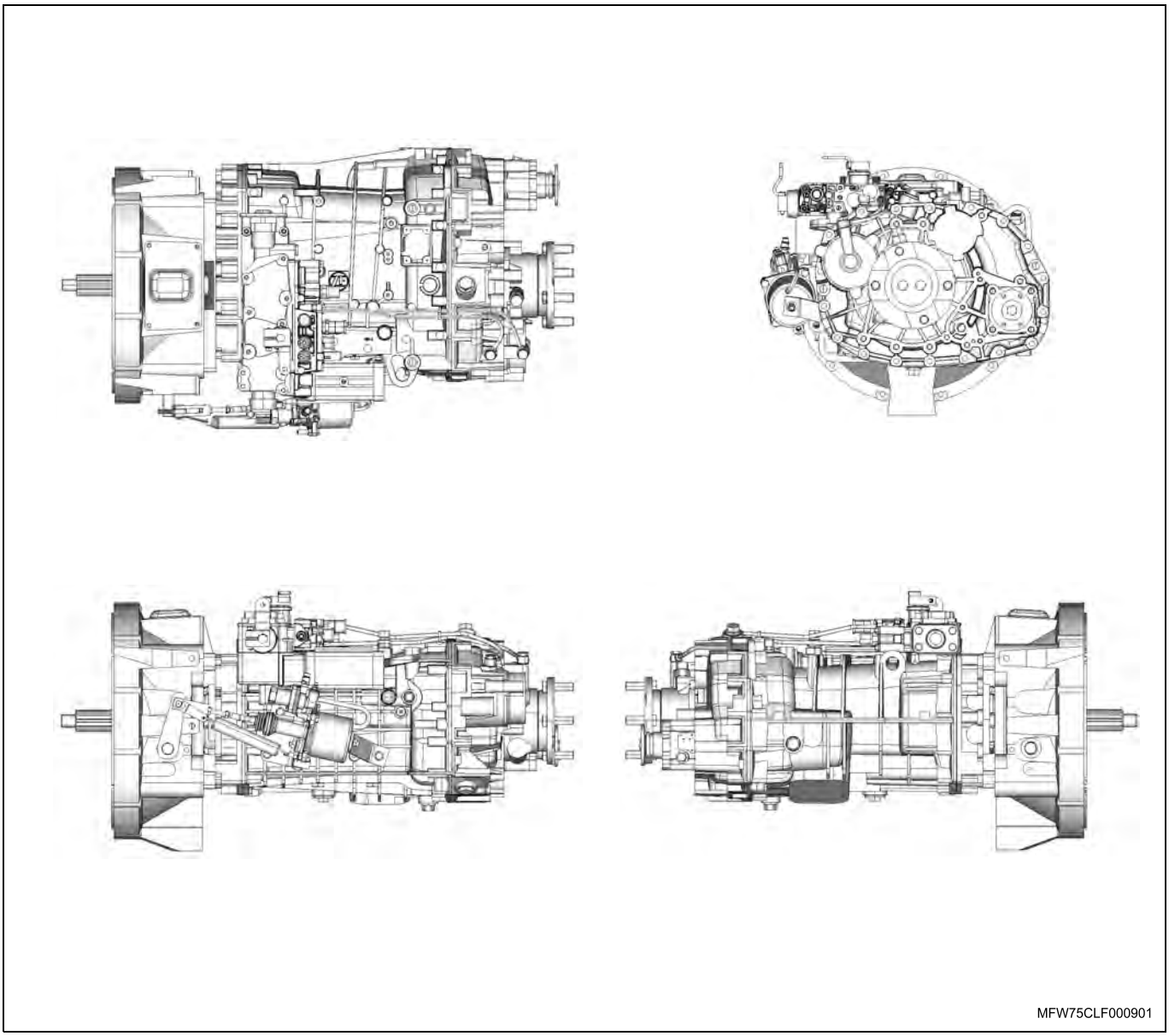
General Description

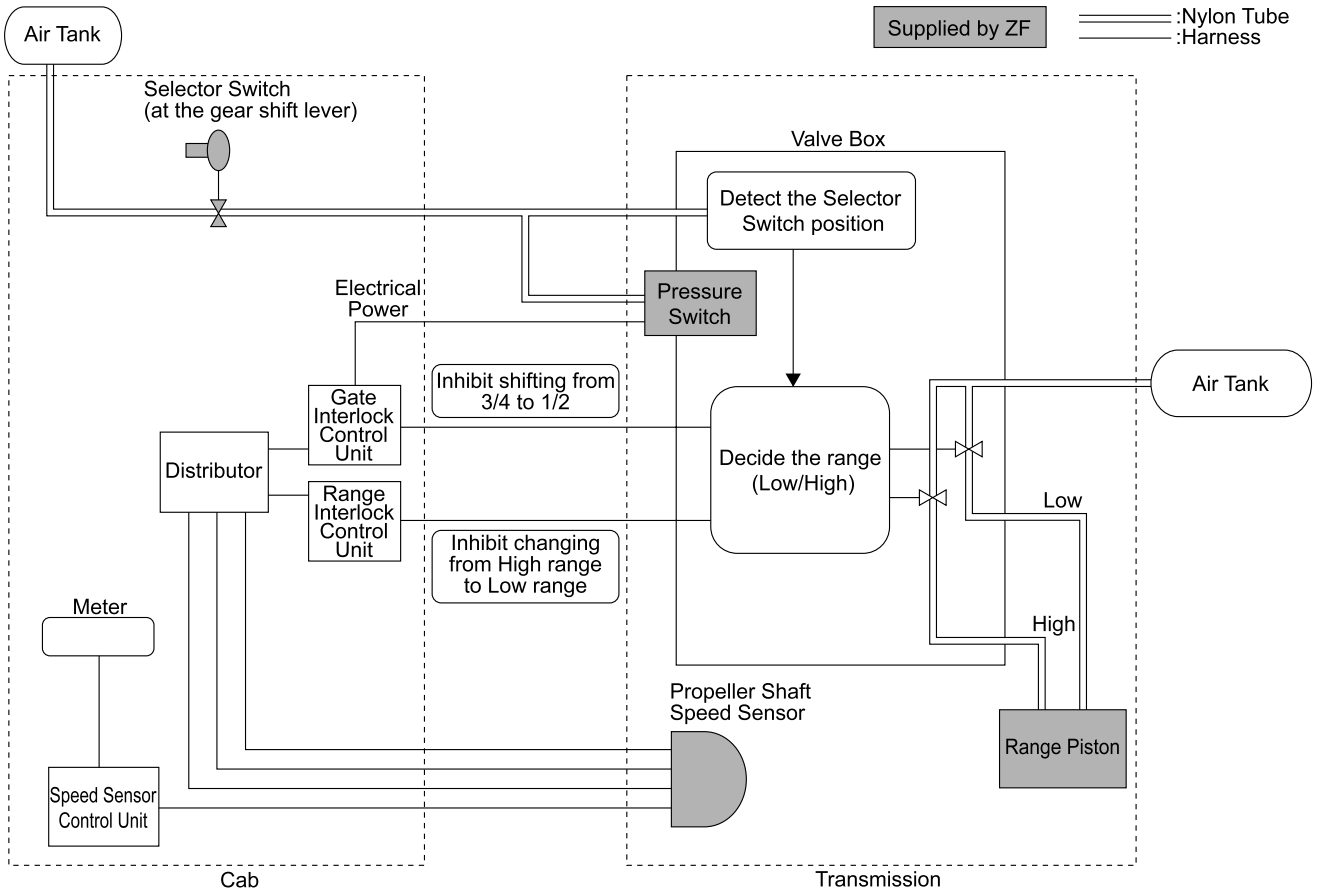
Description of Function and Operation

Outline View

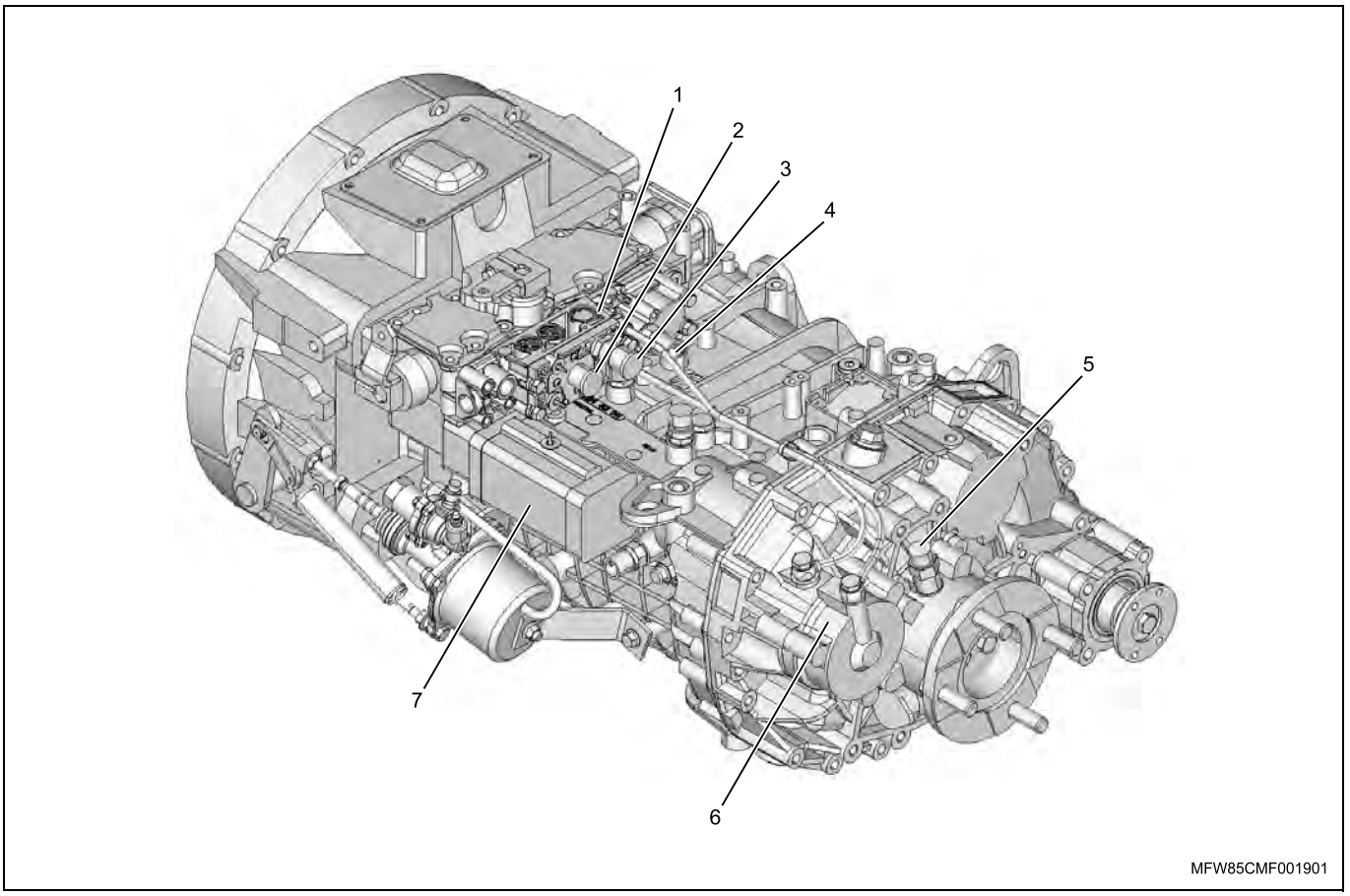


MFW75CLF000901

The ZF9S1110 transmission is an 9-speed transmission that uses "Single H Shift" pattern for shift control. The ZF9S1110 transmission has a synchromesh mechanism that switches a low range (1st through 4th gears) and a high range (5th through 8th gears). It also has an interlock system to protect the synchromesh mechanism. There is also a magnetic valve structure in the power assist circuit that does not allow air to be supplied unless the clutch pedal is fully depressed.


Air Tank
Supplied by ZF
:Nylon Tube
:Harness
Selector Switch
(at the gear shift lever)
Valve Box
Detect the Selector Switch position
Electrical Power
Pressure Switch
Inhibit shifting from 3/4 to 1/2
Gate Interlock Control Unit
Air Tank
Distributor
Range Interlock Control Unit
Decide the range (Low/High)
Low
Inhibit changing from High range to Low range
Meter
High
Propeller Shaft Speed Sensor
Range Piston
Speed Sensor Control Unit
Cab
Transmission
MFW85CLF003301

Components Location Diagram



Legend

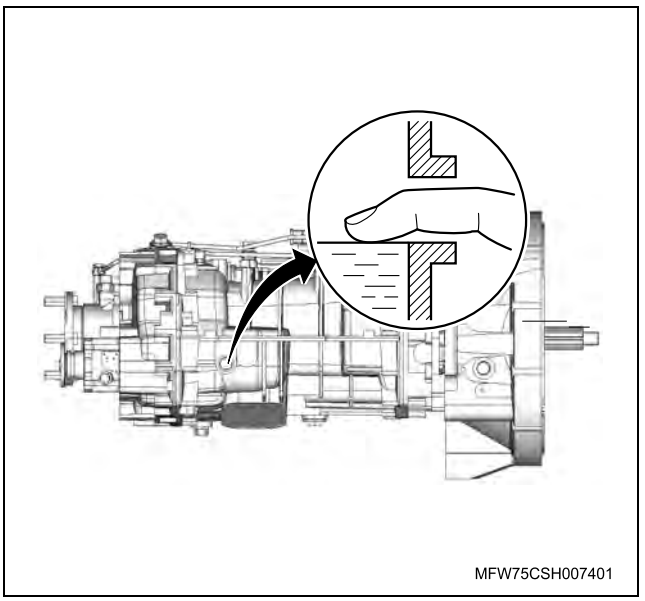
1. Valve Box
2. ECU Switch
3. Pressure Switch
4. Neutral Switch
5. Propeller Shaft Speed Sensor
6. Range Piston
7. Power Assist

Inspection and Replacement of the Transmission Oil

Inspection of the transmission oil

1. Park the vehicle on a flat surface.
2. Remove the filler plug.
3. Inspect whether the oil level is lower than the bottom edge of the hole, through the filler plug hole as shown in the diagram.
4. Refill the oil if the oil level is below the specified level.
   Oil used
   - Refer to "Transmission Oil" in this section.
5. Tighten the filler plug at the specified torque.
   - The gasket can be reused.

Tightening torque: 60 N·m (6.1 kg·m / 44 lb·ft)

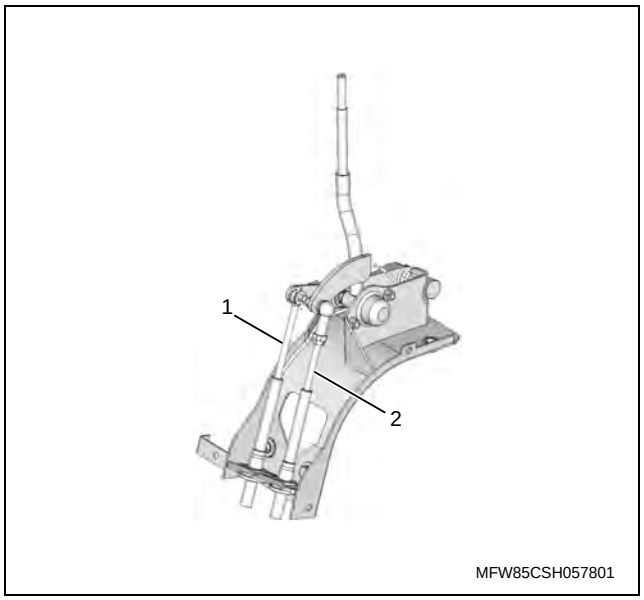


Manufacturer (02B)	Trade name (02B)
HUILES BERLIET S.A., SAINT PRIEST/F	RTO LONGEVIA P ECO 80W-90
HUILES BERLIET S.A., SAINT PRIEST/F	RTO LONGEVIA TCX ECO 75W-90
IGOL FRANCE SA, AMIENS/F	GEAR M 80W90
IGOL FRANCE SA, AMIENS/F	SYNTHEGEAR SAE75W90
KROON-OIL B.V., ALMELO/NL	TRANSMISSION OIL SP 1011
KUWAIT PETROLEUM R&T B.V., EUROPOORT RT/ NL	Q8 GEAR OIL XG SAE 80W-90
KUWAIT PETROLEUM R&T B.V., EUROPOORT RT/ NL	Q8 TRANS XGS SAE 75W-90
LIQUI MOLY GMBH, ULM/D	HYPOID GETRIEBEÖL TDL SAE 80W-90
MAZIVA ZAGREB D.O.O, ZAGREB/HR	INA HIPENOL SHD 75W-90
MAZIVA ZAGREB D.O.O, ZAGREB/HR	INA HIPENOL TDL 80W-90
MEGUIN GMBH & CO. KG MINERALOELWERKE, SAARLOUIS/D	MEGOL GETRIEBEOEL TRUCK-SYNTH SAE 75W-90
MEGUIN GMBH & CO. KG MINERALOELWERKE, SAARLOUIS/D	MEGOL HYPOID-GETRIEBEOEL TDL SAE 80W-90
MILLERS OILS LIMITED, BRIGHOUSE/GB	SYNTRAN FE
MINERALÖL-RAFFIN. DOLLBERGEN, UETZE-DOLLBERGEN/D	PENNASOL MEHRZWECK-GETRIEBEOEL GL 4 SAE 80W
MINERALÖL-RAFFIN. DOLLBERGEN, UETZE-DOLLBERGEN/D	PENNASOL MEHRZWECK-GETRIEBEOEL GL 4 SAE 85W-90
MINERALÖL-RAFFIN. DOLLBERGEN, UETZE-DOLLBERGEN/D	PENNASOL MEHRZWECK-GETRIEBEOEL GL 4 SAE 90
MODRICA OIL REFINERY, MODRICA/BIH	TRANSLUBE GL-4 SAE 80W
MODRICA OIL REFINERY, MODRICA/BIH	TRANSLUBE GL-4 SAE 90
MORRIS LUBRICANTS, SHREWSBURY/GB	LODEXOL SS 80W
MORRIS LUBRICANTS, SHREWSBURY/GB	SERVOL EP 80W/90
MOTUL SA, AUBERVILLIERS CEDEX/F	MOTUL GEAR SYNT TDL 75W-90
NESTE MARKKINOINTI OY, ESPOO/FIN	NESTE HYPOIDI TDL S 75W-90
NEW PROCESS AG, TÜBACH/CH	GEAROIL SYNTH
OEST, GEORG MINERALÖLWERK, FREUDENSTADT/D	OEST MEHRZWECK-GETRIEBEÖL FE SAE 80W-90
OEST, GEORG MINERALÖLWERK, FREUDENSTADT/D	OEST SYNTH GETRIEBEÖL SAE 75W-90
OK NEDERLAND, STAPHORST/NL	OK UNI-CARDAN OIL LD-SAE 75W/90
OK NEDERLAND, STAPHORST/NL	QUINTOL TRANSMISSION OIL VS-45 SAE 75W/90
OMV REFINING & MARKETING GMBH, WIEN/A	OMV GEAR OIL XD-4 SAE 80W-85
OMV REFINING & MARKETING GMBH, WIEN/A	OMV UNIGEAR S SAE 75W-90
OMV REFINING & MARKETING GMBH, WIEN/A	OMV UNIGEAR SAE 80W-90
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL GEAR CBS SAE 75W/85
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL GEAR SA SAE 80W
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL GEAR SA SAE 80W/85
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL GEAR SA SAE 80W/90
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL GEAR SA SAE 85W/90
PAKELO MOTOR OIL S.R.L, SAN BONIFACIO (VR)/I	PAKELO GLOBAL MULTIGEAR TS SAE 75W/90
PANOLIN AG, MADETSWIL/CH	PANOLIN SUPER DUTY SYNTH 75W/90
PANOLIN AG, MADETSWIL/CH	PANOLIN TOPGEAR 80W/90
PETROGAL S.A., LISBOA/P	GALP TRANSVEX TDL 75W90
RAVENSBERGER SCHMIERSTOFFVERTRIEB GMBH, WERTHER/D	RAVENOL SLG SPEC. LKW GETR.ÖL 80W90
REPSOL YPF LUBRICANTES Y ESPECIALIDADES, MADRID/E	CARTAGO FE LD 75W90
S.A.E.L., MADRID/E	GULF SYTHETIC GEAR LUBRICANT 75W-90
SHARJAH NATIONAL LUBE OIL CO. LTD., SHARJAH/UAE	SHARLU EP GEAR LUBE 80W/90 (GL-4)

Gear Control Cable

Components

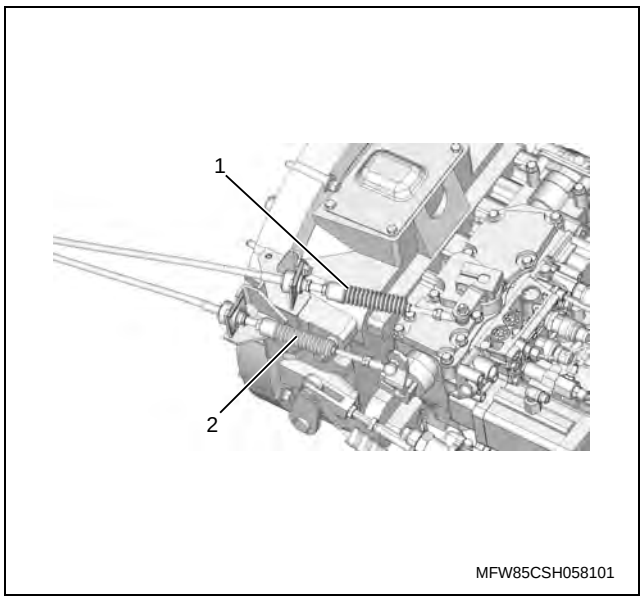
Cab side



Legend

1. Select cable
2. Shift cable

Transmission side



Legend

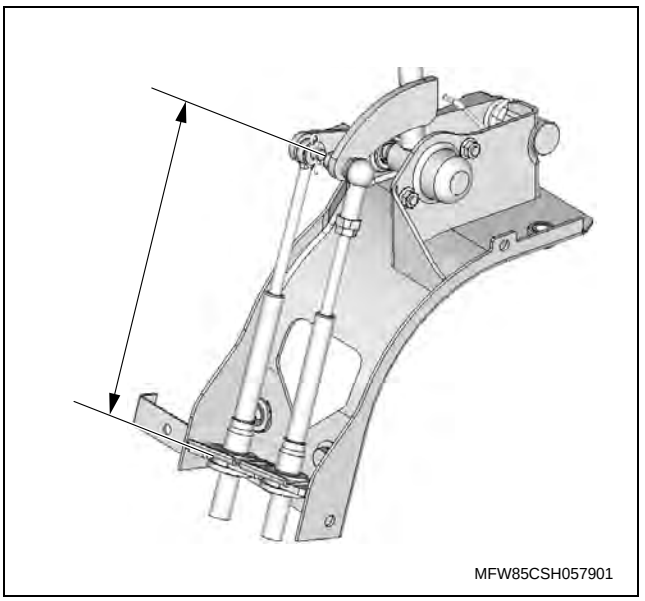
1. Select cable
2. Shift cable

Adjustment

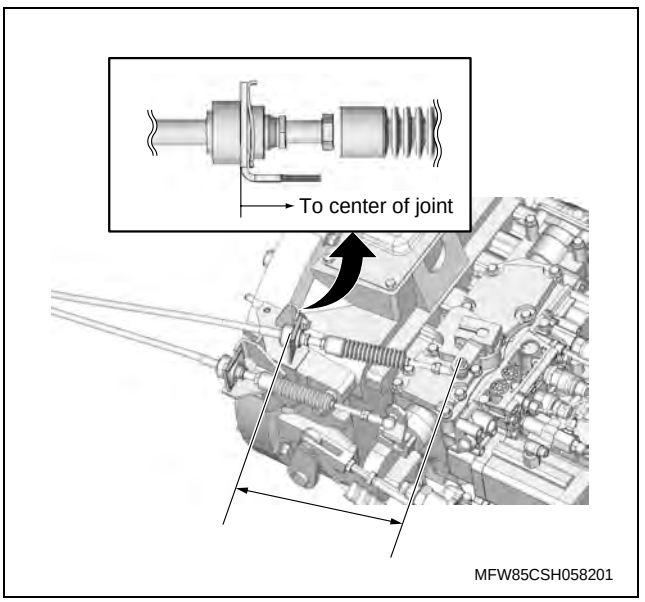
- Refer to "Shift Lever ASM" or "Transmission ASM" in this section for removal, installation and tightening torque on each cable.

Tightening of
each ball joint lock nut : 13 N·m (1.3 kg·m / 113 lb·in)

1. Adjust the length of the select cable (cab side) to the specified value.
   - Installation length of the select cable: 210 mm (8.27 in)



2. Adjust the length of the select cable (transmission side) to the specified value.
   - Installation length of the select cable: 240 mm (9.45 in)

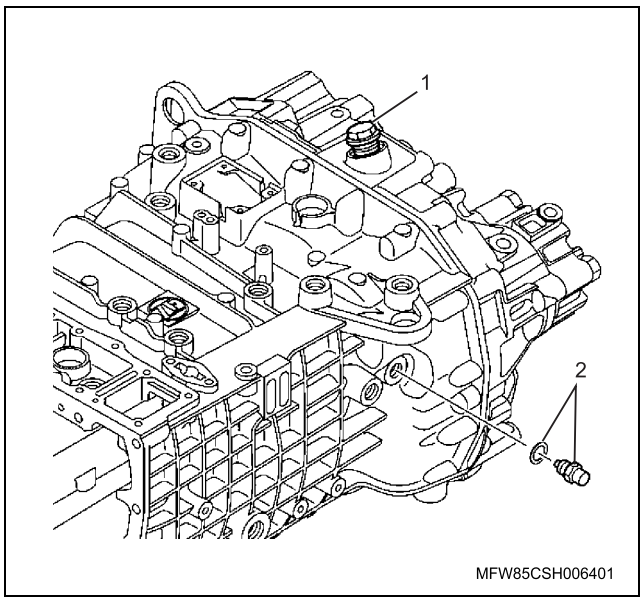


3. Adjust the length of the shift cable (cab side) to the specified value.

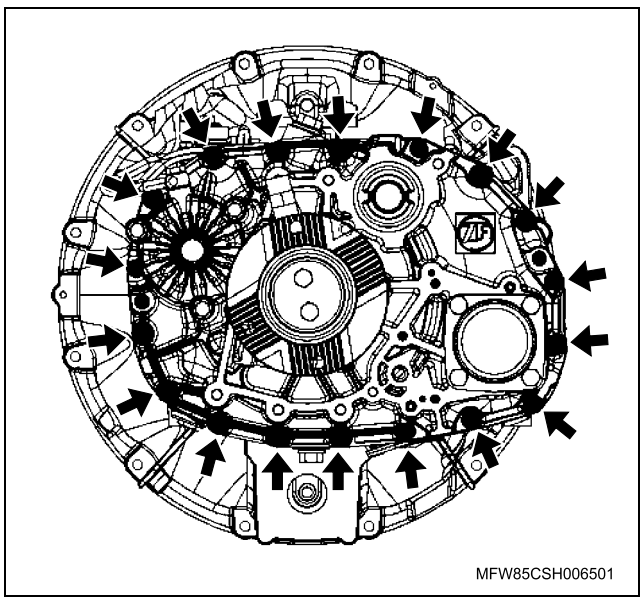
Range-Change Group

Removal

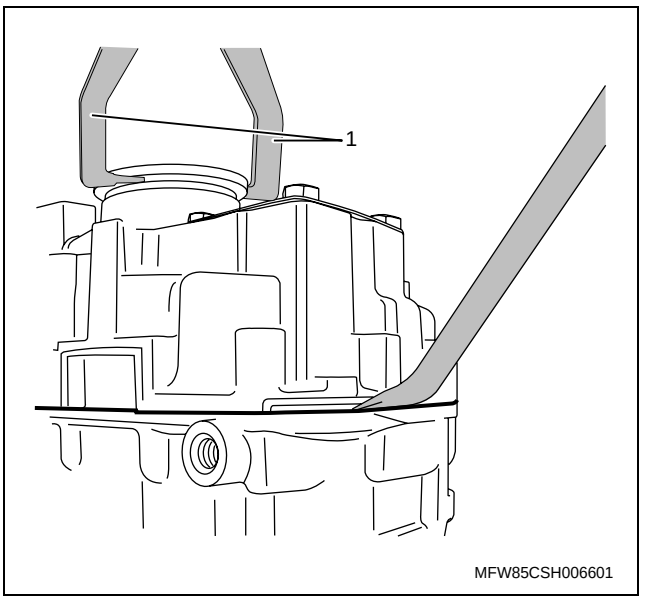
1. Loosen both the pivot bolts (1), don't remove yet.
2. Remove the pawl stop (2).



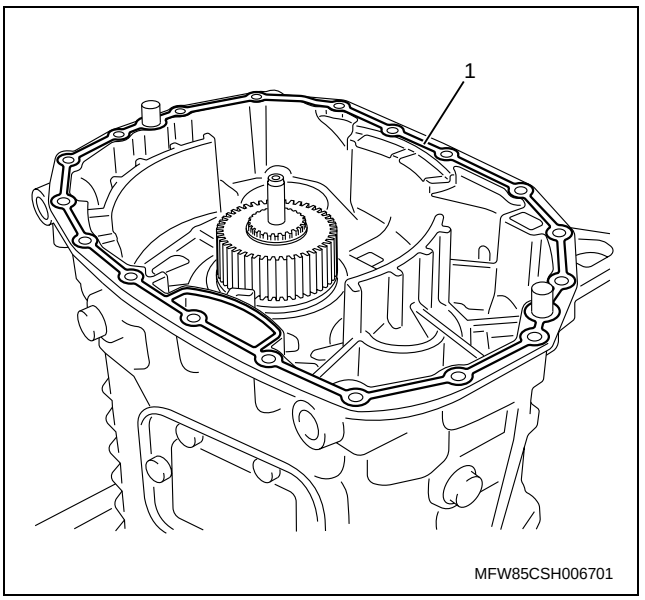
3. Remove the bolts from range-change group.



4. Secure the fixture : 1T66 153 417 (ZF) (1) to the output flange. Use a crane and the 2 pry bars to separate range-change group from basic transmission.



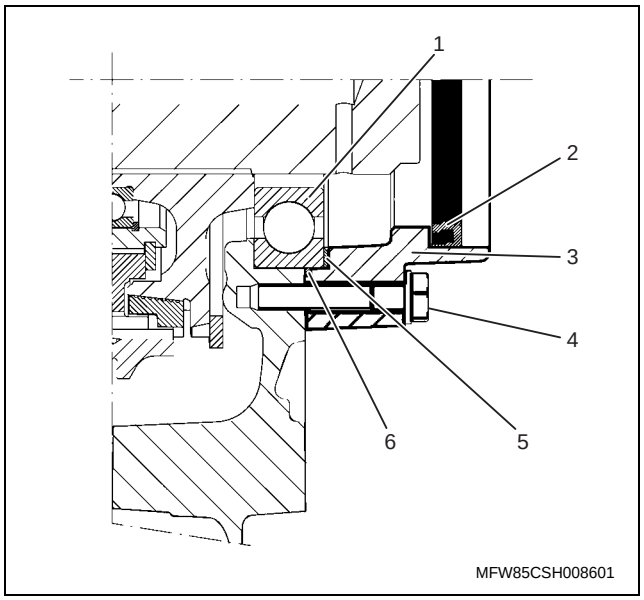
5. Remove the gasket (1) and clean the sealing faces.



Bearing Cover

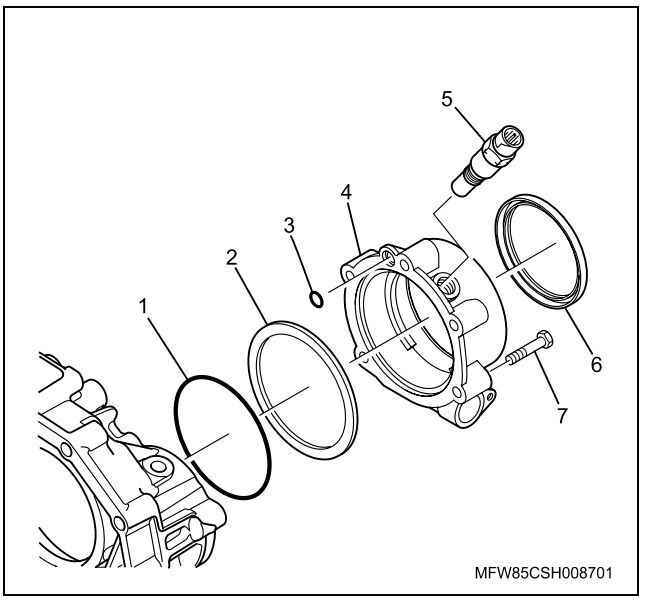
Removal

1. Remove the propeller shaft speed sensor.
2. Remove the 5 bolts from the bearing cover.
3. Loosen the bearing cover by tapping gently with a plastic hammer.
4. Remove the bearing cover, the shim, the O-ring (large) and O-ring (small).
5. Use a plastic mandrel to drive the shaft seal out of the bearing cover.



Legend

1. Ball bearing
2. Shaft seal
3. Bearing cover
4. Bolt
5. Shim
6. O-ring (large)



Legend

1. O-ring (large)
2. Shim
3. O-ring (small)
4. Bearing cover
5. Propeller shaft speed sensor
6. Shaft seal
7. Bolt

Installation

Measuring Bearing Cover

NOTE:
The ball bearing (1) must make contact with collar of the housing (4).

1. Calculate thickness of the shim (3).
   - Dimension A : Measure the bearing cover (2) between the sealing face and the bearing seat.
   - Dimension B : Measure from the ball bearing (1) to the sealing face of the range-change housing (4).

Calculation example

Dimension A = 8.70 mm (0.343 in)

Dimension B = 8.30 mm (0.327 in)

Shim without clearance = 0.40 mm (0.016 in)

Specified axial clearance of ball bearing between 0 and 0.10 mm (0 and 0.004 in).

Thickness of shim = 0.3 to 0.4 mm (0.012 to 0.016 in)

2. Select the corresponding shim (3) using spare part catalog and prepare for installation.

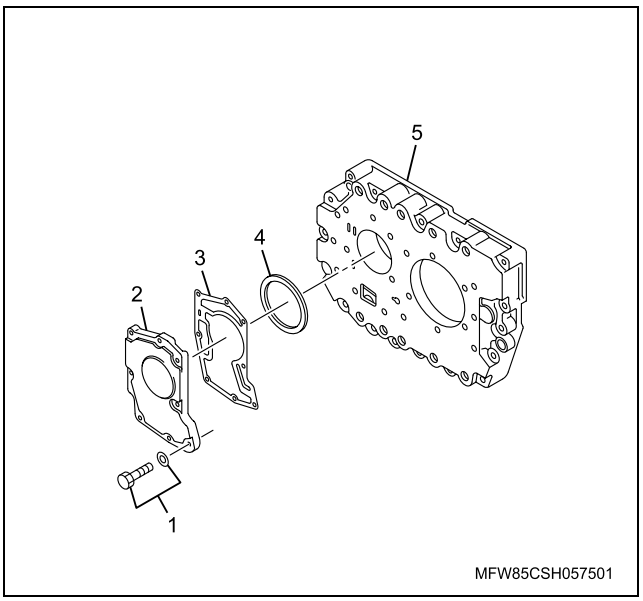
Oil Pump

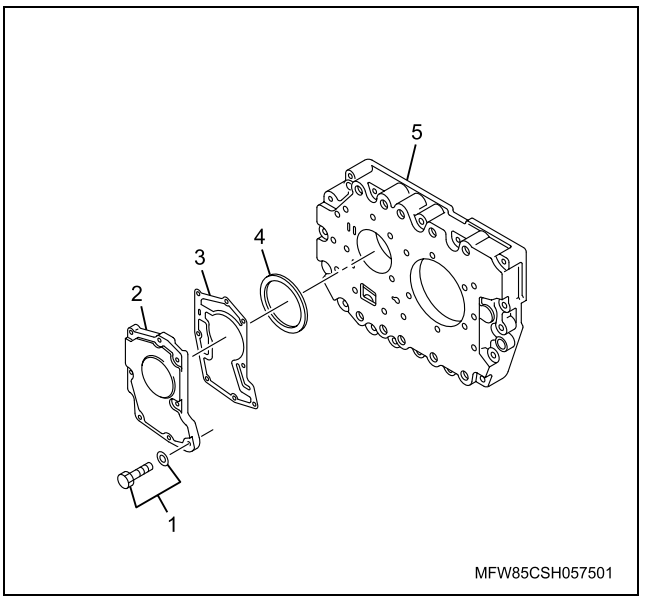
Removal

1. Loosen the bolts (1) and remove with the washers (1).
2. Remove the pump (2) and the gasket (3) from the housing (5).
   - Remove the pump (2) using pry bars and remove together with the gasket (3).

NOTE:
Use cast pockets as pry bar leverage points.

3. Remove the shim (4) from the countershaft.





Reassembly

1. Place the shim (4) on countershaft.

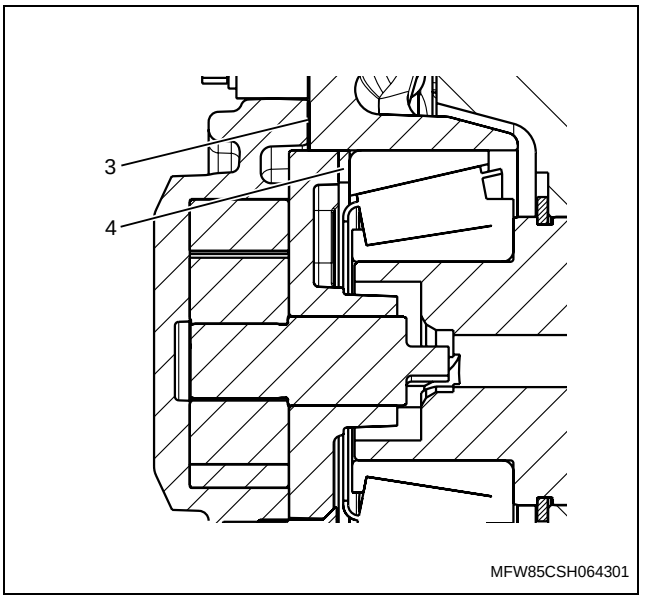
NOTE:
The shim size is calculated in accordance with the provisions.
Refer to "Bearing Setting on Countershaft" in this section.

2. Place new gasket (3) on the housing (5).
3. Install the pump (2) in the housing (5) and knock firmly home using plastic hammer.

CAUTION:
Groove in countershaft and driver of pump must engage positively.

4. Install the bolts (1) with the washers (1) and tighten.

Tightening Torque: 23 N·m (2.3 kg·m / 17 lb·ft)



9. Slide the reverse gear (34) for reverse gear over the needle cage and onto the main shaft using gentle turning movements. Spline faces towards sleeve carrier.
10. Heat inner race of the taper roller bearing (35) to around 120 °C (248 °F) and slide onto the main shaft, drive on until firmly home.

CAUTION:
Always wear protective gloves when handling heated the taper roller bearing inner race.

11. Rotate the main shaft and place output end in support : 1X56 138 535 (ZF).
12. Slide both the needle cages (26) onto the main shaft.
13. Attach the helical gear (25) for 1st gear above needle cage using gentle turning movements. Spline faces in direction of input end.
14. Place the clutch body (24) and the synchronizer ring (19) on the spline.

CAUTION:
Check wear limit of all synchronizer rings and/or clutch bodies, refer to "Planetary Drive with Synchronizer Unit" in this section.
For all synchronizer units, use the parts stated in brochure 1297 754 101 "ZF lock synchronizers, component investigation". Apply a thin coat of oil to all synchronizer rings.

15. Heat the synchronizer body (20) to around 120 °C (248 °F) and place on spline of the main shaft. The synchronizer body is symmetrical and can therefore be positioned regardless of the positions of its ends. Drive on the synchronizer body until fully home.

CAUTION:
Always wear protective gloves when handling heated the synchronizer bodies.

16. Slide the sliding sleeve (23) for 1st/2nd gear over the synchronizer body, the synchronizer ring, and the clutch body and bring into contact with the helical gear for 1st gear. Ensure that recesses of inside of sliding sleeves match the equipment points of the synchronizer body (for compression springs and compression pieces).
17. Use the suitable tool to insert the 3 compression springs (21) with the pressure pieces (22) into holes of the synchronizer body and/or guide into sliding sleeve.

NOTE:
Use new compression springs.

18. Fit the synchronizer ring (19). The synchronizer ring lugs must reach into the synchronizer body recesses.
19. Place the clutch body (18) on the synchronizer ring and pull sliding sleeve into central position (neutral). Thereby, press on the synchronizer ring and the clutch body.
20. Slide the needle cage (16) and the helical gear (17) for 2nd gear onto the bearing bushing (15) and jointly warm to around 120 °C (248 °F).

CAUTION:
Always wear protective gloves when handling heated parts.

21. Attach parts on the main shaft and fit the bearing bushing (15) with no axial clearance, if necessary drive on until firmly home. The bushing collar faces input drive.
22. Snap in the securing ring (14).

NOTE:
The securing ring's axial clearance must be between 0 and 0.10 mm (0 and 0.004 in). Select corresponding the securing ring.

CAUTION:
Keep the securing ring free of burrs. It is the thrust face for the needle cage.

23. Slide both the needle cages (13) onto the main shaft.
24. Slide the helical gear (12) (3rd gear for TD version and 4th gear for TO version) over the needle cage onto the main shaft using gentle turning movements. Driving spline faces towards input end.
25. Place the clutch body (11) on the helical gear (12).
26. Fit the synchronizer ring (6).
27. Heat the synchronizer body (7) to around 120 °C (248 °F) and place on the main shaft with longer hub facing input end. If necessary, drive on until firmly home.

CAUTION:
Always wear protective gloves when handling heated the synchronizer bodies.

NOTE:
The lugs of the synchronizer ring (6) must reach into the recesses of the synchronizer body (7).

Bearing Setting on Main Shaft and Input Shaft

Installation

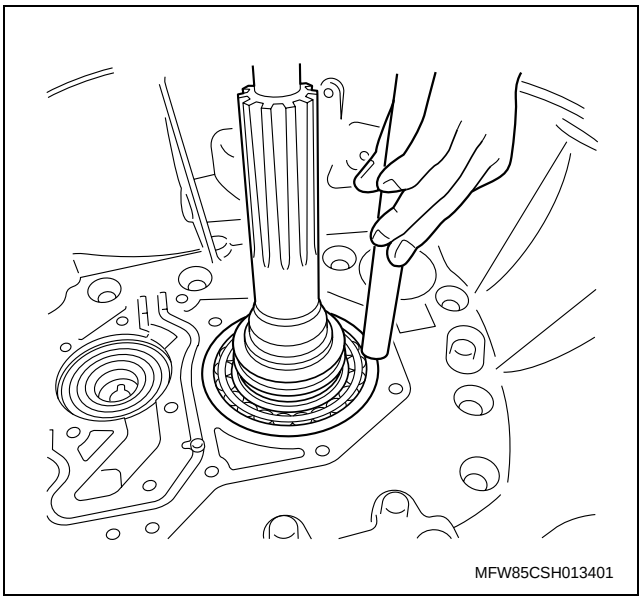
CAUTION:
Set the main shaft and the input shaft with clearance. Clearance is 0 to 0.10 mm (0 to 0.004 in)

1. Move the transmission into vertical position.

NOTE:
Leave the housing to cool before setting the bearing.

2. Set input bearing to zero clearance. To do this, use mandrel to drive outer the bearing race towards the main shaft.

CAUTION:
Do not press or strike area around oil ducts. Otherwise housing will be damaged.

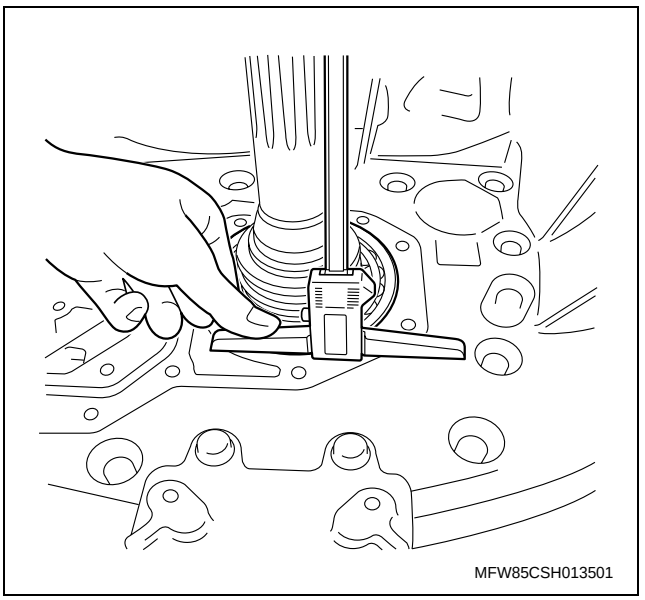

MFW85CSH013401

3. Rotate the input shaft and the main shaft a few times to center the bearing rollers of bearing points. Use sharp object to check whether bearing rollers can move.

NOTE:
When there is no clearance, the bearing rollers must be free of clearance, that is, they must not move. Pretension must not however be reached.

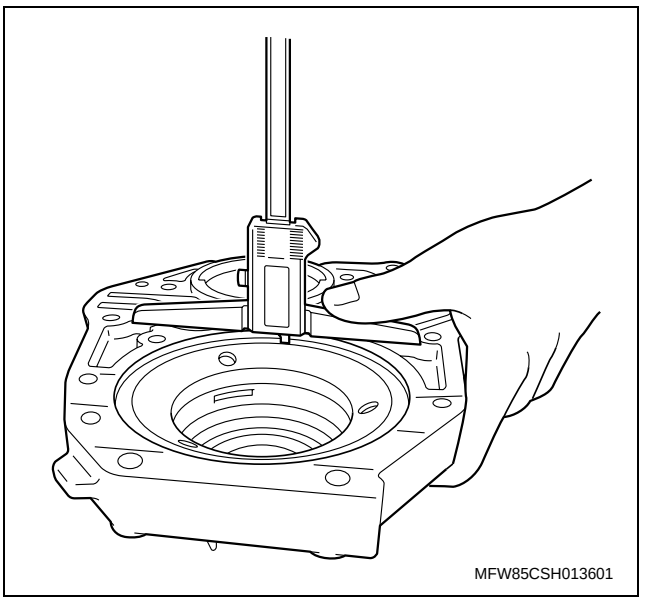
4. Use depth gage to measure distance between upper edge of the outer bearing race and the connection face of the clutch housing; take note of measurement and extract thickness of the gasket. The result is measurement "B".
   Example: B = 2.40 mm – 0.40 mm (0.094 in – 0.016 in) (gasket)
   B = 2.00 mm (0.079 in)

NOTE:
Take measurement at two opposite points and form an average of the two.


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5. Use depth gage to measure distance between connection face and contact surface of shim, note as measurement "A". Example : A = 3.85 mm (0.152 in)

NOTE:
Take measurement at two opposite points and form an average of the two.


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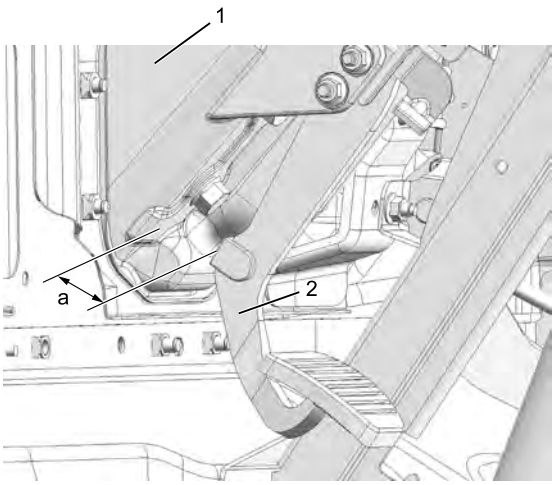
6. Calculate and note down the difference "C".
   Example : C = A – B = 3.85 mm – 2.00 mm (0.152 in – 0.079 in)
   C = 1.85 mm (0.073 in)
7. Calculate thickness "D" of the shim.
   Example : D = C – clearance = 1.85 mm – 0.10 mm (0.073 in – 0.004 in)
   D = 1.75 to 1.85 mm (0.069 to 0.073 in)
8. Select the shim using spare parts catalog.

Clutch ASM free play inspection and adjustment

Inspection of clutch ASM free play

1. Block the wheels, make sure that the parking brake is set and with the engine idling, depress the clutch pedal all the way in.
2. Put into 1st gear, slowly release the clutch pedal to determine the distance (a) between the clutch pedal stopper and the pedal box just prior to engagement of the clutch.

Distance (a) between the pedal stopper and pedal box when clutch engages	38 mm (1.50 in) or more



Legend

1. Pedal box
2. Clutch pedal

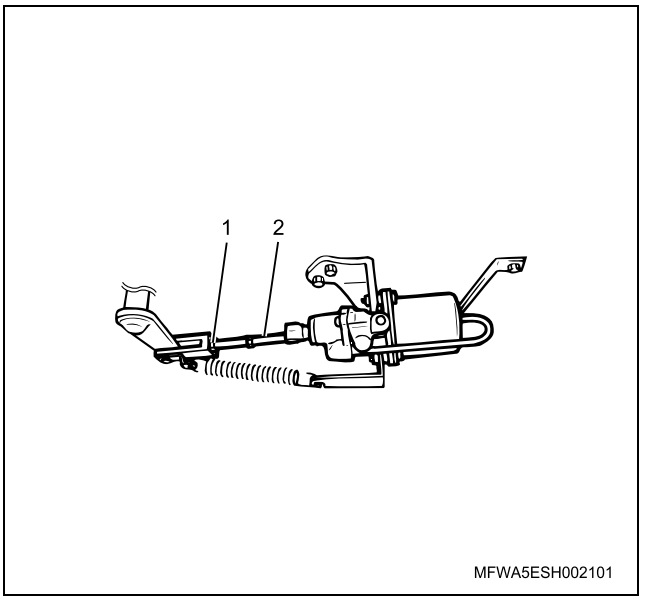
Adjustment of the clutch ASM free play

If the clutch ASM free play is not within the specified range, stop the engine and adjust the push rod at the clutch booster.

1. Remove the clutch booster return spring.
2. Loosen the push rod lock nut.
3. While pushing out the push rod, turn until it becomes firm.
4. From this position, loosen the push rod back according to the number of turns shown below.

Number of reversing turns of the clutch booster push rod	
Assembly Standard	2 1/2 - 3

5. Firmly tighten the lock nut and re-attach the return spring.
6. Inspect the clutch ASM free play is in the specification.
   - Refer to the previously described inspection procedure for clutch ASM free play.



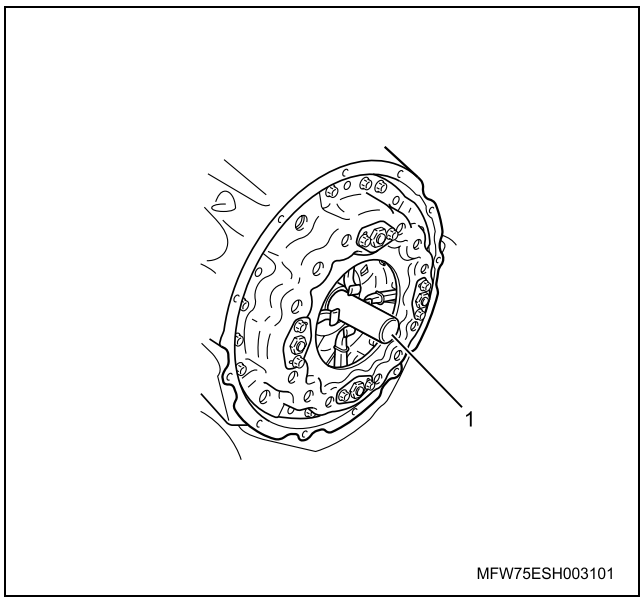
Legend

1. Lock nut
2. Push rod

3. Remove the clutch cover ASM.
   - Insert the clutch pilot aligner in the clutch disk. (Prevents dropping of the clutch disk.)

Special Tool

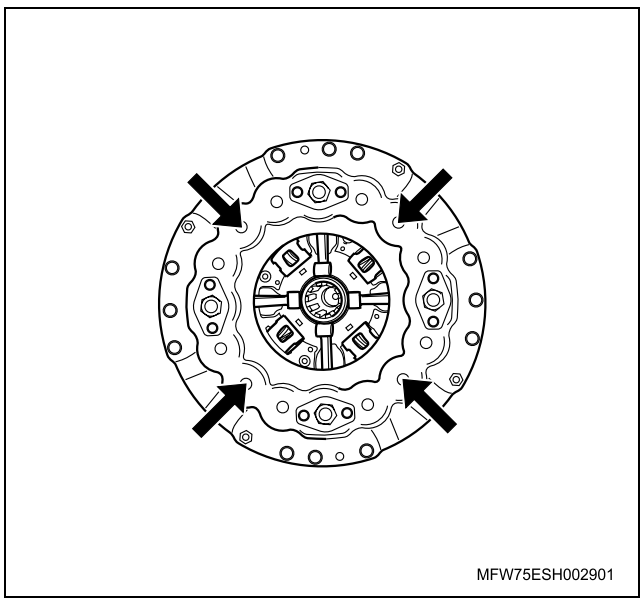
Clutch pilot aligner	
Parts number	Clutch disk spline small diameter
1-8525-3022-0	35.95 mm (1.4154 in)



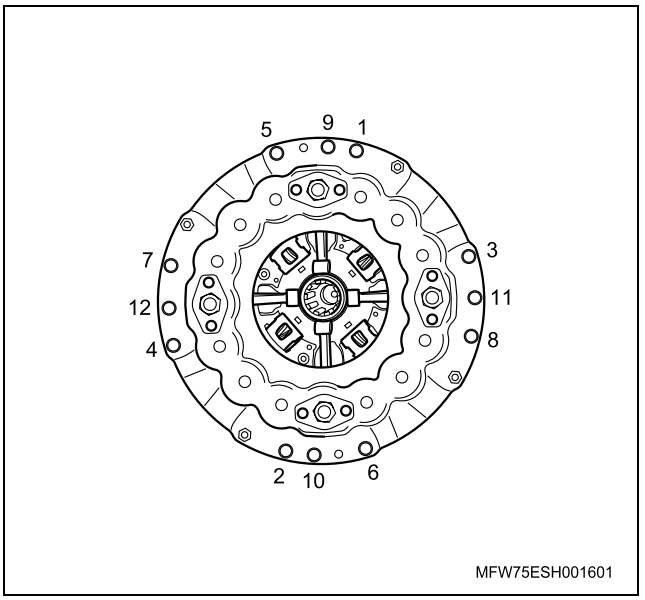
Legend
1. Clutch pilot aligner

- Fix the pressure plate and clutch cover in place in 4 locations using dummy bolts for fixation of the pressure plate, the nuts and the washers.

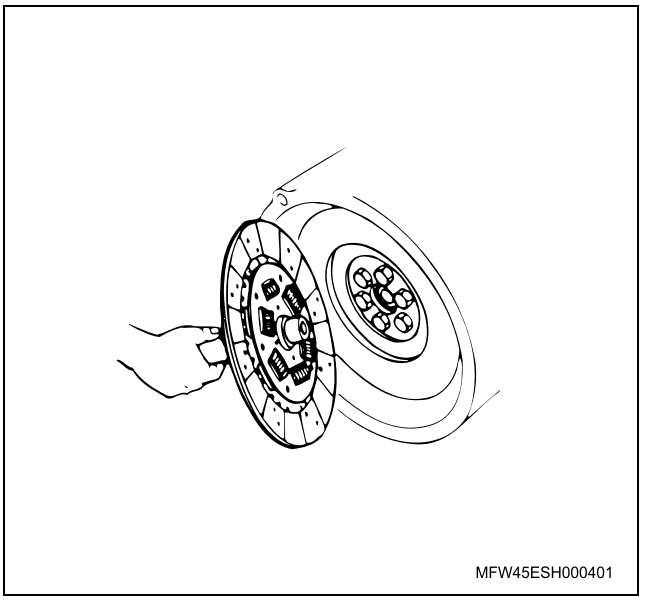
Dummy bolt	M10 × 1.25 L = 150 × 4 pieces



- Remove the clutch cover set bolts on diagonal from each other, in order, referring to the diagram.



4. Remove the clutch disk.



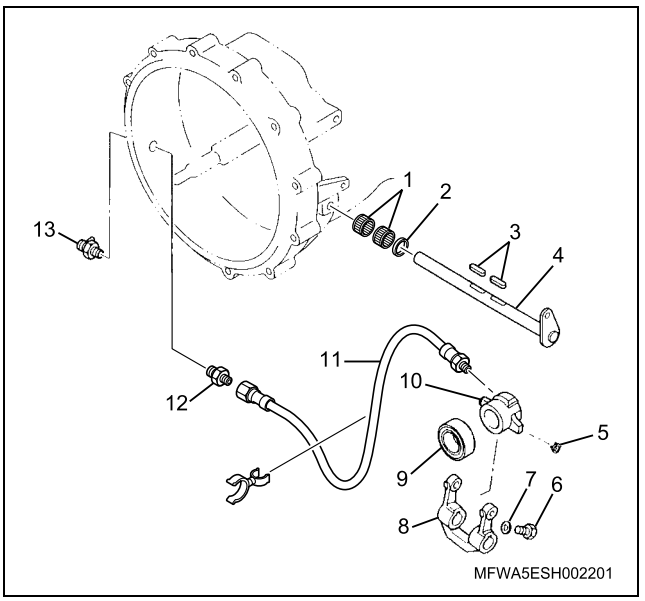
5. Remove the strap plate.
   - Release the lock on the clutch cover and pressure plate tightening bolts and remove the bolts.

- Direct the marking of the needle bearing toward the insertion side.

17. Fill the needle bearing and the space between the needle bearing and the dust seal with grease (BESCO L-2, L-3 grease or equivalent). Orient the dust seal lip towards the outside to install it in its specified position.
18. Insert the clutch shaft into the clutch housing and install the key.
19. Install the clutch shaft to the shift fork.
    - Install the shift fork matched to the clutch shaft key.
    - Align the hole of the shift fork set bolt with the hole of the clutch shaft and tighten the set bolt at the specified torque.

Tightening torque	N·m (kg·m / lb·in)
13 (1.3 / 113)	

20. Install the release bearing and the shift block.
    - Firmly fit the release bearing to the shift block.
    - Apply thin coat of grease (BESCO L-2 or L-3 grease or equivalent) to the contact surface of the shift block and the fork as well as inside of the block.
21. Insert the block into the front cover and install the return spring.
22. Install the adapter.
23. Install the flexible hose and grease fitting.



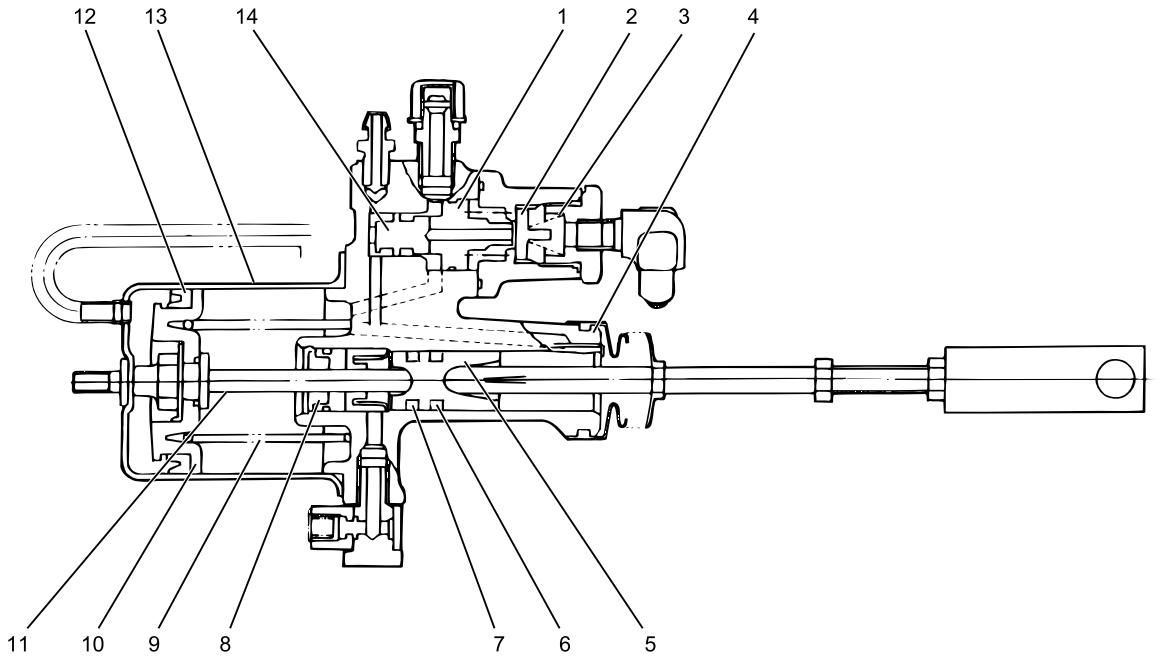
Legend

1. Needle Bearing
2. Dust Seal
3. Key
4. Clutch Shaft
5. Return Spring
6. Shift Fork Set Bolt
7. Washer
8. Shift Fork
9. Release Bearing
10. Shift Block
11. Flexible Hose
12. Adapter
13. Grease Fitting

24. Apply grease (variant grease S or equivalent) thinly and as evenly as possible to whole circumference of the top gear shaft within about 40 mm (1.57 in) from tip of spline.
    (Do not need to apply grease to the tooth crevices of spline.)
25. Mount the transmission ASM.
    - Refer to "Transmission ASM" in Section 5C Manual Transmission ZF9S1110.

Clutch Booster

Description of Function and Operation



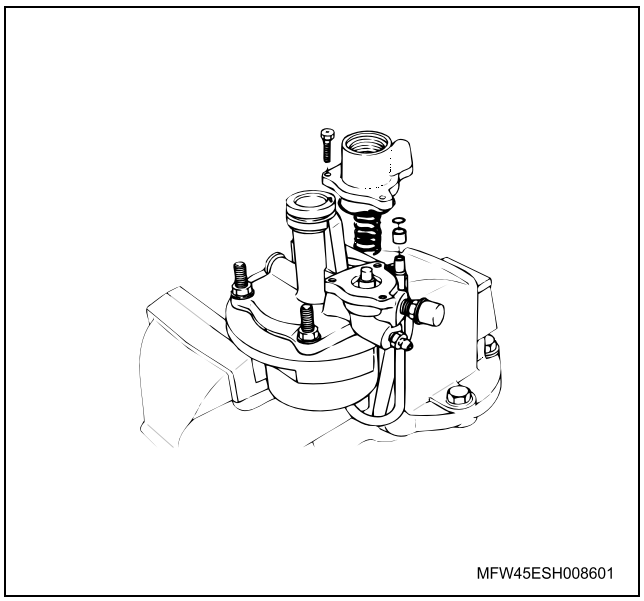
MFW45EMF000101

Legend

1. Relay Piston (Valve Piston Section)
2. Poppet Valve
3. Poppet Spring
4. Cylinder Body
5. Hydraulic Piston
6. Piston Cup Gasket
7. Piston Cup Gasket
8. Oil Seal
9. Return Spring
10. Power Piston
11. Push Rod
12. Piston Cup Gasket
13. Cylinder Shell
14. Relay Piston (Relay Piston Section)

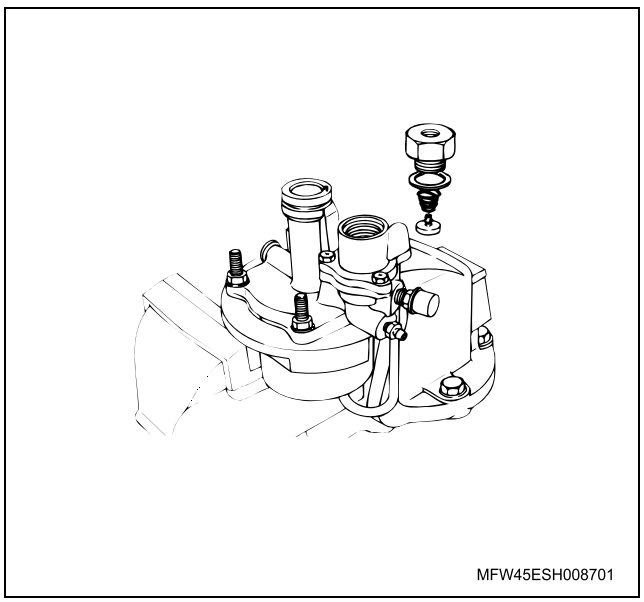
Clutch booster primary specifications

Clutch size		15 inch
Engine type		6HK1-TCS
Power piston diameter × stroke	(mm (in))	ϕ90 (3.54) × 35.8 (1.409)
Hydraulic piston diameter	(mm (in))	ϕ19.05 (0.7500)
Push rod diameter	(mm (in))	ϕ8 (0.31)
Relay piston section diameter	(mm (in))	ϕ16 (0.63) × 3.6 (0.142)
Valve piston section diameter	(mm (in))	ϕ23.5 (0.925)

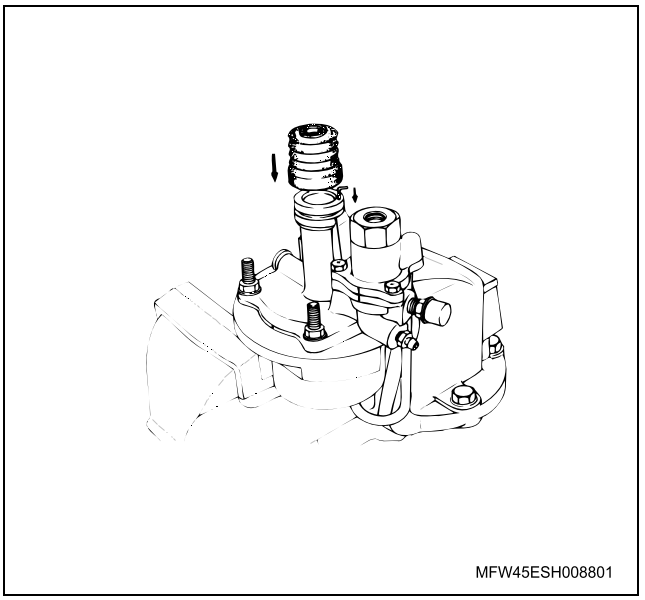


18. Install the poppet valve and the spring onto the upper valve body and next, coat the gasket with air master paste and assemble the connector.

Tightening torque	N·m (kg·m / lb·ft)
25 (2.5 / 18)	



19. Install springs into the intake and exhaust paths at the tip of the cylinder body, apply rubber grease to the guard installation groove, and install the guard.



Installation

1. Mount the clutch booster.

Tightening torque	N·m (kg·m / lb·ft)
Transmission - Bracket (installation bolt)	53 (5.4 / 39)
Clutch Booster - Bracket (installation nut)	42 (4.3 / 31)

2. Apply grease to the clevis pin and assemble it to the clutch shaft lever.

BESCO L-2, L-3 grease or equivalent

3. Mount the air hoses and the oil pipes.
4. Remove air from the clutch system.