



Powering Business Worldwide

Service Manual

Eaton Transmissions

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Warnings and Precautions



SM0148

Before starting a vehicle always be seated in the driver's seat, place the transmission in neutral, set the parking brakes and disengage the clutch.

Before working on a vehicle place the transmission in neutral, set the parking brakes and block the wheels.

Before towing the vehicle place the transmission in neutral, and lift the rear wheels off the ground, or remove the axle shafts, or disconnect the driveline to avoid damage to the transmission during towing.

The description and specifications contained in this service publication are current at the time of printing.

Eaton Corporation reserves the right to discontinue or modify its models and/or procedures and to change specifications at any time without notice.

Any reference to brand name in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.



This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.

Warning: Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician.

Caution: Failure to follow indicated procedures may cause component damage or malfunction.

Note: Additional service information not covered in the service procedures.

Tip: Helpful removal and installation procedures to aid in the service of this unit.

Always use genuine Eaton replacement parts.

Purpose and Scope of Manual

This manual is designed to provide detailed information necessary to service and repair the Eaton® transmissions listed on the front.

How to use this Manual

The procedure sections are laid out with a general heading at the top outside edge of each page followed by more specific headings and the procedures. To find the information you need in these sections, first go to the section that contains the procedure you need. Then look at the heading at the top and outside edge of each page until you find the one that contains the procedure you need.

Transmission Overhaul Procedures follow the general steps for complete disassembly and then assembly of the transmission.

Note: In some instances the transmission appearance may be different from the illustrations, but the procedure is the same.

Disassembly Precautions

It is assumed in the detailed disassembly instructions that the lubricant has been drained and the necessary linkage and air lines (if fitted) have been removed from the chassis.

Removal of the gear shift remote control housing assembly is included in the detailed instructions; however, this assembly may also be removed from the transmission before removing unit from vehicle.

Follow each procedure closely in each section, making use of both the text and the pictures.

Cleanliness

Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. The outside of the unit should be carefully cleaned before starting the disassembly. Dirt is abrasive and can damage bearings.

Assemblies

When disassembling the various assemblies, such as the mainshaft, range change epicyclic, layshaft and remote control housing, lay all parts on a clean bench in the same sequence as removed. This procedure will simplify reassembly and reduce the possibility of losing parts. When pulling off synchroniser hubs follow the procedures detailed in 'Disassembly' using a suitable puller of adequate capacity. Failure to adhere to the recommended procedures may cause irreparable damage.

Snap rings

Remove snap rings with pliers designed for this purpose. New selective fit snap rings must be fitted as specified in 'Reassembly'.

Input shaft

The input shaft on direct drive transmission can be removed without removing the front case. Take care not to misplace or lose the mainshaft spigot bearing.

Bearings

Carefully wash and relubricate all bearings as removed and protectively wrap until ready for use. Remove bearings with pullers designed for this purpose.

When Pressing

Apply force to shafts, housings etc. with restraint. Movement of some parts is restricted. Do not apply force after the part being driven stops solidly. Use soft hammers for all disassembly work.

Do not use pry bars or chisels to separate casing halves and housings or irreparable damage may be caused.

Inspection Precautions

Before reassembling the transmission, the individual parts should be carefully checked to eliminate those damaged. They should be renewed. This inspection procedure should be carefully followed to ensure the maximum wear life from the rebuilt unit.

The cost of a new part is generally a small fraction of the total cost of downtime and labour, should the use of a questionable part make additional repairs necessary before the next regularly scheduled overhaul. Recommended inspection procedures are set forth in the following check list.

Bearings

- Wash all bearings in clean solvent. Check rollers and races for pits and spalled areas. Renew damaged bearings.
- Lubricate undamaged bearings and check for axial and radial clearances. Renew bearings with excessive clearances.
- Check fits of bearings in housing bores. If outer races turn too freely in the bores, the housing should be renewed. Check housing bores for signs of wear prior to taking this action. Only replace housing if wear is seen as a result of bearing spin.

Gears

- Check gear teeth for pitting of the tooth faces. Gears with pitted teeth should be renewed. Check the reverse gear dog engagement teeth for freedom from damage.
- Check the internal bearing surfaces for wear of the effects of overheating.
- Check axial clearances of gears. Where excessive clearance is found, check gear and hub for excessive wear.
- Maintain the specified axial clearance on all mainshaft gears.

Bearing Sleeve — Mainshaft

- Sleeves with groove formation, pits or which have either been overheated or worn out must be renewed.

Synchroniser Assemblies

- Check to ensure all splines are free from excessive wear.
- Check that the engagement dog teeth on the sliding sleeves, synchroniser rings are free from chipping and burring.
- Check that the synchroniser ring cones are not excessively worn or showing the effects of overheating. Check the clearance between the synchroniser ring and the synchroniser flange is between 3.01 mm maximum and 0.50 mm minimum.
- Renew the springs, plungers and rollers.

Splines

- Check splines on all shafts for wear. If synchroniser hubs, output drive flange or clutch hub have worn into the sides of the splines, the shafts in this condition must be renewed.

Thrust Washers

- Check surfaces of all thrust washers. Washers scored or reduced in thickness should be renewed.

Range Change Planet Gears, Spindles and Needle Roller Bearings

- It is found necessary to dismantle the planet gears, retain each gear, spindle, rollers, spacers and washers in their respective set for reassembly in the same relative position.
- If uneven wear is found in the planet gears, check lubrication holes for blockage and renew all rollers.
- Renew planet spindle grubscrews on reassembly.

Reverse Idler Gear

- Check bearings and shaft for wear from action of roller bearings.

Clutch Release Parts

- Check clutch release parts, yokes and bearing carrier. Check pedal shafts. Renew worn shafts and bearings.

Gear Selector Shaft Assembly

- Check forks and keys for wear at contact points. Renew worn parts.
- Check forks for alignment.
- Check forks for excessive and uneven wear, renew worn forks.
- Check lock screw in selector block. A lock screw with worn taper must be renewed.
- Check condition and fit of selector key and interlock key in shift shaft. Worn or damaged keys must be renewed.

Gear Shift Remote Control

- Check spring tension on cross shaft. Renew tension springs if shaft moves too freely.
- If housing is dismantled, check cross shaft and inner lever and the bearing bushes for wear. Renew worn parts.
- Check all seals and locating journals. Renew worn parts.

Bearing Covers

- Check covers for wear from thrust. Renew covers worn or grooved from thrust of bearing outer race.
- Check bores of covers for wear. Renew those worn oversize.

Oil Return Seals

- Check oil seal in front bearing cover for damage and wear, renew if necessary.
- Check oil seal in speedometer housing for damage or wear, renew if necessary. Renew grit shield if worn or loose on flange.
- Check oil seal tracks for wear and renew if worn or grooved.
- Check the oil sealing ring in the muff ring for wear or breakage.

O-Rings

- Renew all O-rings.

Oil Pump

- Check the oil pump rotors and covers for scoring and wear. The complete pump assembly must be renewed if scored or excessively worn, or its serviceability is suspect in any way.

Assembly Precautions

Make sure that interiors of all housings are clean. It is important that dirt be kept out of transmission during reassembly. Dirt is abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during reassembly.

Gaskets

Use new gaskets where detailed only (neutral detent cover and remote control housing covers). All other locations ensure mating faces are clean and undamaged and apply a continuous bead of Loctite 5900 Flange Sealant to one face only. Do not apply excessive sealant or allow it to penetrate into the bearings.

Capscrews

Use thread sealant on all capscrews. Refer section '**Specification**' for torque ratings.

'O' Rings

Lubricate all 'O' rings lightly with silicone lubricant.

Initial Lubrication

Lubricate bearings with gearbox oil during reassembly.

Axial Clearances

Refer section '**Specification**' to maintain the end float of mainshaft gears.

Bearings

Use of the correct special tools and bearing drivers is recommended for the installation of bearings. Heating the bearing inner tracks will aid installation.

Output Shaft Drive Flange

Tighten the nut to the correct torque.

Do not under any circumstances use an impact wrench to tighten the flange/yoke nut. Use only a hand operated torque wrench or a stall torque motor. Failure to carry out these instructions can cause damage to the locking medium of the nut.

During disassembly and again during reassembly prior to tightening the new nut, it is important to ensure that the output shaft does not slide through the bearing, or the assembled range change synchroniser roller, plungers and springs may be displaced.

A suitable spacer should be temporarily assembled under the nut to allow for the thickness of the nut locking insert to ensure the shaft is firmly held in the bearing until the nut can be torque tightened.

Synchroniser Hubs & Flanges

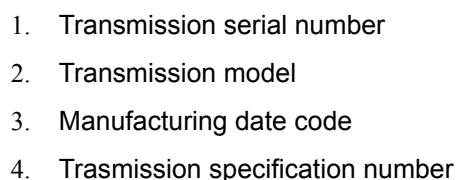
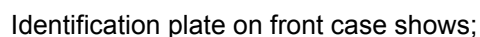
All synchroniser hubs are an interference fit on the mainshaft splines and must be heated to approximately 85°C (180°F) before installation.

All synchroniser flanges to be lubricated before assembly.

Layshaft

The shaft is only available as a complete assembly for service.

All transmissions are fitted with an identification plate on left hand side of the front case on horizontal transmission and right hand side of the front case on vertical transmission.



The transmission specification number is unique to each customer and gives precise details of the transmission design level. This number must be quoted when ordering replacement parts.

FSO - 6109A

F S O - 6 1 09 A/B

Fuller _____ T T T
Synchronised _____
Overdrive _____

Ratio Set
Forward Speeds
Design Level
X 100 = Nominal Torque Capacity (in lb-ft)

SM0301

The model number gives basic information about the transmission and is explained above. Use this number when calling for service assistance or replacement parts.

Serial Number

The serial number is the sequential identification number of the transmission. Before calling for service assistance, write number down. It may be needed.

Technical Data

FS(O)-6109

Speeds

8 Forward (all synchronised) + 1 Crawler (synchroniser optional), 1 Reverse

Power Take-off openings

Left side two standard SAE openings, 6 bolts short length (vertical mounting)

Bottom side two standard SAE openings, 6 bolts short length (horizontal mounting)

Extended layshaft PTO standard

PTO speed (% of engine speed)

Left side / bottom PTO's turn at 47% (Overdrive 62%) of engine speed

On the extended layshaft:

PTO's turn at 76% (Overdrive 102%) of engine speed

Speedometer

Provision in rear bearing cover (mechanical or electronic)

Reverse Switch

Provision in intermediate case for installation of switch

Neutral Switch

Provision in intermediate case for installation of switch

Weight

Including output flange, remote control assembly

152.5 Kg

Oil Capacity

8.5 litres

Ratios and Steps

Speed	FS-6109A	FSO-6109A
8	1.00	0.75
7	1.34	1.00
6	1.85	1.38
5	2.48	1.86
4	3.55	2.65
3	4.77	3.55
2	6.55	4.90
1	8.81	6.59
Crawler	12.64	9.45
Reverse	13.21	9.88

FS(O)-6209

Ratios and Steps

Speeds

8 Forward (all synchronised) + 1 Crawler (synchroniser optional), 1 Reverse

Power Take-off openings

Left side two standard SAE openings, 6 bolts short length (vertical mounting)

Bottom side two standard SAE openings, 6 bolts short length (horizontal mounting)

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7	1.34	1.00
6	1.85	1.38
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4	3.55	2.65
3	4.77	3.55
2	6.55	4.90
1	8.81	6.59
Crawler	12.64	9.45
Reverse	13.21	9.88

Speedometer

Provision in rear bearing cover (mechanical or electronic)

Reverse Switch

Provision in intermediate case for installation of switch

Neutral Switch

Provision in intermediate case for installation of switch

Weight

Including output flange, remote control assembly

152.5 Kg

Oil Capacity

8.5 litres

FS(O)-6309

Ratios and Steps

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Speed	FS-6309A	FSO-6309A
8	1.00	0.75
7	1.34	1.00
6	1.85	1.38
5	2.48	1.86
4	3.53	2.64
3	4.74	3.53
2	6.52	4.87
1	8.76	6.55
Crawler	12.57	9.40
Reverse	13.14	9.83

Speedometer

Provision in rear bearing cover (mechanical or electronic)

Reverse Switch

Provision in intermediate case for installation of switch

Neutral Switch

Provision in intermediate case for installation of switch

Weight

Including output flange, remote control assembly

152.5 Kg

Oil Capacity

8.5 litres

FS(O)-8209

Ratios and Steps

Speeds

8 Forward (all synchronised) + 1 Crawler (synchroniser optional), 1 Reverse

Power Take-off openings

Left side two standard SAE openings, 6 bolts short length (vertical mounting)

Bottom side two standard SAE openings, 6 bolts short length (horizontal mounting)

Extended layshaft PTO standard

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8	1.00	0.75
7	1.34	1.00
6	1.85	1.38
5	2.48	1.86
4	3.55	2.65
3	4.77	3.55
2	6.55	4.90
1	8.81	6.59
Crawler	12.64	9.45
Reverse	13.21	9.88

Speedometer

Provision in rear bearing cover (mechanical or electronic)

Reverse Switch

Provision in intermediate case for installation of switch

Neutral Switch

Provision in intermediate case for installation of switch

Range Change Inhibitor (Optional)

To prevent the driver damaging the engine and transmission.

Weight

Including output flange, remote control assembly

152.5 Kg

Oil Capacity

8.5 litres

FS(O)-8309

Ratios and Steps

Speeds

8 Forward (all synchronised) + 1 Crawler (synchroniser optional), 1 Reverse

Power Take-off openings

Left side two standard SAE openings, 6 bolts short length (vertical mounting)

Extended layshaft PTO standard

PTO speed (% of engine speed)

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On the extended layshaft:

PTO's turn at 76% (Overdrive 102%) of engine speed

Speed	FS-8309A	FSO-8309A
8	1.00	0.75
7	1.34	1.00
6	1.85	1.38
5	2.48	1.86
4	3.53	2.64
3	4.74	3.53
2	6.51	4.87
1	8.76	6.55
Crawler	12.57	9.40
Reverse	13.14	9.83

Speedometer

Provision in rear bearing cover (mechanical or electronic)

Reverse Switch

Provision in intermediate case for installation of switch

Neutral Switch

Provision in intermediate case for installation of switch

Weight

Including output flange, remote control assembly

152.5 Kg

Oil Capacity

8.5 litres

Torque Rating

Correct torque application is extremely important to assure long transmission life and dependable performance. Overtightening or under-tightening can result in a loose installation and, in many instances,

eventually cause damage to transmission gears, shafts or bearings. Use of a thread sealer/locking compound is recommended for all capscrews. Do not torque capscrews dry.

Description	Quantity	Torque Value	Thread Size	Additional Comments
Clutch Housing Studs	10	81 Nm min.	M18	Installed with Loctite 242.
Clutch Housing Nuts	10	190 - 203 Nm	M18	With plain and spring washers
Clutch Housing Capscrews	10	190 - 203 Nm	M18	With plain and spring washers
Clutch Housing Studs	12	32 - 37 Nm	M12	Studs with scotch grip
Clutch Housing Nuts	12	140 - 150 Nm	M12	For aluminium bolted material
Clutch Housing Nuts	12	120 - 130 Nm	M12	For steel bolted material
Clutch Housing Nuts	12	110 - 120 Nm	M12	For cast iron bolted material
Front PTO Cover	6	35 - 39 Nm	M10	Flange headed screws
Selector Block Tapered Lockscrew	1	35 - 39 Nm	M10	Patchlock or Thread coated with Loctite 270
Front Case to Intermediate Case	4	45 - 55 Nm	M10	Flange headed fastners (no washers) - fastened directly to the case
Front Case to Intermediate Case	14	45 - 55 Nm	M10	Flange headed fastners and nuts (no washers)
Rear Case to Intermediate Case	17	45 - 55 Nm	M10	Flange headed fastners and nuts (no washers)
PTO / Reverse Idler Cover	6	35 - 39 Nm	M10	Flange headed screws
End Cover - Remote Control Hsg.	4	19 - 24 Nm	M8	Flange headed screws
Pivot Pin - Overdrive Selector Fork	2	19 - 24 Nm	M8	With spring washers
Slave Valve - Double H Shift	2	19 - 24 Nm	M6	With spring washers
Poppet Valve - Single H Shift	1	16 - 22 Nm	M16	
Oil Strainer	1	40 - 47 Nm	M40	
Sun Gear Retaining Capscrew	1	225 - 255 Nm	M16	Use new patchlock coated cap-screw
Reaction Plate	3	24 - 30 Nm	M8	Socket headed countersunk screws
Planet Gear Spindles	5	4 - 6 Nm	M6	Socket head location grub screws
Oil Pump	8	35 - 39 Nm	M10	With spring wahsers
Remote Control Housing	4 / 6	35 - 39 Nm	M10	Flange headed screws
Remote Control Shift Lever	1	35 - 39 Nm	M10	1 capscrew and nut

Selector Shaft Detent Cover	2	19 - 24 Nm	M8	With spring washers
Oil Filler Plug	1	32 - 37 Nm	M24	
Layshaft Front Bearing Cover	4	69 - 78 Nm	M12	Flange headed screws
Front Bearing Cover	5	35 - 39 Nm	M10	Flange headed screws with locking coat
Remote Control Hsg. Detent Cover	2	19 - 24 Nm	M8	With spring washers
Speedometer Pinion Adaptor	1	24 - 30 Nm	M22	With rubber washer
Rear Case PTO Cover	4	69 - 78 Nm	M12	Flange headed screws
Reverse Switch	1	24 - 30 Nm	M16	
Range Indicator Switch	1	24 - 30 Nm	M16	
Neutral Switch	1	24 - 30 Nm	M16	
Speeo Sensor	1	24 - 30 Nm	M16	
Range Change Cylinder Cover	3	35 - 39 Nm	M10	Flange headed screws
Range Change Piston Nut	1	95 - 115 Nm	M16	With Loctite 242
Output Shaft Locknut	1	600 - 700 Nm	M39	With Nylon locking insert
Filter / Pressure Regulator	2	19 - 24 Nm	M6	
Air Connectors		8 - 14 Nm	1/8" NPTF	
Air Supply		8 - 14 Nm	3/8" NPTF	

Gear End Floats

IMPORTANT: All Dimensions are in mm.

Gear	3rd	2nd	1st Cra	wler	Reverse
Low Limit	0.31	0.25	0.35	0.35	0.22
High Limit	0.67	0.45	0.53	0.55	0.50
Tolerance	0.36	0.20	0.18	0.20	0.28

Synchroniser Ring to Synchroniser Flange Clearance

IMPORTANT: All Dimensions are in mm.

Mainshaft Gear	Pyrolitic Carbon
Minimum	0.50
Maximum	3.01
Range Change	
Minimum	0.50
Maximum	2.16

Lubrication

Proper Oil Level

Before checking the oil level, lubricant temperature must be between 15.5°C and 48.8°C (60°F and 120°F).

Before working on the vehicle, place vehicle on level ground, put transmission in neutral, set brakes, and block wheels.

Check lubricant level by using the fill hole usually located on the right side of the transmission.

Lubricant must be level with the bottom of the filler plug hole opening.

Draining Oil

Drain transmission oil while the oil is warm. To drain oil, remove the drain plug from the bottom of the case. Clean the drain plug before re-installing.

Refilling

Clean area around filler plug. Fill transmission until lubricant is level with the bottom of the filler plug hole. The exact amount of oil varies with the transmission and the installation angle.

Do not overfill. This causes oil to be forced out of the case through the mainshaft and input shaft seals.

Operating Temperature

It is important that the transmission operating temperature do not exceed 120°C (250°F) for an extended period of time. Operating temperatures above 120°C (250°F) cause breakdown of the oil and shorten transmission life. The following conditions in any combination can cause operating temperatures of over 120°C (250°F):

1. Operating consistently at road speeds under 32 km/h (20 m.p.h.).
2. High engine RPM
3. High ambient air temperatures
4. Restricted air flow around transmission
5. Exhaust system too close to transmission
6. High horsepower, over-drive gear operation
7. High power PTO operation for extended periods of time while stationary

High operating temperatures may require more frequent oil changes.

Recommended Lubricants

Note: Original Equipment manufacturers (OEMs) may have different lubricant requirements. These recommendations require Eaton approval. Refer to the OEM service manual for the specific lubricant requirement.

- Multi-viscosity engine oils (such as 15W-40) are not recommended.
- Do not mix engine oil and gear oils in the same transmission.
- Do not mix lubricants with different viscosities (SAE Grades).
- Do not introduce additives and/or friction modifiers. Additives of any kind added later to the oil can result in unpredictable consequences.
- Use clean containers when transferring the lubricant from bulk storage to transmission.
- Eaton does not approve mineral lubricants by brand name.
- Visit **www.Roadranger.com** (select Products, Lubricants) for a copy of the latest Lubricant Recommendations via Manual #TCMT0021.

Mineral Oils

Recommended Lubricants		
Type	Viscosity Grade (SAE)	Ambient Temperature
Diesel Engine Oil API CD / CF	50 40 30	Above - 12°C Above - 12°C Below - 12°C
Mild EP Gear Oil API GL-4	90 80W	- 12°C to 38°C - 26°C to 21°C

Lubrication Change and Inspection	
ON HIGHWAY USE	
First 5000 to 10,000 Km	Change transmission oil on new units.
Every 20,000 Km or 2 months	Inspect oil level. Check for leaks.
Every 100,000 Km or 12 months	Change the transmission oil.
OFF HIGHWAY USE	
First 40 hours or 2 months	Change transmission oil on new units.
Every 40 hours or 4 months	Inspect oil level. Check for leaks.
Every 1000 hours or 12 months	Change the transmission oil.

Synthetic Oils

Recommended Lubricants		
Type	Viscosity Grade (SAE)	Ambient Temperature
Eaton PS-164	50	Above - 40°C

Lubrication Change and Inspection	
ON HIGHWAY USE	
Every 20,000 Km or 2 months	Inspect oil level. Check for leaks.
Every 800,000 Km or 5 years	Change the transmission oil.
OFF HIGHWAY USE	
Every 40 hours or 2 months	Inspect oil level. Check for leaks.
Every 2000 hours or 5 years	Change transmission oil.

Recommended Tools

Some repair procedures pictured in this manual show the use of specialized tools. Their actual use is recommended as they make transmission repair easier, faster, and prevent costly damage to critical parts.

But for the most part, ordinary mechanic's tools such as socket wrenches, screwdrivers, etc., and other standard shop items such as a press, mauls and soft bars are all that is needed to successfully disassemble and reassemble any Eaton Transmission.

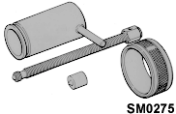
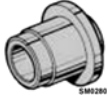
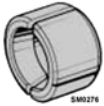








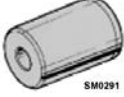





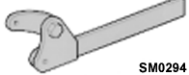

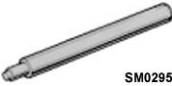
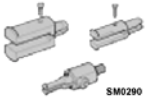
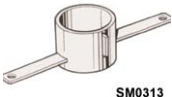

Illustration	Tool No.	Description	Illustration	Tool No.	Description
	LC 105A	Layshaft bearing remover		E 109-5	LRC cross shaft seal and bush installer. Use with E 109.
	E 105-4	Halves layshaft-bearing remover. Use with LC 105A.		E 109-6	Layshaft bearing cup installer adaptor. Use with E 109.
	E 108	Driver		E 109-7	Input shaft seal installer adaptor. Use with E 109.
	E 108-5	Replacer adaptor input shaft bearing. Use with E 108.		E 109-8	Main selector shaft bush installer adaptor. Use with E 109.
	E 108-6	Mainshaft rear seal replacer adaptor. Use with E 108.		E 109-9	Main selector shaft plug installer adaptor. Use with E 109.
	E 109	Driver		E 109-11	Layshaft bearing cone installer. Use with E 109.
	E 109-10	Driver extension. Use with E 109.		E 114	Mainshaft rear bearing pilot.
	E 115	Flange holding adaptor plate		E 116A	Mainshaft assembly lifting fixture. Use with E116-1.
	E 116-1	Mainshaft assembly lifting adaptor. Use with E 116A.		LC 113A	Flange holding wrench

Illustration	Tool No.	Description	Illustration	Tool No.	Description
	MS 284	Slide hammer		E 117	Reverse idler shaft retaining pin installer.
	MS 284-1	Extractor set - bearing / bush		E 118A	Sun gear retainer
	E 119	Remover adaptor reverse idler shaft. Use with MS 284.			

Special Tools Manufacturers

Below are the addresses and phone numbers of the companies that make tools specifically for Eaton transmissions.

SPX


Global Headquarters
3515 Ballantyne Corporate Place
Charlotte, North Carolina 28277
United States
Phone: +1 (704) 752-4400
Web site: <http://www.spx.com/en/products-and-services/diagnostics.aspx>

SPX (UK) Ltd.

Genoa House
Everdon Park
Heartlands Business Park
Daventry
Northamptonshire NN11 8YH
England Phone: + 44 (01327) 303400
Web site:

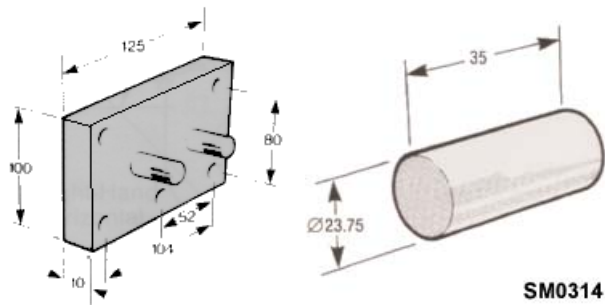
<http://www.spxuk.co.uk/>

The following general purpose puller are available from Sykes-Pickavant Ltd., or through their Dealers.

Illustration	Description
	Puller Kit - Series 1500 with Hydraulic Ram

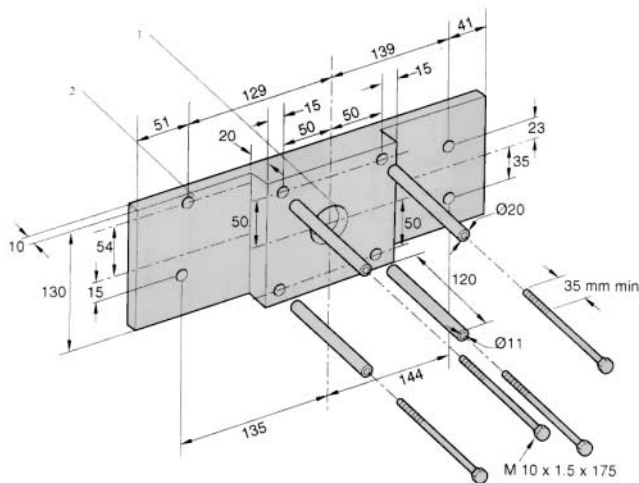
Locally Made Tools

The following illustration shows a suitable cradle which can be used to stand the transmission 'on end' during 'Disassembly' and 'Reassembly'. The thickness of the block has been calculated to lift the mainshaft the required distance during removal and installation of the layshaft. If the height of the cradle is increasing, the thickness of the block should be increased by the same amount.



Mounting plates - 2 off Dummy Planet Gear Spindle

IMPORTANT: All dimensions are in mm.



Tool for 4 point ball bearing removal

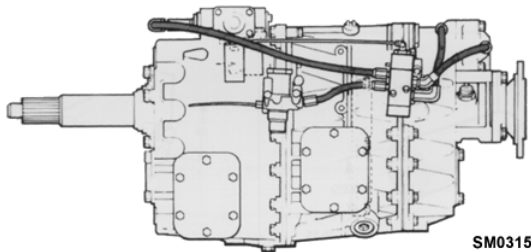
1. 1 off hole 1.5 inches diameter 16 threads per inch whitworth form to suit Sykes Picavant hydraulic ram No 150 000.
2. 8 holes 11 mm diameter.

Preventive Maintenance

Everyday there are countless vehicles operating over the highways with transmissions in such a neglected mechanical condition, they can be referred to as failures looking for a place to break down. They lack a proper and organized preventive maintenance program.

Preventive maintenance is a general term which applies to all procedures necessary to have maximum life and satisfactory service at the lowest possible cost, short of removing and repairing the unit.

Checks Before Transmission Removal



A number of conditions contrary to good preventive maintenance can generally be pointed to when inspecting a failed transmission. Taking a few minutes every so many hours or miles to do a few simple checks could help avoid eventual breakdown or reduce the repair cost. If the transmission is not cared for, it will breakdown.

Note: Transmission appearance may differ, the procedure is the same.

Clutch Housing Mounting

- Check all capscrews of clutch housing flange for looseness.

Clutch Release Bearing

- Remove hand hole cover and check radial and axial clearance in release bearing.
- Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.

Clutch Pedal Shaft and Bores

- Pry upward on shafts to check wear.
- If excessive movement is found, remove clutch release mechanism and check bushings on bores and wear on shafts. See OEM literature.

Lubricant

- Change at specified service intervals.
- Use only the types and grades as recommended. Refer section 'Lubrication Information'.

Filler and Drain Plugs

- Remove filler plugs and check level of lubricant at specified intervals. Tighten fill and drain plugs securely.

Capscrews and Gaskets

- Check all capscrews, especially those on PTO covers and rear bearing covers for looseness which would cause oil leakage.
- Check PTO opening and rear bearing covers for oil leakage due to faulty gasket.

Gear Shift Lever

- Check for looseness and free play in housing. If lever is loose in housing, check Direct Control Assembly.

Direct Control Assembly

- Remove the direct control assembly from the transmission.
- Check the tension spring for set and wear.
- Check gear shift lever bottom end for wear in the slots and check for wear of finger assembly and housing.

Checks with drive line dropped

Universal Joint Companion Flange or Yoke Nut

- Check for tightness. Tighten to recommended torque.

Output Shaft (Yoke Nut Tightened)

- Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

Checks with Universal Joint Companion

Flange or Yoke removed

Note: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. Do not use crocus cloth, emery paper, or other abrasive materials that will mar surface finish.

Splines on Output Shaft

- Check for wear from movement and chucking action of the universal joint companion flange or yoke.

Mainshaft Rear Bearing Cover

- Check oil seal for wear.

Rear Seal Maintenance

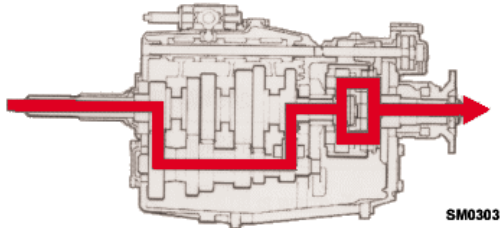
Leakage in transmission rear seals is perhaps the most common problem in truck transmissions. The problem is more than a nuisance because if not repaired, a leaking seal can lead to catastrophic transmission failure. There have been strides in reducing leakage through improved designs and the use of new seal materials. However, the most important way to reduce this problem continues to be through proper service and installation procedures.

It can be very time consuming and expensive to replace a rear seal system, then find the oil seal system was not causing the oil leakage. Using the following checklist, inspect the transmission to insure proper identification of the leak path.

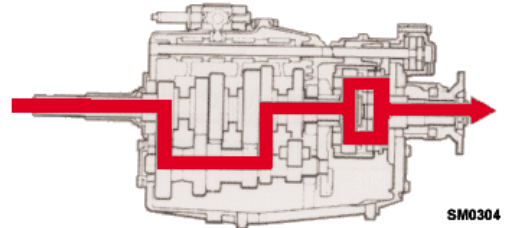
Before disassembling the rear seal system, clean the rear bearing cover, the rear seal, and the output yoke. **DO NOT USE A HIGH PRESSURE SPRAY WASHER TO CLEAN THE REAR SEAL SYSTEM. USE A CLEAN DRY CLOTH.** Run the vehicle, then inspect these areas for oil leaks.

Power Flow

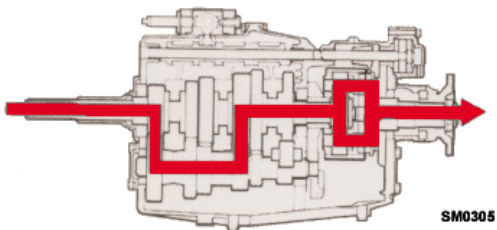
Reverse Gear



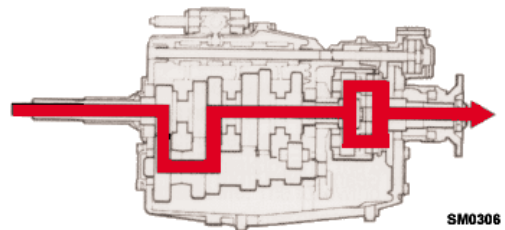
Crawler Gear



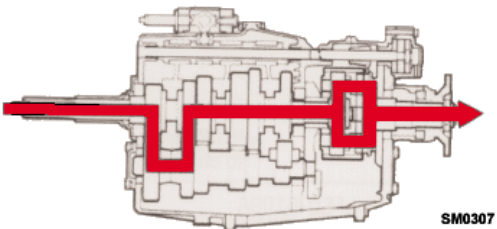
First Gear



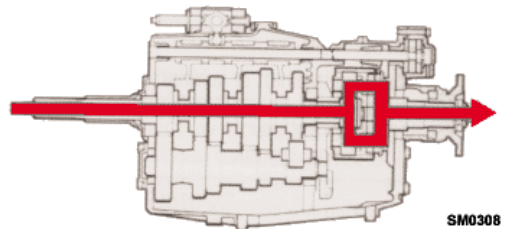
Second Gear



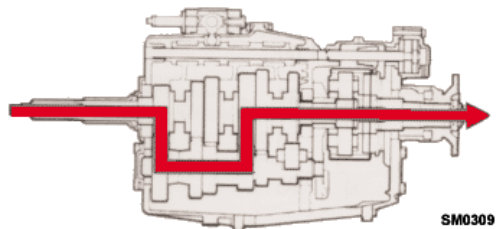
Third Gear



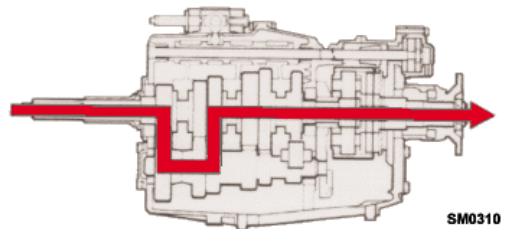
Forth Gear



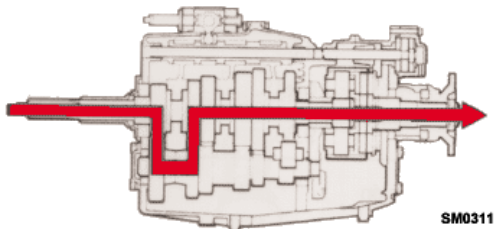
Fifth Gear



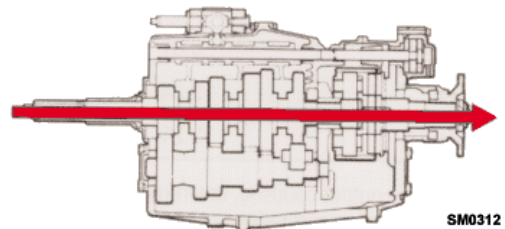
Sixth Gear



Seventh Gear



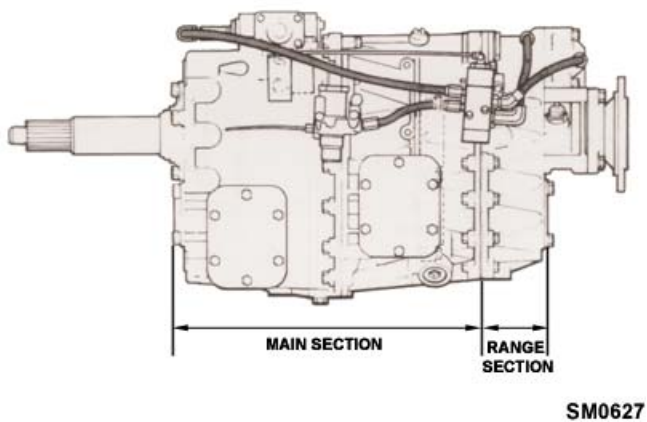
Eighth Gear



Note: Above illustrations are for direct drive type vertical transmission.

Features

The Eaton 9-speed transmissions have nine forward speeds and are part of a medium duty range of synchromesh transmissions. They have a simple shift pattern using a unique single rail selector mechanism. Direct drive or overdrive top gear versions are available. An epicyclic reduction gear with air operated synchromesh engagement is located between the 5-speed main section of the transmission and the output flange. With the reduction gear engaged, crawler (low) gear and 1st, 2nd, 3rd and 4th gears can be selected and engaged in the normal way. With the reduction gear locked out, 5th, 6th, 7th and 8th gears are similarly available. Single H or double H shift systems may be fitted.



The Epicyclic Reduction Gear

Component

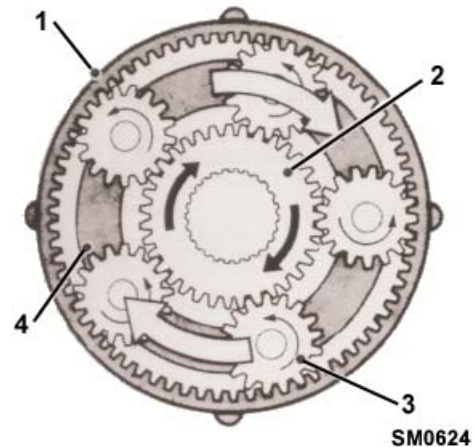
The epicyclic reduction gear consists of three main components:

1. Annulus
2. Sun Gear
3. Planet Gear

The annulus, which is the outer, internally toothed ring gear, is secured to the sliding sleeve of the range change synchroniser assembly.

The sun gear, which is splined and bolted to the transmission mainshaft and runs concentrically with, but independent of the annulus.

The planet gear, which runs in mesh with both the annulus and the sun gear. In this application it consists of a series of five planet gears, running independently on their axes by which they are attached to the planet gear carrier. The carrier is an integral part of the transmission output shaft.



1. Annulus
2. Sun Gear
3. Planet Gears
4. Planet Gear Carrier

System Theory

If the annulus is held stationary and the sun gear is rotated, the planet gears are driven round the annulus at a speed governed by the size of the sun gear and planet gears relative to the annulus. The planet gears turn on their axes and force the carrier to rotate in the same direction as, but slower than, the sun gear. The output shaft, being an integral part of the carrier rotates with it.

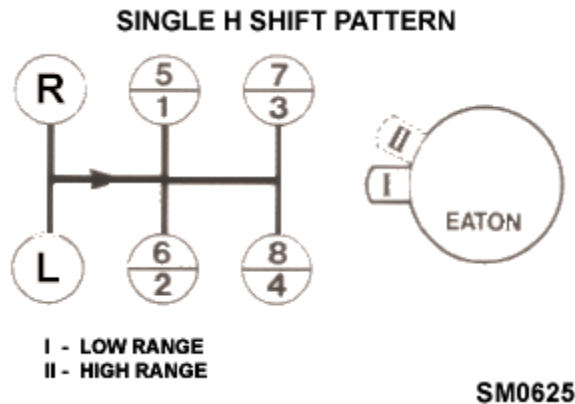
Operation

In the Eaton 9-speed transmissions, the 'LOW RANGE' or reduction mode ratio is achieved by sliding the range change synchroniser sleeve and the annulus into mesh with a flange which is secured by a reaction plate to the transmission rear case.

This locks the annulus, and the output shaft therefore rotates in the same direction as, but slower than, the mainshaft.

In the 'HIGH RANGE' or direct drive mode the synchroniser sleeve is slid out of mesh with the reaction plate and into mesh with a flange splined to the planet gear carrier. As the annulus and the planet carrier are now locked together, the planet gears are no longer able to rotate, and the whole epicyclic assembly rotates as a single unit. The output shaft therefore runs at the same speed as the mainshaft.

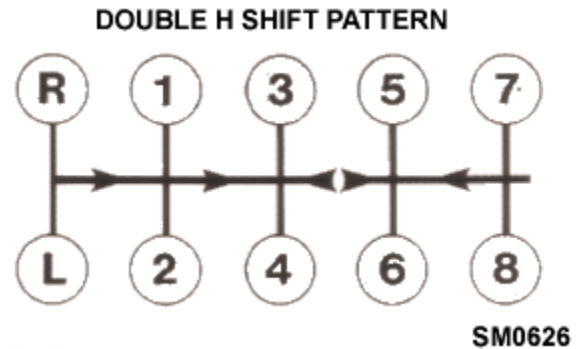
With the single H shift system, a manually operated air switch on the gear lever knob engages 'high' or 'low' range as required.



An interlock pin between the two selector shafts and an air control valve, fitted to the LRC, prevent the range change operating unless the gear change selector shaft is in the neutral position.

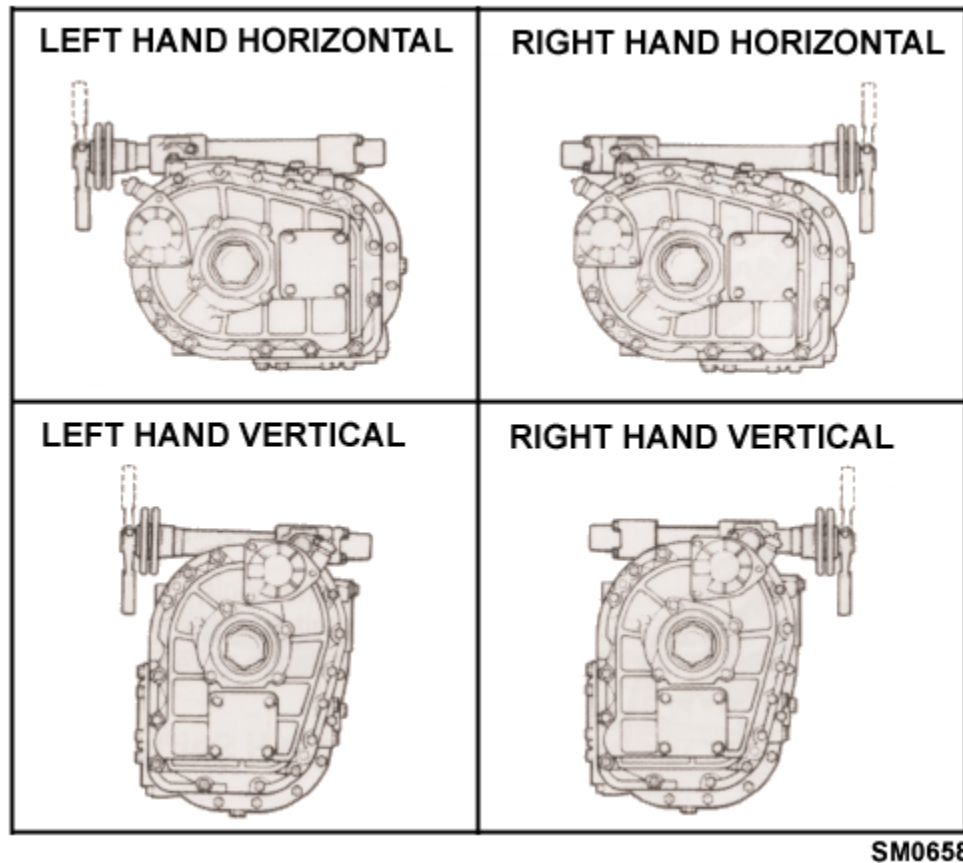
With the double H shift system, a spring loaded detent is placed in the neutral gate between the 3/4 and 5/6 gear positions. As the gear lever is pushed past this detent to the 5th gear position, a slave valve automatically supplies air to shift the range change from low to high. The unique single rail selector mechanism engages 1st, 2nd, 3rd or 4th gears in the main section, but now with the range change in 'high' thus giving 5th, 6th, 7th and 8th gears.

When changing from 5th to 4th, past the detent, the slave valve operates to change from 'high' to 'low' range.



Range changes are selected automatically as gear lever is moved over detent.

Transmission Installations



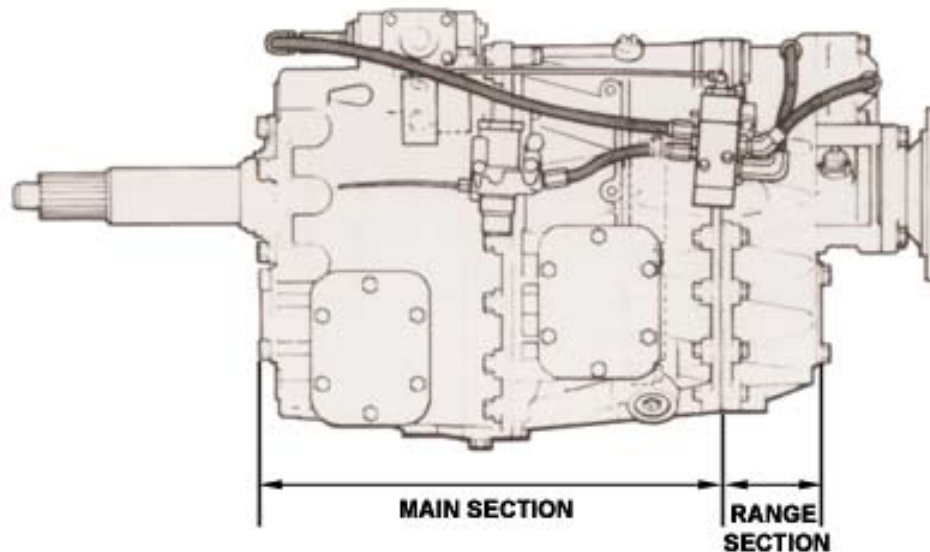
The transmission will be installed from factory as vertically or horizontally mounted. The gear change remote control will also be installed either right or left sided. These installation orientations can not be changed during service.

The synchroniser assemblies are of the ring cones manufactured separately from the gears. This allows the synchroniser rings and flanges to be renewed without the need to renew the gears themselves. Reverse gear is engaged by sliding the reverse/crawler sliding sleeve to engage with the flange on reverse gear but without the assistance of a synchroniser cone.

The transmission is fitted with a pressure fed lubrication system.

The oil is drawn through a strainer in the lower, left-hand side of the transmission by the twin rotor oil pump which is driven directly from the rear of the layshaft. The mainshaft is drilled throughout its entire length and cross drillings take the oil to all the mainshaft bearings, the input shaft bearing and the range change epicyclic planet gear bearings. Transmissions are available with the oil pump and case suitably modified in production to enable an oil cooler to be fitted.

System Theory



SM0627

The Eaton nine-speed synchromesh transmissions consist of a four-speed plus crawler (low) gear and reverse gear main section, and an auxiliary, two speed range change section. This provides either a direct drive 'high' range or 'low' range output through the medium of an epicyclic reduction gear.

All the forward gears in the main section have synchromesh engagement and are manually selected and engaged. The range change also has synchromesh engagement and is air operated. A shift cylinder, mounted in the rear transmission case, slides a synchroniser sleeve, which forms an integral part of the epicyclic annulus gear, into or out of mesh with the planet gear carrier or a reaction plate in the case giving high or low ratio accordingly.

Air to the high and low range ports on the shift cylinder is supplied via a slave valve. This is activated directly by the remote control shaft on the double H shift system, or by a manually operated selector valve in the gear lever knob on the single H shift system.

With the single H shift system, 'high' or 'low' range should be pre-selected before the gear lever is moved, the actual range change taking place only when the selector shaft is moved through the neutral position.

An air control valve works in conjunction with the interlock mechanism to prevent the range change operating prematurely after pre-selection.

With the double H shift system the range change is activated automatically as the gear lever is moved across a detent in the neutral gate between the 3/4 and 5/6 gear lever positions.

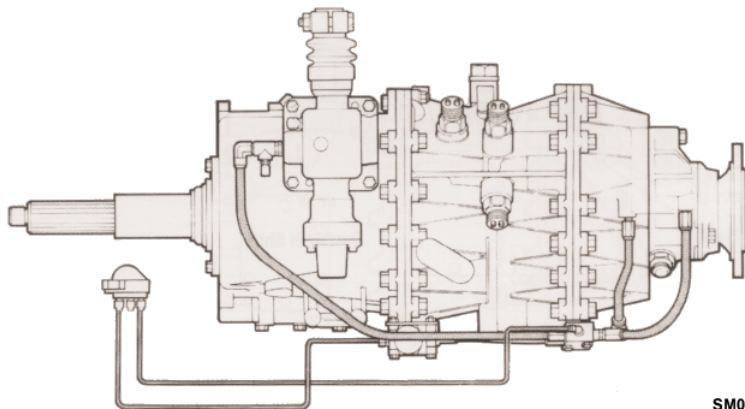
Air System Maintenance

In order to ensure that the transmission functions without problems and has a long life, the compressed air reservoirs on the vehicle must be drained regularly* and the filter on the transmission cleaned every 80,000 km (or 6 months).

*Please consult the Operating Instructions supplied by the vehicle manufacturer.

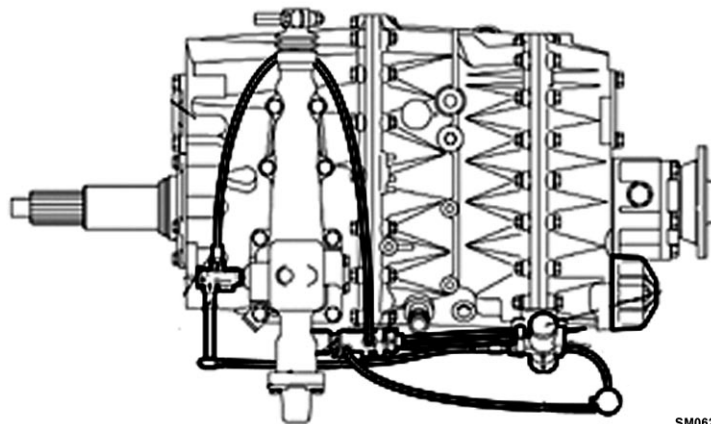
Range Change Shift Air Lines

Single H shift gear change air line connections with Exhaust Valve



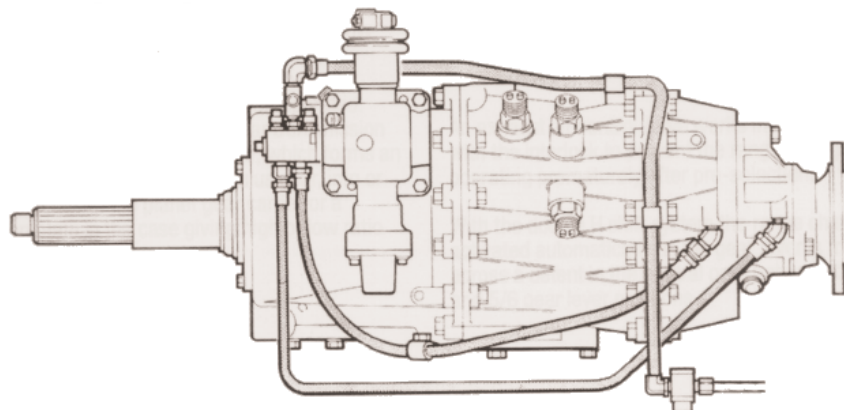
SM0628

Single H shift gear change air line connections with Mecman Valve



SM0629

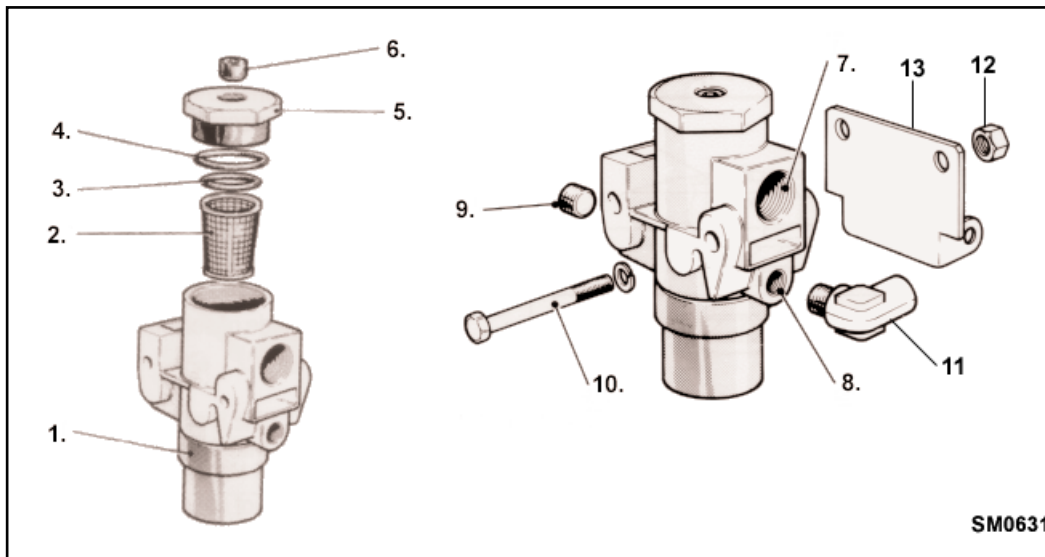
Double H shift gear change air line connections



SM0630

Filter Pressure Regulator

FILTER PRESSURE REGULATOR



- | | |
|------------------------------|--------------------------|
| 1. Filter Pressure Regulator | 8. Outlet Port * |
| 2. Filter Element | 9. Outlet Seal Plug * |
| 3. Seal Ring | 10. Capscrew with washer |
| 4. O-Ring | 11. Adaptor * |
| 5. End Cap | 12. Nut |
| 6. Plug | 13. Mounting Bracket |
| 7. Air Supply Port | |

* Alternative positions

Removal and disassembly of Filter Pressure Regulator

Procedure -

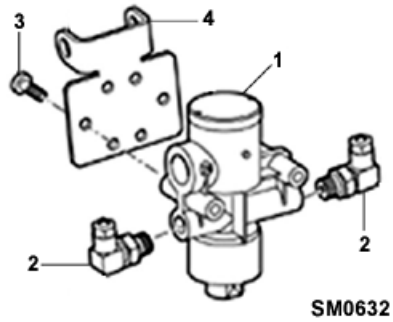
1. Remove end cap.
2. Remove filter insert from housing and clean.
Cleaner: Soap and water solution, cold cleaner etc. then blow element from inside using compressed air.
3. Clean filter regulator housing.

Assembly and installation of Filter Pressure Regulator

Procedure -

1. Renew filter element, seal ring and O-ring if necessary.
2. Fit end cap, tighten to the correct torque.
3. Unscrew seal plug (9), attach test connection with gauge. Check filter regulator function.

Mecman Regulator

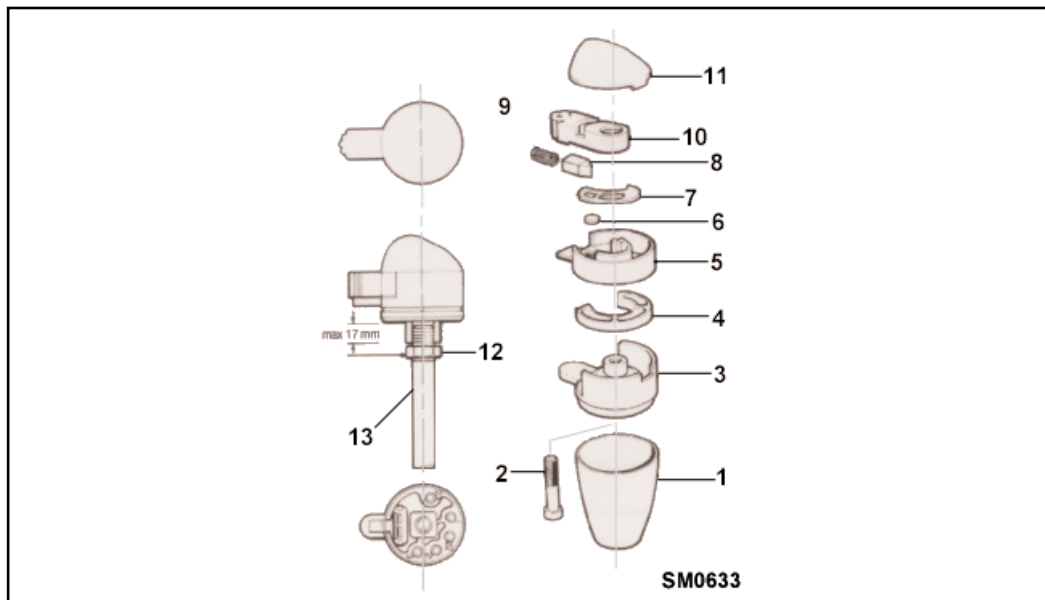


1. Filter Regulator
2. Adaptor
3. Capscrew
4. Mounting Bracket

Filter regulator as used on later models. This component is non-serviceable.

Selector Valve

SELECTOR VALVE



- | | |
|-------------------------|-----------------------|
| 1. Cowl | 8. Plunger |
| 2. Socket Head Screw | 9. Compression Spring |
| 3. Base | 10. Lever |
| 4. Seal | 11. Cap |
| 5. Housing | 12. Lock Nut |
| 6. Preassure Pad | 13. Shift Lever |
| 7. Anti Rattling Spring | |

Removal and disassembly of Selector Valve

Procedure -

1. Remove cowl.
 2. Disconnect all air lines.
 3. Loosen lock nut and unscrew selector valve from shift lever.
 4. To disassemble the valve remove socket head screw
- Note:** Take care not to break tang from cap.
5. Thoroughly clean inside of selector valve.

Assembly and installation of of Selector Valve

Procedure -

1. Renew seal ensuring that it is fitted correctly.
 2. Smear sealing surface of base using lubricant supplied in Service Kit.
- CAUTION:** Do not use any other type of lubricant.
3. Reassemble valve and tighten socket headed screw to the correct torque.
 4. Screw selector valve onto shift lever and secure with locknut.

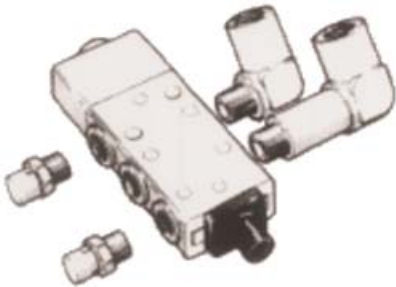
Note: Only screw down max. 17 mm, otherwise the housing will be deformed and the valve will leak.

5. Connect all air lines and test for leaks. Tighten air connections to 2.7 - 3.4 Nm.
6. Refit cowl. Tighten socket head screw to 10 - 12 Nm.

Slave Valve

The changeover from 'low' range to 'high' range and vice versa is controlled on single H shift transmissions by means of the selector valve which in turn activates the slave valve, or on double H transmissions by direct mechanical activation of the slave valve by a cam/detent on the remote control shift lever.

Slave Valve - Single H (constant feed to range cylinder)



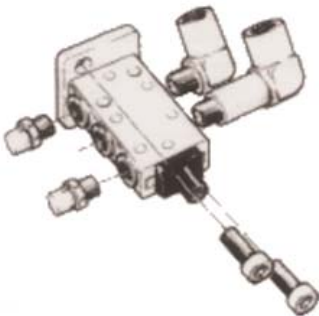
SM0634

Slave Valve (Mecman) - Single H (Air feed to range cylinder only when transmission is in neutral)



SM0635

Slave Valve - Double H



SM0636

System Theory

The slave valve supplies air to push the shift cylinder piston rearwards into the 'low' ratio position or forwards into the 'high' ratio position as required.

An interlock pin between the selector shaft and the shift cylinder piston shaft only allows the range shift to take place when the gear lever is in the neutral position. With single H shift transmissions this also allows for range changes to be pre-selected.

Additionally the single H system (Non Mecman) has an exhaust air control valve. This effectively provides a buffer of air on the reverse side of the piston preventing it from moving, until the gear change lever is moved to the neutral position, when this air is exhausted to atmosphere.

The valves are sealed maintenance free units and must be renewed if faulty.

How to remove Slave Valve

Procedure -

1. Drain the vehicle air reservoirs.
2. Disconnect air lines from the slave valve.
3. Remove the slave valve either from the mounting bracket two capscrews, or from the remote control housing two socket headed capscrews.
4. Unscrew and remove the breather valves and elbow/adaptors from the valve, noting the position and port numbers for reassembly to the new valve.

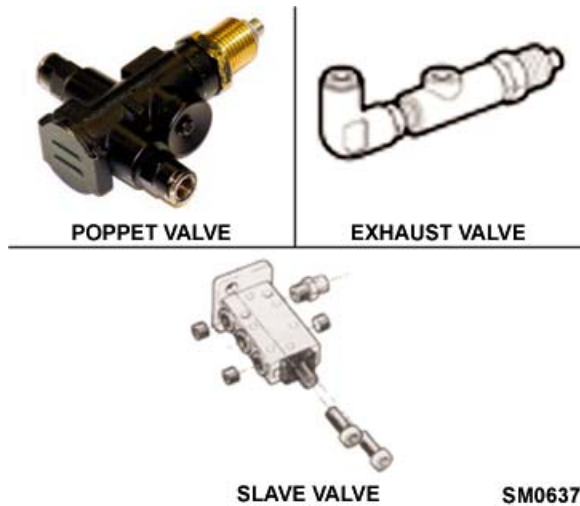
How to install Slave Valve

Procedure -

1. Clean off sealant from breather valves and elbow/adaptors, and ensure airways are clean and unrestricted. Renew breather valves if their serviceability is in doubt.

2. Using PTFE tape or suitable Loctite sealer, install the breather valves, plugs and elbow/adaptors into the valve. (As applicable)
3. Single H shift slave valve - Assemble the slave valve to the mounting bracket, tighten the retaining capscrews to the correct torque.

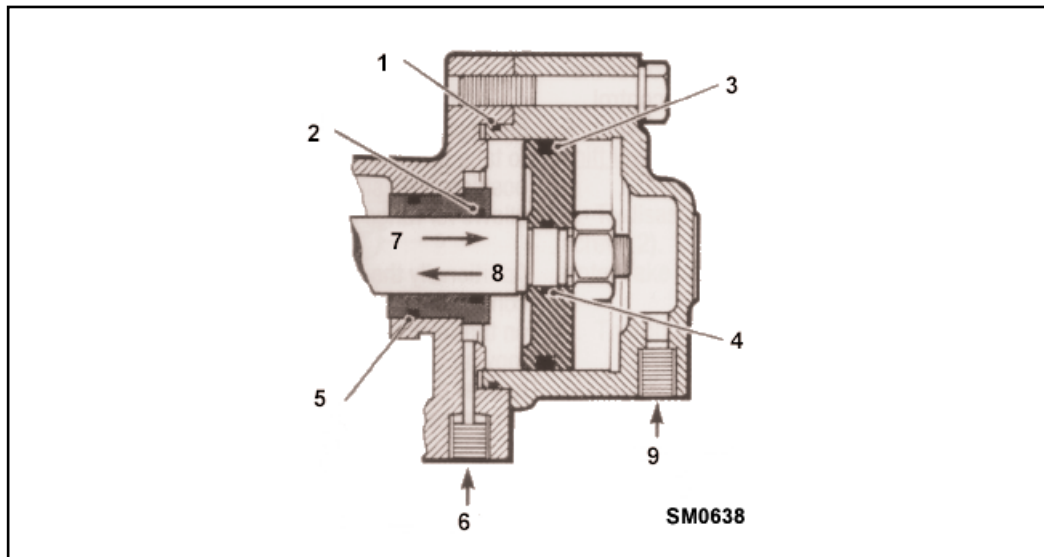
Double H shift slave valve or Single H shift air control valve (Poppet or Exhaust valve), using a new gasket, if applicable, fit the valve to the remote control. Tighten all fastenings to the correct torque.



4. Reconnect the air lines, recharge the vehicle air reservoirs and check for correct function and to ensure freedom from air leaks.

Range Change Shift Cylinder

RANGE CHANGE SHIFT CYLINDER



1. O-Ring
2. O-Ring
3. O-Ring
4. O-Ring
5. O-Ring
6. Low Range Air Port
7. Low Range
8. High Range
9. High Range Air Port

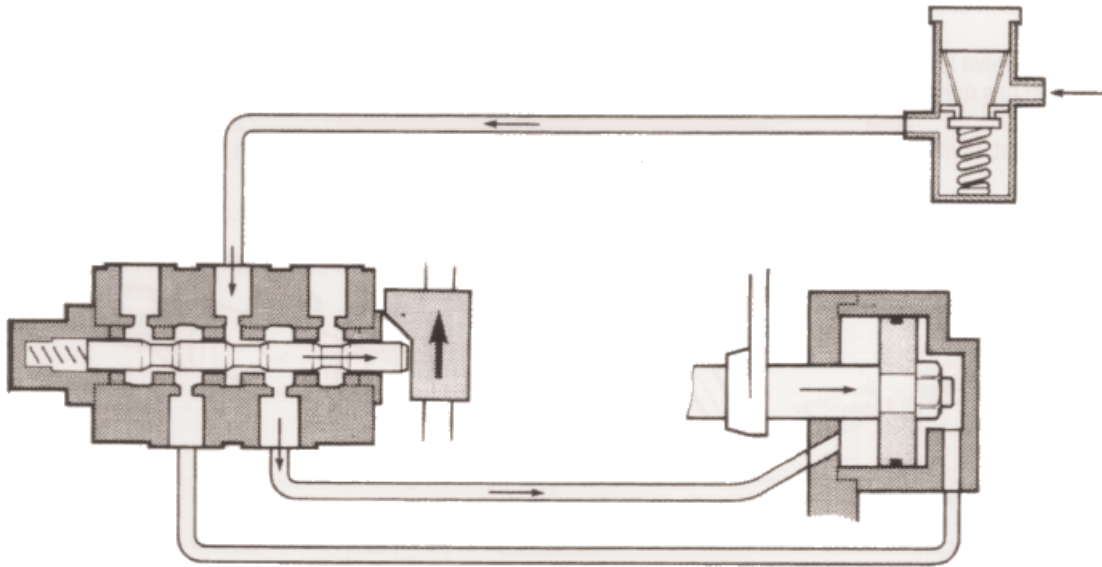
Operation

By switching the selector valve on the gear lever, or by moving the gear lever across the detent between 4th and 5th gears air is supplied by the slave valve to either the high range or low range air port.

Air pressure on the other side of the piston is exhausted to atmosphere through the slave valve. There is a constant air pressure acting against one side or other of the piston at all times on double H and single H transmissions other than on the Mecman system. On the Mecman system air is only supplied to the range change piston when the transmission is in neutral.

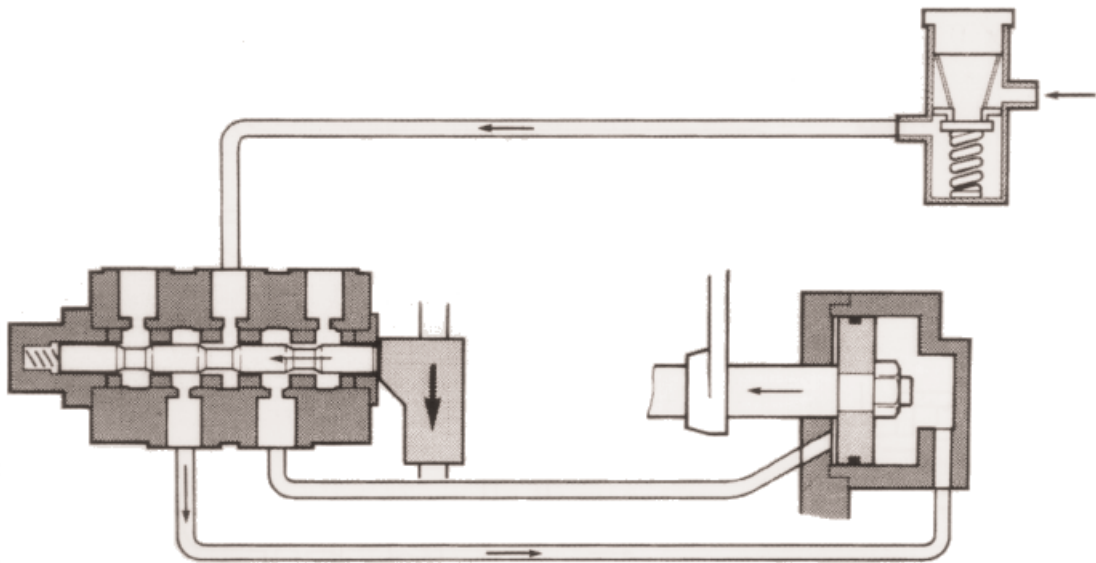
Range Change Air Circuit Diagrams - Double H

Double H Shift - Low Range



SM0639

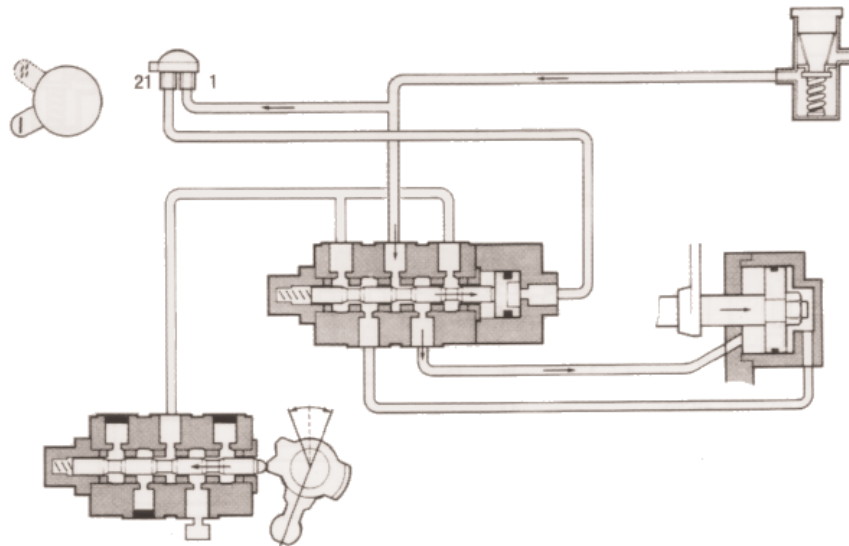
Double H Shift - High Range



SM0640

Range Change Air Circuit Diagrams - Single H

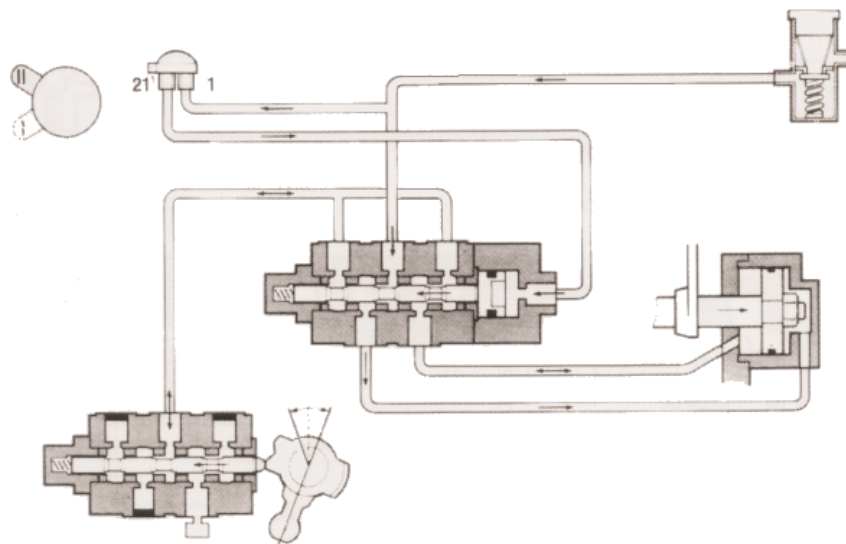
Single H Shift - Low Range (4th gear) Engaged



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0641

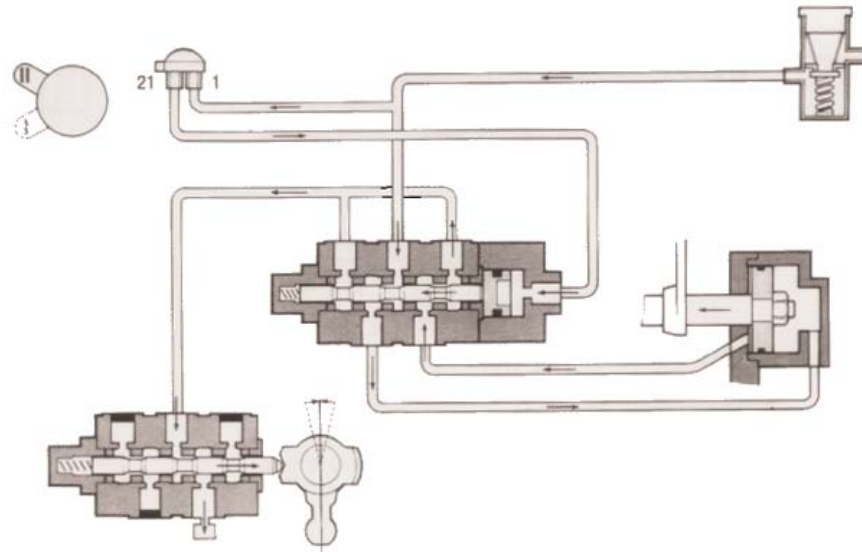
Single H Shift - High Range Preselected



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0642

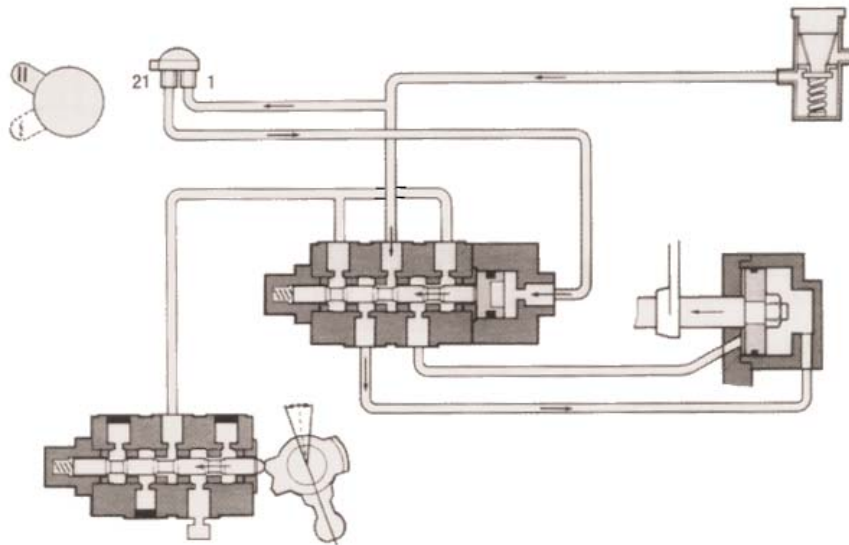
Single H Shift - Neutral Engaged - Exhaust Air Pressure Released - High Range Engaged



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0643

Single H Shift - High Range (5th gear) Engaged



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0644

Exhaust Control Valve

Some transmissions may be fitted with a revised air system as shown in the following pages. The operation of the air system range change is unaltered, only the valves and pipework change. The slave valve is replaced by an updated valve which connects the two exhaust lines internally and therefore has only a single port.

The exhaust control valve is a single poppet valve which functions in the same way as the former valve.



SLAVE VALVE

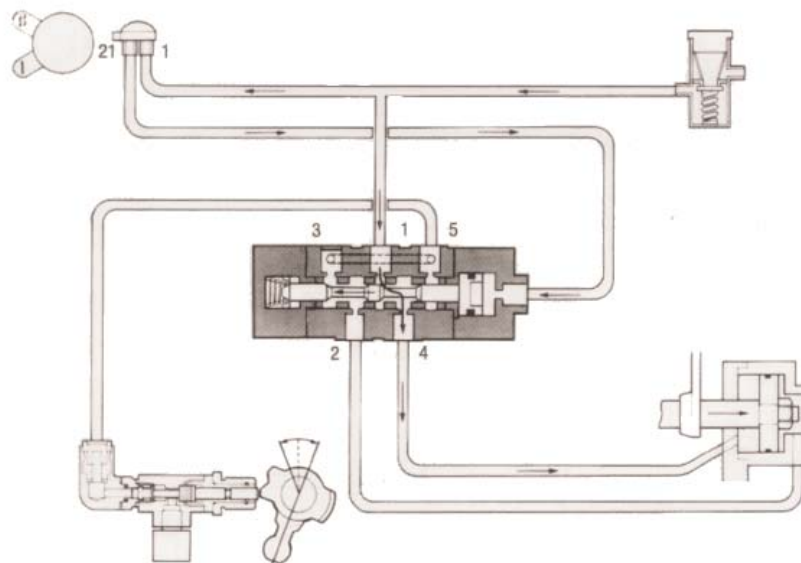


EXHAUST CONTROL VALVE

SM0645

Range Change Shift Air Circuit Diagram with Exhaust Control Valve

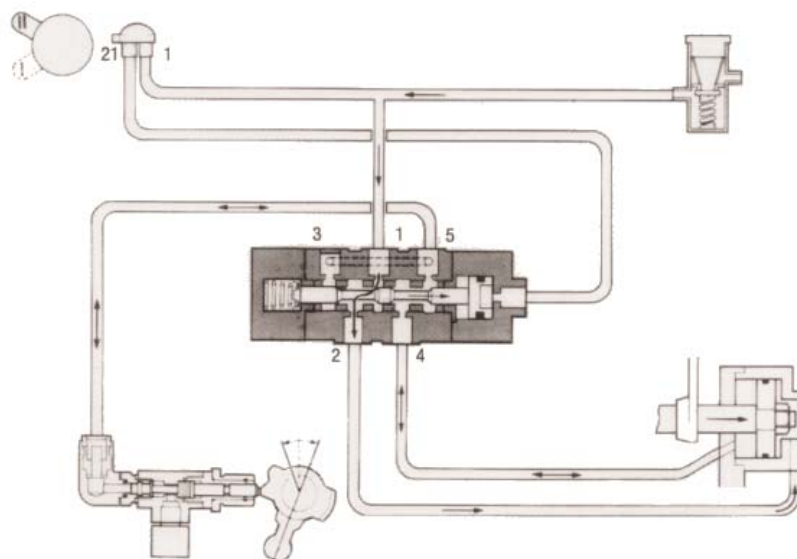
Single H Shift - Low Range (4th gear) Engaged



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0646

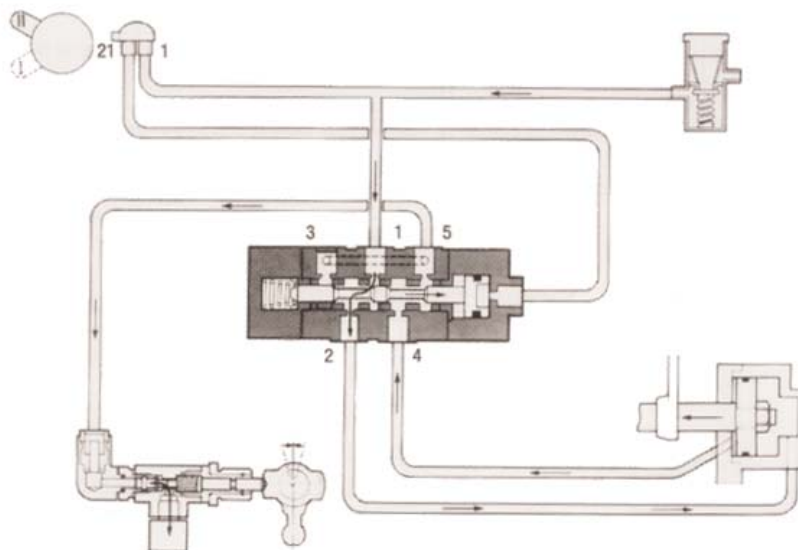
Single H Shift - High Range Preselected



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0647

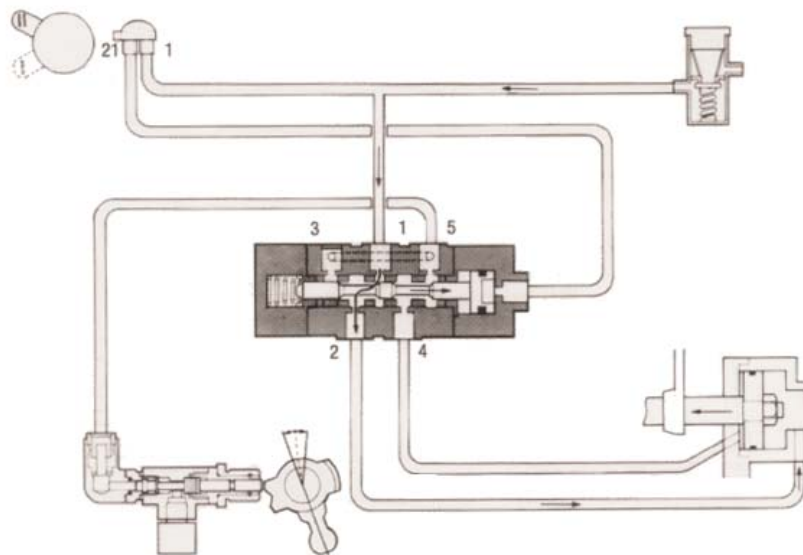
Single H Shift - Neutral Engaged - Exhaust Air Pressure Released - High Range Engaged



1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

SM0648

Single H Shift - High Range (5th gear) Engaged

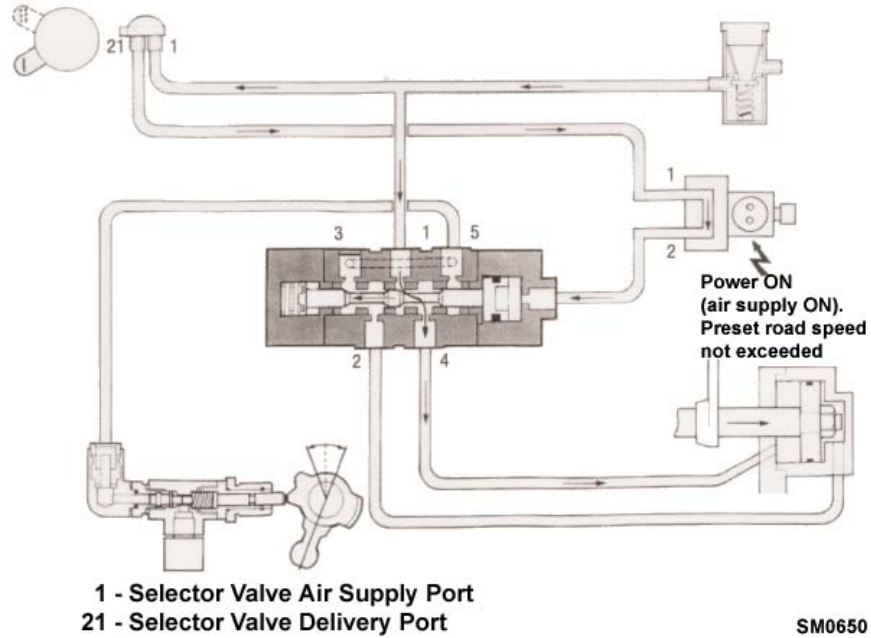


1 - Selector Valve Air Supply Port
21 - Selector Valve Delivery Port

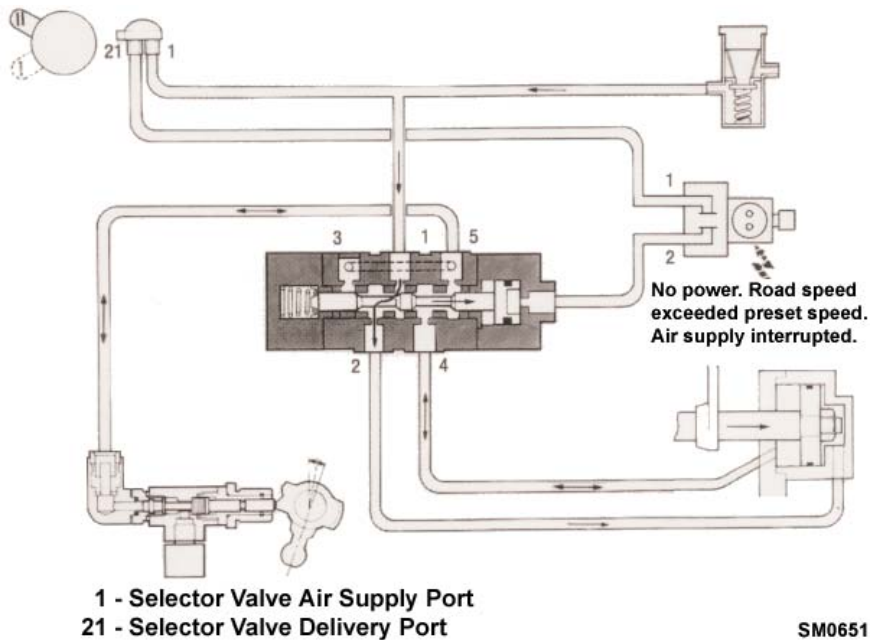
SM0649

Range Change Shift Air Circuit Diagram with Range Inhibitor

Single H Shift - Low Range (4th gear) Engaged

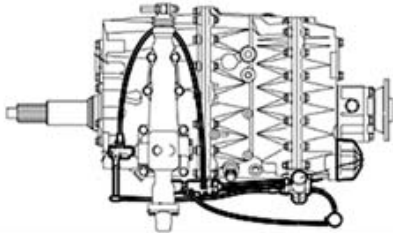


Single H Shift - High Range Preselected



Mecman Valve

Some transmissions may be fitted with a revised air system as shown in the following pages. The arrangement shown is referred to as the 'Mecman' air system.



SLAVE VALVE (MECHMAN)



POPPET VALVE

SM0652

As part of the process of continuous improvement modifications have been made to the air system currently fitted to the nine speed synchromesh transmissions. The change to the current design sees the introduction of a 'neutral feed' range change slave valve (Mecman valve) and LRC poppet valve.

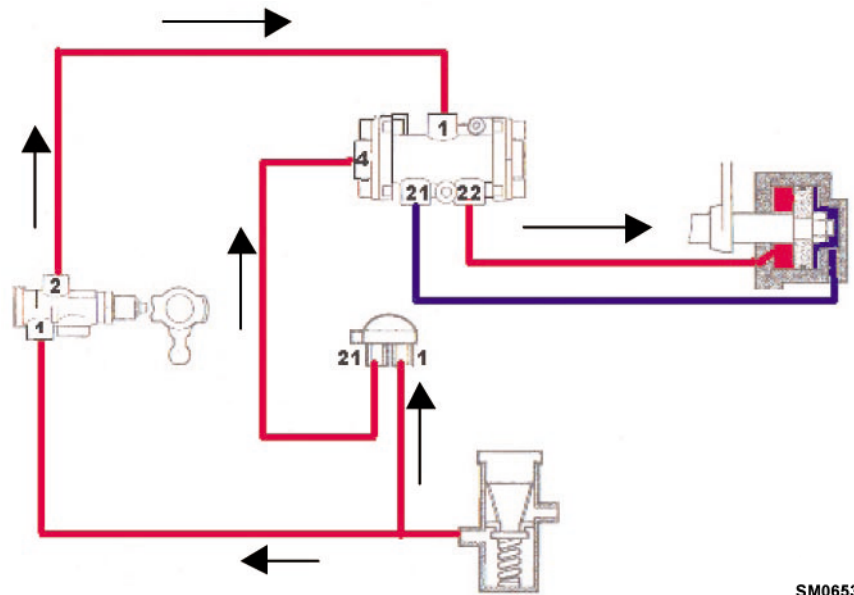
IMPORTANT: These changes, which affect the way in which the air system works, can only be used on transmissions where Pyrolitic synchronisers have been fitted.

Range Change Shift Air Circuit Diagram with Mecman Valve

Transmission in gear - Low range preselected

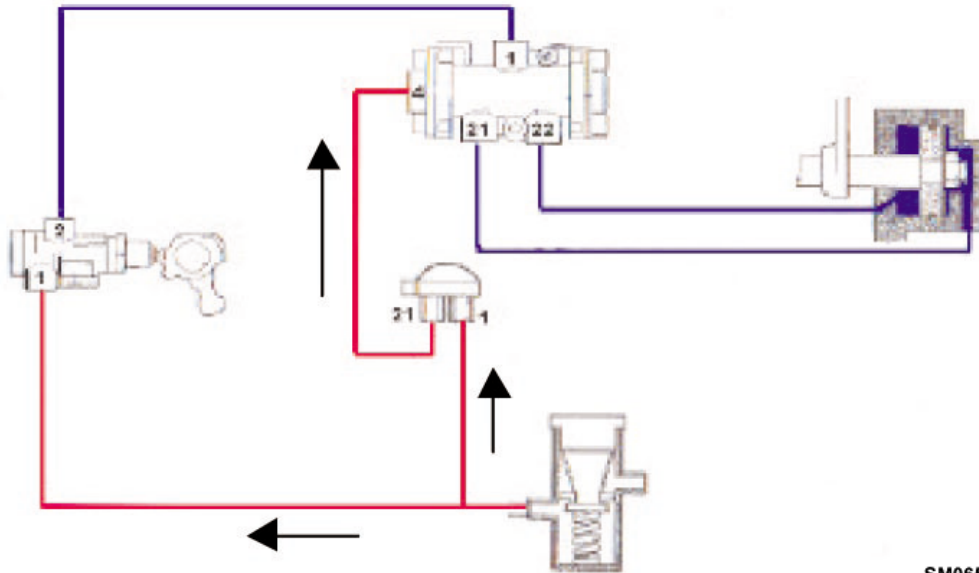
- When the hand control valve is in the low range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) is pressurised. This causes the spool, within the range change slave valve, to be lifted off its seat.
- As the transmission is in gear the air supply from the poppet valve to the range change valve is not present therefore the transmission remains in high range.
- As the transmission is moved to neutral the poppet valve allows air to pass through the range change slave valve and on to the range change cylinder to engage low range.

Transmission in neutral - Low range engaged



- The filter regulator supplies constant air (regulated to 5.5 bar) to both the hand control valve (port 1) and LRC poppet valve (port 1).
- When in neutral air is supplied from the LRC poppet valve (port 2) to the range change slave valve (port 1).
- When the hand control valve is in the low range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) is pressurised. This causes a spool, within the range change slave valve, to be lifted off its seat. Air is now fed from port 1 of the range change slave valve through to port 22 and then on to the low side of the range change cylinder causing the piston to move rearwards - low range is engaged.
- Any air that may have been present in the high side of the range change cylinder vents through the range change slave valve to atmosphere.

Transmission in gear - Low range engaged

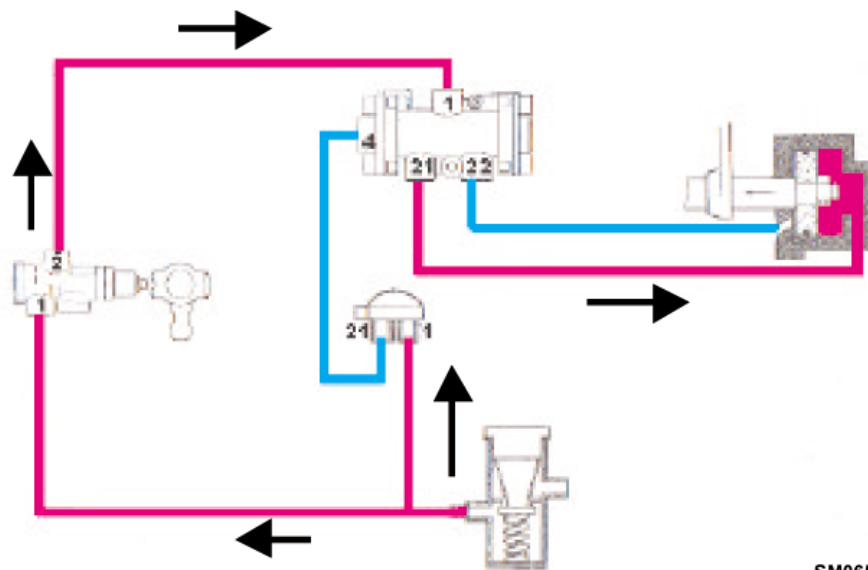


- When a gear is engaged the inner-striking lever of the LRC pushes against the plunger in the poppet valve. As the plunger is pushed inwards the air supply from the poppet valve (port 2) to the range change slave valve (port 1) and subsequently the range change cylinder is cut off venting any air within the range change cylinder to atmosphere.
- Whenever the gear lever passes through neutral the range change cylinder is momentarily pressurised.

Transmission in gear - High range preselected

- When the hand control valve is moved to the high range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) vents to atmosphere. This allows the spring within the range change slave valve to move the internal spool to its relaxed position.
- As the transmission is in gear the air supply from the poppet valve to the range change valve is not present therefore the transmission remains in low range.
- As the transmission is moved to neutral the poppet valve allows air to pass through to the range change slave valve and on to the range change cylinder to engage high range.

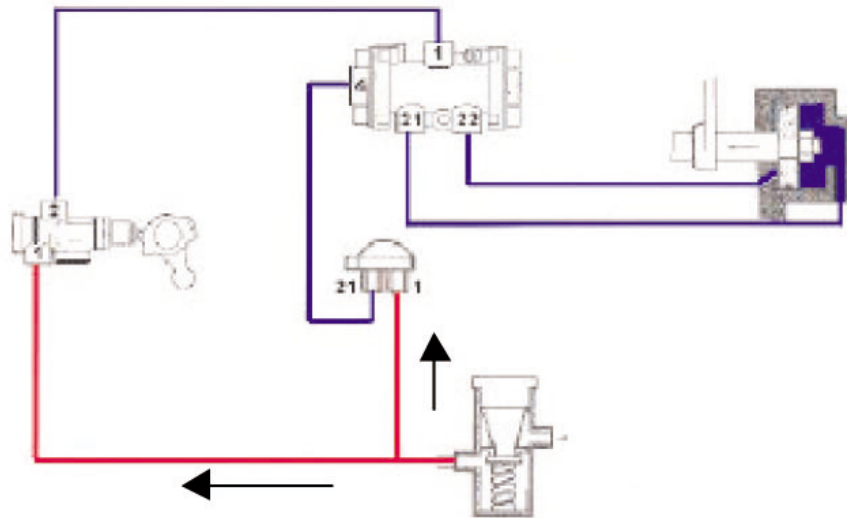
Transmission in neutral - High range engaged



SM0655

- The filter regulator supplies constant air (regulated to 5.5 bar) to the hand control valve (port 1) and poppet valve (port 1).
- Air is supplied from the poppet valve (port 2) to the range change slave valve (port 1)
- When the hand control valve is in the high range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) vents to atmosphere. The spring, within the range change slave valve, causes the internal spool to move to its relaxed position.
- Air is fed from the range change slave valve (port 21) to the high side of the range change cylinder causing the piston to move forwards - high range is engaged.
- Any air that may have been present within the low side of the range change cylinder vents back through the range change slave valve to atmosphere.

Transmission in gear - High range engaged



SM0656

- When a gear is engaged the inner striking lever of the LRC pushes against the plunger in the poppet valve. As the plunger is pushed inwards the air supply from the poppet valve (port 2) to the range change slave valve (port 1) and subsequently the range change cylinder is cut off venting any air within the range change cylinder to atmosphere.
- Whenever the gear lever passes through neutral the range change cylinder is momentarily pressurised.

Range Inhibition System

The Range Inhibition System prevents low range engagement at high speeds. This protects the synchornisers from any abusive shifting that may occur. The Range Inhibition System is a range change valve that has a normally closed electrocal solenoid. The solenoid will interrupt the signal feed from the hand control valve to the range change valve at a pre-determined road speed.

Low and High range available

When the vehicle is below a pre-determined road speed, a 24-volt power supply energizes teh electrical signal to teh solenoid valve. As the solenoid valve energized, the signal feed from the hand control valve to the range change valve is interrupted - low and high range gears are available.

High range only available

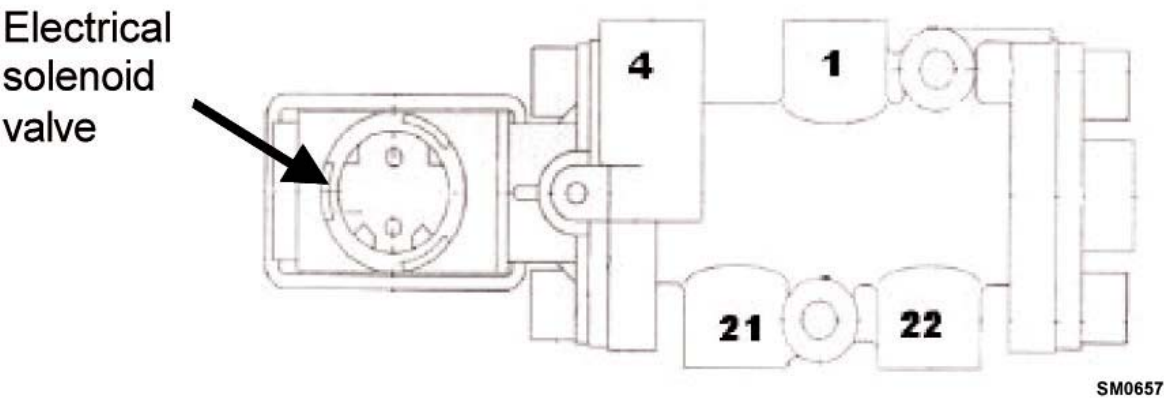
When the vehicle is above a pre-determined road speed, a 24-volt power supply to the electrical solenoid is removed. Since the solenoid valve is de-enegized, the signal feed from the hand control valve to the range chnage valve is interrupted - only high range is avail-able.

Ignition off

When the ignition is switched off, the transmission will default to high range.

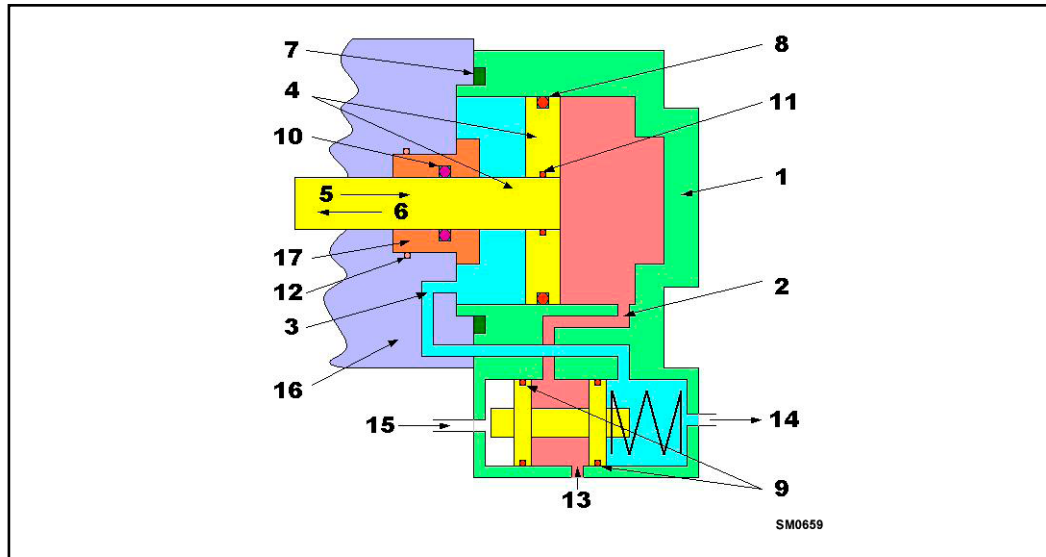
Ignition	Road Speed	Solenoid	Availability	
			Low Range	High Range
On	Low	Energized	Yes	Yes
On	High	De-Energized	No	Yes
Off	None	De-Energized	No	Yes

Range change slave valve - with inhibitor solenoid



Integrated Air System (IAS)

RANGE CHANGE SHIFT CYLINDER - IAS



- | | |
|--------------------------|---------------------|
| 1. IAS Body | 10. O-Ring |
| 2. High Range Air Port | 11. O-Ring |
| 3. Low Range Air Port | 12. O-Ring |
| 4. Piston and Piston Rod | 13. Main Air Supply |
| 5. Low Range | 14. Outlet |
| 6. High Range | 15. Signal Inlet |
| 7. O-Ring | 16. Rear Case |
| 8. O-Ring | 17. Piston Rod Bush |
| 9. O-Ring | |

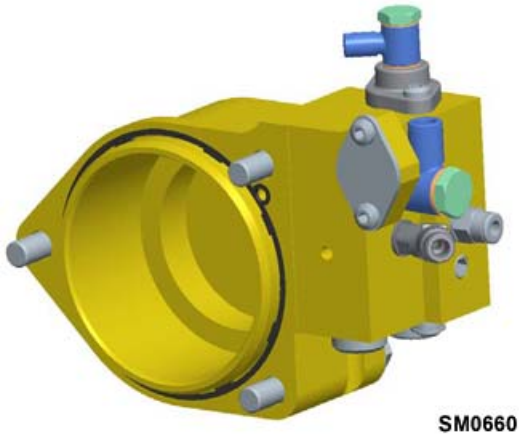
Operation

By switching the selector valve on the gear lever on single H, or by moving the gear lever across the detent between 3/4 and 5/6 gear lever positions air is supplied by the IAS internal slave valve to either the high range or low range air port.

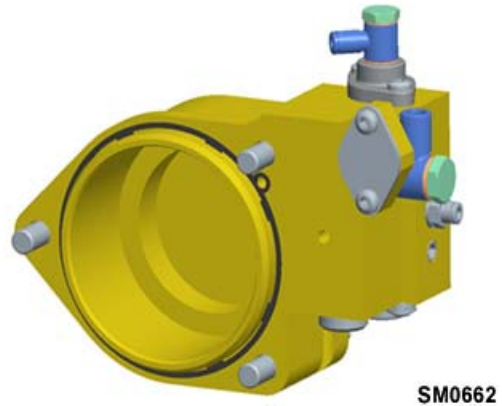
Air pressure on the other side of the piston is exhausted to atmosphere through the IAS outlet. There is a constant air pressure acting against either side of the piston at all times on double H (both pneumatic and electric) and single H (with electric IAS) transmissions. On the transmission with pneumatic single H IAS air is only supplied to the range change piston when the transmission is in neutral.

Types Of IAS Unit

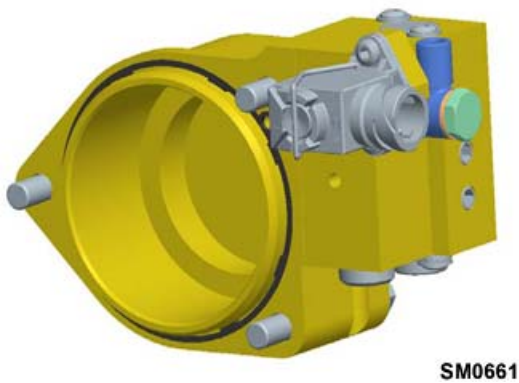
IAS - Pneumatic Version - Single H



IAS - Pneumatic Version - Double H



IAS - Electric Version



IMPORTANT: These components are not serviceable.

Operation

By switching the selector valve or electrical signal on the gear lever.

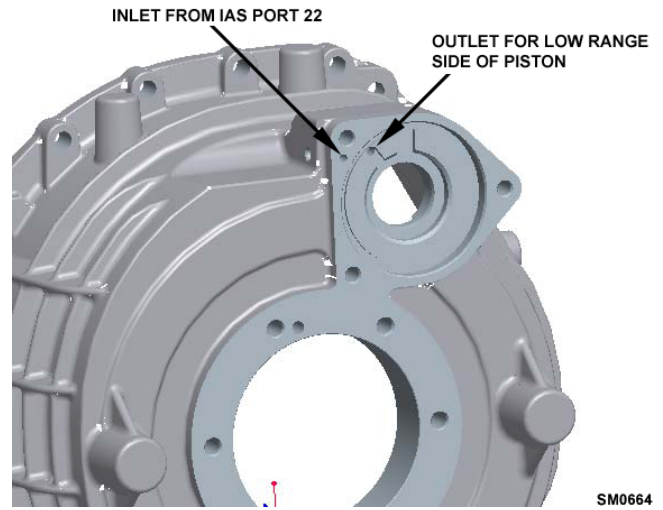
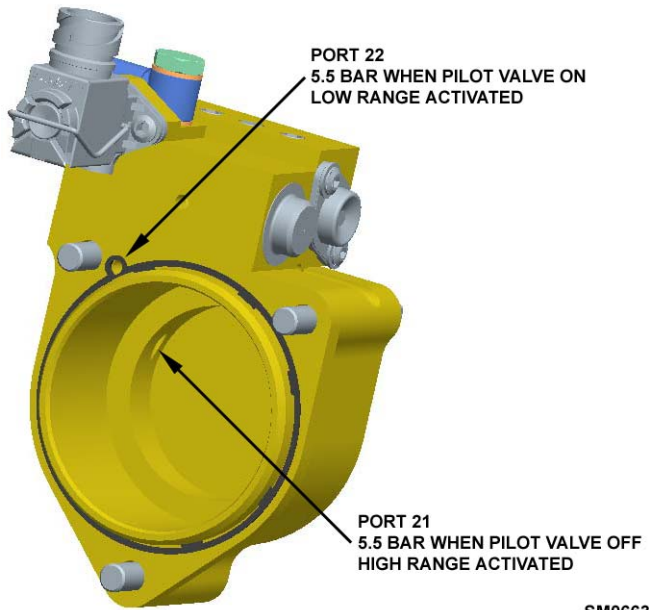
Main air supply 10-12 bar.

Power supply 24 V DC

Operation pressure is 5.5 bar +/-0.5 bar

Range can be changed in neutral only.

Description of internal channels

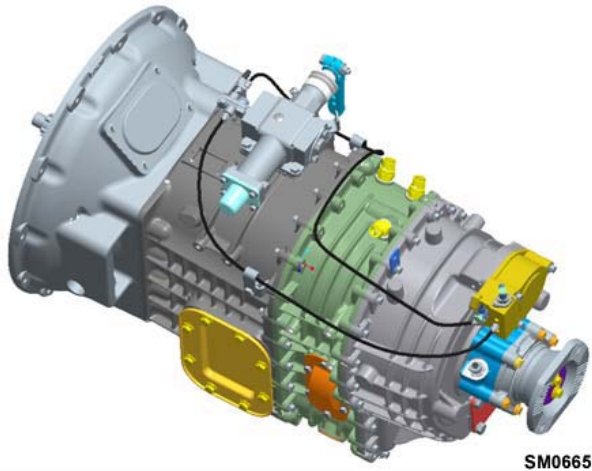


Range Change Shift Air Lines

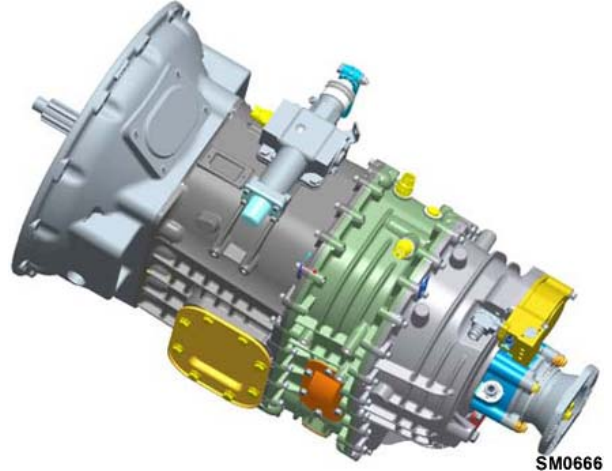
The pneumatics used on the Nine speed synchromesh transmission can be categorised as either single H or double H control.

The following diagrams should be used to determine the type and design level of the air system used on the transmission being serviced in conjunction with the shift pattern in the vehicle.

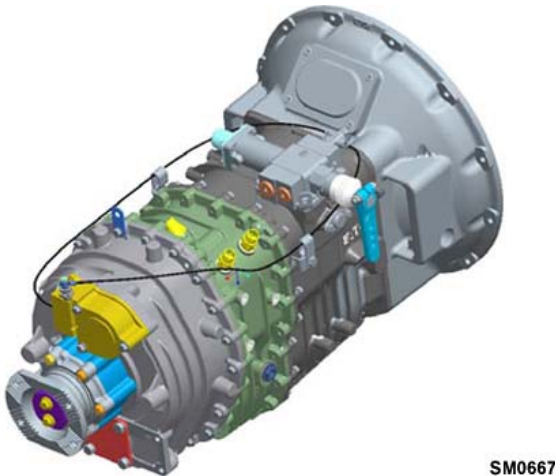
IAS Pneumatic Single H



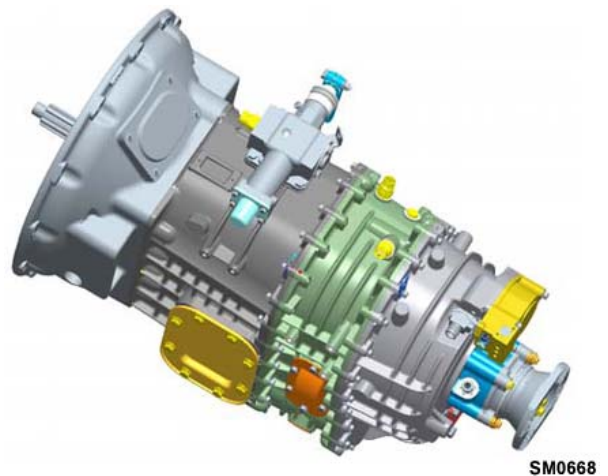
IAS Electric Single H



IAS Pneumatic Double H

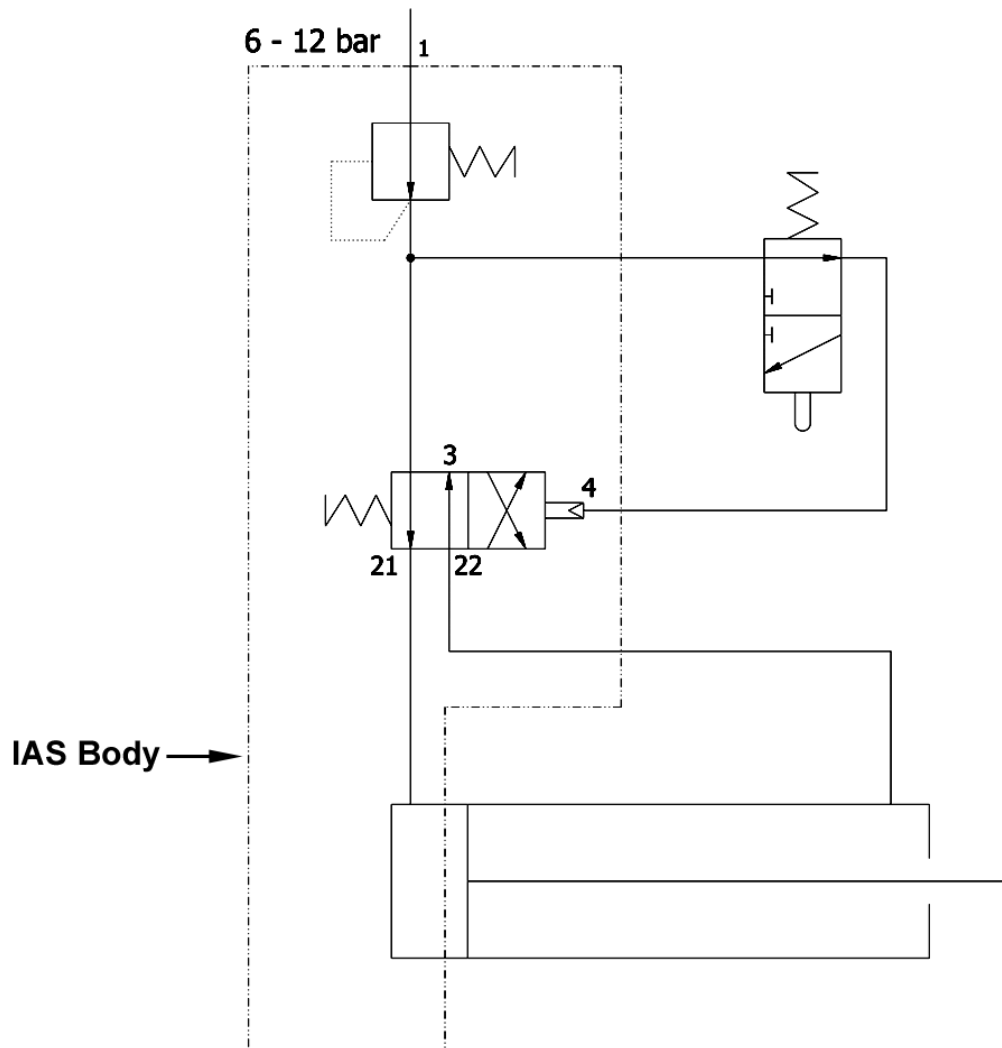


IAS Electric Double H



Range Change Shift Air Circuit Diagram - Double H

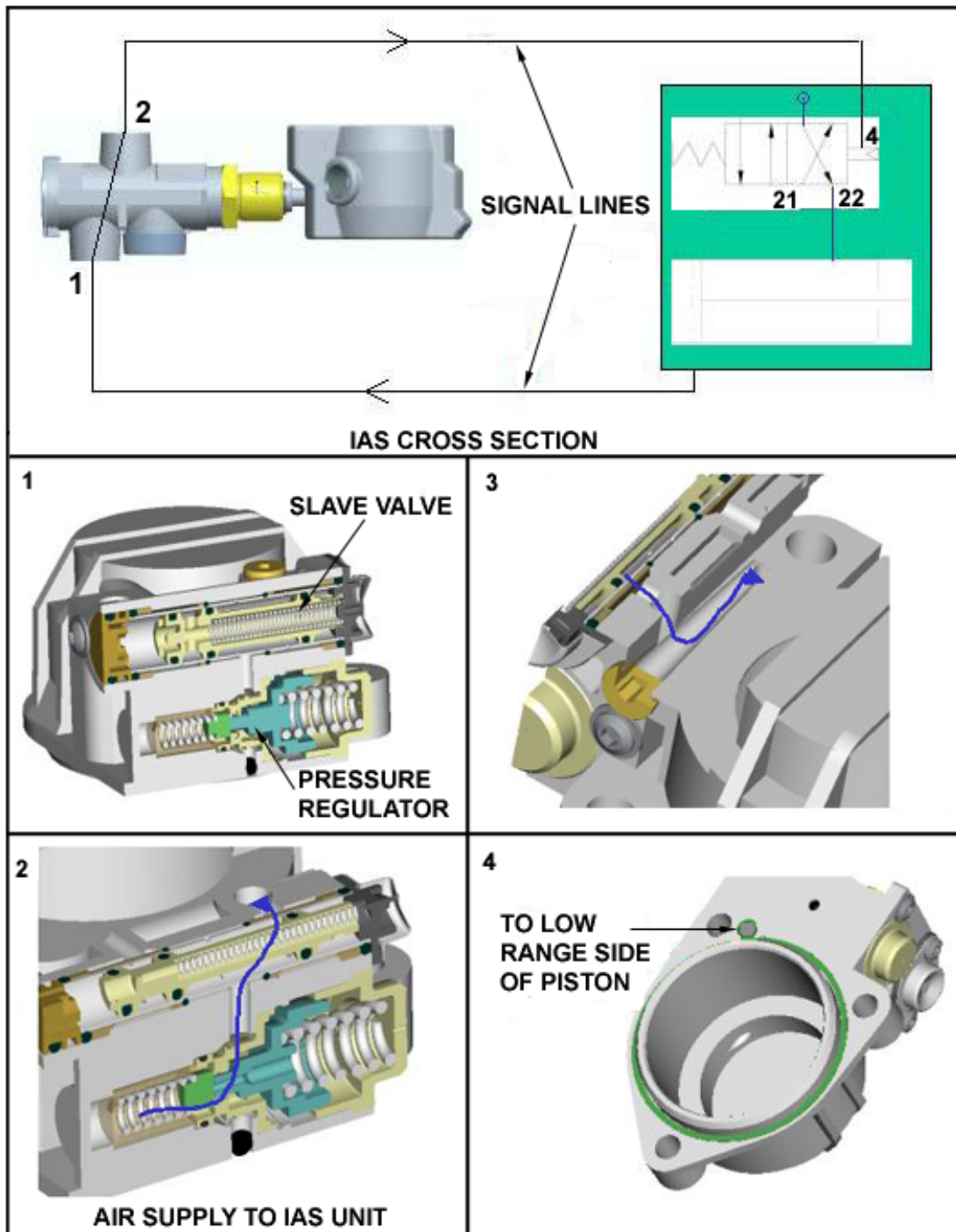
RANGE CHANGE SHIFT AIR CIRCUIT - DOUBLE H



- 1 - Supply**
- 21 - Delivery High Range**
- 22 - Delivery Low Range**
- 3 - Exhaust**
- 4 - Supply Pilot**

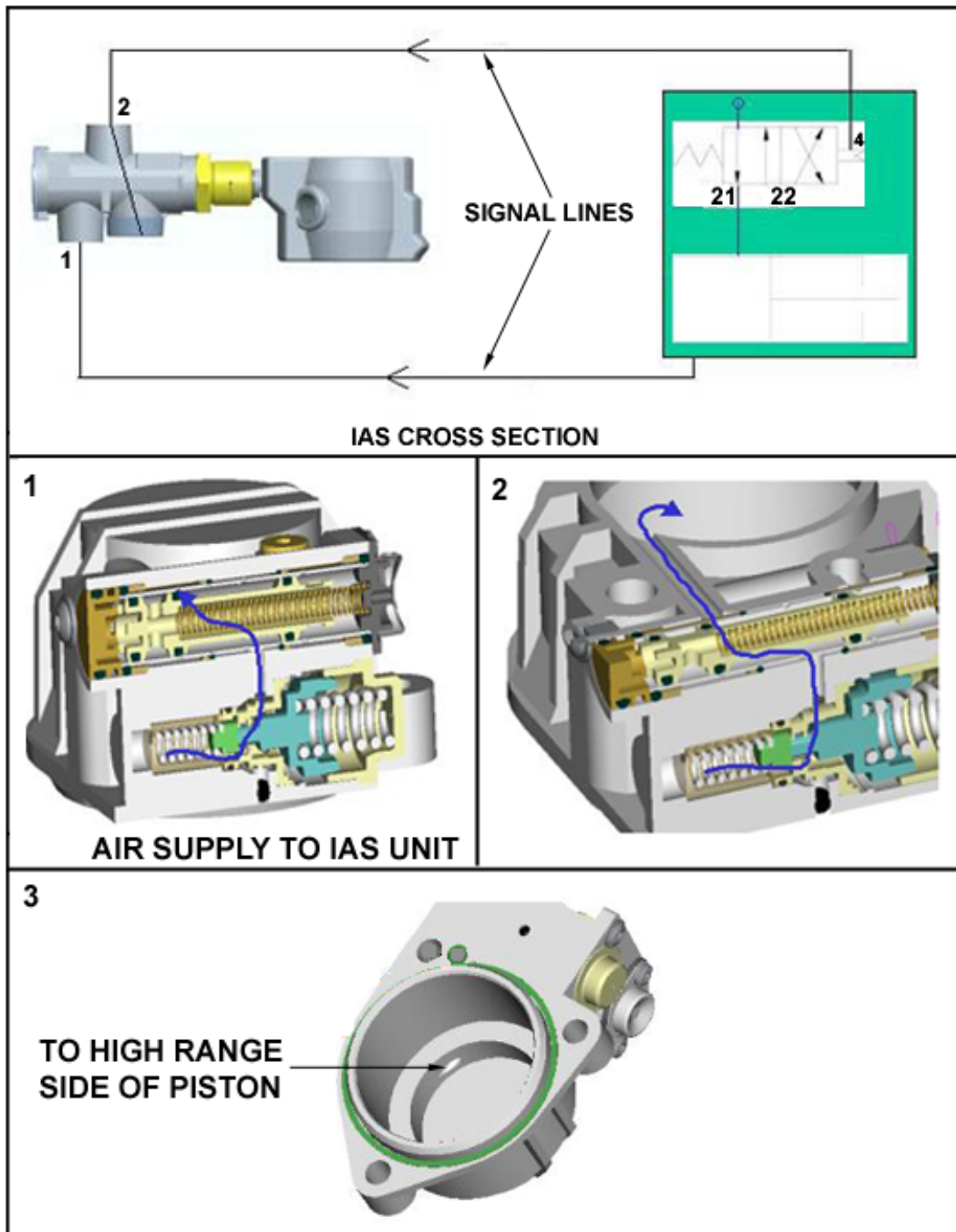
SM0669

Air Circuit Diagram - Double H Shift - Low Range



SM0670

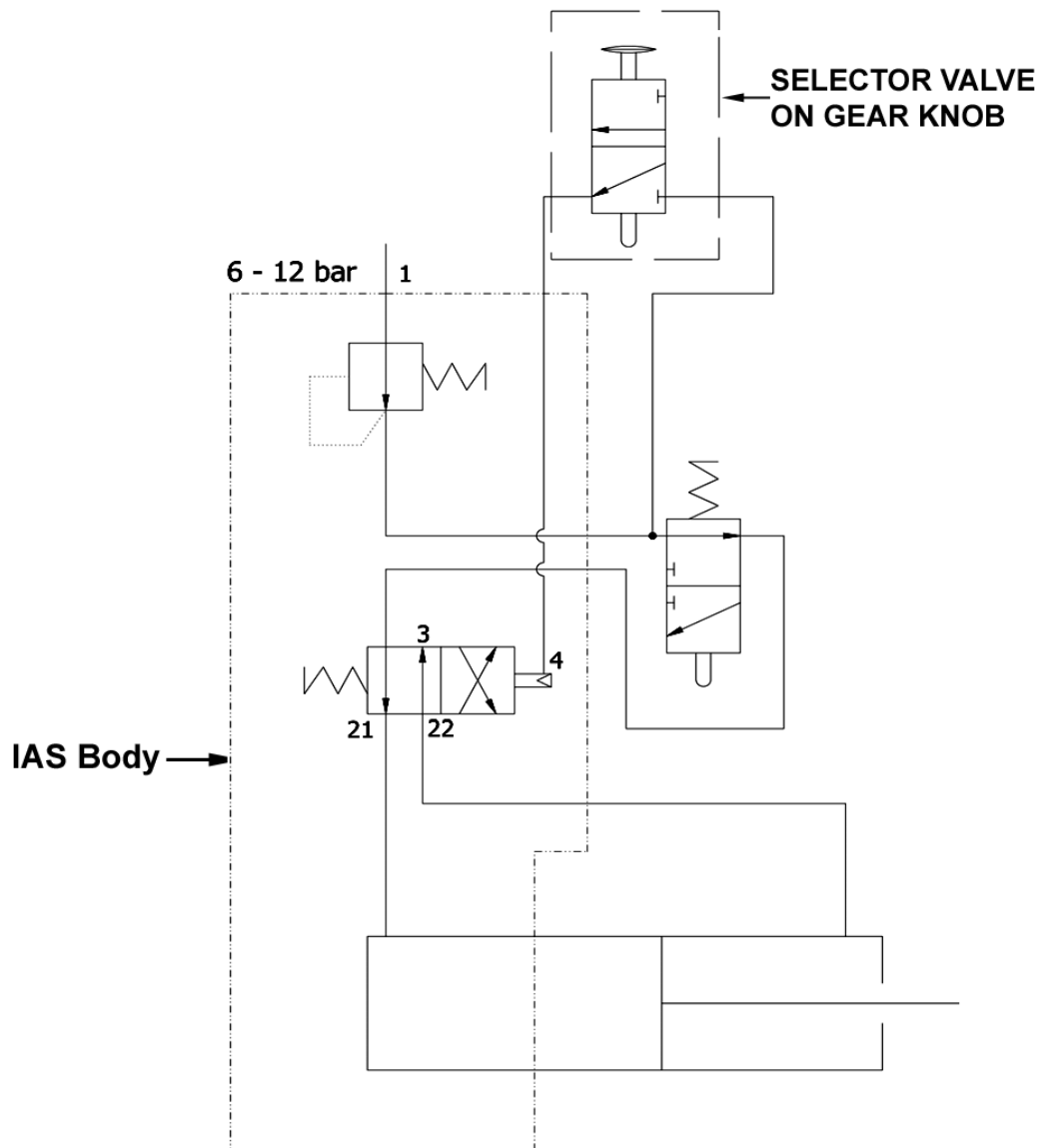
Air Circuit Diagram - Double H Shift - High Range



SM0671

Range Change Shift Air Circuit Diagram - Single H

RANGE CHANGE SHIFT AIR CIRCUIT - SINGLE H



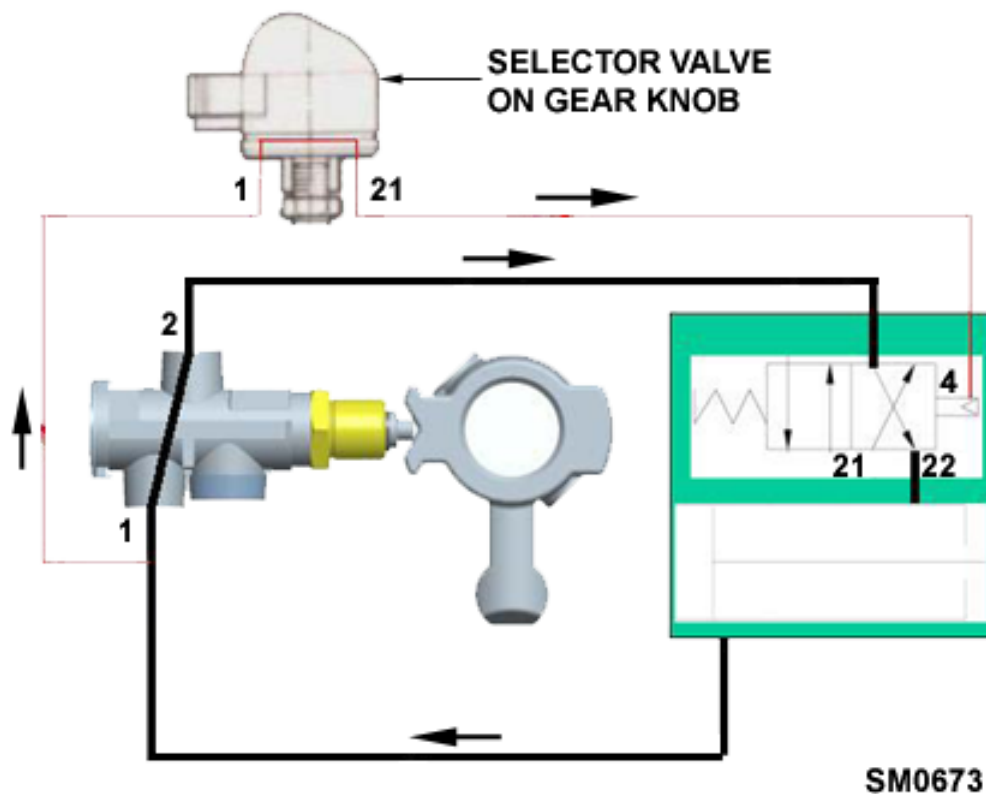
- 1 - Supply**
- 21 - Delivery High Range**
- 22 - Delivery Low Range**
- 3 - Exhaust**
- 4 - Supply Pilot**

SM0672

Transmission in Gear - Low Range Preselected

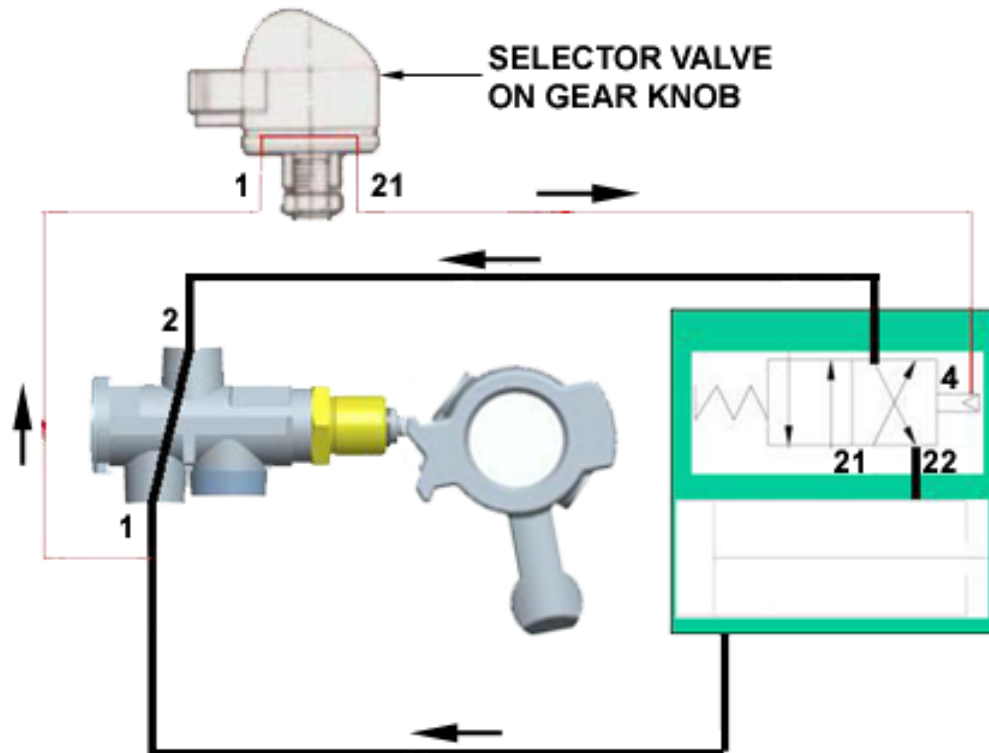
- When the hand control valve is in the low range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) is pressurized. This causes the spool, within the range change slave valve, to be lifted off its seat.
- As the transmission is in gear the air supply from the poppet valve to the range change valve is not present therefore the transmission remains in high range.
- As the transmission is moved to neutral the poppet valve allows air to pass through the range change slave valve and on to the range change cylinder to engage low range.

Transmission In Neutral - Low Range Engaged



- The IAS internal filter regulator supplies constant air (regulated to 5.5 bar) to LRC poppet valve (port 1) and via valve on LRC to the hand control valve (port 1).
- When in neutral air is supplied from the LRC poppet valve (port 2) to the internal IAS range change slave valve.
- When the hand control valve is in the low range position the signal feed pipe from the hand control valve (port 21) to the top of IAS range change slave valve (port 4) is pressurised. This causes a spool, within the range change slave valve, to be pressed down. Air is now fed from port 2 of the LRC valve through to port 22 and then on to the low side of the range change cylinder causing the piston to move rearwards - low range is engaged.
- Any air that may have been present in the high side of the range change cylinder vents through the range change slave valve to atmosphere.

Transmission In Gear - Low Range Engaged



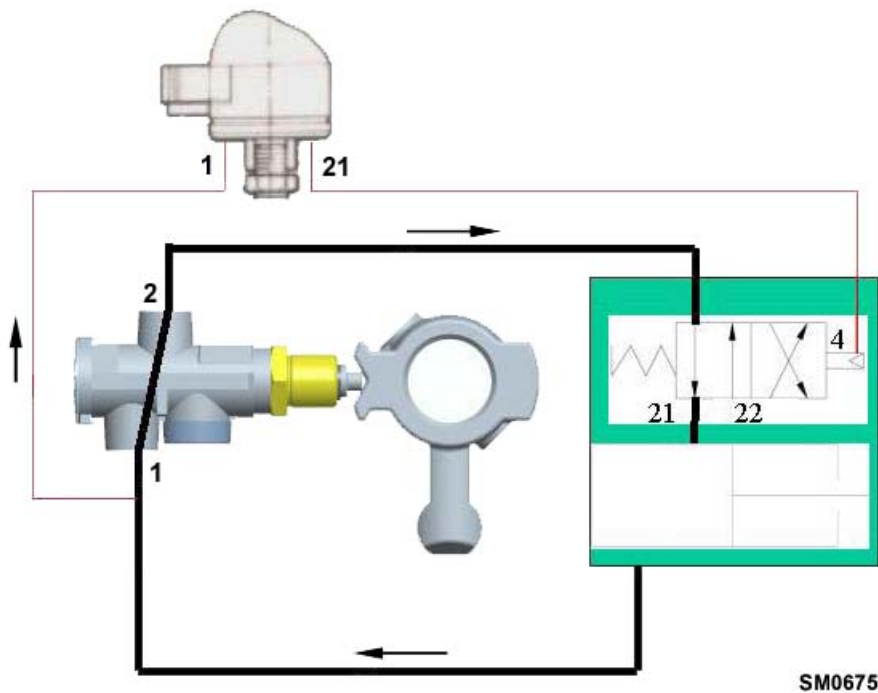
SM0674

- When a gear is engaged the inner-striking lever of the LRC pushes against the plunger in the poppet valve. As the plunger is pushed inwards the air supply from the poppet valve (port 2) to the range change slave valve (port 21) and subsequently the range change cylinder is cut off venting any air within the range change cylinder to atmosphere.
- Whenever the gear lever passes through neutral the range change cylinder is momentarily pressurised.

Transmission in Gear - High Range Preselected

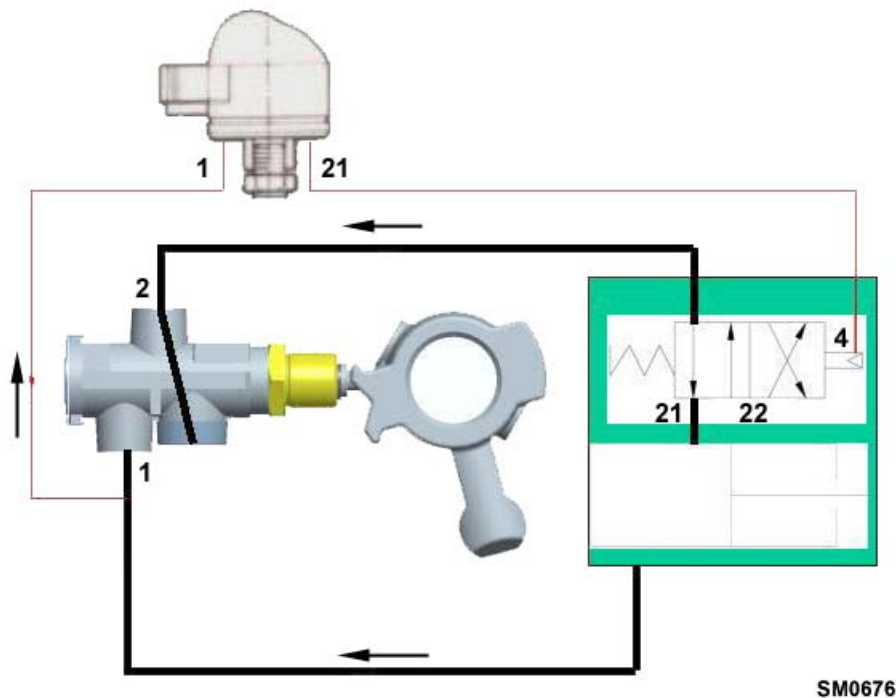
- When the hand control valve is moved to the high range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) vents to atmosphere. This allows the spring within the range change slave valve to move the internal spool to its relaxed position.
- As the transmission is in gear the air supply from the poppet valve to the range change valve is not present therefore the transmission remains in low range.
- As the transmission is moved to neutral the poppet valve allows air to pass through to the range change slave valve and on to the range change cylinder to engage high range.

Transmission in Neutral - High Range Engaged



- The filter regulator supplies constant air (regulated to 5.5 bar) to the hand control valve (port 1) and poppet valve (port 1)
- Air is supplied from the poppet valve (port 2) to the range change slave valve
- When the hand control valve is in the high range position the signal feed pipe from the hand control valve (port 21) to the range change slave valve (port 4) vents to atmosphere. The spring, within the range change slave valve, causes the internal spool to move to its relaxed position.
- Air is fed from the range change slave valve (port 21) to the high side of the range change cylinder causing the piston to move forwards - high range is engaged.
- Any air that may have been present within the low side of the range change cylinder vents back through the range change slave valve to atmosphere.

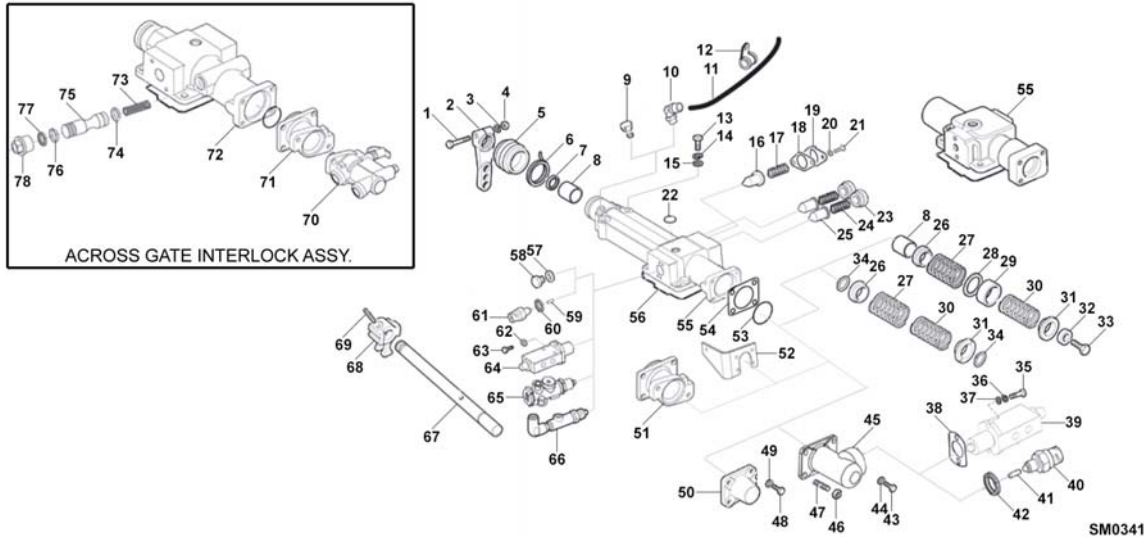
Transmission in Gear - High Range Engaged



- When a gear is engaged the inner striking lever of the LRC pushes against the plunger in the poppet valve. As the plunger is pushed inwards the air supply from the poppet valve (port 2) to the range change slave valve (port 1) and subsequently the range change cylinder is cut off venting any air within the range change cylinder to atmosphere
- Whenever the gear lever passes through neutral the range change cylinder is momentarily pressurised.

Exploded View

REMOTE CONTROL ASSEMBLY



- | | | |
|--|---|--|
| 1. Bolt | 26. Spring Retainer or Cup | 52. Reaction Rod Mounting Bracket (if fitted) |
| 2. Outer Lever | 27. Spring - Booster (If fitted) | 53. O-Ring |
| 3. Spring Washer | 28. Washer (if fitted) | 54. Gasket (if fitted) |
| 4. Nut | 29. Spacer (if fitted) | 55. LRC Housing |
| 5. Boot | 30. Spring - Bias | 56. Seal |
| 6. Cable Tie | 31. Spring Retainer or Bush | 57. Washer OR O-Ring (if fitted) |
| 7. Oil Seal | 32. Plain Washer | 58. Plug (if fitted) |
| 8. Bush | 33. Capscrew | 59. Actuating Pin (if fitted) |
| 9. Breather | 34. Circlip | 60. O-Ring (if fitted) |
| 10. Elbow (if fitted) | 35. Capscrew (if fitted) | 61. Switch (if fitted) |
| 11. Pipe (if fitted) | 36. Spring Washer (if fitted) | 62. Spring Washer |
| 12. Hose Clamp (if fitted) | 37. Plain Washer (if fitted) | 63. Capscrew |
| 13. Capscrew (if fitted) | 38. Joint (if fitted) | 64. Slave Valve (if fitted) |
| 14. Spring Washer (if fitted) | 39. Range Control Valve (if fitted) | 65. Poppet Valve (Single H - if fitted) |
| 15. Plain Washer (if fitted) | 40. Switch (if fitted) | 66. Exhaust Control Valve (Single H - if fitted) |
| 16. Plunger (Single H) | 41. Actuating Pin (if fitted) | 67. Shift Rod |
| 17. Spring (Single H) | 42. O-Ring (if fitted) | 68. Inner Striking Lever |
| 18. Gasket (Single H) | 43. Capscrew (if fitted) | 69. Dowel |
| 19. Detent Cover (Single H) | 44. Spring Washer (if fitted) | 70. Across Gate Cylinder Housing (if fitted) |
| 20. Spring Washer (Single H) | 45. Reverse Gate Switch Housing (if fitted) | 71. Adaptor Housing (if fitted) |
| 21. Capscrew (Single H) | 46. Nut (if fitted) | 72. LRC Housing (for Intellock Assy.) |
| 22. Expansion Plug | 47. Stud (if fitted) | 73. Spring (if fitted) |
| 23. Plug Detent (Double H) | 48. Capscre | 74. Slide Ring (if fitted) |
| 24. Reverse / Range Detent Spring (Double H) | 49. Spring Washer | 75. Piston (if fitted) |
| 25. Plunger (Double H) | 50. End Cover | 76. Slide Ring (if fitted) |
| | 51. Adaptor Housing (if fitted) | 77. Piston Sealing (if fitted) |
| | | 78. Adaptor Bush (if fitted) |

How to disassemble Remote Control Assembly

Special Instructions



WARNING: Wear safety glasses when removing snap rings.

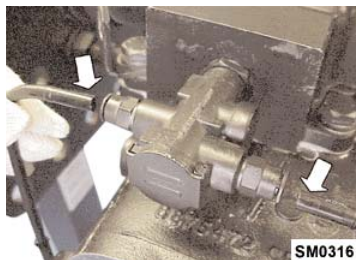
Special Tools

Snap ring pliers

Procedure -

1. Disconnect the vehicle linkage. Mark the position of the outer lever. Remove the air lines from the the air control valve. Remove the air lines from inter-lock assembly (if fitted).

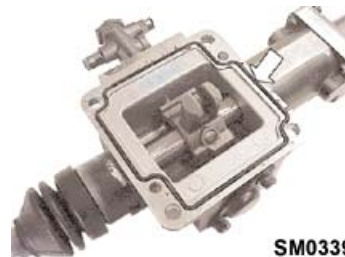
Note: Mark the positions of air lines before removal from the air control valve.



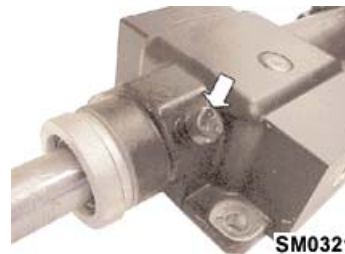
2. Ensure the control assembly is in neutral.
3. Remove bolts, washers and lifting eye (if fitted).



4. Remove the control assembly, dowels and seal.



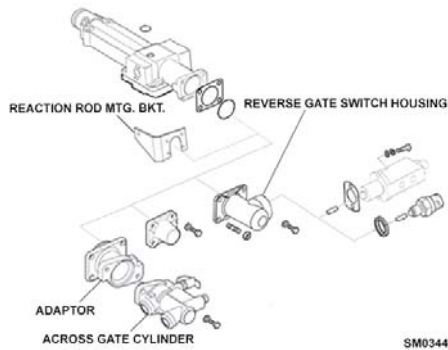
5. Remove breather or elbow assembly (if fitted) from the control assembly.



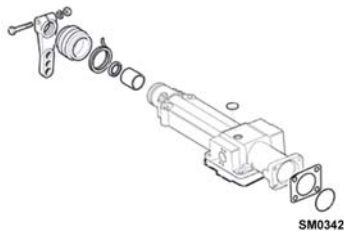
6. Remove the air control valve and actuating pin. OR remove switch or plug (if fitted), 'O' ring or washer (if fitted) and actuating pin.



Note: On some transmissions, air control valve or switch is fitted on reverse gate switch housing.



7. Remove bolt, washer (if fitted) and nut. Remove the outer lever.



Note: The position of the outer lever is marked on the shaft. Check before removal.

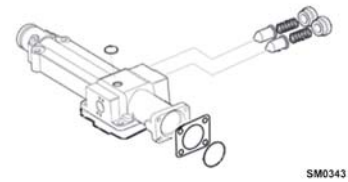
8. Remove rubber boot and cable tie (if fitted).



9. **Single H:** Remove screws and washers (if fitted). Remove reverse detent cover. Pull out the spring and plunger (if fitted). Remove gasket.

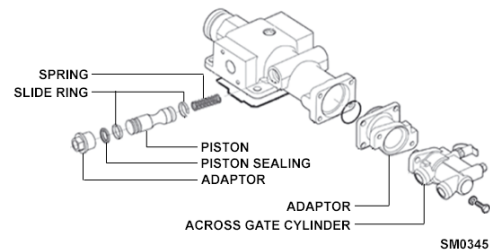


10. **Double H:** Remove plugs, springs and plungers.



11. **Across Gate Interlock Assembly (if fitted):** Remove adaptor, piston sealing, piston with slide rings and spring.

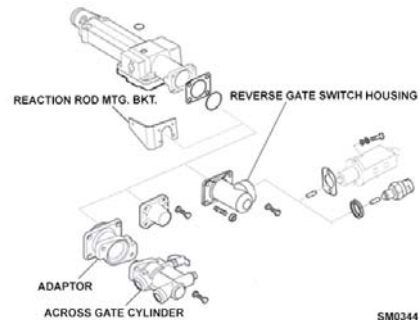
ACROSS GATE INTERLOCK ASSY.



12. Remove screws and washers (if fitted). Remove end cover and 'O' ring or gasket (if fitted). Remove reaction rod mounting bracket (if fitted).

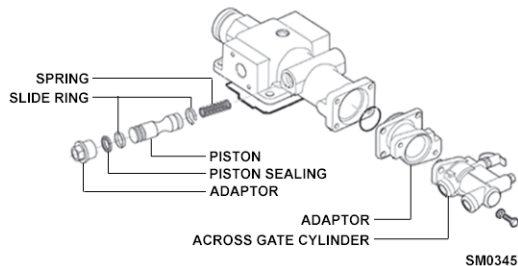


13. **On some transmissions,** Remove screws or studs (if fitted) and washers (if fitted) or nut (if fitted). Remove reverse gate switch housing and reaction rod mounting bracket (if fitted). Remove 'O' ring or gasket (if fitted) and actuating pin.



14. **On some transmissions**, Remove screws and washers (if fitted). Remove across gate cylinder and adaptor. Remove 'O' ring or gasket (if fitted).

ACROSS GATE INTERLOCK ASSY.



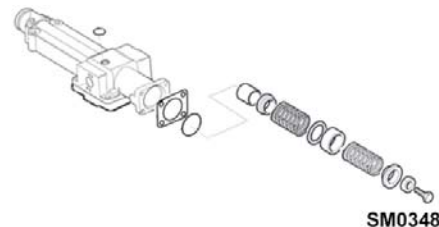
15. Remove the circlip from the shift rod and remove the bias spring retainer. Remove the booster spring (if fitted) and bias spring.



16. Remove booster spring retainer and circlip.



17. **On some transmissions**, remove the capscrew from the end of the shaft. Remove the washer, spring retainer or bush, bias spring, spacer, washer, booster spring (if fitted) and spring retainer or cup.



18. Invert the housing, slide the remote control shaft and inner lever toward the left-hand end of the housing and carefully drift out the expansion plug.



19. Invert the housing, align the grooved pin in the inner striking lever with the expansion plug hole. Drift out the grooved pin. Remove the shift rod and inner striking lever.



20. Remove the shift rod and inner striking lever.



SM0327

How to assemble Remote Control Assembly

Special Instructions



WARNING: Wear safety glasses when installing snap rings.

Special Tools

Snap ring pliers

MS 284-1 Extractor Set

E 109-5 Oil Seal and Bush installer

Procedure -

1. If necessary renew the bearing bushes in the housing. Remove the old bushes using tool MS 284-1. Install the new bushes using tool E 109-5.

IMPORTANT: Clean the control assembly mating face properly.



2. If necessary renew the oil seal using special tool E 109-5.



3. Locate the inner lever into the housing, long grooved side and retaining pin hole toward the rear. Install the shaft through the housing and the lever from the oil seal end of the housing.



4. Align the inner lever on the shaft and install a new grooved pin, ensuring identification mark is in correct position.

Note: Inner striking lever should be supported whilst driving grooved pin, to prevent damage to bushes.



- Fit the inner circlip onto the shift rod. Install the booster spring retainer.



SM0332

- Insert the booster spring (if fitted) and bias spring. Install bias spring retainer and outer circlip onto the shift rod.



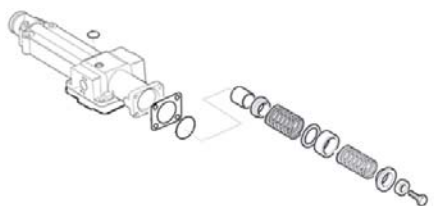
SM0333

- On some transmissions**, remove the capscrew from the end of the shaft.



SM0347

- Install the spring retainer or cup, booster spring (if fitted), washer, spacer, bias spring, spring retainer or bush and washer. Tighten the capscrew to 24 - 30 Nm.



SM0348

- Fit a new 'O' ring or gasket (if fitted).



SM0334

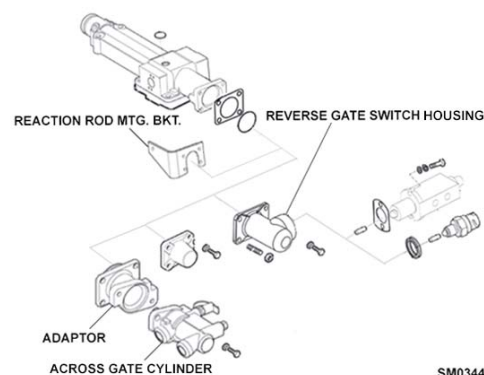
- Install the reaction bracket (if fitted). Secure the end cover to the housing by screws and washers (if fitted). Tighten the screws to 19 -24 Nm.

Note: The word "TOP" has been cast into the cover to identify correct positioning.



SM0335

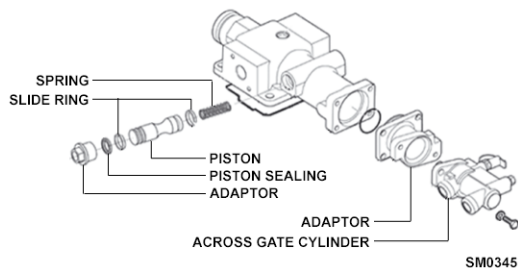
- On some transmissions**, Install reverse gate switch housing and reaction rod mounting bracket (if fitted). Install screws or studs (if fitted) and washers (if fitted) or nut (if fitted). Tighten the screws (if fitted) to 19 -24 Nm. Tighten studs (if fitted) to 14 - 16 Nm and nut to 19 - 24 Nm.



SM0344

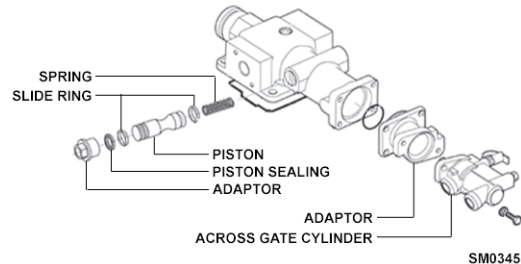
12. **On some transmissions**, Install adaptor and across gate cylinder. Install screws and washers (if fitted). Tighten screws to 24 -30 Nm.

ACROSS GATE INTERLOCK ASSY.



15. **Across Gate Interlock Assembly (if fitted):** Install spring, piston with slide ring, piston sealing and adaptor. Tighten adaptor to 8 -14 Nm.

ACROSS GATE INTERLOCK ASSY.



13. **Single H:** Install the spring and reverse detent plunger (if fitted). Install gasket and detent cover. Install screws and washers (if fitted). Tighten screws to 19 - 24 Nm.

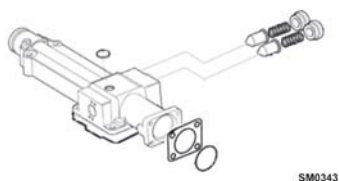


16. Fit the rubber boot with cable tie onto the housing. Align the outer lever with the timing mark on the shift rod. Install the capscrew, washer (if fitted) and nut. Tighten capscrew and nut to 35 -39 Nm.



14. **Double H:** Install detent plungers, springs and plugs. Tighten plugs to 16 - 22 Nm.

IMPORTANT: Install reverse and range detent spring at appropriate hole.



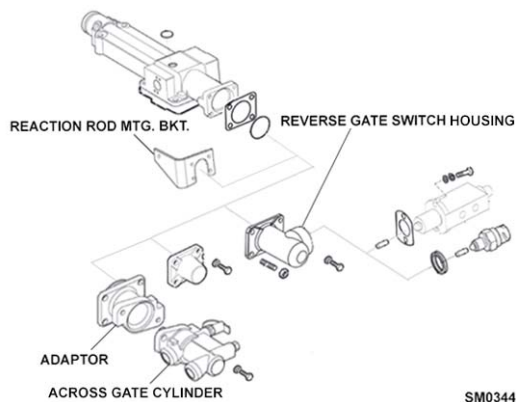
17. Fit the breather or elbow assembly (if fitted). Apply sealant and install expansion plug.



18. Fit the air control valve and actuating pin. OR install the switch activator pin, 'O' ring or washer (if fitted) and neutral switch or plug (if fitted). Tighten the neutral switch to 24 -30 Nm.



Note: On some transmissions, air control valve or switch is fitted on reverse gate switch housing.



19. Replace seal, if necessary. Install dowels on housing. Apply Loctite 5900 sealant to mating faces, if seal is not fitted .

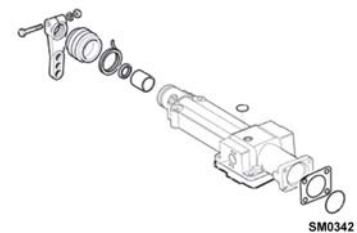


20. Fit the LRC to the transmission ensuring that the inner lever of the LRC locates the selector shaft shift block correctly. Fit the air pipes. Install bolts, screws and lifting eye (if fitted). Tighten capscrews to 35 - 39 Nm.

IMPORTANT: Fit the air pipes as per marking.

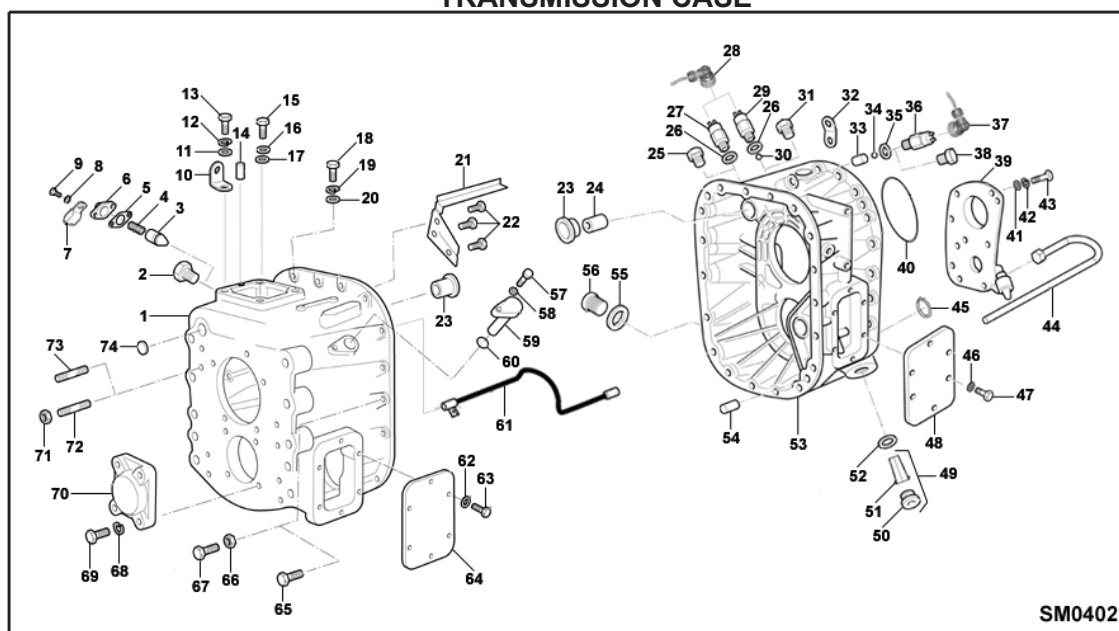


21. Install the outer lever with the timing mark on the shift rod. Tighten the capscrew, washer (if fitted) and nut to 35 -39 Nm. Connect vehicle linkage to the outer lever.



Exploded View

TRANSMISSION CASE



SM0402

- | | | |
|-------------------------------------|---|---|
| 1. Front Case | 26. O-Ring (if fitted) | 51. Strainer |
| 2. Detent Assy. | 27. Reverse Switch | 52. Washer |
| 3. Plunger | 28. Plug - Flying Lead (If fitted) | 53. Intermediate Case |
| 4. Spring | 29. Neutral Switch | 54. Dowel |
| 5. Gasket | 30. Detent Ball (if fitted) | 55. Washer |
| 6. Detent Cover | 31. Plug (if fitted) | 56. Oil Filler Plug |
| 7. Hose Clamp (if fitted) | 32. Lifting Eye | 57. Screw (if fitted) |
| 8. Spring Washer (if fitted) | 33. Interlock Pin | 58. Spring Washer (if fitted) |
| 9. Screw | 34. Detent Ball (if fitted) | 59. Pivot Pin (if fitted) |
| 10. Lifting Eye | 35. O-Ring (if fitted) | 60. O-Ring |
| 11. Plain Washer (if fitted) | 36. Range Indicator Switch | 61. Oil Spray Bar (if fitted) |
| 12. Spring Washer (if fitted) | 37. Plug - Flying Lead (If fitted) | 62. Spring Washer (if fitted) |
| 13. Screw | 38. Plug (if fitted) | 63. Screw |
| 14. Dowel | 39. Oil Pump | 64. PTO Cover |
| 15. Screw | 40. O-Ring | 65. Screw |
| 16. Spring Washer (if fitted) | 41. Plain Washer (if fitted) | 66. Nut |
| 17. Plain Washer (if fitted) | 42. Spring Washer (if fitted) | 67. Screw |
| 18. Screw | 43. Screw | 68. Spring Washer |
| 19. Spring Washer (if fitted) | 44. Oil Strainer & Suction Tube (if fitted) | 69. Screw |
| 20. Plain Washer (if fitted) | 45. Circlip | 70. Layshaft Front Brg. Cover (if fitted) |
| 21. Oil Through | 46. Spring Washer (If fitted) | 71. Nut (if fitted) |
| 22. Pop Rivet | 47. Screw | 72. Stud (if fitted) |
| 23. Bush (for main selector shaft) | 48. PTO Cover | 73. Stud (if fitted) |
| 24. Bush (for range selector shaft) | 49. Oil Strainer Assy. | 74. Cup Plug |
| 25. Plug (if fitted) | 50. Plug | |

How to disassemble Transmission Case

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Transmission Overhauling Stand
 Hoist
 Lifting Sling
 Soft Face Mallet
 Snap Ring pliers
 Flange Holding Wrench - LC 113A
 Sun Gear Retainer - E 118A
 Reverse idler shaft retaining pin installer - E 117
 8 mm Punch
 Slide Hammer - MS 284
 Remover Adaptor Reverse Idler Shaft - E119
 Lifting Fixture - E 116A
 Lifting Adaptor - E116-1
 Replacer adaptor for mainshaft bearing and input shaft bearing - E 108-5
 Driver - E 108
 Driver Extension - E 109-10
 Driver - E 109
Refer section 'Tools Information'

Procedure -

CAUTION: Drain gear oil from the transmission. Clean and refit the drain and filler plug.

Note: The transmission illustrated in this section is a standard ratio vertically installed unit. The procedure is the same for all transmissions but the physical size and number of teeth on some of the gears will vary from those illustrated on overdrive and alternative ratio models. Horizontally installed units have the remote control on the side of the transmission and alternative filler and drain plug positions.

It is recommended that the transmission is overhauled, mounted on the stand illustrated. If a stand is not available the transmission should be stood on wood blocks on the clutch housing until it is inverted. It should then be stood on the rear flange of the intermediate case on the blocks, taking great care not to damage the case flange, to complete the removal of the mainshaft.

1. Using a hoist, mount the transmission onto the stand. Disconnect the air pipes from valves and transmission.

Note: Mark the air pipes position to ensure reassembly to the correct valve ports and the transmission.

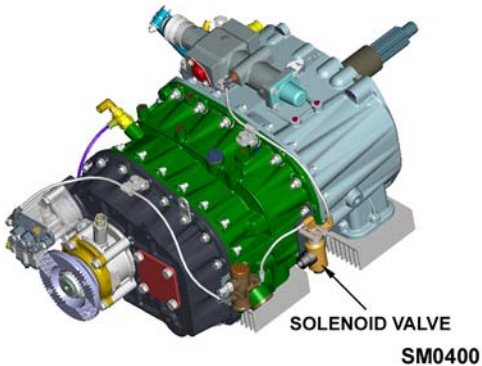


2. Remove the slave valve and mounting bracket (if fitted on the transmission). Protect the valve and air pipes from dirt ingress.



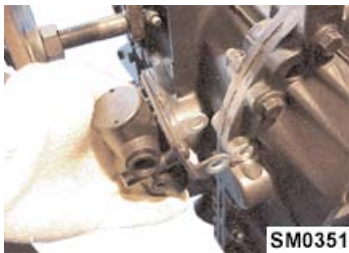
SM0350

3. **On transmission fitted with Across Gate Inter-lock Assembly**, remove the solenoid valve.



SM0400

4. Remove the filter/pressure regulating valve and mounting bracket.



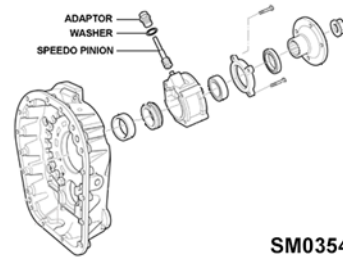
SM0351

5. Ensure neutral is engaged and remove the remote control housing capscrews. Using a soft faced mallet if necessary, separate the housing from the transmission.



SM0352

6. **Mechanical Speedometer (if fitted):** Remove the adaptor, washer and speedometer pinion.



SM0354

7. **Electronic Speedometer (if fitted):** Remove the electronic sender unit and washer (if fitted).



SM0353

Note: On some transmissions, speedometer port is plugged.

8. Using a flange holding wrench LC 113A, slacken but **DO NOT REMOVE** the flange retaining nut. Break the retaining torque only. Remove the flange retaining tool.

WARNING: Do not allow the output shaft to slide in the bearing or the range change synchroniser may spring apart.



SM0355

9. Rotate the transmission on the stand to the vertical position, rear end uppermost.

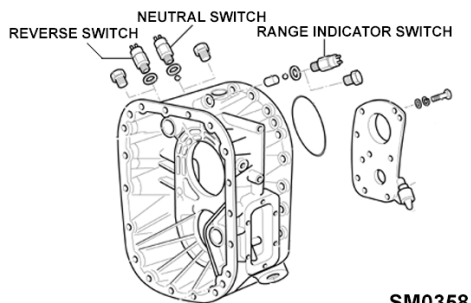


10. Remove the oil strainer plug, washer and strainer.

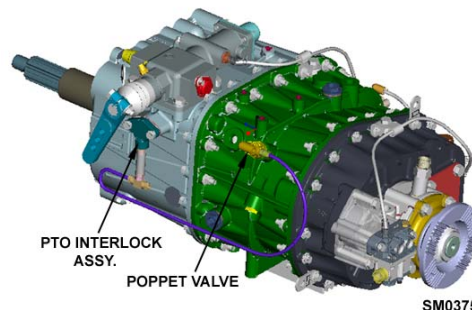
Note: A plug/washer only may be fitted on some multipurpose specification transmissions fitted with an integral strainer.



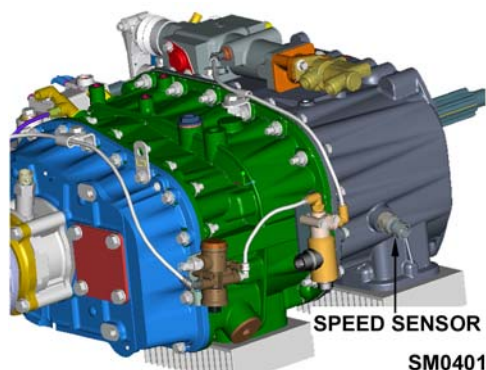
11. Remove the reverse lamp switch or plug (if fitted) and O-ring (if fitted). Remove the range indicator switch or plug (if fitted) and O-ring (if fitted). Remove neutral switches or plug (if fitted) and O-ring (if fitted), collect the ball from each bore as the switches are removed. Use a magnet or tap the case gently to release the balls if necessary.



12. **On transmissions fitted with PTO Interlock Assembly**, poppet valve is fitted in place of neutral switch. Remove the poppet valve, O-ring and ball.



13. **On transmissions fitted with Range Inhibitor System**, remove speed sensor from front case.



14. Remove the capscrews and nuts securing the rear end case to the intermediate case. Remove the lifting eye.



15. Attach a sling and hoist to the output drive flange.

Note: Attach the sling so as to lift the rear case as near vertically as possible.

Raise the hoist and separate the rear case from the intermediate case. Use a soft faced mallet if necessary to aid separation. Remove the dowels.

Note: Do not use pry bars or levers or the case flanges may be damaged.



16. Using the sun gear retainer E 118A to lock the sun gear, unscrew and remove the sun gear retaining bolt and the special washer.

Note: Separate sun gear retainers need to be used for Standard and BBE type rear case planet carrier assembly. .



17. Remove the sun gear.

Note: Sun gear size is different for Standard and BBE rear case planet carrier assembly.



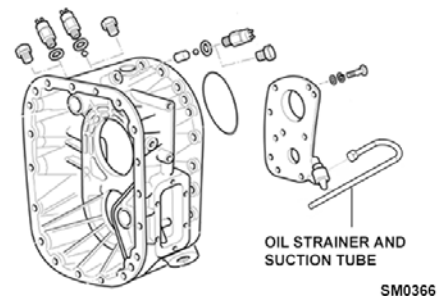
18. Remove the muff ring taking care not to damage the two sealing rings.



19. Remove the capscrews securing the oil pump assembly to the transmission.



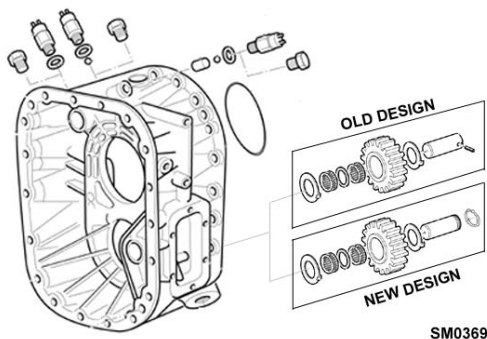
20. **On some multi-purpose specification transmissions**, the oil strainer and suction tube must be removed from oil pump.



21. Using a pry bar under the lugs provided, prise the pump off the locating dowels. Lift out the pump assembly. Remove the O-ring from the housing.

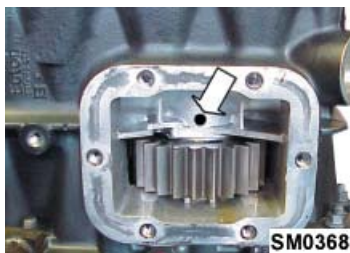


Reverse Idler Shaft



22. **Old Design - Reverse Idler Shaft:** Remove the screws and washers. Remove the PTO provision cover. Using the special tool E 117 or an 8 mm punch, drive the reverse idler shaft grooved pin **INWARDS** until the end is approximately 12 mm below the face of the hole.

Note: Do not allow the pin to 'bottom' against the shaft bore.



23. Screw the slide hammer MS 284 and E119 into the rear of the reverse idler gear shaft and withdraw the shaft from the case. Remove the pin from the shaft if fitted.



24. **New Design - Reverse Idler Shaft:** Remove the expansion plug and circlip from the case. Screw the slide hammer MS 284 and E119 into the rear of the reverse idler gear shaft and withdraw the shaft from the case.



25. Remove the reverse idler gear, bearings and the two thrust washers from the case.



26. Remove the mainshaft bearing thrust washer to prevent loss and invert the transmission assembly on the stand.

Note: If a ball bearing is fitted, the thrust washer cannot be removed at this point.



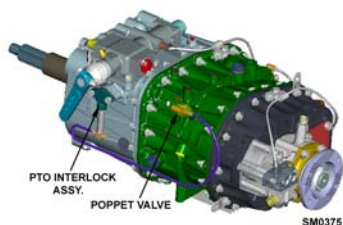
27. Remove the interlock pin, located in the bore between the selector rods, as the transmission in inverted using a magnet if necessary.



28. Remove screws and washers (if fitted). Remove the neutral detent cover, spring, plunger and gas-ket. OR remove screw-in detent assembly (if fitted) from the front case.



29. **On some transmissions**, PTO interlock assembly fitted over the detent cover. Remove the screws, washers (if fitted) and shield. Remove the screws, washers (if fitted) and PTO interlock assembly.



30. Rotate the gear selector shaft as far to the left (vertically mounted) or right (horizontally mounted) so that the front case will not foul the selector block on removal.



31. **On Overdrive model**, remove the screws and washers retaining the two overdrive fork rotating pins. Remove the pins and 'O' rings.



32. Remove clutch housing mounting nuts. Lift out clutch housing.

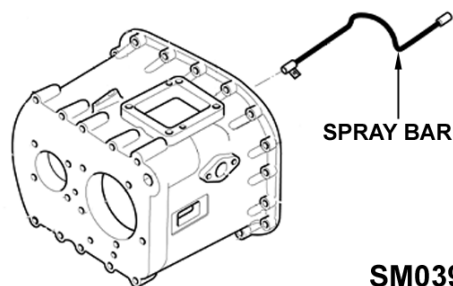


33. Remove capscrews and nuts securing the front case to the intermediate case.

Note: Mark the position of the shorter capscrews threaded into the case.



34. **On horizontal transmissions**, remove the spray bar locating screw from the front face of the front case. Remove this screw before removing the front case.



35. Using a soft faced mallet to break the compound seal, separate the front half case (complete with the input shaft) from the intermediate case, do not use pry bars or chisels to separate the case or the flanges may be damaged.

Note: If difficulty is experienced separating the two casing halves, the input shaft synchroniser flange may have become fixed to the shaft. Should this occur, remove the input shaft cover and bearing outer snap ring, and while lifting the front case half, tap the input shaft with a soft faced mallet to drive the shaft and bearing through the case bore.

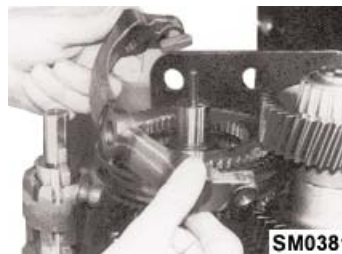
Remove the dowel between front case and intermediate case.



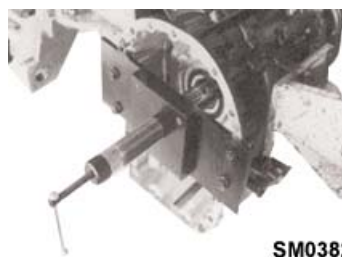
36. Remove the spigot bearing. On horizontal transmissions a restrictor is fitted to the roll pin in the end of the mainshaft.



37. **On the overdrive models**, to prevent loss or damage, disengage and remove the overdrive fork assembly from the 3rd/4th gear synchroniser sleeve and selector. Take care not to lose the selector pads.



38. **On transmissions** fitted with a ball bearing in the rear mainshaft position, use the locally made tool to release the inner race.



39. Assemble the lifting fixture E 116A and adaptor E 116-1 under the 3rd/4th gear synchroniser hub assembly and using the hoist raise the shaft approximately 10 to 20 mm. This allows the layshaft to tilt clear of the mainshaft.



40. Lift out the layshaft.



41. Raise the hoist and lift out the mainshaft and selector assembly. Carefully lower onto a clean bench and remove lifting fixture & adaptor. Separate the selector assembly from the mainshaft.



45. Drive the selector shaft bush from the front case from the outside. Drive the selector shaft bush from the intermediate case by driving the bush forwards. Use driver extension E 109-10 with driver E 109.



42. Drift out the mainshaft rear bearing from the case using a bearing replacer E 108-5 with driver E 108. Do not allow the bearing to fall to the floor.



46. if necessary, replace the range change shaft bush using slide hammer MS 284 and extractor MS 284-1.



43. Drift out the layshaft rear bearing and bearing spacer (if fitted).

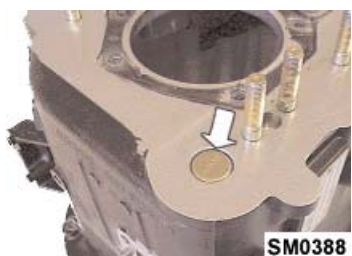


47. Remove the capscrews securing the front bearing cover. Remove the cover.

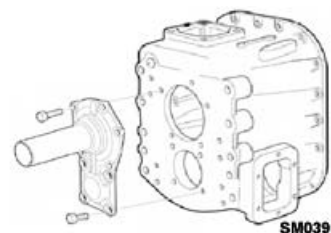


44. If the selector shaft bushes are to be replaced drive the core plug from the front case using driver extension E 109-10 with driver E 109.

Note: Drive the core plug from inside of the front case.



48. **On some transmissions**, integrated type of front bearing cover is fitted. Remove the capscrews and washers (if fitted) securing the front bearing cover. Remove the front bearing cover.



49. **On direct drive models**, remove the input shaft and bearing assembly. Certain specifications have an O-ring seal/plate which must be removed before removing the input shaft cover.



53. Drift out the layshaft front bearing cup using a suitable tool.



50. **On overdrive models**, remove the input shaft bearing outer snap ring.



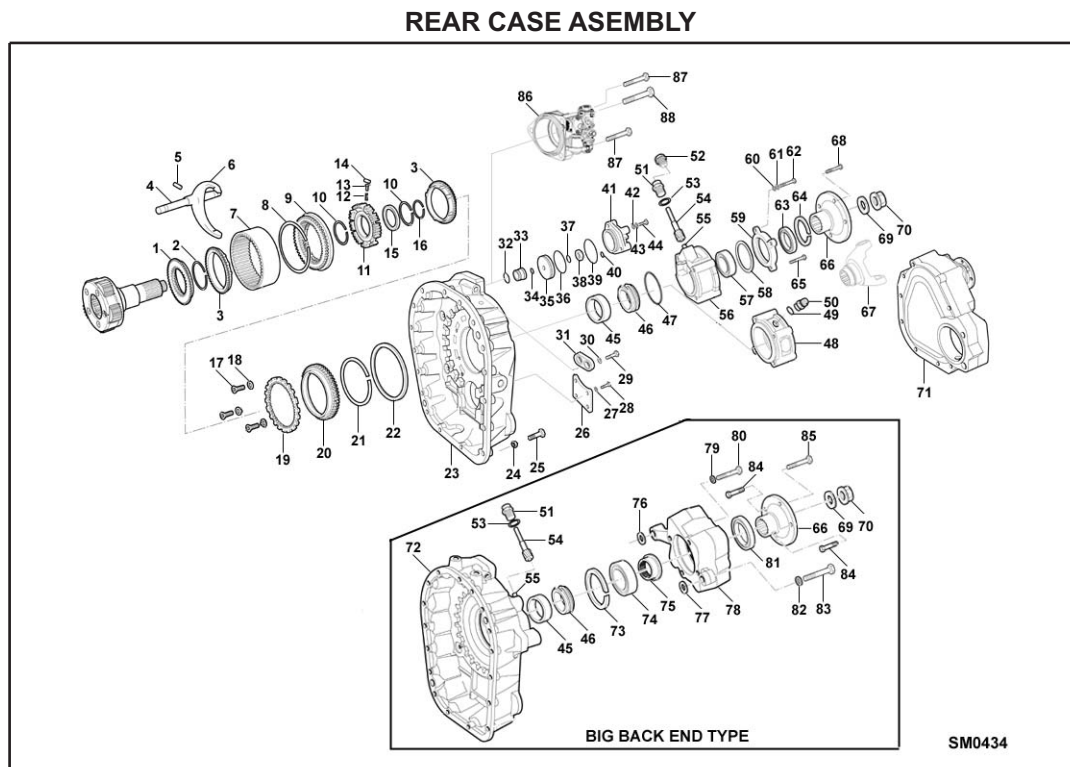
51. Use a soft faced mallet to drive the shaft through the case taking care not to allow the shaft to fall and become damaged.



52. Remove the capscrews and washers (if fitted). Remove the layshaft front bearing cover and graded spacer.



Exploded View



- | | | |
|-------------------------------|---------------------------------|--------------------------------------|
| 1. Synchro Flange | 31. Lifting Eye | 60. Plain Washer (if fitted) |
| 2. Circlip | 32. O-Ring | 61. Spring Washer (if fitted) |
| 3. Synchro Ring | 33. Bush | 62. Screw |
| 4. HI-LO Shift Rod | 34. O-Ring | 63. Oil Seal |
| 5. Grooved Pin | 35. Piston | 64. Circlip (if fitted) |
| 6. Fork | 36. O-Ring | 65. Screw |
| 7. Annulus | 37. O-Ring | 66. Output Drive Flange |
| 8. Circlip | 38. Nut | 67. Yoke (if fitted) |
| 9. Sliding Sleeve | 39. O-Ring | 68. Screw (if fitted) |
| 10. Circlip | 40. O-Ring | 69. Thrust Washer (if fitted) |
| 11. Fixed Hub | 41. Range Change Cylinder | 70. Mainshaft Locknut |
| 12. Spring | 42. Plain Washer (if fitted) | 71. Rear PTO Assy. (if fitted) |
| 13. Plunger | 43. Spring Washer (if fitted) | 72. Rear Case - Big Back End Type |
| 14. Roller | 44. Screw | 73. Circlip |
| 15. Bearing | 45. Spacer | 74. Bearing |
| 16. Circlip | 46. Speedo Drive Gear OR | 75. Abutment Ring |
| 17. Screw | 46. Tachograph Rotor | 76. Shims |
| 18. Retainer | 47. O-Ring (if fitted) | 77. Shims |
| 19. Reaction Plate | 48. Speedo Housing - Mechanical | 78. Mounting Bracket |
| 20. Synchro Flange | 49. Washer | 79. Spring Washer (if fitted) |
| 21. Circlip | 50. Speedo Sensor | 80. Screw |
| 22. Spacer | 51. Adaptor | 81. Oil Seal |
| 23. Rear Case - Standard Type | 52. Plug (if fitted) | 82. Spring Washer (if fitted) |
| 24. Nut | 53. Washer | 83. Screw |
| 25. Screw | 54. Speedo Pinion | 84. Screw (if fitted) |
| 26. Layshaft Rear Cover | 55. Bush | 85. Screw (if fitted) |
| 27. Spring Washer (if fitted) | 56. Speedo Housing - Electronic | 86. Integrated Air Valve (if fitted) |
| 28. Screw | 57. Bearing | 87. Screw (if fitted) |
| 29. Screw | 58. Shim (if fitted) | 88. Screw (if fitted) |
| 30. Spring Washer (if fitted) | 59. Rear Oil Seal Cover | |

How to disassemble Rear Case

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Wooden Block or Spacer

Snap Ring pliers

Refer section 'Tools Information'

Procedure -

1. Support the rear case assembly on a suitable clean block or spacer under the planet carrier assembly.
2. Remove the capscrews and washers (if fitted) securing the range change cylinder cover to the rear case. Remove the cover.

Note: Mark the positions of the capscrews.



3. Remove the nut retaining the range change piston to the shaft. Remove the piston.



4. Remove the output drive flange retaining nut and the drive flange.

Note: Ensure that the flange boss is a close fit in the bearing inner track.



5. Carefully lift the case allowing the output shaft to slide out of the bearing and the range change selector rod to slide out of the bush.



6. Remove the selector fork assembly from the synchroniser sliding sleeve.



7. Lift off the electronic tachograph rotor or speedometer drive gear and spacer (if fitted).



8. Lift off the synchroniser ring.



9. Put identifying marks on the synchroniser sliding sleeve in line with the synchroniser plungers, if not already marked.



10. To separate the annulus from the sliding sleeve, insert a rivet or steel pin, approximately 2-2.3 mm diameter and 10 mm long, into at least three of the holes in the annulus ensuring they are abutting the internal snap ring.



11. Tighten a large (air cleaner) hose clip around the rivets or pins to compress the internal snap ring into the sliding sleeve.



12. Slide the sliding sleeve from the annulus.



Note: Mark the position of the spring plungers and rollers and remove them from the hub.

13. Remove the snap ring securing the synchroniser hub bearing to the output shaft.



14. Invert the assembly and while restraining the hub, drop the end of the shaft onto a stout wood block to shock the hub, bearing assembly and synchroniser ring off the shaft.



15. Remove the snap ring securing the synchroniser flange to the planet carrier.



SM0416

16. Remove the synchroniser flange.



SM0417

17. Remove the socket headed countersunk screws and special washers retaining the rear '**LOW**' synchroniser flange and reaction plate to the rear case.



SM0419

18. Lift out the reaction plate and the rear '**LOW**' synchroniser flange.



SM0420

19. Lift out the spacer plate. On some multi-purpose specification transmissions an additional oil seal may be fitted in the rear case.



SM0421

20. If necessary remove the special snap ring from the synchroniser flange.



SM0422

21. Remove capscrews and washers (if fitted). Remove oil seal cover.

Note: Mark the positions of capscrews.



SM0423

22. Remove the speedo housing.



SM0424

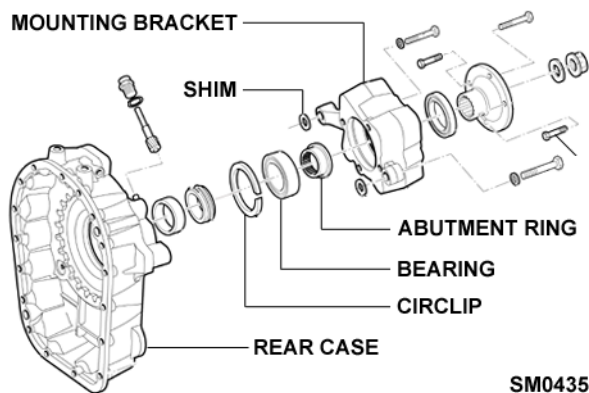
23. If necessary drive the bearing out of the housing using a suitable drift.



26. Separate the range change selector fork from the piston rod by drifting out the grooved pin with a suitable punch.



24. **On Big Back End (BBE) type rear case transmissions**, remove the capscrews and washers (if fitted). Remove mounting bracket and shims. Remove circlip, bearing and abutment ring.



SM0435

27. Remove capscrews and washers (if fitted). Remove the rear PTO cover. Remove the air supply adaptors from the rear case.

Note: Big Back End type rear case does not have PTO rear cover.



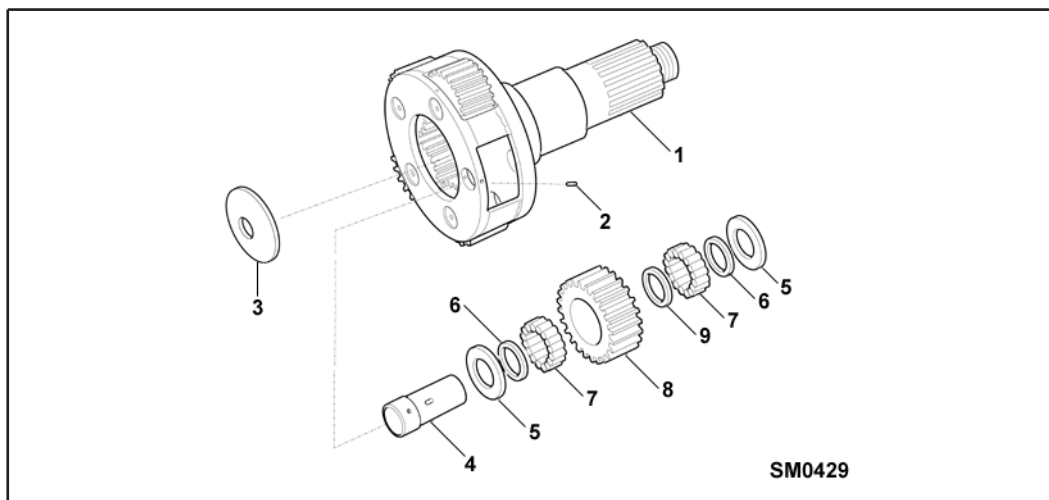
IMPORTANT: The same transmission can have BBE and parking brake simultaneously or only BBE or only parking brake.

25. If necessary remove the bearing retaining snap ring from the range change synchroniser hub and remove the bearing.



Exploded View

PLANET CARRIER ASSEMBLY



1. Output Shaft & Planet Carrier
2. Grub Screw
3. Oil Restrictor (if fitted)
4. Spindle
5. Thrust Washer
6. Thrust Washer
7. Needle Roller
8. Planet Gear
9. Spacer

How to disassemble Planet Carrier Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Soft Mallet

Drift

Refer section 'Tools Information'

Procedure -

1. Remove the bearing spindle retaining grub screws from the planet gear carrier. The screws are peened so that the area around the screw has to be drilled out before the screw is removed.



2. Using a soft faced mallet and suitable drift, drive the bearing spindle out of the carrier in the direction illustrated.

IMPORTANT: The spindle is shouldered and MUST NOT be driven the other way.



3. Slide the gear, bearing rollers, spacers and thrust washers from the carrier. Repeat these operations for the other four gears.



How to assemble Planet Carrier Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Vice

Soft Mallet

Refer section 'Tools Information'

Procedure -

1. Place one thrust washer, grooved face uppermost, and one shim on a flat plate.



SM0433

2. Place the gear onto the thrust washer. Apply a coating of petroleum jelly to the bore of the gear.



SM0436

3. Place half the total quantity of rollers into position.

IMPORTANT: Total 36 nos. roller are available.



SM0437

4. Place the spacer into position.



SM0438

5. Fit the remaining rollers and the shim. Place the thrust washer, grooved side downwards.



SM0439

6. Support the output shaft in a soft jawed vice, planet carrier uppermost and slide the assembled gear into position in the carrier.



SM0440

7. Slide in the gear assembly until the bore of the planet carrier and gear assembly align.



SM0441

8. Ensure the locating hole in the spindle aligns with the hole in the carrier and drive the spindle into the carrier using a soft faced mallet.

Note: There is a lubrication hole directly opposite the locating hole. Do not align the wrong holes.



SM0442

9. Ensure the threads are clean and dry and install a new locating grub screw, using thread locking sealer Loctite 270. Tighten to the correct torque and repeen with a suitable drift. Repeat sub-operations 1-9 for the remaining planet gears.



SM0443

How to assemble Rear Case

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Soft Mallet

Drift

Bush Installer - E 109-5

Driver - E 109

Mainshaft Rear Seal Installer - E 109-12

Refer section 'Tools Information'

Procedure -

1. Drift out the Range change selector rod bush from the rear case.



2. Install a new O-ring into the groove on the outer periphery of the bush carrier. Lubricate sparingly with silicone grease.



3. Install the bush until the O-ring has just entered the case. Wipe off any surplus grease and apply sealer (Loctite 641) around the exposed part of the bush and drive it into the case using bush installer E 109-5 with driver E 109.



4. Install a new O-ring into the range change selector rod bush. Lubricate with silicone grease.



5. Support the range change selector fork and install the selector rod, threaded end to the plain side of the fork.



6. Align the retaining pin holes so that with the threaded end of the selector shaft to the left, the interlock detents are facing you. Install a new grooved pin.



7. Install the snap ring into the range change synchroniser hub and place the bearing into the hub against the snap ring.



8. Install the second snap ring to retain the bearing in the hub.



9. Stand the annulus, plain end down, on a clean bench. Locate the snap ring in the synchroniser sleeve, place the sleeve in the annulus and align the snap ring so that the ends are positioned midway between any two holes in the annulus.



10. Compress the snap ring and push the sleeve into the annulus until the snap ring expands into the annulus locking the two parts together. If necessary use a hose clip to compress the snap ring.



11. Stand the output shaft assembly on a firm support or block approximately 100 mm thick and place the synchroniser flange over the locating splines. Install the retaining snap ring.



12. Place the synchroniser ring over the synchroniser flange. Press the cone firmly down and, using feeler gauges, measure the clearance between the ring and the flange. Renew the flange and ring if the clearance is not within specification. Lubricate the synchroniser ring and flange.

IMPORTANT: Clearance between the ring and the flange should be 0.5 mm - 2.16 mm. Refer section 'Specification'.



13. Place the synchroniser hub and bearing assembly onto the shaft aligning the slots in the hub with the shoulders on the synchroniser ring. Use a soft mallet and drift or mandrel to ensure the bearing is fully home against the stop.



14. Install the retaining snap ring.



15. Install the plungers and springs in the slots. Slide the annulus and sliding sleeve assembly over the planet gears. Align the marks on the sleeve and the middle slot of each group of three in the hub.



16. Support the sleeve in the slightly raised position (approximately 15mm). Install the rollers into the outer slots of each set of grooves on the synchroniser hub.



17. Remove the support lower the sleeve and ensure that the rollers are sitting in the groove of the synchroniser sleeve. Fit the rollers into the central slot of each set of grooves of the synchroniser hub.



18. Place the low synchroniser ring into the synchroniser hub ensuring that the bosses on the synchroniser ring locate in slots of the synchroniser hub. Lubricate the synchroniser ring with transmission oil.



19. Support the rear case on wooden blocks and place the spacer ring into the recess in the rear case.



20. Install the large snap ring into the slot around the outer periphery of the low synchroniser flange.



21. Place the synchroniser flange with snap ring onto the spacer ring.



Note: On some multi-purpose specification transmissions, an additional oil seal should be fitted in the rear case. This should not block off the oil feed hole in the output shaft.

22. Place the reaction plate over the synchroniser flange splines.



23. Apply Loctite 270 on socket headed countersunk screws therads. Install the special washers and socket headed countersunk screws. Tighten the screws to the correct torque 24 - 30 Nm.



24. Place the synchroniser ring over the synchroniser flange. Press the cone firmly down and, using feeler gauges, measure the clearance between the ring and the flange. Renew the flange and ring if the clearance is not within specification. Lubricate the synchroniser ring and flange.

IMPORTANT: Clearance between the ring and the flange should be 0.5 mm - 2.16 mm. Refer section 'Specification'.



25. Locate the selector fork and shaft assembly into the synchroniser sleeve, threaded end of shaft uppermost.



26. Invert the partly assembled case, ensure that the selector shaft bore O-ring is in position and lubricated with silicone grease and locate the case over the output shaft and selector rod.



27. **On transmissions with mechanical speedo**, place the spacer (if fitted) first and speedometer drive over the output shaft.

Note: An equivalent thickness spacer must be used if the speedo drive gear is not fitted.



28. **On transmissions with electronic speedo**, install spacer (if fitted) first and tachograph rotor over the output shaft.

Note: An equivalent thickness spacer must be used if tachograph rotor is not fitted.



29. Install the output shaft bearing in the housing using a soft faced mallet and a suitable tool.



30. Install a new oil seal into the carrier using seal installer E109-12 with driver E 109.



31. Apply sealant to the face of the case. Place the bearing and housing assembly over the shaft and against the case.



32. Apply sealant to the face of the bearing housing and install the rear oil seal cover.



33. Apply sealant to the four capscrews. Install capscrews as per marked positions. Tighten capscrews 35 - 39 Nm.



34. If necessary, change the 'O' rings in the piston. Apply silicon lube 3000 CST to the 'O' rings and fit the piston, flat face uppermost. Fit the nut. Tighten the nut to 95 - 115 Nm with Loctite 242.



35. If necessary, change the range change cylinder cover 'O' ring. Apply silicone lubricant to the 'O' ring and to the bore of the cylinder cover.



36. Apply a coating of Loctite 5900 to the face of the cylinder cover. Fit the cylinder cover. Install capscrews per marked positions and washers (if fitted). Tighten the capscrews to 35 - 39 Nm.



37. Apply a coating of loctite sealant and fit the rear PTO cover. Install capscrews and washers (if fitted). Tighten capscrews to 69 - 78 Nm.



Note: Big Back End type rear case does not have rear pto cover.

38. Apply a smear of grease to the inner periphery of the oil seal. Install the output drive flange. Temporarily place a spacer against the flange and fit the nut. Tighten firmly.

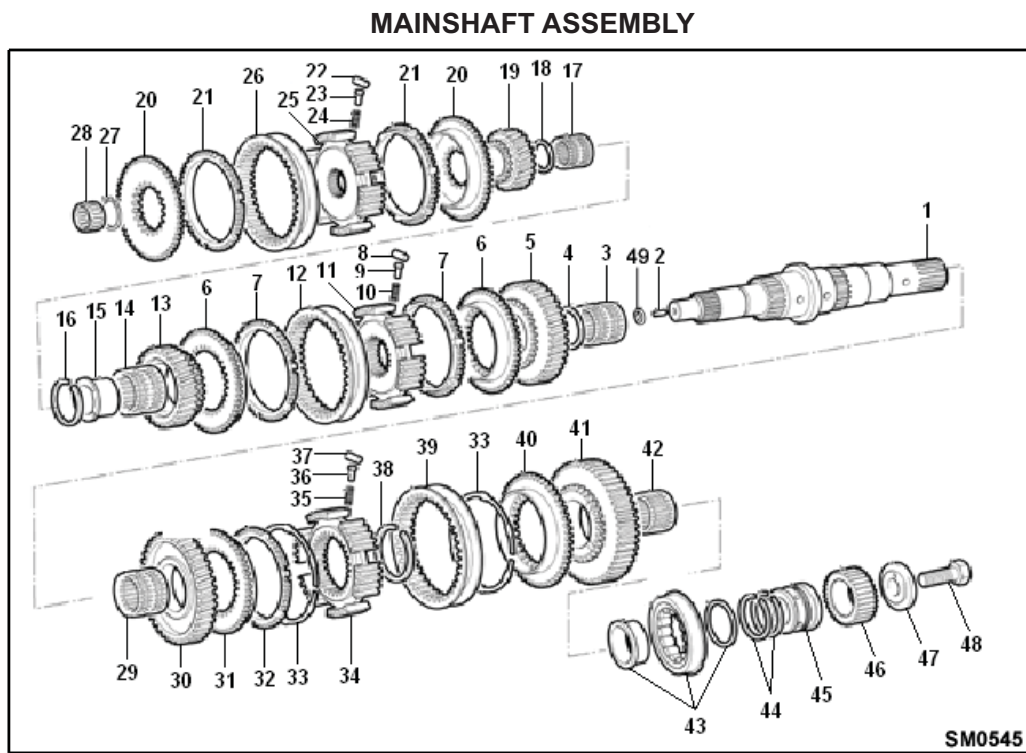
Note: Flange boss fits inside bearing track.



39. Fit the speedo sensor with washer (if fitted). OR speedo pinion and adaptor assembly and rubber washer. Tighten speedometer pinion adaptor to 24 - 30 Nm OR speedo sensor to 24 - 30 Nm.



Exploded View



- | | |
|----------------------------|-------------------------------------|
| 1. Mainshaft | 26. Sliding Sleeve |
| 2. Dowel | 27. Circlip |
| 3. Needle Roller Brg. | 28. Needle Roller Brg. |
| 4. Gear Spacer 1st | 29. Needle Roller Brg. |
| 5. Gear Mainshaft 1st | 30. Gear Mainshaft Crawler |
| 6. Synchro Flange 1/2/3/4 | 31. Synchro Flange Crawler |
| 7. Synchro Ring 1st/2nd | 32. Synchro Ring Cwaler (if fitted) |
| 8. Roller | 33. Circlip (if fitted) |
| 9. Plunger | 34. Fixed Hub Reverse/Crawler |
| 10. Spring | 35. Spring |
| 11. Fixed Hub 1st/2nd | 36. Plunger |
| 12. Sliding Sleeve | 37. Roller |
| 13. Gear Mainshaft 2nd | 38. Circlip |
| 14. Needle Roller Brg. | 39. Sliding Sleeve |
| 15. Sleeve Mainshaft Brg. | 40. Synchro Flange Reverse |
| 16. Circlip | 41. Gear Mainshaft Reverse |
| 17. Needle Roller Brg. | 42. Needle Roller Brg. |
| 18. Gear Spacer 4th | 43. Mainshaft Rear Brg. |
| 19. Gear Mainshaft 3rd | 44. Sealing Ring |
| 20. Synchro Flange 1/2/3/4 | 45. Oil Muff |
| 21. Synchro Ring 3rd/4th | 46. Sun Gear |
| 22. Roller | 47. Retainer |
| 23. Plunger | 48. Screw |
| 24. Spring | 49. Restrictor (if fitted) |
| 25. Fixed Hub 3rd/4th | |

End Float Check

Note: The end float of the gears on the mainshaft is established in manufacture by machining the components to fine tolerances. Before disassembly of the mainshaft the end floats should be checked to ascertain whether they are within the recommended limits.

Where the end float is found to be excessive it is necessary to check the gears, mainshaft, synchroniser hubs and bearing sleeve for wear.

See 'Inspection Precautions' and renew where necessary.



End float may be checked with the mainshaft assembled by using a dial gauge as shown or feeler gauges. Mount the mainshaft assembly on a suitable stand. Locate the dial gauge on the gear and zero the gauge. Raise the gear and record the reading.

Gear End Float

Gear	3rd	2nd	1st	Crawler	Reverse
Low Limit	0.31	0.25	0.35	0.35	0.22
High Limit	0.67	0.45	0.53	0.55	0.50
Tolerance	0.36	0.20	0.18	0.20	0.28

All dimensions are in mm.

How to disassemble Mainshaft Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Vice

Snap ring plier

Press

Mainshaft rear bearing pilot - E 114

Puller kit - Series 1500 with hydraulic ram

Dial gauge

Refer section 'Tools Information'

Procedure -

1. Support the mainshaft. Remove the hollow dowel pin from the mainshaft if necessary and remove the synchroniser ring and flange. Slide the 3rd/4th gear synchroniser sleeve upward until the three rollers are clear of the groove in the sleeve. Remove the rollers, the sleeve the plungers and the springs from the synchroniser hub.



Note: On some transmissions a restrictor is fitted to the dowel pin.

2. Remove the 3rd/4th gear synchroniser hub retaining circlip.



3. Assemble the puller plates over the 3rd/4th gear synchroniser hub and the 3rd gear synchroniser ring and press off the hub and ring, taking care not to damage the synchroniser ring teeth.



4. Lift off the third gear, needle roller bearing and spacer ring. Mark the position of the spacer ring for reassembly.



5. Invert the mainshaft assembly in the press and using puller plates, under the reverse gear, remove the reverse gear and integrated bearing or thrust washer.



IMPORTANT: Some transmissions may be fitted with a bearing track and separate thrust washer.

6. Remove the reverse gear needle roller bearing. Lift off the reverse gear flange from the synchroniser hub.

IMPORTANT: There is no synchroniser ring for the reverse gear.



7. Remove the large internal snap ring from inside the reverse/crawler synchroniser hub.



8. Slide the reverse/crawler gear synchroniser sleeve carefully rearwards until the three rollers are clear of the groove in the sleeve. Remove the rollers, the sleeve, the three plungers and springs from the synchroniser hub.



9. Remove the reverse/crawler synchroniser hub retaining snap ring.



10. Assemble puller plates under the crawler gear and support on the press.



Note: It is imperative that crawler gear is supported and that the remainder of the gears and shaft do not foul the press bed or supporting blocks when the shaft is being pressed through. Press the shaft through crawler gear and the crawler/reverse synchroniser hub.

On specifications with non-synchromesh crawler, there is a second snap ring on the other side of the hub. This snap ring should be left in place.

11. Remove the crawler gear needle roller bearing. Separate the crawler gear synchroniser hub, flange, ring and gear.



12. Invert the shaft and remove the 2nd gear bearing sleeve retaining snap ring.



13. Support the shaft on the press under 1st gear.

Note: It is imperative that 1st gear is supported and that the flange on the shaft does not foul the supporting blocks or press bed when the shaft is being pressed through. Do not allow the shaft to drop through and become damaged or scored.



14. Place the 1st/2nd gear assembly on a bench - 2nd speed gear uppermost. Remove the bearing sleeve and needle roller bearing.



15. Remove 2nd speed gear, synchroniser flange and synchroniser ring.



16. Remove the synchroniser sleeve, rollers, plungers and springs.



17. Remove the synchroniser hub. Remove the synchroniser flange and ring from the 1st speed gear.



18. Remove the 1st gear needle roller bearing and bearing spacer ring.



Check clearance between synchroniser ring and flange

Before assembling the synchroniser assemblies onto the mainshaft, check the fit of each synchroniser ring to the relevant synchroniser flange.



Place the synchroniser ring to the relevant flange and while holding the two parts firmly together, measure the clearance between the two component parts using feeler gauges at several points around the circumference as shown. The clearance should be between 0.5 and 3.01 mm. Renew both parts if the measurement is not within the specified limits. Retain the synchroniser rings and flanges in their respective pairs for assembly in the same relative position.

Note: The reverse gear is fitted with a flange which engages with the sliding sleeve and which is similar in appearance to a synchroniser flange. The conical face however is not machine finished and no synchroniser ring is fitted to the assembly for reverse gear.

How to assemble Mainshaft Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Vice
Snap ring plier
Press
Bearing heater
Hot plate or Temperature controlled oven
Dial gauge
Feeler Gauge

Refer section 'Tools Information'

IMPORTANT: The following parts must be heated to the 85°C prior to assembly using bearing heater. OR place the parts on a hot plate or in temperature controlled oven for not less than 30 minute to make sure that parts are thoroughly heated placing them in position. Once fitted and cooled the parts will shrink to an interference fit.

- 1st/2nd and 3rd/4th fixed hubs
- Reverse/Crawler fixed hub
- 2nd gear bearing sleeve
- Mainshaft rear bearing inner track

Procedure -

1. Support the mainshaft rear end uppermost. Fit the crawler gear bearing.



2. Lubricate the bearing with clean gear oil and fit the crawler gear over the bearing.



3. Fit the crawler gear synchroniser flange to the gear. If a synchroniser ring is fitted this must be lubricated with transmission oil prior to fitment.



4. **Synchronised Crawler** : Take the heated reverse/crawler synchroniser hub, with the internal snap ring groove uppermost, and place it over the splines of the mainshaft. Ensuring that the shoulders on the synchroniser ring align with the slots on the synchroniser hub press it fully home.

Non Synchronised Crawler : Fit the snap ring to one of the internal grooves of the synchroniser hub. Take the heated synchroniser hub, second snap ring groove uppermost, and fit it to the splines on the mainshaft. Press the synchroniser hub fully home.



5. From the range of graded snap rings select the thickest one which fits into the groove with the minimum free play.



Note: Refer Illustrated Part List for part number and thickness of snap ring.

6. Install the snap ring in the groove taking care not to damage the mainshaft bearing surfaces.



7. Check that the gear end float is within the tolerances. Refer section '**Specification**' for gear end float value.



8. Assemble the three springs and plungers into the synchroniser hub. Place the synchroniser sleeve over the hub, pointed teeth downwards, and support it with the internal annular groove just above the hub. Position the three rollers as shown, resting on the heads of the plungers, and press downward on the sleeve.



9. Install the special snap ring into the synchroniser hub ensuring the tongues are properly located in the slots in the hub.



10. Install the reverse gear flange into the synchroniser hub.



IMPORTANT: No synchroniser ring is fitted to reverse gear.

11. Lubricate reverse gear bearing and install the bearing and reverse gear onto the shaft and into the reverse gear flange.



12. Take the heated mainshaft bearing and fit it, flange face downwards, on to the mainshaft.

Note: Some transmissions are fitted with a thrust washer which is not integral to the bearing. In this instance the thrust washer, chamfered side uppermost, should be fitted against the gear. Take the heated mainshaft rear bearing inner track and fit it over the shaft, flange against the thrust washer. Use a soft drift or flanged driver to ensure bearing is fully home against the washer.

When cooled, the bearing track should be sufficiently tight on the shaft to retain the reverse gear on the shaft.

Note: Tool E 114 may be fitted at this stage as a precaution only to retain the bearing on the shaft. It must not be used to retain a loose bearing on the shaft. If the bearing is loose, the cause must be investigated and a new bearing and/or shaft fitted.



13. Invert the shaft in the vice, lubricate and install the 1st gear bearing and 1st gear.



14. Install the bearing spacer ring into the gear and against the bearing.



15. Install the 1st gear synchroniser flange to the gear. Lubricate and fit the synchroniser ring.



16. Support the mainshaft on the press. Place the heated 1st/2nd synchroniser hub over the splines on the shaft. Align the slots with the shoulders on the synchroniser ring and press the hub fully home. Check that the gear end float is within the tolerances stated in section '**Specification**'.



17. Assemble the three springs and plungers into the synchroniser hub. Place the 1st/2nd synchroniser sleeve over the hub, pointed teeth downwards, and support it with the internal annular groove just above the hub. Position the three rollers as shown, resting on the heads of the plungers, and press downward on the sleeve.



18. Lubricate the synchroniser ring with transmission oil. Place the 2nd gear synchroniser ring, ensuring that the shoulders of the synchroniser ring engage the slots of the synchroniser hub, onto the assembly. Place the synchroniser flange onto the assembly.



19. Lubricate the 2nd gear and bearing and position the gear into the synchroniser ring and the bearing into the gear.

Note: A smear of petroleum jelly applied to the outer edge of the bearing will support the bearing to stand proud of the gear and ease the alignment of the bearing sleeve in the next operation.



20. Take the heated 2nd gear bearing sleeve and locate it inside the bearing and over the shaft. Use the press to ensure the sleeve is firmly home against the synchroniser hub.

Note: Rotate 2nd gear left-right for easy insertion of bearing sleeve.



21. From the range of graded snap rings select thickest one which fits into the groove with the minimum free play.



Note: Refer Illustrated Parts List for snap ring thickness and part numbers.

22. Fit the snap ring into the groove taking care not to damage the mainshaft bearing surface.



23. Check that the gear end float is within the tolerances stated in section 'Specification'.



24. Lubricate the 3rd gear bearing and install the bearing and 3rd gear onto the shaft.



25. Place the 3rd gear bearing spacer ring into the gear against the bearing.



26. Lubricate the synchroniser ring with transmission oil. Fit the 3rd gear synchroniser flange and synchroniser ring.



27. Take the heated 3rd/4th synchroniser hub and place it, boss side downwards on the shaft. Ensure that the slots in the hub align with the shoulders on the synchroniser ring. Press the hub fully home and hold under pressure for 3 to 5 minutes.



28. From the range of graded circlips select the thickest one which fits into the groove with the minimum free play.



Note: Refer Illustrated Parts List for circlip thickness and part numbers.

29. Fit the circlip into the mainshaft.



30. Check the gear end float using feeler gauges.



31. Assemble the three springs and plungers into the synchroniser hub. Place the 3rd/4th synchroniser sleeve over the hub, pointed teeth downwards, and support it with the internal annular groove just above the hub. Position the three rollers as shown, resting on the heads of the plungers, and press downward on the sleeve.

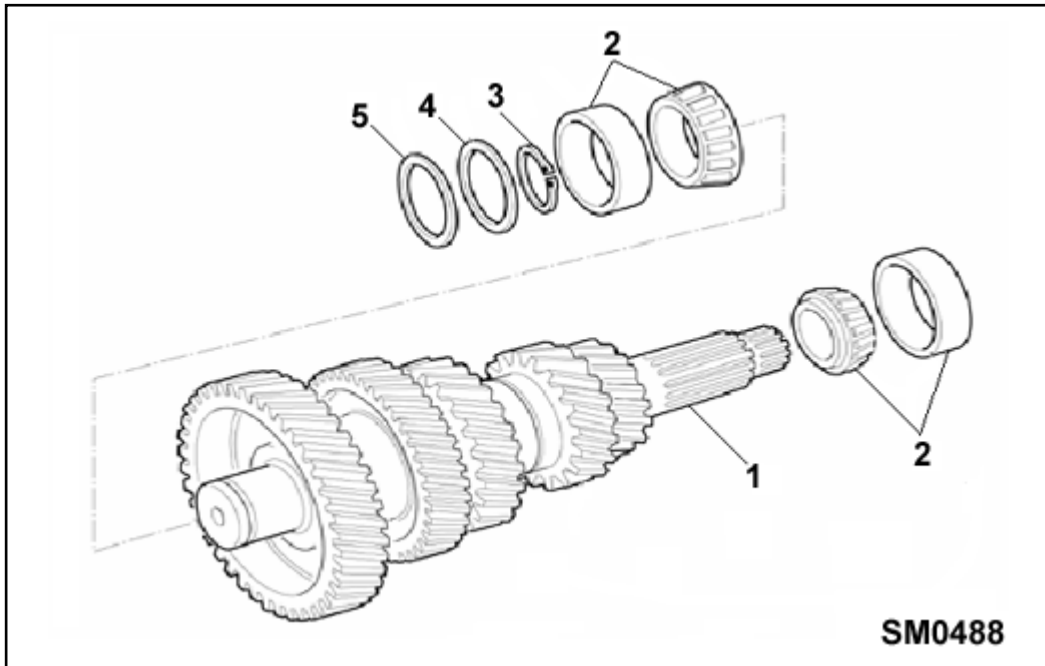


32. If removed fit a new roll pin and, if applicable, restrictor.



Exploded View

LAYSHAFT ASSEMBLY



- | | |
|-------------|-----------|
| 1. Layshaft | 4. Shim |
| 2. Bearing | 5. Spacer |
| 3. Circlip | |

How to disassemble Layshaft

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Snap ring pliers

Bearing remover - LC 105A

Halves - E 105-4

Procedure -

1. Support the shaft assembly and remove the graded circlip retaining the front taper roller bearing.



2. Remove the front bearing cone and roller assembly. Use bearing remover LC 105A and halves E 105-4.



3. Support the shaft and remove the rear bearing cone and taper roller bearing assembly using the same bearing remover and halves.



How to assemble Layshaft

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Bearing heater
Snap ring pliers
Bearing installer - E 109-11

Procedure -

1. Heat the layshaft taper roller bearing inner races to 85° C. Support the shaft assembly forward end uppermost and place the heated inner cone and roller assembly onto the shaft. Use a bearing installer E 109-11 to make sure bearing is fully home.



2. From the range of the graded fit circlips, select the circlip which fits into the groove with the minimum free play.



Note: Refer Illustrated Part List for circlip size and part numbers.

3. Fit the circlip.

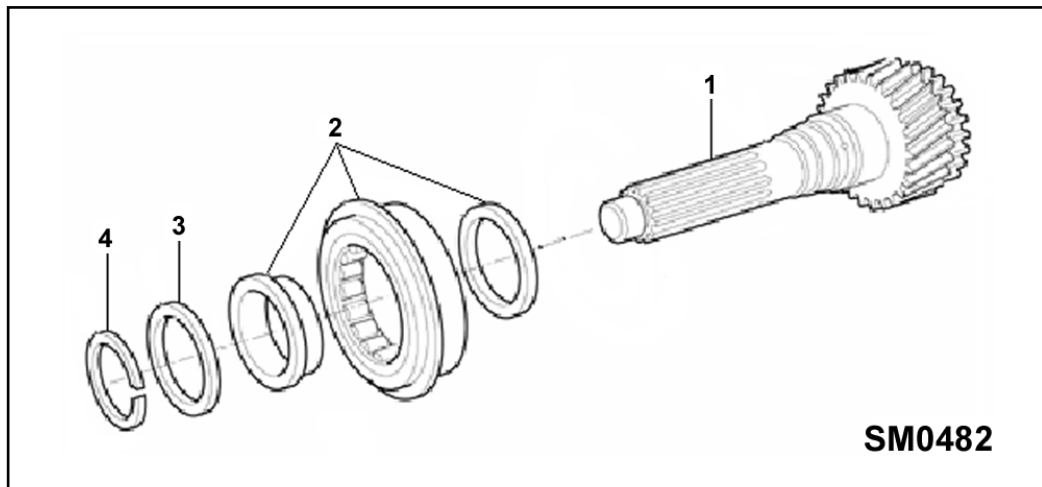


4. Invert the layshaft assembly and fit the heated rear taper roller bearing inner race onto the shaft. Make sure the bearing is fully home using a bearing installer E 109-11.



Exploded View

INPUT SHAFT ASSEMBLY



- 1. Input Shaft
- 2. Bearing
- 3. Spacer
- 4. Circlip

How to disassemble Input Shaft Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Snap ring pliers
Puller
Press

Procedure -

In some cases in service it may be necessary to renew the input shaft either due to wear on the splines caused by the clutch or for implementing a change in clutch type or hub diameter.

On direct drive transmissions, the input shaft can be renewed without disassembling the transmission other than the removal of the clutch housing.

On overdrive transmissions, require the remote control and the front case assembly to be removed for access.

1. Remove the clutch housing assembly. Remove the front bearing cover. Grasp the input shaft firmly and using a soft mallet, joggle the shaft, gear and bearing out of the case.

IMPORTANT: Certain specifications have an O-ring seal/plate which must be removed before removing the input shaft front cover.



2. Support the input shaft and remove the snap ring. Remove the selective fit spacer.



IMPORTANT: Size of input shaft gear for Over-drive and Direct drive transmissions are different.

3. Support the bearing on a press or using a suitable puller, press the shaft through the bearing track. Remove the bearing thrust ring.



IMPORTANT: On horizontal transmissions, a spacer is fitted behind the bearing.

How to assemble Input Shaft

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Bearing heater
Press
Soft mallet
Snap ring pliers
Input shaft seal installer E 109-7
Driver E 109

Procedure -

Note: Heat the bearing assembly thoroughly to approximately 85°C before assembly. This greatly eases assembly and in most cases the bearing track will fit over the shaft without the need to drift it in place.

1. Fit the bearing thrust washer, grooved side uppermost.

IMPORTANT: On horizontal transmissions refit the spacer before fitting the bearing thrust washer.



2. Support the heated bearing assembly, inner track downwards, on a suitable tube. Install the input shaft through the bearing.



3. Use the press, or a soft faced mallet to ensure the bearing is firmly against the gear.



4. Place the original spacer against the bearing and check that the snap ring fits into its groove without free play. Check at several places around the diameter of the shaft. If there is too much free play, or the snap ring does not fit into the groove, a new thicker or thinner spacer respectively is required in place of the original.



Note: Refer Illustrated Parts List for spacer sizes and part numbers.

5. When the correct thickness spacer has been selected and fitted, fit the snap ring.



6. Install the input shaft and bearing assembly into the front case.

On direct drive transmissions, tap the shaft and bearing into the case, from the front, until the bearing snap ring abuts the case.

On overdrive transmissions, remove the bearing outer snap ring and install the shaft and bearing from the inside of the case outwards. Refit the snap ring. Tap the bearing back until the snap ring abuts the case.



7. Stand the transmission upright. Check the mainshaft spigot bearing and replace if necessary. Check that the roll pin is secure in the mainshaft and that the restrictor (if fitted) is in place.

Note: The restrictor is fitted approximately 5 mm from the end of the roll pin.



8. Install the input shaft and bearing assembly making sure that the locating teeth on the input gear engage correctly with the teeth of the synchroniser ring.



9. Renew the input shaft oil seal. Install the new oil seal into the input shaft bearing front cover using input shaft seal installer E 109-7 with driver E 109. Apply a light grease to the seal. Press the seal firmly down to the shoulder ensuring the seal is not damaged.



10. Apply flange sealant to the mating face and install the front cover. Tighten the capscrews to 35 - 39 Nm. Refit the clutch housing assembly.



Exploded View

SELECTOR ASSEMBLY - DIRECT DRIVE	SELECTOR ASSEMBLY - OVERDRIVE
	<p style="text-align: right;">SM0616</p>
<ol style="list-style-type: none"> 1. Selector Key 2. Selector Shaft 3. Interlock Key 4. Fork Reverse / Crawler 5. Fork 1st / 2nd 6. Screw 7. Selector Block 8. Dowel 9. Fork 3rd / 4th 	<ol style="list-style-type: none"> 1. Selector Key 2. Selector Shaft 3. Interlock Key 4. Fork Reverse / Crawler 5. Fork 1st / 2nd 6. Screw 7. Dowel 8. Selector Block 9. Fork Overdrive 10. Selector Overdrive 11. Overdrive Shift Pad

Selector Assembly - Single H

How to disassemble Selector Assembly

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Procedure -

Note: Tapered screw fitted on opposite side on horizontal transmission.

1. Place selector assembly on bench with the selector block to the left. Mark the front of the shaft and key to aid reassembly.



SM0607

2. Hold the assembly by the selector block and withdraw the interlock key from the rear.



SM0608

3. Remove the selector forks from the shaft.



SM0609

4. Remove the screw from the selector block. Slide the selector block and selector key off the selector shaft.



SM0610

How to assemble Selector Assembly

Procedure -

1. Place selector key into slot on the selector shaft with the three small lugs to the front.



2. Put the selector block onto the shaft. Install screw and tighten it to 35 - 39 Nm.

IMPORTANT: If reusing the screw, apply Loctite 270 to the threads before fitting.



3. Place the forks in their respective positions on the selector shaft.



4. Rotate the forks until the slots line up with the groove on the selector shaft for the interlock key. Fit the interlock key from the rear.



5. **On overdrive transmissions**, the 3rd/4th fork is replaced by a selector overdrive. Check the fit of selector before assembling the transmission.



Selector Assembly - Double H

How to disassemble Selector Assembly

Procedure -

1. Remove the tapered capscrew from the selector block.



2. Hold the selector block and 1st/2nd fork; withdraw the selector shaft towards the right.



How to assemble Selector Assembly

Procedure -

1. Hold the selector key, front end to the left. Place 1st/2nd selector fork, in the third slot from left.



2. Place the selector block, pin uppermost and threaded hole facing (vertically mounted unit), into the second slot in the key.

IMPORTANT: Horizontal Units: Place the selector block, with the groove uppermost and the thread hole facing, into the second slot in the key.



3. Place the 3rd/4th selector fork, crank to the left, into the first slot in the key. On overdrive transmissions, place the overdrive selector, ball pin end to the left, into the first slot in the selector key.



4. Place the crawler/reverse selector fork, crank to the right into the last slot in the key.



SM0623

5. Support the key and forks and pass the interlock key, forward end to the left, into position through the forks.



SM0622

6. Still holding the key and forks insert the shaft, smaller segment between the slots facing you, first over the interlock key, then under the selector key and through the forks.



SM0618

7. Pass the shaft through the forks, and align the hole in the selector block with the hole in the shaft. Fit a new tapered cap screw and tighten to 35 -39 Nm.

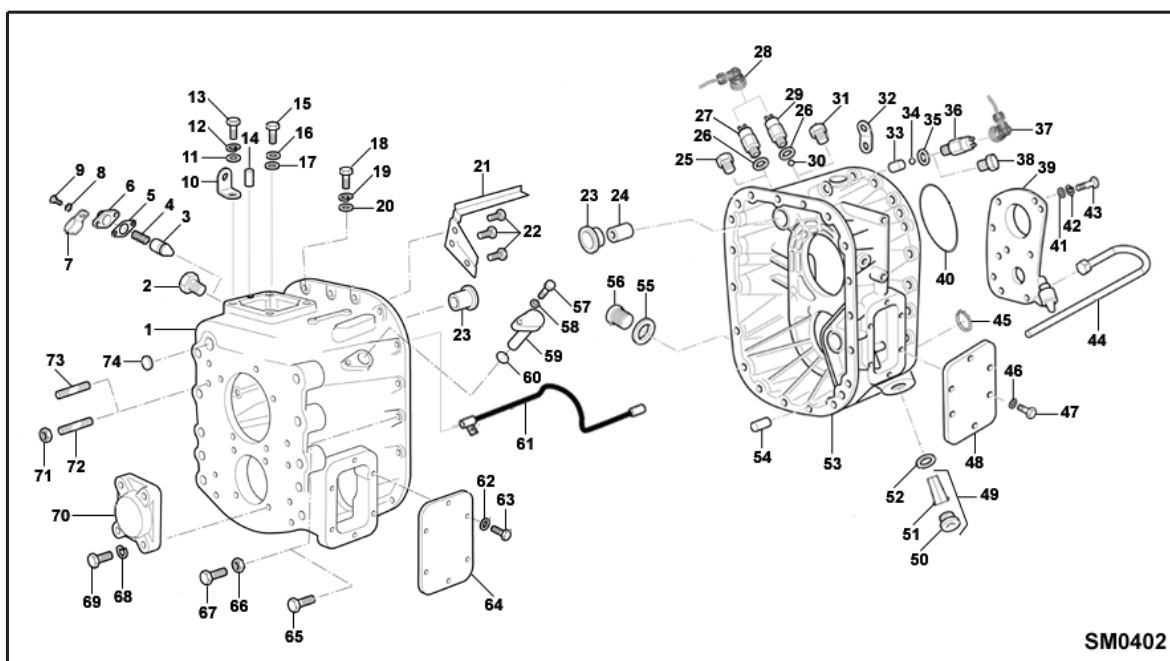
IMPORTANT: If a new screw is not available apply Loctite 270 to the screw threads before fitting.



SM0617

Exploded View

TRANSMISSION CASE



SM0402

- | | | |
|-------------------------------------|---|---|
| 1. Front Case | 26. O-Ring (if fitted) | 51. Strainer |
| 2. Detent Assy. | 27. Reverse Switch | 52. Washer |
| 3. Plunger | 28. Plug - Flying Lead (If fitted) | 53. Intermediate Case |
| 4. Spring | 29. Neutral Switch | 54. Dowel |
| 5. Gasket | 30. Detent Ball (if fitted) | 55. Washer |
| 6. Detent Cover | 31. Plug (if fitted) | 56. Oil Filler Plug |
| 7. Hose Clamp (if fitted) | 32. Lifting Eye | 57. Screw (if fitted) |
| 8. Spring Washer (if fitted) | 33. Interlock Pin | 58. Spring Washer (if fitted) |
| 9. Screw | 34. Detent Ball (if fitted) | 59. Pivot Pin (if fitted) |
| 10. Lifting Eye | 35. O-Ring (if fitted) | 60. O-Ring |
| 11. Plain Washer (if fitted) | 36. Range Indicator Switch | 61. Oil Spray Bar (if fitted) |
| 12. Spring Washer (if fitted) | 37. Plug - Flying Lead (If fitted) | 62. Spring Washer (if fitted) |
| 13. Screw | 38. Plug (if fitted) | 63. Screw |
| 14. Dowel | 39. Oil Pump | 64. PTO Cover |
| 15. Screw | 40. O-Ring | 65. Screw |
| 16. Spring Washer (if fitted) | 41. Plain Washer (if fitted) | 66. Nut |
| 17. Plain Washer (if fitted) | 42. Spring Washer (if fitted) | 67. Screw |
| 18. Screw | 43. Screw | 68. Spring Washer |
| 19. Spring Washer (if fitted) | 44. Oil Strainer & Suction Tube (if fitted) | 69. Screw |
| 20. Plain Washer (if fitted) | 45. Circlip | 70. Layshaft Front Brg. Cover (if fitted) |
| 21. Oil Through | 46. Spring Washer (If fitted) | 71. Nut (if fitted) |
| 22. Pop Rivet | 47. Screw | 72. Stud (if fitted) |
| 23. Bush (for main selector shaft) | 48. PTO Cover | 73. Stud (if fitted) |
| 24. Bush (for range selector shaft) | 49. Oil Strainer Assy. | 74. Cup Plug |
| 25. Plug (if fitted) | 50. Plug | |

How to assemble Transmission Case

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Transmission Overhauling Stand
 Hoist
 Soft Face Mallet
 Snap Ring Pliers
 Layshaft Bearing Cup installer E 109-6
 Driver - E 109
 Replacer Adaptor Mainshaft Bearing E 108-5
 Driver - E 108
 Mainshaft Rear Bearing Pilot E 114
 Input Shaft Seal Installer E 109-7
 Sun Gear Retainer E 118A
 Reverse idler shaft retaining pin installer - E 117
 Slide Hammer - MS 284
 Remover Adaptor Reverse Idler Shaft - E 119
 Lifting Fixture - E 116A
 Lifting Adaptor - E 116-1
 Driver Extension - E 109-10
 Lifting Sling
 Feeler Gauge
Refer section 'Tools Information'

Procedure -

Note: Before reassembling the transmission case ensure that each section case and covers are clean and that all gaskets and jointing/sealing materials are cleaned from the mating faces. When reusing patch lock bolts or fitting capscrews to through holes apply the recommended threadlock or sealant to the threads.

1. Support the intermediate case on the stand, rear face uppermost. Install the layshaft rear bearing cup into the case, using the special tool E 109-6 and E 109. Drive in until almost flush with the rear face of the bearing bore.



2. Install the mainshaft rear bearing outer track and roller assembly snap ring groove outermost into the case, using special tool E 108-5 and with E 108. Invert the case on the stand.



3. Install layshaft in to the case and tilt it.



4. Fit mainshaft rear bearing pilot E 114 over the rear end of the mainshaft. Retain in place with a large washer and the sun gear retaining bolt or suitable equivalent.



5. Locate the selector shaft assembly to the mainshaft. Using lifting fixture E 116A, adaptor E 116-1 and a hoist, lower the assembly into the case making sure the selector shaft enters the rear bush. Support the mainshaft and selectors approximately 20 mm above the normal installed position.



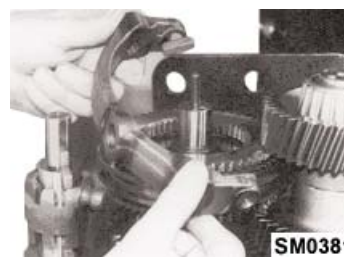
6. On overdrive transmissions locate the selector shaft assembly to the mainshaft without the 3rd/4th overdrive selector fork. This can be assembled later and avoids the risk of the fork pads dropping into the transmission.



7. Lower the hoist and allow the mainshaft, layshaft and selector shaft to rest in their respective bearings and bushes. Ensure the selector block is positioned so that it will not foul the front case and remove the lifting fixture and adaptor.



8. On overdrive transmissions, install the fork pads into the 3rd/4th overdrive selector fork. Engage the fork and pads into the synchroniser sleeve, shorter offset to the right-hand side of the transmission as illustrated.



9. Manoeuvre the 3rd/4th overdrive fork into the selector ball end and rotate the selector until the centre line of the fork pivot pin holes is at approximately 90° to the centre line through the overdrive selector.



10. Lubricate and install the spigot bearing on the mainshaft.



11. Install the input shaft and bearing assembly into the front case.

On direct drive transmissions, tap the shaft and bearing into the case, from the front, until the bearing snap ring abuts the case.

On overdrive transmissions, remove the bearing outer snap ring and install the shaft and bearing from the inside of the case outwards. Refit the snap ring. Tap the bearing back until the snap ring abuts the case.



12. Install the layshaft front bearing cup into the front case, using special tool E 109-6 and E 109.



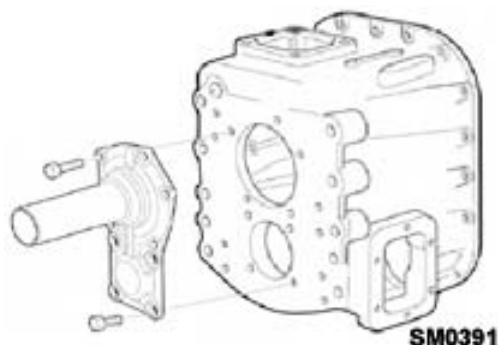
13. If necessary, install a new oil seal into the input shaft bearing front cover using the special tool E 109-7 and E 109. Press the seal firmly down to the shoulder ensuring the seal is not damaged.



14. Lubricate the shaft seal surface and apply flange sealant to the mating face of the front cover. Install the front cover, capscrews and washers (if fitted). Tighten the capscrews to the 35 - 39 Nm.



On some transmissions, integrated type of front bearing cover is fitted. Install the front bearing cover. Install the capscrews and washers (if fitted) securing the front bearing cover. Tighten capscrew to 35 - 39 Nm.



15. Apply sealer to the case mating flange ensuring that there is a continuous bead around the flange and the retaining capscrew holes.



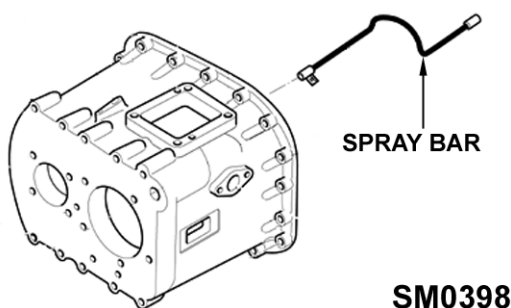
SM0558

16. Locate the front case onto the intermediate case making sure the selector shaft enters the front bush and that the locating teeth on the input gear engage with the teeth on the synchroniser flange. Rotate the input shaft slightly to ensure engagement.



SM0559

17. **On horizontal transmissions**, install the spray bar, use lubrication hole on front case for correct positioning of spray bar. Tighten screw to correct torque value.



SM0398

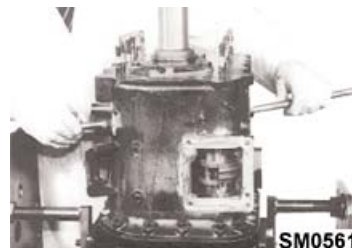
18. Install the capscrews, washers and nuts. Tighten to the 45 - 55 Nm.

IMPORTANT: Install shorter capscrews to appropriate positions.



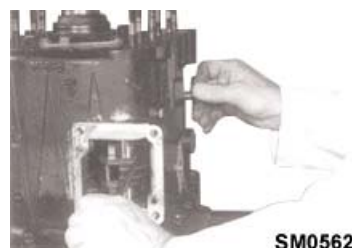
SM0560

19. On overdrive transmissions, using a suitable probe as illustrated, align the overdrive selector fork pivots with the holes in the case. If necessary replace the pivot pin 'O' rings. Apply a coating of Loctite 5900 to the inside face of the pin flanges and install the pins and 'O' rings.



SM0561

20. When aligning the right hand pin, use a screwdriver and lift the selector and fork through the remote control aperture. Install capscrews and washers. Tighten the capscrews to 19 - 24 Nm.



SM0562

21. Invert the case and remove the mainshaft rear bearing pilot E 114.

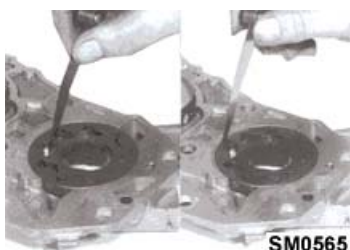


SM0563

22. Install the mainshaft bearing thrust washer, oil groove towards the bearing. If a ball bearing is fitted, heat the inner race and lightly tap into position.

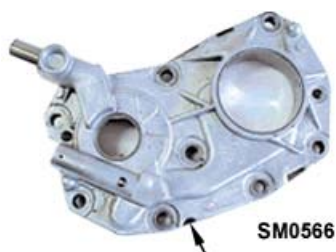


23. Remove the two screws and separate the pump halves. Check that the clearances between the rotors are within the recommended limits. Renew the pump if clearances exceed 0.50 mm.



24. Ensure that the mating faces of the pump halves are clean and install the pump. DO NOT use sealant. Tighten the screws to 35 - 39 Nm.

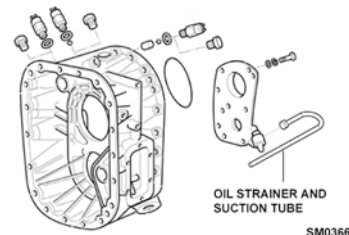
IMPORTANT: Pumps fitted to transmissions NOT fitted with an oil cooler facility are identified by a notch (arrowed) in the edge of the cover.



25. Fit the oil pump ensuring that the flats on the oil pump rotor engage the flats on the countershaft.



26. On some multi-purpose specification transmissions, install the oil strainer and suction tube into the oil pump.



27. Using new washer, refit oil drain plug or oil strainer assembly.



28. If removed, install the sealing rings on the oil muff collar. Check the clearance between the rings and collar as illustrated. Renew the rings if the clearance is less than the recommended tolerance 0.178 mm, or the rings are excessively worn or scored.



29. Lubricate the oil muff and locate it onto the rear of the mainshaft. Carefully compress the sealing rings and push the oil muff into the pump.



30. Install the sun gear onto the mainshaft.



31. Install the special retaining washer against the sun gear and fit a new patchlock retaining capscrew.



32. Using sun gear retainer E 118A to restrain the sun gear. Tighten the capscrew to 225 - 255 Nm. Invert the transmission.



IMPORTANT: Sun gear retainers are different for Big Back End and Standard type sun gear.

Layshaft Front Bearing Preload Setting

For New Bearing

Preload for bearings ~ 0.075 mm to 0.125 mm

Note: The spacer and shim/s combination must be stand proud of the front face of the case. Measure the thickness of the combination.

One standrad spacer is available.

Spacer 8875879 2.05 - 2.10 mm

The following shims are available.

Part No.	Thickness (mm)
F88891	0.051
F88892	0.127
F88893	0.254
F88894	0.508
X8882272	1.2

Measure distance from front housing to bearing outer race. Next calculate the shim using below example.



Example

Measured distance	2.745 mm
Subtract the measured thickness of existing spacer and shim/s combination	2.608 mm = 0.137 mm
Add preload setting	0.125 = 0.262 mm
Additional shim size required	= 0.262 mm (Use 0.254 mm)

IMPORTANT: Check the thickness of the combination of the spacer and all the shims to see that it measures 2.862 mm.



For Used Bearing

Preload for bearings ~ 0.00 mm to 0.05 mm

Note: The existing spacer and shim/s combination must be stand proud of the front face of the case. Measure the thickness of the combination.

One standrad spacer is available.

Spacer 8875879 2.05 - 2.10 mm

The following shims are available.

Part No.	Thickness (mm)
F88891	0.051
F88892	0.127
F88893	0.254
F88894	0.508
X8882272	1.2

Measure distance from front housing to bearing outer race. Next calculate the shim using below example.



Example

Measured distance	2.820 mm
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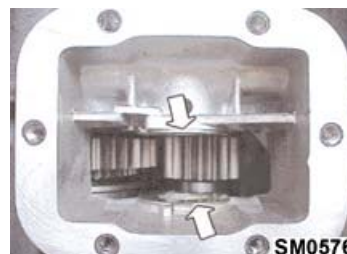
Example

Subtract the measured thickness of existing spacer and shim/s combination	2.608 mm = 0.212 mm
Add preload setting	0.05 = 0.262 mm
Additional shim size required	= 0.267 mm (Use 0.254 mm)

IMPORTANT: Check the thickness of the combination of the spacer and all the shims to see that it measures 2.862 mm.



- Invert the transmission again, rear end uppermost. Apply petroleum jelly to the reverse idler gear thrust washers and locate them into position in the transmission case.



- Install the bearings and spacer into the reverse idler gear. Locate the assembled gear between the thrust washers and into mesh with the layshaft and the mainshaft reverse gear.



Reverse Idler - Old Design

35. Ensure that the components are not dislodged as the idler shaft is fitted. Cross drilled reverse idler shafts should be drifted in until the cross drilled hole aligns with the drilling in the intermediate case and then, having aligned the holes, a new pin should be driven in until flush with the intermediate case, using special tool E 117.



IMPORTANT: Ensuring that the thrust washers and reverse idler gear are aligned fit the reverse idler shaft. Ensure that, where the reverse idler shaft is retained by a pin, the larger diameter of the hole in the reverse idler shaft is facing outwards.

Reverse Idler - New Design

36. Ensure that the components are not dislodged as the idler shaft is fitted. Serrated reverse idle shafts should be driven in until the serrations are fully engaged in the intermediate case. Install the cir-clip.



IMPORTANT: The new design incorporates serrations machined onto the idler shaft to provide retention in the intermediate case.

37. Install the reverse idler gear/PTO cover plate using Loctite sealant. Tighten the capscrews to 35 - 39 Nm.



38. Lubricate the selector interlock pin and install it, rounded end first, into the range indicator switch bore hole. Push it right through until it is located in the selector shaft detent groove.



IMPORTANT: The interlock pin must be installed now, before the rear case assembly is fitted.

39. Apply sealant to the intermediate case rear flange ensuring there is a continuous bead around the flange and the retaining capscrew holes.



40. Lift the rear case assembly, using a lifting sling and hoist. Ensure that the shaft is as near vertical as possible.



41. Lower the rear case assembly over the intermediate case ensuring that the range change selector rod aligns with the bush in the intermediate case. Rotate the output flange slightly to aid alignment over the sun gear, if necessary.

IMPORTANT: Ensure transmission is in neutral, before installing rear case assembly.



42. Install the capscrews, lifting eye and nuts. Tighten capscrews to 45 - 55 Nm.



43. Turn the transmission to the horizontal position. Remove the drive flange retaining nut and temporary spacer. Install a new nut and using the flange holding wrench tighten to 600 - 700 Nm.

Note: DO NOT use an impact wrench.



IMPORTANT: DO NOT allow the output shaft to be knocked or driven inwards while the nut is slackened or removed or the range change synchroniser sleeve may be displaced and the rollers, plungers and springs fall out of the hub.

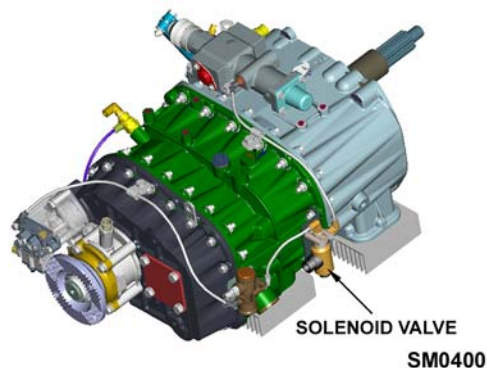
44. Install the filter regulator assembly and mounting bracket.



45. Install range change slave valve and mounting bracket (if fitted on transmission).



46. **On transmission fitted with Across Gate Interlock Assembly**, install the solenoid valve and mounting bracket.



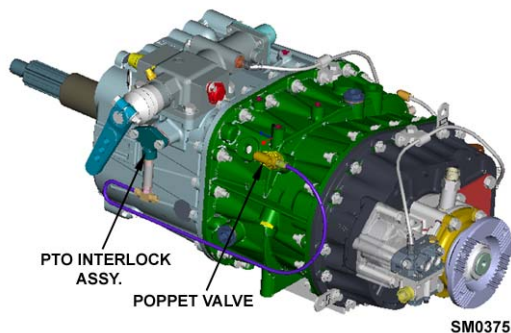
47. Rotate the selector block to position the pin uppermost. Install the neutral detent plunger and spring or screw-in detent assembly (if fitted).



48. Install the cover with a new gasket. Tighten the capscrews to 19 - 24 Nm.



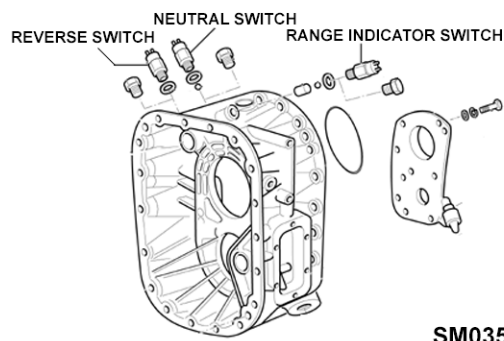
49. **On transmissions fitted with PTO Interlock Assembly**, install detent cover and interlock assembly. Install the screws and washers (if fitted). Install the shield, screws and washers (if fitted). Tighten screws to specification.



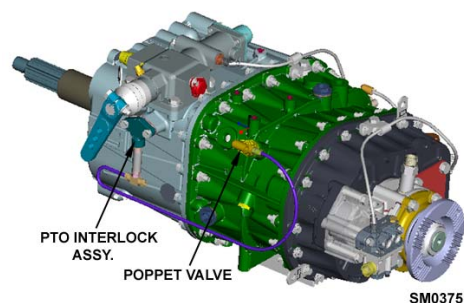
50. If necessary, replace seal (if fitted) between remote control assembly and case. Apply a light coating of Loctite 5900 to the joint face. Install dowels and the remote control ensuring that the selector fork engages in the selector block.



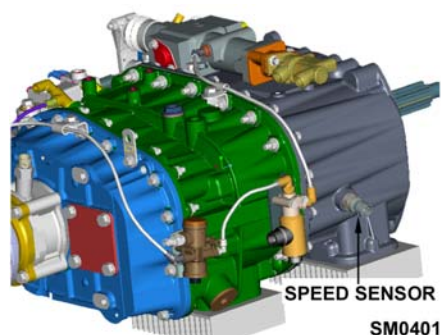
51. Install the reverse lamp switch or plug (if fitted) and O-ring (if fitted). Install the ball, range indicator switch or plug (if fitted) and O-ring (if fitted). Install ball, neutral switches or plug (if fitted) and O-ring (if fitted). Tighten switches to 24 - 30 Nm.



52. **On transmissions fitted with PTO Interlock Assembly**, poppet valve is fitted in place of neutral switch. Remove the poppet valve, O-ring and ball.



53. **On transmission fitted with Range Inhibitor System**, install the speed sensor on the front case.



54. Install clutch housing mounting studs or capscrews (if fitted). Install clutch housing (if fitted). Install nuts (if fitted). Refer section 'Specification' for tightening torques.

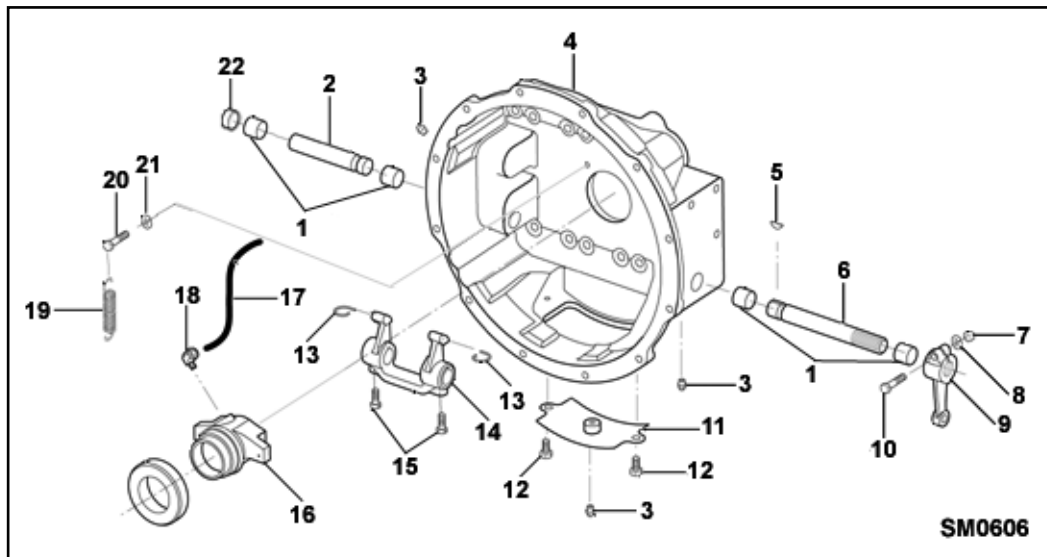


Reconnect all the air supply lines, return lines and connectors to appropriate positions, using PTFE tape or suitable sealant. Tighten air connectors to 8 - 14 Nm.

Attach the hoist and remove the transmission. Check manually that all gears can be engaged using the shift lever noting that it will be necessary to attach a temporary air supply to check the operation of the range change. Re install the transmission and gear shifting linkage.

Exploded View

CLUTCH HOUSING AND RELEASE MECHANISM



- | | |
|----------------------|------------------------|
| 1. Bushing | 12. Capscrew |
| 2. Bearing | 13. Spring |
| 3. Grease Fitting | 14. Fork |
| 4. Clutch Housing | 15. Capscrew |
| 5. Ker | 16. Clutch Thrust Race |
| 6. Shaft | 17. Lubrication Pipe |
| 7. Nut | 18. Adaptor |
| 8. Washer | 19. Spring |
| 9. Drop Lever | 20. Capscrew |
| 10. Bolt | 21. Washer |
| 11. Inspection Cover | 22. Expansion Plug |

How to disassemble Clutch Housing

Special Instructions



WARNING: Wear safety glasses and hand gloves.

Special Tools

Transmission Overhauling Stand
Plier
Soft Face Mallet

Procedure -

1. Support the transmission, disconnect the lubrication pipe. Remove the lower inspection cover.



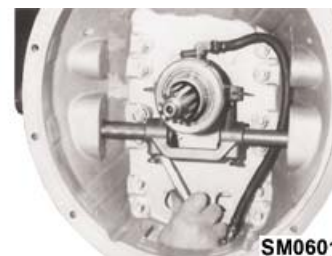
2. Using suitable plier disconnect the clutch thrust race return springs.



3. Remove the clutch housing retaining nuts and washers.



4. Use a ring spanner through the inspection cover hole to undo the nuts behind the cross shaft.



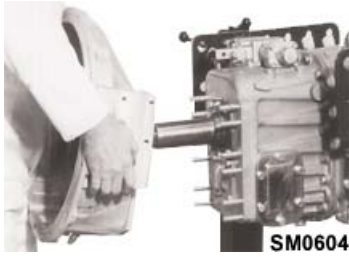
5. Remove the clutch thrust race return spring anchor bolts.



6. Loosen the clutch housing using a soft faced mallet.



7. Lift off the clutch housing assembly.



8. Front of transmission with clutch housing removed.



How to assemble Clutch Housing

Special Instructions



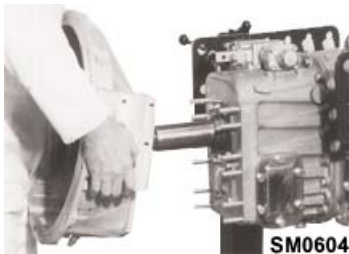
WARNING: Wear safety glasses and hand gloves.

Special Tools

Transmission Overhauling Stand
Plier

Procedure -

1. Install the clutch housing assembly.



2. Fit and tighten the clutch housing retaining nuts or capscrews to the correct torque.



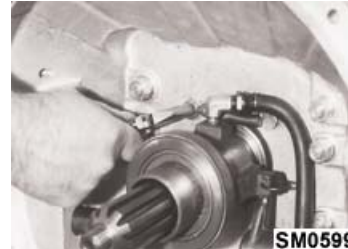
3. Use a ring spanner through the inspection cover hole to tighten the nuts behind the cross shaft.



4. Fit and tighten the clutch thrust race return spring anchor bolts to the correct torque.



5. Reconnect the clutch thrust race return springs



6. Reconnect the lubrication pipe and tighten securely.



7. Refit the lower inspection cover.



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