Chapter: LEP

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***Approval**

The technical content of this document is approved under the authority DOA ref. EASA.21J.048

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SUMMARY OF AMENDMENTS

Content Summary of the relevant amendments in this context, but without requirement on completeness.

Current No.	chapter	page	date of change	Comment
1	00-00-00	31 - 36	10 01 2013	Illustration (special tools) added.
1	24-20-00	3,7	10 01 2013	New illustrations, new tooling (see revision bars).
		13,14-20	10 01 2013	Illustration (special tools) added.
1	76-10-00	1-28	10 01 2013	Illustration (special tools) added,
		29-36	10 01 2013	Chapter ECU revision, New Text, New Illustration
2	00-00-00	1,5-7,16	07 01 2014	Change of engine type description
2	71-00-00	8	07 01 2014	Additional text: Engine storage
2	72-10-00	1	07 01 2014	Index change
2		9 - 28	07 01 2014	Change of text and text order
2	72-30-10	11	07 01 2014	Change of measuring point
2	73-10-00	6, 8	07 01 2014	Change of fuel pressure parameter
2	74-20-00	14	07 01 2014	Work step added
2		16	07 01 2014	Caution added
2	75-00-00	1,8,19, 20	07 01 2014	Cooling air-duct (optional): Removal/Installation added
2	76-10-00	15-42	07 01 2014	Installation regulator corrected
2		35	07 01 2014	Work step + Figure added
2	76-50-00	14	07 01 2014	Fig. 28: legend corrected
2		21	07 01 2014	Caution added
2	79-00-00	5	07 01 2014	Figure updated
2		13	07 01 2014	Tolerances corrected
2		24	07 01 2014	General text corrected
3	72-10-00	7-32	07 01 2018	New gear cover assy. with oil spray nozzle
3	76-10-00	39	07 01 2018	Correction of fuse amperage

NOTES

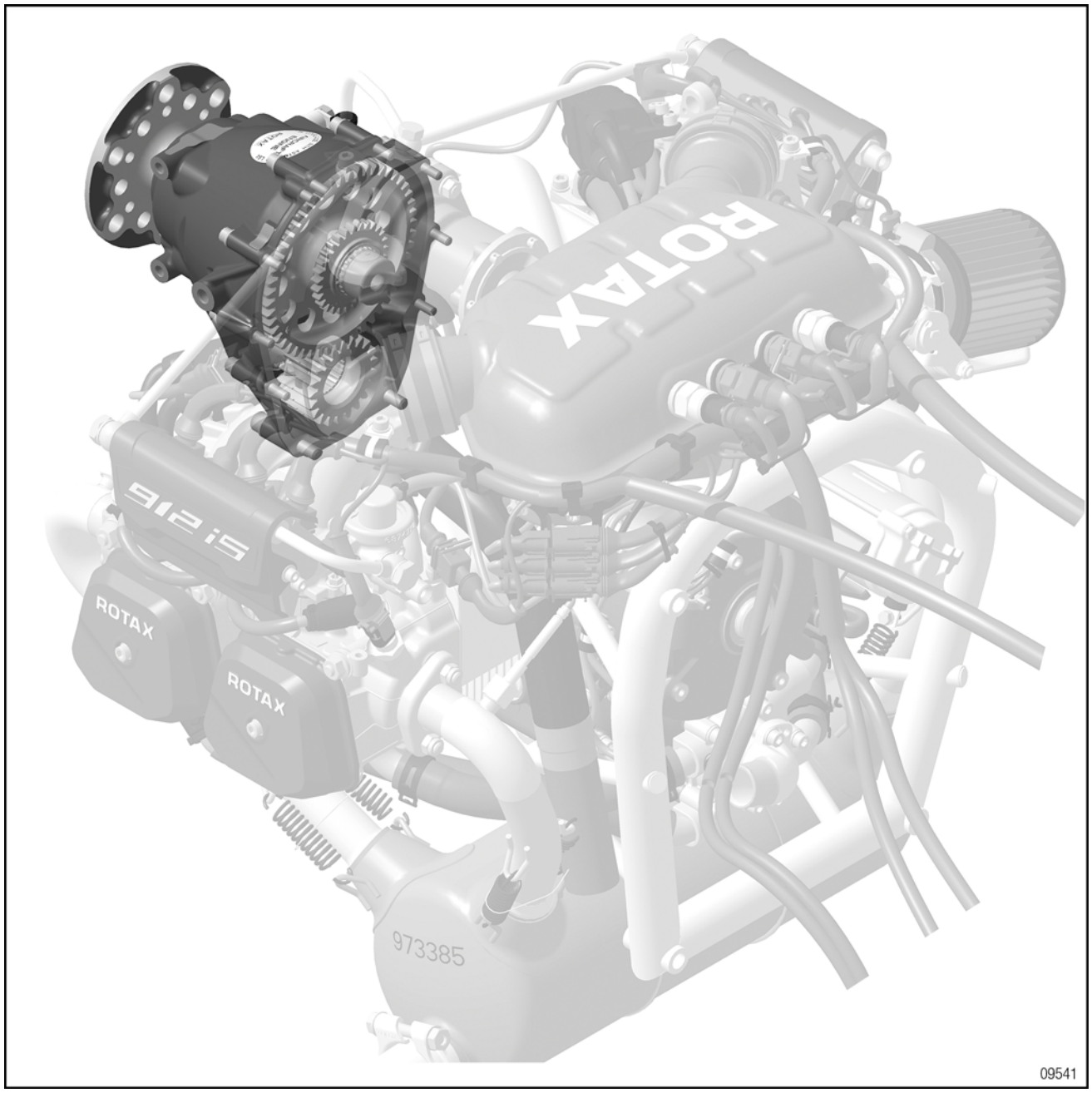
Chapter: 72-10-00

PROPELLER GEARBOX

Introduction

This section describes the maintenance of the ROTAX 912 i Series gearbox. The description is divided into sub-regions and explanations of system functions.

Location on the engine



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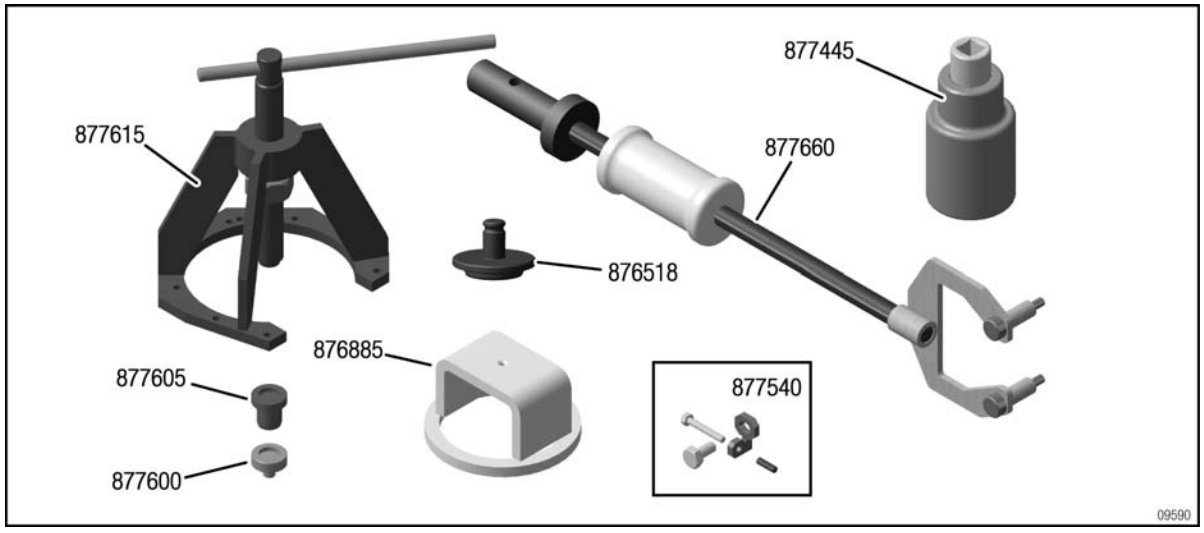
PROPELLER GEARBOX

SPECIAL TOOLS

Description	Part no.
Hot air gun	n.a.
Insert SW 41	877445
Puller	877660
Pushing jig assy.	877540
Mounting yoke	876885
Fixture	n.a.
Circlip pliers	n.a.
Extractor	877615
Press-out mushroom (version 3)	877600
Press-out mushroom (version 2)	877605
Insertion jig	876518

SERVICE PRODUCTS

Description	Part no.
Engine oil	n.a.
LOCTITE 243	897651
LOCTITE 648	899788
LOCTITE 5910	899791
LOCTITE 7063	n.a.
LITHIUM-BASE GREASE	897330



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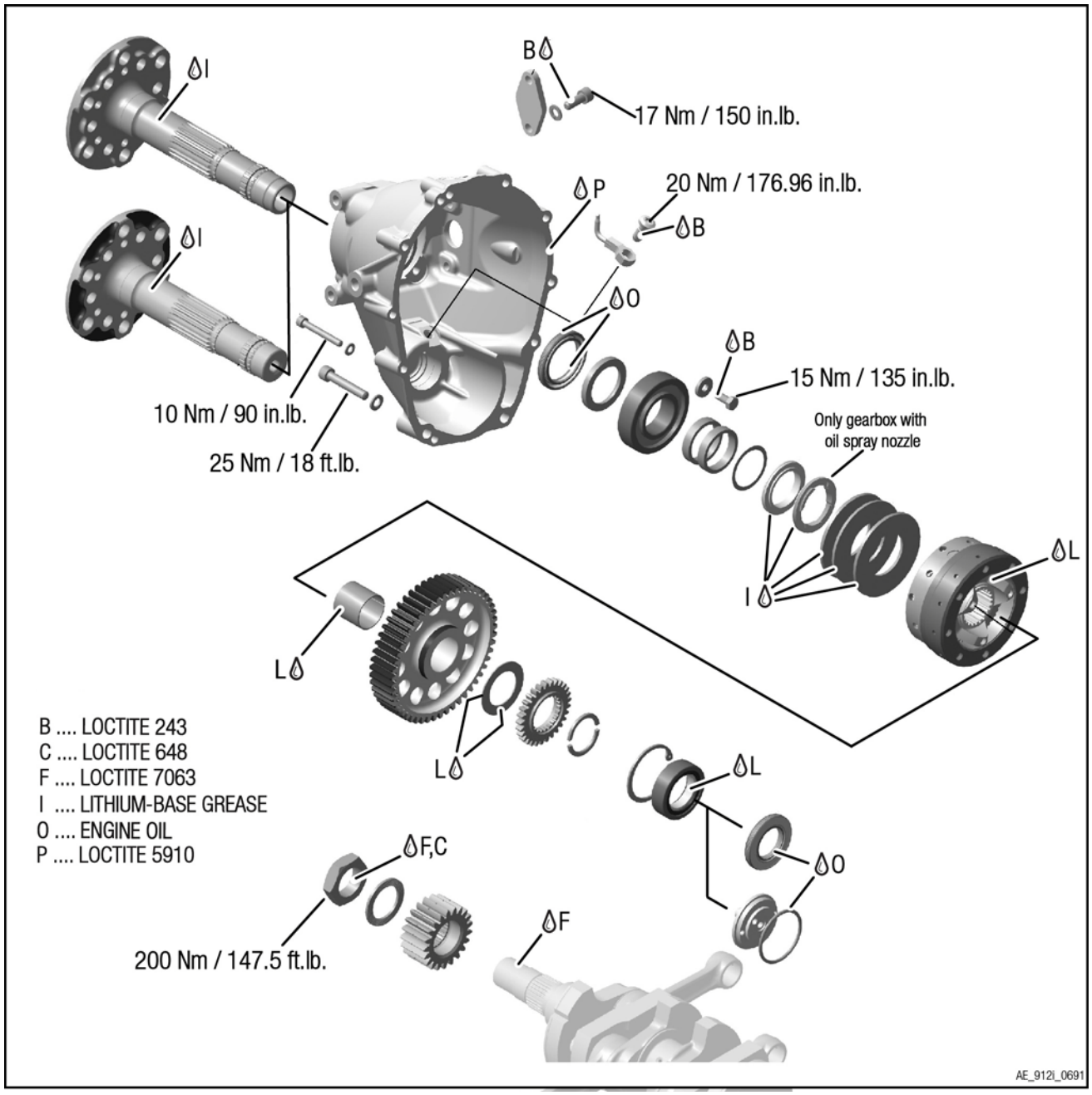
Components



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SYSTEM DESCRIPTION

The propeller shaft is driven by the crankshaft by means of a linear helical gear unit. Gear ratio Crankshaft : propeller shaft 2.43 : 1.
The propeller gearbox has a damping means to counteract torsional vibrations. This consists of torsional shock absorption by means of contoured dogs with axial spring loading by disc springs.

NOTE: This overload clutch also protects the crankshaft from overloading if the propeller comes into contact with the ground.

SAFETY INSTRUCTIONS

⚠ WARNING

Danger of severe burns and scalds! Always allow the engine to cool down to ambient temperature before starting any work.

⚠ WARNING

During work on the engine there is a risk of life-threatening injuries from the propeller and rotating parts in the engine!

- Ensure that the ignition is switched off!
- Disconnect the battery
- Prevent the engine from being unintentionally switched on!

CONNECTIONS FOR DISPLAY SYSTEMS

NOTICE

Follow the instructions in the installation manual regarding connections for instrumentation.

MAINTENANCE

As well as the maintenance and special checks, see the relevant Maintenance Manual Line for the respective 912 i Series engine type.

REMOVAL

REMOVAL OF THE PROPELLER GEARBOX

Preparation

Before the propeller gearbox is removed, the work described below must be carried out to identify any further malfunctions in the propeller gearbox and rectify them as part of repair work.

NOTICE

If these checks are omitted, it may be necessary to dismantle the propeller gearbox again to rectify any faults after it has been repaired.

- General visual inspection. See relevant Maintenance Manual Line for the 912 i Series engine type.
- Engine cleaning. See relevant Maintenance Manual Line for the 912 i Series engine type.
- Carry out an engine test run. See relevant Maintenance Manual Line for the 912 i Series engine type.
- Remove surrounding assemblies and detach oil lines.

NOTE: The assemblies and lines are only to be removed if necessary and only as far as is necessary!

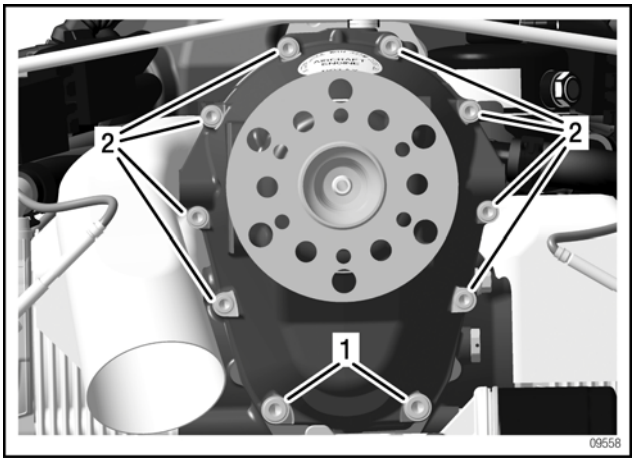
Step	Procedure
1	Fix the crankshaft into place. See relevant Maintenance Manual Line for the respective 912 i Series engine type.
2	Loosen eight M6 Allen screws and two M8 Allen screws together with the washers from the gear cover diagonally from each other. The gear cover is held in place with two dowel pins.

Step	Procedure
3	Install puller part no. 877660 onto the two M8 threaded bolts of the gear cover.
4	The entire propeller gearbox can now be tapped off with the handle without damaging the ball bearing or propeller shaft.

NOTICE

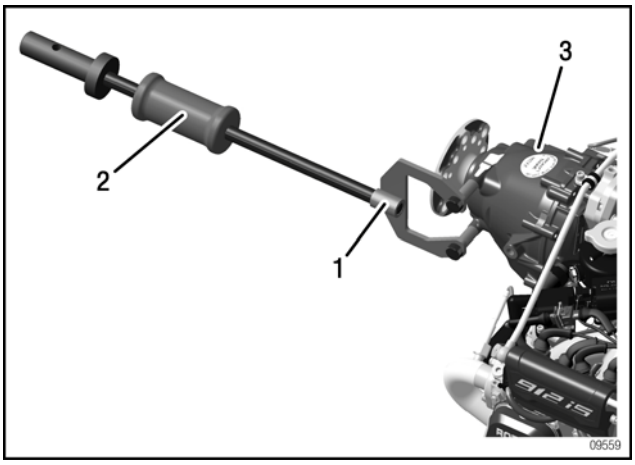
When removing the propeller gearbox, take care not to damage the bearing point and the oil seal running surface (on the roller bearing side) of the propeller shaft.

Fig. 1



1. M8 Allen screw *2. M6 Allen screw*

Fig. 2



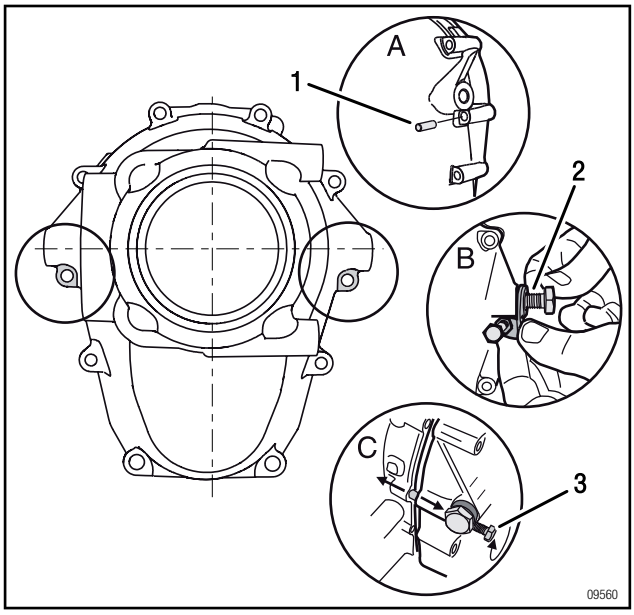
1. Puller part no. 877660 *2. Handle*
3. Gear cover

NOTE: If desired, the optimised special tool part no. 877540 can be used to remove the propeller gearbox.

See Fig. 3.

Step	Procedure
1	Insert the 8x20 dowel pin into the bore on the right and left of the gearbox housing.
2	Install M6x40 hex. screw into the pushing jig assy..
3	Put the pushing jig assy. in the center and fix it with a M10x20 hex. screw.
4	Using the hex. screw, press the gearbox housing off from the crankcase simultaneously on the right and left.

Fig. 3



1. 8x20 dowel pin *2. M10x20 hex. screw*
3. M6x40 hex. screw

DRIVE GEAR - REMOVAL

NOTICE

The gear set has a continuous 6-digit serial number which is marked on the drive gear and on the end of the dog gear. The gears are in pairs and must not be mixed up!

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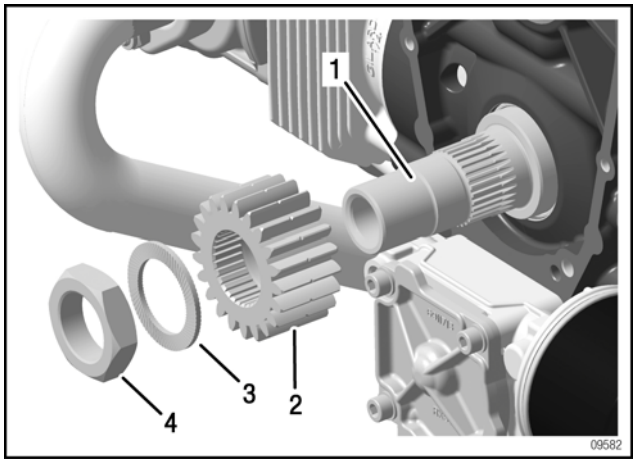
Step	Procedure
1	Heat the M30x1.5 hex. nut with the hot air gun (100-120 °C) (212 °F-248 °F).
2	Loosen M30x1.5 hex. nut with wrench socket SW 41 part no. 877445. NOTE: The hex. nut has a left handed thread!
3	Remove the drive gear and the friction washer from the crankshaft. NOTE: If necessary, carefully press off the drive gear with 2 screw-drivers.

Fig. 4



1. Crankshaft
2. Drive gear
3. Friction washer
4. M30x1.5 hex. nut

DISASSEMBLY

DISASSEMBLY OF THE PROPELLER GEARBOX

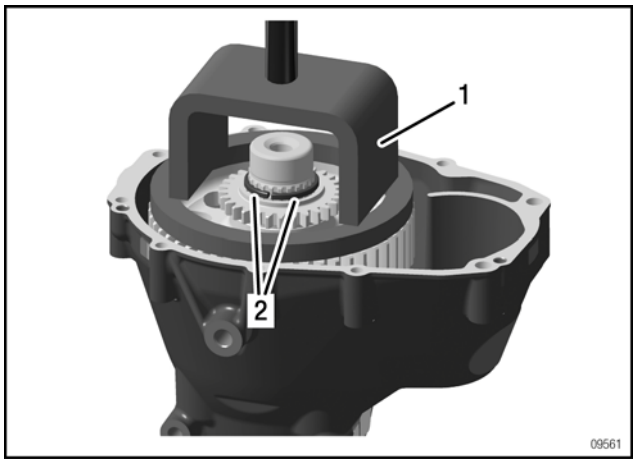
See Fig. 5.

NOTICE

Push the dog gear down only until the ring halves can be taken out, otherwise the gearbox housing can be damaged. The gear cover must be freely rotatable!

Step	Procedure
1	Place the entire gearbox into a suitable fixture and press down the gear with the mounting yoke part no. 876885 until the ring halves can be taken out.

Fig. 5



1. Mounting yoke part no. 876885
2. Ring halves

NOTICE

Do not over-stretch the bearing bushing, otherwise it will become unusable.

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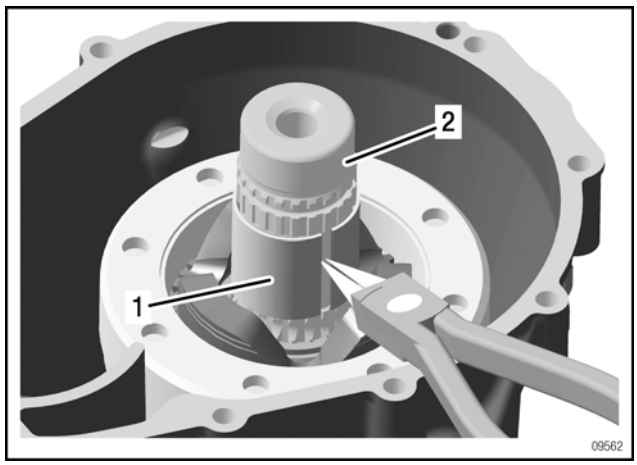
Fig. 6



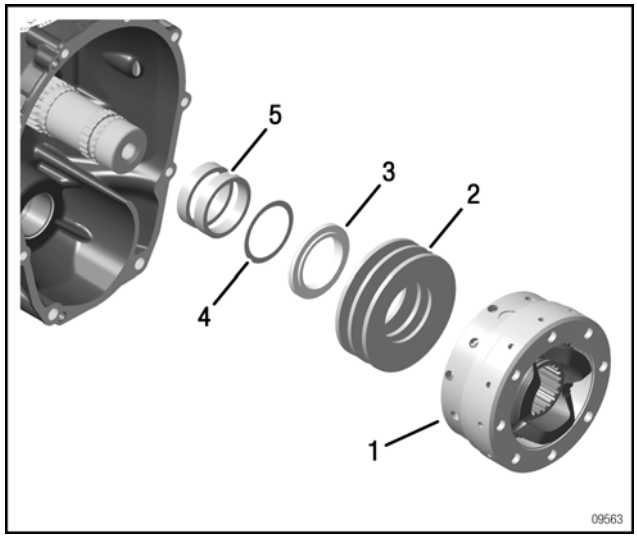
1. Bearing bushing *2. Propeller shaft*

Step	Procedure
2	Remove the clutch assy., 80x35x3 disc spring, step collar, 35.4/43/1 compensating shim and 35.2/42/8 distance sleeve.

NOTICE

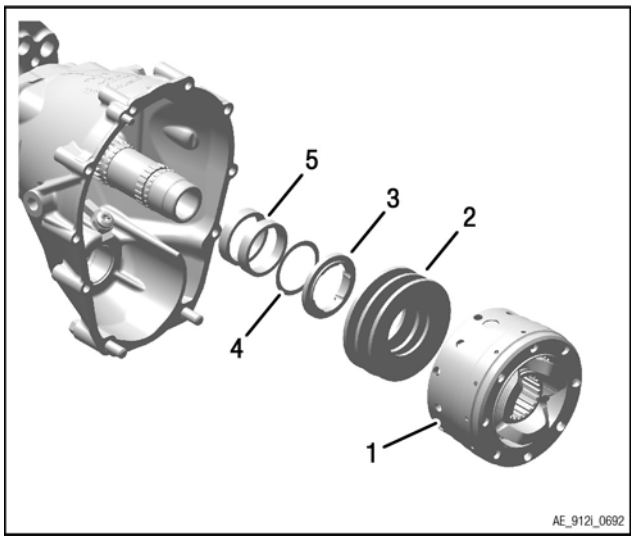
The overload clutch is built in as standard in all certified and non-certified aircraft engines.

Fig. 7



Propeller gearbox with oil spray nozzle:

Fig. 8



1. Clutch assy. *2. Disc springs*
3. Step collar *4. Compensating shim*
5. Distance sleeves

REMOVAL OF THE PROPELLER SHAFT

NOTICE

If the propeller shaft is removed, the oil seal and the deep groove ball bearing must be replaced (see Fig. 10 and/or Fig. 11)!

Step	Procedure
1	Place the gearbox housing on a suitable support.
2	Press out the propeller shaft with an extractor part no. 877615.

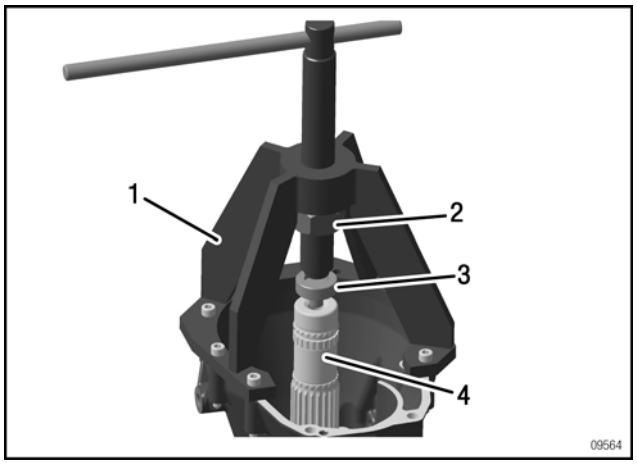
NOTICE

The protection piece (press-out mushroom part no. 877605 or 877600) must be used, otherwise the machined inner diameter of the propeller shaft will be damaged.

NOTE: Alternatively, the hand press can also be used to press out the propeller shaft.

Step	Procedure
3	Screw the extractor onto the gearbox housing with six M6 Allen screws and place press-out mushroom part no. 877605 (for version 2) or press-out mushroom part no. 877600 (for version 3) onto the end of the propeller shaft as protection.
4	Place the pull-in spindle into the extractor support and screw the M24x1.5 hex. nuts onto the spindle from the inside.
5	Held with the spanner, the propeller shaft is pushed out of the gearbox housing by turning the spindle clockwise.

Fig. 9



1. Extractor *2. M24x1.5 hex. nut*

3. Press-out mushroom *4. Propeller shaft*

REMOVAL OF THE DEEP GROOVE BALL BEARING

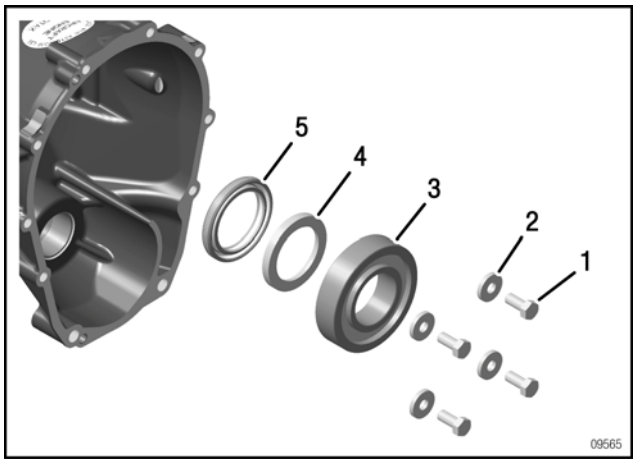
After the propeller gearbox has been removed, the propeller shaft bearing on the crankcase side and the oil seal must be replaced.

NOTICE

The shaft seal is damaged in the process and must therefore be replaced.

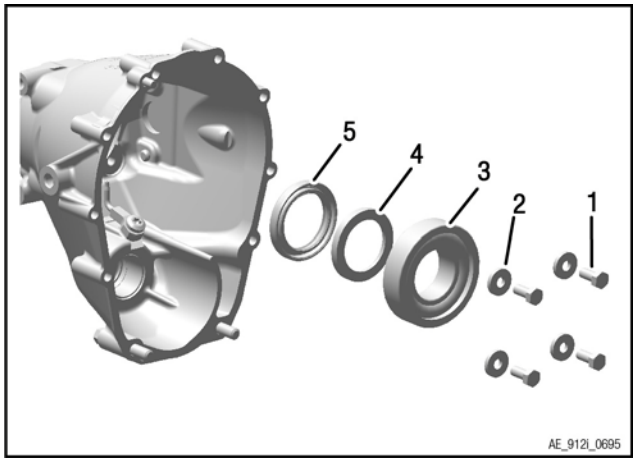
Step	Procedure
1	Loosen 4 M7x16 hex. screws with washers from the gearbox housing.
2	Heat the gearbox housing about 100 to 120 °C (212 °F - 248 °F) and press the deep groove ball bearing together with the oil seal and spacer ring inwards with a suitable insertion jig.

Fig. 10



Propeller gearbox with oil spray nozzle:

Fig. 11



1. M7x16 hex. screw *2. 7.2/18.8/3 washer*

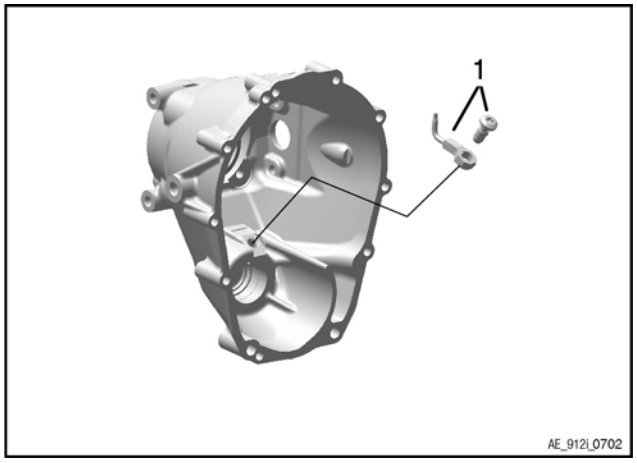
3. Ball bearing 6207 E THNC3 *4. 36/50/5.5 spacer ring*

5. Oil seal AS 40x55x7 FPM

REMOVAL OF THE OIL SPRAY NOZZLE

Step	Procedure
1	Loosen the banjo bolt M8x1with Torx T40.

Fig. 12



1. Oil spray nozzle assy.

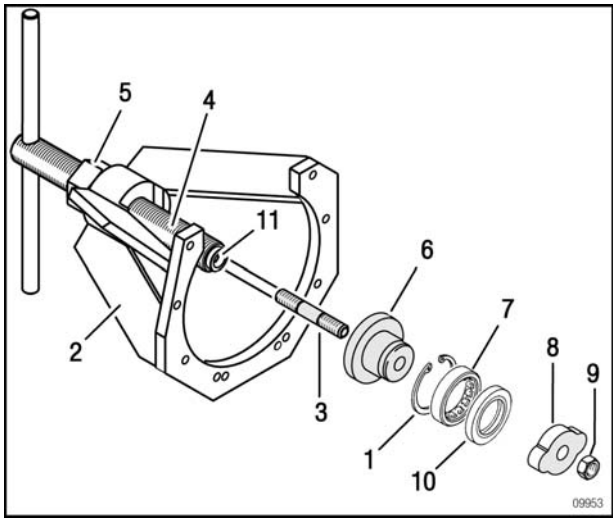
REMOVAL OF THE ROLLER BEARING, VERSION 2

Preparation

- Propeller gearbox must be dismantled in order to remove the roller bearing.
- Remove governor flange.

Step	Procedure
1	Remove retaining ring with circlip tires.
2	Attach extractor part no. 877615 with 8 allen screws M6x25 to the crankcase.
3	Install hex. screw M10x45/20 part no. 941180 into the pull-in spindle part no. 877580 and fix hex. nut M24x1,5 onto the pull-in spindle.
4	For better guidance, place the press-in insert part no. 877592 into the roller bearing.
5	Place the pull-in spindle into the extractor and through the crankcase.
6	On the rear side of the crankcase, push the pullout plate part no. 877560 onto the hex. screw and attach with the hex. nut M10 part no. 242091.

Fig. 13



1. Retaining ring *2. Extractor part no. 877615*
3. Hex. screw M10x45 *4. Pull-in spindle*
5. Hex. nut M24x1,5 *6. Press-in insert part no. 877592*
7. Roller bearing *8. Pullout plate part no. 877560*
9. Hex. nut M10 *10. Oil seal*
11. Spindle

Schritt	Vorgehen
7	Keep pull-in spindle in position with the handle lever and turn the hex. nut clockwise until the roller bearing with oil seal is pulled out of housing.
8	Loosen hex. nut, remove pullout plate with roller bearing and oil seal and withdraw spindle. Unscrew extractor from housing.

NOTICE

The oil seal is damaged in the process and must therefore be replaced.

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REMOVAL OF THE ROLLER BEARING - VERSION 3

Preparation

- The propeller gearbox must be removed so that the roller bearing can be removed.
- Remove the governor flange.

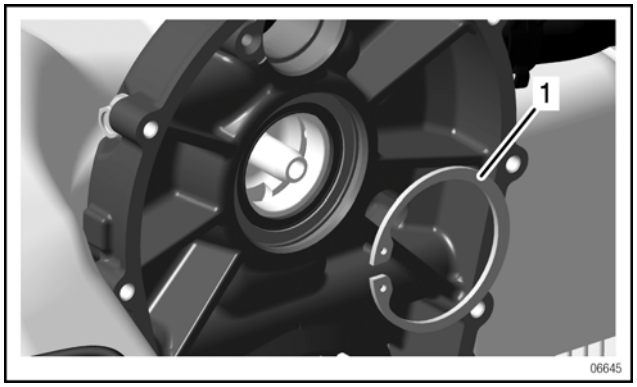
NOTICE

The pressing out process for version 3 with the hydraulic governor is different from that for versions 2 and 4. The roller bearing is pressed out together with the oil inlet flange.

See Fig. 14 to Fig. 15.

Step	Procedure
1	Remove the retaining ring with the circlip pliers.
2	Put on puller part no. 876489 and push the hex. screw through the cap, roller bearing and oil inlet flange.

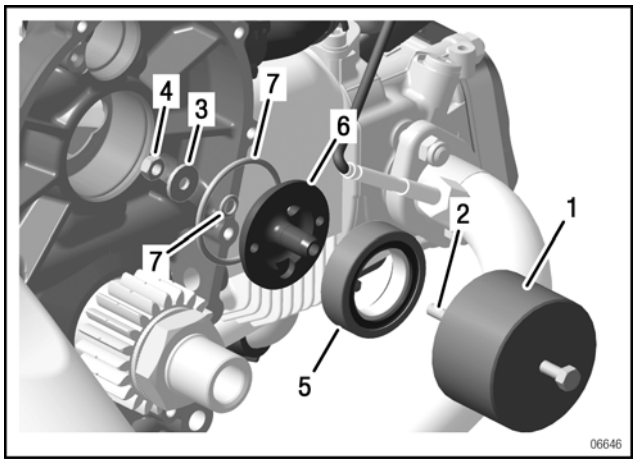
Fig. 14



1. Retaining ring

Step	Procedure
3	Install the washer and nut on the rear.
4	The roller bearing is pressed out together with the oil inlet flange by turning the hex. screw clockwise.
5	Remove the O-rings.

Fig. 15



1. Puller part no. 876489
2. Hex. screw
3. Washer
4. Hex. nut
5. Roller bearing
6. Oil inlet flange
7. O-rings

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INSPECTION

PROPELLER GEARBOX SINGLE PARTS CHECK

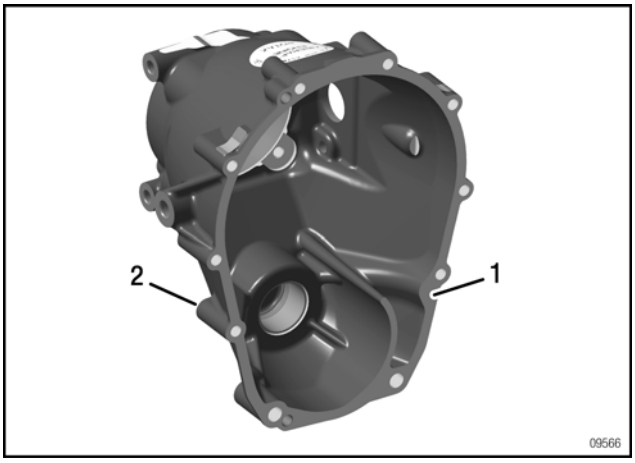
Preparation

- Clean all parts carefully.

GEAR COVER ASSY. CHECK

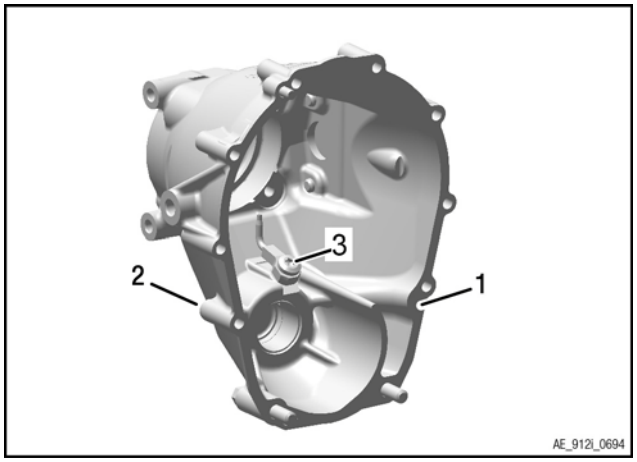
Step	Procedure
1	Inspect the gear cover for cracks using a dye penetrant method or magnetic particle method. NOTE: Only carry out in the case of ground contact!
2	Inspect gear cover for damage. - Depressions and scratches outside flat and sealing surfaces up to a maximum of 0.5 mm in depth and 2 mm in diameter are permissible. - Traces of corrosion and pitting outside sealing surfaces up to a maximum of 0.3 mm in depth and 2 mm in diameter are permissible.
3	Inspect contact surfaces for Allen screws. - Indentations up to a maximum of 0.2 mm are permissible. - Bumps up to a maximum of 0.2 mm are permissible.

Fig. 16



Propeller gearbox with oil spray nozzle:

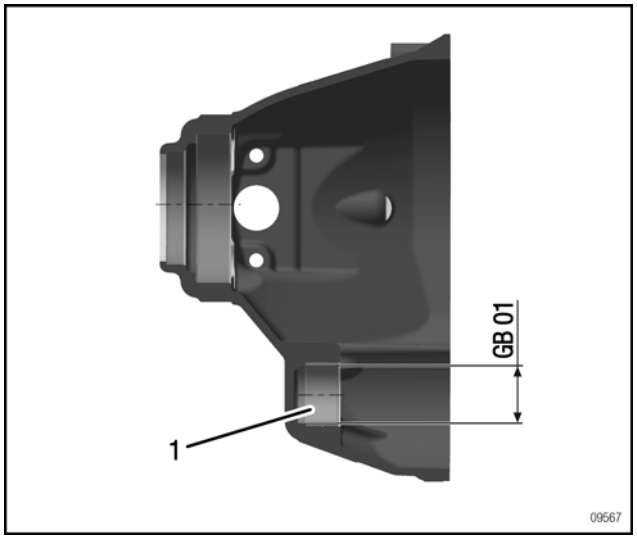
Fig. 17



1. Flat sealing surfaces *2. Contact surfaces*
3. Oil spray nozzle assy.

Step	Procedure
4	Inspect the oil spray nozzle for blockage and bending. Check the correct position of the jet.
5	Inspect that the bearing bushing for supporting the crankshaft in the gear cover is secure and measure dimension (GB01). See also section 72-10-00 Wear limits.

Fig. 18



1. Bearing bushing

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PROPELLER SHAFT - INSPECTION

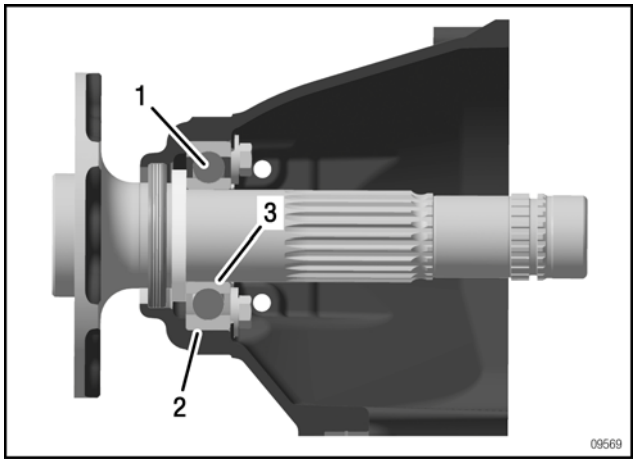
NOTICE

The entire propeller shaft including fastening bores must be free from corrosion; there must be no fretting corrosion at the bearing points either.

Step	Procedure
1	Measure both bearing points. See also section 72-10-00 Wear limits.
2	Roll the propeller shaft and check for runout. Check the axial runout of the propeller flange. See section 72-10-00 Wear limits.
3	Check the oil seal running surface.

NOTE: The ball bearing must have an interference fit between the outer ring and the gearbox housing, and between the inner ring and the propeller shaft. See also section 72-10-00 Wear limits.

Fig. 19

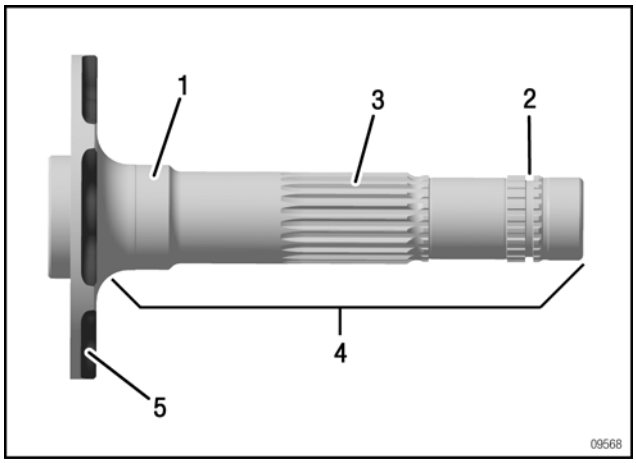


1. Ball bearing *2. Outer ring*

3. Inner ring

Step	Procedure
4	Check the groove for the retaining rings and gear-tooth system for wear and damage.

Fig. 20



1. Oil seal running surface *2. Groove for retaining rings*

3. Gear-tooth system *4. Propeller shaft*

5. Propeller flange

Version 3.

Step	Procedure
1	Measure the inner diameter of the propeller shaft in the vicinity of the oil inlet flange. Dimension. See also section 72-10-00 Wear limits. NOTE: It is not the dimensions GB05 or GB06 which are important, but the backlash GB05/GB06.
2	Check the propeller shaft for cracks. See section 00-00-00. The results of the magnetic particle crack check must be entered in the form provided.

Treatment of corrosion damage and surface damage on the propeller flange.

See Fig. 20.

The flange of the propeller shaft is susceptible to flash rust. After the propeller shaft has been covered with an adhesive plastic tape or a plastic tubetube, the propeller flange can be treated with a blasting medium.

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NOTICE

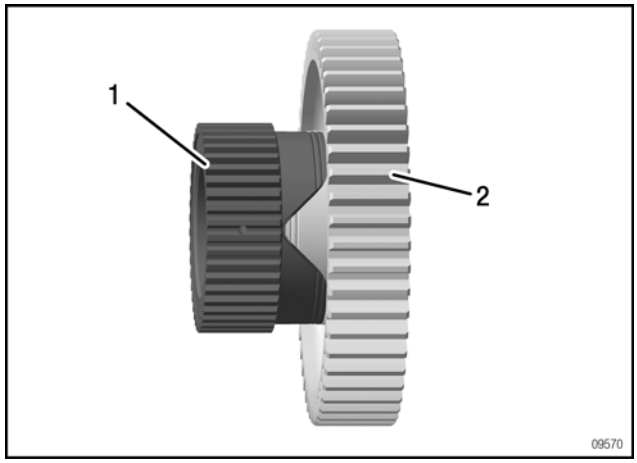
To apply the protective paint, carefully cover the flange surface, fastening bores and the propeller shaft.

To prevent corrosion damage, the rear of the propeller flange should be coated with a layer of anti-corrosion paint.
In the event of more severe corrosion damage which has affected the material, the propeller shaft must be replaced.

DOG HUB CHECK

Step	Procedure
1	Visually check the dog hub for visible pitting on the gear-tooth system and/or in the engagement faces of the dogs; see section 72-10-00 Wear limits. (GB08) NOTE: The cam peaks of the gear must never rest in the trough of the dog hub.
2	Measure the gap between the cam peak and the cam trough; see section 72-10-00 Wear limits. (GB07) NOTE: Slight to moderate traces of wear and pitting on the dogs are permissible.

Fig. 21

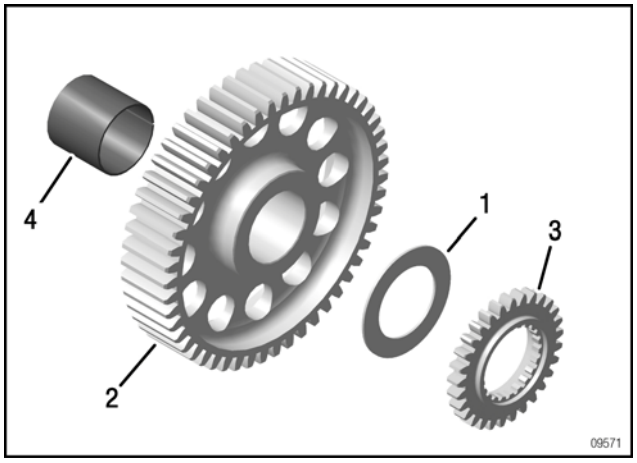


1. Dog hub *2. Gear (propeller shaft)*

THRUST WASHER CHECK, BEARING BUSHING CHECK

Step	Procedure
1	Measure the thickness of the plastic thrust washer between the gear set and the drive gear; see section 72-10-00 Wear limits. (GB11)
2	Check the heat-treated steel bearing bushing for wear.

Fig. 22



1. Thrust washer *2. Gear (propeller shaft)*
3. 29T drive gear *4. Bearing bushing*

STEP COLLAR CHECK, DISC SPRING CHECK

Step	Procedure
1	Check the step collar in the vicinity of the disc spring support for wear.
2	If wear of the disc springs is visible in the contact area, replace the disc springs. Inspect the dimension (GB13) of the non-tensioned disc spring; see section 72-10-00 Wear limits.

NOTE: The step collar for gearbox with oil spray nozzle has recesses in bore.

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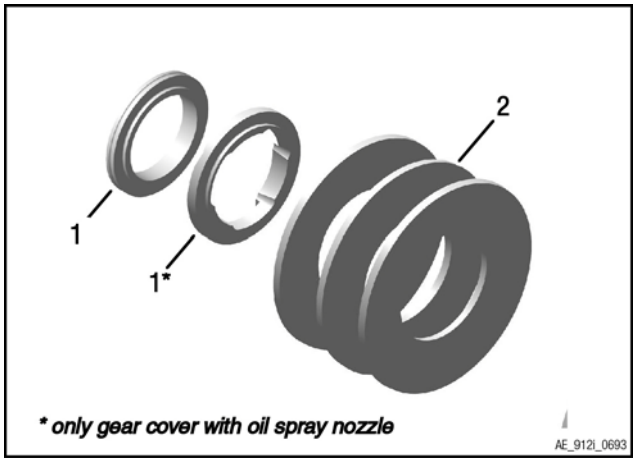
Fig. 23



1. Step collar *2. Disc springs*

CHECKING THE SPLINES

There are two essential splined shaft connections in the gearbox.

- Crankshaft to drive gear
- Propeller shaft to the clutch hub of the overload clutch

NOTE: To check the splines, determine the tooth widths at the tip circle of the respective inner or outer gear-tooth system. The smallest value in each case is significant.

Step	Procedure
1	Inspect all the splines visually for damage and wear. See section 72-10-00 Wear limits. (CS07,GB15, GB14, GB16)

GEAR SET CHECK (GEARS)

The gear set is checked to identify any damage to the gear-tooth system.

NOTICE

Check all the tooth flanks for any damage or pitting.

NOTE: If the gearbox is installed, it is also possible to check the gear set using an endoscope. This must be done in such a manner that an **exact assessment** of the tooth flanks is possible and requires experience.

Pitting

Pitting is damage which is attributable to fatigue of the material. As far as is known today, this is caused when the Hertzian stress permissible for the material in question is exceeded, the tangential stress on the surface (friction stress) and temperature stress. As well as the material and the heat treatment of it, the surface quality and structure, surface treatment and lubricant (viscosity at operating temperature and additives) are also important.

NOTE: The likely location of pitting formation is the dedendum flank of the driving gear. Therefore, begin by checking the drive gear.

Pitting in the gearbox

Pitting in the gearbox can cause high-frequency vibrations. This vibration can cause several problems as it is transferred via the engine to the connected parts:

- Wear on the gearbox (gear profile and contact faces)
- External alternative accessories
- Wear on the exhaust system
- Leaking of the sealing surface of the crankcase

NOTE: This vibration can be detected with a dynamic engine analysis; these are units which are used to adjust propellers. The normal vibration level for the engine is approximately between 1.27 cm and 2.45 cm per second, or the values specified by the aircraft manufacturer for the respective installation apply.

PITTING, GENERAL INFORMATION

NOTE: When pitting occurs it is necessary to distinguish between **tolerable initial pitting** and **flake pitting**. To make the assessment easier for you, see the following assessment tips

Pitting is the breaking off of more or less small, flat material particles from the active tooth flank. Whereas tooth breakage results in failure of the gearbox, this is not the case for pitting damage. There are in this case different stages of damage.

Rate of development

The rate of development depends on the lubricant and amount of stress. The pitting surface can become so large that the remaining undamaged flank can no longer transfer the load. During further operation the gear-tooth system is then completely destroyed.

NOTE: Fine pitting or pitted areas hardly affect the running behaviour of the gear-tooth system at all.

The rule is however pitting damage which increases over time.

A distinction can be made according to the size, type and number of pitting, as follows.

- Slight pitting (initial pitting)
- Destructive pitting
- Flake pitting (large-area flank fractures)

SLIGHT PITTING

Features:

Individual small pits (up to approx. 0.5% of the flank area) or pore-like areas of pitting, generally only present in the dedendum area of the flank. This pit formation can cease during the operating phase of the gearbox.

Causes:

Locally high stresses in gears which have not yet run in can result in isolated pits. The adjustable running-in wear which results in these areas being relieved of stress, as a result of which the formation of pits can cease. Similarly, changed operating conditions can prevent pits which have already formed from developing.

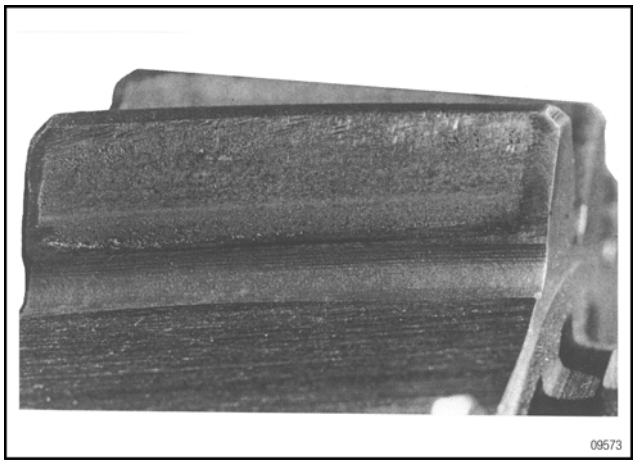
Conclusion:

These pits are not important for safe operation. The gear set can still be used.

NOTE: The illustrations are sometimes not very informative due to fine pitting or the reproduction process. If in doubt, consult technical literature or contact the authorised ROTAX distributor or its service centre.

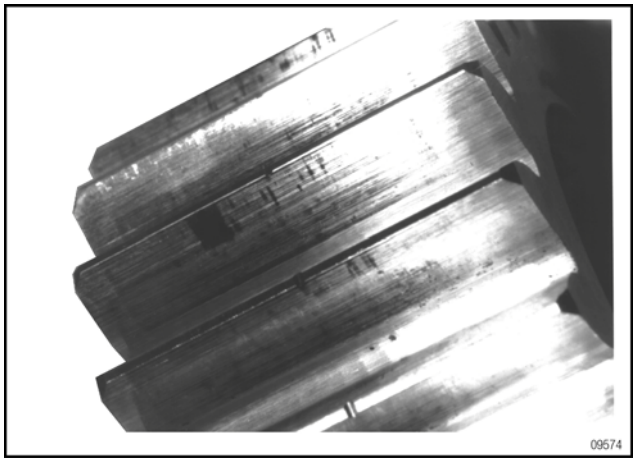
See Fig. 24 to Fig. 26.

Fig. 24



Magnification: approx. 2x

Fig. 25



Magnification: approx. 1.5x

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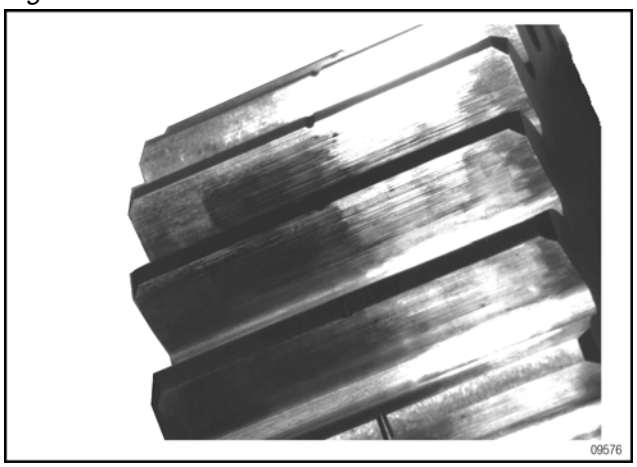
Fig. 26



Magnification: approx. 1.5x

DESTRUCTIVE PITTING

See Fig. 27 and Fig. 28.

Features:

Extensive flank fractures, generally occurring as zones of pitting. The bottom of the fracture generally has a mussel-shaped structure. The total pitting area can be so great that the running smoothness is noticeably affected and/or the remaining flank area which still bears the load is rapidly destroyed by wear etc.

Causes:

Pitting is attributable to the fatigue of the material due to combined stresses from compression and sliding. They are triggered when the material strength is exceeded locally. Essential influences on pit strength are: oil viscosity and oil temperature.

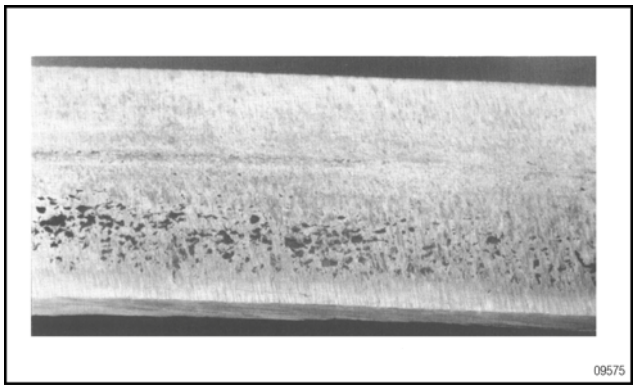
Conclusion:

Pitting of up to 5% of the flank area is permissible if the individual flank fractures do not exceed a size (greatest longitudinal extent) of 0.5 mm. Otherwise the gear set must be replaced!

NOTICE

The whole gear set must always be replaced. Dog hubs or drive gears must not be replaced individually.

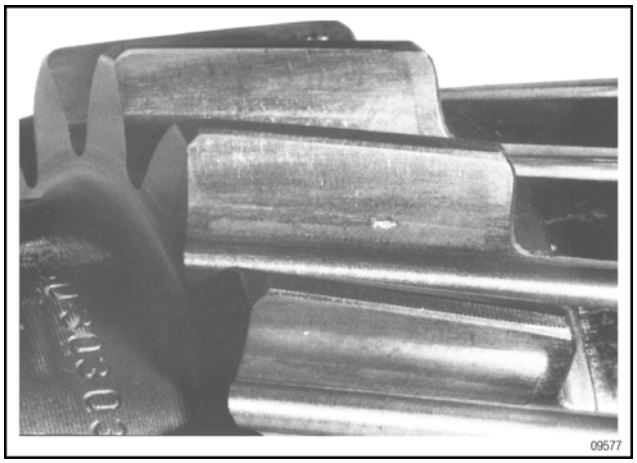
Fig. 27



Pitted area in the dedendum flank region of a spur gear.

Magnification approx. 5x.

Fig. 28



Pit formation in the dedendum region of a spur gear tooth system

Magnification approx. 1.5x.

FLAKE PITTING (LARGE-AREA FLANK FRACTURES)

See Fig. 29 and Fig. 30.

Features:

A large-area, triangular flank fracture emanating from a micropitting zone or a fine line of pits in the tooth dedendum. The fracture area has a relatively constant depth. Further cracks can run obliquely over the flank from the fracture. The damage sometimes extends into the addendum region, which results in breakage of the tooth tip.

NOTICE

If flake pitting is found, the gear set must be replaced.

Max. permissible pitting or flake pitting. See Destructive pitting.

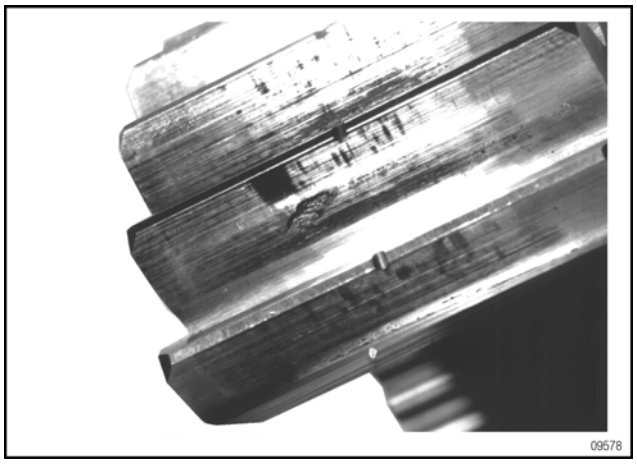
NOTICE

The whole gear set must always be replaced. Gears must not be replaced individually.

Causes:

This pattern of damage generally occurs at low operating oil viscosities and/or high oil temperatures. Apart from these, the same causes apply as for pitting.

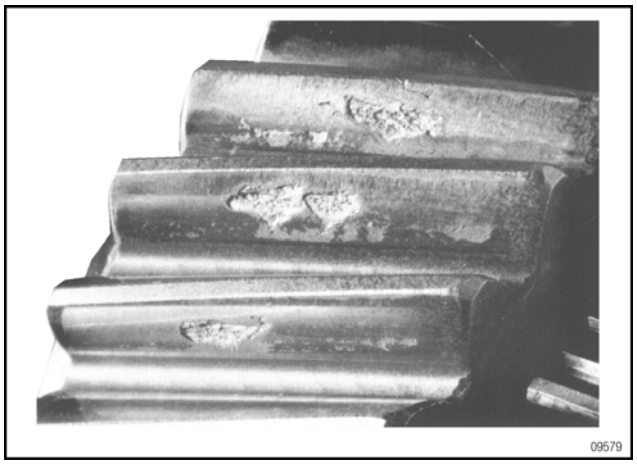
Fig. 29



Triangular flake pitting

Magnification approx. 2x.

Fig. 30



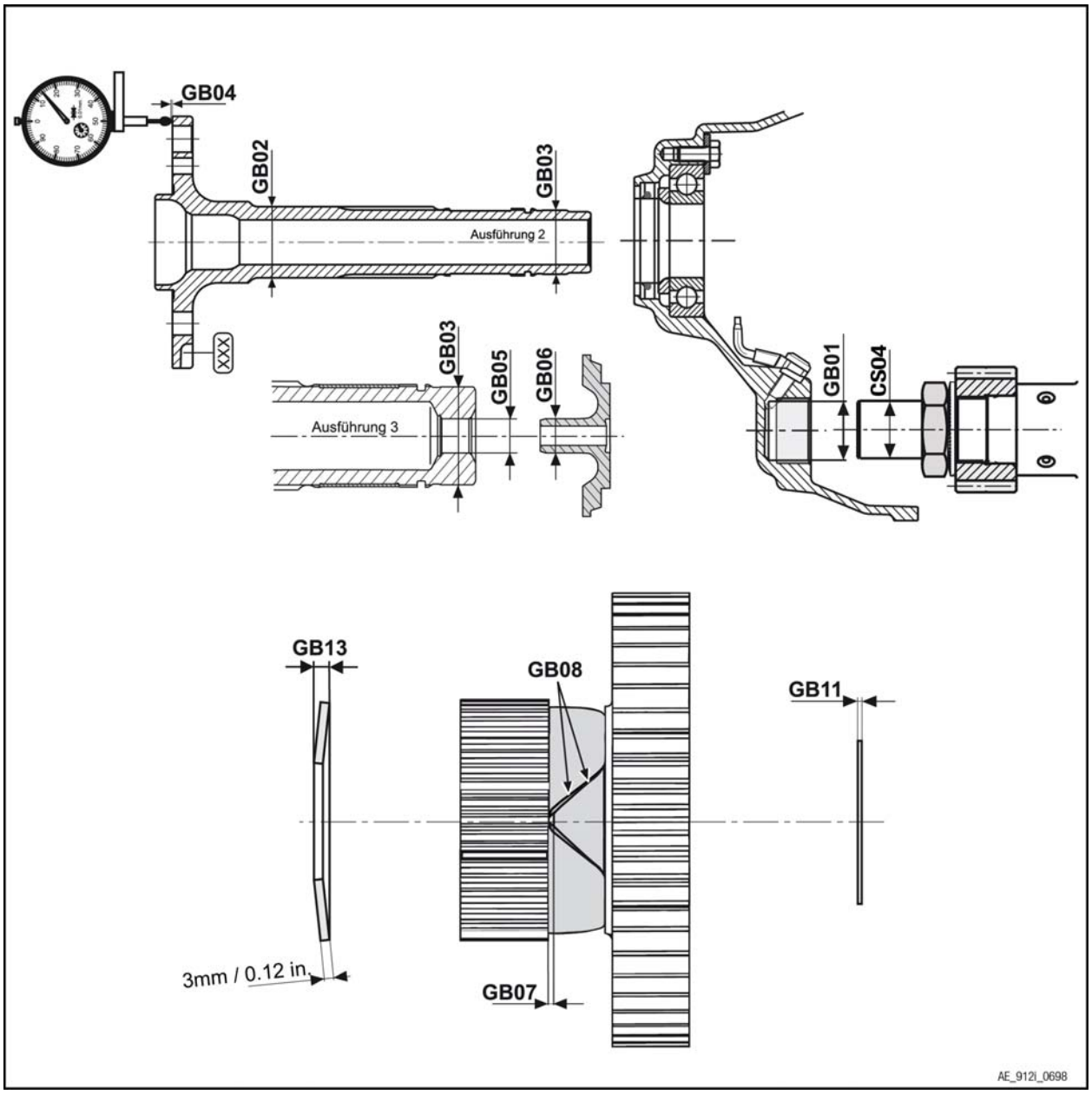
Triangular flake pitting

Magnification approx. 2x.

NOTES

WEAR LIMITS

Fig. 31



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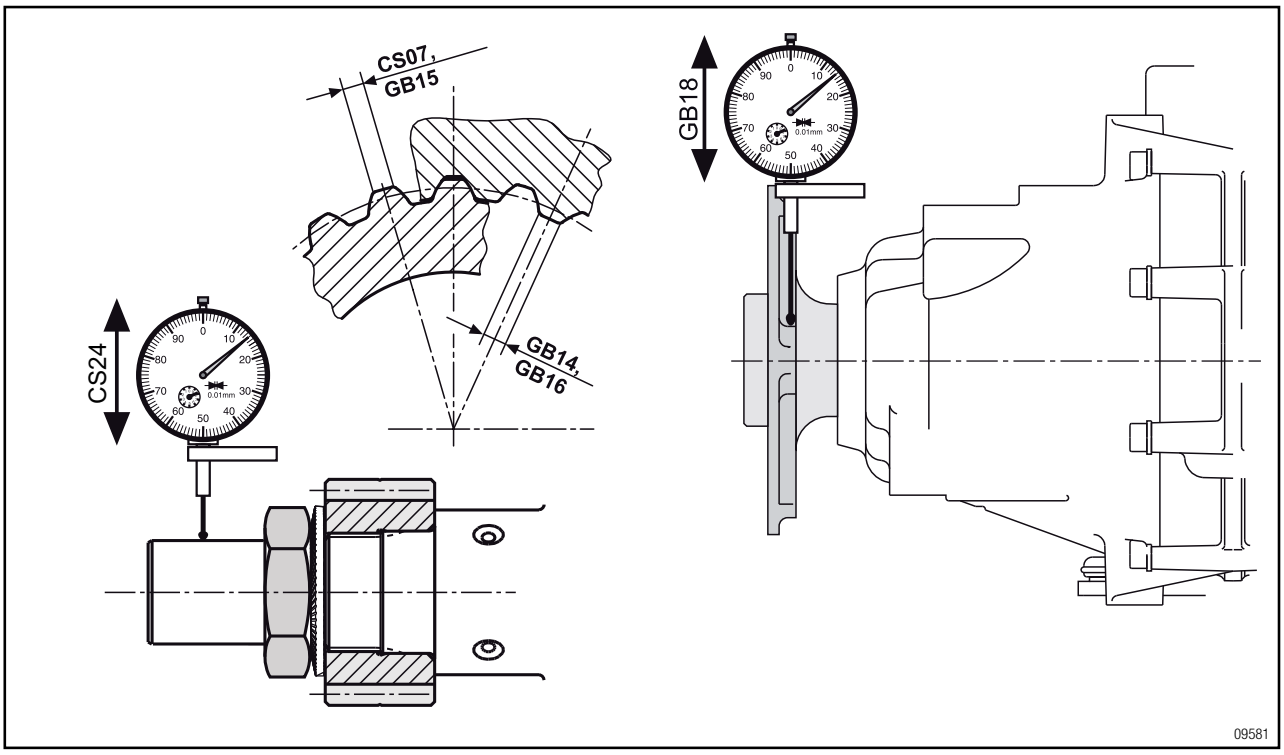
Description	Code	Current measurement value		Tolerance limit	Tolerance limit		Measure-ments
		min	max	100 %	50 %		
Propeller gearbox							
1) Bearing bushing in gear cover							
Bore	GB01	28.03 mm 1.1035 in.	28.04 mm 1.1039 in.	28.10 mm 1.1063 in.	28.07 mm 1.1051 in.	current replaced	
Radial clearance	GB01/ CS04	0.03 mm 0.0012 in.	0.05 mm 0.0020 in.	0.12 mm 0.0047 in.	0.09 mm 0.0035 in.	current replaced	
2) Propeller shaft							
Shaft diameter 35 mm	GB02	35.009 mm 1.3783 in.	35.020 mm 1.3787 in.	35.003 mm 1.3780 in.	35.006 mm 1.37815 in.	current replaced	
Shaft diameter 31.5 mm	GB03	31.470 mm 1.2390 in.	31.481 mm 1.2394 in.	31.460 mm 1.2386 in.	31.465 mm 1.2388 in.	current replaced	
Radial run-out, pro-peller flange at ⌀ 122 mm	GB04	0.00 mm 0.000 in.	0.05 mm 0.0020 in.	0.06 mm 0.0024 in.	0.06 mm 0.0022 in.	current replaced	
Bore at rear end of propeller shaft (only in vers. 3)	GB05	11.00 mm 0.4331 in.	11.02 mm 0.4339 in.			current replaced	
Journal diameter at oil inlet flange (only in vers. 3)	GB06	10.935 mm 0.4305 in.	10.960 mm 0.4315 in.			current replaced	
Radial clearance, bore/journal	GB05/ GB06	0.040 mm 0.0016 in.	0.085 mm 0.0033 in.	0.160 mm 0.0063 in.	0.123 mm 0.0048 in.	current replaced	
3) Dog gear, thrust washer							
Thickness of thrust washer	GB11	1.075 mm 0.0423 in.	1.325 mm 0.0522 in.	1.000 mm 0.0394 in.	1.038 mm 0.0408 in.	current replaced	
Total height of disc spring	GB13	5.20 mm 0.2047 in.	5.40 mm 0.2126 in.	4.80 mm 0.1889 in.	5.00 mm 0.1968 in.	current replaced	

PROPELLER GEARBOX

Fig. 32



Description	Code	Current measurement value		Tolerance limit	Tolerance limit		Measure-ments
		min	max	100 %	50 %		
4) Gear profile							
Crankshaft	CS07	0.95 mm 0.0374 in.	1.00 mm 0.0374 in.	0.80 mm 0.0315 in.	0.88 mm 0.0344 in.	current replaced	
Drive gear	GB14	0.95 mm 0.0374 in.	1.00 mm 0.0374 in.	0.80 mm 0.0315 in.	0.88 mm 0.0344 in.	current replaced	
Propeller shaft	GB15	1.50 mm 0.0591 in.	1.60 mm 0.0630 in.	1.10 mm 0.0433 in.	1.30 mm 0.0512 in.	current replaced	
Clutch/dog hub	GB16	1.50 mm 0.0591 in.	1.60 mm 0.0630 in.	1.10 mm 0.0433 in.	1.30 mm 0.0512 in.	current replaced	
5) Gear set, backlash							
Pitting on drive gear up to 5%		0	0	5%	2.5%	current replaced	
Pitting on dog gear up to 5%		0	0	5%	2.5%	current replaced	
Gear backlash	GB18	0.07 mm 0.0028 in.	0.15 mm 0.0059 in.	0.20 mm 0.0079 in.	0.18 mm 0.0069 in.	current replaced	

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Description	Code	Current measurement value		Tolerance limit	Tolerance limit		Measure-ments
		min	max	100 %	50 %		
6) Overload clutch							
Axial gap	GB07	1.0 mm 0.039 in.	1.2 mm 0.047 in.	0.5 mm 0.020 in.	0.8 mm 0.030 in.	current replaced	
Clutch/dog hub	GB08	0.0 mm 0.000 in.	0.0 mm 0.000 in.	0.2 mm 0.0079 in.	0.1 mm 0.0039 in.	current replaced	
Crankshaft							
Measure crankshaft run-out (installed in housing with drive gear)	CS24	0.000 mm 0.0000 in.	0.060 mm 0.0024 in.	0.080 mm 0.0031 in.		current replaced	
Crankshaft diameter	CS04	27.990 mm 1.1020 in	28.000 mm 1.1024 in	27,950 mm 1.1004 in	27,970 mm 1.1012 in	current replaced	

ASSEMBLY

Preparation

⚠ WARNING

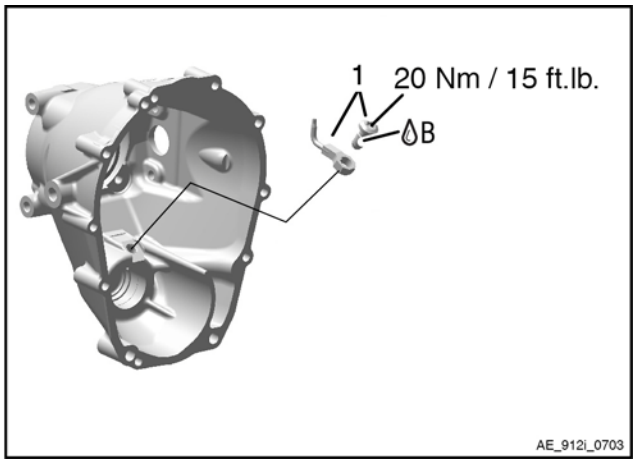
Danger of severe burns and scalds! Wear heat-resistant gloves!

- Heat the gearbox housing with hot air (or in an oven) to approx. 100 to 120°C (212 °F-248 °F).

INSTALLATION OF OIL SPRAY NOZZLE ASSY.

Step	Procedure
1	Insert the oil spray nozzle with the banjo bolt M8x1. The oil spray jet must point to the step collar.
2	Secure the M8x1Banjo bolt with LOCTITE 243. Tightening torque 20 Nm (15 ft.lb.)

Fig. 33

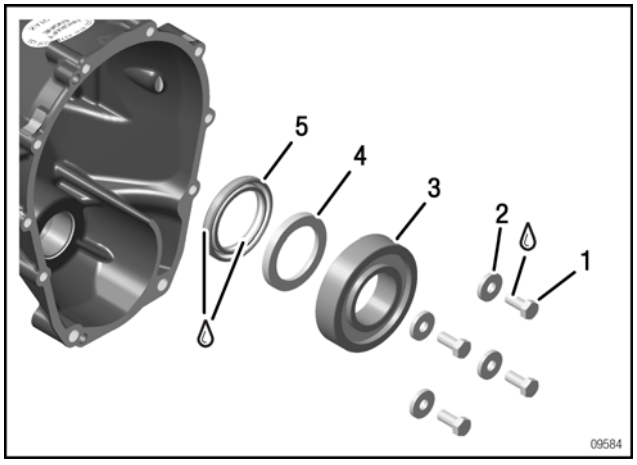


1. Oil spray nozzle and Banjo bolt M8x1

INSTALLATION OF BALL BEARING

Step	Procedure
1	Press the oil seal into the gearbox housing from the inside using insertion jig part no. 876518. NOTE: Lubricate sealing lips with engine oil.
2	Insert the 36/50/5.5 spacer ring with the radius facing the oil seal.
3	Insert the ball bearing. (The cage must be visible.) NOTE: The ball bearing must drop into the bearing position under its own weight!
4	Screw in 4 M7x16 hex. screws with hardened 7.2/18.8/3 washers. Tightening torque 15 Nm (133 in. lb.). NOTE: Secure screws with LOCTITE 243!

Fig. 34



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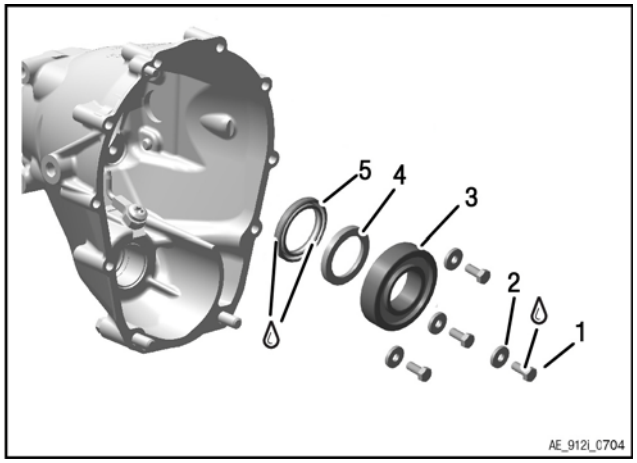
Propeller gearbox with oil spray nozzle:

Fig. 35



1. M7x16 hex. screw
2. 7.2/18.8/3 washer
3. Ball bearing 6207 E THNC3
4. 36/50/5.5 spacer ring
5. Oil seal AS 40x55x7 FPM

PROPELLER SHAFT - INSTALLATION

Preparation

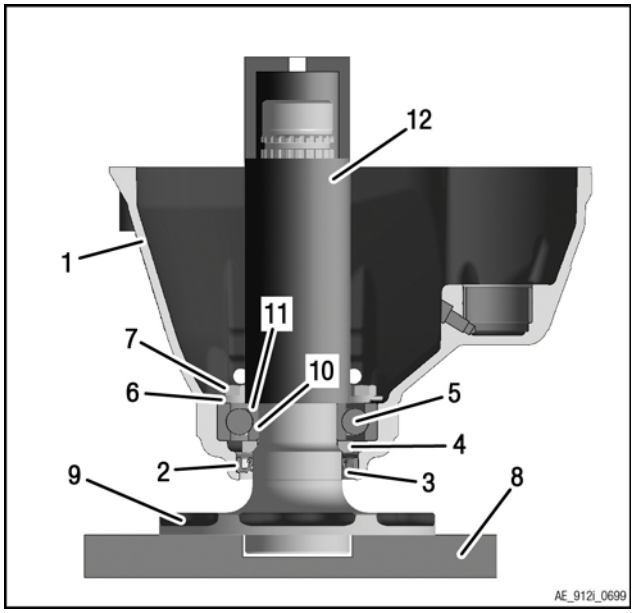
- Place the propeller shaft with the gearbox housing placed on it onto a suitable flat support.
- Lubricate the propeller shaft with LITHIUM-BASE GREASE on the bearing seat.

NOTICE

Push or press on, do not tap on.

Step	Procedure
1	Pull on the sleeve, which is approx. 30 mm longer than the propeller shaft. NOTE: The inner diameter of the sleeve should be selected such that it presses on the inner ring of the bearing.
2	Press on the gearbox housing with a slight turning movement. NOTE: It is advantageous when the gearbox housing is still warm.

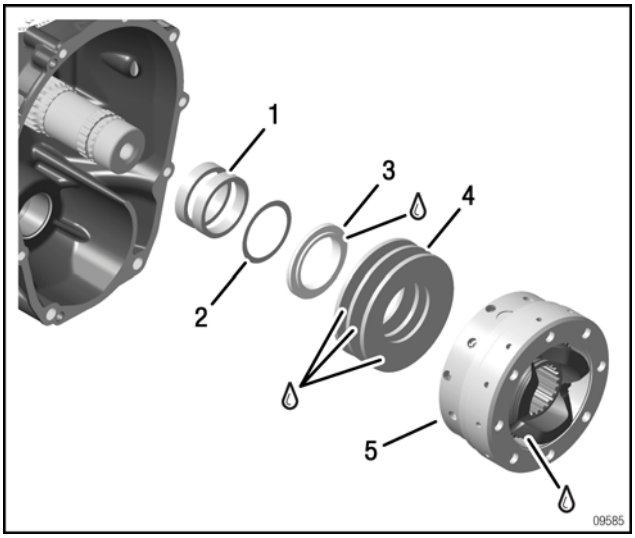
Fig. 36



1. Gearbox housing
2. Oil seal
3. Sealing lips
4. 36/50/5.5 spacer ring
5. Ball bearing
6. 7.2/18.8/3 washer
7. M7x16 hex. screw
8. Support
9. Propeller shaft
10. Bearing seat
11. Inner ring
12. Sleeve

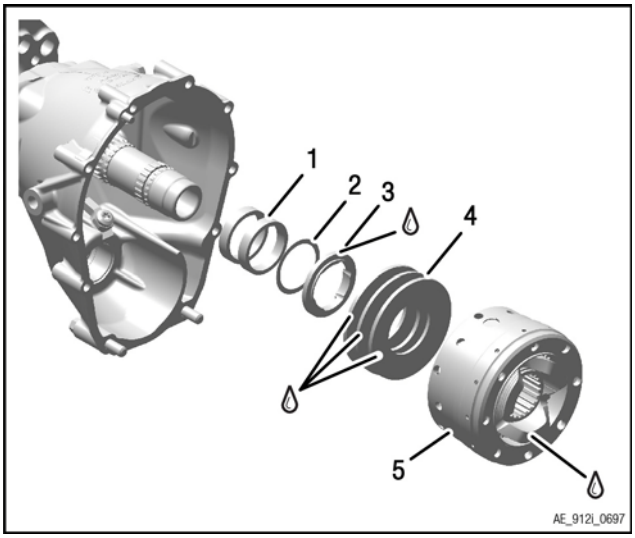
Step	Procedure
3	Push 2 x 35.2/42/8 distance sleeves onto the propeller shaft.
4	Lubricate 2 disc springs (lying against each other) along with the step collar (with a diameter of 40.8 mm facing the disc spring) with LITHIUM-BASE GREASE and push them on. NOTE: The disc springs must lie on the centring collar of the clutch hub!
5	Lubricate the third disc spring (with its rear facing the others) with LITHIUM-BASE GREASE and push it on.
6	Lubricate the clutch on the gear profile with LITHIUM-BASE GREASE and push it onto the propeller shaft.

Fig. 37



Propeller gearbox with oil spray nozzle:

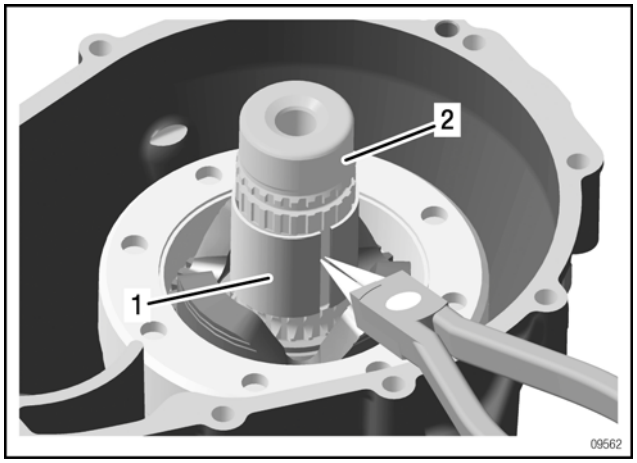
Fig. 38



1. Distance sleeves *2. Compensating shim*
3. Step collar *4. Disc springs*
5. Clutch assy.

Step	Procedure
7	Install the lubricated bearing bushing carefully on the propeller shaft with circlip pliers.

Fig. 39



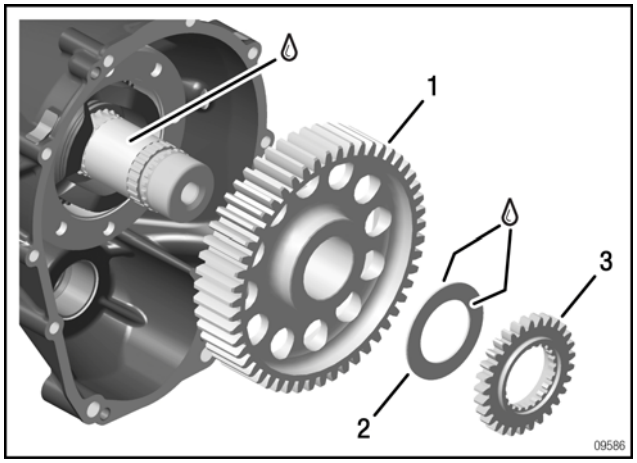
1. Bearing bushing *2. Propeller shaft*

NOTICE

The thrust washer must be replaced every repair.

Step	Procedure
8	Push on the gear (propeller shaft).
9	Lubricate the plastic 33.2/51/1.2 thrust washer on both sides with LITHIUM-BASE GREASE and push it on along with the drive gear.

Fig. 40



1. Gear (propeller shaft) *2. Thrust washer*
3. Drive gear

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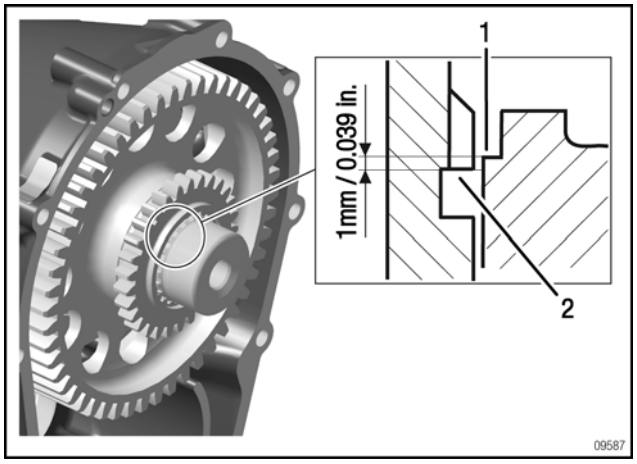
ADJUSTMENT OF THE DISC SPRING PRETENSION

NOTE: To make adjustment easier, it can be spaced out until the contact face for the ring halves aligns with the upper edge in the groove of the propeller shaft.

Step	Procedure
1	Place compensating shims between the distance sleeve and the step collar. NOTE: When the propeller shaft assembly is not tensioned, the contact face for the ring halves must lie 1 mm above the upper edge in the groove of the propeller shaft.

Fig. 41



1. Contact face *2. Upper edge*

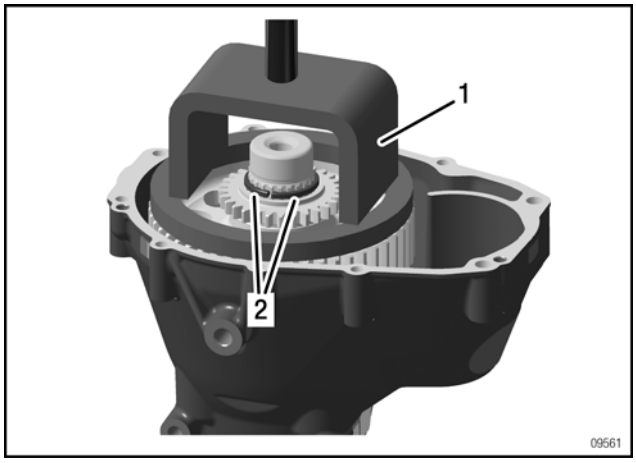
ASSEMBLY OF THE PROPELLER GEARBOX ASSY.

NOTICE

If the disc springs do not sit centrally, the gear (propeller shaft) cannot be pressed down enough to insert the ring halves. Do not increase the force, but remove the clutch again and center the disc springs correctly.

Step	Procedure
1	Place the whole gearbox in a suitable fixture.
2	Press down the gear (propeller shaft) with a mounting yoke part no. 876885 and assemble with new ring halves.

Fig. 42



1. Mounting yoke Part no. 876885 *2. Ring halves*

INSTALLATION

ROLLER BEARING - INSTALLATION

Step	Procedure
1	Lubricate a new O-ring and push it into the crankcase with the oil inlet flange.

NOTE: Ensure that the two M6 threads are horizontal and the recess is suitable for the scavenge oil.

Step	Procedure
2	Install the governor flange with two M6x20 Allen screws and the oil inlet flange with two M6x16 Allen screws lightly at first for better positioning.

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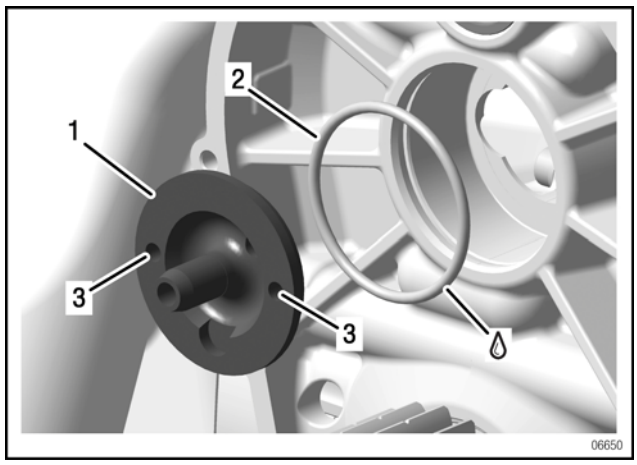
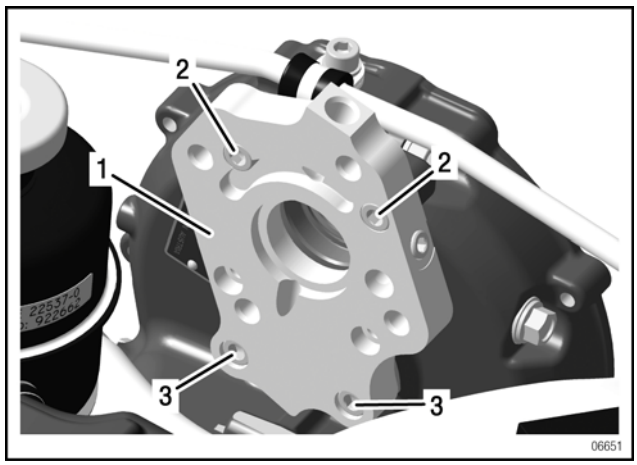
Fig. 43



1. Oil inlet flange *2. O-ring*

3. M6 threaded bores

Fig. 44

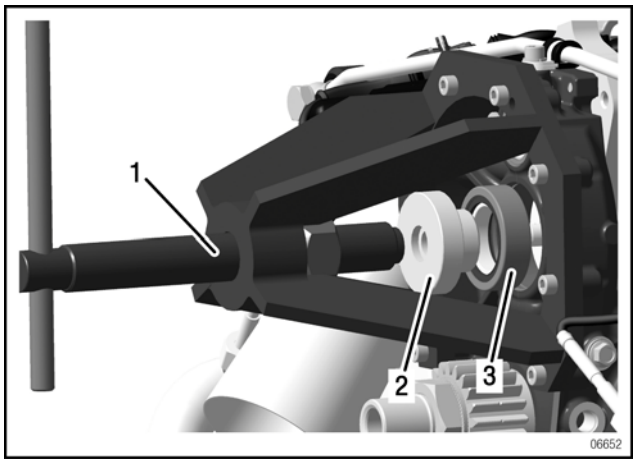


1. Governor flange *2. M6x20 Allen screws*

3. M6x16 Allen screws

Step	Procedure
3	Install the extractor part no. 877615 onto the crankcase, place the press-in mushroom part no. 877590 in the roller bearing, put it on the centring and press it with the spindle into the crankcase as far as it will go.
NOTE:	Place the circlip in the groove with the sharp edge pointing outwards.

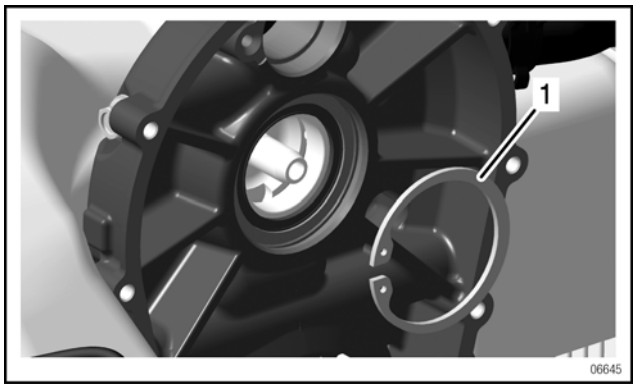
Fig. 45



1. Extractor part no. 877615 *2. Press-in mushroom part no. 877590*

3. Roller bearing

Fig. 46



1. 52x2 retaining ring

Step	Procedure
4	Place on the vacuum pump gear and fix the lubricated drive sleeve with the retaining tool part no. 242660.
5	Secure M8x16 Allen screw with LOCTITE 648 and tighten it. Tightening torque 25 Nm (19 ft.lb.)

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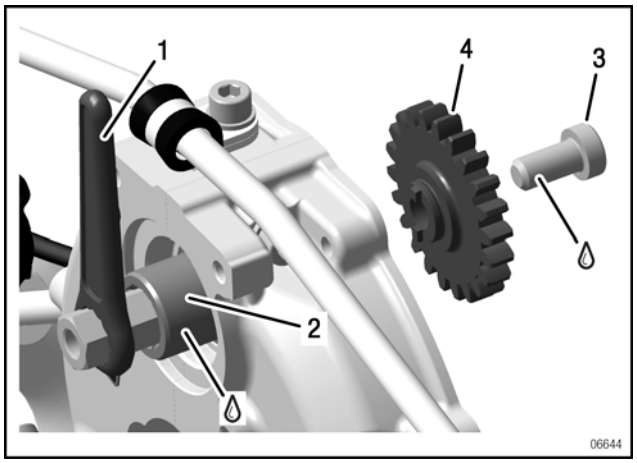
Fig. 47



1. Retaining tool part no. 242660

2. Drive sleeve

3. M8x16 Allen screw

4. Vacuum pump gear

PROPELLER GEARBOX - INSTALLATION

Preparation

NOTICE

No hammering or pressing!
The drive gear must only be pushed on manually.

NOTICE

Ensure that the friction washer is in the correct installation position.

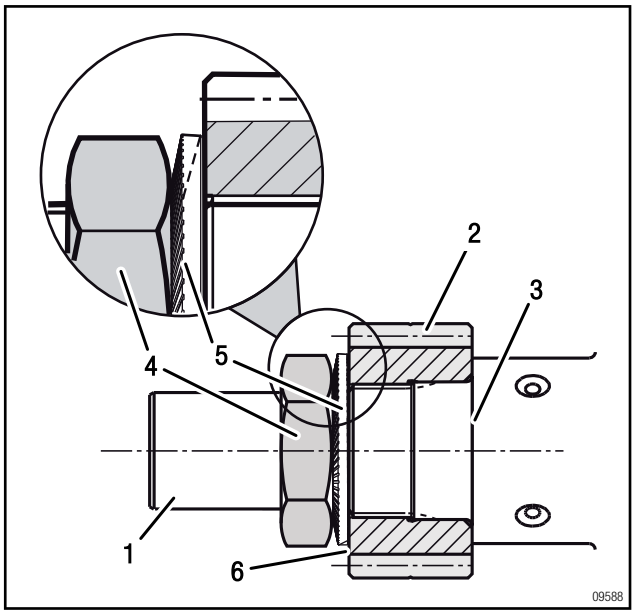
NOTICE

The dog and drive gears are in pairs.
Only use parts with the same serial number.

- Clean and degrease all parts carefully.
- Remove LOCTITE adhesive residue with LOCTITE 7063.
- Visual inspection of the crankshaft on the power take off side.

Step	Procedure
1	Push the drive gear onto the crankshaft. NOTE: Due to limited tolerances, it may be difficult to push the drive gear onto the end of the crankshaft. If necessary, push it on in another position.
2	Secure the M30x1.5 hex. nut with LOCTITE 648 and screw it onto the crankshaft along with the VS-30 friction washer. Tightening torque 200 Nm (147.5 ft.lb.).

Fig. 48



1. Crankshaft (power take off side)
2. Drive gear
3. Crankshaft
4. Hex. nut
5. VS-30 friction washer
6. Serial number

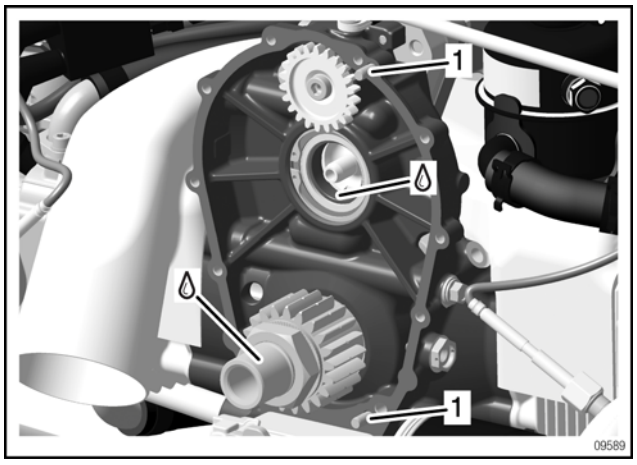
NOTICE

The sealing surface must be free from dirt and oil.

See Fig. 49

Step	Procedure
3	Inspect the run-out. See also section 72-10-00 Wear limits. (CS24) NOTE: If there is slight vertical run-out, replace the nut and repeat the measurement.
4	Insert 2 6x20 dowel pins into the crankcase.
5	Hold the roller bearing rollers in position with LITHIUM-BASE GREASE Nb5051 and lubricate the bearing position of the propeller shaft and crankshaft.

Fig. 49



1. 6x20 dowel pins

NOTICE

If excessive installation force is used, the bearing or vacuum pump gear can be damaged.

Step	Procedure
6	Apply LOCTITE 5910 surface sealing compound to the sealing surface of the gearbox housing and place on the gear cover assy. with the pre-assembled gearbox. NOTE: Move the propeller shaft a little to allow the dog gear to engage.
7	Tap gently on the gearbox housing with a soft-faced hammer to position the gearbox on the crankcase. NOTE: If there is a large amount of resistance at a gap of approximately 10 mm, the bearing rollers of the roller bearing may not be in position.

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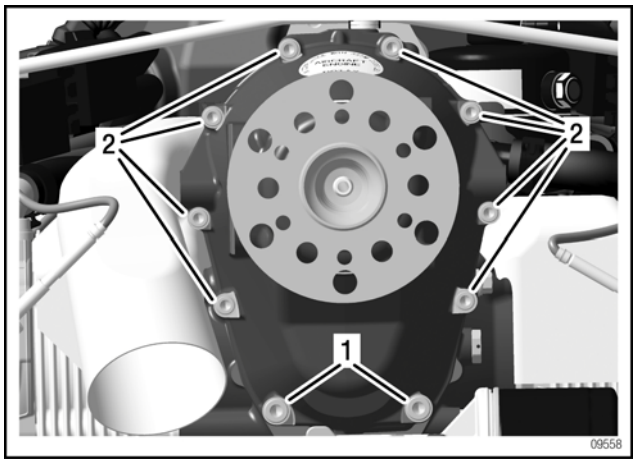
Fig. 50



1. M8 Allen screw *2. M6 Allen screw*

Step	Procedure
8	Tighten 2 M8x45 Allen screws and 8 M6x45 Allen screws with washers 6.4 diagonally from each other. Tightening torque M6: 10 Nm (89 in.lb.) Tightening torque M8: 25 Nm (19 ft.lb.)
9	Inspect the run-out. See also section 72-10-00 Wear limits. (GB18)

Finishing work

- Fill with operating fluids or check filling levels. To do this, see section 12-10-00 Adding operating fluids.
- Carry out an engine test run. See relevant Maintenance Manual Line for the 912 i Series engine type.
- After the engine test run, check the engine and gearbox for leaks.

NOTES