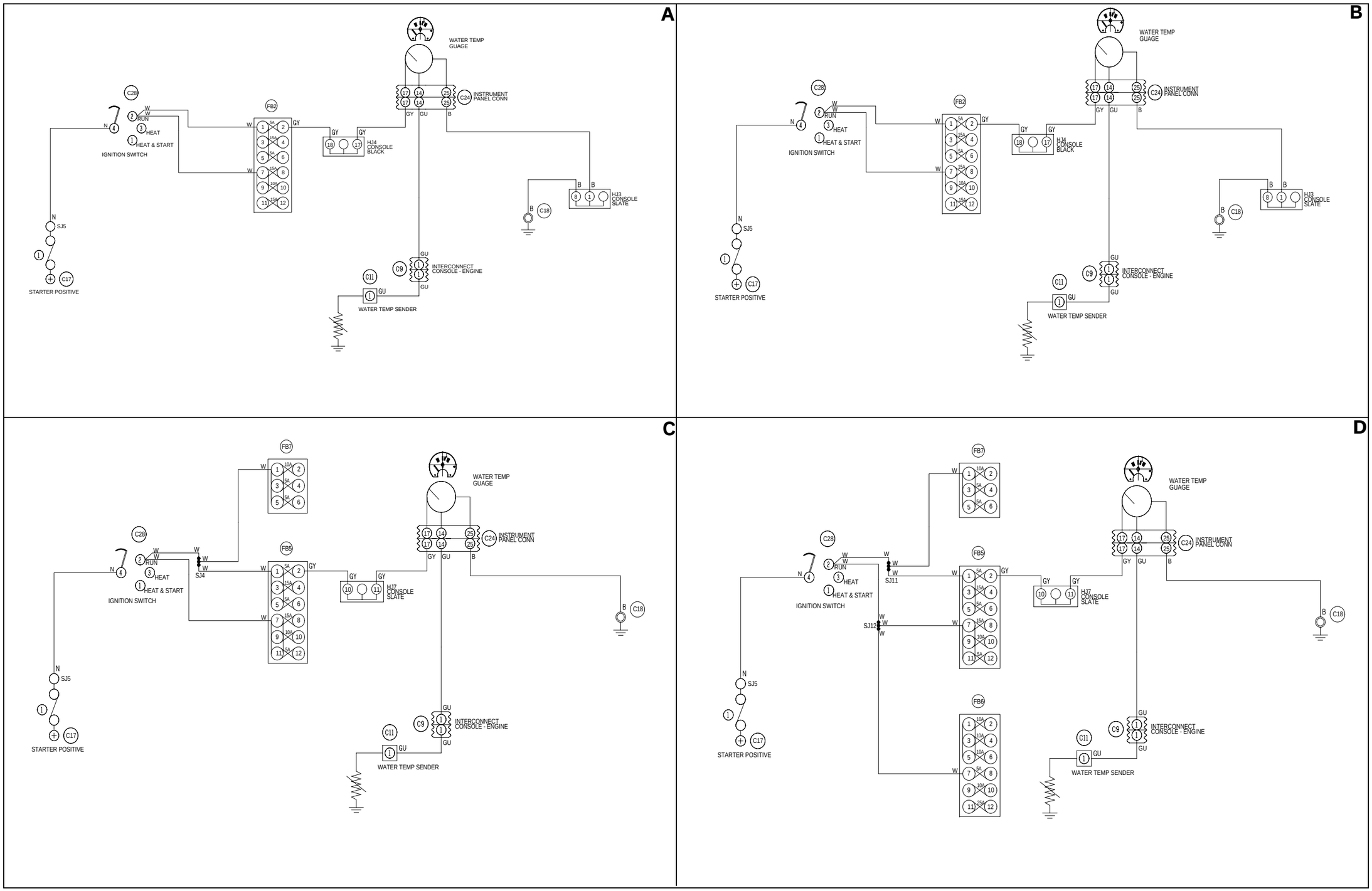


Figure 65

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Tractor Manuals Scotland

Figure 66

A - Instrument Panel Water Temp Gauge HI SPEC NAO
B - Instrument Panel Water Temp Gauge HI SPEC AGCO Cummins Engine
C - Instrument Panel Key Pad Connections HI SPEC WEO
D - Instrument Panel Key Pad Connections HI SPEC Japan

Figure 65

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Tractor Manuals Scotland

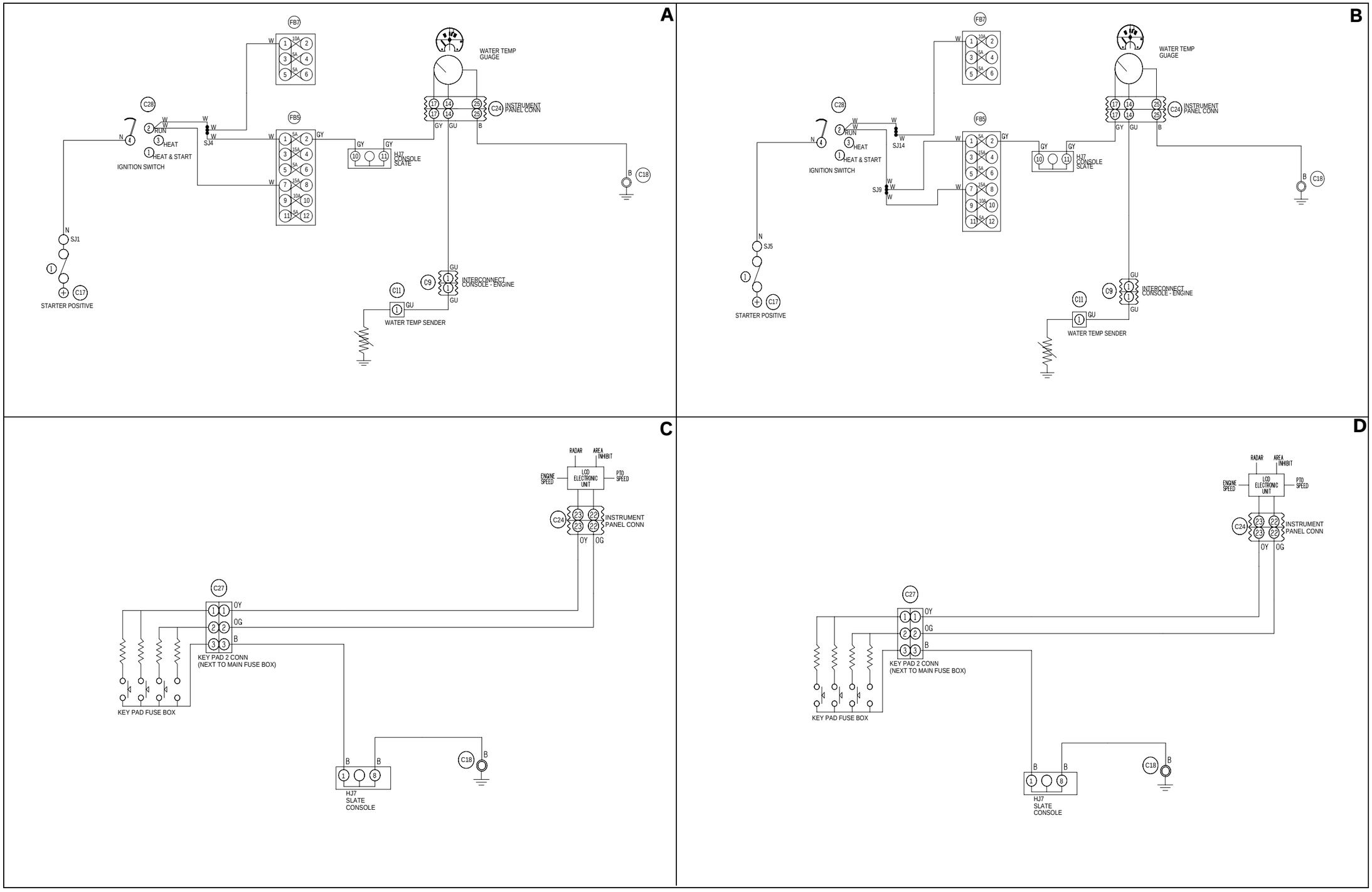


Figure 66

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Tractor Manuals Scotland

Figure 66

Figure 67

A - Instrument Panel Key Pad Connections HI SPEC NAO

B - Instrument Panel Key Pad Connections HI SPEC AGCO Cummins Engine

C - Rear PTO Sensor and Instrument Panel Warning Light Basic WEO

D - Rear PTO Sensor and Instrument Panel Warning Light HI SPEC WEO

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Footstep Wiring Diagrams

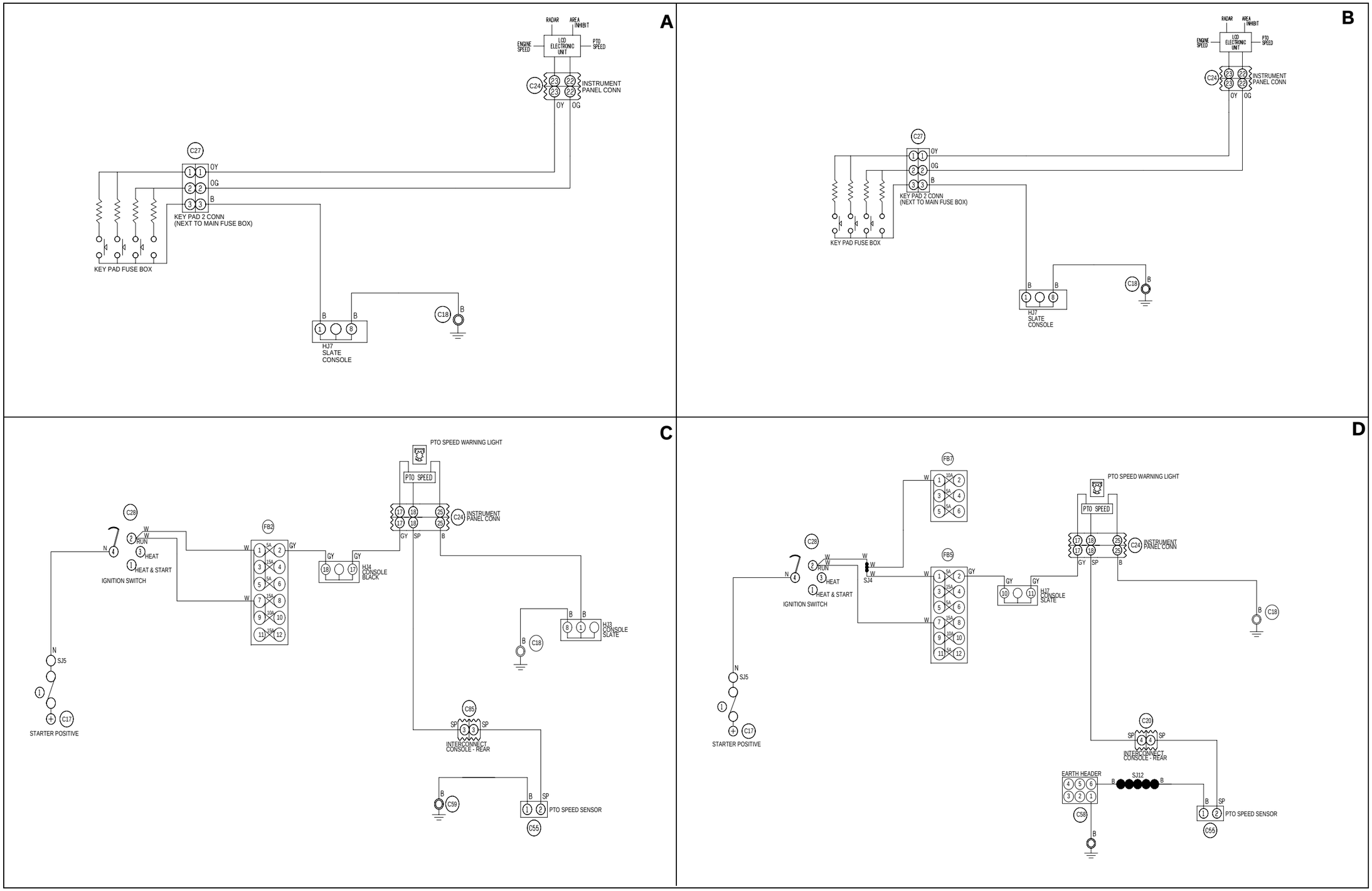


Figure 67

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 68

A - Rear PTO Sensor and Instrument Panel Warning Light HI SPEC Japan
B - Rear PTO Sensor and Instrument Panel Warning Light HI SPEC NAO
C - Rear PTO Sensor and Instrument Panel Warning Light HI SPEC AGCO Cummins Engine
D - Engine Oil Pressure Instrument Panel Warning Light Standard WEO

Figure 67

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Footstep Wiring Diagrams

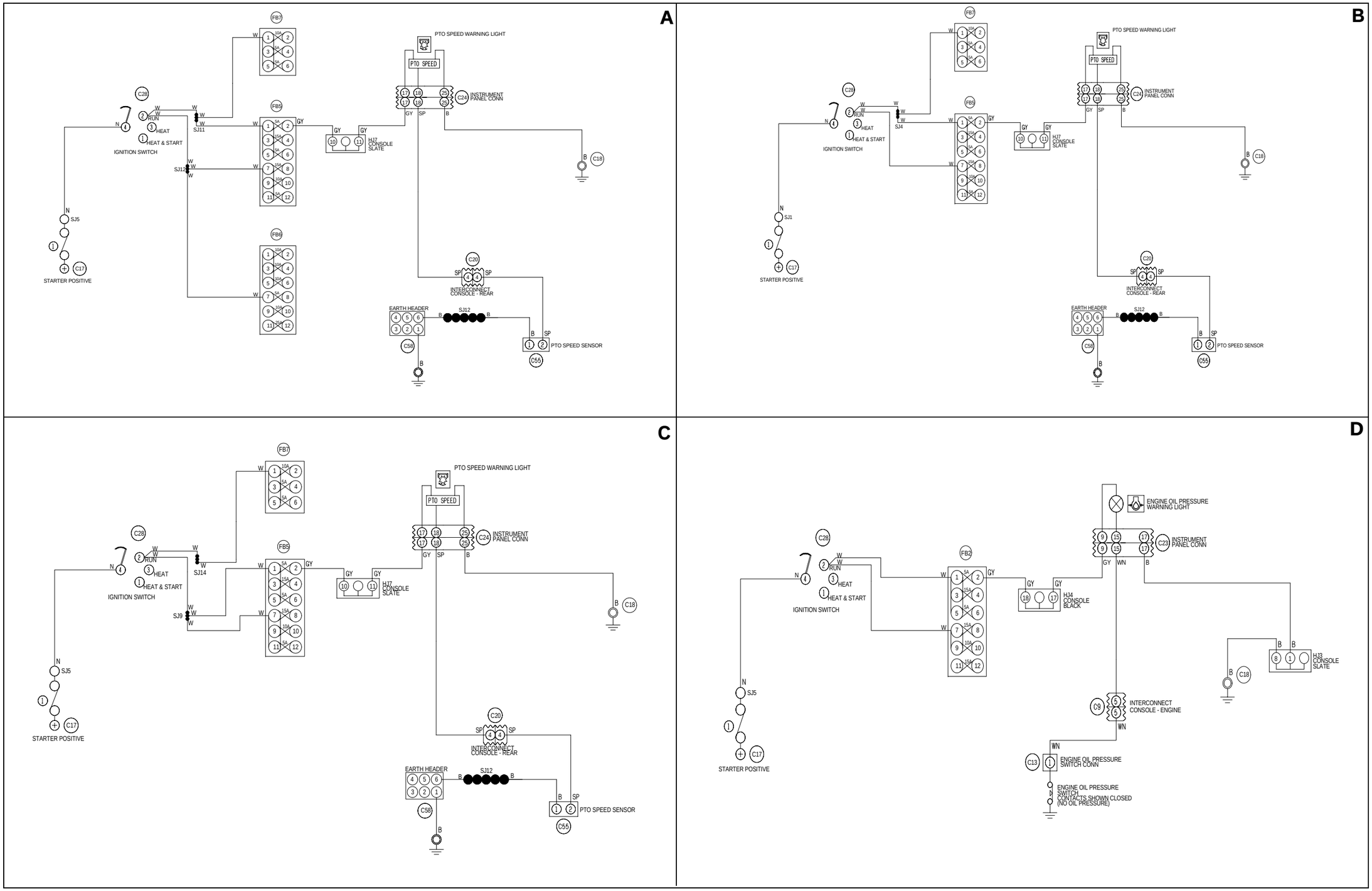


Figure 68

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 68

Figure 69

A - Engine Oil Pressure Instrument Panel Warning Light Basic WEO

B - Engine Oil Pressure Instrument Panel Warning Light Basic NAO

C - Engine Oil Pressure Instrument Panel Warning Light HI SPEC WEO

D - Engine Oil Pressure Instrument Panel Warning Light HI SPEC Japan

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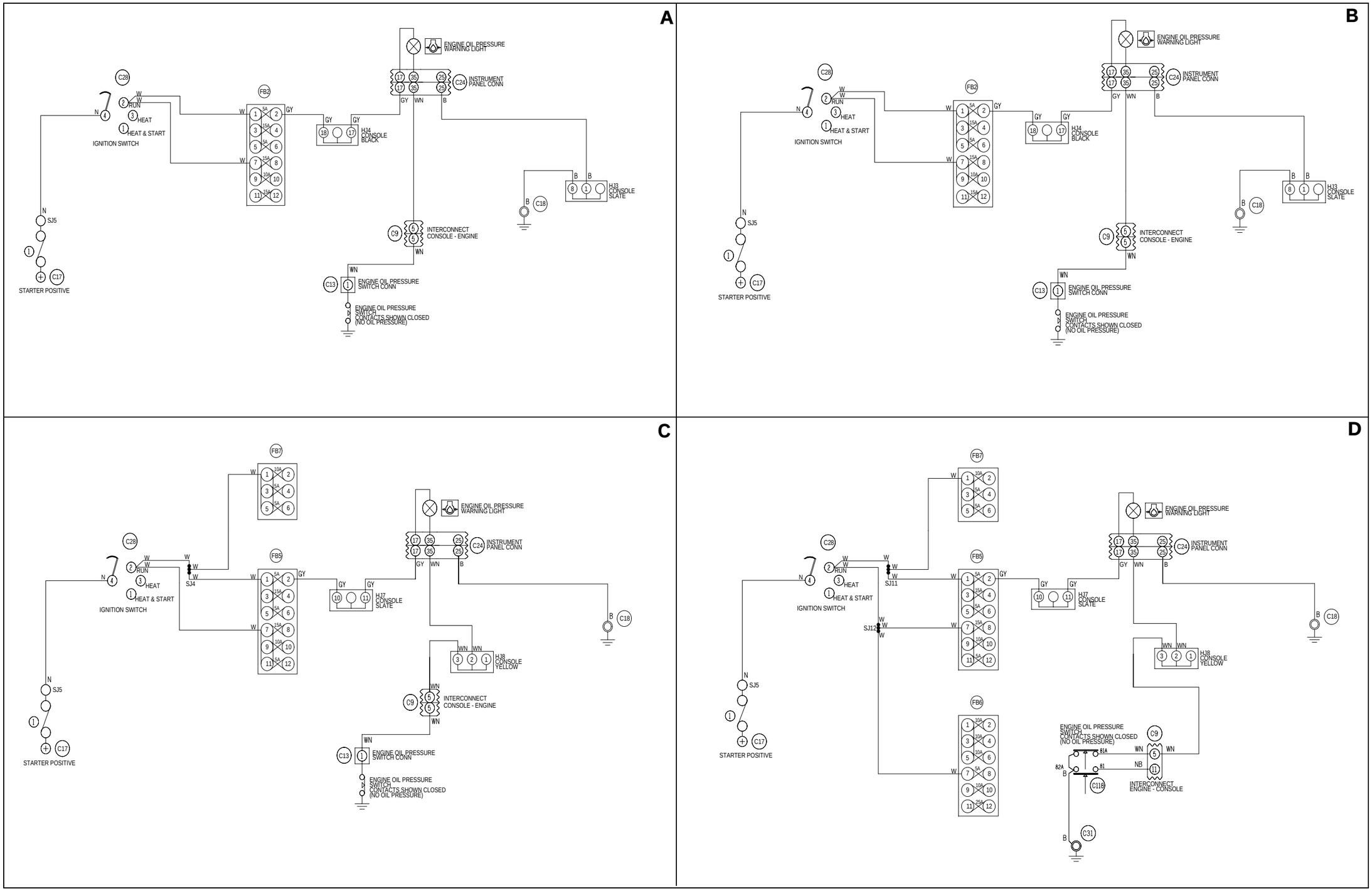


Figure 69

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 70

A - Engine Oil Pressure Instrument Panel Warning Light HI SPEC NAO

B - Engine Oil Pressure Instrument Panel Warning Light HI SPEC AGCO Cummins Engine

C - Transmission Oil Pressure Instrument Panel Warning Light Standard WEO

D - Transmission Oil Pressure Instrument Panel Warning Light Basic WEO

Figure 69

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Tractor Manuals Scotland

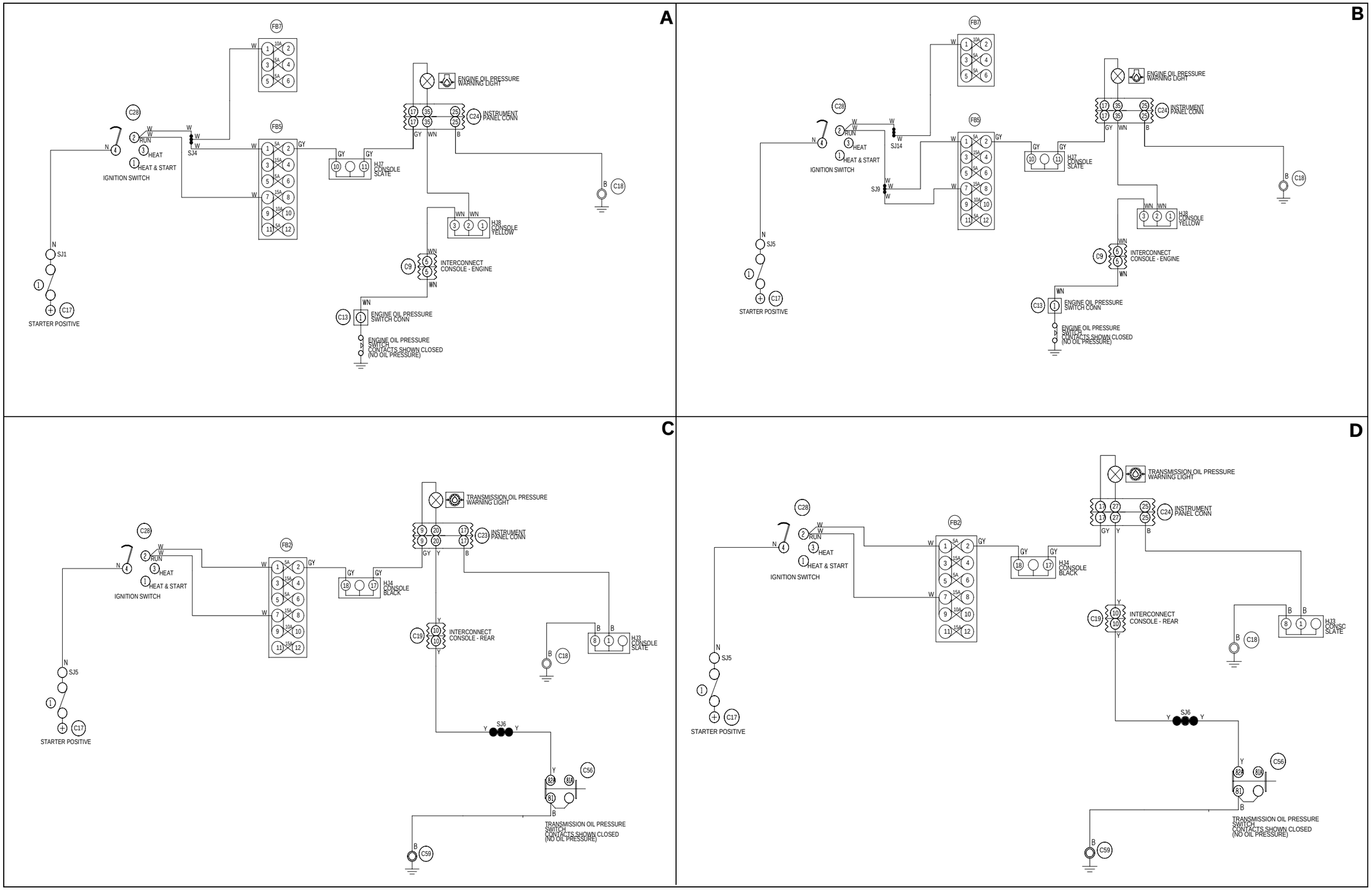


Figure 70

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 71

A - Transmission Oil Pressure Instrument Panel Warning Light Basic NAO

B - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC WEO Non Power Shuttle 2001-2002

C - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC WEO Powershuttle 2001-2002

D - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC Japan Non Powershuttle 2001-2002

Figure 70

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Tractor Manuals Scotland

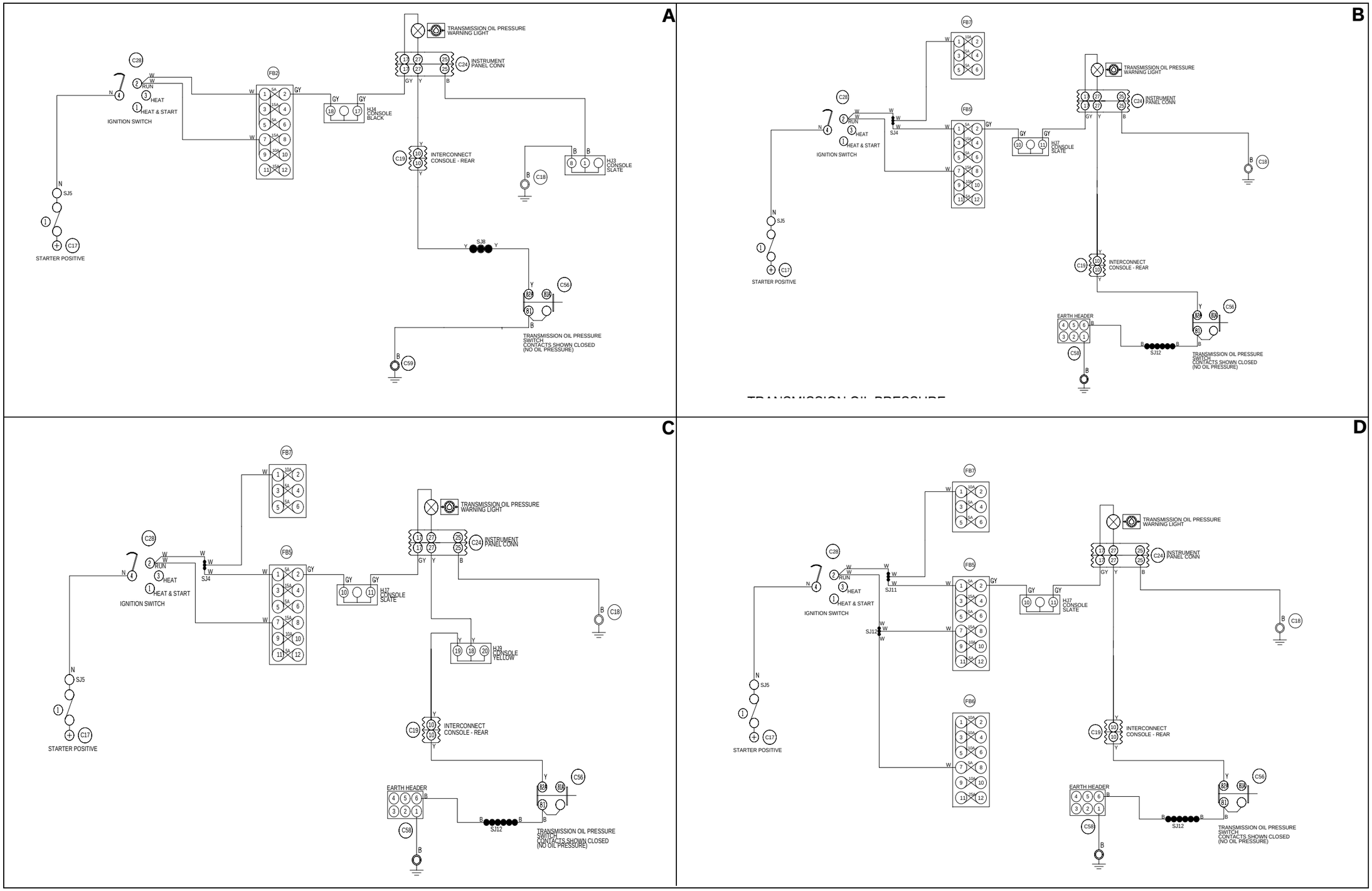


Figure 71

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 72

A - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC Japan 2001-2002

B - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC NAO Non Power Shuttle 2001-2002

C - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC NAO Power Shuttle 2001-2002

D - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC AGCO Cummins Engine Power Shuttle 2001-2002

Figure 71

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Footstep Wiring Diagrams

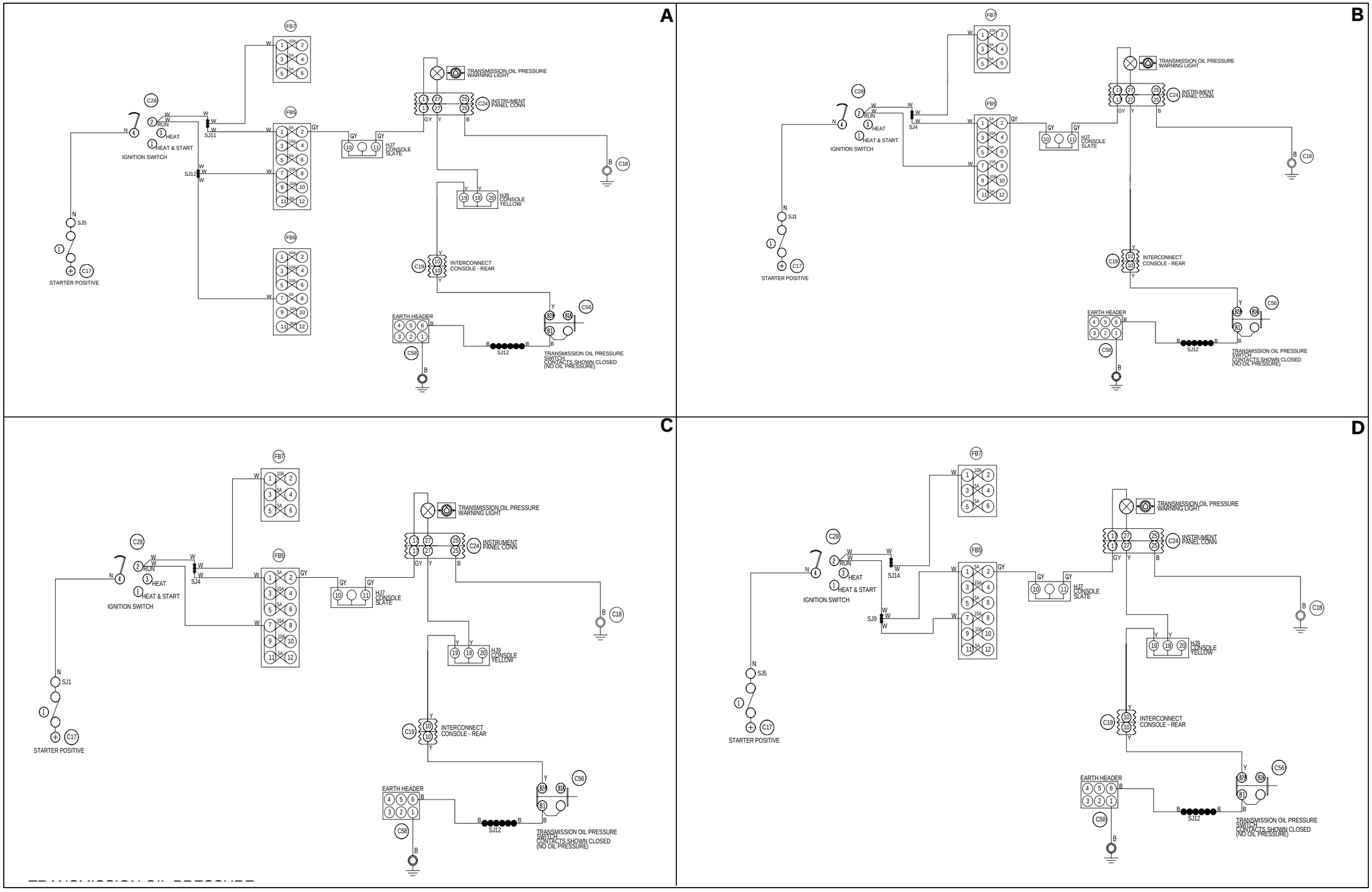


Figure 72

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 73

A - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC WEO Non Power Shuttle 2003
B - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC WEO Power Shuttle 2003
C - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC Japan Non Power Shuttle 2003
D - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC Japan Power Shuttle 2003

Figure 72

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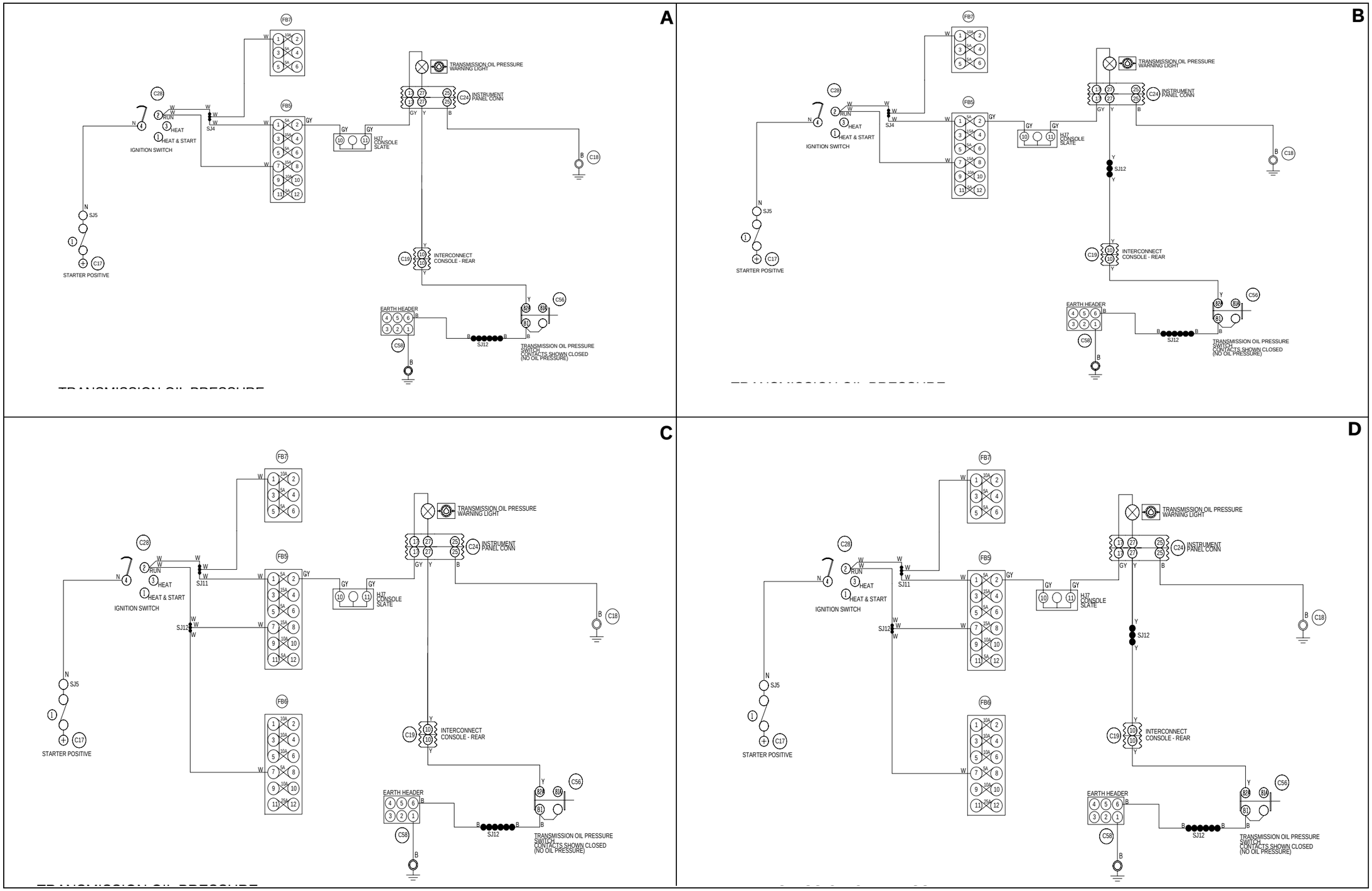


Figure 73

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 74

A - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC NAO Non Power Shuttle 2003
B - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC NAO Power Shuttle 2003
C - Transmission Oil Pressure Instrument Panel Warning Light HI SPEC AGCO Cummins Engine Power Shuttle 2003
D - Instrument Panel Creep Warning Light HI SPEC WEO

Figure 73

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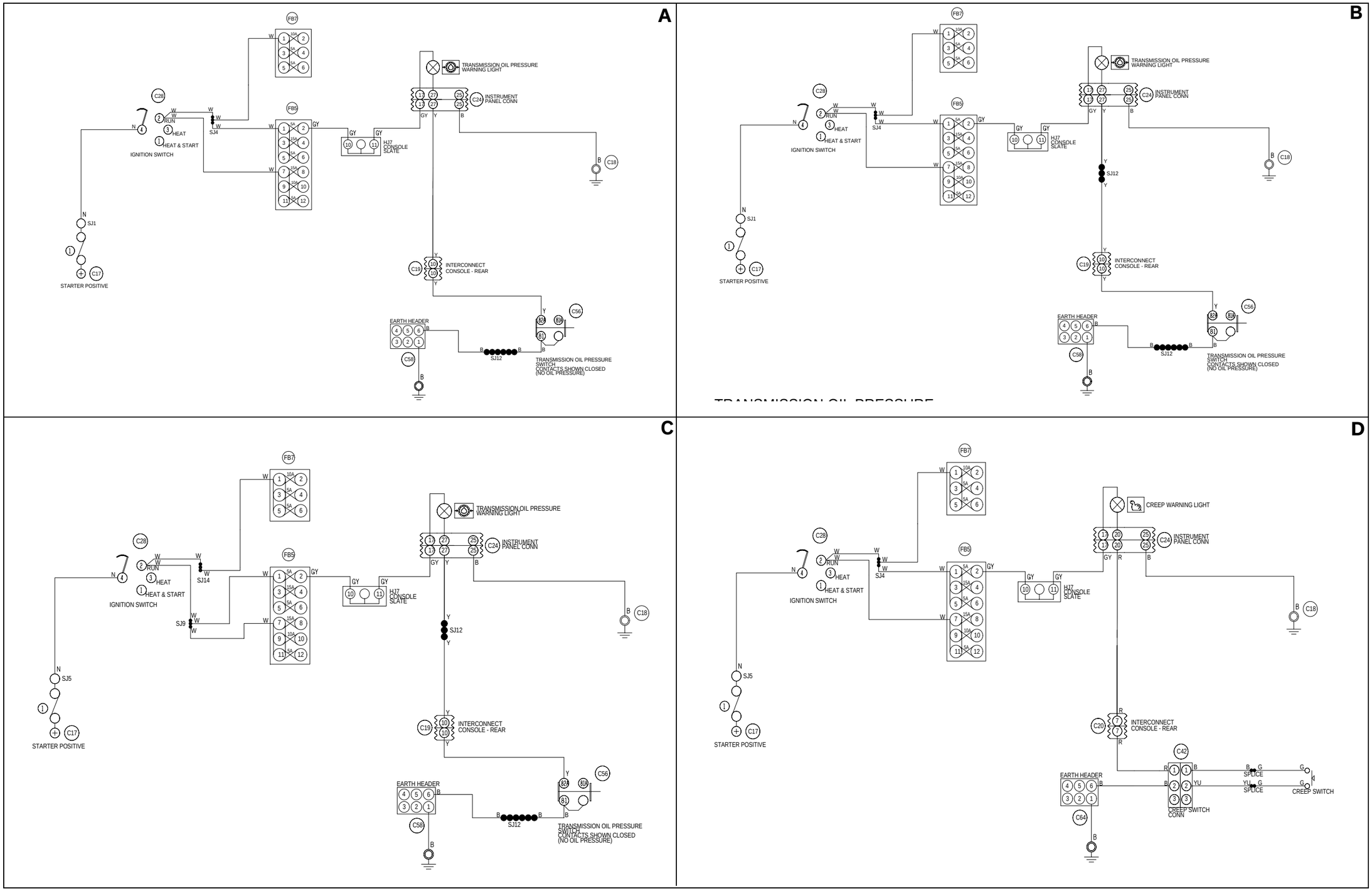


Figure 74

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Figure 75

A - Instrument Panel Creep Warning Light HI SPEC Japan
B - Instrument Panel Creep Warning Light HI SPEC NAO
C - ‘Air Cleaner Blocked’ Instrument Panel Standard WEO
D - ‘Air Cleaner Blocked’ Instrument Panel Basic WEO

Figure 74

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Tractor Manuals Scotland

Footstep Wiring Diagrams

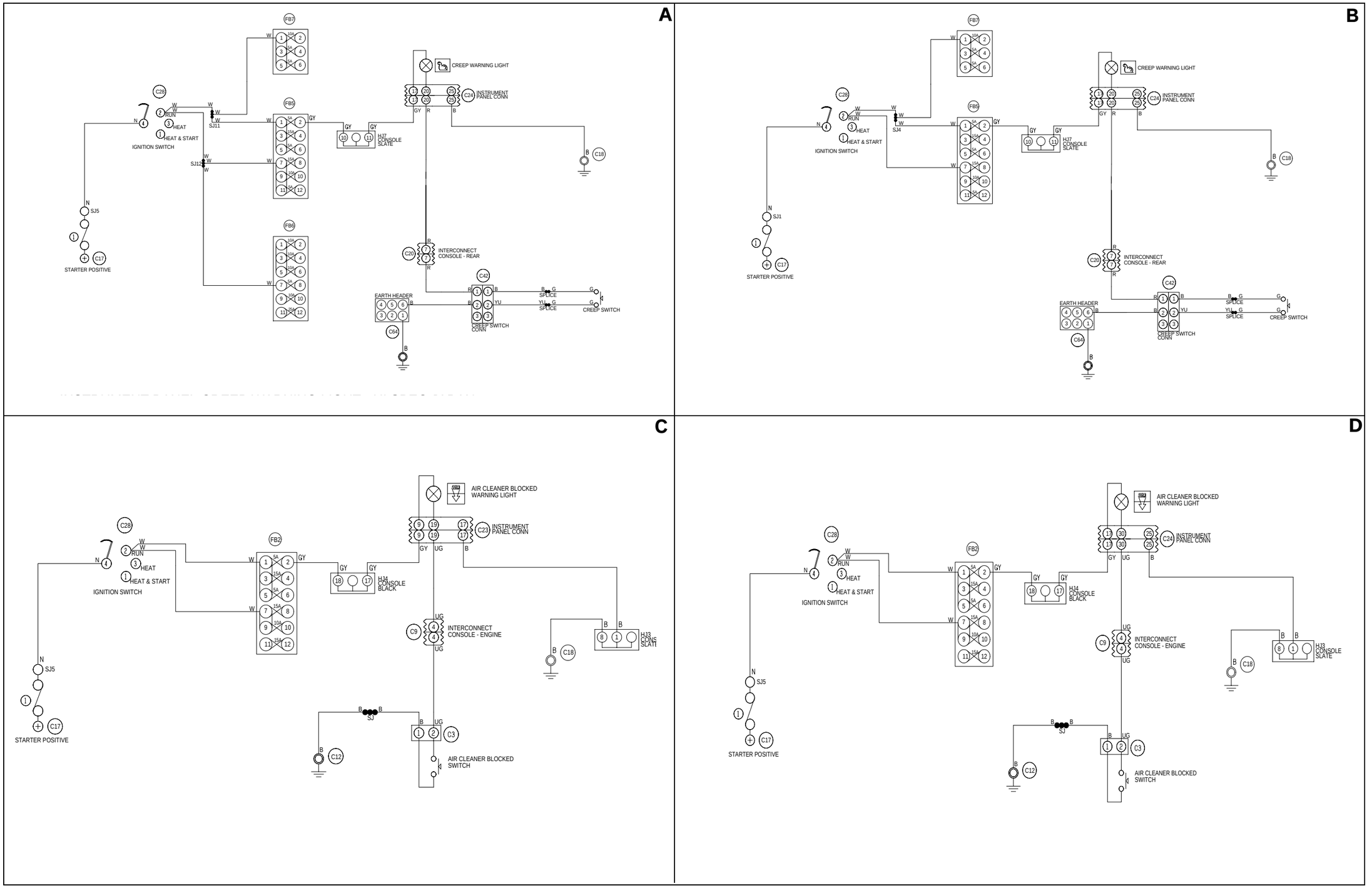


Figure 75

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Tractor Manuals Scotland

Figure 75

Figure 76

A - ‘Air Cleaner Blocked’ Instrument Panel Basic NAO

B - ‘Air Cleaner Blocked’ Instrument Panel HI SPEC WEO

C - ‘Air Cleaner Blocked’ Instrument Panel HI SPEC Japan

D - ‘Air Cleaner Blocked’ Instrument Panel HI SPEC NAO

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Footstep Wiring Diagrams

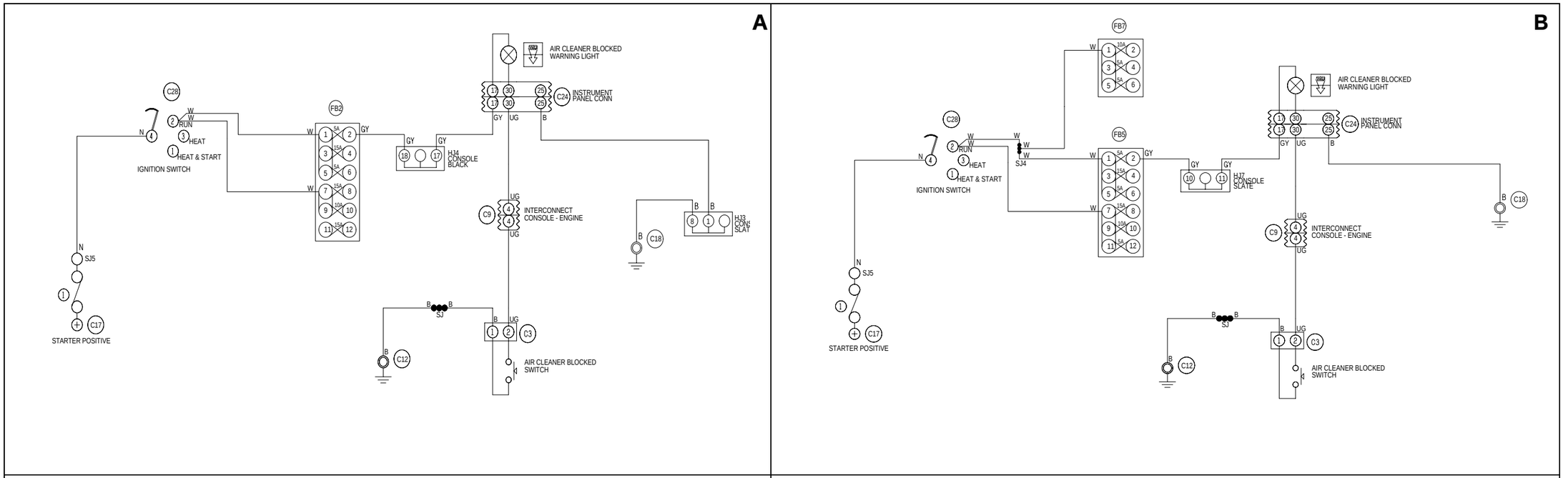


Figure 76l

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Figure 77

A - Air Cleaner Blocked' Instrument Panel HI SPEC AGCO Cummins Engine
B - Alternator No Charge Instrument Panel Warning Light Standard WEO
C - Alternator No Charge Instrument Panel Warning Light Basic WEO
D - Alternator No Charge Instrument Panel Warning Light Basic NAO

Figure 76

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Tractor Manuals Scotland

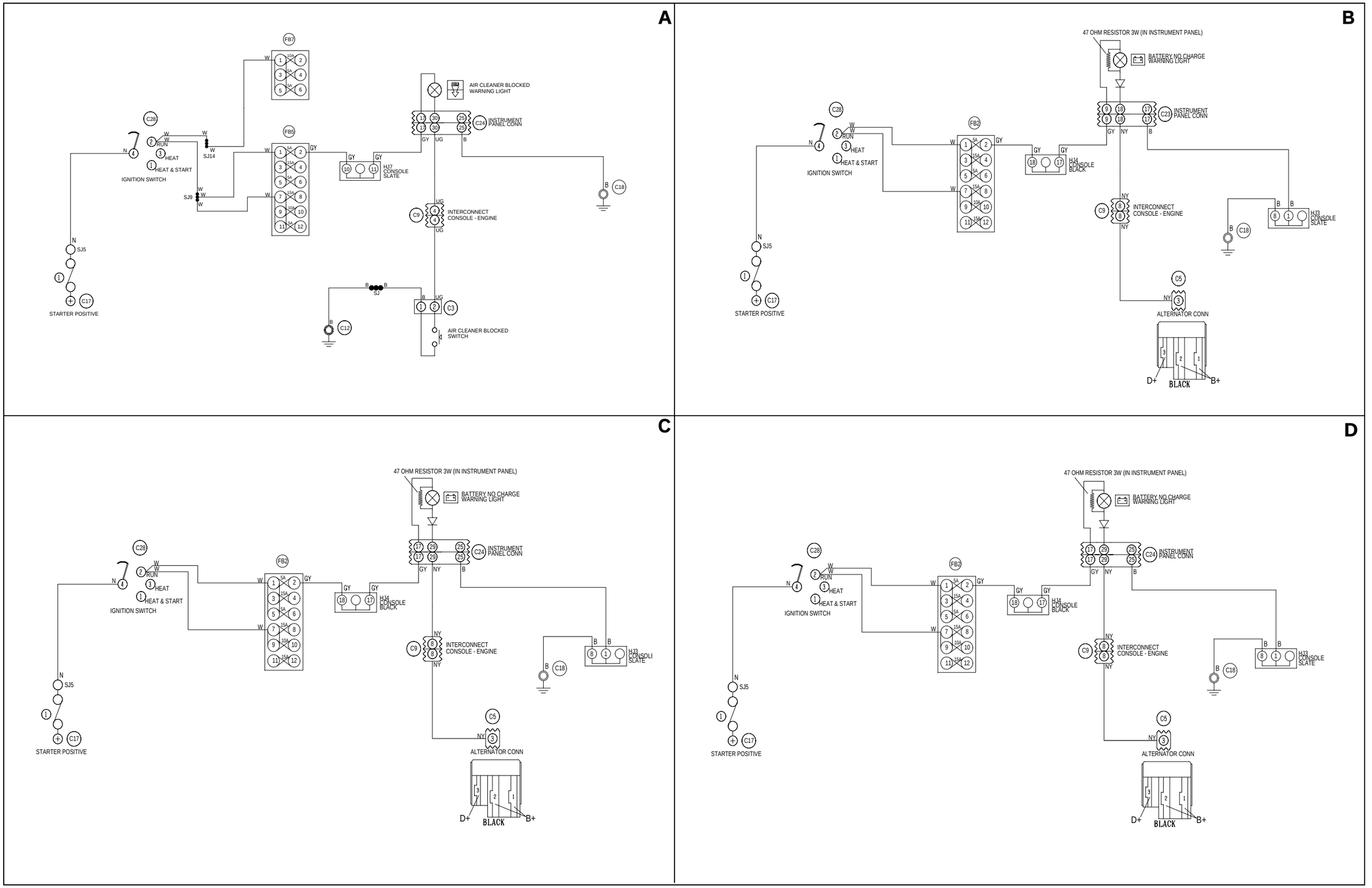


Figure 77

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Tractor Manuals Scotland

Figure 78

A - Alternator No Charge Instrument Panel Warning Light HI SPEC WEO
B - Alternator No Charge Instrument Panel Warning Light HI SPEC Japan
C - Alternator No Charge Instrument Panel Warning Light HI SPEC NAO
D - Alternator No Charge Instrument Panel Warning Light HI SPEC AGCO Cummins Engine

Figure 77

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Tractor Manuals Scotland

Footstep Wiring Diagrams

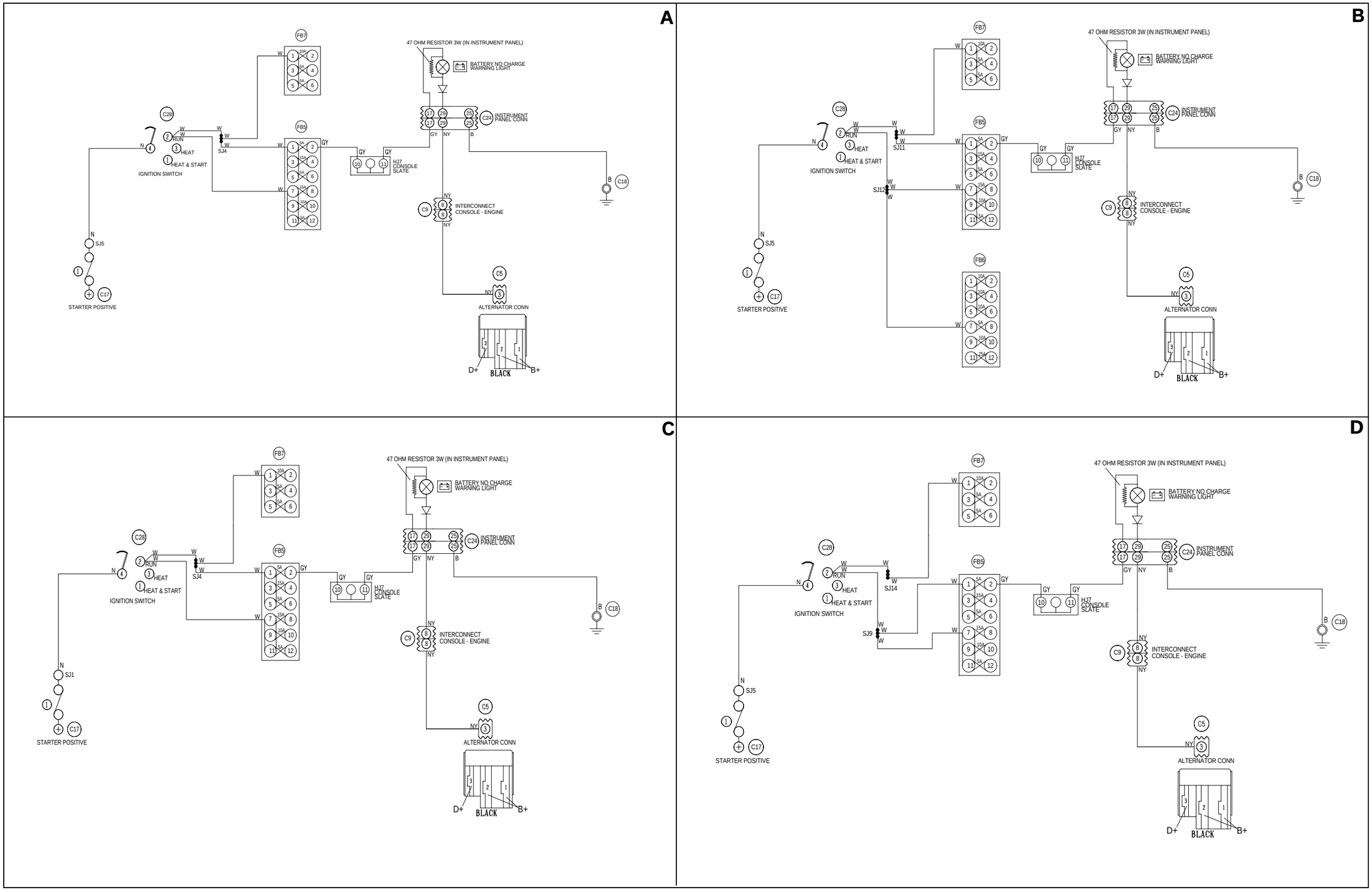


Figure 78

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Tractor Manuals Scotland

Figure 79

A - Handbrake Instrument Panel Warning Light - Standard WEO
B - Handbrake Instrument Panel Warning Light - Basic WEO
C - Handbrake Instrument Panel Warning Light - Basic WEO
D - Handbrake Instrument Panel Warning Light - HI SPEC WEO

Figure 78

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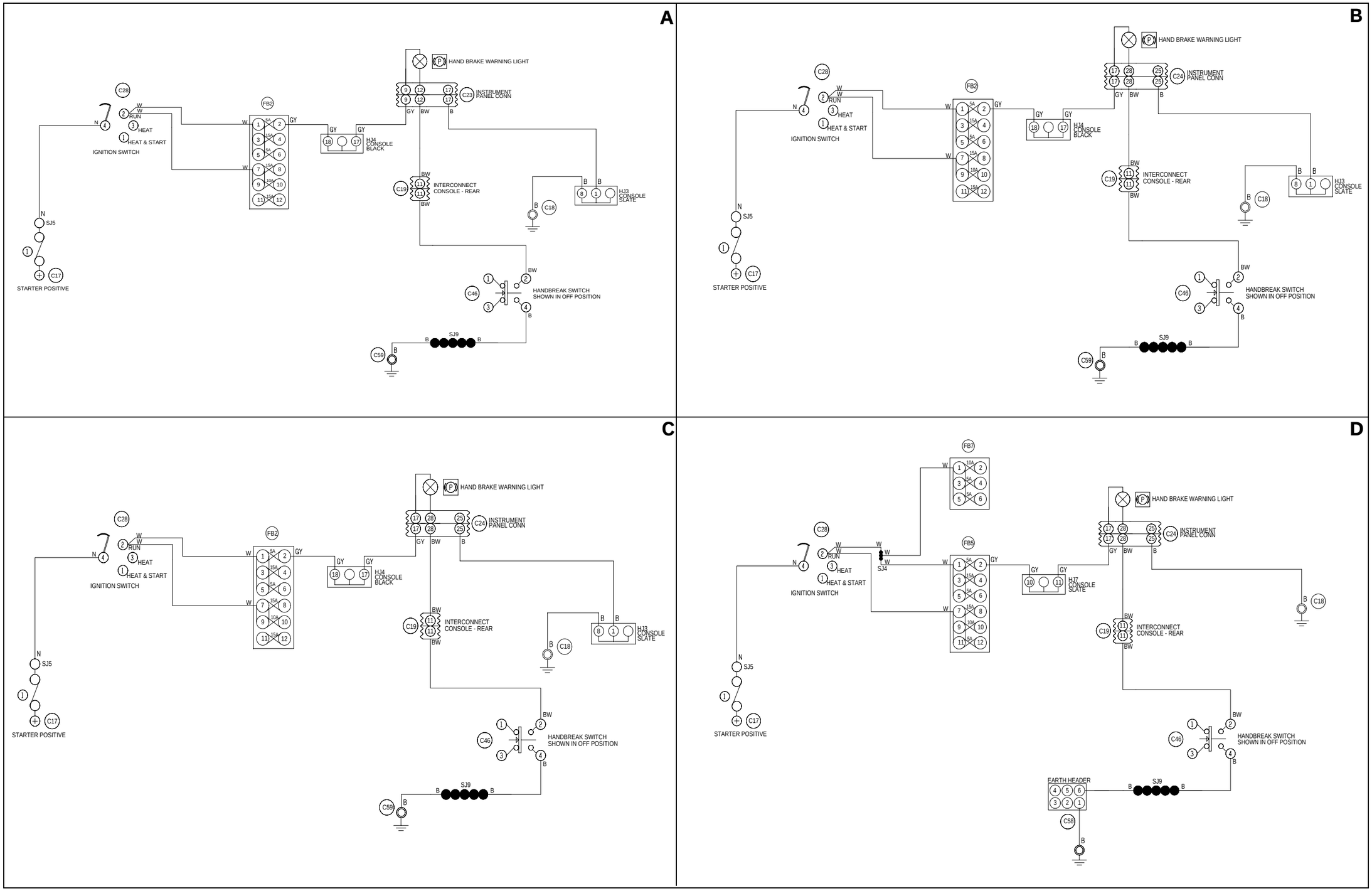


Figure 79

Tractor Manuals Scotland - Please Do Not Copy

Tractor Manuals Scotland

Figure 80

A - Handbrake Instrument Panel Warning Light - HI SPEC Japan
B - Handbrake Instrument Panel Warning Light - HI SPEC NAO
C - Handbrake Instrument Panel Warning Light - HI SPEC AGCO Cummins Engine
D - Hydraulic Lift System Lock - HI SPEC Japan

Figure 79

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Tractor Manuals Scotland

Footstep Wiring Diagrams

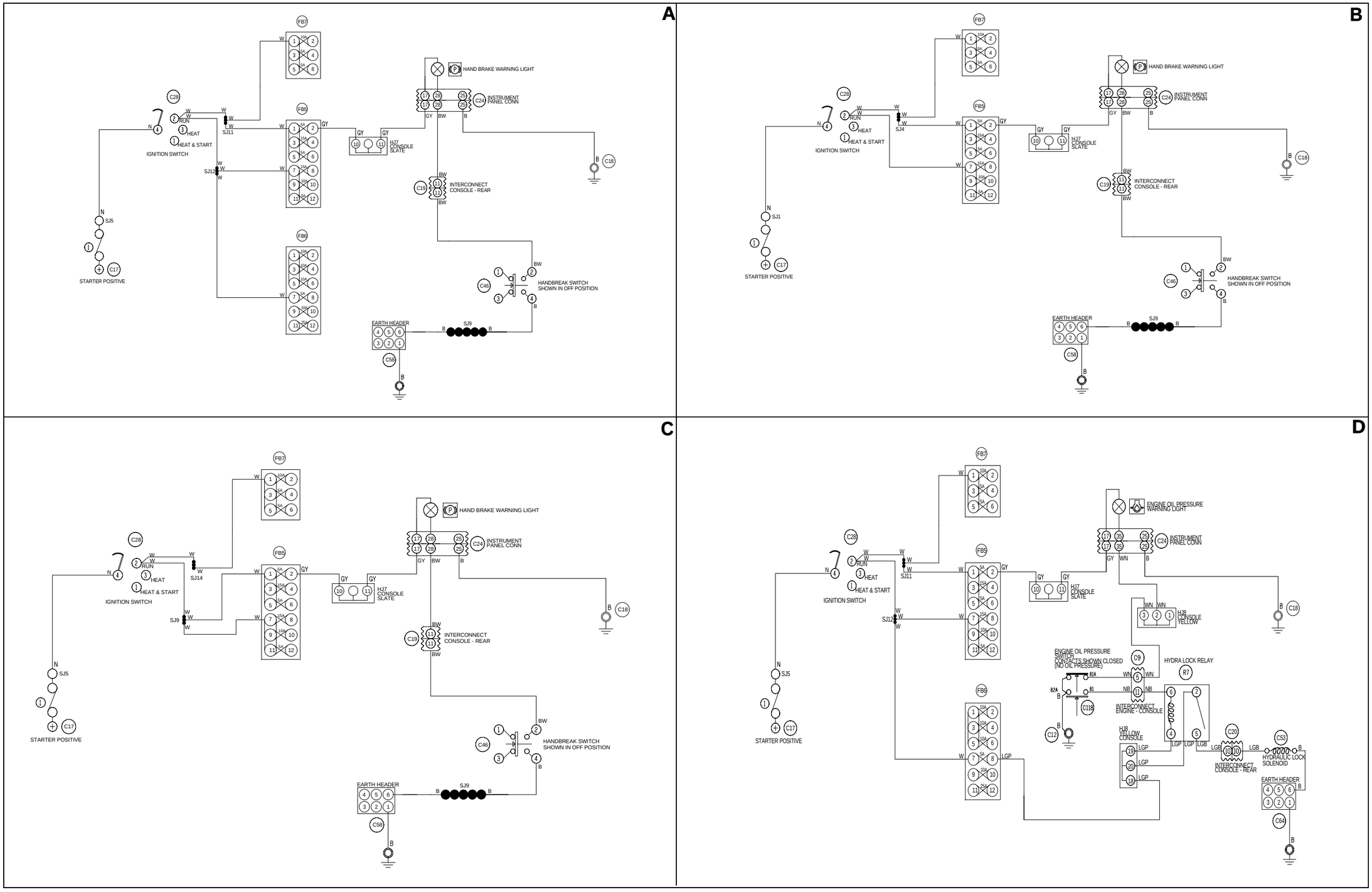


Figure 80

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Tractor Manuals Scotland

Figure 81

A - Power Shuttle/Wet Clutch Cooling Flow Instrument Panel Warning Light - HI SPEC WEO
B - Power Shuttle/Wet Clutch Cooling Flow Instrument Panel Warning Light - HI SPEC Japan
C - Power Shuttle/Wet Clutch Cooling Flow Instrument Panel Warning Light - HI SPEC NAO
D - Power Shuttle/Wet Clutch Cooling Flow Instrument Panel Warning Light - HI SPEC AGCO Cummins Engine

Figure 80

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Footstep Wiring Diagrams

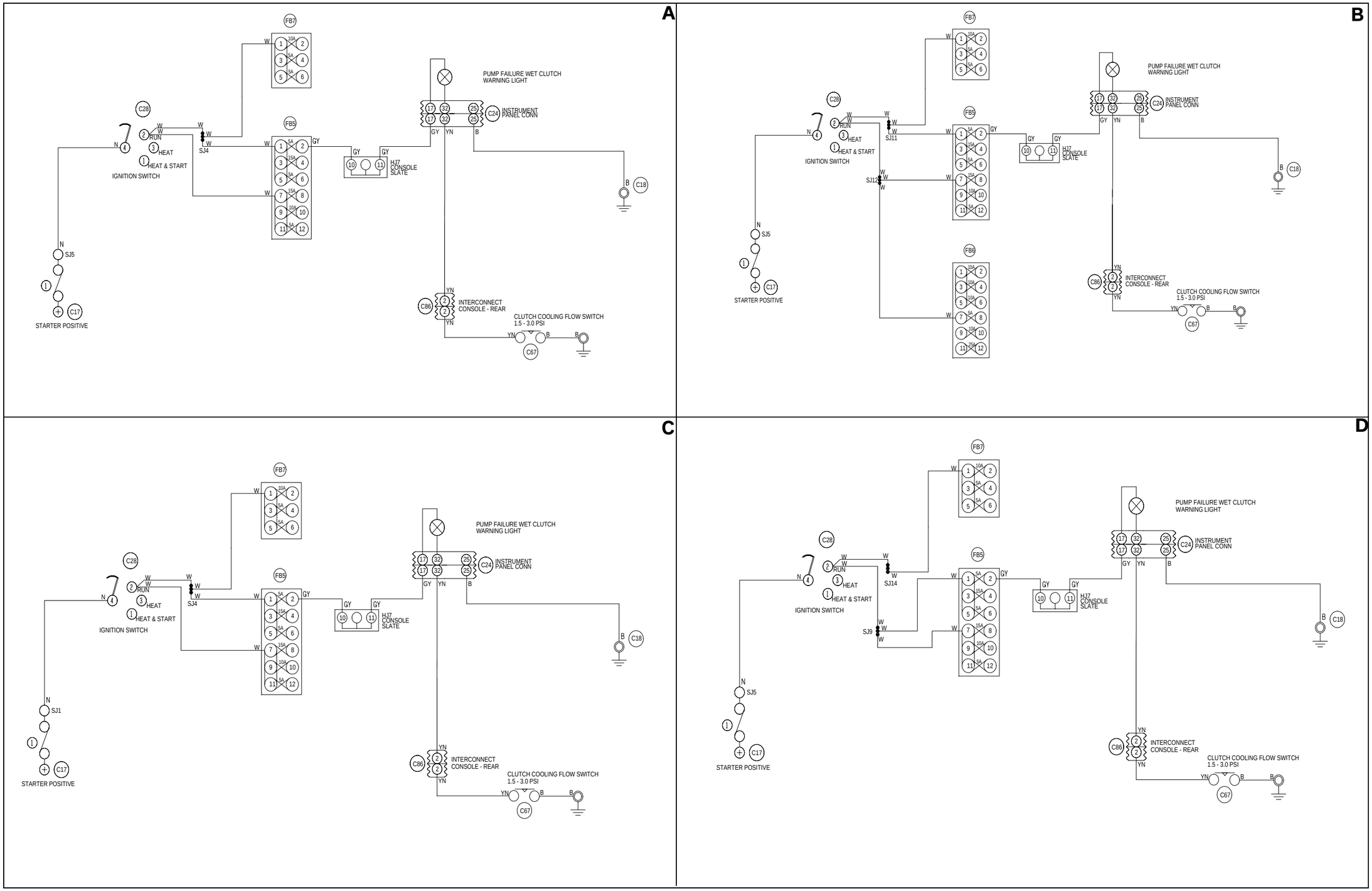


Figure 81

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Figure 82

A - Switch and Instrument Panel Illumination - Standard WEO
B - Switch and Instrument Panel Illumination - Basic WEO
C - Switch and Instrument Panel Illumination - Basic NAO
D - Switch and Instrument Panel Illumination - HI SPEC WEO

Figure 81

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Footstep Wiring Diagrams

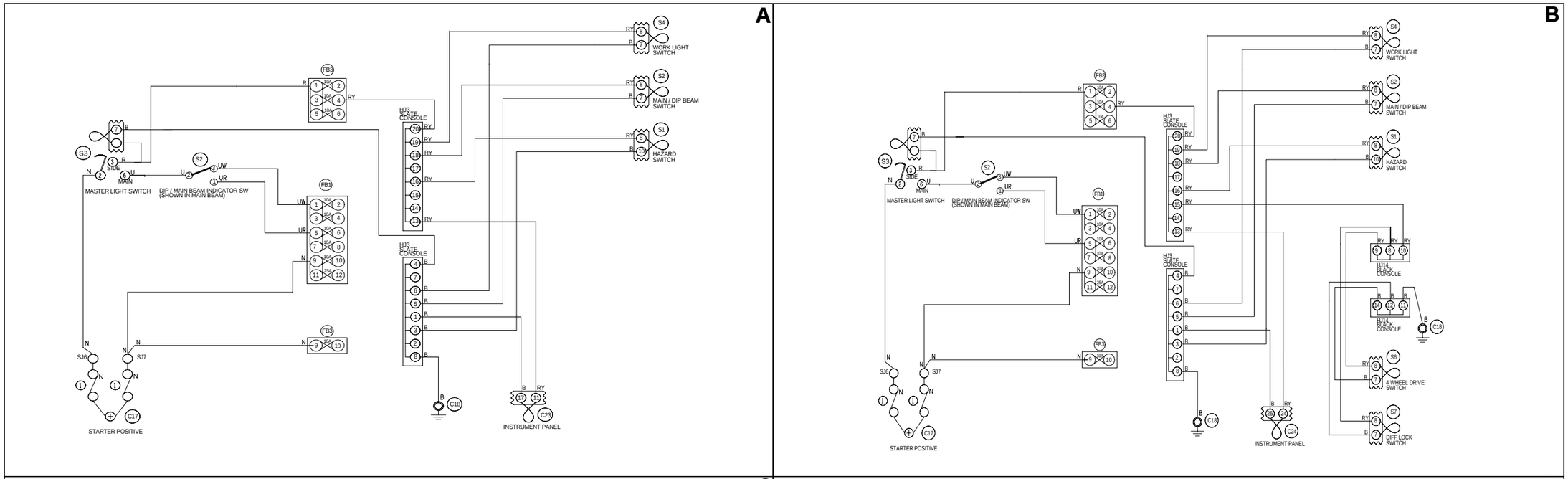


Figure 82

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Figure 83
A - Switch and Instrument Panel Illumination -HI SPEC Japan
B - Switch and Instrument Panel Illumination - HI SPEC NAO
C - Switch and Instrument Panel Illumination - HI SPEC AGCO Cummins Engine
D - Engine Speed Sensor - Standard WEO

Figure 82

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Footstep Wiring Diagrams

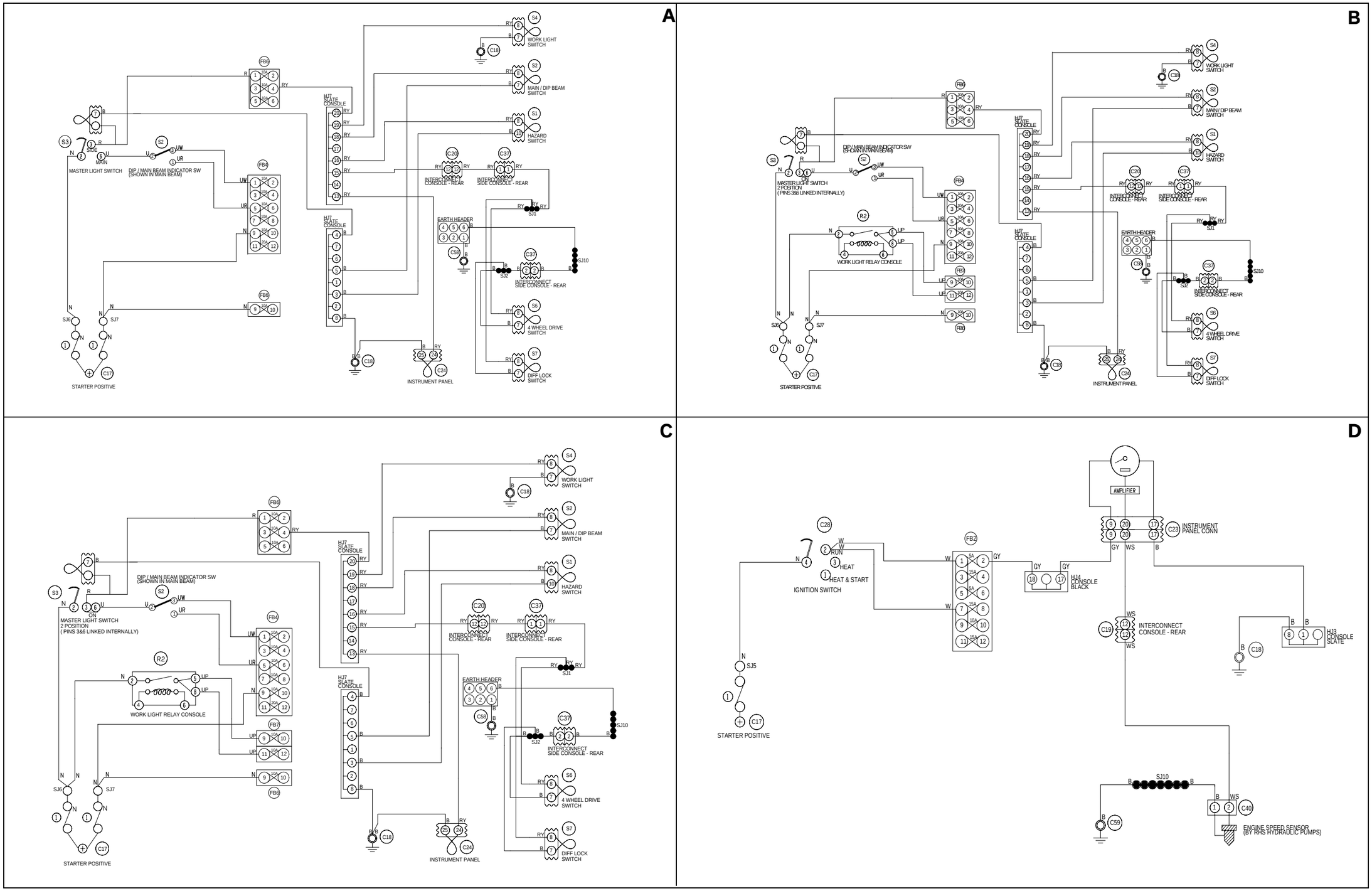


Figure 83

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Figure 84

A - Engine Speed Sensor - Standard WEO

B - Engine Speed Sensor - Basic NAO

C - Engine Speed Sensor - HI SPEC WEO - Non Power Shuttle 2001- 2002

D - Engine Speed Sensor - HI SPEC WEO - Power Shuttle 2001- 2002

Figure 83

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Footstep Wiring Diagrams

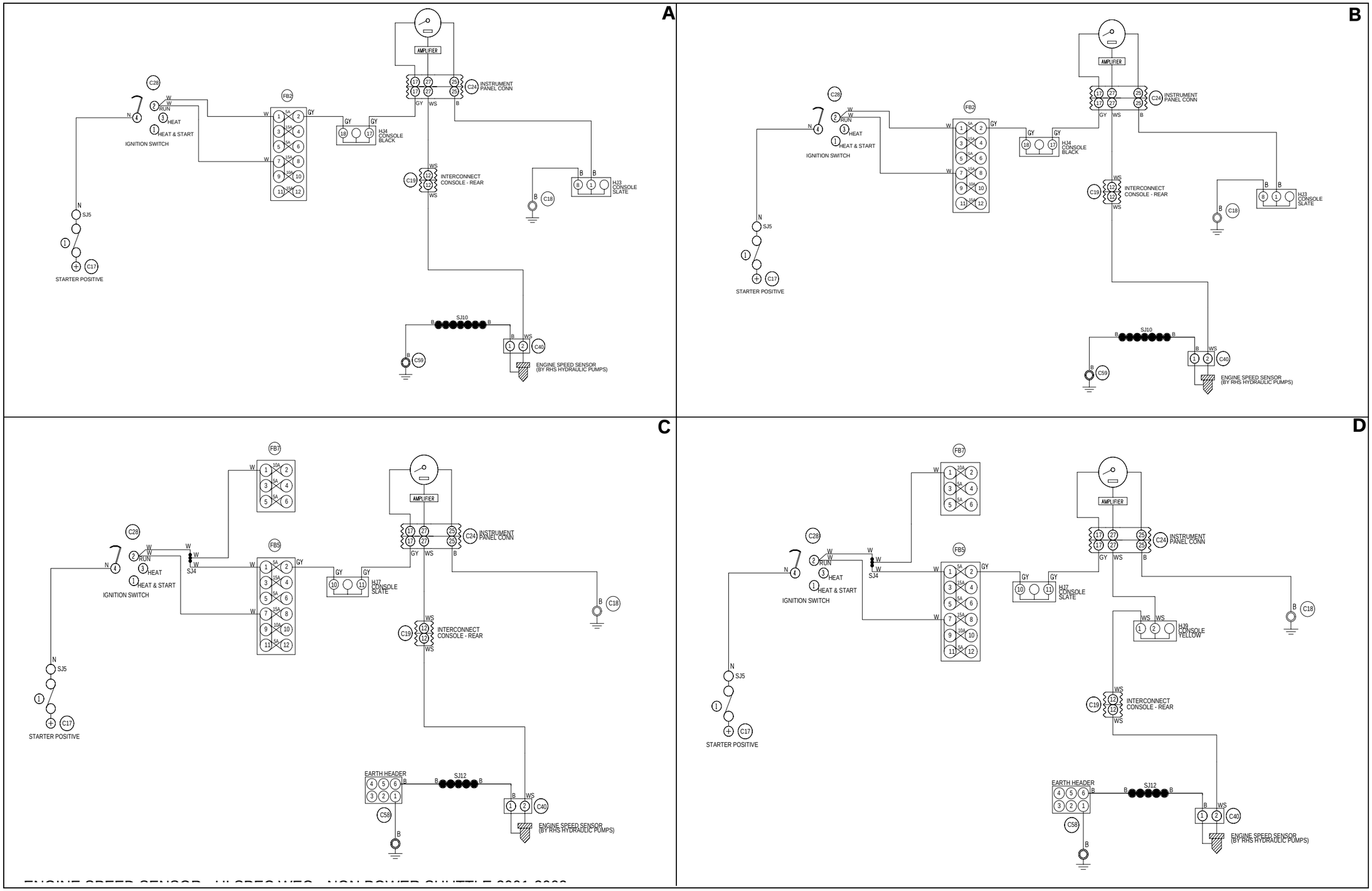


Figure 84

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Figure 85

A - Engine Speed Sensor - HI SPEC Japan - Non Power Shuttle 2001- 2002
B - Engine Speed Sensor - HI SPEC Japan - Power Shuttle 2001- 2002
C - Engine Speed Sensor - HI SPEC NAO - Non Power Shuttle 2001- 2002
D - Engine Speed Sensor - HI SPEC NAO - Power Shuttle 2001- 2002

Figure 84

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Footstep Wiring Diagrams

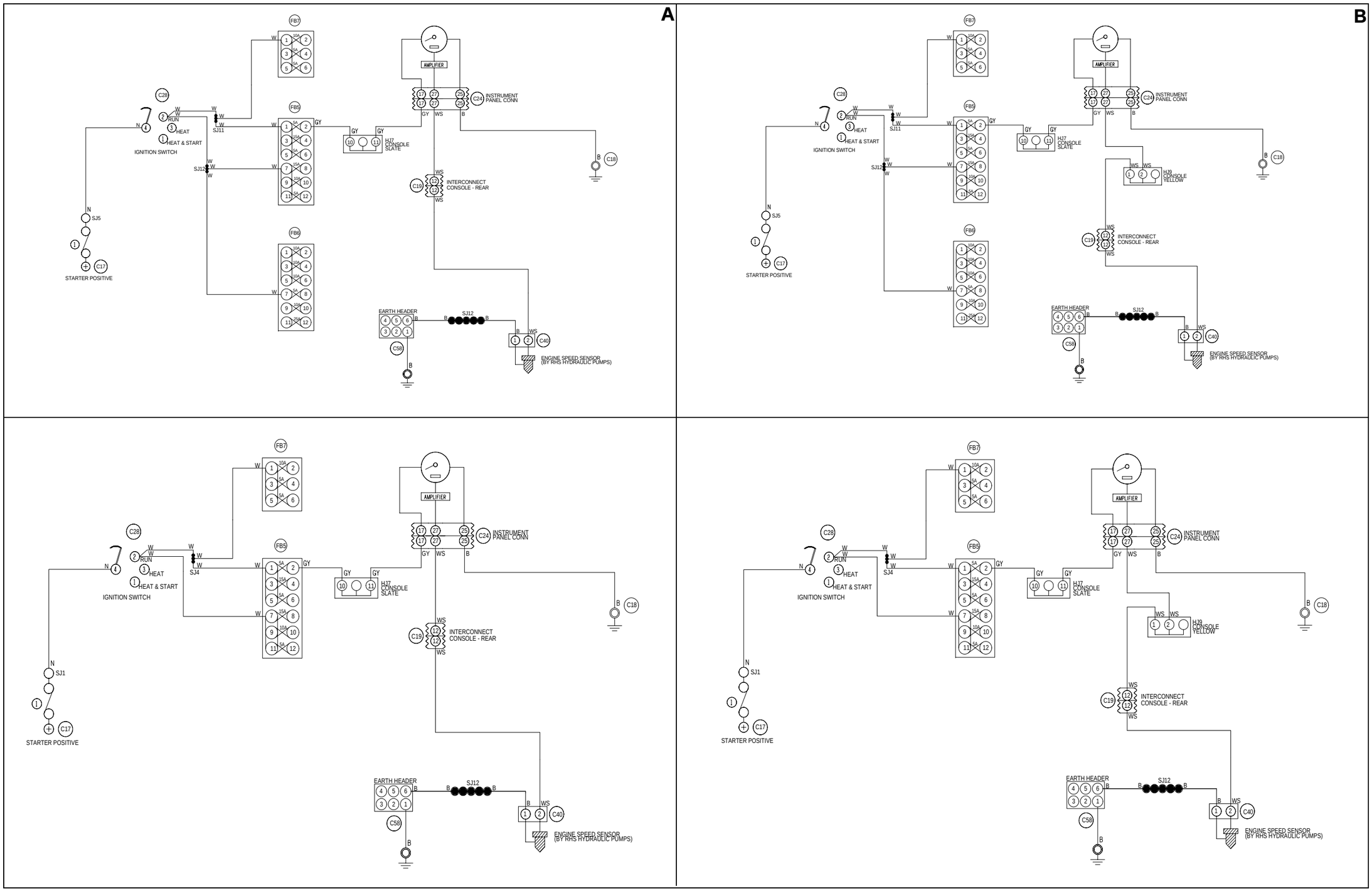


Figure 85

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Figure 86

A - Engine Speed Sensor - HI SPEC AGCO Cummins Engine 2001-2002

B - Engine Speed Sensor - HI SPEC Japan Non Power Shuttle 2001-2002

Figure 85

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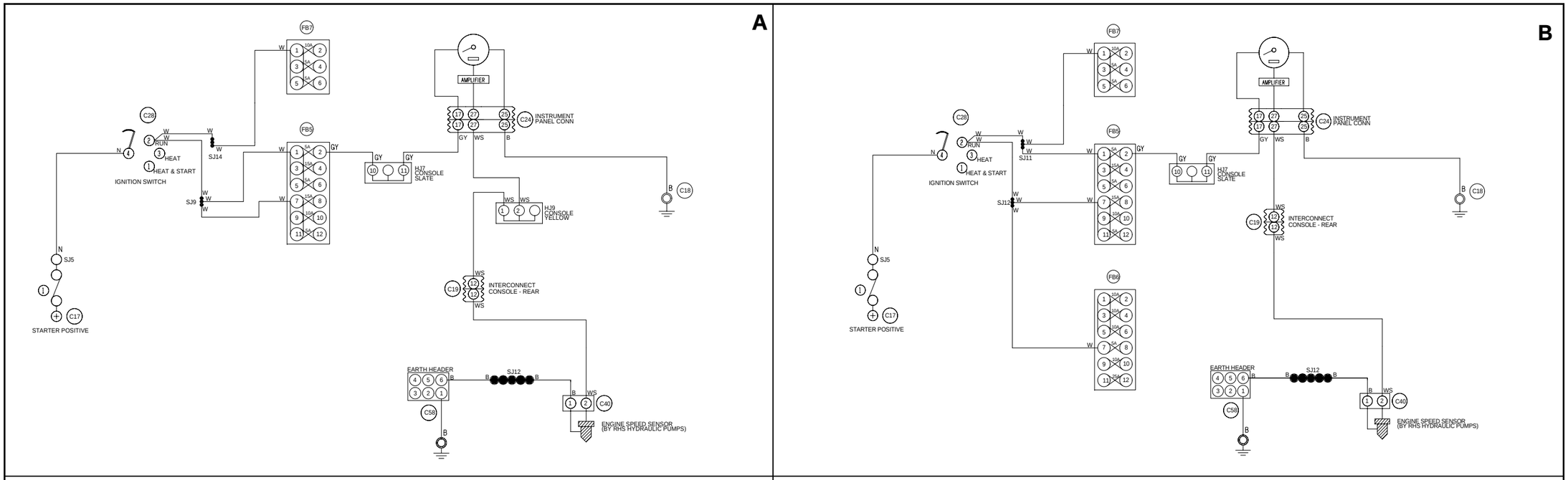


Figure 86

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Figure 86

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SECTION 11

Electronics

INDEX

11A	SPEEDOMETER AND PERFORMANCE MONITOR
11B	ELECTRONIC LIFT CONTROL
11C	ELECTRONIC LIFT CONTROL (TWO LEVER)

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Speedometer and Performance Monitor

Section 11 - Part A

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Operation No.	Description	Page No.
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3-11A	Speed Sensor - Adjust	11A– 8
4-11A	Speed Sensor Magnetic Track- Removal and Refitment	11A– 8
5-11A	Trip Area/Distance Hold Facility - Install	11A–10

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Speedometer and Performance Monitor

DIGITAL SPEEDOMETER

Adjust **1-11A**

Procedure

The digital speedometer (1, Fig.1) displays forward, or reverse, speed only, in kilometres per hour (km/hr) or miles per hour (mile/hr). When in km/hr a small 'M' will be visible in the bottom right-hand corner of the display.

The programme can be changed to select a speedometer reading of km/hr or mile/hr, and for different tyre sizes. When making changes to the speedometer programme the speedometer and PTO (2, Fig.1) digital displays are used and illustrated below.

NOTE: *If any difficulty is experienced or you have made a mistake, turn the ignition switch 'OFF' and start again.*

Selecting km/hr or mile/hr

To change from a km/hr to mile/hr, or vice versa, reading on the speedometer proceed as follows:

1. Open the fuse box cover below the steering wheel to reveal the speedometer control pad (Fig.2), the press buttons are as follows:

   'C' - Change.

   'M' - Mode.

   'O' - Reset.

   '↑' - Select.

2. Turn the ignition switch ON, after three seconds the displays will be as follows:



NOTE: *The last digit on the speedometer could be either a zero or a 1.*

3. Press button **'M'** (mode) once on the control pad:



4. Press '↑' (chevron) to select km/hr (M) or mile/hr (no 'M'), it will cycle between readings every time the button is pressed:



km/hr mile/hr

NOTE: *Speedometer displays only shown.*

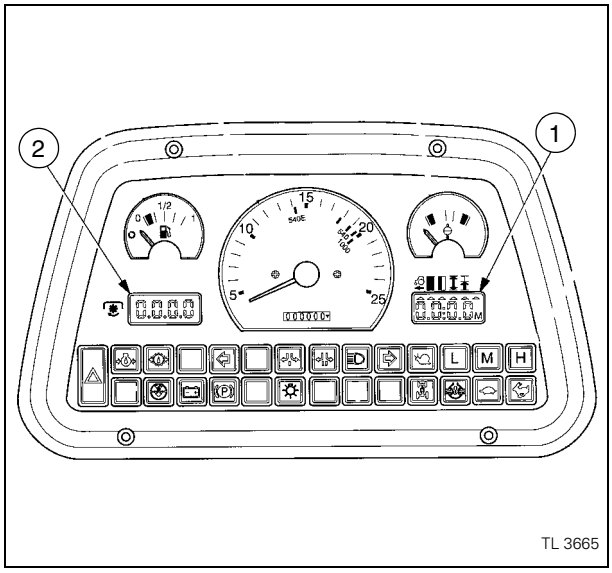


Fig.1

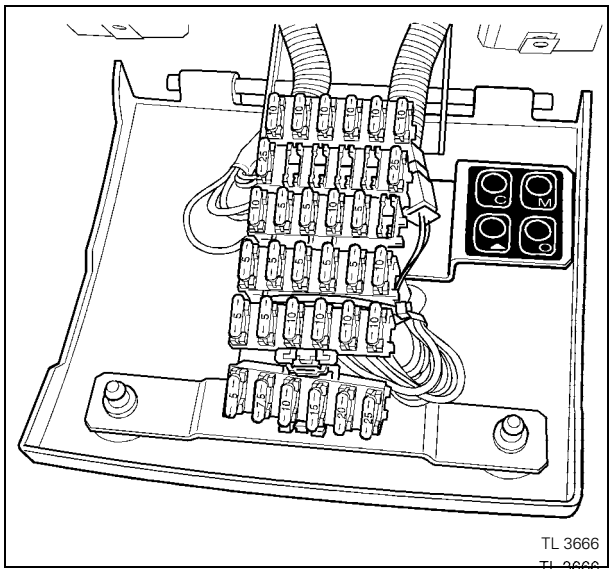


Fig.2

5. To retain the input press 'C' (change) and hold, ignoring the sequence of numbers and dashes. After 3 seconds, the '↑' shows below the tractor emblem and the display returns to normal:



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Change Tyre Size and Checking Accuracy

If the tyres are changed for a different size, or you want to check the accuracy, the speedometer it must be re-programmed.

The 'Driving down the road method' is the most accurate way of inputting the tyre programme figure, it takes into account tyre wear and wheel slip.

1. Mark out a course exactly 100 metres long.
2. Start the engine.
3. Ensure that the speedometer is in km/hr mode (M).
4. Press **'M'**, the display will be as follows:



5. Press **'C'** once (speedometer), twice (performance monitor), the old tyre setting will be displayed:



NOTE: *Tyre size figure used as an example of a unit which has not been programmed.*

6. Engage a slow forward gear.
7. Line the tractor up with the first mark on the course.
8. Press **'M'** to clear the displays:



9. Drive forward (NOT backwards) at any speed to the end of the course. When in line with the marker, STOP, press **'O' twice**. After 3 seconds the display will return to the original mode as follows:



10. If you have made a mistake 'ERROR' will be displayed, turn OFF the ignition switch and start again:



To check the tyre programme figure loaded:

a. Press **'M'**.



b. Press **'C'** twice to display input:



c. Turn OFF the ignition switch or press **'C'** twice to return to its original mode.

Calculation Method

To make the calculation you will need to know the rolling circumference of the rear wheel in metres and convert this into a programme figure. The attached chart gives the more popular tyre sizes, and the calculation has been done for you, if the tyre you require is not listed, the rolling circumference can be obtained from your local tyre supplier.

Tire size	Tire type	Programme figure
14.9R28	Super Traction Radial R1	298
14.9-28	Dyna Torque II R1	292
14.9-28	Traction Sure Grip R1	292
16.9R30	Super Traction Radial R1	272
16.9-30	Dyna Torque II R1	272
16.9-30	Traction Sure Grip R1	275
18.4R30	Super Traction Radial R1	260
18.4-30	Dyna Torque II R1	255
18.4-30	Traction Sure Grip R1	260
12.4R32	Super Traction Radial R1	297
16.9R34	Super Traction Radial R1	254
16.9-34	Dyna Torque II R1	259
16.9-34	Traction Sure Grip R1	257
18.4R34	Super Traction Radial R1	243
18.4-34	Dyna Torque II R1	246
18.4-34	Traction Sure Grip R1	245
12.4R36	Super traction Radial R1	277
12.4-36	Traction Sure Grip R1	275
13.6R36	Super Traction Radial R1	267
13.6-36	Traction Sure Grip R1	265
13.6R38	Super Traction Radial R1	258
16.9R38	Super Traction Radial R1	239
16.9-38	Dyna Torque II R1	238
18.4R38	Super Traction Radial R1	229
18.4-38	Dyna Torque II R1	226
480/70R34	Low Profile Radial	252
520/70R34	Low Profile Radial	242
540/65R34	Low Profile Radial	254
480/70R38	Low Profile Radial	238
540/65R38	Low Profile Radial	238
520/70R38	Low Profile Radial	228
600/65R38	Low Profile Michelin Radial	229
540/65R30	Low Profile Michelin Radial	271

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Speedometer and Performance Monitor

To calculate the programme figure:

For this example we will assume that the tyre is being changed to a 16.9R x 34 radial and it is not on the chart. The rolling circumference of this tyre is 4.717 m.

All settings should be made in km/hr (metric).

Carry out the following calculation:

= (10 ÷ circumference of tyre in meters) x 120.

= (10 ÷ 4.717) x 120.

= 2.120 x 120.

= 254 - this is the figure (tyre programme figure) that has to be programmed into the speedometer.

Speedometer

1. Turn the ignition switch ON.
2. Check that the speedometer is reading in km/hr, if not, change *(see previous instructions).* The display should be as follows:



3. Press **'M'** to instigate change:



4. Press **'C'** once to obtain old tyre setting:



NOTE: *Tyre size figure used as an example.*

5. Press '↑' so that the chevron is at the top right-hand corner of the display:



6. Input the programme figure, either from the chart or your calculation, for this example 254. Press '↑' to change the first number on the right from 8 to 4, keep on pressing until the desired number appears (4):



7. Press **'C'** to accept the number (4) and move on to the next digit on the left, a decimal point will appear on the right of the number being changed:



8. Press '↑' to change the number from 2 to 5 as detailed in paragraph 6:



9. Press **'C'** to accept and move on to the next number:



10. The next number is 2, 2 is the number we require, no change, press 'C' to accept:



11. The zero is not required, to retain the selection of 254, press **'C'**, after 3 seconds the display will return to its original mode:



12. Reset mile/hr if this was the original setting.



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PERFORMANCE MONITOR

Adjust 2-11A

Procedure

The Performance Monitor displays the following functions, see Fig.1:

- Forward speed (1).
- Total area worked (2).
- Trip area worked (3).
- Total distance travelled (4).
- Trip distance travelled (5).

The various functions are selected and changed by the control pad on the right-hand side of the instrument panel. When the ignition switch is turned OFF and switched ON again, the performance monitor will always return to forward speed. The other functions must then be selected.

The trip area and trip distance can be reset to zero, total area and distant cannot.

The instrument programme can be changed to read in metric, (kilometres per hour, kilometres and hectares) or imperial (miles per hour, miles and acres).

NOTE: *If any difficulty is experienced or you have made a mistake, turn the ignition switch 'OFF' and start again.*

Selecting km/hr or mile/hr

To change from a metric to imperial reading, or vice versa, carry out the procedure detailed for the digital speedometer, *(see page 11A-2)*.

Changing tyre size and checking accuracy

If the tyres are changed for a different size, or you want to check the accuracy, the performance monitor must be re-programmed. Carry out the procedure detailed for the digital speedometer, *(see page 11A-3 or 11A-7)*.

Instrument resolution

The maximum distance and area that can be recorded is as follows:

Distance:

Total maximum	9999 km (9999 miles)
Trip maximum	9.999 km (9.999 miles)

When these figures are reached the display will automatically return to zero and start again. The low maximum given to the trip distance is to enable the instrument to record accurately distances down to one metre, or equivalent.

Area:

Total maximum	9999 hectare (9999 acres)
Trip maximum	99.99 hectare (99.99 acres)

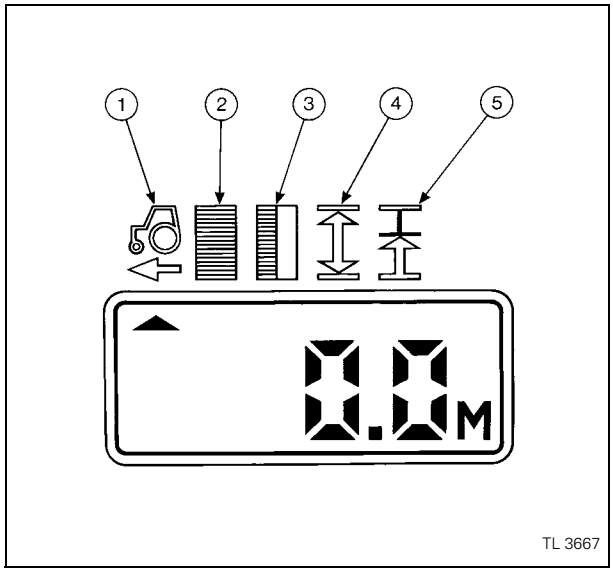


Fig.1

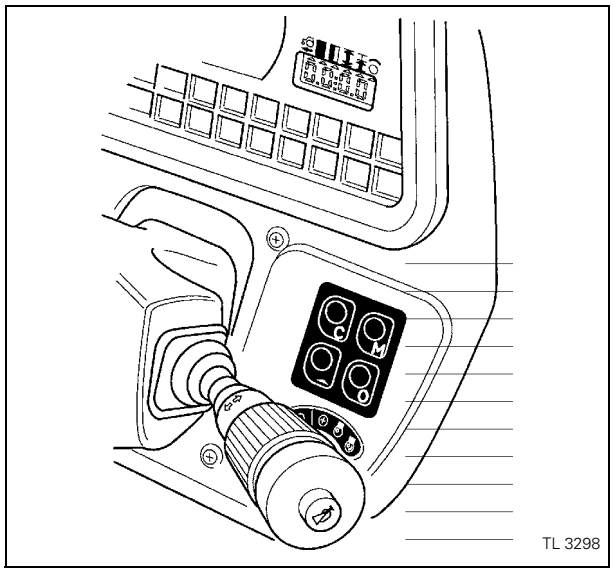


Fig.2

When these figures are reached the display will automatically return to zero and start again.

Selecting the function

The control pad () adjacent to the steering wheel has the following press buttons:

'C' - Change.

'M' - Mode.

'O' - Reset.

'↑' - Select.

To select the required function, with the ignition switched ON, press '↑' button on the control pad until the '↑' symbol is below the function required, it will move in the following sequence:

Speed, Trip distance, total distance, trip area, total area and speed again.

The display will now indicate the function selected.

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Speedometer and Performance Monitor

Resetting trips to zero

To set the trip area or distance reading to zero proceed as follows:

1. Switch the ignition ON.
2. Select the trip required, area or distance, distance shown in this example.



3. Press 'O' (reset) on the control pad and the display will be reset to zero:

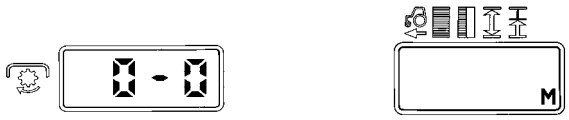
Programme working width

To programme in the working width of the implement for area measurement proceed as follows:

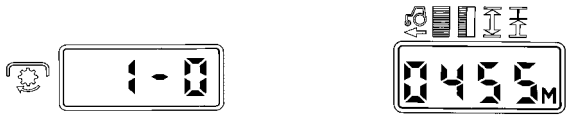
1. Switch the ignition ON.
2. Press 'M' (mode) to show either metric or imperial, the display will look like this:



3. Select metric or imperial by pressing '↑' (chevron), metric is shown in this example:



4. Press 'C' (change), The left-hand display indicates the programme and digit being changed, in this case programme 1. The right-hand display will indicate the working width of the implement already loaded:



5. For this example we will change the working width to 3 metres. The programme must be loaded with the working width of the implement in centimetres or (inches) up to a maximum of 50 metres or 164 feet (1969 inches). An implement with a 3 metre width is 300 cm wide, this is the figure that must be loaded. The previous width loaded is 455 cm in this example.
6. To change the working width, press the '↑' until the chevron appears in the top right-hand corner of the display:



7. Press '↑' to change the first number on the right from 5 to 0, keep pressing until the desired number appears (0):



8. Press 'C' to accept and move on to the next number:



9. Press '↑' to change the second number from 5 to 0:



10. Press 'C' to accept and move to the third number:



11. Press '↑' to change the third number from 4 to 3:



12. Press 'C' to accept, the number has now been loaded.



13. Press 'C' and hold, approximately 3 seconds, until '↑' symbol is under the tractor emblem and release immediately:



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14. The programme has now been accepted and it is displaying speed.

Area/distance hold facility

The trip area or distance reading can be placed on 'hold' as follows:

1. Select the trip required, area or distance, by placing the '↑' (chevron) below the selected item.
2. Press 'C' to stop and hold the reading.
3. Press 'C' to restart the recording.

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Changing Tyre Size - Calculation Method

Refer to the chart and calculations *(see 11A-3)* to obtain the figure to be programmed into the performance monitor.

1. Turn the ignition switch ON.
2. Check that the speedometer is reading in km/hr, if not, change *(see previous instructions 11A-2)*. The display should be as follows:



3. Press **'M'** to instigate change:



4. Press **'C'**, the implement width is now shown.



5. Press **'C'** again to obtain old tyre setting:



NOTE: *Tyre size figure used as an example.*

6. Press '↑' so that the chevron is at the top right-hand corner of the display:



7. Input the programme figure, either from the chart or your calculation, for this example 254. Press '↑' to change the first number on the right from 8 to 4, keep on pressing until the desired number appears (4):



8. Press **'C'** to accept the number (4) and move on to the next digit on the left, a decimal point will appear on the right of the number being changed:



9. Press '↑' to change the number from 2 to 5 as detailed in paragraph 7:



10. Press **'C'** to accept and move on to the next number:



11. The next number is 2, 2 is the number we require, no change, press **'C'** to accept:



12. The zero is not required, to retain the selection of 254, press **'C'** and the following display will be shown:



13. Press **'C'** again and after 3 seconds the display will return to its original mode:



14. Reset mile/hr if this was the original setting.



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Speedometer and Performance Monitor

SPEED SENSOR

Adjust **3-11A**

Procedure

The speed sensor for the speedometer is located behind the left-hand rear wheel hub (1). It obtains the speed information from a magnetic track (2) fixed to the dirt deflector plate on the back of the hub.

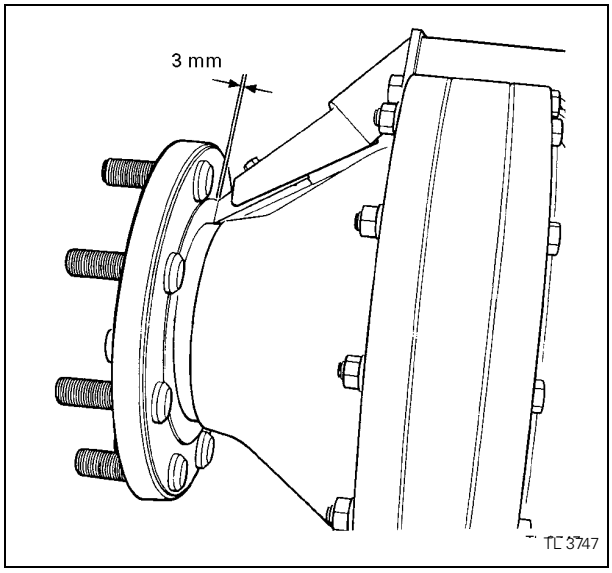
Cleaning

Regularly clean the area around the speed sensor with clean cold water, DO NOT use detergents or hot water/ steam cleaners.

Setting

The sensor should be set 1 mm (0.039 in) from the track, slacken the bolt (3) to make the adjustment.

On tractors fitted with a stainless steel ring and the new type sensor (3816 626 M91), the sensor should be set 3 mm (0.120 in) from the ring.



SPEED SENSOR MAGNETIC TRACK

Removal and Refitment **4-11A**

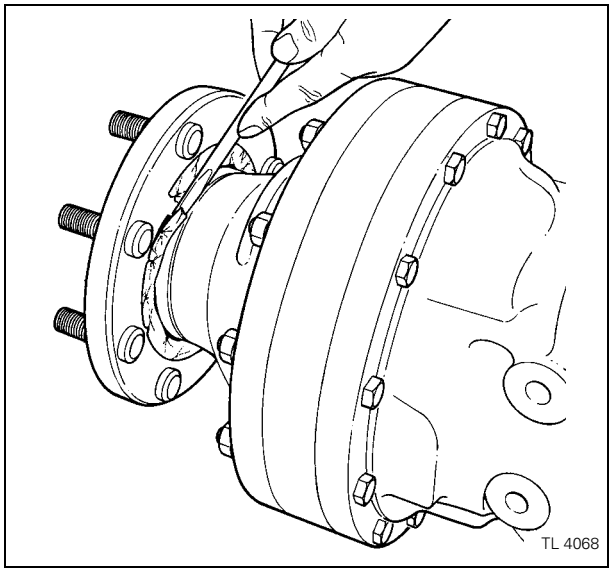
Removal

In the event of the magnetic track becoming damaged, proceed as follows using kit part number 3817 477 M92 which contains the track, adhesive and a stainless steel ring:

1. Remove the speed sensor from the axle housing.
2. With a sharp knife, scraper, or screwdriver remove all traces of the old plastic magnetic track and adhesive, especially in the radius of the deflector plate.
3. Emery cloth the deflector plate to ensure that it is clean.

Adhesive

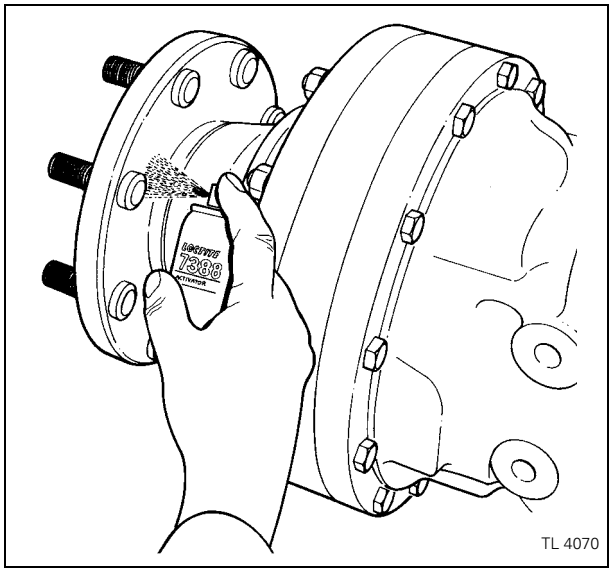
The adhesive to be used must be Loctite 330 Multi-bond, the kit contains 50ml Loctite Adhesive 330 and 40ml Aerosol Loctite Activator 7388



WARNING: Take note of these important instructions, your health could be at risk if you do not implement these instructions.

▲ **Loctite 330: Contains: Aliphatic Methacrylate Esters and Methacrylic Acid. Irritant to eyes and skin.**

▲ **Loctite 7388: Flammable. DO NOT breath spray. Use only in well ventilated areas.**



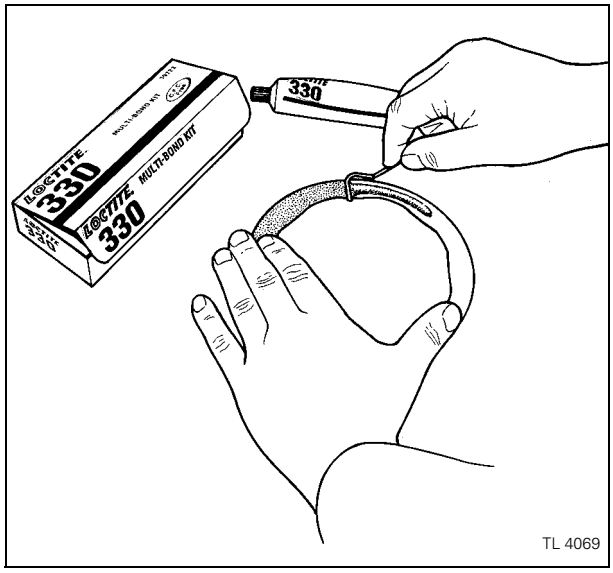
Refitment

4. The Loctite Adhesive 330 must be used in conjunction with Loctite Activator 7388.
5. The surfaces should be dry and as clean as possible otherwise the bond strength could be affected.
6. Wear a pair of goggles, spray a thin film of Loctite Activator 7388 onto the steel deflector plate only and leave to dry.

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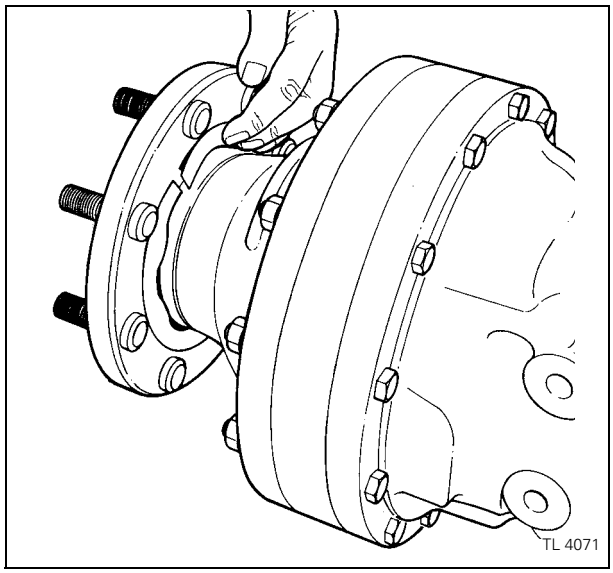
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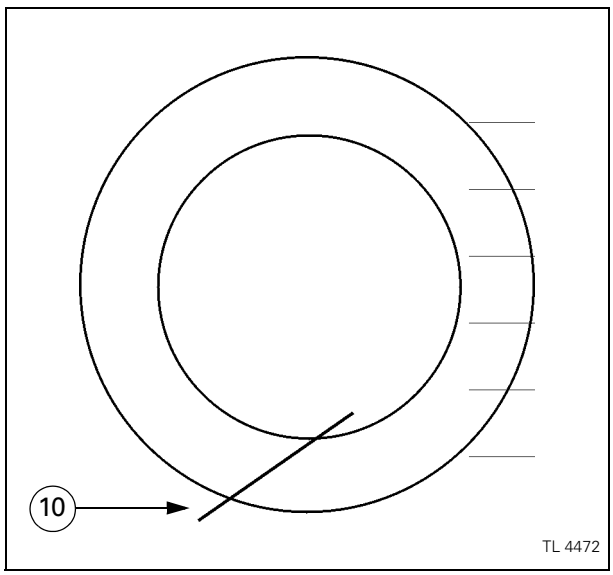
7. The replacement magnetic track will come split, one side is marked with a **'X'**. Spread an even layer of Loctite Adhesive 330 on the side without the 'X'. Use a piece of wire bent to the shape of an 'L' to aid the spreading process. Keep the tube nozzle clear of the Activator and the Activator surface.



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8. Place the magnetic track around the axle, pressing it on to the deflector and at the same time bringing the cut joint together. It fixes in 1-4 minutes, during this time ensure that the joint is tight and keep pressing the track down so that it is level and even. 50% strength will be obtained in approximately 10-30 minutes and full strength in a few hours.
9. When full strength has been obtained fit the protective stainless steel ring.
10. Cut the stainless steel ring with a pair of tinsnips. Remove any rough edges with a file.
11. Wear a pair of goggles, spray a thin film of Loctite Activator 7388 onto the magnetic track and leave to dry.
12. Spread an even layer of Loctite Adhesive 330 on the stainless steel ring. Use a piece of wire bent to the shape of an 'L' to aid the spreading process. Keep the tube nozzle clear of the Activator and the Activator surface.
13. Place the stainless steel ring around the axle, pressing it on to the magnetic track and at the same time bringing the cut joint together. Six small 'G' clamps will assist in keeping the stainless steel ring in place. Smear some grease between the stainless steel ring and the clamps to prevent the clamps sticking to the stainless steel ring.
14. Paint the metal part of the deflector plate with black paint right up to the magnetic track on both edges. This is to prevent water attacking the metal and working its way under the magnetic track.
15. Refit the speed sensor and set its clearance, *(see operation 3-11A)*.


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Speedometer and Performance Monitor

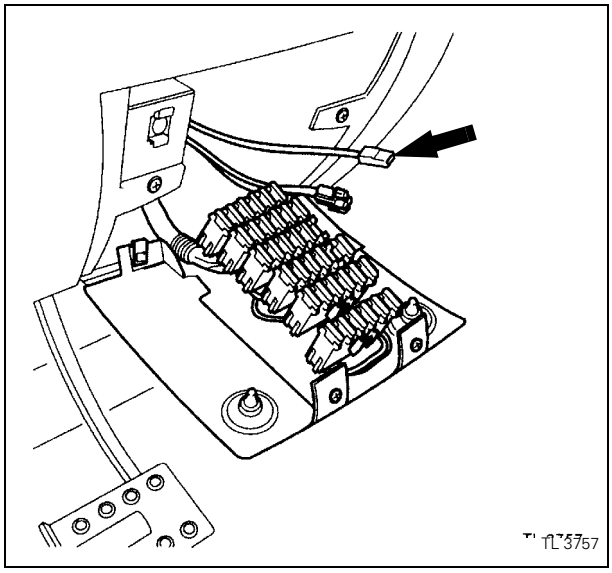
TRIP AREA/DISTANCE HOLD FACILITY

Install **5-11A**

Procedure

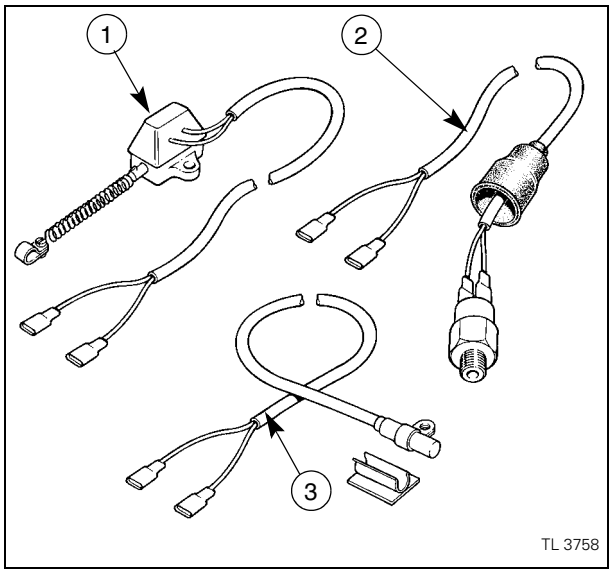
The performance monitor is equipped with a hold facility which will put the trip area or distance, when selected, into HOLD automatically when the implement is lifted out of the ground or operated by some other means.

A wire controlling the performance monitor will be found adjacent to the main fuse box terminating in a single connector. To put the trip area or distance into hold it is only necessary to earth the connection (close circuit). To restart the recording open the switch (open circuit).



The installation of the switch to control the performance monitor must be of local manufacture, Massey Ferguson do supply a range of switches which can be used as follows:

1. Pull switch, part No. 3405 985 M91.
2. Hydraulic pressure switch, part No. 3405 987 M91.
3. Magnet and reed switch, part No. 3405 986 M91.



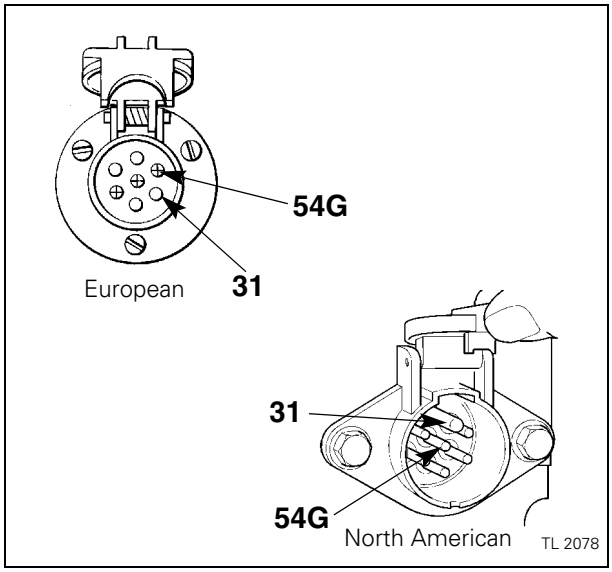
The implement can be wired from the connection adjacent to the fuse box, through the trailer socket and plug mounted at the rear of the tractor using spare terminal 54G. The return earth should be connected to terminal 31 which is connected to the tractor earth system.

Use male connection part number:

3405 168 M1	European.
22 076 A1	North America - SAE.

The cable from the terminal adjacent to the fuse box can be routed down the left-hand side of the console, under the left-hand floor mat (a tunnel is provided), through the rubber grommet and alongside the harness to the trailer socket. The cable should be securely tied to the harness at regular intervals with plastic ties.

To action the hold facility it is only necessary to select either trip area or trip distance by placing the chevron below the symbol.



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Electronic Lift Control (Cab Tractors)

Section 11 - Part B

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Electronic Lift Control

SPECIFICATION

Position Sensor:	
Supply voltage	9.50 VDC nominal (9.60 max. 9.40 min.).
Setting voltage - lift arms UP	75% of supply voltage recorded by multimeter.
Accuracy of setting	±0.03 V.
Draft Sensor:	
Supply voltage	9.50 VDC nominal (9.60 max. 9.40 min.).
Output voltage - no load	50% of supply voltage recorded by multimeter.
Solenoid coil resistance	1.6 ohms.

Special Tools

MF.3020	ELC Harness connector.
MF.3005	Digital Multimeter

General Description

The Electronic Lift Control (ELC) controls the hydraulic lift system to the 3-point linkage in both Draft Control (soil engaging implements), and Position Control (implements working above the ground). This system is made up of the following components:

- The Electronic Control Unit (ECU) microprocessor which is located under the right-hand side cover beside the operator.
- A draft sensor located at the top of the control beam connected to the top link.
- A position sensor that works off the lift arm cross shaft.
- ELC control panel containing all operational controls.
- A linkage control valve with proportional control.
- Internal and external position control switches used to hitch implements. The system is illustrated in Fig.1.

Draft Sensor

This is an active device and when powered provides an output voltage proportional to the load on the top link. When there is no load the output voltage is half of the supply voltage. When the top link is in compression the output goes down, in tension the output rises. If the ECU senses the output voltage is less than 25% or greater than 75% of the supply voltage then something has gone wrong and an error code flashes on the warning light.

The draft sensor generates ±25% of supply voltage output swing for a maximum 25kN (2.1/2 ton) applied load in tension or compression.

Position Sensor

This is also an active device and needs a power supply to work. When the cross shaft is in mid position the output is half of the supply voltage. As the linkage lifts the output goes up, and as it drops the output goes down. If the ECU senses the output voltage is less than 25% or greater than 75% of the supply voltage then something has gone wrong and an error code flashes on the warning light.

The position sensor generates an output voltage swing of 25% of the supply voltage for a movement of 35° from centre.

Control Panel

The Control Panel comprises variable resistors, two switches and warning lights, as follows:

- Lift/lower switch.
- Depth/height control.
- Draft/Intermix position control.
- Maximum height control.
- Lowering speed control.
- Transport active damping switch.
- In addition there are external switches.
- Indicator lights for lifting, lowering, error codes and transport active damping.

Electronic Control Unit

The electronic control unit is a microprocessor controller, it measures signals from the sensors, switches and controls. Internal software drives the hydraulic control valves. It will sense the control valve current and if this is outside a pre-determined range (too low or too high) it will flag a warning error code to indicate that something is wrong. The inputs are sensed and if these voltages are outside the permitted range an error code will flash to inform the operator of a problem.

The software provides the following features:

It senses if the engine is running from the engine oil pressure switch.

It requires the operator to undertake an unlocking procedure to avoid an implement dropping unexpectedly on start-up.

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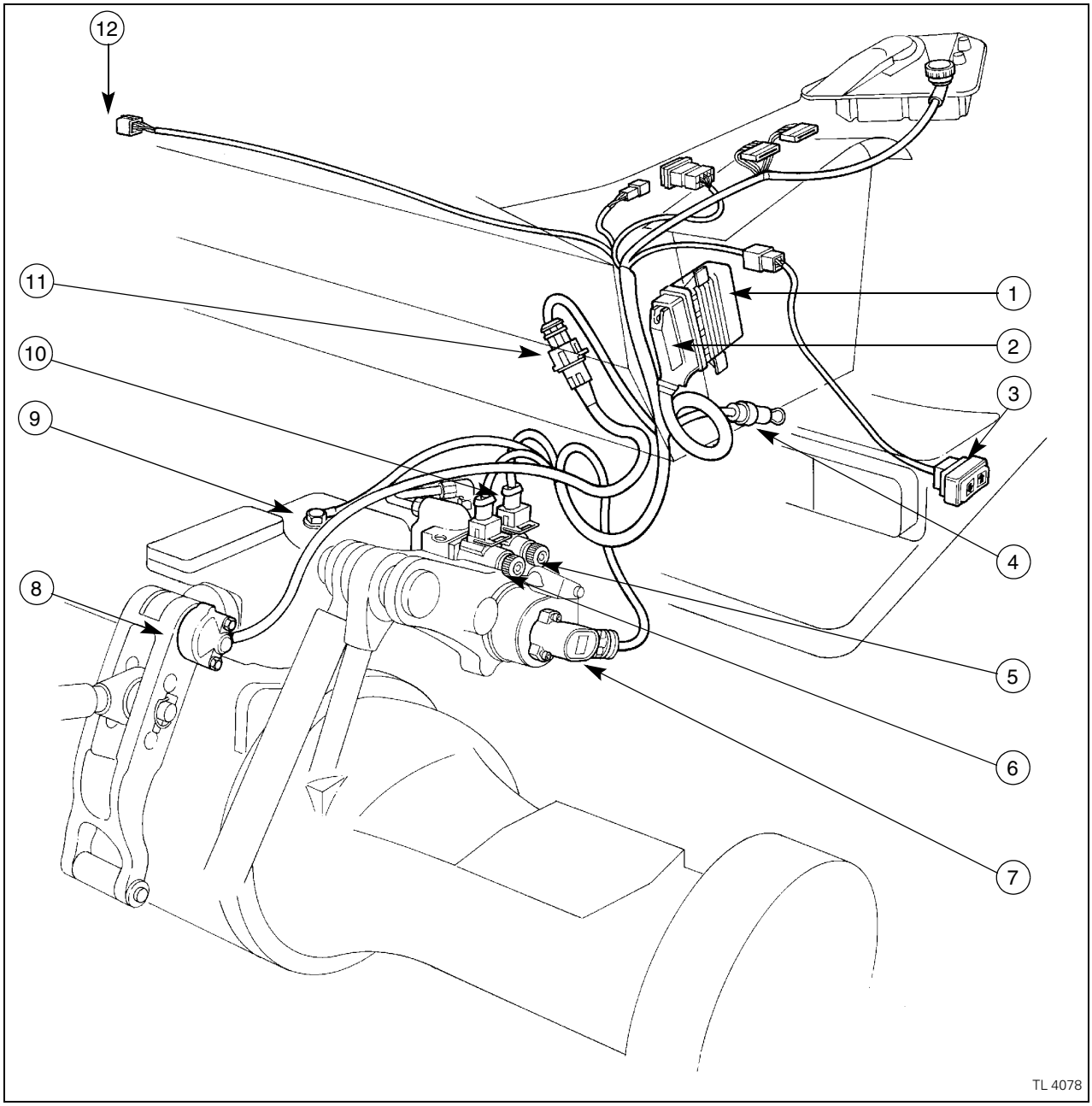


Fig.1

Key to Fig.1 Electronic Lift Control System

1. Electronic Control Unit, microprocessor.
2. 25 pin plug.
3. Position Control switch (right-hand fender).
4. Lift assistor cylinder three-pin plug.
5. RAISE solenoid.
6. LOWER solenoid.
7. Position Sensor.
8. Draft sensor.
9. Earth (ground).
10. Raise solenoid plug with white tag.
11. Draft Sensor connector.
12. Position Control switch connector (to left-hand fender).
13. Power In connector.
14. Position Control switch (cab).
15. Header Joints.
16. Electronic Lift Control panel.

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When unlocked and the position control is operated it seeks to match the link position to the height control knob position. If there is a mis-match an output signal is given to either lift or lower valve.

Implements are dropped by depressing the lift/lowering switch DOWN. The implement is then under Draft or Position Control determined by the position of the Draft/ Position selector potentiometer.

In Draft Control it seeks to balance the top link load to the draft lever position. The greater the imbalance the greater the signal to the lift or lower solenoids.

If the rate of cycling of lift and lowering becomes too great then it reduces the signals to the solenoids. This prevents the system becoming unstable. This also overcomes the need for a response control.

Implements are raised by depressing the lift/lowering switch UP. The implement is now under Position Control and lifts as far as the setting of the maximum height control permits.

The drop rate knob control permits the drop rate to be manually controlled or automatically controlled. In manual the linkage may be adjusted from locked to fast drop.

When lifted in auto mode the system measures the top link load. When the implement is dropped again the signal to the valve is proportional to the measured load. This avoids heavy implements dropping too quickly or light implements being too slow. The weight measurement is in three bands, giving three drop speeds.

External switches override internal controls. They provide a progressive speed of control (slow at first) of the linkage for hitching. The internal controls must be activated after use.

Transport Active Damping

On the road the top link load is measured over a period of time. If the peak load experienced as an implement bounces exceeds the average load measured then the drop valve is operated. This relieves the maximum pressure, damping the tendency to bounce. Subsequently it restores the implement to it's original height. The following advantages will be experienced:

- Tractor pitching is reduced.
- Steering safety is increased.
- Driving speed can be improved.
- Stress reduced in the tractor.

Solenoid Valves

These are proportional valves and provide a change in flow for a change in solenoid current. The minimum current to operate the solenoid is 1 amp. Thereafter output flow is proportional to the current. To achieve a rapid response a dither signal is superimposed on the solenoid current.

The current is not continuous but is rapidly switched to achieve a mean equivalent continuous current (pulse width modulation).

OPERATIONAL CONTROLS

The operation of the control knobs and switches is as follows *(see Fig.2)*:

1. Lift/Lowering Switch

This switch has three positions:

– Raised or transport position, height is set by control (6).
– Neutral or stop position, no movement of the lift arms is possible in this position.
– Lower or work position, the low position is set by the depth/height control (2).

2. Depth/Height Control

This control regulates the depth of the implement in or above the ground. Position '1' is minimum, position '8' maximum, this determines the depth of work. In position '9' the linkage is in FLOAT.

3. Error Code and Status Light

This light has two functions, to indicate when the system is locked and needs activating, and to flash error codes to indicate faults in the system. For further detailed instructions For Electronic Lift Control Error Codes, *(see page 11B-8)*.

4. Draft/Position Selector Control

When this control is turned clockwise to '5' the system is in Draft Control mode. Turn the control counter-clockwise to '2' the system is in Position Control mode.

Turning the control counter-clockwise away from the Draft position will gradually reduce the Draft effect (intermix) until it is in full Position Control.

5. Linkage Lifting Indicator Light

This light will illuminate when the linkage is raising.

6. Maximum Height Control

This control is used to reduce the maximum height of the lift arms and linkage when put into the raise condition.

Rotate the knob counter-clockwise to reduce the maximum height.

7. Linkage Lowering Indicator Light

This light will illuminate when the linkage is lowering.

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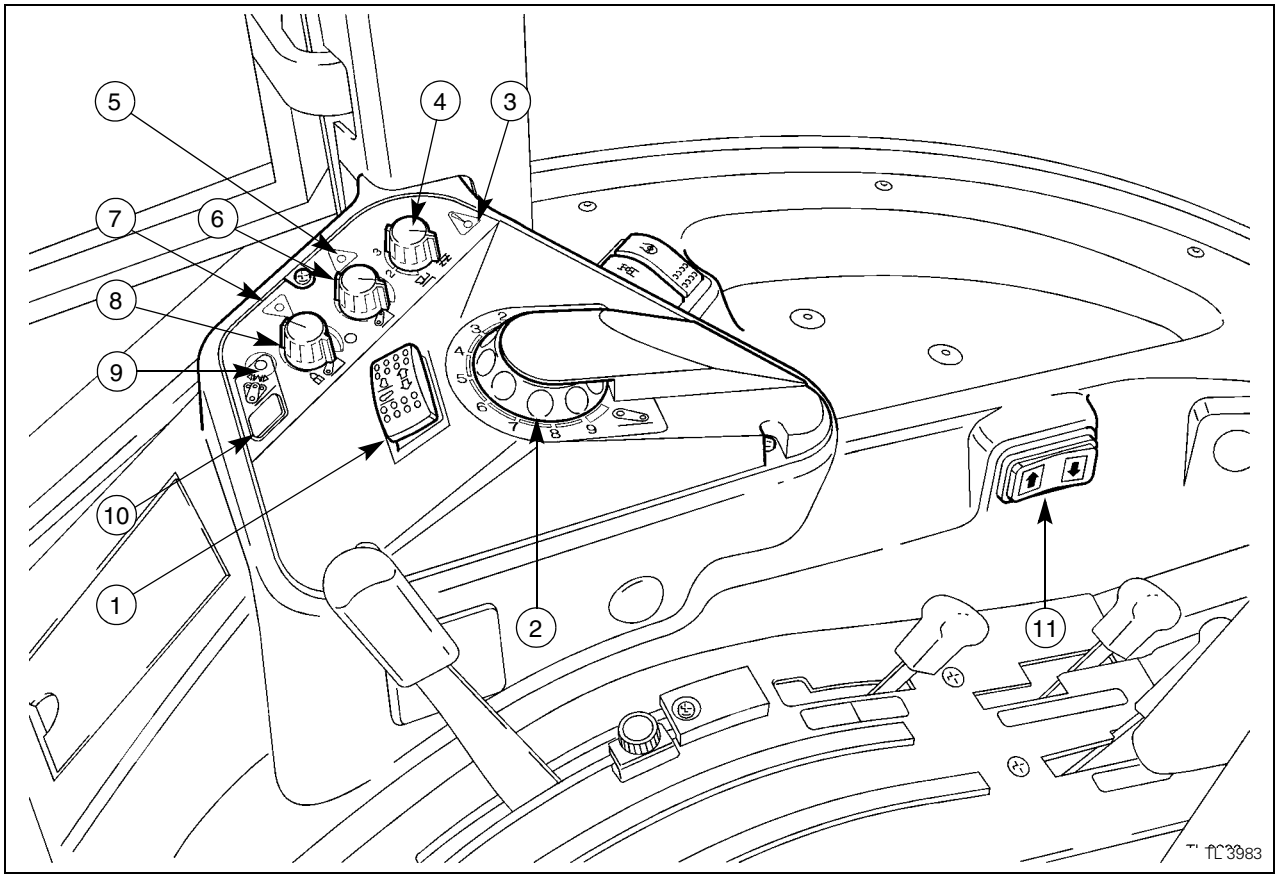


Fig.2

8. Lowering Speed Control

This control can be used in either manual or automatic mode to regulate the lowering speed of the lift arms. It can also be used to lock the lift arms in any position. The positions of the control are as follows in a clockwise direction:

- Linkage locked (padlock).
- Minimum lowering speed.
- Maximum lowering speed.
- System in automatic lowering mode (yellow sector).

In automatic mode, the lowering speed is governed by the weight of the implement.

9. Transport Active Damping Indicator Light

Indicator light shows when system is activated.

10. Transport Active Damping Switch

This switch is used to activate the Transport Active Damping System. This is used to reduce 'Bounce' when transporting implements on the three-point linkage. Press the switch to activate and the indicator light will show.

11. Internal and External Lift/Lower Switches

The tractor is equipped with external Lift/Lower switches (Fig.3) on each rear fender, and an internal switch (11) to aid in the fitment of implements.

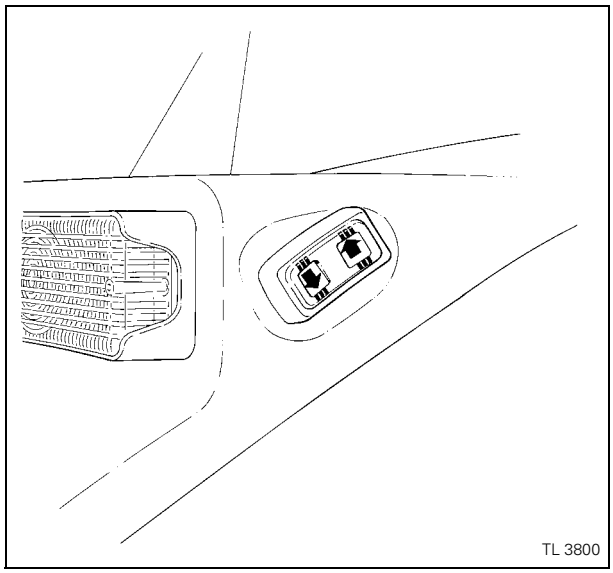


Fig.3

When hitching to an implement, adjust the linkage height by pressing the required side of the switch. The movement will cease as soon as the switch is released.

When the switches have been used it will be necessary to Restart up the System *(see page 11B-6)*.

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Electronic Lift Control

Starting up the System

When the engine is turned OFF the electronic and hydraulic system is locked. To unlock, and activate the system, proceed as follows:

1. Switch ON and start the engine. The Error Code Light, *(see 3, Fig.2)* will flash continuously to indicate the system is locked.
2. Operate the Lift/Lowering switch (1) to 'LIFT' then to 'LOWER'.
3. Adjust the linkage height by turning the Depth/ Height control (2) clockwise to raise.
4. The Linkage Lifting Light (5) will come ON.
5. The Status Light (3) will go OUT to indicate the system is active.
6. Adjust the linkage height to suit the application.

FAULT DIAGNOSIS

The electronic system is constantly monitoring the system for faults. Any faults occurring are indicated by a flashing code on the Error Code light, *(see page 11B-7)* for further details on this type of diagnosis.

Not all faults will lock the linkage, depending upon the seriousness of the fault the linkage may become inoperative in which case it may be necessary to either raise or lower the implement; this can be carried out manually using the following procedure:

1. The electrical solenoid valve (Fig.4) controlling the lift system is located behind the right-hand rear wheel on top of the lift cover. There are two solenoids (1) to raise, (2) to lower.
2. Stop the tractor (engine running), shift all the transmission levers and PTO into neutral and apply the parking brake.

WARNING: ENSURE the cab is unoccupied during this operation to prevent accidental movement of controls which would result in the tractor moving.

▲ ***Keep hands and clothing clear of linkage components.***

▲ ***DO NOT allow anyone to stand near the implement when lifting or lowering.***

▲ ***Serious personal injury could result.***

3. In front of the right-hand wheel and underneath the tractor; press either the raise or the lower solenoid push button located on the end of the coil housing. A long rod or piece of wood fitted with a probe is recommended. The valves can then be operated by passing the probe through the tractor wheel.
4. When the operation is complete the tractor can be moved and the system repaired.

Some Quick Checks

The electronic components used in the system are very reliable and before carrying out any extensive diagnosis or dismantling the following checks may be of some assistance:

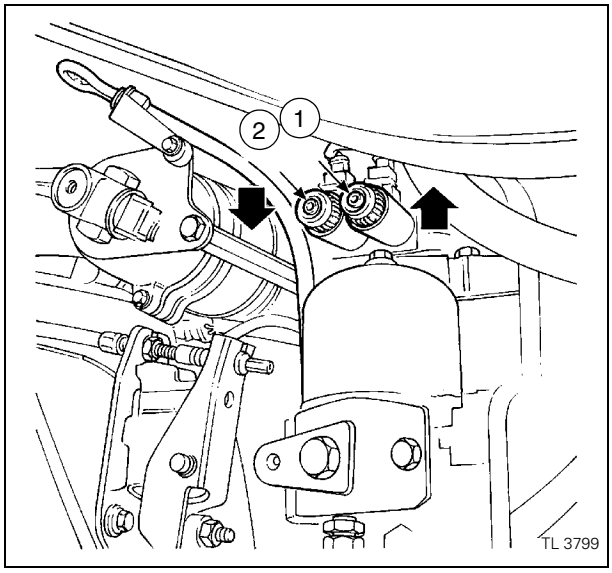


Fig.4

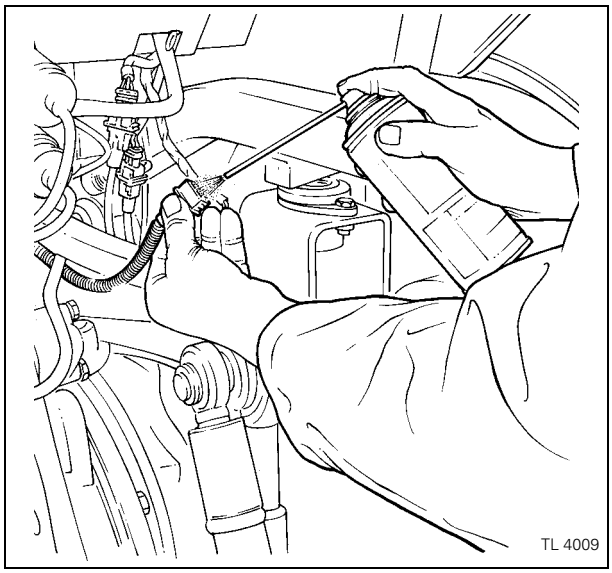


Fig.5

1. Is the engine running and the oil pressure warning light OUT?
2. Is the battery in a satisfactory working condition and properly connected to the tractor?
3. Have you unlocked the system? (see starting up the system on this page).
4. Is the hydraulic power available? Raise the linkage manually to check.
5. The most common cause of failure or intermittent operation is loose or corroded cable connectors, *(see Fig.5)*. Disconnect each plug and socket in turn and clean the terminals (Fig.5). Use an Aerosol tin of terminal cleaner; obtainable from your local radio component shop.
6. Re-connect ensuring a tight sound connection.

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ELECTRONIC LIFT CONTROL ERROR CODES

See page 11B-4 for electronic 3-point hitch operating instructions.

Error codes are displayed as a double series of flashes emitted by the error code and status light, and are used to diagnose operational and system faults. The error codes will only flash each time the engine is started or after a fault is detected.

Example: In the event of a breakdown in the signal wire to the Draft Sensor, fault code 32 is indicated by the following sequence of flashes (see fault code list):

32 = long pause - three flashes - short pause - two flashes - (3 + 2).

If the fault has been eliminated, the status light will flash continuously awaiting to be reset in the normal manner.

A permanent flashing light on the status light indicates that the electronic lift control is locked.

The electronic lift control monitors the system for faults. Any faults occurring are classified in three categories, the reaction of the electronic control varies according to the fault category:

SERIOUS FAULTS

- Control stopped and locked.
- No electrical power to control valve.
- Can only manually raise and lower the 3-point linkage.

  Driver information: Status light outputs fault code. Status light will go out when fault has been rectified.

  Resumption of control: Eliminate the fault, start engine and re-activate the system, - Starting Up the System, *(see page 11B-6).*

MEDIUM SEVERITY FAULT

- Control stopped and locked.
- Would occur if a sensor adjustment is lost. The external switches will still operate. Once the linkage is within range again it can be operated.

  Driver information: Status light outputs fault code. Status light will go out when fault has been rectified.

  Resumption of control: Eliminate the fault, start engine and re-activate the system, - Starting Up the System, *(see page 11B-6).*

MINOR FAULTS

- Control continues.

  Driver information: Status light outputs fault code. Faults can be localised and identified with the aid of the fault code list and work can continue.

RE-SET PROBLEMS

If the Position Sensor (on the lift arms) moves or is incorrectly set it may be found when operating the linkage by the internal and external control switches (lift/lower) the linkage position may exceed the range of the Position Sensor. Under this condition error code 2 + 2 will show and the linkage will lock. Move the linkage back within range using the external control switches and re-set the Position Sensor on the lift arm cross shaft *(see operation 3-11B).*

MICRO-PROCESSOR FAILURE

In the event of a micro-processor failure the error code light could flash one of the codes in the following chart, this must be taken into account when diagnosing a problem with the system.

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Electronic Lift Control

Error Code Chart

Serious Faults

Error Code	Fault and Cause	Remedy
11 (1 + 1)	Electrical short circuit - solenoid valve: 1. Coil short circuit on either of the coils. 2. Short circuit in solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Determine which one and replace the solenoid coil, *(see operation 5-11B).*
12 (1 + 2)	Output signal to RAISE solenoid faulty: 1. Open circuit to solenoid valve. 2. Faulty solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Replace the solenoid coil, *(see operation 11-9A)*
13 (1 + 3)	Output signal to LOWER solenoid faulty: 1. Open circuit to solenoid valve. 2. Faulty solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Replace solenoid coil., *(see operation 11-9A)*
15 (1 + 5)	Internal and Rear Position Control switch(s) faulty: 1. Short circuit to earth. 2. Switch connector fault.	1. Check wiring, connectors and switches on rear fenders and cab to processor unit, *(see operation 8-11B).* 2. Replace faulty switch.
18 (1 + 8)	Lift/lower switch faulty: 1. Switch open circuit.	1. Replace switch or control panel.

Medium Faults

22 (2 + 2)	Position sensor signal faulty (cross shaft): 1. Open circuit or sensor not connected. 2. Possible short circuit or short to earth (-). 3. Position sensor out of adjustment range.	1. Check electrical connectors. 2. Check Position sensor, *(see operation 3-11B).* 3. Re-set adjustment, *(see operation 3-11B).*
23 (2 + 3)	Depth/Height potentiometer signal faulty: 1. Open circuit or potentiometer not connected or faulty. 2. Failed potentiometer.	1. Check all electrical connections, plugs and sockets. 2 Check Depth/Height potentiometer, *(see operation 10-11B).*
24 (2 + 4)	Maximum Height control potentiometer: 1. Open circuit. 2. Potentiometer faulty.	1. Check all electrical connectors. 2. Replace potentiometer or panel.
27 (2 + 7)	Battery voltage unstable: 1. Faulty connection. 2. Low battery voltage.	1. Check all electrical connections. 2. Re-charge or replace battery.

Minor Faults

32 (3 + 2)	Draft sensor signal faulty (upper link pin): 1. Open circuit or sensor not connected. 2. Possible short circuit or short to earth (-). 3. Possible overload.	1. Check electrical connectors. 2. Check Draft Sensor, *(see operation 4-11B).* 3. Reduce weight on 3-point linkage.
34 (3 + 4)	Lowering speed potentiometer: 1. Open circuit, faulty connections. 2. Potentiometer faulty	1. Check all electrical connectors. 2. Replace potentiometer or panel.
35 (3 + 5)	Transport active damping faulty: 1. Unable to switch ON or OFF. 2. Short circuit or short to earth (-). 3. Open circuit, switches not connected	1. Faulty switch - replace control panel. 2. Check for worn cables and rectify. 3. Check all connections.
36 (3 + 6)	Intermix potentiometer: 1. Open circuit, faulty connections. 2. Potentiometer faulty	1. Check all connections. 2. Replace potentiometer or control panel.
38 (3 + 8)	Engine oil pressure switch: 1. Engine oil pressure switch faulty. 2. Open circuit pressure switch to processor.	1. Replace switch on engine cylinder block. 2. Check all wiring and connectors, *(see page 11B-15).*

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SETTING and TESTING the COMPONENTS

Check **1-11B**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

IMPORTANT: *The operating voltages used in this system are less than battery voltage. Use of test lights, jumper wires, etc. will seriously damage the ELC sensors and microprocessor. DO NOT use these tools.*

Test Equipment

The electrical system harness connections are of the sealed/weather proof type and as such are not readily accessible to normal testing methods. Special Tool MF.3020 ELC Harness Connector, can be inserted in between harness connections so that voltage readings can be taken at the Draft and Position Sensors.

An accurate volt meter must be used for setting the sensors, preferably high impedance digital multimeter; for example, the MF.3005, which can read to two decimal places.

Setting, Testing Voltages and Components

The following series of tests can be used for two purposes, to re-set the sensor after repair, or to test the circuit to determine a fault. If during testing the voltages are not obtained, or they do not vary during movement of the component, this will indicate either a fault in the component, harness or a failed microprocessor.

Determining the voltage setting for the Position Sensor and the condition of the Draft Sensor requires a small calculation, it is based on a percentage of the supply voltage from the microprocessor to the sensor. It will be found an advantage to have a calculator to hand when making adjustments or fault finding.

To access the Draft Sensor connector (3) for electrical test purposes, remove the two bolts (1) and the cover plate (2) and carefully pull out the connector. When the tests are complete, carefully reinstall the connector and refit the cover plate. Ensure that all the connectors are securely locked together.

Cleaning and Protective Chemicals

As previously stated, dirty or corroded terminals can cause problems with low voltage electronic systems on tractors. To clean and prevent corrosion there are two products available from AGCO Parts Division:

3600 553 M1 - Protective grease.

3931 225 M1 - 400 ml Aerosol tin Super Lube Terminal Cleaner.

The grease can be used to keep water out of plugs and sockets, cover earthing terminals to prevent corrosion.

The aerosol cleaner is used to clean terminals and to assist in making a good contact.

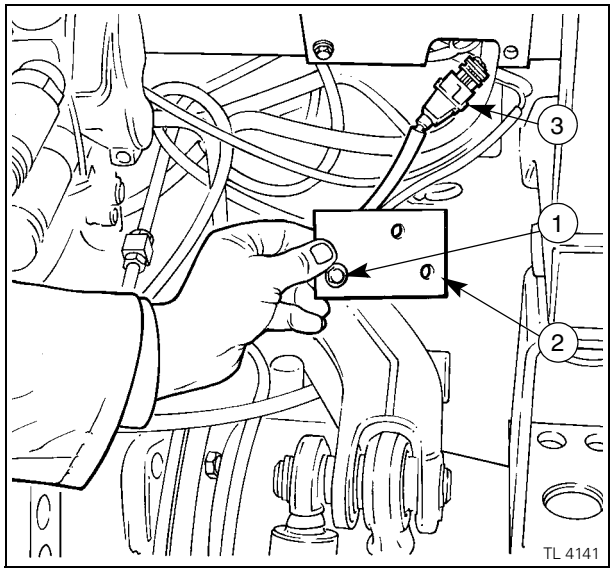


Fig.6

Lift Assistor Cylinders

The microprocessor automatically controls the rate of drop of the implement depending on its weight. On tractors fitted with two lift assistor cylinders the microprocessor must adjust to an increased rate of flow of hydraulic oil through the solenoid valves. This is achieved the insertion of a small three pin plug (System Connector) in the wiring harness, located adjacent to the microprocessor *(see item 4 page 11B-3)*.

For tractors without or with one lift assistor the plug should have a blue loop wire.

For tractors with two lift assistors, the plug should have a yellow loop wire.

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POWER to ELC

Check **2-11B**

Special Tools:
MF.3005 Digital Multimeter

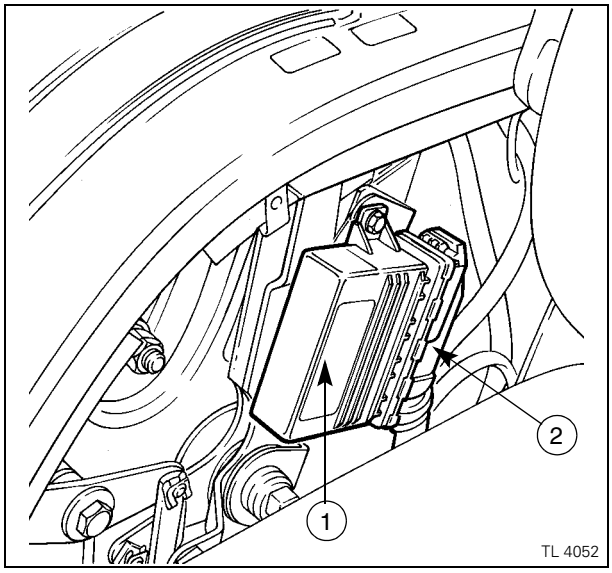
Procedure

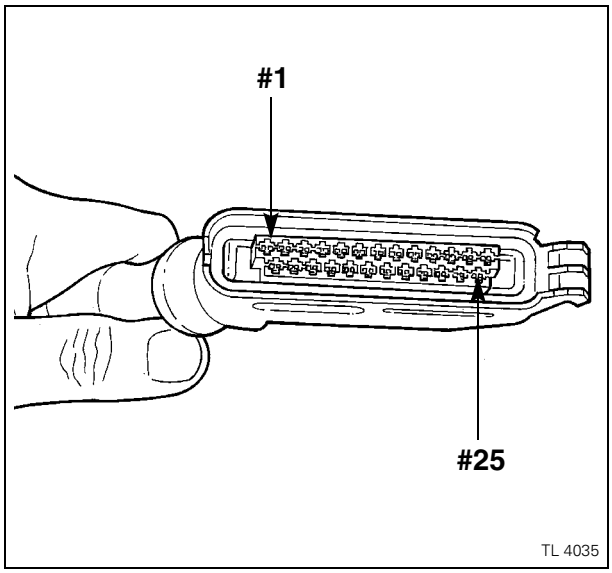
Always check the system using the earth point connected to the system harness. This is located on top of the lift cover. An indication of 'No Power' is the failure of the Error Code light to come ON when the ignition is switched ON. Carry out the following checks:

1. Remove the hydraulic control side cover to gain access to the ECU.
2. Remove 25 pin plug from ECU.
3. Ignition switch ON, engine OFF.
4. Set the MF.3005 Digital Multimeter for volts DC.
5. Multimeter positive probe to ECU pin #25 and negative probe to ECU pin #1.
6. A reading of battery voltage should be obtained, 12 VDC.
7. If there is no voltage carry out the following checks:

Diagnosis

8. Check battery properly connected and earth connection on top of the lift cover is good.
9. Check battery voltage 12 VDC.
10. Check the harness earth to chassis connection.
11. Check fuse in location A5 main fuse box.
    Fuse size 5 amp (tan).
12. Check all electrical plugs and sockets in the circuit.
13. Check that the oil pressure warning light goes OUT when the engine is started.





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POSITION SENSOR

Check **3-11B**

Special Tools:
MF.3005 Digital Multimeter
MF.3020 ELC Harness Connector

Procedure

The position sensor is located on the right-hand end of the lift arm shaft. Setting and testing procedure as follows:

1. Install the MF.3020 ELC Harness Connector between the sensor and the main harness.
2. Set the MF.3005 Multimeter to volts DC.

Supply Voltage

3. Connect the multimeter negative probe to the green terminal (1), positive probe to the blue terminal (3).
4. Ignition ON, engine OFF.
5. Make a note of the supply voltage, this should be 9.5 VDC ± 0.1 V.

For this example the supply voltage is 9.51 VDC.

Setting Voltage

6. Change the multimeter positive probe over to the yellow terminal (2).
7. The setting voltage of the sensor is 75% of the supply voltage.

   In this example the supply voltage is 9.51 VDC the setting voltage is:

   9.51 V x 75% = 7.13 VDC

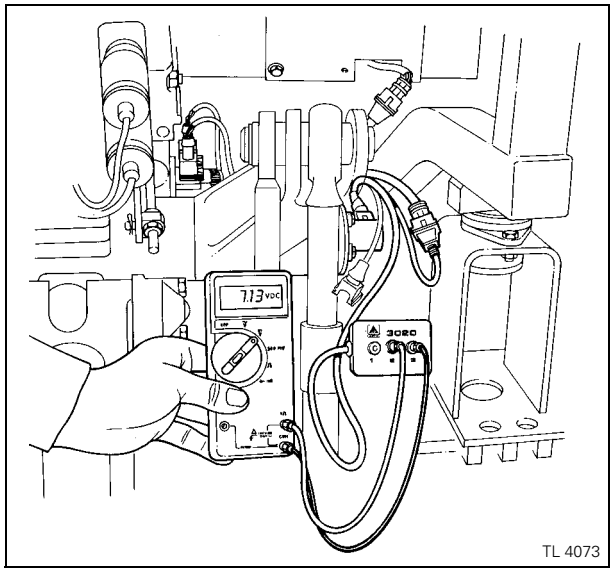
NOTE: *This reading and the reading on the multimeter in the illustration is an example only. Set the sensor to the reading you calculate.*

Setting the Sensor

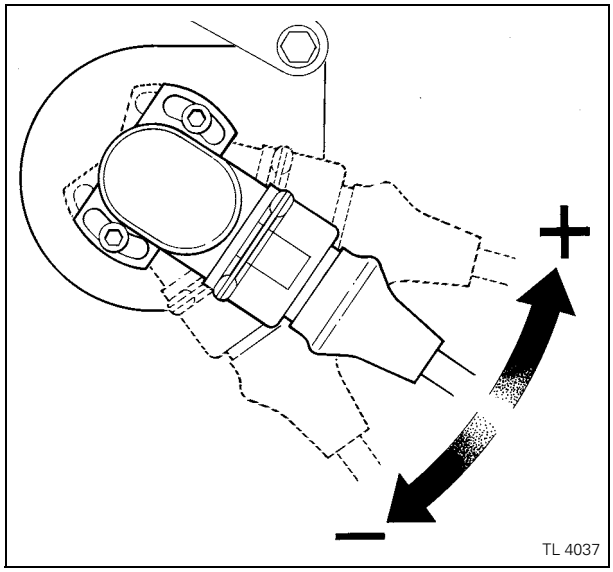
8. No weight on the links, using the engine, raise the links to their full UP position and hold against the internal stop, in this example the voltage reading should be 7.13 VDC.

NOTE: *The lift arms must be in the fully RAISED position. The illustration shows the lift arms down for clarity to clearly indicate the various connections.*

9. If adjustment is required, loosen the two M6 cap screws holding the position sensor to the bracket. Rotate the sensor in its slots so that the meter reads 7.13 VDC ± 0.03 V. Rotate clockwise to decrease the reading, counter-clockwise to increase.
10. Tighten the M6 cap screws. The reading may change on tightening the screws, this should be contained within ± 0.01 of a volt.



TL 4073



TL 4037

Check

11. Move the lower links through their full movement check that the voltage changes progressively and smoothly from the maximum reading, in this case 7.13 VDC (UP), to approximately 2.5 VDC when fully DOWN. Make any further adjustments necessary. When in the UP position, push the lift arms up manually to ensure that they are fully UP.

Diagnosis

12. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates sensor satisfactory.
13. If it is necessary, replace the unit, *(see operation 11-11B).*

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DRAFT SENSOR

Check **4-11B**

Special Tools:
MF.3005 Digital Multimeter
MF.3020 ELC Harness Connector

Procedure

The Draft Sensor is mounted at the top of the control beam on the 3-point linkage and connects the beam to a large damping spring, there is no internal control linkage. Checking procedure as follows:

1. Access the plug and socket and install the MF.3020 ELC Harness Connector between the sensor and the main harness.
2. Set the MF.3005 Digital Multimeter to volts DC.

Supply Voltage

3. Connect the multimeter negative probe to the green terminal (1), positive probe to the blue terminal (3).
4. Ignition ON, engine OFF.
5. ELC switched ON.
6. Make a note of the supply voltage, this should be 9.50 VDC ± 0.10 V.

   For this example the supply voltage is 9.60 VDC.

Checking Voltage

7. Change the multimeter positive probe over to the yellow terminal (2).
8. The checking voltage of the sensor is 50% of the supply voltage, there is no adjustment possible.

   In this example the supply voltage is 9.60 VDC the checking voltage is:

   9.60 V x 50% = 4.80 VDC

NOTE: *This reading and the reading on the multimeter in the illustration is an example only. Set the sensor to the reading you calculate.*

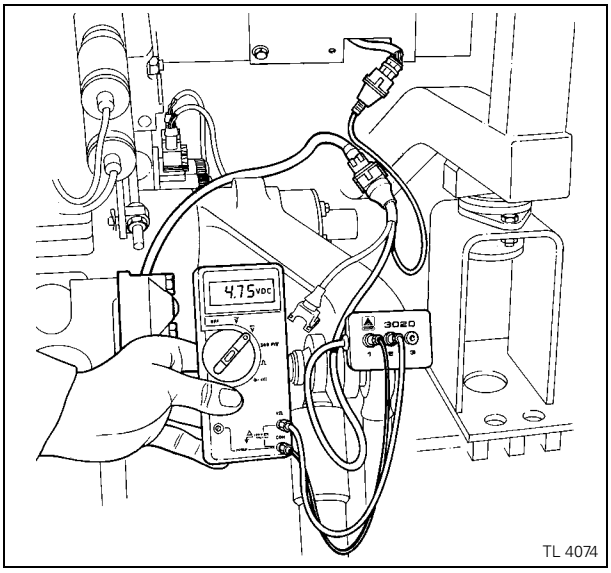
9. No load on the Draft Sensor pin the voltage reading on the meter should read in this example 4.80 VDC ± 0.02V. This indicates that the Draft Sensor is in working order.

Check

10. Locate the top link in the top hole. Pulling the link, the voltage goes up, pushing the voltage will go down.

Diagnosis

11. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates the Draft Sensor is satisfactory.
12. If it is necessary to replace the pin, *(see operation 12-11B)*.



NOTE: *If all the connectors become disconnected, the Draft Sensor (white plug) is connected to the socket with two green wires and a yellow wire.*

ECU MICROPROCESSOR

Check **5-11B**

Procedure

The testing of the ECU microprocessor requires specialist equipment which is only available to the factory where they are made. The decision to replace the unit can only be made on elimination.

Before replacing the unit carry out all the tests that have been described in this section and the initial checks, *(see page 11B-6)*.

To replace the unit, *(see operation 13-11B)*.

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SOLENOID VALVE COILS

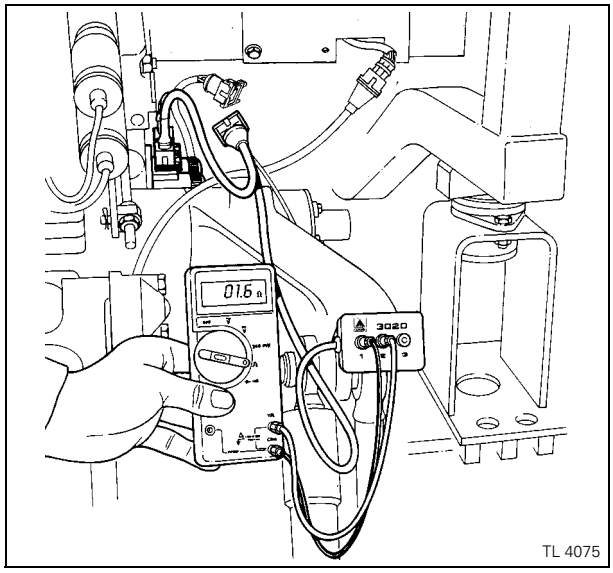
Check **6-11B**

Special Tools:
MF.3005 Digital Multimeter
MF.3020 ELC Harness Connector

Procedure

The testing of the solenoid coil is a simple ohm test across the winding of as follows:

1. Access the solenoid valve and remove the plug from the coil.
2. Install the MF.3020 ELC Harness Connector using the two pin plug.
3. Set the MF.3005 Digital Multimeter to ohms.
4. Connect the multimeter to terminals green (1) and yellow (2).
5. You should obtain a reading of approximately 1.6 ohms.
6. If the coil proves faulty, replace the coil, *(see operation 11-9A).*



TL 4075

EXTERNAL AND INTERNAL SWITCHES and CIRCUIT

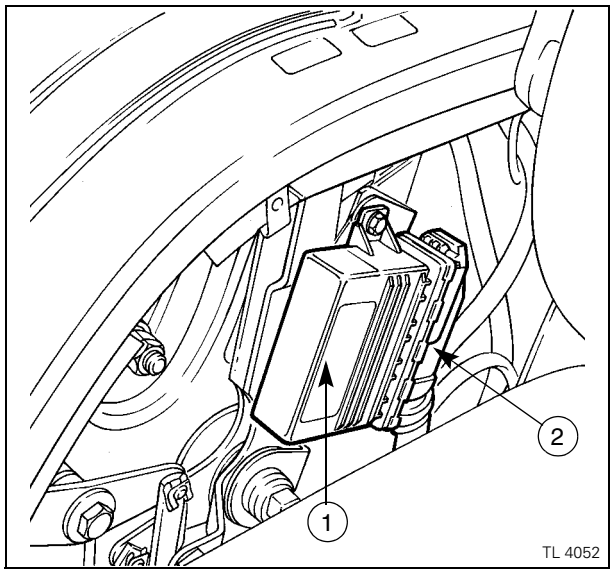
Check **7-11B**

Special Tools:
MF.3005 Digital Multimeter

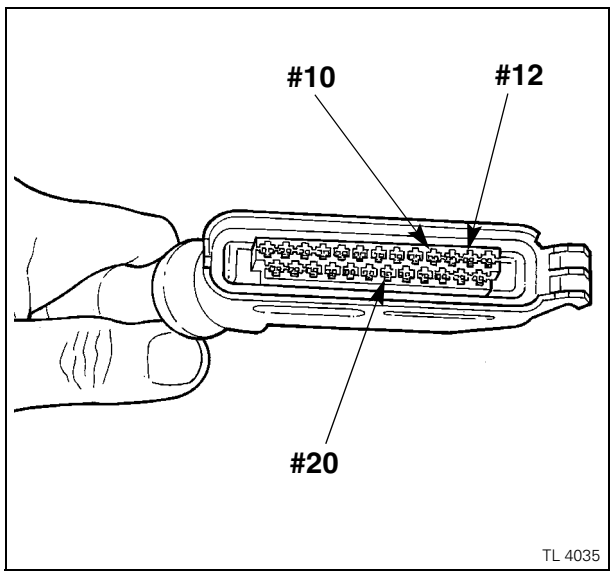
Procedure

The switches are mounted on the left- and right-hand rear fenders and one inside the cab.

1. Remove the hydraulic control side cover to gain access to the ECU.
2. Remove 25 pin plug from ECU.
3. Ignition OFF, engine OFF.
4. With the MF.3005 Digital Multimeter set on ohms or 'bleep' check the circuit between pin #12 on the 25 pin plug and pin #10.
5. Press the RAISE side of each switch in turn to check for closed circuit.
6. With the multimeter set on ohms or 'bleep' check the circuit between pin #12 on the 25 pin plug and pin #20.
7. Press the LOWER side of each switch in turn to check for closed circuit.
8. If necessary, replace the switch.



TL 4052



TL 4035

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ENGINE OIL PRESSURE SWITCH CIRCUIT

Check **8-11B**

Special Tools:
MF.3005 Digital Multimeter

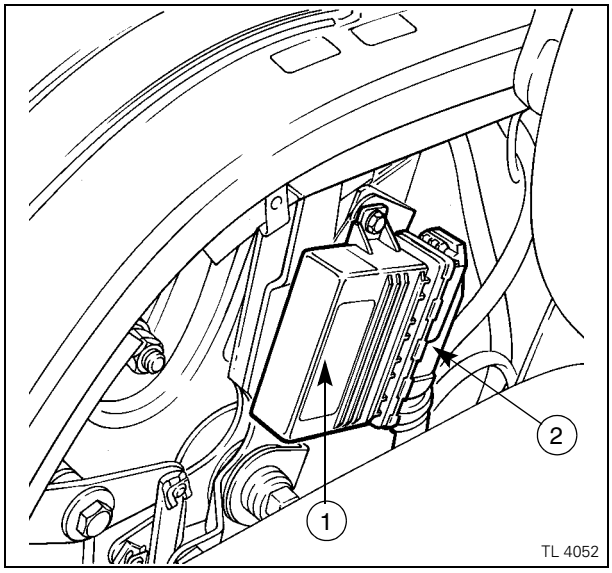
Procedure

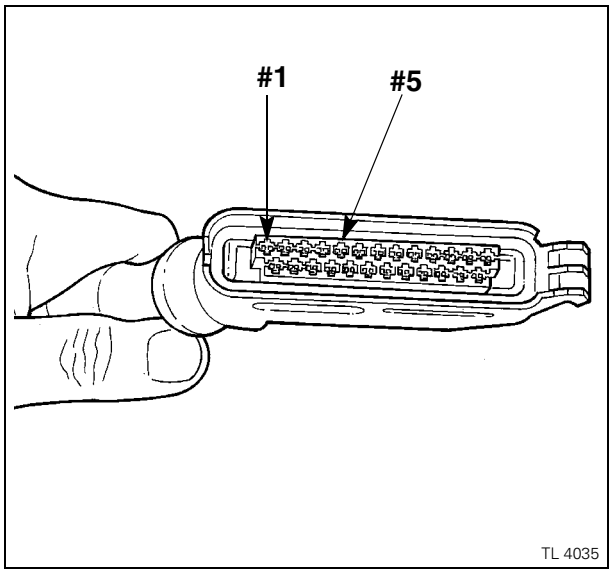
The engine oil pressure is sensed for safety, the engine must be running in order for the rear 3-point linkage to lift or lower.

The first check that the engine oil pressure light goes out when the engine is running. This will indicate that the switch is operational.

To test the circuit:

1. Remove the hydraulic control side cover to gain access to the ECU microprocessor.
2. Remove 25 pin plug from ECU.
3. Ignition OFF, engine OFF.
4. With the MF.3005 Digital Multimeter set on ohms or 'bleep' check the circuit between pin #5 on the 25 pin plug and pin #1 (earth).
5. A reading or 'bleep' should be obtained.
6. If there is an open circuit, check all plugs and sockets.





ELC PANEL

Check **9-11B**

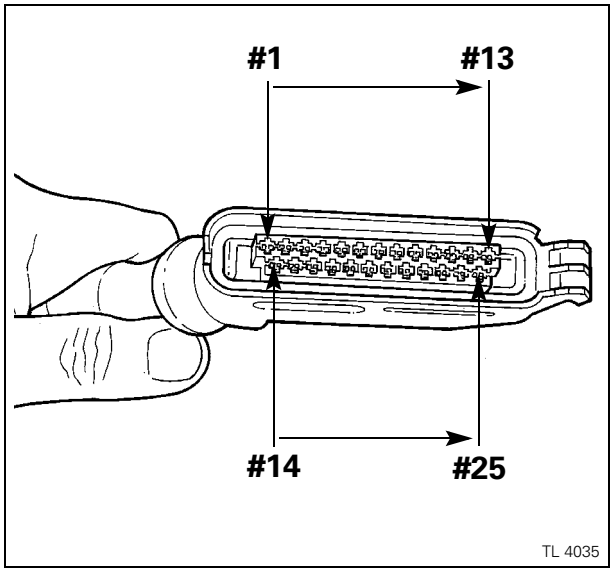
There is no test equipment available to test the ELC Panel, it is therefore recommended that the initial diagnosis is carried out by replacing the panel with another unit of known condition.

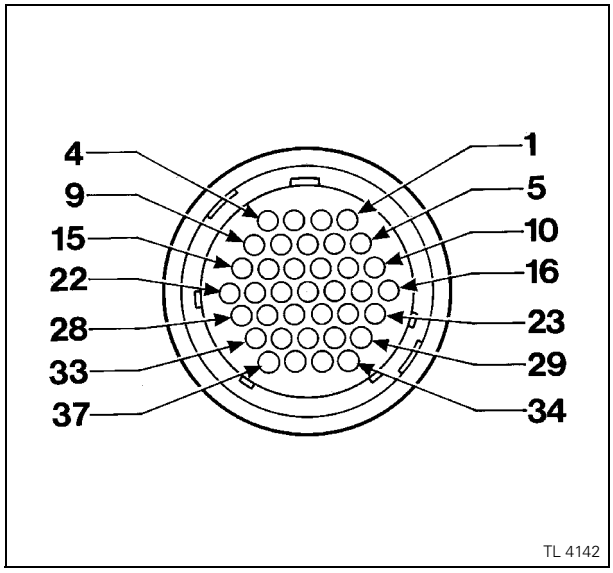
The panel is a simple electrical component containing potentiometers, resisters and diodes. On *page 11B-17* there is a circuit diagram and on the following page an illustration of the components available from the AGCO Parts Division. Instructions on how to access these components will be found on *page 11B-19*.

Testing can be carried out using a digital multimeter, the major components are marked with their values. It is recommended that a person with previous experience of electronics carries out this work.

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ECU 25PIN CONNECTOR AND CONTROL PANEL CONNECTOR

25 Pin Connector

Pin No. (numbered in rows in illustration).

1. Black - System earth negative (-).
2. Blue - Lift solenoid coil pin # 22 and control panel pin # 22 raise LED.
3. White /black - Control panel pin # 2 earth.
4. White/red - Control panel pin # 6 intermix.
5. White/brown - Operating safety, earth through engine oil pressure switch.
6. Grey/black - Solenoid common pin # 2.
7. Brown - Harness connector to pin # 13. Connected on tractors with optional external dual lift rams.
8. Green/brown - Control panel pin # 32 lift/lower switch.
9. White/orange - Control panel pin # 8 error code LED.
10. Pink - External/internal position control switches pin #3 lower.
11. White/pink - Control panel pin # 4 active transport damping.
12. White/grey - External/internal position control switches pin # 2 common.
13. Yellow - Draft sensor and position sensor pin # 3. Also has a jumper to pin # 7 on tractors with optional external dual lift rams.
14. Orange - Lower solenoid pin # 1 and control panel pin # 22 lower LED.
15. Grey - Draft and position sensor pin # 1.
16. White/green - Control panel pin # 30 depth control.
17. Green - Draft sensor pin # 2 signal.
18. Not used.
19. Red - Position sensor pin # 2 signal.
20. Purple - External/internal position control switches pin # 1 up.
21. White/blue - Control panel pin # 15 transport active damping switch.
22. Green/blue - Control panel pin # 11 maximum height.
23. Not used.
24. Green/orange - Control pane pin # 21 lower speed.
25. White - Incoming battery voltage positive (+). Supply comes through ignition switch, 5 amp fuse to ECU.

Control Panel Connector

Pin No. (numbered in rows in illustration)

1. Red/yellow - Panel lights supply for switch panel illumination.
2. White/black - earth to 25 pin connector pin # 3.
3. White/grey - External/internal position control switches pin # 2 common.
4. White/pink - Active transport damping to 25 pin connector pin # 11.
6. White/red - intermix to 25 pin connector pin # 4.
8. White/orange - Error code light to 25 pin connector pin # 9.
11. Green/blue - Maximum height to 25 pin connector pin #22.
15. White/blue - Transport active damping to 25 pin connector pin #21.
21. Green/orange - Lower speed to 25 pin connector pin #24.
22. Blue - Lifting LED to 25 pin connector pin #2.
28. Orange - Lowering LED to 25 pin connector pin #14.
29. Black - earth (-).
30. White/green - Depth control to 25 pin connector pin #16.
32. Green/brown - Raise/lower switch to 25 pin connector pin #8.

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Electronic Lift Control

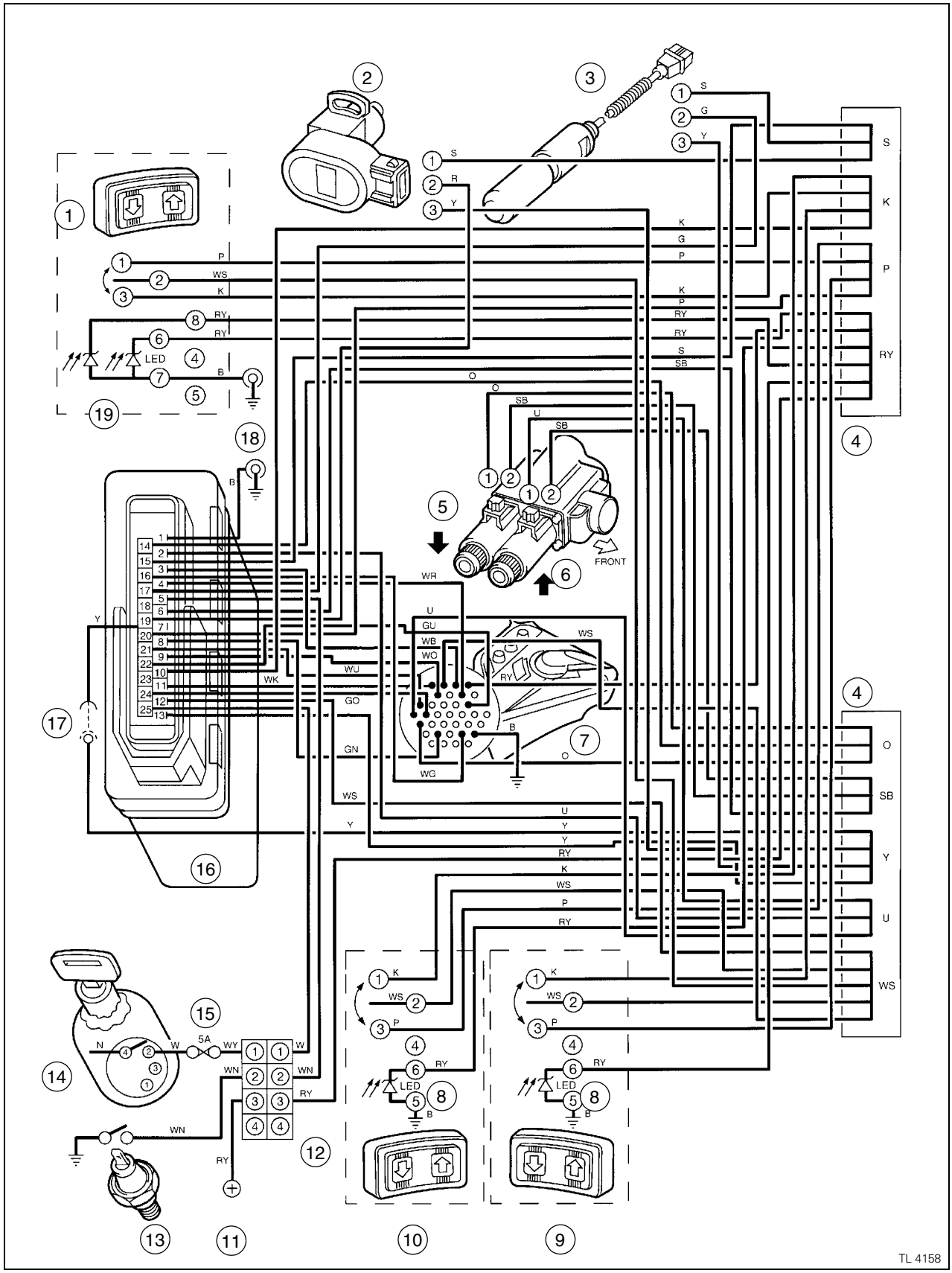


Fig.7 Electronic Lift Control Circuit

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KEY TO ELECTRONIC LIFT CONTROL (ELC) CIRCUIT DIAGRAM

Please refer to (Fig.7).

1. Cab Position Control switch.
2. Position sensor.
3. Draft sensor.
4. Junction block on harness.
5. Lower solenoid.
6. Raise solenoid.
7. ELC control panel.
8. Switch illumination light (LED).
9. Right-hand fender Position Control switch.
10. Left-hand fender Position Control switch.
11. Supply to switch illumination.
12. Harness connector.
13. Engine oil pressure switch.
14. Ignition switch.
15. System fuse 5A in main fuse box.
16. ELC microprocessor Unit.
17. System connector on harness for assistor lift cylinders.
18. Earth (negative).

Cable Colour Codes

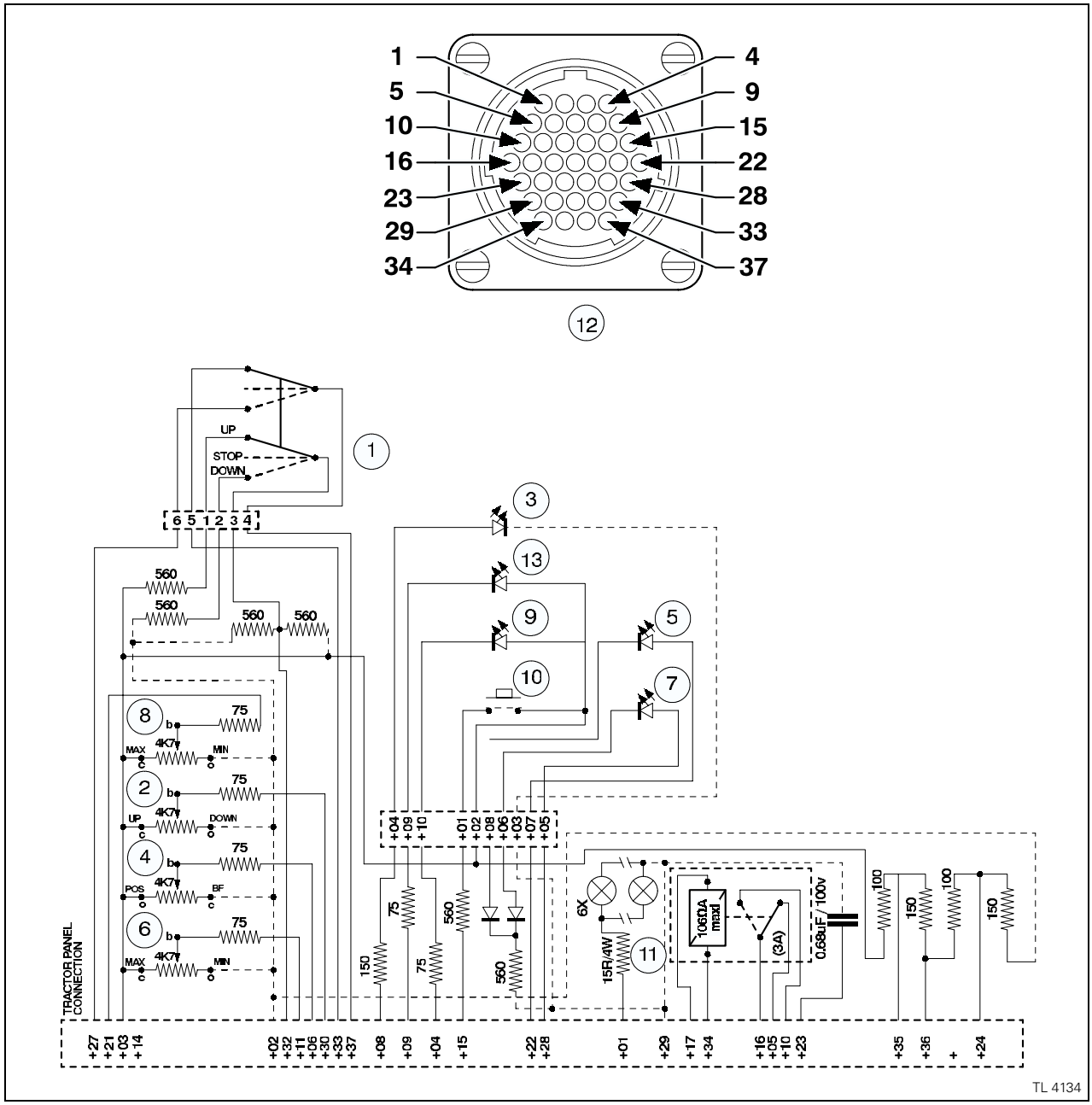
B	Black
G	Green
GO	Green/orange
GN	Green/brown
GU	Green/blue
K	Pink
N	Brown
O	Orange
P	Purple
R	Red
RY	Red/yellow
S	Grey
SB	Grey/black
U	Blue
W	White
WB	White/black
WG	White/green
WK	White/pink
WN	White/brown
WO	White/orange
WR	White/red
WS	White/grey
WU	White/blue
WY	White/yellow
Y	Yellow

NOTE: *The numbers in the small circles are the harness connector pin numbers.*

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Electronic Lift Control



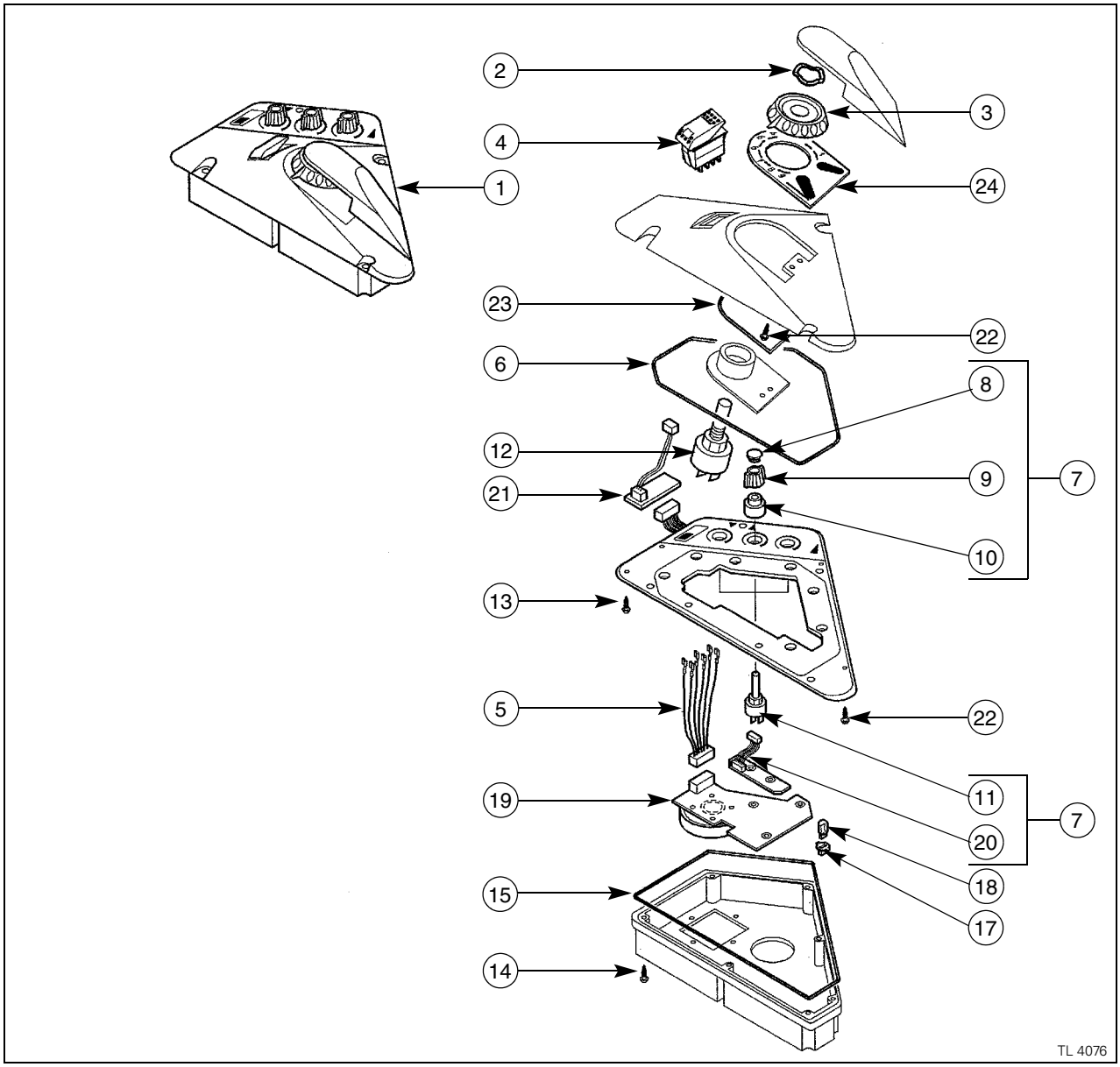
ELC CONTROL PANEL CIRCUIT DIAGRAM

The components of the control panel circuit are as follows:

1. Lift Lowering Switch.
2. Depth/Height Control.
3. Error Code and Status Light.
4. Draft/Position Selector control.
5. Linkage Lifting Indicator light.
6. Maximum Height Control.
7. Linkage Lowering Indicator Light.
8. Lowering Speed Control.
9. Transport Active Damping Indicator Light.
10. Transport Active Damping Switch.
11. Panel illumination lights x 6.
12. Multi-pin plug pin locations.
13. LED not used in this application.

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CONTROL PANEL COMPONENTS

1. ELC control panel assembly.
2. Wavy spring washer.
3. Control knob.
4. Lift/lower switch.
5. Switch connector.
6. Sealing ring.
7. Printed circuit board with potentiometers.
8. Cap.
9. Knob.
10. Dust shield.
11. Potentiometer.
12. Potentiometer lift/lower.
13. Screw 5 mm long.
14. Screw, 9.5 mm long.
15. Sealing ring.
16. Not used.
17. Lamp holder with bulb.
18. Bulb 12 volt, 1.2 watt capless.
19. Printed circuit board.
20. Printed circuit board, part of item 7.
21. Printed circuit board, part of item 12.
22. Screw, 8 mm long.
23. Sealing ring.
24. Decal.

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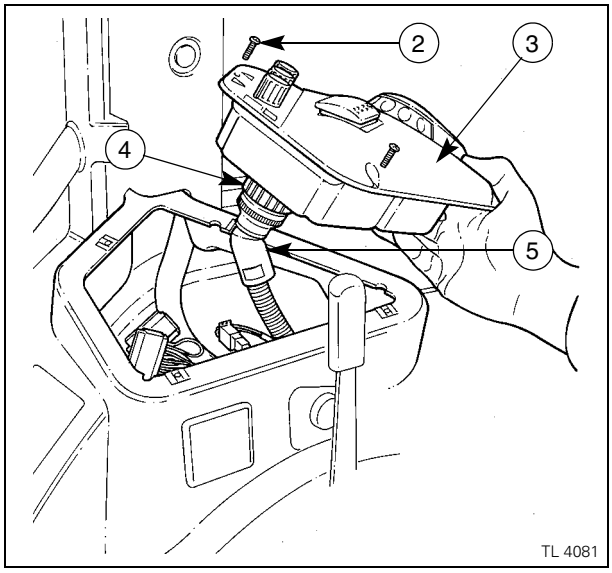
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ELC CONTROL PANEL

Removal and Refitment 10-11B

Removal

1. Ignition switch turned OFF.
2. Remove the four screws retaining the control panel.
3. Carefully lift up the panel.
4. Unscrew the multi-pin connector locking ring.
5. Pull the plug from its socket.

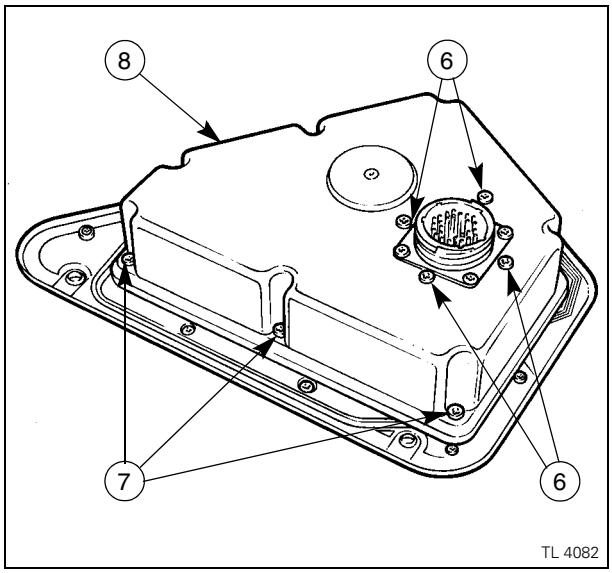


Panel Access

6. Remove the four screws around the multi-pin socket.
7. Remove the seven screws around the rear cover.
8. Carefully lift off the cover, it may be stuck by the sealing ring.

Panel Illumination Lights

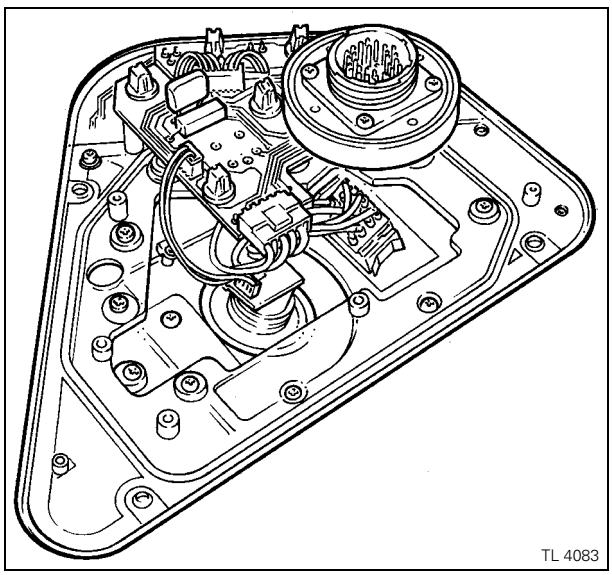
9. The panel is equipped with five lights, each holder is fitted with a 12 volt 1.2 watt capless bulb Massey Ferguson part number 3405 185 M1.
10. Turn the holder counter-clockwise to remove.



Replacement of Panel Components

11. The internal panel components can be obtained from the AGCO Parts Division, the illustration clearly shows those items which can be purchased. It is recommended that repairs are only carried out by a person that has had previous experience in soldering and work on electronics.

    There are no adjustments that can be carried out. A circuit wiring diagram is provided on page 18.

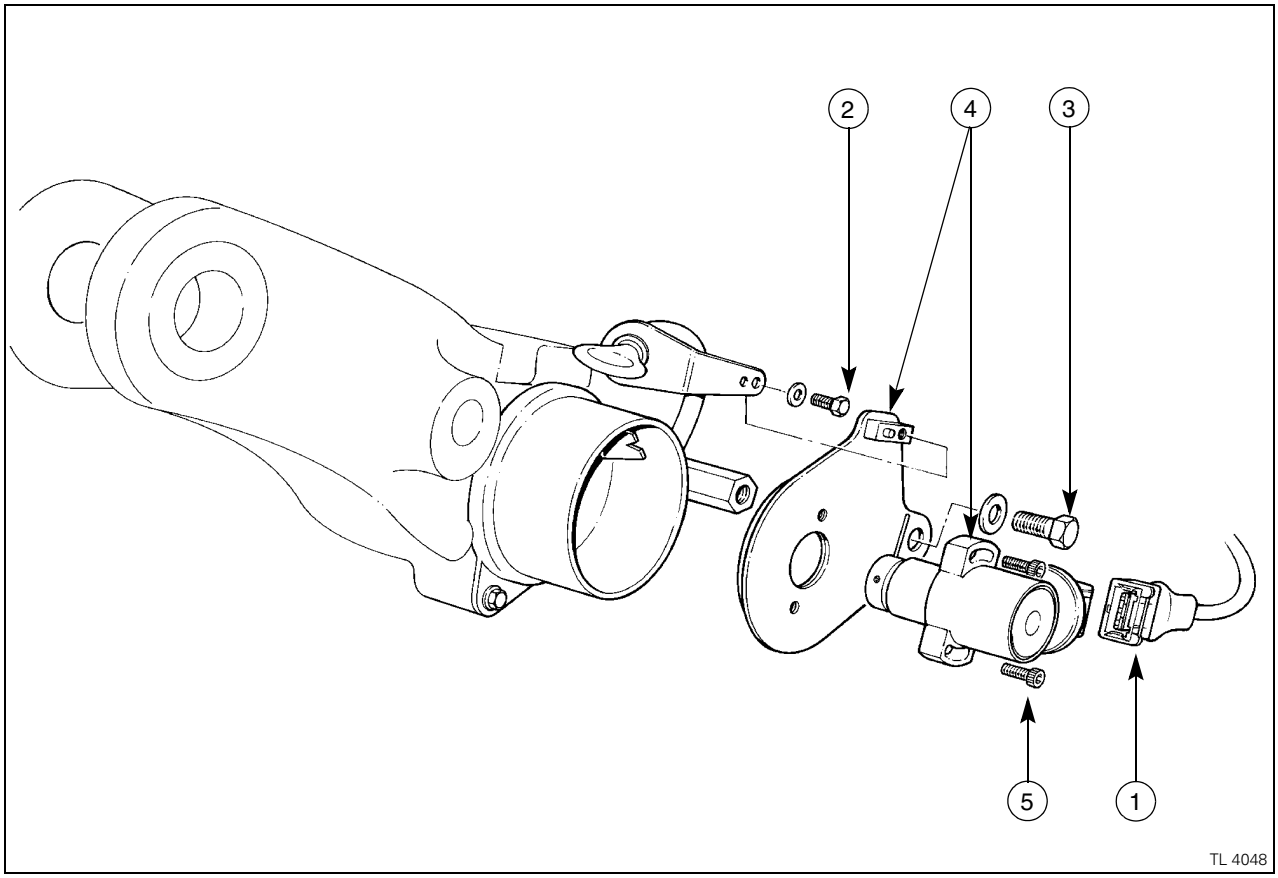


Refitment

12. Reverse procedures 1 to 7 except:
    a. Ensure that all connector are clean and securely connected.
    b. Ensure that the case sealing rings are in place, ingress of dirt can be a problem.
    c. DO NOT over tighten the control panel case screws.
    d. Stow the harness tidily when refitting the control panel to prevent strain on the multi-pin plug.

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POSITION SENSOR

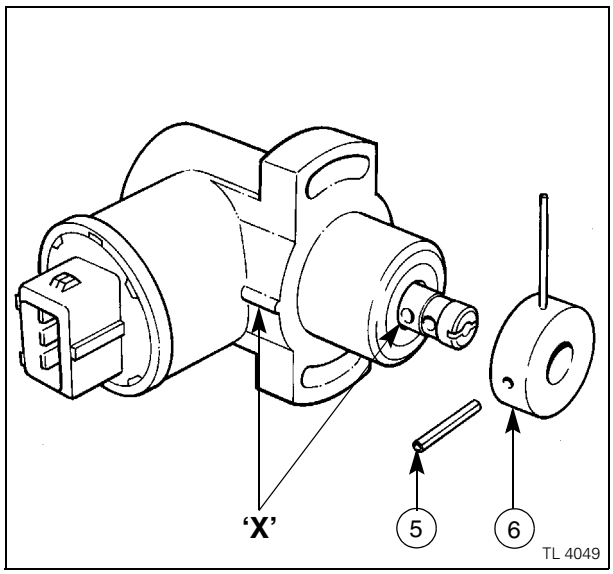
Removal and Refitment 11-11B

Removal

1. Disconnect the harness plug from the sensor.
2. Remove the bolt securing the dipstick tube to bracket.
3. Remove the bolt retaining the sensor bracket to the hexagon bracket support.
4. Carefully lift out the sensor and bracket.
5. Remove the two M6 capscrews and sensor.
6. Press the small pin out of the sensor drive collar assembly.
7. Remove the drive collar assembly.

Refitment

8. Reinstall the collar assembly. It MUST fitted to the shaft in relation to mark 'X' as shown in the illustration. The 'X' mark must also be opposite the indicator cast on the body.
9. Insert the pin.
10. Reverse operations 1 to 5.



IMPORTANT: *Install the sensor with great care, ensure that the lever (wire) on the collar engages correctly with the drive lug in the housing. DO NOT use force.*

11. Smear a little light lubricant on the mounting face to aid adjustment.
12. Reset the Position Sensor, *(see operation 3-11B).*

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Electronic Lift Control

DRAFT SENSOR

Removal and Refitment **12-11B**

No repairs can be carried out on the Draft Sensor, it must be replaced with a new unit in the event of a failure.

Removal

1. Access the connector at the rear of the tractor.
2. Disconnect the harness plug from the Draft Sensor cable.
3. Remove the two bolts and the cover.
4. Remove the retainer plate.
5. Remove the Draft Sensor from the control beam.

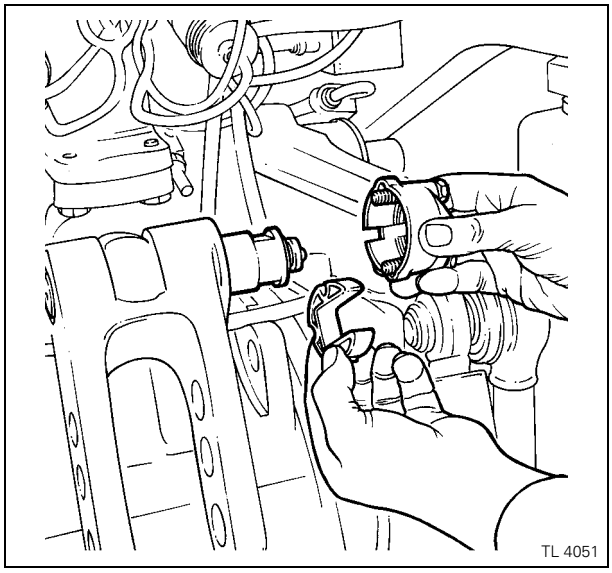
Refitment

6. Reverse procedures 1 to 4, except:

a. Clean the pin and hole before fitting.

b. The pin MUST be fitted as shown in the illustration with the radius part of the location facing to the rear of the tractor.

c. The retainer with the open jaw facing to the rear.



MICROPROCESSOR

Removal and Refitment **13-11B**

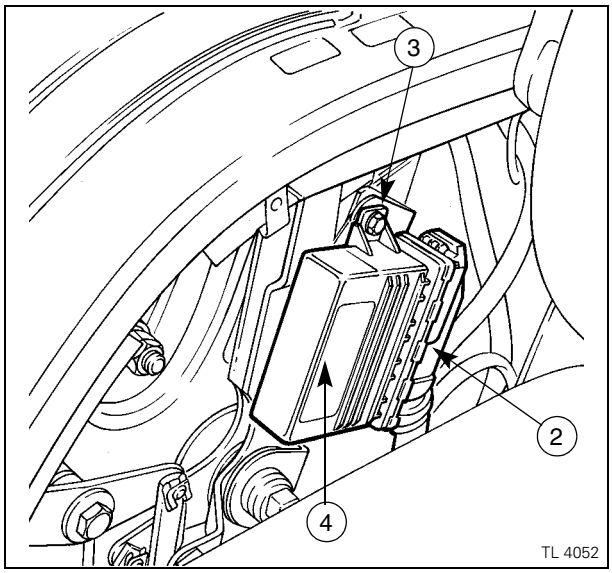
No repairs can be carried out on the Microprocessor, it must be replaced with a new unit in the event of a failure.

Removal

1. Remove the hydraulic control side panel to the operating controls.
2. Disconnect the 25 pin harness connector.
3. Remove the two screws retaining the microprocessor to the lever frame.
4. Remove microprocessor.

Refitment

5. Reverse procedures 1 to 4.
6. Test the system and make any adjustments that are necessary.



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Electronic Lift Control (Two Lever Footstep Tractors)

Section 11 - Part C

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Electronic Lift Control (Two Lever)

SPECIFICATION

Position Control:

Supply voltage	7.88 VDC nominal (7.895 max. 7.865 min.).
Potentiometer setting - lever fully UP	7.45 VDC or above
Lever fully DOWN	Zero (O to -O.15 VDC)
Resistance	4K ohms nominal (4.8K ohms max. 3.2K ohms min.).

Draft Control:

Supply voltage	7.88 VDC nominal (7.895 max. 7.865 min.).
Potentiometer setting - lever fully UP	7.40 to 7.46 VDC.
Lever fully DOWN	Zero (O to -O.15 VDC).
Resistance	4K ohms nominal (4.8K ohms max. 3.2K ohms min.).

Position Sensor:

Supply voltage	9.5 VDC nominal (9.60 max. 9.40 min.).
Setting voltage - lift arms UP	75% of supply voltage recorded by multimeter.
Accuracy of setting	±0.03 V

Draft Sensor:

Supply voltage	9.50 VDC nominal (9.60 max. 9.40 min.).
Output voltage - no load	50% of supply voltage recorded by multimeter.
Solenoid coil resistance	1.6 ohms.

Special Tools

MF.3020	ELC Harness connector.
MF.3005	Digital Multimeter

General Description

The Electronic Lift Control (ELC) controls the hydraulic lift system to the 3-point linkage in both Draft Control (soil. engaging implements), and Position Control (implements working above the ground). This system is made up of the following components:

- The Electronic Control Unit (ECU) which is located under the right-hand side cover beside the operator.
- A draft sensor located at the top of the control beam connected to the top link.
- A position sensor that works off the lift arm cross shaft.
- A draft potentiometer operated by the draft hand lever.
- A position potentiometer operated by the position hand lever.
- A linkage control valve with proportional control. The system is illustrated in Fig.1.

Draft Sensor

This is an active device and when powered provides an output voltage proportional to the load on the top link. When there is no load the output voltage is half of the supply voltage. When the top link is in compression the output goes down, in tension the output rises. If the ECU senses the output voltage is less than 25% or greater than 75% of the supply voltage then something has gone wrong and an error code flashes on the warning light.

The draft sensor generates ± 25% supply voltage output swing for a maximum 25kN (2.1/2 ton) applied load in tension or compression.

Position Sensor

This is also an active device and needs a power supply to work. When the cross shaft is in mid position the output is half of the supply voltage. As the linkage lifts, the output goes up, and as it drops the output goes down. If the ECU senses the output voltage is less than 25% or greater than 75% of the supply voltage then something has gone wrong and an error code flashes on the warning light.

The position sensor generates a 25% of supply voltage output swing for a movement of 35° from centre.

Draft and Position Lever Potentiometers

These are variable resistors (potentiometers) and sense the lever positions. Adjustments are made using screwed connecting links. The draft setting is made with the lever in the UP position and the link adjusted to give a voltage reading.

The position lever link is adjusted to get full travel of the potentiometer across the full range of lever movement.

Both potentiometers are approximately 4KΩ value with 1,7 kΩ resistor in series with the centre slider connection. It has 95 degrees electrical travel.

The Draft sensor generates a signal of ± 25% of the supply voltage for a load of 25KN applied in tension or compression from the top link

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Electronic Lift Control (Two Lever)

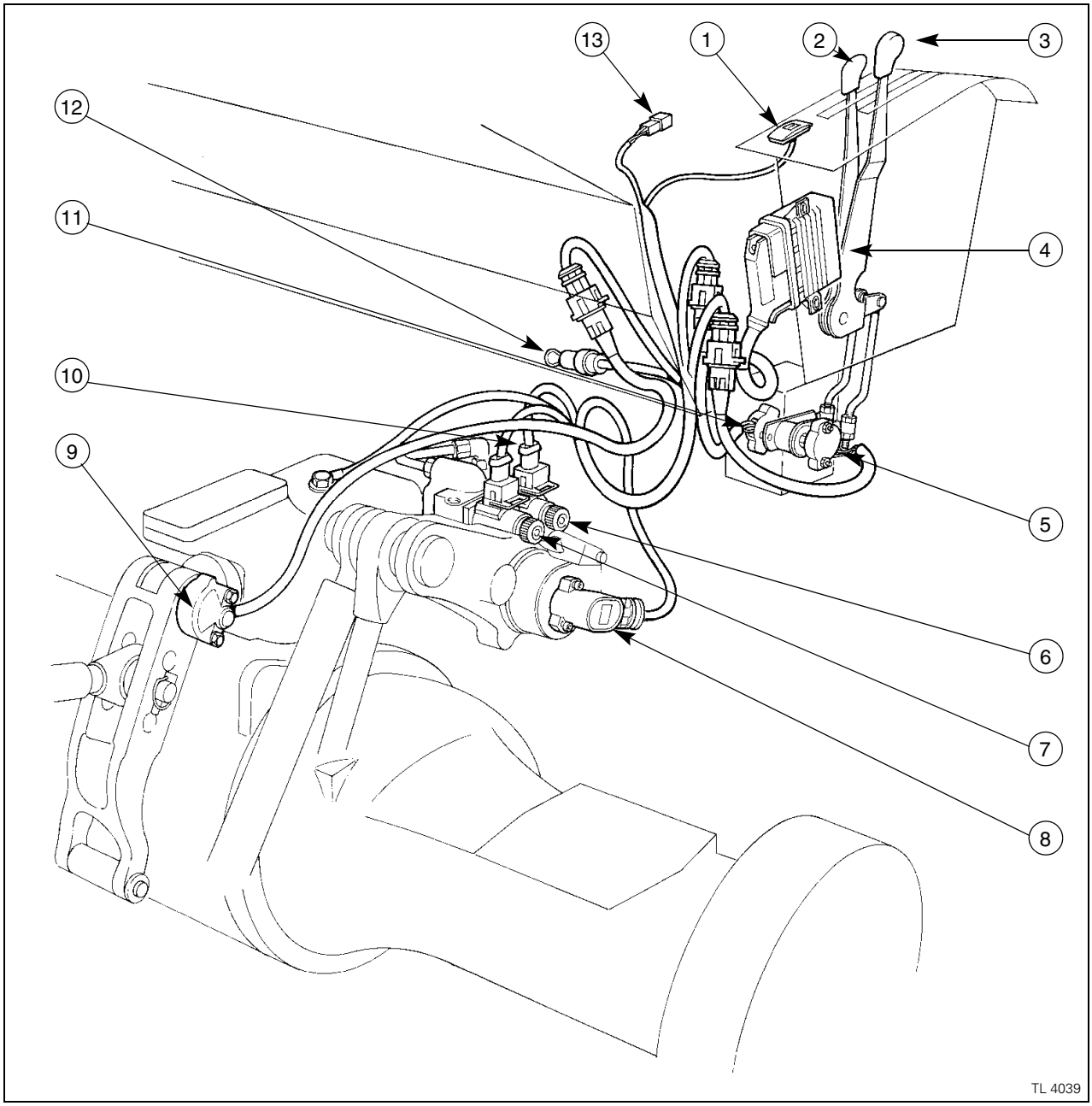


Fig.1

Key to Fig.1 Electronic Lift Control System

1. Active Transport Damping switch and Error Code light.
2. Position Control lever.
3. Draft Control lever.
4. Electronic Control Unit, microprocessor.
5. Draft Control potentiometer.
6. RAISE solenoid.
7. LOWER solenoid.
8. Position Sensor.
9. Draft Sensor.
10. Raise solenoid with tag.
11. Position Control potentiometer.
12. Lift assistor cylinder three-pin plug.
13. Power supply (+).

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Electronic Lift Control (Two Lever)

Electronic Control Unit

The electronic control unit is a microprocessor controller, it measures signals from the sensors, switches and controls. Internal software drives the hydraulic control valves. It will sense the control valve current and if this is outside a pre-determined range (too low or too high) it will flag a warning error code to indicate that something is wrong. The inputs are sensed and if these voltages are outside the permitted range an error code will flash to inform the operator of a problem.

The software provides the following features:

It senses if the engine is running from the engine oil pressure switch.

It requires the operator to undertake an unlocking procedure to avoid an implement dropping unexpectedly on start-up.

When unlocked and the position control is operated it seeks to match the link position to the lever position. If there is a mis-match an output signal is given to either lift or lower valve.

As the implement is dropped into work it senses the rise in the draft force. When the draft force equals or exceeds the draft lever setting it changes into draft control mode.

In Draft Control it seeks to balance the top link load to the draft lever position. The greater the imbalance the greater the signal to the lift or lower solenoids.

If the rate of cycling of lift and lowering becomes too great then it reduces the signals to the solenoids. This prevents the system becoming unstable. This also overcomes the need for a response control.

As the draft lever and implement is lifted at the end of the field the linkage rises until it equals or exceeds the position lever setting. It is now back under position control.

When lifted the system measures the top link load. When the implement is dropped again the signal to the valve is proportional to the measured load. This avoids heavy implements dropping too quickly or light implements being too slow. The weight measurement is in three bands, giving three drop speeds.

Transport Active Damping

On the road the top link load is measured over a period of time. If the peak load experienced as an implement bounces exceeds the average load measured then the drop valve is operated. This relieves the maximum pressure, damping the tendency to bounce. Subsequently it restores the implement to it's original height. The following advantages will be experienced:

- Tractor pitching is reduced.
- Steering safety is increased.
- Driving speed can be improved.
- Stress reduced in the tractor.

Solenoid Valves

These are proportional valves and provide a change in flow for a change in solenoid current. The minimum current to operate the solenoid is 1 amp. Thereafter output flow is proportional to the current. To achieve a rapid response a dither signal is superimposed on the solenoid current.

The current is not continuous but is rapidly switched to achieve a mean equivalent continuous current (pulse width modulation).

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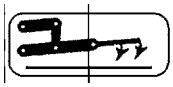
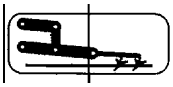
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OPERATIONAL CONTROLS

The operation of the control levers and switches is as follows:

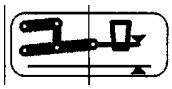
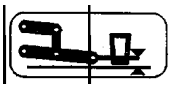
Draft Control Lever

This lever (1, Fig.2) is used to control the working depth of soil-engaging implements. The further the lever is moved to the 'DOWN' position, the deeper the implement will tend to penetrate the ground and, conversely, the nearer the lever is to the 'UP' mark, the shallower the implement will tend to work. When not in use, the lever is placed in the 'UP' position.

Raise.  Lower. 

Position Control Lever

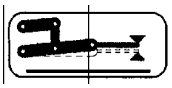
This lever (2, Fig.2) is used to lift and carry implements on the 3-point hitch. It is used to control the height of implements above the ground. Push the lever forward to 'LOWER', pull back to 'RAISE'. The lever can be moved to the right and moved further back to give additional lift *(see paragraph 5)*. When not in use, the lever is placed in the 'UP' (Transport) position.

Raise.  Lower. 

The Position Control can also be used to set maximum linkage height when working in Draft Control. This is used to restrict the height of the linkage; for example, PTO driven implement, to avoid damage to the drive shaft.

Additional Height Position

When the Position Control Lever is moved to the right and pulled fully back (A, Fig.2), beyond the notch, the lift arms give extra lift for engaging and disengaging a pick-up hitch (when fitted).

Additional height position. 

Transport Active Damping Switch

This switch (3, Fig.2) is used to activate the Transport Active Damping System. This is used to improve tractor stability when transporting implements on the 3-point hitch. Press the switch to activate.

Error Code Status Light

This red status light (4, Fig.2) is located in the centre of the Transport Active Damping switch. It is used to indicate the status of the electronic system and to flash error codes to indicate a fault in the system.

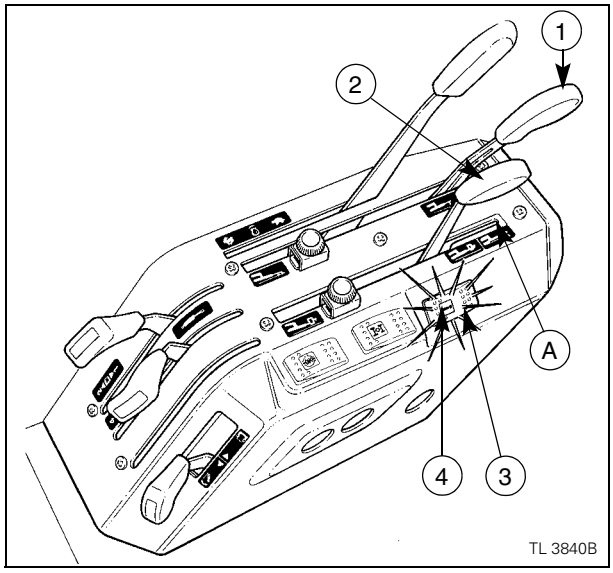


Fig.2

Starting up the System

When the engine is turned OFF the electronic and hydraulic 3-point hitch system is locked. To unlock, and activate the system, proceed as follows:

1. Switch ON and start the engine. The Error Code light will flash continuously to indicate that the system is locked.
2. Move the Draft Control Lever (1, Fig.2) to the 'UP' position.
3. Move the Position Control Lever (2) to the fully 'DOWN' position, pull slowly back past the gate and into the extra lift position, the error code light will go OUT, the system is unlocked and ready for use.
4. Move the Position or Draft Control Lever to the desired position.

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Electronic Lift Control (Two Lever)

FAULT DIAGNOSIS

The electronic system is constantly monitoring the system for faults. Any faults occurring are indicated by a flashing code on the Error Code light, *(see page 11C-7)* for further details on this type of diagnosis.

Not all faults will lock the linkage, depending upon the seriousness of the fault the linkage may become inoperative in which case it may be necessary to either raise or lower the implement; this can be carried out manually using the following procedure:

1. The electrical solenoid valve (Fig.3) controlling the lift system is located behind the right-hand rear wheel on top of the lift cover. There are two solenoids (1) to raise,(2) to lower.
2. Stop the tractor (engine running), shift all the transmission levers and PTO into neutral and apply the parking brake.

WARNING: ENSURE the tractor is unoccupied during this operation to prevent accidental movement of controls which would result in the tractor moving.

▲ ***Keep hands and clothing clear of linkage components.***

▲ ***DO NOT allow anyone to stand near the implement when lifting or lowering.***

▲ ***Serious personal injury could result.***

3. In front of the right-hand wheel and underneath the tractor; press either the raise or the lower solenoid push button located on the end of the coil housing. A long rod or piece of wood fitted with a probe is recommended. The valves can then be operated by passing the probe through the tractor wheel.
4. When the operation is complete the tractor can be moved and the system repaired.

Some Quick Checks

The electronic components used in the system are very reliable and before carrying out any extensive diagnosis or dismantling the following checks may be of some assistance:

1. Is the engine running and the oil pressure warning light OUT?
2. Is the battery in a satisfactory working condition and properly connected to the tractor?
3. Have you unlocked the system? *(see starting up the system page 11C-5)*
4. Is the hydraulic power available? Raise the linkage manually to check, *(see above)*.
5. The most common cause of failure or intermittent operation is loose or corroded cable connectors, *(see Fig.4)*. Disconnect each plug and socket in turn and clean the terminals (Fig.4). Use an Aerosol tin of terminal cleaner; obtainable from your local radio component shop.
6. Re-connect ensuring a tight sound connection.

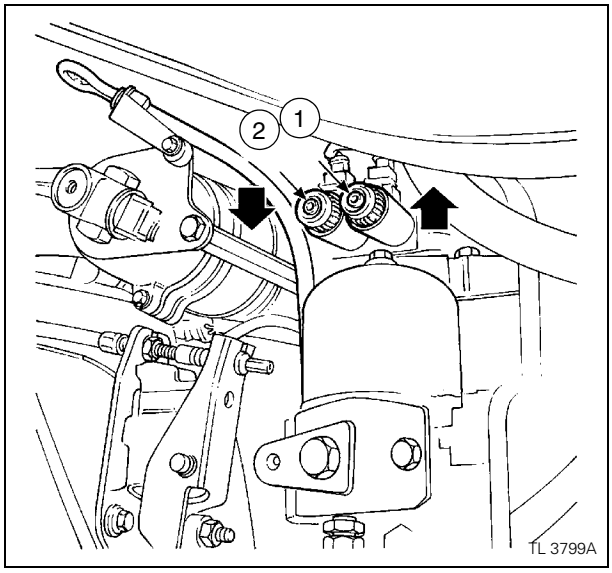


Fig.3

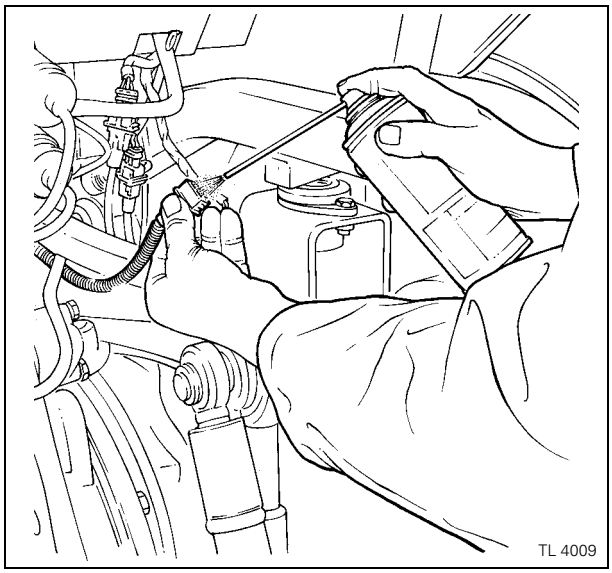


Fig.4

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ELECTRONIC LIFT CONTROL ERROR CODES

See page 11C-4 for electronic 3-point hitch operating instructions.

Error codes are displayed as a double series of flashes emitted by the status light on the Active Transport Damping switch and are used to diagnose operational and system faults. The error codes will only flash each time the engine is started or after a fault is detected.

Example: In the event of a breakdown in the signal wire to the Draft potentiometer, fault code 36 is indicated by the following sequence of flashes (see fault code list):

36 = long pause - **three flashes** - short pause - **six flashes** - (3 + 6).

If the fault has been eliminated, the status light will flash continuously awaiting to be reset in the normal manner.

A permanent flashing light on the status light indicates that the electronic lift control is locked.

The electronic lift control monitors the system for faults. Any faults occurring are classified in three categories, the reaction of the electronic control varies according to the fault category:

Serious Faults

- Control stopped and locked.
- No electrical power to control valve.
- Can only manually raise and lower the 3-point linkage.

  Driver information: Status light outputs fault code. Status light will go out when fault has been rectified.

  Resumption of control: Eliminate the fault, start engine and re-activate the system, - Starting Up the System, (*see page 11C-5*).

Medium Severity Fault

- Control stopped and locked.
- Would occur if a control or sensor adjustment is lost. Once the linkage or control levers are within range again it can be operated.

  Driver information: Status light outputs fault code. Status light will go out when fault has been rectified.

  Resumption of control: Eliminate the fault, start engine and re-activate the system, - Starting Up the System, *(see page 11C-5)*.

Minor Faults

- Control continues.

  Driver information: Status light outputs fault code. Faults can be localised and identified with the aid of the fault code list and work can continue.

Micro-processor Failure

In the event of a micro-processor failure the error code light could flash one of the codes in the following chart, this must be taken into account when diagnosing a problem with the system.

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Electronic Lift Control (Two Lever)

Serious Faults

Error Code Flash	Fault and Cause	Remedy
11 (1 + 1)	Electrical short circuit - solenoid valve: 1. Wiring short to earth on either of the coils, 2. Short circuit in solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Determine which one and replace the solenoid coil, *(see operation 7-11C).*
12 (1+2)	Output signal to RAISE solenoid faulty: 1. Open circuit to solenoid valve, wiring disconnected. 2. Faulty solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Replace the solenoid coil, *(see operation 11-9A)*
13 (1+3)	Output signal to LOWER solenoid faulty: 1. Open circuit to solenoid valve. 2. Faulty solenoid coil.	1. Check wiring, plugs and sockets to solenoid valve. 2. Replace solenoid coil, *(see operation 11-9A)*

Medium Faults

22 (2+2)	Position sensor signal faulty (cross shaft): 1. Open circuit or sensor not connected. 2. Possible short circuit or short to earth (-). 3. Position sensor out of adjustment range.	1. Check electrical connectors. 2. Check Position sensor, *(see operation 5-11C).* 3. Re-set adjustment, *(see operation 5-11C)*
23 (2+3)	Position Lever signal faulty: 1. Open circuit or potentiometer not connected or faulty. 2. Failed potentiometer.	1. Check all electrical connections, plugs and sockets. 2. Check Position potentiometer, *(see operation 3-11C).*
27 (2+7)	Battery voltage unstable: 1. Faulty connection. 2. Low battery voltage.	1. Check all electrical connections. 2. Re-charge or replace battery.

Minor Faults

32 (3+2)	Draft sensor signal faulty (upper link pin): 1. Open circuit or sensor not connected. 2. Possible short circuit or short to earth (-). 3. Possible overload.	1. Check electrical connectors. 2. Check Draft Sensor, *(see operation 6-11C).* 3. Reduce weight on 3-point linkage.
35 (3+5)	Transport active damping faulty: 1. Unable to switch ON or OFF. 2. Short circuit or short to earth (-). 3. Open circuit, switches not connected.	1. Faulty switch - replace. 2. Check for worn cables and rectify. 3. Check all connections.
36 (3+6)	Draft lever sensor signal faulty: 1. Open circuit or sensor not connected. 2. Possible short circuit or short to earth (-).	1. Check electrical connectors. 2. Check Draft Control potentiometer, *(see operation 4-11C).*
38 (3+8)	Engine oil pressure switch: 1. Engine oil pressure switch faulty. 2. Open circuit pressure switch to processor.	1. Replace switch on engine cylinder block. 2. Check all wiring and connectors, *(see operation 10-11C).*

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SETTING and TESTING the COMPONENTS

Check **1-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

IMPORTANT: *The operating voltages used in this system are less than battery voltage. Use of test lights, jumper wires, etc. will seriously damage the ELC sensors and microprocessor. DO NOT use these tools.*

Test Equipment

The electrical system harness connections are of the sealed/weather proof type and as such are not readily accessible to normal testing methods. Special Tool MF.3020 ELC Harness Connector, can be inserted in between harness connections so that voltage readings can be taken at the various sensors.

An accurate volt meter must be used for setting the sensors, preferably high impedance digital multimeter; for example, the MF.3005, which can read to two decimal places.

Setting, Testing Voltages and Components

The following series of tests can be used for two purposes, to re-set the system after repair, or to test the circuit to determine a fault. If during testing the voltages are not obtained, or they do not vary during movement of the component, this will indicate either a fault in the component, harness or a failed microprocessor.

Determining the voltage setting for the Position Sensor and the condition of the Draft Sensor requires a small calculation, it is based on a percentage of the supply voltage from the microprocessor to the sensor. It will be found an advantage to have a calculator to hand when making adjustments or fault finding.

It will be found an advantage to carry out the tests and setting of the components in the following order:

1. Position Potentiometer controls.
2. Draft Potentiometer controls.
3. Position Sensor.
4. Draft Sensor.

This order will involve the minimum amount of moving components.

Access to the connectors for test purposes

The three connectors for the Draft Sensor, Position and Draft Potentiometer are behind the plastic cover at the rear of the side console (Fig.5). Remove the four screws, cover and carefully pull out the connectors. After testing, replace the connectors so that they are protected from the elements.

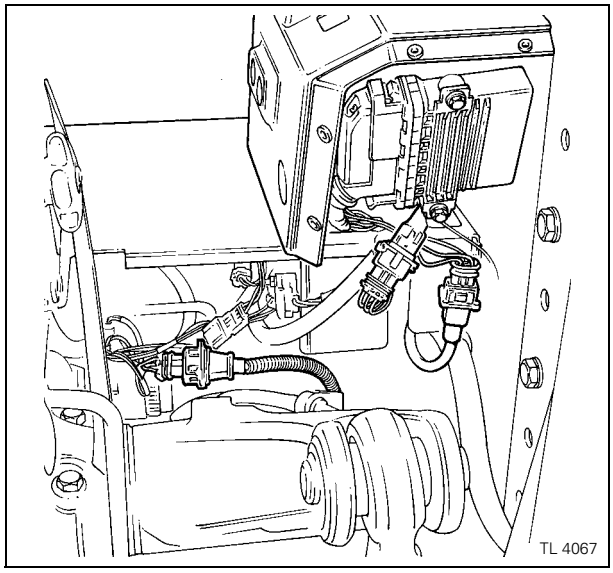


Fig.5

Cleaning and Protective Chemicals

As previously stated, dirty or corroded terminals can cause problems with low voltage electronic systems on tractors. To clean and prevent corrosion there are two products available from AGCO Parts:

3600 553 M1 - Protective grease.

3931 225 M1 - 400 ml Aerosol tin Super Lube Terminal Cleaner.

The grease can be used to keep water out of plugs and sockets, cover earthing terminals to prevent corrosion.

The aerosol cleaner is used to clean terminals and to assist in making a good contact.

Lift Assistor Cylinders

The microprocessor automatically controls the rate of drop of the implement depending on its weight. On tractors fitted with two lift assistor cylinders the microprocessor must adjust to an increased rate of flow of hydraulic oil through the solenoid valves. This is achieved by the insertion of a small three pin plug (System Connector) in the wiring harness, located adjacent to the microprocessor *(see item 12 page 11C-3)*.

For tractors without or with one lift assistor the plug should have a blue loop wire.

For tractors with two lift assistors, the plug should have a yellow loop wire.

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Electronic Lift Control (Two Lever)

POWER to the ELC

Check **2-11C**

Special Tools:

MF.3005 Digital Multimeter

Procedure

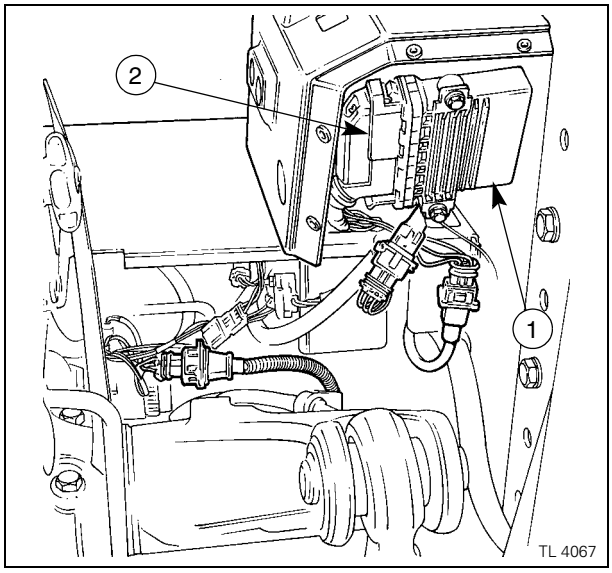
Always check the system using the earth points built into the system harness through the MF.3020 ELC Harness Connector. The earth point is located on top of the lift cover. An indication of 'No Power' is the failure of the Error Code light to come ON when the ignition is switched ON. Carry out the following checks:

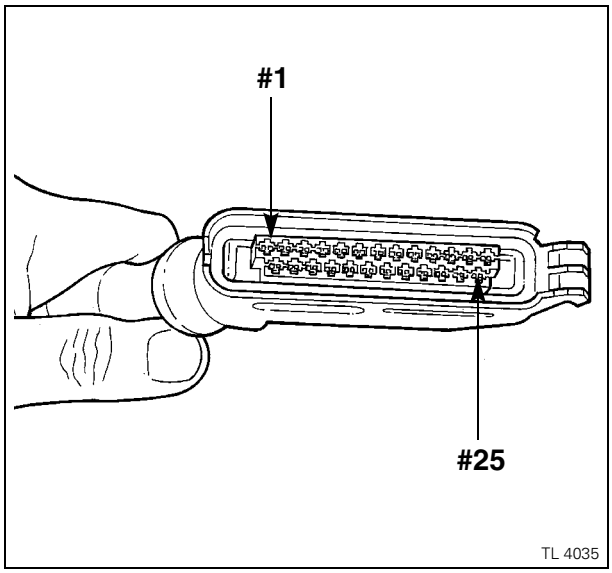
1. Remove the hydraulic control rear cover to gain access to the ECU.
2. Remove 25 pin plug from ECU.
3. Ignition switch ON, engine OFF.
4. Set the MF.3005 Digital Multimeter for volts DC.
5. Multimeter positive probe to ECU pin #25 and negative probe to ECU pin #1.
6. A reading of battery voltage should be obtained, 12 VDC.
7. If there is no voltage carry out the following checks:

Diagnosis

8. Check battery properly connected and earth connection good.
9. Check battery voltage 12 VDC.
10. Check the harness earth to chassis connection.
11. Check fuse in location 4D fuse box behind instrument panel.

    Fuse size 5 amp (tan).
12. Check all electrical plugs and sockets in the circuit.
13. Check that the oil pressure warning light goes OUT when the engine is started.





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POSITION CONTROL POTENTIOMETER

Check **3-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

Procedure

The Position Control potentiometer is mounted on the right-hand side underneath the platform. The control linkage has a threaded rod end, jam nuts are used for adjustment. Setting and test procedures as follows:

1. Access the plug and socket and Install the MF.3020 ELC Harness Connector between the potentiometer and the main harness.

Supply Voltage

2. Set the MF.3005 Digital Multimeter to volts DC.
3. Connect the multimeter negative probe to the blue terminal (3), positive probe to the green terminal (1).
4. Ignition ON, engine OFF.
5. Check the supply voltage, this should be 7.88 VDC ± 0.02 V.

Setting Voltage

6. Change the multimeter positive probe over to the yellow terminal (2).
7. The setting voltage of the potentiometer is 7.45 VDC or above.

Setting the Potentiometer

8. Position the operator's lever in the fully UP position on the console, the voltage reading should be 7,45 VDC or above.
9. If adjustment is required, adjust the two nuts on the threaded linkage so that the meter reads the above voltage or more when the nuts are tight.
10. Lock the two jam nuts.

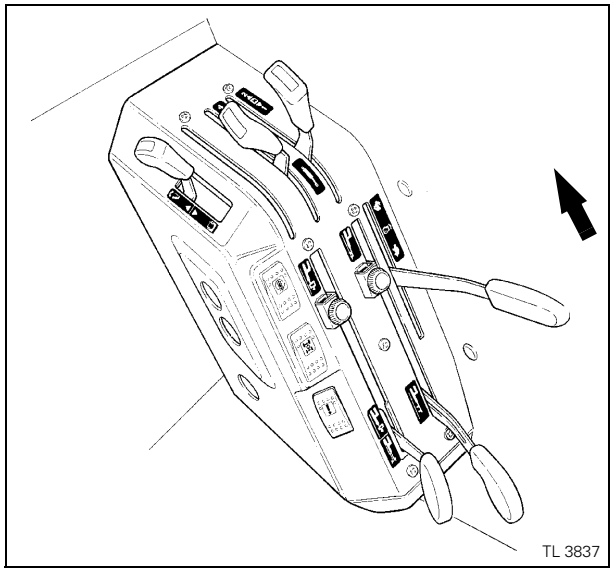
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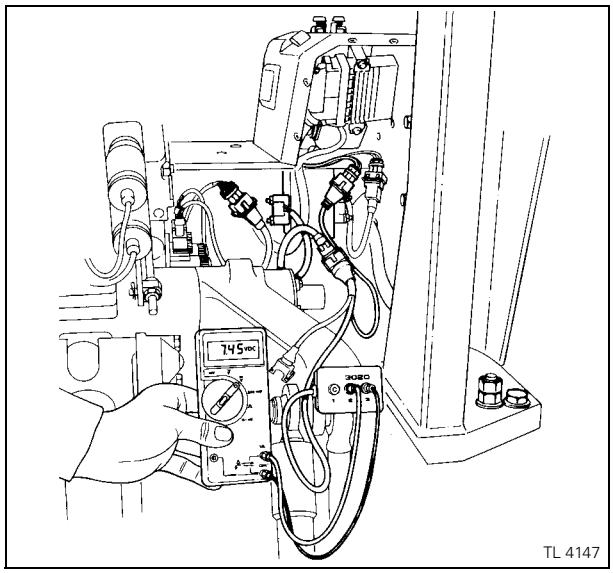
11. Move the lever through its full movement from UP to fully DOWN, check that the voltage changes progressively and smoothly to zero. If the lever does not go to the bottom of the slot, shorten the link and recheck. Make any further adjustments necessary.
12. The resistance of the potentiometer can be checked by setting the multimeter to ohms and connecting to terminals green (1) and blue (3). The resistance should be approximately 4.7 ohms.

Diagnosis

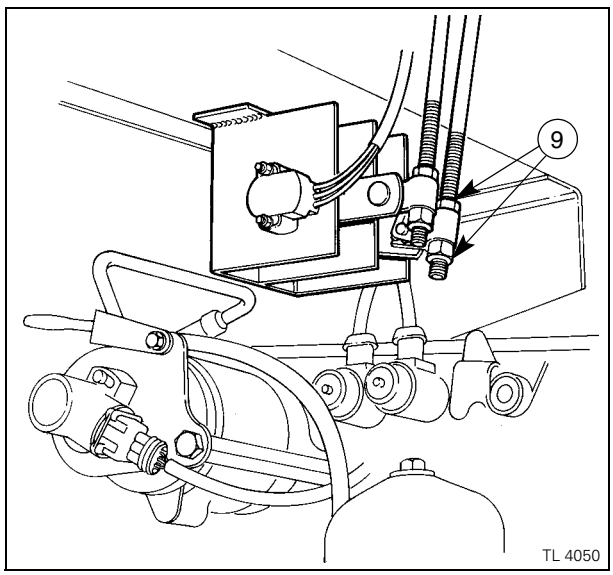
13. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates the potentiometer is satisfactory.
14. If it is necessary to replace the unit, *(see operation 13-11C).*

NOTE: *If the connectors become disconnected, the Position potentiometer is connected to the socket with two white wires and a white/black wire (white band).*


TL 3837



TL 4147



TL 4050

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Electronic Lift Control (Two Lever)

DRAFT CONTROL POTENTIOMETER

Check **4-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

Procedure

The Draft Control potentiometer is mounted on the right-hand side underneath the platform. The control linkage has a threaded rod end, jam nuts used for adjustment. Setting and test procedure as follows:

1. Access the plug and socket and install the MF3020 ELC Harness Connector between the potentiometer and the main harness.

Supply Voltage

2. Set the MF.3005 Digital Multimeter to volts DC.
3. Connect the multimeter negative probe to the green terminal (1), positive probe to the blue terminal (3).
4. Ignition ON, engine OFF.
5. Check the supply voltage, this should be 7.88 VDC ± 0.02 V.

Setting Voltage

6. Change the multimeter positive probe over to the yellow terminal (2).
7. The setting voltage of the potentiometer is 7.40 to 7.46 VDC with Draft lever fully UP.

Setting the Potentiometer

8. Position the operator's lever in the fully UP position on the console, the voltage reading should be between 7.40-7.46 VDC.
9. If adjustment is required, adjust the two nuts on the threaded linkage so that the meter reads between the above voltages when the nuts are tight.
10. Lock the two jam nuts.

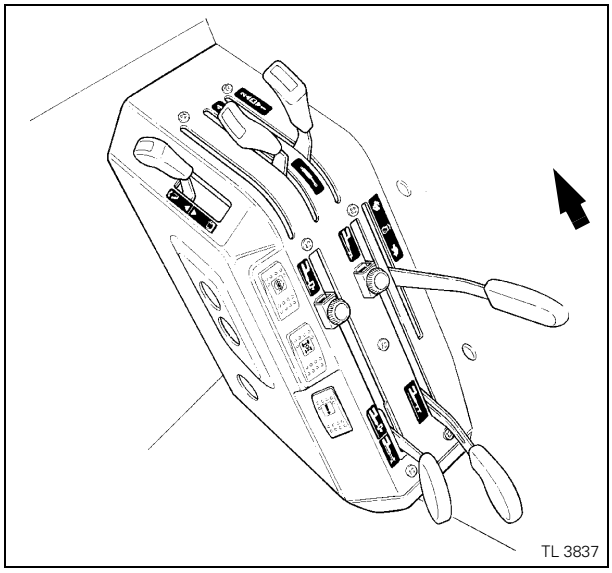
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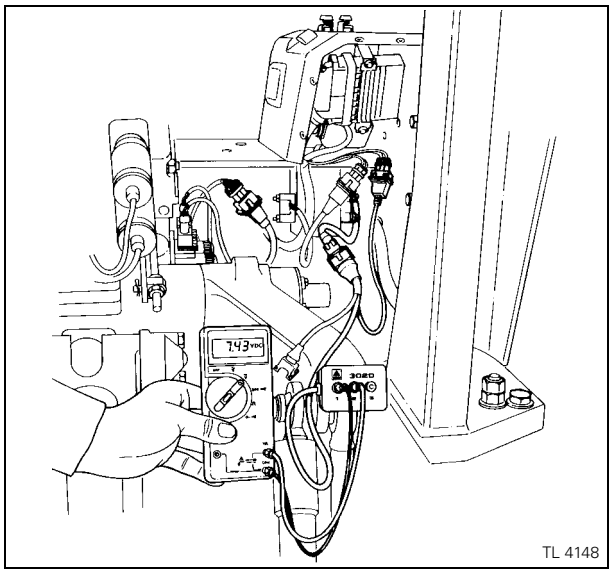
11. Move the lever through its full movement from UP to fully DOWN, check that the voltage changes progressively and smoothly to zero. Make any further adjustments necessary. The zero reading may be negative by 0-0.15VDC.
12. The resistance of the potentiometer can be checked by setting the multimeter to ohms and connecting to green terminal (1) and blue (3). The resistance should be approximately 4.7 ohms.

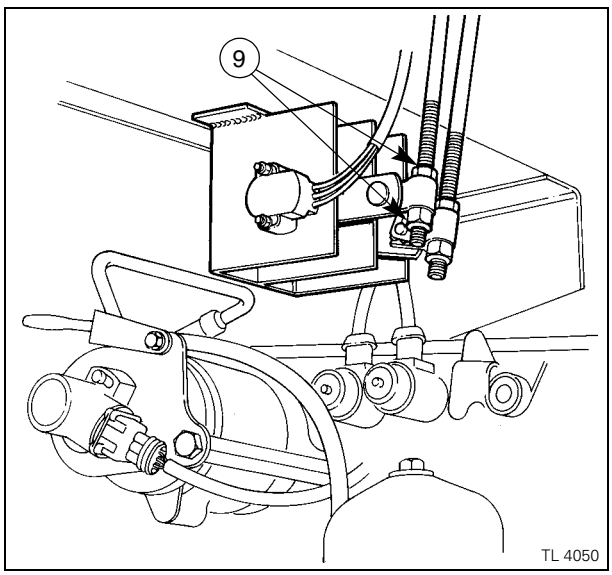
Diagnosis

13. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates the potentiometer is satisfactory.
14. If it is necessary to replace the unit, *(see operation 12-11C).*

NOTE: *If the connectors become disconnected the Draft potentiometer is connected to the socket with two white wires and a white/red wire.*


TL 3837


TL 4148



TL 4050

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POSITION SENSOR

Check **5-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

Procedure

The position sensor is located on the right-hand end of the lift arm shaft. Setting and testing procedure as follows:

1. Install the MF.3020 ELC Harness Connector between the sensor and the main harness.
2. Set the MF.3005 Digital Multimeter to volts DC.

Supply Voltage

3. Connect the multimeter negative probe to the green terminal (1), positive probe to the blue terminal (3).
4. Ignition ON, engine OFF.
5. Make a note of the supply voltage, this should be 9.5 VDC ± 0.1 V.

   For this example the supply voltage is 9.51 VDC.

Setting Voltage

6. Change the multimeter positive probe over to the yellow terminal (2).
7. The setting voltage of the sensor is 75% of the supply voltage.

   In this example the supply voltage is 9.51 VDC the setting voltage is:

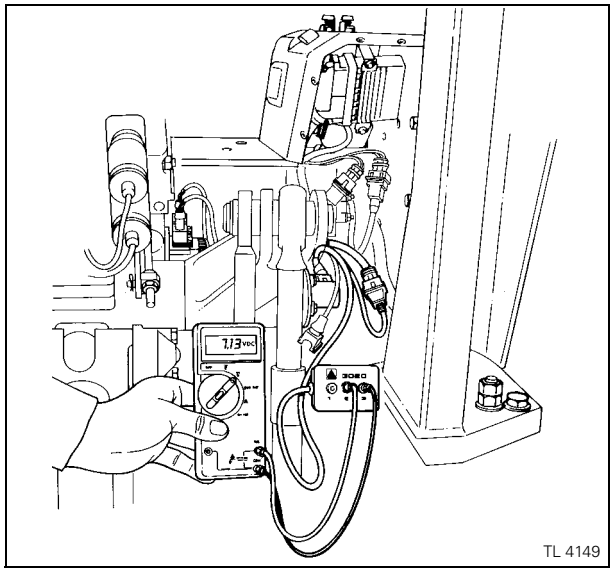
   9.51 V x 75% = 7.13 VDC

Setting the Sensor

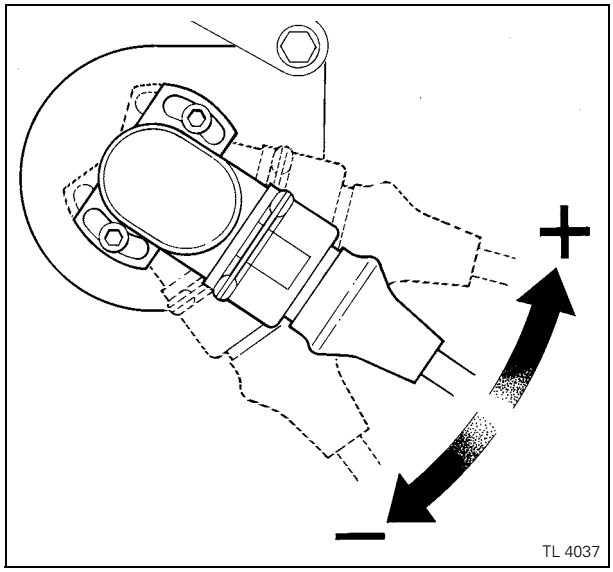
8. No weight on the links, using the engine, raise the links to their full UP position and hold against the internal stop, in this example the voltage reading should be 7.13 VDC.
9. If adjustment is required, loosen the two M6 cap screws holding the position sensor to the bracket. Rotate the sensor in its slots so that the meter reads 7.13 VDC ± 0.03 V. Rotate clockwise to decrease the reading, counter-clockwise to increase
10. Tighten the M6 cap screws. The reading may change on tightening the screws, this should be contained within ± 0.01 of a volt.

Check

11. Move the lower links through their full movement check that the voltage changes progressively and smoothly from the maximum reading, in this case 7.13 VDC (UP), to approximately 2.5 VDC when fully DOWN. Make any further adjustments necessary. When in the UP position, push the lift arms up manually to ensure that they are fully UP.



TL 4149



TL 4037

Diagnosis

12. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates sensor satisfactory.
13. If it is necessary, replace the unit, *(see operation 13-11C)*

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Electronic Lift Control (Two Lever)

DRAFT SENSOR

Check **6-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

Procedure

The Draft Sensor is mounted at the top of the control beam on the 3-point linkage and connects the beam to a large damping spring, there is no internal control linkage. Checking procedure as follows:

1. Access the plug and socket and install the MF.3020 ELC Harness Connector between the sensor and the main harness.
2. Set the MF.3005 Digital Multimeter to volts DC.

Supply Voltage

3. Connect the multimeter negative probe to the green terminal (1), positive probe to the blue terminal (3).
4. Ignition ON, engine OFF.
5. ELC switched ON.
6. Make a note of the supply voltage, this should be 9.50 VDC ± 0.10 V.

   For this example the supply voltage is 9.60 VDC.

Checking Voltage

7. Change the multimeter positive probe over to the yellow terminal (2).
8. The checking voltage of the sensor is 50% of the supply voltage.

   In this example the supply voltage is 9.60 VDC the setting voltage is:

   9.60 V x 50% = 4.80 VDC
9. No load on the Draft Sensor pin the voltage reading on the meter should read in this example 4.80 VDC ± 0.02 V. This indicates that the Draft Sensor is in working order.

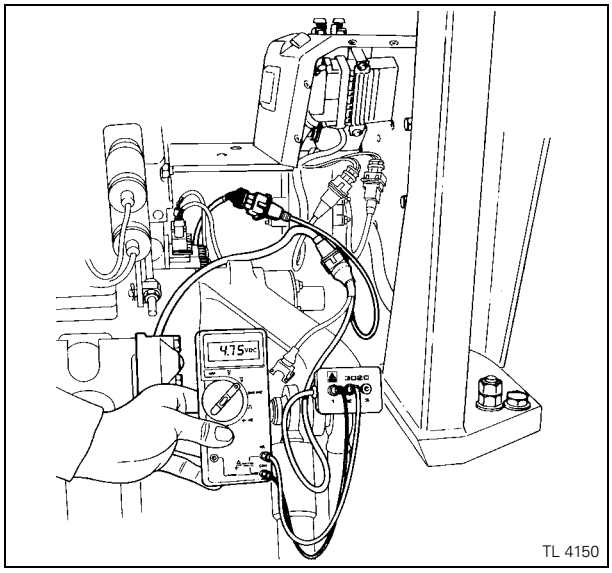
Check

10. Locate the top link in the top hole. Pulling the link, the voltage goes up, pushing the voltage will go down.

Diagnosis

11. A lack of supply voltage indicates a failure of the microprocessor. Obtaining the settings indicates the Draft Sensor is satisfactory.
12. If it is necessary to replace the pin, *(see operation 12-11C)*.

NOTE: *If the connectors become disconnected, the Draft Sensor (white plug) is connected to the socket with two green wires and a yellow wire.*



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SOLENOID VALVE COILS

Check **7-11C**

Special Tools:
MF.3020 ELC Harness Connector
MF.3005 Digital Multimeter

Procedure

The testing of the solenoid coils is a simple ohm test across the coils as follows in the next column:

1. Access the solenoid valve and remove the plug from the coil.
2. Install the MF.3020 ELC Harness Connector using the two pin plug.
3. Set the MF.3005 Digital Multimeter to ohms.
4. Connect the multimeter to terminals green (1) and yellow (2).
5. You should obtain a reading of approximately 1.6 ohms.
6. If the coil proves faulty, replace the coil, *(see operation 11-9C).*

ENGINE OIL PRESSURE SWITCH CIRCUIT

Check **8-11C**

Special Tools:
MF.3005 Digital Multimeter

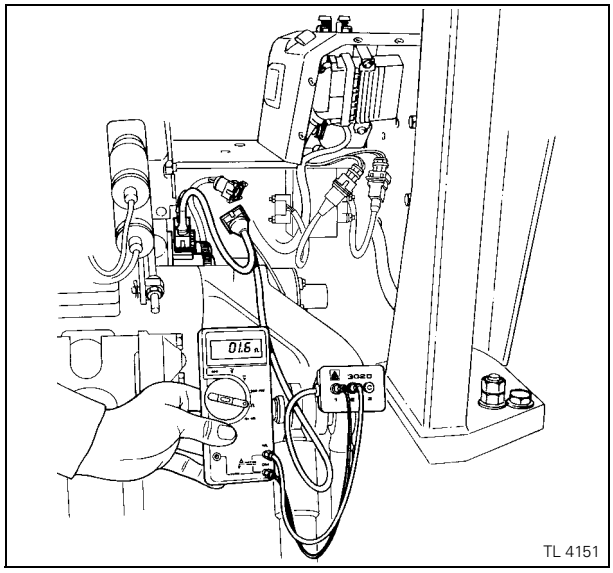
Procedure

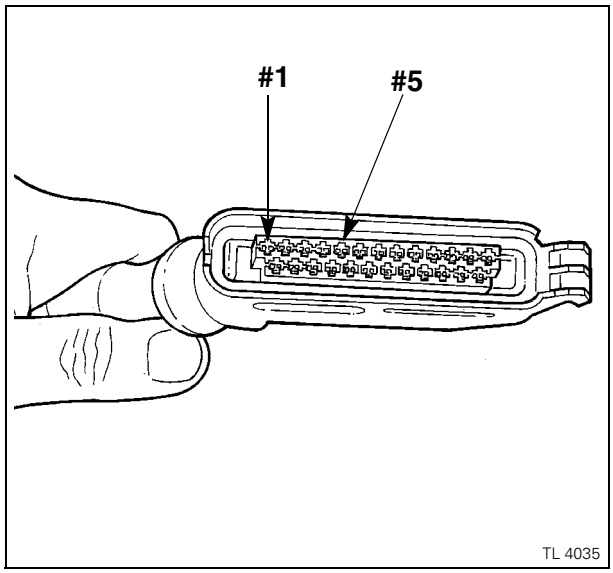
The engine oil pressure is sensed for safety, the engine must be running in order for the rear 3-point linkage to lift or lower.

The first check that the engine oil pressure light goes out when the engine is running. This will indicate that the switch is operational.

To test the circuit:

1. Remove the hydraulic control cover assembly to gain access to the ECU.
2. Remove 25 pin plug from ECU.
3. Ignition OFF, engine OFF.
4. With the MF.3005 Digital Multimeter set on ohms or 'bleep' check the circuit between pin #5 on the 25 pin plug and pin #1 (earth).
5. A reading or 'bleep' should be obtained.
6. If there is an open circuit, check all plus and sockets, *(see page 11C-6).*





ECU MICROPROCESSOR

Check **9-11C**

Procedure

The testing of the ECU microprocessor requires specialist equipment which is only available to the factory where they are made. The decision to replace the unit can only be made on elimination.

Before replacing the unit carry out all the tests that have been described in this section and the initial checks, *(see page 11C-6).*

To replace the unit, *(see operation 13-11C).*

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Electronic Lift Control (Two Lever)

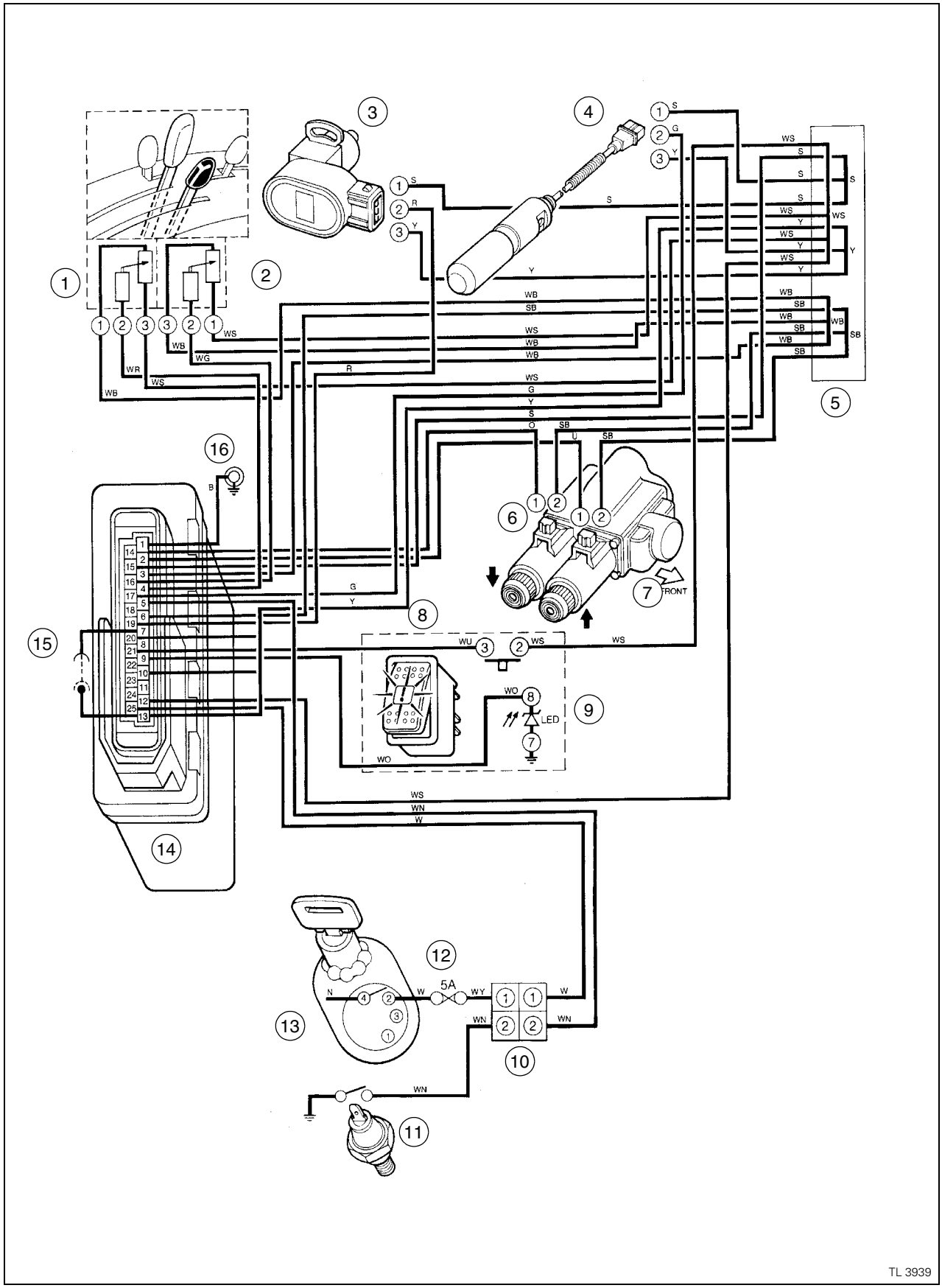


Fig.6 Electronic Lift Control Circuit

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Electronic Lift Control (Two Lever)

Key to Electronic Lift Control (ELC) Circuit.

Refer to (Fig.6).

1. Draft lever and potentiometer.
2. Position lever and potentiometer.
3. Position sensor.
4. Draft sensor.
5. Junction block on harness.
6. Lower solenoid.
7. Raise solenoid.
8. Active damping switch.
9. Status light (LED).
10. Harness connector.
11. Engine oil pressure switch.
12. System fuse 5A in main fuse box.
13. Ignition switch.
14. ELC processor unit.
15. System connector on harness; to be connected on tractors with assistor lift cylinders, disconnected on basic build.
16. Earth (negative).

Cable Colour Codes

B	Black
G	Green
K	Pink
N	Brown
O	Orange
P	Purple
R	Red
RY	Red/yellow
S	Grey
SB	Grey/black
U	Blue
W	White
WB	White/black
WG	White/green
WN	White/brown
WO	White/orange
WR	White/black
WS	White/grey
WU	White/blue
WY	White/yellow
Y	Yellow

NOTE: *The numbers in the small circles are the harness connector pin numbers.*

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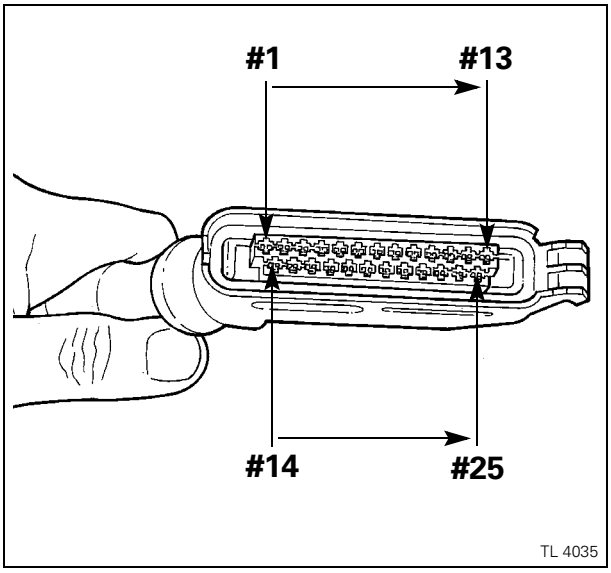
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Electronic Lift Control (Two Lever)

Electronic Control Unit (ECU) 25 Pin Connector and Functions

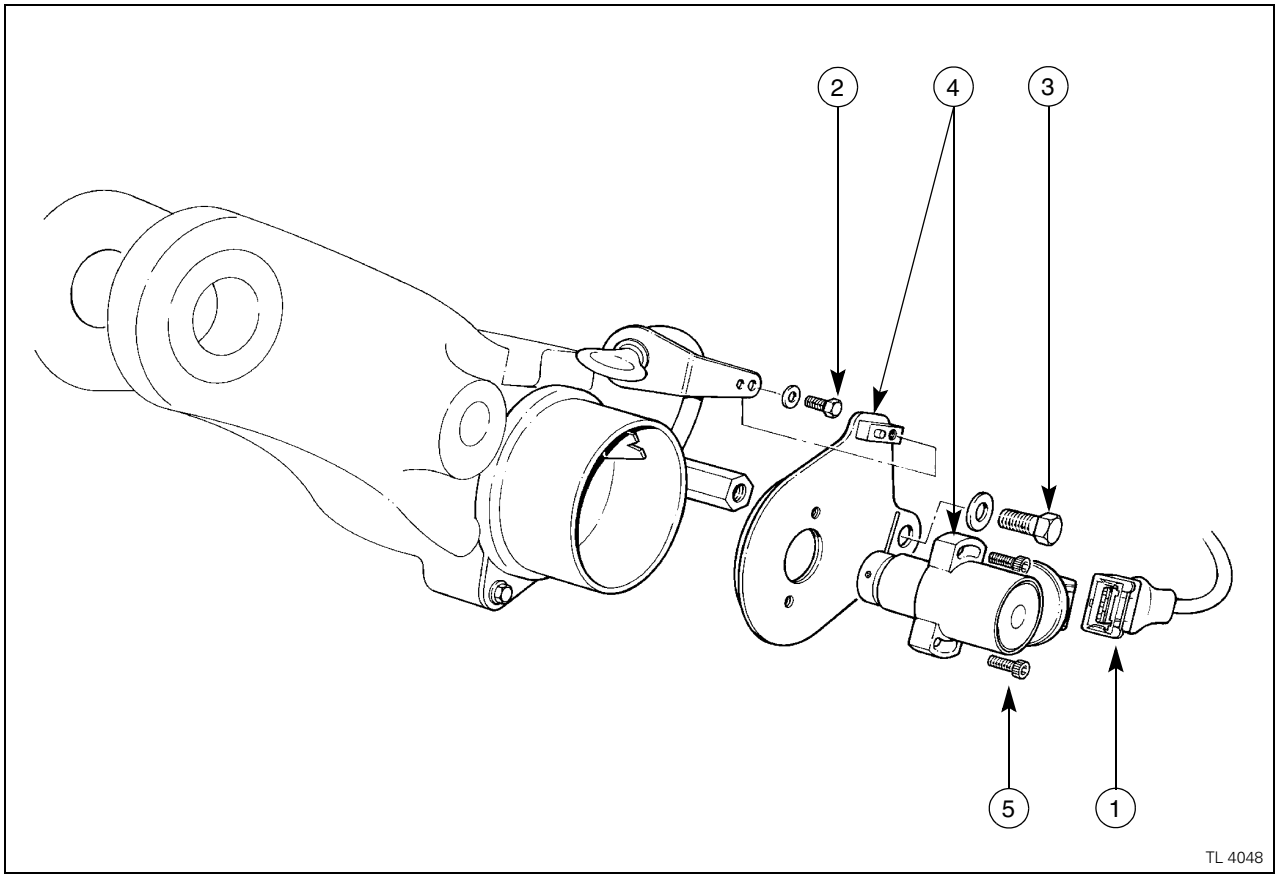
Pin No.

1. Black - System earth.
2. Blue - ECU to lift solenoid coil.
3. Grey/black - Control supply. Controls lift and lower solenoid coils.
4. White/red - Variable signal from Draft Control lever potentiometer.
5. White/brown - Operating safety earth through engine oil pressure switch.
6. Grey/black - Solenoid earth.
7. Harness jumper to pin #13. Only used on tractors with optional external dual lift rams.
8. Not used.
9. White/orange - LED light in active Transport Damping switch.
10. Not used.
11. Not used.
12. White/grey - Control negative earth. Part of Active Transport Damping switch.
13. Yellow - Transducer supply to pin #3 of Position Sensor on lift shaft. Also has a jumper to pin #7 on tractors with optional external dual lift rams.
14. Orange - Lower solenoid.
15. Grey - Transducer earth pin #1 of Position Sensor on lift shaft.
16. White/green - To position Control signal, potentiometer pin #2.
17. Green - Upper link Draft Sensor, pin #2.
18. Not used.
19. Red - Position Sensor signal on lift shaft, pin #2.
20. Not used.
21. White/blue - To pin #3 of Active Transport Damping switch.
22. Not used.
23. Not used.
24. Not used.
25. White - Incoming battery voltage positive (+). supply comes through ignition switch, 5 amp fuse to ECU.



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POSITION SENSOR

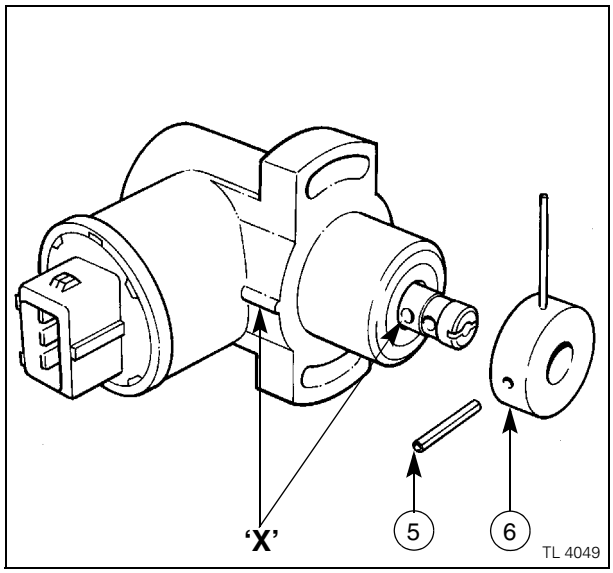
Removal and Refitment 10-11C

Removal

1. Disconnect the harness plug from the sensor.
2. Remove the bolt securing the dipstick tube to bracket.
3. Remove the bolt retaining the sensor bracket to the hexagon bracket support.
4. Carefully lift out the sensor and bracket
5. Remove the two M6 capscrews and sensor.
6. Press the small pin out of the sensor drive collar assembly.
7. Remove the drive collar assembly.

Refitment

8. Reinstall the collar assembly. It MUST fitted to the shaft in relation to mark 'X' as shown in the illustration. The 'X' mark must also be opposite the indicator cast on the body.
9. Insert the pin.
10. Reverse operations 1 to 5.



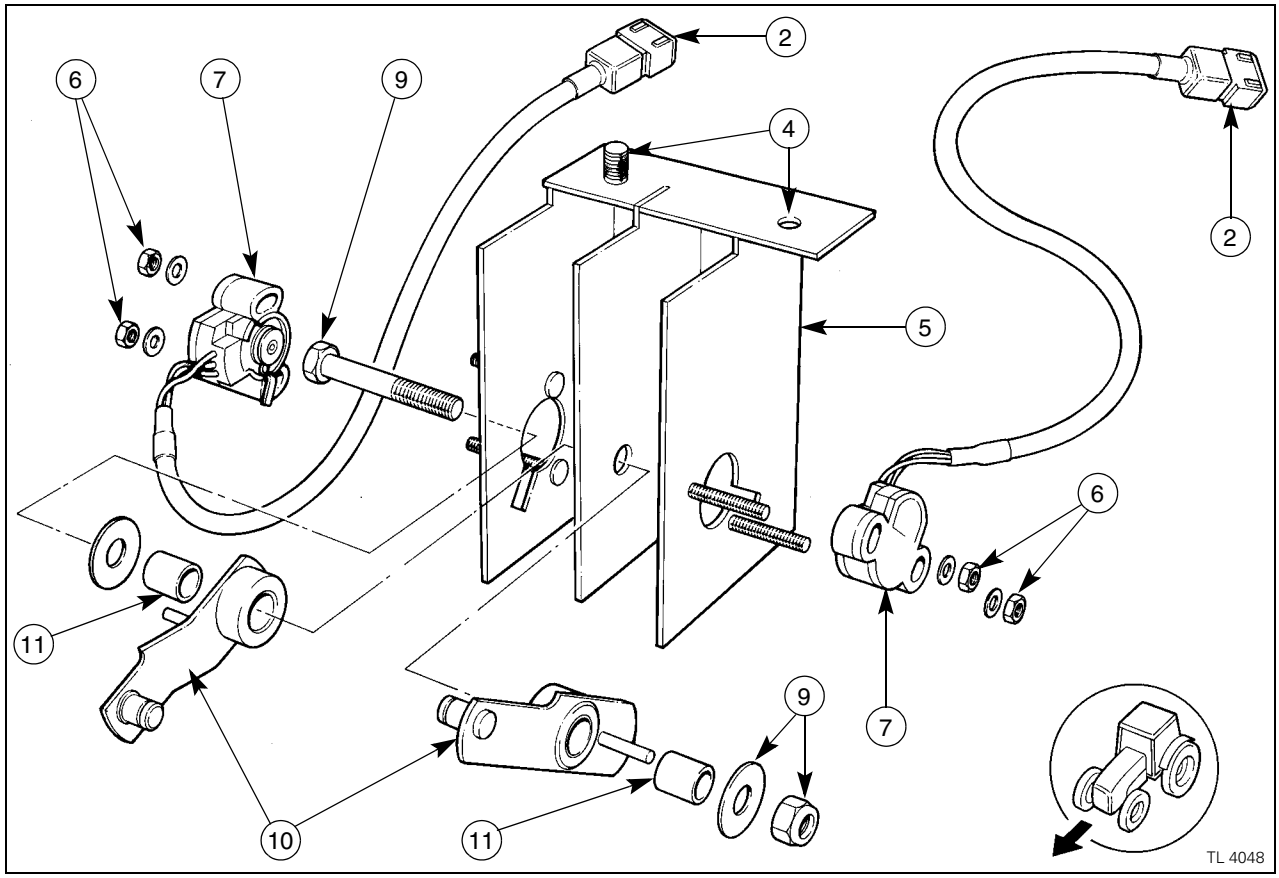
IMPORTANT: *Install the sensor with great care, ensure that the lever (wire) on the collar engages correctly with the drive lug in the housing. DO NOT use force.*

11. Smear a little light lubricant on the mounting face to aid adjustment.
12. Reset the Position Sensor, *(see operation 5-11C).*

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Electronic Lift Control (Two Lever)



DRAFT and POSITION CONTROL POTENTIOMETERS

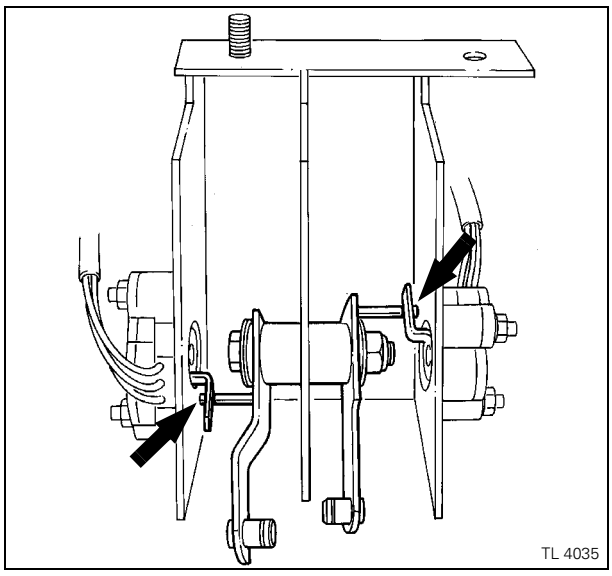
Removal and Refitment 11-11C

Removal

1. Access the connectors at the rear of the tractor.
2. Disconnect the two harness plugs from the Draft and Position control potentiometers.
3. Disconnect the two control rods from the control levers.
4. Remove the nut and bolt holding the Draft and Position control unit to the underside of the platform.
5. Remove the control unit to the work bench.
6. Remove the two nuts and washers holding the failed potentiometer to the bracket.
7. Remove the potentiometer.

Control Levers

8. If necessary, the two levers can be removed by first removing the two potentiometers.
9. Remove the pivot bolt.
10. Remove the two levers.
11. If necessary, the two bushes can be replaced.



Refitment

12. Reverse procedures 1 to 10 except:
    a. The Draft potentiometer cable faces to the front of the tractor when installed, the Position potentiometer to the rear.
    b. Ensure that the lever on the potentiometer is located under the pin on the lever in both cases, as shown in the illustration.
    c. DO NOT over tighten the nut, the levers must work very freely.

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d. When refitting the assembly, ensure that no strain is imposed on the potentiometer levers. Slacken both nuts on the control rods to ensure clearance when assembling.

e. Reset the Position and/or Draft potentiometer, *(see operation 3-11C or 4-11C).*

DRAFT SENSOR

Removal and Refitment 12-11C

No repairs can be carried out on the Draft Sensor, it must be replaced with a new unit in the event of a failure.

Removal

1. Access the connector at the rear of the tractor.
2. Disconnect the harness plug from the Draft Sensor cable.
3. Remove the two bolts and the cover.
4. Remove the retainer plate.
5. Remove the Draft Sensor from the control beam.

Refitment

6. Reverse procedures 1 to 4, except:
   a. Clean the pin and hole before fitting.
   b. The pin MUST be fitted as shown in the illustration with the radius part of the location facing to the rear of the tractor.
   c. The retainer with the open jaw facing to the rear.

MICROPROCESSOR

Removal and Refitment 13-11C

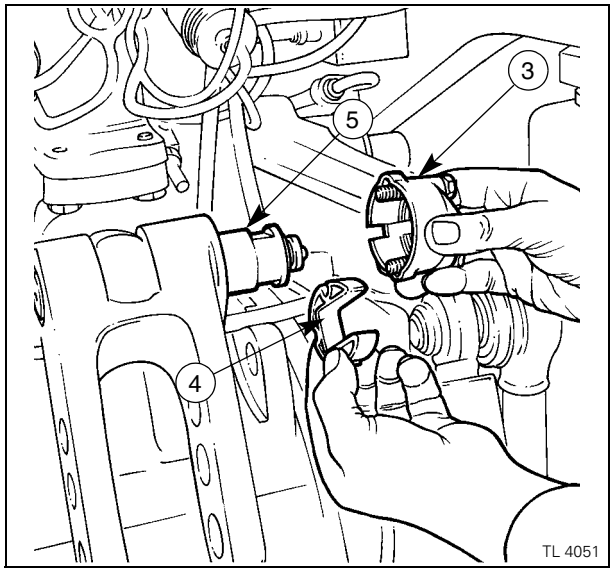
No repairs can be carried out on the Microprocessor, it must be replaced with a new unit in the event of a failure.

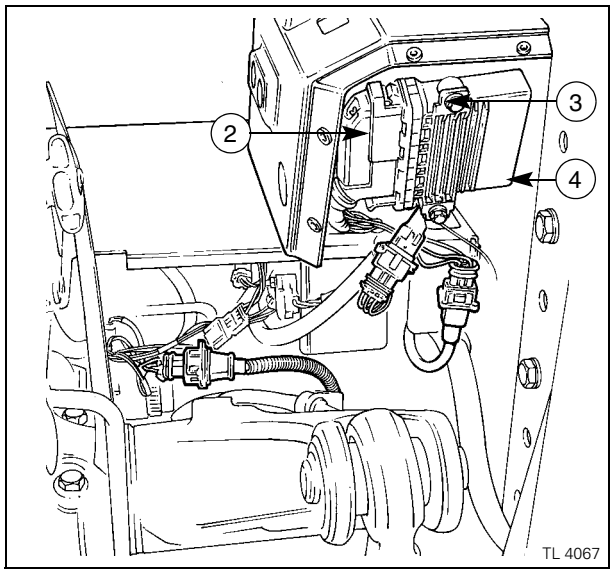
Removal

1. Remove the rear plastic cover on the console.
2. Disconnect the 25 pin harness connector.
3. Remove the two screws retaining the microprocessor to the lever frame.
4. Remove microprocessor.

Refitment

5. Reverse procedures 1 to 4.
6. Test the system and make any adjustments that are necessary.





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Electronic Lift Control (Two Lever)

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SECTION 12

Cab and Sheet Metal

INDEX

12A	CAB
12B	SHEET METAL
12C	AIR CONDITIONING

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Cab

Section 12 - Part A

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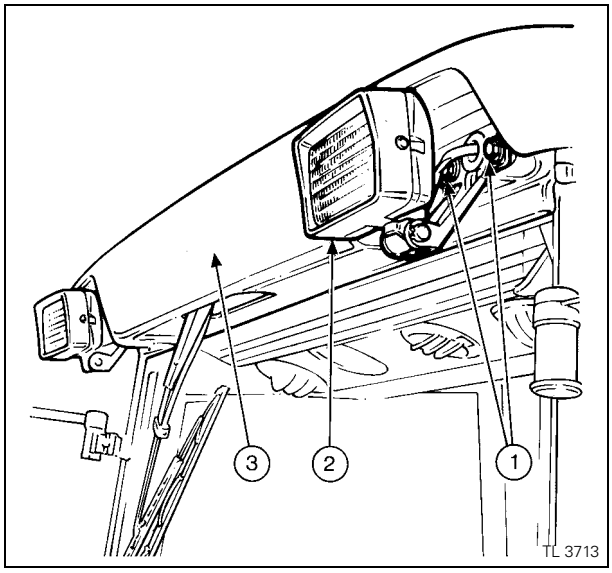
Operation No.	Description	Page No.
1-12A	Windscreen Wiper Motor and Blade - Removal and Refitment	12A–2
2-12A	Heater and Blower Motor - Removal and Refitment	12A–2
3-12A	Heater Water Valve - Removal and Refitment	12A–5
4-12A	Control Panel - Removal and Refitment	12A–5
5-12A	Headlining - Removal and Refitment	12A–6
6-12A	Door Lock and Handle - Removal and Refitment	12A–7

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WINDSCREEN WIPER MOTOR and BLADE

Removal and Refitment 1-12A



Removal

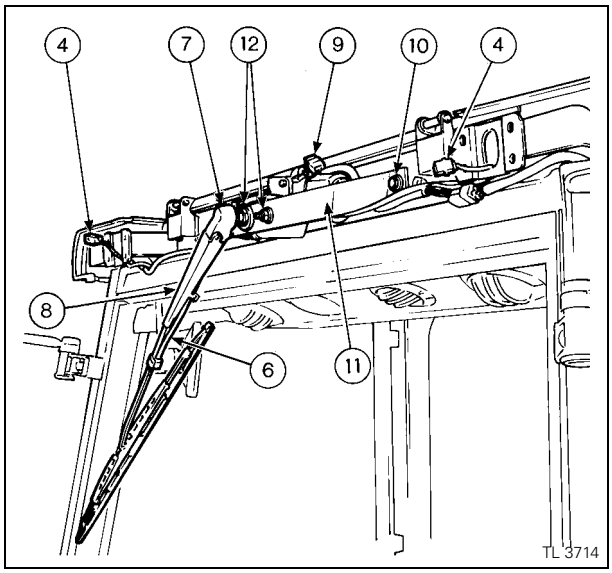
1. Remove the two bolts in each work light mount.
2. Carefully allow the lights to hang down on their wires.
3. Remove the front cover working it forward and down the windscreen wiper arm so that access can be gained to the work light plugs.
4. Disconnect each light.
5. Remove the cover completely threading it off the wiper arm and blade.

Wiper Arm and Blade

6. Disconnect the washer pipe.
7. Lift up the cover and remove the retaining nut.
8. Remove the wiper arm and blade.

Wiper Motor

9. Disconnect the electrical plug.
10. Remove the two bracket bolts.
11. Remove the bracket complete with motor.
12. Remove the two nuts and motor assembly.



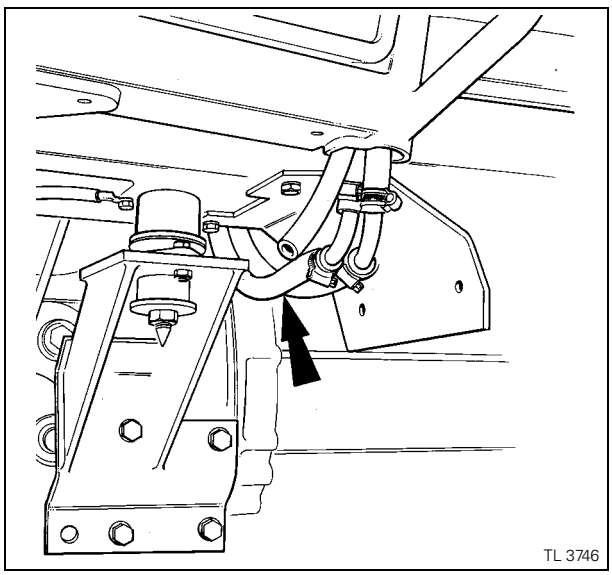
Refitment

13. Reverse procedures 1 to 12 except:

a. Ensure that the washer hose is clipped to the wiper arm.

HEATER and BLOWER MOTOR

Removal and Refitment 2-12A



Removal

1. Place a suitable ladder against the cab to gain access to the front roof hatch.

or:

Stand on the seat and work through the rear hatch.

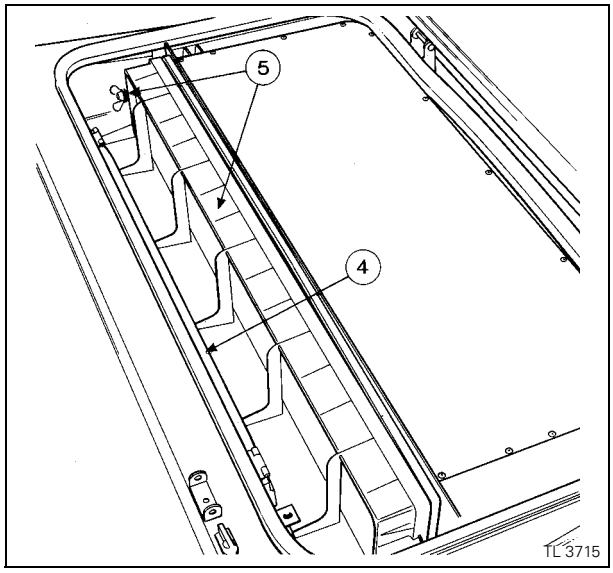
2. Clamp the two hoses at the base of the cab and drain the coolant from the heating system, ensure that the heater is turned ON.
3. Open the hatch and lay flat.

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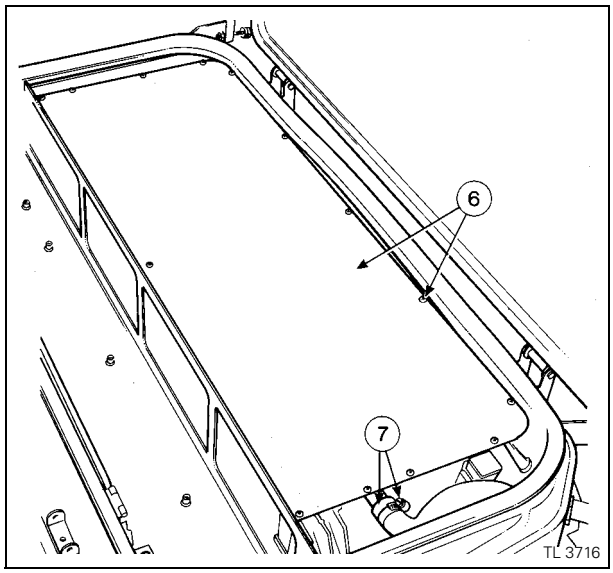
Cab Air Filter

4. Close the recirculating duct.
5. Slacken the two wing nuts and lift out the air filter assembly

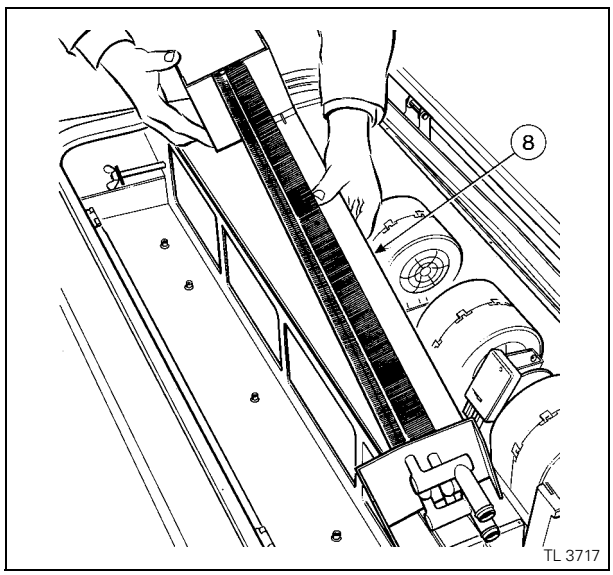


Heater Radiator

6. Remove the 14 self tapping screws and the cover plate.
7. Slacken the two hose clips and slide the hoses off the heater radiator inlet and outlet pipes.



8. Lift the heater radiator out of the casing.



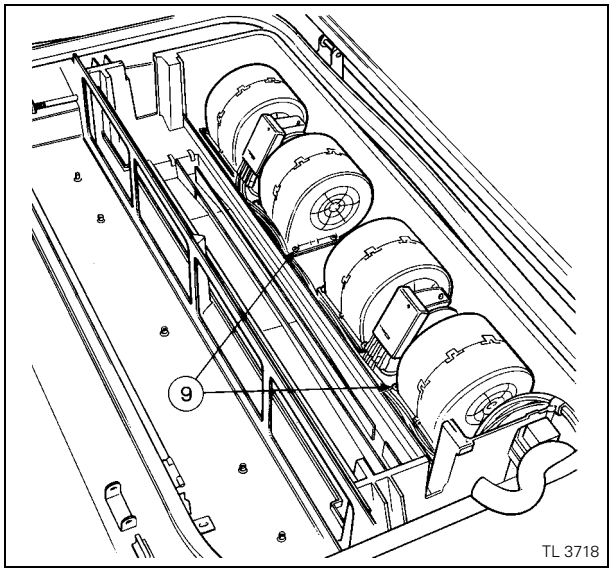
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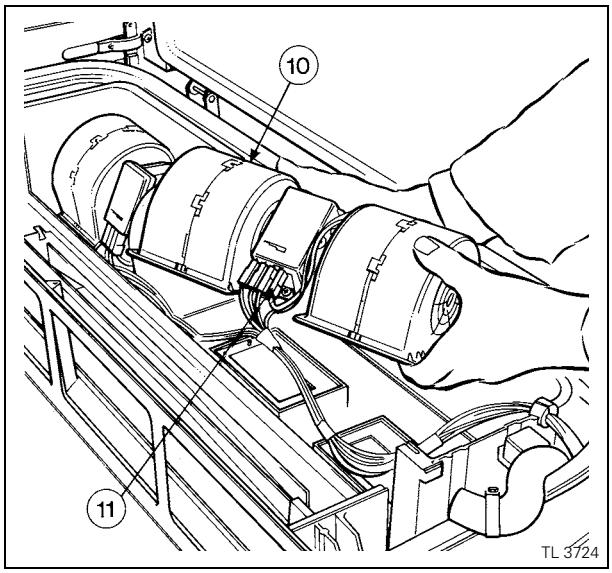
Blower Motor

NOTE: *The radiator has been removed for clarity, it does not have to be removed to service the fan and motor assembly.*

9. Remove the six self tapping screws retaining the two fan housings and motor assembly.



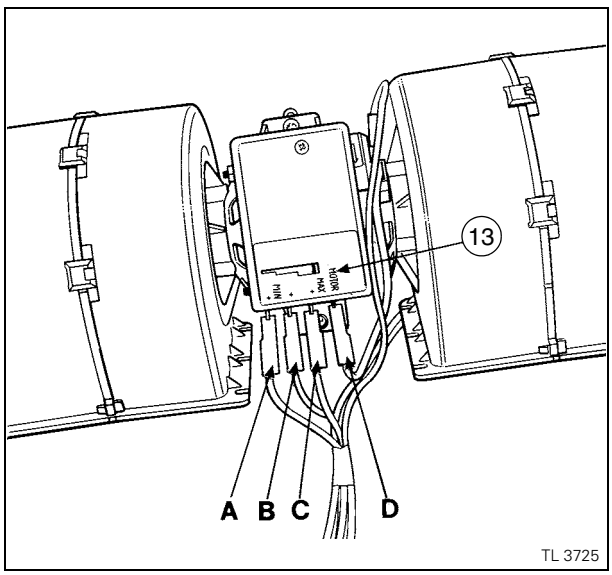
10. Remove the fan and motor assembly.
11. Disconnect the wires.



Refitment

12. Reverse procedures 1 to 11 as required.
13. The connections to the motor are as follows:
    - A.....Blue wire MIN.
    - B.....Green/orange wire +.
    - C.....Red/orange wire +.
    - D.....Orange wire MOTOR MAX.

Black wire to motor frame.



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HEATER WATER VALVE

Removal and Refitment 3-12A

Removal

1. Place a suitable ladder against the cab to gain access to the front roof hatch.

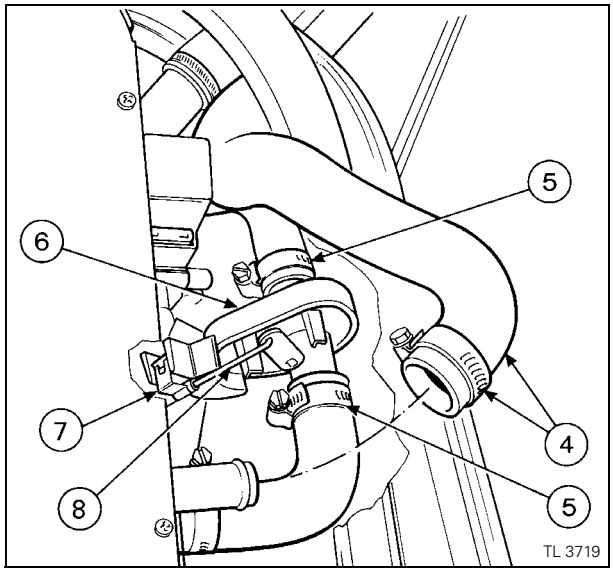
   or:

   Stand on the seat and work through the rear hatch.
2. Drain the coolant from the engine and heating system, ensure that the heater is turned ON.
3. Open the hatch and lay flat.
4. Working through the space between the heater and hatch, slacken the hose clip and disconnect the top hose to the heater radiator, move to one side.
5. Slacken the hose clips on each side of the water valve.
6. Remove the water valve.
7. Remove the spring clip holding the control cable.
8. Disconnect the control cable.

   Control Cable
9. If the control cable needs replacing, disconnect the other end, *(see operation 4-12A)*.

Refitment

10. Reverse procedures 1 to 9.



CONTROL PANEL

Removal and Refitment 4-12A

Removal

To gain access to the back of the control panel for switch or control replacement proceed as follows:

1. Remove the six self tapping screws.
2. Very carefully pull the panel away from the headlining in a level motion.
3. When clear it can be tilted down to gain access to the rear of the panel, The controls are as follows:

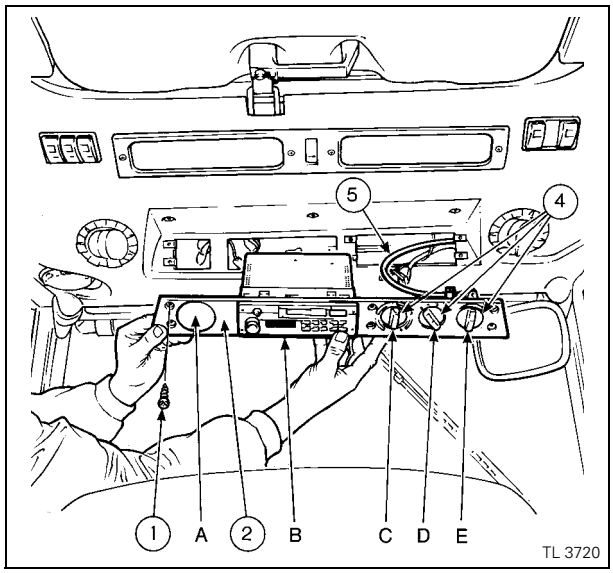
   A. Clock (optional fitment).

   B. Radio

   C. Air conditioning temperature control.

   D. Blower motor speed control.

   E. Heater temperature Control
4. To access the retaining nut on the controls, pull off the knob with a pair of pliers. Take care not to damage the plastic.
5. The heater water valve control cable can be released by removing the retaining clip and disconnecting the end of the wire.



Refitment

6. Reverse procedures 1 to 5.
7. Before reinstalling the panel, ensure that the spring clips, that take the self tapping screws, are correctly located.

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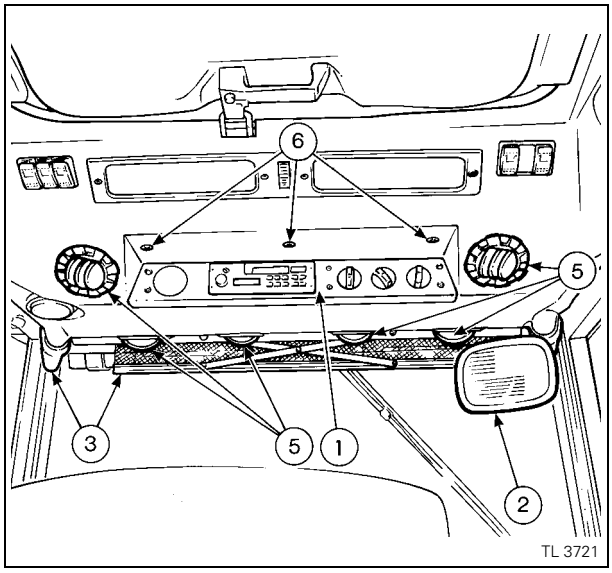
HEADLINING

Removal and Refitment 5-12A

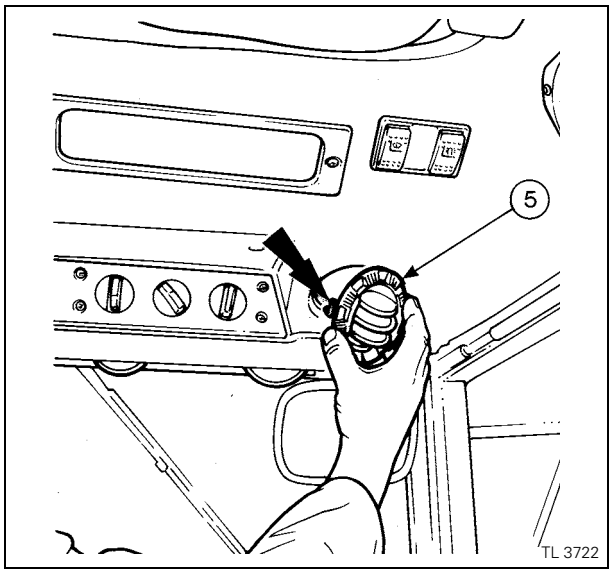
Removal

You will need some help in removing the head lining. Care must be taken, the lining is made of an insulating material which can easily be damaged. Your assistant should be available to support the lining when disconnecting the switches and for final removal. Ensure that you both have clean hands.

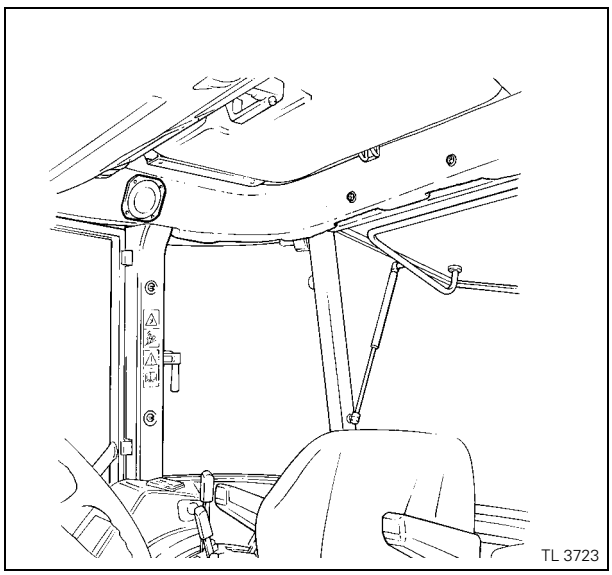
1. Remove the control panel, *(see operation 4-12A)*.
2. Remove the internal mirror.
3. Remove the sun blind and two plastic covers. There are nuts at each side.
4. Remove the left- and right-hand door post covers.
5. Remove the six vents, these are held in with spring clip which is located inside the vent and hold the vent and lining to the internal air chamber. Lever the vent away from the head lining so that your fingers can grip it. Pull sufficiently to allow the vent to move to one side and free one of the legs of the spring clip. Keep your fingers clear of the spring. The vent can now be removed.
6. Remove the three front head lining screws.
7. Very carefully lower the lining to gain access to the rear of the switches. Squeeze the clip on the side of the plug and remove from the switch. Make a note of which plug fits which switch.
8. Disconnect the wires on the back of the interior light.
9. Gain access to the rear of the speakers and disconnect the plug.
10. Remove the three rear headlining screws.
11. Lower the rear of the lining and by tilting it sideways remove it from the cab.
12. Hold the lining up in place and loosely fit the three rear screws.
13. Re-connect the speakers, interior light and switches.
14. Hold the lining in place, ensuring that the recirculating control is in the centre of the slot. Replace the three front retaining screws.
15. Refit the air vents.
16. Refit the control panel.
17. Tuck the lining under the sealing rubber around the hatch.
18. Ensure that all the edges are correctly positioned and tidy around the cab side.



TL 3721



TL 3722

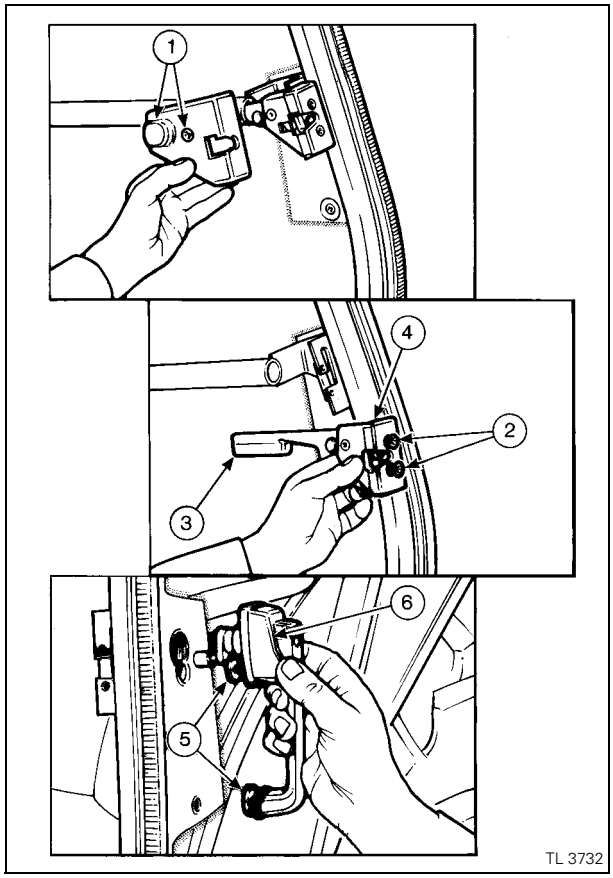

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DOOR LOCK and HANDLE

Removal and Refitment 6-12A



Removal

1. Remove the screw and door lock cover.
2. Remove the two screws on the leading edge of the door.
3. Squeeze up the handle so it is inside the tube.
4. Pull the lock and handle assembly out of the tube and away from the door.
5. Remove the two screws and washers.
6. Remove the door handle.

Refitment

7. Reverse procedures 1 to 6.

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Sheet Metal

Section 12 - Part B

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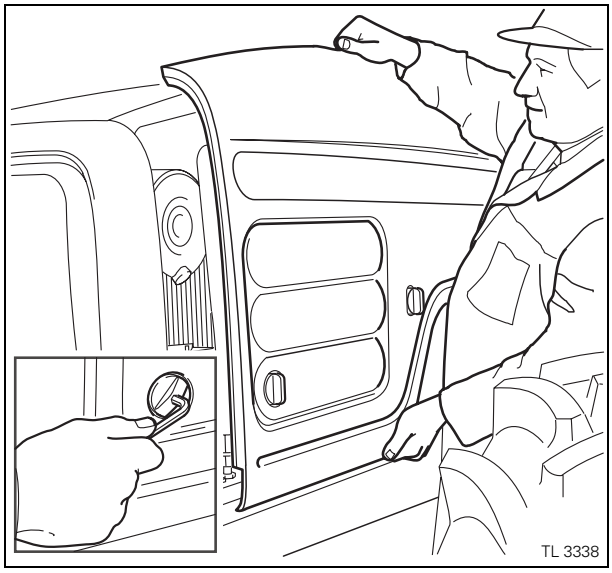
SHEET METAL

Removal and Refitment 1-12B

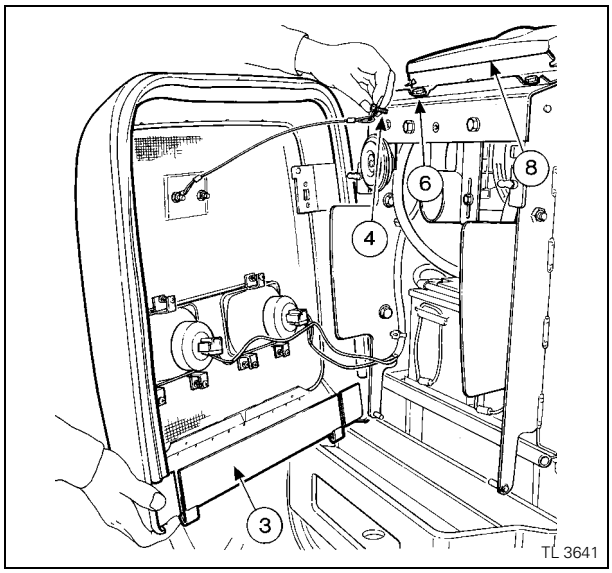
Removal

Sheet Metal

1. Remove the hood side access panels. Turn all three catches through 90° until they are vertical, using a 8 mm hexagon key.
2. Pull the lower edge away from the side of the tractor, and lift clear. Place safely to one side.

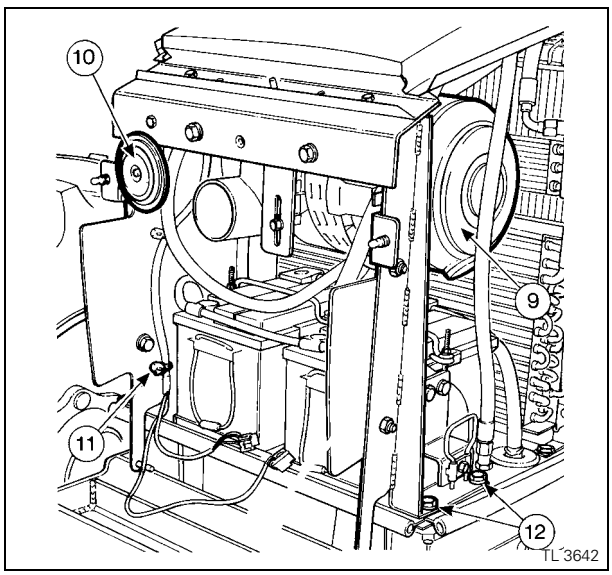


3. Remove the front grille, insert fingers in the gap at the top and pull sharply off the spring loaded catches. The grille will pivot on the lower catches and be restrained by the tie.
4. Remove the bolt and release the tie and remove the grille from the tractor. Place safely to one side.
5. Remove the exhaust pipe.
6. Remove the two front bolts on the centre section.
7. Remove the two rear bolts.
8. Remove the centre section panel.



Front Support

9. Remove the air cleaner, *(see operation 3-3C)*.
10. Remove the horn.
11. Remove the electric cables from the clips.
12. Remove the four bolts, two each side, and lift the front support off the tractor.

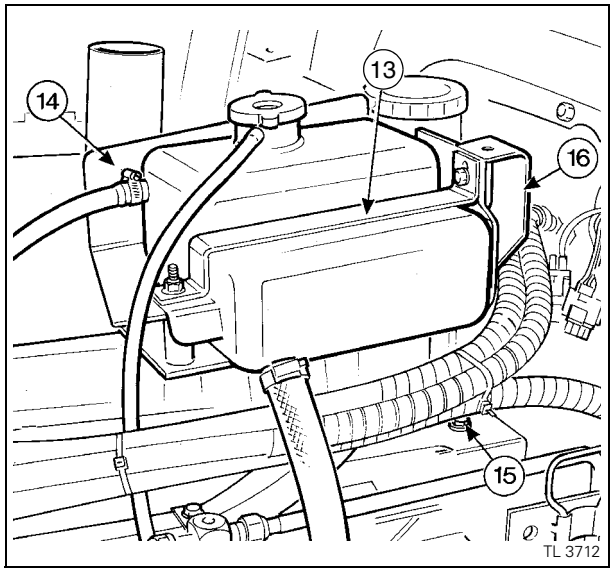


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Rear Support

13. Unbolt the header tank and put to one side.
14. Remove the header tank exhaust shield.
15. Remove the two bolts.
16. Lift the rear support clear of the tractor.



Refitment

17. Reverse procedures 1 to 16 except:
    a. Ensure that all the sealing rubbers around the access panels are in good condition and fitted correctly.
    b. Ensure that the catches are correctly adjusted to hold the panels in position.

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Air Conditioning

Section 12 - Part C

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Air Conditioning

SPECIFICATION

Air Conditioning System

Refrigerant type	R-134a.
Capacity:	
Tractors with four cylinder engines	1400 g (3.1 lb)(49.4 oz).
Tractors with six cylinder engines	1450 g (3.2 lb)(51.2 oz).
Number of R-134a 340 g (12 oz) cans	4-1/4 x 340 g cans = 1445 g (54 oz).
Operating pressures and temperatures:	
Ambient temperatures at 30-40°C (86-104°F) at sea level	
Low side pressure	0.8-1.5 bar (12-22 lbf/in²).
High side pressure	13.8-19.3 bar (200-280 lbf/in²).
Blower motor fuse	30 amp (green).
Location	Adjacent to air conditioner in roof.

Compressor

Make	Sanden.
Type	SD-7H15.
Number of cylinders	7.
Bore	29,3 mm (1.15 in).
Stroke	32,8 mm (1.29 in).
Displacement per revolution	155 cu cm (9.5 cu in).
Refrigerant oil type	PAG - Sanden SP-20.
Capacity	190 cc (6.43 fl oz).
Weight	6.9 kg (15.2 lb).
Drive belt - Tension	108-122 Nm (80-90 ft lb).
Deflection	12-15 mm (1/2-5/8 in).

Electro-Magnetic Clutch

Size	105 mm (4.3 in).
Voltage	12 volt.
Current range	3.6-4.2 Amp.
Air gap	0,4-0,8 mm (0.016-0.031 in).
Coil resistance	2.9-3.1 ohms.
Compressor clutch fuse	10 Amp (red).
Location	Fuse A7 in right-hand door pillar.

Pressure Switch

Combined pressure switch:	
Descending (low) cut-out pressure	2-1 bar (30-15 lbf/in²).
Ascending (high) cut-out pressure	21-24 bar (300-350 lbf/in²).

Temperature Control

Type	Thermo-static, set by driver, controlling the compressor clutch.
Range	1-20°C (34-68°F).
Differential	4°C (7°F).

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Special Tools

Compressor service tools (Robinair part numbers):		AGCO Nos.
10204	Clutch holder	ATP4009-8
10507	Seal seat remover/replacer	ATP4009-3
10508	'O' ring remover/replacer	ATP4009-2
10785	Seal remover/replacer	ATP4009-12
10786	Seal protector	ATP4009-13
10787	Clutch plate installer	ATP4009-14
10916	Oil dip stick	ATP4009-19
14163	External circlip pliers	ATP4009-10
14164	Internal circlip pliers	ATP4009-22
40682	Handle	ATP4009-4
40735	Puller sleeve	ATP4009-6
40737	Puller pilot	ATP4009-7
40749	Clutch plate puller	ATP4009-9
40750	Bearing remover/replacer	ATP4009-5
	Pulley and clutch removal jaws and thumb screws, use with ATP4009-5	ATP4009-25
Special equipment, dependant on the methods used to service the air conditioning system:		
41640/134a	Manifold gauge set with hoses	ATP4000A-1
15401	Rotary vane vacuum pump	ATP4001
13203	Vacuum pump oil - 1 US quart	
16500	Electronic leak detector for R134a	ATP4002
10945	Pocket thermometer	ATP4000A-5
20349B/134a	Dial-a-charge charging cylinder 134a	
25151 (Auto)	Refrigerant recovery station.	
34985	Battery powered refrigerant scales.	
3376 935 M1 (AGCO part number)	Caps for self sealing couplings.	
	Goggles - standard and UV.	

Bolt torques

Clutch retaining nut, M8	18 Nm (13 lbf ft).
Cylinder head bolts, M8	34 Nm (25 lbf ft).
Oil filler plug	20 Nm (15 lbf ft).
Clutch dust cover capscrew, 1/4"-20	3.6 Nm (2.7 lbf ft).
Refrigerant pipe clamp, M8	34 Nm (25 lbf ft).
Hose and pipe connections to:	
Receiver-drier, condenser, expansion valve	34 Nm (25 lbf ft).
Large hose from expansion valve	42 Nm (30 lbf ft).
Small hose to expansion valve	17 Nm (12 lbf ft).
Large (Low Side) quick release coupling	80 Nm (60 lbf ft).
Small (High Side) quick release coupling	40 Nm (30 lbf ft).
Steel pipe to expansion valve - small	13 Nm (10 lbf ft).
Steel pipe from expansion valve - large	25 Nm (18 lbf ft)
Large pressure quick release coupling	60 Nm (44 lbf ft).
Small pressure quick release coupling	40 Nm (30 lbf ft).
Expansion valve to evaporator - small fitting	13 Nm (10 lbf ft).
Expansion valve to evaporator - large fitting	25 Nm (18 lbf ft).

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TEMPERATURE CONVERSION CHART

°C	Temperature	°F
-28.9	-20	-4
-28.3	-19	-2
-27.8	-18	0
-27.2	-17	1.5
-26.7	-16	3
-26.1	-15	5
-25.6	-14	7
-25.0	-13	8.5
-24.4	-12	10
-23.9	-11	12
-23.3	-10	14
-22.8	-9	16
-22.2	-8	17.5
-21.6	-7	19
-21.1	-6	21
-20.5	-5	23
-20.0	-4	25
-19.4	-3	26.5
-18.9	-2	28
-18.3	-1	30
-17.8	0	32
-17.2	1	34
-16.7	2	35.5
-16.1	3	37
-15.6	4	39
-15.0	5	41
-14.5	6	43
-13.9	7	44.5
-13.3	8	46
-12.8	9	48
-12.2	10	50
-11.7	11	52
-11.1	12	53.5
-10.6	13	55
-10.0	14	57
-9.5	15	59
-8.9	16	61

°C	Temperature	°F
-8.3	17	62.5
-7.8	18	64
-7.2	19	66
-6.7	20	68
-6.1	21	70
-5.6	22	71.5
-5.0	23	73
-4.5	24	75
-3.9	25	77
-3.3	26	79
-2.8	27	80.5
-2.2	28	82
-1.6	29	84
-1.1	30	86
-0.5	31	88
0	32	89.5
0.5	33	91
1	34	93
1.5	35	95
2	36	97
2.5	37	98.5
3	38	100
4	39	102
4.5	40	104
7	45	113
10	50	122
12.5	55	131
15.5	60	140
18	65	149
21	70	158
24	75	167
26.5	80	176
29	85	185
32	90	194
35	95	203
37.5	100	212

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PRINCIPLES OF REFRIGERATION

The air conditioning is used to dehumidify and cool hot air as it is brought into or recirculated throughout the tractor cab. This is accomplished by circulating a refrigerant through the system to absorb the heat from the air being brought into the cab and carry that heat out of the cab and dispose of it. This flow of cool filtered air is under full control of the driver. Furthermore, this air flow results in a degree of cab pressurisation which prevents the entry of dust.

Refrigeration systems or air conditioning systems as they will be referred to in this manual, depend upon a number of basic pri5nciples to allow them to remove heat from the tractor cab as follows:

Heat

Cold which is normally thought of as the objective of air conditioning is better defined as an absence of heat. Heat is always present and only the removal of heat can produce cold.

Heat will always flow from the hotter substance to a substance with less heat (Fig.1). The heat will flow to the colder substance until both substances have equal heat values.

Change Of State

Change of state (Fig.2), this term is very important to air conditioning because changes of state of the refrigerant within the air conditioning system are happening all the time.

There are three processes which describe a change of state: Evaporation, Condensation and Freezing.

Evaporation is the term used when enough heat is added to change a liquid substance to a vapour (gas) e.g., boiling water and the vapour (steam) that is given off. At the boiling point of water 100°C (212°F), enough heat is absorbed by the water to change its state. The liquid becomes a vapour. This is called evaporation.

Condensation is the term used to describe the reverse of the evaporation process. If you take a vapour and remove enough heat from it, a change of state will occur which causes the vapour to become liquid. The change of vapour to a liquid is called condensation.

Freezing is another change of state. Freezing results when heat is removed from a liquid substance until it becomes a solid. Remember that everything above -273°C (-459°F) contains some amount of heat. In an air conditioner, freezing is a hazard to be avoided.

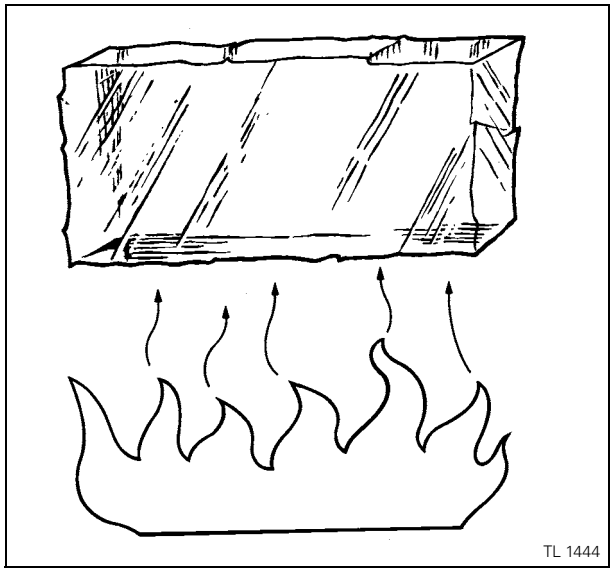


Fig.1 Heat transfer

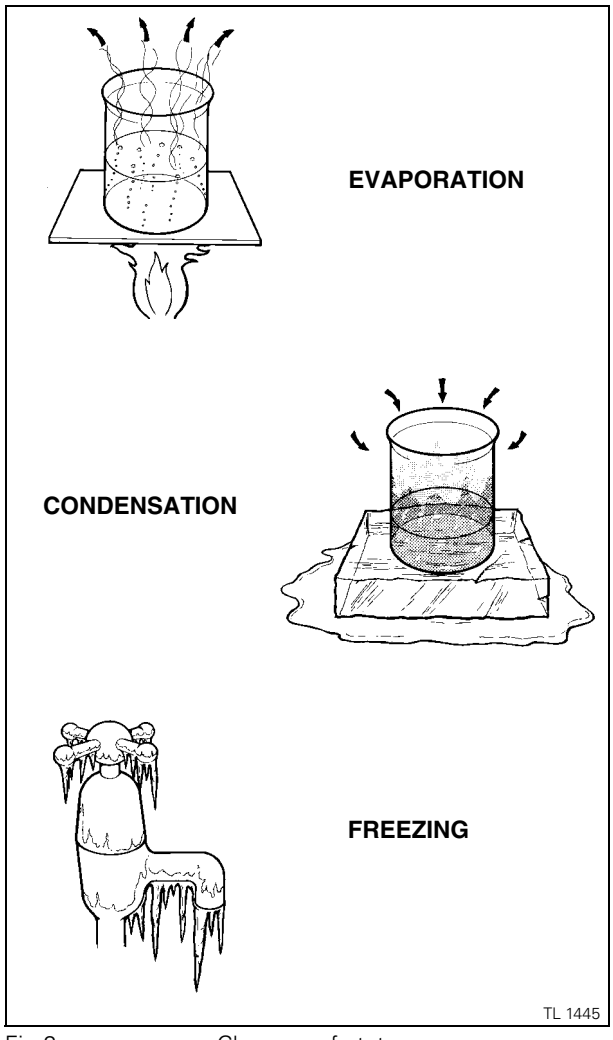


Fig.2 Changes of state

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Air Conditioning

Refrigerant

The refrigerant is obtained for service purposes in cylinders (Fig.3), in some countries it can also be obtained in 340 g (12 oz) cans. It is recommended that it is purchased in cylinders, it can be removed from the cylinder in either gas or liquid form (Fig.4):

Upright for gas.

Inverted for liquid.

A refrigerant must absorb and dissipate heat readily and must be chemically compatible with the components it passes through. The refrigerant used in automotive and farm equipment air conditioning systems is now R-134a, this is the term we will be using. This is a chemical substance (CF_3CH_2F) - (tetrafluoroethane). R-134a is a HFC (hydrofluorocarbon) based refrigerant which has no damaging effect on the ozone layer. Even though R-134a has no damaging effect on the ozone layer, it does contribute to global warming. R-134a falls under the same regulations that effect R-12 handling and re-cycling.

The R-134a refrigerant changes its state readily and thereby absorbs great quantities of heat from inside the tractor cab, it has a low boiling point -26.2°C (-15.1°F) the point at which evaporation occurs (cooling), it carries heat as required by the air conditioning system. When in its liquid state, it is cold enough to absorb heat. In its gaseous state, it is easily compressible, as are all gases. As the pressure is increased, so is temperature, and it changes to a liquid giving up its heat to the ambient temperature.

It is important to know the pressure-temperature relationship of R-134a. If the pressure of R-134a is low, the temperature will also be low. If the pressure of R-134a is high, the temperature will also be high. Remembering this is important, because pressure is very important in the function of the air conditioning system.

For every temperature, there will be a corresponding pressure and this is shown in the table of temperature-pressure relationship of R-134a, which is used in automotive and agricultural systems, is presented in Table 1.

Thus if a gauge is attached to a container of R-134a and the room temperature is 20°C (68°F), the gauge will register 5.6 bar (81 lbf/in²) pressure; in a 30°C (86°F) room, the pressure will be 7.7 bar (112 lbf/in²).

To operate at peak efficiency, the R-134a must be at its coldest state without icing (lowest pressure) in the evaporator and at its warmest (highest pressure) in the condenser.

We mentioned that R-134a vaporises at a low temperature and absorbs great quantities of heat. In the evaporator, the R-134a is under very low pressure. Thus a low temperature is also obtained. This temperature is much lower than the temperature of the air inside the tractor. For this reason, the tractor`s heat will travel to the colder R-134a. As the heat is absorbed, the R-134a vaporises and carries the heat through the compressor to the condenser.

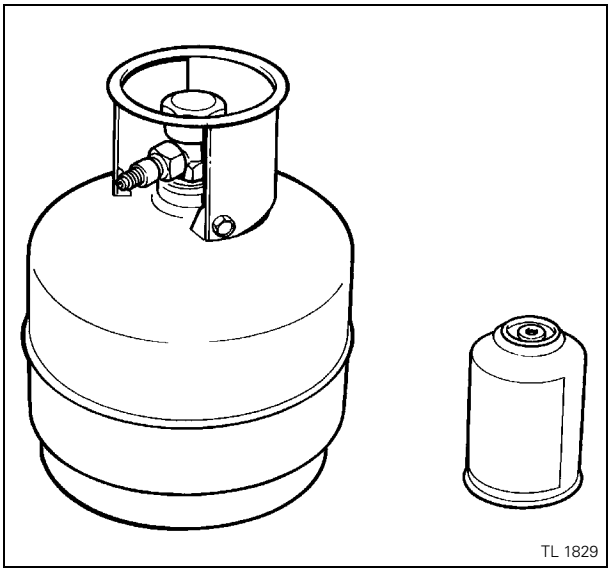


Fig.3 Refrigerant R-134a

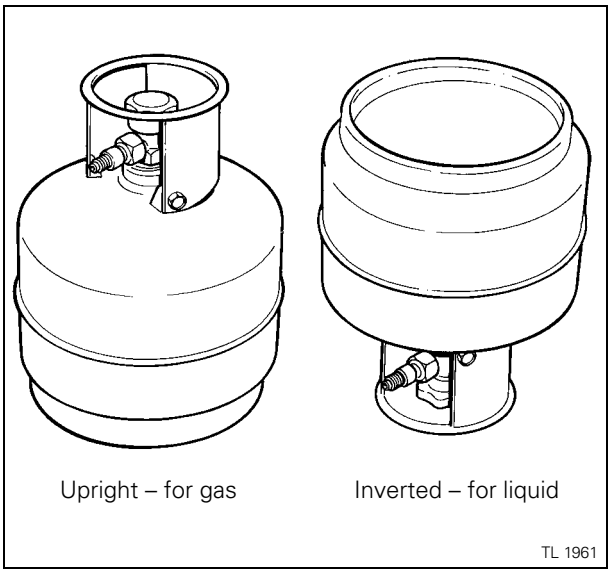


Fig.4

Temperature-pressure relationship of R-134a			
Ambient air temperature		R-134a pressure	
°C	°F	bar	lbf/in²
0	32	2.9	42
5	41	3.5	51
10	50	4.1	59
15	59	4.9	71
20	68	5.6	81
25	77	6.7	97
30	86	7.7	112
35	95	8.9	129
40	104	10.2	147
45	113	11.6	168
50	122	13.2	191
55	131	14.9	216

Table 1

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At the condenser, the R-134a is at a high temperature and high pressure. The temperature of the R-134a is higher than the outside air at the condenser. The heat again flows from the warmer to the colder object, and thus the heat is released outside the tractor. By giving off heat, the R-134a condenses back to a liquid and the cycle starts over again.

How Does an Air Conditioner Cool?

The simple fact is that an air conditioning system is a combination of various mechanical components utilising a chemical medium, refrigerant, to absorb heat from inside the tractor and remove it to the outside air. The remaining cooler air contains less moisture, adding to the cooling sensation. In effect, one might say that an air conditioning system does not really cool the tractor, but it actually 'un-heats' it. Further details, *(see page 12C-13).*

Lubrication

Automotive air conditioning systems carry a charge of special refrigerant oil. R-134a systems require a special oil, in this case a Polyalkylene Glycol (PAG) oil. PAG oils are extremely hydroscopic (moisture absorbing). DO NOT mix this oil with any other type. The refrigerant and oil mix completely, even the refrigerant vapour in the system will carry globules of oil. As liquid or vapour is carried throughout the system it carries enough oil to keep the moving parts of the system lubricated. The compressor is lubricated by its own source as well as by the saturated vapour.

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BASIC COMPONENTS

The air conditioning system used on agricultural tractors contains the following seven basic components:

- Compressor.
- Condenser.
- Receiver-drier.
- Expansion valve.
- Evaporator.
- Temperature control system.
- System protection device.

Each of these components is necessary for system operation, and all are dependent upon the function of one another, each of the basic components listed will be described separately.

Compressor

The tractor is fitted with a 'Sanden' SD-7H15 axial piston compressor (Fig.5) which acts as a pump, moving the refrigerant through the system under pressure.

It is an axial 7-cylinder compressor of the reciprocating piston type. The pistons are operated by a swashplate so that the pistons move back and forth in the cylinders as the shaft is rotated. There are seven separate cylinders at the rear of the compressor, and reed inlet and outlet valves are provided for each cylinder.

High and low side service valve fittings are located on the pipe fittings adjacent to the cylinder head.

Compressor lubrication is by a centrifugal force system, incorporating an oil deflector, and the positive pressure differential lubrication provides an oil film to the cylinder walls, piston rod assemblies, main bearing and shaft seal.

The compressor has a intake stroke and a compression stroke for each cylinder. On the intake stroke, R-134a from the low side of the system (evaporator) is drawn into the compressor through the reed valves. During compression stroke, the vaporous R-134a is compressed. This increase both pressure and temperature of the heat-carrying refrigerant.

The outlet side (discharge) reed valve then open to allow the refrigerant to move to the condenser. The outlet reed valves are the beginning of the high side of the system.

The compressor as previously mentioned, is not intended to be a pump just for circulating the refrigerant. Rather, its job is to exert pressure for two reasons. Pressure makes the vapour hot enough to cool off in the warm air passing through the condenser. At the same time, the compressor raises the refrigerant pressure above the condensing point at the temperature of the surrounding air so it will condense.

The compressor is belt driven from the engine and has an electro-magnetic clutch (Fig.6) which enables the compressor to 'stop' when compressor operation is not required.

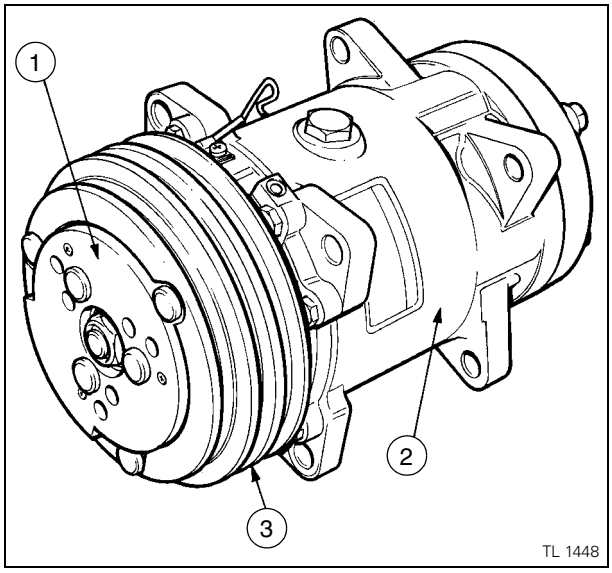


Fig.5 Compressor

1. Electro-magnetic clutch.
2. Compressor.
3. Drive pulley.

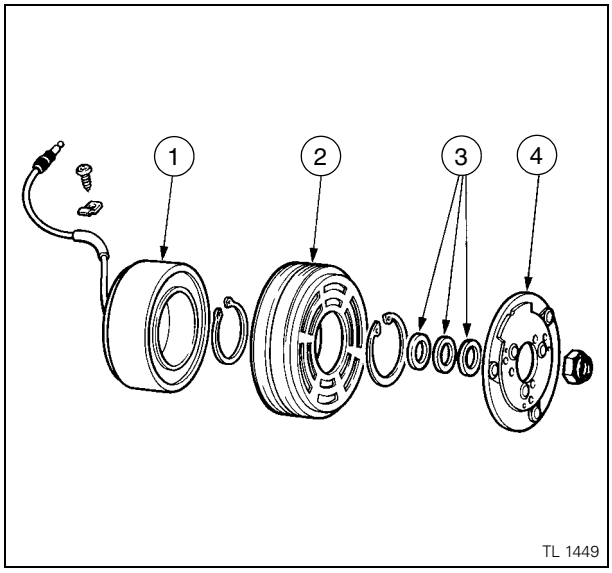


Fig.6 Electro-magnetic clutch

1. Field coil.
2. Rotor pulley and bearing.
3. Clutch adjusting shims
4. Front plate.

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The clutch is a stationary coil type, the magnetic field coil is mounted on the end of the compressor housing behind the driven rotor pulley and engaged by an electrical signal from the temperature control switch. The magnetic clutch engages a steel clutch front plate that is keyed to the compressor drive shaft with the free rotating pulley, causing the compressor to pump. It disengages through spring pressure when the electrical circuit is broken. The clutch is serviceable separate of the compressor.

Condenser

The condenser (Fig.7) is a tube and fin arrangement used to radiate heat very much like a radiator. The condenser is placed in front of the engine radiator and uses the radiator cooling fan to pull air through it.

The condenser receives the heat-laden, high pressure refrigerant vapour from the compressor's discharge hose. This vaporous R-134a enters at the top of the condenser and flows through its coils. Heat follows its natural tendency, flowing from hot R-134a vapours to the 'cooler' ambient air passing through the coils.

As the R-134a vapours are cooled and flow down through the condenser, a point is reached where condensation occurs. The vaporous R-134a becomes liquid R-134a. At this point of condensation, the largest amount of heat is given off by the R-134a. The refrigerant in the lower portion of the condenser is warm, high-pressure liquid.

Under normal operating conditions the condenser will have a combination of hot refrigerant vapour in the upper two-thirds of its coils, with the lower third of the coils containing the warm liquid refrigerant which has condensed. This high pressure, liquid refrigerant flows from the condenser and on to the receiver-drier.

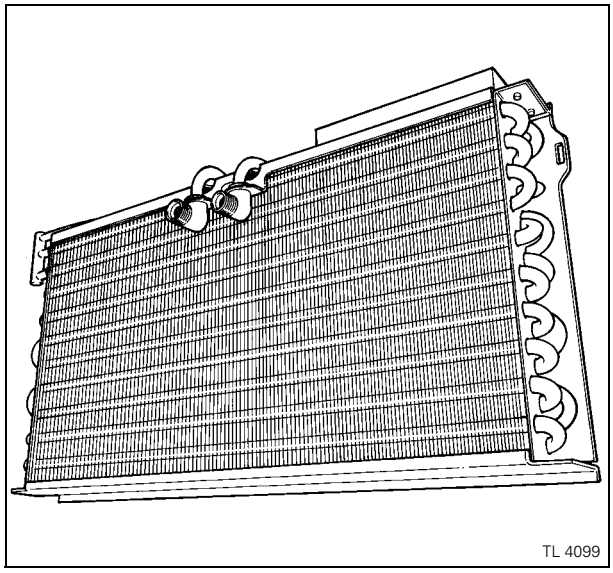


Fig.7 Condenser

Receiver-drier

The receiver-drier (Fig.8) receives R-134a flow from the condenser, it consists of a tank, a filter, a drying agent (dessicant), and a pick-up tube. It has several functions.

First, the receiver-drier acts as a storage tank, holding the liquid R-134a from the condenser until it is required by the evaporator, requirements vary according to operation.

Second, it also acts as a protection agent for the system. The portion of the receiver-drier which contains the drying agent separates any moisture from the R-134a. The drying agent (also called dessicant) is in the form of Silica Gel. It is important that moisture be removed from the system, as it can be extremely harmful to the air conditioning system components and to the system operation.

IMPORTANT: *The drying agent is strictly a back-up means of absorbing trace amounts of water vapour remaining after the system has been thoroughly evacuated. Under no circumstances can drying of the system be dependent upon the drying agent in this receiver.*

R-134a refrigerant require a different dessicant to that used with R-12. DO NOT use an R-12 receiver-drier on a R-134a system, the dessicant can break down and block the system.

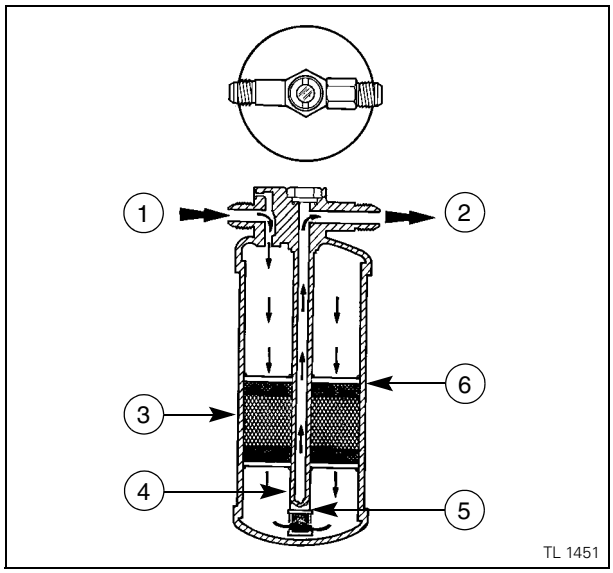


Fig.8 Receiver-drier

Key to Fig.8.

1. Inlet.
2. Outlet.
3. Dessicant drying agent.
4. Pick-up tube.
5. Filter screen.
6. Filter pads.

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Expansion Valve

The expansion 'H' valve (Fig.9) is located at the inlet and outlet ports of the evaporator, this valve gets its name from its 'H' design. The valve is between the High and Low Side of the system. The refrigerant flow to the evaporator must be controlled to obtain maximum cooling, while assuring complete evaporation of the liquid refrigerant within the evaporator. This is accomplished by the thermostatic expansion valve. It performs the following three functions:

Metering Action - A metered orifice within the valve changes the pressure of the incoming liquid refrigerant from high pressure to low pressure.

Modulating Action - A Thermostatically controlled valve, located within the expansion valve body, fluctuates towards the open or closed position as required to control the liquid refrigerant passing through the orifice at the ball valve. This supplies the correct amount of refrigerant to the entire evaporator, while assuring that all of the incoming refrigerant is vaporised.

The low pressure created at the expansion valve makes it possible for the liquid refrigerant to vaporise as it passes through the evaporator coils, absorbing heat from the incoming air to the tractor cab.

Controlling Action - The valve must quickly respond to changes in heat load conditions. As increased heat is sensed, the valve will move toward an open position to increase refrigerant flow. Decreased heat load or increased compressor output volume due to increased engine speed will cause the valve to move toward a closed position, restricting the amount of R-134a entering the evaporator.

The expansion valve is a combined unit with the inlet through one port (lower) and the outlet through the other (upper). A sensor and diaphragm chamber filled with a small amount of refrigerant gas is mounted in the outlet port and monitors the temperature of the R-134a as it leaves the evaporator. It controls the operation of the ball valve and spring in the inlet port and the flow of refrigerant.

When the expansion valve is functioning properly, the evaporator core will be lightly frosted at the entrance, over all of the end coils and outlet pipe.

The expansion valve is non-adjustable and must be replaced as a complete assembly if it is not operating properly.

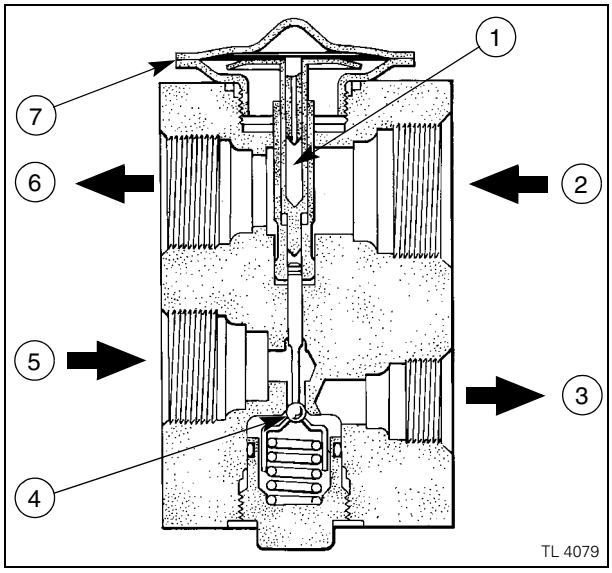


Fig.9 Expansion valve

Key to Fig.9.

1. Temperature sensor.
2. From Evaporator.
3. To evaporator.
4. Ball valve and spring.
5. From receiver-drier.
6. To compressor.
7. Diaphragm chamber.

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Evaporator

The evaporator (Fig.10), like the condenser, consists of a refrigerant coil mounted in a series of thin cooling fins. It provides a maximum amount of heat transfer in a minimum amount of space. The evaporator is mounted in the cab roof in a housing in a position so that warm air from the cab or outside can be blown across the coils and fins. It is a combined unit containing evaporator and heater matrix as one assembly.

The evaporator receives refrigerant from the thermostatic expansion valve as a low pressure, cold atomised liquid. As this cold refrigerant passes through the evaporator, heat moves from the warm air into the cooler refrigerant.

When the liquid refrigerant receives enough heat to induce a change of state, a large quantity of heat moves from the air to the refrigerant. This causes the refrigerant to change from a low pressure, cold, atomised liquid, into a low pressure, cold vapour. The vaporous R-134a then continues on to the inlet (suction) side of the compressor.

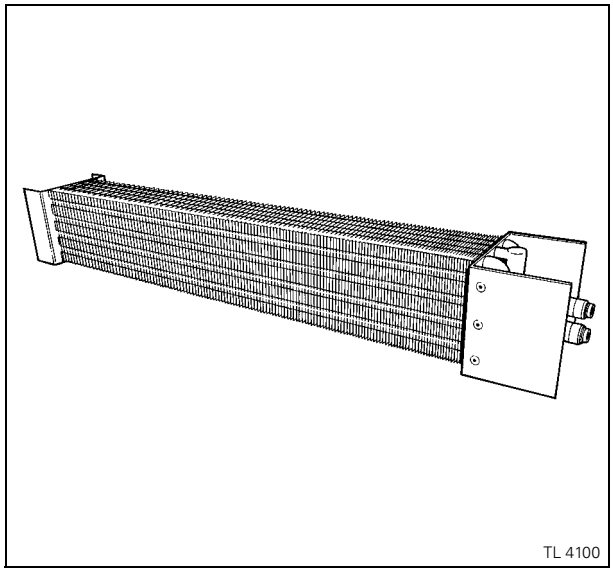


Fig.10 Evaporator

Blower Fan and Motor

An important component in the cooling action of the evaporator is the blower motor/fan (Fig.11), also located in the evaporator housing. The blower draws warm air from the inside of the cab or from the outside through a filter and evaporator. It then blows it through louvres, so that the 'cooled' air enters the cab. The blower motor is controlled by a fan switch with three settings from Low to High.

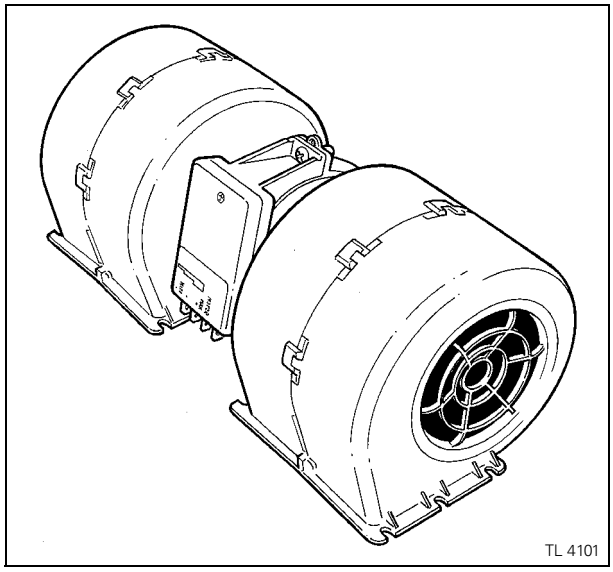


Fig.11 Blower Fan and Motor

System Protection Device (High/Low Pressure Switch)

The system uses a combined high/low pressure switch (Fig.12) located in the compressor discharge port between the compressor and the condenser to provide compressor protection. This switch is referred to as a discharge pressure switch. It is installed on the high pressure side of the compressor and is wired in series with the compressor clutch circuit to protect the system against excessive high, this is normally caused by a blocked condenser; or low pressure due to the loss of refrigerant.

Low pressure protection, the circuit closes on rising pressure at 2,8 bar (40 lbf/in²) maximum, and opens on descending pressure between 2,1 - 1 bar (30 - 15 lbf/in²).

High pressure protection, the circuit opens on rising pressure between 20,7 - 24,2 bar (300 - 350 lbf/in²) and closes at 5,5 - 8,3 bar (80 - 120 lbf/in²) below opening pressure.

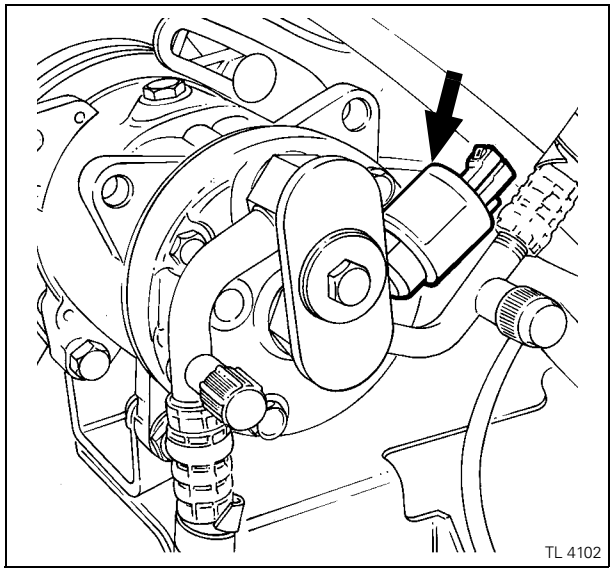


Fig.12 High/Low Pressure Switch

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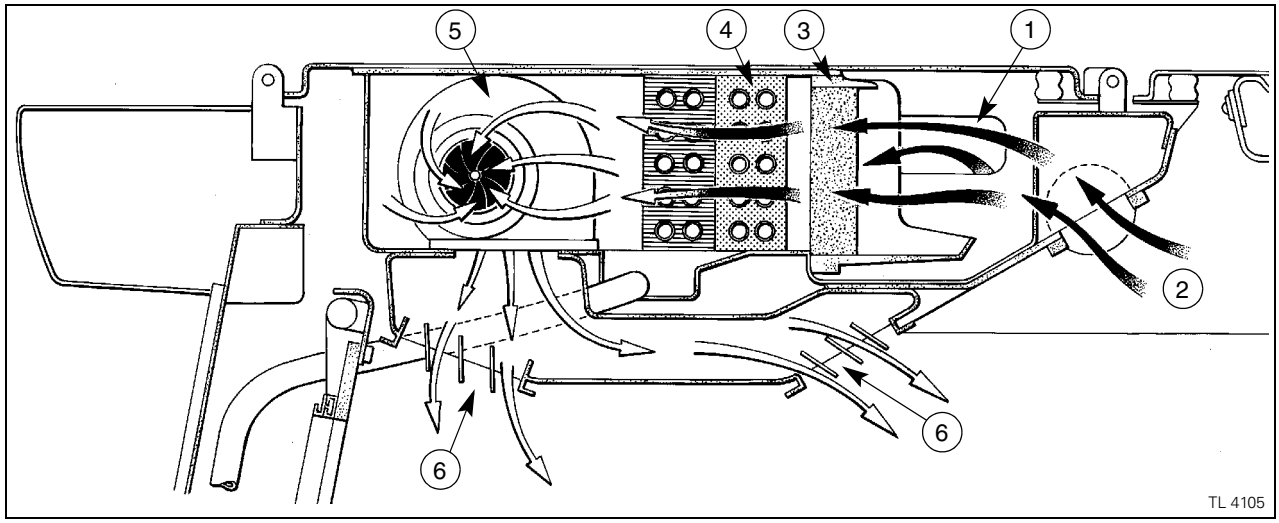


Fig.13 Cab Air Flow

Cab Air Filter and Air Flow

Air from outside (1, Fig.13) or recirculated air (2) is drawn through a filter (3) and evaporator (4) located in the cab roof by a blower motor (5). The cool air is then blown through ducts and adjustable louvres (6) into the operator area.

Air can be recirculated by opening the louvres in the cab headlining which reduces the amount of outside air flow and mixes that flow with air drawn from the cab.

The cab air filter is a replaceable paper type, similar to an engine air cleaner. It can be cleaned by using a jet of compressed air.

Temperature Control System

The temperature control is maintained by the cycling clutch system, the compressor is run intermittently by controlling the application and release of its clutch by the temperature control system in the cab.

The temperature control switch (Fig.14) includes a temperature sensing probe, end of which sits between the fins of the evaporator. If cooling at the evaporator does not match the control switch setting, the switch turns ON the compressor clutch to increase flow of refrigerant through the system. When the system reaches its required temperature the compressor is turned OFF.

Self-Sealing Couplings

Self-sealing couplings (Fig.15) are installed in the air conditioning lines to enable the tractor to be split without having to discharge the system. These self-sealing couplings facilitate separation of the tractor between the engine and transmission and cab removal and replacement.

These couplings are situated on the left-hand side of the tractor in front of the cab: one is installed in the high pressure liquid line after the receiver-drier, the other in the evaporator to compressor line. A pair of caps are available to seal-off the couplings to prevent loss of refrigerant or the ingress of moisture. Part number 3376 935 M1.

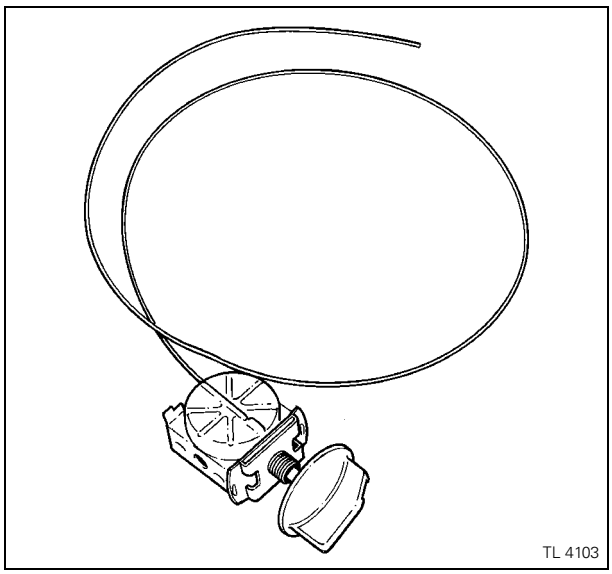


Fig.14 Temperature Control Switch

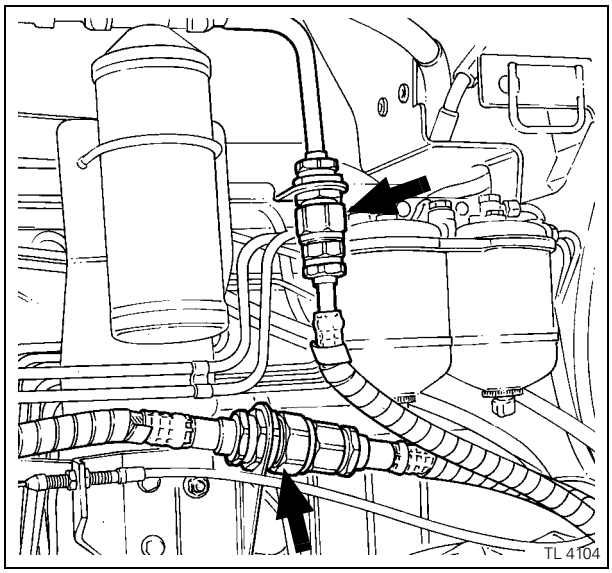


Fig.15 Self-sealing Couplings

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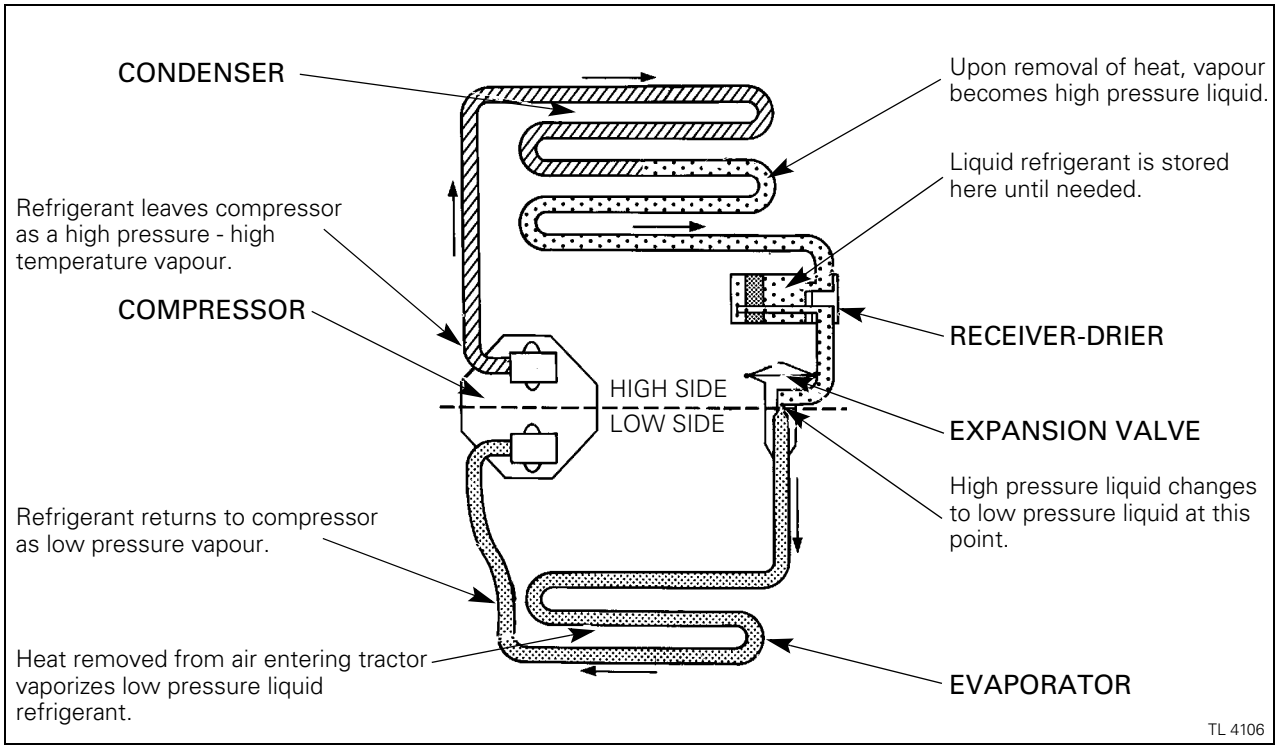


Fig.16 Basic refrigeration cycle

SYSTEM OPERATION

System Description

Any refrigeration system takes advantage of the principles described on *page 12C-5*. The schematic air conditioning circuit illustrated in Fig.16 contains five of the basic parts: a compressor, a condenser, a receiver-drier, an expansion valve and an evaporator.

The air conditioning cycle is divided into two pressure systems called the **High Side** and the **Low Side**, (see Fig.16 and Fig.18).

High Side simply refers to the side of the system in which high pressure exists. As shown in the illustration, the High Side is (following the flow arrows) from the outlet side of the compressor, through the condenser, through the receiver-drier and to the expansion valve.

It is the compressor's job to create higher pressure (and temperature) so the R-134a will be able to condense and release heat to the condenser and the air flowing through it. A pressure differential is created at the expansion valve - the dividing point on the High side of the system. The expansion valve has been described on *page 12C-10*.

Low Side is the term used for the portion of the air conditioning system in which low pressure and temperature exist. From the expansion valve, through the evaporator to the inlet side of the compressor, the R-134a is in a low-pressure state. This allows heat to be transferred from the inside of the tractor cab to the 'colder' R-134a, which then carries it away.

Basic Refrigeration Cycle

Refrigerant gas under low pressure is drawn into the compressor where it is compressed to a high pressure. During compression, the refrigerant gas is heated. When sufficient pressure is built up, the hot gas, hotter than the ambient air temperature, passes into the condenser where it cools by giving off heat to the air passing over the condenser surfaces.

As the refrigerant gas cools, it condenses into a liquid at high pressure and accumulates in the receiver-drier. The high pressure liquid refrigerant passes to the expansion valve at the entrance to the evaporator. At the valve orifice the pressure is lowered and the refrigerant enters the evaporator core as a low pressure liquid. When the refrigerant is exposed to the lower evaporator pressure, it begins to boil and change to a vapour state. As the refrigerant passes through the evaporator, it continues to boil absorbing heat from air passing over the evaporator surfaces until it is completely vaporised. From the evaporator the cool low pressure refrigerant gas is drawn back to the compressor and the cycle repeated.

Thus the air passing over the evaporator surfaces is cooled simply by giving up heat to the colder refrigerant during the boiling process. Each time the cab air is circulated across the evaporator fins, it gets cooler and cooler. When the temperature sensing probe, placed between the fins, senses that the air has cooled to the temperature selected by the operator, it signals the thermostat switch to disengage the compressor clutch. The R-134a stops circulating through the system. When the temperature rises, the switch activates the clutch and the cycle begins again.

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Air Conditioning

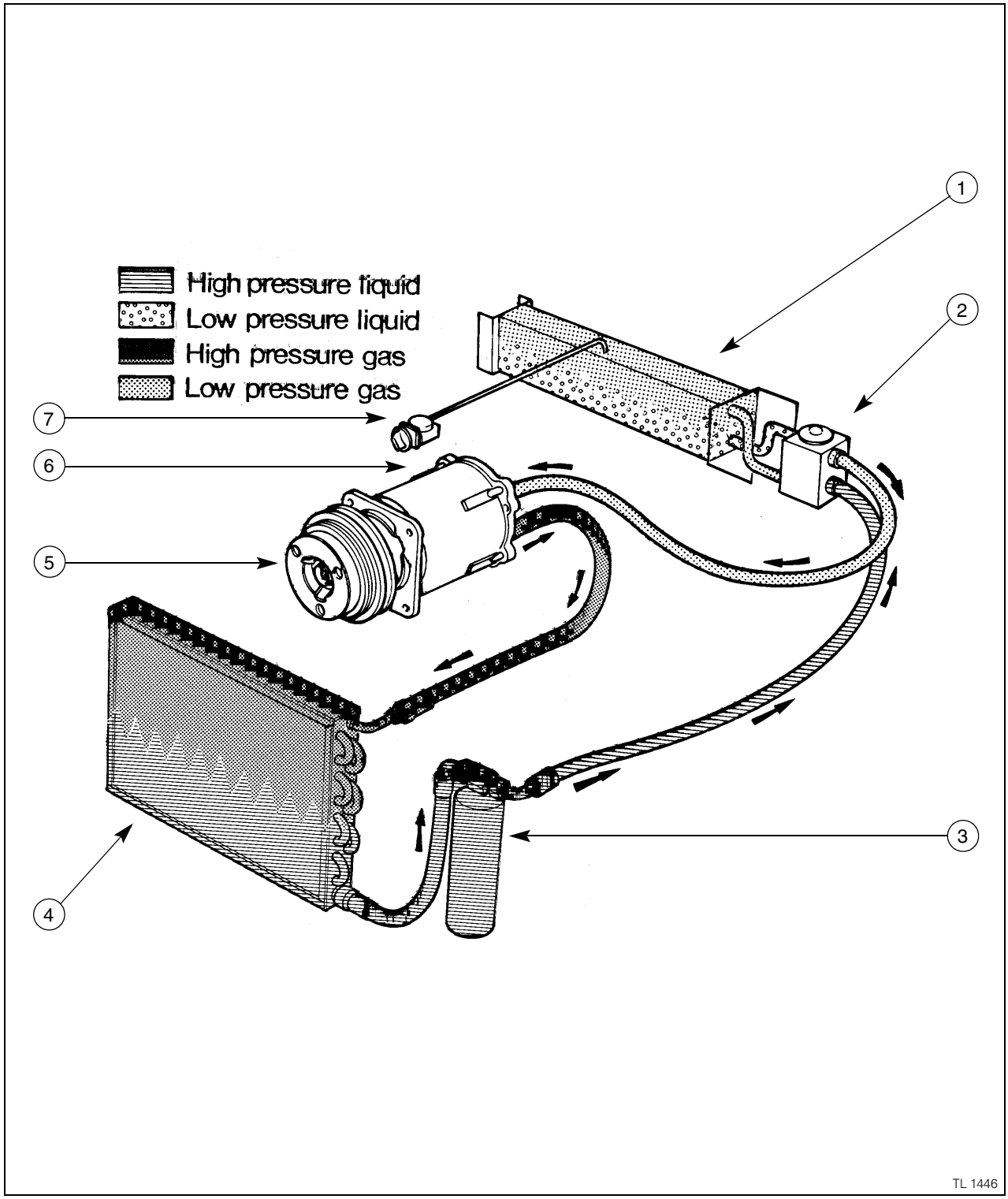


Fig.17 Air Conditioning System

1. Evaporator.
2. Expansion valve.
3. Receiver-drier.
4. Condenser.
5. Electromagnetic clutch.
6. Compressor.
7. Thermostatic switch.

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SAFETY PRECAUTIONS

Working around an air conditioning system can be easy and safe, there are however a few safety precautions which must be observed in order to ensure your safety.

WARNING: Observe the following:

- ***A propane torch detector MUST NOT BE USED ON R-134a charged systems to locate leaks.***
- ***DO NOT fill the system with any other gas except R-134a. The use of butane gas can result in explosion and personnel injury.***
- ***Always practice safety by thinking before acting.***
- ***KEEP CONTAINERS OUT OF REACH OF CHILDREN.***
- ***Suitable eye protection must be worn when handling R-134a refrigerant. Escaping refrigerant can cause blindness or serious frost bite because of its low boiling point -26,2°C (-15.1°F) at atmospheric pressure. If liquid refrigerant should come in contact with the eyes they must be washed immediately with large quantities of cool water on the eye to thaw it, cover the eye with a sterile bandage to keep out the dirt and rush to seek professional help.***
- ***Wear gloves when handling refrigerant, if it should contact the skin, frostbite can occur and should be treated with water as with the eye and professional help sought.***
- ***Damp containers must not be handled with bare hands while charging system. Your hand could be frozen to the container. Wetting the container and your hand will separate them.***
- ***Refrigerant systems must always be worked on in a well ventilated area, vapours are heavier than air and can accumulate in low places. If it necessary to discharge the refrigerant this must be carried out using the appropriate recovery equipment. Do not inhale concentrated refrigerant vapour, or swallow liquid refrigerant, for any reason.***
- ***Persons overcome by refrigerant vapour should immediately go, or be moved, to fresh air. Lie down, do not take exercise. Use artificial respiration if person is unconscious. Call a doctor.***
- ***Keep away from flames and hot metal surfaces. Avoid welding or brazing when refrigerant vapours are present. Do not place gas or electric heaters in places where refrigerant vapours are expected. It is advisable not to smoke in the presence of refrigerant vapour.***
- ***Store containers of gas in a cool place.***
- ***Do not over-heat cylinders or tins of R-134a refrigerant above 50°C (122°F). Never use a bucket of warm water or a welding torch as overheating will lead to the rupture of the cylinder or tin.***
- ***Pressure from the high side of the air conditioning system must never be open to the refrigerant container since the pressure on the high side can run in excess of 21 bar (300 lbf/in²) which would burst some containers.***
- ***Only pure refrigerant and refrigerant oil must be added to the air conditioning system. Any other substance in the system can react chemically with the refrigerant or system components, causing problems.***
- ***Oil from a refrigeration system must be handled carefully. It may contain acids. Wear gloves, protective clothing and eye protection.***
- ***Keep hands clear of the engine fan and belts when on or near the compressor.***
- ***Be wary of sharp fins on the evaporator or condenser.***
- ***Fire or explosion hazard exists with R-134a under certain conditions. R-134a has been shown to be non-flammable at ambient temperature and atmospheric pressure. However, tests under controlled conditions have indicated that, at pressures above atmospheric and with air concentrations greater than 60% by volume, R-134a can form combustible mixtures. While it is recognized that an ignition source is also required for combustion to occur, the presence of combustible mixtures is a potentially dangerous situation and should be avoided.***
- ***Air conditioning systems using R-134a on automotive equipment, tractors and combines etc. should not be pressure tested or leak tested with compressed air. Some mixtures of air/R-134a have been shown to be combustible at elevated pressures. These mixtures are potentially dangerous and may result in fire or explosion causing injury or property damage. Additional health and safety information may be obtained from refrigerant and lubrication manufacturers.***

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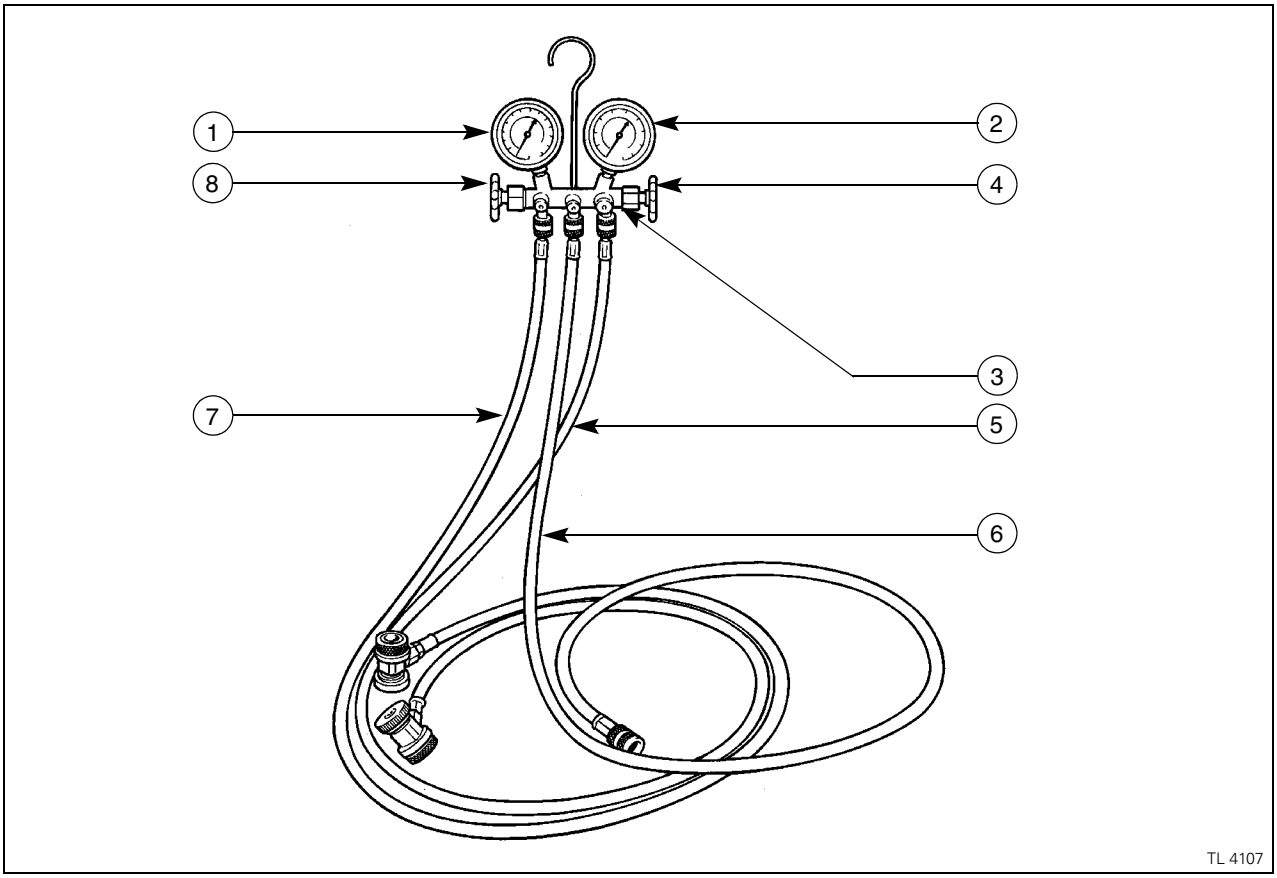


Fig.18 Manifold Gauge Set

SERVICE TOOLS

To service the air conditioning system you will require some basic diagnostic equipment. We recommend that you have the following items:

Manifold Gauge Set

The manifold gauge set (Fig.18) is the most important tool used to service air conditioning systems. The manifold set is used to determine the system's high and low side pressures the correct refrigerant charge system diagnosis and operating efficiency. It is designed to read both high and low sides at the same time, because pressures must be compared to determine system operation. These are available in metric or imperial calibration. It is also used to remove, evacuate and refill the system.

Low Side Gauge - This gauge (1) reads from 0 to 25 bar (0 to 350 lbf/in²) (pressure scale) in a clockwise direction, and 0 to-1 bar (0 to 30 in. Hg) of Mercury (vacuum scale) in a counter clockwise direction. This low side gauge is called a compound gauge and has a dual purpose - to register both **Pressure** and **Vacuum**. This gauge has a **Blue** colour identifying features and is used to measure low side pressure at the service valve on the compressor.

High Side Gauge - This gauge (2) reads from 0 to 50 bar (0 to 500 lbf/in²) in a clockwise direction, the high side gauge has a **Red** colour identifying features and is a **Pressure** gauge only. It measures the high side pressure at the service valve on the compressor.

The manifold (3) is designed to control refrigerant flow when it is connected into the system, pressure is registered on both gauges at all times. During all tests, both the low (8) and high (4) side hand valves are in the closed position (turned inward until the valve is seated).

Refrigerant will flow around the valve stem to the respective gauges and register the system high and low pressures. The hand valves isolate the low and high side from the central portion of the manifold.

A blue test hose (7) connected to the fitting directly under the low side gauge is used to connect the low side of the test manifold into the low side of the system. A similar red hose (5) connection is found on the high side.

The centre fitting on the manifold is used to connect a service hose (6) to remove, charge or evacuate the system. The service hose is **Yellow**.

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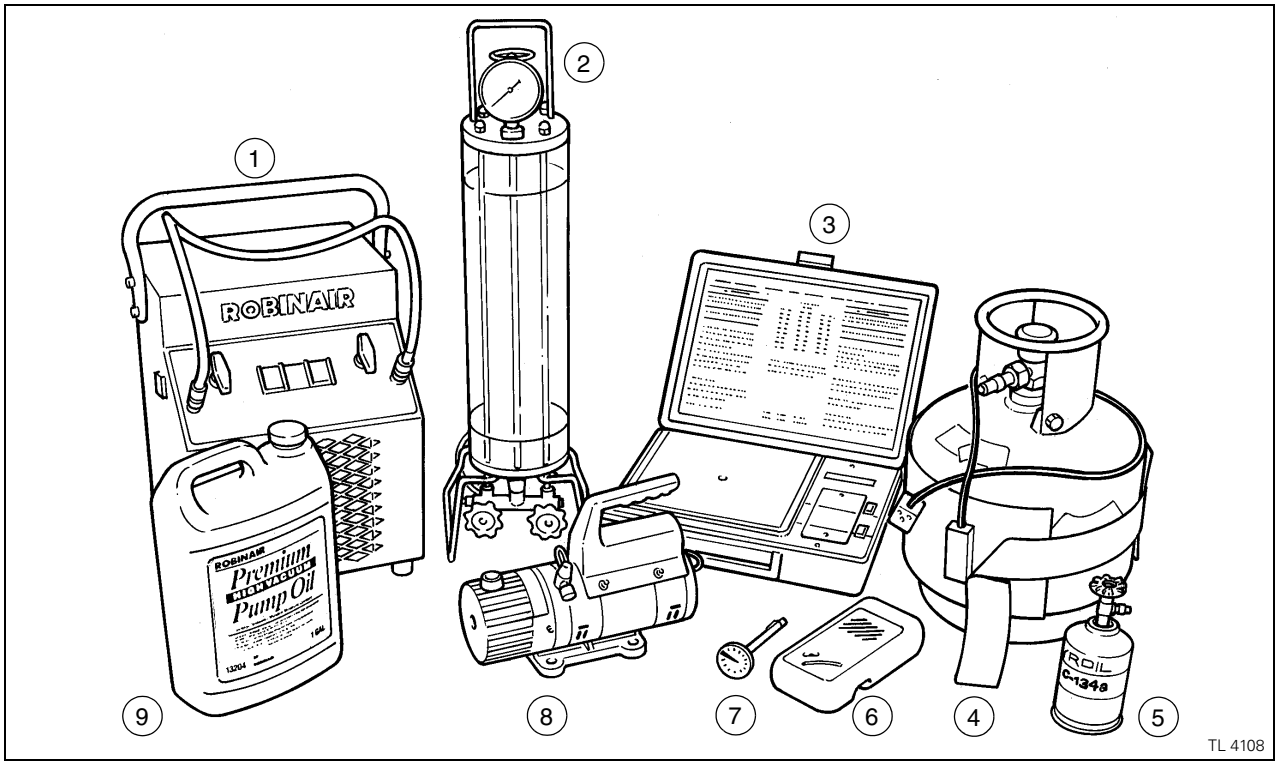


Fig.19 Service Tools and Equipment

Refer to Fig.19 for the following items;

1. Refrigerant Recovery Station

The illustration shows a typical refrigerant recovery station which is easy and light to handle. It is used in conjunction with a refrigerant tank (see 1, Fig.20). The recovery station is connected to the manifold gauge set and the tank. The tank is fitted with a float switch for over fill protection. The unit requires an electrical supply for the pump and fan.

2. Dial-a-Charge Charging Cylinder

The Dial-a-Charge is the easy simple way of accurately measuring R-134a refrigerant into the system. It eliminates under- and over-charging, use refrigerant from bulk cylinders. A heater enables fast charging by overcoming any pressure equalization between the cylinder and system.

Not designed for transporting refrigerant.

alternatively:

3. Charging Scales

The refrigerant can be accurately weighed into the system by placing the cylinder of gas on charging scales which can be programmed to control the weight of gas being loaded into the system.

4. Cylinder Heater Blanket

A heater blanket assures a complete transfer of refrigerant. It wraps around the cylinder, maintaining an even temperature for a constant positive pressure that speeds the transfer of refrigerant and assures a complete charge every time. It is fitted with a thermostat and protected with a thermal cut-off.

5. Can Dispensing Valve

In some countries the supply of R134a is made in 340 gm (12 oz) cans, this requires a can dispensing valve as illustrated fitted to a can of refrigerant.

Leak Detection

6. *Electronic Leak Detector*

Rugged, fully portable battery powered gas leak detector Detects refrigerant gases down to 3g (1/10 oz) per year with audible alert signal, a search probe is used to find the leaks.

alternatively:

Detection Dye

An ultraviolet fluorescent dye tracer can be added to the system during repair to check for leaks. The dye can also be installed with an injector on the Low Side once the system is charged, the dye attaches to the oil and not the refrigerant. This means if the refrigerant is removed and new refrigerant is installed, the dye is still in the system. An ultraviolet lamp is required to show up the leak.

CAUTION: *Always wear protective eye goggles that screen out excessive UV light that can damage your eyesight when using ultraviolet lamp.*

Continued:

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alternatively:

Bubble Type Leak Detector

A bottle of full strength liquid dish washing detergent, child's soap bubble solution, or commercial bubble type detector can be used by swabbing the connections to check for bubbles indicating leak.

7. Pocket Thermometer

A dependable pocket thermometer for simple temperature measurement, it comes with a pocket-clip carrying case for protection and easy access.

8. Vacuum Pump

The purpose of the vacuum pump is to remove air and moisture from the system by lowering the pressure and vaporizing it, then exhausting it along with the air.

Moisture in a refrigeration system, directly or indirectly is the cause of most problems and complaints. Moisture can freeze-up in the system, usually in the expansion valve, it can also cause corrosion of metals.

9. Vacuum Pump Oil

Special oil for use with the vacuum pump.

Refer to Fig.20.

1. Refrigerant Tank

A 30 lb refrigerant tank with float switch used with recovery unit for the storage of removed refrigerant.

2. Compressor Tools

A set of tools detailed in the front of this section for the replacement of the electro-magnetic clutch and the shaft seal.

3. Eye Protection Goggles

Quality goggles with specially designed breathing vents. Must be used when handling refrigerants.

UV goggles must be worn when using ultraviolet lamp for leak testing.

PRELIMINARY CHECKS

Check **1-12C**

Procedure

The most common complaint with air conditioning systems is that there is 'no cooling' or 'insufficient cooling'. It is imperative that the 'Preliminary Checks' detailed in below are carried out before any dismantling or testing of the system.

CHECK THE SIMPLE ITEMS FIRST

Trouble-shooting air conditioning systems must be done in a logical order starting with the simplest and most obvious possibilities. The following items must be checked before proceeding:

1. Check the tractor engine cooling system and ensure that there are no leaks and that the coolant level is correct.

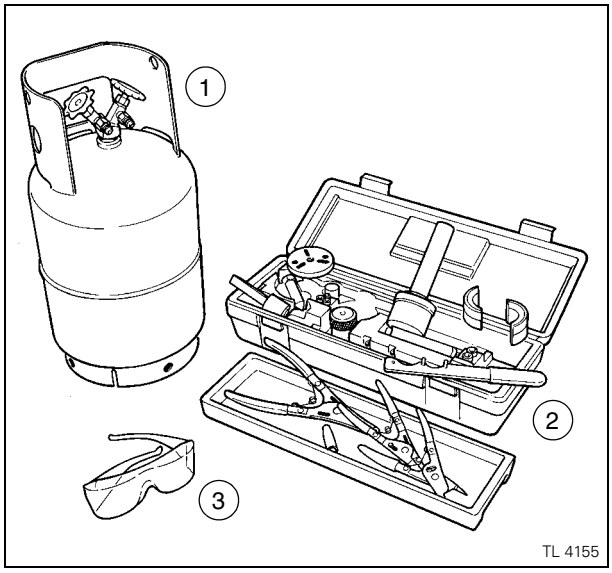


Fig.20

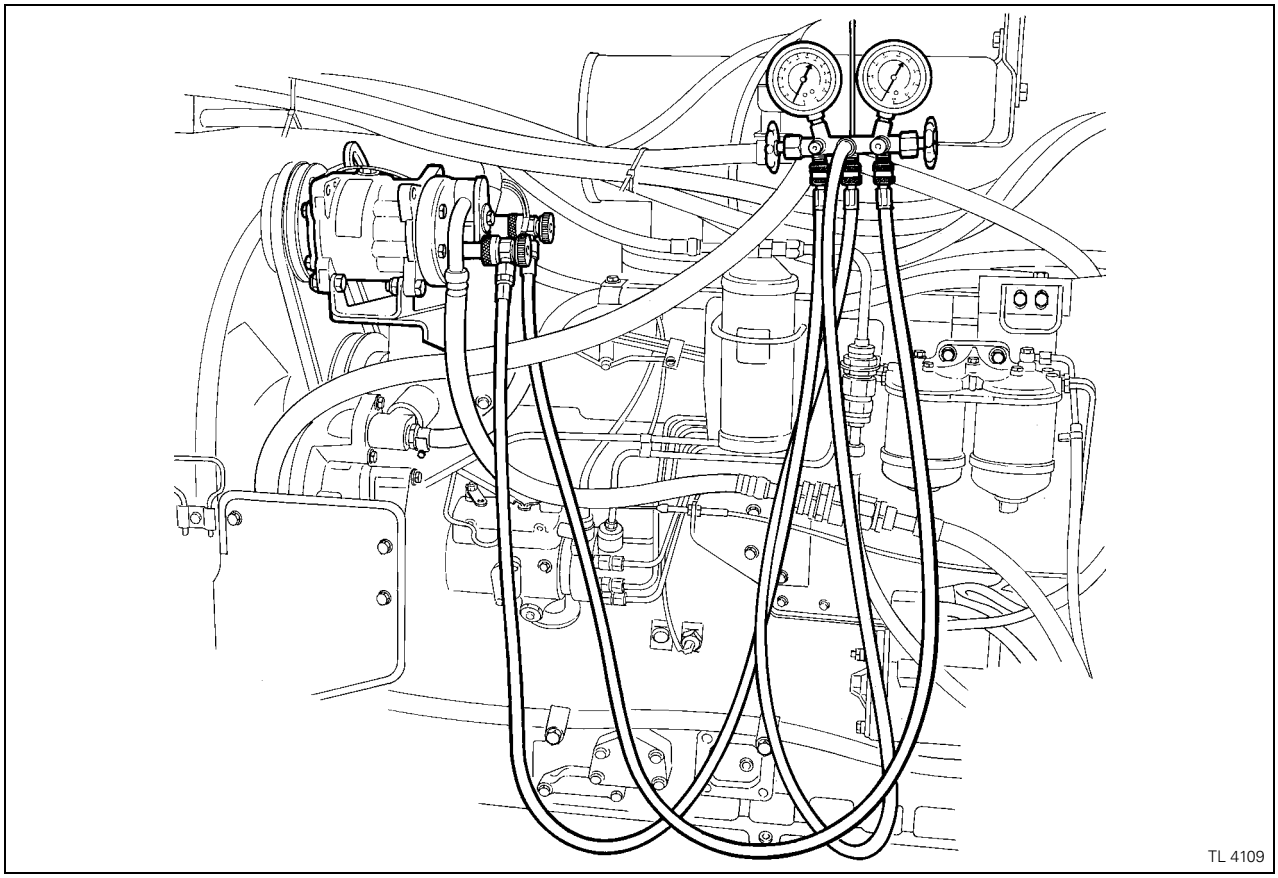
2. Check the compressor and alternator/fan belts, they must be serviceable and correctly tensioned.
3. Check the condenser and engine radiator and see that the cores are not blocked with dirt or debris. Clean with compressed air or water.
4. The condenser fins must not be bent or damaged. Air must be able to flow through freely. Special fin combs are available to straighten fins.
5. Check the hood side screens and front grille to ensure that they are not blocked with dirt or debris. Clean with compressed air or water.
6. Check the cab air filter for blockage, clean or replace the element as necessary.
7. Check the blower and ducts for correct operation.
8. Check the main air conditioning system and compressor fuses are not blown:

   Fuse adjacent to the air conditioner/heater in roof - 30 amp. Fan blower motor.

   Fuse in right-hand door pillar location A7 - 10 amp. compressor clutch.
9. Inspect all lines and fittings for evidence of dirt or oil accumulation or dampness, this would indicate leakage. Ensure that there are no kinks or wear spots due to insufficient clearance.
10. Check that the compressor clutch engages when the temperature control is turned to full COLD. If not, check through the electrical system.
11. Check the evaporator drain tubes are clear at the base of the cab 'A' and 'B' posts.
12. Check condition of all wiring connections.

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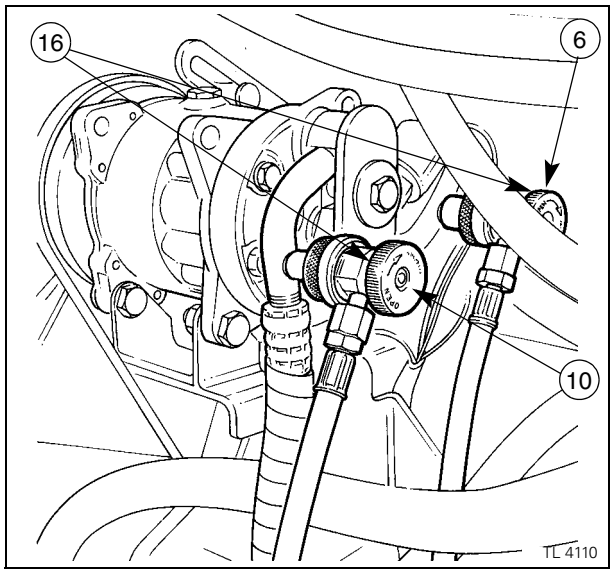
TESTING THE SYSTEM

Check **2-12C**

Special Tools:
Pressure Gauge and Manifold Set
Vacuum Pump
Goggles

Procedure

1. Before beginning the test procedure, carry out the Preliminary Checks, *(see operation 1-12C)*.
2. Hang up the manifold set in a convenient position.
3. The hoses, gauges and hand wheels are colour coded for your convenience. The red hose is coupled to the high side of the system. The blue hose to the low side and the centre test hose should be yellow.
4. Close both manifold hand wheels (turn clockwise).
5. Remove the protective caps from the service valves on the Low (suction) and High (pressure) Side pipe fittings at the rear of the compressor.
6. High Side - Red Hose, close the field service coupler, turn the knob counter-clockwise until finger tight.
7. Place the service coupler onto the male fitting on the pipe, compressor to condenser.



8. Push in on the knob of the service coupler with your thumb, while pulling up on the sleeve, until it bottoms on the male fitting; then release.
9. Check to see if it is correctly seated by pulling up on the service coupler.
10. Low Side - Blue Hose, repeat operations 5 to 9 connecting to the pipe evaporator to compressor.

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Purging the System

IMPORTANT: *According to law, refrigerant must not knowingly be exhausted to the atmosphere.*

11. Connect the central yellow hose to the vacuum pump.
12. Open both manifold hand wheels.
13. Start the pump and run for a few moments to remove any air or moisture in the pipes. The gauges will show maximum vacuum when this is achieved.
14. Close both manifold hand wheels.
15. Turn OFF the vacuum pump.

Testing the Pressures

16. Open the two service couplers, turn the knob clockwise until it stops for maximum flow.
17. The two gauges will now read the pressure in the system. This will be dependent on the ambient temperature; higher the temperature, higher the pressure. *(see Table 1 on page 12C-6).*
18. If the gauges do not record any pressure, the system is empty.
19. If the system contains refrigerant, start the engine and stabilize the system, *(see operation 3-12C).*
20. If the gauge readings are within the specification *(see Table 2),* stop the air conditioning system and disconnect the hoses from the system.
21. If the pressures shown on the gauges differ from the specifications, determine the problem and make necessary repairs or adjustments. refer to the diagnostic section:

    Diagnosis - Check, *(see operation 13-12C)*

    Pressure Reading Diagnosis, *(see operation 17-12C)*

Removing Field Service Couplers

22. To disconnect the manifold set and field service couplers, turn the knob counter-clockwise until finger tight, to close the valve.
23. Pull up on the sleeve of the service coupler while pushing in on the knob with your thumb to release the field service coupler from the male fitting.
24. Replace the protective caps on the service valves if no further action is required.

STABILISING THE SYSTEM

Check **3-12C**

Procedure

With the manifold gauge set connected and air purged manifold and hoses, operating stability of pressure and temperature must be attained by running the refrigeration system to obtain accurate readings.

1. Ensure that all test hoses, gauge set and other equipment is away from all engine moving parts. Keep hoses from touching hot manifolds. Start the engine and adjust the speed to 1500 rev/min.
2. Ensure the cab heater is OFF.
3. Turn the air conditioner controls to maximum cooling (full cold). Set blower fan to high speed so that the compressor is operating.
4. Open the cab doors to quickly eliminate interior heat.
5. Operate the system under these conditions for 5-10 minutes. The system will be stabilised for test readings.
6. The gauge readings will be the prime indicator of how the system is operating, *(see operation 4-12C)* Performance Testing.

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Pressure/Temperature Chart - R134a

At temperature entering condenser		High Side pressure (discharge) compressor outlet	
°C	°F	bar	lbf/in²
Up to 20	Up to 68	6,5-8,5	94-123
20-25	68-77	9,8-11,8	142-171
25-30	77-86	13-15	189-218
30-35	86-95	16,3-18,3	236-265
35-40	95-104	19,5-21,5	283-312

Air temperature leaving louvers in cab		Low Side pressure (suction) evaporator outlet	
°C	°F	bar	lbf/in²
5-11	41-52	0,1-1,1	1,5-16
7-13	45-55	0,2-1,2	2,9-17
10-16	50-61	0,4-1,4	5,8-20
13-19	55-66	0,6-1,6	9-23
15-22	59-72	0,8-1,8	12-26

Table 2

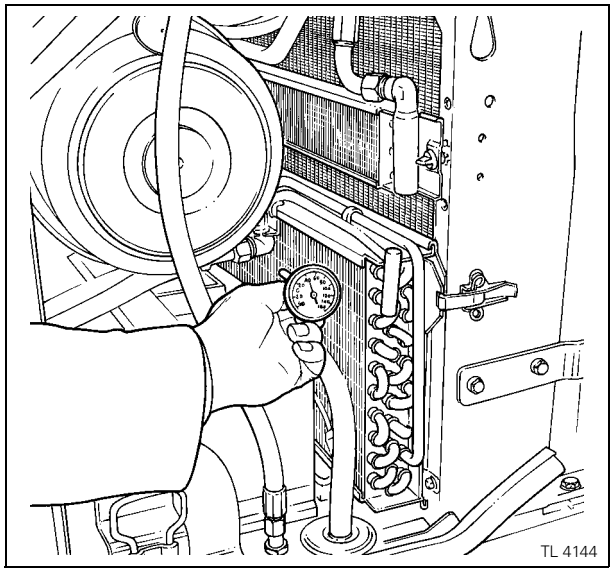
PERFORMANCE TESTING

Check 4-12C

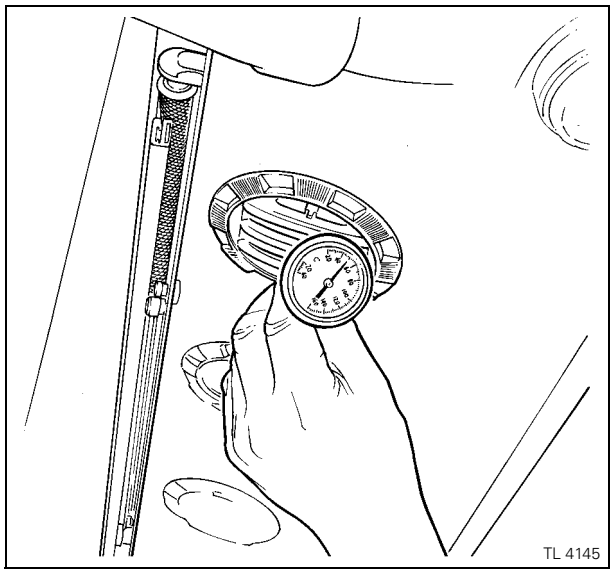
Procedure

To determine if the system is operating properly before trouble-shooting and repairs, or after repairs have been made, a system performance test should be carried out. A performance test will reveal system pressures and temperatures of the air entering the condenser and leaving the louvres in the cab. Refer to the Pressure-Temperature Chart Table 2 to establish if the pressure readings are correct.

1. Park the tractor in the shade or enclosure, it should not, if possible be in direct sunlight prior to evaluation of the system. The ambient temperature should be at least 20°C (68°F).
2. Install the manifold gauge set, *(see operation 2-12C)*.
3. Stabilise the system, *(see operation 3-12C)*.
4. Ensure that the cab heater is OFF.
5. Open the recirculating vent for full recirculation.
6. Close all windows and doors.
7. Open all the louvres in the cab.
8. Ensure that the transmission is in neutral and the parking brake applied.
9. Start the engine and run at 1500 rev/min.
10. Set the temperature control switch at its coldest setting.
11. Measure the ambient (outside) air temperature with a thermometer held 50 mm (2 in) in front of the condenser. Ambient temperature affects the system pressure (especially the high side). Compare the thermometer reading to the temperatures and pressures shown in the Pressure-Temperature Chart Table 2.



Taking Ambient Temperature



Taking Evaporation Temperature

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12. Insert a thermometer into the air conditioning outlet duct nearest the evaporator. Turn the blower switch to low and note the outlet air temperature. This should read 7-13ºC (45-55ºF) at approximately 20-25ºC (68-77ºF) ambient temperature. Note that higher temperatures and high humidity will increase outlet temperature.
13. Make a note of the gauge readings and the ambient and outlet air temperature. Insufficient charge is indicated by both high and low side gauge readings registering lower than stated in the Pressure-Temperature Chart, Table 2. This is one of the most common causes of air conditioning failure - LOSS OF REFRIGERANT.
14. Both gauge readings should be checked at the point just before the clutch disengages when cycling.

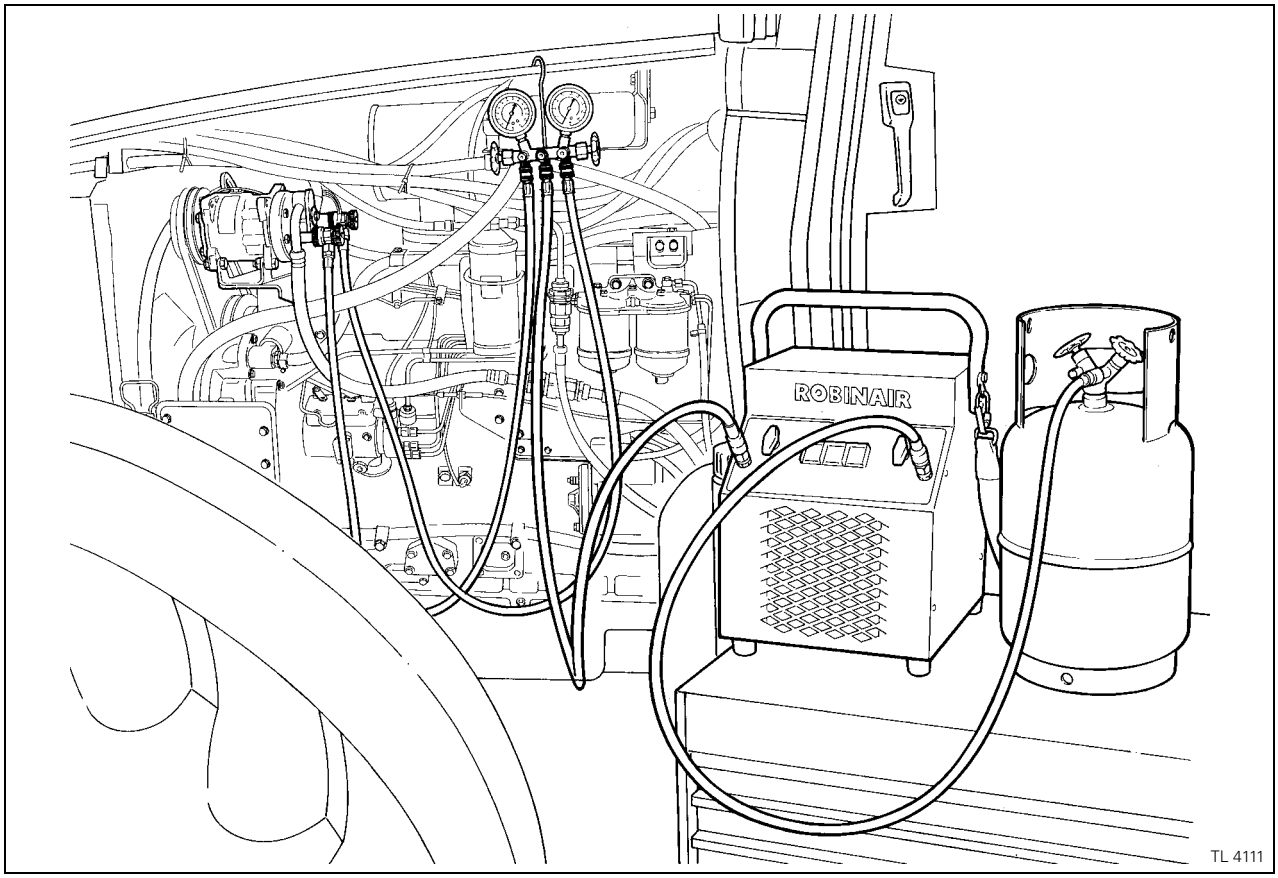
Refrigerant Loss

IMPORTANT: *On systems containing R-134a, 'topping-up' the system refrigerant is NOT recommended. Can result in serious compressor damage.*

15. Some refrigerant loss will occur in one year's operation, and this is recognised as normal. Vibration, hose porosity, and general construction of the system make a leak-proof system nearly impossible. On a systems using R-134a it is not possible to put in a partial charge of refrigerant, because it is not possible to gauge the amount in the system by viewing the sight glass in the receiver-dryer. The refrigerant must first be removed, system repaired, and then a known amount by the weight method loaded into the system.

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REFRIGERANT RECOVERY

Removal **5-12C**

Special Tools:
Pressure Gauge and Manifold Set
Vacuum Pump
Refrigerant Recovery/Recycling Station
Storage Cylinder
Goggles

Procedure

Before any work can be carried out on the system it must have the gas safely removed (discharging the system). UNDER NO CIRCUMSTANCES SHOULD THE SYSTEM BE DISCHARGED TO ATMOSPHERE.

There are many makes of refrigerant Recovery or Recycling Stations. A Recovery Station will recover the refrigerant from the system and place it in a storage cylinder. The refrigerant removed will require processing by a specialist company. The refrigerant cannot be reused.

A Recovery/Recycling Station will remove the refrigerant, clean and filter, removing oil, acids and particles on the way to a storage tank. The refrigerant can be reused in the system.

You must follow the manufacturers instructions, this procedure is for guidance only.

1. Install the Pressure Gauge and Manifold Set, *(see operation 2-12C)*.
2. Purge the hoses and manifold, *(see operation 2-12C)* procedures 10 to 13.
3. Connect the yellow hose from the manifold to the inlet connection on the Recovery/Recycling Station.
4. Connect the other yellow hose from the discharge connection on the recovery unit to the storage cylinder.
5. Recover the R-134a refrigerant from the system by following the manufactures instructions.

WARNING: Disconnect hoses with extreme caution! All hoses may contain liquid refrigerant under pressure. Liquid refrigerant can cause frost bite.

6. When recovery is complete, disconnect the storage cylinder and Recovery/Recycling Station. The system can now be safely worked on.

IMPORTANT: *Dirty gas that has been recovered should not be reused in the system again. It should be re-filtered and cleaned by a recycling unit.*

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FLUSHING THE SYSTEM

Removal **6-12C**

Procedure



CAUTION: *Never use compressed air to flush the system which contains R-134a refrigerant. There is a possibility of fire/explosion and personal injury.*

There is considerable controversy over the question of whether or not to flush air conditioning systems since R-11 can no longer be used. The best solution is to replace clogged components.

If it is necessary to clean out the system, flush with dry Nitrogen to remove oil, particles and other matter.

IMPORTANT: *DO NOT flush the compressor, expansion valve and receiver-drier, they must be removed from the system or by-passed.*

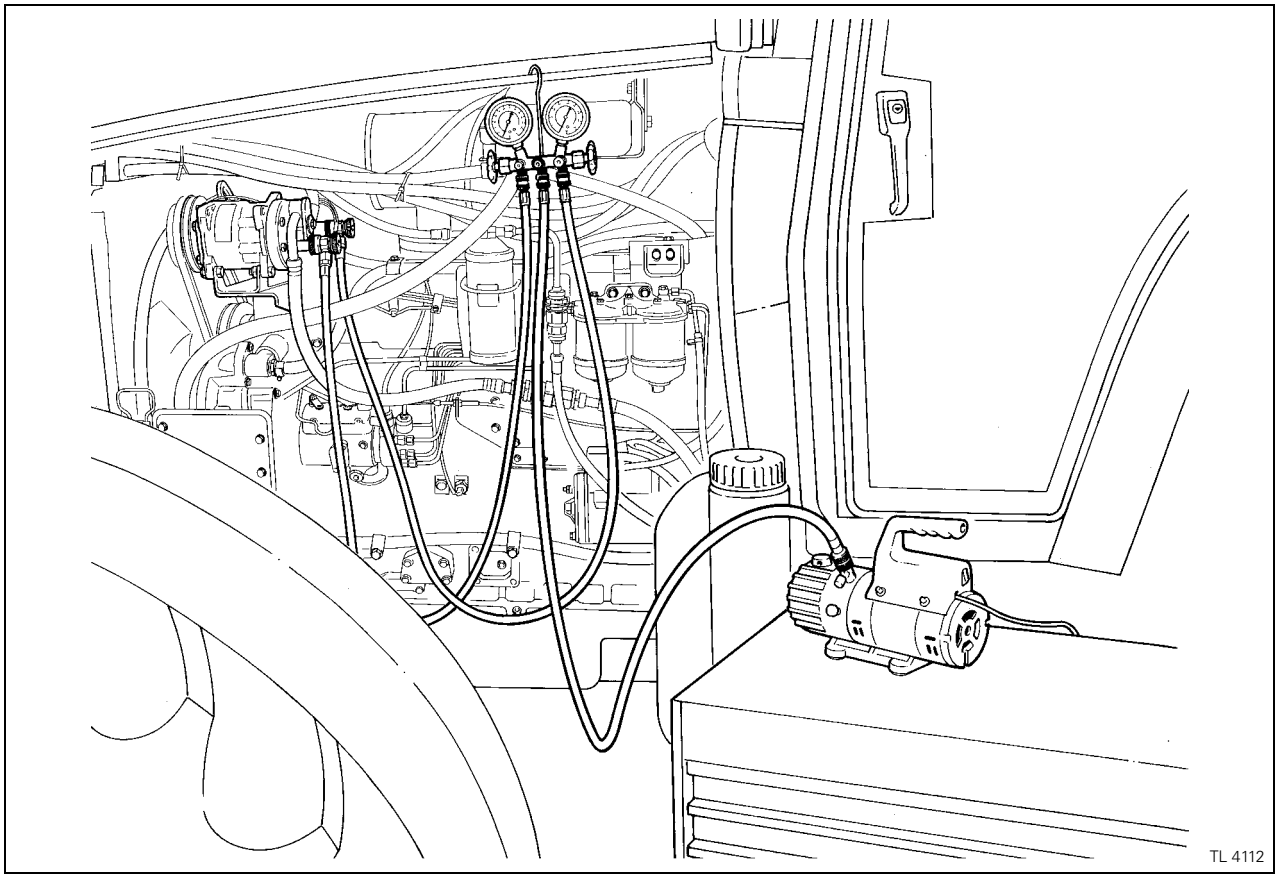
1. Detach and seal all lines from the individual component to be flushed.

NOTE: *If the entire system is being flushed, replacement of the receiver-drier is recommended (if not already being done). When flushing the rest of the system, detach the receiver-drier, compressor and expansion valve and by-pass it. Install a new unit after the procedure is complete.*

2. Connect a cylinder of Nitrogen to the specific component(s) through a suitable pressure reducing valve and hose.
3. Open the cylinder valve, so that the gas flows through the component(s) taking the contaminates with it.
4. Close the valve and remove the cylinder.
5. Reconnect the component(s) into the system. Replace the receiver-drier. Flushing is now complete.
6. Evacuate the system allowing at least 45 minutes evacuation period from the point at which the lowest vacuum point is obtained, *(see operation 7-12C).*

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EVACUATING THE SYSTEM

Removal **7-12C**

Special Tools:
Pressure Gauge and Manifold Set
Vacuum Pump

Procedure

A system that has been opened up for repairs, or one which is found to be empty or excessively low on refrigerant. MUST be fully evacuated with a vacuum pump to remove all traces of moisture before a new refrigerant charge is loaded.

Moisture is extremely harmful to the air conditioning system. It can collect and freeze in the orifice of the expansion valve, create harmful acids in the system. The vacuum pump will remove the unwanted moisture and air by lowering the boiling point of water in the system where it will vaporise and can be easily drawn out by the pump.

1. Check the oil level in the compressor, *(see operation 26-12C)*. This task cannot be undertaken when the system is charged with refrigerant.
2. Replace the receiver-drier, *(see operation 29-12C)*.
3. Replace any lost oil in the system.
4. Install the pressure gauge and manifold set, *(see operation 2-12C)*.
5. Connect the yellow hose to the vacuum pump.
6. Start the vacuum pump.
7. Open the low side (blue) manifold hand wheel to its maximum position.
8. Open the high side (red) manifold hand wheel to its maximum position.
9. After 5 minutes, the low side gauge should read below 508 mm Hg (20 in Hg).
10. The high side gauge should register slightly below the zero mark of the gauge. If the high side gauge does not drop below zero, the system is restricted. Evacuation should be stopped until the restriction is removed.
11. The vacuum pump must be left running to pull the system into deep vacuum. The low pressure gauge showing a reading of 711-749 mm Hg (28-29.5 in Hg). This process could take between 30-60 minuets.
12. After this process, close both of the manifold hand wheels and switch off the vacuum pump.
13. The low side gauge should remain at the same vacuum reading. Any change will indicate a leak exists.

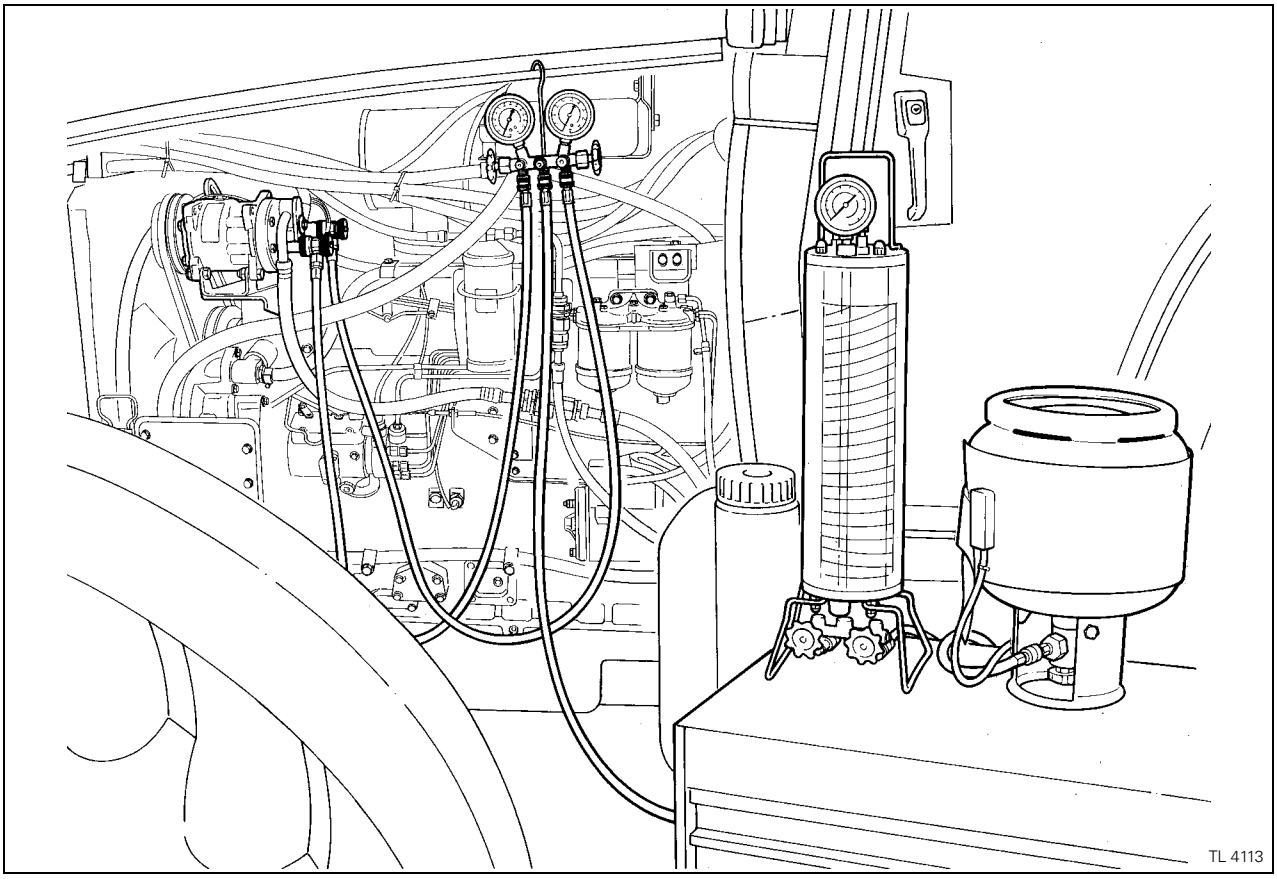
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IMPORTANT: *DO NOT stop the vacuum pump when the high and low side hand wheels are open. If you do, the vacuum pump oil can be pulled into the system by the vacuum.*

14. If a leak exists (gauge returns to zero). Locate and repair the leak, then repeat evacuation procedures.
15. Ensure that both manifold hand wheels are closed.
16. Turn off the vacuum pump and detach the yellow service hose from the pump.
17. Install a complete charge of new R-134a refrigerant in the system, *(see operation 8-12C)*.



RECHARGING THE SYSTEM

Replacement **8-12C**

Special Tools:
Pressure Gauge and Manifold Set
Vacuum Pump
Cylinder Heater Blanket
Goggles
Dial-a-Charge Cylinder
or:
Weighing Scales
or:
Can Dispensing Valve

Procedure

After all indicated repairs have been made, compressor oil level has been checked and adjusted as necessary, and the system has been evacuated to remove all air and moisture, the air conditioning system should be fully charged using one of the following methods.

IMPORTANT: *Remember the following Golden Rule when re-charging the system:*

CHARGE LIQUID REFRIGERANT ON THE HIGH SIDE (CYLINDER INVERTED). ENGINE STOPPED.

CHARGE VAPOUR REFRIGERANT ON THE LOW SIDE (CYLINDER UPRIGHT). ENGINE RUNNING.

CAUTION: *Failure to carry out these instructions could result in a damaged compressor. High pressure could cause personnel injury*

Recharging using Dial-a-Charge cylinder

1. With the pressure gauge and manifold set installed, ensure that both hand wheels are closed. There will be a vacuum in the system due to evacuating the air and moisture.
2. Connect the yellow service hose to the bottom of the Dial-a-Charge cylinder.
3. Connect the Dial-a-Charge heater to the electrical system.

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4. Check that all valves are closed on the Dial-a-Charge.
5. Connect the other yellow service hose between the bottom connection on the Dial-a-Charge and the vacuum pump.
6. Run the pump for a moment or two to purge the Dial-a-Charge and hoses of air by opening the lower valves on the Dial-a-Charge.
7. Disconnect the hose from the vacuum pump and connect it to the cylinder of refrigerant.
8. Place the refrigerant cylinder upside down to charge liquid refrigerant into the Dial-a-Charge.

NOTE: *To ease the filling of the Dial-a-Charge, the cylinder of refrigerant should be warmer than the Dial-a-Charge. Warming the cylinder of gas with warm water or the fitting of a heated blanket will assist. DO NOT exceed 49ºC (120ºF) to increase the internal pressure.*

9. Slowly open the valve on the gas cylinder to fill the Dial-a-Charge. When liquid refrigerant is visible in the sight glass rotate the scale so that the R-134a section is opposite the cursor line, always select the scale that corresponds to the pressure reading on the cylinder pressure gauge.
10. Always fill the Dial-a-Charge cylinder to about 250gm (1/2 lb) more than required. Refer to the specification section to determine the quantity of refrigerant. Determine the shut-off point and close the refrigerant cylinder valve when this point is reached.
11. To make charging the system quicker the pressure of the refrigerant must be increased. Switch ON the heater and after a few minutes, the heater will increase the temperature of the refrigerant and the cylinder will build a positive pressure.
12. The shut-off point must be determined so that the correct amount of R-134a will enter the system. Roll the black ring to the shut-off point on the scale.
13. Reset the scale for any pressure changes.
14. With the engine and air conditioning control OFF, the system under vacuum, open the high side hand valve at the manifold gauge set. Check that the low side hand valve is closed, and then open the valve on the Dial-a-Charge. Control the charge going into the system by the valve on the Dial-a-Charge, NOT from the manifold. Continue charging until the shut off point is reached. If the Dial-a-Charge pressure readings change, be certain to reset the scale to the new pressure reading. Turn off the valve when the predetermined shut-off point is reached.
15. Close the manifold hand wheel.
16. The system recharge is now complete.

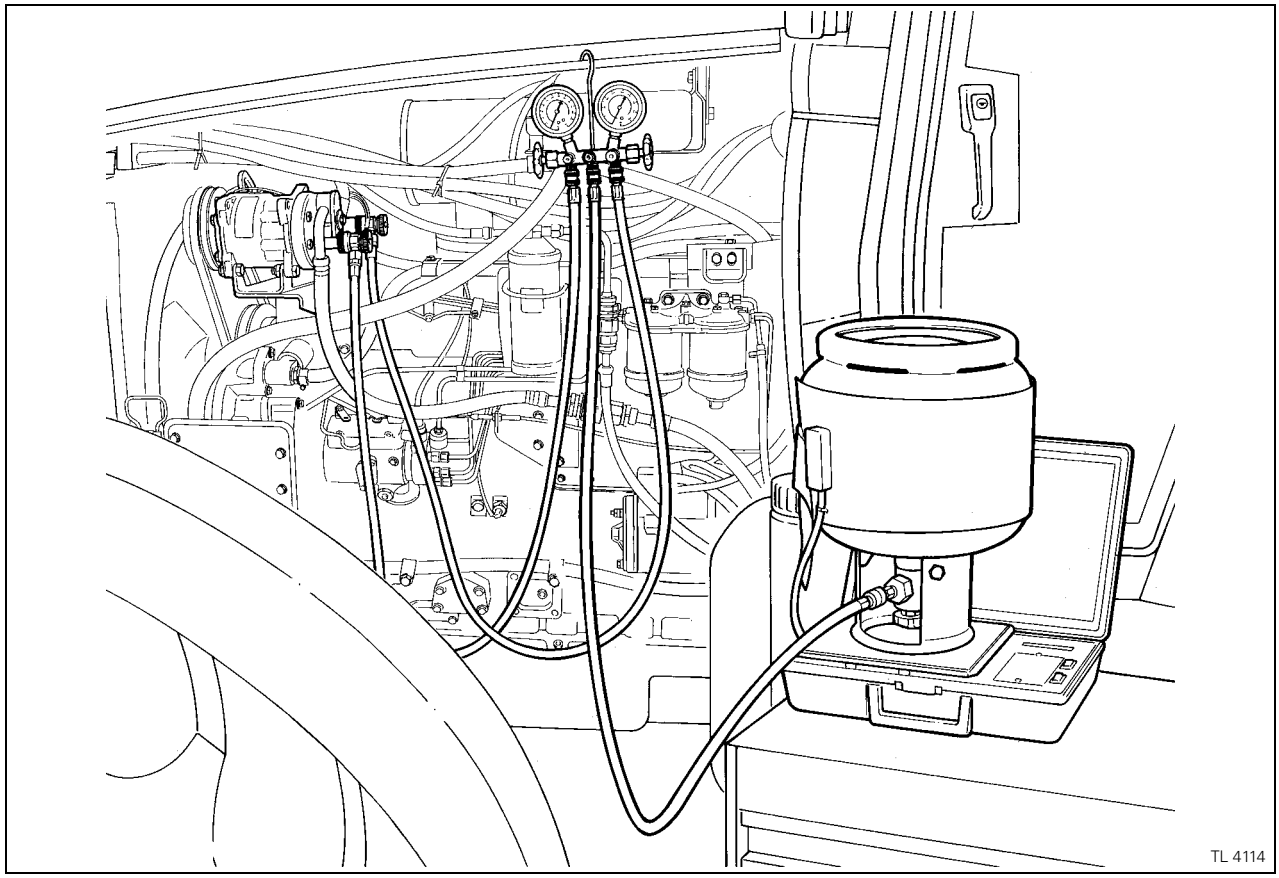
If a full charge cannot be obtained with the engine OFF, proceed as follows:

IMPORTANT: *The liquid refrigerant must enter the system through the service valve on the discharge hose (high side). If liquid refrigerant enters the system on the suction (low side), there will be damage to the compressor and seals.*

17. Close the valve on the Dial-a-Charge. Transfer the yellow service hose from the bottom of the Dial-a-Charge to the connection on the top. This will fill the system with vapour.
18. High Side (red) hand wheel closed, open the Low Side (blue) hand wheel.
19. Start the engine and set the air conditioning controls to normal and the blower to low position so that the compressor is operating.
20. Open the Dial-a-Charge valve, and allow the system to draw in necessary additional R-134a vapour until the shut-off point is reached.
21. When the full charge is in the system close the Dial-a-Charge valve.
22. Close the Low Side hand wheels.
23. Complete a final performance test, *(see operation 9-12C).*

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Recharging using Weighing Scales

1. Purge the manifold and hoses using the vacuum pump.
2. Connect the yellow service hose from the manifold direct to the cylinder of R-134a.
3. Place the refrigerant cylinder upside down on the weighing scales to charge liquid refrigerant into the system.

NOTE: *To ease the filling of the system, the cylinder of refrigerant should be warmer than the ambient temperature. Warming the cylinder of gas with warm water or the fitting of a heated blanket will assist.*

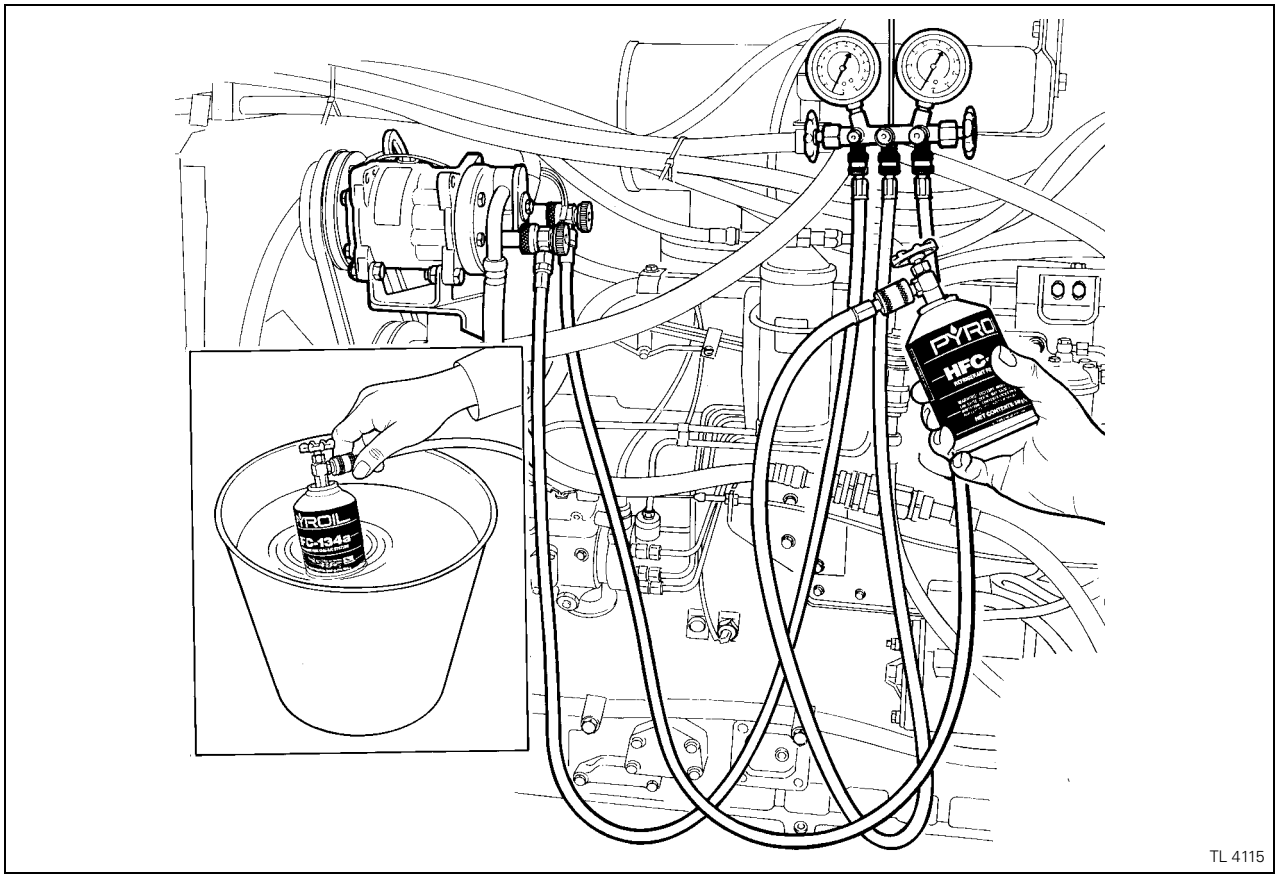
4. Turn on the heater blanket (if fitted) and wait a while until the R-134a is warm.
5. Slowly open the valve on the gas cylinder to fill the hoses and manifold, allow a very small quantity of gas to purge the system of air.
6. Make a note of the scale reading, zero or programme the reading if digital scales are used.
7. From this reading take away the quantity of gas to be installed in the system and make a note of the shut-off point, *(see specification section).*
8. With the engine and air conditioning control OFF, the system under vacuum, open the High Side (red) hand wheel slowly to allow the refrigerant to flow into the system.
9. Watch the scales, as soon as the shut-off point is reached, close the gas cylinder valve.
10. Close the High Side hand wheel.

If difficulty is experienced in recharging the system, proceed as follows:

11. Turn the cylinder of gas the right way up on the scales so that the valve is uppermost. This will fill the system with vapour.
12. High Side (red) hand wheel closed, open the Low Side (blue) hand wheel.
13. Start the engine and set the air conditioning controls to normal and the blower to low position so that the compressor is operating.
14. Open the valve on the cylinder of refrigerant, and allow the system to draw in necessary additional R-134a vapour until the shut-off point is reached on the scales.
15. When the full charge is in the system close the cylinder valve.
16. Close the Low Side hand wheels.
17. Complete a final performance test, *(see operation 9-12C).*

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Recharging from Individual Cans

1. If you are using 340 g (12 oz) cans of R-134a, check that you have enough cans, *(see specification section).*

CAUTION: *DO NOT open the High Side pressure hand valve while charging. High pressure will burst the can and could cause personnel injury.*

2. Ensure that the manifold hand valves are closed.
3. Connect the can dispensing valve to the yellow service hose.
4. Turn the can dispensing valve completely counter-clockwise so that it is fully open.
5. Screw the refrigerant can on to the dispensing valve, be sure it is properly attached.
6. Turn the dispensing valve completely clockwise to puncture the can and close the valve.
7. Loosen the centre hose connection at the manifold and slowly open the can valve. This permits a very small amount of refrigerant to escape and to purge air from the centre hose (about 3 seconds).
8. Close the valve and re-tighten the hose
9. With the engine and air conditioning control OFF, the system under vacuum, open the Low Side hand valve at the manifold gauge set. Check that the high side hand valve is closed, and then open the valve on the can. Allow the full refrigerant charge to flow into the system.
10. Close the manifold valve, fully open the dispensing valve, change the can of R-134a.
11. Repeat procedures 7 to 10 until the correct amount of R-134a has been taken into the system.

IMPORTANT: *DO NOT invert the R-134a container. Liquid refrigerant entering the Low Side of the system will damage the compressor.*

NOTE: *If the system is taking refrigerant slowly, the process can be speeded up by placing the lower 3/4 of the can (DO NOT IMMERSE) in a pail of water not hotter than 49ºC (125ºF), see insert. DO NOT apply heat with a torch, the can will burst.*

12. When a full charge is obtained, close the can valve, close the manifold valve.
13. With a full refrigerant charge the High and Low Side gauge readings should be normal.
14. Complete a Final Performance Test, *(see operation 9-12C).*

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FINAL PERFORMANCE TEST

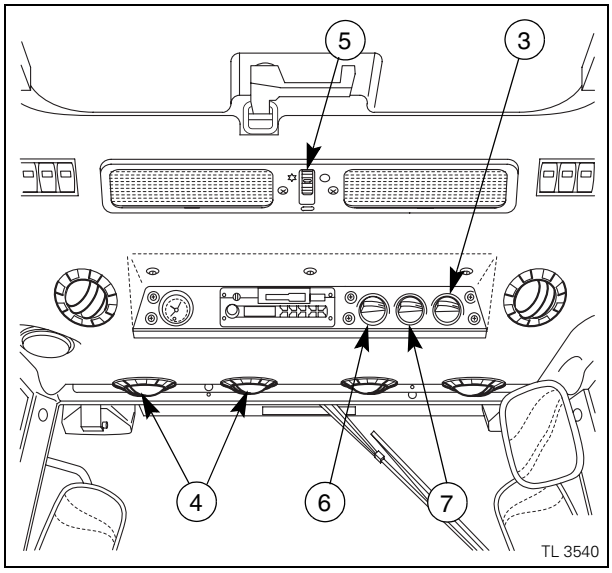
Check **9-12C**

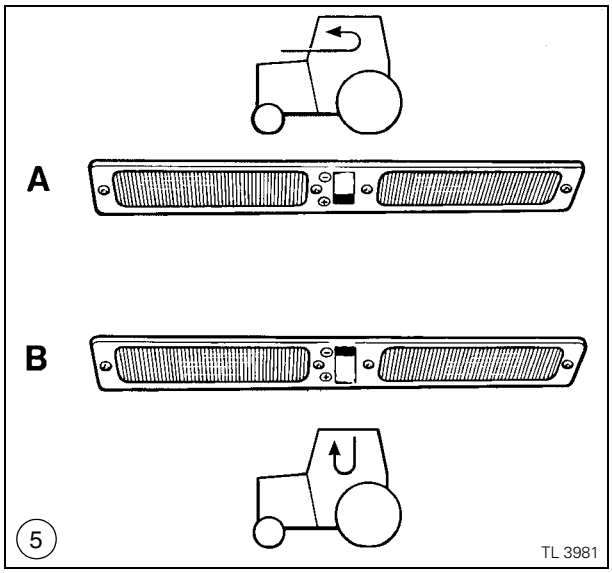
Special Tools:
Thermometer

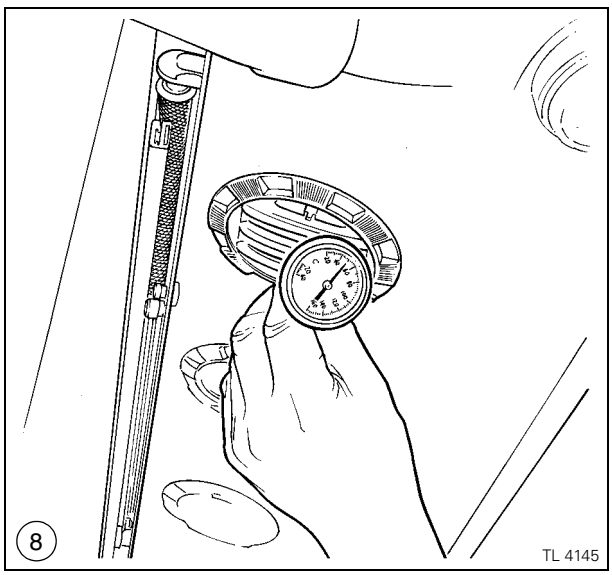
Procedure

After completion of all repairs, and with the system fully charged, the air conditioner should be operated and tested for proper performance. Gauges should still be attached. This final test will examine operation of all components and system controls to be sure proper function has been achieved.

1. With gauges attached, start engine and run at 1500 rev/min for approximately 5 minutes.
2. Close all doors and windows. Close the grille and have all side panels in place.
3. Ensure the cab heater is OFF.
4. Open all the adjustable vents in the cab.
5. Roll the air re-circulation control UP (open) to recirculate the air, position 'B'.
6. Turn the air conditioner control to maximum cooling (full cold).
7. Set the blower fan to low or medium speed so that the compressor is working and producing cool air.
8. Place a thermometer in one of the air conditioner outlet vents in the cab.
9. After the 5 minute stabilisation period, when all components are at normal operating temperature and condition, read the pressure gauge set and compare readings to normal pressure.
10. The thermometer in the air conditioner outlet should read 7-13°C (45-55°F) at approximately 20-25°C (68-77°F) ambient temperature. Refer to the Pressure/Temperature Chart Table 2 *(see page 12C-21)* Note that higher temperatures and high humidity will increase outlet temperature.
11. If the system appears to be operating normally, stop the engine, disconnect the gauge set, replace the service fitting caps.
12. If the system is not operating within specification or displays other abnormal conditions, refer to 'System Diagnosis' *(see operation 13-12C)* for specific information.
13. Affix a service label and date.







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LEAK TESTING

Check **10-12C**

Special Tools:
Electronic Leak Tester
or:
Dye Type Leak Detector
Ultraviolet Lamp
UV Goggles
or:
Bubble Type Tester

Procedure

Approximately 80% of all air conditioning service work will consist of checking for and/or locating leaks. many leaks are caused simply by vibration and by threaded connections coming loose. Re-tightening these will solve the leak. Occasionally a hose will rub on a structural part to create a leak. Remember that a leak is indicated any time more than a 225 g (1/2 lb) of refrigerant is required to charge the system after only one season's use.

A leak test should be performed as part of normal service work with an electronic leak tester, there must be at least a system pressure of 3,5 bar (50 lbf/in²). If low, recover the refrigerant charge and re-charge the system as instructed earlier. Be sure all joints, connections and fittings are free of oil, dirt and other contaminates. A system must always be checked for leaks after it has been repaired and charged.

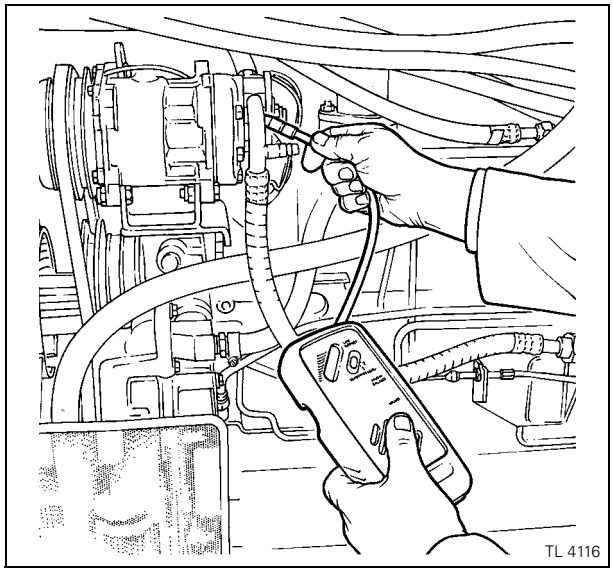
Electronic Leak Tester

1. Make sure the tester battery is good.
2. Set up the tester as recommended by the manufacturer.
3. Pass the probe under the suspected leak area.
4. When a refrigerant leak is encountered the tester will emit a ticking sound, this will quicken, developing into a high pitched squeal as a large quantity of refrigerant is encountered.

General Testing Tips

1. R-134a is heavier than air - test for leaks under the suspected area. R-134a concentrations may be encountered somewhat below the actual leak area.
2. Leak testing is extremely difficult in windy conditions. It may be necessary to shelter the suspect leak area to prevent the wind blowing away the R-134a vapour.
3. Prime areas to check:

a. All connections and pipes
b. Compressor drive shaft
c. Compressor service valves
d. Condenser and evaporator tube ends
e. Receiver-drier sight glass and tube ends
f. Pressure switches
g. Quick release self-sealing couplings



4. If leaks cannot be detected with the system shut off, start the engine, engage the system to build up the system pressure.

Bubble Type Leak Tester

A bottle of full strength liquid dish washing detergent, child's soap bubble solution, or commercial bubble type detector can be used primarily to find leaks at connections. Swab the connections with solution and check for bubbles indicating a leak.

Dye Type Leak Detector

If using UV-fluorescent dye tracer to check for leaks, install 7.5 ml (1/4 oz) into the system during repair. Dye can also be installed with an injector on the Low Side once the system is charged or when the system is under vacuum, depending on the equipment available. The dye attaches to the oil in the system and not the refrigerant, if the refrigerant is removed and new refrigerant is installed, the dye is still in the system. Ultraviolet lamp is required to show up the leaks.

CAUTION: *Always wear protective eye goggles that screen out excessive UV light that can damage your eyesight when using ultraviolet lamp.*

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COMPRESSOR CLUTCH

Check 11-12C

These tests are performed if the clutch does not operate, check the wiring, temperature control system and high/low pressure switch first.

1. Check the amperage and voltage. The current range requirement is 3.6A to 4.2A at 12 volts. Note the following symptoms and remedies:

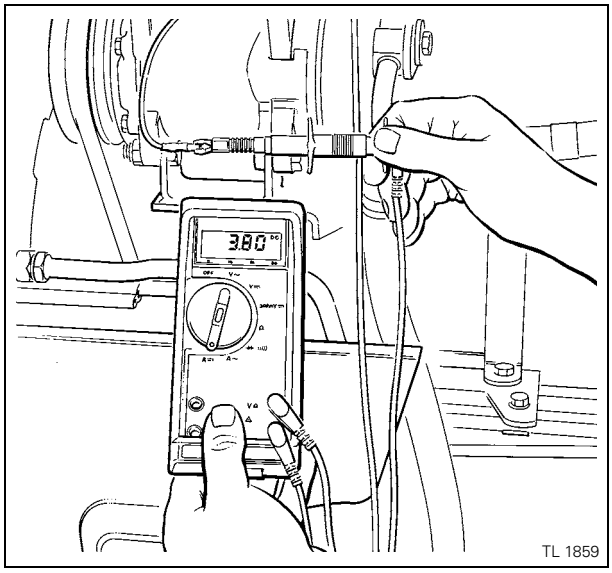
a. A very high current reading - a short circuit within the field coil.

b. No current reading - an open circuit in the winding.

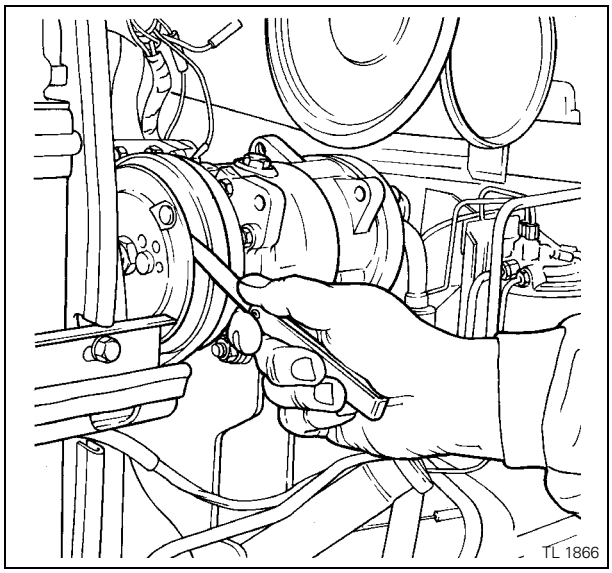
c. An intermittent or poor system ground results in lower voltage at the clutch. Check for tight fit of coil retaining snap ring. Check the ground return for open circuit.

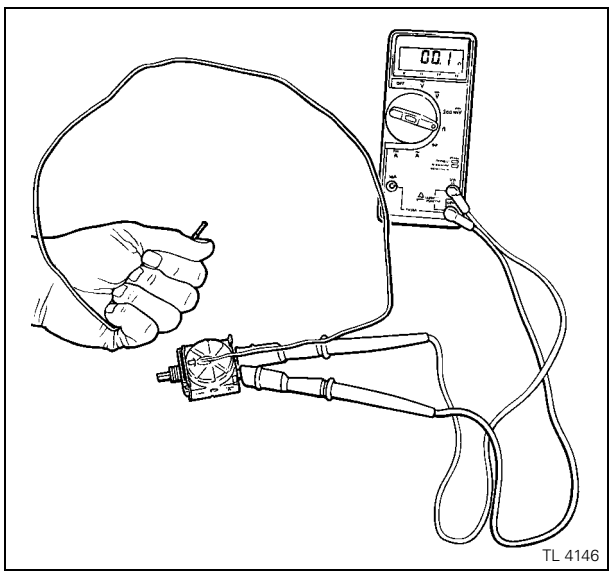
d. Replace field coil for open or short circuit, *(see operation 21-12C).*

2. Air gap, an incorrect air gap could cause erratic engagement or disengagement and/or clutch rattle. Check the air gap with a feeler gauge 0,4 to 0,8 mm (0.016 to 0.031 in), *(see operation 22-12C).*
3. Suspect bearing noise, remove the drive belt and disengage the clutch. Rotate the pulley by hand and listen for bearing noise, feel for rough spots. If excessive, replace the pulley and clutch front plate assembly or bearing set.
4. Carry out final performance test, *(see operation 9-12C).*



TL 1859


TL 1866


TL 4146

TEMPERATURE CONTROL SWITCH

Check 12-12C

Procedure

The temperature control switch will commonly fail in one of three ways:

1. Will not engage the compressor.
2. Will not disengage the compressor.
3. Cycles the compressor too often or delays cycling.

Before condemning the temperature control switch check for low refrigerant charge. Carry out the following checks:

1. With a volt meter check for power supply to switch.
2. If clutch does not engage, connect a jumper wire across the two leads. There should be an audible click when the clutch engages.
3. If the switch will not engage compressor:

a. Set switch to coldest setting.

b. Connect ohmmeter across switch terminals.

c. Warm capillary with your hand, a resistance reading of one ohm or more indicates open switch, replace switch.

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DIAGNOSIS

Check 13-12C

The most common complaint with air conditioning systems is that there is 'no cooling' or 'insufficient cooling'. It is imperative that the 'Preliminary Checks' *(see operation 1-12C)* are carried out before any dismantling or testing of the system.

The following checks are the most important:

1. Correct belt installation and tension.
2. Correct compressor magnetic clutch operation.
3. Condenser air flow blocked due to foreign material in the core or side panels.
4. Cab air filter blocked, air flow restriction.
5. Loose fittings on all components and broken, burst or cut hoses.

After making the above checks, install pressure gauges and thermometers and conduct a diagnosis test.

Following is a brief description of the symptoms that each refrigerant system component will evidence if a malfunction occurs.

Evaporator

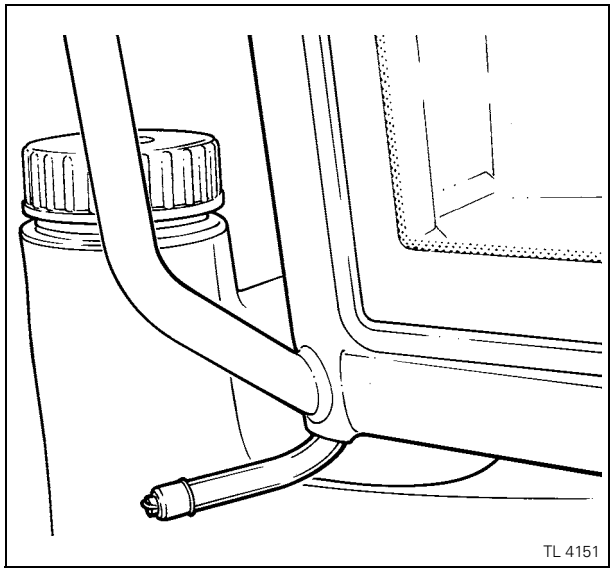
When the evaporator is defective, the trouble will show up as an inadequate supply of cool air. A partially plugged core due to dirt entering past a badly fitted or damaged filter, roof hatch or seal is the usual cause.

1. Remove the evaporator, *(see operation 28-12C)*.
2. Check the fins on the evaporator. All fins that have bends or damage must be made straight.
3. Check the evaporator/heater core for restrictions. Clean the core with a brush and vacuum cleaner. If necessary, carefully flush the outside of the core with water if there is a heavy deposit of dirt. DO NOT use steam to clean the fins and core. Check condition and clean the cab filter, *(see operation 18-12C)*.
4. Check that the water drain holes in the bottom of the plenum chamber are clear and the drain hoses at the base of the cab front door posts. The tubes will have to be pulled out from the fuel tank to check.
5. When replacing the evaporator ensure that all components are clean, the drip tray is in place and the plenum chamber lid is sealed correctly.
6. Ensure that the air filter is correctly installed and clean.

Compressor

Compressor malfunctions will appear in one of four ways: noise, seizure, leakage or low inlet and discharge pressure.

Resonant compressor noises are not cause for alarm; however, irregular noise or rattles are likely to indicate broken parts. To check seizure, stop the engine, de-energise the magnetic clutch and check to see if the drive plate can be rotated.



If rotation is impossible the compressor is seized. Perform the false compressor seizure check before removing the compressor for repair.

Rotate the drive pulley to ensure that the pulley bearings have not failed.

Low discharge pressure may be due to a faulty internal valve, seal, or a restriction in the compressor.

Low discharge pressure may also be due to an insufficient refrigerant charge or a restriction elsewhere in the system. These possibilities should be checked prior to servicing the compressor. If the compressor is inoperative; however, and is not seized, check to see if current is being supplied to the magnetic clutch.

Condenser

A condenser may malfunction in three ways; it may leak, it is restricted or the core is blocked with debris, THIS IS THE MOST COMMON CAUSE OF MALFUNCTION. A condenser restriction will result in excessive compressor discharge pressure. If a partial restriction is present, sometimes ice or frost will form immediately after the restriction as the refrigerant expands after passing through the restriction. If air flow through the condenser or radiator is blocked, a very common fault with agricultural tractors, high discharge pressure will result; this will cause the high pressure safety switch to cut-out.

The following check list will assist:

1. Clean the condenser, *(see operation 20-12C)*.
2. Check that the condenser fins are straight and clean. There must be maximum air flow through the condenser at all times.
3. Check the engine radiator for blockage and clean if necessary.
4. Check the front grille and side panels for blockage and clean if necessary.
5. DO NOT use steam to clean the fins and core.

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Receiver-drier

A receiver-drier may fail due to a restriction inside the body of the unit. A restriction at the inlet to the receiver-drier will cause high head pressures. Outlet tube restrictions will be indicated by low head pressures and little or no cooling. An excessively cold receiver-drier outlet may be indicative of a restriction.

The receiver-drier on systems charged with R-134a does not have a sight glass, if one is fitted it should not be used.

Expansion Valve

Expansion valve failures usually will be indicated by low suction and discharge pressures, and insufficient evaporator cooling. The failure is generally due to malfunction of the temperature sensing diaphragm and subsequent closing of the valve or debris in the system. The formation of ice due to moisture in the system can also block the valve and cause a restriction. A less common cause of the above symptom is a clogged inlet valve due to contamination or desiccant beads loose in the system.

Refrigerant Line Restrictions and Leaks

Restrictions in the refrigerant lines will be indicated as follows:

1. Suction line - A restricted suction line will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.
2. Discharge line - A restriction in the discharge line generally will cause the high pressure and the high pressure safety switch to cut-out.
3. Liquid line - A liquid line restriction will be evidenced by low discharge and suction pressure, and insufficient cooling.
4. Leaks are the most common cause, loose joints, leaking 'O' ring seals, loss of refrigerant.

Electrical Checks

Test to see that the battery voltage is reaching the compressor clutch terminal through the temperature control switch.

Check the ground wire on the compressor clutch. The coil is insulated from ground and requires a good connection, *(see operation 11-12C).*

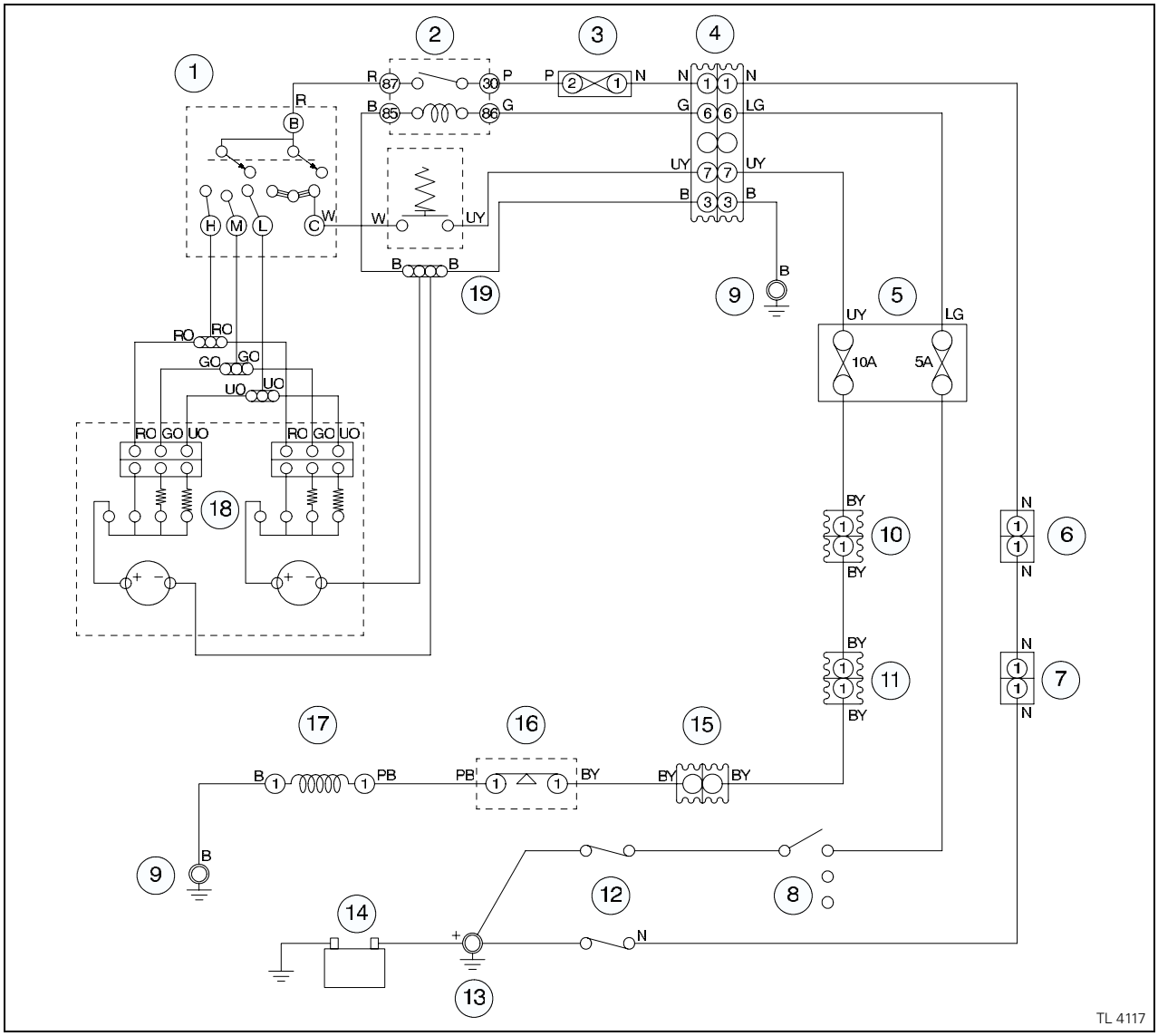
Check the clutch coil resistance, *(see operation 11-12C).*

Check that the blower motor is operating when the control is switched ON.

The wiring diagram on the next page will assist in tracing any electrical faults.

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Key to Wiring Diagram

1. Three speed blower motor switch.
2. Blower motor relay.
3. Blower motor fuse (35 amp).
4. Connector C79, cab harness.
5. Fuse box in right-hand door pillar.
6. Connector C29, cab harness to roof harness.
7. Connector C21, console harness to cab harness.
8. Ignition switch.
9. Earth (ground).
10. Connector C27, cab harness to roof harness.
11. Connector C18, console harness to cab harness.
12. Fusible links.
13. Connection on starter motor solenoid.
14. Battery.
15. Connector C10, engine harness to console harness.
16. High/low pressure safety switch.
17. Compressor clutch.
18. Blower motors.
19. Temperature control switch.

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TROUBLE SHOOTING INDICATORS

Check **14-12C**

Procedure

When trouble-shooting a system there are certain conditions that can indicate a problem area. If a component performs or feels different to touch than is stated here, that component is a good place to start looking for trouble. The readings on the pressure gauges will confirm. With the manifold gauge set installed, start the tractor and run the engine at 1500 rev/min with the temperature control set for maximum cooling and the blower speed to maximum. Stabilise the system.

1. Low side pressure 0,4 to 1 bar (6 to 15 lbf/in²).
2. High side pressure 10,6 to 13,4 bar (154 to 194 lbf/in²).

NOTE: *Pressures at sea level, ambient temperature 25 to 30°C (77 to 86°F).*

3. Compressor will be hot to touch.
4. Line from compressor to condenser very hot to touch.
5. Condenser hot to touch on inlet side. Warm to touch on outlet side.
6. Receiver-drier and lines warm to touch.
7. Expansion valve inlet cool to touch.
8. Expansion valve outlet and evaporator inlet cool or cold to touch.
9. Evaporator and suction line running to compressor inlet cool to touch.
10. Air from cab louvres cold - check the thermometer against temperature chart, *(see operation 4-12C).*

False Compressor Seizure

Slipping or broken air conditioning drive belts and/or scored clutch surfaces may be experienced on initial start-up of an air conditioning compressor after an extended period of storage or non-operation of the compressor. This would indicate a seized compressor; however, an overhaul or replacement of the compressor may not be necessary.

During extended periods of non-operation, changes in temperature cause the refrigerant in the air conditioning compressor to expand and contract. During this movement, lubricating oil carried by the refrigerant tends to migrate from highly polished surfaces in the compressor such as ball seats and axial plate. Without lubricating oil at these polished surfaces, they 'wring' together and appear seized.

Before the time and expense of an overhaul is invested, use the following check to determine if the compressor is actually seized. With a clutch holding tool on the clutch drive plate, `rock' the shaft in the opposite direction of normal rotation. After the compressor is broken loose, rotate the compressor at least three complete turns counter-clockwise. Start the engine and operate the compressor for a minimum of one minute.

This procedure will not affect a compressor that is actually seized but should be attempted before overhauling a compressor known to be idle for a month or longer.

Compressor and Fan Belt Test

1. Check the condition of both the fan and compressor drive belts, and replace any in poor condition.
2. Adjust the tension of the fan and compressor belt to 350Nm (80 lbf) at a point halfway between the two pulleys with a tension gauge.
3. The compressor pulley and fan pulley must be aligned to within 3 mm (3/32 in) of each other.
4. Ensure that the compressor mountings are tight and not cracked or broken.

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SYSTEM FAULT FINDING

Check **15-12C**

Procedure

Interpreting the findings of trouble-shooting and diagnosis can be the most difficult part of pinpointing an air conditioning problem due to the similarities of the symptoms. Listed here in Table 3 are some of the common failures, the complaint, indications and the corrective actions. Always carry out the Preliminary Checks first, *(see operation 1-12C)*.

Symptom	Problem Diagnosis	Correction	See Operation
No cooling at louvres	Loose or broken drive belt.	Tighten or replace belt.	19-12C
	Compressor failure.	See Test Condition 8.	21-12C
	Magnetic clutch slipping or will not engage.	See compressor fault finding chart.	16-12C
	Electrical failure.	Inspect fuses.	
		Inspect all electrical connections.	
		Check temperature control system.	12-12C
		Check blower motor and switch.	2-12A
	Lack of refrigerant.	See Test Conditions 4, 5 and 6.	17-12C
	Expansion valve failure.	See Test Conditions 6 and 11.	17-12C
	Restricted system.	See Test Condition 7.	17-12C
	Restricted air flow.	Check evaporator for blockage.	28-12C
		Check blower operation.	2-12A
		Check cab filter.	18-12C
		Check louvre operation.	
	Excessive air or moisture in the system.	See Test Conditions 2 and 10.	17-12C
	Condenser blocked.	See Test Condition 9.	17-12C
Not enough cooling at louvres	Lack of refrigerant.	See Test Conditions 4 and 5.	17-12C
	Restricted air flow.	Check the following:	
		Check for blocked evaporator.	28-12C
		Check blower operation.	2-12A
		Check cab air filter.	18-12C
		Check louvre operation.	
	High side restricted.	See Test Condition 7.	17-12C
	Some air and moisture in system.	See Test Condition 1.	17-12C
	Temperature control switch faulty.	Replace switch.	31-12C
	Blower fan running too fast.	Turn to slower speed.	
	Heater water valve leaking.	Replace water valve.	3-12A
Warm air at the louvres	Excessive moisture in the system.	See Test Condition 2.	17-12C
	Expansion valve stuck open flooding the evaporator.	See Test Condition 11.	17-12C
	Total loss of refrigerant.	See test condition 5.	17-12C
	Clutch failure.	See compressor fault finding chart.	16-12C
	Compressor failure.	See compressor fault finding chart.	16-12C
	Heater valve ON.	Turn OFF heater valve.	

Table 3

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Air Conditioning

Symptom	Problem Diagnosis	Correction	See Operation
Compressor will not engage	Slipping drive belt.	Tighten belt.	19-12C
	Low pressure cut-out switch in operation.	See Test Condition 12. Check temperature control system.	17-12C
	High pressure cut-out switch in operation.	See Test Condition 9.	17-12C
	Magnetic clutch failure.	Check magnetic clutch.	11-12C
	Temperature control system faulty.	See Test Condition 3.	17-12C
	Compressor cycles on and off too fast.	See Test Condition 3.	17-12C
Intermittent cooling	Receiver-drier saturated.	See Test Condition 1.	17-12C
	Condenser blocked with dirt.	Clean out condenser and engine radiator.	20-12C
		See Test Condition 9.	17-12C
Excessive noise in system	Refrigerant overcharge.	See Test Condition 9.	17-12C
	Compressor failure.	See Test Condition 8. See compressor fault finding chart.	17-12C 16-12C
	Blower motor failure.	Replace or repair: motor.	2-12A
	Bearing failure.	Check magnetic clutch and compressor.	11-12C

Table 3

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COMPRESSOR FAULT FINDING

Check **16-12C**

Procedure

Symptom	Problem Diagnosis and Inspection	Cause and Remedy	See Operation
LACK OF COOLING Smooth running compressor. Unusually high suction pressure with unusually low discharge pressure.	1. Valve plate test.	*Replace or repair:* Broken head or block gasket. Broken or deformed reed valve. Foreign substance under reed. valve or gasket.	23-12C
Unusually low suction and discharge pressure.	1. Check for low refrigerant charge. 2. Leak check compressor. 3. Leak check and diagnose system.	*Replace or repair:* Shaft seal leak. Service port leak. Cylinder head leak. Gasket leak. Oil filler plug leak. Cracked cylinder block. Front housing 'O' ring leak.	 22-12C 23-12C 23-12C
Rough running, intermittent or inoperative. Intermittent or inoperative.	1. Check fan belt tension. 2. Check clutch air gap. 3. Check clutch volts, amps and coil lead wire. 4. Shaft turning smoothness test.	Tension drive belt. Adjust air gap. *Replace or repair:* Broken lead wire. Clutch coil defect - internal system ground. Compressor failure - internal.	18-12C 21-12C 21-12C 20-12C
UNUSUAL NOISE Clutch engaged	1. Check compressor mounting components. 2. Check engine components. 3. Check compressor. 4. Check for intermittent slipping clutch. 5. Check for proper refrigerant charge. 6. Check clutch bearing. 7. Check oil level. 8. Shaft turning smoothness test. 9. Remove valve plate and inspect.	 See Test Condition 8. Adjust air gap - defective coil. Recharge and recheck. Replace bearing. Restore to correct level. Compressor failure - internal *Replace or repair:* Broken discharge valve or container. Broken suction valve reed. Broken gasket.	 17-12C 22-12C 2-12C 22-12C 21-12C 24-12C
Clutch disengaged 'chattering'	1. Check air gap.	*Replace or repair:* Adjust air gap.	22-12C

Table 4

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PRESSURE READING DIAGNOSIS

Check **17-12C**

Procedure

To correctly fault find the air conditioning system it will be necessary to connect the gauge and manifold set to obtain High and Low Side pressure readings, and you will need to know the temperature of the air discharging into the cab.

Table 5 and the twelve Test Conditions in the following pages will assist you in diagnosing the problem:

Pressure Problem Chart			
Problem	Low pressure gauge	High pressure gauge	See test condition number
No cooling	Very low	Very Low	12
No cooling	High	High	9, 10 and 11
Not enough cooling	Normal	Normal	1, 2 and 3
Not enough cooling	Low	Low	4, 5, 6 and 7
Not enough cooling	High	Low	8
Not enough cooling	High	High	9 and 10
On and off cooling	Normal	Normal	1
On and off cooling	Low	Low	6 and 7
Noise in system	Normal	High	8
Refer to pressure temperature chart, *(see operation 4-12C)*.			

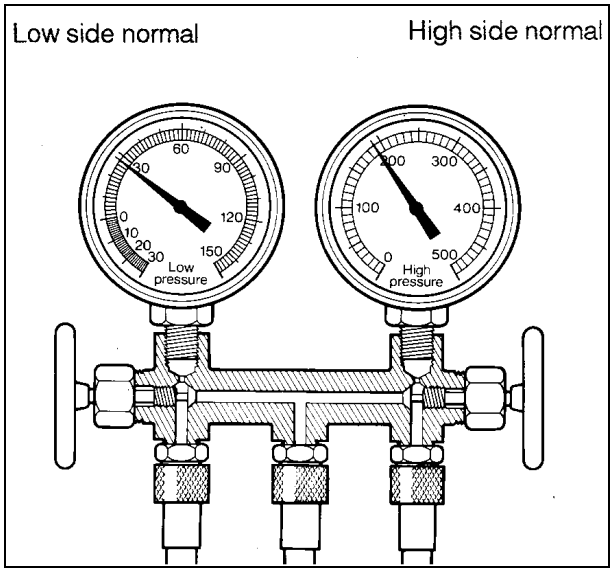
Table 5

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TEST CONDITION 1

Some air and moisture.



Gauge readings

Low side gauge - normal.

High side gauge - normal.

Other symptoms

- Discharge air - slightly cool, may not cool during hot part of the day.
- Low side gauge does not fluctuate with switch 'on' and 'off' cycle.

Diagnosis

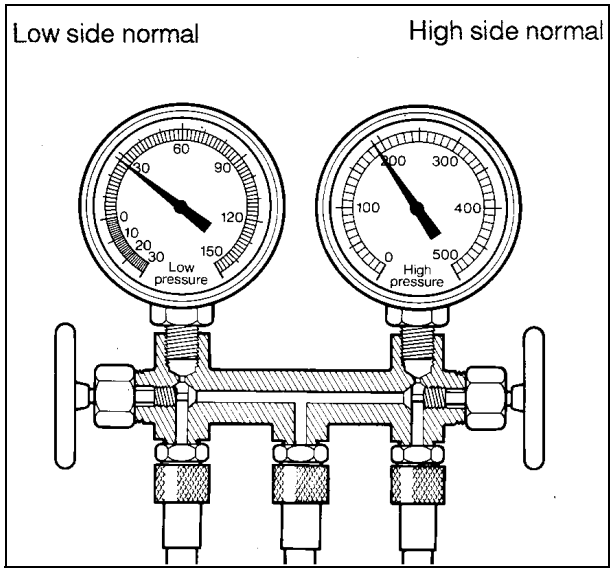
- Some air and moisture in the system.

Correction

1. Leak test system. Leak test the compressor seal area and self sealing couplings very carefully.
2. Remove refrigerant from system.
3. Repair leaks as located.
4. Replace receiver-drier. The drier is probably saturated with moisture.
5. Check the oil level in the compressor.
6. Evacuate the system for at least 30 minutes.
7. Charge the system with R-134a.
8. Operate the system and check the performance.

TEST CONDITION 2

Excessive moisture.



Gauge readings

Low side gauge - normal.

High side gauge - normal.

Other symptoms

- Discharge air - becomes warm as low side cycles into vacuum. As moisture is released by saturated desiccant, it becomes trapped and freezes at the expansion valve, blocking R-134a flow into the evaporator.
- Discharge air - becomes warm all the time during the hot part of the day. Warmer ambient temperatures cause more moisture to be released from saturated desiccant. It collects and freezes at the expansion valve, blocking R-134a flow into the evaporator.

Diagnosis

- Excessive moisture in the system.

Correction

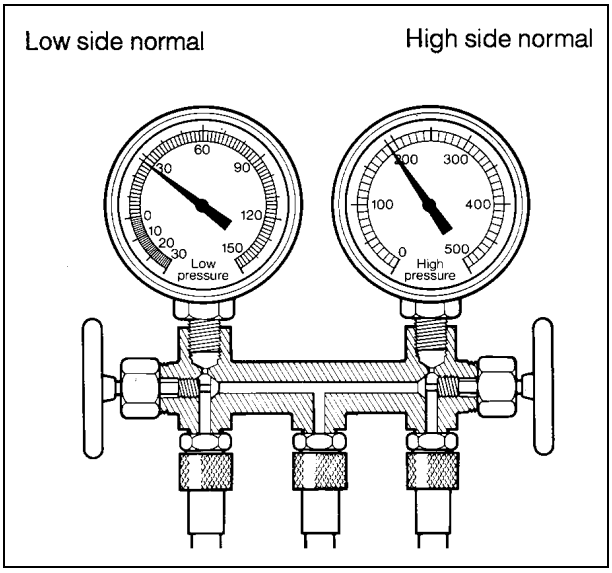
1. Leak test system. Leak test the compressor seal area and self sealing couplings very carefully.
2. Remove refrigerant from system.
3. Repair leaks as located.
4. Replace receiver-drier. The drier is probably saturated with moisture.
5. Check the oil level in the compressor.
6. Evacuate the system for at least 30 minutes.
7. Charge the system with R-134a.
8. Operate the system and check the performance.

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TEST CONDITION 3

Defective temperature control system.



Gauge readings

Low side gauge - normal.

High side gauge - normal.

Other symptoms

- Compressor - cycles ‘on’ and ‘off’ too fast.
- Low side gauge - not enough range shown on low side gauge.

Diagnosis

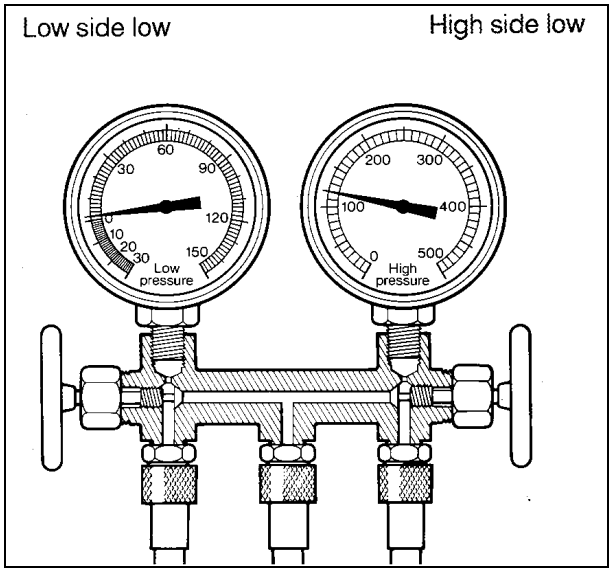
- Defective temperature control system.

Correction

1. Stop the engine and turn air conditioner ‘off’.
2. Check through electrical system, *(see page 12C-35)*, replace defective components.
3. Operate the system and check performance.

TEST CONDITION 4

Low R-134A charge.



Gauge readings

Low side gauge - low or vacuum.

High side gauge - low.

Other symptoms

- Discharge air - slightly cool.

Diagnosis

- System slightly low on R-134a.

Correction

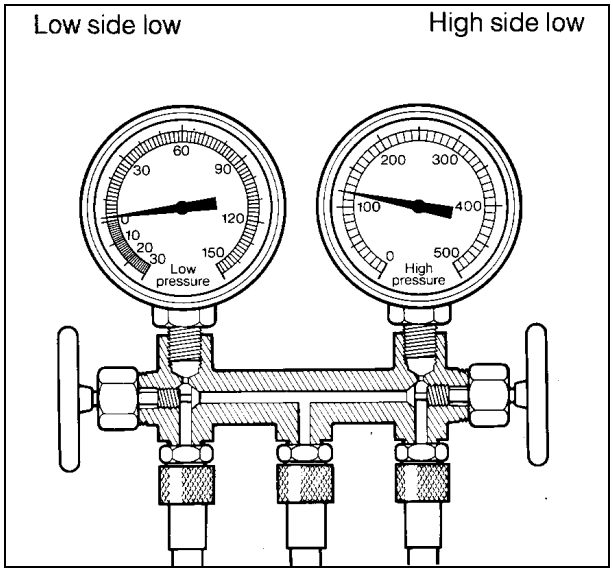
1. Leak test system.
2. Discharge refrigerant from the system if necessary to replace units or lines.
3. Repair leaks as located.
4. Check the oil level in the compressor. System may have lost oil due to leakage.
5. Evacuate the system using the vacuum pump.
6. Charge the system with R-134a.
7. Operate the system and check the performance.

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TEST CONDITION 5

Very low R-134A charge.



Gauge readings

Low side gauge - low or vacuum.

High side gauge - low.

Other symptoms

- Discharge air - warm.

Diagnosis

- System very low on R-134a.
- Possible leak in system.

Correction

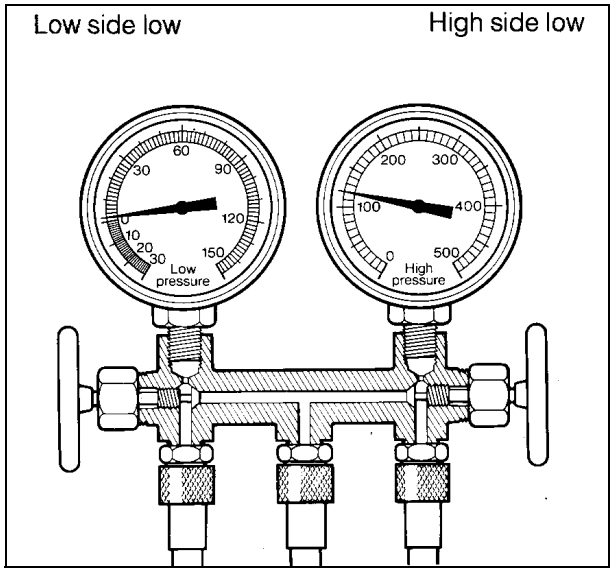
1. Leak test system.

NOTE: *Remove and add a full charge to the system before leak test to ensure a leak test indication.*

2. Leak test compressor seal very carefully.
3. Discharge refrigerant from the system if necessary to replace units or lines.
4. Repair leaks.
5. Check compressor oil level. System may have lost oil due to leakage.
6. Evacuate the system using the vacuum pump.
7. Charge system with R-134a.
8. Operate the system and check performance.

TEST CONDITION 6

Expansion valve stuck closed.



Gauge readings

Low side gauge - low.

High side gauge - low to vacuum.

Other symptoms

- Discharge air - slightly cool.
- Expansion valve - Sweating or frost build up.

Diagnosis

- Expansion valve stuck closed.
- Expansion valve inlet blocked.
- Temperature Sensing malfunction.

Correction

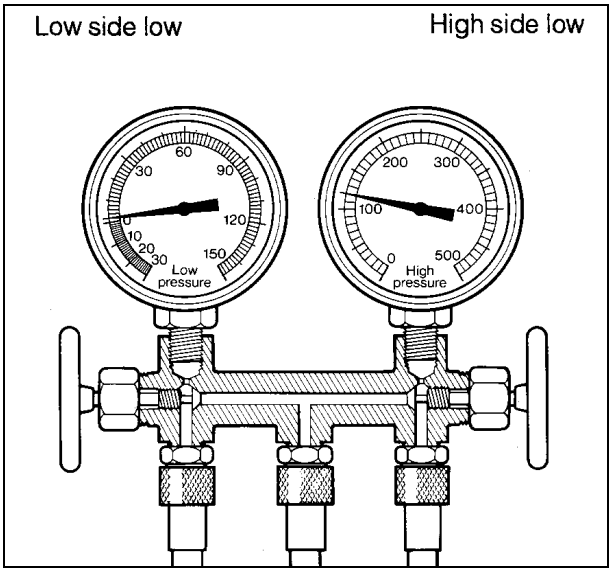
1. Clean out expansion valve or replace.
2. Evacuate the system using the vacuum pump.
3. Charge the system with R-134a.
4. Operate the system and check performance.

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TEST CONDITION 7

Restriction in high side.



Gauge readings

Low side gauge - low.

High side gauge - low.

Other symptoms

- Discharge air - slightly cool.
- High side lines - cool and also shows sweating or frost. Frost will build-up after the point of restriction.

Diagnosis

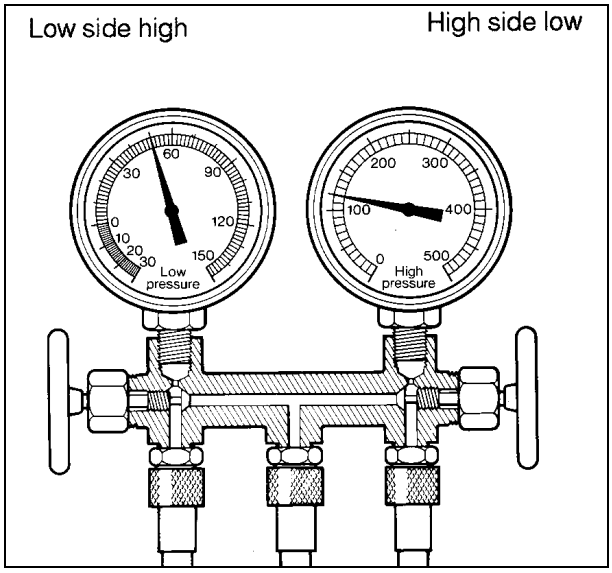
- Restriction in the high side of the system.
- Receiver-drier malfunction.

Correction

1. Discharge the system.
2. Remove and replace the receiver-drier, liquid lines or other defective components.
3. Evacuate the system using the vacuum pump.
4. Charge the system with R-134a.
5. Operate the system and check performance.

TEST CONDITION 8

Compressor malfunction.



Gauge readings

Low side gauge - high.

High side gauge - low.

Other symptoms

- Compressor noisy.
- Discharge air - slightly cool.

NOTE: *If the compressor is not noisy with these Gauge readings, the problem may be caused by a loose or worn drive belt.*

Diagnosis

- Compressor - malfunction.

Correction

1. Discharge the refrigerant from the system.
2. Remove, repair or replace the compressor.
3. Check the compressor oil level.
4. Replace the receiver-drier if:

a. The system has been previously opened.

b. The system has operated for two or more seasons with the present unit.

c. Compressor inspection reveals dessicant particles inside (very fine golden or brown particles).

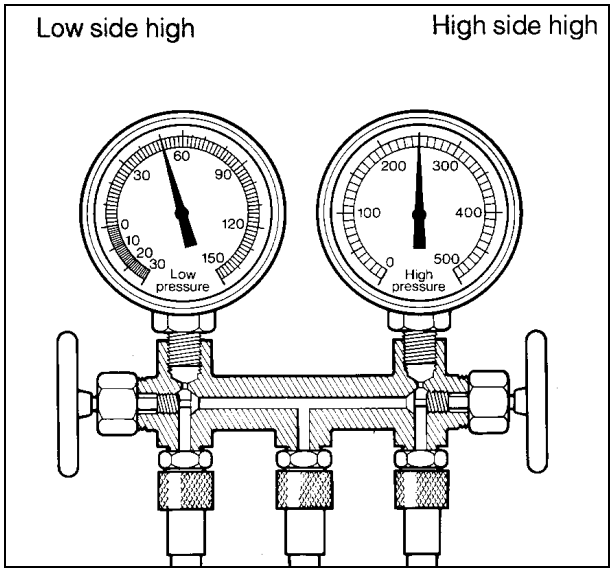
5. Evacuate the system using the vacuum pump.
6. Charge the system with R-134a.
7. Operate the system and check performance.

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TEST CONDITION 9

Condenser malfunction.



Gauge readings

Low side gauge - High.

High side gauge - High.

Other symptoms

- Discharge air - warm.
- High side lines - very hot.

Diagnosis

- Malfunctioning condenser or over charge.
- High/Low pressure safety cut-out switch in operation.

Correction

1. Inspect the condenser for blocked air passages, bent or damaged fins, or other obstructions preventing the flow of air through the condenser.
2. Check that the tractor engine radiator is not restricted.
3. Carry out an inspection of the tractor engine cooling system, ensure that the radiator pressure cap is the correct type and pressure, rectify any faults found.

After making the above corrections:

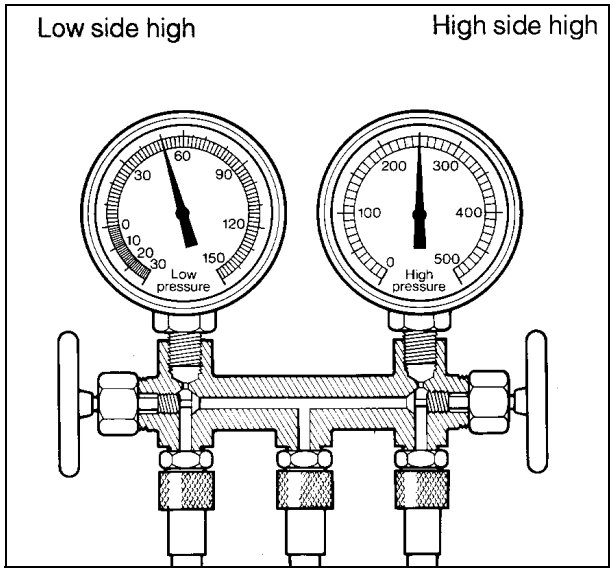
4. Operate the system and check the performance.

If the Gauge readings are still too high:

5. Discharge the system.
6. Remove and inspect the condenser to ensure free passage of refrigerant or replace the condenser.
7. Replace the receiver-drier.
8. Evacuate the system using the vacuum pump.
9. Charge the system with R-134a.
10. Operate the system and check performance.

TEST CONDITION 10

Excessive air and moisture.



Gauge readings

Low side gauge - high.

High side gauge - high.

Other symptoms

- Discharge air - slightly cool.

Diagnosis

- Large amount of air and moisture.

Correction

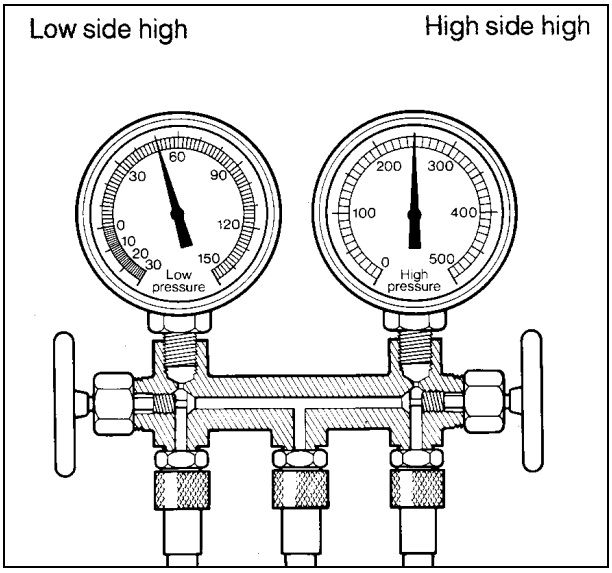
1. Discharge the refrigerant from the system.
2. Replace the receiver-drier which may be saturated with moisture.
3. Evacuate the system using the vacuum pump.
4. Charge the system with R-134a.
5. Operate the system and check performance.

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TEST CONDITION 11

Expansion valve stuck open.



Gauge readings

Low side gauge - high.

High side gauge - normal to high.

Other symptoms

- Discharge air - warm.
- Evaporator - sweating or frost.

Diagnosis

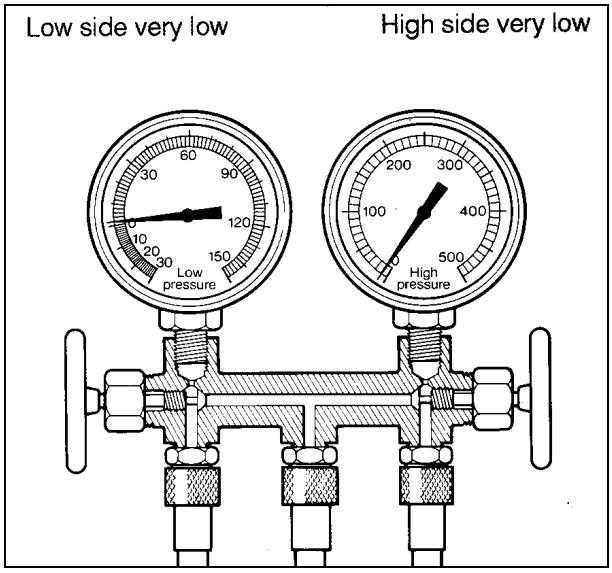
- Expansion valve stuck open.

Correction

1. Discharge the system.
2. Replace the expansion valve.
3. Evacuate the system using the vacuum pump.
4. Charge the system with R-134a.
5. Operate the system and check performance.

TEST CONDITION 12

Safety cut-out switch in operation.



Gauge readings

Low side gauge - very low or zero.

High side gauge - very low or zero.

Other symptoms

- Discharge air - warm.

Diagnosis

- High/Low pressure safety cut-out switch in operation.
- Loss of refrigerant

Testing

1. Leak test system.

Correction

1. Discharge the refrigerant from the system if necessary to replace units or lines.
2. Repair leaks.
3. Check compressor oil level. System may have lost oil due to leakage.
4. Evacuate the system using the vacuum pump.
5. Charge the system with R-134a.
6. Operate the system and check performance.

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CAB AIR FILTER

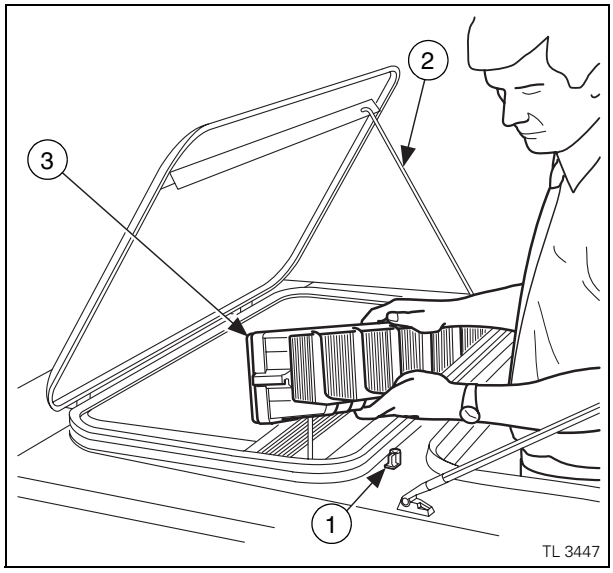
Servicing **18-12C**

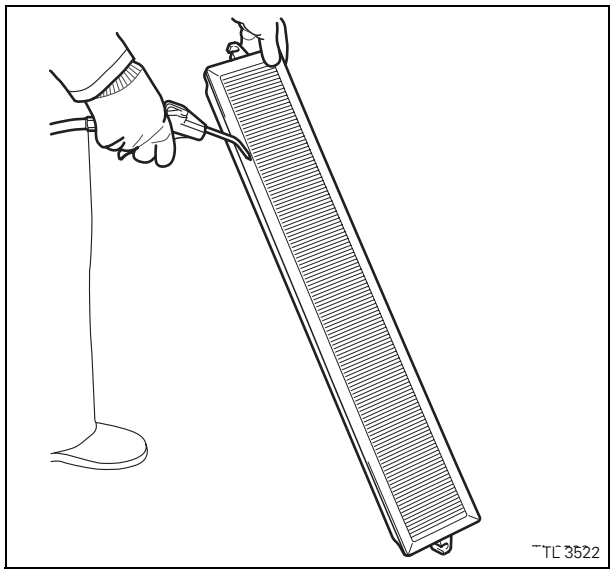
Procedure

1. Open the escape hatch and carefully hinge back over the cab roof.
2. Standing on the seat, reach through and turn the catches and lift and prop up the cover with the stay.
3. Loosen-off the two wing nuts and lift out the filter assembly taking care not to spill any accumulated dust.
4. Remove the element from the frame.
5. Clean the filter by carefully tapping it and then directing compressed air, maximum pressure 100 lbf/in² (7 bar), through the filter in the opposite direction to normal air flow.

IMPORTANT: *An incorrectly fitted cab air filter could result in a serious blockage of the air conditioning evaporator due to the ingress of dirt.*

6. Clean the filter chamber with a damp lint-free cloth.
7. Refit the filter, ensure that it seats correctly in the plenum chamber.
8. Close up all the hatches.



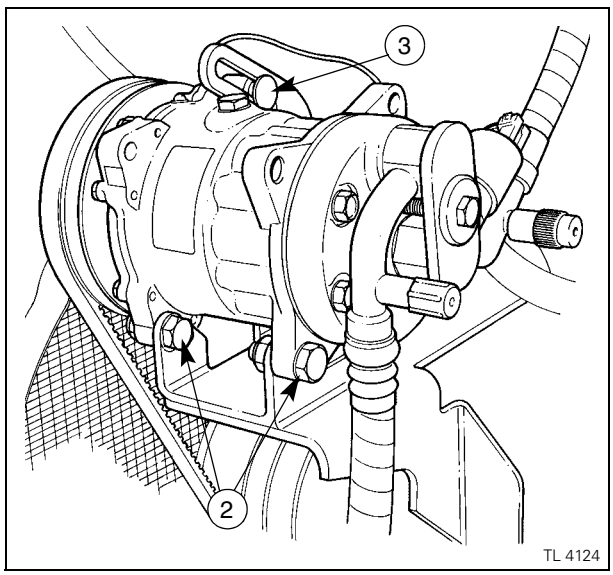


COMPRESSOR BELT TENSION

Servicing **19-12C**

Procedure

1. Remove the hood side panel.
2. Slacken the compressor mounting bolts.
3. Slacken the compressor adjustment bolt.
4. Pull the compressor away from the engine to tension the belt, the correct tension is 108-122 Nm (80-90 lbf) or 1/2-5/8 in (12-15 mm) belt deflection in the centre between the two pulleys.
5. Tighten all mounting and adjusting bolts.
6. Check that the engine alternator/fan belt is correctly adjusted.



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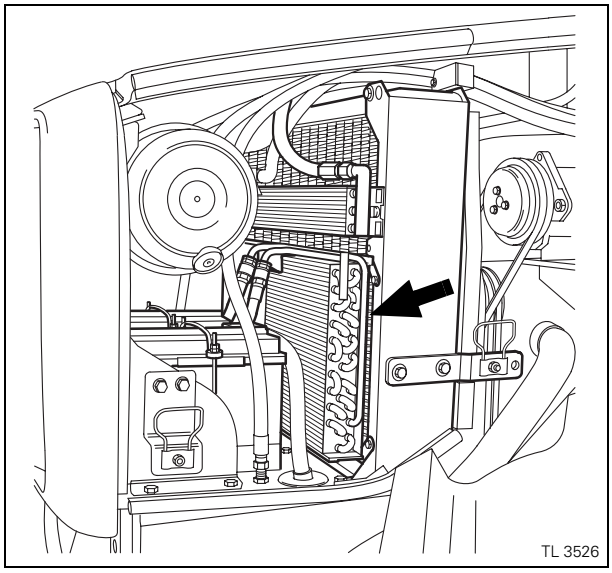
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CONDENSER

Service 20-12C

Procedure

1. Remove the two side panels.
2. Blow out any dust around the condenser.
3. Release the two spring clips retaining the condenser.
4. Partially withdraw the condenser from one side.
5. Clean the condenser by directing compressed air, maximum pressure 7 bar (100 lbf/in²), through the core in the opposite direction to normal air flow.
6. Clean the other half of the condenser by repeating procedure 4 on the other side.
7. After cleaning, slide the condenser back into position, refit the spring clips.



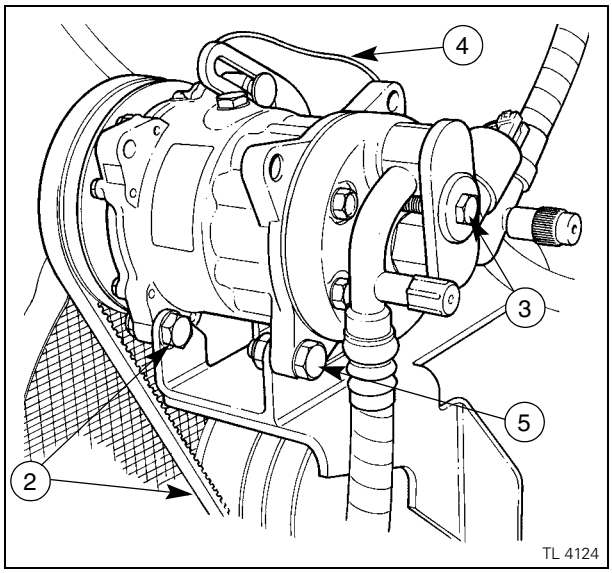
COMPRESSOR

Removal and Refitment 21-12C

Removal

CAUTION: *The air conditioning system MUST NOT be left open for any length of time. Whenever a component is removed, or a pipe connection disconnected all apertures MUST be capped to prevent the ingress of dirt and moisture. Moisture is the enemy of air conditioning systems.*

1. Recover the refrigerant from the air conditioning system, *(see operation 5-12C).*
2. Slacken the compressor mounting bolts and remove the drive belt.
3. Disconnect the suction and discharge hoses from the compressor. Seal both hoses to prevent the ingress of dirt and moisture. Discard the pipe end 'O' rings.
4. Disconnect the lead wire to the harness.
5. Remove the compressor mounting bolts and the compressor from the tractor.
6. Place caps over the inlet and outlet ports of the compressor to prevent ingress of dirt and moisture.



Refitment

7. Check the compressor oil level, *(see operation 25-12C).*
8. Reverse procedures 1 to 6 except:

a. Lubricate the new 'O' rings with clean compressor oil and tighten the hose clamp bolt to a torque of 34 Nm (25 lbf ft).

b. Tension the drive belt, *(see operation 19-12C).*

c. Replace the receiver-drier, *(see operation 28-12C).*

d. Evacuate the system, *(see operation 7-12C.*

e. Recharge the system, *(see operation 8-12C).*

f. Leak test the system, *(see operation 10-12C).*

g. Carry out final performance test, *(see operation 9-12C).*

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COMPRESSOR CLUTCH

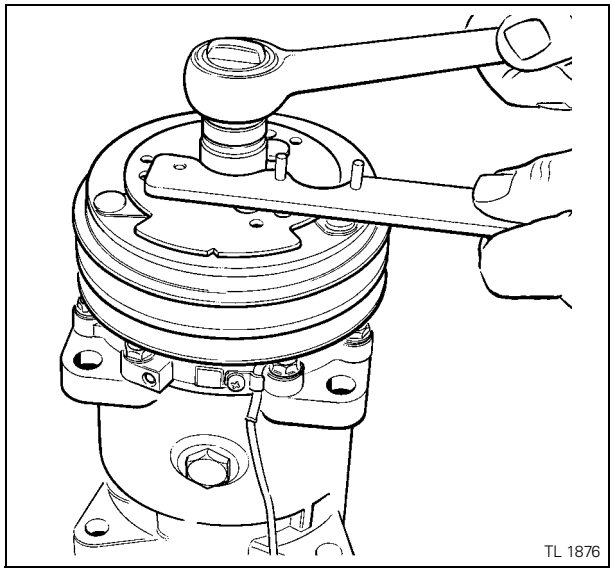
Removal and Refitment **22-12C**

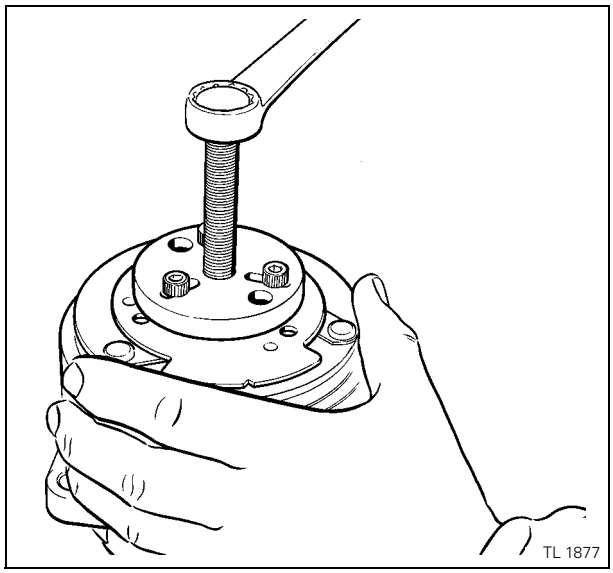
Special Tools:

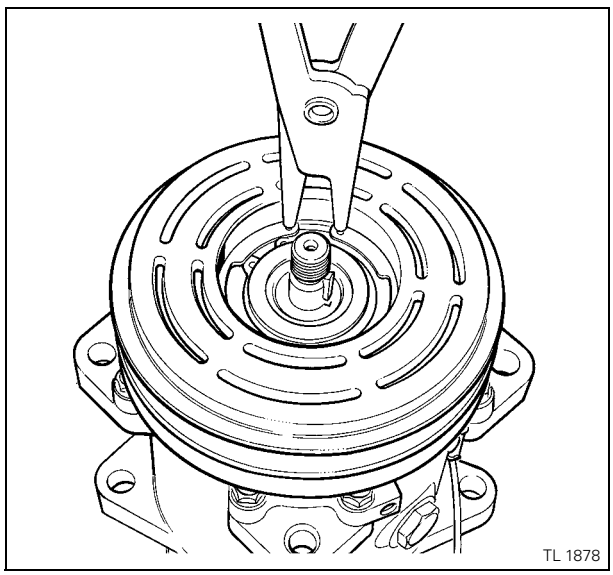
10204 Clutch holder
10787 Clutch plate installer
14163 External circlip pliers
14164 Internal circlip pliers
40682 Handle
40735 Puller sleeve
40737 Puller pilot
40749 Clutch plate puller
40750 Bearing remover/replacer
Qty. 2 off 3/8-16 x 1 1/4 in Socket head cap screws
Qty. 3 off 1/4-20 x 1 1/4 in Socket head cap screws

Removal

1. Remove the compressor, *(see operation 21-12C)*.
2. Remove the three set screws and the metal cover over the front clutch plate.
3. Insert the pins of the clutch holder (10204) into threaded holes in the clutch front plate. Hold the clutch plate stationary. Remove the shaft nut with a 3/4 inch across flats socket.
4. Remove the clutch front plate using the puller (40749) and the three cap screws. Align the puller centre bolt to the compressor shaft. Finger tighten the three cap screws in the threaded holes. Turn the centre bolt clockwise with a 13/16 inch across flats socket until the front plate is loosened. Remove the front plate.
5. Remove the dust cover, be careful to avoid distorting the cover when removing.
6. Remove the shaft key by lightly tapping it loose with a screwdriver and hammer.
7. Remove the internal bearing circlip by using the internal circlip pliers (14164).
8. Remove the external front housing circlip by using the external circlip pliers (14163).


TL 1876

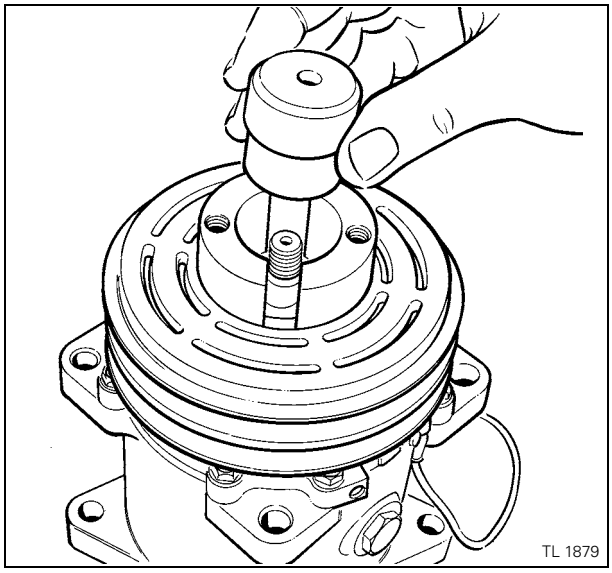

TL 1877


TL 1878

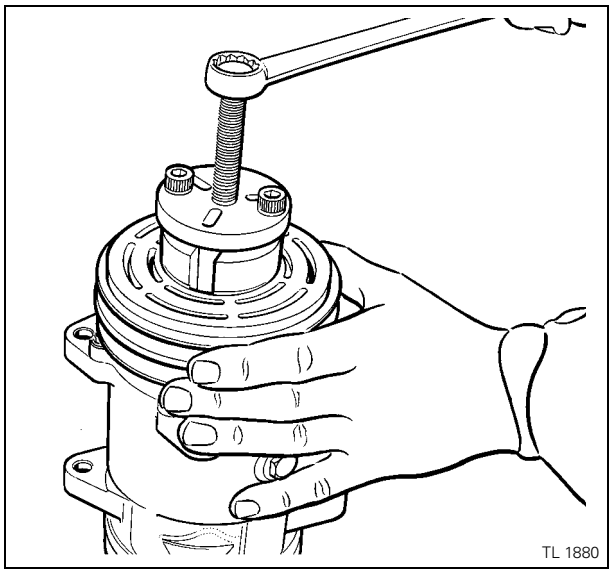
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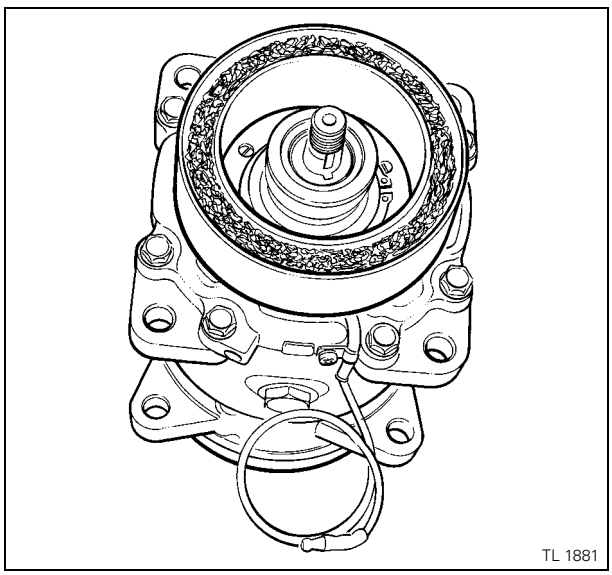
9. Remove the pulley assembly by inserting the lip of the jaws of the sleeve puller (40735) into the circlip groove. Place the puller pilot (40737) inside the jaws of the sleeve to hold them in place.



10. Place two cap screws through the puller plate (40749) that align with the threaded holes in the two parts of the sleeve puller and hand tighten.
11. Turn the puller centre bolt clockwise using a 13/16 inch across flats socket until the rotor is free.
12. Lift off the rotor and puller.



13. Remove the field coil by loosening the lead wire from the clip.
14. Using external circlip pliers, remove the circlip and field coil.

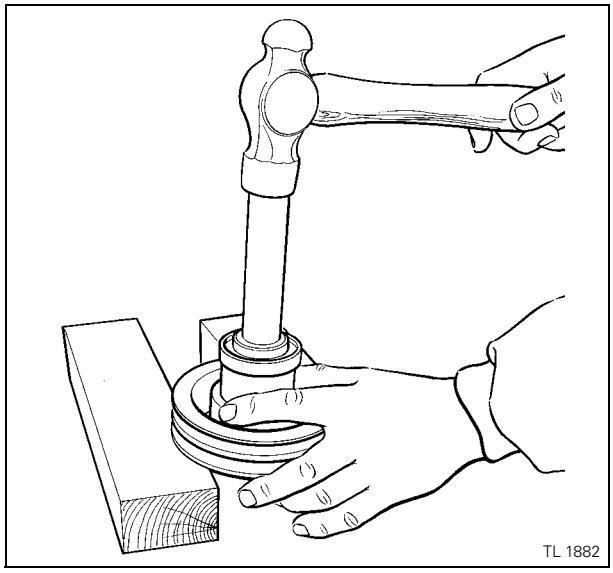


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Pulley bearing

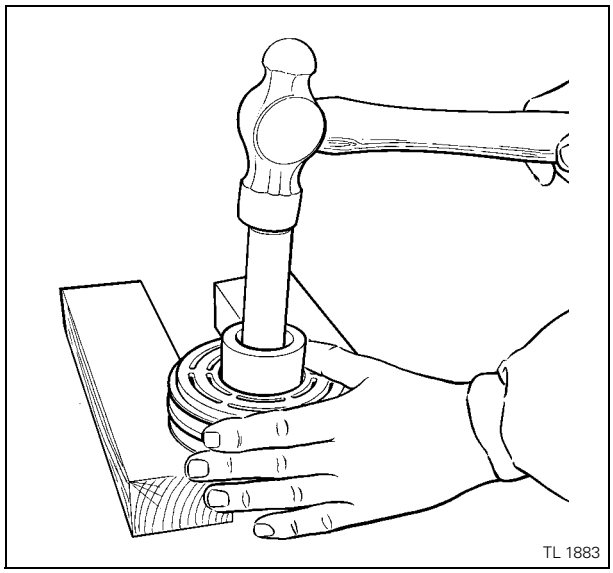
15. Remove the bearing retaining ring and support the pulley on two blocks of wood spaced to allow clearance for the bearing.
16. Screw the handle (40682) into the large end of the bearing remover tool (40750) and drive or press the bearing out.


TL 1882

Refitment

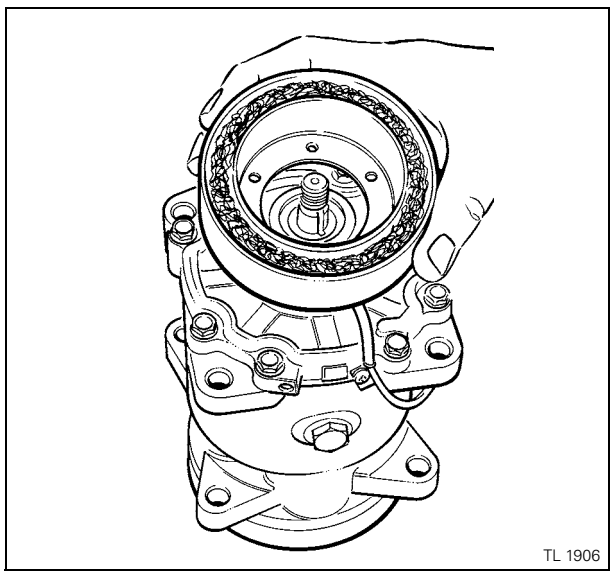
Pulley bearing

17. Place the bearing face down on a clean flat surface. Align and insert a new bearing into the pulley housing.
18. Screw the handle (40682) into the small end of the bearing installer tool (40750) and drive or press the bearing into place. Replace the bearing retaining ring.


TL 1883

Field coil

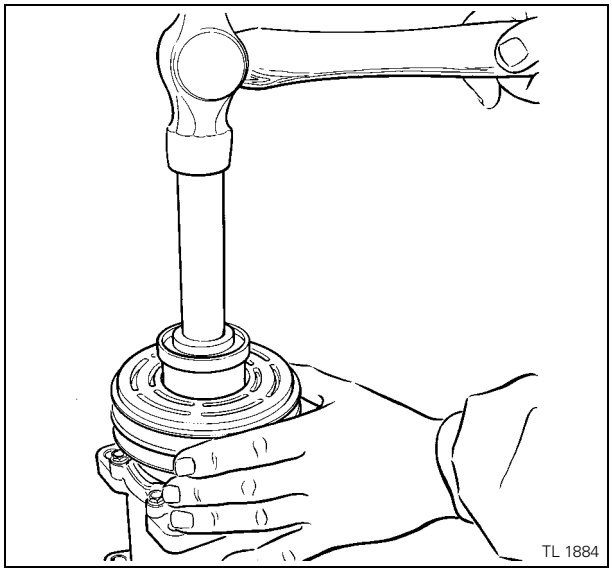
19. Install the field coil, ensure that the coil is seated correctly on the flange protrusion to prevent coil movement and correctly locate the lead wire.
20. Replace the rotor pulley. Support the compressor on the four mounting ears at the compressor rear. If you are using a vice, clamp only on the mounting ears, never on the compressor body. Align the rotor assembly squarely on the front housing hub.


TL 1906

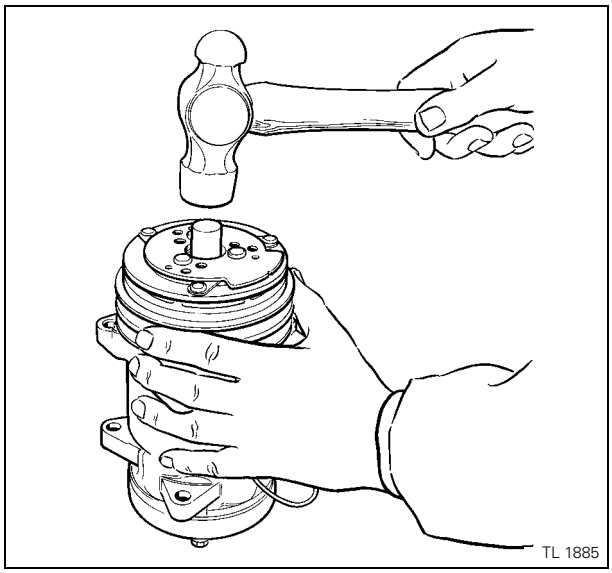
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21. Screw the handle (40682) into the large end of the bearing remover tool (40750) and drive or press the pulley until it bottoms against the compressor front housing hub.
22. Reinstall the internal bearing circlip with the pliers.
23. Reinstall the external front housing circlip with the pliers.
24. Check that the original clutch shims are in place on the compressor shaft.



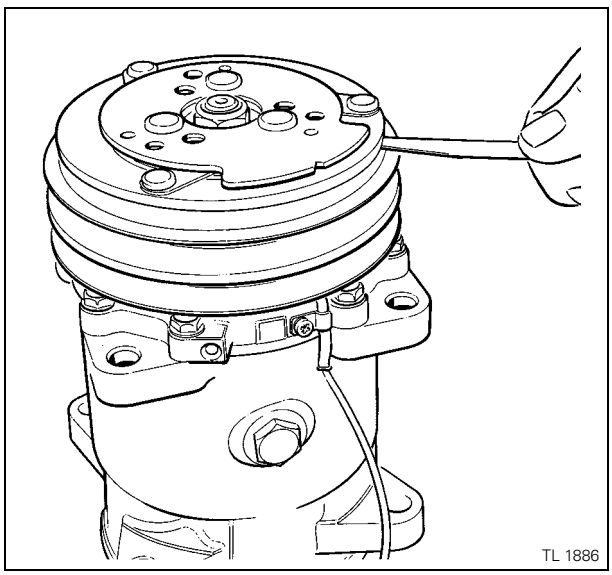
25. Replace the compressor shaft key and align the front plate keyway to the shaft key.
26. Using the clutch plate installer (10787), tap the front plate onto the shaft until it has bottomed to the clutch shims. Note a distinct sound change.
27. Replace the shaft nut and torque to 18 Nm (13 lbf ft).



28. Check the air gap with the feeler gauge, it should be 0,4-0,8 mm (0.016-0.031 in). If the air gap is not constant around the circumference, lightly pry up on the counter-weighted front plates at the low spots. Lightly tap down the high spots.

NOTE: *The air gap is determined by the spacer shims. When refitting or installing a new clutch assembly, try the original shims first. When installing a new clutch onto a compressor that did not have a clutch, use the 1* mm *(0.040 in), 0,5* mm *(0.020 in), and 0,25* mm *(0.005 in) shims from the clutch accessory pack.*

29. If the air gap does not meet the specification in procedure 28, add or subtract shims by repeating procedures 24 to 27.
30. Replace the dust cover and tighten the screws to a torque of 3,6 Nm (2.7 lbf ft).
31. Replace the compressor, *(see operation 21-12C).*



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COMPRESSOR SHAFT SEAL

Removal and Refitment **23-12C**

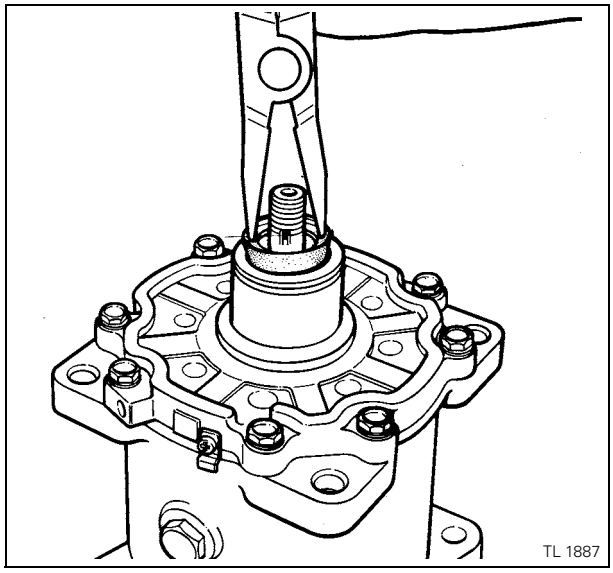
Special Tools:

10507	*Seal seat remover/replacer*
10508	*'O' ring remover/replacer*
10785	*Seal remover/replacer*
10786	*Seal protector*
14163	*External circlip pliers*
14164	*Internal circlip pliers*

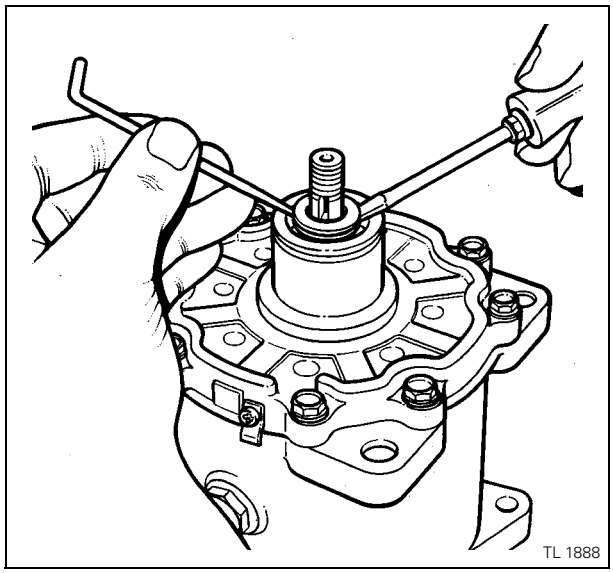
Removal

1. Remove the compressor, *(see operation 21-12C).*
2. Remove the clutch front plate, *(see procedures 2, 3 and 4, operation 22-12C).*

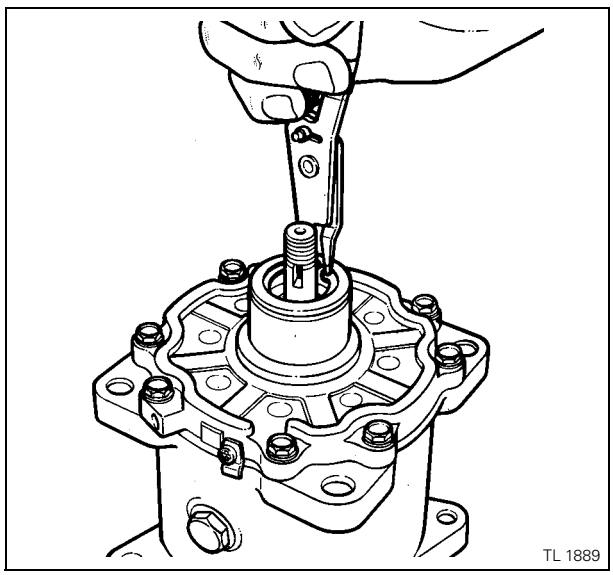
NOTE: *Shaft seal replacement should be done on a bench. Never reuse any old parts of the shaft seal assembly.*


TL 1887

3. Using either of the circlip pliers, insert the tool points into the two holes of the felt ring metal retainer and lift out the felt ring.
4. Remove the clutch shims. Use 'O' ring remover/ replacer (10508) and a small screwdriver (as shown) to prevent the shim binding on the shaft.


TL 1888

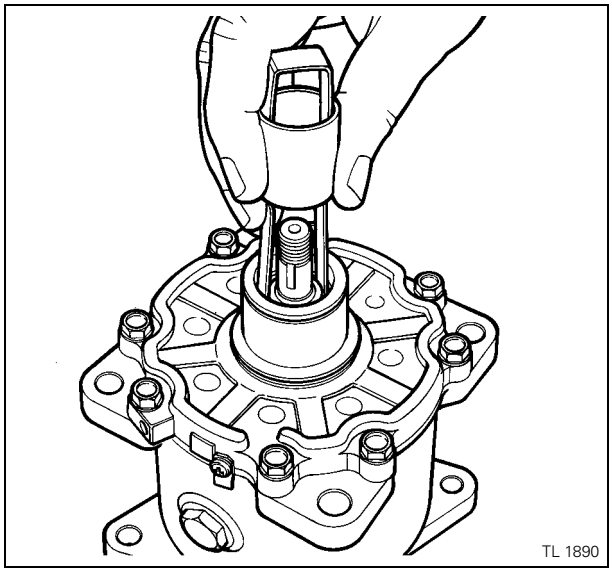
5. Remove the shaft seal seat retaining snap ring with the internal snap ring pliers (14164).


TL 1889

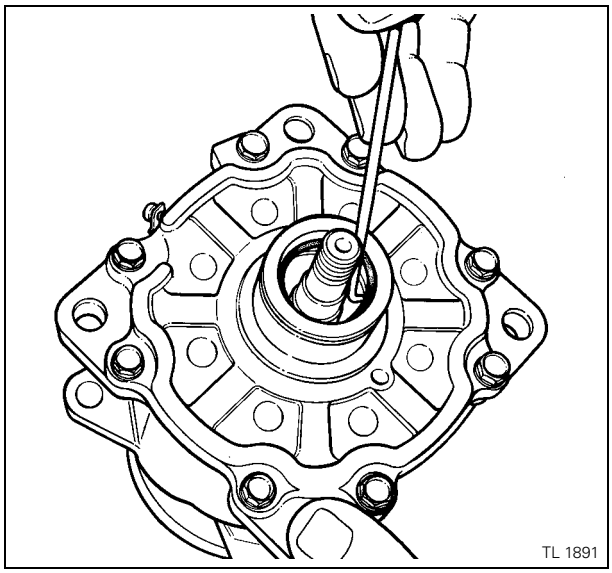
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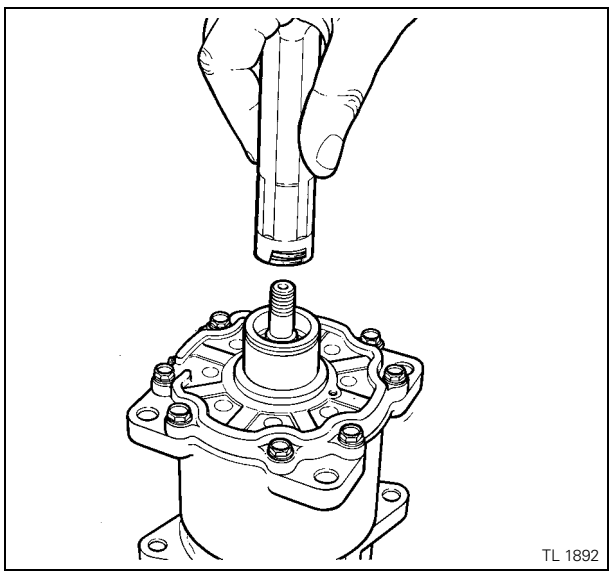
6. Remove the shaft seal seat, using the seal seat remover (10507), insert the tool into the housing and grasp the groove on the steel seat. Slide the sleeve over the tool to hold it in the seal groove while pulling the seal seat out.


TL 1890

7. Use the 'O' ring hook (10508) to remove the shaft seal 'O' ring. Be careful not to scratch the groove.


TL 1891

8. Insert the seal remover/replacer tool (10785) against the seal assembly. Press down against the seal spring and twist the tool clockwise until it engages the slots of the seal cage. Lift out the seal assembly.


TL 1892

Refitment

9. Clean out the seal cavity thoroughly:

a. Clean and blow out with a dry pressurised vapour.

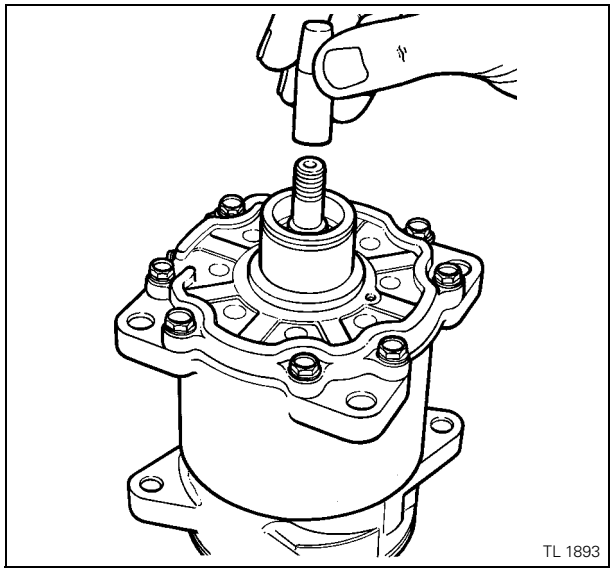
b. Clean thoroughly with a 'lint free' or synthetic cloth and clean refrigerant oil. Then blow out with dry pressurised vapour.

c. Check that all foreign substances are thoroughly removed.

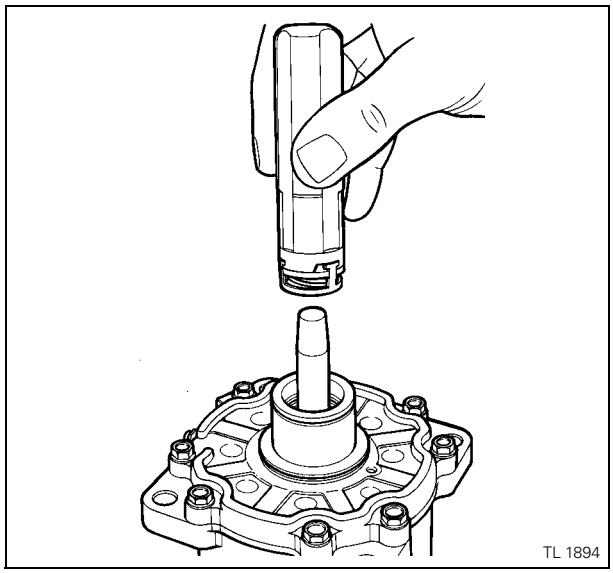
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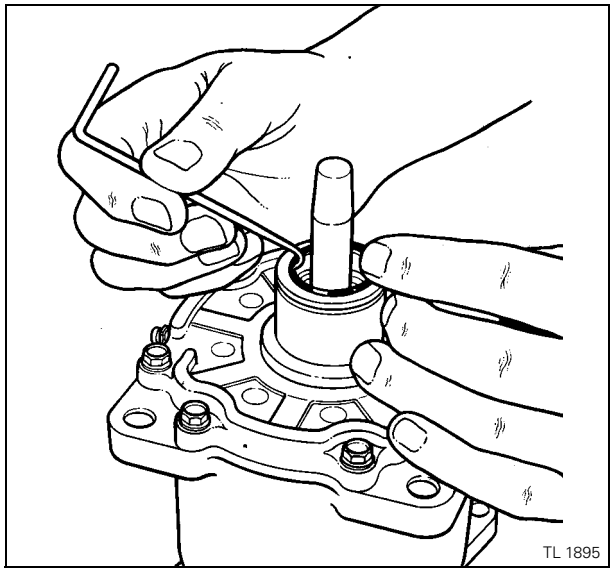
10. Insert the seal sleeve protector (10786) over the compressor shaft.



11. Do not touch the new seal mating surfaces. Dip the mating surfaces in clean refrigerant oil before proceeding.
12. Engage the slots of the seal remover/replacer (10785) to the new seal cage and insert the seal assembly firmly into place in the compressor seal cavity. Twist the tool in the opposite direction to disengage the tool from the seal cage. Remove the tool.



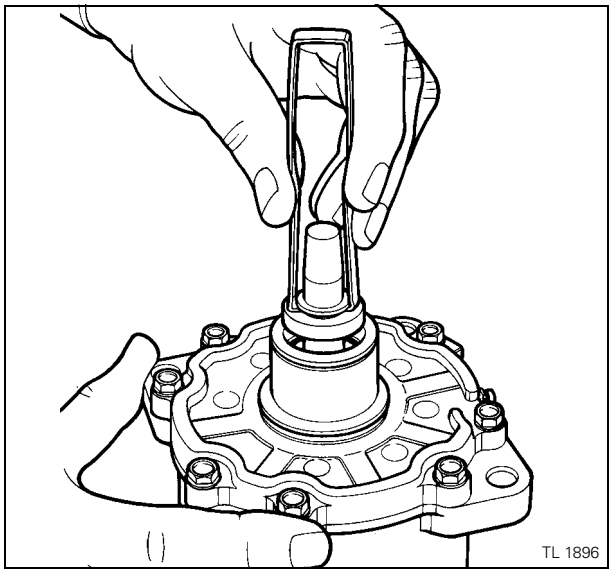
13. Coat the new 'O' ring with clean refrigerant oil. Place carefully in the seal groove with the 'O' ring remover/replacer. Do not scratch the surface or damage the 'O' ring.



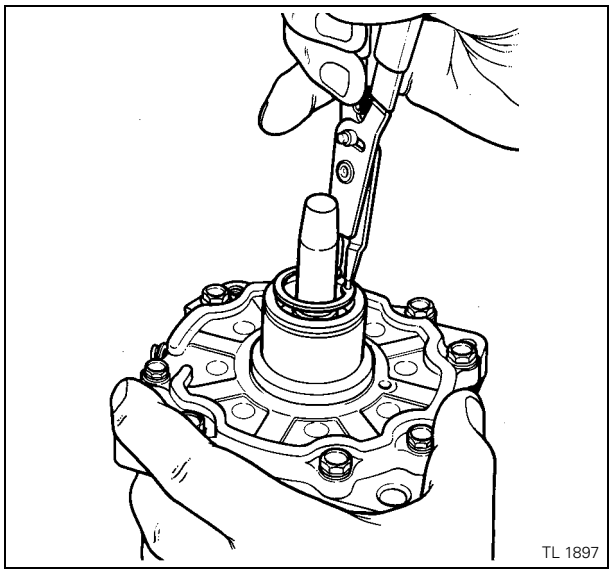
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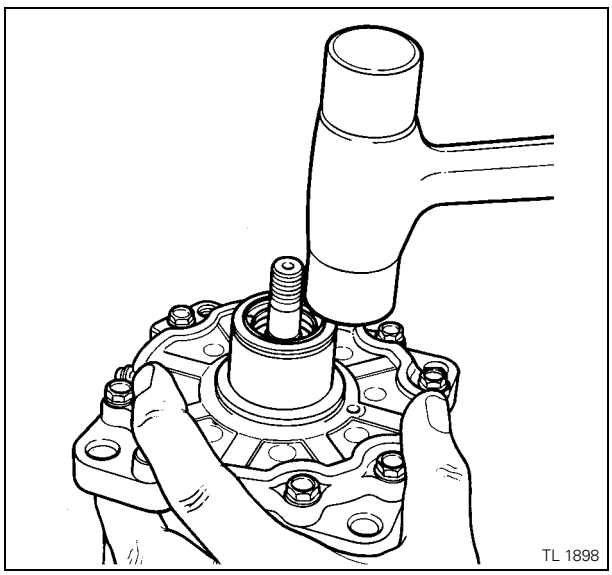
14. Coat the seal retainer with clean refrigerant oil. Use the seal seat tool (10507) to install. Press lightly against the seal.


TL 1896

15. Reinstall the circlip. Bevelled edge lies outwards (away from the compressor). Flat side lies towards the compressor. It may be necessary to lightly tap the circlip to securely position it in the groove.
16. Remove the seal protector.
17. Replace the clutch spacer shims.


TL 1897

18. Tap the new felt ring into place.
19. Reinstall the clutch front plate assembly, *(see operation 22-12C)*.
20. Refit the compressor to the tractor, *(see operation 21-12C)*.


TL 1898

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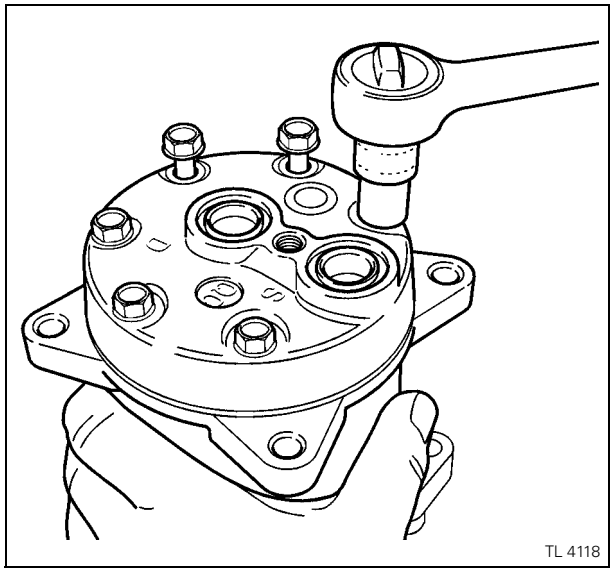
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COMPRESSOR CYLINDER HEAD AND VALVE PLATE

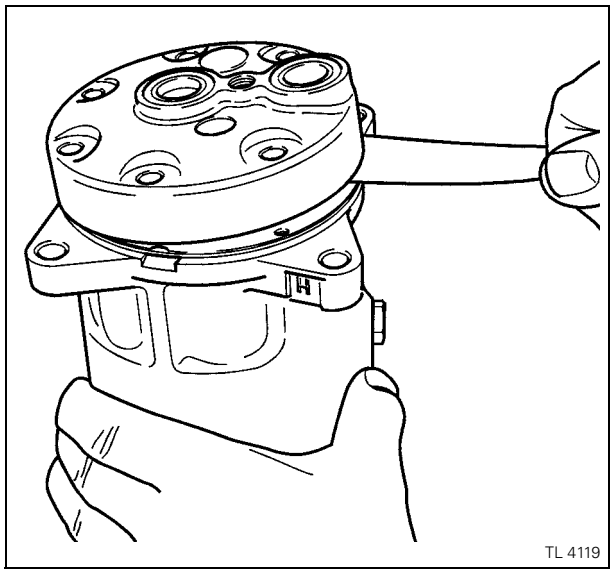
Removal and Refitment 24-12C

Removal

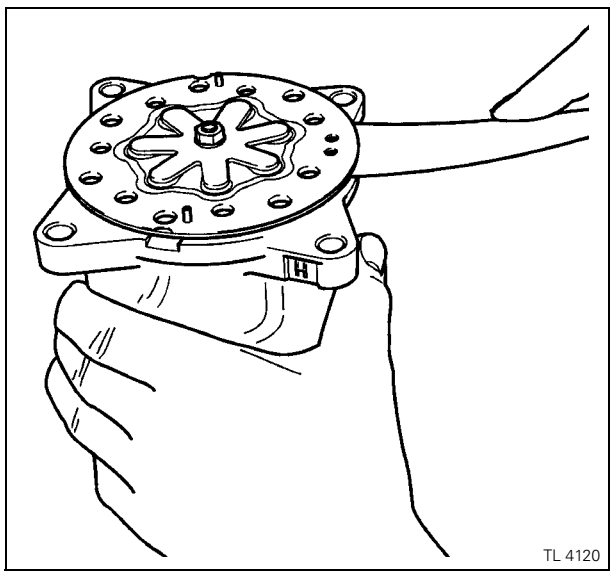
1. Remove the compressor, *(see operation 21-12C).*
2. Inspect the cylinder head for damage. Discard if damaged.
3. Remove the six cylinder head cap screws using a 13 mm socket.


TL 4118

4. Use a small hammer and the gasket scraper to tap the outer edge of the cylinder head until it is freed from the valve plate. Inspect for damage. (The cylinder head gasket normally sticks to the valve plate).


TL 4119

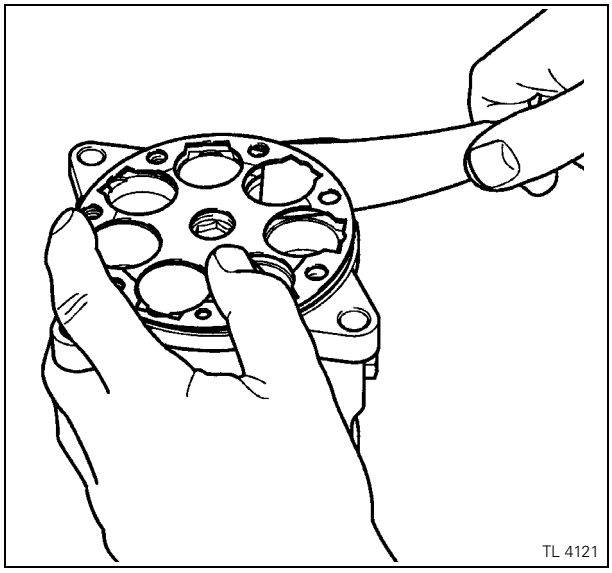
5. Position the gasket scraper between the outside edge of the valve plate and the cylinder block and lightly tap the valve plate loose.
6. Inspect the reed valves and discharge retainer. Discard assembly if any portion is damaged.


TL 4120

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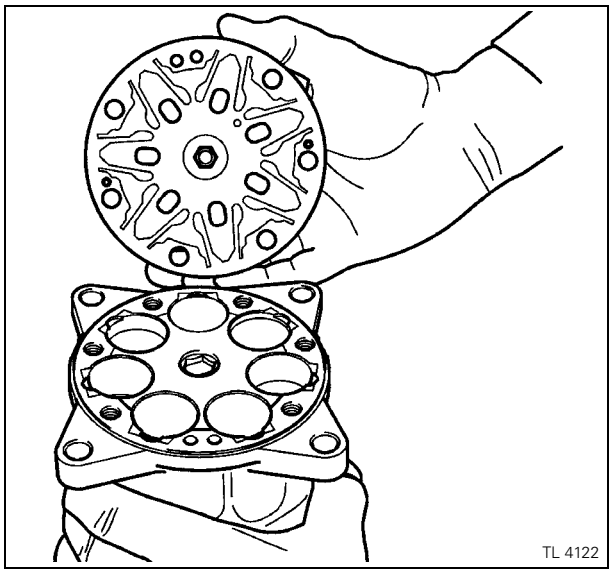
Tractor Manuals Scotland

7. If the valve plate and/or cylinder head are to be reused, carefully remove the gasket material using the gasket scraper. Do not damage the cylinder block or valve plate surfaces.

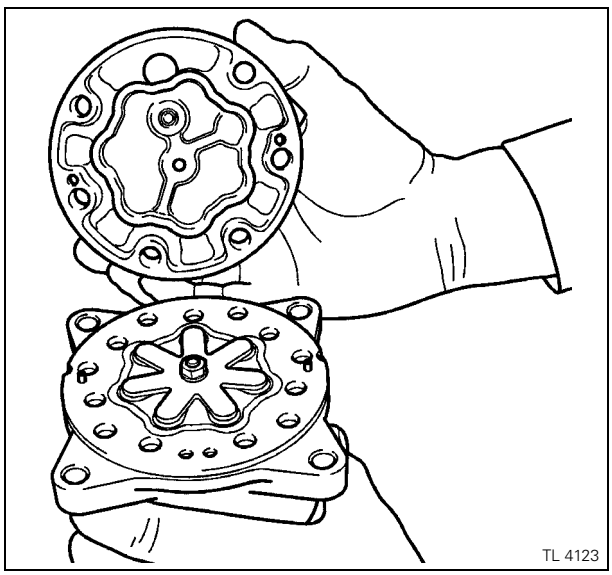

TL 4121

Refitment

8. Coat the valve plate gaskets with clean refrigerant oil.
9. Install the valve plate gasket, aligning it to the locating pin holes and oil orifice in the cylinder block. (For easy reference, the gaskets have a notch at the bottom outside edge).
10. Install the valve plate with the discharge valve, retainer and nut pointing away from the cylinder block, align the valve plate locating pins to the pin holes in the block and position the plate.


TL 4122

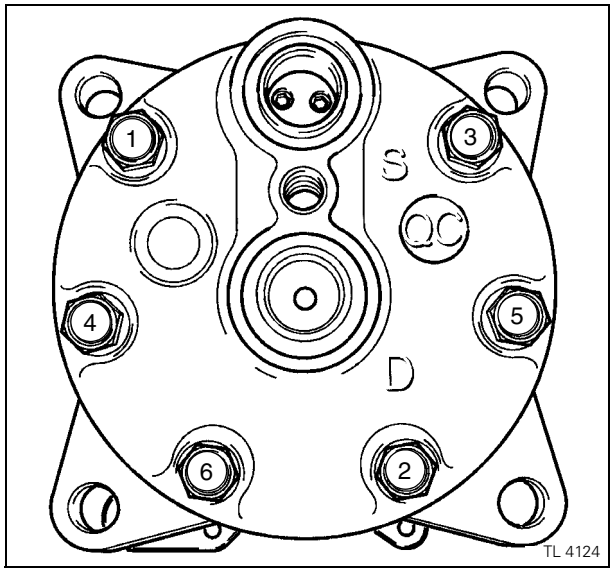
11. Position the top valve plate gasket and install the cylinder head.


TL 4123

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12. Torque the cap screws to 34 Nm (25 lbf ft) using the 'star' configuration as shown.
13. Reinstall the compressor, *(see operation 21-12C)*.



TL 4124

LUBRICATING OIL

Check 25-12C

Procedure

Lubrication oil is introduced into the system in three ways:

1. Checking and topping-up the compressor.
2. Introducing a measured amount into the component replaced.
3. Using an oil injector.

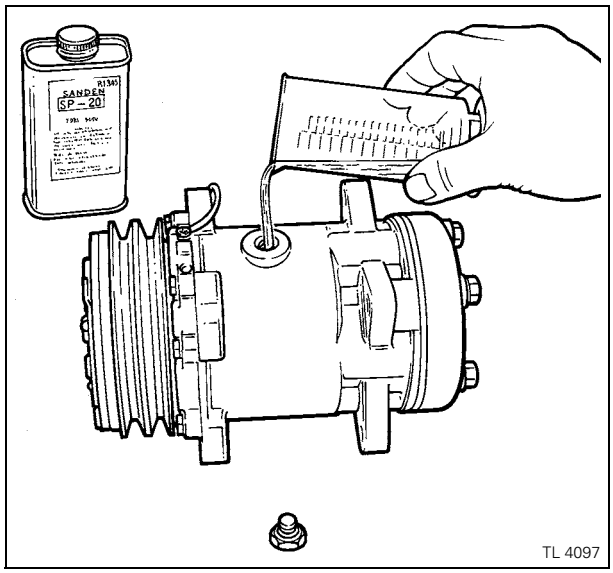
The compressor method will ensure that the oil is up to the required level, using a dip stick, at the time of repair and before the system is recharged, *(see operation 26-12C)*. This has the added advantage of ensuring that there is adequate oil and it is clean. The oil will then pass into the system during the initial running of the compressor.

The second method is to add a prescribed quantity of oil into the component that has been replaced using a measuring cylinder or syringe. Table 6 gives the quantities of oil required for each component:

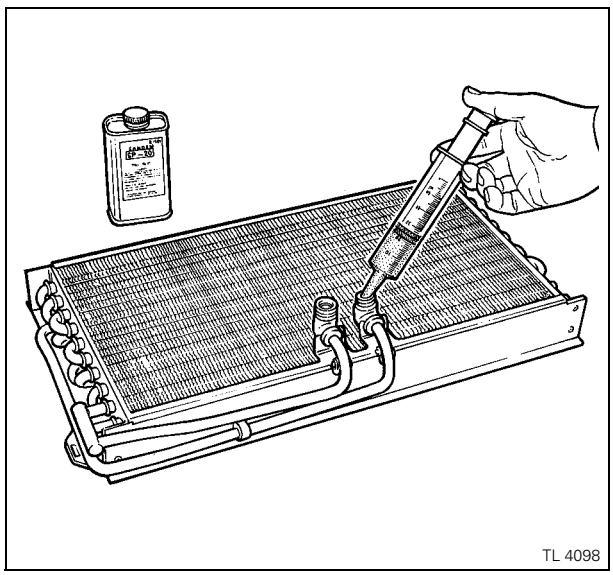
Component	Amount of oil	
	cc	fl oz
Evaporator	60	2.0
Condenser	30	1.0
Receiver-drier	15	0.5
Hoses	10	0.3

Table 6

The third method is to introduce the required quantity of oil when the system has been charged using an oil injector. This piece of equipment has a container for the oil, a control valve and is connected to the High Side of the system with a hose pipe. With the air conditioning operating the valve is opened the oil is drawn into the system, refer to the manufacturers instructions.



TL 4097


TL 4098

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COMPRESSOR OIL LEVEL

Check **26-12C**

Special Tools:
10916 Oil dip stick

Procedure

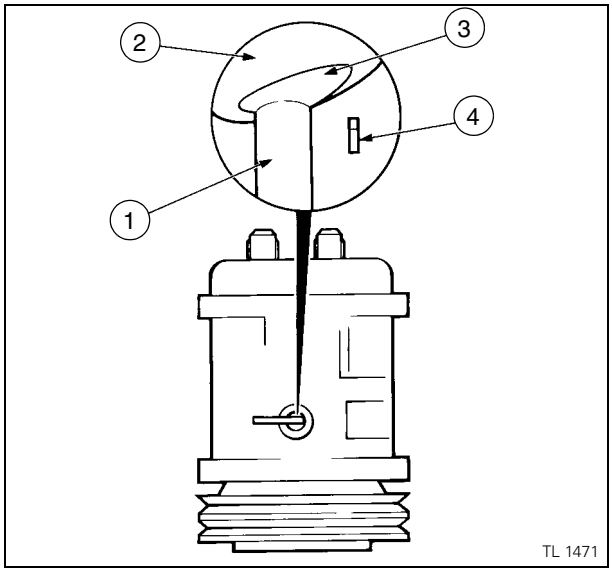
Compressor oil level is not checked as a regular maintenance procedure. The oil level and condition should be checked whenever a leak is encountered or the system is discharged.

If a component is replaced or a total refrigerant loss is experienced the compressor should be removed, drained of oil and refilled with the correct amount of clean oil.

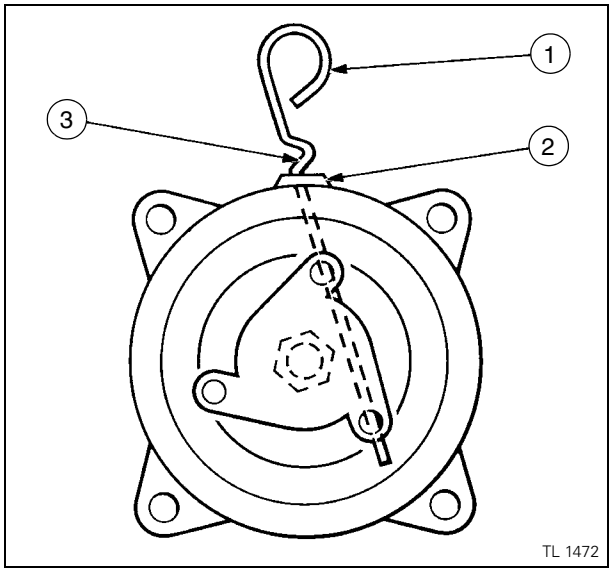
To check the compressor oil level the system must be discharged. Only new, pure. moisture-free refrigerant oil must be used in air conditioning systems. Refrigeration oil is highly refined and dehydrated. Therefore, the oil container must always be kept tightly closed when not in use. If the container is left uncapped, even for a short time, moisture will be absorbed from the atmosphere by the oil, and then introduced into the air conditioning system.

If possible, run the engine and system for about 15-20 minutes to allow the oil to distribute through the system.

1. After the compressor and system has been run, stop the engine. Remove the refrigerant from the system. Clean the dipstick.
2. Loosen the compressor mounting bolts, remove the drive belt, and move the compressor to a horizontal position so that the oil filter plug is at top dead centre.
3. Thoroughly clean the oil filter plug and the area around it. Loosen the filler plug slowly to allow trapped refrigerant pressure to escape through the loosened threads.
4. Ensure that the compressor is level. Look through the filler plug hole and rotate the clutch front plate until the internal parts are in the position shown in the illustration. This will permit the dipstick to be inserted clear of the internal parts.
5. A dipstick can easily be made to the dimensions given in the illustration.
6. Looking at the front end of the compressor (pulley end), insert the dipstick diagonally from upper left to lower right until the dipstick stop contacts the filler hole surface. Remove the dipstick and count the increments of oil. Oil should be between the 2nd and 4th increment on the dipstick when level. Add oil as necessary. The capacity when empty will be found in specifications at the front of this section.



1. Piston rod.
2. Ball socket.
3. Rod ball.
4. Dipstick.



1. Dipstick.
2. Oil filler hole.
3. Stop.

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IMPORTANT: *Only use recommended clean refrigerant oil. PAG Sanden SP-20.*

7. Check the condition of the oil:

Light brown and clean - oil in good condition

Dark brown and clean - long use in good condition

Black and contaminated - change oil and locate problem area

8. Install the oil filler plug, first checking that the sealing 'O' ring is not twisted.
9. Clean the seat and 'O' ring and torque the plug to 20 Nm (15 lbf ft). Do not overtighten the plug to stop a leak. If the plug leaks, replace the 'O' ring.

CONDENSER

Removal and Refitment 27-12C

Removal

1. Remove the two side panels.
2. Recover the refrigerant from the air conditioning system, *(see operation 5-12C).*
3. Disconnect the inlet pipe from the condenser, discard the 'O' ring and cap the end to prevent the entry of moisture.
4. Un-latch the two spring clips.
5. Disconnect the outlet pipe from the condenser, discard the 'O' ring and cap the end.
6. Slide out the condenser from the left hand side.

IMPORTANT: *Do not damage the condenser fins on the mounting stud projecting from the radiator casing.*

Refitment

7. Reverse procedures 2 to 6 except:

a. Lubricate the new inlet and outlet hose 'O' rings with clean compressor oil.

b. Tighten both hose fittings to a torque of 34 Nm (26 lbf ft) using a backing wrench.

c. Check the compressor oil level, add an extra 30 ml (1 fl oz) of oil above the specified level mark on the dipstick. Do this to replace the oil held in the old condenser.

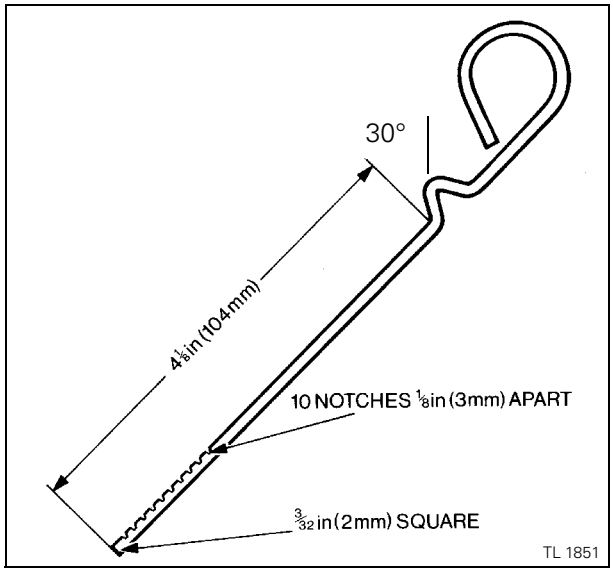
d. Replace the receiver-drier, *(see operation 29-12C).*

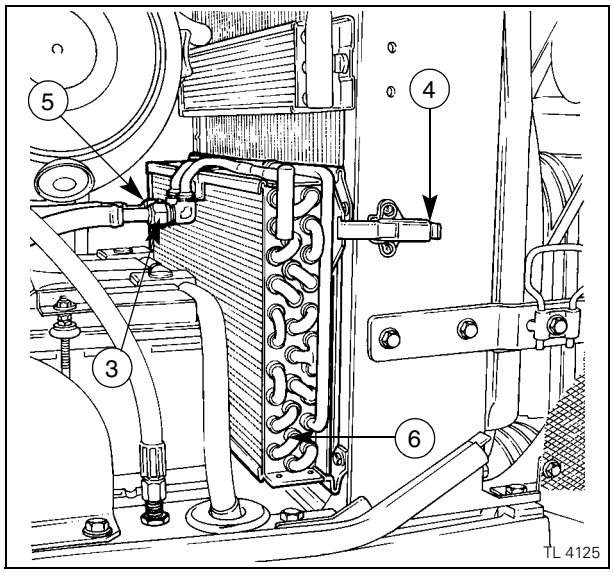
e. Evacuate the system, *(see operation 5-12C).*

f. Complete system charge, *(see operation 8-12C).*

g. Leak test the condenser, *(see operation 10-12C).*

h. Carry out final performance test, *(see operation 9-12C).*





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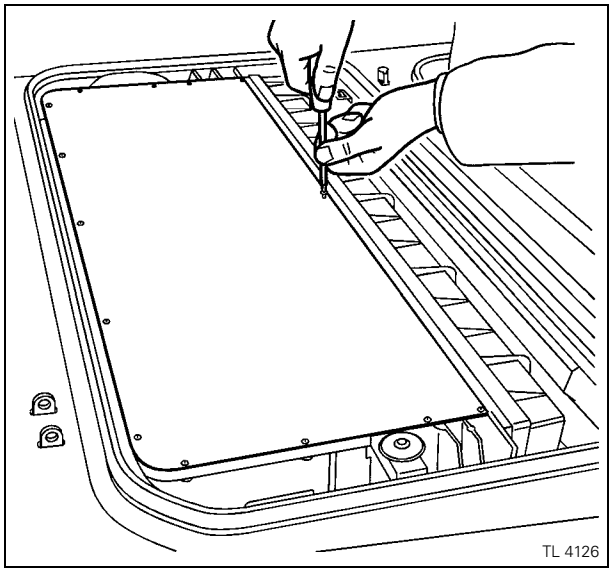
EVAPORATOR AND EXPANSION VALVE

Removal and Refitment 28-12C

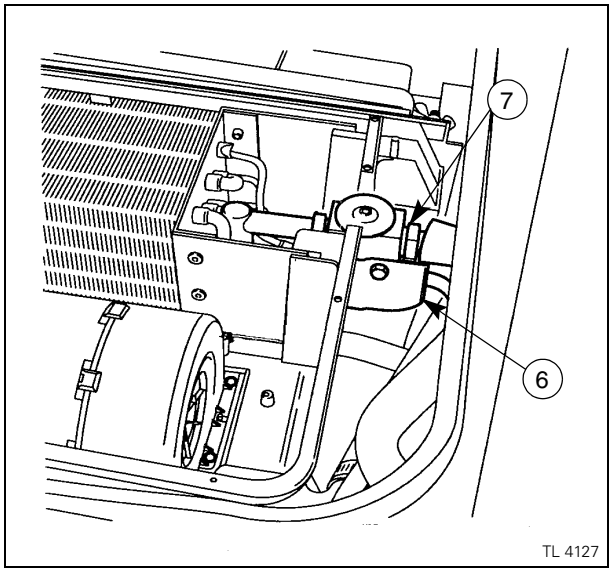
Removal

NOTE: *The heater core and evaporator are one common unit and can only be replaced as a single assembly.*

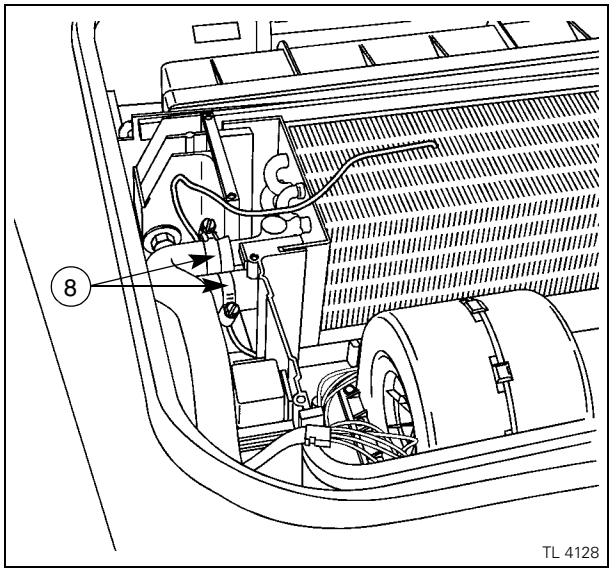
1. Recover the refrigerant from the system, *(see operation 5-12C)*.
2. Drain the coolant from the cab heater.
3. Open the escape hatch and carefully hinge back over the cab roof.
4. Standing on the seat, reach through and turn the catches, lift and fully open up the front cover.
5. Remove the 14 screws and the top cover plate.



6. On the left-hand side, remove the cover around the expansion valve.
7. Disconnect the refrigerant supply and return pipes from the expansion valve.



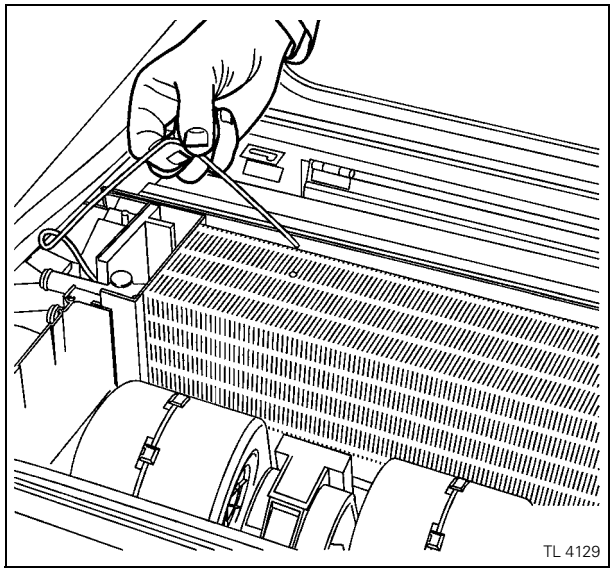
8. On the right-hand side, disconnect the two hoses from the heater.



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9. Extract the temperature control switch capillary tube from the evaporator core.



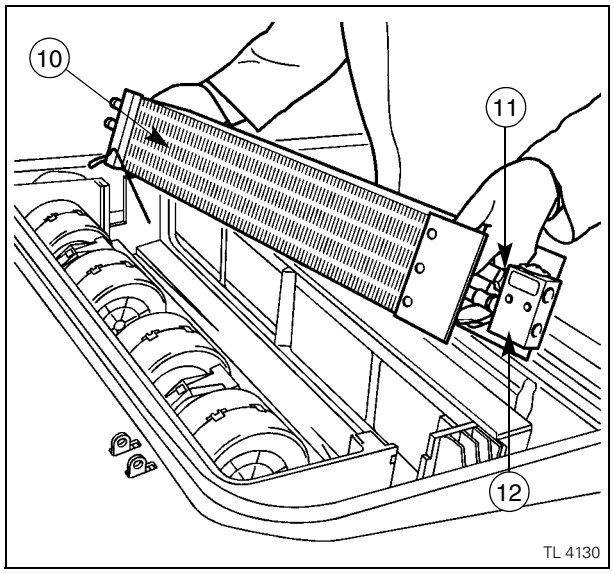
10. Lift out the evaporator and expansion valve assembly.

Expansion Valve

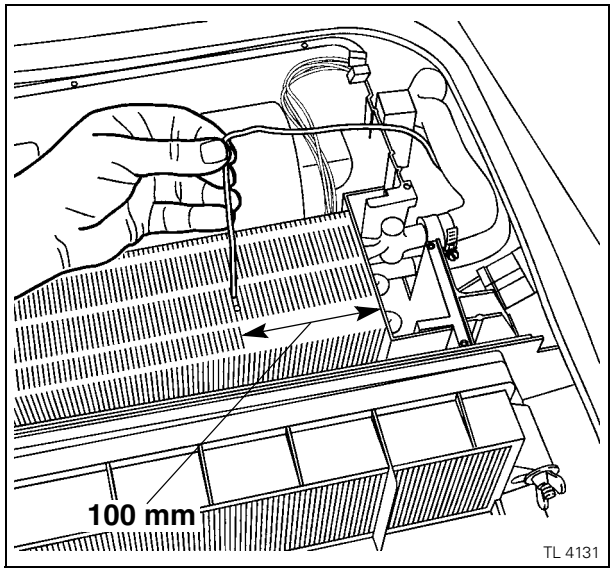
11. Unscrew the two pipe connections, evaporator core to expansion valve.
12. Remove the expansion valve.
13. Remove and discard all pipe fitting 'O' rings.

Refitment

14. Reverse procedures 2 to 13, except:
    a. Replace all 'O' rings and lightly lubricate with PAG oil prior to assembly.
    b. If the evaporator is replaced, add approximately 60cc (2 fl. oz) PAG oil to the evaporator to compensate for lost oil in the system.



    c. Install the temperature control switch capillary tube 100 mm (4 in) from the right-hand side into the core between the 2nd and 3rd row of the evaporator system, 100 mm (4 in) deep.
    d. Replace the receiver-drier, *(see operation 29-12C).*
    e. Evacuate the system, *(see operation 7-12C).*
    f. Complete system charge, *(see operation 8-12C).*
    g. Leak test the evaporator and expansion valve connections, *(see operation 10-12C).*
    h. Carry out final performance test, *(see operation 9-12C).*

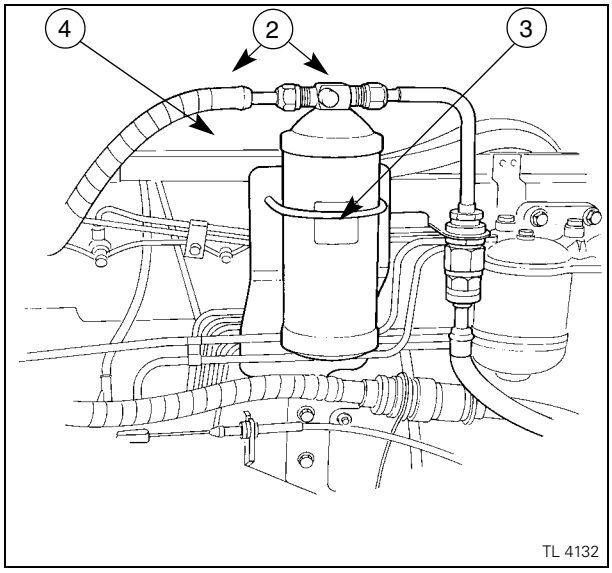


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RECEIVER-DRIER

Removal and Refitment 29-12C



Removal

1. Recover the refrigerant from the air conditioning system, *(see operation 5-12C)*.
2. Disconnect the inlet and outlet pipes and discard the 'O' rings.
3. Slacken the 'U' clamp nuts.
4. Remove the receiver-drier.

IMPORTANT: *Do not remove the sealing plugs from the replacement receiver-drier until it is to be fitted because the dessicant will become saturated, rendering the drier useless.*

Refitment

5. Reverse procedures 2 to 5 except:

a. Lubricate the new inlet and outlet hose 'O' rings with clean compressor oil.

b. Tighten both hose and pipe fittings to a torque of 34 Nm (26 lbf ft) using a backing wrench.

c. Check the compressor oil level, add an extra 15 ml (1/2 fl oz) of oil above the specified level mark on the dipstick. Do this to replace the oil held in the old receiver-drier.

d. Evacuate the system, *(see operation 7-12C)*.

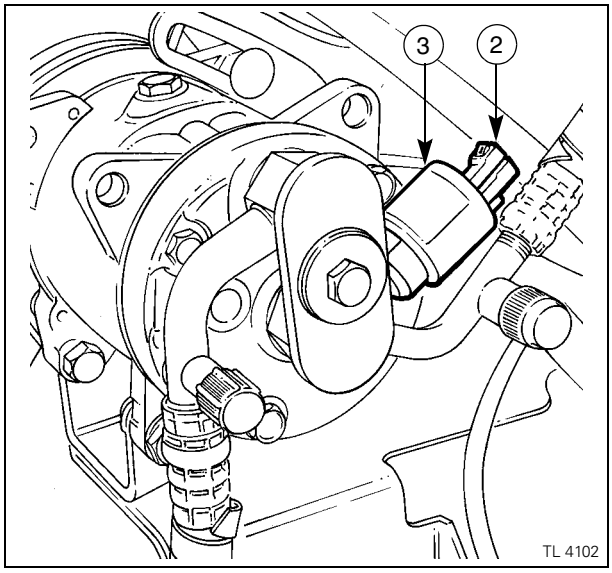
e. Complete system charge, *(see operation 8-12C)*.

f. Leak test the receiver-drier, *(see operation 10-12C)*.

g. Carry out final performance test, *(see operation 9-12C)*.

HIGH/LOW PRESSURE SWITCH

Removal and Refitment 30-12C



Removal

1. Remove the left-hand side panel.
2. Disconnect the two wires from the pressure switch.
3. Slowly unscrew the pressure switch and check for a leakage of gas.

NOTE: *A self sealing valve is installed in the fitting on the pipe and will prevent leakage when the switch is removed.*

4. If there is a leakage of gas use a core valve remover to check the tightness of the self sealing valve.

Refitment

5. Lubricate the threads of a new pressure switch with clean compressor oil. Connect the switch to the fitting on the discharge hose.
6. Reconnect the wires to terminals marked COMP and A/C THERMO.
7. During run-up of system check for gas leakage with an electronic leak detector, *(see operation 10-12C)*.

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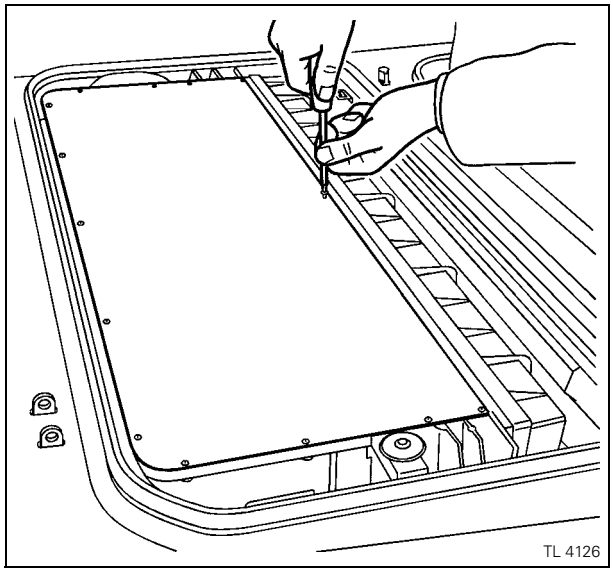
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TEMPERATURE CONTROL SWITCH

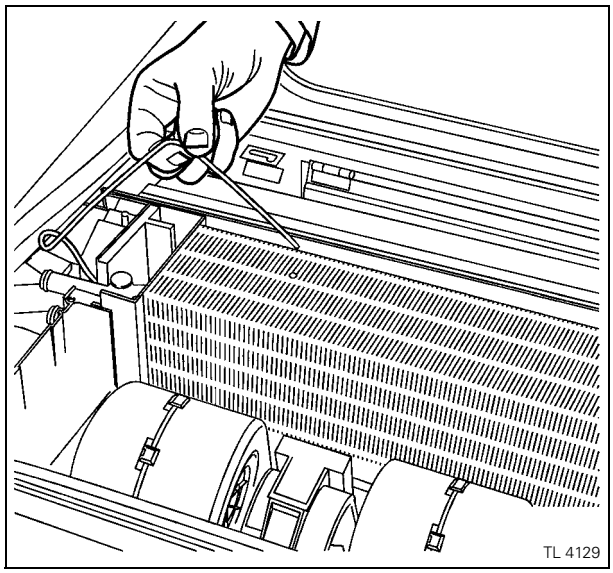
Removal and Refitment **31-12C**

Removal

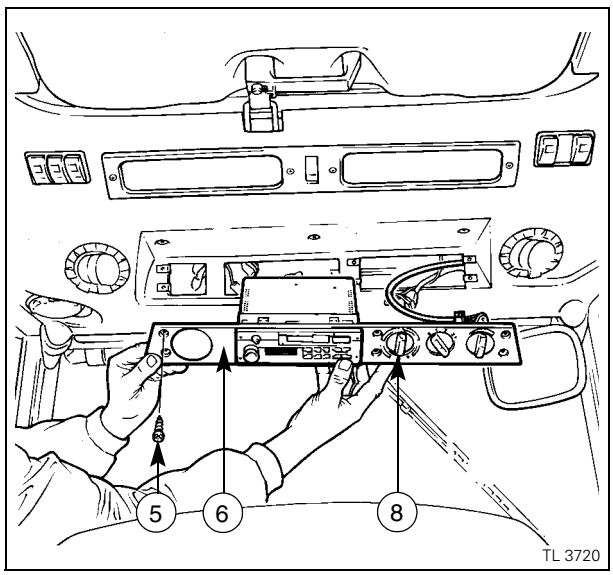
1. Open the escape hatch and carefully hinge back over the cab roof.
2. Standing on the seat, reach through and turn the catches, lift and fully open up the front cover.
3. Remove the 14 screws and the top cover plate.



4. Extract the temperature control switch capillary tube from the evaporator core and move it clear of the housing.



5. In the cab, remove the six self-tapping screws.
6. Very carefully pull the switch panel away from the headlining in a level motion.
7. When clear, disconnect the two wires.
8. Remove the control knob by pulling with a pair of pliers.
9. Remove the retaining nut behind the knob.
10. Remove the switch from the panel.
11. Pull the capillary tube out from the cab.

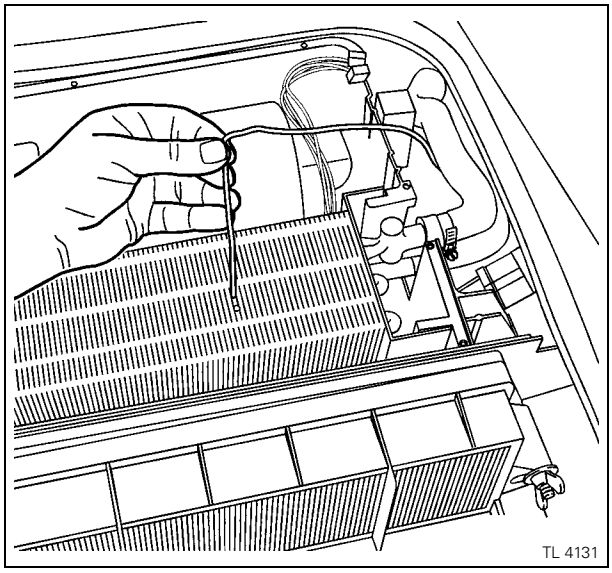


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Tractor Manuals Scotland

Removal

12. Feed the capillary tube through the aperture in the direction of the water valve.
13. From the cab roof, retrieve the end of the tube.
14. Reverse procedures 1 to 10 except:
    a. Install the temperature control switch capillary tube into the original hole. If a new evaporator has been fitted, install100 mm (4 in) from the right-hand side into the coil between the 2nd and 3rd row of the evaporator system, 100 mm (4 in) deep.
    b. The blue wire is connected to the switch terminal marked OUT, the white to IN.
    c. Before re-installing the panel, ensure that the spring clips that take the self tapping screws are correctly located.


TL 4131

BLOWER MOTOR

Removal and Refitment **32-12C**

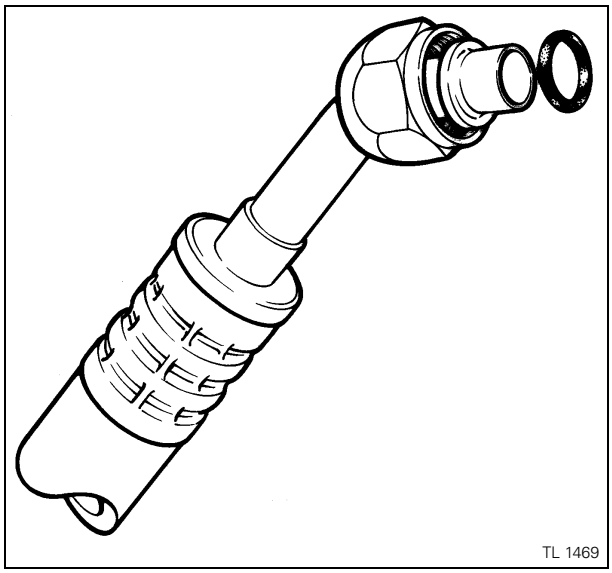
Please refer to Section 12A, page 12A-2 operation 2-12A for repair information.

AIR CONDITIONER HOSES

Removal and Replacement **33-12C**

Procedure

All major components of the air conditioning system (compressor, condenser, evaporator etc.) have inlet and outlet connections that are fitted with 'O' ring fittings. The type of fitting is shown in the illustration.


TL 1469

IMPORTANT: *When replacing pipes or hoses always fit new 'O' rings.*

1. Check the torque of the fitting (see specification section) and, if loose, tighten to the proper torque. Always use a backing wrench to prevent twisting and damage to the 'O' ring. DO NOT overtighten. Again leak test the joint.
2. If the leak is still present, recover the refrigerant from the system, *(see operation 5-12C).*
3. Discard the old 'O' ring and install new 'O' ring after coating it with clean compressor oil.
4. Retorque the fitting using a backing wrench to one of the torques listed in the specification section at the front of this section, *(see page 12C-3).*
5. If a hose has been replaced, add an extra 10 cc (0.5 fl oz) of oil above the specified level marked on the compressor dipstick. Do this to replace the oil held in the old hose.
6. Replace the receiver-drier, *(see operation 29-12C).*
7. Evacuate the system, *(see operation 7-12C).*
8. Complete system charge, *(see operation 8-12C).*
9. Leak test the hose joints, *(see operation 10-12C).*
10. Carry out final performance test, *(see operation 9-12C).*

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SECTION 13

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13A	FRONT POWER TAKE-OFF AND FRONT THREE-POINT LINKAGE
13B	3RD & 4TH CONTROL VALVE SECTIONS
13C	REVERSE BLEEPER AND LIGHT

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Section 13 - Part A

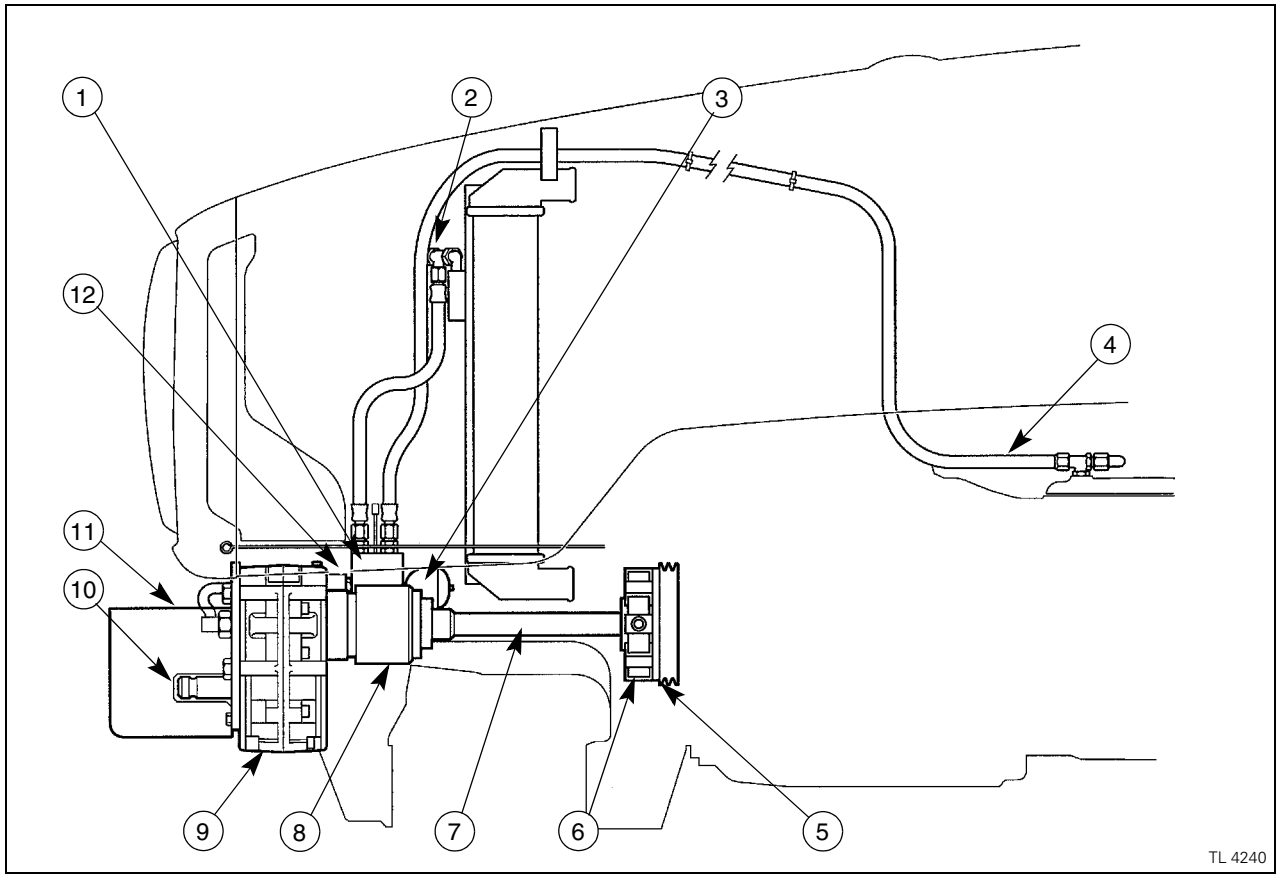
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Operation No.	Description	Page No.
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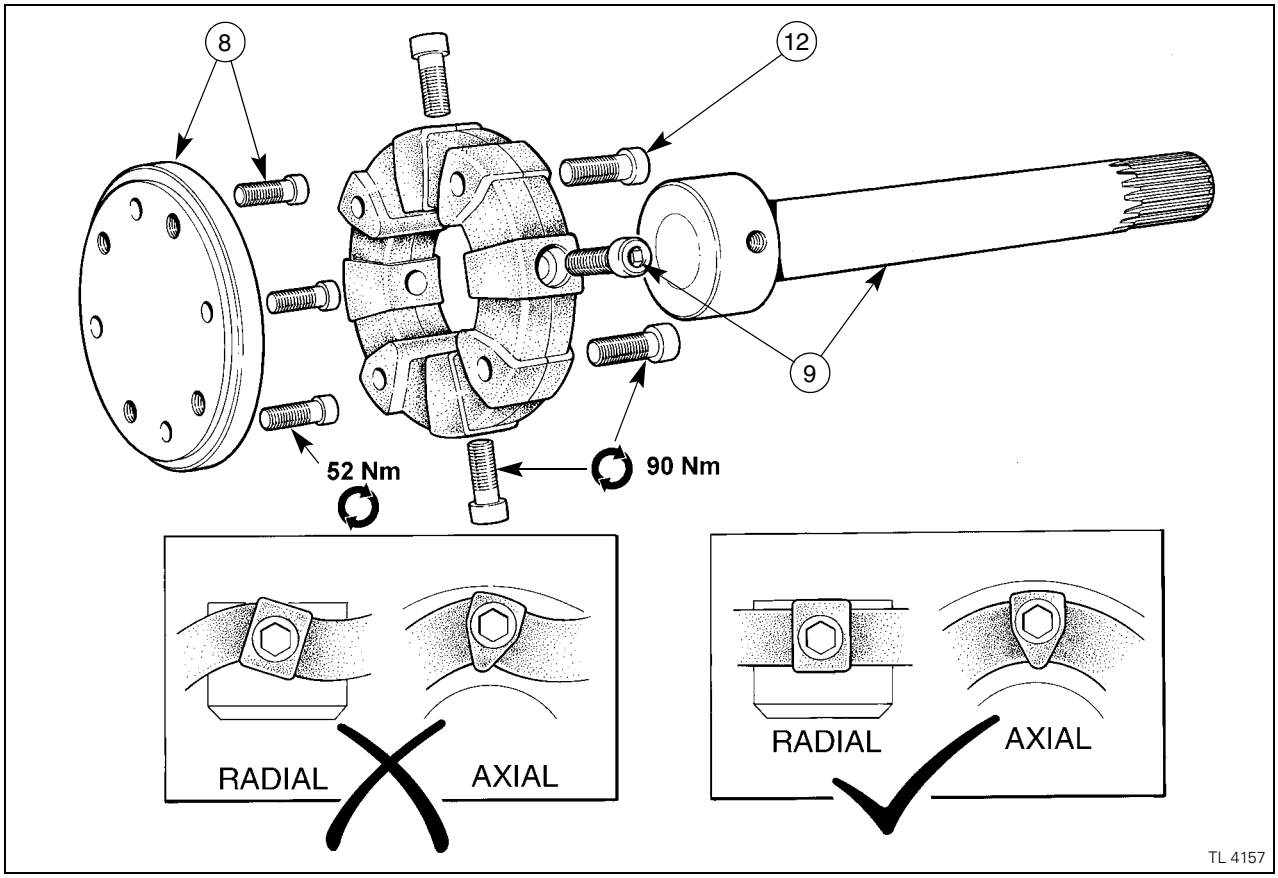


Front Power Take-off Installation

1. Hydraulic control valve.
2. Hydraulic supply from oil cooler.
3. Accumulator.
4. Hydraulic return to transmission.
5. Flywheel pulley adaptor plate.
6. Flexible coupling.
7. Drive shaft.
8. Hydraulic clutch.
9. Reduction gearbox.
10. Front PTO shaft.
11. PTO guard.
12. Solenoid control valve.

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FRONT POWER TAKE-OFF

Installation 1-13A

Procedure

1. Position the tractor in the workshop so that there is access to lifting equipment and it can be worked on all round.
2. Remove the hood front grille, side panels and centre section of the hood.
3. Remove the batteries.
4. Remove the front support, *(see operation 1-12B)*.
5. Remove the front weight frame.
6. First, mark the steering hoses so that they can be replaced correctly, disconnect the hoses.
7. Remove the plate the batteries are mounted on.

Drive Shaft

8. Fit the adaptor plate to the crankshaft pulley, apply Massey Ferguson Stud Lock (Loctite 270) and tighten the four cap screws to a torque of 52 Nm (40 lbf ft).

NOTE: *On tractors with six cylinder engines, the adaptor plate will only fit in two position on the pulley. The set of threaded holes are not all at 90°.*

IMPORTANT: *The radial and axial cap screws connecting the rubber element to the hub and adaptor plate must all be tightened to the torque given using a torque wrench.*

Ensure that on tightening the hexagon capscrews the aluminium bushes in the rubber part are not twisted, but sit straight. Apply grease under the head of the screw and apply counter pressure on the element to ***prevent twisting of the rubber part*** *during tightening of the screws. This is particularly important with the radial screws, refer to the illustration.*

9. Slide the drive shaft into the coupling, apply a small amount of grease under the head of the radial capscrews and a drop of Massey Ferguson Stud Lock (Loctite 270) to the thread. Tighten to a torque of 90 Nm (65 lbf ft). It will be necessary to use a clamp to squeeze up the blocks to insert the screws.
10. To install the drive shaft pass it down between the engine and radiator, shaft end first and locate it into position.
11. Fit the coupling to the pulley adaptor by means of the axial capscrews.
12. Apply a small amount of grease under the head of the capscrews and a drop of Massey Ferguson Stud Lock (Loctite 270) to the thread. Tighten to a torque of 90 Nm (65 lbf ft).
13. Apply a small amount of grease to the drive shaft spline.

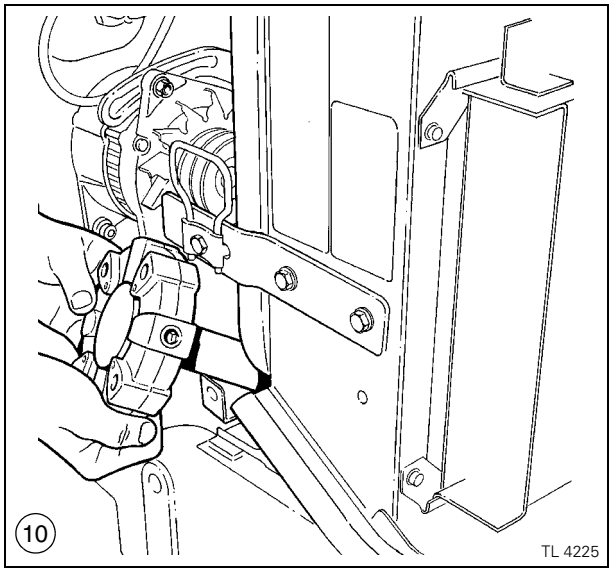
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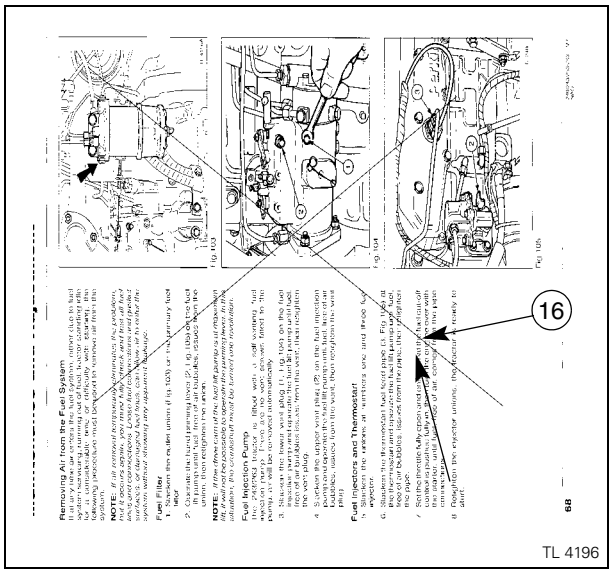
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Gearbox

14. Remove the protective wrapping around the clutch.
15. Lift the front PTO gearbox and clutch assembly by the lifting eye and install onto the front of the tractor.



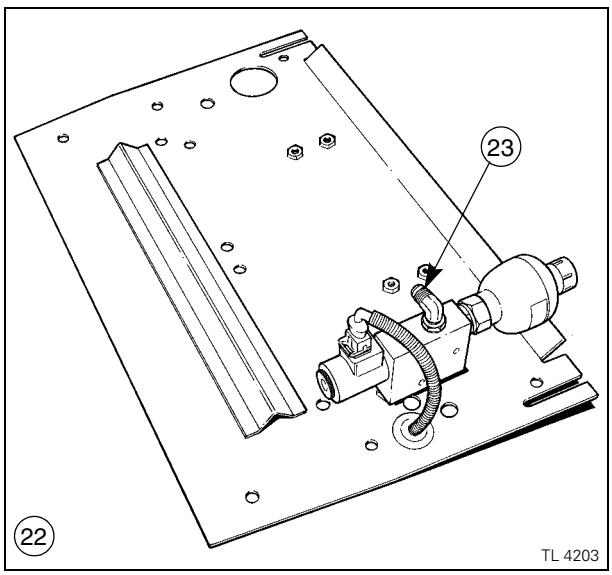
16. Tighten the four mounting bolts - front support plate to front casting - to a torque of 395 Nm (290 lbf ft).
17. Remove the lifting eye and replace with the breather.
18. Remove the PTO guard and install the hydraulic hose to the rotary coupling, re-fit the guard.
19. Check the oil level in the gearbox, *(refer to the Operator Instruction Book for grade of oil).*
20. Fit the 1000 rev/min decal below the PTO shaft.
21. Ensure that the safety cap is fitted to the PTO shaft.



Hydraulic Control Valve

NOTE: *Install the two long hoses from the front linkage, under the radiator and through to the right-hand side of the tractor before fitting the battery support plate.*

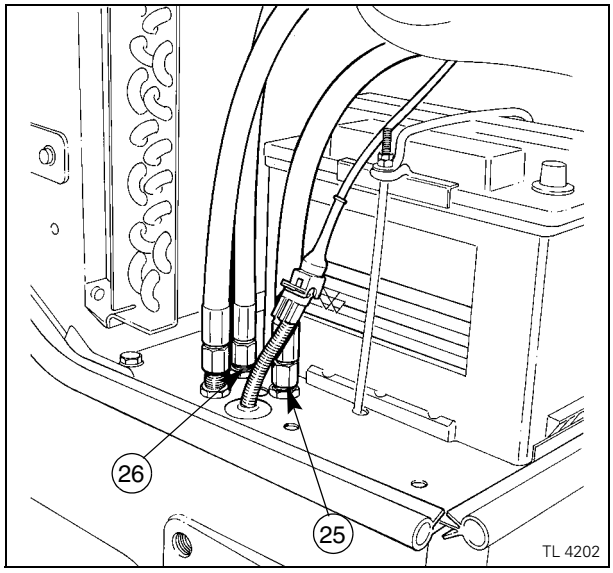
22. Assemble the hydraulic control valve to the battery support plate, the accumulator goes to the rear. Pull the electrical lead through the rubber grommet.
23. Connect the hose from the clutch to the elbow on the control valve.



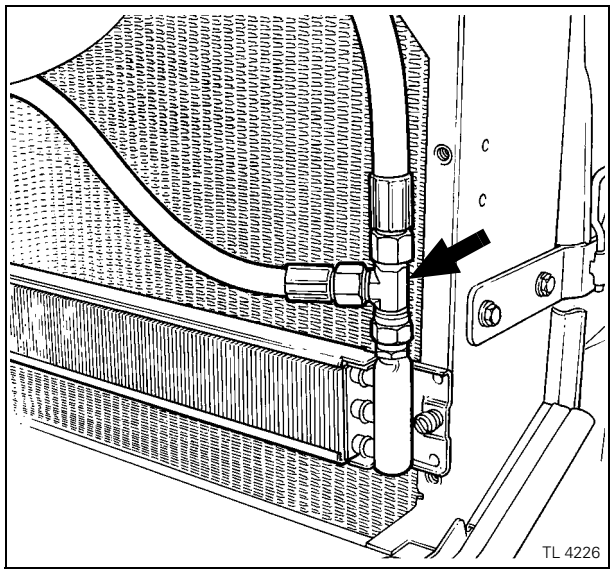
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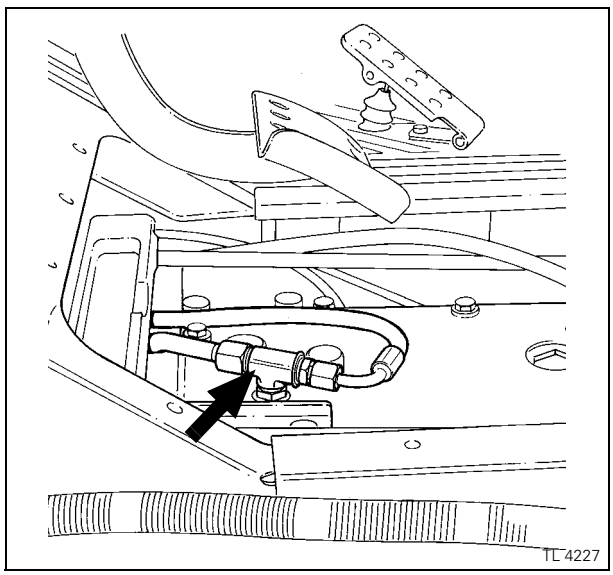
24. Install the battery support plate, front support, batteries, air cleaner and steering hoses.
25. The front connection out of the control valve is the pressure connection from the oil cooler.
26. The rear port is the return to the transmission case.



27. The pressure pipe is connected to a tee adjacent to the oil cooler.



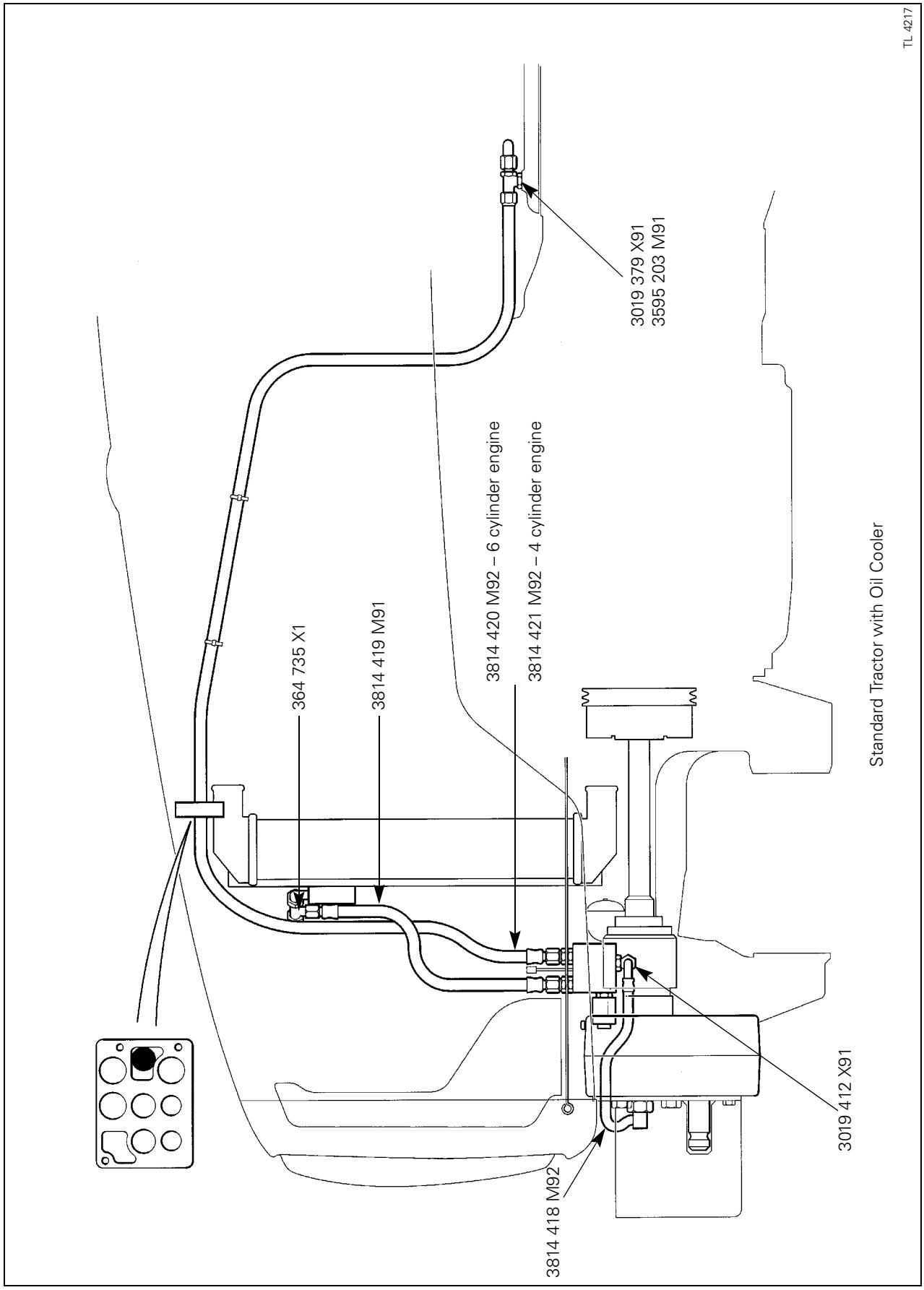
28. The return pipe is connected to a tee on the gearbox top cover.
29. Install the hydraulic pipes as shown in the following illustrations. Tie the pipes in place with plastic ties and ensure that they do not foul any moving parts, and are kept away from hot parts and sharp edges.



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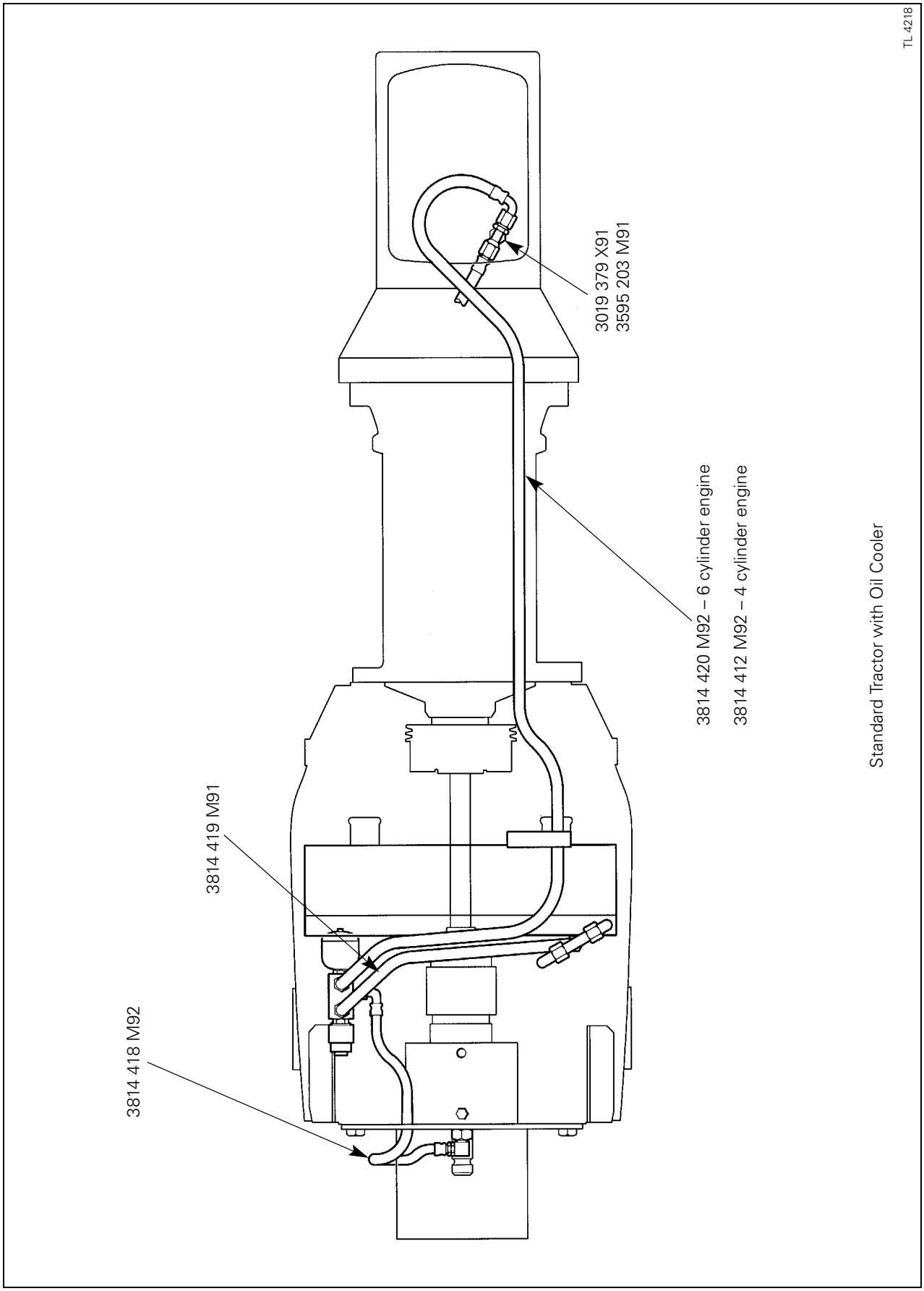
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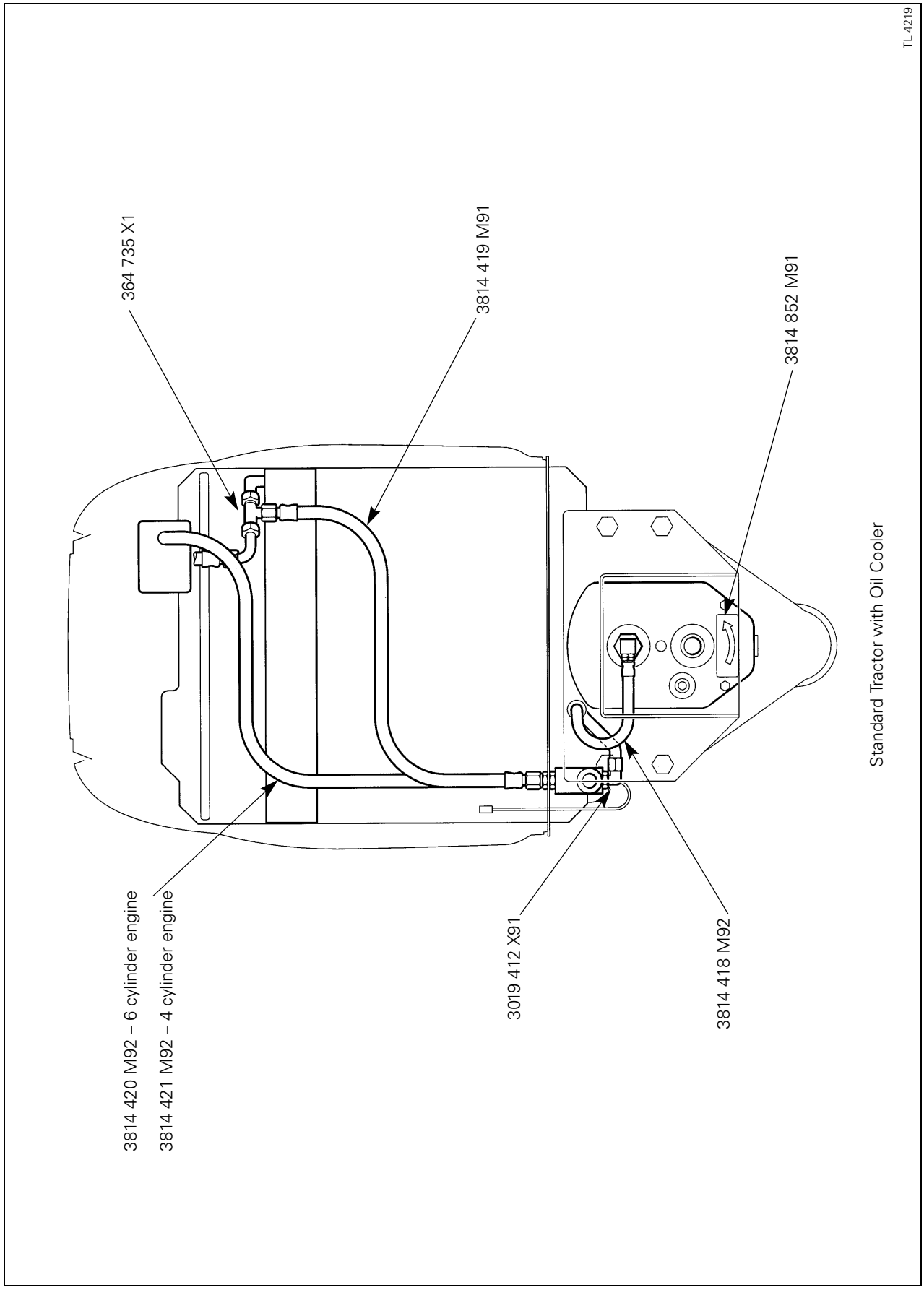
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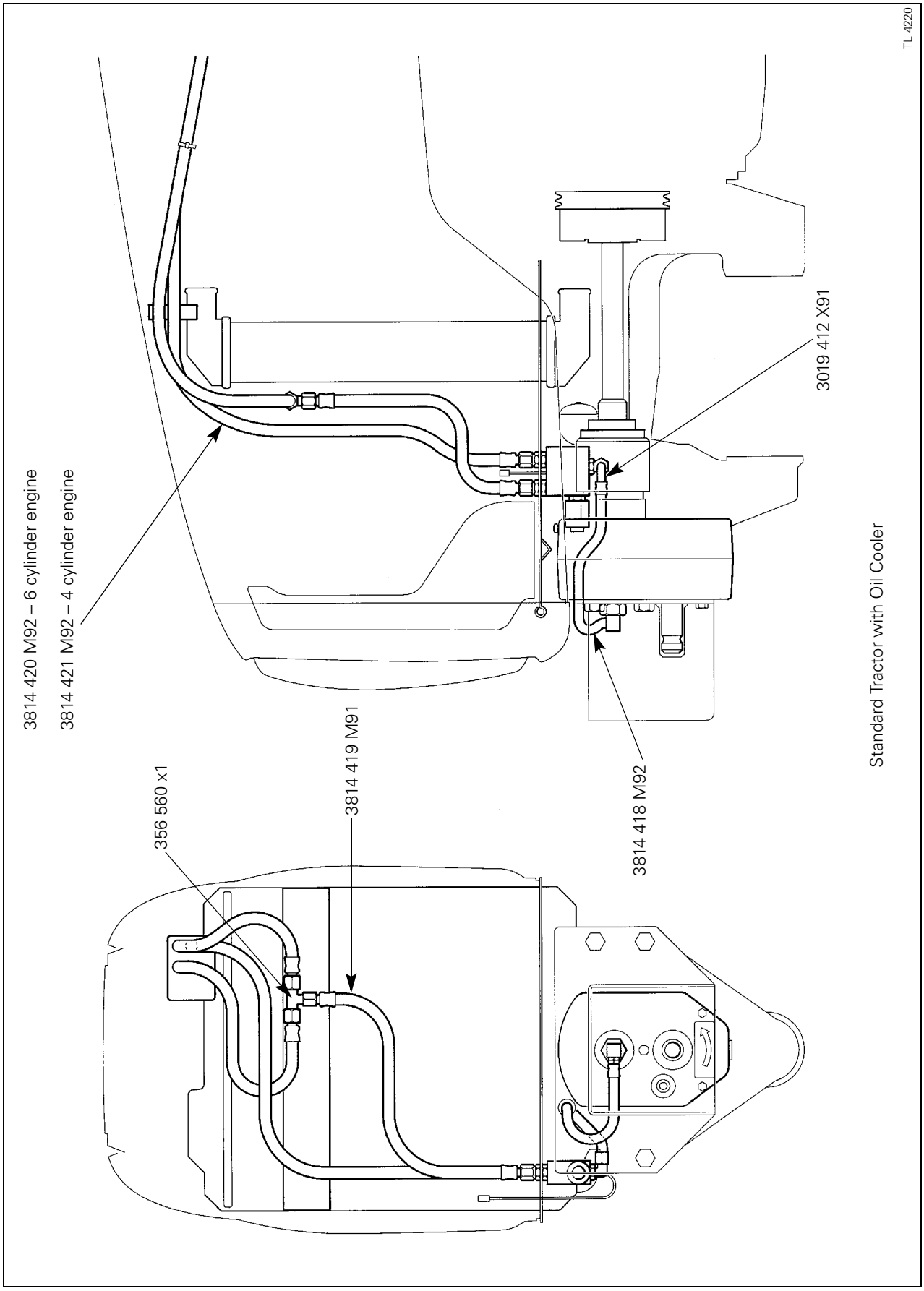
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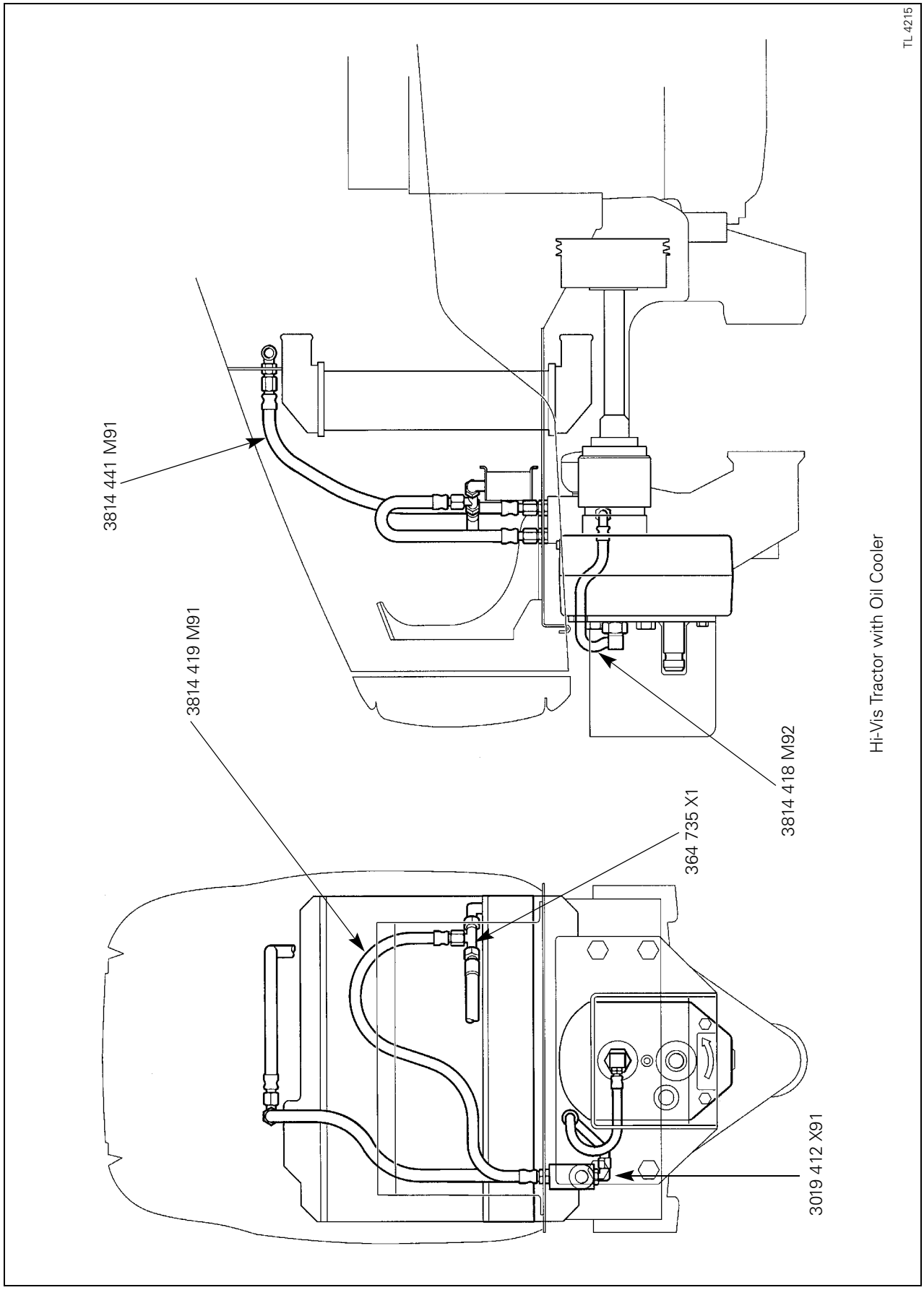
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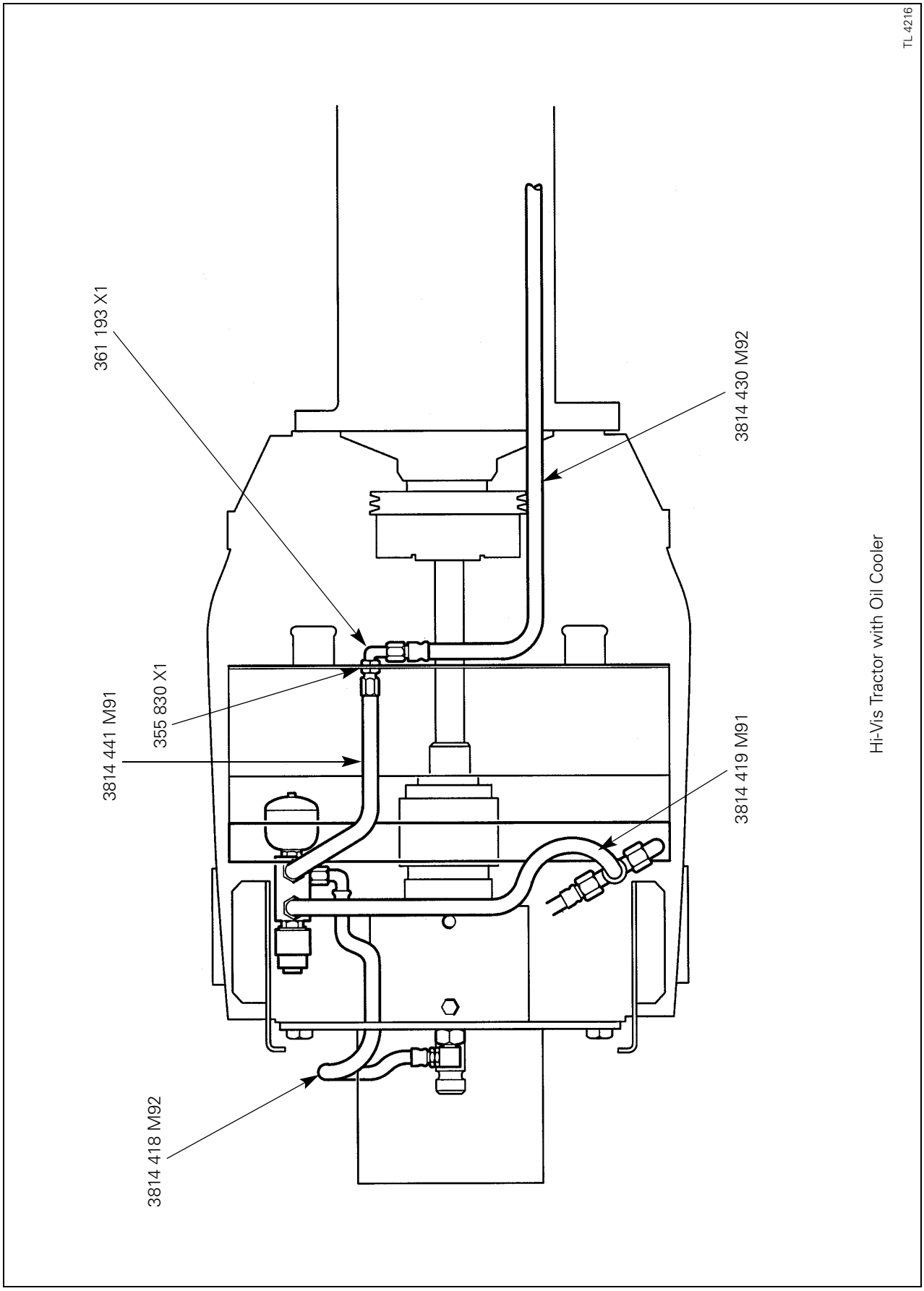
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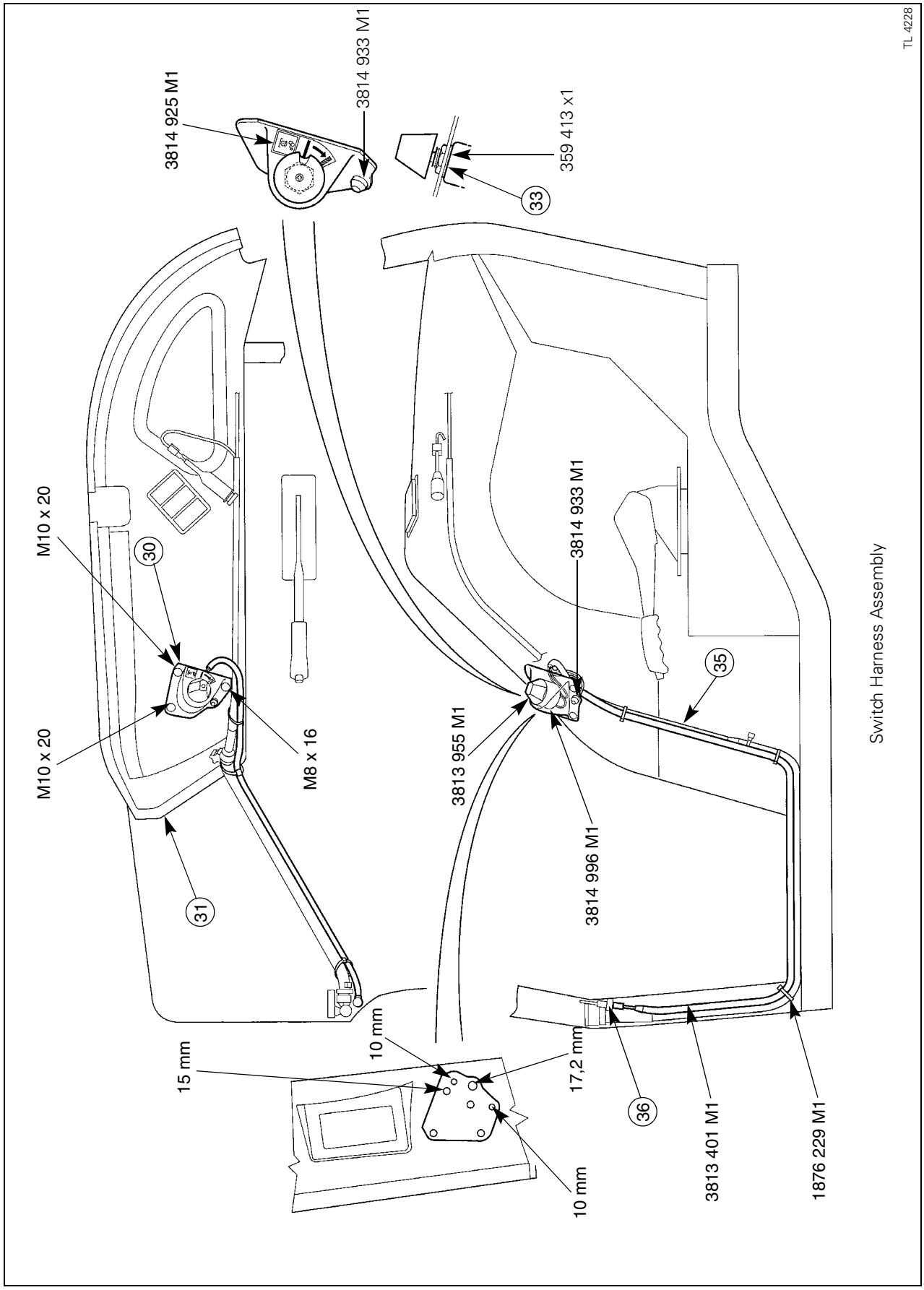
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Electrical Switch and Harness

30. The electrical switch is mounted on the right-hand fender in the cab.
31. Remove the right-hand floor mat and the grey right-hand plastic fender cover.
32. The switch mounting locates on the two vertical M10 holes in the fender. It will be necessary to drill two additional 15 mm holes for the bolts, one 15 mm for the wires and one 17,2 mm for the indicator light. The plastic mounting can be used as a jig.
33. Fit the switch to the mounting, fitting the 7/8" lock washer first then the nut. Install the knob and decal with the notch in the knob opposite the black line on the decal.
34. Connect up the switch, the white/green wire to terminal 'X' on the switch and the green/orange wire to terminal 'C'. The remaining two wires are connected to the light.
35. Re-fit the fender cover positioning the wiring harness along side the existing harness and secure with plastic ties.
36. The end of the harness terminates under the right-hand side of the console.

Front Harness

37. The front harness is taken from the connector adjacent to the control valve, up over the top of the radiator, through one of the holes in the rubber block and securing it to the hydraulic pipes to the steering unit.
38. The end of the harness terminates in front of the console along side the other connectors.

Console Harness and Control Module

There are two console central harness depending on the age of the tractor. The early tractors are not provided with a connection into the main tractor harness, this connection has to be made.

39. Ensure that the battery is disconnected.

Tractors without harness plug

40. Remove the instrument panel.
41. Install the harness alongside the main harness and hold in position with plastic ties.
42. The control module is located adjacent to the relays and held in position with the long plastic tie.
43. The switch part of the harness is tied to the main harness on the right-hand side of the console and is connected to the switch harness.
44. The front part of the harness is taken through the large rubber grommet to the connector behind the engine.
45. The harness must now be connected to the orange header block:
    a. Select and cut any white/brown wire in the orange header block behind the instrument panel, and strip the ends.
    b. Crimp and solder terminals to the separated white/brown wires.
    c. Insert the terminals into the base of the six way header block (any cavity) attached to the harness.
    d. Fit the six way header block cover and snap into position.
46. Connect the power cable to the auxiliary power socket adjacent to the main fuse box on the right-hand side.

Tractors with harness plug

47. Remove the instrument panel.
48. The control module is located adjacent to the relays and held in position with the long plastic tie.
49. Install the harness alongside the main harness and hold in position with plastic ties.
50. The switch part of the harness is tied to the main harness on the right-hand side of the console and is connected to the switch harness.
51. The front part of the harness is taken through the large rubber grommet to the connector behind the engine.
52. For connection into the main harness, there is a four pin plug adjacent to the main fuse box on the left-hand side, make the connection.
53. Connect the power cable to the auxiliary power socket adjacent to the main fuse box on the right-hand side.

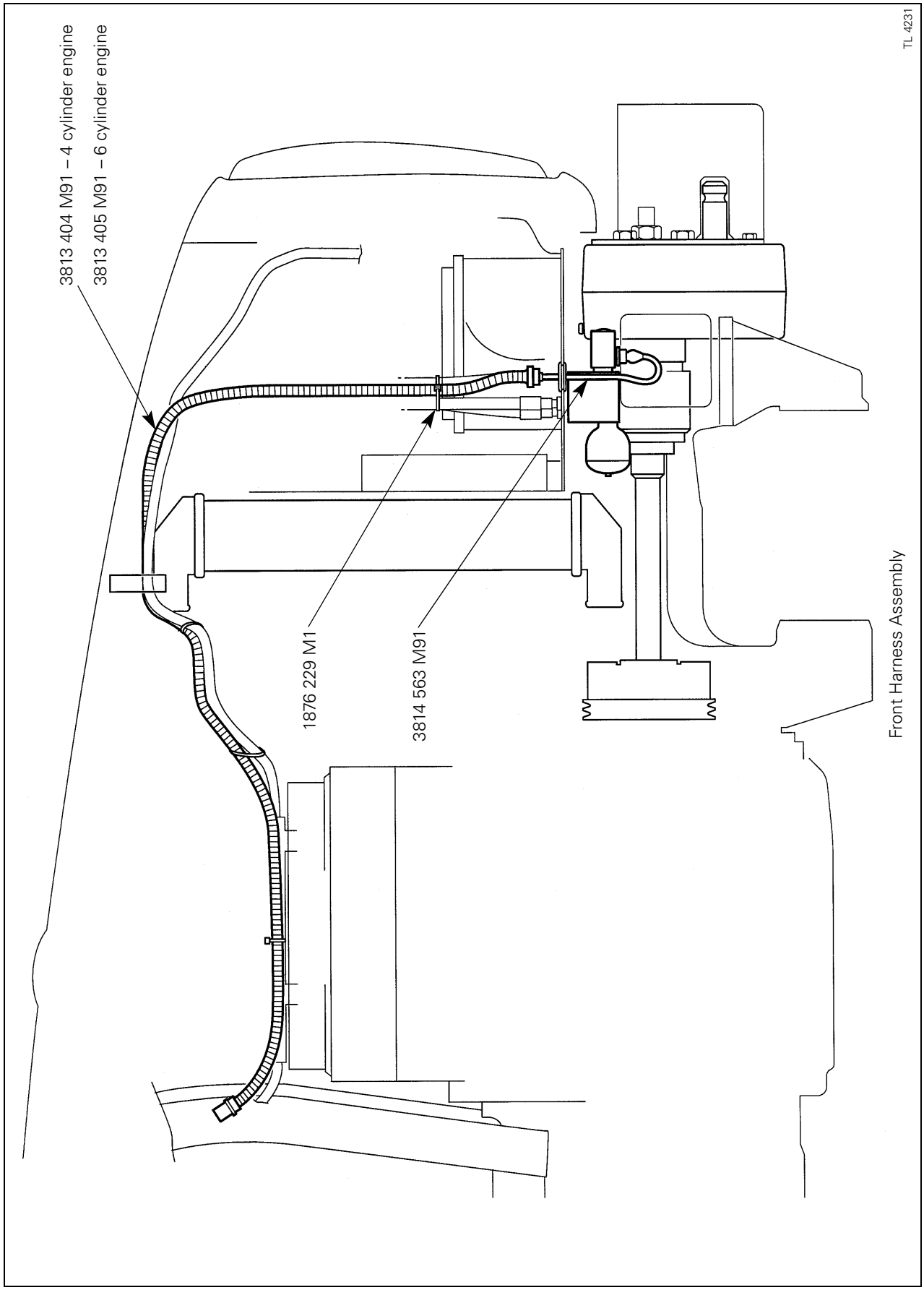
General

54. Ensure that all the harness are securely tied into position and that they do not foul any moving parts, for example, brake pedals and gear shift linkage.
55. The control module prevents operation of the PTO when starting the engine. If the PTO is switched ON and the engine is started the PTO will not work, it will be necessary to switch the power take-off OFF and then ON.
56. The PTO is switched ON by turning clockwise, OFF by pushing in the knob.
57. To purge the system, start the engine and run at 1200 rev/min. Operate the PTO several times to remove all the air from the hydraulic system.
58. Check for leaks, rectify any faults found.

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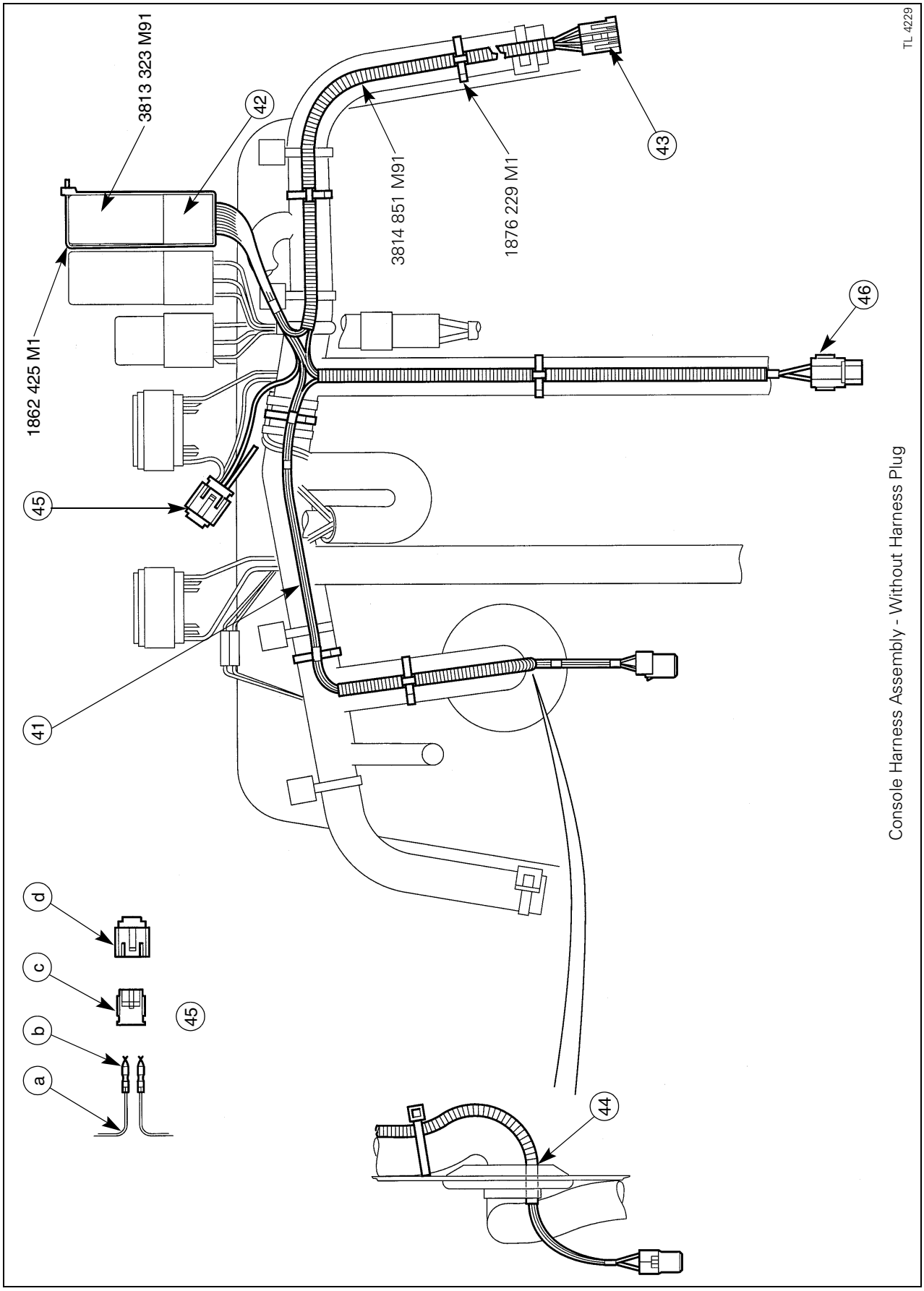
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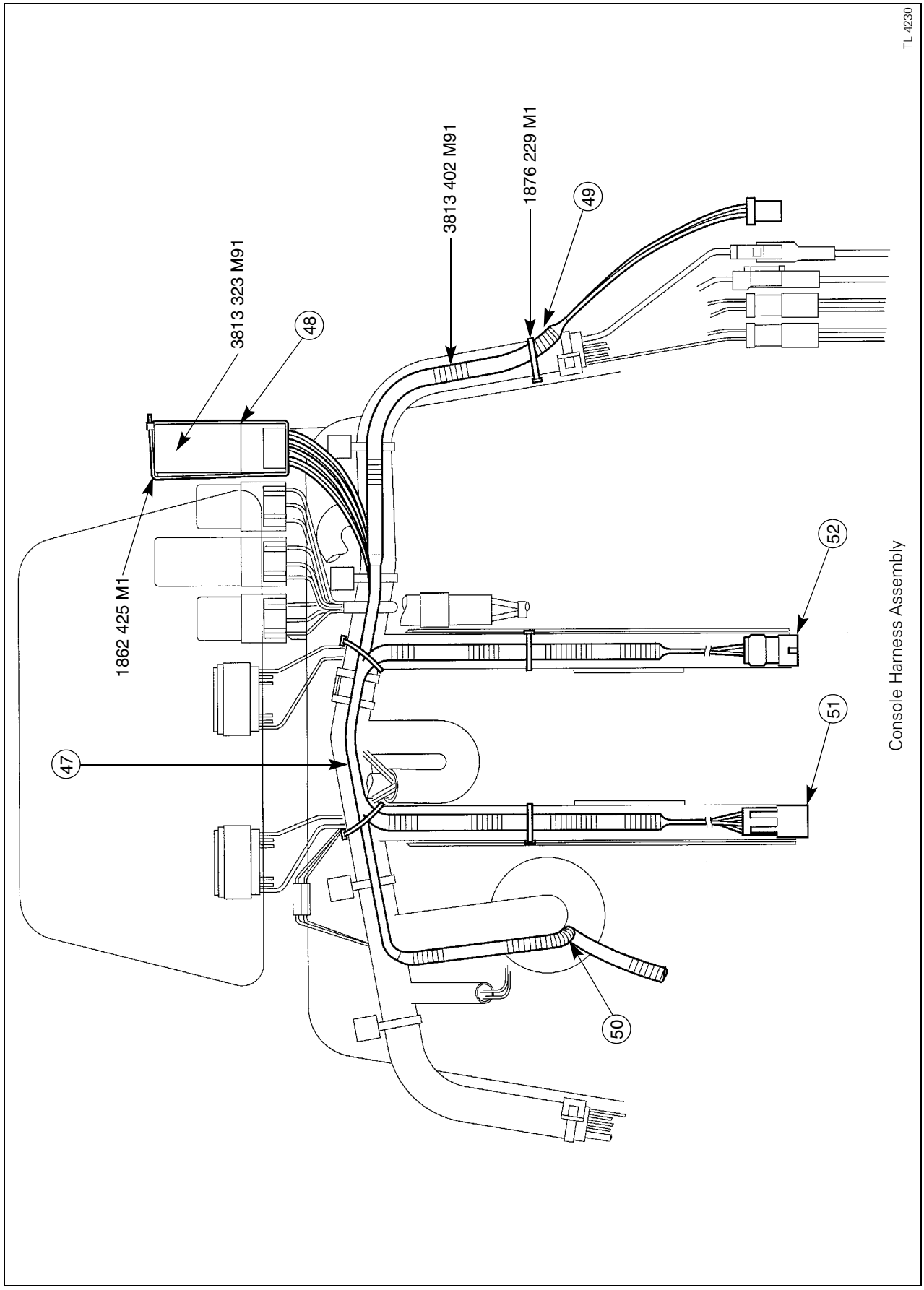
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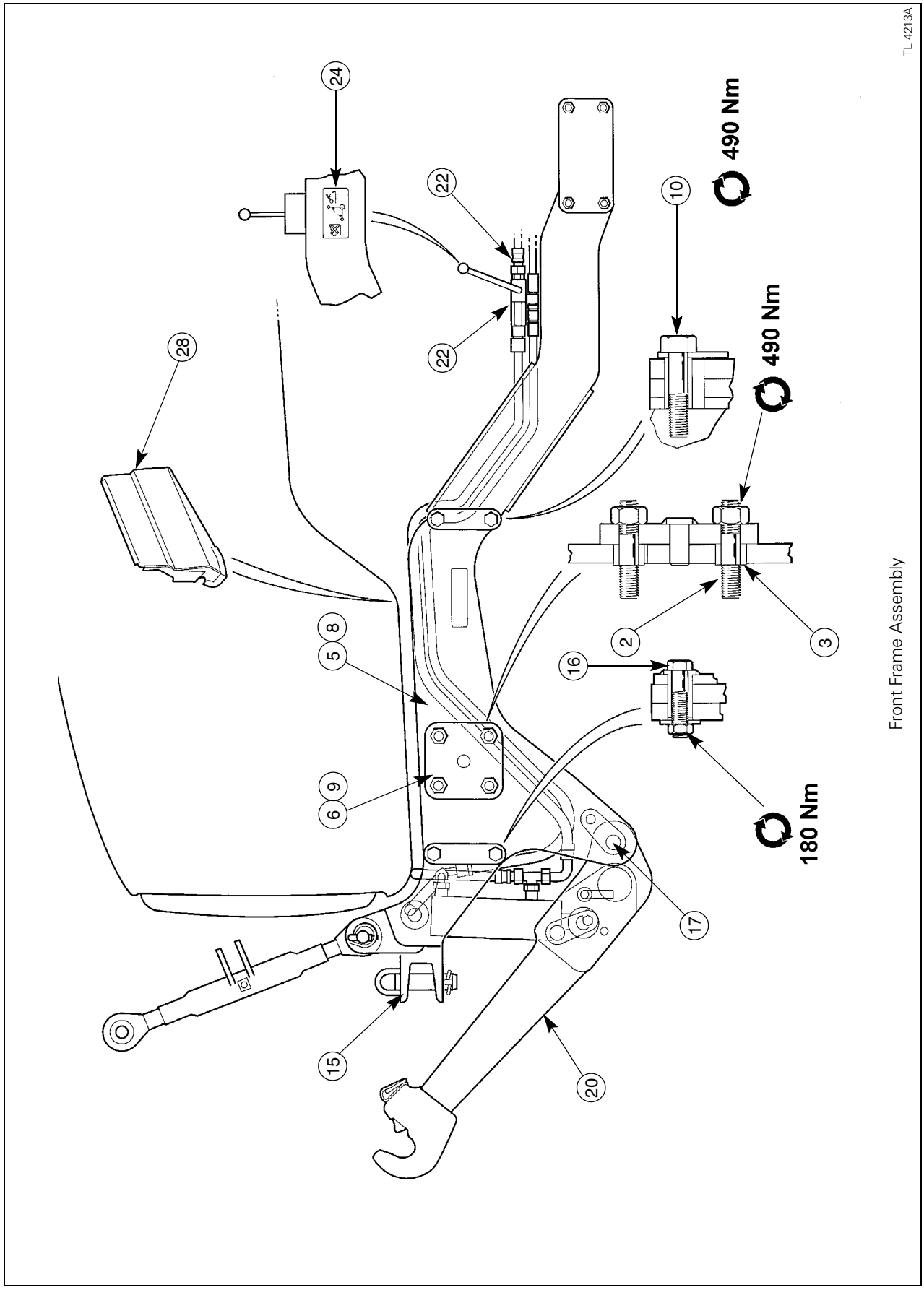
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FRONT THREE-POINT LINKAGE

Installation 2-13A

Procedure

There are two types of front linkage, normal-duty and heavy-duty. The normal-duty linkage side frames only go back as far as the clutch housing mounting point. Heavy-duty linkage frames extend to the rear axle and are tensioned.

NOTE: *The instructions given refer to one side of the tractor, these must be duplicated for the other side.*

1. Install the front PTO, *(see operation 1-13A)*.
2. Install the four M20 studs on the side of the support casting.
3. On to each stud place the four spacers.

Normal-duty Frame

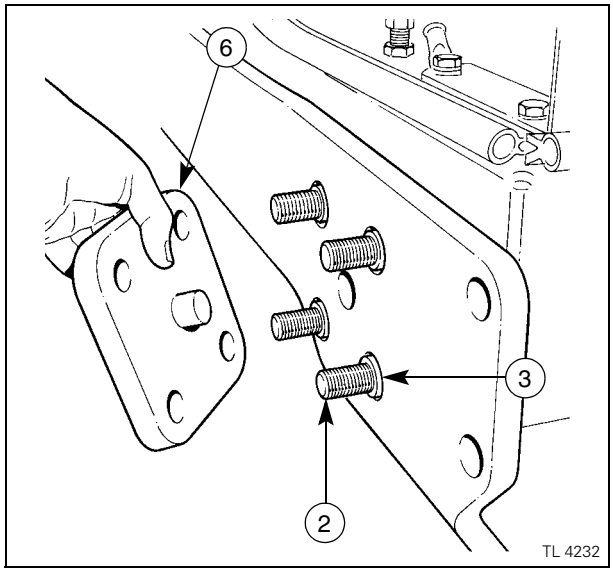
4. Install the bracket on the lower set of holes on the clutch housing.
5. Lift the side frame into position.

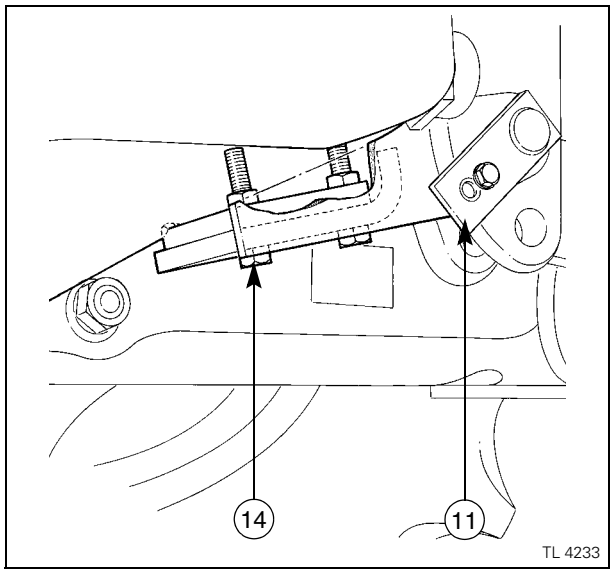
NOTE: *At this stage DO NOT tighten any nuts or bolts, leave all the frame loose, to assist in aligning the components.*

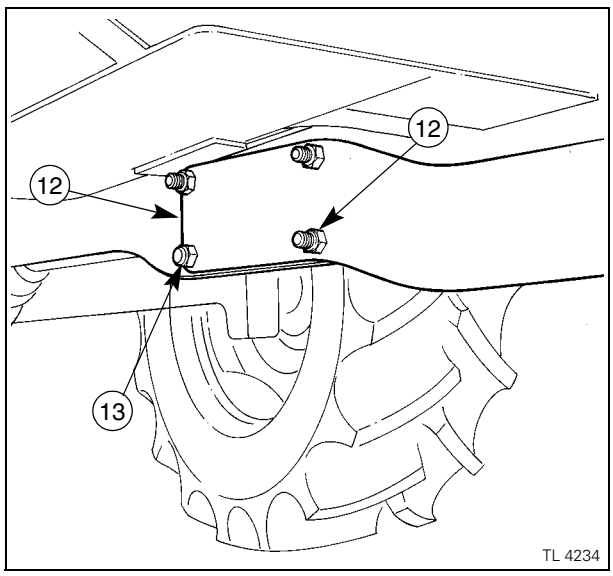
6. On the front mounting (four studs) fit the square plate with the pin and the nuts.
7. Fit the two M16 bolts to the clutch housing securing the frame to bracket.

Heavy-duty Frame

8. Lift the side frame into position.
9. On the front mounting (four studs) fit the square plate with the pin and the nuts.
10. Fit the two long spacers, spacer plate and M20 bolts at the rear of the front support casting.
11. Remove the lower link pivot pin and install the rear tension bracket, replace the pin and lock with the bolt and washer.
12. Install the frame extension between the front frame and the rear axle with three M16 bolts.
13. Install the tie rod in the front lower hole.
14. Connect the rear tension bracket with two M16 bolts x 70mm long to the frame extension.



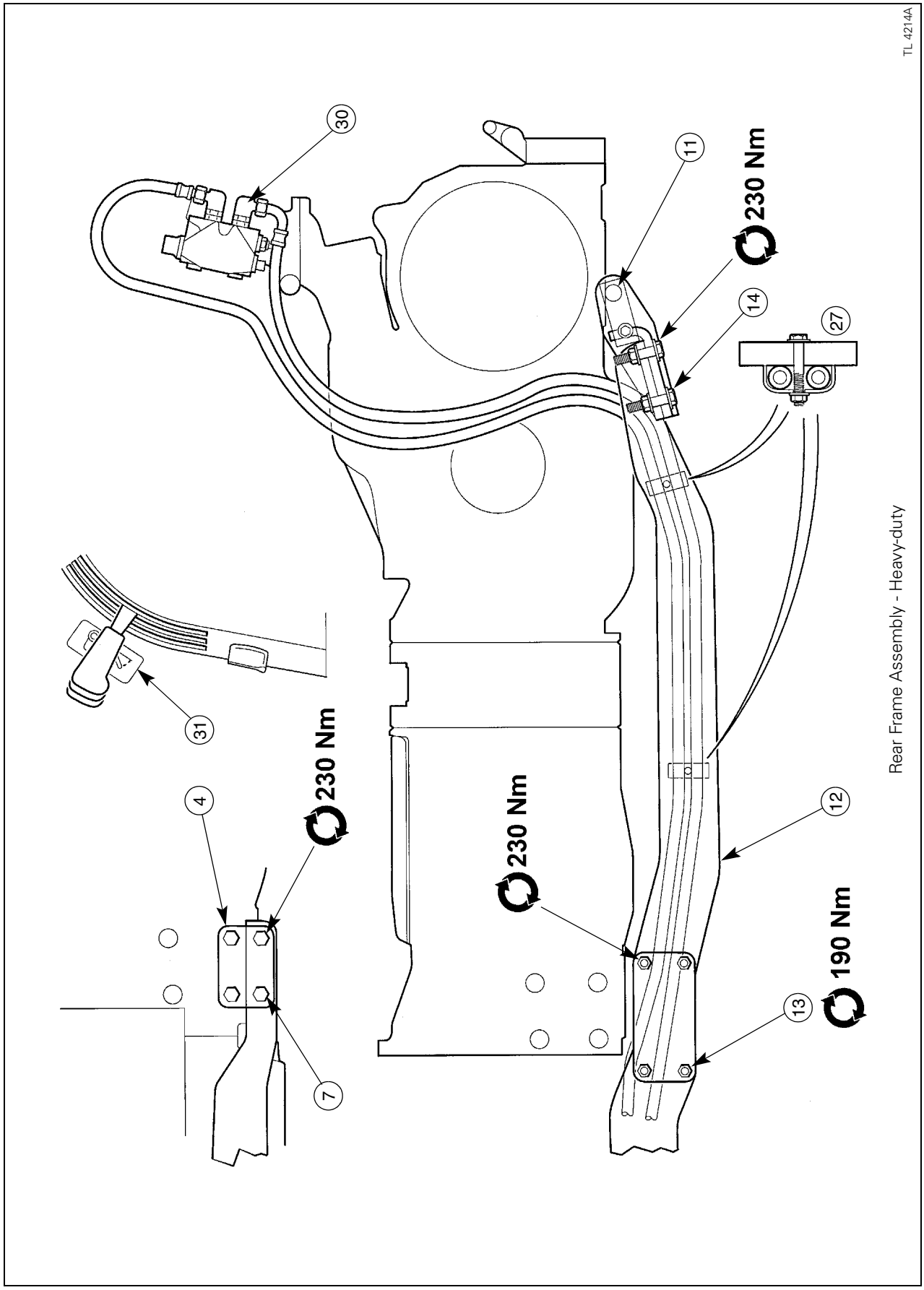




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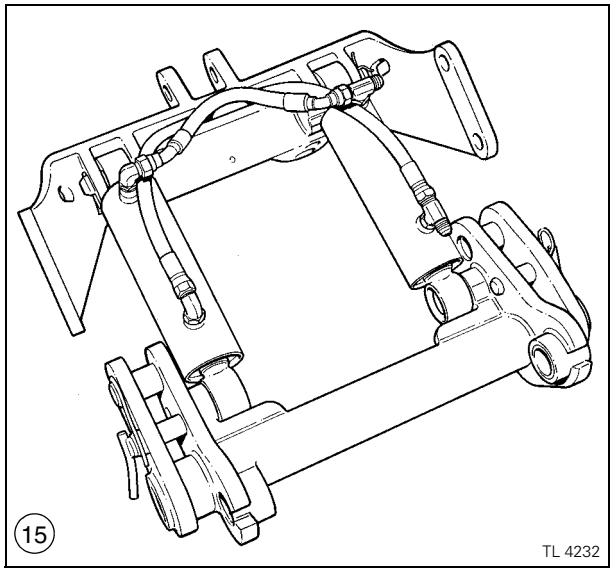


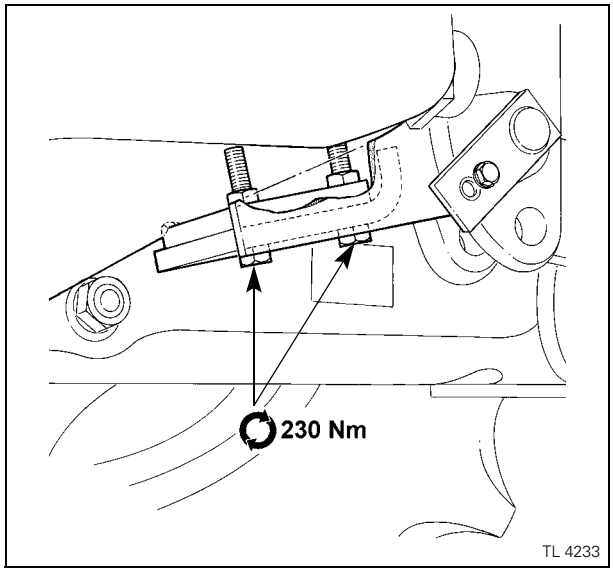
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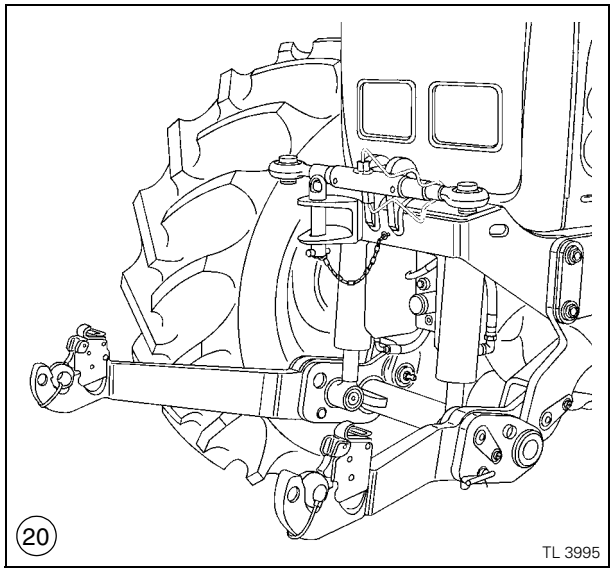
General

15. Assemble the front frame assembly with the hydraulic cylinders and hoses as shown in the illustration. Grease all the pins on assembly.
16. Lift the assembly into position fitting the combined dowel pins, nuts and bolts. The dowel pins are a precision fit and it will be necessary to ensure correct alignment before they will fit.
17. Insert the lower pivot pins.
18. When the frame is in position tighten all the nuts and bolts to the following torques:
    a. Combined dowel pin bolts 180 Nm (135 lbf ft).
    b. All M16 nuts and bolts 230 Nm (170 lbf ft).
    c. All M20 bolts 490 Nm (360 lbf ft).
    d. Tie rod nuts 190 Nm (140 lbf ft) (heavy-duty only).
19. Heavy-duty only, tighten the two long bolts through the rear tension bracket until the two faces of the brackets are brought together, tighten to 230 Nm (170 lbf ft).





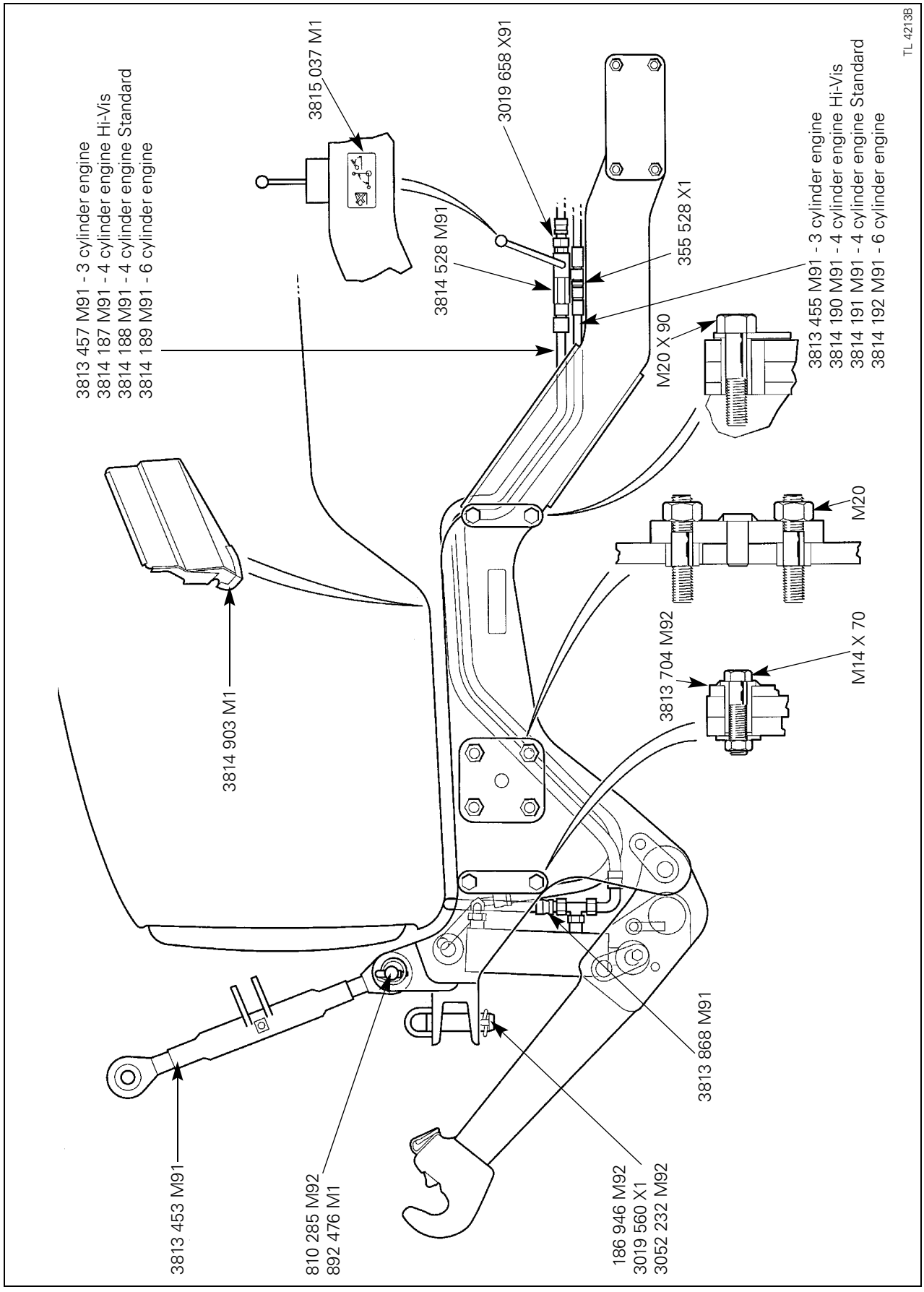
20. Fit the front lift arms, stow the top link in its stowage position and fit the drawbar pin and secure the chain with a split pin as shown in the illustration.
21. Lubricate the pivot points with a grease gun.



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Hydraulics

The front linkage is operated by a third valve block at the rear of the tractor.

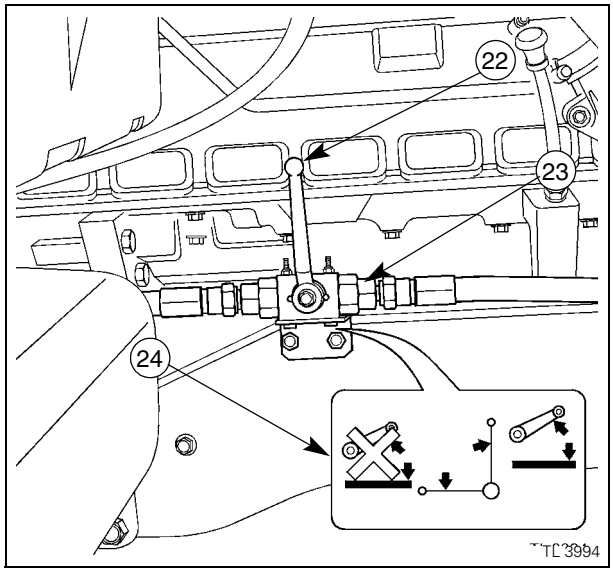
22. Install the shut-off valve on the right-hand side of the engine mounted on the main frame.
23. The one-way restrictor is fitted on the linkage side of the shut-off valve.
24. Fit the decal below the valve.
25. The two front hoses should have been fitted when installing the front PTO. The hose connected to the lower hydraulic cylinder connection is connected to the restrictor valve, shut-off valve and the top connection on the control valve. The upper hose to the hydraulic cylinders is joined to the rear hose with an adaptor and the lower connection on the control valve.
26. The hoses are attached to the inside of the frame. On four cylinder tractors the hoses pass through the front and rear holes in the front support casting.

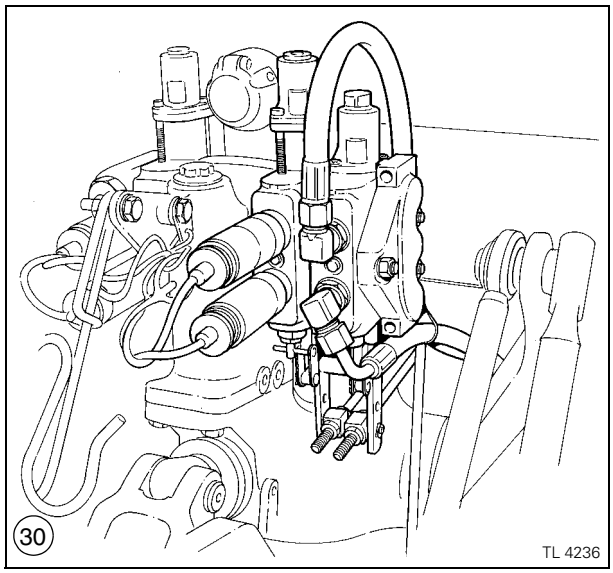
    On six cylinder engines the hoses pass through the front hole in the front support, and exit above the front support between fan guard and engine.
27. Clip the hoses to the frame and use plastic ties as necessary to prevent the hoses being damaged.
28. Apply the plastic edging strip to the lower edge of the fan guard to protect the hydraulic hoses.
29. Install the third control valve section and connect up the linkage to the hand levers.
30. Fit the two elbows to the control valve section and connect the hoses.
31. Tie the two hoses to the steel pipe behind the valve to prevent them fouling the lift arms.
32. Position the decal adjacent to the control lever.

Testing

CAUTION: Stand clear of the front linkage when removing the air. Movement of linkage can be violent and could cause personal injury.

33. When all connections are made, check that the shut-off valve is open. Place the front linkage in its operating position.
34. Start the engine and run at 1200 rev/min and operate the third control valve lever. Check that the linkage raises when the lever is pulled back. Operate the lever in both directions to remove the air from the system.
35. Increase the engine speed to obtain full pressure and operate the control valve to lift the relief vale. Check the system for leaks. Rectify any faults found.

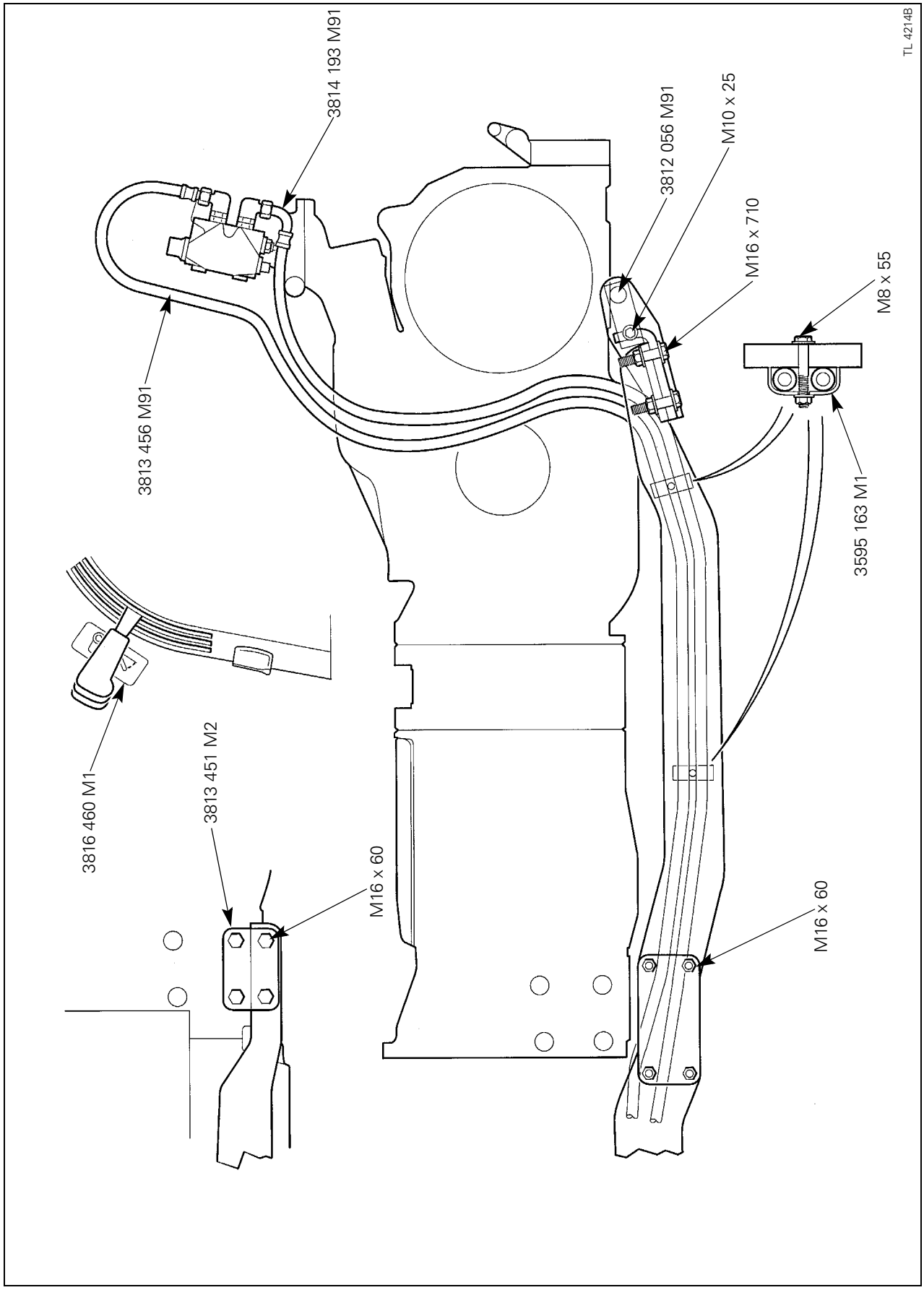




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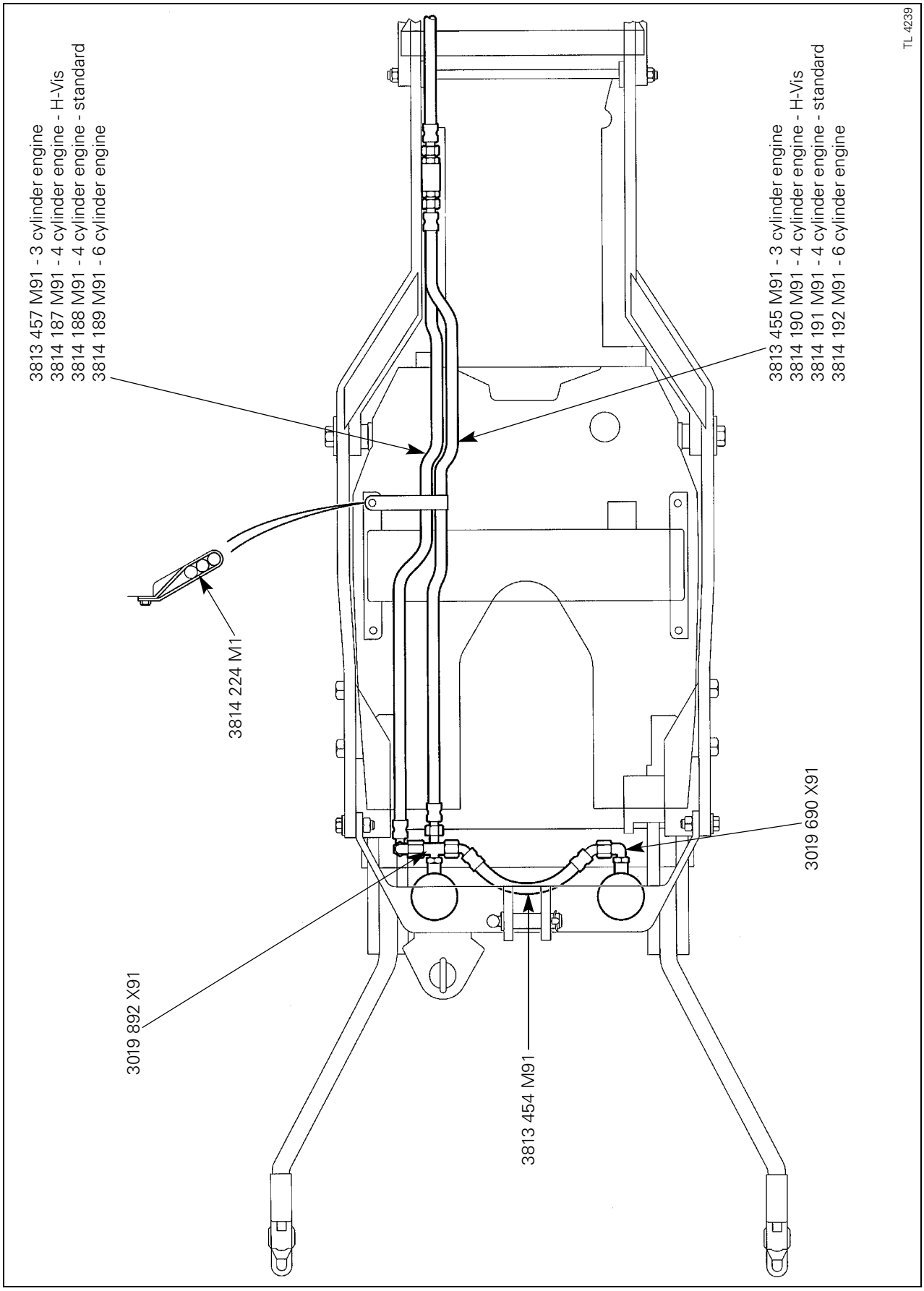
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Section 13 - Part B

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1-13B	3rd and 4th Spool Valve Sections - Installation	13B–2

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3RD & 4TH CONTROL VALVE SECTIONS

Installation 1-13B

Procedure

1. Disconnect the control rods at the base of the control valve.
2. Remove the trailer socket and bracket from the top of the valve.
3. Remove the trailer brake quick release coupling and bracket from the right-hand side of the valve.
4. Disconnect the combined flow and supply pipes on the left-hand side of the valve.

Removal of the Valve Assembly

5. Remove the four bolts at the base of the valve assembly and lift off the valve.

Removal of the End Plate

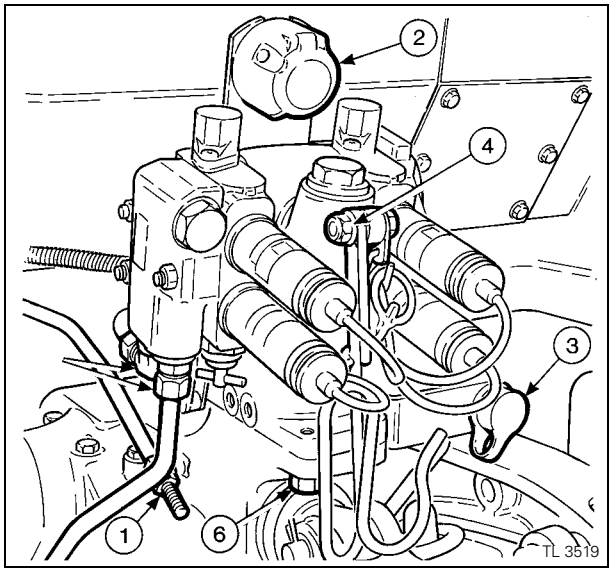
6. Mask off any open ports and clean the external surfaces so that they are free of all loose dirt, paint etc.
7. Remove the three nuts and washers on one end from the tie rods that pass the valve.
8. Remove the end piece.
9. Remove and discard the 'O' rings between the end plate and the valve section.

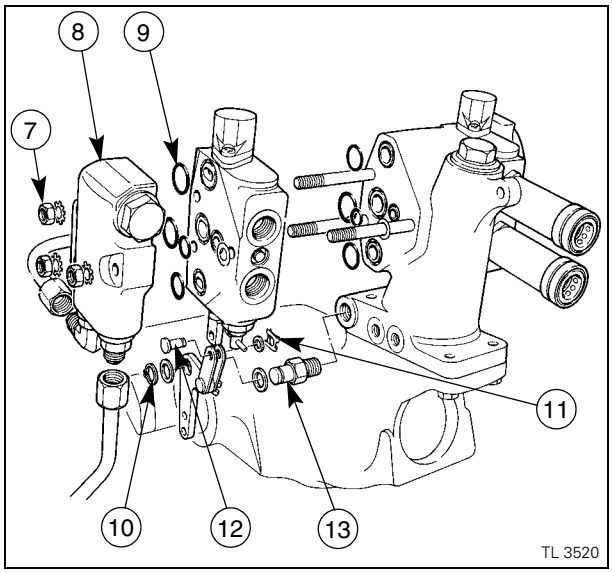
NOTE: *There is a green shim washer fitted between each section, located by the tie rod to the rear, (see arrows on illustration).*

Fitting the New Linkage

IMPORTANT: *The third valve section is fitted to the right-hand side of the valve assembly.*

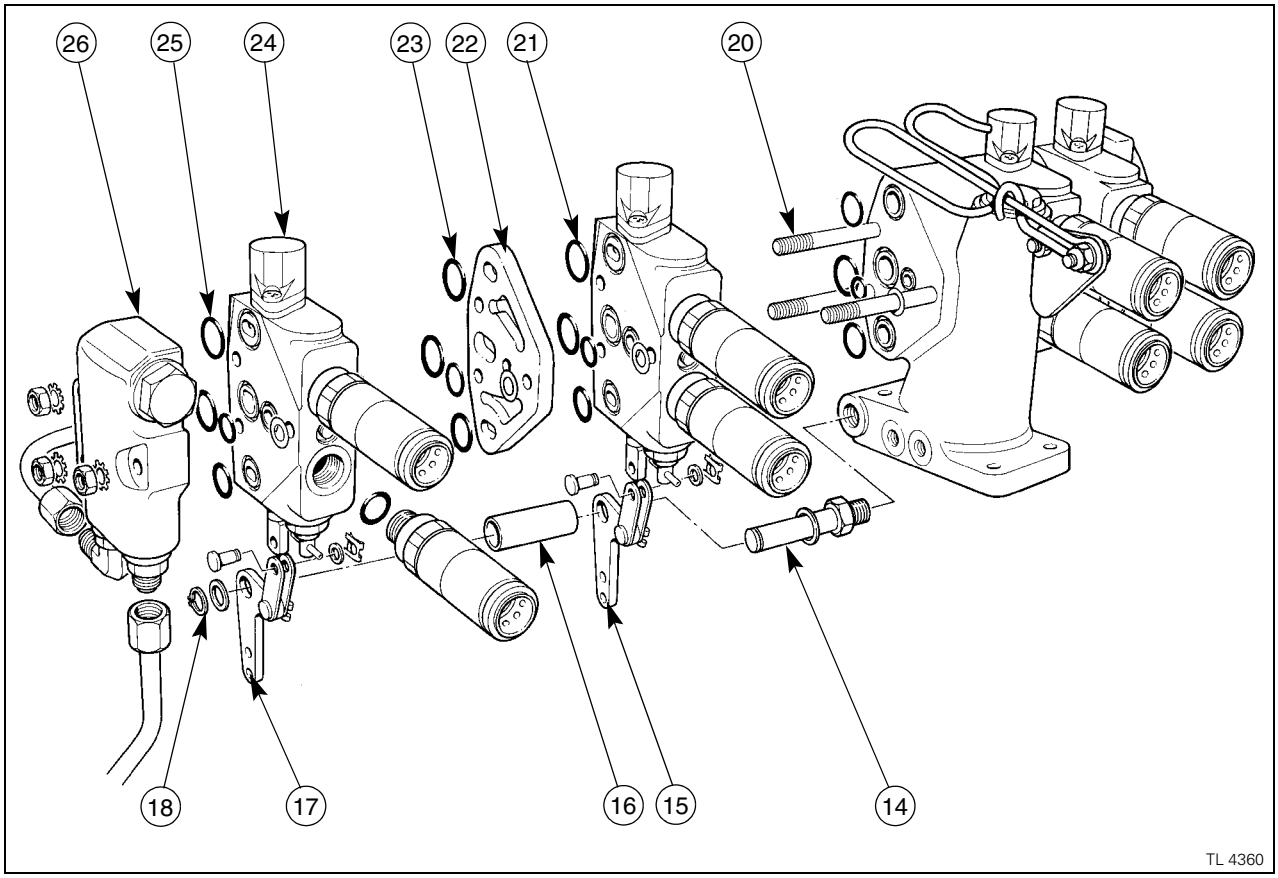
10. Remove the circlip and washer from the end of the pivot pin.
11. Remove the spring clip and washer from the pin.
12. Withdraw the pin and remove the linkage.
13. Remove the pivot pin.
14. Fit the new, longer pivot pin and washer.
15. Refit the linkage, by reversing procedures 12 to 13.
16. Slide the spacer tube onto the pivot pin.
17. Fit the new linkage from the kit.
18. Fit the washer and a new circlip to the pivot pin.
19. If a fourth valve section is being fitted repeat procedures 10 to 18 for the other side of the valve assembly.





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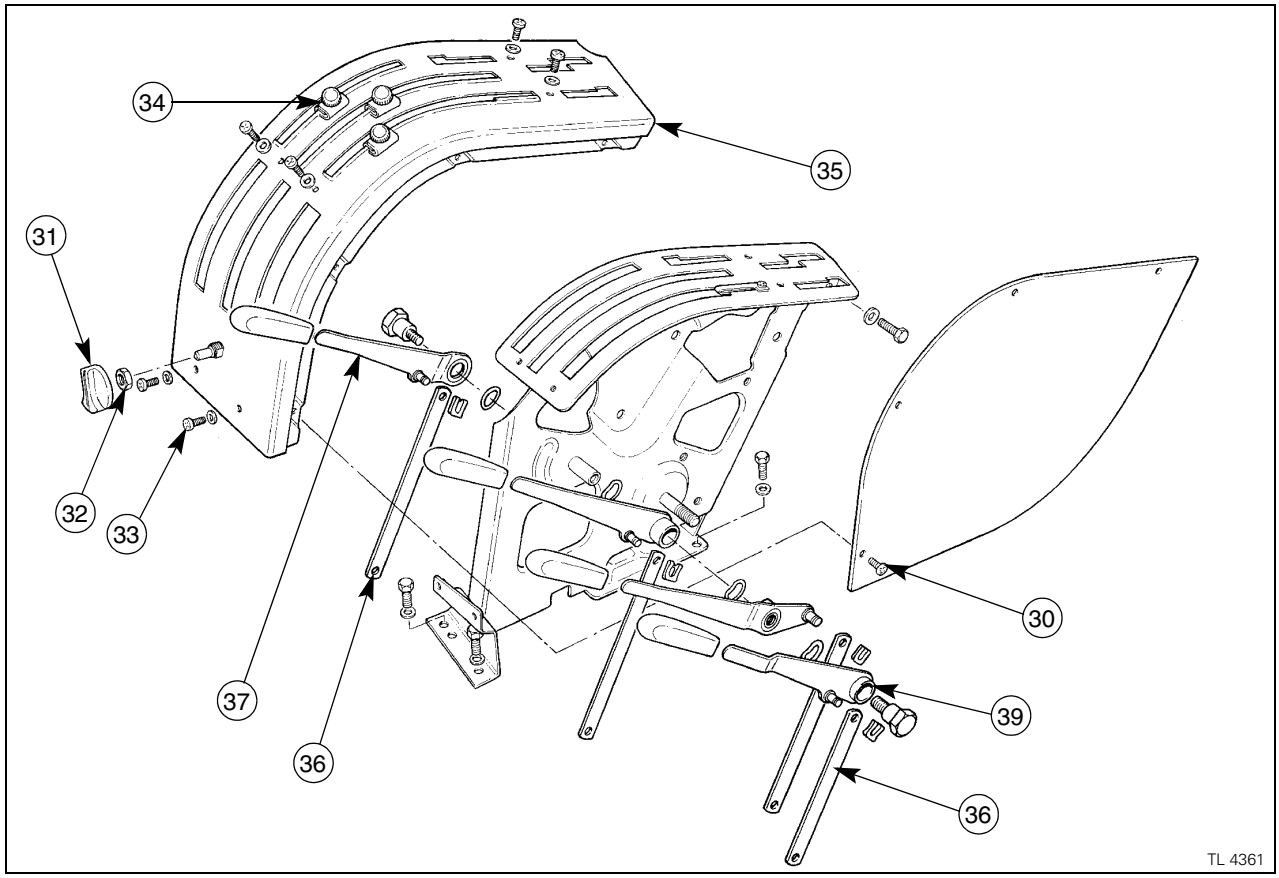
Fitting the New Valve Section

20. Remove a tie rod and replace it with a new, longer tie rod. Repeat for the other two tie rods.
21. Fit a new set of 'O' rings and a green shim washer to the spacer block.
22. Carefully slide the spacer block onto the tie rods.
23. Fit a new set of 'O' rings and a green shim washer to the valve section.
24. Carefully slide the valve section onto the tie rods.
25. Fit a new set of 'O' rings and a green shim washer to the end piece.
26. Carefully slide the end piece onto the tie rods and fit the new nuts and washers to the tie rods.
27. Fit the control linkage to the new valve section.
28. If a fourth valve section is being fitted repeat procedures 7 to 9 and 20 to 27 for the other side of the valve assembly.
29. Evenly tighten the tie rod nuts, finishing with a torque of 20 Nm (15 lbf ft).

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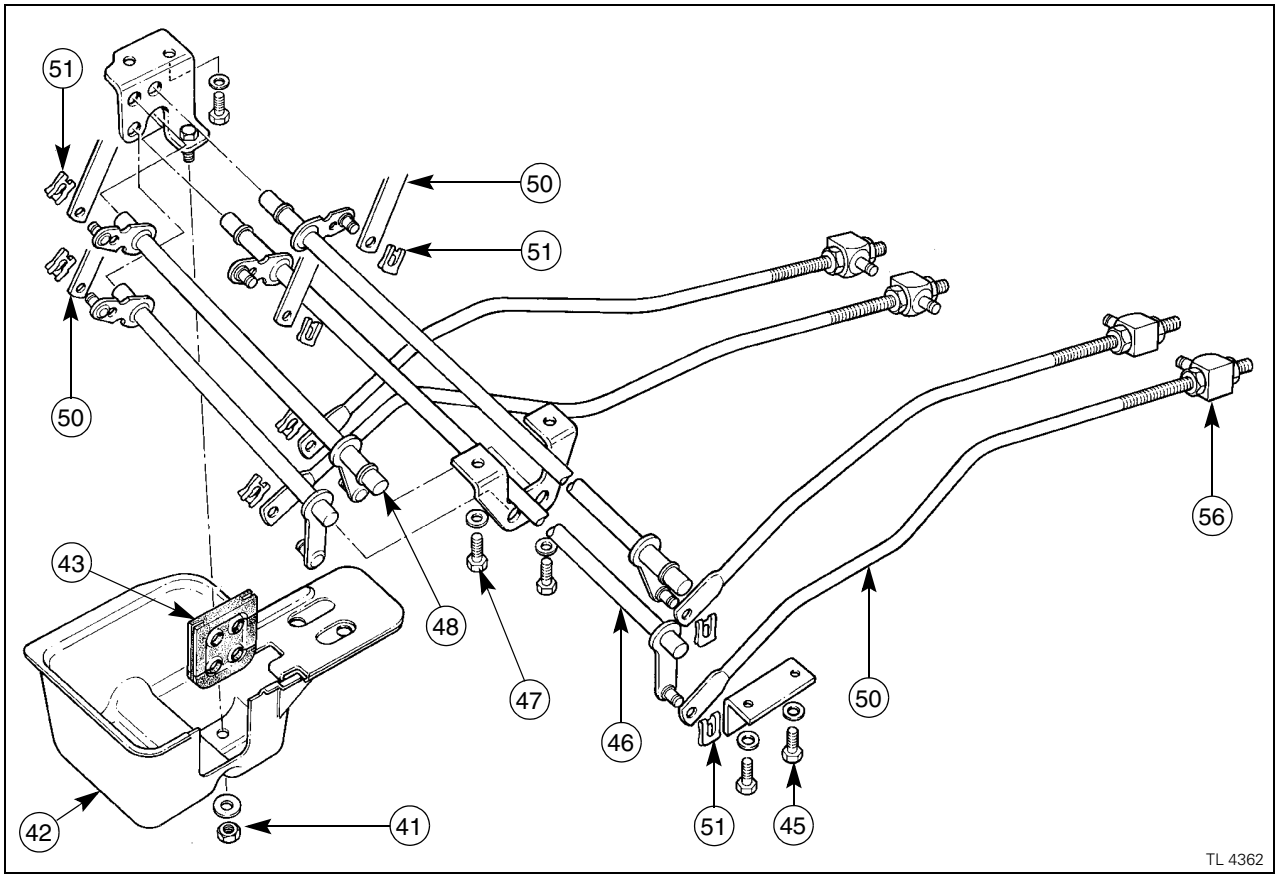


Fitting the Levers

30. Remove the four cross head screws and the side panel.
31. Pull the knob off the spindle.
32. Remove the nut.
33. Remove the six screws.
34. Remove the lever clamps.
35. Carefully remove the quadrant cover.
36. Fit the control rods to the new lever(s).
37. Fit the third valve lever ensuring that the wavy washer is in place.
38. If a fourth valve is being fitted remove the bolt securing the first and second valve levers.
39. Fit the new lever using the special bolt from the kit. Ensure that the wavy washer is correctly fitted.
40. Reverse procedures 30 to 35.

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Fitting the Cross Shafts

41. Remove the nut and washer.
42. Lower the cover down the draft and position control rods, sliding it out of the rubber seal.
43. Remove the rubber seal, cuts are provided in the rubber so it can be prised off the cross shafts.
44. If a fourth control valve is being fitted it will be necessary to make another cut in the rubber for the cross shaft.
45. Remove the bolts and the bracket.
46. If required, fit the long cross shaft into position and refit the bracket and bolts.
47. Remove the bolts and the bracket.
48. Fit the short cross shaft from the kit (if not already fitted).
49. Refit the bracket and the bolts.
50. Fit the control rods to the cross shafts.
51. Fit the spring clips.
52. Refit the rubber seal to the cross shafts.
53. Refit the cover, ensuring that the rubber seal is located correctly.
54. Refit the nut and washer.

Refitting the Control Valve Assembly

NOTE: If a fourth valve has been fitted, the combined flow and the oil supply pipes will need to be replaced with the pipes included in the kit

55. Refit the control valve assembly by reversing procedures 1 to 5.
56. Adjust the control rods so that the levers are in line and in the centre of the slots.

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Section 13 - Part C

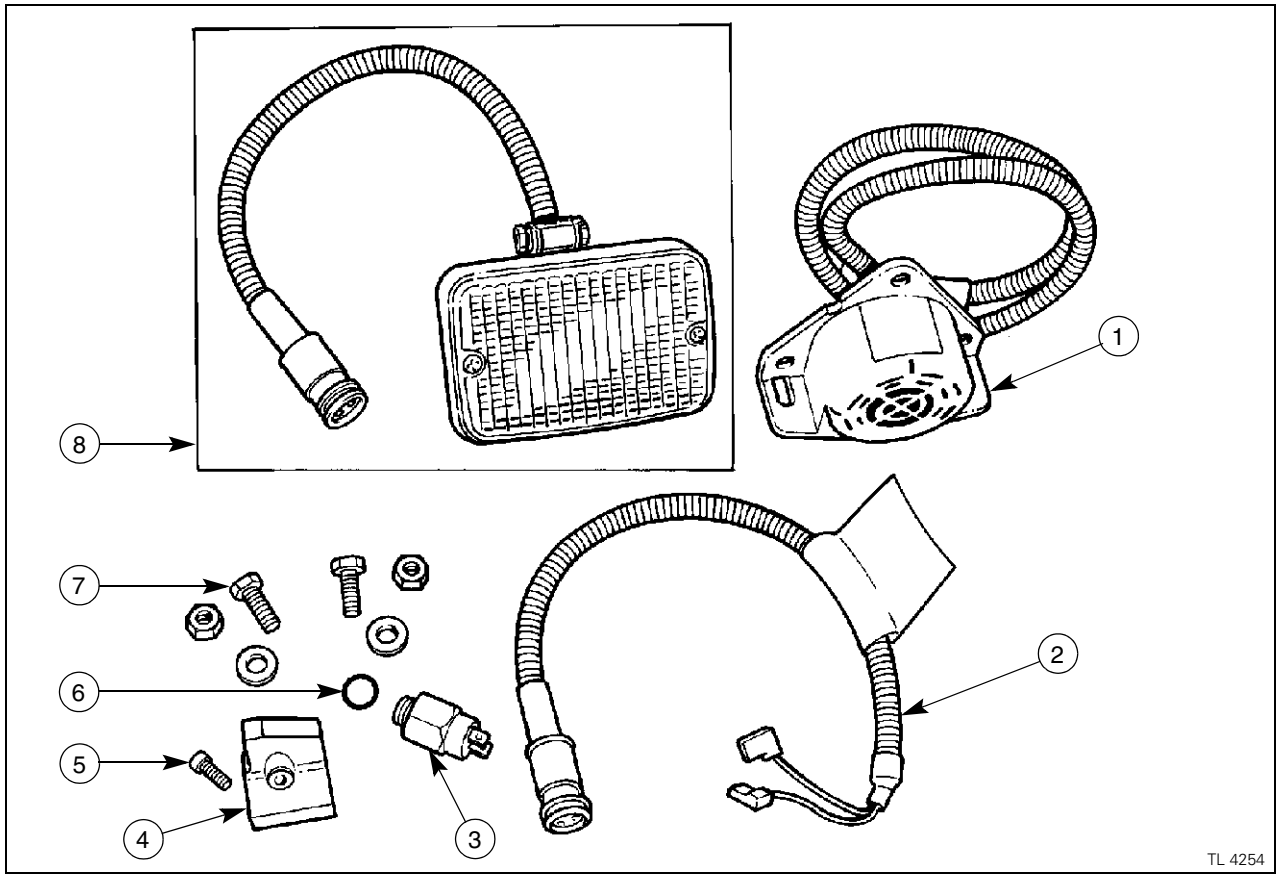
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Operation No.	Description	Page No.
1-13C	Reverse Bleeper and Reverse Light - Installation	13C–3

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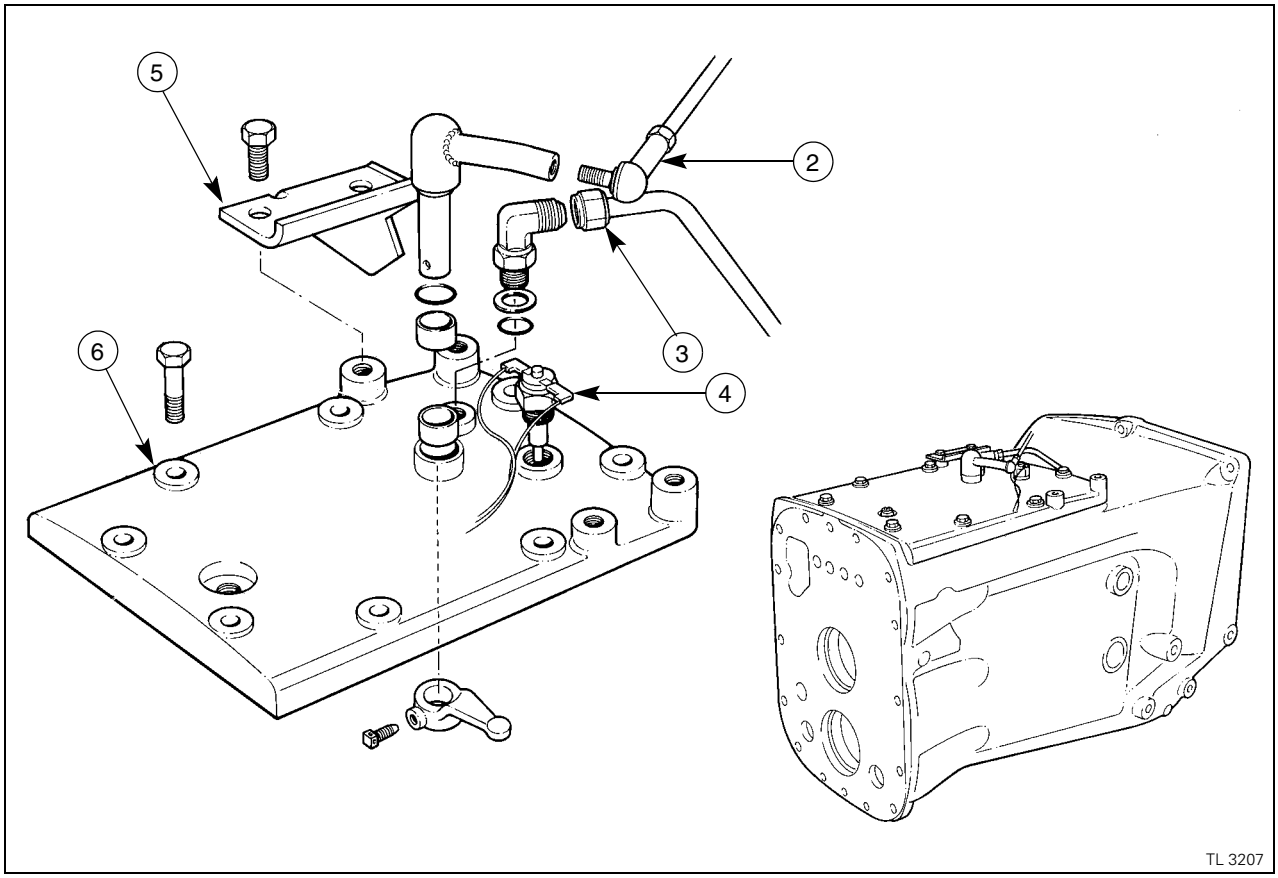
Accessories



1. Reverse bleeper.
2. Wiring harness.
3. Switch.
4. Actuator.
5. Cap head screw.
6. 'O' Ring.
7. Bleeper fitting hardware.
8. Reverse light (*optional*).

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REVERSE BLEEPER AND LIGHT

Installation **1-13C**

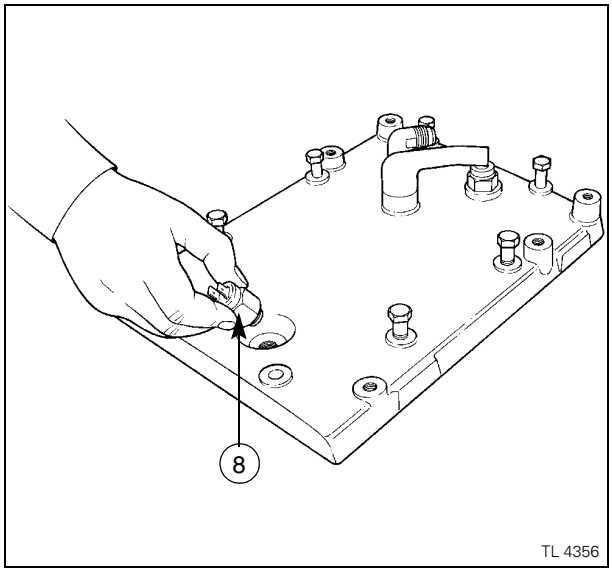
Procedure

1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the wires to the safety start switch.
5. Remove the bolts and the clutch cable bracket.
6. Remove the top cover.
7. Remove dried gasket material from the machined faces.

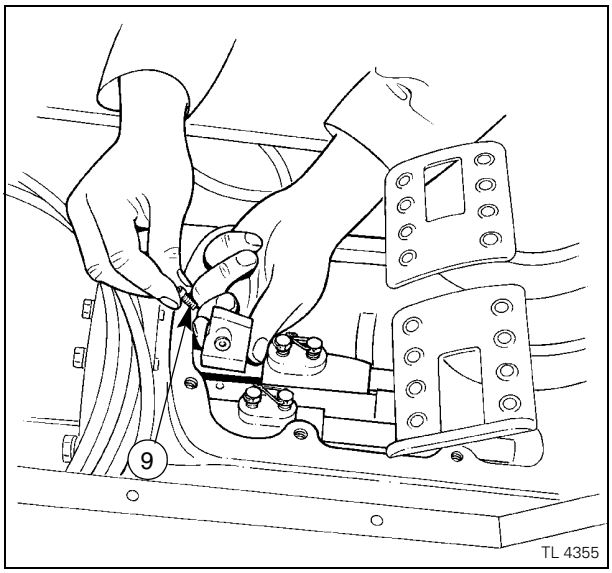
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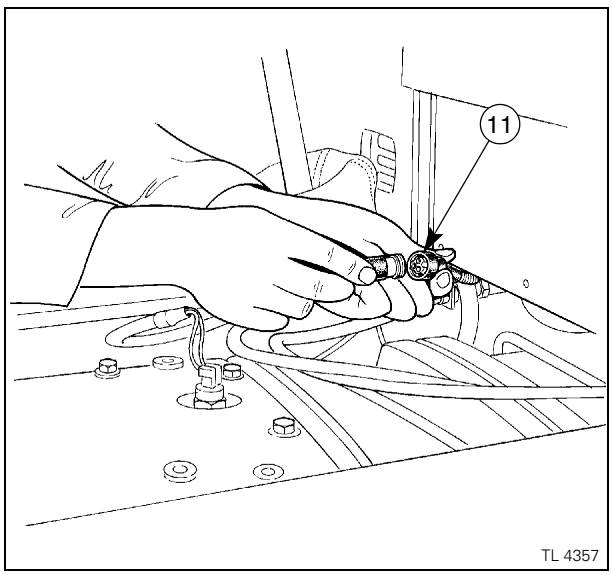
8. Fit the switch and ‘O’ ring to the top cover.



9. Apply one or two drops of Massey Ferguson Studlock (Loctite 270) to the cap head screw before fitting the actuator to the selector rail.
10. Reverse procedures 2 to 6 except:
   a. Lubricate both switches with a small quantity of transmission oil before installation.
   b. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to torque of 115 Nm (85 lbf ft).



11. Fit the wiring harness to the reverse bleeper switch.
12. Connect the wiring harness plug to the socket.
13. Refit the cab floor or footplates.

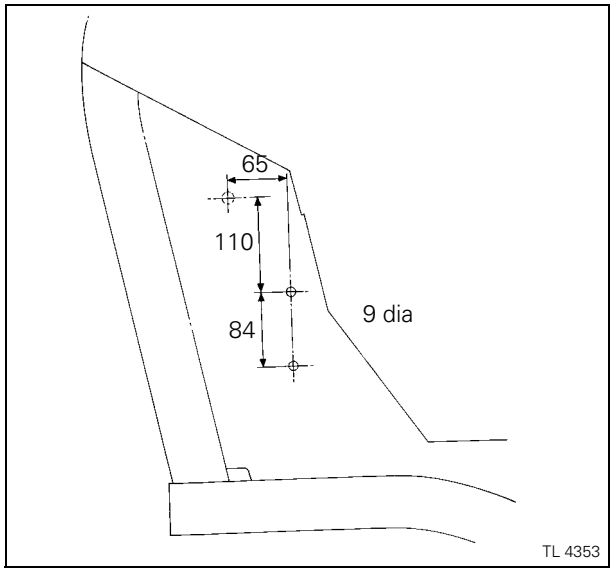


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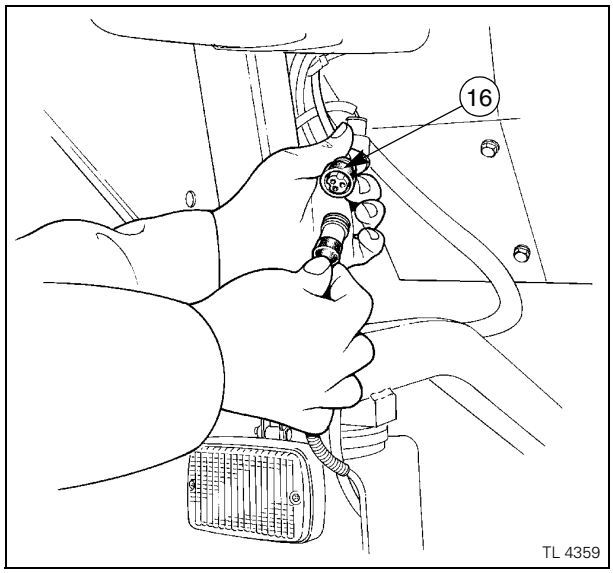
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Reverse Bleeper

14. Drill two holes as shown.
15. Fit the reverse bleeper with nuts and bolts provided.



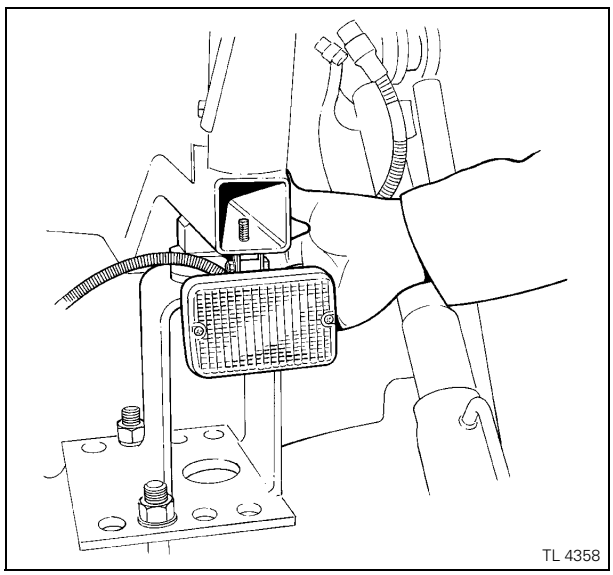
16. Connect the reverse bleeper wiring harness plug to the socket.



Reverse Light

17. Remove the plastic blanking plug and fit the reverse light.
18. Connect the reverse light wiring harness plug to the socket.

NOTE: *For Power Shuttle tractors only procedures 14 to 16 or 17 and 18 apply.*



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SECTION 14

Service Tools

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14A SERVICE TOOLS

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Service Tools

Section 14 - Part A

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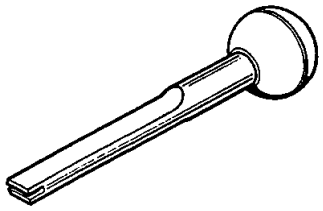
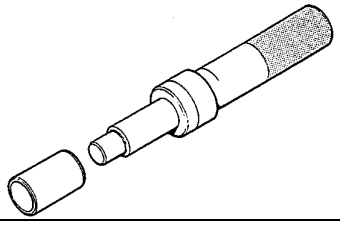
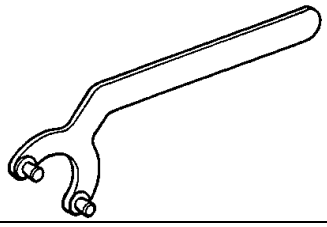
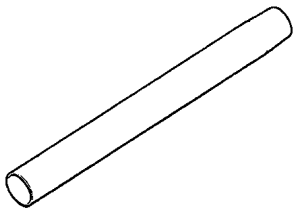
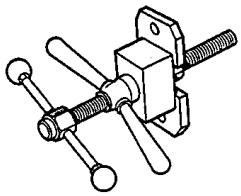
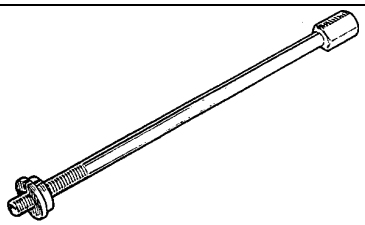
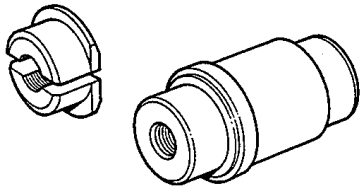
The importance of the use of approved special tools can hardly be over-emphasised. They are essential if service operations are to be carried out efficiently and safely. The amount of time which they save can be considerable.

The following pages illustrate the current range of Special Service Tools used on the 4200 series range of tractors.

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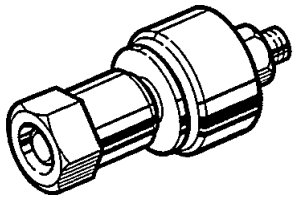
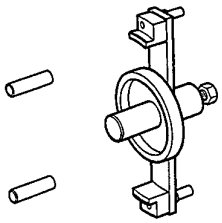
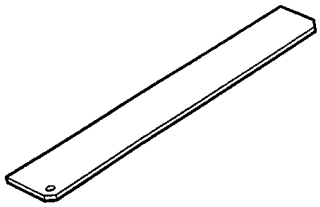
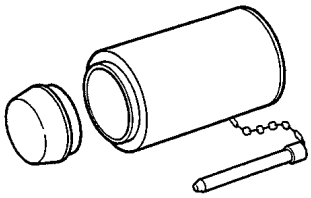
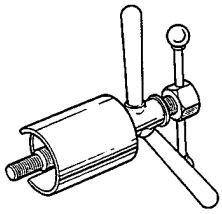
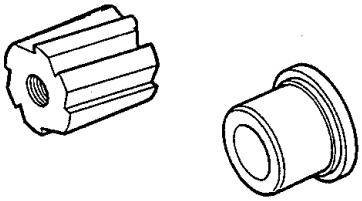
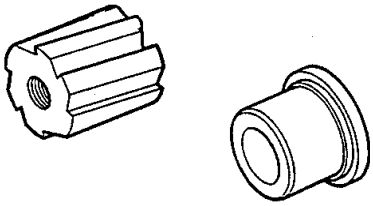
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Service Tools

Tool number	Description	Illustration
MS.63	Spring fitting tool	
MF.159B	Clutch centraliser	
MF.163	Spring retainer nut wrench	
MF.177A	Main input shaft oil seal protector	
MF.195C	PTO shaft needle bearing remover/replacer - main tool	
MF.195-5B	PTO shaft needle bearing remover	
MF.195-6B	PTO shaft needle bearing replacer Used with MF.195–5B	

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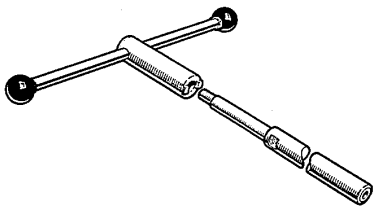
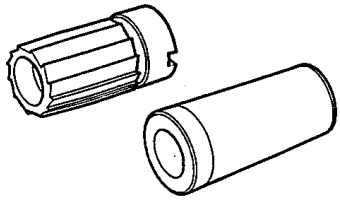
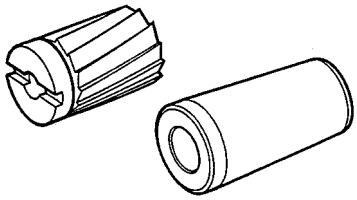
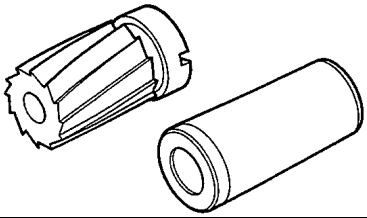
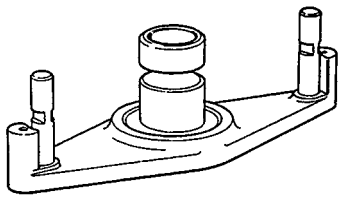
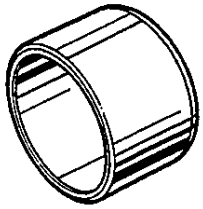
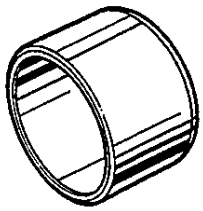
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Tool number	Description	Illustration
MF.218B	PTO bearing housing replacer	
MF.245D	Differential bearing pre-load gauge	
MF.245D-1	Straight edge	
MF.255B	PTO input shaft oil seal replacer	
MF.263A	Front axle and steering bush remover (main tool)	
MF.263-2	Front axle and steering bush remover/replacer adaptors 1 1/2 in diameter bushes Used with MF.263 and MS.550	
MF.263-5	Front axle and steering bush remover/replacer adaptors (1 3/4 in diameter bushes) Used with MF.263 and MS.550	

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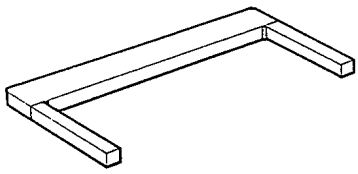
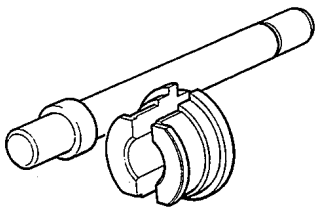
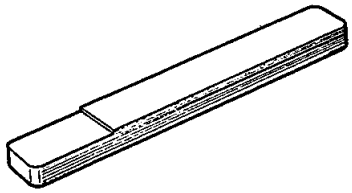
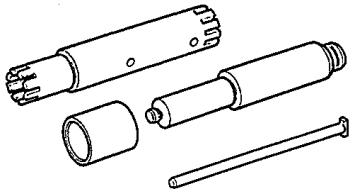
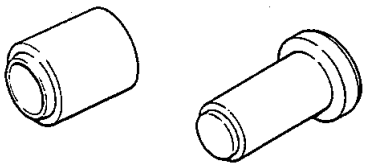
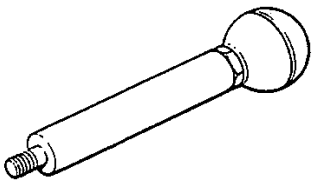
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Service Tools

Tool number	Description	Illustration
MF.264	Front axle and steering bush reamer main tool	
MF.264-1	Reamer and pilot 1 1/2 in diameter bushes Used with MF.264	
MF.264-2	Reamer and pilot 1 7/8 in diameter bushes Used with MF.264	
MF.264-8	Reamer and pilot 1 3/4 in diameter bushes Used with MF.264	
MF.267A	Epicyclic pre-load gauge	
MF.267-1	Sleeve - normal-duty axle (Part of MF.267A)	
MF.267-2	Sleeve - heavy-duty axle (Part of MF.267A)	

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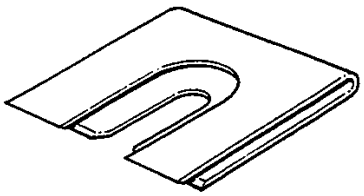
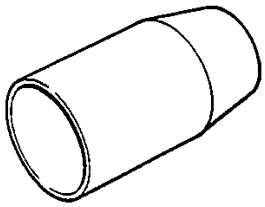
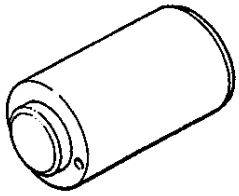
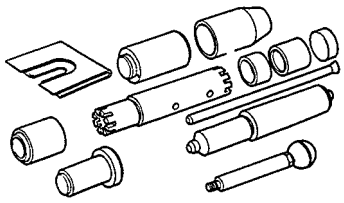
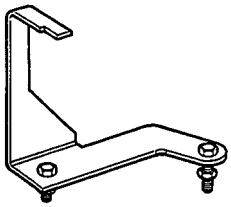
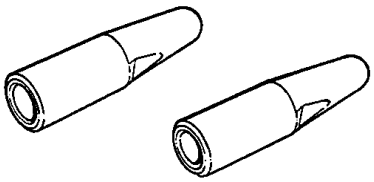
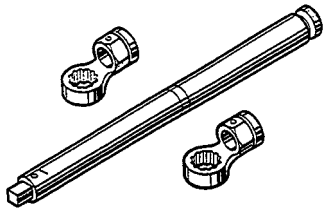
Tractor Manuals Scotland

Tool number	Description	Illustration
MF.273A	Hydraulic control lever setting fixture	
MF.314	Clutch release lever height setting gauge - 12 in clutch	
MF.315A	PTO input shaft needle roller bearing remover/replacer	
MF.333	Draft control rod gauge	
MF.349	Pump valve facing cutter and coining tool. Included kit MF.355	
MF.350	Pump valve chamber clip replacer. Included in kit MF.355	
MF.351	Pump valve chamber plug remover replacer. Included in kit MF.355	

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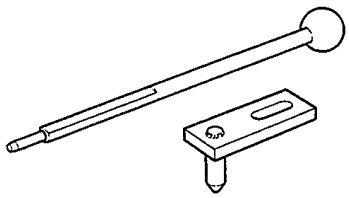
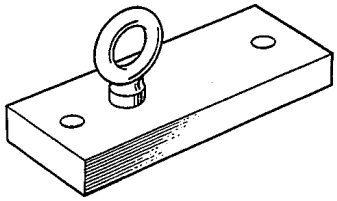
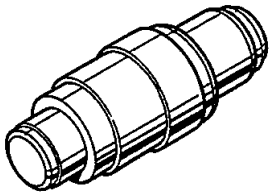
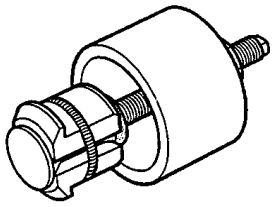
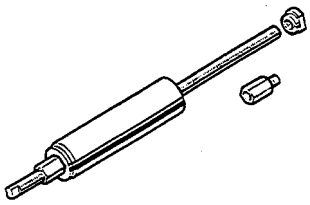
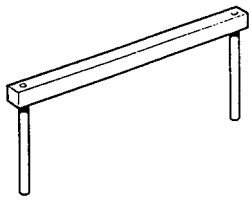
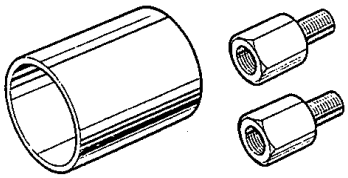
Tractor Manuals Scotland

Service Tools

Tool number	Description	Illustration
MF.352	Control valve spring retainer clip. Included in kit MF.355	
MF.353	Control valve body 'O' ring guide. Included in kit MF.355	
MF.354	Control valve body replacer. Included in kit MF.355	
MF.355	Hydraulic pump overhaul kit. Kit contains 6 tools (MF.349 to MF.354 inclusive)	
MF.356E	Position and draft control setting gauge.	
MF.366	PAVT wheel guide pegs	
MF.367B	Transmission case ring spanner set	

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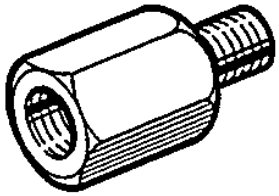
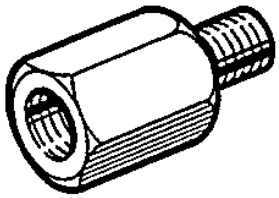
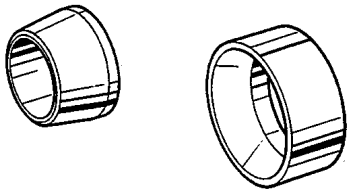
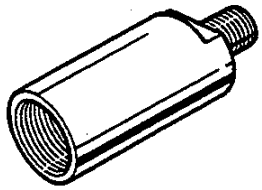
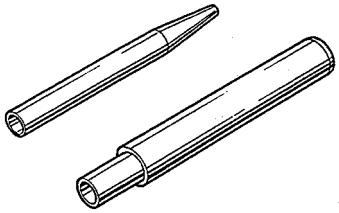
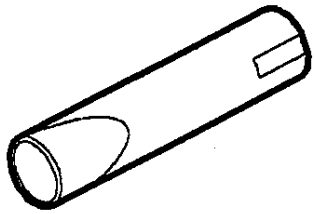
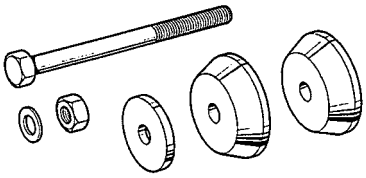
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Tool number	Description	Illustration
MF.414A	Synchromesh setting pin	
MF.418A	Hydraulic lift cover remover replacer	
MF.421	Main drive shaft needle roller bearing and seal replacer	
MF.422A	Bearing, sleeve and oil seal remover	
MF.444	Axle pivot pin remover	
MF.446	Clutch release lever height setting gauge - 13 in clutch	
MF.451B	Four-wheel drive swivel pin remover (used with MF.195C)	

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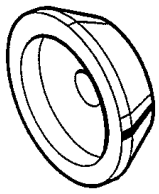
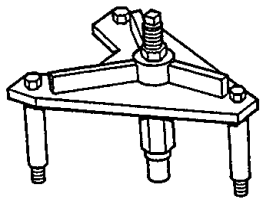
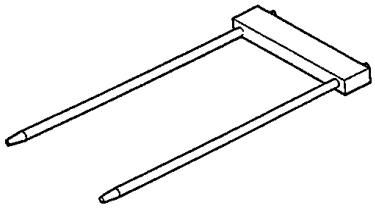
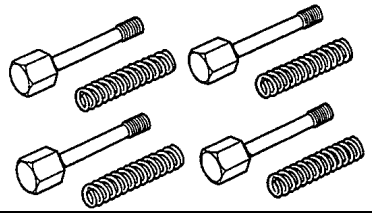
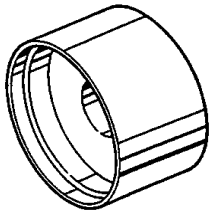
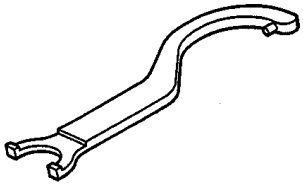
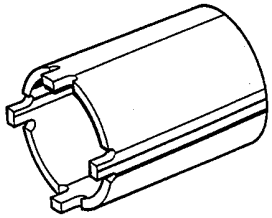
Tractor Manuals Scotland

Service Tools

Tool number	Description	Illustration
MF.451B-2	Replacement adaptor only - M14 (part of MF.451B)	
MF.451B-3	Replacement adaptor only - M18 (part of MF.451B)	
MF.453	Hydraulic ram piston seal replacer (94,5 mm diameter)	
MF.455	Relief valve testing capsule	
MF.467	Brake pull rod seal protector	
MF.468	Brake pull rod seal protector	
MF.471A	Differential lock spring compressor	

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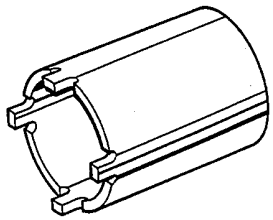
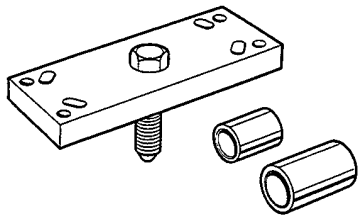
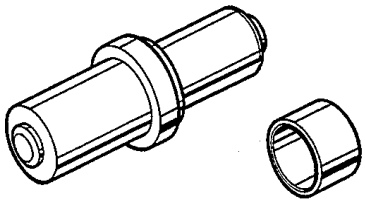
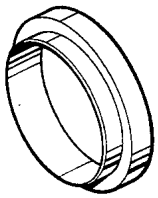
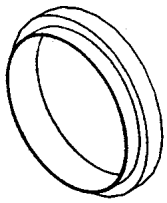
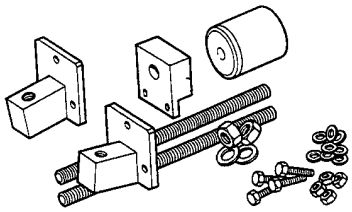
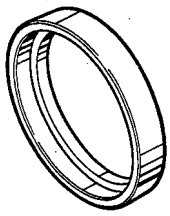
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Tool number	Description	Illustration
MF.471-1	Differential lock spring compressor adaptor (part of MF.471A)	
MF.476	Bearing remover/replacer	
MF.477	Gear set support tool	
MF.478	Bearing pre-load tool	
MF.479	Clutch release bearing installer Used with MS.550	
MF.482	Steering cylinder wrench. Four-wheel drive axle	
MF.483	Hub nut wrench (AG 66 axle)	

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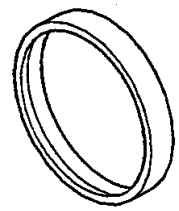
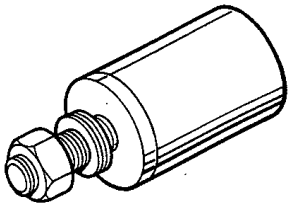
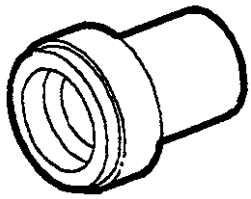
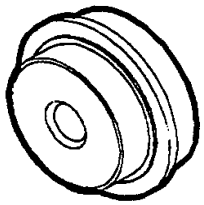
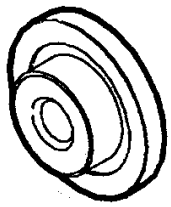
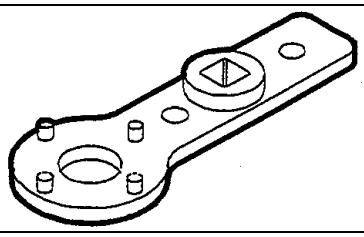
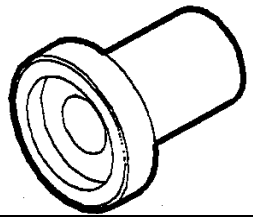
Tractor Manuals Scotland

Service Tools

Tool number	Description	Illustration
MF.487	Hub locknut wrench (AG 75, 85, 105 axles)	
MF.488	Hub carrier puller (AG 66, 75, 85, 105 axles)	
MF.489	Bearing, sleeve and oil seal remover	
MF.493	Hub seal installer (AG 66 axle)	
MF.494	Hub seal installer	
MF.495	Planetary ring gear replacer (AG 66 axle)	
MF.496	Wear ring installer (AG 66 axle)	

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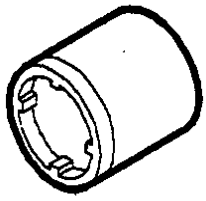
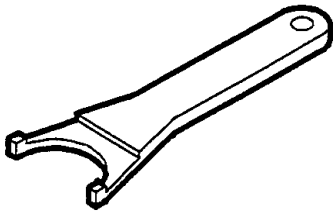
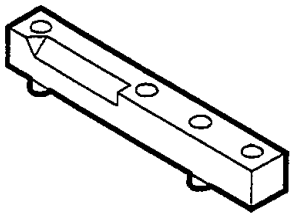
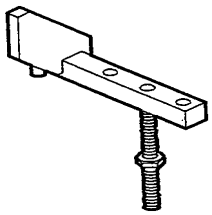
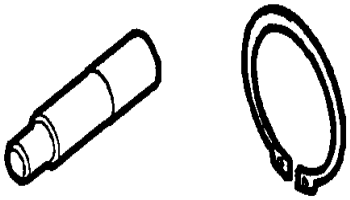
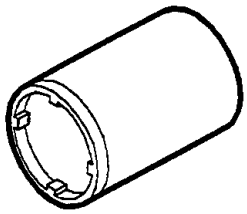
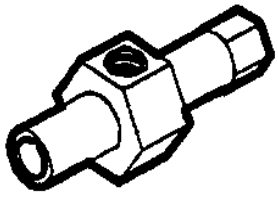
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Tool number	Description	Illustration
MF.497	Wear ring installer	
MF.498	Planetary gear replacer	
MF.499	Drive shaft seal installer	
MF.500	Front axle bearing installer Used with MS.550	
MF.501	PTO cassette seal installer Used with MS.550	
MF.502	Pinion nut wrench. Four-wheel drive axle	
MF.503	Pinion oil seal installer Four-wheel drive axle	

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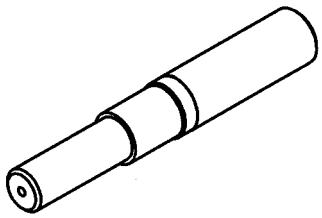
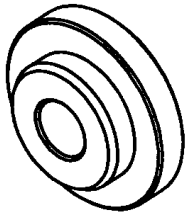
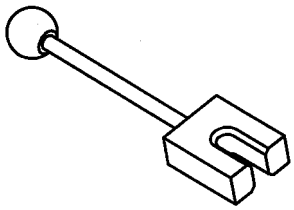
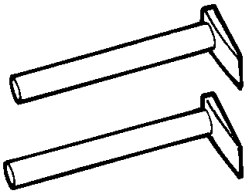
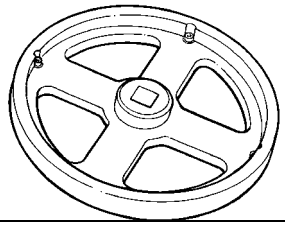
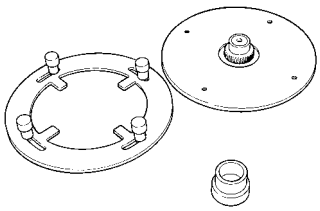
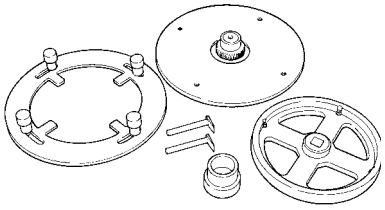
Tractor Manuals Scotland

Service Tools

Tool number	Description	Illustration
MF.504	Steering pivot nut wrench. Two-wheel drive axle	
MF.505	Steering cylinder wrench. Two-wheel dive axle	
MF.506	Ram arm gauge - position	
MF.507	Ram arm gauge - draft	
MF.508	Pump drive sprocket remover	
MF.509	Steering ball joint wrench. Two-wheel drive axle	
MF.510	Back pressure test adaptor	

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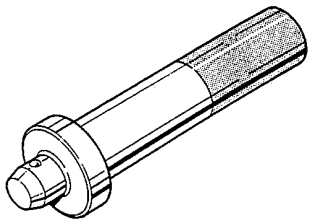
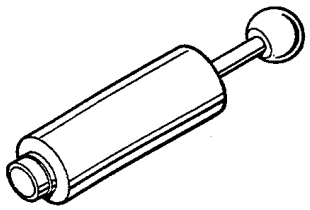
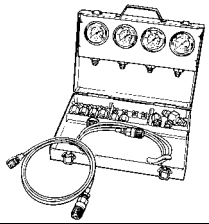
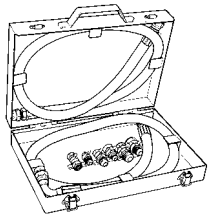
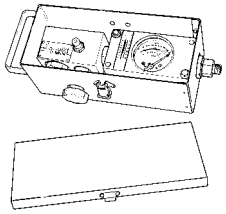
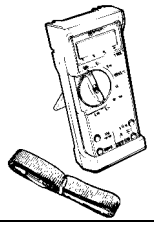
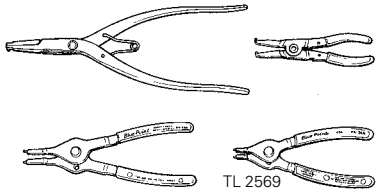
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Tool number	Description	Illustration
MF.512	Clutch centraliser	
MF.513	Input seal installer Used with MS.550	
MF.514	Valve setting gauge	
MF.515	Power Shuttle Kit Retaining Wedges	
MF.516	Power Shuttle Kit Wrench Assembly	
MF.517	Power Shuttle Kit Clutch Retaining fixture	
MF.519	Power Shuttle Tool Kit	

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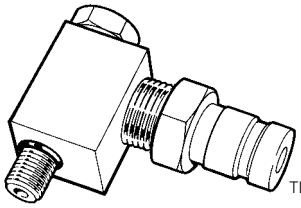
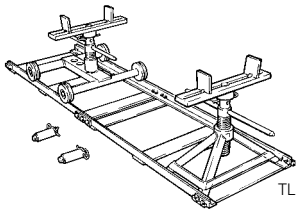
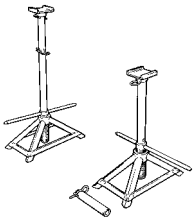
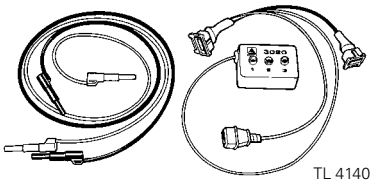
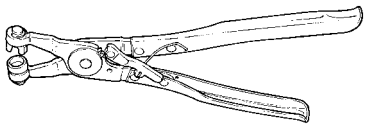
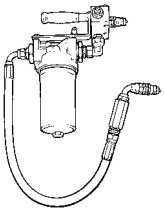
Tractor Manuals Scotland

Service Tools

Tool number	Description	Illustration
MS.550	Universal handle	
MS.1667	'O' ring and seal fitting tool	
MF.3001A	Pressure test kit	 TL 3077
MF.3002	Hose test kit	 TL 2481
MF.3003	Hydraulic flow meter (60 litre/minute)	 TL 2482
MF.3005	Digital multimeter	 TL 2490
MF.3008	Circlip plier set	 TL 2569

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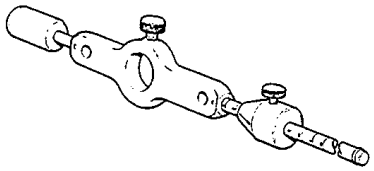
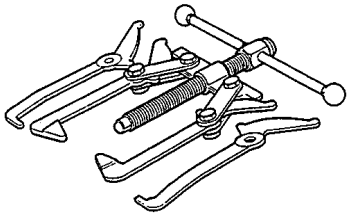
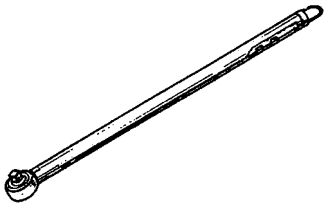
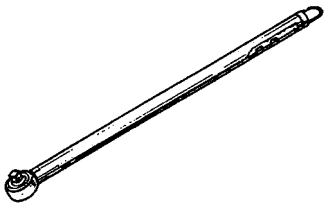
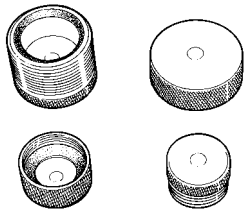
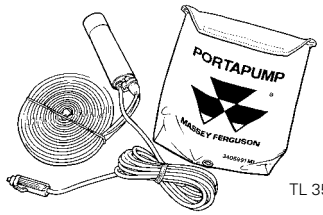
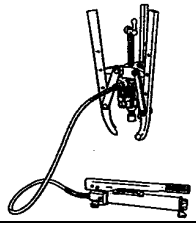
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Tool number	Description	Illustration
MF.3011	PTO hydraulic test point	 TL 4164
MF.3012	Tractor splitting track	 TL 2618
MF.3013	Cab stands	 TL 2620
MF.3020	ELC Harness Connector (use with MF.3005 Multimeter)	 TL 4140
MF.3024	Constant Tension Clip Pliers	 TL 4384
MF.3025	Oil Filter Kit	 TL 4347

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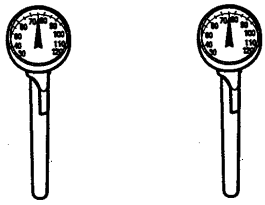
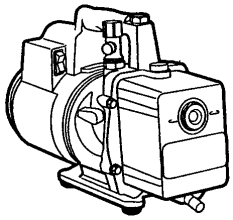
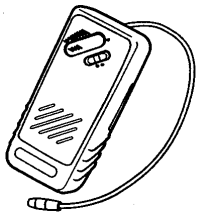
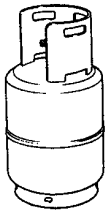
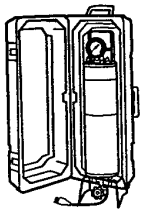
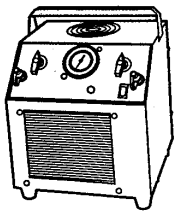
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Service Tools

Tool number	Description	Illustration
FT.4062A	Bearing pre-load tool	
6312A (18G.2)	Universal puller	
TE.7377	Torque wrench 1/2 in square drive 30-150 lbf/ft	
TE.7379	Heavy-duty torque wrench 3/4 in square drive 100-600 lbf/ft	
3376 935 M1	Air conditioning Blanking plug and cap	 TL 4165
3405 991 M1	Portapump	 TL 3579
MS.1713	30 ton hydraulic puller kit	 TL 3954

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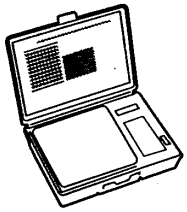
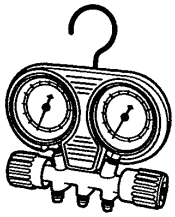
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Tool number	Description	Illustration
10945	Pocket thermometer - 2 off	
13203	Vacuum pump oil - 1 US quart	
15401	Vacuum pump - two stage 93 litre per minute	
16500	Electronic leak detector - with batteries and spare sensor	
17571	30lb refrigerant tank - with float switch	
20349B	Metric dial-a charge charging cylinder for R134a complete with carry case 2200 gm. capacity	
25151	Refrigerant recovery unit 220-240 volt	

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Service Tools

Tool number	Description	Illustration
34985	Battery powered refrigerant charging scales	
41640	Side wheel gauge set - metric for R134a systems	
45605	Heater blanket for refrigerant cylinder	Not illustrated

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