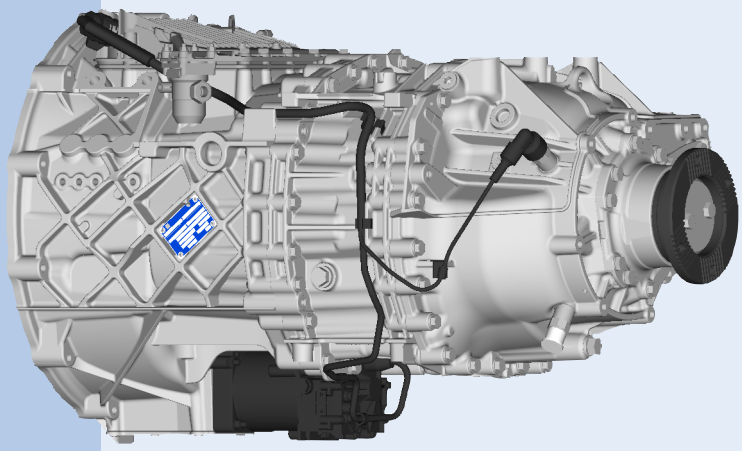
ZF-AS TRONIC

Repair Manual

Trucks and Buses



10-, 12- and 16-speed version
without ZF-Intarder

Repair Level 3

1327 751 102b

Subject to technical changes

Printed in Germany

ZF Friedrichshafen AG, MC-C dept. / 2002-01

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1327 751 102b

Index	Date of issue	Initiator	Remark
a	2004-02	LKS-T dept.	The scope of validity of the ZF-AS Tronic transmission Repair Manual was extended to 10-, 12-, and 16-speeds.
b	2007-05	LKS-T dept.	Complete revision of text, i.a. the following items were added: - Solid sealings - Measuring disks in helical gears and on the main shaft. - Service Information No. 08_00, 02_04, 02_05, 20_04, 25_05. - New clutch release mechanism

This documentation is intended for skilled personnel trained by ZF Friedrichshafen AG to carry out maintenance and repair work on ZF products.

This manual deals with the standard ZF products in accordance with the state of development on the date of issue.

However, due to continuing technical development of the product, repair work might require work practices and test or adjustment data not contained in this manual.

We recommend that work done on your ZF product is carried out only by skilled mechanics who have had their practical and theoretical knowledge updated on a regular basis at our Customer Service / After Sales training center.

Service Centers equipped by ZF Friedrichshafen AG all over the world offer you:

1. Continually trained personnel,
2. Specified equipment, e.g. special tools,
3. Genuine ZF spares, according to our latest specifications.

All work performed at these Service Centers is carried out conscientiously and with utmost care.

Warranty:
Repair work carried out at ZF Service Centers is subject to the contractual conditions prevailing in the individual case.

Damage resulting from work performed by non-ZF personnel in an improper and unprofessional manner and any consequential costs are excluded from the contractual liability agreement. Exclusion of liability also applies if genuine ZF spares are not used.

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Safety Instructions

In principal, companies repairing ZF units are responsible for their own work safety.

To avoid injury to personnel and damage to products, all safety regulations and legal requirements which apply to repair and maintenance work must be adhered to.
Before starting work, mechanics must familiarize themselves with these regulations.

Personnel required to carry out repairs on ZF products must receive appropriate training in advance. It is the responsibility of each company to ensure that their repair staff is properly trained.

The following safety instructions appear in this manual:

NOTE
Refers to special working procedures, methods, information, use of auxiliary equipment, etc.

CAUTION
This is used when incorrect, unprofessional working practices could damage the product.

⚠ **DANGER**
This is used when lack of care could lead to personal injury or death.

General Information

Read this manual carefully before starting any tests or repair work.

CAUTION
Pictures, drawings, and components shown do not always represent the original object, but are used to illustrate working procedures.
Pictures, drawings, and components are not to scale. Conclusions about size and weight should not be drawn (even within a complete illustration).
Always follow the working steps as described in the text.

After completion of repair work and testing, skilled staff must check whether the product is functioning correctly.

⚠ **THREATS TO THE ENVIRONMENT!**
Lubricants, consumables, and cleaning agents must not be allowed to enter the soil, ground water, or sewage system.

- **Ask your local environment agency for safety information on the relevant products and adhere to their requirements.**
- **Collect used oil in a suitably large container.**
- **Dispose of used oil, dirty filters, lubricants, and cleaning agents in accordance with environmental protection guidelines.**
- **When working with lubricants and cleaning agents always refer to the manufacturer's instructions.**

CAUTION
The transmission must NOT be suspended by the input shaft NOR by the output flange.

ZF Service Information must be observed. This information is available at all ZF Service Centers or via the ZF-ServiceLine.

In case of doubt always turn to the relevant department within ZF Customer Service / After Sales Service for advice.
All work on transmissions is to be performed by experts only and under clean conditions.
Use specified tools to dismantle and assemble transmissions.

After removing the transmission from the vehicle, clean it thoroughly with a suitable cleaning agent before opening.
Pay particular attention to the projections and recesses of housings and covers when cleaning.

Parts joined with Loctite are easier to separate if warmed with a fan heater.

Cleaning Parts

Remove remains of old gaskets on all sealing surfaces. Carefully remove burrs or similar patches of roughness using an oilstone.

Lube bores and grooves must be free of anti-corrosion agents and foreign matter; check for perfect passage.

Carefully cover opened transmissions to prevent foreign matter from entering.

Reusing Parts

Parts such as roller bearings, disks, thrust washers etc., must be inspected by a competent person who should decide whether or not they can be re-used. Replace parts which are damaged or have suffered from excessive wear.

Gaskets, Locking Plates

Parts which cannot be removed without being damaged must always be replaced with new parts (e.g. gaskets and locking plates).

Shaft Seals

Always change shaft seals with rough, ripped, or hardened sealing lips. Seal contact surfaces must be totally clean and in perfect condition.

Reworking

Rework may be carried out on seal contact surfaces using plunge-cut grinding only, never use an emery cloth. Ensure that there are no traces of grinding or scroll.

If rework is needed on spacer disks, shims etc. because of clearance adjustment, ensure that the reworked areas contain no face runout and have the same surface quality.

Transmission Assembly

Find a clean work area to assemble the transmission. Gaskets are installed without sealing compound or grease. When measuring silicon-coated gaskets, do **not include the silicon layer.** During assembly, comply with all adjustment data and tightening torques in the Repair Manual.

Bearings

If bearings are mounted in heated condition, they are to be heated evenly (e.g. heating cabinet). Temperature should be at approx. 85 °C and must not exceed 120 °C. Each mounted bearing must be lubricated with operating oil.

Sealing

If a specific sealing agent* is to be used for sealing, comply with the manufacturer's directions for use. Apply a thin layer of sealing agent to the surfaces and spread evenly. Do not allow sealing to enter oil ducts and bores. On oil-carrying ducts and bores, wipe off the sealing agent on the surfaces to be sealed near apertures to ensure that no sealing agent enters the oil feeds when the parts are pressed together.

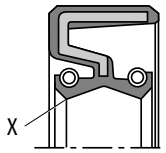
Shaft Seals

a) Apply a light coat of sealing agent* on circumference of shaft seals with "steel jacket".

b) **Never apply sealing agent** to shaft seals with "rubber jacket", but apply a thin coat of Vaseline 8420 to the outer circumference or wet with a lubricant, e.g. a water-soluble, concentrated washing-up liquid (e.g. Pril, Coin, Palmolive).

c) Shaft seals with steel and rubber jackets should be treated on the outer circumference of the rubber jacket as described for shaft seal b).

d) Dual shaft seals have two sealing lips. The dust-proof sealing lip (X) must face outwards.



e) Fill the gap between the sealing lips so it is 60 % filled with grease (e.g. produced by Aral, such as Aralub HL2 or by DEA, such as Spectron FO 20).

f) If possible, heat shaft seal bores to between 40 and 50 °C (makes fitting easier). Press in shaft sealing ring with mounting or face plate until firmly home at relevant installation depth.

Retaining Agents

Retaining agents* may only be used where specified by the parts list.
Always comply with manufacturer's directions for use when using retaining agents (e.g. Loctite).
During assembly, comply with all adjustment data, checking data, and tightening torques.

Transmission Oil

After completing repairs, fill transmissions with transmission oil. For the procedure and approved oil grades, refer to the transmission Operating Instructions and TE-ML List of Lubricants (refer to identification plate) which can be obtained from all ZF Customer Service / After Sales Centers and on the Internet under www.zf.com.
After filling the transmission with oil, tighten the screw plugs at the oil filling point and the oil overflow using the specified torques.

* refer to expendable material

Tightening Torques for Bolts/Screws and Nuts Extract from ZFN 148

This standard applies to screws/bolts acc. to DIN 912, DIN 931, DIN 933, DIN 960, DIN 961, as well as ISO 4762, ISO 4014, ISO 4017, ISO 8765, ISO 8676, and to nuts acc. to DIN 934 as well as ISO 4032, ISO 8673.

This Standard contains data on tightening torques for screws/bolts and nuts in strength categories 8.8, 10.9, and 12.9, and nuts in strength categories 8, 10, and 12.

Surface condition of bolts/screws and nuts: Thermally blackened and oiled or galvanized and oiled or galvanized, chromated, and oiled.

Tighten screws/bolts with a calibrated ratchet dial torque or ratchet wrench.

NOTE
Deviating tightening torques are listed separately in the Repair Manual.

Regular screw thread

Size	Tightening torque (Nm) for		
Screw/Bolt	8.8	10.9	12.9
Nut	8	10	12
M4	2.8	4.1	4.8
M5	5.5	8.1	9.5
M6	9.5	14	16.5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250

Fine screw thread

Size	Tightening torque (Nm) for		
Screw/Bolt	8.8	10.9	12.9
Nut	8	10	12
M8x1	24	36	43
M9x1	36	53	62
M10x1	52	76	89
M10x1.25	49	72	84
M12x1.25	87	125	150
M12x1.5	83	120	145
M14x1.5	135	200	235
M16x1.5	205	300	360
M18x1.5	310	440	520
M18x2	290	420	490
M20x1.5	430	620	720
M22x1.5	580	820	960
M24x1.5	760	1100	1250
M24x2	730	1050	1200
M27x1.5	1100	1600	1850
M27x2	1050	1500	1800
M30x1.5	1550	2200	2550
M30x2	1500	2100	2500

Edition: August 1991

Screw Plugs DIN 908, 910, and 7604

The screw plug tightening torques were determined according to DIN 7604 for screwing into steel, gray cast, and aluminum alloys.
The values are based on experience and are intended as reference values for the fitter.
The values for the tightening torque apply analogously to screw plugs according to DIN 908 and DIN 910, as the thread geometries are almost identical.

General rule:
Screw/Bolt class 5, ZFN 148-1
Screw/Bolt material: Steel acc. to DIN 7604.
Surface condition: As manufactured (without surface protection) and lightly oiled or galvanized, chromated, and lightly oiled.

Screw plugs (DIN 908, 910, 7604)

Dimensions	Tightening torque in Nm screwed into	
	steel/gray cast	Al alloy
M8x1	20*	10*
M10x 1	25 / 30*	15 / 20*
M12x1.5	35	25
M14x1.5	35	25
M16x1.5	40	30
M18x1.5	50	35
M20x1.5	55	45
M22x1.5	60 / 80*	50 / 65*
M24x1.5	70	60
M26x1.5	80 / 105*	70 / 90*
M27x2	80	70
M30x1.5	100 / 130*	90 / 130*
M30x2	95	85
M33x2	120	110
M36x1.5	130	115
M38x1.5	140	120
M42x1.5	150	130
M42x2	145	125
M45x1.5	160	140
M45x2	150	130
M48x1.5	170	145
M48x2	160	135
M52x1.5	180	150
M60x2	195	165
M64x2	205	175

* DIN 7604 Form C

Union Screws DIN 7643

The tightening torques were determined for screwing into steel, gray cast, and aluminum alloys.
The values are based on experience and are intended as reference values for the fitter.

General rule:
Screw/Bolt class 5, ZFN 148-1
Material: 9SMnPb28K acc. to DIN 1651
Surface condition: As manufactured (without surface protection) and lightly oiled or galvanized, chromated, and lightly oiled.

Union screws (DIN 7643)

Pipe outer diameter	Thread	Tightening torque in Nm
4 - 5	M8x1	20 - 25
6	M10x1	25 - 35
8	M12x1.5	30 - 40
10	M14x1.5	35 - 40
12	M16x1.5	45
15	M18x1.5	50
18	M22x1.5	60
22	M26x1.5	90
28	M30x1.5	130
35	M38x1.5	140

Status: October 1995

Withdrawn DIN	Title	Substitute ISO standard	Result of check / measures [1]
DIN 1	Tapered pins	ISO 2339	- some can be replaced → changed to ISO 2339 - parts which cannot be replaced (e.g. where 1 = 36 mm) documented as DIN 1 OLD
DIN 7	Cylindrical pins	ISO 2338	- some can be replaced → changed to ISO 2338 - parts which cannot be replaced (e.g. diameter 13 and 14 and/or where 1 = 36 mm) documented as DIN 7 OLD
DIN 84	Cylindrical screws	ISO 1207	- some can be replaced → changed to ISO 1207 - parts which cannot be replaced (e.g. M2.6) documented as DIN 84 OLD
DIN 85	Flat head bolts	ISO 1580	- can be replaced → changed to ISO 1580
DIN 94	Split pins	ISO 1234	- can be replaced → changed to ISO 1234
DIN 417	Threaded pins	ISO 7435	- can be replaced → changed to ISO 7435
DIN 439-1 DIN 439-2	Hex nuts Hex nuts	ISO 4036 ISO 4035 ISO 8675	- cannot be replaced → documented as DIN 439 OLD
DIN 551	Threaded pins	ISO 4766	- can be replaced → changed to ISO 4766
DIN 553	Threaded pins	ISO 7434	- can be replaced → changed to ISO 7434
DIN 555	Hex nuts	ISO 4034	- cannot be replaced → documented as DIN 555 OLD
DIN 558	Hex bolts/screws	ISO 4018	- some can be replaced → changed to ISO 4018 - parts which cannot be replaced (e.g. M12, with new SW) documented as DIN 558 OLD
DIN 601	Hex bolts/screws	ISO 4016	- some can be replaced → changed to ISO 4016 - parts which cannot be replaced (e.g. M10 and M12, with new SW) documented as DIN 601 OLD
DIN 912	Cylindrical screws	ISO 4762	- some can be replaced → changed to ISO 4762 - parts which cannot be replaced (e.g. M18, M22, M27, and M33) documented as DIN 912 OLD
DIN 931-1	Hex bolts/screws	ISO 4014	- some can be replaced → changed to ISO 4014 - parts which cannot be replaced (e.g. M10, M12, M14, and M22 with new SW) documented as DIN 931 OLD
DIN 933	Hex bolts/screws	ISO 4017	- some can be replaced → changed to ISO 4017 - parts which cannot be replaced (e.g. M10, M12, M14, and M22 with new SW) documented as DIN 933 OLD
DIN 934	Hex nuts	ISO 4032 ISO 8673	- cannot be replaced replaced as a result of uneven nut height and for M10, M12, M14, and M22 with new SW.
DIN 960	Hex bolts/screws	ISO 8765	- some can be replaced → changed to ISO8765 - parts which cannot be replaced (e.g. M10, M12, M14, and M22 with new SW) documented as DIN 960 OLD
DIN 961	Hex bolts/screws	ISO 8676	- some can be replaced → changed to ISO 8676 - parts which cannot be replaced (e.g. M10, M12, M14, and M22 with new SW) documented as DIN 961 OLD
DIN 963	Countersunk bolts	ISO 2009	- cannot be replaced as a result of modified head dimensions → documented as DIN 963 OLD
DIN 964	Countersunk bolts	ISO 2010	- cannot be replaced as a result of modified head dimensions → documented as DIN 964 OLD

1) with reference to productive parts numbered at ZF

Withdrawn DIN	Title	Substitute ISO standard	Result of check / measures [1)]
DIN 965	Countersunk bolts	ISO 7046	- cannot be replaced as a result of modified head dimensions → documented as DIN 965 OLD
DIN 980	Locking nuts	ISO 7042 ISO 10513	- cannot be replaced → documented as DIN 980 OLD
DIN 985	Locking nuts	ISO 10511	- cannot be replaced → documented as DIN 985 OLD
DIN 1440	Washers	ISO 8738	- some can be replaced → changed to ISO 8738 - parts which cannot be replaced documented as DIN 1440 OLD
DIN 1443	Bolts	ISO 2340	- can be replaced → changed to ISO 2340
DIN 1444	Bolts	ISO 2341	- can be replaced → changed to ISO 2340
DIN 1471	Grooved pins	ISO 8744	- some can be replaced → changed to ISO 8744 - parts which cannot be replaced (e.g. 1 = 6 mm) documented as DIN 1471 OLD
DIN 1472	Grooved pins	ISO 8745	- some can be replaced → changed to ISO 8745 - parts which cannot be replaced (e.g. 1 = 6, and 25 mm) documented as DIN 1472 OLD
DIN 1473	Grooved pins	ISO 8740	- some can be replaced → changed to ISO 8740 - parts which cannot be replaced (e.g. 1 = 4, 5, 6, 25, and 50 mm) documented as DIN 1473 OLD
DIN 1474	Grooved pins	ISO 8741	- can be replaced → changed to ISO 8741
DIN 1475	Grooved pins	ISO 8742	- can be replaced → changed to ISO 8742
DIN 1476	Grooved stud	ISO 8746	- can be replaced → changed to ISO 8746
DIN 1477	Grooved stud	ISO 8747	- can be replaced → changed to ISO 8747
DIN 1481	Clamping pins	ISO 8752	- some can be replaced → changed to ISO 8752 - parts which cannot be replaced (e.g. 1 = 36) documented as DIN 1481 OLD
DIN 6325	Cylindrical pins	ISO 8734	- some can be replaced → changed to ISO 8734 - parts which cannot be replaced (e.g. 1 = 36) documented as DIN 6325 OLD
DIN 7346	Clamping pins Flange	ISO 13337	- some can be replaced → changed to ISO 13337 - parts which cannot be replaced (diameter 7, 11, and 23 mm) documented as DIN 6325 OLD
DIN 7976	Self-tapping screws	ISO 1479	- can be replaced → changed to ISO 1479
DIN 7978	Tapered pins	ISO 8736	- some can be replaced → changed to ISO 8736 - parts which cannot be replaced (e.g. 1 = 36) documented as DIN 7978 OLD
DIN 7979	Cylindrical pins	ISO 8733 ISO 8735	- some can be replaced → changed to ISO 8733/8735 - parts which cannot be replaced documented as DIN 7979 OLD
DIN 7981	Self-tapping screws	ISO 7049	- can be replaced → changed to ISO 1479
DIN 7982	Self-tapping screws	ISO 7050	- cannot be replaced → documented as DIN 7982 OLD
DIN 7985	Cheese-head screws	ISO 7045	- can be replaced → changed to ISO 7045

1) with reference to productive parts numbered at ZF

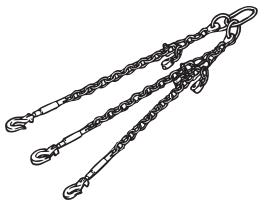
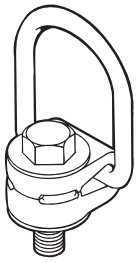
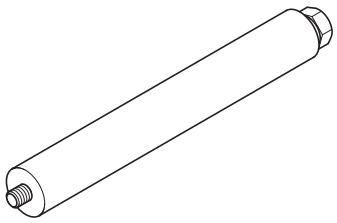
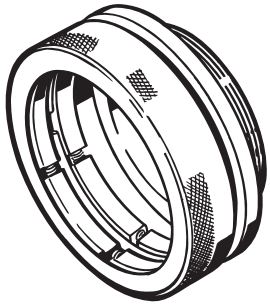
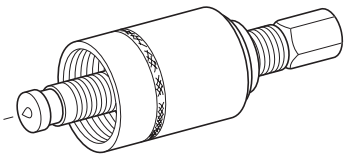
Designation ZF part number	Name	Quantity approx.	Application	Remarks
Grease 0750 199 019	For example: Spectron FO 20	1 gram 1 gram 2 grams	Shaft sealing ring **02.510** Grooved ring **02.630** Shaft sealing ring **31.080**	
Grease 0671 190 050	Olista Longtime 3EP	5 grams 3 grams 5 grams 3 grams	Shaft sealing rings **68.060/140** Bush **68.130** Locating face Release fork **68.060** Release bearing **68.050** Ball cup **68.060/120**	
Sealing compound 0666 790 054	1215 gray	3 grams	Sealing surface housing I / housing II (depends upon the version, also refer to chapter on “Mounting Housing I“)	
Sealing compound 0666 790 033	No. 574	 3 grams 0.5 grams 0.5 grams 1 gram	**Sealing surface** Connection plate / Housing I Cover **31.050** Sealing cap **32.010/050** Range change housing / Housing II (depends upon the version, also refer to chapter on “Mounting RC Housing“)	
Jointing compound 0666 690 017	No. 241	0.5 grams	Hex-head screw **02.670**	
Jointing compound 0666 690 022	No. 262	0.5 grams	Ball bolt **06.080**	
Anti-corrosion oil 0750 199 008	For example MZK 150	 1 ml	Pump shaft **02.560** Rotor **02.550**	
Transmission oil	according to ZF List of Lubricants TE-ML 02	refer to: Type plate	Oil fill transmission	

NOTE: Inquire size of containers before placing any orders!

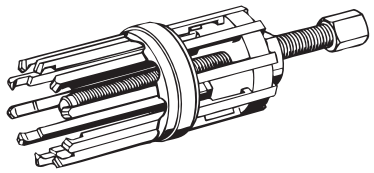
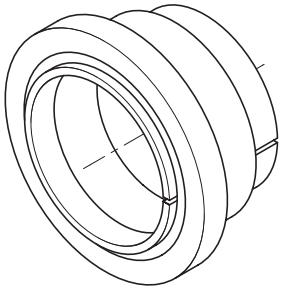
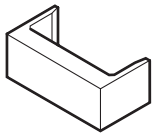
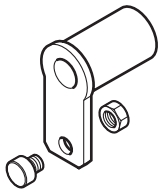
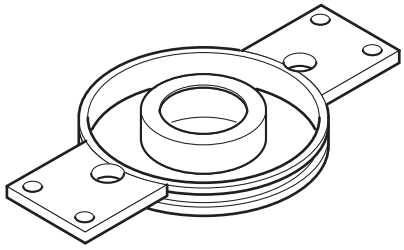
Designation	Specification	Measuring device	Remarks
Axial Clearance of the Countershaft **03.010**	−0.05 to +0.05 mm	Depth gage micrometer	Get tapered roller bearing into zero position (backlash-free) and measure. Adjust play with the compensating disk **03.050**.
Axial Clearance of the Countershaft **03.110**	−0.05 to +0.05 mm	Depth gage micrometer	Get tapered roller bearing into zero position (backlash-free) and measure. Adjust play with the compensating disk **03.150**.
Axial clearance Input Shaft / Connection Plate	0 to 0.10 mm	Depth gage micrometer	Adjust play with the compensating disk **02.100**.
Axial Clearance Securing Ring on Input Shaft	0 to 0.10 mm	Feeler gage	Adjust play with the compensating disk **02.120**.
Axial Clearance Output Bearing	0 to 0.10 mm	Depth gage micrometer	If necessary, adjust play with the compensating disk **31.030**.
Axial Clearance Main Shaft / Sun Gear	2 mm +/−0.1	Depth gage micrometer	Adjust play with the compensating disk **32.380**.
Axial Clearance Gear to Wheel Disk on Main Shaft	0 to 0.10 mm	Depth gage micrometer	Use the snap ring to adjust the play.
Axial Clearance Constant Gear 2 to Wheel Disk on Input Shaft	0 to 0.10 mm	Depth gage micrometer	Adjust play with the snap ring **02.290**.
Axial Clearance MS Disk to Wheel Disk on Main Shaft	0.15 to 0.25 mm	Depth gage micrometer	Use the MS disk* to adjust the play.
Screw plug **31.200, 31.190**	60 Nm	Torque wrench	
Remove screw plug **31.090**	15 Nm	Torque wrench	

* MS disk = measured disk on main shaft

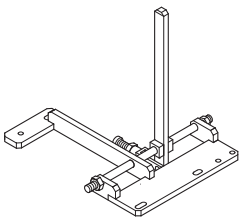
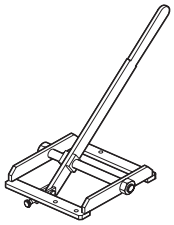
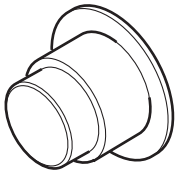
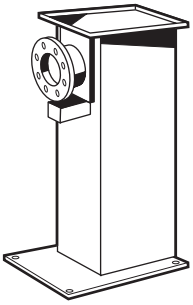
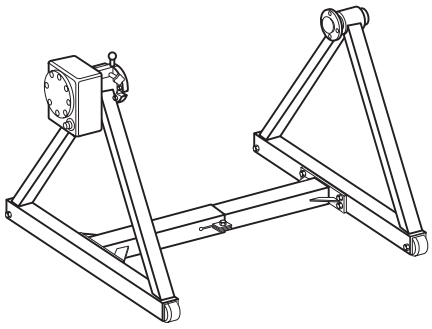
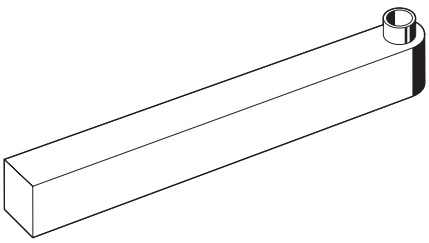
Designation	Specification	Measuring device	Remarks
Hex-head screw **32.550**	120 Nm	Torque wrench	
Hex-head screw **31.370**	50 Nm	Torque wrench	
Hex-head screw **68.130**	115 Nm	Torque wrench	
Impulse sensor **31.230, 31.260**	45 Nm	Torque wrench	

Fig. no.	Figure	Order no. Application	Qty.	Remarks
1		**1X56 137 795** **3-strand chain** for lifting the transmission	1	Alternatively: Order no. 1X56 137 391 ordinary
2		**1T66 154,240** **Eye bolt** M10 for lifting up the housing parts *Only M10 screws with quality 10.9 and higher may be used.*	2	commercial or 1T66 160 494 for clearance holes/through borings
3		**1X56 138 443** **Support** for vertical positioning of the transmission	4	Chapter "Putting Transmission in Vertical Position" Alternatively: Mobile or stationary assembly stand (refer to fig. 13 and 14)
4		**1X56 136 740** **Gripper** Extract tapered roller bearing of countershaft (in conjunction with the basic device 1X56 122 304)	1	Chapter "Countershaft"
5		**1X56 122 304** **Basic equipment** combined with tool 1X56 136 740 and/or 1X56 138 195	1	Chapter "Housing I" and "Countershaft"

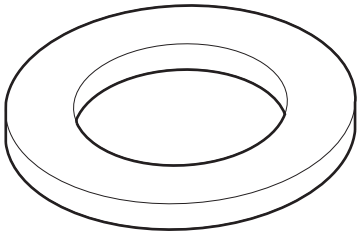
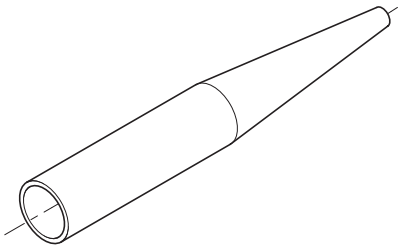
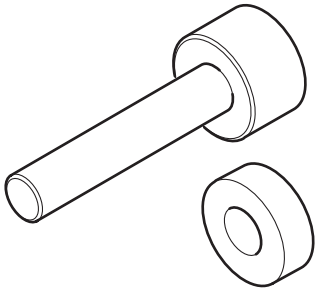
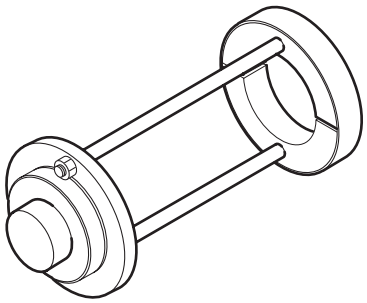
NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
6		**1X56 122 314** for ball bearings with 10 balls **1X56 138 295** for ball bearings with 11 balls **Extractor** for ball bearings **31.020** from planet carrier (removal) **Caution**: Both extractors are not suitable for use with impact wrenches.	1	Chapter "RC Housing" hydr. variant upon request 1X53 188 009 was replaced by 1X56 138 295
7		**1X56 138 087** **Extractor** Bearing inner ring **32.310/1** at the planet carrier	1	Chapter "Planet Carrier"
8		**1X56 138 207** **Bracket** Assembly of range change synchronization	6	Chapter "RC Housing"
9		**1X56 138 208** **Fixing bolt** R gear, secure reversing gear	2	Chapter "Putting Transmission Without RC in Vertical Position"
10		**1X56 138 203** **Fixing plate** Fixing and centering the main shaft	1	Chapter "Putting Transmission Without RC in Vertical Position"

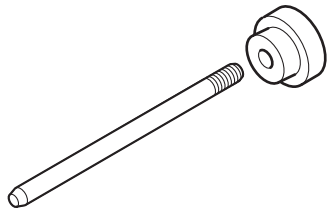
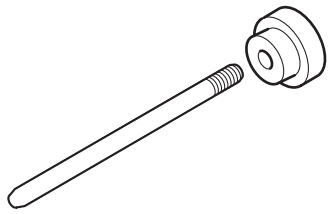
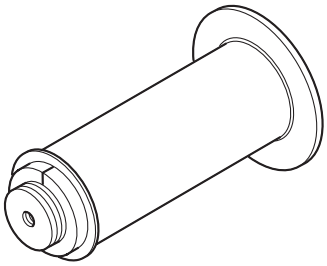
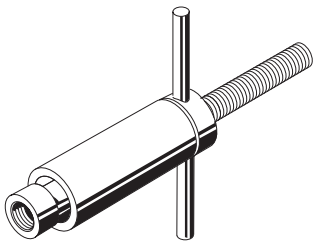
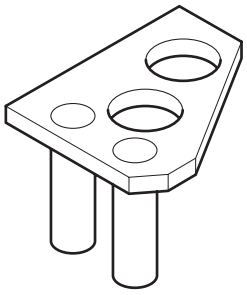
NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
11	Version A  Version B 	**1X56 138 095** **Setting fixture** for selector rails	1	Chapter "Transmission Actuator" Only variant B is now available.
12		**1X56 138 215** **Adapter** for assembly of bushes and shaft sealing rings of release fork	2	Chapter "Clutch Release Mechanism" (Version A)
13		**1P01 181 850** **Assembly block (stationary)** in conjunction with basic plate 1X56 138 297 and clamping plate 1X56 139 608	1	Alternatively: 4 supports 1X56 138 443 (Refer to figure no. 3)
14		**1X56 137 450** (optional) **Transmission assembly stand (mobile)** in conjunction with an adapter 1X56 138 232	1	Alternatively: 4 supports 1X56 138 443 (Refer to figure no. 3)
15		**1X56 138 063** **Drift key** for driving out fitting pins	1	Chapter "RC Housing" and "Housing I"

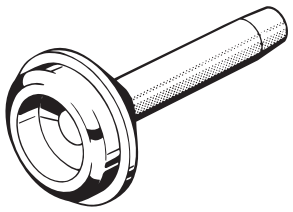
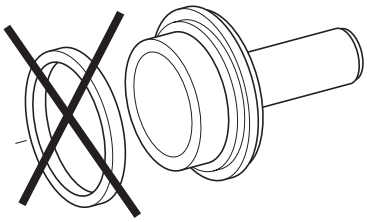
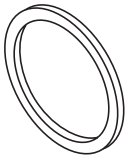
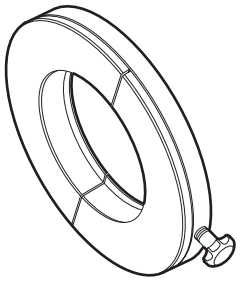
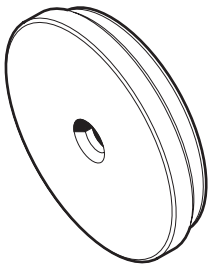
NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
16		**1X56 138 097** **Mounting plate** Synchronization **02.200**	1	Chapter “Input Shaft” Assembly aid
17		**1X56 138 081** **Assembly sleeve** Synchronization **02.200**	3	Chapter “Input Shaft”
18		**1X56 138 205** **Assembly fixture** Pipe **04.020** on main shaft	1	Chapter “Main Shaft”
19		**1X56 138 191** **Bush** (pressure piece) For protecting the shaft when removing it.	1	Chapter “Housing I“ commercial
20		**1X56 138 195** **Extracting fixture** Tapered roller bearings **02.080** on the input shaft	1	Chapter “Housing I“

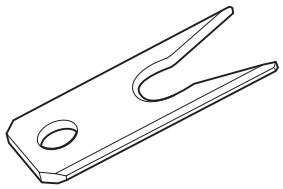
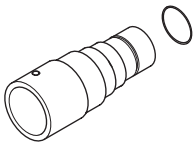
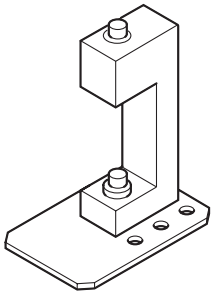
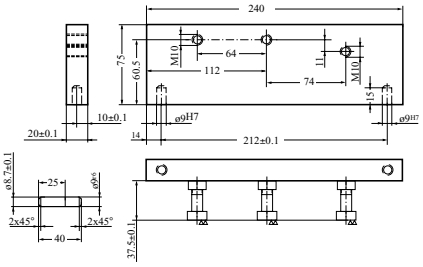
NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
21		**1X56 138 200** **Assembly tool** Centering oil tube **01.430**	1	Chapter “Housing I“ Alternatively: M4 dowel pin with nut
22		**1X56 138 201** **Assembly tool** Centering oil tube **01.420**	1	Chapter “Housing I“ Alternatively: M8 dowel pin with nut
23		**1X56 138 216** **Fixture** Lifting and mounting fixture for the assembly or disassembly of the input shaft	1	Chapter “Housing I“ and “Shaft Pack”
24		**1X56 045 808** **Mounting fixture** Input shaft in conjunction with 1X56 138 216	1	Chapter “Housing I“
25		**1X56 138 197** **Assembly fixture**	1	Chapter “Shaft Pack“ and “Input Shaft“

NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
26		**1X56 099 063** **Adapter** For shaft sealing ring with release flange	1	Chapter "Connection Plate"
27		**1X56 137 124** **Adapter** For installing the shaft sealing ring at the output cover (in conjunction with a spacer ring 1X56 138 189)	1	Chapter "Output Cover"
28		**1X56 138 189** **Spacer ring** For shaft sealing ring 105 x 125 x 12 at output cover (in connection with adapter 1X56 137 124)	1	Chapter "Output Cover"
29		**1X56 138 420** **Extracting fixture** Clutch body **32.280** at the planet carrier in conjunction with the pressure plate 1X56 138 424.	1	Chapter "Planet Carrier"
30		**1X56 138 424** **Pressure plate**	1	Chapter "Planet Carrier"

NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
31		**1X56 138 426** **Fork** Compress the securing ring **32.290**.	1	Chapter "Planet Carrier"
32		**1X56 138 546** **Press-in mandrel** For assembly of bearing bushes and cam rollers of the release fork.	1	Chapter "Clutch Release Mechanism" (Version B)
33		**1X56 138 547** **Support** For the release fork	1	Chapter "Clutch Release Mechanism" (Version B)
34		**Sketch:** **Setting aid** for piston rods on transmission actuator	1	Chapter "Transmission Actuator" Assembly aid

NOTE: Please inquire as to packaging unit before ordering.

Fig. no.	Figure	Order no. Application	Qty.	Remarks
1		**6008 208 503** **ZF-Testman pro complete** Scope of supply: - 6008 208 100 ZF-Testman pro with DPA05 + cable - 6008 208 015 Application CD - 6008 208 016 License	1	Only for ZF Sales and Service Organizations
2		**6008 208 501** **ZF-Testman pro diagnosis software** Scope of supply: - 6008 208 011 ZF-Testman pro Update CD - 6008 208 015 Application CD - 6008 208 016 License	1	Only for ZF Sales and Service Organizations
3		**6008 208 003** **ZF-Testman pro for ZF customers** Scope of supply: - 6008 208 100 ZF-Testman pro with DPA05 + cable - 6008 208 900 ZF-Testman pro software for user interface (basic CD installation)	1	following agreement with ZF Friedrichshafen AG
4		**Application software** **ZF-AS Tronic 2** 6008 208 819	1	Single user license
5		**6008 207 003** **AS Tronic table mode adapter**	1	Adapter cable for programming and configuration purposes and for diagnosis outside the vehicle

NOTE: Please inquire as to packaging unit before ordering.

Preparatory Work

CAUTION
After every repair, the transmission must be tested for function and leakage on a test bench.

General

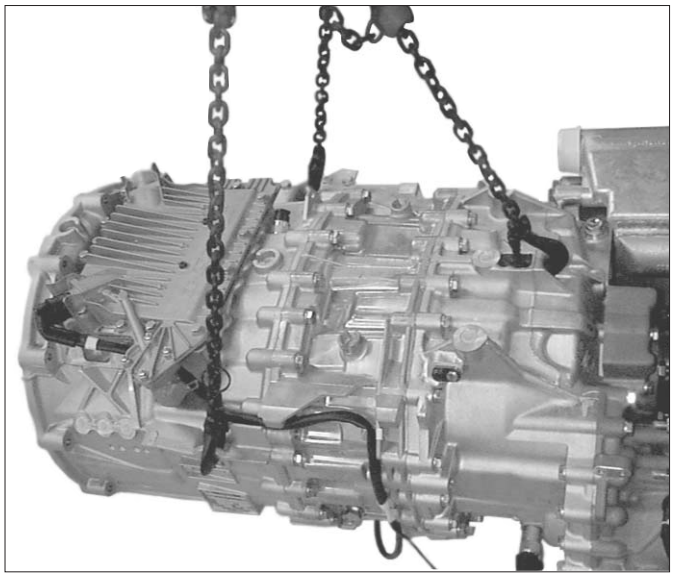
In this Repair Manual, we provide a description for the disassembly and/or assembly of the ZF-AS Tronic transmission (10-, 12-, and 16-speed) without utilizing the mobile transmission swivel stand **1X56 137 450**.

1 For lifting or transport, the three-trace chain **1X56 137 795** is inserted into the eyes of the transmission.

2 Prepare oil collecting basin.

3 Remove oil drain plug and drain oil.

In the case that you are repairing a transmission with an Intarder, you will need also the Intarder Repair Manual e. g. **6085 751 022**, in this Repair Manual you will also find a description of the disassembly/assembly of the Intarder.



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With transmission swivel stand*

1 Secure adapter **1X56 138 232** to the mobile transmission swivel stand **1X56 137 450**.

Fasten transmission to the adapter **1X56 138 232**.

NOTE*
We recommend the stationary assembly stand **1P01 181 850** in connection with basic plate **1X56 138 297** and the clamping plate **1X56 139 608** for specialized workshops.
For further information, please contact ZF Friedrichshafen AG, MKS-IP department (Customer Service).

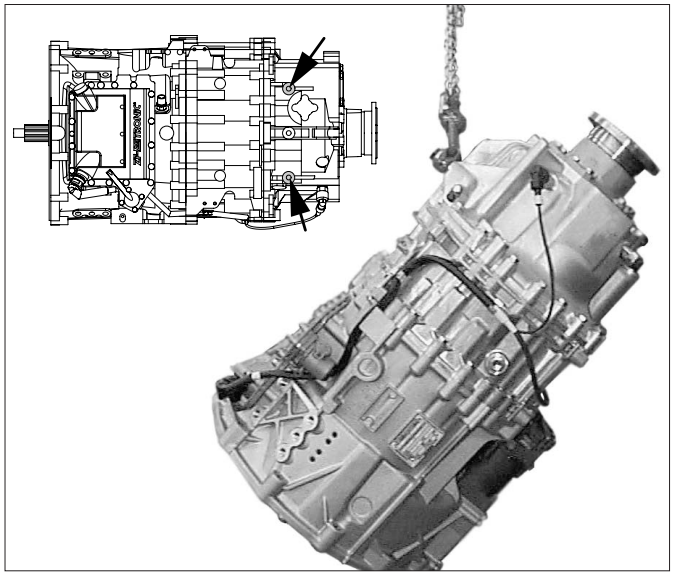
* Option

Without transmission swivel stand

1 Prepare two squared timbers on level, solid underground.

2 Mount 2 lifting lugs M16x1.5 to the RC housing (see arrow). Hang in chain and lift transmission with a crane.

CAUTION
Do not use the lug at the RC housing! The lug is too weak to bear the entire transmission weight: "Danger of housing fracture".



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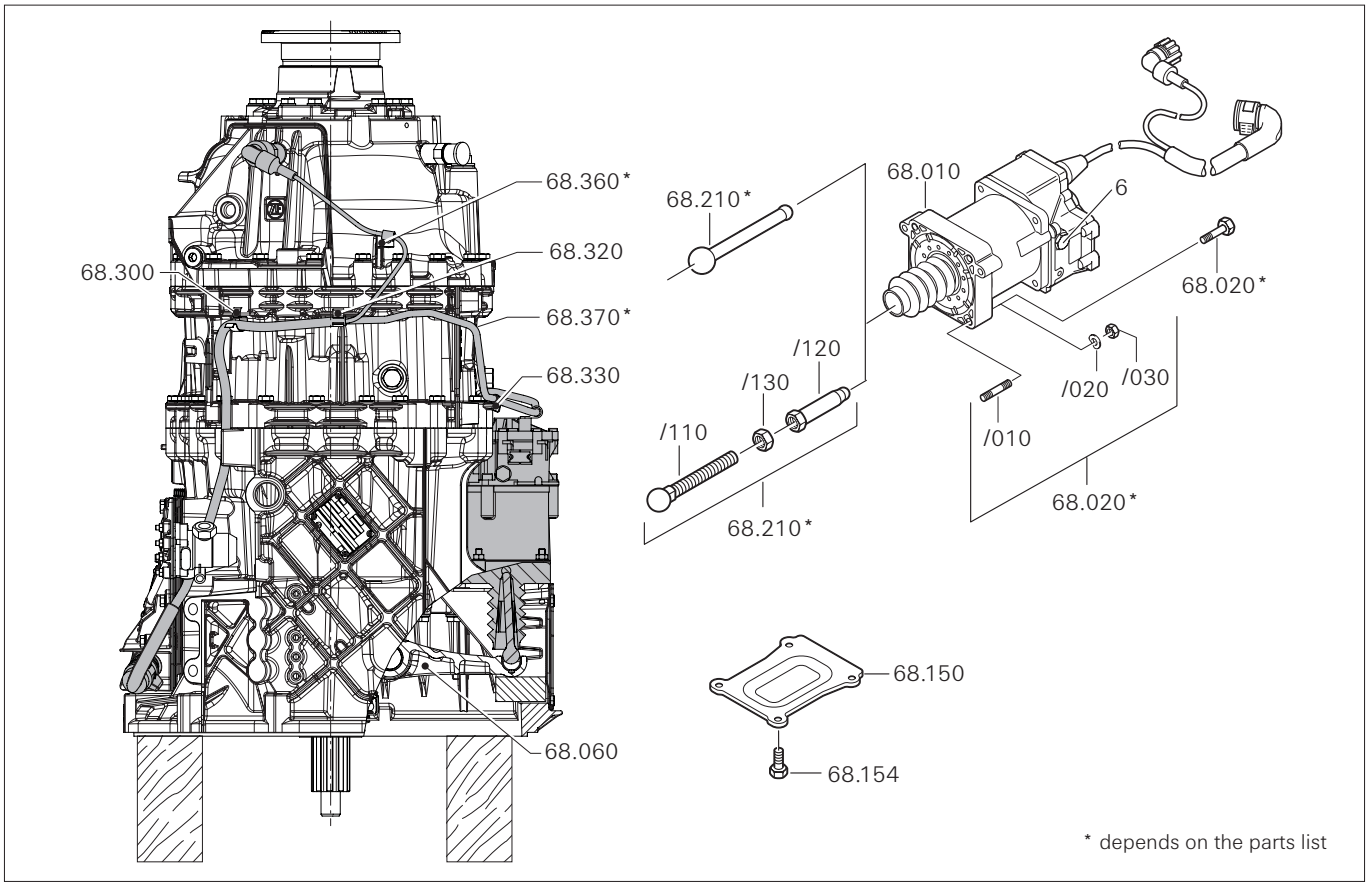
3 Place transmission with the clutch bell housing onto the squared timbers.

CAUTION
Transmission must not stand on input shaft.

015018

Clutch actuator



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Removing Clutch Actuator

1 Disconnect plug connection from the transmission actuator and from the output speed sensor.

2 Remove cable harness from cable clamps **68.300**, **68.320**, **68.330** and, if necessary, remove the fixing devices **68.360**, **68.370**.

3 Remove 4 M8 hex-head screws **68.154** and take off the cover **68.150**.

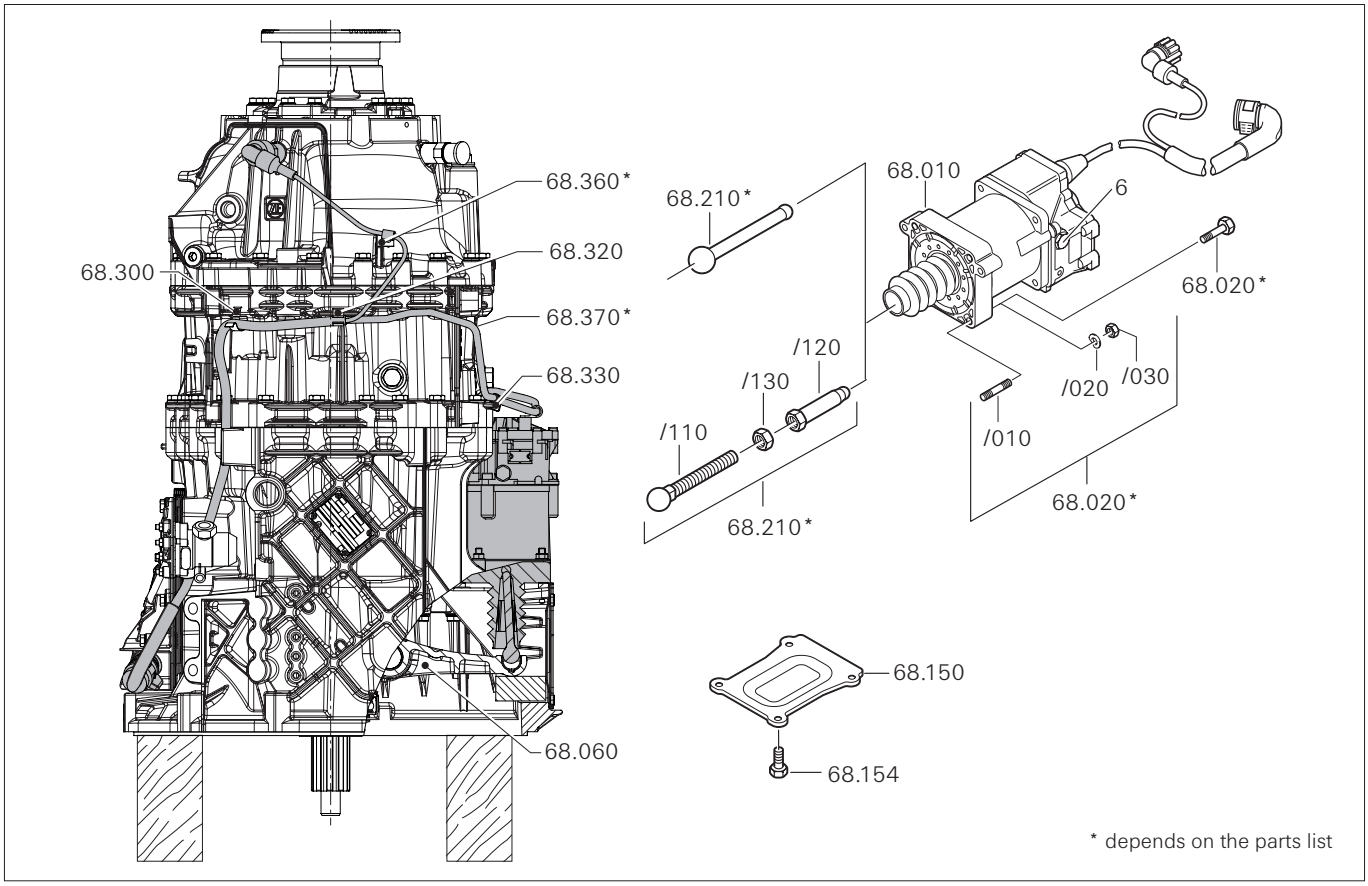
4 Remove 4 M8 hex-head screws **/030** with shims and/or 4 M8 hex-head screws **68.020**.

5 Take off clutch actuator **68.010**.

6 Take push rod **68.210** completely out of the release fork **68.060**.

NOTE

- For removal and fitting of release fork, refer to the chapter “Clutch Release Mechanism”.



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Mounting the Clutch Actuator

NOTE
The setting dimension (overall length) of the adjustable push rod* **68.210** can be taken from the parts list.
Tighten the hex-head screw **/130** to 52 Nm.

1 Insert push rod **68.210** into the recess of the release fork **68.060**.

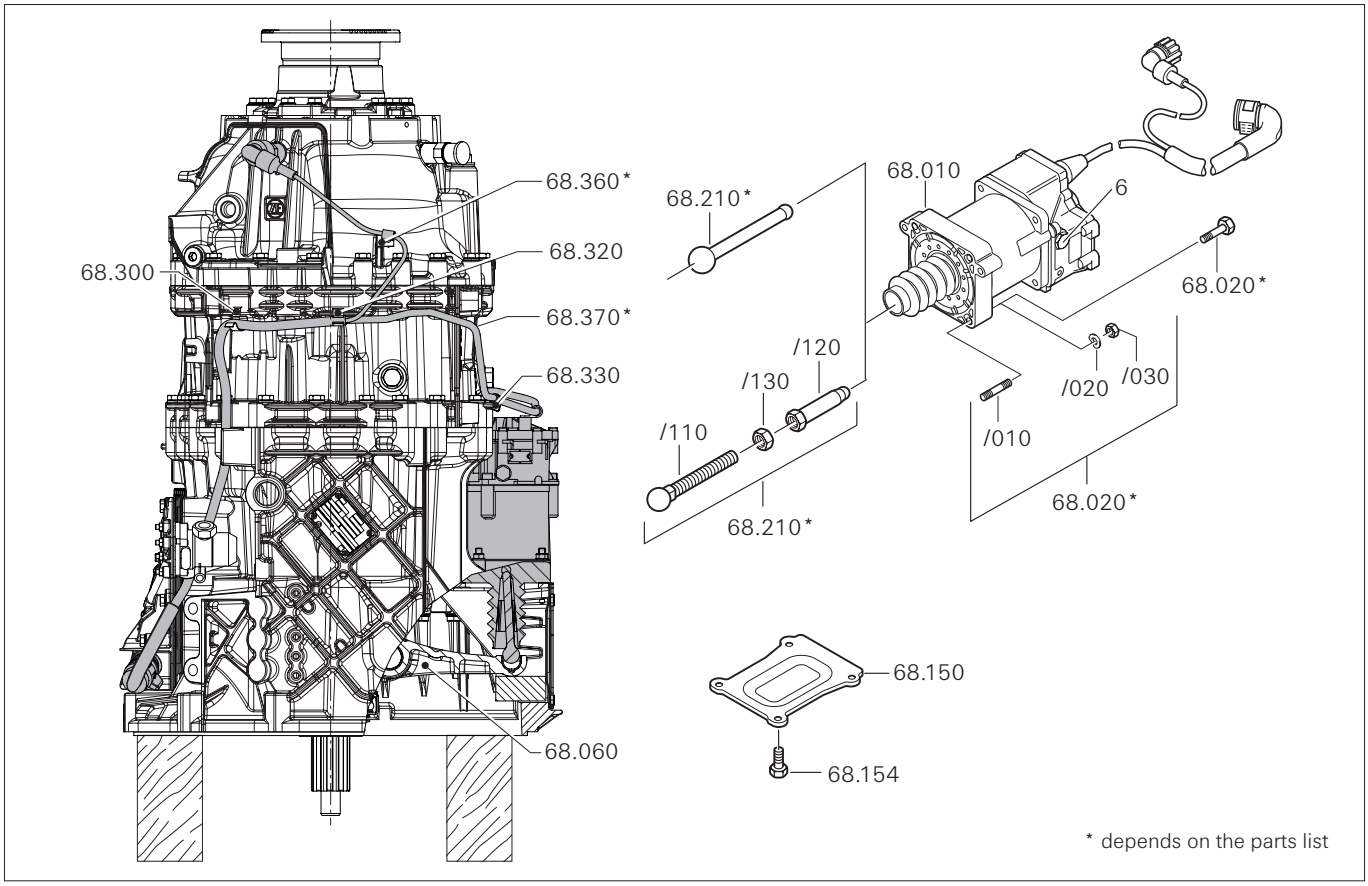
2 When mounting the clutch actuator **68.010**, pay attention to correctly positioning the connections and correctly seating the push rod **68.210**.

Mount clutch actuator - in relation to the parts list version - by means of 4 hex-head screws **68.020** and/or 4 hex-head nuts.
Tightening torque for the
M8 hex-head nuts **/030**: 23 Nm
M8 dowel pins **/010**: 10 Nm
Hex-head screws **68.020**: 23 Nm

3 Fasten cover **68.150** with 4 M8 hex-head screws **68.154**.
Tightening torque: 23 Nm

Vent Clutch Actuator
For venting the clutch actuator, loosen the screw **(6)** M12x1.5.
In the case that the sealing ring at the screw is worn, replace the sealing ring.
Tighten the screw **(6)** to 22 Nm.

* depends on the parts list



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CAUTION

- **Do not bend cable or tighten hard.**
- **Avoid chafing points.**
- **Fit connectors with traction relief and check detent.**

4 If damaged, replace the cable clamps **68.300**, **68.320**, **68.330** and, if necessary, the fixing devices **68.360**, **68.370**.

5 Press cable harness into the cable clamps and, if necessary, into the fixing devices.

6 Connect plug connection from the transmission actuator and from the output speed sensor.

NOTE

- For fastening the wiring of the transmission actuator, also refer to the Service Information No. 02_04 in the Annex.

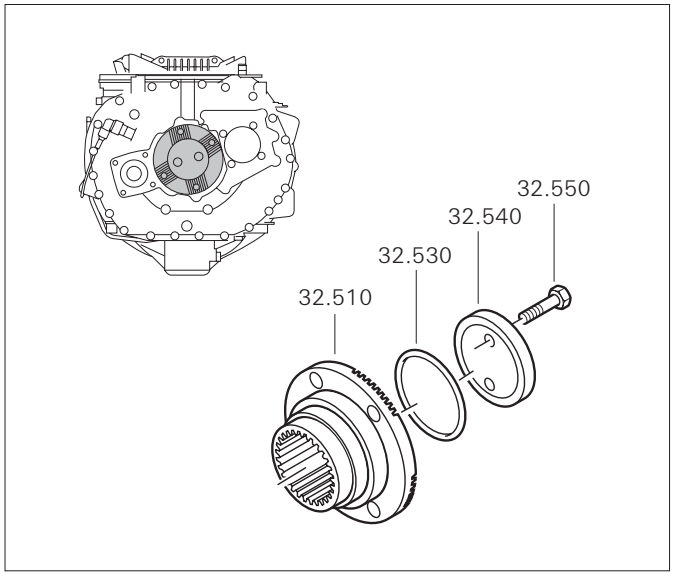
Output Flange

Removing the Output Flange

1 Remove two hex-head screws **32.550** and take off washer **32.540**.

2 Pull off the output flange **32.510** by means of a commercial three-armed puller and remove the O-ring **32.530**.

NOTE
Do not damage shaft during pull-off process; this is why you should be using a thrust piece.



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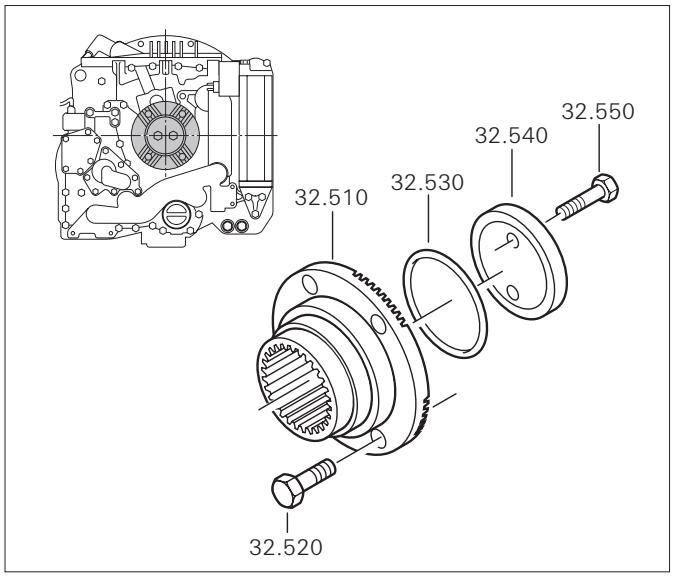
Mounting the Output Flange

1 Heat output flange **32.510** to max. 70 °C and slide onto spline of planetary carrier until firmly home (axial abutment). Ensure that in the case of the Intarder version, the screws **32.520** are plugged in.

⚠ DANGER
Only touch hot output flange when wearing protective gloves.

2 Once the output flange has cooled down, press the O-ring **32.530** into the groove between the shaft and the output flange.

3 Fasten washer **32.540** with 2 M12 hex-head screws **32.550**.
Tightening torque: 120 Nm



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Output Cover

NOTE
In the case of transmissions equipped with an Intarder, this chapter is superfluous since those parts are not available.

Removing the Output Cover

1 Remove 10 M10 hex-head screws **31.070** and lift off output cover **31.050**.

2 If necessary, remove the compensating disk **31.030**.

3 Use a suitable tool to remove shaft sealing ring **31.080**; do not damage output cover in the process.

4 Remove 4 M12 hex-head screws **31.120**. Take off cover **31.110** and seal/gasket **31.100**.

Mounting the Output Cover

1 Coat the outer circumference of the shaft sealing ring **31.080** with spirit (ethanol) and press into output cover **31.050** using the mounting adapter **1X56 137 124** in connection with the ring **1X56 138 189** and ensure that it is firmly home (axial abutment). Slightly grease sealing lip.

2 **In the case of a version with a compensating disk: Determine thickness "C" of the compensating disk.**

Dimension A: Measure output cover **31.050** between sealing face and bearing seat.

Dimension B: Measure from ball bearing **31.020** to sealing face of range-change housing **31.010**.

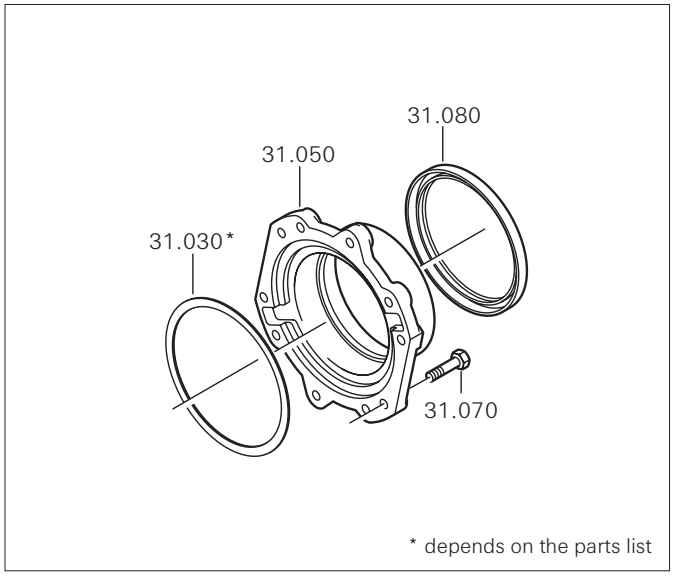
Calculation example: A – B = C

Dimension A = 5.4 mm
– Dimension B = 5.0 mm

Shim without clearance = 0.4 mm

Axial play of the ball bearing 0 to 0.1 mm.

Thickness of the compensating disk
Dimension C = 0.3 up to 0.4 mm



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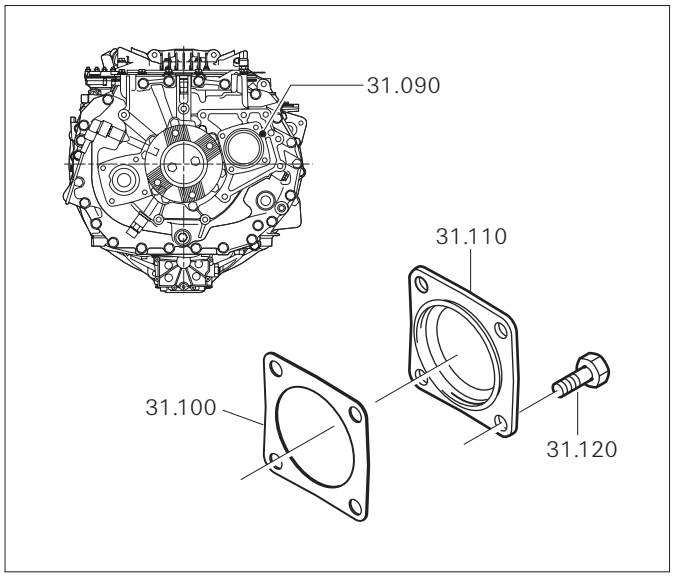
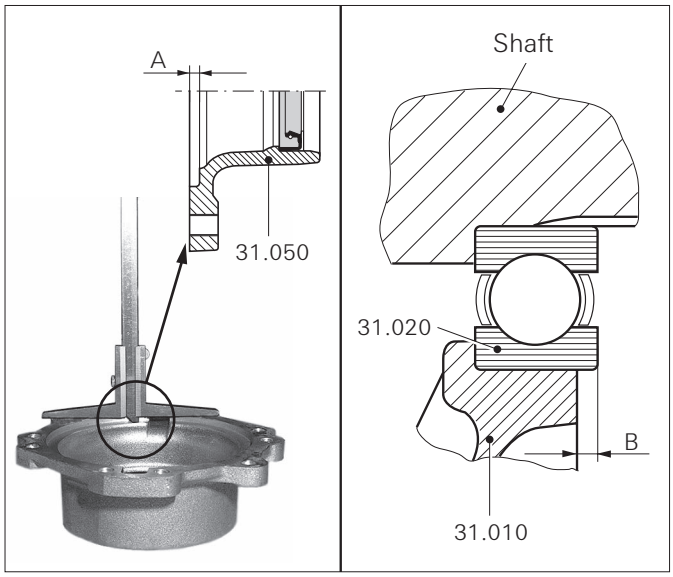


015193



015194

3 If necessary, select the corresponding compensating disk **31.030** by using the spare parts catalog.

NOTE
The compensating disk **31.030** is no longer needed for modern transmissions since the output cover **31.050** was modified accordingly.

4 Coat the sealing surface of the output cover **31.050** with **Loctite no. 574**.

NOTE
Sealing surfaces must be clean and free of oil and grease.

5 Put on the output cover **31.050** if necessary, with the compensating disk **31.030**.

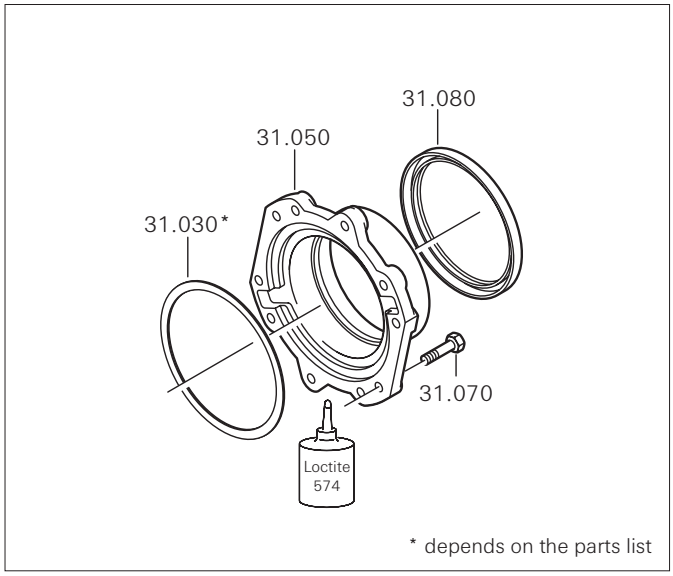
6 Tighten 10 M10 hex-head screws **31.070** to 46 Nm.

NOTE
Do only mount cover **31.110** if the range change housing has already been installed and the screw plug **31.090** was installed as well.

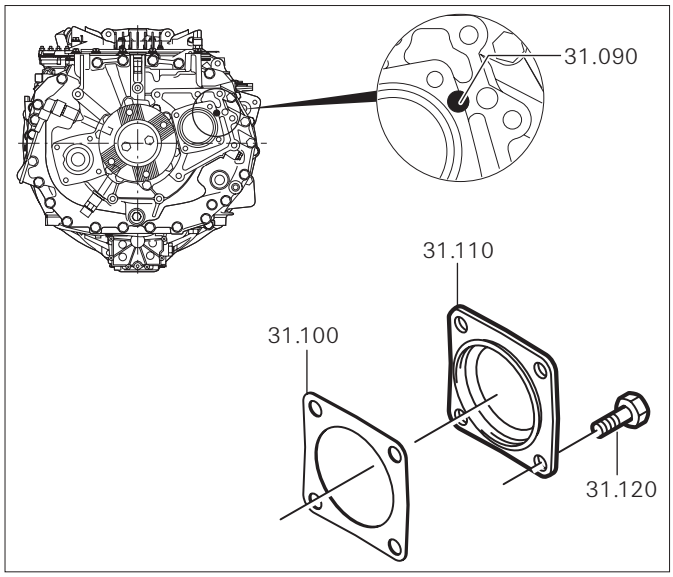
7 Clean sealing surface at RC housing and cover **31.110**.

8 Fit new seal/gasket **31.100** and cover **31.110**.

9 Tighten four M12 hex-head screws **31.120** to 79 Nm.



028255



018225

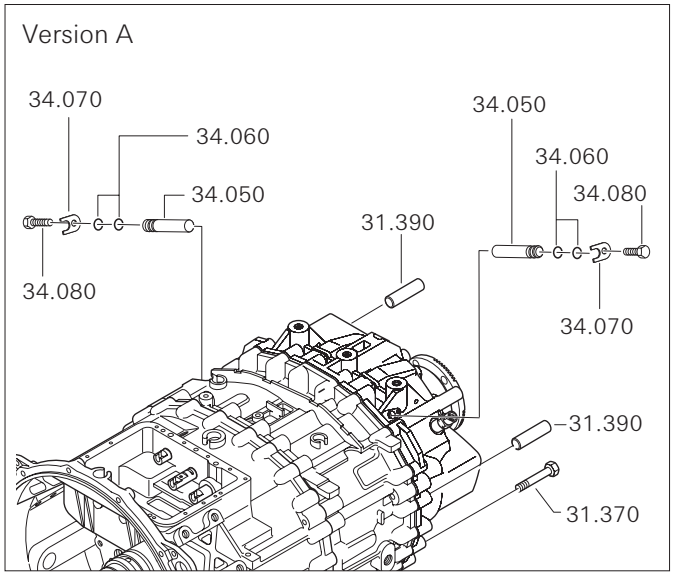
RC housing

Dismounting the RC Housing

Transmission is in vertical position with the output end pointing upwards (refer to Preparatory Work).

Version A

1 Remove the two hex-head screws **34.080**, the holding plate **34.070** , and the pivot bolts **34.050**. Take the O-rings **34.060** off the pivot bolts.

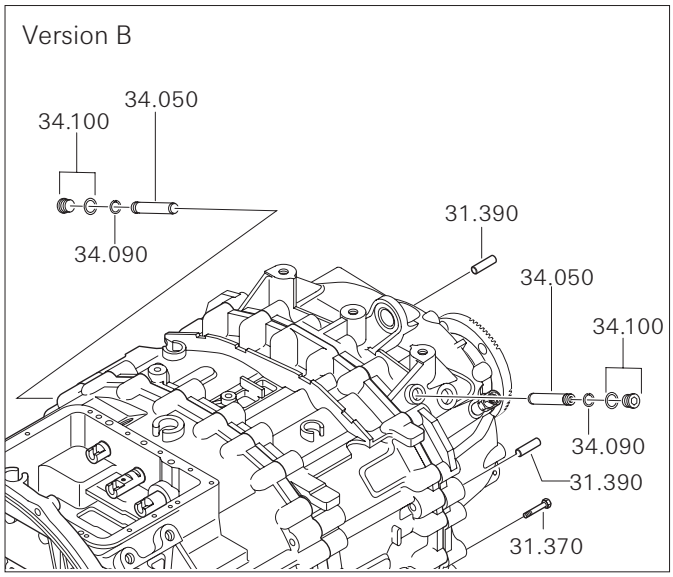


Version B

If necessary, also remove the two screw plugs 34.100. Dismount the pivot bolts **34.050** – M8 extractor thread – and remove the snap ring **34.090**.

2 Remove 2 cylindrical pins **31.390** – M12 extractor thread – and 22 hex-head screws **31.370**.

NOTE
Push out the cylinder pins with the drift key **1X56 138 063**.



3 Fix 2 lifting eyes on output flange and/or planet carrier and hang in chain.

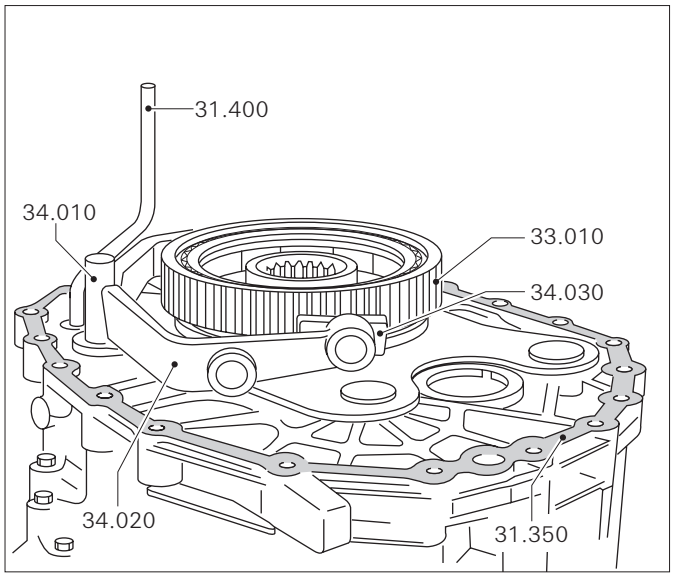
4 Use a crane to lift complete range change housing.

5 If necessary, remove the seal/gasket **31.350**.

6 Remove the spray pipe **31.400**.

7 Lightly lift the selector rail **34.010** and remove the gear shift fork **34.020** and the selector pads **34.030**.

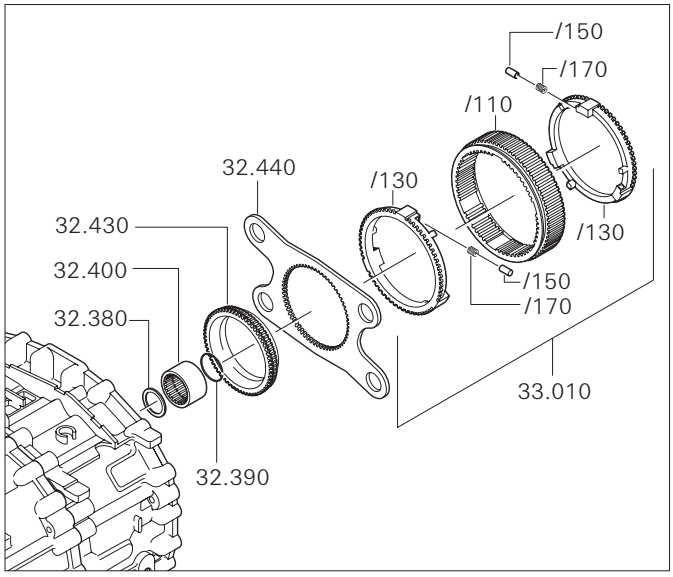
8 Completely remove the synchronization **33.010**.



CAUTION
Cover the synchronization 33.010 with a cloth.
6 bushes /150 and 6 pressure springs /170 are jumping out when taking off the synchronizer rings /130.

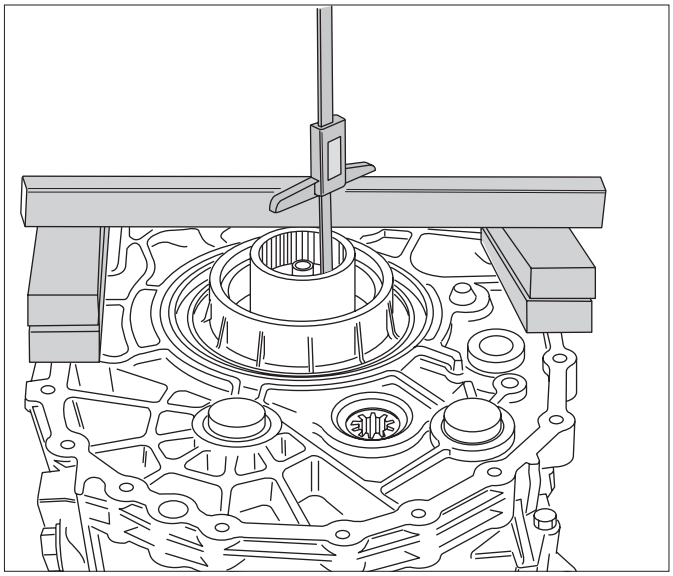
9 Lift plate **32.440** with 2 rim levers and remove the clutch body **32.430**.

10 Remove the sleeve **32.400** with the securing ring **32.390** and the compensating disk **32.380**.



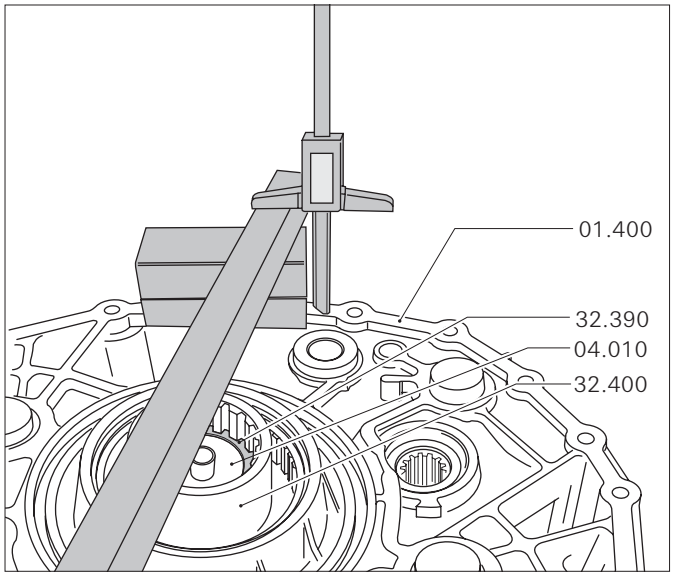
021763

Play Setting of the Main Shaft – Planetary Carrier



016660

Determine dimension B_1



016661

Determine dimension B_2

Version with liquid sealing

(See ZF-Service Information No. 02_05 in the Annex.)

1 Prerequisite for measuring the compensating disk. Snap in securing ring **32.390** in the sleeve **32.400** and put onto the main shaft **04.010**.

2 Install the measuring plane.

3 **Dimension B_1**: Measure from the measuring plane to the securing ring **32.390**.

4 **Dimension B_2**: Measure from the measuring plane to the sealing face at the housing II **01.400**.

5 **Dimension B**: Determine the distance from the securing ring **32.390** to the sealing face at the housing II **01.400**.

Example:

B = B_2 – B_1
B = 100 mm – 74.7 mm
B = 25.3 mm

Version with solid sealing

(See ZF-Service Information No. 02_05 in the Annex.)

1 Prerequisite for measuring the compensating disk. Snap in securing ring **32.390** in the sleeve **32.400** and put onto the main shaft **04.010**.

2 Install the measuring plane.

3 **Dimension B_1**: Measure from the measuring plane to the securing ring **32.390**.

4 **Dimension B_2**: Measure from the measuring plane to the sealing face at the housing II **01.400** (without the seal/gasket **31.350**).

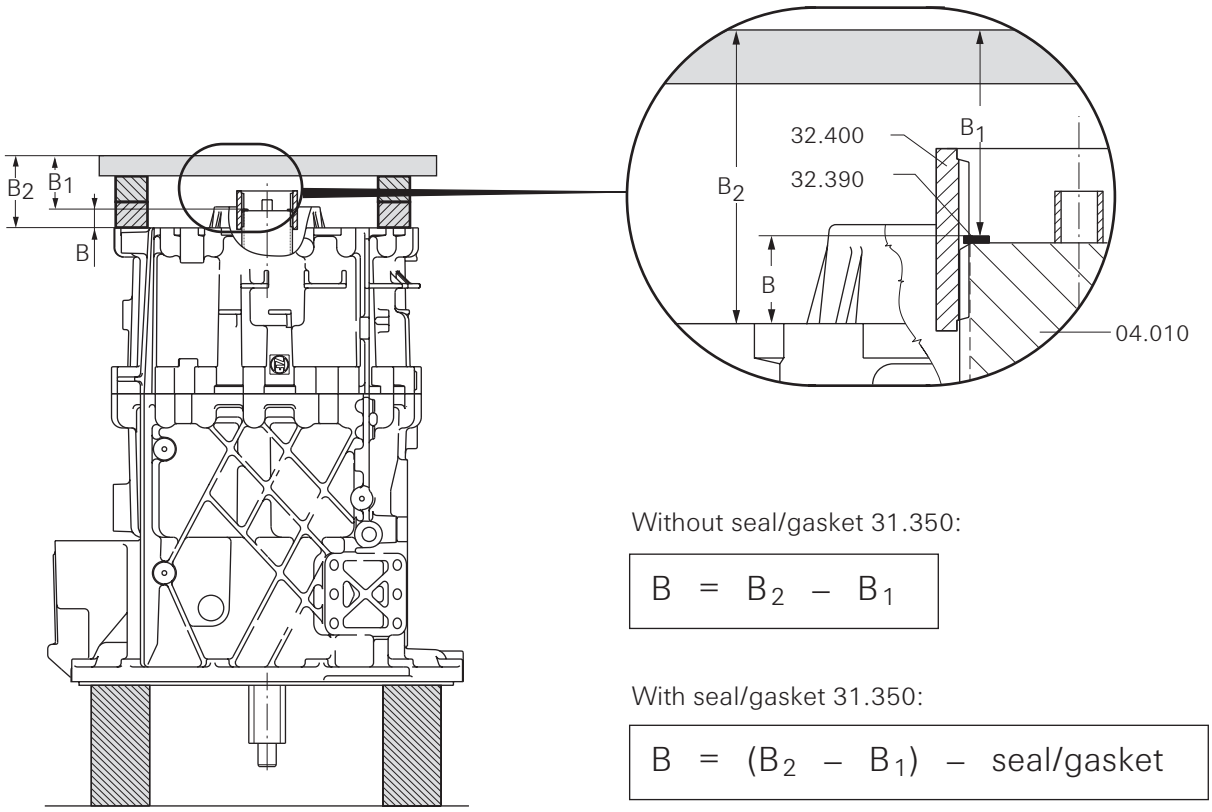
5 **Dimension B**: Determine the distance from the securing ring **32.390** to the sealing face at the housing II **01.400**.

NOTE
The thickness of the seal/gasket must be measured **without** taking the seam/crimp into account!

Example:

B = (B_2 – B_1) – seal/gasket
B = (100 mm – 74.35 mm) – 0.35 mm
B = 25.65 mm – 0.35 mm
B = 25.30 mm

Determine dimension B



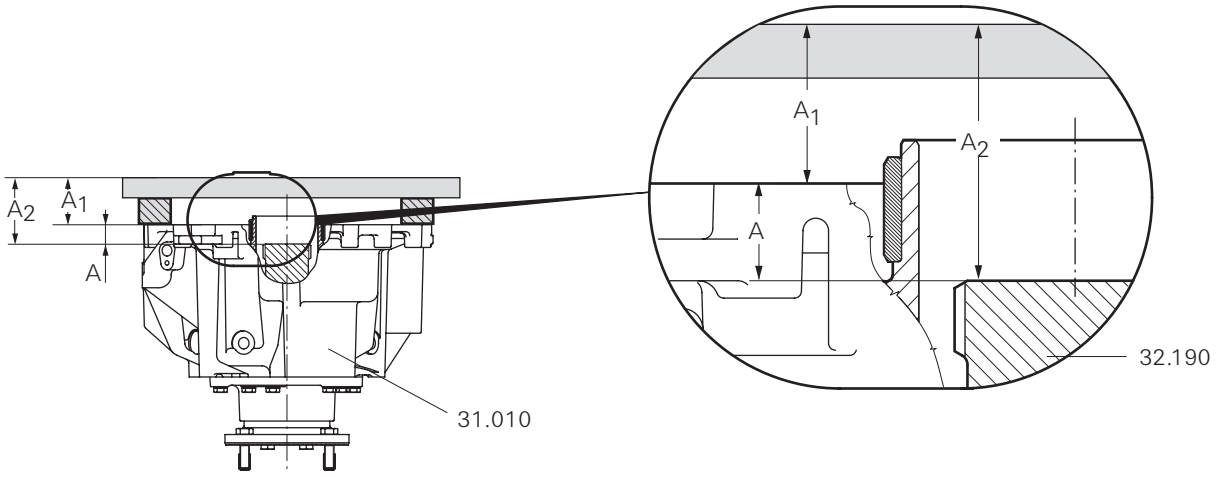
Without seal/gasket 31.350:

$$B = B_2 - B_1$$

With seal/gasket 31.350:

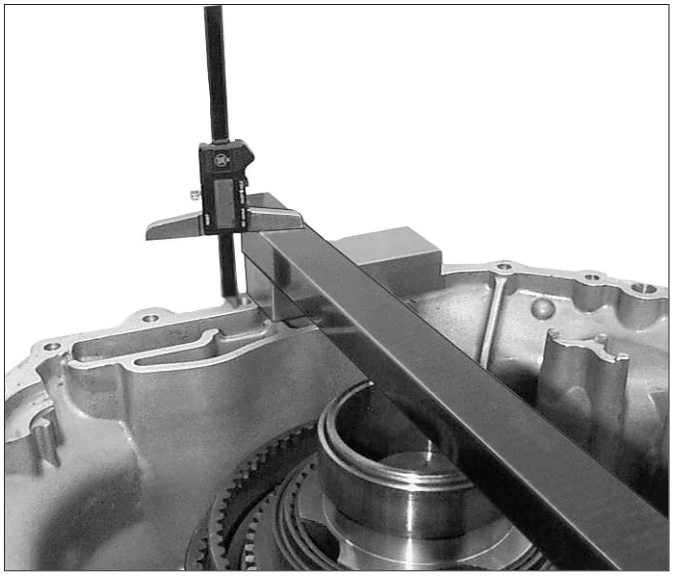
$$B = (B_2 - B_1) - \text{seal/gasket}$$

Determine dimension A

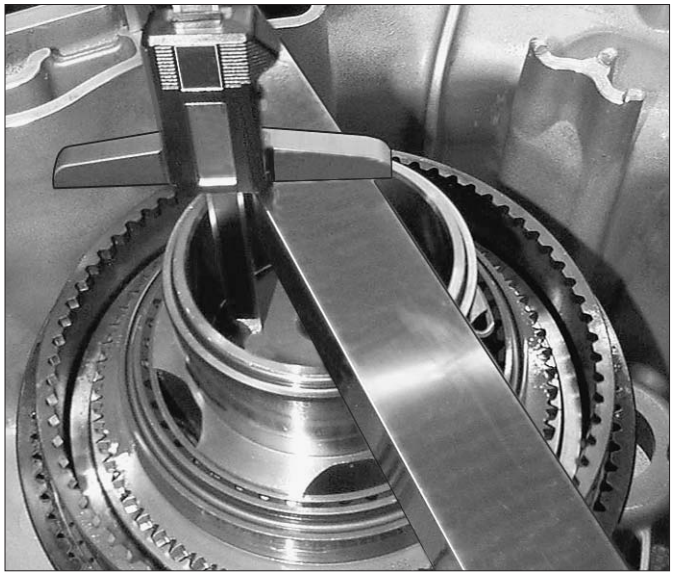


$$A = A_2 - A_1$$

015200



Determine dimension A_1 016662



Determine dimension A_2 016663

6 **Dimension A_1**: Measure from the measuring plane to the sealing face at the RC housing **31.010**.

7 **Dimension A_2**: Measure from the measuring plane to the sun gear **32.190**.

8 **Dimension A**: Determine the distance from the sun gear **32.190** to the sealing face at the RC housing **31.010**.

Example:

A =	**A_2**	**– A_1**
A =	129.3 mm	– 100 mm
A =	**29.3 mm**	

9 **Calculate the thickness (S)** of the compensating disk **32.380**.
S = (A – B) – play

NOTE
A play or clearance of **$2^{\pm 0.1}$ mm** between the sun gear **32.190** and the main shaft **04.010** must be considered mandatory.

Example:

S =	**(A – B)**	**– 2 mm (play)**
S =	(29.3 mm – 25.3 mm)	– 2 mm
S =	4.0 mm	– 2 mm
S =	**2.0 mm**	

10 Select compensating disk **32.380** using spare parts catalog.

6 **Dimension A_1**: Measure from the measuring plane to the sealing face at the RC housing **31.010** (without the seal/gasket **31.350**).

7 **Dimension A_2**: Measure from the measuring plane to the sun gear **32.190**.

8 **Dimension A**: Determine the distance from the sun gear **32.190** to the sealing face at the RC housing **31.010**.

Example:

A =	**A_2**	**– A_1**
A =	129.3 mm	– 100 mm
A =	**29.3 mm**	

9 **Calculate the thickness (S)** of the compensating disk **32.380**.
S = (A – B) – play

NOTE
A play or clearance of **$2^{\pm 0.1}$ mm** between the sun gear **32.190** and the main shaft **04.010** must be considered mandatory.

Example:

S =	**(A – B)**	**– 2 mm (play)**
S =	(29.3 mm – 25.3 mm)	– 2 mm
S =	4.0 mm	– 2 mm
S =	**2.0 mm**	

10 Select compensating disk **32.380** using spare parts catalog.

Mounting the RC Housing

1 Place compensating disk **32.380** on main shaft.

NOTE
For measuring of the compensating disk **32.380** please refer to the chapter on “Play Setting of Main Shaft - Planetary Carrier”.

2 Insert the securing ring **32.390** in the sleeve **32.400**. Securing ring must rest firmly on base of groove in the sleeve.

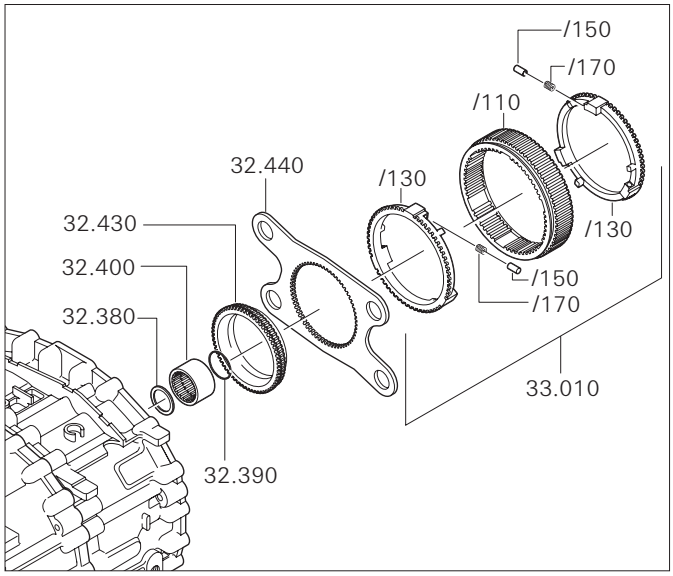
3 Fit sleeve **32.400** onto main shaft. The securing ring **32.390** is flat on the compensating disk **32.380**.

4 Put the clutch body **32.430** and the plate **32.440** on the housing II.

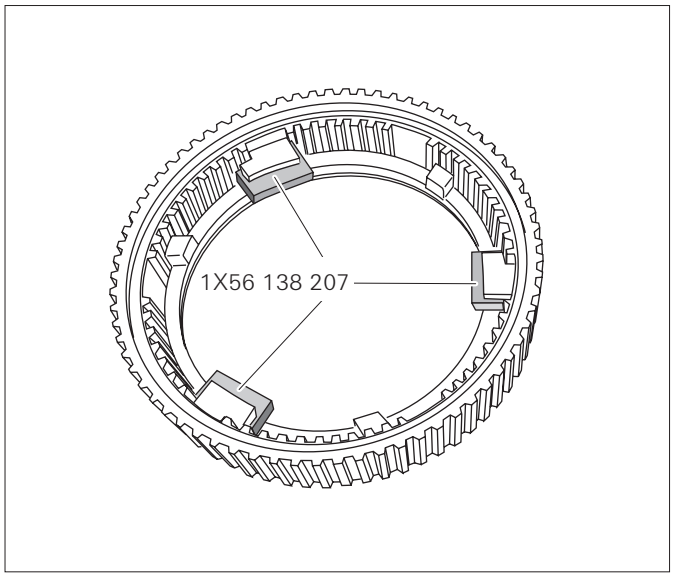
5 For the two synchronizer rings **/130**: Insert 3 pressure springs **/170** and 3 bushes **/150** in each and secure with a bracket **1X56 138 207**.

6 Insert both synchronizer rings **/130** into the sliding sleeve **/110** and remove the bracket **1X56 138 207**.

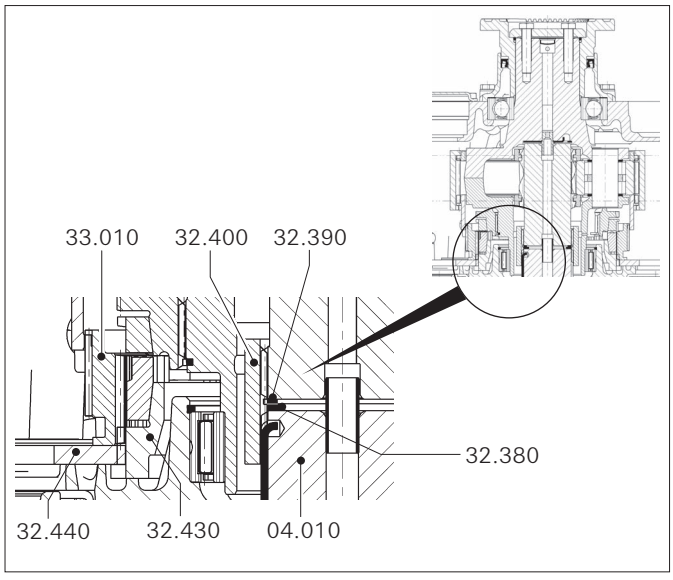
7 Put the complete synchronization with the synchronizer rings **/130**, bushes **/150**, and pressure springs **/170** onto the clutch body **32.430**.



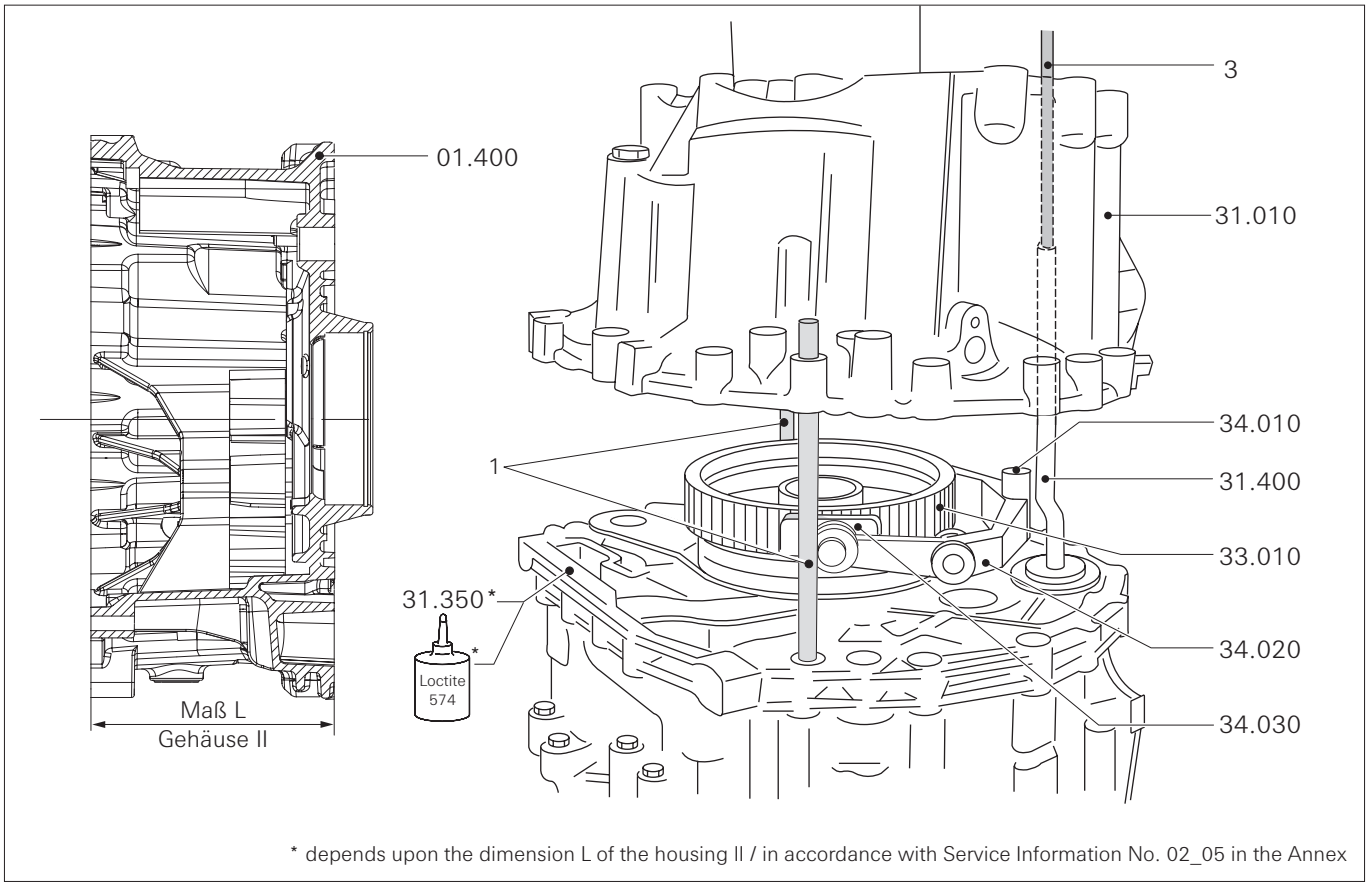
021763



015191



018085



* depends upon the dimension L of the housing II / in accordance with Service Information No. 02_05 in the Annex

028226

8 Clean sealing surfaces.

NOTE
The sealing faces on the housing I and the RC housing must be clean and free of oil and grease.

CAUTION
The correct seal/gasket must be used in accordance with Service Information No. 02_05 (also see Annex) otherwise, the transmission may be damaged.

9 Determine dimension L of the housing II **01.400**.

10 Depending on the version:
L = $184.5_{-0.1}$ mm and/or $227.5_{-0.1}$ mm:
Coat the sealing face at housing II with **Loctite no. 574**.

– OR –

L = $183.75_{-0.13}$ mm and/or $226.75_{-0.13}$ mm:
Put on seal/gasket **31.350**.

11 Insert the spray pipe **31.400** – longer end towards the RC housing.

12 Insert the selector pads **34.030** in the gear shift fork **34.020** and ensure correct positioning in the sliding sleeve **33.010** and the selector rail **34.010**.

13 Screw in two commercial M10 guide bolts **(1)** into the housing II **01.400**.

14 Fix 2 lifting eyes on output flange and/or planet carrier and hang in chain.

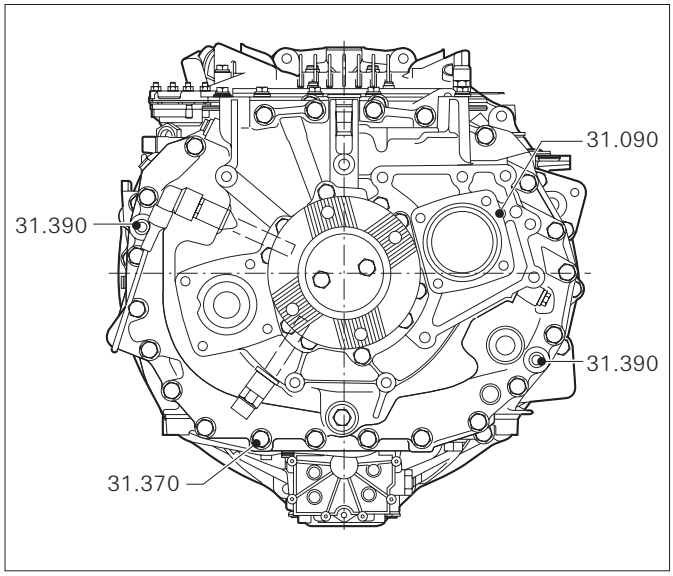
15 Hook in chain at hoist and cautiously lower the RC housing **31.010** onto housing II.
Use an auxiliary tool **(3)** (e. g. pin) in order to insert the spray pipe **31.400** into the bore of the screw plug **31.090**.
Remove the two M10 guide bolts **(1)**.

CAUTION
Appropriate handling is essential when positioning the RC housing and when driving in the cylindrical pins – danger of housing fracture.

16 Tighten screw plug M10x1 **31.090** to 15 Nm.

17 Insert two cylindrical pins **31.390**. Screw in 22 hex-head screws **31.370** and tighten to 50 Nm.

CAUTION
Screws of an appropriate length must be used to mounting the retaining plates.



018224

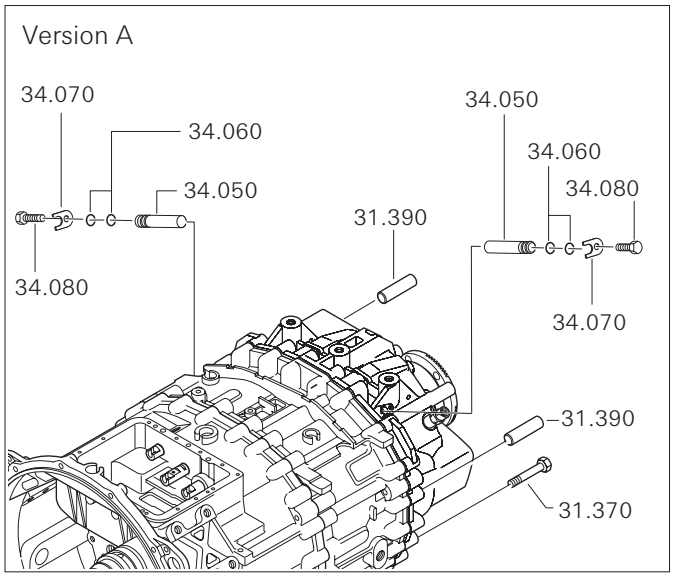
Version A

18 Insert new O-rings **34.060** at the pivot bolts **34.050**.

NOTE
If the pivot bolts **34.050** are inserted too far into the RC housing, then, you will have to dismount the RC housing again.

19 Insert the pivot bolts by means of the retaining plate **34.070** via the RC housing's bore into the gear shift fork **34.020**.

20 Fasten the retaining plate **34.070** with a hex-head screw **34.080** each and tighten to 23 Nm.



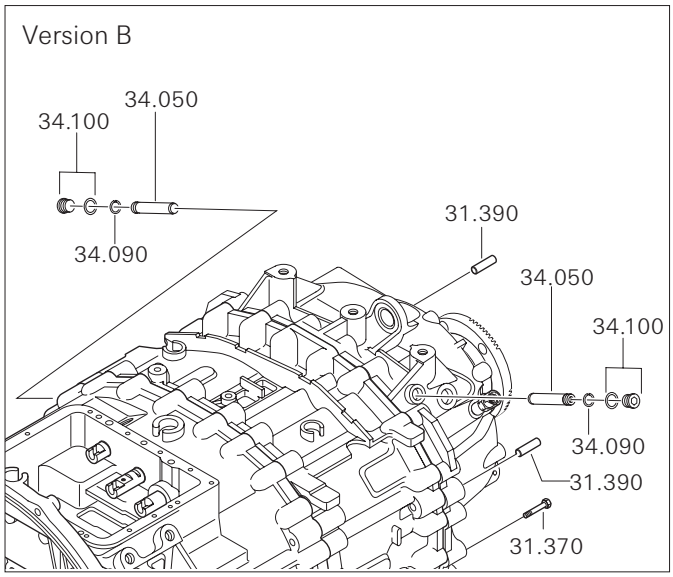
015167

Version B

18 Insert the snap ring **34.090** at the pivot bolts.

19 Cautiously insert the pivot bolts via the RC housing's bore into the gear shift fork **34.020**.

20 Tighten screw plug with sealing ring **34.100** to 40 Nm.



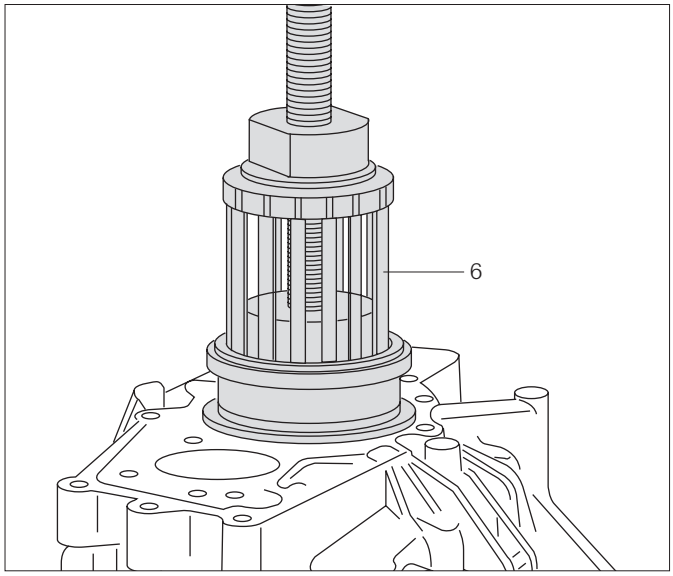
021762

Dismantling the RC Housing

1 Remove the output flange (refer to the corresponding chapter) and the output cover (refer to the corresponding chapter).

2 Remove all screw plugs and the impulse sensor from the RC housing.
Pull off the ball bearing **31.020** and take off the RC housing **31.010** from the planetary carrier by means of an extractor **(6) 1X56 122 314** for ball bearings with 10 balls and/or **1X56 138 295** for ball bearings with 11 balls.

3 Use a manually operated press to press the ball bearing **31.020** out of the range change housing.



015189

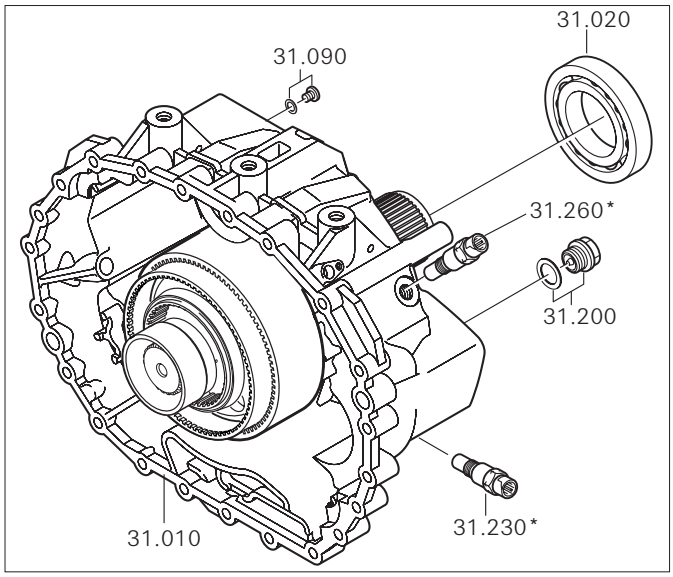
Assembling the RC Housing

1 Insert the ball bearing **31.020** in the RC housing **31.010**.

2 Heat up the bearing's inner rings of the ball bearing **31.020** to max. 120 °C and put on the complete RC housing until it axially abuts with the planetary carrier.

⚠ DANGER

Only touch heated parts when wearing protective gloves.



* Also refer to the parts list [BoM] or the ZF-Service Information No. 08_00 in the Annex.

015173

NOTE
Ensure that you only fit the screw plug M10x1 **31.090** when you certainly know that the RC housing has already been mounted to housing II.

3 Replace the sealing rings at the screw plugs.

Tightening torques:

Screw plug M24x1.5 **31.200**	60 Nm
Impulse sensor **31.230**	45 Nm
Impulse sensor **31.260**	45 Nm

4 Remove the output flange (refer to the corresponding chapter "Output Flange") and the output cover (refer to the corresponding chapter "Output Cover).

Planet Carrier

Disassembling the Planet Carrier

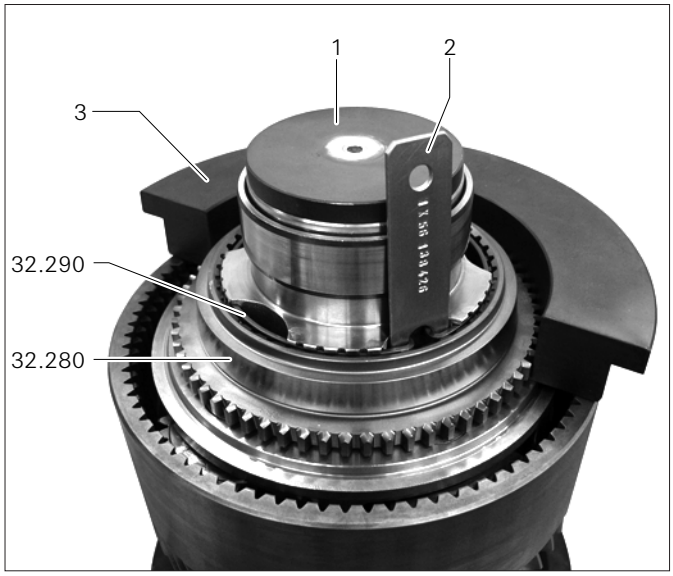
1 Place pressure plate **(1) 1X56 138 424** onto the planet carrier.

2 Use tool **(2) 1X56 138 426** for contracting the securing ring **32.290**.

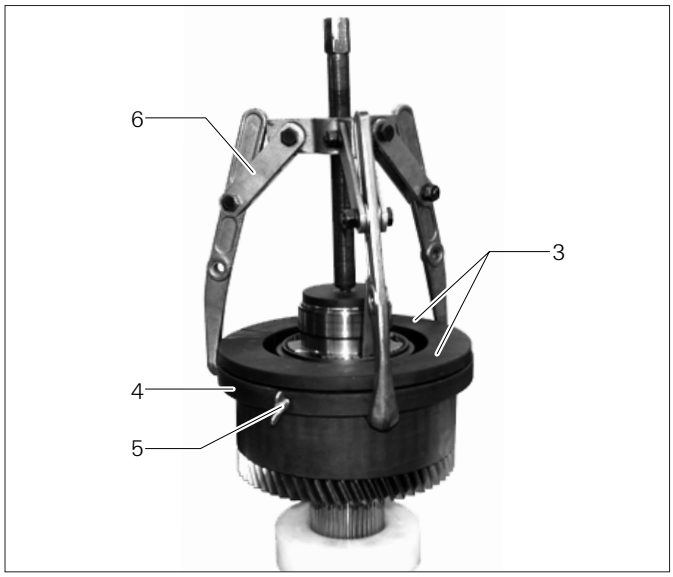
3 Take off the half-shells **(3)** from the tool **1X56 138 420** and push the small shoulder underneath the clutch body **32.280**.

4 Push the ring **(4)** from the tool **1X56 138 420** onto the two half-shells **(3)** and tighten the screw **(5)**.

5 Pull off the clutch body **32.280** by means of a commercial three-armed puller **(6)**.



023594



023595

NOTE for transmissions equipped with an Intarder
Remove the 10 hex-head screws **32.144** and pull off the step-up gear **32.140** by means of a two-arm puller.

6 Position the planet carrier laterally on the ring gear.

7 Remove the locking wire **32.240** (e. g. with 2 small screwdrivers).

⚠ DANGER

Ring gear 32.130 is free and can fall down.
– Risk of injury –

8 Take off the ring gear carrier **32.230**.

9 If necessary, remove the locking wire **32.122**.

10 Take thrust ring **32.120** out of the ring gear **32.130**.

11 Turn the planet carrier by 180° and use a mandrel to drive the planetary bolt **32.050** out of the planet carrier **32.010**.

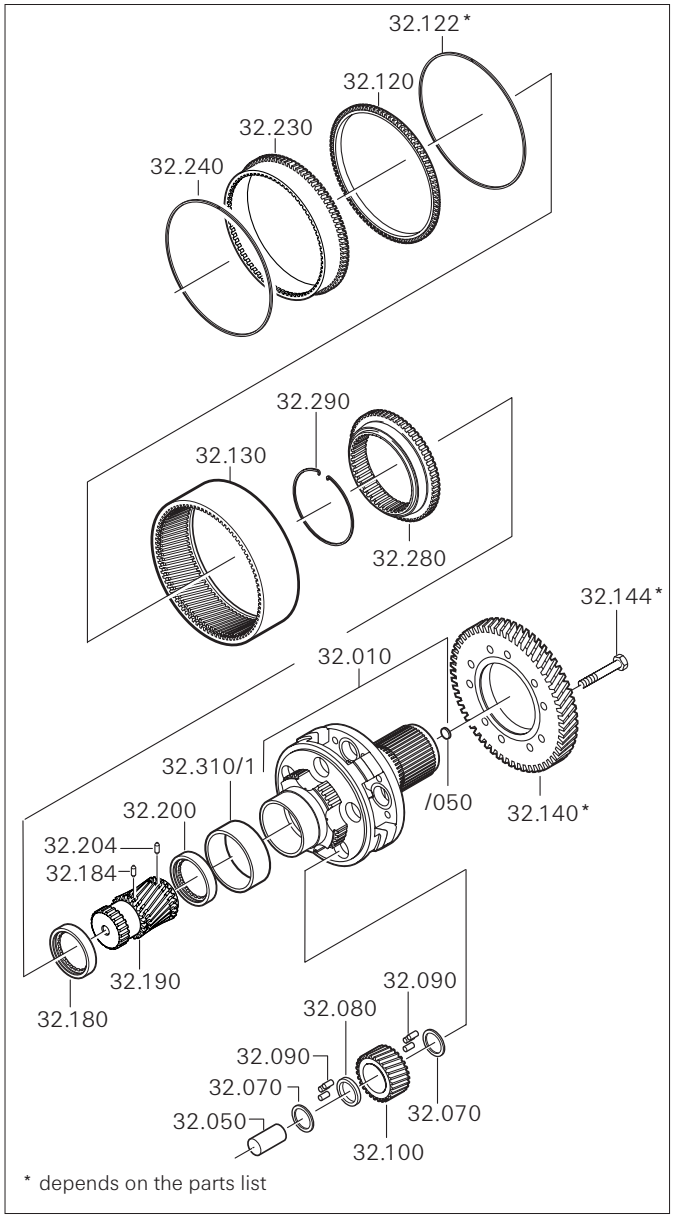
12 Take out the planetary gear set **32.100** (contains 5 planetary gears). Take out the intermediate washers **32.070**, **32.080** and rollers **32.090** from the planetary gears.

13 The sun gear **32.190** is released.

14 Offset pressure disks **32.200**, **32.180** by 1/2 a tooth so that the driving pins **32.204**, **32.184** are released.

15 Remove the driving pins **32.204**, **32.184**.

16 Pull of the bearing inner ring **32.310/1** by means of an extractor **1X56 138 087**.



028301

Pre-Assembling the Sun Gear

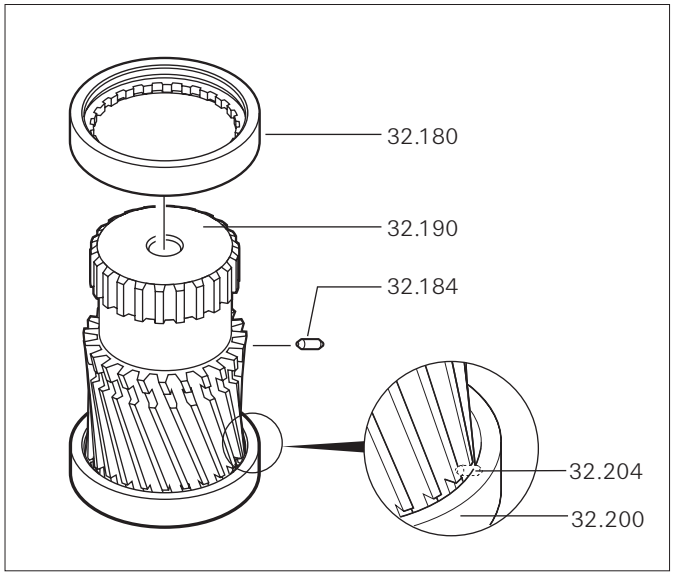
1 Insert the driving pin **32.204** in the sun gear **32.190**.

2 Slide the pressure disk **32.200** – the shorter shoulder points towards the planetary gear – into the spline of the sun gear **32.190** and offset the two. Thereby, the driving pin **32.204** is secured.

3 Slide the pressure disk **32.180** – the shorter shoulder points towards the planetary gear – into the spline of the sun gear **32.190**.

4 Insert the driving pin **32.184** into the bore of the sun gear.

5 Push the pressure disk **32.180** upwards and offset it so that the driving pin **32.184** is secured.



015188

Pre-Assembling the Planetary Gear Set

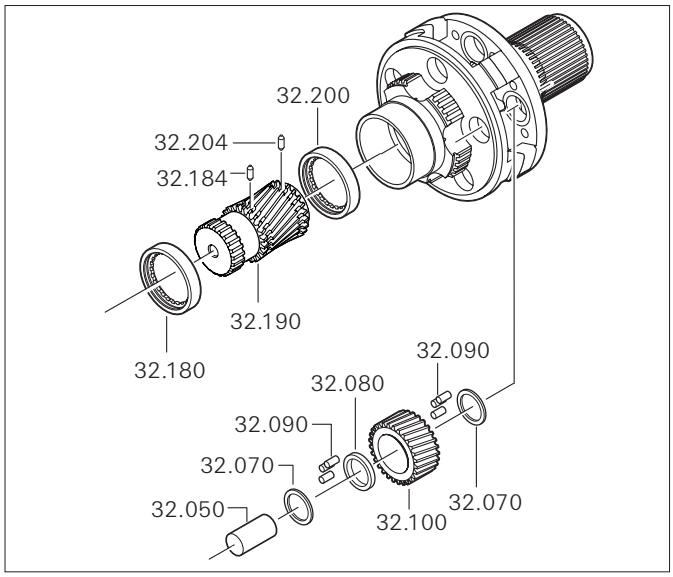
CAUTION
Planetary gears may not be replaced individually, always replace the entire set.

1 Grease all needle rollers **32.090** with transmission oil.

2 Insert the thinner intermediate disk **32.070** in the planetary gear **32.100** and position the 14 rollers **32.090** in the planetary gear.

3 Insert the thicker intermediate disk **32.080** and, again, introduce 14 rollers **32.090** into the planetary gear. Finally, add on top a thin intermediate disk **32.070**.

4 These work steps must be performed for all 5 planetary gears.



028362

Completing the Planet Carrier

⚠ DANGER
Always wear protective gloves when handling heated parts.

1 Heat up the bearing inner ring **32.310/1** to max. 120 °C and slide onto the planet carrier until firmly home (axial abutment).

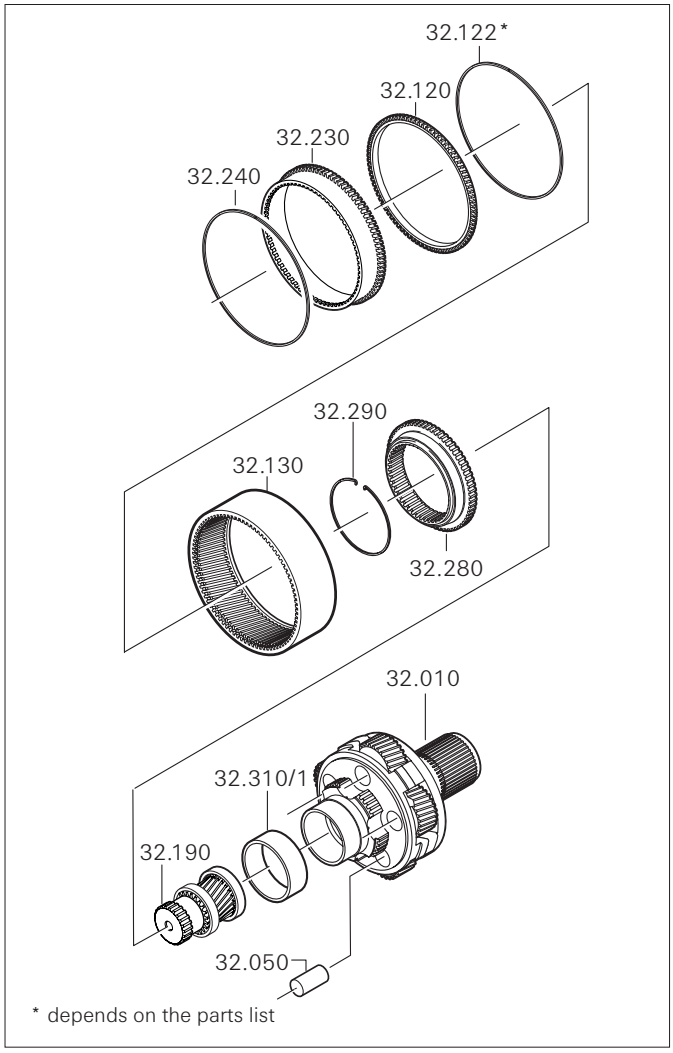
2 Insert the pre-assembled sun gear **32.190** in the planet carrier **32.010** . Ensure that the driving pins cannot fall out.

⚠ DANGER
Fingers may get stuck/jammed!

3 Hold pressure disk at the sun gear upwards and insert the pre-assembled planetary gears **32.100**. Insert the planetary gear pins **32.050** and center the planetary gears.

4 Use a plastic hammer in order to cautiously hammer in the planetary gear pins **32.050** into the planet carrier bore (until they no longer protrude).

5 Insert the securing ring **32.290** into the planet carrier **32.010**.



028363

⚠ DANGER
Always wear protective gloves when handling heated parts.

6 Heat up the clutch body **32.280** to max. 120 °C and slide onto the planet carrier until firmly home (axial abutment). Use pliers here in order to help contracting the securing ring **32.290**. The securing ring snaps into the groove of the clutch body.

7 If necessary, use locking wire **32.122**.

8 Insert the thrust ring **32.120** – ground side points towards the output – into the ring gear **32.130**.

9 Slide the ring gear **32.130** (output-end) and the ring gear carrier **32.230** (input-end) onto the planet carrier so that the locking wire **32.240** (e. g. by means of a small screwdriver) can be put into the groove of the ring gear **32.130**.

NOTE
The locking wire **32.240** must make contact with the ring gear's groove base.

Only for the Intarder version

Assembly of Step-Up Gear

1 Heat up the step-up gear **32.140** to 120 up to 130 °C.

2 Screw in two M12 guide pins into the planet carrier **32.010**.

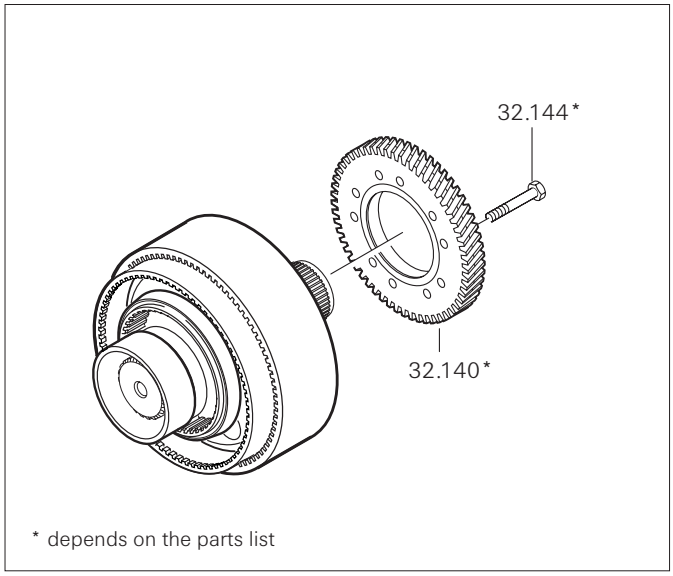
⚠ DANGER

Only touch heated parts when wearing protective gloves.

3 Put the hot step-up gear **32.140** – shoulder towards output – onto the planet carrier.

4 Remove M12 guide pins.

5 Screw in 10 M12 hex-head screws **32.144** and tighten to 135 Nm.



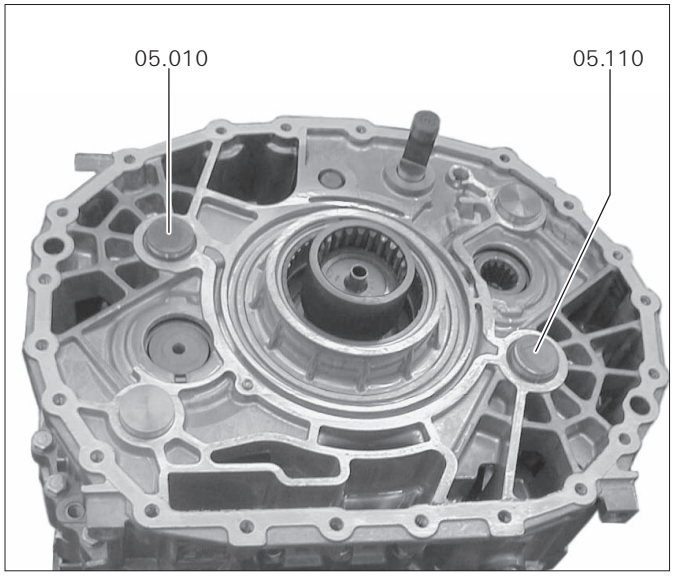
* depends on the parts list

028364

Place transmission without RC (planetary range) in horizontal position.

1 Replace the two reverse gear bolts **05.010**, **05.110** by the tools **(9) 1X56 138 208**.

NOTE
The reverse gear's reversing gears are secured by means of a tool **(9) 1X56 138 208**.



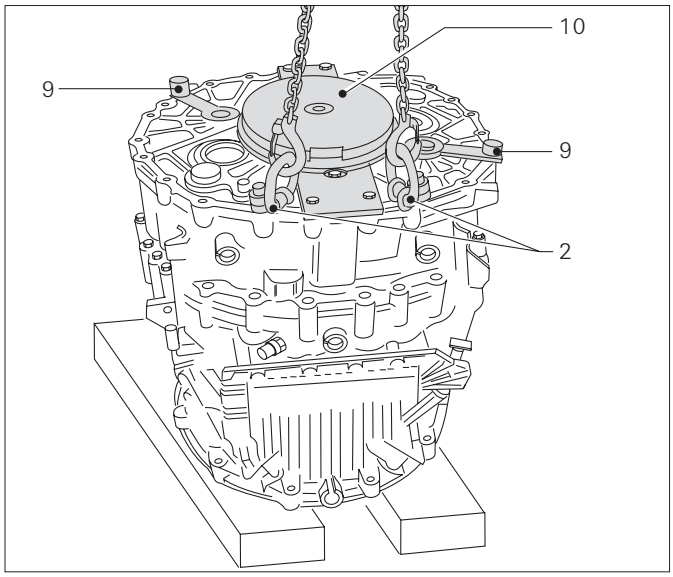
018269

2 Fasten the holding plate **(10) 1X56 138 203** to the housing II.

3 Make oil collecting basin and skids available.

4 Mount 2 lifting lugs **(2) 1T66 154 240** to the housing II. Hook in the chain and put transmission into horizontal position using a hoist.

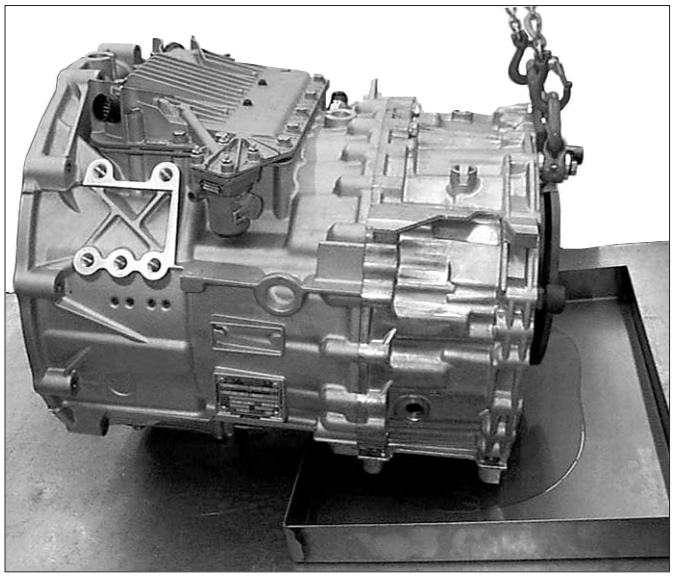
NOTE
Residual transmission oil may be drained; position the oil collecting basin correspondingly.



015187

5 Remove the lifting lugs.

6 For removing the transmission actuator, please refer to the corresponding chapter.



015192

Transmission Actuator

Removing Transmission Actuator

1 Depending on parts list: Remove breather **74.120** and/or angle piece **74.140** and cannon plug **74.130** from the transmission actuator **74.030**.

2 Remove 15 M8 hex-head screws **74.090**, **74.070** from the transmission actuator **74.030**.

3 Take off transmission actuator **74.030** from the transmission housing.

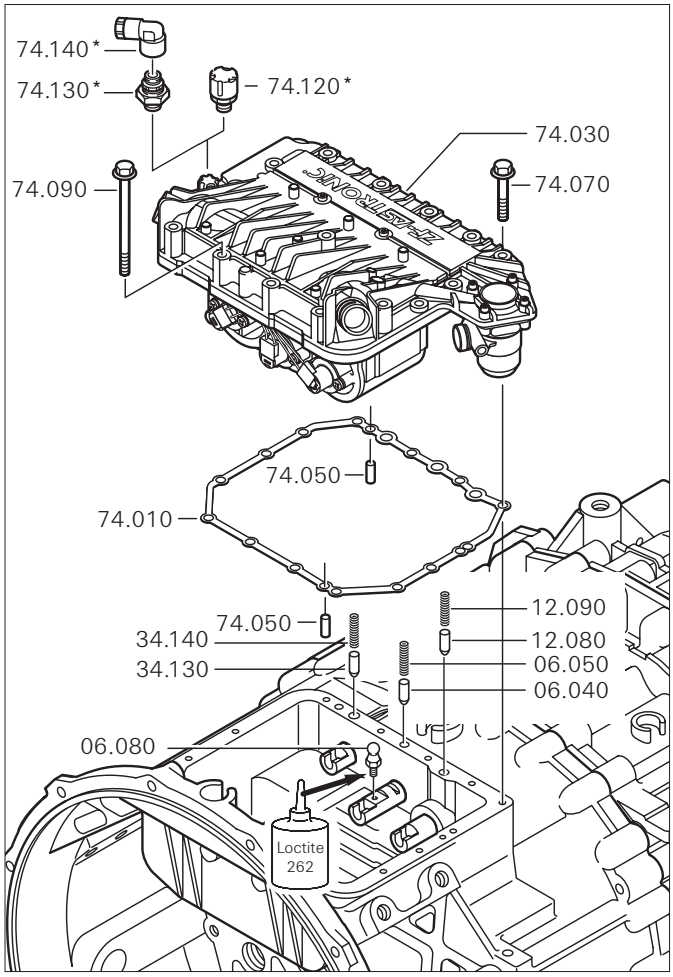
NOTE
Please pay attention to the fact that the rubber seals (item **/170**, also refer to Fig. 017908 / chapter “Mounting Transmission Actuator”) are also removed otherwise they may fall into the transmission housing.

4 Remove compression springs **06.050**, **34.140**, **12.090** and detent pins **06.040**, **34.130**, **12.080**. Replace the two cylinder pins **74.050** if they are damaged.

5 Remove seal **74.010** and clean sealing surfaces on transmission housing and transmission actuator.

NOTE
A transmission actuator kit is available.
It consists of transmission actuator **74.030**, seal **74.010,** and breather **74.120**.

6 In the case that housing I **01.010,** is dismounted - refer to the corresponding chapter - also remove the ball pins **06.080**.



* depends on the parts list

015166

Mounting Transmission Actuator

NOTE
Only mount the transmission actuator, if the transmission is completely assembled.

1 Coat the threads of the ball pins **06.080** with **Loctite no. 262**. Tighten ball pins to 23 Nm.

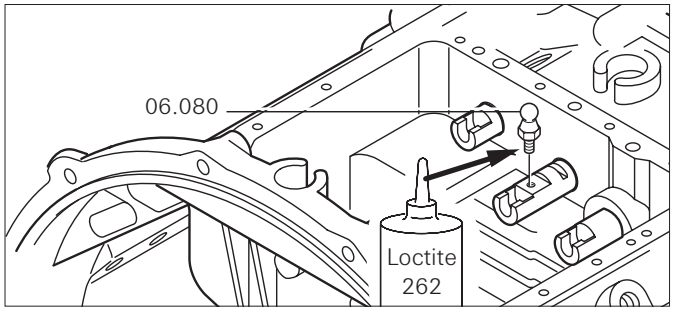
2 Fasten the fixture **(11) 1X56 138 095**. Hook in the corresponding selector rails with the lever. Manually turn the input shaft and use lever to engaged gears.

3 Engage S/G and R/C selector rails in the transmission in output direction. Move the central selector rail into neutral.

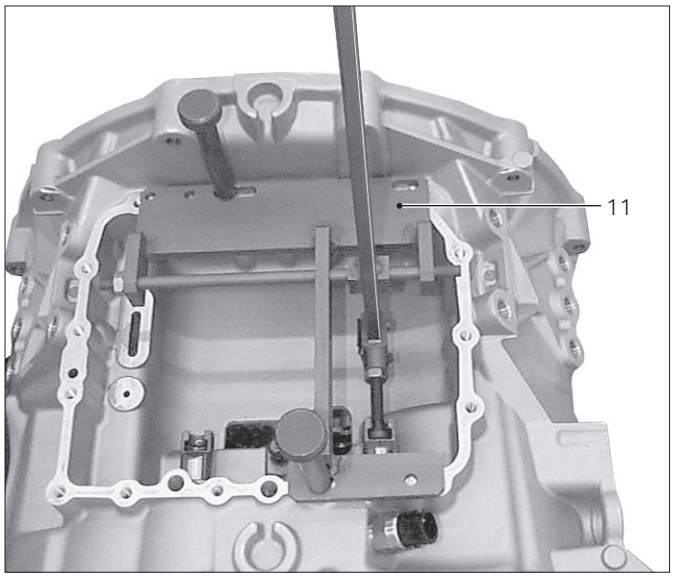
4 Remove the fixture **(11)** and put a new seal/gasket **74.010** onto the transmission housing.

5 Move piston rod **(4)** on transmission actuator into central position (neutral). The correct position is reached when slight resistance can be felt when pulling out the piston rod **(4)**. Align the two other piston rods **(3** and **5)** with the same level.

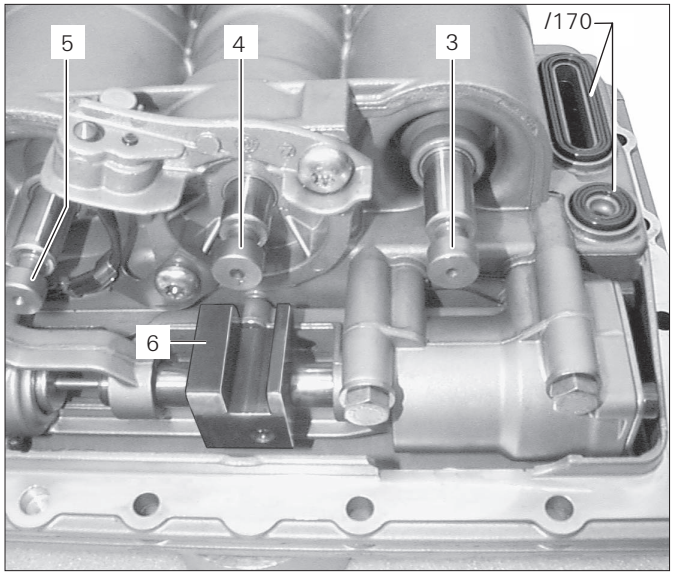
6 Selector gate **(6)** and piston rod **(4)** must be one above the other (flush). Ensure that the rubber seals **/170** on the transmission actuator are inserted.



017429

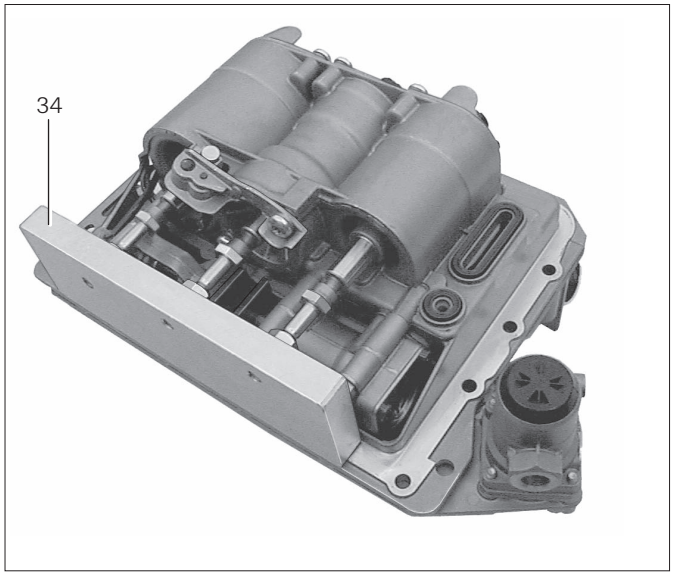


015183



017908

NOTE
An auxiliary tool **(34)** can be manufactured for setting the piston rods.
For auxiliary tool sketch refer to Fig. 34.
Upon request, the auxiliary tool **(34)** can also be supplied by ZF with the following order number: **1X56 138 244**.



017907

7 Insert the detent pins **06.040**, **34.130**, **12.080** and the compression springs **06.050**, **34.140**, **12.090**.

8 Align ball pins **06.080** vertically.
The ball pins **06.080** engage with the selector gate **(6)** when putting on the transmission actuator.

9 Attach transmission actuator **74.030** ensuring that the piston rods **(3**, **4**, **5)** of the transmission actuator fully engage with the selector rails of the transmission.

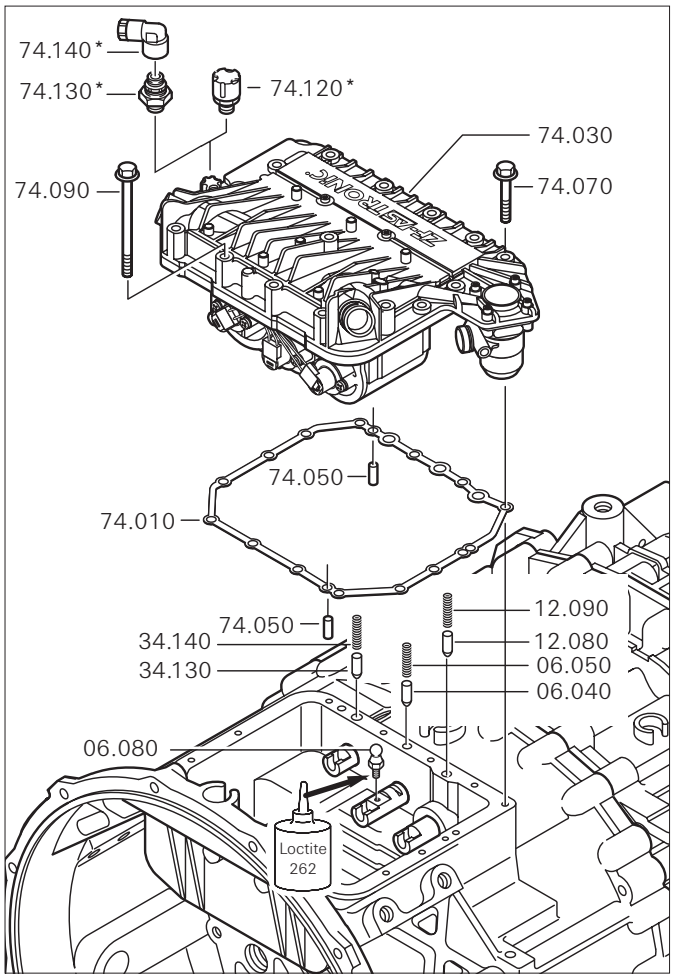
10 Tighten M8 hex-head screws **74.090**, **74.070** to 23 Nm.

11 Depending on parts list:
Tighten cannon plug **74.130** to 18 Nm and fasten the angle piece **74.140** and/or tighten the breather **74.120** to 10 Nm.

CAUTION
Pay attention to the following instructions if the transmission actuator was replaced or renewed:
- **Reprogram the transmission actuator!**
- **Transfer vehicle parameters from removed transmission or re-enter.**

12 Connect air line to transmission actuator's pressure relief valve.

13 Connect the cable harness otherwise functions inspections with the diagnosis device is not possible.



* depends on the parts list

015166

Removing the Upper Section from the Lower Section

NOTE
Seal kit 0501 319 863 contains both screws **/150-1**, the flat seal **/150-2**, and the profile seal **/150-3**.

CAUTION
Record the data on the type plate. This is needed for ordering spare parts and for correspondence.

1 Remove both screws **/150-1**.

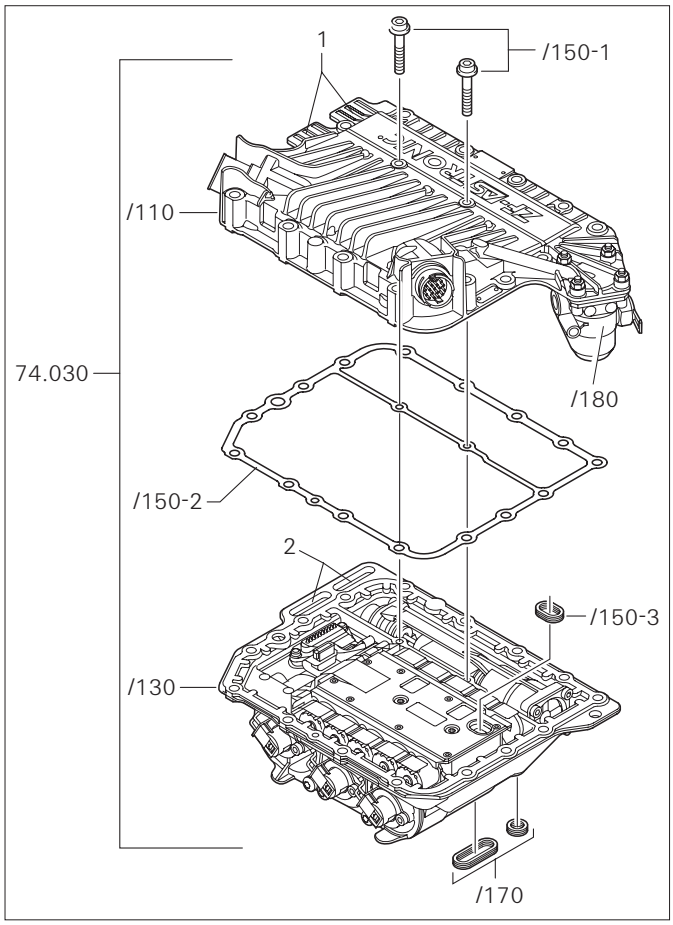
2 Raise upper section **/110** at the pressure relief valve **/180** and use both tabs **(1)** to carefully move it sideways into the grooves* **(2)**. Disconnect plug connections **(7**, **8)**.

3 Remove seals **/150-3** and **/170**.

4 Remove seal **/150-2** and clean sealing faces.

* not possible with the 18-pin variant

024361



019352

Mounting the Upper Section to the Lower Section

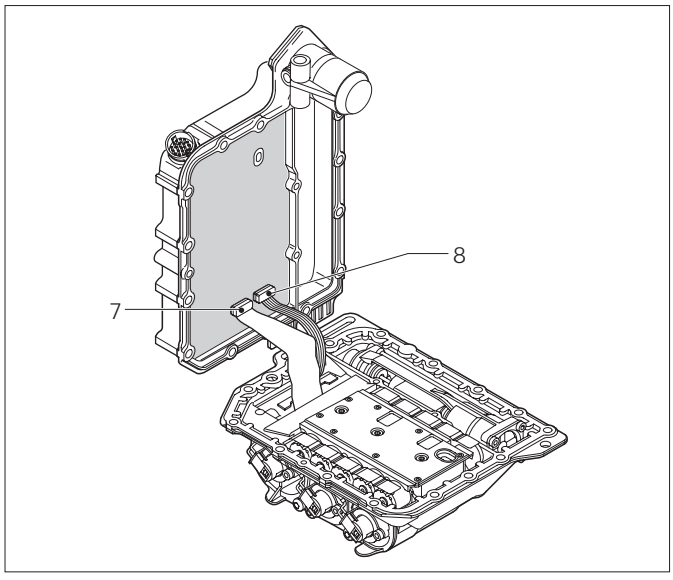
1 Insert seal **/150-3**.

2 Place seal **/150-2** on upper section **/130**.

3 Re-connect plug connections **(7** and **8)**. Check again: Solid seating of plug connection.

4 Place upper section**/110** on lower section **/130**.
Ensure that the seal/gasket **/150-2** does not slip, fix if necessary. Tighten the two screws **/150-1** to 9.5 Nm.

5 Insert seals **/170**.



018205

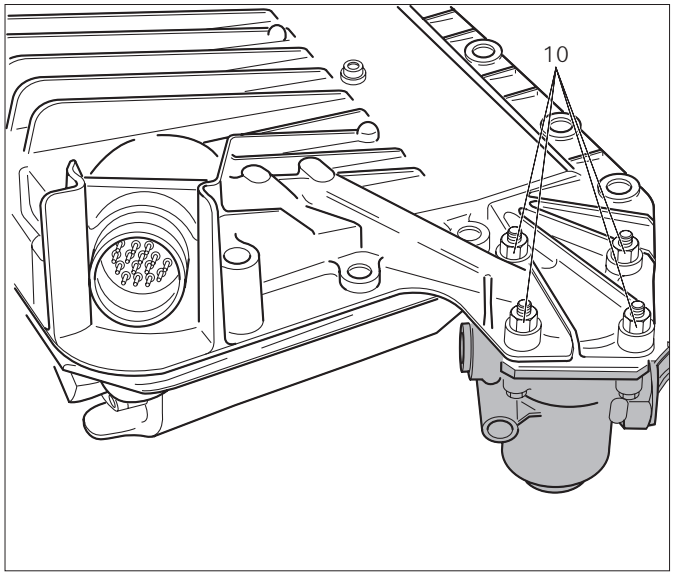
Replacing Pressure Relief Valve
(repair kit 0501 320 849)

NOTE
Mark the installation position of the pressure relief valve **/180** for fitting later on.

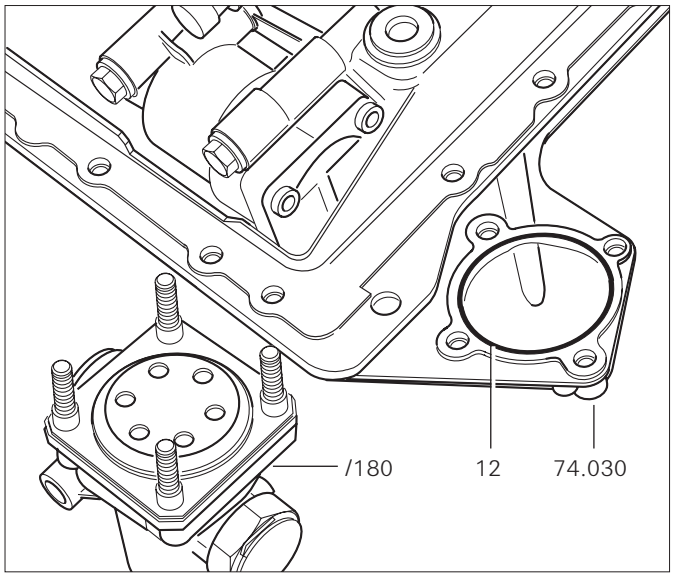
1 Remove 4 nuts (**10**) and take off pressure relief valve **/180** and O-ring (**12**).

CAUTION
Do not use grease to fit O-ring (12).

2 Insert new O-ring (**12**), use 4 nuts (**10**) to mount the pressure relief valve **/180** to the transmission actuator **74.030**.
Tightening torque: 7 Nm



019251



019252

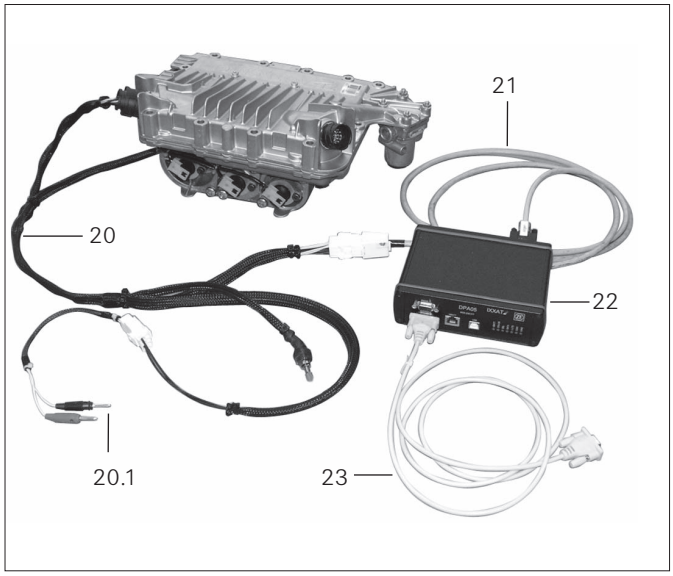
Programming Transmission Actuator

When replacing the transmission actuator and/or upper section, customer-specific programming and/or parameter setting (entering EOL data) will be required.

During parameter setting, the EOL data are entered in the transmission actuator's electronics using **ZF-Testman pro and** the corresponding **software**.

Diagram of transmission actuator programming
Item:

20 Table mode adapter
20.1 Power supply connection
21 Cable from table mode adapter to the DPA05
22 DPA05
23 Cable to laptop and/or PC

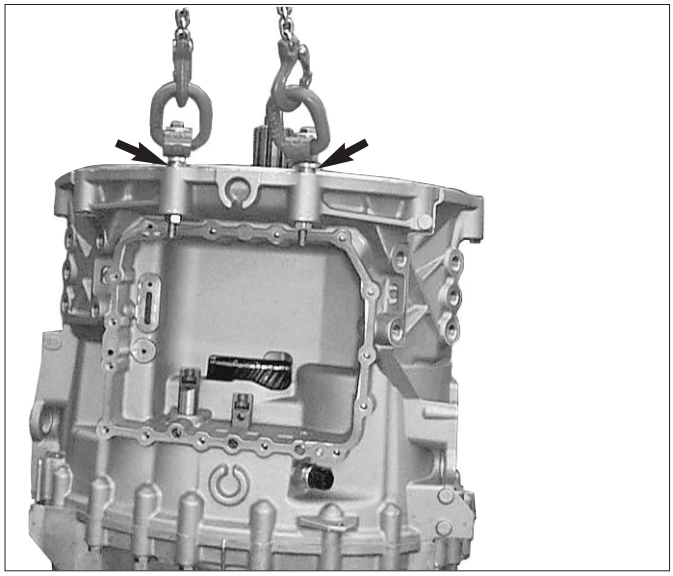


028537

CAUTION
When programming a new transmission actuator, transfer the vehicle parameters from the transmission actuator removed or re-enter them.

Putting transmission in vertical position

1 Fasten 2 lifting lugs **1T66 154 240** to the housing I; ensure that with 2 to 3 washers respectively, the shoulder to the centering diameter can be bridged (see arrow).

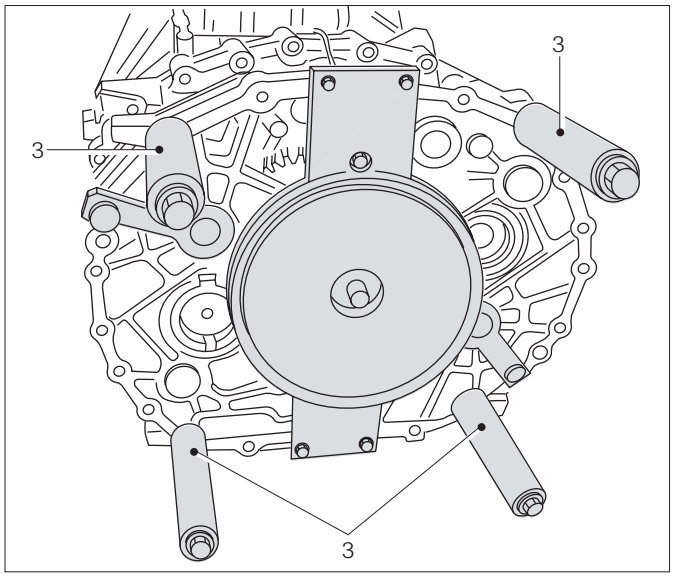


015184

2 Hook in the chain and lift the transmission.

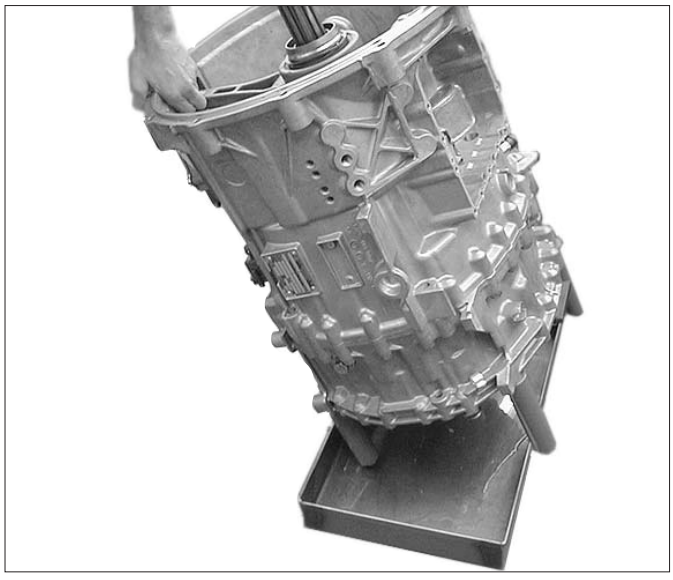
NOTE
Residual transmission oil may be drained; position the oil collecting basin correspondingly.

3 Screw in 4 supports **(3) 1X56 138 443** into the housing II.



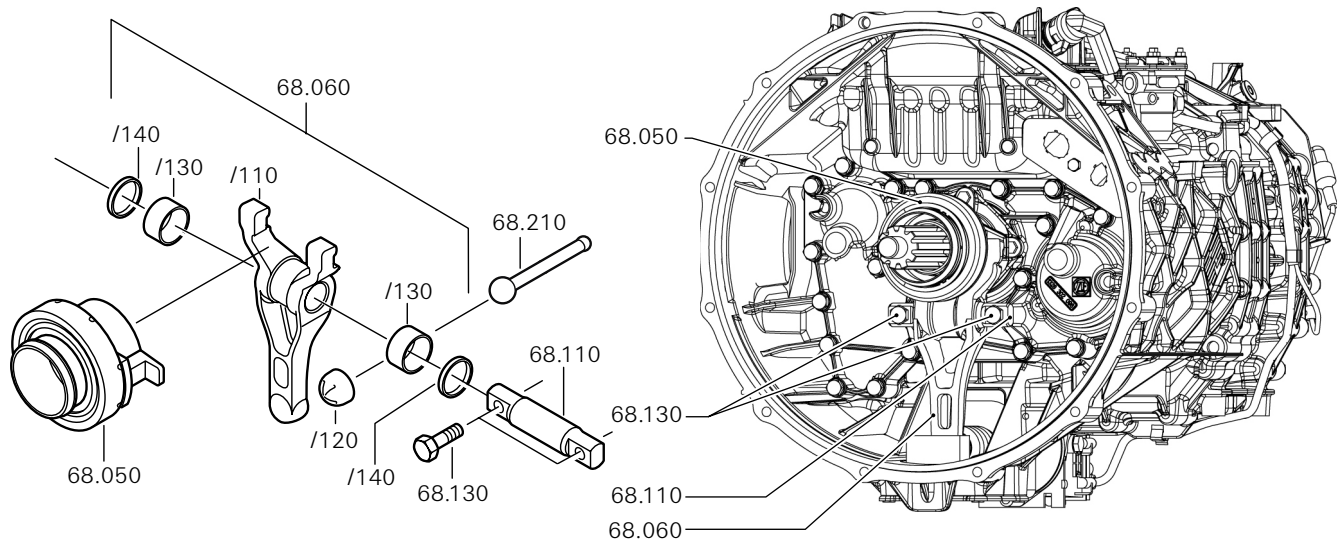
015185

4 Lift transmission cautiously and position on the four supports.



015186

Clutch Release Mechanism



Clutch Release Mechanism: Version A

028365

Removing Release Fork

1 Remove 2 M12 hex-head screws **68.130** from release shaft **68.110**.

2 Take release bearing **68.050** and release fork **68.060** off the input shaft.

3 Slide the release shaft **68.110** out of the release fork **68.060**. If necessary, take out the push rod **68.210** from the release fork.

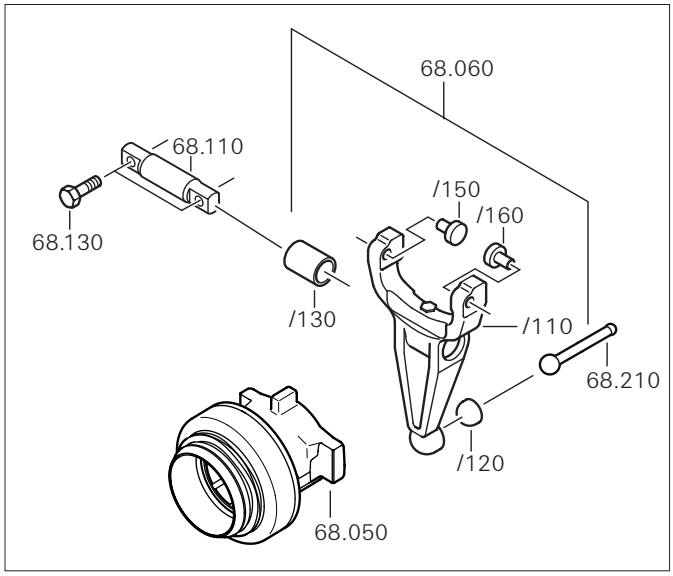
Version A: Release fork with cams

4 Dismantling the release fork **68.060**:
Remove the two shaft sealing rings **/140** and bearing bushes **/130** with suitable tools.
Renew the ball cups **/120** if they are damaged or worn.

Version B: Release fork with cam rollers

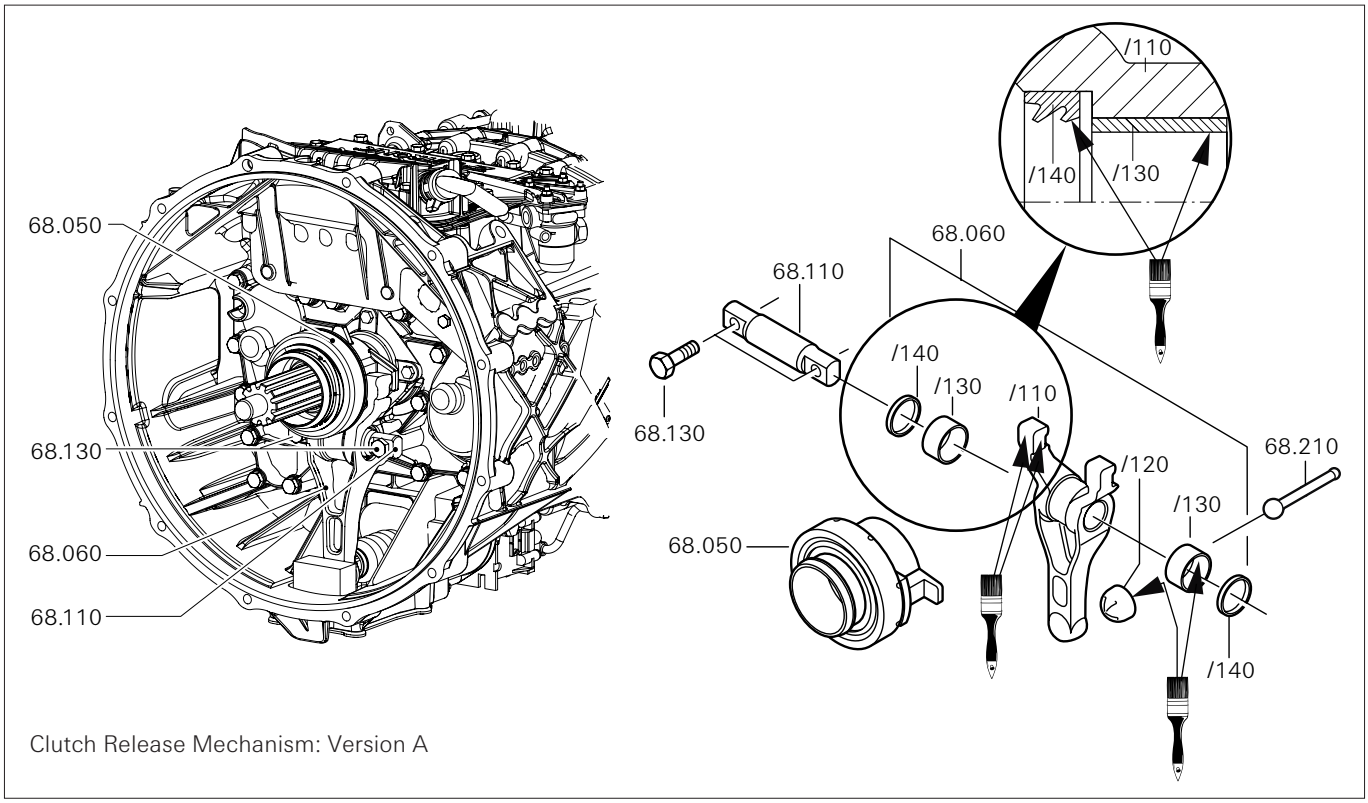
CAUTION
Do not wash the following components:
- Release fork 68.060.
- Release bearing 68.050

4 Disassemble the release fork **68.060**:
Remove the bearing bush **/130** with suitable tools.
Drive out cam rollers **/150** and **/160** from the release fork **68.060** (e. g. with a punch).
Renew ball cups **/120** if damaged or worn.



028231

Mounting the Release Fork



Clutch Release Mechanism: Version A

028366

CAUTION
The release fork 68.060 and the release bearing 68.050 of the versions A and B are not mutually interchangeable. The release shaft 68.110 however is always identical.

Version A: Clutch release mechanism with cams

1 Assembling the release for **68.060** .
An adapter **1X56 138 215** is needed as support for the release fork**/110**. Another adapter **1X56 138 215** is used to press in the two bushes **(/130)** and shaft sealing rings **(/140)** (pay attention to the installation position) one after the other.

2 Fill the shaft sealing rings **/140** with grease between the sealing lips. Press in bearing bushes **(/130).** For greasing, use OLISTA LONGTIME 3EP (ZF no. 0671 190 050).

3 Press in ball cups **(/120). For greasing, use** OLISTA LONGTIME 3EP (ZF no. 0671 190 050).

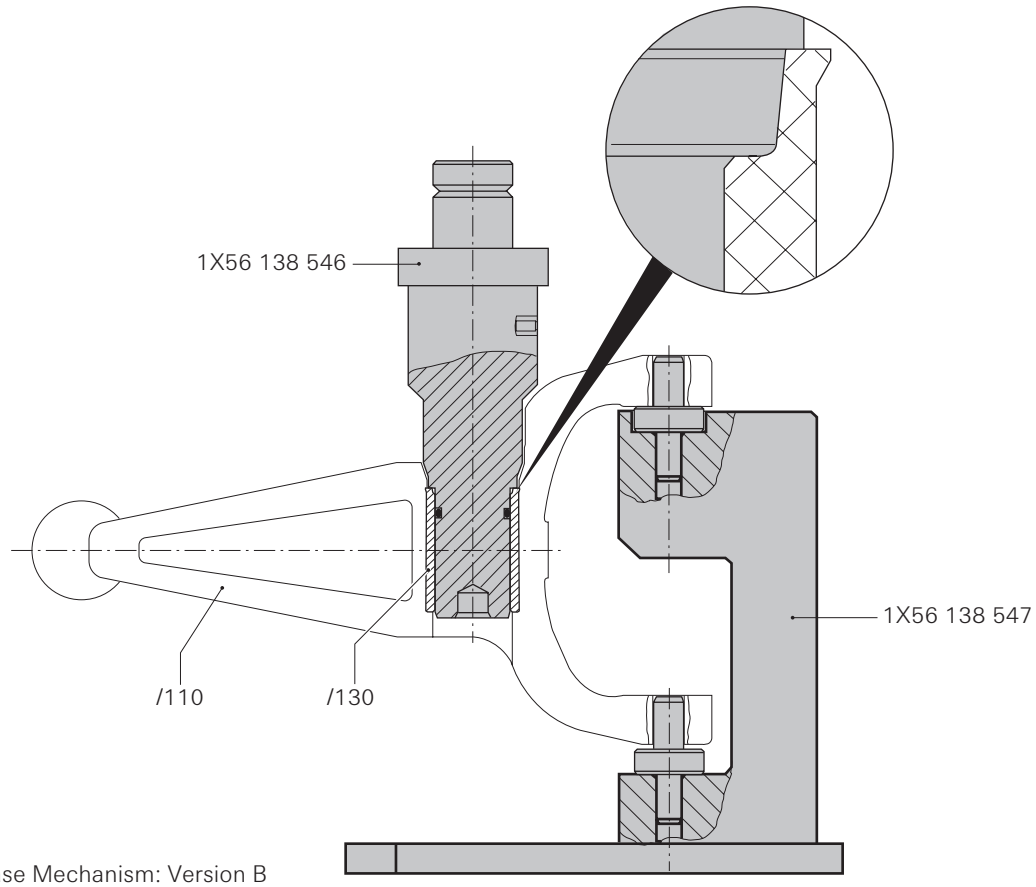
4 Guide release shaft **68.110** into release fork **68.060**, do not damage shaft sealing rings in the process.

5 Position release bearing **68.050** on release flange (guide tube).

NOTE
Do not grease the sliding seat “release bearing – release flange”.

6 Apply grease to contact face towards the release bearing **68.050** at the release fork **68.060**. For greasing: Use OLISTA LONGTIME 3EP (ZF no. 0671 190 050). Engage release fork **68.060** with release bearing **68.050**.

7 Fasten the release shaft **68.110** with 2 M12 hex-head screws **68.130** to the connection plate.
Tightening torque: 115 Nm



Clutch Release Mechanism: Version B

028244

Version B: Release fork with cam rollers

CAUTION
Always press in the bearing bush /130 first, then the cam rollers /150 and /160.

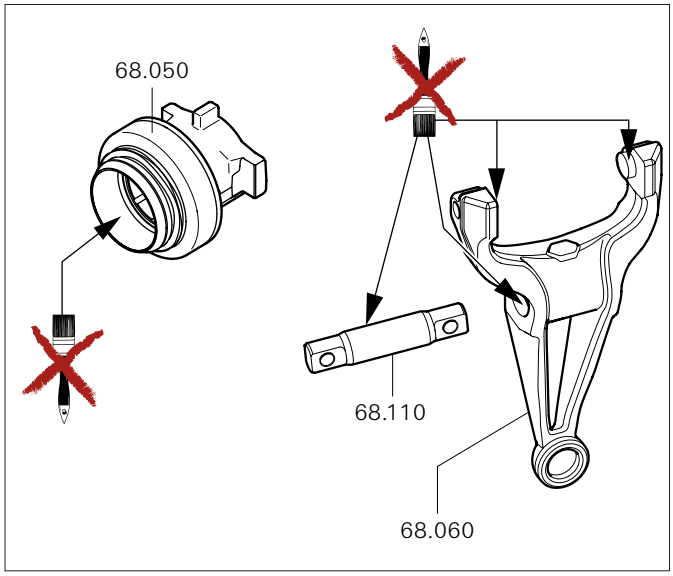
1 Assemble the release fork **68.060**. While doing that, use the assembly fixture **1X56 138 547** as a support.

NOTE
Press in the bearing bush – rim facing the press-in mandrel.

Use the press-in mandrel **1X56 138 546** for pressing in the bearing bush **/130** until firmly home in the release fork **/110** so that the bush's rim fully engages in the groove of the release fork.

2 Use the press-in mandrel **1X56 138 546** in order to press in the cam rollers **/150** and **/160** until firmly home in the release fork **/110**.

CAUTION
Do not grease the following components:
- Cam rollers
- Sliding seat “Release bearing – release flange”
- Release shaft
- Bearing bush (greased ex works)



028239

3 Press in ball cup **/120**. For greasing, use OLISTA LONGTIME 3EP (ZF no. 0671 190 050).

4 Slide release shaft **68.110** into release fork **68.060**.

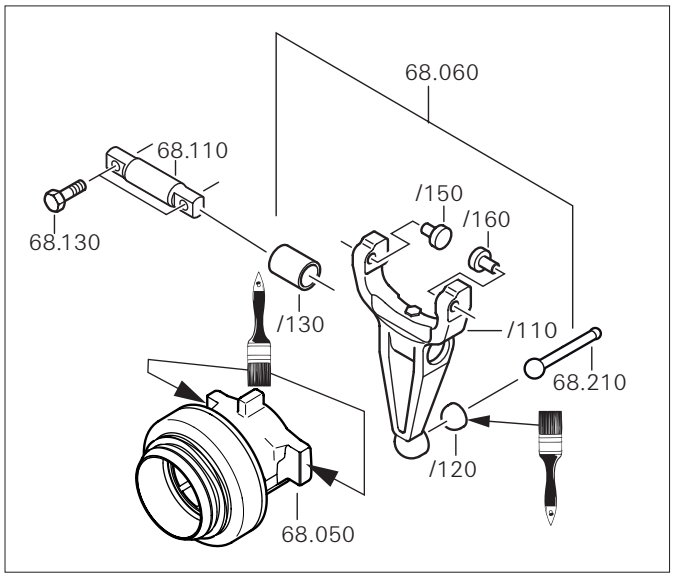
NOTE
The release shaft in the bearing bush has play.

5 Grease the front-end of the cams from the release bearing with OLISTA LONGTIME 3EP (ZF no. 0671 190 050).

6 Position release bearing **68.050** on release flange (guide tube).

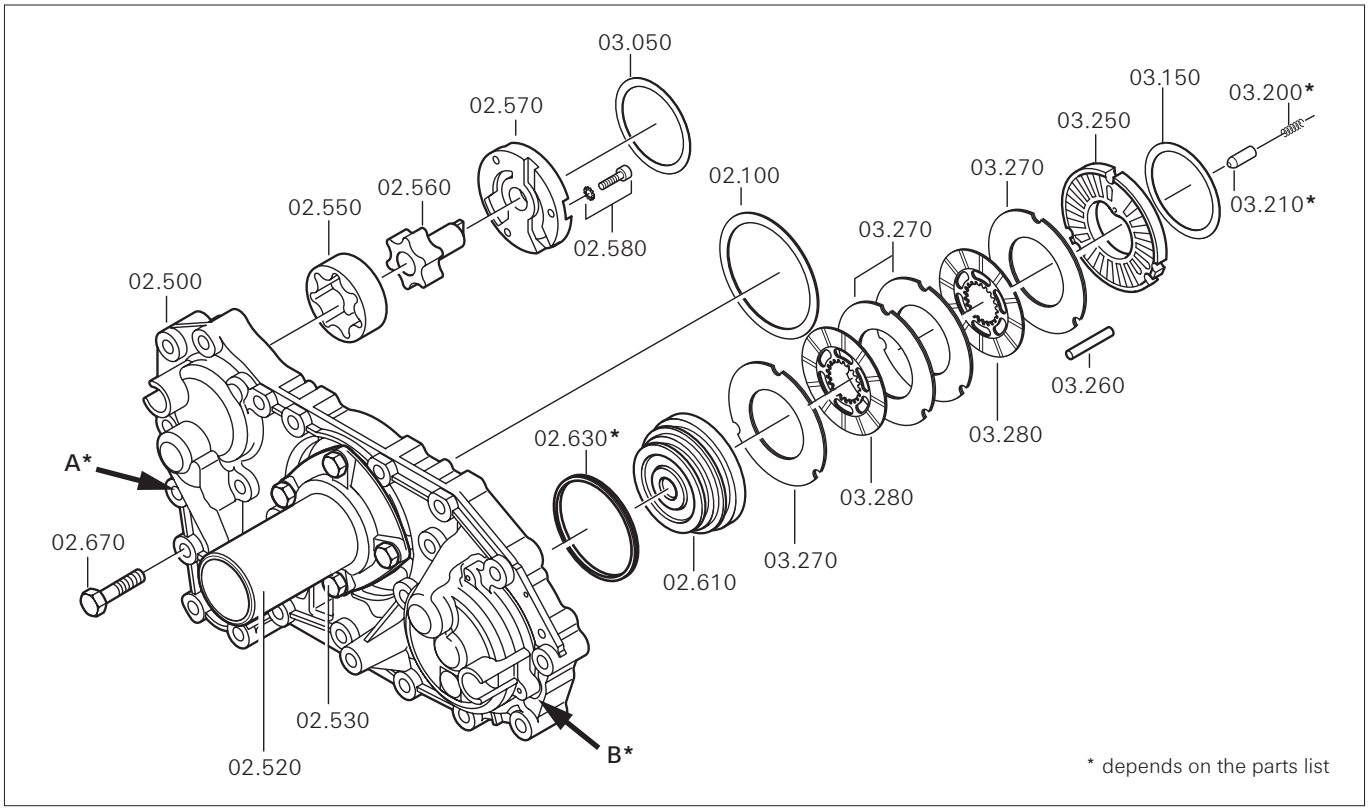
7 Engage release fork **68.060** with release bearing **68.050**. Ensure push rod **68.210** is seated correctly.

8 Mount release shaft **68.110** with 2 M12 hex-head screws **68.130** to the clutch housing. Tightening torque: 115 Nm



028233

Connection Plate



028303

Removing Connection Plate

1 Remove the 22 M10 hex-head screws **02.670**.

2 Lift the connection plate **02.500** with a suitable tool or, if necessary, use the M8 thread for pressing off (refer to arrows A, B).

NOTE
In order to lift off the connection plate, it is much easier if the release flange **02.520 has not** been removed. Otherwise, the connection plate tends to cant/misalign.

3 Remove the compensating disks **03.050, 02.100**, **03.150**, detent pin **03.120**, and the pressure spring **03.200**.

4 Remove the brake cover **03.250** from the connection plate as well as the outer multidisks **03.270** and the lined multidisks **03.280**.

5 Take out the brake piston **02.610** and, when removing the groove ring **02.630**, pay attention to the installation position (important for subsequent re-installation).

6 Exchange the cylindrical pins **03.260** if they are defective.

7 Disassemble the pump for parts inspection (visual) and cleaning.

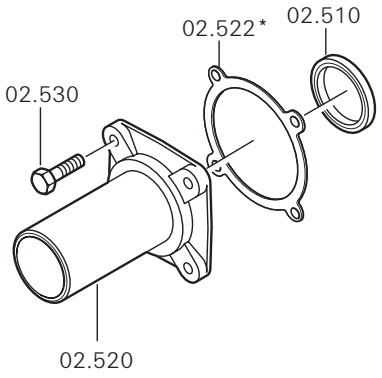
8 Remove three Torx screws **02.580**.

9 Remove the pump cover **02.570**, pump shaft **02.560**, and rotor **02.550**.

10 Remove four M8 hex-head screws **02.530** and lift off the release flange **02.520**.

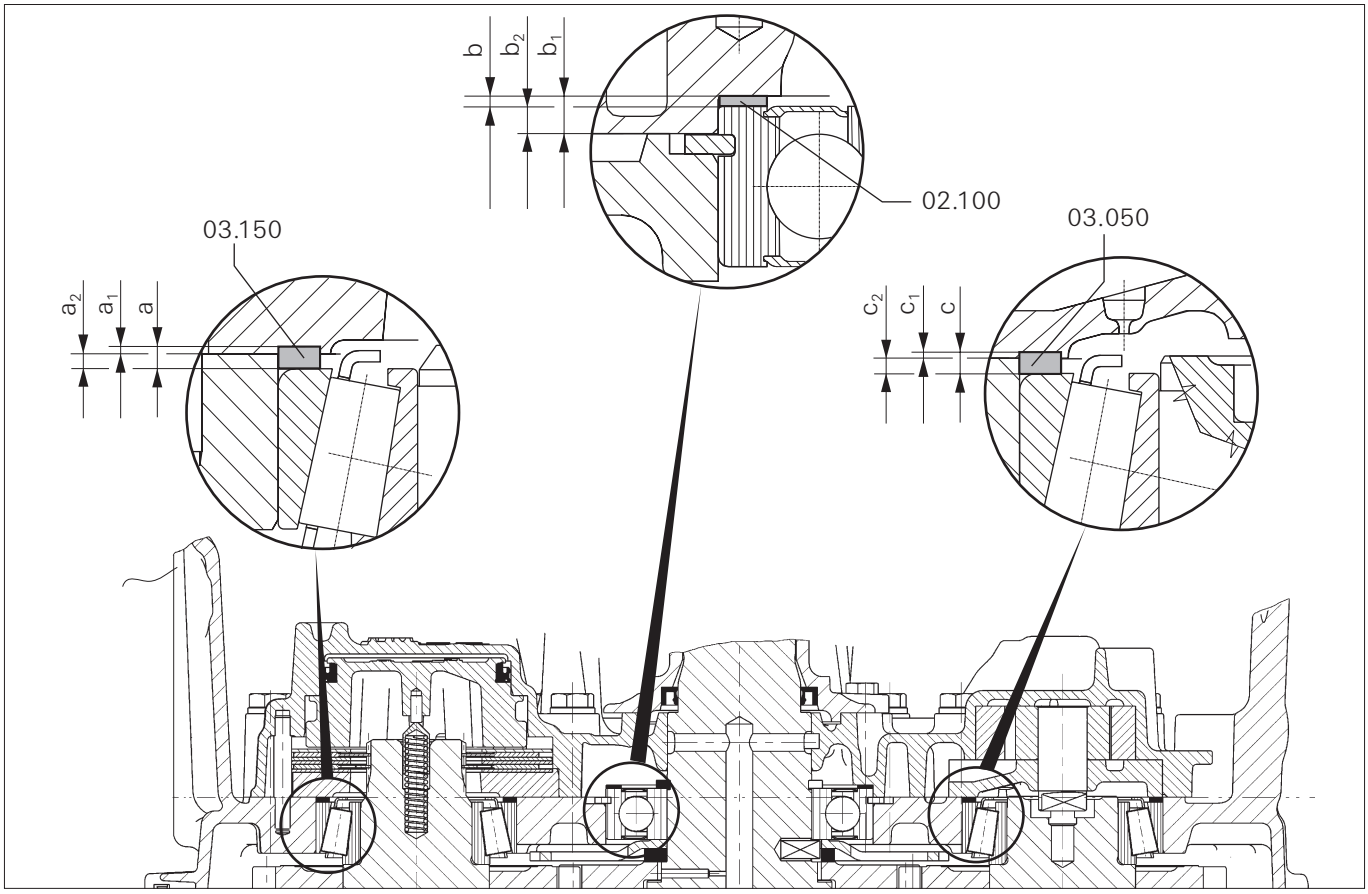
11 If necessary, remove the seal/gasket **02.522**.

12 Use a suitable tool to remove shaft sealing ring **02.510** from the release flange **02.520**.



* depends on the parts list

028302



015199

Measure the Connection Plate

1 Turn input shaft several times back and forth. Thereby, the taper rollers of the bearings are aligned and bearing outer races are rolled in. To set the specified countershaft setting dimension of –0.05 to +0.05 mm, you first need to reach “Zero Clearance”

2 Use a drift to place the outer bearing rings on taper rollers free of clearance.

3 Use sharp object to check whether taper rollers of bearing can be moved.

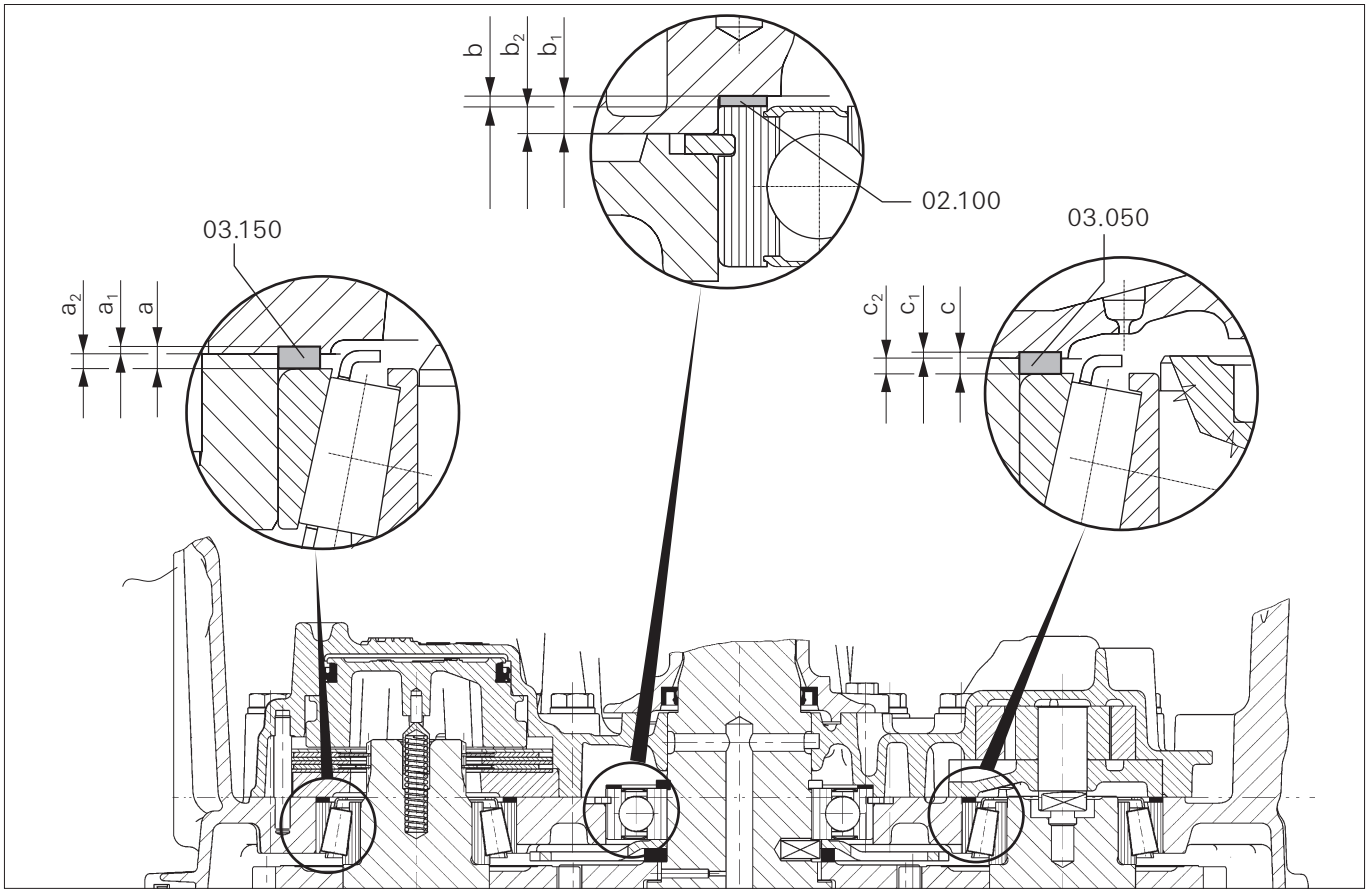
NOTE
Zero clearance is attained when the taper rollers are solidly fixed but there is no preload reached.

4 Determine the distance of the bearing’s outer ring to the housing’s sealing face:

Pump	E. g. dimension c_2 = 2.00
transmission brake	E. g. dimension a_2 = 1.95
input shaft	E. g. dimension b_2 = 3.90

5 Measure connection plate.
Distance of sealing face connection plate

to pump cover.	E. g. dimension c_1 = 0.05
to brake cover	E. g. dimension a_1 = 0.15
to abutment face of disk **02.100**	
input shaft	E. g. dimension b_1 = 5.50



015199

6 Determine thickness of disks:

Calculation example

Pump:
$c_1 + c_2 = c$ = disk **03.050**
0.05 + 2.00 = 2.05 mm = disk **03.050**

Transmission brake:
$a_1 + a_2 = a$ = disk **03.150**
0.15 +1.95 = 2.10 mm = disk **03.150**

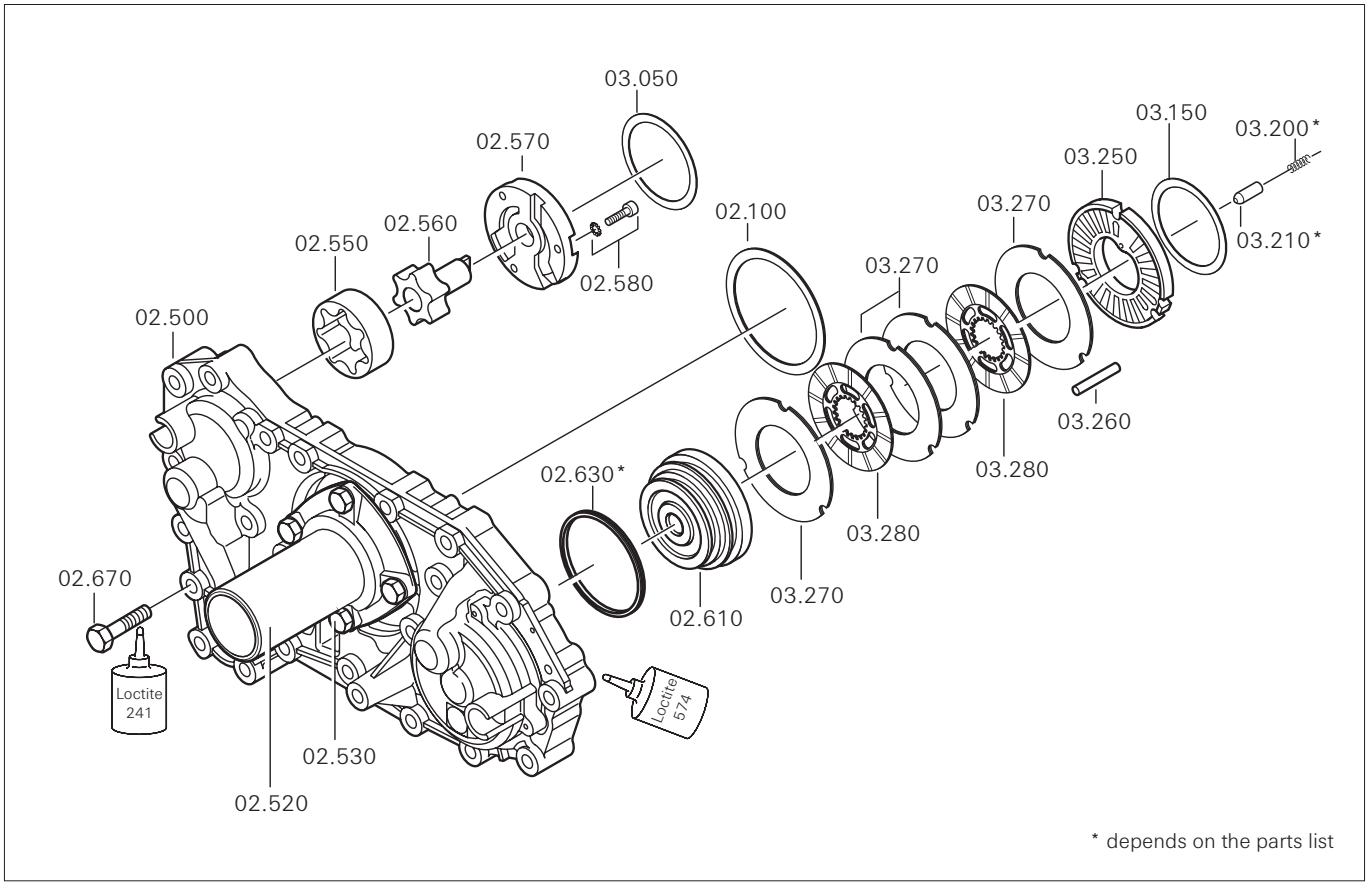
Input shaft
$b_1 - b_2 = b$ = disk **02.100**
5.50–3.90 = 1.60 mm = disk **02.100**

7 Pay attention to the following aspects for the selection of the disks:

Countershafts:
Preload and/or play
–0.05 mm up to +0.05 mm

Input shaft:
Play
0 up to 0.10 mm
Deduct the play from the thickness of the disk.

8 Put the compensating disks **03.050**, **03.150** onto the bearing's outer rings. Slightly grease the compensating disks **02.100** (for improved assembly) and place into connection plate.



028304

Mounting the Connection Plate

1 Clean the sealing faces of the following components:
Connection plate **02.500,** release flange **02.520**, and housing I **01.010**.

NOTE
All sealing faces and the M10 threaded holes on housing I must be clean and free of oil and grease.

2 Mount the pump.
Insert the rotor **02.550**, pump shaft **02.560**, and pump cover **02.570**.
Tighten 3 M6 screws **02.580** with 10 Nm.

3 Insert a new grooved ring **02.630** in the piston **02.610**; pay attention to its installation position.

4 Insert the piston **02.610** in the connection plate **02.500**.

5 If the three cylindrical pins **03.260** were removed, then insert them in the housing I.

6 Put the compensating disks **03.150** and **03.050** correctly onto the bearing's outer rings.
Slightly grease the compensating disks **02.100** and insert in the connection plate.

CAUTION
Do not mix up the compensating disks 03.150 and 03.050.

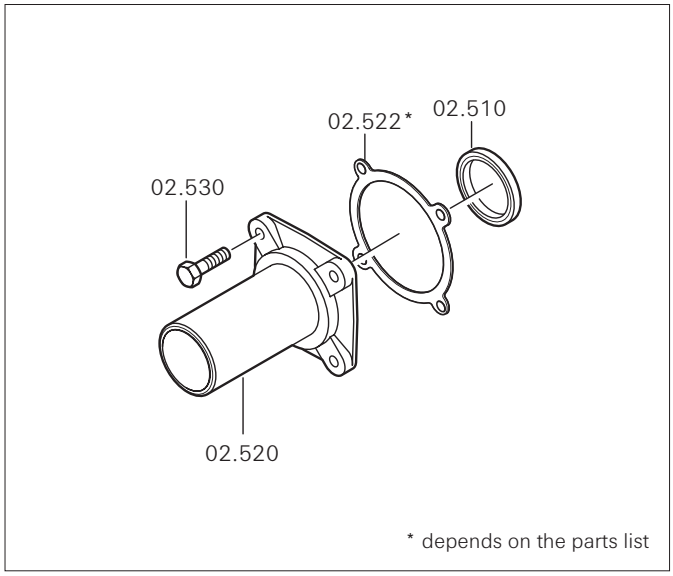
7 Position the brake cover **03.250** on the housing's sealing face. The collar of the brake cover **03.250** points in the direction of the multidisk package.

8 Mount the outer multidisks **03.270** and the lined multidisks **03.280** in accordance with the respective parts list.
In the case of 4 outer multidisks, then, in between the two lined multidisks, there must always be 2 outer multidisks.
(Number and size of the multidisks depends upon the parts list).

9 Press in shaft sealing ring **02.510** using tool **1X56 099 063 6** into the release flange **02.520** until it axially abuts.

NOTE
- Coat the outer circumference of the shaft sealing rings with spirits (ethanol).
- The sealing lip must point towards the transmission's interior.

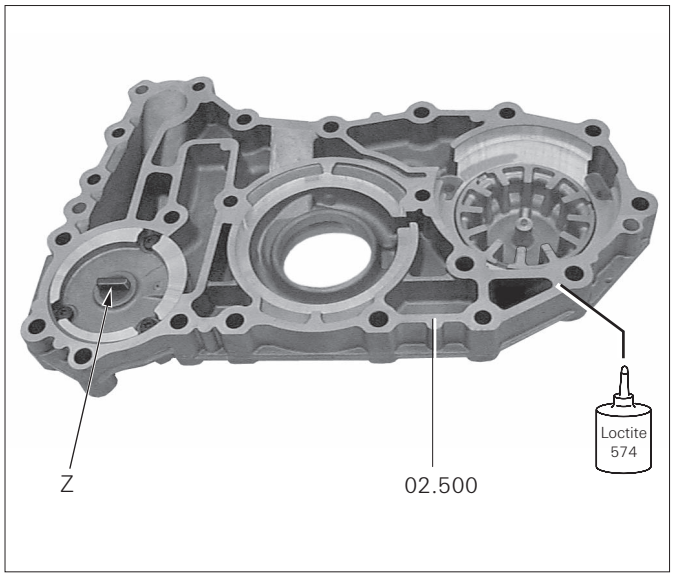
10 Put on gasket/seal **02.522** and fasten the release flange **02.520** by means of four M8 hex-head screws **02.530** to the connection plate **02.500**.
Tightening torque: 23 Nm



028302

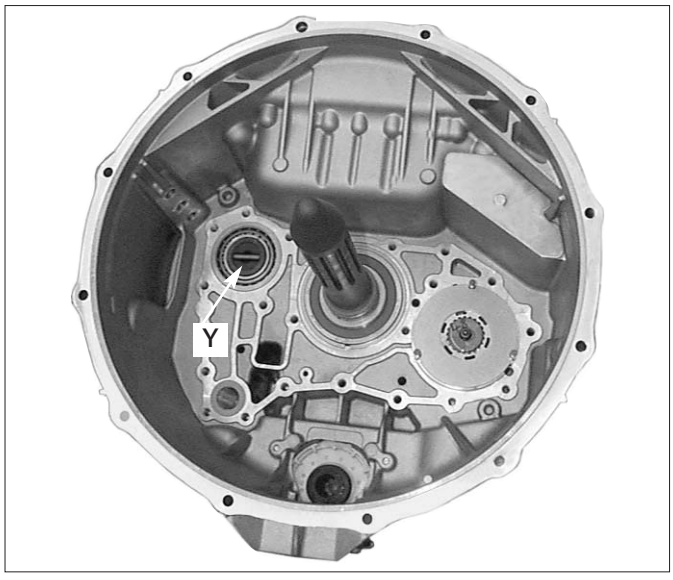
11 Coat the sealing surface of the connection plate **02.500** with **Loctite no. 574**.

12 Cautiously put the connection plate **02.500** on the input shaft of the transmission housing. Align the pump driver **(Z)** in such a way that it meshes with the groove **(Y)** of the countershaft.



014820

13 Coat 22 M10 hex-head screws **02.670** with **Loctite No. 241** or use new, micro-encapsulated hex-head screws.
Tightening torque: 46 Nm



014819

Housing I

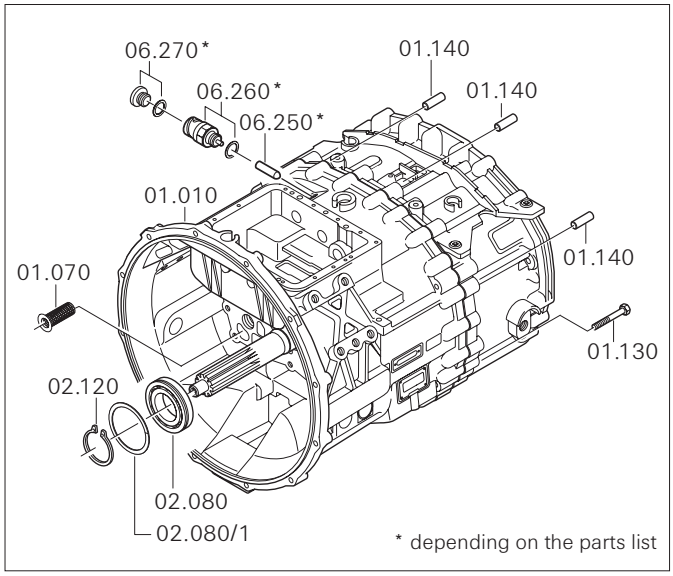
Removing Housing I

1 Remove neutral switch **06.260** and pin **06.250** and/or screw plug **06.270**.

2 Remove securing ring **02.120**.

3 Remove snap ring **02.080/1** at the ball bearing **02.080**.

4 Remove filter **01.070**.

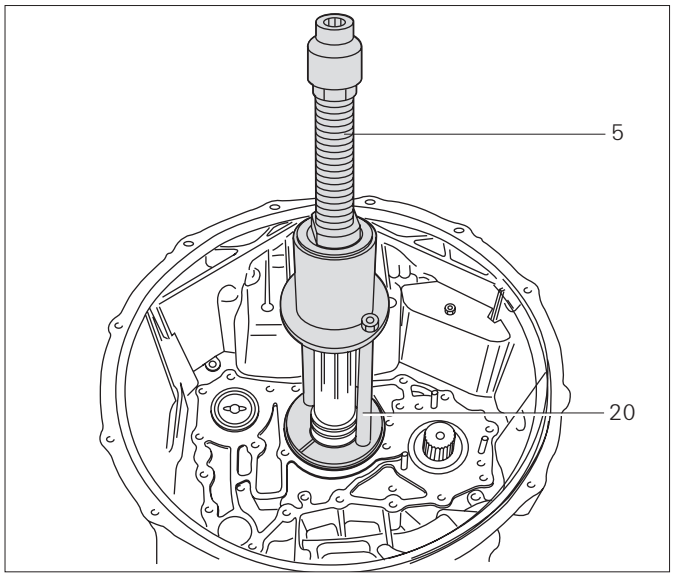


015176

5 Put the connecting piece **1X56 138 191**on the input shaft. Fixture **(20) 1X56 138 195** meshes with the ball bearing's annular groove. The basic device **(5) 1X56 122 304** must be fastened to the fixture. Pull off the ball bearing **02.080**.

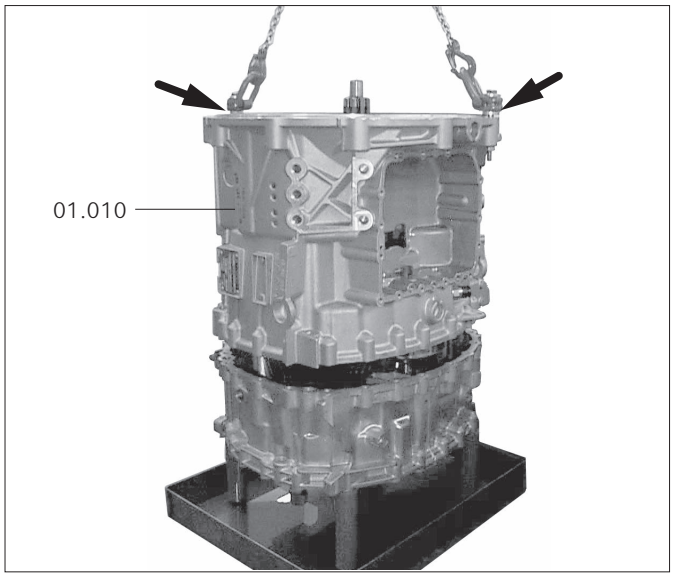
6 Remove the 24 M10 hexagonal screws **01.130**. Remove the 4 cylinder pins **01.140** – M12 extractor thread.

NOTE
Push out the cylinder pins **01.140** with the drift key **1X56 138 063**.



015177

7 Mount 2 lifting lugs **1T66 154 240** to the housing I **01.010**. Thereby, housing's centering must not be damaged. Bridge the gap to the centering with 2 up to 3 washers (see arrow). Hook in 3 chains (string) **1X56 137 795** and cautiously lift off the housing I **01.010**.



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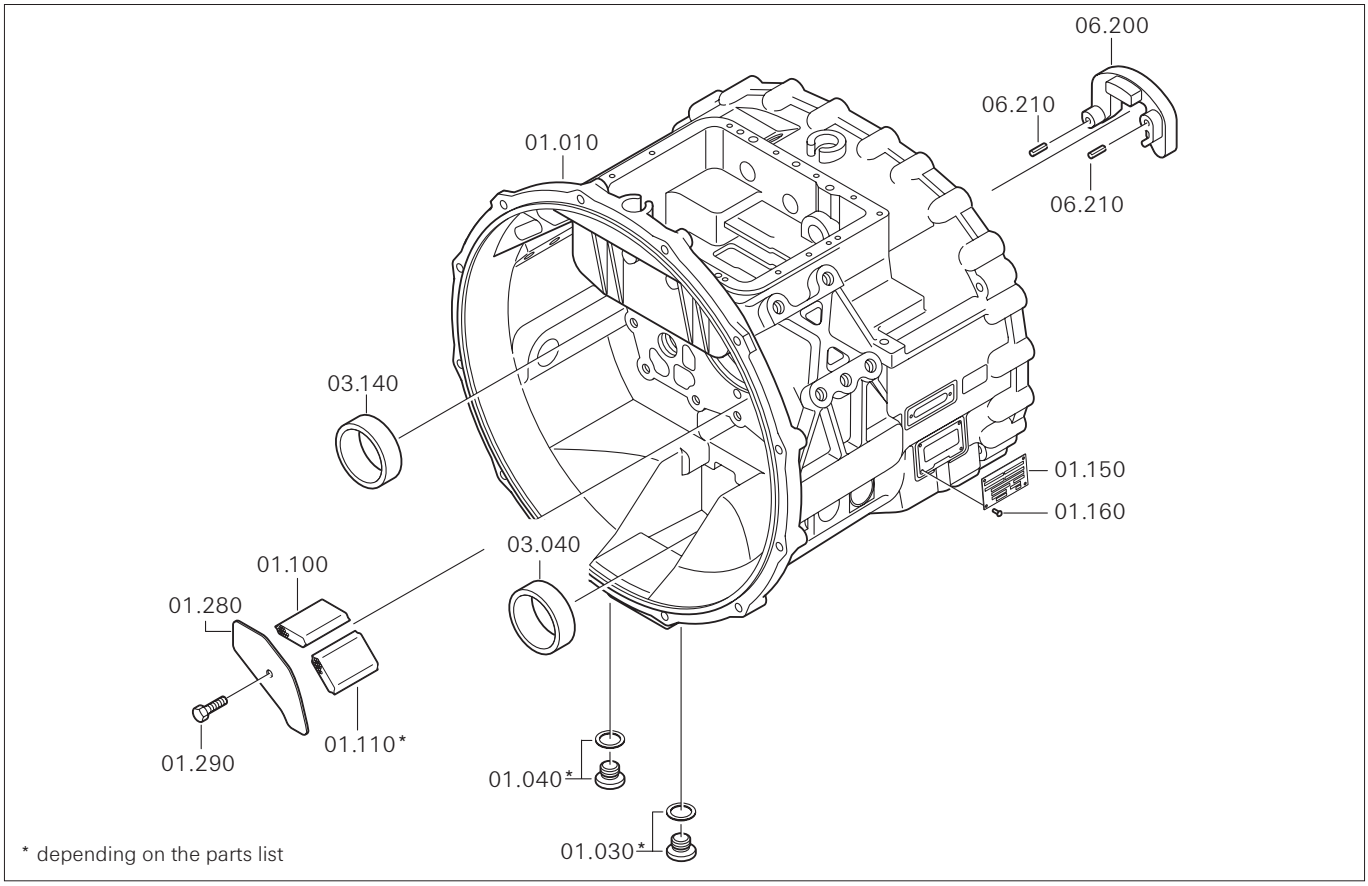


015175

Dismantling Housing I

Remove the following parts:
- Bearing's outer rings **03.140**, **03.040**
- Type plate **01.150**
- Screw plugs M22x1.5 **01.030**, **01.040**
- M8 hex-head screw **01.290**
- Cover **01.280**
- Vent **01.100, 01.110**
- Spacer **06.200** and
- Two clamping pins **06.210**

Assembling Housing I

1 Insert the bearing's outer rings **03.140**, **03.040** in the housing I **01.010**.

2 Insert the vent **01.100**, **01.110** and the cover **01.280** with an M8 hex-head screw **01.290** .
Tightening torque: 23 Nm

3 Screw in screw plugs M22x1.5 **01.030/01.040** with sealing ring.
Tightening torque: 50 Nm

4 Insert spacer **06.200** with two clamping pins **06.210** in housing I.

5 Mount type plate **01.150** with 4 blind rivets **01.160**.

Fitting Housing I

1 Clean sealing surfaces.

NOTE
The sealing faces on housing I and housing II must be clean and free of oil and grease.

CAUTION
The correct seal/gasket must be used in accordance with Service Information No. 02_05 (also see Annex) otherwise, the transmission may be damaged.

2 Determine dimension L of the housing II **01.400**.

3 Depending on the version:
L = $184.5_{-0.1}$ mm and/or $227.5_{-0.1}$ mm:
Coat the sealing face at housing II with sealing compound 1215 (company Three Bond).

– OR –

L = $183.75_{-0.13}$ mm and/or $226.75_{-0.13}$ mm:
Put on seal/gasket **01.020**.

4 Apply tools **1X56 138 200 and 1X56 138 201** (see arrows) for centering the spray pipes **01.420**, **01.430** in the housing I **01.010** (for the installation of the spray pipes see chapter on “Shaft Package”).

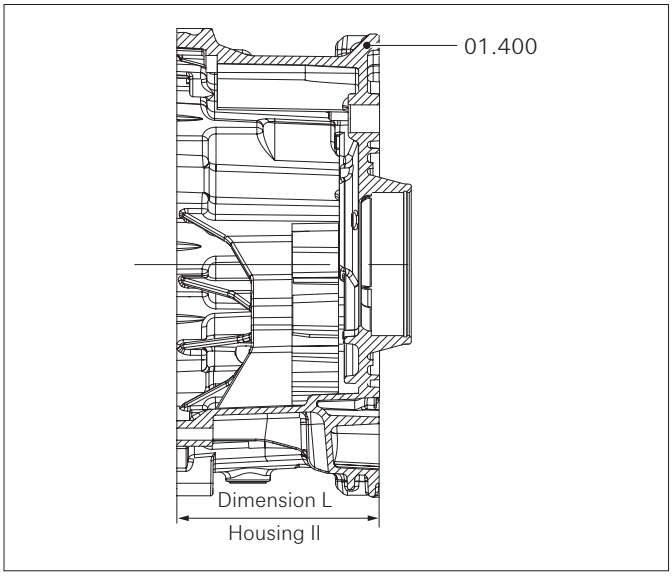
6 Cautiously put on housing I **01.010** on housing II **01.400**.

7 Check whether the spray pipes **01.420**, **01.430** are correctly positioned in the housing I.

8 Remove tools **1X56 138 200 and 1X56 138 201**.

9 Insert the cylinder pins **01.140** (do not fully push in) and tighten 24 M10 hex-head screws **01.130** with 50 Nm.
Then, subsequently drive in cylinder pins **01.140** until they axially abut.

CAUTION
Screws of an appropriate length must be used to mounting the retaining plates.



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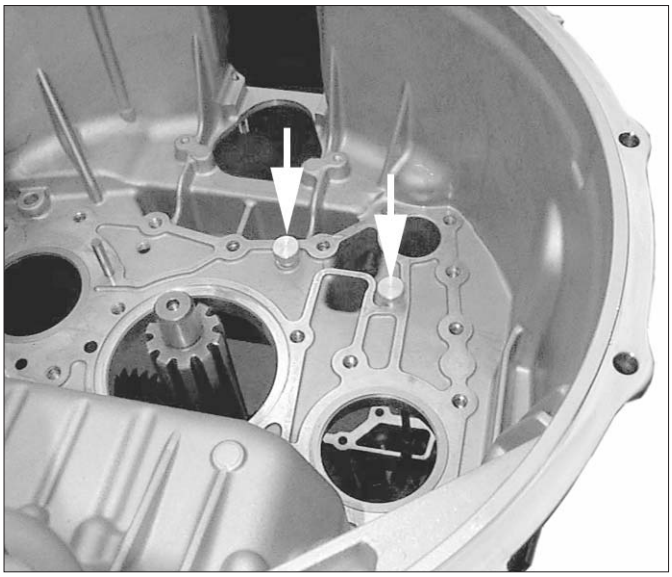

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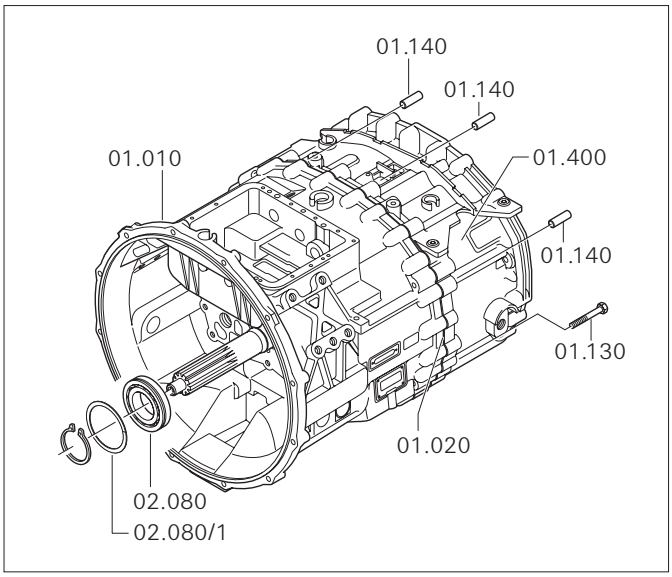


028223

10 Insert the snap ring **02.080/1** into the groove of the ball bearing.

11 Heat up the inner ring of the ball bearing **02.080** with a heating arbor to approx. 80 - 90 °C.

⚠ DANGER

Only touch heated parts when wearing protective gloves.

12 Insert the ball bearing **02.080** so that the snap ring **02.080/1** is flat on housing I. If necessary, push on with the outer tube with of the fixture **(23) 1X56 138 216**. Push on the input shaft until axial abutment with the fixture **1X56 138 216** in combination of the mounting fixture **(24) 1X56 045 808** onto the ball bearing.

13 Remove the fixtures and use a feeler gage for measuring the thickness of the securing ring **02.120**.
Consider a **play of 0 up to 0.10 mm** for the selection of the securing ring **02.120**.

14 Insert the securing ring **02.120**.

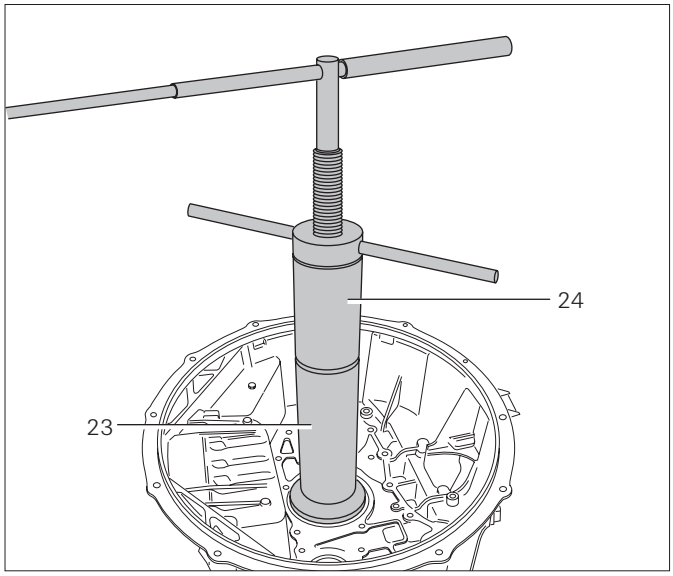
NOTE
The securing ring **02.120** must make contact with the input shaft's groove base.

15 Insert the pin **06.250** and tighten the neutral switch **06.260** with 45 Nm and/or the screw plug **06.270** with 35 Nm.

NOTE
Always renew the sealing ring at the neutral switch and/or the screw plug.

16 Insert filter **01.070**.

17 For removing the connection plate, please refer to the corresponding chapter.



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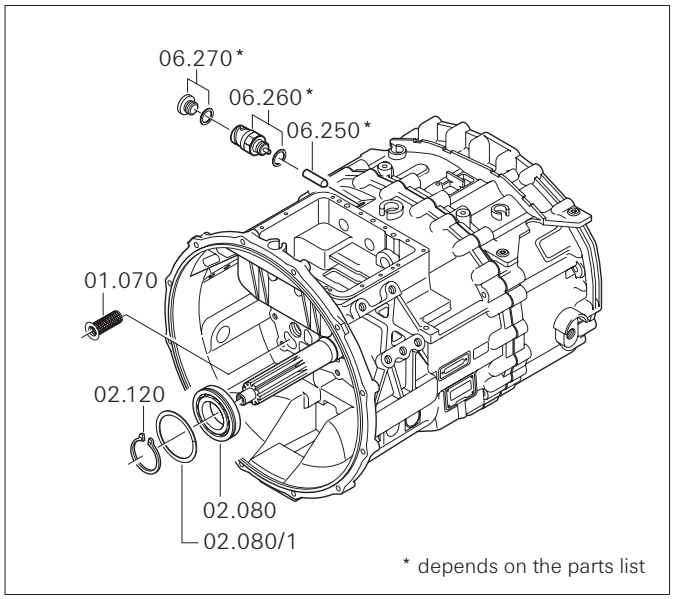


028224

Shaft pack

Removing Shaft Pack

1 For dismantling of housing I, refer to the corresponding chapter.

2 Remove the fixing bolts **1X56 138 208** and push the reverse gear's intermediate gears **05.040**, **05.140** to the side.

3 Remove the two spray pipes **01.420**, **01.430**.

4 Tilt the countershafts **03.010**, **03.110** to the side and take them out.

5 Place fixture **(25) 1X56 138 197** onto the inputshaft. Slide sleeves **(1** and **2)** over gear selector rails.
Mount the fixture **(23) 1X56 138 216** to the input shaft.

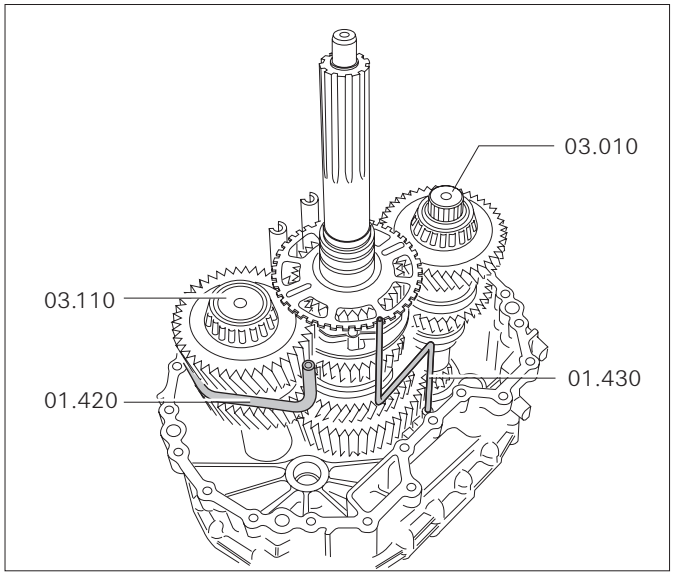
NOTE
The fixture **(23) 1X56 138 216** consists of two half-shells, a tube, and a threaded coupling. At the one side, place the lugs of the two half-shells into the groove of the input shaft. At the other side, insert the threaded coupling and put tube on top. Screw in an M10 lug bolt at the threaded coupling of the fixture **1X56 138 216**.

6 Hang in the 3-strand chain **1X56 137 795** at the lug bolt.

7 Use a hoist to lift the input shaft and the main shaft as one unit out of the housing II.

8 Slide bushes **(1** and **2)** upwards and remove the selector rails.
In the case of a 16-gear main shaft, hold onto the sliding sleeve **04.060** and remove the selector rails.

9 Clamp main shaft and input shaft in a vise with protective chucks.



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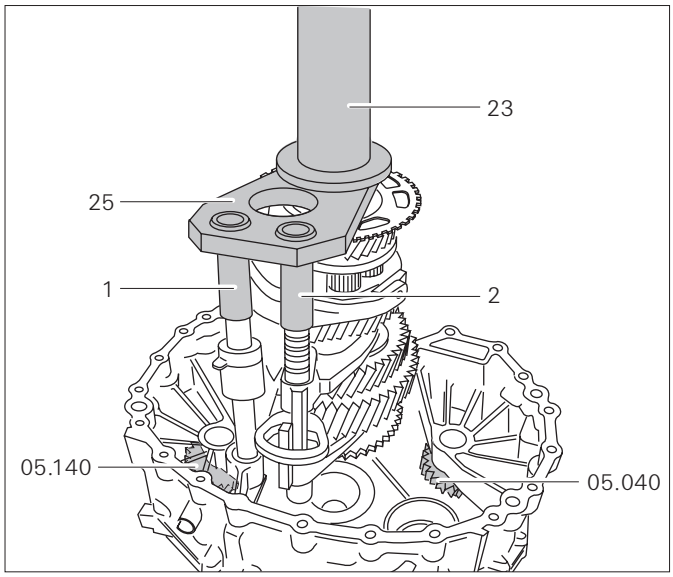

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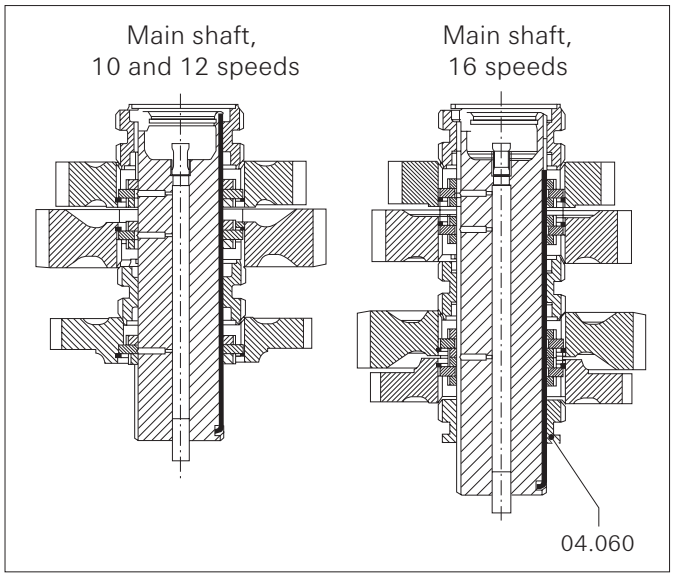
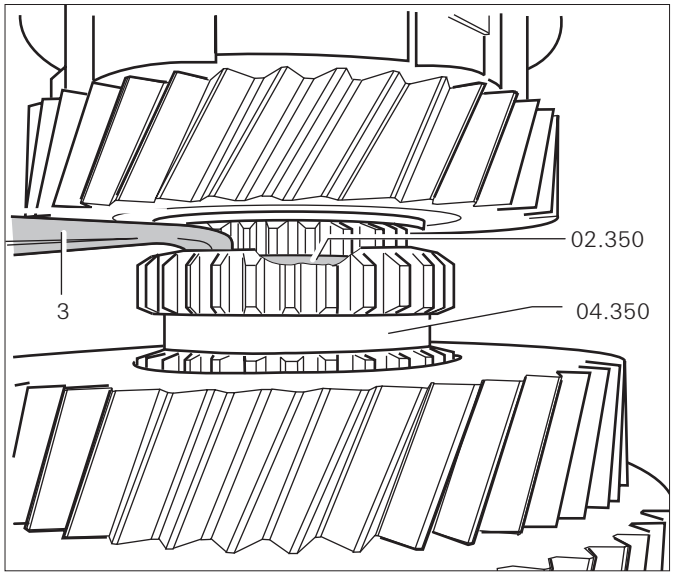


018216

10 Push sliding sleeve **04.350** in output direction. Now, the securing ring **02.350** becomes visible.

11 Use sharp flat-nosed pliers **(3)** for contracting the securing ring **02.350** and lift off the input shaft from the main shaft.

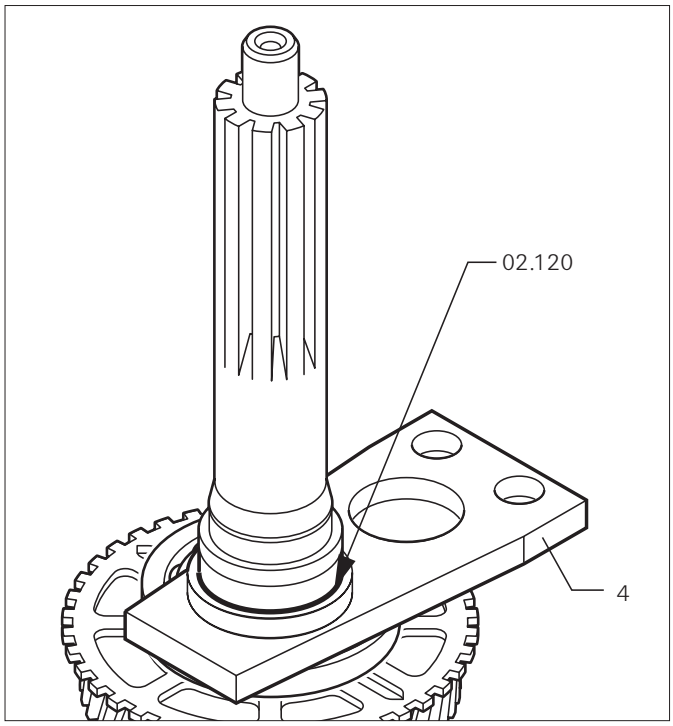


016667

12 Take off the fixture **1X56 138 216** and the bushes (**1** and **2**) of the fixture **1X56 138 197** from the input shaft.

13 Secure the guiding plate **(4)** of the fixture **1X56 138 197** with the securing ring **02.120**.

14 For disassembling the input shaft, please refer to the corresponding chapter.



016448

Installing Shaft Pack

1 Position the fixtures **(25) 1X56 138 197** and **(23) 1X56 138 216** at the input shaft.

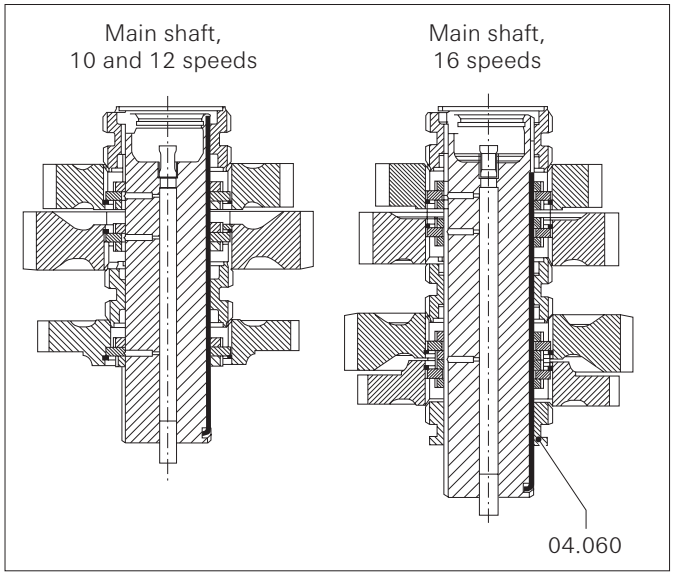
2 Lift input shaft onto the main shaft by means of a hoist. Push sliding sleeve **04.350** in output direction.

3 Use sharp flat-nosed pliers **(3)** for contracting the securing ring **02.350** and put the input shaft on the main shaft.

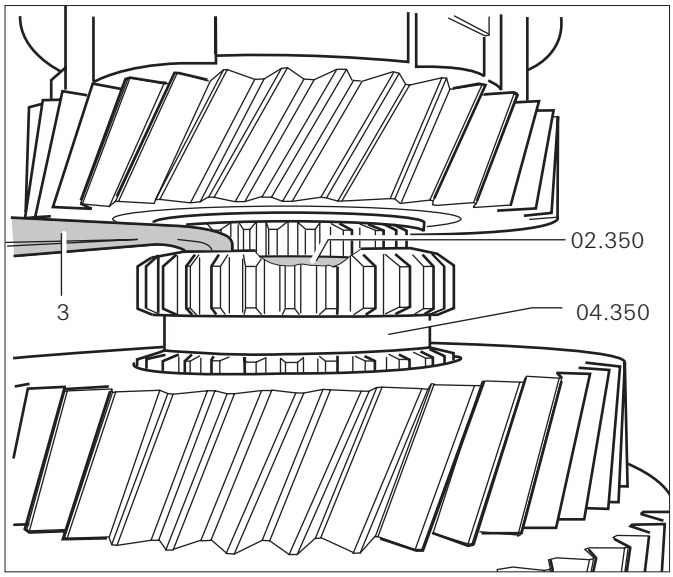
CAUTION
Check whether the securing ring has fully engaged in the main shaft. If the securing ring is not correctly mounted, total loss (complete breakdown) will be the consequence.

4 Put the shift forks of the completed gear change shafts in the corresponding sliding sleeves. Push the bushes (**1** and **2**) of the fixture **1X56 138 197** on top of the gear change shafts.
In the case of a 16-speed version, hold the sliding sleeve **04.060** upwards and insert the selector rail.

5 Assembly information: Insert the reversing gears **05.040** and **05.140** for the reverse gear in housing II.
Use a hoist to insert the input shaft and main shaft in the housing II.
Remove the fixtures **(25) 1X56 138 197** and **(23) 1X56 138 216**.



018216



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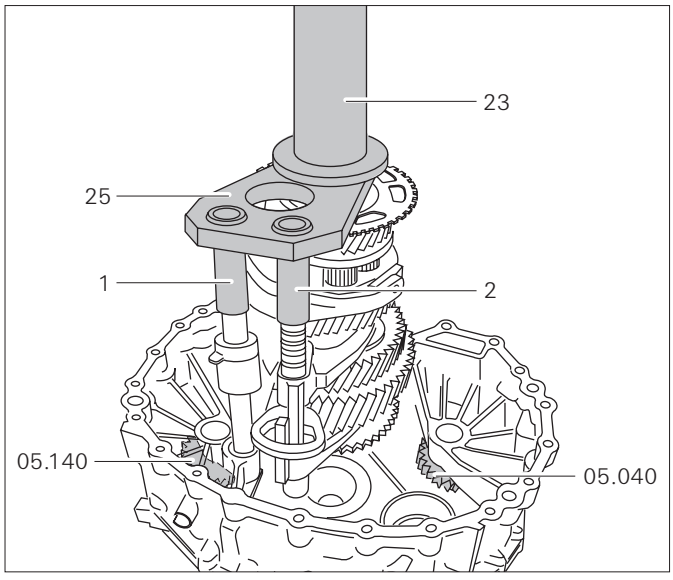
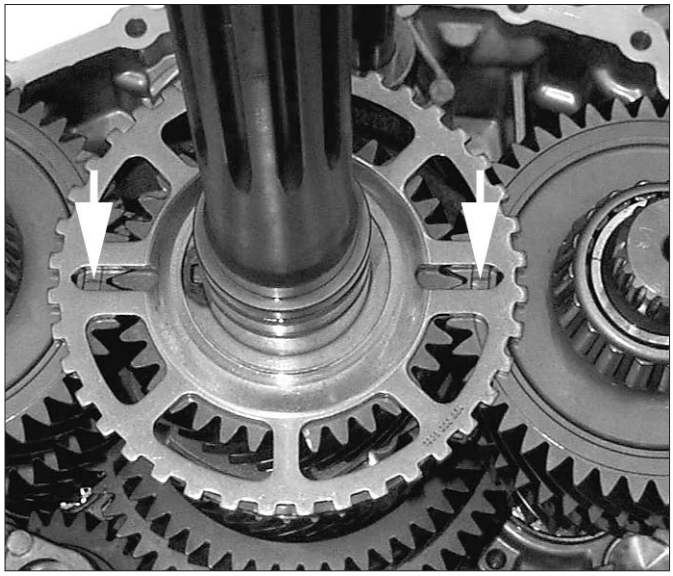


016666

6 Insert **in accordance with the respective marks** the countershafts **03.010**, **03.110**.

CAUTION
The respective marks on the countershaft must be within the range of the small counting disk 02.060 window (see arrows).



016449

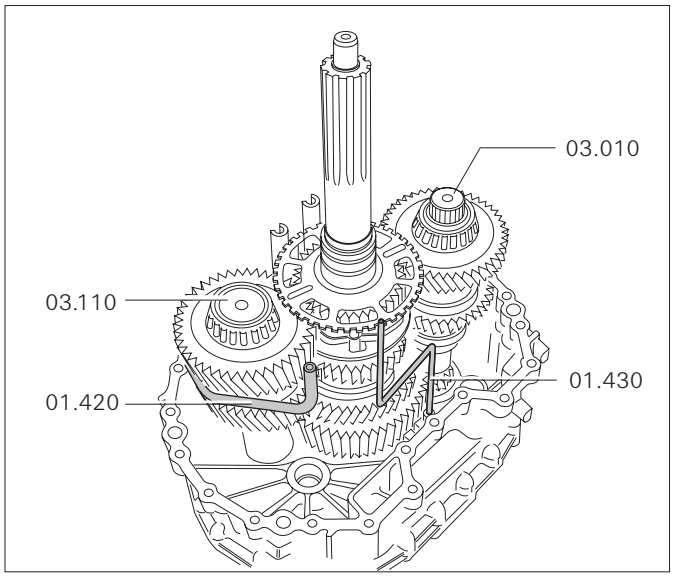
7 Engage the reverse gear and ensure that the reversing gears **05.040** and **05.140** are meshing with the countershafts.

8 Fix the reversing gears **05.040** and **05.140** in position by means of a fixing bolt **1X56 138 208**.

9 Shift into neutral (sliding sleeves to be brought into neutral position) and turn shaft pack around one time.

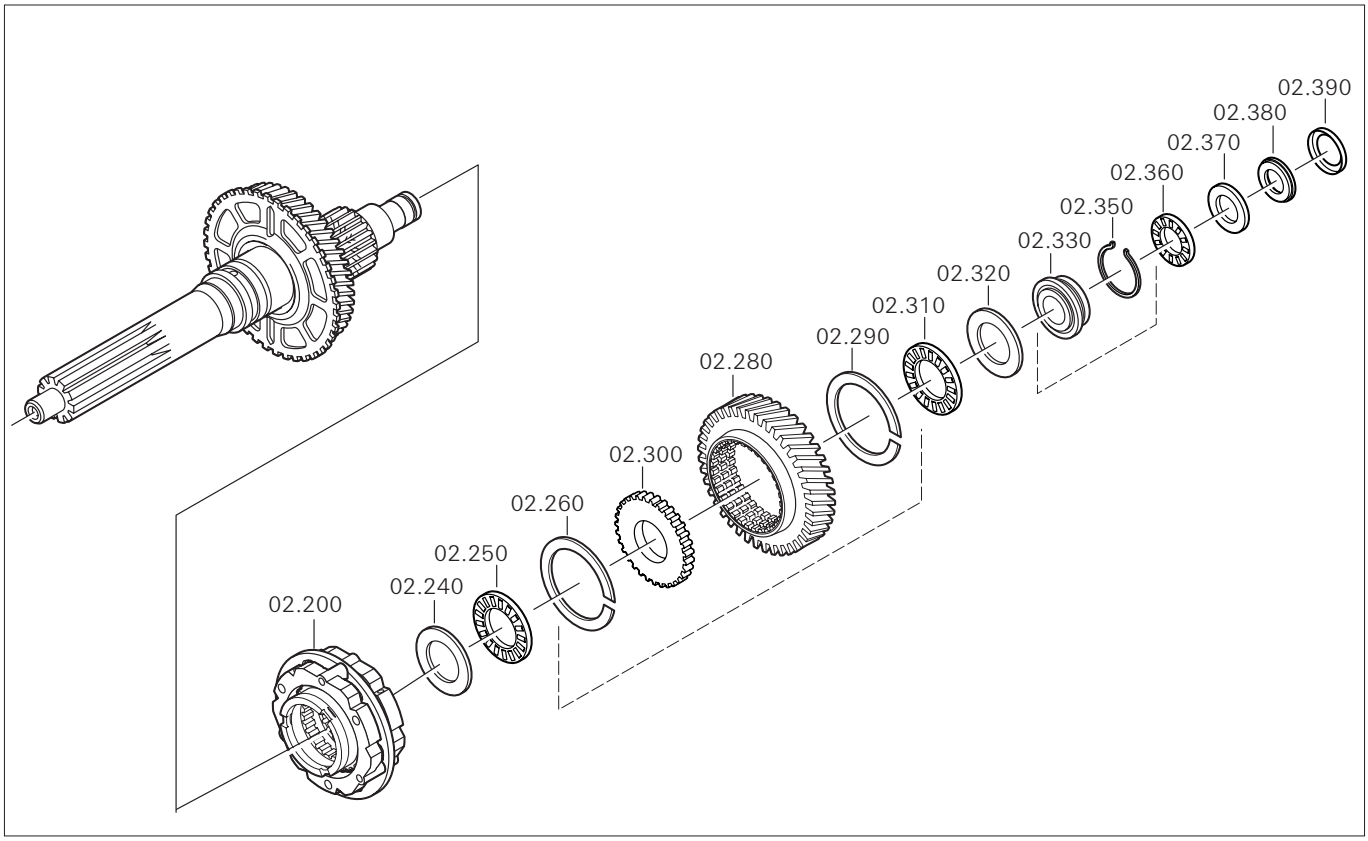
10 Insert the two spray pipes **01.420** and **01.430**.

11 For mounting the housing I, please refer to the corresponding chapter.



016665

Input shaft



017891

Disassembling the Input Shaft

NOTE
Clamp input shaft in a vise with protective chucks for disassembly.

1 Destroy the securing ring **02.390** of the split ring **02.380** with a chisel and remove it.

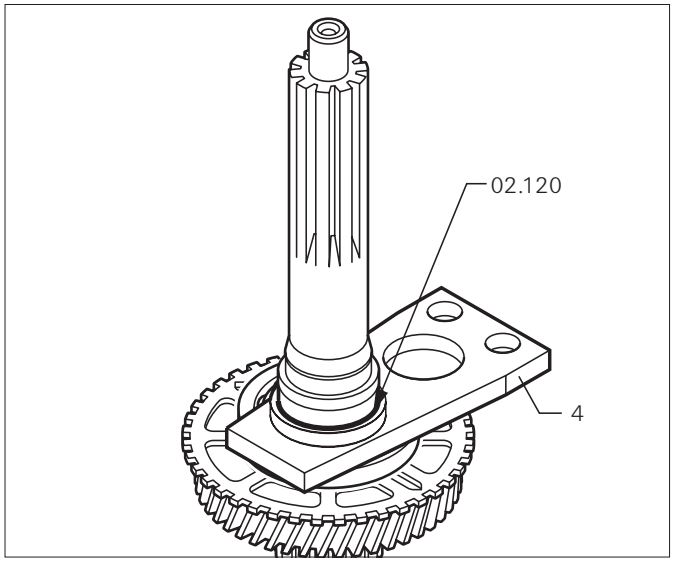
⚠ DANGER
Always wear protective glasses when working with a chisel.

2 Remove the following parts from the input shaft:
- Split ring **02.380**
- Disk **02.370**
- Axial roller cage **02.360**
- Bearing ring **02.330** with securing ring **02.350**
- Disk **02.320**
- Axial needle cage **02.310**
- Helical gear constant 2 **02.280**
- Axial needle cage **02.250**
- Disk **02.240**

3 For the disassembly of the helical gear constant 2 **02.280**:
Remove the snap ring **02.290** and **02.260** and take out the bearing disk **02.300**.

4 Completely remove the synchronization **02.200**. For disassembling the synchronization, please refer to the corresponding chapter.

5 Remove the securing ring **02.120** and the guide plate **(4)**.



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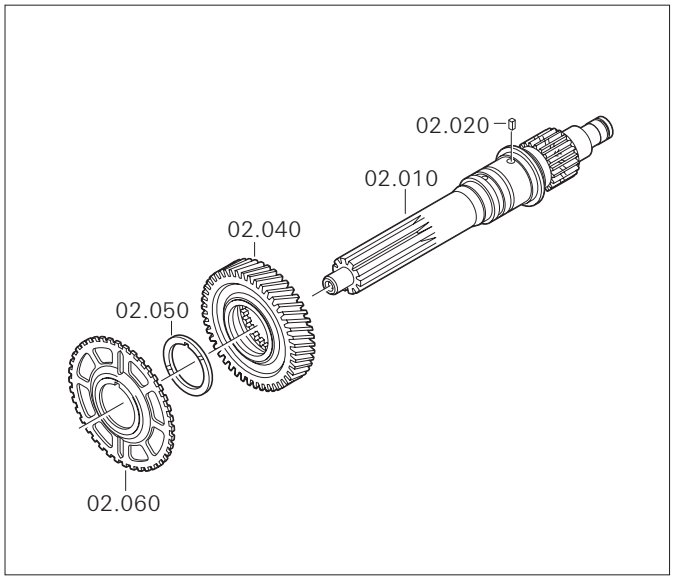
6 Take off the counting disk **02.060**, thrust plate **02.050**, and the helical gear constant 1 **02.040** from the input shaft. If necessary, use a manually operated press.

7 Remove bolts **02.020**.



017893

Disassembling Synchronization

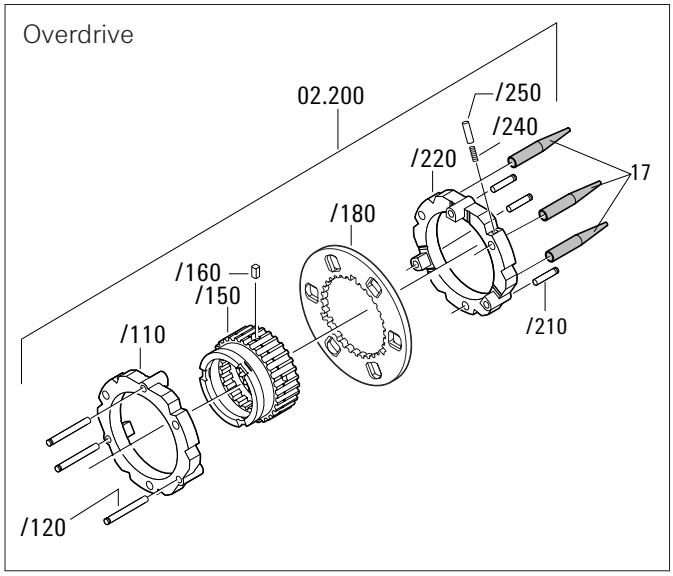
1 Put synchronization **02.200** with the collar facing downwards onto a table. Cover with a cloth. Pull off the K2 synchronizer ring **/220** in upward direction.

⚠ DANGER

There will be 3 pressure springs /240 and 3 cylindrical rollers /250 jumping out of the bores.

2 Push bolts **/160** through the gear shifting sleeve **/150**. Offset plate **/180** by half a tooth and remove it from the gear shifting sleeve **/150**.

3 If necessary, the pins **/120** and **/210** can be pressed out from the synchronizer rings **/110** and **/220**.



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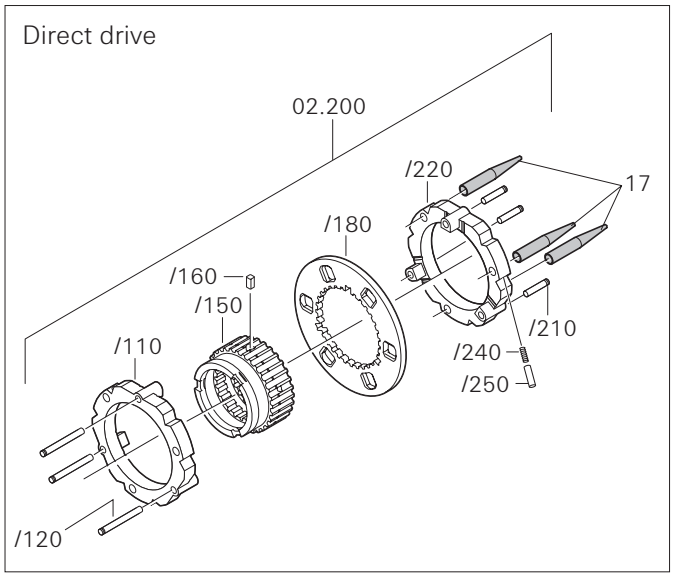

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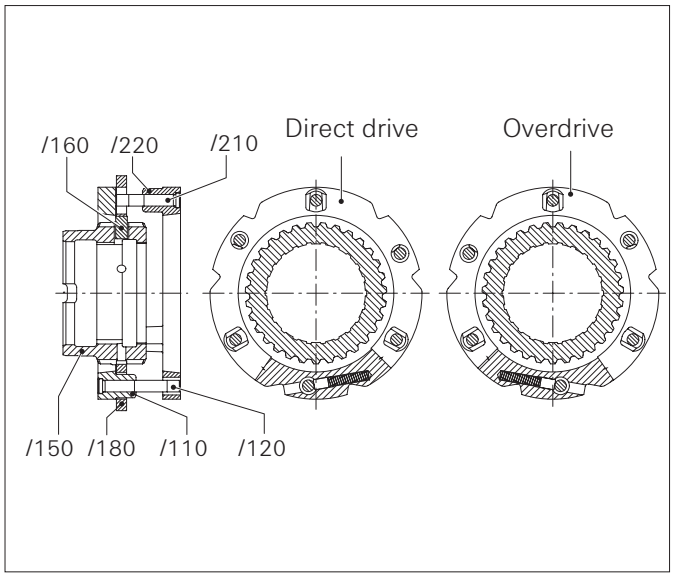


018217

Assembling the Synchronization

NOTE
In the event of repairs, the synchronizer rings and plate should always be replaced in complete sets. Pleased pay attention to Service Information No. 20_04 in the Annex.

CAUTION
Pay attention to the part number at the synchronizer ring /220:

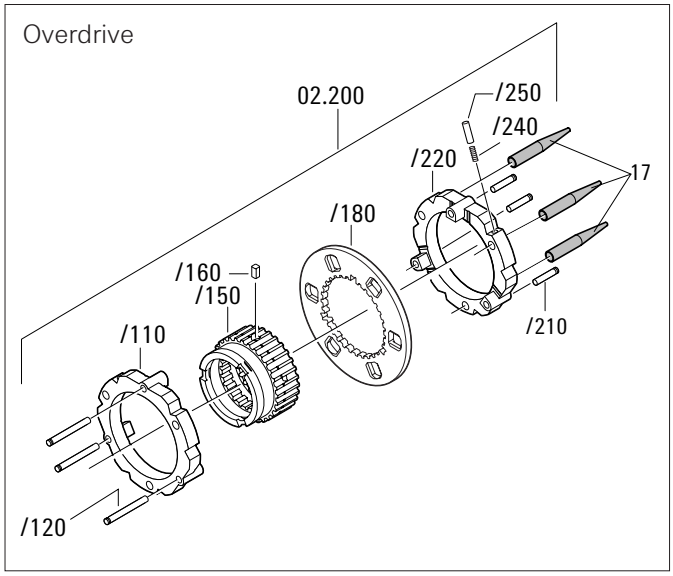
Overdrive	**Direct drive**
1328 302 014	**1328 302 013**
1328 302 086	**1328 302 085**
1328 302 113	**1328 302 112**

1 Press in the longer 3 pins **/120** in the synchronizer ring **/110** and the shorter 3 pins **/210** in the synchronizer ring **/220**.

2 Put the plate **/180** on the gear shifting sleeve **/150** and offset by half a tooth.

3 Align the bores of the gear shifting sleeve **/150** with one of the 3 recesses of the plate **/180**.
Insert the bolts **/160** via the gear shifting sleeve's bore until firmly home.

4 Insert a pressure spring **/240** and a cylindrical roller **/250** into each of the three bores of the synchronizer ring **/220** and secure by means of assembly sleeves **(17) 1X56 138 081**.



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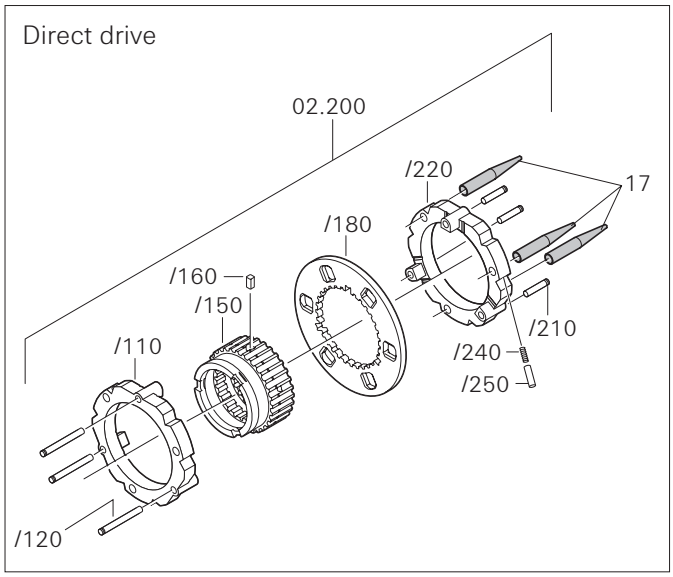

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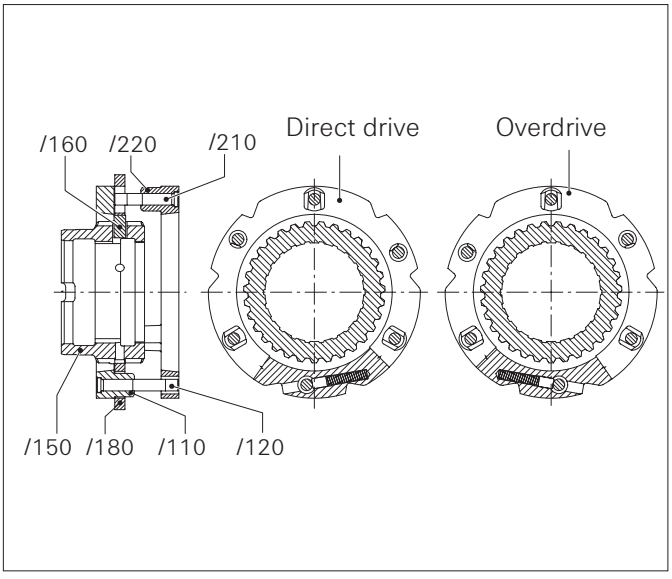
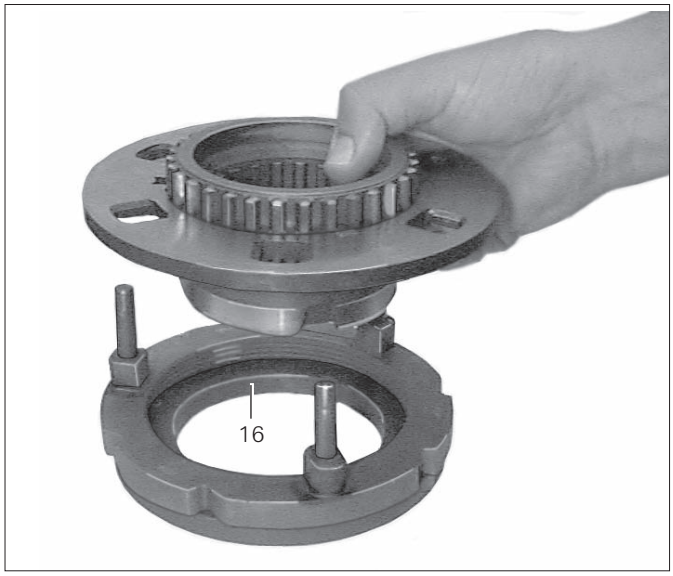


018217

5 Onto the assembly plate **(16) 1X56 138 097**: Put on synchronizer ring K1 **/110** and the complete gear shifting sleeve **/150** with plate **/180**.

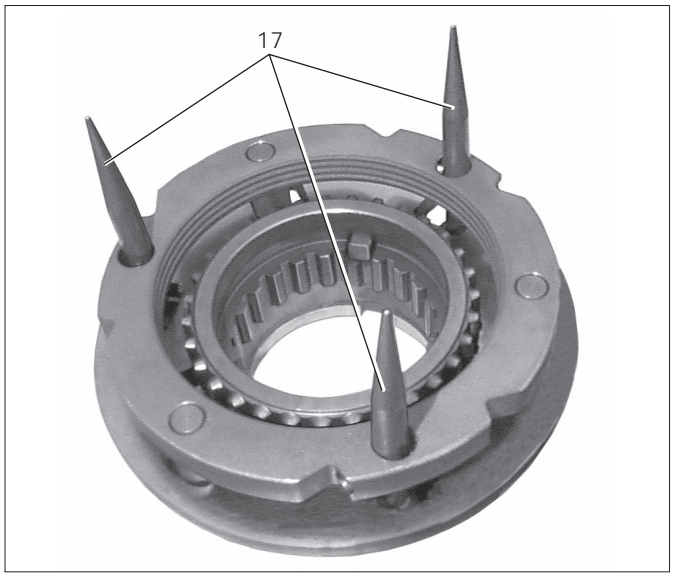


017894

6 Put the K2 synchronizer ring **/220** with the 3 assembly sleeves **(17)** onto the locking bolts **/120** of the K1 synchronizer ring **/110**.

7 Evenly press synchronizer rings together.

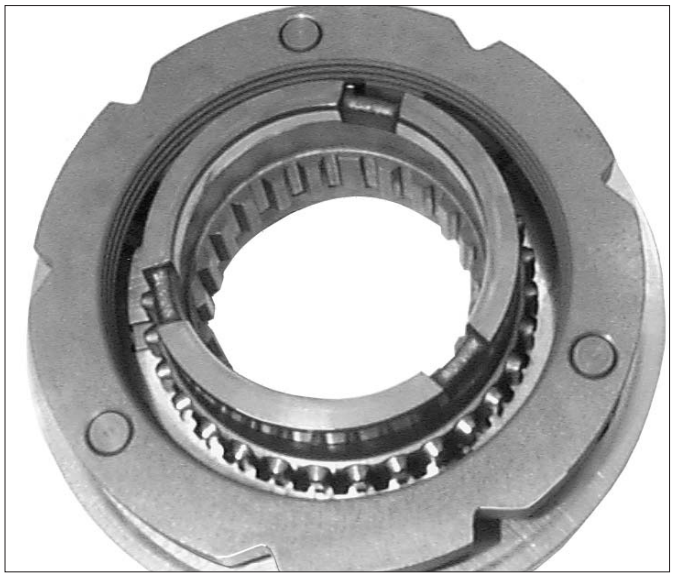
8 Remove the assembly sleeves **(17)** and, in parallel, press down the K2 synchronizer ring **/220**.



017895

9 Turn synchronization around.
Position synchronization centrally by pulling the plate **/180** with the gear shifting sleeve **/150** upwards and, in parallel, pressing the synchronizer ring **/110** downwards.

Please check that the bolt **/160** did not fall out.



017896

Setting the Axial Play of the Bearing Disk in Constant Gear 2

(See ZF-Service Information No. 25_05 in the Annex.)

NOTE

The necessary **axial play** of **0 up to 0.10 mm** is set by means of the snap rings.

Measurement 1

1 For the helical gear constant 2 **02.280**: Insert the bearing disk (wheel disk) **02.300** and the two snap rings **02.260** and **02.290**.

2 Measure from the rim of the helical gear constant 2 **02.280** to the wheel disk **02.300**; set depth gage to zero.

Measurement 2

3 Put the complete helical gear constant 2 **02.280** onto a tube or something similar so that the wheel disk is pushed upwards.

4 Measure from the rim of the helical gear constant 2 **02.280** to the wheel disk **02.300**.

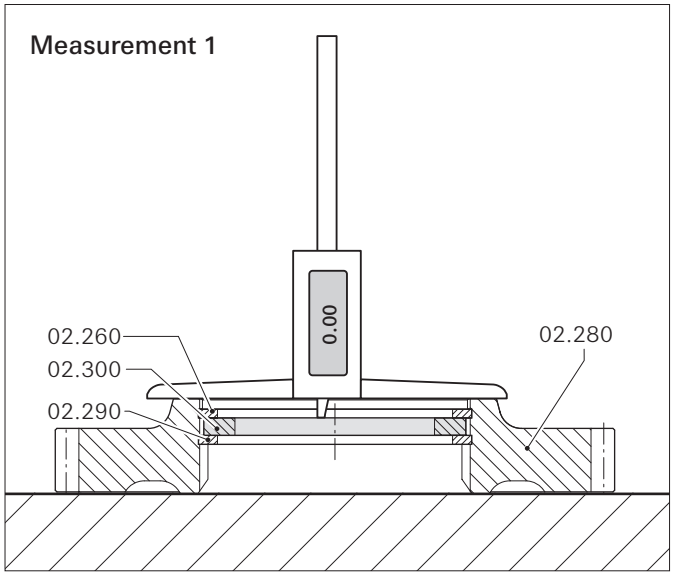
5 If the measurement value is outside of the tolerance range (0 up to 0.10 mm): Disassemble the snap ring **02.290**.

6 Select and mount a new snap ring (calculated) **02.290** from the OTK.

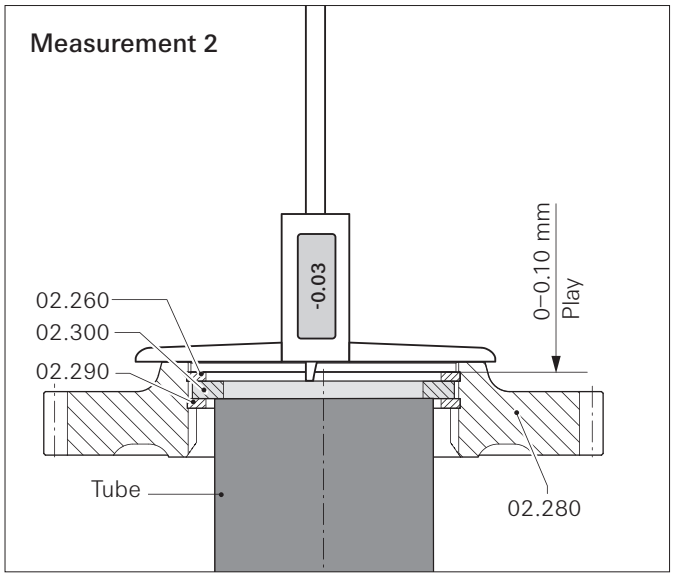
7 If necessary (at clearance 0), insert snap ring **02.290** into the groove by applying soft blows.

8 Check the axial play again.

9 Repeat the steps of action until the measurement value resides within the tolerance range.



028248



028249

Assembling the Input Shaft

1 Clamp input shaft in a vise with protective chucks for assembly.

2 Insert bolts **02.020** into input shaft **02.010**.

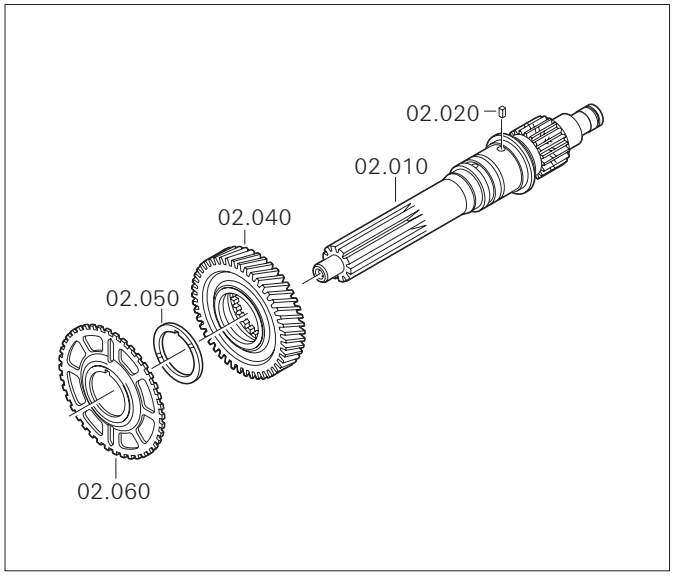
3 Put on helical gear constant 1 **02.040** and thrust plate **02.050**.

4 Push on counting disk **02.060**.

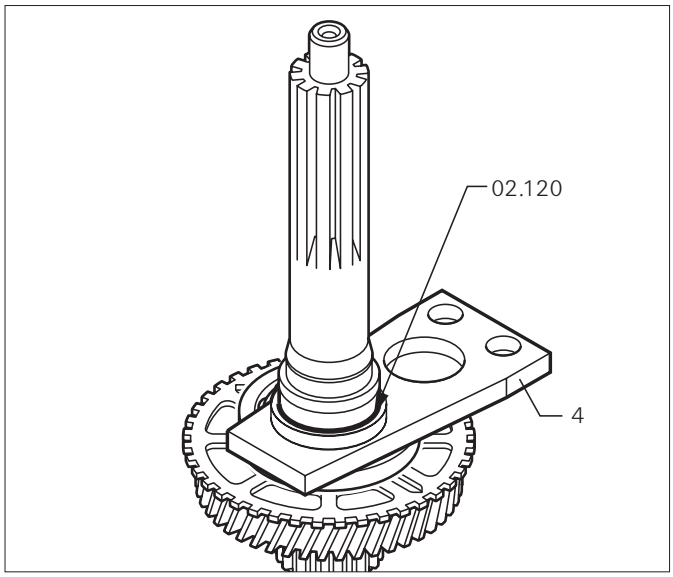
NOTE
Play of up to 0.3 mm admissible between bolts **02.020** and counting disk **02.060**.

5 Put on the guiding plate **(4)** of the fixture **1X56 138 197** and secure with securing ring **02.120**.

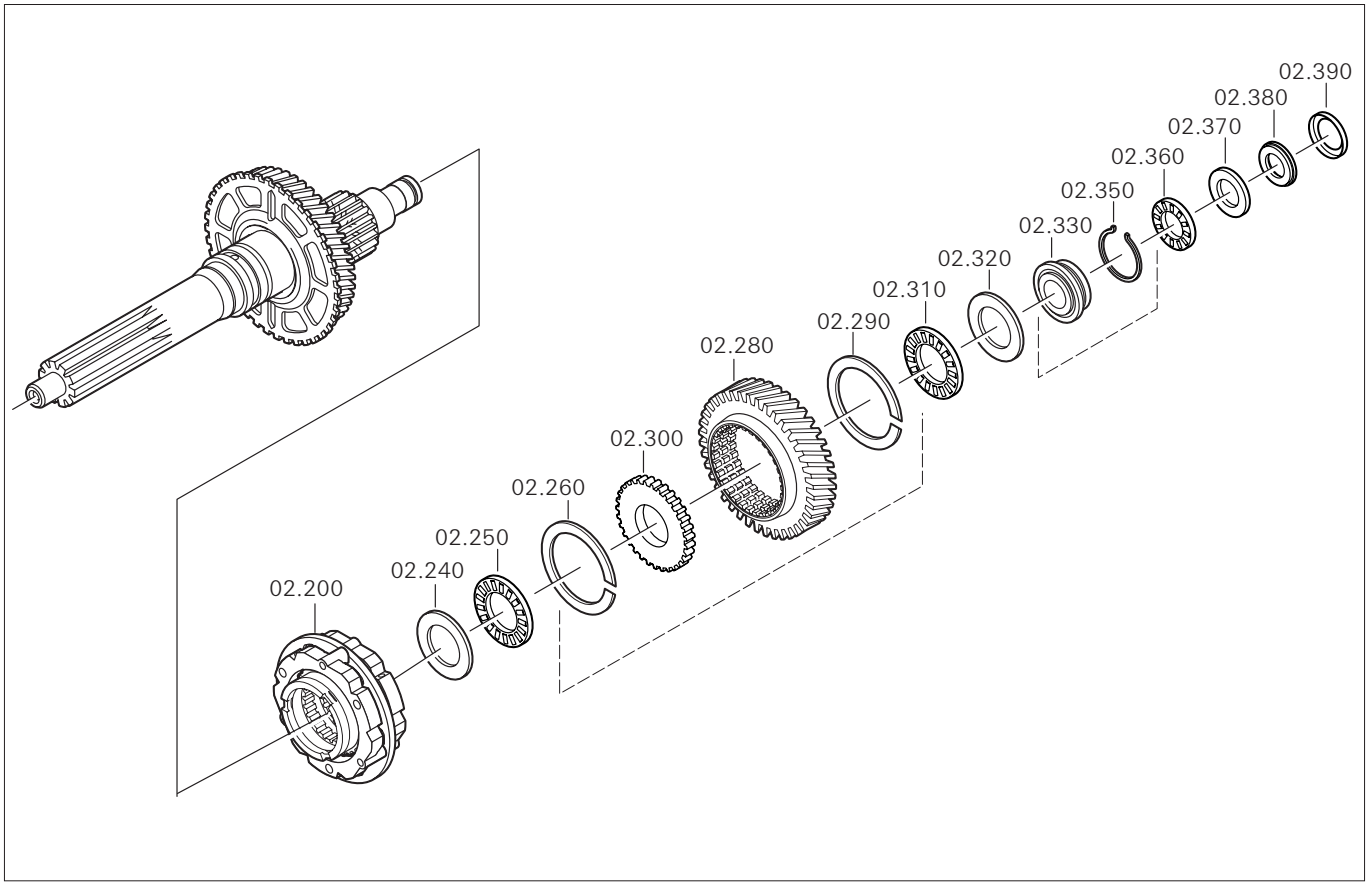
6 Turn input shaft by 180° and clamp input end in a vise with protective chucks.



017893



017926



017891

7 Insert the synchronization **02.200**, the disk **02.240**, and the axial needle cage **02.250** onto the input shaft.

8 Put the complete helical gear constant 2 onto the input shaft.

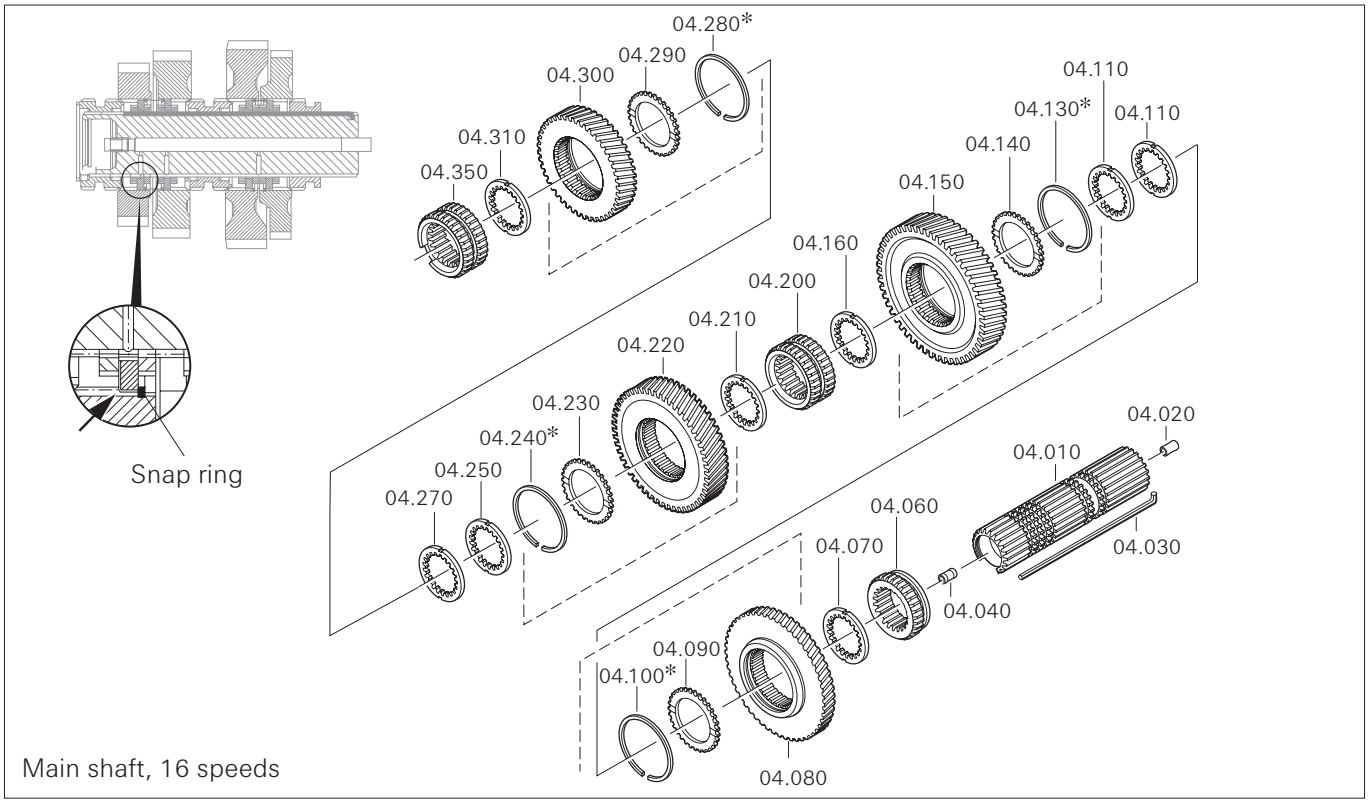
9 Subsequently put the parts - one after the other - onto the input shaft:
- Axial needle cage **02.310**
- Disk **02.320**
- Bearing ring **02.330** with securing ring **02.350**
- Axial roller cage **02.360**
- Disk **02.370**
- Split ring **02.380**
- Securing ring **02.390**

10 Secure securing ring **02.390** by staking 3x120°.

11 For installing the input shaft, please refer to the chapter “Install Shaft Package”.

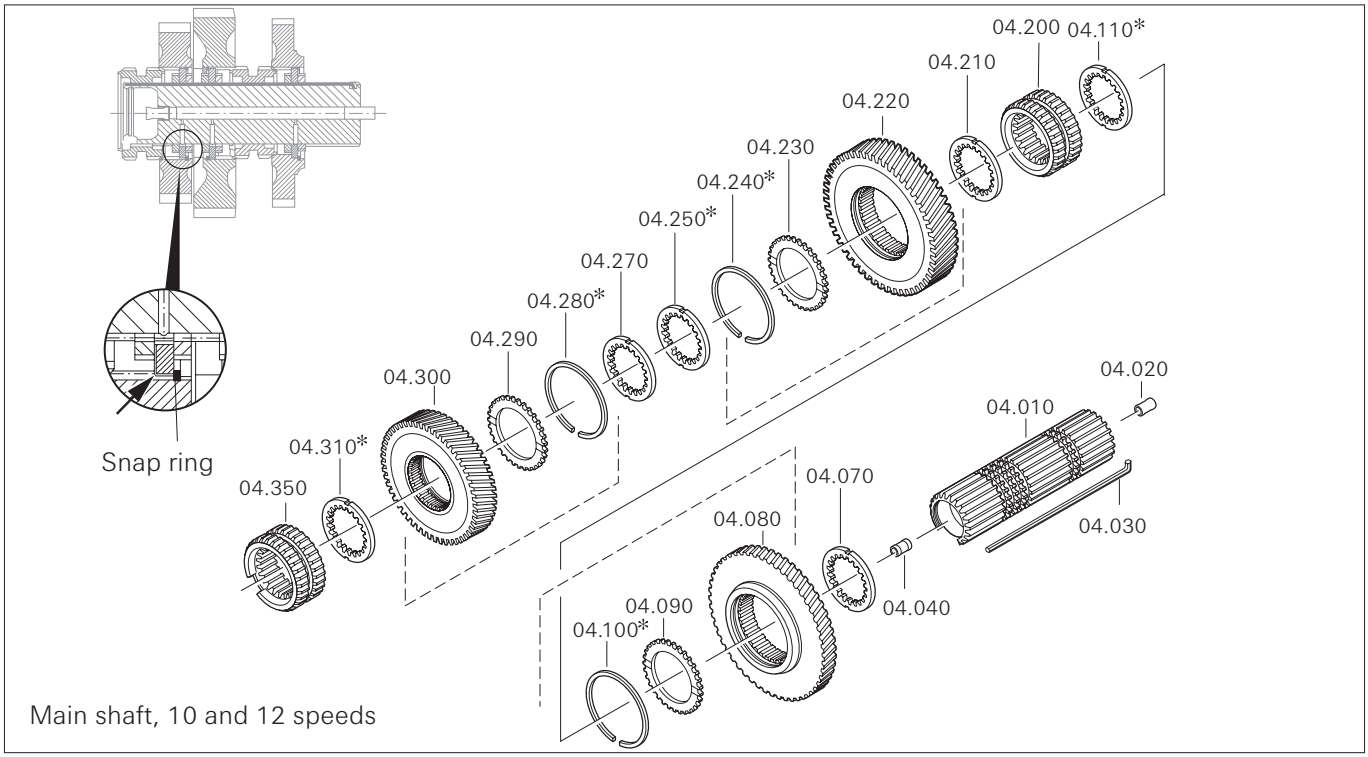
Main Shaft

NOTE
In the figure: All disks and snap rings that are marked with « * » feature a label so that during assembly they can be assigned to the correct assembly location. Thus, the measurement process is implemented for control purposes only.



Main shaft, 16 speeds

017889



Main shaft, 10 and 12 speeds

017890

Dismantling Main Shaft

1 Clamp main shaft in a vise with protective chucks.

2 Remove oil pipe **04.040**.

3 Press spline **04.030** out of the bore (e.g. with a small screwdriver) and pull downwards. Secure the last helical gear again with the spline.

4 Pull off the sliding sleeve **04.350**.

5 Offset the main shaft (MS) disk **04.310** by 1/2 a tooth and take it off.

6 Pull off the helical gear **04.300**. Take the wheel disk **04.290** and the snap ring **04.280** out of the helical gear.

7 Offset the disk **04.270** and the main shaft (MS) disk **04.250** by 1/2 a tooth and take them off.

8 Pull off the helical gear **04.220**. Take the disk **04.230** and the snap ring **04.240** out of the helical gear.

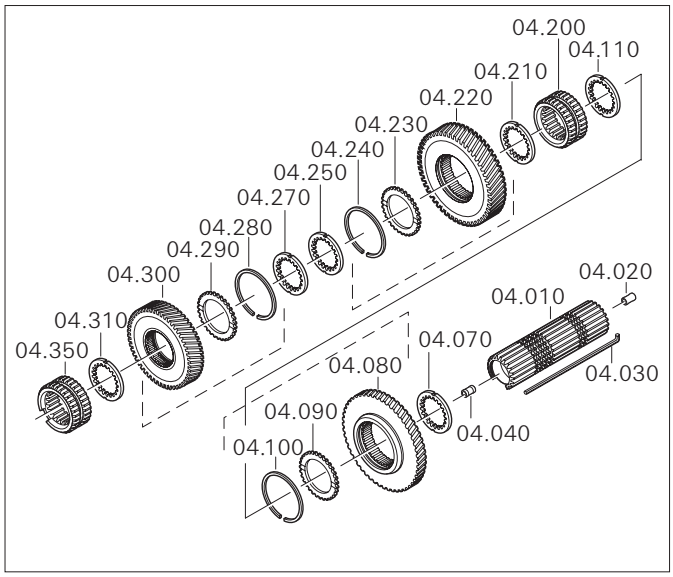
9 Offset the wheel disk **04.210** and take it off.

10 Take off the sliding sleeve **04.200**.

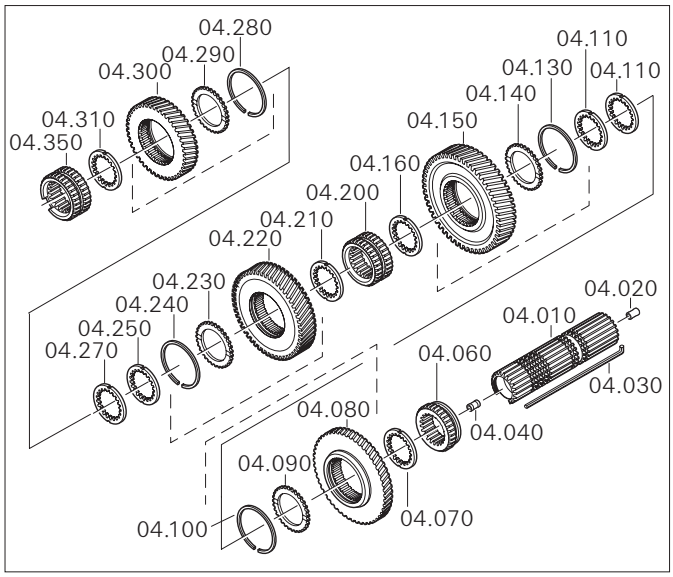
11 Remove the following parts from the main shaft **04.010**:
- Main shaft (MS) disk **04.160***
- Helical gear **04.150***
- Wheel disk **04.140***
- Snap ring **04.130***
- 2* and/or 1 main shaft (MS) disk **04.110**
- Snap ring **04.100**
- Wheel disk **04.090**
- Helical gear **04.080**
- Disk **04.070** and
- Sliding sleeve **04.060***

12 If the oil pipe **04.020** is damaged, please remove it.

Main shaft, 10 and 12 speeds 015207



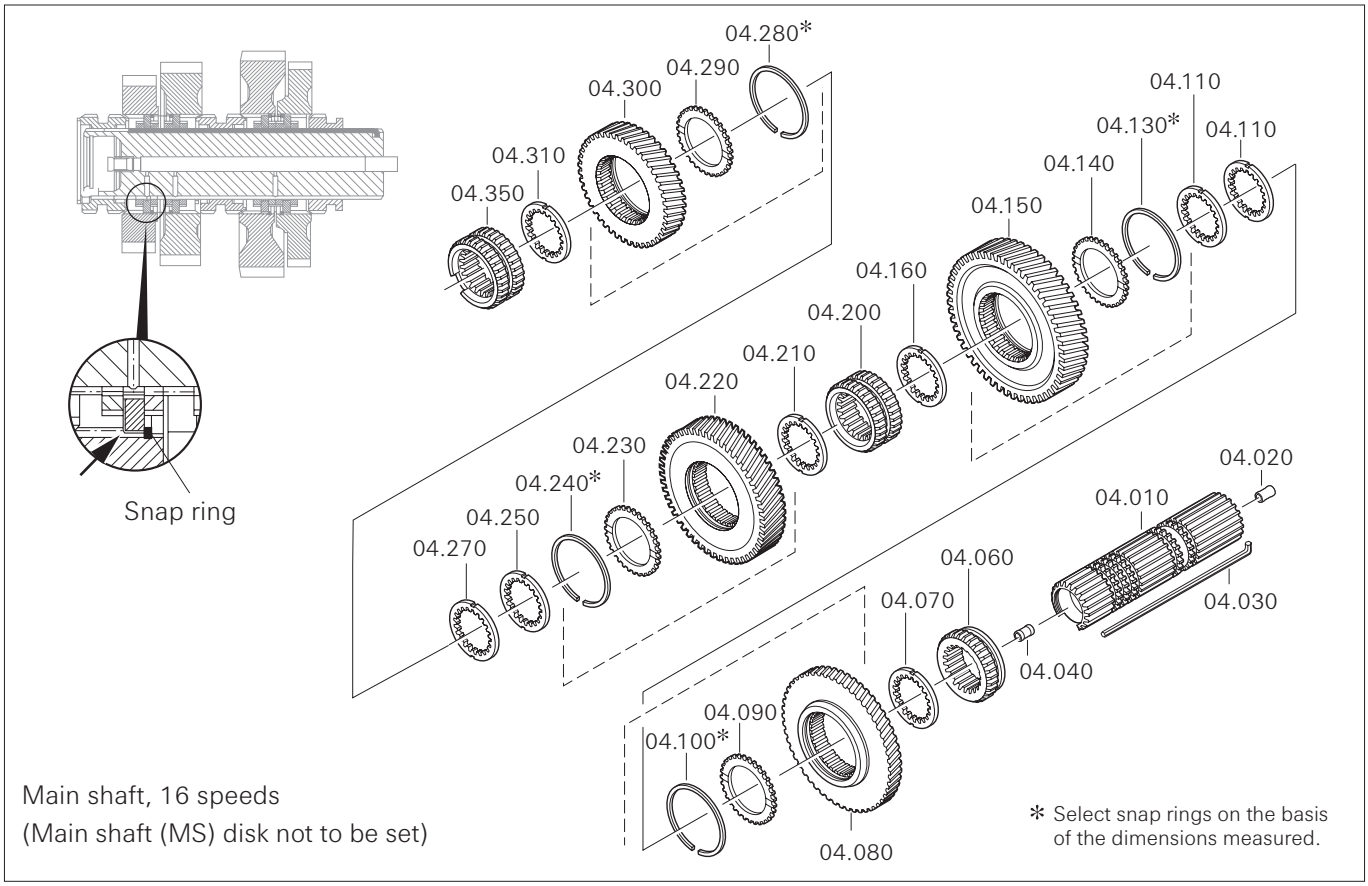
Main shaft, 10 and 12 speeds 015206



Main shaft, 16 speeds 015205

* only for 16 speeds

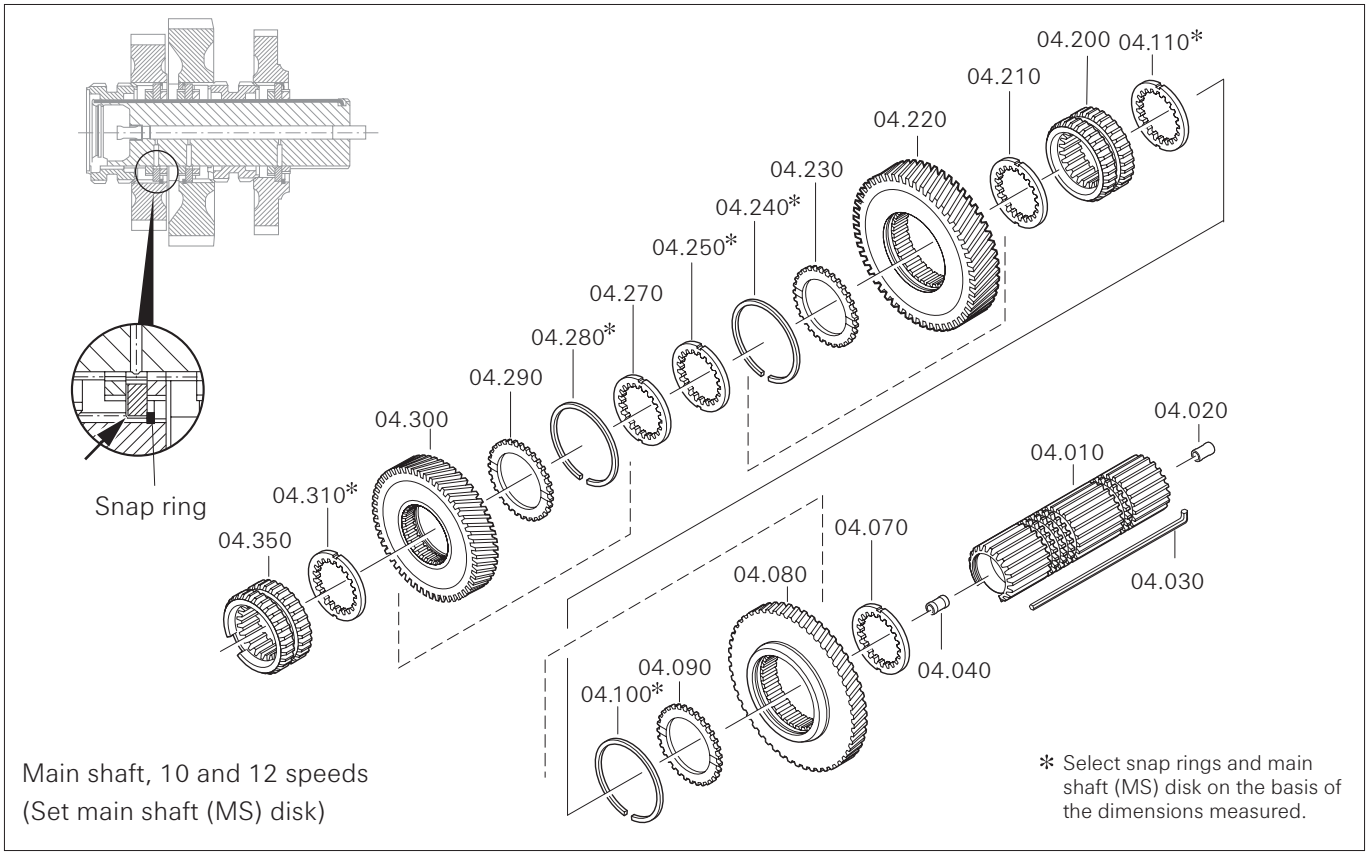
Assembling Main Shaft



Main shaft, 16 speeds
(Main shaft (MS) disk not to be set)

* Select snap rings on the basis of the dimensions measured.

017889



Main shaft, 10 and 12 speeds
(Set main shaft (MS) disk)

* Select snap rings and main shaft (MS) disk on the basis of the dimensions measured.

017890

1 Drive in oil pipe **04.020** using tool **1X56 138 205** in the main shaft **04.010**. Control dimension: Oil pipe protrudes by 15^{-1} mm.

2 Clamp main shaft in a vise with protective chucks.

3 For the 16-speed version, push the sliding sleeve **04.060*** onto the main shaft in such a manner that the recesses of the inner gearing point towards the spline **04.030**.

4 Push the disk **04.070** onto the main shaft. In the groove of the main shaft, offset the disk **04.070** by half a tooth and secure it with the spline **04.030**.

NOTE
The spline is located in the main shaft's gearing where you can also find the blind hole's bore.

CAUTION
When completing the helical gear set ensure that the stamping reduction (see arrow on Fig. 017889 and 017890) of the wheel disks 04.090, 04.230, 04.290, 04.140* does not point towards the snap ring.

5 Insert the wheel disk **04.090** and the snap ring **04.100** in the helical gear **04.080**.

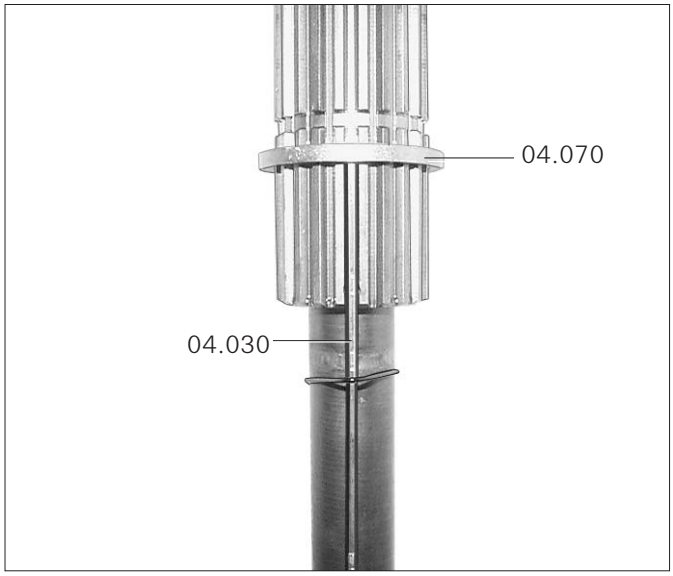
6 Set axial play of the helical gear **04.080** in relation to the wheel disk **04.090** in accordance with the instructions given in the respective chapters.

7 Push the complete helical gear **04.080** onto the main shaft.

8 Put on the main shaft (MS) disk **04.110** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk(s).

9 Set axial play of the main shaft (MS) disk **04.110** in relation to the wheel disk **04.090** in accordance with the instructions given in the respective chapters.

10 For the 16-speed version, put on the 2nd. disk **04.110*** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk.



Main shaft, 10 and 12 speeds 016658

11 Insert the wheel disk **04.140***and the snap ring **04.130*** in the helical gear **04.150***.

12 Set axial play of the helical gear **04.150*** in relation to the wheel disk **04.140*** in accordance with the instructions given in the respective chapters .

13 Push the complete helical gear **04.150*** onto the main shaft.

14 Put on the disk **04.160*** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk.

15 Push the sliding sleeve **04.200** onto the main shaft.

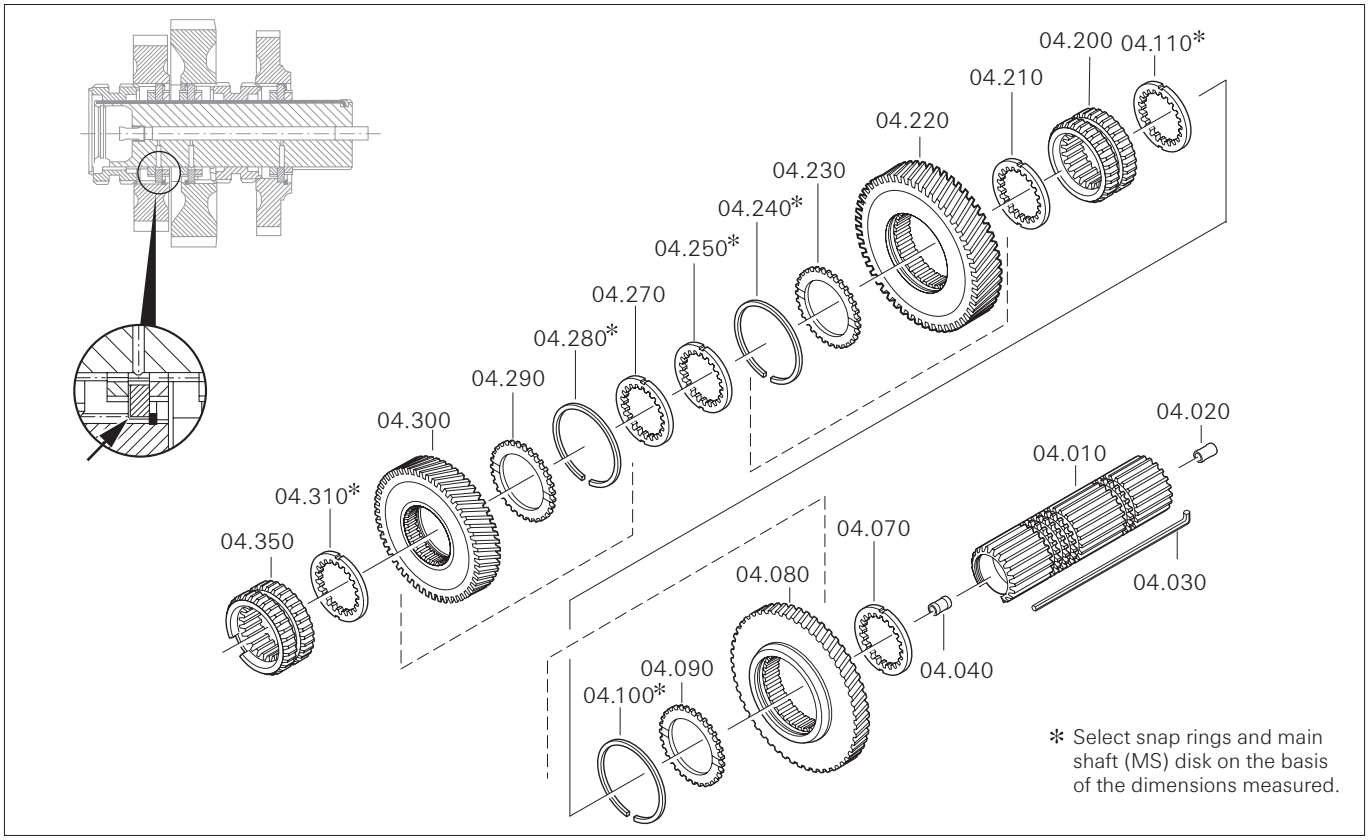
16 Put on the disk **04.230** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk.

17 Insert the wheel disk **04.210** and the snap ring **04.240** in the helical gear **04.220**.

18 Set axial play of the helical gear **04.220** in relation to the wheel disk **04.210** in accordance with the instructions given in the respective chapters.

19 Push the complete helical gear **04.220** onto the main shaft.

* only for 16 speeds



017890

20 Put on the main shaft (MS) disk **04.250** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk.

21 Set axial play of the main shaft (MS) disk **04.250** in relation to the wheel disk **04.210** in accordance with the instructions given in the respective chapters.

22 Put on the disk **04.270** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk(s).

23 Insert the wheel disk **04.290** and the snap ring **04.280** in the helical gear **04.300**.

24 Set axial play of the helical gear **04.300** in relation to the wheel disk **04.290** in accordance with the instructions given in the respective chapters.

25 Push the complete helical gear **04.300** onto the main shaft.

26 Put on the main shaft (MS) disk **04.310** and offset by half a tooth. Push the spline **04.030** upwards and adjust the disk.

27 Set axial play of the main shaft (MS) disk **04.310** in relation to the wheel disk **04.290** in accordance with the instructions given in the respective chapters.

28 Push the sliding sleeve **04.3500** onto the main shaft with the recess upwards. Align the recess of the sliding sleeve and the main shaft with one another.

29 Snap the spline's **04.340** lug into the blind hole's bore.

30 Insert the oil pipe **04.040**.

31 For the installation of main shaft, please refer to the corresponding chapter.

Set the Axial Play Gear to Wheel Disk

(See ZF-Service Information No. 25_05 in the Annex.)

NOTE

For explanations on the setting of the required **axial play of 0 up to 0.10 mm**, please refer to the example of the helical gear **04.080**. The same procedure applies for the helical gears **04.220**, **04.300**, and, if necessary, **04.150** (16-speed version).

Measurement 1

1 Insert the wheel disk **04.090** and the snap ring **04.100** in the helical gear **04.080**.

2 Measure from the rim of the helical gear **04.080** to the wheel disk **04.090**; set depth gage to zero.

Measurement 2

3 Put the complete helical gear **04.080** onto a tube or something similar (so that the wheel disk and the snap ring are being pushed upwards).

4 Measure from the rim of the helical gear **04.080** to the wheel disk **04.090**.

5 If the measurement value is outside of the tolerance range (0 up to 0.10 mm): Disassemble the snap ring **04.100**.

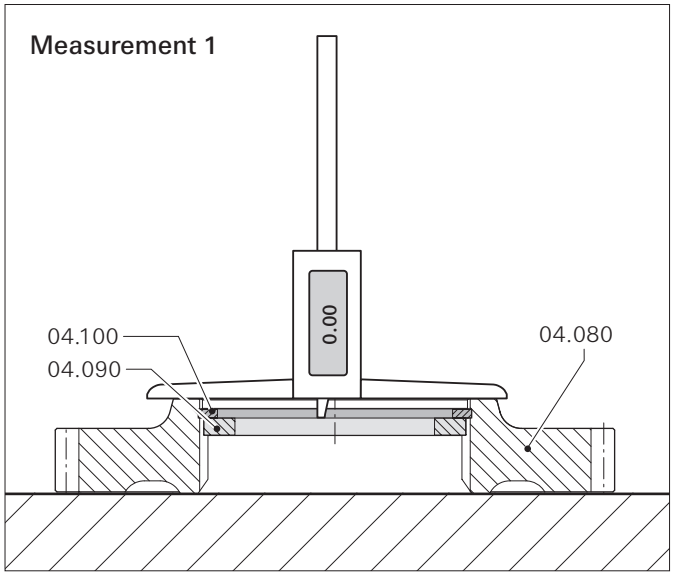
6 Select and mount a new snap ring (calculated) **04.100** from the OTK.

7 If necessary (at clearance 0), insert the snap ring **04.100** into the groove by applying soft blows.

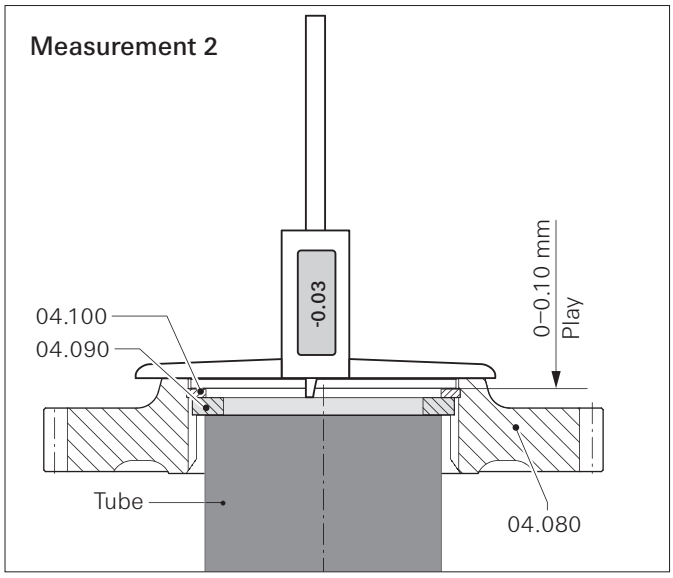
8 Check the axial play again.

9 Repeat the steps of action until the measurement value resides within the tolerance range.

10 Set the axial play for the helical gears **04.220**, **04.300**, and, if necessary, **04.150** in the same way.



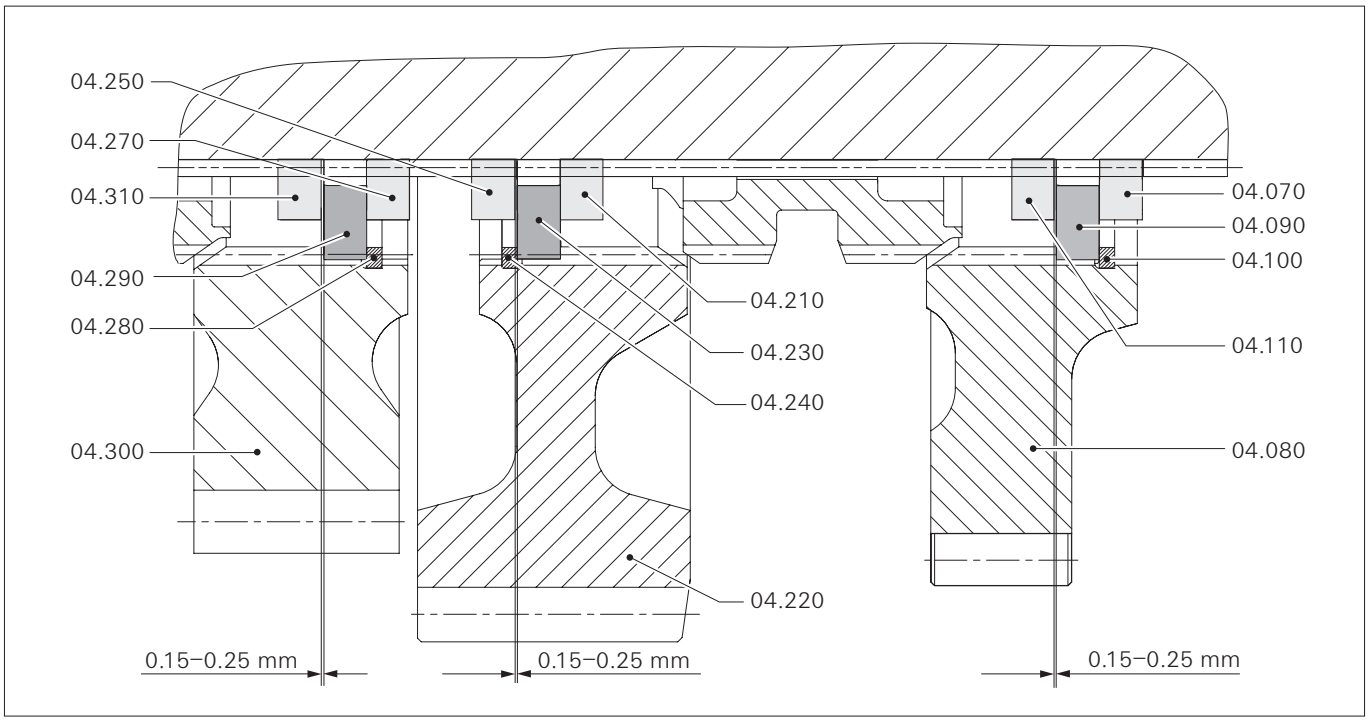
028247



028246

Set the Axial Play of the Main Shaft (MS) Disk in Relation to the Wheel Disk

(See ZF-Service Information No. 25_05 in the Annex.)



028194

Setting this type of axial play is a process which is only done with 12-speed transmissions. For exceptions, see ZF-Service Information No. 25_05 in the Annex.

NOTE

For explanations on the setting of the required **axial play of 0.15 up to 0.25 mm**, please refer to the example of the helical gear **04.080**. The same procedure applies for the helical gears **04.220** and **04.300**.

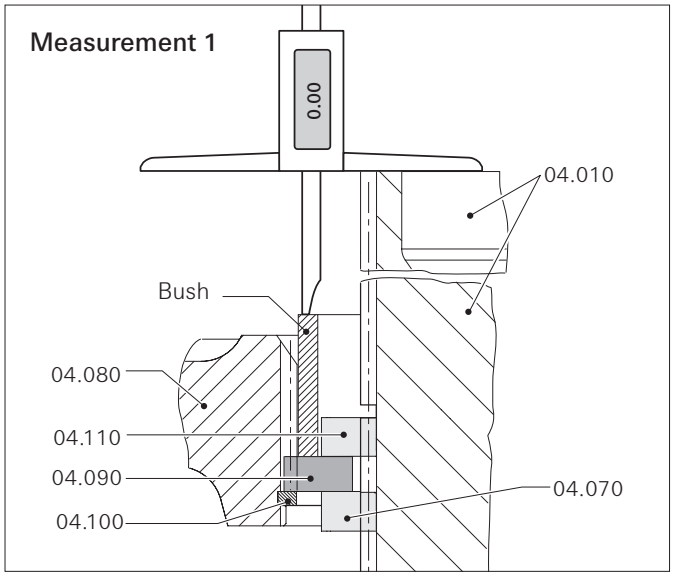
Measurement 1

1 Mount the disk **04.070** onto the main shaft **04.010**.

2 Mount the helical gear **04.080** with the securing ring **04.100** and the wheel disk **04.090** onto the main shaft.

3 Mount the main shaft (MS) disk **04.110** onto the main shaft.

4 Measure from the input-end of the main shaft up to the bush; depth gage must be set to zero.



028227

CAUTION

The measurement must be effected directly on the wheel disk or by mains of a bush located on the wheel disk.

Measurement 2

5 Raise the helical gear **04.080**.

NOTE
2 rim levers or something similar is necessitated for raising the helical gear **04.300**.

6 Measure from the input-end of the main shaft up to the bush.

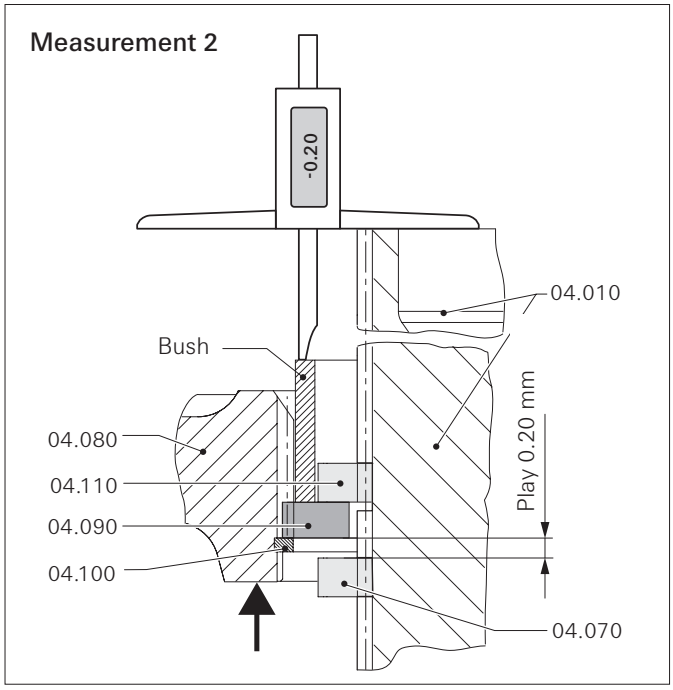
7 If the measurement value is outside of the tolerance range (0.15 up to -0.25 mm): Lift off the main shaft (MS) disk **04.110**.

8 Select and mount a new main shaft (MS) disk (calculated) **04.110** from the OTK.

9 Check the axial play again.

10 Repeat the steps of action until the measurement value resides within the tolerance range.

11 Set the axial play for the helical gears **04.220** and **04.300** in the same way.



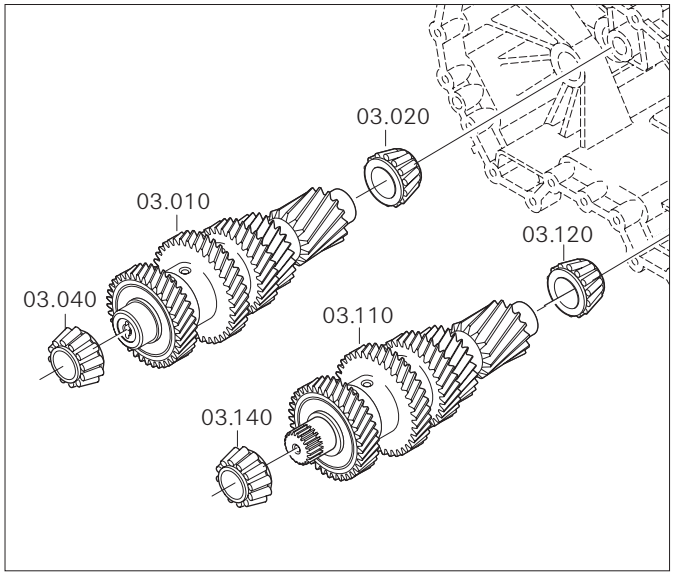
028234

Countershaft

Disassembling the Countershaft

1 Pull off the bearing's inner rings **03.020**, **03.040**, **03.120**, **03.140** with the gripping insert **1X56 136 740** and the basic tool **1X56 122 304**.

NOTE
Further disassembly of the countershaft is not possible, i.e. when the gearing is damaged, you will always have to replace the complete countershaft.



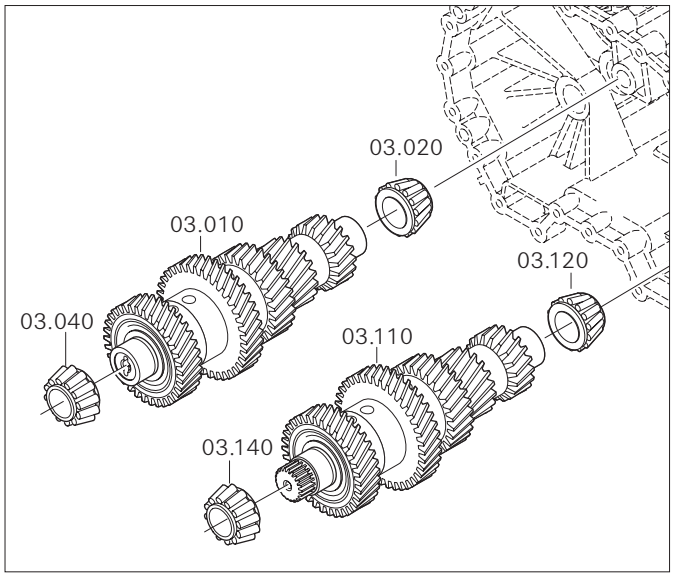
16-speed version 016668

Mounting the Countershaft

CAUTION
Check the tapered roller bearings; if necessary, replace them because the gripping process may have damaged the bearing rollers.

1 Heat up the bearing's inner rings **03.020**, **03.040**, **03.120**, **03.140** to approx. 120 °C and position axially, in a playfree manner on the countershaft.

⚠ DANGER
Only touch heated parts when wearing protective gloves.



10- and 12-speed version 016669

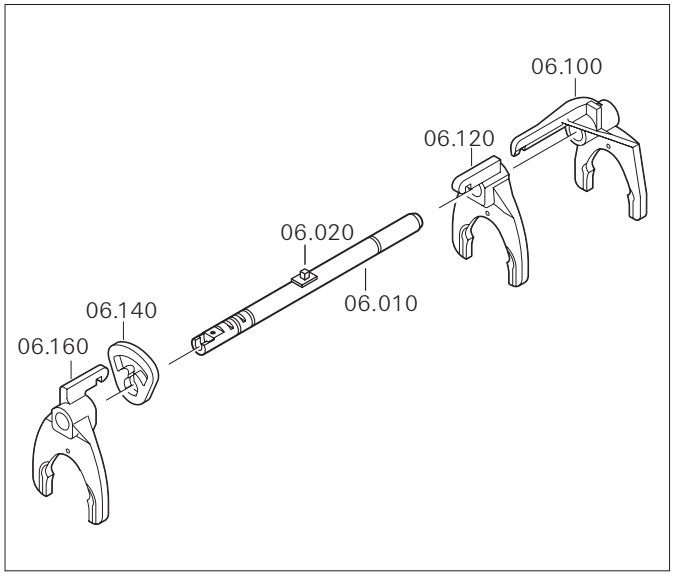
2 For installing the countershaft, please refer to the chapter "Install Shaft Package".

Selector Shaft

Dismantling the Selector Shaft

1 Unlock the shift forks **06.100***, **06.120**, **06.160** and take them out.

2 Remove interlock **06.140** from selector shaft **06.010**.



16-speed version 028241

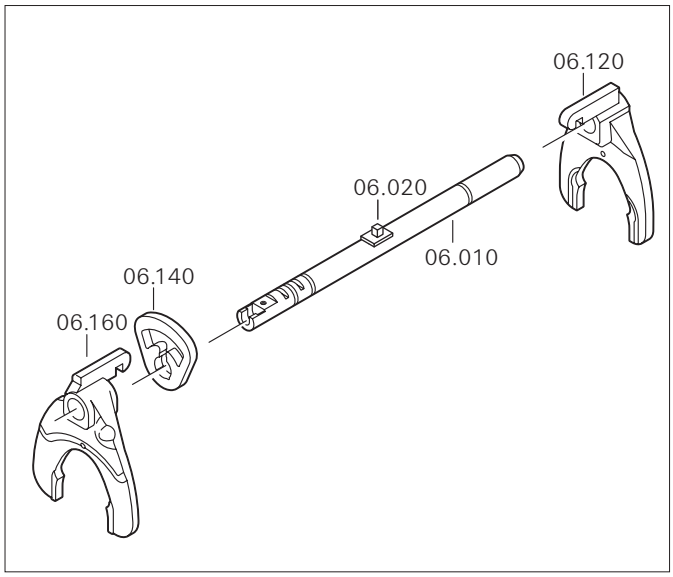
Assembling the Selector Shaft

1 Place interlock **06.140** on selector shaft.

2 Thread shift forks **06.100*, 06.120** and **06.160** into interlock in correct positional arrangement.

CAUTION
Do not interchange shift forks 06.120 and 06.160; refer to parts list.

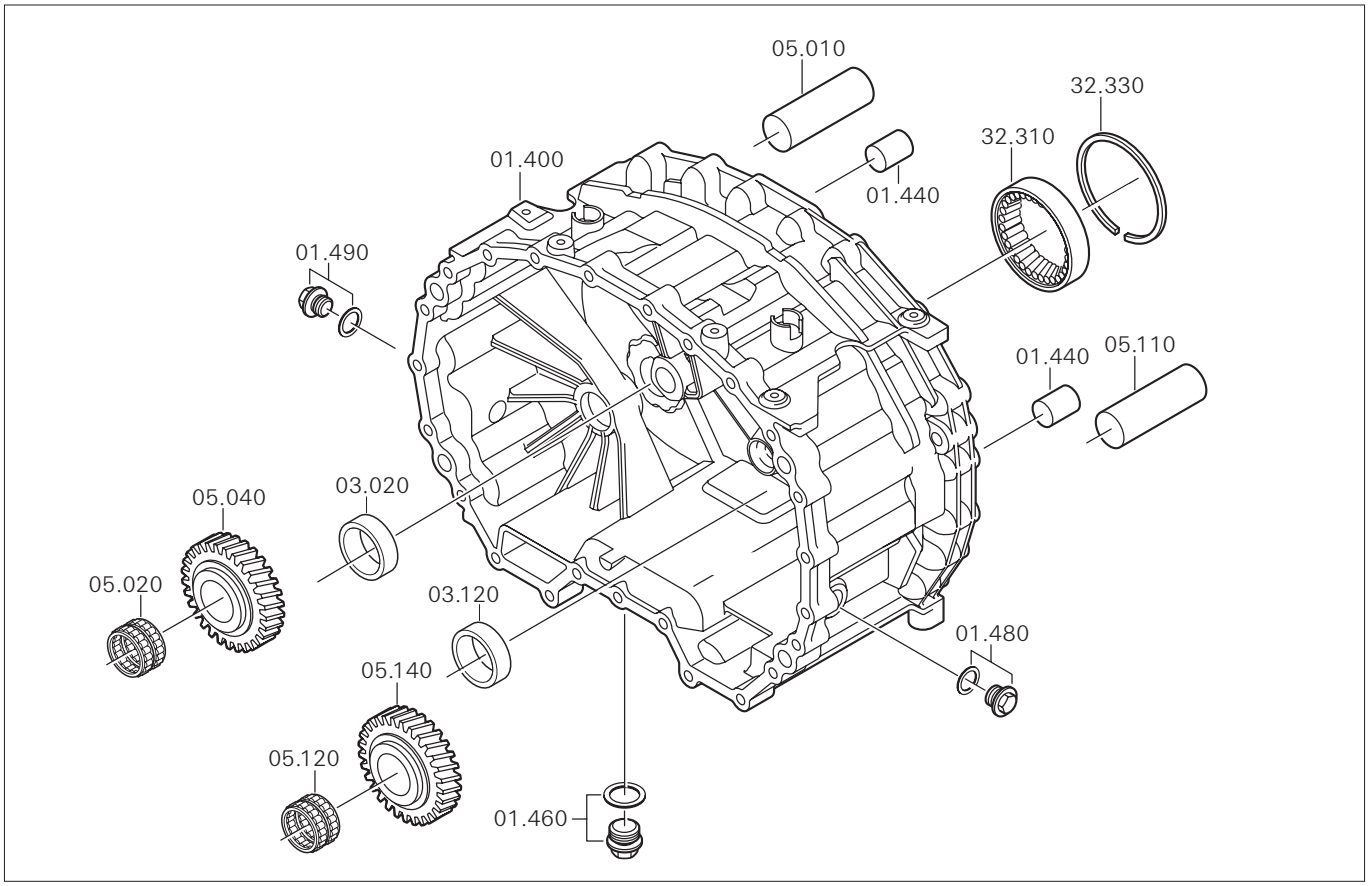
3 For installing the selector shaft, please refer to the chapter “Install Shaft Pack”.



12-speed version 028240

* only for 16-speed version

Housing II



028197

Dismantling Housing II

NOTE
The idler shafts **05.010**, **05.110** have already been removed.

1 Remove the R gear's reversing gears **05.040**, **05.140** and take out the needle cages **05.020**, **05.120**.

2 Remove the M24x1.5 screw plugs **01.460**, **01.480**, **01.490**.

⚠ DANGER
Only touch heated parts when wearing protective gloves.

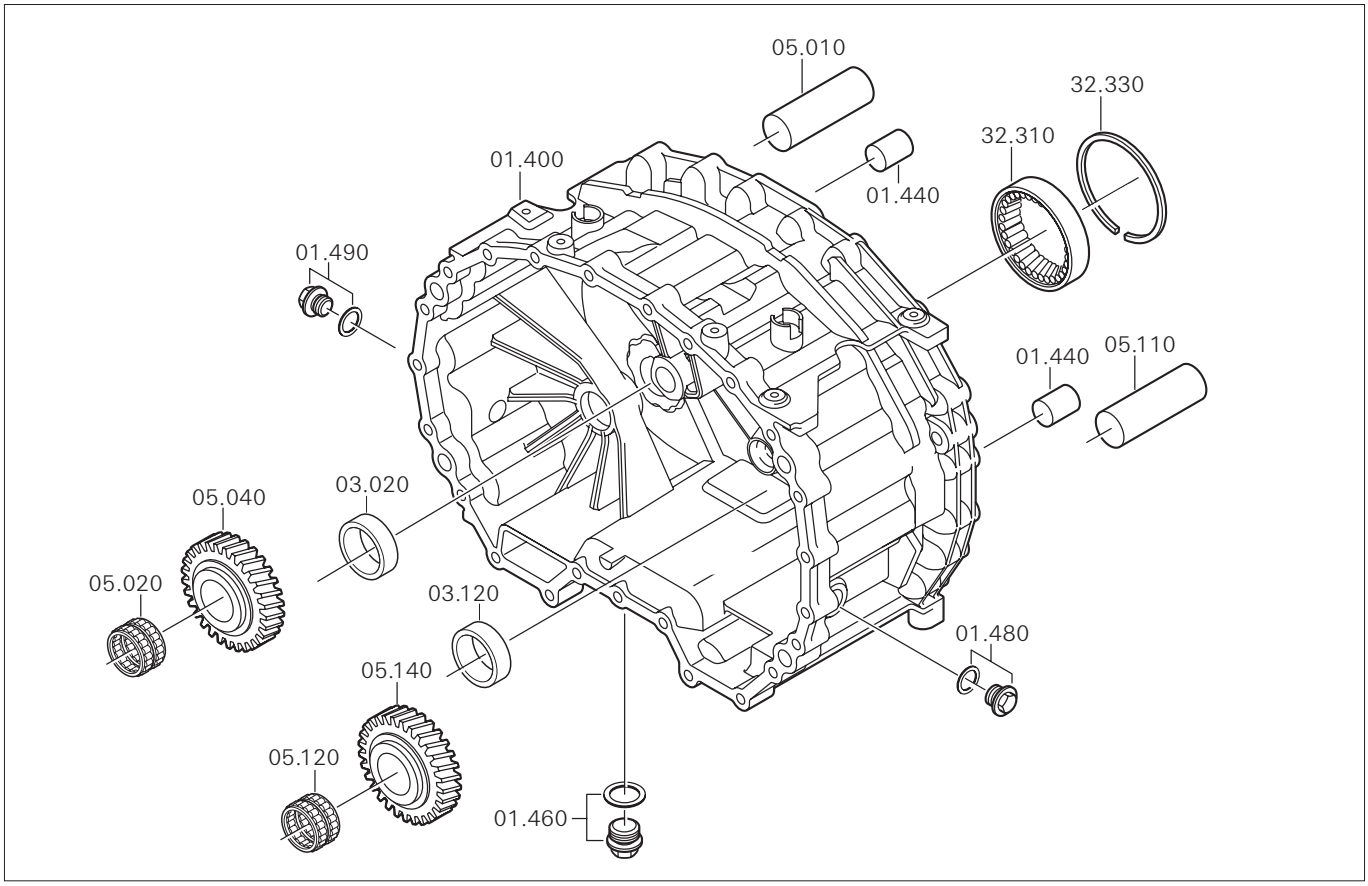
3 Remove the bearing's outer rings from the tapered-roller bearings **03.020**, **03.120** in the case that the bearing's inner rings at the countershaft are to be replaced.

Prior to the removal of the bearing's outer rings, heat up the bearings' seats to approx. 80 °C.

4 Remove snap ring **32.330**.

5 Heat up the bearings' seat to approx. 100 °C and cautiously remove the bearing's outer ring of the cylindrical roller bearing **32.310**.

6 Only remove the bolts **01.440** if they are defective or if the housing II is to be replaced. Heat up the housing II to approx. 90 °C and drive out bolts.



028196

Assembling Housing II

⚠ DANGER

Only touch heated parts when wearing protective gloves.

CAUTION

In order to avoid the generation of assembly grooves, lightly coat the bearings' seats with oil prior to heating them up.

1 Heat up the bearing seat of the cylindrical roller bearing **32.310** to approx. 100 °C and insert the bearing's outer ring in the housing II (until it axially abuts).

2 Insert snap ring **32.330**.

3 Heat up the bearings' seats of the tapered-roller bearings **03.020**, **03.120** to approx. 100 °C and insert the bearing's outer rings.

4 Tighten the M24x1.5 screw plugs **01.460, 01.480**, **01.490** with 60 Nm.

5 Insert the R gear's reversing gears **05.040, 05.140** together with the needle cages **05.020**, **05.120**.

6 The idler shafts **05.010**, **05.110** are installed at a later point in time.

7 If the bolts **01.440** are missing, then heat up the housing II to approx. 90 °C, lightly grease the bolts and drive them in cautiously or use a manually operated press for pressing them in.

CAUTION

Avoid canting/misalignment of bolts during assembly danger of housing fracture!

8 For the installation of shaft pack, please refer to the corresponding chapter.

Impulse sensor and speed sensor (output sensor) in ZF transmissions

As requested by some customers, ZF transmission production series are delivered without impulse sensor or speed sensor. The threaded hole is then sealed by a screw plug. If the impulse sensor or speed sensor should go missing during a repair operation, it will not be possible to determine which impulse sensor or speed sensor is to be installed. Tables 1, 2 and 3 are to assist in detecting the relevant components.

Transmissions affected

- ECOLITE: S 6-36, S 5-42, S 6-85, 6 S 850, 6 S 1600
- ECOMID: 9 S 75, 9 S 109, 16 S 109, 8 S 180
- ECOSPLIT: 8 S 151, 8 S 181; 8 S 221; 8 S 251; 16 S 151, 16 S 181; 16 S 221; 16 S 251
- ECOMAT: HP 500; HP 590; HP 600; HP 502; HP 592; HP 602
- ASTRONIC

Measures

Repair method for transmissions :
Assembly of new output sensor according to parts list and exchange of old component in accordance with the table.

Repair method for vehicles :
Replacement of output sensor in accordance with parts list, comparison of old component with the contents of the table or inspection of the respective speed sensor in the vehicle.

Replacement transmissions :
Depending on the parts list, output sensor is either installed on the replacement transmission or bore hole is sealed with a screw. In this case, the vehicle manufacturer is responsible for the correct installation of the output sensor.

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Ersteller: Ammann

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Variants of impulse sensors / speed sensors, mechanical transmissions

Table 1

sensor types ➔	impulse sensor "Inductive"	impulse sensor "Hall"	impulse sensor "Hall"	KITAS I "Hall" (standard)	KITAS I Inductive (for Telma)		
plug connection ➔	Renk	Renk	Bajonett DIN 72585	Bajonett DIN 72585	Bajonett DIN 72585	sensor distance (mm)	
	Part No.	Part No.	Part No.	Part No.	Part No.		application according to transmission type
	0501 208 791	0501 209 399	0501 210 855	0501 211 731	---	19,8	6 S 1600 with/without Intarder, S 6-85; 9 S 109, 16S 109, 8 S 180 Model maintenance package; 9 S 75, 9 S 109, 16S 109, 8 S 180 with Intarder, ECOSPLIT 3 with Intarder
	0501 208 792	0501 209 400	0501 210 856	0501 211 732	---	25	S 5-42, S 6-36, 6 S 850
	0501 208 793	---	---	---	0501 211 842	35	8 S 180 with Telma
	0501 208 794	0501 209 402	0501 210 858	0501 211 734	---	63,2	S 5-42 implemented by Daimler-Chrysler Wörth
	0501 208 795	0501 209 403	0501 210 859	0501 211 735	---	90	9 S 109, 16S 109, 8 S 180 ECOSPLIT 3 without Intarder
	0501 208 796 Voith + Telma	---	0501 210 860 Voith	---	0501 211 843 Telma	115	6 S 1600, S 6-85
	0501 208 796	---	---	---	0501 211 843	115	8 S 180 + Telma Model maintenance package
	---	---	0501 210 991	---	---	136,8	8 S 180 + Voith Model maintenance package

Variants of impulse sensors / speed sensors, ECOMAT transmission

Table 2

Sensor type ➔	impulse sensor "inductive"	impulse sensor "Hall"	impulse sensor "Hall"	KITAS I "Hall" (standard)	KITAS I inductive (for Telma)		
plug connection ➔	Renk	Renk	Bajonett DIN 72585	Bajonett DIN 72585	Bajonett DIN 72585	sensor distance (mm)	
	Part No.	Part No.	Part No.	Part No.	Part No.		Observation
	0501 208 793	---	0501 210 857	---	0501 211 842	35	applied to ECOMAT 1/2, with co-axial transmission type and angle drive with thread bolt M18x1,5. Co-axial transmission type depends on the output cover version.
	0501 208 794	0501 209 402	0501 210 858	0501 211 734	---	63,2	applied to ECOMAT 1/2, with co-axial transmission version and thread bolt M18x1,5. Not possible if angle drive applied. Co- axial transmission type depends on the type of output cover.

Variants of switches and impulse sensors /ASTRONIC transmissions

Table 3

sensor type ➔	impulse sensor "Hall"	impulse sensor "Hall"	KITAS I "Hall" (standard)	Neutral position switch			
plug connection ➔	Renk	Bajonett DIN 72585	Bajonett DIN 72585		sensor distance (mm)		
	Part No.	Part No.	Part No.	Part No.		Observation	
	0501 209 399	0501 201 855	0501 211 731	---	19,5	with Intarder	threaded bolt sealed with
	0501 209 403	0501 210 859	0501 211 735	---	90	without Intarder	Screw plug 0768 406 235 consists of: ⇩
				0501 210 059	---		Screw plug (M18x1,5) 0636 302 021 + sealing 0634 801 055

Wiring Fastening for Clutch Actuator on ASTRONIC Transmissions

During the course of further development work, the wiring fastening for the clutch actuator was modified. The two retaining plates, to which the cable harness was previously attached by means of cable clips, were discarded in two modification stages. They have been replaced by cable clamps. A modification related to this has also been undertaken on housing section 2. The new housing section 2 has been introduced to volume production by modifying the parts list and using new item numbers.

Components affected:

Parts list modification for 1st stage

	NEW	OLD		
Designation	**Item number**	**Item number**	**Model no.**	**Mod. +)**
Housing, short	1327 301 023	1327 301 020	1327 1327	2223D 2227D
Fixing device	no longer used	1328 301 052 (1x)		
Cable clip	0501 317 817 (1x)	0501 317 817 (2x)		
Housing, long	1328 301 060	1328 301 045	1328 1328 1329 1329	2231D 2234D 2237D 2239D
Fixing device	no longer used	1328 301 052 (1x)		
Cable clip	0501 317 817 (1x)	0501 317 817 (2x)		

+) Mod = announcement number of parts list modification

Parts list modification for 2nd stage

	NEW	OLD		
Designation	**Item number**	**Item number**	**Model no.**	**Mod. +)**
Fixing device	no longer used	1328 301 052 (1x)	1327 1328 1329 1337	2250D
Cable clip	no longer used	0501 317 817 (1x)		
Fastening	0501 214 086 (1x)	---		

+) Mod. = announcement number of parts list modification

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Availability of parts in spare parts system:

Designation	Item number	Remark
Housing, OLD	1327 301 020	can no longer be supplied
Housing, OLD	1328 301 045	can no longer be supplied
Fixing device	1328 301 052	can still be supplied
Cable clip	0501 317 817	available
Fastening	0501 214 086	available, can only be fitted on new housing 2

Start data:

1st modification stage

The start of the parts list modification has been recorded as follows:

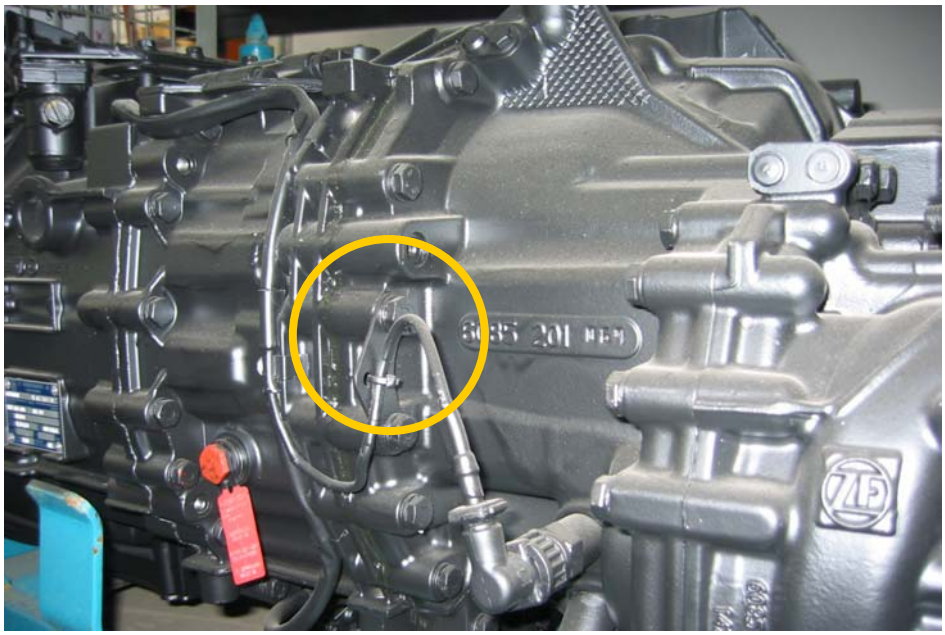
Transmission	Model no.	As of product number	Mod. +)
12 AS 3001	1329	262.440	2239D
12 AS 3001 IT	1329	261.753	2237D
16 AS TD/TO IT	1328	262.655	2234D
16 AS TD/TO	1328	262.643	2231D
12 AS TD/TO	1327	263.843	2227D
12 AS TD/TO IT	1327	263.895	2223D

+) Mod. = announcement number of parts list modification

2nd modification stage

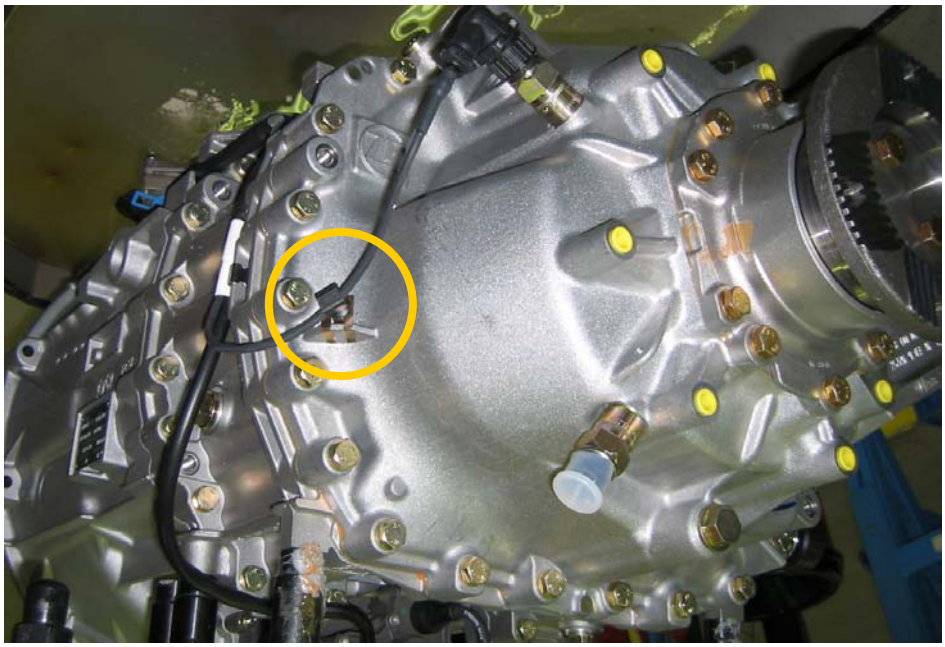
Only the start date of December 1, 2003 has been recorded for the modification.

OLD fastening of wiring



Fixing device
1328 301 052

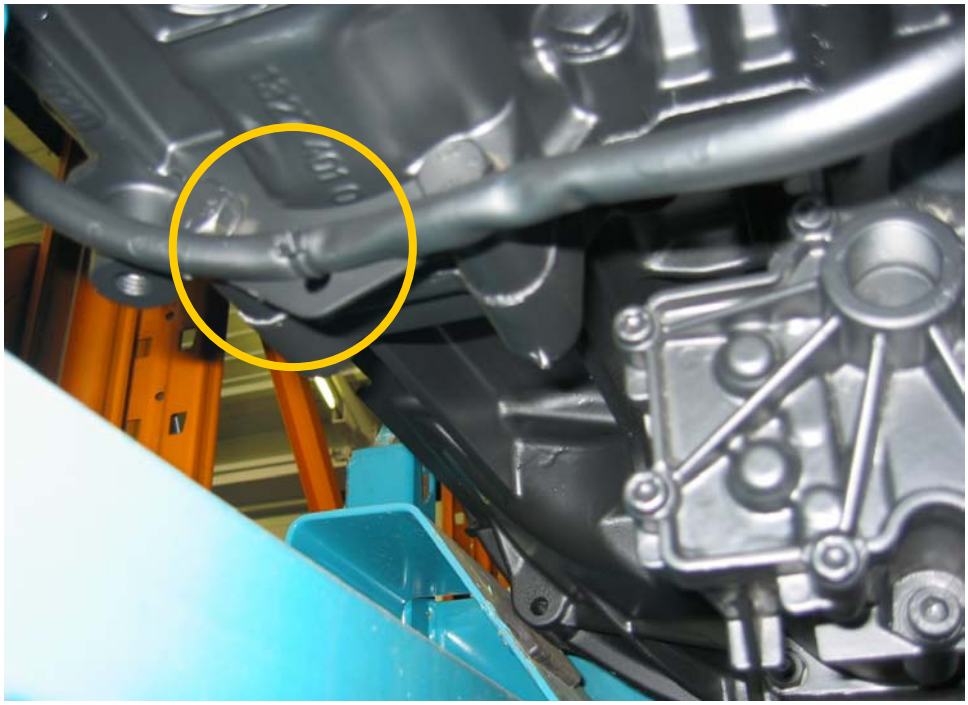
NEW fastening of wiring



Fastening
0501 214 086

Fastening for wiring (underside of transmission, second modification stage)

OLD

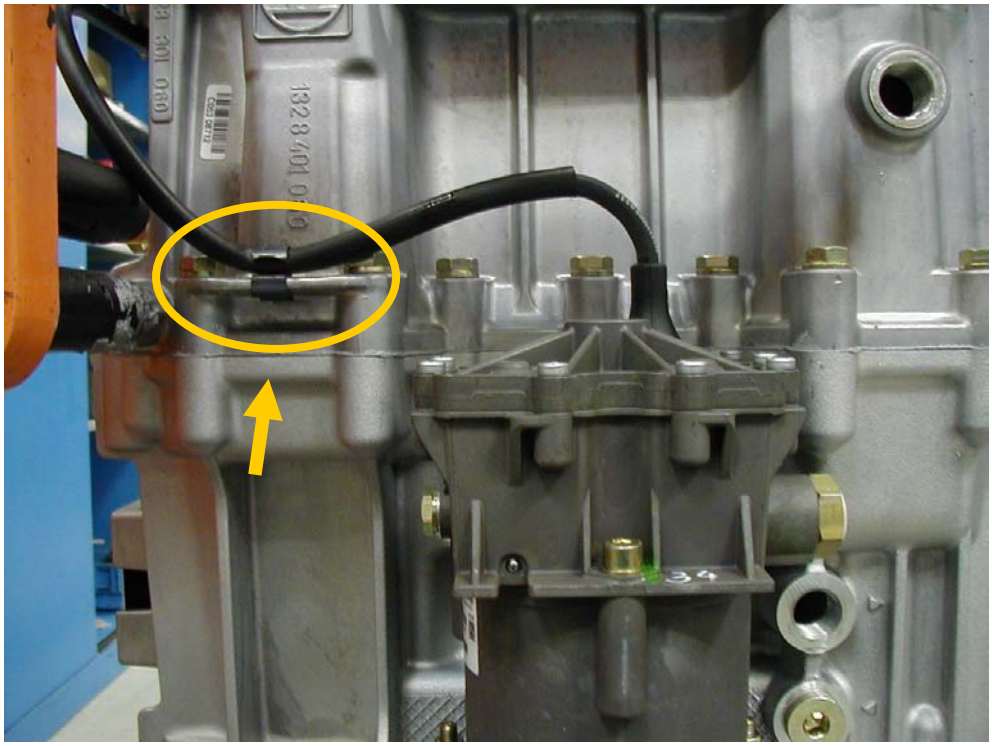


Fixing device
1328 301 052

NEW

Cable clamp 0659 050 410

Modified point on housing 2



New Splitter Group Synchronizer Unit in ASTRONIC Transmissions

During the course of further development work, the splitter group synchronizer unit in the ASTRONIC 2 transmission has been further optimized. The design of the synchronizer rings and plate has been changed. To ensure uniformity, the synchronizer rings and plate of the synchronizer unit in the ASTRONIC 1 transmission have also been modified.

Components affected:

ASTRONIC 1

- **Synchronizer unit for DD version, direct gear**

Scope of parts			NEW Modular system PL 1314 202 089	OLD Modular system PL 1314 202 082
			consisting of:	consisting of:
Pos.	Designation	Qty.	Item number	Item number
110	Synchronizer ring	1	**1328 302 084**	**1328 302 111**
120	Pin	3	0731 201 698	0731 201 698
150	Gear shift sleeve	1	1314 302 188	1314 302 188
160	Bolt	3	1328 302 016	1328 302 016
180	Plate	1	**1328 302 109**	**1328 302 015**
190	Circlip	1	0730 505 158	0730 505 158
210	Pin	3	0731 201 699	0731 201 699
220	Synchronizer ring	1	**1328 302 085**	**1328 302 112**
240	Compression spring	3	0732 040 385	0732 040 385
250	Cylinder roller	3	0635 470 046	0635 470 046

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ASTRONIC 2

- **Synchronizer unit for OD version, overdrive gear**

Scope of parts			NEW Modular system PL 1328 202 039	OLD Modular system PL 1328 202 016
			consisting of:	consisting of:
Pos.	**Designation**	**Qty.**	**Item number**	**Item number**
110	Synchronizer ring	1	**1328 302 084**	**1328 302 111**
120	Pin	3	0731 201 698	0731 201 698
150	Gear shift sleeve	1	1328 302 064	1328 302 064
160	Bolt	1	1328 302 072	1328 302 072
180	Plate	1	**1328 302 109**	**1328 302 015**
210	Pin	3	0731 201 699	0731 201 699
220	Synchronizer ring	1	**1328 302 086**	**1328 302 113**
240	Compression spring	3	0732 040 385	0732 040 385
250	Cylinder roller	3	0635 470 046	0635 470 046

- **Synchronizer unit for DD version, direct gear**

Scope of parts			NEW Modular system PL 1328 202 040	OLD Modular system PL 1328 202 017
			consisting of:	consisting of:
Pos.	**Designation**	**Qty.**	**Item number**	**Item number**
110	Synchronizer ring	1	**1328 302 084**	**1328 302 111**
120	Pin	3	0731 201 698	0731 201 698
150	Gear shift sleeve	1	1328 302 064	1328 302 064
160	Bolt	1	1328 302 072	1328 302 072
180	Plate	1	**1328 302 109**	**1328 302 015**
210	Pin	3	0731 201 699	0731 201 699
220	Synchronizer ring	1	**1328 302 085**	**1328 302 112**
240	Compression spring	3	0732 040 385	0732 040 385
250	Cylinder roller	3	0635 470 046	0635 470 046

Measures:

In the event of repairs, the synchronizer rings and plate should always be replaced in complete sets. Old and new components must not be combined with one another. Old parts may be used up.

Spare parts:

If repairs are undertaken, 3 synchronizer kits are available and have to be ordered under the relevant kit number.

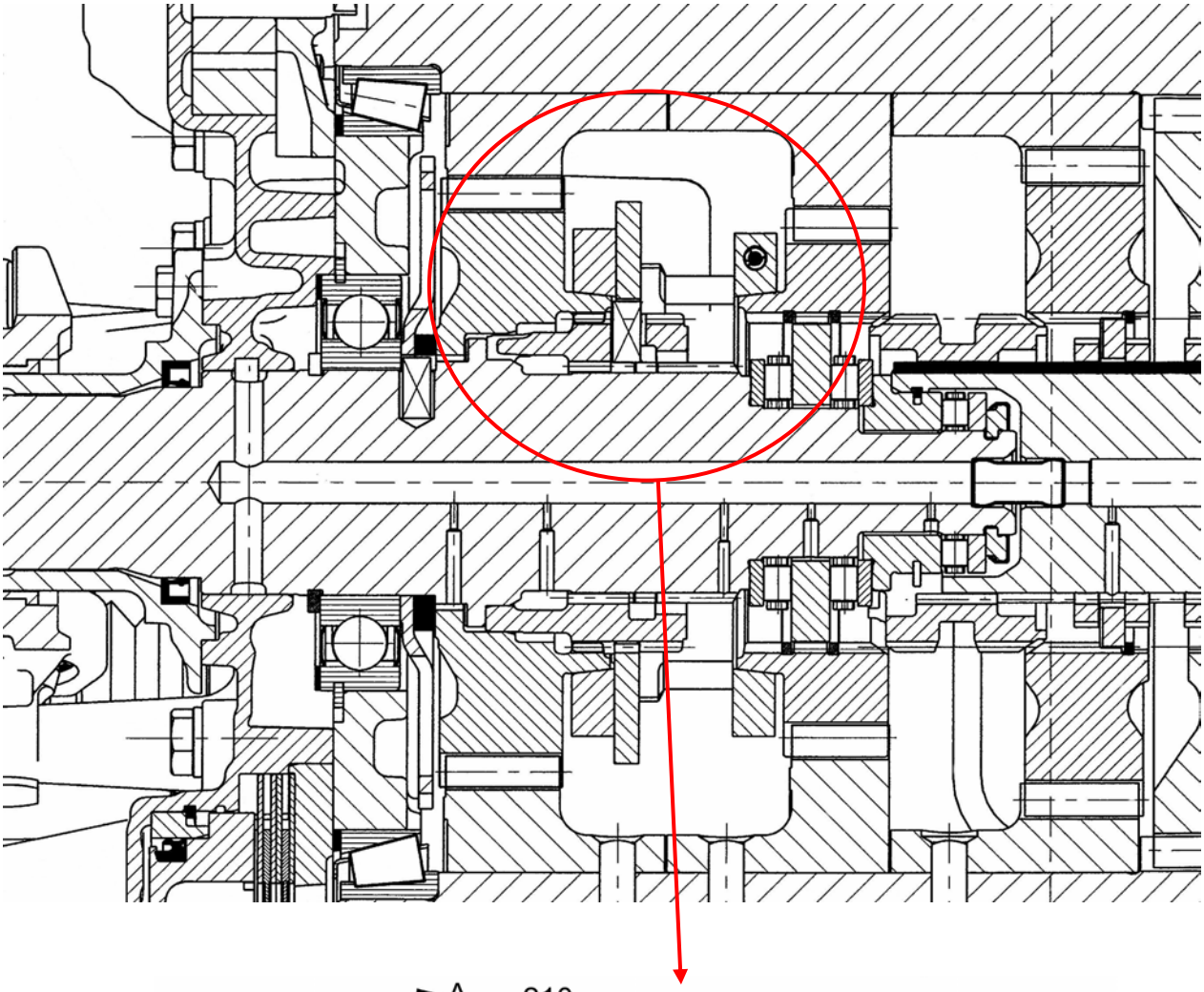
Synchronizer kits available:

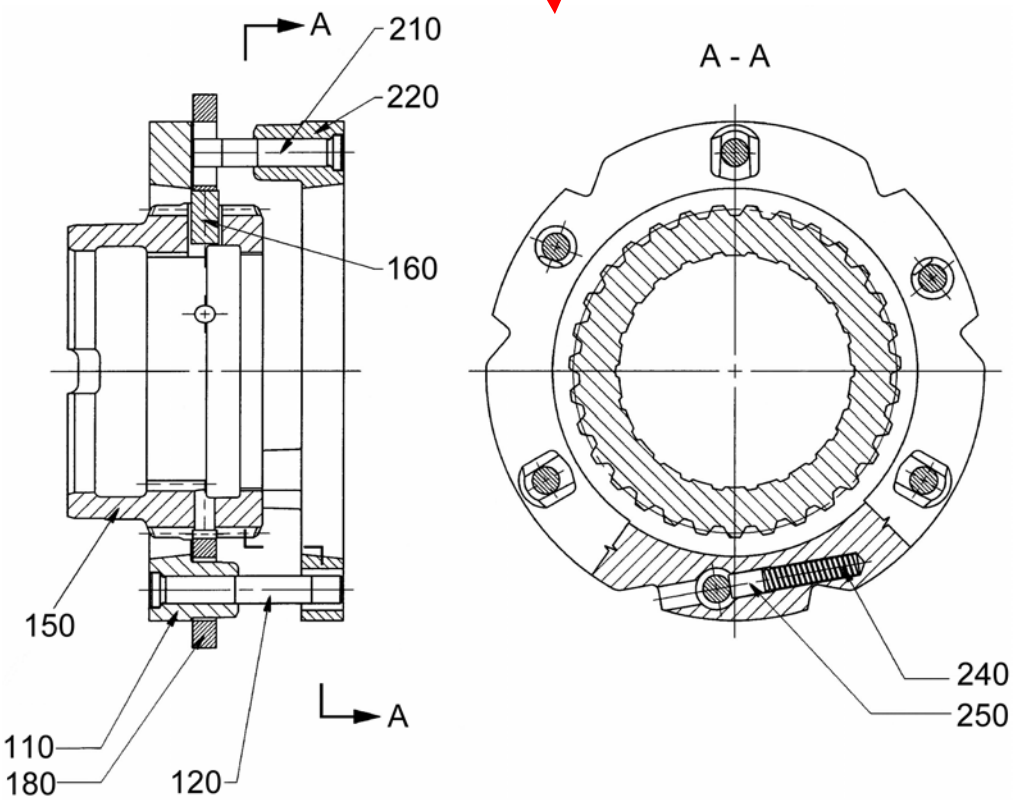
Kit order number	Version	Scope of parts identical to modular system PL	Transmission type
1314 298 007	DD (direct gear)	1314 202 089	ASTRONIC 1
1328 298 001	OD (overdrive)	1328 202 039	ASTRONIC 2
1328 298 002	DD (direct gear)	1328 202 040	ASTRONIC 2

Start data:

Modular system parts list	Model no.	Serial number	Date	Bulletin number Change to parts list
1314 202 089	1314, 1318	--	15-04-2004	3544D
1328 202 039	1327, 1329, 1337, 1338, 1339	--	15-03-2004	3543D
1328 202 040	1327 1328 1329 1338 1353	276.490 276.492 276.485 -- 301.120	17-03-2004 17-03-2004 17-03-2004 -- 27-09-2004	3545D

Sample sketch of installation situation of splitter group synchronizer unit in ASTRONIC 2 transmissions





New Housing Seals in ASTRONIC 2 Transmissions

In the past, the housing seals used on ASTRONIC 2 transmissions have involved a liquid gasketing agent. Solid seals (metal gaskets) are to be used instead in the future. The thicknesses of the metal gaskets must be taken into account in the housing assembly. New housings 2 with a reduced total length have been introduced for this purpose. There are two versions of housing 2, with different lengths.

The new components, housings and metal gaskets are being launched into volume production through parts list changes.

Measures:

The new housings are being introduced in two steps:

1st step: Introduction of housing with reduced total length, (raw part as before, see Figure 2).
2nd step: Introduction of housing with reduced total length with optimized raw part (new pressure die cast part, see Fig. 3).

The following MUST be noted during repairs:

Old housings must be fitted with **liquid gaskets,**
New housings must be fitted with **solid seals (2 metal gaskets).**

Non-compliance with this procedure will result in transmission failure!

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Components affected:

- Housing 2 (1st step)

	OLD	NEW	
Designation	**Item number**	**Item number**	**Remark**
Housing	1328 301 060	1328 301 069	Housing 2, long version
Housing	1327 301 023	1327 301 026	Housing 2, short version

- Seals

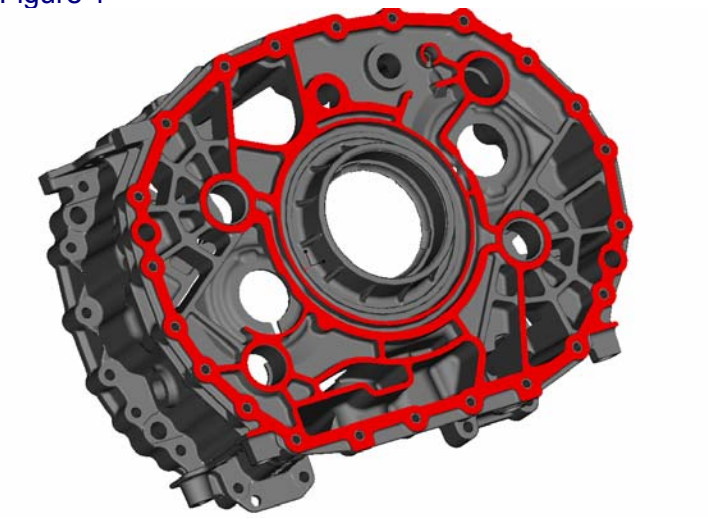
	Designation	Item number	Remark
OLD	Sealing compound	0666 791 001	Replacement part, 22 g tube
	Gasket	0666 790 040	Replacement part, 7 g tube
NEW	Seal	0501 321 442	Metal gasket, Clutch housing - housing 2
	Seal	0501 321 443	Metal gasket, Housing 2 - GP housing

Diagram of sealing face/GP thrust surface of housing 2:

- **OLD** Assembly with liquid gasket

Housing sealing face and thrust surface of GP plate at the same height

Figure 1

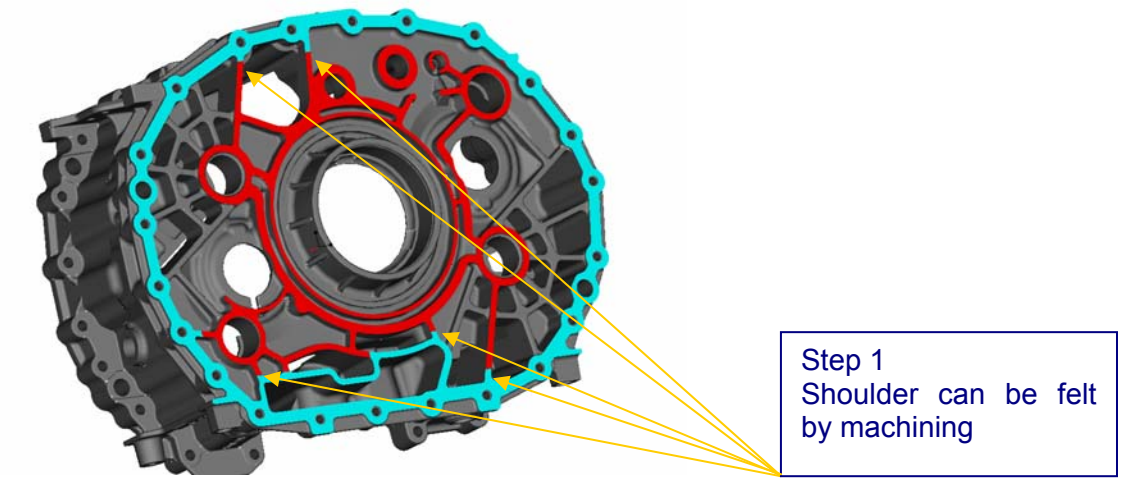


- **NEW, volume production introduction of 1st step**

Assembly with solid seal
Shoulder can be felt when machining between housing's sealing face and thrust surface of GP plate.

Blue = Housing's sealing face
Red = Thrust surface of GP plate
Date for introduction as of approx. January /February 2005

Figure 2



- **NEW, volume production introduction of 2nd step**

Assembly with solid seal

Interruption of webbing, visual division of housing's sealing face from thrust surface of GP plate.
Conversion into new pressure die cast shape.
Date of introduction approx. 3rd quarter of 2005

Figure 3

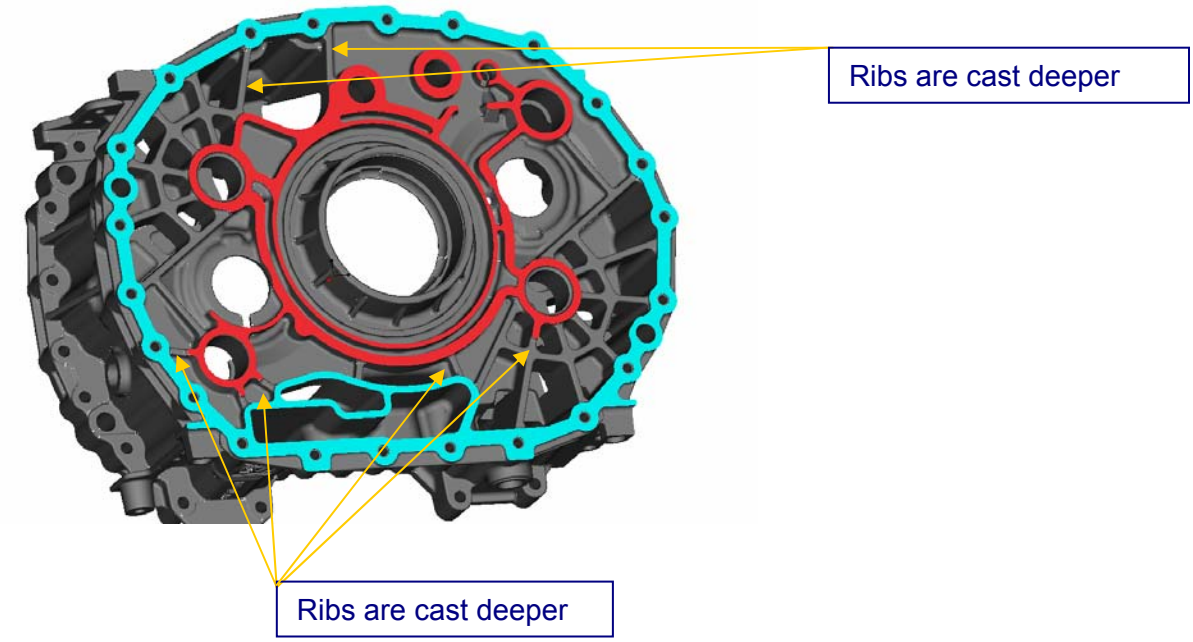


Diagram of ASTRONIC 2 transmission

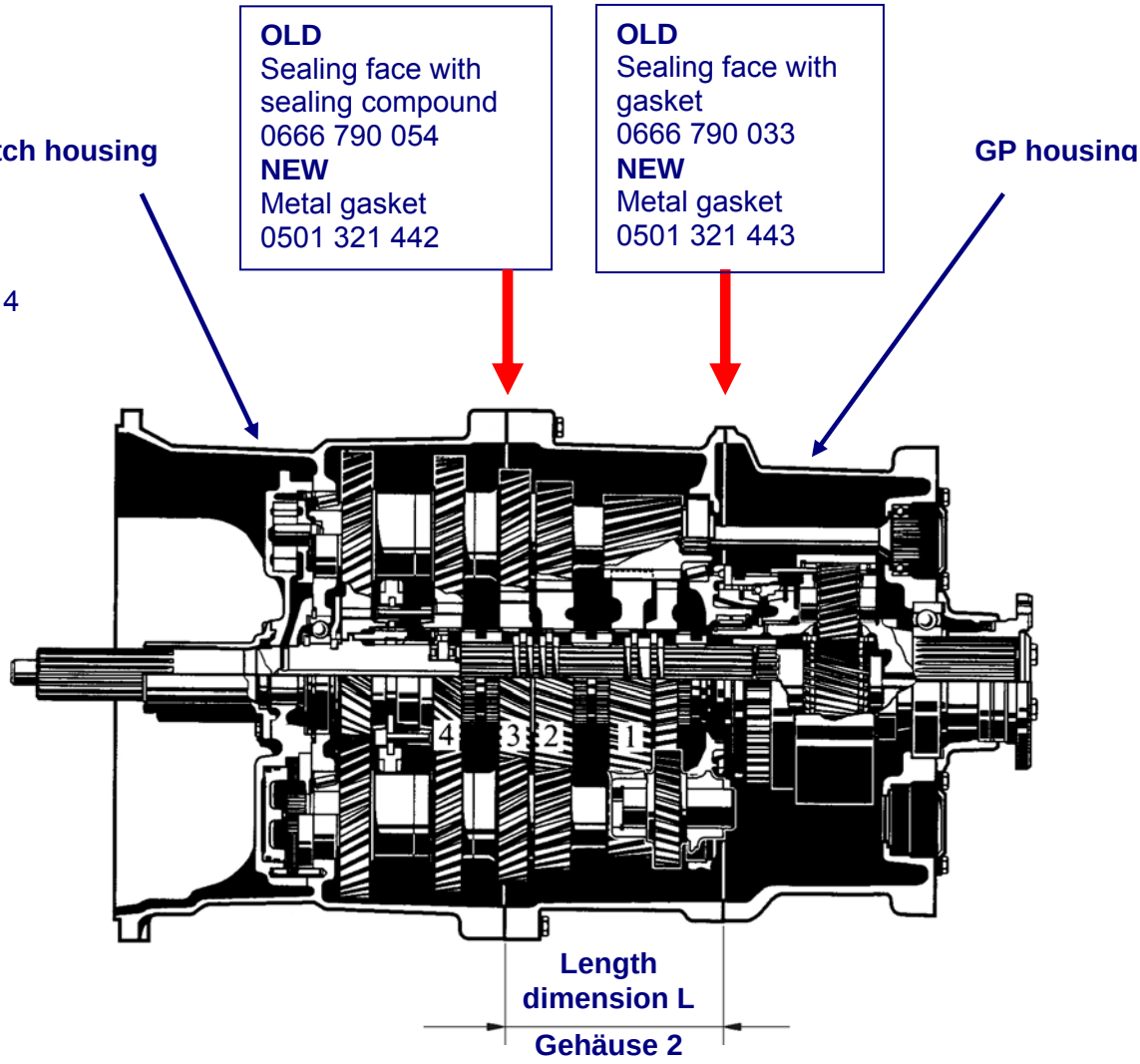


Figure 4

	Item number	Dimension L, housing 2	Remark
OLD	1328 301 060	227.5 -0.1	Housing 2, long version
	1327 301 023	184.5 -0.1	Housing 2, short version
NEW	1328 301 069	226.75 -0.13	Housing 2, long version
	1327 301 026	183.75 -0.13	Housing 2, short version

Start data:

Parts list modification for 1st step

Parts list change notification	Launch date	Remark
9723D	15.06.2005	Housing 2, long new + 2 metal gaskets
1019E	15.06.2005	Housing 2, short new + 2 metal gaskets

Spare parts:

Liquid gaskets are still available for repairs. The metal gaskets are included in the current sealing kit 1327 298 001. Old housings 2 will be used up and replaced by kits (each containing one housing 2 and two metal gaskets). Any old housings 2 still available can be used.

Kits available

New ► • **Housing 1327 298 002** consisting of:

Quantity	Designation	Order number	Remark
1	Housing	1327 301 026	Short version
1	Seal	0501 321 442	Clutch housing - housing 2
1	Seal	0501 321 443	Housing 2 - GP housing

New ► • **Housing 1328 298.003** consisting of:

Quantity	Designation	Order number	Remark
1	Housing	1328 301 069	Long version
1	Seal	0501 321 442	Clutch housing - housing 2
1	Seal	0501 321 443	Housing 2 - GP housing

• **Sealing kit 1327 298 001** consisting of:

Quantity	Designation	Order number	Remark
4	Sealing ring	0730 008 637	A 24x29
2	Sealing ring	0730 009 515	A 22x27
1	Sealing ring	0634 801 013	A 10x14
1	Seal	0501 316 322	
1	Shaft seal	0750 111 348	OTK 55x70x8
2	Shaft seal	0734 309 397	
1	Shaft seal	0734 319 459	105x125x12/9.5
1	O-ring	0634 313 805	82x4
4	O-ring	0634 313 523	13x2
1	Grooved ring	0501 318 282	71.7x6.5
1	Compression spring	0732 040 385	
2	Gasket	0666 790 040	7 g tube
1	Sealing compound	0666 791 001	22 g tube
1	Seal	1238 308 201	
2	Sealing ring	0634 801 308	A20x24
New ► 1	Seal	0501 321 442	Metal gasket
New ► 1	Seal	0501 321 443	Metal gasket

Noise reduction through axial setting of clearance for disks/shims and gears in AS Tronic transmissions

Within the context of noise reduction, we will, in the near future, enable the following settings:

- Constant gear 2 to wheel disk on the input shaft (via the OTK securing ring);
- Gears to wheel disks on the main shaft (via OTK securing ring);
- Main shaft disks to wheel disks on the main shaft (via OTK main shaft disks).

For selection purposes, technical kits (OTKs) for securing rings and main shaft disks have been introduced.

Measures:

Clearance setting for

- Constant gear 2 to wheel disk on the input shaft (via the OTK securing ring);
  is done with 12-speed and 16-speed transmissions.

- Gears to wheel disks on the main shaft (via OTK securing ring);
  is done with 12-speed and 16-speed transmissions.

- Main shaft disks to wheel disks on the main shaft;
  is only done with 12-speed transmissions.

Exception:

In the case of transmissions belonging to the model ZF Maxton (FreedomLine: 1338, 1339, and 1327 with nickel-coated disks) no setting of the main shaft disks to the wheel disks on the main shaft is done; no OTKs have yet been set up. The nickel-coated disks used so far will still be installed.

Implementation of the indicated measures only in the case of:

a) Transmissions to be repaired -> where the wheel disks and the main shaft disks have already been set;
b) Exceptional cases where noise-related complaints have been filed -> upon prior agreement with Friedrichshafen After-Sales Service, Technical Customer Service, LKS-T dept.

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Note:

The main shaft disks (item no.: 04.070, 04.210, 04.270) will not be replaced by the OTK mains haft disks. The snap ring (circlip) of the constant gear 2 on the input shaft, item no. 02.260, will not be replaced by an OTK securing ring but with the previously used snap ring no. 0730 513 973 (thickness: 2.50) (also refer to Figures 3 and 4, Page 6).

For proceedings relating to clearance setting, please refer to illustrations in the documentation.
"Technical Annual Seminar 2005, no. 04, ZF_AS Tronic in the Truck, Charts 16 to 21."

Components affected:

Main Shaft

	NEW:	OLD:	
Designation	**Part number**	**Part number**	**Comment**
Main Shaft	1327 304 032	1327 304 025	12-speed, standard, ZF Maxton (FreedomLine)
Main shaft	1329 304 012	1329 304 009	12-speed, 1329 model

OTK securing ring gears for wheel disks on the main shaft, for all 12-speed and 16-speed transmissions

		NEW:	OLD:	
Item	**Designation**	**Part number**	**Part number**	**Comment**
	Securing ring consisting of	**0769 144 299**	--	OTK (2.50 up to 2.70) Drawing no.: 0730 514 005
04.100 04.240 04.280	Snap ring Snap ring Snap ring Snap ring Snap ring	0730 513 973 0730 514 006 0730 514 007 0730 514 008 0730 514 009	0730 513 973 -- -- -- --	2.5 2.55 2.60 2.65 2.70

OTK securing ring for constant gear 2 to the wheel disk, for all 12-speed and 16-speed transmissions

		NEW:	OLD:	
Item	**Designation**	**Part number**	**Part number**	**Comment**
	Securing ring consisting of	**0769 144 298**	--	(2.50 to 2.80) Drawing no.: 0730 514 005
02.290	Snap ring Snap ring Snap ring Snap ring Snap ring Snap ring Snap ring	0730 513 973 0730 514 006 0730 514 007 0730 514 008 0730 514 009 0730 514 010 0730 514 011	0730 513 973	2.50 2.55 2.60 2.65 2.70 2.75 2.80

OTK main shaft disks to wheel disks on the main shaft, only for 12-speed transmissions (not the ZF Maxton model no.: 1338, 1339, and 1327 with nickel-coated disks)

		NEW:	OLD:	
Item	**Designation**	**Part number**	**Part number**	**Comment**
04.070 04.110 04.210 04.250 04.270 04.310	Disk consisting of	**0769 143 685**	--	(7.00 to 7.20) Drawing no. 1314 304 014
	Disk Disk Disk Disk Disk	1314 304 008 1327 304 033 1327 304 034 1327 304 035 1327 304 036	1314 304 008 -- -- -- --	7.00 7.05 7.10 7.15 7.20

OTK = optional technical kit

Start data:

The changes will be introduced into the parts list (PL) system as follows:

Model no.	Memo no. about the PL change	Interchange-ability	Date	As of prod-uct number	Comment
1329	0878E	in sets	11.08.05	343.201	MS disks
1327, 1337, 1348, 1353	0879E	in sets	11.08.05	342.936	MS disks
1327, 1338	0880E	single	24.08.05	344.117	Main shaft
1327, 1328, 1337, 1348, 1353	0881E	in sets	11.08.05	342.936	K2 – snap ring
1327, 1329, 1337, 1338, 1339, 1348, 1353	0882E	in sets	11.08.05	342.936	MS – snap ring

MS = main shaft, K2 = constant gear 2, PL = parts list

Spare parts:

Available spare parts, standard

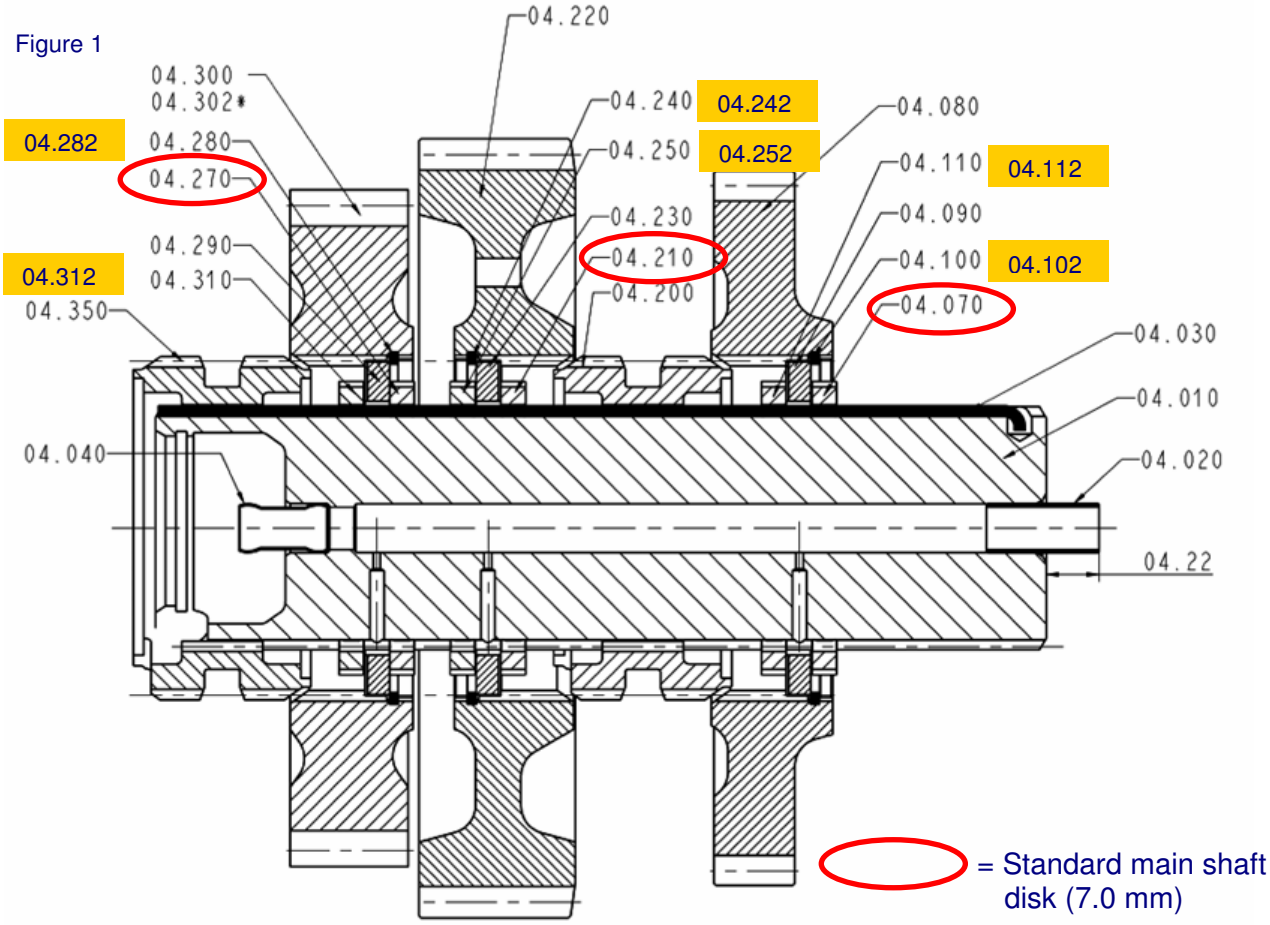
Designation	Part number	Technical information
Main shaft	1328 304 032	Replaces 1327 304 025
Main shaft	1329 304 012	Replaces 1329 304 009
OTK securing ring	0769 144 298	(2.50 to 2.80) constant gear 2
OTK securing ring	0769 144 299	(2.50 to 2.70) main shaft gears
OTK main shaft disk	0769 143 685	(7.00 to 7.20) main shaft disks

ZF Maxton, spare parts available (FreedomLine)

Designation	Part number	Technical information
Main shaft	1328 304 063	Old shaft, still to be used.
Main shaft	1327 304 032	Replaces 1327 304 025
Main shaft disk	1328 304 049	Nickel-coated disk, still to be used.

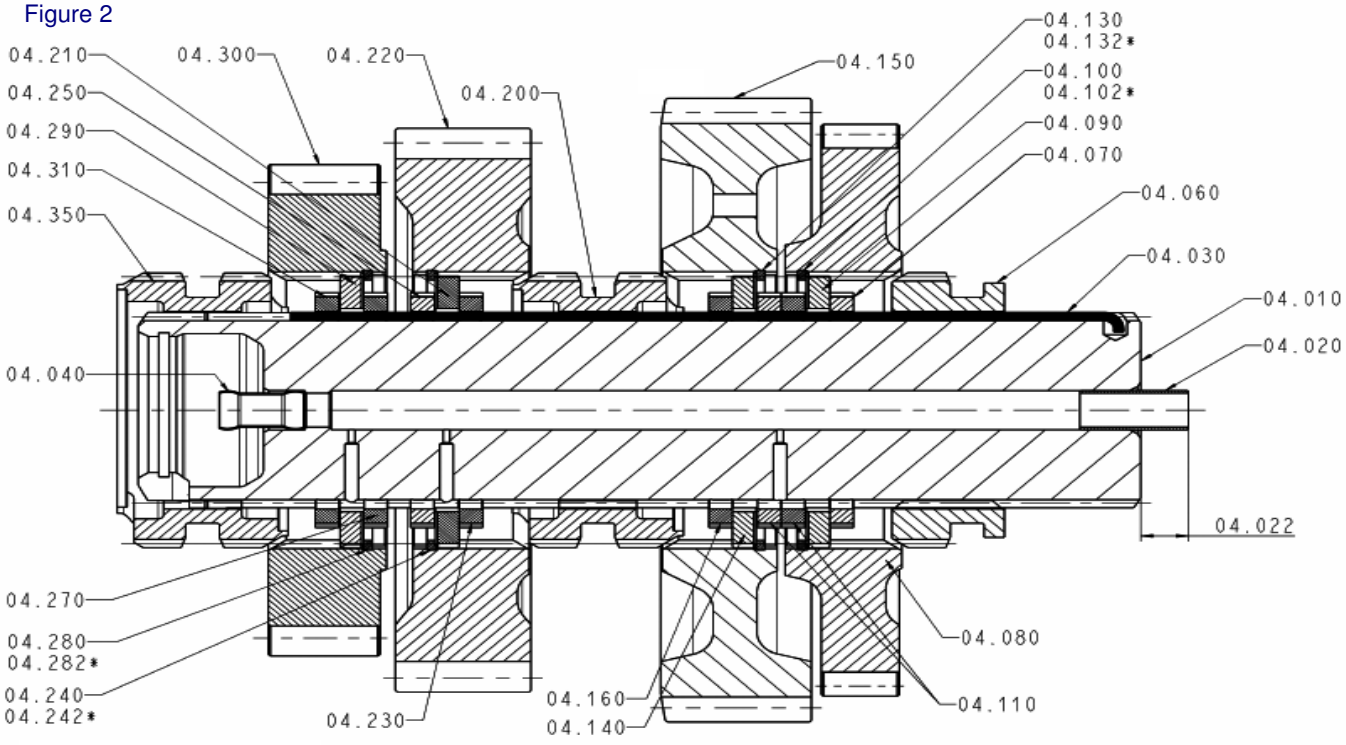
Sketch on installation situation main shaft – gears, 12-speed version

Figure 1



Sketch on installation situation main shaft – gears, 16-speed version

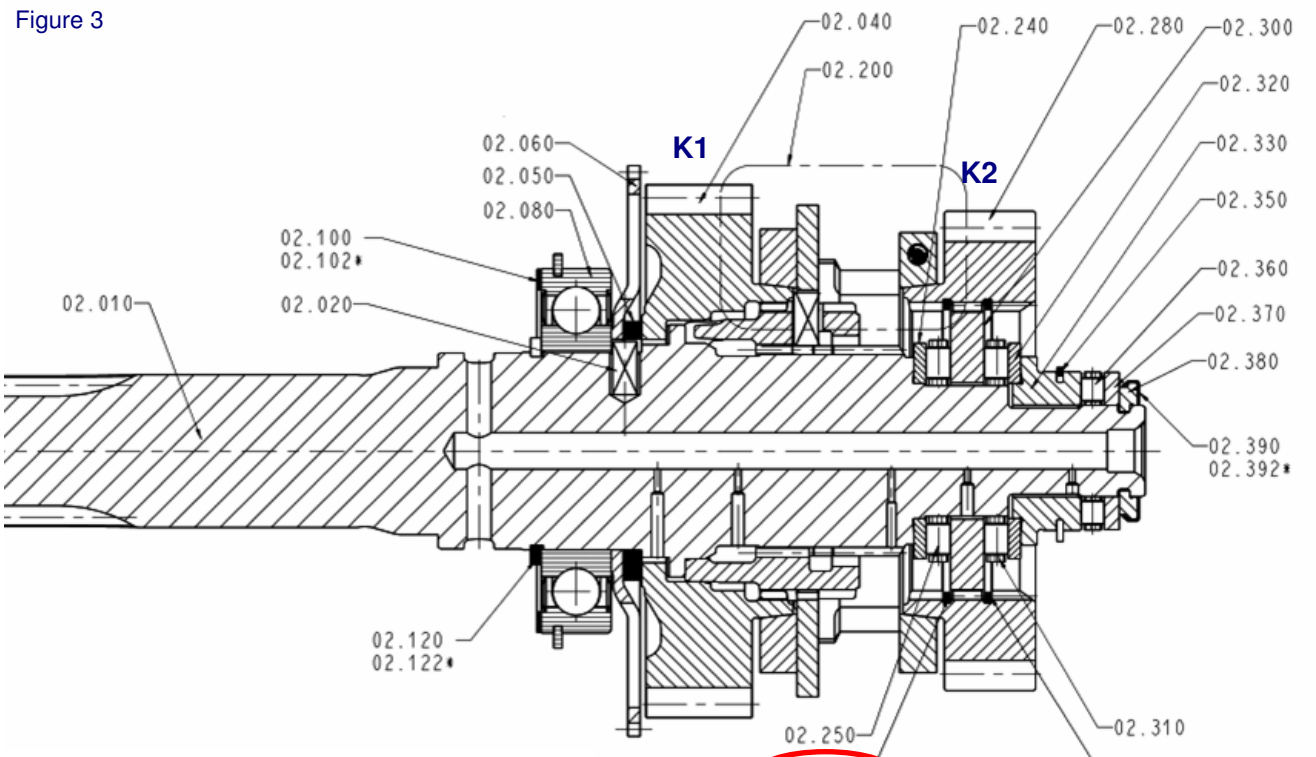
Figure 2



xx.xxx created (yellow color) and established with * / those marked item numbers do include information on clearance setting in the parts list

Sketch on installation situation input shaft constant gear 2, 12-speed version

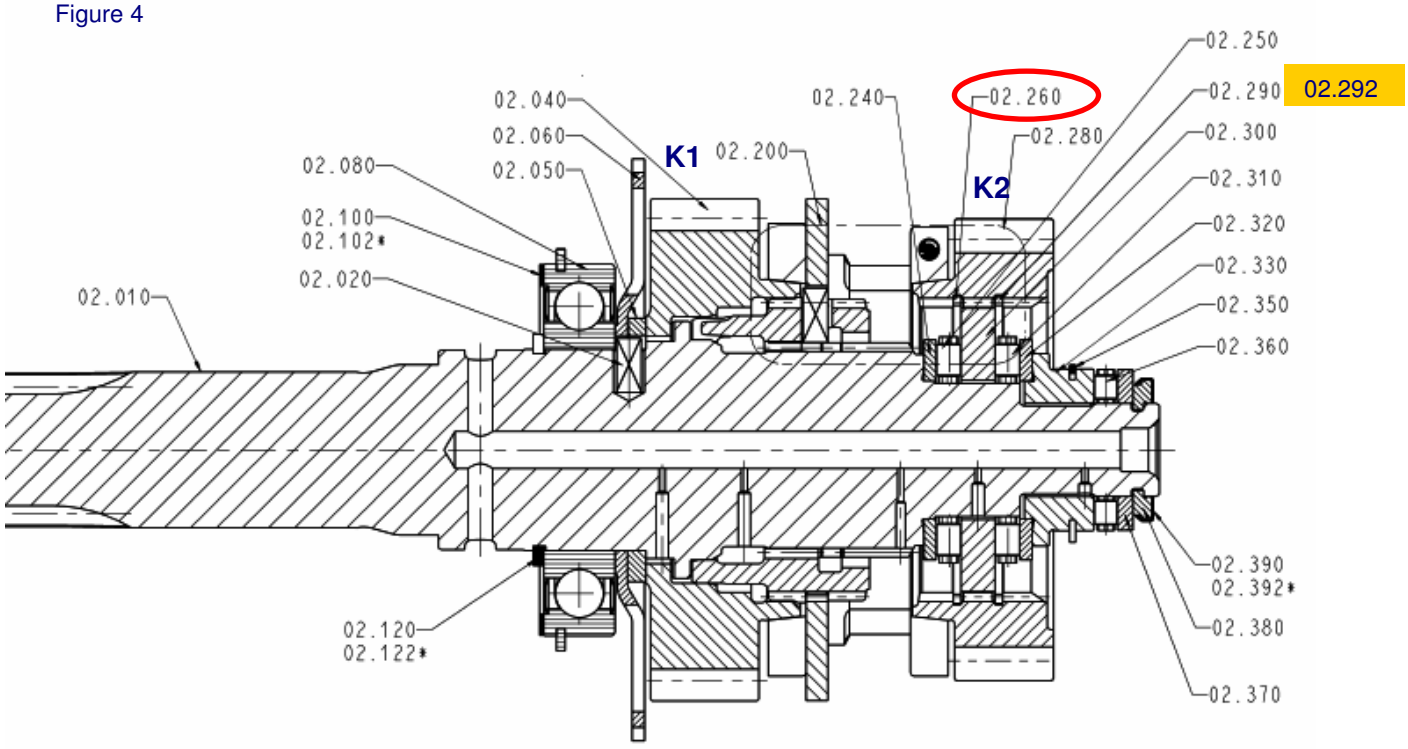
Figure 3



= Standard snap ring (2.5 mm)

Sketch on installation situation input shaft constant gear 2, 16-speed version

Figure 4



xx.xxx created (yellow color) and established with * / those marked item numbers do include information on clearance setting in the parts list

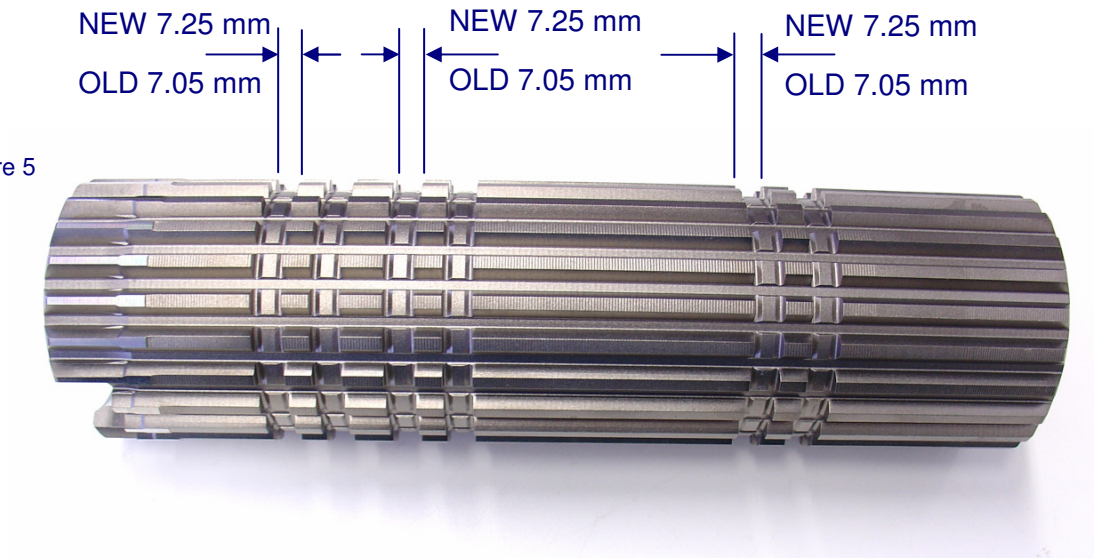
Note:

The OTKs for the main shaft disks on the main shaft are not downward compatible since the recess for the setting had to be enlarged respectively on the main shaft.

- ⇨ **Old main shaft disks** can be **mounted** to the **new main shaft**.
- ⇨ **New main shaft disks** (OTK) **cannot be mounted** to the **old main shaft**.

Changes in the nominal dimension of the groove's thickness on the main shaft no. 1327 304 032 and 1329 304 012.

Figure 5



Main shaft disk in the OTK no. 0769 143 685.

Figure 6

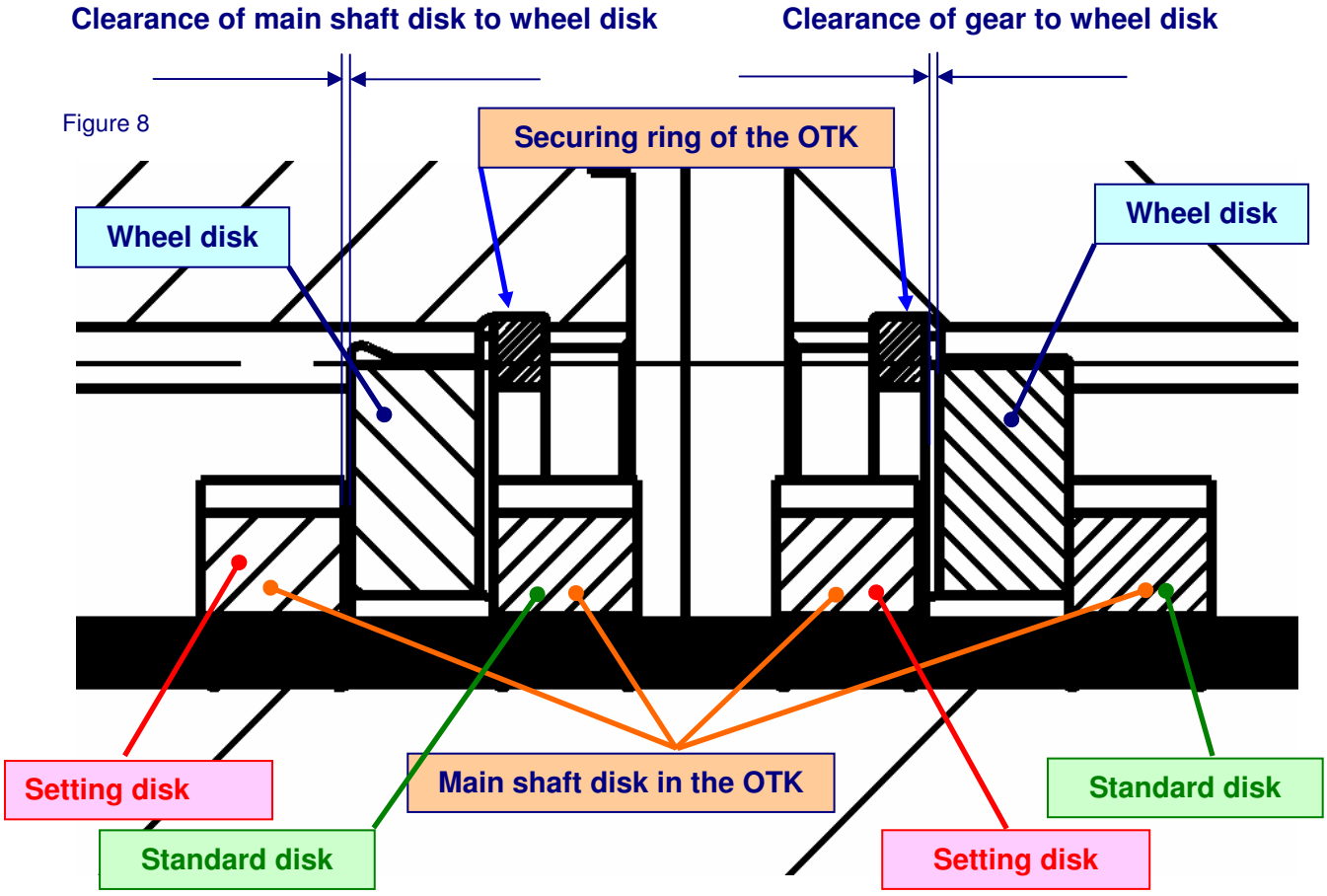
Securing ring in the OTK no. 0769 144 298 / 299.

Figure 7

Clearance settings:

Components	OLD:	NEW:	Comment
Gear to wheel disk	no setting (0.05 to 0.30 mm)	**0 to 0.10 mm**	with OTK no.: 0769 144 298 with OTK no.: 0769 144 299
Main shaft disks to wheel disk	no setting (0.20 to 0.45 mm)	**0.15 to 0.25 mm**	**Lubricating film required** with OTK no. 0769 143 685

Figure 8



Validity:

The present Service Information is valid for an unlimited period as of February 01, 2006.