

Mechanical Transmissions

TRSM0004 EN-US

February, 2025

FS(O)-5406

FS(O)-6406



Powering Business Worldwide

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1. General Information

Purpose and Scope of the Manual

This manual is designed to provide detailed information necessary to service and repair Eaton FS(O)-5406 and FS(O)-6406A transmissions.

How to Use this Manual

Disassembly and assembly instructions in this manual make use of a typical FS(O)-X406 transmission. Some illustrations and pictures show parts that may differ from one transmission model to another, according to its application and serial number, but the procedure is the same.

In addition, it is also assumed in the manual that the transmission has been removed from the vehicle and the lubricant has been drained.

The manual has been divided into three sections:

1. *General Information*

This section contains information and technical references of the transmission such as Warnings, Precautions and Care in Disassembly and Assembly, Identification and Designation of Models, Gear Ratios, Tightening Torque and Sealants Specifications, Lubrication, and Special Tools.

2. *Operation*

This section contains information on the transmission operation and functioning: Gear Shift Lever Diagram, Tips for the Driver, Power Flow, and Troubleshooting.

3. *Disassembly and Assembly*

This section contains procedures for disassembling, assembling, and adjusting the transmission components. At the beginning of each procedure, Exploded Views of the set of parts are provided with the identification and description of each part, to make easy its visualization during the procedure.

To disassemble and assemble the transmission completely, carefully follow the instructions in this manual in its natural sequence, making use of the text, illustrations, and pictures provided. Always observe the precautions and recommendations in the manual.

For more detailed information on product improvement, repair procedures, and other subjects related to service, please contact:

Eaton Ltda. - Divisão Transmissões
Pós-venda & Serviços
Rua Clark, 2061 - Caixa Postal 304
CEP 13270 - Valinhos, São Paulo - Brasil

SAC 0800 170 551
www.eaton.com.br
pecasouvidor@eaton.com

NOTE: Eaton reserves the right to make modifications in its products and to change specifications included in this manual at any time without previous notice.

Warnings and Precautions



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

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

Before towing the vehicle, place the transmission in neutral and lift the rear wheels off the ground, or disconnect the cardan shaft to avoid damage to the transmission during towing.

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

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

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



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

Ignoring instructions, choice of tools, materials and recommended parts indicated in this publication can endanger the maintenance technician or vehicle operator's safety.

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

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

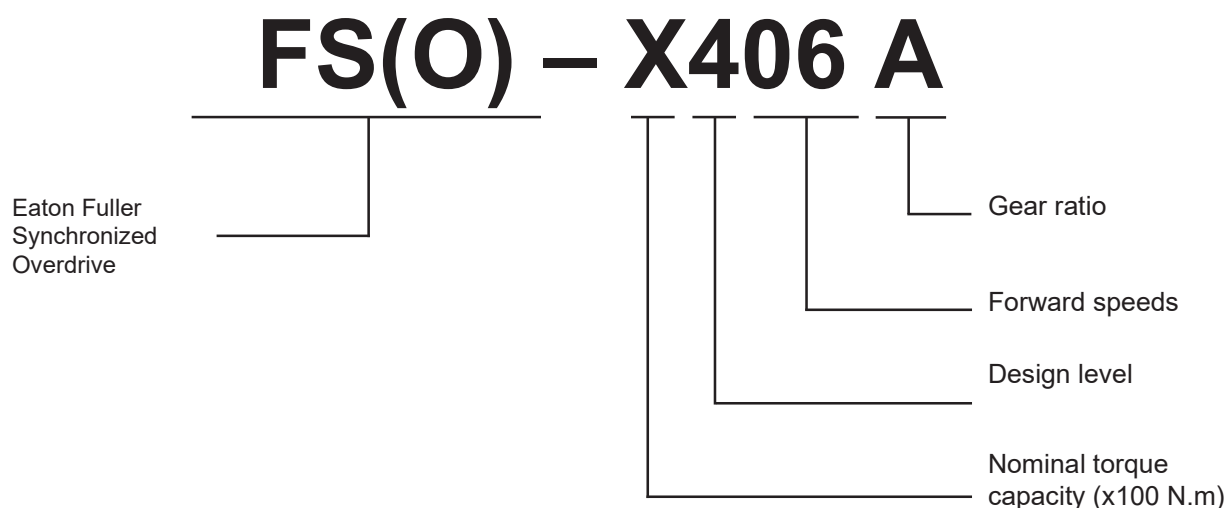
NOTE: Additional service information not covered in the service procedures.

TIP: Suggestions for useful procedures to assist in the service of the unit.

Always use genuine Eaton replacement parts.

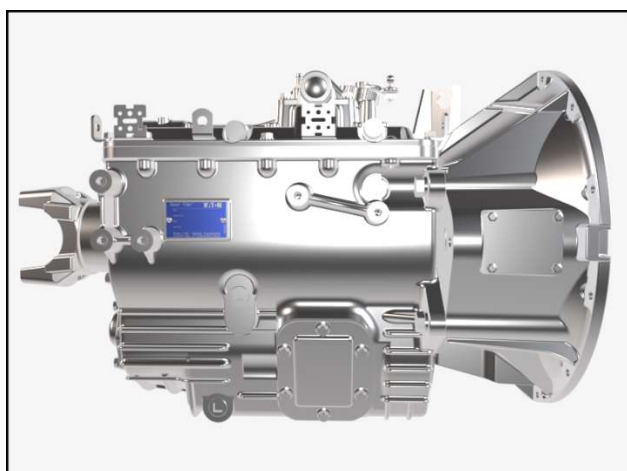
Model Designation

All Eaton transmissions are identified by the model designation and serial number. This information is stamped on the identification plate fixed to the transmission case.



WARNING! Do not remove or destroy the transmission identification plate.

NOTE: When ordering replacement parts or calling for service support, please inform numbers found in the identification plate.



Gear Ratio

		FS(O)-5406A		FS(O)-6406A	
Torque	N.m	700		780/900	
	Lb.ft	516		575/664	
		Z	Ratio	Z	Ratio
Input torque	Input Shaft (I)	28	1.50	28	1.50
	Countershaft (C)	42		42	
1 st	Countershaft (C)	10	7.05	10	7.05
	Main Shaft (M)	47		47	
2 nd	Countershaft (C)	16	4.13	16	4.13
	Main Shaft (M)	44		44	
3 rd	Countershaft (C)	28	2.52	28	2.52
	Main Shaft (M)	47		47	
4 th	Countershaft (C)	33	1.59	33	1.59
	Main Shaft (M)	35		35	
5 th	Countershaft (C)	Direct	1.00	Direct	1.00
	Main Shaft (M)				
6 th	Countershaft (C)	48	0.78	48	0.78
	Main Shaft (M)	25		25	
Reverse	Countershaft (C)	10	6.75	10	6.75
	Reverse Idle Gear (R)	21		21	
	Main Shaft (M)	45		45	

Z = Number of teeth

C = Countershaft

M = Main Shaft

R = Reverse Idle Gear

I = Input Shaft

Definition and Calculation

Gear ratio of a transmission speed is the relationship between the transmission's output and input speeds, with the said gear shifted. If the gear ratio is greater than 1, it means that the transmission's output speed is slower than the input speed and it is said that there is a reduction in the speed. On the other hand, if the gear ratio is less than 1, the transmission's output speed will be faster than the input speed and, in this case, it is said that there is an overdrive.

The gear ratio is calculated by dividing the number of teeth of the driven gear by the number of teeth of the driving gear of that specific speed and multiplying by the ratio of the input gear set.

Example:

Input gear ratio = C ÷ I (input gear set) = 42 ÷ 28 = 1.5

1st speed ratio = M ÷ C (1st speed) x 1,5 (input gear set) = 47 ÷ 10 x 1,5 = 7.05

This means that the 1st speed gear ratio is 9.01:1 or, in other words, with the transmission shifted into the 1st speed, the engine (input shaft) makes 7.05 revolutions for every revolution of the transmission's output shaft. So, in 1st gear, there is a reduction in the output speed.

Lubrication

Proper lubrication procedure is the key to a good and complete maintenance program.

If the oil is not doing its job, or if the oil level is ignored, all the other possible maintenance procedures will not be enough to keep the transmission running or to assure a long transmission life.

Eaton transmissions are designed so that all the internal parts operate in an oil circulating bath, created by the motion of gears and shafts. Thus, all parts are properly lubricated if the following procedures are closely followed:

1. Maintain proper oil level by checking it regularly;
2. Change oil regularly following the maintenance interval chart;
3. Use the recommended grade and type of oil;
4. Buy the oil from a reputable dealer.

Oil change and level check

Periodic transmission oil change eliminates possible bearing failures, ring wear and seizures, since the products from normal wear in service (tiny metal particles), which circulate in the transmission oil, are harmful to these parts.

In addition, the oil changes chemically due to the repeated heating and cooling cycles of a transmission in use.

As a general guide, the following chart provides the interval recommendation for oil level check and oil change.



WARNING! Always follow the vehicle manufacturer maintenance recommendation, which prevails over this chart.

	Lubricant Oil	Service Type	Oil Change Interval	Check oil level every
FS(O)-5406A	• SAE 40 • SAE 50	Highway	100,000 km	10,000 km
		Vocational	50,000 km or 2 years or 5,000h	7,500 km
		Bus	50,000 km or 2 years or 5,000h	50 hours
FS(O)-6406A	• SAE 40 • SAE 50	Highway	100,000 km	10,000 km
		Vocational	50,000 km or 2 years or 5,000h	7,500 km
		Bus	50,000 km or 2 years or 5,000h	50 hours

NOTE:

- The oil must be changed on the recommended mileage or time interval, whatever occurs first.
- Daily, check the transmission for lubricant oil leaks and make the proper repairs when necessary.

Oil draining

It is essential to drain the transmission while the oil is hot.

To drain oil, remove the magnetic drain plug. Clean the drain plug before reinstalling it.

Oil refilling

Oil level check

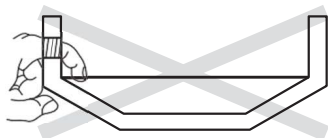
Before checking oil level, clean case area around filler plug and if necessary, add enough oil to maintain the proper oil level.



WARNING! Do not mix lubricant of different types and brands, as this may cause incompatibility issues.



Correct Oil Level



Incorrect Oil Level

6106/02

Clean the case area around oil filler plug, remove the plug, and refill the transmission until the lubricant level is aligned with the bottom of the filler plug hole.

The oil volume varies depending on the inclination of the transmission in relation to the chassis and the inclination of the vehicle in relation to the ground. To complete the level, the vehicle must be on a flat, horizontal surface.

NOTE: Do not add oil above the recommended level. This will cause the oil to be forced out through the front bearing cover, control cover, shift lever cover, etc.

Tightening Torques and Sealants

The correct application of adhesives and sealants is important to assure a proper assembly and to avoid leakages.

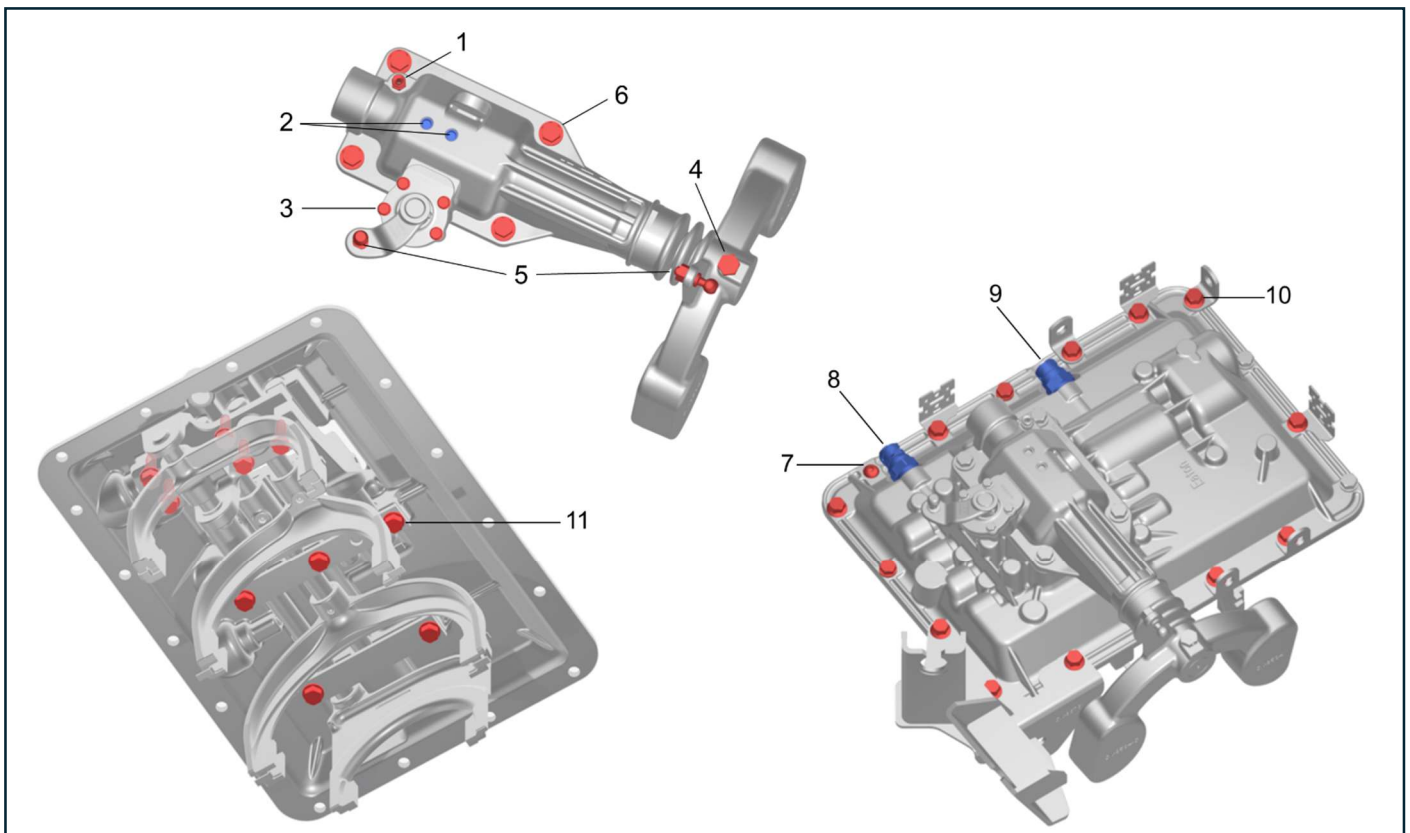
Tightening capscrews, plugs, and nuts to the proper torque is important to prevent them from loosening and to avoid oil leakage, assuring a long transmission life. Additionally, use the recommended threadlocker.



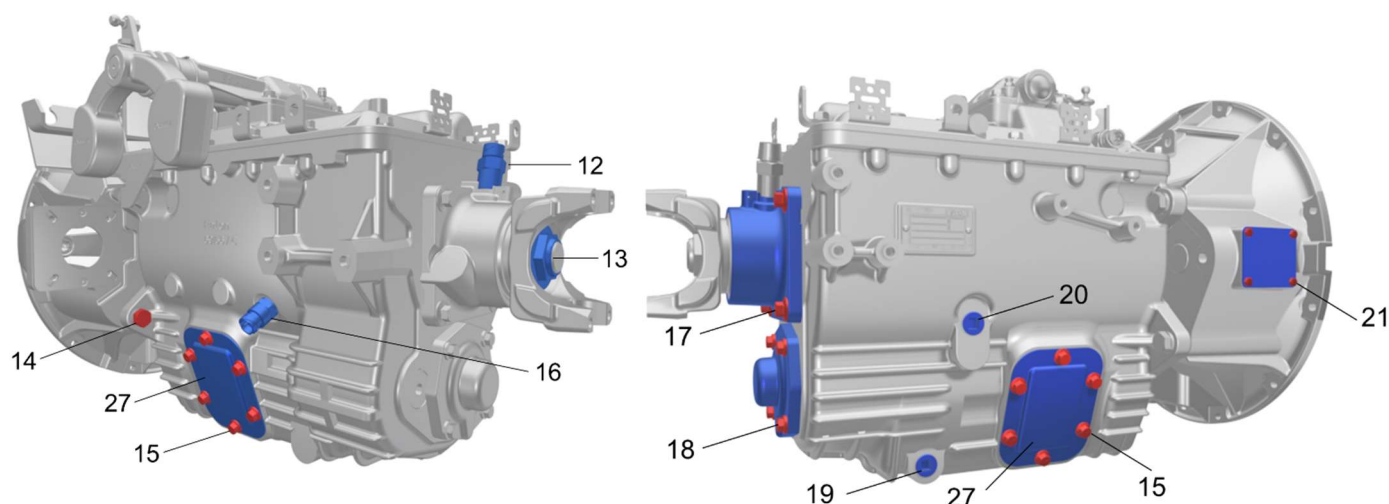
WARNING! Always use a torque wrench to obtain the recommended torque.

The following table shows the recommended torques and sealants for the transmission's fasteners and components.

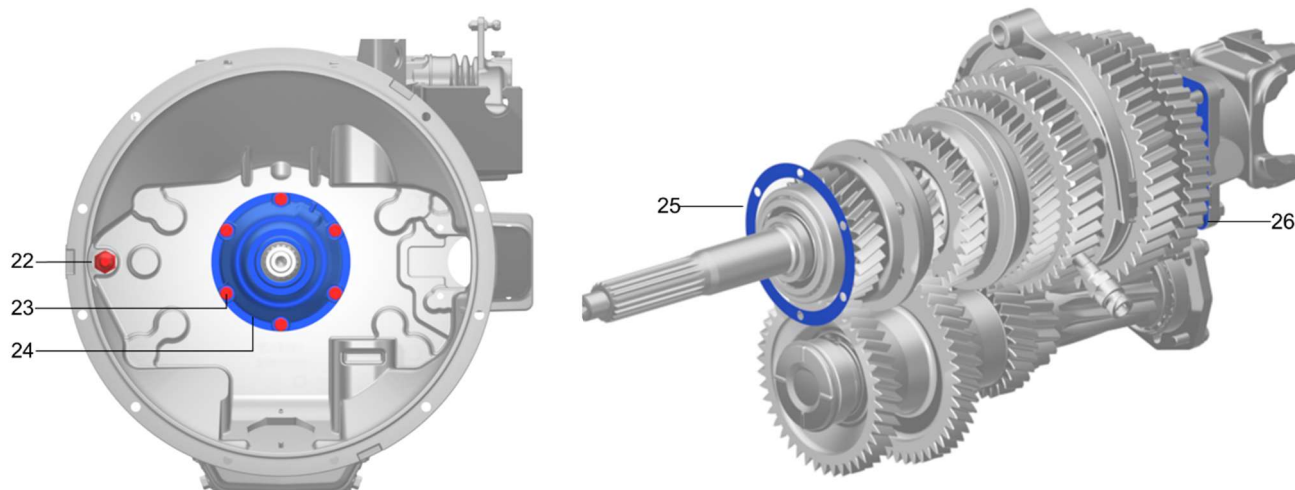
In the table, the item number corresponds to the number of the part in the exploded views included in this manual. Please refer to the exploded views to identify the item in the table.



Item	Number	Description	Torque N.m (Lb.ft)	Remarks
1	3315948	Breather		Conical thread, light tightening until locking
2	6716(2x)	Expansion plug		Apply Dow Corning 780 or Loctite 61
3	3362072(4x)	Tower cover PF	4-7 (2.9-5)	Apply Loctite 262 to the screws threads
4	3220	7/16 - 20 UNF - 3A	50-55 (36-40)	
5	3343860(2X)	Spherical pin	19-25 (14-18)	At the thread
6	X-8C-604(4x)	PF M10 x 1.5 x 25	19-26 (14-19)	Apply Loctite 262 to the screws threads
7	30032146	PF	25-30 (18-22)	
8	A0015459409	Neutral sensor	21-27 (15-20)	Apply Loctite 518
9	3004078	Reverse light switch	21-27 (15-20)	Apply Loctite 518
10	X-8-688(11x) and X-8C-600(5x)	PF 3/8 - 16 x 1	48-61 (35-45)	Apply Loctite 262 to the screws threads
11	X-8-6110 (5X) and 233043 (5x)	PF 3/8-16 x 1-1/4 and 3/8-16 x 1	28-33 (20-25)	Apply Loctite 262 to the screws threads



Item	Number	Description	Torque N.m (Lb.ft)	Remarks
12	3344636	Speed sensor	30-40 (22-29)	
13	4304690	Thread	644-711 (475-524)	Apply
14	X-8-1011(4x)	PF 5/8-11x2-1/4	196-224 (144-165)	Apply Loctite 262 to the screws threads
15	239613(12x)	PF 3/8-16	47-61 (34-45)	Apply Loctite 262 to the screws threads
16	A0125424217	Rotation sensor	21-27 (15-20)	Apply Dow Corning 780
17	3004440	PF 1/2" - 13 UNC	82-94 (60-69)	
18	X-8C-604(4x)	PF 3/8-16X1-1/4	48-54 (35-40)	Apply Loctite 262 to the screws threads
19	226858	3/4 drain plug	30-41 (22-30)	
20	5580140	Filling plug	34-47 (25-34)	
21	1CM612P(4x)	PF M6x1.2x10		



Item	Number	Description	Torque N.m (Lb.ft)	Remarks
22	3361453	Spherical pin		
23	239614(6x)	PF 5/16-18x .81	21-23 (15-17)	
24	3313360	Retainer cap Input Shaft Bearing		
25	3315659	Retainer cap gasket of the Input Shaft Bearing		
26	3315662	Shim - 0.102 MM		

Recommended threadlocker and sealant

Threadlockers:

- Loctite 262
- Loctite 570 (Eaton E677)

Adhesive and Sealants:

- Dow Corning 780

Chemical adhesives can fulfill more than one function:

1. Thread locking, which prevents loose screws by vibration or improper torque.
2. Screw lock and seal, preventing loose screws while ensuring that no lubricant leakage will occur through the holes.
3. Sealing gasket between contact surfaces, replacing gaskets made of other materials and reducing the number of spare parts.

Applying threadlockers onto bolts and plugs

To apply properly:

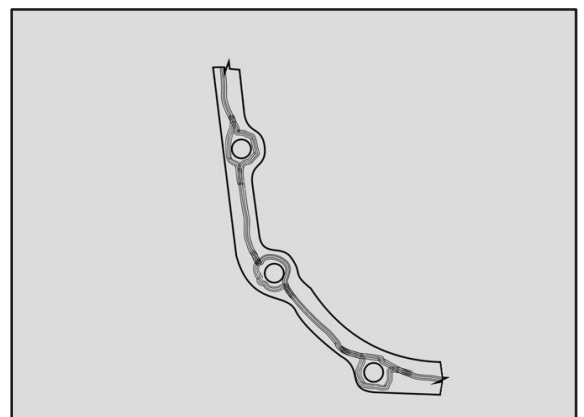
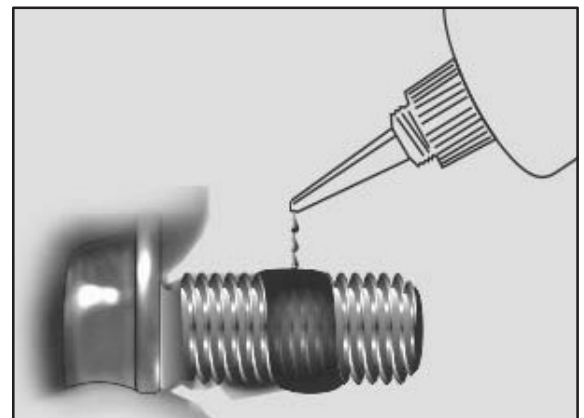
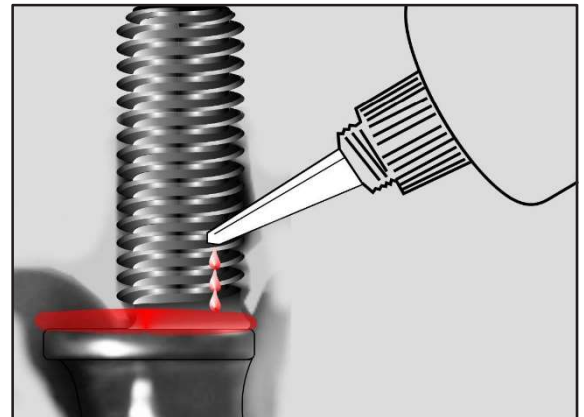
- Remove all traces of previous adhesive from the hole thread. Clean up threads with a tap and remove cutting chips with compressed air.
- Clean the screw and its hole with alcohol. Wait for the alcohol to dry on the screw and apply compressed air into the hole to dry it completely.
- Apply adhesive (threadlocker) on the screw thread in the central area that will be housed into the threaded hole, covering 3 or 4 fully continuous fillets to ensure that no leakage will occur.



WARNING! When using compressed air, wear safety glasses and ear plugs.

Applying sealant onto the contact surfaces

- The surfaces that will receive the application of sealant or adhesive must be perfectly clean and free of oil or oxidation and must not contain particles that could damage the seal. Thoroughly clean signs of old sealant and dirt from surfaces.
- When recommended, apply sealant onto the bolt and plug contact surface with the transmission case or covers.
- On the contact surface of transmission cases, apply a continuous sealant string along the surface and around the capscrew holes and dowel pins.
- Dow Corning 780 sealant cannot remain exposed to the air for more than 15 minutes; perform the parts assembly within this time.



Precautions during disassembly and assembly



When assembling the transmission, it is important to lubricate gear bearings, needle roller bearings, non sealed bearings, and all other parts under friction conditions, with the lubricant that will be placed inside the transmission, in order to prevent damage to transmission parts during initial gear movement.

Cleaning and handling

In order to completely clean the parts, wash them into a bath of solvent (kerosene, for instance), moving every part up and down slowly until all the old lubricant and foreign material have been dissolved.



Care must be taken to avoid skin rashes, fire hazard, and vapor inhalation when using solvents.

Non sealed bearings

Immerse the bearings in clean solvent. Move them up and down slowly in order to loosen the deposits. Dry the bearings by means of moisture free compressed air, without driving the air jet in the direction of rotating the bearing at high speed. Repeat the operation until the bearings are thoroughly clean.



Never drive the air jet in the direction of rotating the bearing at high speed. That can damage bearings.

Synchronizer assemblies

Precautions during disassembly and assembly

Avoid bad handling of synchronizer assemblies. Either drops or bumps when disassembling or assembling may cause them to lock.

Housings

Clean the interior and exterior of cases, covers, etc., thoroughly. Die cast parts can be cleaned in soluble oil tanks. The parts are to remain in the bath for the time it takes to become completely clean. The parts cleaned in tank solutions should be rinsed with clean water to remove any alkaline trace after cleaning process.



Care must be taken to avoid vapor inhalation and skin rashes when using alkaline solutions. Every cleaned part must be totally dried at once by means of moisture free compressed-air or lint free soft cloth, not containing any abrasive material such as metal filings, contaminated oil, or polishing compounds.

Inspection

A thorough and careful inspection of each part is very important for the transmission life. The replacement of parts showing either wear or fatigue will avoid future expensive and foreseen failures.



Gears, shafts, and synchronizer assemblies

Check carefully all gear teeth for wear, pitting, chipping, and cracks. If gear teeth show areas where the case hardening is worn through or cracked, the gear should be replaced with a new one.

Check shafts for warping and excessive wear or damaged splines.

Cases, covers, etc.

Make sure cases, covers, etc. are completely clean and that contact surfaces and bearing bores are free from nicks or burrs. Check carefully every part for cracks, excessive wear, or any other condition that may cause oil leak or a future failure.

Needle roller bearings

Check carefully every roller for wear, pitting, cracks, or spalled areas to determine whether they are suitable for continued use. After inspection, dip the needle roller bearings in an oil bath and then wrap them in a lint-free cloth or paper, so as to protect them until they are ready for assembling.

Oil seals, snap rings, and snap pins

Any oil seal, snap ring, etc. damaged during maintenance, should be replaced with a new one. Replacement of oil seals and snap rings is cheaper when the transmission is disassembled than a premature overhaul to replace these parts in a future time.

Oil leakage through a worn seal may result in failures of other more expensive components of the transmission. The sealing elements should be handled carefully, particularly during assembly. Cuts, scratches, or rolled up seal lips decrease the sealing efficiency.

NOTE: *When assembling the transmission, apply petroleum jelly onto oil seal lips.*

Precautions during disassembly and assembly

Parts replacement

When replacement is necessary, use only genuine Eaton transmission parts to assure continued performance and extended life from the transmission. The use of either non-genuine or remanufactured parts, besides not having the factory's warranty, may lead to severe damage to the unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, do not reuse a questionable part which could lead to additional repairs and expense soon after assembly.

To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the transmission's history, the vehicle's mileage, application, etc.



Special Tools

Throughout this manual, several transmission maintenance procedures are performed using special tools specifically recommended for this purpose.

These special tools are required for properly servicing the transmission and its use will prevent damages to the transmission and its components.

In addition, the use of these tools is important to prevent personal injuries and to preserve the safety of the service provider.



WARNING! Following the disassembly and assembly instructions and using the recommended special tools in this manual are important to prevent personal injuries and/or damage to the transmission and its components.

Special tools can be ordered directly from the approved manufacturer:

Especifer Industria e Comércio de Ferramentas Ltda.

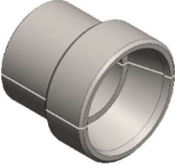
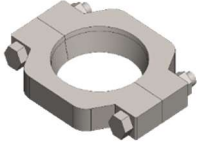
Av. Horst Frederico João Heer, 1945 - Galpão B

Europark Comercial - CEP 13348-578

Indaiatuba, São Paulo - Brasil

Phone: +55 19 3936-9797

www.especifer.com.br

Code	Tool	Description
E005017 (use with E005014)		BEARING CONE PULLER - MAIN SHAFT (6TH GEAR SIDE - POCKET)
E005021 (use with E005014)		BEARING CONE PULLER - COUNTERSHAFT (REVERSE SIDE)
E005020 (use with E005014)		BEARING CONE PULLER - MAIN SHAFT (REVERSE SIDE)
E017014		BEARING CONE PULLER - INPUT SHAFT
E005019 (use with E005014)		BEARING CONE PULLER - COUNTERSHAFT (DRIVEN GEAR SIDE)
EEA-17136 (use with E001082)		BEARING CAP PULLER OF THE BEARING RETAINING COVER OF THE INPUT SHAFT
E012010		MAIN SHAFT REAR BEARING RETAINER COVER PULLER KIT (2 CLAWS)
E005014		EXTRACTION SPINDLE
E003003 OPTIONAL		HEAVY IMPACT SLIDE HAMMER
E017015 (use with E005018)		BRACKET FOR EXTRACTING REVERSE PIN

Code	Ferramenta	Description
E005018 (use with E017015)		EXTRACTOR ROD
E001084		INPUT SHAFT FRONT COVER SEAL AND MAIN SHAFT BEARING CONE INSTALLER "POCKET"
E001082 (use with EEA-24001)		FRONT RETAINING CAP BEARING CAP INSTALLER
E001083 (use with EEA-24001)		REAR RETAINING CAP BEARING CAP INSTALLER
E001085 (use with EEA-24001)		MAIN SHAFT REAR COVER SEAL INSTALLER
E006012 (use with EEA-24001)		MAIN SHAFT REAR BEARING COVER SEAL INSTALLER
EEA-24001		UNIVERSAL CABLE FOR INSTALLERS
E010020		INPUT SHAFT BALL BEARING INSTALLER
E010021		COUNTERSHAFT BEARING INSTALLER (REVERSE SIDE AND DRIVEN GEAR)
E010019		MAIN SHAFT CONICAL BEARING INSTALLER (REVERSE SIDE)

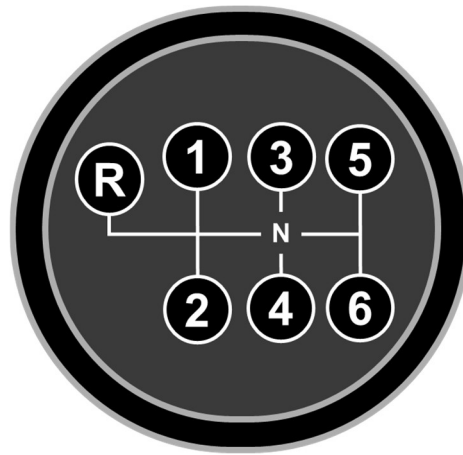
2. Operation

Gear Shift Lever Pattern

FS(O)-5406A and FS(O)-6406A transmissions have six forward synchronized speeds and one reverse speed.

To shift into speeds, follow the shift pattern shown in the diagram.

An interlocking device prevents accidental transmission shifting to reverse gear. To shift into the reverse gear, put shift lever at the position, push it down, and complete the shifting.



Tips for the Driver

Always use the clutch to change gears. The incorrect use of the clutch may cause premature failures of the synchronizer assembly.

Always select a starting gear that will provide sufficient power (torque) for the vehicle's working condition (terrain).

Never slam or jerk the gear shift lever to complete gear shifting.

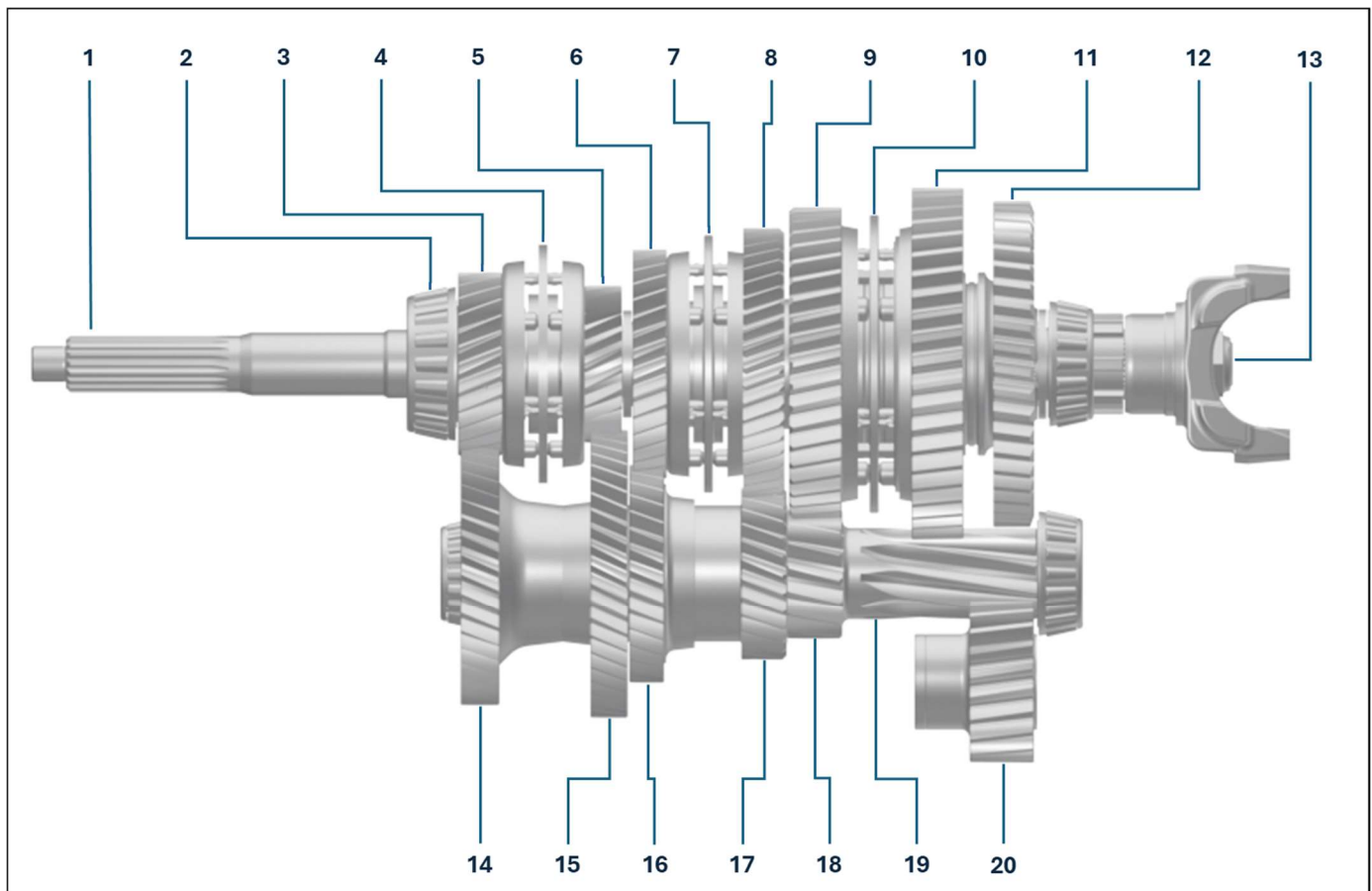
Never leave the shift lever in the neutral position when going downhill.

Power Flow

The transmission must efficiently transfer the engine's power or torque to the vehicle's driveline.

It is important to know what happens in the transmission during this transfer in order to carry out an effective troubleshooting or when repairs are needed.

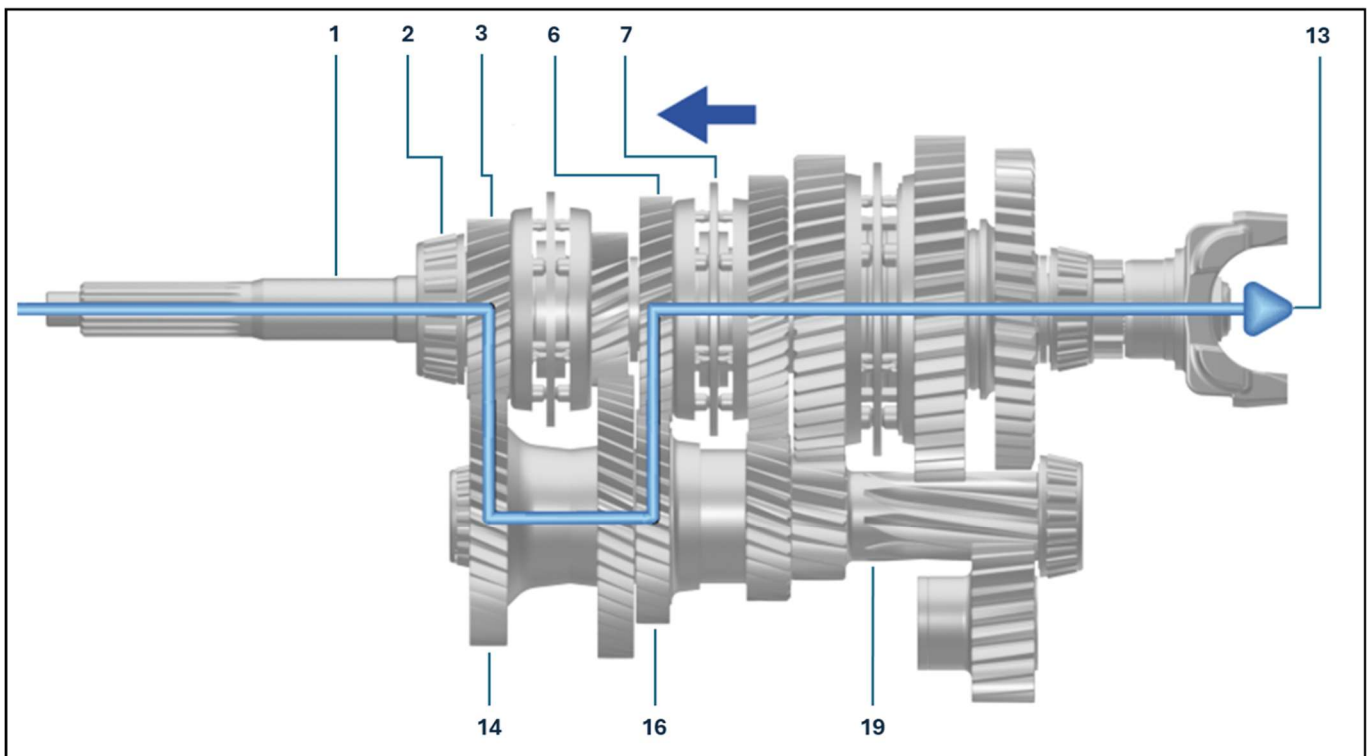
Identification of Gears and Synchronizers



- | | |
|--|--|
| 1. Input shaft | 11. 1 st /2 nd speed synchronizer gear |
| 2. Main shaft "pocket" bearing cone | 12. Main shaft reverse speed gear |
| 3. Input shaft drive gear | 13. Main shaft |
| 4. 5 th /6 th speed synchronizer assembly | 14. Countershaft driven gear |
| 5. Main shaft 6 th speed gear | 15. Countershaft 6 th speed gear |
| 6. Main shaft 4 th speed gear | 16. Countershaft 4 th speed gear |
| 7. 3 rd /4 th speed synchronizer assembly | 17. Countershaft 3 rd speed gear |
| 8. Main shaft 3 rd speed gear | 18. Countershaft 2 nd speed gear |
| 9. Main shaft 2 nd speed gear | 19. Countershaft |
| 10. 1 st /2 nd speed synchronizer assembly | 20. Reverse Idle gear |

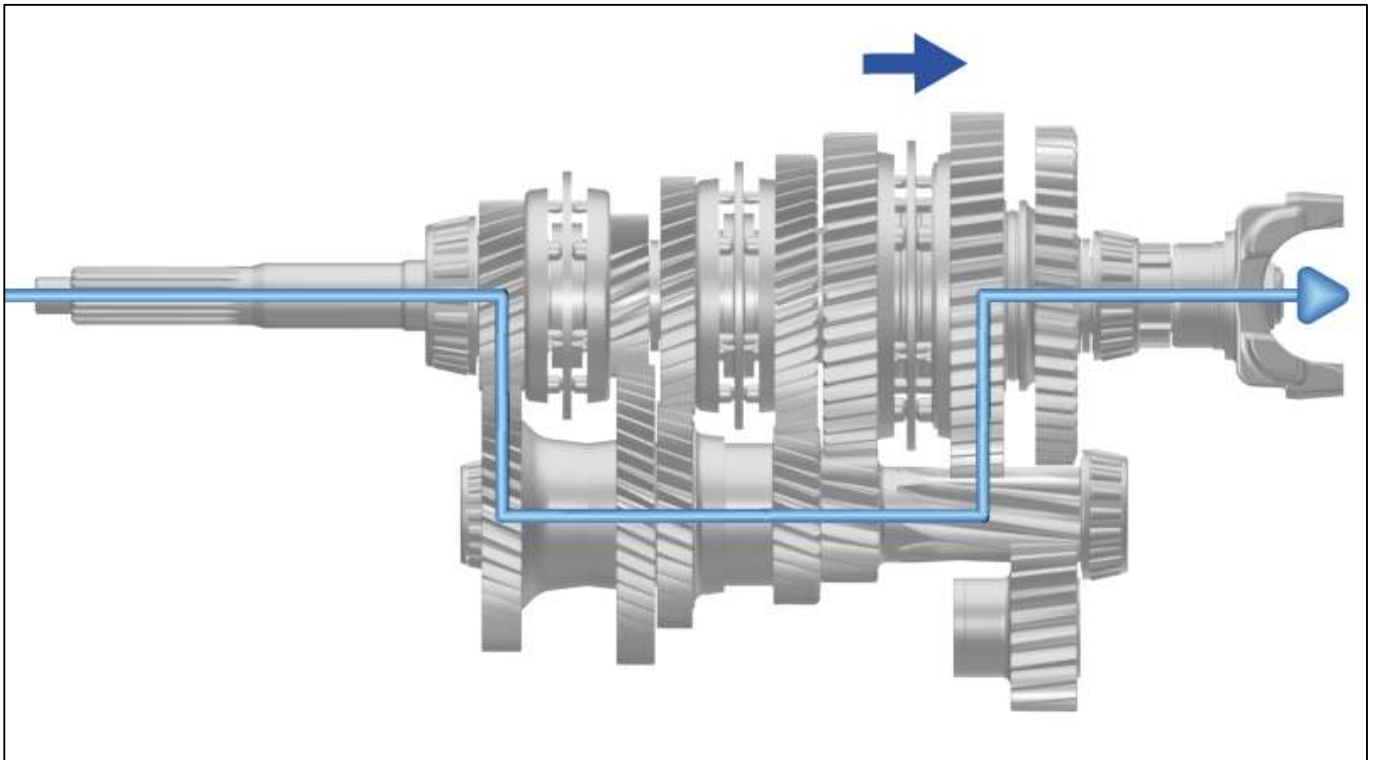
How the transmission works

1. Torque from the engine is transferred, through the clutch, to the transmission's input shaft (1). The direction of the rotation is the same as of the engine, always clockwise.
2. From the input shaft, the torque is transferred to the countershaft driven gear (14) through the input shaft drive gear (3), performing the first reduction in the transmission. All gears on the countershaft (19) rotate attached to this shaft at the same speed and the direction of the rotation is counterclockwise.
3. The input shaft (1) rotates apart from the main shaft (13) in order to transmit power to the countershaft (19) independently of the main shaft. Between these two shafts there is a conical bearing (2) known as "pocket", installed on the main shaft end and supported on the input shaft, which allows both shafts to rotate at different rotation speeds.
4. The torque along the countershaft (19) is transmitted to all the gears of the main shaft (13), assembled on needle roller bearings. Each gear on the main shaft rotates at a different speed, according to the gear ratio of that specific shifted speed (see Gear Ratio table in the General Information section).
5. When a forward speed is shifted (the example in the figure shows the 4th speed), the torque is transferred to the main shaft (13) by the corresponding gear (6) of that shifted speed, through the synchronizer (7) spline that is actuating. At this point, the second reduction occurs inside the transmission. In the forward speeds, the direction of rotation of the main shaft is always clockwise.

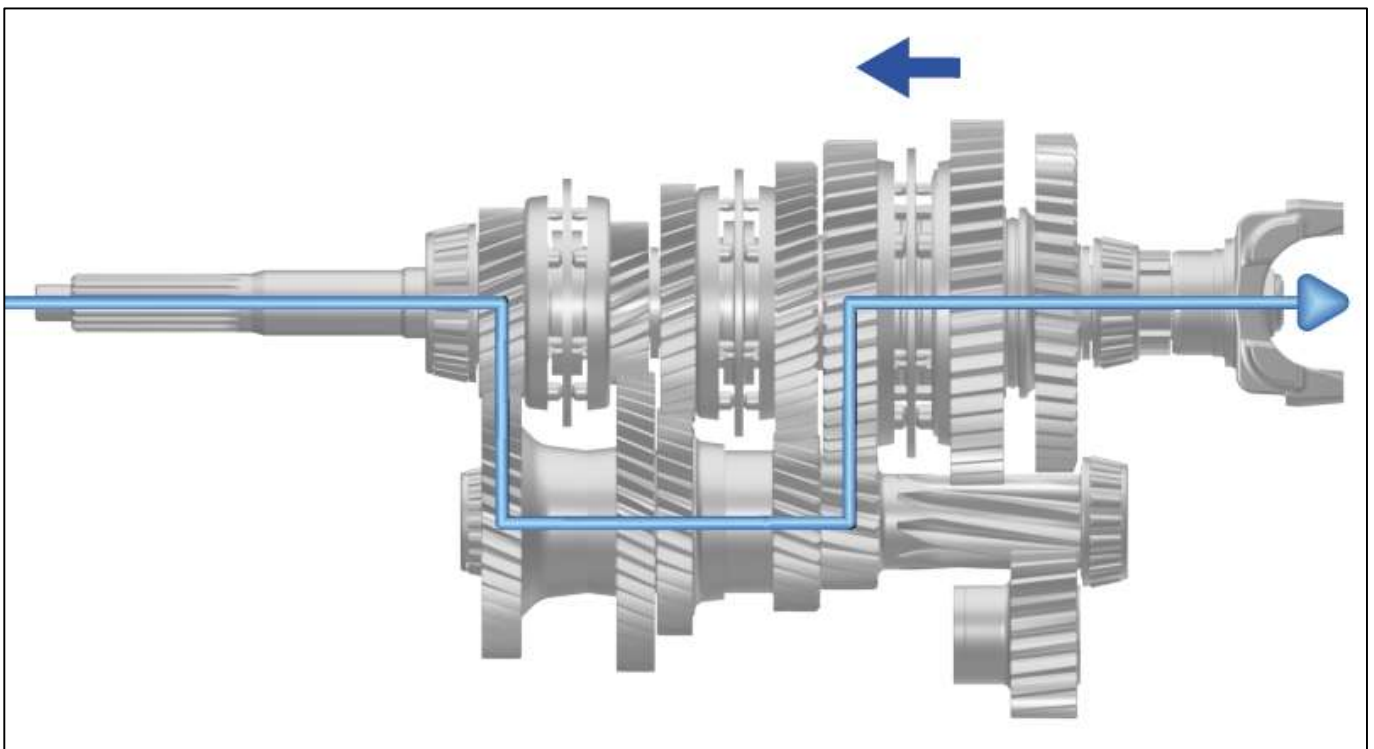


- | | |
|---|---|
| 1. Input shaft | 13. Main shaft |
| 2. Main shaft "pocket" bearing cone | 14. Countershaft driven gear |
| 3. Input shaft drive gear | 16. Countershaft 4 th speed gear |
| 6. Main shaft 4 th speed gear | 19. Countershaft |
| 7. 3 rd /4 th speed synchronizer assembly | |

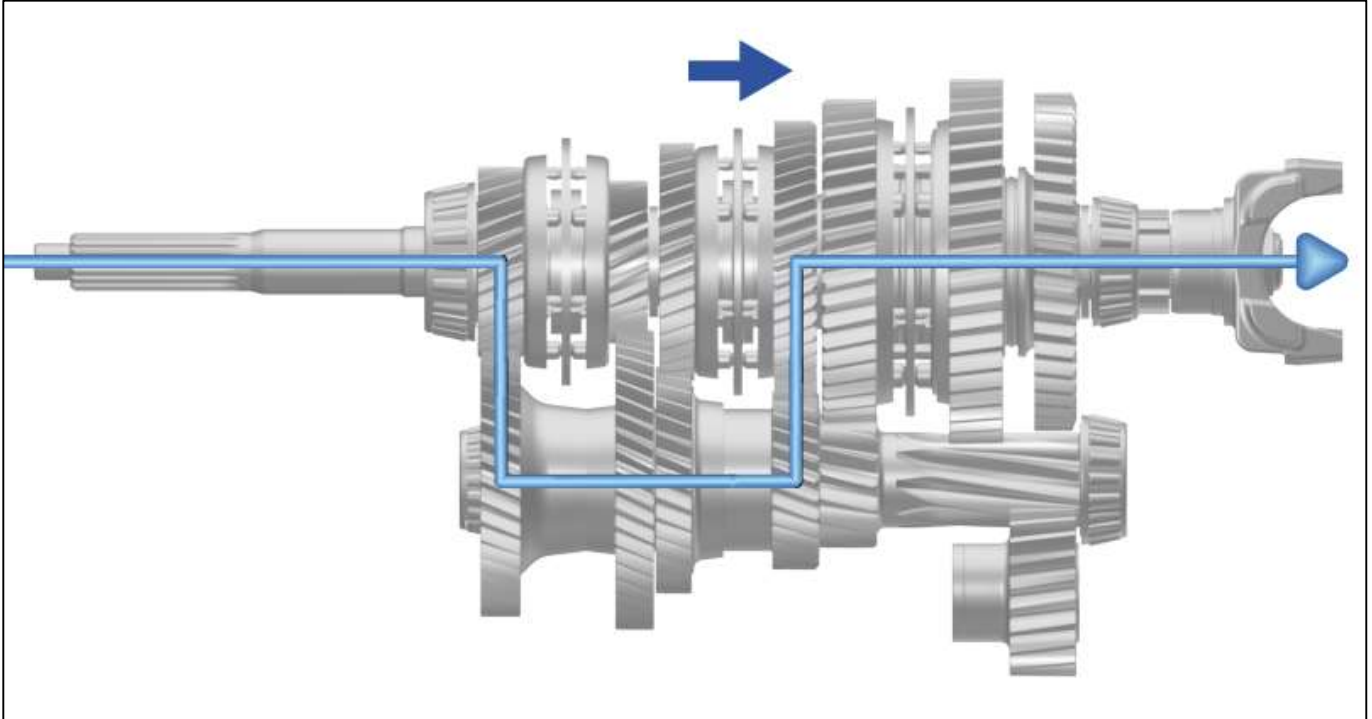
1st Speed



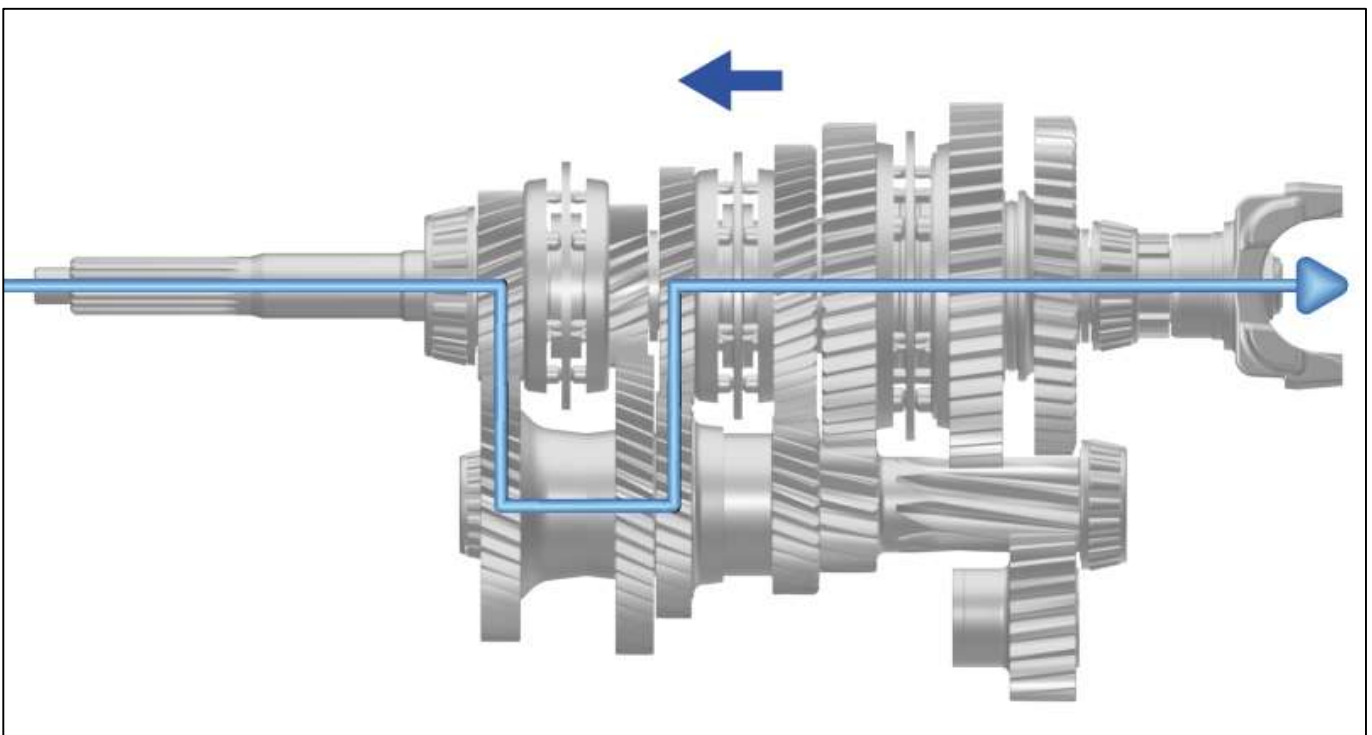
2nd Speed



3rd Speed



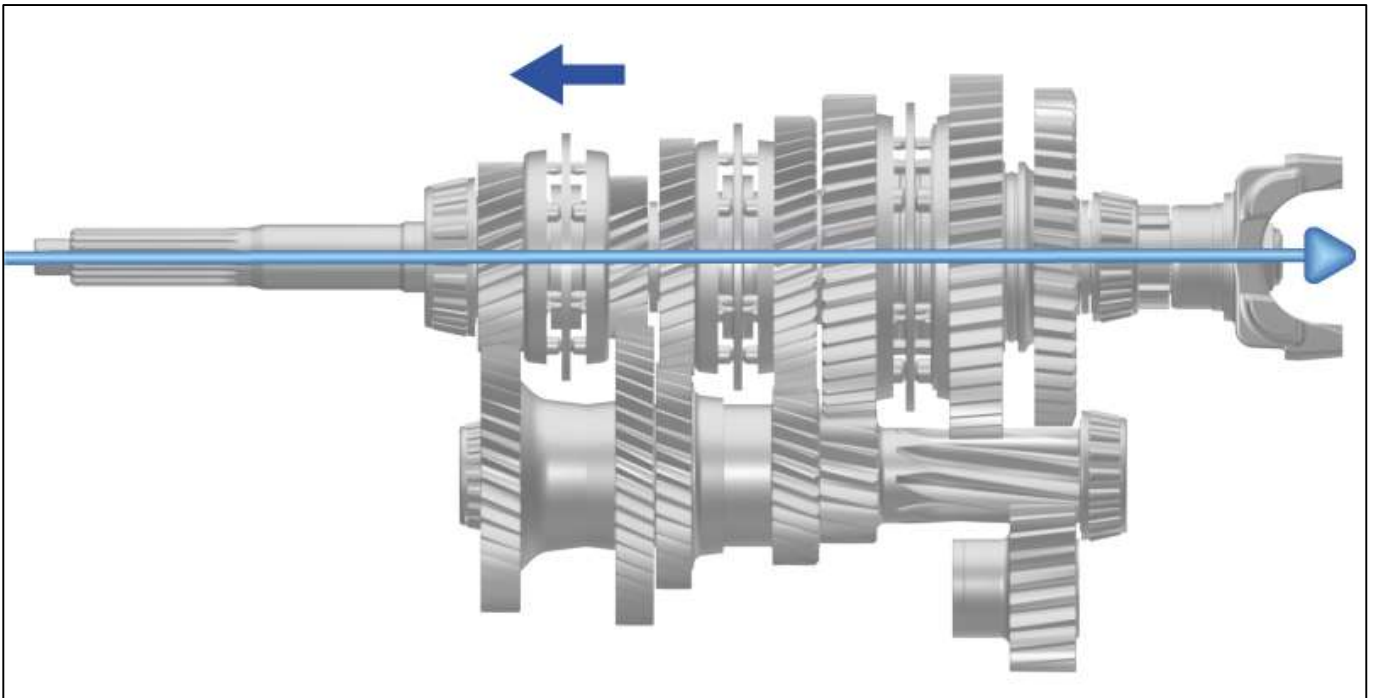
4th Speed



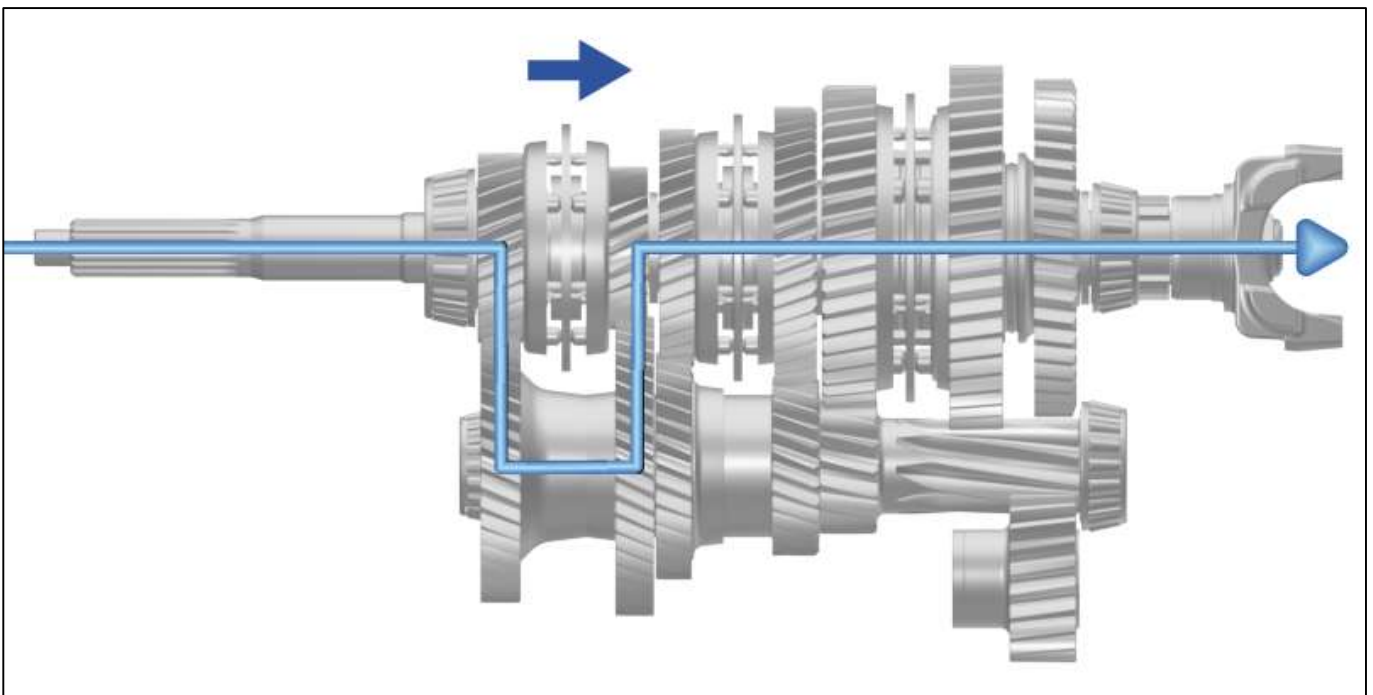
5th Speed

The 5th speed in this transmission is a direct drive speed. This designation is due to the fact that in this speed the input shaft, although it drives the countershaft together, transfers the engine torque directly to the main shaft, without any gear reduction.

The coupling teeth of the pilot shaft mesh with the coupling teeth of the 5th speed synchronizer which, in turn, transfers the torque to the main shaft. Everything happens as if it were a single shaft.

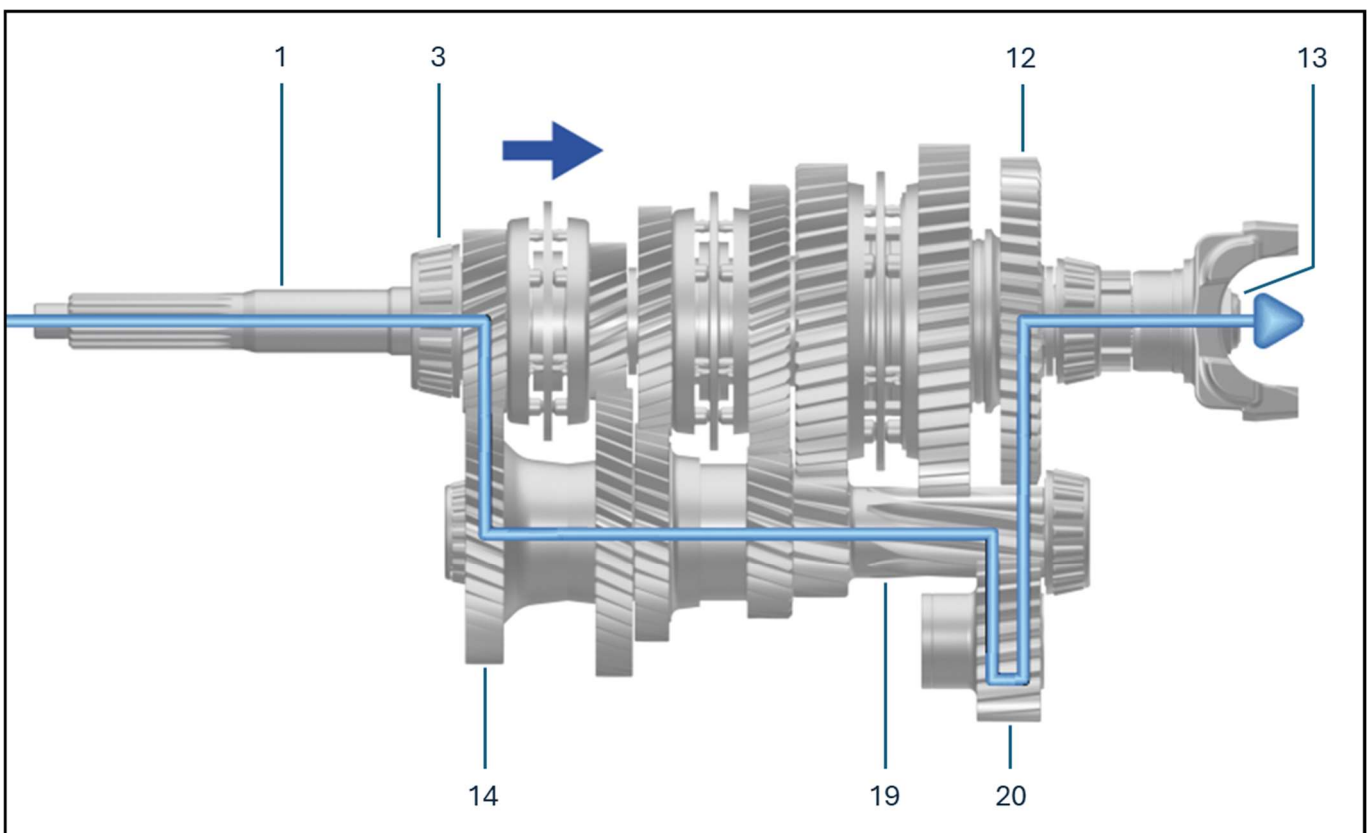


6th Speed



Reverse Speed

1. When the reverse speed gear is shifted, the torque is transferred from the input shaft (1) to the countershaft (19) performing the first reduction (3 and 14) of the reverse speed.
2. The torque is then transferred from the countershaft (19) through the reverse gear of the countershaft (19) to the intermediate reverse gear (20), (pair 19 and 20) of this speed, and finally, the torque is transferred from the intermediate reverse gear (20) to the reverse gear of the main shaft (12) performing the second reduction.
3. As a result of the reverse idle gear (20) in this engagement, the rotation of the main shaft (13) is counterclockwise. This way, the rotation to the wheels is inverted and the vehicle can go backward.



- | | |
|-----------------------------------|--|
| 1. Input shaft | 14. Countershaft driven gear |
| 3. Input shaft drive gear | 19. Countershaft 1 st /reverse speed gear |
| 12. Main shaft reverse speed gear | 20. Reverse Idle gear |
| 13. Main shaft | |

The following chart presents some transmission malfunctions with their most common causes and possible solutions.

Problem	Probable cause	Possible solution	Reference
Transmission noise when in neutral	Incorrect idle speed adjustment	Adjust idle speed	Instructions on vehicle's manual
	Improper or damaged clutch disc	Replace disc	Instructions on vehicle's manual
	Loose or damaged engine or transmission mounts	Replace and/or tighten mounts	Instructions on vehicle's manual
	Worn or damaged universal yoke	Replace universal yoke	Instructions on vehicle's manual
	Unbalanced or warped cardan shaft	Replace or repair cardan shaft	Requires specific procedure
	Low lubricant level	Fill with recommended oil to the proper level	Lubrication, in this manual
	Contaminated lubricant	Drain all fluid, clean the transmission, and refill with recommended oil	Lubrication, in this manual
	Worn or damaged gears and/or bearings	Replace damaged parts	Instructions on this manual
Transmission noise with shifted gears	Misalignment due to loose tightening capscrews	Retighten capscrews	Instructions on this manual
	Improper or damaged clutch disc	Replace disc	Instructions on vehicle's manual
	Low lubricant level	Fill with recommended oil to the proper level	Lubrication, in this manual

Problem	Probable cause	Possible solution	Reference
Transmission noise with shifted gears (continued)	Worn or damaged flywheel bushing or bearing	Replace	Instructions on vehicle's manual
	Vibration from other vehicle components (cardan shaft, mounts, universal yoke)	Verify and repair as per vehicle's manual	Instructions on vehicle's manual
	Misalignment between engine and transmission	Realign	Instructions on vehicle's manual
	Worn or damaged gears and/or bearings	Replace damaged parts	Instructions on this manual
	Warped main shaft or countershaft	Replace the shaft	Instructions on this manual
Hard shifting	Clutch malfunction (not releasing)	Verify and adjust clutch driving system	Instructions on vehicle's manual
	Wrong adjustment of clutch pedal	Adjust pedal stroke	Instructions on vehicle's manual
	Worn or damaged flywheel bushing or bearing	Replace	Instructions on vehicle's manual
	Improper lubricant	Replace	Lubrication, in this manual
	Low lubricant level	Fill with recommended oil to the proper level	Lubrication, in this manual
	Worn or damaged control tower components	Replace damaged parts	Control tower, in this manual

Problem	Probable cause	Possible solution	Reference
Hard shifting (continued)	Worn or damaged synchronizer rings	Replace rings	Synchronizer assemblies, in this manual
	Excessively worn or damaged synchronizer assemblies (Synchronizer assembly and/or sleeve)	Replace synchronizer assemblies	Synchronizer assemblies, in this manual
	Selective sleeve adjustment and incorrect synchronizer assembly	Correct	Synchronizer assemblies, in this manual
	Worn or damaged shifting system (yokes, nylon pads, rails, shift blocks)	Replace damaged parts	Instructions on this manual
	Incorrect main shaft or countershaft axial clearance	Adjust clearance	Adjustment of main shaft and countershaft clearances, in this manual
Gear shift rubbing	Clutch malfunction (not releasing)	Verify and adjust clutch driving system	Instructions on vehicle's manual
	Wrong adjustment of clutch pedal	Adjust pedal stroke	Instructions on vehicle's manual
	Malfunction of clutch driving system	Verify and adjust clutch driving system	Instructions on vehicle's manual
	Worn or damaged flywheel bushing or bearing	Replace	Instructions on vehicle's manual
	High idle speed rotation	Adjust idle speed	Instructions on vehicle's manual

Problem	Probable cause	Possible solution	Reference
Gear shift rubbing (continued)	Damaged gear clutching teeth	Replace gear	Instructions on this manual
	Worn or damaged shift yokes nylon pads	Replace nylon pads	Rails, in this manual
Transmission slips out of gears (Jump out)	Misalignment between transmission and engine	Realign	Instructions on vehicle's manual
	Incomplete gear shifting	Shift gear properly	Tips for the Driver, in this manual
	Excessive vibration on gear shift lever due to loose or damaged engine or transmission mounts	Replace and/or tighten mounts	Instructions on vehicle's manual
	Gear shift lever console out of position, forcing the lever	Adjust console	Instructions on vehicle's manual
	Worn or damaged synchronizer assembly	Replace synchronizer assembly	Synchronizer assemblies, in this manual
	Excessive axial clearance on main shaft gears	Adjust clearance	Main shaft axial clearance adjustment, in this manual
	Worn or damaged clutching gear teeth	Replace damaged parts	Instructions on this manual
	Worn or damaged shifting system (control tower, yokes, rails, shift blocks, etc.)	Replace damaged parts	Instructions on this manual

Problem	Probable cause	Possible solution	Reference
Oil leak	Lubricant above proper level	Correct to proper level	Lubrication, in this manual
	Clogged breather	Check breather	
	Worn or damaged oil seals	Replace damaged parts	Instructions on this manual
	Housing capscrews not properly tightened and/or lack of sealant	Reassemble with proper sealant and tightening torque	Tightening torques and sealants, in this manual
	Cracked housing or covers	Replace or repair damaged parts	Requires specific procedure
	Warped or damaged mounting surfaces of housings and covers	Replace or repair damaged parts	Requires specific procedure
Bearing failures	Low lubricant level	Fill to the proper level	Lubrication, in this manual
	Contaminated or not recommended lubricant	Drain all oil and refill with recommended oil	Lubrication, in this manual
	Improper assembly of transmission components	Reassemble transmission	Instructions on this manual
	Improper main shaft or countershaft axial clearance	Adjust clearance	Adjustment of main shaft and countershaft clearances, in this manual
	Bearings were not lubricated prior to assembly	Replace damaged parts. Assemble following instructions	Lubrication, in this manual
Double shifting	Double gear shifting interlock system assembled improperly	Reassemble transmission	Instructions on this manual

3. Disassembly and Assembly

The “General Information” section contains important information and specifications to be used when servicing the transmission.

During assembly, inspect all components for wear.

During assembly, replace any part when required.

CAUTION: *Whenever you use a vise to secure transmission components during service, for example shafts, gears, etc., protect the jaws with an aluminum angle or other soft material to prevent damage to the part.*

During assembly, lubricate the following parts using the same lubricant specified for the transmission:

- Main shaft gears and reverse idle gear bores, faces and cones;
- Contact surfaces of synchronizer rings, cones, and friction surfaces;
- Needle bearings and conical bearings;
- Thrust surfaces, bearing bushings.

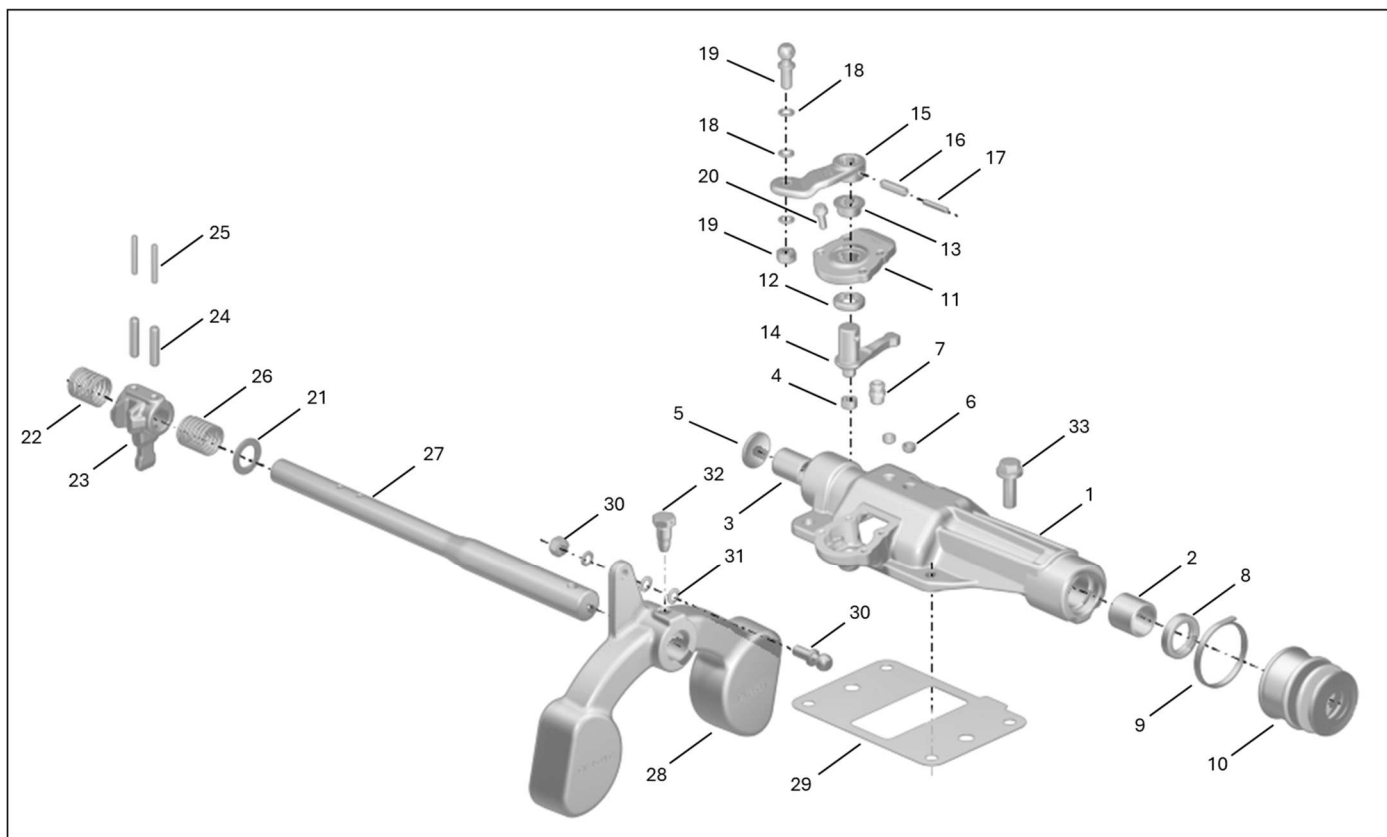
During assembly, constantly check the transmission (horizontally) to ensure that gears and synchronizers are rotating smoothly and freely.

Apply MS-9C grease onto following parts of the control tower:

- Bushings, inner levers, pivot balls of shift pins, pivot pins.

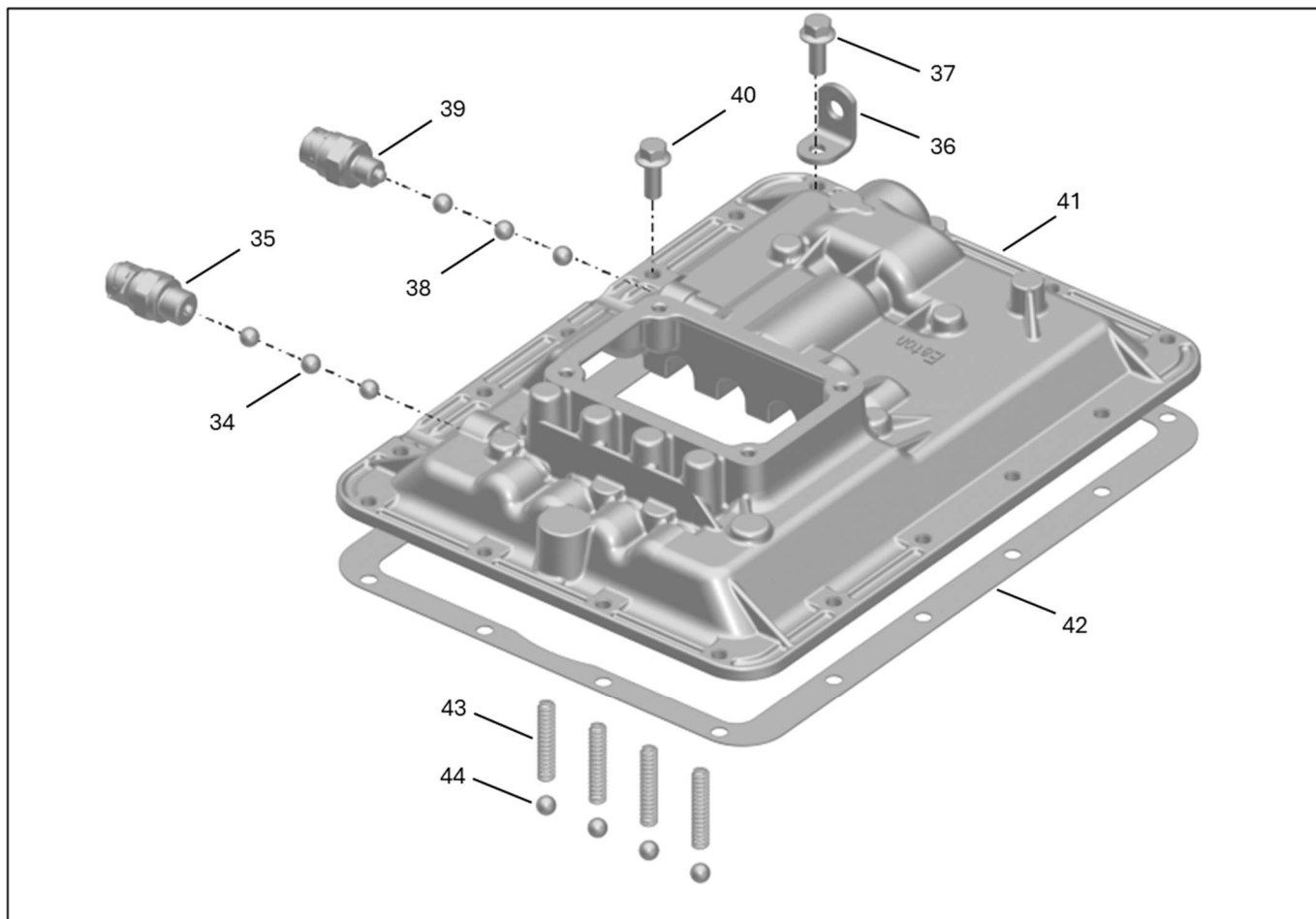
Apply petroleum jelly onto oil seal lips.

Control Tower Exploded View



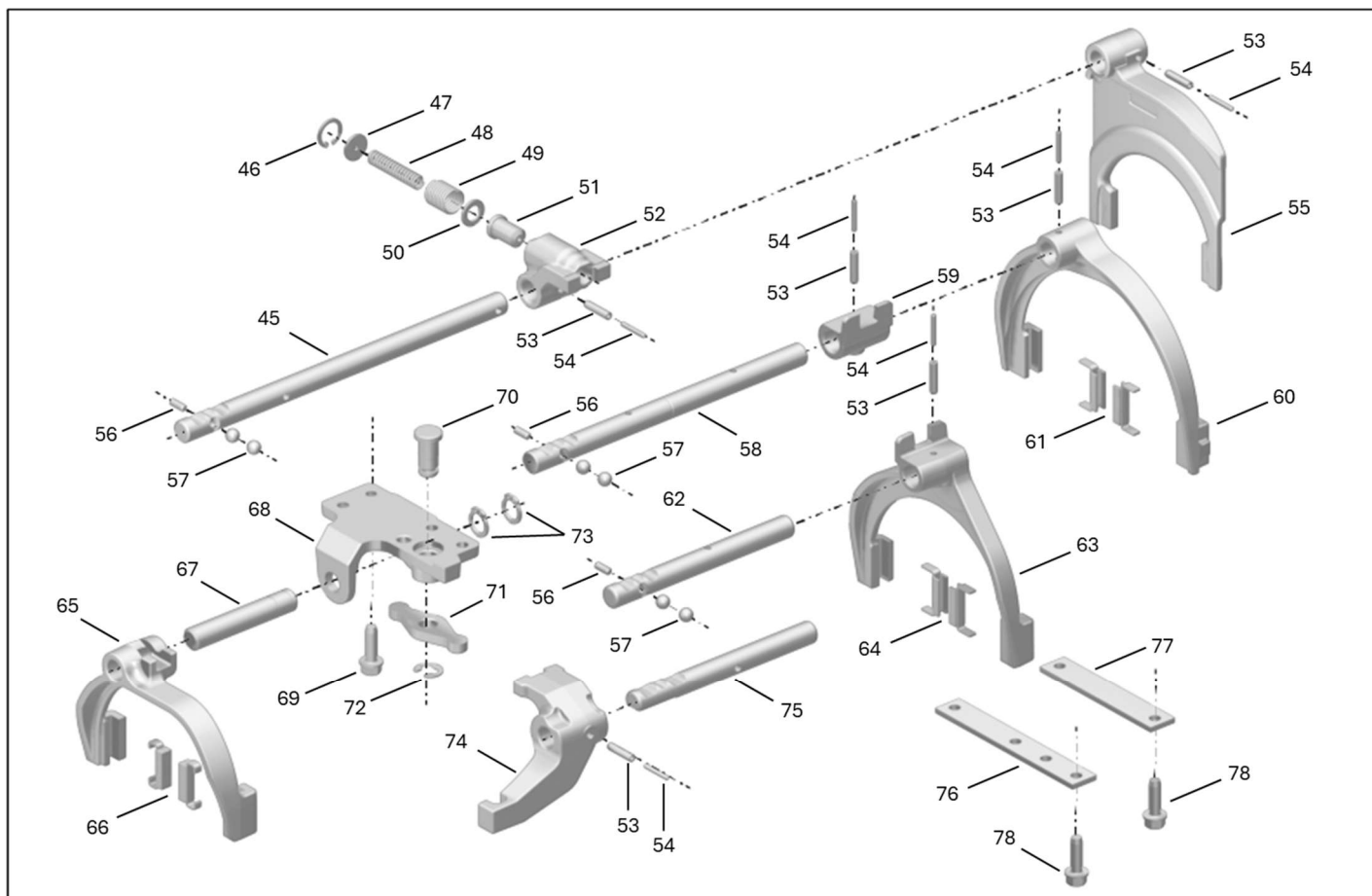
1 TOWER HOUSING AND BUSHINGS ASSEMBLY	12 OIL SEALER	23 INTERNAL GEAR LEVER
2 BUSHING	13 BUSHING	24 SNAP PIN
3 BUSHING	14 INTERNAL SELECTION LEVER	25 SNAP PIN
4 BUSHING	15 EXTERNAL SELECTION LEVER	26 SPRING
5 EXPANSION PLUG	16 SNAP PIN	27 HITCH SHAFT
6 EXPANSION PLUG	17 SNAP PIN	28 SHIFT LEVER
7 BREATHER	18 WASHER	29 CONTROL TOWER GASKET
8 OIL SEALER	19 SPHERICAL PIN WITH THREAD	30 SPHERICAL PIN WITH THREAD
9 CLAMP	20 SCREW	31 WASHER
10 PROTECTOR	21 WASHER	32 SCREW
11 CONTROL TOWER CAP	22 SPRING	33 SCREW

Control Cover Exploded View



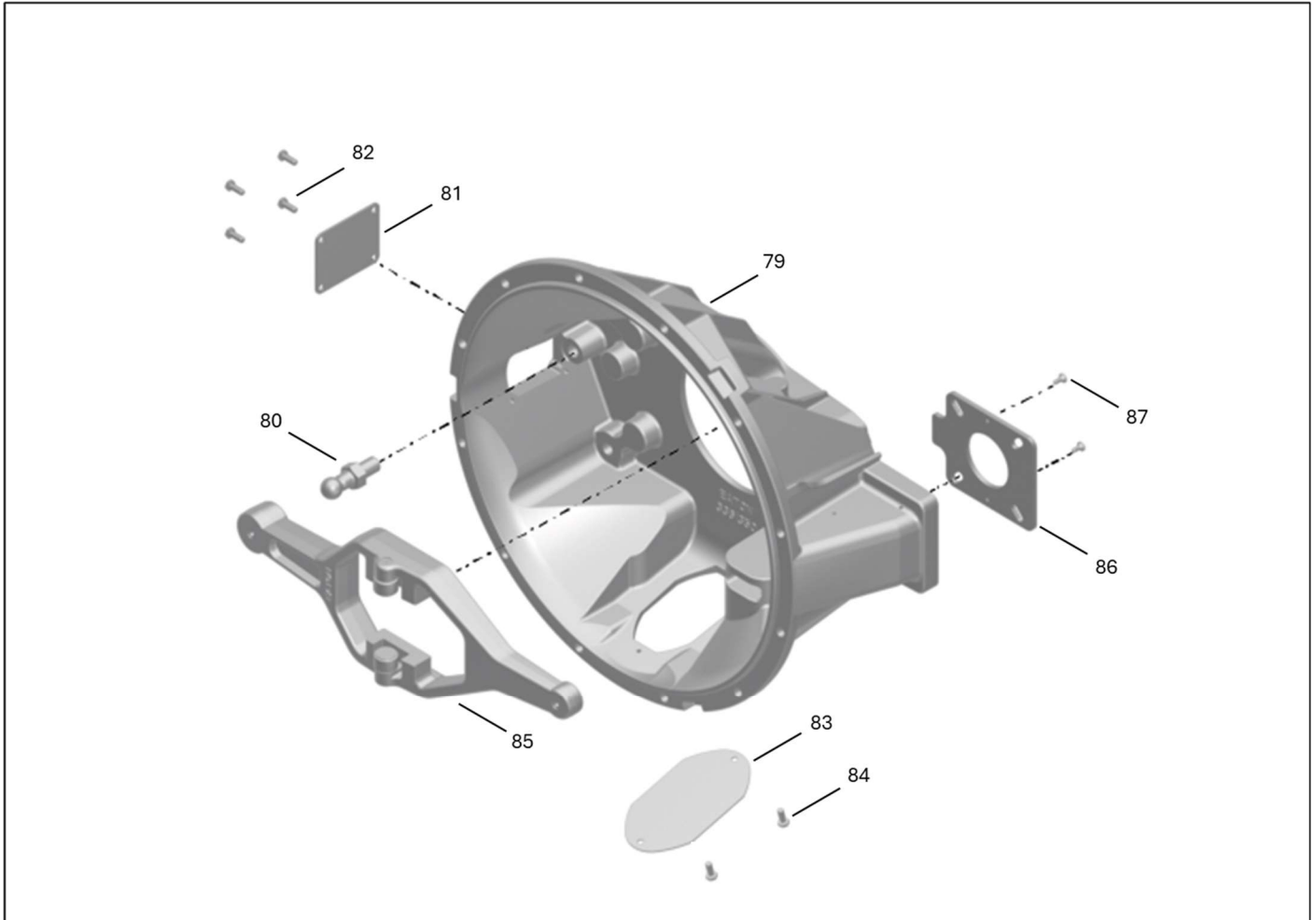
34 SPHERE	38 SPHERE	42 GASKET
35 NEUTRAL LIGHT SWITCH	39 REVERSE LIGHT SWITCH	43 SPRING
36 LIFTING PLATE	40 SCREW	44 SPHERE
37 SCREW	41 CONTROL COVER	

Shift Yokes and Rails Exploded View



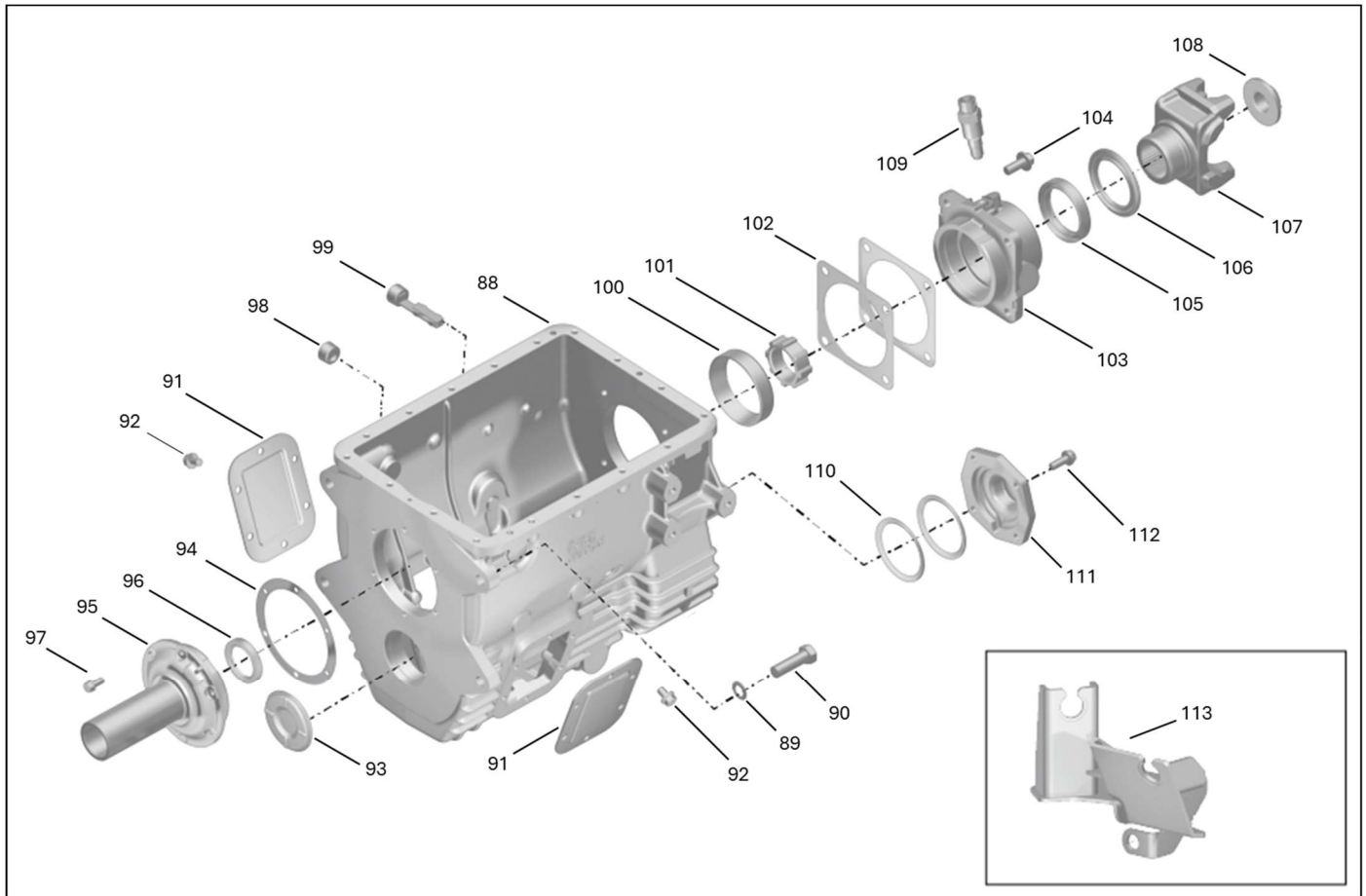
45	REVERSE RAIL	57	SPHERE	69	SCREW
46	RING LOCK	58	1 ST /2 ND SPEED RAIL	70	ACTUATOR PIN
47	SUPPORT WASHER	59	1 ST /2 ND SPEED RAIL HITCH	71	ARTICULATION LEVER
48	PLUNGER SPRING	60	1 ST /2 ND SPEED CHANGE YOKE ASSEMBLY	72	RING LOCK
49	SPRING	61	BUSHING	73	RING LOCK
50	SUPPORT WASHER	62	3 RD /4 TH SPEED RAIL	74	5 TH /6 TH SPEED RAIL
51	PLUNGER	63	3 RD /4 TH SPEED CHANGE YOKE ASSEMBLY	75	5 TH /6 TH SPEED RAIL
52	REVERSE HITCH	64	BUSHING	76	PLATE
53	SNAP PIN	65	5 TH /6 TH SPEED CHANGE YOKE ASSEMBLY	77	PLATE
54	SNAP PIN	66	BUSHING	78	SCREW 3/8 - 16 UNC - 2A
55	REVERSE YOKE	67	5 TH /6 TH SPEED YOKE RAIL		
56	LOCKING PIN	68	SUPPORT		

Clutch Case Exploded View



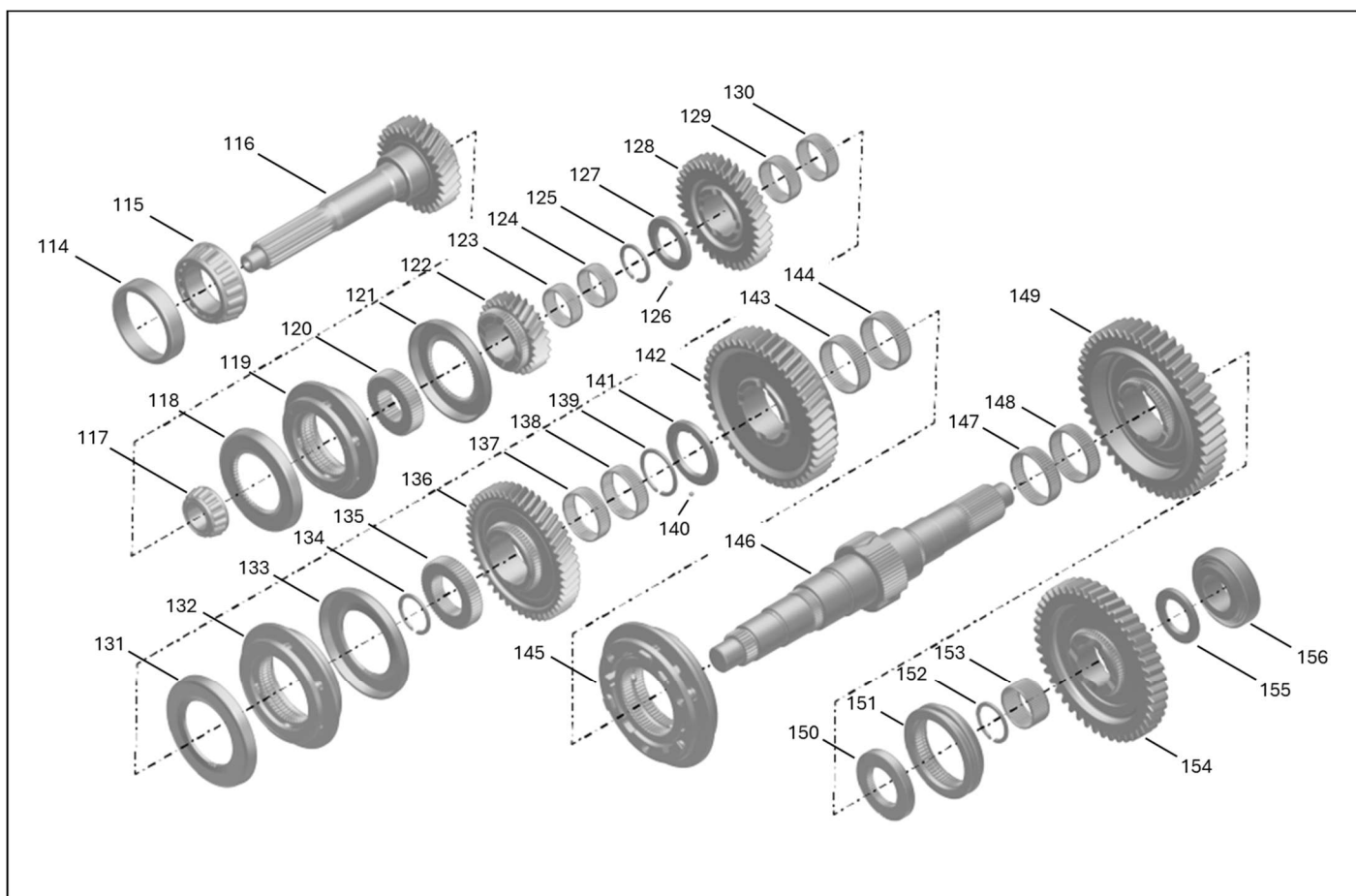
79	CLUTCH CASE	82	SCREW M6 x 1.0 x 12	85	GEAR YOKE
80	SPHERICAL PIN	83	OPENING CAP	86	ADAPTER PLATE
81	INSPECTION CAP	84	SCREW M6 x 1.0 x 12	87	SCREW

Transmission Case Exploded View



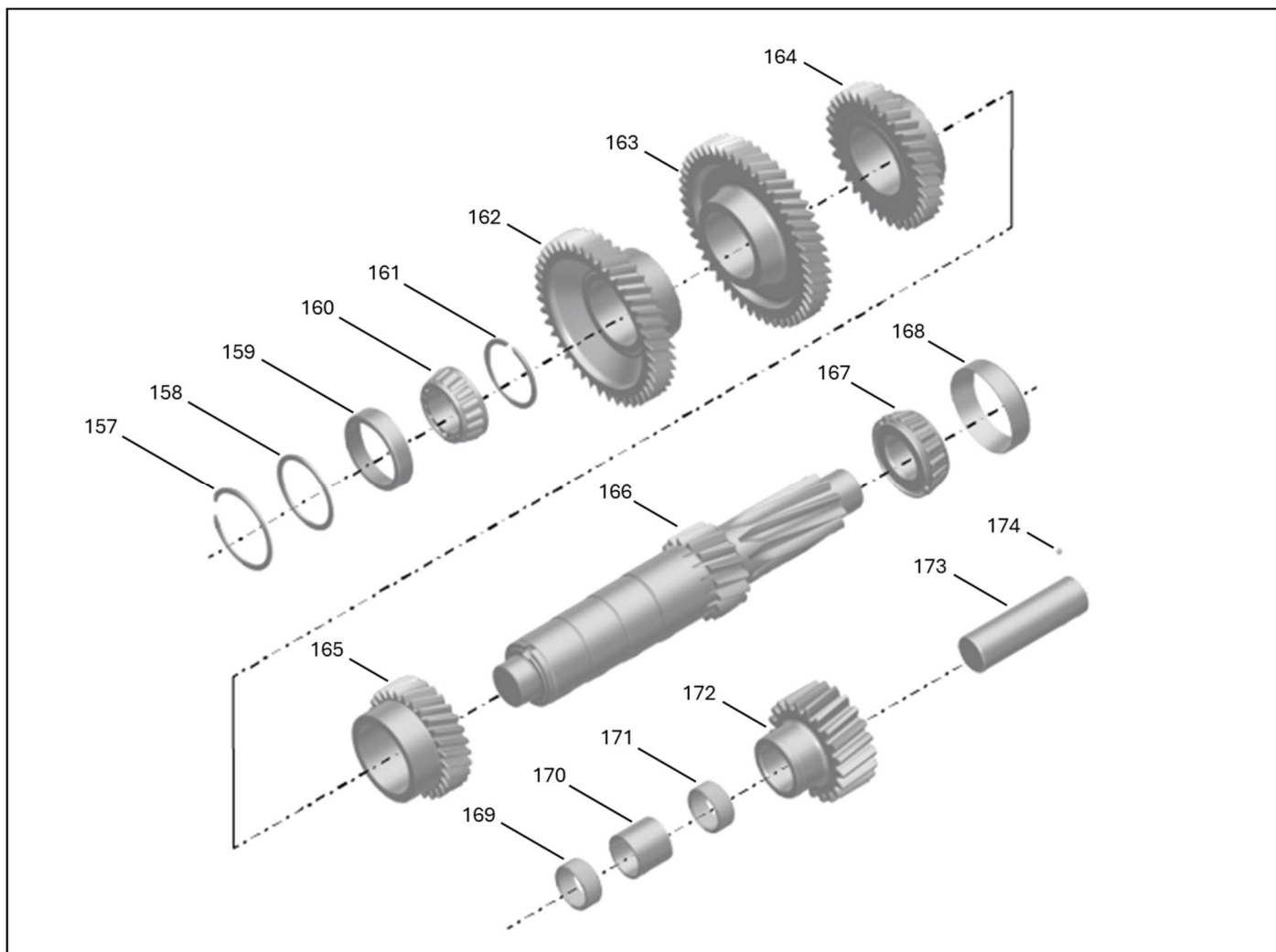
88	TRANSMISSION CASE	97	SCREW 5/16 - 18 UNC - 2A	106	OIL DEFLECTOR
89	WASHER	98	PLUG	107	UNIVERSAL GASKET YOKE
90	SCREW	99	DRAIN PLUG	108	THREAD
91	PTO WINDOW CAP	100	BEARING CAP	109	SPEEDOMETER SENSOR
92	SCREW	101	SPEEDOMETER ROTOR	110	AXIAL PLAY ADJUSTMENT SHIM
93	CAP	102	AXIAL PLAY ADJUSTMENT SHIM	111	COUNTERSHAFT REAR BEARING RETAINER CAP
94	INPUT SHAFT BEARING RETAINER CAP GASKET	103	MAIN SHAFT REAR BEARING RETAINER CAP	112	SCREW
95	INPUT SHAFT BEARING RETAINER COVER	104	SCREW 1/2 - 13 UNC - 2A	113	CABLE SUPPORT
96	OIL SEALER	105	OIL SEALER		

Input Shaft and Main Shaft Exploded View



114	BEARING CAP	129	NEEDLE ROLLER BEARINGS	144	NEEDLE ROLLER BEARINGS
115	BEARING CONE	130	NEEDLE ROLLER BEARINGS	145	ASSEMBLY SYNCHRONIZER
116	INPUT SHAFT	131	SYNCHRONIZER COVER	146	MAIN SHAFT
117	CONE OF THE CONICAL BEARING	132	ASSEMBLY SYNCHRONIZER	147	NEEDLE ROLLER BEARINGS
118	SYNCHRONIZER COVER	133	SYNCHRONIZER COVER	148	NEEDLE ROLLER BEARINGS
119	ASSEMBLY SYNCHRONIZER	134	RING LOCK	149	1 ST SPEED GEAR OF THE MAIN SHAFT
120	5 TH /6 TH SPEED HITCH HUB	135	3 RD /4 TH SPEED HITCH HUB	150	REVERSE HITCH HUB
121	SYNCHRONIZER COVER	136	3 RD SPEED GEAR OF THE MAIN SHAFT	151	REVERSE HITCH SLEEVE
122	MAIN SHAFT MULTIPLIED 6 TH SPEED GEAR	137	NEEDLE ROLLER BEARINGS	152	RING LOCK
123	NEEDLE ROLLER BEARINGS	138	NEEDLE ROLLER BEARINGS	153	NEEDLE ROLLER BEARINGS
124	NEEDLE ROLLER BEARINGS	139	RING LOCK	154	MAIN SHAFT REVERSE SPEED GEAR
125	RING LOCK	140	SPHERE	155	THRUST WASHER
126	SPHERE	141	LOCK WASHER	156	BEARING CONE
127	LOCK WASHER	142	2 ND SPEED GEAR OF THE MAIN SHAFT		
128	4 TH SPEED GEAR OF THE MAIN SHAFT	143	NEEDLE ROLLER BEARINGS		

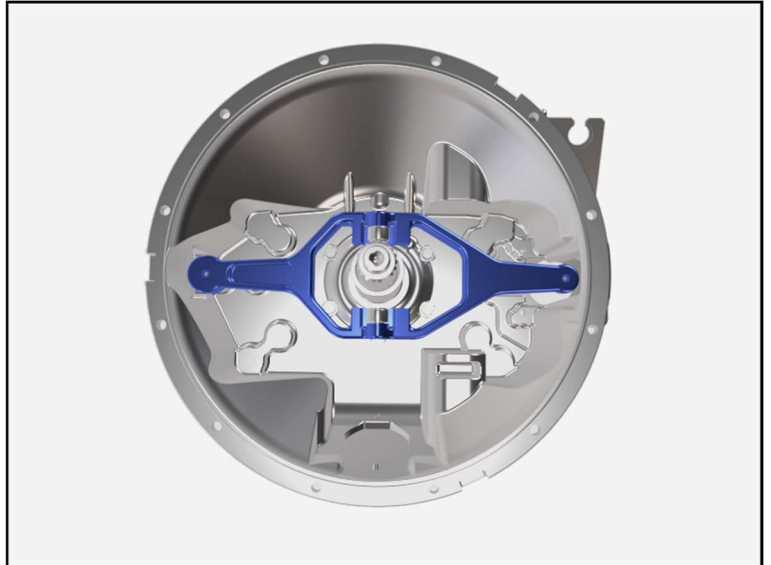
Countershaft Exploded View



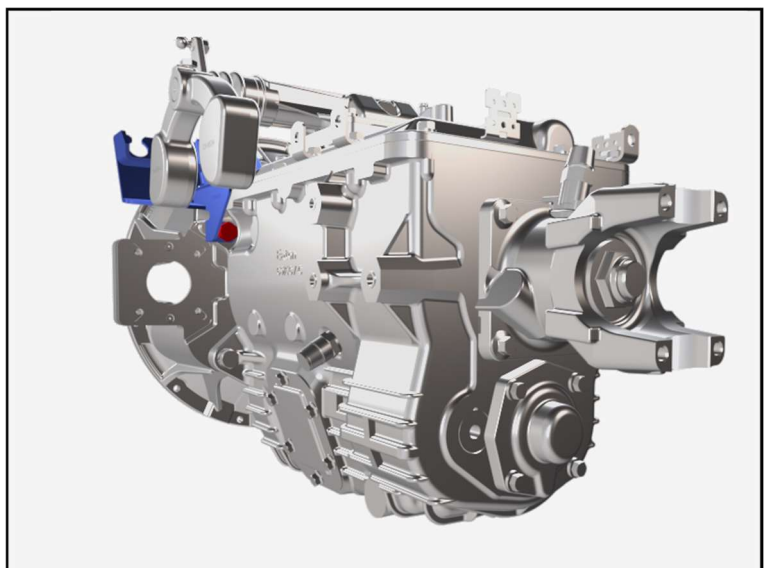
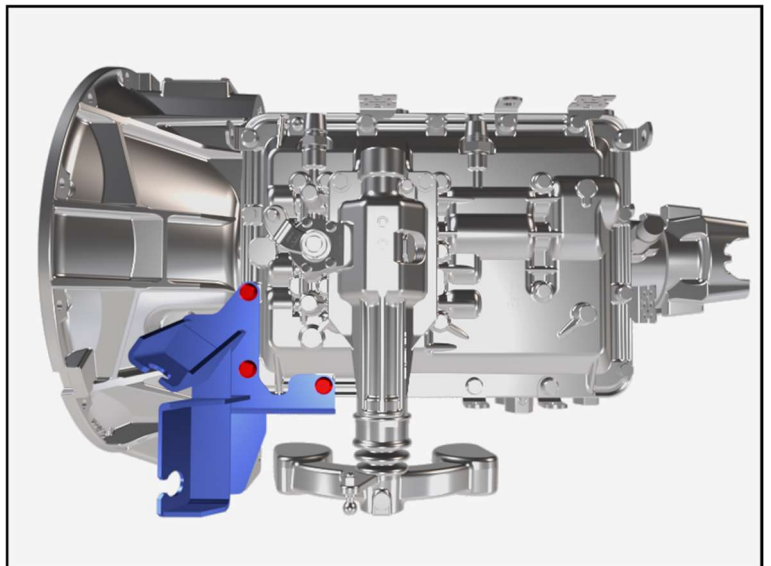
157	RING LOCK	163	COUNTERSHAFT MULTIPLIED 6 th SPEED GEAR	169	NEEDLE ROLLER BEARINGS
158	THRUST WASHER	164	4 th SPEED GEAR OF THE COUNTERSHAFT	170	SPACER
159	BEARING CAP	165	3 rd SPEED GEAR OF THE COUNTERSHAFT	171	NEEDLE ROLLER BEARINGS
160	BEARING CONE	166	COUNTERSHAFT	172	REVERSE IDLER GEAR
161	RING LOCK	167	BEARING CONE	173	SHAFT OF THE REVERSE IDLER GEAR
162	COUNTERSHAFT DRIVEN GEAR	168	BEARING CAP	174	SPHERE

Transmission Disassembly

1. Set the transmission in neutral.
2. Remove the clutch release yoke.

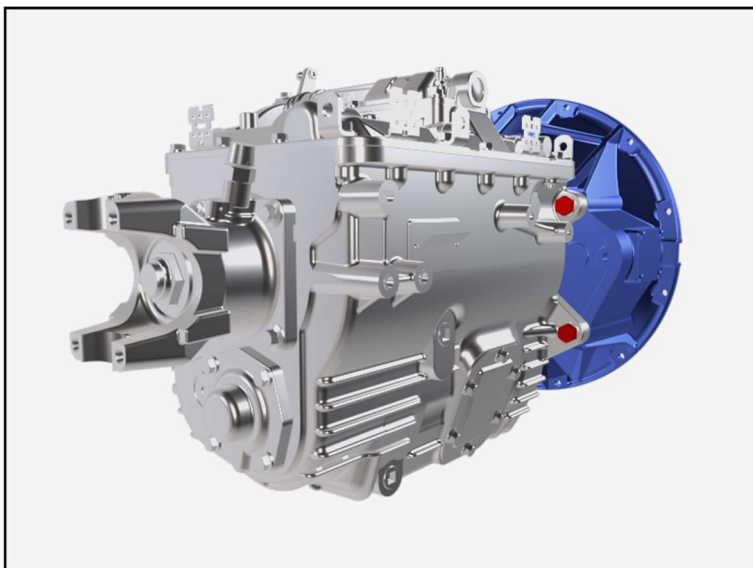
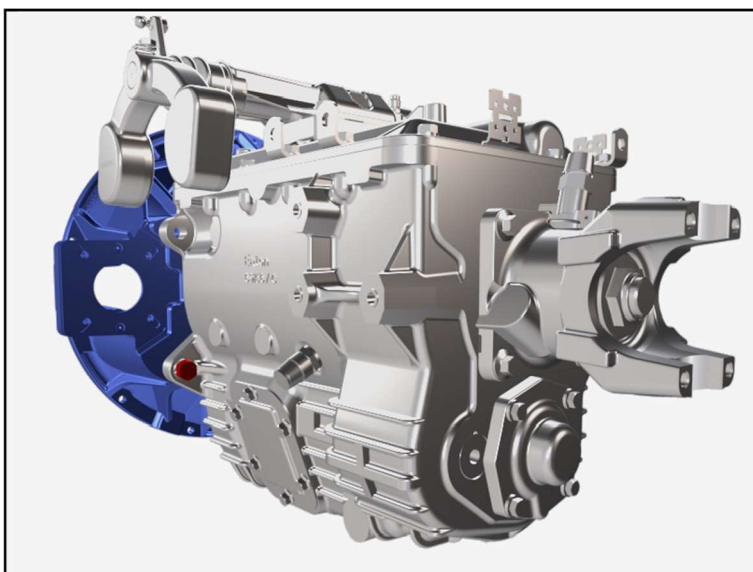


3. Loosen the three upper screws and the lower bolts and remove the selection and engagement cable bracket. 9/16" and 24mm sockets.



Disassembly and Assembly

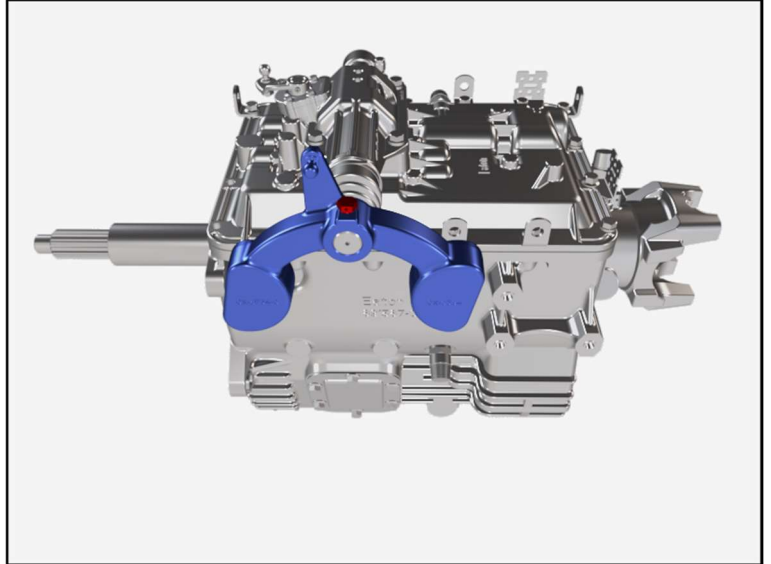
4. Loosen the three remaining bolts and remove the clutch housing. 24mm socket.



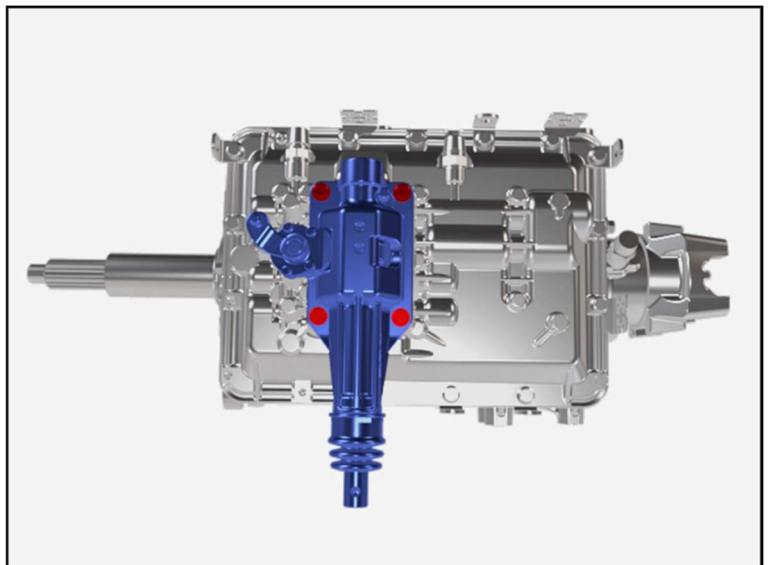
5. Place the transmission on the rotating stand.

Control Tower Removal

1. Remove the counterweight from the hitch rod.
16mm socket.

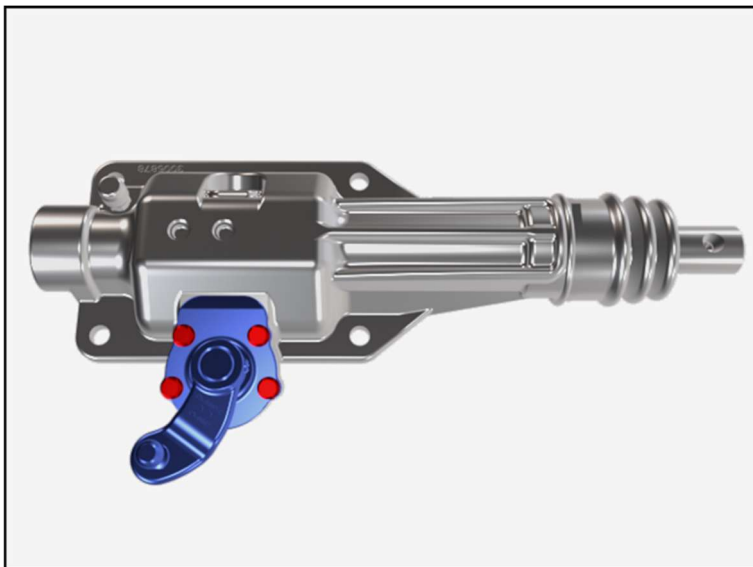


2. Loosen the four bolts and remove the control tower.
9/16" socket.



Control Tower Disassembly

3. Loosen the bolts on the selection lever cover.
8mm socket.



4. Remove the snap pin and remove the external selection lever.



5. Remove the breather.
11mm wrench.

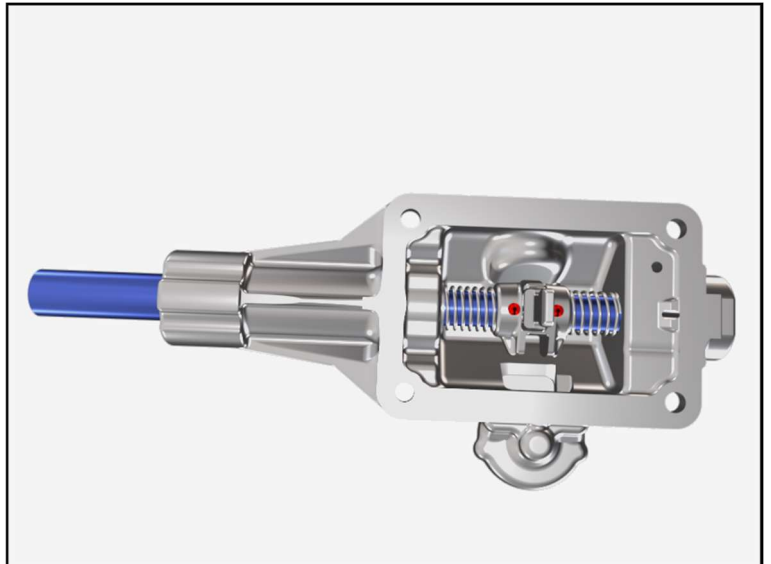


Disassembly and Assembly

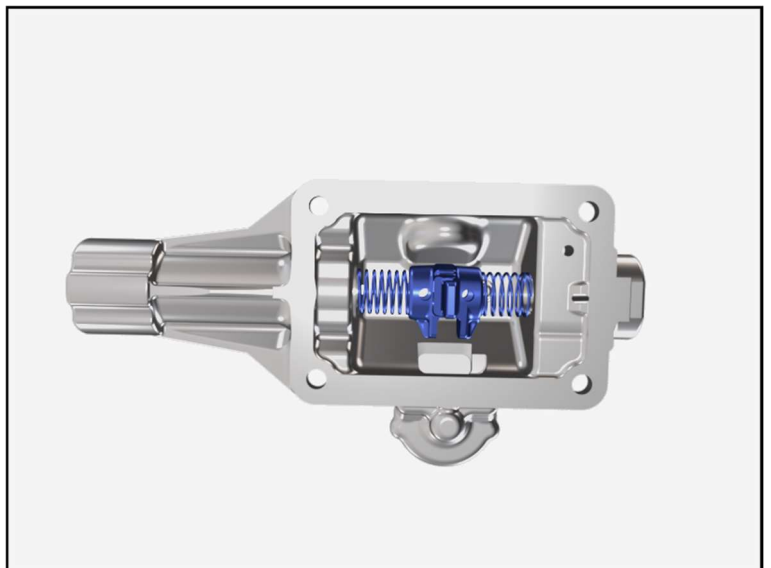
6. Open the clamp and remove the protective hood.



7. Loosen snap pins and remove the hitch shaft.



8. Remove springs and internal shift lever.

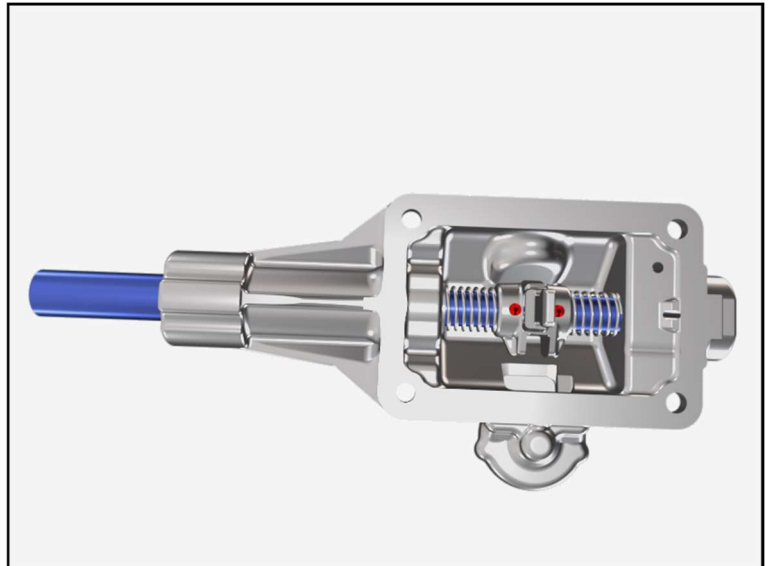


Control Tower Assembly

1. Check the condition of the items and replace the seal if there is oil seeping from the area. Bushing, only if displaying excessive wear.



2. Fit the hitch shaft and at the same time position the springs and the internal shift lever.
3. Align the bores in the hitch shaft and the internal shift lever and insert the snap pins.



4. Fit the protective hood and reposition the clamp.



Disassembly and Assembly

5. Place the breather again.

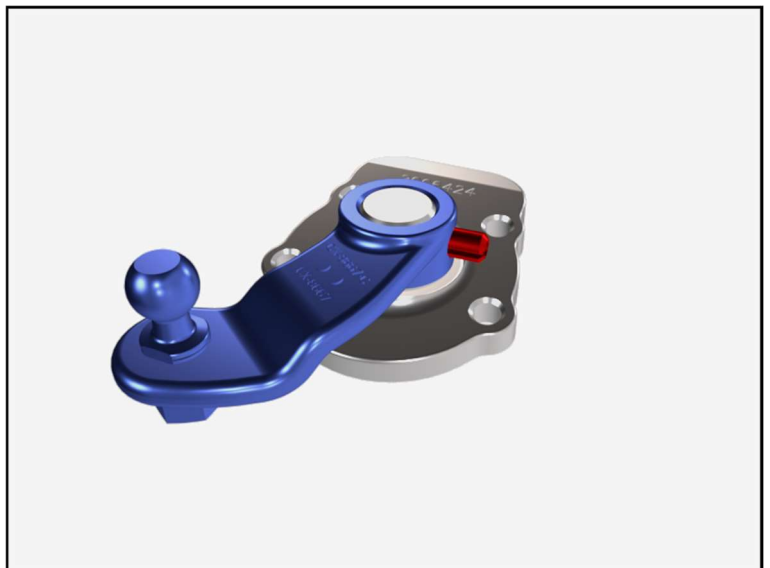


6. Install the internal selection lever.

NOTE! Check the condition of the items and replace the seal if there is oil seeping from the area. Bushing, only if displaying excessive wear.

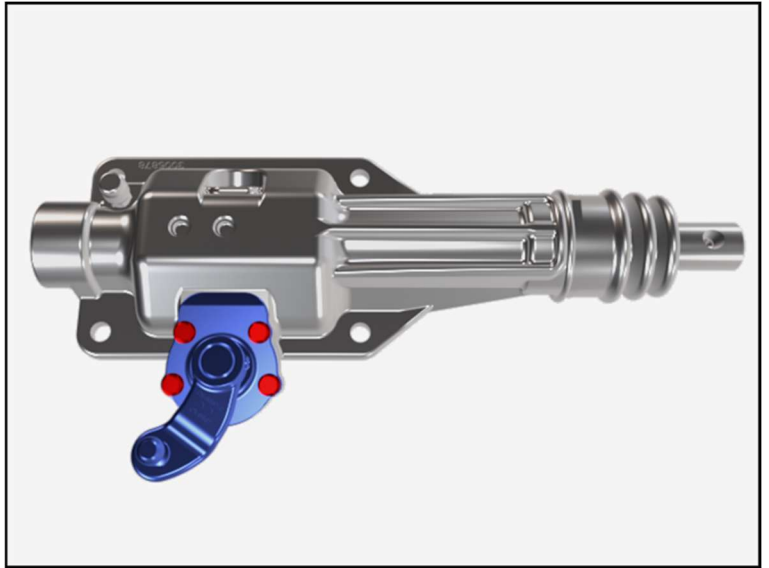


7. Fit the internal selection lever into its seat, position the external selection lever, align the bores, and insert the snap pin.



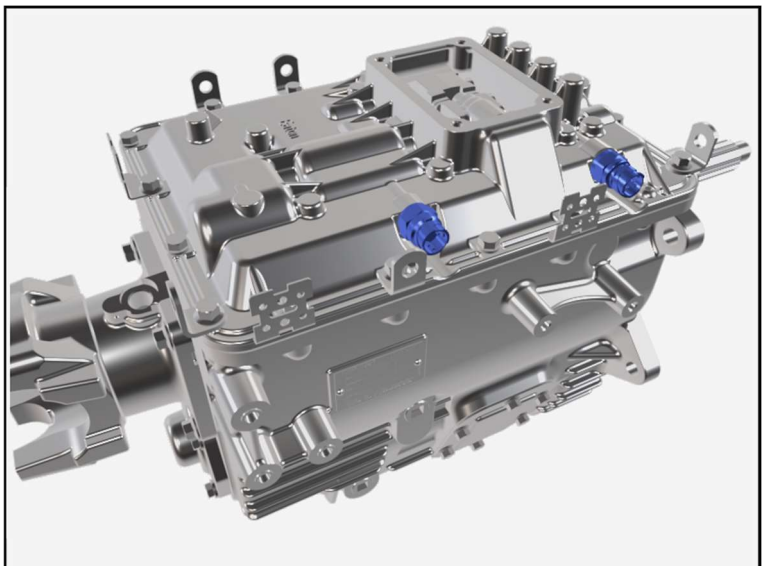
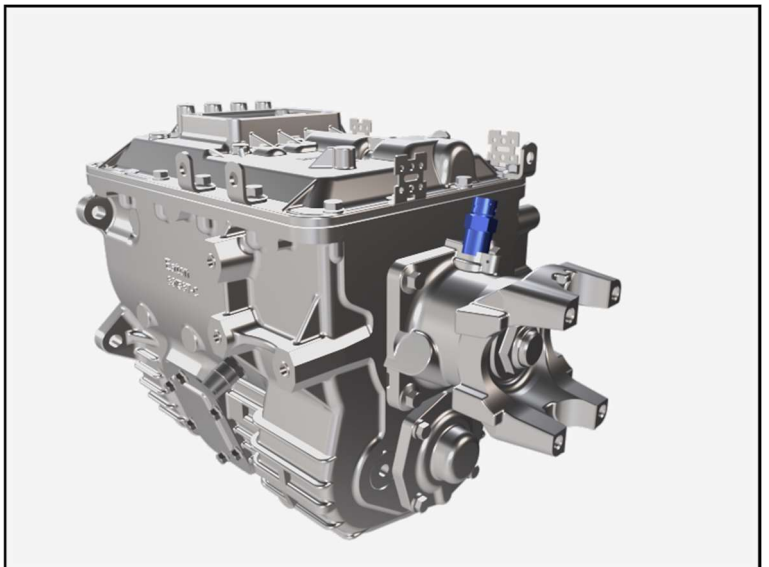
Disassembly and Assembly

8. Install the selection lever cover onto the control tower.



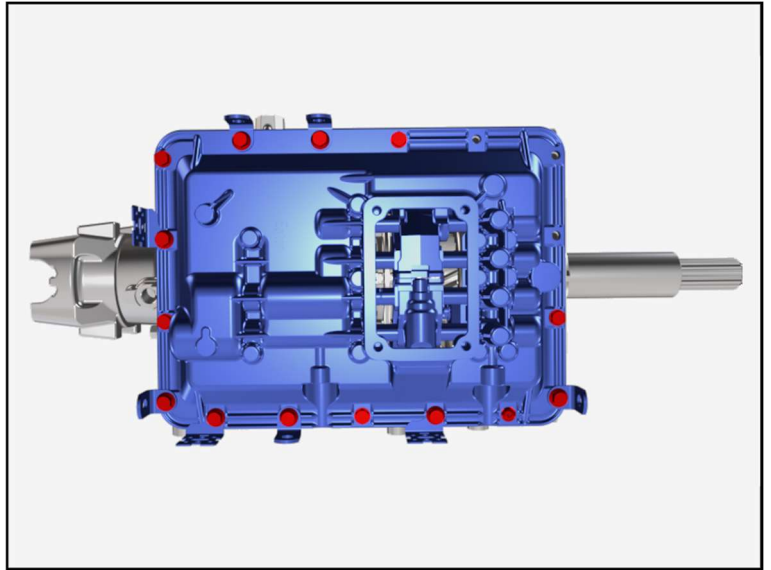
Control Cover Removal

1. Remove the speedometer sensor.
27mm socket.
2. Remove the reverse speed and neutral sensors.
27mm socket.

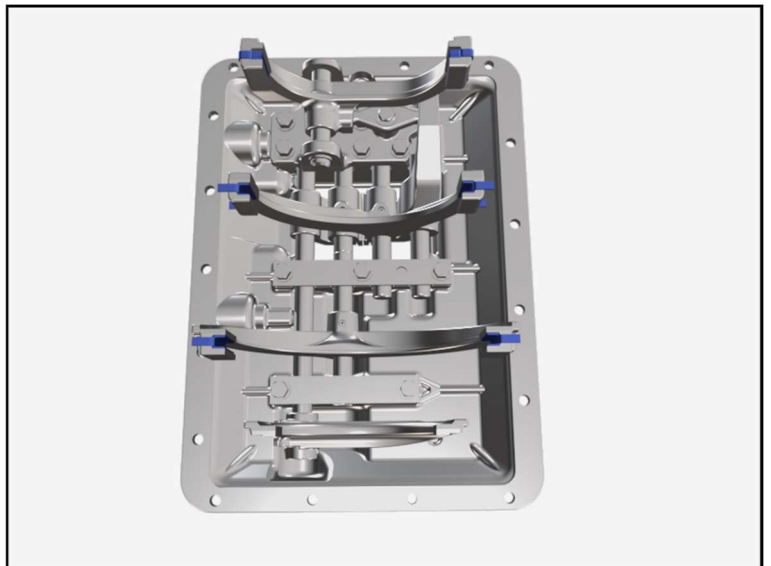


Disassembly and Assembly

3. Loosen the remaining 14 bolts and remove the control cover. 9/16" socket.



4. Check the condition of the shift yoke nylon pads for wear.



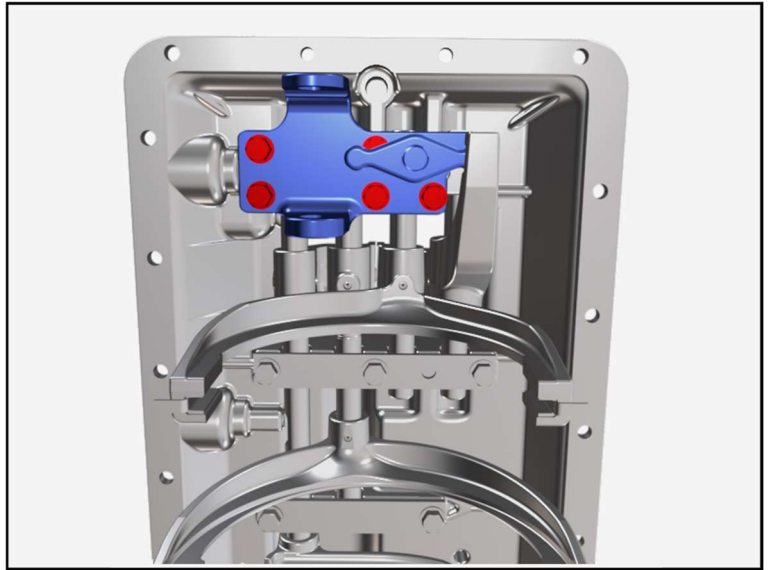
Control Cover Disassembly

1. Release the snap rings and remove the 5th and 6th gear shift shaft and yoke.



Disassembly and Assembly

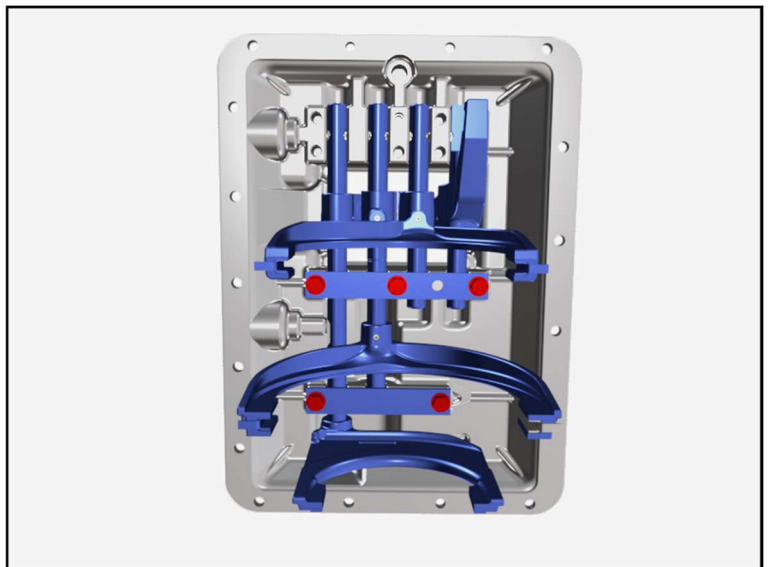
2. Loosen the bolts and remove the 5th/6th gear shift yokes shifter base.
9/16" socket



3. Release the locking ring and remove the articulation lever.



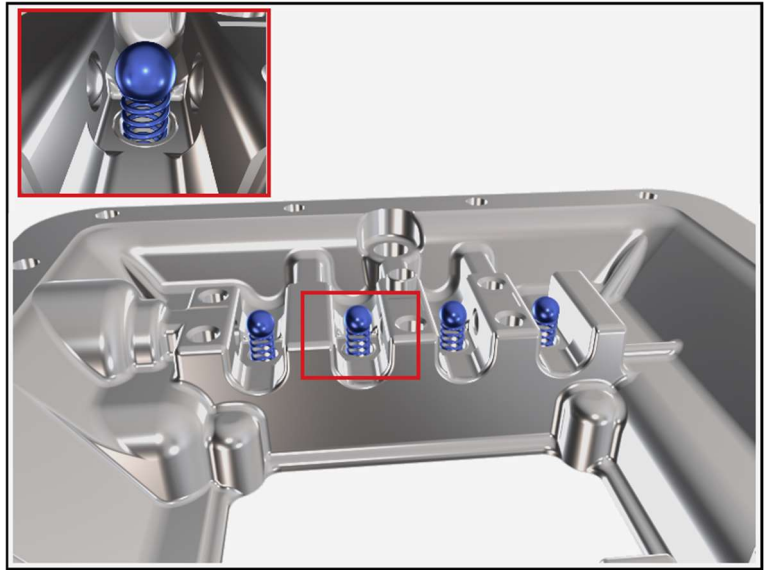
4. Loosen the bolts and remove the fixing bars and the shift rails with the 3rd/4th, 1st/2nd, and reverse gear shift yokes.
9/16" socket



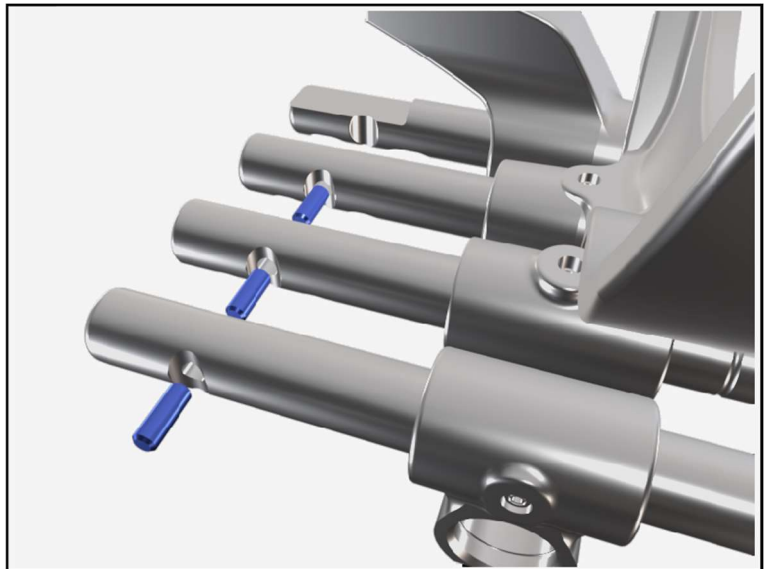
Disassembly and Assembly



WARNING! The positioning devices are spring loaded and pressed, which can throw the balls during disassembly.

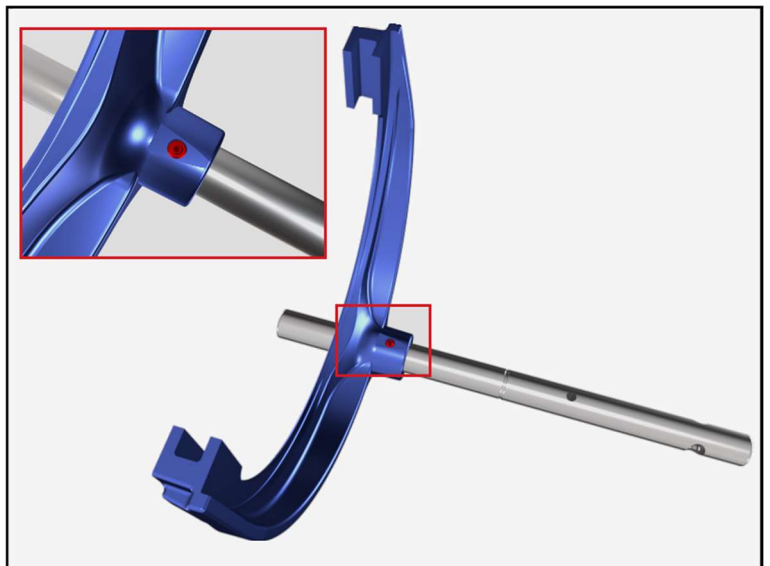


CAUTION! The gear shift interlock pins may fall out during disassembly.



Shift Yokes and Rails Disassembly

1. The shift yokes are attached to the rails using snap pins.
2. Remove snap pin and separate shift yoke from rail.
3. Release the locking ring and remove the articulation lever.



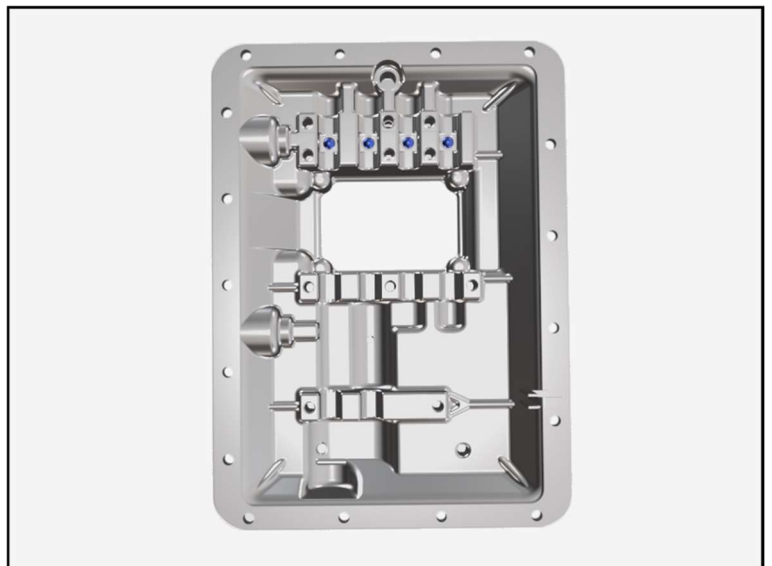
Shift Yokes and Rails Assembly

1. The shift yokes are attached to the rails using snap pins.
2. Fit the shift yoke onto the rail and align the bores.
3. Insert the snap pin until it enters completely.



Control Cover Assembly

1. Position the shift rail positioning devices in their seats on the control cover.

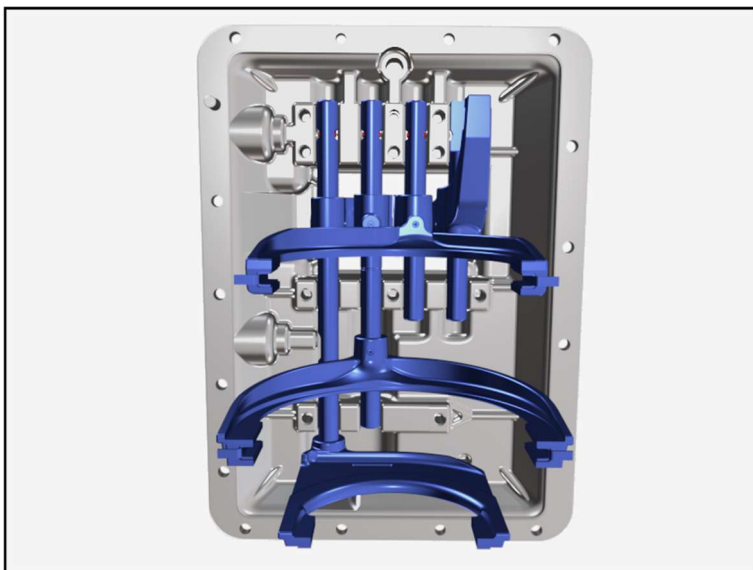


Disassembly and Assembly

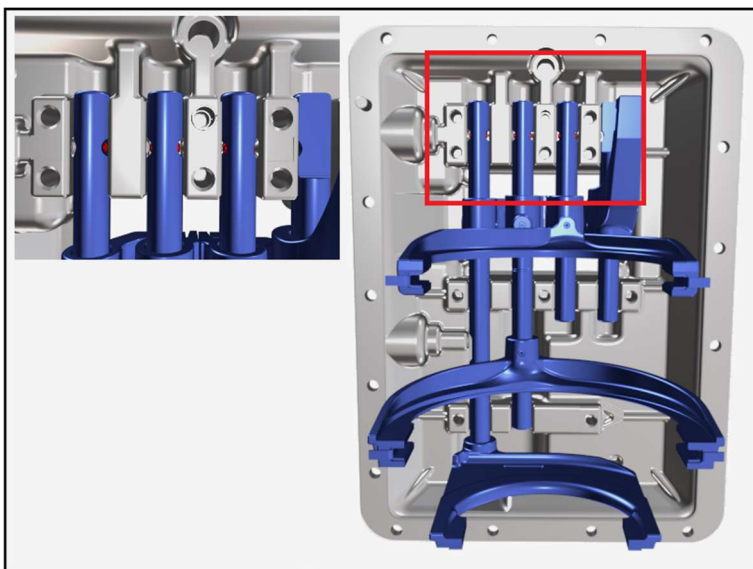
2. Place the 3rd/4th, 1st/2nd gear, and reverse gear shift rails on the positioning devices, with the interlocking pins already inserted in their seats.



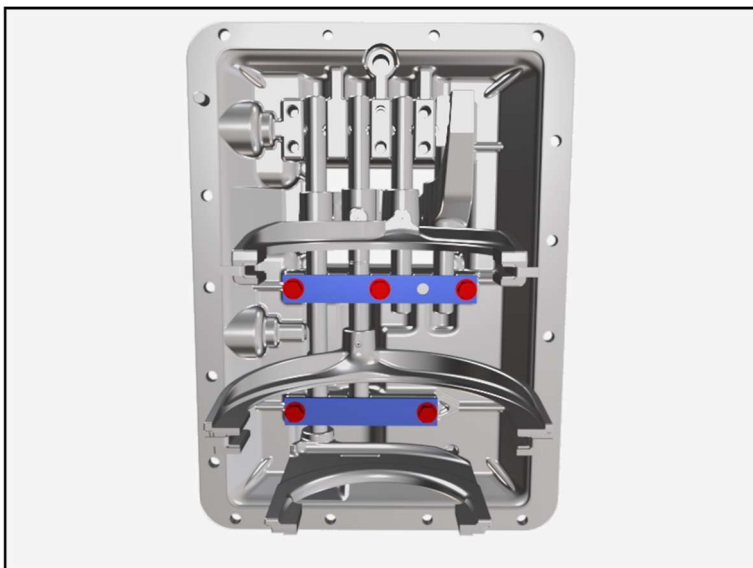
WARNING! When assembling the rails, make sure that all positioning devices are in their seats.



3. Press the rails so that they are aligned on the control cover.
4. Check that the interlocking pins are positioned on the rails.

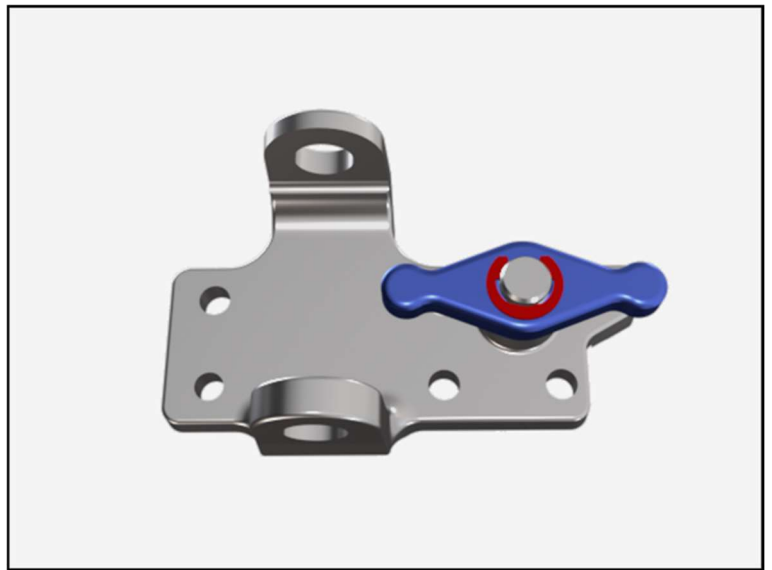


5. Without releasing the rails, position the retaining bars and tighten their bolts.

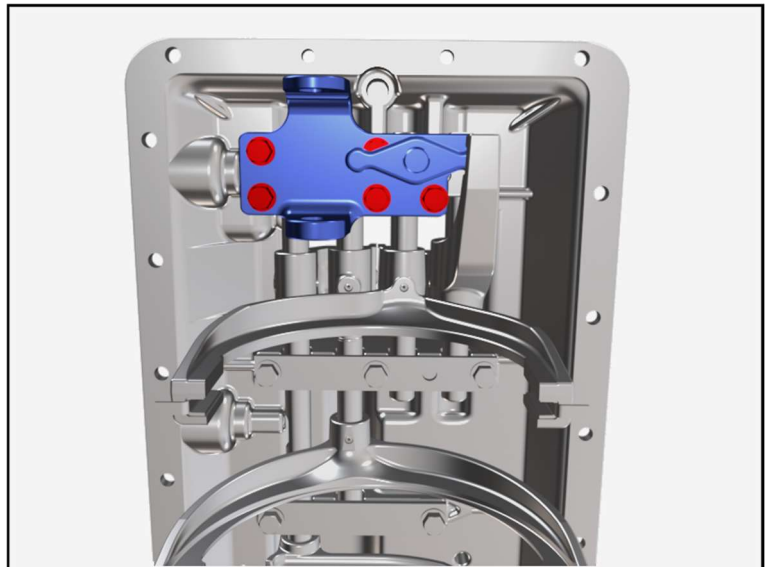


Disassembly and Assembly

6. Fit the articulation lever into the base and place the locking ring.



7. Reposition the 5th/6th gear shift yoke shifter base and tighten the bolts.



8. Install the 5th and 6th gear shift shaft and yoke and their locking rings.



Input Shaft Removal

1. Rotate the stand so that the front of the transmission is facing upwards.
2. Loosen the screws and remove the front transmission cover. 13mm socket.



3. Removal and installation of the input shaft cover seal.

NOTE! Use special tool E001084 for installation.



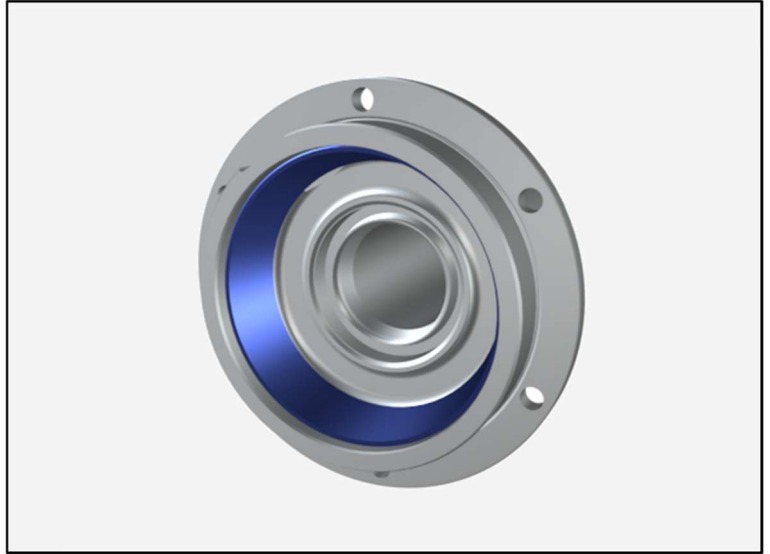
Disassembly and Assembly

4. Removal and installation of the bearing cap.

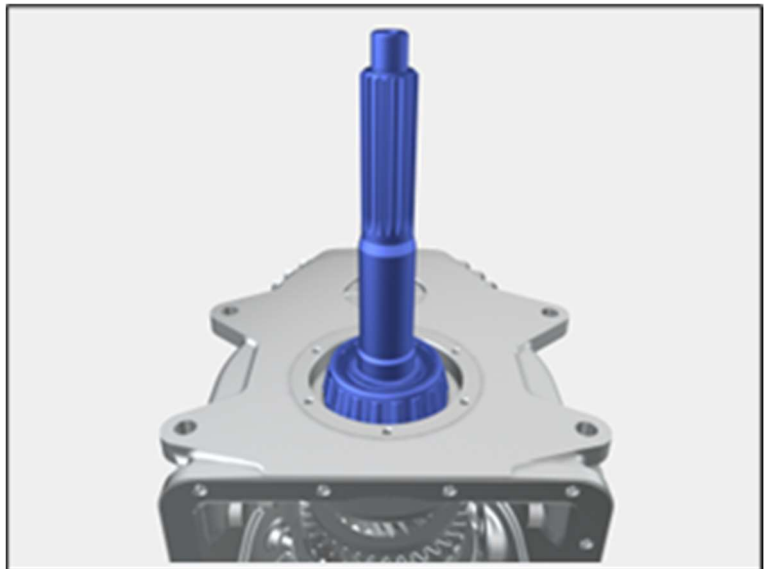
NOTE! Use special tools EEA-17136 and E001082 for removal.



NOTE! Use special tools E001082 and EEA-24001 for installation.



5. Remove the input shaft assembly.



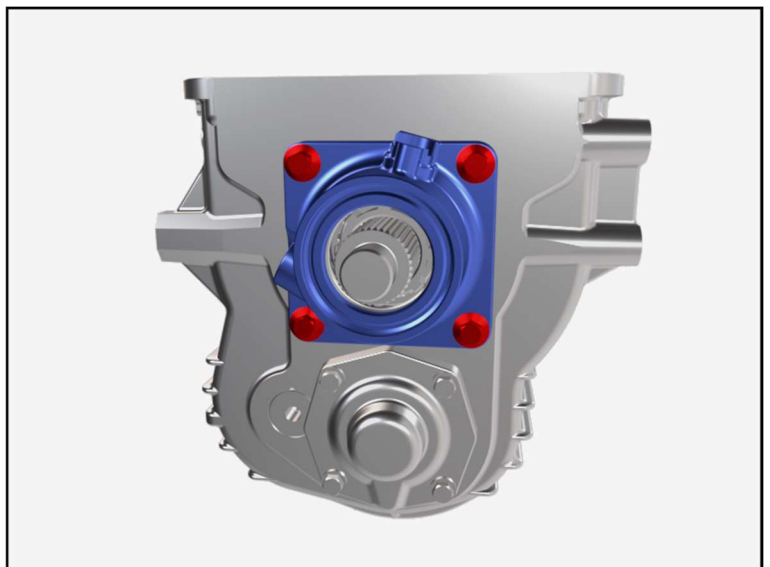
6. Check the condition of the bearing and bearing cap of the main shaft.

Main Shaft Assembly Removal and Disassembly

1. Place the transmission in a horizontal position, loosen the nut, and remove the yoke.
46mm socket.

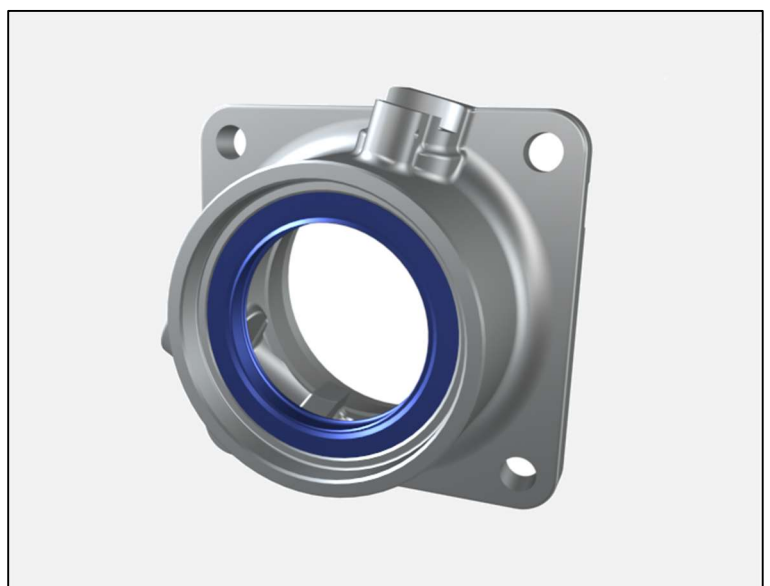


2. Loosen the four bolts and remove the main shaft rear cover.
15mm socket



3. Removal and installation of the main shaft bearing cover seal.

NOTE! Use special tool E006012 for installation.

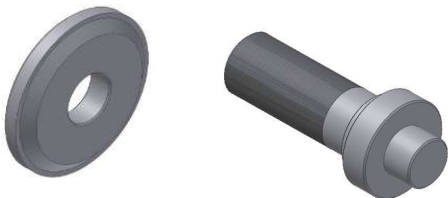


4. Removal and installation of the main shaft rear bearing cap.

NOTE! Use special tool E-012010 for removal.

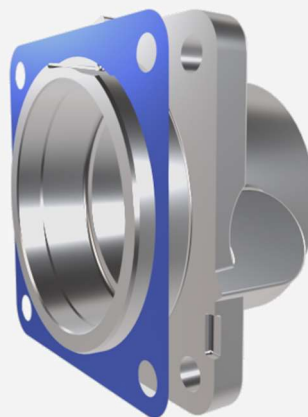
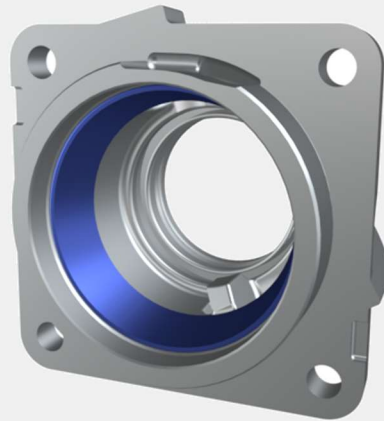


NOTE! Use special tools E001083 and EEA-24001 for installation.



5. Save the main shaft axial clearance adjustment shims for use in assembly.

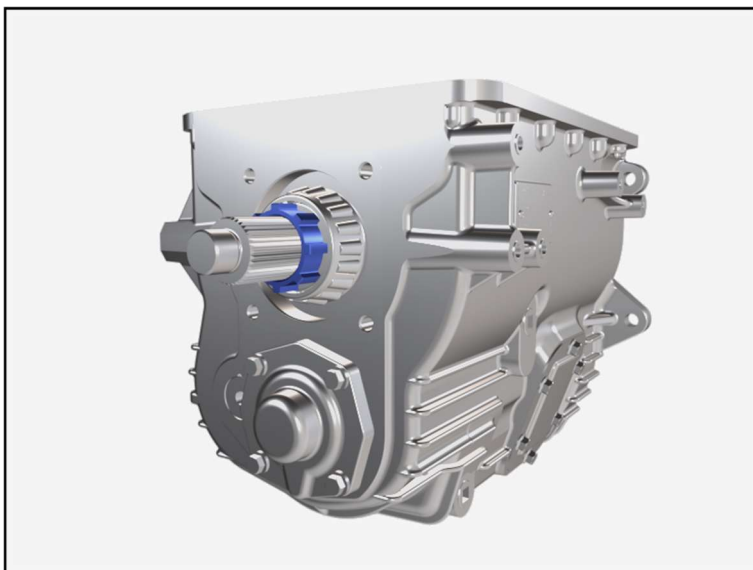
Disassembly and Assembly



6. Check the condition of the bearing cap of the main shaft on the rear cover.

Disassembly and Assembly

7. Remove the speedometer sensor rotor.



8. Remove the complete main shaft assembly using a hoist and lifting strap.



9. Check the condition of the front and rear main shaft bearings.
10. Place the main shaft on a workbench in a vertical position, with the front bearing facing up.

Disassembly and Assembly

11. Remove the 5th and 6th speed synchronizer assembly.



12. Remove the bearing cone from the “pocket” main shaft.

NOTE! Use special tools E005017 and E005014.



13. Remove the 5th and 6th speed synchronizer hub.



14. Remove the 6th speed gear.



15. Remove the two needle bearings of the 6th speed gear.



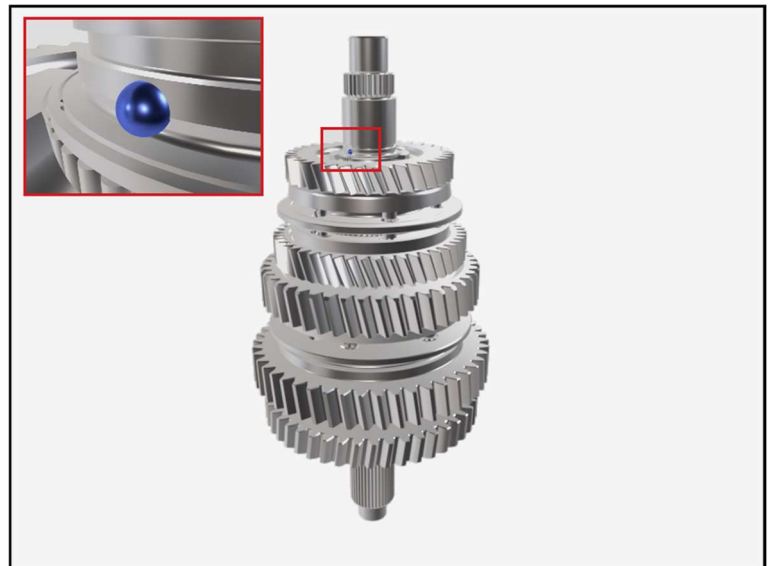
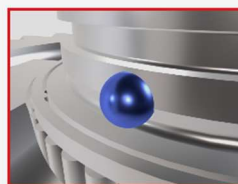
16. Remove the locking ring.



17. Remove the thrust washer.



WARNING! Remove the retaining ball from the thrust washer.



18. Remove the 4th speed gear.



Disassembly and Assembly

19. Remove the two needle bearings of the 4th speed gear.



20. Remove the 3rd and 4th speed synchronizer assembly.



21. Remove the locking ring.



22. Remove the 3rd and 4th speed synchronizer hub.



23. Remove the 3rd speed gear.



24. Remove the two needle bearings of the 3rd speed gear.



25. Remove the locking ring.



26. Remove the thrust washer.



WARNING! Remove the retaining ball from the thrust washer.



27. Remove the 2nd speed gear.



28. Remove the two needle bearings of the 2nd speed gear.

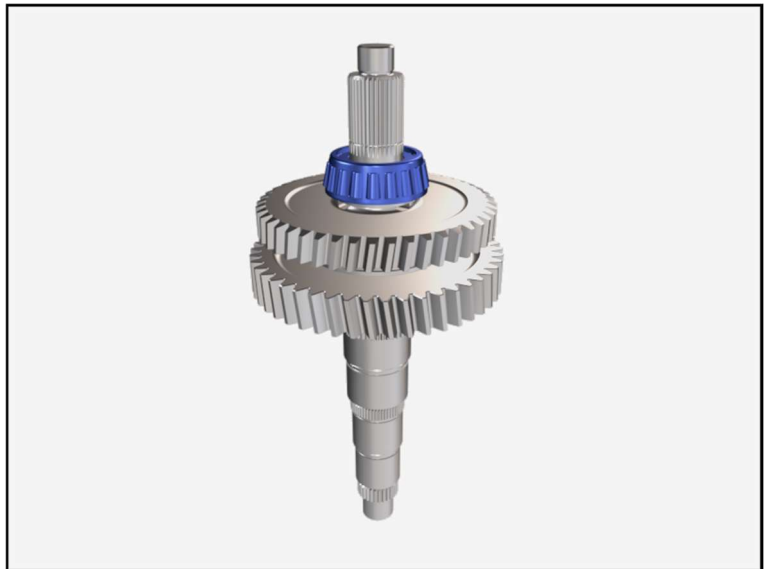


29. Remove the 1st and 2nd speed synchronizer assembly.



30. Turn the main shaft over and remove the bearing cone from the main shaft, reverse side.

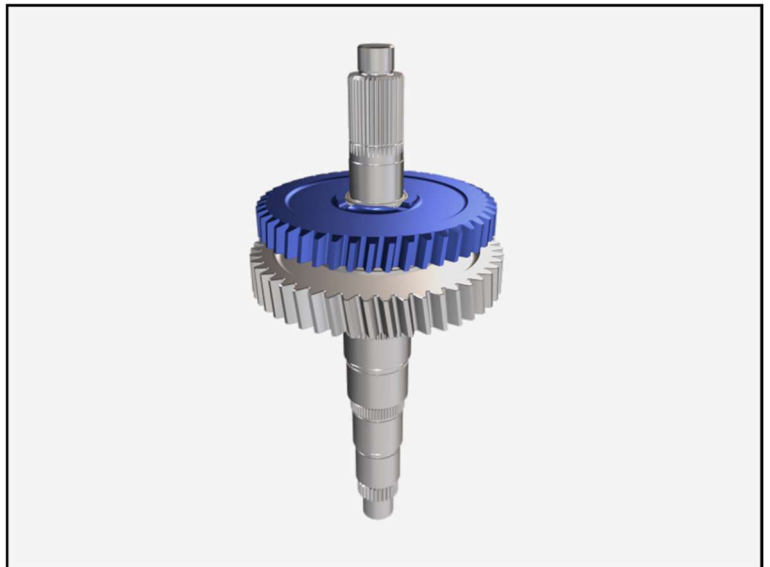
NOTE! Use special tools E005020 and E005014.



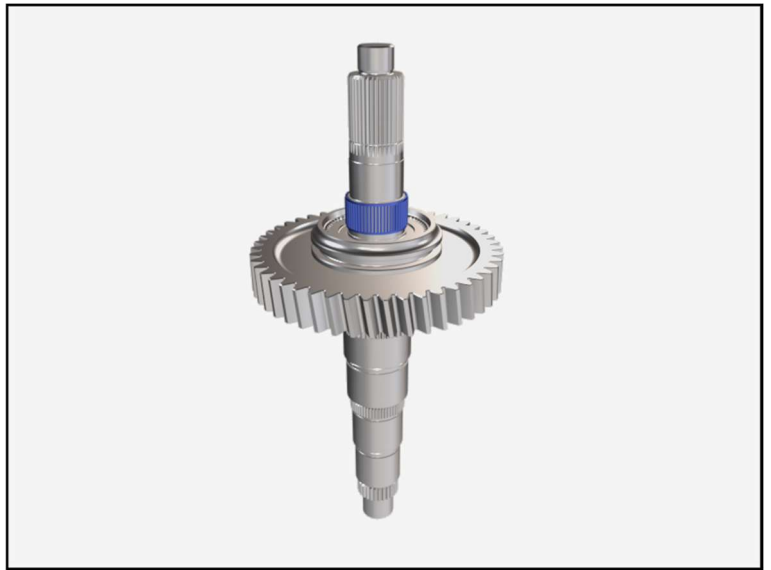
31. Remove the thrust washer.



32. Remove the reverse speed gear.



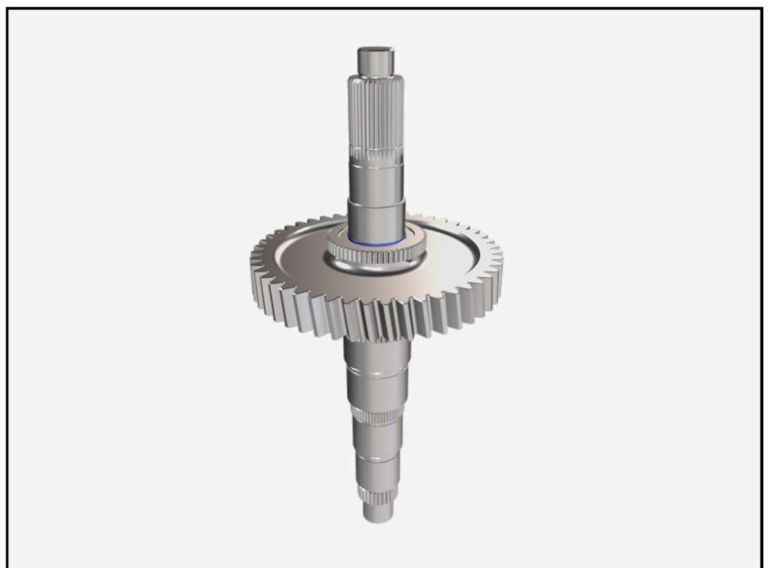
33. Remove the two needle bearings of the reverse speed gear.



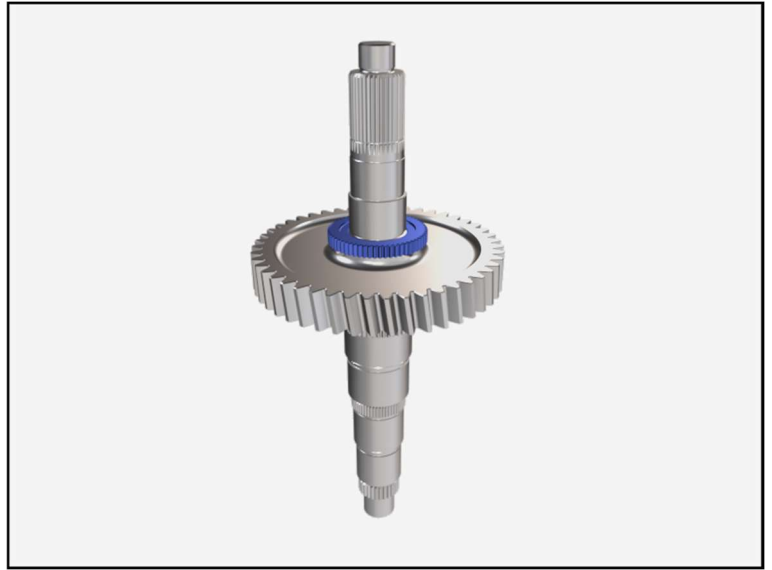
34. Remove the reverse speed engagement synchronizer sleeve.



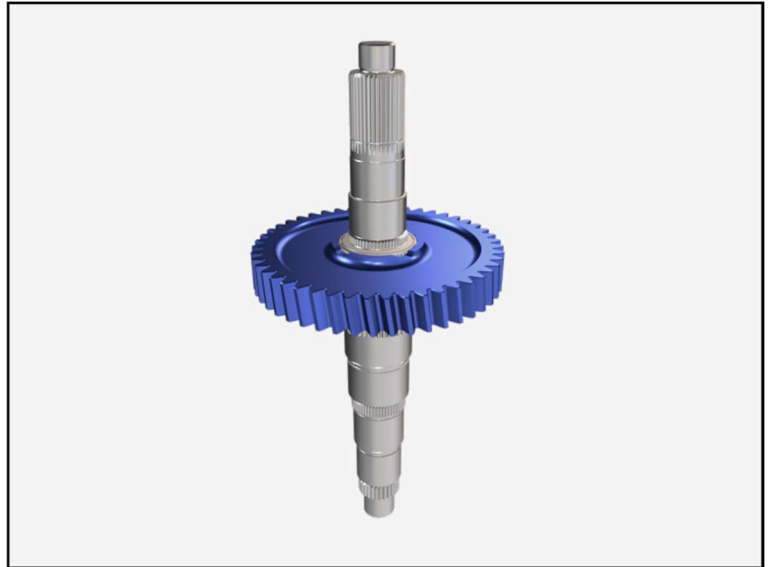
35. Remove the locking ring.



36. Remove the 1st speed synchronizer hub.



37. Remove the 1st speed gear.



38. Remove the two needle bearings of the 1st speed gear.

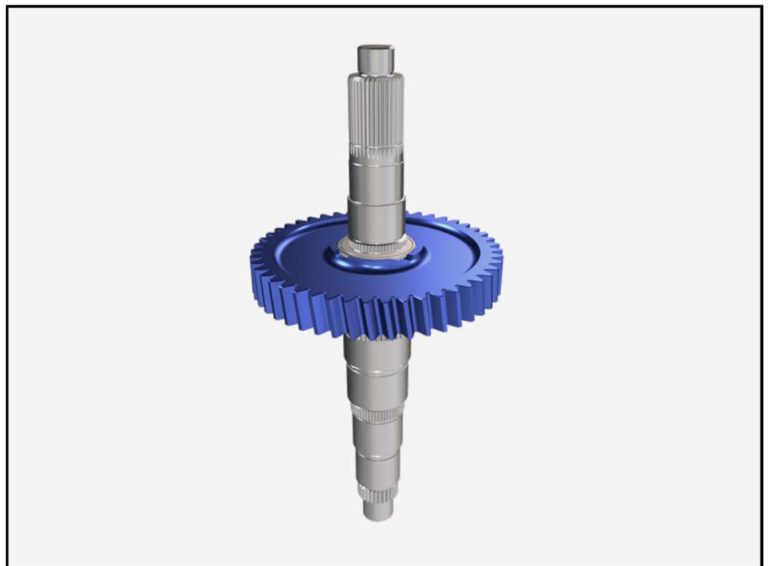


Assembly of Main Shaft Assembly

1. Place the main shaft on a workbench in a vertical position with the spline of the transmission output yoke facing upwards.
2. Position the 1st speed two needle bearing.

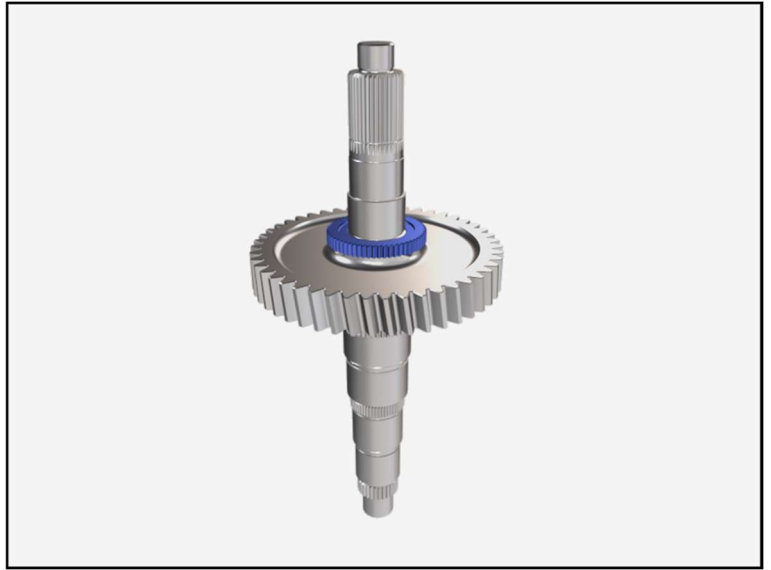


3. Position the 1st speed gear.

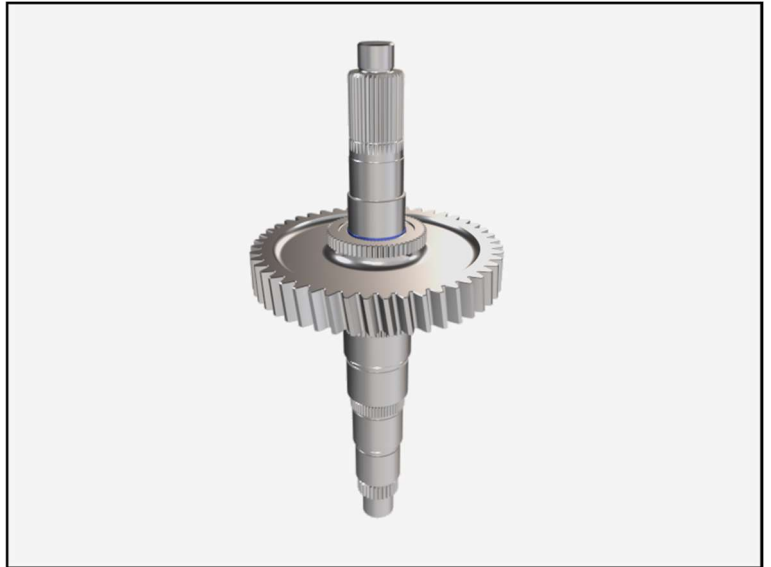


Disassembly and Assembly

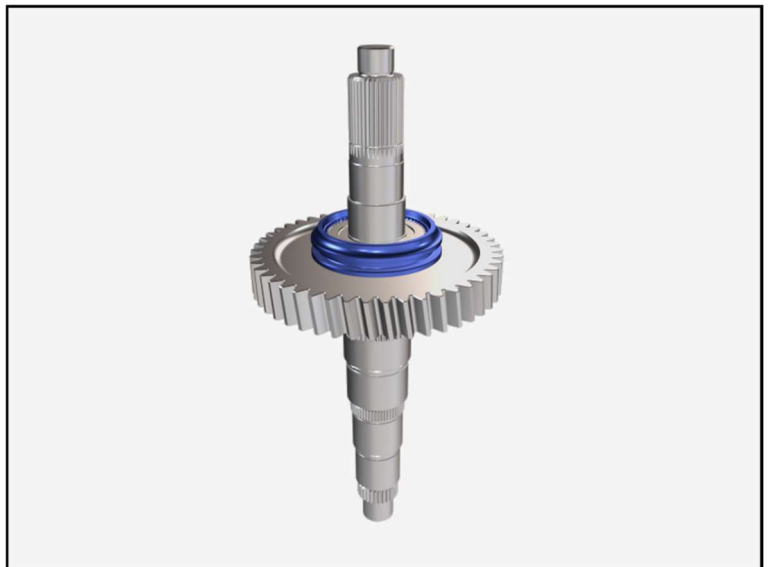
4. Position the 1st speed synchronizer hub.



5. Insert the locking ring.

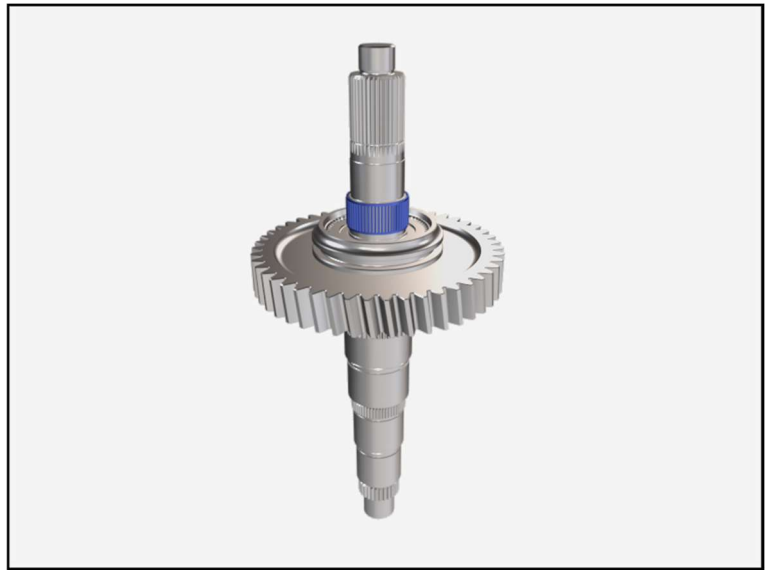


6. Position the reverse speed engagement synchronizer sleeve.

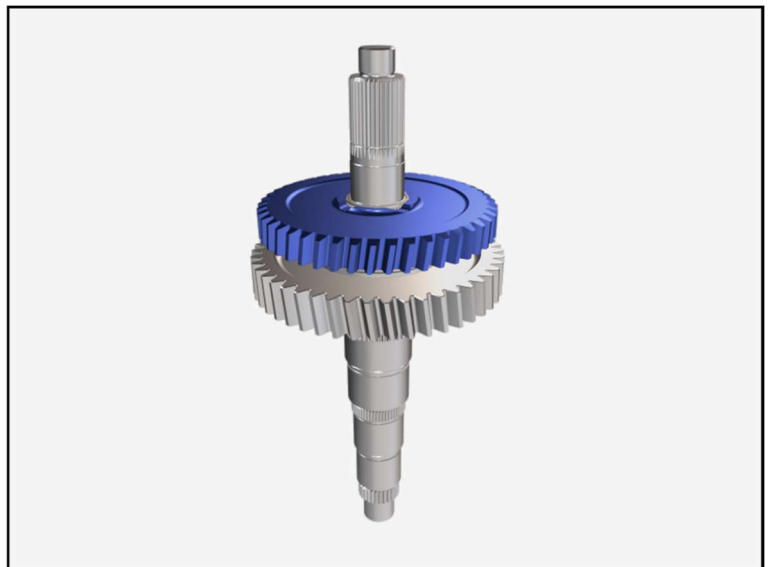


Disassembly and Assembly

7. Position the two needle bearings of the reverse speed gear.



8. Position the reverse speed gear.



9. Position the thrust washer.



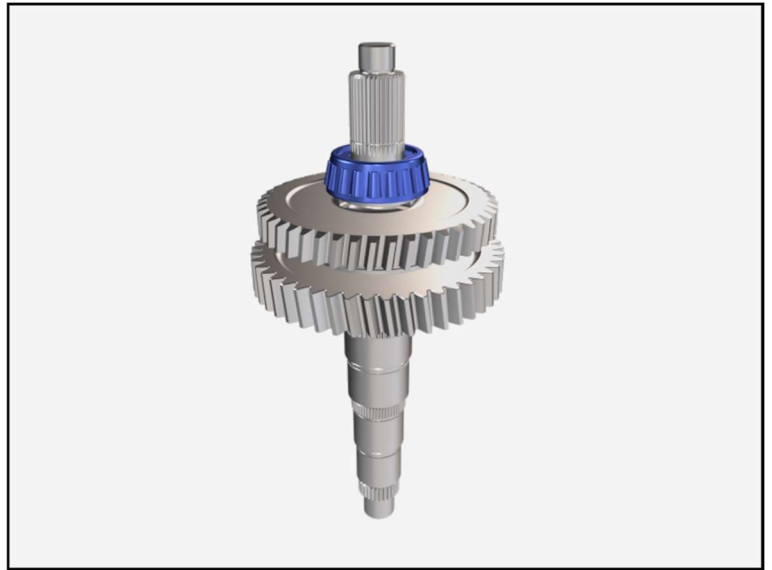
Disassembly and Assembly

10. Install the reverse side main shaft bearing cone.

NOTE! Use the special tool E010019 with a press.



NOTE! Apply lubricating oil used in the transmission to the inside diameter of the bearing cone.



11. Place the main shaft on a workbench with the rear bearing facing down.

12. Position the 1st and 2nd speed synchronizer assembly.



13. Position the two needle bearings of the 2nd speed gear.



14. Position the 2nd speed gear.



15. Position the retaining ball.



16. Insert the retaining ball, then the thrust washer, fitting the groove of the washer into the ball.



17. Insert the locking ring.



18. Position the two needle bearings of the 3rd speed gear.



19. Position the 3rd speed gear.



Disassembly and Assembly

20. Position the 3rd and 4th speed synchronizer hub.



21. Insert the locking ring.



22. Position the 3rd and 4th speed synchronizer assembly.



Disassembly and Assembly

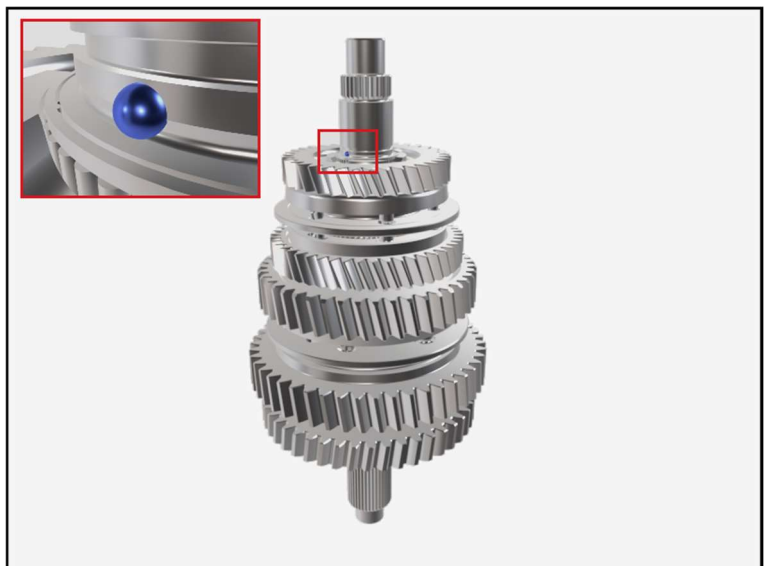
23. Position the two needle bearings of the 4th speed gear.



24. Position the 4th speed gear.



25. Position the retaining ball.



Disassembly and Assembly

26. Place the thrust washer, fitting its recess into the retaining ball.



27. Insert the locking ring.



28. Position the two needle bearings of the 6th speed gear.



29. Position the 6th speed gear.



30. Position the 5th and 6th speed synchronizer hub.



31. Install the “pocket” main shaft bearing cone.

NOTE! Use the special tool E001084 with a press.



NOTE! Apply lubricating oil used in the transmission to the inside diameter of the bearing cone.

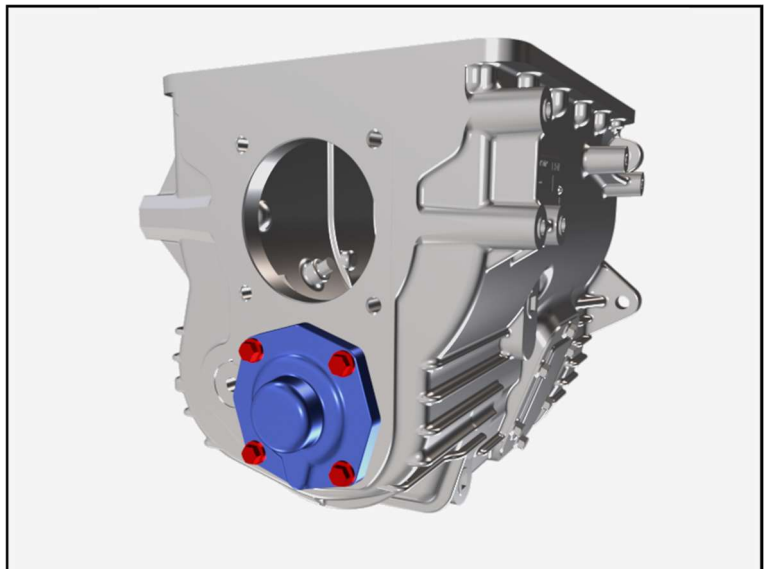


32. Position the 5th and 6th speed synchronizer assembly.



Reverse Idle Gear Assembly Removal

1. Remove the countershaft bearing cover. 14mm socket.

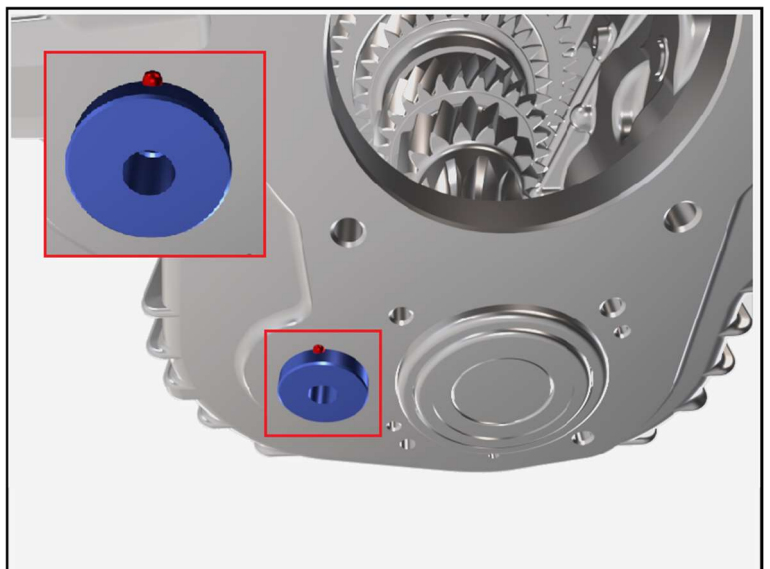
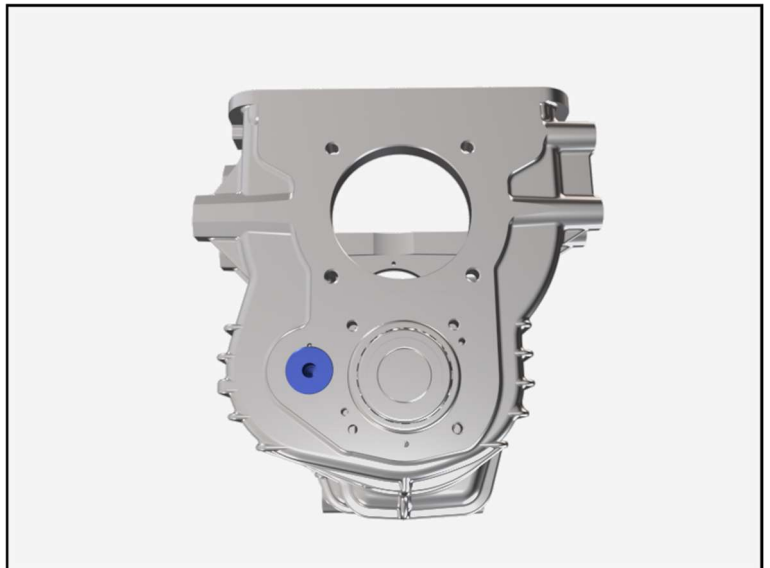


2. Remove the shaft from the reverse idle gear.

NOTE! Use special tools E017015 and E005018.



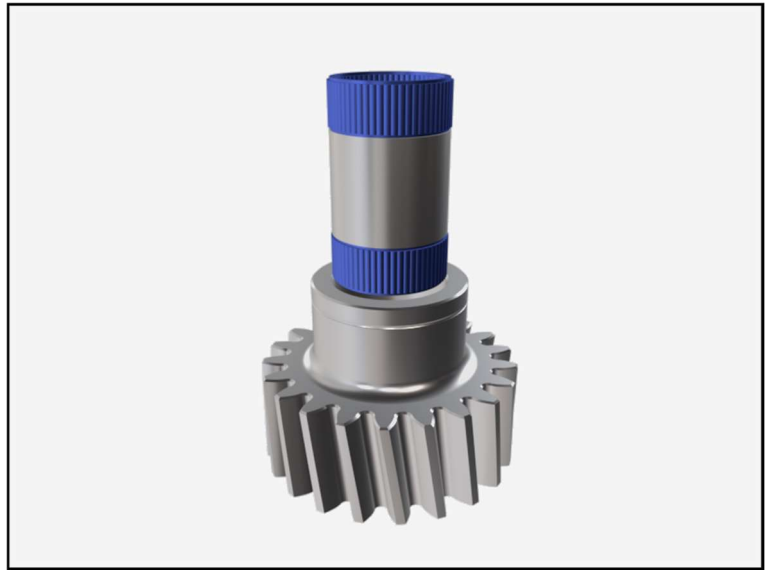
WARNING! Remove the retaining ball from the reverse idler gear shaft.



3. Remove the reverse idle gear.



4. Remove the two needle bearings and the center spacer.



Countershaft Assembly Removal and Disassembly

1. Remove the conical bearing cap from the countershaft, driven gear side and reverse gear from the housing, where required.

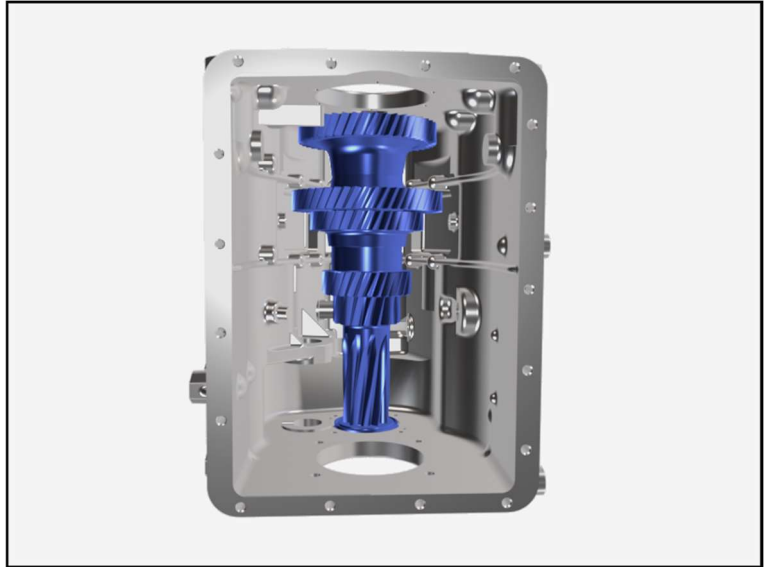
NOTE! When replacing the bearing cone, the cap must be replaced.



2. Check the condition of the countershaft bearing cap on the rear cover.

Disassembly and Assembly

3. Remove the countershaft assembly using a hoist and lifting strap and place it on a workbench.



4. Remove the bearing cone from the countershaft on the driven gear side.

NOTE! Use special tools E005019 and E005014.



5. Check the condition of the front countershaft bearing.
6. Remove the locking ring.



Disassembly and Assembly

7. Use a press to remove all gears from the countershaft in the sequence below.
8. Driven gear countershaft.



9. 6th speed gear countershaft.



10. 4th speed gear countershaft.



11. 3rd speed gear countershaft.



12. Turn the countershaft over and remove the bearing cone from the reverse side countershaft.

NOTE! Use special tools E005020 and E005014.



13. Check the condition of the rear countershaft bearing.

14. Remove the conical bearing cap from the countershaft, driven gear side and reverse gear from the housing, where required.

NOTE! When replacing the bearing cone, the cap must be replaced.



Countershaft Assembly

1. Position the countershaft in a press with the 1st and reverse speed gears facing up.



2. Install the reverse side countershaft bearing cone.

NOTE! Use the special tool E010021 with a press.



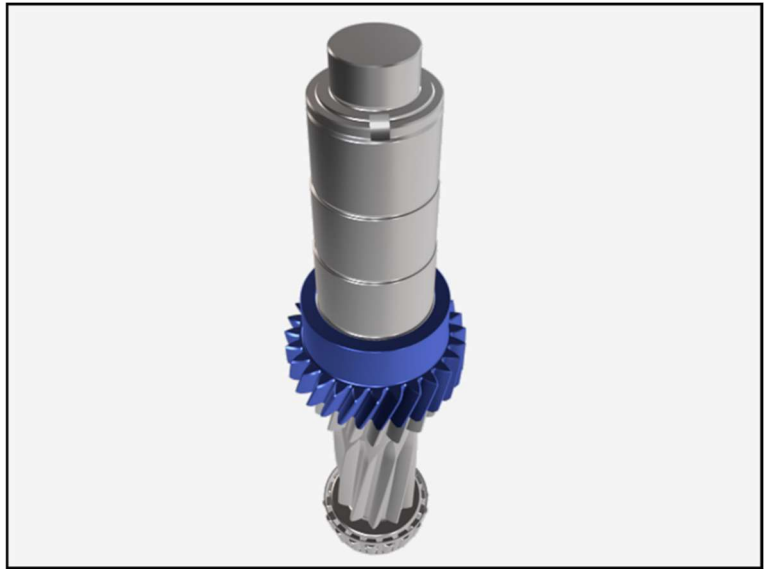
NOTE! Apply lubricating oil used in the transmission to the inside diameter of the bearing cone.



3. Turn the countershaft.

Disassembly and Assembly

4. Using the press, place the 3rd speed gear on the countershaft.



5. Place the 4th speed gear on the countershaft.



6. Place the 6th speed gear on the countershaft.



Disassembly and Assembly

7. Place the driven gear on the countershaft.



8. Place the countershaft on a workbench and put the locking ring.



9. Install the countershaft bearing cone, driven gear side.

NOTE! Use the special tool E010021 with a press.



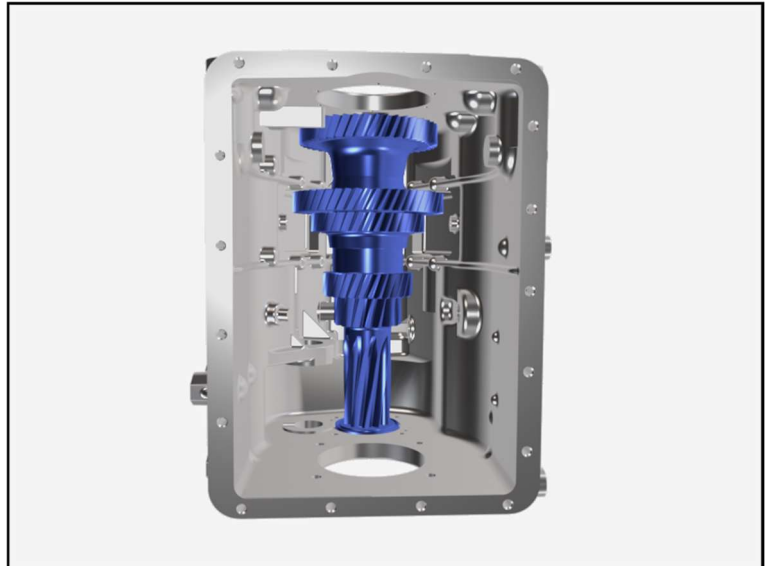
NOTE! Apply lubricating oil used in the transmission to the inside diameter of the bearing cone.



Transmission Assembly

Countershaft Installation

1. Reposition the countershaft assembly into the transmission case.

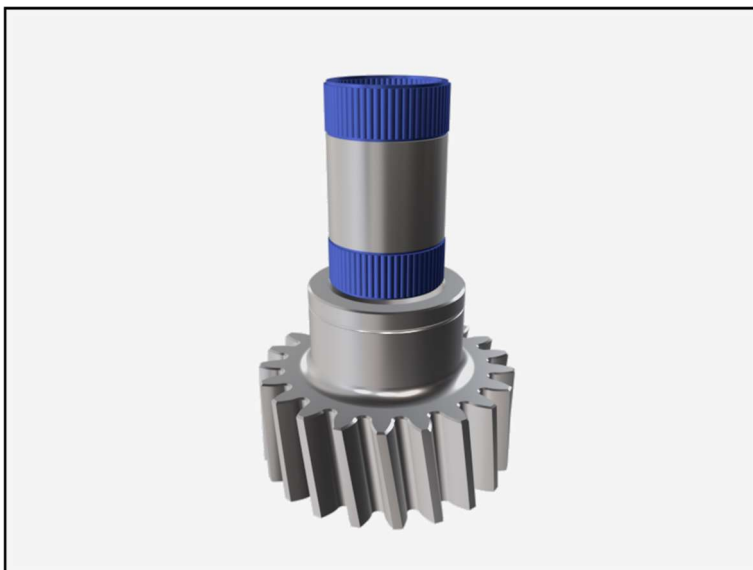


2. Fit the outer cover of the countershaft rear bearing.



Disassembly and Assembly

3. Fit the two needle bearings with central spacer into the reverse idle gear.



4. Reposition the reverse idler gear into the transmission case.



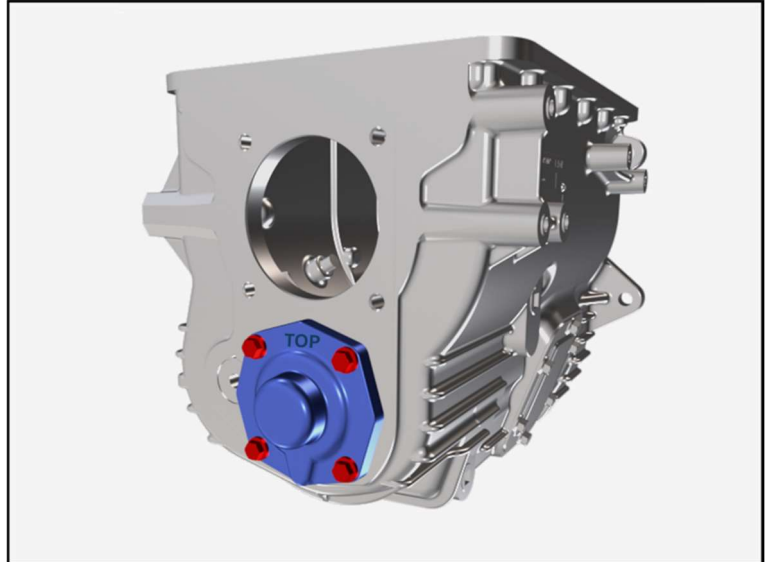
5. Fit the reverse idle gear shaft, observing the alignment of its retaining ball.



6. Clean the contact surfaces between the countershaft rear cover and the transmission case, removing any traces of previous sealant.
7. Assemble the countershaft rear cover, using the same adjustment shims for the first check of the axial clearance. At this first stage, do not use sealant.



WARNING! *The TOP marking on the cover must be mounted facing upwards to avoid compromising bearing lubrication.*

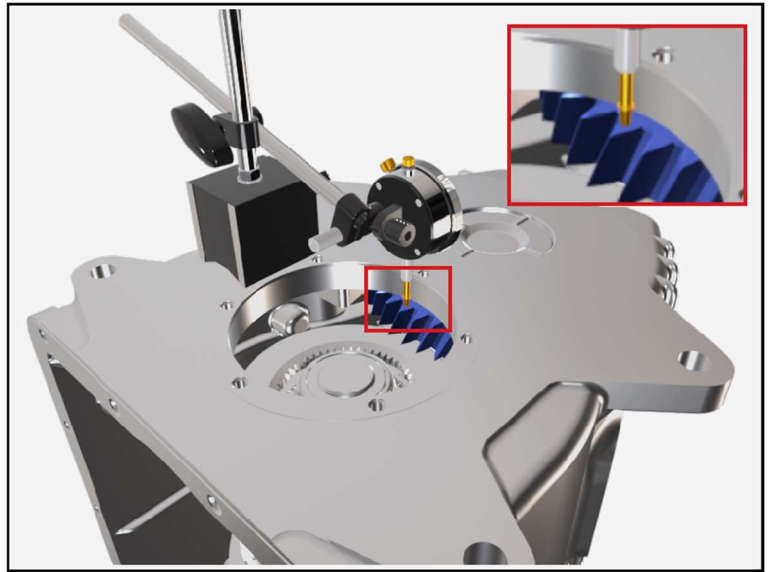


Countershaft Axial Clearance Measurement

1. Turn the transmission so that its front part is facing up.
2. Remove the side cover for the power outlet.
9/16" socket



3. Place the magnetic base on the transmission case and the dial indicator on the countershaft driven gear.



4. Through the power outlet window, lever the countershaft gear, note the axial clearance value, and compare it with the table.



CAUTION! Rest the lever on the root of the gear teeth to prevent damage.

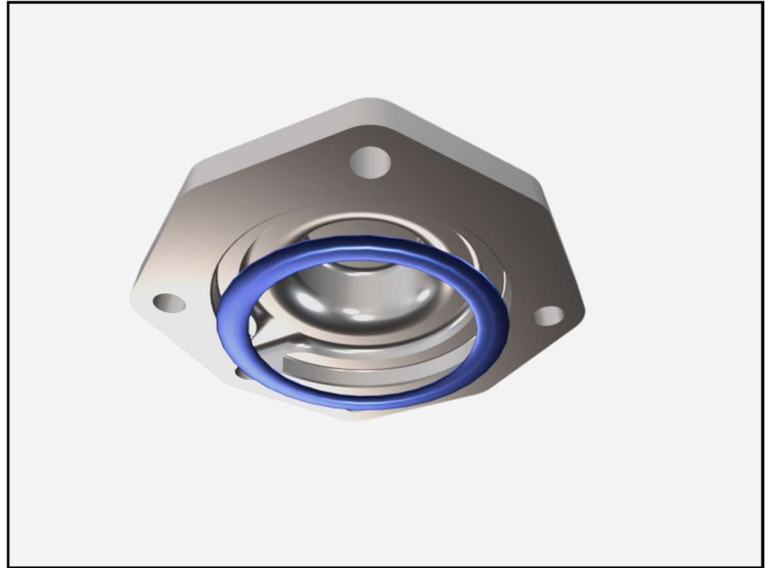


Transmission model	Countershaft axial clearance
FS(O)-5406A	0.153 - 0.254 mm (0.0060 - 0.0100 in)
FS(O)-6506A	0.153 - 0.254 mm (0.0060 - 0.0100 in)

- If necessary, remove the cover and add or remove shims to adjust the clearance as per the table.

TIP! The axial play decreases in the countershaft when you add shims to the cover.

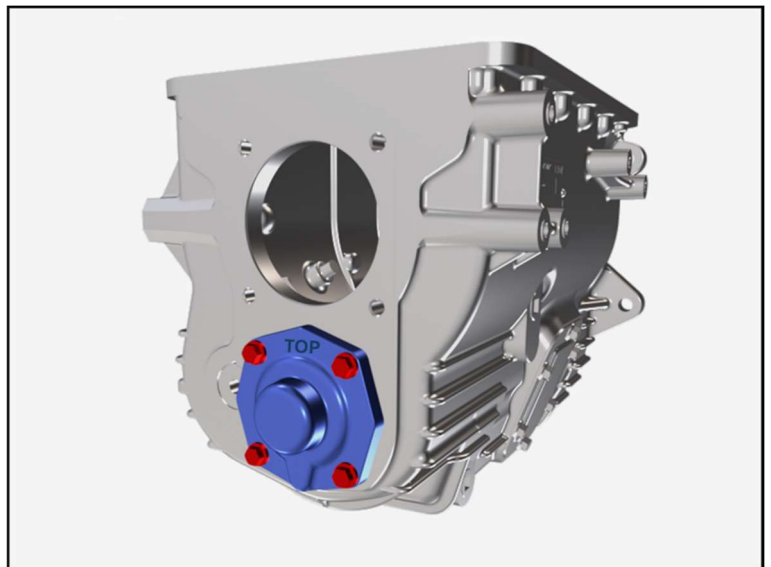
NOTE! The exploded views display the available shim thicknesses.



- After adjusting the axial clearance, remove the countershaft rear cover again.
- Apply a string of sealant to the contact face of the transmission case.
- Reassemble the countershaft rear cover and apply torque.



WARNING! The TOP marking on the cover must be mounted facing upwards to avoid compromising bearing lubrication.

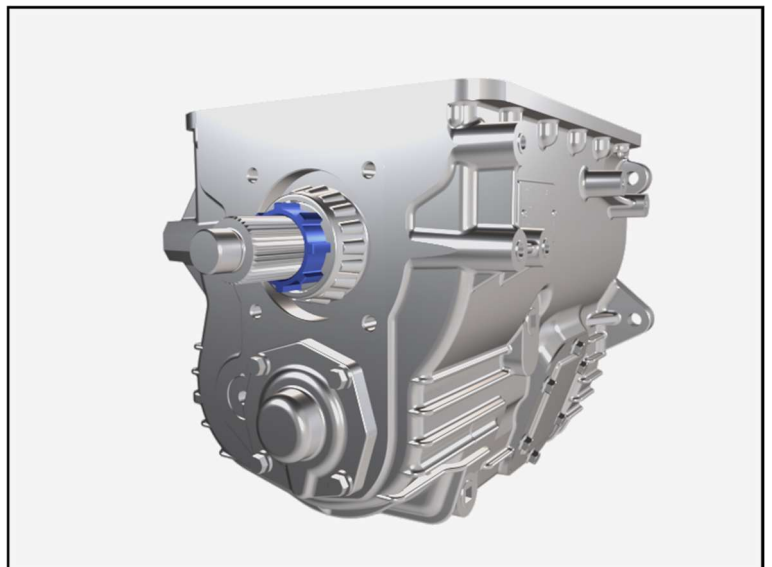


Main Shaft Installation

1. Place the transmission in a horizontal position.
2. Reposition the main shaft assembly, observing the correct fit of the gears between the main shaft and the countershaft.



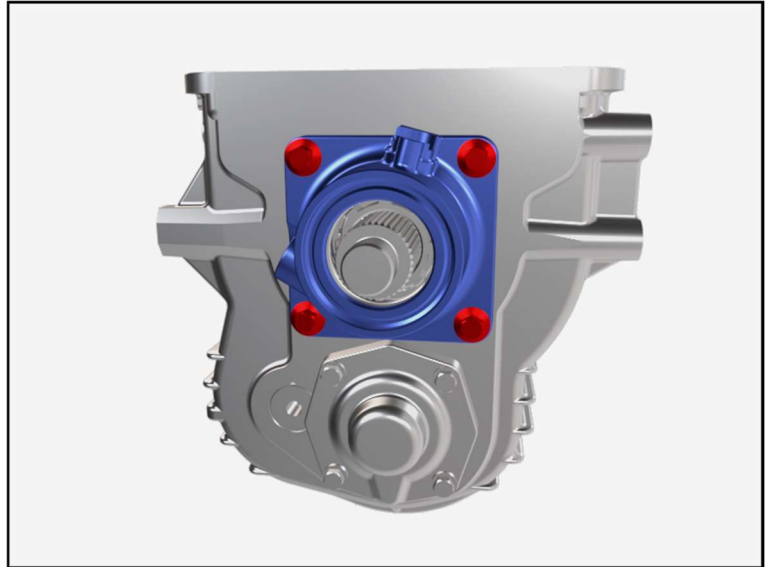
3. Place the speedometer sensor rotor.



4. Clean the contact surfaces of the rear cover, shims, and transmission case, removing any traces of previous sealant.

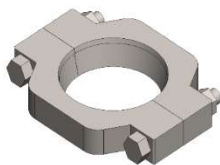
5. Assemble the countershaft rear cover, initially using the same adjustment shims for the 1st check of the axial clearance. At this first stage, do not use sealant.

NOTE: Install the cover with the speedometer sensor housing facing upwards.



6. Turn the transmission so that its front part is facing up.
7. Clean the contact surfaces between the front cover and the transmission case, removing any traces of the previous gasket.
8. Removal and replacing of the input shaft bearing cone.

NOTE: Use special tool E017014 combined with a press for removal.

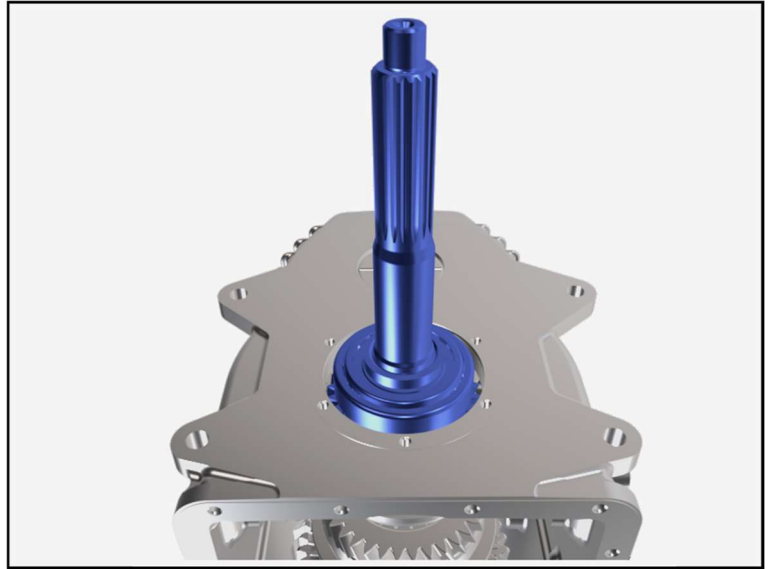


NOTE: Use special tool E010020 for installation.



Disassembly and Assembly

9. Position the input shaft assembly.



10. Position the front transmission cover with a new sealing gasket. Pay attention to the assembly position (reference facing upwards).



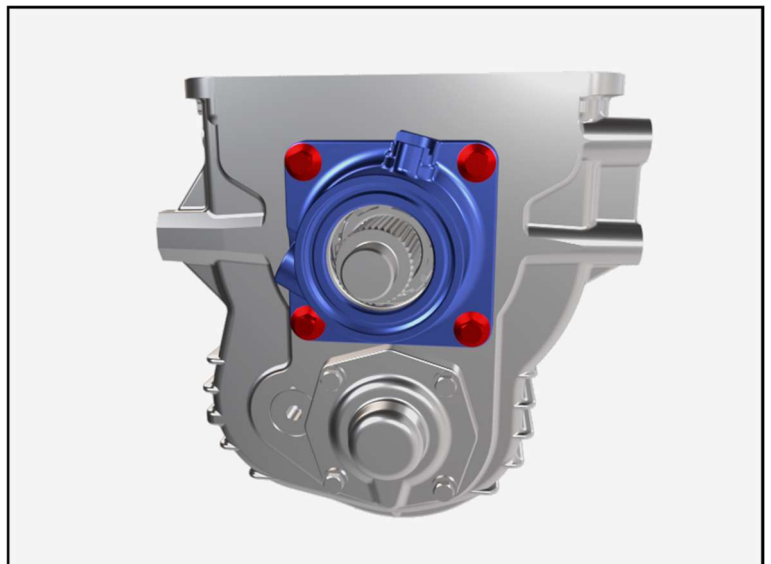
WARNING! *The prominent projection on the cover must be mounted facing upwards to avoid compromising the bearing lubrication.*



11. Place and tighten the screws in a criss-cross pattern.

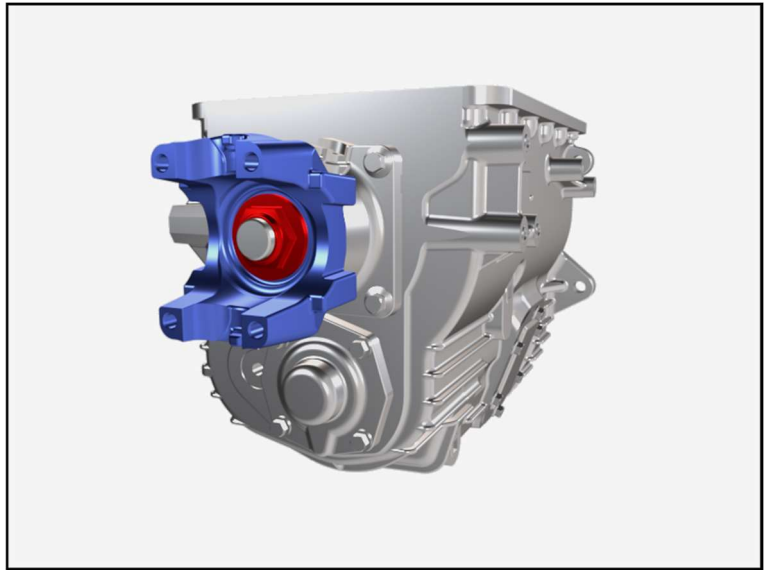
Main Shaft Axial Clearance Measurement

1. Assemble the main shaft rear cover.

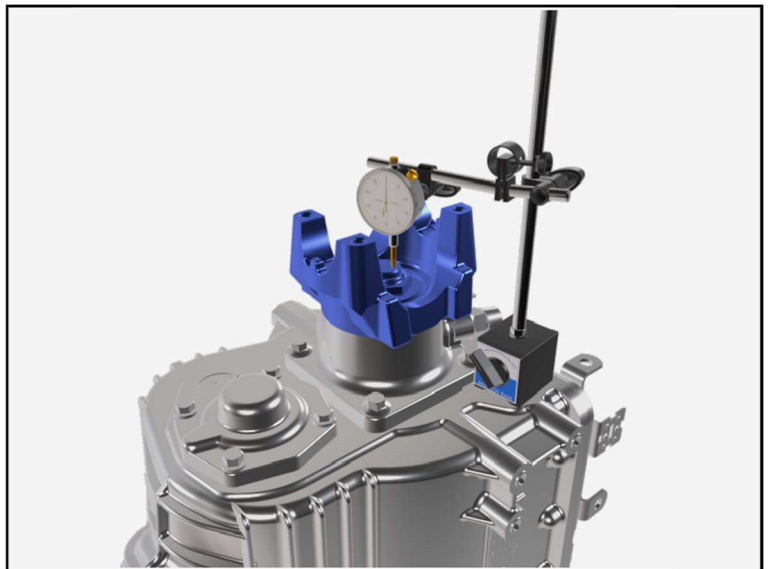


Disassembly and Assembly

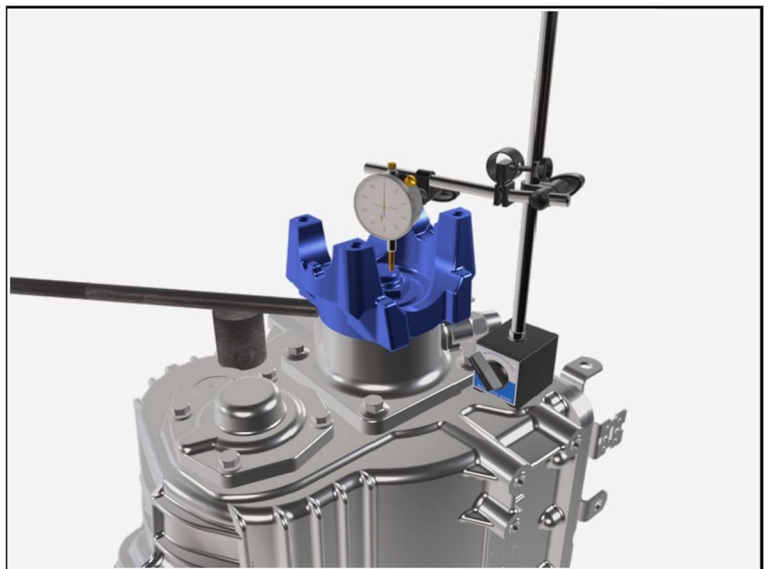
2. Fit the yoke and tighten just enough to secure the part while measuring the clearance.



3. Turn the transmission in 180° so that its rear part is facing up.
4. Place the magnetic base on the transmission case and the dial indicator on the rear end of the main shaft.



5. Lever the yoke, note the axial clearance value, and compare it with the table.

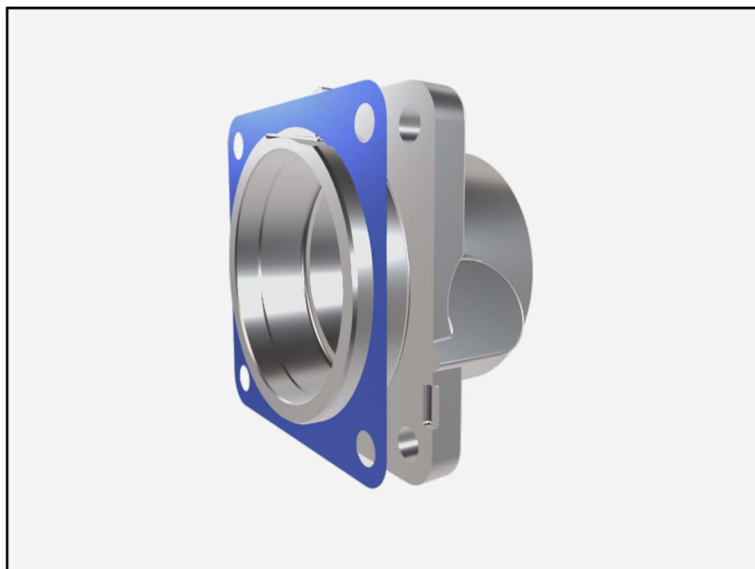


Transmission model	Main shaft axial clearance
FS(O)-5406A	0.153 - 0.254 mm (0.0060 - 0.0100 in)
FS(O)-6506A	0.153 - 0.254 mm (0.0060 - 0.0100 in)

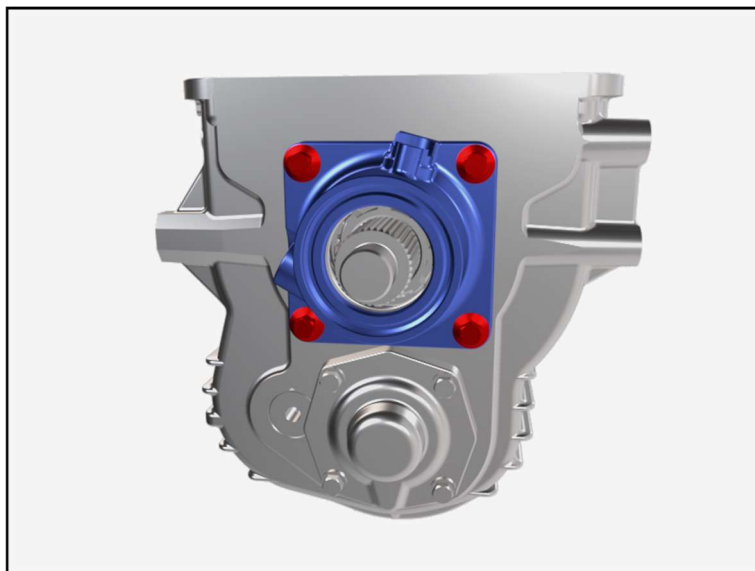
- If necessary, remove the yoke, remove the cover, and add or remove shims to adjust the clearance according to the table.

TIP! The axial play increases in the main shaft when you add shims to the cover.

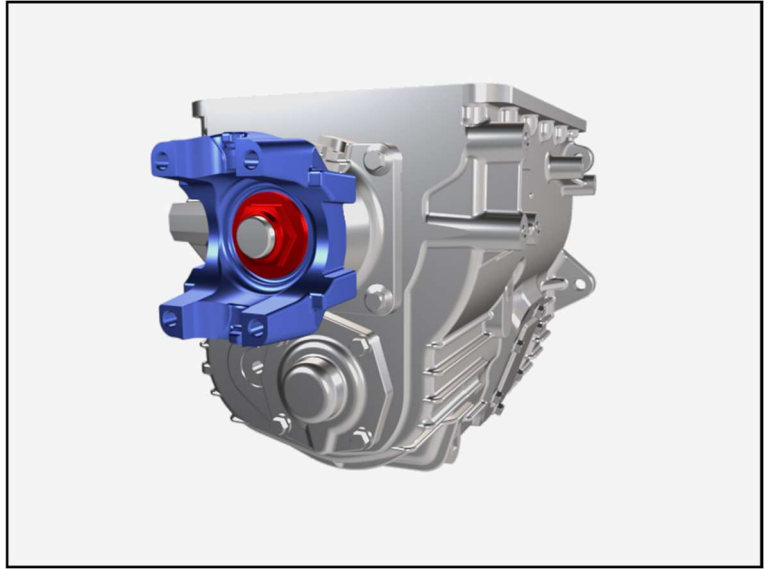
NOTE! The exploded views display the available shim thicknesses.



- After adjusting the axial clearance, apply a string of sealant to the contact face of the transmission case and to one of the shim faces.
- Assemble the rear cover and apply torque in a criss-cross pattern.



9. Assemble the yoke and apply the final torque (it is necessary to place the transmission horizontally and use the yoke locking tool).



10. Clean the contact surfaces between the power outlet side cover and the transmission case, removing any traces of previous sealant.
11. Apply a string of sealant to the contact face of the transmission case.
12. Assemble the power outlet side cover, insert the screws, and apply the torque in a cross-cross pattern.



Control Cover Installation

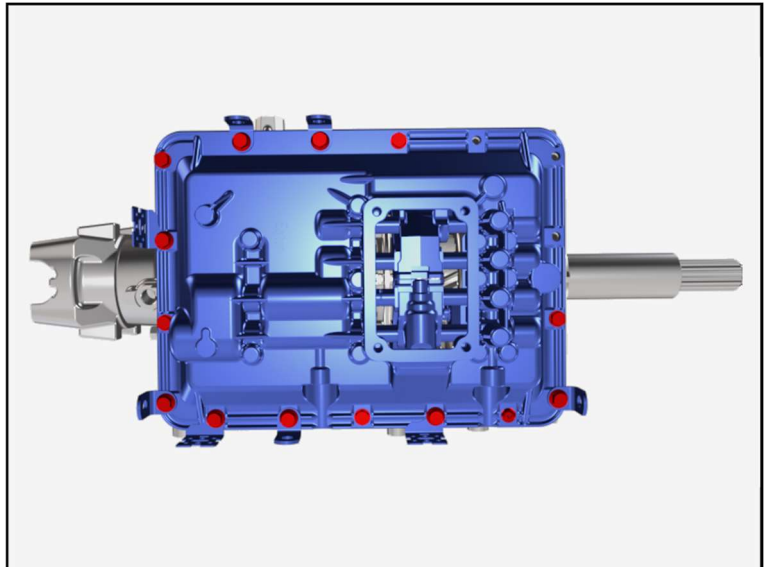
1. Turn the transmission and place it in a horizontal position.
2. Make sure all speed gears are disengaged on both the transmission and the control cover yokes, this will make assembly easier.
3. Clean the contact surfaces between the control cover and the transmission case, removing any traces of previous gasket.
4. Fit a new sealing gasket in the transmission case.
5. Place the control cover over the transmission.

Disassembly and Assembly

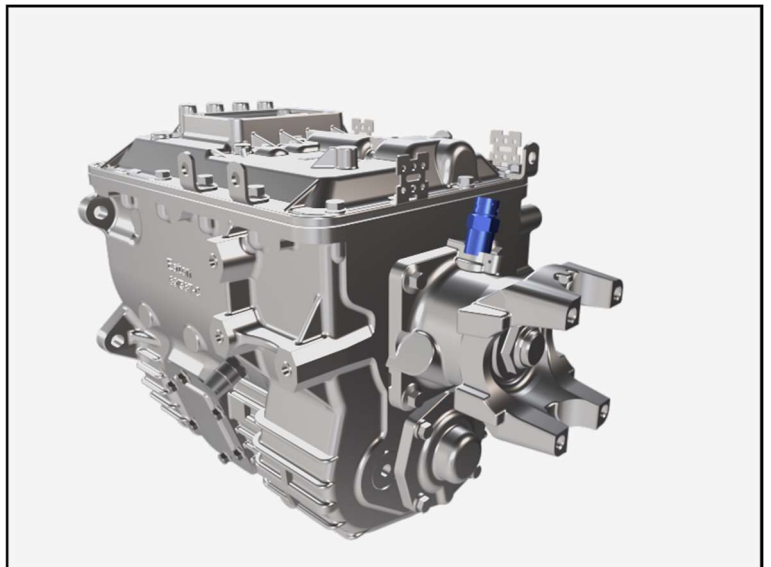
6. Make sure the shift yokes are aligned with the synchronizer assemblies.



7. Lower the control cover, insert the bolts, and tighten them in a criss-cross pattern.

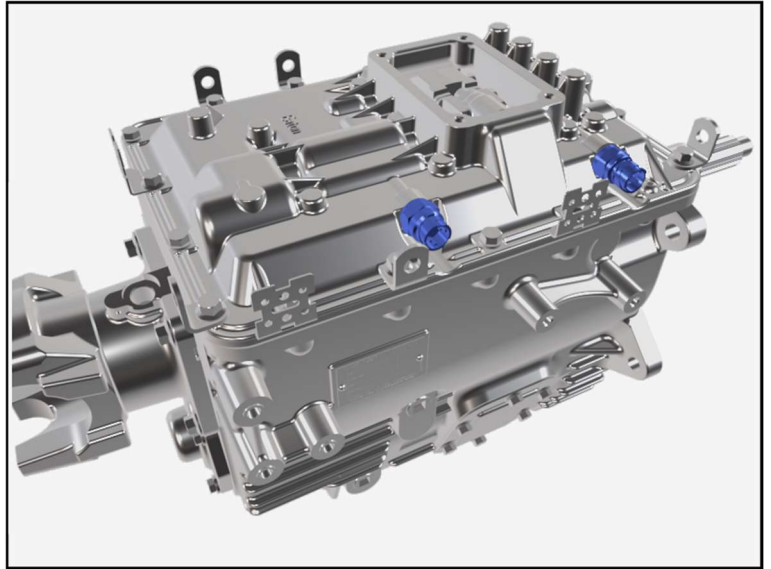


8. Install the speedometer sensor.



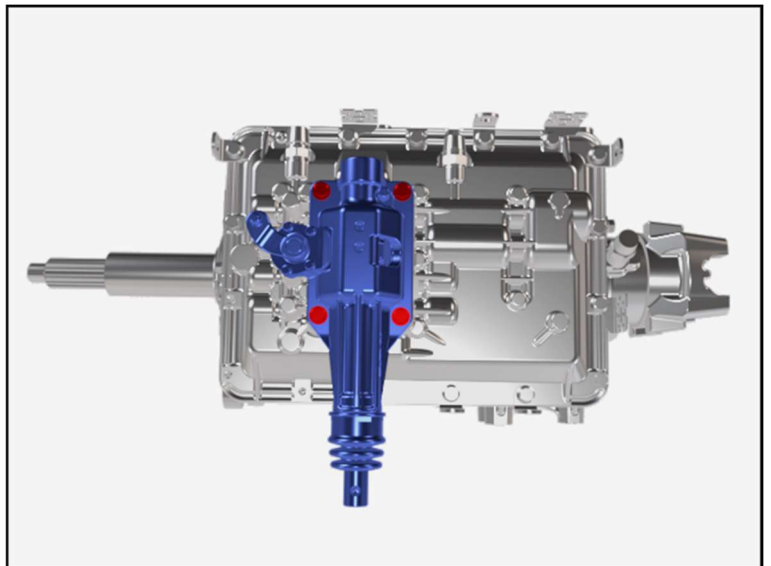
Disassembly and Assembly

9. Install the reverse speed and neutral sensors.

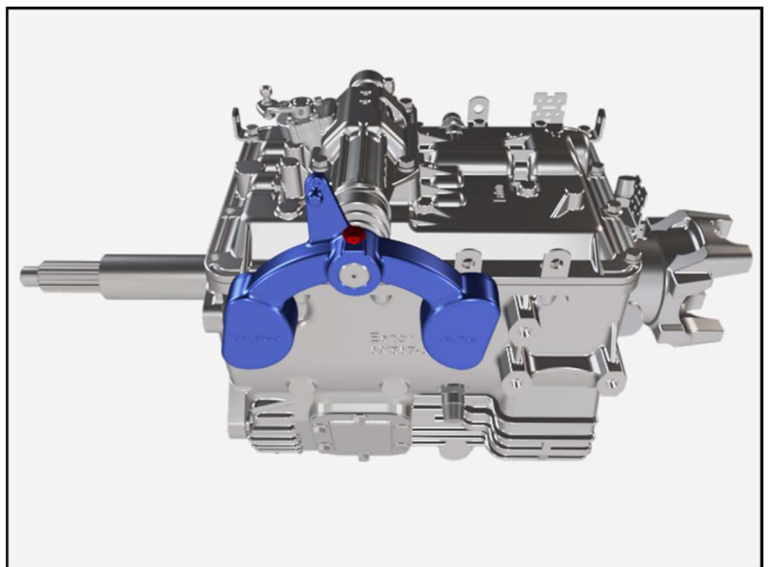


Control Tower Installation

1. Reposition the control tower with a new gasket and apply torque in a criss-cross pattern.

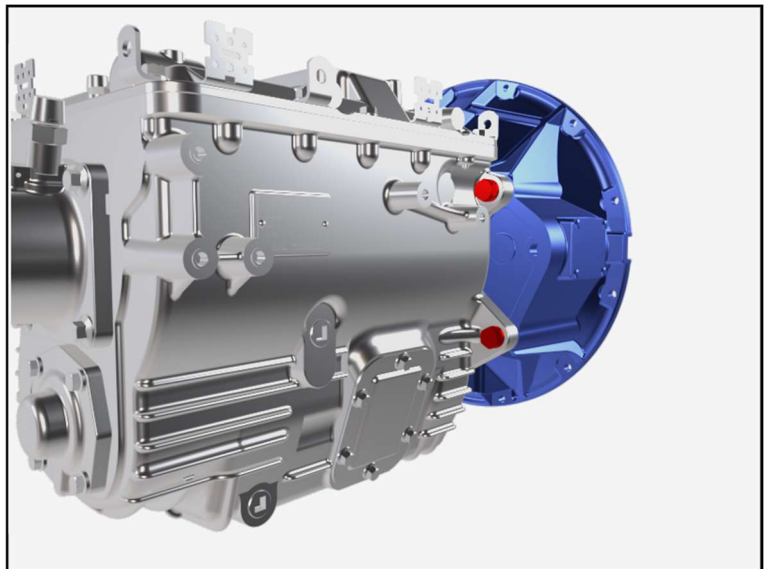
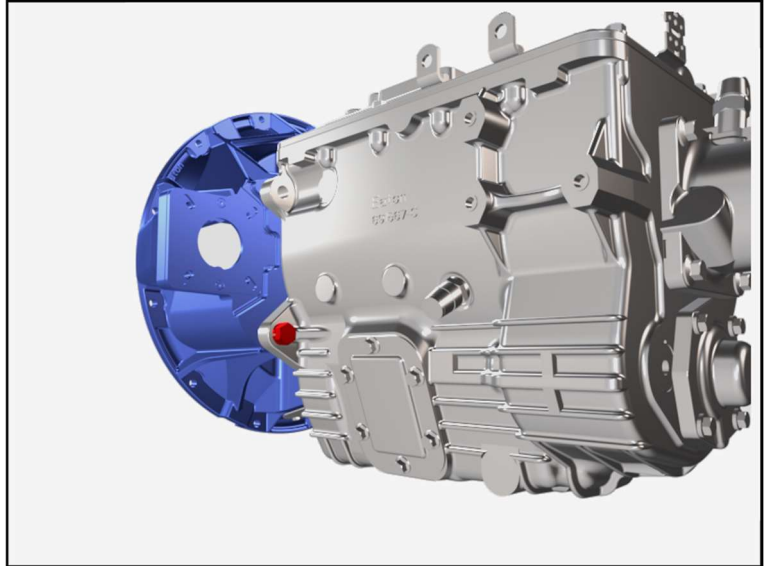


2. Reposition the counterweight hitch rod and torque the bolt.



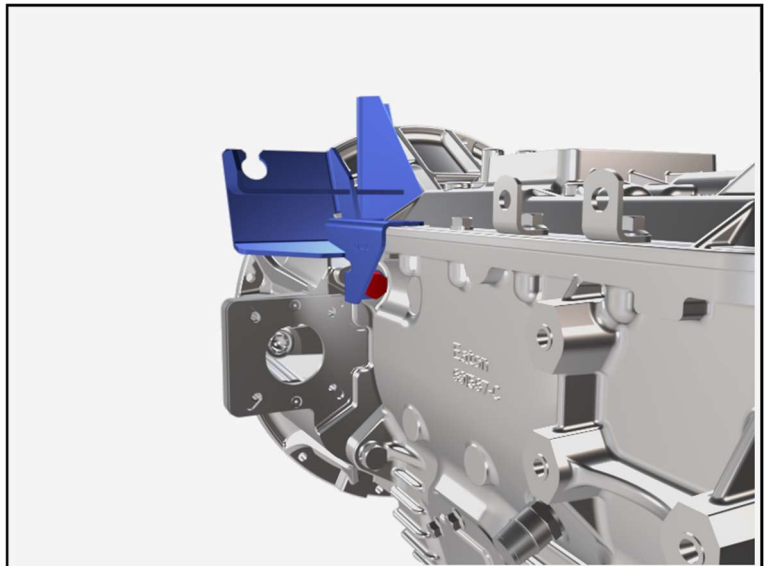
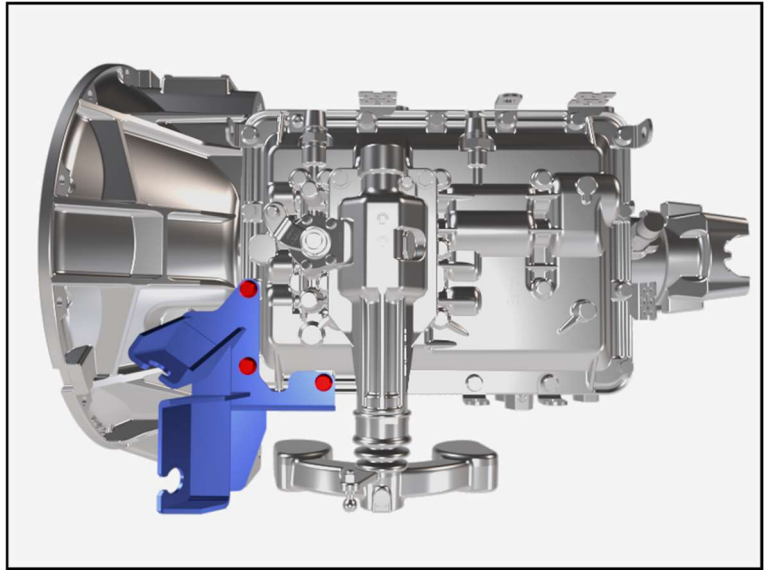
Final Assembly

1. Remove the transmission from the rotating stand.
2. Reposition the clutch case and install the bolts, except for the screw securing the selection and engagement cable bracket.

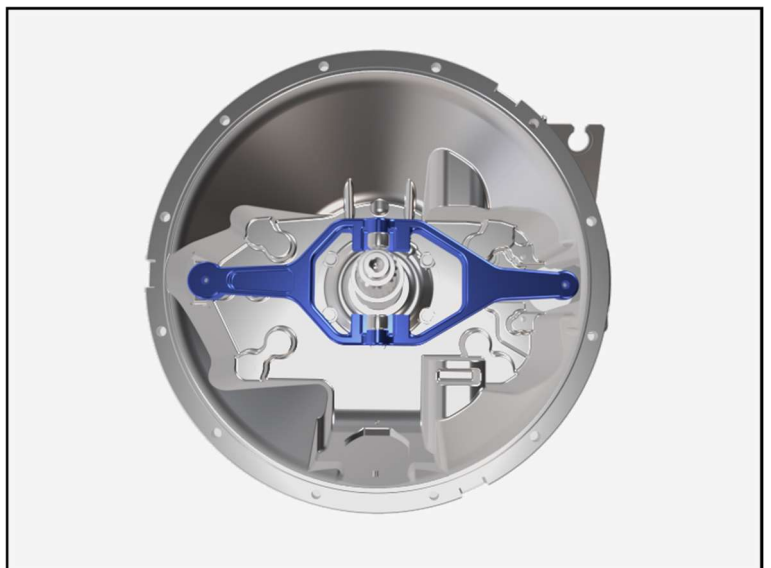


Disassembly and Assembly

3. Reposition the selection and engagement cable bracket, place the three upper screws and the lower retaining bolt.



4. Apply torque to the clutch case and selection and engagement cable bracket bolts.
5. Position the clutch drive shift yoke and temporarily secure it with a Hellerman type strap.



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