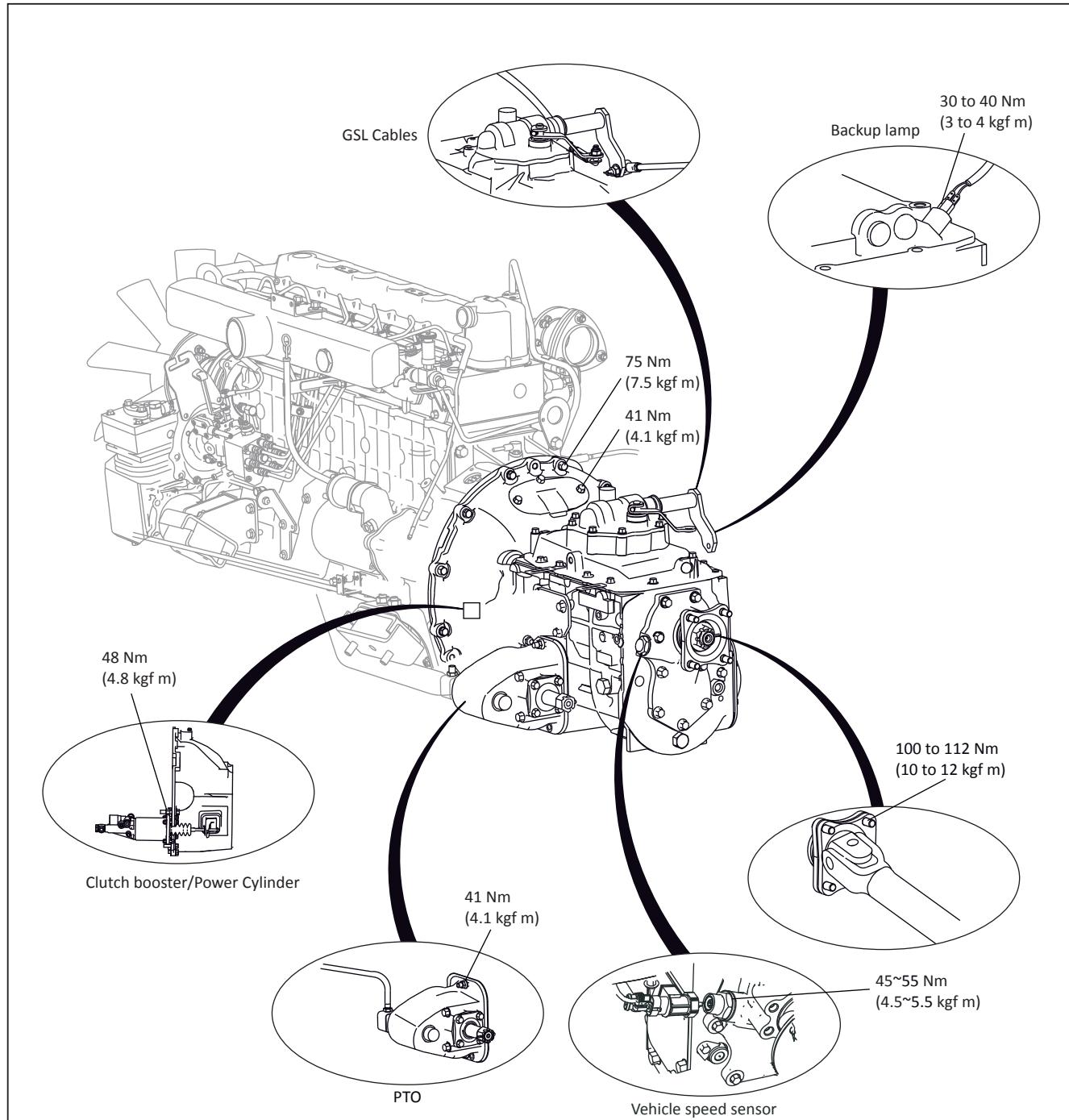


5. SERVICE PROCEDURE

5.1 REMOVAL AND INSTALLATION OF TRANSMISSION



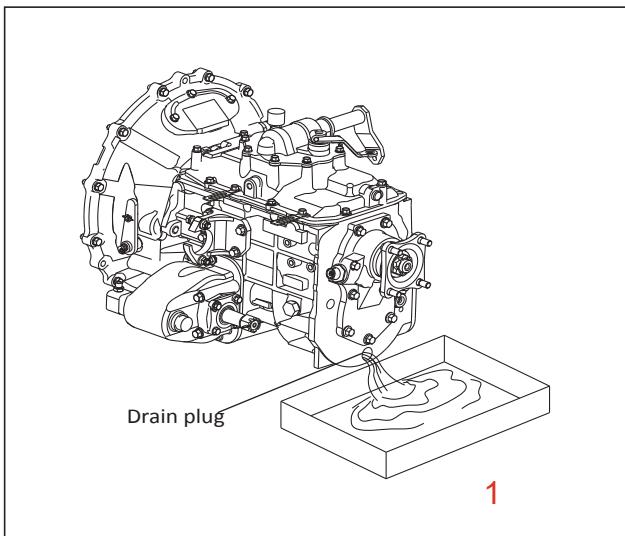
NOTES :

Use Anabond® 683M - RTV Silicone Sealant



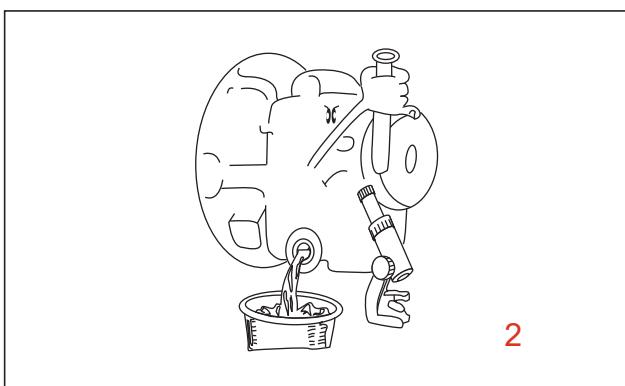
Trucks**Draining Transmission Oil**

- a) Remove the drain plug to drain transmission oil.

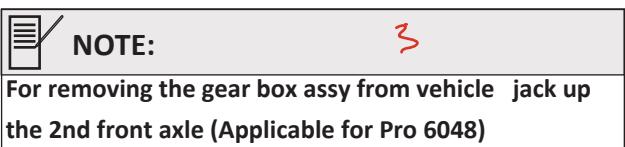


- b) Check the gear oil quantity, when discharged.
Particularly check for metal pieces and chips.

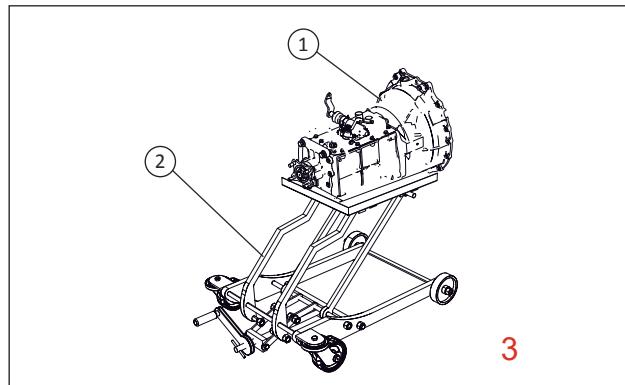
The drain plug is made of magnet and hence it will have metal pieces and chips adhering on its surface. 2

**Positioning the transmission trolley**

- 3
e) Move the trolley below the vehicle, keeping the lifting tray at lower position.
4
f) Align the trolley to the proper position below the transmission.



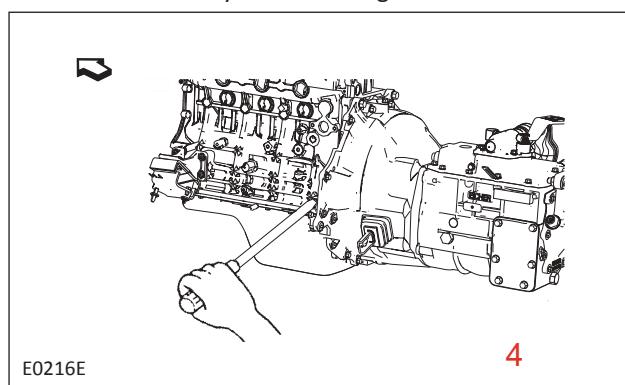
- g) Place the Transmission trolley (ST000095) under the transmission assembly and raise the trolley according to transmission height.



1. Transmission

2. Transmission trolley - ST000095

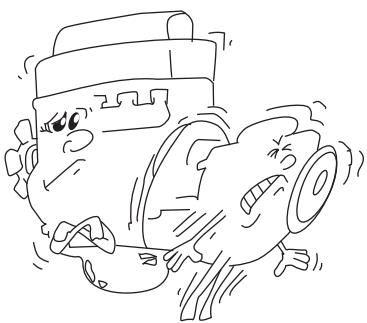
- 6
h) Remove transmission housing mounting bolts mounted with flywheel housing.

**NOTES :** 4

To remove the transmission from the engine. Insert a screw driver into the grooves in the clutch housing.



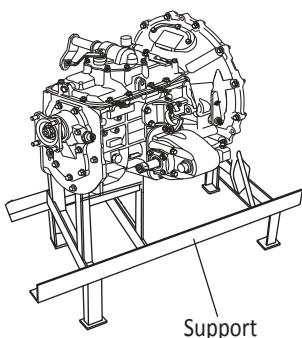
Move the transmission rearwards without jerking. Never jerk the transmission as it could cause damage to the drive pinion, pilot bearing, clutch disc, dowel pin etc.



- 7** i) Lock up the transmission by using locking chain.
 j) Gently lower down the jack, pull it back a little to disconnect main shaft from clutch assembly then fully lower down the jack and take out transmission assembly from vehicle.

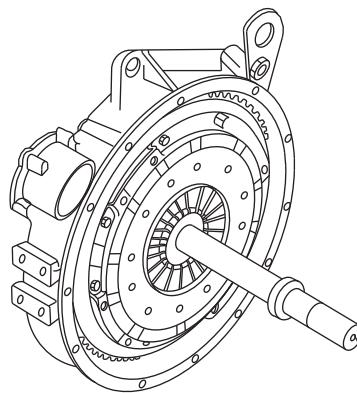
Supporting Transmission

1 Use a transmission jack and support the transmission.



Clutch centring

Center the clutch disc with Clutch Alignment Arbor (special tool).



Clutch Alignment Arbor
(refer special tools for part no)

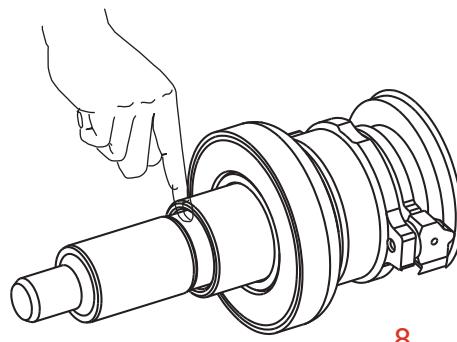
Key Points For Installation

1 Check the drive pinion splines for rust. If rust is found, remove it by wire brushing.

2 Apply grease to the clutch disc sliding surface of the drive pinion, with fingers.

3 Slide the release bearing two or three times to remove excess grease from outside.

(Do not remove grease from the cylindrical portion over which the release bearing slides).



NOTE:

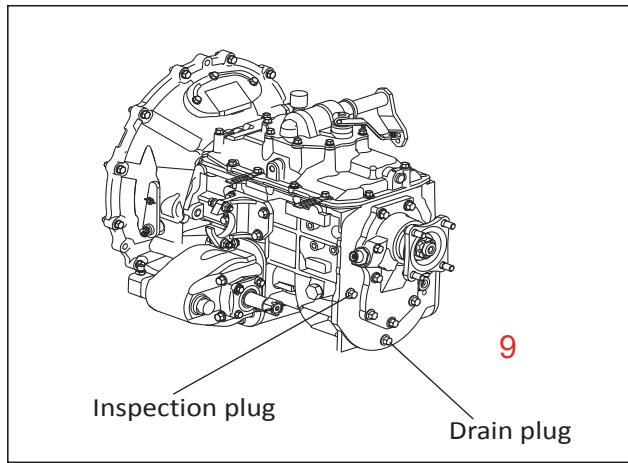
If excess grease is not removed, grease could drip, causing clutch slippage.

4

- 3) Clean the fly wheel housing and clutch housing mounting surface and tighten to specified torque.

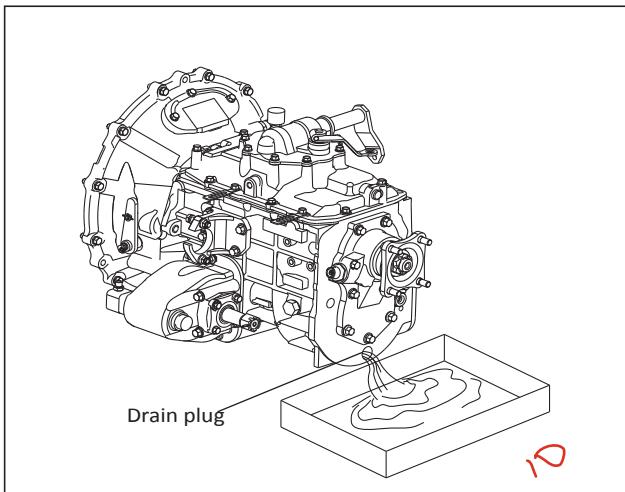
Pouring Transmission Oil

- 1 ● After the transmission is installed, pour oil until it overflows from the inspection port.
- 2 ● For oil Qty. Please refer specifications table
- 3 ● Apply THREEBOND 1105D or equivalent to the threads of the inspection plug and drain plug



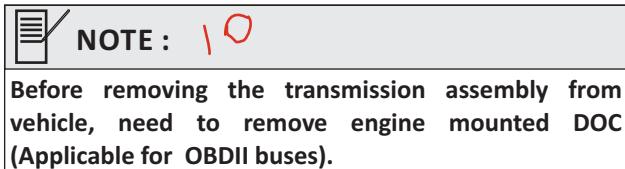
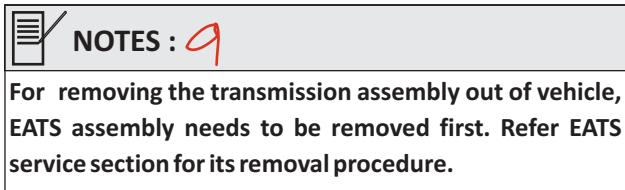
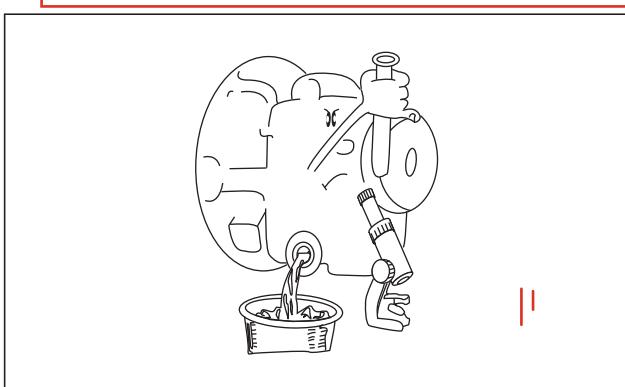
Draining Transmission Oil

- 1 a) Remove the drain plug to drain transmission oil.

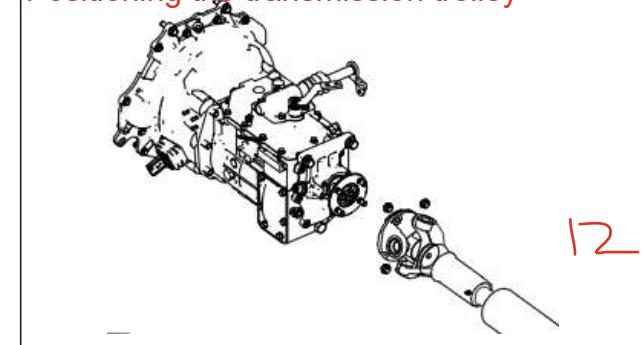


- 1 b) Check the gear oil quantity, when discharged.
2 Particularly check for metal pieces and chips.

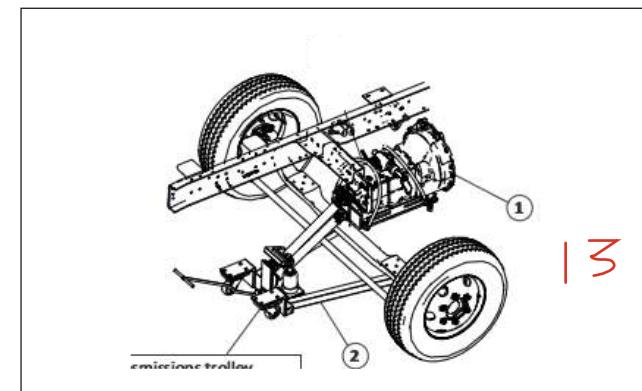
The drain plug is made of magnet and hence it will have metal pieces and chips adhering on its surface. 8



- 1 c) Disconnect shift cable and select cable from shift lever and select lever from transmission side.
2 d) Disconnect propeller shaft and other attaching components like booster connection, sensor electrical connection from transmission side.

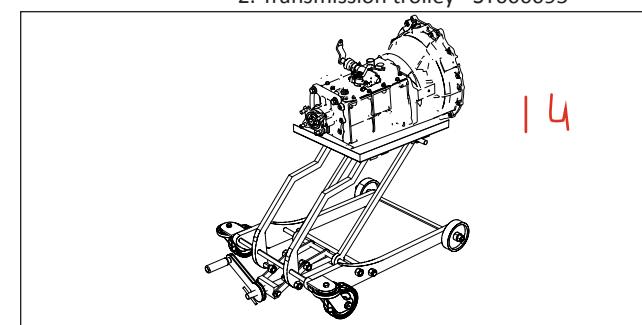
Positioning the transmission trolley

- 3 e) Place the Transmission trolley (ST000095) under the transmission assembly and raise the trolley according to transmission height.

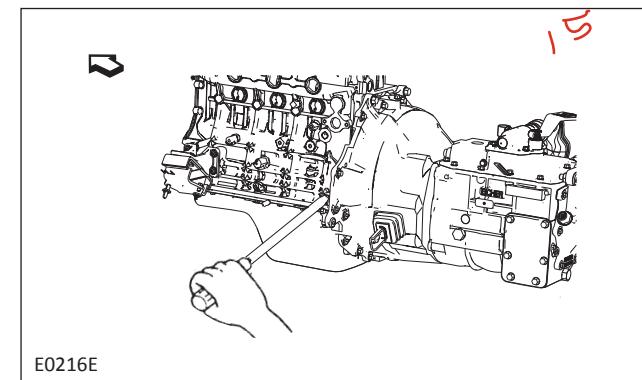


1. Transmission

2. Transmission trolley - ST000095



- 4 f) Remove transmission housing mounting bolts mounted with flywheel housing.



**NOTES :**

11

To remove the transmission from the engine. Insert a screw driver into the grooves in the clutch housing.

**Caution :**

2

Move the transmission rearwards without jerking. Never jerk the transmission as it could cause damage to the drive pinion, pilot bearing, clutch disc, dowel pin etc.

- 5) Gently lower down the trolley pull it back a little to disconnect main shaft from clutch assembly then fully lower down the trolley and take out transmission assembly from vehicle.

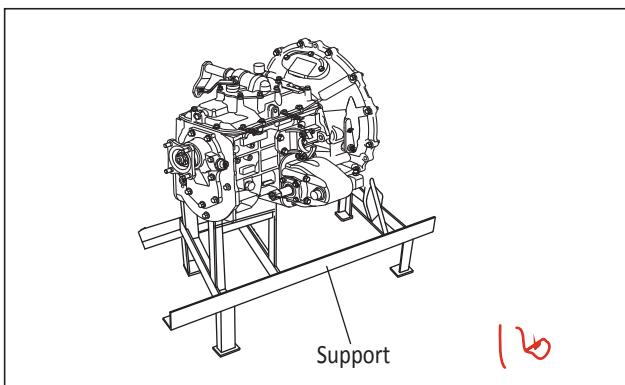
**NOTES :**

12

Transmission assembly to be taken out from STC (Side Tyre Carrier) hatch provided on LH side of vehicle.

Supporting Transmission

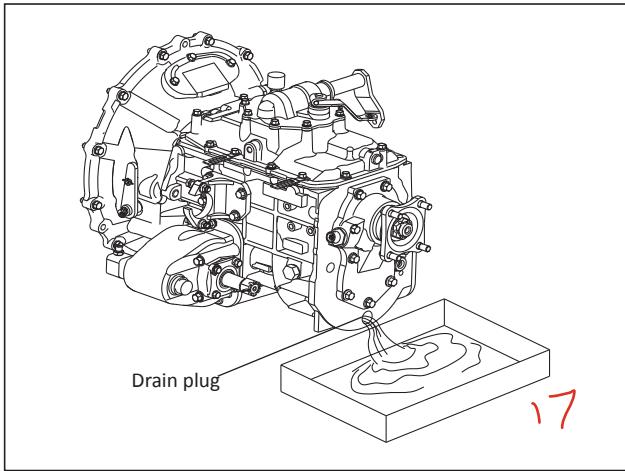
- 1) Use a transmission jack and support the transmission.



6019 HD BUS

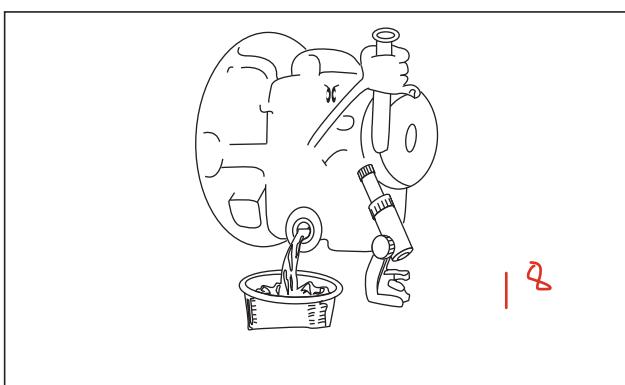
Draining Transmission Oil

- 1 a) Remove the drain plug to drain transmission oil.

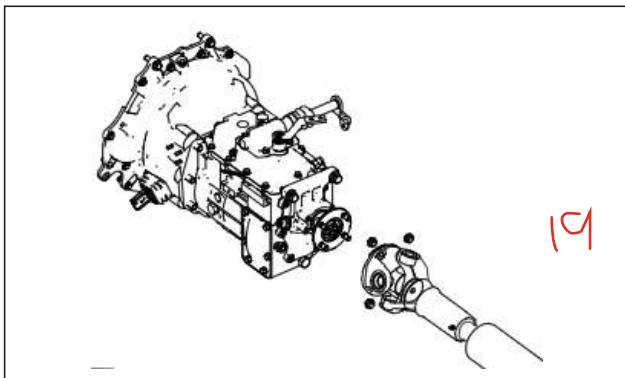


- 2 b) Check the gear oil quantity, when discharged.
Particularly check for metal pieces and chips.

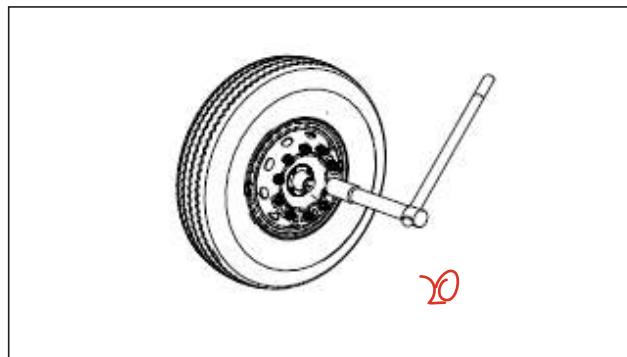
The drain plug is made of magnet and hence it will have metal pieces and chips adhering on its surface. 13



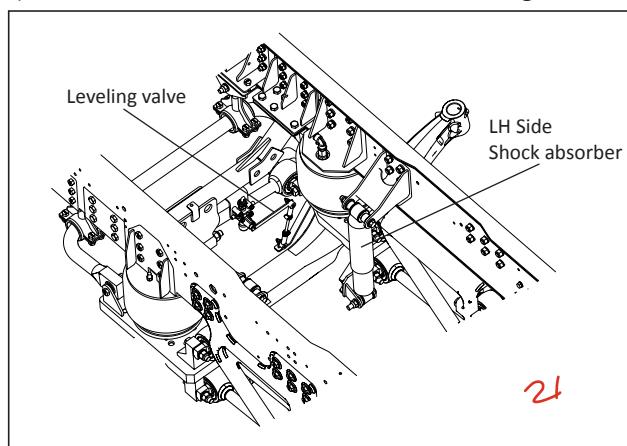
- 1 c) Disconnect shift cable and select cable from shift lever and select lever from transmission side.
2 d) Disconnect propeller shaft and other attaching components like booster connection, sensor electrical connection from transmission side.



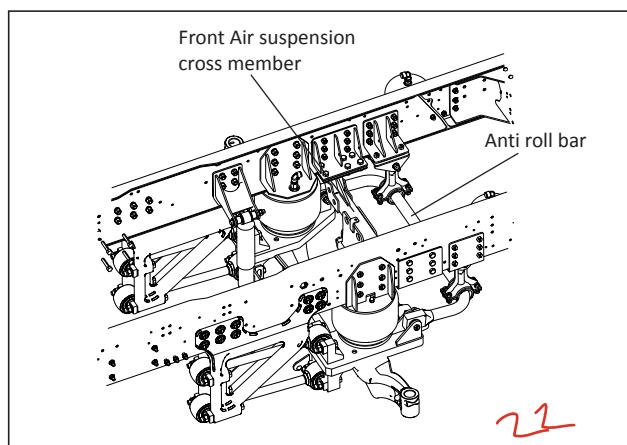
- 3 e) Remove the LH side tyre.



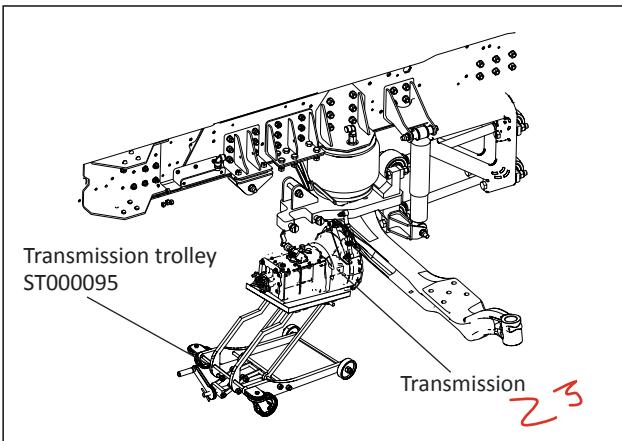
- 4 f) Remove the LH side shock absorber & leveling valve.



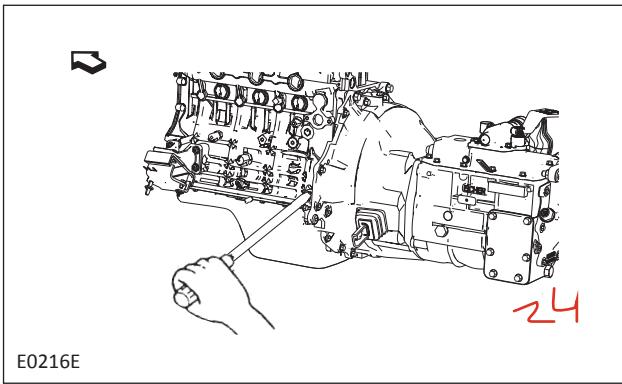
- 5 g) Remove the anti-roll bar & front air suspension cross member before placing transmission trolley.



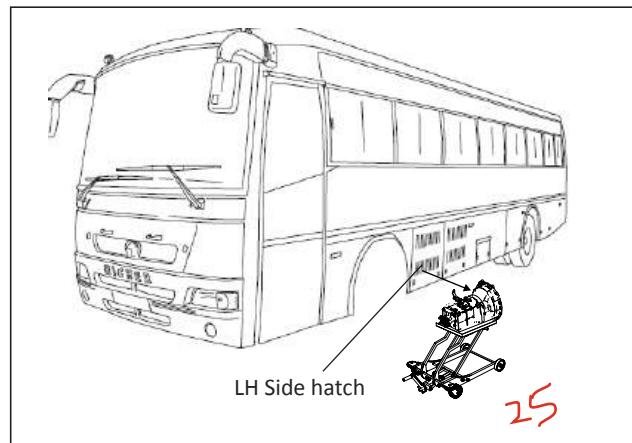
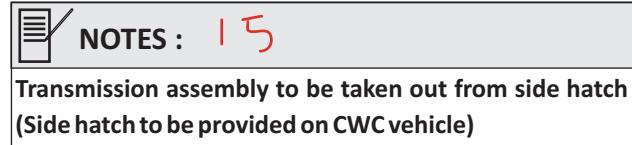
- 6 h) Place the Transmission trolley (ST000095) under the transmission assembly and raise the trolley according to transmission height.



- 7) i) Remove transmission housing mounting bolts mounted with flywheel housing.

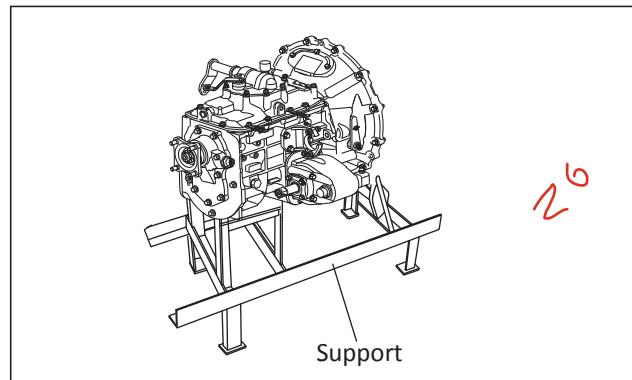
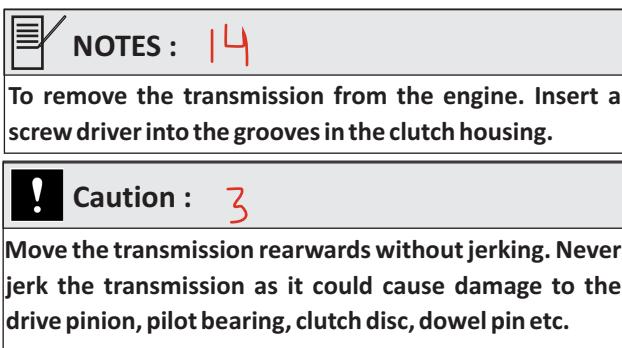


- 8) j) Gently lower down the trolley pull it back a little to disconnect main shaft from clutch assembly then fully lower down the trolley and take out transmission assembly from vehicle.



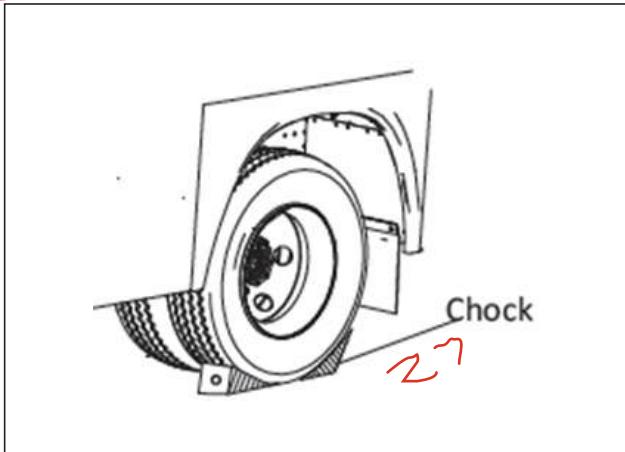
Supporting Transmission

1) Use a transmission jack and support the transmission.

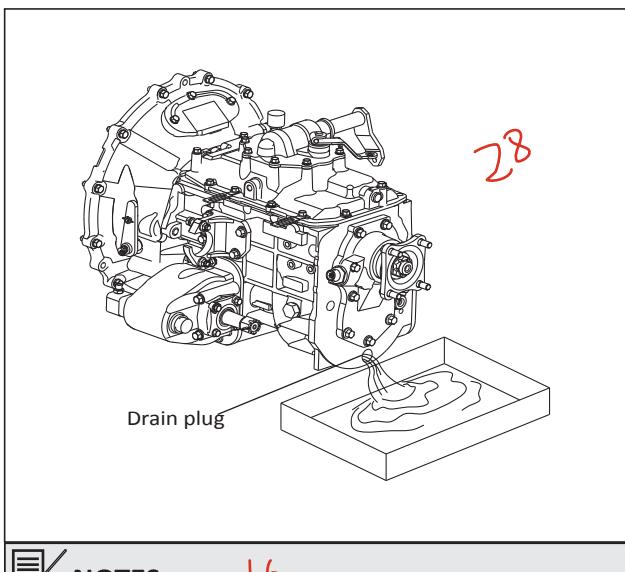


Pro Skyline AMT Buses

- 1** a) Disconnect battery cable (-ve) from battery terminal.
2 b) Chock the wheel of vehicle.



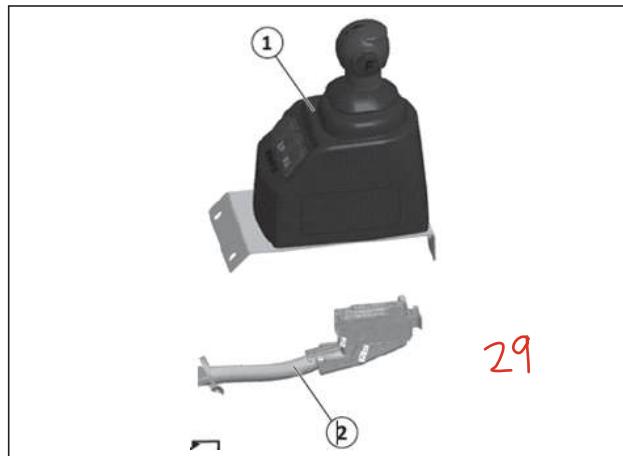
- 3** c) Remove the drain plug to drain transmission oil. Collect the oil in basket.



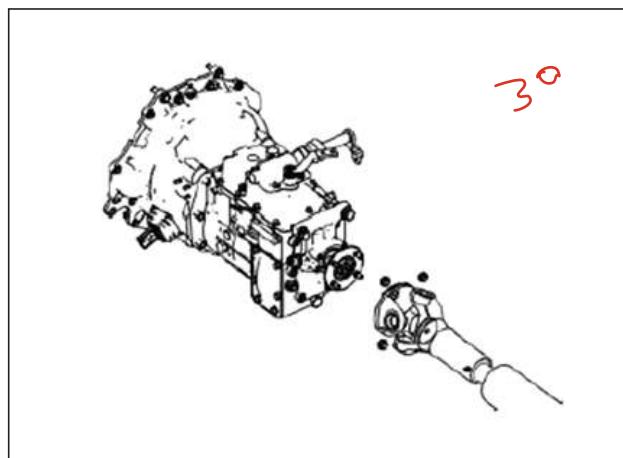
NOTES : **16**

For removing the transmission assembly out of vehicle, EATS assembly needs to be removed first. Refer EATS service section for its removal procedure.

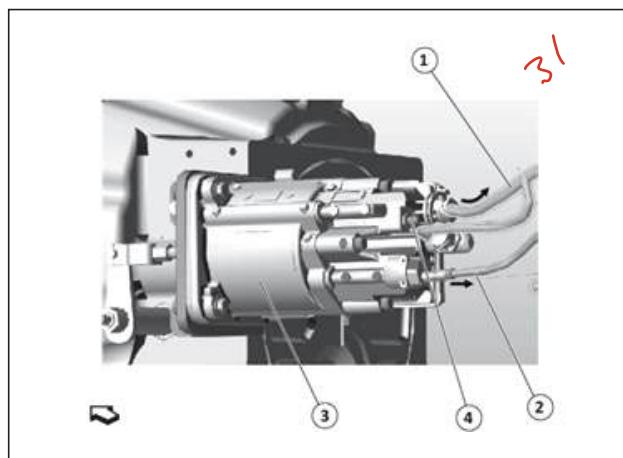
- 4** d) Disconnect all SLU connection from transmission side.



- 1**. SLU (Shift Unit Level) **2**. Wiring harness
5 e) Disconnect propeller shaft and other attaching components like booster connection, sensor electrical connection from transmission side.

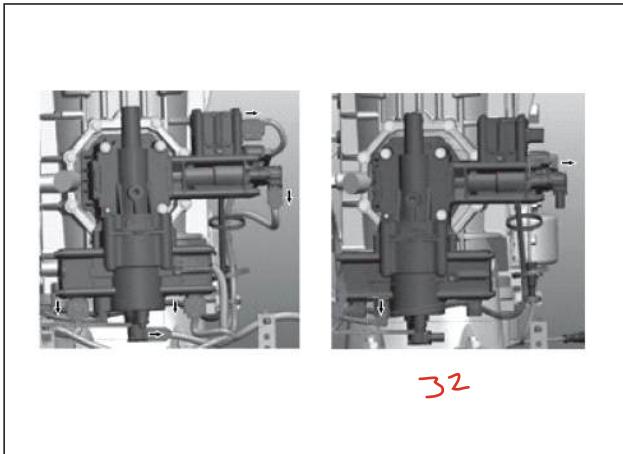


- 6** f) Disconnect the electrical and pneumatic connections from PCA.



- 1**. Electrical connection **3**. Pneumatic Clutch Actuator (PCA)
2. Pneumatic connection **4**. Bleed port

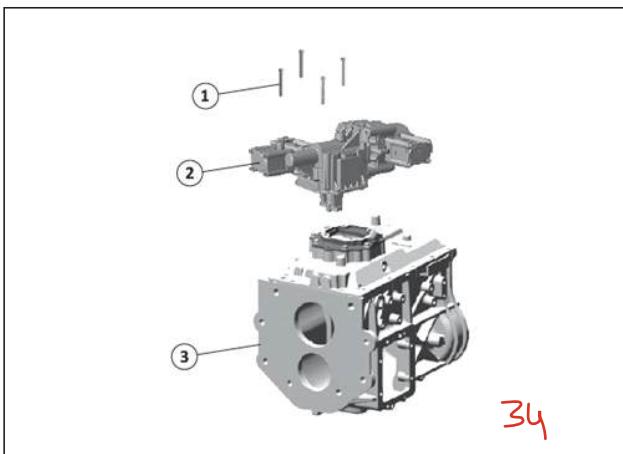
- 7 g) Disconnect all electrical and pneumatic connections from X-Y Actuator.



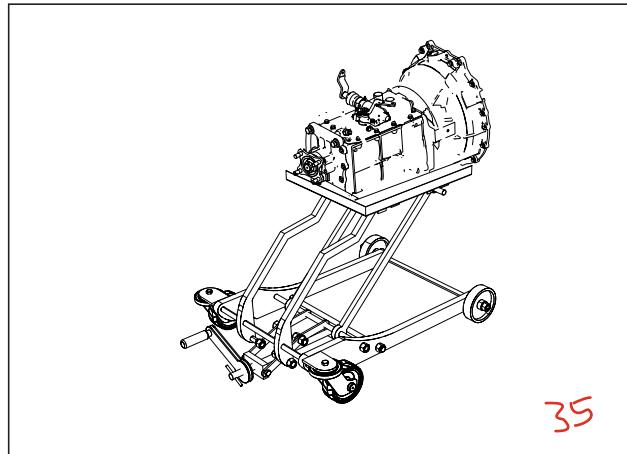
- 8 h) Open four bolt of Service Hatch Provided in inner bus body for Transmission and remove hatch.



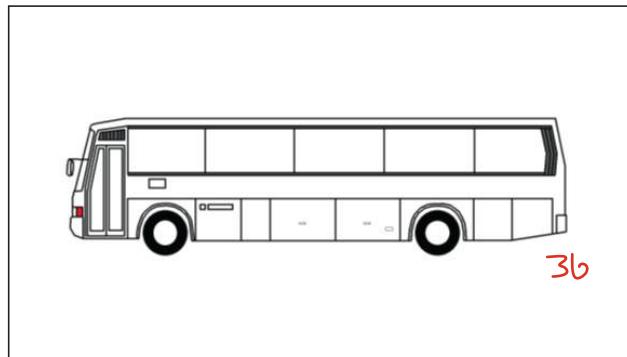
- 9 i) Remove XY actuator from hatch by opening the 4 bolt of XY actuator for removing the transmission.



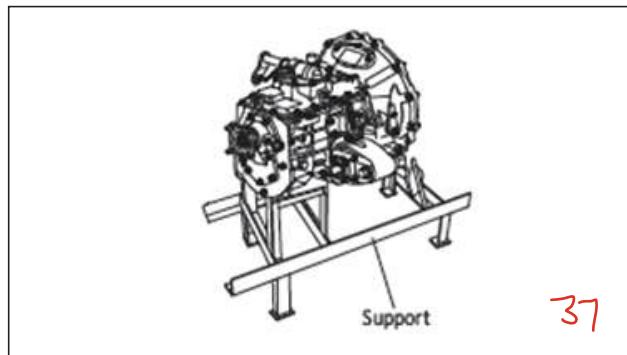
- j) Place the Transmission trolley under the transmission assembly and raise the trolley according to transmission height



- 10 k) Remove transmission housing mounting bolts mounted with flywheel housing. To remove the transmission Insert a screw driver into the grooves in the clutch housing.
- 11 l) Lock up the transmission by using locking chain
- 13 m) Gently lower down the jack, pull it back a little to disconnect main shaft from clutch assembly then fully lower down the jack and take out transmission assembly from vehicle by using STC hatch.

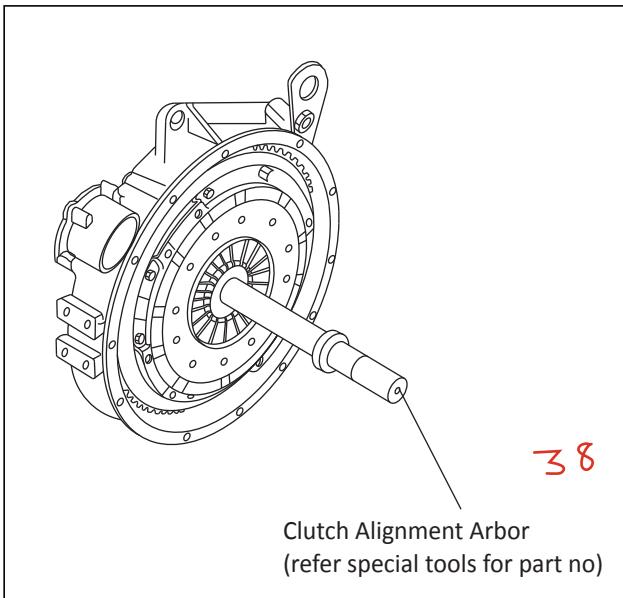


- 14 n) Use a transmission jack and support the transmission



Clutch centring

Center the clutch disc with Clutch Alignment Arbor (special tool).

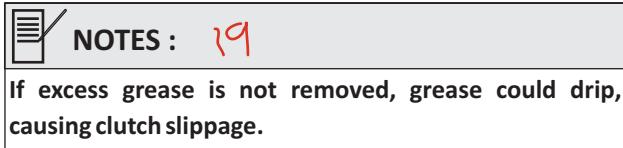
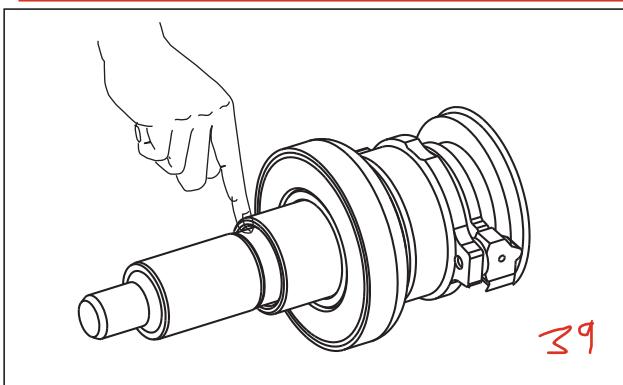
**Key Points For Installation**

1) Check the drive pinion splines for rust. If rust is found, remove it by wire brushing.

2) Apply grease to the clutch disc sliding surface of the drive pinion, with fingers.

3) Slide the release bearing two or three times to remove excess grease from outside.

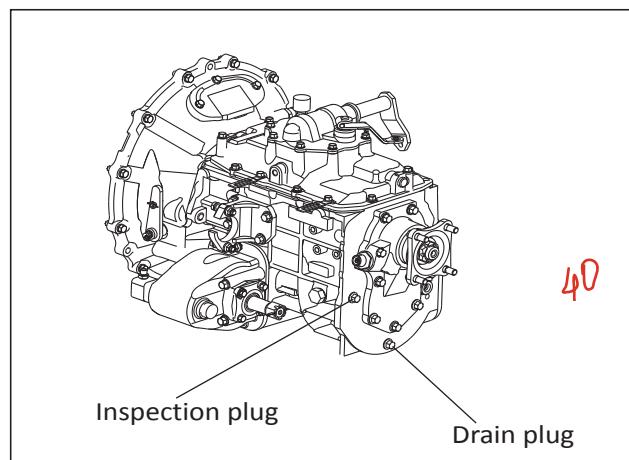
(Do not remove grease from the cylindrical portion over which the release bearing slides).



2) Clean the fly wheel housing and clutch housing mounting surface and tighten to specified torque.

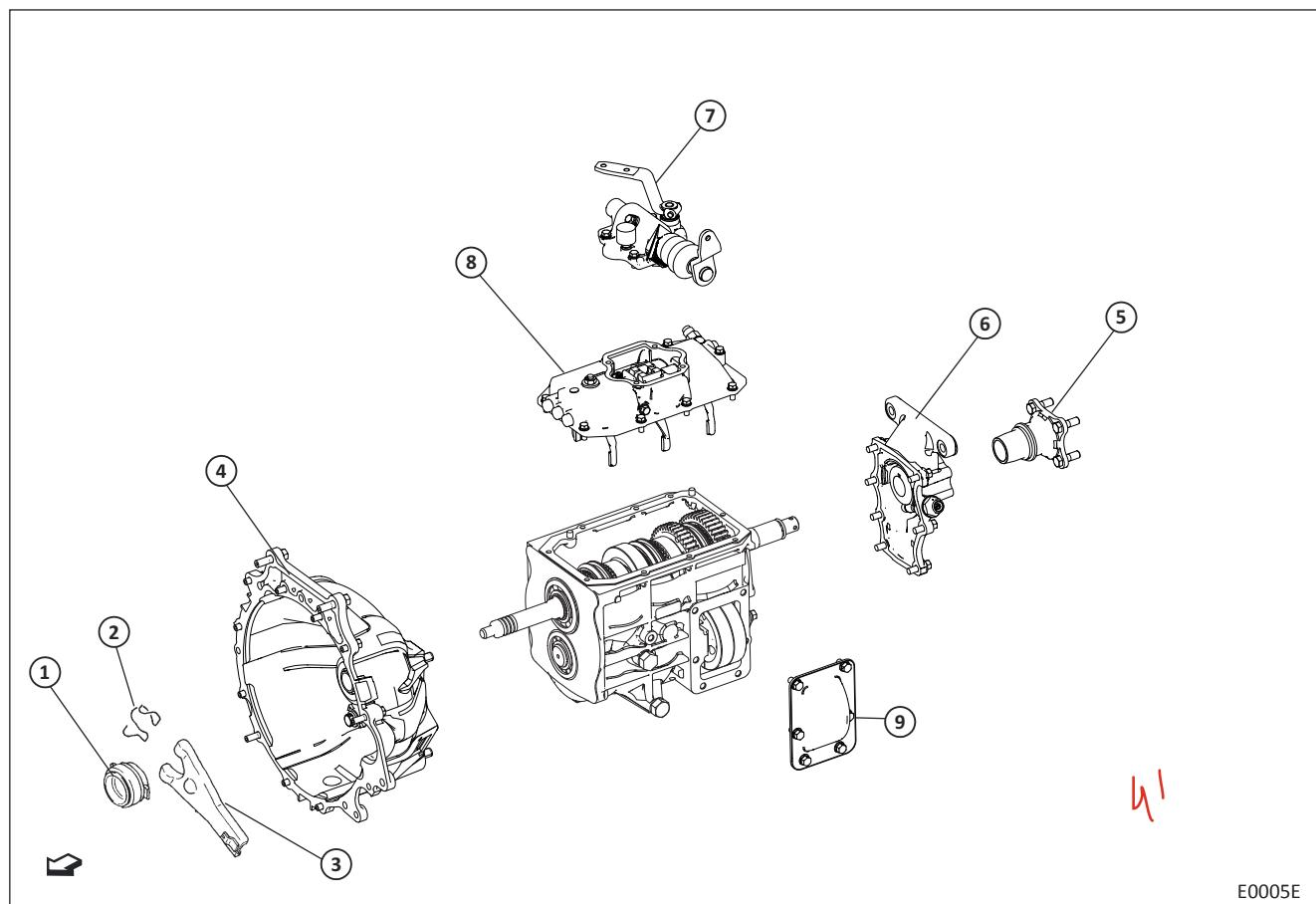
Pouring Transmission Oil

- After the transmission is installed, pour oil until it overflows from the inspection port.
- For oil Qty. Please refer specifications table
- Apply THREEBOND 1105D or equivalent to the threads of the inspection plug and drain plug



5.2 DISASSEMBLY AND REASSEMBLY OF TRANSMISSION (Horizontal type)

5.2.1 Transmission Disassembly & Assembly



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9

1. Clutch release bearing

2. Return spring

3. Clutch release rocker arm

4. Clutch housing

5. Companion flange

6. Rear cover

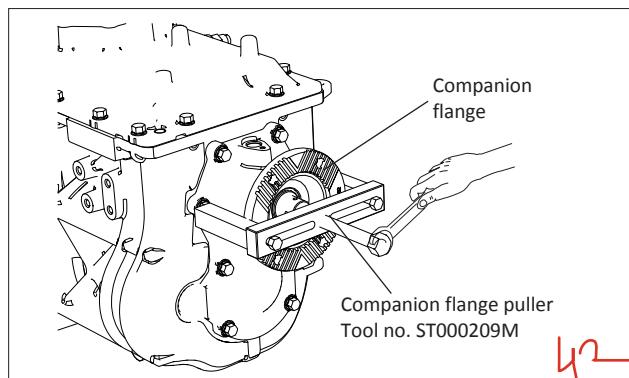
Assembly Sequence

9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

7. Gear shifter upper

8. Gear shifter lower

9. PTO cover



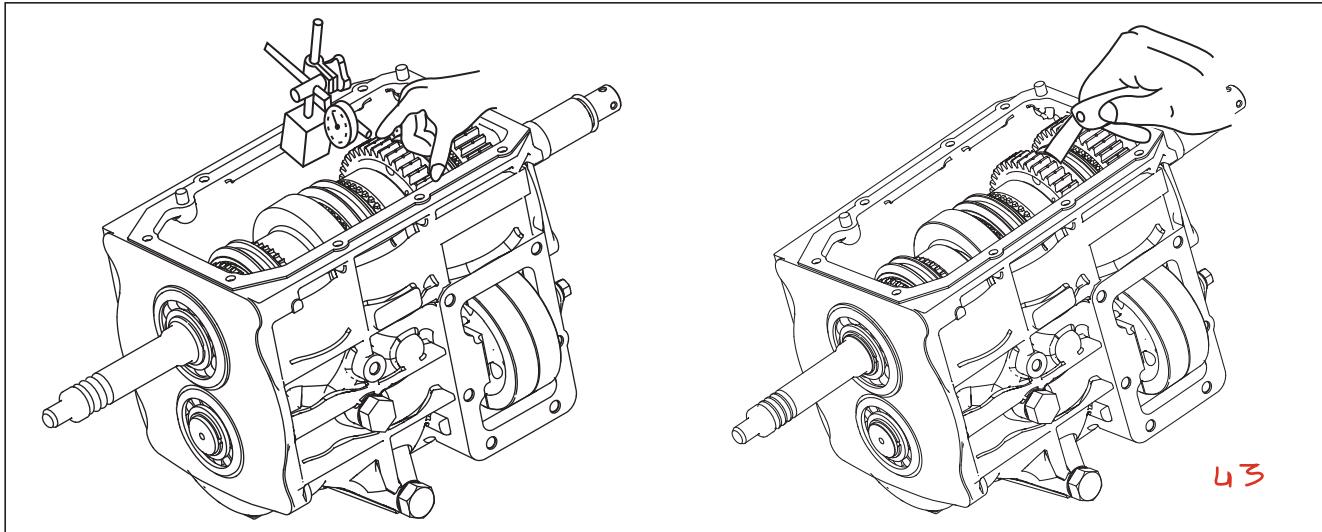
NOTES : 20

Do not remove the oil seal unless defective.

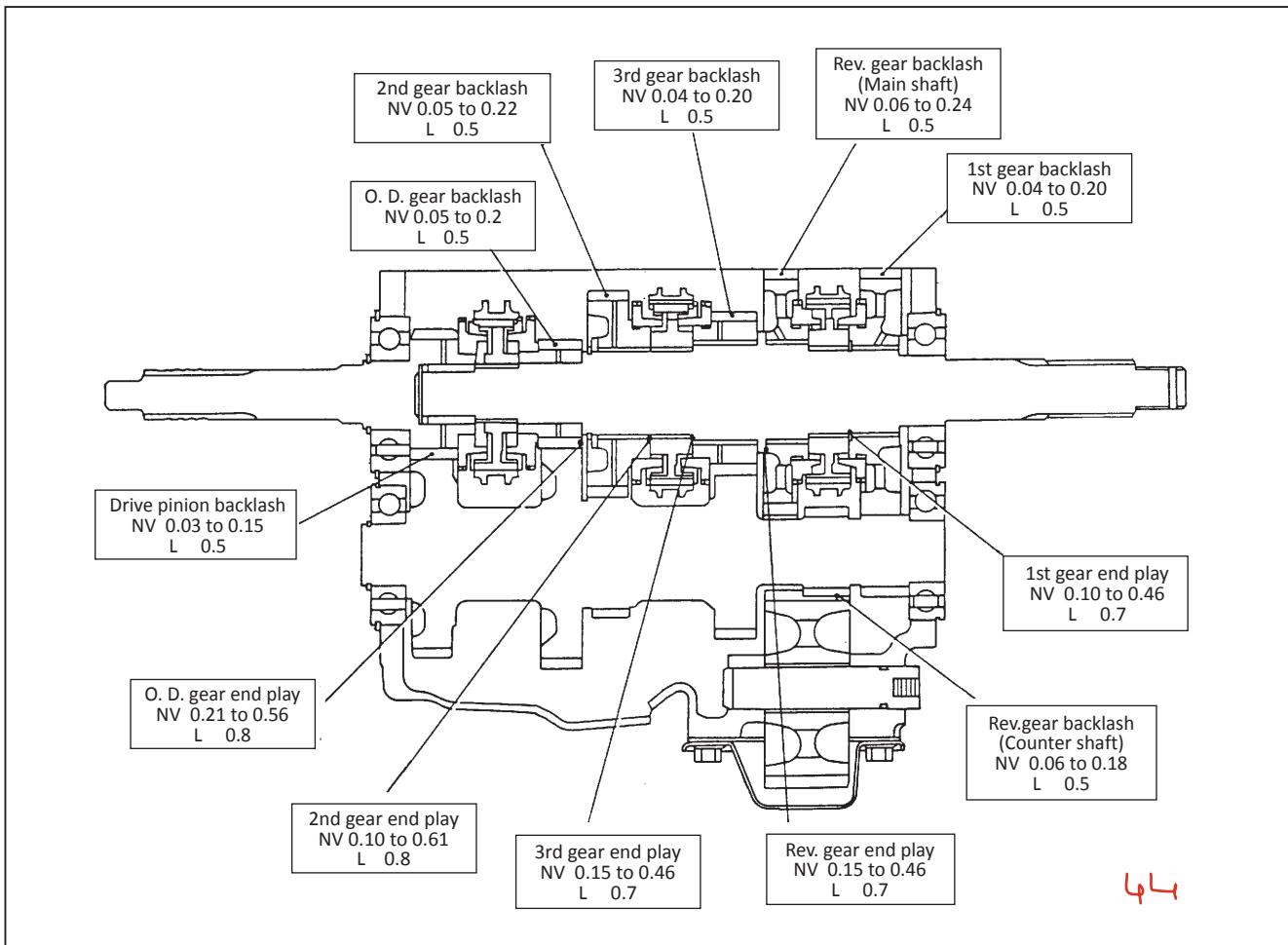
- 1 Use companion flange puller special tool ST000209M to remove the companion flange

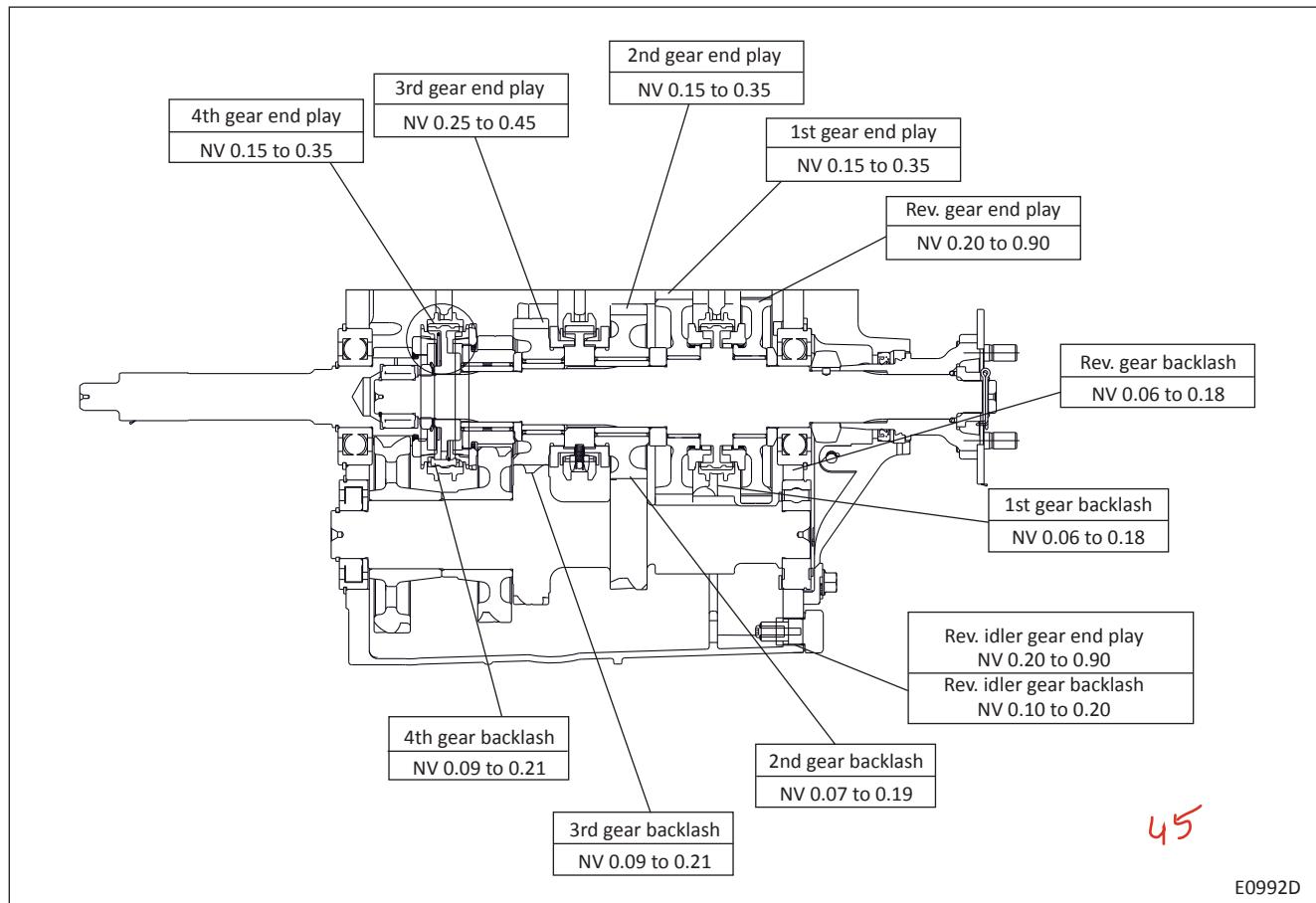
5.2.2 INSPECTION BEFORE DISASSEMBLY

Before disassembly, measure backlash and end play of each gear. If the measured value exceeds the service limit, replace the defective parts.

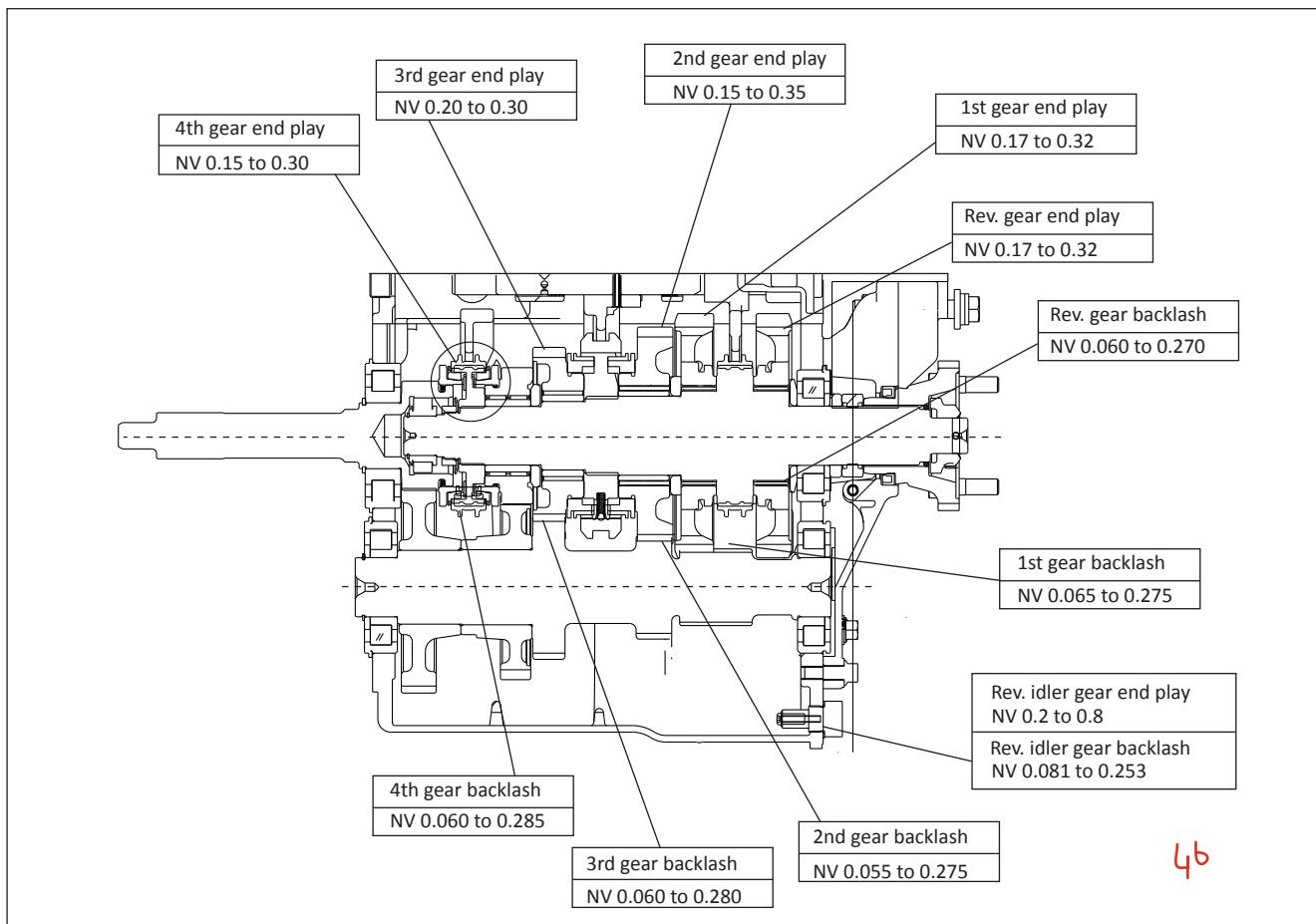


5.2.2.1 Transmission assembly gear end play & backlash ET30S5

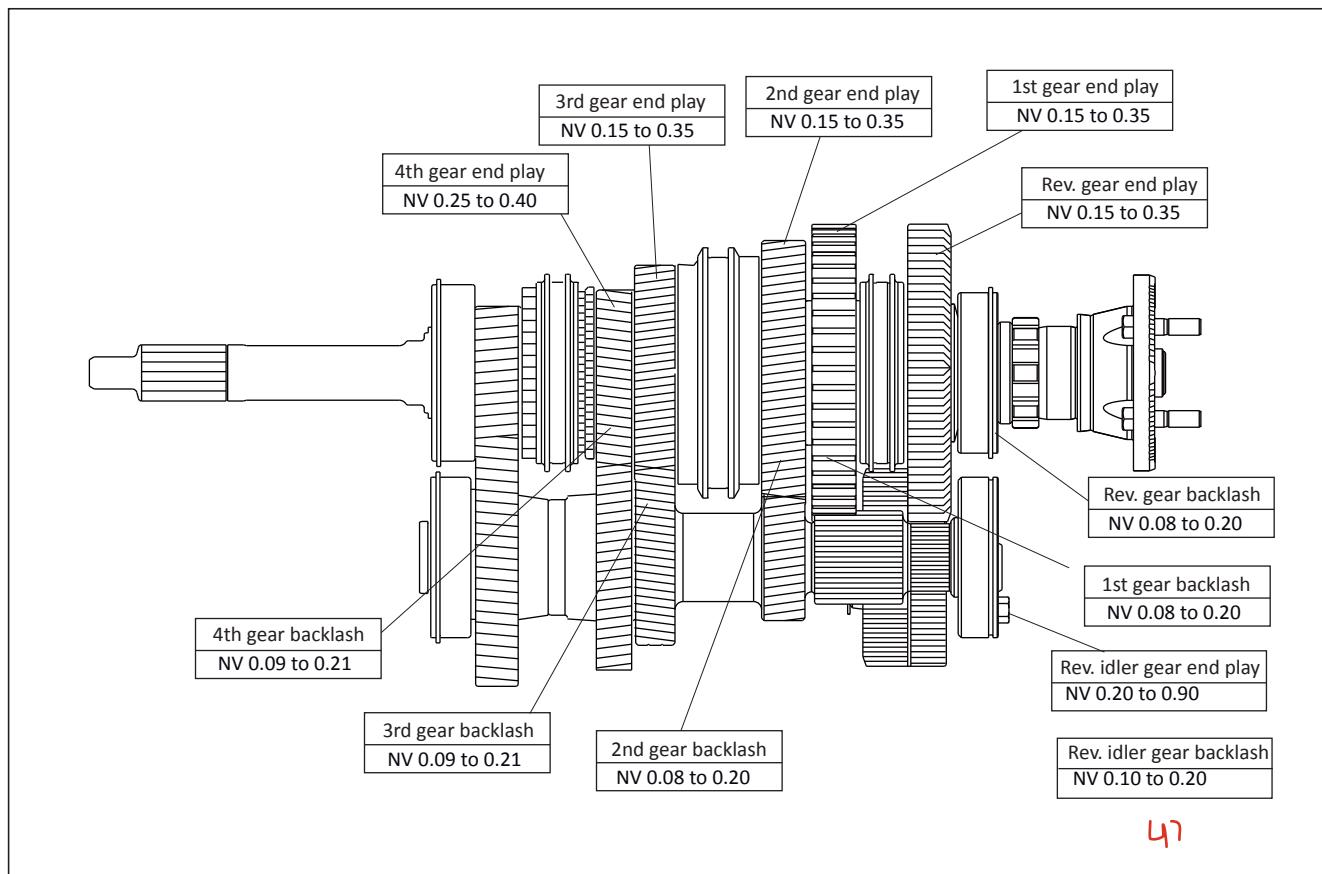


5.2.2.2 Transmission assembly gear end play & backlash ET35S5

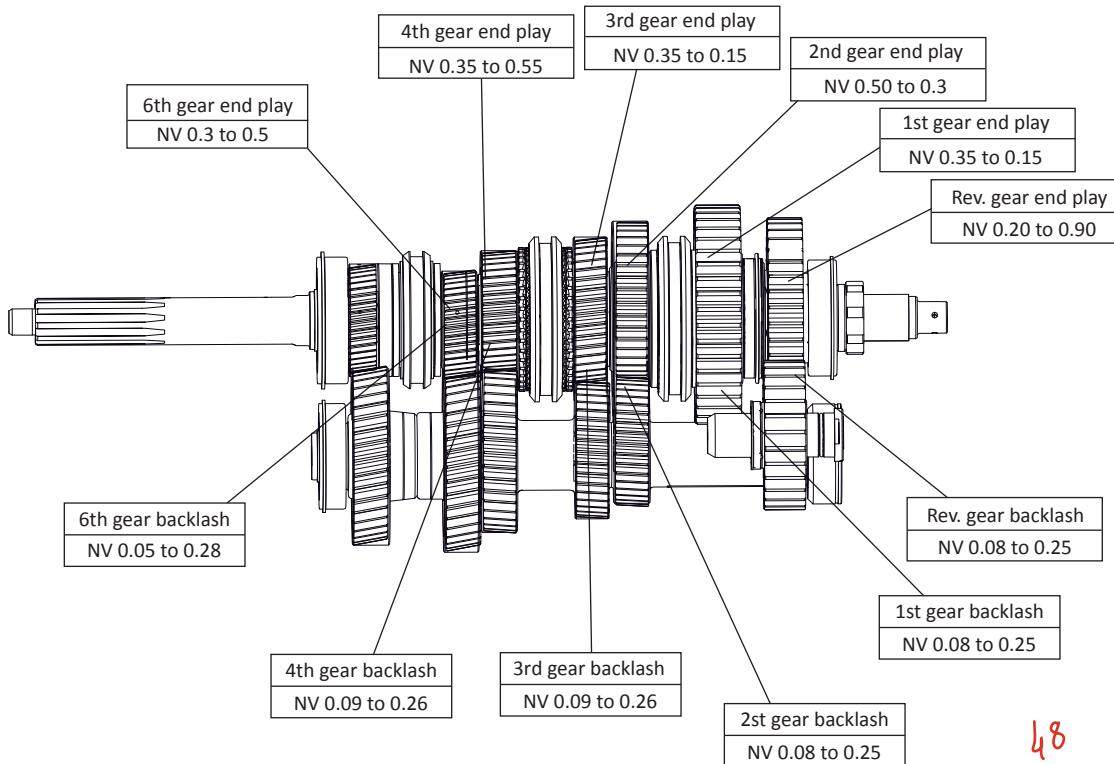
E0992D

5.2.2.3 Transmission assembly gear end play & backlash ET40S5

5.2.2.4 Transmission assembly gear end play & backlash ET60S5

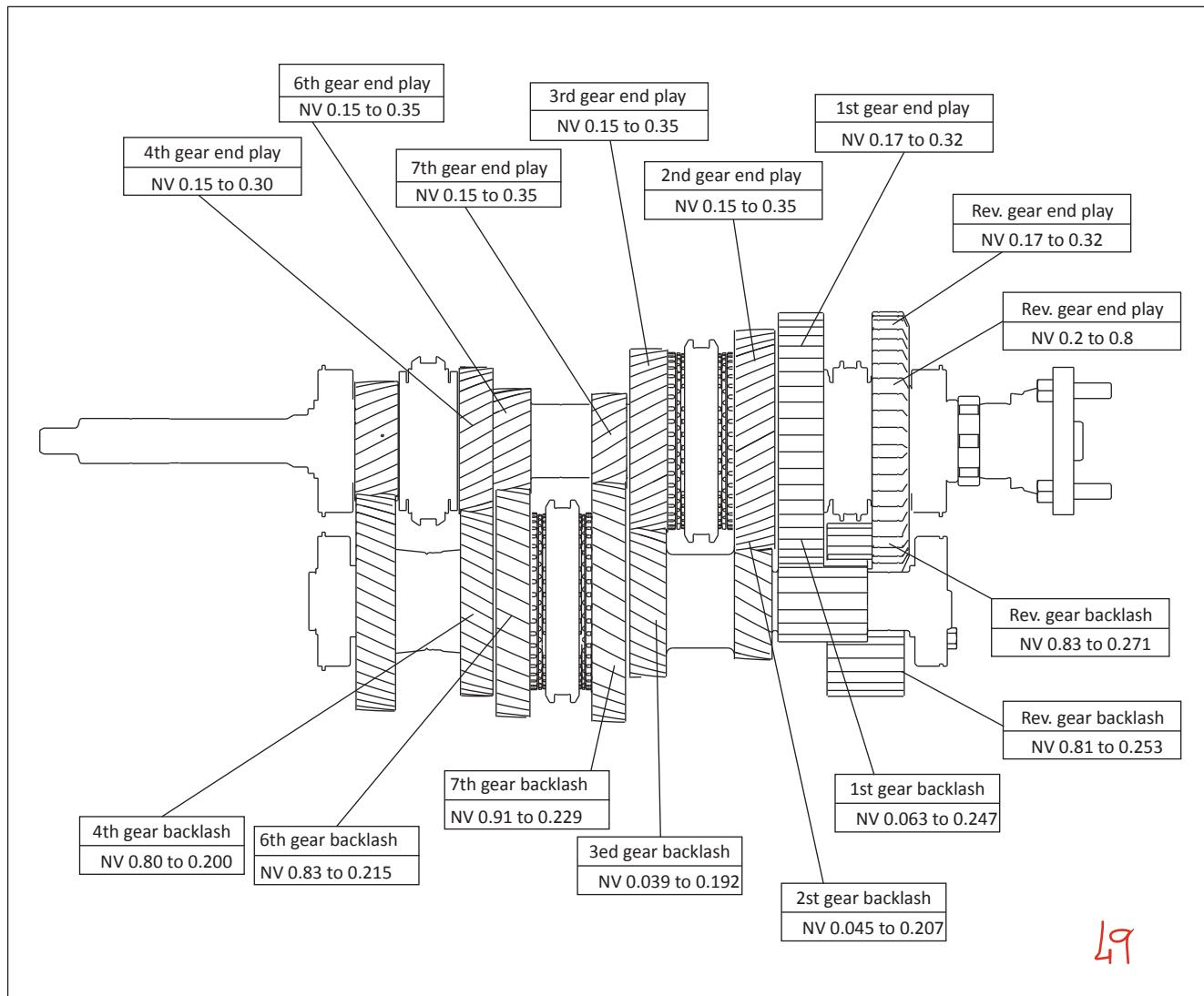


5.2.2.5 Transmission assembly gear end play & backlash ET70S6



E2289D

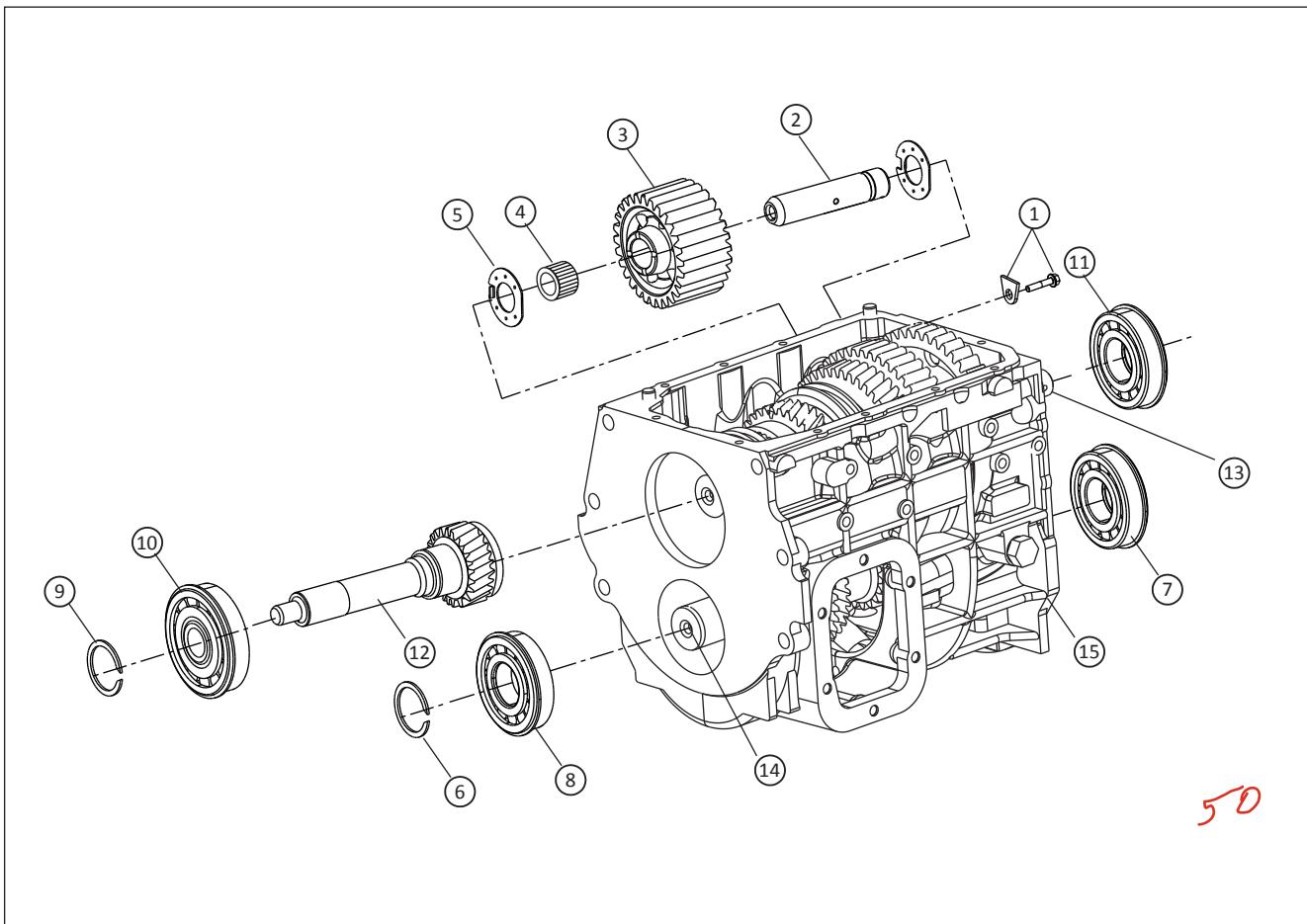
5.2.2.6 Transmission assembly gear end play & backlash ET50S7 / ET60S7



NOTES : 21

If the assembly standard play in diametrical direction is not obtained even after bearing replacement, check the main shaft and replace as needed.

5.2.3 DISASSEMBLY & ASSEMBLY OF TRANSMISSION

**Disassembly Sequence**

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15

Assembly Sequence

15 → 14 → 13 → 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

1 Lock piece & Bolt

2 Reverse gear shaft & O ring

3 Reverse gear

4 Needle roller bearing

5 Washer Reverse idler gear

6 Snap ring

7 Bearing

8 Bearing

9 Snap ring

10 Bearing

11 Bearing

12 Drive pinion

13 Main shaft

14 Counter shaft

15 Transmission case

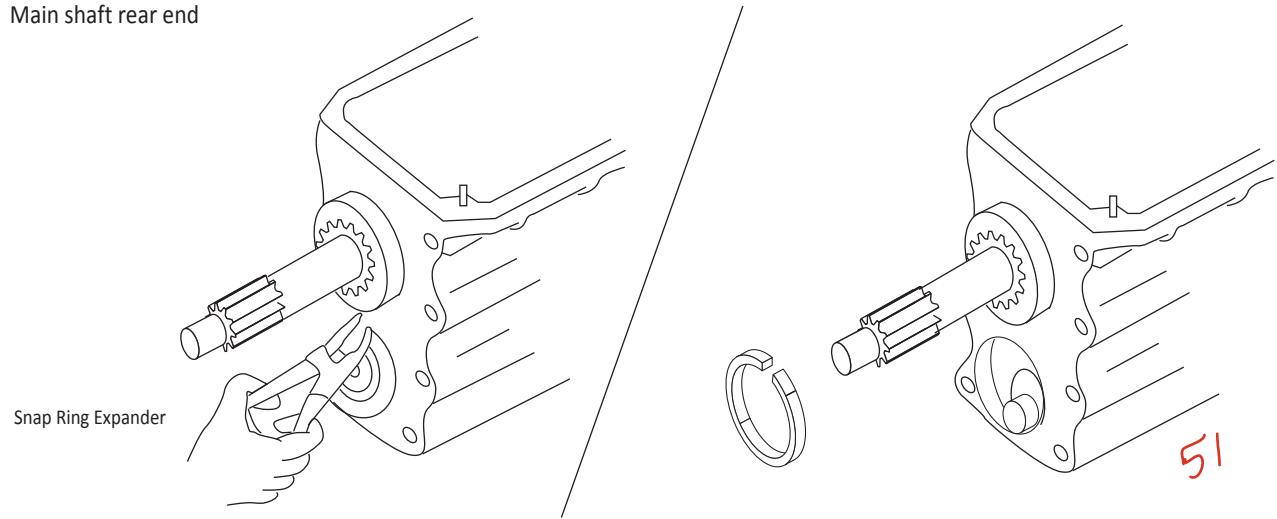


NOTES : 22

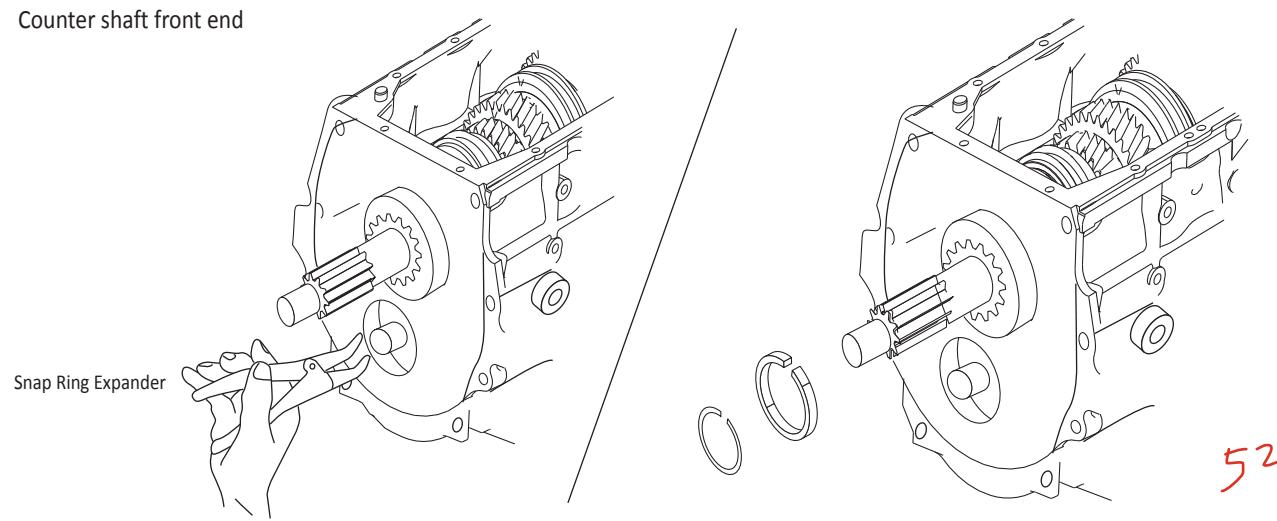
Before removing the main shaft assembly, remove all bearings from front and rear ends of the counter shafts and lay counter shaft in the transmission case.

- 2) Use Snap Ring Expander (standard tool) to remove snap rings.

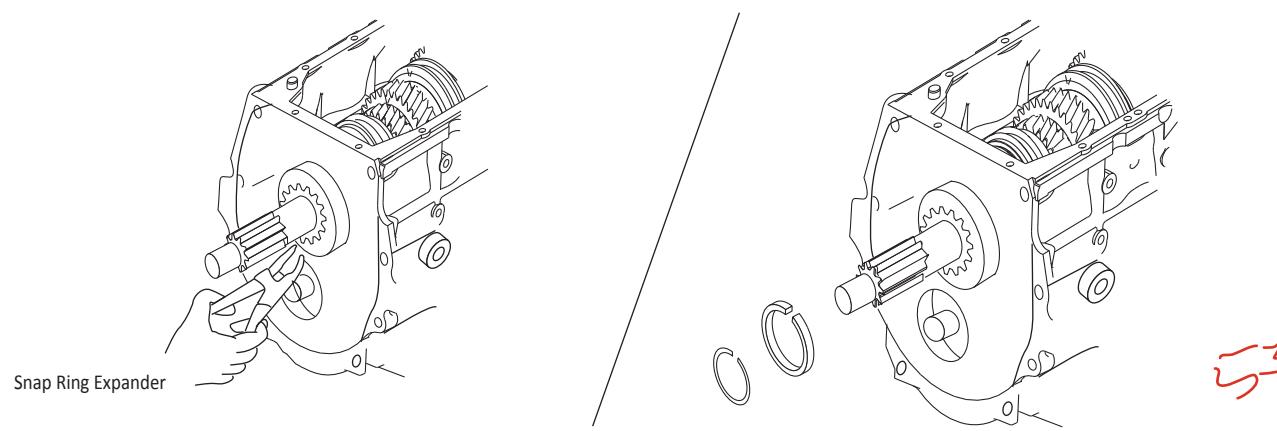
Main shaft rear end



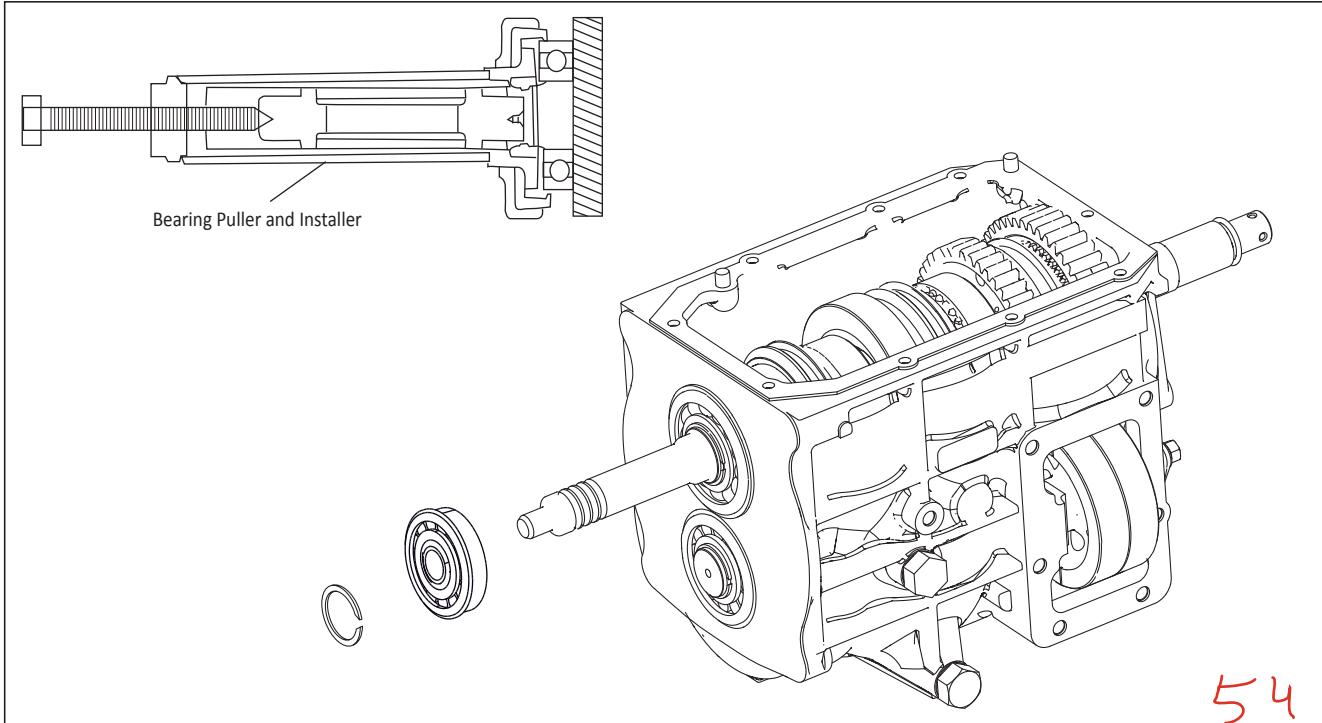
Counter shaft front end



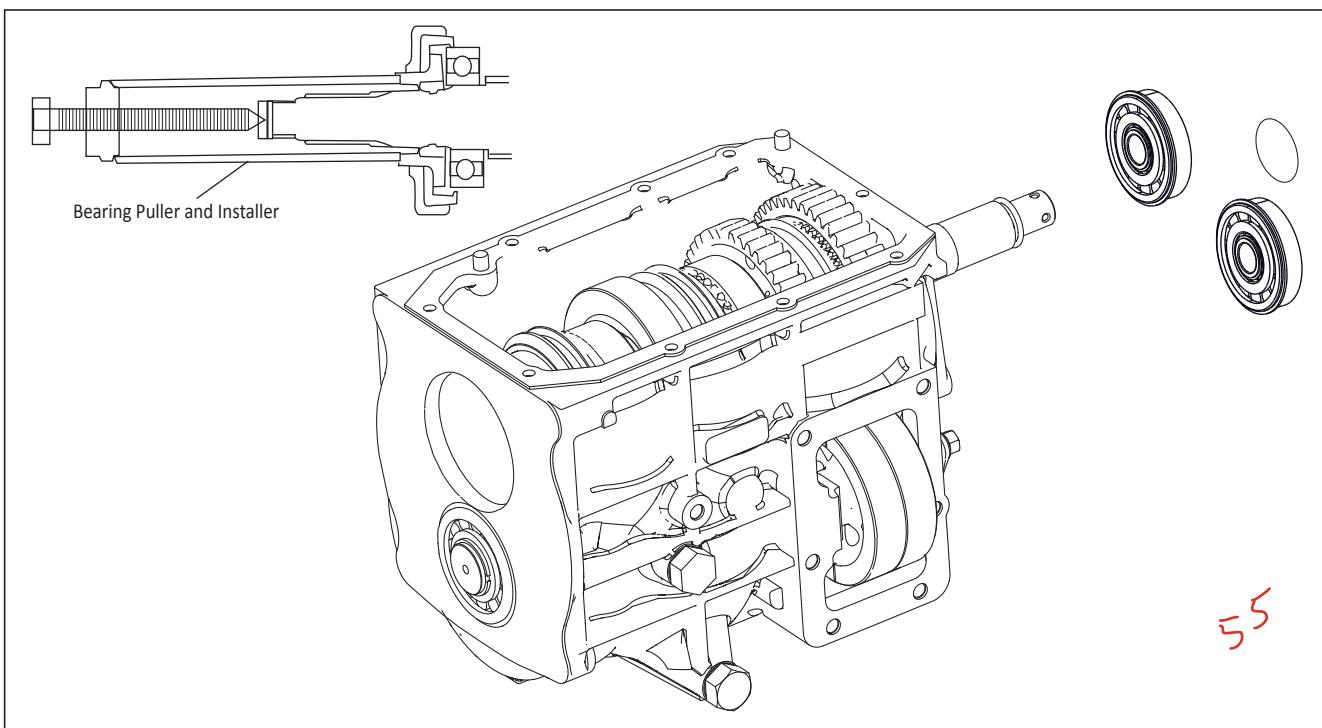
Drive pinion



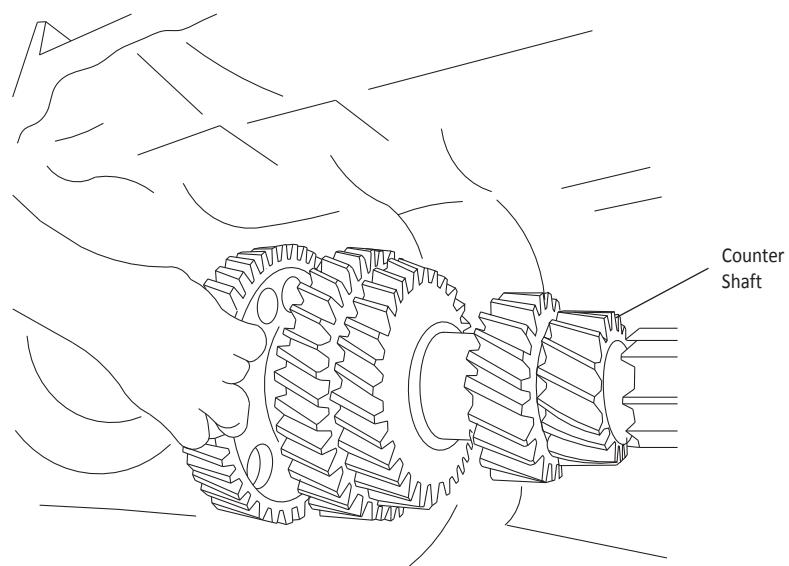
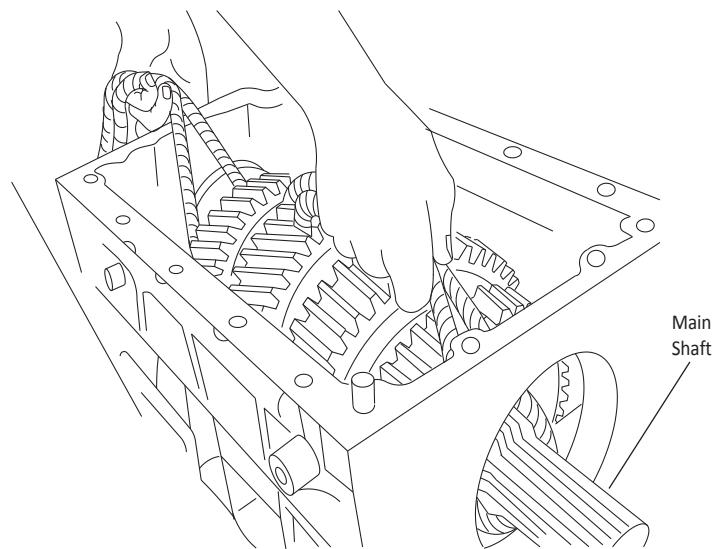
- 2 3) Use Bearing puller & Installer (special tool) to remove front and rear bearings from the counter shaft. (Refer service tools for part no.)



- 3 4) Use Bearing Puller & Installer (special tool) to remove the bearing from the rear of the main shaft. (Refer service tools for part no.)

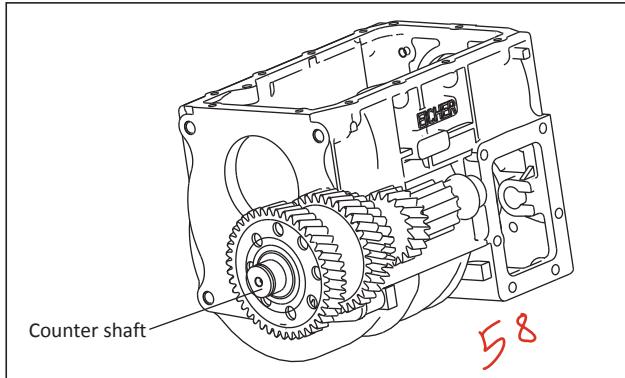


- 4 Support the main shaft assembly and hold the first gear.
Next lift the main shaft assembly by slightly tilting it and remove from the gear box. Then remove the counter shaft assembly.



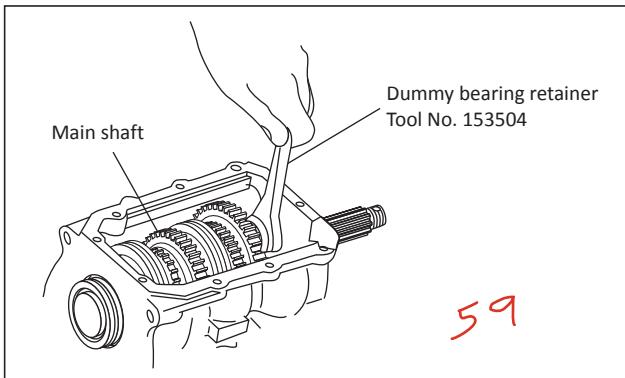
1) Counter shaft assembly

- 5 Place the counter shaft assembly in the bottom of the transmission case positioned correctly forward to backward.

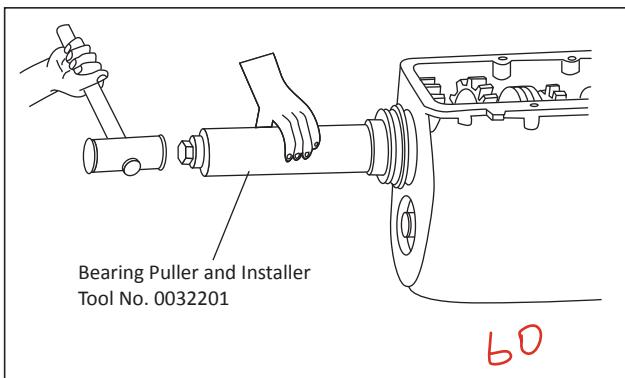


2) Main Shaft Assembly

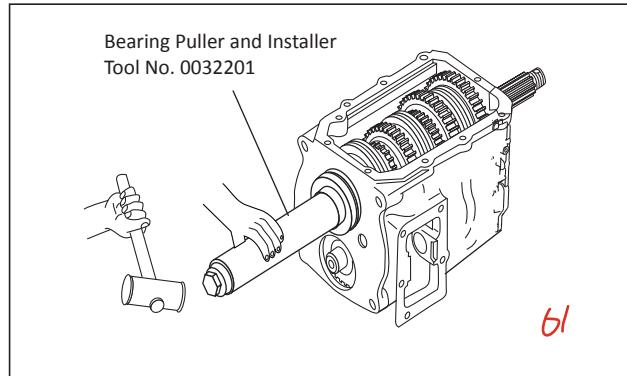
- 6 Support the front of the main shaft by dummy bearing retainer (special tool).



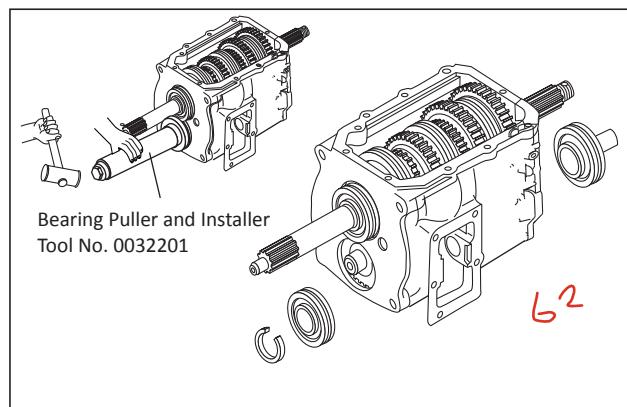
- 7 3) Use bearing installer (Special tool) to install the bearing fitted with snap ring to the rear end of the main shaft.



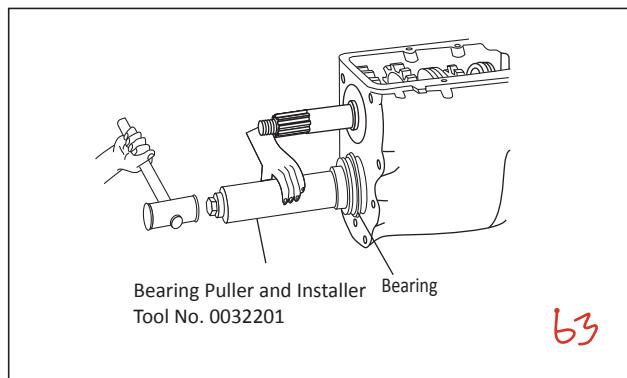
- 8 4) Use Bearing Installer (special tool) when installing the bearing to the drive pinion and when installing the drive pinion to the transmission case.



- 9 5) Support the rear of the counter shaft by counter shaft dummy bearing (Special tool). Use bearing Installer (Special tool) to install the bearing fitted with snap ring. Then, install the snap ring on counter shaft.

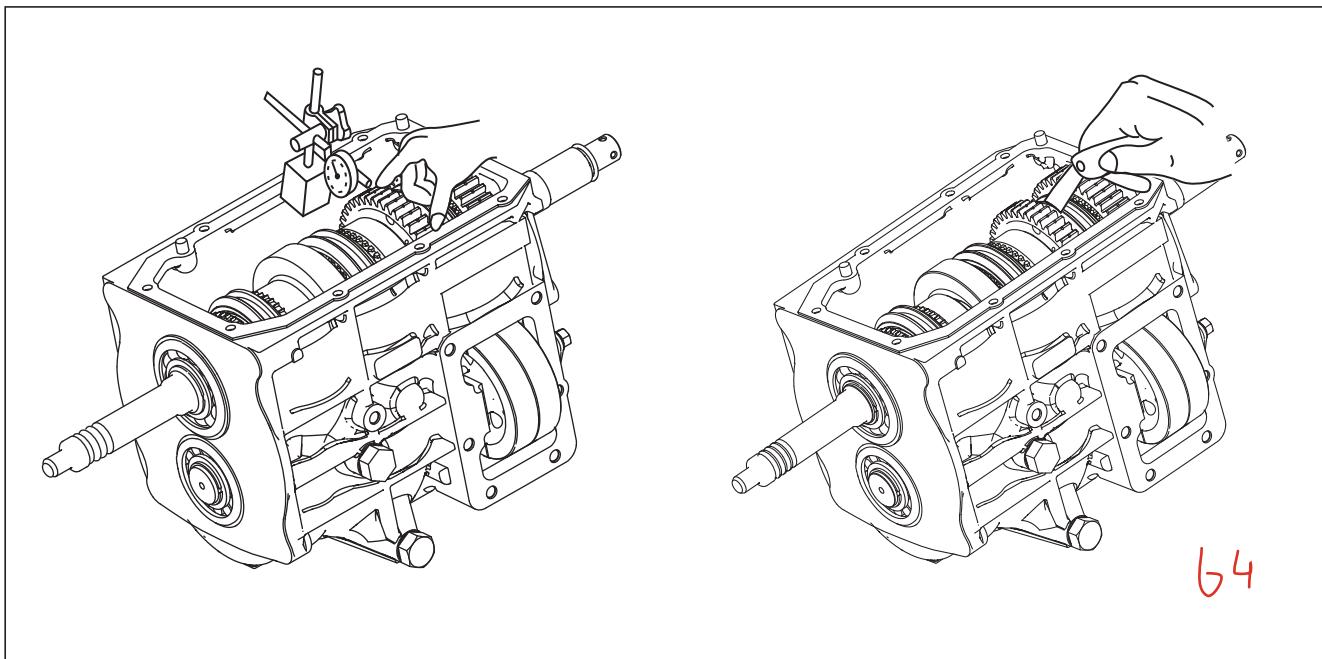


- 10 6) Remove the special tool from the rear end of the counter shaft and install the bearing using Bearing Installer (Special tool).

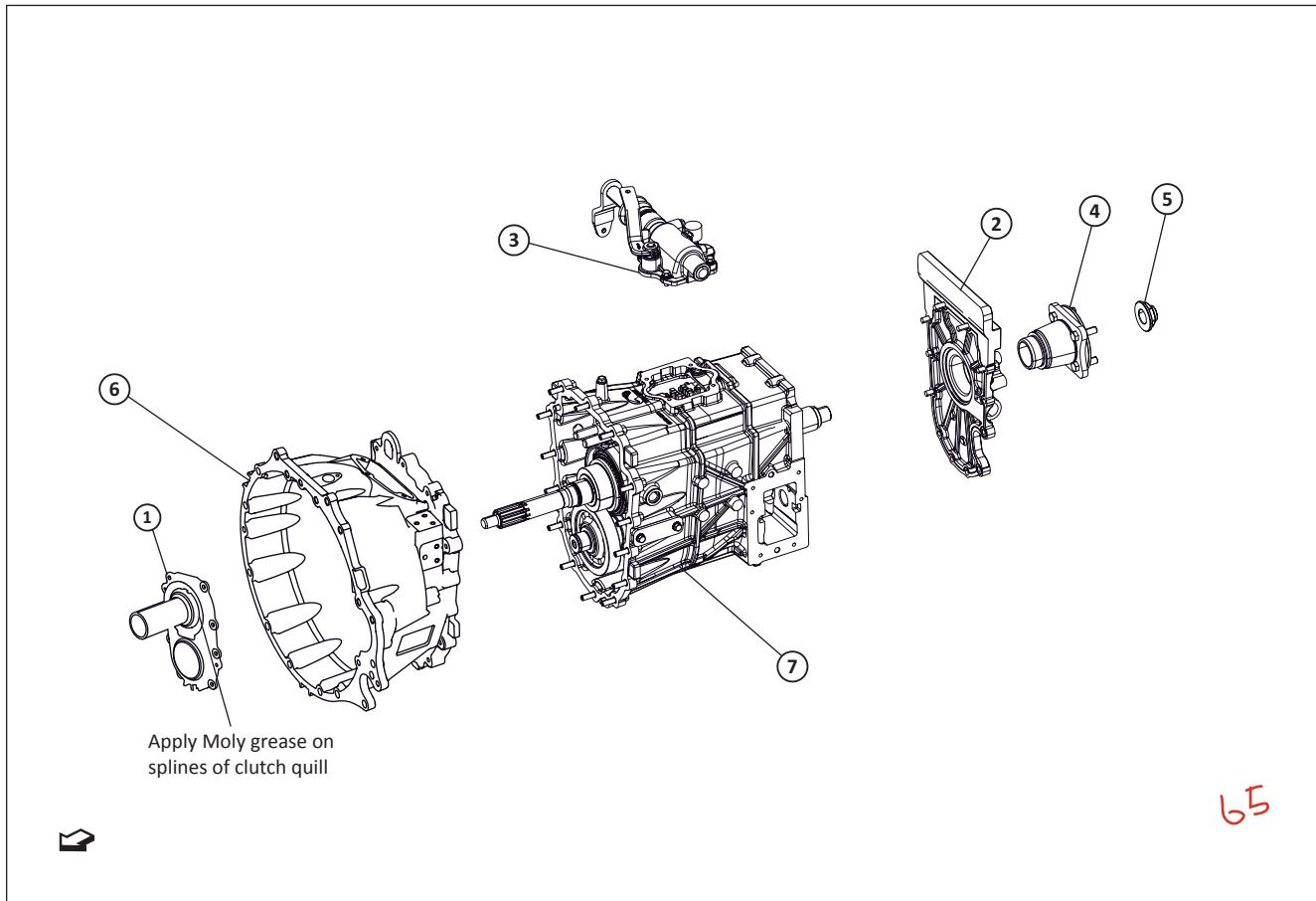


NOTES : 23
After installation, check rotation of all gears

- 11) After assembly, check backlash and end play of each gear.



5.4 DISASSEMBLY AND REASSEMBLY OF TRANSMISSION (VERTICAL TYPE)



Disassembly Sequence

5 → 4 → 2 → 3 → 1 → 6 → 7

1. Clutch Quill

2. Rear cover

Assembly Sequence

7 → 2 → 4 → 5 → 3 → 6 → 1

3. Gear shifter upper

4. Companion flange

5. Nut

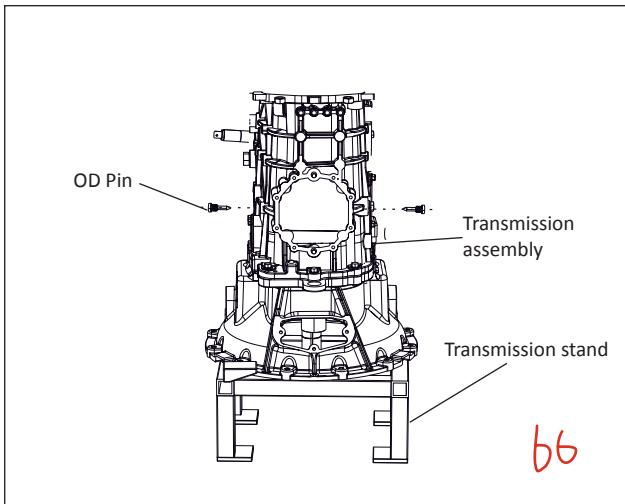
6. Clutch housing

⑦ Transmission Housing



NOTE : 24

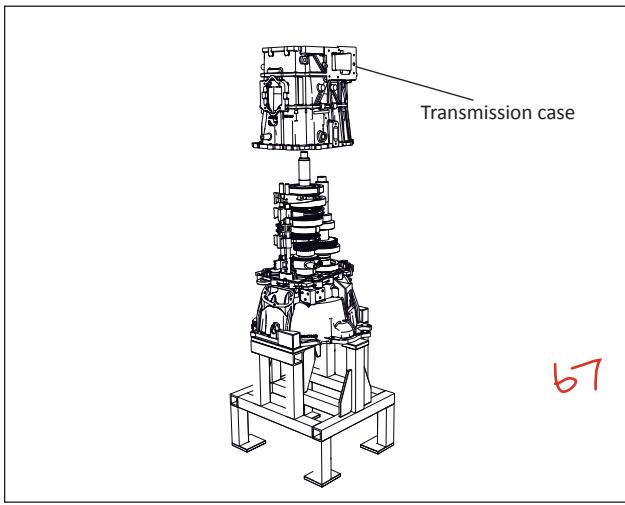
Apply Moly grease on splines of clutch quill before
installation

Transmission housing Removal

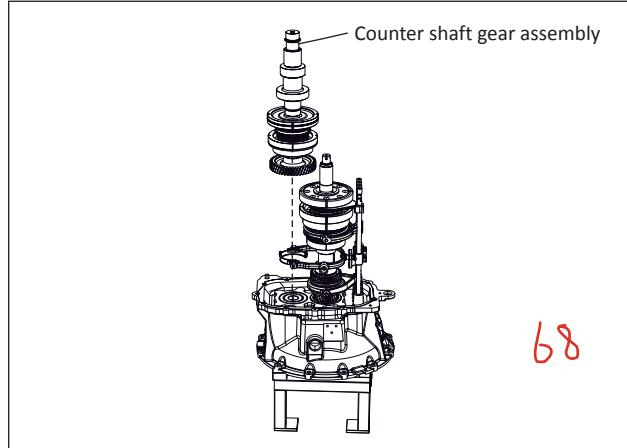
- 1** g) Place the transmission assembly on the mounting stand as shown in illustration.
- 2** h) Remove transmission Clutch housing holding bolts.
- 3** i) Remove rear cover transmission OD Pin.

NOTES : **25**

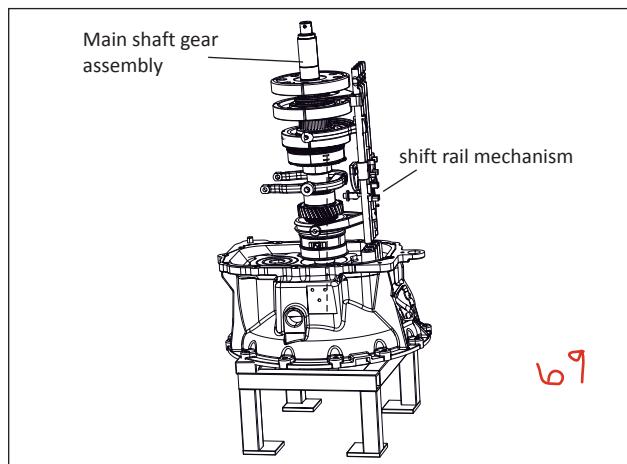
While placing the transmission assembly on the mounting stand, ensure that transmission drive shaft side to face downward direction.



- 4** j) Then gently lift the transmission case.

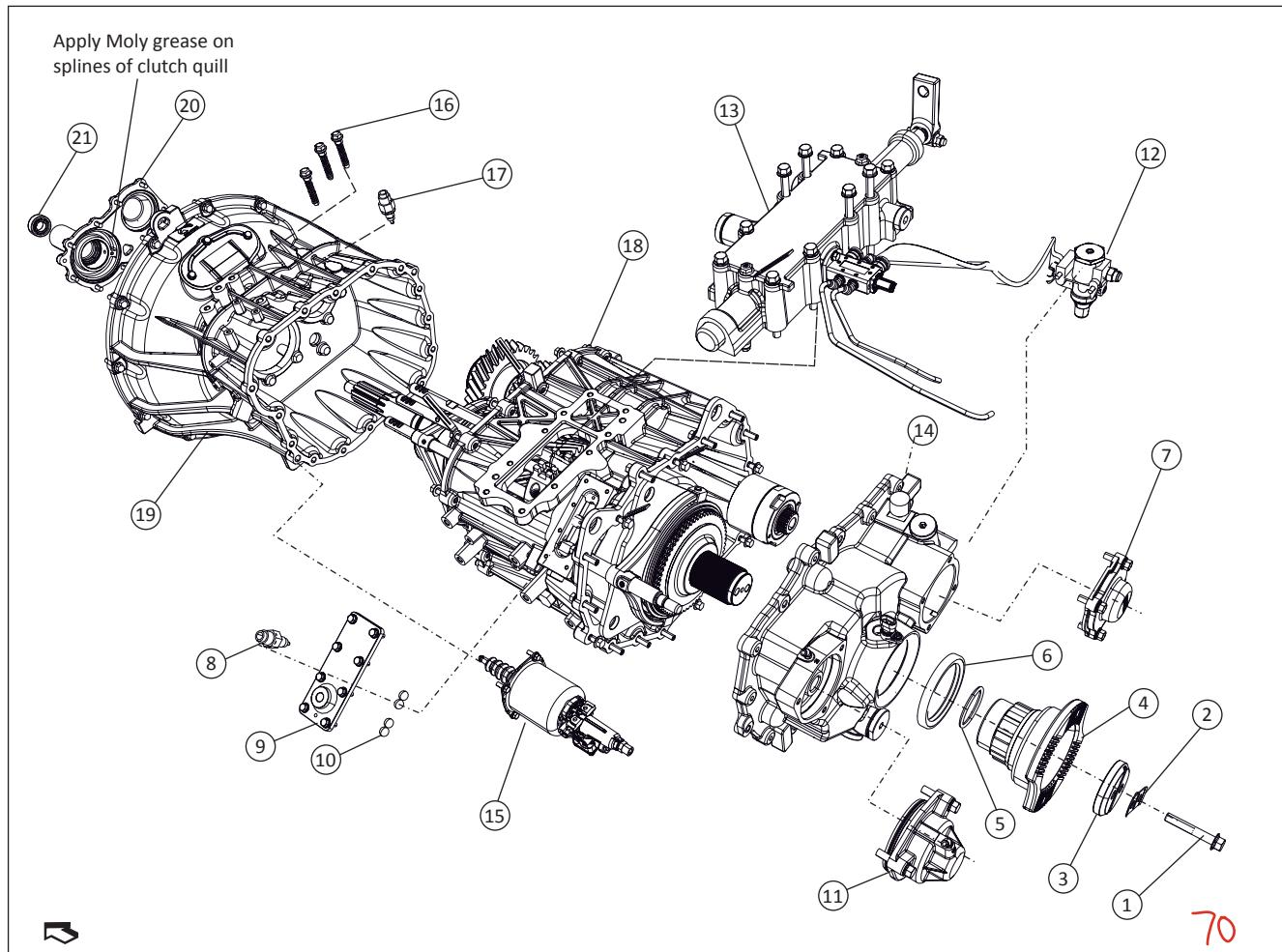


- 5** k) Then remove by lifting counter shaft gear assembly.



- 6** l) Then remove main shaft gear assembly along with the shift rail mechanism by slightly tilting it towards counter shaft side.

5.5 DISASSEMBLY AND REASSEMBLY OF TRANSMISSION (ET140S9)



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11
12 → 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21

- 1. Bolt
- 2. Washer lock planetary
- 5. O-Ring
- 6. Oil seal
- 9. Sensor
- 10. Plate
- 13. Upper case assy
- 14. Rear cover
- 17. Switch assy. Backup lamp
- 18. Middle housing assy
- 21. Bearing

Assembly Sequence

21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13 → 12
11 → 10 → 9 → 8 → 7 → (6) → 5 → 4 → 3 → 2 → 1

- 3. Lock plate
- 4. Companion flange
- 7. PTO cover assy.
- 8. Filter regulator
- 11. Iron Ball
- 12. Pneumatic cylinder Assy
- 15. Clutch booster
- 16. Plug screw, spring, ball
- 19. Front housing assy
- 20. Clutch quill assy



NOTE : 26

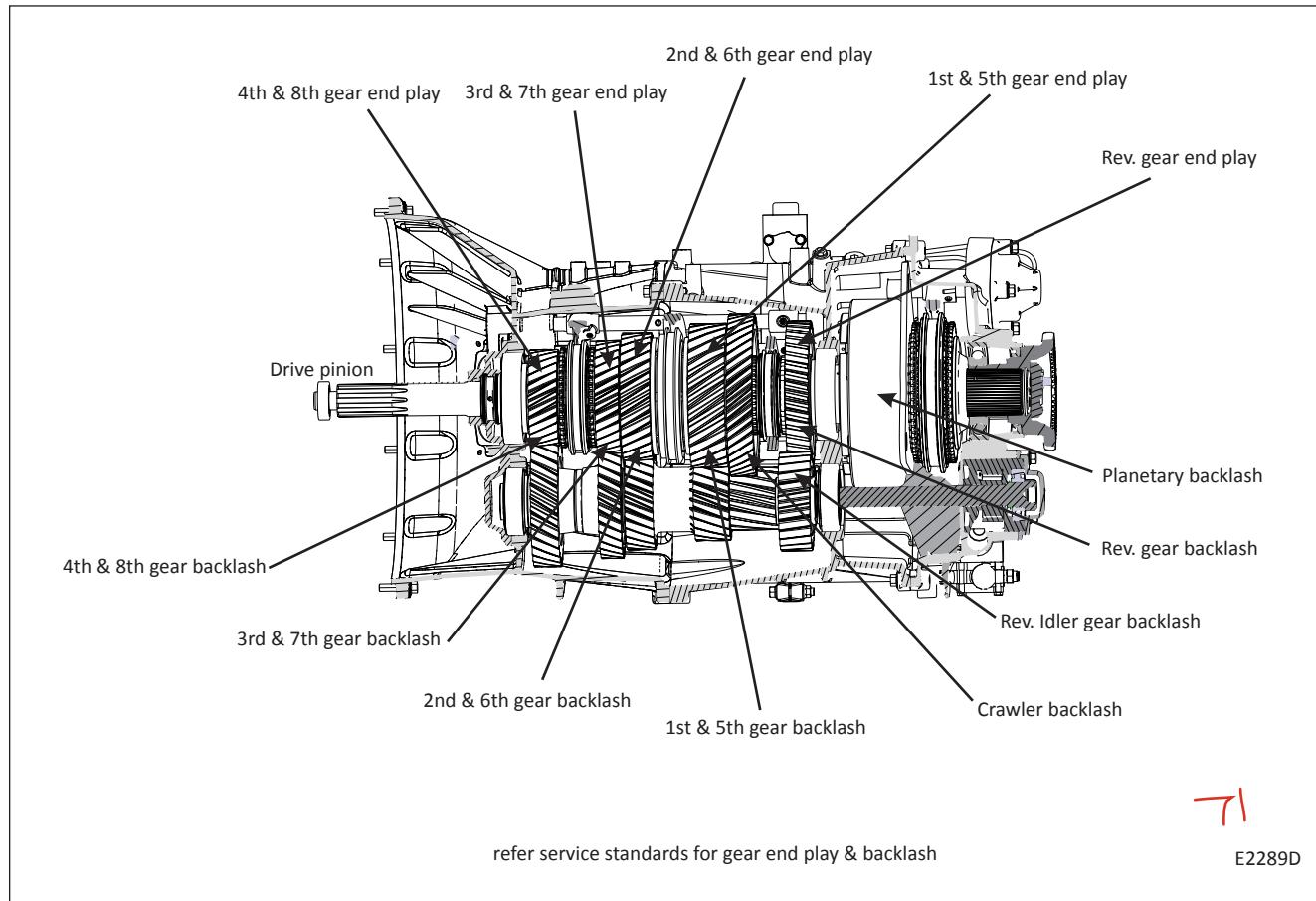
Do not remove the oil seal unless defective.



NOTE : 27

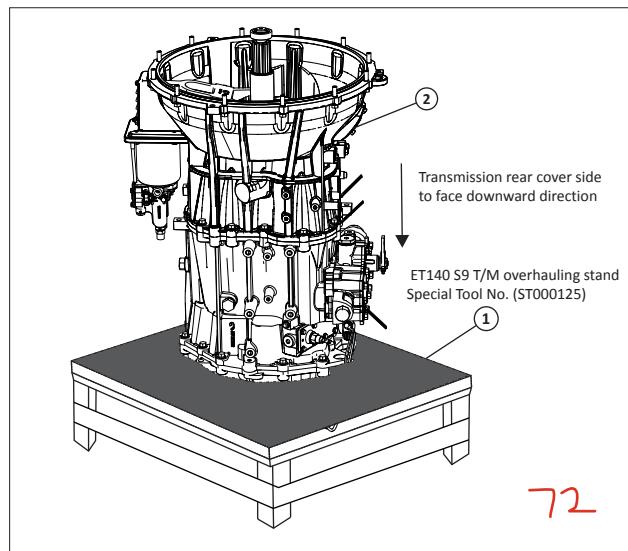
Apply Moly grease on splines of clutch quill before installation

5.5.1 Transmission assembly gear end play & backlash

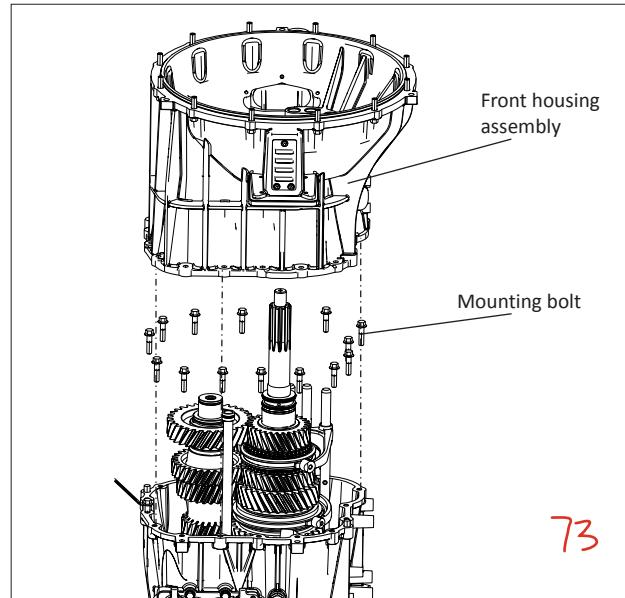


Transmission housing Removal

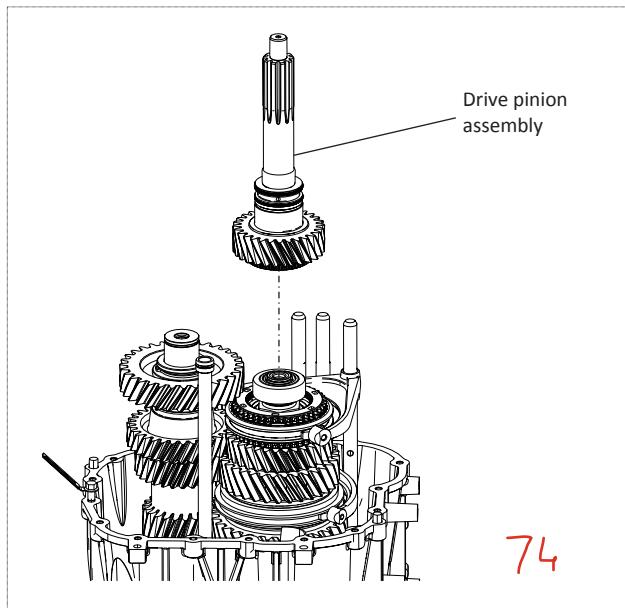
- a) Place the transmission assembly on the T/M overhauling stand Special tool (ST000125) as shown in the illustration.



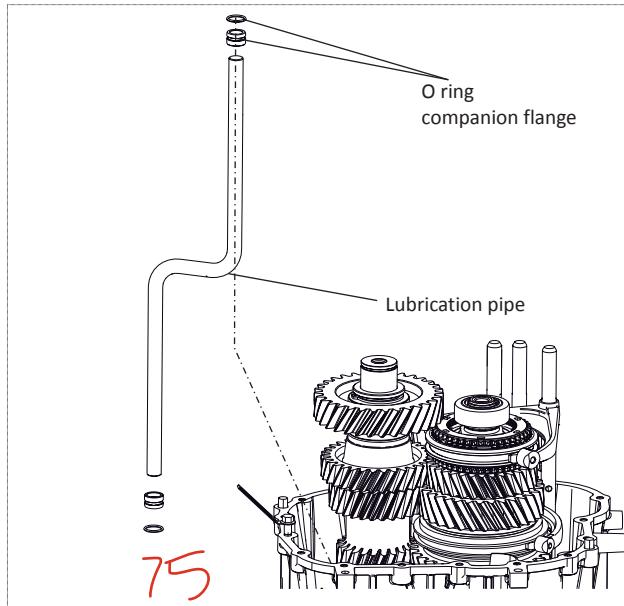
1. ET140 S9 T/M overhauling stand (ST000125) 2. Transmission assy



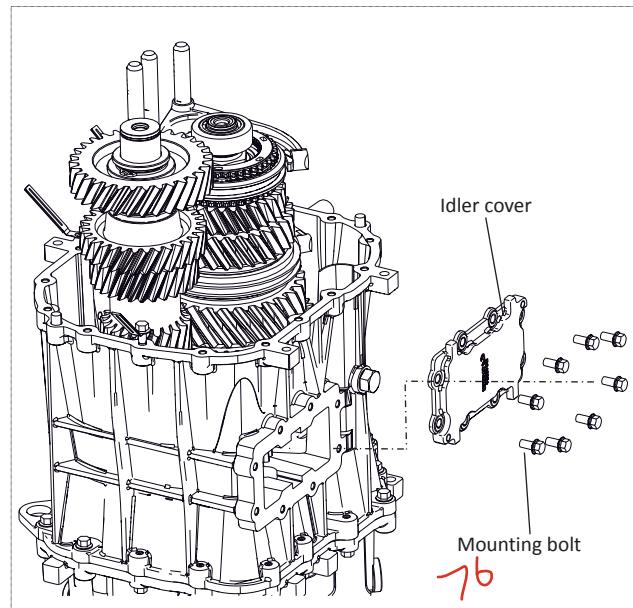
- b) Remove the mounting bolts and gently lift the front housing assembly.



3 c) Take out the drive pinion assembly.



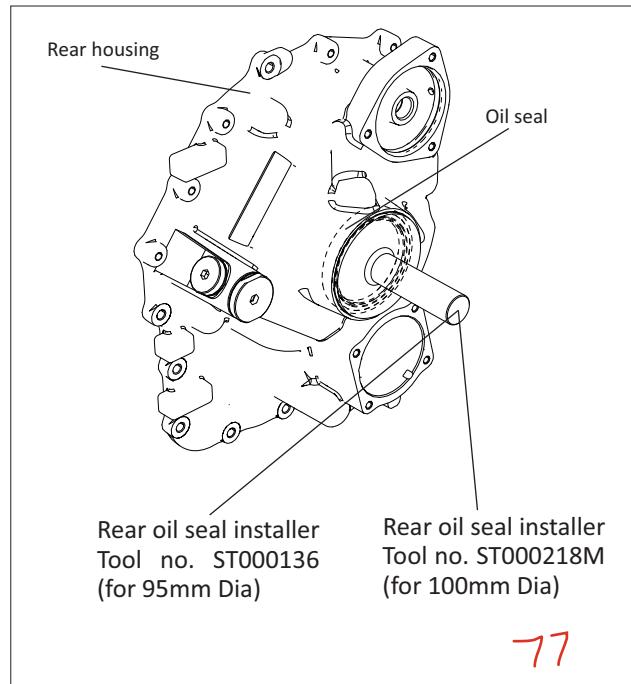
4 d) Remove the lubrication pipe assembly from transmission.



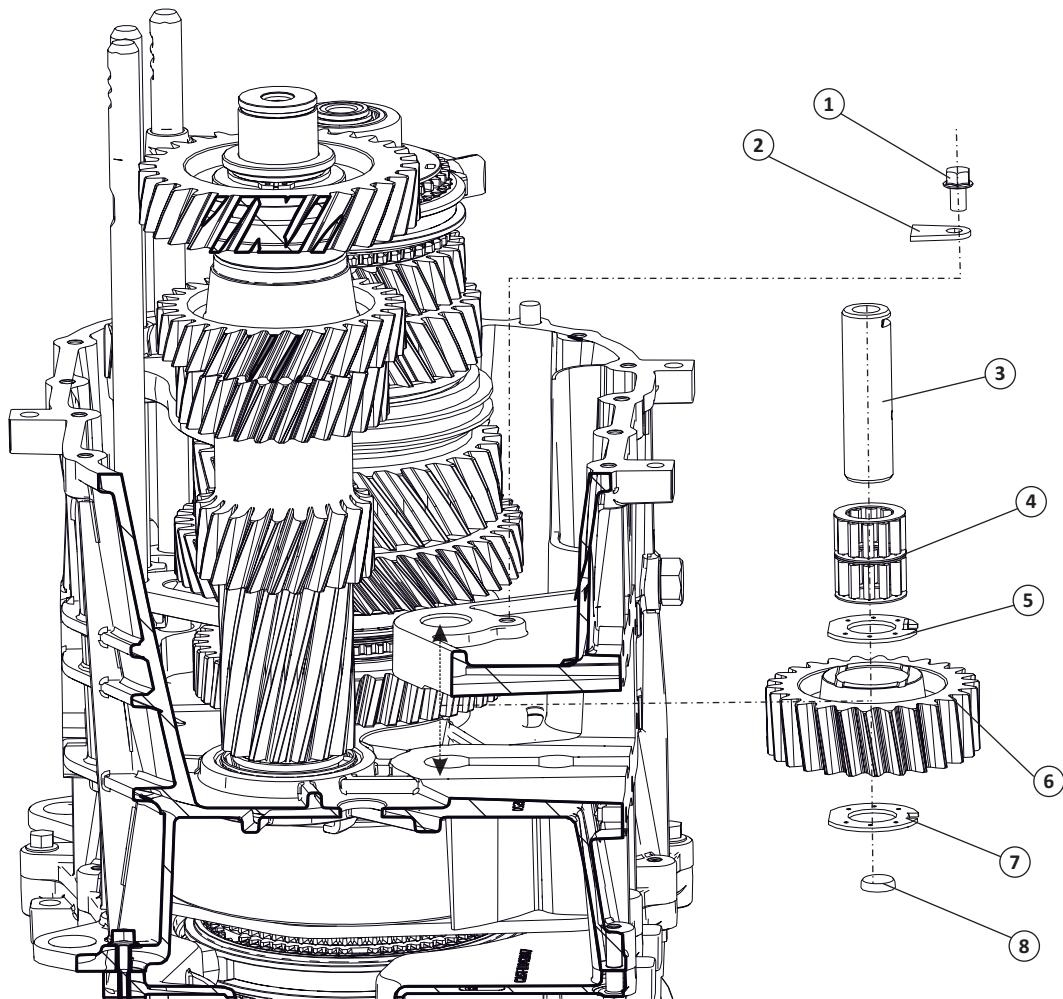
5 e) Loosen mounting bolts and remove Idler cover assembly.

Rear cover oil seal installer

- a) Install the rear oil seal using special tool oil seal installer no. ST000218M (for 100mm Dia.) & ST000136 (for 95mm Dia) on rear housing of transmission.



5.5.2 Disassembly and Assembly of Idler gear



Disassembly Sequence

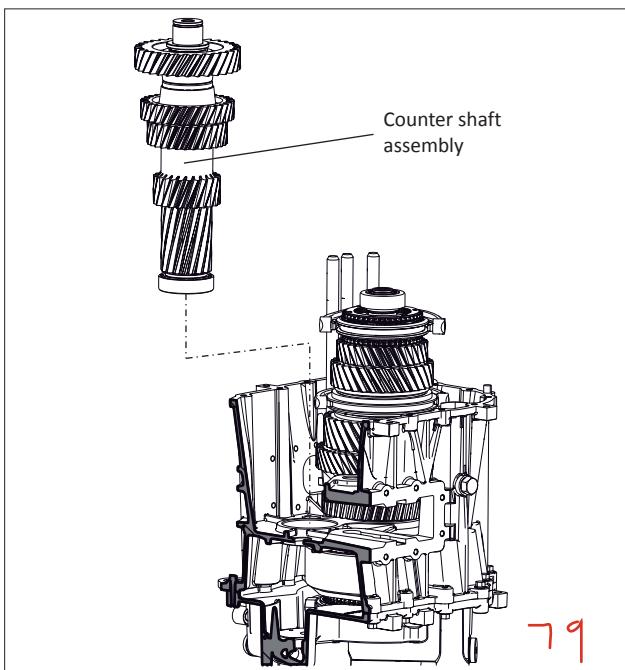
1 → 2 → 5 → 7 → 8 → 3 → 4 → 6

Assembly Sequence

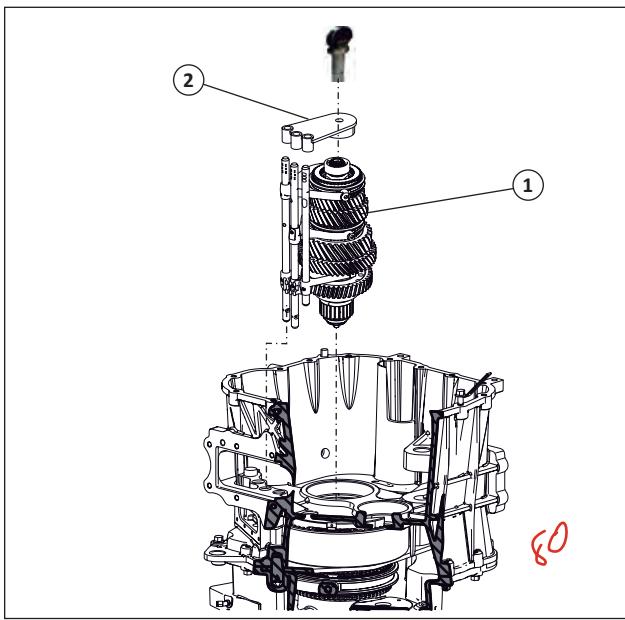
6 → 4 → 3 → 8 → 7 → 5 → 2 → 1

- | | | |
|------------------|----------------|----------------|
| 1. Bolt and stud | 4. Bearings | 7. Lock washer |
| 2. Locking plate | 5. Lock washer | 8. Sealing cap |
| 3. Idler shaft | 6. Idler gear | |

w) Take out the counter shaft assembly.

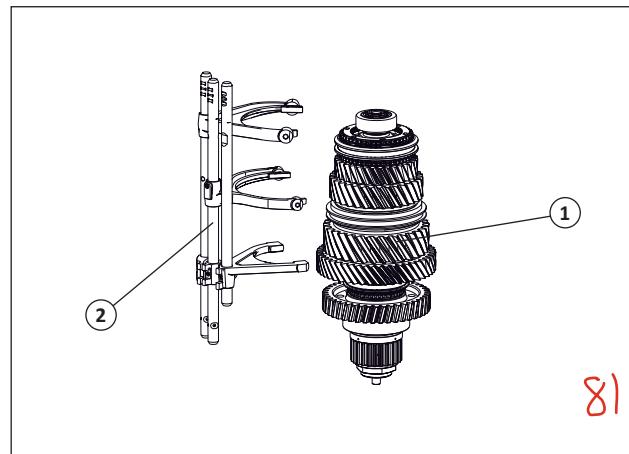


x) Remove the main shaft and rail fork assembly
2 simultaneously using main shaft lifting special tool (ST000097).



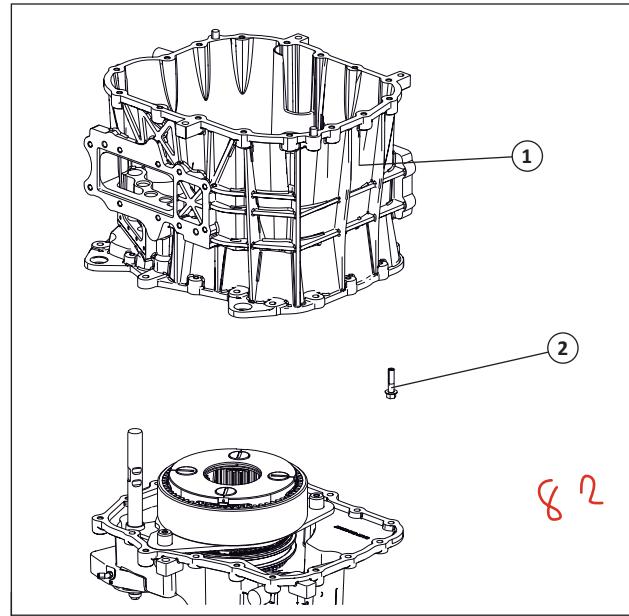
1. Main shaft and rail assembly 2. Main shaft lifting tool - ST000097

y) Remove the rail fork assembly from main shaft assembly.

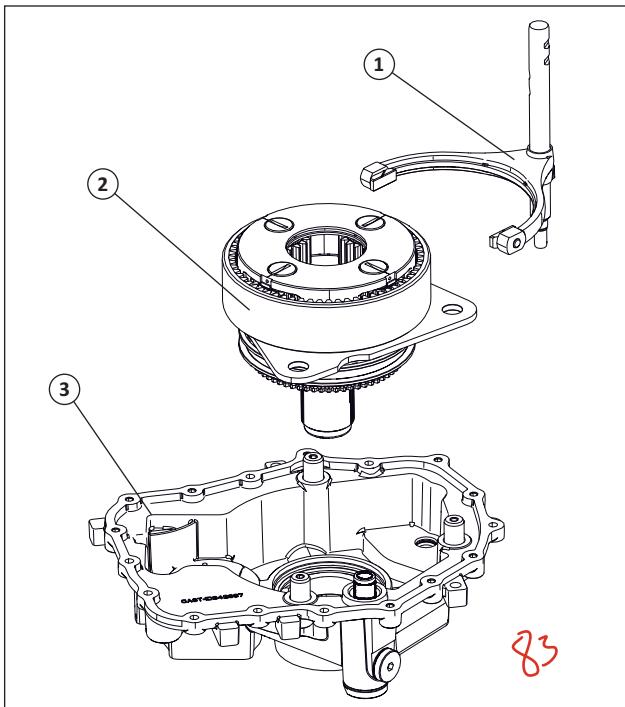


1. Main shaft assembly 2. Rail fork assembly

z) Remove middle housing mounting bolts and middle housing assembly as per sequence.



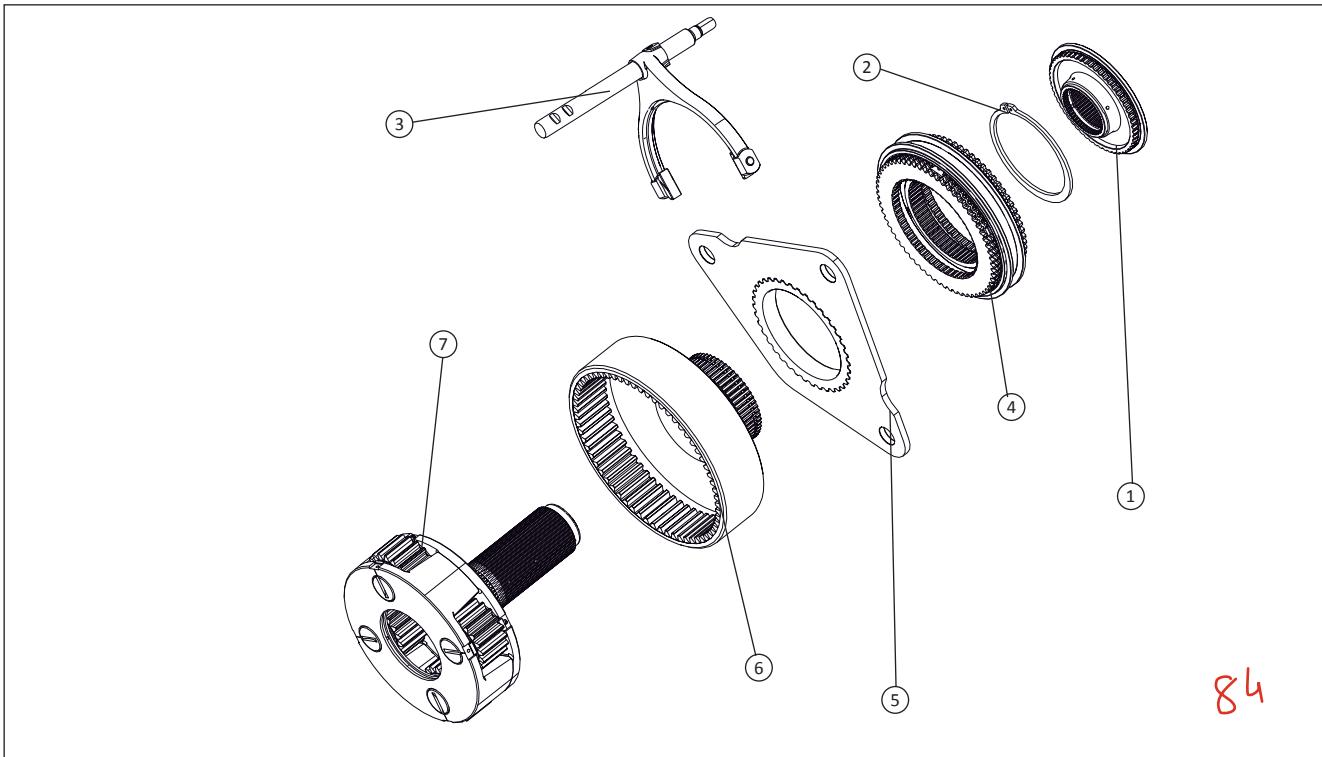
1. Mounting bolts 2. Middle housing assembly



1. Rail fork assembly 2. Planetary assembly 3. Rear housing

5.5.3 Planetary and rail fork assembly

- a) Remove planetary assembly and rail fork assembly
| simultaneously from rear cover.



1. Helical gear
2. Snap ring
3. Fork rail

4. Synchroniser
5. Plate
6. Ring gear assembly

7. Planetary

Disassembly Sequence

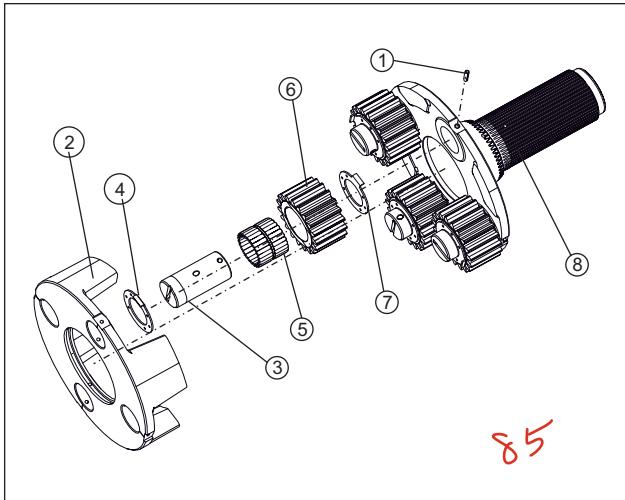
1 → 2 → 3 → 4 → 5 → 6 → 7

Assembly Sequence

7 → 6 → 5 → 4 → 3 → 2 → 1

b) Disassemble the planetary assembly as per sequence given.

2



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8

Assembly Sequence

8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

- | | | |
|------------------|----------------|-----------------|
| 1. Spring pin | 4. Lock washer | 7. Washer |
| 2. Cover | 5. Bearing | 8. Career shaft |
| 3. Planetary pin | 6. Planet gear | |

3c) Fix the career shaft assembly in jaw.

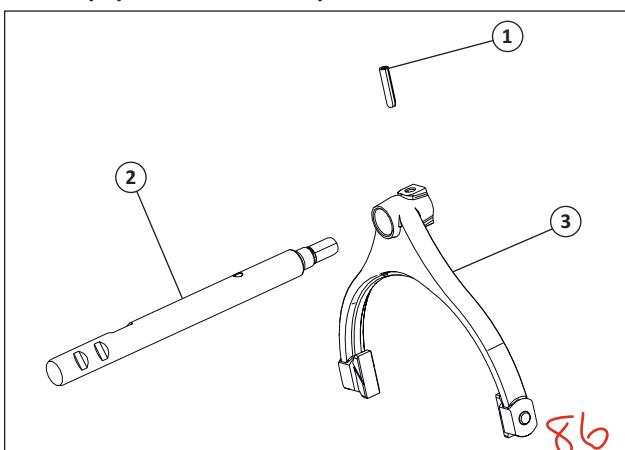
4d) Remove the all spring pins.

5e) Remove the planetary Cover.

6f) Disassemble all the planetary gears.

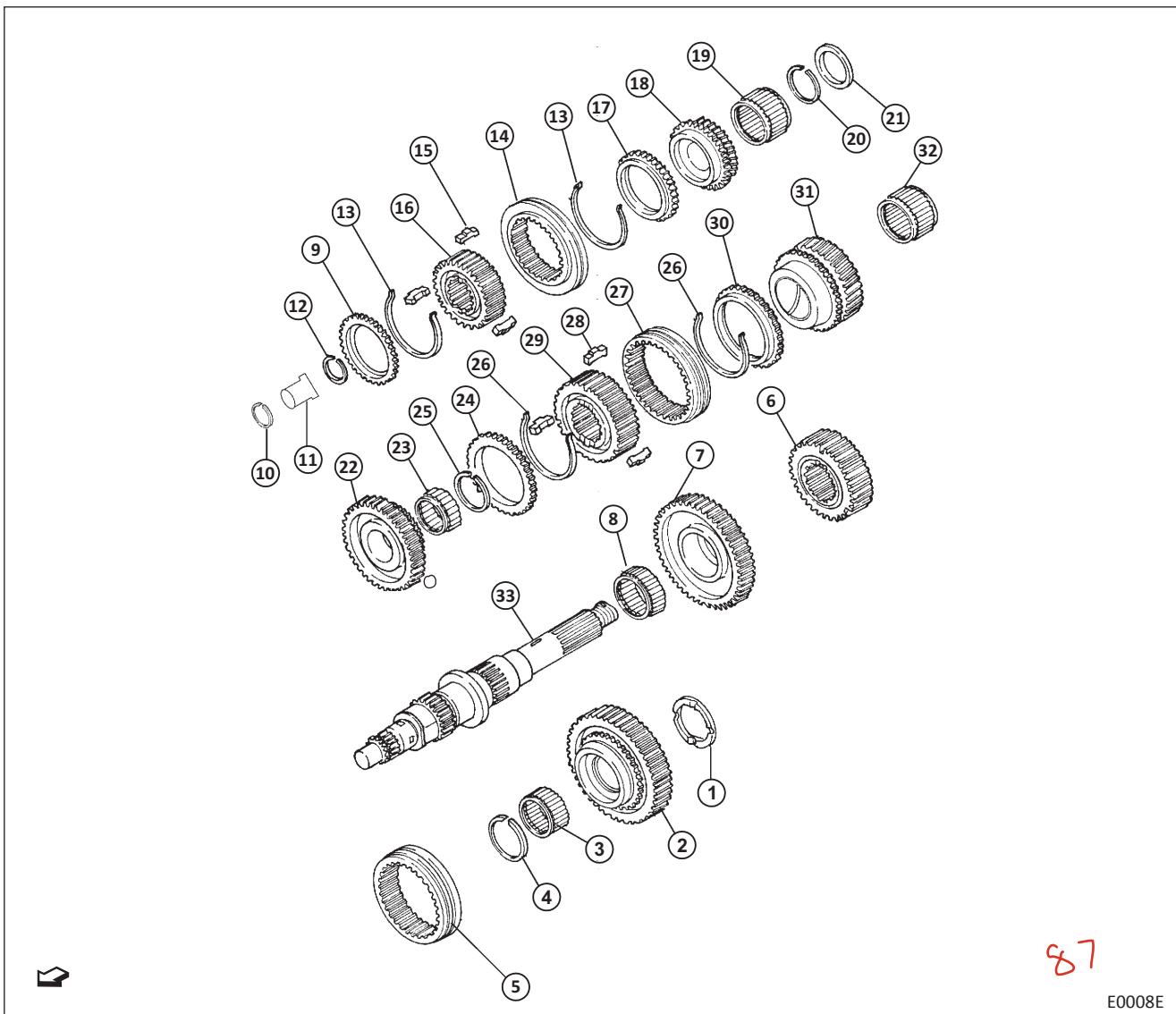
7g) Remove the pins from all NRB (Needle Roller Bearing).

Planetary Synchro fork assembly



- | | |
|---------------|-------------------|
| 1. Spring pin | 4. Planetary fork |
| 2. Shift rail | |

1h) Remove pin using a suitable rod by hammering

5.6 MAIN SHAFT GEARS DISASSEMBLY & ASSEMBLY**5.6.1 ET 30S5****Disassembly Sequence**

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 →
 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 →
 23 → 24 → 25 → 26 → 27 → 28 → 29 → 30 → 31 → 32 → 33

Assembly sequence

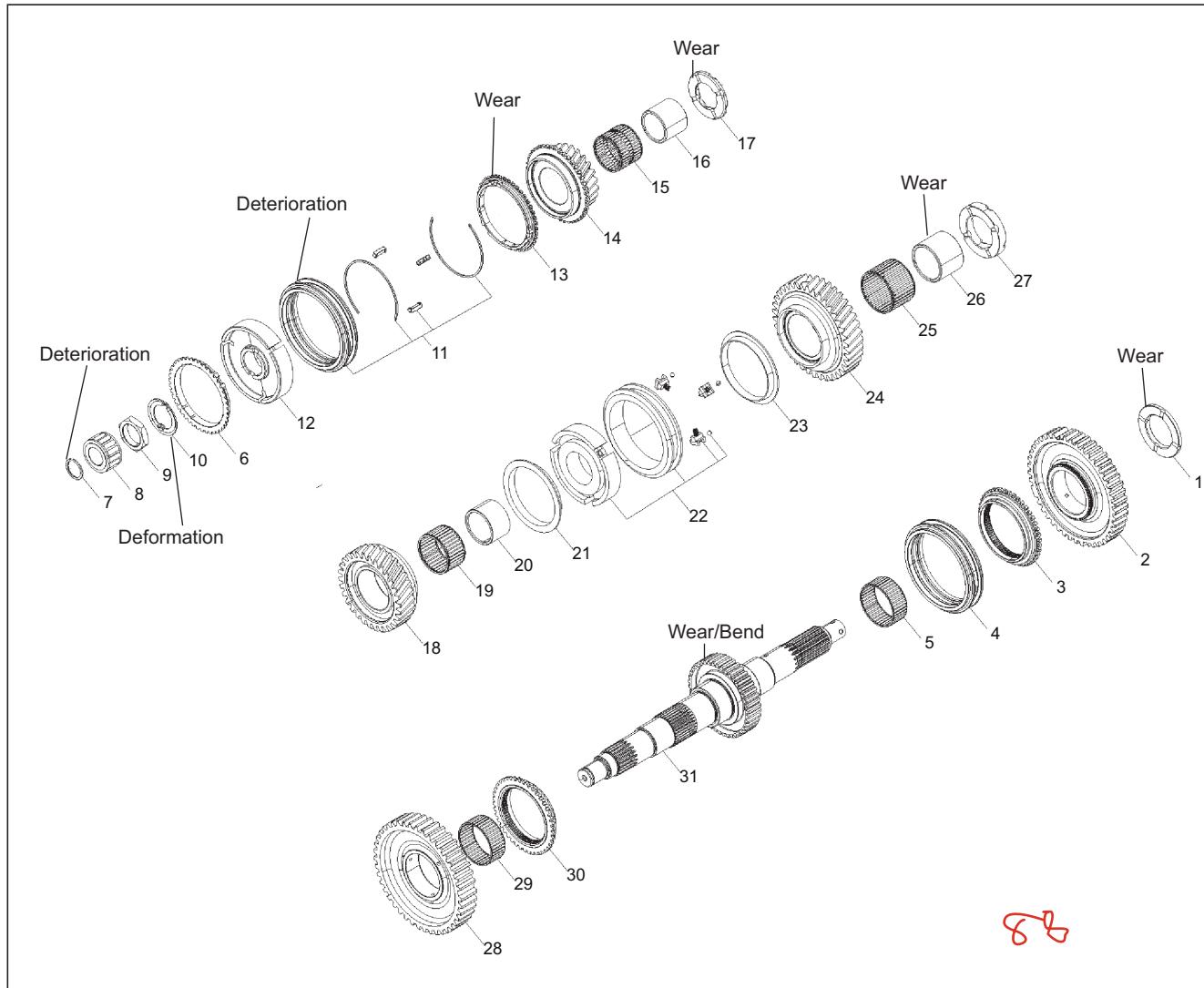
33 → 32 → 31 → 25 → 26 → 25 → 24 → 23 →
 30 → 27 → 28 → 29 →
 22 → 21 → 20 → 12 → 15 → 12 → 14 → 13
 19 → 16 → 17 → 18 →
 11 → 10 → 5 → 4 → 3 → 2 → 1
 9 → 6 → 7 → 8

- (1) 1st gear thrust washer
- 2. 1st gear
- 3. Needle roller bearing
- (4) Snap ring
- 5. Synchronizer sleeve
- 6. Synchronizer hub
- 7. Reverse gear
- (8) Needle roller bearing
- (9) 5th synchronizer ring

- 10. Snap ring
- 11. Sleeve
- 12. Snap ring
- 13. Shifting key spring
- 14. 4th & 5th synchronizer sleeve
- 15. Shifting key
- 16. 4th & 5th synchronizer hub
- (17) 4th synchronizer ring
- 18. 4th gear
- 19. Needle bearing
- 20. Snap ring
- 21. 2nd gear thrust washer
- 22. 2nd gear
- 23. Needle roller bearing
- 24. 2nd gear synchronizer ring
- 25. Snap ring
- 26. Shifting key spring
- (27) 2nd & 3rd synchronizer

- sleeve
- 28. Shifting key
- 29. 2nd & 3rd synchronizer hub
- 30. 3rd gear synchronizer ring
- 31. 3rd gear
- 32. Needle roller bearing
- 33. Main shaft

5.6.2 ET35S5



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 →
 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 →
 23 → 24 → 25 → 26 → 27 → 28 → 29 → 30 → 31 → 32 → 33

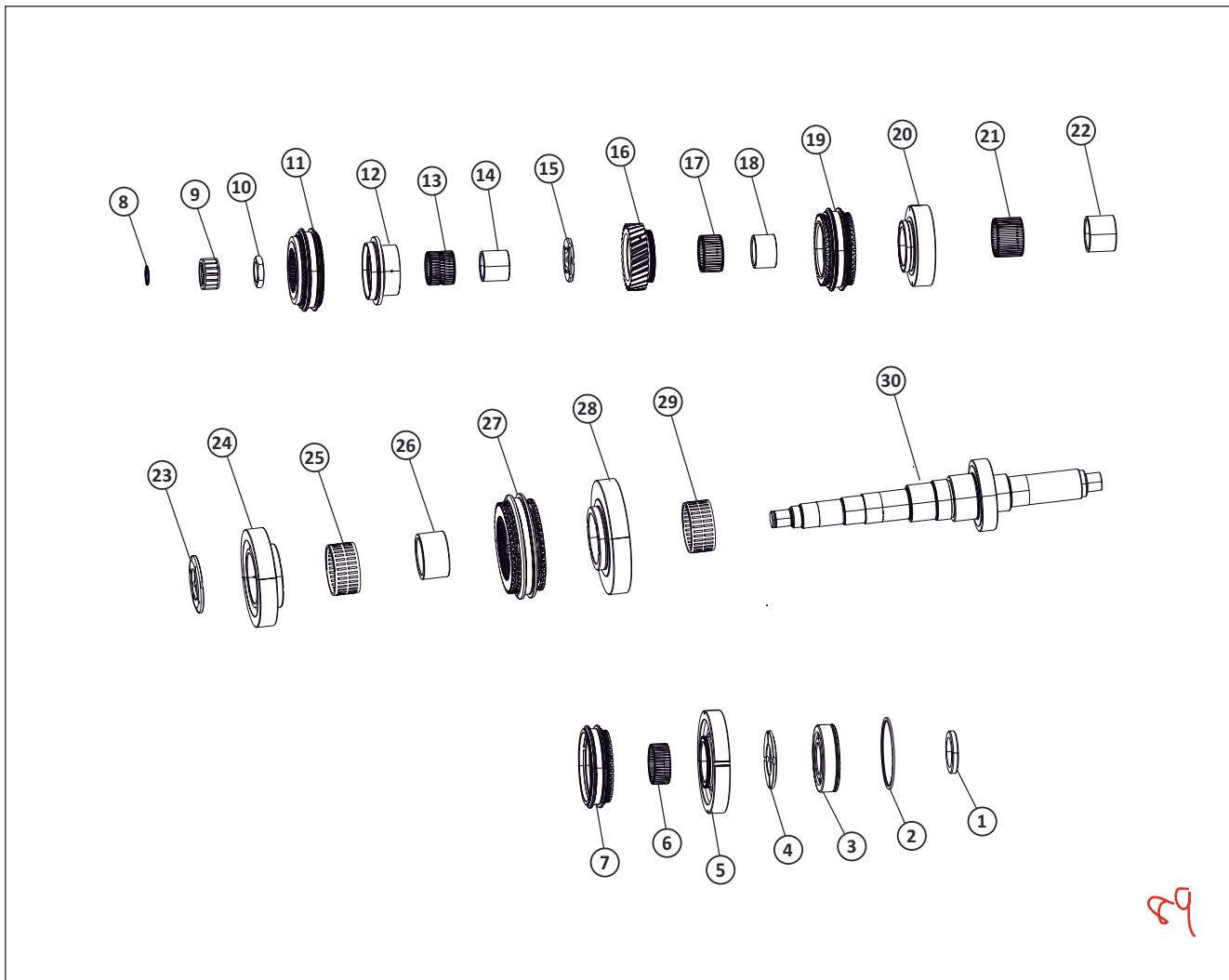
Assembly Sequence

31 → 30 → 29 → 28 → 27 → 26 → 25 → 24 → 18 → 17 → 16 → 15 → 14a → 14 → 13 → 12 → 7 → 6 → 5 → 4 → 3 → 2 → 1
 23 → 21 → 22 → 20 → 19
 11 → 10 → 9 → 8

- 1 Thrust washer
- 2 Reverse Gear
- 3 Synchronizer ring
- 4 Synchronizer sleeve
- 5 Needle roller bearing
- 6 Synchronizer ring
- 7 Snap ring
- 8 Pilot bearing
- 9 Nut main shaft
- 10 Washer, hub lock
- 11 Synchronizer sleeve assy.
- 12 Synchronizer hub
- 13 Synchronizer ring
- 14 4th gear
- 15 Needle roller bearing
- 16 Sleeve 4th gear
- 17 Thrust washer
- 18 3rd gear
- 19 Needle roller bearing
- 20 Sleeve 3rd gear
- 21 Synchronizer ring
- 22 Synchronizer Hub assy.

- 24 2nd gear
- 25 Needle roller bearing
- 26 Sleeve 2nd gear
- 27 Thrust washer
- 28 1st gear
- 29 Needle roller bearing
- 30 Synchronizer ring
- 31 Main shaft

5.6.3 ET35S6



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17

18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27 → 28 → 29 → 30

Assembly Sequence

A horizontal sequence of 31 numbered circles from 1 to 31. Circle 27 has an arrow pointing to circle 24, indicating a skip in the sequence.

23 → 21 → 22 → 20 → 19

11 → 10 → 9 → 8 ━━━━━━

2. Speedo gear spacer 10. Main shaft nut 18. Sleeve 3rd gear 26. Bearing sleeve 4th

3. Bearing main shaft ⑪ Synchronizer sleeve assy. ⑯ Synchronizer sleeve assy. ㉗ 1st & 2nd synchro

4. Thrust washer reverse gear 12. Gear mainshaft OD 20. 3rd gear assy. 28. 1st gear main shaft

5. Reverse gear assembly 13. NRB 4th gear 21. NRB 2nd gear 29. 1st needle bearing
6. NRB 1st gear 14. Shaft 15. 22. Shaft 23. 26. Main shaft

6. Needle roller bearing
7. Synchronizer sleeve assembly
14. Sleeve 4th gear
15. Thrust washer 3rd/4th gear
22. Sleeve 2nd gear.
23. Thrust washer reverse gear
30. Main shaft

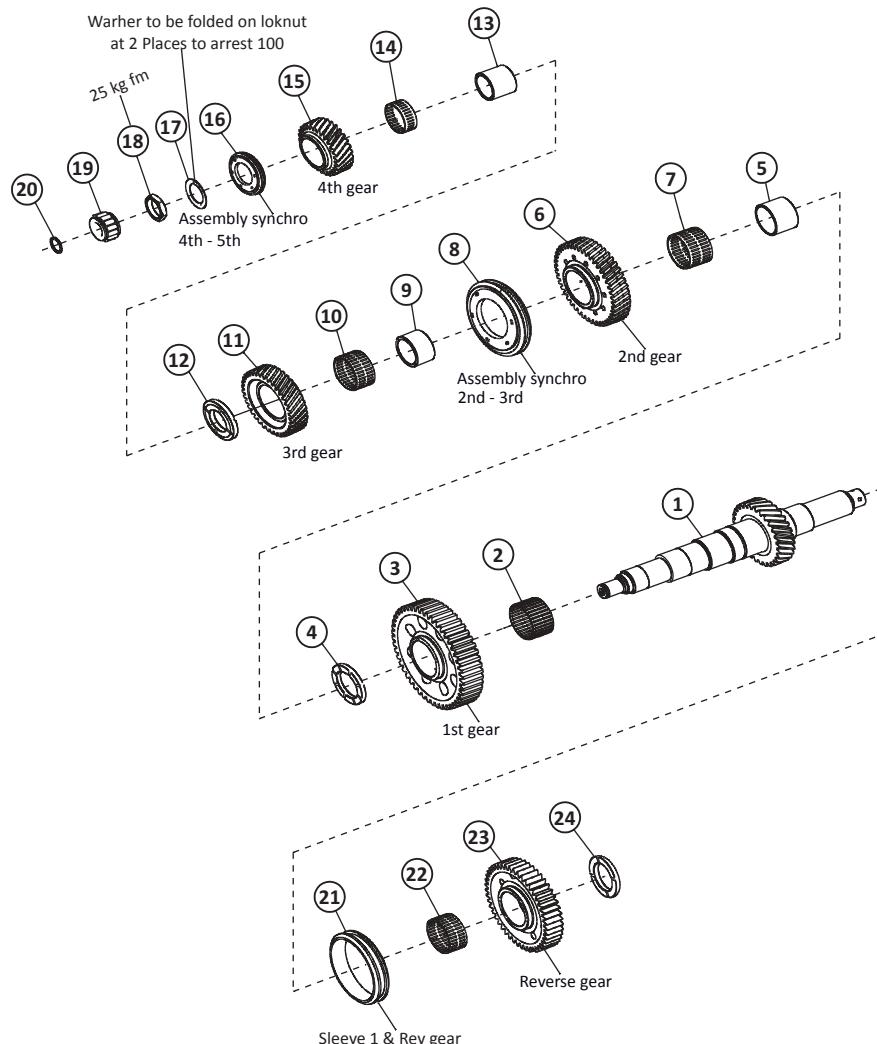
⑦ Synchronizer sleeve assy.
⑧ Snap ring main shaft
⑨ Spanner

15. Thrust washer 3rd 4th gear
16. 4th gear assy
23. Thrust washer reverse gear
24. 2nd gear main shaft

18. Snap ring main shaft 19. 4th gear assy. 24. 2nd gear main shaft

43-86

5.6.4 ET40S5



E1133D

Disassembly Sequence

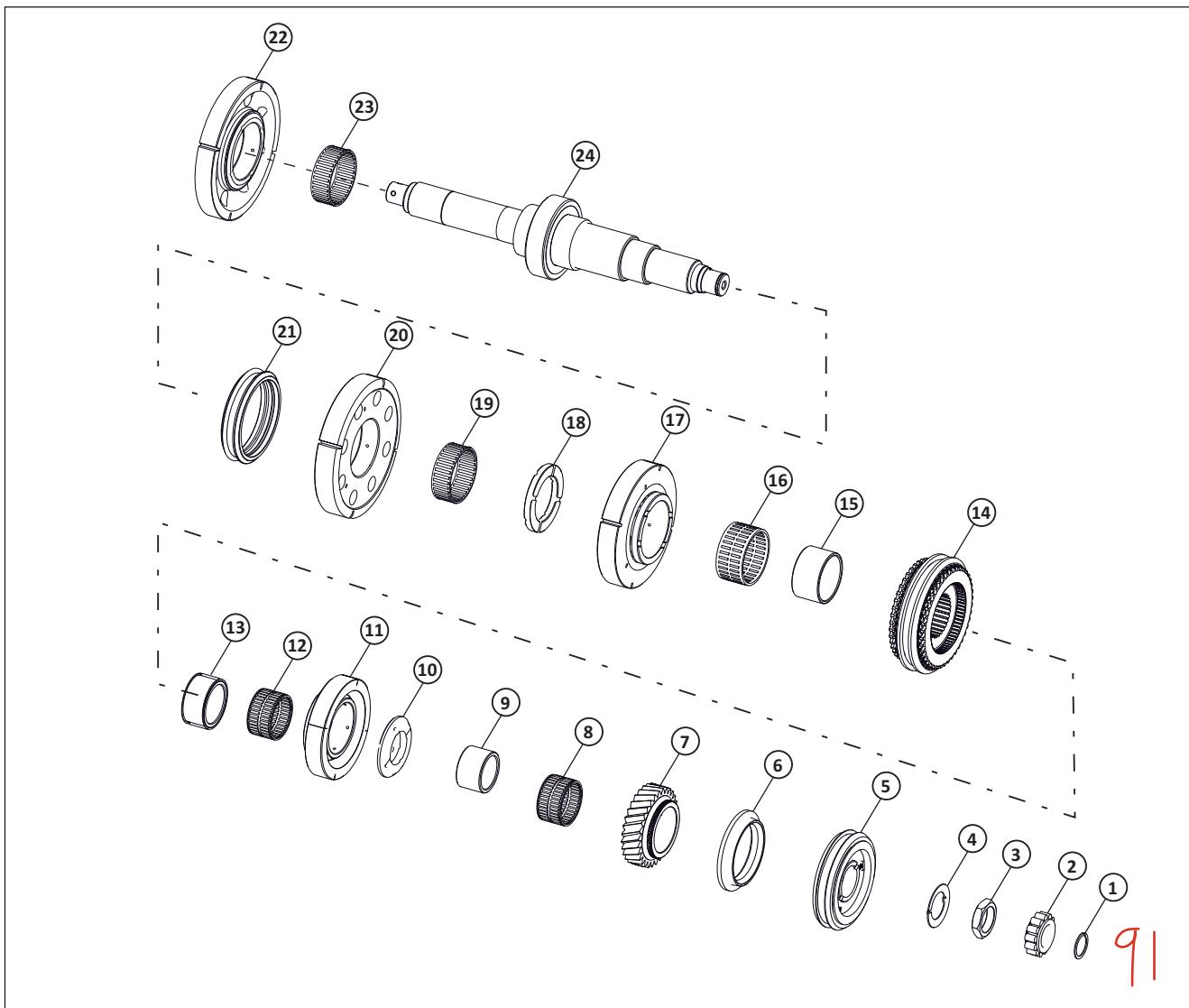
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 →
 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 → 23 → 24

Assembly Sequence

24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13
 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

- | | | |
|-------------------------------|---------------------------------|------------------------------|
| 1. Thrust washer reverse gear | 9. Assembly synchro 4th-5th | 17. Assembly synchro 2nd-3rd |
| 2. Reverse gear main shaft | 10. 4th gear main shaft | 18. 2nd gear main shaft |
| 3. Bearing needle | 11. Bearing 4th gear main shaft | 19. Bearing |
| 4. Sleeve synchro | 12. Bearing sleeve 4th gear | 20. Bearing sleeve |
| 5. Snap ring main shaft | 13. Thrust washer 3rd gear | 21. Thrust washer |
| 6. Pilot bearing main shaft | 14. 3rd gear main shaft | 22. 1st gear main shaft |
| 7. Nut main shaft | 15. Bearing needle 3rd gear | 23. Bearing roller 1st gear |
| 8. Washer hub lock | 16. Bearing sleeve | 24. Main shaft |

5.6.5 ET40S6



Disassembly Sequence

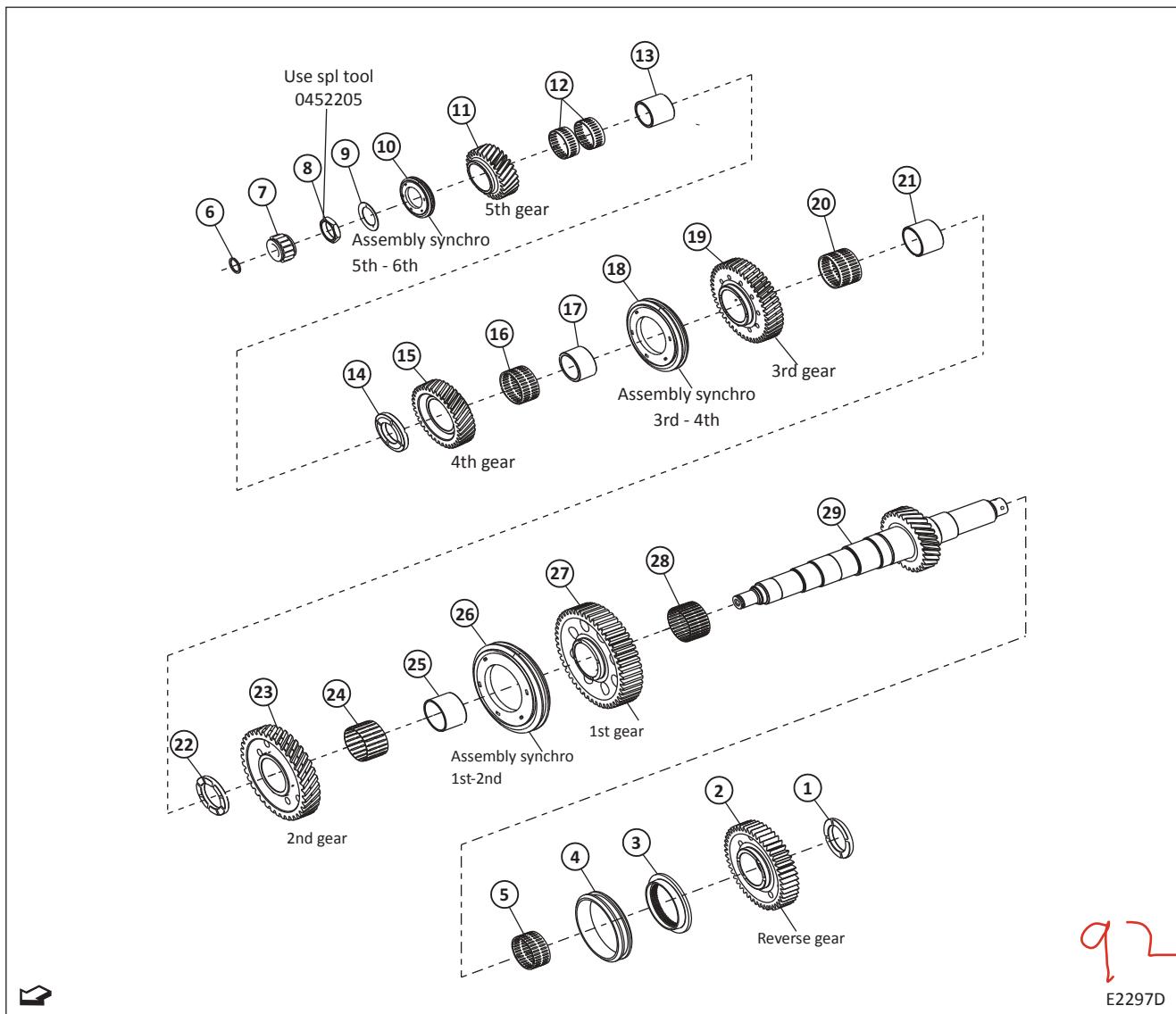
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13
14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 → 23 → 24

Assembly Sequence

24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13
12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

- | | | |
|--|---|-----------------------------|
| (1) Snap ring | 9. Sleeve bearing 4th gear | 17. 2nd gear main shaft |
| 2. Pilot bearing | 10. Thrust washer 3rd & 4th gear | 18. Thrust washer 1st gear |
| 3. Nut main shaft | 11. 3rd gear main shaft | 19. Bearing |
| 4. Hub lock washer | 12. 3rd gear bearing | 20. 1st gear main shaft |
| (5) Synchronizer assembly 4th & 5th gear | 13. Sleeve bearing 3rd gear | 21. Sleeve synchronizer |
| 6. Cone synchronizer | (14) Synchronizer assembly 2nd & 3rd gear | 22. Reverse gear main shaft |
| 7. 4th Gear main shaft | 15. Sleeve bearing 2nd gear | 23. Bearing |
| 8. 4th Gear bearing | 16. Needle bearing | 24. Main shaft |

5.6.6 ET70S6 / ET80S6 / ET90S6



E2297D

Disassembly Sequence

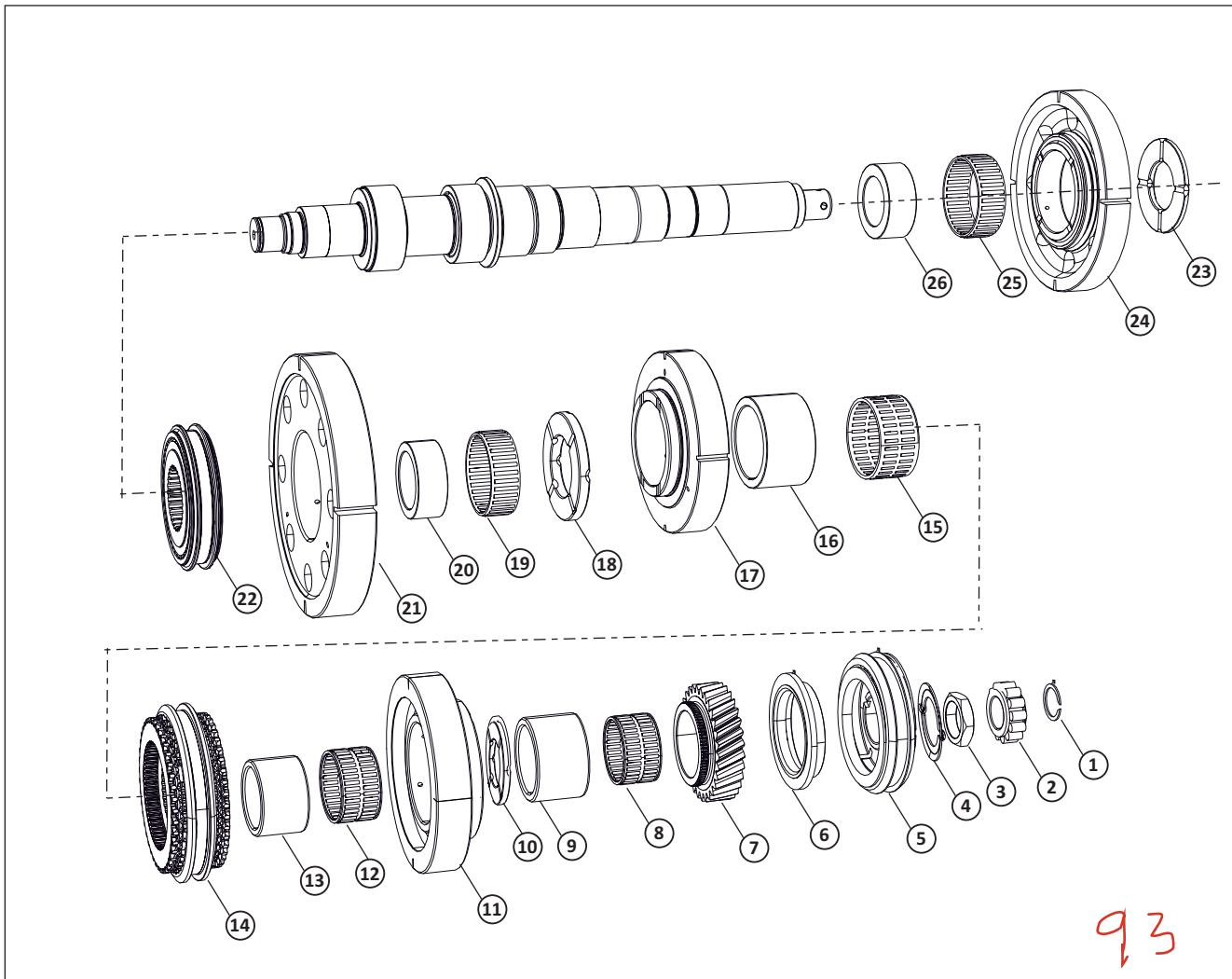
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 →
18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27 → 28 → 29

Assembly Sequence

29 → 28 → 27 → 26 → 25 → 24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13
12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

- | | | |
|-----------------------------------|-----------------------------------|-----------------------------------|
| 1. Thrust washer revers gear | 11. 5th gear main shaft | 21. Bearing sleeve |
| 2. Reverse gear main shaft | 12. Bearing 5th gear main shaft | 22. Thrust washer |
| 3. Clutch body ring | 13. Bearing sleeve 5th gear | 23. 2nd gear main shaft |
| 4. Sleeve synchronizer | 14. Thrust washer 4th gear | 24. Bearing roller 2nd gear |
| 5. Bearing needle | 15. 4th gear main shaft | 25. Bearing sleeve |
| 6. Snap ring main shaft | 16. Bearing needle 4th gear | 26. Assembly synchronizer 1st-2nd |
| 7. Pilot bearing main shaft | 17. Bearing sleeve | 27. 1st gear main shaft |
| 8. Nut, Main shaft | 18. Assembly synchronizer 3rd-4th | 28. Bearing roller |
| 9. Washer hub lock | 19. 3rd gear main shaft | 29. Main shaft |
| 10. Assembly synchronizer 5th-6th | 20. Bearing | |

5.6.7 ET50S7 / ET60S7



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13
 14 → 15 → 16 → 17 → 18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26

Assembly Sequence

26 → 25 → 24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13
 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

① Snap ring main shaft

2. Pilot bearing

3. Nut main shaft

4. Hub lock washer

⑤ Synchronizer assembly 4th & 5th gear

6 Cone Synchronizer assembly 4th gear

7. 4th Gear main shaft

8. 4th Gear bearing

9. Sleeve bearing 4th gear

10. Thrust washer 3rd & 4th gear

11. 3rd gear main shaft

12. 3rd gear bearing

13. Sleeve bearing 3rd gear

⑭ Synchronizer assembly 2nd & 3rd gear

15. Sleeve bearing 2nd gear

16. Needle bearing

17. 2nd gear main shaft

18. Thrust washer 1st gear

19. Bearing

20. Sleeve synchronizer

21. 1st gear main shaft

22. Hub synchronizer

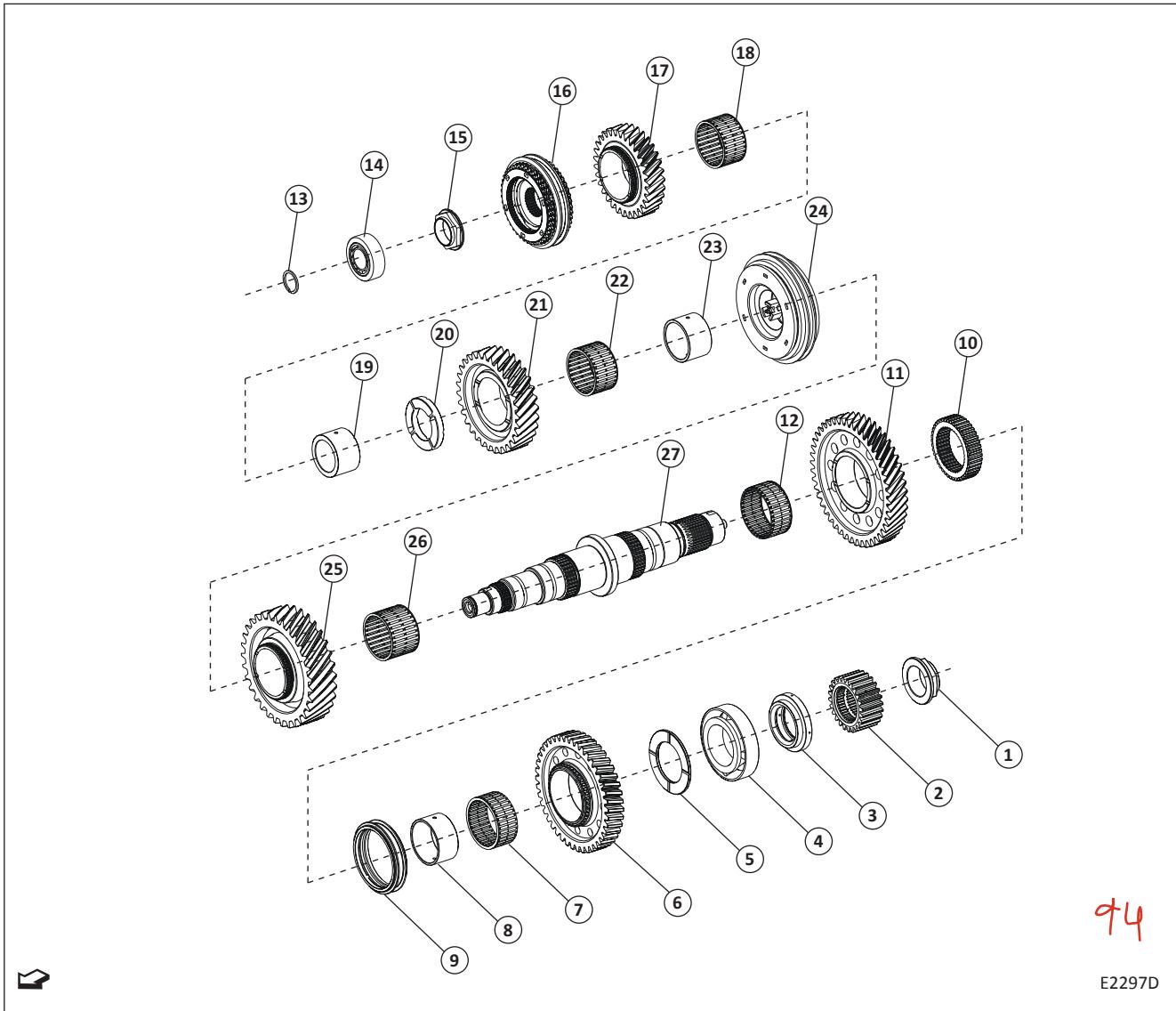
23. Thrust washer gear

24. Reverse gear main shaft

25. Bearing

26. Sleeve

5.6.8 ET140S9

**Disassembly Sequence**

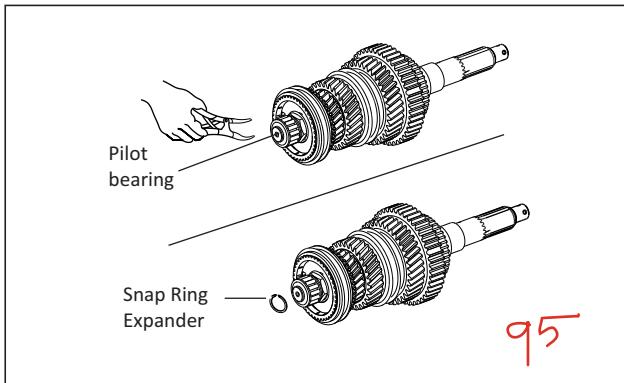
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 →
18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27

Assembly Sequence

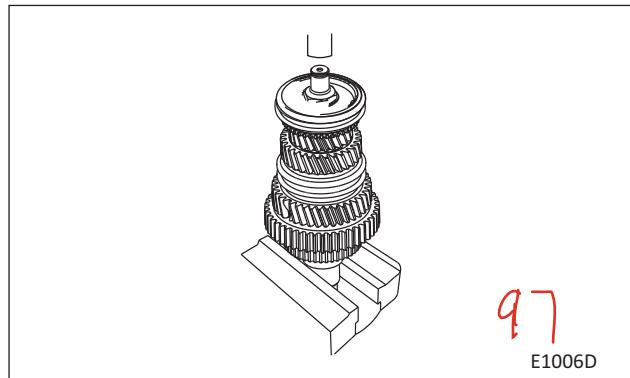
27 → 26 → 25 → 24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13
12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

- | | | |
|-----------------------------------|---------------------------------|-----------------------------------|
| 1. Main shaft nut | 11. Crawler gear main shaft | 21. 2nd gear main shaft |
| 2. Sun gear | 12. Bearing 1st gear main shaft | 22. Bearing 2nd gear main shaft |
| 3. Ring | 13. Snap ring | 23. Bearing sleeve |
| 4. Taper roller bearing | 14. Taper roller bearing | 24. Assembly synchronizer 1st-2nd |
| 5. Thrust washer | 15. Nut main shaft | 25. 1st gear main shaft |
| 6. 1st Gear main shaft | 16. Synchronizer assy 3rd -4th | 26. Bearing 1st gear main shaft |
| 7. Bearing 1st gear main shaft | 17. 3rd gear main shaft | 27. Main shaft |
| 8. Bearing sleeve | 18. Bearing 3rd gear main shaft | |
| 9. Sleeve synchroniser | 19. Bearing sleeve | |
| 10. Hub synchroniser crawler gear | 20. Thrust washer | |

- 1) To remove the snap rings from the main shaft, use the Snap Ring Expander (Standard Tool). First remove the snap ring before the pilot bearing.



- 4) Hold the mainshaft assembly in the hydraulic press as illustrated in the fig. and press out all the gears.

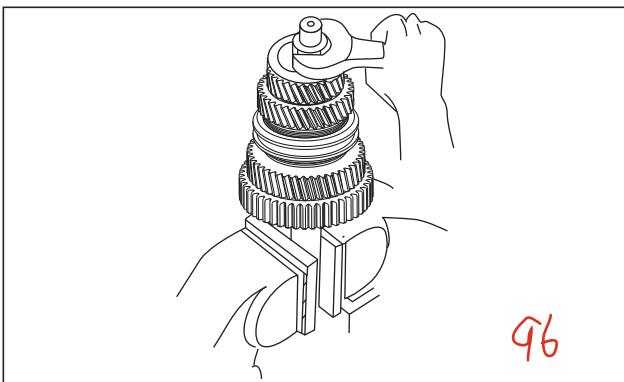


- 2) Mount the main shaft assembly in a vise between copper plate or wooden blocks, and using the special tool, Pilot Bearing Puller, remove the pilot bearing.

3) Removal of lock nut

- A Transmission :- Using the Spanner, remove the lock nut.

Then remove the lock washer.

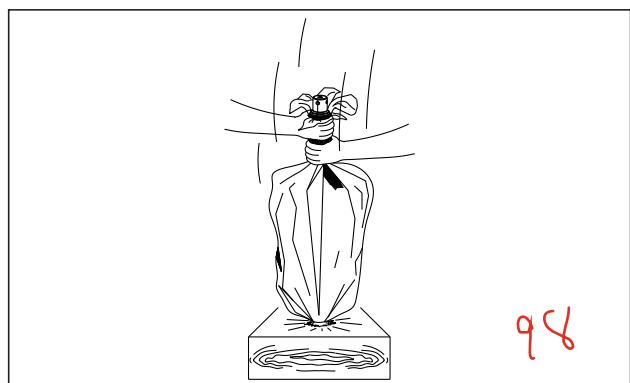


NOTE : 28

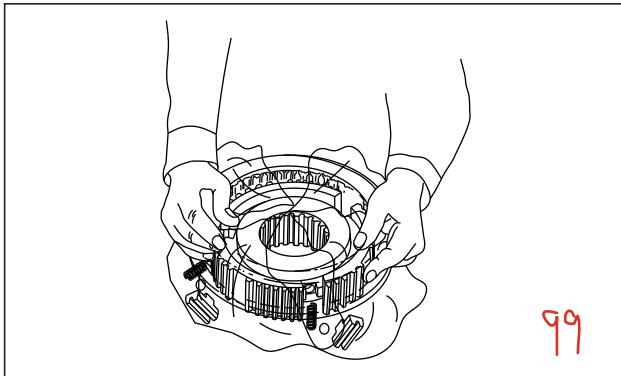
Hold the main shaft firmly from the bottom to prevent it from falling off suddenly.
Carefully remove all gears and synchroniser assemblies from the press.

In case if press is not available you may also use following method to remove the sleeves by using the weight of gears

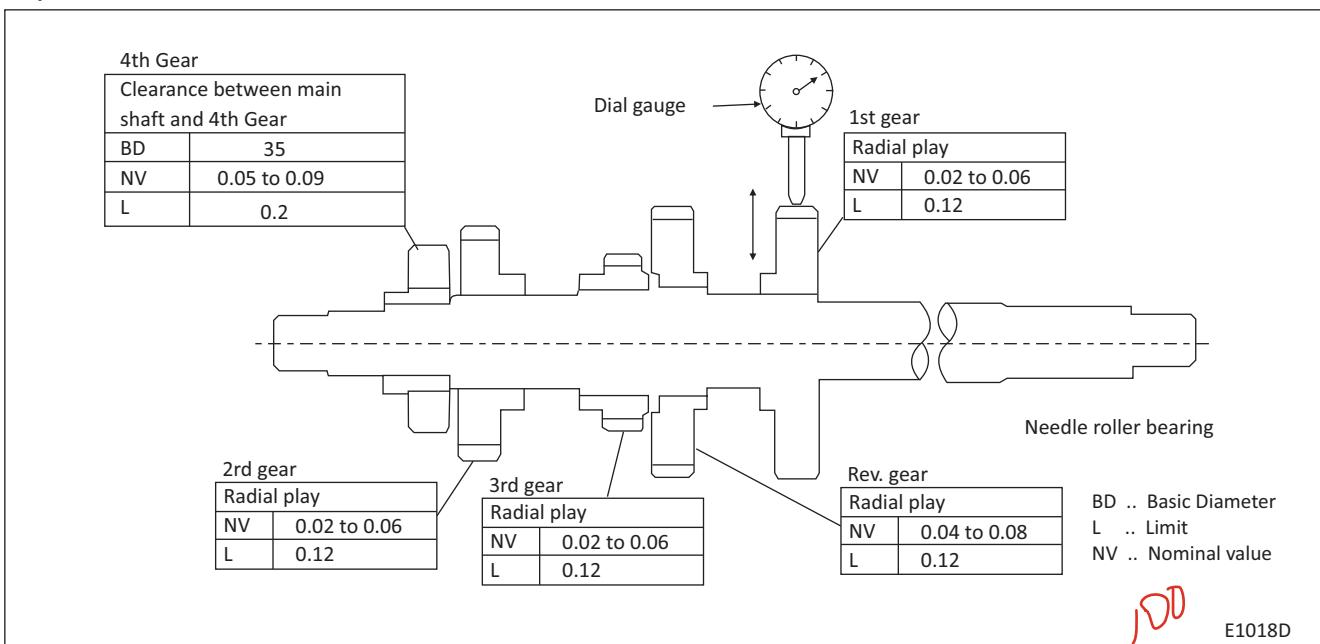
- 6
7
- Cover complete main shaft assembly with a piece of cloth
 - Invert and lightly hit the main shaft against the wooden block.



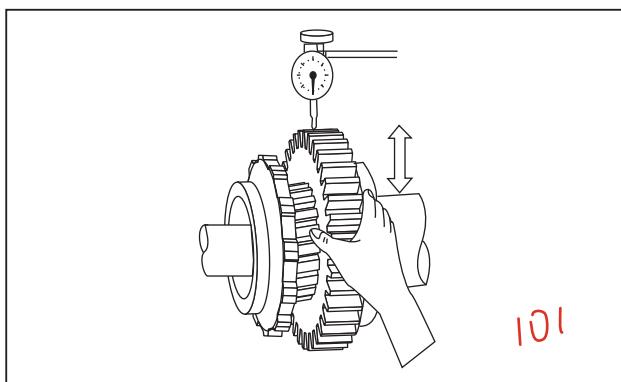
- 8** ● Now carefully remove the cloth piece and remove one by one gear and synchronizer assembly.



Inspection



- Measure the play in diametrical direction of main shaft gears and needle roller bearings. If the play exceeds the service limit, replace the parts.

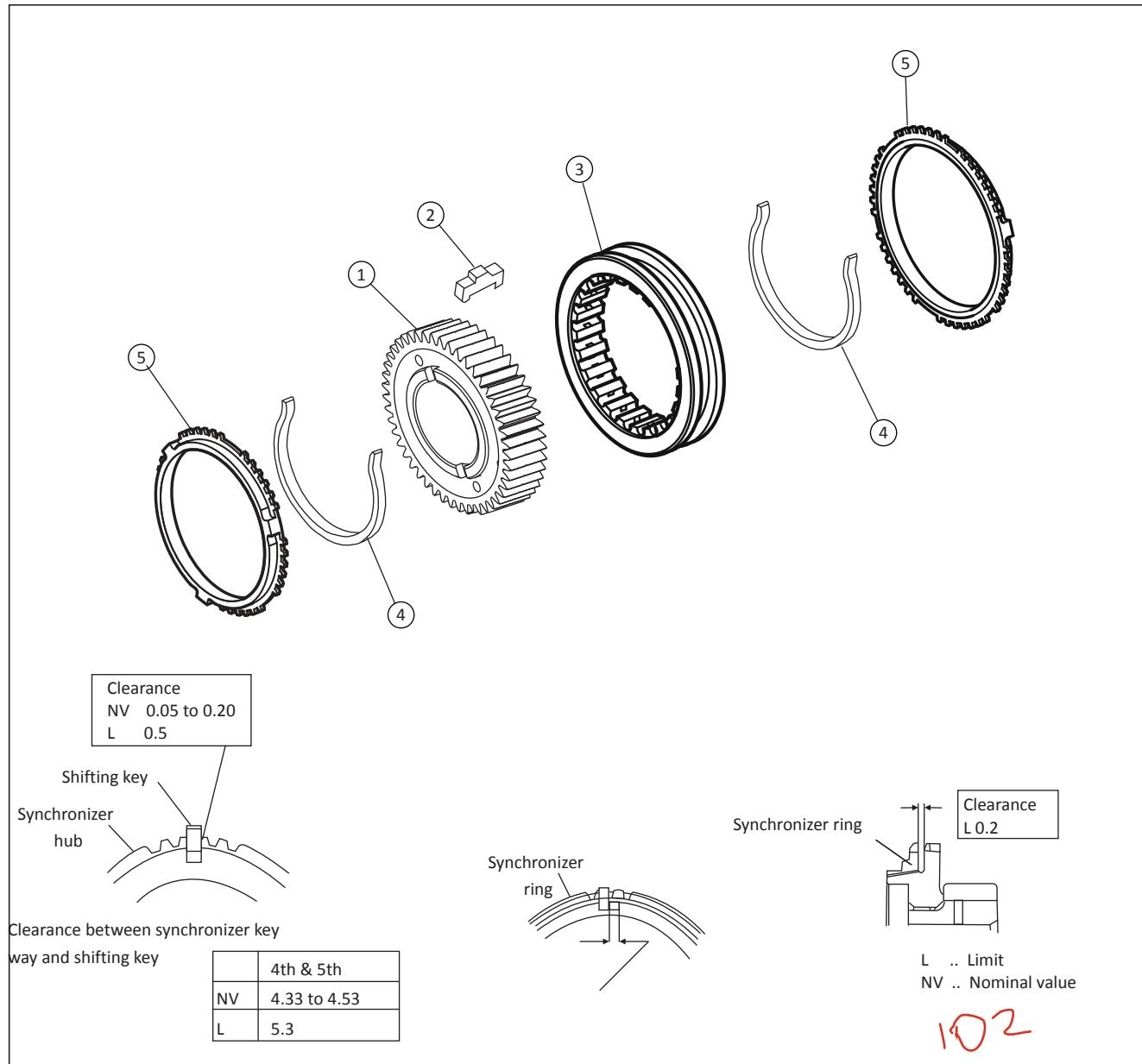


NOTE : 29

If the assembly standard play in diametrical direction is not obtained even after bearing replacement, check the main shaft and replace as needed.

5.7 DISASSEMBLY & ASSEMBLY - SYNCHRONIZER ASSEMBLY

5.7.1 Synchronizer With Shifting Key Mechanism



Disassembly Sequence

5 → 4 → 3 → 2 → 1

Assembly Sequence

1 → 2 → 3 → 4 → 5

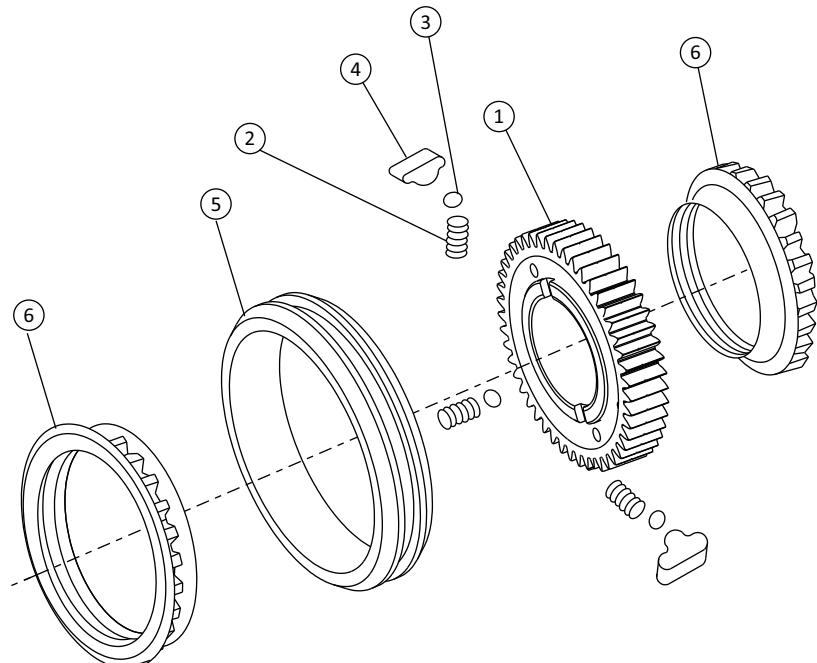
1. Hub synchro
2. Shifting key
3. Sliding sleeve
4. Shifting key spring
5. Synchronizer ring

NOTE:

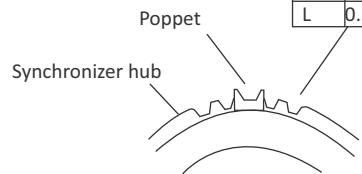
If a gear slip off occurs, check the synchronizer cone of each gear assembly and synchronizer sleeve spline and chamfered portions and replace defective parts.

30

5.7.2 Synchronizer with poppet and spring Mechanism

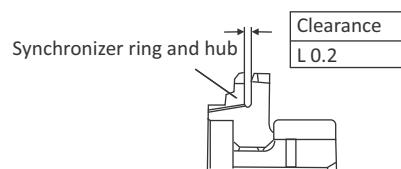


Clearance	
NV	0.05 to 0.20
L	0.5



Clearance between synchronizer hub and poppet

	2nd & 3rd
NV	4.33 to 4.53
L	5.3



L .. Limit
NV .. Nominal value

1D3

Disassembly Sequence

6 → 5 → 4 → 3 → 2 → 1

Assembly Sequence

1 → 2 → 3 → 4 → 5 → 6

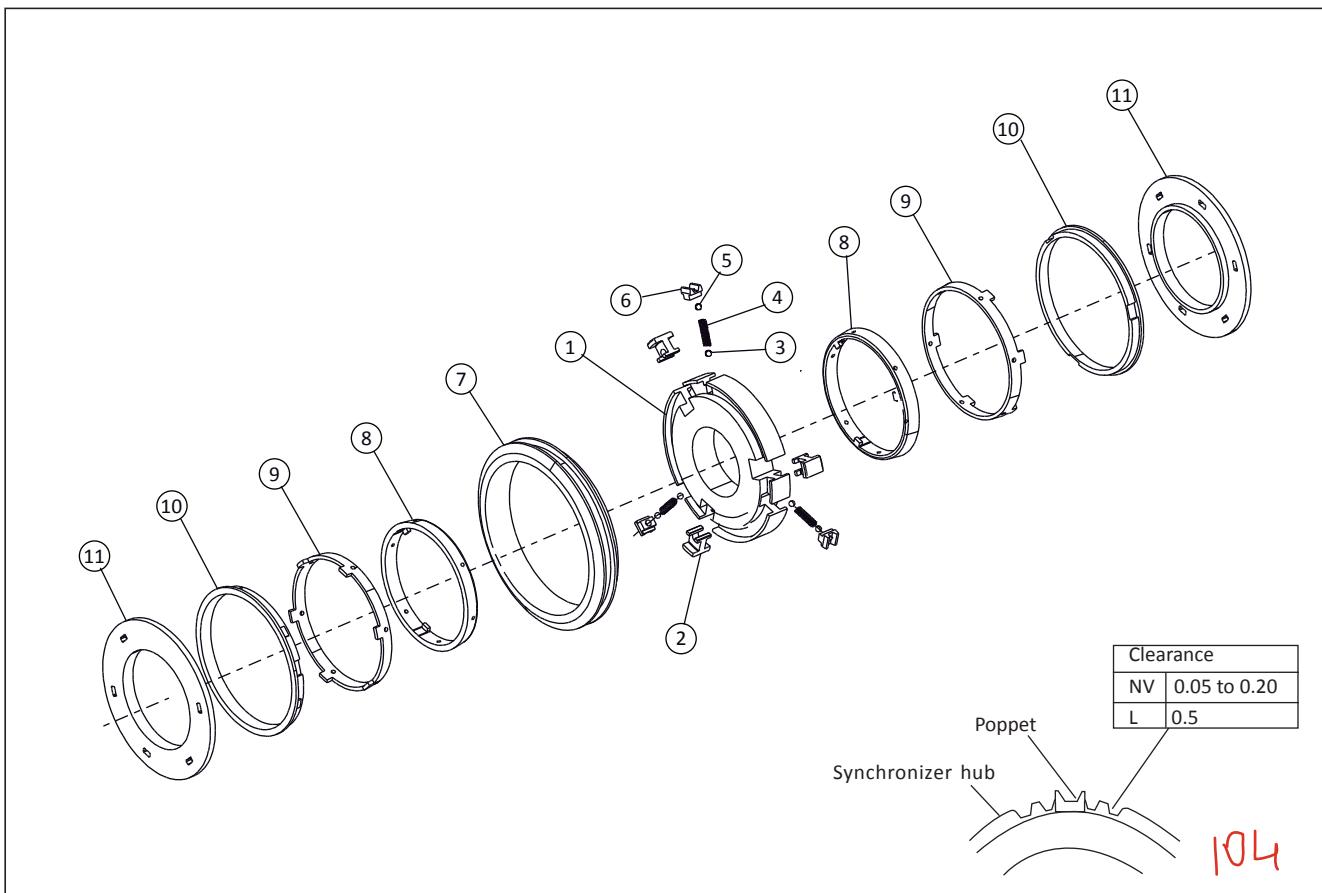
1. Hub synchro
2. Spring
3. Ball Steel
4. Poppet
5. Sliding sleeve
6. Ring synchro

NOTE:

If a gear slip off occurs, check the synchronizer cone of each gear assembly and synchronizer sleeve spline and chamfered portions and replace defective parts.

31

5.7.3 Double Cone Synchronizer Mechanism



Disassembly Sequence

11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

Assembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11

1. Hub Synchro
7. Sliding sleeve

2. Block
8. Inner ring

3. Lower pin ball
9. Clutch Cone

4. Spring

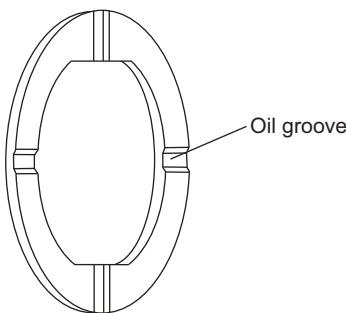
10. Ring synchronizer

5. Upper pin ball
11. Clutch body ring

NOTE:

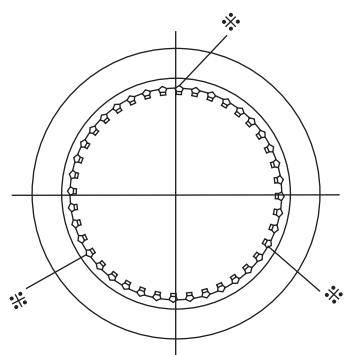
If a gear slip off occurs, check the synchronizer cone of each gear assembly and synchronizer sleeve spline and chamfered portions and replace defective parts.

31



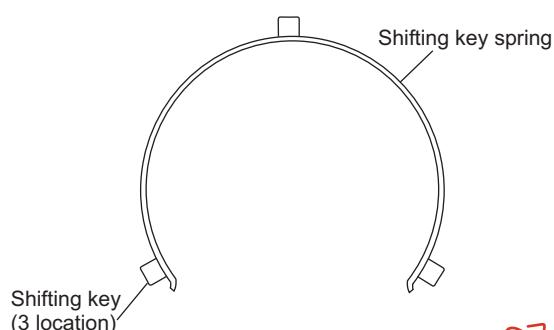
105

- 1) Install the thrust washer with the side having oil grooves facing toward the gear.



106

- 2) Install the synchronizer sleeve so that shifting keys are positioned at three locations marked* in the illustration.



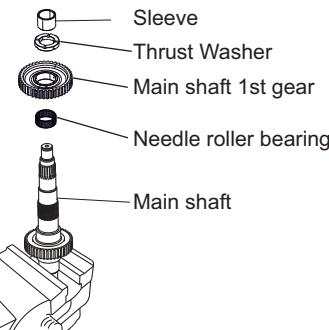
107

- 3) Fit shifting keys into key ways. Then, install the shifting key spring so that the gap between its ends is not located at the shifting key positions.

NOTE :

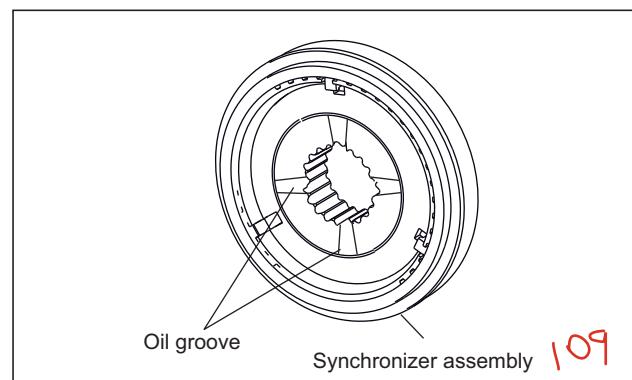
When installing the shifting key springs on both sides, make sure that their slits are not in the same direction.

33



108

- 4) Install the needle roller bearing, main shaft 1st gear and 2nd gear's thrust washer to the main shaft and install the main shaft 2nd gear bearing sleeve by striking uniformly with a special tool sleeve installer (120 22 25).
- 5) Install the needle roller bearing and main shaft 2nd gear assembly to the main shaft and then, fit synchronizer cone, install the 2nd & 3rd synchronizer assembly along with hub, and then install the main shaft 3rd gear bearing sleeve by striking uniformly with a special tool (120 22 26).
- 6) Install the needle roller bearing, synchronizer cone, main shaft 3rd gear assembly and 4th gear thrust washer to the main shaft and install the main shaft 4th gear bearing sleeve striking uniformly with a special tool.
- 7) Install the needle roller bearing and main shaft 4th gear assembly to the main shaft and press fit the synchronizer assembly (Key type) uniformly, using a special tool.



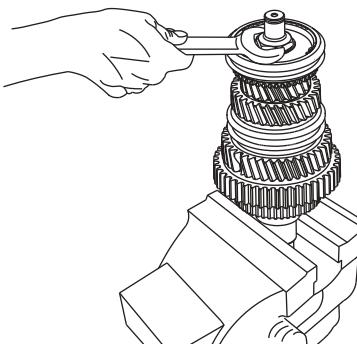
109

NOTE:

1. Install the synchronizer assembly with the side having the oil groove facing the main shaft 4th gear assembly.
2. When installing the synchronizer assembly, apply force against the synchronizer hub.

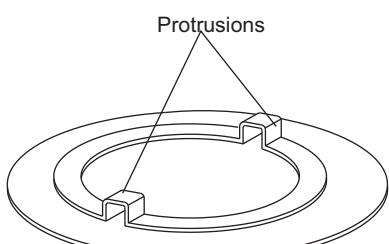
34

35



110

- 8) Install the lock nut and washer to the main shaft and using the special tool, Single spanner, tighten the lock nut to specified torque.

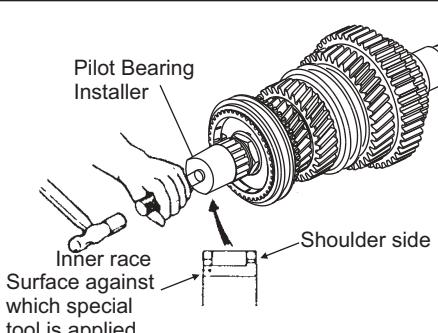


111

NOTE:

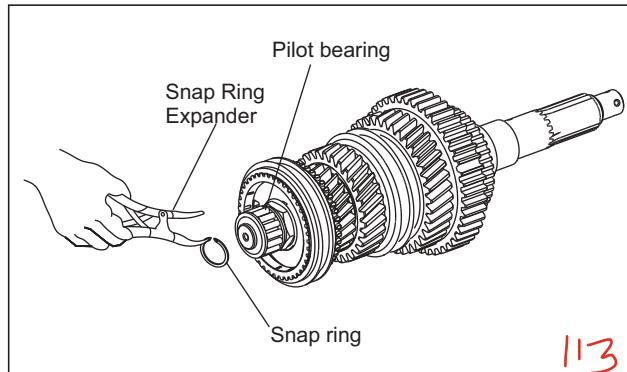
³⁶
Install the lock washer to the synchronizer hub, making sure that the protrusions at two places in the lock washer are fitted into the slots in the hub.

- 9) Using the special tool, Bearing Installer, drive the pilot bearing onto main shaft.



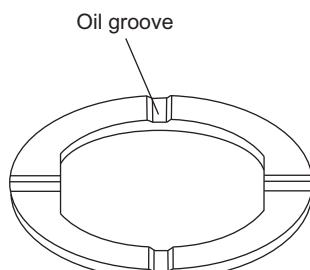
112

- 10) Using the standard special tool, Snap Ring Expander, fit the snap ring into position.



113

- 11) Install the synchronizer sleeve, needle roller bearing, main shaft 1st and reverse gear and 1st gear thrust washer to the main shaft.

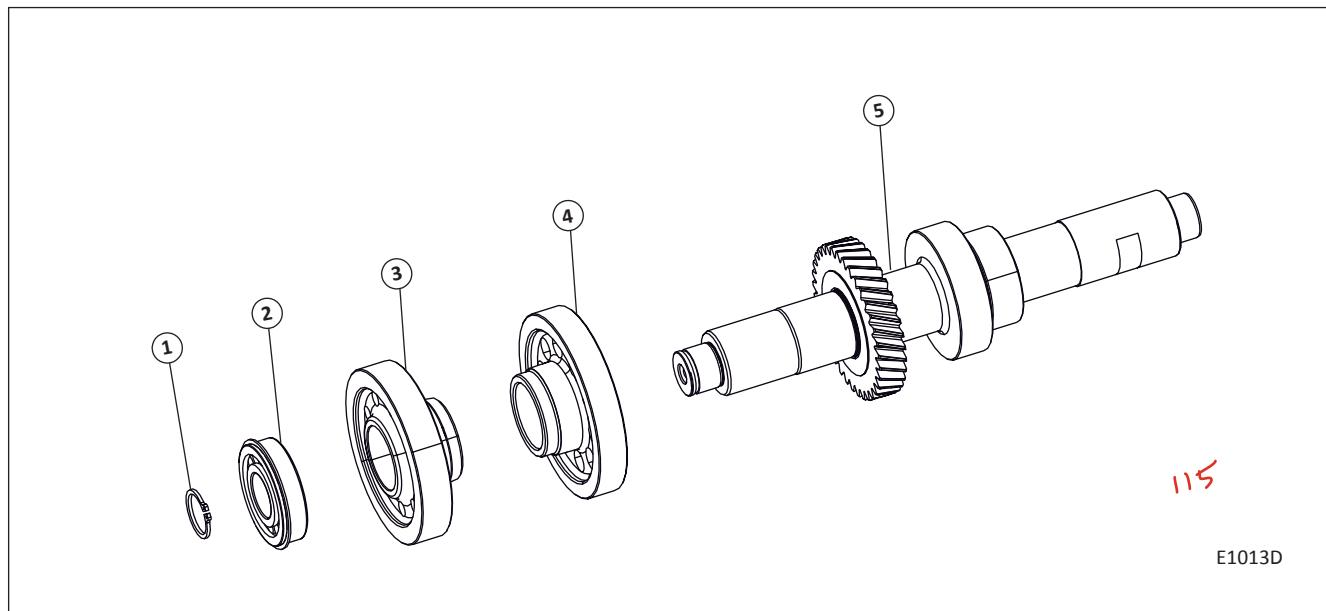


114

NOTE :

³⁷
Install the 1st gear thrust washer so that its side with oil grooves faces gear.

5.8 COUNTER SHAFT DISASSEMBLY & ASSEMBLY



Disassembly Sequence

1 → 2 → 3 → 4 → 5

1. Lock ring
2. Roller bearing
3. Counter shaft 5th gear

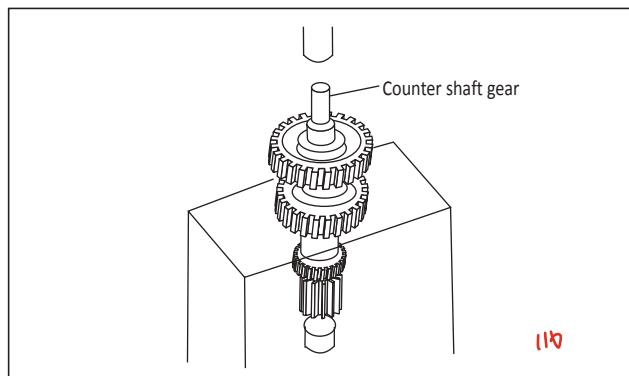
Assembly Sequence

5 → 4 → 3 → 2 → 1

4. Counter shaft 6th gear
5. Counter shaft

5.8.1 Disassembly

| Using the hydraulic press, remove the gears from counter shaft.



Note : Remove load for 5th & constant mesh gear should be with in 19000~20000 kgfcm

38

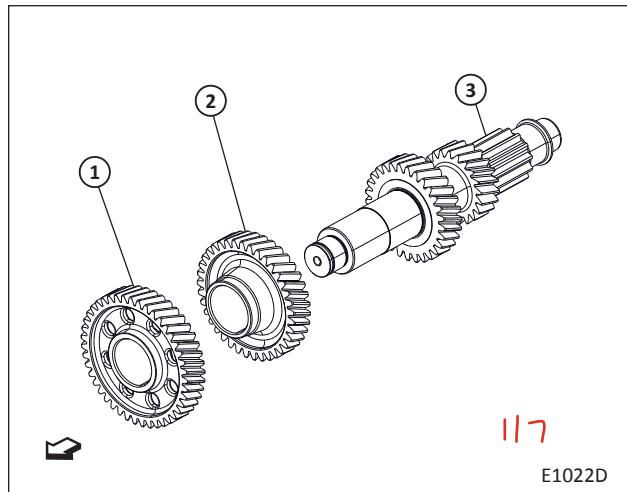
5.8.2 Assembly

| Using the hydraulic press, Install the gears on counter shaft.

Note : Press load for 5th gear -14000~18000 kgfm press load for constant mesh gear 15000~20000 kgfm

39

5.8.3 Inspection of counter shaft gears



1. Counter shaft constant mesh gear

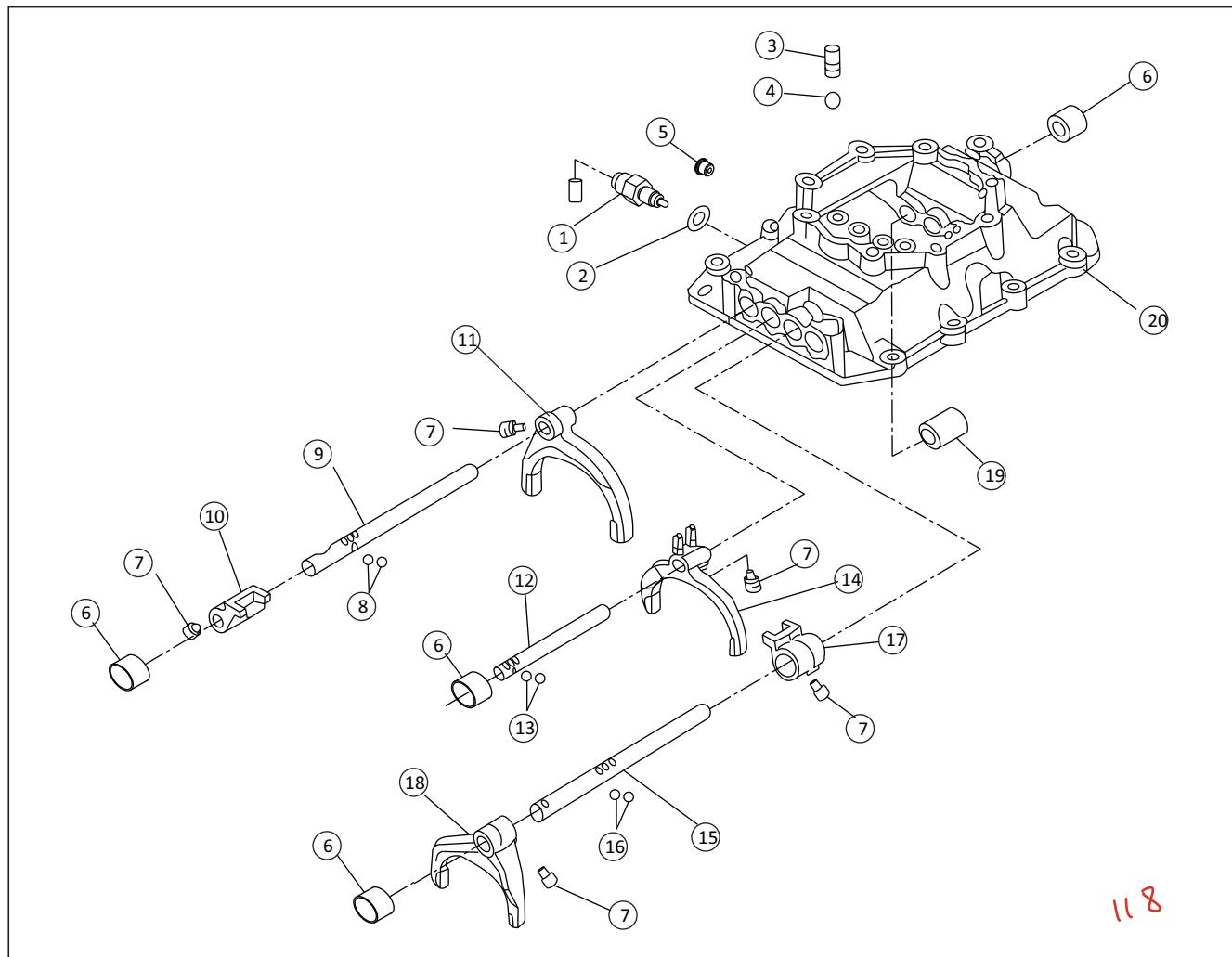
2. Counter shaft 4th gear

3. Counter shaft

2 a) Inspect gear teeth profile for any damage, scoring mark, over heating marks.

3 b) Visually inspect counter shaft for any damage.

5.9 GEAR SHIFTER, LOWER - DISASSEMBLY AND ASSEMBLY



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20

Assembly Sequence

20 → 19 → 15 → 16 → 17 → 18 → 12 → 13 → 14 → 9 → 8 → 10 → 11 → 7 → 6 → 5 → 4 → 3 → 2 → 1

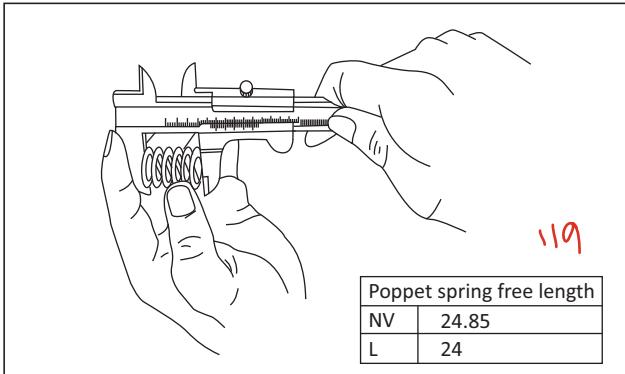
- | | | | |
|------------------------------|-------------------------------|--------------------------|--------------------------|
| 1. Backup lamp switch | 2. Gasket | 3. Poppet Spring | 4. Steel ball |
| 5. Plug case lower | 6. Dust plug | 7. Set bolt | 8. Steel ball |
| 9. 1st & Rev. shift rail | 10. 1st & Rev shift rail jaw | 11. 1st & Rev shift fork | 12. 2nd & 3rd shift rail |
| 13. Steel ball & Pin | 14. 2nd & 3rd shift rail fork | 15. 4th & 5th shift rail | 16. Steel ball |
| 17. 4th & 5th shift rail jaw | 18. 4th & 5th shift fork | 19. Bushing | 20. Gearshift lower case |

Note :

When disassembling the shift rail, take care not to lose the interlock pin B (integrated into the 2nd & 3rd shift rail), steel ball.

40

1) Springs

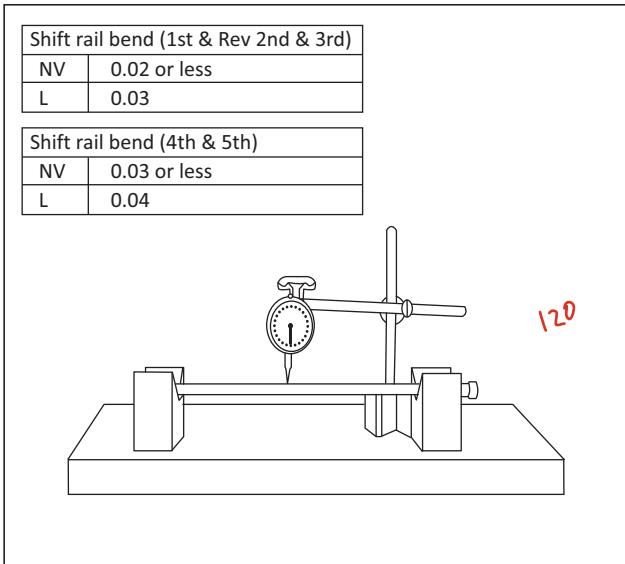


| Measure free length of each spring and replace if the limit has been reached.

NOTES : 41

Do not stretch the spring when it is used

2) Shift rails



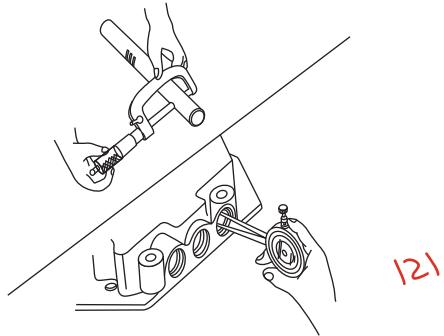
| Check the shift rail for bend (Bend is half of the reading on the dial gauge). Correct or replace the part if the limit has been reached.

Shift rail to gear shift lower case hole clearance (1st & Rev, 2nd & 3rd)

NV	0.18 to 0.22
L	0.3

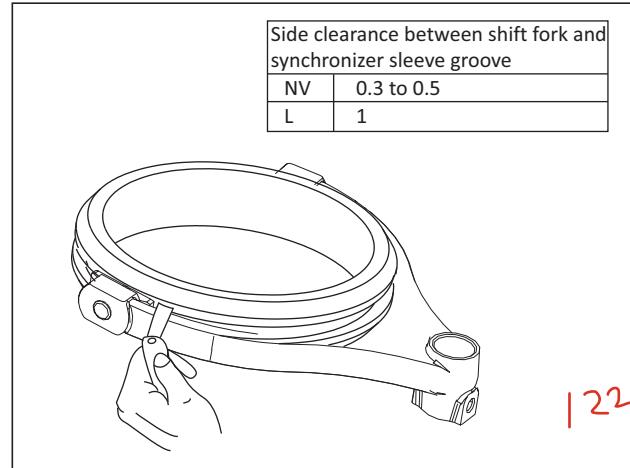
Shift rail to gear shift lower case bushing clearance (4th & 5th)

NV	0.04 to 0.14
L	0.2



| Measure the shift rail O.D. and shift rail hole I.D. in the gearshift lower case to obtain the clearance. If it exceeds the limit, replace the parts.

3) Shift fork and synchronizer sleeve

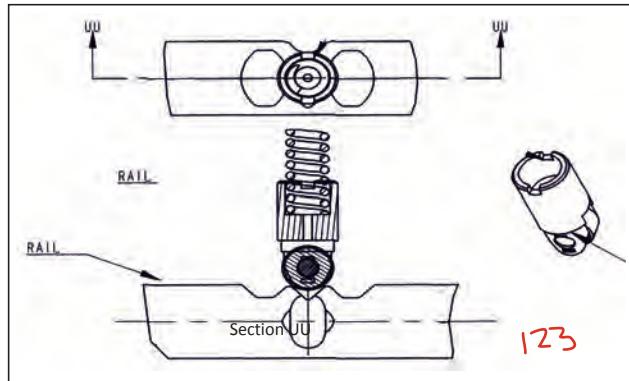


| Measure the clearance between the shift fork and synchronizer sleeve and if it exceeds the limit, replace the parts.

(1) Detent Assembly

Groove in Detent Assy. is to be kept Perpendicular to the axis of rail during assembly

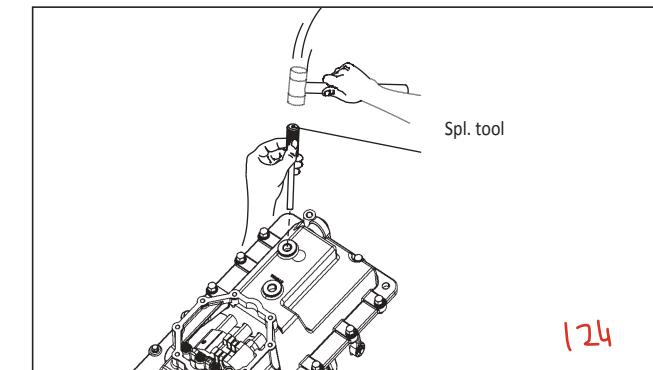
42



2) For gear shifter lower assembly fitted with spring pin

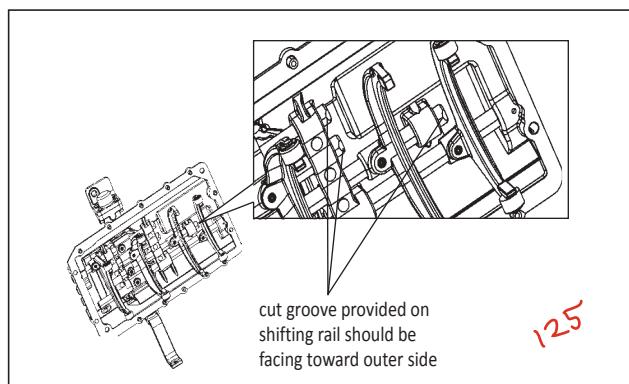
a) Pin Spring Removal

Remove "Pin Spring Assy." with the help of special tool pin installer.

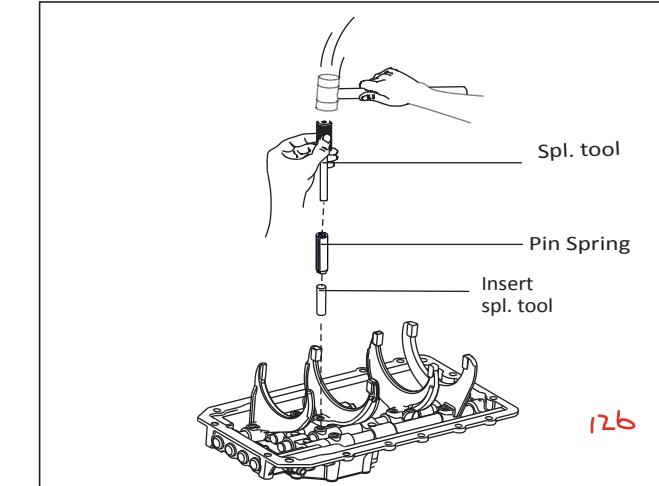


b) Pin Spring Assembly

During installation, cut groove provided on shifting rail should be facing toward outer side. refer below figure

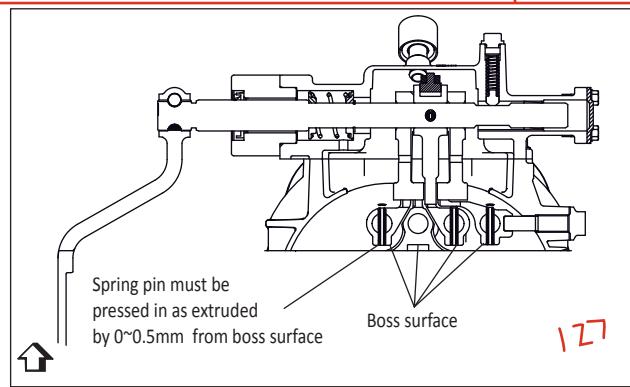


Align the Fork hole and shift rail hole with the help of insert (spl. tool & install the pin spring with the help of spl. tool. (refer special tools for part no)



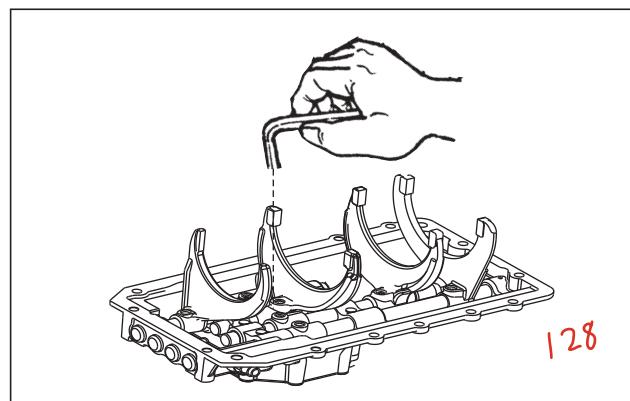
Note : Spring pin must be pressed in as extruded by 0~0.5mm from boss surface

43

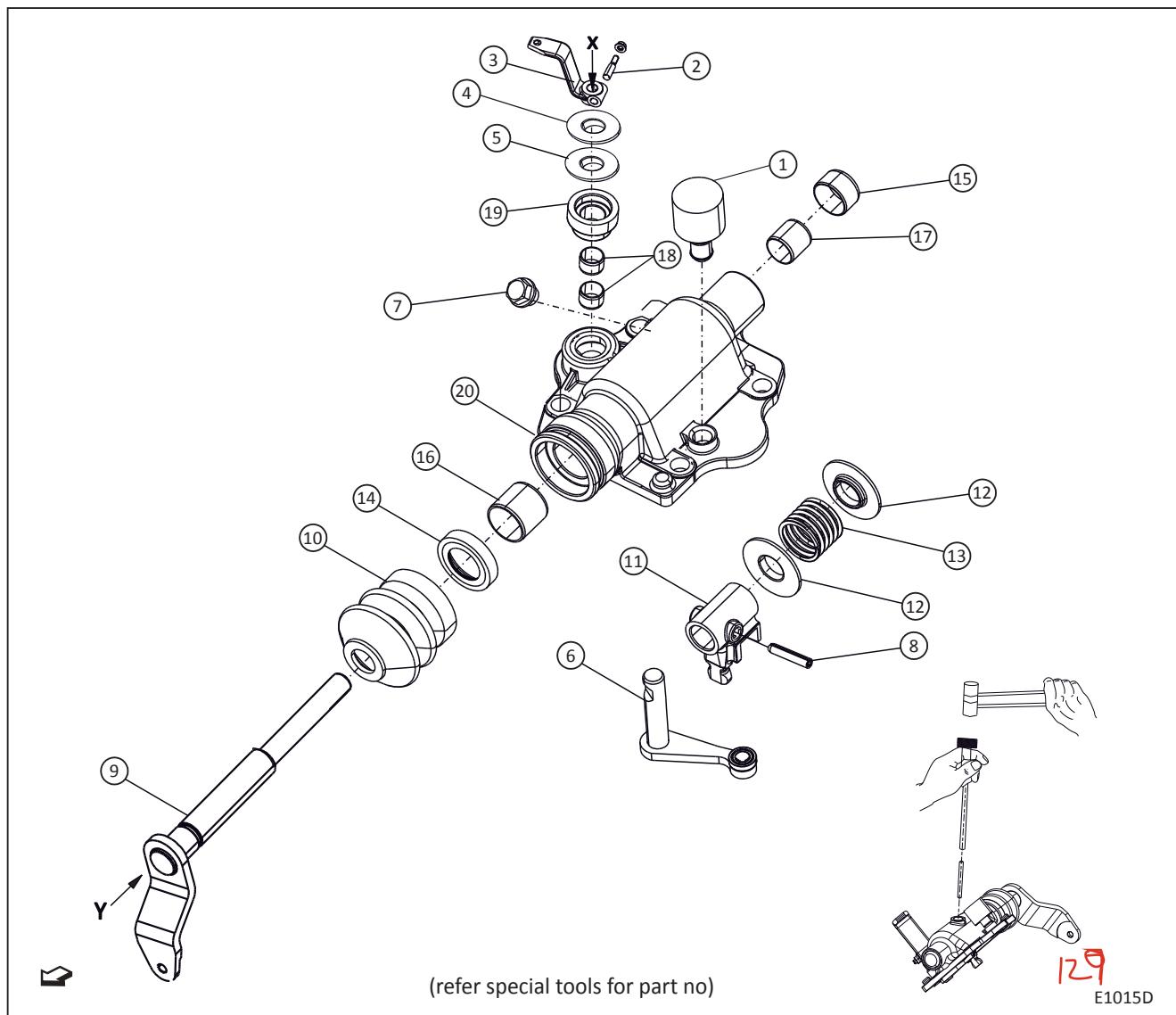


3) For Gear shifter lower assembly fitted with set bolt

After installation, stake the shift rail set bolt at more than three places by punching.



5.10 DISASSEMBLY & ASSEMBLY OF GEAR SHIFTER – UPPER COVER (HYBRID GSL)



Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 → 18 → 19 → 20

Assembly Sequence

20 → 19 → 18 → 17 → 16 → 15 → 14 → 13 → 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

1. Air breather	2. Lock pin	3. Select lever-B	4. Shim	5. Oil seal
6. Assy select lever-A	7. Plug screw	8. Pin spring	9. Assy cross shaft	10. Boot
11. Sliding lever	12. Retainer select spring	13. Spring	14. Oil seal	15. Plug, dust
16. Bush	17. Bush, cross shaft	18. Bush, select lever -A	19. Bushing, case upper	20. Upper case

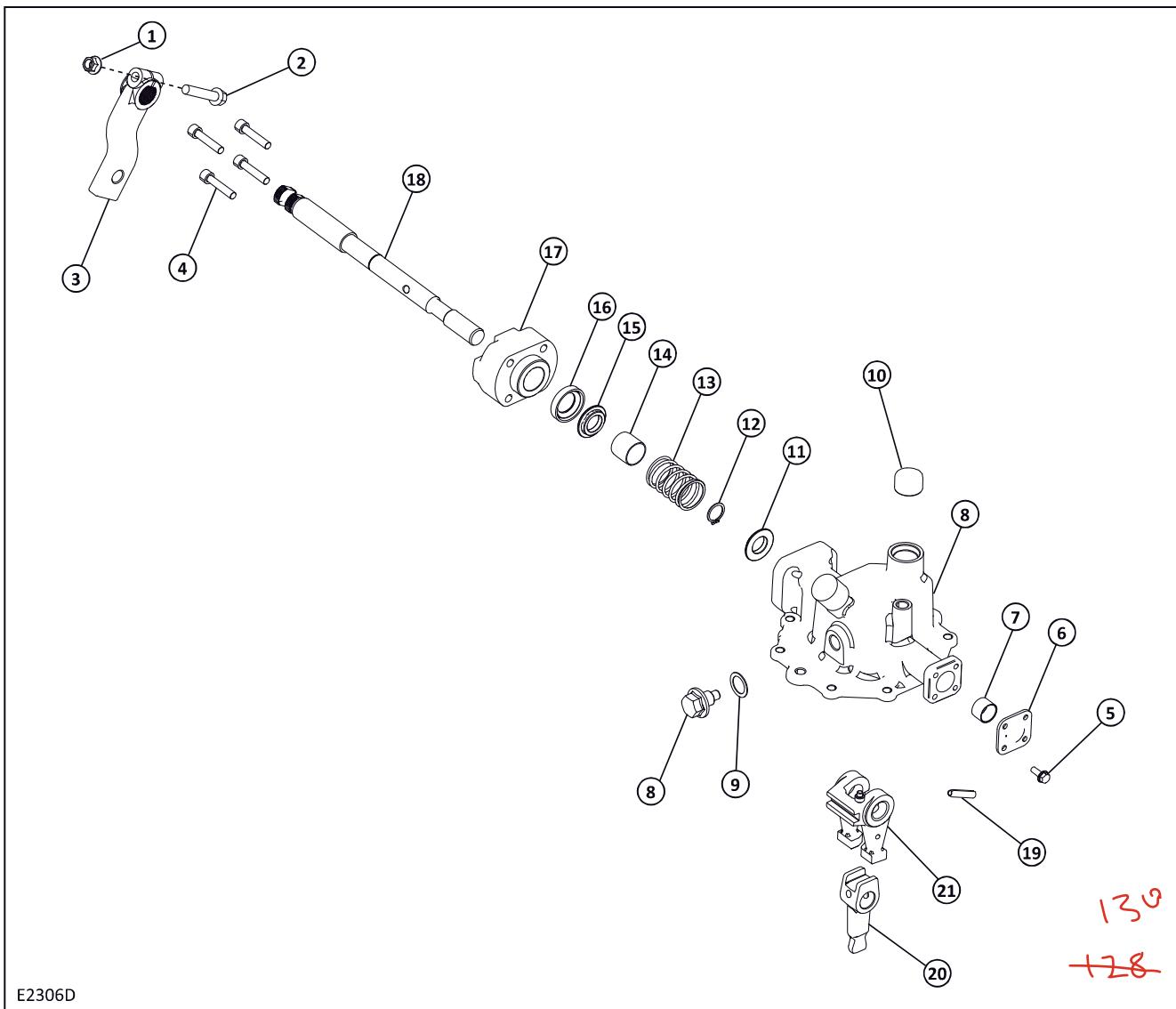


NOTES :

44

Remove pin spring assembly after aligning sliding lever and plug screw hole with the help of insert.

5.10.1 Disassembly and Assembly of gear shifter Upper



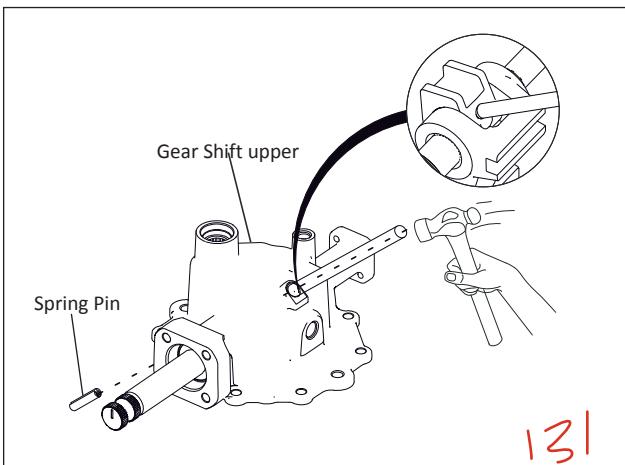
Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 →
18 → 19 → 20 → 21

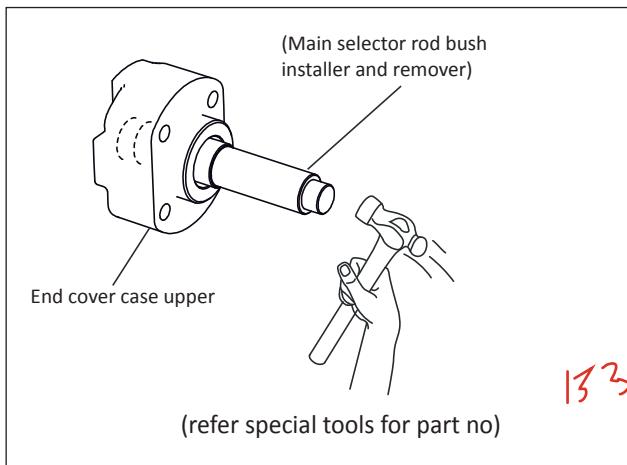
Assembly Sequence

21 → 20 → 19 → 18 → 17 → 16 → 15 → 14 → 13 → 12 → 11 → 10 → 9 → 8 → 7 → 6 →
5 → 4 → 3 → 2 → 1

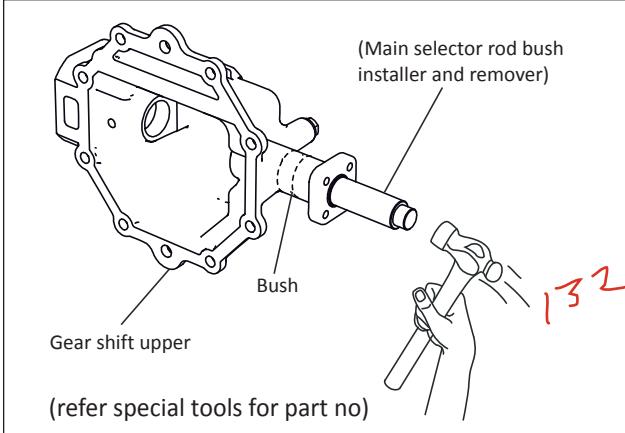
- 1. Nut
- 2. Bolt
- 3. Lever cross shaft
- 4. Hex screw
- 5. Nut
- 6. Cover case
- 7. Bush
- 8. Assembly case upper
- 9. Blocker bolt
- 10. Air breather
- 11. Spring retainer
- 12. Snap ring
- 13. Spring select case upper
- 14. Bush cross shaft
- 15. Spring retainer
- 16. Oil seal
- 17. End cover
- 18. Cross shaft
- 19. Spring pin
- 20. Shifter finger
- 21. Select lever assembly



- 1 a) Align the blocker pin to breather hole.
- 2 b) Remove pin using a suitable rod by hammering as shown in the illustration



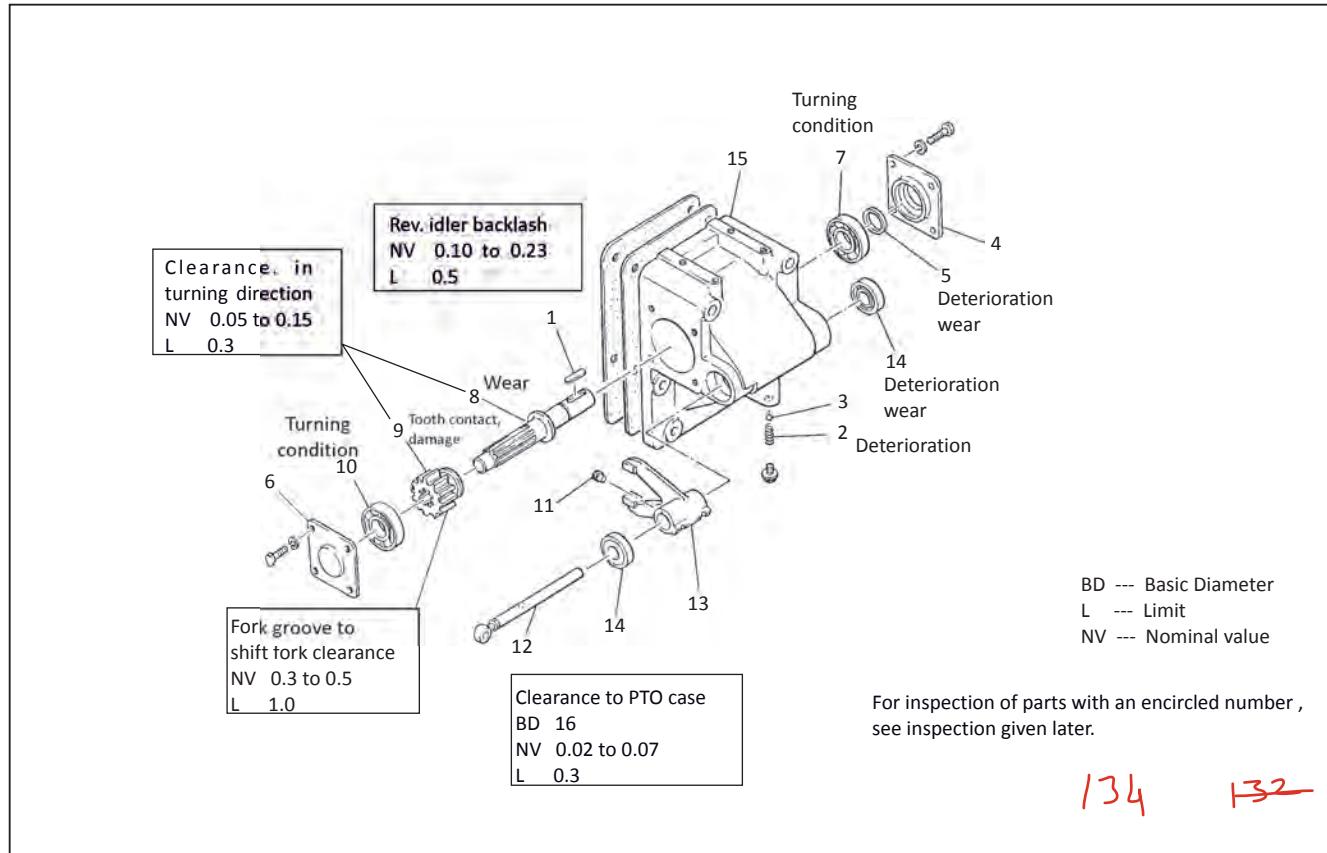
-
-
- c) Place the into end cover case upper and remove control bushing by slightly hammering with the help of mallet.

4

- 3 c) Place the into gear shift upper housing and remove gear shift upper control bushing by slightly hammering with the help of mallet.

5.11 TRANSMISSION PTO CONTROL

5.11.1 Disassembly, Assembly And Inspection of PTO Gear Box (Hydraulic)



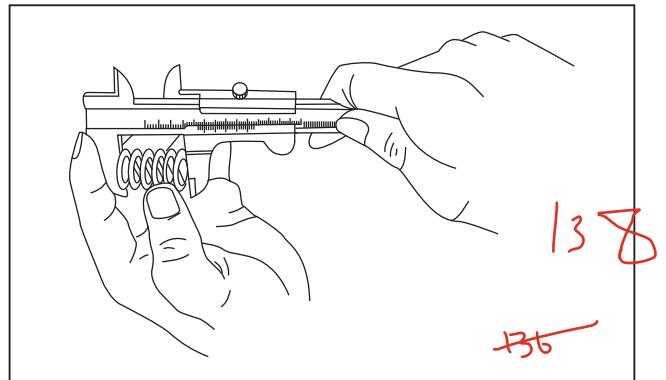
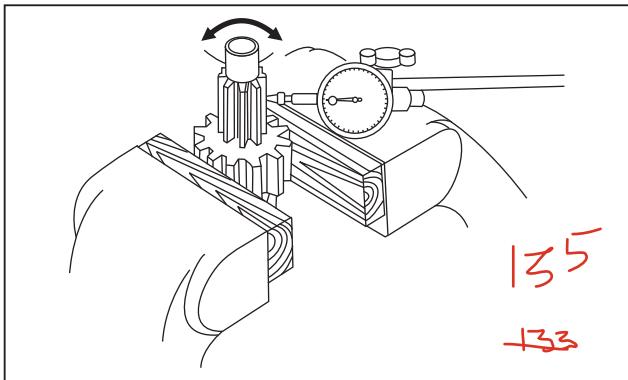
Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15

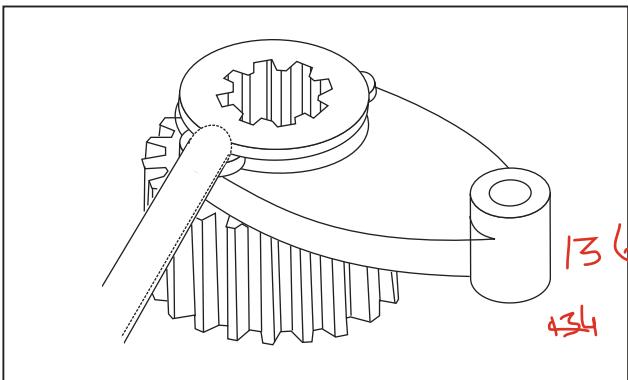
Assembly sequence

15 → 14 → 12 → 13 → 11 → 10 → 9 → 6 → 8 → 7
 ──────────→ 3 → 2 → 1
 4 → 5

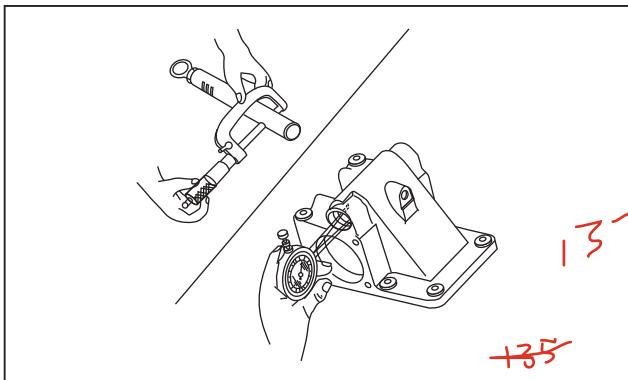
1 Sunk key	5 Oil seal	9 PTO gear	13 PTO shift fork
②Poppet spring	6 Front cover	10 Ball bearing	14 Oil seal
3 Steel ball	7 Ball bearing	11 Set bolt	15 PTO case
4 Rear cover	8 PTO shaft	12 PTO shift rail	



- 1) Measure the clearance between the PTO gear and PTO shaft in turning direction. Replace parts if the limit is exceeded.



- 2) Measure the clearance between the PTO gear fork groove and shift fork. Replace parts if the limit is exceeded.



- 3) Measure the shift rail O.D. and shift rail hole I.D. of the P.T.O. case to obtain the clearance between the shift rail and P.T.O. case. Replace parts if the limit is exceeded.

- 4) Measure the free length of poppet spring and, if it is below the limit replace.

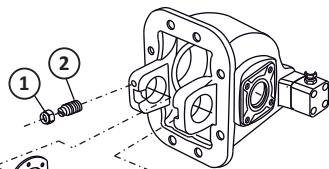
NOTE:

Do not stretch the poppet spring for reuse.

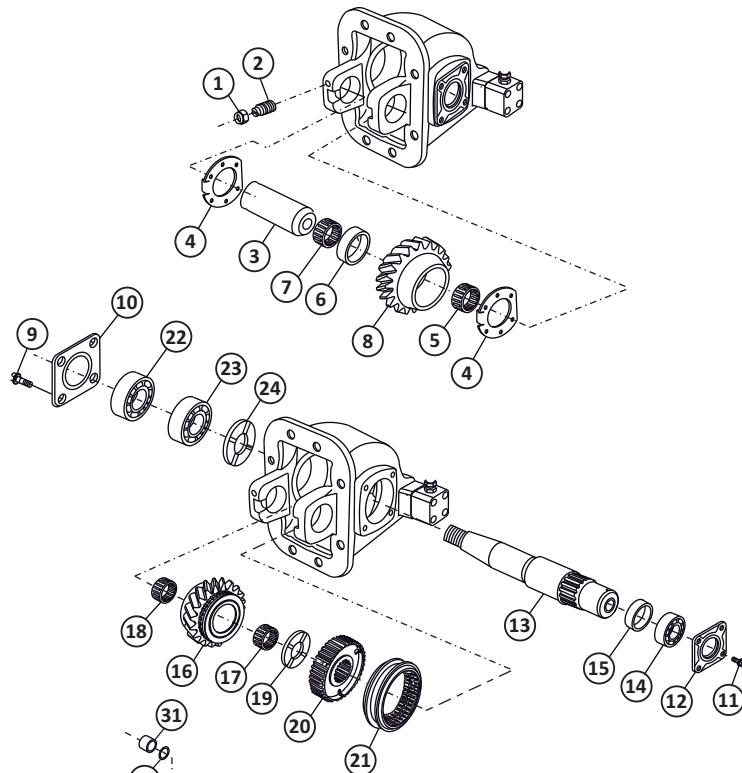
45

5.11.2 Disassembly and Assembly of Pneumatic Type Transmission PTO Control

Step 1

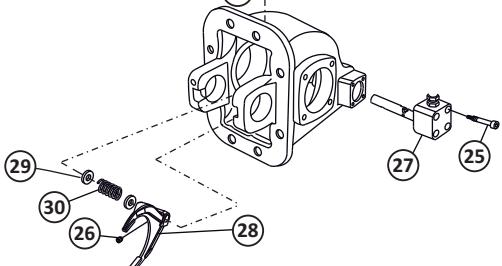


Step 2



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Step 3



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Inspection:

- a) Inspect idler gear PTO, sleeve synchronizer cable and lever for deformation and replace if required.
- b) Inspect ball bearing, oil seal, gear output shaft and PTO shaft teeth for deformation or wear and replace if required.

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Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 →
 18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27 → 28 → 29 → 30 → 31 → 32

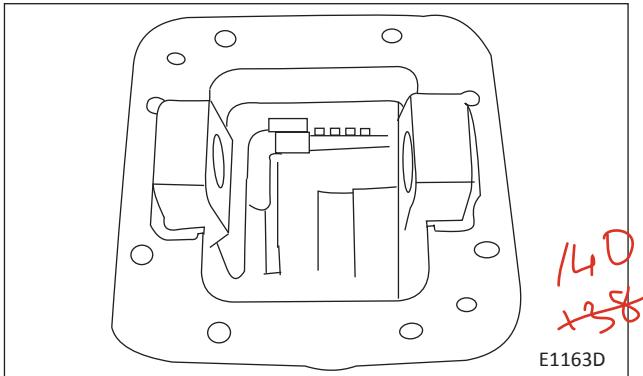
Assembly Sequence

27 → 28 → 29 → 30 → 26 → 25 → 32 → 31 → 13 → 15 → 14 → 17 → 18 → 19 → 20 → 21 → 16 → 24 → 22 →
 23 → 12 → 11 → 10 → 9 → 3 → 4 → 5 → 6 → 7 → 8 → 4 → 2 → 1

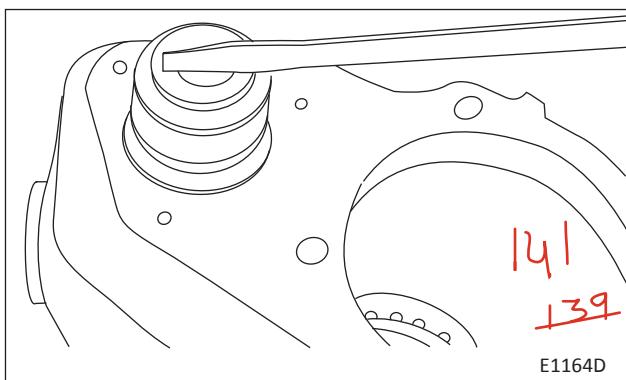
1. Nut jam	2. Screw adjusting	3. Shaft idler	4. Washer idler gear
5. Needle roller bearing	6. Spacer needle bearing	7. Needle roller bearing	8. Idler gear PTO
9.Bolt (M8x1.25x12)	10.Bearing cap front	11.Bolt (M8x1.25x12)	12.Bearing cap front
13.Output shaft PTO (HYVA)	14.Ball bearing	15.Spacer	16.Gear output shaft assy.
17.Needle roller bearing	18.Needle roller bearing	19.Thrust washer	20.Hub synchronizer- PTO
21.Sleeve synchronizer	22.Ball bearing	23.Ball bearing	24.Thrust washer PTO
25.Hex socket head bolt	26.Bolt, Set	27.Cylinder assy. PTO	28.Fork PTO
29.Washer	30.Return spring	31.Plug dust	32.Oil seal

Assembly Procedure

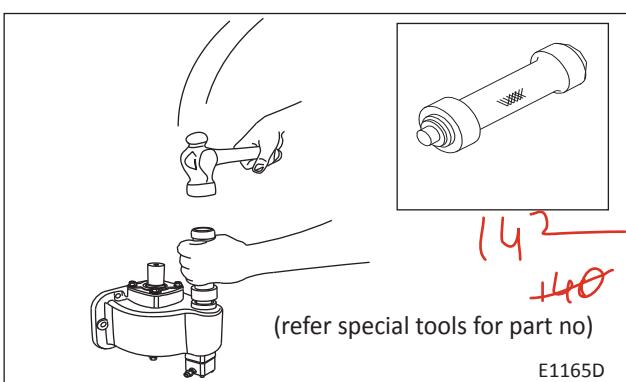
- 1 a) Insert shifting spindle assy with fork and tighten the allen screw with allen key.



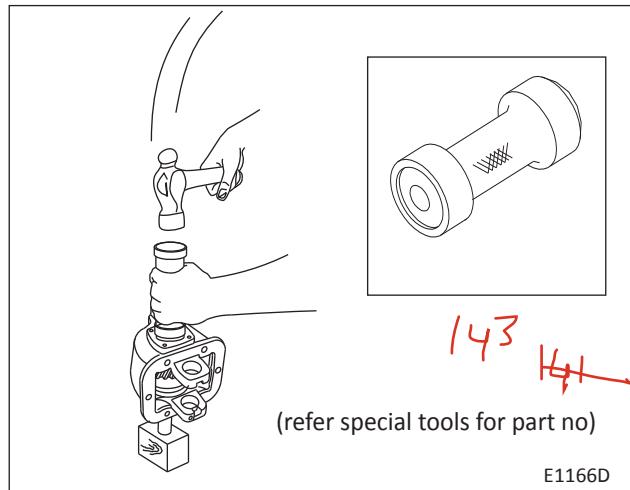
- 2 b) Put retracting spring and seal assy on the spindle.
Tighten the screw with the help of a screw driver.



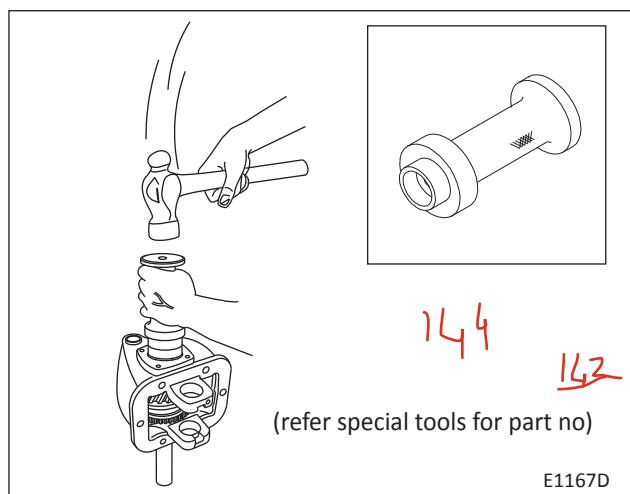
- 3 c) Install seal rail fork shift with the help of special tools.



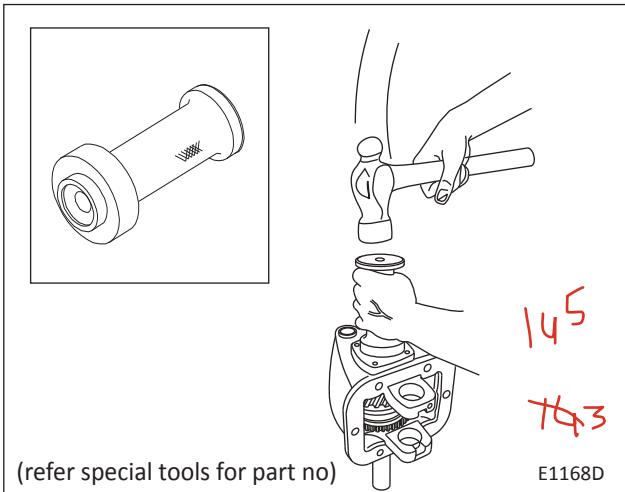
- d) Put all main shaft parts inside housing and insert shaft (with one spacer and pneumatic cylinder side bearing). Use special tool for drifting the bearing into its seat. Align all the internal parts along with pressing of bearing.
- 4 e) Install bearing pneumatic cylinder side with the help of special tools.



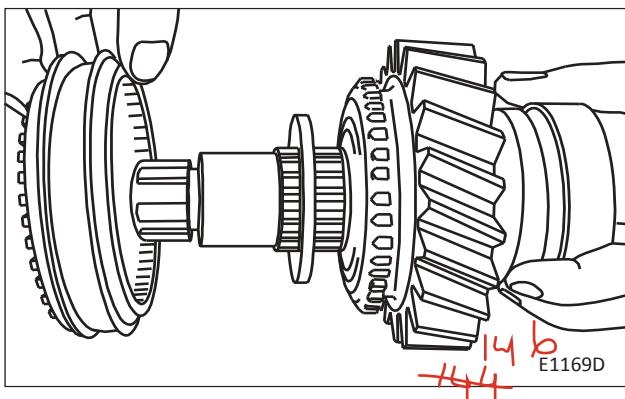
- 5 f) Install bearing inner spline end side with the help of special tools



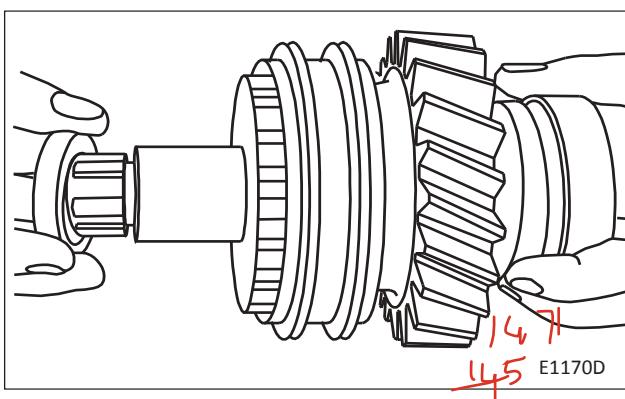
- 7 g) Install bearing outer spline end side with the help of special tools.



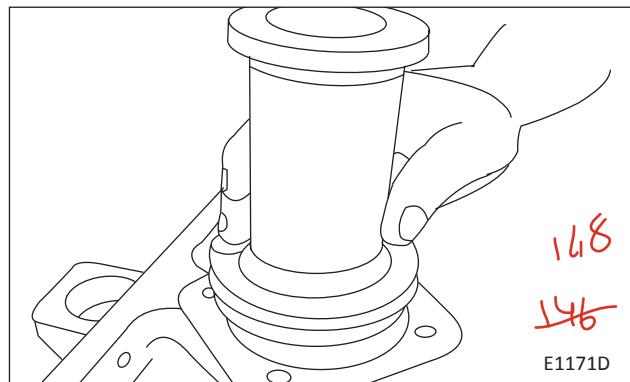
- 8 h) Insert fixed dog and sliding sleeve taking the above mentioned precautions.



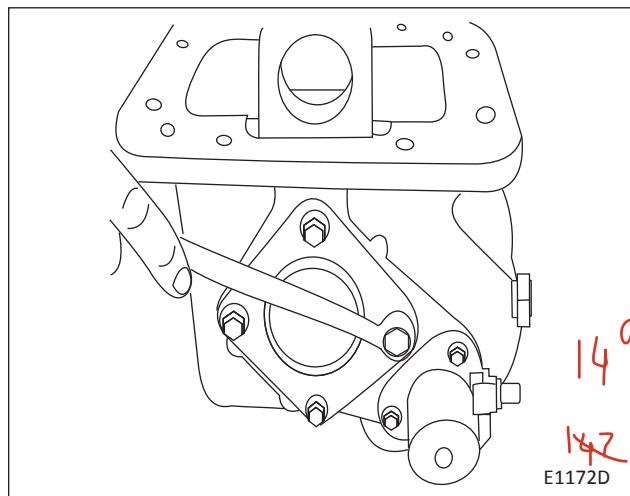
- 9 i) Put splined end thrust washer.



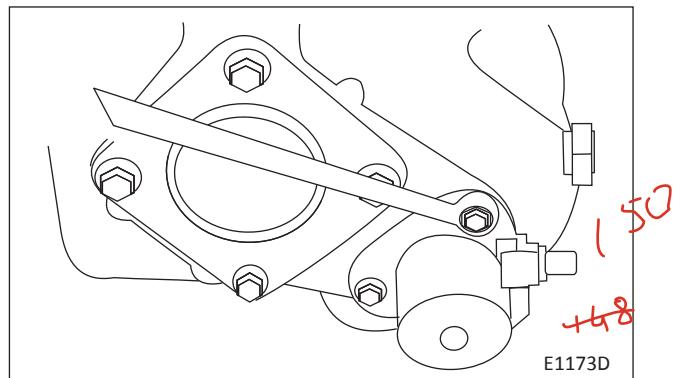
- j) Press splined end bearing with the help of special tool 10 until bearing butts against the thrust washer. (refer special tools for part no)



- 11 k) Put pneumatic cylinder back in its place.

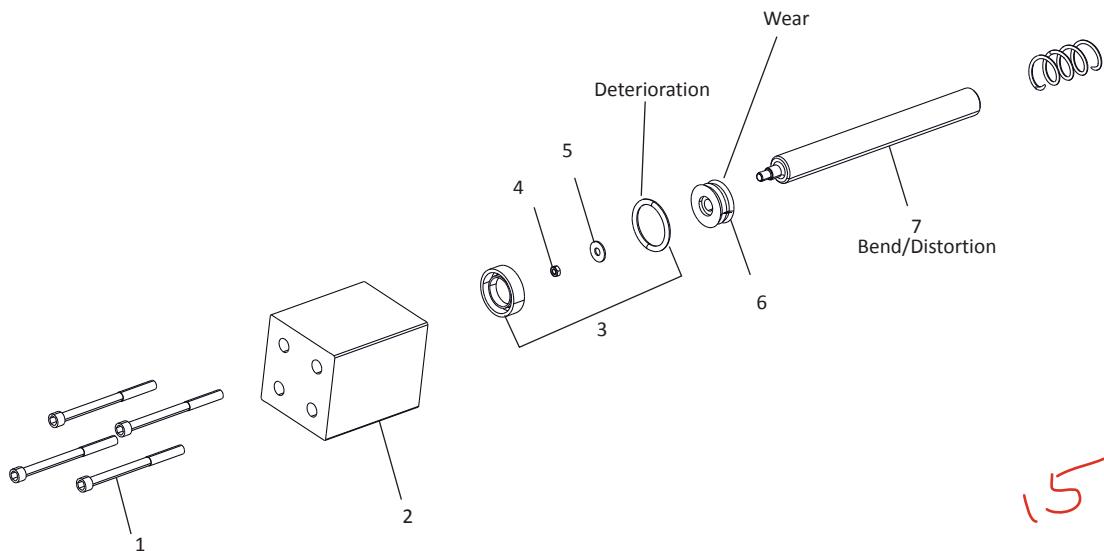


- 12 l) Put end cover plate back.

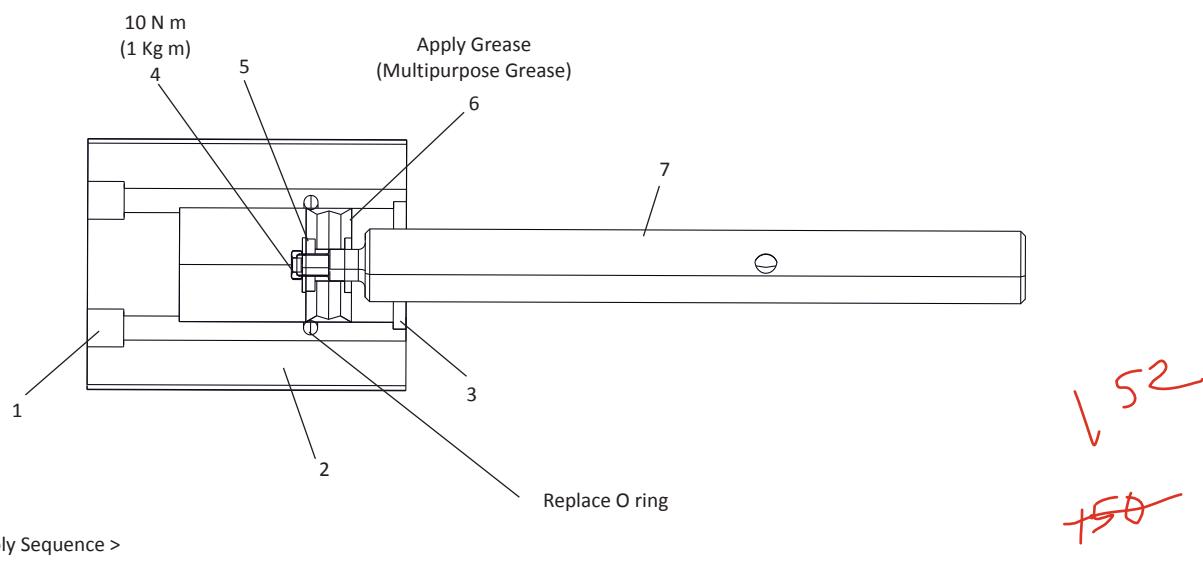


5.11.3 PTO Pneumatic Cylinder

Disassembly

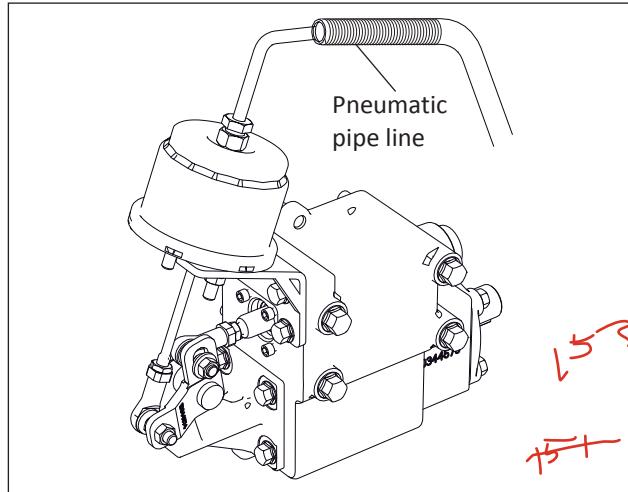


Assembly

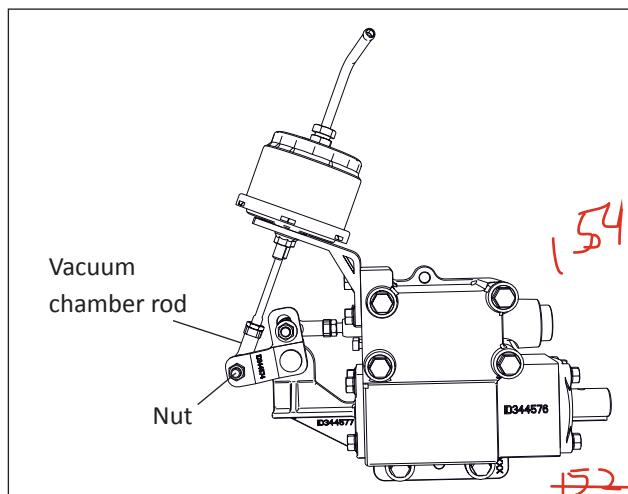


5.12 VACUUM OPERATED PTO**5.12.1 Disassembly**

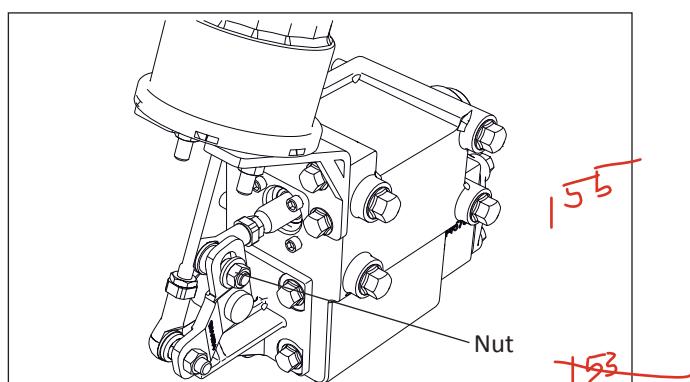
- 1 a) Disconnect pneumatic line by pulling the pipe.



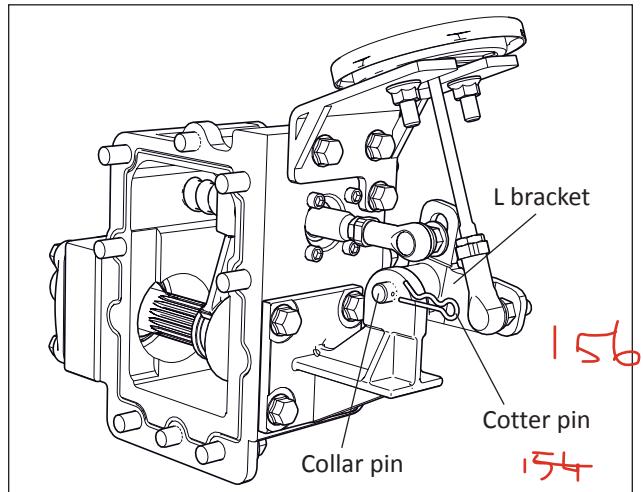
- 2 b) Remove vacuum chamber rod eye bolt by loosening the nut.



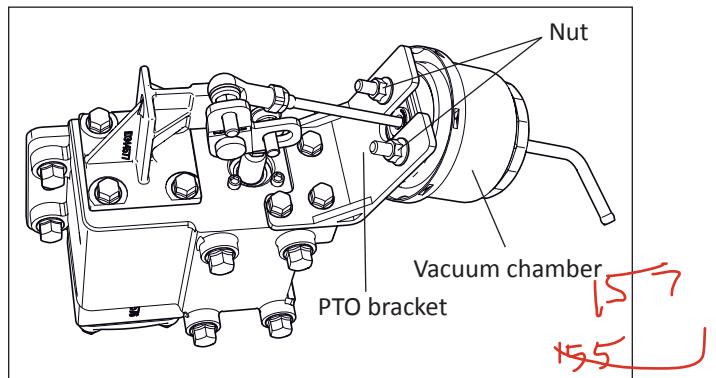
- 3 c) Remove PTO assembly linkage by loosening the nut.



- 4 d) Remove collar pin and L bracket by removing cotter pin.



- 5 e) Loosen nuts and remove vacuum chamber from PTO bracket.



- f) Release the pneumatic pressure, Loosen the nut and pull pipes from both side of the solenoid (input and output).

- 7 g) Pull out the switch by pressing, disconnect it from harness.



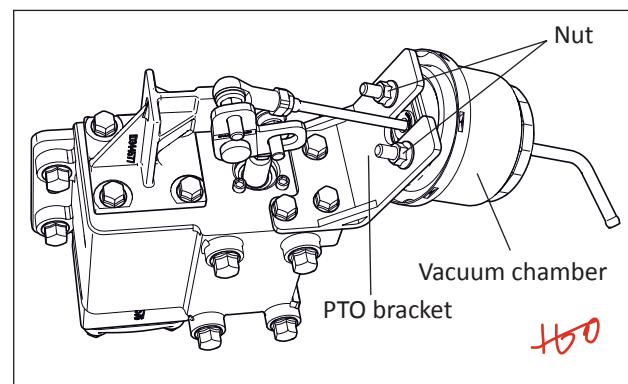
5.12.2 Assembly

- a) Connect the harness and press switch to dashboard.

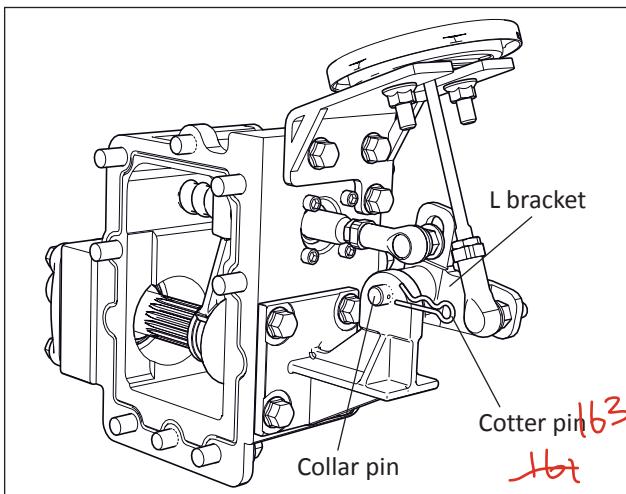


- 2 b) Tighten the nut & press inlet & outlet pipe to the solenoid.

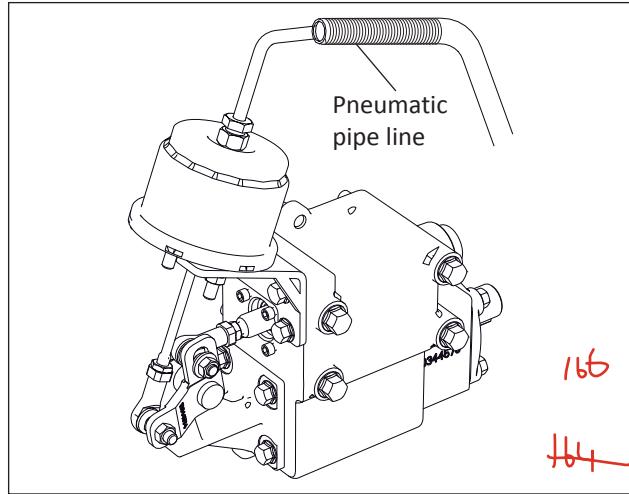
- 3 c) Tighten the nuts to refit vacuum chamber with PTO bracket.



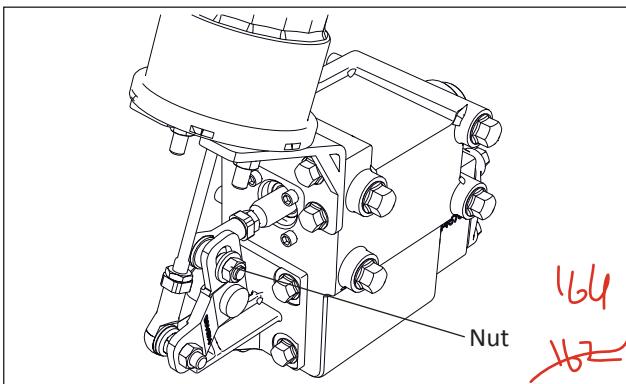
4 d) Insert collar pin with L bracket and lock with cotter pin.



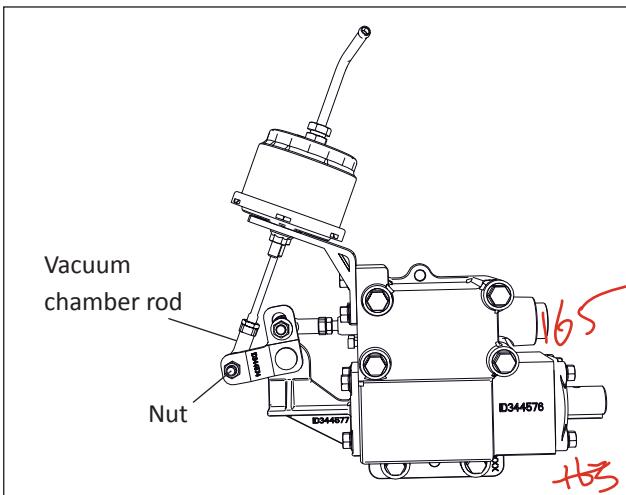
7 g) Connect pneumatic line and press the pipe.



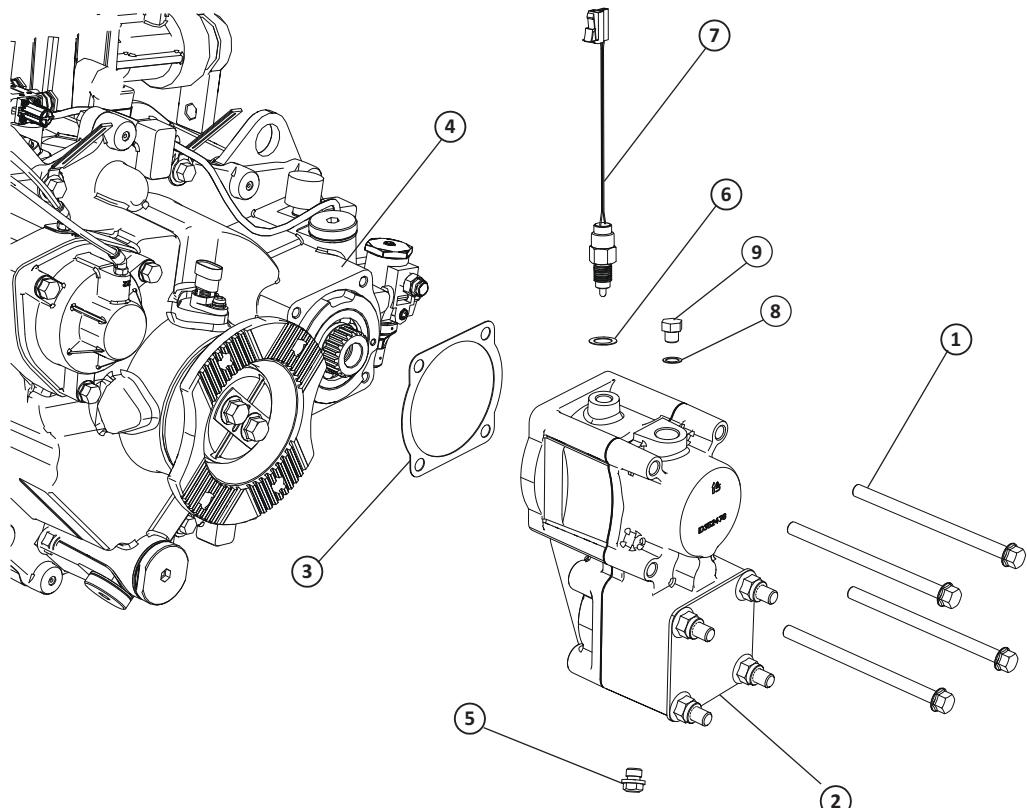
5 e) Tighten nut to refit PTO assembly linkage.



6 f) Refit vacuum chamber rod eye bolt and tighten the nut.



5.13 DISASSEMBLY AND ASSEMBLY OF ET140S9 PTO (POWER TAKE OFF)

**Disassembly Sequence**

5 → 1 → 2 → 3 → 7 → 6 → 9 → 8

Assembly Sequence

8 → 9 → 6 → 7 → 5 → 3 → 2 → 1

1. Bolt

7. Backup lamp

2. PTO Assembly

8. Washer

3. Gasket

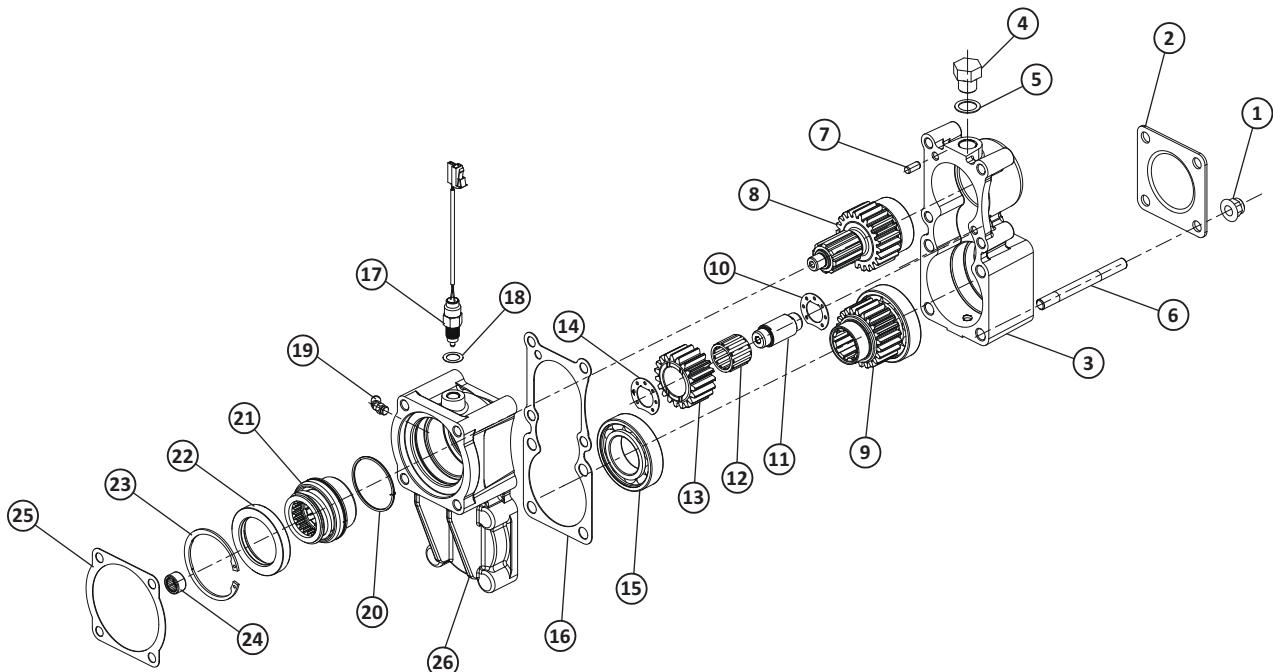
9. Level plug

4. TM Rear Cover

5. Drain plug

6. Washer

5.13.1 Disassembly and Assembly of PTO



168

166

Disassembly Sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12 → 13 → 14 → 15 → 16 → 17 →
 18 → 19 → 20 → 21 → 22 → 23 → 24 → 25 → 26 → 27 → 28 → 29

Assembly Sequence

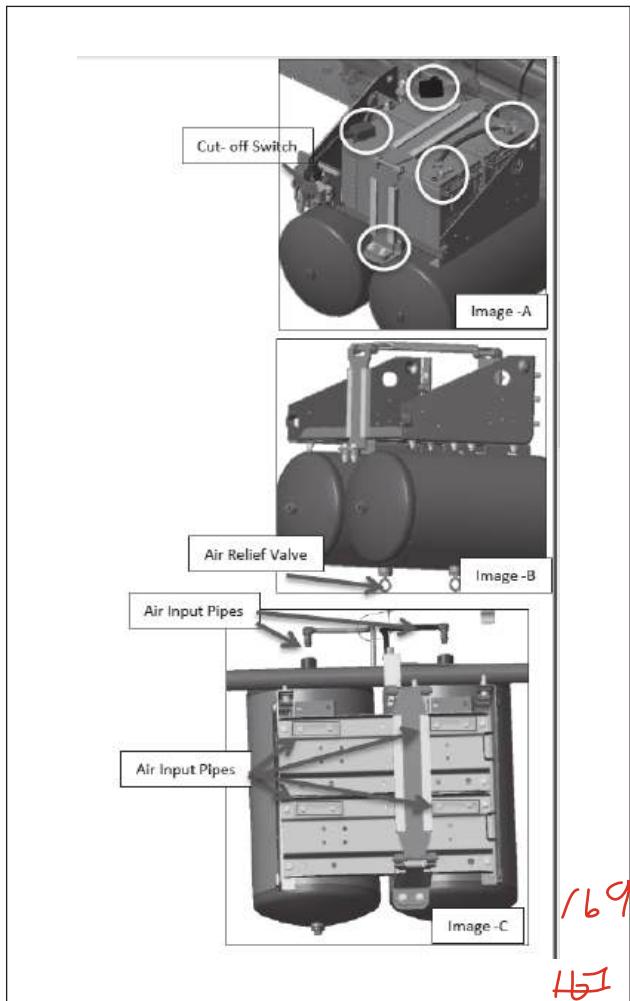
29 → 28 → 27 → 26 → 25 → 24 → 23 → 22 → 21 → 20 → 19 → 18 → 17 → 16 → 15 →
 14 → 13 → 12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

1. Lock nut	6. Stud	11. Idler shaft PTO	16. Gasket	21. Coupler assy.	26. PTO housing
2. PTO rear plate	7. Dowel pin	12. Bearing	17. Backup lamp switch	22. Spacer	
3. PTO Case	8. Input gear assembly	13. Idler gear PTO	18. Gasket	23. Circlip	
4. Level plug	9. Output gear assembly	14. Lock washer	19. Elbow adaptor	24. Needle bush	
5. Gasket	10. Lock washer	15. Ball bearing	20. O-ring	25. Gasket	

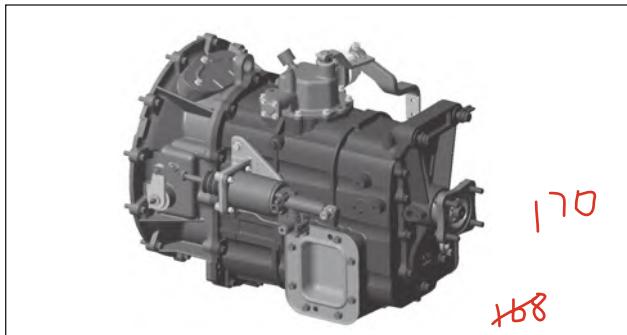
SERVICE PROCEDURE

ET60S7 PTO Fitment Guideline

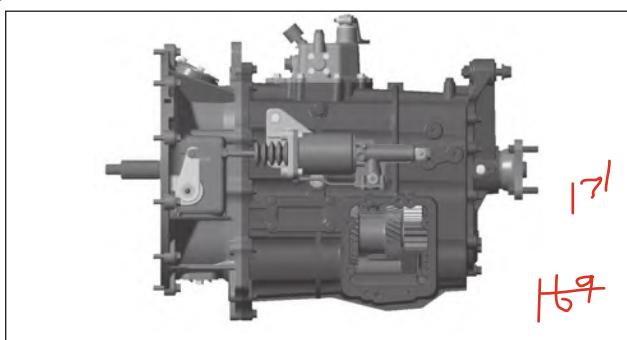
- 1 • Cut-off the ignition off and Cut off the battery connection using cut off switch.
- 2 • Remove all battery connection marked in image -A.
- 3 • Remove the battery from Carrier and remove the air from the Brake Tanks by pulling relief valves from the bottom of the tank. Marked in image B.
- 4 • After removing complete Air from the System (tanks) Plug Out the Air Brake routings. Marked in image -C.
- 5 • Remove the air tanks By Removing Bolts Marked in image -C.
- 6 • Now PTO Fitment Can be Done as per PTO Fitment Guide line From Slide.

**Disassembly**

- a) Step 1-Drain Out Oil & Disassemble Transmission from Vehicle



- b) Step 2 Remove idler cover & its bolt.



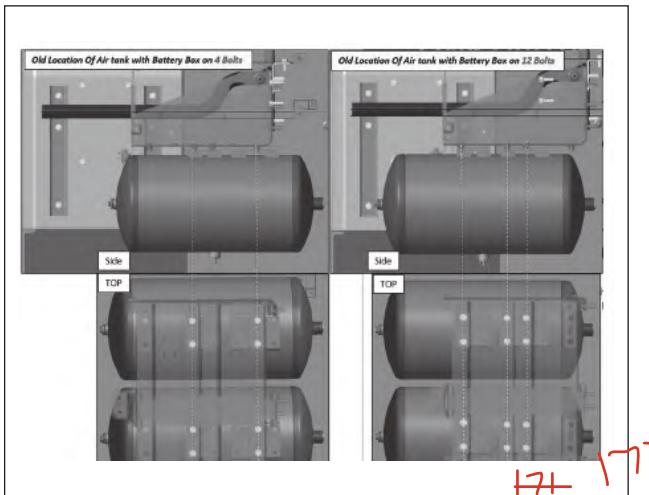
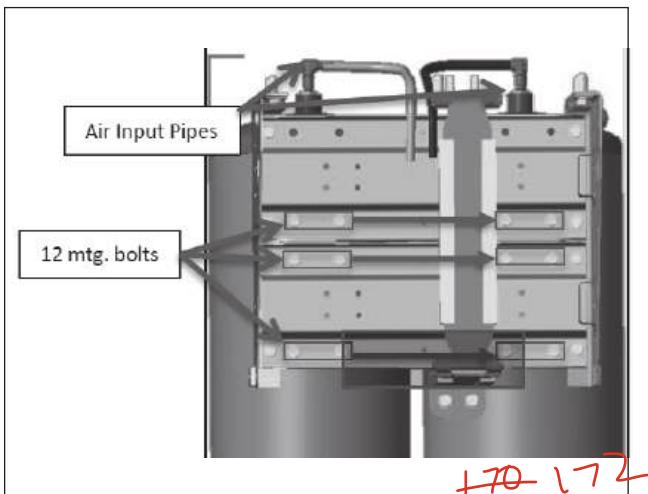
- c) Step 3 Then assemble respective PTO assy

assembly

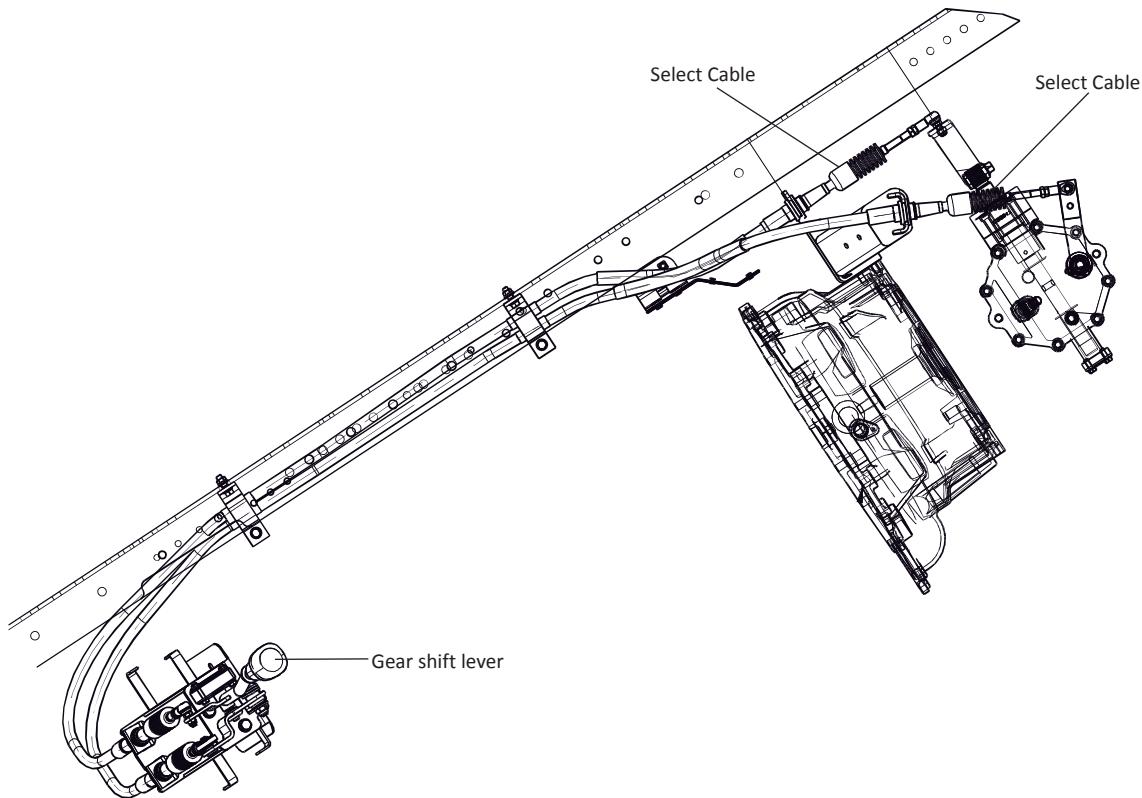
- 1 Reassemble the bottom Air tanks slightly ahead from the original location but now with 12 bolts. (The arrangement of Air tank will match Up the marked bolts for mtg.)
- 2 •After air tanks fitment completed put back the air input pipes into the tank as it was. (Check that No air Leakage Should be observed)
- 3 •Again fit all battery connection as It was and now Complete the Cabin and Chassis PTO Routing.

NOTE 47

- 1.Both the Hose routing To be clamp with Brake bunch at every 200mm.
- 2.Over All Fitment will Lead to Air tank Movement Slightly Outside
- 3.Airtank Bolts and Torque Value of 45~55 N.m



5.14 DISASSEMBLY AND ASSEMBLY OF HYBRID GSL



174

172

5.14.1 Disassembly

Disassembly of shifter cable

NOTES : 48

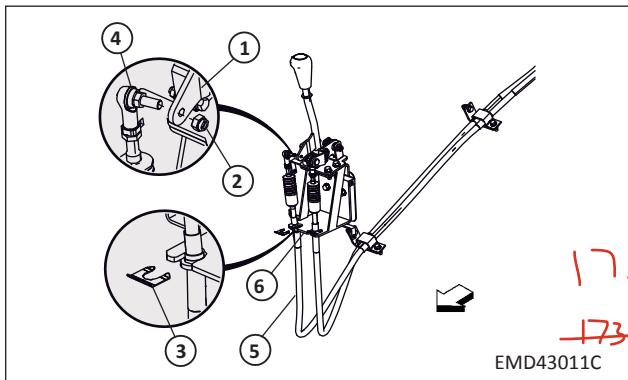
Before going to removal, shift the gear shift lever in neutral position and apply parking brake.

- a) Loosen shift cable mounting nut then remove mounting nut from gear shift arm then pull out shift cable ball joint from gear shift arm.

NOTES : 49

While loosening shift cable mounting nut, make use of two spanner, one to hold on ball joint nut and one to loosen shift cable mounting nut to avoid rotation of ball joint.

- 2 b) Remove the retainer clip from cable mounting bracket.



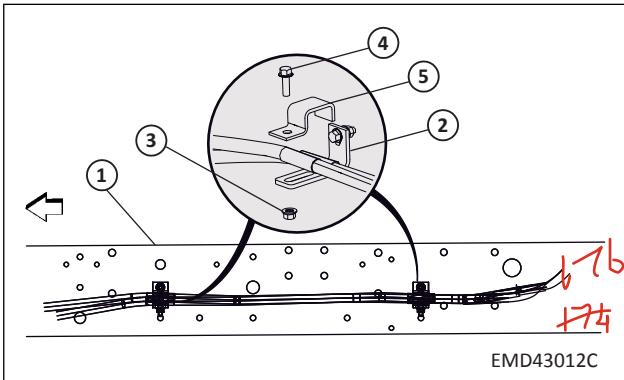
175

173

EMD43011C

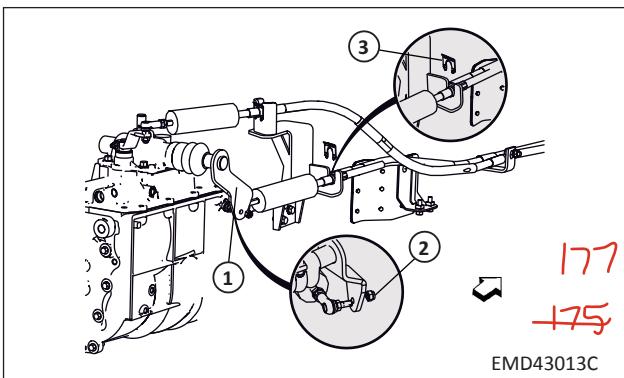
1. Gear shift arm
2. Mounting nut
3. Retainer clip
4. Ball joint
5. Shift cable
6. Cable mounting bracket

- 3c) Tilt cabin then remove shift cable by removing cable support bracket from 'L - clamp' which is fitted chassis on chassis frame.

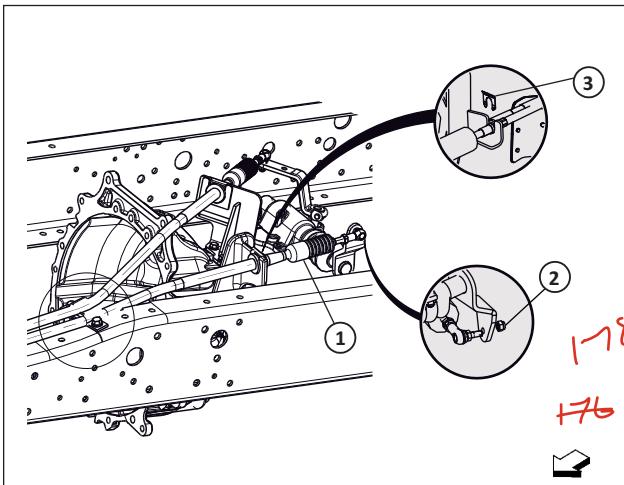


1. Chassis frame 3. Nut 5. Cable support bracket
2. L- clamp 4. Bolt

- 4d) Loosen shift cable mounting nut then remove mounting nut from shift lever (which is fitted on transmission top cover assembly).
5e) Remove retainer clip from shift select bracket (which is fitted on clutch housing) then pull out shift cable from transmission side.



1. Shift lever 2. Mounting nut 3. Retainer clip



1. Shift lever 2. Mounting nut 3. Retainer clip

NOTES : 50

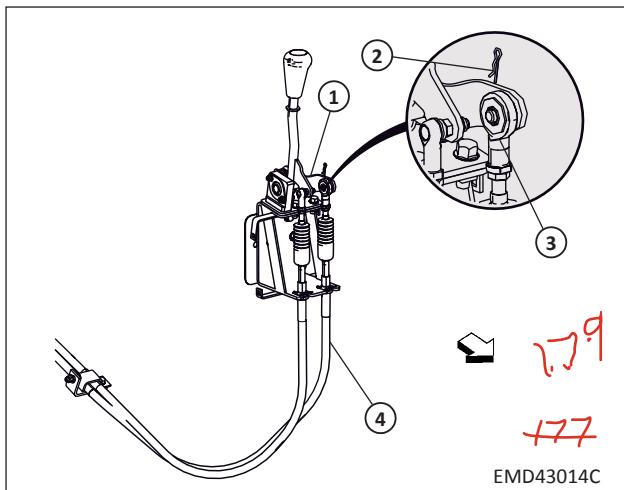
Shift cable should be pulled towards transmission rear side by gently twisting and bending the cable to avoid interference with other parts.

Removal of selector cable

NOTES : 51

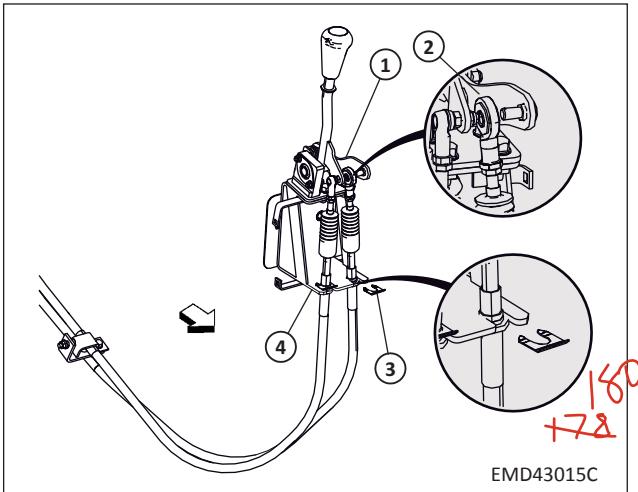
Before going to removal, shift the gear shift lever in neutral position and apply parking brake.

- a) Remove select cable eye joint snap pin from gear select arm.



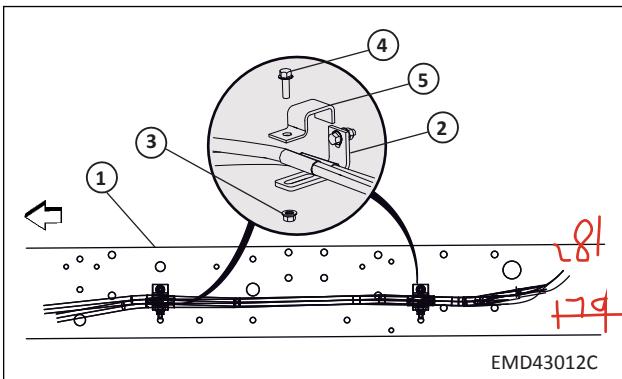
1. Select arm 3. Eye joint
2. Snap pin 4. Select cable

- 2 b) Pull out select cable eye joint from gear select arm.
 3 c) Remove retainer clip from cable mounting bracket.



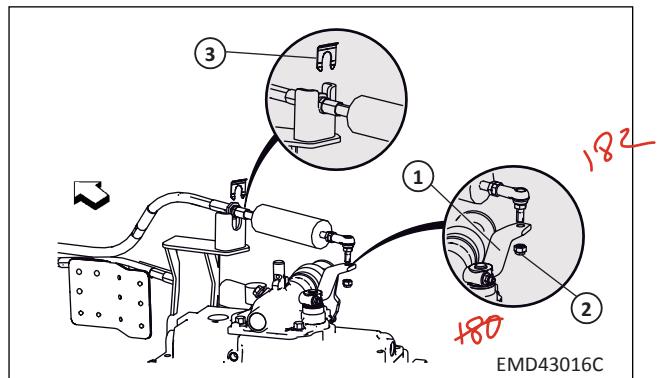
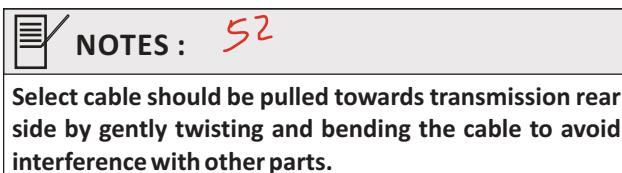
1. Gear select arm 3. Retainer clip
 2. Eye joint 4. Cable mounting bracket

- 4 d) Tilt cabin then remove select cable by removing cable support bracket from 'L - clamp' which is fitted chassis on chassis frame.



1. Chassis frame 3. Nut 5. Cable support bracket
 2. L- clamp 4. Bolt

- 5 e) Loosen select cable mounting nut then remove mounting nut from select lever (which is fitted on transmission top cover assembly).
 f) Remove retainer clip from select bracket (which is fitted on clutch housing) then pull out shift cable from transmission side.



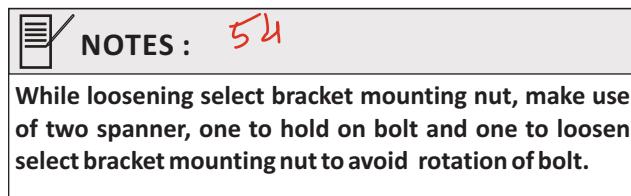
1. Select lever 2. Mounting nut 3. Retainer clip

Removal of gear shift lever

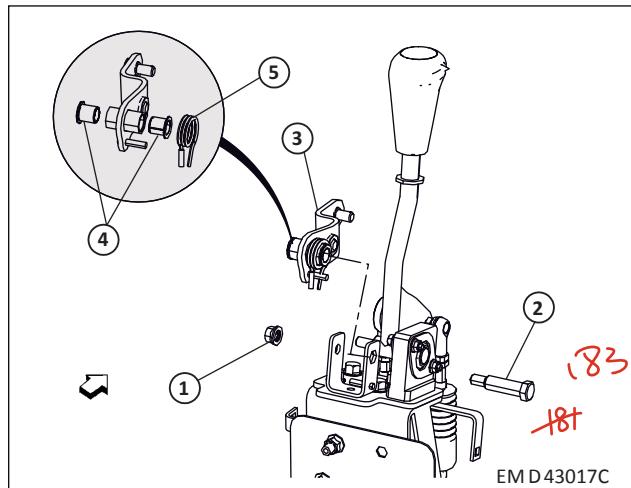


Before going to removal, shift the gear shift lever in neutral position.

- a) Loosen gear select bracket mounting nut then remove mounting nut and bolt from gear select bracket.

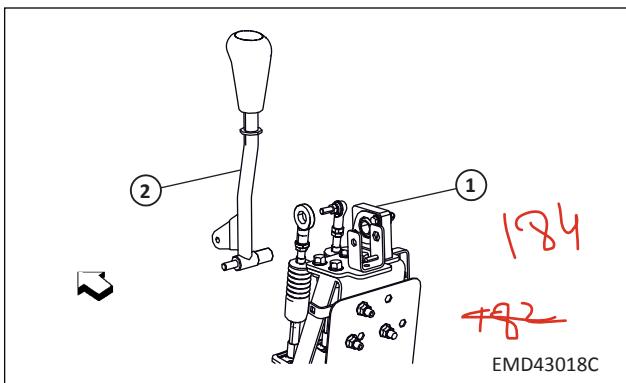


- b) Take out select bracket assembly then remove spring and bush from select bracket assembly.



1. Mounting nut 3. Select bracket assembly 5. Spring
 2. Bolt 4. Bush

- 3** c) Then take out gear shift lever assembly from lever support bracket.

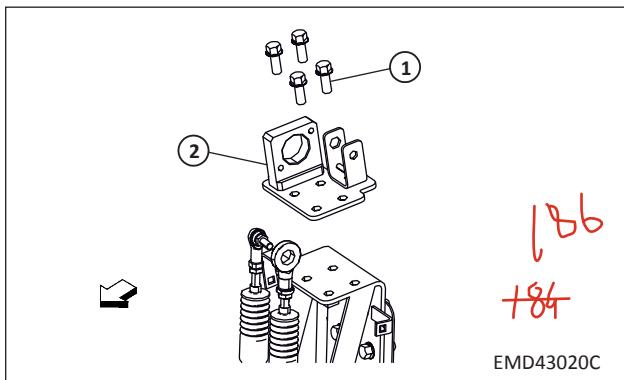


1. Lever support bracket 2. Gear shift assembly

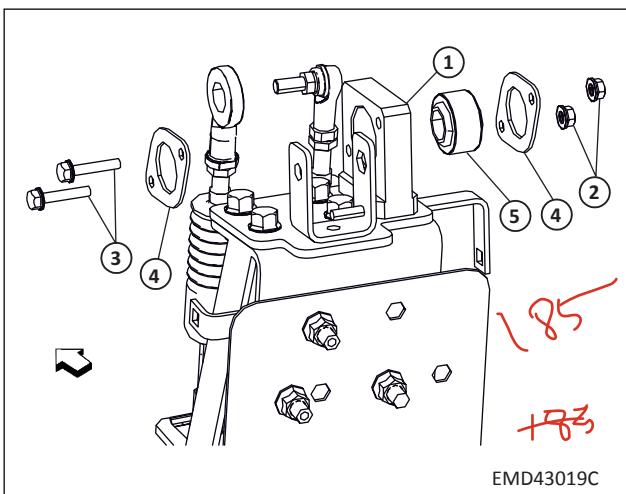
- 4** d) Loosen two mounting nuts from lever support bracket end then remove two mounting nuts and bolts.
5 e) Then remove support plates and bush from lever support bracket as shown in figure.

- 6** f) Loosen four mounting bolts then remove mounting bolts from lever support bracket.

- 7** g) Then take out lever support bracket.



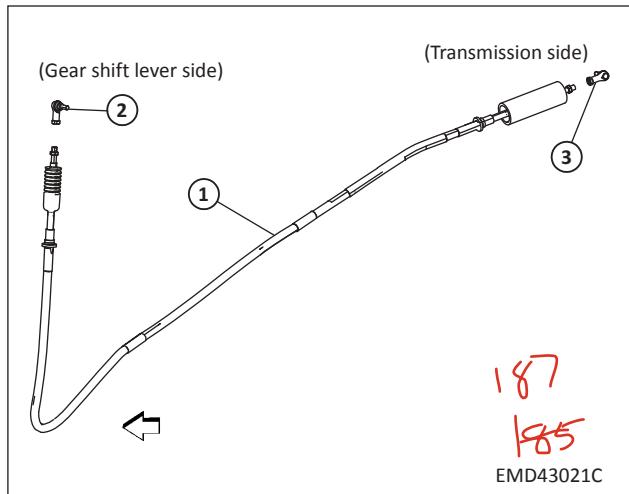
1. Mounting nut 2. Lever support bracket



1. Lever support bracket 3. Bolt
2. Mounting nut 4. Support plate

5.14.1.1 Disassembly of Shifter cable

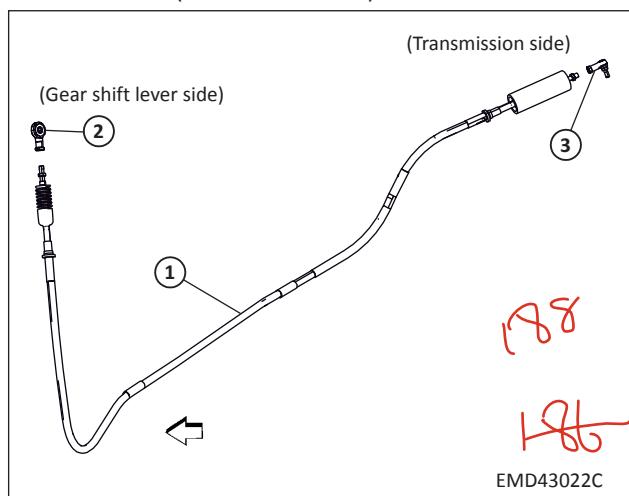
- 1 a) Loosen ball joint by rotating anticlockwise from both ends of the shift cable.

**Disassembly**

1. Shift cable 2. Ball joint 3. Ball joint

Disassembly of Selector cable

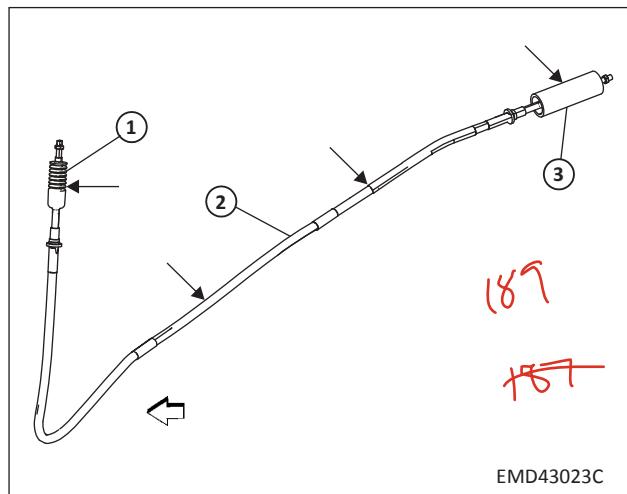
- 1 a) Loosen eye joint by rotating anticlockwise from select cable (gear shift lever side).
2 b) Loosen ball joint by rotating anticlockwise from select cable (transmission side).

**Disassembly**

1. Shift cable 2. Eye joint 3. Ball joint

5.14.1.2 Inspection**Inspection of shifter and selector cable**

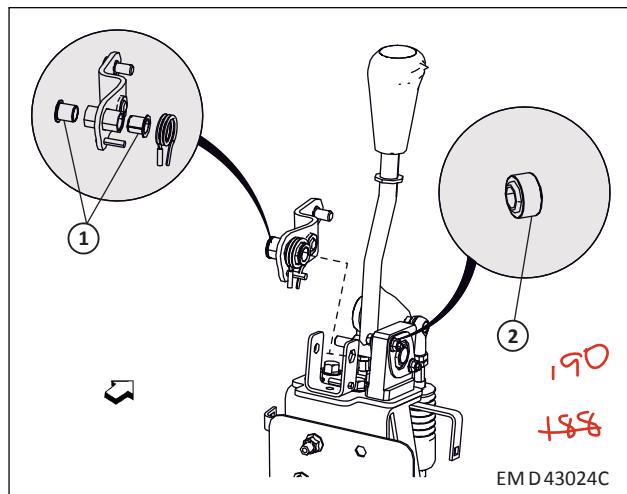
- 1 a) Check the following items in cable (arrow marked area) and replace if necessary.
2 b) Damage, cuts, bend, peeling and free movement of cable.



1. Bellow 2. Cable 3. Dust shield

Inspection of gear shift lever

- 1 a) Check the select bracket bush and shift arm bush and replace if necessary.

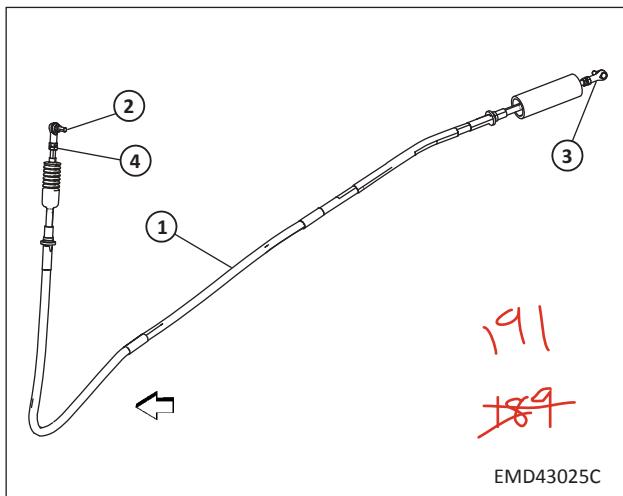


1. Select bracket bush 2. Shift arm bush

5.14.2 Assembly

5.14.2.1 Assembly of shifter cable

- 1 a) Fit ball joint in to the shift cable both ends then tighten ball joint by rotating clock wise then tighten lock nut by hand.

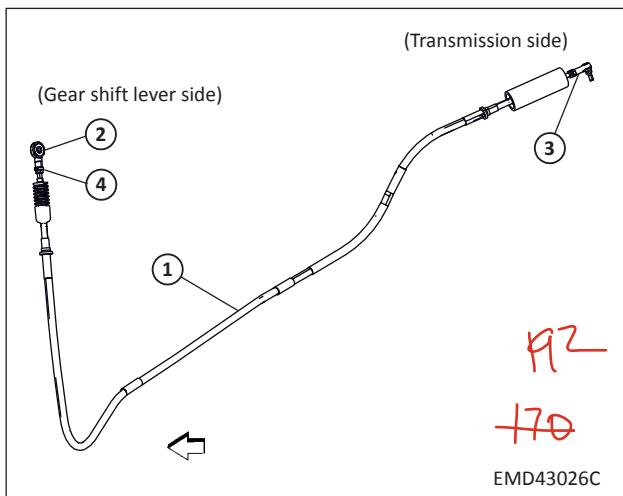


Assembly Sequence

1. Shift cable 2. Ball joint 3. Ball joint 4. Lock nut

5.14.2.2 Assembly of selector cable

- 1 a) Fit the eye joint in to the shift cable (gear shift lever side) then tighten eye joint by rotating clock wise then tighten lock nut by hand.
2 b) Fit the ball joint in to the shift cable (transmission side) then tighten ball joint by rotating clock wise then tighten lock nut by hand.



Assembly Sequence

1. Shift cable 2. Eye joint 3. Ball joint 4. Lock nut

NOTES : 55

Cable adjustment has to done after replacement of ball joint/eye joint.

Basically cable are supplied in pre adjusted condition how ever after refitment, cable length to be measured and adjusted.

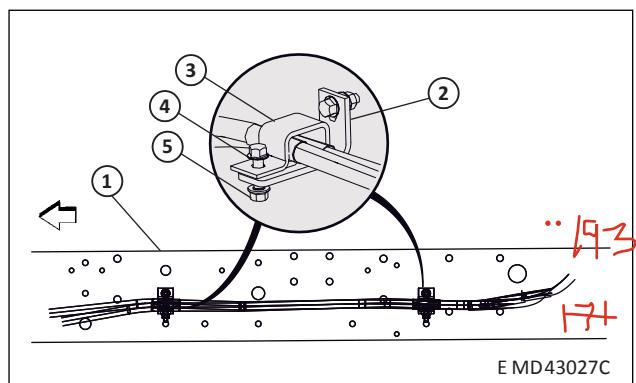
5.14.2.3 Assembly of shifter of cable

- 1 a) Insert shift cable front end towards shifter assembly through slot provided on cabin floor.

NOTES : 56

Shift cable front side fitted with bellow and shift cable end side fitted with dust shield.

- 2 b) Route shift cable through L-clamp which is fitted on chassis frame then fix the cable support bracket.



1. Chassis frame 3. Cable support bracket 5. Nut
2. L- clamp 4. Bolt

- 3 c) Insert retainer clip in shift select bracket (which is fitted on clutch housing).
4 d) Insert ball joint in to shift lever (transmission side) then tighten mounting nut.

5.14.2.4 Assembly of selector cable

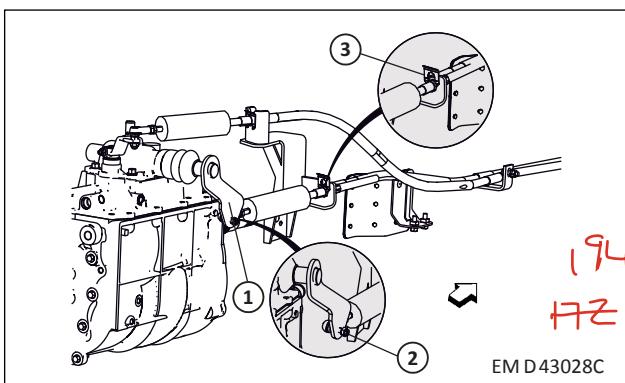
- 1** a) Insert select cable front end towards shifter assembly through slot provided on cabin floor.



NOTES : 57

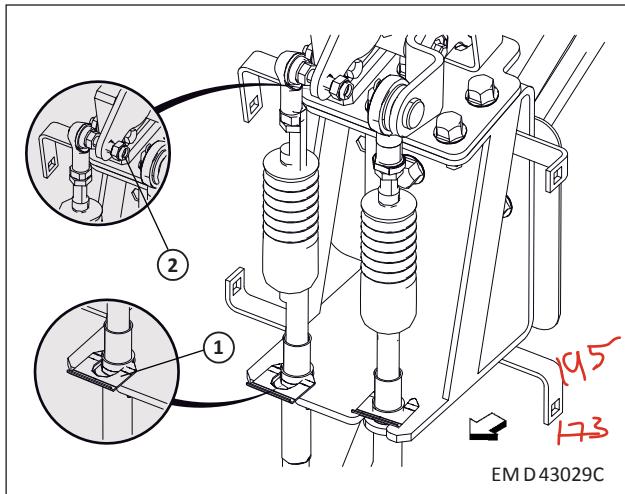
Select cable front side fitted with bellow and select cable end side fitted with dust shield.

- 2** b) Route select cable through L-clamp which is fitted on chassis frame then fix the cable support bracket.

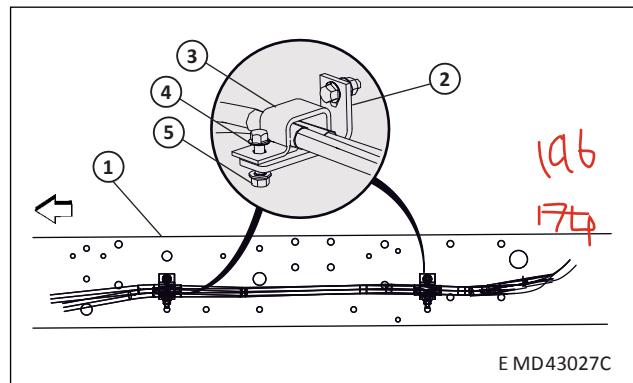


1. Shift lever 2. Mounting nut 3. Retainer clip

- 5** e) Insert retainer clip in mounting bracket (which is fitted on gear shift lever).
6 f) Insert ball joint in to shift arm (gear shift lever side) then tighten mounting nut.

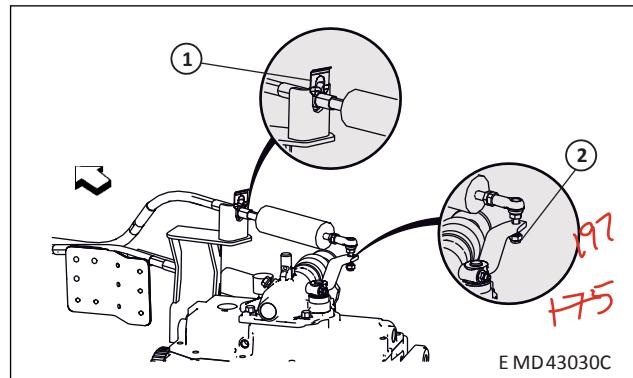


1. Retainer clip 2. Mounting nut



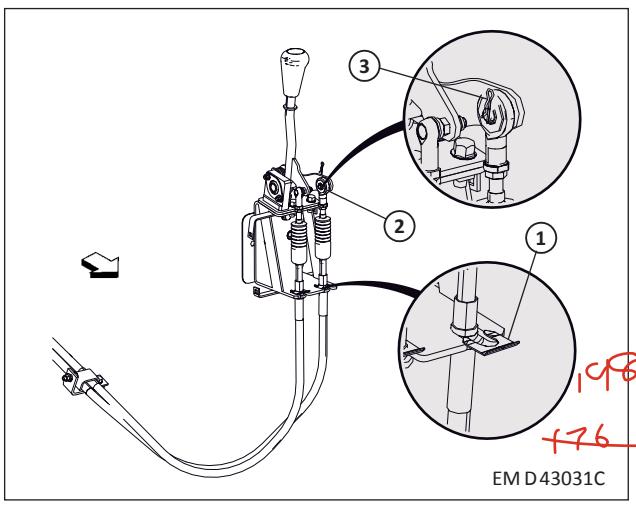
1. Chassis frame 3. Cable support bracket 5. Nut
2. L-clamp 4. Bolt

- 3** c) Insert retainer clip in select bracket (which is fitted on clutch housing).
4 d) Insert ball joint in to shift lever (transmission side) then tighten mounting nut then insert snap pin.



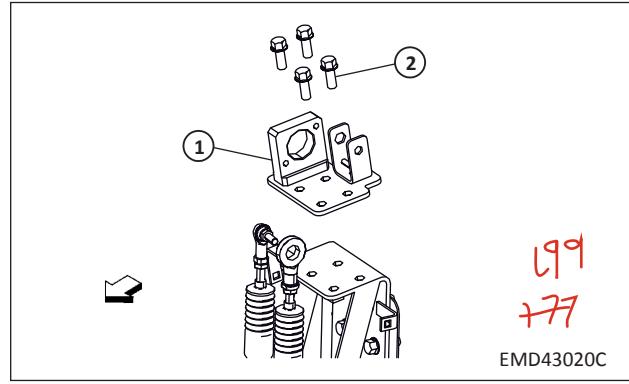
1. Retainer clip 2. Mounting nut

- 5** e) Insert retainer clip in mounting bracket (which is fitted on gear shift lever).
6 f) Insert ball joint in to shift arm (gear shift lever side) then tighten mounting nut.

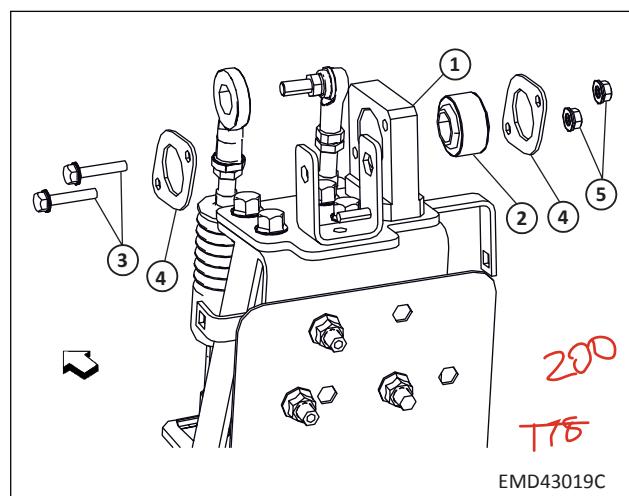


5.14.2.5 Assembly of gear shift lever

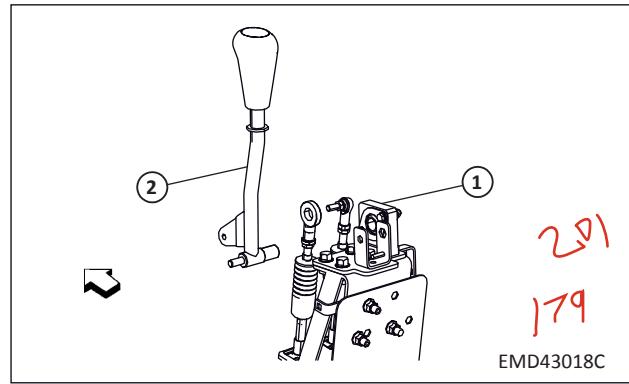
- a)** Place lever support bracket then tighten four mounting bolts.



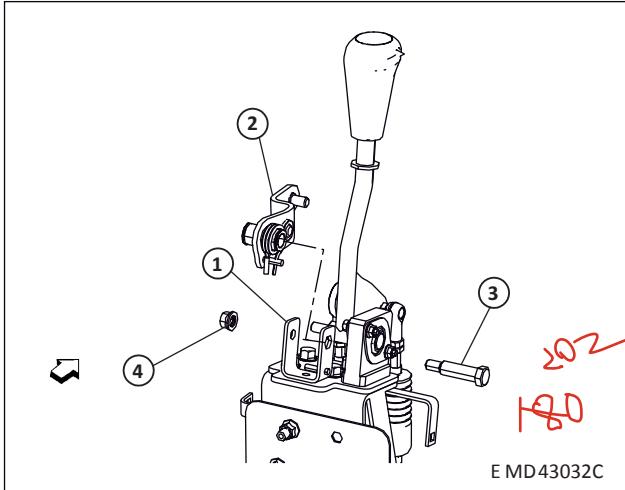
- b)** Insert bush, mounting bolts and locate support plates in lever support bracket then tighten mounting nuts.



- c)** Then place out gear shift lever assembly in lever support bracket.



- 4** d) Locate select bracket assembly in lever support bracket (U-bracket) then insert bolt then tighten mounting nut.



1. Lever support bracket (U - bracket)
2. Select bracket assembly
3. Bolt
4. Mounting nut

5.14.2.6 Adjustment

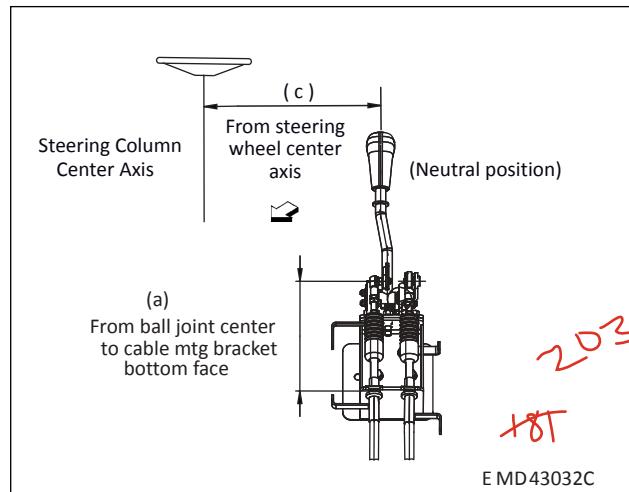
Adjustment of shifter / selector cable and gear shift lever



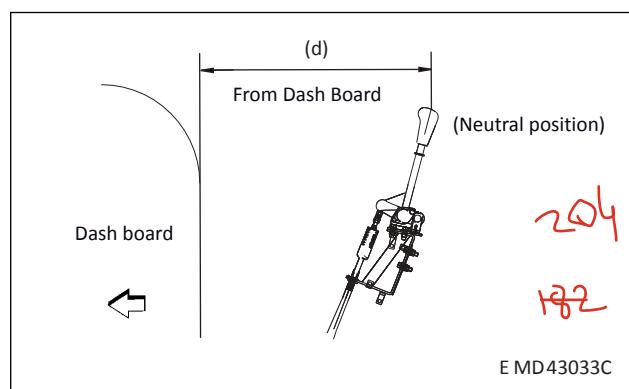
NOTES : 58

Before going to adjust, shift the gear shift lever neutral position .

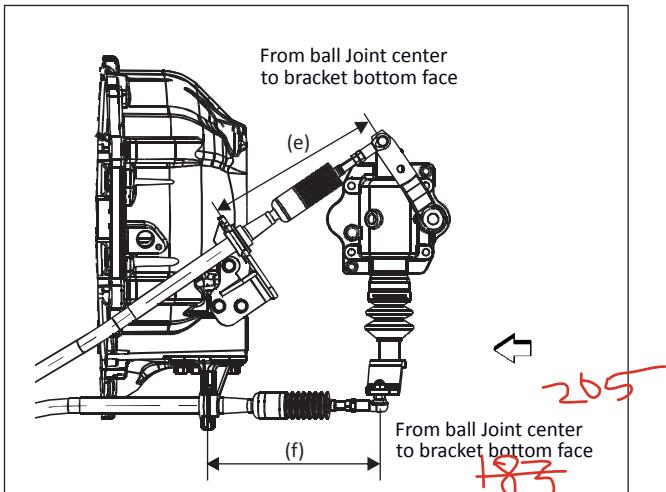
- 1** a) Check and adjust the distance between ball joint center to cable mounting bracket bottom face (gear shift lever side) as shown in figure.
- 2** b) Check and adjust the distance between gear shift lever center to steering shaft assembly center as shown in figure.



- 3** c) Check and adjust the distance between gear shift lever center to dashboard as show in figure.

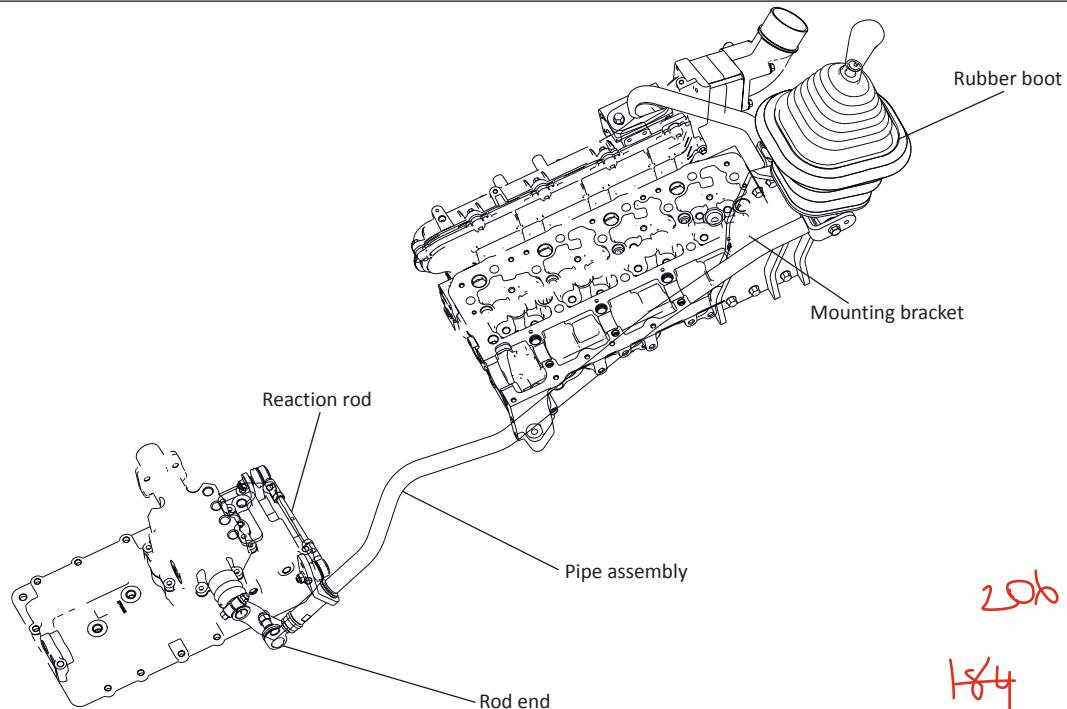


- 4 d) Check and adjust the distance between ball joint center to shift select bracket bottom face (transmission side) as show in figure.



5.15 DISASSEMBLY AND ASSEMBLY OF SINGLE ROD GSL SYSTEM (SRGSL)

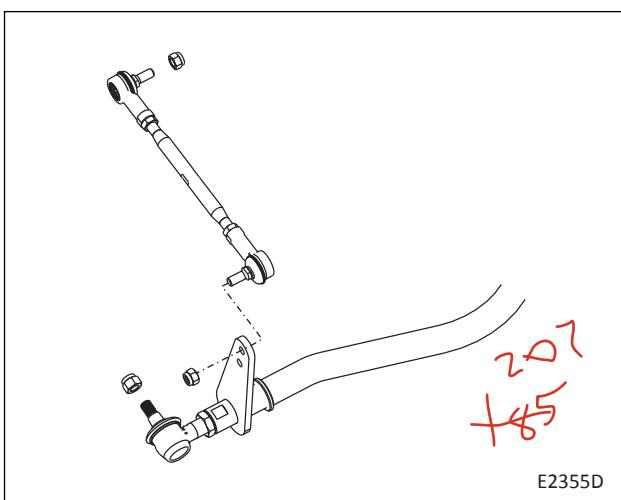
5.15.1 Disassembly



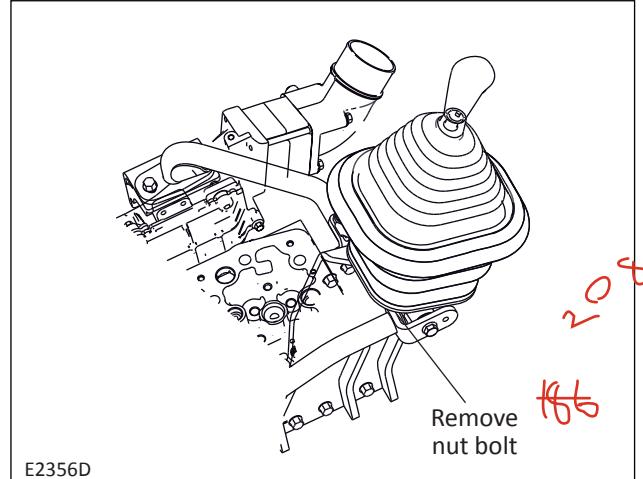
- 1 a) Gear to be shift neutral condition & tilt the cabin
- 2 b) Loosen & remove the ball joint of rod assy. & reaction rod from transmission upper case.
- 3 c) Inspect ball joint for excessive wear, if found replace it.

NOTE : *59*

For removal of Gear shifter mounting bolt Turbo intake hose, EGR pipe to removed.

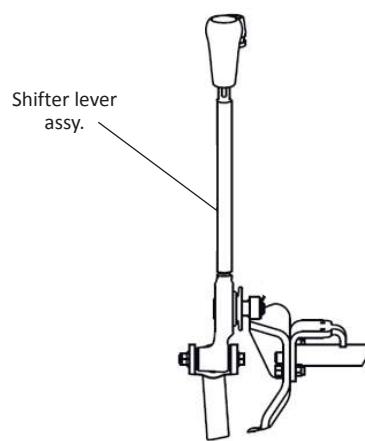
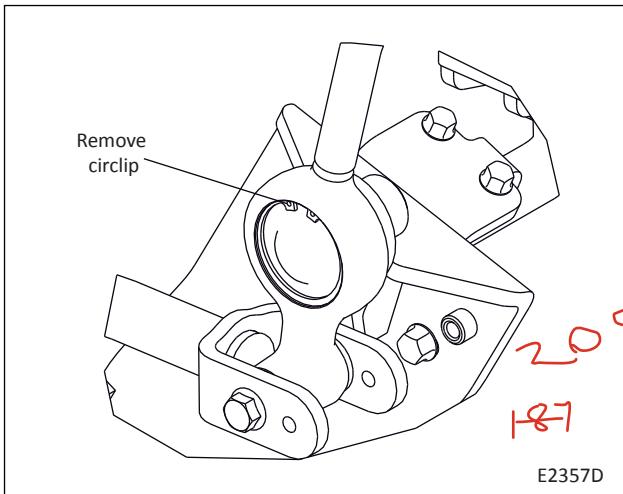


- 4 d) Loosen & remove the nut-bolt from upper end and take out single rod assy.



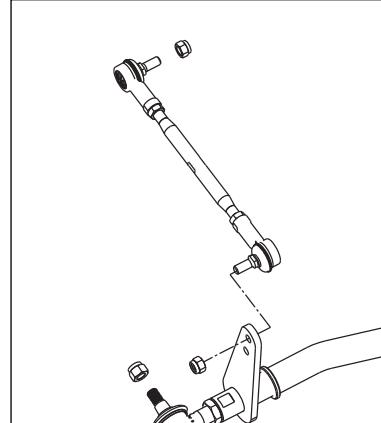
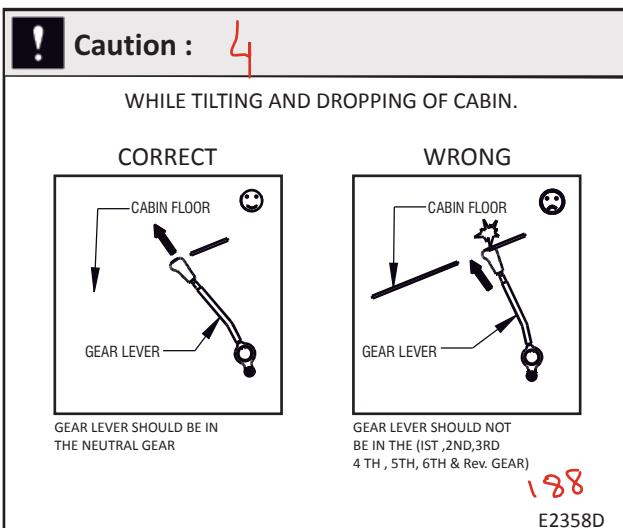
- 5 e) Remove the mounting nut of shifter lever.
- 6 f) Remove the lower mounting of silicon boot (key 11)
- 7 g) Remove shift lever assy. Followed by gear shift knob, boot holder, PVC boot.
- 8 h) Inspect PVC boot, boot holder, if worn replace them.

9) Remove the circlip.



c) Shifter lever assy. To be mounted on bracket with open spanner.

d) Refit the nut-bolt at upper end and refit single rod assy.

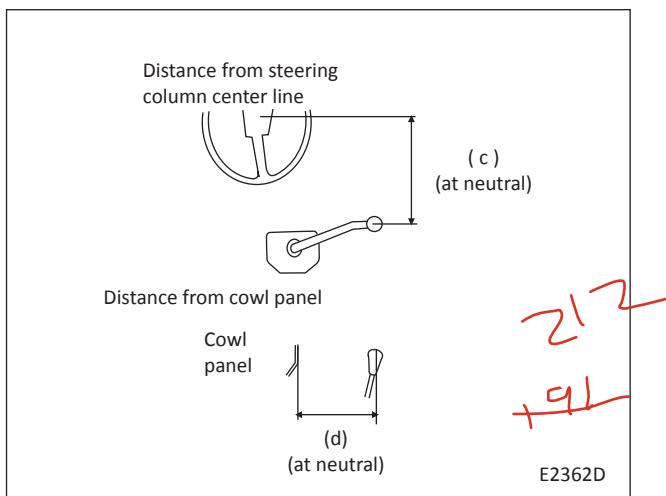


e) Refit the ball joint at lower end.



Cabin to be dropped carefully on chassis in gear forward (3rd Gear) position only.

- a) Assembly single rod to be assembled with shift lever by fixing the position of single rod. Insert a pin between bracket & single rod and assemble shift lever and single rod assy.
- b) Fit the bearing. Refit the circlips by using circlip plier.

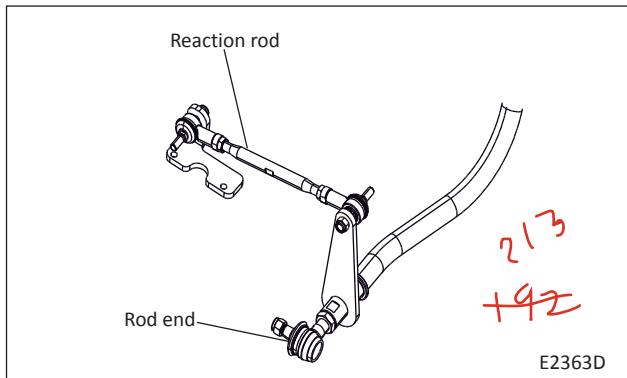
5.15.2 Adjustment After Reassembly

- 1** a) Adjust the turnbuckle of rod for the dimension shown in the figure.
- 2** b) After the adjustment, tighten the lock nut of each turnbuckle.



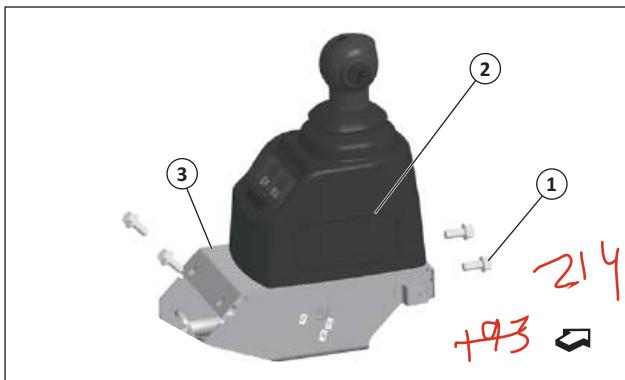
NOTE : *61*

After adjustment, make sure that it is possible to shift or select each position.



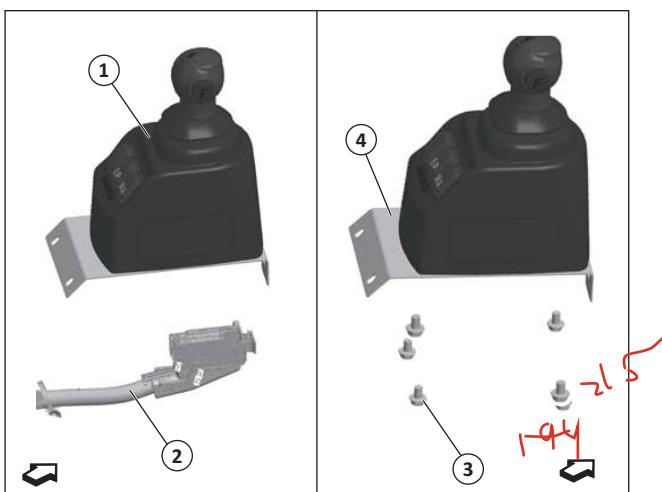
5, 6, 7 Speed TM**5.16 Shift Lever Unit (SLU)****5.16.1 Removal**

- a) Remove mounting screws and remove SLU with its bracket.



1. Screw 2. SLU 3. Bracket

- b) Disconnect the wiring harness from SLU connector and loosen screws to remove SLU from its bracket.



1. SLU 2. Wiring harness 3. Screw 4. Bracket

- c) Remove all the three switches by pressing gently.



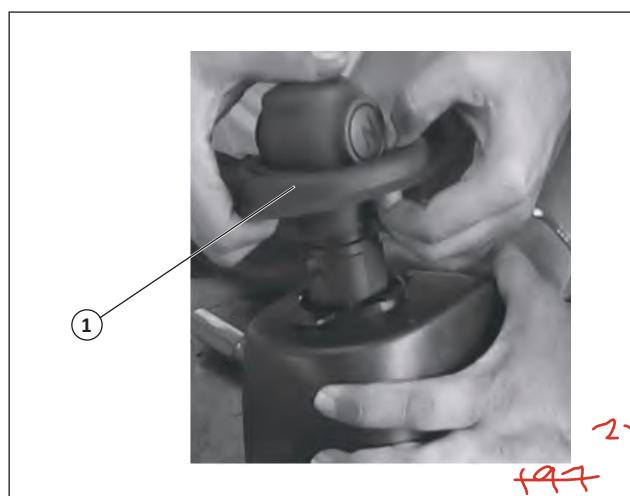
- d) Disconnect wiring connections from each individual switches.



NOTES : 62

If connections are incorrect, wrong information will be displayed in the dashboard. Hence do marking carefully while removing to avoid incorrect installation.

- e) Remove the rubber boot by pulling it upward.



1. Rubber boot

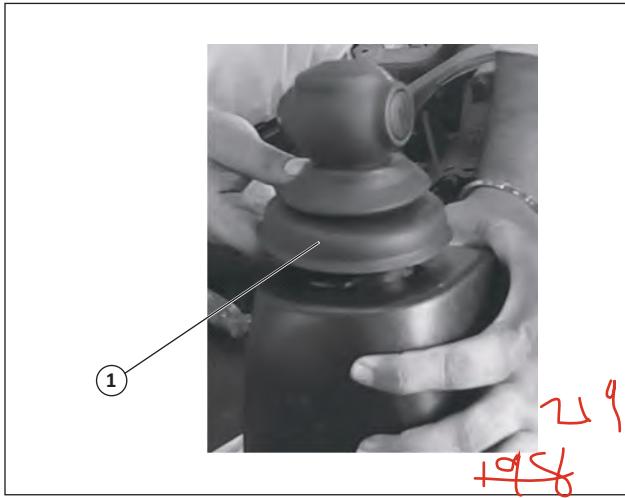


Caution : 5

Sharp edge tools should not be used to remove rubber boot .

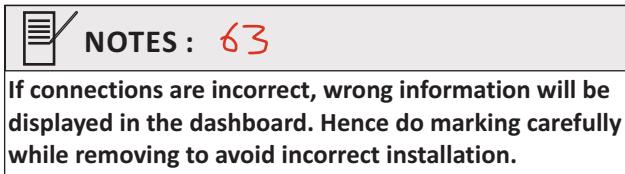
5.16.2 Disassembly

- 1 a) Slide the rubber boot on the gear shifting lever and fix it properly.

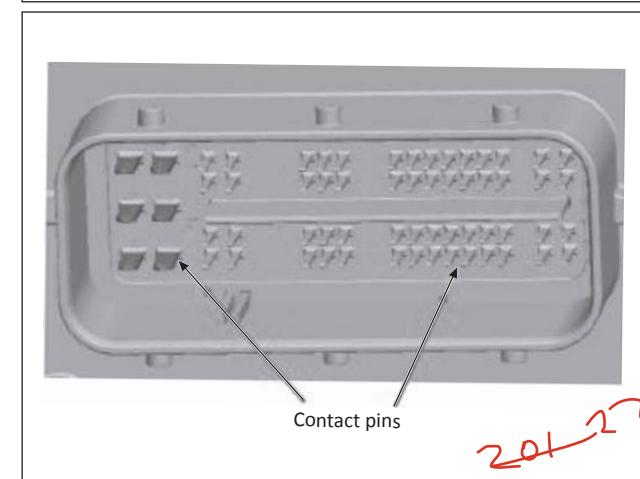


1. Rubber boot

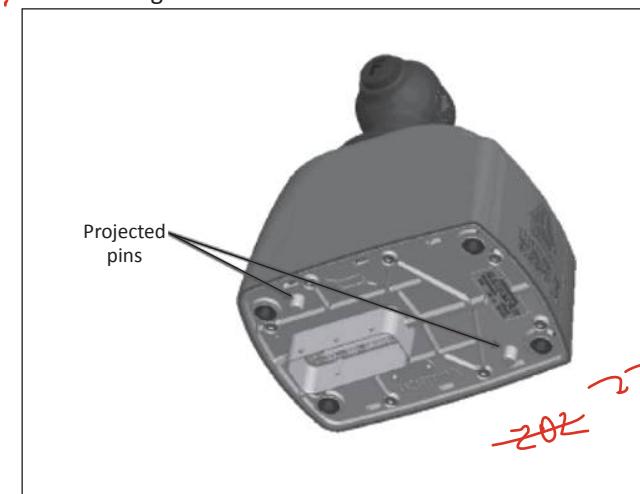
- 2 b) Connect the wiring connections to each individual switches. Make sure the connections are correct.



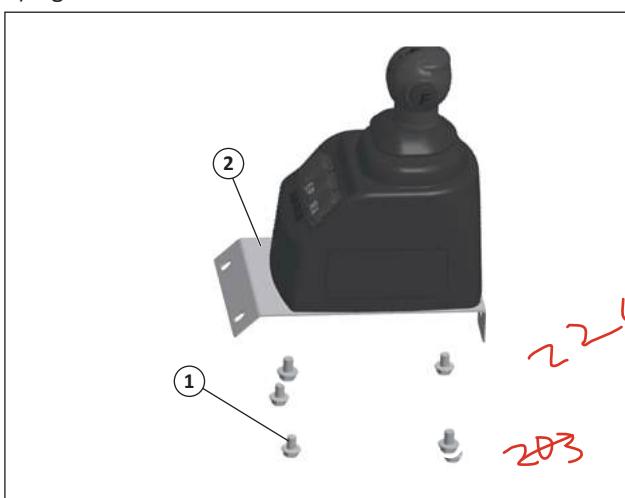
- 3 c) Re-fit the switches by pressing.



- 4 d) Use the two projected pins for prefixing the SLU in its mounting bracket.



5 e) Tighten screws to fix SLU on its bracket.

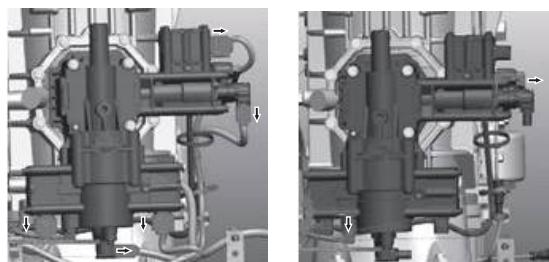


1. Screw 2. Bracket

5.16.3 X-Y ACTUATOR

5.16.3.1 Disassembly

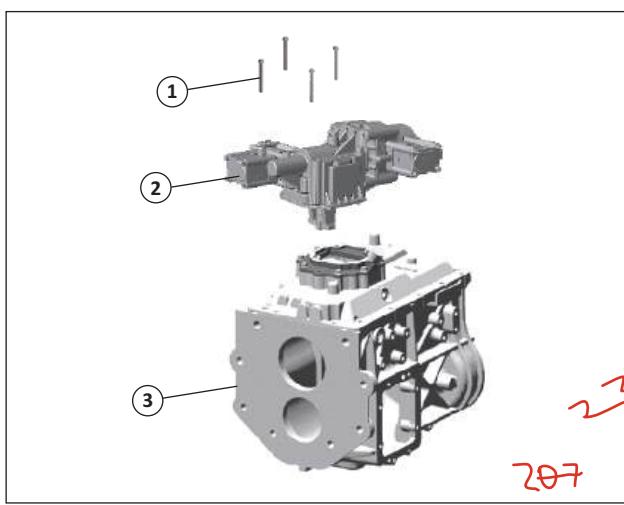
- a) Disconnect all electrical and pneumatic connections from X-Y Actuator.



205

206

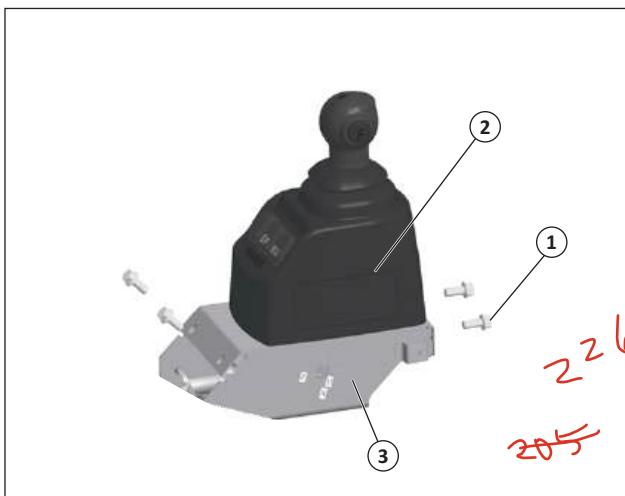
- b) Loosen four bolts and take the X-Y Actuator outside from the transmission housing.



1. Bolt 2. X-Y Actuator 3. Transmission housing

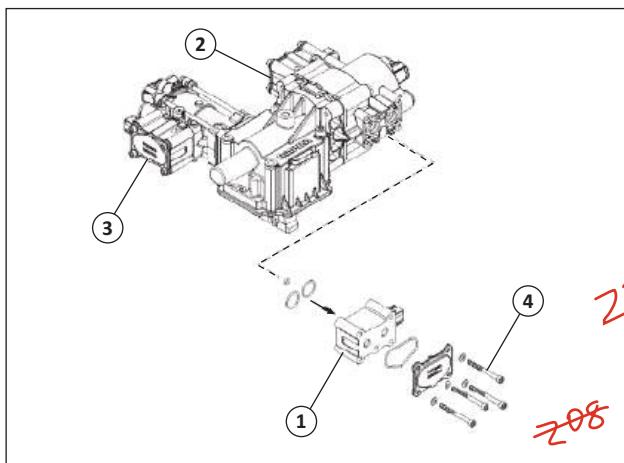
1. SLU 2. Wiring harness

g) Using screws, mount the SLU in the mounting bracket.



1. Screw 2. SLU 3. Mounting bracket

- c) Loosen four bolts and remove one solenoid valve (X1).
3 Similarly remove other two solenoid valves (X2 & X3).



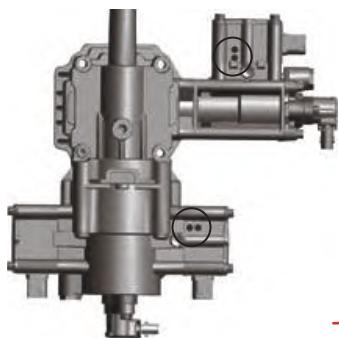
1. Solenoid valve (X1)
3. Solenoid valve (X3)

2. Solenoid valve (X2)
4. Bolt



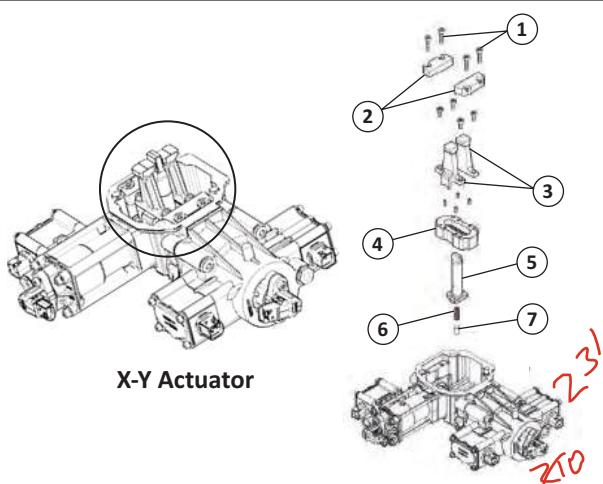
NOTES : 65

Single dot mark given on X1 solenoid valve. Double dot mark given on X2 and X3 solenoid valve. X2 is different from X3 in construction, hence do marking carefully while removing to avoid wrong installation.



230
231

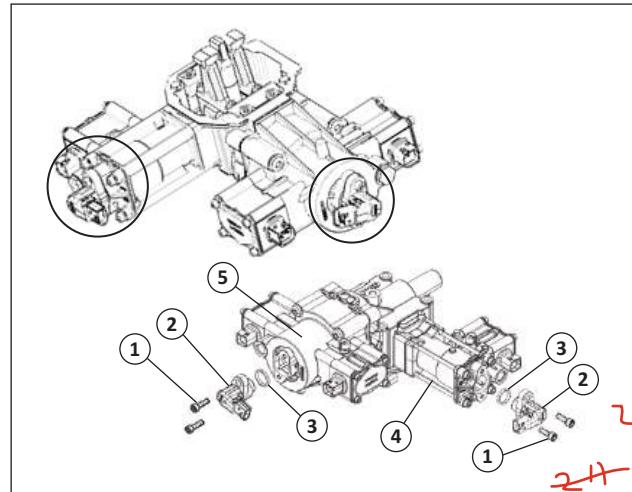
- 4) d) Loosen bolts to remove two guide plate, two locking piece, guiding pieces, a lever and lock bolt with springs.



X-Y Actuator

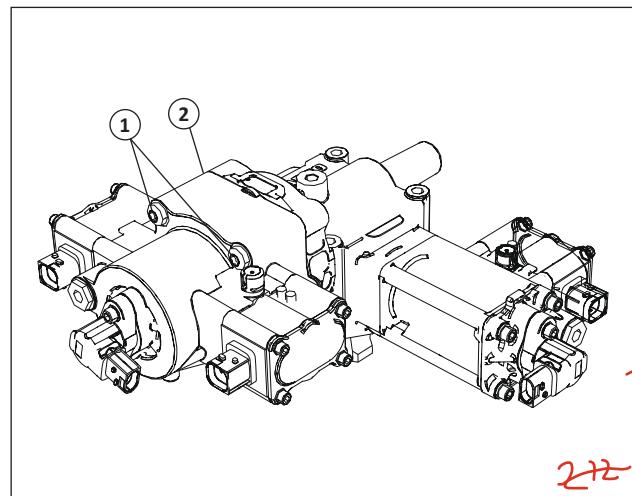
1. Bolt 2. Guide palte 3. Locking pieces
4. Guiding pieces 5. Lever 6. Spring
7. Lock bolt

- 5) e) Loosen bolts to remove two distance select sensor with O-ring each on rail piston assembly and gear piston assembly.



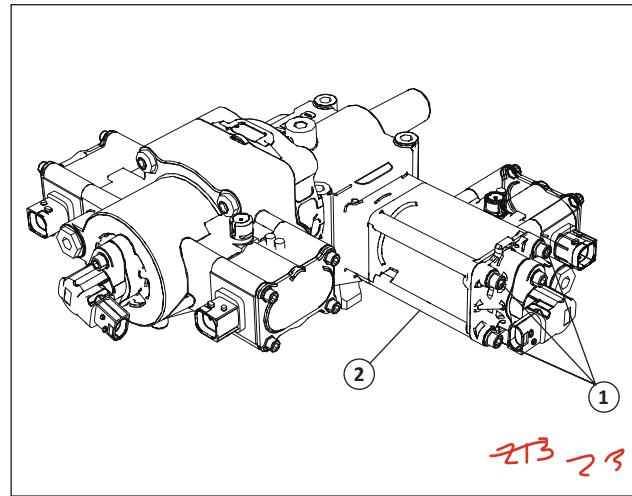
1. Bolt 2. Distance select sensor 3. O-ring
4. Rail piston assembly 5. Gear piston assembly

- 6) f) Loosen four bolts to remove gear piston assembly.



1. Bolt 2. Gear piston assembly

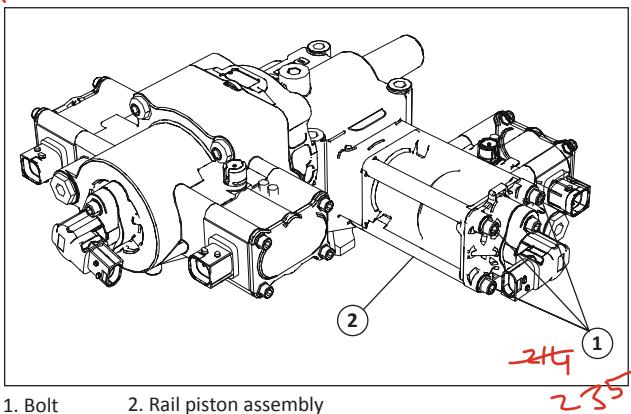
- 7) g) Loosen four bolts to remove rail piston assembly.



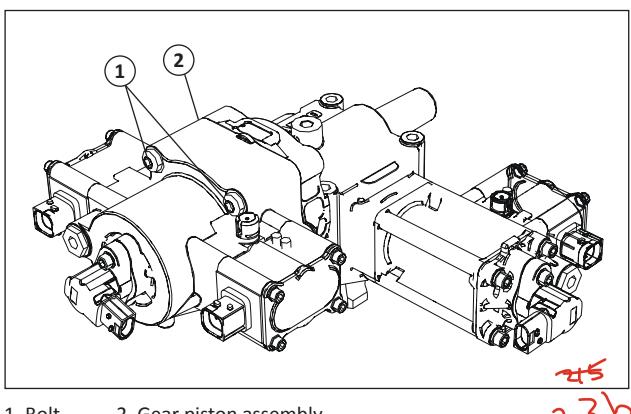
1. Bolt 2. Rail piston assembly

5.15.3.2 Assembly

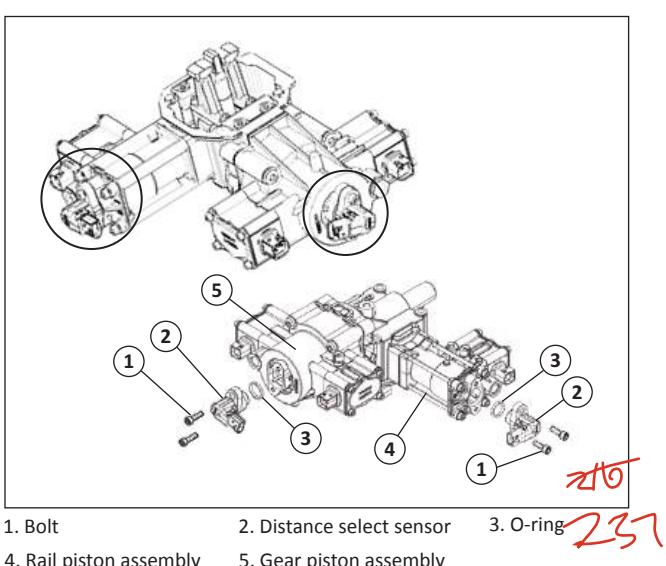
a) Using four bolts re-fit rail piston assembly.



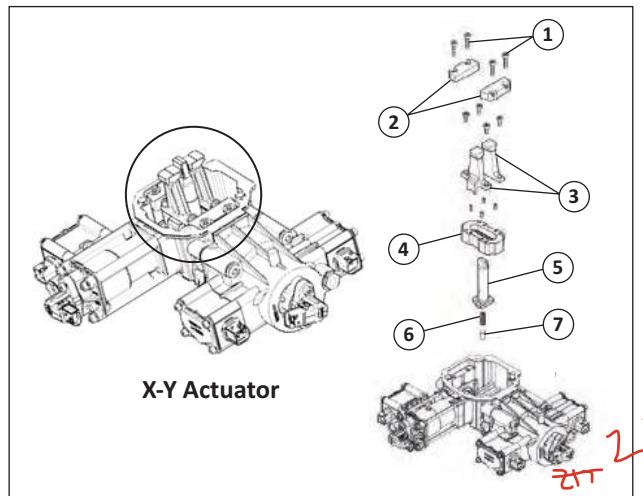
b) Using four bolts re-fit gear piston assembly.



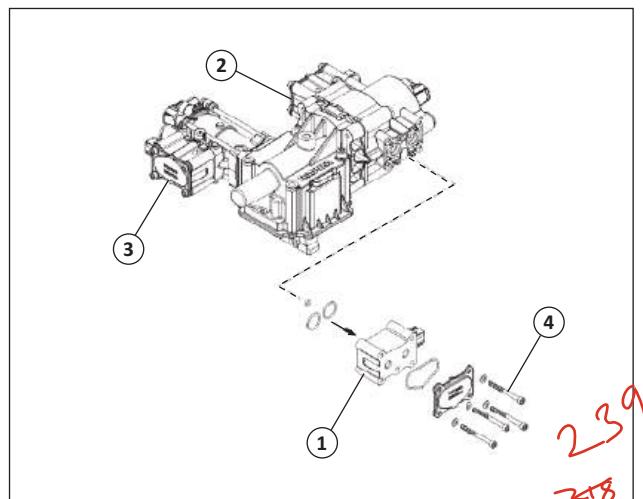
c) Using bolts re-fit two distance select sensor with O-ring each on rail piston assembly and gear piston assembly.



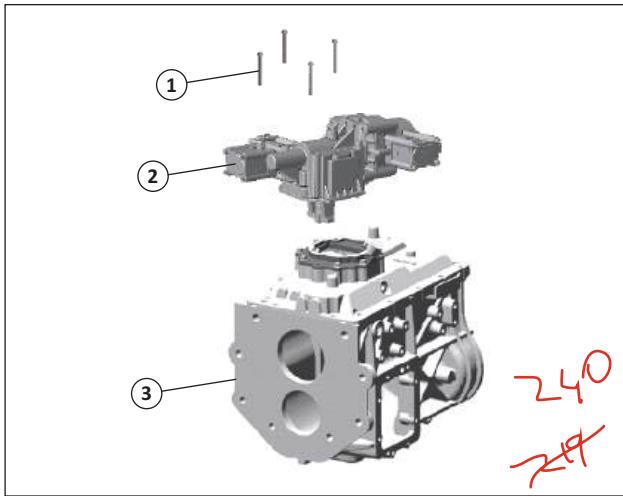
d) Using bolt re-fit two guide plate, two locking piece, guiding pieces, a lever and lock bolt with springs.



e) Using four bolts re-fit each solenoid valve (X1, X2 & X3).

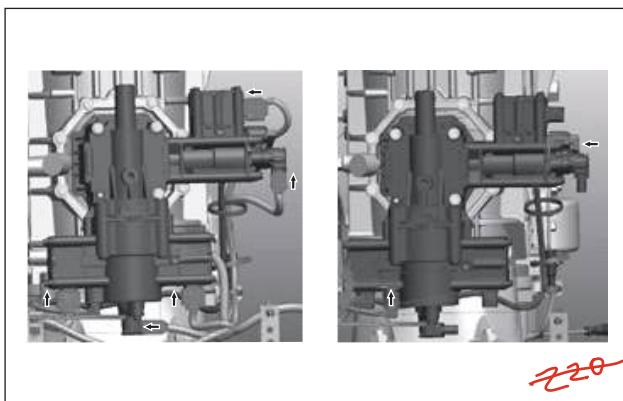


- f)** Using mount the X-Y Actuator on the transmission housing and tighten with screws.



1. Bolt 2. X-Y Actuator 3. Transmission housing

- g)** Connect all electrical and pneumatic connections to the X-Y Actuator.



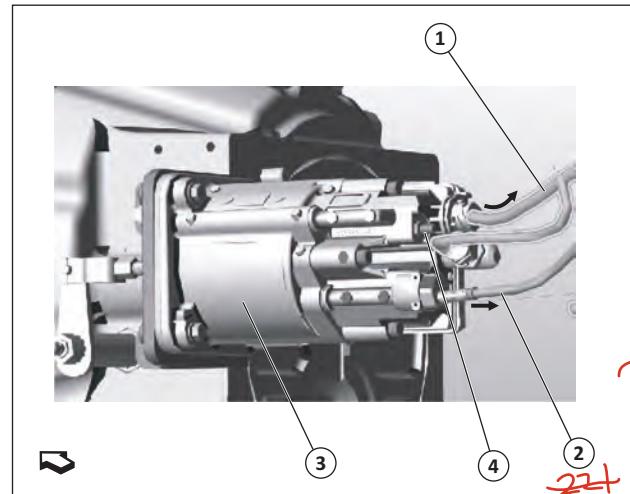
5.16.4 PNEUMATIC CLUTCH ACTUATOR (PCA)

5.16.4.1 Disassembly

Caution : 6

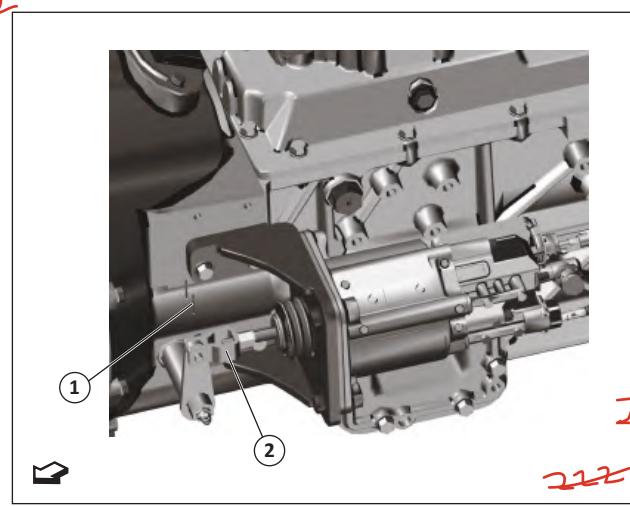
Bleed the air available in the pneumatic pipelines before removal of pneumatic Clutch Actuator (PCA) through its bleed port.

- a)** Disconnect the electrical and pneumatic connections from PCA



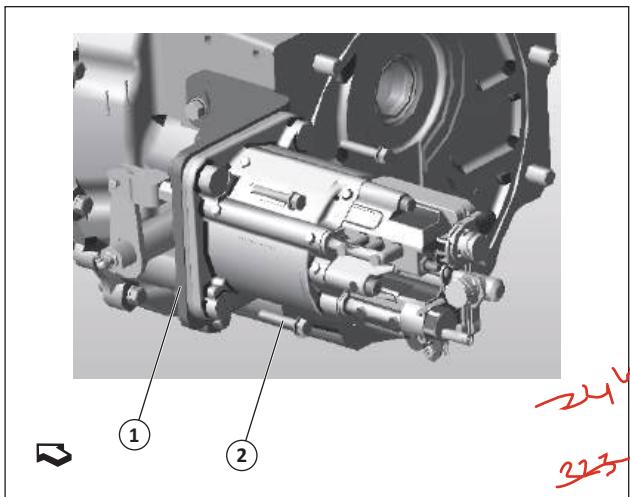
1. Electrical connection 2. Pneumatic connection
3. Pneumatic Clutch Actuator (PCA) 4. Bleed port

- b)** Remove cotter pin to disconnect the push rod linkage.



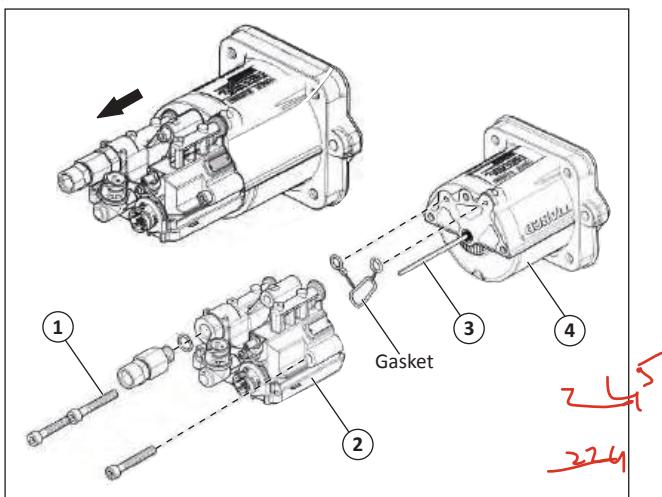
1. Cotter pin 2. Push rod linkage

- c) Loose the four bolts on the mounting bracket and take
3 the PCA outside.



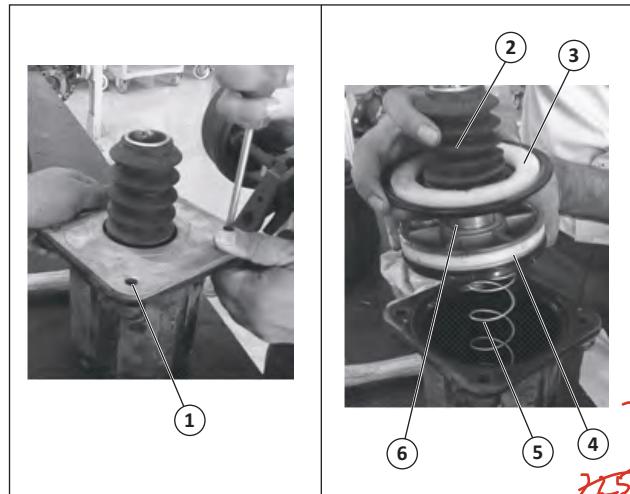
1. Mounting bracket 2. Bolt

- d) Loosen bolts to remove solenoid valve box & distance
4 sensor from PCA body.



1. Bolt 2. Solenoid valve box
 3. Distance sensor 4. PCA body

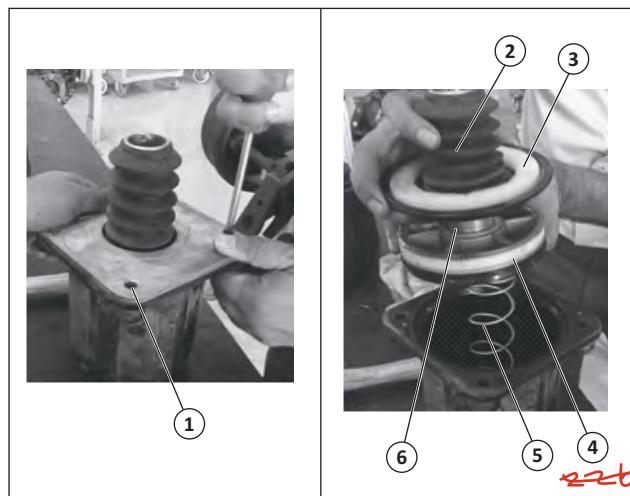
- e) Loosen four screws to remove PCA piston, guide ring,
5 front plate, compression spring, and boot from PCA
 body.



1. Bolt 2. Boot
 4. Front plate 5. Compression spring
 6. PCA piston 3. Guide ring

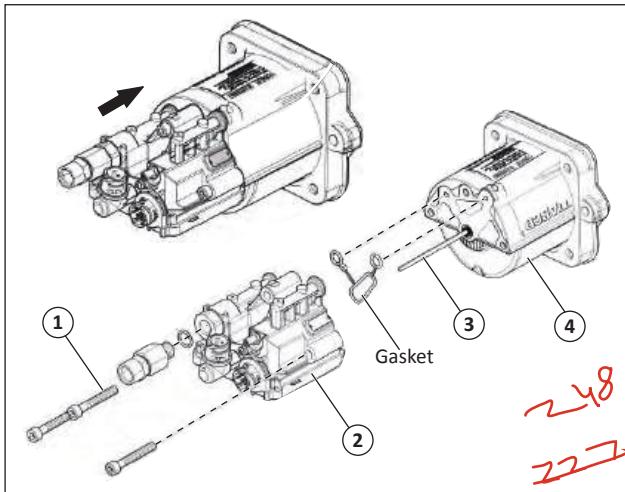
5.3.2 Assembly

- a) Using four screws to refit PCA piston, guide ring, front
 plate, compression spring, and boot in PCA body.



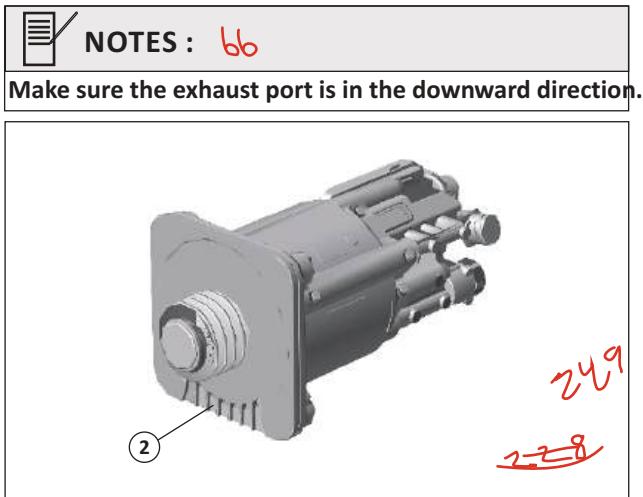
1. Bolt 2. Boot
 4. Front plate 5. Compression spring
 6. PCA piston 3. Guide ring

- b)** Using bolts refit solenoid valve box & distance sensor with PCA body.

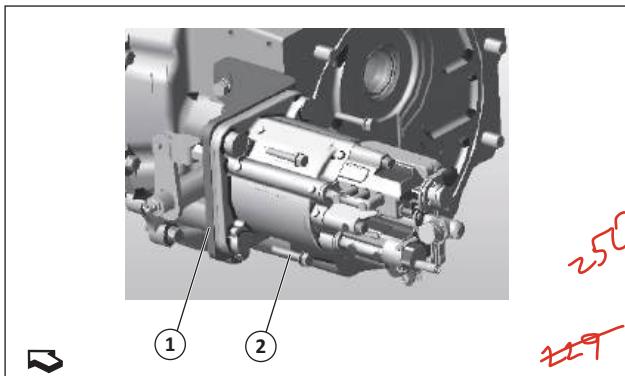


1. Bolt
2. Solenoid valve box
3. Distance sensor
4. PCA body

- c)** Fix the PCA in to the bracket available in the mounting flange by using four bolt.

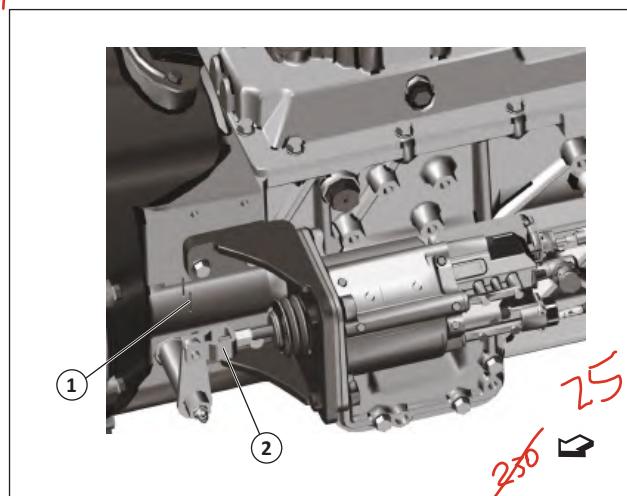


1. Exhaust port



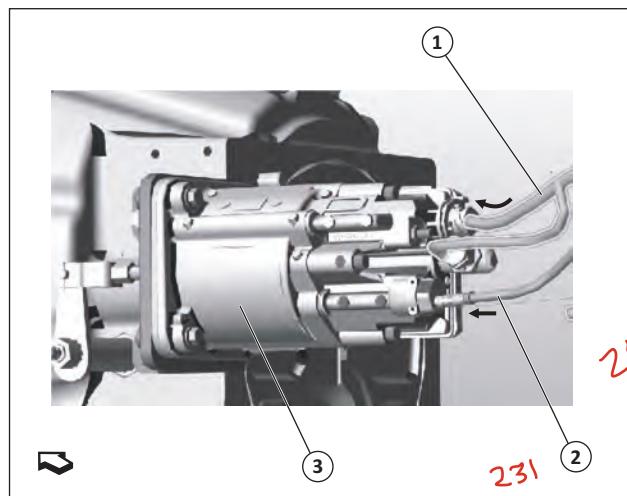
1. Mounting bracket 2. Bolt

- d)** Using cotter pin connect the push rod linkage.



1. Cotter pin 2. Push rod linkage

- e)** Connect the electrical and pneumatic connections to the PCA.

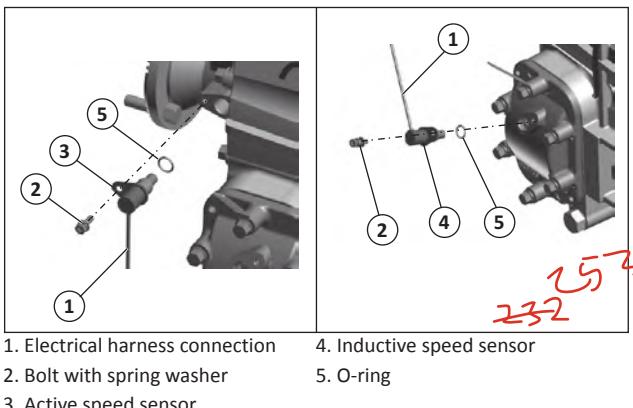


1. Electrical connection
2. Pneumatic connection
3. Pneumatic clutch actuator (PCA)

5.16.4 ACTIVE AND INDUCTIVE SPEED SENSOR

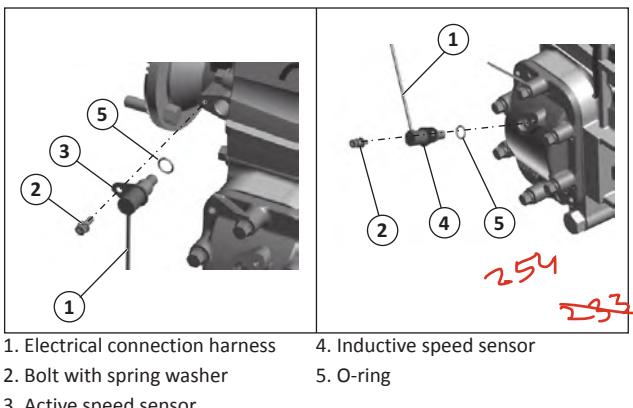
5.16.4.1 Disassembly

- 1) a) Disconnect the electrical harness connection from sensors.
- 2) b) Loosen bolt to remove active & inductive speed sensors and O-ring.



5.16.4.2 Assembly

- a) Install the O-ring, active & inductive speed sensors and tighten with bolt.
- b) Connect the electrical harness connection on sensors.

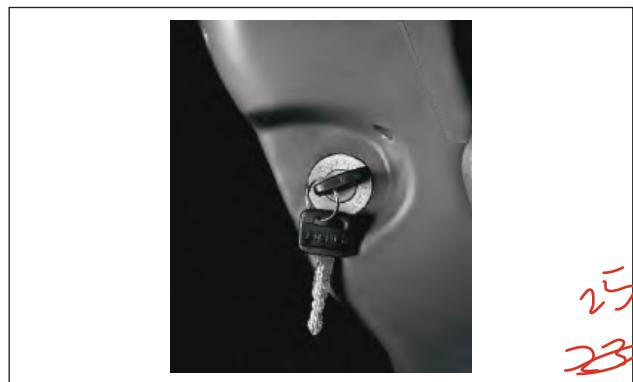


5.16.5 LEARNING PROCEDURE

Vehicle Learning Process is a process in which AMT adjusts itself with different parameters of the vehicle for accurate and precise operations. 67

Need: After any repair, components change, service wear and tear or initial fitments reasons any parameter being used by AMT may change necessitating need of learning. 68

- 1) a) Ensure the Parking brake is ON
- 2) b) Switch off ignition and BATTERY CUT OFF SWITCH wait for 30 seconds



- 3) c) Press both neutral button and function button and then switch on Battery cutoff and ignition switch(Ensure both buttons should be pressed up to the completion of learning process).
- 4) d) Now clutch learning will happen
- 5) e) After clutch learning the N (Flashing N) will be displayed in the display.
- 6) f) Crank the engine within 10 secs and then the gear learning will start (ensure both buttons pressed up until completion)
- 7) g) After the Gear learning, the N will be continuously present in the display (Which indicates that the learning is successfully completed)
- 8) h) Switch off the ignition and wait for 30 seconds
- 9) i) Switch ON ignition. N should be displayed on dashboard.



NOTES : 69

If learning is stopped then check the error codes and rectify error then repeat the learning process

5.16.6 STOPPING THE VEHICLE

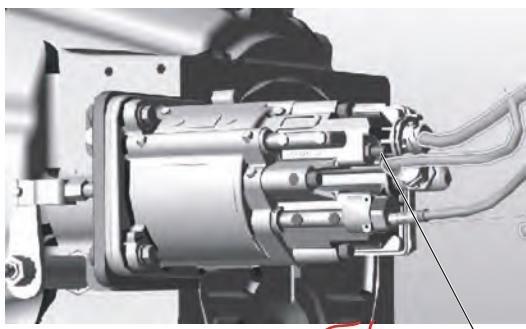
- 1 a) When the vehicle speed decreases towards zero, SLU disengages clutch automatically to prevent engine stall.
- 2 b) When the vehicle is stopped while in automatic mode and a gear engaged, the SLU initiates a shift to the appropriate starting gear (depending upon the load).
- 3 c) If a gear remains engaged for a predefined time of 3 minute while vehicle stopped and ignition ON, SLU intends to shift to neutral. Driver can prevent this automatic shift to neutral by gently depressing the accelerator pedal for a short time. This automatic shift is initiated in both manual and automatic mode.

**NOTES :**

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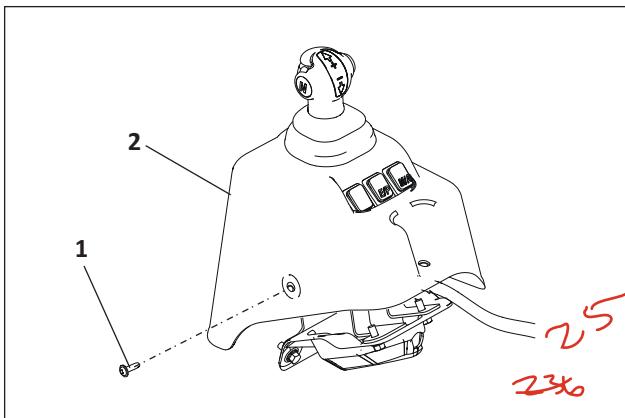
This function is implemented to protect the clutch.

- 4 a) If the clutch remain in close condition, gear also in engage condition and vehicle stopped, switch off the engine ignition and battery cut off. Switch ON the battery and engine ignition, the clutch will automatically open if the air pressure is sufficient (min. 6.5 bar).
- 5 b) If the clutch remain in close condition, gear also in engage condition, and vehicle gets stopped. Due to electrical and pneumatic line failure no air pressure in the pneumatic line and no current supply in SLU. Then in such case pressurized air should be supplied by any external source to PCA through bleed valve, to open the clutch. After that vehicle can be moved / toed to nearest service station for repair.



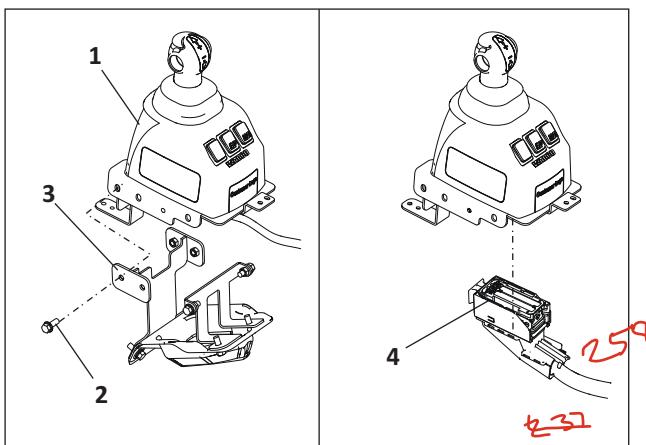
9 Speed TM**5.16 Shift Lever Unit (SLU)****5.16.1 Removal**

- 1** a) Remove AMT console mounting screws and remove console.



1. Screw 2. SLU

- 2** b) Loosen and remove SLU to bracket mounting bolts.
Disconnect the wiring harness from SLU connector and take out SLU.

1. SLU 3. Bracket
2. Bolt 4. Wiring harness connector**5.16.2 Disassembly**

- a) Remove all the three switches by pressing gently.

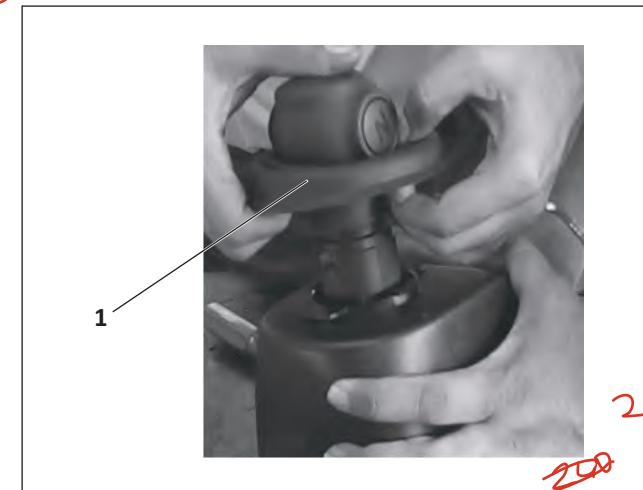


- 2** b) Disconnect wiring connections from each individual switches.

**NOTES : 71**

If connections are incorrect, wrong information will be displayed in the dashboard. Hence do marking carefully while removing to avoid incorrect installation.

- 3** c) Remove the rubber boot by pulling it upward.



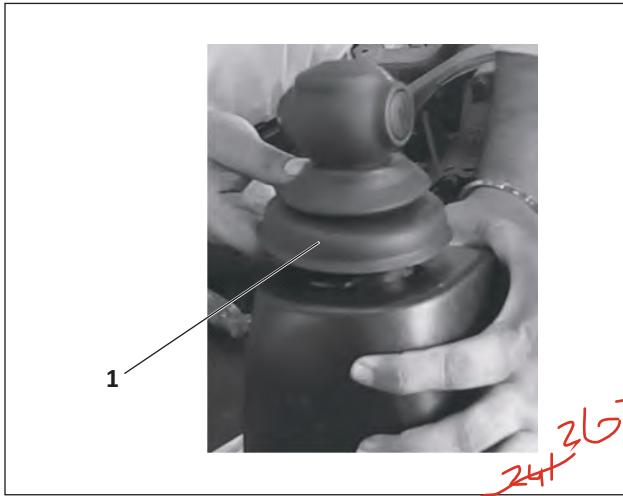
1. Rubber boot

Caution : 7

Sharp edge tools should not be used to remove rubber boot .

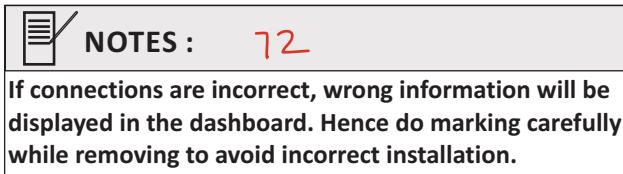
5.16.3 Assembly

- 1 a) Slide the rubber boot on the gear shifting lever and fix it properly.

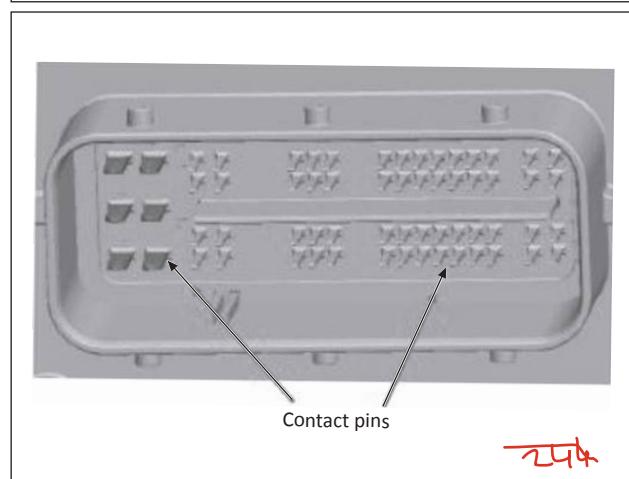


1. Rubber boot

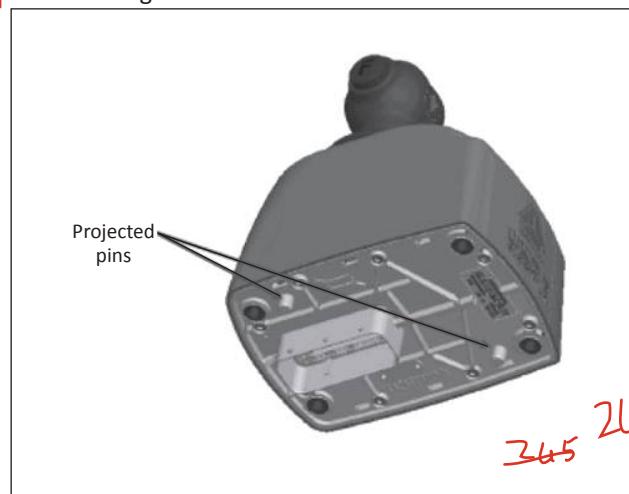
- 2 b) Connect the wiring connections to each individual switches. Make sure the connections are correct.



- 3 c) Re-fit the switches by pressing.

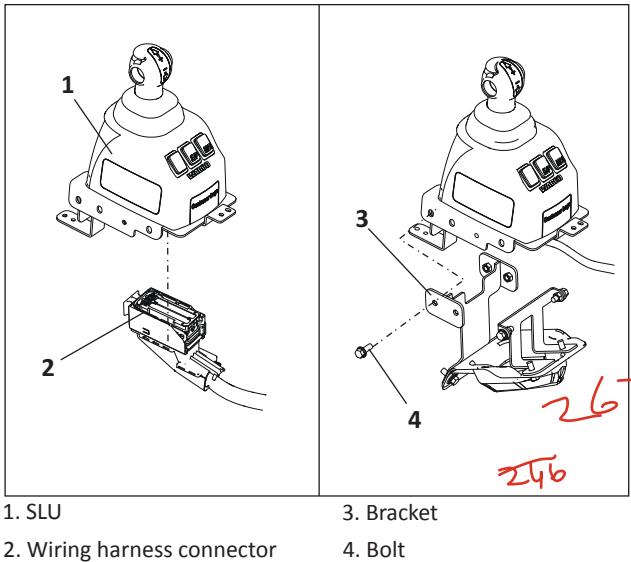


- 4 d) Use the two projected pins for prefixing the SLU in its mounting bracket.

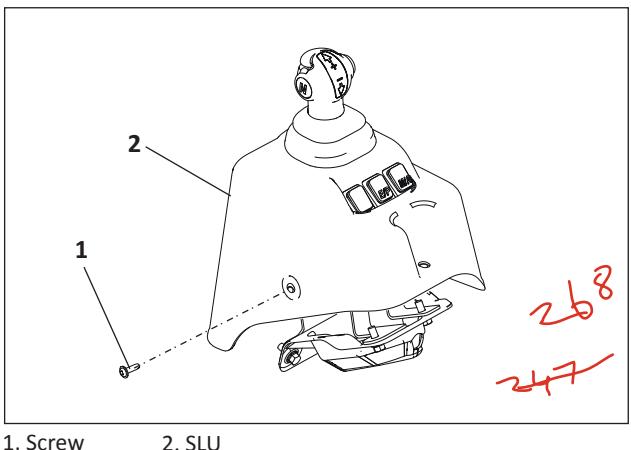


5.16.4 Re-fitment

- a) Connect the SLU wiring harness and place the SLU on bracket and tighten with mounting bolts.

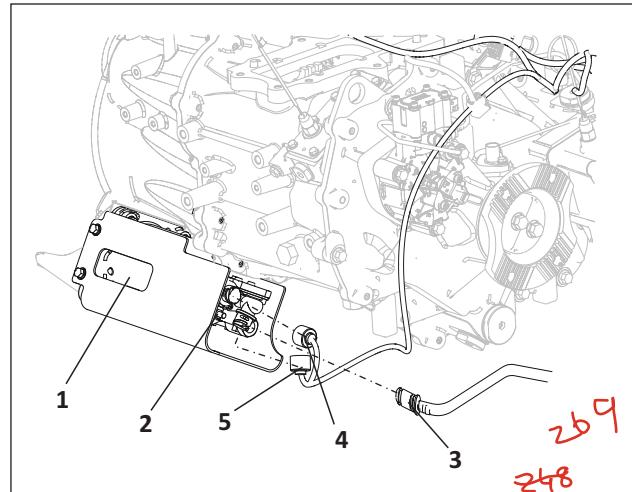


- b) Install the AMT console and tighten with mounting screws.

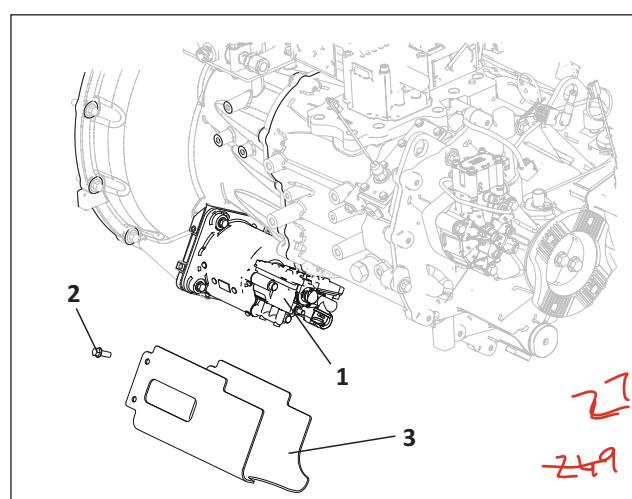
**5.17. Pneumatic Clutch Actuator (PCA)****5.17.1 Removal**

Bleed the air available in the pneumatic pipelines before removal of pneumatic Clutch Actuator (PCA) through its bleed port.

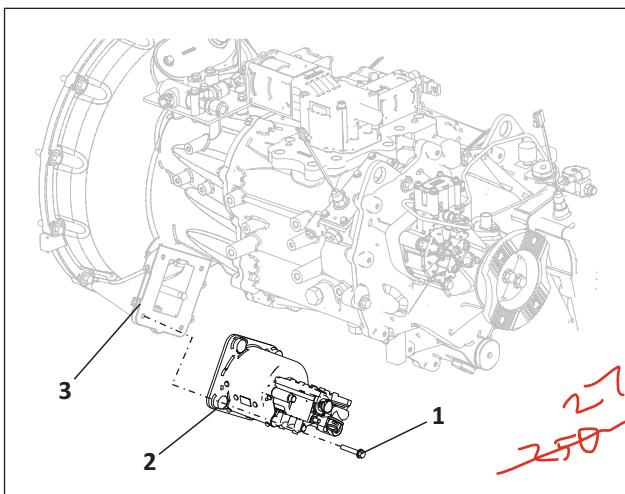
- 1 a) Disconnect the air supply connection from PCA.
2 b) Disconnect the electrical solenoid valves & distance sensor connections from PCA.



- 3c) Loosen and remove the PCA cover mounting bolts and take out the PCA cover from clutch control unit.



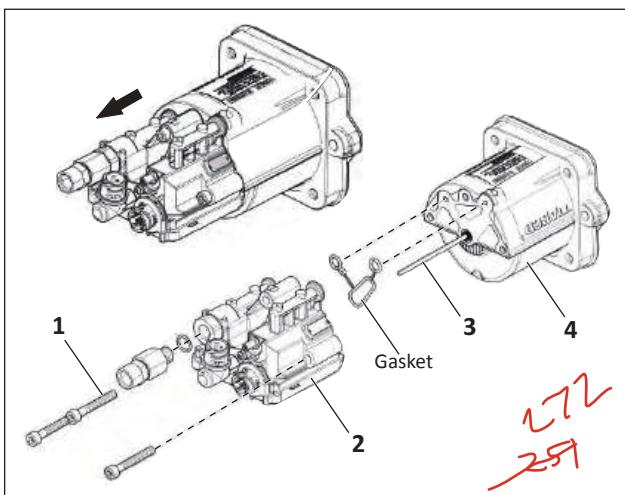
- d) Loosen and remove the PCA mounting bolts and take out the PCA from clutch control unit.



1. PCA mounting bolt
②Pneumatic Clutch Actuator (PCA)
3. Clutch control unit

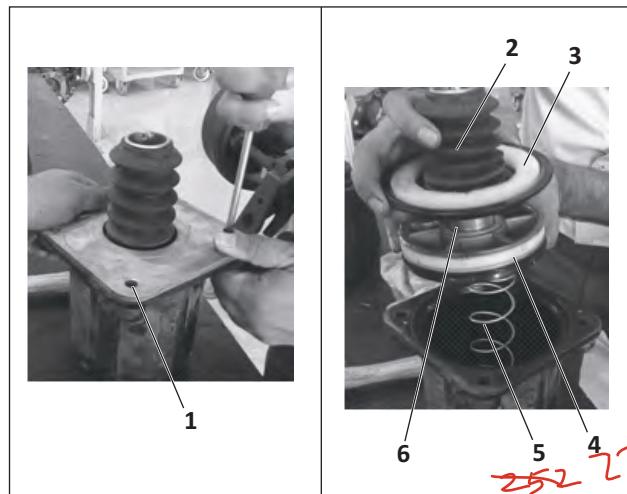
5.17.2 Disassembly

- a) Loosen bolts to remove solenoid valve box & distance sensor from PCA body.



1. Bolt
2. Solenoid valve box
3. Distance sensor
4. PCA body
Gasket

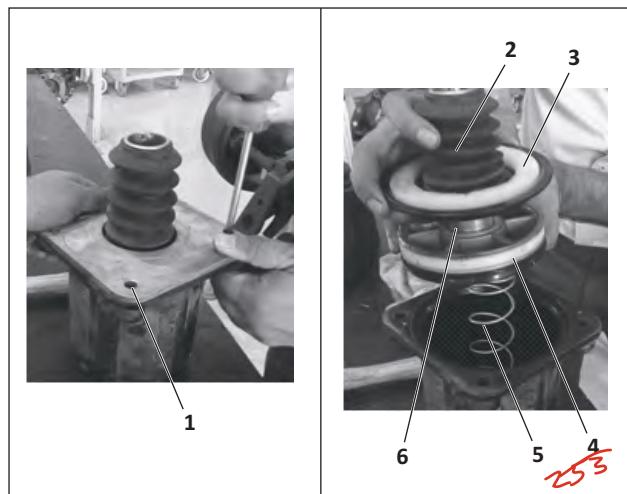
- b) Loosen four bolts to remove PCA piston, guide ring, front plate, compression spring, and boot from PCA body.



1. Bolt
2. Boot
3. Guide ring
4. Front plate
5. Compression spring
6. PCA piston

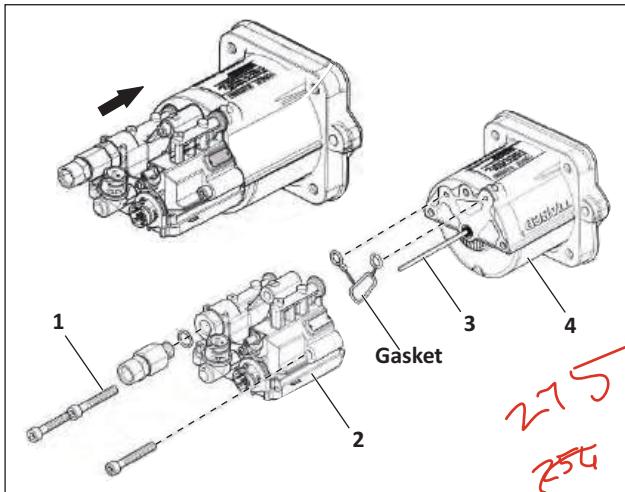
5.17.3 Assembly

- a) Using four bolts to refit PCA piston, guide ring, front plate, compression spring, and boot in PCA body.



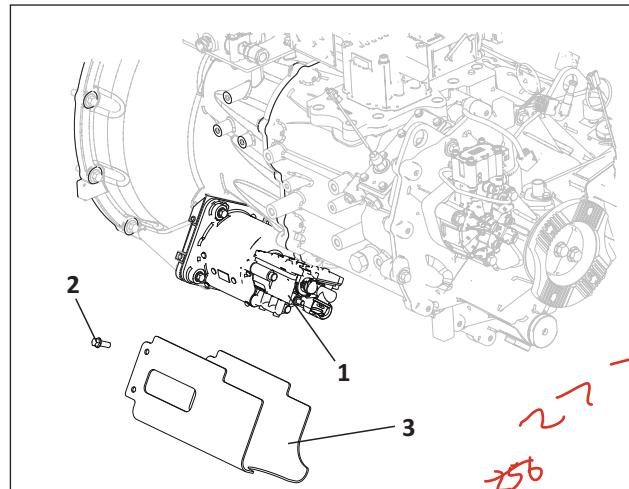
1. Bolt
2. Boot
3. Guide ring
4. Front plate
5. Compression spring
6. PCA piston

- b)** Using bolts refit solenoid valve box & distance sensor with PCA body.



1. Bolt 3. Distance sensor
2. Solenoid valve box 4. PCA body

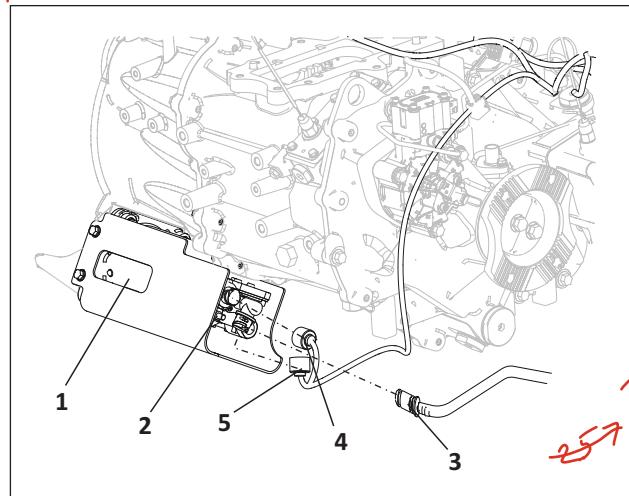
- 2b)** Install the PCA cover and tighten the mounting bolts.



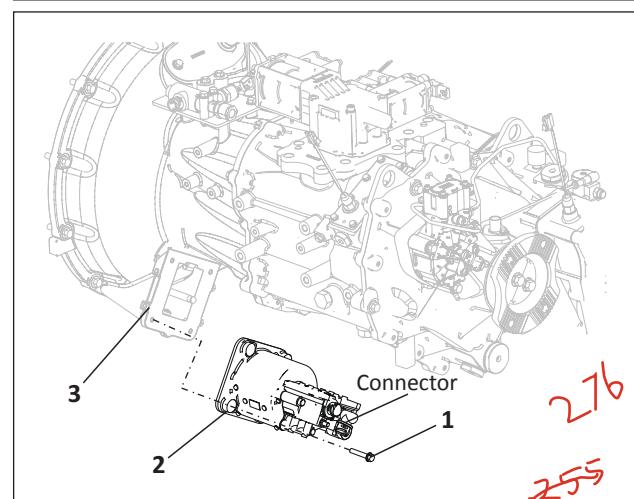
1. Pneumatic Clutch Actuator (PCA) 3. PCA cover
2. PCA cover bolt

- 3c)** Connect the electrical solenoid valves & distance sensor connections.

- 4d)** Connect the air supply connection.



1. Pneumatic Clutch Actuator (PCA) 4. Solenoid valves connection
2. Bleed screw 5. Distance sensor connection
3. Air supply connection

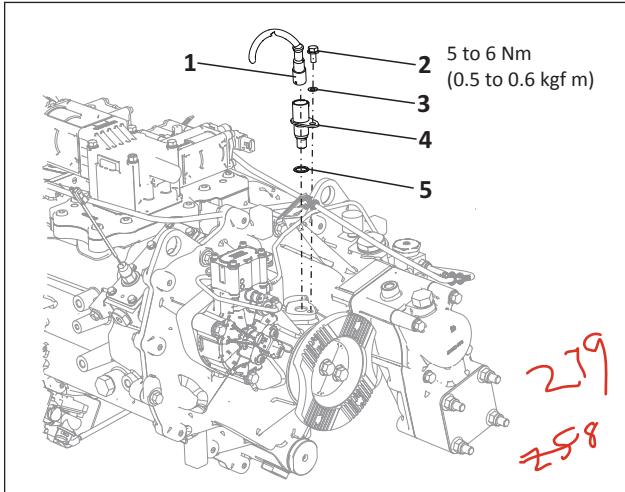


1. PCA mounting bolt 3. Clutch control unit
②Pneumatic Clutch Actuator (PCA) 2. Connector

5.18.4 Active Speed Sensor

5.18.1 Removal & Re-fitment

- 1 a) Disconnect the harness connection from active speed sensors.
- 2 b) Loosen bolt and remove the active speed sensor along with washer.
- 3 c) Remove the O-ring



- | | |
|--------------------------------|-----------------------|
| 1. Harness active speed sensor | 4. Active speed senor |
| 2. Active speed senor bolt | 5. O-ring |
| 3. Washer | |

Disassembly sequence

1 → 2 → 3 → 4 → 5

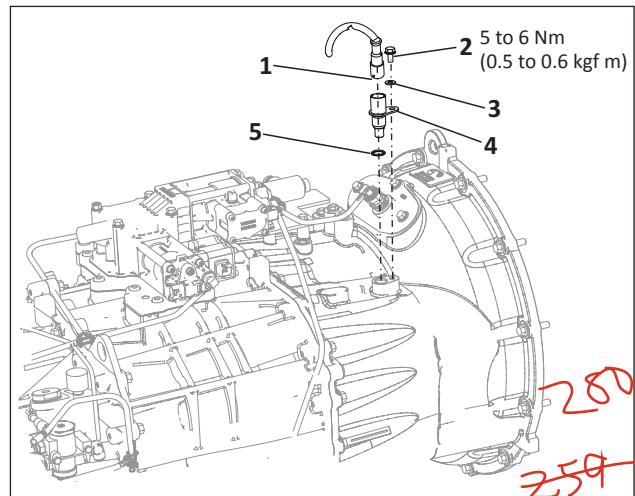
Assembly sequence

5 → 4 → 3 → 2 → 1

5.19 Inductive Speed Sensor

5.19.1 Removal & Re-fitment

- 1 a) Disconnect the harness connection from inductive speed sensors.
- 2 b) Loosen bolt and remove the inductive speed sensor along with washer.
- 3 c) Remove the O-ring



- | | |
|-----------------------------------|--------------------------|
| 1. Harness inductive speed sensor | 4. Inductive speed senor |
| 2. Inductive speed senor bolt | 5. O-ring |
| 3. Washer | |

Disassembly sequence

1 → 2 → 3 → 4 → 5

Assembly sequence

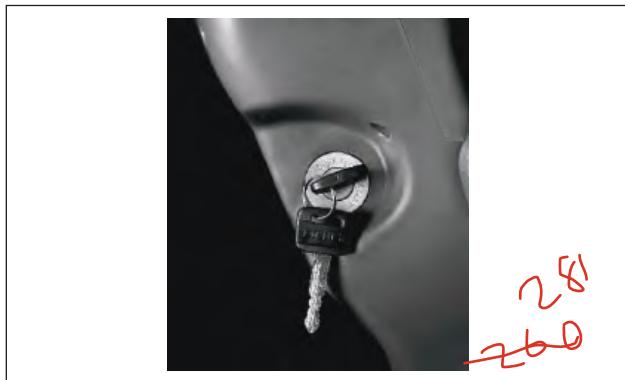
5 → 4 → 3 → 2 → 1

5.20 MANUAL LEARNING PROCEDURE

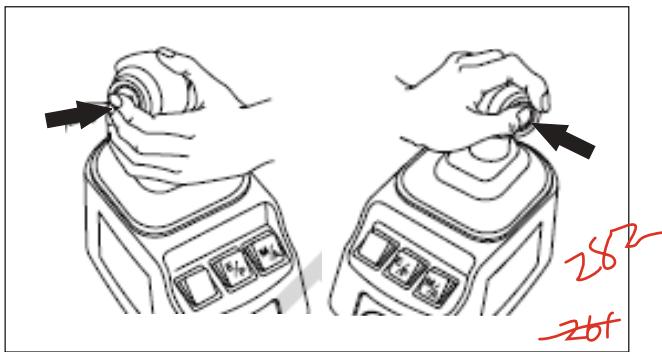
Vehicle Learning Process is a process in which AMT adjusts itself with different parameters of the vehicle for accurate and precise operations.

Need: After any repair, components change, service wear and tear or initial fitments reasons any parameter being used by AMT may change necessitating need of learning.

- 1 a) Ensure the Parking brake is ON
- 2 b) Switch off ignition and battery cut off switch wait for 120 seconds



- 3 c) Switch ON the battery cut off switch and ignition switch then press the neutral and function button simultaneously.(Ensure both buttons should be pressed up to the completion of learning process).

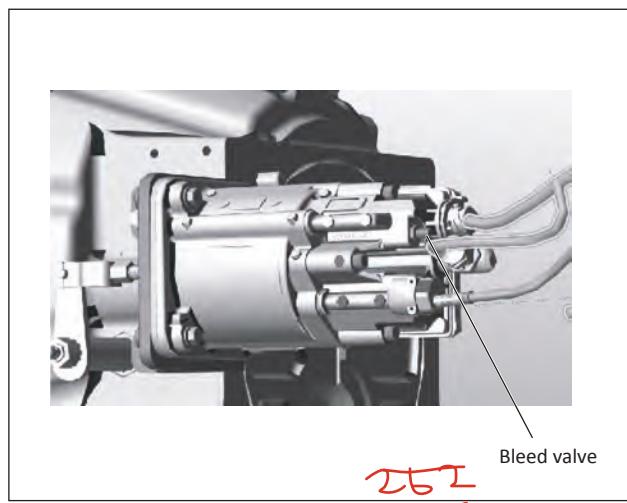


- 4 d) Now clutch learning will happen
- 5 e) After clutch learning, buzzer sound will come and N (Neural) Symbol will display in cluster.
- 6 f) After buzzer sound, crank the engine immediately and then the gear learning will start (ensure both buttons pressed up until completion)
- 7 g) After the Gear learning, the N will be continuously present in the display (Which indicates that the learning is successfully completed)
- 8 h) Switch off the ignition and wait for 30 seconds
- 9 i) Switch ON ignition. N should be displayed on dashboard.

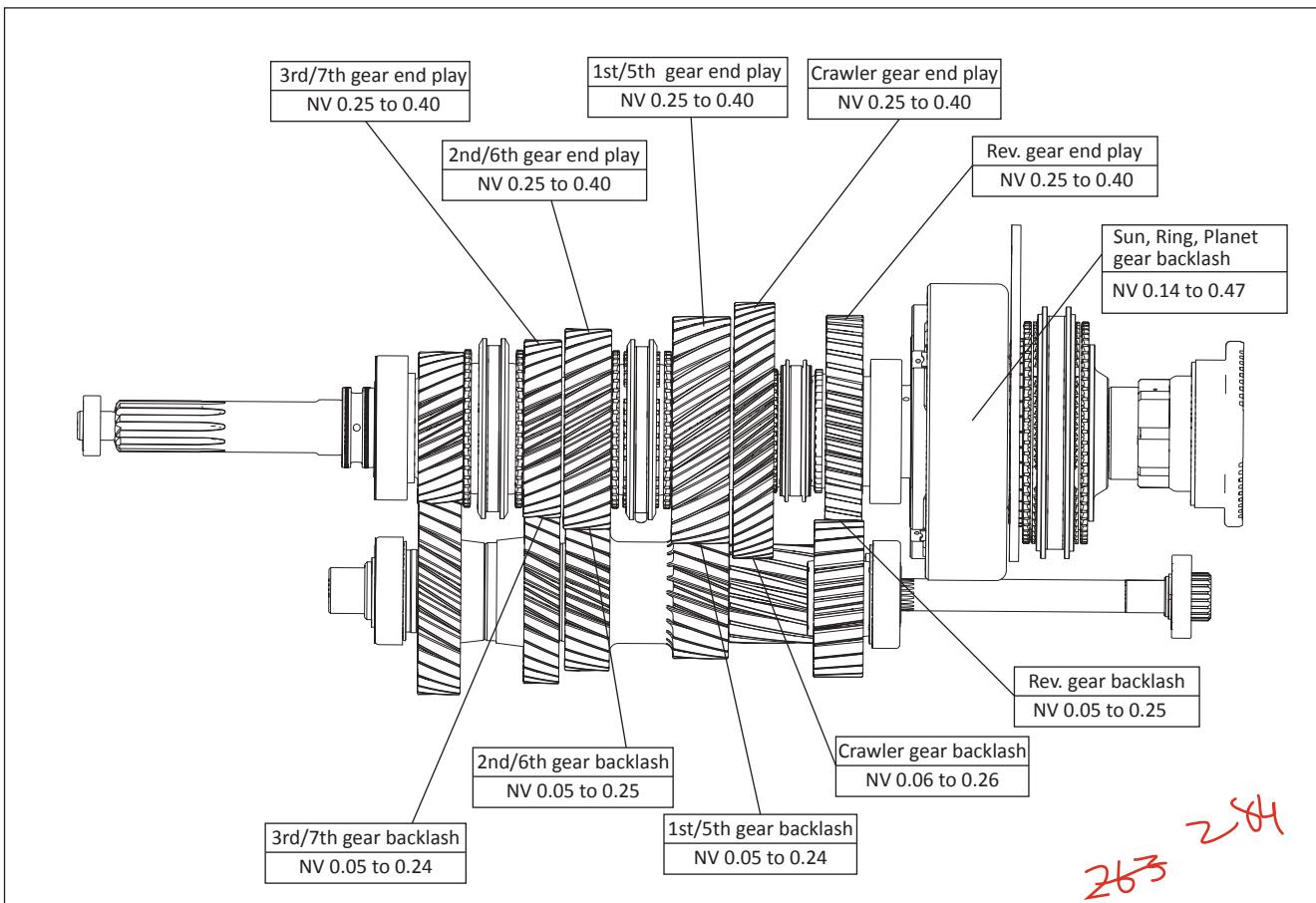
NOTES : 77

If learning is stopped then check the error codes and rectify error then repeat the learning process

- 10 a) If the clutch remain in close condition, gear also in engage condition and vehicle stopped, switch off the engine ignition and battery cut off. Switch ON the battery and engine ignition, the clutch will automatically open if the air pressure is sufficient (min. 6.5 bar).
- 11 b) If the clutch remain in close condition, gear also in engage condition, and vehicle gets stopped. Due to electrical and pneumatic line failure no air pressure in the pneumatic line and no current supply in GSU. Then in such case pressurized air should be supplied by any external source to PCA through bleed valve, to open the clutch. After that vehicle can be moved / toed to nearest service station for repair.



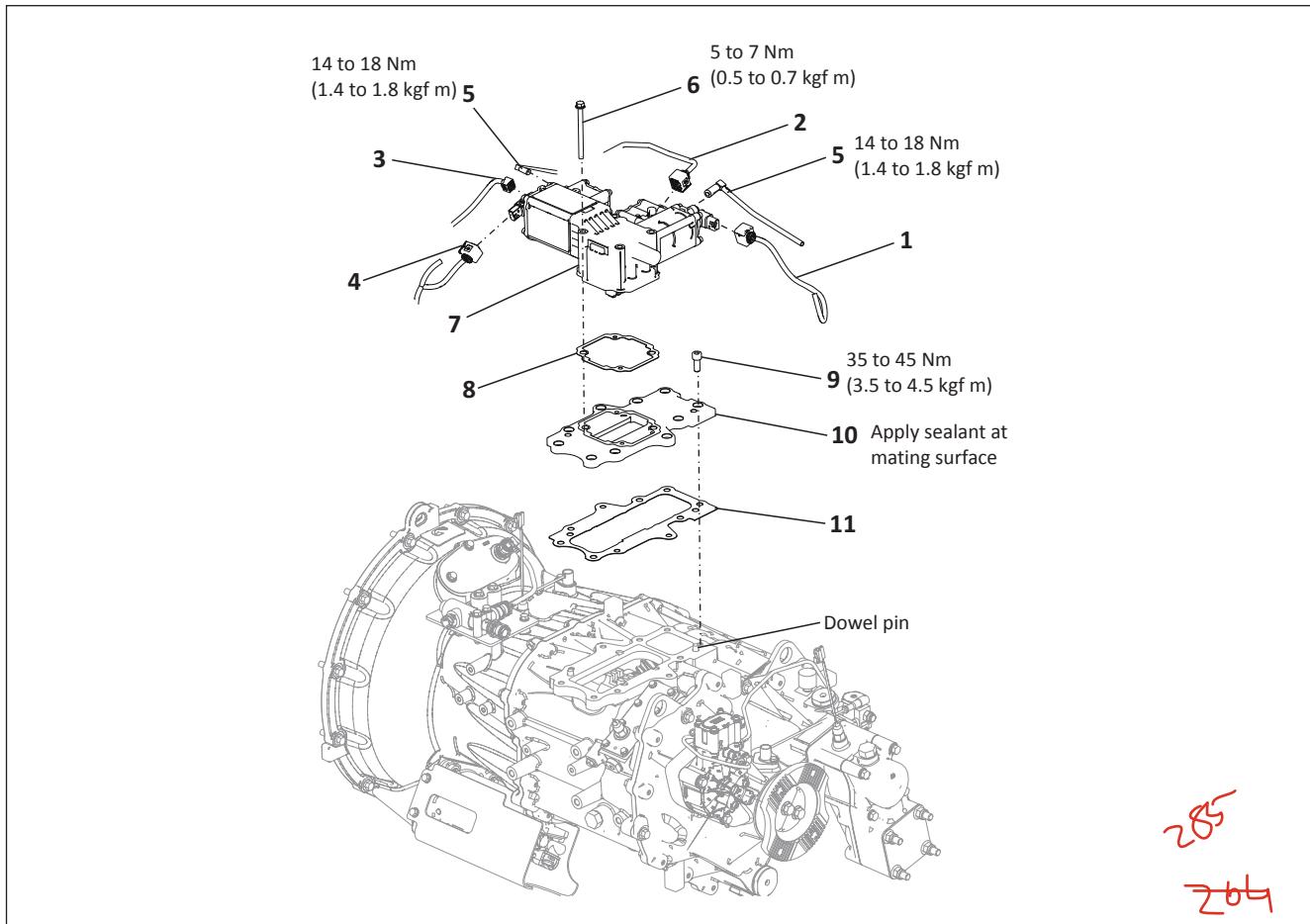
Transmission assembly gear end play & backlash ET140S9



5.21 XY Actuator**5.21.1 Removal & Re-fitment**

- 1** a) Disconnect the XY actuator connectors.
2 b) Remove the air input /output pipes

- 3** c) Loosen and remove the XY actuator mounting bolts and take out the XY actuator and gasket.
- 4** d) Loosen and remove the adapter plate mounting bolts and take out the adapter plate and gasket.



- | | | |
|--------------------------|---------------------------|-----------------------------------|
| 1. X4 actuator connector | 5. Pneumatic supply pipes | 9. Adapter plate socket head bolt |
| 2. X2 actuator connector | 6. XY actuator bolt | 10. Adapter plate |
| 3. X1 actuator connector | 7. XY actuator | 11. Gasket |
| 4. X3 actuator connector | 8. Gasket | |

Disassembly sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11

Assembly sequence

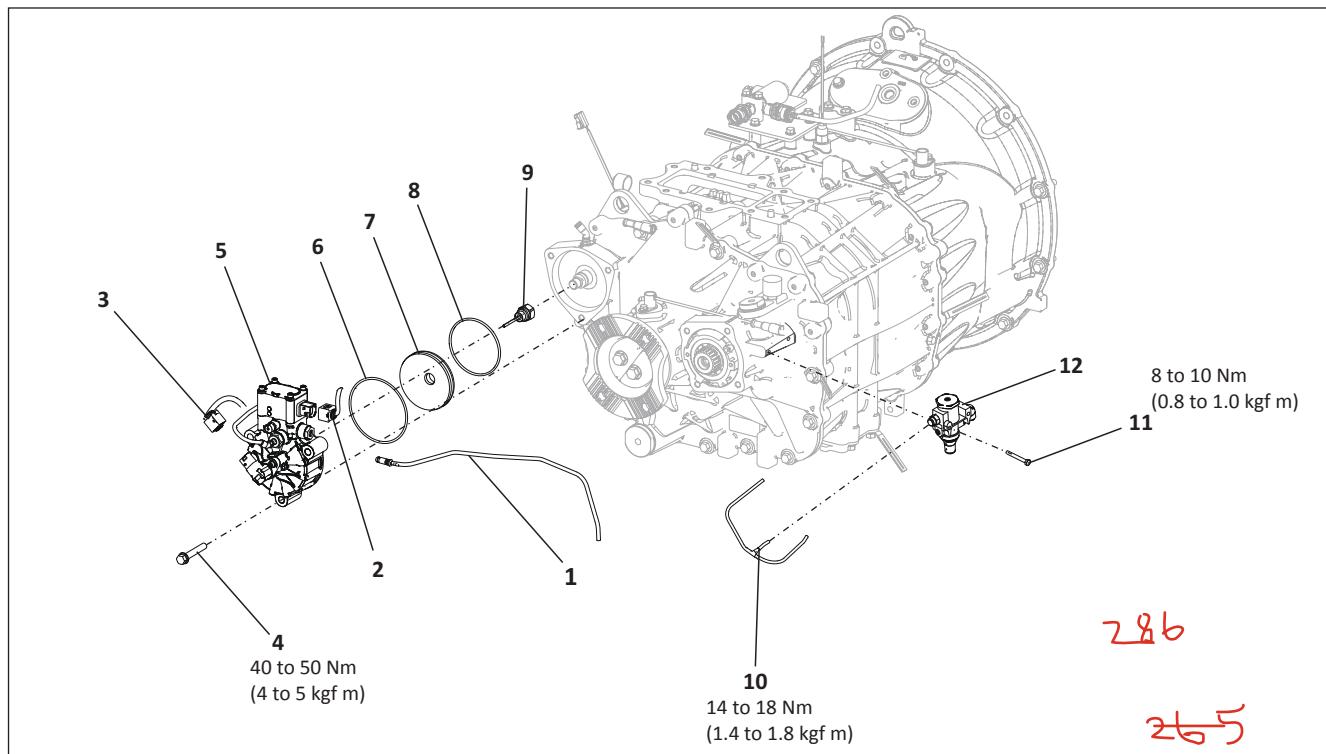
11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

5.22 Range Cylinder**5.22.1 Removal & Re-fitment**

- 1 a) Disconnect the distance position sensor, range actuator connection and pneumatic pipe.
- 2 b) Loosen and remove the range cylinder mounting bolts and take out the range cylinder and O-ring.

3 c) Remove the range piston, O-ring and armature.

4 d) Loosen and remove the filter regulator mounting bolts and remove the filter.



1. Pneumatic pipe

2. Range actuator connection

3. Distance position sensor connection

4. Range cylinder mounting bolts

5. Range cylinder

6. O-ring

7. Range piston assembly

8. O-ring

9. Armature

10. Pneumatic supply pipe

11. Filter regulator mounting bolt

12. Filter regulator

Disassembly sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → 10 → 11 → 12

Assembly sequence

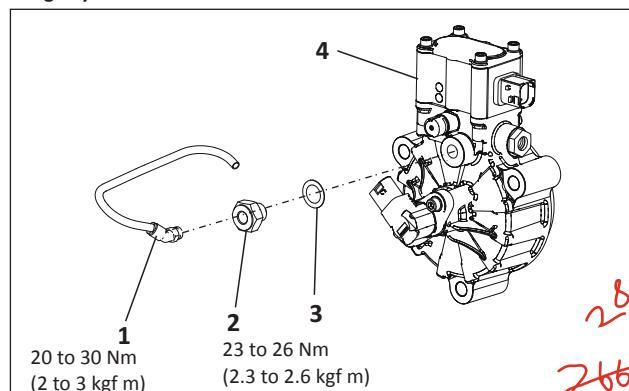
12 → 11 → 10 → 9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1



NOTES : 78

O-ring should be properly fitted on cylinder groove .

Range Cylinder



1. Range cylinder pipe

2. Pneumatic coupling

3. Gasket

4. Range cylinder

Disassembly sequence

1 → 2 → 3 → 4

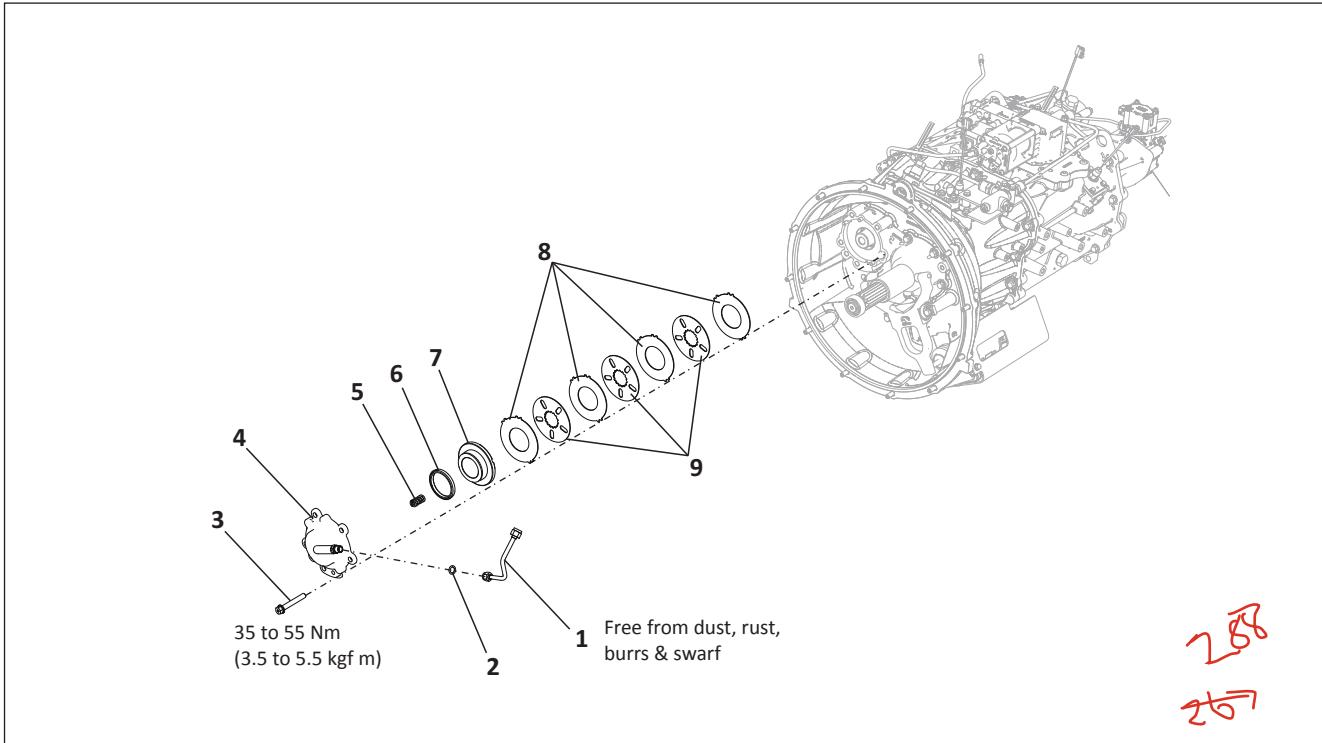
Assembly sequence

4 → 3 → 2 → 1

5.23 Counter Shaft Braking (CSB) unit

5.23.1 Removal & Re-fitment

- 1 a) Remove the CSB inlet pipe from both sides along with washer.
- 2 b) Loosen and remove the CSB housing mounting bolts and take out the CSB housing.
- c) Remove the Spring, piston ring, piston and CSB Pressure & friction plates by using screw driver from quill assembly.



- | | |
|---------------------|--------------------|
| 1. CSB inlet pipe | 6. Piston ring |
| 2. Washer | 7. Piston |
| 3. CSB housing bolt | 8. Pressure plates |
| 4. CSB housing | 9. Friction plates |
| 5. Spring | |

Disassembly sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9

Assembly sequence

9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

Caution : 9

Do not use grease or any lubricant.

- 4 a) Insert Pressure plate & Friction in sequence (P-F) one by one in to quill assembly
- 5 b) Insert spring on centre of the CSB unit and Mount CSB unit aligned with dowel and tighten mounting


NOTES :

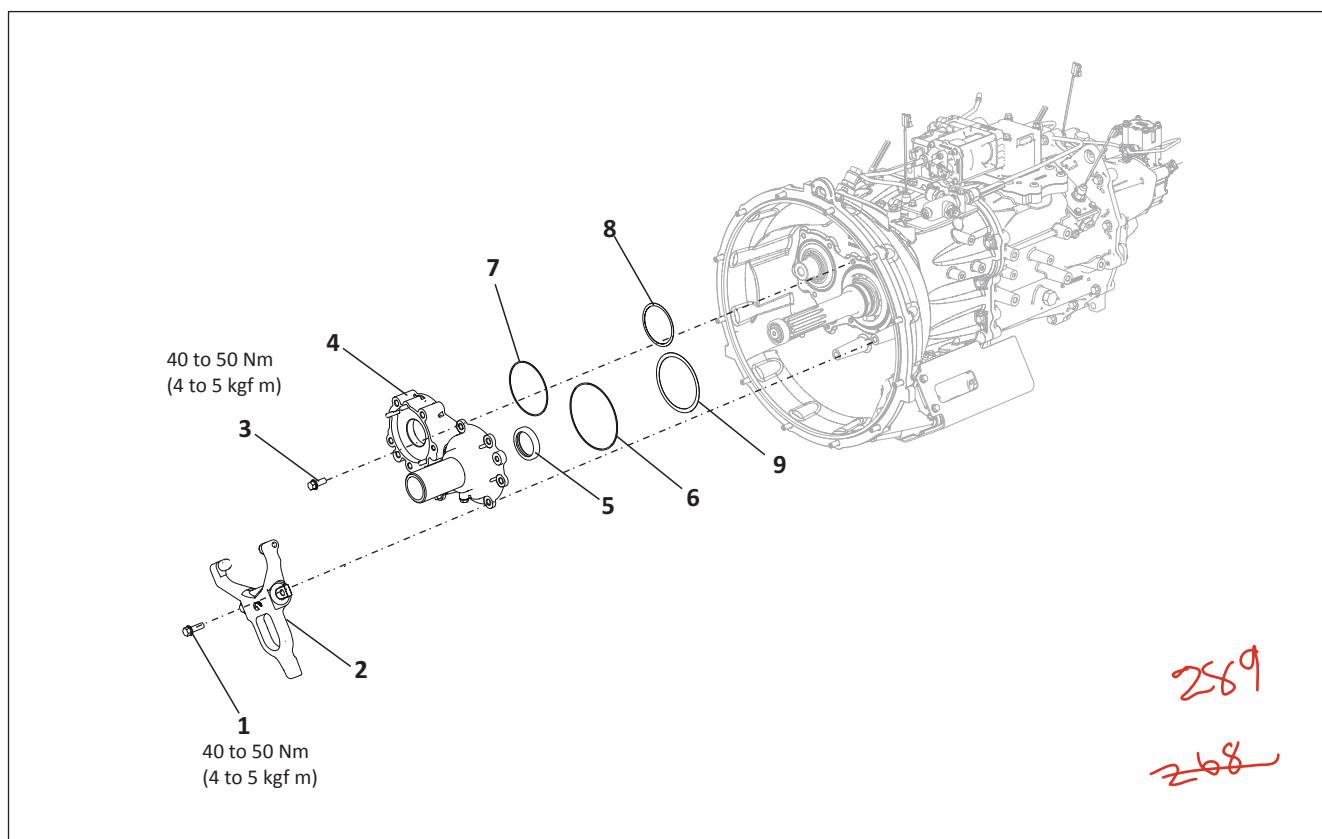
79

Insert pressure and friction plate. Pressure plate wont be fitted in wrong direction.

5.24 Clutch Quill & Fork

5.24.1 Removal & Re-fitment

- 1 a) Loosen and remove the clutch release fork mounting bolts and take out the clutch release fork
 2 b) Loosen and remove the clutch quill mounting bolts and take out the clutch quill assembly.
- c) Remove the oil seal & O-rings.
 d) Remove the shims



- | | |
|--------------------------------------|--------------------------|
| 1. Clutch release fork mounting bolt | 6. O-ring - drive pinion |
| 2. Clutch release fork | 7. O-ring - CSB |
| 3. Clutch quill mounting bolt | 8. Shim CS |
| 4. Clutch quill | 9. Shim MS |
| 5. Oil seal | |

Disassembly sequence

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9

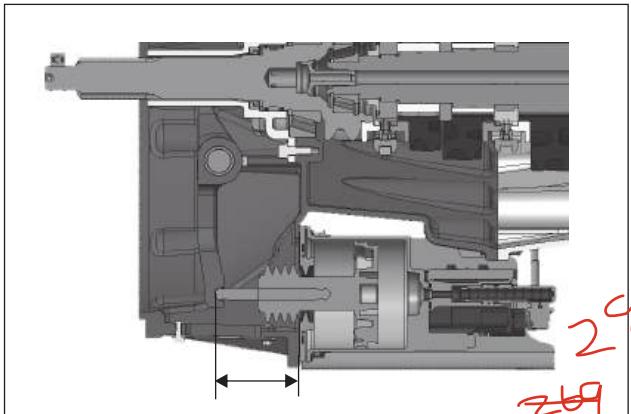
Assembly sequence

9 → 8 → 7 → 6 → 5 → 4 → 3 → 2 → 1

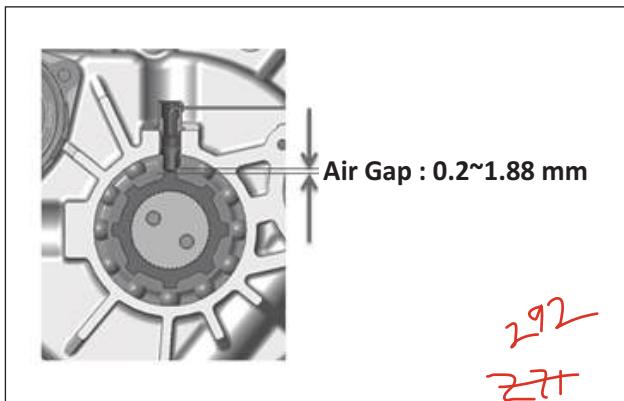
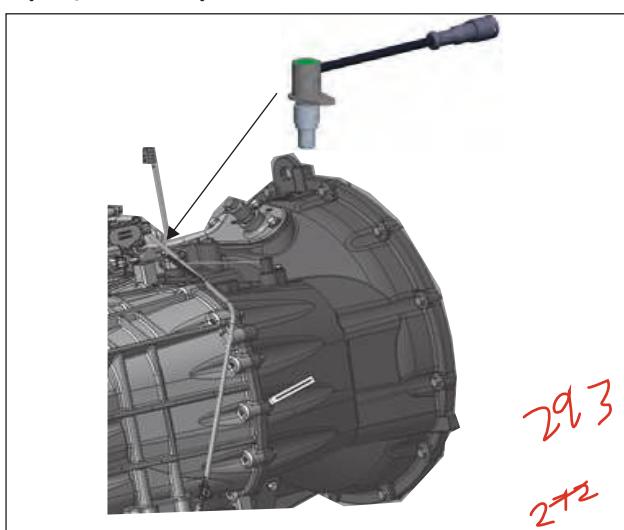
Clutch learning failure analysis

If clutch learning failed please refer below guidelines
Guideline

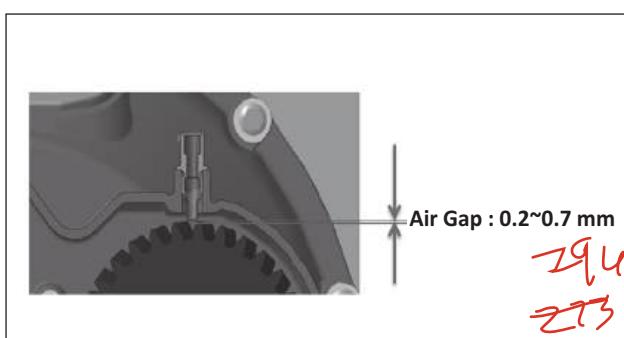
- 1 a) Ensure the PCA standout 90.5 ± 3 mm
- 2 b) Ensure the PCA push travel : $19.2 \sim 22.4$ mm
- 3 c) If PCA push rod is not moving , please check air pressure is sufficient (8 Bar)
- 4 d) Check the push rod length i.e. 121.5 mm

**Active / Output speed sensor**

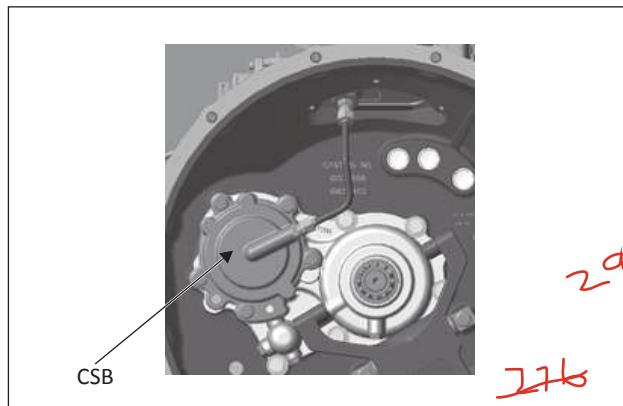
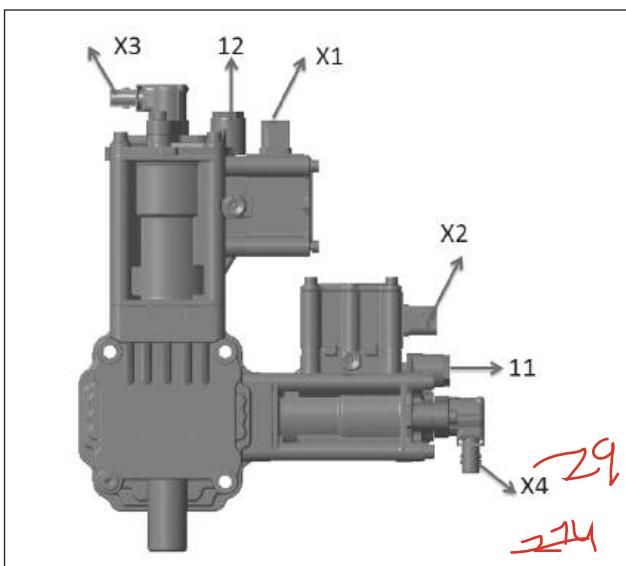
- 1 a) Air Gap between pole wheel and sensor should be 0.2 to 1.8 mm for proper gear shifting
- 2 b) Identification : Output speed sensor connector – orange in color
- 3 c) Mating female connector having sticker with mentioning "Active speed sensor "
- 4 d) Mounted on Rear cover as shown
- 5 e) If Rev gear will not engage –check the input and output speed sensor connectors are properly fitted or not

**Input / Passive speed sensor**

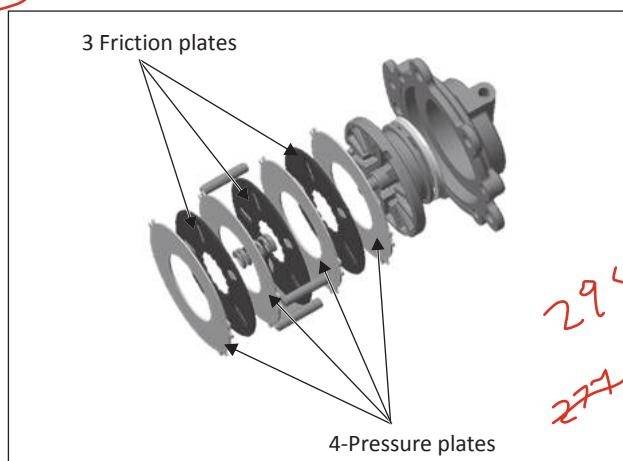
- 1 a) Air Gap between pole wheel and input speed sensor should be 0.2 to 0.7 mm for proper gear shifting
- 2 b) Identification : Input speed sensor connector – black in color
- 3 c) Mating female connector having sticker with mentioning "Passive speed sensor "
- 4 d) Mounted on Idler cover as shown
- 5 e) If Rev gear will not engage –check the input and output speed sensor connectors are properly fitted or not.



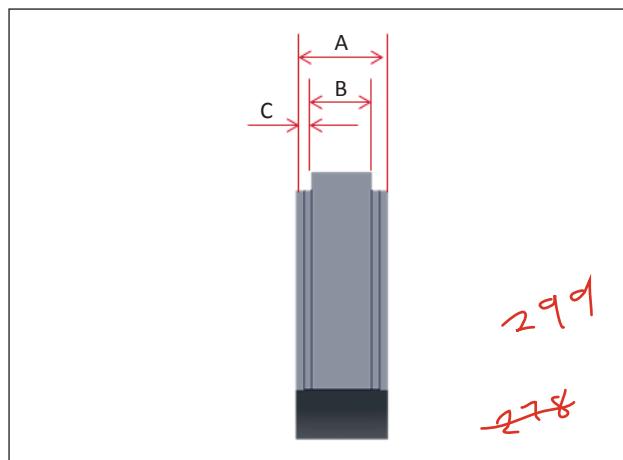
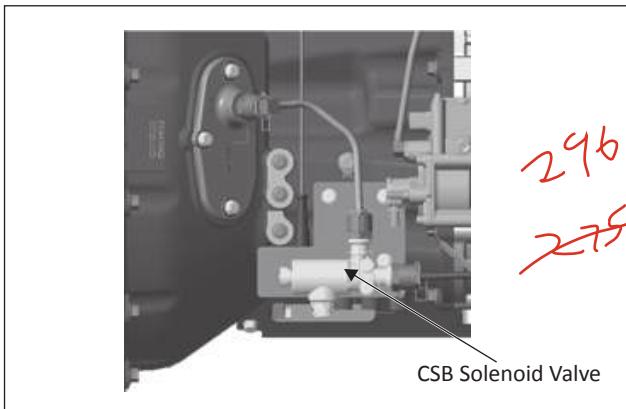
XY actuator- Gear learning failure analysis



- 1 a) Ensure XY actuator orientation as per given CAD image
- 2 b) Check the X1,X2,X3 & X4 connections are proper as per given image
- 3 c) Check for the air pressure between 6.5 to 8 Bar
- 4 d) Check the Shift travel & Select travel are as per design specification though UDT tool (Shift -11 mm ,select -12 mm)

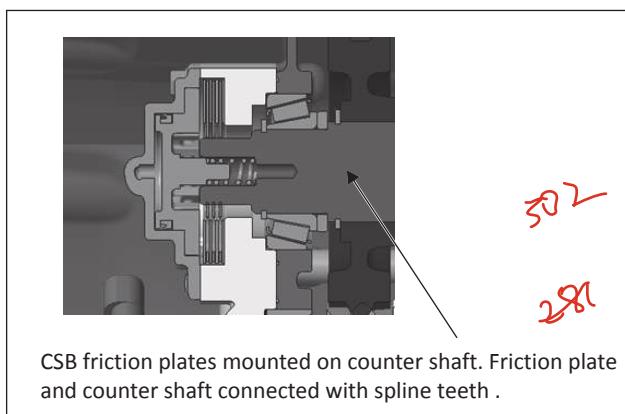
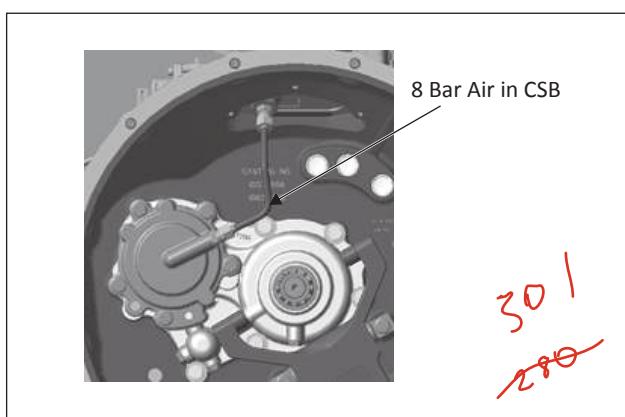
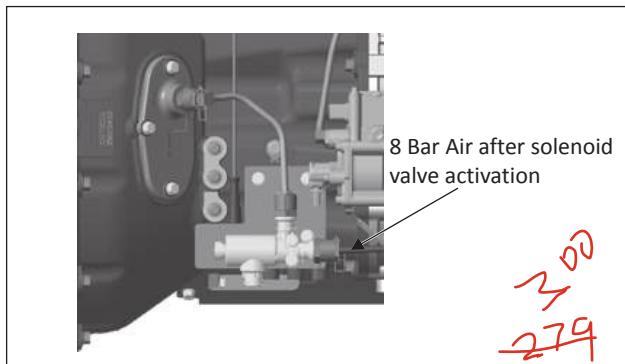


CSB & CSB Solenoid failure analysis

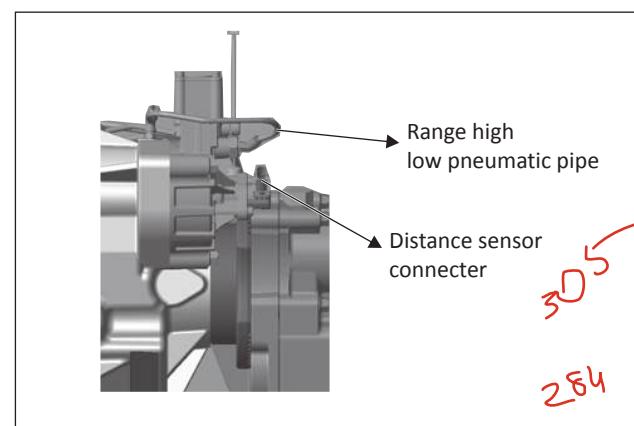
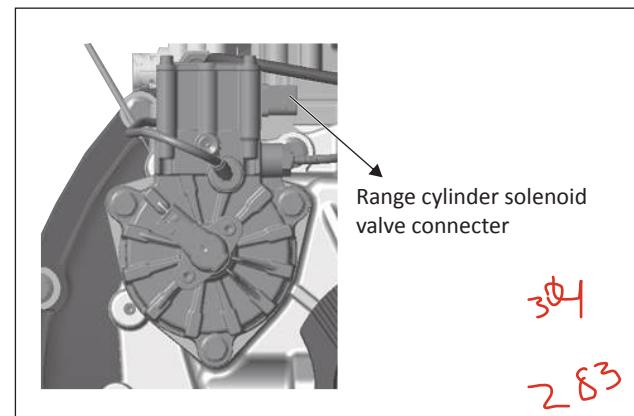
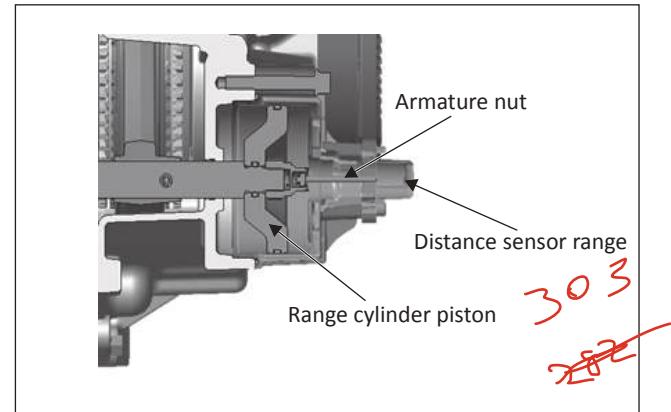


- 1 a) Ensure CSB solenoid valve orientation as per given CAD image
- 2 b) Check the solenoid connections is properly connected .
- 3 c) Check for the input air pressure between 6.5 to 8 Bar
- 4 d) Check no air leakage and no pipe pinching for proper air supply.
- 5 e) Friction Disc thickness in new condition) mm-2.3(+/-0.1). It is recommended to replace friction disc if friction disc thickness became 1.7 mm after wear .

A- Friction plate thickness =2.3(+/-0.1)
 B- Plate thickness =1.5
 C- Friction Material Thickness = 0.4

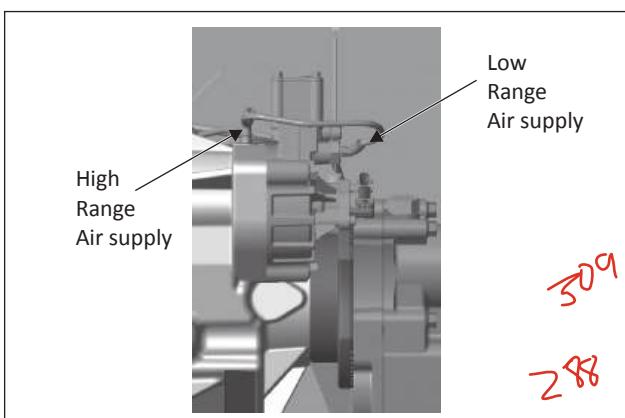
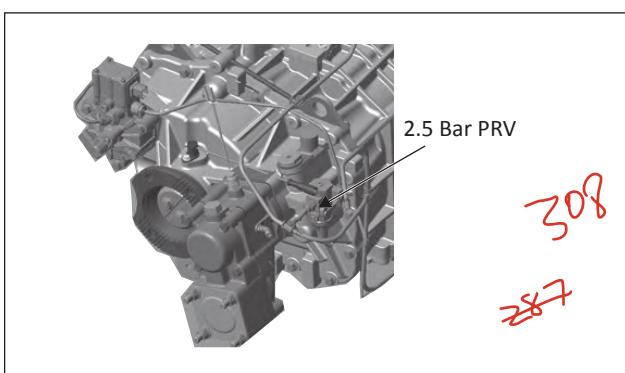
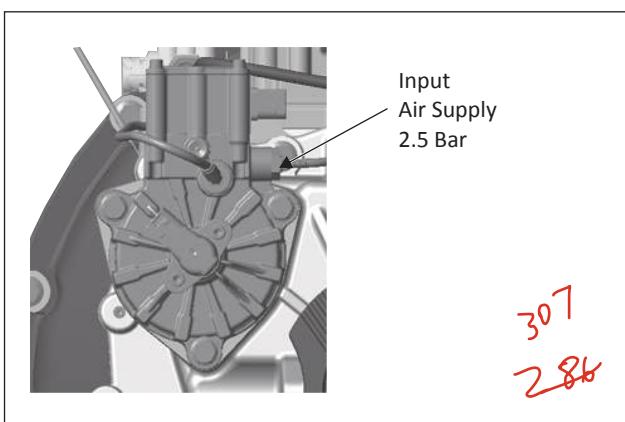
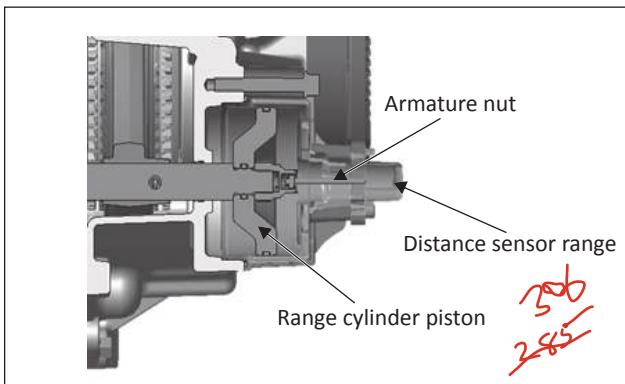
CSB & CSB Solenoid Function**CSB & CSB solenoid Functionality as per below sequence**

- 1** a) Solenoid activated
- 2** b) 8 Bar air activate CSB
- 3** c) CSB brakes counter shaft RPM while shifting

Range cylinder failure analysis

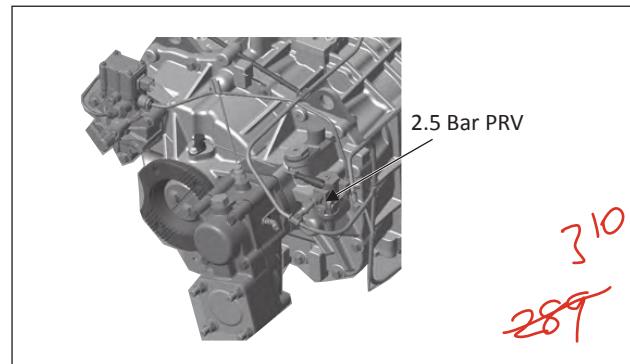
- 1** a) Check and ensure range cylinder valve and distance sensor connection are properly fitted as per given cad image .
- 2** b) Check for the input air pressure 2.5 Bar for range cylinder.
- 3** c) Check no air leakage and no pipe pinching for proper air supply.

Range cylinder Function



- 1 a) 2.5 Bar Air supply through 2.5 Bar PRV mounted on rear cover .
- 2 b) Solenoid valve activation for air supply either for low range or high range .
- 3 c) Distance sensor ensures travel for range selection

PRV



- 2.5 Bar PRV:
- 1 a) Ensure PRV orientation as per given CAD image and 2.5 bar marking before fitment .
 - 2 b) Check the pneumatic connections are properly connected .
 - 3 c) Check for the input air pressure between 6.5 to 8 Bar and output 2.5 Bar
 - 4 d) Check no air leakage and no pipe pinching for proper air supply.