

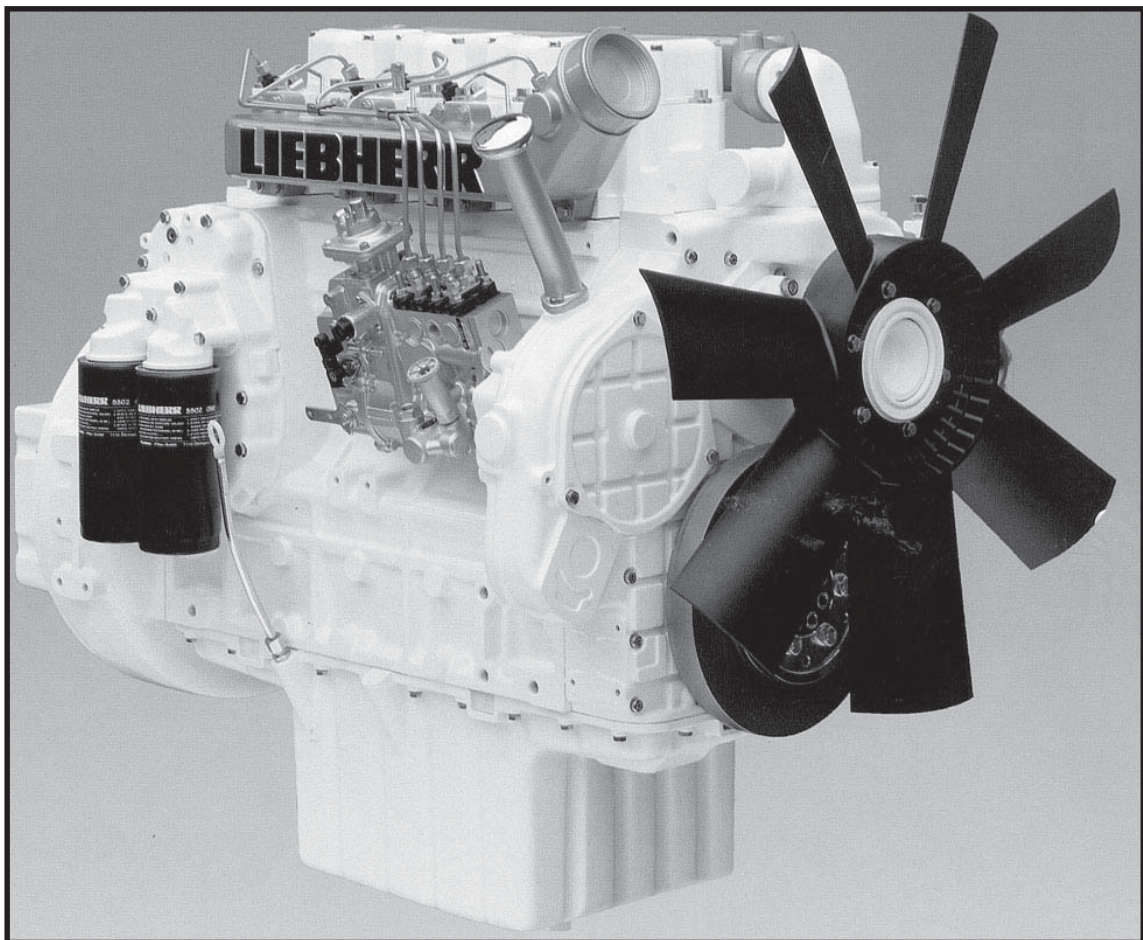
Workshop Manual

LIEBHERR-Diesel engines

D 904 / D 906

D 914 / D 916

D 924 / D 926



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Contents Engines

1. Technical Data

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Manuel-No.

Owner

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FOREWORD

This manual has been issued to provide you with a description of technical procedures, such as disassembly, assembly, adjustments and Technical Data of Liebherr Diesel engines.

The descriptions and notes in this manual are brief, but precise, and is supported by photographs and drawings to help you maintain and repair your Liebherr engine.

However, only skilled mechanics already familiar with most standard engine repairs should perform these procedures.

We also have included instructions on maintenance and care of your Liebherr Diesel engine, which are also covered in the Operation and Maintenance Manual for your particular machine.

Before any maintenance and repair, be sure to observe all applicable Safety Regulations and Accident Prevention Guidelines.

For all repairs you will need a complete and good set of standard tools, as well as special tools and fixtures, as shown.

Keep your work area as neat and clean as possible.

During the course of repairs, always replace seals, such as O-rings, gaskets, etc. with new ones.

Tighten screw connections, if not stated otherwise, to the required tightening torques.

This manual has been written by **Liebherr - Machines - Bulle S.A., Dept. BE - MD** and issued by the **Service Dept. of Liebherr Hydraulikbagger GmbH, Kirchdorf / Iller , Dept. VS.**

This manual will be revised as needed, as a registered manual owner, you will receive all updates, to reflect the current engine series.

In certain cases, Service Information bulletins might also be used as updates.

No part of this manual may be reproduced or copied in any form or handed to outsiders without our written permission.

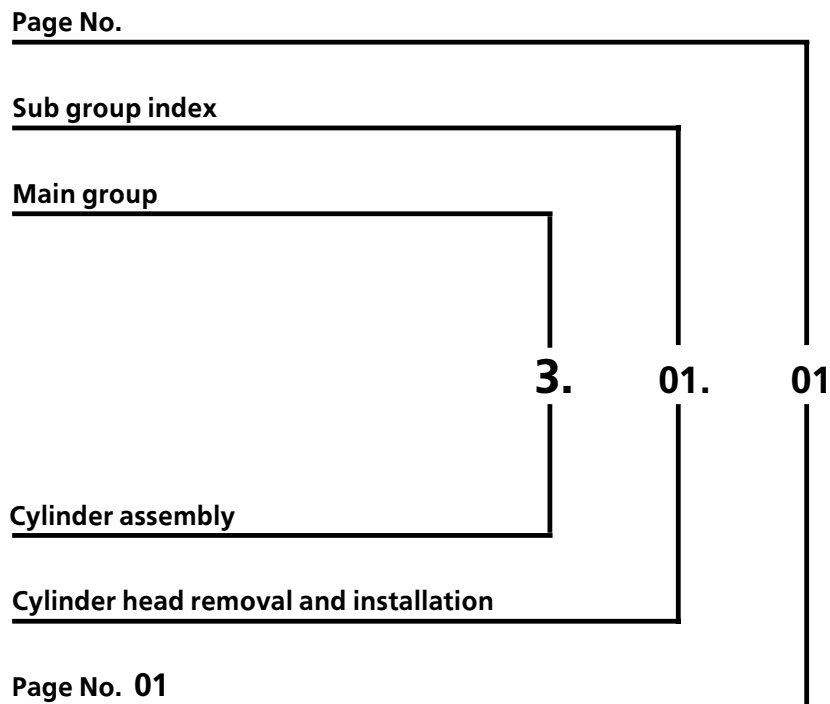
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We hope that with the information contained in this manual and your cooperation, we have taken another step towards improved service for Liebherr Diesel engines.

Liebherr - Machines - Bulle S.A.

Explanation of index

In order to make it easier to find certain information or to remove or add pages, the following system has been established:



The main groups can be found on the index page of this manual.

The sub groups can be found on the sub group index pages in front of every main group.

In case of minor changes, we will issue revised pages with the latest date.

If an already existing sub group is updated completely, a new sub group number will be assigned.

The new group number will list the engine serial number, for which this new or revised information is valid.

Sub Group Index

1.01	Engine data
1.05	Fuel injection system
1.08	Cylinder assembly
1.12	Crank and camshaft drive
1.15	Lubrication system
1.18	Cooling system
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1.25	Cylinder identification, engine number, crankcase number, connecting rod number, engine identification plate and engine identification

LIEBHERR	Benennung/Description/Dénomination Technical Data	Typ Model Type	D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de	
		Blatt/Page/Feuille 1.00	
Datum/Edition/Date 01.99			

Motordaten		Engine data		Caractéristiques du moteur					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Gesamtvolumen cm³	Total displacement (cu.inch) cm³	Cylindrée totale cm³	5608 (342)	5608 (342)	8412 (513)	8412 (513)	6107 (373)	9161 (559)	9960 (608)
Arbeitsweise	Engine type	Cycle	Viertakt - Diesel Four stroke diesel diesel, à 4 temps						
Verbrennungs- verfahren	Combustion system	Principe de combustion	Direkteinspritzung Direct injection Injection directe						
Bohrung mm	Bore (inch) mm	Alésage mm	115 (4.528)				120 (4.724)		122 (4.803)
Hub mm	Stroke (inch) mm	Course mm	135 (5.315)						142 (5.590)
Gewicht der Motoren trocken ohne Kühlein- richtung kg	Weight of engin dry, without radiator (lbs) kg	Poids du moteur à sec, sans système de refroidisse- ment kg	NA ca. 680, TB ca. 690 (approx. 1500/1521 env.	ca. 690 (approx. 1521) env.	NA ca. 890, TB ca. 900 (approx. 1962/1984 env.	ca. 900 (approx. 1984) env.	ca. 700 (approx. 1543) env.	ca. 890 (approx. 1962) env.	ca. 900 (approx. 1984) env.
Drehrichtung	Direction of rotation	Sens de rotation	auf Schwungrad gesehen counter-clockwise Vu sur le volant links when facing flywheel a gauche						
Nenndrehzahl 1/min	Rated speed (RPM) 1/min	Regime nominal 1/min	2000	2000/2100	2000	2000	1800/2000	1800/2000/ 2100	1800/2000/ 2100
Niedrigste Leerlaufdrehzahl 1/min	Minimum idle speed (RPM) 1/min	Vitesse min.de ralenti 1/min	800 - 900				700 - 1100	700 - 1000	
Verdichtungs- verhältnis	Compression ratio	Taux de compression	17 : 1	15,5 : 1	17 : 1	15,5 : 1	15,9 : 1	15,9 : 1	16 : 1

Motordaten		Engine data		Caractéristiques du moteur				
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Gesamtvolumen cm³	Total displacement (cu.inch) cm³	Cylindrée totale cm³	6640 (405)		9960 (608)		6640 (405)	9960 (608)
Arbeitsweise	Engine type	Cycle	Viertakt - Diesel For stroke diesel diesel, à 4 temps					
Verbrennungs- verfahren	Combustion system	Principe de combustion	Direkteinspritzung Direct injection Injection directe					
Bohrung mm	Bore (inch) mm	Alésage mm	122 (4.803)					
Hub mm	Stroke (inch) mm	Course mm	142 (5.590)					
Gewicht der Motoren trocken ohne Kühlein- richtung kg	Weight of engin dry, without radiator (lbs) kg	Poids du moteur à sec, sans système de refroidisse- ment kg	ca. 710 (approx. 1565) env.		ca. 900 (approx. 1984) env.		ca. 710 (approx.1565) env.	ca. 900 (approx.1984) env.
Drehrichtung	Direction of rotation	Sens de rotation	auf Schwungrad gesehen links counter-clockwise when facing flywheel Vu sur le volant a gauche					
Nenndrehzahl 1/min	Rated speed (RPM) 1/min	Regime nominal 1/min	1500, 1800, 2000, 2100					
Niedrigste Leerlaufdrehzahl 1/min	Minimum idle speed (RPM) 1/min	Vitesse min.de ralenti 1/min	700 - 1100					
Verdichtungs- verhältnis	Compression ratio	Taux de compression	17,2 : 1					

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Motordaten		Engine data		Caractéristiques du moteur	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Gesamtvolumen cm ³	Total displacement (cu.inch) cm ³	Cylindrée totale cm ³	6640 (405)	9960 (608)	
Arbeitsweise	Engine type	Cycle	Viertakt - Diesel	Four stroke diesel	diesel, à 4 temps
Verbrennungs-verfahren	Combustion system	Principe de combustion	Direkteinspritzung	Direct injection	Injection directe
Bohrung mm	Bore (inch) mm	Alésage mm	122 (4.803)		
Hub mm	Stroke (inch) mm	Course mm	142 (5.590)		
Gewicht der Motoren trocken ohne Kühleinrichtung kg	Weight of engin dry, without radiator (lbs) kg	Poids du moteur à sec, sans système de refroidisse-ment kg	ca. 710 (approx. 1565) env.	ca. 900 (approx. 1984) env.	
Drehrichtung	Direction of rotation	Sens de rotation	auf Schwungrad gesehen links	counter-clockwise when facing flywheel	Vu sur le volant a gauche
Nenndrehzahl 1/min	Rated speed (RPM) 1/min	Regime nominal 1/min	1500, 1800, 2000, 2100		
Niedrigste Leerlaufdrehzahl 1/min	Minimum idle speed (RPM) 1/min	Vitesse min.de ralenti 1/min	700 - 1100		
Verdichtungs-verhältnis	Compression ratio	Taux de compression	17,2 : 1		

1.01.02

Motordaten			Engine data		Caractéristiques du moteur				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Kompressionsdruck bar	Compression pressure (PSI) bar	Compression bar	20 - 28 (290 - 406)	18 - 26 (261 - 377)	20 - 28 (290 - 406)	18 - 26 (261 - 377)	19 - 27 (275 - 392)	19 - 27 (275 - 392)	19 - 27 (275-392)
Ventilspiel Einlaß kalt Auslaß kalt mm	Valve clearance Inlet cold Exhaust cold (inch) mm	Jeu des soupapes Admission froid Echappement froid mm	0,2 (0.0079) 0,25 (0.0098)						
Zündfolge	Firing order	Ordre d'allumage	1 - 3 - 4 - 2		1 - 5 - 3 - 6 - 2 - 4		1 - 3 - 4 - 2	1 - 5 - 3 - 6 - 2 - 4	
<u>Ventilöffnungszeiten</u>	<u>Valve adjustment</u>	<u>Calage de la distribution</u>							
Einlaß öffnet vor OT Grad	Inlet opens before TDC degree	Admission ouverte avant PMH degrés	15 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)		
Einlaß schließt nach UT Grad	Inlet closed after BDC degree	Admission fermée après PMB degrés	45 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)		
Auslaß öffnet vor UT Grad	Exhaust opens before BDC degree	Echappement ouv.avant PMB degrés	54 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)		
Auslaß schließt nach OT Grad	Exhaust closed after TDC degree	Echappement fermée après PMH degrés	14 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)		
Abstand des Kolbens vom Zylinderkopf mm	Piston clearance to cylinder head (inch) mm	Espace neutre entre le piston et la culasse mm	1,15 - 1,67 (0,0453 - 0,0657)						

Motordaten		Engine data	Caractéristiques du moteur					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Kompressions- druck bar	Compression pressure (PSI) bar	Compression bar	20 - 28 (290 - 406)					
Ventilspiel Einlaß kalt Auslaß kalt mm	Valve clearance Inlet cold Exhaust cold (inch) mm	Jeu des soupapes Admission froid Echappement froid mm	0,25 (0.0098) 0,30 (0.0118)					
Zündfolge	Firing order	Ordre d'allumage	1 - 3- 4 - 2		1 - 5 - 3 - 6 - 2 - 4		1 - 3- 4 - 2	1 - 5 - 3 - 6 - 2 - 4
<u>Ventilöffnungs- zeiten</u>	<u>Valve adjustment</u>	<u>Calage de la distribution</u>						
Einlaß öffnet vor OT Grad	Inlet opens before TDC degree	Admission ouverte avant PMH degrés	15 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Einlaß schließt nach UT Grad	Inlet closed after BDC degree	Admission fermée après PMB degrés	45 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Auslaß öffnet vor UT Grad	Exhaust opens before BDC degree	Echappement ouv.avant PMB degrés	54 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Auslaß schließt nach OT Grad	Exhaust closed after TDC degree	Echappement fermée après PMH degrés	14 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)		(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)		(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Abstand des Kolbens vom Zylinderkopf mm	Piston clearance to cylinder head (inch) mm	Espace neutre entre le piston et la culasse mm	1,15 - 1,67 (0,0453 - 0,0657)					

Motordaten		Engine data		Caractéristiques du moteur		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926TI -EA5		
Kompressions- druck bar	Compression pressure (PSI) bar	Compression bar	20 - 28 (290 - 406)			
Ventilspiel Einlaß kalt Auslaß kalt mm	Valve clearance Inlet cold Exhaust cold (inch) mm	Jeu des soupapes Admission froid Echappement froid mm	0,25 (0.0098) 0,30 (0.0118)			
Zündfolge	Firing order	Ordre d'allumage	1 - 3- 4 - 2	1 - 5- 3 - 6 -2 -4		
<u>Ventilöffnungs- zeiten</u>	<u>Valve adjustment</u>	<u>Calage de la distribution</u>				
Einlaß öffnet vor OT Grad	Inlet opens before TDC degree	Admission ouverte avant PMH degrés	15 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)	(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)	(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Einlaß schließt nach UT Grad	Inlet closed after BDC degree	Admission fermée après PMB degrés	45 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)	(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)	(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Auslaß öffnet vor UT Grad	Exhaust opens before BDC degree	Echappement ouv.avant PMB degrés	54 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)	(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)	(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Auslaß schließt nach OT Grad	Exhaust closed after TDC degree	Echappement fermée après PMH degrés	14 (messen ohne Ventilspiel bei Ventilhub 0,4 mm)	(measured without valve play at valve stroke 0,4 mm) (inch = 0,0157)	(mesure sans jeu de soupape avec une ouverture de soupape de 0,4 mm)	
Abstand des Kolbens vom Zylinderkopf mm	Piston clearance to cylinder head (inch) mm	Espace neutre entre le piston et la culasse mm	1,15 - 1,67 (0,0453 - 0,0657)			

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1.05.01

Einspritzanlage			Fuel injection system			Système d'injection			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Einspritzpumpe</u> Fabrikat	<u>Fuel injection pump</u> Make	<u>Pompe d'injection</u> Marque	Bosch A				Bosch MW		Bosch P
<u>Regler</u> Fabrikat	<u>Governor</u> Make	<u>Régulateur</u> Marque	Bosch RSV	Bosch RQV / RSV	Bosch RSV	Bosch RQV / RSV	Bosch RSV	Bosch RSV	Bosch RSV / RQV-K
<u>Einspritzdüse</u> Bosch	<u>Injection nozzle</u> Bosch	<u>Injecteur</u> Bosch	DLLA 142 S 980	DLLA 132 S 981 (RQV) DLLA 142 S 980 (RSV)	DLLA 142 S 980	DLLA 132 S 981 (RQV) DLLA 142 S 980 (RSV)	DLLA 142 S 1189		
Einspritzdruck Betriebsdruck bar	Injection pressure Operating press. (PSI) bar	Press.d'injection Press.en service bar	252 ⁺⁸ (3657-3774)	RQV = 217 ⁺⁸ (3147-3263) RSV = 252 ⁺⁸ (3657-3774)	252 ⁺⁸ (3657-3774)	RQV = 217 ⁺⁸ (3147-3263) RSV = 252 ⁺⁸ (3657-3774)	217 ⁺⁸ (3147 - 3263)		
Einspritzdruck Neuzustand bar	Injection pressure in new condition (PSI) bar	Press.d'injection à l'état neuf bar	260 ⁺⁸ (3774-3890)	RQV = 225 ⁺⁸ (3263-3379) RSV = 260 ⁺⁸ (3774-3890)	260 ⁺⁸ (3774-3890)	RQV = 225 ⁺⁸ (3263-3379) RSV = 260 ⁺⁸ (3774-3890)	225 ⁺⁸ (3263 - 3379)		
Förderbeginn vor O.T. in Grad Kurbelwinkel	Fuel delivery begin before TDC in degree	Début d'injec.av. PMH en °d'angle de vilebrequin	26 ± 1	RQV = 26 ± 1 RSV = 28 ± 1	26 ± 1	RQV = 26 ± 1 RSV = 28 ± 1	20 ± 1	20 ± 1 D 916 T n (RPM) = 1800/2100 ^{1/min} 22 ± 1 D 916 T/TI n (RPM) = 2000 ^{1/min} 20 ± 1 D 916 TI n (RPM) = 1800 ^{1/min} 15 ± 1 D 916 TI n (RPM) = 2100 ^{1/min}	20 ± 1 n (RPM) = 1800/2000 ^{1/min} 16 ± 1 n (RPM) = 2100 ^{1/min}

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1.05.02

Einspritzanlage		Fuel injection system	Système d'injection		
Motortype	Engine Type	Type de moteur	D 924TI-EA5	D 926 TI-EA5	
<u>Einspritzpumpe</u> Fabrikat	<u>Fuel injection pump</u> Make	<u>Pompe d'injection</u> Marque	Bosch H-RP43		
<u>Regler</u> Fabrikat	<u>Governor</u> Make	<u>Régulateur</u> Marque	Bosch EDC		
<u>Einspritzdüse</u> Bosch	<u>Injection nozzle</u> Bosch	<u>Injecteur</u> Bosch	DLLA 145 P 669		
Einspritzdruck Betriebsdruck bar	Injection pressure Operating press. (PSI) bar	Press.d'injection Press.en service bar	217 + 8 (3147 - 3263)		
Einspritzdruck Neuzustand bar	Injection pressure in new condition (PSI) bar	Press.d'injection à l'état neuf bar	225 + 8 (3263 - 3379)		
Förderbeginn vor O.T. in Grad Kurbelwinkel	Fuel delivery begin before TDC in degree	Début d'injec.av. PMH en °d'angle de vilebrequin	Angaben siehe Motor-Typenschild Details see Engine Type-plate Pour details voir Plaque signalétique moteur		

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Einspritzanlage			Fuel injection system		Système d'injection					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI	
<u>Einspritzpumpen Antrieb</u> Untergruppe 7.06, 7.10, 7.11	<u>Injection pump drive side</u> sub-group 7.06, 7.10, 7.11	<u>Entrainement de la pompe d'injec.</u> sous-group 7.06, 7.10, 7.11								
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,002 - 0,010)							
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)							
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,15 (0,0024 - 0,0059)							
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)							
Durchmesser Nabe mm	Hub diameter (inch) mm	Diamètre Moyeu mm	60 ^{- 0.06} - 0,09 (2,3587 - 2,3598)							
Durchmesser Lagerbuchse mm	Bushing diameter (inch) mm	Diamètre couss. du palier mm	60 ^{+ 0,06} (2,3622 - 2.3646)							

1.05.03

Einspritzanlage Fuel injection system Système d'injection					
Motortype		Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5
Einspritzpumpen Antrieb Untergruppe 7.07		Injection pump drive side sub-group 7.07	Entrainement de la pompe d'injec. sous-group 7.07		
Axialspiel mm		Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,3 (0,002 - 0,0118)	
Grenzwert mm		Limit (inch) mm	Valeur limite mm	0,6 (0,024)	
Radialspiel mm		Radial clearance (inch) mm	Jeu radial mm	0,08 - 0,16 (0,003 - 0,006)	
Grenzwert mm		Limit (inch) mm	Valeur limite mm	0,25 (0,0098)	
Durchmesser Nabe mm		Hub diameter (inch) mm	Diamètre Moyeu mm	60 ^{-0,08} -0,10 (2,3583 - 2,359)	
Durchmesser Lagerbuchse mm		Bushing diameter (inch) mm	Diamètre couss. du palier mm	60 ^{+0,06} (2,3622 - 2.3646)	

Zylindereinheit		Cylinder Assembly	Unité-Cylindre						
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Zylinderkopf</u>	<u>Cylinder head</u>	<u>Culasse</u>							
<u>Ventilführungen</u> Aussendurch- messer mm	<u>Valve guide</u> Outside diameter (inch) mm	<u>Guide de soupape</u> Diamètre extérieur mm	16 ^{+0,039} _{+0,028} (0,6310 - 0,6315)						
Bohrung im Zylinderkopf mm	Bore in cylinder head (inch) mm	Alésage de culasse mm	16 ^{+0,011} (0,6299 - 0,6304)						
Ventilführung Innendurch- messer mm	Valve guide Inside diameter (inch) mm	Guide de soupape Diamètre intérieur mm	10 ^{+0,022} _{+0,013} (0,3942 - 0,3946)						
Übermaßstufen Außendurch- messer mm	Oversized Outside diameter (inch) mm	Cotes de réparat. Diamètre extérieur mm	16,25 ^{+0,039} _{+0,028} (0,6409 - 0,6413) 16,5 ^{+0,039} _{+0,028} (0,6507 - 0,6511)						
Bohrung im Zylinderkopf Übermaß mm	Bore in cylinder head oversized (inch) mm	Alésage du culasse Cotes de réparation mm	16,25 ^{+0,011} (0,6398 - 0,6402) 16,5 ^{+0,011} (0,6496 - 0,6500)						
Ventilschaft Durchmesser Einlaß mm	Valve stem Diameter Inlet (inch) mm	Tige de soupape Diamètre Admission mm	9,96 ^{-0,010} (0,3917 - 0,3921)						
Ventilschaft Durchmesser Auslaß mm	Valve stem Diameter Exhaust (inch) mm	Tige de soupape Diamètre Echappement mm	9,95 ^{-0,010} (0,3913 - 0,3917)						
Ventilschaftspiel Einlaß normal mm	Valve stem clearance, Inlet normal (inch) mm	Jeu de la tige de soupape/Admis- sion, normale mm	0,053 - 0,072 (0,0021 - 0,0028)						
Einlaß Grenzwert mm	Inlet Limit (inch) mm	Admission Limite mm	0,12 (0,0047)						

Zylindereinheit			Cylinder Assembly		Unité-Cylindre			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
<u>Zylinderkopf</u>	<u>Cylinder head</u>	<u>Culasse</u>						
<u>Ventilführungen</u> Aussendurch- messer mm	<u>Valve guide</u> Outside diameter (inch) mm	<u>Guide de soupape</u> Diamètre extérieur mm	16 ^{+0,039} _{+0,028} (0,6310 - 0,6315)					
Bohrung im Zylinderkopf mm	Bore in cylinder head (inch) mm	Alésage de culasse mm	16 ^{+0,011} (0,6299 - 0,6304)					
Ventilführung Innendurch- messer mm	Valve guide Inside diameter (inch) mm	Guide de soupape Diamètre intérieur mm	10 ^{+0,022} _{+0,013} (0,3942 - 0,3946)					
Übermaßstufen Außendurch- messer mm	Oversized Outside diameter (inch) mm	Cotes de réparat. Diamètre extérieur mm	16,25 ^{+0,039} _{+0,028}	(0,6409 - 0,6413)	16,5 ^{+0,039} _{+0,028}	(0,6507 - 0,6511)		
Bohrung im Zylinderkopf Übermaß mm	Bore in cylinder head oversized (inch) mm	Alésage du culasse Cotes de réparation mm	16,25 ^{+0,011}	(0,6398 - 0,6402)	16,5 ^{+0,011}	(0,6496 - 0,6500)		
Ventilschaft Durchmesser Einlaß mm	Valve stem Diameter Inlet (inch) mm	Tige de soupape Diamètre Admission mm	9,96 _{-0,010} (0,3917 - 0,3921)					
Ventilschaft Durchmesser Auslaß mm	Valve stem Diameter Exhaust (inch) mm	Tige de soupape Diamètre Echappement mm	9,95 _{-0,010} (0,3913 - 0,3917)					
Ventilschaftspiel Einlaß normal mm	Valve stem clearance, Inlet normal (inch) mm	Jeu de la tige de soupape/Admis- sion, normale mm	0,053 - 0,072 (0,0021 - 0,0028)					
Einlaß Grenzwert mm	Inlet Limit (inch) mm	Admission Limite mm	0,12 (0,0047)					

Zylindereinheit		Cylinder Assembly	Unité-Cylindre		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Zylinderkopf	Cylinder head	Culasse			
Ventilführungen Aussendurch- messer mm	Valve guide Outside diameter (inch) mm	Guide de soupape Diamètre extérieur mm	16 ^{+0,039} _{+0,028}	(0,6310 - 0,6315)	
Bohrung im Zylinderkopf mm	Bore in cylinder head (inch) mm	Alésage de culasse mm	16 ^{+0,011}	(0,6299 - 0,6304)	
Ventilführung Innendurch- messer mm	Valve guide Inside diameter (inch) mm	Guide de soupape Diamètre intérieur mm	10 ^{+0,022} _{+0,013}	(0,3942 - 0,3946)	
Übermaßstufen Außendurch- messer mm	Oversized Outside diameter (inch) mm	Cotes de réparat. Diamètre extérieur mm	16,25 ^{+0,039} _{+0,028}	(0,6409 - 0,6413)	16,5 ^{+0,039} _{+0,028} (0,6507 - 0,6511)
Bohrung im Zylinderkopf Übermaß mm	Bore in cylinder head oversized (inch) mm	Alésage du culasse Cotes de réparation mm	16,25 ^{+0,011}	(0,6398 - 0,6402)	16,5 ^{+0,011} (0,6496 - 0,6500)
Ventilschaft Durchmesser Einlaß mm	Valve stem Diameter Inlet (inch) mm	Tige de soupape Diamètre Admission mm	9,96 _{-0,010}	(0,3917 - 0,3921)	
Ventilschaft Durchmesser Auslaß mm	Valve stem Diameter Exhaust (inch) mm	Tige de soupape Diamètre Echappement mm	9,95 _{-0,010}	(0,3913 - 0,3917)	
Ventilschaftspiel Einlaß normal mm	Valve stem clearance, Inlet normal (inch) mm	Jeu de la tige de soupape/Admis- sion, normale mm	0,053 - 0,072	(0,0021 - 0,0028)	
Einlaß Grenzwert mm	Inlet Limit (inch) mm	Admission Limite mm	0,12	(0,0047)	

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Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Ventilschaftspiel Auslaß normal mm	Valve stem clearance Exhaust normal (inch) mm	Jeu de la tige de soupape/Echap- pement normale mm	0,063 - 0,082 (0,0025 - 0,0032)						
Auslaß Grenzwert mm	Exhaust Limit (inch) mm	Echappement Limit mm	0,13 (0,0051)						
Ventilsitzring Einlaß Außen- durchmesser normal mm	Valve seat ring Inlet outside dia- meter normal (inch) mm	Bague de siege de soup. Admission diam.extér.cote d'origine mm	54,5 ^{+0,085} _{+0,066} (2,1483 - 2,1490)						
Einlaß Außen- durchmesser Übermaßstufen mm	Inlet outside dia- meter oversized (inch) mm	Admission dia- mètre extérieur cotes de réparat. mm	54,75 ^{+0,085} _{+0,066}	(2,1581 - 2,1589)		55 ^{+0,085} _{+0,066}	(2,1680 - 2,1687)		
Einlaß Bohrung im Zylinderkopf normal mm	Inlet bore diame- ter in cyl. head normal (inch) mm	Admission alésage dans la culasse normal mm	54,5 ^{+0,019} (2,1457 - 2,1464)						
Einlaß Bohrung im Zylinderkopf Übermaßstufen mm	Inlet bore diame- ter in cyl.head oversized (inch) mm	Admission alésage dans la culasse cotes de réparat. mm	54,75 ^{+0,019}	(2,1555 - 2,1563)		55 ^{+0,019}	(2,1654 - 2,1661)		
Auslaß Außen- durchmesser normal mm	Exhaust outside diameter normal (inch) mm	Echappement diaméter extér. normal mm	46,5 ^{+0,070} _{+0,054} (1,8328 - 1,8335)						
Auslaß Außen- durchmesser Übermaßstufen mm	Exhaust outside diameter oversized (inch) mm	Echappement alésage extér. cotes de réparat. mm	46,75 ^{+0,070} _{+0,054}	(1,8427 - 1,8433)		47 ^{+0,070} _{+0,054}	(1,8525 - 1,8531)		
Auslaß Bohrung im Zylinderkopf normal mm	Exhaust bore dia- meter in cyl.head normal (inch) mm	Echappement alésage dans la culasse, normal mm	46,5 ^{+0,016} (1,8307 - 1,8313)						
Auslaß Bohrung im Zylinderkopf Übermaßstufen mm	Exhaust bore dia- meter in cyl. head oversized (inch) mm	Echappem.alésa- ge dans la culasse cotes de réparat. mm	46,75 ^{+0,016}	(1,8406 - 1,8412)		47 ^{+0,016}	(1,8504 - 1,8510)		

Zylindereinheit		Cylinder Assembly	Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Ventilschaftspiel Auslaß normal mm	Valve stem clearance Exhaust normal (inch) mm	Jeu de la tige de soupape/Echap- pement normale mm	0,063 - 0,082 (0,0025 - 0,0032)					
Auslaß Grenzwert mm	Exhaust Limit (inch) mm	Echappement Limit mm	0,13 (0,0051)					
Ventilsitzring Einlaß Außen- durchmesser normal mm	Valve seat ring Inlet outside dia- meter normal (inch) mm	Bague de siege de soup. Admission diam.extér.cote d'origine mm	54,5 ^{+0,085} _{+0,066} (2,1483 - 2,1490)					
Einlaß Außen- durchmesser Übermaßstufen mm	Inlet outside dia- meter oversized (inch) mm	Admission dia- mètre extérieur cotes de réparat. mm	54,75 ^{+0,085} _{+0,066}	(2,1581 - 2,1589)	55 ^{+0,085} _{+0,066}	(2,1680 - 2,1687)		
Einlaß Bohrung im Zylinderkopf normal mm	Inlet bore diame- ter in cyl. head normal (inch) mm	Admission alésage dans la culasse normal mm	54,5 ^{+0,019} (2,1457 - 2,1464)					
Einlaß Bohrung im Zylinderkopf Übermaßstufen mm	Inlet bore diame- ter in cyl.head oversized (inch) mm	Admission alésage dans la culasse cotes de réparat. mm	54,75 ^{+0,019}	(2,1555 - 2,1563)	55 ^{+0,019}	(2,1654 - 2,1661)		
Auslaß Außen- durchmesser normal mm	Exhaust outside diameter normal (inch) mm	Echappement diaméter extér. normal mm	53,3 ^{+0,085} _{+0,066} (2,1010 - 2,1018)					
Auslaß Außen- durchmesser Übermaßstufen mm	Exhaust outside diameter oversized (inch) mm	Echappement alésage extér. cotes de réparat. mm	53,55 ^{+0,085} _{+0,066}	(2,1109 - 2,1116)	53,8 ^{+0,085} _{+0,066}	(2,1207 - 2,1215)		
Auslaß Bohrung im Zylinderkopf normal mm	Exhaust bore dia- meter in cyl.head normal (inch) mm	Echappement alésage dans la culasse, normal mm	53,3 ^{+0,019} (2,0984 - 2,0992)					
Auslaß Bohrung im Zylinderkopf Übermaßstufen mm	Exhaust bore dia- meter in cyl. head oversized (inch) mm	Echappem.alésa- ge dans la culasse cotes de réparat. mm	53,55 ^{+0,019}	(2,1083 - 2,1090)	53,8 ^{+0,019}	(2,1181 - 2,1189)		

Zylindereinheit		Cylinder Assembly	Unité-Cylindre		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Ventilschaftspiel Auslaß normal mm	Valve stem clearance Exhaust normal (inch) mm	Jeu de la tige de soupape/Echap- pement normale mm	0,063 - 0,082 (0,0025 - 0,0032)		
Auslaß Grenzwert mm	Exhaust Limit (inch) mm	Echappement Limit mm	0,13 (0,0051)		
Ventilsitzring Einlaß Außen- durchmesser normal mm	Valve seat ring Inlet outside dia- meter normal (inch) mm	Bague de siege de soup. Admission diam.extér.cote d'origine mm	54,5 ^{+0,085} _{+0,066} (2,1483 - 2,1490)		
Einlaß Außen- durchmesser Übermaßstufen mm	Inlet outside dia- meter oversized (inch) mm	Admission dia- mètre extérieur cotes de réparat. mm	54,75 ^{+0,085} _{+0,066} (2,1581 - 2,1589)	55 ^{+0,085} _{+0,066} (2,1680 - 2,1687)	
Einlaß Bohrung im Zylinderkopf normal mm	Inlet bore dia- meter in cyl. head normal (inch) mm	Admission alésage dans la culasse normal mm	54,5 ^{+0,019} (2,1457 - 2,1464)		
Einlaß Bohrung im Zylinderkopf Übermaßstufen mm	Inlet bore dia- meter in cyl.head oversized (inch) mm	Admission alésage dans la culasse cotes de réparat. mm	54,75 ^{+0,019} (2,1555 - 2,1563)	55 ^{+0,019} (2,1654 - 2,1661)	
Auslaß Außen- durchmesser normal mm	Exhaust outside diameter normal (inch) mm	Echappement diaméter extér. normal mm	53,3 ^{+0,085} _{+0,066} (2,1010 - 2,1018)		
Auslaß Außen- durchmesser Übermaßstufen mm	Exhaust outside diameter oversized (inch) mm	Echappement alésage extér. cotes de réparat. mm	53,55 ^{+0,085} _{+0,066} (2,1109 - 2,1116)	53,8 ^{+0,085} _{+0,066} (2,1207 - 2,1215)	
Auslaß Bohrung im Zylinderkopf normal mm	Exhaust bore dia- meter in cyl.head normal (inch) mm	Echappement alésage dans la culasse, normal mm	53,3 ^{+0,019} (2,0984 - 2,0992)		
Auslaß Bohrung im Zylinderkopf Übermaßstufen mm	Exhaust bore dia- meter in cyl. head oversized (inch) mm	Echappem.alésa- ge dans la culasse cotes de réparat. mm	53,55 ^{+0,019} (2,1083 - 2,1090)	53,8 ^{+0,019} (2,1181 - 2,1189)	

Zylindereinheit		Cylinder Assembly		Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Einlaß Höhe Ventilsitzring normal mm	Inlet valve seating ring height normal (inch) mm	Admission haut. bague de siège de soupape, normal mm	NA = 10,7 -0,1 (0,4173-0,4213) TB = 9,7 -0,05 (0,3799-0,3819)	9,7 -0,05 (0,3799-0,3819)	NA = 10,7 -0,1 (0,4173-0,4213) TB = 9,7 -0,05 (0,3799-0,3819)	9,7 -0,05 (0,3799 - 0,3819)			
Einlaß Höhe Ventilsitzring 1. Übermaßstufe mm	Inlet valve seating ring height 1 st oversize (inch) mm	Admission haut. bague de siège de soup.1 ^{er} cotes de réparat. mm	NA=10,95 -0,1 (0,4272-0,4311) TB = 9,95 -0,05 (0,3898-0,3917)	9,95 -0,05 (0,3898-0,3917)	NA=10,95 -0,1 (0,4272-0,4311) TB = 9,95 -0,05 (0,3898-0,3917)	9,95 -0,05 (0,3898 - 0,3917)			
Einlaß Höhe Ventilsitzring 2. Übermaßstufe mm	Inlet valve seating ring height 2 nd oversize (inch) mm	Admission haut. bague de siège de soup.2 ^e cotes de réparat. mm	NA = 11,2 -0,1 (0,4370-0,4409) TB = 10,2 -0,05 (0,3996-0,4016)	10,2 -0,05 (0,3996-0,4016)	NA = 11,2 -0,1 (0,4370-0,4409) TB = 10,2 -0,05 (0,3996-0,4016)	10,2 -0,05 (0,3996 - 0,4016)			
Auslaß Höhe Ventilsitzring normal mm	Exhaust valve seating ring height normal (inch) mm	Echappem. haut. bague de siège de soupape, normal mm	10,7 - 0,1 (0,4173 - 0,4213)						
Auslaß Höhe Ventilsitzring Übermaßstufen mm	Exh. valve seating ring height oversize (inch) mm	Echappem. haut. bague de siège de soup.cotes de réparat. mm	10,95 - 0,1 (0,4272 - 0,4311)				11,2 - 0,1 (0,4370 - 0,4409)		
Einlaß/Auslaß Bohrungstiefe im Zylinderkopf normal mm	Depth of inlet / exhaust bore in cyl.head, normal (inch) mm	Admis./Echap.pro-fondeur d'alésage de la culasse normal mm	13,5 + 0,1 (0,5315 - 0,5354)						
Einlaß/Auslaß Bohrungstiefe im Zyl.Kopf Übermaßstufen mm	Depth of inlet / exh. bore in cyl. head oversize (inch) mm	Admis./Echap.pro-fondeur d'alésage de la culasse cotes de répar. mm	13,75 + 0,1 (0,5413 - 0,5453)				14 + 0,1 (0,5512 - 0,5551)		
Ventilsitzbreite Einlaß mm	Valve seat width Inlet (inch) mm	Largeur de siège soupape Admission mm	NA = 2,5 +0,9 (0,0984-0,1339) TB = 2,9 +0,1 (0,1142-0,1535)	2,9 + 1 (0,1142-0,1535)	NA = 2,5 +0,9 (0,0984-0,1339) TB = 2,9 +0,1 (0,1142-0,1535)	2,9 + 1 (0,1142 - 0,1535)			
Ventilsitzbreite Auslaß mm	Valve seat width Exhaust (inch) mm	Largeur de siège soupape Echappement mm	2 + 0,8 (0,0787 - 0,1102)						
Ventilteller Ø Einlaß mm	Valve head diameter Inlet (inch) mm	Tête de soupape Ø Admission mm	NA= 51,6 ±0,1 (2,0276-2,0354) TB = 52,7 ±0,1 (2,0709-2,0787)	52,7±0,1 (2.0709-2,0787)	NA = 51,6 ±0,1 (2,0276-2,0354) TB = 52,7 ±0,1 (2,0709-2,0787)	52,7 ±0,1 ((2,0709 - 2,0787))			

Zylindereinheit			Cylinder Assembly		Unité-Cylindre			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Einlaß Höhe Ventilsitzring normal mm	Inlet valve seating ring height normal (inch) mm	Admission haut. bague de siège de soupape, normal mm	10,2 - 0,05 (0,3996 - 0,4016)					
Einlaß Höhe Ventilsitzring 1. Übermaßstufe mm	Inlet valve seating ring height 1 st oversize (inch) mm	Admission haut. bague de siège de soup.1 ^{er} cotes de réparat. mm	10,45 - 0,05 (0,4094 - 0,4114)					
Einlaß Höhe Ventilsitzring 2. Übermaßstufe mm	Inlet valve seating ring height 2 nd oversize (inch) mm	Admission haut. bague de siège de soup.2 ^e cotes de réparat. mm	10,7 - 0,05 (0,4193 - 0,4213)					
Auslaß Höhe Ventilsitzring normal mm	Exhaust valve seating ring height normal (inch) mm	Echappem. haut. bague de siège de soupape, normal mm	10,9 - 0,05 (0,4272 - 0,4291)					
Auslaß Höhe Ventilsitzring Übermaßstufen mm	Exh. valve seating ring height oversize (inch) mm	Echappem. haut. bague de siège de soup.cotes de réparat. mm	11,15 - 0,05 (0,4370 - 0,4390)			11,4 - 0,05 (0,4469 - 0,4488)		
Einlaß/Auslaß Bohrungstiefe im Zylinderkopf normal mm	Depth of inlet / exhaust bore in cyl.head, normal (inch) mm	Admis./Echap.pro- fondeur d'alésage de la culasse normal mm	14 + 0,1 (0,5512 - 0,5551)					
Einlaß/Auslaß Bohrungstiefe im Zyl.Kopf Über- maßstufen mm	Depth of inlet / exh. bore in cyl. head oversize (inch) mm	Admis./Echap.pro- fondeur d'alésage de la culasse cotes de répar. mm	14,25 + 0,1 (0,5610 - 0,5650)			14,5 + 0,1 (0,5709 - 0,5748)		
Ventilsitzbreite Einlaß mm	Valve seat width Inlet (inch) mm	Largeur de siège soupape Admission mm	2 + 0,9 (0,0787 - 0,1142)					
Ventilsitzbreite Auslaß mm	Valve seat width Exhaust (inch) mm	Largeur de siège soupape Echappement mm	3,2 + 1,5 (0,1260 - 0,1850)					
Ventilteller Ø Einlaß mm	Valve head diameter Inlet (inch) mm	Tête de soupape Ø Admission mm	52,2±0,1 (2,0512 - 2,0591)					

Zylindereinheit			Cylinder Assembly		Unité-Cylindre	
Motortype	Engine Type	Type de moteur	D 924 TI - EA 5	D 926 TI-EA5		
Einlaß Höhe Ventilsitzring normal mm	Inlet valve seating ring height normal (inch) mm	Admission haut. bague de siège de soupape, normal mm	10,2 -0,05 (0,3996 - 0,4016)			
Einlaß Höhe Ventilsitzring 1. Übermaßstufe mm	Inlet valve seating ring height 1 st oversize (inch) mm	Admission haut. bague de siège de soup. 1 ^{er} cotes de réparat. mm	10,45 -0,05 (0,4094 - 0,4114)			
Einlaß Höhe Ventilsitzring 2. Übermaßstufe mm	Inlet valve seating ring height 2 nd oversize (inch) mm	Admission haut. bague de siège de soup. 2 ^e cotes de réparat. mm	10,7 -0,05 (0,4193 - 0,4213)			
Auslaß Höhe Ventilsitzring normal mm	Exhaust valve seating ring height normal (inch) mm	Echappem. haut. bague de siège de soupape, normal mm	10,9 - 0,05 (0,4272 - 0,4291)			
Auslaß Höhe Ventilsitzring Übermaßstufen mm	Exh. valve seating ring height oversize (inch) mm	Echappem. haut. bague de siège de soup. cotes de réparat. mm	11,15 - 0,05 (0,4370 - 0,4390)		11,4 - 0,05 (0,4469 - 0,4488)	
Einlaß/Auslaß Bohrungstiefe im Zylinderkopf normal mm	Depth of inlet / exhaust bore in cyl. head, normal (inch) mm	Admis./Echap. profondeur d'alésage de la culasse normal mm	14 + 0,1 (0,5512 - 0,5551)			
Einlaß/Auslaß Bohrungstiefe im Zyl. Kopf Übermaßstufen mm	Depth of inlet / exh. bore in cyl. head oversize (inch) mm	Admis./Echap. profondeur d'alésage de la culasse cotes de répar. mm	14,25 + 0,1 (0,5610 - 0,5650)		14 + 0,1 (0,5709 - 0,5748)	
Ventilsitzbreite Einlaß mm	Valve seat width Inlet (inch) mm	Largeur de siège soupape Admission mm	2 + 0,9 (0,0787 - 0,1142)			
Ventilsitzbreite Auslaß mm	Valve seat width Exhaust (inch) mm	Largeur de siège soupape Echappement mm	3,2 + 1,5 (0,1260 - 0,1850)			
Ventilteller Ø Einlaß mm	Valve head diameter Inlet (inch) mm	Tête de soupape Ø Admission mm	52,2 ± 0,1 (2,0512 - 2,0591)			

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Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Ventilteller Ø Auslaß mm	Valve head diameter Exhaust (inch) mm	Tête de soupape Ø Echappement mm	Ø 43,6 ± 0,1 (1,7126 - 1,7205)						
Sitzwinkel Einlaß Grad	Valve seat angle Inlet degree	Angle de siège Admission degrés	NA = 45° TB = 30°	30°	NA = 45° TB = 30°	30°			
Sitzwinkel Auslaß Grad	Valve seat angle Exhaust degree	Angle de siège Echappement degrés	45°						
Randstärke Einlaß mm	Rim thickness Inlet (inch) mm	Epaisseur de bord Admission mm	NA = 2 (0,0787) TB = 2,3 (0,0906)	2,3 (0,0906)	NA = 2 (0,0787) TB = 2,3 (0,0906)	2,3 (0,0906)			
Randstärke Auslaß mm	Rim thickness Exhaust (inch) mm	Epaisseur de bord Echappement mm	1,9 (0,0748)						
Verschleißgrenze Einlaß Auslaß mm	Wear Limit Inlet Exhaust (inch) mm	Limite d'usure Admission Echappement mm	1,5 (0,059)						
Ventilrücksteh- maß Einlaß normal mm	Valve recess Inlet normal (inch) mm	Retrait de soup. Admission normal mm	1,2+0,2 (0,0472 - 0,0551)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	1,9 (0,0748)						
Ventilrücksteh- maß Auslaß normal mm	Valve recess Exhaust normal (inch) mm	Retrait de soupape Echappe- ment normal mm	NA = 1,5+0,2 (0,0591-0,0669) TB = 1,3+0,2 (0,0512-0,0591)	1,3+0,2 (0,0512-0,0591)	NA = 1,5+0,2 (0,0591-0,0669) TB = 1,3+0,2 (0,0512-0,0591)	1,3 +0,2 (0,0512 - 0,0591)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	NA = 2,2 (0,0866) TB = 2 (0,0787)	2 (0,0787)	NA = 2,2 (0,0866) TB = 2 (0,0787)	2 (0,0787)			

Zylindereinheit		Cylinder Assembly	Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Ventilteller Ø Auslaß mm	Valve head diameter Exhaust (inch) mm	Tête de soupape Ø Echappement mm	48,8±0,1 (1,9173 - 1,9252)					
Sitzwinkel Einlaß Grad	Valve seat angle Inlet degree	Angle de siège Admission degrés	30°					
Sitzwinkel Auslaß Grad	Valve seat angle Exhaust degree	Angle de siège Echappement degrés	45°					
Randstärke Einlaß mm	Rim thickness Inlet (inch) mm	Epaisseur de bord Admission mm	2,82 (0,1110)					
Randstärke Auslaß mm	Rim thickness Exhaust (inch) mm	Epaisseur de bord Echappement mm	2,92 (0,1150)					
Verschleißgrenze Einlaß Auslaß mm	Wear Limit Inlet Exhaust (inch) mm	Limite d'usure Admission Echappement mm	1,8 (0,0709)					
Ventilrücksteh- maß Einlaß normal mm	Valve recess Inlet normal (inch) mm	Retrait de soup. Admission normal mm	1,2+0,2 (0,0472 - 0,0551)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	1,9 (0,0778)					
Ventilrücksteh- maß Auslaß normal mm	Valve recess Exhaust normal (inch) mm	Retrait de soupape Echappe- ment normal mm	1,3+0,2 (0,0512 - 0,0596)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	2 (0,0787)					

Zylindereinheit			Cylinder Assembly		Unité-Cylindre	
Motortype		Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI -EA5	
Ventilteller Ø Auslaß	mm	Valve head diameter Exhaust (inch) mm	Tête de soupape Ø Echappement mm	48,8±0,1 (1,9173 - 1,9252)		
Sitzwinkel Einlaß	Grad	Valve seat angle Inlet degree	Angle de siège Admission degrés	30°		
Sitzwinkel Auslaß	Grad	Valve seat angle Exhaust degree	Angle de siège Echappement degrés	45°		
Randstärke Einlaß	mm	Rim thickness Inlet (inch) mm	Epaisseur de bord Admission mm	2,82 (0,1110)		
Randstärke Auslaß	mm	Rim thickness Exhaust (inch) mm	Epaisseur de bord Echappement mm	2,92 (0,1150)		
Verschleißgrenze Einlaß Auslaß	mm	Wear Limit Inlet Exhaust (inch) mm	Limite d'usure Admission Echappement mm	1,8 (0,0709)		
Ventilrücksteh- maß Einlaß normal	mm	Valve recess Inlet normal (inch) mm	Retrait de soup. Admission normal mm	1,2+0,2 (0,0472 - 0,0551)		
Grenzwert	mm	Limit (inch) mm	Valeur limite mm	1,9 (0,0778)		
Ventilrücksteh- maß Auslaß normal	mm	Valve recess Exhaust normal (inch) mm	Retrait de soupape Echappe- ment normal mm	1,3+0,2 (0,0512 - 0,0596)		
Grenzwert	mm	Limit (inch) mm	Valeur limite mm	2 (0,0787)		

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Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Gesamthöhe des Zylinderkopfes mm	Total of height cylinder head (inch) mm	Hauteur totale de culasse mm	114 - 0,2 (4,4803 - 4,4882)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	113,3 (4,4606)						
Ventilfeder Windungen insgesamt	Valve spring Total windings	Ressort de soup. Spires au total	Bisher, pre viously, jusqu' à 7,8		Neu, new, nouveau 6,3		6,3 2 Feder Ausl. 2 st spring Exh. 2 e Ressort Echap. 7		
Länge ungespannt normal mm	Length unloaded normal (inch) mm	Longueur non comprimée normal mm	Bisher, pre viously, jusqu' à 775 (2,953)		Neu, new, nouveau 57 (2,244)		57 (2,244) 2 Feder Ausl. 2 st spring Exh. 2 e Ressort Echap. 49,8 1,961)		
Länge ungespannt Ermüdungsgrenze mm	Length unloaded Fatigue limit (inch) mm	Longueur non comprimée, limite de fatigue mm			Neu, new, nouveau 55 (2,1654)		57 (2,1654) 2 Feder Ausl. 2 st spring Exh. 2 e Ressort Echap. 47 1,850)		
Zylinderkopf-schrauben Länge mm	Cylinder head bolt Length (inch) mm	Boulons de culasse Longueur mm	161 -1,5 (6,2795 - 2,1654)						
Grenzwert mm	Limit (inch) mm	Valeur limit mm	162,5 (6,3976)						
Zylinderlauf-buchse Bohrung,normal mm	Cylinder liner Bore, normal (inch) mm	Chemise de cylinder Alésage, normal mm	115 +0,02 (4,5276 - 4,5283)				120 +0,02 (4,7244 - 4,7252)		122 +0,02 (4,8031 - 4,8039)
Bohrung Verschleißgrenze mm	Bore wear Limit (inch) mm	Alésage Limite d'usure mm							
Überstand zum Kurbelgehäuse mm	projecting length to crankcase (inch) mm	projektion à boîte de manivelle mm	Weichstoff-Dichtung soft substance gasket joint non métallique molle		0,03 - 0,08 (0,0012 - 0,031)		Metall-Dichtung metal gasket joint métallique		0,05 - 0,1 (0,002 - 0,0039)

Zylindereinheit		Cylinder Assembly	Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Gesamthöhe des Zylinderkopfes mm	Total of height cylinder head (inch) mm	Hauteur totale de culasse mm	114 - 0,2 (4,4803 - 4,4882)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	113,3 (4,4606)					
<u>Ventilfeder</u> Windungen insgesamt	<u>Valve spring</u> Total windings	<u>Ressort de soup.</u> Spires au total	6,75		2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement		7,75	
Länge ungespannt normal mm	Length unloaded normal (inch) mm	Longueur non comprimée normal mm	63,5 (2,5)		2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement		55,5 (2,1850)	
Länge ungespannt Ermüdungsgrenze mm	Length unloaded Fatigue limit (inch) mm	Longueur non comprimée, limite de fatigue mm	61,5 (2,4213)		2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement		53,5 (2,1063)	
<u>Zylinderkopf-schrauben</u> Länge mm	<u>Cylinder head bolt</u> Length (inch) mm	<u>Boulons de culasse</u> Longueur mm	161 -1,5 (6,2795 - 2,1654)					
Grenzwert mm	Limit (inch) mm	Valeur limit mm	162,5 (6,3976)					
<u>Zylinderlauf-buchse</u> Bohrung,normal mm	<u>Cylinder liner</u> Bore, normal (inch) mm	<u>Chemise de cylindrer</u> Alésage, normal mm						
Bohrung Verschleißgrenze mm	Bore wear Limit (inch) mm	Alésage Limite d'usure mm						
Überstand zum Kurbelgehäuse mm	projecting length to crankcase (inch) mm	projektion à boîte de manivelle mm	Weichstoff-Dichtung soft substance gasket joint non métallique molle		0,03 - 0,08 (0,0012 - 0,031)		Metall-Dichtung metal gasket joint métallique 0,05 - 0,1 (0,002 - 0,0039)	

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Zylindereinheit		Cylinder Assembly	Unité-Cylindre		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Gesamthöhe des Zylinderkopfes mm	Total of height cylinder head (inch) mm	Hauteur totale de culasse mm	114 - 0,2 (4,4803 - 4,4882)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm			
Ventilfeder Windungen insgesamt	Valve spring Total windings	Ressort de soup. Spires au total	6,75	2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement	7,75
Länge ungespannt normal mm	Length unloaded normal (inch) mm	Longueur non comprimée normal mm	63,5 (2,5)	2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement	55,5 (2,1850)
Länge ungespannt Ermüdungsgrenze mm	Length unloaded Fatigue limit (inch) mm	Longueur non comprimée, limite de fatigue mm	61,5 (2,4213)	2 Feder Auslaß 2nd Spring Exhaust 2e Ressort Echappement	53,5 (2,1063)
Zylinderkopf-schrauben Länge mm	Cylinder head bolt Length (inch) mm	Boulons de culasse Longueur mm	161 - 1,5 (6,2795 - 6,3386)		
Grenzwert mm	Limit (inch) mm	Valeur limit mm	162,5 (6,3976)		
Zylinderlauf-buchse Bohrung, normal mm	Cylinder liner Bore, normal (inch) mm	Chemise de cylinder Alésage, normal mm	122 + 0,2 (4,8031 - 4,8039)		
Bohrung Verschleißgrenze mm	Bore wear Limit (inch) mm	Alésage Limite d'usure mm			
Überstand zum Kurbelgehäuse mm	projecting length to crankcase (inch) mm	projektion à boîte de manivelle mm	Metall-Dichtung metal gasket joint métallique 0,05 - 0,1 (0,002 - 0,0039)		

Zylindereinheit			Cylinder Assembly			Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI	
Kolben Durchmesser normal mm	Piston Diameter normal (inch) mm	Piston Diamètre normal mm	115 (4,5276)				120 (4,7244)		122 (4,8031)	
Bohrung für Kolbenbolzen mm	Piston pin bore diameter (inch) mm	Alésage d'axe de piston mm	45 ^{+0,012} _{+0,005} (1,7719 - 1,7721)							
Kolbenbolzen Durchmesser mm	Piston pin diameter (inch) mm	Diamètre axe de piston mm	45 ^{-0,006} (1,7714 - 1,7717)							
Kolbenringnut Höhe 1. Ringnut mm	Piston ring groove width of 1 nd groove (inch) mm	Hauteur de gorge pour segment de feu mm	2,72 ± 0,015 (0,1065 - 0,1077)	gemessen auf based on mesuré sur	Ø 112 (4,4094)		2,72 ± 0,015 (0,1065 - 0,1077)	gemessen auf based on mesuré sur	Ø 117 (4,4063)	3,22 ± 0,015 g. Ø 119 (0,1262 - b.o.(4,6850) 0,1274) m.s.
Höhe 2. Ringnut mm	Width 2 nd groove (inch) mm	Hauteur de la 2 ^e gorge mm	2,5 ^{+0,08} _{+0,06} (0,1008 - 0,1016)							
Höhe Ölringnut mm	Width of scraper ring groove (inch) mm	Hauteur de gorge pour segment racleur d'huile mm	4 ^{+0,04} _{+0,02} (0,1583 - 0,1591)							
Kolbenringe	Piston rings	Segments								
Axialspiel 1. Kompressions- ring mm	Axial clearance 1 st compression ring (inch) mm	Jeu axial 1 ^{er} seg- ment de compression mm	0,010 - 0,030 (0,0004 - 0,0012)	gemessen auf based on mesuré sur	Ø 112 (4,4094)		0,010-0,030 (0,004- 0,0012)	gemessen auf based on mesuré sur	Ø 117 (4,4063)	0,110-0,165 g. Ø 119 (0,0043 - b.o.(4,6850) 0,0065) m.s.
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm								
2. Kompressionsring mm	2 nd compression ring (inch) mm	2 ^e segment de compression mm	0,010 - 0,022 (0,0004 - 0,0009)							0,070 - 0,102 (0,0028 - 0,0040)

Zylindereinheit			Cylinder Assembly			Unité-Cylindre		
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Kolben Durchmesser normal mm	Piston Diameter normal (inch) mm	Piston Diamètre normal mm	122 (4,8031)					
Bohrung für Kolbenbolzen mm	Piston pin bore diameter (inch) mm	Alésage d'axe de piston mm	45 ^{+0,012} _{+0,005} (1,7719 - 1,7721)					
Kolbenbolzen Durchmesser mm	Piston pin diameter (inch) mm	Diamètre axe de piston mm	45 ^{-0,006} (1,7714 - 1,7717)					
Kolbenringnut Höhe 1. Ringnut mm	Piston ring groove width of 1 nd groove (inch) mm	Hauteur de gorge pour segment de feu mm	3,22 ±0,015 (0,1262 - 0,1274)	gemessen auf based on mesuré sur		Ø 119 (4,6850)		
Höhe 2. Ringnut mm	Width 2 nd groove (inch) mm	Hauteur de la 2 ^e gorge mm	2,5 ^{+0,08} _{+0,06} (0,1008 - 0,1016)					
Höhe Ölingnut mm	Width of scraper ring groove (inch) mm	Hauteur de gorge pour segment racleur d'huile mm	4 ^{+0,04} _{+0,02} (0,1583 - 0,1591)					
Kolbenringe	Piston rings	Segments						
Axialspiel 1. Kompressions- ring mm	Axial clearance 1 st compression ring (inch) mm	Jeu axial 1 ^{er} seg- ment de compression mm	0,110 - 0,165 (0,0043 - 0,0065)	gemessen auf based on mesuré sur		Ø 119 (4,6850)		
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm						
2. Kompressionsring mm	2 nd compression ring (inch) mm	2 ^e segment de compression mm	0,070 - 0,102 (0,028 - 0,0040)					

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Zylindereinheit		Cylinder Assembly		Unité-Cylindre		
Motortype		Engine Type	Type de moteur	D 924 TI-EA5	D 924 TI-EA5	
Kolben Durchmesser normal mm	Piston Diameter normal (inch) mm	Piston Diamètre normal mm	122 (4,8031)			
Bohrung für Kolbenbolzen mm	Piston pin bore diameter (inch) mm	Alésage d'axe de piston mm	45 ^{+0,012} _{+0,005} (1,7719 - 1,7721)			
Kolbenbolzen Durchmesser mm	Piston pin diameter (inch) mm	Diamètre axe de piston mm	45 ^{-0,006} (1,7714 - 1,7717)			
Kolbenringnut Höhe 1. Ringnut mm	Piston ring groove width of 1 nd groove (inch) mm	Hauteur de gorge pour segment de feu mm	3,22 ±0,015 (0,1262 - 0,1274)	gemessen auf based on mesuré sur	Ø 119 (4,6850)	
Höhe 2. Ringnut mm	Width 2 nd groove (inch) mm	Hauteur de la 2 ^e gorge mm	2,5 ^{+0,08} _{+0,06} (0,1008 - 0,1016)			
Höhe Ölringnut mm	Width of scraper ring groove (inch) mm	Hauteur de gorge pour segment racleur d'huile mm	4 ^{+0,04} _{+0,02} (0,1583 - 0,1591)			
Kolbenringe	Piston rings	Segments				
Axialspiel 1. Kompressions- ring mm	Axial clearance 1 st compression ring (inch) mm	Jeu axial 1 ^{er} seg- ment de compression mm	0,110 - 0,165 (0,0043 - 0,0065)	gemessen auf based on mesuré sur	Ø 119 (4,6850)	
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm				
2. Kompressionsring mm	2 nd compression ring (inch) mm	2 ^e segment de compression mm	0,070 - 0,102 (0,028 - 0,0040)			

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Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm							
Ölschlitzring mm	Slotted oil ring (inch) mm	Segment racleur mm	0,010 - 0,025 (0,0004 - 0,0010)						0,030 - 0,065 (0,0012 - 0,0026)
Spielgrenze mm	Clearance limit (inch) mm	Limit de jeu mm							
Stoßspiel Ver- dichtungsringe normal mm	Gap clearance, compression ring, normal (inch) mm	Jeu à la coupe segments de compression, normal mm	0,4 - 0,65 (0,0157 - 0,0256)						
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm							
Stoßspiel Ölschlitzring normal mm	Gap clearance slotted oil ring normal (inch) mm	Jeu à la coupe segment racleur normal mm	0,3 - 0,6 (0,0118 - 0,0236)						
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm							
<u>Pleuelstange</u>	<u>Connecting rod</u>	<u>Bielle</u>							
Bohrung für Kolbenbolzen- buchse mm	Piston pin bore in bushing (inch) mm	Alésage pour bague de pied de bielle mm	49 + 0,025 (1,9291 - 1,9301)						
Außendurch- messer Kolben- bolzenbuchse mm	Outside diameter piston pin bushing (inch) mm	Bague de pied de bielle, Diamètre extérieur mm	49,065 + 0,04 (1,9317 - 1,9333)						

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Zylindereinheit		Cylinder Assembly	Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm						
Ölschlitzring mm	Slotted oil ring (inch) mm	Segment racleur mm	0,030 - 0,065 (0,0012 - 0,0026)					
Spielgrenze mm	Clearance limit (inch) mm	Limit de jeu mm						
Stoßspiel Ver- dichtungsringe normal mm	Gap clearance, compression ring, normal (inch) mm	Jeu à la coupe segments de compression, normal mm	0,4 - 0,65 (0,0157 - 0,0256)					
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm						
Stoßspiel Ölschlitzring normal mm	Gap clearance slotted oil ring normal (inch) mm	Jeu à la coupe segment racleur normal mm	0,3 - 0,6 (0,0118 - 0,0236)					
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm						
<u>Pleuelstange</u>	<u>Connecting rod</u>	<u>Bielle</u>						
Bohrung für Kolbenbolzen- buchse mm	Piston pin bore in bushing (inch) mm	Alésage pour bague de pied de bielle mm	49+0,025 (1,9291 - 1,9301)					
Außendurch- messer Kolben- bolzenbuchse mm	Outside diameter piston pin bushing (inch) mm	Bague de pied de bielle, Diamètre extérieur mm	49,065+0,04 (1,9317 - 1,9333)					

Zylindereinheit		Cylinder Assembly	Unité-Cylindre		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm			
Ölschlitzring mm	Slotted oil ring (inch) mm	Segment racleur mm	0,030 - 0,065 (0,0012 - 0,0026)		
Spielgrenze mm	Clearance limit (inch) mm	Limit de jeu mm			
Stoßspiel Ver- dichtungsringe normal mm	Gap clearance, compression ring, normal (inch) mm	Jeu à la coupe segments de compression, normal mm	0,4 - 0,65 (0,0157 - 0,0256)		
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm			
Stoßspiel Ölschlitzring normal mm	Gap clearance slotted oil ring normal (inch) mm	Jeu à la coupe segment racleur normal mm	0,3 - 0,6 (0,0118 - 0,0236)		
Stoßspiel Grenzwert mm	Gap clearance limit (inch) mm	Jeu à la coupe Limite mm			
<u>Pleuelstange</u>	<u>Connecting rod</u>	<u>Bielle</u>			
Bohrung für Kolbenbolzen- buchse mm	Piston pin bore in bushing (inch) mm	Alésage pour bague de pied de bielle mm	49 + 0,025 (1,9291 - 1,9301)		
Außendurch- messer Kolben- bolzenbuchse mm	Outside diameter piston pin bushing (inch) mm	Bague de pied de bielle, Diamètre extérieur mm	49,065 + 0,04 (1,9317 - 1,9333)		

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Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Innendurchmesser eingepreßt mm	Inside diameter installed (inch) mm	Diamètre intérieur après montage à la presse mm	Neu new nouveau	45,040 + 0,015 (1,7732 - 1,7738)			Reparatur Repair Reparation	45,0449 + 0,075 (1,7734 - 1,7764)	
Spiel des Kolbenbolzens in der Buchse mm	Piston pin clearance in bushing (inch) mm	Jeu de l'axe de piston dans la bague de pied de bielle mm	Neu new nouveau	0,04 - 0,061 (0,0016 - 0,0024)			Reparatur Repair Reparation	0,045 - 0,126 (0,0018 - 0,005)	
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm				0,20 (0,0079)			
Bohrung für Pleuellager mm	Connecting rod bearing bore (inch) mm	Diamètre d'alésage des paliers de tête de bielle mm				80 + 0,019 (3,1496 - 3,1504)			
Pleuellagerschalen Innendurchmesser, normal mm	Bearing shell, inside diameter, normal (inch) mm	Coussinets de tête de bielle, Diamètr. intérieure, normal mm				75,05 + 0,043 (2,9547 - 2,9564)			
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous-dimensionnées				4			
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous dimensionnée de mm				0,25 (0,0098)			
Lagerbreite mm	Width of bearing (inch) mm	Largeur des paliers mm				34 - 0,4 (1,3228 - 1,3386)			
Pleuelstangenbreite mm	Width of connecting rod (inch) mm	Largeur de corps de bielle mm				44,85 - 0,2 (1,7579 - 1,7657)			
Mittenabstand von Pleuellager zur Kolbenbolzenbuchse mm	Centerline distan. between bearing and bushing (inch) mm	Entraxe du palier de bielle au coussinet d'axe de piston mm				228 - 0,05 (8,9744 - 8,9764)			

Zylindereinheit			Cylinder Assembly		Unité-Cylindre			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Innendurchmesser eingepreßt mm	Inside diameter installed (inch) mm	Diamètre intérieur après montage à la presse mm	Neu new nouveau	45,040 + 0,015 (1,7732 - 1,7738)		Reparatur Repair Reparation	45,0449 + 0,075 (1,7734 - 1,7764)	
Spiel des Kolbenbolzens in der Buchse mm	Piston pin clearance in bushing (inch) mm	Jeu de l'axe de piston dans la bague de pied de bielle mm	Neu new nouveau	0,04 - 0,061 (0,0016 - 0,0024)		Reparatur Repair Reparation	0,045 - 0,126 (0,0018 - 0,005)	
Spielgrenze mm	Clearance limit (inch) mm	Limite de jeu mm		0,20 (0,0079)				
Bohrung für Pleuellager mm	Connecting rod bearing bore (inch) mm	Diamètre d'alésage des paliers de tête de bielle mm		80 + 0,019 (3,1496 - 3,1504)				
Pleuellagerschalen Innendurchmesser, normal mm	Bearing shell, inside diameter, normal (inch) mm	Coussinets de tête de bielle, Diamètre. intérieure, normal mm		75,05 + 0,043 (2,9547 - 2,9564)				
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous-dimensionnées		4				
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous dimensionnée de mm		0,25 (0,0098)				
Lagerbreite mm	Width of bearing (inch) mm	Largeur des paliers mm		34 - 0,4 (1,3228 - 1,3386)				
Pleuelstangenbreite mm	Width of connecting rod (inch) mm	Largeur de corps de bielle mm		44,85 - 0,2 (1,7579 - 1,7657)				
Mittenabstand von Pleuellager zur Kolbenbolzenbuchse mm	Centerline distan. between bearing and bushing (inch) mm	Entraxe du palier de bielle au coussinet d'axe de piston mm		228 - 0,05 (8,9744 - 8,9764)				

Zylindereinheit			Cylinder Assembly			Unité-Cylindre		
Motortype		Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5			
Innendurchmesser eingepreßt		Inside diameter installed	Diamètre intérieur après montage à la presse			45,040 +0,015 (1,7732 - 1,7738)		
mm		(inch) mm	mm					
Spiel des Kolbenbolzens in der Buchse		Piston pin clearance in bushing	Jeu de l'axe de piston dans la bague de pied de bielle			0,04 - 0,061 (0,0016 - 0,0024)		
mm		(inch) mm	mm					
Spielgrenze		Clearance limit	Limite de jeu			0,20 (0,0079)		
mm		(inch) mm	mm					
Bohrung für Pleuellager		Connecting rod bearing bore	Diamètre d'alésage des paliers de tête de bielle			80 +0,019 (3,1496 - 3,1504)		
mm		(inch) mm	mm					
Pleuellagerschalen Innendurchmesser, normal		Bearing shell, inside diameter, normal	Coussinets de tête de bielle, Diamètr. intérieure, normal			75,05 +0,043 (2,9547 - 2,9564)		
mm		(inch) mm	mm					
Anzahl der Untermaßstufen		Number of undersizes	Nombre de cotes sous-dimensionnées			4		
Untermaß je Stufe		Undersized measurement in increments of	Chaque cote sous dimensionnée de			0,25 (0,0098)		
mm		(inch) mm	mm					
Lagerbreite		Width of bearing	Largeur des paliers			34 - 0,4 (1,3228 - 1,3386)		
mm		(inch) mm	mm					
Pleuelstangenbreite		Width of connecting rod	Largeur de corps de bielle			44,85 - 0,2 (1,7579 - 1,7657)		
mm		(inch) mm	mm					
Mittenabstand von Pleuellager zur Kolbenbolzenbuchse		Centerline distan. between bearing and bushing	Entraxe du palier de bielle au coussinet d'axe de piston			228 - 0,05 (8,9744 - 8,9764)		
mm		(inch) mm	mm					

Zylindereinheit			Cylinder Assembly		Unité-Cylindre				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Parallelität von Pleuellager zur Pleuellagerbuchse mm	Parallel distance between bearing and bushing (inch) mm	Parallélisme du palier de bielle au coussinet d'axe de piston mm	0,011 (0,0004)						
<u>Pleuellagerspiele</u>	<u>Connecting rod bearing clearance</u>	<u>Jeu-palier de tête de bielle</u>							
Radialspiel normal mm	Radial clearance, normal (inch) mm	Jeu radial normal mm	0,06 - 0,122 (0,0024 - 0,0048)						
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valuer limite (dépende de la pression de l'huile) mm	0,19 (0,0075)						
Axialspiel normal mm	Axial clearance, normal (inch) mm	Jeu axial normal mm	0,15 - 0,45 (0,0059 - 0,0177)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)						
<u>Pleuelschrauben</u> Länge mm	<u>Connecting rod bolt</u> Length (inch) mm	<u>Boulons de tête de bielle</u> Longueur mm	65 - 0,6 (2,5354 - 2,5591)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	65,5 (2,5787)						

Zylindereinheit		Cylinder Assembly	Unité-Cylindre					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Parallelität von Pleuellager zur Pleuellagerbuchse mm	Parallel distance between bearing and bushing (inch) mm	Parallélisme du palier de bielle au coussinet d'axe de piston mm	0,011 (0,0004)					
<u>Pleuellagerspiele</u>	<u>Connecting rod bearing clearance</u>	<u>Jeu-palier de tête de bielle</u>						
Radialspiel normal mm	Radial clearance, normal (inch) mm	Jeu radial normal mm	0,06 - 0,122 (0,0024 - 0,0048)					
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valuer limite (dépende de la pression de l'huile) mm	0,19 (0,0075)					
Axialspiel normal mm	Axial clearance, normal (inch) mm	Jeu axial normal mm	0,15 - 0,45 (0,0059 - 0,0177)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)					
<u>Pleuelschrauben</u> Länge mm	<u>Connecting rod bolt</u> Length (inch) mm	<u>Boulons de tête de bielle</u> Longueur mm	65 - 0,6 (2,5354 - 2,5591)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	65,5 (2,5787)					

Zylindereinheit	Cylinder Assembly	Unité-Cylindre	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5 D 926 TI-EA5
Parallelität von Pleuellager zur Pleuellagerbuchse mm	Parallel distance between bearing and bushing (inch) mm	Parallélisme du palier de bielle au coussinet d'axe de piston mm	0,011 (0,0004)
<u>Pleuellagerspiele</u>	<u>Connecting rod bearing clearance</u>	<u>Jeu-palier de tête de bielle</u>	
Radialspiel normal mm	Radial clearance, normal (inch) mm	Jeu radial normal mm	0,06 - 0,122 (0,0024 - 0,0048)
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valuer limite (dépende de la pression de l'huile mm	0,19 (0,0075)
Axialspiel normal mm	Axial clearance, normal (inch) mm	Jeu axial normal mm	0,15 - 0,45 (0,0059 - 0,0177)
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)
<u>Pleuelschrauben</u> Länge mm	<u>Connecting rod bolt</u> Length (inch) mm	<u>Boulons de tête de bielle</u> Longueur mm	65 - 0,6 (2,5354 - 2,5591)
Grenzwert mm	Limit (inch) mm	Valeur limite mm	65,5 (2,5787)

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1.08.18

Triebwerk			Crank and Camshaft Drive			Embiellage				
Motortype		Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Zwischenrad</u>		<u>Intermediate gear wheel</u>	<u>Pignon intermédiaire</u>							
Radialspiel	mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,121 (0,0020 - 0,0048)						
Grenzwert	mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)						
Axialspiel	mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)						
Grenzwert	mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)						
Lagerzapfen Durchmesser	mm	Journal diameter (inch) mm	Portée Diamètre mm	45 -0,050 -0,075 (1,7687 - 1,7697)						
Lagerbuchse Durchmesser	mm	Bushing diameter (inch) mm	Diamètre coussinet de palier mm	45 + 0,046 (1,7717 - 1,7735)						
<u>Nockenwelle</u>		<u>Camshaft</u>	<u>Arbre à cames</u>							
Axialspiel	mm	Axial clearance (inch) mm	Jeu axial mm	0,3 - 0,45 (0,0118 - 0,0177)						
Grenzwert	mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)						
Radialspiel	mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,15 (0,0024 - 0,0059)						
Grenzwert (Öl-druck entscheidend)	mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (Dépend de la pression de l'huile) mm	0,22 (0,0087)						

Triebwerk			Crank and Camshaft Drive			Embiellage		
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
<u>Zwischenrad</u> Radialspiel mm	<u>Intermediate gear wheel</u> Radial clearance (inch) mm	<u>Pignon intermédiaire</u> Jeu radial mm	0,05 - 0,121 (0,0020 - 0,0048)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					
Lagerzapfen Durchmesser mm	Journal diameter (inch) mm	Portée Diamètre mm	45 ^{-0,050} _{-0,075} (1,7687 - 1,7697)					
Lagerbuchse Durchmesser mm	Bushing diameter (inch) mm	Diamètre coussinet de palier mm	45 ^{+0,046} (1,7717 - 1,7735)					
<u>Nockenwelle</u> Axialspiel mm	<u>Camshaft</u> Axial clearance (inch) mm	<u>Arbre à cames</u> Jeu axial mm	0,3 - 0,45 (0,0118 - 0,0177)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,15 (0,0024 - 0,0059)					
Grenzwert (Öl-druck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (Dépend de la pression de l'huile) mm	0,22 (0,0087)					

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
<u>Zwischenrad</u> Radialspiel mm	<u>Intermediate gear wheel</u> Radial clearance (inch) mm	<u>Pignon intermédiaire</u> Jeu radial mm	0,05 - 0,121 (0,0020 - 0,0048)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)		
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		
Lagerzapfen Durchmesser mm	Journal diameter (inch) mm	Portée Diamètre mm	45 -0,050 -0,075 (1,7687 - 1,7697)		
Lagerbuchse Durchmesser mm	Bushing diameter (inch) mm	Diamètre coussinet de palier mm	45 + 0,046 (1,7717 - 1,7735)		
<u>Nockenwelle</u> Axialspiel mm	<u>Camshaft</u> Axial clearance (inch) mm	<u>Arbre à cames</u> Jeu axial mm	0,3 - 0,45 (0,0118 - 0,0177)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,8 (0,0315)		
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,15 (0,0024 - 0,0059)		
Grenzwert (Öl-druck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (Dépend de la pression de l'huile) mm	0,22 (0,0087)		

Triebwerk		Crank and Camshaft Drive		Embiellage					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Lagerbuchse Innendurchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre intérieur mm	60+0,06 (2,3622 - 2,3646)						
Lagerzapfen Durchmesser mm	Journal diameter (inch) mm	Portée Diamètre mm	59,91+0,03 (2,3587 - 2,3598)						
Nockenhub Einlaß mm	Valve cam lift Inlet (inch) mm	Levée de came- admission mm	8,5 (0,3346)						
Nockenhub Auslaß mm	Valve cam lift exhaust (inch) mm	Levée de came- échappement mm	9 (0,3543)						
<u>Kurbelwelle</u>	<u>Crankshaft</u>	<u>Vilebrequin</u>							
Hubzapfen Durchmesser normal mm	Connecting rod pin diameter normal (inch) mm	Maneton diamètre normal mm	75 ^{- 0,010} ^{- 0,029} (2,9516 - 2,9524)						
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4						
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnée de mm	0,25 (0,0098)						
Zapfenhärte normal HRC	Hardness normal HRC	Dureté du maneton normal HRC	54 ± 3						
Grenzwert HRC	Limit HRC	Valeur limite HRC	42						

Triebwerk			Crank and Camshaft Drive		Embiellage			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Lagerbuchse Innendurchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre intérieur mm	60 +0,06 (2,3622 - 2,3646)					
Lagerzapfen Durchmesser mm	Journal diameter (inch) mm	Portée Diamètre mm	59,91 +0,03 (2,3587 - 2,3598)					
Nockenhub Einlaß mm	Valve cam lift Inlet (inch) mm	Levée de came- admission mm	8,5 (0,3346)					
Nockenhub Auslaß mm	Valve cam lift exhaust (inch) mm	Levée de came- échappement mm	9 (0,3543)					
<u>Kurbelwelle</u>	<u>Crankshaft</u>	<u>Vilebrequin</u>						
Hubzapfen Durchmesser normal mm	Connecting rod pin diameter normal (inch) mm	Maneton diamètre normal mm	75 -0,010 -0,029 (2,9516 - 2,9524)					
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4					
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnée de mm	0,25 (0,0098)					
Zapfenhärte normal HRC	Hardness normal HRC	Dureté du maneton normal HRC	54 ± 3					
Grenzwert HRC	Limit HRC	Valeur limite HRC	42					

Triebwerk			Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
Lagerbuchse Innendurchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre intérieur mm	60 + 0,06 (2,3622 - 2,3646)			
Lagerzapfen Durchmesser mm	Journal diameter (inch) mm	Portée Diamètre mm	59,91 + 0,03 (2,3587 - 2,3598)			
Nockenhub Einlaß mm	Valve cam lift Inlet (inch) mm	Levée de came- admission mm	8,5 (0,3346)			
Nockenhub Auslaß mm	Valve cam lift exhaust (inch) mm	Levée de came- échappement mm	9 (0,3543)			
<u>Kurbelwelle</u>	<u>Crankshaft</u>	<u>Vilebrequin</u>				
Hubzapfen Durchmesser normal mm	Connecting rod pin diameter normal (inch) mm	Maneton diamètre normal mm	75 - 0,010 - 0,029 (2,9516 - 2,9524)			
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4			
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnée de mm	0,25 (0,0098)			
Zapfenhärte normal HRC	Hardness normal HRC	Dureté du maneton normal HRC	54 ± 3			
Grenzwert HRC	Limit HRC	Valeur limite HRC	42			

Triebwerk			Crank and Camshaft Drive			Embiellage			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Hauptlagerzapfen Durchmesser normal mm	Crankshaft bearing journal Diameter normal (inch) mm	Tourillen principal Diamètre normal mm	98 ^{- 0,012} _{- 0,034} (3,8569 - 3,8578)						
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4						
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnées de mm	0,25 (0,0098)						
Zapfenbreite mm	Width of journal (inch) mm	Largeur du tourillon mm	40 ^{+0,2} (1,5748 - 1,5827)						
Zapfenhärte normal HRC	Hardness of journal, normal HRC	Dureté du tourillon, normal HRC	54 ± 3						
Grenzwert HRC	Limit HRC	Valeur limite HRC	42						
<u>Kurbelwellen- lager</u>	<u>Crankshaft main bearing</u>	<u>Palier de ligne d'arbre</u>							
Bohrung für Kurbelwellen- lager mm	Bore diameter for main bearing (inch) mm	Alésage de palier de ligne d'arbre mm	104 ^{+ 0,022} (4,0945 - 4,0954)						
Lagerschalen Innendurchmesser normal mm	Bearing shell Inside diameter, normal (inch) mm	Diamètre intérieur normal mm	98,05 ^{+ 0,046} (3,8602 - 3,8620)						
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnés	4						

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1.12.05

Triebwerk		Crank and Camshaft Drive	Embiellage					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Hauptlagerzapfen Durchmesser normal mm	Crankshaft bearing journal Diameter normal (inch) mm	Tourillen principal Diamètre normal mm	98 ^{-0,012} _{-0,034} (3,8569 - 3,8578)					
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4					
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnées de mm	0,25 (0,0098)					
Zapfenbreite mm	Width of journal (inch) mm	Largeur du tourillon mm	40 ^{+0,2} (1,5748 - 1,5827)					
Zapfenhärte normal HRC	Hardness of journal, normal HRC	Dureté du tourillon, normal HRC	54 ± 3					
Grenzwert HRC	Limit HRC	Valeur limite HRC	42					
<u>Kurbelwellen- lager</u>	<u>Crankshaft main bearing</u>	<u>Palier de ligne d'arbre</u>						
Bohrung für Kurbelwellen- lager mm	Bore diameter for main bearing (inch) mm	Alésage de palier de ligne d'arbre mm	104 ^{+0,022} (4,0945 - 4,0954)					
Lagerschalen Innendurchmesser normal mm	Bearing shell Inside diameter, normal (inch) mm	Diamètre intérieur normal mm	98,05 ^{+0,046} (3,8602 - 3,8620)					
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnés	4					

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Hauptlagerzapfen Durchmesser normal mm	Crankshaft bearing journal Diameter normal (inch) mm	Tourillen principal Diamètre normal mm	98 ^{- 0,012} _{- 0,034} (3,8569 - 3,8578)		
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnées	4		
Untermaß je Stufe mm	Undersized measurement in increments of (inch) mm	Chaque cote sous- dimensionnées de mm	0,25 (0,0098)		
Zapfenbreite mm	Width of journal (inch) mm	Largeur du tourillon mm	40 ^{+0,2} (1,5748 - 1,5827)		
Zapfenhärte normal HRC	Hardness of journal, normal HRC	Dureté du tourillon, normal HRC	54 ± 3		
Grenzwert HRC	Limit HRC	Valeur limite HRC	42		
<u>Kurbelwellen- lager</u>	<u>Crankshaft main bearing</u>	<u>Palier de ligne d'arbre</u>			
Bohrung für Kurbelwellen- lager mm	Bore diameter for main bearing (inch) mm	Alésage de palier de ligne d'arbre mm	104 ^{+0,022} (4,0945 - 4,0954)		
Lagerschalen Innendurchmesser normal mm	Bearing shell Inside diameter, normal (inch) mm	Diamètre intérieur normal mm	98,05 ^{+0,046} (3,8602 - 3,8620)		
Anzahl der Untermaßstufen	Number of undersizes	Nombre de cotes sous- dimensionnés	4		

Triebwerk			Crank and Camshaft Drive			Embiellage			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Untermaß je Stufe mm	Undersized measurements in increments of (inch) mm	Chaque cote sous-dimensionnée de mm	0,25 (0,0098)						
Radialspiel normal mm	Radial clearance normal (inch) mm	Jeu radial normal mm	0,062 - 0,130 (0,0024 - 0,0051)						
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (dépend de la pression d l'huile) mm	0,2 (0,0079)						
<u>Kurbelwellen-paßlager</u>	<u>Crankshaft thrust bearing</u>	<u>Coussinet de palier d'ajustage</u>							
Axialspiel normal mm	Axial clearance normal (inch) mm	Jeu axial normal mm	0,16 - 0,351 (0,0063 - 0,0138)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,5 (0,0197)						
Paßlagerzapfen Breite, normal mm	Thrust bearing journal length normal (inch) mm	Tourillon ajusté Largeur, normal mm	40+0,062 (1,5748 - 1,5772)						
Hohlkehlenradius mm	Fillet radius (inch) mm	Rayon de congé mm	5 ± 0,25 (0,1870 - 0,2067)						
Paßlagerstuhlbreite mm	Thrust bearing mount width (inch) mm	Largeur du palier ajusté mm	33 ^{-0,010} _{-0,039} (1,2977 - 1,2988)						
Paßlagerstuhlbreite mit Anlauf-scheiben, normal mm	Thrust bearing width incl.thrust washers, normal (inch) mm	Largeur du palier avec cales de jeu latéral, normal mm	39.711 + 0,129 (1,5634 - 1,5685)						

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1.12.07

Triebwerk			Crank and Camshaft Drive		Embiellage			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Untermaß je Stufe mm	Undersized measurements in increments of (inch) mm	Chaque cote sous-dimensionnée de mm	0,25 (0,0098)					
Radialspiel normal mm	Radial clearance normal (inch) mm	Jeu radial normal mm	0,062 - 0,130 (0,0024 - 0,0051)					
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (dépend de la pression d l'huile) mm	0,2 (0,0079)					
<u>Kurbelwellen- paßlager</u>	<u>Crankshaft thrust bearing</u>	<u>Coussinet de palier d'ajustage</u>						
Axialspiel normal mm	Axial clearance normal (inch) mm	Jeu axial normal mm	0,16 - 0,351 (0,0063 - 0,0138)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,5 (0,0197)					
Paßlagerzapfen Breite, normal mm	Thrust bearing journal length normal (inch) mm	Tourillon ajusté Largeur, normal mm	40+0,062 (1,5748 - 1,5772)					
Hohlkehlenradius mm	Fillet radius (inch) mm	Rayon de congé mm	5 ± 0,25 (0,1870 - 0,2067)					
Paßlagerstuhl- breite mm	Thrust bearing mount width (inch) mm	Largeur du palier ajusté mm	33 ^{-0,010} _{-0,039} (1,2977 - 1,2988)					
Paßlagerstuhl- breite mit Anlauf- scheiben, normal mm	Thrust bearing width incl.thrust washers, normal (inch) mm	Largeur du palier avec cales de jeu latéral, normal mm	39.711 + 0,129 (1,5634 - 1,5685)					

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Untermaß je Stufe mm	Undersized measurements in increments of (inch) mm	Chaque cote sous-dimensionnée de mm	0,25 (0,0098)		
Radialspiel normal mm	Radial clearance normal (inch) mm	Jeu radial normal mm	0,062 - 0,130 (0,0024 - 0,0051)		
Grenzwert (Öldruck entscheidend) mm	Limit (depending on oil pressure level) (inch) mm	Valeur limite (dépend de la pression d l'huile) mm	0,2 (0,0079)		
<u>Kurbelwellen- paßlager</u>	<u>Crankshaft thrust bearing</u>	<u>Coussinet de palier d'ajustage</u>			
Axialspiel normal mm	Axial clearance normal (inch) mm	Jeu axial normal mm	0,16 - 0,351 (0,0063 - 0,0138)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,5 (0,0197)		
Paßlagerzapfen Breite, normal mm	Thrust bearing journal length normal (inch) mm	Tourillon ajusté Largeur, normal mm	40 + 0,062 (1,5748 - 1,5772)		
Hohlkehlenradius mm	Fillet radius (inch) mm	Rayon de congé mm	5 ± 0,25 (0,1870 - 0,2067)		
Paßlagerstuhl-breite mm	Thrust bearing mount width (inch) mm	Largeur du palier ajusté mm	33 - 0,010 - 0,039 (1,2977 - 1,2988)		
Paßlagerstuhl-breite mit Anlauf-scheiben, normal mm	Thrust bearing width incl.thrust washers, normal (inch) mm	Largeur du palier avec cales de jeu latéral, normal mm	39.711 + 0,129 (1,5634 - 1,5685)		

Triebwerk		Crank and Camshaft Drive		Embiellage					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Anlaufscheiben Dicke normal mm	Thrust washer Thickness, normal (inch) mm	Cales de jeu latéral epaisseur, normal mm	3,375 + 0,05 (0,1329 - 0,1348)						
Anzahl der Übermaßstufen	Number of oversizes	Nombre de cotes de réparation	2						
Übermaß je Stufe mm	Oversized measurement in increments of (inch) mm	Chaque cote de réparation mm	0,25 (0,0098)						
<u>Hydraulikpumpen</u> - Antrieb Untergruppe 8.28	<u>Hydraulic pump</u> drive sub-group 8.28	<u>Entrainement de</u> <u>pompe hydraul.</u> sous-group 8.28							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)						
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,082 (0,0020 - 0,0032)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)						
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	50 ^{- 0,050} - 0,066 (1,9659 - 1,9665)						
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	50 ^{+ 0,016} (1,9685 - 1,9691)						

Triebwerk			Crank and Camshaft Drive			Embiellage		
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Anlaufscheiben Dicke normal mm	Thrust washer Thickness, normal (inch) mm	Cales de jeu latéral epaisseur, normal mm	3,375 + 0,05 (0,1329 - 0,1348)					
Anzahl der Übermaßstufen	Number of oversizes	Nombre de cotes de réparation	2					
Übermaß je Stufe mm	Oversized measurement in increments of (inch) mm	Chaque cote de réparation mm	0,25 (0,0098)					
Hydraulikpumpen - Antrieb Untergruppe 8.28	Hydraulic pump drive sub-group 8.28	Entrainement de pompe hydraul. sous-group 8.28						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm						
Grenzwert mm	Limit (inch) mm	Valeur limite mm						
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm						
Grenzwert mm	Limit (inch) mm	Valeur limite mm						
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm						
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm						

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Anlaufscheiben Dicke normal mm	Thrust washer Thickness, normal (inch) mm	Cales de jeu latéral epaisseur, normal mm	3,375+0,05 (0,1329 - 0,1348)		
Anzahl der Übermaßstufen	Number of oversizes	Nombre de cotes de réparation	2		
Übermaß je Stufe mm	Oversized measurement in increments of (inch) mm	Chaque cote de réparation mm	0,25 (0,0098)		
<u>Hydraulikpumpen</u> - Antrieb Untergruppe 8.28	<u>Hydraulic pump</u> drive sub-group 8.28	<u>Entrainement de</u> <u>pompe hydraul.</u> sous-group 8.28			
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm			
Grenzwert mm	Limit (inch) mm	Valeur limite mm			
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm			
Grenzwert mm	Limit (inch) mm	Valeur limite mm			
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm			
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm			

Triebwerk			Crank and Camshaft Drive			Embiellage			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Hydraulikpumpen - Antrieb</u> Untergruppe 8.29	<u>Hydraulic pump drive</u> sub-group 8.29	<u>Entrainement de pompe hydraul.</u> sous-group 8.29							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,12 - 0,37 (0,0047 - 0,0146)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)						
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0019 - 0,0048)						
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)						
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	44,95 - 0,016 (1,769 - 1,7697)						
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)						
<u>Hydraulikpumpen - Antrieb</u> Untergruppe 8.26	<u>Hydraulic pump drive</u> sub-group 8.26	<u>Entrainement de pompe hydraul.</u> sous-group 8.26							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
<u>Hydraulikpumpen - Antrieb</u> Untergruppe 8.29	<u>Hydraulic pump drive</u> sub-group 8.29	<u>Entrainement de pompe hydraul.</u> sous-group 8.29			
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,12 - 0,37 (0,0047 - 0,0146)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0019 - 0,0048)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)		
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	44,95 - 0,016 (1,769 - 1,7697)		
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)		
<u>Hydraulikpumpen - Antrieb</u> Untergruppe 8.26	<u>Hydraulic pump drive</u> sub-group 8.26	<u>Entrainement de pompe hydraul.</u> sous-group 8.26			
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		

Triebwerk	Crank and Camshaft Drive		Embiellage						
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm							
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm							
<u>Hydraulikpumpen - Antrieb</u>	<u>Hydraulic pump drive</u>	<u>Entrainement de pompe hydraul.</u>							
Untergruppe 8.27	sub-group 8.27	sous-group 8.27							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm							

Triebwerk			Crank and Camshaft Drive			Embiellage		
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,131 (0,0020 - 0,0052)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	45 ^{-0,050} -0,075 (1,7687 - 0,7697)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)					
<u>Hydraulikpumpen</u> <u>- Antrieb</u>	<u>Hydraulic pump</u> <u>drive</u>	<u>Entrainement de</u> <u>pompe hydraul.</u>						
Untergruppe 8.27	sub-group 8.27	sous-group 8.27						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,09 - 0,18 (0,0035 - 0,0071)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	60 ^{-0,060} -0,090 (2,3587 - 2,3598)					

Triebwerk			Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,131 (0,0020 - 0,0052)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)			
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	45 ^{-0,050} _{-0,075} (1,7687 - 0,7697)			
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)			
<u>Hydraulikpumpen - Antrieb</u>	<u>Hydraulic pump drive</u>	<u>Entrainement de pompe hydraul.</u>				
Untergruppe 8.27	sub-group 8.27	sous-group 8.27				
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)			
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,09 - 0,18 (0,0035 - 0,0071)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)			
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	60 ^{-0,060} _{-0,090} (2,3587 - 2,3598)			

Triebwerk			Crank and Camshaft Drive			Embiellage			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm							
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm							
<u>Hydraulikpumpen - Antrieb</u>	<u>Hydraulic pump drive</u>	<u>Entrainement de pompe hydraul.</u>							
Untergruppe 8.30	sub-group 8.30	sous-group 8.30							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							

Triebwerk		Crank and Camshaft Drive	Embiellage					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	60,03 + 0,06 (2,3634 - 2,3657)					
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,15 - 0,35 (0,0059 - 0,0138)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,094 (0,0024 - 0,0037)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	30 -0,020 -0,041 (1,1795 - 1,1803)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	30 +0,053 +0,040 (1,1827 - 1,1832)					
<u>Hydraulikpumpen - Antrieb</u>	<u>Hydraulic pump drive</u>	<u>Entrainement de pompe hydraul.</u>						
Untergruppe 8.30	sub-group 8.30	sous-group 8.30						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					

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Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	60,03 + 0,06 (2,3634 - 2,3657)		
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,15 - 0,35 (0,0059 - 0,0138)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,094 (0,0024 - 0,0037)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)		
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	30 -0,020 -0,041 (1,1795 - 1,1803)		
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	30 +0,053 +0,040 (1,1827 - 1,1832)		
<u>Hydraulikpumpen - Antrieb</u>	<u>Hydraulic pump drive</u>	<u>Entrainement de pompe hydraul.</u>			
Untergruppe 8.30	sub-group 8.30	sous-group 8.30			
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,25 (0,0020 - 0,0098)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		

Triebwerk	Crank and Camshaft Drive		Embiellage						
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm							
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet de palier diamètre mm							
<u>Zahnrad für Hydraulikpumpen -Antrieb im Schwungradgehäuse</u>	<u>Gear for hydraulic pump drive in flywheel housing</u>	<u>Roue dentée d'entraînement de pompe hydraul. dans le carter de volant</u>							
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm							
Grenzwert mm	Limit (inch) mm	Valeur limite mm							
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm							

Triebwerk		Crank and Camshaft Drive	Embiellage					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0020 - 0,0048)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	44,95 - 0,016 (1,7691 - 1,7697)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet de palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)					
<u>Zahnrad für Hydraulikpumpen -Antrieb im Schwungradge- häuse</u>	<u>Gear for hydraulic pump drive in flywheel housing</u>	<u>Roue dentée d'en- trainement de pompe hydraul. dans le carter de volant</u>						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,13 - 0,24 (0,0051 - 0,0094)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,18 (0,0024 - 0,0071)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	70 -0,060 -0,090 (2,7524 - 2,7535)					

Triebwerk		Crank and Camshaft Drive		Embiellage	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0020 - 0,0048)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)		
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	44,95 - 0,016 (1,7691 - 1,7697)		
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Coussinet de palier diamètre mm	45 + 0,056 (1,7717 - 1,7739)		
<u>Zahnrad für Hydraulikpumpen -Antrieb im Schwungradge- häuse</u>	<u>Gear for hydraulic pump drive in flywheel housing</u>	<u>Roue dentée d'en- trainement de pompe hydraul. dans le carter de volant</u>			
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,13 - 0,24 (0,0051 - 0,0094)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)		
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,06 - 0,18 (0,0024 - 0,0071)		
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)		
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Portée Diamètre mm	70 -0,060 -0,090 (2,7524 - 2,7535)		

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Triebwerk		Crank and Camshaft Drive		Embiellage						
Motortype		Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Lagerbuchse Innendurchmesser	Bushing inside diameter	Coussinet du palier diamètre								
mm	(inch) mm	mm								

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Triebwerk		Crank and Camshaft Drive		Embiellage		
Motortype		Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Lagerbuchse Innendurchmesser mm	Bushing inside diameter (inch) mm	Coussinet du palier diamètre mm	70,03 ^{- + 0,06} _{- 0,03} (2,7559 - 2,7594)			

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Motorschmierung			Lubrication Oil system		Lubrification - moteur				
Motor type	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Schmieröl-Druckpumpe</u>	<u>Lubrication oil pressure pump</u>	<u>Pompe de graissage sous pression</u>							
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	2000	2000 / 2100	2000		1800 / 2000	1800 / 2000 / 2100	
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2800	2800 / 2940	2800		2520 / 2800	2520 / 2800 / 2940	
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min	Zahnrad- breite Gear wheel width Largeur de pignon 15mm (inch = 0,5906) 66 / 2800 1/min (17,4) (RPM) 69 / 2940 1/min (18,2) (RPM) 18mm (inch = 0,7087) 79 / 2800 1/min (20,9) (RPM) 83 / 2940 1/min (21,9) (RPM)		23 mm (inch = 0,9055) 101 / 2800 1/min (26,6) (RPM) 27 mm (inch = 1,0629) 118 / 2800 1/min (31,2) (RPM)		15 mm (inch = 0,5906) 59/2520 1/min (15,6) (RPM) 66/2800 1/min (17,4) (RPM) 18 mm (inch = 0,7087) 71/2520 1/min (18,8) (RPM) 79/2800 1/min (20,9) (RPM)	23 mm (inch = 0,9055) 91/2520 1/min (24) (RPM) 101/2800 1/min (26,6) (RPM) 106/2940 1/min (28) (RPM)	27 mm (inch = 1,0629) 106/2520 1/min (28) (RPM) 118/2800 1/min (31,2) (RPM) 124/2940 1/min (32,8) (RPM)
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)						
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)						
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)		Motorlage: Position of engine: Position du moteur:	Ölwannenseite zeigt nach oben Oil-pan points upward Coté carter d'huile vers le haut			

Motorschmierung			Lubrication Oil system		Lubrification - moteur			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Schmieröl- Druckpumpe	Lubrication oil pressure pump	Pompe de graissage sous pression						
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	1500, 1800, 2000, 2100					
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2100, 2520, 2800, 2940					
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min	Zahnrad- breite Gear wheel width Largeur de pignon 79 / 2800 1/min, 83 / 2940 1/min (20,9) (RPM) (21,9) (RPM) 20 mm (inch 0,7874) 65 / 2100 1/min, 78 / 2520 1/min (17,2) (RPM) (20,6) (RPM) 87 / 2800 1/min, 91 / 2940 1/min (23) (RPM) (67,2) (RPM)	18mm (inch = 0,7087) 59 / 2100 1/min (15,6) (RPM) 71 / 2520 1/min (18,8) (RPM)	27mm (inch = 1,0629) 89 / 2100 1/min, 106 / 2520 1/min (23,5) (RPM) (28) (RPM) 118/2800 1/min, 124 / 2940 1/min (31,2) (RPM) (32,8) (RPM) 30 mm (inch 1,1811) 98 / 2100 1/min, 118/ 2520 1/min (25,9) (RPM) (31,2) (RPM) 131/2800 1/min, 138/ 2940 1/min (34,6) (RPM) (36,8) (RPM)	18mm (inch = 0,7087) 59(15,6) 2100 1/min (RPM) 71 (18,8) 2520 1/min (RPM) 79 (20,9) 2800 1/min (RPM) 83(21,9) 2940 1/min (RPM) 20mm (inch = 0,7874) 65(17,2) 2100 1/min (RPM) 78 (20,6) 2520 1/min (RPM) 87 (23) 2800 1/min (RPM) 91 (67,2) 2940 1/min (RPM)	27mm (inch = 1,0629) 89(23,5) 2100 1/min (RPM) 106 (28) 2520 1/min (RPM) 118(31,2) 2800 1/min (RPM) 124(32,8) 2940 1/min (RPM) 30mm (inch = 1,1811) 98(25,9) 2100 1/min (RPM) 118 (31,2) 2520 1/min (RPM) 131(34,6) 2800 1/min (RPM) 138(36,8) 2940 1/min (RPM)	
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)					
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)					
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)	Motorlage: Position of engine: Position du moteur:	Ölwannenseite zeigt nach oben Oil-pan points upward Coté carter d'huile vers le haut			

05 / 2003

1.15.02

Motorschmierung		Lubrication Oil system		Lubrification - moteur	
Motor type	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
Schmieröl-Druckpumpe	Lubrication oil pressure pump	Pompe de graissage sous pression			
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	1500, 1800, 2000, 2100		
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2100, 2520, 2800, 2940		
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min	*18mm(inch=0,7087) 59(15,6) 2100 1/min (RPM) 71 (18,8) 2520 1/min (RPM) 79 (20,9) 2800 1/min (RPM) 83(21,9) 2940 1/min (RPM) *20mm(inch=0,7874) 65(17,2)2100 1/min (RPM) 78 (20,6) 2520 1/min (RPM) 87 (23) 2800 1/min (RPM) 91 (67,2) 2940 1/min (RPM)	*27mm(inch=1,0629) 89(23,5) 2100 1/min (RPM) 106 (28) 2520 1/min (RPM) 118(31,2) 2800 1/min (RPM) 124(32,8) 2940 1/min (RPM) *30mm(inch=1,1811) 98(25,9)21001/min (RPM) 118 (31,2) 25201/min (RPM) 131(34,6) 2800 1/min (RPM) 138(36,8) 2940 1/min (RPM)	*Zahnbreite Gear wheel width Largeur de pignon
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)		
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)		
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)	Motorlage: Position of engine: Position du moteur:	Ölwannenseite zeigt nach oben Oil-pan points upward Côté carter d'huile vers le haut

Motorschmierung			Lubrication Oil system		Lubrification - moteur					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI	
Sicherheitsventil Öffnungsdruck bar	Pressure relief valve setting (PSI) bar	Soupape de sécurité pression d'ouverture bar	9 ± 1 (116 - 145)							
<u>Schmieröl- Absaugepumpe</u>	<u>Lubrication oil suction pump</u>	<u>Pompe d'aspira- tion d'huile de graissage</u>								
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min			2000			1800 / 2000 / 2100		
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min			2800			2520 / 2800 / 2940		
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min			Zahnrad- breite Gear wheel width Largeur de pignon	27 mm (inch = 1,0629) 118 / 2800 1/min (31,2) (RPM) 30 mm (inch = 1,1811) 131/ 2800 1/min (34,6) (RPM)		27 mm (inch = 1,0629) 106/2520 1/min (28) (RPM) 118/2800 1/min (31,2) (RPM) 124/2940 1/min (32,8) (RPM)	30 mm (inch = 1,1811) 118/2520 1/min (31,2) (RPM) 131/2800 1/min (34,6) (RPM) 138/2940 1/min (36,5) (RPM)	
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)							
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)							
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)		Motorlage: Position of engine: Position du moteur:		Ölwannenseite zeigt nach oben Oil-pan points upward Coté carter d'huile vers le haut			

Motorschmierung			Lubrication Oil system		Lubrification - moteur			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Sicherheitsventil Öffnungsdruck bar	Pressure relief valve setting (PSI) bar	Soupape de sécurité pression d'ouverture bar	9 ± 1 (116 - 145)					
Schmieröl- Absaugpumpe	Lubrication oil suction pump	Pompe d'aspira- tion d'huile de graissage						
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min		1500, 1800, 2000, 2100				1500,1800 2000,2100
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min		2100, 2520, 2800, 2940				2100,2520 2800,2940
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min		Zahnrad- breite 30mm (inch=1,1811) 98 (25,9)2100 1/min (RPM) 118(31,2)2520 1/min (RPM) Gear wheel width 131(34,6)2800 1/min (RPM) 138(36,8)2940 1/min (RPM) Largeur de pignon 33 mm (= 1,2992) 108/2100 1/min, 130 / 2520 1/min (28,5) (RPM) (34,3) (RPM) 144 / 2800 1/min, 151 / 2940 1/min (38) (RPM) (39,9) (RPM)				30 mm(inch=1,1811) 98(25,9) 2100 1/min (RPM) 118(31,2)2520 1/min (RPM) 131(34,6)2800 1/min (RPM) 138(36,8)2940 1/min (RPM) 33 mm (inch=1,2992) 108(28,5)2100 1/min (RPM) 130(34,3)2520 1/min (RPM) 144(38)2800 1/min (RPM) 151(39,9)2940 1/min (RPM)
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)					
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)					
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)		Motorlage: Position of engine: Position du moteur:		Ölwannenseite zeigt nach oben Oil-pan points upward Coté carter d'huile vers le haut	

05 / 2003

1.15.04

Motorschmierung			Lubrication Oil system		Lubrification - moteur		
Motor type	Engine Type	Type de moteur	D 924 TI-EA5		D 926 TI-EA5		
Sicherheitsventil Öffnungsdruck bar	Pressure relief valve setting (PSI) bar	Soupape de sécurité pression d'ouverture bar	9 ± 1 (116 - 145)				
Schmieröl- Absaugpumpe	Lubrication oil suction pump	Pompe d'aspira- tion d'huile de graissage					
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	1500, 1800, 2000, 2100				
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2100, 2520, 2800, 2940				
Fördermenge ± 5% bei 1 bar Gegendruck Öl SAE 30/90°C l/min	Output ± 5% at 14.5 PSI back pressure, Oil SAE 30 (190°F) (GPM) l/min	Débit ± 5% à 1 bar de contre- pression huile SAE 30/90°C l/min		*30mm(inch = 1,1811) 98(25,9)2100 1/min (RPM) 118(31,2)2520 1/min (RPM) 131(34,6)2800 1/min (RPM) 138(36,8)2940 1/min(RPM) *33mm (inch = 1,2992) 108(28,5)2100 1/min(RPM) 130(34,3)2520 1/min(RPM) 144(38)2800 1/min(RPM) 151(39,9)2940 1/min(RPM)	*Zahnbreite Gear wheel width Largeur de pignon		
Axialspiel der Förderräder normal mm	Axial clearance between pump gears, normal (inch) mm	Jeu axial pignons pousseurs, pignons poussés, normal mm	0,05 - 0,12 (0,0019 - 0,0047)				
Grenzwert mm	Limit (inch) mm	Valeur Limite mm	0,22 (0,0087)				
Zahnflankenspiel zum Antriebsrad auf der Kurbel- welle mm	Backlash between pump drive gear wheels (inch) mm	Jeu entre dents sur roue menante du vilbrequin mm	0,15 - 0,25 (0,0059 - 0,0098)	Motorlage: Position of engine: Position du moteur:	Ölwannenseite zeigt nach oben Oil-pan points upward Coté carter d'huile vers le haut		

Motorschmierung			Lubrication Oil system		Lubrification - moteur				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
<u>Öldruck</u>	<u>Oil pressure</u>	<u>Pression d'huile</u>							
Einstellung Neu-Motor bei Nenndrehzahl 1/min bar	Adjustment new-engine at rated speed RPM (PSI) bar	Réglage moteur neuf à regime nominal 1/min bar	4+1 (58+14,5)		Öltemperatur Oil temperature Température d'huile		90±5°C (185 - 203°F)		
bei 1400 1/min mindestens bar	at 1400 RPM min. (PSI) bar	à 1400 1/min mini bar	3 (43,5)		_____ "		_____		
bei 800 1/min mindestens bar	at 800 RPM min. (PSI) bar	à 800 1/min mini bar	2 (29)		_____ "		_____		
Schmieröl- mindestdrücke bei Nenndrehzahl 1/min bar	Lube-oil- min.pressure at rated speed RPM (PSI) bar	Press.mini de l'huile de grais- sage à regime nom. 1/min bar	3,5 (51)		_____ "		_____		
bei 1400 1/min bar	at 1400 RPM (PSI) bar	à 1400 1/min bar	2,5 (36,3)		_____ "		_____		
bei 800 1/min bar	at 800 RPM (PSI) bar	à 800 1/min bar	1,5 (21,8)		_____ "		_____		
Schmieröl- temperatur maximal °C	Lube-oil- temperature max. (°F) C	Tempér.de l'huile de graissage max. °C	115 (239)						
Schmieröl- verbrauch	Oil consumption	Consommation d'huile							
bei eingelaufe- nem Motor in % zum Kraftstoff- verbrauch	in %, in compari- son to fuel con- sumption on broken in engine	en % de la consommation de gazole (apne's rodage)	≈ 1						

Motorschmierung			Lubrication Oil system		Lubrification - moteur			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
<u>Öldruck</u>	<u>Oil pressure</u>	<u>Pression d'huile</u>						
Einstellung Neu-Motor bei Nenndrehzahl 1/min bar	Adjustment new-engine at rated speed RPM (PSI) bar	Réglage moteur neuf à regime nominal 1/min bar	4+1 (58+14,5)	Öltemperatur Oil temperature Température d'huile		90±5°C (185 - 203°F)		
bei 1400 1/min mindestens bar	at 1400 RPM min. (PSI) bar	à 1400 1/min mini bar	3 (43,5)	_____ "		_____		
bei 800 1/min mindestens bar	at 800 RPM min. (PSI) bar	à 800 1/min mini bar	2 (29)	_____ "		_____		
Schmieröl- mindestdrücke bei Nenndrehzahl 1/min bar	Lube-oil- min.pressure at rated speed RPM (PSI) bar	Press.mini de l'huile de grais- sage à regime nom. 1/min bar	3,5 (51)	_____ "		_____		
bei 1400 1/min bar	at 1400 RPM (PSI) bar	à 1400 1/min bar	2,5 (36,3)	_____ "		_____		
bei 800 1/min bar	at 800 RPM (PSI) bar	à 800 1/min bar	1,5 (21,8)	_____ "		_____		
Schmieröl- temperatur maximal °C	Lube-oil- temperature max. (°F) C	Tempér.de l'huile de graissage max. °C	115 (239)					
Schmieröl- verbrauch	Oil consumption	Consommation d'huile						
bei eingelaufe- nem Motor in % zum Kraftstoff- verbrauch	in %, in compari- son to fuel con- sumption on broken in engine	en % de la consommation de gazole (apne's rodage)	≈0,8					

Motorschmierung		Lubrication Oil system	Lubrification - moteur		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5	
<u>Öldruck</u>	<u>Oil pressure</u>	<u>Pression d'huile</u>			
Einstellung Neu-Motor bei Nenndrehzahl 1/min bar	Adjustment new-engine at rated speed RPM (PSI) bar	Réglage moteur neuf à regime nominal 1/min bar	4+1 (58+14,5)	Öltemperatur Oil temperature Température d'huile	90±5°C (185 - 203°F)
bei 1400 1/min mindestens bar	at 1400 RPM min. (PSI) bar	à 1400 1/min mini bar	3 (43,5)	_____ "	_____
bei 800 1/min mindestens bar	at 800 RPM min. (PSI) bar	à 800 1/min mini bar	2 (29)	_____ "	_____
Schmieröl-mindestdrücke bei Nenndrehzahl 1/min bar	Lube-oil-min.pressure at rated speed RPM (PSI) bar	Press.mini de l'huile de grais-sage à regime nom. 1/min bar	3,5 (51)	_____ "	_____
bei 1400 1/min bar	at 1400 RPM (PSI) bar	à 1400 1/min bar	2,5 (36,3)	_____ "	_____
bei 800 1/min bar	at 800 RPM (PSI) bar	à 800 1/min bar	1,5 (21,8)	_____ "	_____
Schmieröl-temperatur maximal °C	Lube-oil-temperature max. (°F) C	Tempér.de l'huile de graissage max. °C	115 (239)		
Schmieröl-verbrauch	Oil consumption	Consommation d'huile			
bei eingelaufenem Motor in % zum Kraftstoffverbrauch	in %, in comparison to fuel consumption on broken in engine	en % de la consommation de gazole (apne's rodage)	≈ 0,8		

Motorschmierung			Lubrication Oil system		Lubrification - moteur					
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI	
<u>Ölfilter-Ölkühler</u> <u>Umgehungs-</u> <u>ventil</u>	<u>Oil-Filter /</u> <u>Oil cooler</u> <u>By-pass valve</u>	<u>Clapet de dériva-</u> <u>tion</u> <u>Filtre à huile</u> <u>Radiateur d'huile</u>								
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	6±1 (73 - 102)							
Windungen der Feder insgesamt	Total spring windings	Spires totales du ressort	10,5							
Länge ungespannt normal mm	Spring length unloaded normal (inch) mm	Longueur non comprimée normal mm	75 (2,953)							
Länge ungespannt Grenzwert mm	Spring length unloaded Limit (inch) mm	Longueur non comprimée normal mm	72 (2,853)							
<u>Kolbenkühldüse</u>	<u>Piston cooling</u> <u>nozzle</u>	<u>Buse de</u> <u>refroidissement</u> <u>pour piston</u>								
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	0,8+0,2 (12 - 14,5)							

Motorschmierung			Lubrication Oil system		Lubrification - moteur			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
<u>Ölfilter-Ölkühler</u> <u>Umgehungs-</u> <u>ventil</u>	<u>Oil-Filter /</u> <u>Oil cooler</u> <u>By-pass valve</u>	<u>Clapet de dériva-</u> <u>tion</u> <u>Filtre à huile</u> <u>Radiateur d'huile</u>						
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	6 ± 1 (73 - 102)					
Windungen der Feder insgesamt	Total spring windings	Spires totales du ressort	10,5					
Länge ungespannt normal mm	Spring length unloaded normal (inch) mm	Longueur non comprimée normal mm	75 (2,953)					
Länge ungespannt Grenzwert mm	Spring length unloaded Limit (inch) mm	Longueur non comprimée normal mm	72 (2,853)					
<u>Kolbenkühldüse</u>	<u>Piston cooling</u> <u>nozzle</u>	<u>Buse de</u> <u>refroidissement</u> <u>pour piston</u>						
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	0,8+0,2 (12 - 14,5)					

Motorschmierung			Lubrication Oil system		Lubrification - moteur	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
<u>Ölfilter-Ölkühler</u> <u>Umgehungs-</u> <u>ventil</u>	<u>Oil-Filter /</u> <u>Oil cooler</u> <u>By-pass valve</u>	<u>Clapet de dériva-</u> <u>tion</u> <u>Filtre à huile</u> <u>Radiateur d'huile</u>				
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	6 ± 1 (73 - 102)			
Windungen der Feder insgesamt	Total spring windings	Spires totales du ressort	10,5			
Länge ungespannt normal mm	Spring length unloaded normal (inch) mm	Longueur non comprimée normal mm	75 (2,953)			
Länge ungespannt Grenzwert mm	Spring length unloaded Limit (inch) mm	Longueur non comprimée normal mm	72 (2,853)			
<u>Kolbenkühldüse</u>	<u>Piston cooling</u> <u>nozzle</u>	<u>Buse de</u> <u>refroidissement</u> <u>pour piston</u>				
Öffnungsdruck bar	Opening pressure (PSI) bar	Pression d'ouverture bar	0,8+0,2 (12 - 14,5)			

Motorkühlung			Cooling System		Système de refroidissement du moteur				
Motor type	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Kühlmittelpumpe (am Aggregate-träger angebaut)	Coolant - pump (on accessory drive gear box)	Pompe de réfri-gerant (sur carter ole distribution)							
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	2000					2100	
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2312					2428	
Fördermenge l/min	Output (GPM) l/min	Débit l/min	ca. 270 / 2312 1/min (appr.71) (RPM) ca. 284 / 2428 1/min (appr.75) (RPM)		abhängig vom Widerstand im Motor depending on back pressure in engine dépend de la résistance dans le moteur				
Kühlmittelpumpe (im Aggregate-träger integriert)	Coolant - pump (integr.in accessory drive gear box)	Pompe de réfri-gerant (intégrée au carter de distribution)							
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	2000	2000 / 2100	2000		1800 / 2000	1800 / 2000 / 2100	
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	3363	3363 / 3532	3363		3027 / 3363	3027 / 3363 / 3532	
Fördermenge l/min	Output (GPM) l/min	Débit l/min	ca. 270 / 3027 1/min (appr.71,3) (RPM) ca. 315 / 3532 1/min (appr.83,2) (RPM)		ca. 300 / 3363 1/min (appr.79,3) (RPM)		abhängig vom Widerstand im Motor depending on back pressure in engine dépend de la résistance dans le moteur		
Spaltmaß zwischen Laufrad u. Aggregate-träger mm	Proper distance between impeller a.acces.drive gear box (inch) mm	Jeu axial entre poue à ailettes et carter bar	0,9 - 1,113 (0,00354 - 0,0438)				Messung measured mesuré	siehe see voir	5.11, 5.12, 5.13, 5.14 5.11, 5.12, 5.13, 5.14 5.11, 5.12, 5.13, 5.14
Mit Bundlagerung	With cooland end bearing	Avec palier collet							
Untergruppe 5.18	sub-group 5.18	sous-group 5.18							

Motorkühlung			Cooling System		Système de refroidissement du moteur		
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5			
<u>Kühlmittelpumpe (am Aggregate-träger angebaut)</u>	<u>Coolant - pump (on accessory drive gear box)</u>	<u>Pompe de réfri-gerant (sur carter ole distribution)</u>					
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min					
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min					
Fördermenge l/min	Output (GPM) l/min	Débit l/min					
<u>Kühlmittelpumpe (im Aggregate-träger integriert)</u>	<u>Coolant - pump (integr.in accessory drive gear box)</u>	<u>Pompe de réfri-gerant (intégrée au carter de distribution)</u>					
Motordrehzahl 1/min	Engine speed (RPM) 1/min	Régime moteur 1/min	1500 / 1800 / 2000 / 2100				
Pumpendrehzahl 1/min	Pump speed (RPM) 1/min	Régime de la pompe 1/min	2523 / 3027 / 3363 / 3532				
Fördermenge l/min	Output (GPM) l/min	Débit l/min	ca. 225 / 2523 1/min (appr.71,3) (RPM) ca. 300 / 3363 1/min (appr. 79,3) (RPM)	ca. 270 / 3027 1/min (appr.71,3) (RPM) ca. 315 / 3532 1/min (appr.83,2) (RPM)	abhängig vom Widerstand im Motor depending on back pressure in engine dépend de la résistance dans le moteur		
Spaltmaß zwischen Laufrad u. Aggregate-träger mm	Proper distance between impeller a.acces.drive gear box (inch) mm	Jeu axial entre poue à ailettes et carter bar	0,9 - 1,113 (0,00354 - 0,0438)		Messung measured mesuré	siehe see voir 5.11, 5.12, 5.13, 5.14 5.11, 5.12, 5.13, 5.14 5.11, 5.12, 5.13, 5.14	
<u>Mit Bundlagerung</u>	<u>With cooland end bearing</u>	<u>Avec palier collet</u>					
Untergruppe 5.18	sub-group 5.18	sous-group 5.18					

Motorkühlung			Cooling System		Système de refroidissement du moteur					
Motortype		Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Axialspiel	Axial clearance	Jeu axial	0,05 - 0,35 (0,0019 - 0,0138)							
mm	(inch) mm	mm								
Grenzwert	Limit	Valeur limite	0,45 (0,0177)							
mm	(inch) mm	mm								
Radialspiel	Radial clearance	Jeu radial	0,02 - 0,086 (0,0008 - 0,0033)							
mm	(inch) mm	mm								
Grenzwert	Limit	Valeur limite	0,12 (0,0047)							
mm	(inch) mm	mm								
Lagerzapfen Durchmesser	Shaft diameter	Diamètre de l'axe	20 - 0,020 - 0,033 (0,7861 - 0,7866)							
mm	(inch) mm	mm								
Lagerbuchse Durchmesser	Bushing inside diameter	Diamètre du coussinet	20 + 0,053 (0,7874 - 0,7895)							
mm	(inch) mm	mm								
Mit Bundlagerung	With cooland and bearing	Avec palier collet								
Untergruppe 5.19	sub-group 5.19	sous-group 5.19								
Axialspiel	Axial clearance	Jeu axial	0,08 - 0,13 (0,0031 - 0,0051)							
mm	(inch) mm	mm								
Grenzwert	Limit	Valeur limite	0,15 (0,0059)							
mm	(inch) mm	mm								
Radialspiel	Radial clearance	Jeu radial	0,02 - 0,086 (0,0008 - 0,0033)							
mm	(inch) mm	mm								

Motorkühlung		Cooling System	Système de refroidissement du moteur					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,35 (0,0019 - 0,0138)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,45 (0,0177)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,02 - 0,086 (0,0008 - 0,0033)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,12 (0,0047)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	20 - 0,020 - 0,033 (0,7861 - 0,7866)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	20 + 0,053 (0,7874 - 0,7895)					
<u>Mit Bundlagerung</u>	<u>With cooland and bearing</u>	<u>Avec palier collet</u>						
Untergruppe 5.19	sub-group 5.19	sous-group 5.19						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,08 - 0,13 (0,0031 - 0,0051)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,15 (0,0059)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,02 - 0,086 (0,0008 - 0,0033)					

Motorkühlung			Cooling System		Système de refroidissement du moteur	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,05 - 0,35 (0,0019 - 0,0138)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,45 (0,0177)			
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,02 - 0,086 (0,0008 - 0,0033)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,12 (0,0047)			
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	20 - 0,020 - 0,033 (0,7861 - 0,7866)			
Lagerbuchse Durchmesser	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	20 + 0,053 (0,7874 - 0,7895)			
<u>Mit Bundlagerung</u>	<u>With cooland and bearing</u>	<u>Avec palier collet</u>				
Untergruppe 5.19	sub-group 5.19	sous-group 5.19				
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,08 - 0,13 (0,0031 - 0,0051)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,15 (0,0059)			
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,02 - 0,086 (0,0008 - 0,0033)			

Motorkühlung			Cooling System		Système de refroidissement du moteur				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,12 (0,0047)						
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	20 - 0,020 - 0,033 (0,7861 - 0,7866)						
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	20 + 0,053 (0,7874 - 0,7895)						
Mindestdruck im Kühlsystem (Thermostate offen) bar	Minim. pressure in radiator system (thermostats open) (PSI) bar	Press min. du système de refroidissement (Thermostats ouvert) bar	1,1 (16)	gemessen am Kühlmittelpumpen-Ausgang, bei Motoren Nenndrehzahl measured at coolant pump outlet, at engine rated speed mesuré à la sortie de la pompe réfrigér, à moteur regime nominal					
Kühlmitteltemperatur maximal °C	Coolant-temperatur max. (°F) °C	Température maxi du réfrigérant °C	100 (212)						
Thermostate Öffnungstemperatur °C	Thermostats opening temperatur (°F) °C	Thermostats température d'ouverture °C	71 (160)		79 (174)		83 (181)		
Thermostate Öffnungshub mm	Thermostats opening stroke (inch) mm	Thermostats course d'ouverture mm	8 (0,3149)						

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1.18.05

Motorkühlung			Cooling System		Système de refroidissement du moteur			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,12 (0,0047)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	20 - 0,020 - 0,033 (0,7861 - 0,7866)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	20 + 0,053 (0,7874 - 0,7895)					
Mindestdruck im Kühlsystem (Thermostate offen) bar	Minim. pressure in radiator system (thermostats open) (PSI) bar	Press min. du système de refroid (Thermostats ouvert) bar	1,1 (16)	gemessen am Kühlmittelpumpen-Ausgang, bei Motoren Nenndrehzahl measured at coolant pump outlet, at engine rated speed mesuré à la sortie de la pompe réfrigér, à moteur regime nominal				
Kühlmitteltemperatur maximal °C	Coolant-temperatur max. (°F) °C	Température maxi du réfrigérant °C	100 (212)					
Thermostate Öffnungstemperatur °C	Thermostats opening temperatur (°F) °C	Thermostats température d'ouverture °C	71 (160)	79 (174)		83 (181)		
Thermostate Öffnungshub mm	Thermostats opening stroke (inch) mm	Thermostats course d'ouverture mm	8 (0,3149)					

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1.18.06

Motorkühlung			Cooling System		Système de refroidissement du moteur		
Motor type	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,12 (0,0047)				
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	20 - 0,020 - 0,033 (0,7861 - 0,7866)				
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	20 + 0,053 (0,7874 - 0,7895)				
Mindestdruck im Kühlsystem (Thermostate offen) bar	Minim. pressure in radiator system (thermostats open) (PSI) bar	Press min. du système de refroidissement (Thermostats ouvert) bar	1,1 (16)	gemessen am Kühlmittelpumpen-Ausgang, bei Motoren Nenndrehzahl measured at coolant pump outlet, at engine rated speed mesuré à la sortie de la pompe réfrigér, à moteur regime nominal			
Kühlmitteltemperatur maximal °C	Coolant-temperatur max. (°F) °C	Température maxi du réfrigérant °C	100 (212)				
Thermostate Öffnungstemperatur °C	Thermostats opening temperatur (°F) °C	Thermostats température d'ouverture °C	71 (160)	79 (174)	83 (181)		
Thermostate Öffnungshub mm	Thermostats opening stroke (inch) mm	Thermostats course d'ouverture mm	8 (0,3149)				

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Motorkühlung			Cooling System			Système de refroidissement du moteur				
Motortype		Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Lüfterantrieb		Fan drive	Entrainement de							
Untergruppe 5.05,		sub-group 5.05,	ventilateur							
5.06		5.06	sous-group 5.05,							
			5.06							
Axialspiel		Axial clearance	Jeu axial	0,1 - 0,4						
mm		(inch) mm	mm	(0,0039 - 0,0157)						
Grenzwert		Limit	Valeur limite	0,55						
mm		(inch) mm	mm	(0,0217)						
Radialspiel		Radial clearance	Jeu radial	0,05 - 0,122						
mm		(inch) mm	mm	(0,0019 - 0,0048)						
Grenzwert		Limit	Valeur limite	0,25						
mm		(inch) mm	mm	(0,0098)						
Lagerzapfen Durchmesser		Shaft diameter	Diamètre de l'axe	44,95 -0,016						
mm		(inch) mm	mm	(1,7691 - 1,7697)						
Lagerbuchse Durchmesser		Bushing inside diameter	Diamètre du coussinet	45 +0,056						
mm		(inch) mm	mm	(1,7717 - 1,7739)						

1.18.07

Motorkühlung		Cooling System	Système de refroidissement du moteur					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
<u>Lüfterantrieb</u> Untergruppe 5.05, 5.06	<u>Fan drive</u> sub-group 5.05, 5.06	<u>Entrainement de ventilateur</u> sous-group 5.05, 5.06						
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,1 - 0,4 (0,0039 - 0,0157)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)					
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0019 - 0,0048)					
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)					
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	44,95 ^{-0,016} (1,7691 - 1,7697)					
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	45 ^{+0,056} (1,7717 - 1,7739)					

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Motorkühlung			Cooling System		Système de refroidissement du moteur	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
<u>Lüfterantrieb</u> Untergruppe 5.05, 5.06	<u>Fan drive</u> sub-group 5.05, 5.06	<u>Entrainement de ventilateur</u> sous-group 5.05, 5.06				
Axialspiel mm	Axial clearance (inch) mm	Jeu axial mm	0,1 - 0,4 (0,0039 - 0,0157)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,55 (0,0217)			
Radialspiel mm	Radial clearance (inch) mm	Jeu radial mm	0,05 - 0,122 (0,0019 - 0,0048)			
Grenzwert mm	Limit (inch) mm	Valeur limite mm	0,25 (0,0098)			
Lagerzapfen Durchmesser mm	Shaft diameter (inch) mm	Diamètre de l'axe mm	44,95 ^{-0,016} (1,7691 - 1,7697)			
Lagerbuchse Durchmesser mm	Bushing inside diameter (inch) mm	Diamètre du coussinet mm	45 ^{+0,056} (1,7717 - 1,7739)			

1.18.08

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1.22.01

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Zylinderkopf-schrauben	Cylinder head bolts	Vis de culasse	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	$\angle^{\circ}30 + 30 + 60 + 60 = 180$			Weichstoff-Zylinderkopfdichtung Soft-Cylinder Head Gasket Joint en matériau tendre, sans amiante	
Zylinderkopf-schrauben nachziehen	Retorque cylinder head bolts	Resserrer les vis de culasse			$\angle^{\circ}90$			Weichstoff-Zylinderkopfdichtung Soft-Cylinder Head Gasket Joint en matériau tendre, sans amiante	
Zylinderkopf-schrauben	Cylinder head bolts	Vis de culasse	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 90 + $\angle^{\circ}70 + 70 + 70 + 70 = 280$			Metallelastomer-Zylinderkopfdichtung Metal-Elastomer Head Gasket Joint en métal + élastomère	
Schrauben für Kipphebelbock	Screws for rocker arm support	Vis de support de culbuteur			M 10 x 65 Nm 65 48 ft - lbs				
Pleuelschrauben	Connecting rod bearing cap bolts	Vis de tête de bielle	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	$\angle^{\circ}45 + 30 + 30 = 105$				
Hauptlager-schrauben	Main bearing cap mounting bolts	Vis de paliers de ligne d'arbre	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	$\angle^{\circ}30 + 30 + 30 = 90$				
Schwungrad-schrauben	Flywheel mounting bolts	Vis de volant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 14x1,5x50	$\angle^{\circ}30 + 35 = 65$ Nm 180-330 = 330 133-244 ft - lbs	M 16x1,5x50	$\angle^{\circ}30 + 25 = 55$ Nm 180-330 = 330 133-244 ft - lbs	
Schwungradge-häuseschrauben	Flywheel housing mounting bolts	Boulons de carter de volant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12x55	$\angle^{\circ}30$ Nm 80 59 ft - lbs	Nm 45 33 ft - lbs	M 12 x 65	$\angle^{\circ}30$ Nm 110 81 ft - lbs
Schrauben für Lüfterseitiges Kurbelwellen-ende	Screws on fan side end of crankshaft	Vis sur le vilebrequin côté hélice	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12x1,5x160	$\angle^{\circ}45 + 45 = 90$ Nm 100-160 = 160 74-118 = 118 ft - lbs	M 16x1,5x160	$\angle^{\circ}40 + 30 + 30 = 100$ Nm 100-300 = 300 74-221 ft - lbs	
Schraube am Zwischenrad	Intermediate gear wheel assembly mounting bolt	Vis sur pignon intermédiaire	vorspannen pretorque préserrage	Nm 60 44 ft - lbs		$\angle^{\circ}70$ Nm 280 206 ft - lbs			

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous					
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4		D 926 TI-EA4	
Zylinderkopf-schrauben	Cylinder head bolts	Vis de culasse	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	$\angle^{\circ}30 + 30 + 60 + 60 = 180$		Weichstoff-Zylinderkopfdichtung Soft-Cylinder Head Gasket Joint en matériau tendre, sans amiante		
Zylinderkopf-schrauben nachziehen	Retorque cylinder head bolts	Resserrer les vis de culasse				$\angle^{\circ}90$		Weichstoff-Zylinderkopfdichtung Soft-Cylinder Head Gasket Joint en matériau tendre, sans amiante		
Zylinderkopf-schrauben	Cylinder head bolts	Vis de culasse	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	Nm 90 + $\angle^{\circ}70 + 70 + 70 + 70 = 280$		Metallelastomer-Zylinderkopfdichtung Metal-Elastomer Head Gasket Joint en métal + élastomère		
Schrauben für Kipphebelbock	Screws for rocker arm support	Vis de support de culbuteur			M 10 x 65 Nm 65 48 ft - lbs			M 10 x 110 (ZBS) Nm 75 55 ft - lbs		
Pleuelschrauben	Connecting rod bearing cap bolts	Vis de tête de bielle	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	$\angle^{\circ}45 + 30 + 30 = 105$				
Hauptlager-schrauben	Main bearing cap mounting bolts	Vis de paliers de ligne d'arbre	vorspannen pretorque		Nm 30	$\angle^{\circ}30 + 30 + 30 = 90$				
Schwungrad-schrauben	Flywheel mounting bolts	Vis de volant	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	M14x1,5x50 $\angle^{\circ}30 + 35 = 65$ Nm 180-330 = 330 133-244 ft - lbs	M 16x1,5x50 $\angle^{\circ}30 + 25 = 55$ Nm 180-330 = 330 133-244 ft - lbs	Nm90 66ft-lbs	M 16x1,5x130 $\angle^{\circ}30 + 30 + 40 = 100$ Nm 180-330 = 330 133-244 ft-lbs	
Schwungradge-häuseschrauben	Flywheel housing mounting bolts	Boulons de carter de volant	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	M 12x55 $\angle^{\circ}30$ Nm 80 59 ft - lbs	Nm 45 33 ft - lbs	M 12 x 65 $\angle^{\circ}30$ Nm 110 81 ft - lbs	Nm45 33 ft - lbs	M 12 x 140 $\angle^{\circ}80$ Nm 110 81 ft - lbs
Schrauben für Lüfterseitiges Kurbelwellen-ende	Screws on fan side end of crankshaft	Vis sur le vilebrequin côté hélice	vorspannen pretorque préserrage		Nm 30 22 ft - lbs	M 12x1,5x160	$\angle^{\circ}45 + 45 = 90$ Nm 100-160 = 160 74-118 = 118 ft - lbs	M 16x1,5x160	$\angle^{\circ}40 + 30 + 30 = 100$ Nm 100-300 = 300 74-221 ft - lbs	
Schraube am Zwischenrad	Intermediate gear wheel assembly mounting bolt	Vis sur pignon intermédiaire	vorspannen pretorque préserrage		Nm 60 44 ft - lbs		$\angle^{\circ}70$ Nm 280 206 ft - lbs			

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1.22.02

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous				
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5					
Zylinderkopf-schrauben	Cylinder head bolts	Vis de culasse	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm90 + ∠°70 + 70 + 70 + 70 = 280			Metallelastomer-Zylinderkopfdichtung Metal-Elastomer Head Gasket Joint en métal + élastomère	
Schrauben für Kipphebelbock	Screws for rocker arm support	Vis de support de culbuteur		M 10x65 Nm 65 48 ft - lbs	M 10x110 (ZBS) Nm 75 55 ft - lbs				
Pleuelschrauben	Connecting rod bearing cap bolts	Vis de tête de bielle	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	∠° 45 + 30 + 30 = 105				
Hauptlager-schrauben	Main bearing cap mounting bolts	Vis de paliers de ligne d'arbre	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	∠° 30 + 30 + 30 = 90				
Schwungrad-schrauben	Flywheel mounting bolts	Vis de volant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M14x1,5x50 ∠°30 + 35 = 65 Nm 180-330 = 330 133-244 ft - lbs	M 16x1,5x50 ∠°30 + 25 = 55 Nm 180-330 = 330 133-244 ft - lbs	Nm90 66ft-lbs	M 16x1,5x130 ∠°30 + 30 + 40 = 100 Nm 180-330 = 330 133-244 ft-lbs	
Schwungradge-häuseschrauben	Flywheel housing mounting bolts	Boulons de carter de volant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12x55 ∠°30 Nm 80 59 ft - lbs	Nm 45 33 ft - lbs	M 12 x 65 ∠°30 Nm 110 81 ft - lbs	Nm45 33 ft - lbs	M 12 x 140 ∠°80 Nm 110 81 ft - lbs
Schrauben für Lüfterseitiges Kurbelwellen-ende	Screws on fan side end of crankshaft	Vis sur le vilebrequin côté hélice	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12x1,5x160 ∠°45 + 45 = 90 Nm 100-160 = 160 74-118 = 118 ft - lbs	M 16x1,5x160	∠°40 + 30 + 30 = 100 Nm 100-300 = 300 74-221 ft - lbs		
Schraube am Zwischenrad	Intermediate gear wheel assembly mounting bolt	Vis sur pignon intermédiaire	vorspannen pretorque préserrage	Nm 60 44 ft - lbs	∠°70 Nm 280 206 ft - lbs				
Schraube a. Nocken-wellenzahnrad	Camshaft drive gear wheel moun-ting bolt	Vis sur pignon d'arbre à cames	vorspannen pretorque préserrage	M 16x1,5 Nm 60 44 ft - lbs	∠°60 Nm 280 206 ft - lbs	vorspannen pretorque préserrage	M 20x1,5 Nm 130 96 ft - lbs	∠°105 NM 650 480 ft - lbs	
Schraube a. Nocken-wellenzahnrad mit Zahnrad für Lüfterantrieb	Camshaft drive gear wheel moun-ting bolt with gear for fan drive	Vis sur pignon d'arbre à cames av. pignon p. entrain. de ventilateur	vorspannen pretorque préserrage	M 16x1,5 Nm 60 44 ft - lbs	∠°60 Nm 280 206 ft - lbs	vorspannen pretorque préserrage	M 20x1,5 Nm 130 96 ft - lbs	∠°105 NM 650 480 ft - lbs	

Schraubenanzugswerte			Torque Specifications			Valeurs de serrage des vis / écrous			
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Schraube am Nockenwellen-zahnrad	Camshaft drive gear wheel mounting bolt	Vis sur pignon d'arbre à cames	vorspannen pretorque préserrage	M 16x1,5 Nm 60 44 ft - lbs	∠°60 Nm 280 206 ft - lbs	vorspannen pretorque préserrage	M 20x1,5 Nm 130 96 ft - lbs	∠°105 Nm 650 480 ft - lbs	
Schraube a. Nockenwellenzahnrad mit Zahnrad für Lüfterantrieb	Camshaft drive gear wheel mounting bolt with gear for fan drive	Vis sur pignon d'arbre à cames av. pignon p. entrain. de ventilateur	vorspannen pretorque préserrage	M 16x1,5 Nm 60 44 ft - lbs	∠°60 Nm 280 206 ft - lbs	vorspannen pretorque préserrage	M 20x1,5 Nm 130 96 ft - lbs	∠°105 Nm 650 480 ft - lbs	
Nutmutter am Einspritzpumpen-Antrieb	Ring nut on injection pump drive	Ecrou à rainure surentrainement de la pompe à injection	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 300 221 ft-lbs				
Schrauben f. Zahnrad E.P.-Antrieb (Antriebslagerung im Aggregateträ.)	Inject.pump drive retaining bolts (drive bearing in acc.drive gear box)	Vis de fixation de l'entraînement de la pompe a'injection	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	∠°40 Nm 110 81 ft-lbs				
Mutter für Zahnwelle an der Einspritzpumpe	Locknut for splined shaft on injection pump	Ecrou pour arbre cannelé de la pompe à injection	M 14 x 1,5 Nm 85 +15 63 - 74 ft - lbs		M 18 x 1,5 Nm 100 +10 74 - 81 ft - lbs		M 20 x 1,5 Nm 150 +10 111 - 118 ft - lbs		
Einspritzventilbefestigung	Injector holder mounting screw	Fixation d'injecteur			Nm 23 17 ft - lbs				
Überwurfmutter für Einspritzdüse	Union nut for injector nozzle	Ecrou - raccord fixant pour injecteur			Nm 50 +20 37 - 52 ft - lbs				
Einspritzleitungen	Fuel supply line nuts	Conduites d'injection			Nm 20 15 ft - lbs				
Kolbenkühlöse ab Motor-Nr.	Piston cooling nozzle as from Engine-No.	Buse de refroidis. pour piston à partir de moteur no.			Nm 30 22 ft - lbs				
Schraube für Kühlmittelpumpenzahnrad	Coolant pump drive gear wheel retaining bolt	Vis pour pignon de pompe à réfrigérant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	∠°90 Nm 115 85 ft-lbs				

Schraubenanzugswerte			Torque Specifications			Valeurs de serrage des vis / écrous				
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)		D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)		D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Schraube am Nockenwellen-zahnrad	Camshaft drive gear wheel mounting bolt	Vis sur pignon d'arbre à cames	vorspannen pretorque M 16x1,5 Nm 60 préserrage 44 ft - lbs		∠°60 Nm 280 206 ft - lbs	vorspannen pretorque M 20x1,5 Nm 130 préserrage 96 ft - lbs		∠°105 Nm 650 480 ft - lbs		
Schraube a. Nockenwellenzahnrad mit Zahnrad für Lüfterantrieb	Camshaft drive gear wheel mounting bolt with gear for fan drive	Vis sur pignon d'arbre à cames av. pignon p. entrain. de ventilateur	vorspannen pretorque M 16x1,5 Nm 60 préserrage 44 ft - lbs		∠°60 Nm 280 206 ft - lbs	vorspannen pretorque M 20x1,5 Nm 130 préserrage 96 ft - lbs		∠°105 Nm 650 480 ft - lbs		
Nutmutter am Einspritzpumpen-Antrieb	Ring nut on injection pump drive	Ecrou à rainure surentrainement de la pompe à injection								
Schrauben f.Zahnrad E.P.-Antrieb (Antriebslagerung im Aggregateträ.)	Inject.pump drive retaining bolts (drive bearing in acc.drive gear box	Vis de fication de l'entraînement de la pompe a'injection	vorspannen pretorque préserrage Nm 30 22 ft - lbs		∠°40 Nm 110 81 ft-lbs					
Mutter für Zahnwelle an der Einspritzpumpe	Locknut for splined shaft on injection pump	Ecrou pour arbre cannelé de la pompe à injection	M 14 x 1,5 Nm 85 +15 63 - 74 ft - lbs		M 18 x 1,5 Nm 100 +10 74 - 81 ft - lbs		M 20 x 1,5 Nm 150 +10 111 - 118 ft - lbs			
Einspritzventil-befestigung	Injector holder mounting screw	Fixation d'injecteur	Nm 23 17 ft - lbs							
Überwurfmutter für Einspritzdüse	Union nut for injector nozzle	Ecrou - raccord fixant pour injecteur	Nm 40 +10 30 - 37 ft - lbs							
Einspritz-leitungen	Fuel supply line nuts	Conduites d'injection	Nm 20 15 ft - lbs							
Kolbenkühldüse	Piston cooling nozzle	Buse de refroidis. pour piston	Nm 30 22 ft - lbs							
Schraube für Kühlmittel-pumpenzahnrad	Coolant pump drive gear wheel retaining bolt	Vis pour pignon de pompe à réfrigérant								

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
Schrauben für Zwischenflansch-Befestigung an Nabe Einspritzpumpen-Antrieb	Screws for intermediate flange on hub injection pump drive	Vis pour carter intermédiaire-pour fixation au moyeu d'entr.pompe inject.	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 250 185 ft - lbs	
Schrauben für Zwischenflansch-Befestigung an Zahnrad Einspritzpumpen-Antrieb	Screws for intermediate flange on gear wheel injection pump drive	Vis pour carter intermédiaire-pour fixation sur roue dentée de entr. pompe injection	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 61 45 ft - lbs	
Mutter für Zahnwelle an der Einspritzpumpe	Locknut for splined shaft on injection pump	Ecrou pour arbre cannelé de la pompe à injection	M 24 x 1,5 Nm 355 262 ft - lbs			
Einspritzventilbefestigung	Injector holder mounting screw	Fixation d'injecteur	Nm 23 17 ft - lbs			
Überwurfmutter für Einspritzdüse	Union nut for injector nozzle	Ecrou - raccord fixant pour injecteur	Nm 40+10 30 - 37 ft - lbs			
Einspritzleitungen	Fuel supply line nuts	Conduites d'injection	Nm 20 15 ft - lbs			
Kolbenkühldüse	Piston cooling nozzle	Buse de refroidis. pour piston	Nm 30 22 ft - lbs			
Mutterf. Kühlmittelpumpenlaufrad (Kühlmittelp.i. Aggregateträger integriert)	Coolant pump impeller wheel locknut (Coolant pump in acc. drive gear box)	Ecrou de fixat. de la roue a'ailettes pompe à eau (Pompe à eau est integre en support d'aggregat)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 70+25 52 - 70 ft-lbs	
Schraube(Schmieröldüse) f. Kühlmittelpumpen-Befestigung Lagerung m. Bundlager	Screw (lubrication nozzle) for cooland pump mount Coolant end bearing	Vis (tuyere huile graissage) de fixation de la roue dentée de pompe à eau avec palier collet	Nm 20 15 ft - lbs			
Schraube für Zahnrad-Lüfterantrieb	Fan drive retaining bolt	Vis de fixation de la roue dentée d'entraînement du ventilateur	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	⚡°50 Nm 120 89 ft-lbs	

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous				
Motortype	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Nutmutter am Kühlmittel-pumpenlaufrad	Ring nut on coolant pump impeller wheel	Ecrou à rainure sur pignon de pompe à réfrigérant	Nm 100 74 ft - lbs						
Schraube für Kühlmittel-pumpennabe	Fan hub retaining bolt on coolant pump shaft	Vis pour moyeu de pompe à réfrigérant	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	⚡°90 Nm 115 85 ft-lbs				
Mutterf. Kühlmittel-pumpenlaufrad (Kühlmittelp. i. Aggregateträger integriert)	Coolant pump impeller wheel locknut (Coolant pump in acc. drive gear box)	Ecrou de fixat. de la roue a'ailettes pompe à eau (Pompe à eau est integre en support d'aggregat)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 70 + 25 52 - 70 ft-lbs				
Schraubef. Kühlmittel-pumpenzahnrad (Kühlmittelp. i. Aggregateträger integriert)	Coolant pump drive gear wheel retaining bolt (Coolant pump in acc. drive gear box)	Vis de fixation de la roue dentee de pompe à eau (Pompe à eau est integre en support d'aggregat))	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 70 + 25 52 - 70 ft-lbs				
Schraubef. Kühlmittel-pumpen-Befestigung (Kühlmittelp. i. Aggregateträger integriert)	Screw for coolant pump mount (Coolant pump in acc. drive gear box)	Vis de fixation de la pompe de refroidissement (Pompe à eau est integre en support d'aggregat)	Nm 15 11 ft - lbs						
Schraube (Schmieröldüse) f. Kühlmittel-pumpen-Befestigung Lagerung m. Bundlager	Screw (lubrication nozzle) for cooland pump mount Coolant end bearing	Vis (tuyere huile graissage) de fixation de la roue dentee de pompe a'eau avec palier collet	Nm 20 15 ft - lbs						
Schraube für Zahnrad-Lüfterantrieb	Fan drive retaining bolt	Vis de fixation de la roue dentée d'entraînement du ventilateur	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	⚡°50 Nm 120 89 ft-lbs				
Schraube für Nabe am Lüfterantrieb	Screw for hub on fan drive	Vis de fixation de moyeu de hélice	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 80 Nm 270 200 ft-lbs				
Schraube für Nabe am Lüfterantrieb mit Lüfterkupp lung (2speed)	Screw for hub on fan drive with fan coupling (2speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 140 Nm 270 200 ft-lbs				
Schraube für Nabe am Lüfterantrieb mit Visco-u. Lüfterkupplung (2speed)	Screw for hub on fan drive with visco and fan coupling (2speed)	Vis de fixation de moyeu de hélice avec visco et embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 110 Nm 270 200 ft-lbs				

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous			
Motor type	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Nutmutter am Kühlmittel-pumpenlaufrad	Ring nut on coolant pump impeller wheel	Ecrou à rainure sur pignon de pompe à réfrigérant						
Schraube für Kühlmittel-pumpennabe	Fan hub retaining bolt on coolant pump shaft	Vis pour moyeu de pompe à réfrigérant						
Mutterf. Kühlmittel-pumpenlaufrad (Kühlmittelp. i. Aggregateträger integriert)	Coolant pump impeller wheel locknut (Coolant pump in acc. drive gear box)	Ecrou de fixat. de la roue a' ailettes pompe à eau (Pompe à eau est integre en support d'aggregat)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 70 + 25 52 - 70 ft-lbs			
Schraubef. Kühlmittel-pumpenzahnrad (Kühlmittelp. i. Aggregateträger integriert)	Coolant pump drive gear wheel retaining bolt (Coolant pump in acc. drive gear box)	Vis de fixation de la roue dentee de pompe à eau (Pompe à eau est integre en support d'aggregat))	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 70 + 25 52 - 70 ft-lbs			
Schraubef. Kühlmittel-pumpen-Befestigung (Kühlmittelp. i. Aggregateträger integriert)	Screw for coolant pump mount (Coolant pump in acc. drive gear box)	Vis de fixation de la pompe de refroidissement (Pompe à eau est integre en support d'aggregat)					Nm 15 11 ft - lbs	
Schraube (Schmieröldüse) f. Kühlmittel-pumpen-Befestigung Lagerung m. Bundlager	Screw (lubrication nozzle) for cooland pump mount Coolant end bearing	Vis (tuyere huile graissage) de fixation de la roue dentee de pompe a'eau avec palier collet					Nm 20 15 ft - lbs	
Schraube für Zahnrad-Lüfterantrieb	Fan drive retaining bolt	Vis de fixation de la roue dentée d'entraînement du ventilateur	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	⚙°50 Nm 120 89 ft-lbs			
Schraube für Nabe am Lüfterantrieb	Screw for hub on fan drive	Vis de fixation de moyeu de hélice	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 80 Nm 270 200 ft-lbs			
Schraube für Nabe am Lüfterantrieb mit Lüfterkupplung (2speed)	Screw for hub on fan drive with fan coupling (2speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 140 Nm 270 200 ft-lbs			
Schraube für Nabe am Lüfterantrieb mit Visco-u. Lüfterkupplung (2speed)	Screw for hub on fan drive with visco and fan coupling (2speed)	Vis de fixation de moyeu de hélice avec visco et embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 110 Nm 270 200 ft-lbs			

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous			
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5				
Schraube für Nabe am Lüfterantrieb	Screw for hub on fan drive	Vis de fixation de moyeu de hélice	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 80 Nm 270 200 ft-lbs			
Schraube für Nabe am Lüfterantrieb mit Lüfterkupp- lung (2speed)	Screw for hub on fan drive with fan coupling (2speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 140 Nm 270 200 ft-lbs			
Schraube für Nabe am Lüfterantrieb mit Visco-u.Lüfter- kupplung (2speed)	Screw for hub on fan drive with visco and fan coupling (2speed)	Vis de fixation de moyeu de hélice avec visco et embrayage du ventilateur (2speed)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 16 x 1,5 x 110 Nm 270 200 ft-lbs			
Schraube für Nabe am Lüfterantrieb mit Lüfterkupp- lung (3speed)	Screw for hub on fan drive with fan coupling (3speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (3speed)			M 16 x 1,5 x 160 Nm 180 133 ft-lbs			
Schrauben für Riemenscheibe auf der Kurbelwelle	Screws for V-belt pulley on crankshaft	Vis pour poulie à courroie sur le vilebrequin	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12 x 45	$\angle 30 + 15 = 45$ Nm 90-140 = 140 66 - 103 ft - lbs	M 12 x 90 Nm 70-110 = 110 52 - 81 ft - lbs	M 16x1,5x160 Nm 300 222 ft - lbs
Schrauben für Abgassammelrohr am Zylinderkopf	Screws for Exhaust mani fold on cylinder head	Vis pour tuyau d'échappement culasse			M 8 x 80 Nm 36 27 ft -lbs			
Mutter für Riemenscheibe an der Lichtmaschine	Alternator pulley lock nut	Ecrou de poulie à courroie sur l'alternateur	(Lucas) 5/8-18 UNF - 2A Nm 54 ⁺³ 40-42 ft - lbs	(Bosch) 5/8-18 UNF - 2A Nm 102 ^{±7} 70-80 ft - lbs	M 14 x 1,5 Nm 35 ⁺¹⁰ 26 - 33 ft - lbs	M 16 x 1,5 Nm 50 ^{±5} 33 - 41 ft - lbs	M 24 x 1,5 Nm 135 ^{±15} 88-110 ft-lbs	M 27 x 1,5 Nm 155 ^{±15} 103 - 126 ft - lbs
Mutter für Luftpresser- zahnrad	Air compressor drive gear wheel lock nut	Ecrou de pignon de compresseur d'air	M 18 x 1,5 Nm 80 ⁺¹⁰ 59 - 66 ft - lbs	M 20 x 1,5 (SW = 30mm) Nm 150 (inch = 1,1811) 111 ft - lbs	M 20 x 1,5 (SW = 27mm) Nm 200 (inch = 1,0629) 148 ft-lbs			
Mutter für Zahnrad an der Hydraulikpumpe	Locknut for gear wheel on the hydraulic pump	Ecrou pour pignon pompe hydraulique			Nm 50 ⁺¹⁰ 37 - 44 ft -lbs			
Zweilochmutter am Hydraulik- pumpen-Antrieb (Antrieb schaltbar)	Two hole nut on the hydraulic pump drive(drive controllable)	Ecrou à 2trous pour entoillement de pompe hydraulic (entraîn. commuta.)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 300 222 ft-lbs			

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous				
Motor type	Engine Type	Type de moteur	D 904 NA/TB	D 904 T	D 906 NA/TB	D 906 T/TI	D 914 T/TI	D 916 T/TI	D 926 TI
Schraube für Nabe am Lüfterantrieb mit Lüfterkupplung (3speed)	Screw for hub on fan drive with fan coupling (3speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (3speed)	M 16 x 1,5 x 160 Nm 180 133 ft-lbs						
Schrauben für Riemenscheibe auf der Kurbelwelle	Screws for V-belt pulley on crankshaft	Vis pour poulie à courroie sur le vilebrequin	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12 x 45	∠°30 + 15 = 45 Nm 90-140 = 140 66 - 103 ft - lbs	M 12 x 90 Nm 70-110 = 110 52 - 81 ft - lbs		M 16x1,5x160 Nm 300 222 ft - lbs
Schrauben für Abgassammelrohr am Zylinderkopf	Screws for Exhaust mani fold on cylinder head	Vis pour tuyau d'échappement culasse	M 8 x 80 Nm 36 27 ft -lbs						
Mutter für Riemenscheibe an der Lichtmaschine	Alternator pulley lock nut	Ecrou de poulie à courroie sur l'alternateur	(Lucas) 5/8-18 UNF - 2A Nm 54 ⁺³ 40-42 ft - lbs	(Bosch) 5/8-18 UNF - 2A Nm 102 ^{±7} 70-80 ft - lbs	M 14 x 1,5 Nm 35 ⁺¹⁰ 26 - 33 ft - lbs	M 16 x 1,5 Nm 50 ^{±5} 33 - 41 ft - lbs	M 24 x 1,5 Nm 135 ^{±15} 88-110 ft-lbs	M 27 x 1,5 Nm 155 ^{±15} 103 - 126 ft - lbs	
Mutter für Luftpresserzahnrad	Air compressor drive gear wheel lock nut	Ecrou de pignon de compresseur d'air	M 18 x 1,5 Nm 80 ⁺¹⁰ 59 - 66 ft - lbs	M 20 x 1,5 (SW = 30mm) Nm 150 (inch = 1,1811) 111 ft - lbs	M 20 x 1,5 (SW = 27mm) Nm 200 (inch = 1,0629) 148 ft-lbs				
Mutter für Zahnrad an der Hydraulikpumpe	Locknut for gear wheel on the hydraulic pump	Ecrou pour pignon pompe hydraulique	Nm 50 ⁺¹⁰ 37 - 44 ft -lbs						
Zweilochmutter am Hydraulikpumpen-Antrieb (Antrieb schaltbar)	Two hole nut on the hydraulic pump drive (Drive controllable)	Ecrou à 2twus pour entoillement de pompe hydraulic (entoilnem. commut.)							
Zweilochmutter am Hydraulikpumpen-Antrieb	Two hole nut on the hydraulic pump drive	Ecrou à 2twus pour entoillement de pompe hydraulic							
Schraube für Dayco-Rollen	Screw for Dayco-roller	Vis pour poulie-Dayco							

Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous			
Motortype	Engine Type	Type de moteur	D 924 T-E (A1,A2)	D 924 TI-E (A2,A3)	D 926 T-E (A1,A2)	D 926 TI-E (A2,A3)	D 924 TI-EA4	D 926 TI-EA4
Schraube für Nabe am Lüfterantrieb mit Lüfterkuppelung (3speed)	Screw for hub on fan drive with fan coupling (3speed)	Vis de fixation de moyeu de hélice avec embrayage du ventilateur (3speed)	M 16 x 1,5 x 160 Nm 180 133 ft-lbs					
Schrauben für Riemenscheibe auf der Kurbelwelle	Screws for V-belt pulley on crankshaft	Vis pour poulie à courroie sur le vilebrequin	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	M 12 x 45	∠°30 + 15 = 45 Nm 90-140 = 140 66 - 103 ft - lbs	M 12 x 90 Nm 70-110 = 110 52 - 81 ft - lbs	M 16x1,5x160 Nm 300 222 ft - lbs
Schrauben für Abgassammelrohr am Zylinderkopf	Screws for Exhaust mani fold on cylinder head	Vis pour tuyau d'échappement culasse	M 8 x 80 Nm 36 27 ft -lbs					
Mutter für Riemenscheibe an der Lichtmaschine	Alternator pulley lock nut	Ecrou de poulie à courroie sur l'alternateur	(Lucas) 5/8-18 UNF - 2A Nm 54 ⁺³ 40-42 ft - lbs	(Bosch) 5/8-18 UNF - 2A Nm 102 ^{±7} 70-80 ft - lbs	M 14 x 1,5 M 35 ⁺¹⁰ 26 - 33 ft - lbs	M 16 x 1,5 Nm 50 ^{±5} 33 - 41 ft - lbs	M 24 x 1,5 Nm 135 ^{±15} 88-110 ft-lbs	M 27 x 1,5 Nm 155 ^{±15} 103 - 126 ft - lbs
Mutter für Luftpresserzahnrad	Air compressor drive gear wheel lock nut	Ecrou de pignon de compresseur d'air	M 18 x 1,5 Nm 80 ⁺¹⁰ 59 - 66 ft - lbs	M 20 x 1,5 (SW = 30mm) Nm 150 (inch = 1,1811) 111 ft - lbs	M 20 x 1,5 (SW = 27mm) Nm 200 (inch = 1,0629) 148 ft-lbs			
Mutter für Zahnrad an der Hydraulikpumpe	Locknut for gear wheel on the hydraulic pump	Ecrou pour pignon pompe hydraulique	Nm 50 ⁺¹⁰ 37 - 44 ft -lbs					
Zweilochmutter am Hydraulikpumpen-Antrieb (Antrieb schaltbar)	Two hole nut on the hydraulic pump drive (Drive controllable)	Ecrou à 2twus pour entoillement de pompe hydraulic (entoilnem. commut.)	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 300 222 ft - lbs			
Zweilochmutter am Hydraulikpumpen-Antrieb	Two hole nut on the hydraulic pump drive	Ecrou à 2twus pour entoillement de pompe hydraulic	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 240 177 ft - lbs			
Schraube für Dayco-Rollen	Screw for Dayco-roller	Vis pour poulie-Dayco	vorspannen pretorque préserrage	Nm 20 15 ft - lbs	M 10 x 50 Nm 48 35 ft - lbs			

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Schraubenanzugswerte			Torque Specifications		Valeurs de serrage des vis / écrous	
Motortype	Engine Type	Type de moteur	D 924 TI-EA5	D 926 TI-EA5		
Zweilochmutter am Hydraulik- pumpen-Antrieb	Two hole nut on the hydraulic pump drive	Ecrou à 2twus pour entrouisse- ment de pompe hydraulic	vorspannen pretorque préserrage	Nm 30 22 ft - lbs	Nm 240 177 ft - lbs	
Schraube für Dayco-Rollen	Screw for Dayco- roller	Vis pour poulie- Dayco	vorspannen pretorque préserrage	Nm 20 15 ft - lbs	M 10 x 50 Nm 48 35 ft - lbs	

1.22.08

Torque specifications:

For screws and bolts according to DIN 912, 931, 933, 960, 961

Allowed tolerance $\pm 10\%$

Surface condition: screw Mn or Zn phosphated, not lubricated or oiled $\mu_{tot.} = 0,14$ Ft-lbs = Nm x 0.736

normal thread	8.8 Nm	10.9 Nm	12.9 Nm
M6	10	15	18
M8	25	36	43
M10	49	72	84
M12	85	125	145
M14	135	200	235
M16	210	310	365
M18	300	430	500
M20	425	610	710
M22	580	820	960
M24	730	1050	1220

fine thread	8.8 Nm	10.9 Nm	12.9 Nm
M8x1	27	39	46
M10x1,25	52	76	90
M12x1,25	93	135	160
M12x1,5	89	130	155
M14x1,5	145	215	255
M16x1,5	225	330	390
M18x1,5	340	485	570
M20x1,5	475	680	790
M22x1,5	630	900	1050
M24x2	800	1150	1350

Surface condition: screw galvanized, not lubricated or oiled, $\mu_{tot} = 0,125$

M6	9,6	14	16
M8	23	34	40
M10	46	67	79
M12	79	115	135
M14	125	185	220
M16	195	290	340
M18	280	400	470
M20	395	560	660
M22	540	760	890
M24	680	970	1150

M8x1	25	37	43
M10x1,25	49	71	83
M12x1,25	87	130	150
M12x1,5	83	120	145
M14x1,5	135	200	235
M16x1,5	210	310	360
M18x1,5	315	450	530
M20x1,5	440	630	730
M22x1,5	590	840	980
M24x2	740	1050	1250

Torque specifications

For screw plugs according to DIN 908, 910, hollow screws according to DIN 7623, 7643 with seal rings according to DIN 7603.

Thread	Nm
M 6 x 1	7
M 8 x 1.5	7.5
M 10 x 1	10.4
M 12 x 1.5	20
M 14 x 1.5	27
M 16 x 1.5	37
M 18 x 1.5	40
M 20 x 1.5	47
M 22 x 1.5	57
M 24 x 1.5	68
M 26 x 1.5	75
M 27 x 2	87
M 30 x 1.5	115
M 30 x 2	115

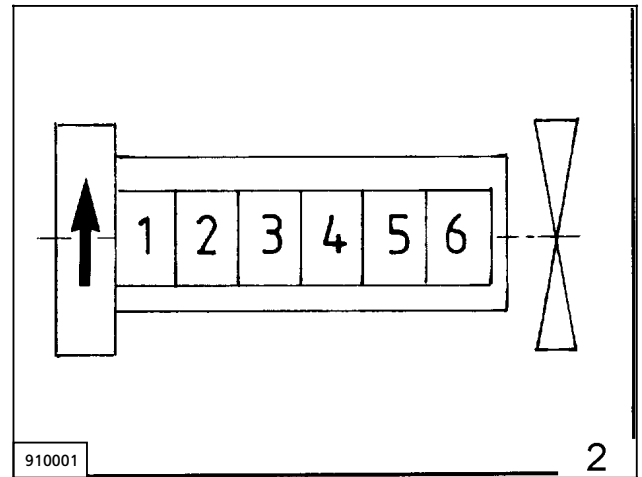
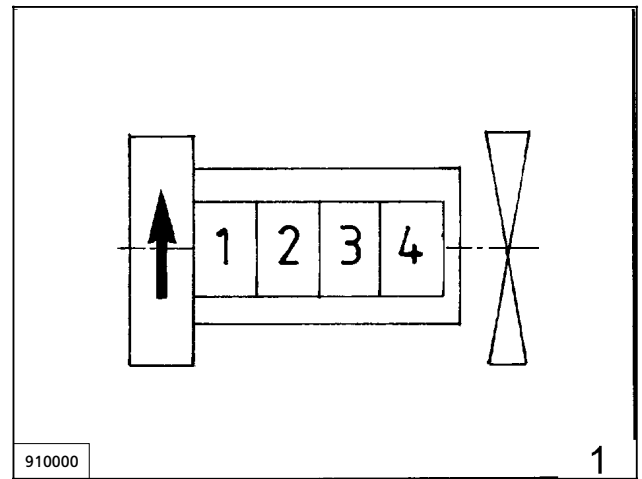
Thread	Nm
M 33 x 2	120
M 36 x 1.5	155
M 36 x 2	155
M 38 x 1.5	171
M 39 x 2	215
M 42 x 1.5	240
M 42 x 2	240
M 45 x 1.5	270
M 45 x 2	270
M 48 x 1.5	300
M 48 x 2	300
M 52 x 1.5	380
M 52 x 2	380
M 56 x 2	430
M 60 x 2	510
M 64 x 2	570
M 65 x 2	620

Cylinder arrangement, Engine S/N, Crankcase number, Connecting rod number, Engine data plate, and Engine identification

Cylinder arrangement:

Cylinder No. 1 is located next to the flywheel .
 The number sequence for the 4-cylinder engine is shown in fig. 1, the 6-cylinder engine is shown in fig. 2.

The engine rotates counterclockwise when facing the flywheel.



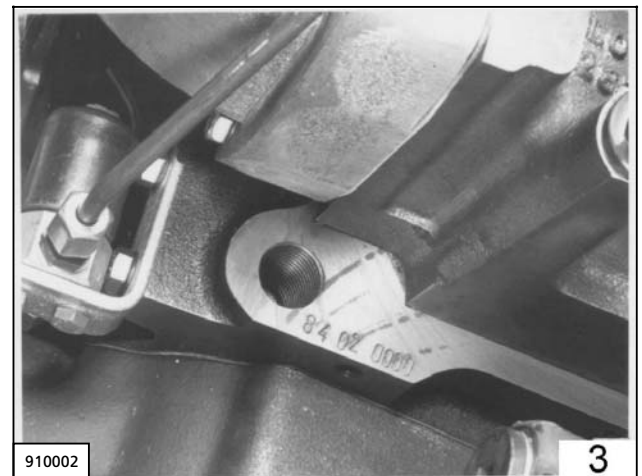
Engine identification / serial number:

The engine identification / serial number is embossed in the engine data tag and the engine block / crankcase.

The engine identification number is embossed on top of the crankcase after the last cylinder, on the left side, when facing the flywheel.

Engine identification number - example:

97	01	0050
Manuf. year	4-cylinder	Running S/N
	02 = 6-cylinder	

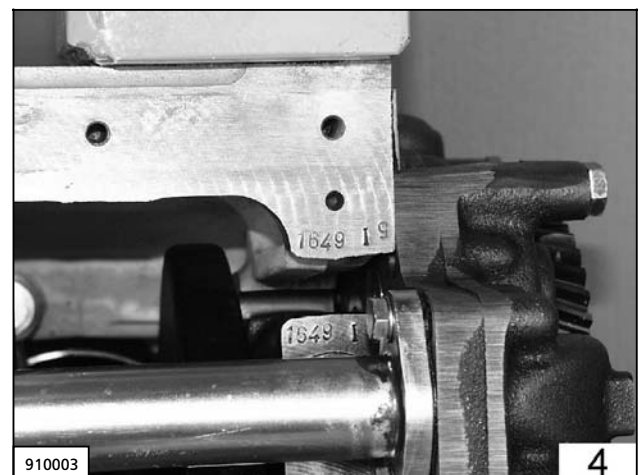


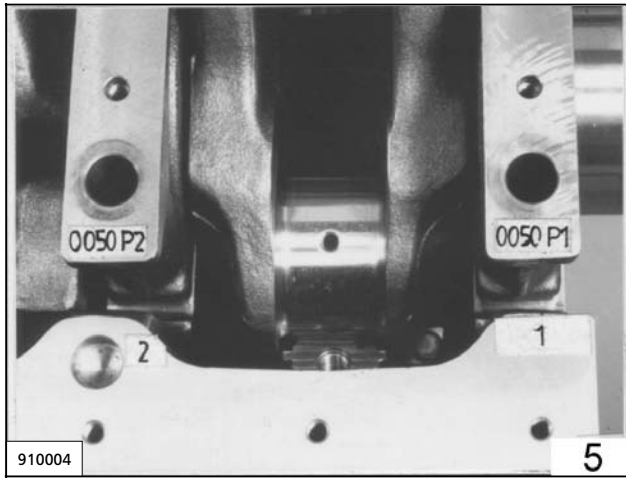
Crankcase number:

The crankcase number is embossed on the lower crankcase opposite the fan-side bearing seat.

Crankcase number - example:

0050	P	5
Running S/N	Manuf. year	Running No. for bearing caps
	A = 1982	5 = for 4 cyl. engine
	B = 1983	7 = for 6 cyl. engine
	etc.	
	P = 1997	
	etc.	





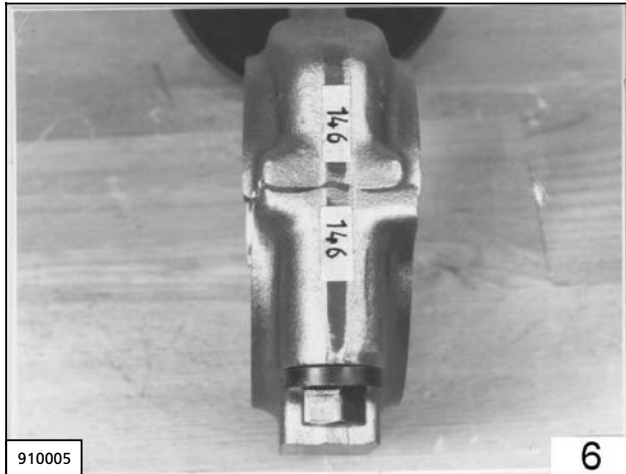
The main bearing caps are identified on the left hand side (as seen from the flywheel) with the crankcase number and the running bearing cap number 1, 2, 3, etc. .

The running bearing cap numbers are embossed on the crankcase, starting at the flywheel.

Crankcase position: oil pan points upward.

Note:

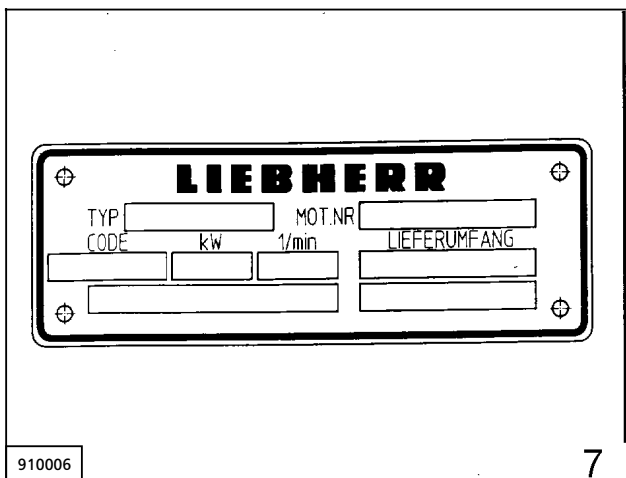
The main bearing cap numbers and the crankcase numbers must match during installation.



Connecting rod numbers:

The connecting rods and the corresponding bearing caps are identified on the right hand side, as seen from the flywheel in numerical sequence, starting at the flywheel .

The marked connecting rod side must be installed on the right hand side, as seen from the flywheel. Engine in the installed position.



Engine identification / data plate:

The engine data plate is located on the right hand side of the crankcase, as seen from the flywheel, right above the injection pump.

On some engine models, a second data plate is installed on the air intake pipe.

Engine data:

Type = D 914T, D 926TI etc.

Mot. Nr. = Engine serial number

Code = Engine (performance)
inspection number

KW = Engine output in KW

1/min. = Rated engine speed

Lieferumfang = Id. No. of engine configuration

In addition, the performance standards are noted in the lower left field, after the engine is tested.

Additional identification / data plate:

For additional identification, an additional data plate may be installed.

Data:

- Code = Engine performance inspection number
- Field 1 = EC member identification number
- Field 2 = Approval per EC regulation
R 24 or R 49
- Field 3 = Approval number

Engine data plate for "E" (emission optimized) engines from 1997

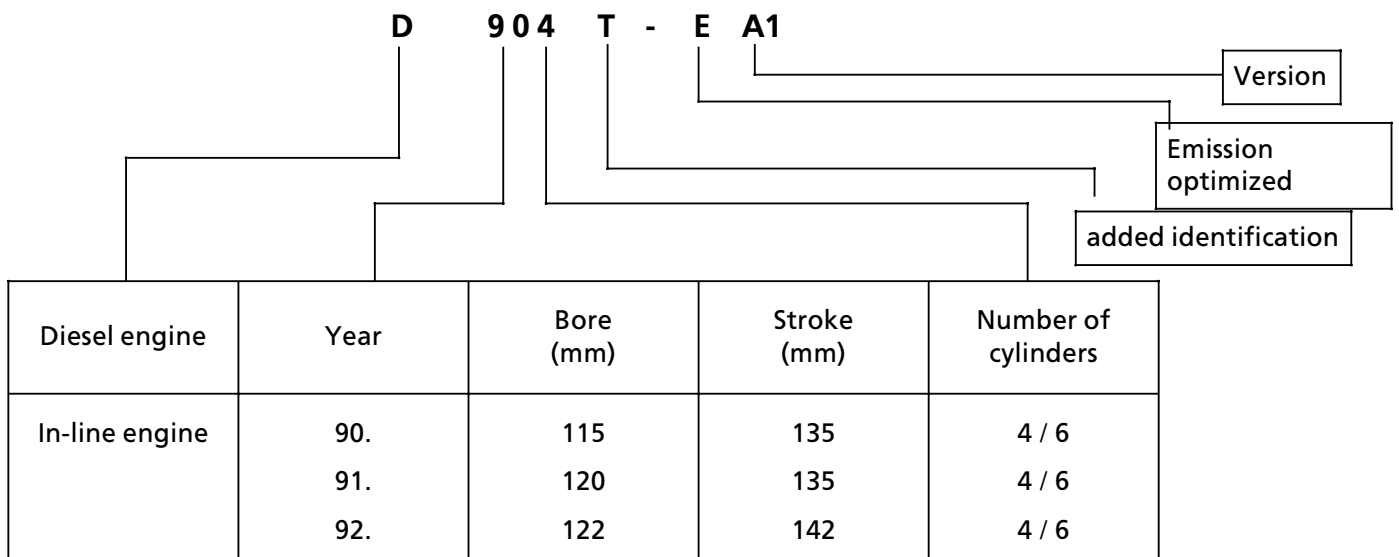
Note:

The text on the engine data plate is in English.

Original data plate:

German text:

Engine identification



Additional identification:

- NA = Naturally aspirated engine
- TB = moderately turbo charged
- T = Turbo charged engine
- TI = Turbo charged and intercooled engine

Version:

- A1 = Distributor type injection pump
- A2 = MW - / P 3000 - Injection pump
- A3 = P 7100 - Injection pump
- A4 = P7100 + EDC (Electronic regulation)
- A5 = H - RP43 - Control-sleeve injection pump
+ EDC (Electronic regulation))

Sub Group Index

2.01	Inspections
2.05	Dry air filter
2.08	Service fluids
2.10	Sealing and locking compounds, greases
2.15	Adjust valve clearance
2.17	Check compression pressure
2.19	Check and adjust fuel injection timing
2.21	Check and calibrate * fuel injectors, remove and install injector nozzle
2.23	Check, flame glow plug system, remove and install
2.24	Heating flange checking, removal and installation
2.25	Check piston clearance
2.27	Check alternator V-belt tension, adjust and replace
2.28	Check V-belt tension for air conditioning, compressor and generator installation, adjust and replace
2.29	V-belt tension for air conditioning, compressor and generator replace (Dayco-fastening device)
2.32	Remove, install and test thermostat
2.35	Adjust, remove and install oil pressure relief valve
2.38	Check, remove and install oil separator
2.50	Troubleshooting

*** Calibration should be performed by a qualified repair (Bosch) facility**

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type	D 904 / 914 / 924
			906 / 916 / 926
		Ab/from/à partir de	
Datum/Edition/Date	Inspections, Checks and Adjustments	Blatt/Page/Feuille	
05/2003		2.00	

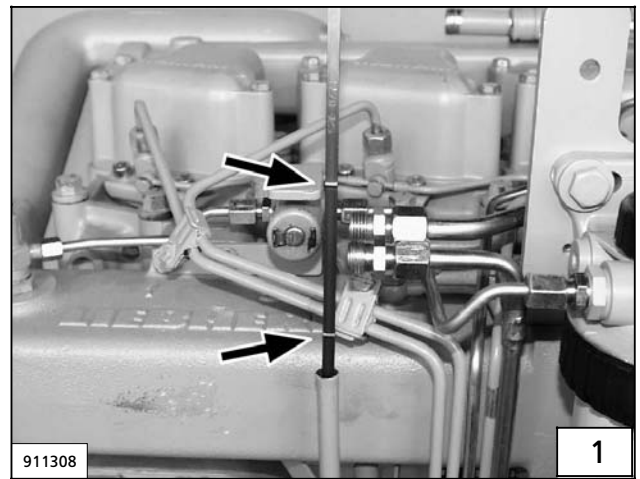
		Daily maintenance Every 50 - 100 hrs.	Also every 500 hrs (at least 1 x annual)	Also every 1000 hrs.	Also every 2000 hrs.	Also every 3000 hrs.	Also every 2 years	Work to be carried out	Check	Clean	Replace	Adjust	Interval Hrs./Years	D 904 /906 NA /TB	D 904 /906 /914 /916 /926 T /TI	D 924 /926 T - E A1	D 924 /926 T /TI-E A2,A3,A4,A5	Fig.	Sub Group No.	
MAINTENANCE	☐							Check engine oil level	☐				daily	☐	☐	☐	☐	1		
	☐							Check coolant level	☐				daily	☐	☐	☐	☐	2	2.08	
	☐							Visual inspection (contamination, damage)	☐				daily	☐	☐	☐	☐	3		
	☐							Air filter - vacuum indicator	☐				daily	☐	☐	☐	☐	4	2.05	
	☐							Water separator on fuel filter	☐	☐			daily	☐	☐	☐	☐	5,6		
		☐						Fuel tank - drain water and sediments (at least 1 x per week)		☐			50-100	☐	☐	☐	☐	7		
		☐						Dust collector on air filter		☐			50-100	☐	☐	☐	☐	8	2.05	
			☐					Engine brake	☐				500		☐	☐	☐	9	8.65	
			☐					Check oil, coolant, fuel system for leaks, condition	☐				500	☐	☐	☐	☐	10,11		
			☐					Radiator, pressure relief valve, fan	☐	☐			500	☐	☐	☐	☐	12		
			☐					Water filter (if installed)			☐		500	☐	☐	☐	☐	13,14		
				☐				Corrosion inhibitor/antifreeze, DCA 4 (in case of water filter installation)	☐				500	☐	☐	☐	☐		2.08	
				☐				Engine oil (first at 500 hrs.) Important: see 2.08			☐		500	☐	☐	☐	☐	15,16	2.08	
				☐				Lube oil filter			☐		500	☐	☐	☐	☐	17		
				☐				Battery and cable connections	☐				500	☐	☐	☐	☐	18		
				☐	☐			Fuel fine filter (or in case of drop in engine performance)			☐		1000			☐		19		
				☐	☐			Fuel pre-filter (or in case of drop in engine performance)			☐		1000			☐		19		
				☐				Fuel pre-filter - (or in case of drop in engine performance)	☐	☐	☐		1000	☐	☐		☐	21,22, 23		
				☐				Fuel pre-filter (or in case of drop in engine performance)			☐		1000	☐	☐		☐	20		
					☐			Fuel fine filter (or in case of drop in engine performance)			☐		2000	☐	☐		☐	20		
					☐			Grease gear on flywheel	☐	☐			1000	☐	☐	☐	☐	24		
					☐			Mounting of oil pan and engine brackets	☐				1000	☐	☐	☐	☐	25		
			☐	☐				Check air intake and exhaust system - for leaks, condition (first after 500 hrs.)	☐				1000	☐	☐	☐	☐	26,27, 28		
								Air filter main element (according to maintenance indicator / annually)			☐				☐	☐	☐		2.05	
								Air filter safety element (at every 3rd change of the main element/annually) never clean!			☐					☐	☐		2.05	
							☐	Coolant with corrosion inhibitor/antifreeze			☐		2 years	☐	☐	☐	☐	30,31, 32,33	2.08	
	CHECK AND ADJUSTMENT			☐					Tension + condition of V-belt (alternator)	☐		☐	☐	500	☐	☐	☐	☐		2.27
				☐					Tension + condition of V-belt (air conditioner compressor)	☐		☐	☐	500			☐	☐		2.28 2.29
				☐					Valve play	☐			☐	500		☐				2.15
				☐	☐				Valve play (1. Adjustment at 500 hrs.)	☐			☐	1000	☐					2.15
					☐				Valve play	☐			☐	1000			☐	☐		2.15
					☐				Engine regulation (engine RPM)	☐			☐	1000	☐	☐	☐	☐	29	
					☐				Flame glow plug (at begin of cold season)	☐	☐			1000	☐	☐	☐	☐		2.23
						☐			Injector valve (or in case of drop in engine performance)	☐		☐	☐	3000	☐	☐	☐	☐		2.21
							☐		Coolant pump (first at 6000 hrs.)	☐		☐		3000	☐	☐	☐	☐		5.11 5.12
							☐		Oil separator			☐		2 years	☐	☐	☐	☐		2.38
☐ First and only maintenance interval																				
☐ Repeat interval																				

Check engine oil level:

The engine must be in a horizontal position.

Turn the engine off, wait 2 - 3 minutes, pull the dipstick, wipe it off and reinsert it. Pull it out again. Add oil, if necessary.

Do not operate the engine with the oil level below the lower mark (Min.) .



Check the coolant level:

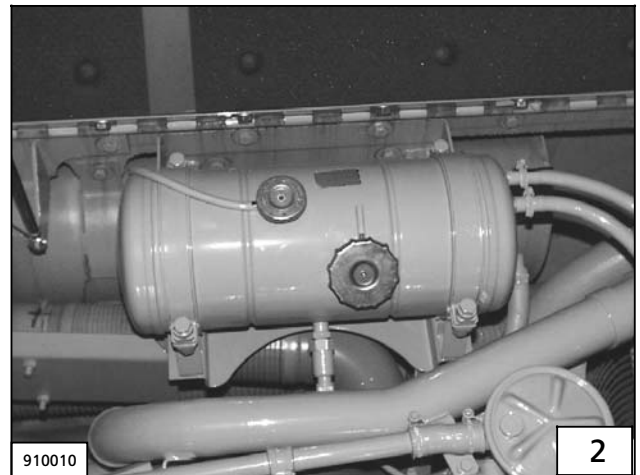
Check the coolant level on the expansion tank or the radiator. Turn the radiator cap to the first notch, wait until any residual pressure is relieved. Continue to rotate the cap to the 2nd notch and remove it.

Add coolant to maximum level.

For coolant specifications, refer to sub group 2.08.

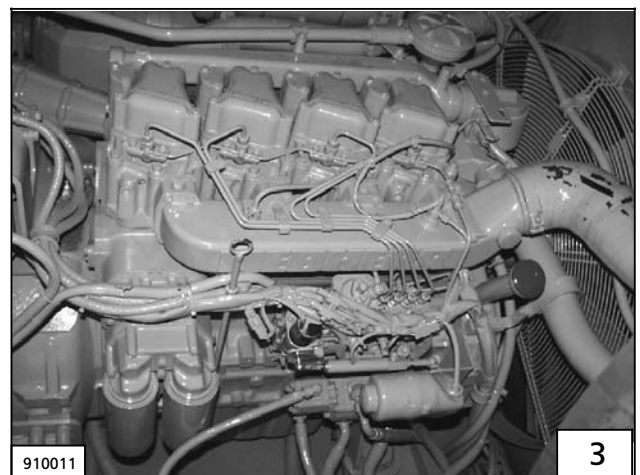
Caution:

Open and remove the radiator cap only at a coolant temperature below 194° F (90°C) .



Visual inspection (contamination, damage):

Check the engine for contamination and damage.

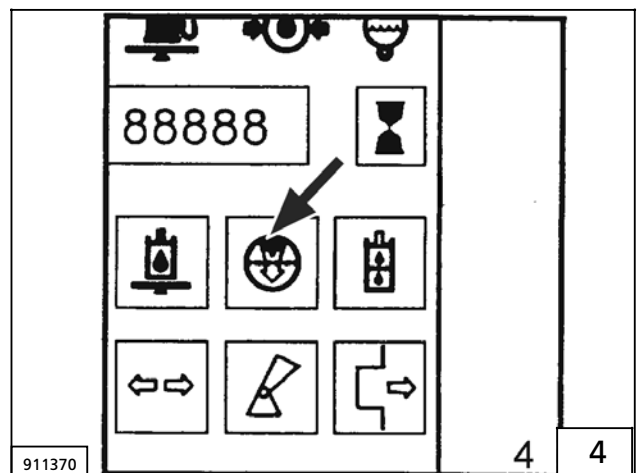


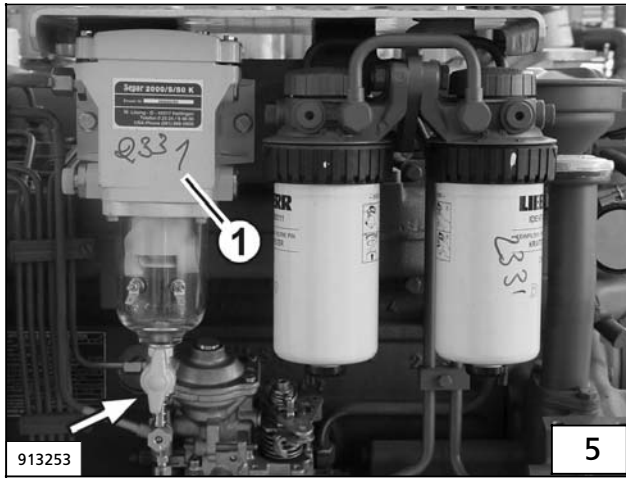
Air filter - vacuum indicator:

Check the vacuum indicator or the vacuum indicator light on the instrument panel in the operator's cab.

When the indicator light lights up, change the filter insert.

For description of the air filter, refer to sub group 2.05 or the machine's Operation and Maintenance Manual.



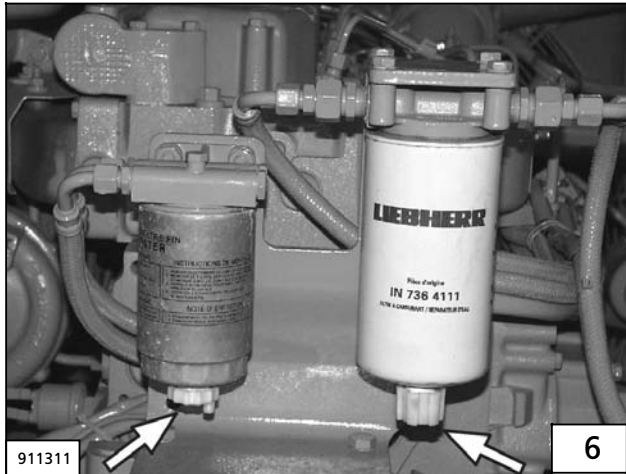


Check the water separator on the fuel filter:

On fuel filters 1 with inspection possibilities for water content, check water level. Drain off water, as necessary.

Open the drain plug, drain water until clean fuel emerges, close drain plug.

Catch fuel in a suitable container.



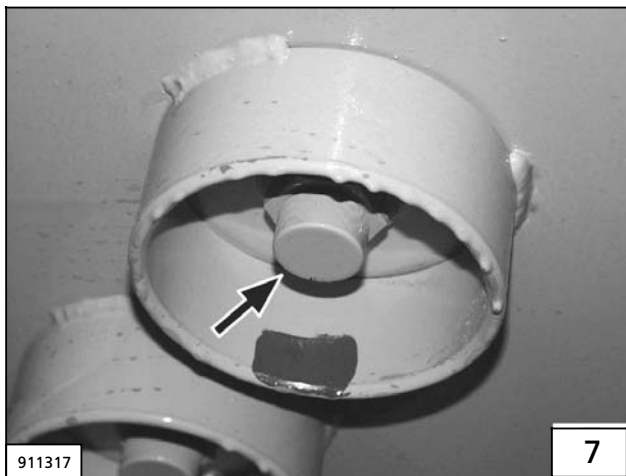
On fuel filters without inspection possibilities for water content:

Open drain plug, drain water until clean fuel emerges, close drain plug.

Catch fuel in a suitable container.

Note:

If a pre-filter with water separator is installed, check the water level and drain off via the drain valve or drain plug, as necessary (see fig. 21).



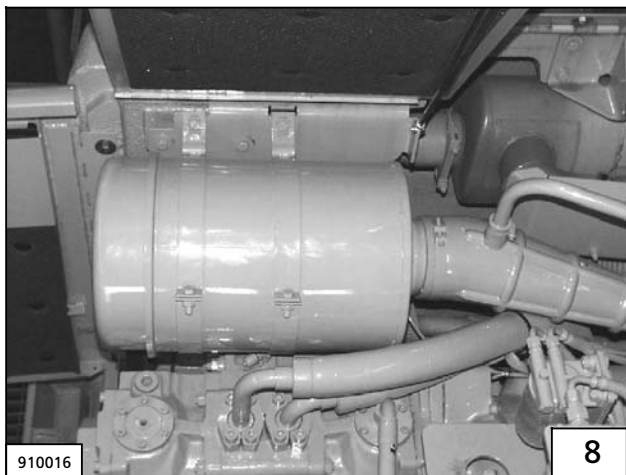
Drain water and sediments from fuel tank:

On the underside of the fuel tank, open the drain plug or drain valve and drain off water and sediments until clean fuel emerges.

Close drain plug or valve.

Catch fuel in a suitable container.

Refer to the machine Operation and Maintenance Manual for details.



Dust collector on air filter:

Remove the dust collector, empty, clean and reinstall.

Make sure the seal ring is seated properly.

For versions with dust ejector valve, push valve open and clean.

On systems with automatic dust ejection, this step is not required.

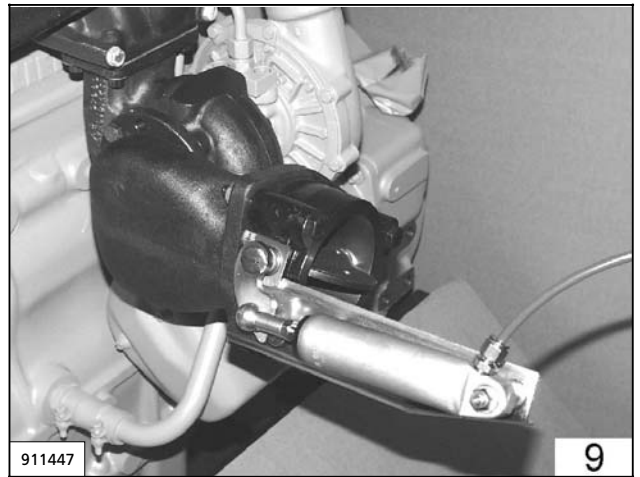
For air filter description, refer to sub group 2.05.

Refer to machine's Operation and Maintenance Manual for details.

Engine brake:

Actuate the engine brake several times to check for proper function.

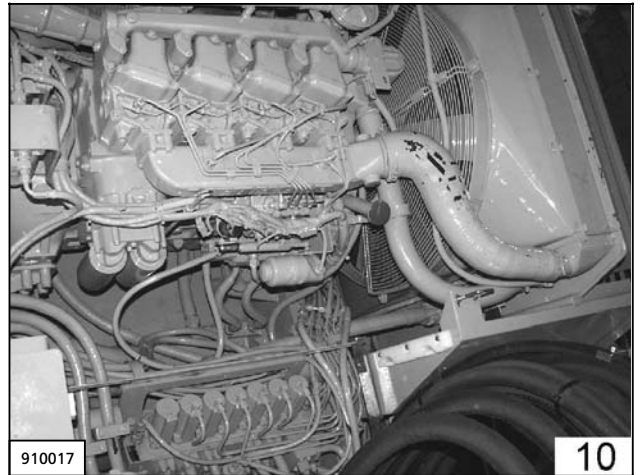
For description of engine brake, refer to sub group 8.65



Oil, coolant and fuel system:

Check connections, hoses, lines for leaks and condition.

Reseal in case of leakage, or replace defective hoses or lines.

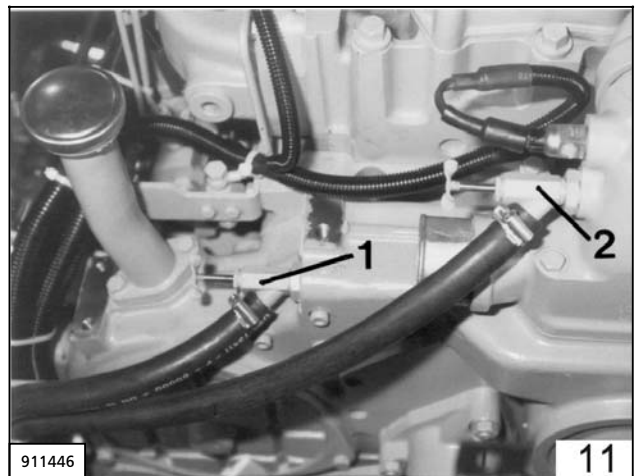


Heater connection: 1 = supply line
 2 = return line

Replace brittle or damaged coolant hoses.

Note:

When replacing heater valves or heater connections, coat threads with Omnivisc 1050, or Reinzoplast sealing compound or use Flui-Flex sealing tape or a comparable product.

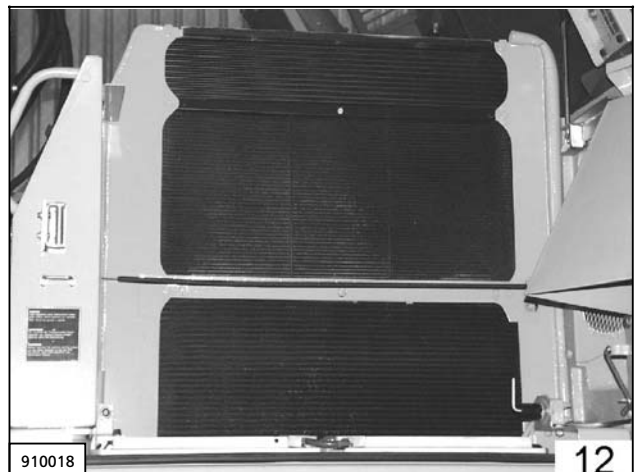


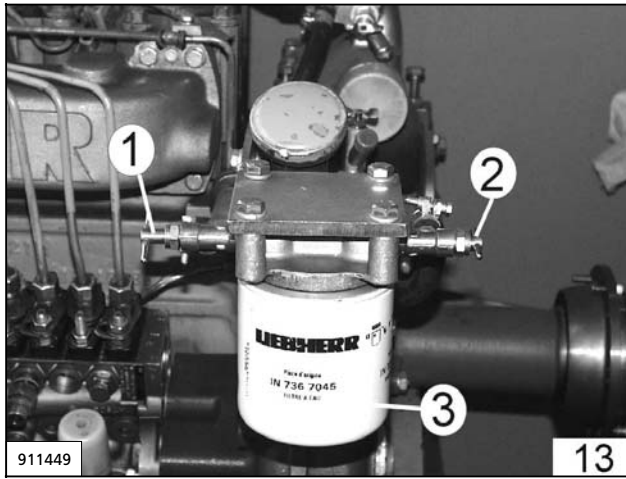
Radiator, pressure relief valve, fan:

Clean the radiator, cooling circuit, as necessary.

Change the radiator cap with relief valve (cooling system) in case of leaks. Replace defective fan.

On machines with intercooler installation, clean cooling circuit, also check fan for cracks, damage and distortion, as necessary.





Change coolant filter:

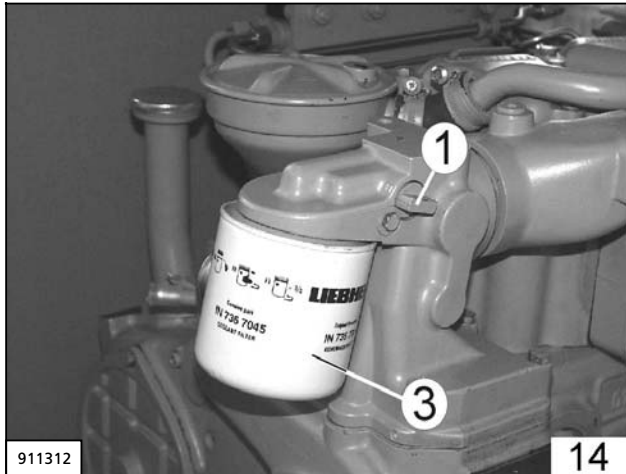
Remote installation -

Close shut off valves 1 and 2, remove coolant filter 3.

Clean sealing surface on filter console.

Install new coolant filter 3, lightly oil the rubber seal ring, hand-tighten.

Open the shut off valves 1 and 2, check the coolant level, coolant concentration, add coolant, as necessary.



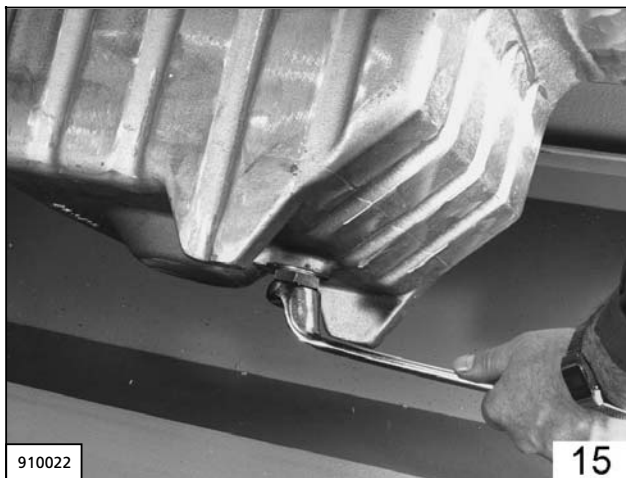
Coolant filter installation on thermostat housing:

Close the shut off valve 1 on the thermostat housing, move the knob from the horizontal to vertical position.

Unscrew coolant filter 3. Clean the sealing surface on the filter console.

Install new coolant filter 3, lightly oil the rubber seal ring, hand-tighten.

Open the shut off valve 1, move from vertical to horizontal position to filter. Check the coolant level / coolant concentration, add coolant, as necessary.

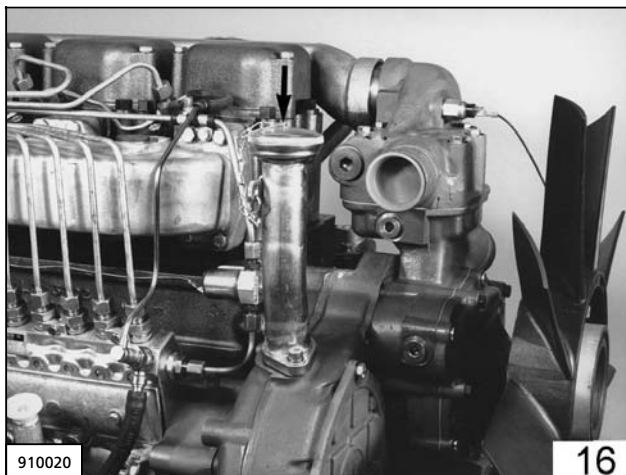


Change engine oil:

Change engine oil only when the engine is warm!

Open the drain or drain plug and drain the oil into a suitable container.

Close oil pan again.



Add oil through filler neck until it reaches the upper mark on the dipstick (Max.).

to check the oil level, refer to page 2.01.02, fig. 1.

For oil quantities, refer to the machine's Operation and Maintenance Manual or the Technical Data in the Service Manual.

For details about lube oil specification, viscosity and oil change intervals, refer to sub group 2.08.

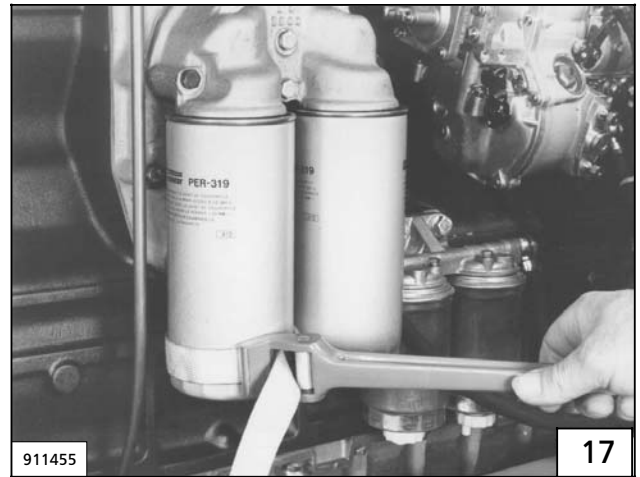
Change lube oil filter :

Remove lube oil filters and clean sealing surfaces on filter console .

Lightly oil rubber seal ring, install new lube oil filters, and hand- tighten.

Note:

Lube oil filters may be remotely installed, away from the engine.



Battery and cable connections:

Check the battery fluid level, it must be approx. 10 to 15 mm above the plates.

Use only distilled water to refill batteries.

Check battery poles and terminals, check connections, clean regularly and coat with acid resistant grease.

Check the electrolyte level. For a fully charged battery the spec. weight is 1.28 kg/ l(31.5° Bé)

Recharge the battery if electrolyte level is low.



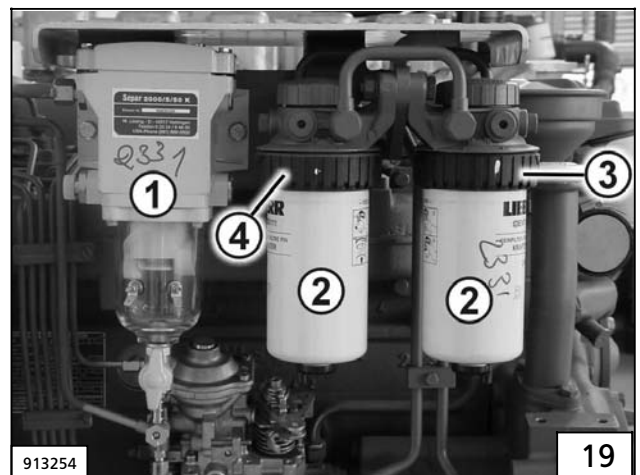
Change the fuel filter:

1 = pre-filter, stage 1, 2 = fine filter, stage 2

Turn the mounting rings 3 and 4 counterclockwise and remove the filter elements 2 from the filter console.

Push mounting rings 3 and 4 over the new filter elements 2, attach to filter console. Tighten mounting rings 3 and 4 all the way.

Bleed fuel system, refer to sub group 7.22, 7.23 for details.



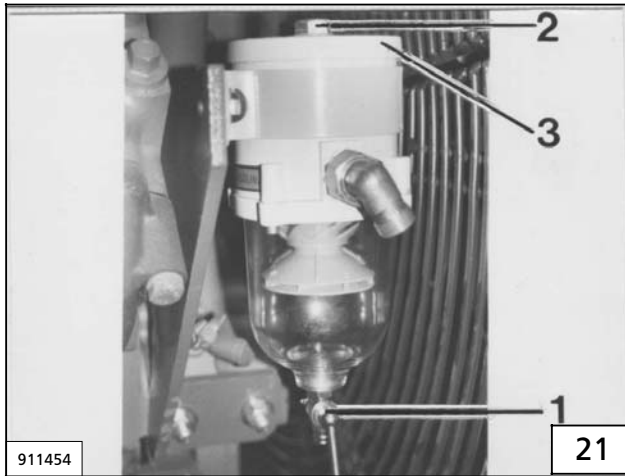
1 = pre-filter, stage 1, 2 = fine filter, stage 2
 Remove the fuel filter elements 1 and 2 and clean the sealing surfaces on the filter console .
 Lightly oil the rubber seal ring, install the new filter elements 1 and 2, and tighten by hand.
 Bleed fuel system, refer to sub group 7.22, 7.23 for details.

Note:

Fuel filter elements, stage 1 can also be installed as pre-filters in front of the fuel pump.

For fuel filters with water separator, remove the container from the filter insert, clean it and attach on new filter element.





Clean fuel pre-filter with water separator:

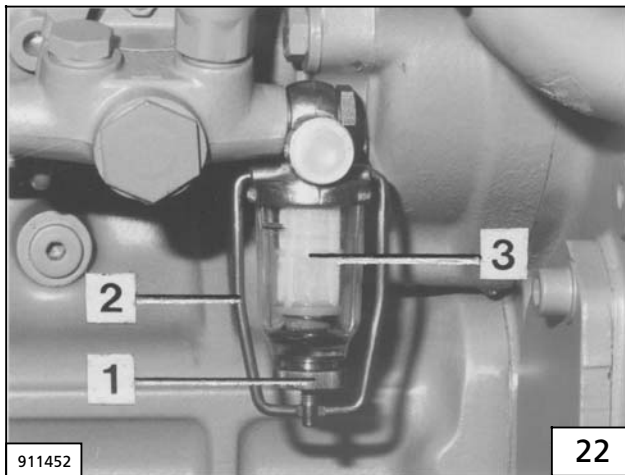
Close the shut off valve (if installed) on the fuel tank.

Open the drain valve 1, and drain the fuel into a suitable container.

Remove screw 2, remove the cover 3 and remove the filter. Clean filter screen and housing. Replace defective O-ring or seal ring and reassemble pre-filter.

Change the filter insert on the prefilter with changeable insert.

Bleed fuel system, refer to sub group 7.22, 7.23 for details.



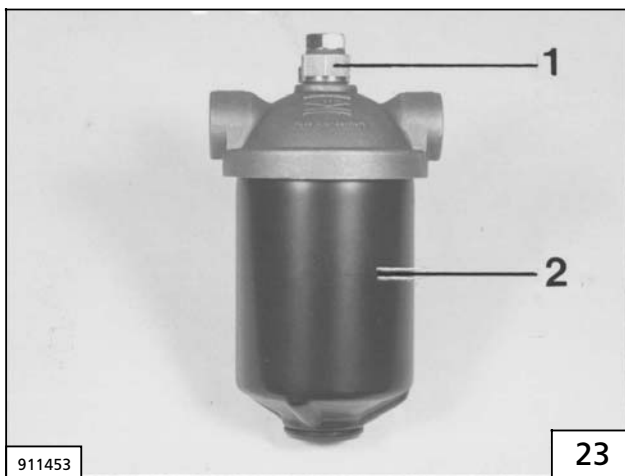
Clean fuel pre-filter:

Note: Always bring a new seal ring.

Close the shut off valve (if installed) on the fuel tank.

Loosen the knurled nut 1, swing the tension bracket 2 out, and remove the sight gauge 3 with filter screen. Clean the sight gauge and filter screen. Replace the seal rings and reassemble the pre-filter. Open the shut off valve.

Bleed fuel system, refer to sub group 7.22, 7.23 for details.



Close the shut off valve (if installed) on the fuel tank.

Open the screw 1, remove the filter housing 2 with filter. Clean filter screen and housing. Replace damaged O-ring or seal ring and reassemble pre-filter.

Open the shut off valve.

Bleed fuel system, refer to sub group 7.22, 7.23 for details.



Grease the gear on the flywheel:

Remove the inspection cover of the flywheel housing, check the flywheel teeth for damage, lubricate teeth with multi purpose grease. Turn the engine with the starter.

Reinstall the cover.

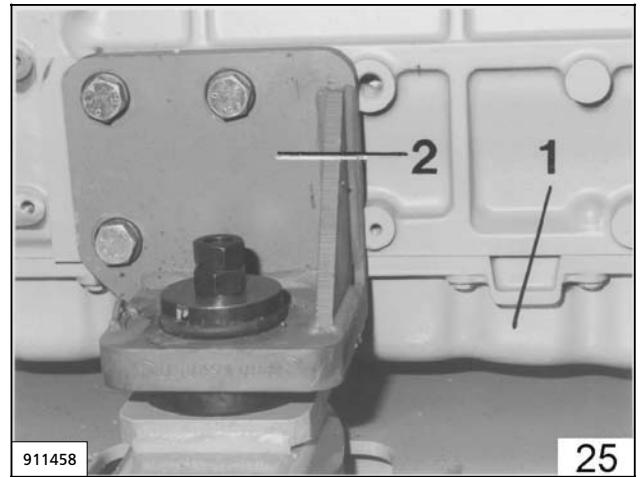
Notes:

Multi purpose grease to grease the flywheel: Molykote Longterm 2 Plus, Ft 1 v 26 (made by Bosch), Avilub LD (made by Avia).

US = NLGI No. 2 Grade - EP2

Check the mounting of the oil pan and engine brackets:

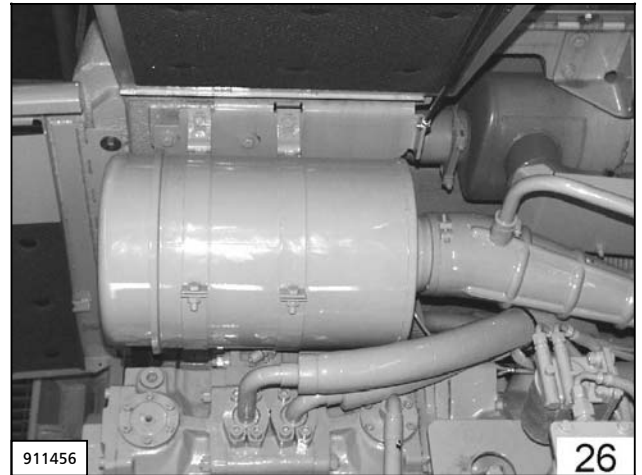
Check the tightness of the screws on oil pan 1 and engine mounting brackets 2 . Tighten / torque, as necessary.



Check intake and exhaust system for leaks, condition:

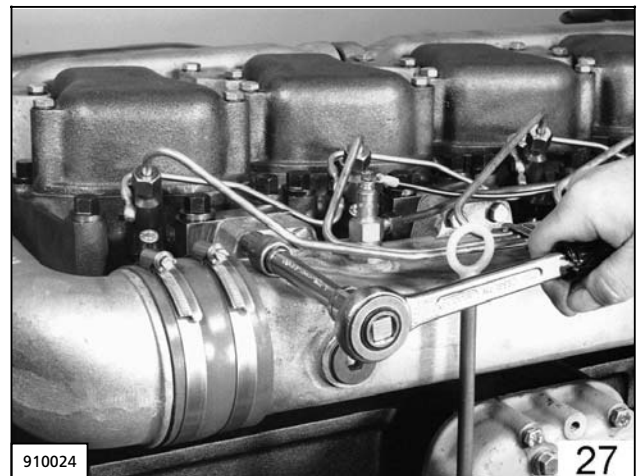
Check the air intake lines between air filter and engine, between air filter and turbo charger and /or air line from turbocharger to intercooler and from intercooler to engine for leaks. Tighten hose clamps, as necessary. Replace worn or damaged parts.

Check the exhaust sytem for leaks.
Replace worn or damaged seals and parts.



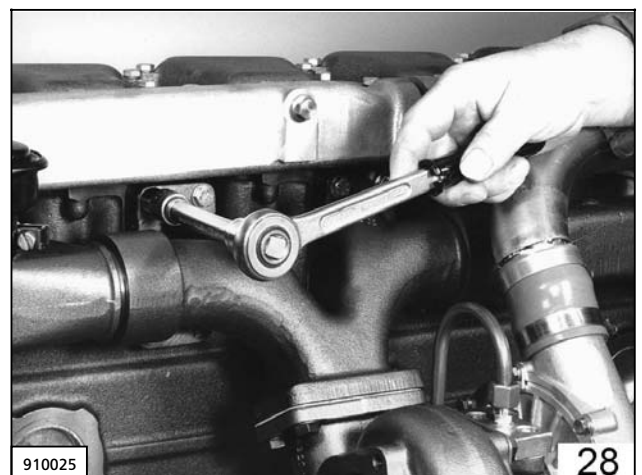
Check intake manifold:

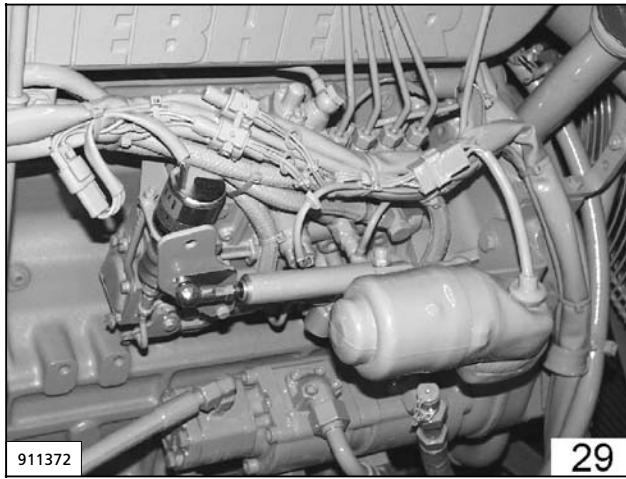
Check mounting on the cylinders heads for leaks, tighten / torque screws, as necessary.



Check exhaust manifold:

Check mounting on the cylinders heads and turbocharger for leaks, tighten screws, as necessary. If necessary, replace worn / burned out gaskets.



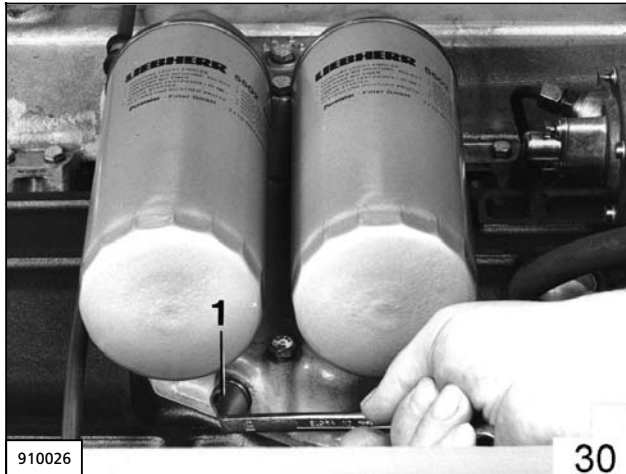


Engine regulation (throttle control):

Check the throttle control for easy movement when the engine is turned off.

On the injection pump, check if the throttle control lever contacts the stop at full load / RPM. Adjust, if necessary .

Replace worn or damaged ball joints and parts.



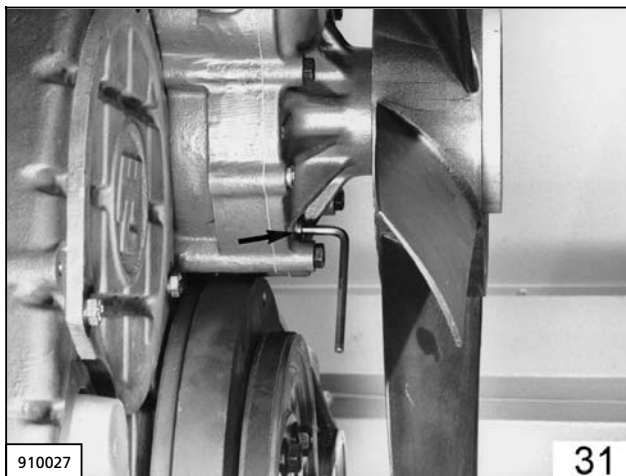
Drain coolant:

Open the drain plug the bottom of the radiator.

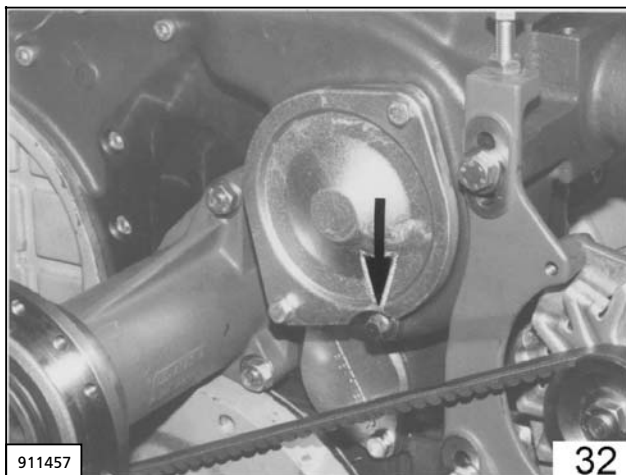
On the engine, remove the drain plug 1, see fig. 30 on the bottom of the oil cooler housing.

Depending on the engine, remove the drain plug on the coolant pump, see fig. 31,32.

Catch coolant in a suitable container.



Coolant drain plug installed on external coolant pump on timing gear cover.



Coolant drain plug on the coolant pump integrated in timing gear cover.

Add coolant:

Install / close the drain plugs on the engine and the radiator.

Open the heater valves, remove the bleeder screw 1 on the coolant return from the cylinders heads.

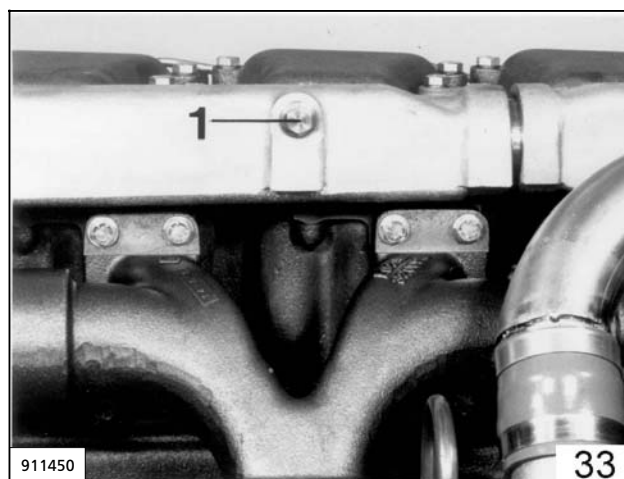
Add coolant until it runs out on the bleeder hole.

Install / tighten the bleeder screw and fill the cooling system to maximum level.

Note: If a line runs from the coolant return on the engine to the radiator or expansion tank, then the bleeding procedure can be eliminated.

Start the engine and bring it to operating temperature. Check the coolant level again and add more coolant, if necessary.

For quantities, refer to Technical Data page of corresponding machine or the Operation and Maintenance Manual.



Important:

To provide anti-corrosion protection for the cooling system, the coolant must contain at least 50 Vol. % corrosion inhibitor / antifreeze all year round. This protects the system to approx. -37°C (-35° F).

For a list of approved corrosion inhibitors / antifreeze and mixing ratios refer to sub group 2.08.

Add the required liquid DCA to the cooling system if a coolant filter is installed.

For details, refer to sub group 2.08 or your Operation and Maintenance Manual.

THE DRY AIR FILTER

Note:

Air filters differ, depending on machine model .

Observe the maintenance guidelines in the Operation and Maintenance manuals for each machine.

Maximum engine protection against premature wear due to dust is only possible if the air filter (fig. 1) is serviced at regular intervals.

The dry air filter is designed to provide maximum protection with very long service intervals.

When the maximum permissible vacuum is reached, the maintenance indicator on the clean air connection of the air filter (fig. 2) and /or the indicator light H13 (fig. 3) lights up.

Note: Instrument panels vary, depending on the machine model.

Maintenance includes replacement of filter elements.

For safety reasons, we do not recommend to wash the filter elements.

We recommend to remove the filter element only after the maintenance indicator is actuated and lights up on the control panel, but at least once a year.

Removing and installing the filter elements too often can damage the seals between filter element and filter housing.

The safety element should only be changed after every third change of the main element, but at least once a year.

Before installing a new element, carefully clean the seals and the sealing surface in the housing.

On the dust ejector (fig. 4, pos. 4) push the ejection slit open weekly to prevent it from getting stuck in the closed position due to humidity and dust.

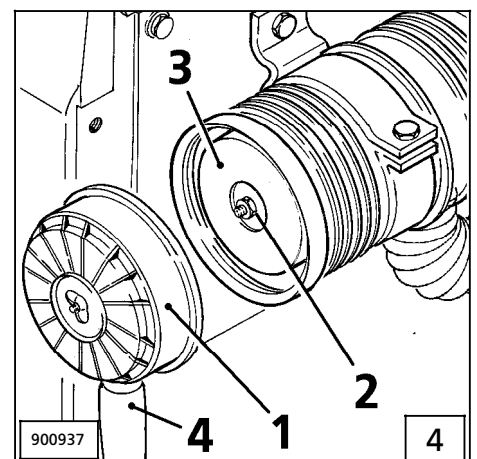
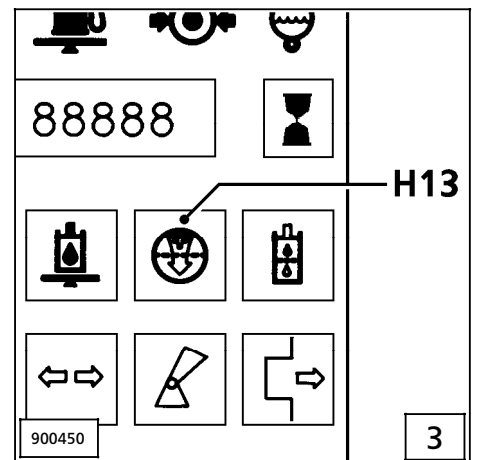
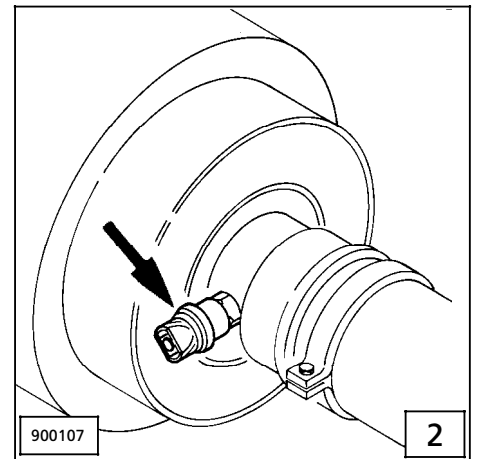
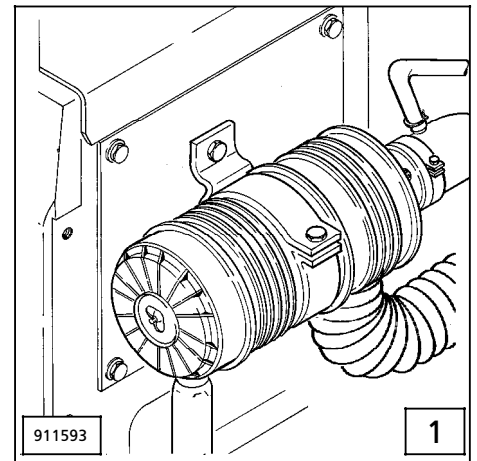
TO REPLACE THE MAIN FILTER ELEMENT

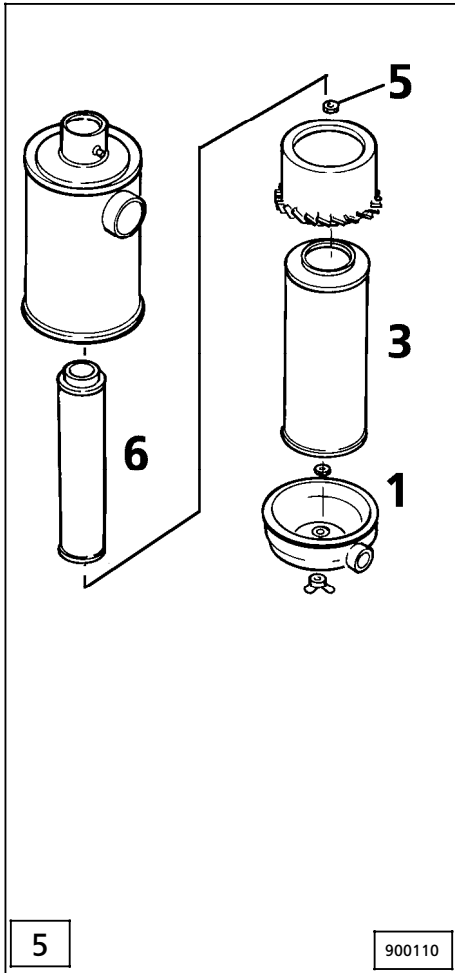
With the engine turned off, remove the cover 1, remove the nut 2 and remove the dirty main element 3 (fig. 4).

Clean the inside of the air filter housing and the sealing surface on the housing with a damp rag.

DO NOT use air pressure to blow out the housing.

Insert a new main element, make sure it is seated tightly. Tighten the nut 2 and install the filter housing cover 1 .





TO REPLACE THE SAFETY ELEMENT (fig. 5)

The safety element 6 should be replaced after the main element has been replaced three times, or at least once a year.

However, if it is found that the safety element is dirty, it must be replaced immediately.

Note: DO NOT clean the safety element!

We recommend to have this done by qualified maintenance personnel or a LIEBHERR service technician.

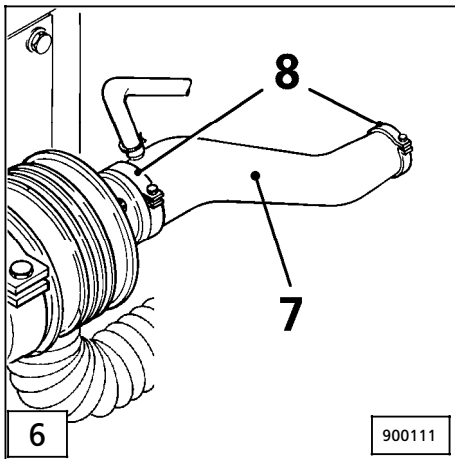
Remove the main element as described previously.
Remove the special nut 5 and take out the safety element 6.

Carefully clean the inside of the air filter housing with a damp rag.

Clean the sealing surfaces in the housing and check for damage.

Carefully insert a new safety element and secure with the special nut 5.

Install the main element 3 and install the filter cover (see previous section "To replace the main element").



CHECK THE CLEAN AIR LINE (fig. 6)

The clean air line between the filter exit and the engine air intake pipe 7 must be checked for damage and leaks every time a filter element is replaced.

If necessary, retighten the hose clamp screws 8 . Check and tighten the hose clamp screw 8, as necessary.

Service Fluids

Lubricants:

Lube oil specification

In modern Diesel engines, only high alloyed lube oils are used. They consists of basic oil with additives.

The lube oil recommendation for Liebherr Diesel engines is based on the following specifications and guidelines.

API - classification : CG-4, CF-4, CH-4
 (American Petroleum Institute)

ACEA (CCMC) - classification : E2-96 (D4), E3-96 (D5), E4-98, E5-99
 (Association des Constructeurs Européens de l'Automobile)

Naturally aspirated engines	CG-4, CF-4, CH-4, E2-96, (D4)
Turbo charged engines	CG-4, CF-4, CH-4, E2-96, (D4), E3-96, (D5), E4-98, E5-99

Lube oil viscosity

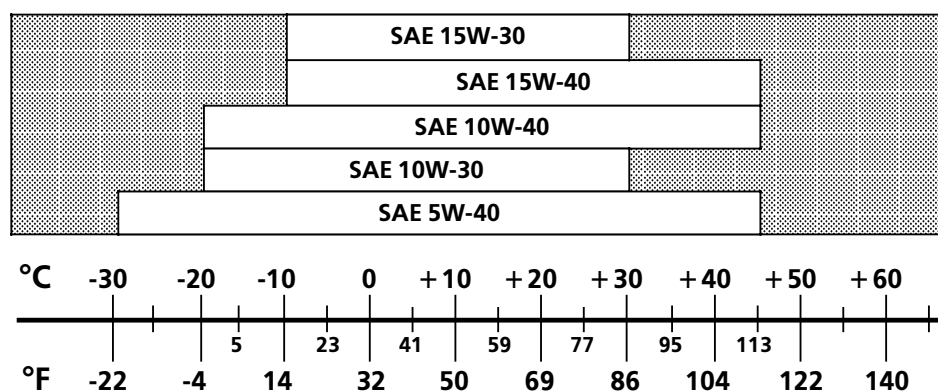
The selection of the lube oil viscosity is made according to SAE classification (Society of Automotive Engineers).

The ambient temperture is the determining factor for the correct selection of the SAE classification.

The selection of the SAE classification gives no information about the quality of a lube oil.

If the viscosity is too high, it can lead to starting problems, if it is too low, the lubrication efficiency can be endangered.

The temperature ranges shown in the chart below are guidelines and can be exceeded or fallen below for a short time.



Oil change intervals

The first oil change is due after 250 - 500 operating hours when using oils according to the lubrication guidelines. Additional filter changes are due every 500 hrs. and oil changes are due depending on the temperature zone, sulfur content in the fuel and oil quality, as shown in the chart below.

When using E3-96, (D5), E4-98, E5-99 oils in naturally aspirated engines, the change interval of 500 hrs. may be exceeded.

If the given operating hours are not reached within one year, then the engine oil and filters should be changed at least once a year.

INTERVALS IN OPERATING HOURS		NA - engine	T - engine
Operating conditions	Sulfur content in fuel	Oil specification CH-4 CG-4 CF-4 E2-96 (D4)	Oil specification CH-4 CG-4 CF-4 E2-96 (D4)
Ambient temperature up to 14° F (-10°C)	up to 0.5 % above 0.5 %	500 hrs. 250 hrs.	500 hrs. 250 hrs.
below 14° F (-10°C)	up to 0.5 % above 0.5 %	250 hrs. 125 hrs.	250 hrs. 125 hrs.

COOLANT

To provide anti-corrosion protection in the cooling system, the coolant must contain at least 50 % of the total volume of corrosion inhibitor / antifreeze fluid all year round. This mixture protects the system to approx. -37°C.

In case coolant is lost, check the ratio. The percentage of antifreeze should not fall below 50 % of the total volume.

Do not exceed 60% corrosion inhibitor / antifreeze, since a higher ratio would actually reduce the cooling efficiency and antifreeze protection.

Check the ratio during maintenance, change the coolant at least once every two years.

Coolant with DCA 4 (DCA 4 = Diesel coolant additives).

To assure protection against corrosion of the cooling system, the coolant must contain at least 50% corrosion / Antifreeze mixture all year round. This protects the cooling system to about - 37° C (35° F).

When fluid is added to the coolant mixture, it must be assured that the mixture maintains a 50% antifreeze content.

Important: Do not use a mixture of more than 60% corrosion / antifreeze , as a high ratio would actually reduce the cooling and antifreeze protection.

Check and correct the ratio of corrosion inhibitors / antifreeze mixture and DCA4 concentration during maintenance work (every 500 hrs.).

The DCA 4 concentration must be between 0.3 and 0.8 units per liter (per quart).

We recommend test kit CC 2602 M, made by Fleetguard .

The coolant must be changed every 2 years. Check the cooling system, flush, if necessary, before adding new coolant.

Refilling the cooling system

When refilling the cooling system after repairs, add liquid DCA 4 in addition to the DCA4 concentration in the water filter to the corrosion / antifreeze mixture .

Cooling system capacity	Required amount of liquid DCA 4			DCA 4 water filter	
Liter	No. of units per 0.5 liter		Liter	Description	Id.No.
24 - 39	3	or	1,4	WF 2071	7367045
40 - 59	4	or	1,9	WF 2072	7381493
60 - 79	5	or	2,4	WF 2073	7367052
80 - 115	8	or	3,8	WF 2073	7367052

Water filter change intervals

Change the water filter every 500 hrs.

If no coolant was lost in the cooling system, the DCA4 concentration in the cooling system is adequate if the filter is changed every 500 hrs.

Using DCA 4 without corrosion / antifreeze

In certain circumstances, and if ambient temperatures are constantly above freezing, for instance in tropical regions, and no corrosion / antifreeze is available, a mixture of water and DCA4 may be used.

To protect the cooling system from corrosion, use **double the amount of DCA4** than when using corrosion / antifreeze and DCA4 to cool the system.

The DCA 4 concentration must be between 0.6 - 1.06 units per liter.

Check and correct the DCA4 concentration during maintenance work (every 500 hrs.).

The coolant must be changed once a year.

Before adding new coolant, check the cooling system for contamination; flush, if necessary.

Fresh water guidelines:

To mix the coolant , only clean, preferably soft water should be used. Often, but not always, regular drinking water can be used. Sea water, brackish waters, well water or industrial waste water may not be used.

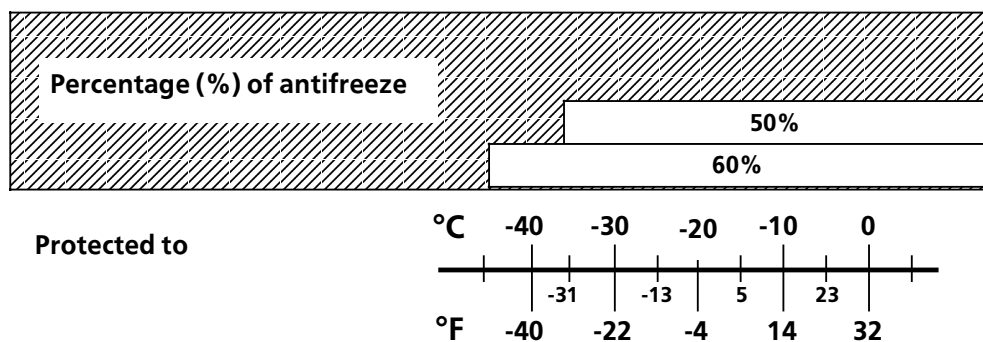
Fresh water quality when using corrosion inhibitors / antifreeze fluids:

Sum of alkaline earths (water hardness)	:	0.6 to 3.6 mmol/dm ³ (3 to 20°d)
Ph-value at 20° C	:	6.5 to 8.5
Content of chlorides - ions	:	max. 80 mg/dm ³
Content of sulfates - ions	:	max. 100 mg/dm ³

Fresh water quality when using coolant with DCA 4 :

Sum of alkaline earths (water hardness)	:	0.6 to 2.7 mmol/dm ³ (3 to 15°d)
Ph-value at 20° C	:	6,5 bis 8,0
Content of chlorides - ions	:	max. 80 mg/dm ³
Content of sulfates - ions	:	max. 80 mg/dm ³

Mixing ratio corrosion inhibitors / antifreeze fluids



The percentage of antifreeze should not exceed 60%, a higher concentration will adversely affect antifreeze protection and heat transfer rates!

RECOMMENDED CORROSION INHIBITORS - ANTIFREEZE FLUIDS

BRAND

MANUFACTURER

Agip Antifreeze Plus
Agip-Auto Langzeit-Frostschutz
Antigel DB 486
Aral Antifreeze Extra
Aral Antifreeze T
Avia Antifreeze APN

Agip Petroll S.p.A Rom Italien
Agip Schmiertechnik GmbH, Würzburg
Sotragal SA, St. Priest / Frankreich
Aral GmbH, Bochum
Aral GmbH, Bochum
Deutsche Avia Mineralöl GmbH, München

BP Antifrost X 2270 A
BP Napgel C 2270/1

Deutsche BP AG, Hamburg
BP Chemicals LTD., London/England

DEA Kühlerfrostschutz
DEUTZ Kühlschutzmittel 0101 1490
DOW Kühlmittel D 542 / 1993

DEA Mineraloel AG/ Hamburg
DEUTZ Service International GmbH, Köln
BOSS Chemie AG, Wittenbach/Schweiz

Frostschutz 600

Mobil Schmierstoff GmbH, Hamburg

Glacelf SX
Glyco Shell
Glysantin (G 48-00)

Elf Lubrifiants Paris / Frankreich
Shell Chemie GMBH, Eschborn
BASF AG, Ludwigshafen

Igol Antigel Type DB

Igol France, Paris / Frankreich

Motul Anti-Freeze

Motul SA, Aubervilliers Cedex / Frankreich

ÖMV - Kühlerfrostschutzmittel
OZO Frostschutz S

ÖMV AG, Wien/Österreich
Total Deutschland GmbH, Düsseldorf

Total Multiprotect

Total Deutschland GmbH, Düsseldorf

Diesel fuels

Diesel fuels should meet the minimum requirements of the listed permissible fuel specifications. The sulfur content should not exceed 0.5 % .

A higher sulfur content affects the oil change intervals and engine service life.

Lubricating ability

Due to the reduction of the sulfur content, the lubricating ability of the Diesel fuel has been questioned. Tests have shown that Diesel fuels with a max. sulfur content of 0.05 %, as is valid in Europe, can cause wear in injection systems (especially for distributor type injection pumps).

"Brand name fuels " (in Germany) contain these lubrication additives as part of their additive package. The fuel lubricating ability must therefore be <400 µm according to HFRR (60°) Test .

The additive should be added by the supplier as the responsible party for fuel quality. The addition of secondary lubrication additives by the customer is not recommended.

Diesel fuels for low ambient temperatures

In ambient temperatures below approx. 32° F (0°C), the flow properties for summer Diesel fuel can become insufficient due to paraffin excretion. The same applies for winter Diesel fuels at temperatures below approx. -15°C (5° F) .

Often Diesel fuel with additives is offered for use in temperatures to -20°C (-4° F) .

To prevent operational problems, the Diesel fuel must be mixed with regular gasoline or kerosene at even lower temperatures.

Mixing regular gasoline with Diesel fuels should be considered a last resort. The ratio should not exceed 30 % per volume.

Do not use Super gasoline to mix with Diesel fuel.

Depending on the ratio of Diesel fuel and gasoline or kerosene, the engine output may be reduced to some degree. For that reason, keep the additives as low as possible, taking the ambient temperature into consideration.

For safety reasons, always mix the fuel in the fuel tank.

When refueling, add the specifically lighter additive before adding the Diesel fuel. After refueling, run the engine until the mixed fuel is distributed throughout the complete fuel system.

For mixing ratio, see chart.

Additives for Diesel fuel (Flow improvers)

Commercially available flow improvers can also help to improve the Diesel fuel for cold temperatures. When using these additives, observe the manufacturer's instructions regarding quantities and use.

Approved fuel specifications:

DIN EN 590

ASTM D 975 - 89a 1 D and 2

For additional fuel specifications consult the Engine design dept.

Diesel fuel mixing ratio (Vol.-%)

Ambient temperature °C	Summer Diesel fuel %	Additive %	Winter Diesel fuel %		Additive %	
			- 15°C	- 20°C	- 15°C	- 20°C
0 to - 10	70	30	100	100	-	-
- 10 to - 15	50	*50	100	100	-	-
- 15 to - 20	-	-	70	100	30	-
- 20 to - 25	-	-	50	70	*50	30

* If more than 50% are necessary, use only kerosene, DO NOT USE regular gasoline .

Sealing and locking compounds and greases

The list below contains all sealing compounds, locking compounds and greases needed for engine maintenance, disassembly and assembly.

Use these materials as described in various sections of this manual.

Sealing and locking compounds:

Hylomar SQ 32 / M	or	Reinzoplast, Omnivisc 1050
Loctite 222	or	Omnifit 50 M
Loctite 242 / 243		
Loctite 262	or	Omnifit 100 M
Loctite 270	or	Omnifit 200 M
Loctite 601	or	Omnivisc 1050
Loctite 638		
Loctite 640 / 648	or	Omnifit 230 M
Loctite - Silicone - Transparent	or	Omnivisc 1002

Greases:

Molykote Longterm 2 Plus

Ft1v34 (Fa. Bosch) only for 28V / 95 A alternator

Barrierta L55 / 3

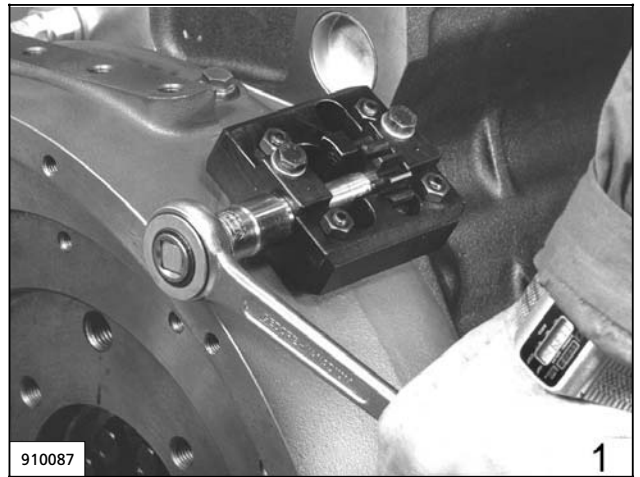
Staburags NBU 12

Valve Clearance Adjustment

Use Special Tool No. 30.

For valve clearance, see engine specification - Technical Data.

Wait until engine has cooled down and remove valve covers on all cylinders. Install hand crank, Special Tool No. 30, to flywheel housing.



Rotate engine crankshaft with hand crank until valves on the corresponding cylinder overlap.

See chart below.



Check valve clearance on the corresponding cylinder to be adjusted by inserting the feeler gauge between valve stem and rocker lever. If the valve clearance must be adjusted, loosen lock nut on rocker lever adjustment screw and adjust screw to proper clearance. Retighten lock nut.

Recheck valve clearance.

Note:

Cylinder 1 is position next to the flywheel. The engine crankshaft rotation is counterclockwise, facing the flywheel. The exhaust valve is positioned closer to the flywheel.



Cylinder Valves			
D 904/914/924		D 906/916/926	
Overlap	Adjust	Overlap	Adjust
4	1	6	1
2	3	2	5
1	4	4	3
3	2	1	6
		5	2
		3	4

Checking and Adjusting Valve Play on Engines with additional Engine Brake System (ZBS)

Special Tool No. 30

Valve Play: refer to Technical Data
 Check when engine cold.

Remove cylinder head covers, install turning device, special tool no. 30 on the flywheel housing.

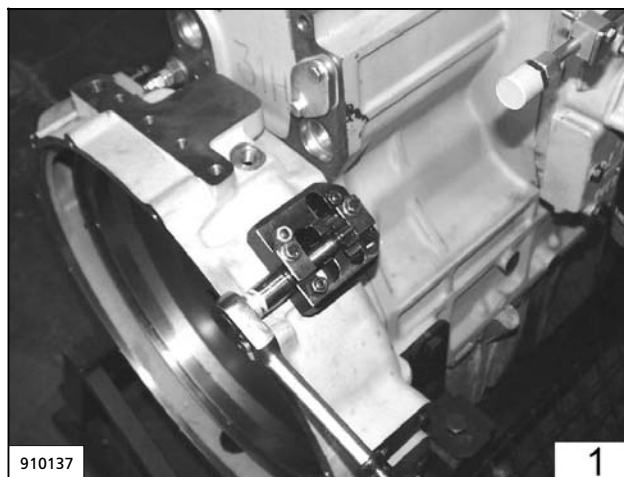
Turn crankshaft in turning direction until the valves of the cylinder opposite the one to be adjusted overlap.

For Specifications refer to table.

Note:

Cylinder 1 is on the flywheel side.

Turning direction left when looking onto the flywheel. Outlet valves of the corresponding cylinder on the flywheel side.



Valves of the Cylinder			
D 924		D 926	
Overlap	Adjusting	Overlap	Adjusting
4	1	6	1
2	3	2	5
1	4	4	3
3	2	1	6
		5	2
		3	4

Checking:

Inlet Valves: Push thickness gauge between valve and rocker lever and check valve play.



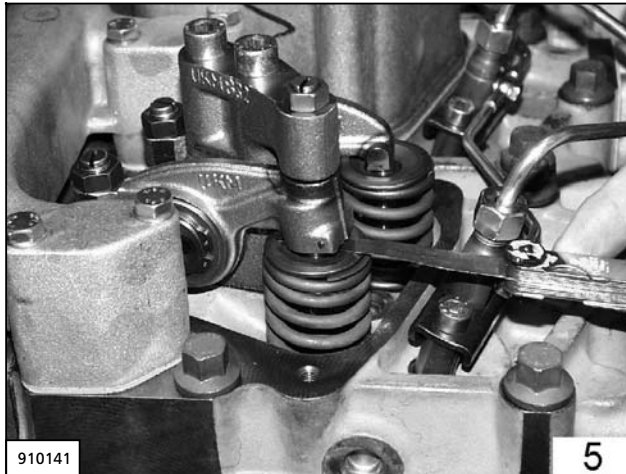


Outlet Valves: Items see picture 11

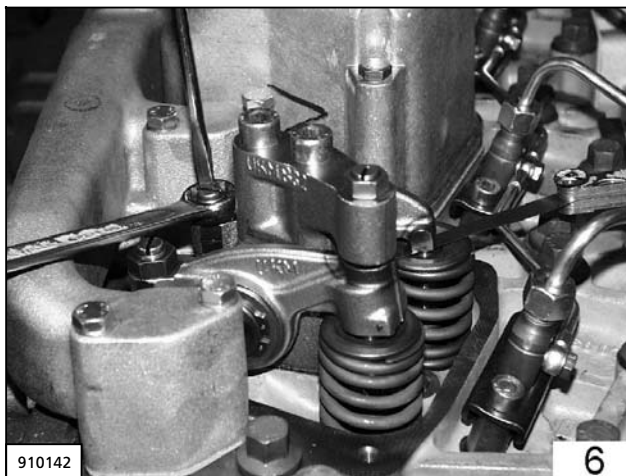
Using a screw driver. push rocker lever in the area of piston 5 down towards the valve several times until no more oil is running out of the relief bore 6.

Note:

The oil must be pressed out of the piston area entirely.



Place thickness gauge between outlet valve and piston 5 and check valve play.

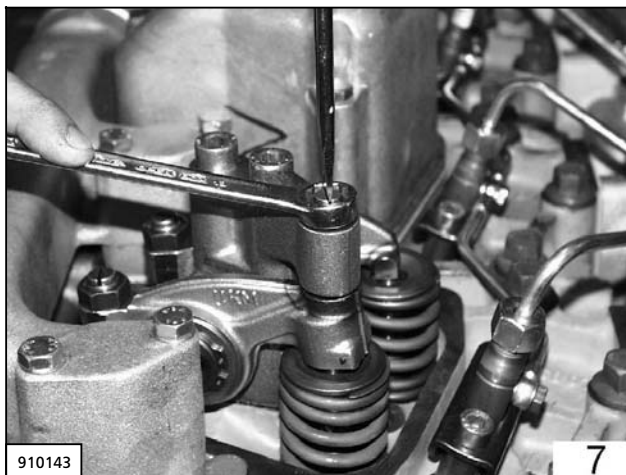


Adjustment:

Inlet Valves:

Untie lock nut on the adjusting screw of the corresponding rocker lever and correct the adjustment. Retighten lock nut.

Check the adjustment after retightening the lock nut.



Outlet Valves: Items see picture 11

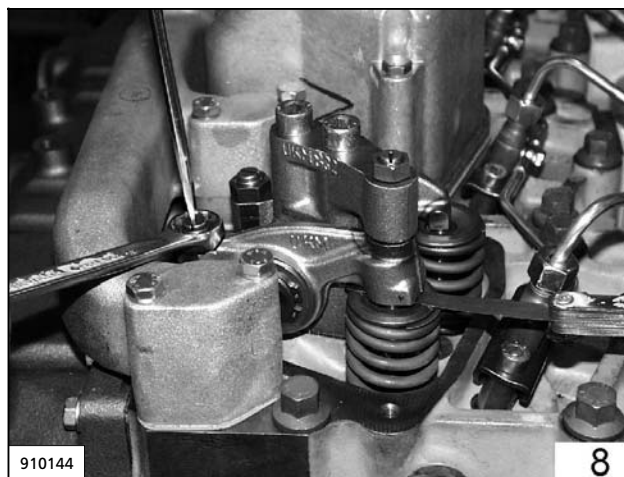
Untie lock nut 2 and turn out adjustment screw 1 as far as possible without using force.

Untie lock nut 4 and turn out adjustment screw 3 until 0.5 mm of the thickness gauge can be pushed between piston 5 and valve.

Turn in adjustment screw 3 until the thickness gauge is clamped. This pushes piston 5 back.

Adjust a valve play of 0.5 mm on adjusting screw 3.

Retighten lock nut 4.

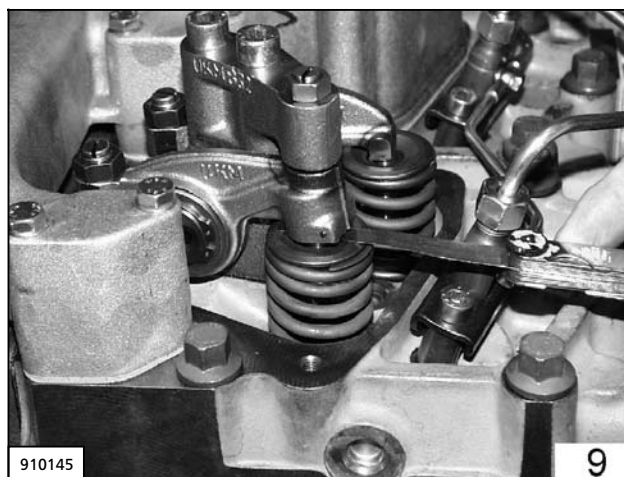


Place thickness gauge 0.3 mm between piston 5 and valve.

Using a screw driver, press rocker lever onto valve in the area of the piston 5, until piston 5 has reached its stop.

Note:

Oil has to be pushed out of the piston chamber completely. At this point no oil should run out of the relief bore 6.

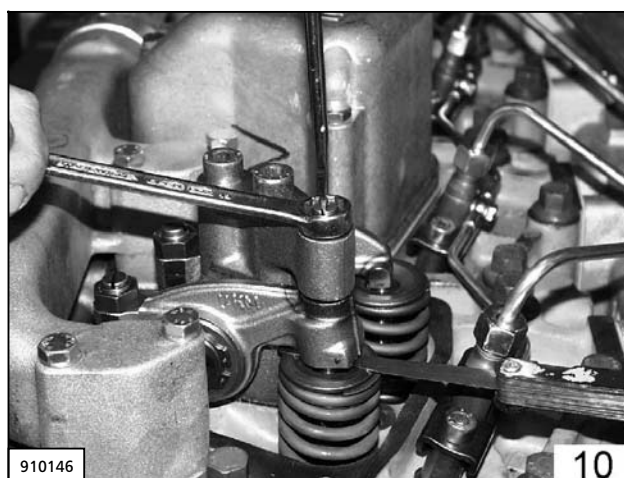


Keep piston 5 in a depressed position and turn adjustment screw 1 until valve play is reached.

Retighten lock nut 2.

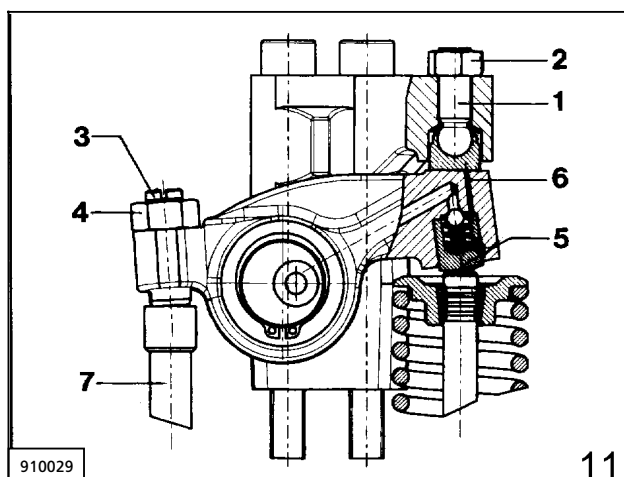
Note:

After adjustment turn push rod 7, must have play.



After all valves are adjusted, replace cylinder head covers using new gaskets.

Remove turning device.



Check engine compression pressure

Use special tool No. 1, 2

For compression pressure, see Technical Data.
Remove all fuel injectors, see sub group 7.18.
Insert adapter, special tool No. 2, with seal ring in place of the fuel injectors and clamp down the adapter with the injector holder.



Important:

The compression pressure is based on an engine speed of 150^{RPM} minimum.

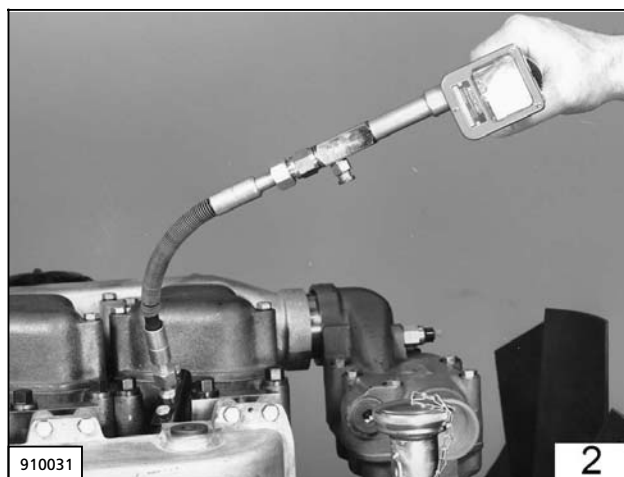
Before the test, check the valve clearance.

The engine should be operated for a short time at half speed before checking the compression pressure. This procedure will ensure a sufficient pressure seal due to the oil film in the combustion chambers.

Connect compression tester, special tool No. 1, to the adapter. Measure the compression pressure while cranking the starter.

The pressure test must be performed with the shut off in the off / no load position.

Repeat the pressure test on all cylinders. After the compression pressure test is completed, remove the adapter and reinstall the fuel injectors, using new seal rings.



Note:

The pressures of the individual cylinders should be within the pressure range indicated on the Technical Data page. Deviations should not exceed 3-4 bar .

Check begin of delivery (FB = fuel begin) (injection pumps-Type "A")

Use special tool No. 4, 30

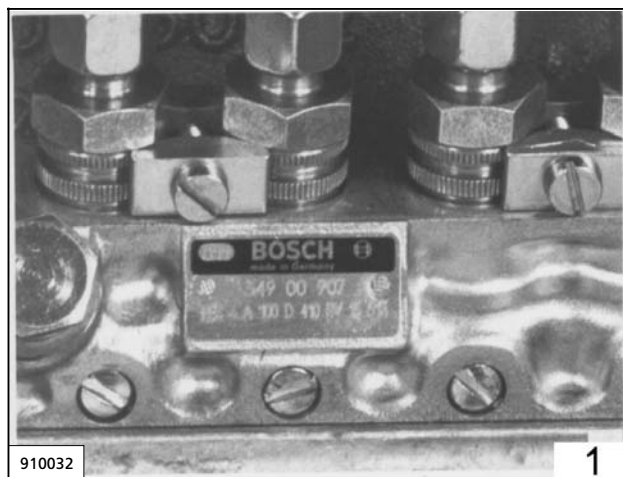
For begin of delivery data, see Technical Data.

Note:

The injection pump type is noted on the data tag of the injection pump.

Example: PES 6 A etc.

↑
Injection pump - Type "A"

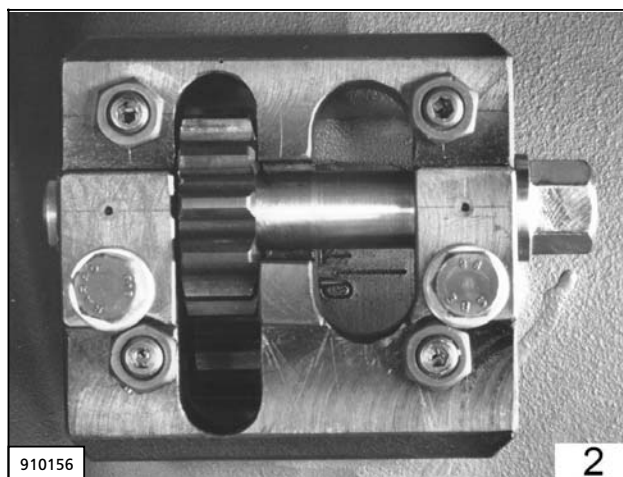


Check:

Remove the valve cover on cylinder 1 (next to the flywheel). Install turning tool, special tool No. 30, on the inspection hole on the flywheel housing and set cylinder 1 to ignition -OT (OT=top dead center). The direction of rotation is counterclockwise, as seen from the flywheel.

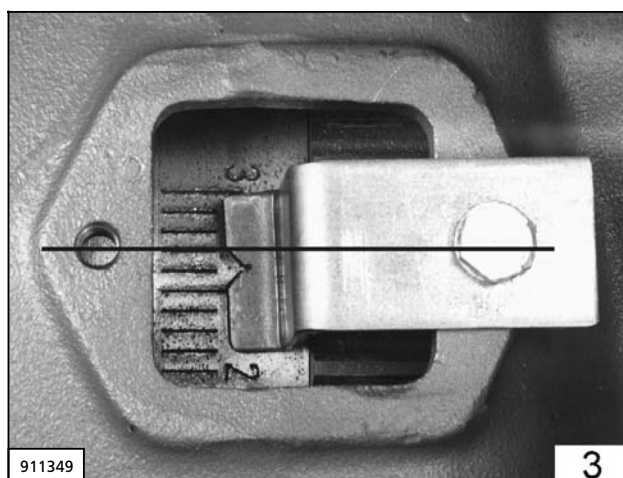
Note:

The top dead center (OT) as well as the 10° to 30° indication is marked on the flywheel. The turning tool is also marked.

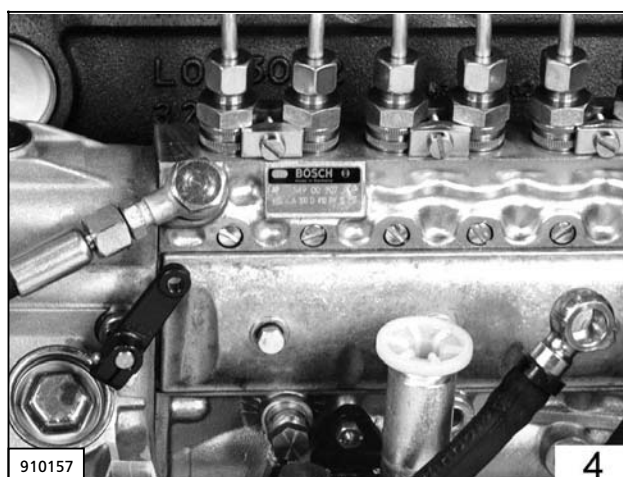


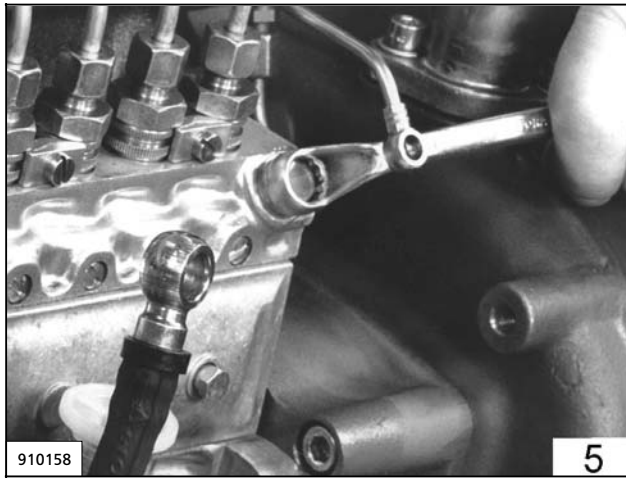
Note:

In case no turning tool is available, the reference point for OT or FB is the center between the two threaded holes for the cover. Fabricate a pointer and bolt it to the flywheel housing.

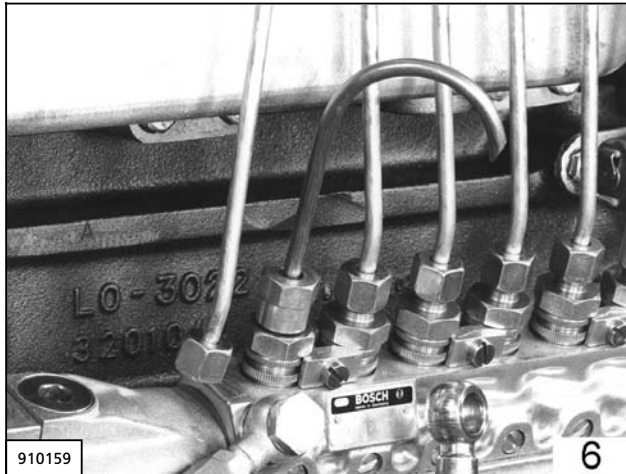


Remove the fuel supply line at the injection pump and connect in its place a high pressure hand pump, special tool No. 4. Connect the suction side of the hand pump to the tank line or a separate container with clean fuel.

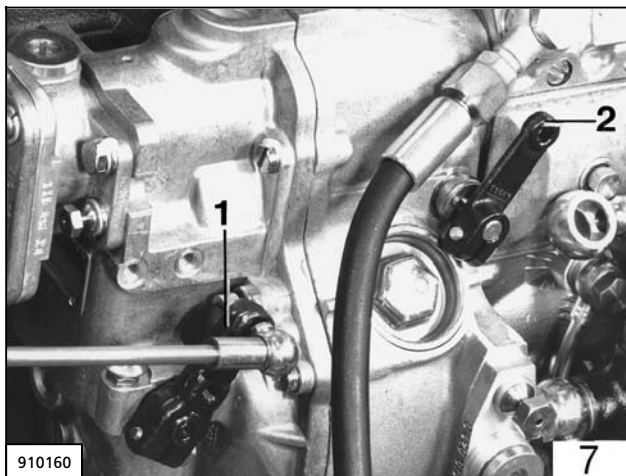




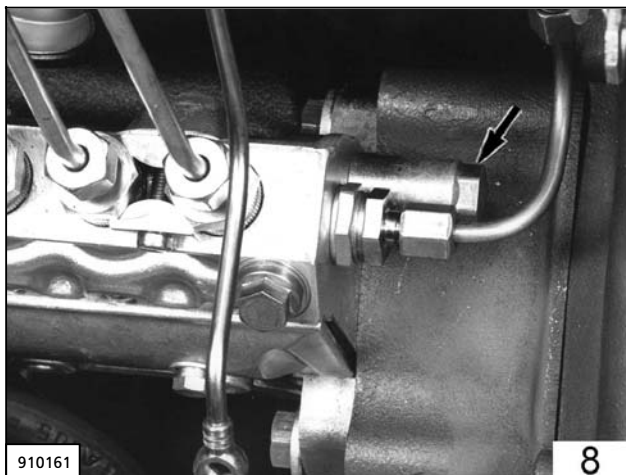
Remove the fuel return line and plug fuel return connection on injection pump.



Disconnect the supply line to the No.1 fuel injector on the injection pump and install a special drip tube.



Move the shut off lever 2 to the 'run' position. Move the throttle control lever 1 on the injection pump to the maximum load / RPM position.



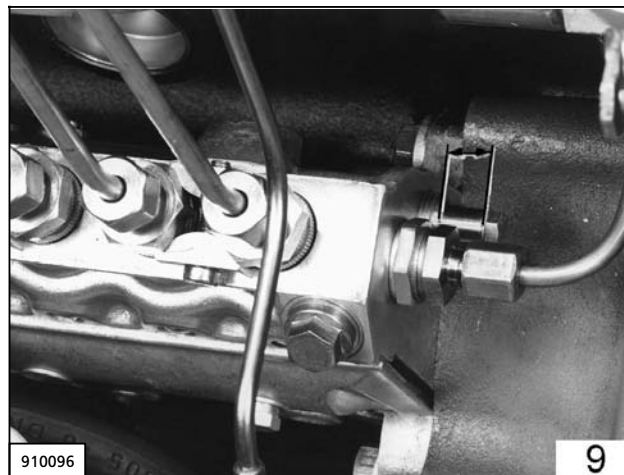
Remove the cap at the regulator rod of the injection pump.

Note:

The starting boost injection must be turned off.

RQV regulator: Push the regulator rod back until it locks.

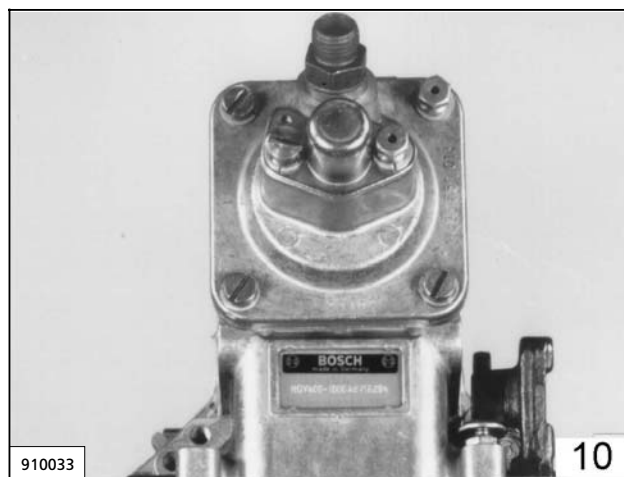
RSV regulator: The regulating rod may only extend 10 to 12 mm from the end of the thread for the safety cap. Hold the regulating rod in this position, until the high pressure hand pump is actuated. The regulating rod will then remain in this position.



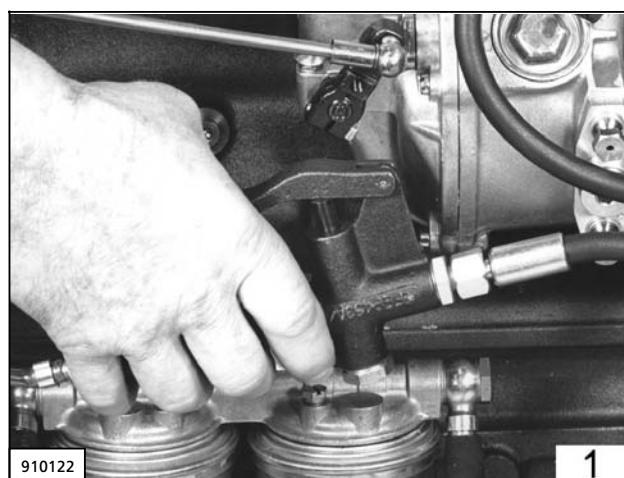
Note:

The regulator description is engraved on the data plate of the regulator.

Example: RQV ... etc. RSV ...etc.



Turn the engine by 90° in reverse of its normal direction of rotation. Actuate the high pressure hand pump until fuel flows from the overflow pipe. Turn the engine slowly in its direction of rotation until the fuel flow decreases to drops, meaning FB-Delivery Begin is reached.



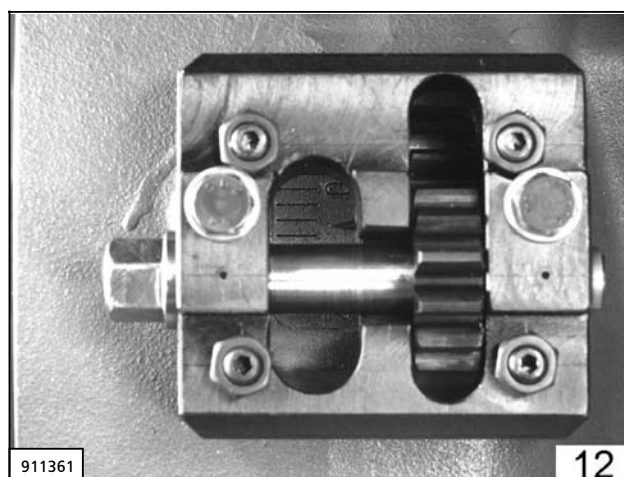
The markings on the turning device and on the flywheel must match.

Remove the high pressure hand pump, plug and overflow pipe.

Install cap for regulator rod and all fuel lines, using new seals.

Install cylinder head cover, using new gasket.

Bleed fuel system, see sub group 7.22.



Check begin of delivery (FB) (injection pumps-Type "MW" and "P")

Use special tool No. 4, 6, 30

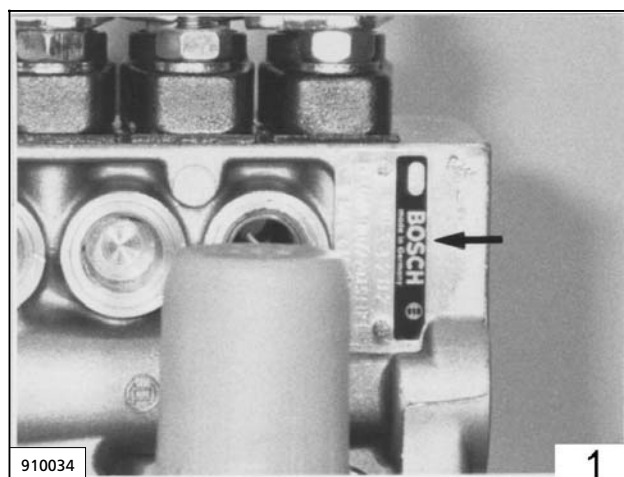
For begin of delivery data, see Technical Data or for "E" (emission optimized) engines, check the data tag under INJECTION TIMING - Example: 20°

Note:

The injection pump type is noted on the data tag of the injection pump.

Example : PES 6 MW etc.

↑
Injection pump - Type "MW"

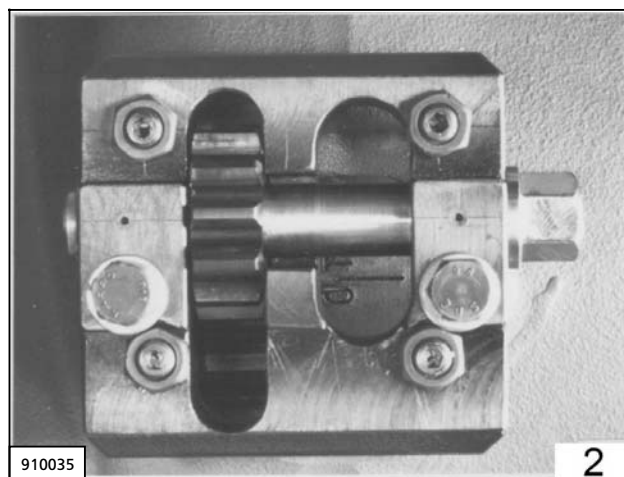


Check:

Remove the valve cover on cylinder 1 (next to the flywheel). Install turning tool, special tool No. 30, on the inspection hole on the flywheel housing and turn cylinder 1 to ignition -OT (OT=top dead center). The direction of rotation is counterclockwise, as seen from the flywheel.

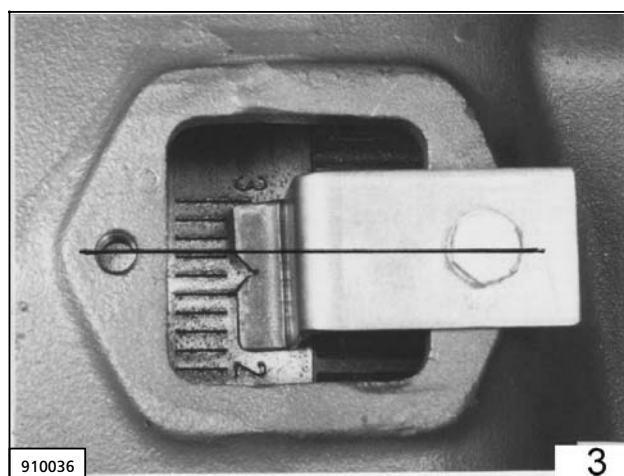
Note:

The top dead center (OT) as well as the 10° to 30° indication is marked on the flywheel. The turning tool is also marked.

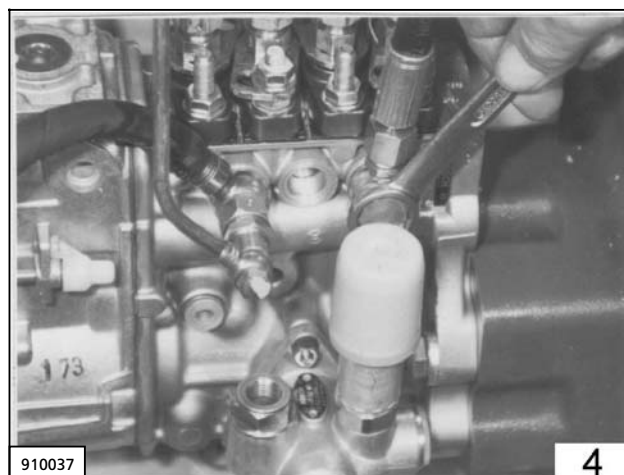


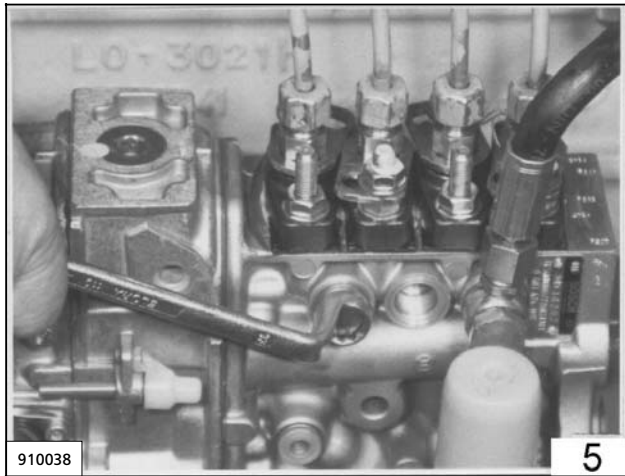
Note:

In case the turning tool is not available, the reference point for OT or FB is the center between the two threaded holes for the cover. Fabricate a pointer and bolt it to the flywheel housing.

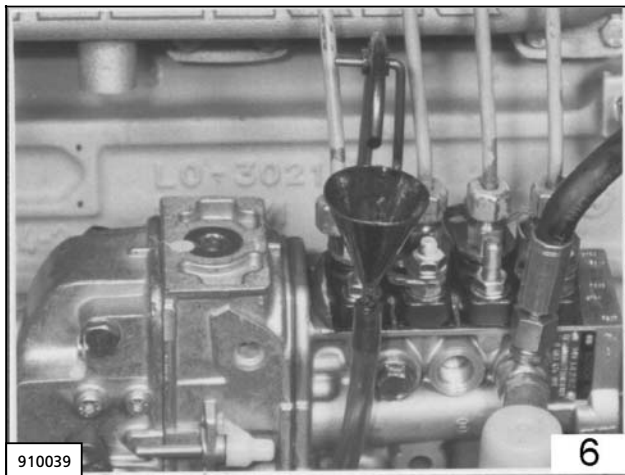


Remove the fuel supply line at the injection pump and connect in its place a high pressure hand pump, special tool No. 4. Connect the suction side of the hand pump to the tank line or a separate container with clean fuel.

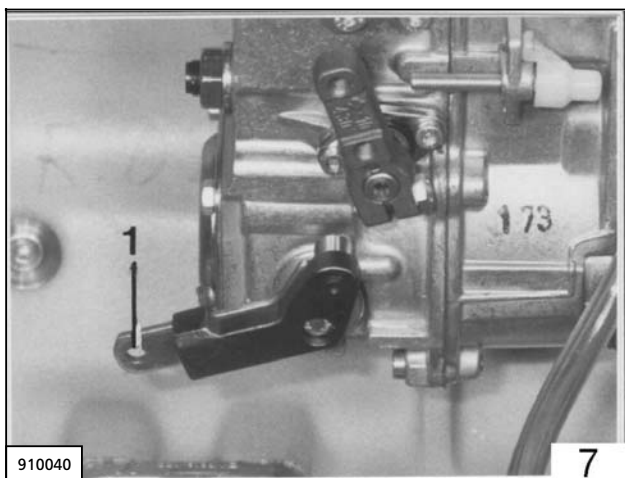




Remove the fuel return line and plug fuel return connection on injection pump.



Disconnect the supply line to the No. 1 fuel injector on the injection pump and install a special drip tube.

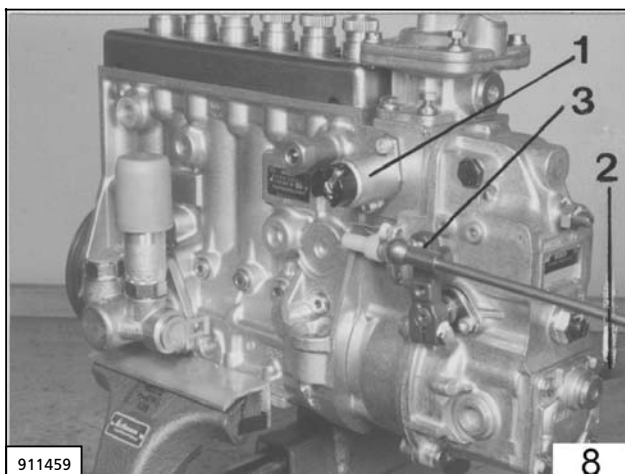


Important:

The additional starting fuel must be turned off.

RSV-Regulator :

Move the shut off lever 1 on the injection pump to the off position and install tool No. 6 on the shut off lever 1. Move the lever back to the run position. Move the throttle lever to full load / RPM.



RSV-Regulator with solenoid for release of additional starting fluid:

The solenoid 1 may not be energized with electrical current.

Bring the shut off lever 2 on the injection pump from off position to the run position.

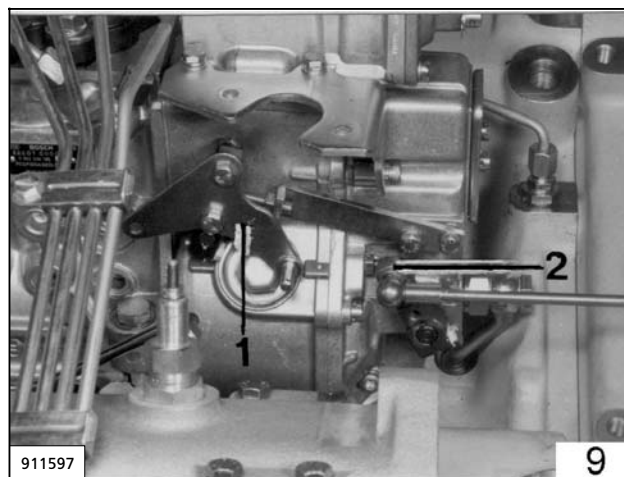
Move the throttle lever 3 to full load / RPM.

RQV - K - Regulator:

Injection pumps with this regulator have no starting groove on the elements. The additional starting fuel does not need to be turned off to check or adjust begin of delivery (FP = timing).

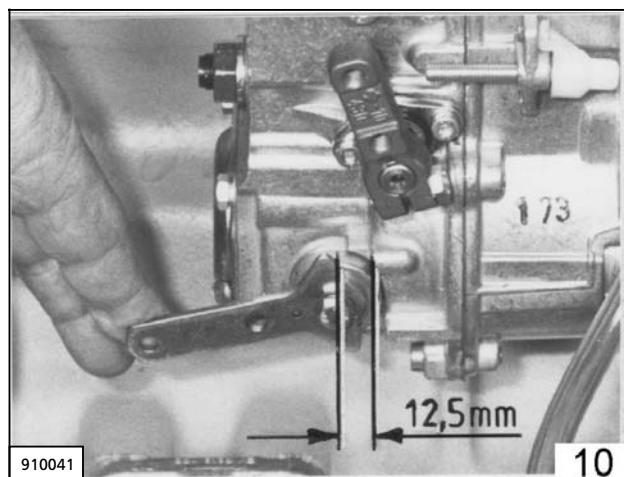
Bring the shut off lever 1 on the injection pump to the run position .

Move the throttle lever 2 to full load / RPM.



Note:

If special tool No. 6 is not available to turn off the additional starting fuel on the RSV-Regulator (see fig. 7), then set the shut off lever to the dimension shown in fig. 10 between the stop on the shut off lever and the stop on the injection pump. Secure lever in this position.



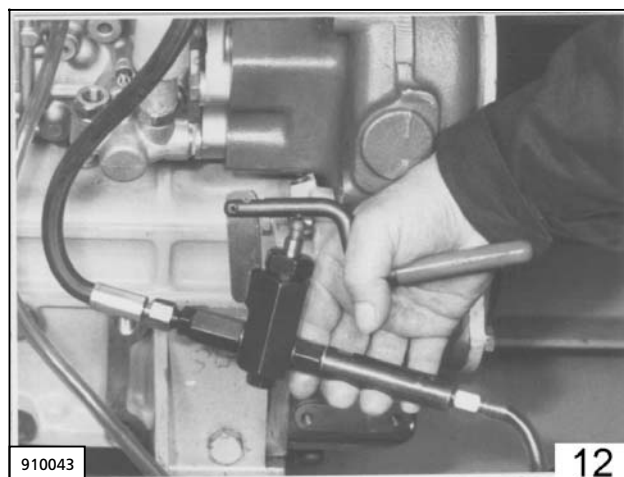
The regulator identifications are shown on the data plate of the regulator.

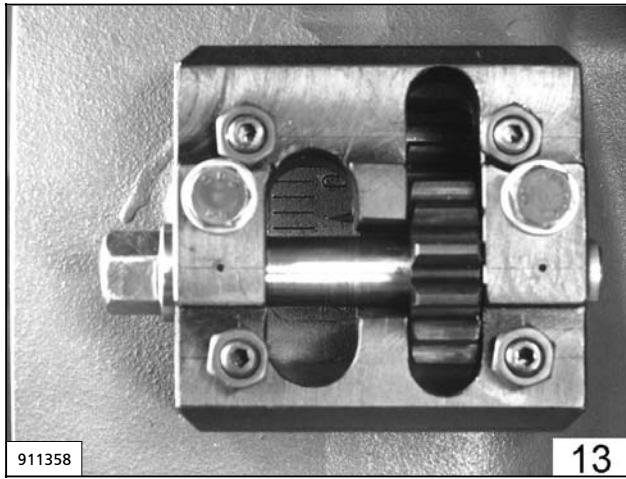
Example: RSV..... etc.

Note: If necessary, loosen the plug on the injection pump to bleed the system.



Turn the engine 90° against its normal direction of rotation. Actuate the high pressure hand pump until fuel flows from the overflow pipe. Turn the engine slowly in the normal direction of rotation until the fuel flow decreases to drops, which means the FB - begin of delivery - is reached.





The timing mark on the flywheel / pointer of the turning tool and the timing data listed in the Technical Data page must match.

Remove the high pressure hand pump, plug, overflow pipe and retaining tool for the additional starting fuel as well as the turning device.

Install all fuel lines, using new seals.

Install cylinder head cover, using new gasket.

Bleed fuel system, see sub group 7.22.

Checking Begin of Delivery

(Injection Pump Model "VE" = Distributor Injection Pump)

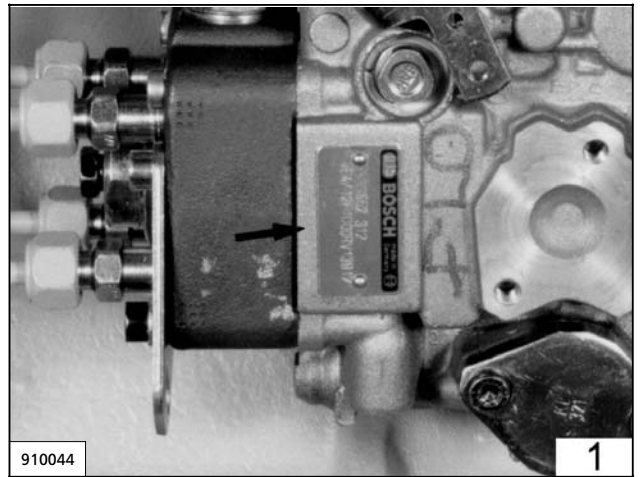
Special Tool No. 7, 8, 9, 30

Note:

The Injection Pump Model is mentioned on the ID-Tag of the Injection Pump.

Example: V E 4 / and so on

↑
Injection Pump Model "VE"



Check:

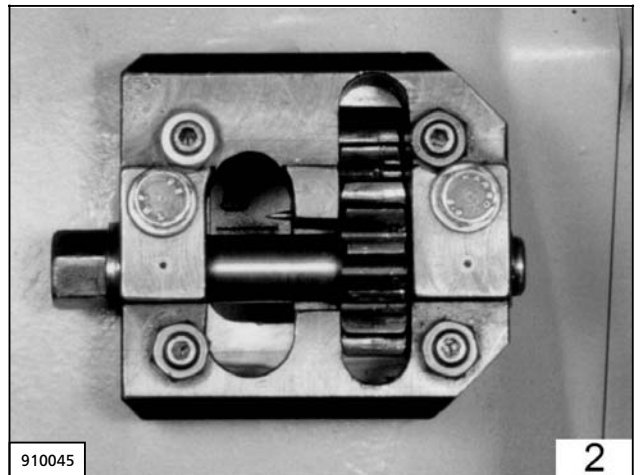
Remove cylinder head cover on cylinder 1.

Install turning device, special tool no. 30, on the inspection hole of the flywheel housing and crank engine until cylinder 1 is at ignition upper death point (OT = upper death point).

Note:

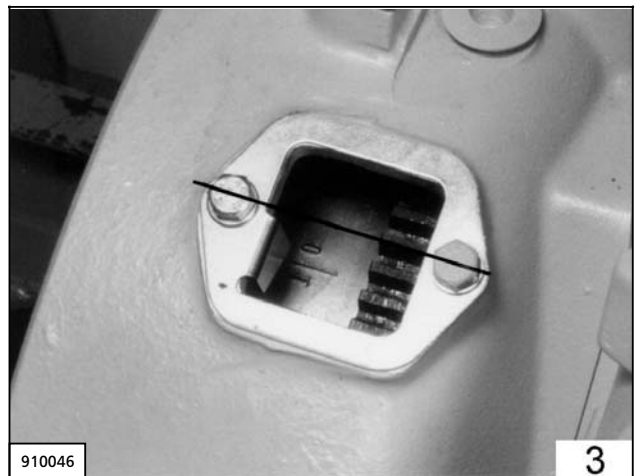
Turning direction is left looking at the flywheel.

OT and 10 - 30° marks before OT are given on the flywheel. Turning device has a marking.

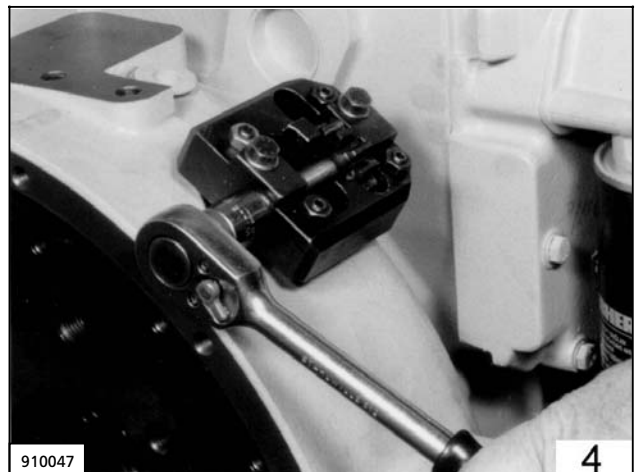


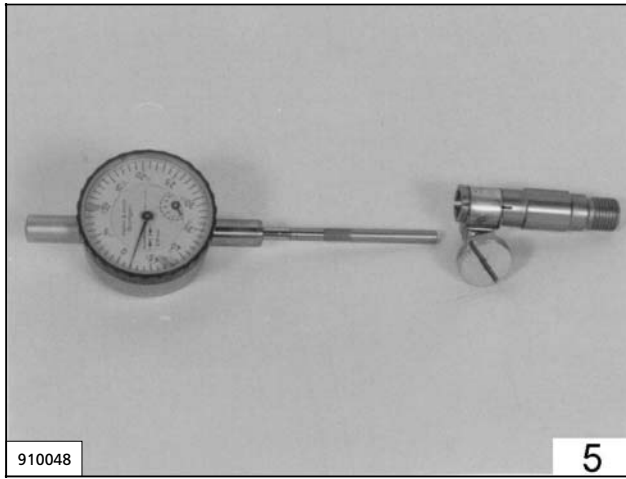
Attention:

If there is no turning device with marking available, the reference for OT and Begin of Delivery will be the center of the two thread holes on the flywheel housing.

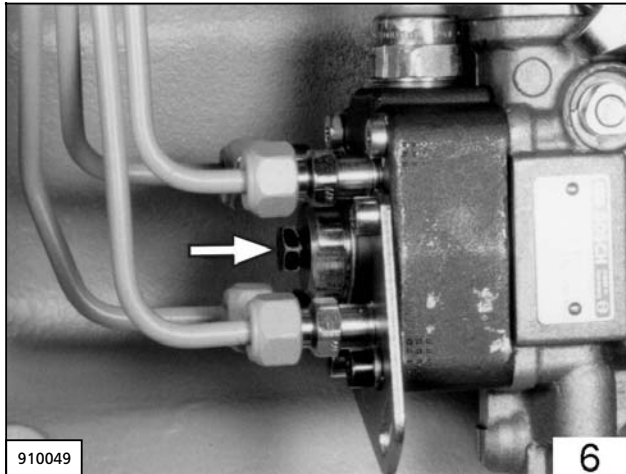


Turn engine against turning direction away from OT to approximately 30°.

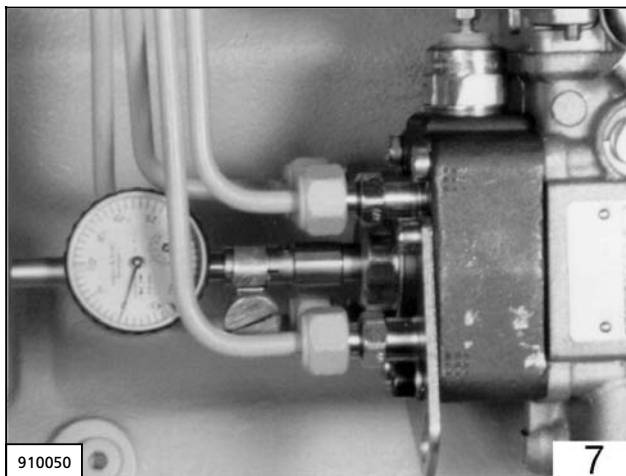




Turn out measuring point on the measuring gauge, special tool no. 7 and install intermediate piece, special tool no. 9. Screw test point into intermediate piece.



Remove plug on the distributor head of the injection pump.

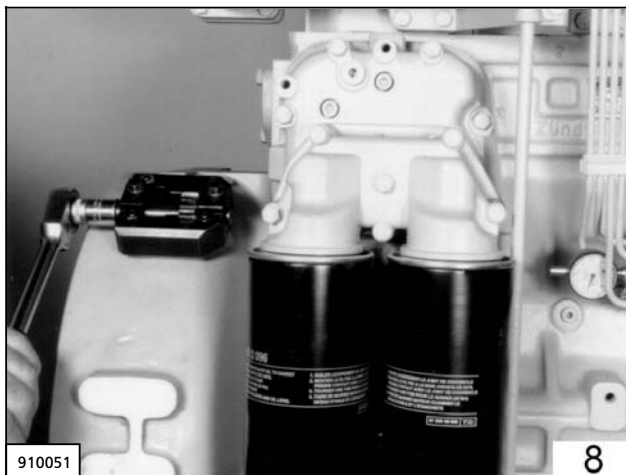


Turn measuring device, special tool no. 8, into the distributor head, insert measuring gauge with test point and set measuring gauge to "=" under a pretension of appr. 1mm.

Clamp measuring gauge in measuring device.

Note:

Observe free flow position of the measuring gauge.



Turn engine until OT is reached. Read measuring data on measuring gauge.

Attention:

DB is correctly adjusted if the measuring data at OT correspond with the data mentioned on the name plate under INJECTION TIMING in mm.

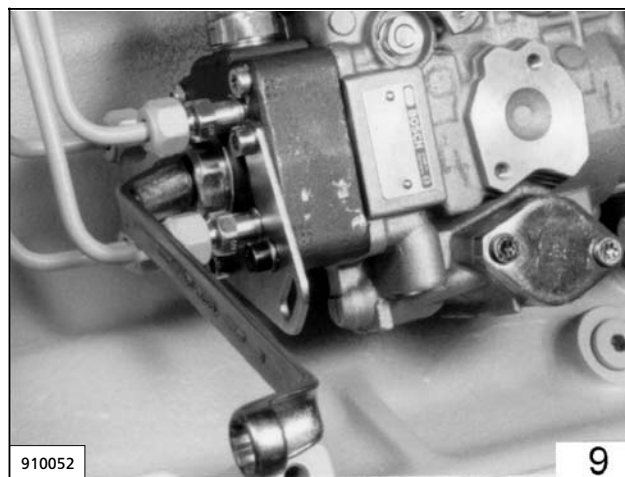
If the mentioned data can't be reached, the DB adjustment needs to be corrected, see 2.19.25 under DB Adjustment.

Remove measuring gauge and measuring device.

Install plug in the distributor head and tighten.

Remove turning device.

Install cylinder head cover using new gasket.



Checking Delivery Begin (DB) (Injection Pump type P with EDC = Electronic Diesel Control)

Special Tool No. 9.2, 30

Delivery Begin Specifications see ID tag under INJECTION TIMING

Note:

The type of Injection Pump is stated on the ID tag of the Injection Pump:

Example: P E S 6 P... etc.

Injection Pump Model "P"



Check:

Remove cylinder head cover on cylinder 1.

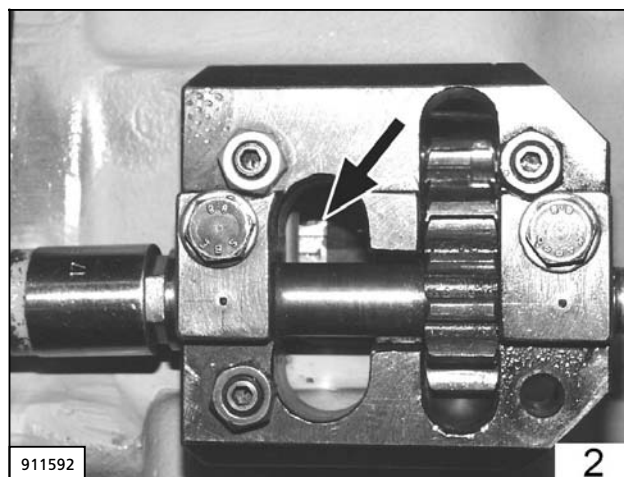
Install turning device, special tool No: 30 on the inspection hole of the flywheel housing and crank engine until cylinder 1 is at ignition upper dead point (OT= upper dead point).

Turning direction is left looking onto the flywheel.

Having reached upper dead point turn engine back against the turning direction by appr. 45°.

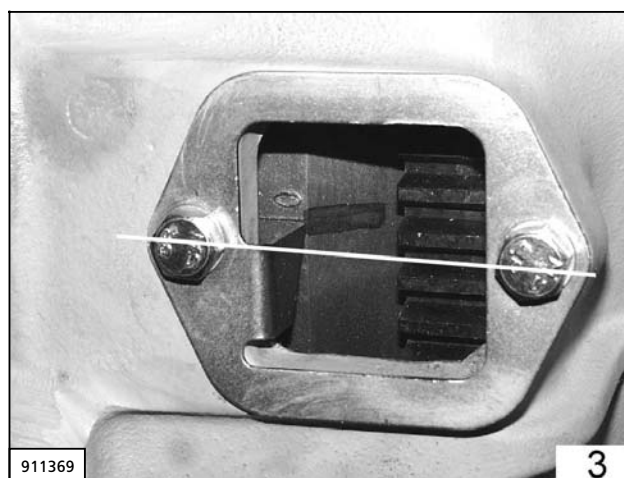
Note:

OT mark and marks for checking DB from 10 to 30° are given on the flywheel. The turning device also has a mark.

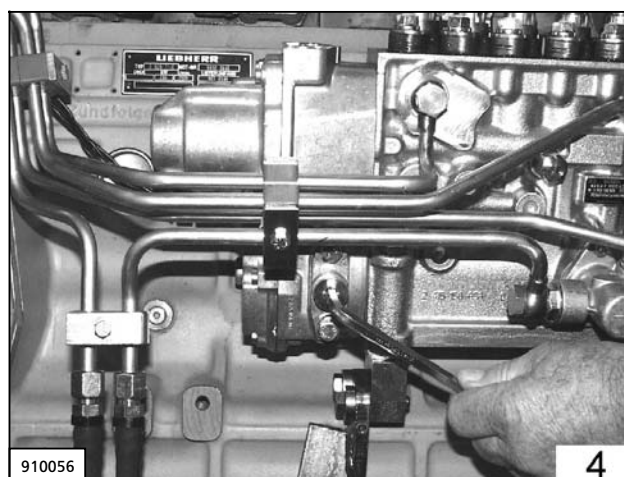


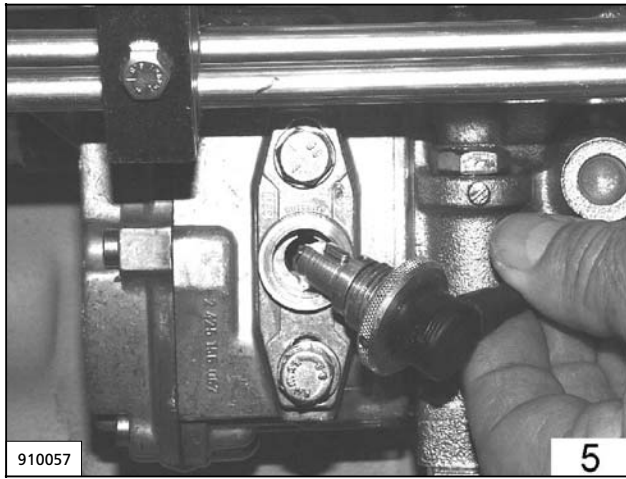
Note:

If there is no turning device with marks available, the reference for OT and begin of delivery will be the center of the two thread holes in the flywheel housing.



Remove plug from the flange on the injection pump regular (EDC) together with the gasket.

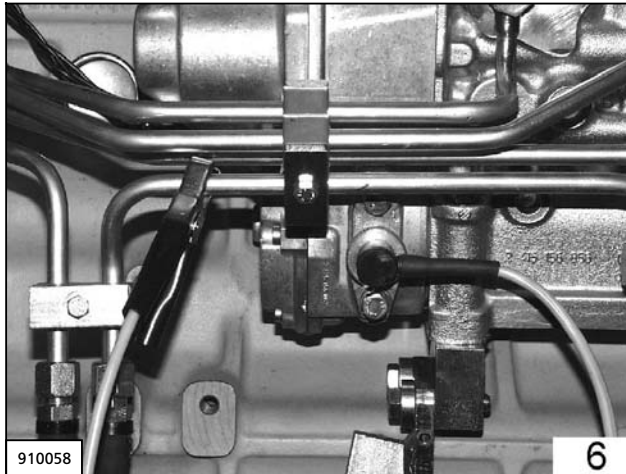




Put impulse transmitter, special tool No. 9.2 into the flange tightening the mounting screws by hand.

Note:

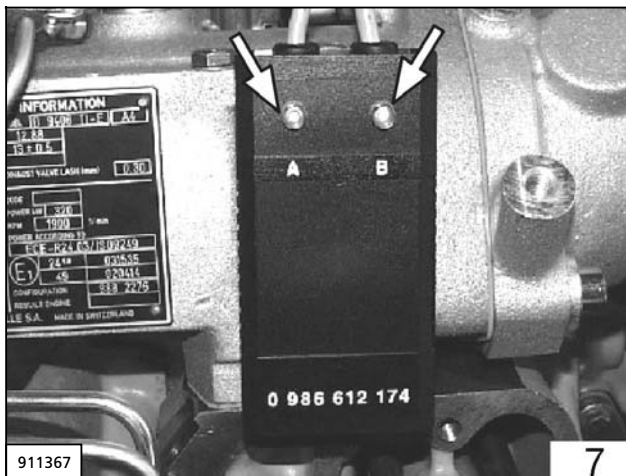
The guide notch on the shaft of the transmitter must correspond with the slot in the bore of the flange.



Connect the ground clamp of the impulse transmitter with ground of the engine.

Note:

The injection pump must be without current, the ignition of the machine must be turned off.



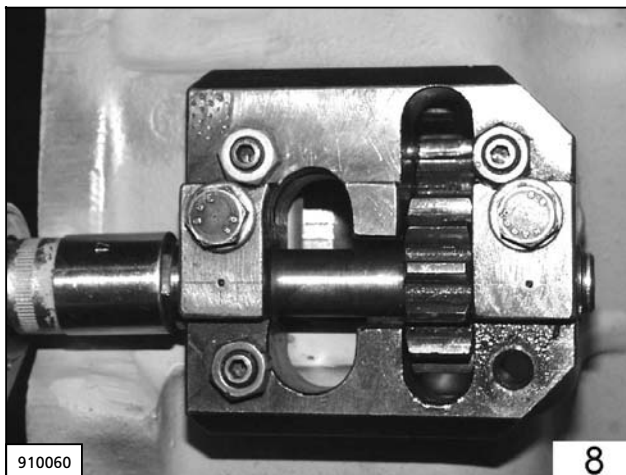
Turn engine slowly in turning direction until lamp on the impulse transmitter lights up.

Keep turning the engine carefully until second lamp lights up.

Note:

As soon as both lamps light up the exact position for DB = Delivery Begin is reached.

If only the second lamp lights up the DB position is overturned and the test needs to be carried out again.

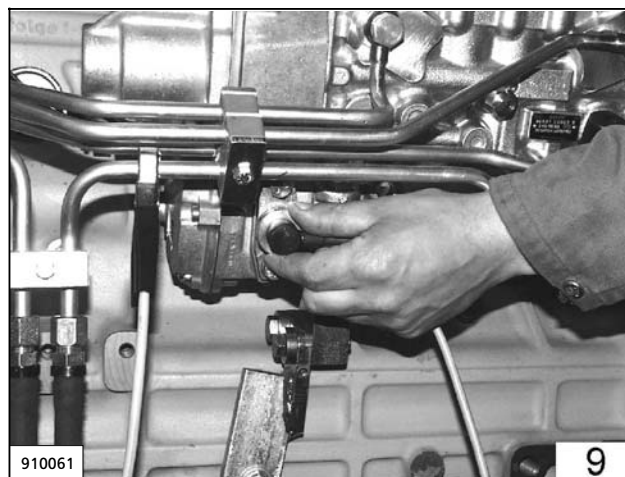


The markings on the turning device and the specifications shown on the ID tag under INJECTION TIMING must match on the inspection hole of the flywheel housing.

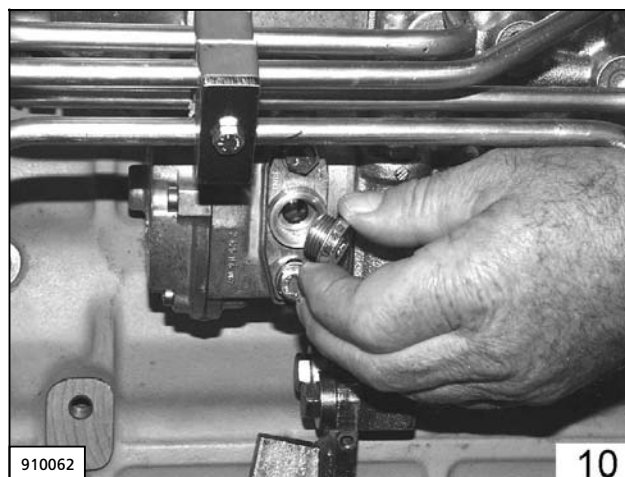
Note:

If the stated value cannot be reached, the DB adjustment must be corrected, see 2.19.30 under DB adjustment.

Untie screws on the impulse transmitter and remove transmitter.



Install plug with gasket into the flange and tighten.



Remove turning device.

Mount cylinder head cover with gasket.

**Check begin of delivery (FB)
(injection pump type "H-RP43"
(control sleeve fuel injection pump) with
"EDC" = Electronic regulation)**

Special Tool No. 9.2, 30

For begin of delivery engine data tag, INJECTION
TIMING.

Important:

The fuel delivery begin (FB) data for above injection
pump type is always data given in degrees crank
angle according to OT (= Upper death point).

The top dead center (OT) and the mark to check the
fuel delivery begin (FB) as well an 20° before OT to
10° after OT is marked on the flywheel.

The hand crank, special tool No. 30 is also marked.

Note:

The injection pump type is noted on the data tag of
the injection pump.

For example: PES 6 H etc.

↑
Injection pump - type "H-RP43"
(Control sleeve fuel injection pump)



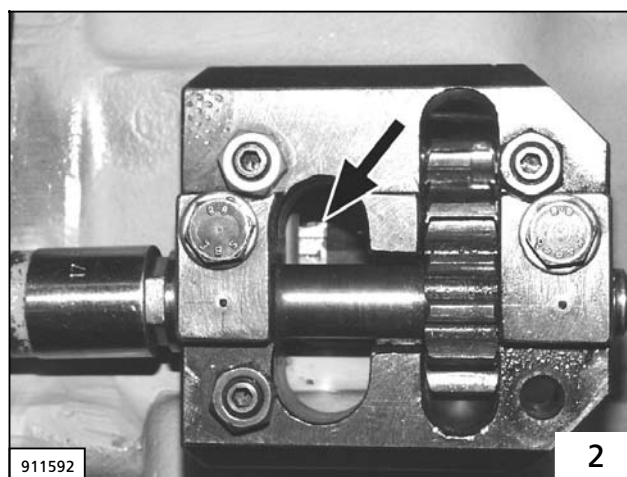
To check:

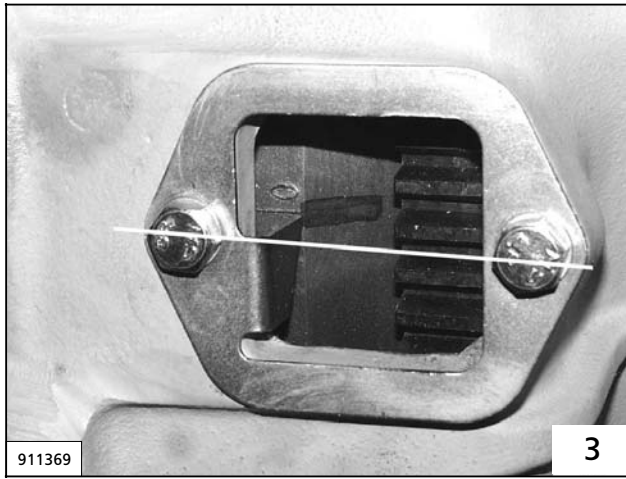
On cylinder 1, remove the cylinder valve cover.

Install the handcrank, special tool No. 30 on the
inspection port - flywheel housing - and set cylinder
1 to ignition OT (OT = top dead center).

Direction of rotation is to the left, as viewed onto
the flywheel.

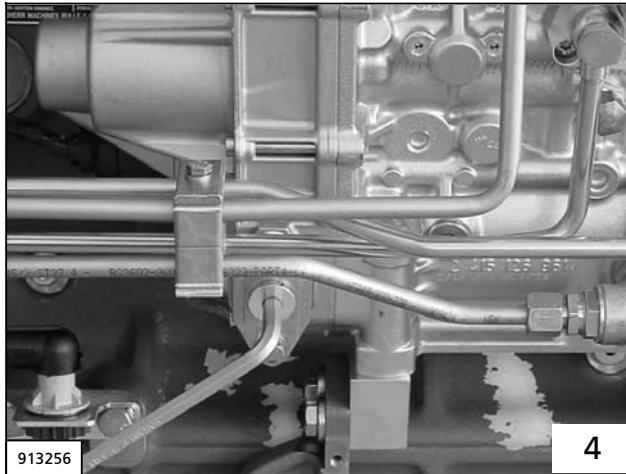
Then turn the engine by approx. 45° against the
direction of rotation.



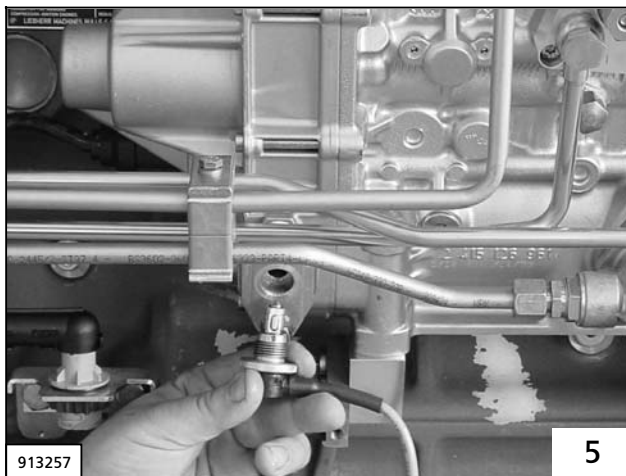


Note:

If no marked handcrank is available, the center of the distance between the bore holes next to the inspection port represents the reference point for the OT or FB.



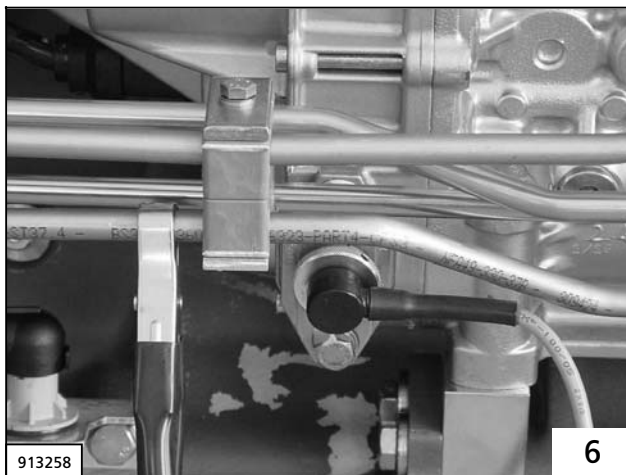
Remove the plug from the flange on the injection pump regulator (EDC) and remove with seal ring.



Insert a light sensor, special tool Nr. 9.2, into the flange and install the mounting screw by hand and tighten.

Note:

The guide nose on the shaft of the light sensor must align with the groove in the intake bore in the flange.



Clamp the ground clip of the light sensor to the ground on the engine.

Note:

The injection pump may not be energized turn off the ignition on the machine.

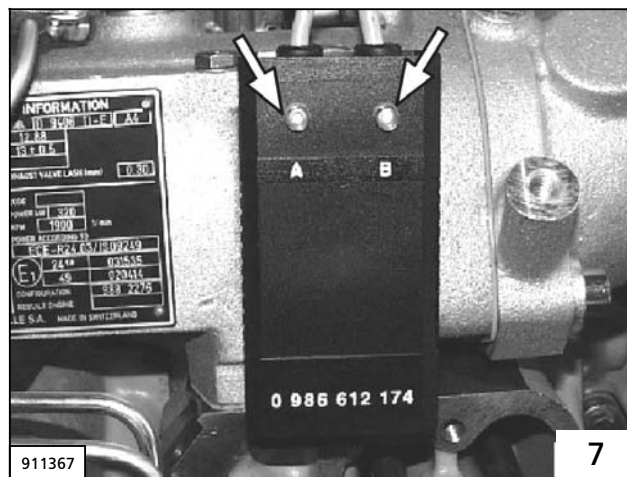
Slowly turn the engine in direction of rotation until a light on the light sensor lights up.

Carefully continue to turn the engine in direction of rotation until the second light lights up.

Note:

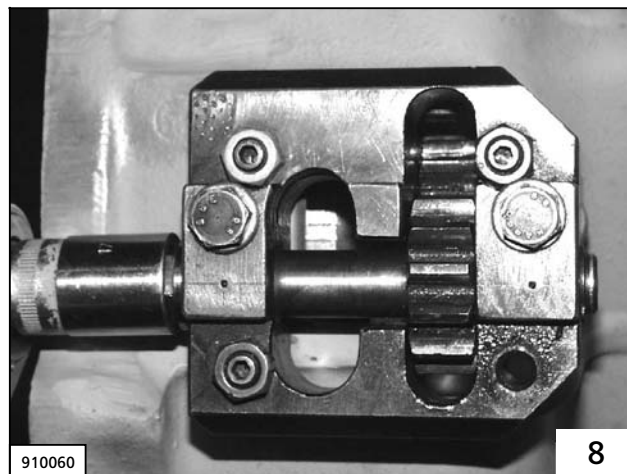
When all two lights on the light sensor light up, then the exact FB position is reached.

If only the second light lights up, then the FB-setting is too far and the test must be repeated.

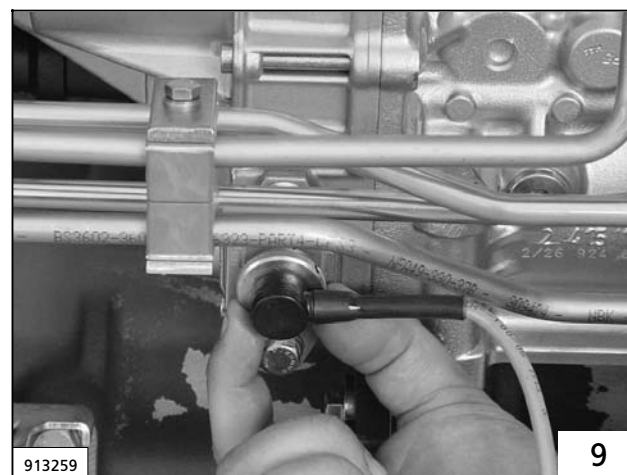


On the inspection port on the flywheel housing, the marks on the hand crank and the FB data given on the engine data tag under INJECTION TIMING must match.

If the given value is not reached, then the FB adjustment must be corrected, see 2.19.34, to set the FB setting.



Remove the mounting screw for the light sensor from the flange and remove the sensor.



Install the plug with seal ring into the flange and tighten.

Remove the hand crank.

Install the cylinder valve cover with new gasket.



Adjust Fuel Delivery Begin (FB)

Injection pump drive installed on timing gear housing.

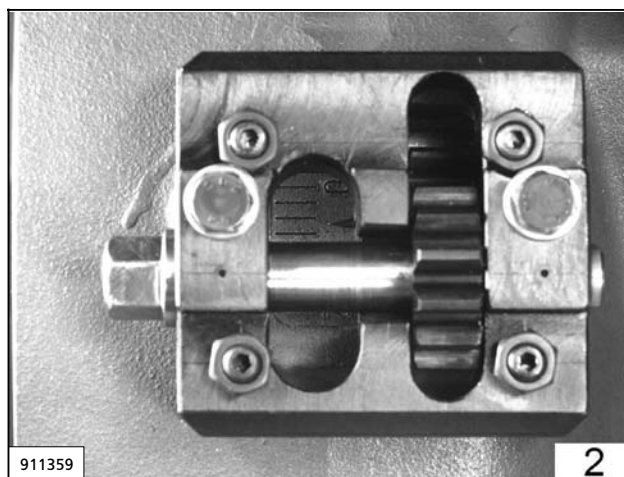
Use Special Tools No. 4, 6, 30

Remove screws on cover for injection pump drive.
Remove cover from timing gear housing.



Install rotating device, tool No. 30 on flywheel housing inspection window and adjust cylinder 1 to exact FB mark.

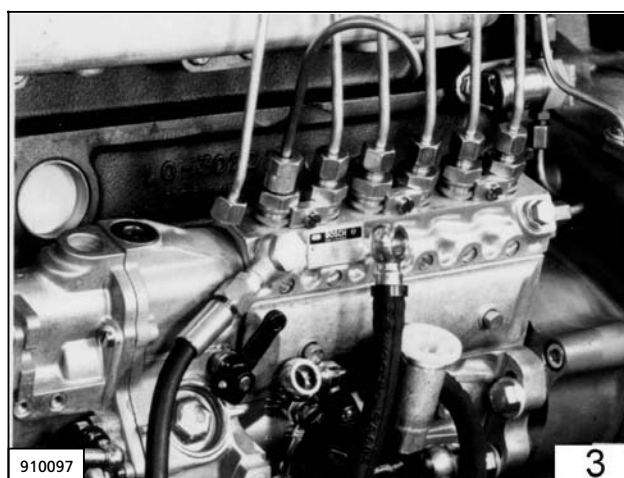
FB data - see Technical Data.



Install high pressure hand pump, special tool No. 4 to injection pump, connection overflow pipe and plug. Move lever to full load, turn off starting boost (on injection pump - Type MW a retaining tool, special tool no. 6, is required).

Note:

These procedures are described on page 2.19.01/02 or 2.19.05/06.

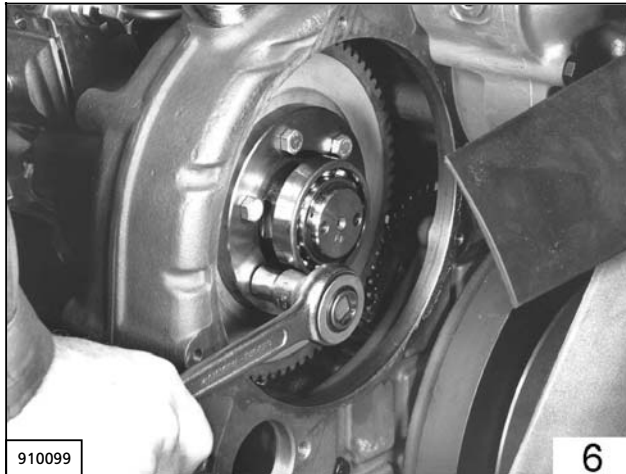


Loosen screws on injection pump drive.





Turn injection pump drive mounting bolts with a commercially available socket wrench about 90° to the left (as seen from the fan side to the hub). Actuate the high pressure hand pump, fuel flows from overflow pipe to cylinder 1. Slowly turn injection pump drive hub to the right until the fuel flow is reduced to drops, which means FB-Delivery Begin is properly adjusted.



Tighten screws on injection pump drive and check delivery again, as described on page 2.19.01 or 2.19.05 (depending on type A or MW injection pump).



Install cover with new O-ring, apply oil lightly to O-ring and push cover into timing gear housing.

Insert screws and tighten.

Remove high pressure hand pump, plug, overflow pipe, rotating device and on the MW injection pump also the retaining device for starter boost injection.

Install all fuel lines with new seals.

On injection pump Type A install cap for regulator rod.

Install cylinder head cover with new gasket.

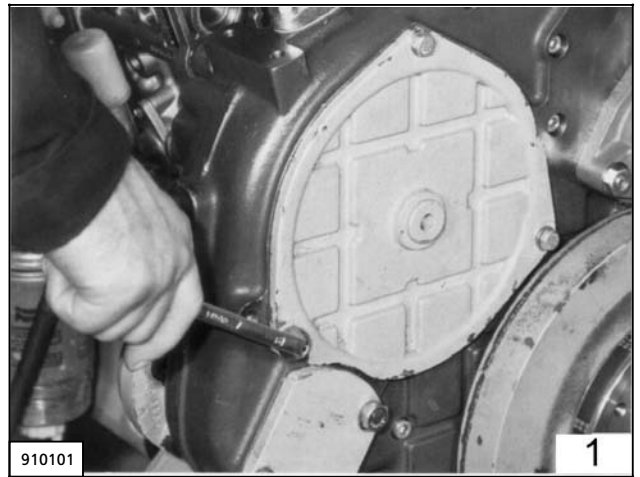
Bleed fuel system, see sub group 7.22.

Adjust Fuel Delivery Begin (FB)

Injection pump drive installed on timing gear housing.

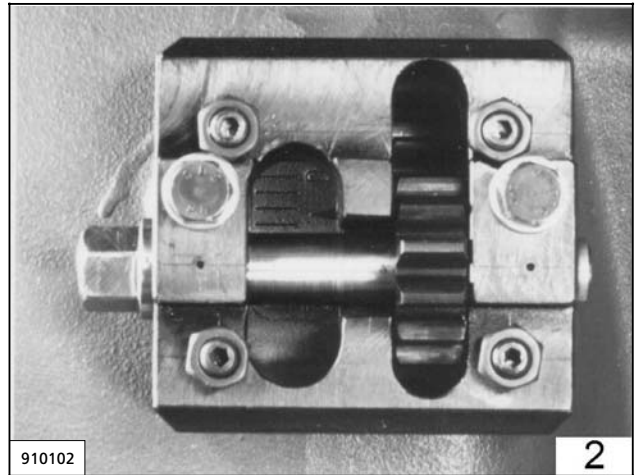
Use Special Tools No. 4, 6, 30.

Remove screws on cover for injection pump drive.
Remove cover from timing gear housing.



Install rotating device, tool No. 30 on flywheel housing inspection window and adjust cylinder 1 to exact FB mark.

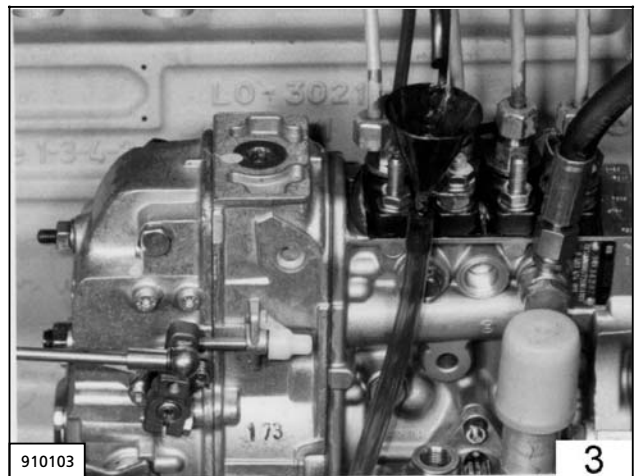
FB data - see Technical Data.



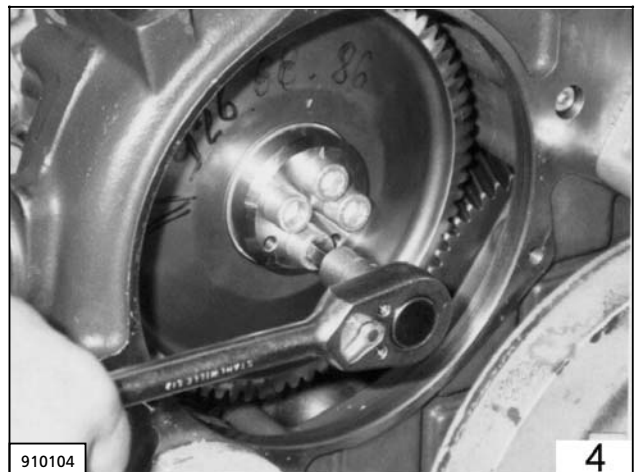
Install high pressure hand pump, special tool No. 4 to injection pump, connection overflow pipe and plug. Move lever to full load, turn off starting boost (on injection pump - Type MW a retaining tool, special tool no. 6, is required).

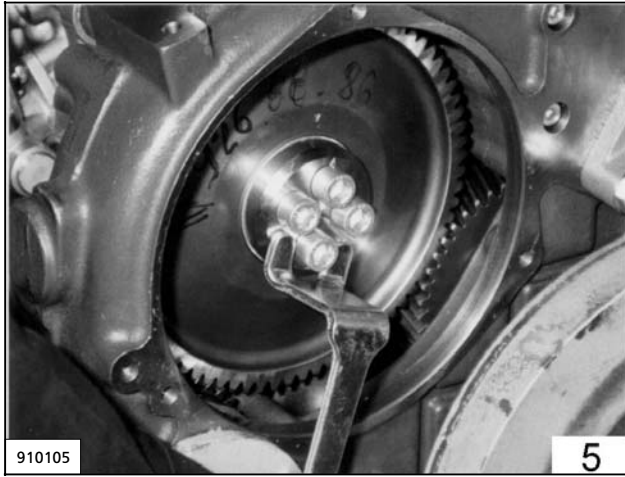
Note:

These procedures are described on page 2.19.01/02 or 2.19.05/06.



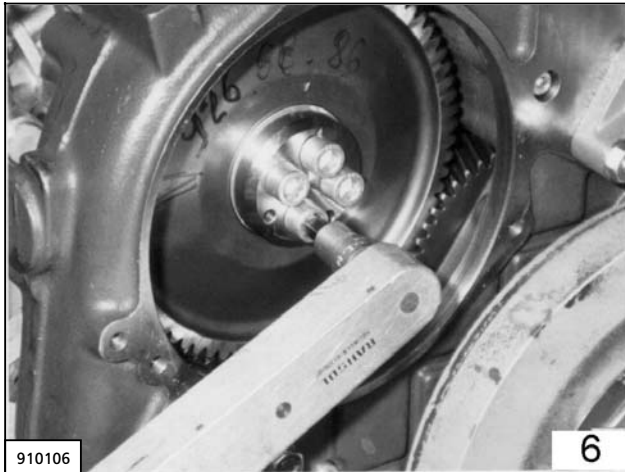
Loosen screws on injection pump drive.





Turn injection pump drive mounting bolts with a commercially available socket wrench DIN 3116 - C 35 about 90° to the left (as seen from the fan side to the hub).

Actuate the high pressure hand pump, fuel flows from overflow pipe to cylinder 1. Slowly turn injection pump drive hub to the right until the fuel flow is reduced to drops, which means FB-Delivery Begin is properly adjusted.



Tighten screws on injection pump drive.
For tightening torque, see Technical Data.

Check delivery begin again, as described on page 2.19.01 or 2.19.05 (depending on type A or MW injection pump).



Install cover with new O-ring, apply oil lightly to O-ring and push cover into timing gear housing.

Insert screws and tighten.

Remove high pressure hand pump, plug, overflow pipe, rotating device and on the MW injection pump also the retaining device for starter boost injection.

Install all fuel lines with new seals.

On injection pump Type A install cap for regulator rod.

Install cylinder head cover with new gasket.

Bleed fuel system, see sub group 7.22.

Adjusting Begin of Delivery

(Injection Pump Model "VE = Distributor Injection Pump)

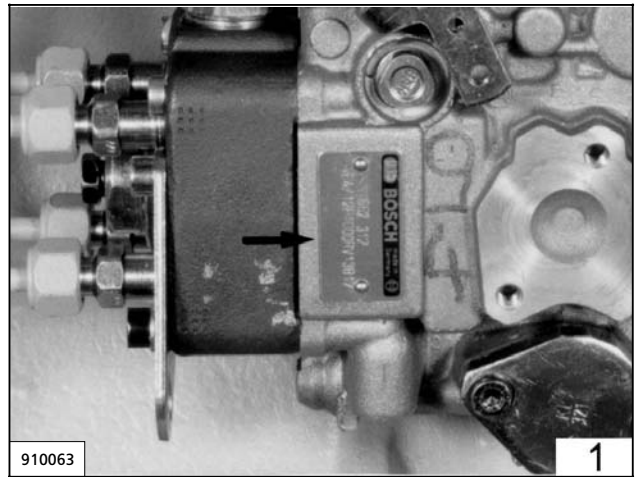
Special Tool No. 7, 8, 9 30

Note:

The model of the injection pump is mentioned on the name plate.

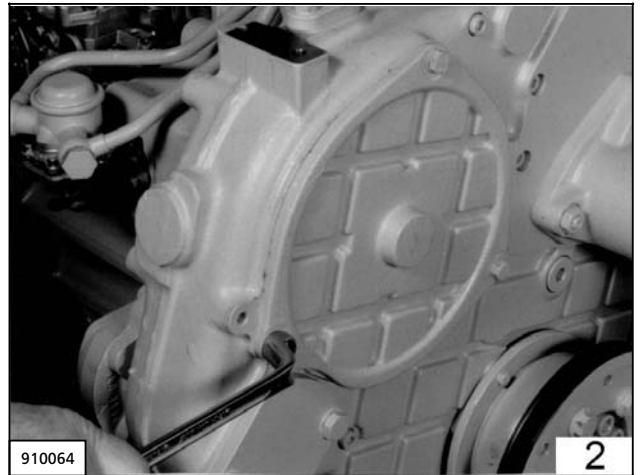
Example V E 4 / and so on

↑
Injection Pump Model "VE"



Untie and remove screws on the cover for the injection pump drive.

Press off cover from component carrier.

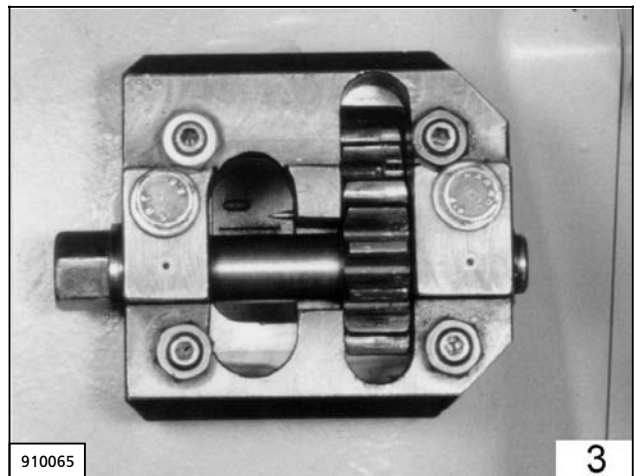


Remove cylinder head cover on cylinder 1.

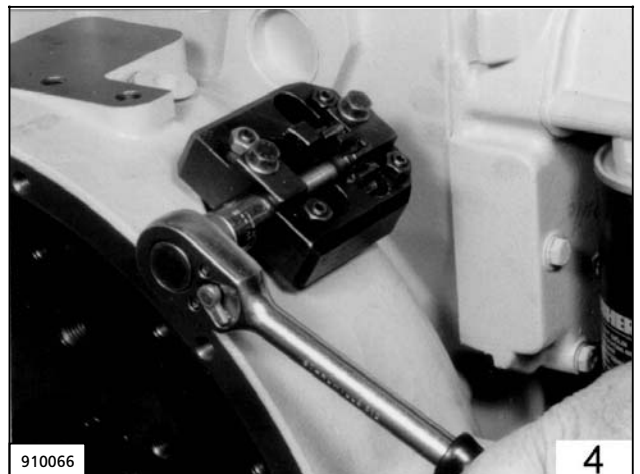
Install turning device, special tool no. 30, on the inspection hole on the flywheel housing and put cylinder no. 1 to upper death point.

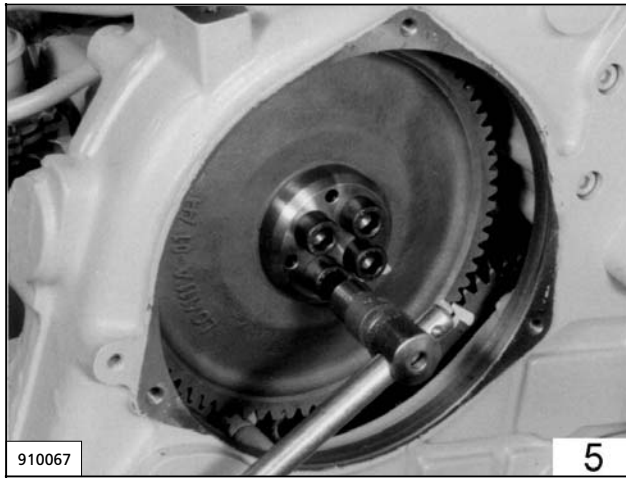
Note:

Specifications about OT = upper death point and markings on the flywheel see 2.19.08 under checking DB = Delivery Begin.

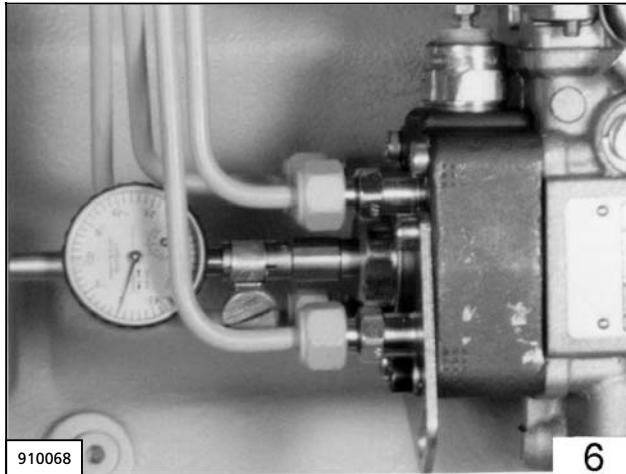


Turn engine back from OT appr. 30° against the turning direction.





Untie screws on the pump drive and tighten again with 30 Nm.

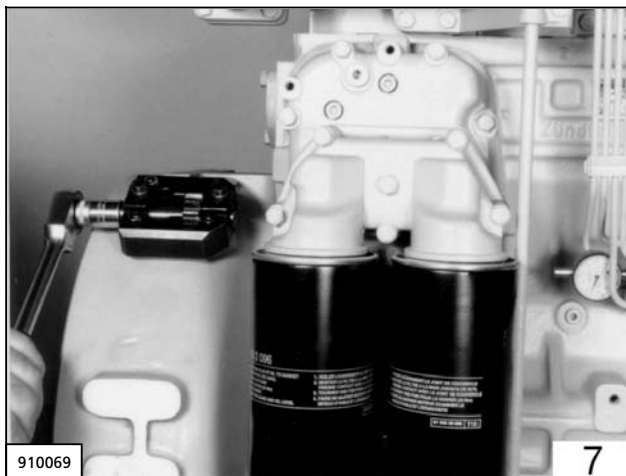


Remove plug on the distributor head.

Turn measuring device, special tool no. 8 into the distributor head, insert measuring gauge with test point, special tool no. 7, 9 and set measuring gauge to "0" under a pretension of appr. 1mm. Clamp measuring gauge into measuring device.

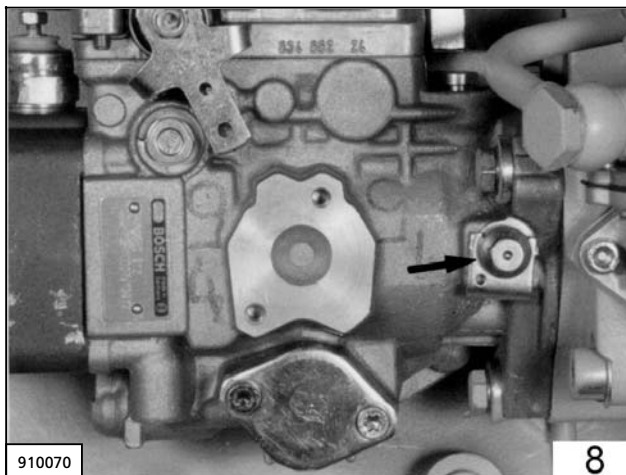
Note:

Observe free flow position of the measuring gauge. These steps are clearly described under "Checking DB" on page 2.19.08.



Read off adjusting data on the name plate of the engine under INJECTION TIMING in mm.

Turn engine in turning direction until measuring gauge has reached corresponding data.



Untie locking screw on the injection pump and remove support plate, tighten locking screw again.

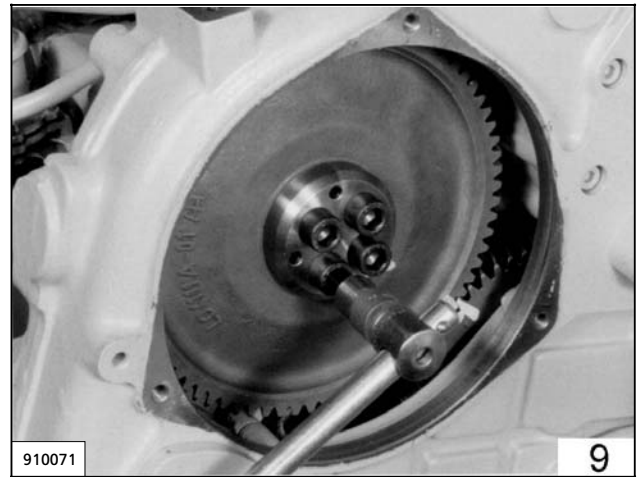
Tightening torque: 10 - 15 Nm

Note:

With the locking screw the drive shaft of the injection pump is clamped.

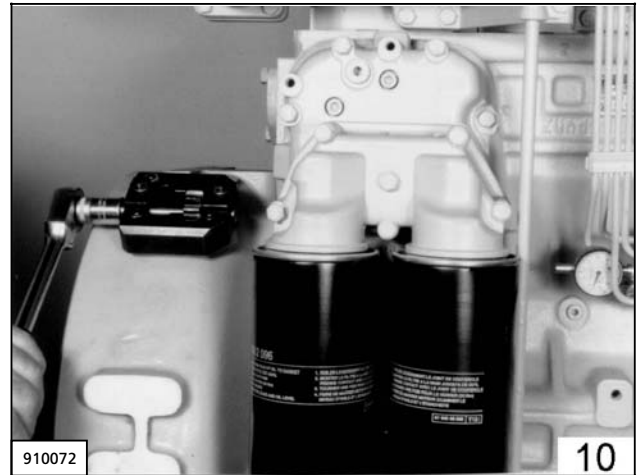
Don't turn engine anymore.

Untie screws on the pump drive.

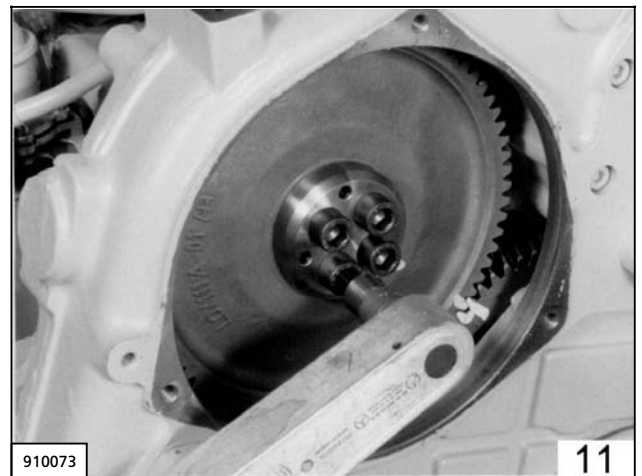


Turn engine back from OT = upper death point
appr. 30° against the turning direction.

Then turn engine in turning direction until OT is
reached.



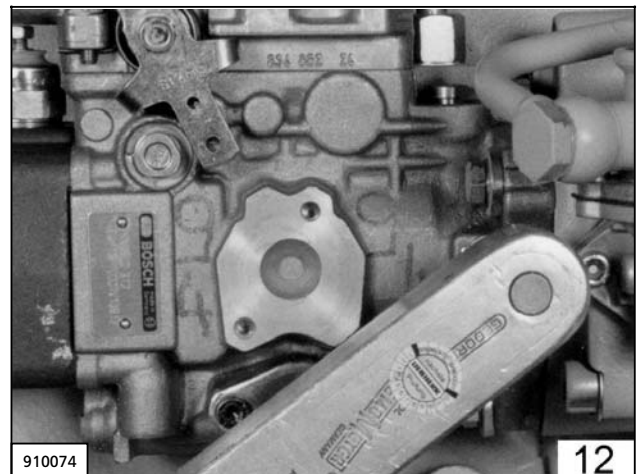
Tighten screws on the pump drive using a torque of
30 Nm.

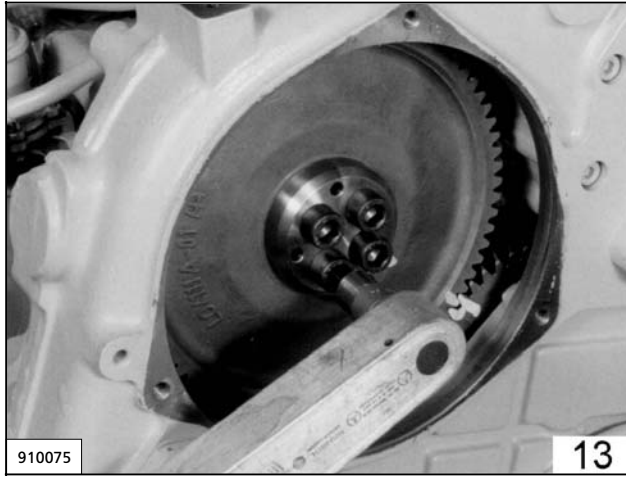


Untie locking screw on the injection pump and
install support plate.

Retighten locking screw.

Tightening torque: 10 - 15 Nm.

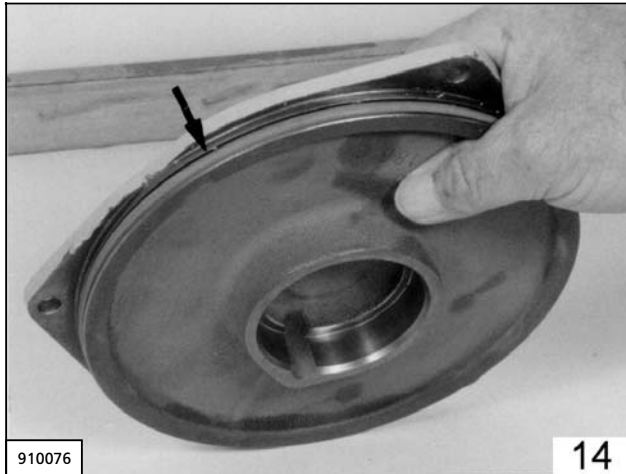




Tighten screws on the pump drive.

Tightening torque: 110 Nm.

Again check DB = Delivery Begin as described under 2.19.08.



Install new O-Ring on the cover of the pump drive, lubricate O-Ring and install cover onto the component carrier.

Install screws and tighten.

Remove measuring gauge and measuring device, install plug into distributor head and tighten.

Remove turning device.

Install cylinder head cover using a new gasket.

Adjusting Delivery Begin (DB)

(Injection Pump type P with EDC = Electronic Diesel Control)

Special Tool No. 9.2, 30

Delivery Begin Specifications see engine ID tag under INJECTION TIMING

Note:

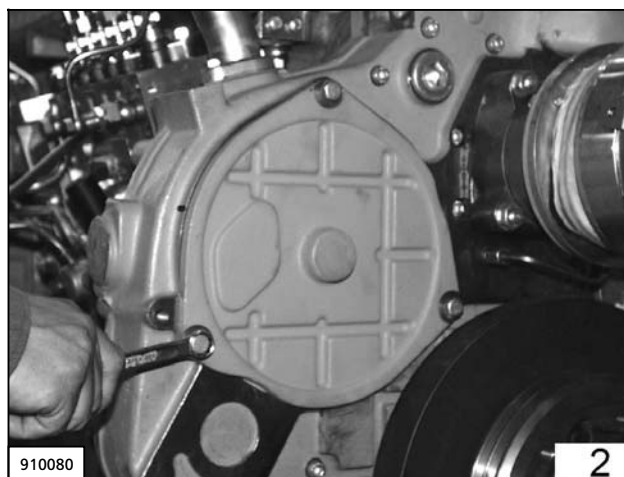
The type of Injection Pump is stated on the ID tag of the Injection Pump.

Example: P E S 6 P ... etc.

Injection Pump Model "P"

Untie screws from the cover for the injection pump drive and unscrew.

Remove cover from the component carrier.



Remove cylinder head cover on cylinder1.

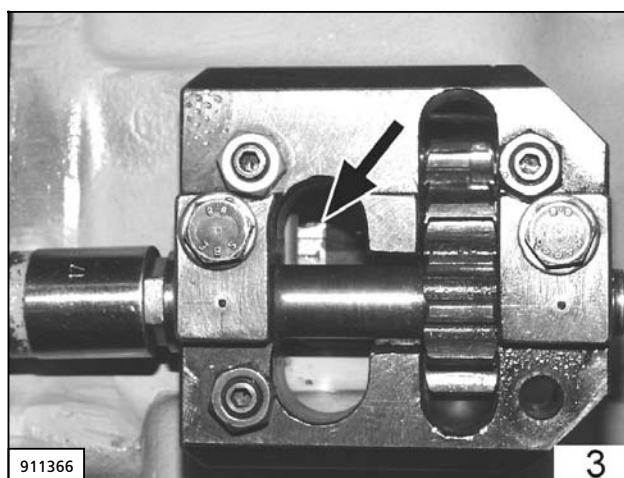
Install turning device, special tool No: 30 on the inspection hole of the flywheel housing and crank engine until cylinder 1 is at ignition upper dead point (OT= upper dead point).

Turning direction is left looking onto the flywheel.

Having reached upper dead point turn engine back and put cylinder 1 to the exact DB-mark.

Note:

Specification for OT and flywheel marks see checking DB under 2.19.10/2.19.11.



Remove plug from the flange on the injection pump regulator (EDC) together with the gasket.

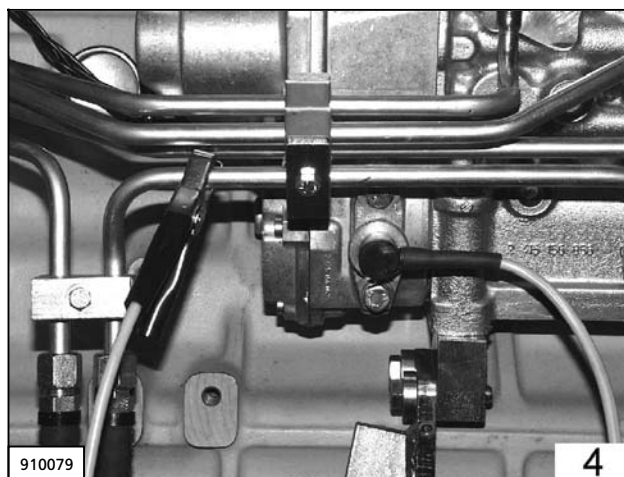
Put impulse transmitter, special tool No. 9.2 into the flange tightening the mounting screws by hand.

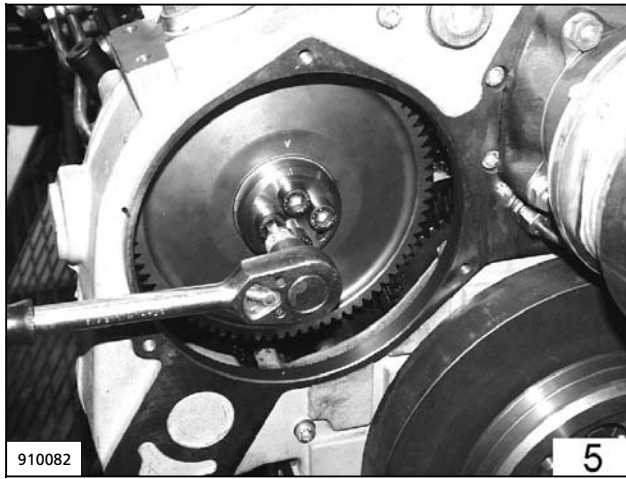
Connect the ground clamp of the impulse transmitter with ground of the engine.

The injection pump must be without current, the ignition of the machine must be turned off.

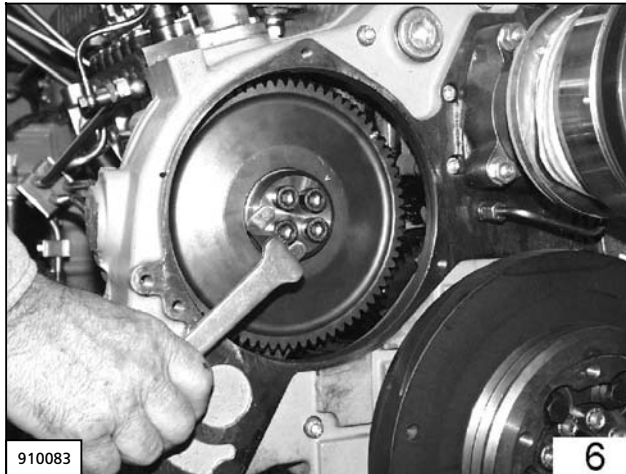
Note:

These steps are precisely described under group 2.19.10/2.19.11.



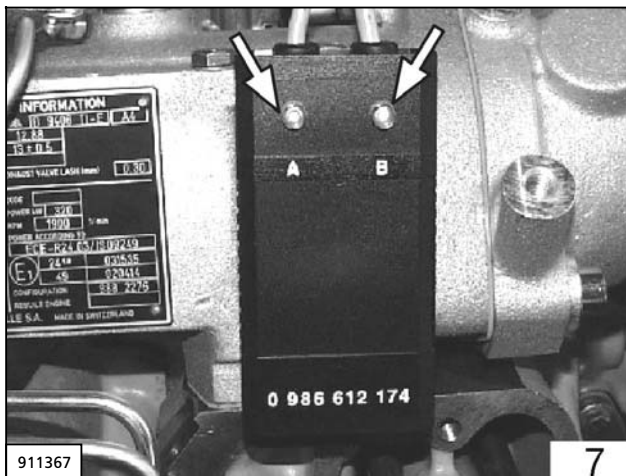


Untie screws on the Injection Pump Drive.
Check again if the engine is still on DB-mark.



Turn the Pump Drive Hub with a common nut spanner DIN 3116 - C35 appr. 45° to the left.

Turning direction to be seen from the fan side to the drive hub.



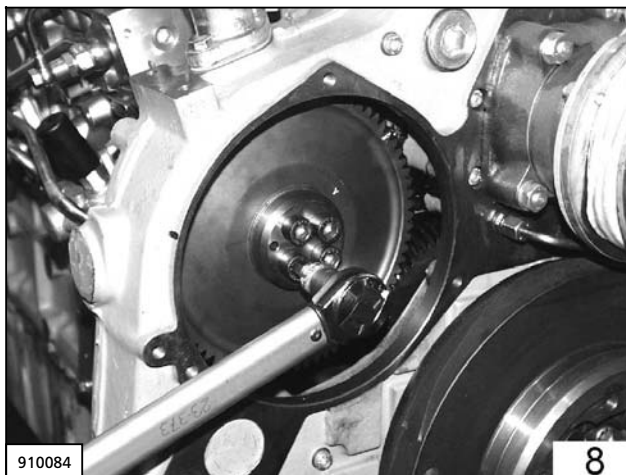
Slowly turn injection pump drive hub to the right until one lamp of the impulse transmitter lights up.

Keep turning drive hub cautiously, until the second lamp lights up.

Note:

If both lamps on the impulse transmitter are on, the exact DB position is reached.

If only the second lamp is on, The DB position is overturned and the adjustment needs to be carried out again.



Tighten the screws on the injection pump drive.

See technical data for tightening specifications.

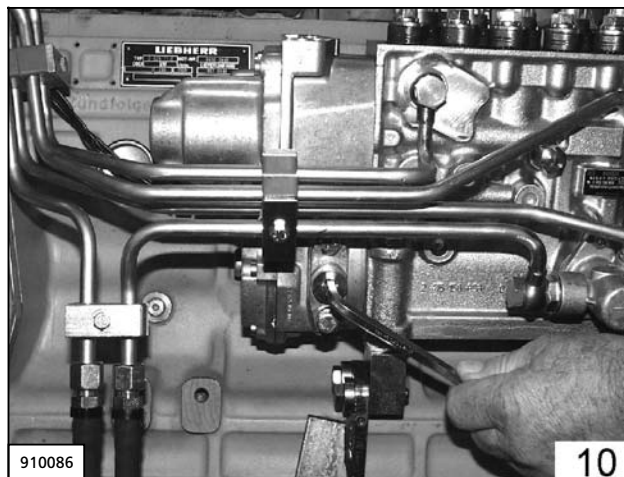
Check DB one more time as described under 2.19.10/ 2.19.11.

Install new O-Ring to the cover of the injection pump drive, lubricate slightly and push cover into component carrier.

Insert screws and tighten.



Remove impulse transmitter, install plug with a new gasket ring.



Remove turning device.

Mount cylinder head cover with new gasket.

Adjust begin of delivery (FB)

(Injection Pump type "H-RP43" (control sleeve fuel injection pump) with EDC = Electronic regulation)

Special Tool No. 9.2, 30

For begin of delivery data, see engine data tag, INJECTION TIMING.

Important:

The fuel delivery begin (FB) data for above injection pump type is always data given in degrees crank angle according to OT (OT = Upper death point).

Note:

The injection pump type is noted on the data tag of the injection pump.

For example: PES 6 H etc.

↑
Injection pump - type "H-RP43"
(Control sleeve fuel injection pump)



Untie screws from the cover for the injection pump drive and unscrew.

Remove cover from the component carrier.



Remove cylinder head cover on cylinder 1.

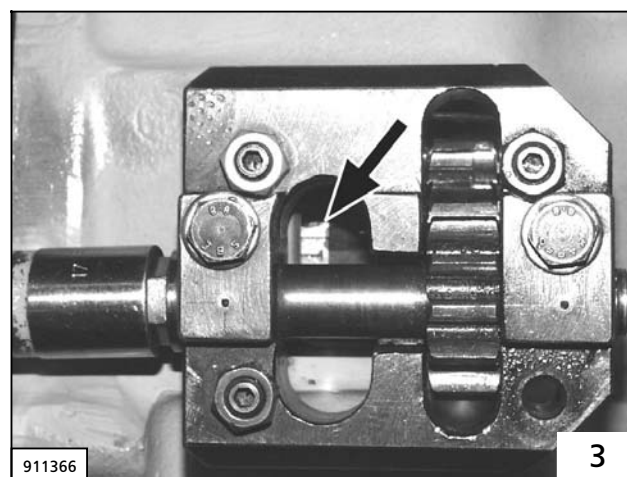
Install turning device, special tool No. 30 on the inspection hole of the flywheel housing and crank engine until cylinder 1 is at ignition upper dead point (OT = Upper dead point).

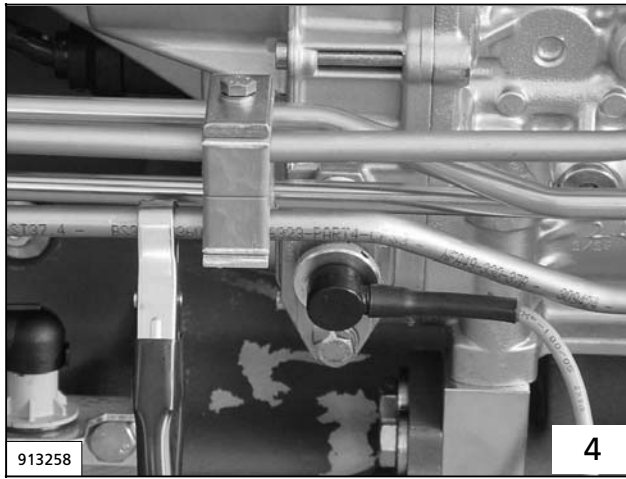
Turning direction is left looking onto the flywheel.

Heaving reached upper dead point turn engine back and put cylinder 1 to the exact FB-mark.

Note:

Specification for OT and flywheel marks see checking FB under 2.19.12 / 2.19.13.





Remove plug from the flange on the injection pump regulator (EDC) together with the gasket.

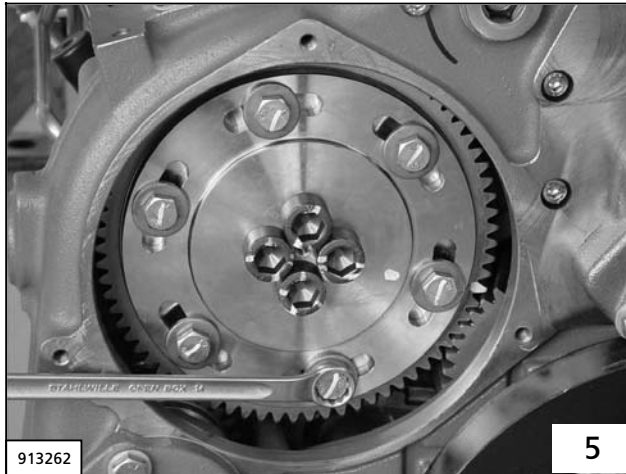
Put impulse transmitter, special tool No. 9.2 into the flange tightening the mounting screws by hand.

Connect the ground damp of the impulse transmitter with ground of the engine.

The injection pump must be without current the ignition of the machine must be turned off.

Note:

These steps are precisely described under group 2.19.12 / 2.19.13



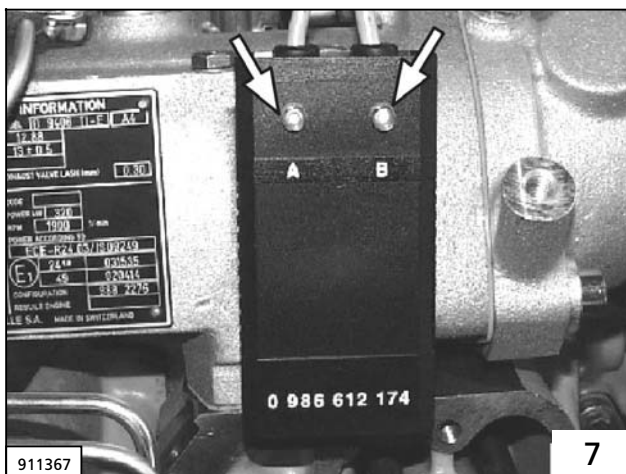
Untie screws on the intermediate flange.

Check again if the engine is still on FB-mark.



Turn left with a socket head screw the pump drive hub to limit of the screws on the oblong hole.

Turning direction to be seen from the fan side to the drive hub.



Slowly turn injection pump drive hub to the right until one lamp of the impulse transmitter lights up.

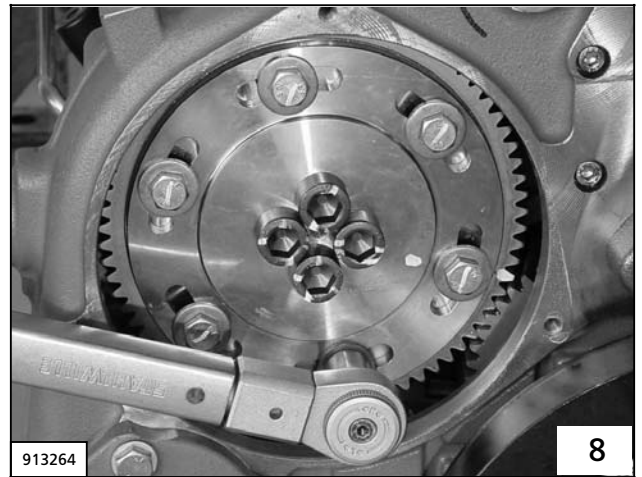
Keep turning drive hub cautiously, until the second lamp lights up.

Note:

If both lamps on the impulse transmitter are on, the exact FB position is reached.

If only the second lamp is on, the FB position is overturned and the adjustment needs to be carried out again.

Tighten the screws on the intermediate flange.
See technical data for tightening specifications.
Check FB one more time as described under 2.19.12
/ 2.19.13.



Install new O-Ring to the cover of the injection pump drive, lubricate slightly and push cover into component carrier.
Insert screws and tighten.



Remove impulse transmitter, install plug with a new gasket ring.



Remove turning device.
Mount cylinder head cover with new gasket.

Test and calibrate fuel injectors Remove and install fuel injector nozzle

Use special tool No. 3

For correct fuel injection (opening) pressure, refer to Technical Data.

To remove fuel injector. refer to sub group 7.18.

Check:

Carefully remove all carbon deposits from the injector nozzle. Connect fuel injector to injector testing device, special tool No. 3.

Important:

Use only filtered Diesel fuel or clean injector testing fluid for this test.

Caution:

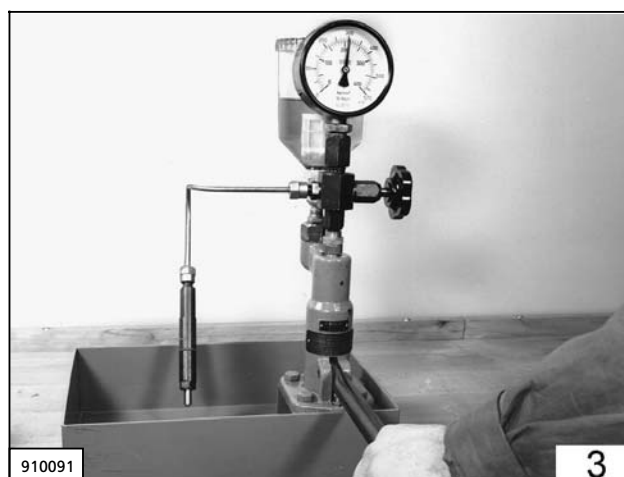
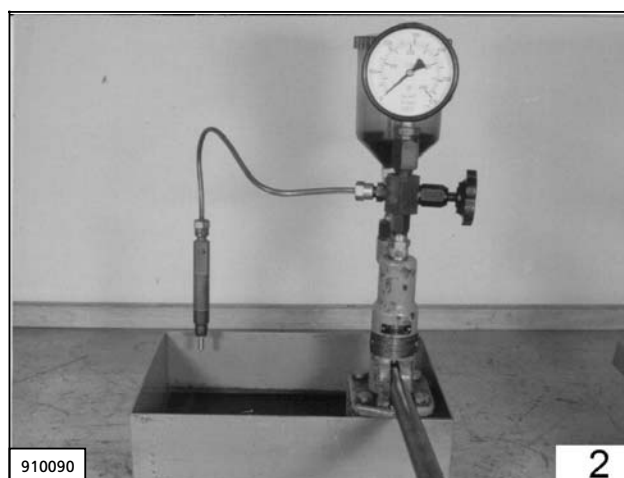
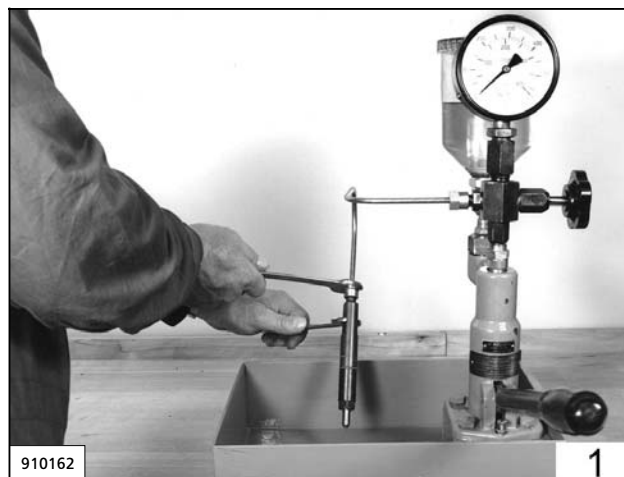
Do not expose hands or fingers to fuel jets at the injector nozzle. The fuel jets will penetrate the skin, entering flesh and destroying tissue. If Diesel fuel enters the blood stream, blood poisoning can occur!

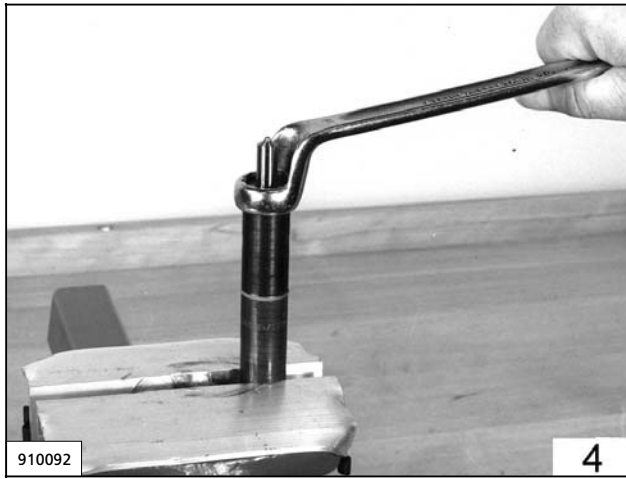
Actuate the lever of the injector testing device quickly several times, with the pressure gauge turned off, the injector nozzle must emit a rattling type noise. At the same time, observe the injector nozzle spray pattern. The fuel spray is satisfactory if all jets emit a uniformly shaped mist (pattern) without a side streamer appearance.

Turn on the pressure gauge, slowly press the lever of the injector testing device down until fuel emerges from the nozzle. Read the opening (or cracking) pressure on the gauge and compare with the values listed on the Technical Data page. Please note the different values for new and used injectors!

Note:

The injector nozzle should not drip, even at a pressure of 25-30 bar below the recommended minimum opening pressure.





Calibration of fuel injector:

Place the fuel injector in a vise. Remove the injector nozzle .

For removal and installation of injector nozzle, see below.

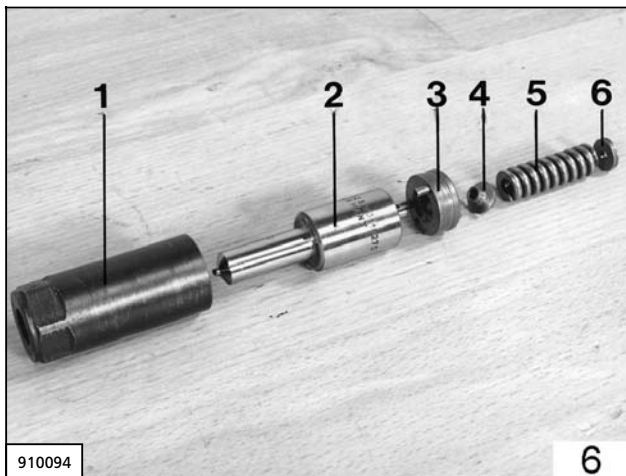
Important: The repair and / or calibration of injectors should only be performed by qualified repair shops (Bosch) with the proper tools, parts and cleaning facilities!



Remove the spring, add or remove shims 6, as necessary.

Add shims to increase opening pressure, remove shims to decrease opening pressure.

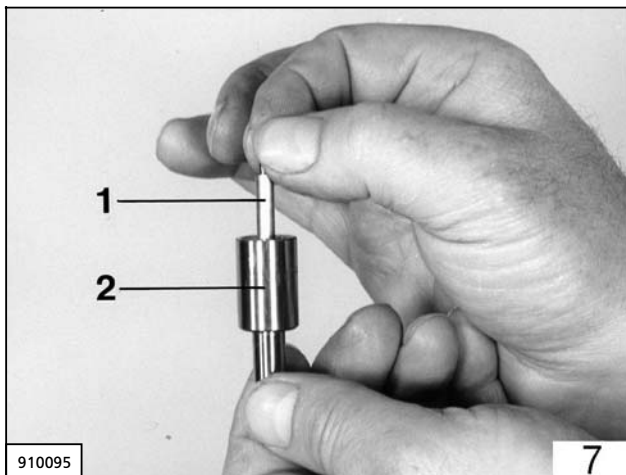
Reassemble the fuel injector and repeat the test.



Removal and installation of injector nozzle

Removal:

Unscrew and remove the nozzle retainer nut 1, injector nozzle 2, spacer with guide pins 3, pressure pin 4, compression spring 5 and pressure adjustment shims 6 from the injector.



Clean needle 1 and housing 2 in clean Diesel fuel and check operation with drop test. Hold the nozzle in vertical position, insert the needle partially and release it. The needle valve should slowly but continuously slide into the nozzle, due to its own weight. If this is not the case, replace the injector nozzle.

Clean the other injector components in clean Diesel fuel.

Installation:

Insert shims, compression spring, pressure pin, spacer with guide pins and nozzle with needle valve in fuel injector. Screw on nozzle retainer nut, torque nut.

For tightening torques, refer to Technical Data page.

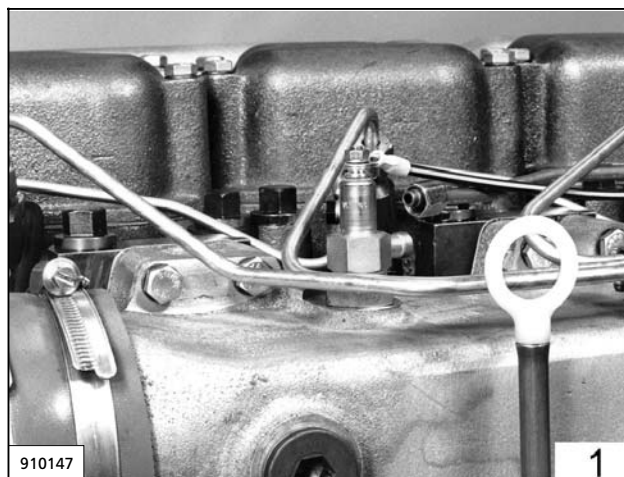


Flame glow / pre-heater system testing, removal and installation

Testing:

Check the solenoid valve:

Disconnect the fuel supply line at the flame glow plug. At the injection pump, move the shut off lever to the 'off / stop' position. Crank the engine with the starter, fuel should flow from the supply line.



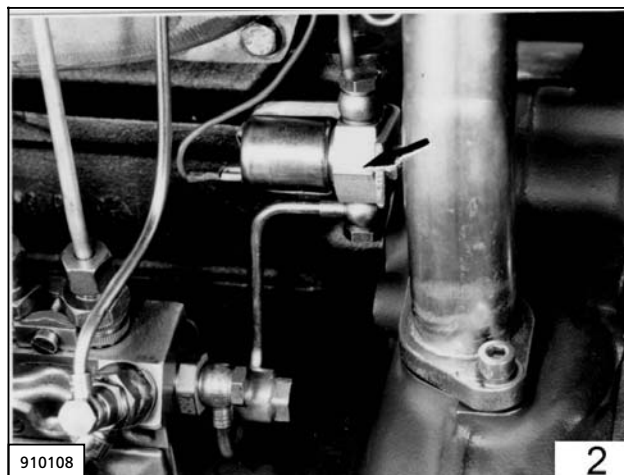
Bring the shut off lever on the injection pump from stop to the 'run' position and start the engine, the fuel must stop flowing from the supply line.

Note:

If no fuel is flowing when cranking the engine, or if fuel flow doesn't stop when the engine is running, replace the solenoid valve.

When changing the valve, pay attention to the flow direction which is marked on the valve with an arrow.

Caution: Perform test carefully to avoid burns!

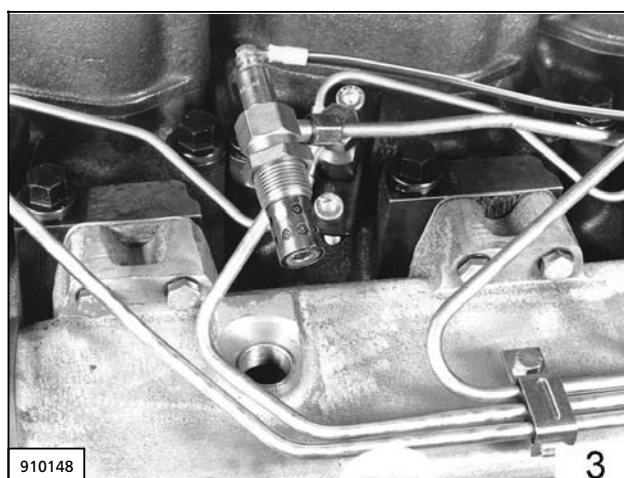


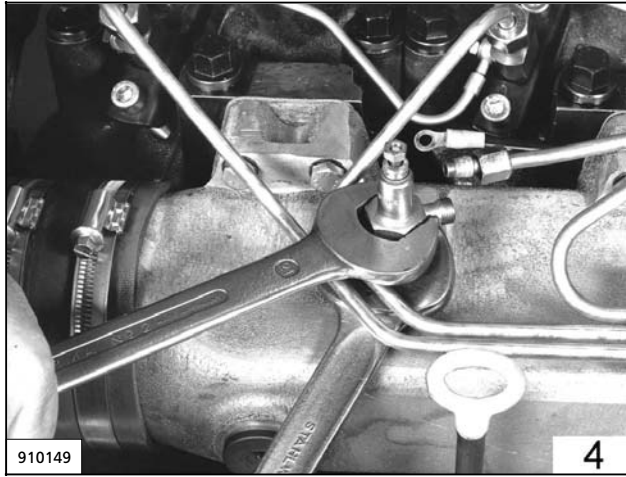
Check the flame glow plug:

Remove the flame glow plug and connect to the fuel supply line and the electrical wire. Move the shut off lever on the injection pump to the 'OFF / stop' position. Make a good connection between the flame glow plug and the ground, then preheat. The plug element must start to glow red. Crank the engine with the starter to see if fuel flows through the plug and evaporates on the red-hot element.

Note:

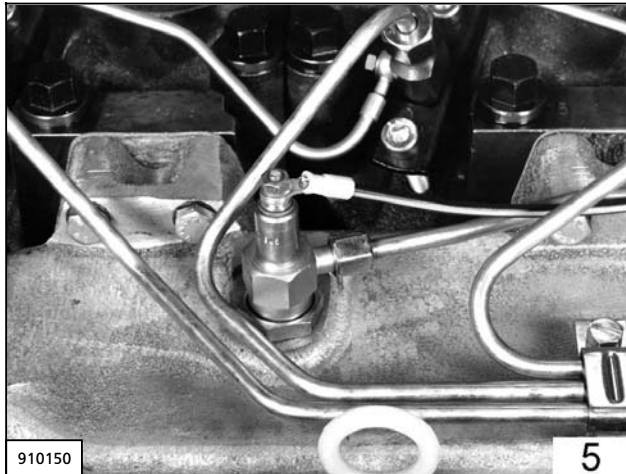
If the flame glow plug does not get hot, or if the fuel does not get to the heater coil when cranking the engine, then the flame glow plug must be replaced.





Remove the flame glow plug:

Disconnect the electrical wire and the fuel supply line. Loosen the lock nut and unscrew the flame glow plug from the intake manifold.



Install the flame glow plug:

Apply sealing compound, such as Hylomar SQ 32 M, Omnivisc 1050 or Reinzoplast to the plug threads and install into intake manifold. Connect the fuel supply line to the plug and tighten. Tighten the lock nut at the plug and attach the electrical wire.

Heating flange checking, removal and installation

Technical data:

Nominal voltage: $U = 24V$

Nominal power after 50s on 24V: $1,9kW \pm 10\%$

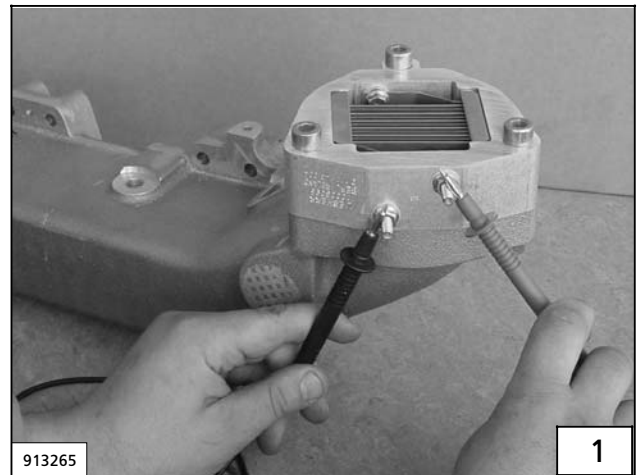
Resistance (Ohm): $250 \pm 10\%$ by $20^{\circ}C$ ($68^{\circ}F$)

Checking:

Disconnect the cable on the heating flange.
Connect on the poles the Ohmmeter or multimeter
and check the resistance.

Note:

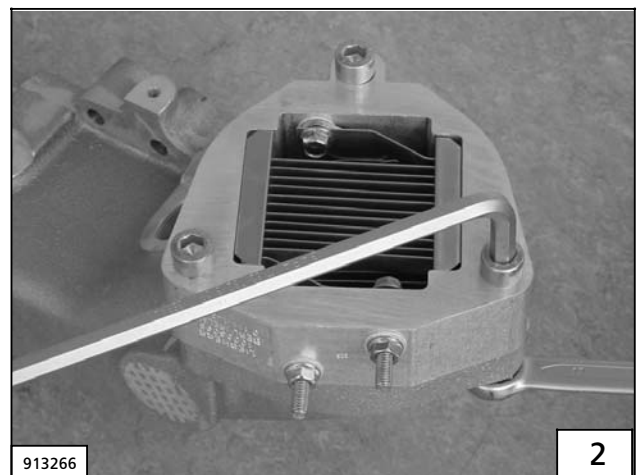
If the heating element is intact, the resistance must
have the values shown in the specification technical
characteristics, otherwise the heating element must
be changed.



Removal:

Disconnect the cable on the heating element.

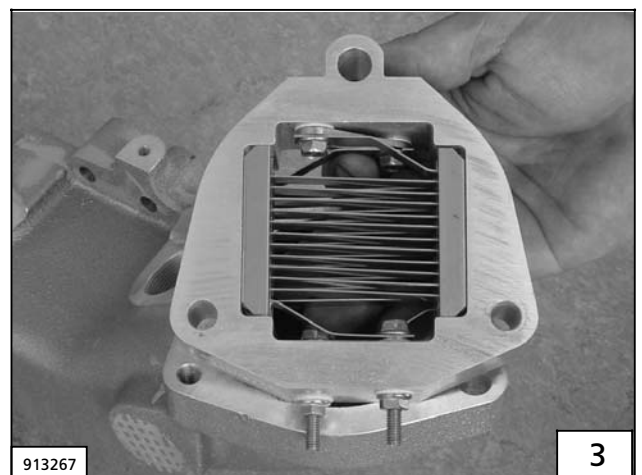
Disengage and unscrew the bolts by
counterholding the nuts.

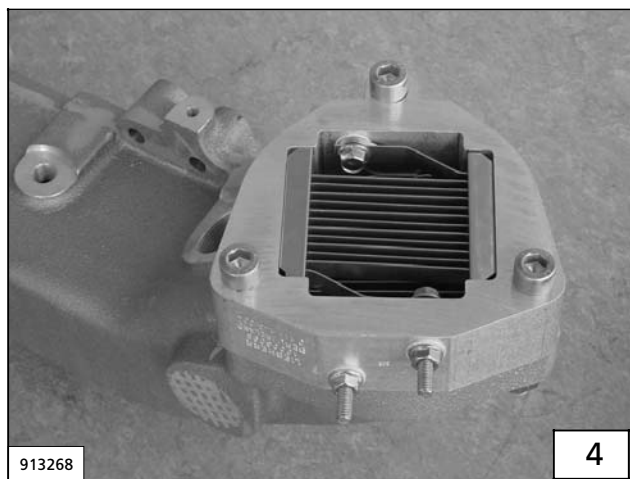


Remove the heating element from the suction pipe
(manifold).

Clean careful the joint surface.

Don't drop part fragments into the suction pipe.





Installation:

Install heating flange with new gaskets, mount the screws and nuts and tight. Connect the electric cable.

Measure and adjust piston clearance

Use special tool No. 5, 10, 30

Note:

The piston clearance should be checked when changing pistons, piston rods, the crankshaft or crankcase. It should also be checked if the crankcase is machined.

Cylinder head is removed, see sub group 3.01.

Install the retaining device, special tool No. 10 on the crankcase to hold the cylinder liner.

Insert and clamp dial gauges into dial gauge holder, special tool No. 5.

Place the holder on a level surface and adjust the dial gauges to "0" under preload.

Important:

Please note the various dial gauge installation points on the dial gauge holder, special tool No. 5, in relation to the piston diameters.

Engine D 904 / 906 = Ø piston 115 mm = Ø test point distance 106 mm, see fig 5.

Engine D 914 / 916 = Ø piston 120 mm = Ø test point distance 115 mm, see fig. 6.

Engine D 924 / 926 = Ø piston 122 mm = Ø test point distance 115 mm, see fig. 6.

Install the special engine turning tool No. 30 on the inspection hole on the flywheel housing. Use the turning tool to position the piston to be checked below top dead center (TDC).

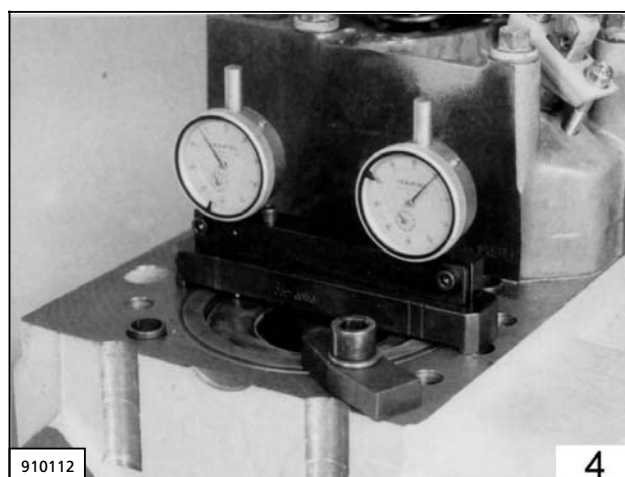
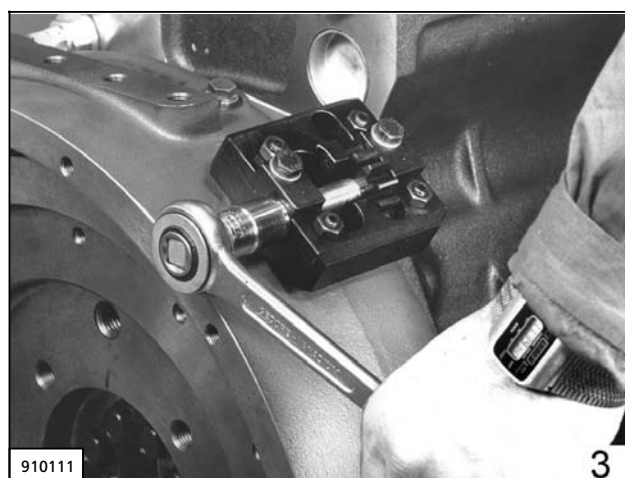
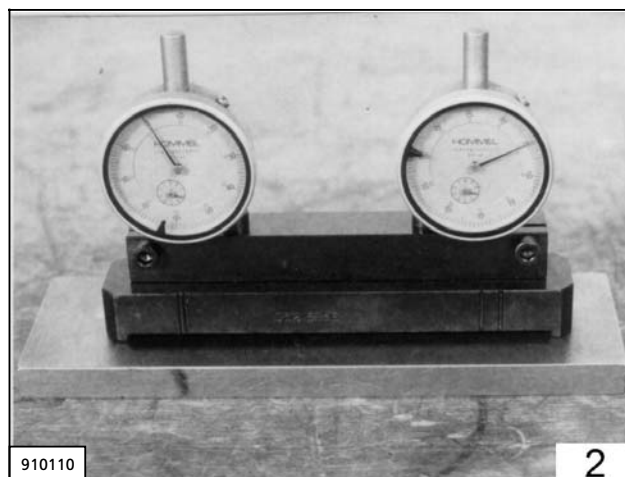
Position the dial gauge holder crosswise to the engine block (crankcase housing). Observe the various piston diameters on the dial gauge holder. Slowly turn the engine with the turning tool until the piston has reached top dead center (TDC). Read and note the highest measurement on the dial gauges. Determine the medium measurement (measurement A) of two values and compare it with the chart.

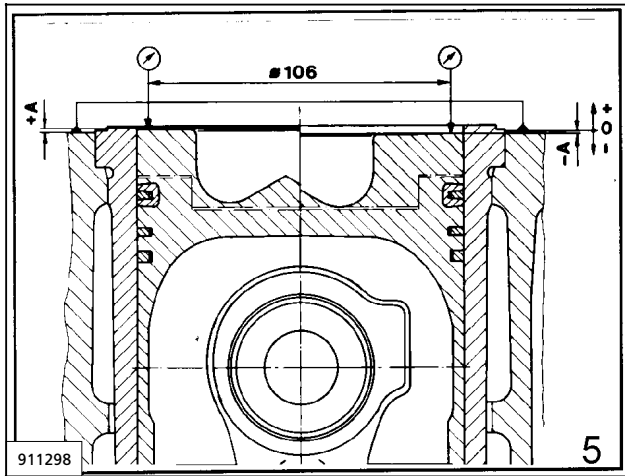
Example:

1 gauge shows + 0.04 mm, the 2nd gauge - 0.06 mm

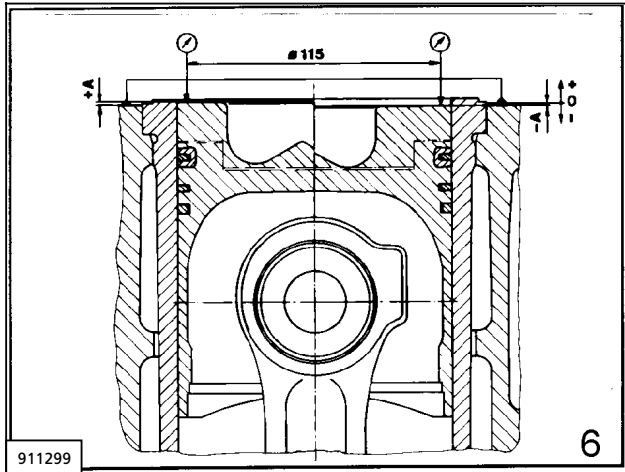
$$+ 0.04 - 0.06 = \frac{- 0.02}{2} = - 0.01$$

Medium value = - 0,01 mm





For measuring points on the D 904 / 906 engines with piston $\varnothing$ of 115 mm, see fig. 5.



For measuring points on the D 914 / 916 / 924 / 926 engines with piston $\varnothing$ of 120 or 122 mm, see fig. 6.

Note:

If the piston clearance is checked without the special tool, the measuring points, depending on the piston diameter, must be crosswise to the engine axis, see fig. 5 and 6.

The values given in the chart below are valid only for these measuring points.

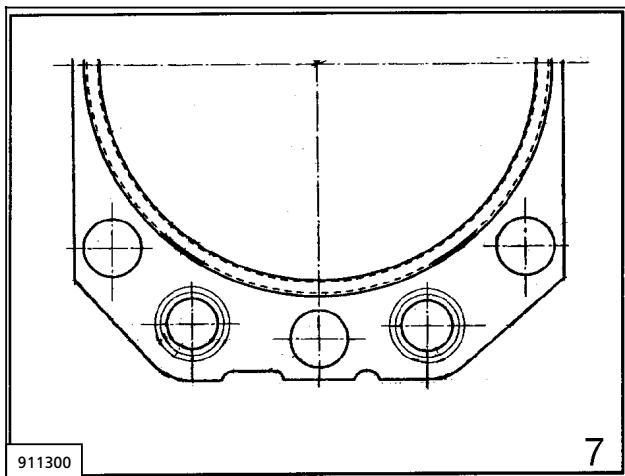


Chart - Piston clearance measurement

Measurement A Medium value determined from 2 measuring points	Cylinder head gasket " thickness "	Cylinder head gasket
- 0.24 to + 0.09 mm	1.3 mm	Soft gasket Fig. 7
	1.25 mm	Metalic elastomer gasket Fig. 8

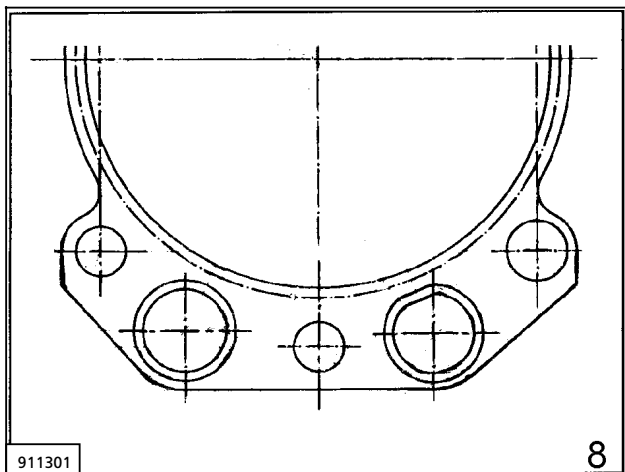
IMPORTANT:

If the soft cylinder head gaskets were installed, soft cylinder head gaskets (see fig. 7) must be reinstalled.

If metal elastomer cylinder head gasket were installed, metal cylinder head gaskets (see fig. 8) must be reinstalled.

This has two reasons:

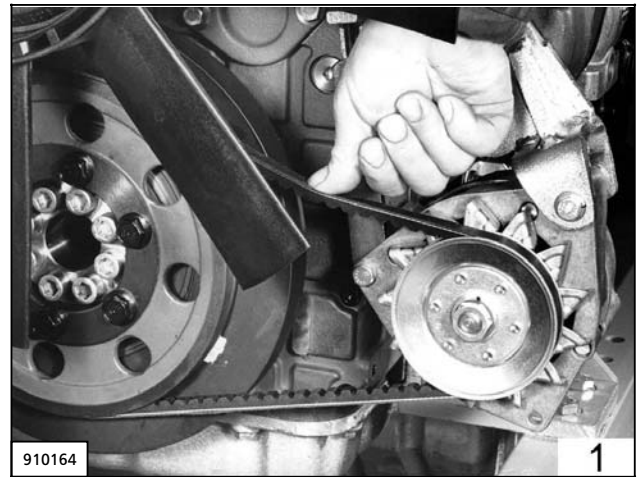
- The liner protrusion between soft and metal gaskets is different.
- Metal gaskets are installed with different liners, which have a rough serrated gasket mating surface.



Checking V-belt Tension by Hand

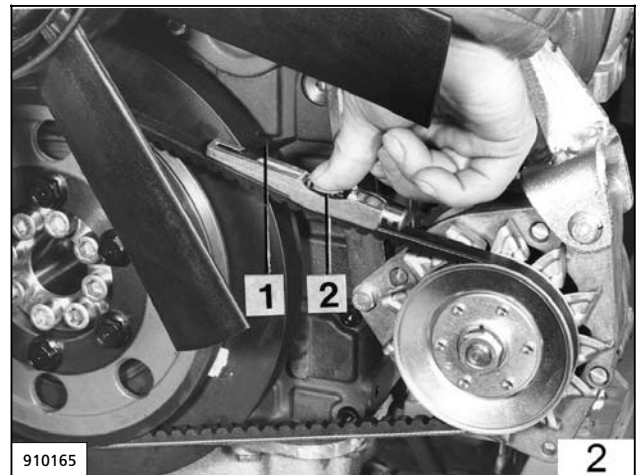
Alternator 28 Volt, 27 Ampere

The V-belt tension is correctly adjusted, when the v-belt can be deflected with the thumb by approximately 3/8 in. (10 mm) between the two pulleys)



Checking V-belt Tension with Tension Indicator: (for inst. the "KRIKIT" tool manufactured by GATES)

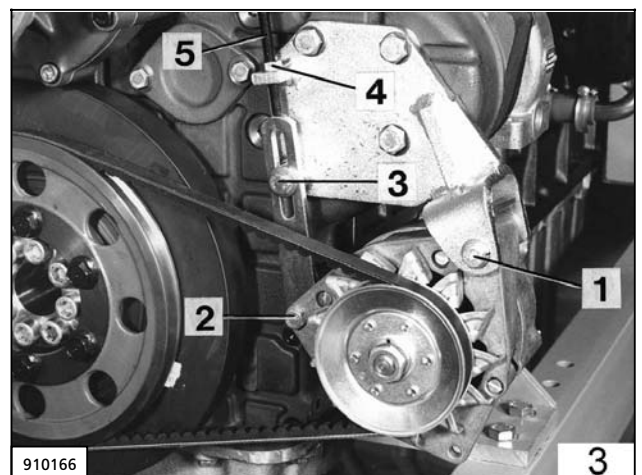
Push indicator lever Pos. 1 into tension indicator. Place indicator on v-belt in center between pulleys. The indicator guide must line-up with the v-belt. Place thumb on push-button Pos. 2 and push tension indicator slowly with increasing force against v-belt until the retaining spring releases the indicator lever. Cautiously remove tension indicator and read actual v-belt tension on "KG" scale on indicator lever. Compare reading with proper tension as indicated in table below.

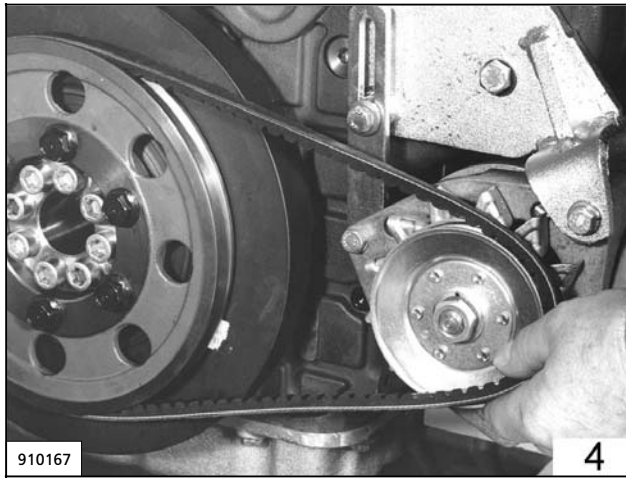


Belt size	New belt "KG" reading	Used belt "KG" reading
12,5 mm	40 - 45	30 - 40
1 inch	88 - 100 lb	66 - 88 lb

V-Belt Tension Adjustment:

Loosen bolts Pos. 1,2, 3 and lock nut Pos. 4. Readjust set screw Pos. 5 to required v-belt tension, tighten and torque lock nut and all bolts. Recheck v-belt tension.





V-Belt Replacement:

Loosen bolts Pos. 1, 2, 3 and lock nut Pos. 4 (see fig. 3). Back-up set screw Pos. 5 all the way. Position alternator as close as possible toward engine block and remove old v-belt. Install new v-belt, adjust v-belt tension as described before. Tighten and torque lock nut and all bolts. Recheck v-belt tension.

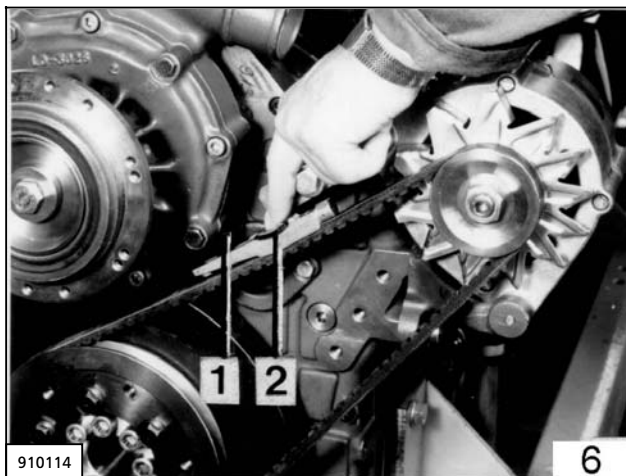


Alternator V-Belt: Checking for Tension, Adjustment and Replacement

Alternator 28 Volt, 55 Ampere

Checking by Hand:

The v-belt is correctly adjusted, when moderate thumb pressure halfway between the pulleys deflects the belt by about 10 mm (3/8 in.)



Checking with Gates "KRIKIT" Tension Gauge:

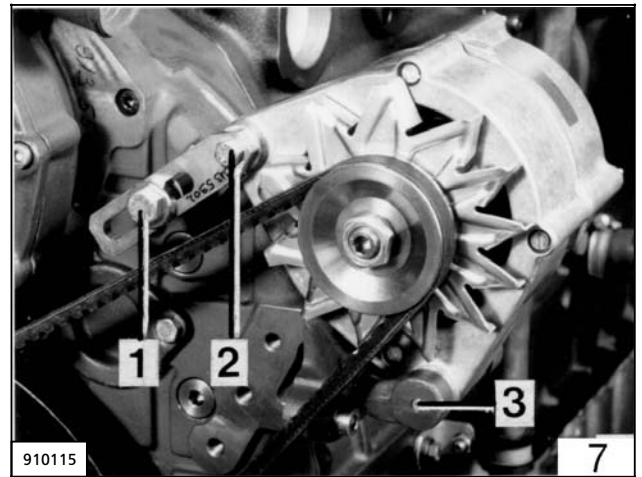
Push indicator lever 1 into gauge and place gauge on belt between pulleys. The guide must be flush with the v-belt side. Depress button 2 slowly against top surface of belt, until spring releases indicator. Carefully remove gauge and read belt tension at the intersection of the "KG" scale and the indicator. Compare with chart below:

Belt size	New belt "KG" reading	Used belt "KG" reading
12,5 mm	40 - 45	30 - 40
1 inch	88 - 100 lb	66 - 88 lb

V-Belt Adjustment:

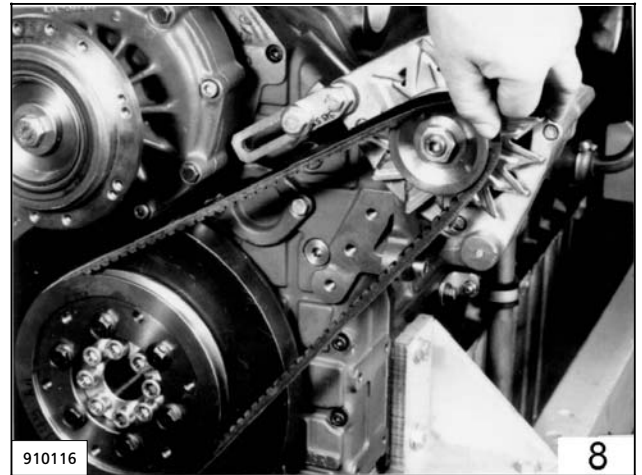
Loosen screws 1, 2 and 3. On screw 2, hold nut. With a pry bar, push alternator away from engine until proper v-belt tension has been reached. Retighten all screws.

Recheck tension of v-belt.



V-Belt Replacement:

Loosen screws 1, 2 and 3 (see fig. 7). On screw 2, hold nut. Push alternator against engine and remove v-belt. Install new belt, adjust tension and retighten all screw.

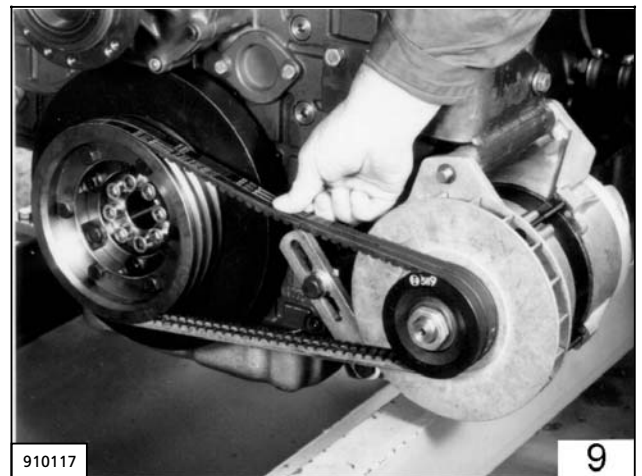


Alternator V-belt: Checking for Tension, Adjustment and Replacement; Lubricate Alternator

Alternator 28 Volt, 95 Ampere

Checking by Hand:

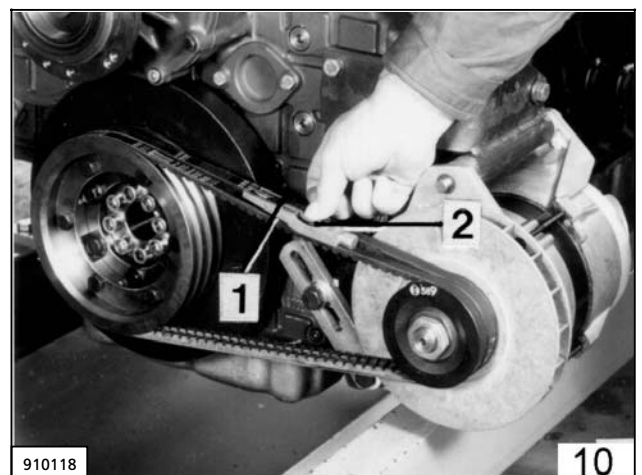
The v-belt is correctly adjusted when moderate thumb pressure halfway between the pulleys deflects the belt by about 10 mm (3/8 in.).

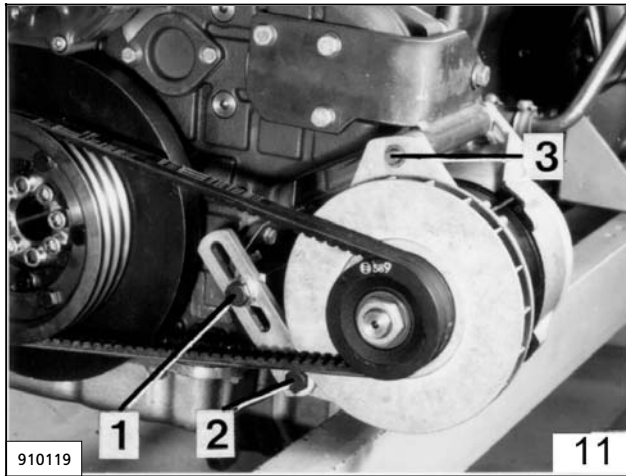


Checking with Gates "KRIKIT" Tension Gauge:

Push indicator lever 1 into gauge and place gauge on belt between pulleys. The guide must be flush with the v-belt side. Depress button 2 slowly against top surface of belt, until spring releases indicator. Carefully remove gauge and read belt tension at the intersection of the "KG" scale and the indicator. Compare with chart below:

Belt size	New belt "KG" reading	Used belt "KG" reading
12,5 mm	40 - 45	30 - 40
1 inch	88 - 100 lb	66 - 88 lb



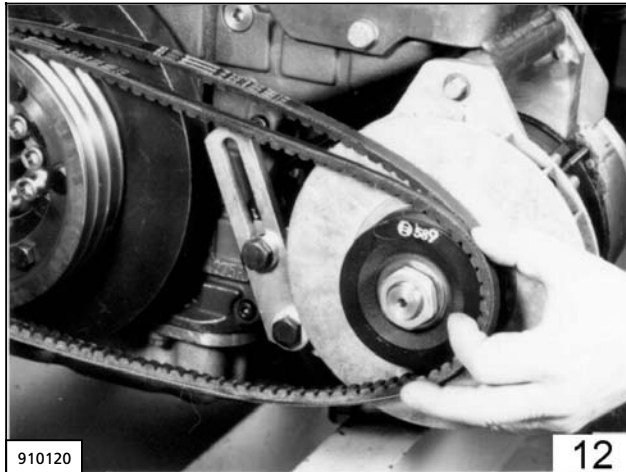


V-Belt Adjustment:

Loosen screws 1, 2 and 3. Push alternator away from engine until proper v-belt tension has been reached.

Retighten all screws.

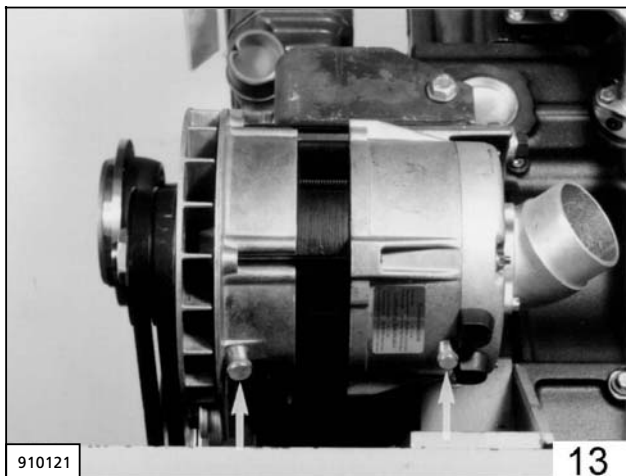
Recheck tension of v-belt.



V-Belt Replacement:

Loosen screws 1, 2 and 3 (see fig. 11).

Push alternator against engine and remove v-belt. Install new belt, adjust tension and retighten all screws.



Lubricate Alternator:

Note:

The alternator must be lubricated every 1.000 hours or once a year, whichever comes first. At the two lubrication points, fill the two grease cups with grease (BOSCH Ft v 34, etc.) and reinstall.

Check tension of V-belt for air conditioning compressor and alternator installation, adjust and replace.

Up to engine S/N 98 01 0814

Use special tool No. 9.1

Check V-belt tension by hand:

The V-belt tension is correct when the V-belt can be deflected by 13mm at the center between the pulleys of crankshaft and alternator or in the center between tension pulley 2 and air conditioner compressor pulley with a force of 120 N um .

Check the V-belt tension with the "Krikit 2" tension indicator unit:

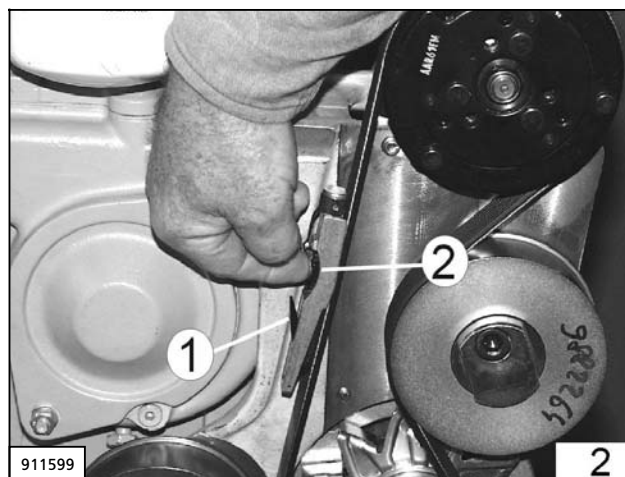
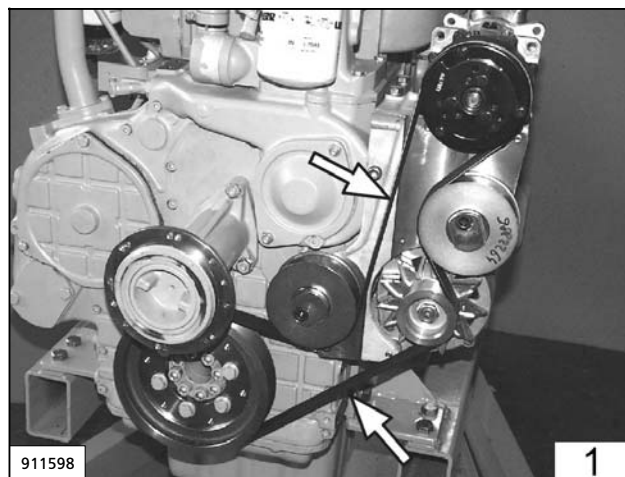
Use special tool No. 9.1

Push the indicator arm 1 into the tension indicator. Place the indicator on the V-belt in the center between the two pulleys of crankshaft and alternator, or in the center between tension pulley 2 and air conditioner compressor pulley .

Push the button 2 evenly at a right angle to the V-belt until the retaining spring disengages.

Carefully lift off the tension indicator and read the test value on the "KG" scale and the indicator arm.

Compare the test value with the chart.



V-belt size	New belt KG reading	Used belt KG reading
8 grooves approx. 28 mm wide	50	40 - 50

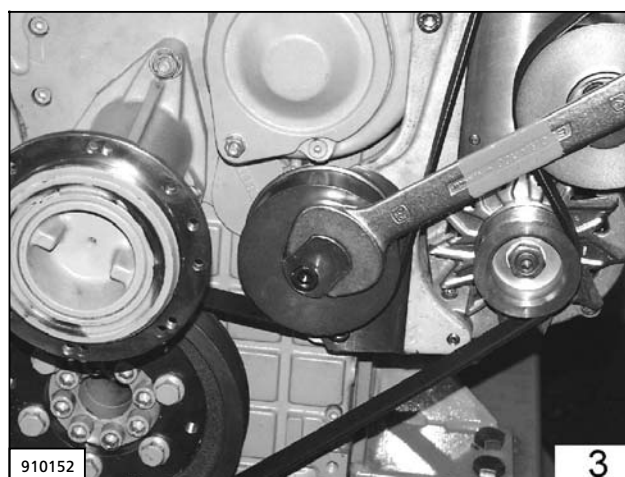
Adjust V-belt:

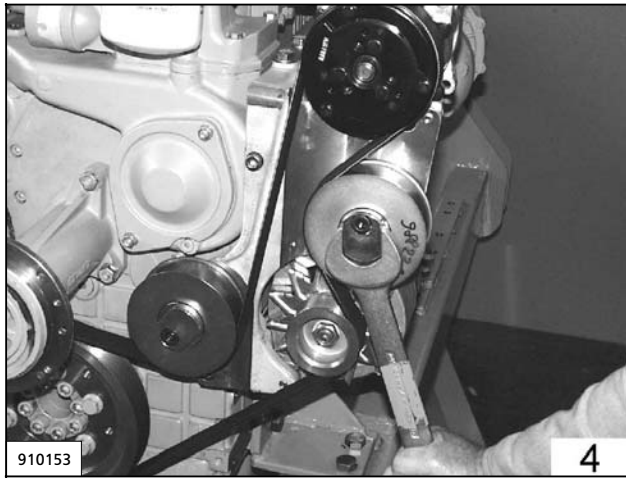
For positioning, refer to page 2.28.02.

Loosen screw 1 and turn the tension pulley 2 with (WS 36) wrench 45° in clockwise direction, tighten screw 1 .

Note:

Screws 1, 3 are socket head screws up to the above mentioned engine S/N.





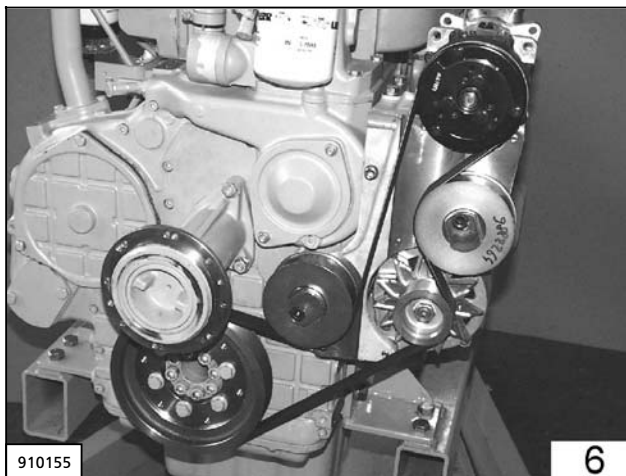
Loosen screw 3 and turn the tension pulley 4 with a (WS 36) wrench in clockwise direction until the correct V-belt tension is reached. Tighten screw 3.



Change V-belt:

Loosen screws 1, 3 and turn the tension pulleys 2, 4 with wrench (SW 36) in counterclockwise direction.

Remove V-belt.



Install and adjust new V-belt.

Retighten all parts.

Important:

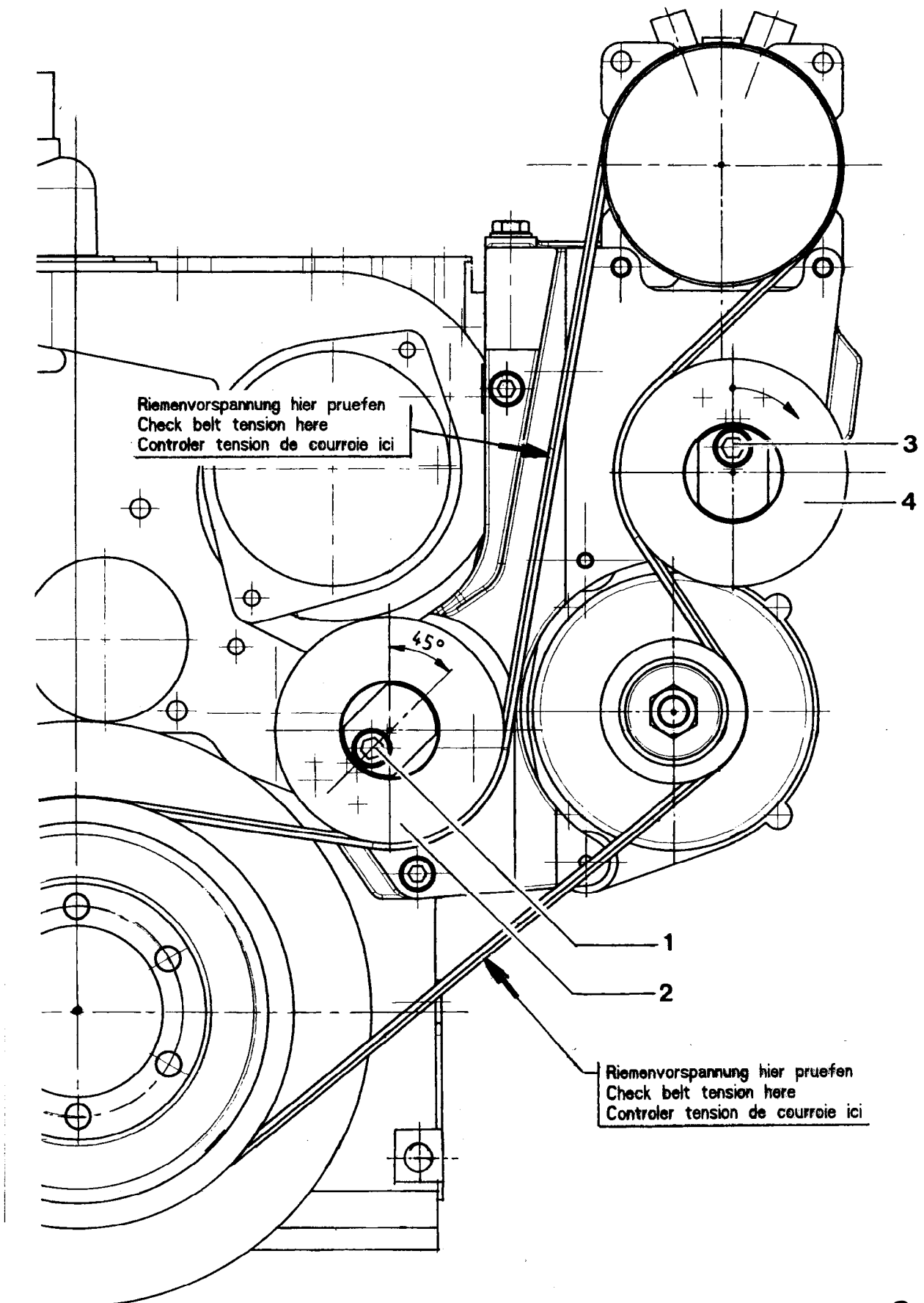
Let the new V-belt run about 15 - 20 minutes, recheck tension and readjust, if necessary.

Antrieb für Klima-Kompressor und Generator

Drive for Air-Compressor and Alternator

Commende pour compresseur climatiseur et generateur

ab Motor Nr. / up to Engine No. / jusqu'au du moteur n° 98 01 0814



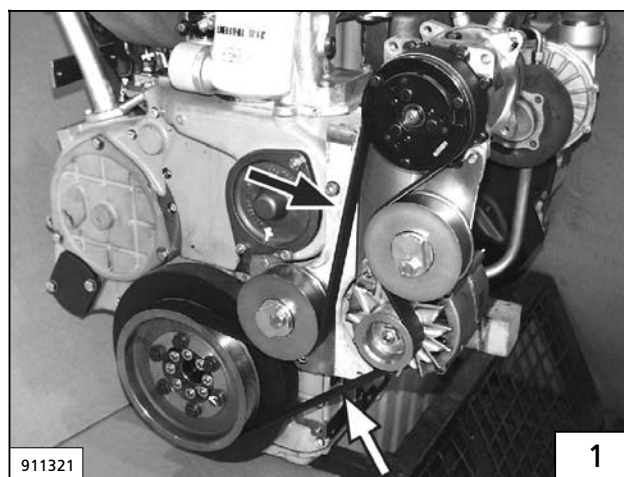
Check tension of V-belt for air conditioning compressor and alternator installation, adjust and replace.

From engine S/N 98 01 0815

Use special tool No. 9.1

Check V-belt tension by hand:

The V-belt tension is correct when the V-belt can be deflected by 13mm at the center between the pulleys of crankshaft and alternator or in the center between tension pulley 2 and air conditioner compressor pulley with a force of 120 N um .



Check the V-belt tension with the "Kriket 2" tension indicator unit:

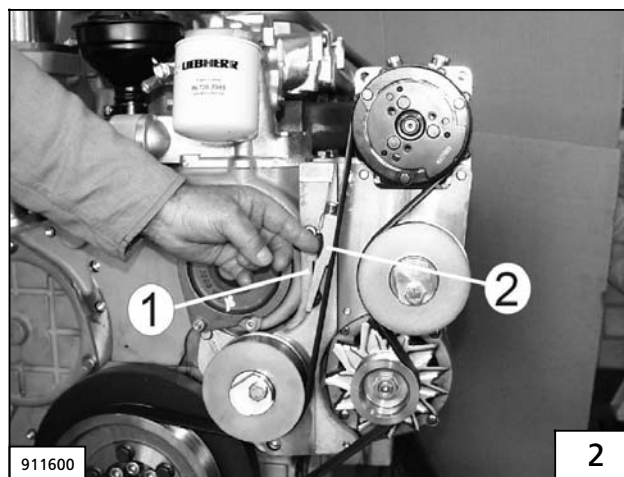
Use special tool No. 9.1

Push the indicator arm 1 into the tension indicator. Place the indicator on the V-belt in the center between the two pulleys of crankshaft and alternator, or in the center between tension pulley 2 and air conditioner compressor pulley .

Push the button 2 evenly at a right angle to the V-belt until the retaining spring disengages.

Carefully lift off the tension indicator and read the test value on the "KG" scale and the indicator arm.

Compare the test value with the chart.



V-belt size	New belt KG reading	Used belt KG reading
8 grooves approx. 28 mm wide	50	40 - 50

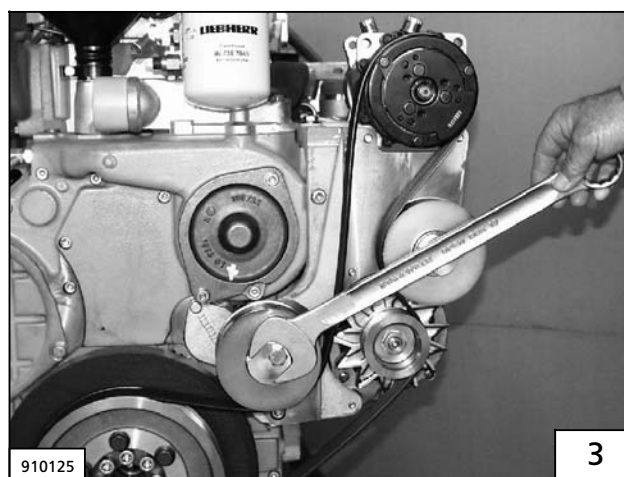
Adjust V-belt:

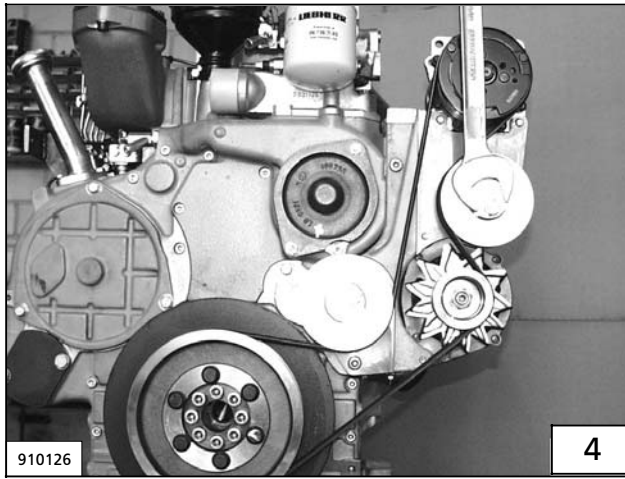
For positioning, refer to page 2.28.06.

Loosen screw 1 and turn the tension pulley 2 with a (WS36) wrench 45° in clockwise direction, tighten screw 1 .

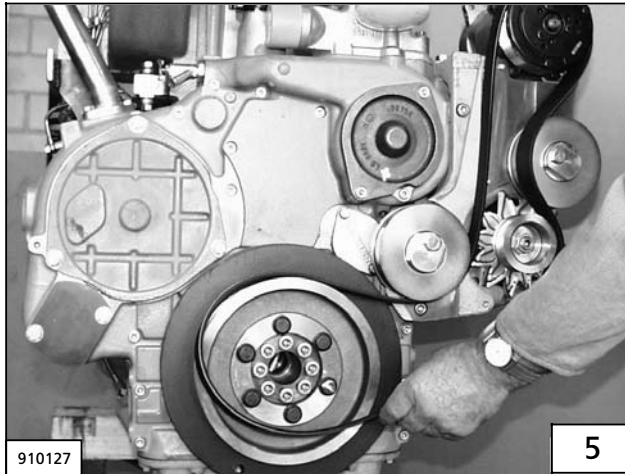
Note:

Screws 1 and 3 are hex head screws beginning with above mentioned engine S/N.





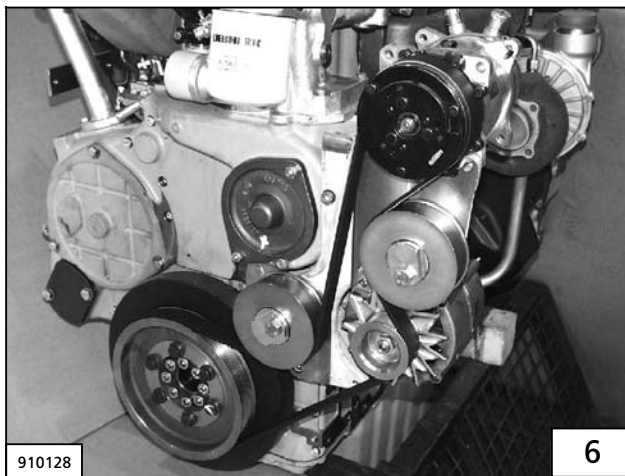
Loosen screw 3 and turn the tension pulley 4 with a (WS 36) wrench in clockwise direction until the correct V-belt tension is reached. Tighten screw 3.



Change V-belt:

Loosen screws 1, 3 and turn the tension pulleys 2, 4 with a (WS 36) wrench in counterclockwise direction.

Remove V-belt.



Install and adjust new V-belt.

Retighten all parts.

Important:

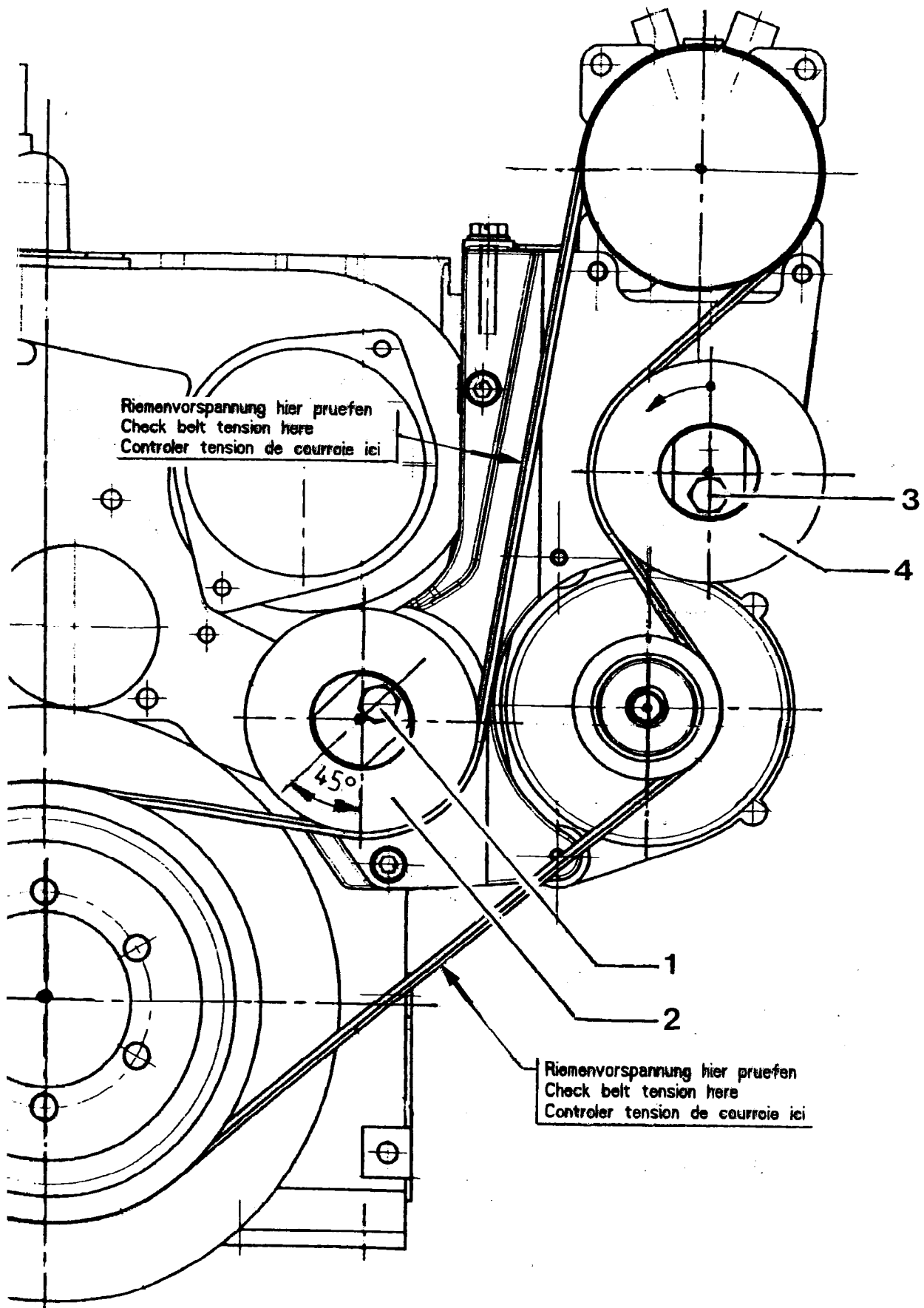
Let the new V-belt run about 15 - 20 minutes, recheck tension and readjust, if necessary.

Antrieb für Klima-Kompressor und Generator

Drive for Air-Compressor and Alternator

Commende pour compresseur climatiseur et generateur

ab Motor Nr. / from Engine No.. / à partir du moteur n° 98 01 0815



Check tension of V-belt for air conditioning compressor and alternator installation, adjust and replace.

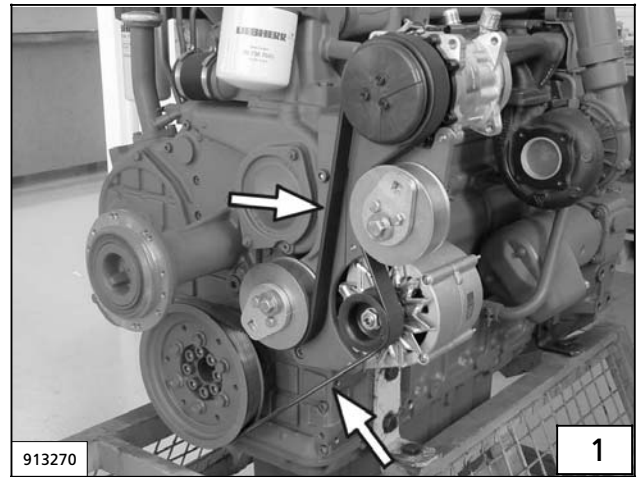
From engine S/N 2000 01 0070

Use special tool No. 9.1

For positioning, refer to page 2.28.11

Check V-belt tension by hand:

The V-belt tension is correct when the V-belt can be deflected by 13mm at the center between the pulleys of crankshaft and alternator or in the center between tension pulley 2 and air conditioner compressor pulley with a force of 120 N um .



Check the V-belt tension with the "Krikrit 2" tension indicator unit:

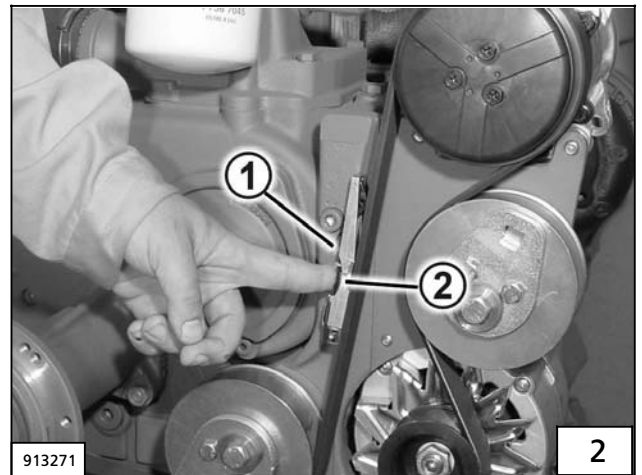
Use special tool No. 9.1

Push the indicator arm 1 into the tension indicator. Place the indicator on the V-belt in the center between the two pulleys of crankshaft and alternator, or in the center between tension pulley 2 and air conditioner compressor pulley .

Push the button 2 evenly at a right angle to the V-belt until the retaining spring disengages.

Carefully lift off the tension indicator and read the test value on the "KG" scale and the indicator arm.

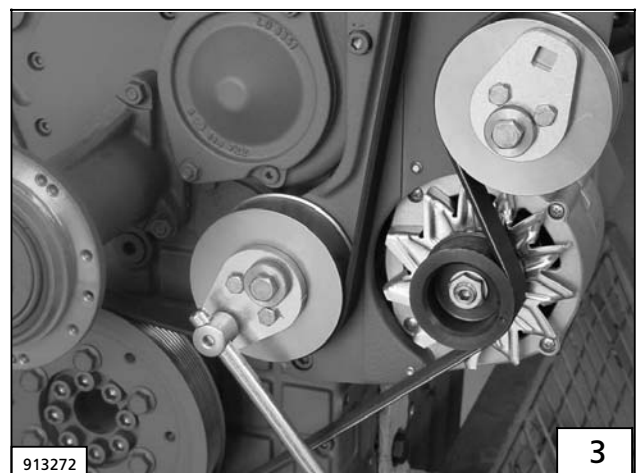
Compare the test value with the chart.

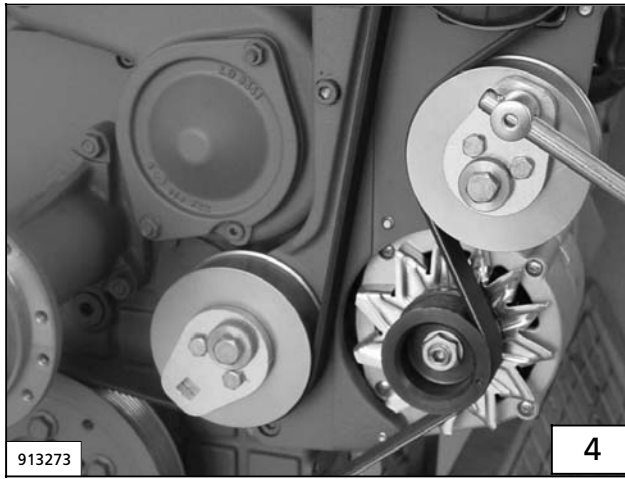


V-belt size	New belt KG reading	Used belt KG reading
8 grooves approx. 28 mm wide	50	40 - 50

Adjust V-belt:

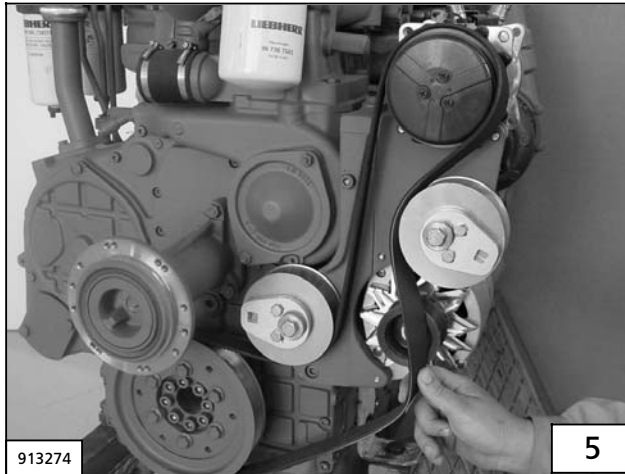
Loosen screw 1 and turn the tension pulley 2 with a ratchet according to DIN 3122, D12,5 ($\frac{1}{2}$ ") in clockwise direction, tighten screw 1





Loosen screw 3 and turn the tension pulley 4 with a ratched according to DIN 3122 D12,5 ($\frac{1}{2}$ ") in clockwise direction until the correct V-belt tension is reached.

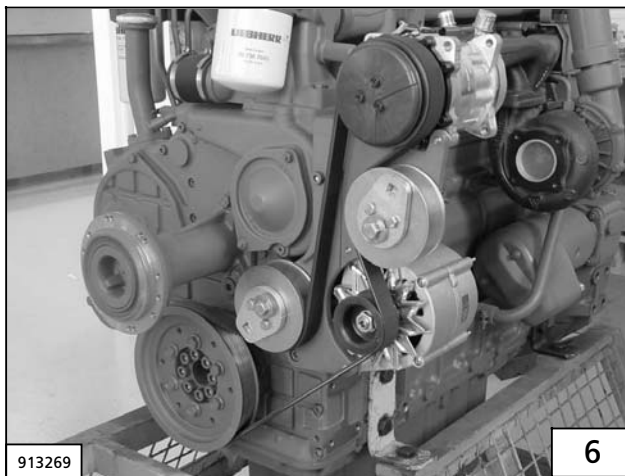
Tighten screw 3.



Change V-belt:

Loosen screws 1, 3 and turn the tension pulleys 2, 4 with a ratched according to DIN 3122 D12,5 ($\frac{1}{2}$ ") in counterclockwise direction.

Remove V-belt.



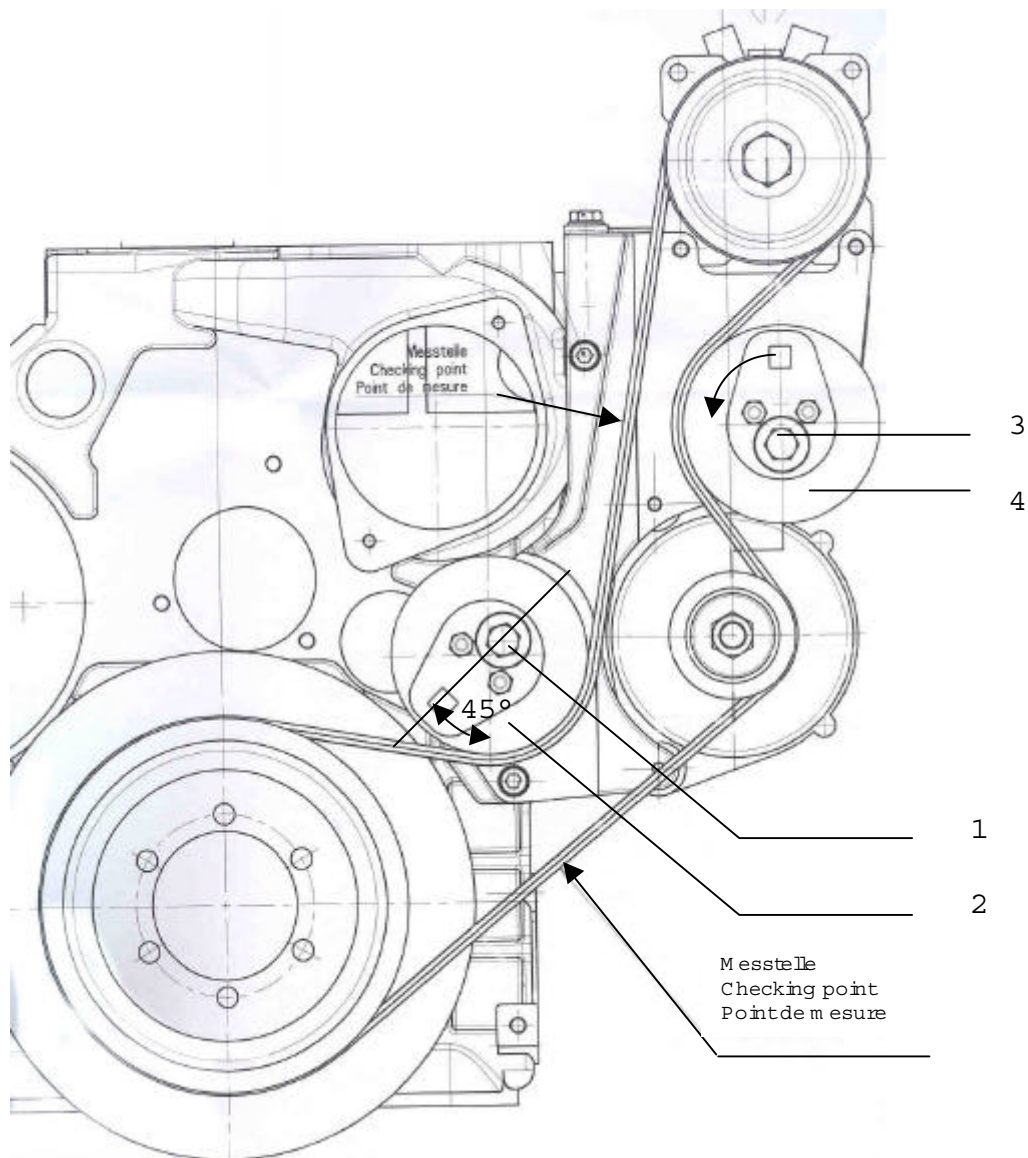
Install and adjust new V-belt.

Retighten all parts.

Important:

Let the new V-belt run about 15 - 20 minutes, recheck tension and readjust, if necessary.

Antrieb für Klima-Kompressor und Generator
Drive for Air-Compressor and Alternator
Commende pour compresseur climatiseur et generateur
ab Motor Nr. 2000 01 0070



Change the V-belt for the air-conditioner compressor and alternator installation (Dayco - tensioning device)

Note:

This installation is self-tensioning and therefore maintenance free. The V-belt only has to be checked for wear.

To change the V-belt:

Insert the ratched according to DIN 3122D 12,5 ($\frac{1}{2}$ "") into the square hole on the tensioning device.

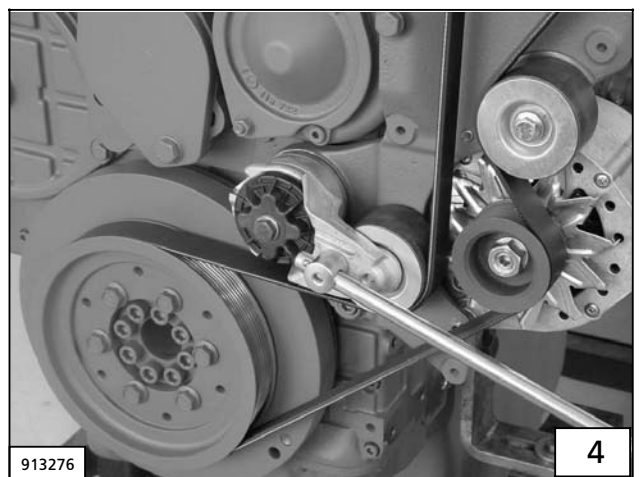
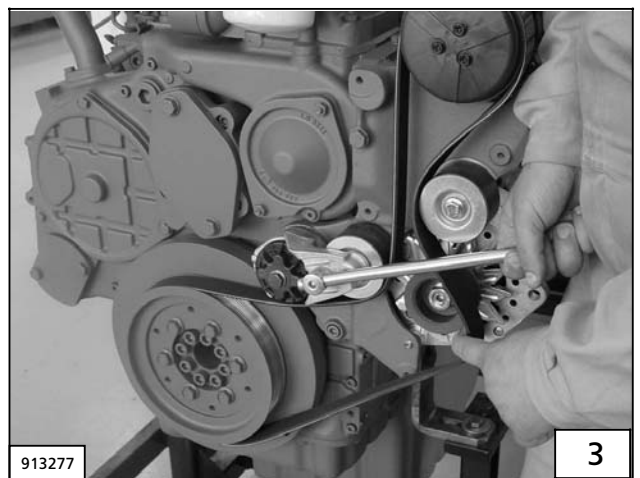
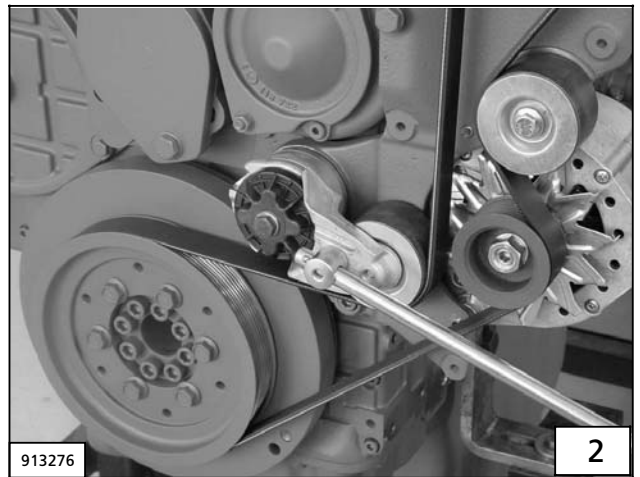
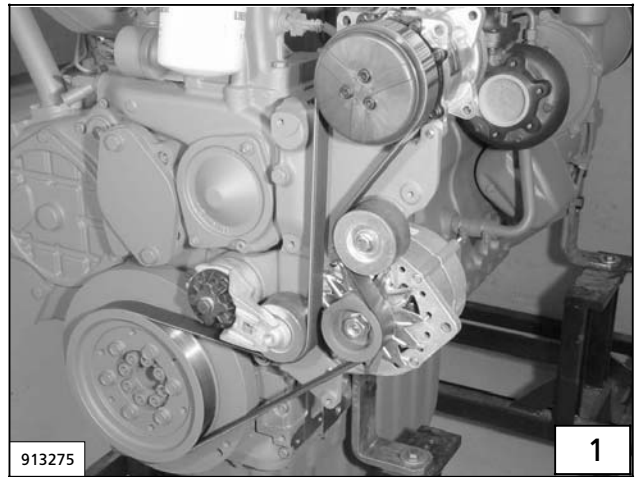
Move the tensioning device moved back against the spring force in counterclockwise direction to the stop and remove the V-belt.

With the tensioning device moved back, place a new V-belt onto the pulleys of crankshaft, air conditioner compressor, alternator and deflection pulley and return the tensioning device again to tensioned position.

Note:

When changing the V-belt, check the tension pulley and deflection pulley for easy movement and play.

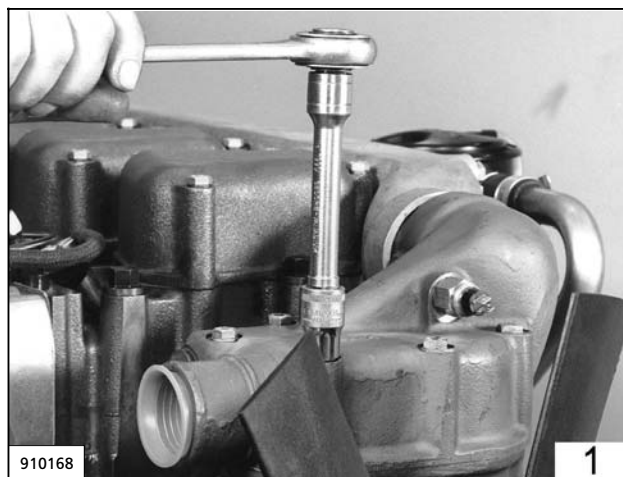
Replace defective tension pulley and deflection pulley.



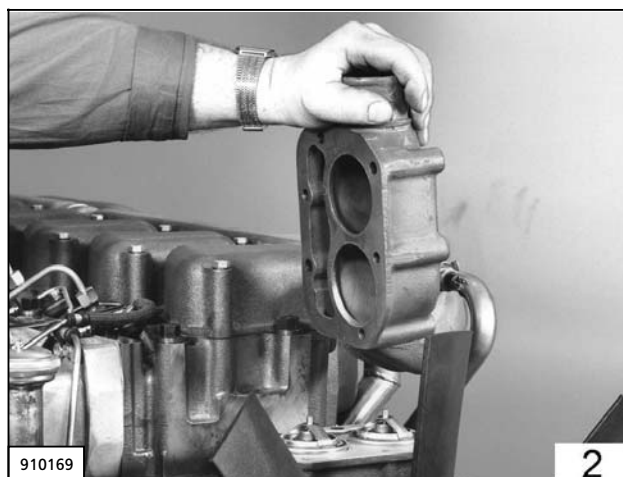
Thermostat Removal Installation and Testing

Thermostat Removal:

Drain coolant from cooling system (see page 2.01).
Remove coolant overflow hose from thermostat housing cover. Loosen and remove cover screws on thermostat housing.



Lift off the thermostat housing cover and remove from the coolant collection pipe.



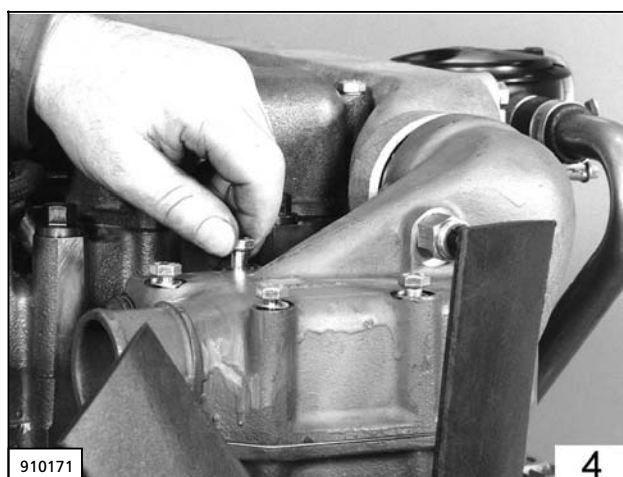
Remove thermostat

Clean sealing surface on the thermostat housing and thermostat housing cover.
Take out and clean the connecting pipe of the coolant collecting pipe, put on new O-rings and install.



Assembly:

Install thermostat and put on new gasket.
Put on thermostat housing cover and tighten, install coolant hose.
Add coolant, see sub group 2.01



Thermostat Testing:

Remove thermostat as described before.

For proper thermostat setting see Engine Specifications. Fasten thermostat assembly to piece of wire and place it into container filled with water. Heat water and monitor its increasing temperature. Note water temperature at which thermostat starts to open up. Compare this opening temperature with data in Engine Specifications.

Note:

The nominal opening temperature is indicated on all thermostat assemblies.

**Remove, install and test the thermostats
(coolant pump integrated in timing gear cover)**

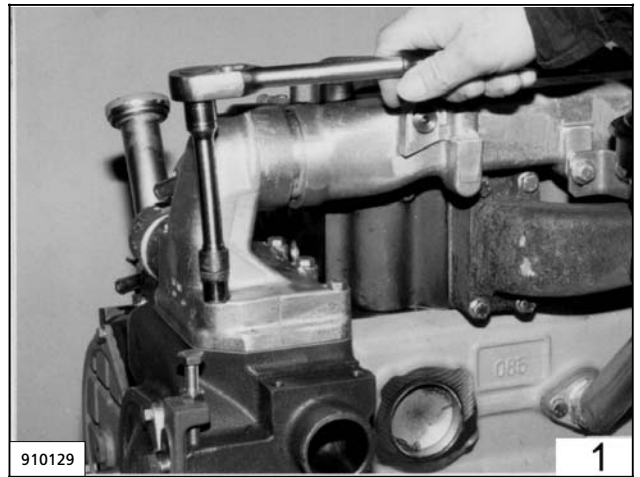
Removal:

Drain the coolant, see sub group 2.01.

Remove the coolant hoses on the thermostat housing cover.

Remove the wire from the coolant temperature sensor.

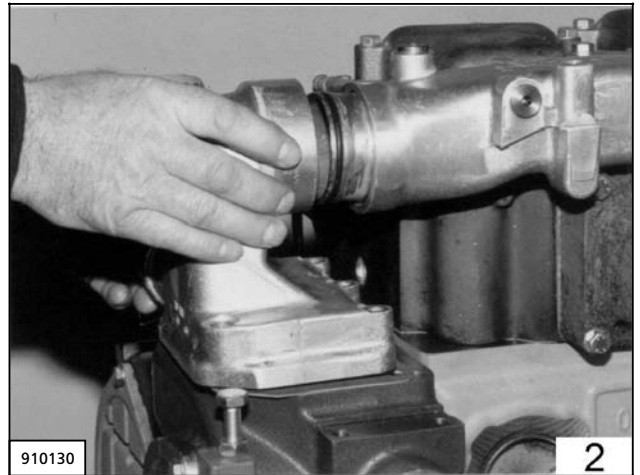
Loosen and remove the cover screws on the thermostat housing.



Remove the thermostat housing towards the fan side from the timing gear cover and the coolant manifold.

Note:

If the coolant filter is installed on the thermostat housing cover, remove the cover with the filter.



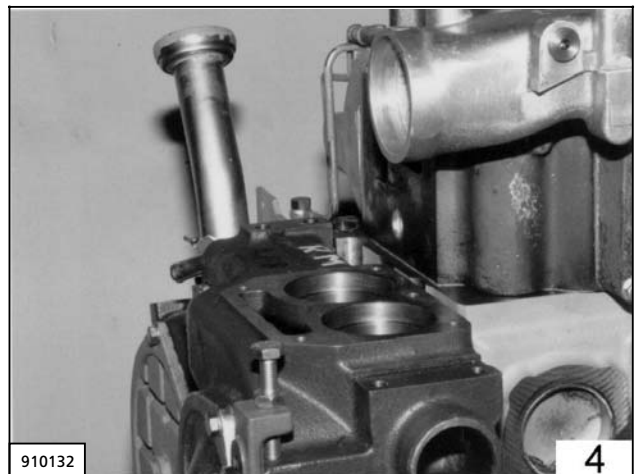
Remove the old seal and the thermostats with support rings from the timing gear cover.



Remove the connector sleeves from the coolant manifold.

Clean the sealing surfaces on the timing gear cover, thermostat housing cover and coolant manifold.

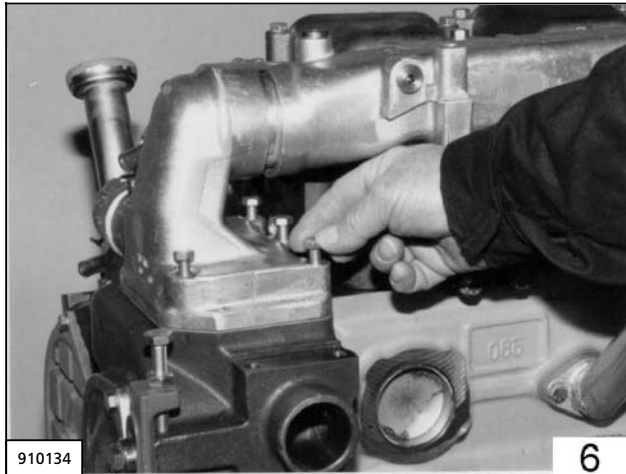
Clean or replace the connector sleeves, install new O-rings, lightly oiled, and insert the connector sleeves into the coolant manifold.





Installation:

Insert the thermostats and support rings, install a new gasket.



Push the thermostat housing cover from the fan side onto the connector sleeve. Install and tighten screws.

Install coolant hoses and wire for coolant temperature sensor.

Add coolant, see sub group 2.01.

Check thermostat:

Thermostat removed.

For test values, see Technical Data.

Attach thermostats to a wire and place in a container filled with water. Heat the water and check when the thermostat starts to open up. Measure the water temperature and compare test value with data on Technical Data page.

Note:

The nominal opening temperature is marked on all thermostats.

Oil Pressure Relief Valve Adjustment, Removal and Installation

Use special tool no. 78.

Note:

The oil pressure setting on this relief valve is factory adjusted and should be readjusted only if required. For oil pressure settings see Engine Specifications.



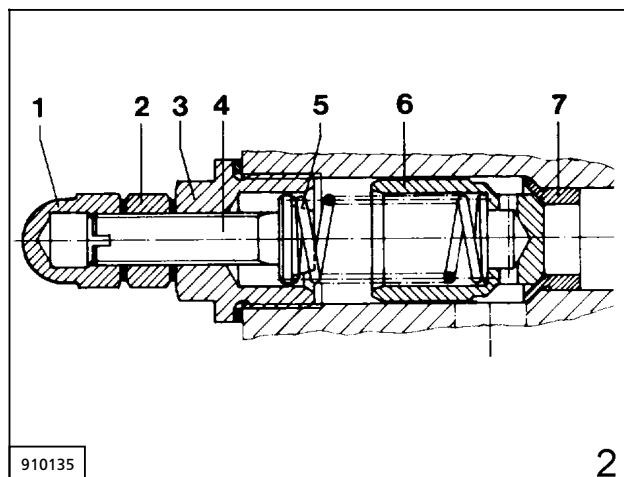
Oil Pressure Adjustment:

Hold lock nut Pos. 2 in place with wrench, open and remove cap screw Pos. 1. Hold relief valve cartridge Pos. 3 in place with wrench and loosen lock nut Pos. 2. Adjust set screw Pos. 4 to proper oil pressure setting.

Clockwise rotation will increase setting.

Counterclockwise rotation will decrease setting.

Torque locknut and install cap screw with new seal ring.



Relief Valve Removal:

Remove cartridge Pos. 3, tension spring Pos. 5 and plunger Pos. 6 from relief valve assembly.

Valve seat Pos. 7 can be removed with a custom made offset punch.

Relief Valve Installation:

If removed, insert valve seat with punch, special tool no. 78. Place plunger and tension spring into relief valve housing. Back-up set screw all the way and screw cartridge with new seal ring into relief valve housing. Adjust oil pressure setting with set screw as described before. Torque lock nut and install cap screw with new seal ring.

Test, remove and install oil separator

Note:

The oil separator may be installed on the exhaust side of the engine or on the timing gear cover, depending on the engine version. There are two different sizes of oil separators.

Test:

Pull the dipstick and connect 'slack tube manometer' to the engine dipstick tube. Start the engine and bring to maximum RPM. Read the crankcase vacuum pressure on the slack tube manometer and compare with test values.

Note:

For this test, the engine must be in horizontal position, at operating temperature and the oil level must be correct.

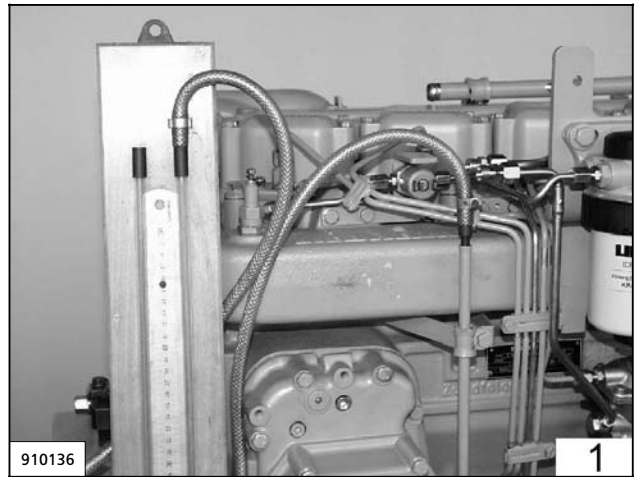
Testing procedure: (Oil separator "small" version)

Passing flow rate: 75 ± 10 l/min
Suction vacuum pressure: -250 ± 20 mm WS
Crankcase vacuum pressure: - 30 to - 80 mm WS

Testing procedure: (Oil separator "large" version)

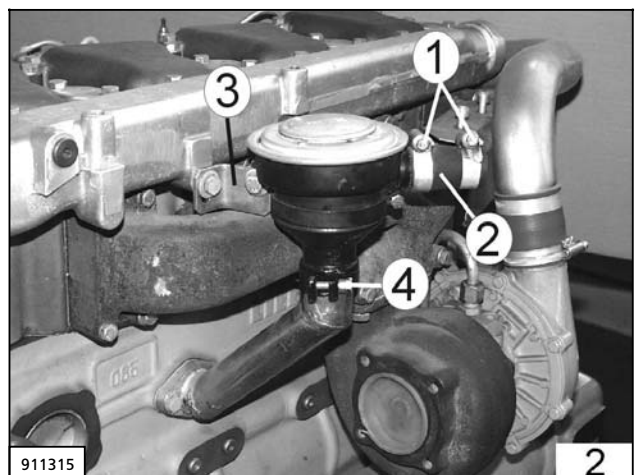
Passing flow rate: 100 ± 20 l/min
Suction vacuum pressure: -200 ± 20 mm WS
Crankcase vacuum pressure : - 10 to - 80 mm WS

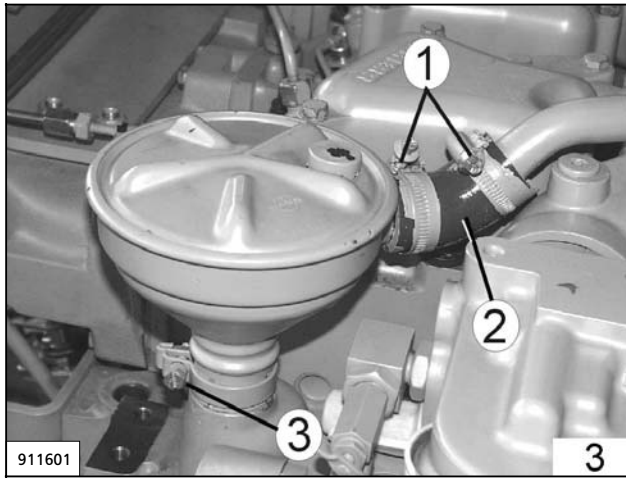
WS = Wassersaeule / water column



Removal: (Installation on exhaust side)

Loosen the hose clamps 1 and push the hose 2 from the oil separator. Remove the retaining bracket 3. Loosen the mounting clamp 4 and remove the oil separator.





Removal: (Installation on timing gear cover)

Loosen the hose clamps 1 and push the hose 2 from the oil separator. Loosen the mounting clamp 3 and remove the oil separator.



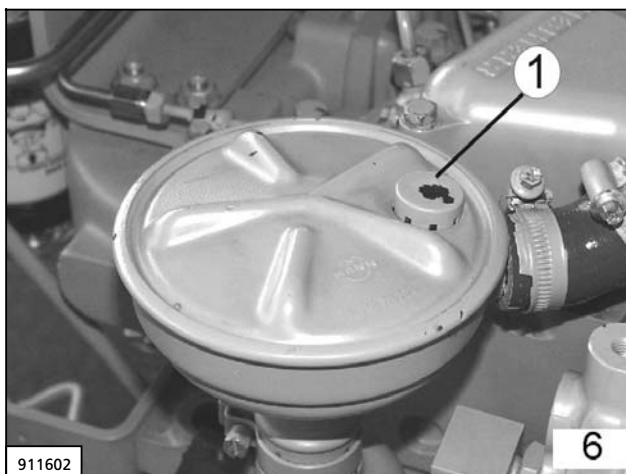
Installation:

Insert new O-ring into the oil separator. Push the oil separator onto the pipe or fitting on the timing gear cover and tighten the mounting clamps. Install retainers, push on hose and tighten hose clamps.



Note: (Oil separator "small version")

A damaged oil separator (for example if the cover is dented or oil fumes escape from the breather bores 1 on the membrane vent) is not functioning properly and must be replaced.



Note: (Oil separator "large version")

A damaged oil separator (for example if the cover is dented, oil fumes escape from the breather bores 1 on the membrane vent) is not functioning properly and must be replaced.

Important:

Replace the oil separator if the given crankcase vacuum pressure cannot be reached or every two years.

Troubleshooting

Problem	Cause	Remedy
1) Engine will not start	Fuel tank empty.	Add fuel and bleed the fuel system.
	Fuel precleaner stopped up.	Clean screen.
	Fuel filter stopped up, in winter due to paraffin deposits.	Clean fuel filter and bleed fuel system- Use fuel for cold season use.
	Fuel lines leak.	Check all fuel line connections for leaks and retighten fittings.
	Starter is defective.	Remove starter and have it checked in a service center. Have starter repaired if defective.
	Battery is dead.	Check battery, charge it, if necessary.
	Electrical connection to battery, starter or ignition are loose.	Check all electrical wires and tighten, if necessary.
	Glow Plug system is defective (at cold temperature).	Check solenoid valve and glow plug, replace if necessary.
2) Engine starts, but then cuts off again	Check all causes in paragraph 1, except electrical test and glow plug system.	See paragraph 1.
	Bleeder hole in fuel cap stopped up.	Clean fuel cap.
3) Engine runs irregularly, cuts off or does not reach full power	Check all causes in paragraph 1 and 2, except electrical test and glow plug system.	See paragraph 1 and 2.
	Fuel filter dirty.	Clean fuel filter.
	Exhaust cap for engine brake is closed or stuck.	Check position of cap.
	Overflow valve on injection pump will not hold pressure.	Check, replace, if necessary.
	Valve on fuel pump leaks.	Check fuel pump in service center, replace, if necessary.
	Compressor dirty.	Clean compressor.
	Charge pressure too low.	Check exhaust turbocharger.
	Begin of delivery of injection pump not correct.	Check begin of delivery, readjust if necessary.

Problem	Cause	Remedy
	Injector nozzles do not work properly.	Check nozzles, adjust or replace.
	Injection pump, flow quantity not adjusted properly, regulating rod does not move freely.	Check injection pump in service center
	Accelerator rod is not at full load stop.	Check rod and adjust, if necessary.
	Engine compression too low.	Check valves, piston and cylinder. Replace if necessary.
4) Exhaust is black.	Air filter is dirty.	Clean air filter.
	Leaks in the air intake system.	Check hoses or lines, replace if necessary.
	Exhaust cap for engine brake is closed or stuck.	Check position of cap.
	Injector nozzles are dirty or plugged.	Check nozzles, adjust or replace.
	Begin of delivery on injection pump is not adjusted properly.	Check begin of deliver, adjust, if necessary.
	Amount of fuel flowing from injection pump is too large.	Check injection pump in service center.
5) Exhaust is blue.	Lube oil level in engine is too high.	Correct oil level.
	Lube oil enters combustion chamber and burns. Play between valve shaft and valve guides is too large, piston rings are worn, broken or too tight. Wear on piston and cylinder bushings.	Repair or replace cylinder heads. Replace pistons and bushings.
	Seal on compressor side on turbocharger is defective.	Check turbo charger, replace if necessary.
6) Exhaust is white.	Cylinder head gasket is defective, allowing coolant into combustion chamber.	Replace cylinder head gasket.
	Cylinder head cracked or leaking.	Replace cylinder head.
7) Engine knocks rapidly.	Injector nozzles leak or do not properly spray fuel.	Check injector nozzles, adjust or replace.
	Injection pump begin of delivery misadjusted.	Check begin of delivery, readjust, if necessary.

Troubleshooting

Problem	Cause	Remedy
8) Engine knocks	Fuel injector nozzles damaged or dirty.	Check fuel injector nozzles, adjust or replace.
	Piston rings dirty or broken, piston worn.	Check piston or cylinder bushing and replace, if necessary.
	Main bearing or connecting rod bearing is defective.	Install new engine bearing or repair.
9) Coolant temperature too high	Not enough coolant in cooling system.	Add coolant.
	Air in cooling system.	Bleed cooling system.
	Cooler outside dirty.	Clean cooling circuit.
	Cooler inside dirty.	Clean radiator.
	Thermostat defective.	Check thermostats, replace if necessary.
	Coolant pump defective.	Check coolant pump, repair or replace.
	Fan defective.	Check fan, replace if necessary.
10) Lubrication oil pressure is too low	Oil level in oil pan is too low.	Add oil to proper mark.
	Lube oil is too thin.	Drain oil, add proper oil.
	Oil pressure gauge or transmitter is defective.	Check oil pressure and replace defective gauge or transmitter.
	Lube oil pressure pump is defective.	Replace lube oil pressure pump.
	Valve on lube oil pressure pump is stuck in open position.	Check valve on lube oil pressure pump and replace, if necessary.
	Bearing play is too large due to bearing damage.	Replace engine bearing or repair.
11) Lube oil in cooling system	Oil cooler or cooler plate leaks.	Remove, replace if leaks are found.
	Cylinder head gaskets leak.	Replace cylinder head gaskets.
12) Cooling water in lube oil	Cylinder head gaskets leak.	Replace cylinder head gaskets.
	O-rings on cylinder bushings leak.	Replace O-rings.

Sub Group Index

3.01	Cylinder head removal and installation
3.05	Cylinder head disassembly and assembly
3.08	Valves, valve seats, valve guides and valve springs inspection
3.12	Rocker arm support, rocker arm, push rods and valve tappet inspection
3.15	Rebuild cylinder head (valve seats, valve guides)
3.18	Piston removal, inspection and installation
3.22	Cylinder liner removal, inspection and installation
3.23	Repair procedure for insufficient cylinder liner protrusion - in relation to crankcase
3.25	Connecting rod inspection and bushing replacement

LIEBHERR	Benennung/Description/Dénomination Cylinder Assembly	Typ Model D 904 / 914 / 924 Type 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 3.00
Datum/Edition/Date 01.99		

Cylinder Head Removal and Installation

Use special tool no. 32

Cylinder Head Removal:

Drain cooling system. See sub group 2.01 for coolant draining procedures.

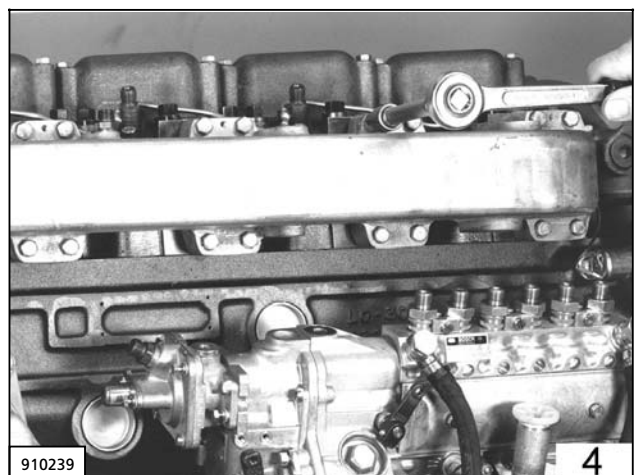
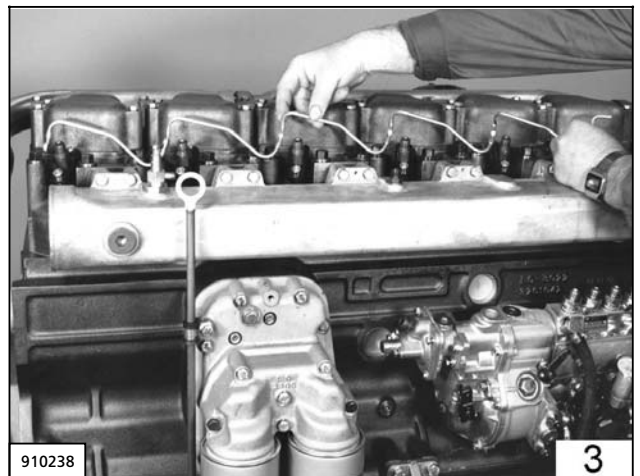
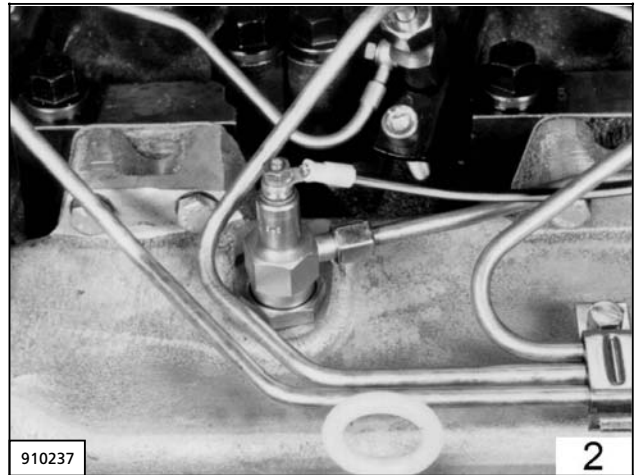
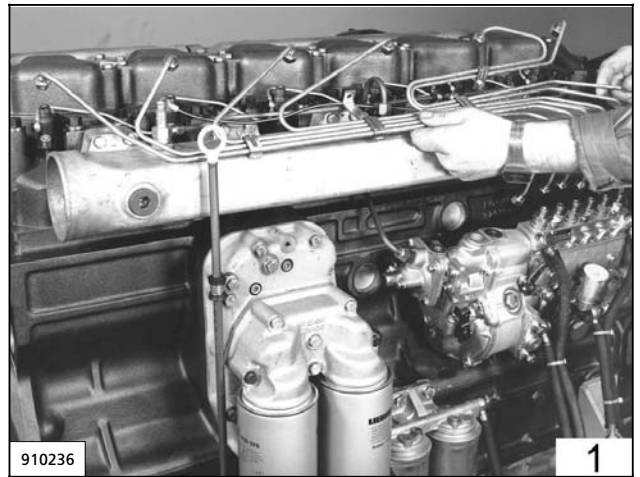
Loosen and remove fuel supply lines from injection pump and fuel injectors.

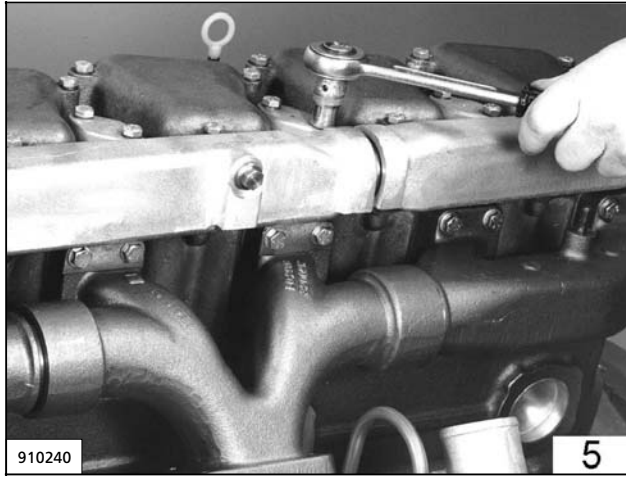
Remove electrical wire and fuel supply line from preheater glow plug.

Loosen and remove fuel overflow line from fuel injectors and disconnect from fuel return hose.

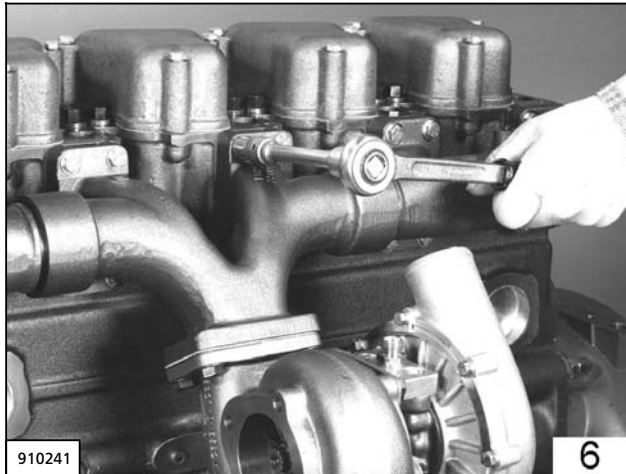
Remove air compressor intake line, crankcase breather line (natural aspirated engines) and pressure sensing line to aneroid (turbo charged engines - see sub-group 10.20) from the air intake manifold.

Remove air intake manifold from engine. For removal procedures see sub group 8.55.

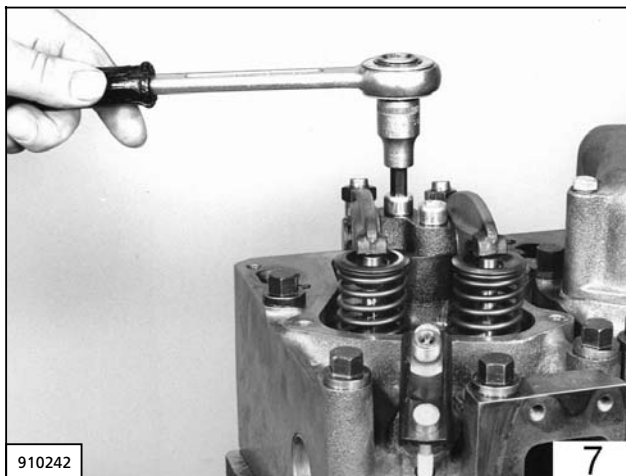




Unscrew coolant manifold and remove manifold from thermostat housing cover. For removal procedures see sub-group 8.58.



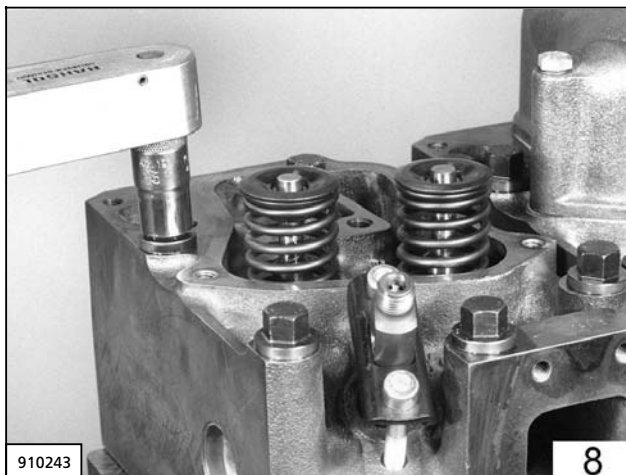
Unscrew and remove exhaust manifold from cylinder heads. For removal procedures see sub-group 8.52.



Unscrew and remove valve cover and rocker lever support and remove push rods.

Note:

If the additional engine brake system (ZBS) is installed, also remove the oil supply line from the cylinder heads.



Loosen and remove the cylinder head screws. Remove the cylinder head and the cylinder head gasket. Clean the threads in the crankcase, clean crankcase and cylinder head surface.

Note:

If the fuel injector remains installed, always place the cylinder head on its side. The injector nozzle protrudes on the bottom of the cylinder head.

Installation:

Place new cylinder head gasket over the line up sleeves on the crankcase.

IMPORTANT:

If the soft type cylinder head gasket was installed, reinstall a soft cylinder head gasket.

If the metal elastomer cylinder head gasket was installed, reinstall a metal gasket. This is necessary due to different cylinder liners . cylinder protrusion on the crankcase. The liners with metal gaskets also have a serrated gasket mounting surface.

Note:

When replacing pistons, connecting rods, crankshaft or crankcase, measure the piston clearance.

To check the piston clearance, refer to sub group 2.25



Cautiously place cylinder head on head gasket. Measure length of all cylinder head mounting bolts and replace the ones exceeding the maximum length listed in the Engine Specifications.

Note:

Cylinder head mounting bolts exceeding the maximum permissible length are stretched and must be replaced.



Lubricate the threads and the shoulder of the cylinder head mounting screws lightly with oil, install and torque screws.

Torque, using the angle method, tool No. 32.

For sequence, refer to fig. 12.

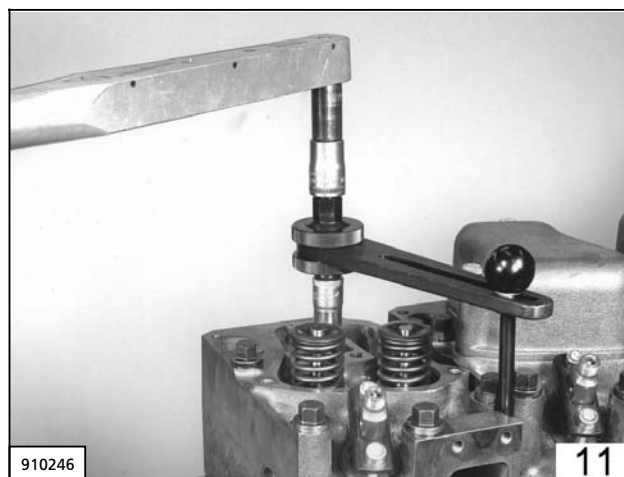
For tightening torques, see Technical Data.

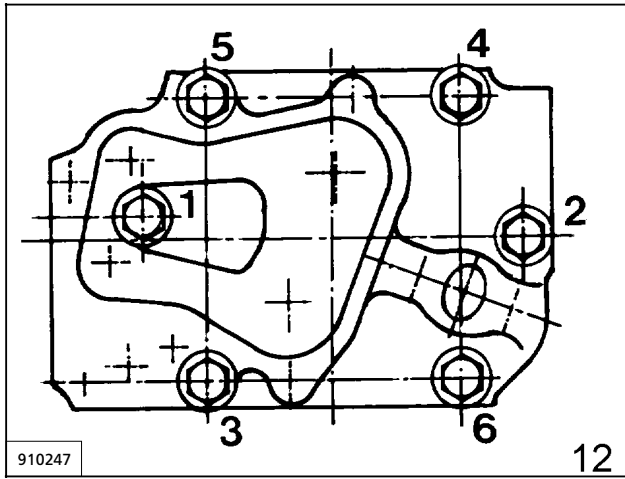
IMPORTANT: Instructions are only for soft type cylinder head gaskets.

After installation, bring the engine to operating temperature, turn the engine off and allow it to cool down. When cold (ambient temperature), retorque cylinder head mounting screws.

For retorque values, see Technical Data.

Check and adjust valve clearance after retorquing.





Insert push rods, install the rocker arm assembly and tighten the mounting screws.

Adjust valves, see sub group 2.15.

Install valve cover with new gasket. Install exhaust, coolant and air intake manifolds, using new gaskets. Install air compressor intake line, crankcase breather line and LDA (aneroid sensing) line on air intake manifold. Connect leak oil return line.

Connect fuel supply line and electrical wires to flame glow plug.

If auxiliary engine brake system (ZBS) is installed, install oil supply line.

Connect supply lines to fuel injectors.

For tightening torque, refer to Technical Data.

Add coolant, see sub group 2.01.

Bleed the fuel system, see sub group 7.22. /7.23.

Cylinder Head Disassembly and Assembly

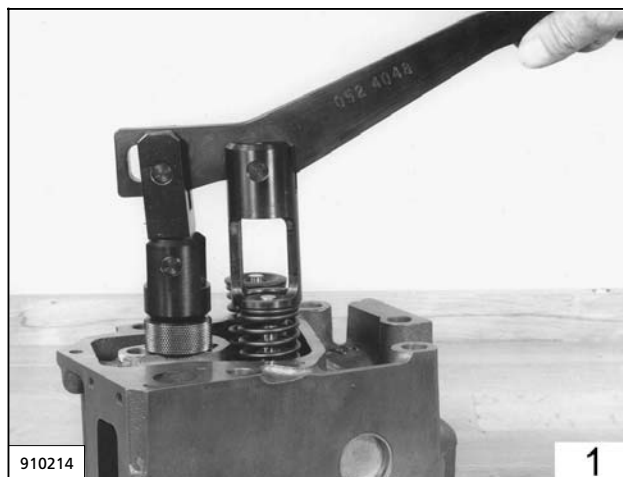
Use special tools no. 40, no. 65, no. 72 and no. 74

Cylinder Head Disassembly:

To remove cylinder head see sub group 3.01.

To remove fuel injector see sub group 7.18.

Place cylinder head on flat surface. Bolt valve spring compressor, special tool no. 40, to rocker lever support mount. Place compression tool on valve spring retainer, push hand lever down to compress valve spring and remove both half collets.



Release pressure and remove top spring retainer, valve spring and bottom spring retainer.

Note:

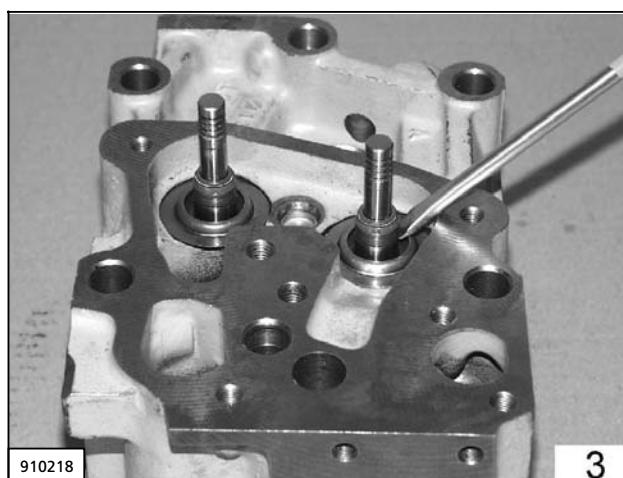
Depending on the version, one or two valve springs are installed on the exhaust valve.



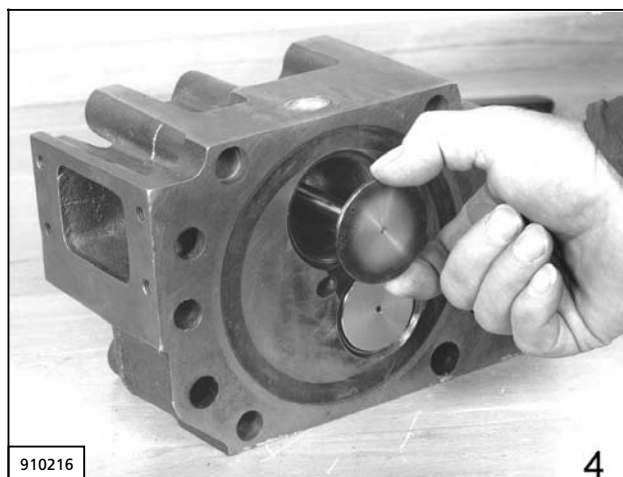
If installed, remove the valve stem seals from the valve guides.

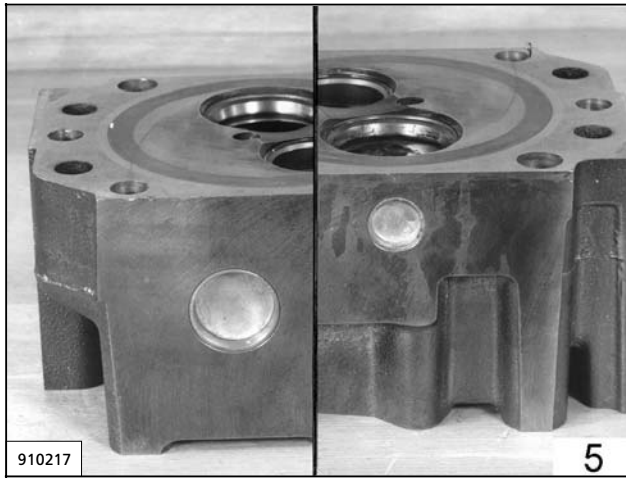
Note:

Depending on the cylinder head version, valve stem seals may be installed on the intake and exhaust valves.



Place the cylinder head on its side and remove the valves from the valve guides.

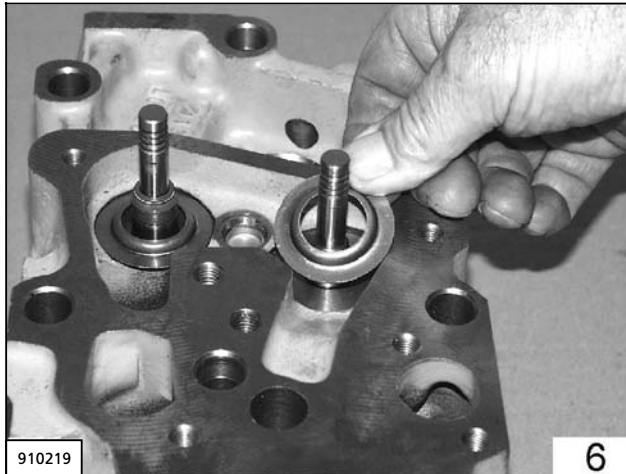




Replace the freeze plugs only in case of leakage or severe rust!

Knock out the old freeze plugs, insert new plugs with sealing compound, such as Loctite 648 or Omnifit 230 M .

Use punch, special tool No. 72, 74.



Assembly:

Lubricate valve stems with engine oil and insert into the valve guides. Position cylinder head on the sealing surface. Place the bottom spring retainers over the valve guides.



Install valve stem seal rings:

Slide the special mounting tool No. 65 on the valve stem.

Push valve stem seal over the mounting tool onto the valve guides.

Remove the special tool.

Note:

If valve stem seals are replaced with the cylinder heads installed, then the corresponding piston must be set to OT (OT= top dead center) before installation.

Install valve springs and upper spring retainer. Compress valve springs with special tool and insert keepers on the valve. Release valve spring and remove special tool.

Important:

Be certain that the keepers are properly seated!

Valve, Valve Seat, Valve Guide and Valve Spring Inspection

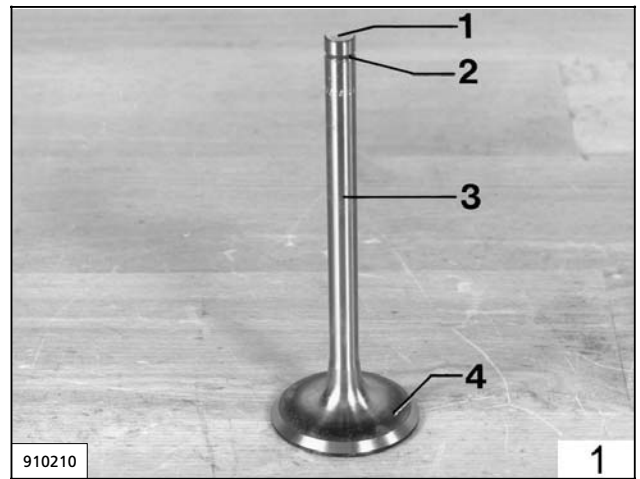
Valve and Valve Seat Inspection:

To remove valves see sub group 3.05.

Clean valves and remove any carbon deposit.

Inspect valve stem contact surface Pos. 1, retainer lock groove Pos. 2 and valve stem surface Pos. 3 for any damage or wear.

Check valve head Pos. 4 for burns or impact marks.
Replace valve if it shows any damage or excessive wear.

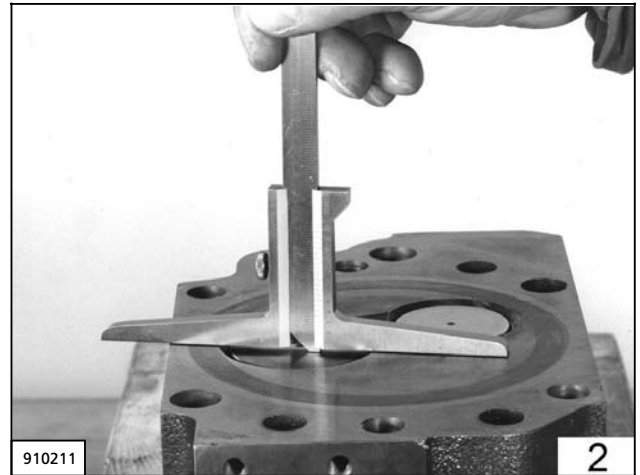


Place both valves into valve guides on cylinder head and measure distance from cylinder head mounting surface to valve head surface.

For proper dimensions see Engine Specifications.

Note:

If the measured distance is not within the specified tolerance, the valve or the valve seat in the cylinder head must be replaced.



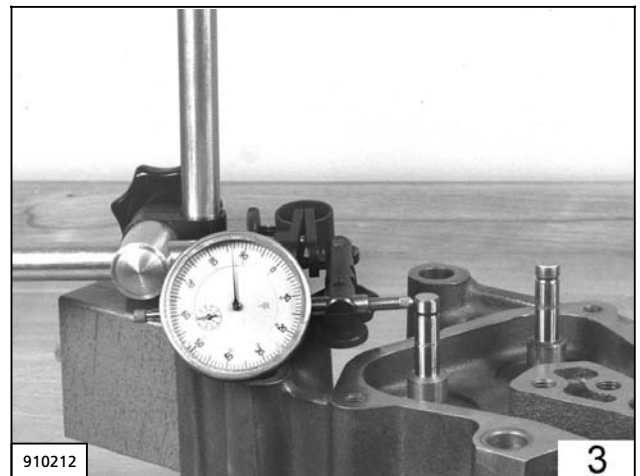
Valve and Valve Guide Inspection:

Place both valve stems into valve guides on cylinder and measure play between stem and guide.

For proper dimensions see Engine Specifications.

Note:

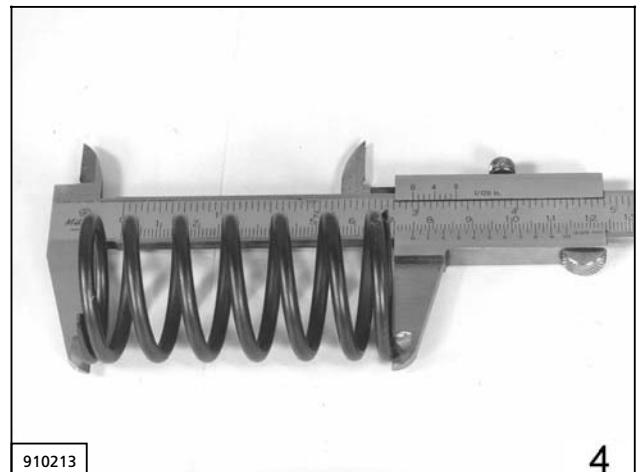
If the measured play is not within specifications, or the valve stem shows excessive wear, the valve and valve guide must be replaced.



Valve Spring Inspection:

Measure the length of the valve spring removed.

For proper dimensions see Engine Specifications.



Rocker Lever Support, Rocker Lever, Push Rod and Tappet Inspection

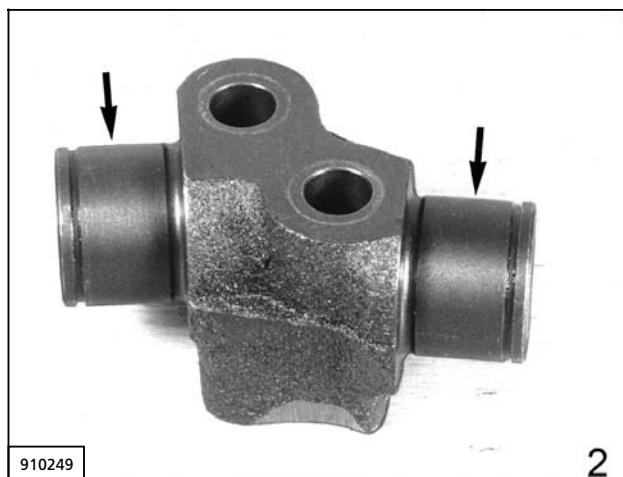
Rocker Lever Support and Rocker Lever Inspection:

To remove rocker lever support see sub group 3.01.

Place rocker lever support in vise. Use protective jaw covers to avoid damage. Remove both retaining rings and remove rocker levers.



Inspect rocker lever support and check for wear.

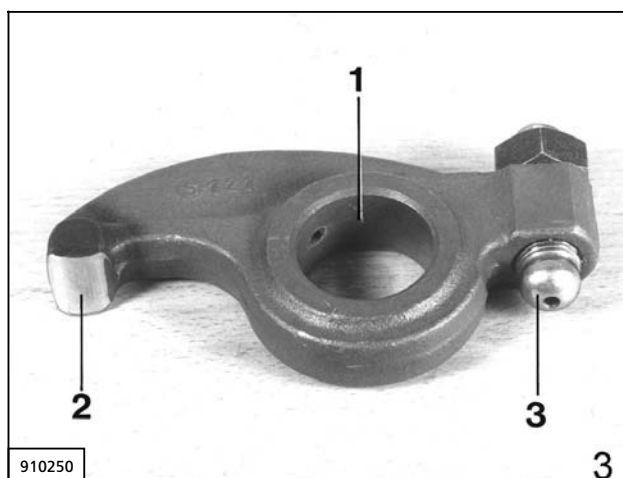


Check rocker lever bore Pos. 1, rocker lever contact surface Pos. 2 and valve clearance set-screw Pos. 3 for wear.

Check rocker lever and set-screw lubrication bores for restrictive deposits to be removed.

Replace any defective component.

Lubricate rocker lever support pins with engine oil. Place both rocker levers on support pins and secure levers with retaining rings.



Push Rod Inspection:

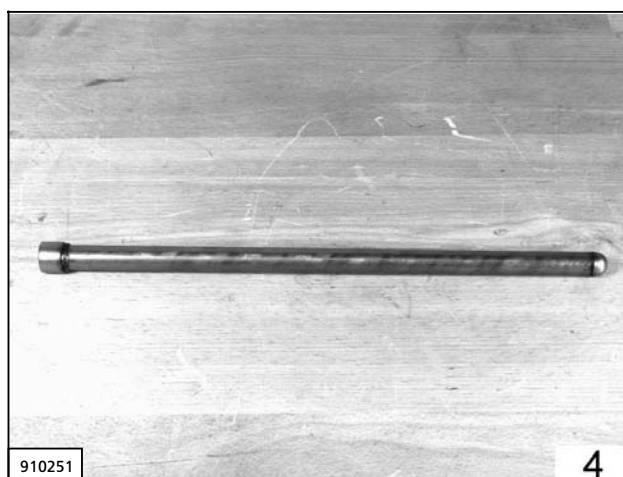
To remove push rods see-sub group 3.01.

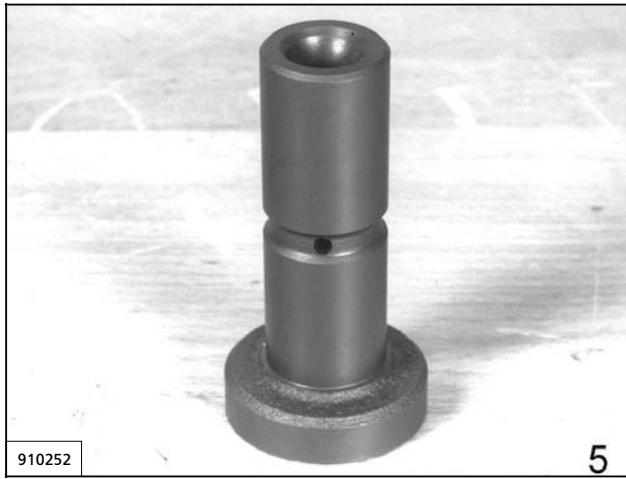
Check push rods for bending or deformation.

Check push rod contact surface for wear.

Check push rod lubrication bores for restrictive deposits to be removed.

Replace damaged push rods.





Tappet Inspection:

To remove tappets see main group 9.00.

Check tappets for any wear and lubrication bores in tappets for restrictive deposits to be removed.

Replace worn or damaged tappets.

Cylinder Head Rebuilding

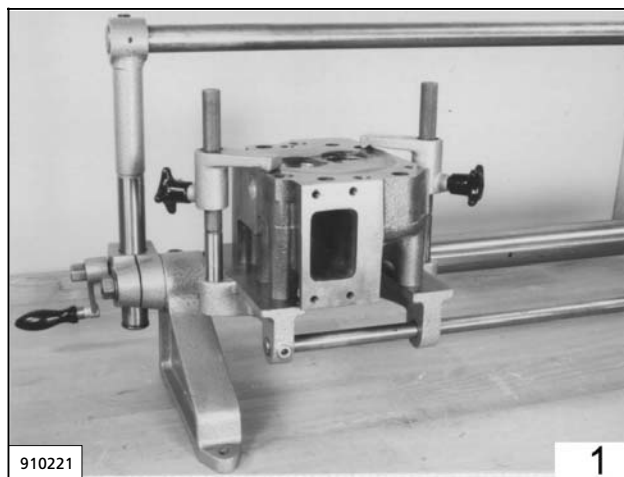
Valve Seat Machining:

Use special tool no. 41, 42, 43, 44, 45, 46 and no. 52.

To disassembly cylinder head see sub group 3.05.

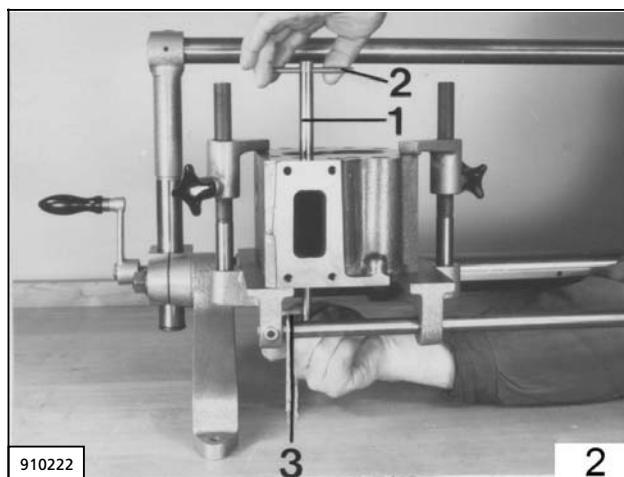
The valve guides must remain installed.

Mount cylinder head to cylinder head fixture, special tool no. 41.



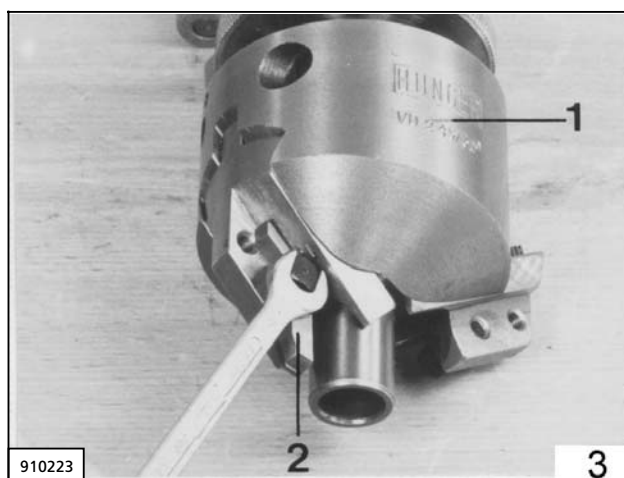
Clean valve guide and insert pilot shaft Pos. 1, special tool no. 44. Insert rods Pos. 2 and Pos. 3, special tools no. 45 and no. 46, into pilot shaft bores.

Hold lower rod in position and secure pilot shaft in valve guide by turning upper rod. Place pilot shaft and cylinder head in vertical position.

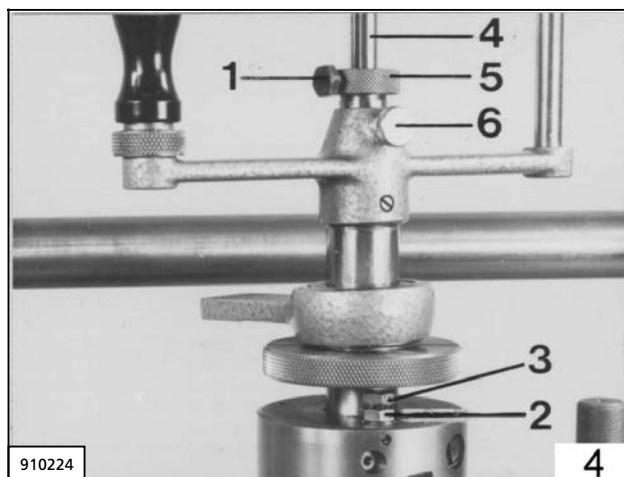


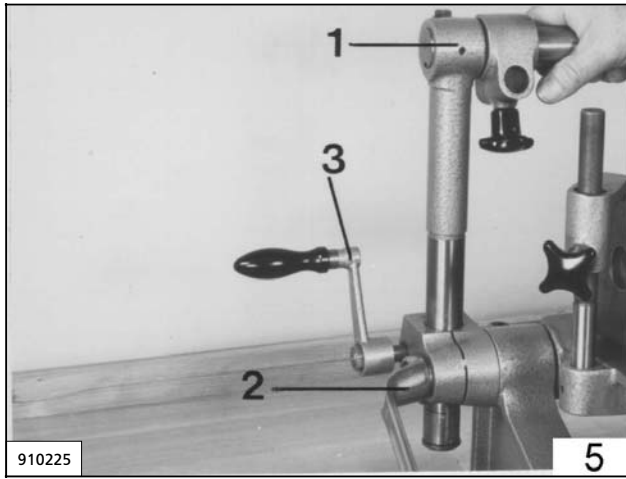
Correctly position and insert multiple edge cutting tool Pos. 2, special tool no. 43, 52 into valve seat cutting head Pos. 1, special tool no. 42.

For proper valve seat angle see Engine Specifications.

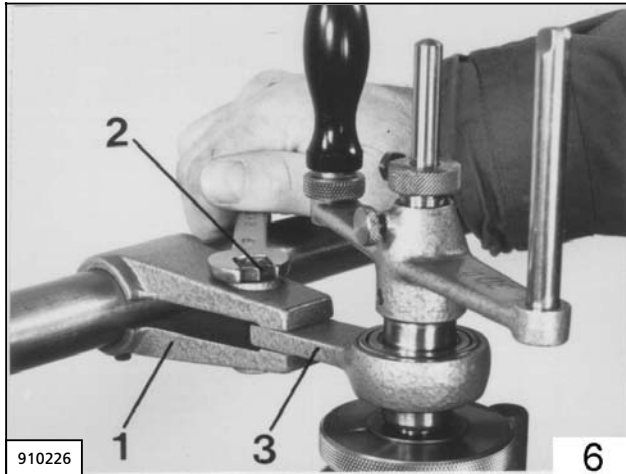


Loosen set-screw Pos. 1 and locknut Pos. 2. Cautiously slide valve seat cutting head over pilot shaft. Position multiple edge cutting tool to center of valve seat contact surface with quick adjustment screw Pos. 3. Push pilot support Pos. 4 lightly against pilot and tighten set-screw Pos. 1. Turn knurled adjustment screw Pos. 5 down and tighten set-screw Pos. 6.



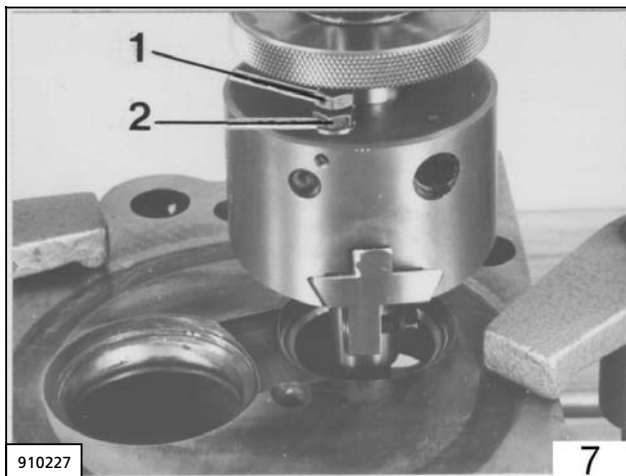


Install steady rest bar Pos. 1 with loose steady rest mount Pos. 2 and adjust steady rest bar to correct height with hand-crank Pos. 3.



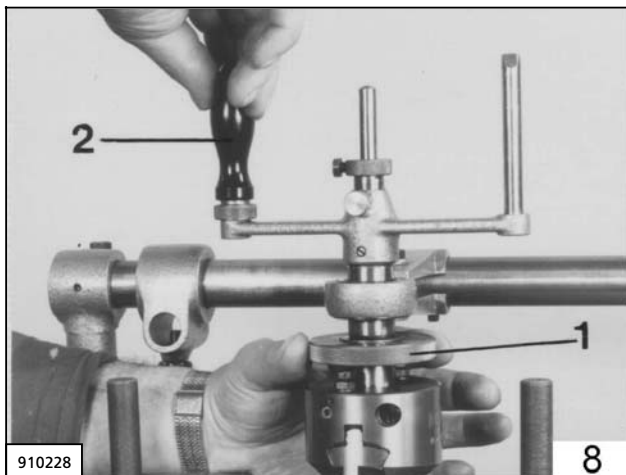
With mounting bolt Pos. 2 loose, position steady rest mounting clamp Pos. 1 to correct location. Insert swivel guide Pos. 3 halfway and tighten mounting clamp bolt.

The valve seat cutting head should rotate as easily after the steady rest installation as it did before without steady rest. In case the cutting head does not rotate freely, the steady rest installation procedure must be repeated.



Position multiple cutting edge tool beside and to the inside of the valve seat surface with quick adjustment screw Pos. 1. Tighten locknut Pos. 2.

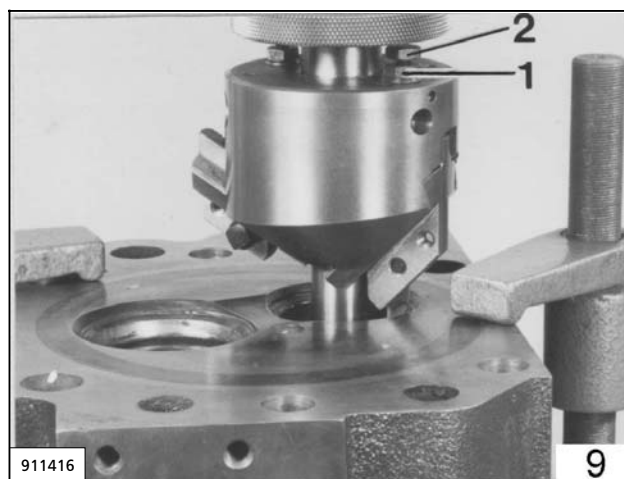
Do not advance cutting tool at this time.



Hold cutting tool advance Pos. 1 in position and turn hand-crank Pos. 2 until cutting tool reaches the outside valve seat edge.

In most cases, the first cuts indicate an irregular cutting pattern.

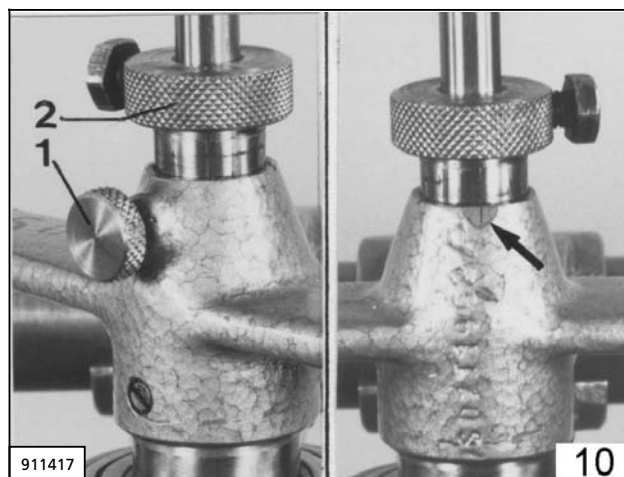
Loosen locknut Pos. 1 and position multiple cutting edge tool beside the inner valve seat edge with quick adjustment screw Pos. 2. Tighten locknut.



Loosen set-screw Pos. 1 and turn down knurled adjustment screw Pos. 2 as required. To turn knurled adjustment screw by one mark will advance cutting tool by 0.004 inch (0.1 mm).

Note.

Never advance tool more than one mark at once.
Tighten set-screw.



Hold cutting tool advance in position and turn handcrank until cutting tool moves across valve seat to outside valve seat edge.

Advance cutting tool by one marker and repeat cutting procedure until a clean cut valve seat surface is present. Repeat last cutting procedure without advancing cutting tool.

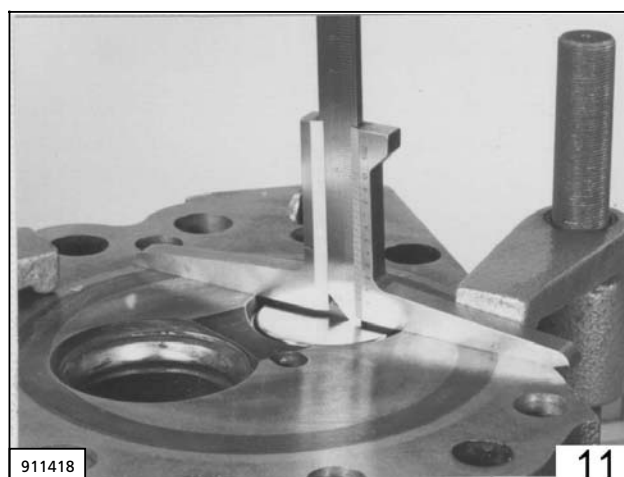
Remove valve seat cutting head and pilot shaft from cylinder head.

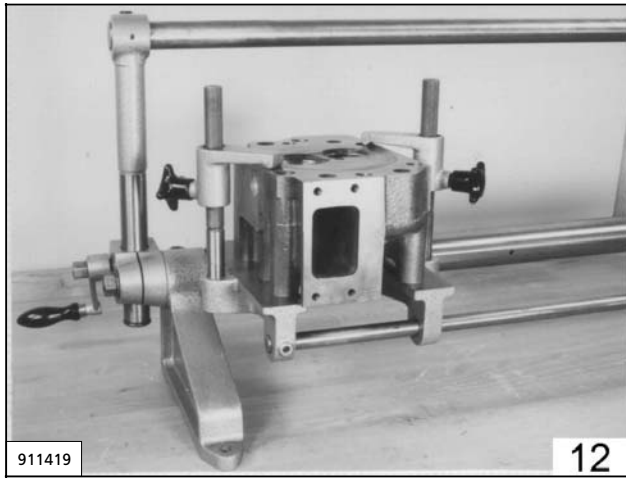
Insert valves into valve guides and measure distance from valve head surface to cylinder head mounting surface.

See Engine Specifications for proper dimensions.

Note:

If the measured distance is not within the specified tolerance, the valve seat rings must be replaced.





Valve Seat Ring Replacement:

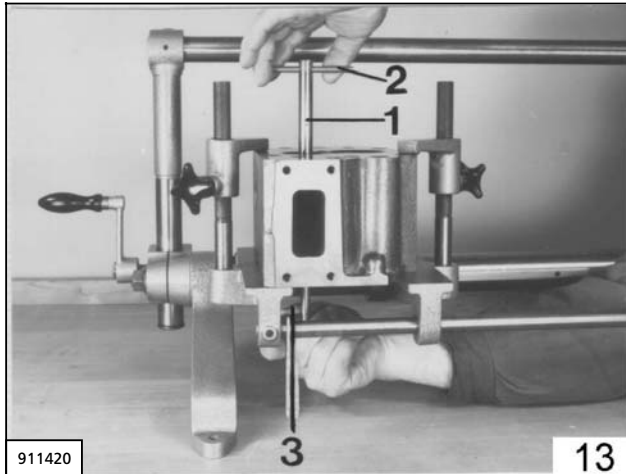
Use special tools no. 41, 44, 45, 46, 47, 48, 49 and 71.

To disassemble the cylinder head see sub group 3.05.

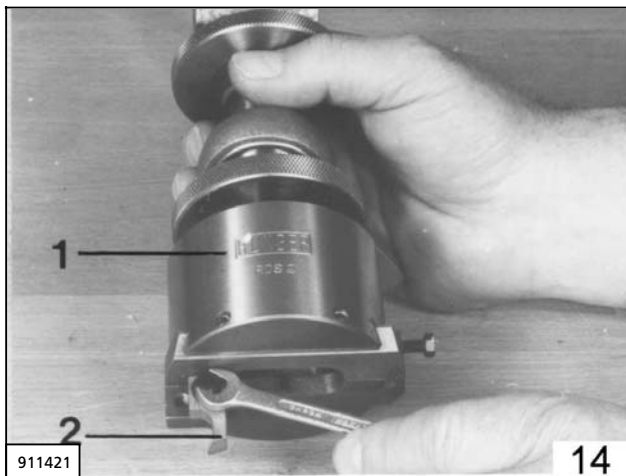
The valve guides must remain installed.

Valve Seat Ring Removal:

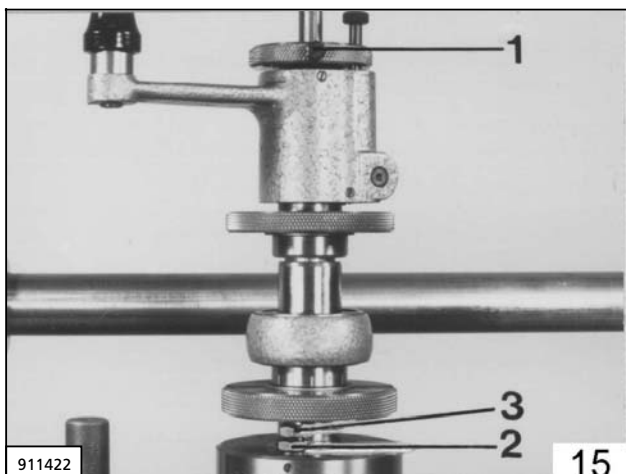
Mount cylinder head to cylinder head fixture, special tool no. 41.



Clean valve guide and insert pilot shaft Pos. 1, special tool no. 44. Insert rods Pos. 2 and Pos. 3, special tools no. 45 and 46, into pilot shaft bores. Hold lower rod in position and secure pilot shaft in valve guide by turning upper rod. Place pilot shaft and cylinder head in vertical position.

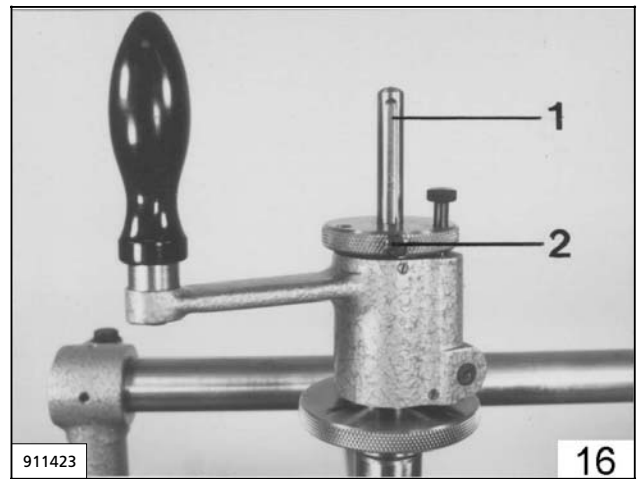


Correctly position and insert cutting tool Pos. 2, special tool no. 49, into valve seat ring cutting head Pos. 1, special tool no. 47.

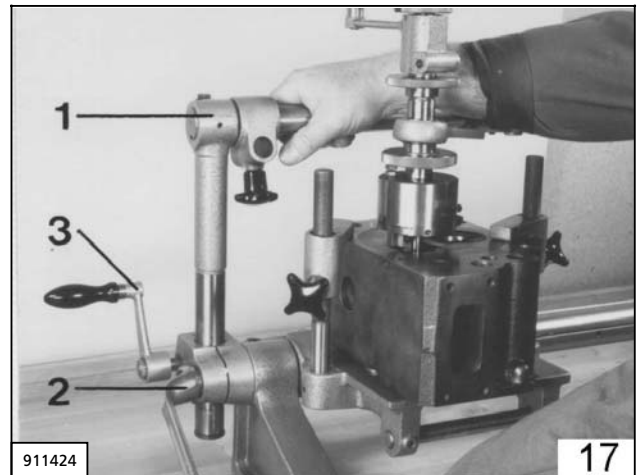


Loosen set-screw Pos. 1 and locknut Pos. 2. Cautiously slide valve seat ring cutting head over pilot shaft. Position cutting tool close to the pilot shaft with quick adjustment screw Pos. 3. Lower valve seat ring cutting head until cutting tool is positioned at the valve seat ring inside center.

Hold valve seat ring cutting head in this position. Push pilot support Pos. 1 lightly against pilot and tighten set-screw Pos. 2.

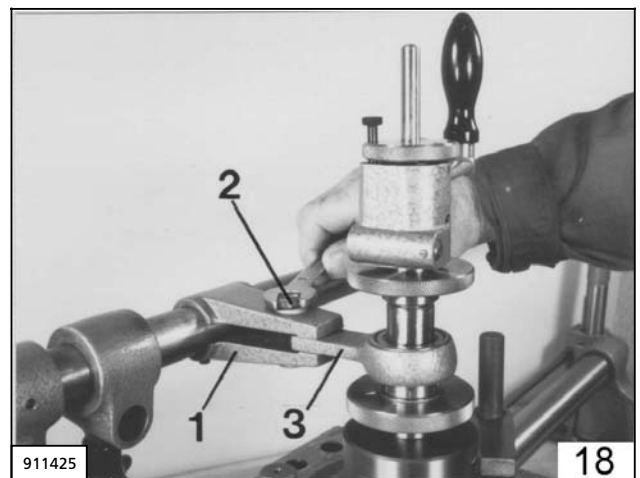


Install steady rest bar Pos. 1 with loose steady rest mount Pos. 2 and adjust steady rest bar to correct height with hand-crank Pos. 3.

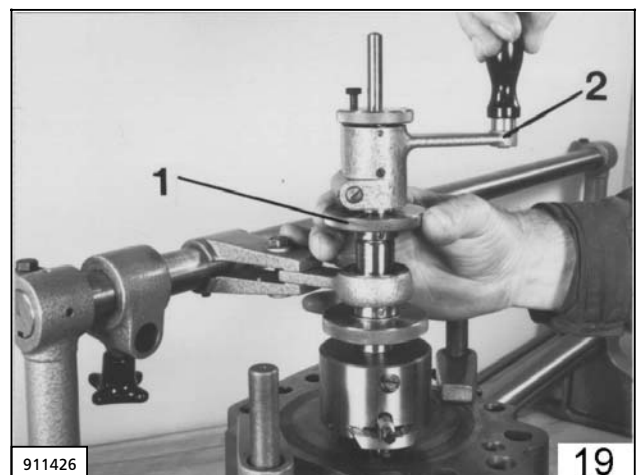


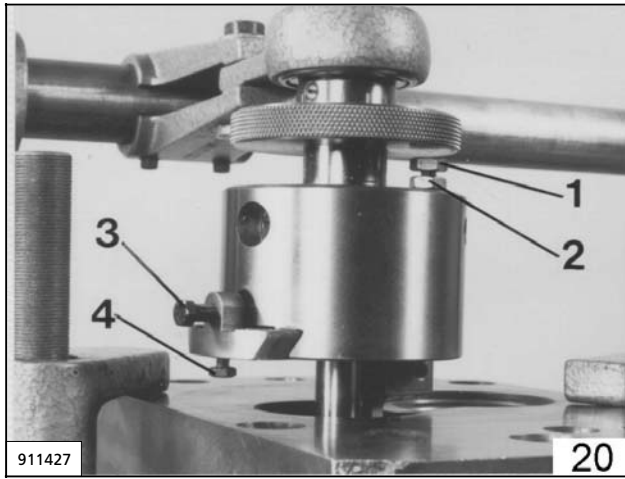
With mounting bolt Pos. 2 loose, position steady rest mounting clamp Pos. 1 to correct location. Insert swivel guide Pos. 3 halfway and tighten mounting clamp bolt.

The valve seat ring cutting head should rotate as easily after the steady rest installation as it did before without steady rest. In case the cutting head does not rotate freely, the steady rest procedure must be repeated.

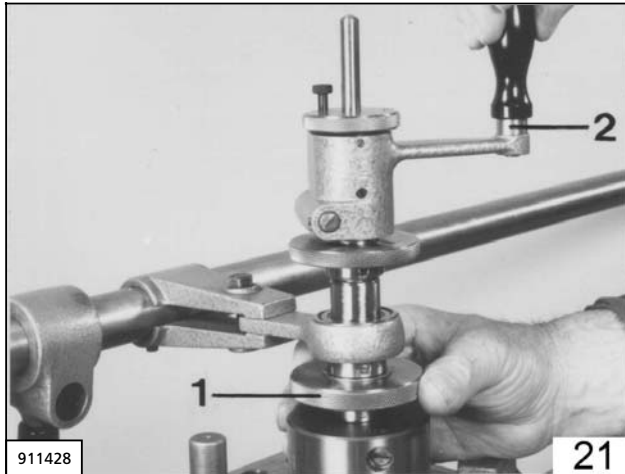


Adjust cutting tool to a level 0.04 inch (1 mm) above the valve seat ring bottom by holding knurled adjustment disc Pos. 1 in position and turning hand-crank Pos. 2.





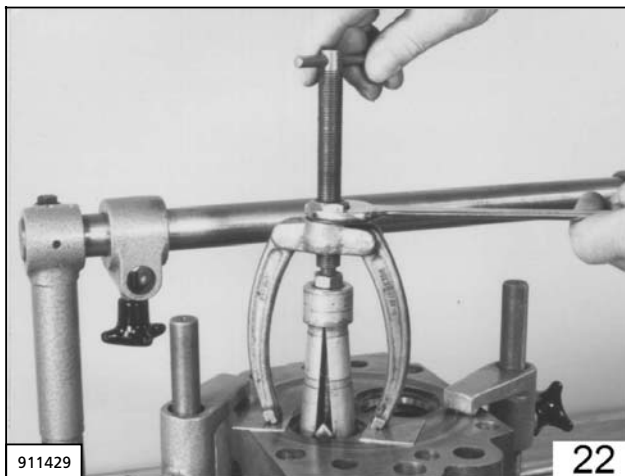
Position cutting tool close to valve seat ring inside (tool should not touch ring) with quick adjustment screw Pos. 1. Tighten locknut Pos. 2. Screw in set-screw Pos. 3 until set-screw touches housing and back-up screw 0.08 - 0.12 inch (2-3 mm). Tighten retaining screw Pos. 4.



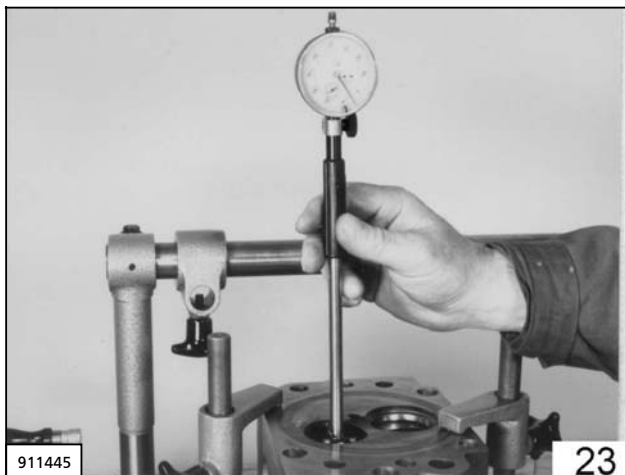
Hold knurled adjustment disc Pos. 1 in place and turn hand-crank Pos. 2 until a groove between 0.08 and 0.12 inch (2-3mm) deep is machined into the valve seat ring. If necessary, readjust cutting tool with quick adjustment screw Pos. 1 (see fig. 20).

Note:

Do not advance cutting tool excessively. It must be possible to turn hand-crank rather easily while cutting. If necessary, release knurled adjustment disc temporarily.



Remove valve seat cutting head and pilot shaft from cylinder head. Reverse claws on standard gear puller, insert claws into the machined valve seat ring groove and position gear puller on cylinder head. To avoid damage to cylinder head, support gear puller legs on copper sheet metal pieces. Remove valve seat rings from cylinder head.



Measure bore inside diameter for valve seat ring with dial indicator or micrometer.

Compare measurement with Engine Specifications.

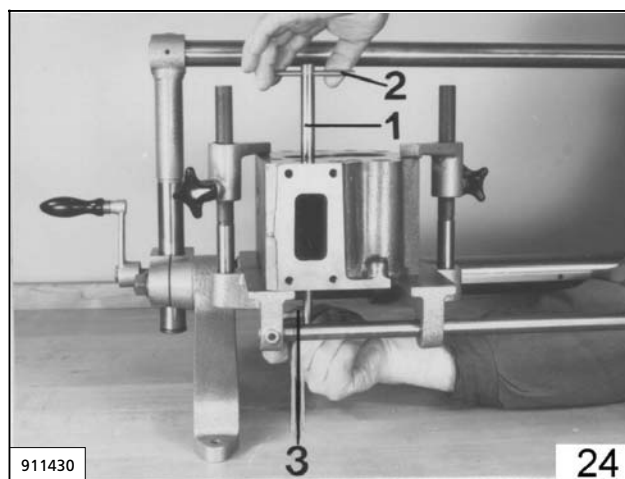
Note:

In case the measurement is not within the specified tolerance, the bore must be remachined for a oversized valve seat ring. See also Engine Specifications.

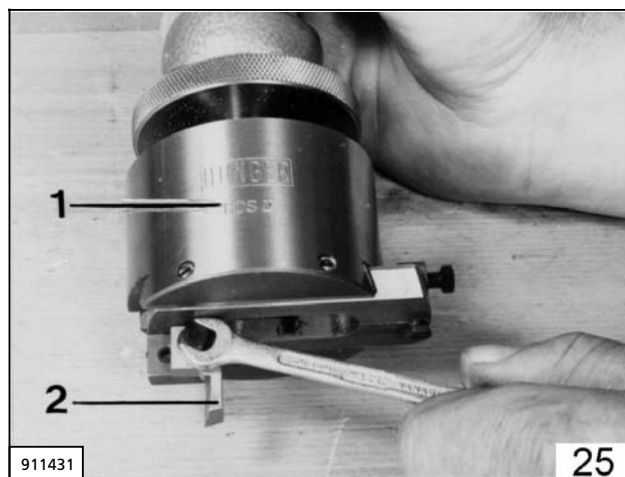
Remachining the Bore for Valve Seat Ring:

The cylinder head must be mounted to cylinder head fixture, special tool no. 41.

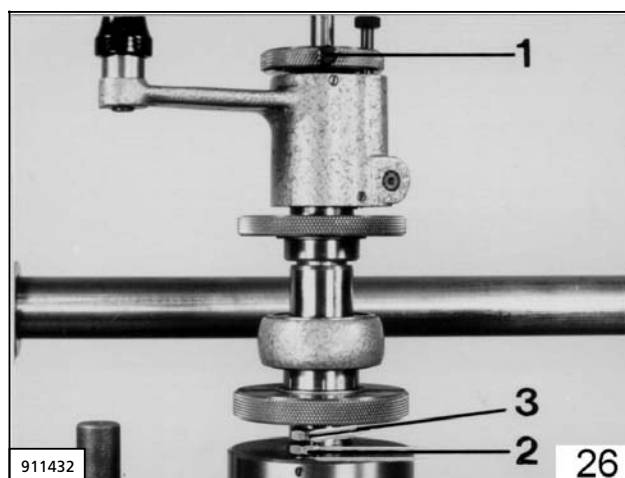
Clean valve guide and insert pilot shaft Pos. 1 special tool no. 44. Insert rods Pos. 2 and Pos. 3, special tools no. 45 and 46, into pilot shaft bores. Hold lower rod in position and secure pilot shaft in valve guide by turning upper rod. Place pilot shaft and cylinder head in vertical position.



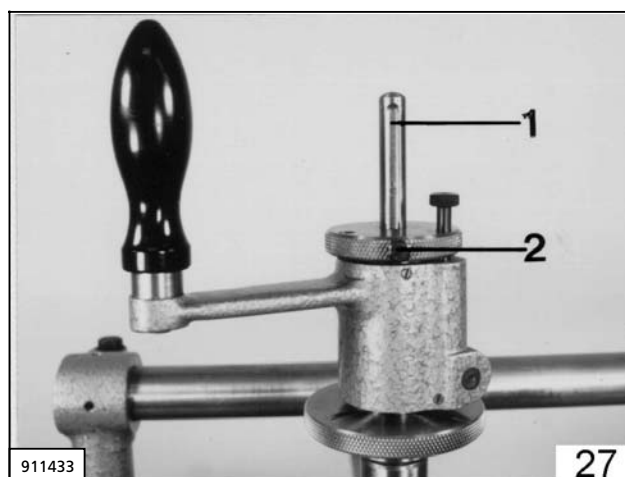
Correctly position and insert cutting tool Pos. 2, special tool no. 48, into valve seat ring bore cutting head Pos. 1, special tool no. 47.

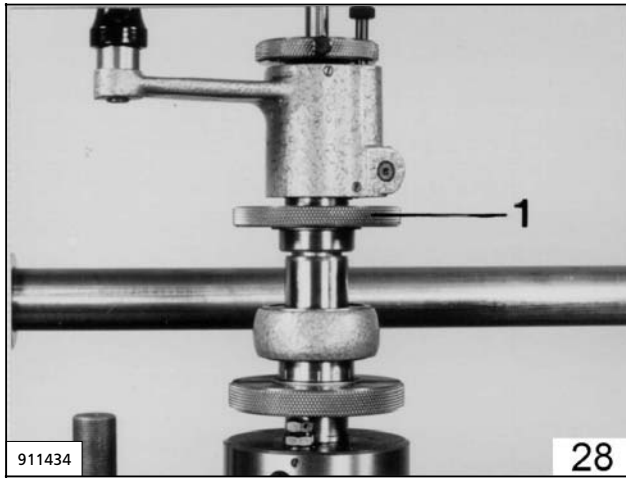


Loosen set-screw Pos 1 and locknut Pos. 2. Cautiously slide ring bore cutting head over pilot shaft. Position cutting tool against cylinder head surface with quick adjustment screw Pos. 3. Tighten locknut Pos. 2.

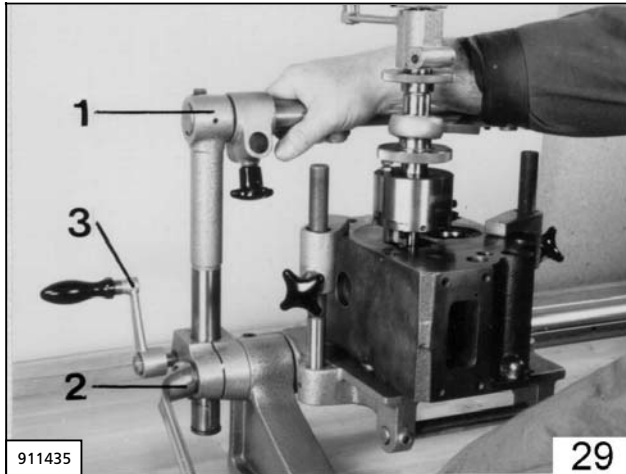


Push pilot support Pos. 1 lightly against pilot and tighten set-screw Pos. 2.

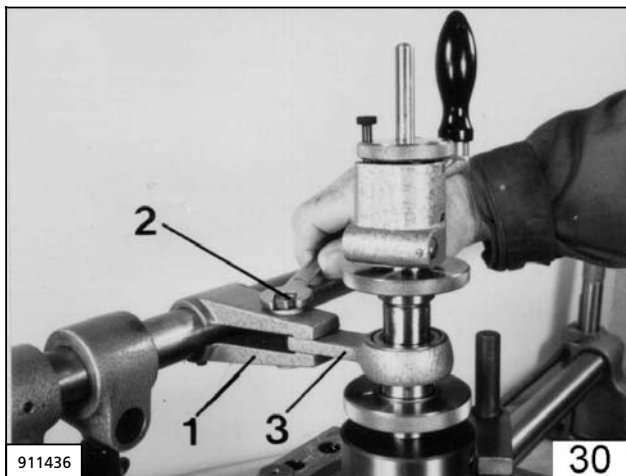




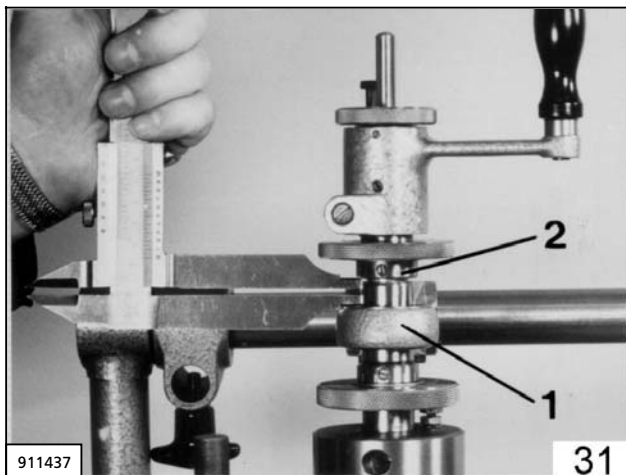
Turn knurled adjustment screw Pos. 1 until cutting tool lifts off the cylinder head surface.



Install steady rest bar Pos. 1 with loose steady rest mount Pos. 2 and adjust steady rest bar to correct height with hand-crank Pos. 3.



With a mounting bolt Pos. 2 loose, position steady rest mounting clamp Pos. 1 to correct location. Insert swivel guide Pos. 3 halfway and tighten clamp bolt. The swivel guide must be positioned horizontally.



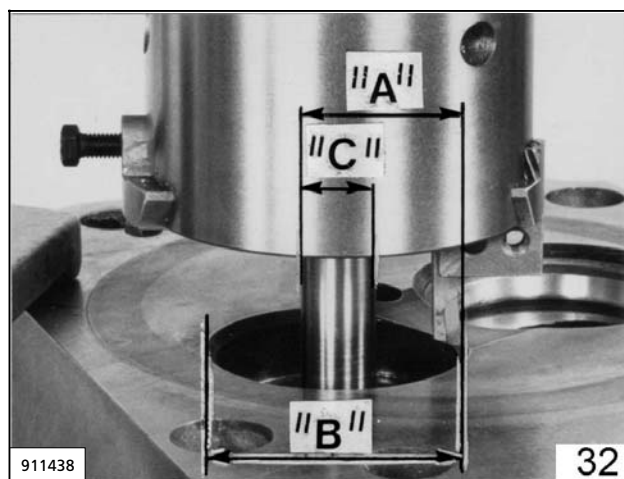
Set correct machining depth for ring bore between swivel guide Pos. 1 and adjustment disc Pos. 2 by adjusting steady rest bar and mounting clamp. Secure steady rest bar and mounting clamp in proper position.

Determine next oversized bore diameter. For correct dimensions see Engine Specifications.

Determine adjustment dimension "A" for cutting tool as follows:

Dimension "A" =

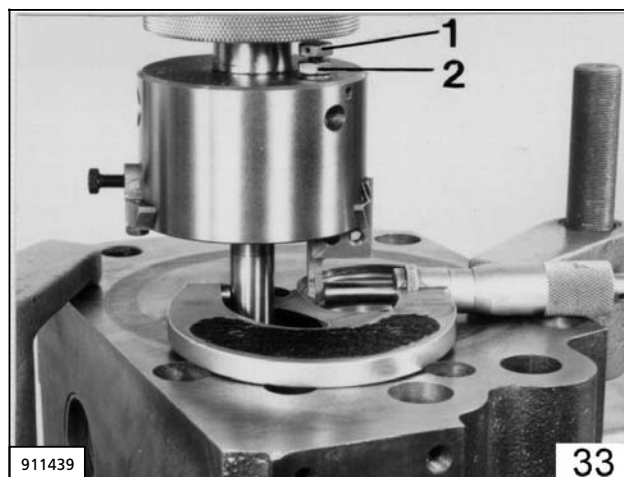
$$\frac{\text{Bore dia. "B" + Pilot shaft dia "C"}}{2}$$



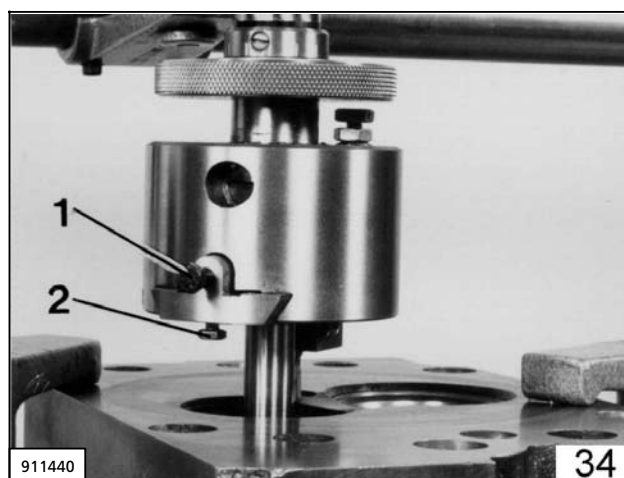
Loosen locknut Pos. 1. Set outside micrometer to dimension "A". Lift up ring bore cutting head and place micrometer against pilot shaft. Position cutting tool against micrometer to dimension "A" with quick adjustment screw Pos. 2. Tighten locknut Pos. 1.

Note:

It is recommended to set the cutting tool to slightly less than dimension "A" for the first cutting process.



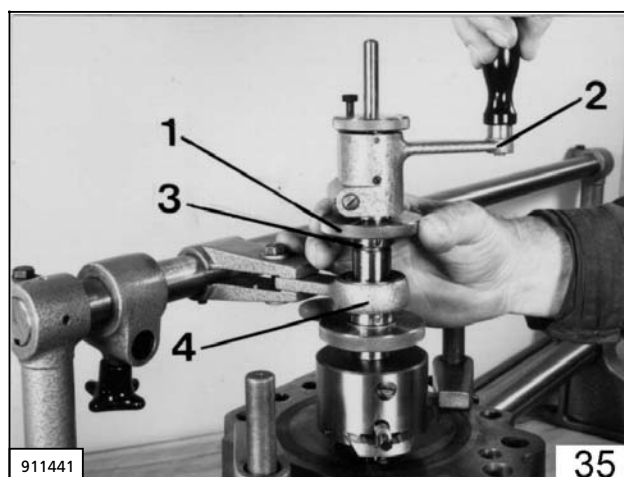
Screw in set-screw Pos. 1 until set-screw touches housing. Tighten retaining screw Pos. 2.

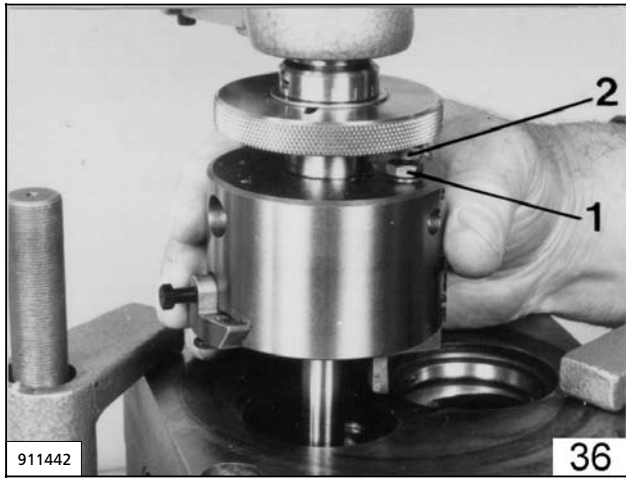


Hold knurled adjustment disc Pos. 1 in place and turn hand-crank until adjustment disc Pos. 3 touches swivel guide Pos. 4.

Note:

Repeat last cutting procedure without advancing the cutting tool.

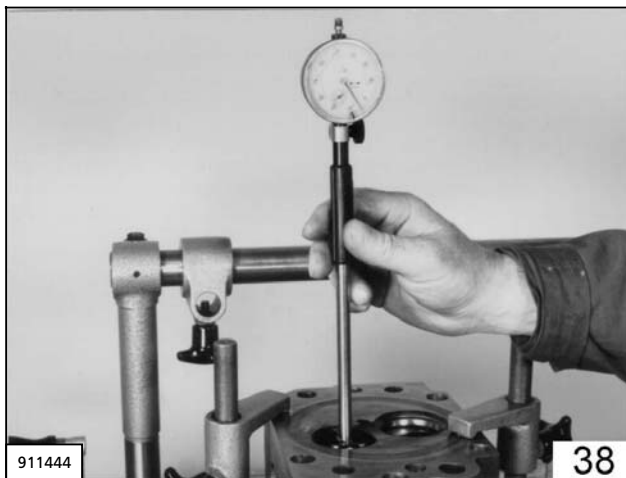




Loosen locknut Pos. 1, lift up ring bore cutting head and reposition cutting tool to the outside of ring bore face with quick adjustment screw Pos. 2.



Machine ring bore face by holding knurled adjustment disc. Pos. 1 in place and turning hand-crank Pos. 2.



Remove ring bore cutting head and pilot shaft from cylinder head. Check ring bore diameter for proper dimension.

Install valve seat rings:

Method 1:

Cool down valve seat rings in liquid nitrogen to -175°C to -190°C (-283°F to -310°F).

Place valve seats in the bore of the cylinder heads with pliers and knock in with punch, special tool No. 71.

Method 2:

Heat up the cylinder head to $+250^{\circ}\text{C}$ (480°F). Knock valve seat rings into the cylinder head using tool No. 71. Let cylinder head cool down.

Note:

When using method 2, the freeze plugs, see sub group 3.05, fig. 5, must be replaced. Otherwise there is a danger of leakage.

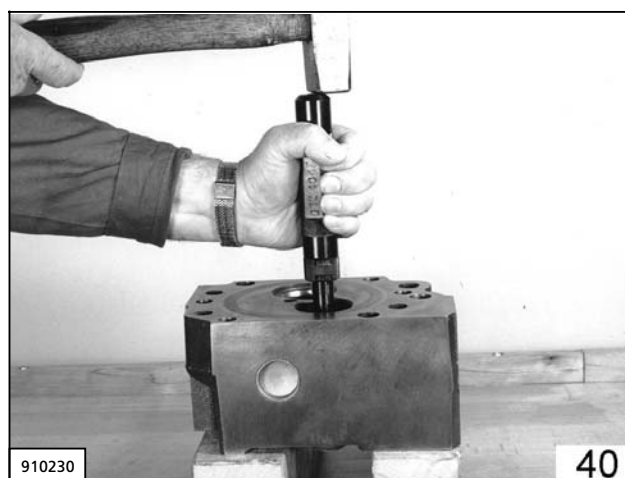


Valve Guide Replacement:

Use special tools no. 50, 51, 70 and 88.

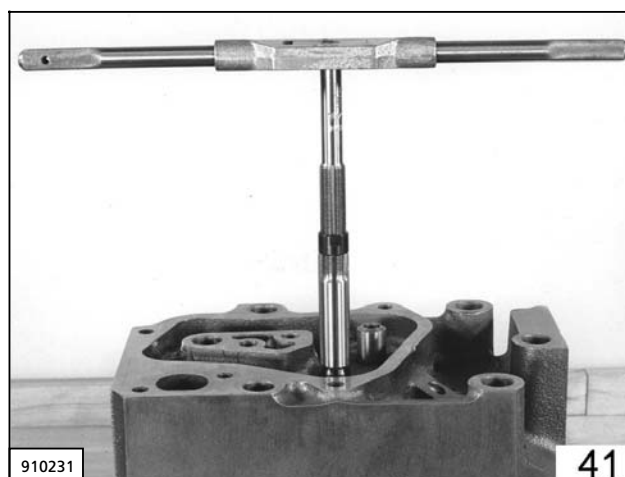
Valve Guide Removal:

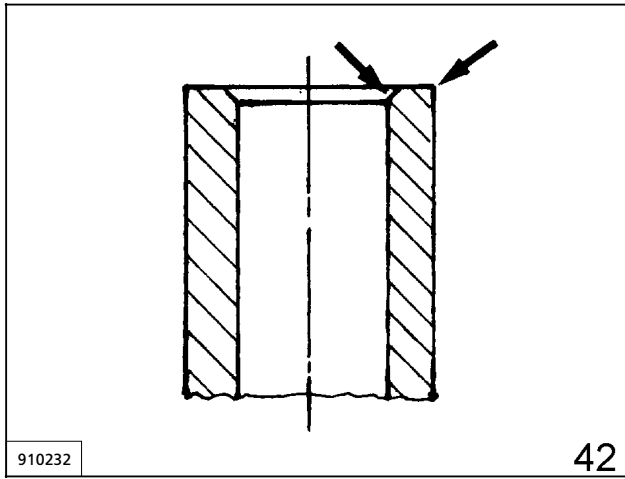
Place cylinder head on support with its mounting surface pointing up. It must be possible to remove valve guides freely. Knock valve guides out of cylinder head with punch, special tool no. 70.



Turn cylinder head around and machine valve guide bores in cylinder head with reamer, special tool no. 50, to next oversized valve guide bore diameter.

For proper oversized bore diameters see Engine Specifications.

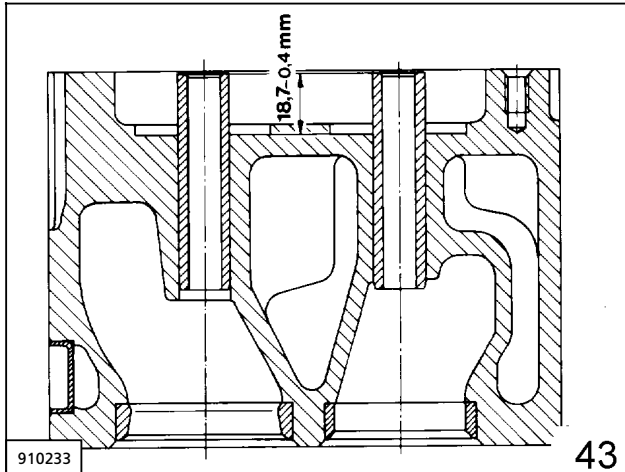




Installation:

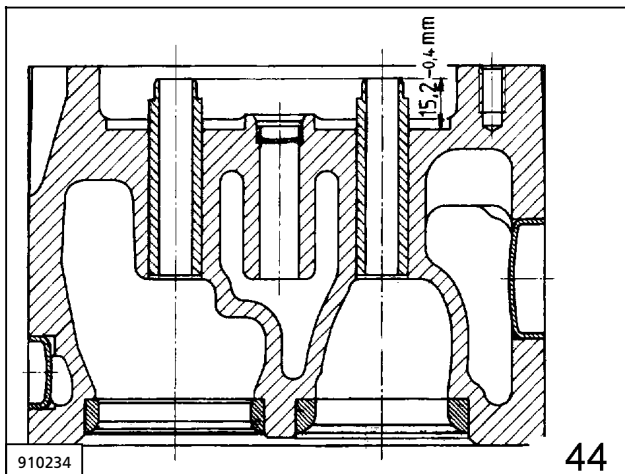
IMPORTANT:

For valve guides without a chamfer for the valve stem seal rings, please be certain that the side of the valve guide with an inside chamfer / no chamfer is on the outside of the cylinder head when pressing them in (see fig. 42).



Valve guides without chamfer for valve stem seals:

Drive valve guides with punch, special tool No. 70 into the cylinder head to the dimension given on fig. 43.



Valve guides with chamfer for valve stem seals:

Drive valve guides with punch, special tool No. 88, into the cylinder head to the dimension noted on fig. 44 .

Method 1:

Cool down valve guides in liquid nitrogen to -175°C to -190°C (-283°F to -310°F) . Lubricate valve guide bores in the cylinder head with oil and drive in valve guides.

Method 2:

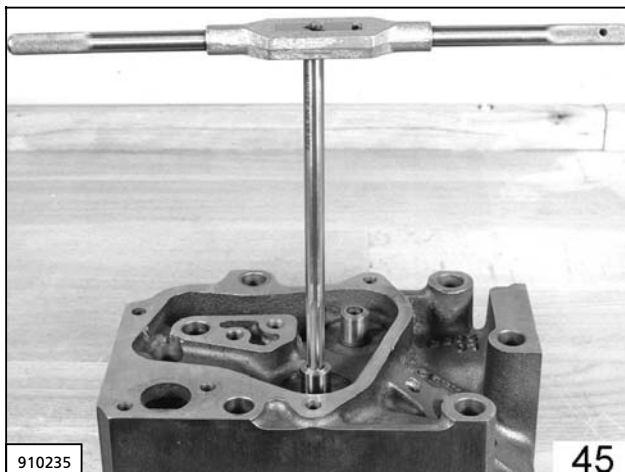
Heat up the cylinder head to $+250^{\circ}\text{C}$ (480°F), lubricate valve guide bores with oil and drive into cylinder head.

Ream valve guides with reamer, special tool No. 51, see fig. 45.

When using method 2, allow the cylinder head to cool down first.

Note:

When using method 2, the freeze plugs, see sub group 3.05, fig .5 must be replaced. Otherwise there is a danger of leakage.



Piston Removal, Installation and Inspection

Use special tools no. 10, 30, 32, 34 and 35.

Piston Removal:

To remove cylinder head see sub group 3.01.

Drain engine oil as outlined see sub group 2.01.

Remove engine oil pan as described in sub group 8.32.

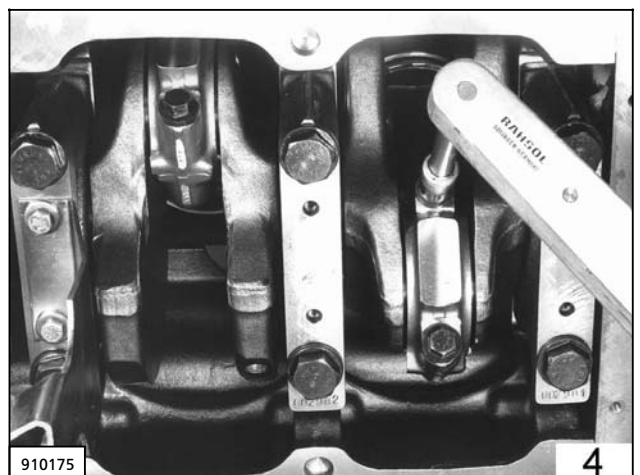
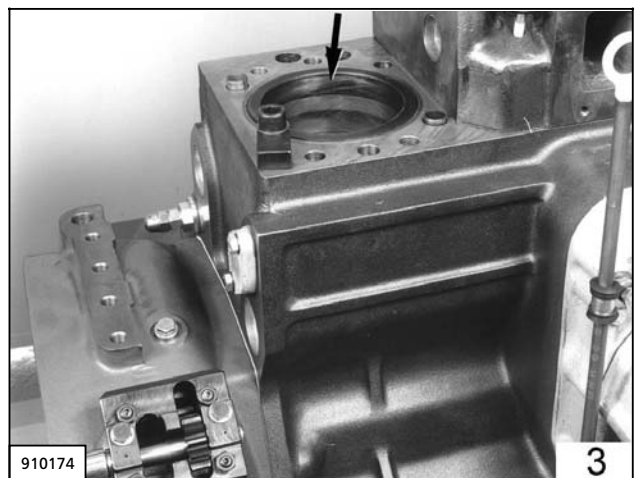
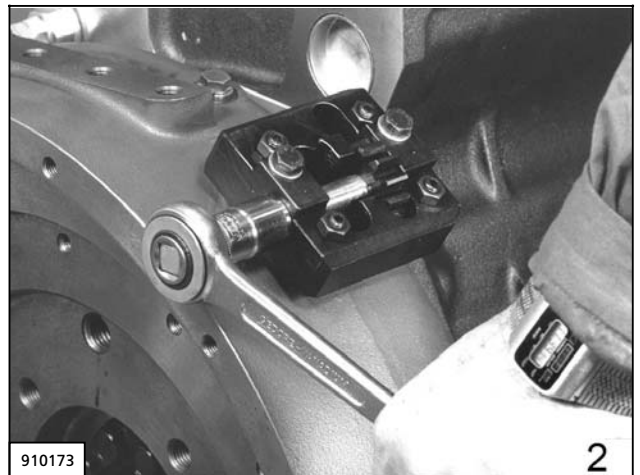
Remove lubrication oil lines, see sub group 8.32.

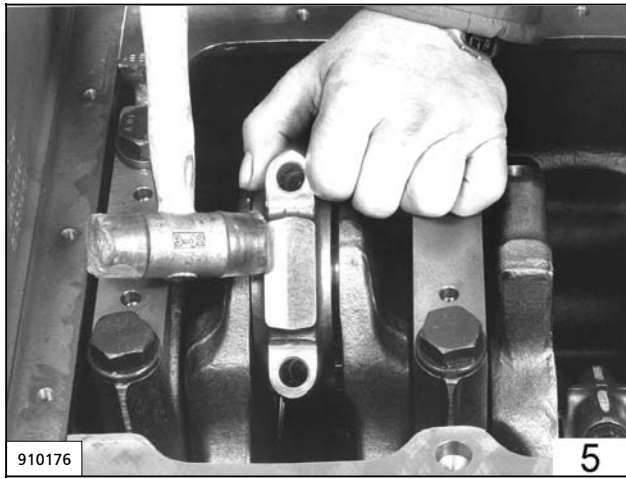
Install hand-crank, special tool no. 30, to flywheel housing at inspection window. Position piston below top dead center (TDC) with hand-crank.

Cautiously remove any carbon deposits from cylinder liner. Avoid any damage to the piston contact surface on the cylinder liner inside.

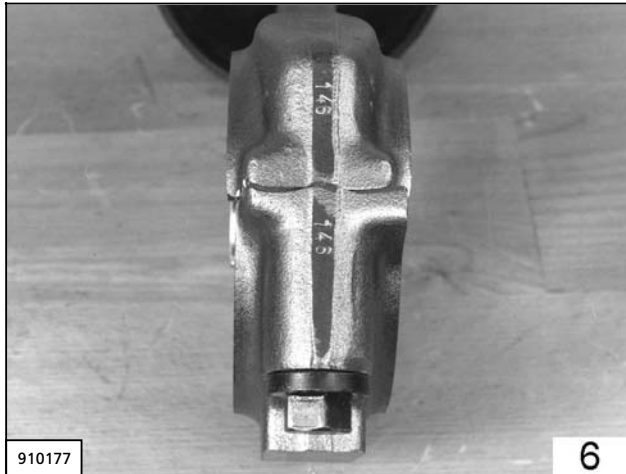
Turn crankshaft with hand-crank to a position that allows easy access to unscrew the connecting rod bearing cap mounting bolts.

Loosen and remove mounting bolts.

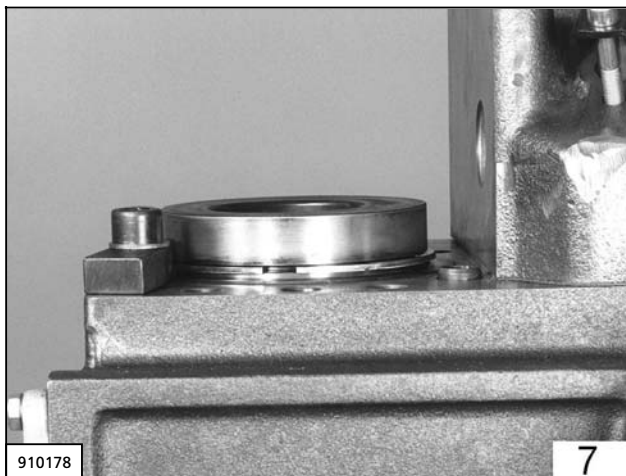




Loosen connecting rod bearing cap with rubber or plastic hammer and remove cap with bearing shell from crankshaft.



Mark bearing cap and respective connecting rod in consecutive numbering sequence for identification.



Remove piston and connecting rod assembly through cylinder liner by pushing both from beneath engine block.

Note:

To avoid any damage to either cylinder liner or connecting rod bearing, remove piston and connecting rod assembly as cautiously as possible.



Remove other bearing shell from connecting rod and place connecting rod in vise with piston on top. To avoid damage use protective jaw covers.

Remove retaining rings for piston pin and push piston pin out of piston. Remove piston assembly.

Note:

Do not mix-up connecting rod bearing halves. The bearing halves must be reused in matched sets.

Piston Installation

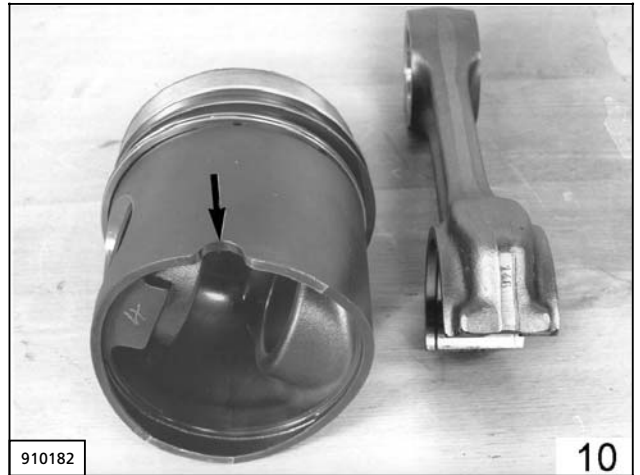
Place connecting rod in vise. To avoid damage use protective jaw covers.

Position piston assembly over connecting rod. Lubricate piston pin with engine oil and push pin into piston bore. Secure pin with retaining rings.



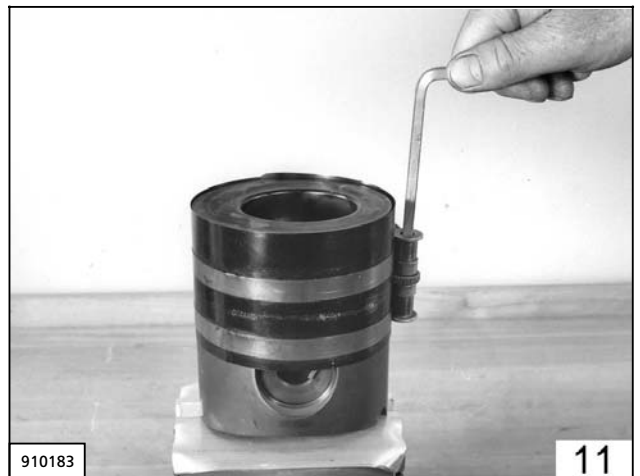
Note:

Because of the piston cooling nozzle, the notched piston side must be positioned at the marked connecting rod side.



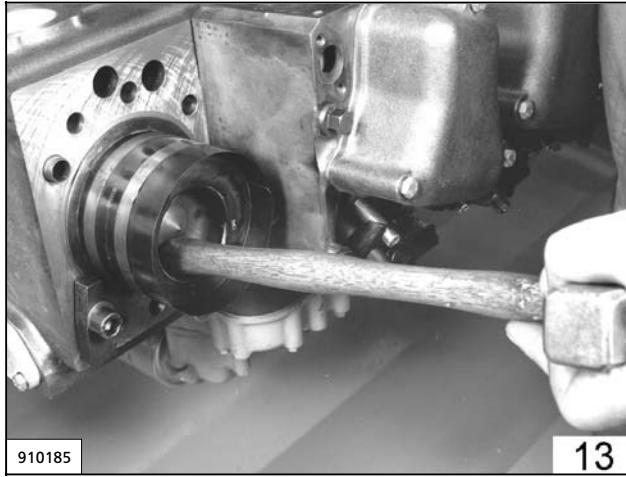
Lubricate piston and piston rings with engine oil. Position piston rings with ring gaps 120° to each other.

Place piston ring compressor, special tool no. 35, around piston and tighten compressor to the extent, that the compressor still slides up and down.



Place bearing shell in connecting rod with its tang resting in connecting rod bearing support groove. Lubricate bearing shell surface with engine oil.





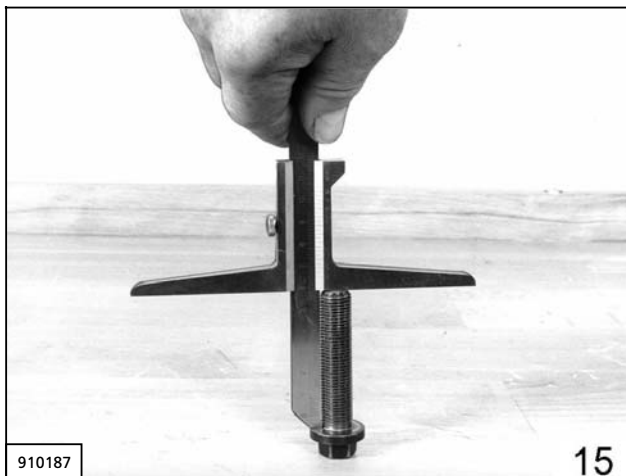
Clean cylinder liner and lubricate with engine oil. Place connecting rod and piston assembly in line with cylinder liner and cautiously push piston into liner until connecting rod bearing rests against crankshaft pin. Avoid any damage to the cylinder liner surface during installation.

Note:

Viewed from the flywheel side and with the engine in upright position, the market connecting rod side must be located on the right-hand side.



Place matching bearing shell in connecting rod bearing cap with its tang resting in bearing cap groove. Lubricate bearing shell surface with engine oil. Line up bearing cap and connecting rod with its markings matching and place bearing cap over crankshaft pin on connection rod.



Measure bearing cap mounting bolt length and compare measurement with dimensions given in Engine Specifications.

Note:

Mounting bolt that are stretched must be replaced.



Screw in and pretorque bearing cap mounting bolts. Apply final torque with torque angle indicator, special tool no. 32.

See Engine Specifications for proper torque.

Note:

Measure piston clearance as outlined in sub-group 2.25.

Piston and Piston Ring Inspection:

The piston must be removed from cylinder.
Adjust piston ring pliers to piston diameter with setscrew on pliers.
For correct piston diameter see Engine Specifications.
Remove all piston ring.

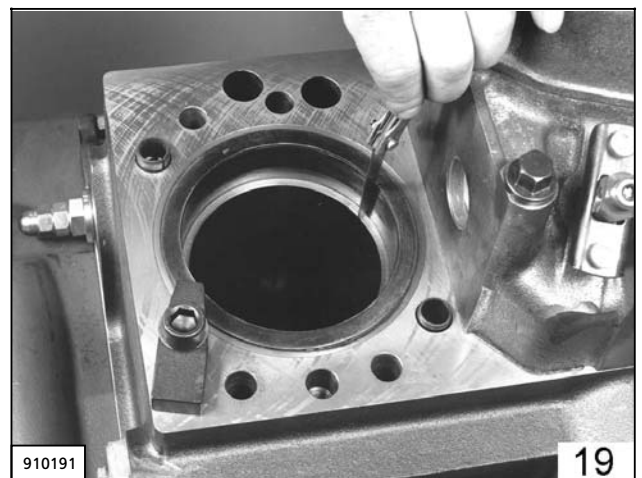
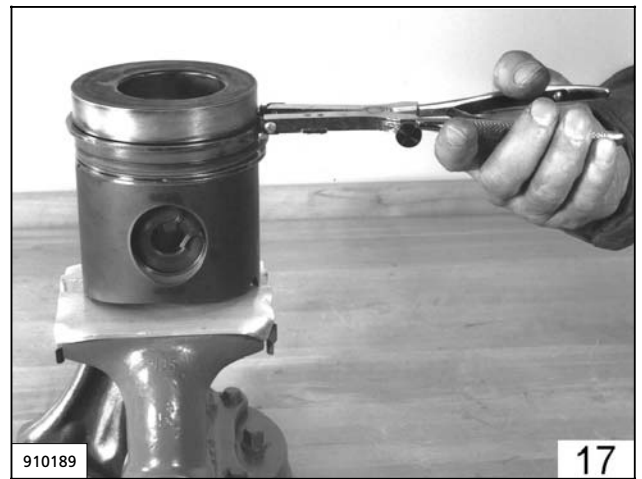
Note:

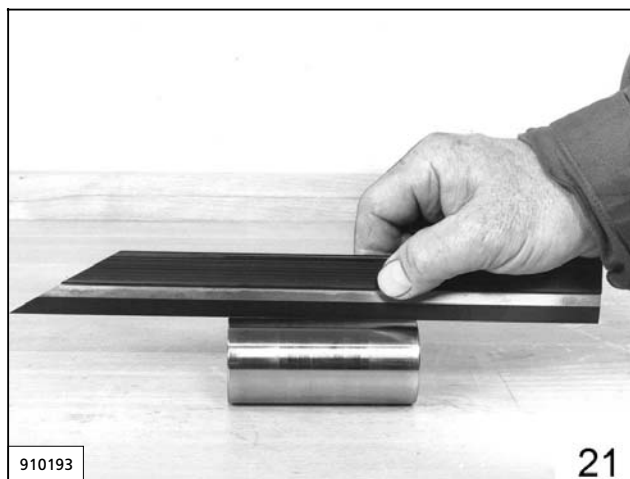
In case the piston rings are reused, the rings must be placed again into their respective grooves on the piston.

Clean piston and piston ring grooves.
Check piston for wear and damage.
Visually check piston rings for wear and deformation.

Place piston rings individually into cylinder liner and measure ring cap with feeler gauge.
For correct dimensions see Engine Specifications.

Install piston rings with piston ring pliers. The "TOP" mark on piston rings must point upward.
Check axial play between piston ring and groove.
For correct dimensions see Engine Specifications.





Visually check piston pin for wear.

Note:

Anytime the piston or piston rings are replaced, inspect cylinder liner also and replace it if required.

To inspect and replace the piston liner see sub group 3.22.

Cylinder liner removal, installation and inspection:

Use special tools no. 10 and 11.

Cylinder liner removal:

To remove piston from cylinder, see sub group 3.18. Choose the proper disc depending on the cylinder liner diameter.

Slant the disc on the lower end of the cylinder liner puller, special tool no. 11, and insert liner puller into cylinder liner from the top. Straighten the disc and position it against the lower cylinder end.

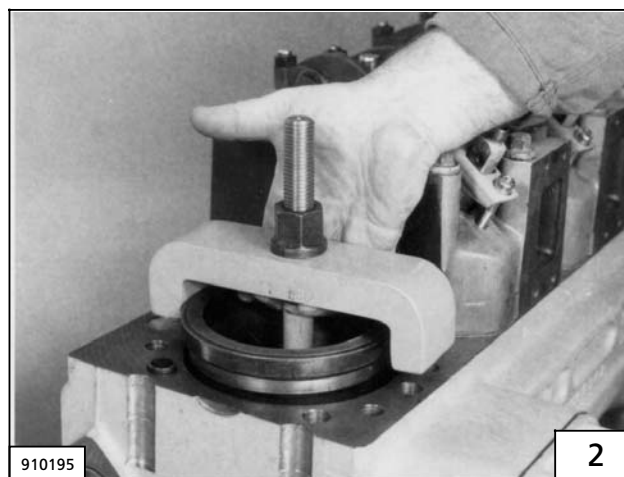
Pull the cylinder liner from engine bloc by turning the nut on the puller spindle.



Remove the cylinder liner and puller from the engine bloc and remove the puller from the liner.

Note:

In case the cylinder liner is being reused, mark the liner and liner bore in the engine bloc. Mark the piston. The pistons and cylinder liners should not be interchanged!



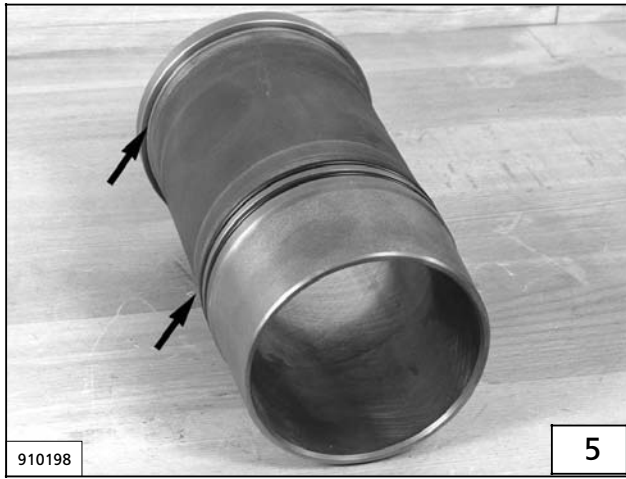
Cylinder Liner Installation:

Carefully clean liner bore, recess for liner flange and sealing surface for lower liner O-rings in the engine bloc.



Remove O-rings from cylinder liner. Thoroughly clean liner flange, pressfit surfaces and O-ring grooves on the cylinder liner.





Install new O-rings on cylinder liner flange and lower end.

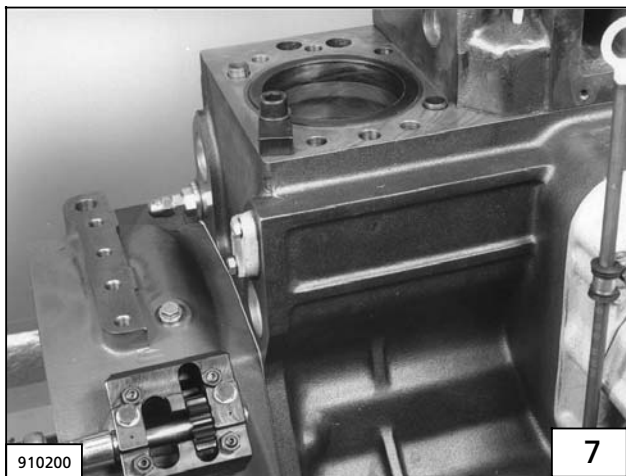
Note:

For the new engines, the sealing on the oil pan side of cylinder liners was changed from 2 O-Rings to 3 O-Rings.

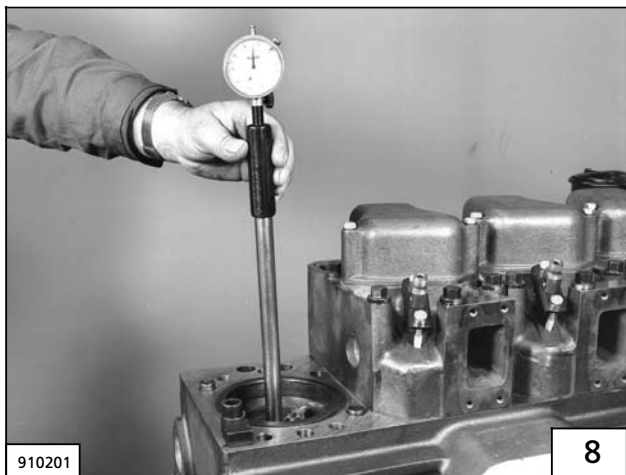
The O-ring on the liner flange fall out for engines D 914 / 916 / 924 / 926 beginning with serial number 2003 01 297 0.



Lubricate press-fit seats and O-rings on cylinder liner with grease GBUY 131. Cautiously insert and press cylinder liner into bore in engine bloc.



Bolt cylinder liner retainer, special tool no. 10, to engine bloc.



Cylinder Liner Inspection:

To remove piston from cylinder see sub group 3.18.

Inspect cylinder liner bore for wear and damage. Measure inside diameter on liner bore with micrometer or dial gauge.

For proper dimensions see Engine Specifications.

Note:

In case the cylinder liner must be replaced, inspect piston assembly also and replace if required. For procedures to remove the piston see sub-group 3.18.

Repairing insufficient cylinder liner protrusion in reference to the crankcase

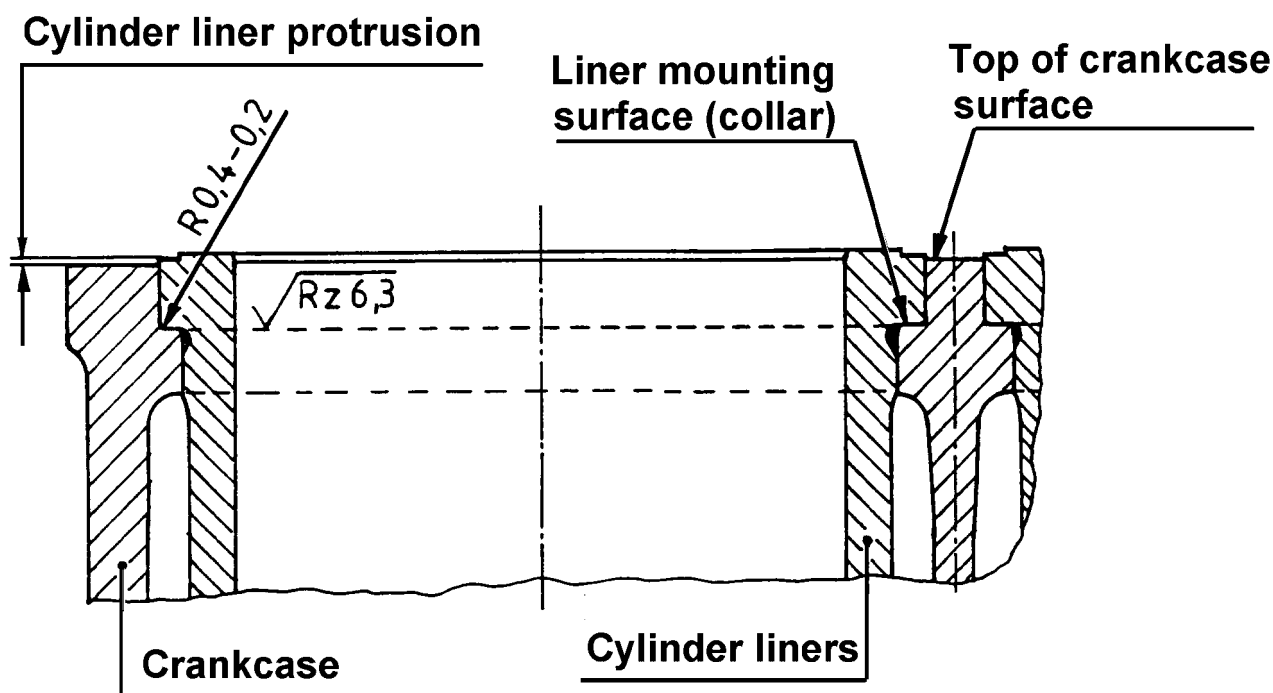
Note:

If the cylinder liner protrusion in reference to the crankcase is too small or if the liner mounting surface (collar) on the crankcase is uneven, the surface can be remachined.

Oversized cylinder liners are available.

For data regarding cylinder liner protrusion in reference to crankcase, see Technical Data.

For remachining / repair procedure, see below.



911659

Required tools:

Mira BB-86 Type M 20 (220V)
Special steel MB 88 AD
Repair ring BB - RR

Available from:

Fa. Walter Krupp - Dieseltechnik GmbH
Göddertzgarten 38
D-53340 Meckenheim
Postfach 1147 - D- 53333 Mannheim
Tel.: 02225/92010 Fax: 02225/17532
or in the US, contact LCE
(LIEBHERR Construction Equipment Co.),
Newport News,
VA (757-928-8737)

Arbeitsvorgang

Voraussetzungen für eine einwandfreie Arbeit sind:

- a ein gut geschliffener Drehstahl
- b ein sauber gereinigtes Gerät
- c eine absolut saubere Aufspannfläche

Séquence des opérations

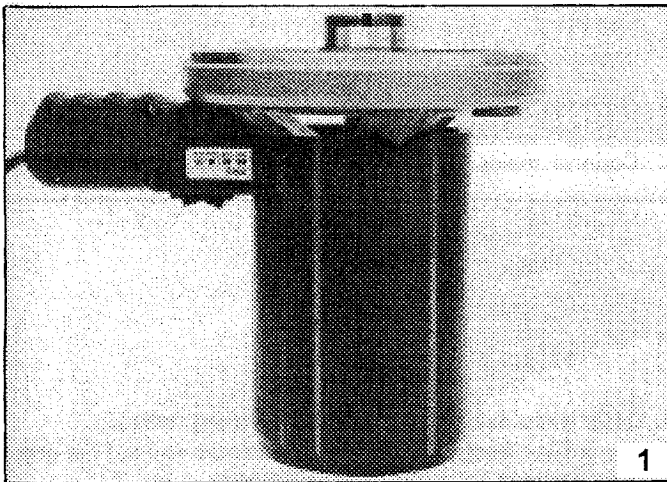
Les conditions à remplir pour obtenir des résultats impeccables sont:

- a un outil bien affûté
- b un appareil bien nettoyé
- c une surface de fixation absolument propre

Working process

For a perfect work, following points are essential:

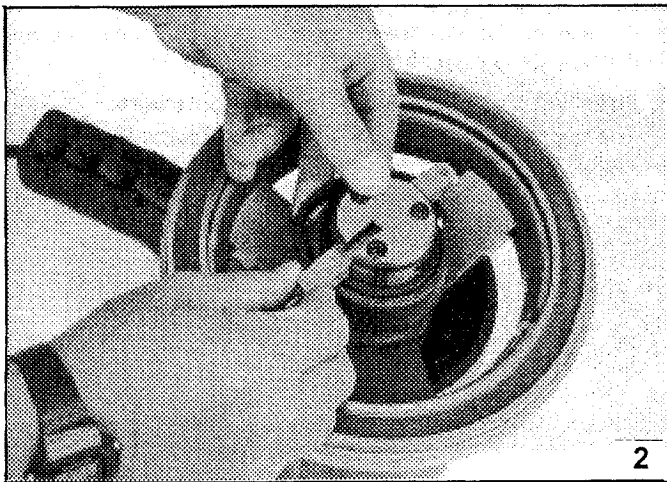
- a a well ground cutting tool
- b a clean unit
- c an absolutely clean set up area



1. Um den Drehstahl in den Drehkopf einführen zu können, muss die Vorschubmutter so weit hinuntergedreht werden (Blockierschraube lösen), dass sich die Oberkante der Stahlführung unterhalb des Magnettringes befindet.

1. Pour pouvoir introduire l'outil dans la tête porte-outil, le dispositif d'avance doit être abaissé (dégager la vis de blocage) jusqu'à ce que le bord supérieur du logement de l'outil se trouve au-dessous de la base magnétique.

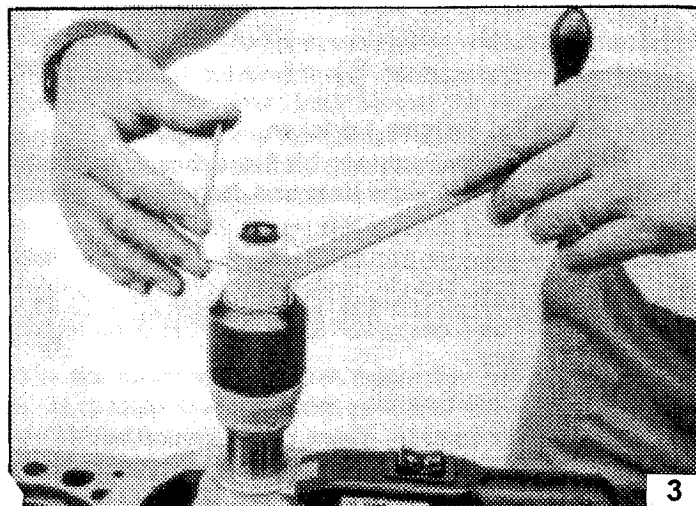
1. In order to introduce the turning tool into the spindle head, the vertical feed must be advanced (loosen blocking screw) until the upper side of the guiding way comes lower than the magnet base.



2. Schnellverstellhebel drücken und den Drehstahl mit dem Vorschubgewinde nach oben so einführen, dass die Zentrierrolle auf die Seite der Markierung "R" am Drehkopf zu liegen kommt. Drehstahl in Mittelverstellung schieben und Schnellverstellhebel loslassen.

2. Appuyer sur l'étrier de réglage rapide et introduire l'outil avec le filetage d'avance vers le haut, et le galet de centrage du côté de la marque "R" sur le couvercle de la tête. Poser l'outil en position médiale et lâcher l'étrier.

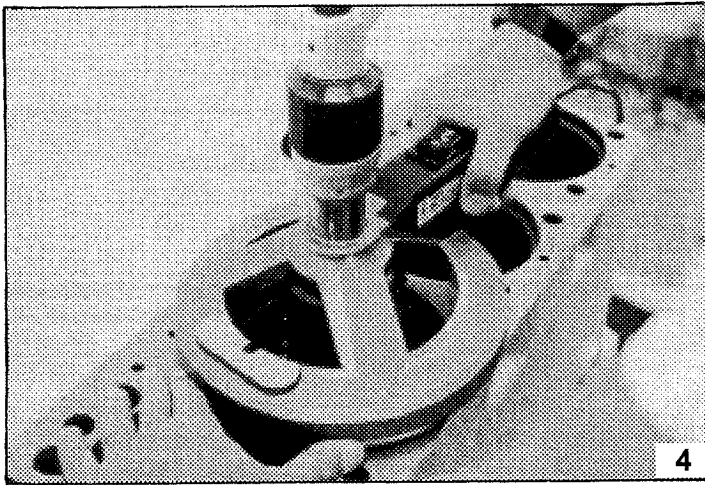
2. Push the quick tool setting bow and introduce the cutting tool with the thread on the upper side, so that centering roll stays on the side of the turning head which is marked "R". Place the cutting tool to the center position and release the quick setting bow.



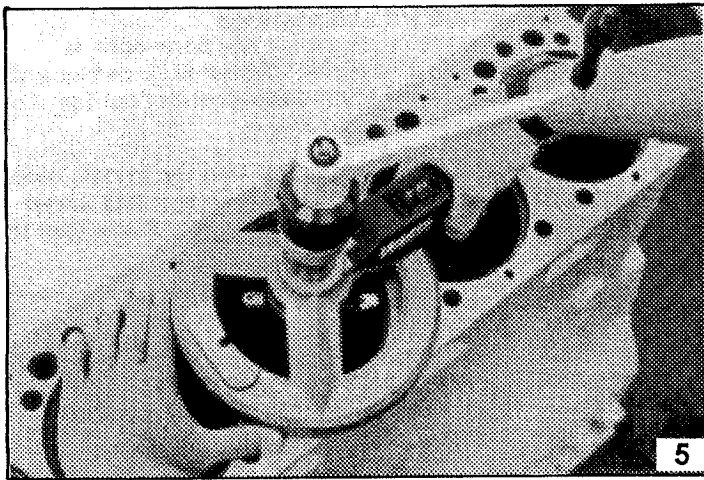
3. Drehkurbel montieren und Arretierschraube festziehen.

3. Monter la manivelle et fixer la vis de blocage.

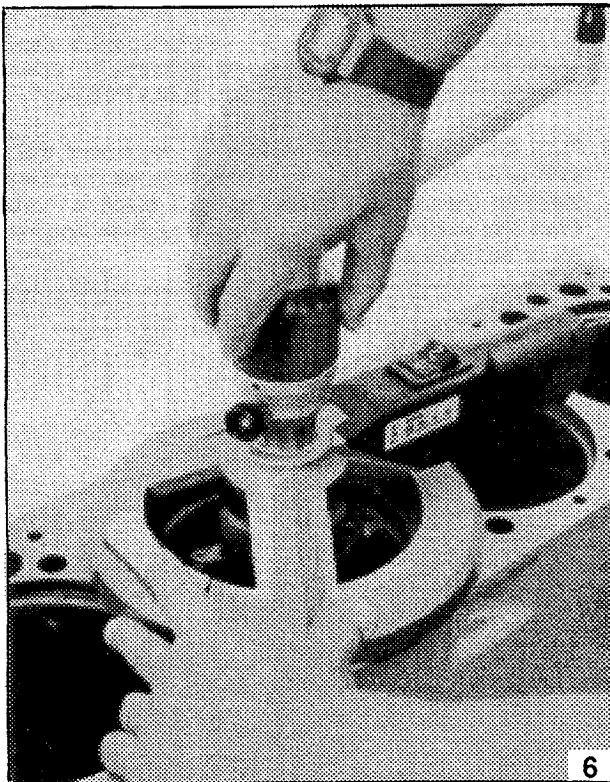
3. Fit the turning handle and block the locking screw.



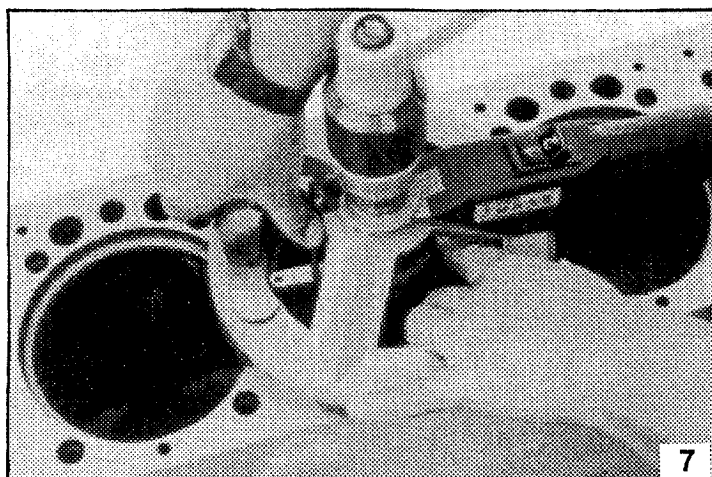
- 4. Gerät mit beiden Händen auf die gereinigte Oberfläche des Motorblockes aufsetzen (Handgriff nach rechts).
Netzstecker anschliessen.
- 4. Poser l'appareil des deux mains sur la surface bien propre du bloc moteur, (poignée vers la droite).
Brancher l'appareil au réseau.
- 4. Place the unit on top of the cleaned set up area, holding it with both hands (handle looking to the right side).
Connect mains plug.



- 5. Gerät leicht exzentrisch über die Bohrung stellen.
Der grösste Abstand zum Geräte-Zentrum soll auf der gegenüberliegenden Seite des Handgriffes sein.
- 5. Poser l'appareil en position légèrement excentrique au-dessus de l'alésage. Le plus grand espace vers le centre de l'appareil devra se trouver au côté opposé de la poignée.
- 5. Place unit slightly excentric to the counterbore.
The bigger distance to the centre of the unit shall be on the opposite side of the handle.



- 6. Kippschalter auf Stellung 1 drücken.
Vorschubmutter zurückdrehen bis Stahlschneide höher als die zu bearbeitende Fläche steht und dann Blockierschraube leicht anziehen.
- 6. Mettre l'interrupteur reversible en position 1.
Reculer le dispositif d'avance jusqu'à ce que la pointe de l'outil se trouve plus haut que la surface à usiner, et serrer légèrement la vis de bocage.
- 6. Tip switch to position 1.
Lift the spindle head by means of the vertical advancing device until the cutting edge is higher than the counterbore seat; lock slightly.



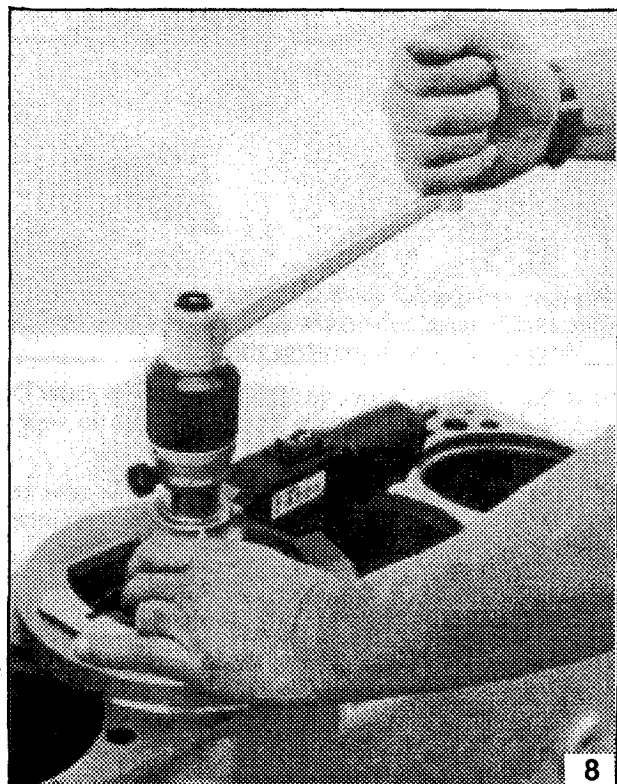
7. Schnellverstellhebel drücken und Zentrierrolle an der Stelle mit dem grössten Zentrumsabstand an die Bohrungswand drücken.

Dann Schnellverstellhebel loslassen und Kippschalter auf Mittelposition stellen.

7. Appuyer sur l'étrier de réglage rapide et faire contacter le galet de centrage à la paroi, à l'endroit de la plus grande distance. Puis lâcher l'étrier et mettre l'interrupteur en position neutre (médiale).

7. Push the quick tool setting bow and place the centering roll against the counterbore wall, at the large centering distance.

Release the setting bow and tip the tumbler switch to the central position.



8. Zum Zentrieren des Gerätes Planvorschubring mit 2 Fingern festhalten und mit der anderen Hand die Kurbel im Uhrzeigersinn drehen.

Das Gerät wird sich jetzt bei jeder Umdrehung exzentrisch bewegen.

Durch weiteres Drehen der Handkurbel bewegt sich die Zentrierrolle gegen das Gerätezentrum und die excentrische Bewegung wird immer kleiner bis das Gerät still steht.

Achtung: Planvorschubring im richtigen Moment loslassen, wenn die Zentrierrolle die Bohrungswand praktisch rundherum noch leicht berührt.

Hat die Zentrierrolle den Kontakt zur Bohrungswand verloren, so kann durch Festhalten des Planvorschubringes und Drehen der Handkurbel im Gegenuhrzeigersinn die Zentrierrolle wieder nach aussen bewegt werden bis das Gerät wieder eine excentrische Bewegung ausführt.

Sollte in der Zwischenzeit der Restmagnetismus nicht mehr vorhanden sein, so muss er wieder hergestellt werden (Kippschalter auf "1", dann zurück in die Mittelposition).

Der Zentriervorgang kann jetzt wiederholt werden.

"Nach einiger Übung macht das Zentrieren richtig Spass".

8. Pour le centrage de l'appareil tenir la bague avance horizontale par deux doigts et tourner la manivelle dans le sens des aiguilles de la montre.

L'appareil aura alors un mouvement excentrique à chaque tour de manivelle.

Par une rotation continue de la manivelle et en tenant la bague avance horizontale, le galet de centrage reculera vers le centre de l'appareil et le mouvement excentrique deviendra de plus en plus petit jusqu'à ce que l'appareil soit à l'arrêt.

Attention: Lâcher au bon moment la bague avance horizontale, c'est-à-dire aussitôt que le galet touche légèrement la paroi tout autour.

Au cas où le galet perd le contact à la paroi, il peut de nouveau être bougé vers l'extérieur en tenant la bague avance horizontale et en tournant la manivelle dans le sens opposé aux aiguilles de la montre, jusqu'à ce que l'appareil ait de nouveau un mouvement excentrique.

Si la rémanence d'aimantation est perdue entretemps, il faut la rétablir (interrupteur réversible en position 1, puis en position médiale).

Le procédé de centrage peut maintenant être répété.

"Vous verrez qu'après avoir acquis un peu d'expérience, le procédé de centrage vous plaira".

8. For centering the unit, hold the horizontal advancing ring with 2 fingers and turn the handle clockwise.

The unit will now move excentrically with every revolution. This excentric movement will decrease and finally stop as the centering roll moves back against the centre of the unit.

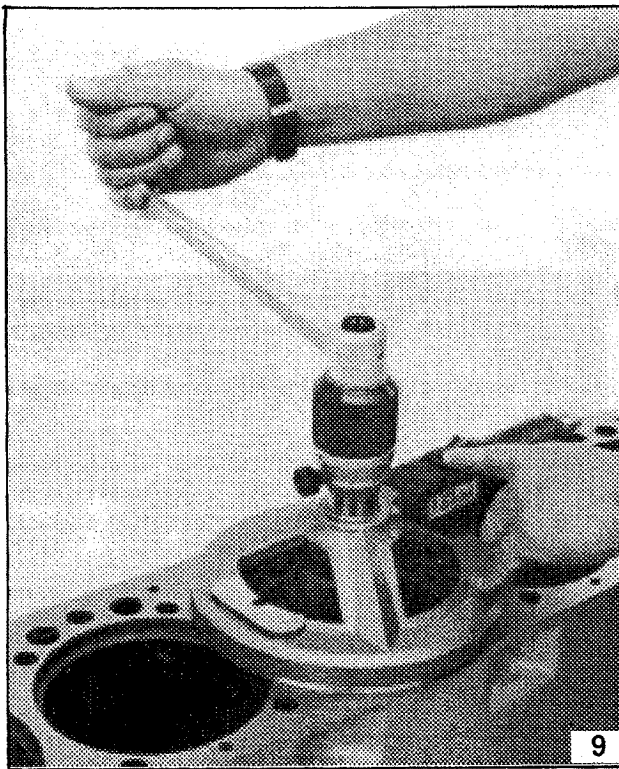
Attention: Release the horizontal feeding ring at the right moment, when the centering roll is just slightly touching the counterbore wall all around.

If the centering roll loses the contact to the counterbore wall, the tool can be moved to the opposite side by again holding the horizontal feeding ring and turning the handle counter-clockwise, until the unit is moving again excentrically.

If in the meantime a residual magnetism has gone lost, it has to be re-established (tumbler switch to position 1, then back to the centre position).

The centering procedure can now be repeated.

"With some practice the centering process will make fun".



9. Ist eine genaue Zentrierung erreicht, so wird der Kippschalter auf Stellung "1" gedrückt.

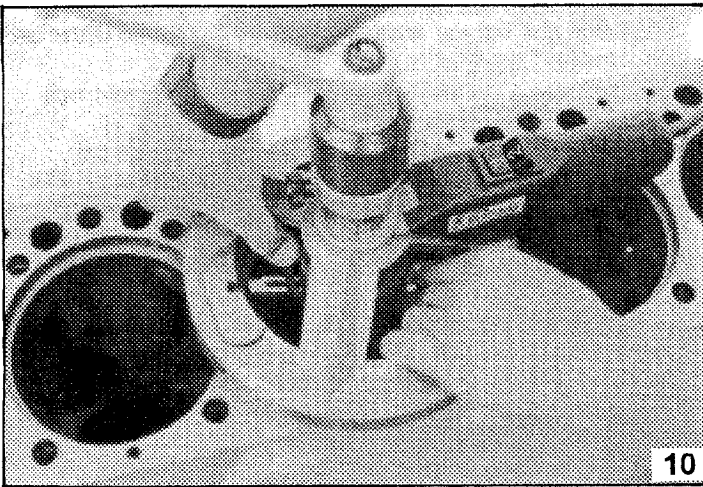
Kontrolle: Auch nach dem Magnetisieren soll sich die Handkurbel leicht drehen lassen und die Zentrierrolle sollte praktisch rundherum die Bohrungswand leicht berühren.

9. Lorsqu'un centrage exact a été obtenu, on appui sur la position 1 de l'interrupteur.

Contrôle: Après mise en aimantation la manivelle devra se laisser tourner aisément et le galet devrait pratiquement toucher légèrement la paroi tout autour.

9. Once an exact centering has been achieved, set the tumbler switch onto position 1.

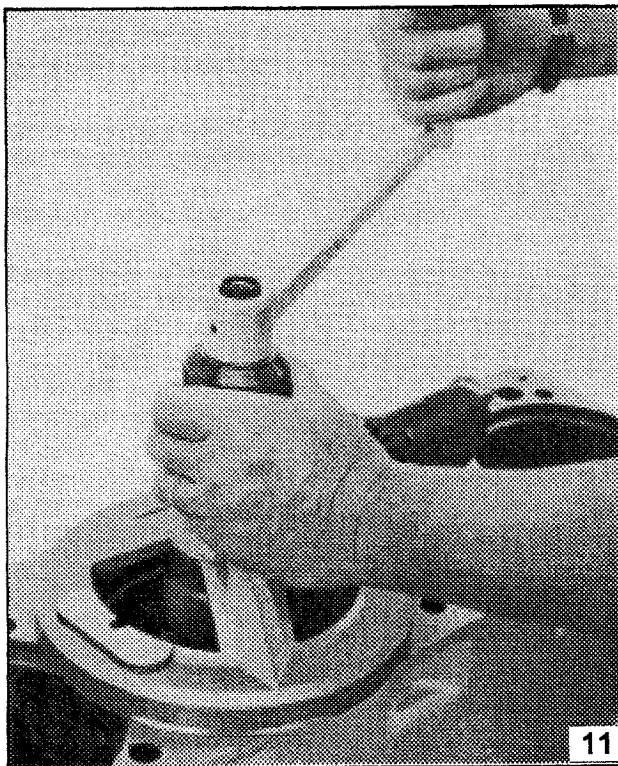
Check: After magnetizing, the handle must turn freely and the centering roll should slightly contact the counterbore wall all around.



10. Jetzt wird der Schnellverstellhebel gedrückt und der Drehstahl durchgeschoben, bis die Hartmetallschneide über der Mitte des Büchsenbundsitzes steht.

10. Il faut appuyer l'étrier de réglage rapide et pousser l'outil jusqu'à ce que sa pointe se trouve au-dessus du siège de l'épaulement.

10. Pushing down the quick setting bow allows now to move the tool with the cutting bit on top of the counterbore seat.



11. Blockierschraube lösen und Handkurbel drehen unter gleichzeitigem langsamem Drehen der Vorschubmutter (beide im Uhrzeigersinn) bis der Drehstahl den Büchsenbundsitz berührt.

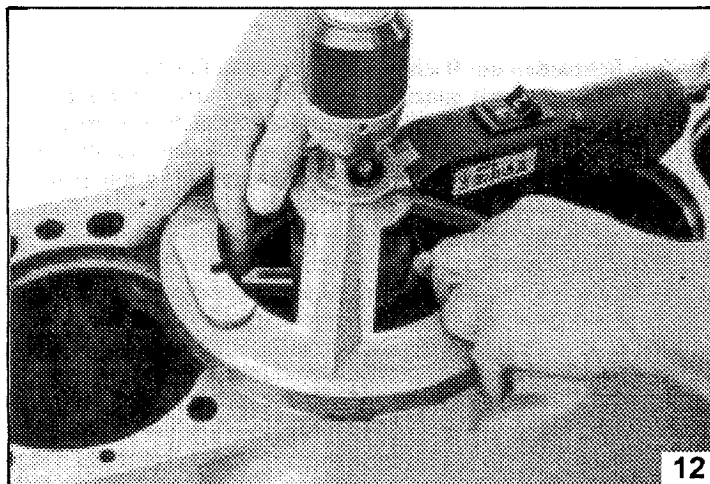
Wurde vorher an einer bestimmten Stelle die Tiefe ausgemessen, so muss man natürlich auch an dieser Stelle touchieren durch leichtes Hin- und Herbewegen der Drehkurbel. Dann die Blockierschraube leicht anziehen.

11. Il faut dégager la vis de blocage, tourner la manivelle et simultanément tourner le dispositif d'avance (les deux dans le sens des aiguilles de la montre) jusqu'à ce que l'outil prenne contact avec siège.

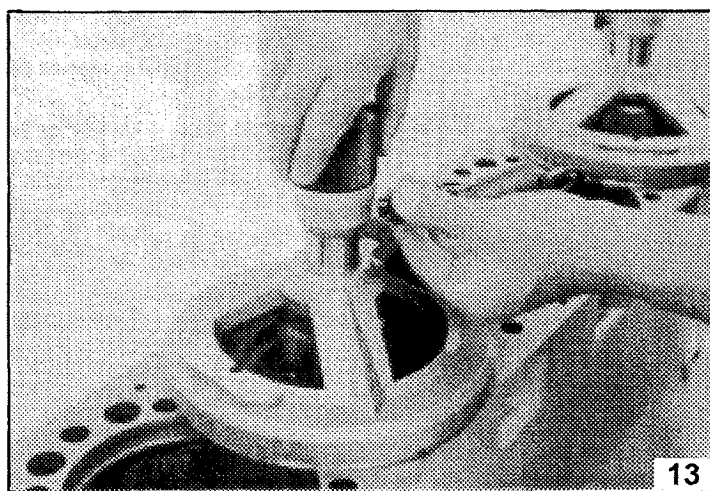
Si la profondeur du siège avait été prise auparavant, il faudrait naturellement chercher le contact à ce même endroit, en effectuant un léger mouvement de va-et-vient de la manivelle.

Puis serrer la vis de blocage.

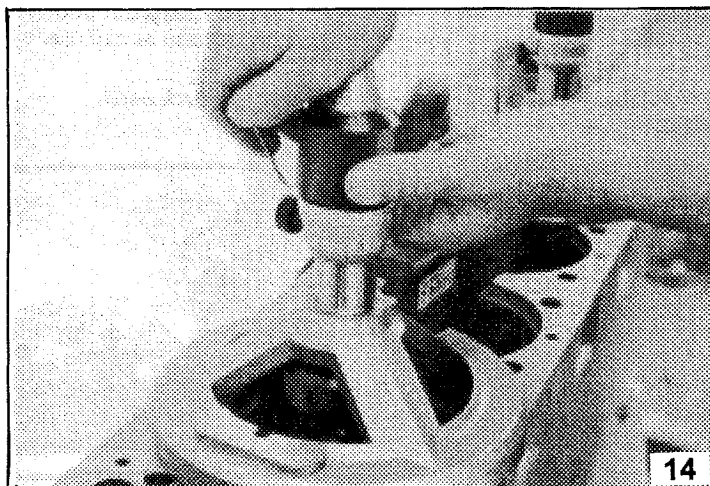
11. Loosen the locking screw, slowly turn the handle and simultaneously the advancing device (both clockwise) until the cutting tool contacts the seat.



12. Schnellverstellhebel drücken und Drehstahl in den freien Raum zurückstossen, bis die Hartmetallspitze knapp vor dem Büchsenbundsitz steht.
12. Il faut appuyer l'étrier d'avance rapide et retourner l'outil dans l'espace libre jusqu'à ce que la pointe de l'outil soit juste devant le siège.
12. Push the quick setting bow and return the cutting tool into the free space, the hard metal tip just before the counterbore.



13. Blockierschraube lösen und mit der Vorschubmutter die gewünschte Sitztiefe einstellen.
Dann ist die Blockierschraube leicht festzuziehen.
13. Dégager la vis de blocage et régler la profondeur voulue au moyen du dispositif d'avance.
Ensuite serrer légèrement la vis de blocage.
13. Loosen locking screw and set the correct depth by means of the advancing device.
Reblock the locking screw.



14. Je nach Arbeitsweise kann der Noniusring auf 0 gestellt werden. Dazu wird mit dem Drehstahl auf der bearbeiteten Oberfläche des Motorblockes touchiert.
Dann ist die Blockierschraube und mit einem Inbus-Schlüssel die Feststellschraube des Noniusrings zu lösen.
Jetzt stellt man den Noniusring auf 0 und auf den entsprechenden Teilstrich am Spindelhal.
Die Mikrometereinteilung am Noniusring zeigt nun die aktuelle Tiefe der Arbeitsspitze des Drehstahles an.
Bei einem Drehstahl-Wechsel ist die 0-Justierung natürlich zu wiederholen.
14. Selon la méthode de travail le vernier peut être réglé à 0. Puis on établit le contact de l'outil avec la surface d'étanchéité du bloc.
Dans ce but la vis de blocage et celle du vernier doivent être desserrées, cette dernière à l'aide d'une clé inbus.
Puis on règle le vernier sur 0 à la marque correspondante de la broche.
La réparation micrométrique au vernier indique alors la profondeur réelle de la pointe de l'outil.
Lors d'un remplacement de l'outil, l'ajustage à 0 doit être répété.
14. According to the working method, the vernier can be set to 0. For this purpose the cutting has to be brought into contact with the sealing surface of the engine block. Then the locking screw of the advancing device and the locking screw of the vernier have to be loosened.
The vernier can now be set to the mark on the spindle.
The micrometer graduation on the vernier shows the actual depth of the cutting tool bit.
By a replacement of the cutting tool, this 0-setting has of course to be repeated.



15. Zum Schneiden des Büchsenbundsitzes den Griff der Antriebskurbel mit ganzer Hand umfassen und Kurbel im Uhrzeigersinn gleichmäßig drehen. Dabei gleichzeitig mit der anderen Hand den Planvorschubring festhalten, wodurch sich der Drehstahl mit einem Vorschub von 0,144 mm pro Kurbelumdrehung nach aussen bewegt.

Sobald die Drehstahlspitze in der Nähe der Seitenwand angekommen ist, muss mit mehr Vorsicht gearbeitet werden. Dazu ist die Kurbel etwas langsamer zu drehen und der Planvorschubring zwischen den Fingern leicht schleifen zu lassen. Damit ist es möglich, den Drehvorgang zu stoppen, sobald ein erhöhter Widerstand, hervorgerufen durch das Anstossen des Drehstahles an der Seitenwand, verspürt wird.

Achtung: Handdrehkurbel unter Arbeitsdruck nie zurückdrehen, sonst bricht die Hartmetallplatte am Drehstahl aus.

15. Pour surfacer le siège pour la chemise. Saisir la poignée à pleine main et tourner la manivelle régulièrement dans le sens des aiguilles de la montre. Tenir simultanément la bague avance horizontale de l'autre main pour obtenir une avance de l'outil de 0,144 mm par tour de manivelle.

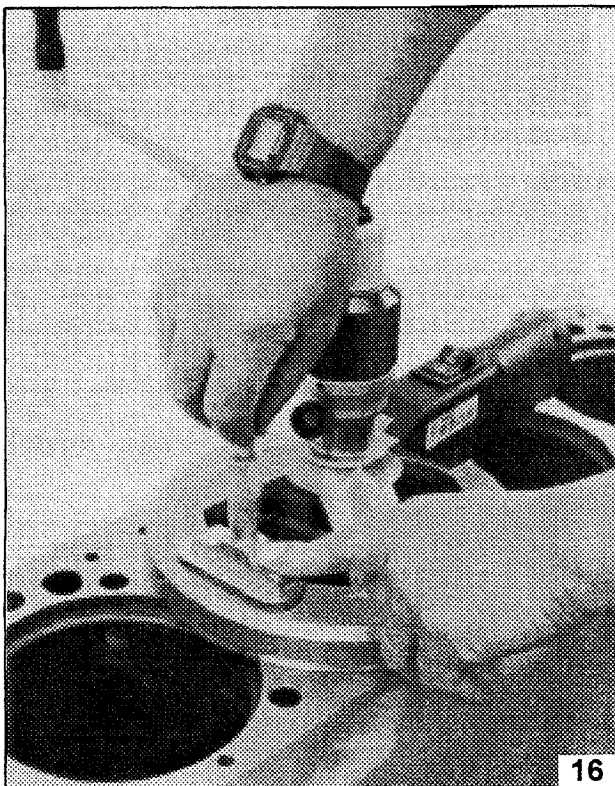
Dès que la pointe de l'outil s'approche de la paroi de l'épaulement, il faut tourner plus prudemment. Dans ce but actionner la manivelle plus lentement et laisser glisser légèrement la bague entre les doigts. Il est ainsi possible d'arrêter l'avance dès qu'une plus grande résistance se fait sentir, celle-ci provenant d'un attouchement de l'outil contre la paroi.

Attention: Ne jamais tourner la manivelle en arrière lorsque l'outil est sous pression de travail, afin d'éviter une rupture de la pointe en métal dur.

15. For refacing of the counterbore seat hold handle firmly, turning it regularly clockwise. With the other hand hold simultaneously cross feed ring, thus obtaining a horizontal feed of .00567" (0,144 mm) per revolution.

Turn handle more carefully when carbide tip approaches the wall, and let cross feed ring slip partially between your fingers. This permits you to stop turning as soon as carbide tip touches the wall.

Attention: Don't force the handle to move backwards, otherwise the hard metal tip might break.



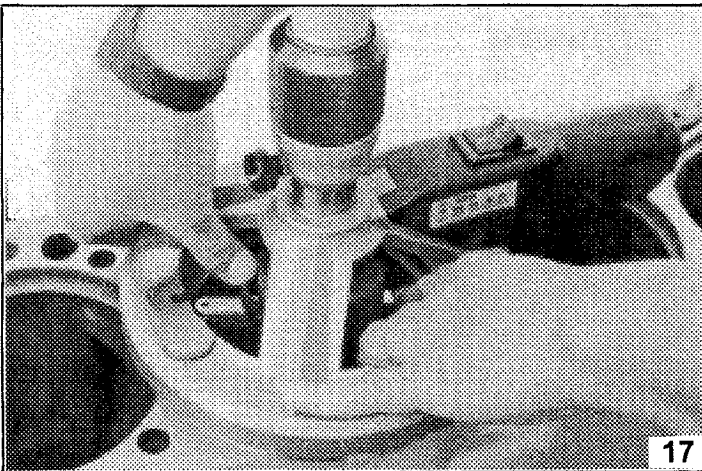
16. Die am BB-Ständer angebrachte Messfläche erlaubt eine Kontrolle der Büchsenbundsitz-Tiefe ohne das Gerät zu entfernen.

Die Messhöhe bis Motorblock beträgt 35,00 mm.

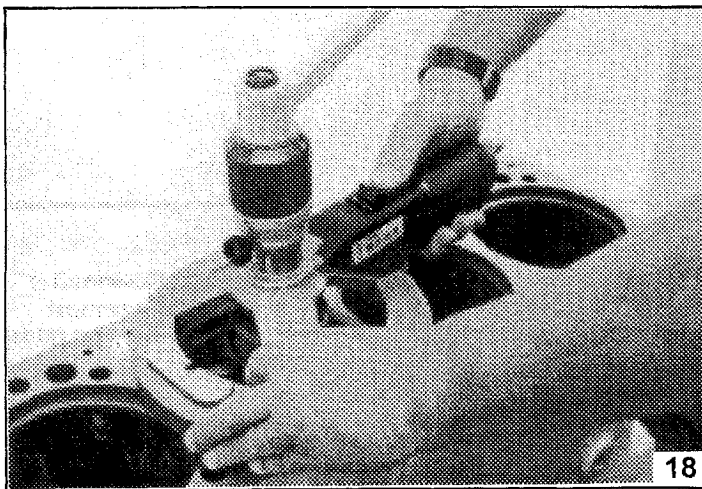
16. L'emplacement de mesure pour le micromètre à l'appareil permet un contrôle de la profondeur de l'épaulement, sans devoir retirer l'appareil.

La hauteur entre la surface d'étanchéité au bloc moteur et l'emplacement de mesure pour le micromètre est de 35,00 mm.

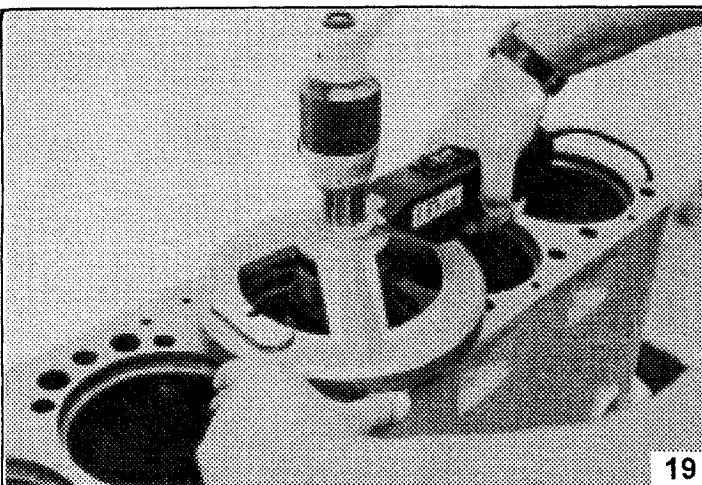
16. The measuring level allows to check the counterbore depth without removing the until. The level height above the engine surface amounts to 1,378" (35,00 mm).



17. Drehstuhl nach dem Drücken des Schnellverstellhebels zurückschieben bis die Zentrierrolle an der Bohrungswand ansteht. So wird beim Aufsetzen des Gerätes auf die nächste Bohrung schon eine Grobzentrierung erreicht.
17. Retourner l'outil jusqu'à ce que le galet de centrage touche la paroi. On obtient ainsi un centrage préliminaire de l'appareil pour le prochain alésage.
17. Push the quick setting bow downwards and remove the cutting tool until the centering roll touches the counterbore wall. Thus a rough centering of the unit on the next counterbore is obtained.



18. Kippschalter kurz auf Stellung 2 drücken und Gerät abheben.
18. Appuyer brièvement sur la position 2 à l'interrupteur. Retirer l'appareil des deux mains.
18. Tip tumbler switch onto pos. 2 and remove the unit with both hands.



19. Gerät mit Druckluft von den Metallspänen befreien und auf die saubere Oberfläche der nächsten Bohrung auflegen.
19. Libérer l'appareil des copeaux métalliques à l'aide d'air comprimé. Poser des deux mains l'appareil sur la surface bien propre de l'alésage suivant.
19. Blow the metal chips from the unit by means of compressed air and place it onto the clean surface above the next counterbore.

Connecting Rod Inspection and Bushing Replacement

Use special tools no. 32 and 82.

Connecting Rod Inspection:

To remove connecting rod see procedures in sub group 3.18.

Clean connecting rod and check lubrication bores for deposits to be removed. Inspect connecting rod bushing for wear.

Measure inside diameter in connecting rod bushing with micrometer on several locations and write down measurements. Compare measurements with dimensions given in Engine Specifications.

Note:

In case the measurements do not conform with the dimensions specified, the connecting rod bushing must be replaced.

Correctly place respective bearing shells in connecting rod bearing support and connecting rod bearing cap.

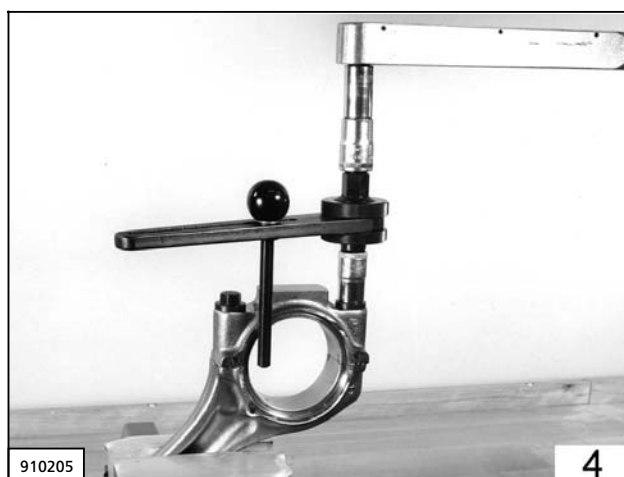
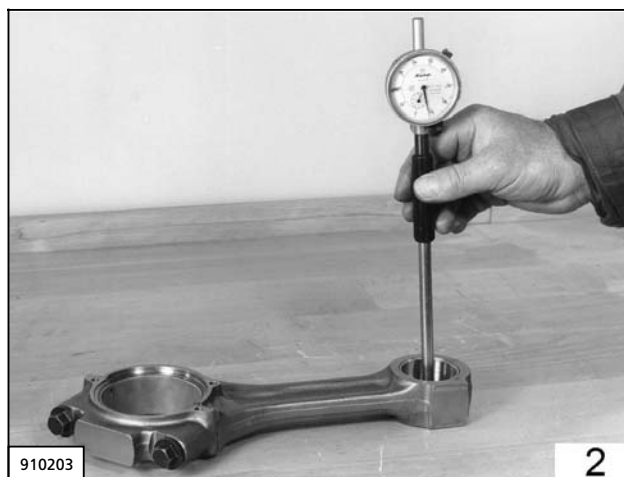
For installation procedure see sub group 3.18.

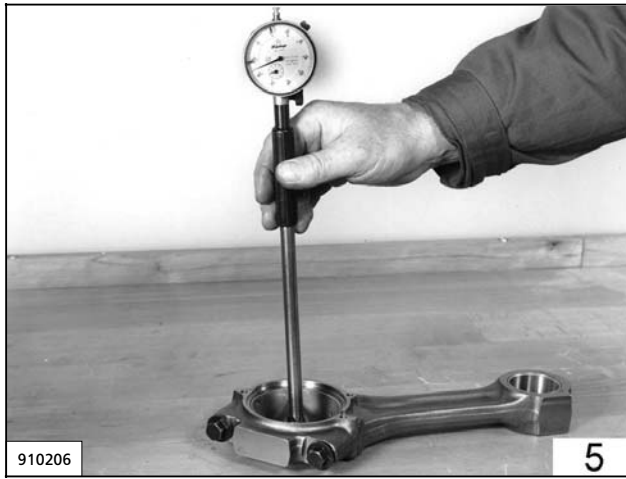
Place connecting rod in vise. To avoid damage use protective jaw covers. Line-up bearing cap and connecting rod with its markings matching and temporarily install bearing cap to connecting rod with mounting bolts. Pretorque mounting bolts and apply final torque with torque angle indicator, special tool no. 32.

See Engine Specifications for proper torque.

Note:

Measure mounting bolt length and replace stretched bolts as outlined in sub group 3.18.



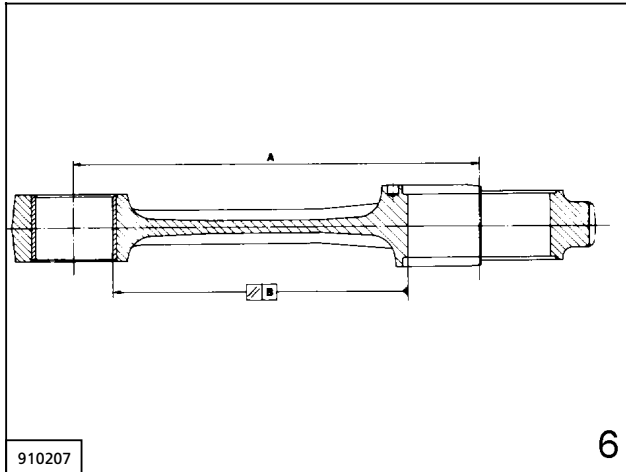


Measure inside diameter on connecting rod bearing with micrometer or dial gauge on several locations and write down measurements. Compare measurements with dimensions given in Engine Specifications.

Note:

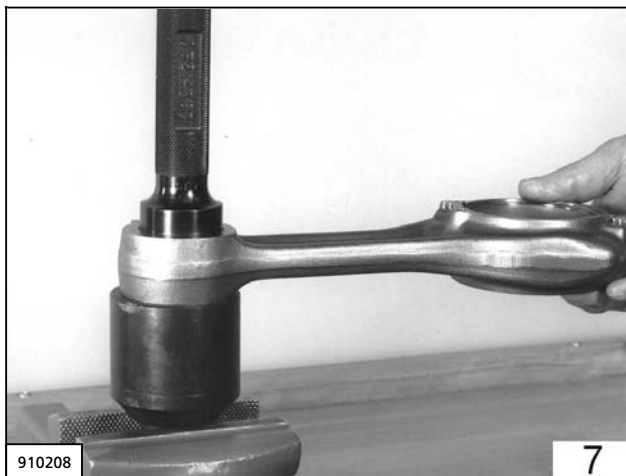
The connecting rod bearing shells are manufactured to assume their correct dimension after installation and should not be remachined. In case the measurements differ from the required dimensions, both bearing shells must be replaced.

For undersized bearing shells and crankshaft pins see Engine Specifications.



Measure centerline distance "A" between connecting rod bearing and bushing bores and parallel distance "B" between connecting rod bushing and bearing bore with proper measuring device.

For correct dimensions see Engine Specifications.



Connecting Rod Bushing Replacement:

Remove worn or damaged bushing from connecting rod with punch, special tool no. 82.



Lubricate new bushing with engine oil, line-up lubrication bores on bushing and connecting rod and press bushing into connecting rod with same punch.

Note:

The connecting rod bushing is manufactured to assume its correct dimension after installation and should not be remachined.

SUB GROUP INDEX

4.01	Crankcase, Main Bearing and Thrust Bearing Inspection
4.05	Crankshaft Inspection and Grinding
4.10	Camshaft and Camshaft Bushing Inspection
4.12	Camshaft Bushing Replacement

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type	D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de	
		Blatt/Page/Feuille	
Datum/Edition/Date	Crankcase, Crankshaft, Camshaft Inspection and Bearing Replacement	4.00	
01.99			

Crankcase, Main Bearing and Thrust Bearing Inspection

Use special tool no. 32.

Crankcase Inspection:

The engine must be completely disassembled as described in main group 9.00.

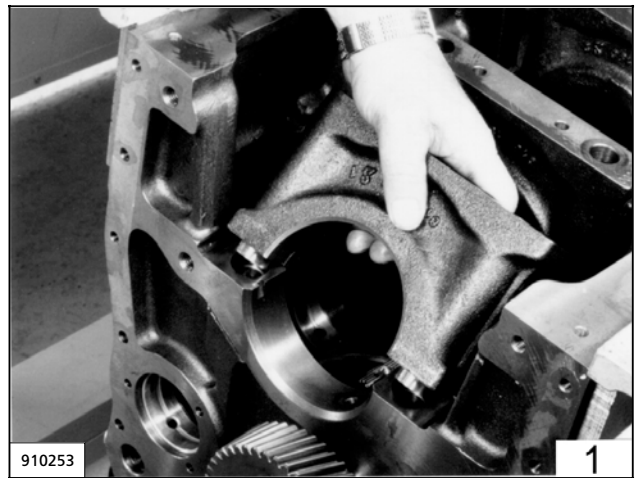
Clean crankcase and check lubrication bores for any deposits to be removed.

Place numbered main bearing and thrust bearing caps on respective bearing mounts in crankcase.

Note:

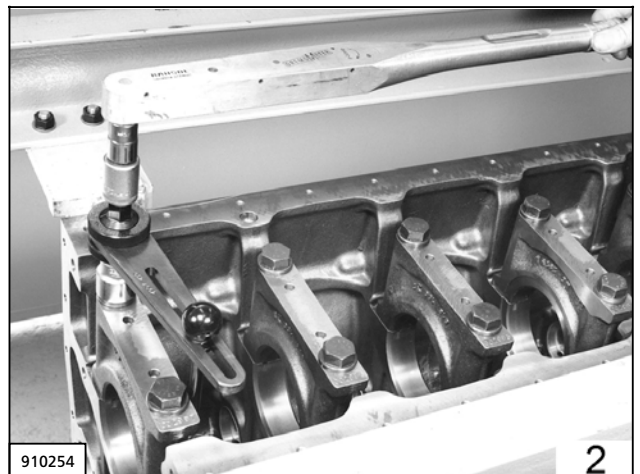
The bearing caps are identified in numbering sequence starting at the flywheel and on the lefthand side of the caps with the engine block turned upside down.

See main group 1.00 for numbering sequence.



Screw in and pretorque cap mounting bolts. Apply final torque with angle indicator, special tool no. 32.

See Engine Specification for proper torque.

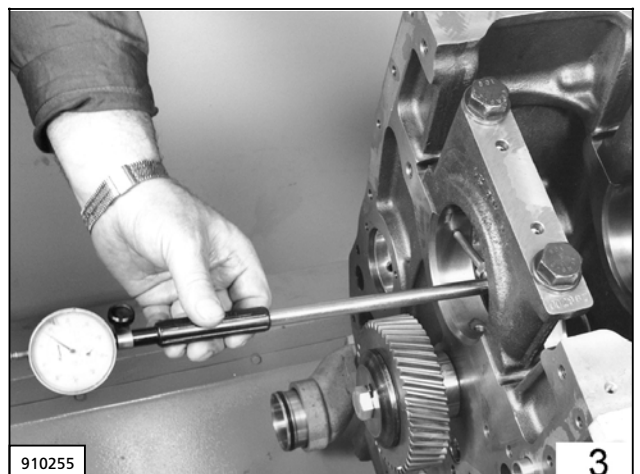


Measure bore diameter for bearing on three different locations with micrometer or dial gauge.

Note:

Take one measurement in direction of cylinder axis and one measurement each, 30° below and above the contact surface between crankcase and bearing cap.

See Engine Specification for proper dimensions.



Important:

Should the bore diameter for the crankshaft bearings not conform with the required dimensions, both the crankcase and bearing caps must be replaced. Otherwise, the crankshaft bearings will lack the proper pretension.



Main Bearing Inspection:

Loosen and remove main bearing and thrust bearing cap mounting bolts. Loosen bearing caps with rubber or plastic hammer and remove caps from crankcase.



Place main bearing shells in bearing mounts on crankcase and bearing caps.

Note:

In case the old bearing are reused, install bearing shells in matched pairs and into proper location as marked during disassembly. Do not mix-up the individual bearing shells. Install bearing shells with their tongs resting in the grooves on crankcase bearing mounts and caps. The bearing half-shells for the crankcase have one tong, while the bearing half-shells for the bearing caps have two tongs.



Place caps for main bearings and thrust bearing on respective bearing mounts in crankcase (install as identified in number sequence). Screw in and torque cap mounting bolts as described at fig. 2.

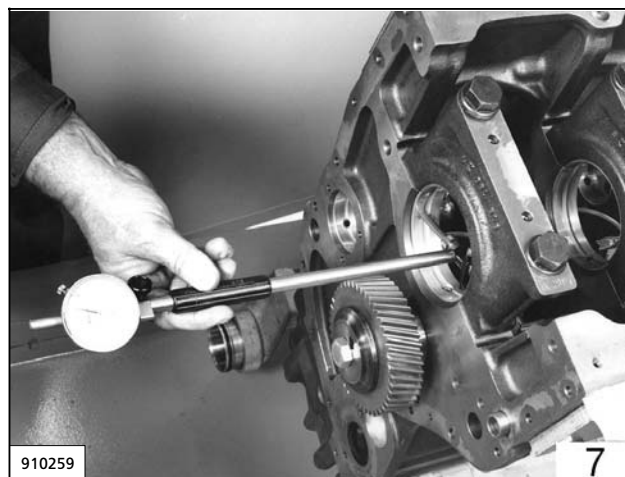
Measure bearing inside diameter on three locations with micrometer or dial gauge as described at fig. 3.

See Engine Specifications for proper dimensions.

Important:

In case the inside diameter of the bearing, does not conform with the required dimension, or the bearing shells show any damage, both bearing shells must be replaced and the measurement repeated. Do not try to rework the bearing shells in any case. In case the crankshaft has to be ground, use bearing shells with undersized inside diameter.

See Engine Specifications for detail on undersized bearings.



Thrust Bearing Inspection:

Place thrust washers on thrust bearing mount and measure entire width with micrometer.

See Engine Specifications for proper axial play.

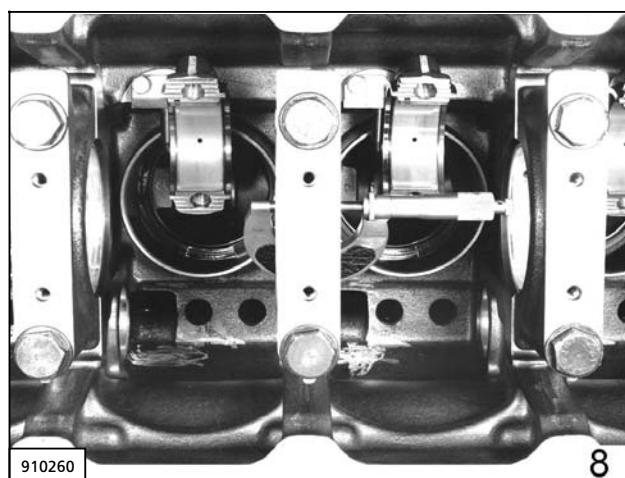
Important:

To determine the axial play, measure distance between the thrust washer contact surfaces on crankshaft.

In case the axial play exceeds the required dimensions, or the thrust washers show any damage, the thrust washers must be replaced.

In case it becomes necessary to surface grind the contact surfaces on the crankshaft, oversized thrust washers must be used.

See Engine Specifications for detail on oversized thrust washers.



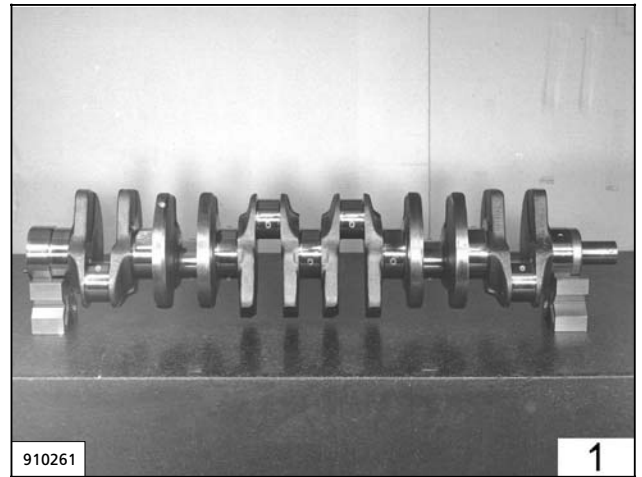
Crankshaft Inspection and Grinding

Crankshaft Inspection:

To remove crankshaft see procedures in main group 9.00.

Clean crankshaft and check lubrication bores for any deposits to be removed.

Place crankshaft with outside bearing journals on V-notch shaped supports.

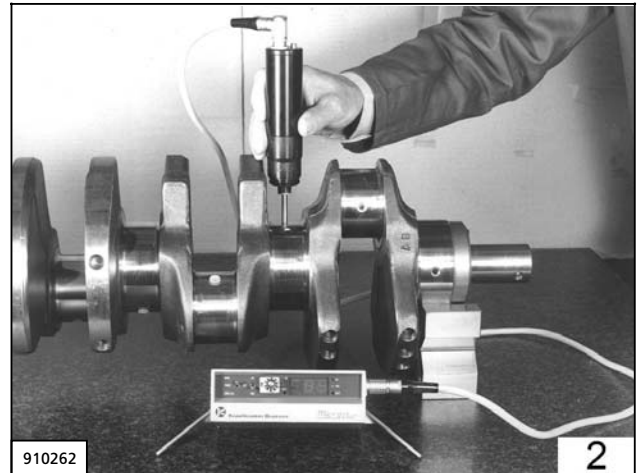


Measure surface hardness on crankshaft bearing journals and connecting rod pins with standard type hardness tester.

See Engine Specifications for proper hardness.

Note:

Depending on the hardness tester design and type, it might become necessary to cross-reference the hardness by mean of comparison charts.

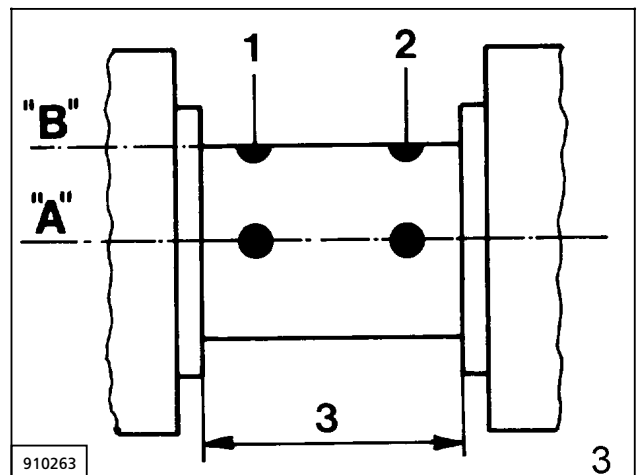


Visually inspect crankshaft at bearing journals and connecting rod pins as well as thrust washer contact surfaces for wear and hairline cracks.

Measure crankshaft bearing journal and connecting rod pin diameters at location 1 and location 2 in direction "A" and 90° repositioned in direction "B".

Determine measurement 3 on thrust bearing.

Compare measurements with data given in Engine Specifications.

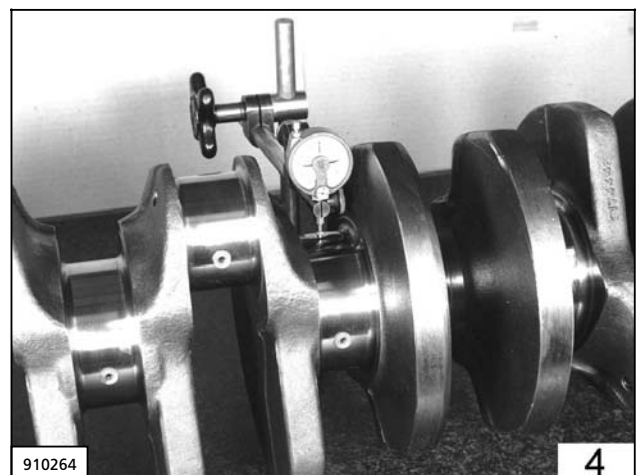


Check crankshaft for proper true run, offset, straightness and parallel alignment.

Compare measurement taken with dimensions given in crankshaft drawing.

Note:

Should the measurement not conform with the required dimensions, the crankshaft must be remachined ground or replaced entirely.



Crankshaft Grinding:

Important:

In case the hardness tests show a soft spot on the crankshaft bearing journals or connecting rod pins, the crankshaft must be heat treated and hardened before grinding can take place.

Grind down crankshaft to next undersized diameter.

See Engine Specification for undersized diameter dimensions.

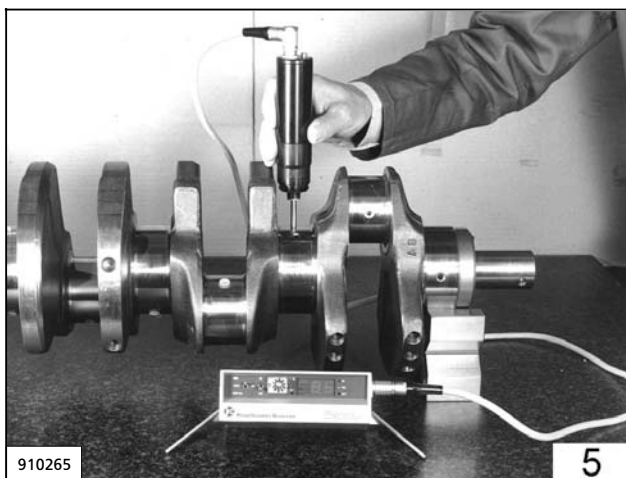
For proper surface quality and fillet radius see crankshaft drawing.

Note:

In case one crankshaft bearing journal or connecting rod pin must be remachined, all journals or rod pins must be ground to the same undersized diameter dimensions.

The crankshaft contact surfaces for the thrust washers can be surface-ground as well.

During the grinding process, the fillet radius on crankshaft bearing journal and connecting rod pin must be maintained.



Round out lubrication bores slightly, without causing grooves or notches, after grinding. Do not chamfer or countersink lubrication bores.

Carefully clean crankshaft and lubrication bores.

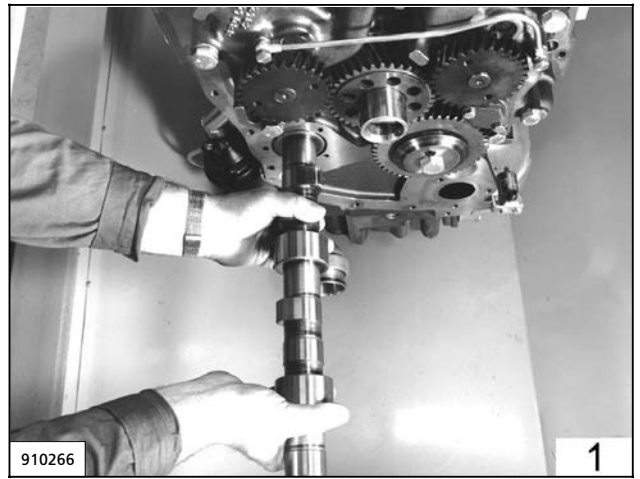
Recheck surface hardness on crankshaft bearing journals and connecting rod pins as outlined at fig. 2.

Recheck crankshaft visually and dimensionally as outlined at fig. 3 and fig. 4.

Camshaft and Camshaft Bushing Inspection

Checking Axial Play

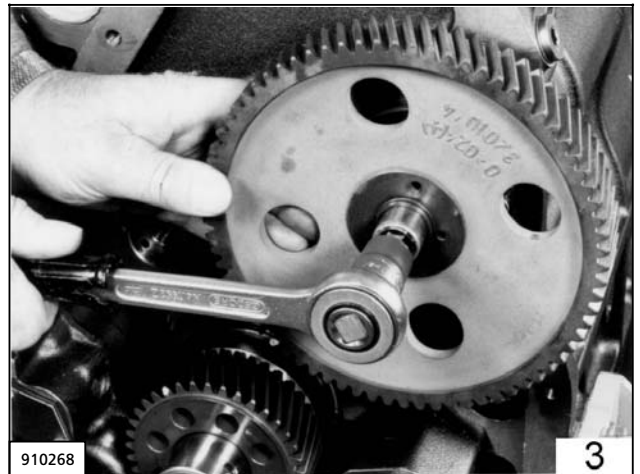
The engine must be completely disassembled as described in main group 9.00.
Place camshaft in camshaft bushings on crankcase.



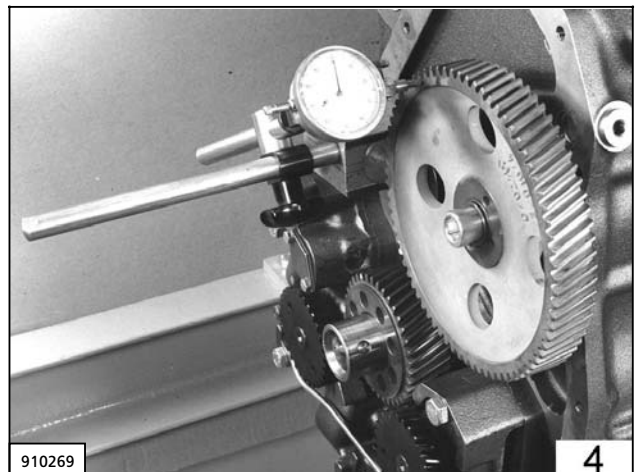
Place thrust washer over camshaft into crankcase and secure with mounting bolts.

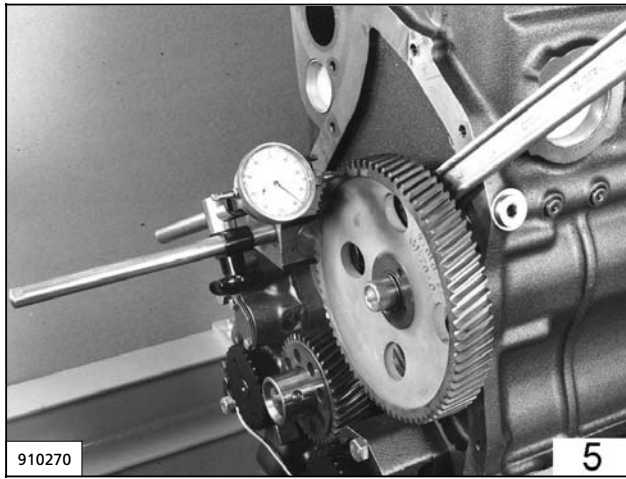


Align camshaft drive gear wheel with dial pin and install gear wheel on camshaft. Secure gear wheel with mounting bolt.



Push camshaft drive gear wheel against thrust washer. Secure dial gauge holder with dial gauge to crankcase, place dial gauge feeler pin against gear wheel. Set dial gauge to "0" with gear wheel pushed against thrust washer.

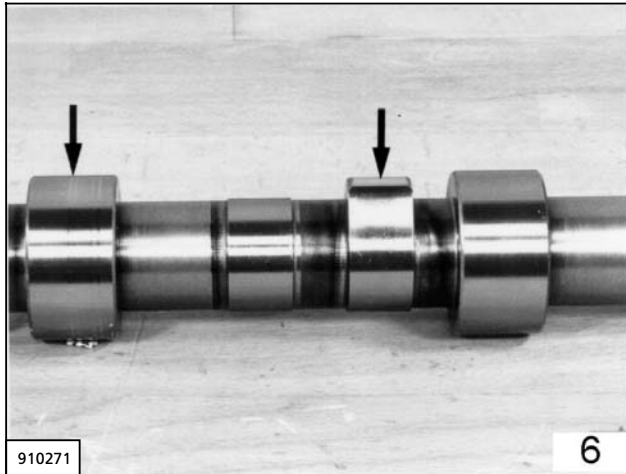




Push camshaft drive gear wheel toward dial indicator and read axial play.
See Engine Specifications for proper play.

Note:

In case the axial play measured exceeds the specifications, the thrust washer must be replaced and the axial play rechecked. In case the axial play remains excessive, even though the thrust washer was replaced, the camshaft or the drive gear wheel must be replaced.



Camshaft Inspection:

The camshaft must be removed.
Visually check camshaft bearing journals and cam surfaces for wear and damage.



Measure camshaft bearing journal diameter with micrometer or dial gauge.
See Engine Specifications for proper dimensions.

Note:

A camshaft, that does show wear or damage or whos measurements do not conform with the dimensions specified, must be replaced.



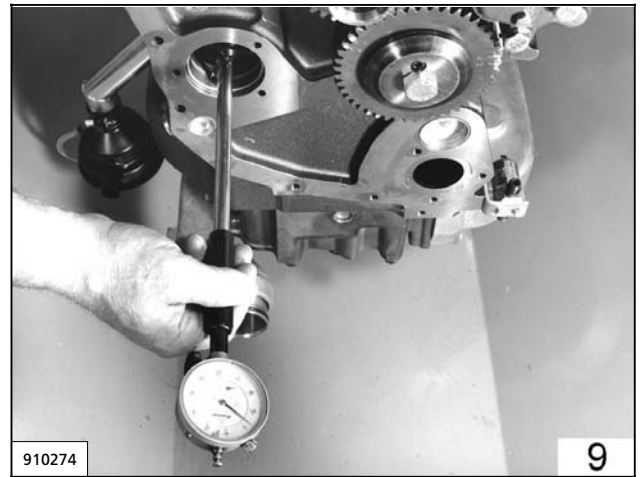
Camshaft Bushing Inspections:

Visually check camshaft bushings in crankcase for wear or damage.

Measure bushing inside diameter with micrometer or dial gauge on two locations in horizontal and vertical direction (90° repositioned). Compare measurements with data given in Engine Specifications.

Note:

Should the measurements not conform with the required dimensions or the bushing are damaged, the camshaft bushings must be replaced. In case replacement becomes necessary, all camshaft bushings must be replaced.



Camshaft Bushing Replacements

Use special tools no. 12 and 73.

Camshaft Bushing Removal:

The engine must be completely disassembled as described in main group 9.00.

For positioning and installation measurements see page 4.12.03.

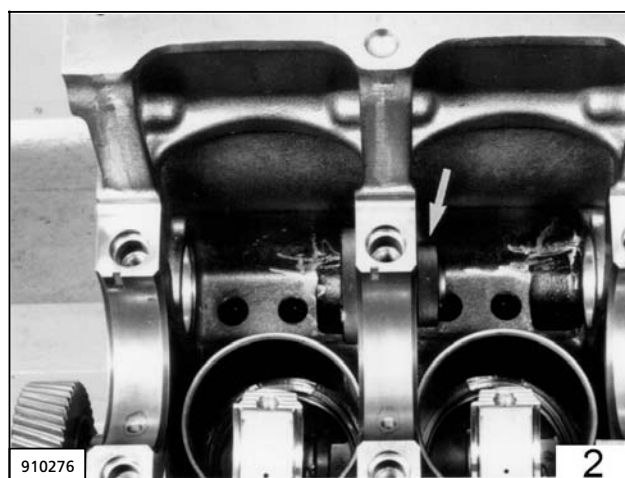
Knock-out and remove lubrication bore plug from crankcase front.

Note:

This front plug also can be knocked out from the flywheel side with a long punch (rod) through the lubrication bore.

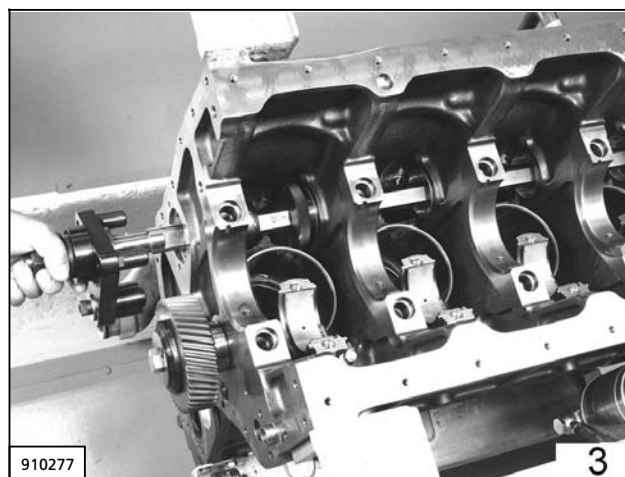


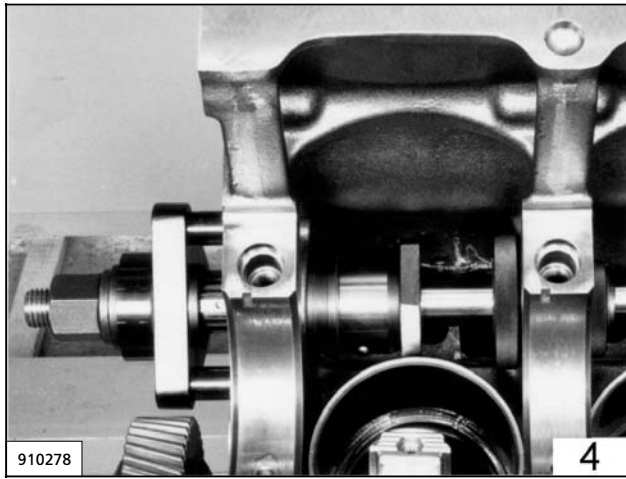
Place two guide bushings Pos. 1 from camshaft bushing removal and installation device, special tool no. 12, into second and last camshaft bushing, seen from crankcase front side. Secure guide bushings in place with excenter-rings Pos. 2.



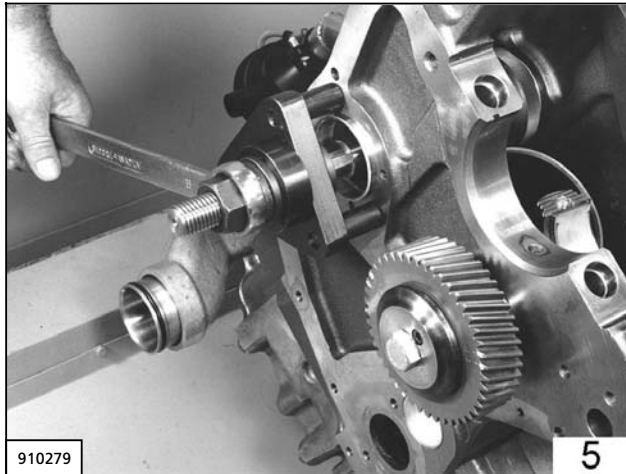
Position glide element Pos. 3 as shown on page 4.12.03 ("Remove" = "Ausziehen") and place glide element behind the first camshaft bushing support seen from crankcase front side.

Insert bushing removal and installation device with shaft Pos. 4 into glide element Pos. 3 and guide bushings Pos. 1.

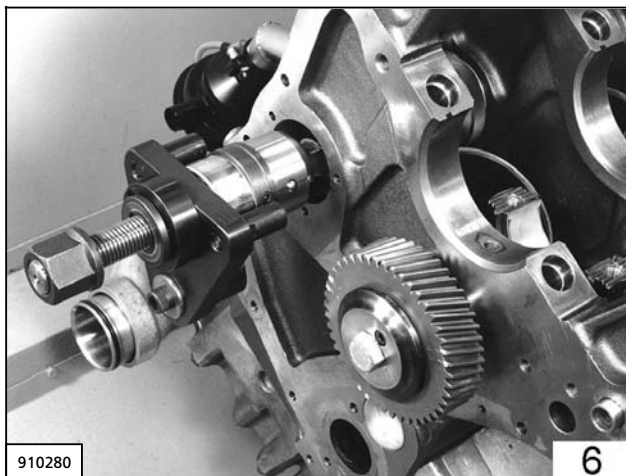




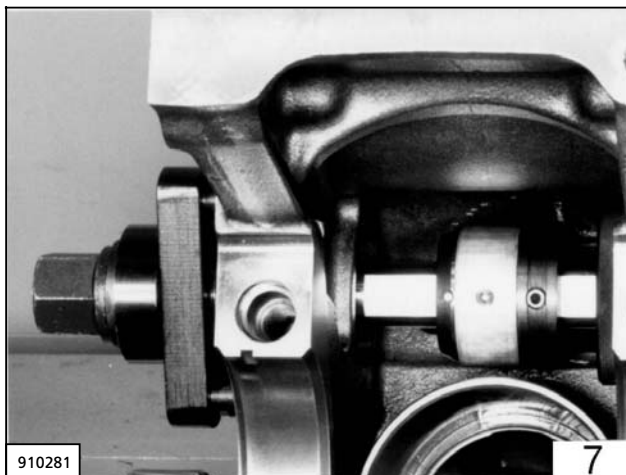
Place positioning pin Pos. 5 in lubrication bore and retaining plate Pos. 6 on the machined surfaces on shaft Pos. 4.



Remove camshaft bushing by turning the hex head nut Pos. 7.



Turn back hex head nut Pos. 7, remove retaining plate Pos. 6 and pull shaft Pos. 4 with glide element Pos. 3 and camshaft bushing from crankcase. Remove glide element Pos. 3 and camshaft bushing from shaft.

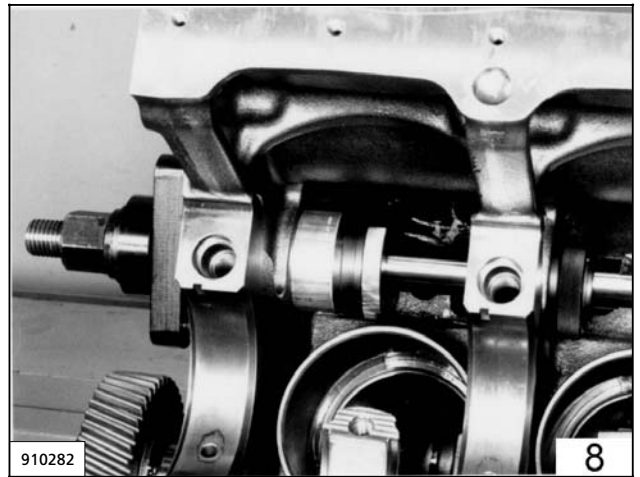


Camshaft Bushing Installation:

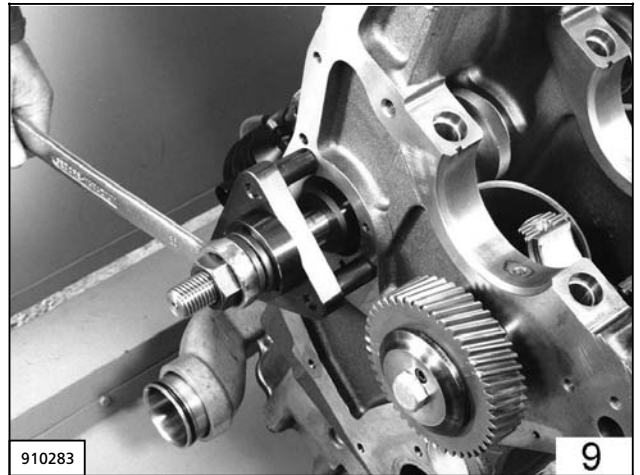
Clean and lubricate bushing bore in crankcase with engine oil.

Turn glide element Pos. 3 around as shown on page 4.12.03 ("Install" = "Einziehen"). Place new camshaft bushing on glide element Pos. 3 and lubricate camshaft bushing with engine oil. The lubrication bore of the camshaft bushing must rest over the positioning ball on glide element. Place glide element Pos. 3 with bushing behind the bushing support in crankcase, insert removal and installation shaft Pos. 4 into glide element Pos. 3 and guide bushings Pos. 1.

Place positioning pin Pos. 5 in lubrication bore and retaining plate Pos. 6 on machined surfaces on shaft Pos. 4.



Insert camshaft bushing by turning hex head nut Pos. 7 until it bottoms out.



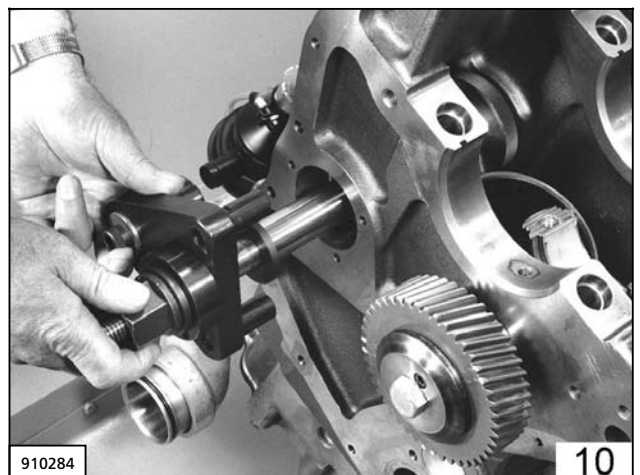
Turn back hex head nut Pos. 7, remove retaining plate Pos. 6 and pull shaft Pos. 4 from crankcase. Remove glide element Pos. 3 from installed camshaft bushing.

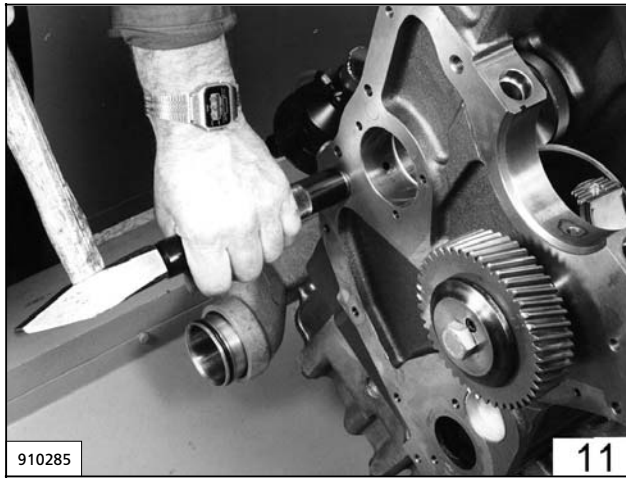
Note:

Remove all camshaft bushings, one after the other as described before.

The guide bushings Pos. 1 must be repositioned as required keeping a sufficient distance to each other. The camshaft bushings are manufactured to assume their correct dimensions after installation. There is no need to remachine the bushings after installation.

The lubrication for the last camshaft bushing (closest to the flywheel) is accomplished through a camshaft lubrication bore.



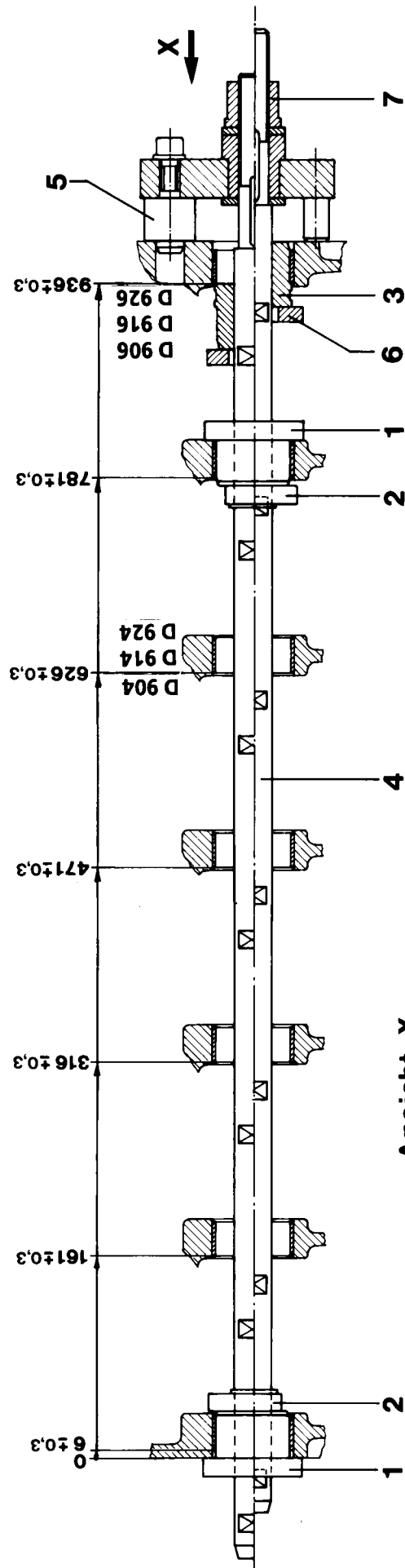


When all camshaft bushings are replaced, put liquid sealant, such as Loctite 270 or Omnifit 200 M, on new plug and insert plug into lubrication bore on crankcase with punch, special tool no. 73.

Ausziehen

pull out

extraction

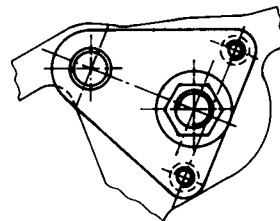


Einziehen

push in

introduction

Ansicht X



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5.02	Fan / hub installation on water pump, fan drive removal and installation (Coolant pump integrated in timing gear cover)	
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LIEBHERR	Benennung/Description/Dénomination	Typ Model Type
	Components - Front section	D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
Datum/Edition/Date		Blatt/Page/Feuille
05 / 2003		5.00

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5.28	Tach drive removal, repair and installation	up to engine S/N 86 01 1581
5.29	Tach drive removal, repair and installation	from engine S/N 86 01 1582
5.35	Coolant shut off valve for coolant filter on thermostat housing, removal and installation	

LIEBHERR	Benennung/Description/Dénomination Components - Front section	Typ Model Type D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 5.00-01
Datum/Edition/Date 05 / 2003		

Fan and fan hub removal and installation (Fan installation on coolant pump)

Removal:

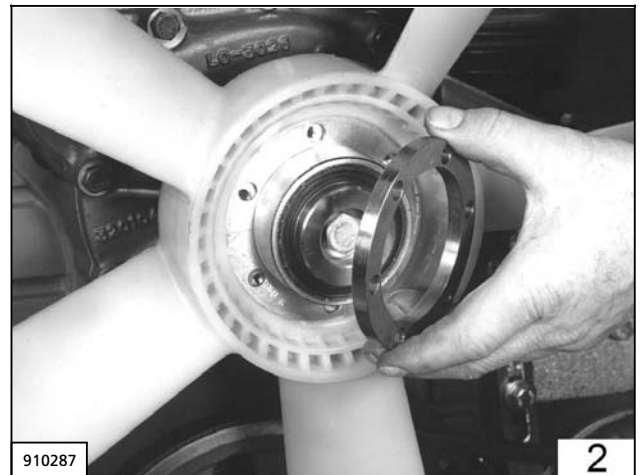
Loosen and remove fan mounting screws.



Remove pressure flange and fan from hub assembly.

Note:

Before removing the fan, note the position of the fan blades.



Loosen and remove the retaining screw on the fan hub drive shaft.



Remove pressure flange and fan hub assembly from drive shaft.

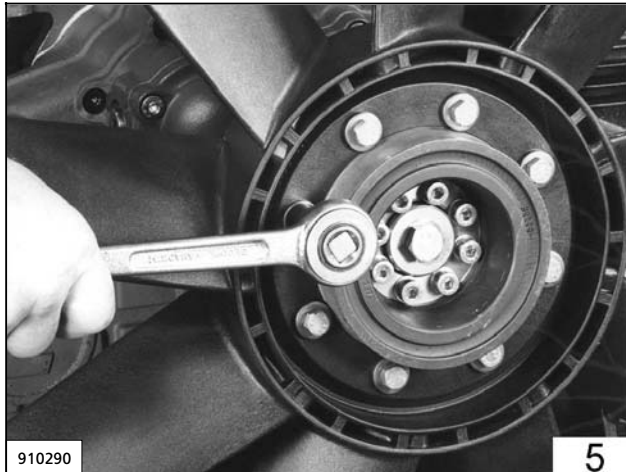


Fan and hub installation

Place fan hub assembly and mounting flange on drive shaft, insert and torque retaining bolt.

See Engine Specifications for proper torque setting.

Place fan on fan hub assembly, position mounting flange, screw in and torque fan mounting bolts.



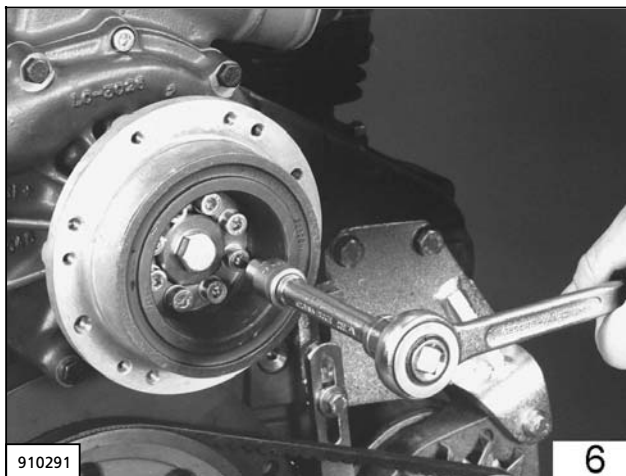
Fan and fan hub removal and installation (fan installation on coolant pump)

Removal:

Loosen and remove fan mounting screws.
Remove fan from fan hub.

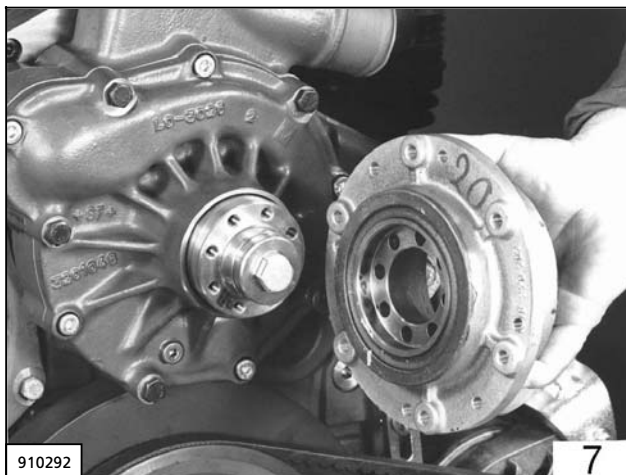
Note:

Before removing the fan, note the position of the fan blades.



Loosen and remove mounting bolts from fan hub assembly.

Remove fan hub assembly from drive shaft.



Fan and hub installation:

Place fan hub assembly on drive shaft, screw in and torque fan hub mounting bolts.

Place fan on fan hub assembly, insert and torque fan mounting bolts.

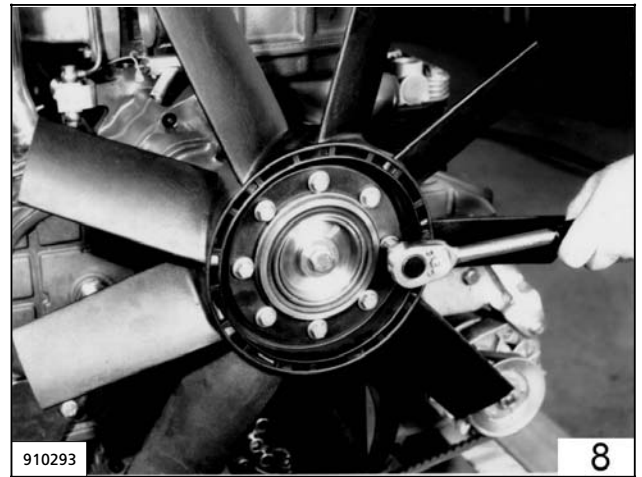
Fan and fan hub removal and installation (Fan installation on coolant pump)

Removal:

Loosen and remove fan mounting screws.
Remove the fan from the fan hub.

Note:

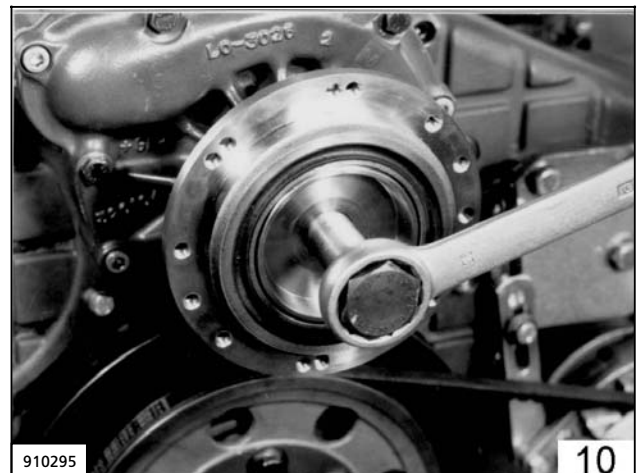
Before removing the fan, note the position of the fan blades.



Loosen and remove the retaining screw on the fan hub drive shaft.



Install a M 24 x 1.5 screw into the hub center and, by turning, pull hub from shaft.

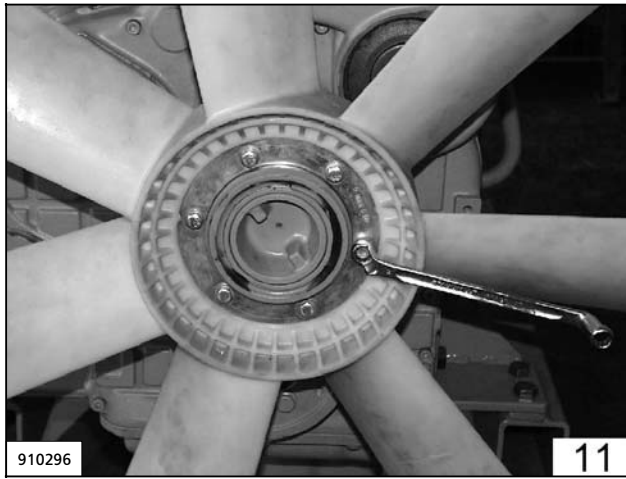


Installation:

Place hub on shaft, install and tighten center mounting screw.

For proper torque, see Engine Specifications.

Place fan on hub, install and tighten mounting screw.



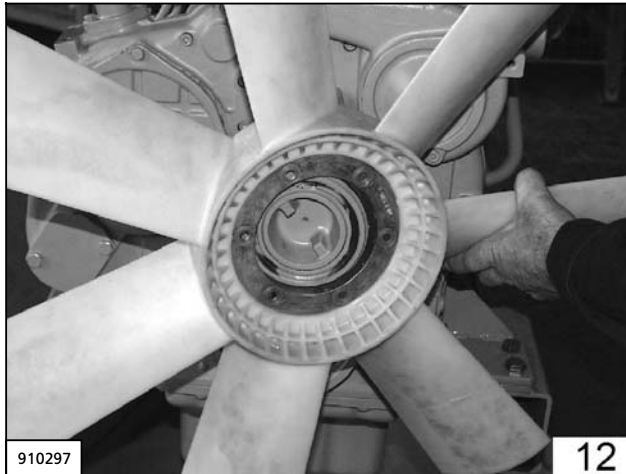
Fan and hub removal and installation (Coolant pump integrated in the timing gear cover)

Removal:

Loosen and remove fan mounting screws.

Note:

Depending on the type of fan, the fan can be installed on the fan hub with the mounting flange from the front or from the rear.



Remove the fan from the fan hub.

Note:

Before removing the fan, note the position of the fan blades.

Installation:

Place fan on fan hub, install and tighten the mounting screws.



Removal and installation of fan from Visco coupling (Coolant pump integrated in timing case)

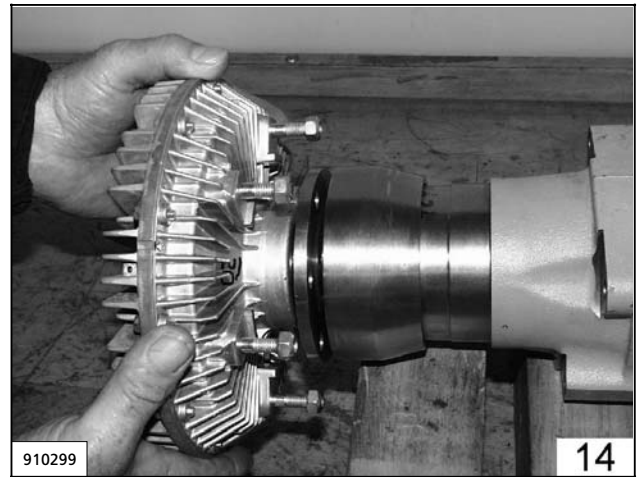
Removal:

Loosen and remove the mounting screws on the Visco coupling to the fan drive.

Remove the Visco coupling together with the fan from the fan hub.

Important:

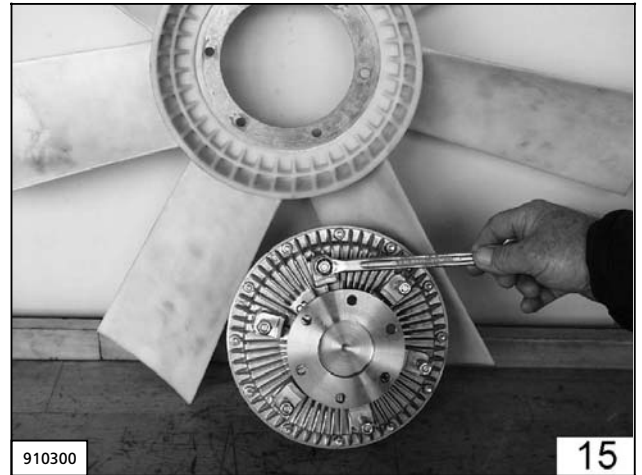
Set the Visco coupling down only in vertical position (installation position), in any other position, there is the danger that the oil runs out.



Loosen and remove the nuts on the Visco coupling. Remove the fan from the Visco coupling.

Note:

Before removing the fan, note the position of the fan blades.



Installation:

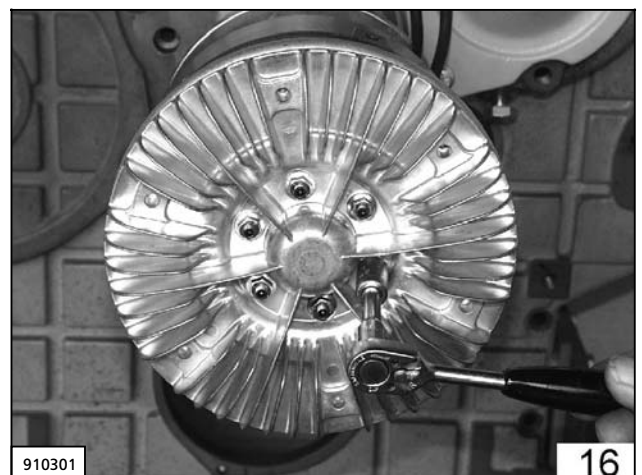
Position the fan onto the Visco coupling, install and tighten the nuts.

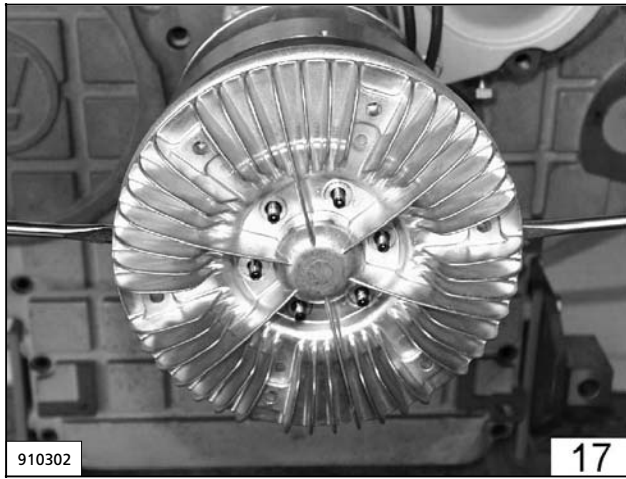
Push the Visco coupling onto the fan hub, insert the screws and tighten.

Removal and installation of fan from (3-stage) fan coupling

(Coolant pump integrated in timing gear cover)

Loosen and remove the mounting screws on the fan coupling.





With two screw drivers, push off the cooling fin ring from the fan coupling.



Loosen and remove the mounting screws on the magnetic ring.



Remove the magnetic ring from the fan coupling.



Loosen and remove the nuts on the fan coupling.

Remove the fan from the fan coupling.

Note:

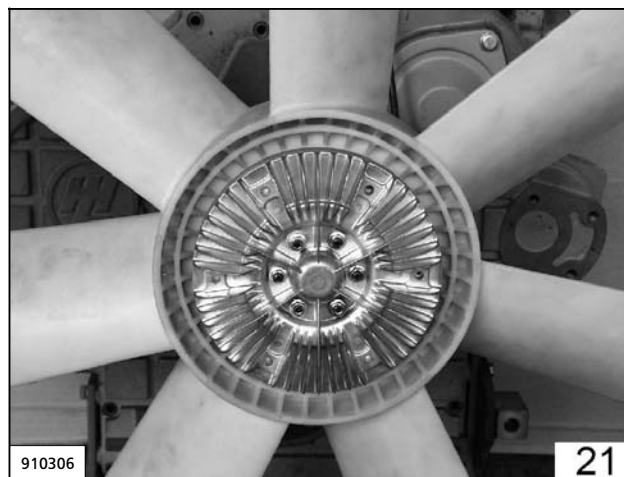
Before removing the fan, note the position of the fan blades.

Installation:

Place the fan on the fan coupling, install and tighten the nuts .

Slide the magnetic ring on the fan coupling, install and tighten the screws.

Attach the cooling fin ring, install and tighten the nuts.



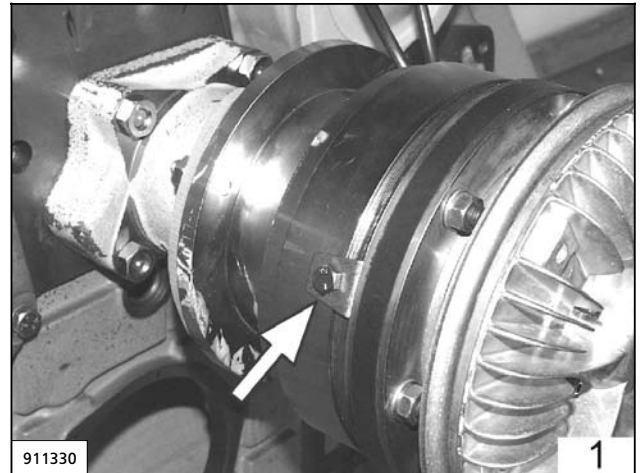
Fan drive removal and installation (Coolant pump integrated in the timing gear cover)

Note:

Depending on the engine type, the fan drive can be fixed, with Visco coupling or with fan coupling.

Important:

If a fan coupling is installed on the fan drive, the fan coupling can be mechanically blocked if the correct engine fan RPM is not reached. Example: due to a defect in the power supply. Install two screws M 6x10 through the brackets in the threads in the cooling fin ring.



Fan drive without lube oil supply: (with ball bearing)

Removal:

Drain the coolant, see sub group 2.01.

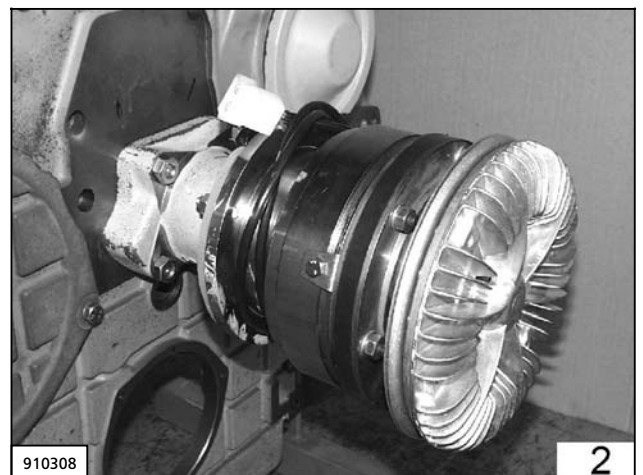
Remove the radiator.

Remove the fan, see sub group 5.01.

If a fan coupling is installed, remove the wire on the distribution point.

Note:

Do not remove the wire on the fan coupling!



Loosen and remove the nuts on the fan drive.





Remove fan drive from the timing gear cover.



Installation:

Clean the mounting surface and bore on the timing gear cover.

Clean fan drive and install new O-ring. lubricate the O-ring lightly with oil.



Push the fan drive into the timing gear cover by turning the drive shaft (mesh gear).



Install and tighten nuts.

If fan coupling is installed, install wire to distribution point.

Install fan and radiator.

Add coolant, see sub group 2.01.

Fan drive with lube oil supply (with bushings)

Removal:

Drain the coolant, see sub group 2.01.

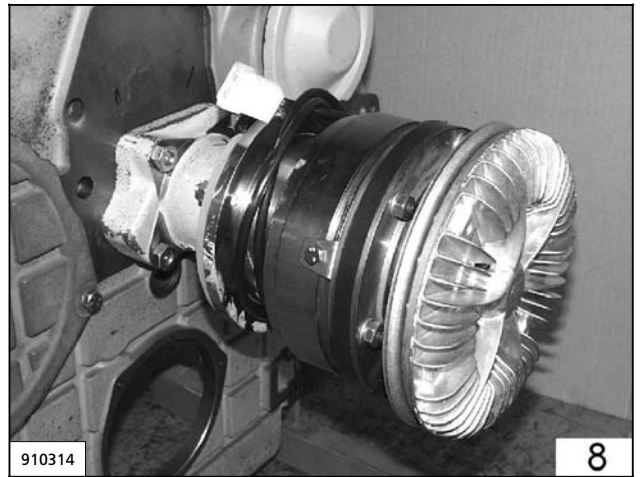
Remove the radiator.

Remove the fan, see sub group 5.01.

If a fan coupling is installed, remove the wire on the distribution point.

Note:

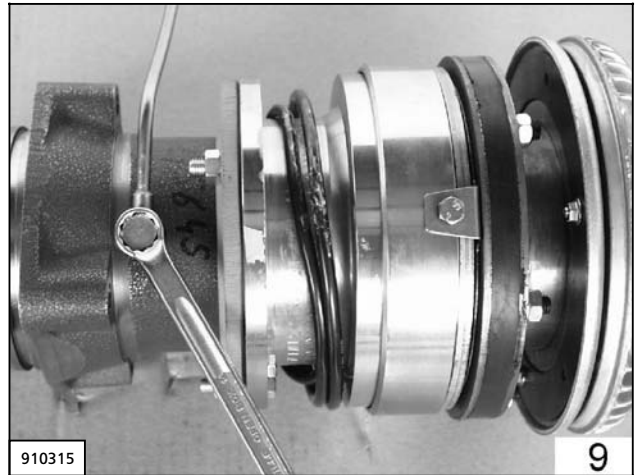
Do not remove the wire on the fan coupling!



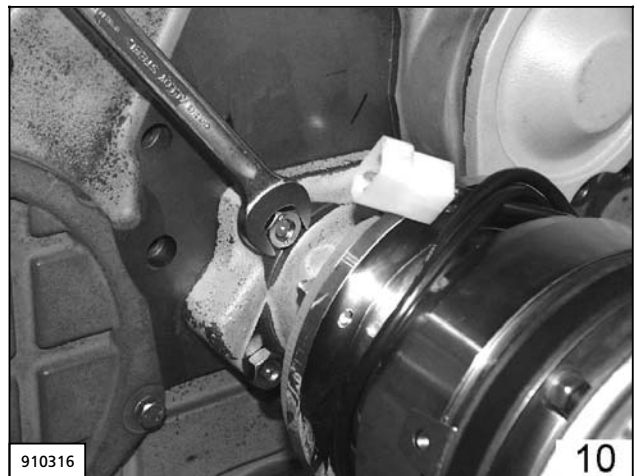
Note:

The fan drive with bearing bushings can be lubricated via the timing gear cover with O-ring seal or via a lube oil line.

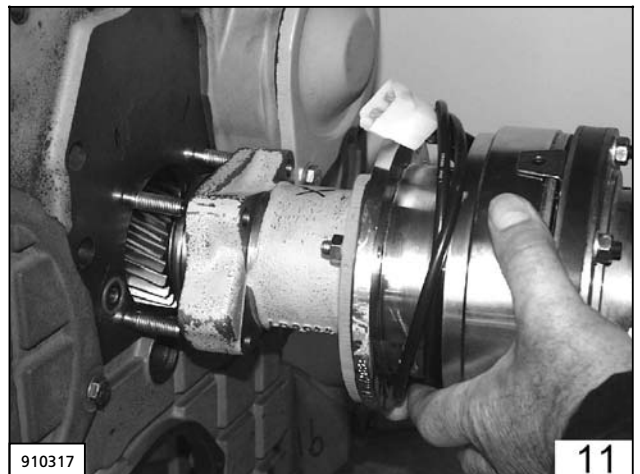
If lubrication is via a lube oil line, remove it from the fan drive.

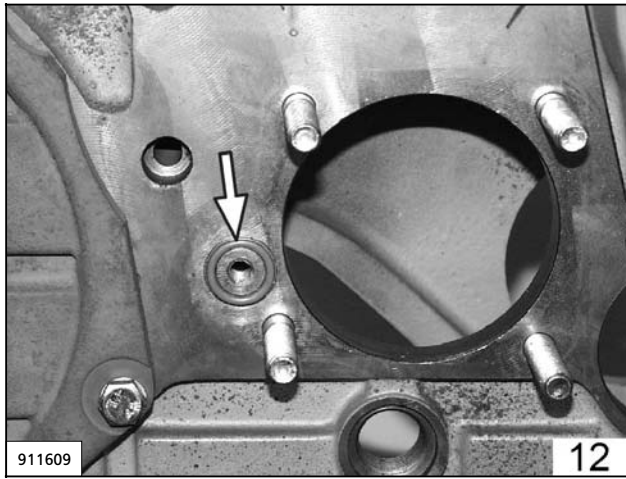


Loosen and remove the nuts on the fan drive.



Remove fan drive from the timing gear cover.

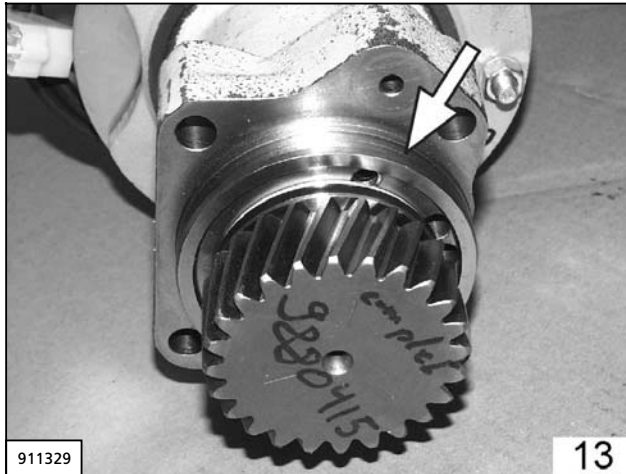




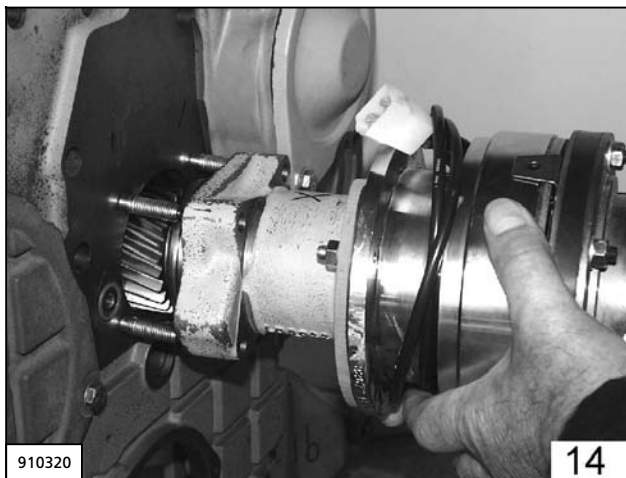
Installation:

Clean the mounting surface and bore and groove for the O-ring lube oil bore on the timing gear cover.

Lubricate new O-ring with grease and place it in the groove on the lube oil supply in the timing gear cover if lube oil is supplied via the timing gear cover.



Clean fan drive and install new O-ring. lubricate the O-ring lightly with oil.



Push the fan drive into the timing gear cover by turning the drive shaft (mesh gear).



Install and tighten nuts.

Install lube oil line (if necessary).

If fan coupling is installed, install wire to distribution point.

Install fan and radiator.

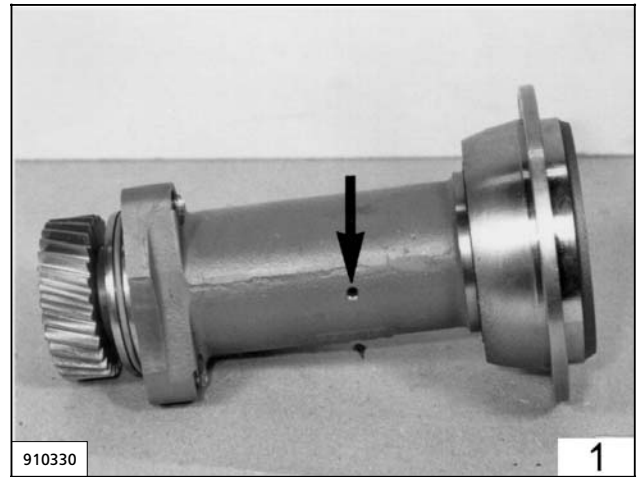
Add coolant, see sub group 2.01.

Fan and Fan Drive Disassembly and Assembly:
(Coolant pump integrated in timing case cover)

To Engine N. 89 01 2496
Special Tools N. 23, 85, 86

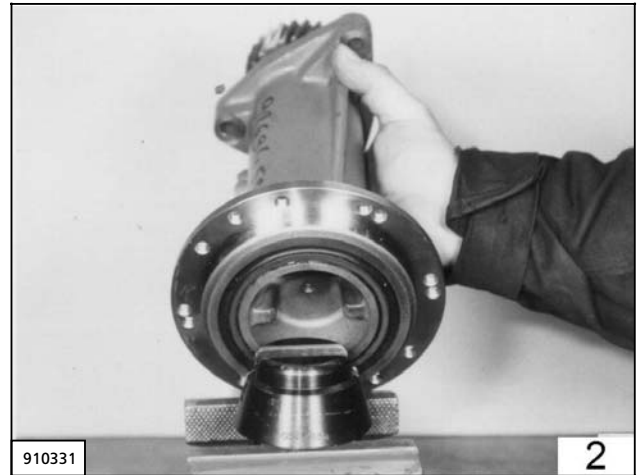
Note:

Fan drive must be sealed if oil drains from the leakage bore hole in the housing.



Disassembly:

Refer to sub group 5.02 for removal of fan drive.
Refer to page 5.03.03 for positioning.
Install retaining device for shaft 1, special tool no. 23 into bench vise and set fan drive onto retainer.

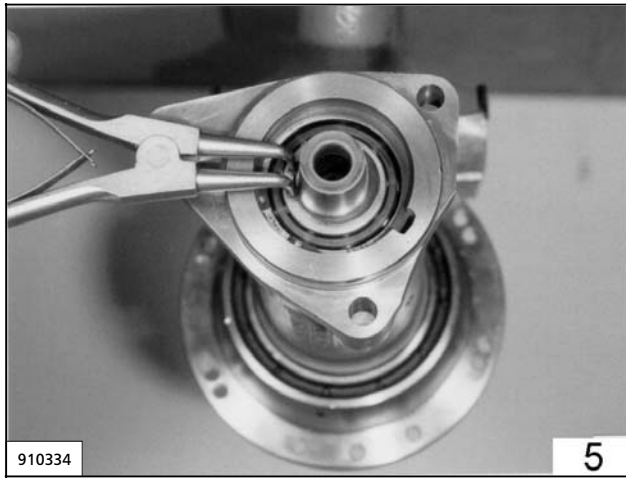


Remove screw 2 and take off washer 3.

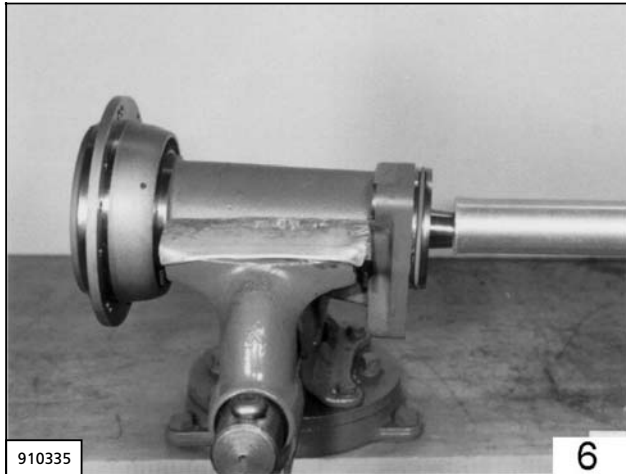


Pull gear 4 with commercially available puller from shaft 1.

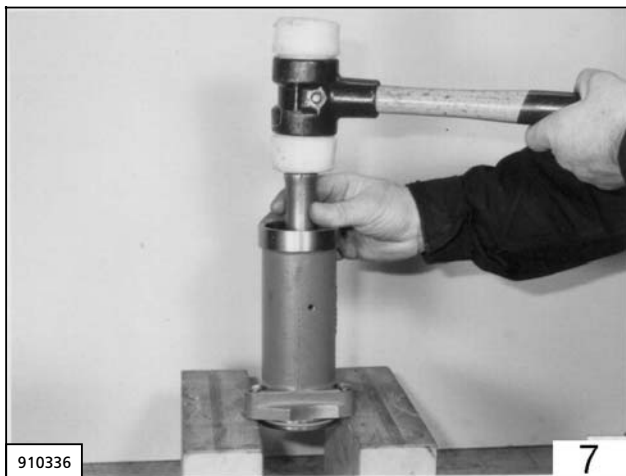




Release lock rings 5 and 6.



Remove fan drive from retainer. Hold housing 7 in vise, knock shaft 1 with bearing 8 from housing.



Set housing 7 on supports and knock ball bearing 9 or dual ball bearing 10 (see version A) with a long punch from housing. Drive shaft seal ring 11 from housing 7, using punch.

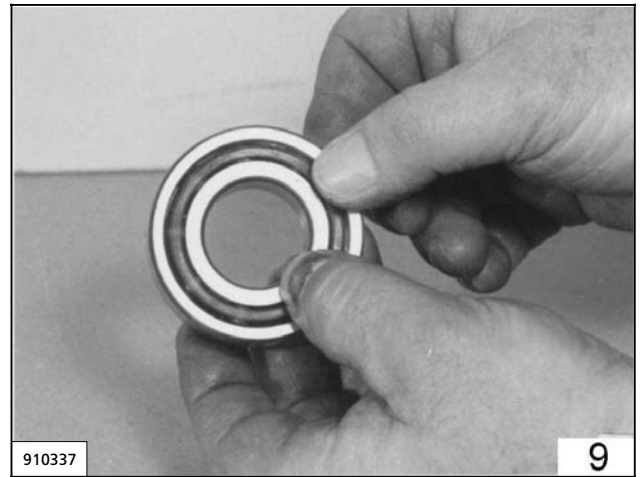


Release snap ring 12 and push ball bearing 8 with two levers from shaft 1.

Note:

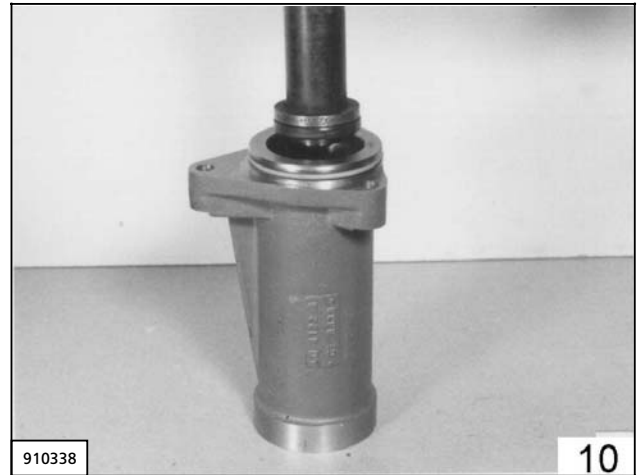
Before removing, check ball bearing 8 first on shaft 1 (visual and sound check). If the ball bearing passes inspection, do not remove!

Check ball bearing 9 or dual ball bearing 10 (see version A) visually and by sound. Replace bearing if necessary.
Carefully clean all parts and bearing seats.



Assembly:

Set housing 7 on flat surface and press new shaft seal ring 11 with a punch, special tool no. 86 into housing.
Lightly oil sealing edge.



Push ball bearing 9 or dual ball bearing 10 (see version A) with a punch, special tool no. 85 into housing 7.
Install snap ring 5.



Set ball bearing 8 onto vise, insert shaft 1 and ball bearing onto bearing seat.
Install snap ring 12.





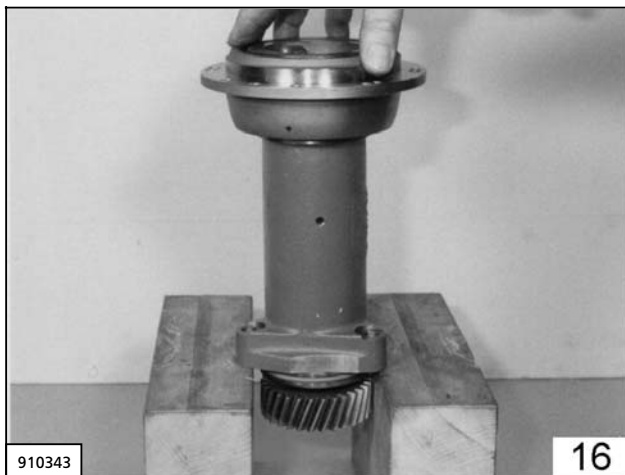
Set housing 7 on even surface. Apply Loctite or Omnivisc 1002 to seat for bearing 8 in housing 7. Apply Loctite 638 to seat for ball bearing 9 or dual ball bearing 10 (see version A) on shaft 1. Carefully insert shaft into housing and push through shaft seal ring 11, ball bearing 9 or dual ball bearing 10 (see version A) and push in.



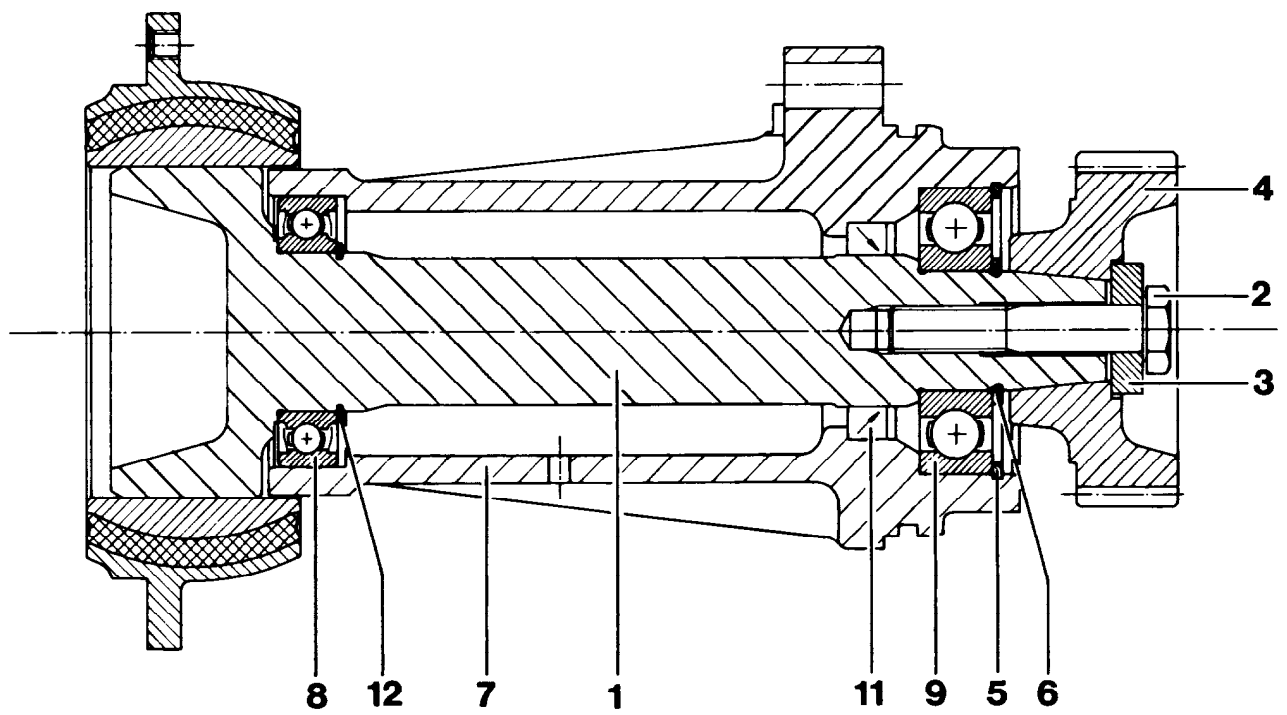
Turn fan drive around and insert snap ring 6.



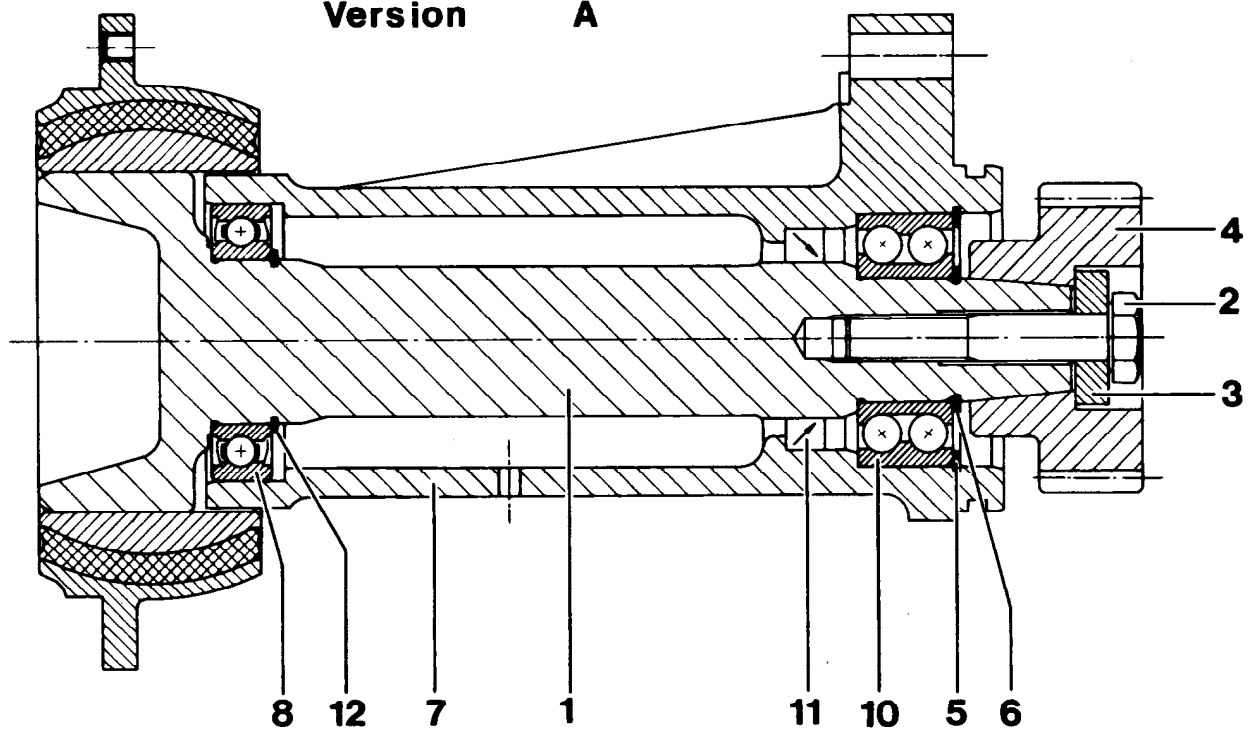
Install retaining device, special tool no. 23 into vise and set fan drive onto retainer. Push gear 4 onto shaft 1, install washer 3 and screw 2 and tighten. For tightening torque, see Technical Data.



Remove fan drive from retaining device and turn it to check easy movement.



Ausführung A
Version A



Fan drive disassembly and assembly

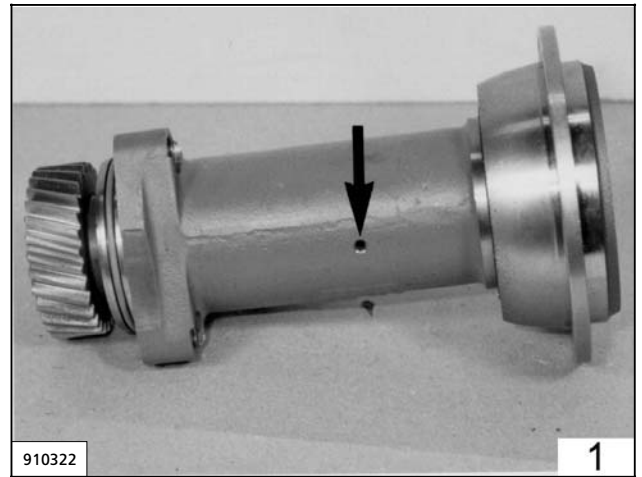
(coolant pump integrated in timing gear cover)
fixed drive, with ball bearings

from engine S/N 89 01 2497

use special tools No. 23, 85, 86

Note:

Fan drive must be sealed if oil drains from the leakage bore hole in the housing.

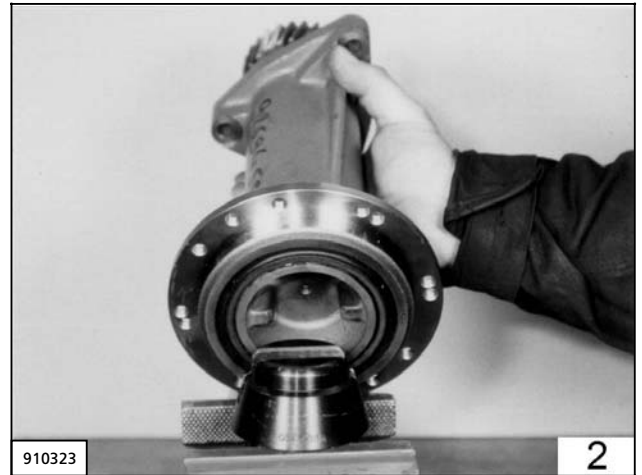


Disassembly:

Refer to sub group 5.02 for removal of fan drive.

Refer to page 5.04.03 for positioning.

Install retaining device for shaft 1, special tool no. 23 into bench vise and set fan drive onto retainer.

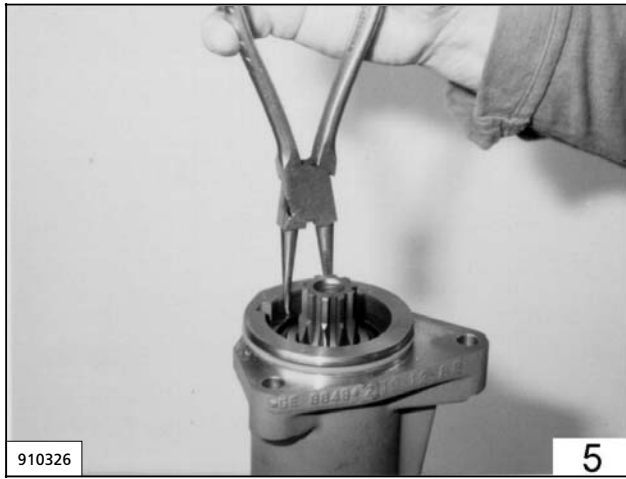


Remove screw 2 and take off washer 3.



Pull gear 4 from shaft 1.

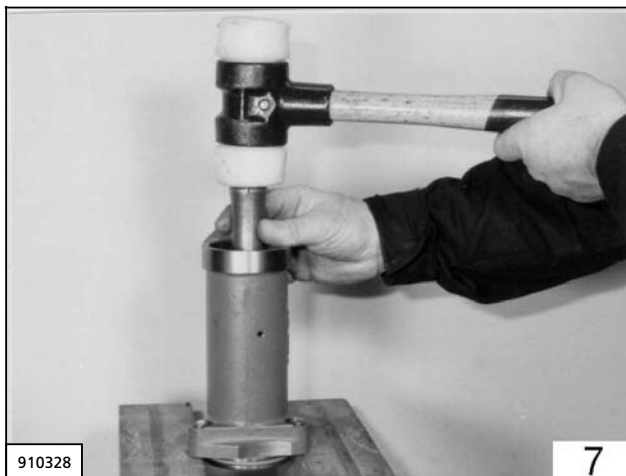




Release lock ring 5.



Remove fan drive from retainer. Hold housing 6 in vise, knock shaft 1 with bearing 7 from housing.



Set housing 6 on supports and knock ball bearing 8 or dual ball bearing 9 (see version A) with a long punch from housing. Drive shaft seal ring 10 from housing 6, using punch.

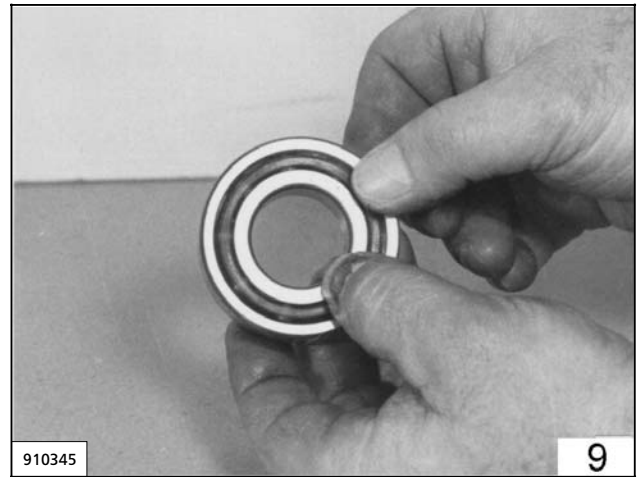


Release snap ring 11 and push ball bearing 7 with two levers from shaft 1.

Note:

Before removing, check ball bearing 7 first on shaft 1 (visual and sound check). If the ball bearing passes inspection, do not remove!

Check ball bearing 8 or dual ball bearing 9 (see version A) visually and by sound. Replace bearing if necessary.
Carefully clean all parts and bearing seats.



Assembly:

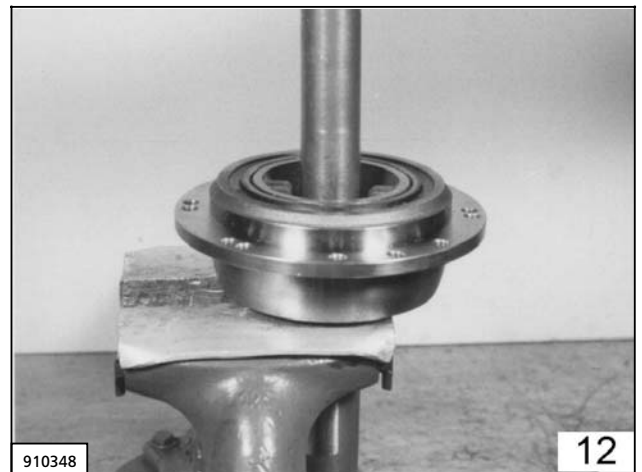
Set housing 6 on flat surface and press new shaft seal ring 10 with a punch, special tool no. 86 into housing.
Lightly oil sealing edge.



Push ball bearing 8 or dual ball bearing 9 (see version A) with a punch, special tool no. 85 into housing 6.
Install snap ring 5.

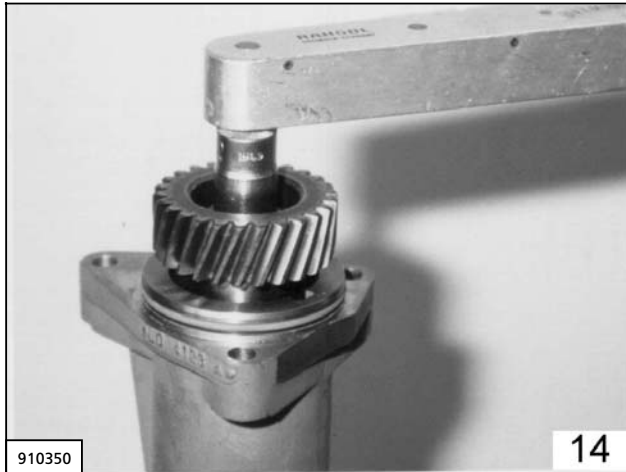


Set ball bearing 7 onto vise, insert shaft 1 and ball bearing onto bearing seat.
Install snap ring 11.

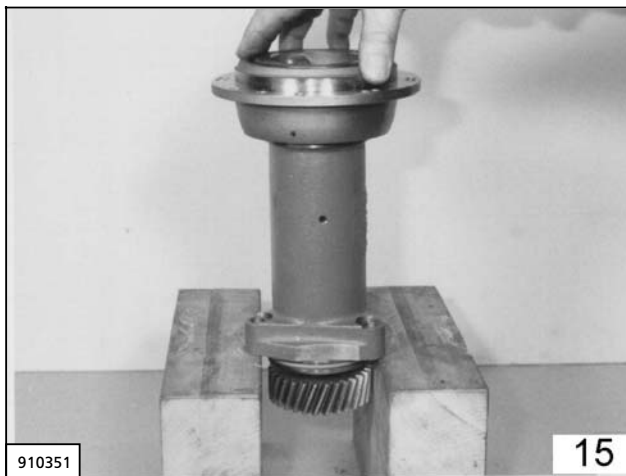




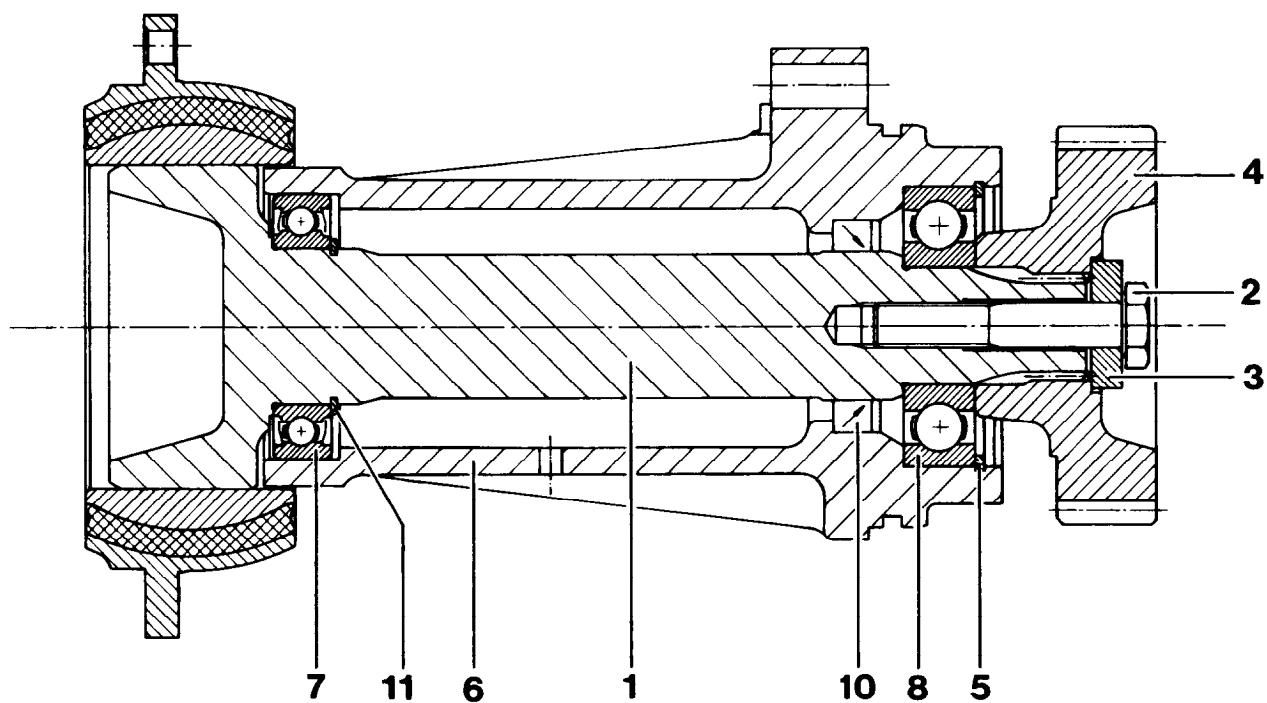
Set housing 6 on even surface. Apply Loctite Silicon Transparent or Omnivisc 1002 to seat for bearing 7 in housing 6.
Carefully insert shaft into housing and push through shaft seal ring 10, ball bearing 8 or dual ball bearing 9 (see version A) and push in.



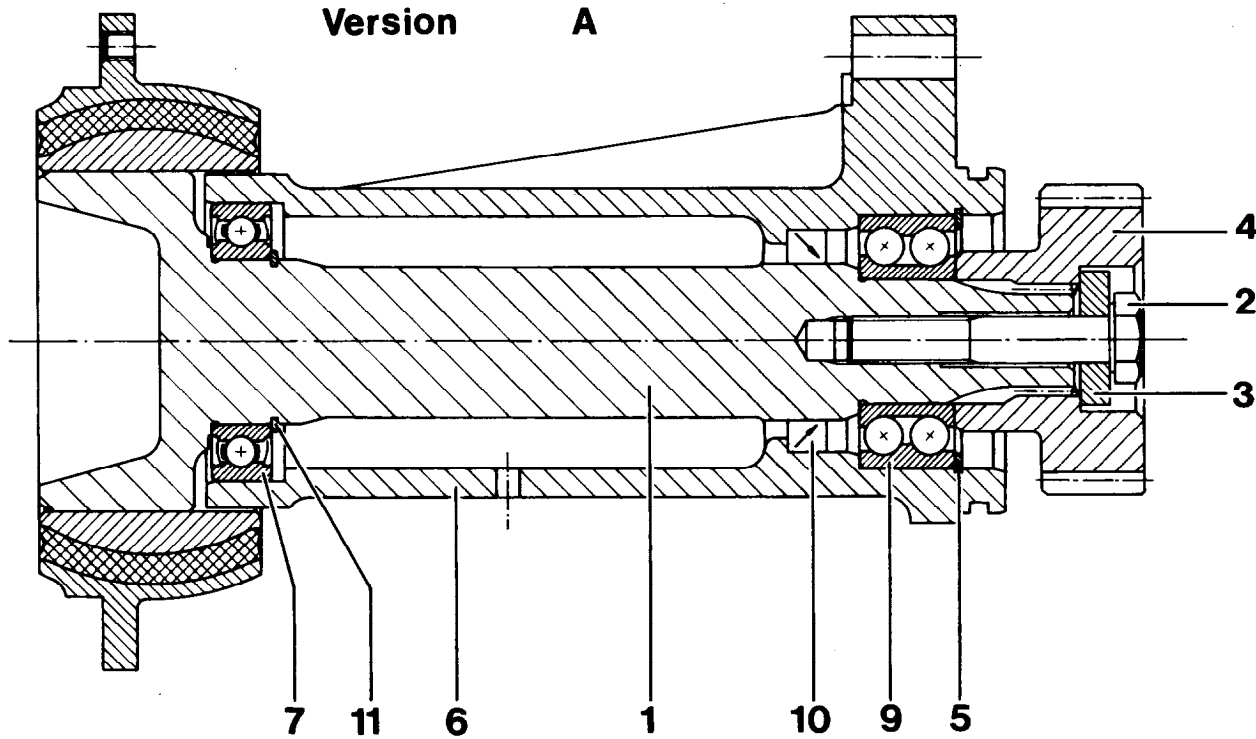
Install retaining device, special tool no. 23 into vise and set fan drive onto retainer.
Push gear 4 onto shaft 1, install washer 3 and screw 2 and tighten.
For tightening torque, see Technical Data.



Remove fan drive from retaining device and turn it to check easy movement.



Ausführung A
Version A



Disassembly, inspection and assembly of fan drive with fan coupling or Visco coupling (with ball bearings or bushing)

Use special tools No. 81, 84, 85, 86, 89

2-stage and 3-stage fan coupling, mounted with ball bearings:

For positioning, see page 5.05.09 (front side)

Disassembly and inspection:

Note:

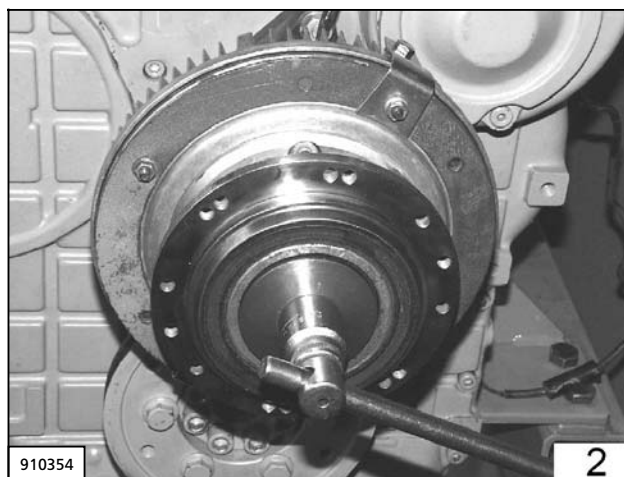
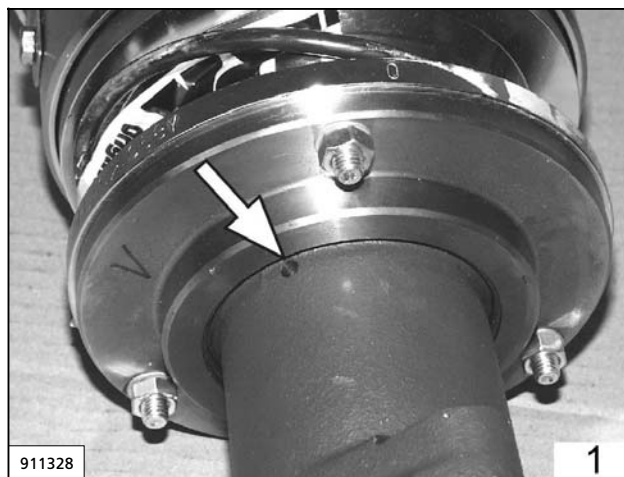
The fan drive must be resealed if oil drains from the leakage bore in the housing.

Loosen screw 1 on the fan drive with the fan drive installed on the engine. Prevent the engine from turning by inserting a suitable tool between the flywheel and the flywheel housing at the inspection hole.

Remove fan drive, see sub group 5.02.

Turn out screw 1 approx. 15 mm, place the fan coupling 2 on a level surface, so that the bearing housing 3 is accessible, see fig. 3.

Separate the fan coupling 2 from the fan shaft 4 by hitting the screw 1 with a soft (brass) punch.





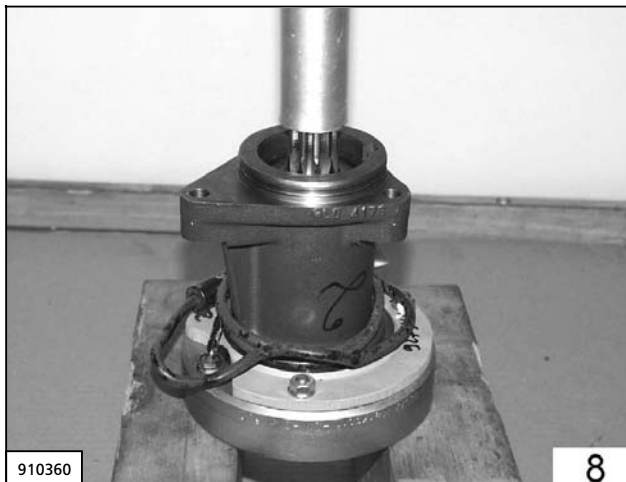
Remove screw 1, disk 5 (2-stage) and fan coupling 2 from fan shaft 4 / bearing housing 3.



Install the gear 6 into a vise, using protective jaws. Loosen and remove screw 7, remove disk 8.

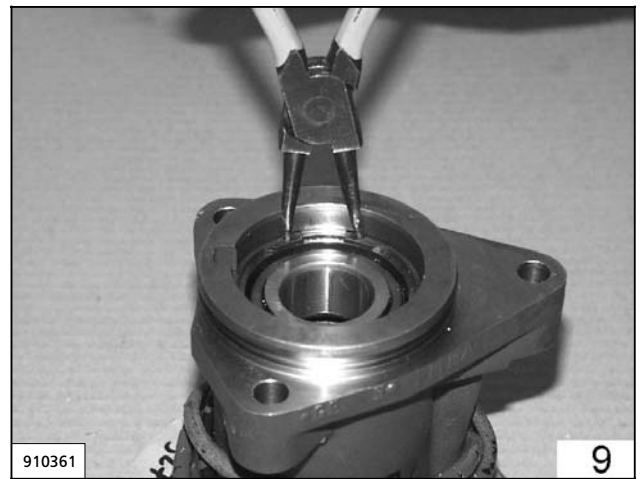


Remove gear 6 from fan shaft 4 .



Place bearing housing 3 on a level surface and drive the fan shaft and ball bearings 9, 10 from the bearing housing 3 by hitting the splined end of fan shaft 4 with a soft (brass) punch.

Release the snap ring 11 .



Place the bearing housing 3 on a level surface and knock the ball bearing 12 with a soft (brass) punch from the bearing housing.

Knock shaft seal 13 with a punch from bearing housing.

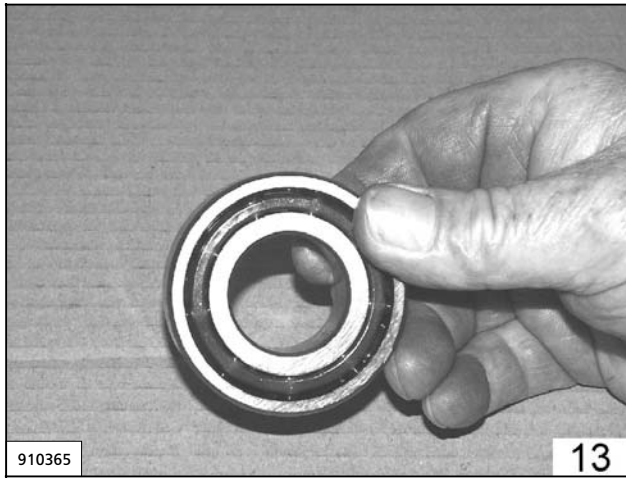


Loosen and remove nuts 14 .



Remove magnetic spool 15 with wire from bearing housing.





Check ball bearing 9, 10, 12 for damage and smooth operation (perform a visual and sound check).

Clean all parts, clean bearing seats.

Note:

Replace all worn or damaged parts.



Assembly:

Press new shaft seal 13 with punch, special tool No. 86 into bearing housing 3 .

Lightly grease sealing edges of shaft seal.



Press ball bearing 12 with punch, special tool No. 85 into bearing housing 3 .

Install snap ring 11 .



Carefully insert fan shaft 4 into bearing housing 3 through the shaft seal 13 and ball bearing 12 . Press the shaft in until it is fully seated.

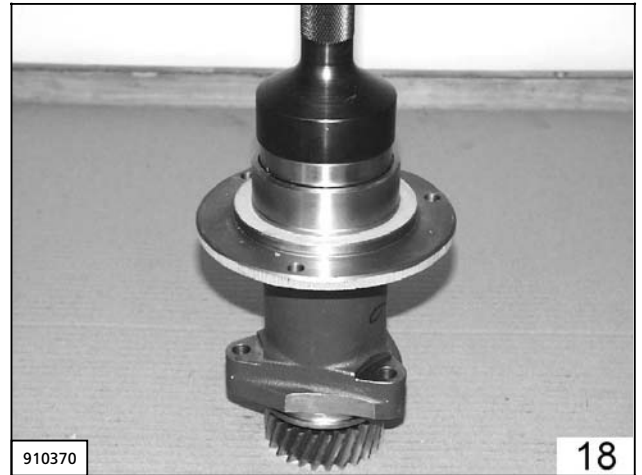
Push gear 6 onto fan shaft 4, install disk 8 and install screw 7 .

Place the gear into a vise, using protective jaws and tighten screw 7.

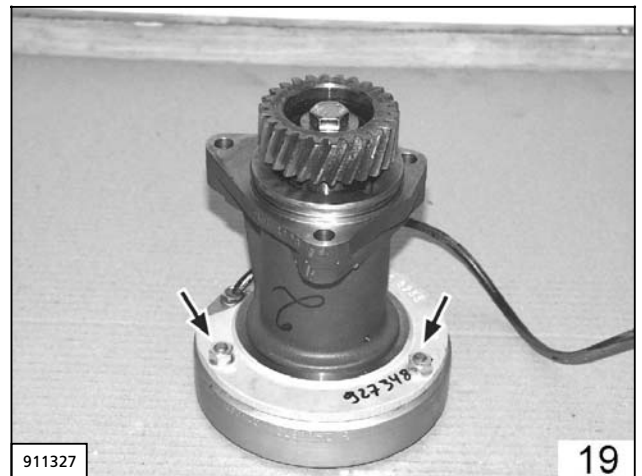
For tightening torque, see Technical Data.



Press the ball bearing 9, 10 with a pipe (over fan shaft 4) into the bearing housing 3 .



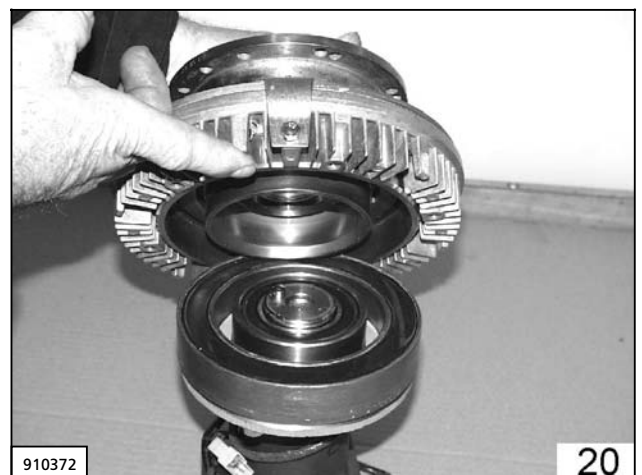
Position the magnetic spool 15 with wire on the bearing housing 3, install and tighten nuts 14 .



Push the fan coupling 2 over the magnetic spool 15 onto the fan shaft 4 .

Note:

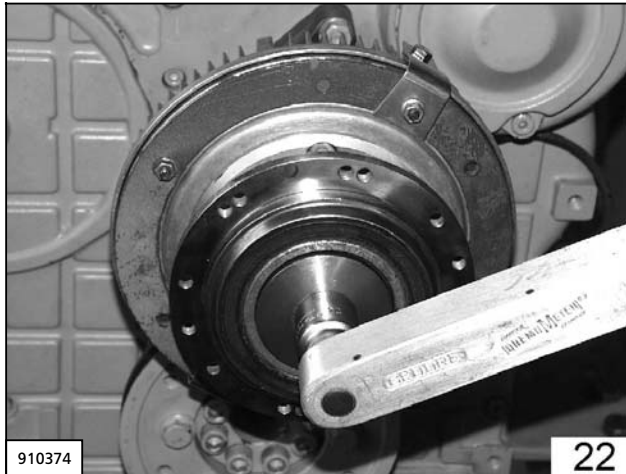
The roll pin 16 in the fan shaft 4 must align with the bore in fan coupling 2.





Install screw 1 with disk 5 (2-stage) and tighten lightly.

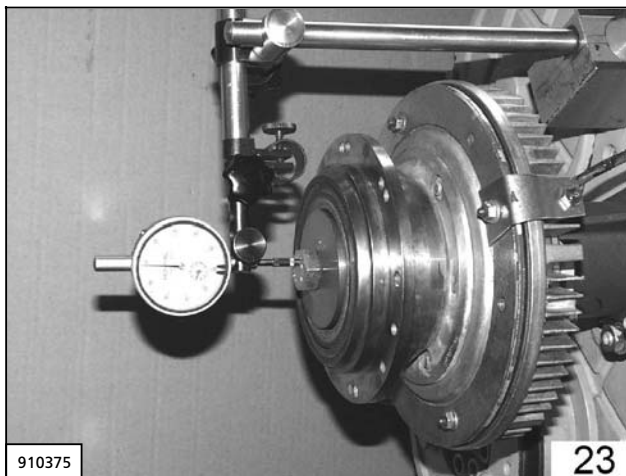
Check fan drive for easy movement by turning it.



Install fan drive, see sub group 5.02.

Prevent the engine from turning by inserting a suitable tool between the flywheel and flywheel housing at the inspection hole. Tighten screw 1.

For tightening torques, see Technical Data.



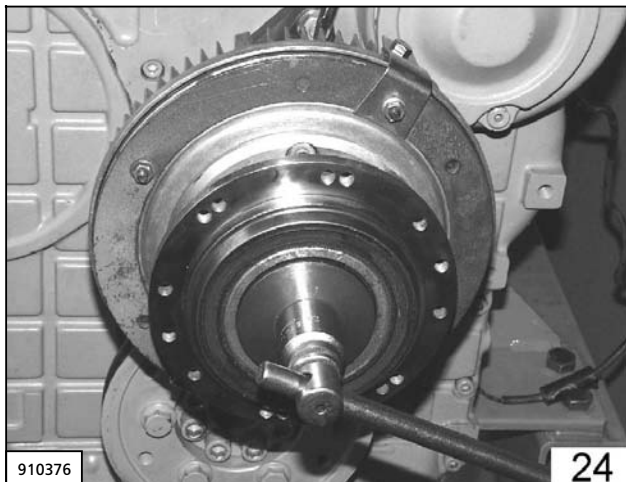
Fan coupling, 2-stage and 3-stage, bearing with bearing bushings:

For positioning, see page 5.05.09 (reverse side).

Check axial play:

Install commercially available dial gauge to a dial gauge holder and attach on timing case. Position the dial gauge on screw 1 and check the axial play by moving the fan coupling 2 back and forth.

For dimension, see Technical Data.



Disassemble and check:

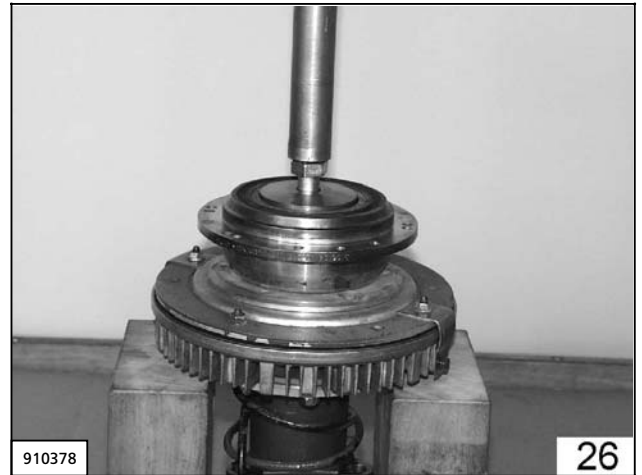
Loosen the screw 1 on the fan drive with the fan drive installed on the engine. Prevent the engine from turning by inserting a suitable tool between the flywheel and flywheel housing at the inspection hole.

Remove the fan drive, see sub group 5.02.

Turn out screw 1 approx. 15 mm , place the fan coupling with the mounting surface on a level surface as shown in fig. 25 so that the fan drive shaft 4 is accessible.



Separate the fan coupling 2 from the fan shaft 4 by hitting the screw 1 with a soft (brass) punch.



Remove screw 1, disk 5 (2-stage) and fan coupling 2 from the fan shaft 4 / bearing housing 3 .



Pull the fan shaft 4 from the bearing housing 3.

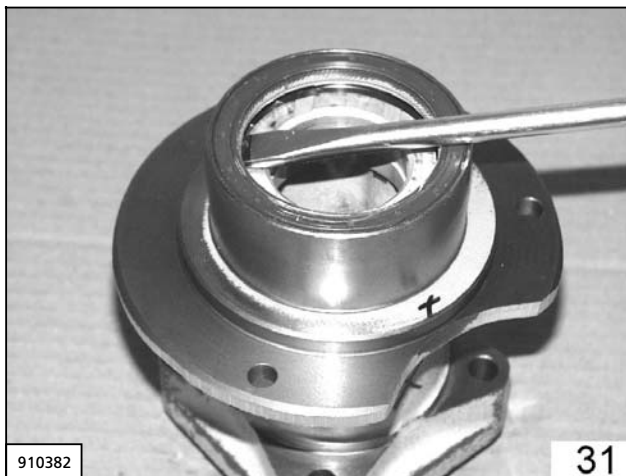




Loosen and remove nuts 6.

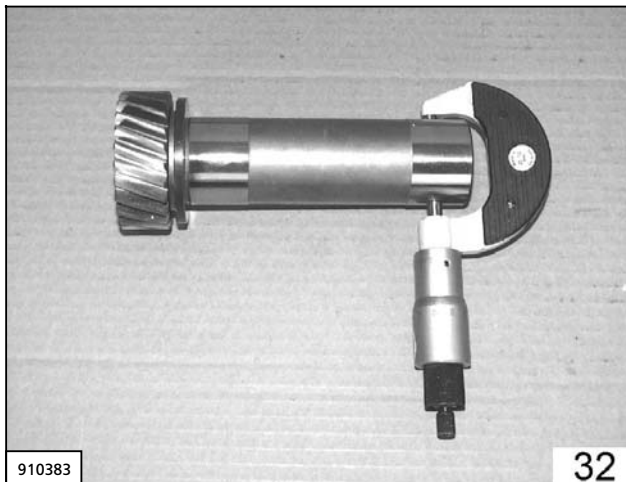


Remove magnetic spool 7 with wire from bearing housing.



Pry shaft seal 8 from bearing housing.

Clean all parts, check oil bores for clear passage.

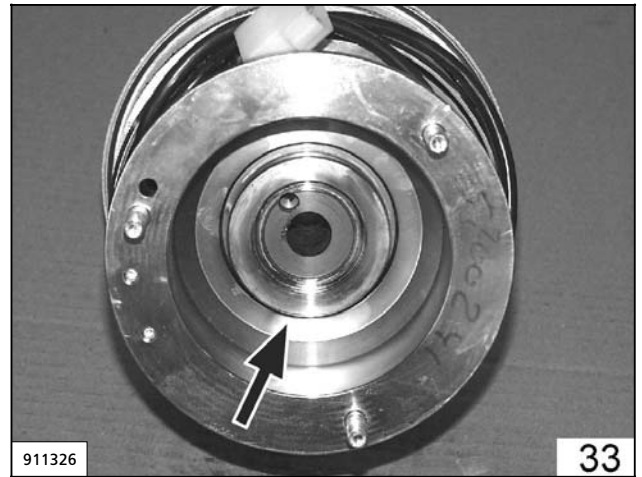


Check running surfaces for collar bearing 9, 10 and thrust surface for collar bearing 9 on ring 11 on the fan shaft 4 for damage (visually).

Measure bearing shaft diameter on running surfaces of fan shaft 4.

For dimensions, see Technical Data.

Check the contact surface for the collar bearing 10 on fan coupling 2 for wear (visually).



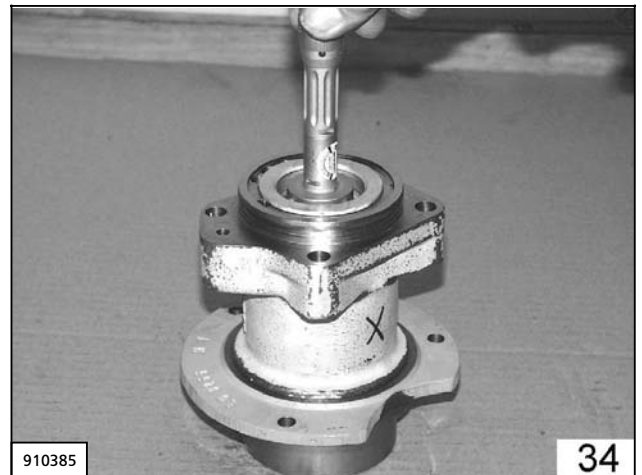
Check collar bearing 9, 10 in the bearing housing 3 for wear (visually).

Measure with inside dial gauge.

For dimensions, see Technical Data.

Note:

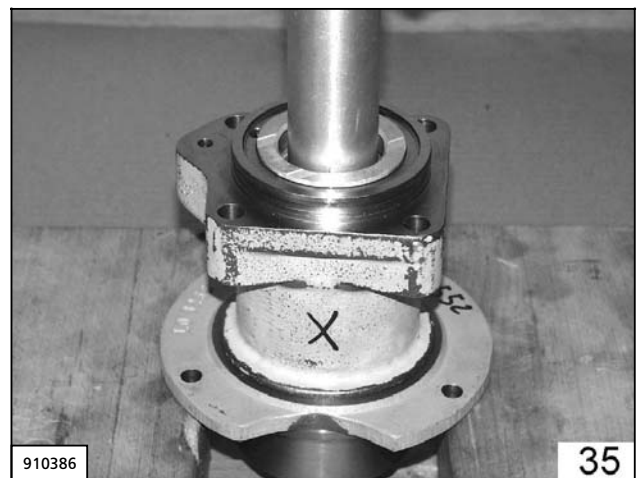
Any parts which are outside the given tolerances or are damaged must be replaced.



Replace the collar bearing in the bearing housing:

Place the bearing housing 3 on a base and knock out the collar bearing 9 with a punch.

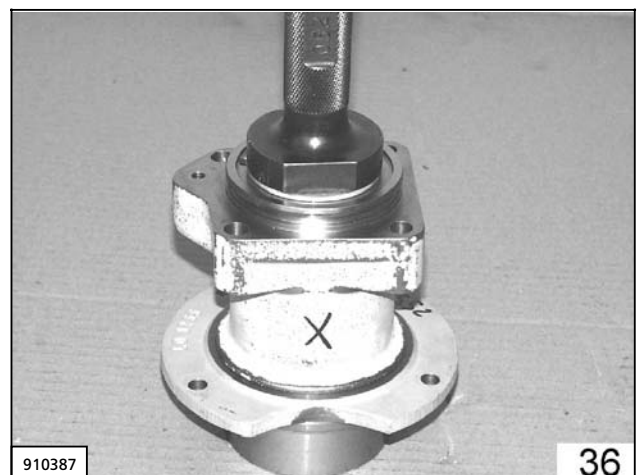
Turn the bearing housing over and press out collar bearing 10 with punch, special tool No. 81.

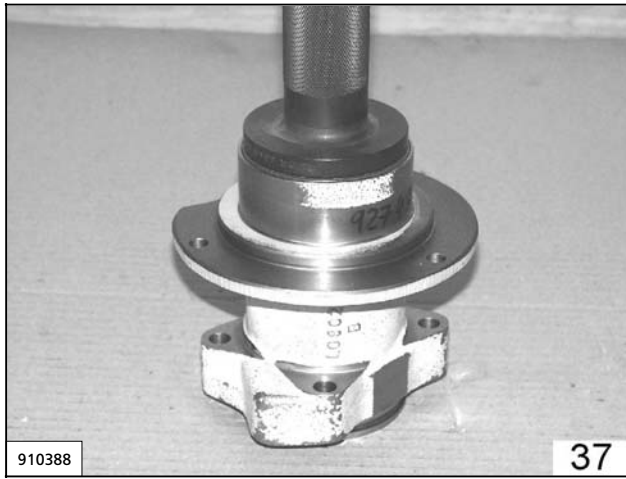


Cool the new bearings 9, 10 in liquid nitrogen to -175 to -195°C (-280 to -320° F) and drive into bearing housing 3 with punch, special tool No. 81.

Note:

The collar bearings 9, 10 are premachined and do not need to be machined after installation.

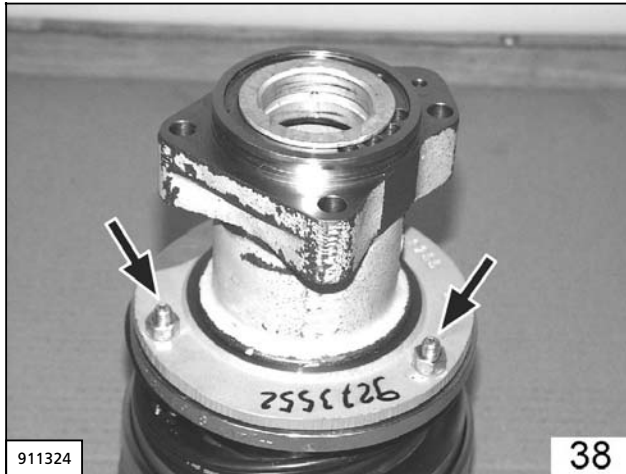




Assembly:

Press the new shaft seal ring 8 with punch, special tool No. 89 into bearing housing 3 .

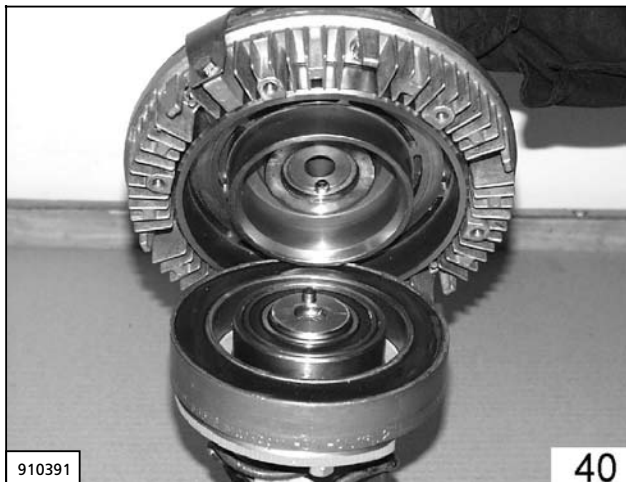
Fill the cavity between the two sealing lips with high temperature grease. Example: Barrierta L55/3.



Slide the magnetic spool 7 with wire onto bearing housing 3, install and tighten nuts 6.



Lubricate the fan shaft 4 on the running surfaces and on the thrust surface with oil and push into the bearing housing 3 .



Carefully push the fan coupling 2 onto the fan shaft 4 and into the bearing housing 3 .

Note:

The roll pin 12 in the fan shaft 4 must align with the bore in fan coupling 2.

Install screw 1 with disk 5 (2 stage) and tighten lightly.

Check fan drive for easy movement by turning it.



Install fan drive, see sub group 5.02.

Prevent the engine from turning by inserting a suitable tool between the flywheel and flywheel housing at the inspection hole. Tighten and torque screw 1.

For tightening torque, see Technical Data.

Important:

Check the axial play again when the fan drive is installed, see fig. 23 .



Visco coupling, with ball bearing:

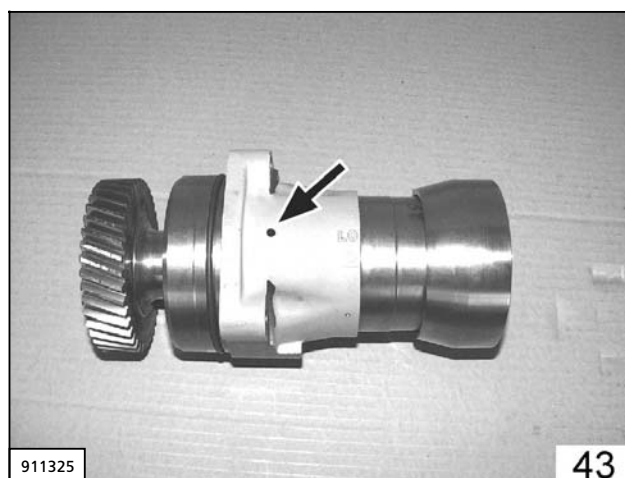
Remove the fan / Visco coupling, see sub group 5.01.

For sectional view, see page 5.05.10.

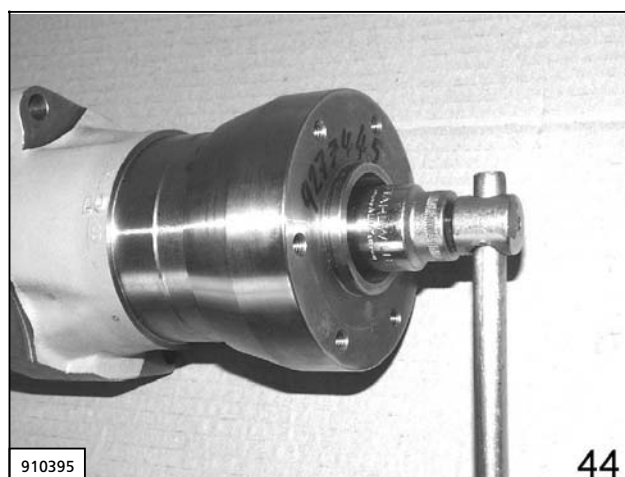
Disassembly and inspection:

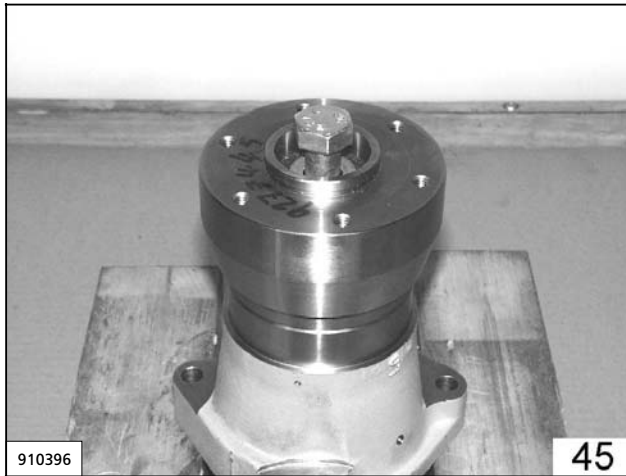
Note:

The fan drive must be resealed if oil emerges on the weep hole of the housing.

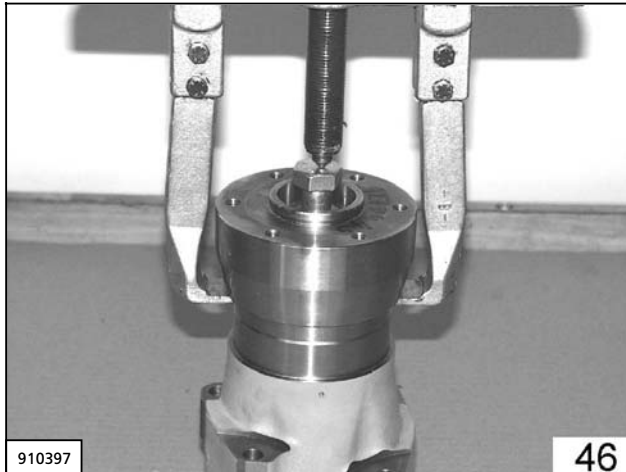


Loosen screw 1, with the fan drive installed on the engine. Prevent the engine from turning by inserting a suitable tool between the flywheel and flywheel housing at the inspection hole.

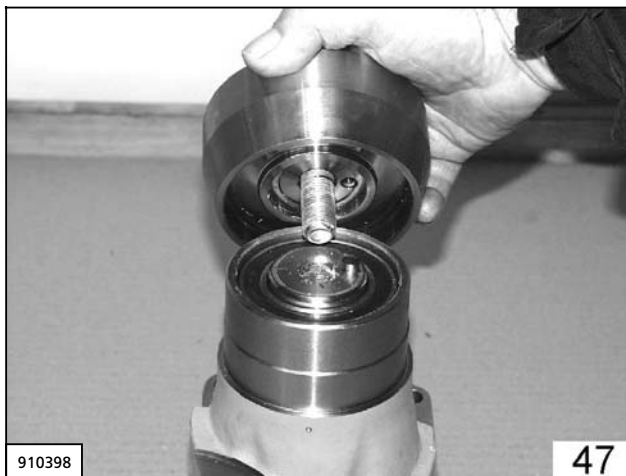




Remove the fan drive, see sub group 5.02.
Turn out screw 1 approx. 15 mm (5/8").



With commercially available puller, pull the fan hub 2 from the fan shaft 4.



Remove screw 1, disk 14 with fan hub 2 from the fan shaft 4 / bearing housing 3 .



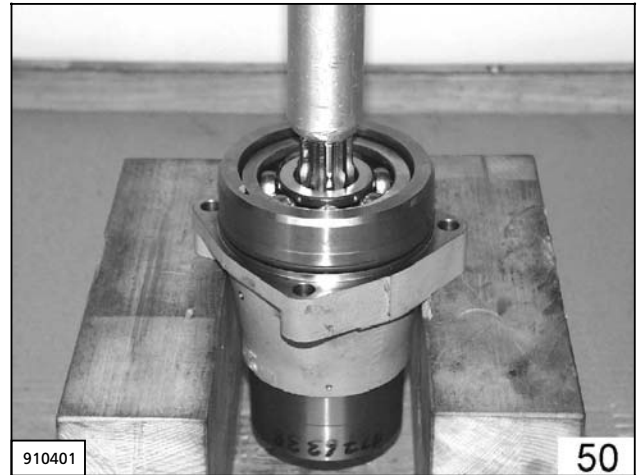
Put the gear 5 into a vise, using with protective jaws.

Loosen and remove screw 6, remove disk 7.

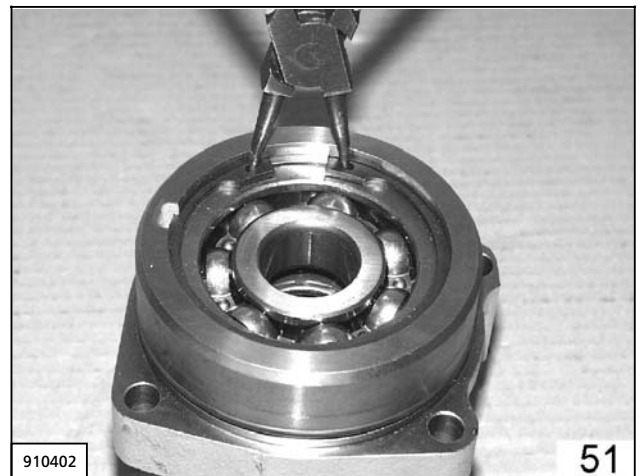
Remove gear 5 from fan shaft4.



Place the bearing housing 3 on a level surface as shown in fig. 50 and with a soft (brass) punch, hit the splined side of fan shaft 4 to drive the fan shaft and ball bearing 8 from the bearing housing 3.

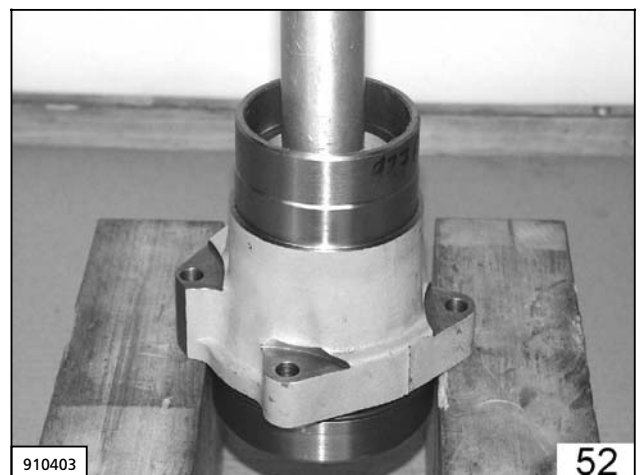


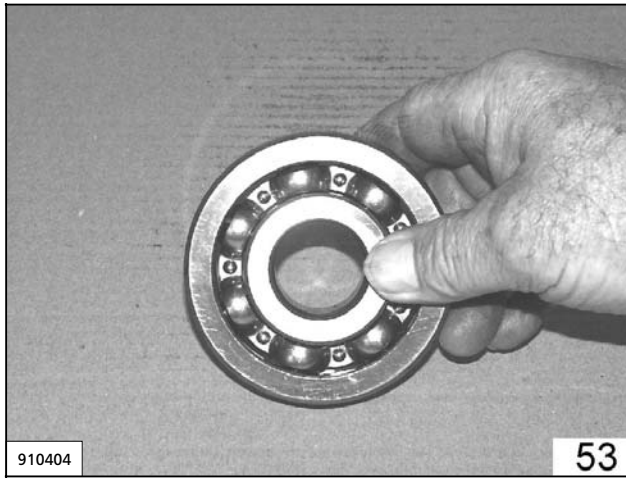
Remove snap ring 9.



Place the bearing housing 3 on a level surface (see fig. 52) and drive the ball bearing 10 with a soft (brass) punch from the bearing housing 3.

Use the punch and knock out the shaft seal 11 from the bearing housing 3.



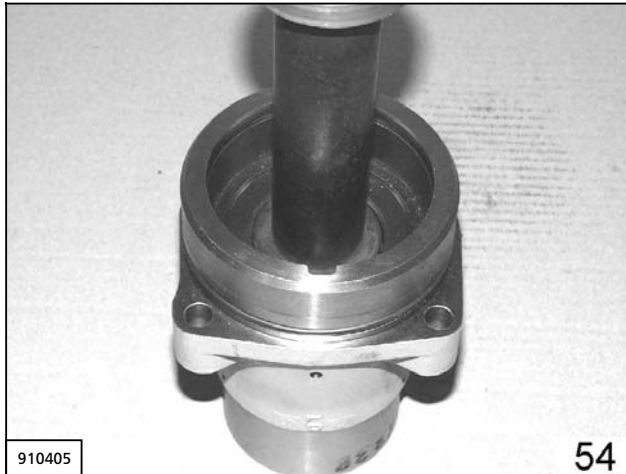


Check ball bearing 8, 9 for wear, damage and quiet movement (sight and sound test).

Clean all parts, clean bearing seats.

Note:

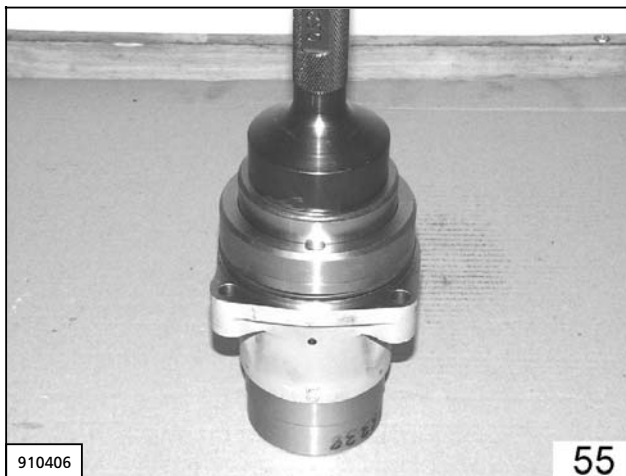
Any parts which are damaged must be replaced.
Always replace worn or damaged bearings.



Assembly:

Press the new shaft seal 11 with punch, special tool No. 86 into the bearing housing 3.

Fill the cavity between the two sealing lips with grease.



Press the ball bearing 10 with punch, special tool No. 84 into the bearing housing 3.

Install the snap ring 9.



Slide the spacer 12 on the fan shaft 4 and carefully guide the fan shaft 4 into the bearing housing 3. Press the shaft 4 via the shaft seal 22 and ball bearing 10 until the shaft bottoms out.

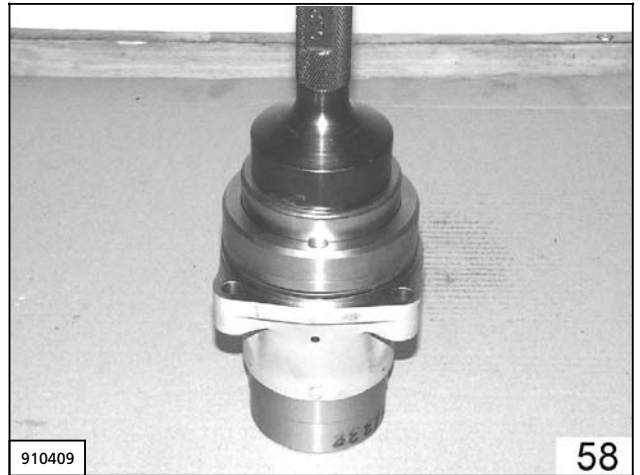
Install the gear wheel 5 on the fan shaft 4, add disk 7 and install screw 6 .

Put the gear 5 into a vise using protective jaws. tighten and torque screw 6 .

For tightening torque, see Technical Data.



Press the ball bearing 8, using a tube or a piece of pipe into the bearing housing 3, see fig. 58 .



Push the fan hub 2 onto the fan shaft 4.

Note:

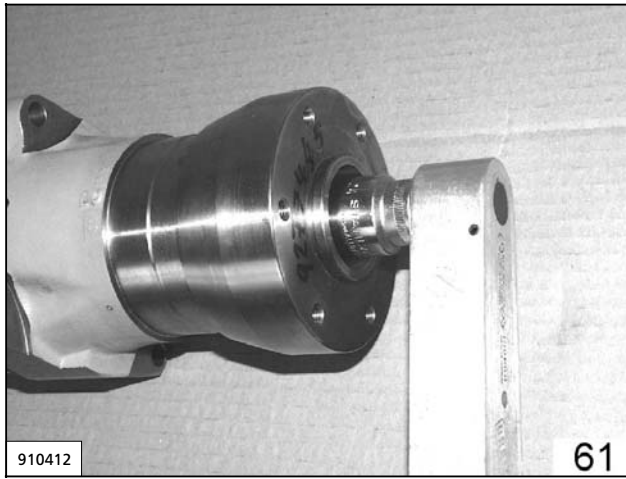
The roll pin 13 in fan shaft 4 must align with the bore in fan hub 2.



Install screw 1 with disc 14 and tighten lightly.

Turn the fan drive to check for easy movement .





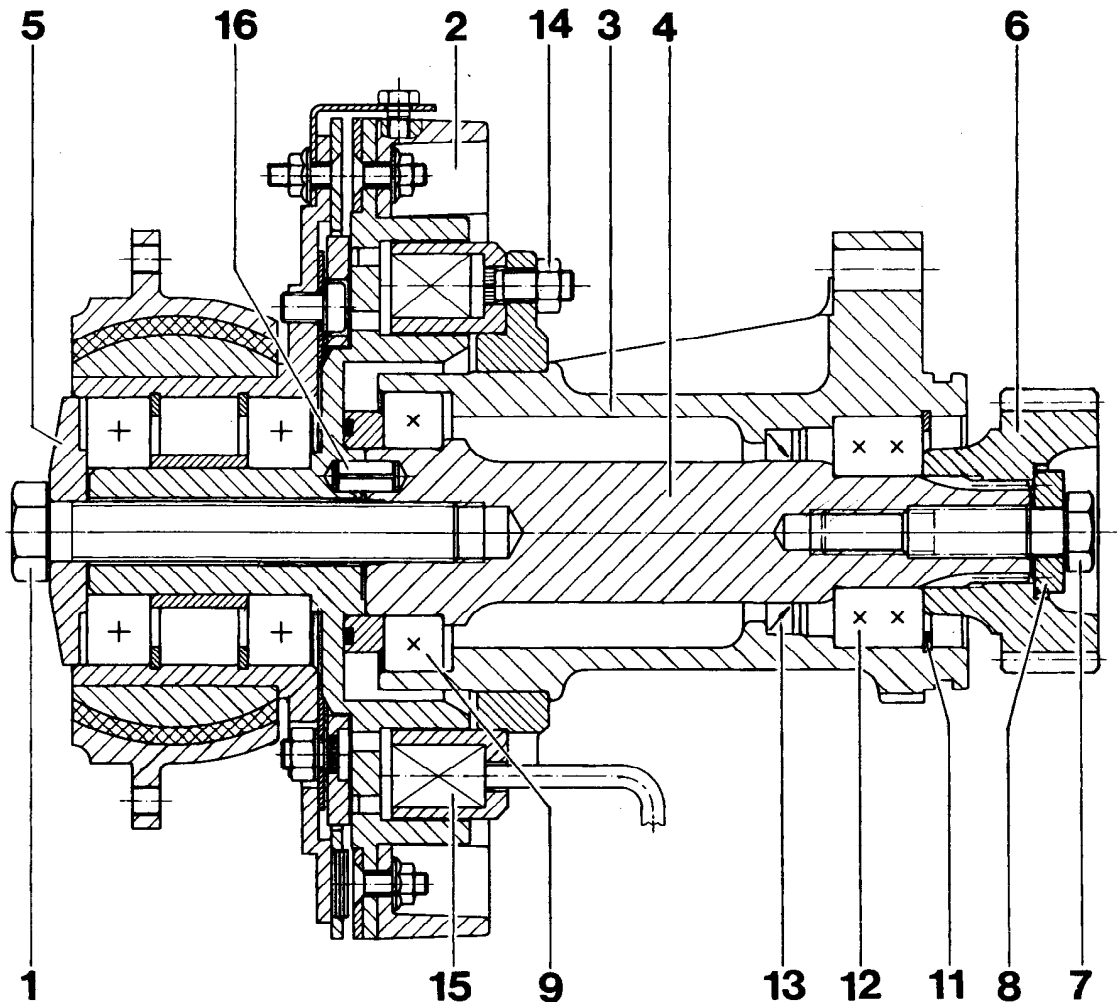
Install the fan drive, see sub group 5.02.

Prevent the engine from turning by inserting a suitable tool between the flywheel and flywheel housing at the inspection hole. Tighten and torque screw 1.

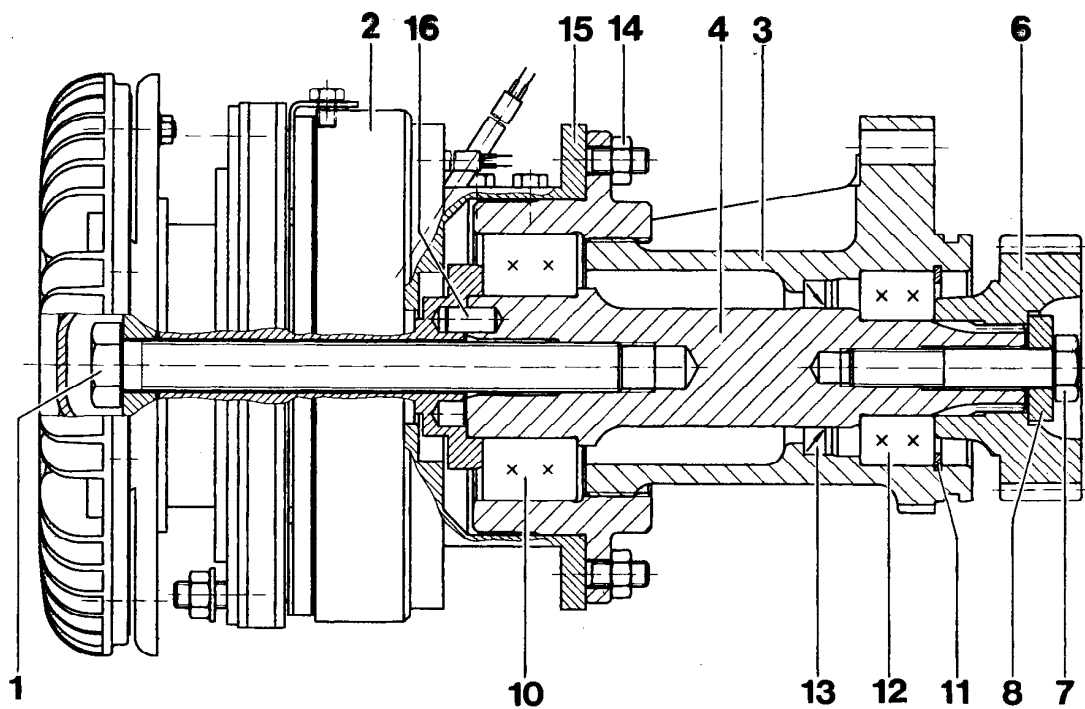
For tightening torques, see Technical Data.

Install fan or Visco coupling, see sub group 5.01

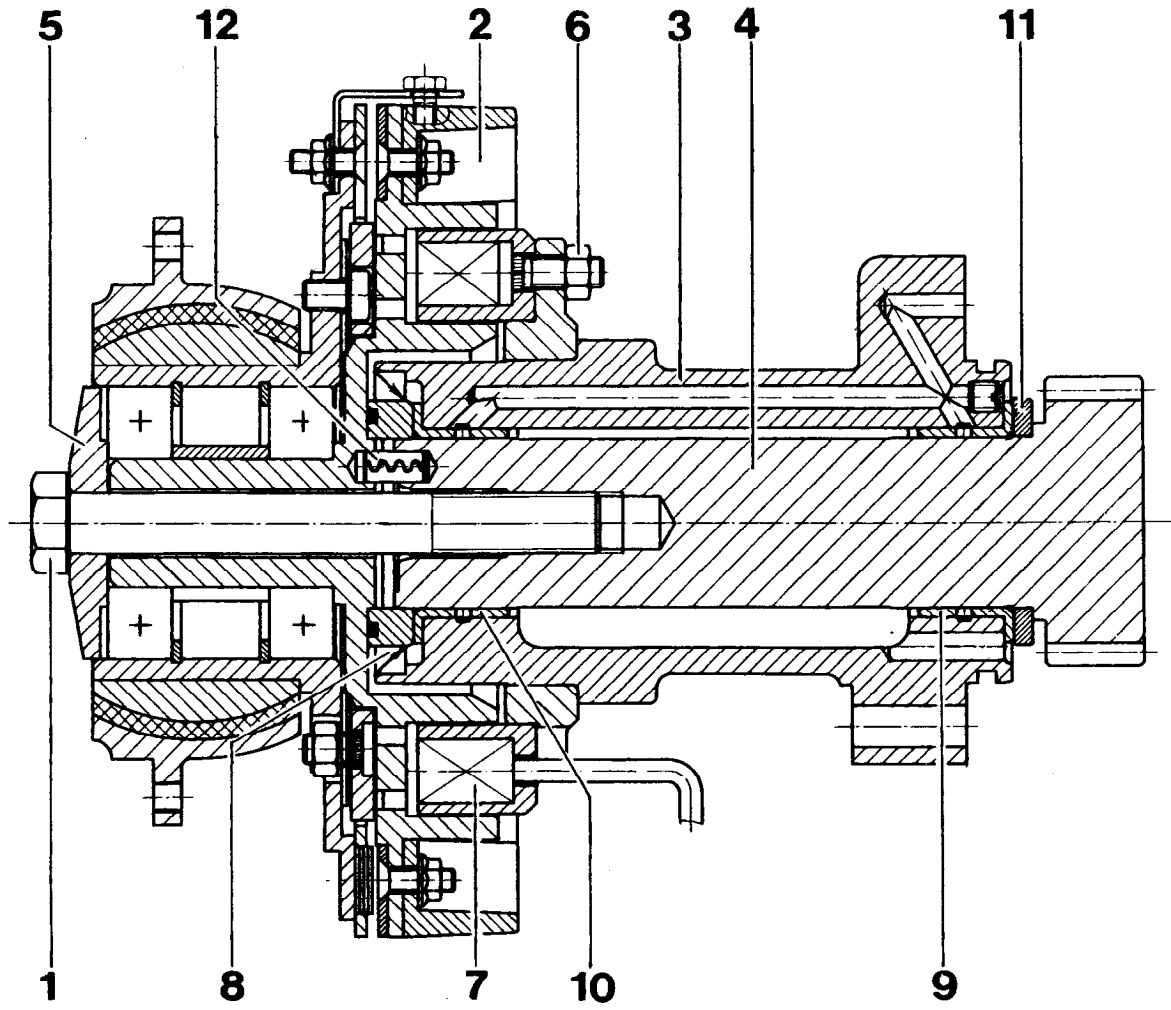
2 - Stufig / 2 - Speed / 2 - Vitesses



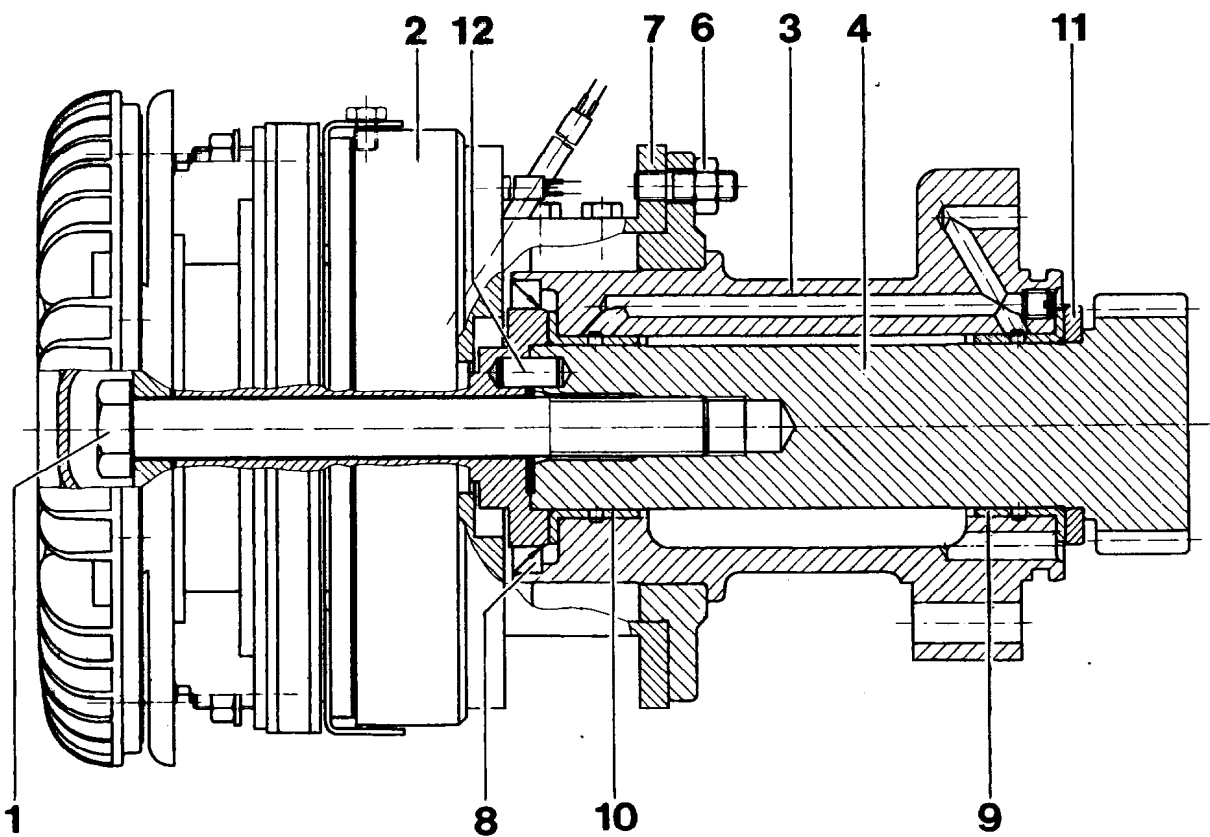
3 - Stufig / 3 - Speed / 3 - Vitesses

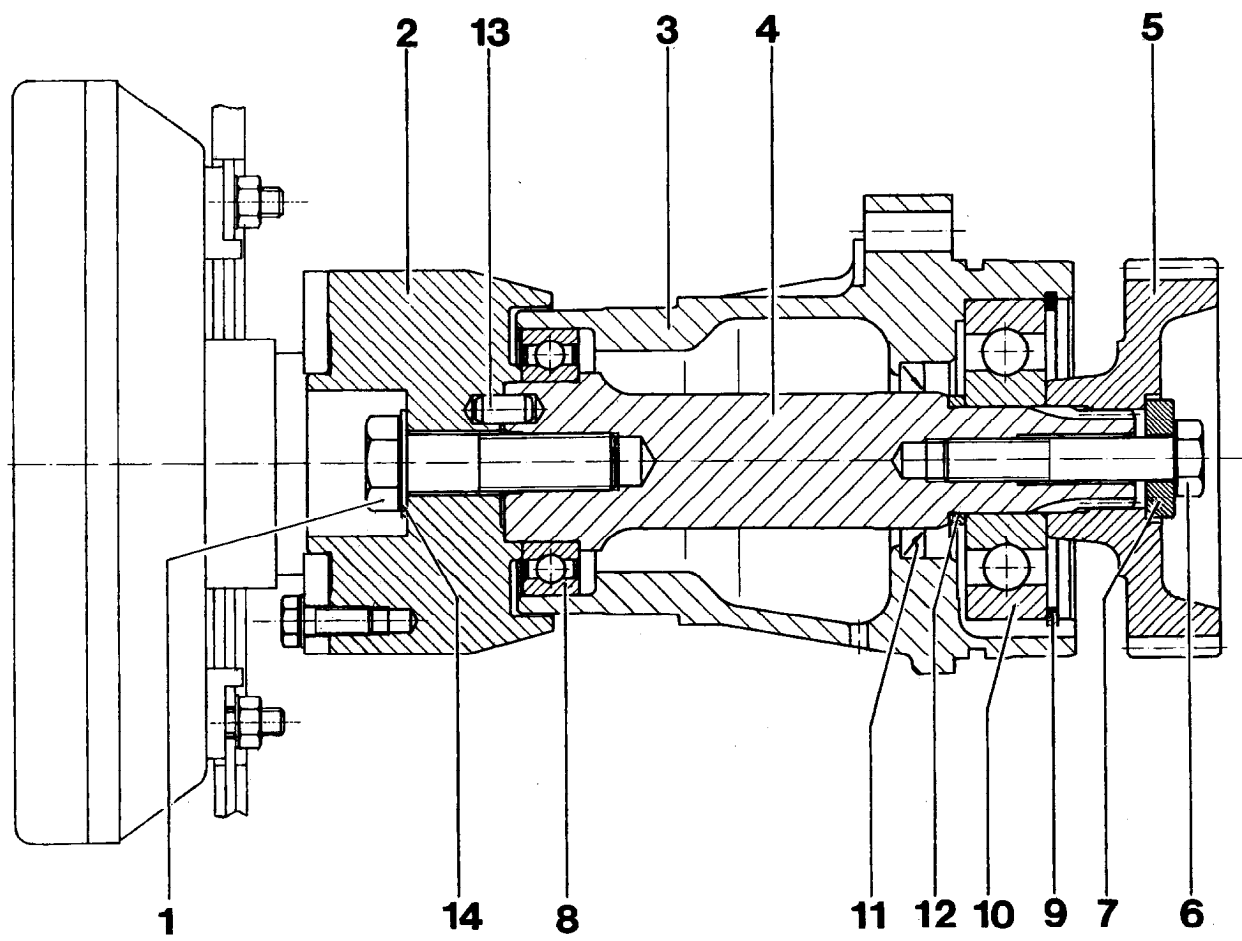


2 - Stufig / 2 - Speed / 2 - Vitesses



3 - Stufig / 3 - Speed / 3 - Vitesses





Fan drive disassembly and assembly Fixed drive, with bearing bushings

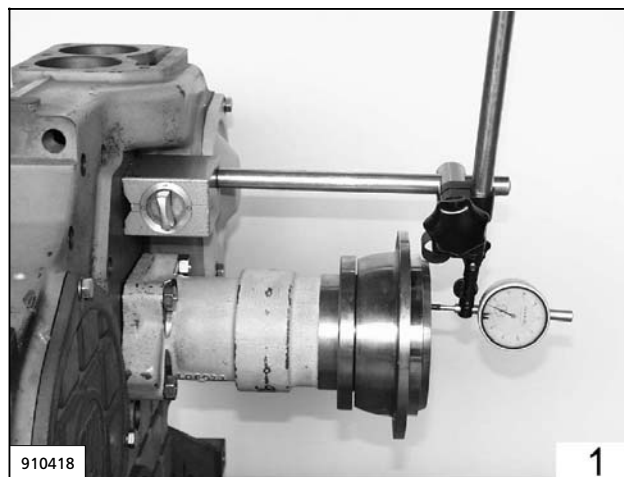
Use special tool No. 81, 89

For sectional view, see page 5.06.03

Check axial play:

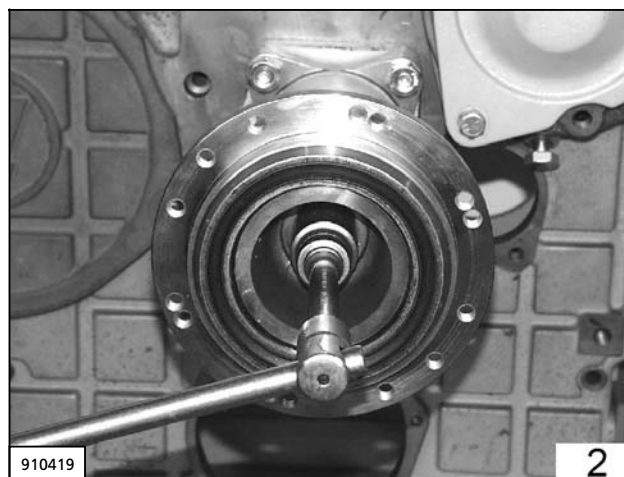
Attach commercially available dial gauge holder with dial gauge on the timing gear cover. Position the gauge against the fan hub 2 (preload and zero dial gauge) and measure the axial play by moving the fan hub back and forth.

For dimensions, see Technical Data.



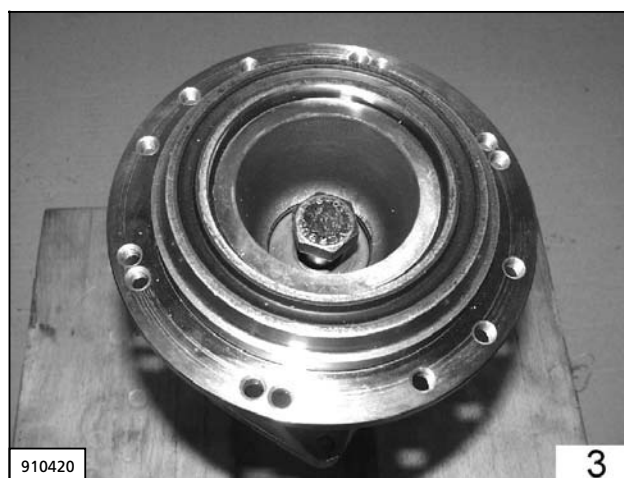
Disassembly and inspection:

Loosen screw 1 with the fan drive installed on the engine. Prevent the engine from turning by inserting a suitable tool between the flywheel and the flywheel housing at the inspection hole.

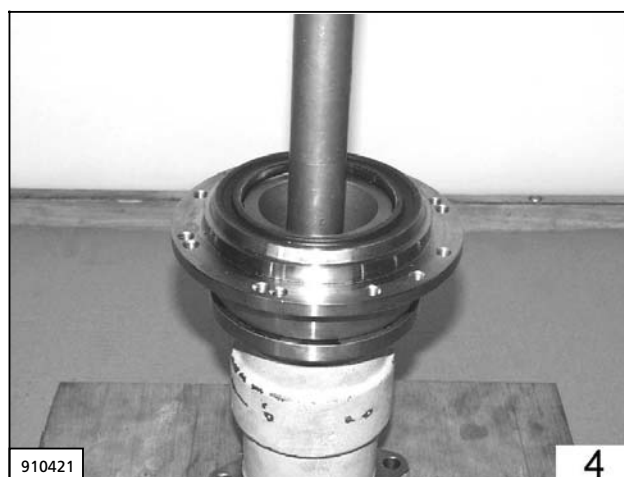


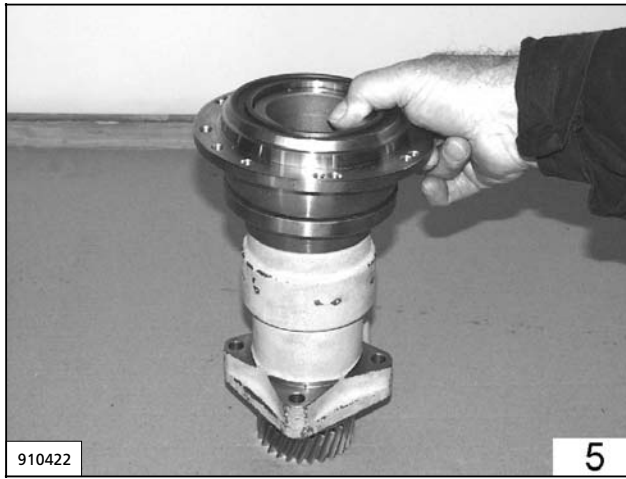
Remove fan drive, see sub group 5.02.

Turn out screw 1 approx. 15 mm, place the fan drive with mounting surface on a level surface, so that the fan shaft 3 is clear, see fig. 3 and 4.

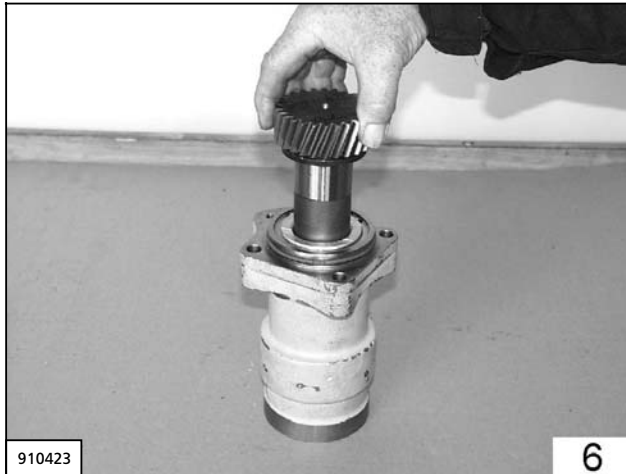


Separate the fan hub 2 from the fan shaft 3 by hitting the screw 1 with a soft (brass) punch.





Remove the screw 1. Remove the fan hub 2 from the fan shaft 3 / bearing housing 4.

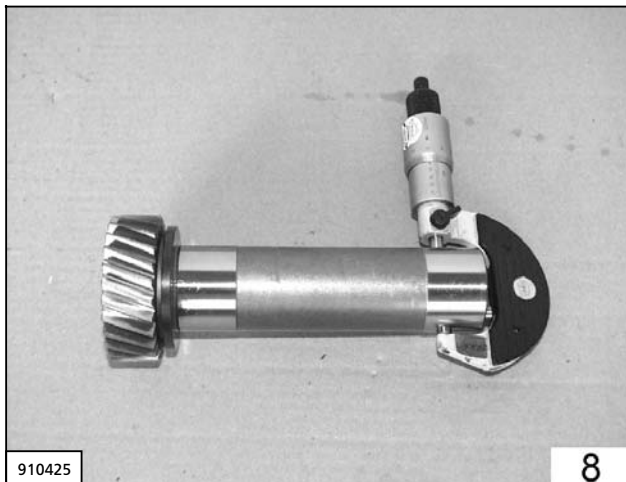


Pull the fan shaft 3 from the bearing housing 4 .



Pry the shaft seal 5 from the bearing housing 4.

Clean all parts, check the lube oil drillings to ensure they are clear and unobstructed.

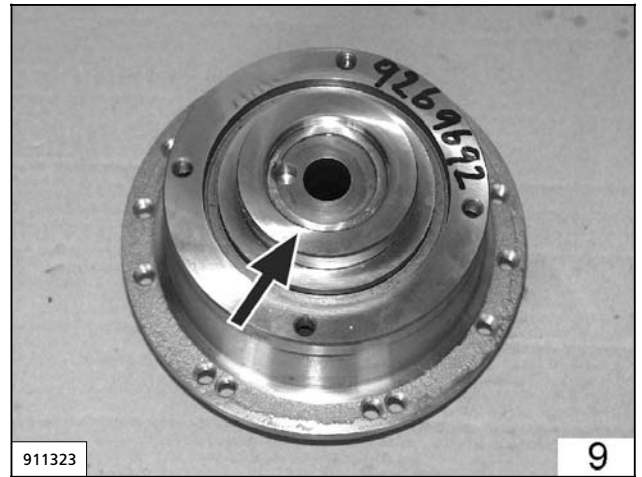


Check the running surfaces for bearing 6, 7 as well as the thrust surface for bearing 7 on the fan shaft 3 (visually).

Measure the bearing shaft diameter on the running surfaces of fan shaft 3.

For dimensions, see Technical Data.

Check the running surface for the thrust bearing 6 on the fan hub 2 for wear (visually).



Check the bearing 6, 7 in the bearing housing 4 for wear and damage (visually).

Measure with inside dial gauge.

For dimensions, see Technical Data.

Note:

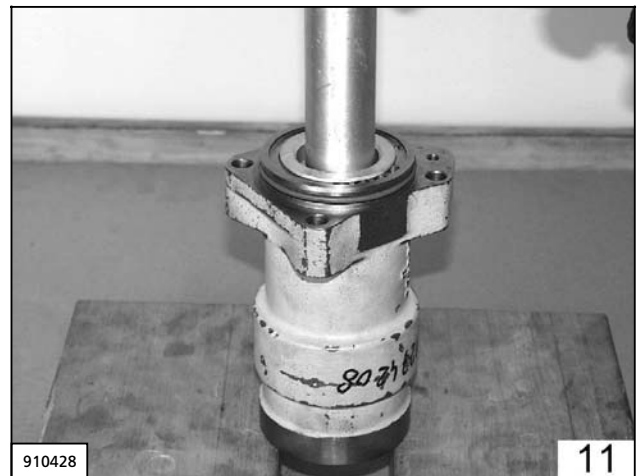
Replace all worn or damaged parts and parts which are outside the given tolerances .



Replace collar bearing in bearing housing:

Place the bearing housing 4 on a level surface and drive collar bearing 7 with a punch from the bearing housing.

Turn the bearing housing 4 over and push out collar bearing 6 with punch, special tool No. 81 .



Cool the new collar bearings 6, 7 in liquid nitrogen to -175 to -195°C (-280 to -320°C) and drive with punch, special tool No. 81 into the bearing housing 4 until flush (seated).

Note:

The collar bearings 6, 7 are premachined and do not need to be machined after installation .





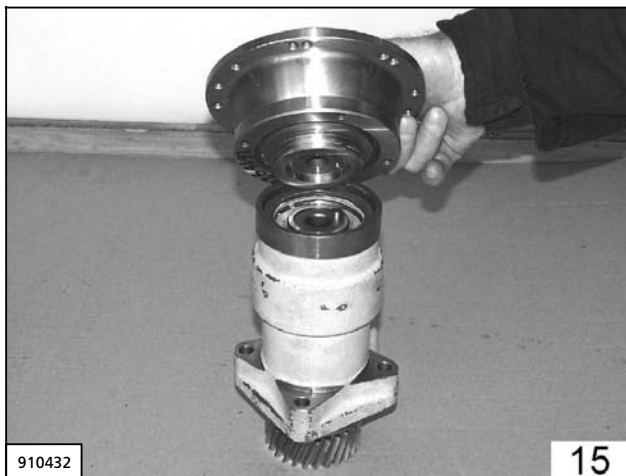
Assembly:

Press the new shaft seal 5 with punch, special tool No. 89, into the bearing housing 4.

Fill the cavity between the two sealing lips with high temperature grease. Example ; Barrierta L55/3.



Lubricate the fan shaft 3 on the running surfaces and on the thrust surface with oil and slide into the bearing housing 4.



Carefully push fan hub 2 on the fan shaft 3 and into the bearing housing 4.

Note:

The roll pin 8 in the fan shaft 3 must align with the bore in fan hub 2.



Install screw 1 and tighten lightly.

Check the fan drive for easy movement by turning it.

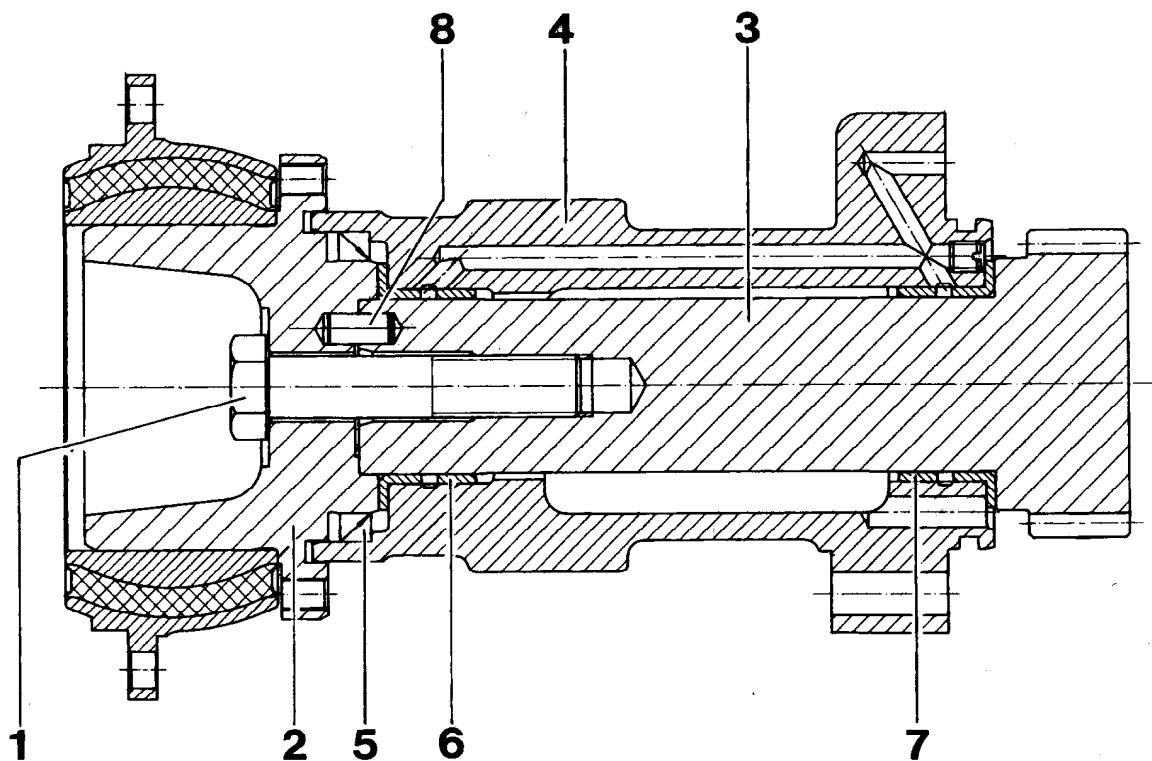
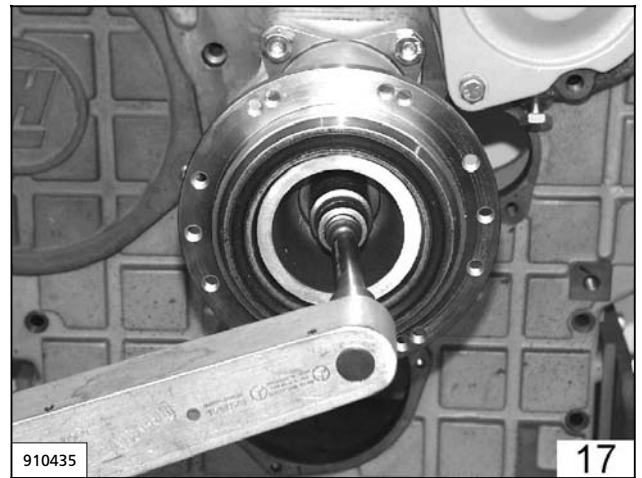
Install the fan drive, see sub group 5.02.

Prevent the engine from turning by inserting a suitable tool between the flywheel and the flywheel housing at the inspection hole. Tighten screw 1.

For tightening torque, see Technical Data.

Important:

Check the axial play again when the fan drive is installed, see fig. 1.



Coolant Temperature Sending Unit Replacement:

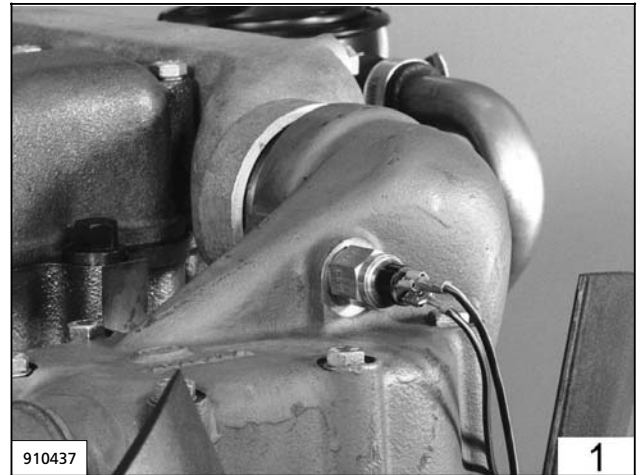
Note:

The coolant temperature sending unit might be defective if the coolant temperature is not within the specified values.

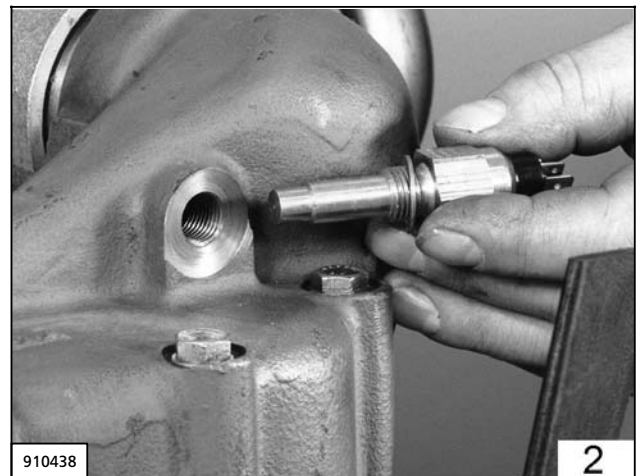
For coolant temperatures. see Technical Data.

Drain coolant, see sub group 2.01.

Remove wire from sending unit and remove sending unit from thermostat housing cover.

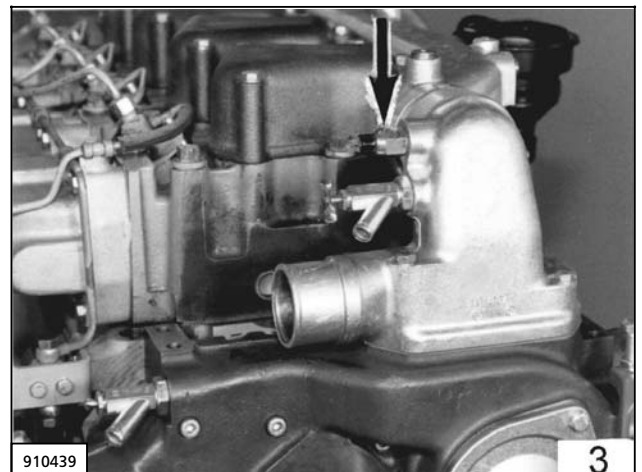


Install new temperature sending unit, using new seal ring, into thermostat housing cover. Install wire. Add coolant, see sub group 2.01.



Note:

On engines with integrated coolant pump in the timing case cover, the coolant temperature sending unit is installed on the thermostat housing cover which is installed on the timing case (see fig. 3).



Coolant Pump Removal and Installation

Coolant Pump Removal:

To drain coolant from cooling system see sub-group 2.01.

Remove supply and return hoses to radiator and heater assemblies.

Remove radiator assembly.

Remove fan assembly, see sub-group 5.01.

Remove electrical wire from coolant temperature sending unit.

Unscrew and remove coolant pump mounting bolts.

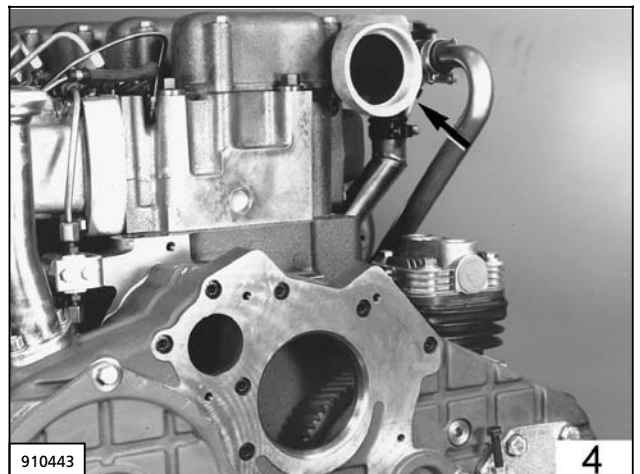
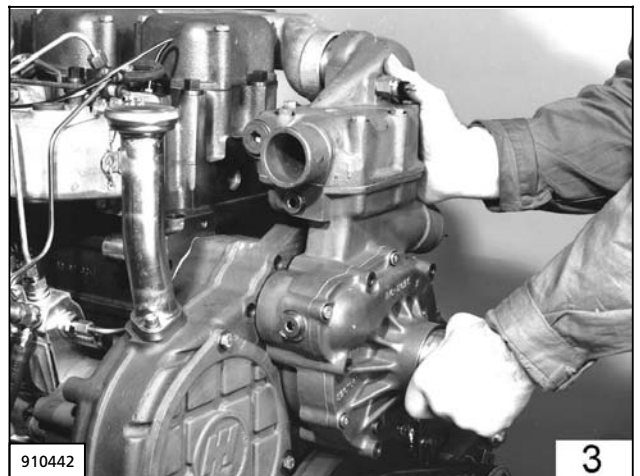
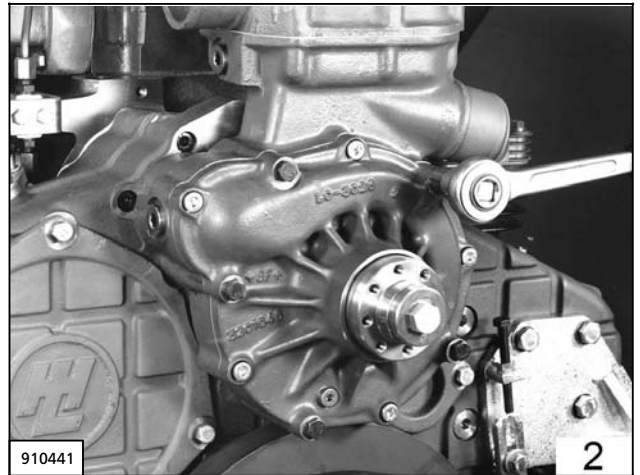
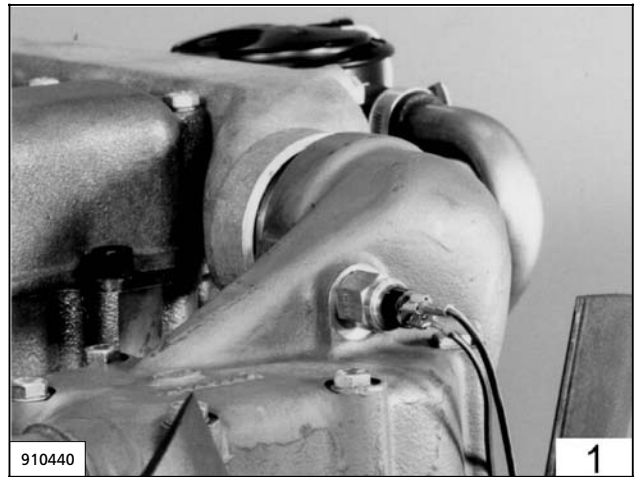
Important:

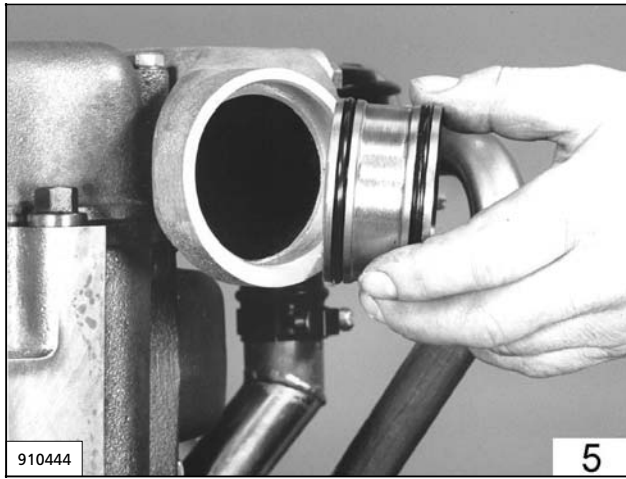
Remove hex head screws only!

Pull off and remove coolant pump assembly with thermostat housing cover from timing and accessory drive gear box as well as from coolant manifold.

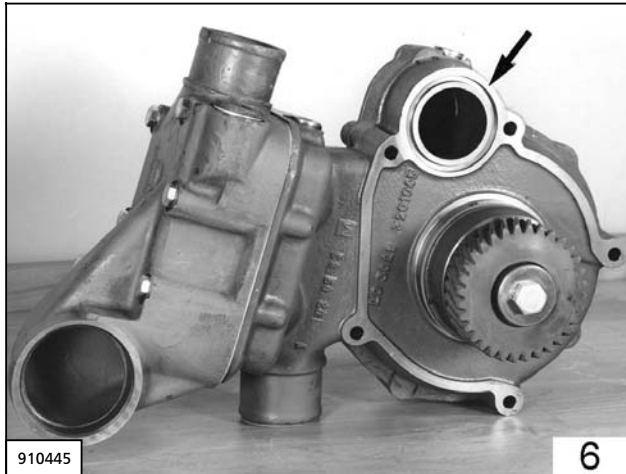
Coolant Pump Installation:

Clean connector tube bores in thermostat housing cover and coolant manifold.

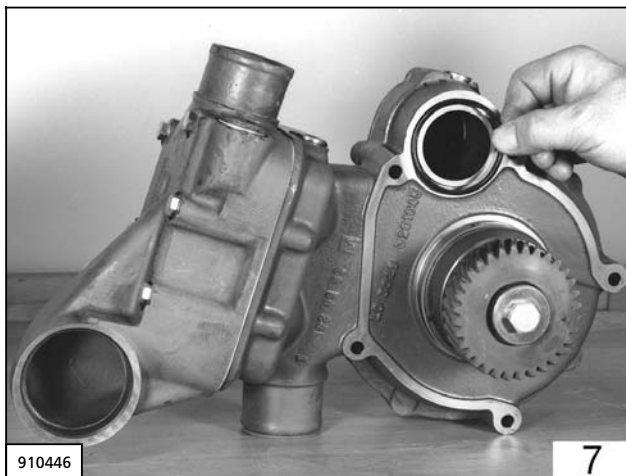




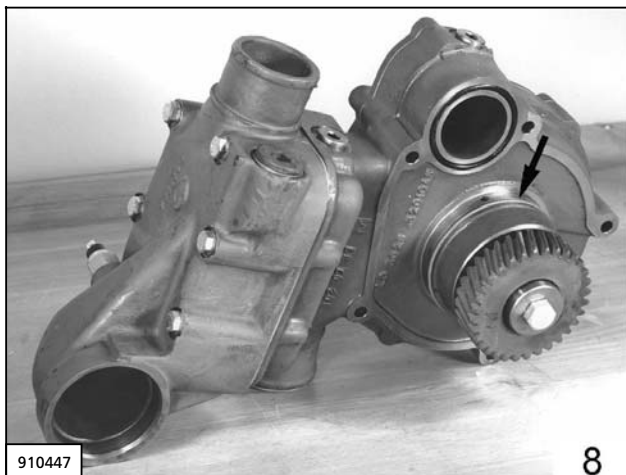
Clean connector tube and replace old o-rings with new ones. Lubricate o-rings with engine oil and insert connector tube into coolant manifold.



Clean o-ring groove on coolant pump assembly and mounting surfaces on coolant pump as well as timing and accessory drive gear box.

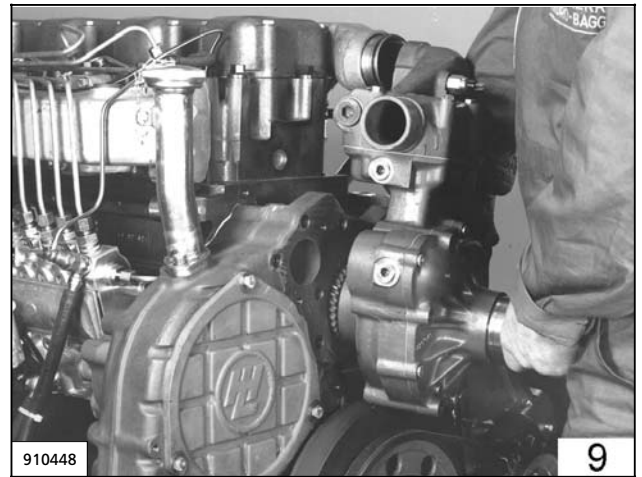


Lubricate new o-ring with grease and place it in groove on coolant pump assembly.

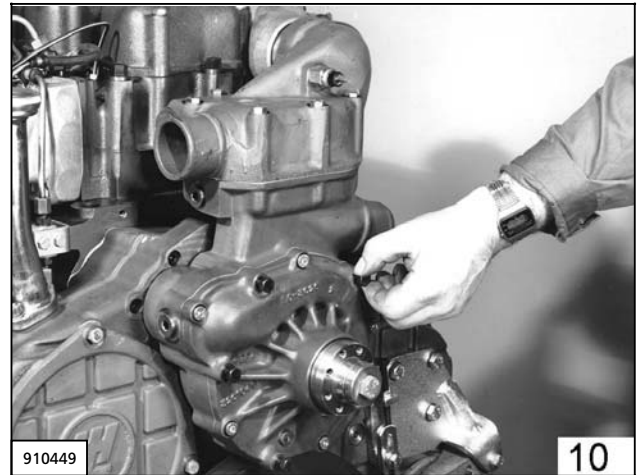


Replace other o-ring on coolant pump assembly with new one and lubricate o-ring with engine oil.

Place coolant pump assembly with thermostat housing cover in timing and accessory drive gear box, and rotate the pump shaft until the pump drive gear wheel meshes with the gear wheel in the timing and accessory drive gear box.
Completely insert thermostat housing cover into connector tube on coolant manifold and coolant pump assembly into the timing and accessory drive gear box.



Screw in and torque coolant pump mounting bolts. Reconnect electrical wire to coolant temperature sending unit. Reinstall fan and radiator assemblies, supply and return hoses to radiator and heater assemblies.
To refill cooling system with coolant see sub-group 2.01.



**Coolant pump removal and installation, check axial play
(coolant pump (version I) integrated in timing gear cover)**

Up too engine S/N 93 01 1641

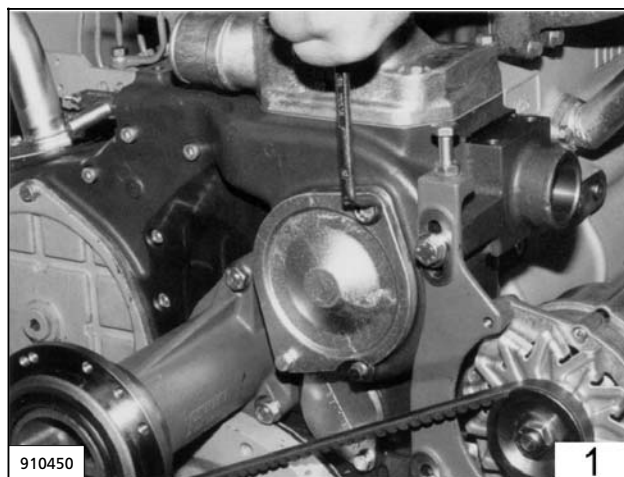
For modification to version II see SI G-8-8-12/93

Use special tool No. 24

Removal:

Drain the coolant, as necessary, see sub group 2.01

Loosen and remove the nuts on the coolant pump cover. Pry the cover from the timing gear cover.

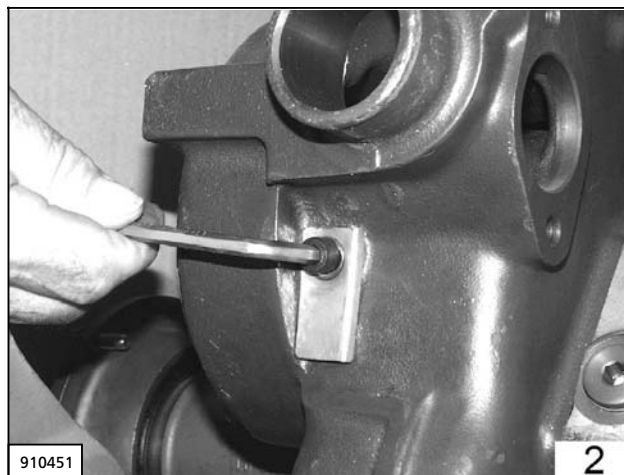


Loosen and remove the water pump housing retainer screw. to hold the coolant pump in the timing gear cover.

Remove the stop screw, cover and disk.

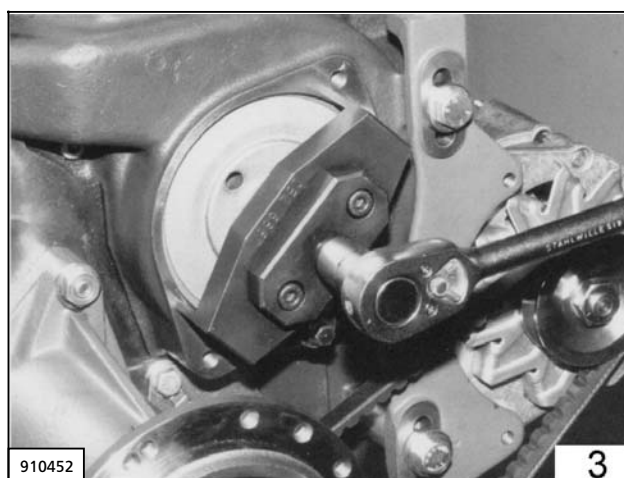
Note:

Retainer screw thread size M8x55, Id. No. 498 0783.

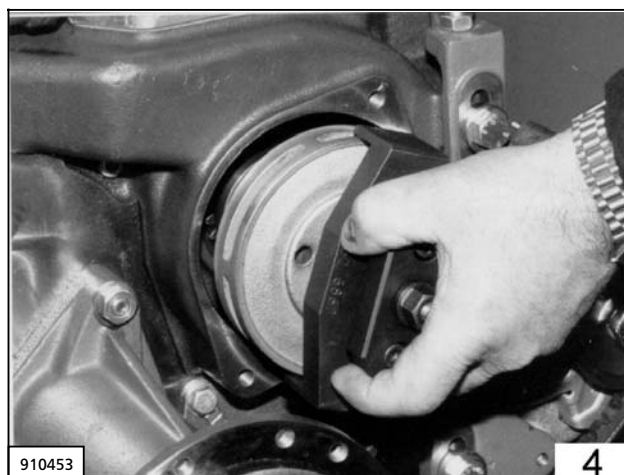


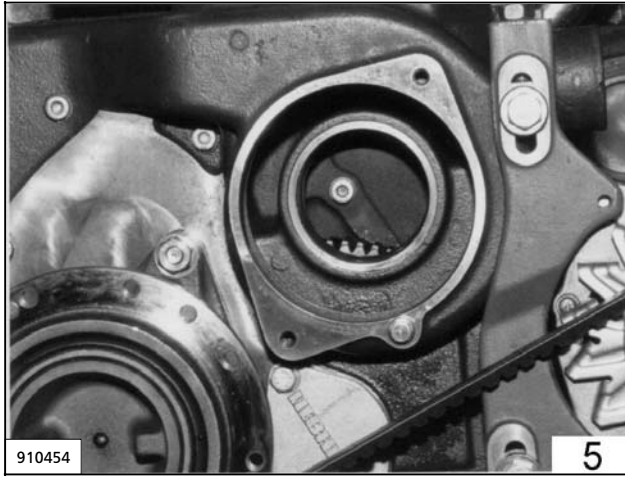
Attach the coolant pump puller, special tool No. 24 to the threaded holes in the impeller wheel and pull the coolant pump from the timing gear cover by turning the screw on the puller.

Note: Failure to drain sufficient coolant could cause coolant to run into the lube oil circuit (crankcase),



Remove the coolant pump from the timing gear cover and remove the pulling device.





Installation:

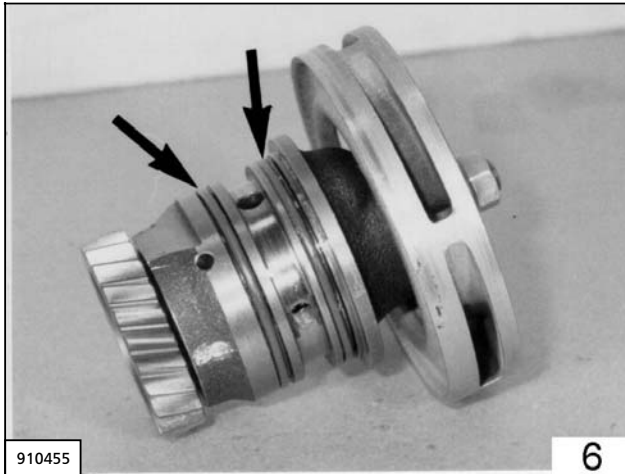
Clean the sealing surface for the end cover, mounting surface for the coolant pump housing and the mating surface for the coolant pump housing in the timing gear cover.

Evenly spray the mating bore for the coolant pump in the timing gear cover with Molykote 3402-C, Id. No. 865 5020 .

Note: Be certain to clean out the weep hole!

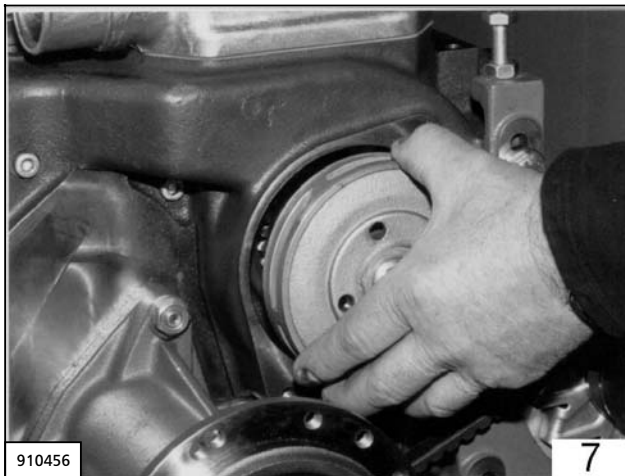
Do not exceed 0.009 mm . See SI G-8-8-12/93.

After the layer dries, lubricate the bore with grease (Staburags NBU 12) or a similar product .



Clean the coolant pump and install new O-rings.

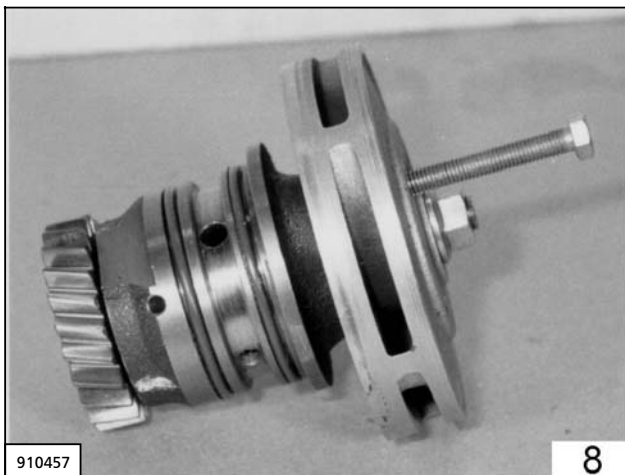
Lubricate the coolant pump on the O-rings and on the surface between the O-rings with grease (Staburags NBU 12) or a similar product .



Insert the coolant pump into the timing case housing by turning the pump shaft until the gears mesh and push the pump in.

Important:

Before inserting the pump into the timing gear case, position the housing of the coolant pump until the threads for the mounting screw in the housing and bores in the timing case cover align when the coolant pump is pushed in.



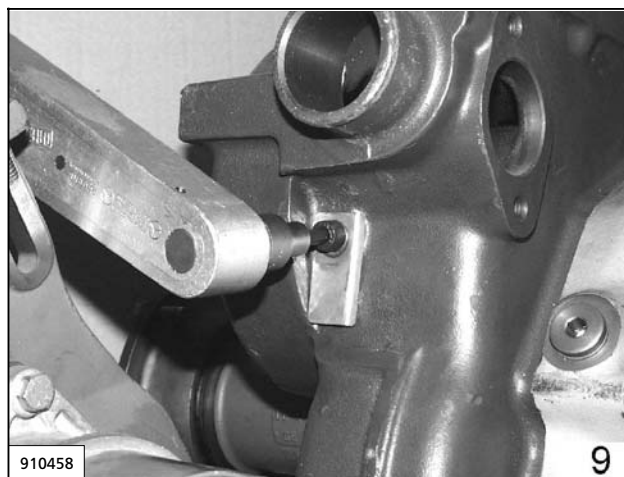
Note:

As an additional installation aid, before inserting the coolant pump into the timing case cover, a M 8 screw can be inserted into one of the two threaded bores in the impeller and the housing can be held with the cast ridge on the impeller.

Then insert the coolant pump as described in fig. 7. If the threads from housing and bores from timing case cover do not match, turn the engine to align the two bore holes.

Apply Loctite 242/243 to the threads of the retainer screw and insert with washer and weep hole cover into the bore of the timing gear cover. Screw the screw into the threads of the coolant pump, tighten and torque screw.

For tightening torque, see Technical Data.



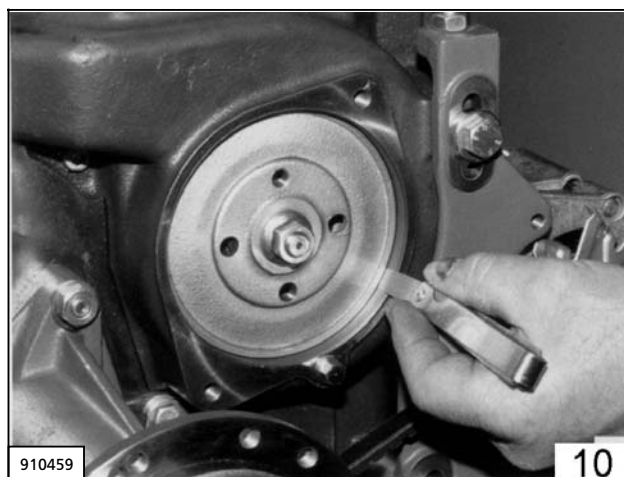
Check the clearance between the impeller wheel and the bore in the timing gear cover with a feeler gauge.

For dimension, see Technical Data.

Note:

The dimension noted on the Technical Data page is for the dimension on both sides of the impeller wheel.

When checking with a feeler gauge, divide the value by 2.



Clean the cover, install a new, lubricated O-ring and push the cover into the timing gear cover.

Install and tighten nuts.

Add coolant, see sub group 2.01.

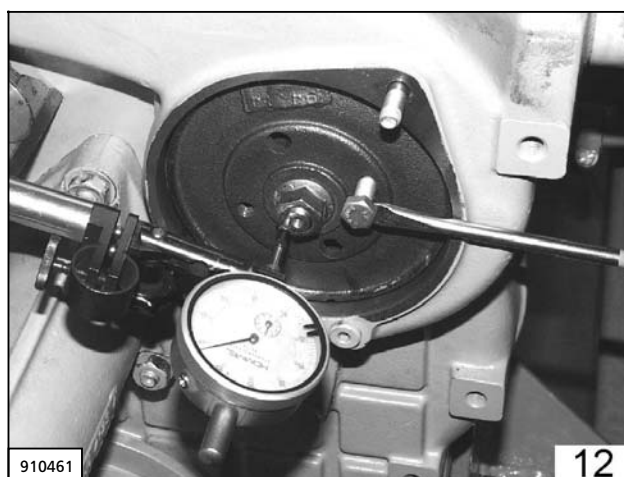


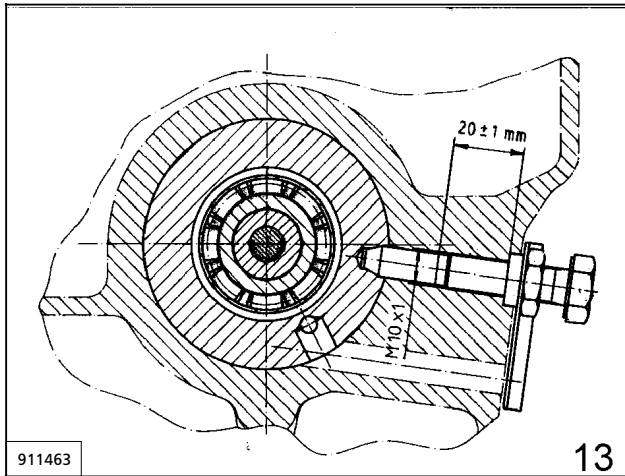
Check the axial play:

Attach a commercially available dial gauge holder with a dial gauge on the coolant pump shaft and move the impeller wheel back and forth. To perform this test, install a screw M8 into one of the threads in the impeller wheel, see fig. 12. Check the axial play.

Permissible axial play = 0.1 mm
Max. play = 0.12 mm

If the maximum play is exceeded, the coolant pump must be replaced.





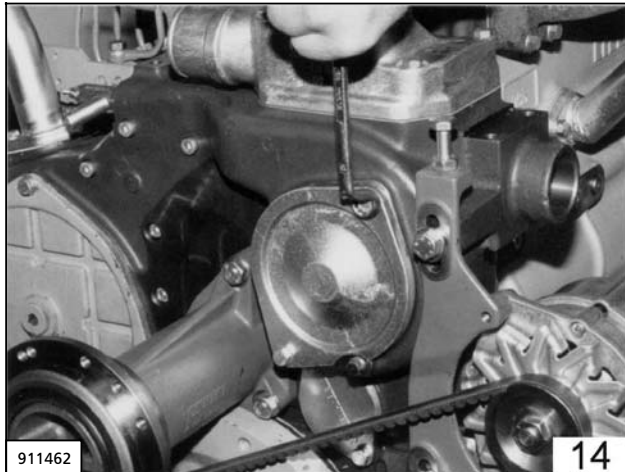
Coolant pump removal and installation, check axial play, see also SI G-8-8-12/93

Repair solution for engines up to S/N 93 01 1641
Use special tool No. 24

Important:

When changing the coolant pump integrated into the timing gear cover, up to the above mentioned engine S/N, only the following repair solution may be used.

If the coolant pump is still mounted the original way (screw M8 - see fig. 9), the mounting hole must be redrilled and retapped to M10x1 - 20 mm deep. See special drill / tap, Id. No. 864 1275



Removal:

Drain the coolant, see sub group 2.01.

Loosen and remove the nuts on the coolant pump cover. Pry the cover from the timing gear cover.

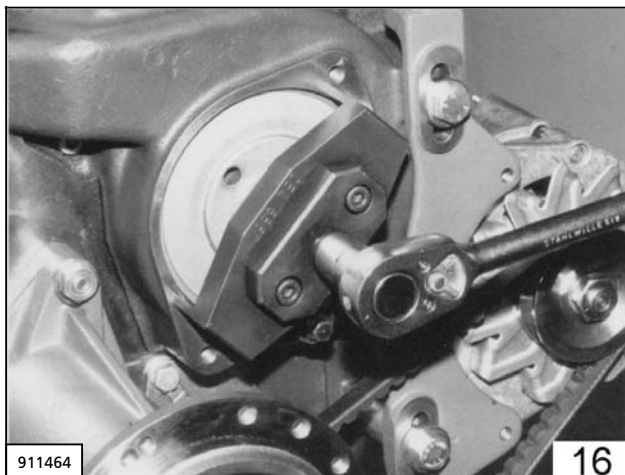


Note:

This description refers to an engine which has been modified to accept the new (both bearings are splash lubricated) coolant pump!

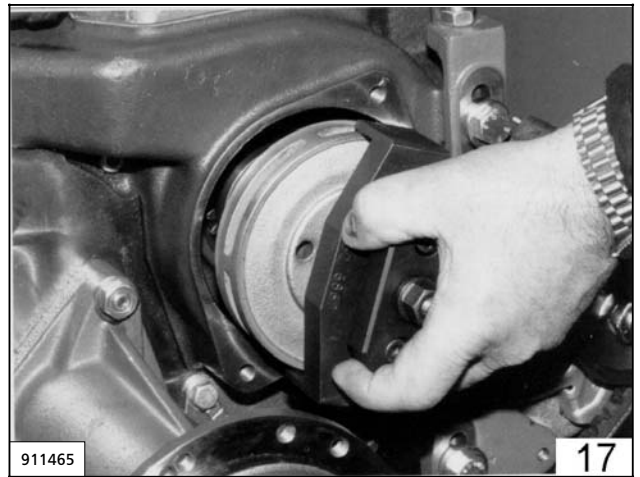
Hold the coolant pump retaining screw in the timing gear cover with a wrench and loosen the lock nut.

Remove the mounting screw, the wheel hole cover and the spacers.



Install the coolant pump puller, special tool No. 24 to the holes in the impeller wheel and pull the coolant pump from the timing gear cover by turning the screw on the pulling device.

Remove the coolant pump from the timing gear cover and remove the coolant pump puller.

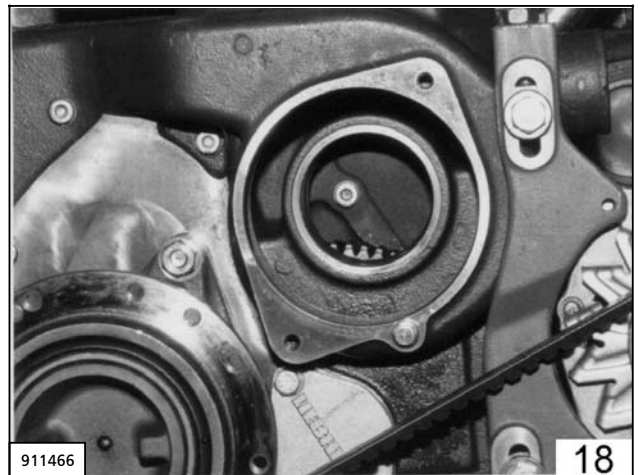


Installation:

Clean the sealing surface for the end cover, mounting surface for the coolant pump housing and the mating surface for the coolant pump housing in the timing gear cover.

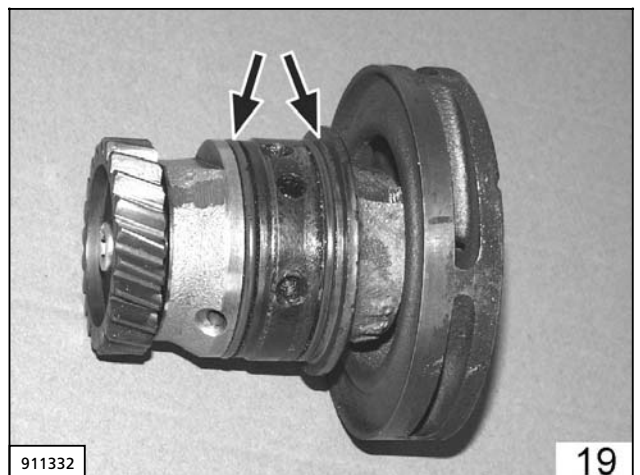
Check the mating surface for the coolant pump in the timing gear cover to ensure that the surface is covered. Otherwise spray evenly with Molykote 3402-C. Do not exceed 0.009 mm .

After the layer dries, lubricate the bore with grease (Staburags N BU 12) .

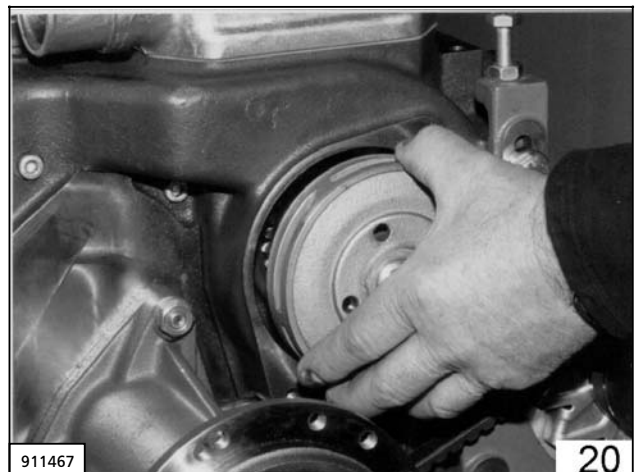


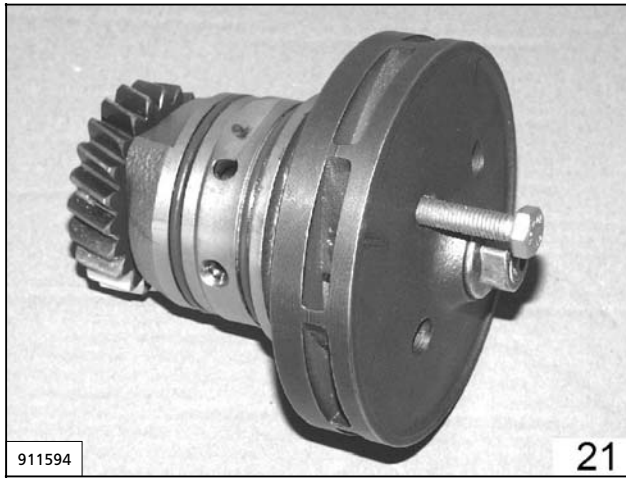
Clean the coolant pump and install new O-rings.

Lubricate the coolant pump on the O-rings and on the surface between the O-rings with grease (Staburags NBU 12) or a similar product.



Push the coolant pump into the timing gear cover by turning the drive shaft (gear mesh) in such a way that the bore in the coolant pump and the bore or screw hole for mounting screw in the timing gear cover line up.

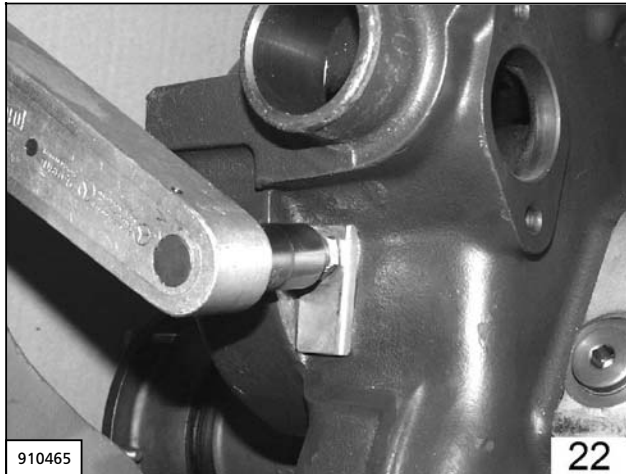




Note:

As an installation aid, install a screw size M8 into the threaded hole of the impeller wheel before installing the coolant pump. This locks the impeller wheel to the pump housing and the impeller wheel can be used to rotate / line up the pump.

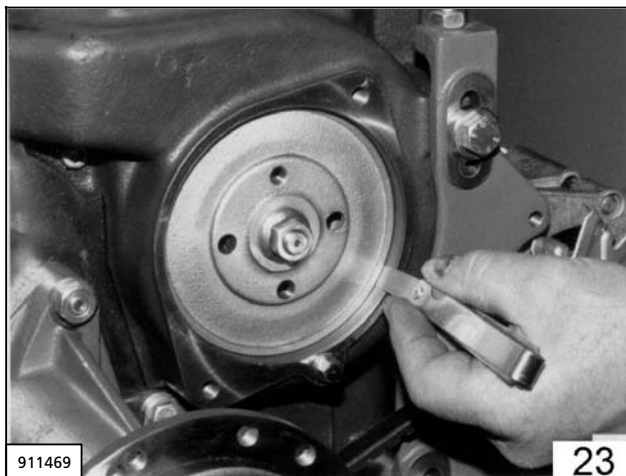
Insert the coolant pump into the timing gear cover, see fig. 20. Turn the engine while pushing in the coolant pump to align the two bore holes.



Push the evoer and washer onto the retainer screw. Apply Loctite 242/243 to the threads of the retainer screw. Install, tighten and torque screws.

For tightening torques, see Technical Data.

Align the cover with the weep hole, hold the screw and tighten the lock nut.



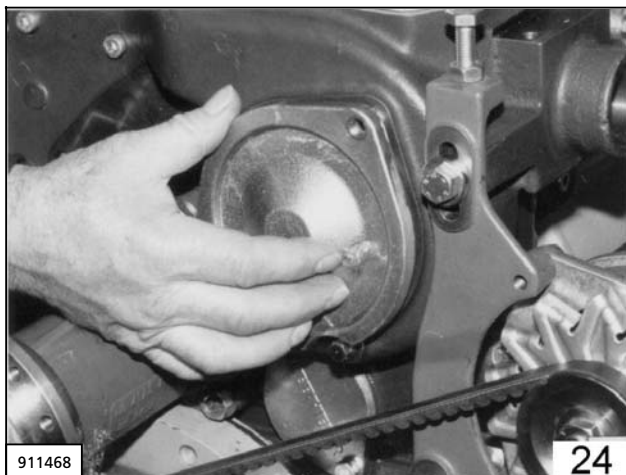
Check the clearance between the impeller wheel and the bore in the timing gear cover with a feeler gauge.

For dimension, see Technical Data.

Note:

The dimension given in the Technical Datta page is for the dimensions on both sides of the impeller wheel.

When checking with a feeler guage, divide the value by 2.



Clean the cover, install a new lubricated O-ring and push the cover into the timing gear cover.

Install and tighten nuts.

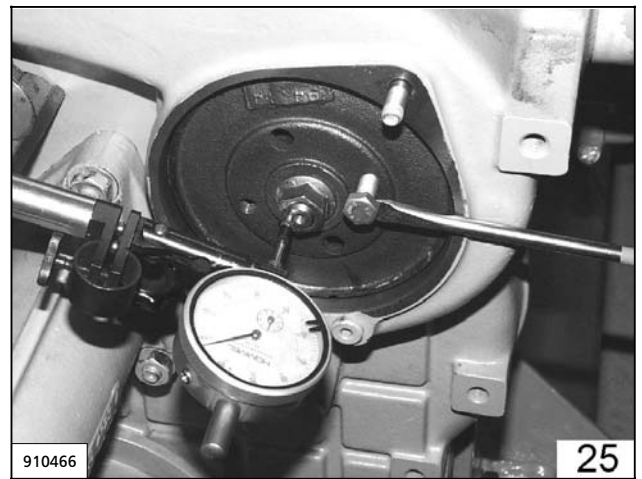
Add coolant, see sub group 2.01.

Check the axial play:

Install a commercially available dial gauge holder with dial gauge to the coolant pump shaft and move the impeller back and forth. To perform this test, install a screw M8 into one of the threads in the impeller wheel, see fig. 25. Check the axial play.

Permissible axial play = 0.1 mm
Max. play = 0.12 mm

If the max. play is exceeded, the coolant pump must be replaced.



**Coolant pump removal and installation, check axial play
(coolant pump version II integrated in timing gear cover)**

from engine S/N 93 01 1642

For modification to version III see SI G-4-13-05/97

Use special tool No. 24

Removal:

Drain the coolant, see sub group 2.01

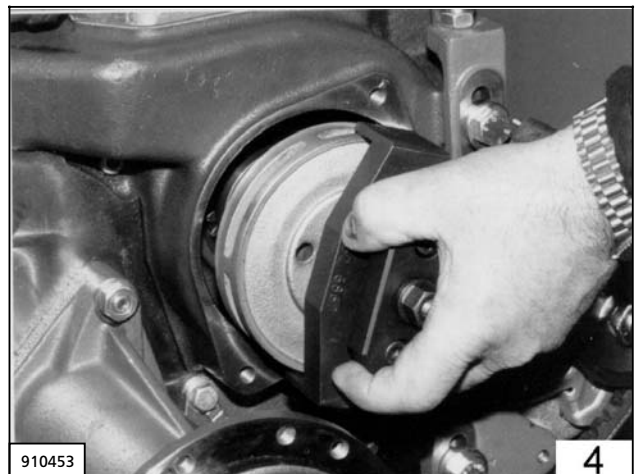
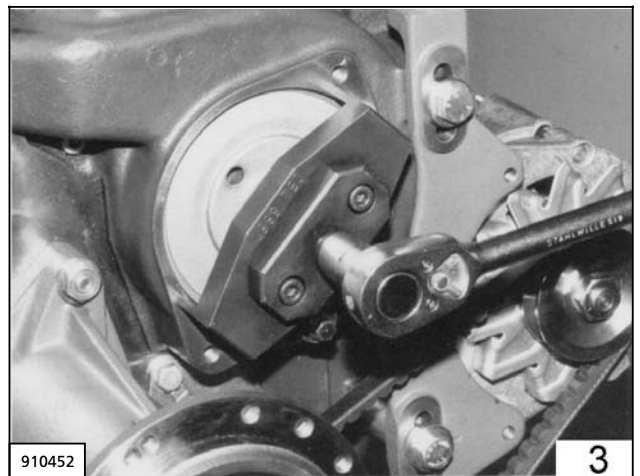
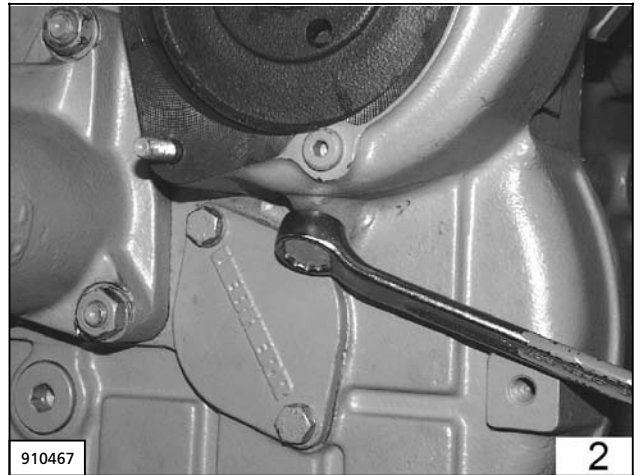
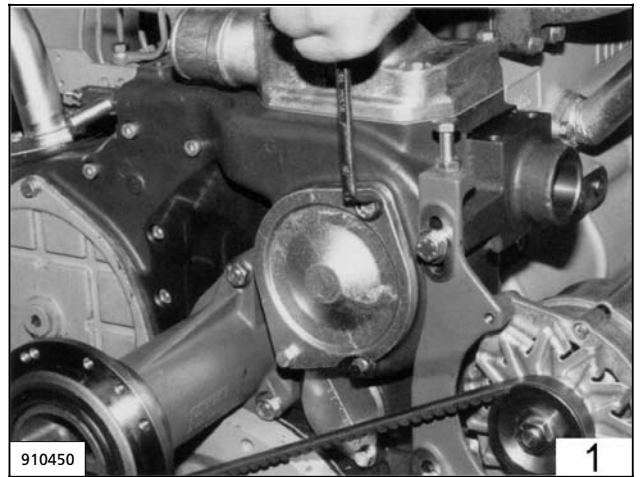
Loosen and remove the nuts on the cover of the coolant pump. Pry the cover from the timing gear cover.

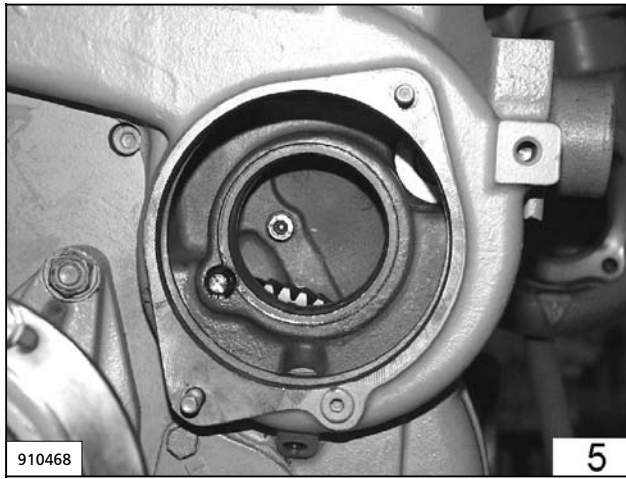
Loosen and remove the water pump housing retainer screw.

Attach coolant pump puller, special tool No. 24 to the threaded holes in the impeller wheel and pull the coolant pump from the timing gear cover by turning the screw on the puller.

Note: Failure to drain sufficient coolant could cause coolant to run into the lube oil circuit (crankcase).

Remove the coolant pump from the timing gear cover and remove the pulling device.



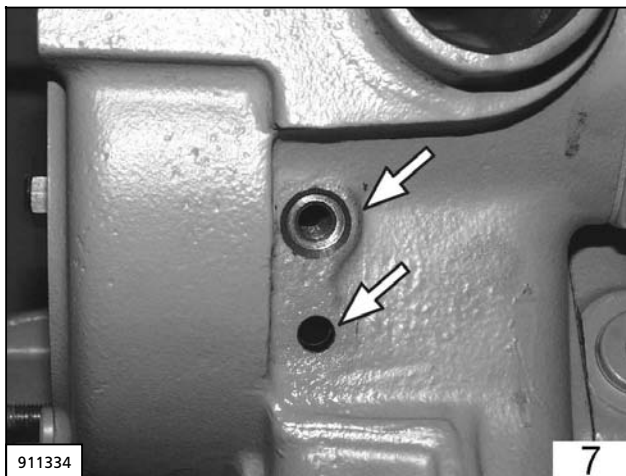


Installation:

Clean the sealing surface for the end cover, mounting surface for the coolant pump housing and the mating surface for the coolant pump housing in the timing gear cover.

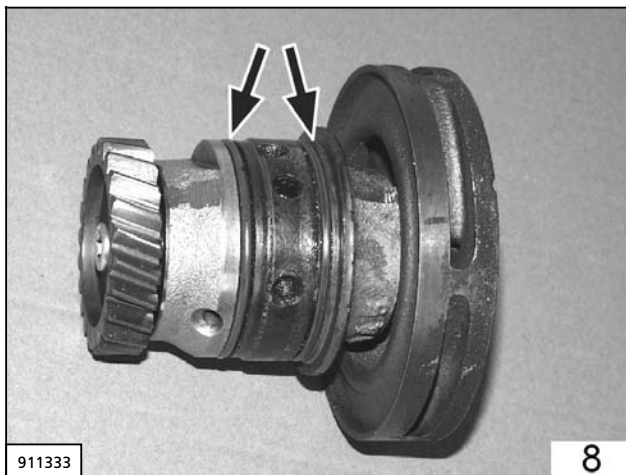


Remove the screw for the weep hole cover and remove the cover.



Clean the bore for the retainer screw and the weep hole bore.

Reinstall the weep hole cover.

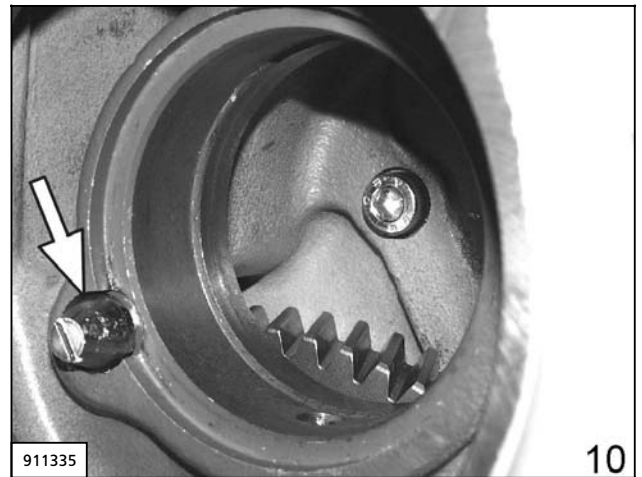
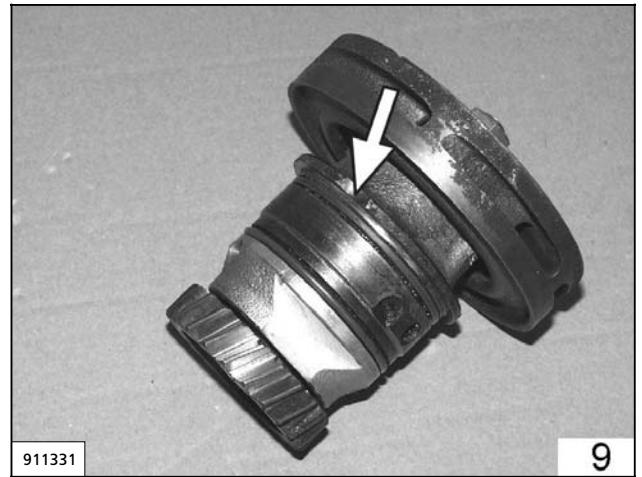


Clean the coolant pump and install new O-rings.

Lubricate the coolant pump on the O-rings and on the surface between the O-rings as well as the mating surface in the timing gear cover with grease (Staburags NBU 12) or a similar product.

Push the coolant pump into the timing gear cover by turning the drive shaft (gear mesh) in such way that the cut out in the coolant pump housing, see fig. 9 and the positioning screw in the timing gear cover, see fig. 10, line up, when pushed in.

Note: Do not force or hit the pump to install.

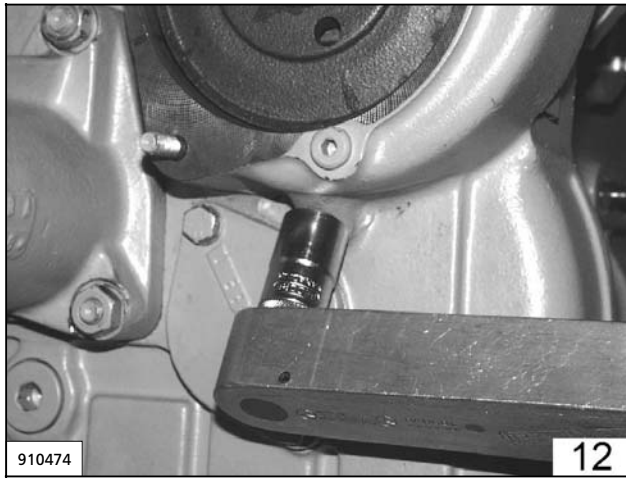


Note:

As an installation aid, install a screw size M8 into the threaded hole of the impeller wheel before installing the coolant pump. This locks the impeller wheel to the pump housing and the impeller wheel can be used to rotate/ line up the pump.

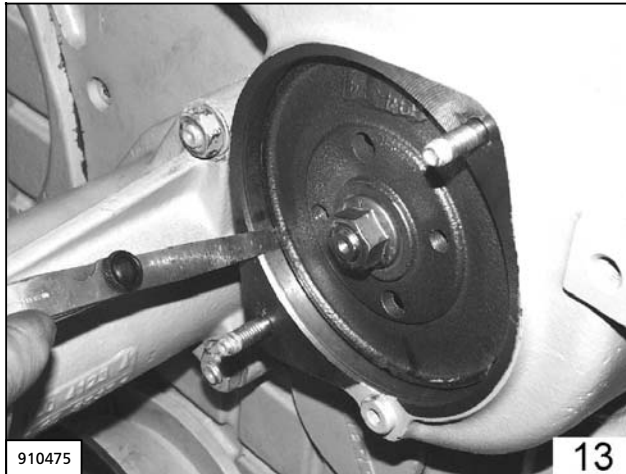
Insert the coolant pump into the timing gear cover, as described for fig. 9. If the cut out in the housing and the positioning screw in the timing gear cover do not exactly line up, turn the engine while pushing in the coolant pump to align the cut out and the positioning screw.





Apply Loctite 242/243 to the threads of the retainer screw. Install, tighten and torque screw.

For tightening torques, see Technical Data.



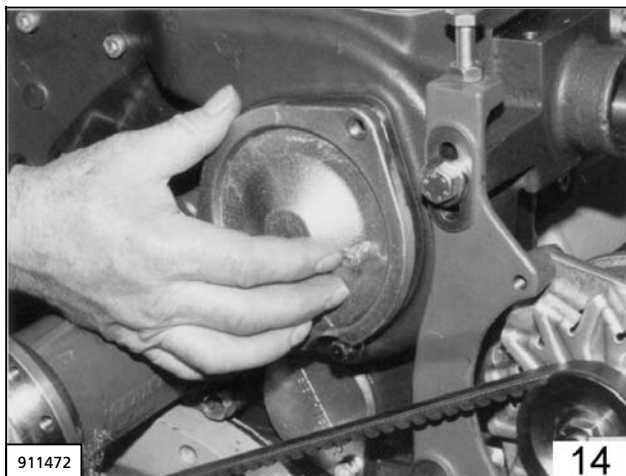
Check the clearance between the impeller wheel and the bore in the timing gear cover with a feeler gauge.

For dimension, see Technical Data.

Note:

The dimension given in the Technical Data page is for the dimensions on both sides of the impeller wheel.

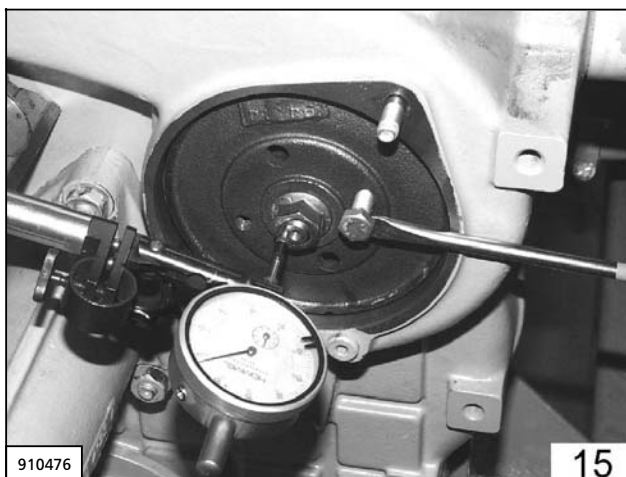
When checking with a feeler gauge, divide the values by 2.



Clean the cover, install a new, lubricated O-ring, and push the cover into the timing gear cover.

Install and tighten nuts.

Add coolant, see sub group 2.01.



Check the axial play:

Install a commercially available dial gauge holder with a dial gauge on the coolant pump shaft and move the impeller wheel back and forth. To perform this stest, install a screw M8 into one of the threads in the impeller wheel, see fig. 15. Check the axial play.

Permissible axial play = 0.1 mm

Max. play = 0.12 mm

If the max. play is exceeded, the coolant pump must be replaced.

**Coolant pump removal and installation
with collar bearings (bushings)
(coolant pump version III integrated in timing gear
cover)**

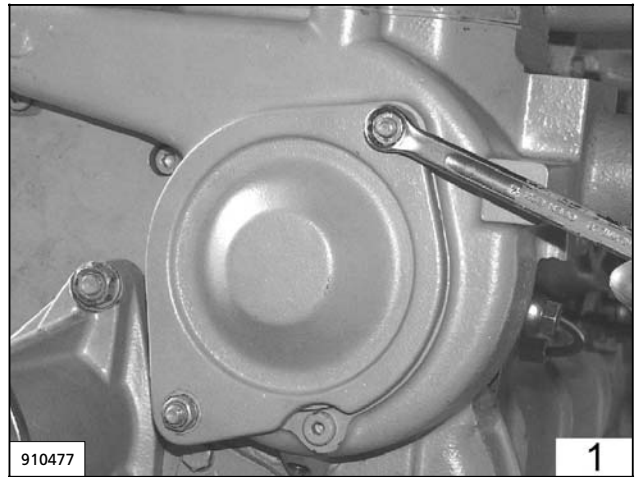
Up to engine S/N 2001 02 1093

Use special tool No. 24

Removal:

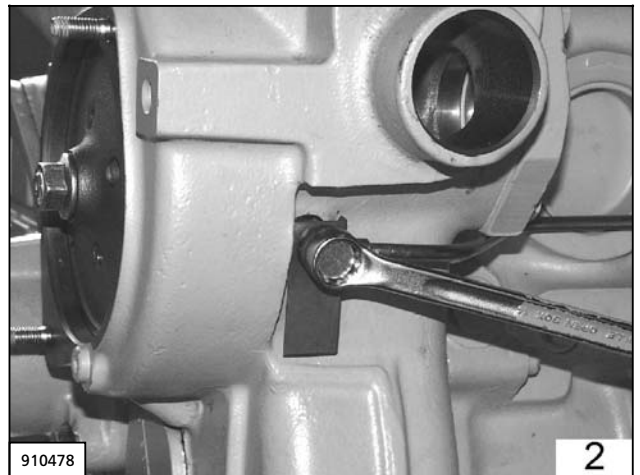
Drain the coolant, see sub group 2.01

Loosen and remove the nuts on the cover of the
coolant pump. Pry the cover from the timing gear
cover.

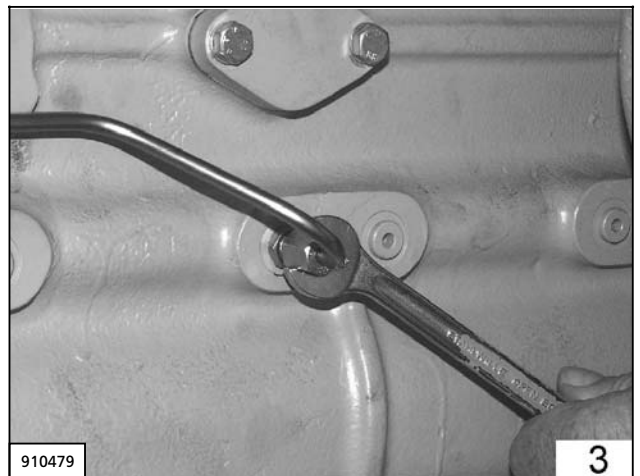


Loosen and remove the fitting on the retainer
screw (lube oil nozzle) for the coolant pump.

Remove the cover for the weep hole.

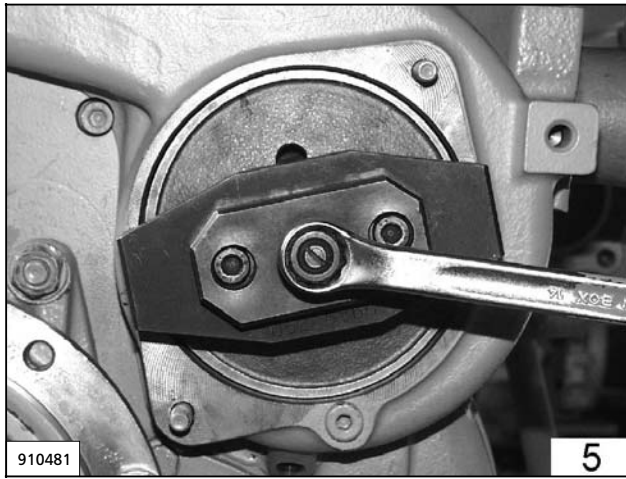


Remove the union nut of the lube oil line from the
fitting on the crankcase and remove the line.



Loosen and remove the coolant pump retainer
screw (lube oil nozzle) from the timing gear cover.



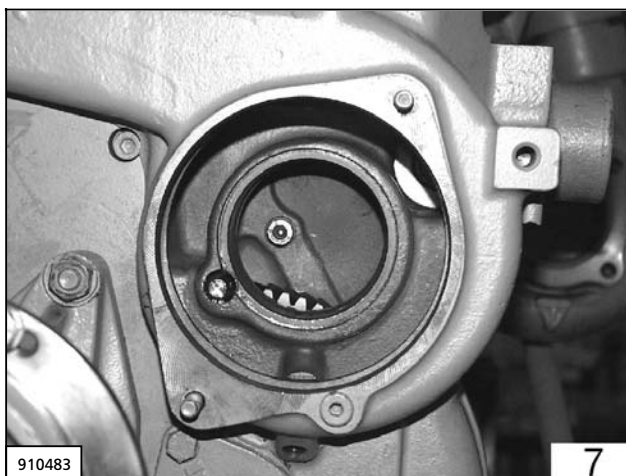


Attach coolant pump puller, special tool No. 24 to the threaded holes in the impeller wheel and pull the coolant pump from the timing gear cover by turning the screw on the puller.

Note: Failure to drain enough coolant could cause coolant to run into the lube oil circuit (crankcase).



Remove the coolant pump from the timing gear cover and remove the pulling device.

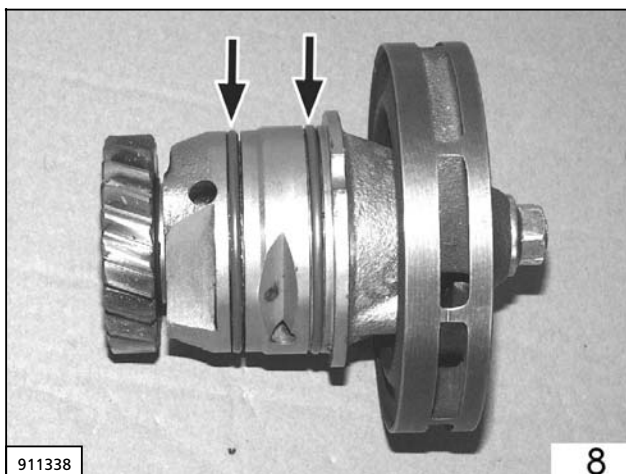


Installation:

Clean the sealing surface for the end cover, mounting surface for the coolant pump housing and the mating surface for the coolant pump housing in the timing gear cover.

Clean the threaded bore and the leakage bore.

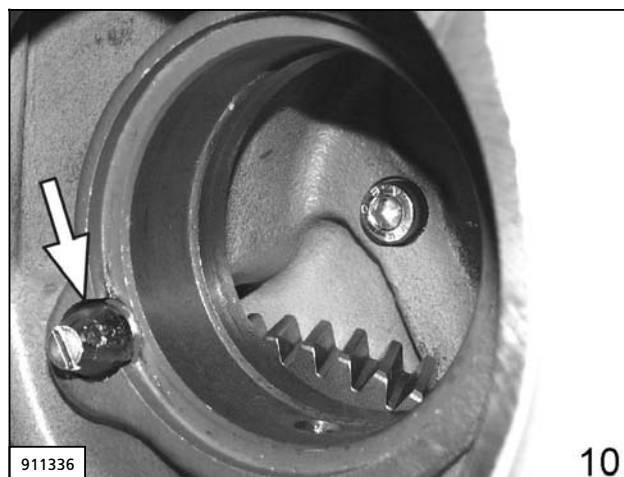
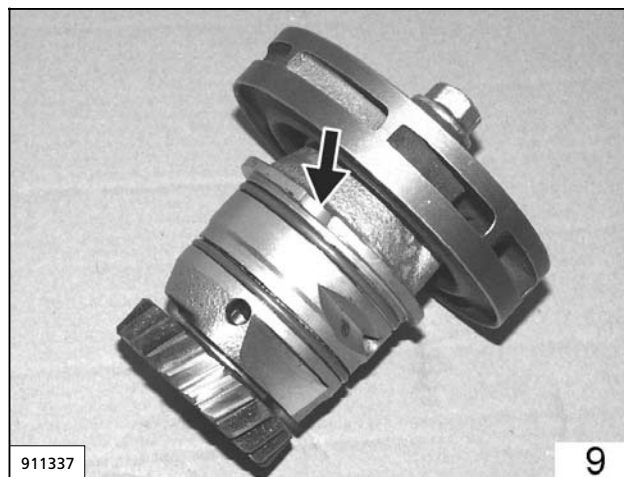
Clean the bore for the retainer screw (spray nozzle) and the weep hole bore.



Clean the coolant pump and install new O-rings.

Lubricate the coolant pump on the O-rings and on the surface between the O-rings as well as the mating surface in the timing gear cover with grease (Staburags NBU 12) or a similar product.

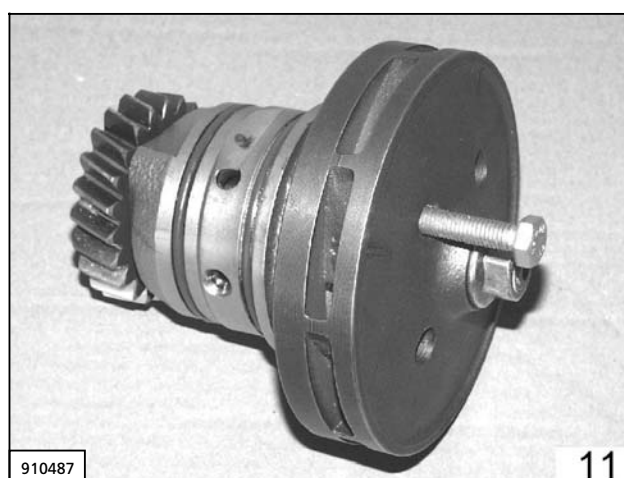
Push the coolant pump into the timing gear cover by turning the drive shaft (gear mesh) in such way that the cut out in the coolant pump housing, see fig. 9 and the positioning screw in the timing gear cover, see fig. 10, line up, when pushed in.



Note:

As an installation aid, install a screw size M8 into the threaded hole of the impeller wheel before installing the coolant pump. This locks the impeller wheel to the pump housing and the impeller wheel can be used to rotate /line up the pump.

Insert the coolant pump into the timing gear cover, as described for fig. 9. If the cut out in the housing and the positioning screw in the timing gear cover do not exactly line up, turn the engine while pushing in the coolant pump to align the cut out and the positioning screw.



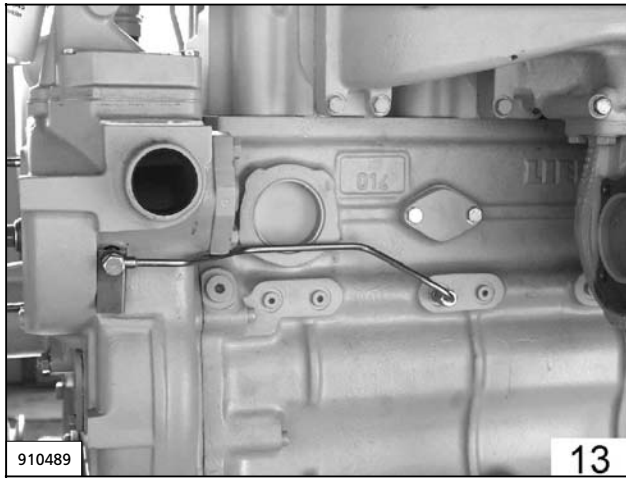
Apply Loctite 242/243 to the thread of the retainer screw (lube oil nozzle) and tighten.

For tightening torque, see Technical Data.

Note:

Be certain that the thread for the retainer screw is clean. Otherwise the tightening torque of only 15 ft. lbs. will be absorbed by the dirty threads and the retainer screw will not seal against the coolant pump housing. Result, oil leaks from the weep hole.

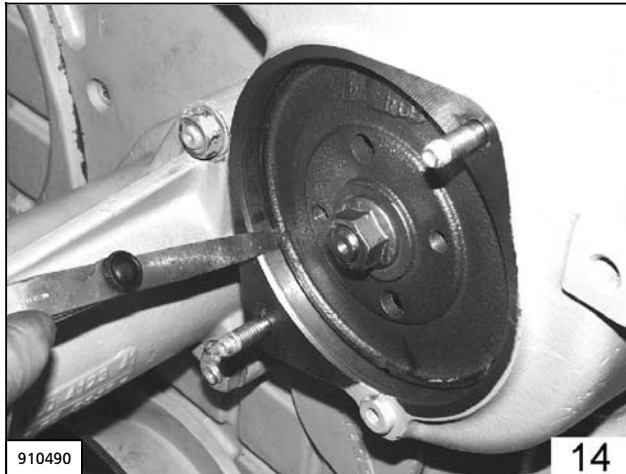




Install the lube oil line with the weep hole cover and new seal ring on the retainer screw and on the crankcase.

Note:

It may be necessary to replace the weep hole cover since it also acts as a seal between the lube line and the retainer screw.



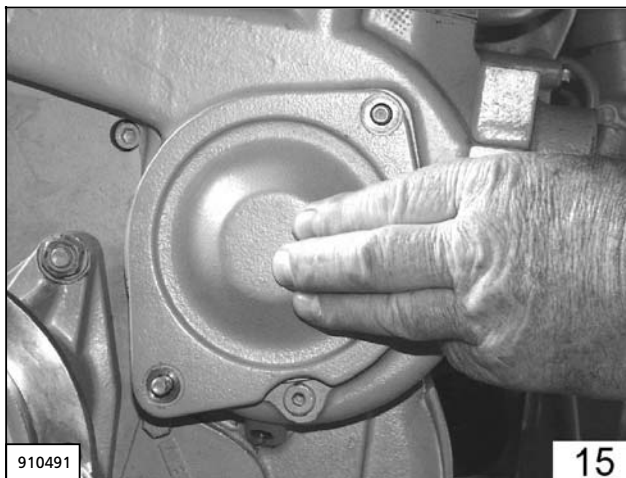
Check the clearance between the impeller wheel and the bore in the timing gear cover with a feeler gauge.

For dimension, see Technical Data.

Note:

The dimension given in the Technical Data page is for the dimensions on both sides of the impeller wheel.

When checking with a feeler gauge, divide the value by 2.



Clean the cover, install a new, lubricated O-ring, and push the cover into the timing gear cover.

Install and tighten nuts.

Add coolant, see sub group 2.01.

Coolant Pump removal and installation with collar bearings (bushings) (Coolant pump (version IV) integrated in timing gear cover).

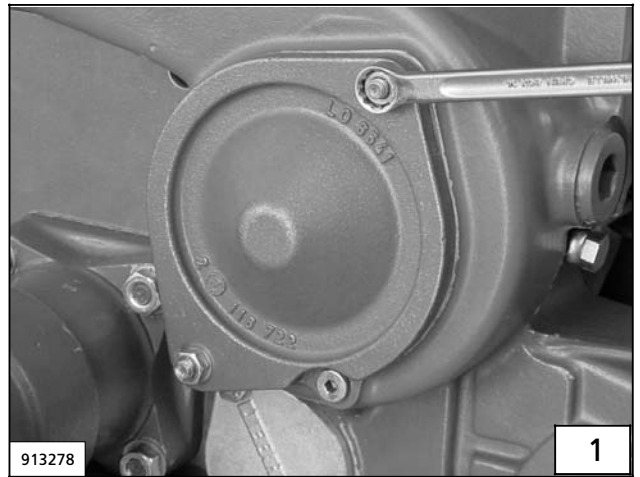
From engine S/N 2001 02 1094

Use special tool No. 24, 66

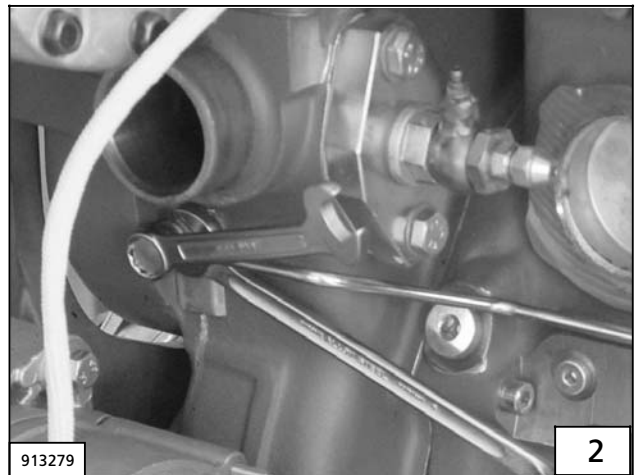
Removal:

Drain the coolant, see subgroup 2.01.

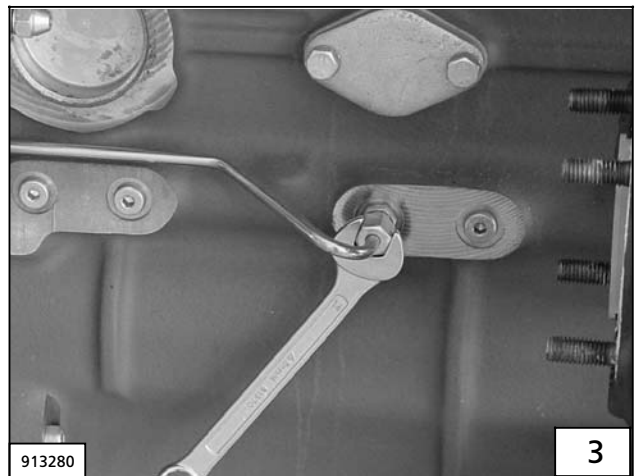
Loosen and remove the nuts on the cover of the coolant pump. Dry the cover from the timing gear cover.



Loosen the hollow screw for the lube oil line on the mounting screw (lube oil nozzle) while holding the mounting screw, and remove.

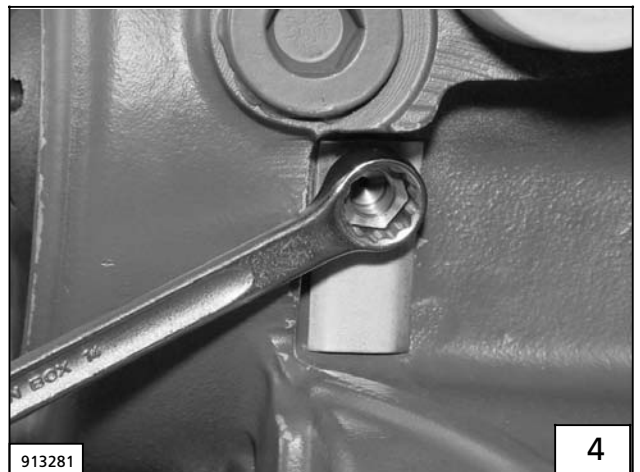


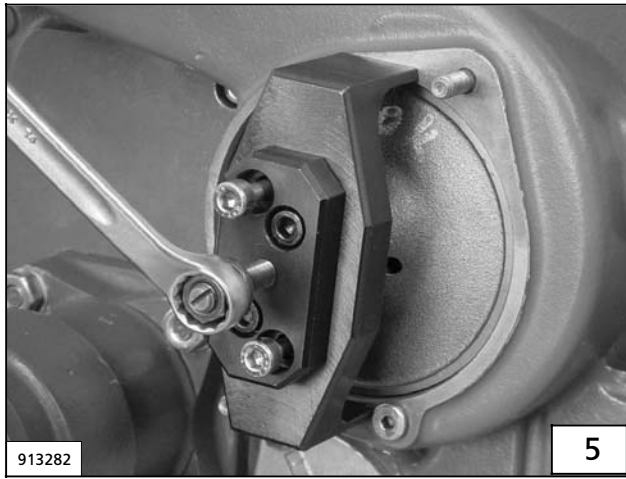
Remove the union nut of the lube oil line from the fitting on the crankcase and remove the line.



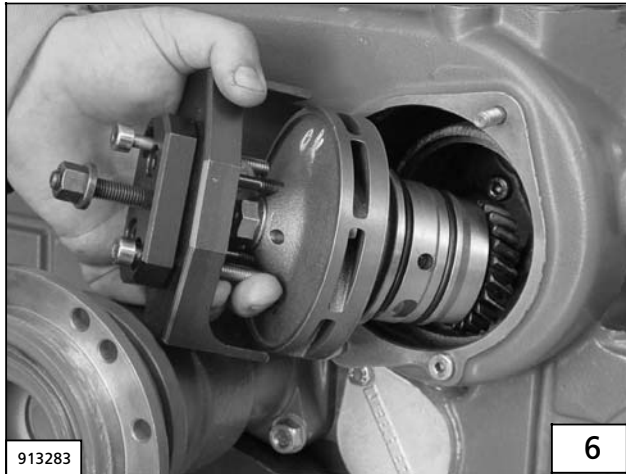
Loosen and remove the coolant pump retainer screw (lube oil nozzle) from the timing gear cover.

Remove the cover for the weep hole.





Attach coolant pump puller, special tool No. 24 to the threaded holes in the impeller wheel and pull the coolant pump from the timing gear cover by turning the screw on the puller.



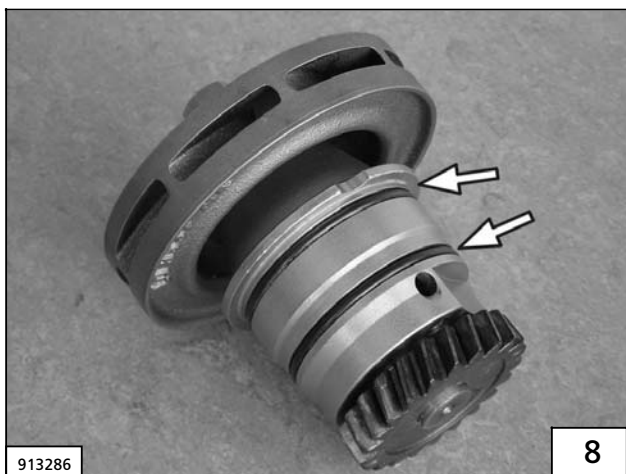
Remove the coolant pump from the timing gear cover and remove the pulling device.



Installation:

Clean the sealing surface for the end cover, mounting surface for the coolant pump housing and the mating surface for the coolant pump housing in the timing gear cover.

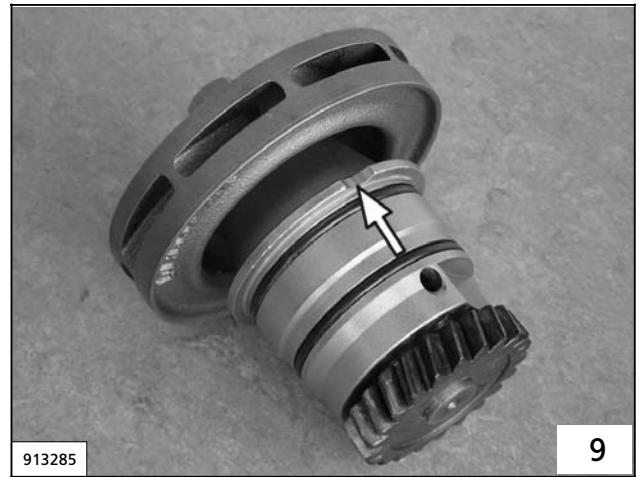
Clean the threaded bore and the leakage bore.



Clean the coolant pump and install new O-rings.

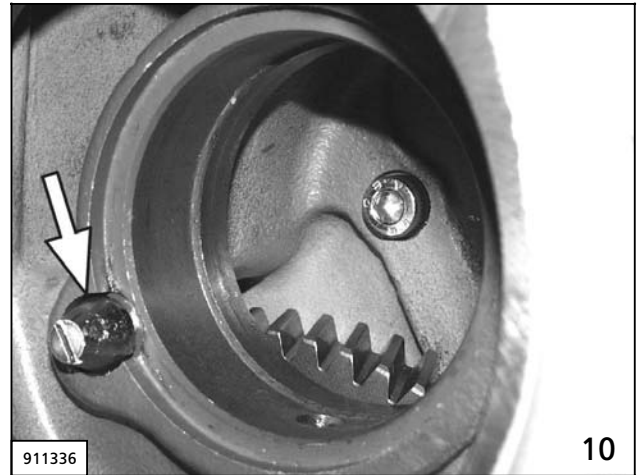
Lubricate the coolant pump on the O-rings and on the surface between the O-rings as well as the mating surface in the timing gear cover with grease (Staburags NBU 12) or a similar product.

Push the coolant pump into the timing gear cover by turning the drive shaft (gear mesh) in such way that the cut out in the coolant pump housing see fig. 9 and the positioning screw in the fig. 10, line up, when pushed in.



Important:

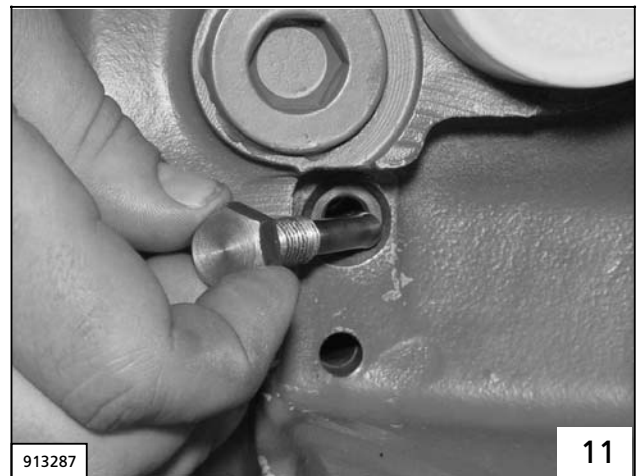
The installation aid described for the other timing case integrated coolant pumps with the two screws in the impeller and retention of impeller with the coolant pump housing may not be used on this coolant pump (damage to the slip ring seal).



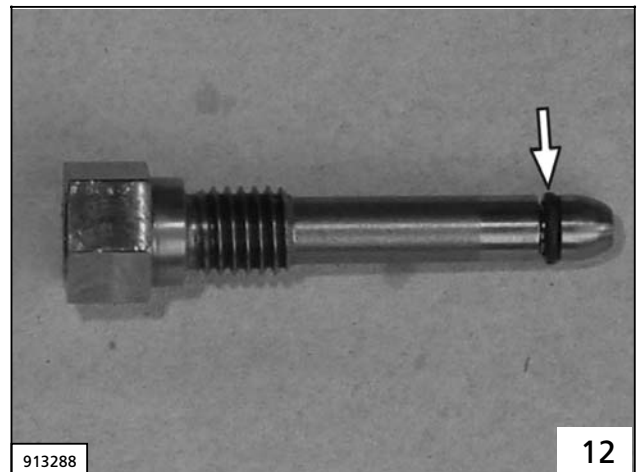
Indent the retainer screw, special tool No. 66 in the hole of the timing gear cover and bring the hole on the coolant pump and timing gear cover in correct position.

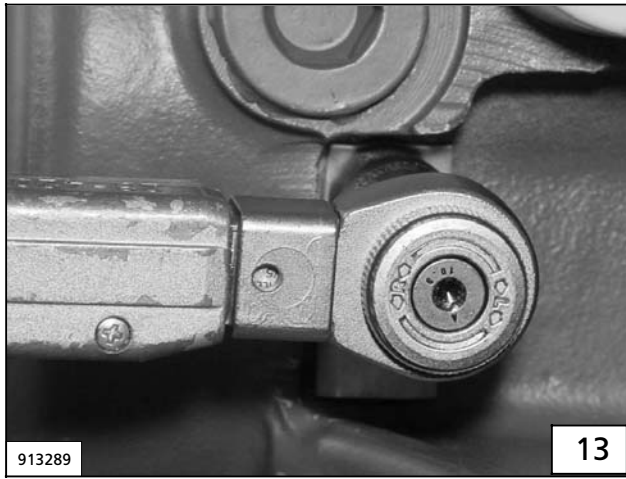
Note:

The holes into the coolant pump and timing gear cover must be coaxial otherwise by screwing the mounting screw (lube oil nozzle) the O-ring can be damaged.



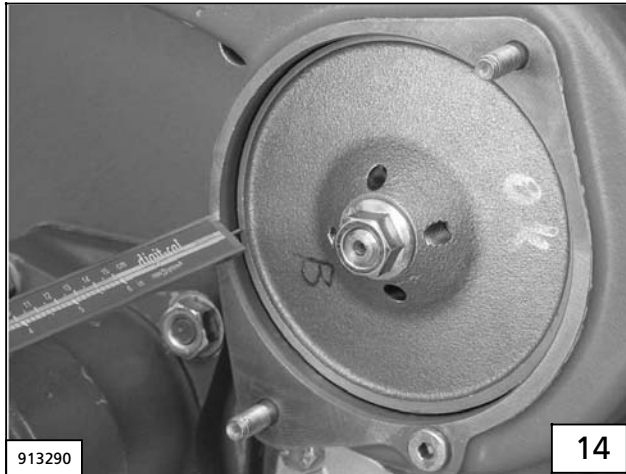
Apply a new O-ring to the mounting screw (lube oil nozzle), lubricated O-Ring.





Apply Loctite 243 to the thread of the retainer screw (lube oil nozzle) reinstall weep hole on weep hole bore and tighten.

For tightening torque, see Technical Data.

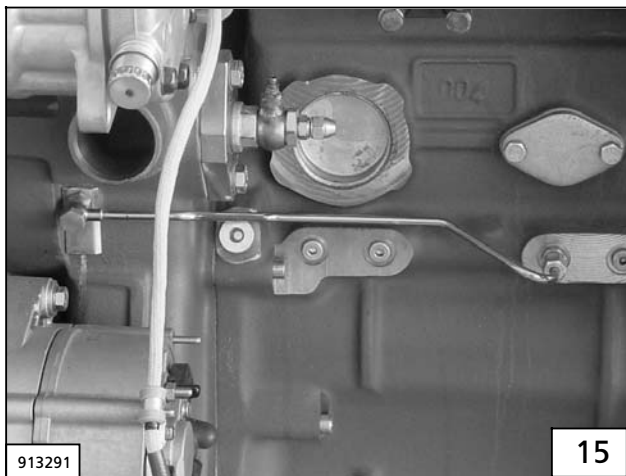


Measure the distance between the installation surface cover and the outer impeller with a depth gauge

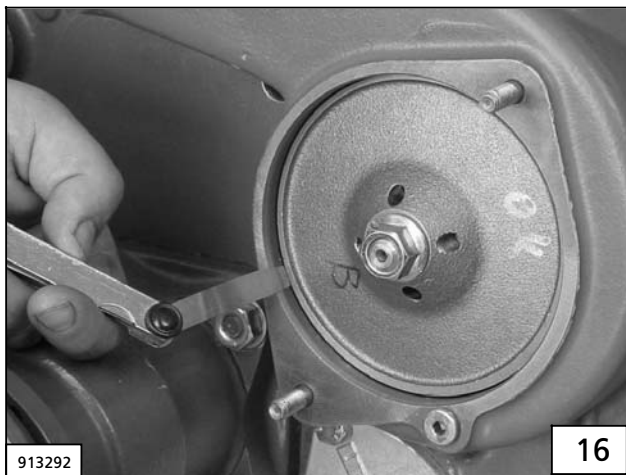
$$\text{Distance} = 9,2 \begin{matrix} + 1,3 \\ - 1 \end{matrix} \text{ mm}$$

Note:

The coolant pump is installed correctly if the noted gap is retained.



Install the lube oil line with new seal rings to the mounting screw (lube oil nozzle) and install on the crankcase.



Check the gap between the impeller and the bore in the timing case with a slip gauge.

For gap dimension, see Technical Data.

Note:

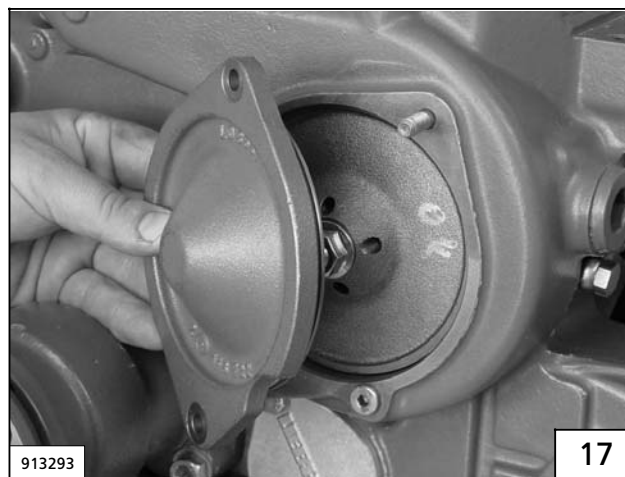
The measurement noted on the Technical Data page is the complete dimension on both sides of the impeller.

When checking with a slip gauge, use half the value!

Clean the cover, install a new lubricated O-ring, and push the cover into the timing gear cover.

Install and tighten nuts.

Add coolant, see sub group 2.01.



Coolant Pump Disassembly and Assembly

Use special tools no. 14, 20, 36, 64, 83, 84 and 85.

Note:

The coolant pump must be rebuilt when excessive amounts of coolant or engine oil leak through the pump weep holes. These holes are located in the pump housing mounting flange immediately in front of the timing gear box, and in the pump cover behind the fan hub. Engine oil leaks can only occur through the weep holes in the pump housing mounting flange immediately in front of the timing gear box.

Coolant Pump Disassembly:

The coolant pump assembly must be removed as described under sub-group 5.10.

To remove the fan assembly see sub-group 5.01.

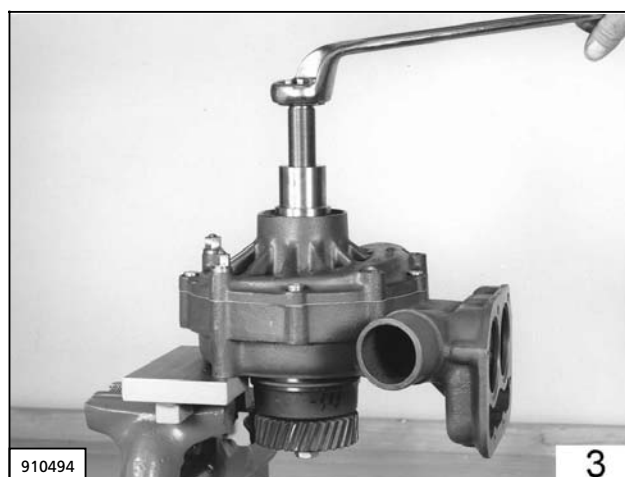
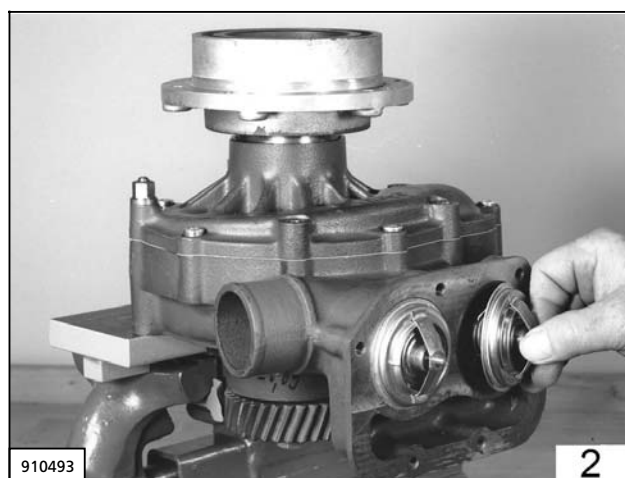
For sectional drawing, see back of page 5.15.05.

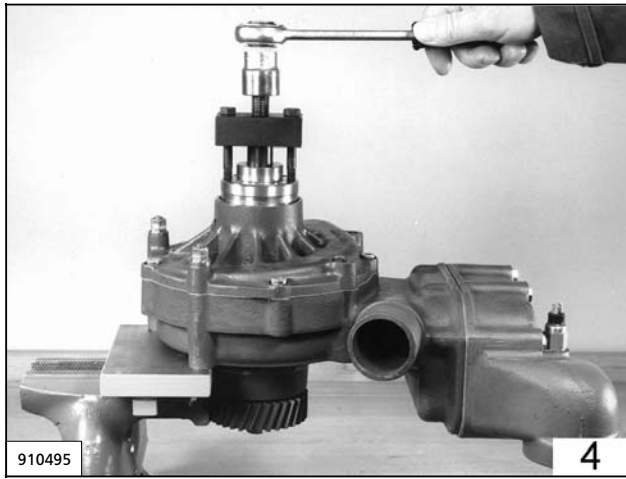
Place coolant pump assembly fixture, special tool no. 14, in a vise. Fasten coolant pump to fixture in such a way that the pump drive gear wheel remains in a fixed position.

Unscrew and remove mounting bolts on thermostat housing cover Pos. 1. Remove thermostat housing cover and thermostat assemblies Pos. 2.

For thermostat testing procedures see sub-group 2.32.

Loosen center screw 3 and remove. Remove retaining ring 4, or washer 13. Remove fan hub 5. Install a M 24 x 1.5 screw into hub 6, or into fan hub 11. By turning this screw, pull hub, or fan hub, with ball bearing 7 from shaft 8, or from cover 9.

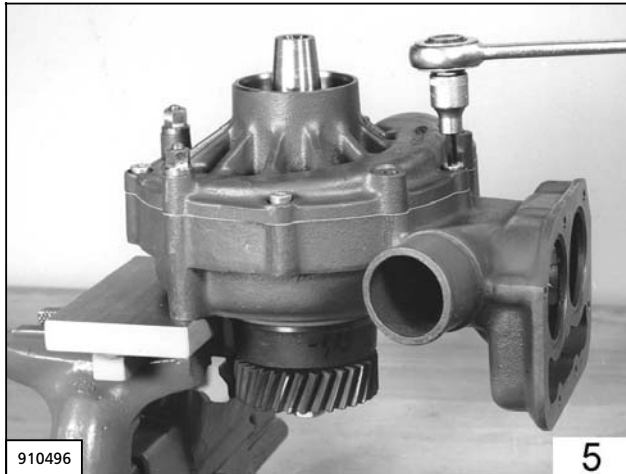




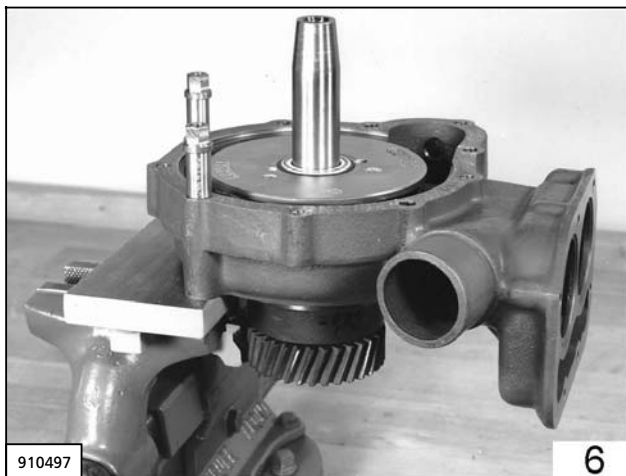
Earlier version D 906 engines were equipped with a different fan hub. See detail "X" of drawing at back of page 5.15.05.

Remove screw 10 and fan hub 12. Loosen and remove screw 14. Remove washer 13.

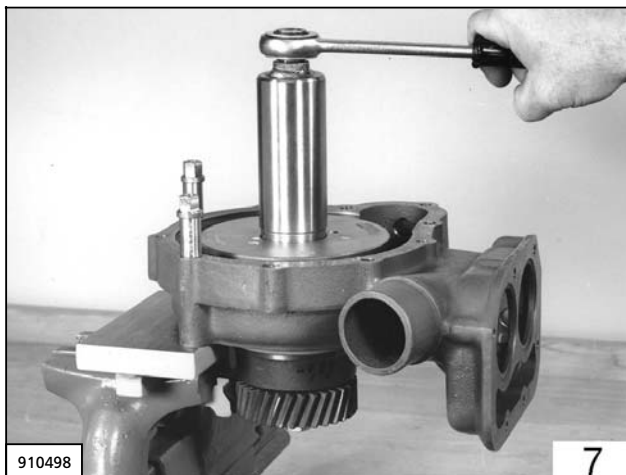
With puller, special tool no. 20, pull hub 6a with ball bearing 7 from shaft 8, or from cover 9.



Loosen and remove mounting bolts Pos. 15 on housing cover Pos. 9. Remove fastening nuts on pump assembly fixture and press off and remove cover Pos. 9 from pump housing Pos. 16 and drive shaft Pos. 8.



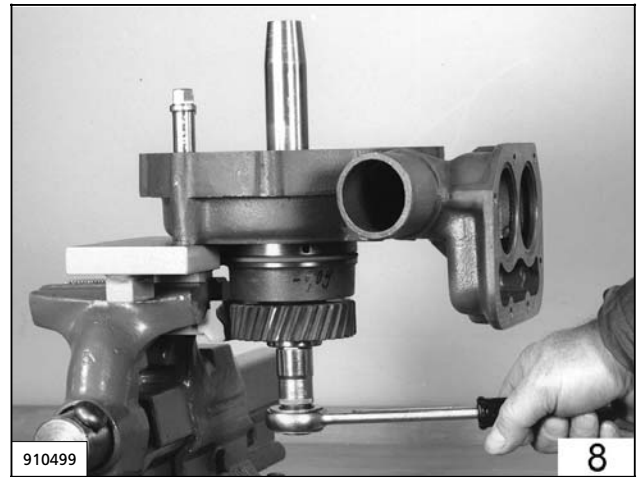
Fasten coolant pump to assembly fixture using two installation bushings, special tool no. 64.



Remove glide ring seal Pos. 17 and loosen and remove ring nut Pos. 18 with wrench, special tool no. 36.

Loosen retaining screw Pos. 19.

Remove coolant pump from assembly fixture.



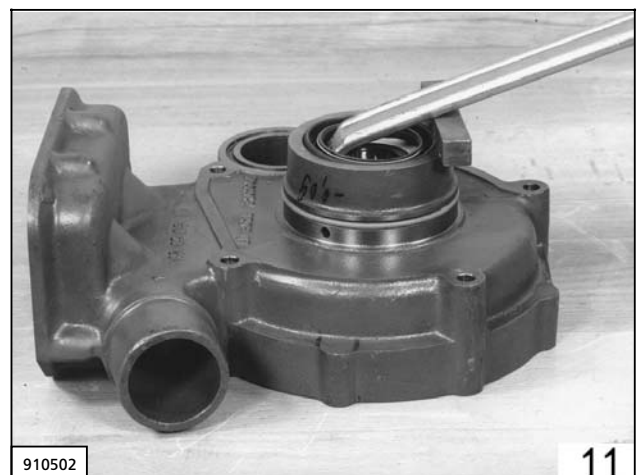
Remove retaining screw Pos. 19, washer Pos. 20 and gear wheel Pos. 21.

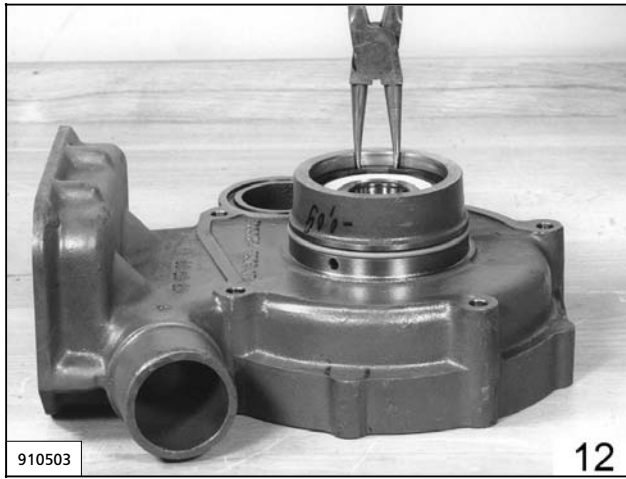


Place pump housing Pos. 16 on soft support. Place a soft-metal punch against the splined end surface of the drive shaft Pos. 8 and knock drive shaft and impeller wheel Pos. 23 out of pump housing Pos. 16.

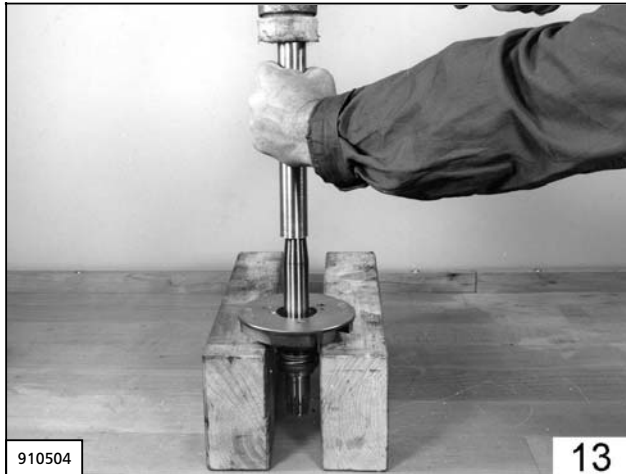


Remove shaft seal bushing Pos. 22 and shaft seal Pos. 24 with pry bar from pump housing Pos. 16.

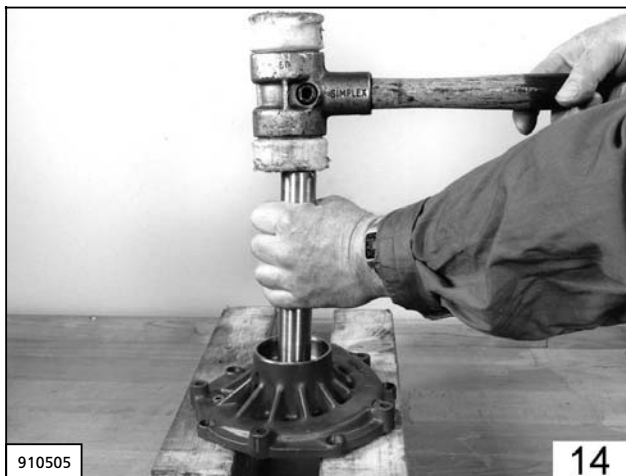




Remove retaining ring Pos. 25 and knock ball bearing Pos. 26 with punch out of pump housing Pos. 16.



Place impeller wheel on soft support and knock out pump shaft Pos. 8 with soft-metal punch. Remove glide ring seals Pos. 27 and Pos. 28 as well as tapered bushing Pos. 29 from drive shaft Pos. 8 and impeller wheel Pos. 23.



Place housing cover Pos. 9 on soft support and knock out glide ring seal Pos. 30 with punch and hammer.



At hub 6, or fan hub 11, remove retainer clip ring 31 and push off, or pull off, ball bearing 7.
At hub 6a (see detail "X"), push off ball bearing 7 with screw driver or pry bar.

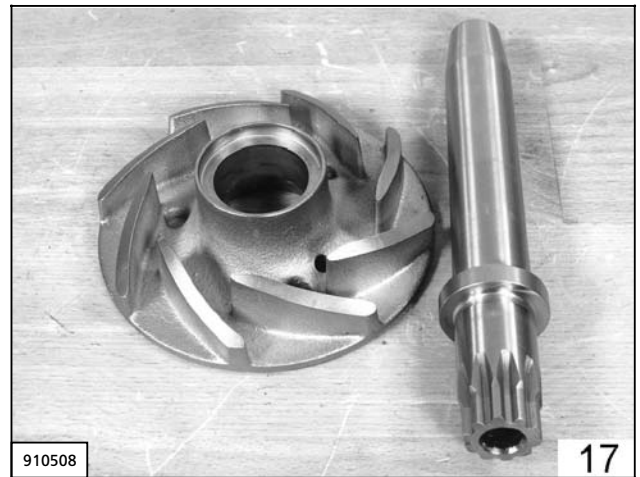
Note:

Before removing the ball bearing, visually check the bearing for excessive play, spin it and listen for sound. The ball bearing should not be removed or replaced in case the bearing is found to be in proper working condition.
Clean all individual components, especially the sealing and mounting surfaces.

Visually inspect the contact surface of shaft seal lip Pos. 24 on shaft seal bushing Pos. 22 for possible wear in from of a groove. Install bushing reversed or replace entire bushing in case of excessive wear.



Visually inspect drive shaft Pos. 8 and impeller wheel Pos. 23 for any wear and replace either one if required.

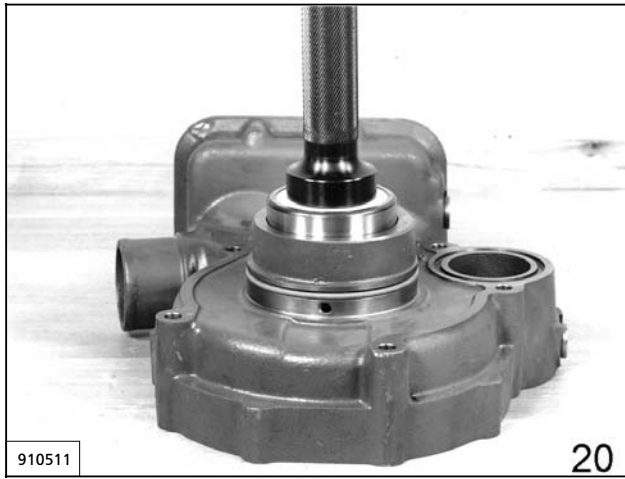


Visually check tapered bushing Pos. 29 and ring nut Pos. 18. The ring nut should screw on freely. Replace either one if required.



Visually inspect ball bearing Pos. 26 for excessive play, spin bearing and listen for sound. Replace ball bearing if needed.

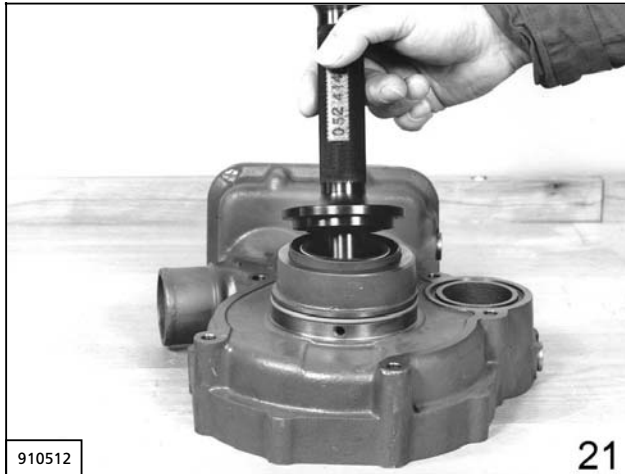




Assembly:

Place pump housing 16 on a level surface. Apply locking compound (Omnivisc 1002, Loctite-Silicone transparent (US = 595), etc.) to seat for ball bearing 26 in housing 16.

Install ball bearing 26 with punch, special tool no. 85, into housing. Snap retaining ring 25 into position.



Install new shaft lip seal 24 with punch, special tool no. 85, into housing 16.

Make sure that the seal seats true and is not tilted (see drawing back of page 5.15.05).

Coat seal lip lightly with engine oil.



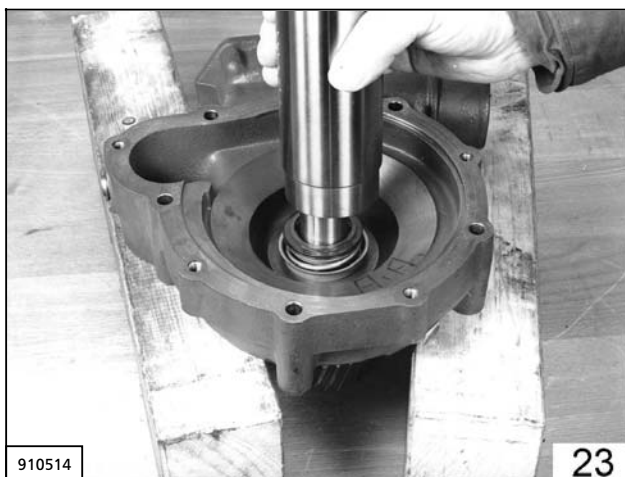
Insert pump shaft 8 into ball bearing 26.

Place new O-ring 34 on the shaft so that it will seat on the ball bearing side.

Slide on thrust ring 22 and place gear wheel 21 on splined end of shaft. Install washer 20, thread in screw 19 and tighten slightly.

Important:

If the thrust ring 22 doesn't have a groove to accept O-ring 34 (earlier version), apply a sealing compound (Loctite-Silicone transparent (US = 595), Omnivisc 1002, etc.) to the thrust ring in the area of the O-ring contact surface.



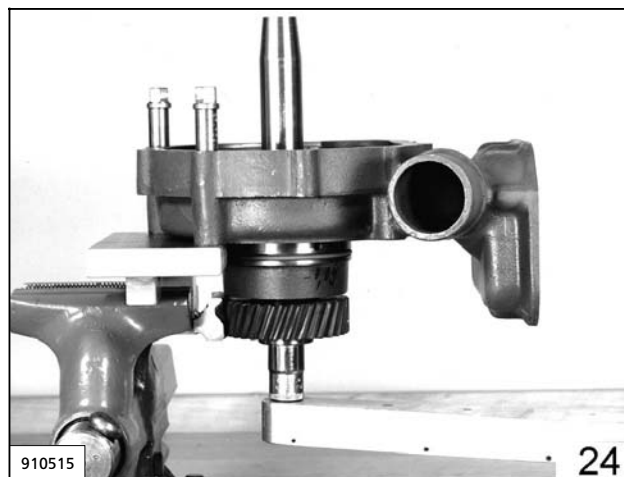
Place pump housing Pos. 16 with the gear wheel on bottom on level support. Slide glide ring seal Pos. 27 over drive shaft Pos. 8 and install glide ring seal with punch, special tool no. 83, into pump housing Pos. 16.

Important:

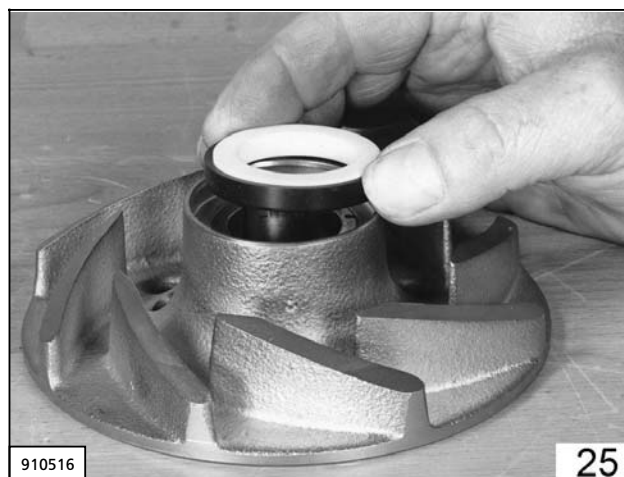
After the glide ring seal installation, ensure absolute clean seal ring contact surfaces.

Place the coolant pump assembly fixture, special tool no. 14, in vise and fasten coolant pump housing with 2 installation bushings, special tool no. 64, to the fixture in such a way that the pump drive gear remains in a fixed position. Tighten screw 19.

For tightening torque, see Technical Data.

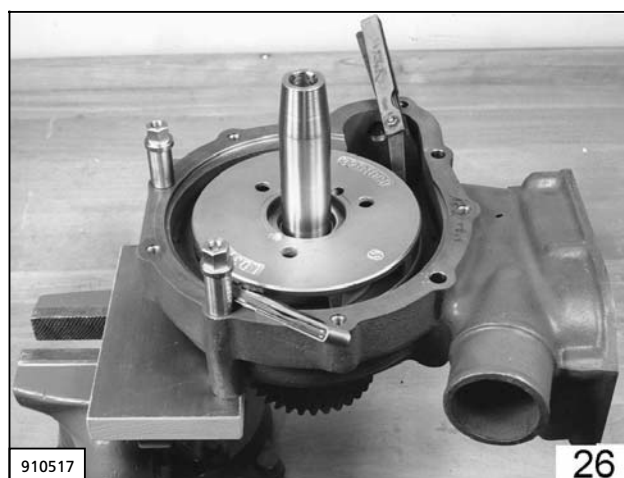


Place tapered clamp bushing 29 into impeller 23, apply locking compound, such as Omnifit 50 M or Loctite 222 to bushing threads. Start ring nut 18. Apply a 1:1 mixture of denatured alcohol and water to the outside of the rubber surface of new glide ring seal 28 and push the seal into the impeller.



Slide the impeller 23 over the drive shaft 8 until the required gap between housing 16 and impeller is reached. Measure the distance with feeler gauges on opposite sides simultaneously.

See page 5.15.05 for proper distance.

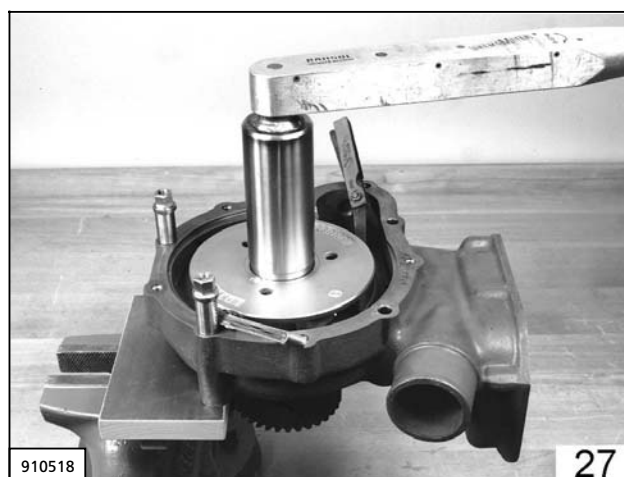


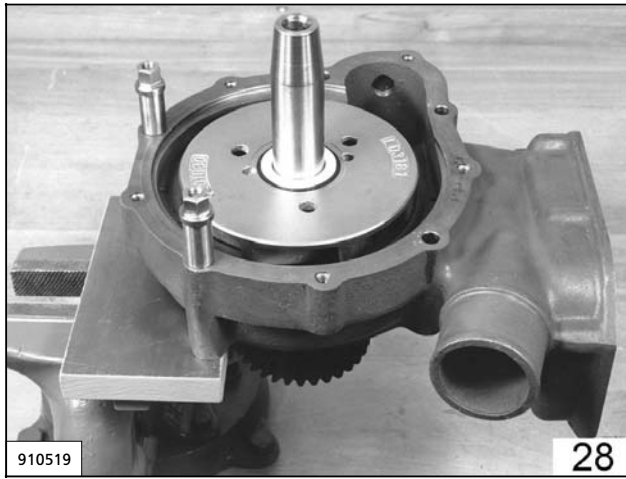
Tighten and torque ring nut 18 with wrench, special tool no. 36.

For tightening torque, see Technical Data.

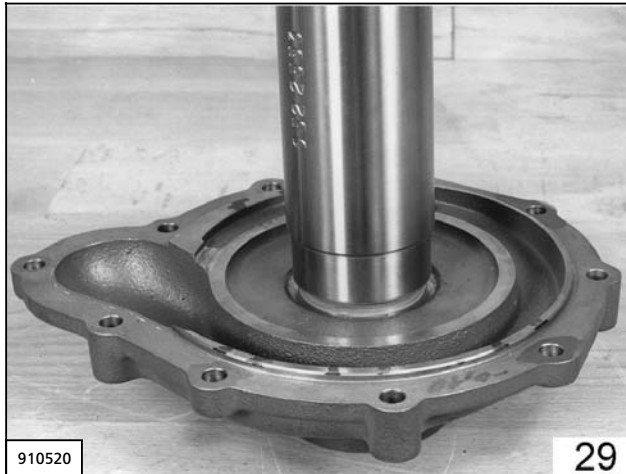
Important:

After tightening the ring nut, recheck the gap between impeller and pump housing while applying an axial force of approx. 44 lbs. (20 kg) to shaft 8 to avoid axial movement while measuring.

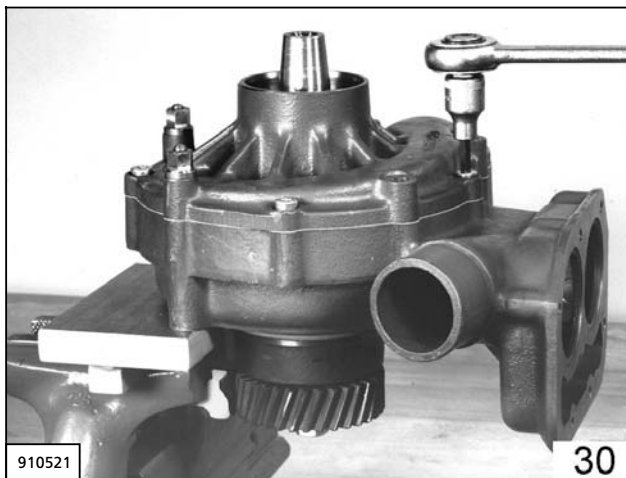




Apply a 1:1 mixture of denatured alcohol and water to the outside rubber surface of glide ring seal 17 and press seal into impeller wheel 23.

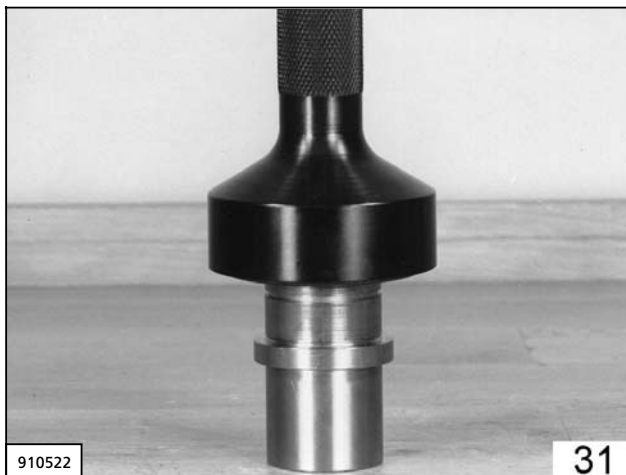


Place housing cover Pos. 9 on level support and install new glide ring seal Pos. 30 with punch, special tool no. 83.



Remove fastening nuts and installation bushings from pump assembly fixture.

Replace gasket Pos. 32 on pump housing, slide housing cover Pos. 9 over drive shaft Pos. 8 and place cover on pump housing. Mount coolant pump with fastening nuts again to assembly fixture. Screw in and torque mounting bolts Pos. 15.

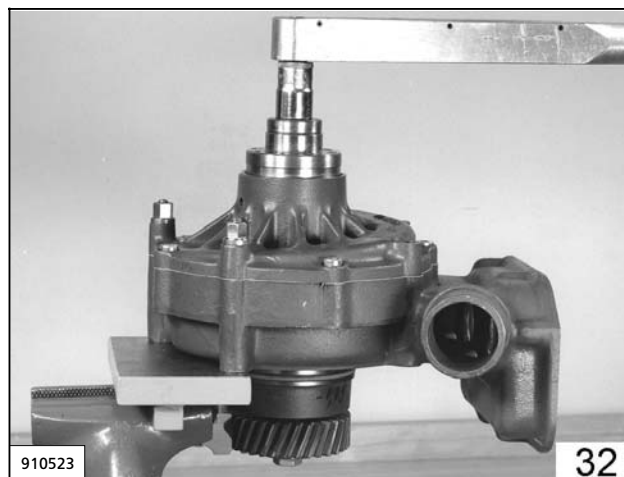


Place hub 6, or hub 11, 6a (see detail "X") on level support and press on ball bearing 7 with punch, special tool no. 84. Snap in retaining ring 31. Apply locking compound (Omnivisc 1002, Loctite-Silicone transparent (US = 595), etc.) to the seat for ball bearing 7 in cover 9.

Place hub 6, or fan hub 11, on shaft 8. Install fan hub 5, retaining ring 4 or washer 13. Install screw 3 and tighten.

Push hub 6a (see detail "X") on shaft 8. Install washer 13 and screw 14, tighten screw. Push on fan hub 12, install screws 10 and tighten.

For torque values for screws 3, 14, see Engine Specifications.



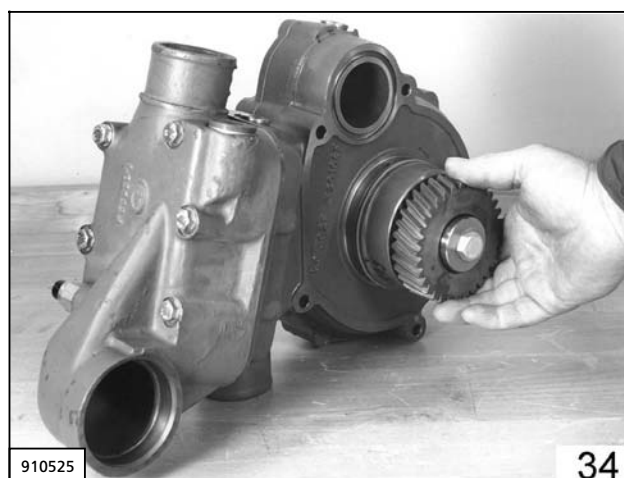
Reinstall both thermostat assemblies Pos. 12 with new gaskets Pos. 33 in thermostat housing. Place thermostat housing cover Pos. 1 on housing and install cover with mounting bolts.



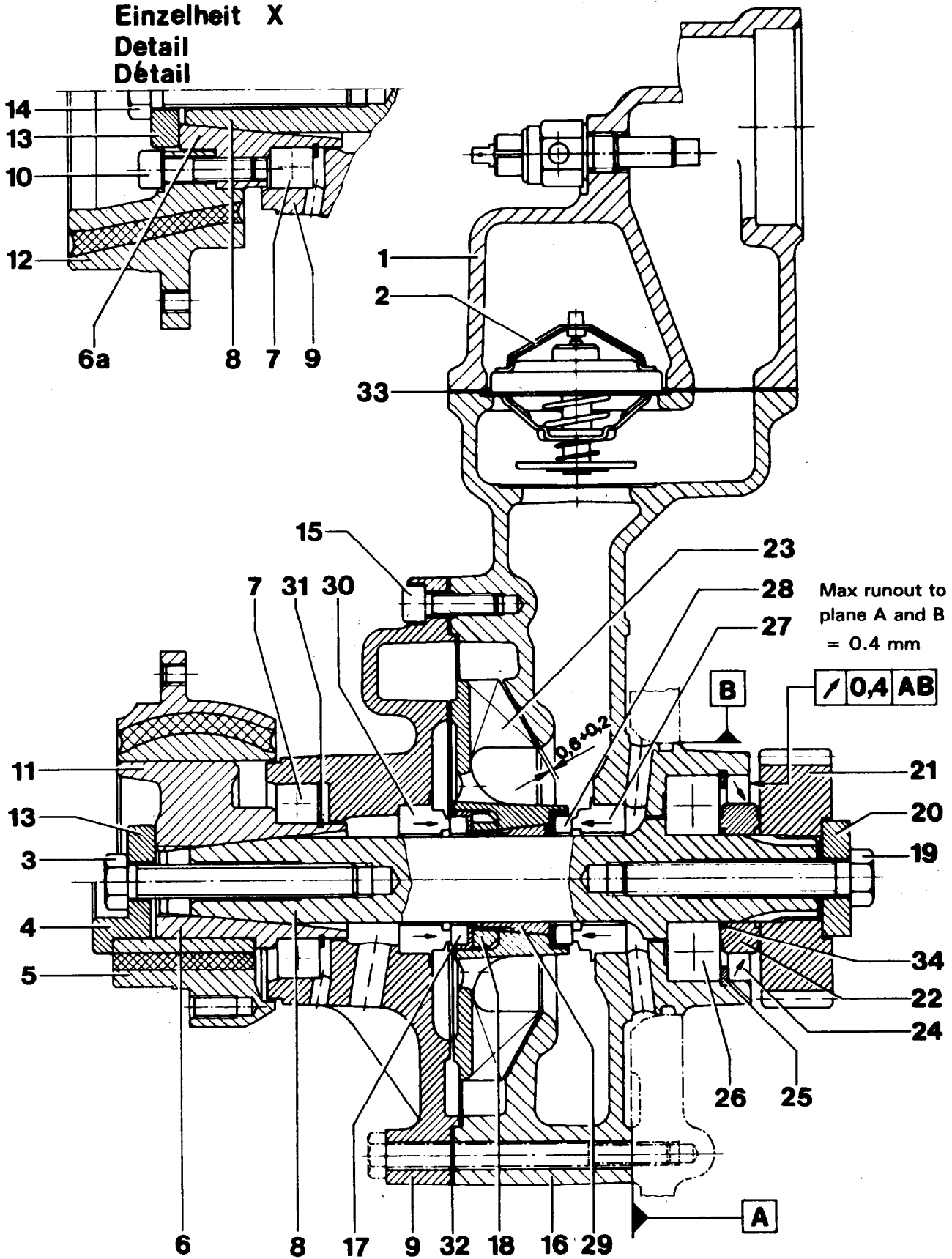
Remove coolant pump from assembly fixture and check operation by turning the pump drive shaft.

Important:

Before starting engine, make sure that the coolant pump, as well as the entire cooling system, contains the proper amount of coolant.



Einzelheit X
Detail
Détail



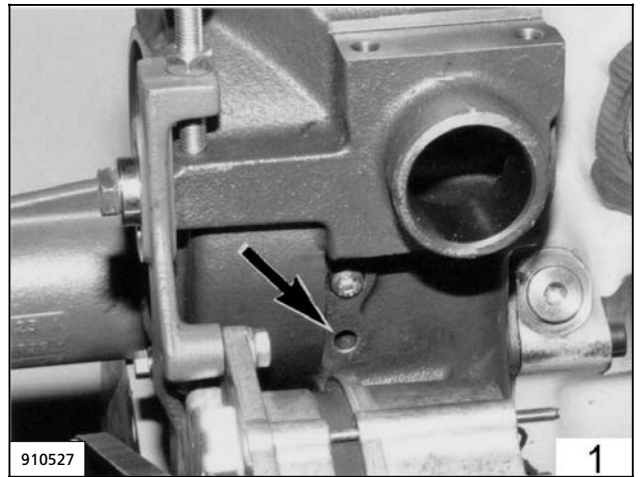
Coolant Pump Disassembly and Assembly (coolant pump integrated in timing case cover)

up to Engine no. 93 01 1641

Special tool no. 25, 86, 87

Note:

The coolant pump must be rebuilt if excessive amounts of coolant or engine oil leak through the leakage bores in the timing gear housing.

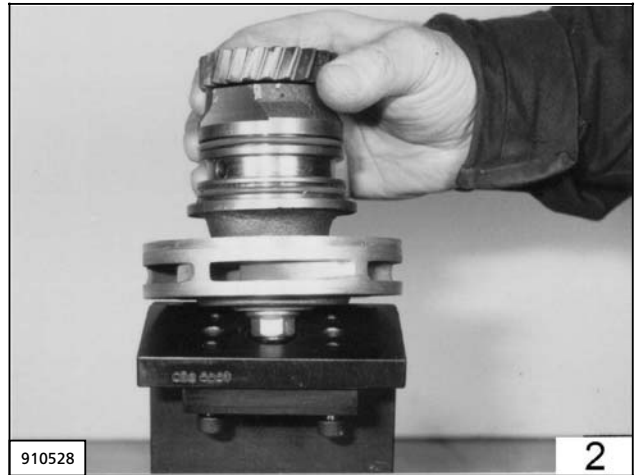


Disassembly:

Remove the coolant pump as described in sub group 5.11.

See reverse page 5.16.04 for position.

Place coolant pump assembly fixture, special tool no. 25, into vise and hold coolant pump on impeller 1 in fixture.

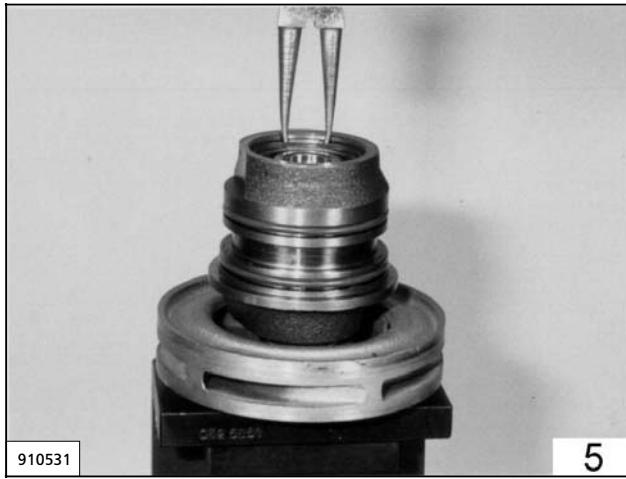


Loosen and remove screw 2.



Remove gear 3.





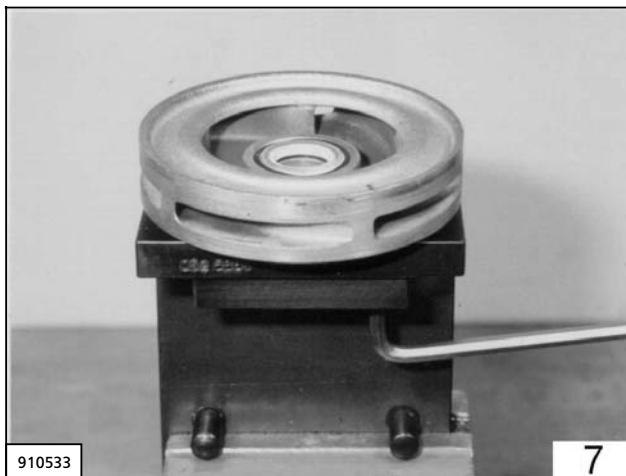
Release snap ring 4.



Remove nut 5 and simultaneously pull impeller 1 from shaft 6. Remove coolant pump from retaining device.

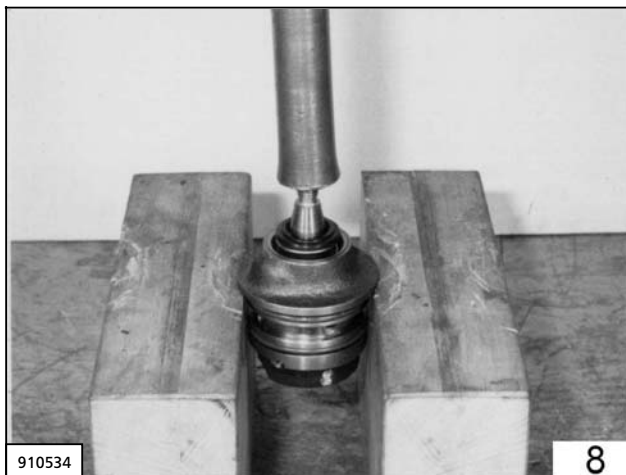
Note:

When removing nut 5, hold shaft 6 on the gear side with a screw, which has been inserted with a washer into the thread.



Remove impeller 1, glide ring seal 7 and nut 5 from assembly fixture.

Remove glide ring seal 7 from impeller 1.

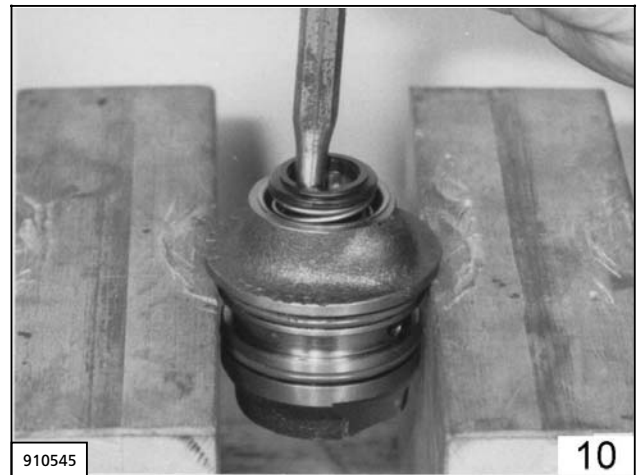


Place housing 8 on flat surface, knock drive shaft 6 and ball bearing 9 from housing by hitting the tapered shaft side.

Release snap ring 10.

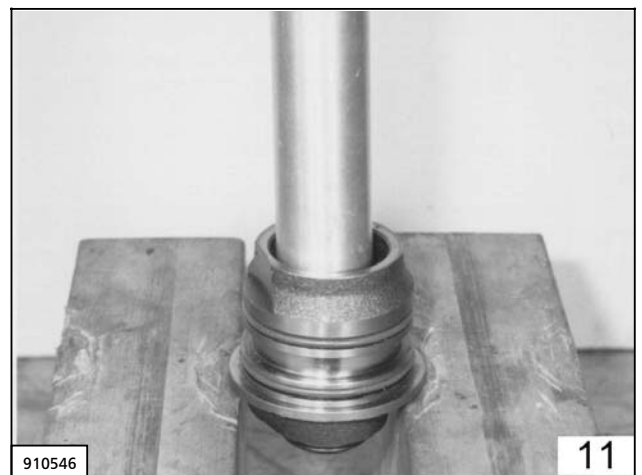


Set housing 8 on flat surface and knock ball bearing 11 and shaft seal ring 12 from housing, using a punch.

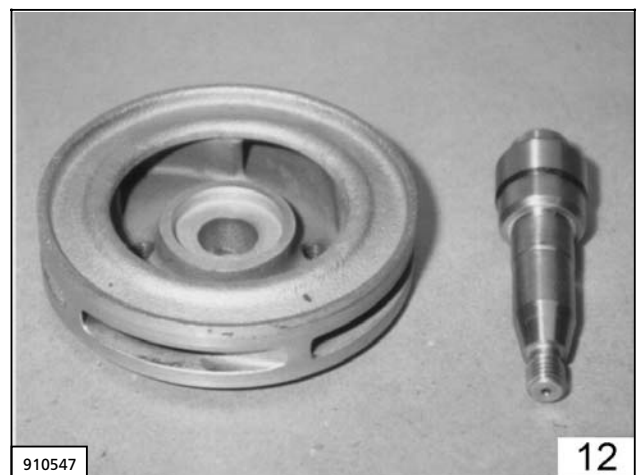


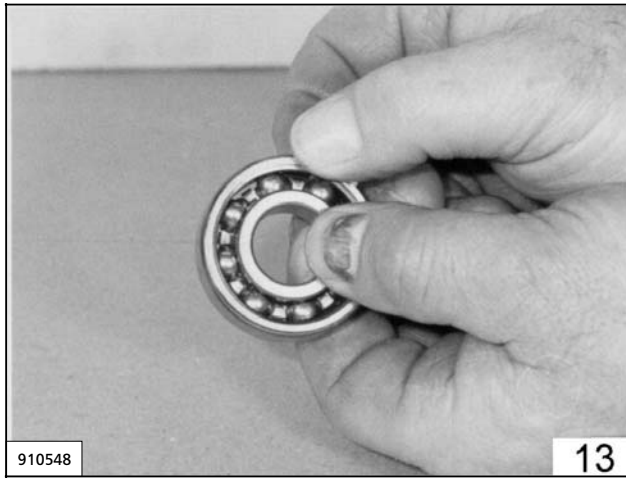
Turn housing 8 over and drive glide seal ring 13 with a punch from housing.

Carefully clean all parts.



Visually check shaft 6 and impeller 1 for wear, replace if necessary.





Check ball bearing 9 and 11 visually and spin to check for sound. Replace, if necessary.



Assembly:

Place housing 8 on flat surface. Apply locking compound, such as Loctite 601, to seat for ball bearing 11 in housing 8 and push ball bearing 11 with a punch all the way into the housing 8.



Insert new shaft seal ring 12 with punch, special tool no. 86, into housing 8.

Observe proper installation clearance and make sure the seal is not tilted, see reverse page 5.16.04.

Lightly oil the sealing edge of the shaft seal ring.

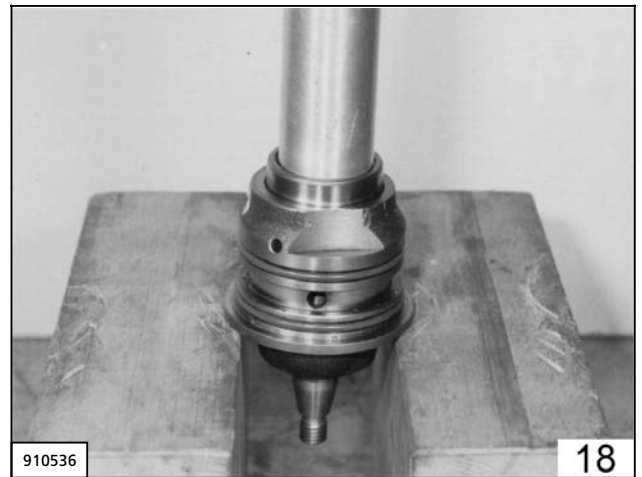


Insert snap ring 10.

Carefully push shaft 6 through the shaft seal 12 and into the ball bearing 11 until seated.



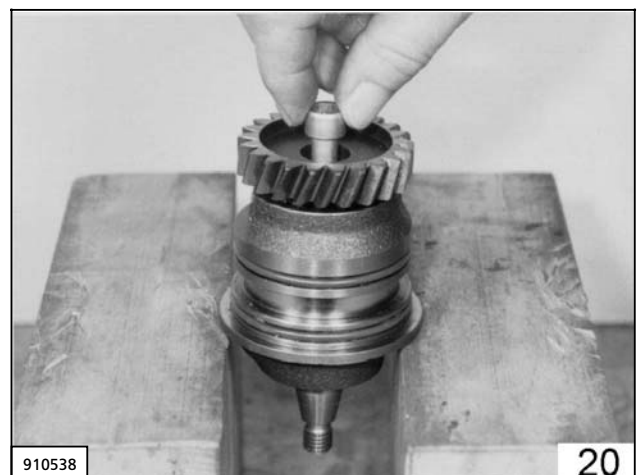
Push ball bearing 9 with a punch over shaft 6 into housing 8.

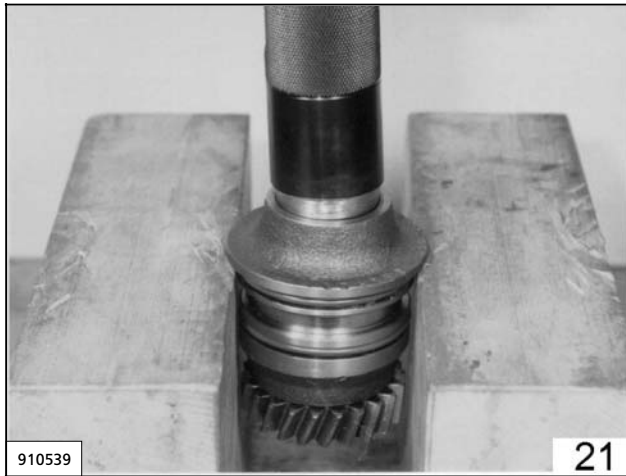


Install the snap ring 4.



Insert gear 3 into ball bearing 9, apply locking compound (Loctite 242/243) to the threads of the screw, insert the screw and tighten lightly.

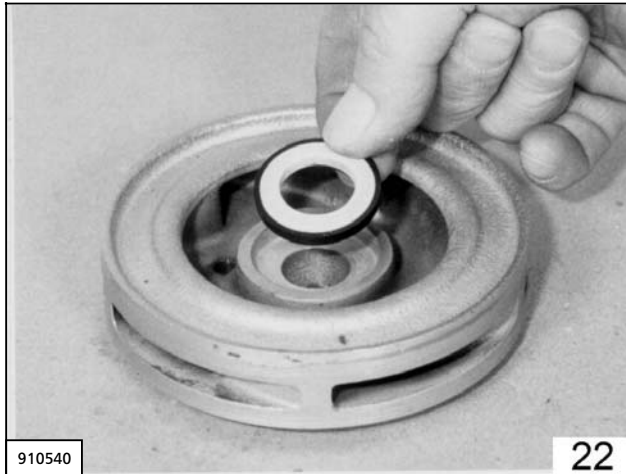




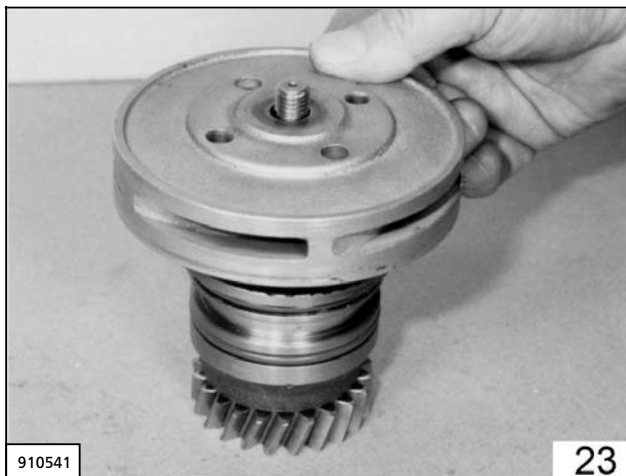
Place the housing 8 on a level surface and press the new seal 13 with a punch, special tool No. 87 over the shaft 6 into housing 8.

Important:

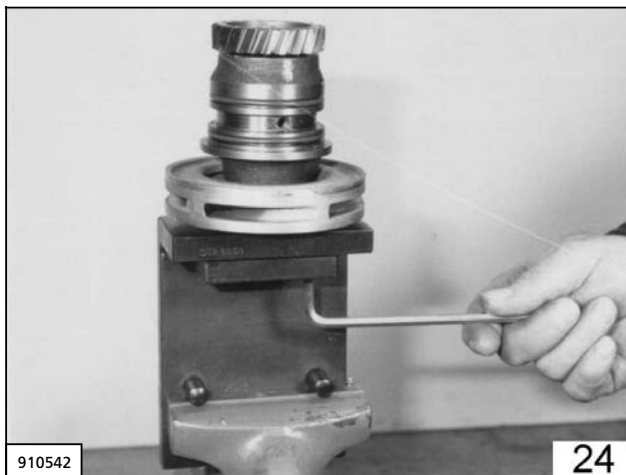
When installing the pump seals, make sure the sealing surfaces are absolutely clean.



Apply a mixture of water and denatured alcohol (ratio 1:1) to the outside of the seal 7 and carefully push the seal into the impeller wheel 1.



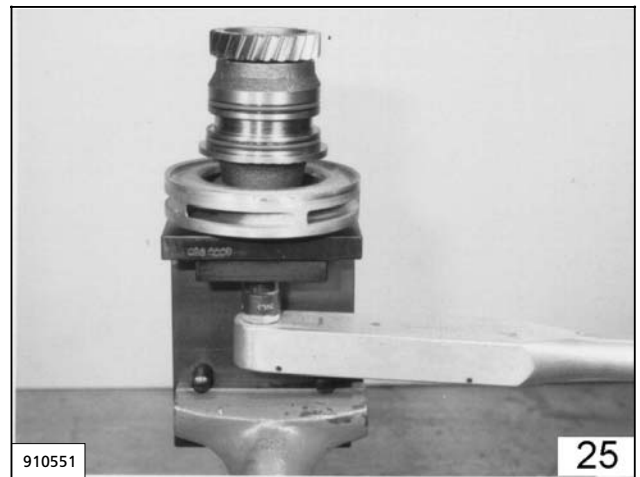
Carefully position the impeller wheel 1 with seal 7 onto the shaft 6. Apply locking compound (Loctite 242/243) to the threads of shaft 6, install nut 5 and tighten lightly.



Place the holding fixture, special tool No. 25 in a vise and mount the coolant pump with the impeller wheel 1 on the fixture.

Tighten nut 5.

Tightening torque, see Technical Data.



Tighten screw 2.

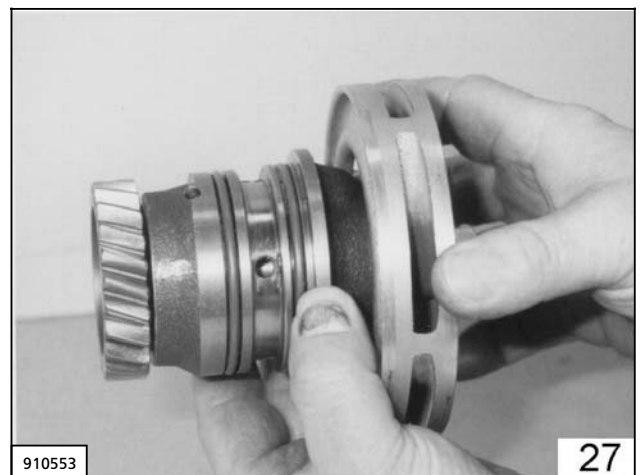
Tightening torque, see Technical Data.

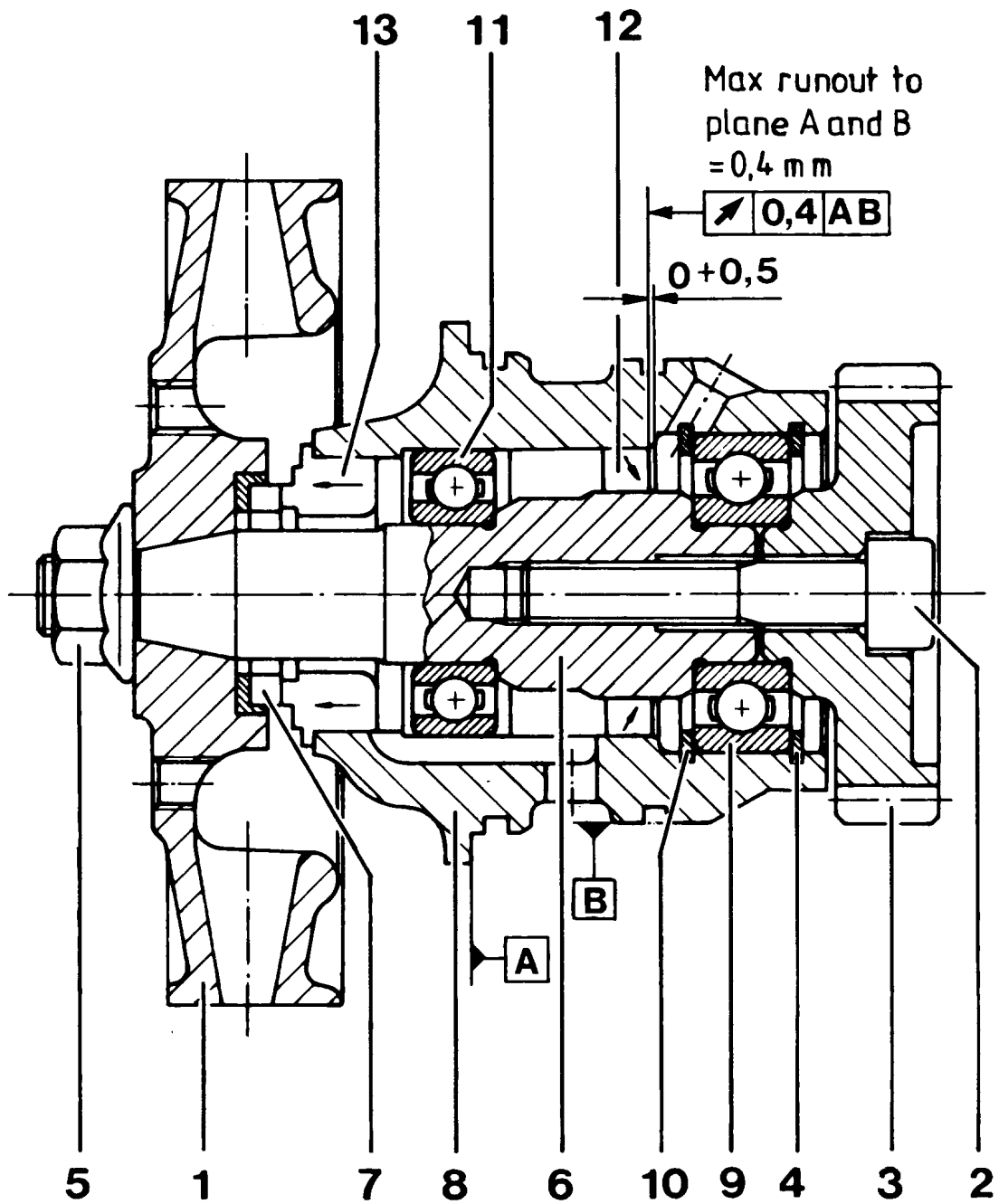


Remove coolant pump from retaining device and turn to check for easy movement.

Important:

Before operating the coolant pump, make sure coolant has been added.





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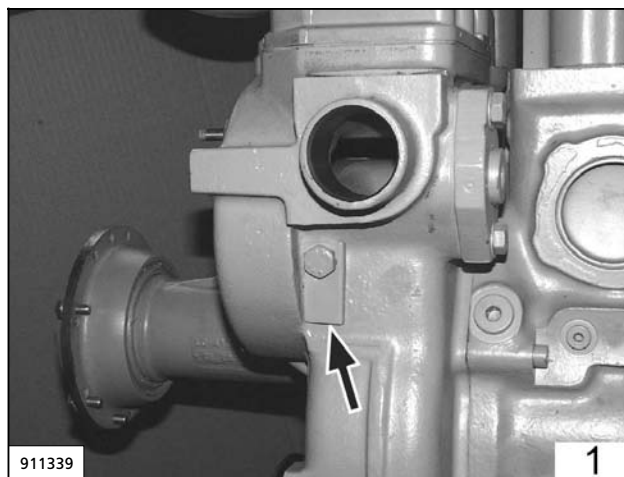
Coolant pump disassembly and assembly (coolant pump (version II) integrated in timing gear cover)

from engine S/N 93 01 1642

Use special tool No. 25, 87, 90

Note:

The coolant pump must be rebuilt or replaced when coolant leaks excessively from the weep hole in the timing gear cover.



Disassembly:

The coolant pump is removed, as outlined in sub group 5.11, 5.12.

For a sectional view, see page 5.17.04 (reverse side)

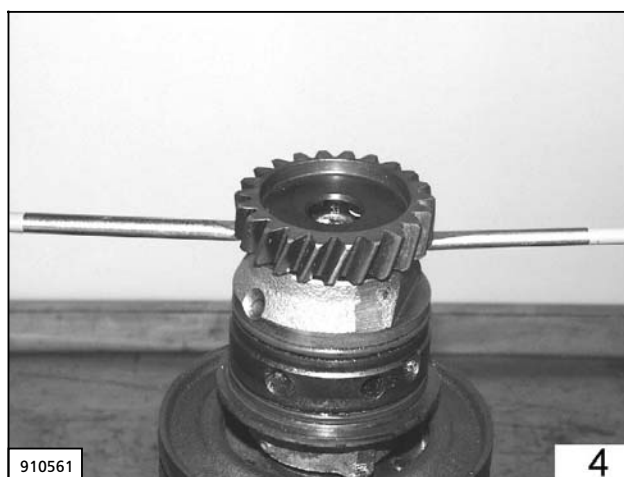
Place the holding and puller fixture, special tool No. 25, in a vise and mount the coolant pump with the impeller wheel 1 on the fixture.



Loosen and remove screw 2 .

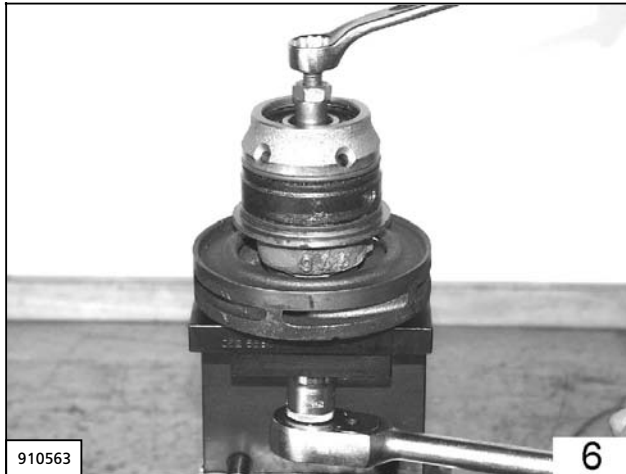


Pry the gear 2 off the pump shaft using 2 screw drivers.





Remove snap ring 4.

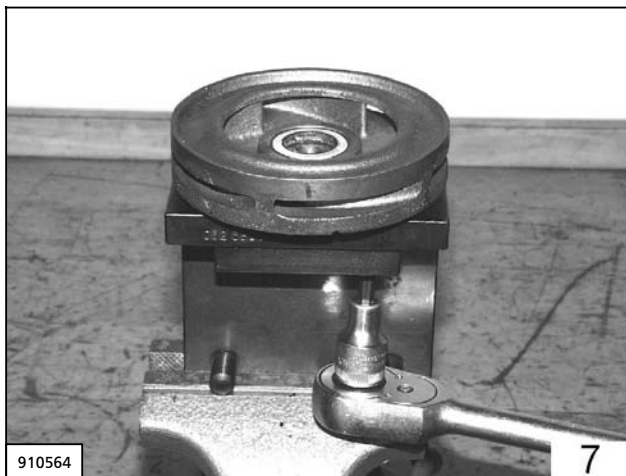


Remove the nut 5 and at the same time, pull the impeller wheel 1 from shaft 6.

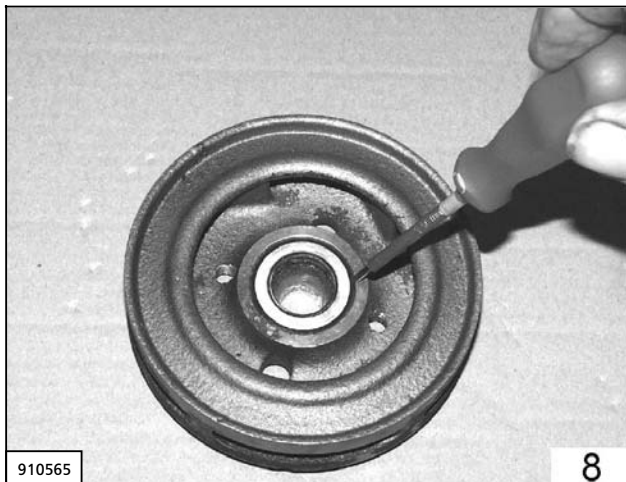
Remove the coolant pump from the fixture.

Note:

When removing nut 5, hold shaft 6 on the gear side with a screw which was inserted in the thread and counter- locked with a washer and nut.

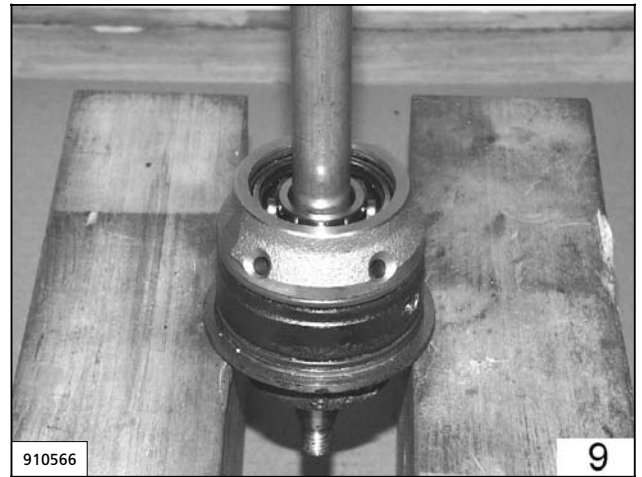


Remove impeller wheel 2, ceramic seal 7 and nut 5 from the fixture.

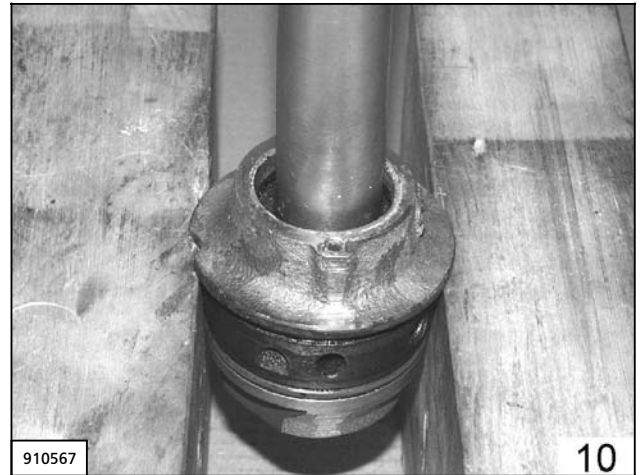


Remove the other half of the seal 7 from the impeller wheel 1.

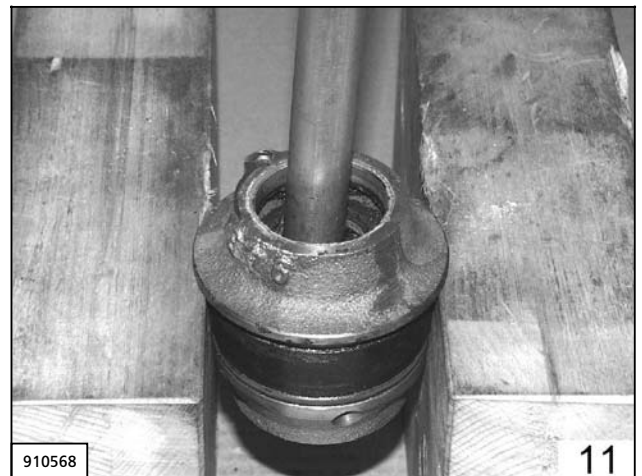
Place the housing 8 on a level surface as shown in fig. 9. With a soft punch, drive knock shaft 6 with slinger plate 9 and seal 10 from housing 8 by hitting the gear side of the shaft.



Turn the housing 8 over, drive ball bearing 11, spacer 12 and ball bearing 13 with a soft punch from the housing.



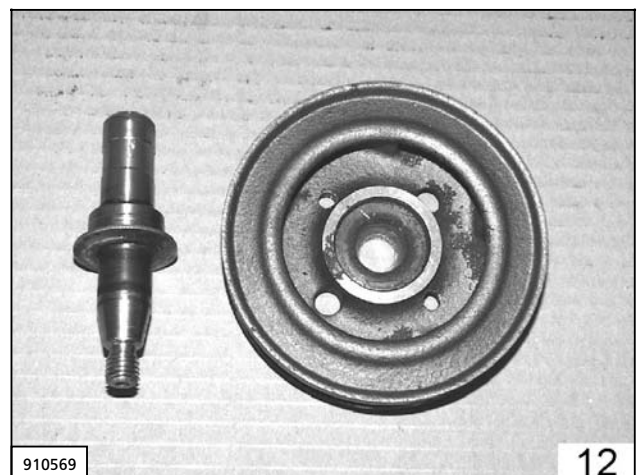
Drive the shaft seal 14 with a punch from housing 8.

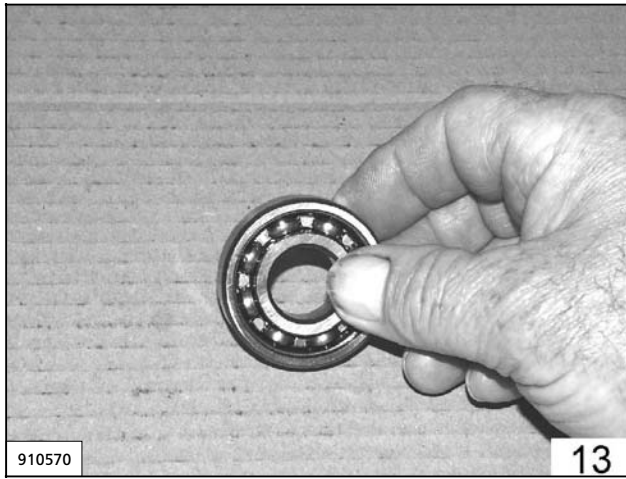


Clean all parts.

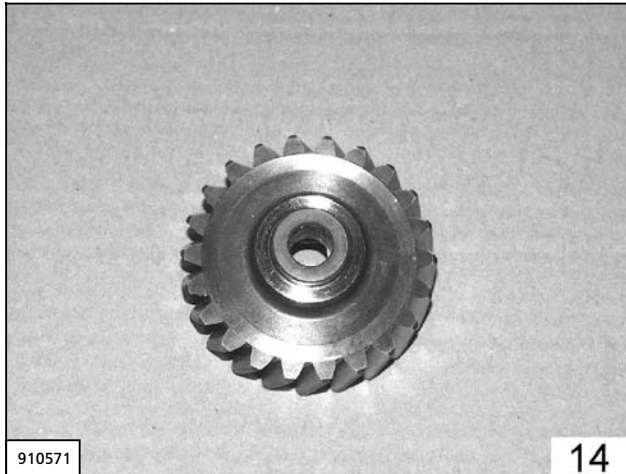
Check the impeller wheel 1 and shaft 6 for wear and damage (visually). Replace parts, as necessary.

On shaft 6, check if the slinger plate is securely seated. If necessary, install a new slinger plate with Loctite 242, 243.

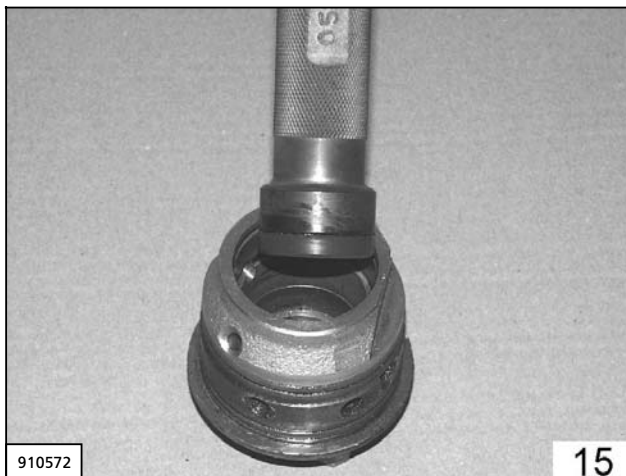




Check ball bearing 11, 13 visually for excessive play and wear. Spin the bearing to check for smooth operation. Replace bearings, if necessary.



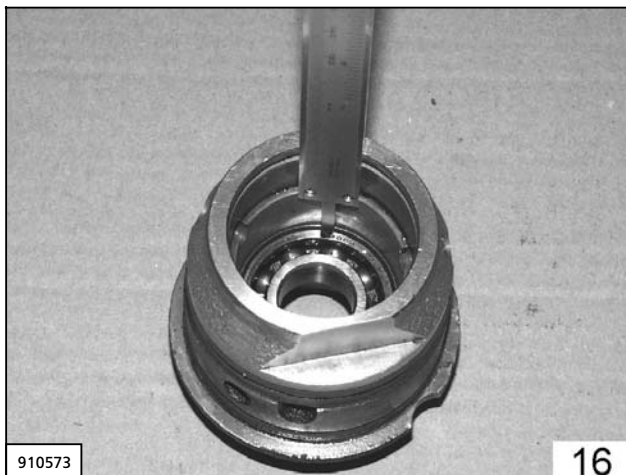
On gear 3, check the teeth for wear, replace if necessary.



Assembly:

Lubricate the new shaft seal 14 between the two sealing lips on several points with grease (Barrierta L 55/3) or similar product .

With a punch, special tool No. 90, press the seal all the way into housing 8.



Grease the ball bearing 13 lightly with multi-purpose grease and press it with a matching punch into the housing, to the dimension given on page 5.17.04 (reverse side).

Carefully push shaft 6 from the impeller wheel side through the shaft seal 14 and ball bearing 13 all the way into the housing 8.



Push the spacer 12 onto shaft 6, lightly lubricate ball bearing 11 with multi-purpose grease and press it with a matching punch over shaft 6 all the way into housing 8.

Note:

The seal on ball bearing 11 must point towards the gear side.

Important:

When pressing in ball bearing 11, make sure not to move ball bearing 13. The dimension given on the reverse side of page 5.17.04 must be maintained.

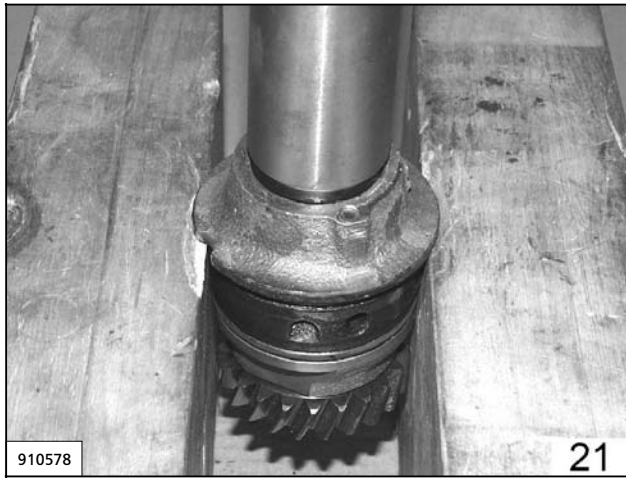


Install the snap ring 4.



Insert gear 3 into ball bearing 11, apply locking compound (Loctite 242/243) to the threads of screw 2, insert the screw and tighten lightly.



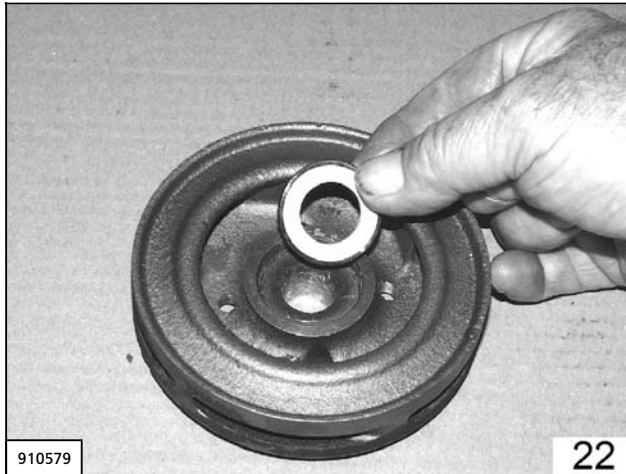


Place the housing 8 on a level surface as shown in fig. 21 and press the new ceramic seal 10 with a punch, special tool No. 87, over shaft 6 into housing 8.

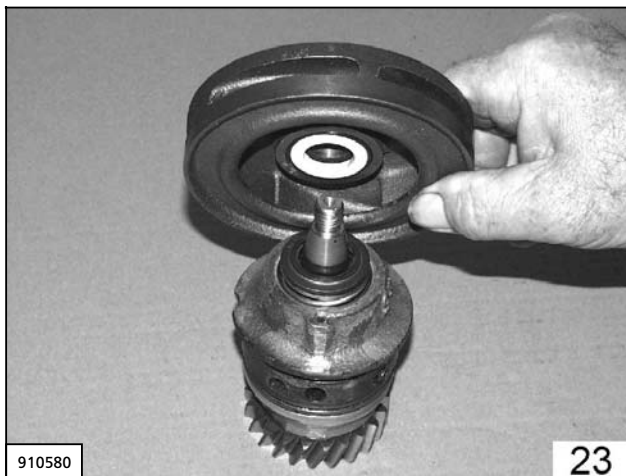
Important:

When installing the pump seals, make sure the sealing surfaces are absolutely clean.

The pump seals contain carbon and ceramic and could crack if dropped, hit or incorrectly installed. Handle with care!



Apply a mixture of water and denatured alcohol (ratio 1:1) to the outside of the pump seal 7, and carefully push the seal into the impeller wheel 1.



Carefully position the impeller wheel 1 with seal 7 onto the shaft 6.

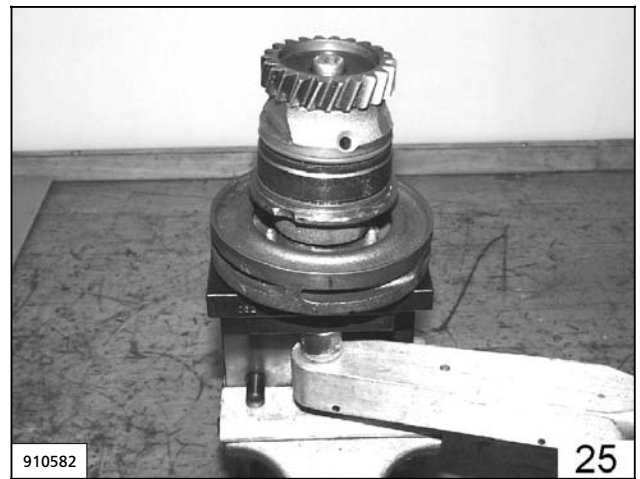
Apply locking compound (Loctite 242/243) to the threads of shaft 6, install nut 5 and tighten lightly.



Place the holding fixture, special tool No. 25, in a vise and mount the coolant pump with the impeller wheel 1 on the fixture.

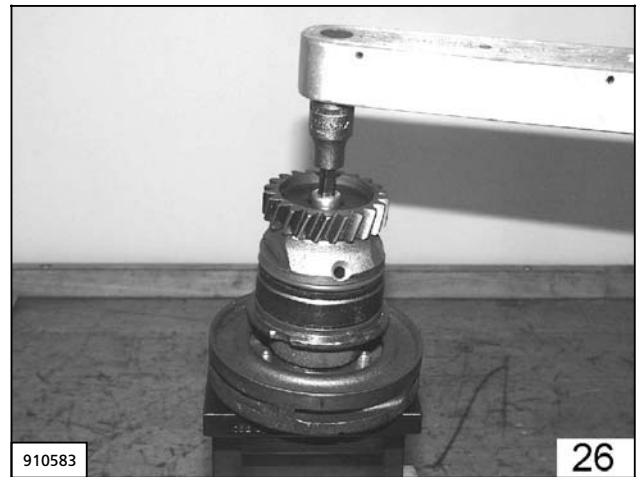
Tighten nut 5 .

For tightening torques, see Technical Data.



Tighten screw 2.

For tightening torques, see Technical Data.

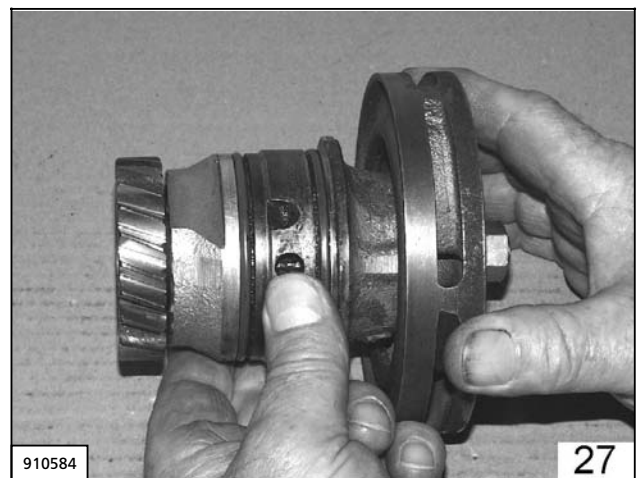


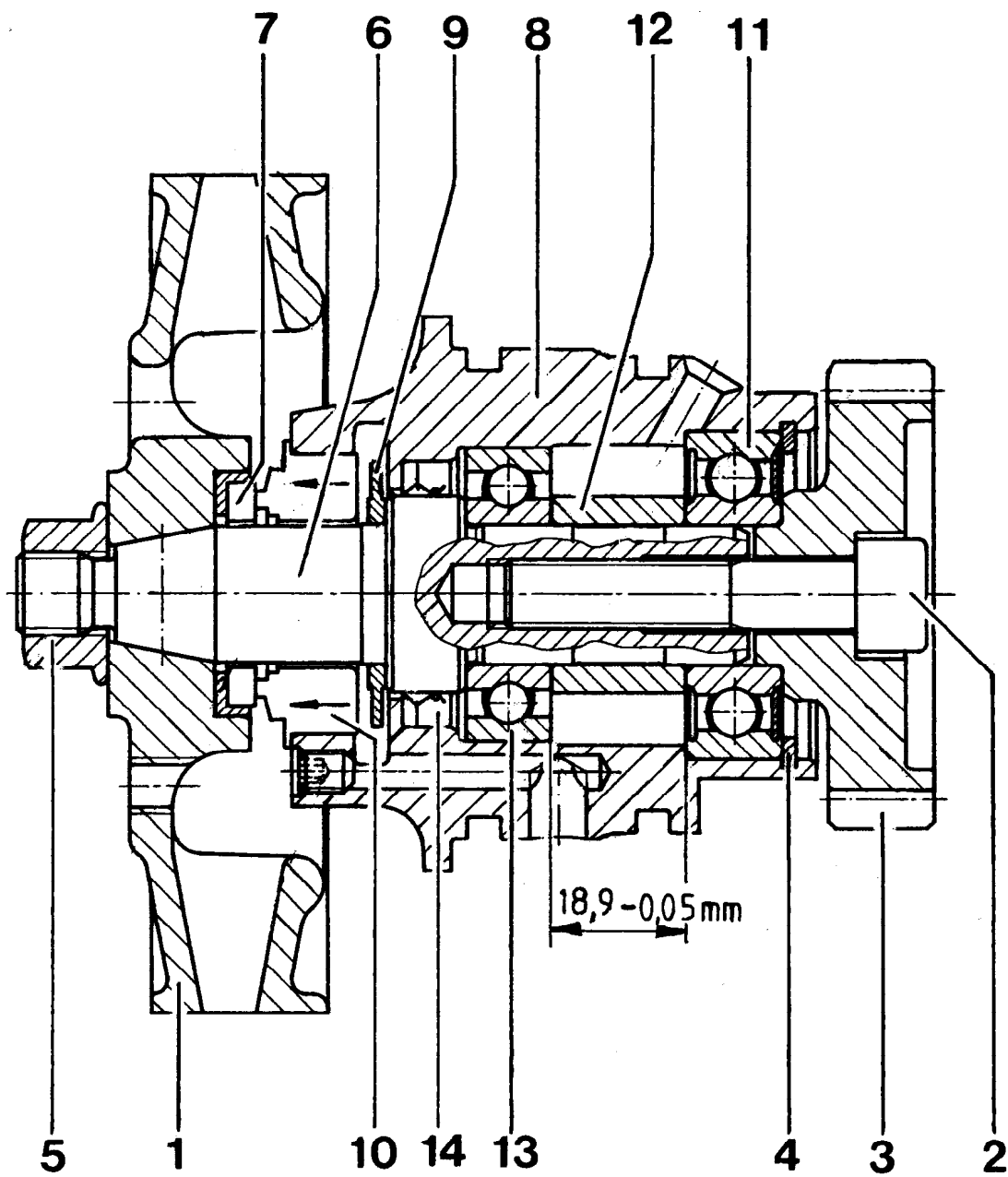
Remove the coolant pump from the fixture and turn the impeller wheel 1 to check for easy movement.

Important:

Before starting the engine, make sure that the cooling system contains the proper amount of coolant.

If necessary, clean and flush the cooling system and refill with new coolant.





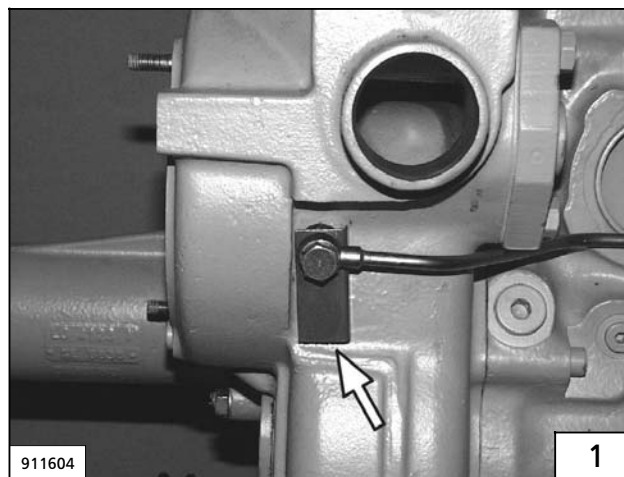
**Coolant pump disassembly and assembly with collar bearing (bushings)
(coolant pump version III integrated in timing case)**

Up to engine S/N.2001 02 1093

Use special tool No. 25, 72, 87, 91

Note:

The coolant pump must be rebuilt or replaced when coolant leaks excessively from the weep hole in the timing case.



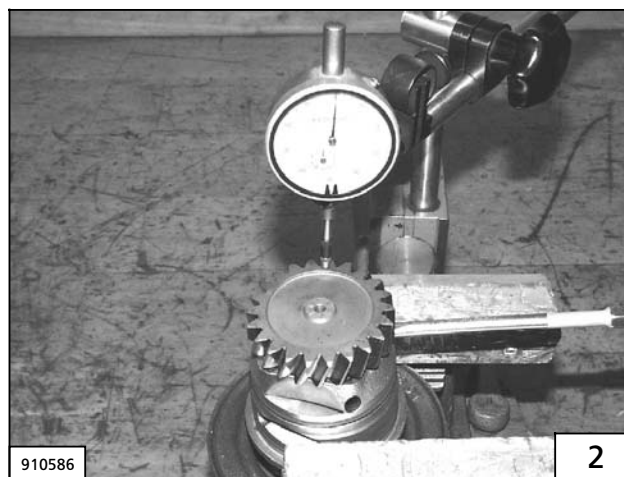
Check the axial play:

The coolant pump is removed, as outlined in sub group 5.13

For sectional view, see page 5.18.04

Place the coolant pump with the housing 6 into a vise using protective jaws. Install a commercially available dial gauge holder with dial gauge and place it on gear 4. Check the axial play by moving the gear back and forth.

For dimension, see Technical Data.



Disassembly and inspection:

Place fixture, special tool No. 25, in a vise and mount the coolant pump with the impeller wheel 1 on the fixture.



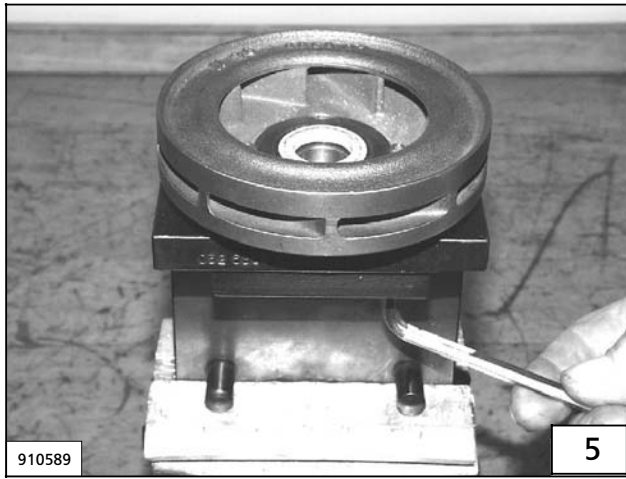
Remove nut 2 and at the same time, pull the impeller wheel 1 from shaft 3.

Remove the coolant pump from the fixture.

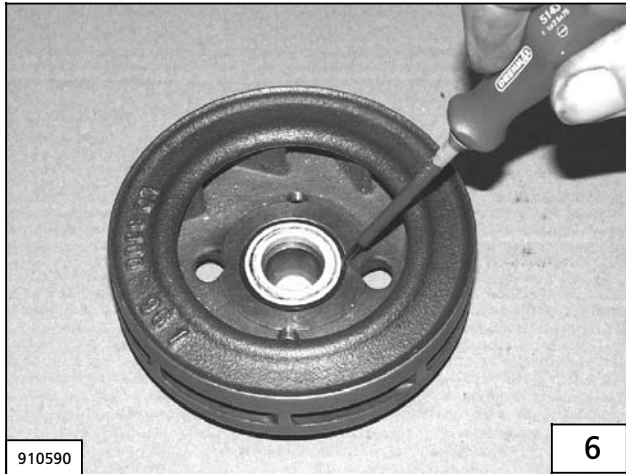
Note:

When removing the nut 2, hold gear 4 to prevent the shaft from turning.

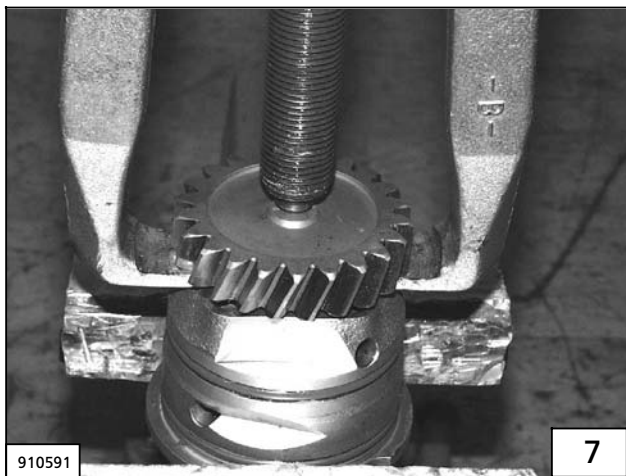




Remove the impeller wheel 1, seal 5 and nut 2 from the fixture.



Remove the seal 5 from the impeller wheel 1.



Place housing 6 into a vise and pull the gear 4 with a commercially available puller from shaft 3.

Note: DO NOT overtighten the housing in the vise.



Place housing 6 on a level surface. With a soft (brass) punch, drive shaft 3 with shaft seal 7, ceramic seal 8 and shaft seal 9 from housing 6 by hitting the gear side of the shaft.

Place shaft 3 into a vise using protective jaws, pry off the slinger plate 7 and remove shaft seal 9.



Clean all parts.

Visually check impeller 1 for wear and erosion.

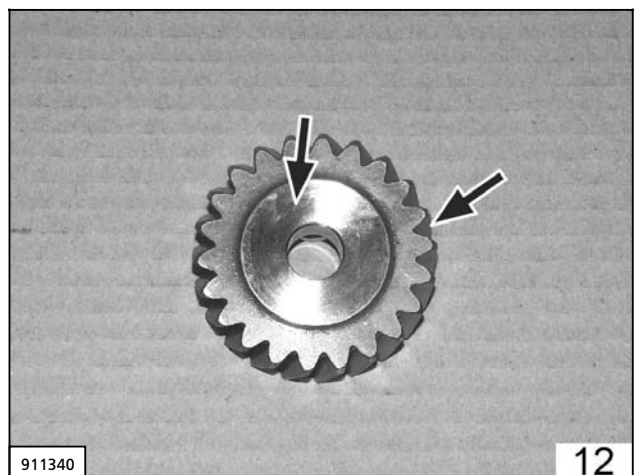


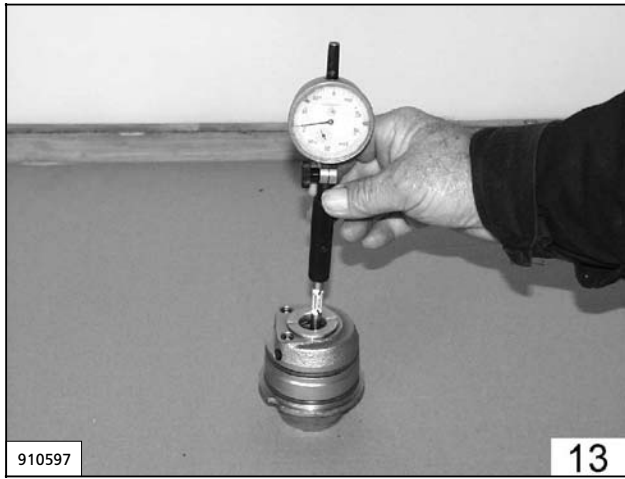
On shaft 3, visually check the running and thrust surfaces for the collar bearings (bushings) 10,11 for wear.

Measure the pin diameter, see Technical Data for dimensions.



On gear 4, visually check the teeth and thrust surface for the collar bearing 10 for wear.





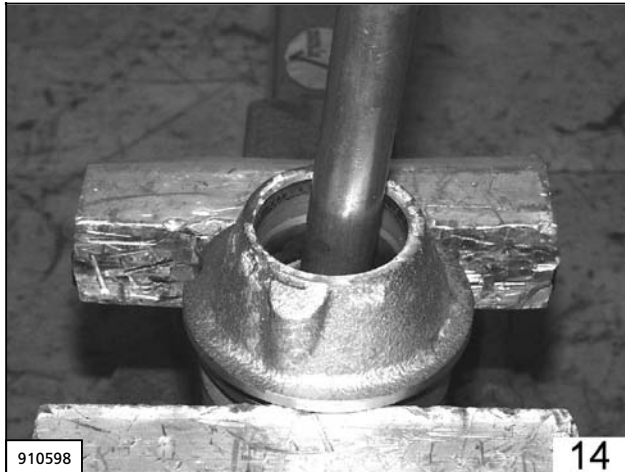
Visually check the collar bearing 10,11 in housing 6 for wear.

Measure with an inside dial gauge, see fig. 13.

For dimensions, see Technical Data.

Note:

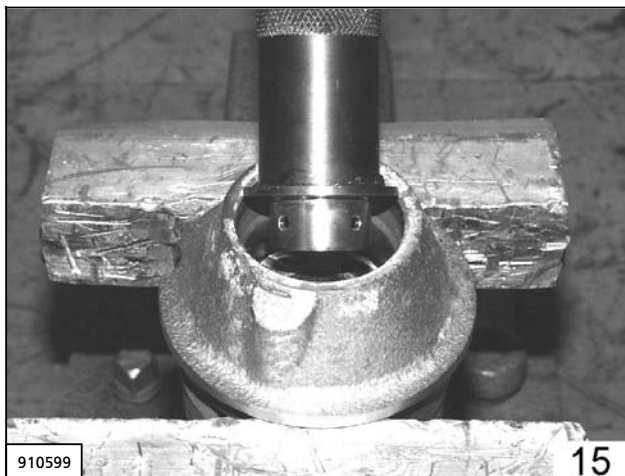
Replace all worn and damaged items.



Replace collar bearings (bushings) in the housing:

Place the housing 6 into a vise as shown in fig. 14 and drive out collar bearing 10 with a punch.

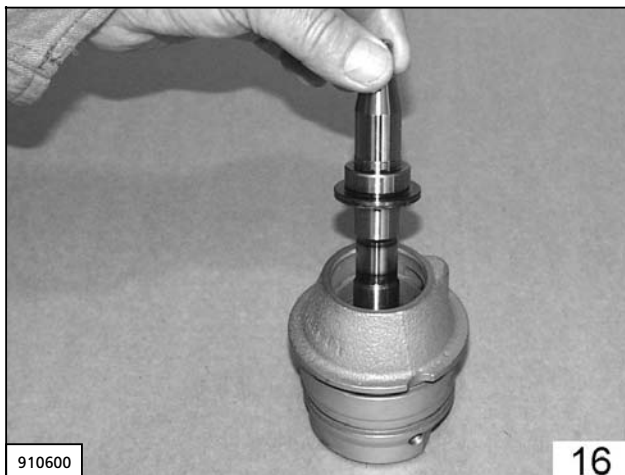
Turn the housing over and press out the bearing 11 with a punch.



Cool new bearings 10,11 in liquid nitrogen to -175°C to -195°C (-280 to -320°F) and drive them with a punch, special tool No. 72 into the housing 6 until they are flush and seated.

Note:

The collar bearings 10, 11 are premachines and do not have to be machined after installation.



Assembly:

Lubricate the collar bearings 10, 11 with multi purpose grease, insert shaft 3 from the impeller wheel side into the collar bearings / housing 6.

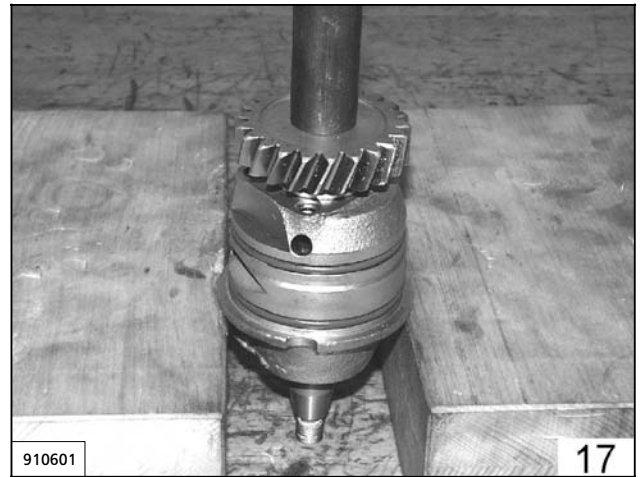
Heat the gear 4 to approx. +280 °C (530 °F) , support the shaft 3 on a level surface and press gear 4 with a suitable piece of pipe onto the shaft 3 until the gear is seated against the bearing 10.

Note:

The mounting surfaces on shaft 3 and gear 4 must be free of grease and oil.

Check the axial play, as outlined in fig. 2.

For dimensions, see Technical Data.



Lubricate the new shaft seal 9 between the two sealing lips on several points (every 45°) with grease (Barrierta L 55/3) or similar product and push with a punch, special tool No. 91, over shaft 3 into housing 6 to the dimension given on page 5.18.04 .



Apply locking compound (Loctite 242/243) to the slinger plate 7 and press it onto the shaft 3 until it is seated with a suitable piece of pipe.



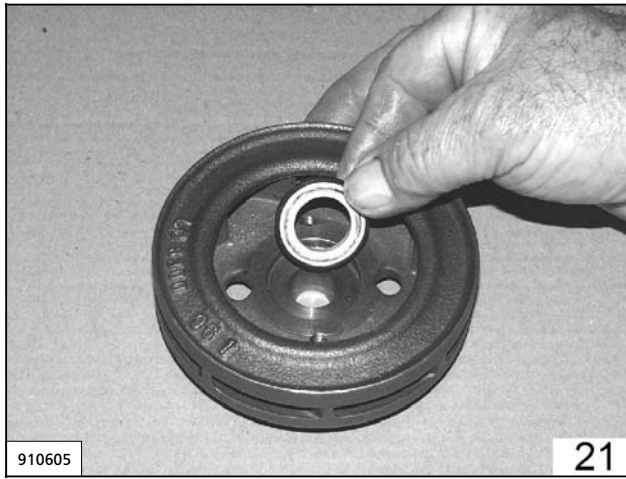
Carefully press the ceramic seal 8 with punch, special tool No. 87, over shaft 3 into the housing 6 .

Important:

When installing the pump seals, make sure the sliding surfaces are absolutely clean.

The pump seals contain carbon and ceramic and could crack if dropped, hit or incorrectly installed. Handle with care!





Apply a mixture of water and denatured alcohol (ratio 1:1) to the outside of the pump seal 5, and carefully push the seal into the impeller wheel 1.

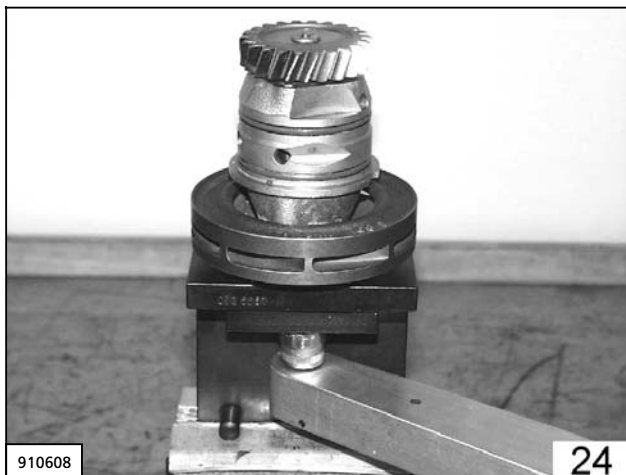


Carefully position the impeller wheel 1 with seal 5 onto the shaft 3.

Apply locking compound (Loctite 242/243) to the threads of shaft 3, install the nut 2 and tighten lightly.



Place the holding fixture, special tool No. 25, into a vise and mount the coolant pump with the impeller wheel 1 on the fixture.



Tighten nut 2.

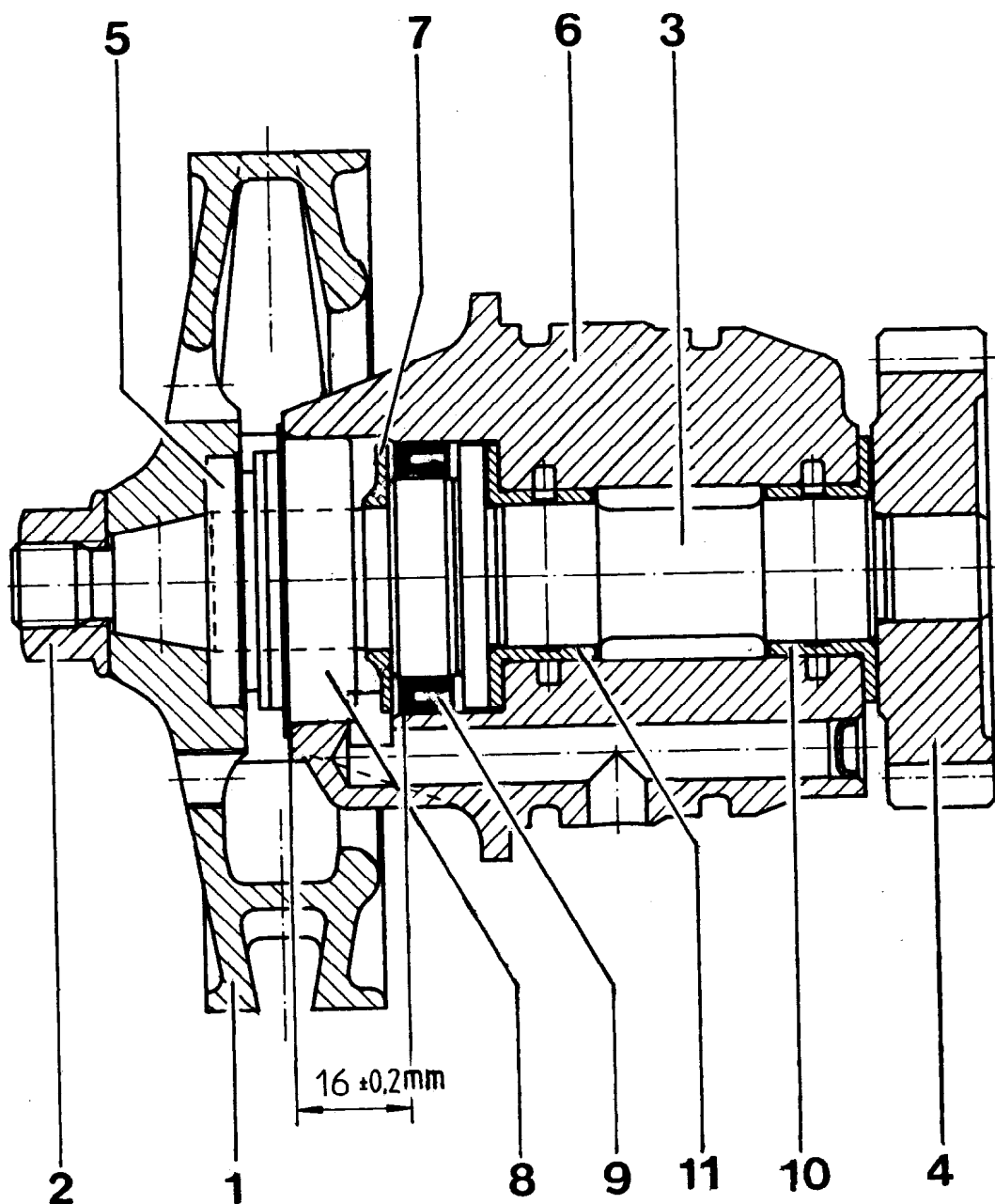
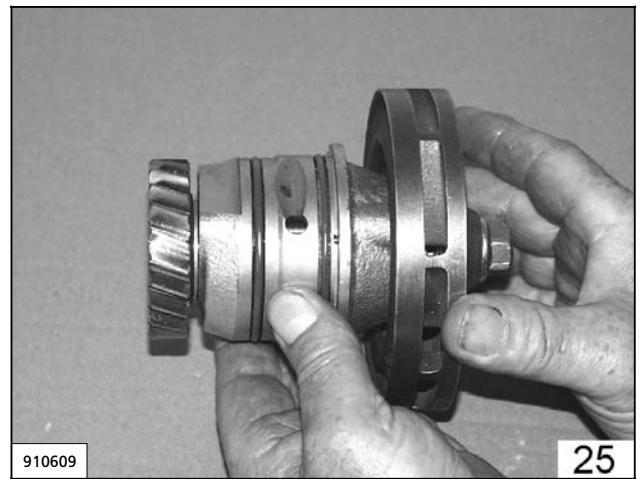
For tightening torques, see Technical Data.

Remove the coolant pump from the fixture and turn the impeller wheel 1 to check for easy movement.

Important:

Before starting the engine, make sure that the cooling system contains the proper amount of coolant.

If necessary, clean and flush the cooling system and refill with new coolant.



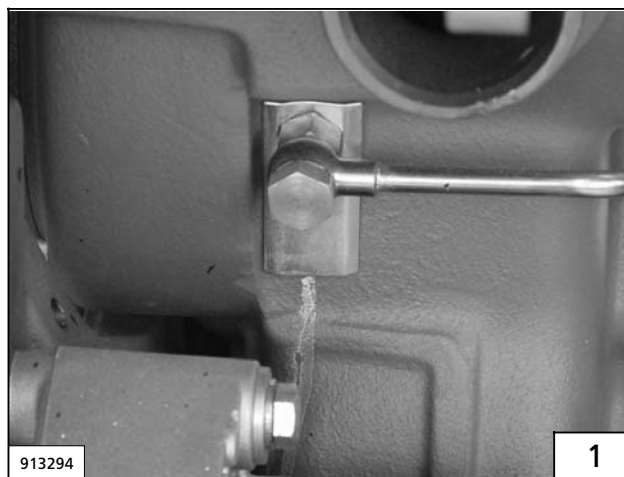
Coolant pump disassembly and assembly with collar bearing (bushings) (coolant pump version IV integrated in timing case)

From engine S/N 2001 02 1094

Use special tool No. 72, 91, 92

Note:

The coolant pump must be rebuilt or replaced when coolant leaks excessively from the weep hole in the timing case.



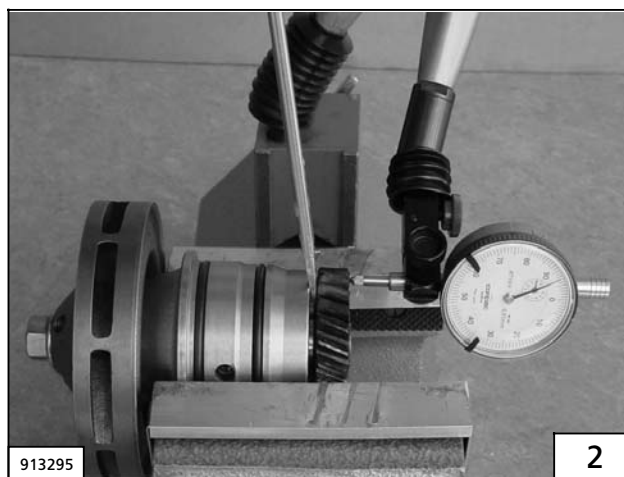
Check the axial play:

The coolant pump is removed, as outlined in sub group 5.14

For sectional view, see page 5.19.04

Place the coolant pump with the housing 4 into a vise using protective jaws. Install a commercially available dial gauge holder with dial gauge and place it on gear 5. Check the axial play by moving the gear back and forth.

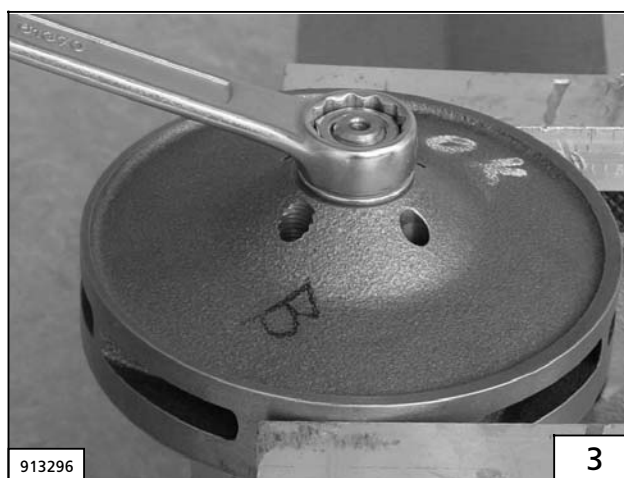
For dimension, see Technical Data.



Disassembly and check:

Place the coolant pump on the impeller 1 into a bench vise with protective jaw covers.

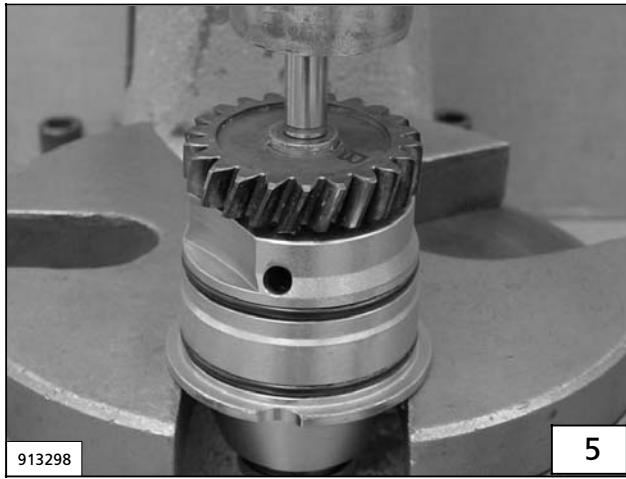
Loosen and remove nut 2.



Place the coolant pump on housing 4 into a bench vise with protective jaw covers.

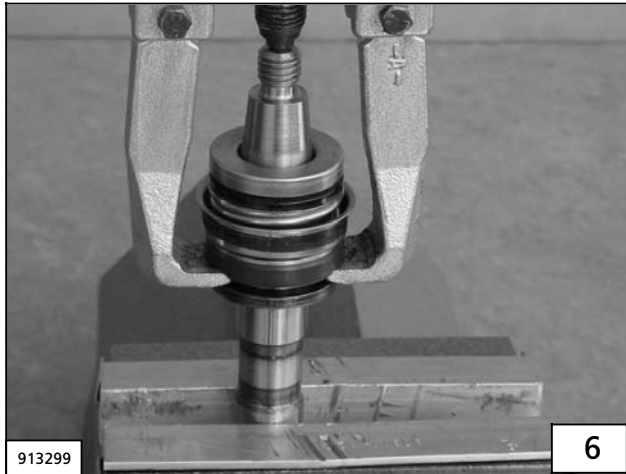
Pull the impeller 1 with a commercially available puller from shaft 3.



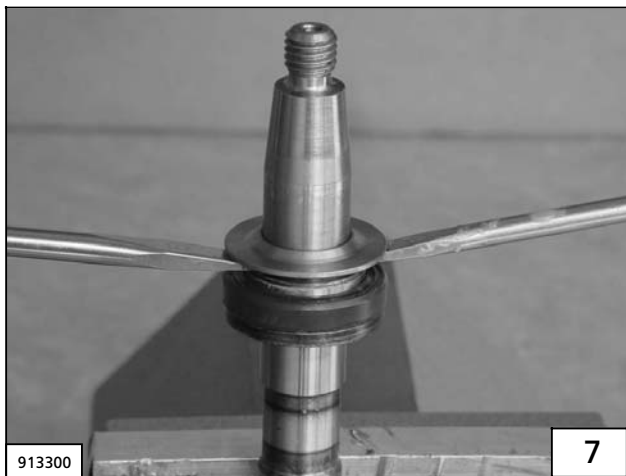


Place housing 4 onto a level surface, gear 5 must point upward.

Push the shaft 3 with suitable punch through gear 5 and with shaft seal ring 6, ring 7 and slip ring seal 8 from housing 4.



Place shaft 3 into a bench vise with protective jaw covers. Pull the slip ring seal 8 with a commercially available puller from shaft 3.



Push off ring 7 from shaft 3 and remove the shaft seal ring 6.



Clean all parts.

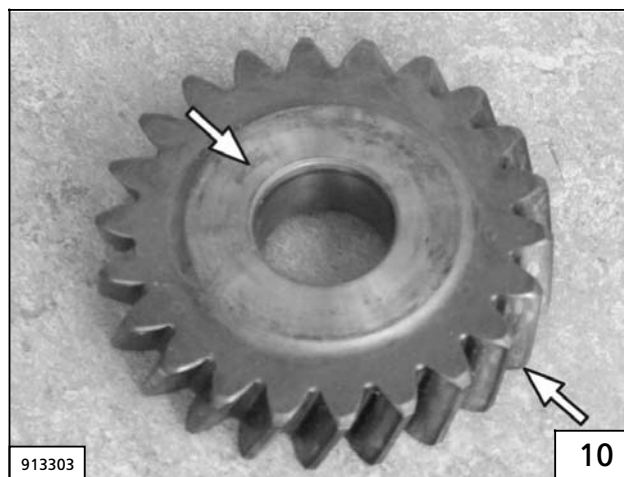
Check the impeller 1 for wear (visual check).

On shaft 3, check the running surfaces or the thrust surface for collar bushing 9, 10 for wear (visual check).

Measure the pin diameter, for values see Technical Data.



On gear 5, check the teeth and the thrust surface for the collar bearing 10 for wear (visual check).



Check the collar bearing 9, 10 in housing 4 for wear (visual check).

Measure with slide gauge.

For values, see Technical Data.

Note:

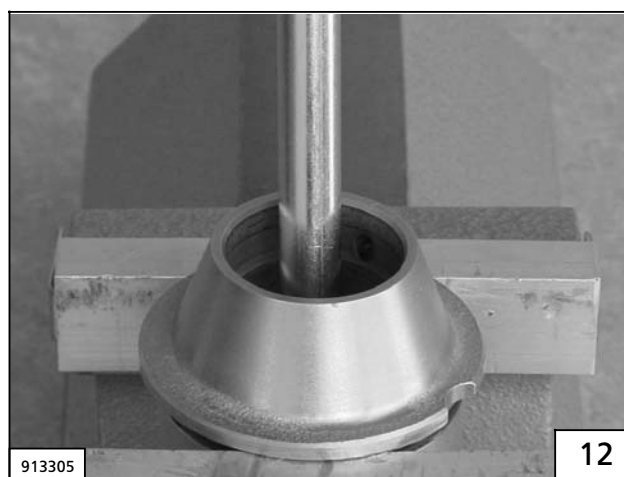
Any parts which are not within the given test values, or which show damage must be replaced.



Replace the collar bearing in the housing:

Place housing 4 into a bench vise with protective jaw covers and drive out the collar bearing 10 with a mandrel.

Turn the housing over and push out the collar bearing 9 with a mandrel.





Cool down a new collar bearing 9, 10 in liquid nitrogen to - 175° C to - 195°C (-280 to -320°F) and drive in with punch, special tool No. 72 into housing 4 until flush.

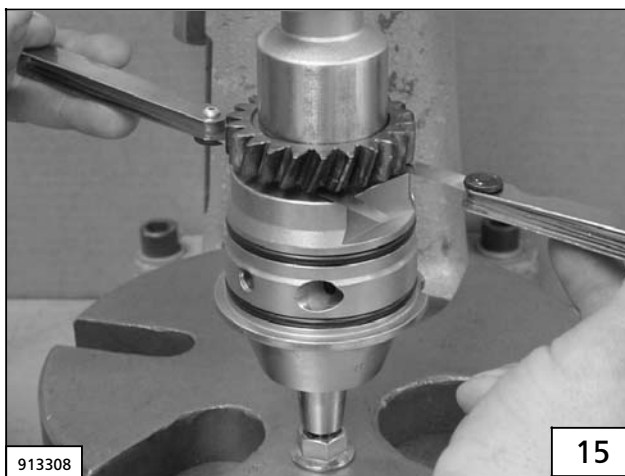
Note:

Collar bearings 9, 10 are ready-made bearings and do not have to be remachined.



Assembly:

Grease the collar bearing 9, 10 with multi purpose grease, guide shaft 3 from the impeller side into the collar bearing or into housing 4.



Warm up gear 5 in a heater to + 280°C (530°F), support the shaft 3 on lever surface and press the gear 5 with a suitable piece of pipe onto the shaft 3.

Caution:

When pressing the gear on, set the axial play with two slide gauges between the collar bushing 10 and gear 5.

After pressing it on, check the axial play as described in "Check axial play".

For axial play data see page 5.19.04 or Technical Data.

The press surfaces on shaft 3 and gear 5 must be free of oil and grease.



Grease new shaft seal ring 6 between the sealing and protective lip on several points (approx. every 45°) evenly with grease (Barrierta L55/3) and push with punch, special tool No. 91 over shaft 3 into housing 4 to the distance given on page 5.19.04.

Apply a retaining compound (Loctite 243) to ring 7 and press with suitable piece of pipe onto shaft 3 to the stop.



Press new slipring seal 8 with punch, special tool No. 92, into housing 4 or shaft 3.

Caution:

When installing the slipring seal, keep the gap ($12 \pm 0,3\text{mm}$) given on page 5.19.04 between the surface of the seal and the end of the seal to the impeller exactly.

The punch, special tool No. 92 is fashioned in such a way that this dimension is retained after pressing the slip ring seal in.

Observe at most cleanliness when installing the slip ring seal!



Push the impeller 1 on shaft 3.

Apply a retaining compound (Loctite 243) onto the thread on shaft 3, install nut 2 and tighten lightly.

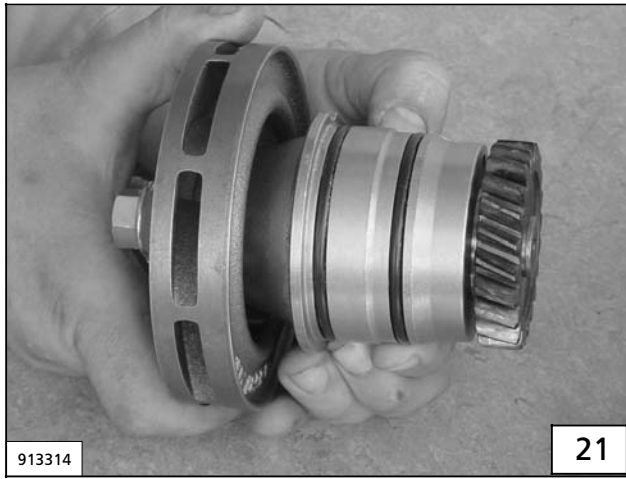


Place the coolant pump on the impeller 1 into a bench vise with protective jaw covers.

Tighten nut 2

For tightening torque, refer to Technical Data.

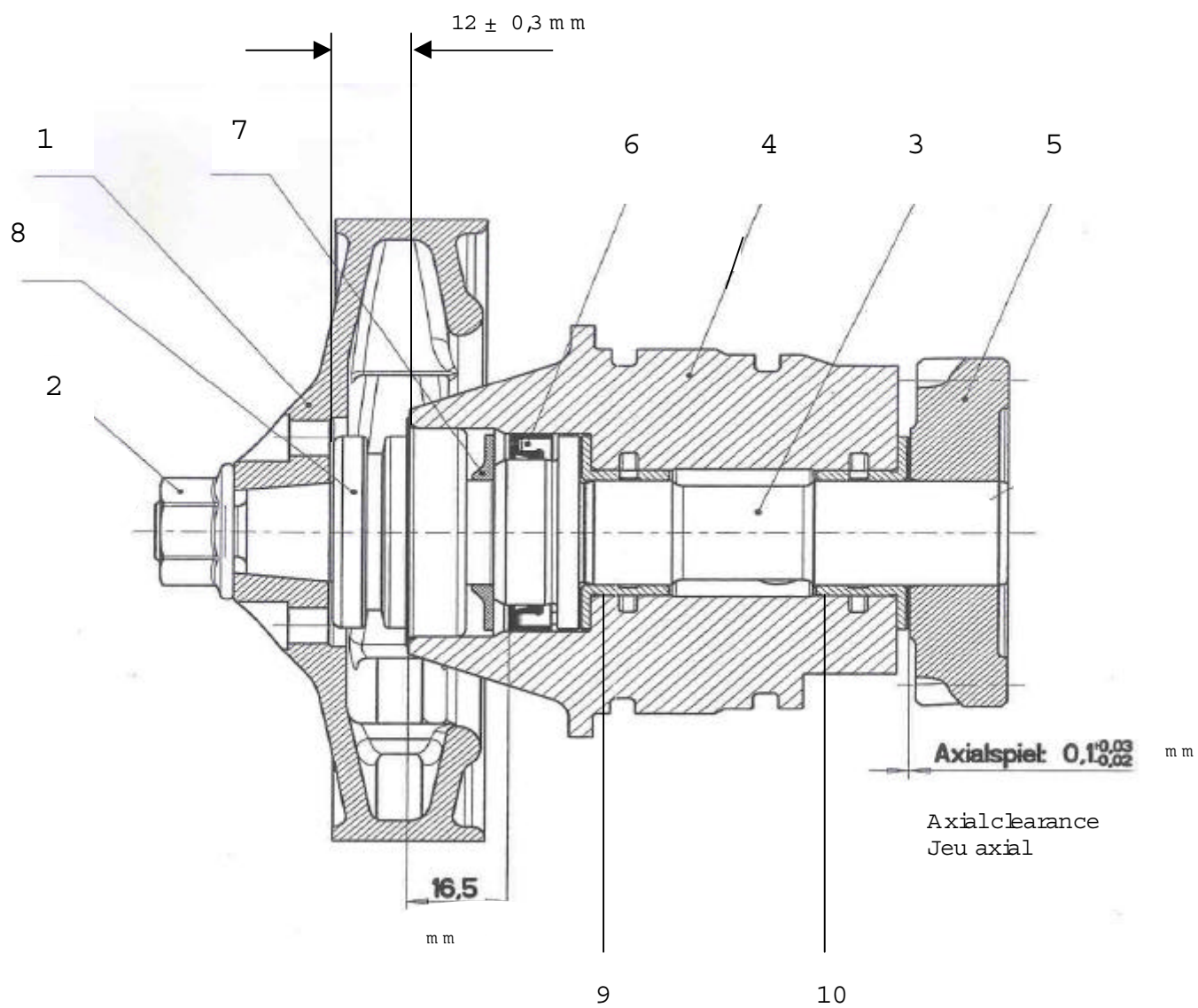




Check the coolant pump for easy movement by turning on impeller 1.

Caution:

Make sure that coolant has been added before operating the coolant pump.



Pulley and Vibration Damper Removal and Installation

Pulley and Vibration Damper Removal:

To remove the alternator v-belt see sub-group 2.27.

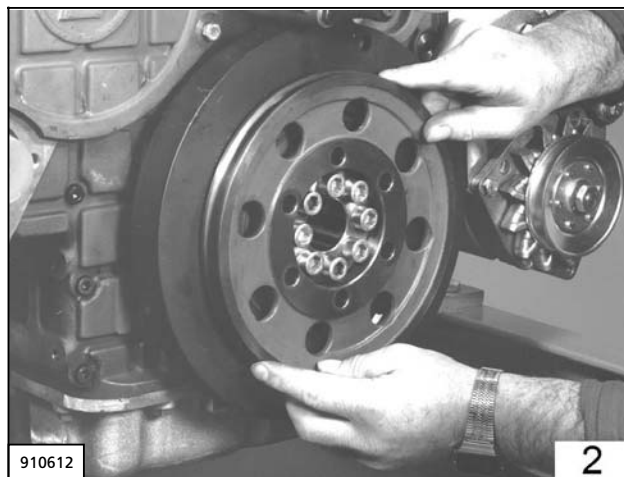
Loosen and remove pulley mounting bolts.

Note:

Hold starter ring gear in position with pry bar through inspection window in flywheel housing while loosening the pulley mounting bolts.



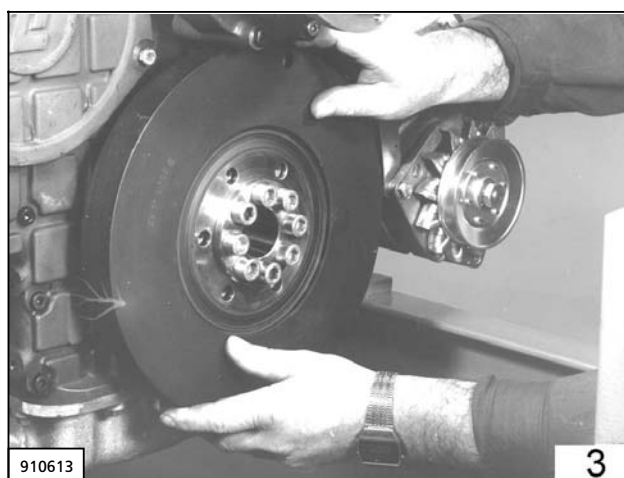
Remove pulley from hub.



Remove vibration damper from hub.

Note:

There is no vibration damper at the D 904 NA and D 904 TB engine.



Pulley and Vibration Damper Installation:

Place vibration damper on hub.

Place pulley on hub and install assembly with mounting bolts.

For proper torque, see Engine Specifications.

Reinstall alternator v-belt as described in sub-group 2.27.



Front Crankshaft Seal Replacement

Use special tool no. 79.

Crankshaft Seal Removal:

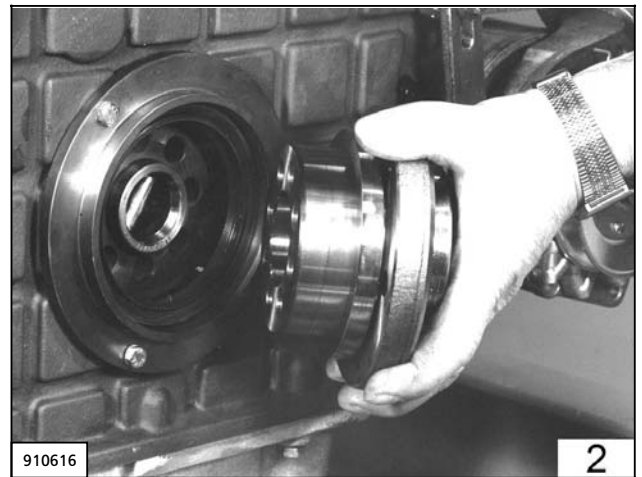
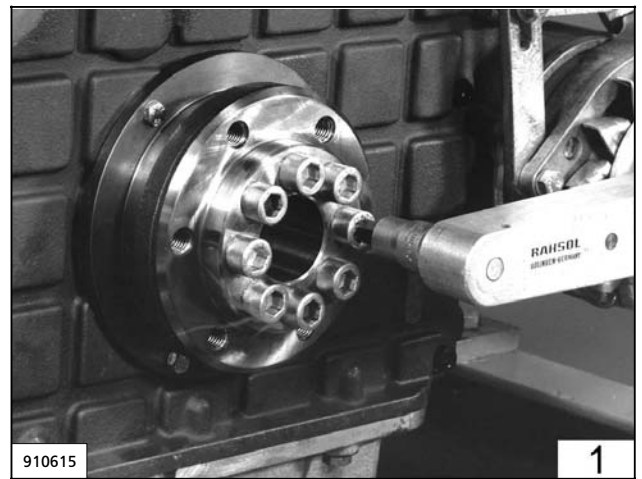
To remove pulley and vibration dampener from hub see sub-group 5.20.

Loosen and remove hub mounting bolts from crankshaft.

Note:

Hold starter ring gear in position with pry bar through inspection window in flywheel housing while loosening the pulley mounting bolts.

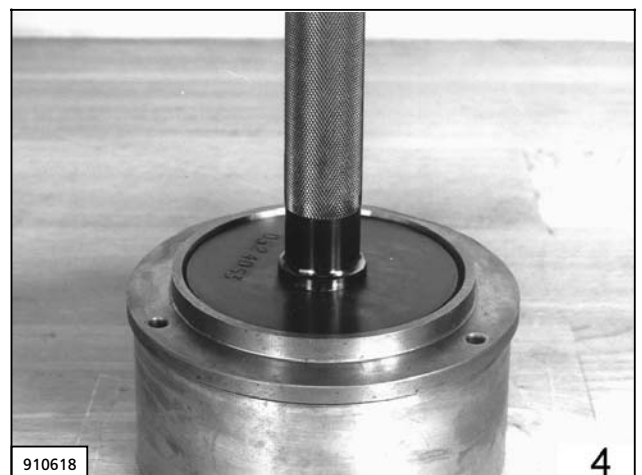
Remove hub from crankshaft.

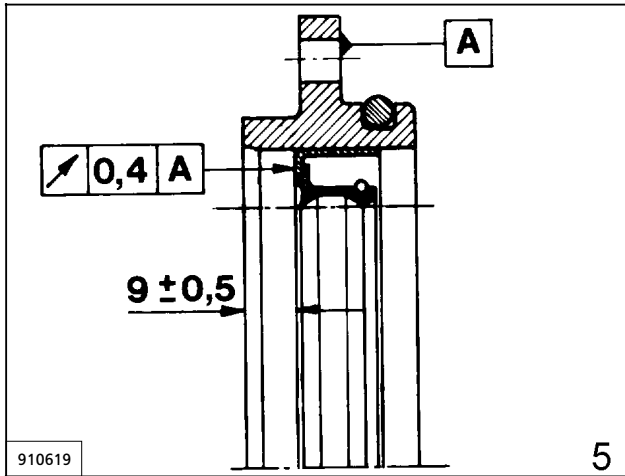


Loosen and remove front crankshaft seal mounting flange bolts and pull flange from timing and accessory drive gear box.



Properly support seal mounting flange in horizontal position and remove shaft seal with punch plate, special tool no. 79.





Crankshaft Seal Installation:

Place new shaft seal on mounting flange and press seal with punch plate into specified location. Check for proper shaft seal position. Replace O-ring on seal mounting flange with new one.

Note:

Should the hub show wear in form of a groove where it contacts the seal lip, the shaft seal must be relocated in the seal mounting flange toward the engine block. Replace the hub in case the entire seal lip contact surface on the hub is worn or damaged.



On several places (every 45°) between seal lip and protector lip, apply approx. 3mm (1/8") of grease (Molykote Longterm 2 Plus, etc.). Lightly oil O-ring. Install seal mounting flange into timing gear box; install screw and tighten.



Cautiously place hub on crankshaft. Screw in and torque hub mounting bolts.

See Engine Specifications for proper torque.

Tachometer Drive Removal, Repair and Installation:

Installation on camshaft.

Removal:

For position of components, see page 2.

Remove tachometer drive from flange 1 with seal ring 2.



Repair:

Note:

The tachometer drive must be repaired if the drive shaft 3 shows excessive play, allowing oil leakage through the gauge connection.

Place tachometer drive in bench vise. To avoid damage, use protective jaw covers.

Remove drive shaft 3 from housing 4. Push shaft seal ring 5 and bushing 6 from housing, using a punch.

Remove the housing 4 from vise, turn it around and place it in vise. Remove bushing 7 with punch.

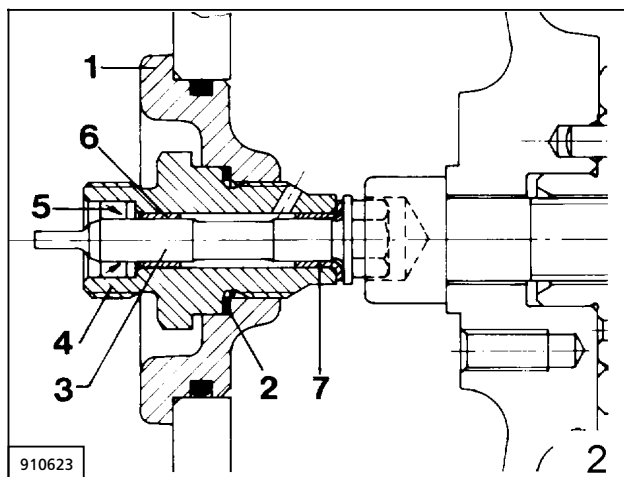
Carefully clean all parts.

Visually check shaft 3 for wear.

Place housing 4 in vise.

Install new bushing 7 with punch. Turn housing 4 around and install new bushing 6 with punch.

Press in new shaft seal ring 5 with punch. Lightly lubricate shaft seal lip and place drive shaft 3 into tachometer drive assembly.



Installation:

Place new seal ring 2 on tachometer drive and screw tachometer drive into mounting flange 1 until hex head contacts timing gear. Tighten tachometer drive in mounting flange.





Tachometer Drive Removal. Repair and Installation:

Installation on injection pump drive up to engine no. 86 01 1581.

Removal:

For position of components, see fig. 5.

Remove tachometer drive from flange 1 with seal ring 2.

Repair:

Note:

The tachometer drive must be repaired if the drive shaft 3 shows excessive play, allowing oil leakage through the gauge connection.

Place tachometer drive in bench vise. To avoid damage, use protective jaw covers.

Remove drive shaft 3 from housing 4. Push shaft seal ring 5 and bushing 6 from housing, using a punch.

Remove the housing 4 from vise, turn it around and place it in vise. Remove bushing 7 with punch.

Carefully clean all parts.

Visually check shaft 3 for wear.

Place housing 4 in vise.

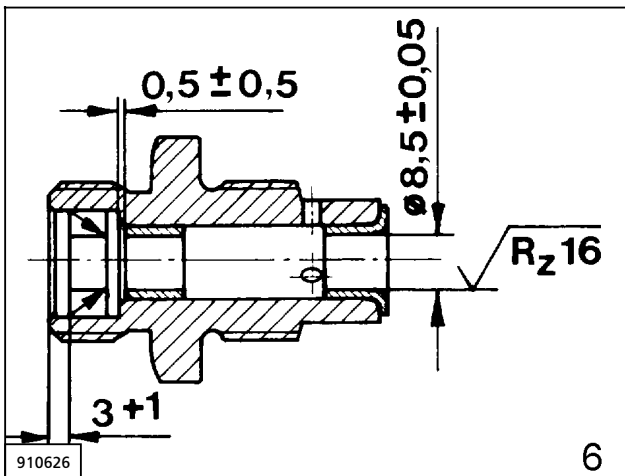
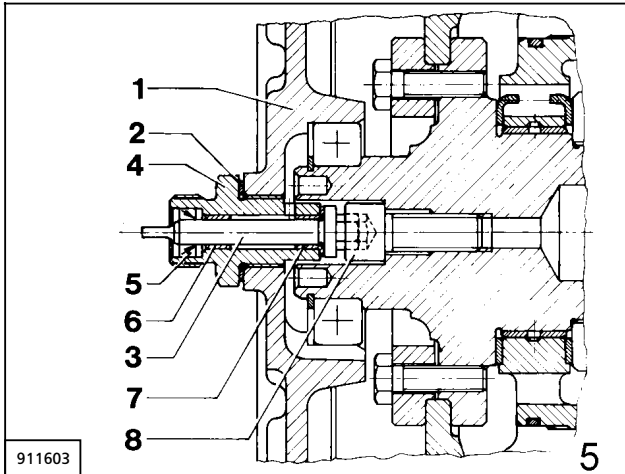
Install new bushing 7 with punch. Turn housing 4 around and install new bushing 6 with punch.

Press in new shaft seal ring 5 with punch. Lightly lubricate shaft seal lip and place drive shaft 3 into tachometer drive assembly.

Important:

Bushing 7 must be machined after installation. See fig. 6 for dimensions, see fig. 6.

If screw 8 has been removed, coat threads with a locking compound, such as Loctite 262 or Omnifit 100 M before reinstallation.



Installation:

Place new seal ring 2 on tachometer drive and screw tachometer drive into mounting flange 1 until hex head contacts timing gear. Tighten tachometer drive in mounting flange.

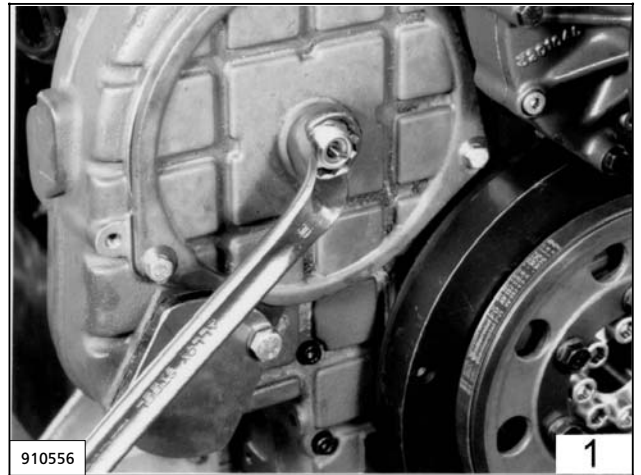
Tachometer Drive Removal. Repair and Installation:

Installation on injection pump drive from engine no. 86 01 1582, see fig. 2.
Injection pump drive bearing integrated in timing gear housing, see fig. 3.

Removal:

For position of components, see fig. 2, 3.

Remove tachometer drive from flange 1 with seal ring 2.



Repair:

Note:

The tachometer drive must be repaired if the drive shaft 3 shows excessive play, allowing oil leakage through the gauge connection.

Place tachometer drive in bench vise. To avoid damage, use protective jaw covers.

Remove drive shaft 3 from housing 4. Push shaft seal ring 5 and bushing 6 from housing, using a punch.

Remove the housing 4 from vise, turn it around and place it in vise. Remove bushing 7 with punch.

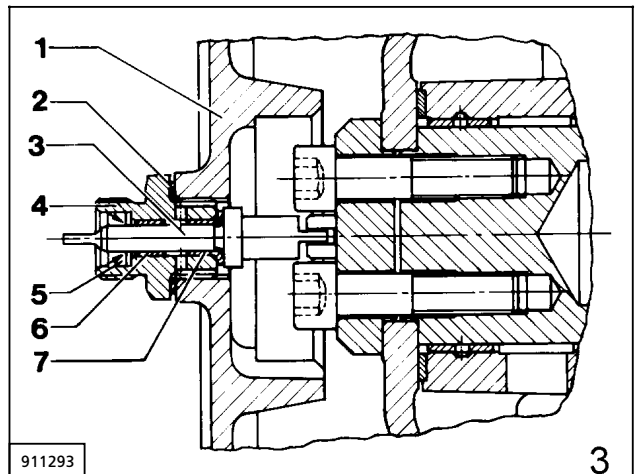
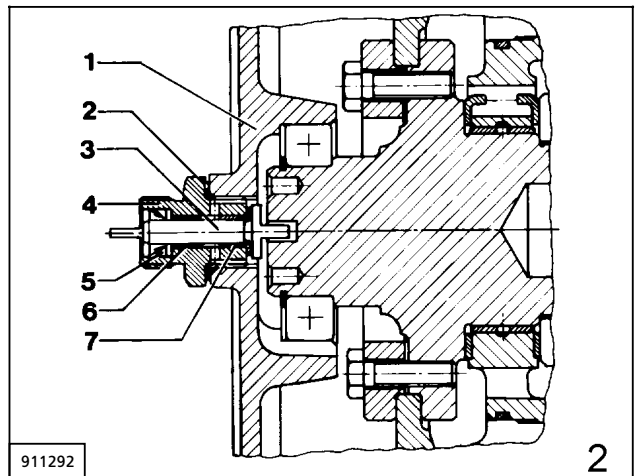
Carefully clean all parts.

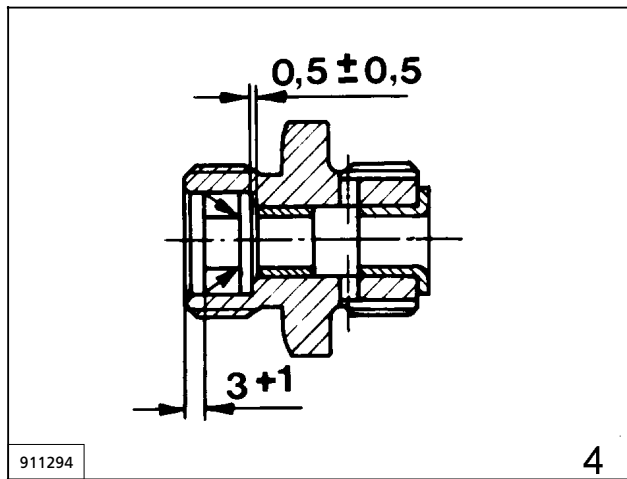
Visually check shaft 3 for wear.

Place housing 4 in vise.

Install new bushing 7 with punch. Turn housing 4 around and install new bushing 6 with punch.

Press in new shaft seal ring 5 with punch.





Important:

Note the installation measurements given in fig. 4.

Lightly lubricate the shaft and push it in housing 4.



Installation:

Place new seal ring 2 on tachometer drive and screw tachometer drive 3 (insert pin into groove) into cover 1 and tighten.

Remove and install coolant shut off valve with coolant filters on thermostat housing

Note:

In case of coolant leakage on the shutoff valve, the valve must be resealed.



Removal:

Drain the coolant, see sub group 2.01.

Remove the retaining screw for the shut off valve on the thermostat housing.

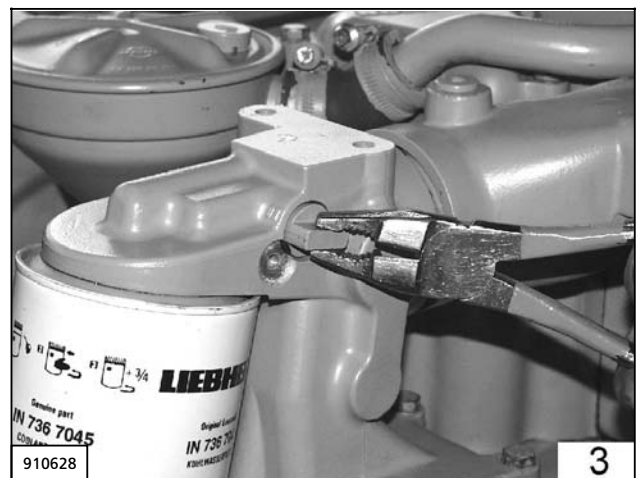
Remove the retaining screw and the washer.



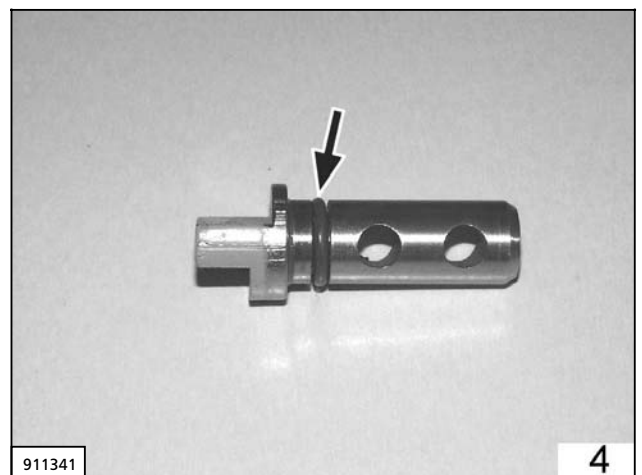
Pull the shut off valve with a pair of pliers from the thermostat housing.

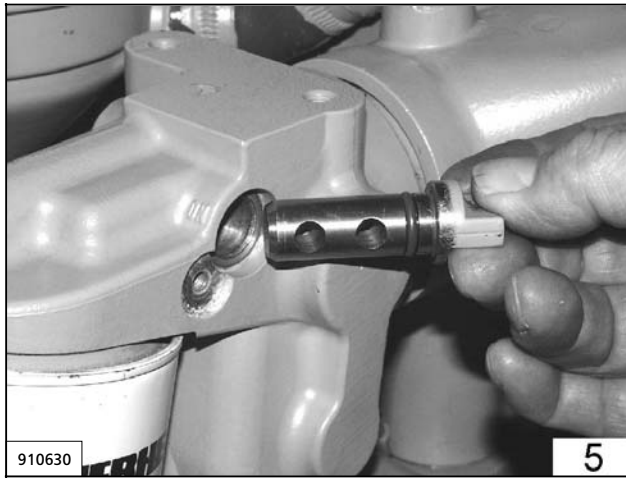
Clean the bore in the thermostat housing and shut off valve.

Note: Replace worn or damaged part.



Install a new O-ring on shut off valve. Grease the O-ring lightly.



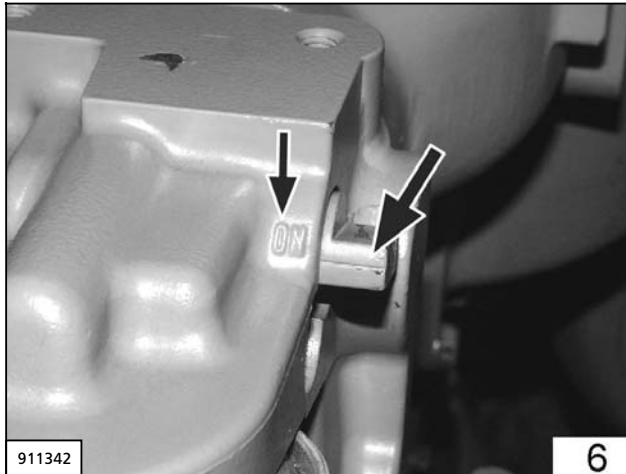


Installation:

Push the shut off valve into the bore of the thermostat housing.

Important:

The groove on the knob of the shut off valve must point to the "ON" position on the thermostat housing, when installed, see fig. 6.



Install the washer, insert the retaining screw and tighten.

Check the shut off valve for easy movement.

Open the shut off valve, set the groove on the knob to the "ON" position or bring the knob to horizontal position in relation to the coolant filter.

Add coolant, see sub group 2.01.

Sub Group Index

- 6.01 Flywheel Removal and Installation**
- 6.05 Starter Ring Gear Replacement**
- 6.08 Rear Crankshaft Seal Replacement**

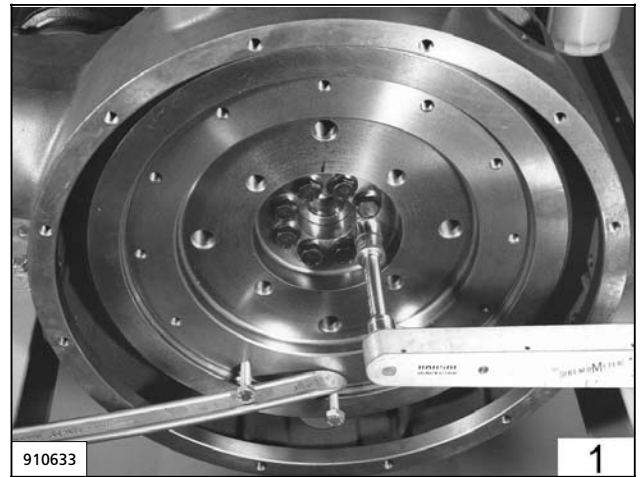
LIEBHERR	Benennung/Description/Dénomination	Typ Model D 904 / 914 / 924 Type 906 / 916 / 926
Datum/Edition/Date 01.99	Components Flywheel Section	Ab/from/à partir de Blatt/Page/Feuille 6.00

Flywheel Removal and Installation

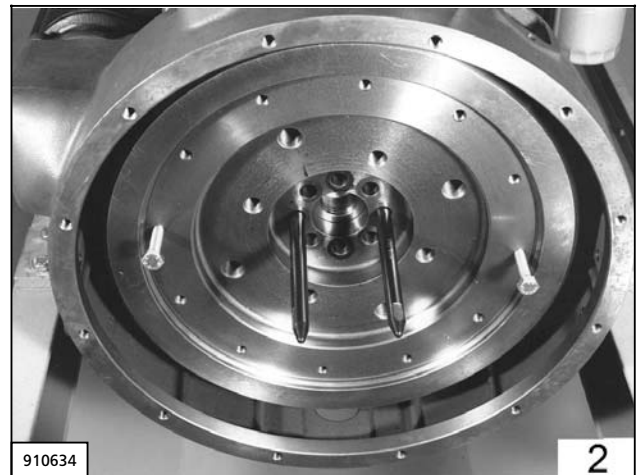
Use special tool no. 62.

Flywheel Removal:

Screw two additional bolts into existing flywheel bores. Place prybar between bolts and hold flywheel in position. Loosen flywheel mounting bolts and remove them all but two bolts.

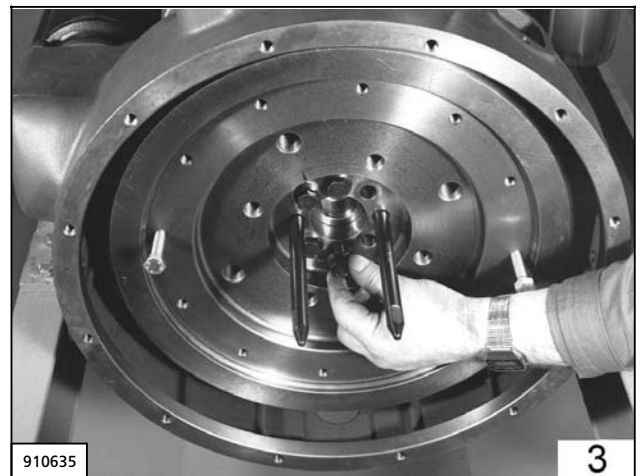


Insert two guide pins, special tool no. 62, in two flywheel bores opposite to each other and screw guide pins into flywheel mounting flange on crankshaft. Remove the two remaining mounting bolts, pull-off and remove flywheel from crankshaft.



Flywheel Installation:

Position flywheel properly on crankshaft, with guide pins in respective bores, and push flywheel on crankshaft flange. Insert and hand-tighten mounting bolts. Hold flywheel in position with prybar and torque all mounting bolts.



Ring Gear Removal:

To remove flywheel see sub-group 6.01.

With flywheel in horizontal position support ring gear equally on several locations. Heat ring gear with torch and press flywheel from ring gear.

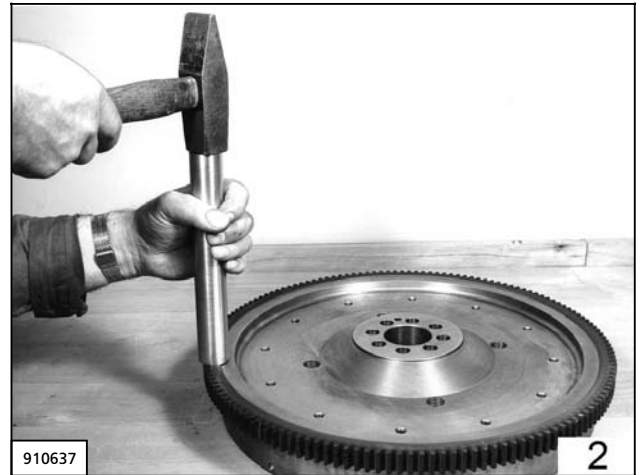


Ring Gear Installation:

Clean press-seat surface on ring gear and flywheel. Place and support flywheel in horizontal position. Heat replacement ring gear to approximately 430°F (220°) and press it onto flywheel.

Note:

Before starting the engine, lubricate the ring gear with general-purpose (GP) grease. (Molykote Longterm 2 Plus, BOSCH Ft 1 v 26, AVIA Avilub LD, etc.).



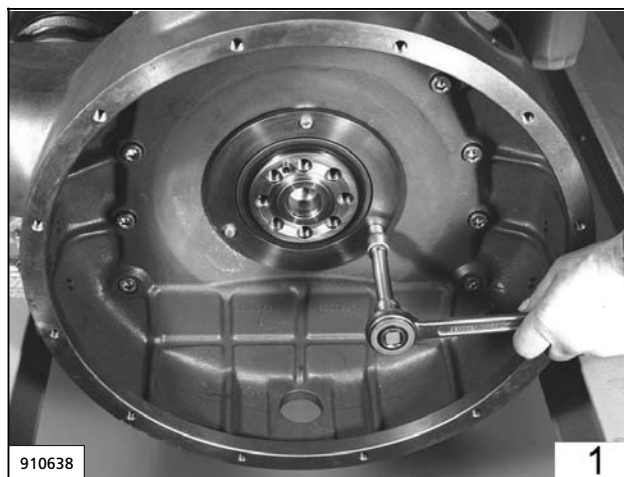
Rear Crankshaft Seal Replacement

Use special tools no. 60 and no. 79.

Crankshaft Seal Removal:

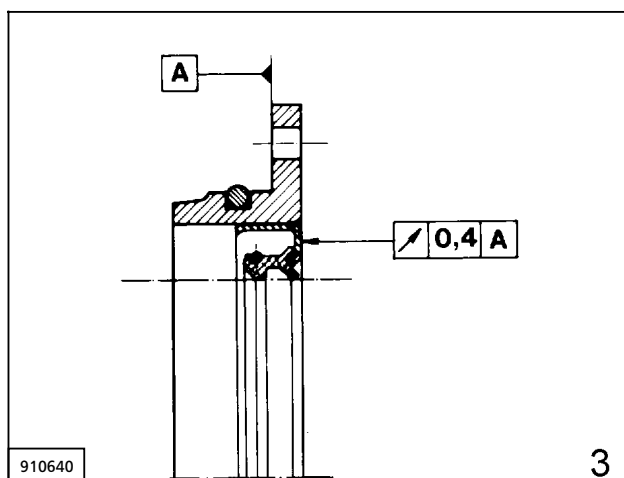
To remove flywheel see sub-group 6.01.
Remove rear crankshaft seal mounting flange bolts and pull mounting flange from engine block.

Properly support seal mounting flange in horizontal position and press-out shaft seal with punchplate, special tool no. 79.



Crankshaft Seal Installation:

Place new shaft seal on seal mounting flange and press it into location with punchplate. Check for proper shaft seal position. Replace o-ring on seal mounting flange with new one.



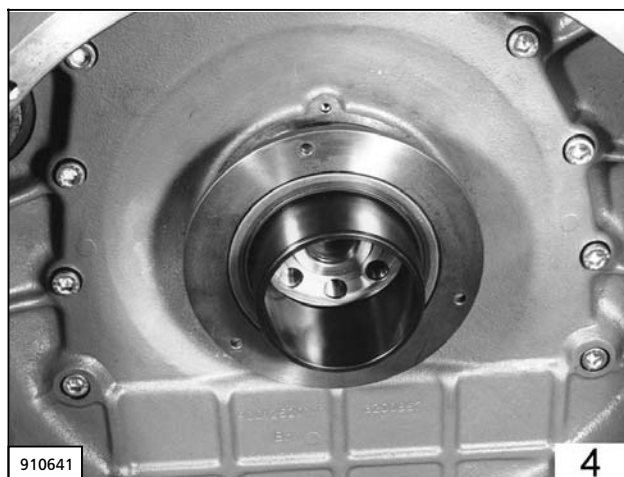
On several places (every 45°) between seal lip and protector lip, apply approx. 3 mm (1/8") of grease (Molykote Longterm 2 Plus, etc.).

Lightly oil O-ring. Push seal mounting flange with installation sleeve, special tool no. 60, on crankshaft.

Install and tighten mounting screws.

Note:

Should the crankshaft show wear in form of a groove where it contacts the seal lip, the shaft seal must be relocated in the seal mounting flange towards the engine block,



Sub group Index

7.01	Fuel injection pump removal and installation	
7.02	Fuel injection pump removal and installation (injection pump drive integrated in the timing gear cover)	
7.03	Distributor injection pump (VE) removal and installation	
7.04	Fuel injection pump with "EDC" (Electronic regulation) Removal and installation	
7.05	Fuel injection pump drive removal and installation (without variable fuel begin advance)	
7.06	Fuel injection pump drive removal and installation , inspection and repair (Injection pump integrated in the timing gear cover)	
7.07	Fuel injection pump drive removal and installation, inspection and repair (Injection pump drive integrated in the timing gear cover) (Injection pump drive integrated in the timing gear cover)	
7.10	Fuel injection pump drive disassembly, inspection and assembly (without variable fuel begin advance)	up to engine S/N 85 01 0269
7.11	Fuel injection pump drive disassembly, inspection and assembly (without variable fuel begin advance)	from engine S/N 85 01 0270
7.14	Remove and install injection pump type "H-RP43" (control sleeve fuel injection pump) with "EDC" (Electronic regulation)	
7.15	Replace / inspect fuel pressure relief / overflow valve	
7.18	Fuel injector removal and installation	
7.20	Fuel pump removal and installation	
7.22	Bleeding the fuel system	
7.23	Bleeding the fuel system (distributor for (VE) injection pump)	

LIEBHERR	Benennung/Description/Dénomination Fuel Injection System	Typ Model D 904 / 914 / 924 Type 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 7.00
Datum/Edition/Date 05 / 2003		

Fuel Injection Pump Removal and Installation

Use special tool no. 15.

Injection Pump Removal:

Disconnect engine speed control as well as engine shut-off cables and linkages from injection pump.

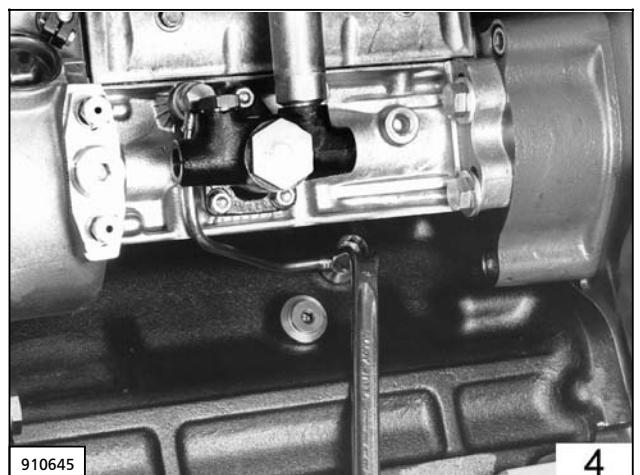
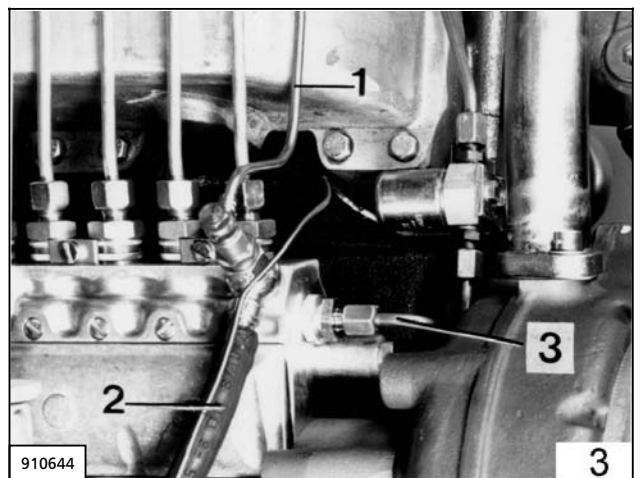
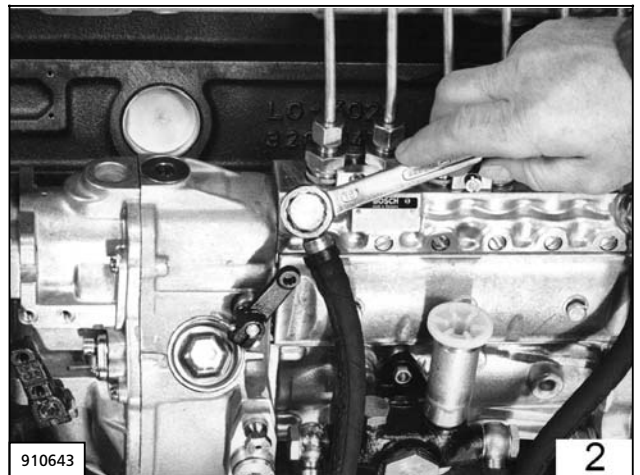
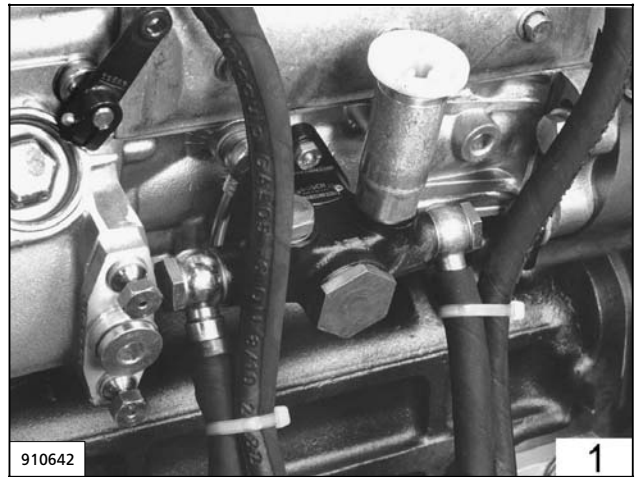
On turbocharged engines with aneroid control (charge pressure sensing control) disconnect manifold pressure sensing line from aneroid (see sub-group 10.20).

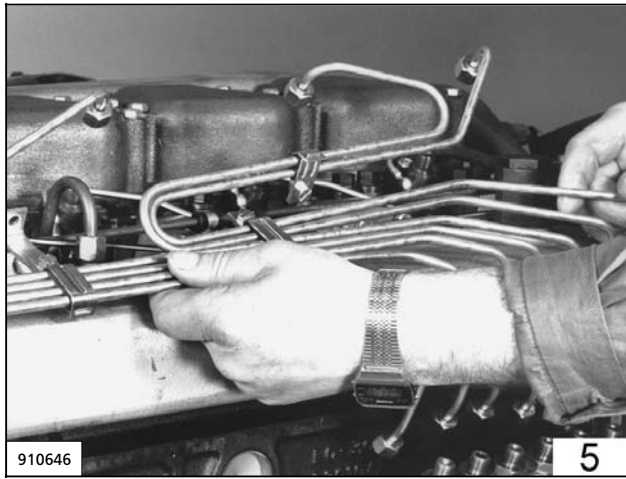
Disconnect and remove fuel lines at injection pump.

Disconnect and remove fuel line between fuel filter assembly and injection pump.

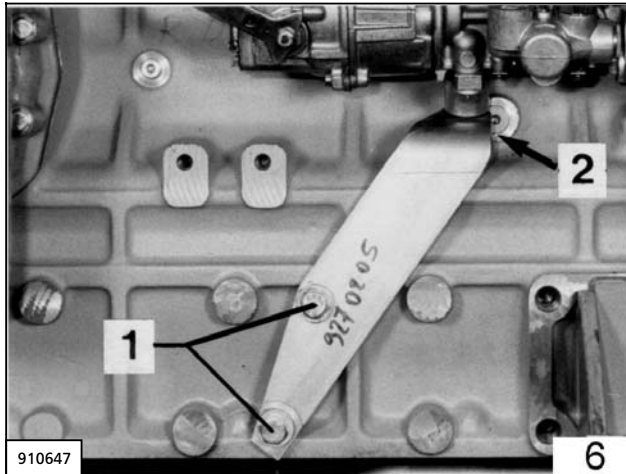
Disconnect fuel overflow line Pos. 1 from injectors, fuel return line Pos. 2 to fuel tank and fuel supply line Pos. 3 to preheater solenoid valve from injection pump.

Remove lubricating oil line.





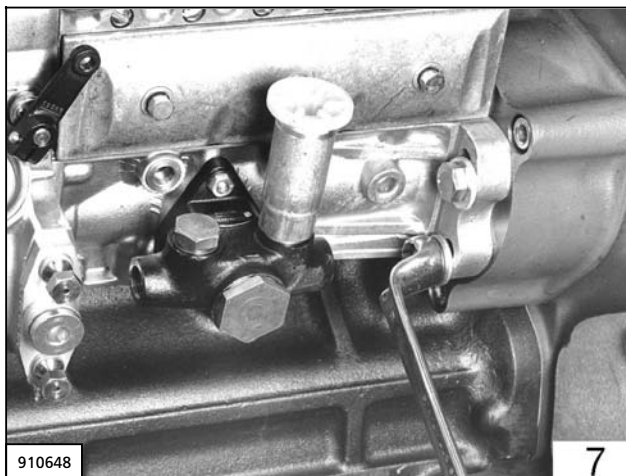
Remove all fuel supply lines between injection pump and injectors.



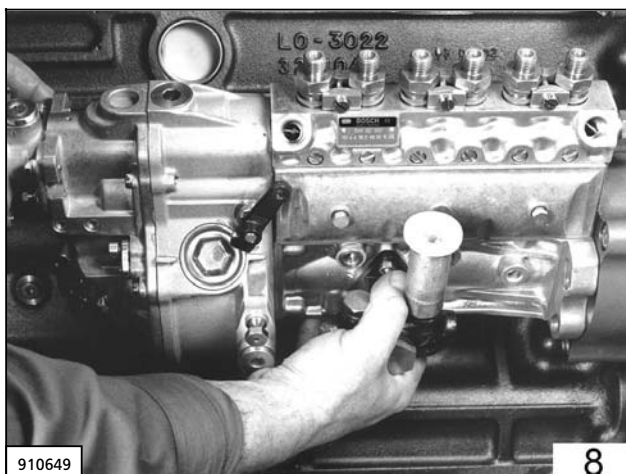
Note:

On 6 cylinder engine and MW injection pumps, the support bracket from the injection pump to the crankcase must also be removed.

Loosen and remove screws 1 for the support on the crankcase housing. Remove screw 2 between bracket and retainer plate.



Remove screws on mounting flange of injection pump.



Carefully pull injection pump from pump carrier on the engine.

Note:

If an injection pump support bracket is installed, see fig. 6, remove injection pump including support.

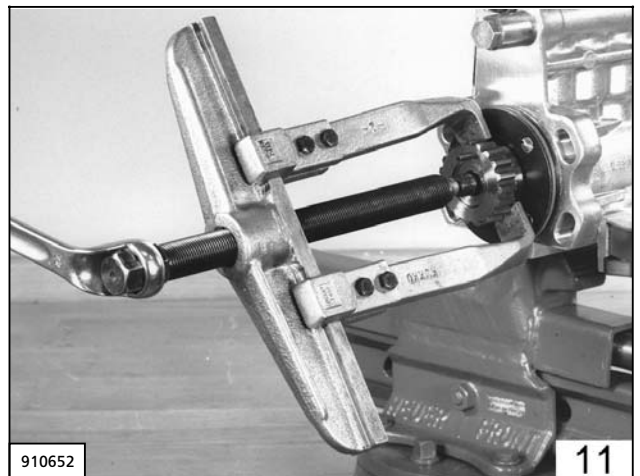
If the coupling housing pulls out when the injection pump is removed, remove the housing from the gear shaft of the injection pump and slide it back onto the hub of the injection pump drive.



Place the injection pump in vise. To avoid damage, use protective jaw covers. Hold splined shaft adapter in position with retainer, special tool no. 15, and remove locknut with open end wrench.

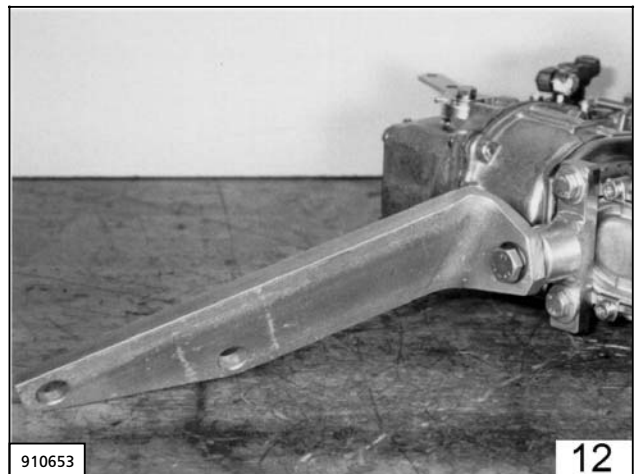


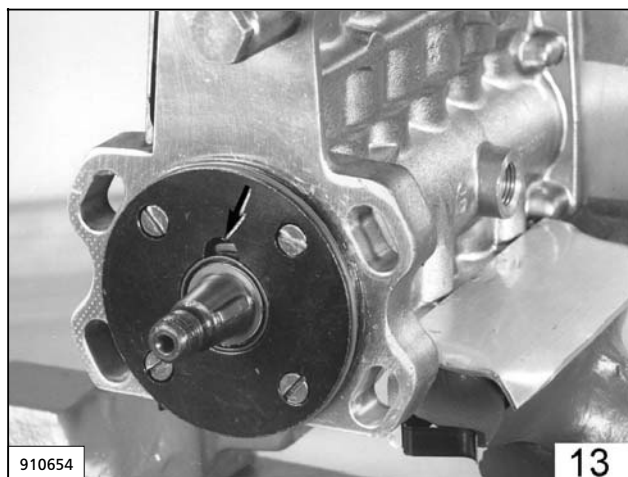
Remove retaining device and pull gear shaft with commercially available puller. Do not loose or damage Woodruff key from pump shaft!



Note:

When installing the injection pump support bracket, see fig. 6, remove the bracket from the injection pump.





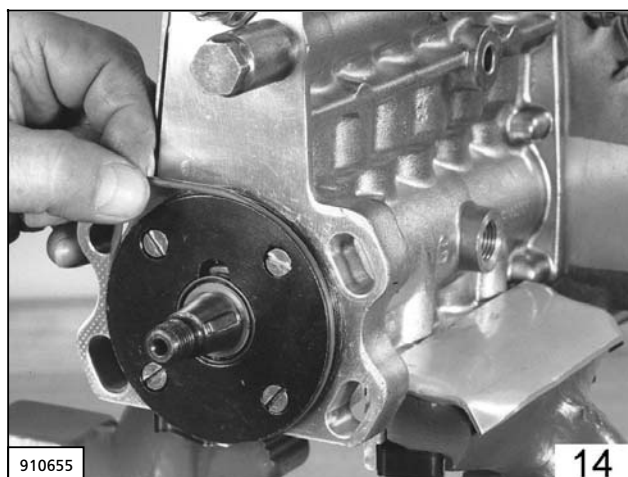
Installation:

Place the injection pump in vise, pull the gear shaft over the Woodruff key onto the drive shaft. Install lock washer and nut. Hold gear shaft with retaining tool and tighten the nut.

For tightening torque, see Technical Data.

Important:

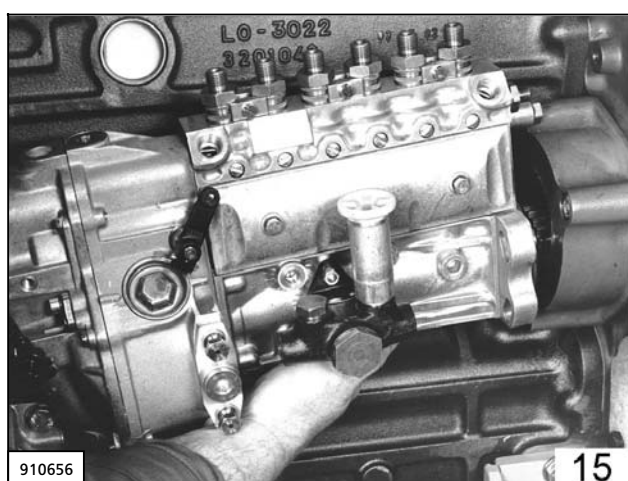
Before installing the gear shaft, check if the lubrication oil return line is installed properly on the injection pump. The cutout must point to the top. See fig. 13.



Lubricate O-ring and install it on mounting flange on injection pump.

Note:

When installing an injection pump support bracket, see fig. 12, install the support bracket to the injection pump first.



Place the injection pump to the pump carrier on pump drive assembly. Line up splined pump shaft and tension pin with the matching bore in the pump drive hub. Slide the pump shaft into the coupling and the pump flange completely into pump carrier. Install and torque screws.

Note:

Before tightening the mounting screws, connect the lubrication line and the fuel line to the solenoid valve to the injection pump. This way the proper installation position of the injection pump is assured.

When installing an injection pump support bracket, see fig. 6, tighten screws 1 on the crankcase housing first, then tighten screw 2.

Install injection lines, lube oil line, fuel line to solenoid valve, fuel return line to tank, leak oil return line, fuel line from fuel filter and fuel lines on pump, using new seals.

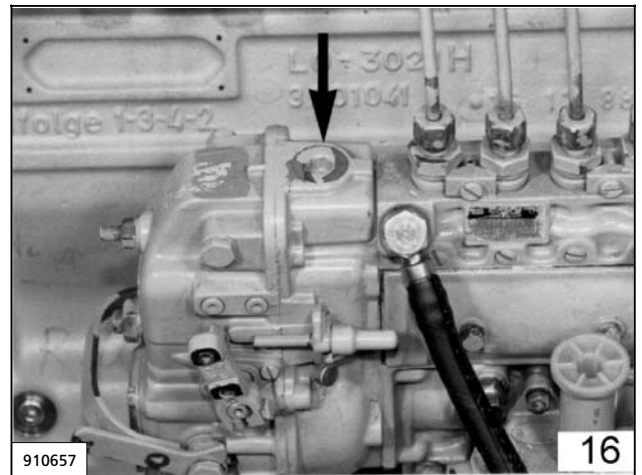
Connect the LDA line, throttle control and shut off device.

Check fuel delivery begin, see sub group 2.19.

Bleed fuel system, see sub group 7.22.

Important:

Before putting the new injection pump in service, add approx. 1 l engine oil, see fig 16 into regulator housing.



Fuel Injection Pump Removal and Installation (pump drive integrated in timing case)

Special tool no. 15.

Removal:

Remove throttle control and shut off device.

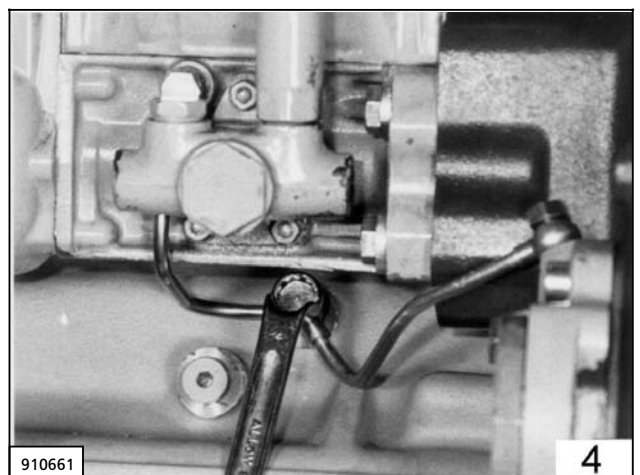
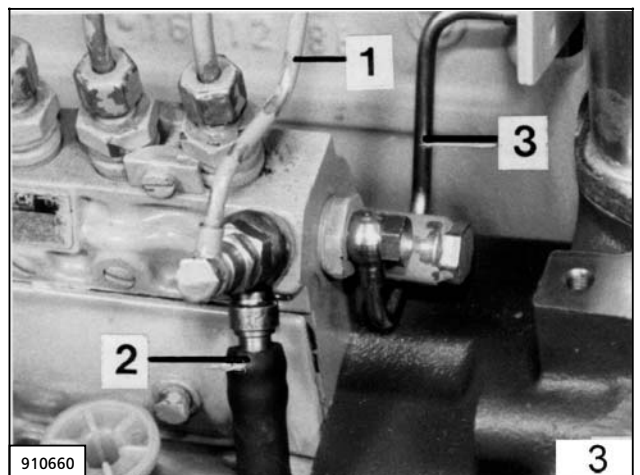
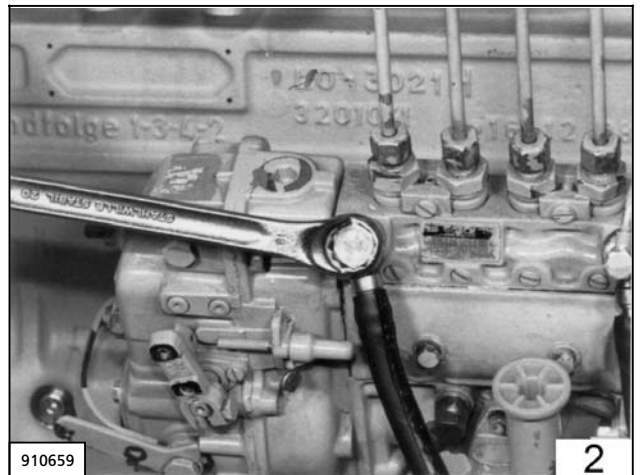
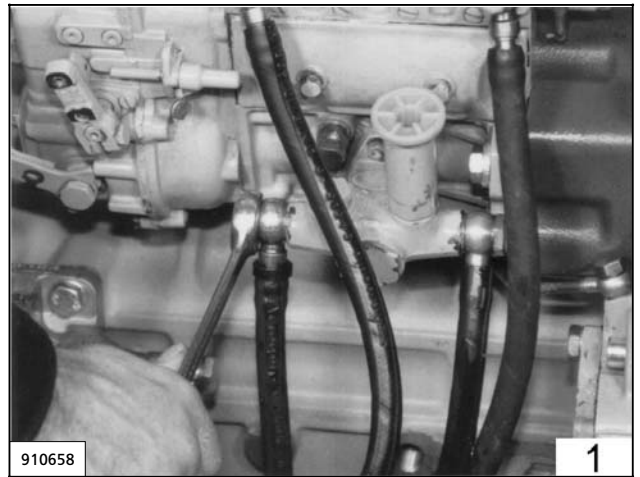
On injection pump with LDA, remove line to suction pipe, see sub group 10.20.

Remove fuel lines on fuel pump.

Remove fuel lines between fuel filter and injection pump.

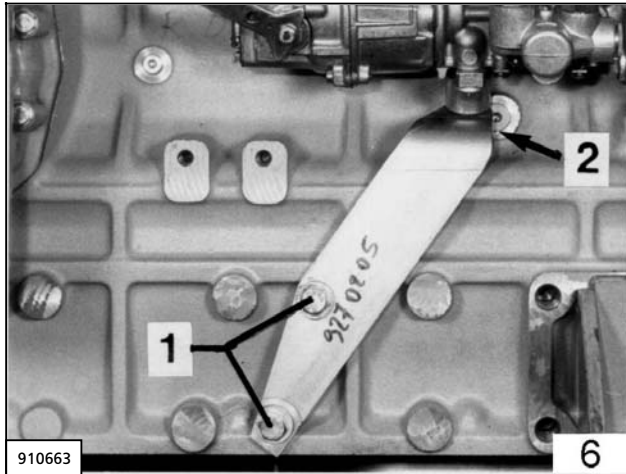
Remove leak overflow line 1 from injectors. fuel return line 2 to tank and fuel line 3 to solenoid valve.

Remove lubrication line.





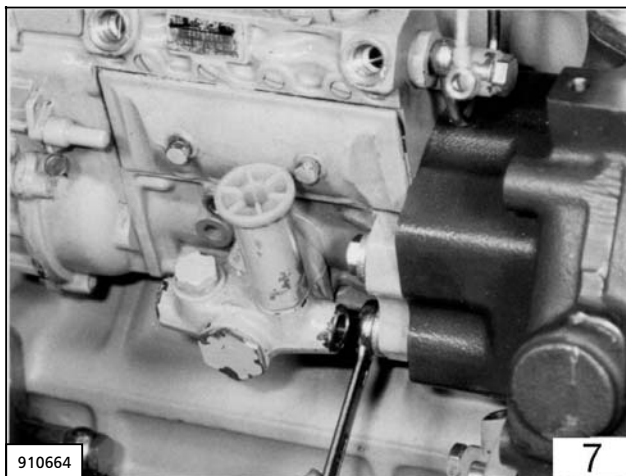
Remove fuel supply lines on injection pump and on injectors.



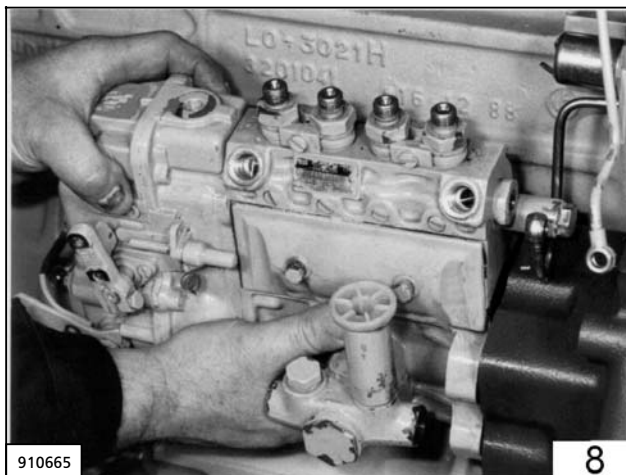
Note:

On 6 cylinder engine and MW injector pumps, the support from injection pump to crankcase must also be removed.

Loosen and remove screws 1 for the support on the crankcase housing. Remove screw 2 between bracket and retainer plate.



Remove screws on mounting, flange of injection pump.

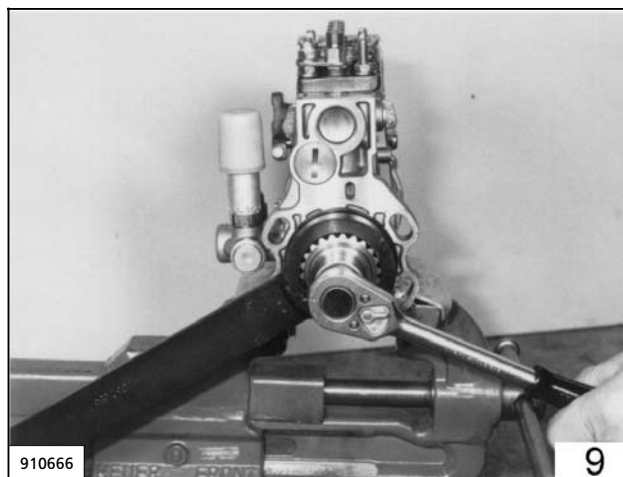


Carefully pull injection pump from pump carrier on the engine.

Note:

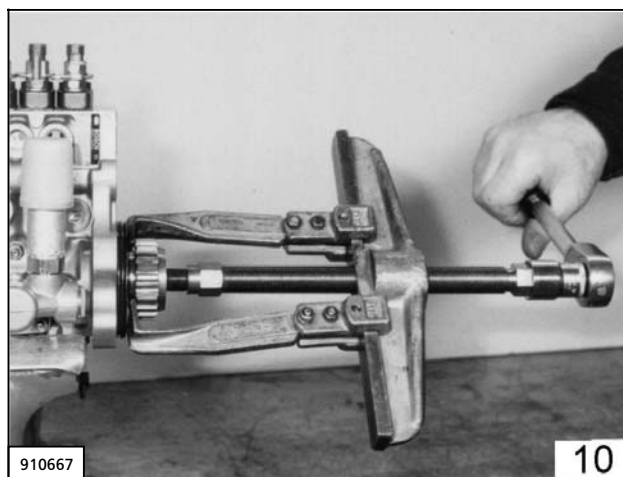
If an injection pump support is installed, see fig. 6, remove injection pump including support.

Place the injection pump in vise. To avoid damage, use protective jaw covers. Hold shaft in position with retainer, special tool no. 15, and remove locknut with open end wrench.



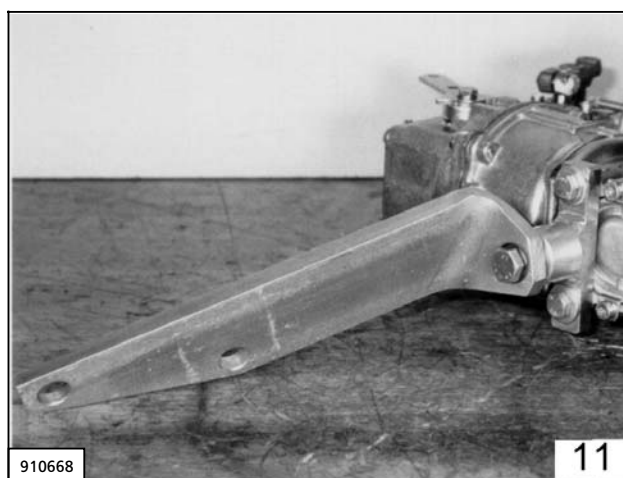
Remove retainer and pull gear shaft with commercially available puller.

Do not loose or damage Woodruff key from pump shaft!



Note:

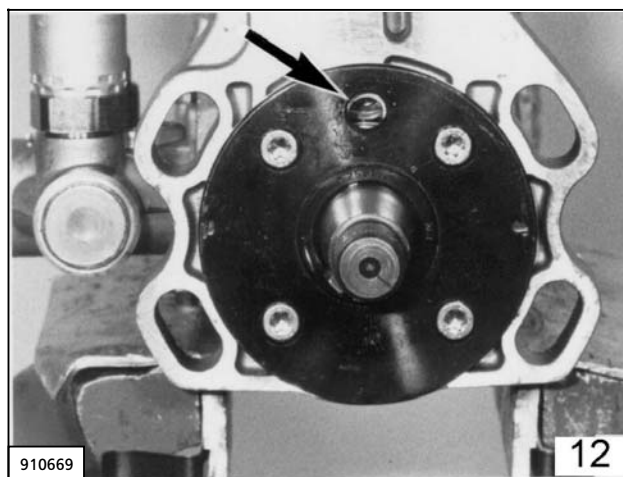
When installing the injection pump support bracket, see fig. 6, remove the bracket from the injection pump.

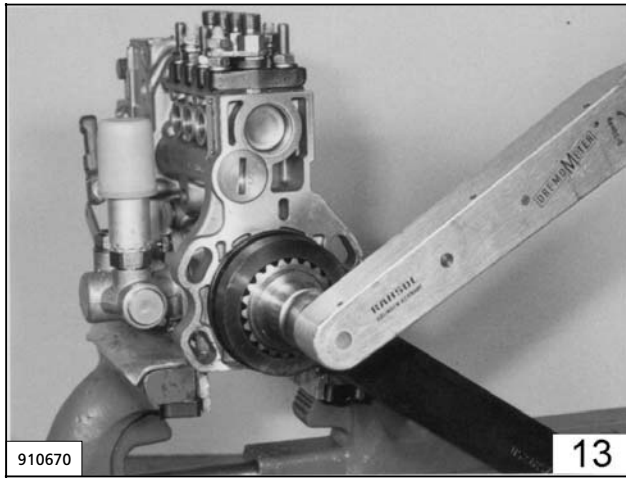


Installation:

Important:

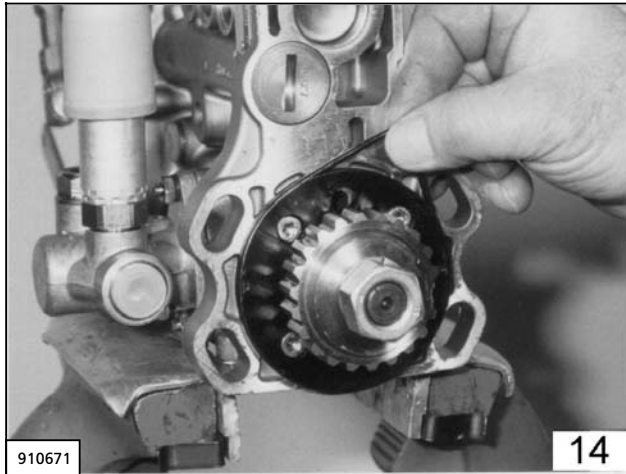
Before installing the gear shaft, check if the lubrication oil return line is installed properly on the injection pump. The cutout must point to the top.





Place the injection pump in vise, pull the gear shaft over the Woodruff key onto the drive shaft. Install lock washer and nut. Hold gear shaft with retaining tool and tighten the nut.

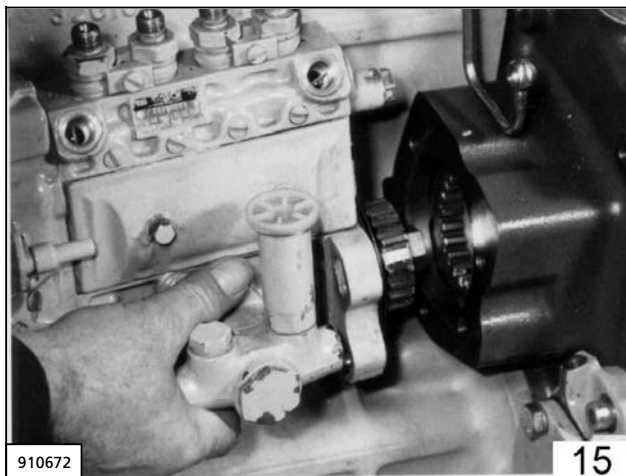
For tightening torque, see Technical Data.



Lubricate O-ring and install it on mounting flange of injection pump.

Note:

When installing an injection pump support bracket, see fig. 11, install the support bracket to the injection pump first.



Line up the injection pump to the pump shaft and tension pin with the matching cutout (missing tooth) in the pump drive hub.

Slide the pump shaft into the coupling and the pump flange completely into the pump carrier. Install and torque screws.

Note:

Before tightening the mounting screws, connect the lubrication line and the fuel line to the solenoid valve to the injection pump. This way the proper installation position of the injection pump is assured.

When installing an injection pump support bracket, see fig. 6, tighten screws 1 on the crankcase housing first, then tighten screw 2.

Install injection lines, lube oil line, fuel line to solenoid valve, fuel return line to tank, leak oil return line, fuel line from fuel filter and fuel lines on pump, using new seals.

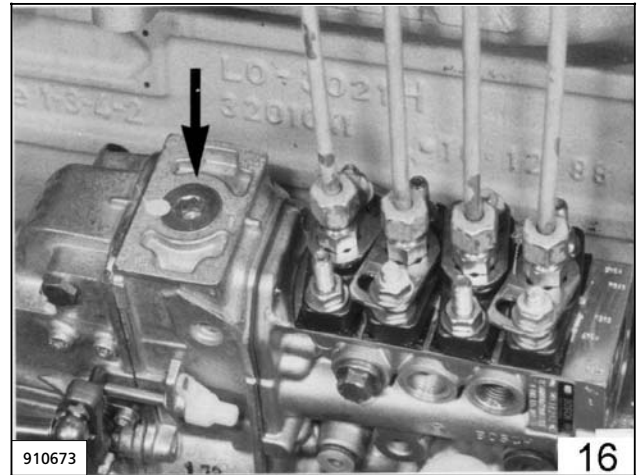
Connect the LDA line, throttle control and shut off device.

Check fuel delivery begin, see sub group 2.19.

Bleed fuel system, see sub-group 7.22.

Important:

Before putting the new injection pump in service, add approx. 1 l engine oil into regulator housing, see fig. 16.



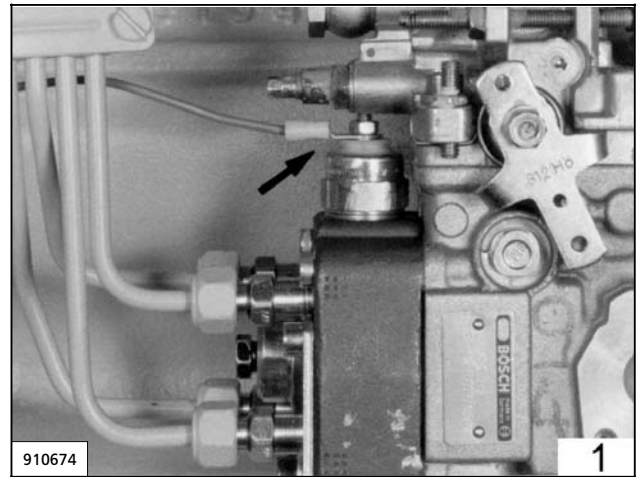
Removal and Installation of the Distributor Injection Pump (VE)

Special tool no. 15, 27

Removal:

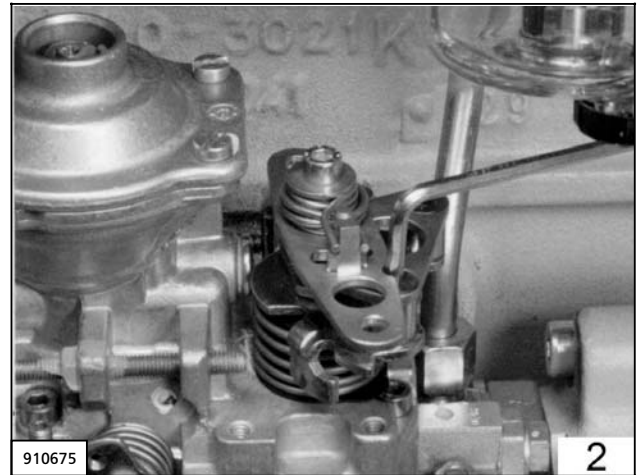
Remove fuel lift pump, see sub group 7.20

Remove electric wire on shut off solenoid.



Remove RPM control from the alternate lever.

Remove alternate lever from the RPM control lever.



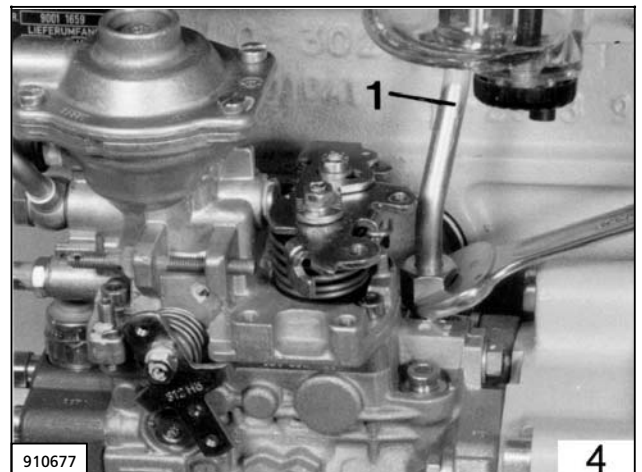
Remove injection lines from the injection pump and injection valves.

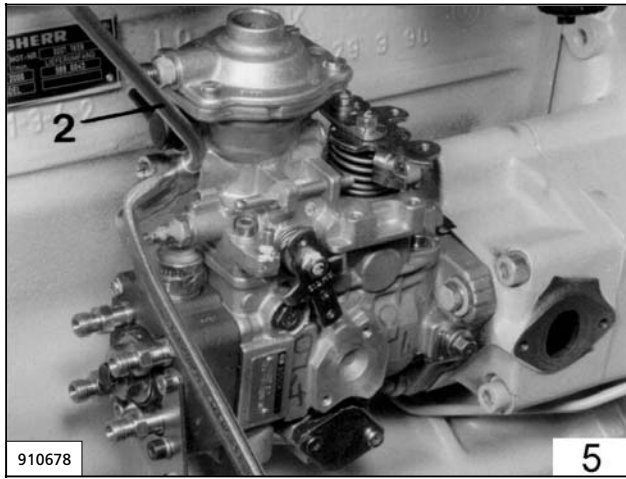
Remove LDA - Lines from LDA (=Load Depending Stop) and suction line (see sub group 10.20).

Remove injection- and LDA-lines.

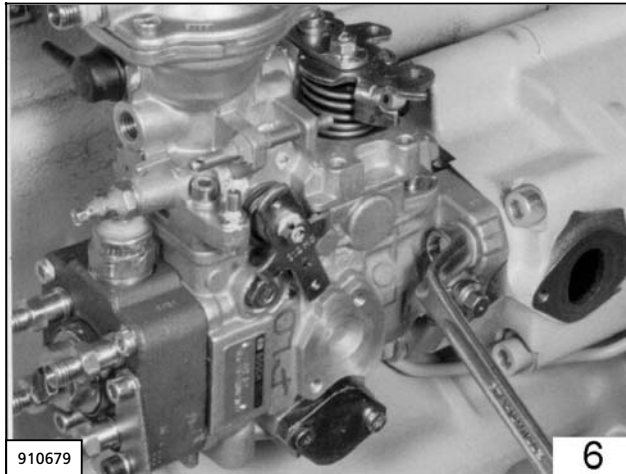


Remove fuel line 1 from the fine filter to the injection pump.

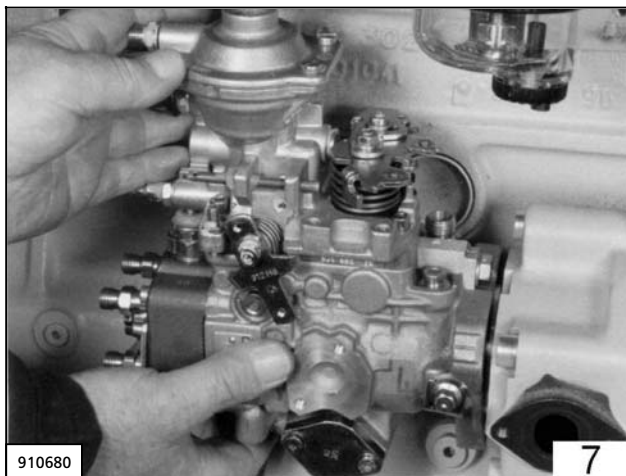




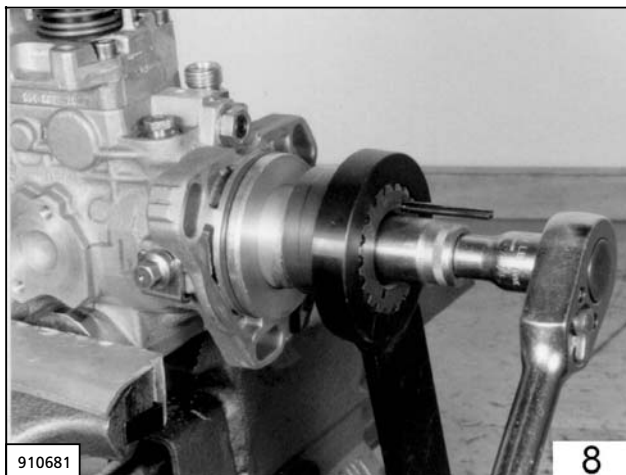
Remove fuel return line 2 to the tank together with the leak oil return line from the injection nozzles.



Untie mounting flange screws of the injection pump and remove.



Pull injection pump out of the pump carrier.



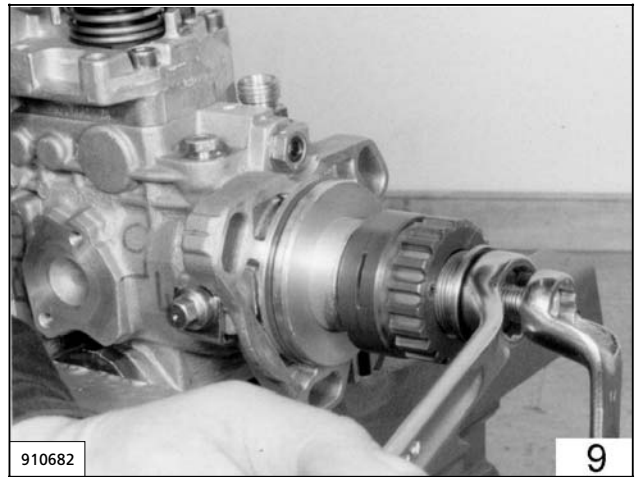
Put injection pump into an vice with protecting jaws.

Hold tight toothed shaft with holding device, special tool no. 15, untie nut and remove.

Remove holding device, screw puller, special tool no. 27, into shaft and pull drive shaft out.

Note:

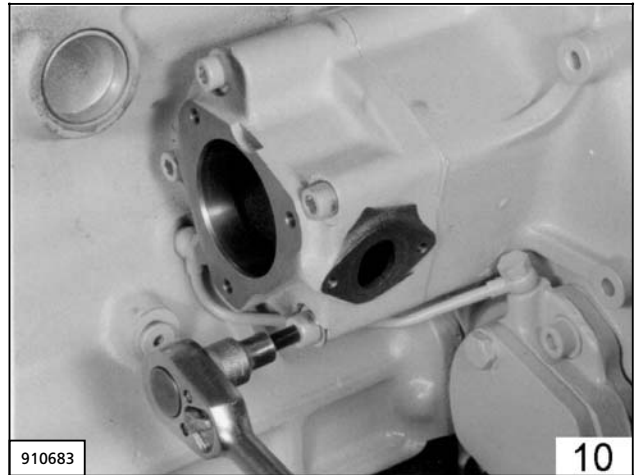
Observe the woodruff key in the drive shaft.



Remove Pump Carrier:

Untie screws on the pump carrier and remove.

Take off pump carrier from the component carrier.

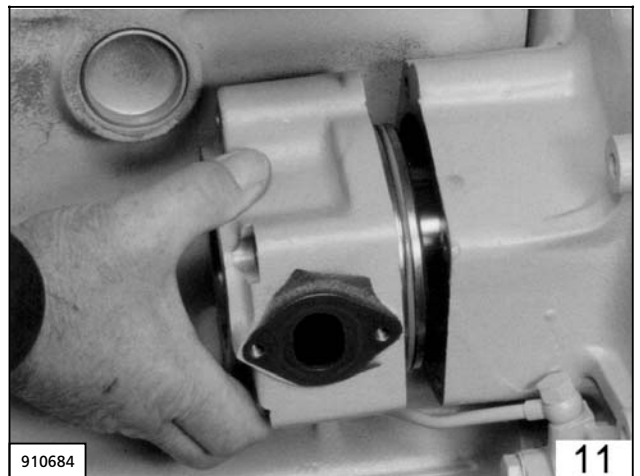


Installation:

Installation the Pump Carrier:

Use new O-ring and lubricate.

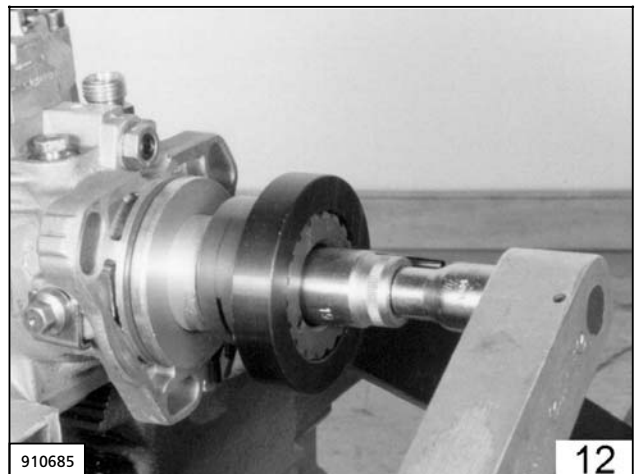
Insert pump carrier into component carrier, install screws and tighten.

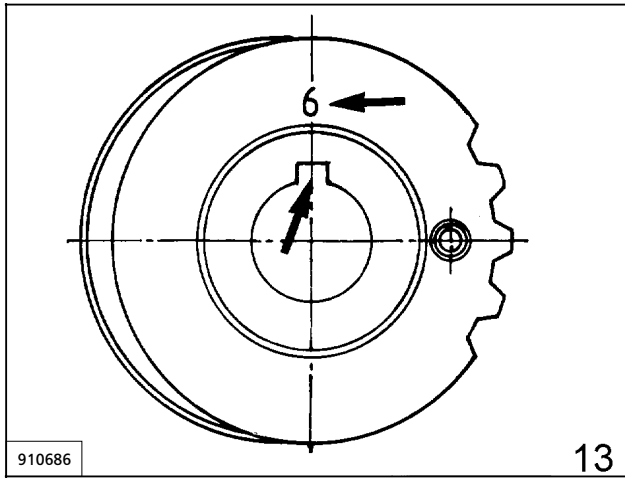


Clamp injection pump, slide toothed shaft over the woodruff key onto the drive shaft.
Mount spring ring and nut.

Hold toothed shaft tight with the holding device, special tool no. 15 and tighten nut.

See Technical Data for tightening torque.





Important:

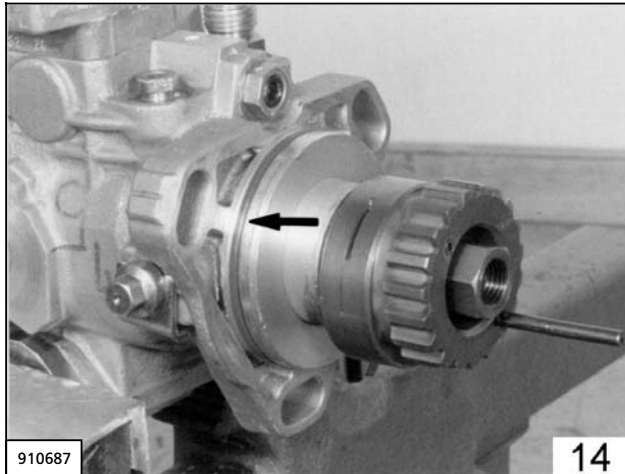
Toothed shaft for 4 resp. 6 cylinder engines are different.

They are marked on the front side, see picture 13.

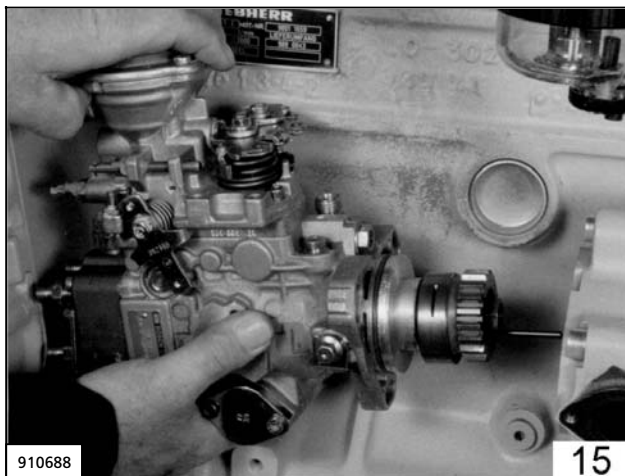
Marking 4 = 4 cylinder engine

Marking 6 = 6 cylinder engine

The marking has to correspond with the slot for the woodruff key in the toothed shaft.

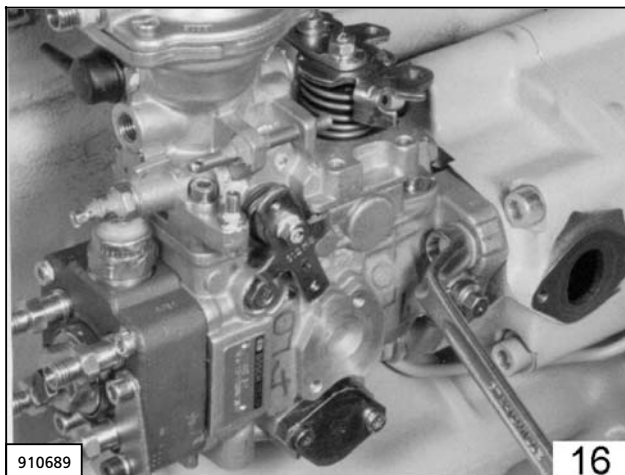


Install new O-ring in the flange for the injection pump and lubricate.



Insert the injection pump with the toothed shaft into the drive hub so that the tension pin in the toothed shaft corresponds with the bore in the drive hub.

Push injection pump into pump carrier.



Install screws on the flange and tighten.

Install injection lines with LDA lines on the injection pump and nozzles resp. LDA and suction pipe.

Important:

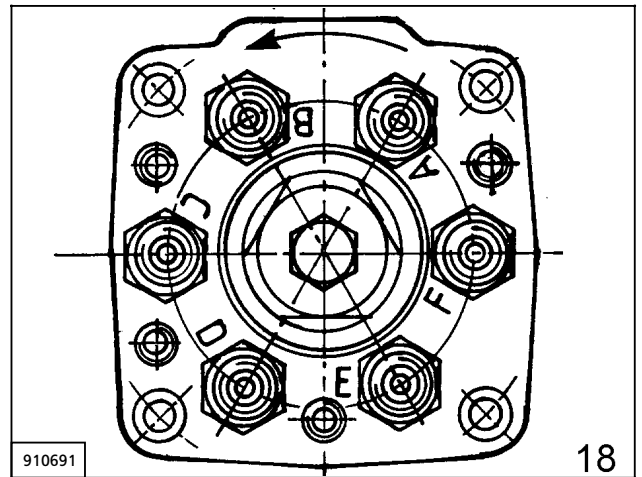
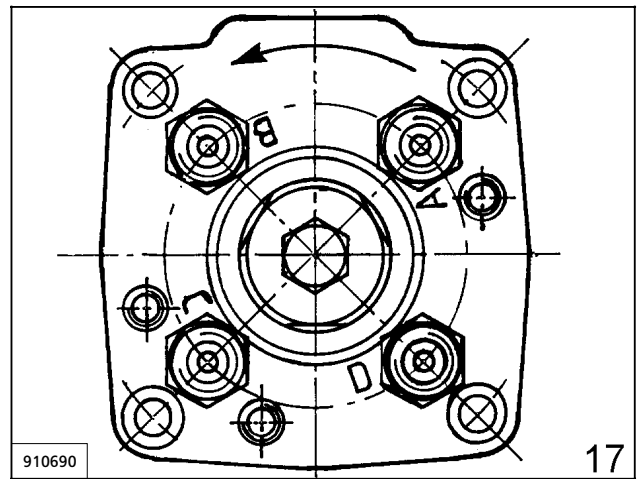
The connections for the injection lines are marked on the distributor head of the injection pump with letters according to the firing order.

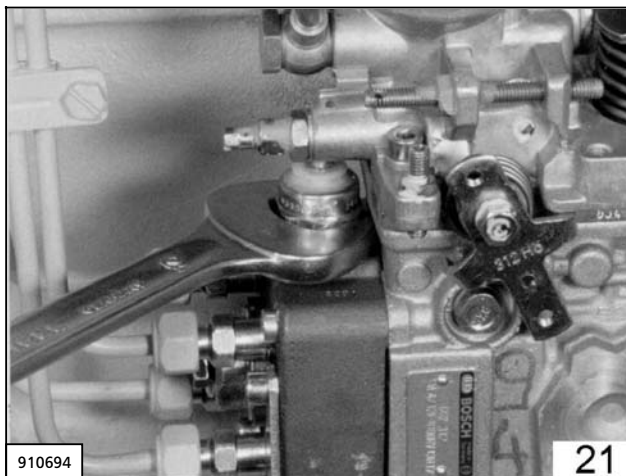
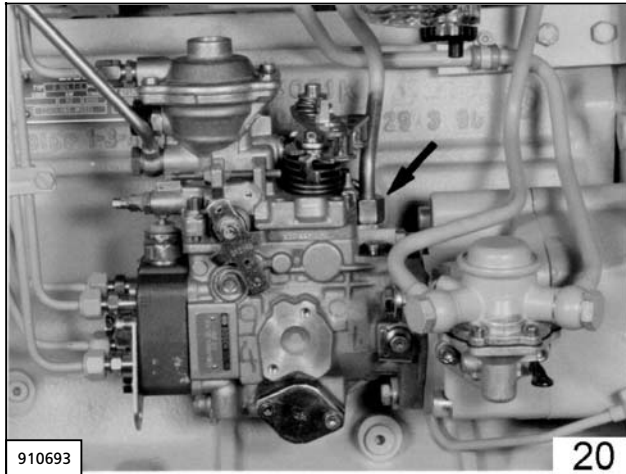
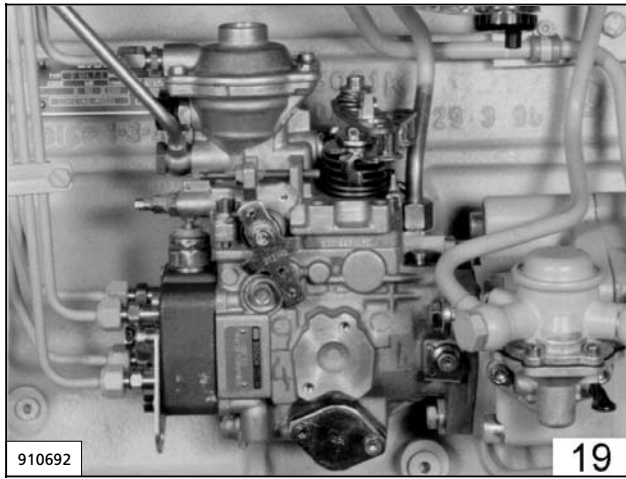
4 cylinder engine: see picture 17.

Letter	Cylinder-No.
C	1
D	3
A	4
B	2

6 Cylinder - engine: see picture 18

Letter	Cylinder-No.
C	1
D	5
E	3
F	6
A	2
B	4





Using new gasket rings install fuel return lines, leak oil line of the injection nozzles, fuel line from the fine filter.

Install alternate lever and RPM control.

Install fuel lift pump, see sub group 7.20.

Connect electric wire to the stop solenoid.

Check DB = delivery begin respectively adjust, see sub group 2.19.08, 2.19.25.

Vent fuel system, see sub group 7.23.

Important:

Before operating a new injection pump, fill 1/4 Liter (1quart) of diesel fuel into the fuel line after the fine filter, see page 20.

Removal and Installation of Stop Solenoid

Note:

If current is supplied, the stop solenoid is pulled and keeps the fuel supply bore to the high pressure chamber of the injection pump open. If current is cut off, the magnetic field will collapse and the sealing cone closes the fuel supply bore to the high pressure chamber.

The engine will stop.

Remove electric wire from the stop solenoid.

Remove stop solenoid from the injection pump.

Fit new O-ring to the stop solenoid, lubricate lightly and mount stop solenoid into the injection pump and tighten.

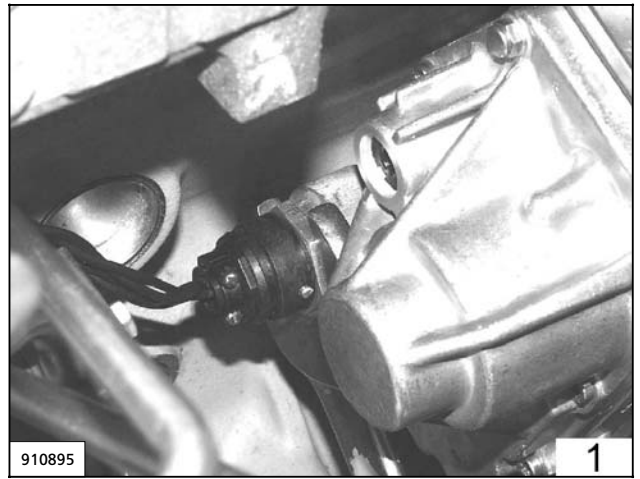
Connect electrical wire.

Removing and Installing Injection Pumps with "EDC" (Electronic Diesel Control)

Special Tool no. 15, 29.

Removal:

Remove mounting screws from the electric plug on the pump regulator (EDC).



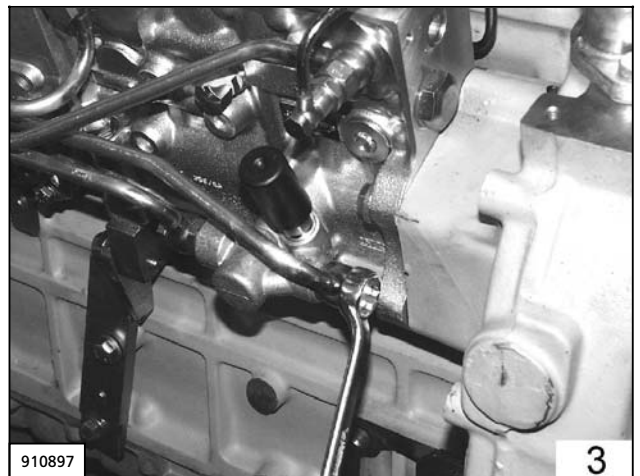
Remove plug from the injecton pump regulator (EDC).

Note:

Injection pump has to be without current, switch off ignition.

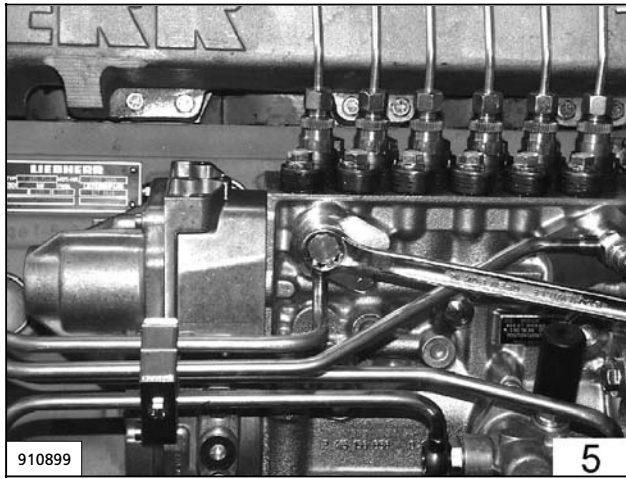


Remove fuel line from the fuel tank to the lift pump.

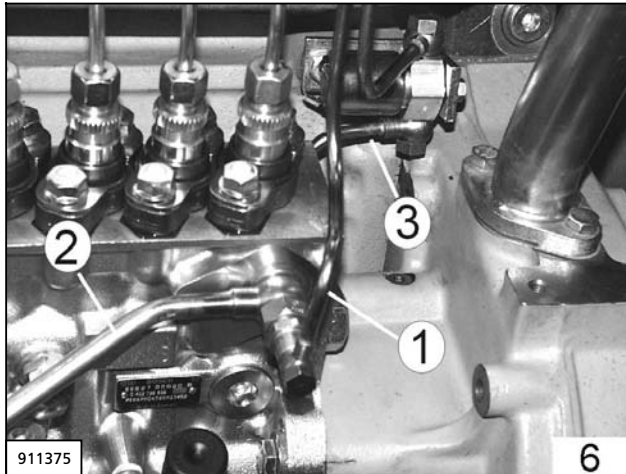


Remove fuel line lift pump / fuel filter from the lift pump.

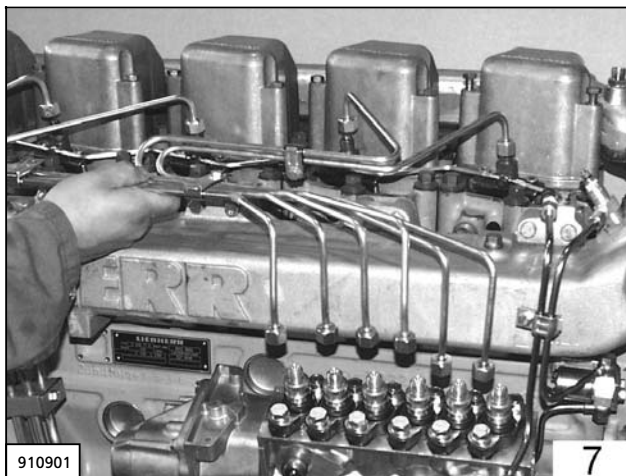




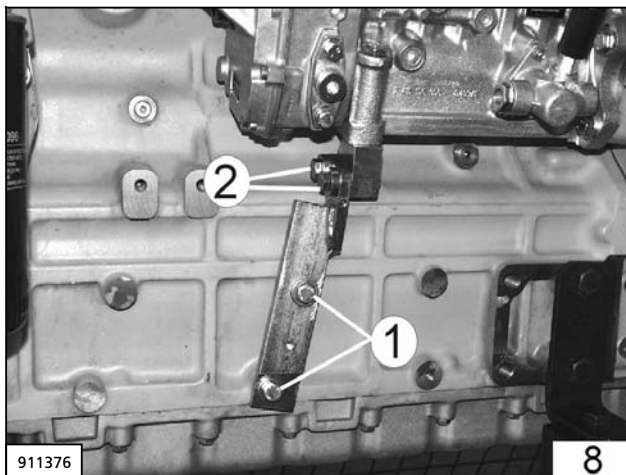
Remove fuel line fuel filter / injection pump from the injection pump.



Remove leak oil return line 1 from the injection valves, fuel return line 2 to the tank and fuel line 3 to the solenoid valve on the injection pump.



Remove fuel lines from the injection pump and valves.

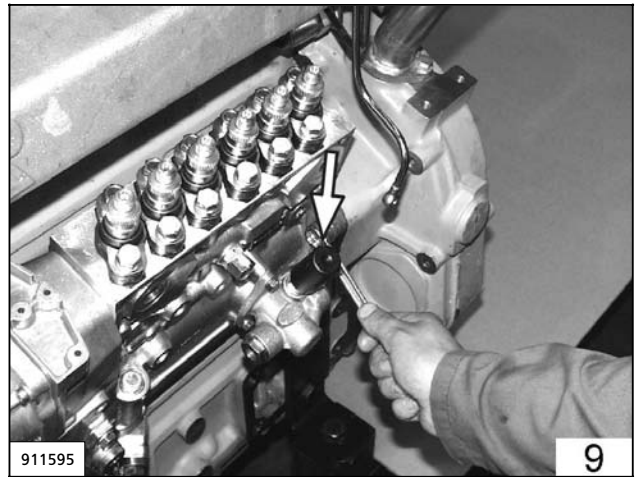


Note:

On 6 cylinder engines the support of the injection pump to the crankcase must be removed as well.

Remove screws 1 of the support on the crankcase, untie screws 2 between bracket and support.

Untie and remove screws from the flange on the injection pump.



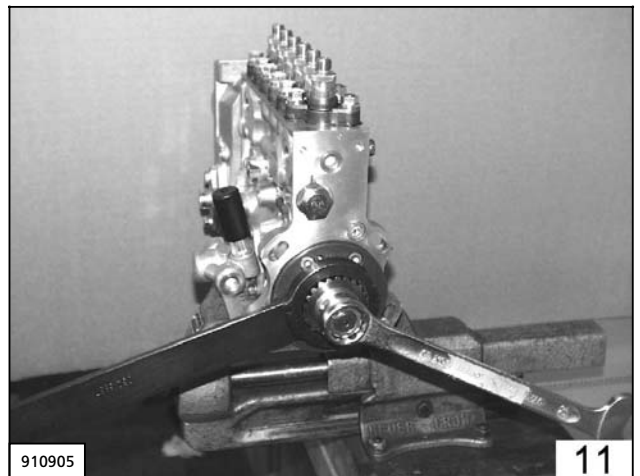
Remove injection pump from the component carrier.

Notice:

Remove injection pump support with the injection pump if installed, see picture 8.



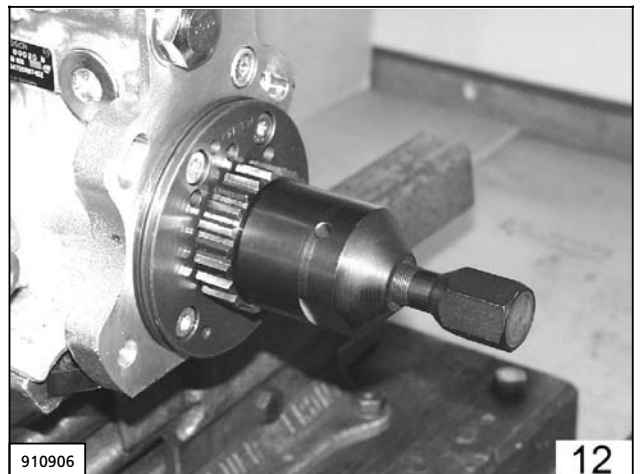
Put injection pump into a vice with protecting jaws. Hold tight toothed shaft with holding device, special tool No. 15. Untie nut and remove.

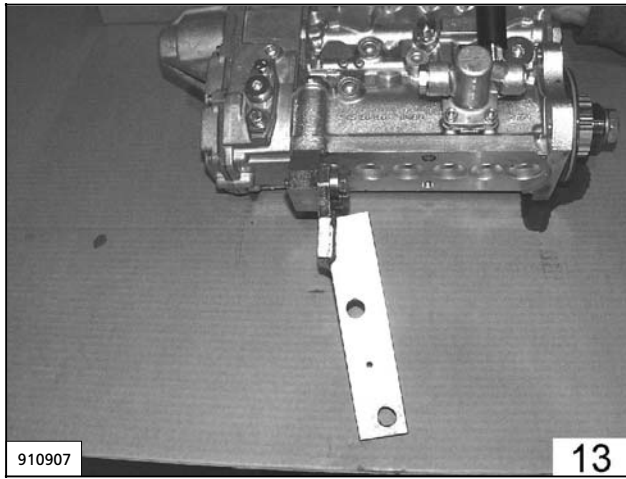


Remove holding device, screw puller, special tool No. 29 into toothed shaft and pull toothed shaft from the drive shaft.

Notice:

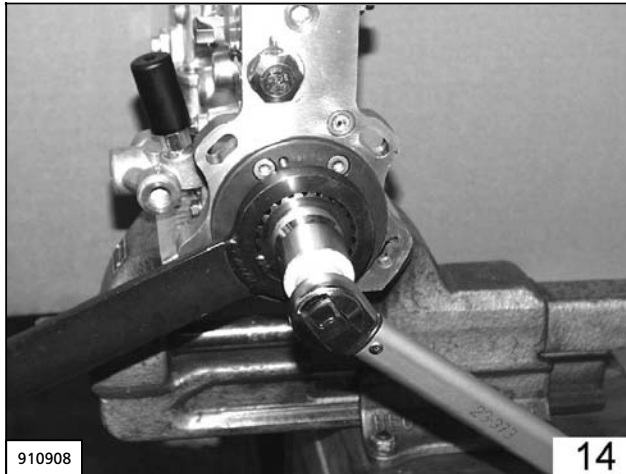
Observe the woodruff key in the drive shaft!





Notice:

If a pump support is installed remove from the injection pump, see picture 8.

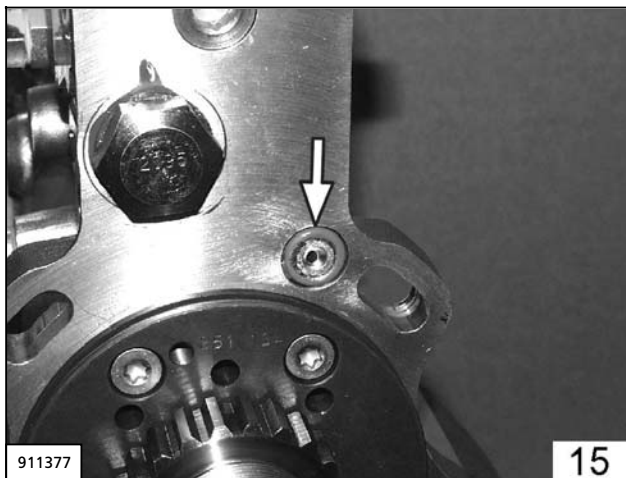


Installation:

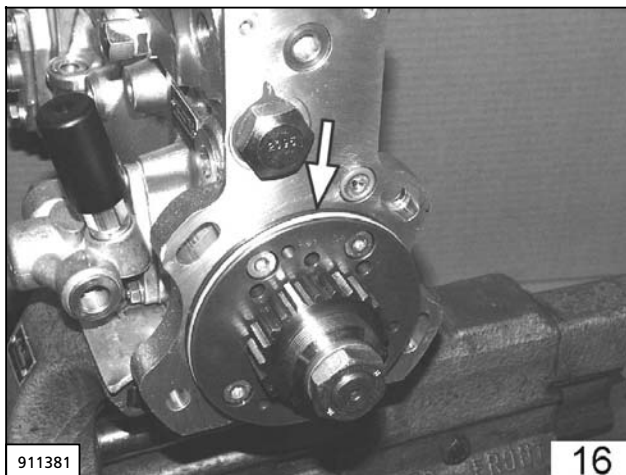
Clamp injection pump, slide toothed shaft over the woodruff key onto the drive shaft, install spring ring and nut.

Hold toothed shaft tight with the holding device, special tool No. 15 and tighten nut.

See technical data for tightening torque.



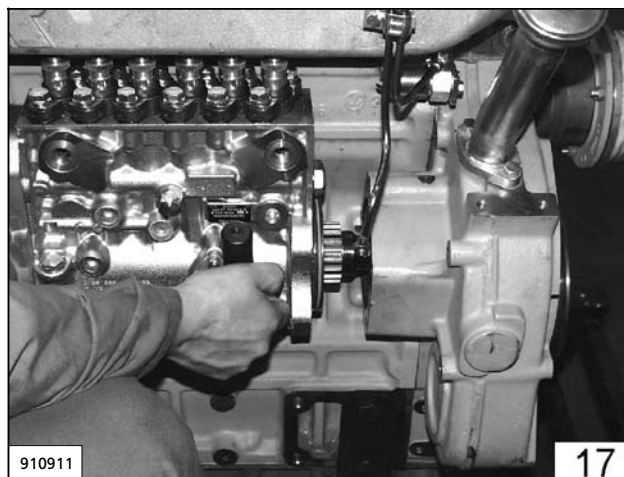
Using grease install new o-ring into groove of injection pump for the lube oil entrance to the injection pump.



Install and lubricate new o-ring on the injection pump flange.

Install the injection pump with the toothed shaft into the drive hub so that the notch in the toothed shaft (missing tooth) and the tooth gap closed by a tension pin in the hub align.

Install injection pump into the component carrier.



Screw in and tighten mounting screws.

Note:

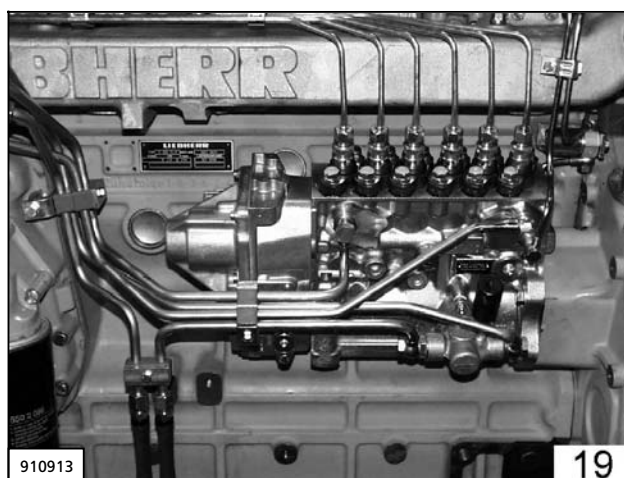
If a pump support is installed, see picture 8, install and tighten screws 1 on the crankcase and the tighten screws 2.



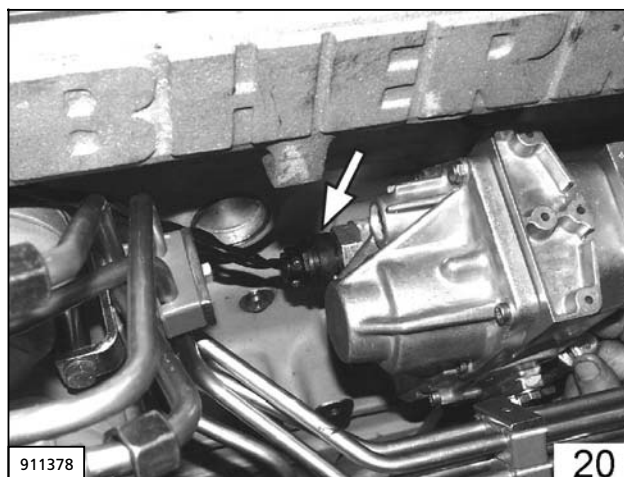
Install fuel injection lines, fuel lines to the solenoid valve, fuel return lines to the tank, leak oil return line, fuel lines from the fuel filter and fuel lines on the fuel lift pump using new gasket rings.

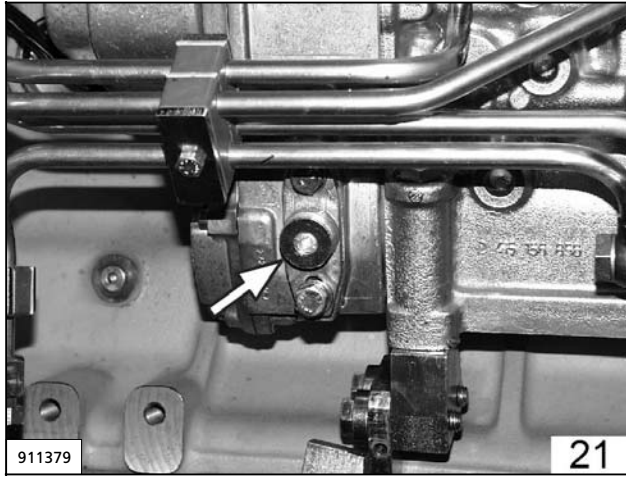
Check begin of delivery and adjust, see sub group 2.19.

Bleed fuel system, see sub group 7.22



Install electric plug and tighten screws.

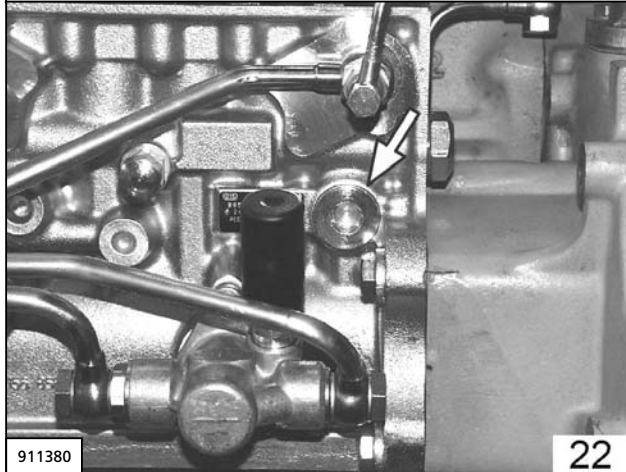




Important:

Before operating a new injection pump, fill up with engine oil.

"EDC"-regulator: fill in approximately 0.1 liters engine oil. Fill in position see picture 21.



Injection pump: fill in approximately 0.4 liters engine oil, fill in position see picture 22.

Fuel Injection Pump Drive Removal and Installation

(without timing device)

Use special tool no. 30.

Pump Drive Removal:

To remove fuel injection pump from pump carrier see sub group 7.01.

Loosen and remove bolts from pump drive cover on timing and accessory drive gear box.

Pull and remove cover plate from timing and accessory drive gear box.

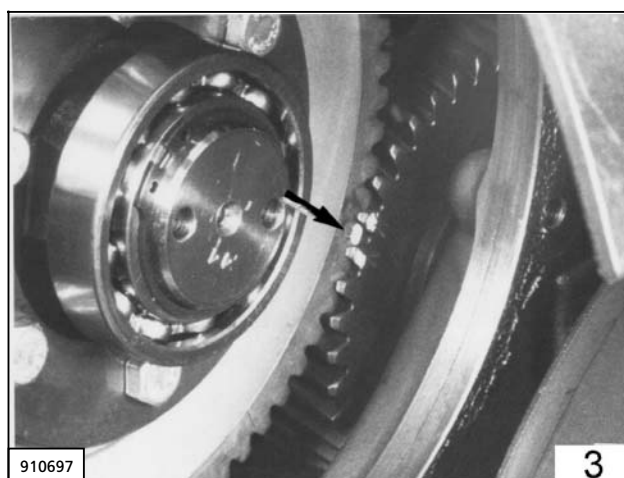
Install hand-crank, special tool no. 30, on flywheel housing at the inspection window.



Rotate engine crankshaft with hand-crank until marked gear wheel tooth of the injection pump drive is positioned between the two marked teeth on the intermediate gear wheel in the timing and accessory drive gear box.

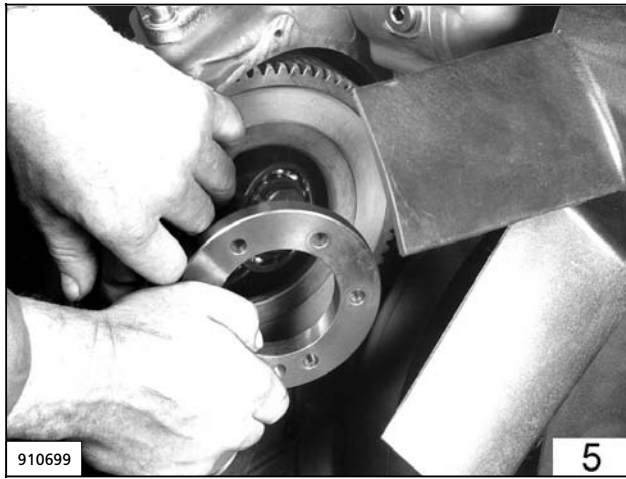
Note:

Teeth on the intermediate gear are marked with EP (injection pump) see also sub group 9.25.

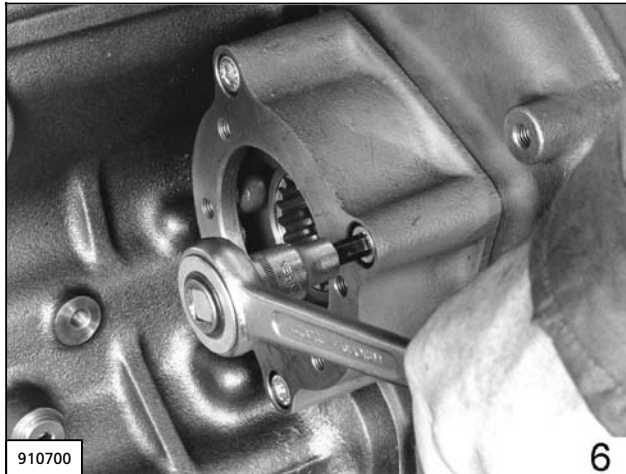


Until and remove screw from the drive of the injection pump.

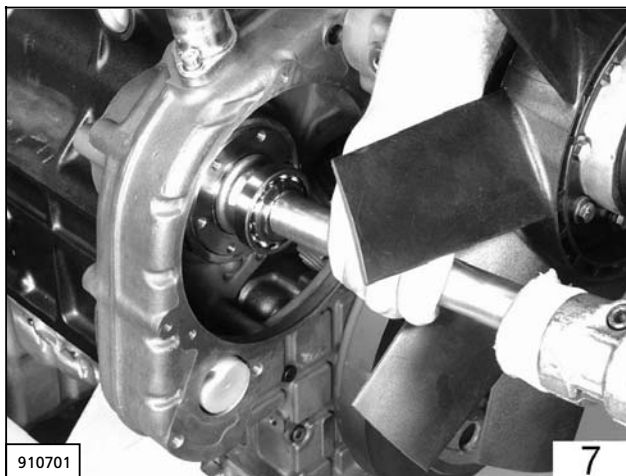




Remove clamp type retaining ring and gear wheel from timing and accessory drive gear box.



Loosen and remove pump carrier mounting bolts.



Using a soft-metal punch cautiously knock injection pump drive out of timing gear box until the O-rings on pump carrier are exposed. Completely remove pump drive assembly from timing and accessory gear box.



Pump Drive Installation:

Replace and lubricate O-rings on pump carrier with engine oil.

Place injection pump carrier and drive assembly into timing and necessary drive gear box.

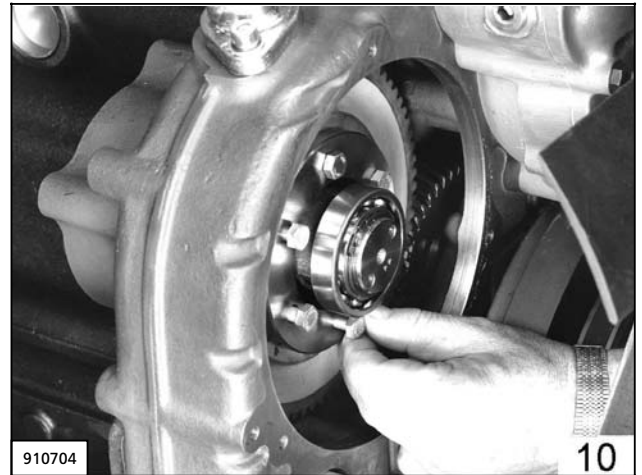
Screw in and torque pump carrier mounting bolts.



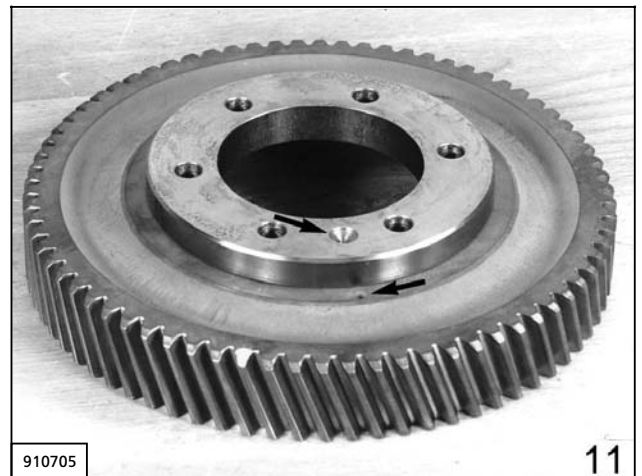
Place pump drive gear wheel into assembly. Ensure that marked gear tooth is positioned between the two marked intermediate gear wheel teeth. Place clamp type retaining ring on hub and screw-in retaining ring bolts.

Note:

Consider the unequal bolt spacing on retaining ring and hub.



Turn pump drive coupling by hand until mark on retaining ring and pump drive gear match. Torque pump drive mounting bolts.



Replace and lubricate cover plate O-ring with engine-oil.

Push pump drive cover plate into its place on timing and necessary drive gear box, screw in and torque cover mounting bolts.



Fuel injection pump drive removal and installation, inspection and repair (Injection pump drive integrated in the timing gear cover)

Use special tool No. 30, 80

Removal:

Remove injection pump, see sub group 7.02, 7.03

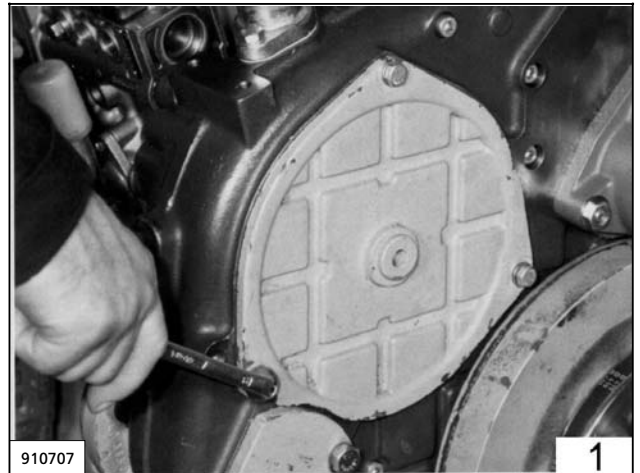
For position, see page 7.06.04

Note:

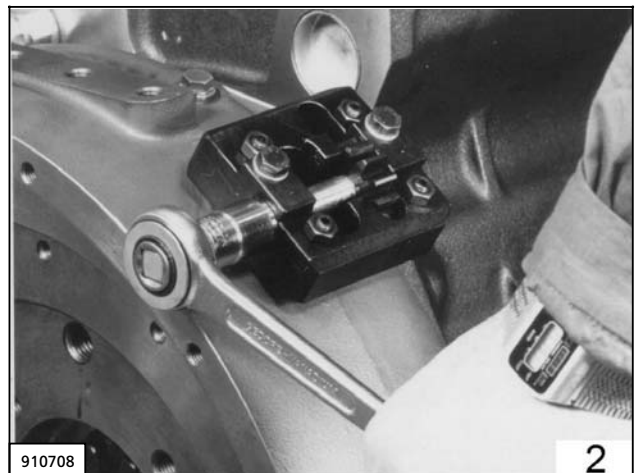
Page 7.06.04 (front side) shows drive for A, MW, P
injection pumps and distributor (VE) injection
pump on the reverse side.

Loosen and remove screws 1 on injection pump
drive cover 2 .

Push cover 2 from timing gear cover.



Install hand crank, special tool No. 30 at the
inspection window on the flywheel housing.

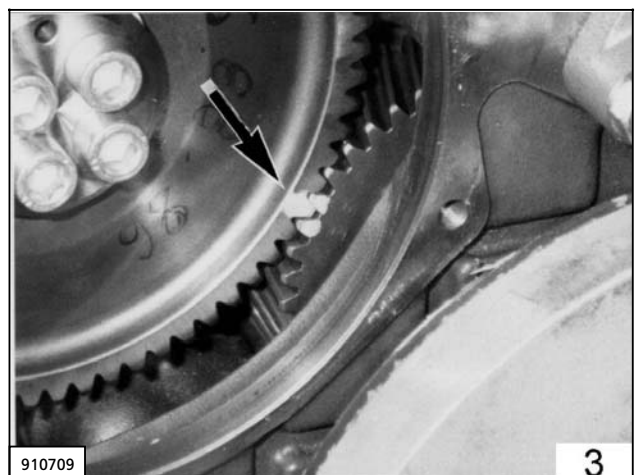


Rotate the engine crankshaft with the hand crank
until the marked tool on the gear of the injection
pump drive is positioned between the two marked
teeth on the intermediate gear .

Note:

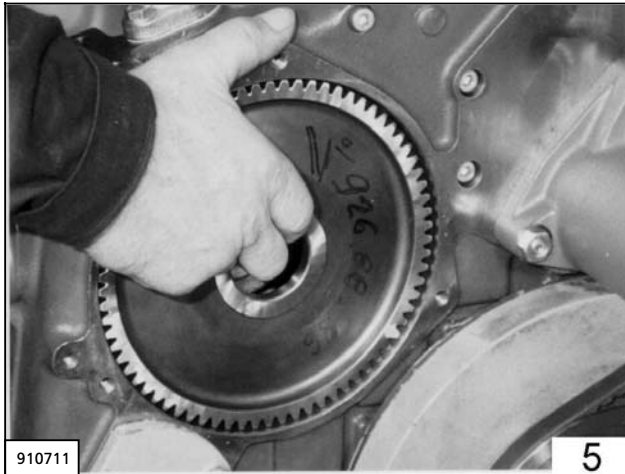
The teeth on the intermediate gear are also marked
EP (EP = Einspritzpumpe = injection pump) .

See also sub group 9.26





Loosen the screws 4 on the injection pump drive and remove them together with the retaining ring 5.



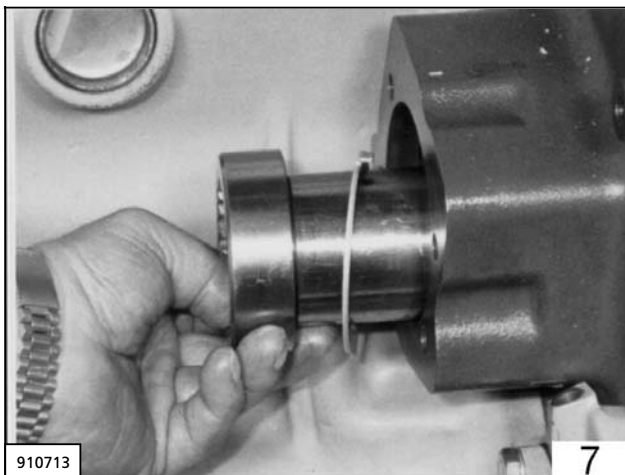
Pull the gear 3 through the opening in the timing gear cover.



Push the drive hub 6 back and remove the thrust ring 7.

Important:

Remove the thrust ring 7 carefully, make sure it does not drop into the timing gear cover.



Remove the drive hub 6 and the thrust ring 8 from the injection pump side from the timing case cover.

Clean all parts.

Note:

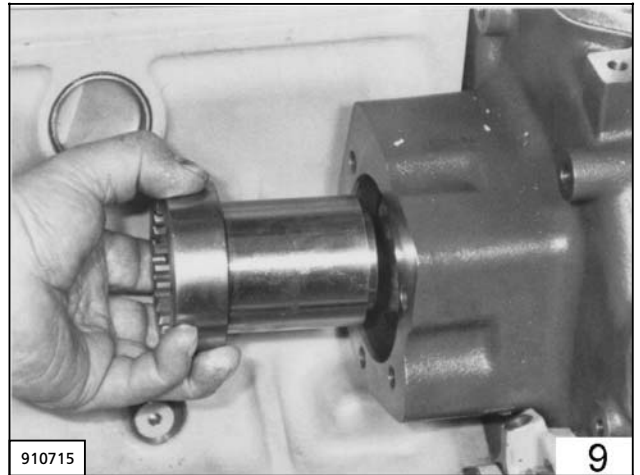
To remove the drive hub 6 on distributor (VE) injection pump drives, the pump carrier 11 must be removed, see sub group 7.03.

Installation:

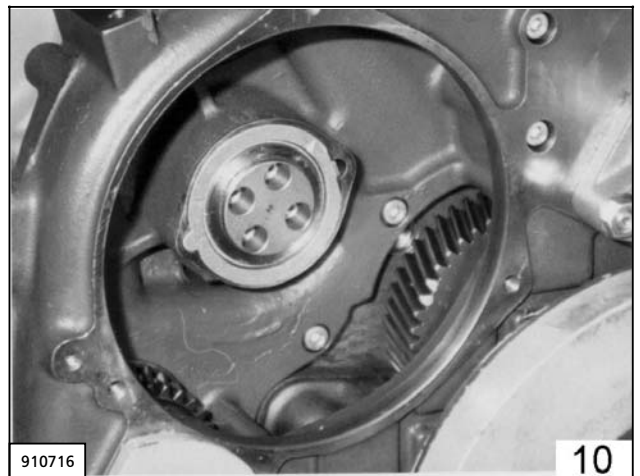
Place the thrust ring 8 into the timing gear cover, making sure to place the retainer properly.



Lubricate the drive hub 6 on the surface for the bearing bushing and thrust ring and push it into the timing gear cover.



Insert the thrust ring 7 with retainers into the timing gear cover and lightly oil the running surface.

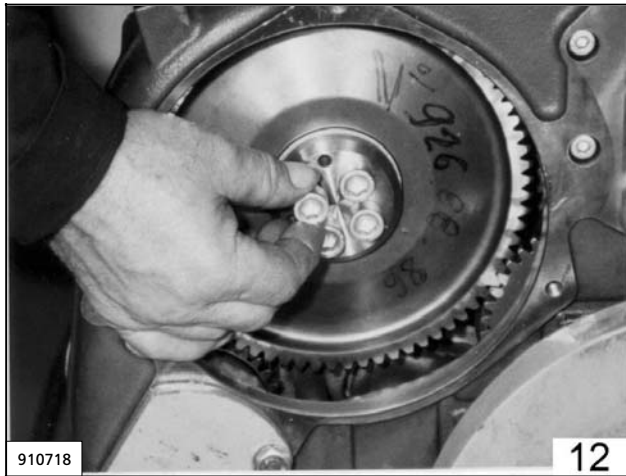


Push the gear 3 onto the drive hub 6, align with the marks on the intermediate gear .

Note:

When inserting gear 3, hold the drive hub 6 from the injection pump side so it does not turn.

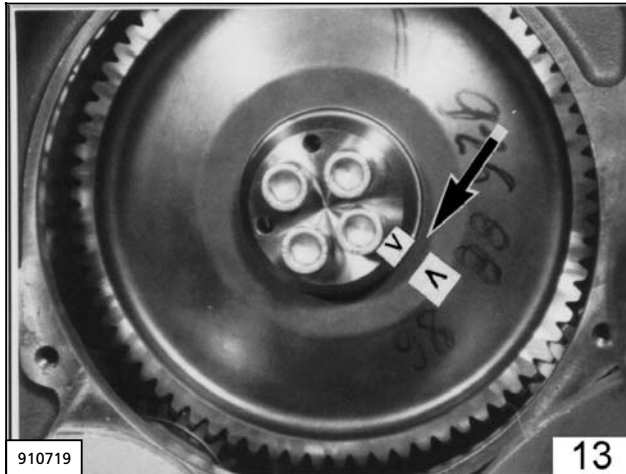




Push the retaining ring 5 into the gear 3 and insert screws 4 (do not tighten them).

Note:

Be aware of the divider between screws on retaining ring 5 and drive hub 6.



Turn the drive hub 6 until the marks on the retaining ring 5 and the gear 3 align. tighten the screws on the injection pump drive.

Tighten screws 4 on the injection pump drive .

For tightening torques, see Technical Data.

IMPORTANT:

After every installation or repair, make sure to check the axial play of the injection pump drive.

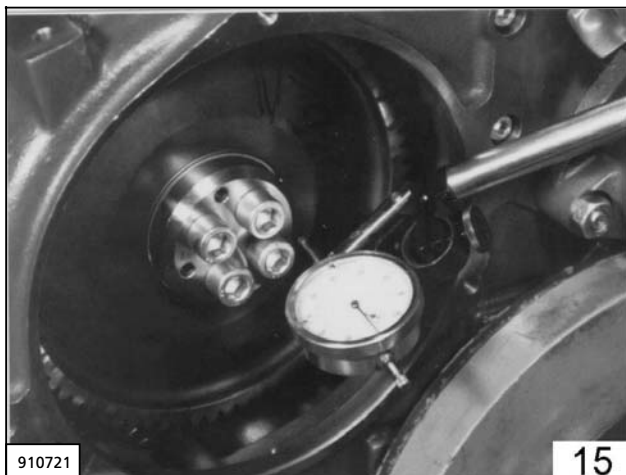
For dimensions, see Technical Data.



Lubricate a new O-ring and install on the cover 2. Push the cover into the timing gear cover, install and tighten screws 1 .

Note:

For distributor (VE) injection pump drives, install the pump carrier 11, see sub group 7.03.



Inspection and repair:

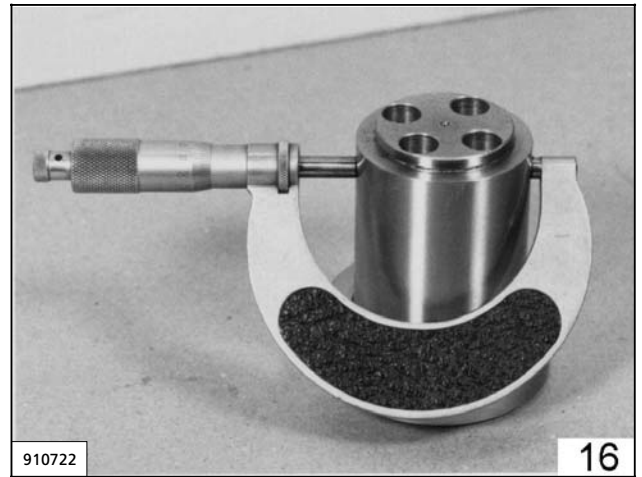
Inspection:

Check the axial play when the injection pump drive is installed.

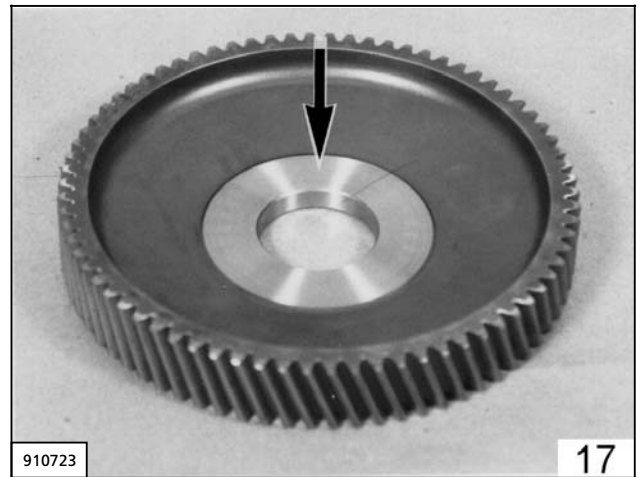
For dimensions, see Technical Data.

Remove injection pump drive, visually check the running surface on drive hub 6 for damage. Check the bearing pin diameter.

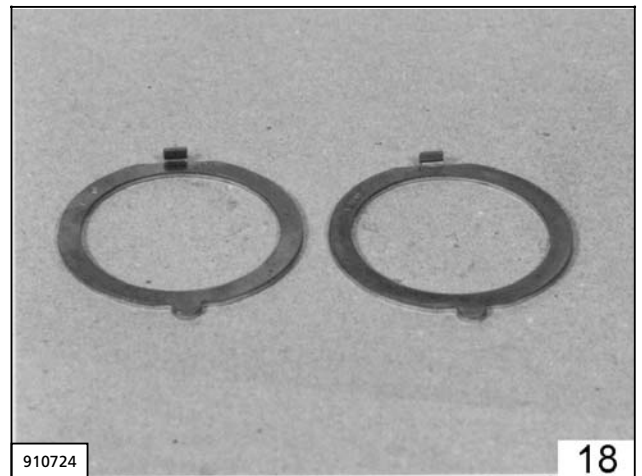
For measurements, see Technical Data.



Visually check gear 3 on the running surface of thrust ring 7 for damage.



Visually check the running surface of the thrust rings 7, 8 and the retainers for wear.

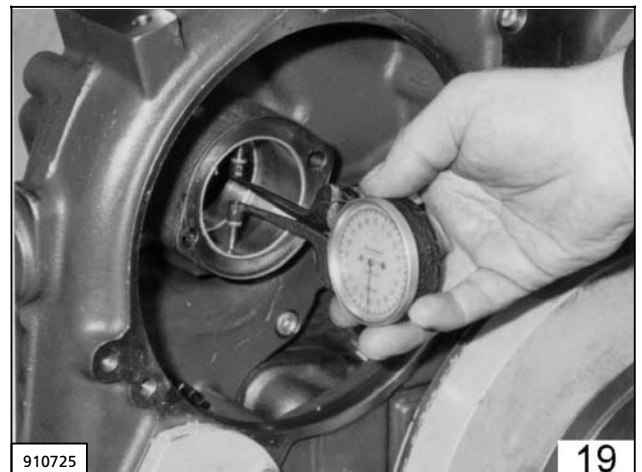


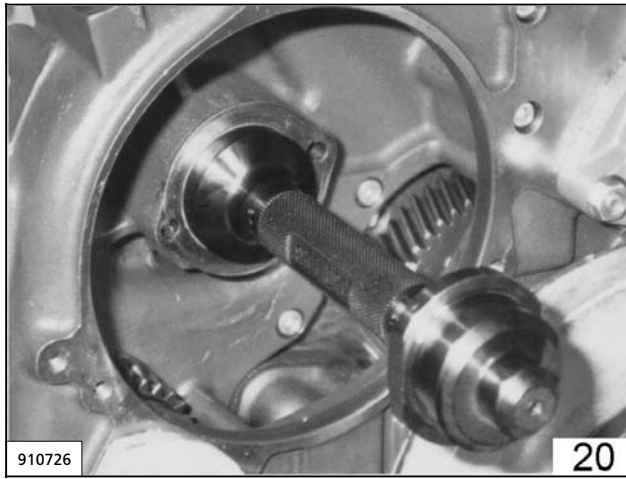
Visually check the bearing bushings 9, 10 in the timing case for damage. Measure with calipers.

Compare with measurements given on Technical Data.

Note:

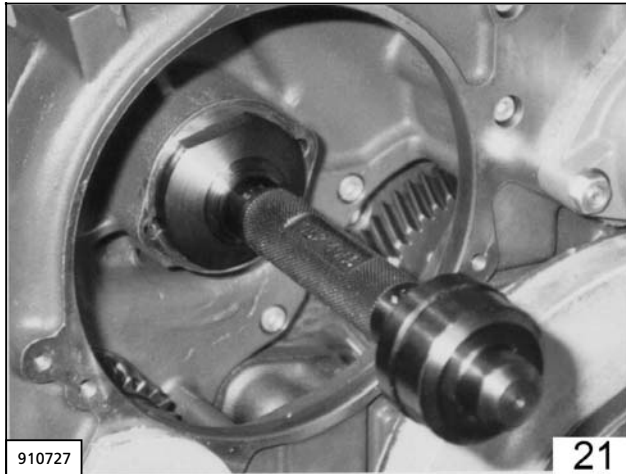
Parts which do not match these measurements or are damaged must be replaced.



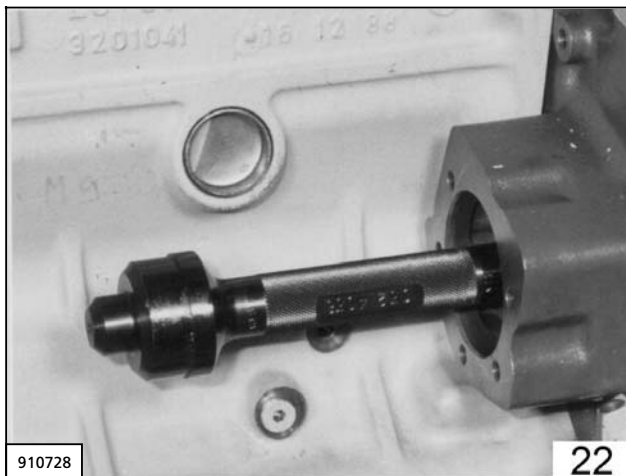


Replace Bearing Bushings in Timing Case:

Drive out the bearing bushings 9. 10 with punch, special tool no. 80 from the fan side from the timing case.



Lightly oil new bearing bushing 9 on the outside and push it with punch, special tool no. 80 from the fan side into the timing case until flush.



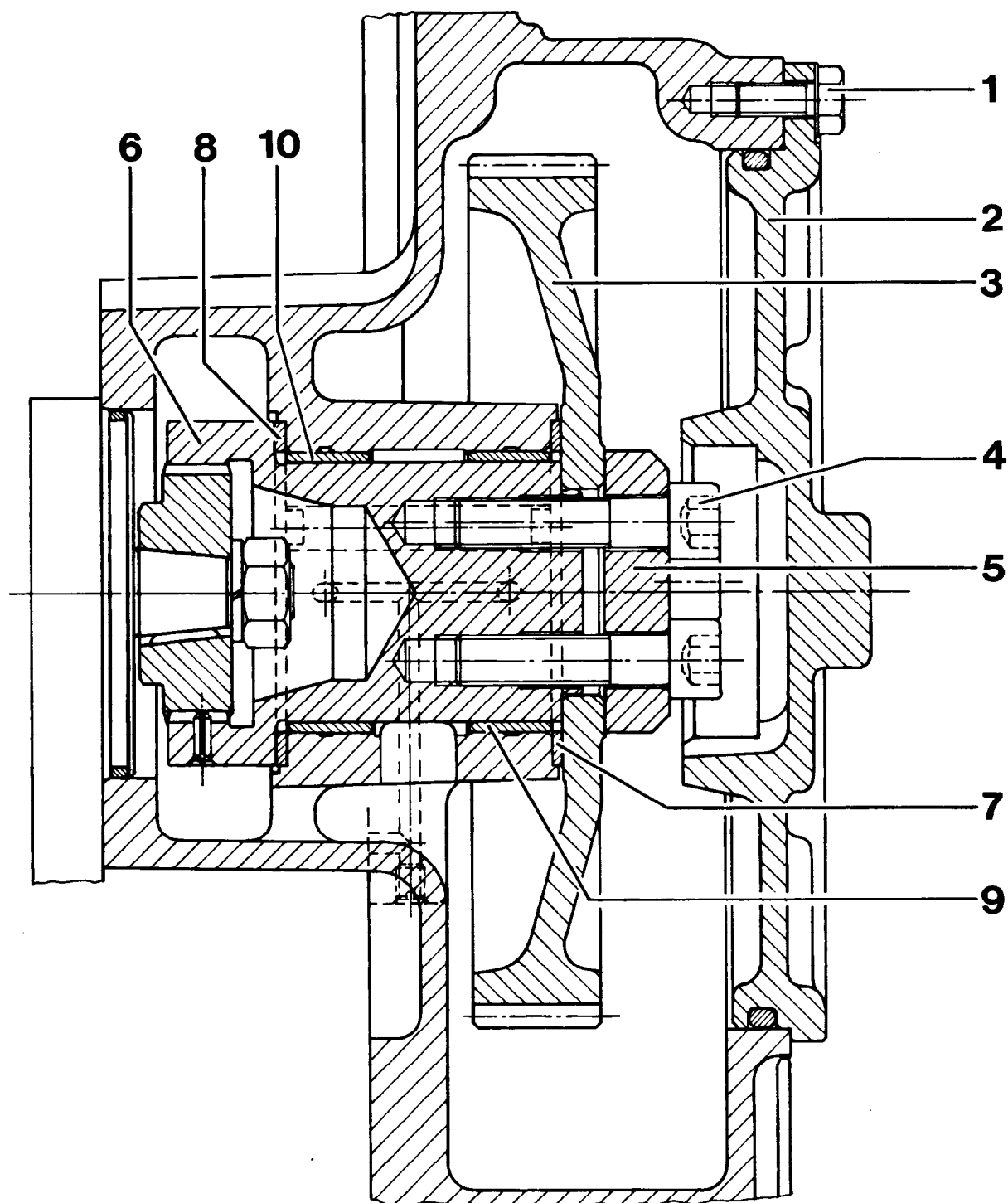
Lightly oil new bearing bushing 10 from the outside and push it from the injection pump side into the timing case with punch, special tool no. 80 until flush.

Note:

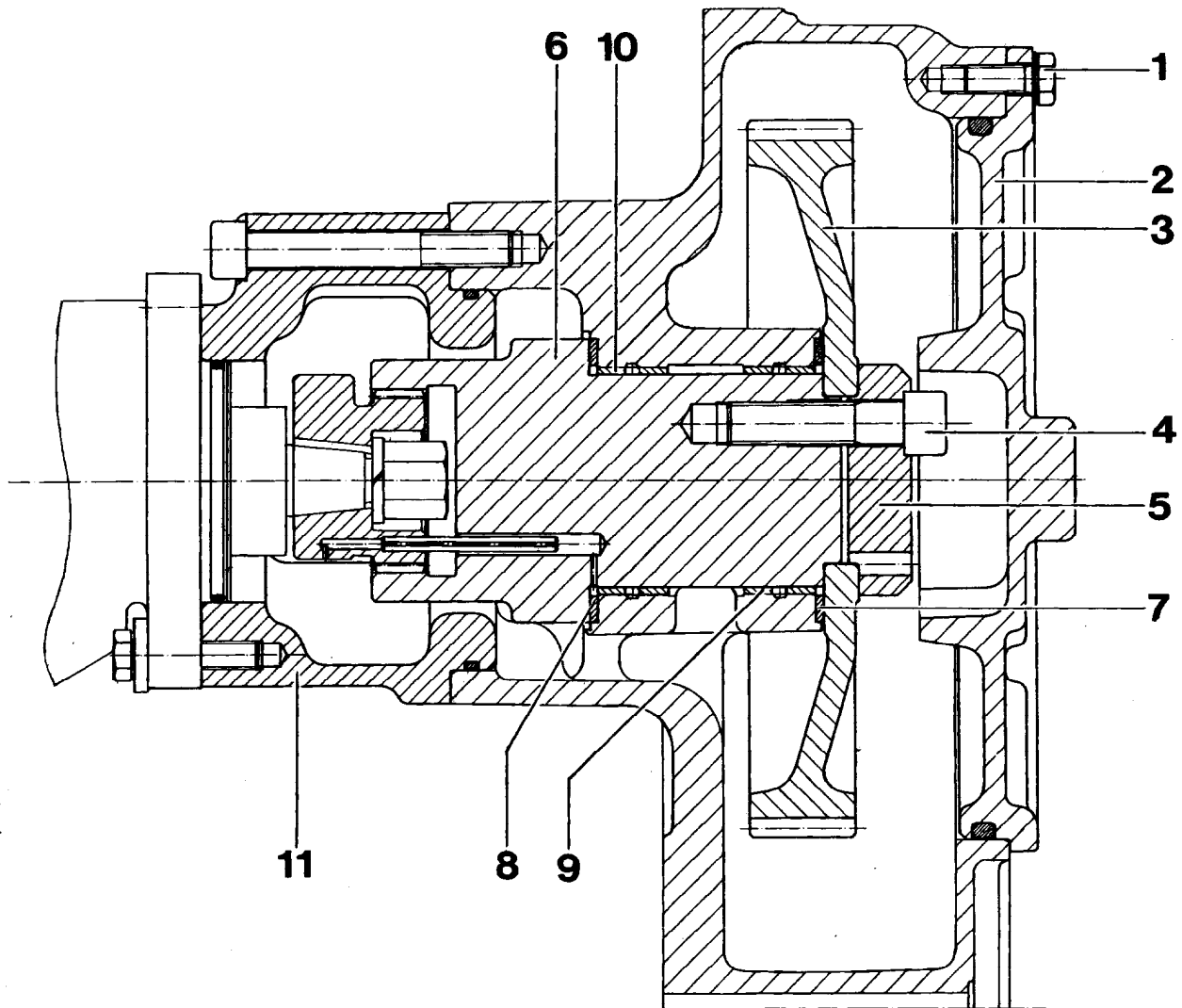
On 4 cylinder engines and engines with integrated timing case it might be necessary to remove the oil cooler plate (see sub group 8.48 / 8.49 / 8.50) to push in the bearing bushing 10.

Bearing bushings 9 and 10 are premachined and do not need to be reworked.

Antrieb für A, MW, P - Einspritzpumpen
Drive for A, MW, P -Injection Pump
L'entraînement pour A, MW, P - Pompe à injection



Antrieb für VE - Einspritzpumpe
Drive for VE - Injection Pump
L'entrainement pour VE - Pompe à injection



Fuel injection pump drive removal and installation, inspection and repair (Injection pump drive integrated in the timing gear cover).

Use special tool No. 30, 80

Removal:

Remove injection pump, see sub group 7.14

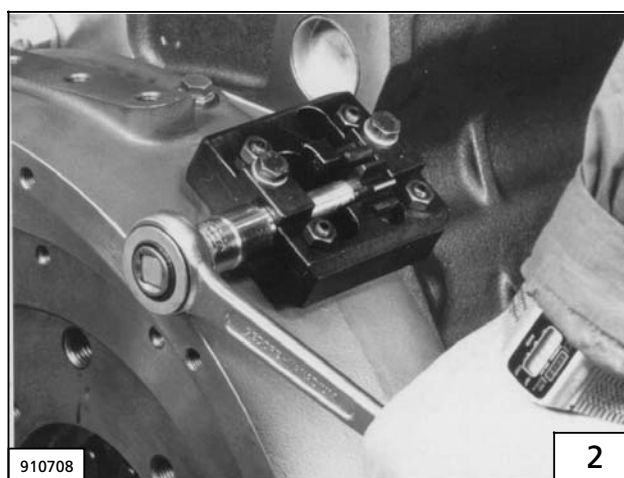
For position, see page 7.07.04 (rear / back)

Loosen and remove screws 1 on injection pump drive cover 2.

Push cover 2 from timing gear cover.



Install hand crank, special tool No. 30 at the inspection.

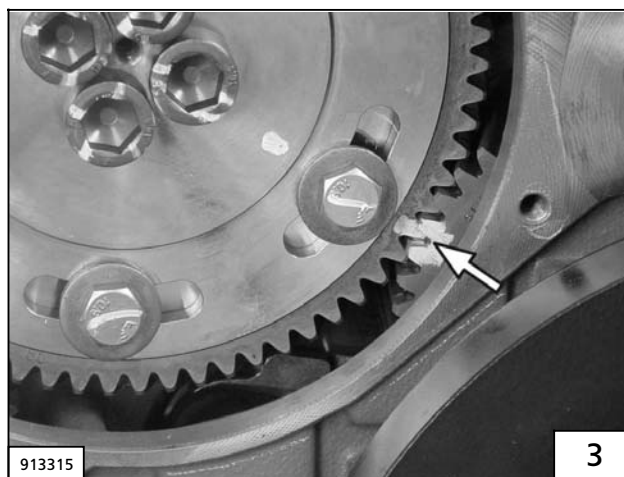


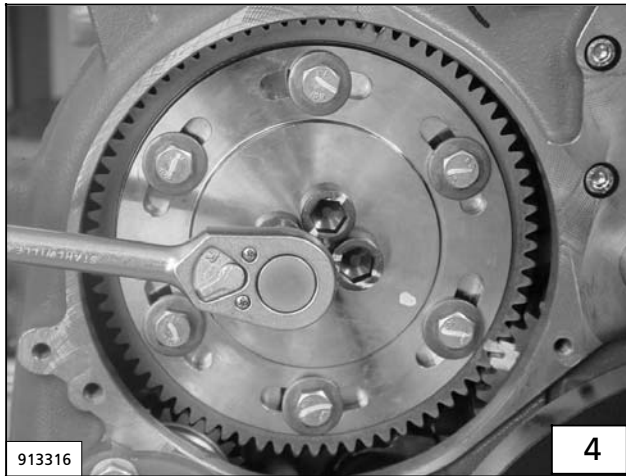
Rotate the engine crankshaft with the handcrank until the marked tool on the gear of the injection pump drive is positioned between the two marked teeth on the intermediate gear.

Note:

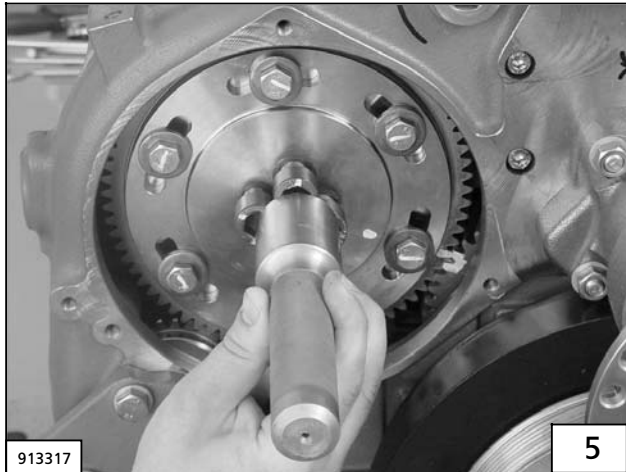
The teeth on the intermediate gear are also marked EP (EP = Einspritzpumpe = Injection pump).

See also sub group 9.26.

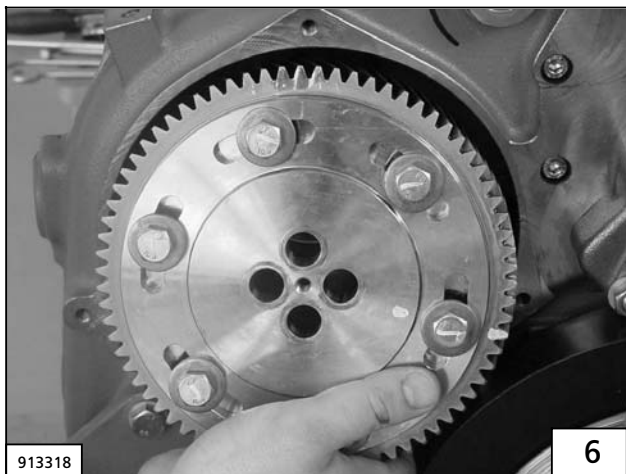




Loosen the screw 3 on the injection pump drive and turn out approx. 15mm.



By punching with soft taper plug on the screws 3, the hub 6 with set pin 7 must be separated from the intermediate flange 5.



Turn out screws 3 and remove intermediate flange 5 with gear 4 through the opening in the timing gear cover.

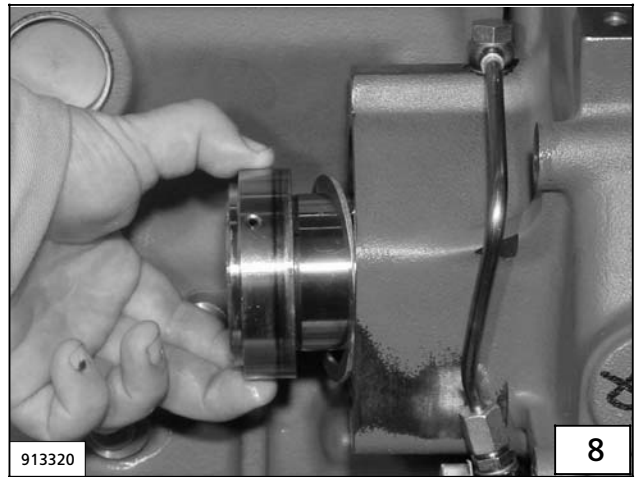


Remove the thrust ring 8 from timing gear cover.

Important:

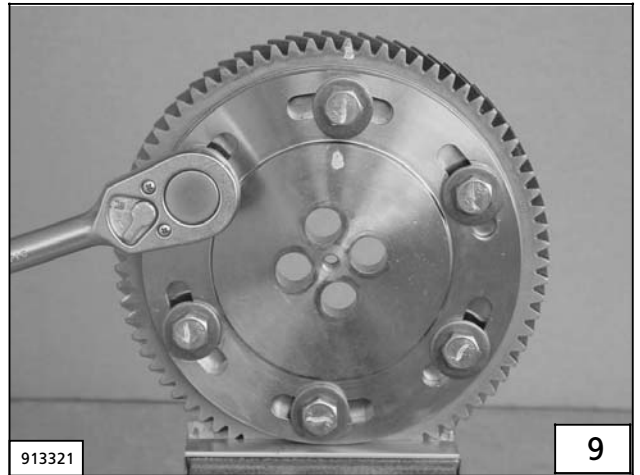
Remove the thrust ring 8 carefully, make sure it does not drop into the timing gear cover.

Remove the drive hub 6 and the thrust ring 9 from the injection pump side from the timing case cover.



Loosen and remove screws 10.

Remove gear 4 from intermediate flange 5.



Installation:

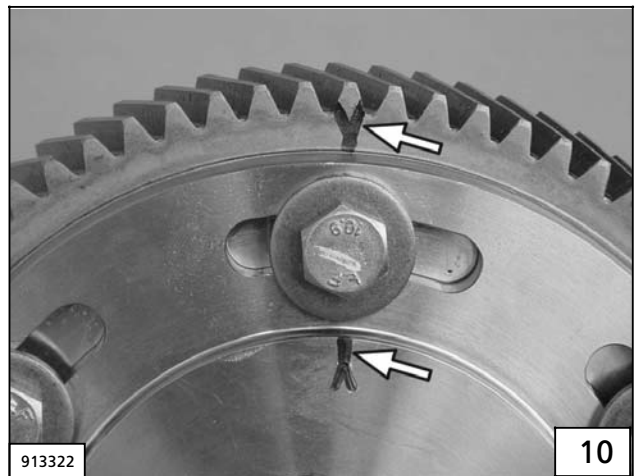
Push the gear 4 onto the intermediate flange 5.

Install screws 10 and tighten.

For tightening torques see Technical Data.

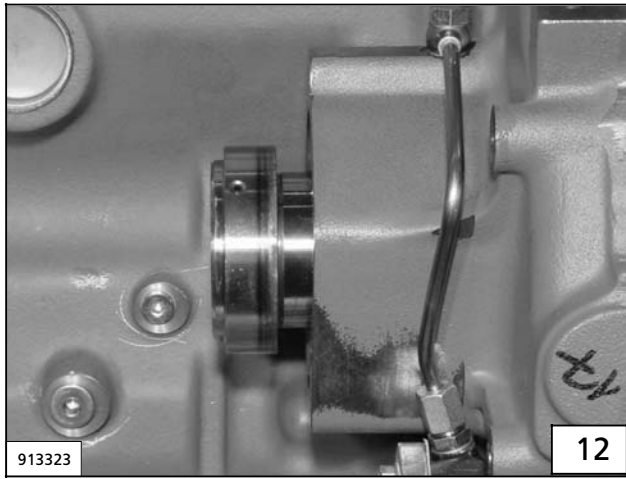
Important:

The marks on the intermediate flange 5 and the gear 4 must be aligned.



Place the thrust ring 9 into the timing gear cover, making sure to place the retainer properly.

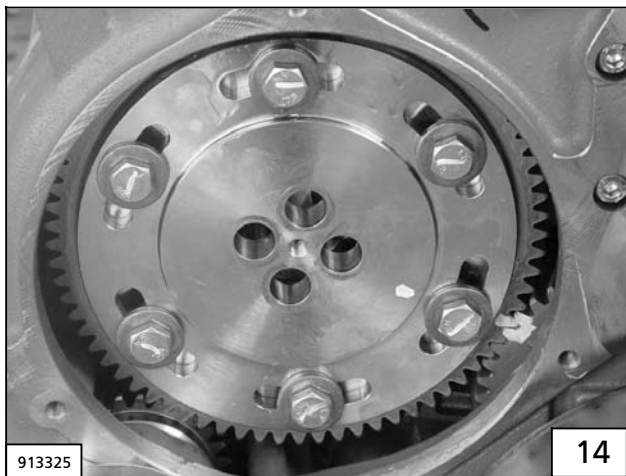




Lubricate the drive hub 6 on the surface for the bearing bushing and thrust ring and push it into the timing gear cover.



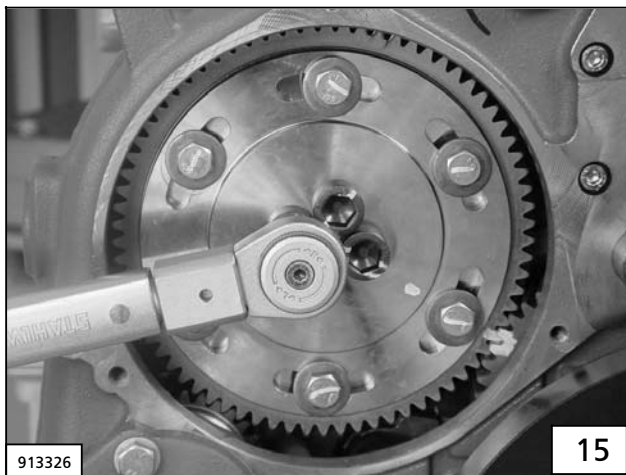
Insert the thrust ring 8 with retainers into the timing gear cover and lightly oil the running surface.



Push the intermediate flange 5 with gear 4 onto the drive hub 6 and adjusting pin 7, so that the marks on the gear 4 and intermediate gear are aligned.

Note:

When inserting intermediate flange 5 with gear 4, hold the drivehub 6 from the injection pump side so it does not turn.



Install and tighten the screws 3.

For tightening torques, see Technical Data.

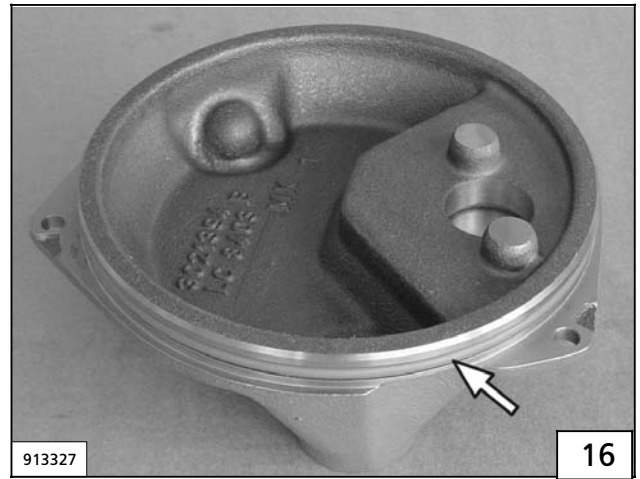
Important:

After every installation or repair make sure to check the axial play of the injection pump drive.

For dimensions, see Technical Data.

Lubricate a new O-ring and install on the cover 2.
Push the cover into the timing gear cover, install
and tighten screws 1.

Install injection pump, see sub group 7 .14.

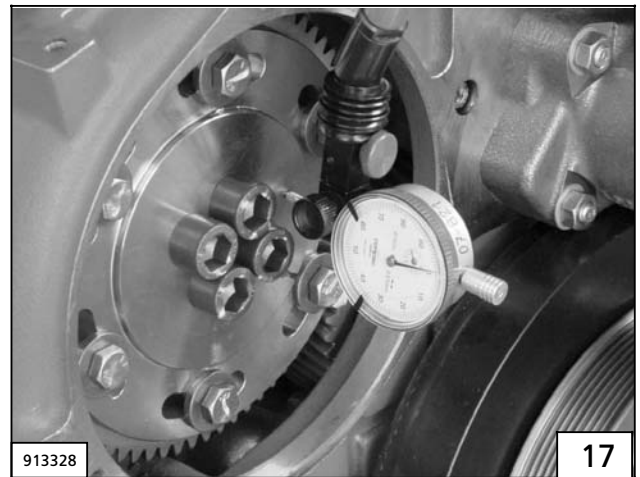


Inspection and repair:

Inspection:

Check the axial play when the injection pump drive
is installed.

For dimensions, see Technical Data.



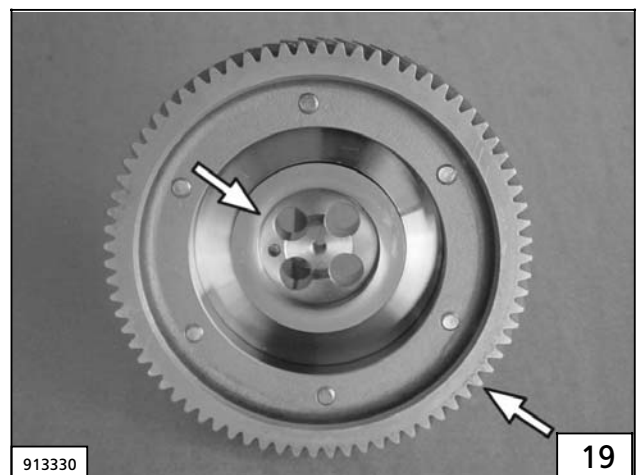
Remove injection pump drive, visually check the
running surface on the drive hub 6 for damage.
Check the bearing pin diameter.

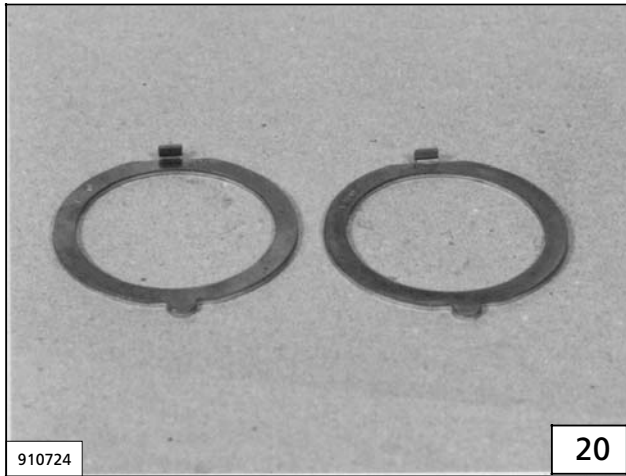
For measurements, see Technical Data.



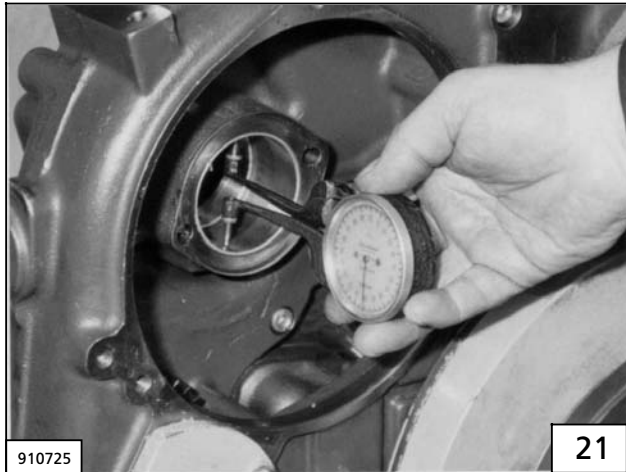
Check the teeth on gear 4 for wear.

Visually check intermediate flange 5 on the running
surface of thrust ring 8 for damage.





Visually check the running surface of the thrust 8, 9 and the retainers for wear.

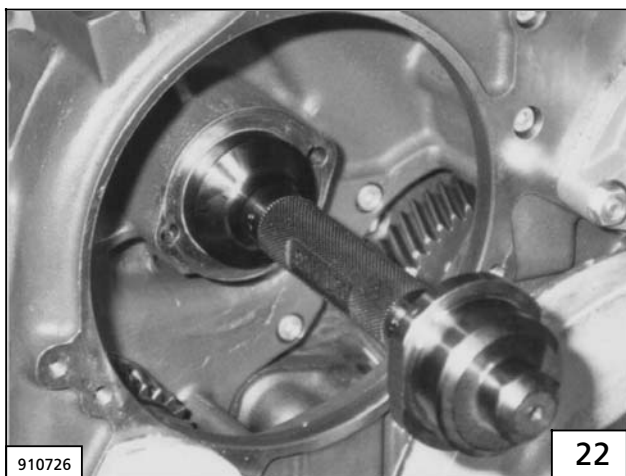


Visually check the bearing bushings 11, 12 in the timing case for the damage.
Measure with calipers.

Compare with measurements given on Technical Data.

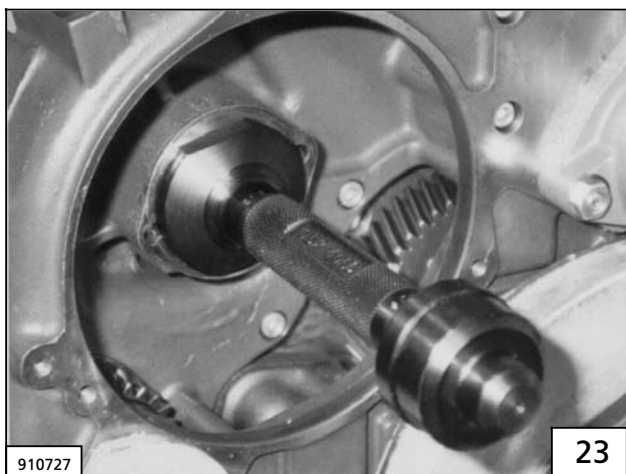
Note:

Parts which do not match these measurements or are damaged must be replaced.



Replace bearing bushings in timing case:

Drive out the bearing bushings 11, 12 with punch, special tool No. 80 from the fan side from the timing case.



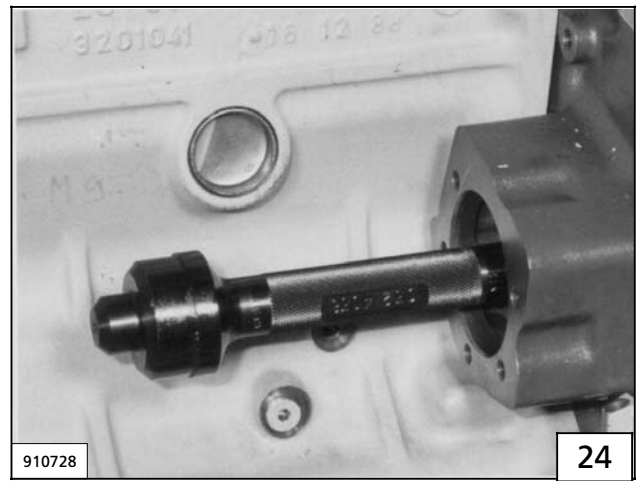
Lightly oil new bearing bushing 11 on the outside and push it with punch, special tool No. 80 from the fan side into the timing case until flush.

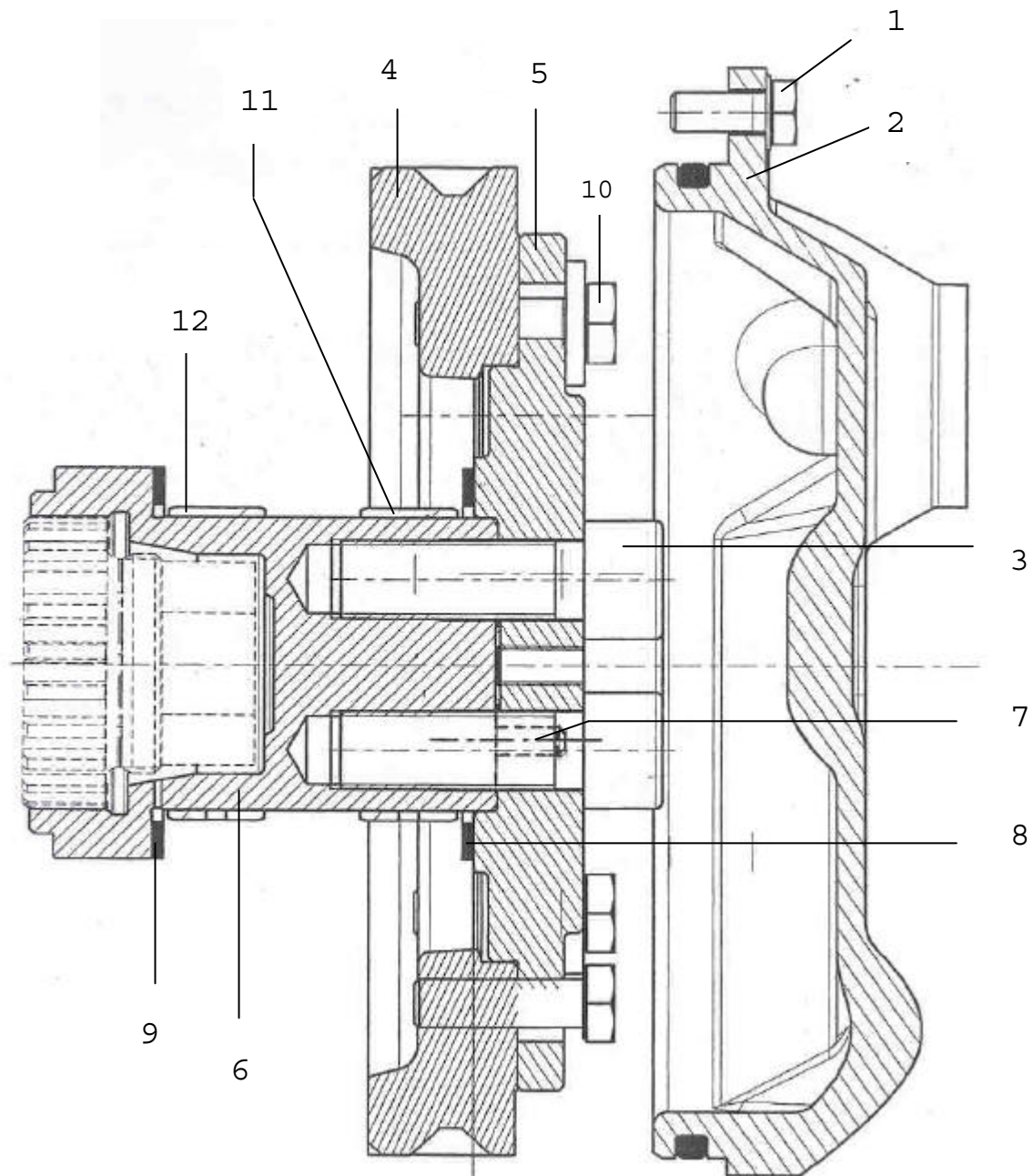
Lightly oil new bearing bushing 12 from the outside and push it from the injection pump side into the timing case with punch, special tool No. 80 until flush.

Note:

On 4 cylinder engines and engines with integrated timing case it might be necessary to remove the oil cooler plate (see sub group 8.48, 8.49, 8.50) to push in the bearing bushing 12.

Bearing bushings 11 and 12 are premachined and do not need to be reworked.





Fuel Injection Pump Drive Disassembly, Inspection and Assembly (without timing device)

up to Engine no. 85 01 0269

Use special tools no. 33, 80, 84.

Pump Drive Assembly and Inspection:

To remove injection pump drive see sub group 7.05.

To position injection pump drive assembly see back page 7.10.03.

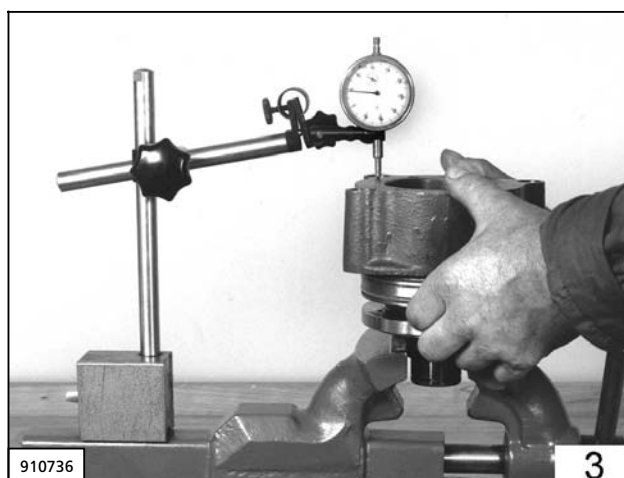
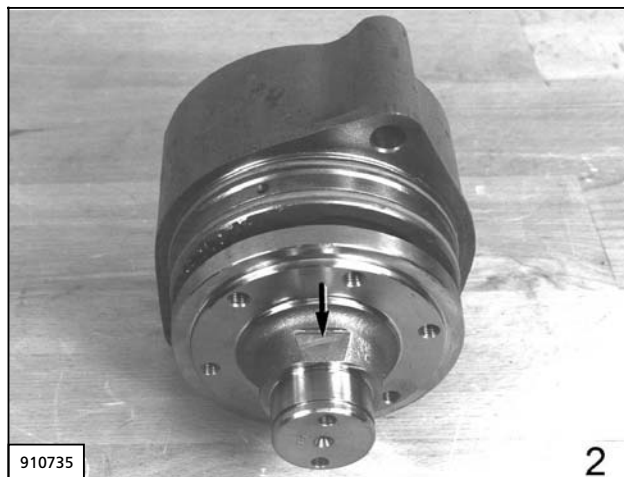
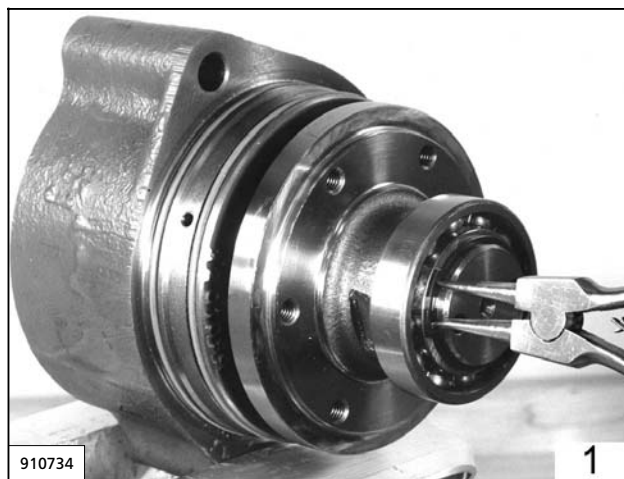
Remove retaining ring Pos. 1 with pliers and ball bearing Pos. 2 with standard gear puller.

At the flats, clamp hub 3 into a vise.

Measure and note axial play between hub Pos. 3 and thrust washers Pos. 7.

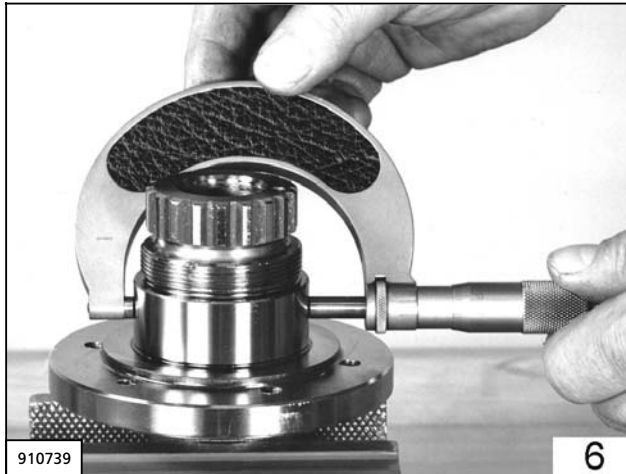
For proper measurements see Engine Specifications.

Remove coupling Pos. 4, loosen and remove ring nut Pos. 5 with wrench, special tool no. 33.





Remove injection pump carrier Pos. 6 and thrust washers Pos. 7 from hub. Clean all components and check lubrication bores for unrestricted oil flow.

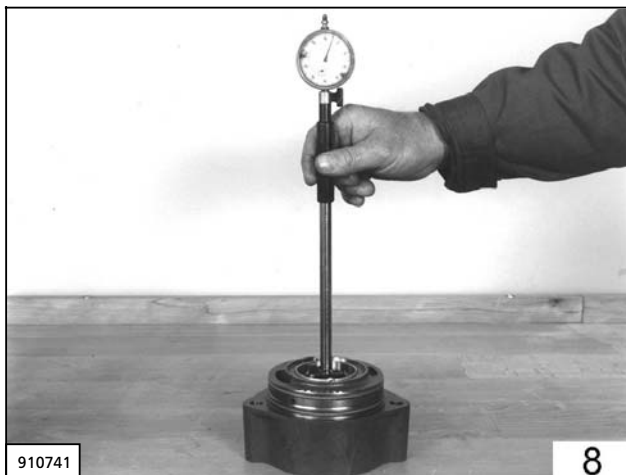


Visually inspect bushing on hub for any damage. Measure and note shaft diameter.

For proper measurements see Engine Specifications.



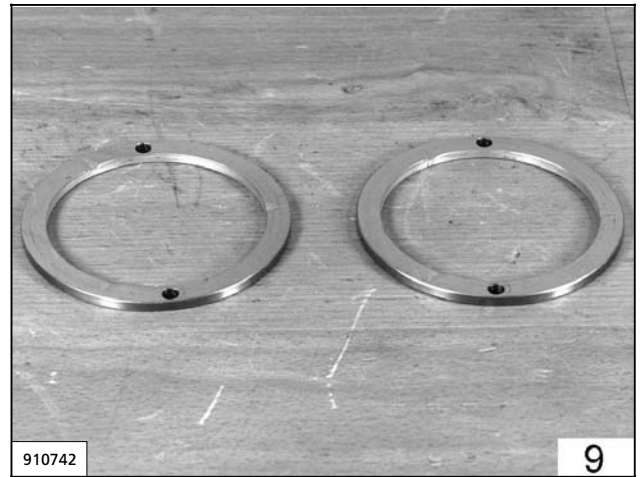
Visually check thrust washer contact surface on hub for wear.



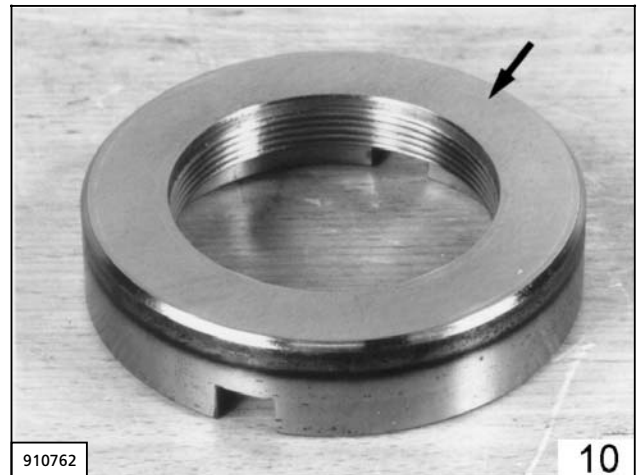
Visually inspect bushing in pump carrier for any damage. Measure and note inside diameter.

For proper measurements see Engine Specifications.

Visually check thrust washer surfaces for wear.



Check surface of the thrustwasher on the threaded ring for wear (sight check only).



Visually check ball bearing for excessive play. Spin ball bearing and listen for sound.



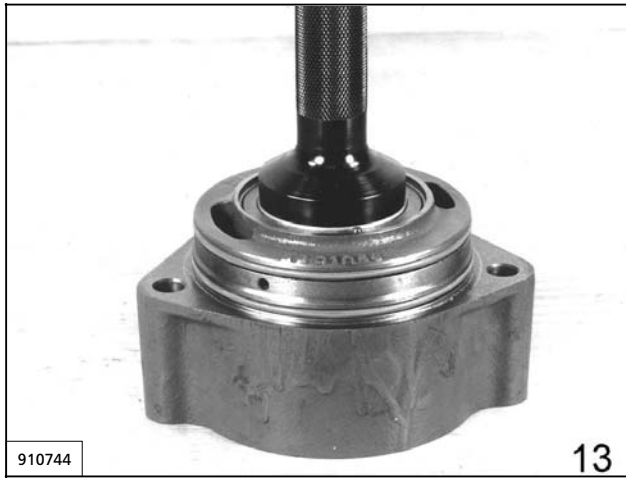
Position and place thrust washers with bores on guide pins Pos. 8 in pump carrier and visually check thrust washer bores and guide pins for excessive wear.

Note:

Any component mentioned before that shows wear, is damaged or does not conform with the specifications must be replaced.

The installation dimensions as listed on page 7.10.03 must be observed.





Pump Carrier Bushing Replacement:

Remove bushing from pump carrier with punch, special tool no. 80.

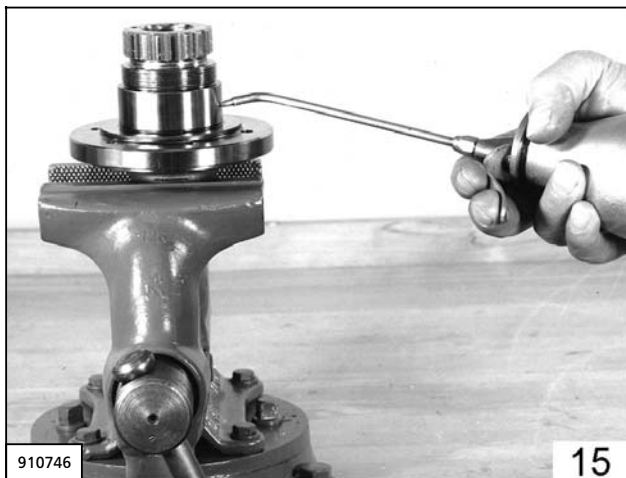


Lubricate new bushing with engine oil and press bushing into pump carrier using the special punch tool.

Consider installation dimensions on page 7.10.03.

Note:

The new bushing is machined to maintain proper inside diameter after it is pressed into pump carrier. Therefore, no rework of the bore is required.



Assembly:

Put the hub into a vise, lubricate bearing surface of the bushing.



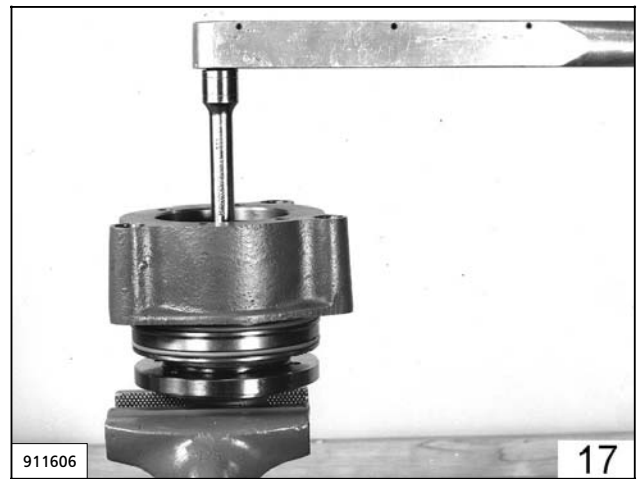
Put thrust washers on to the pins in the pump carrier and lubricate surface. Slide pump carrier over the hub.

Attention:

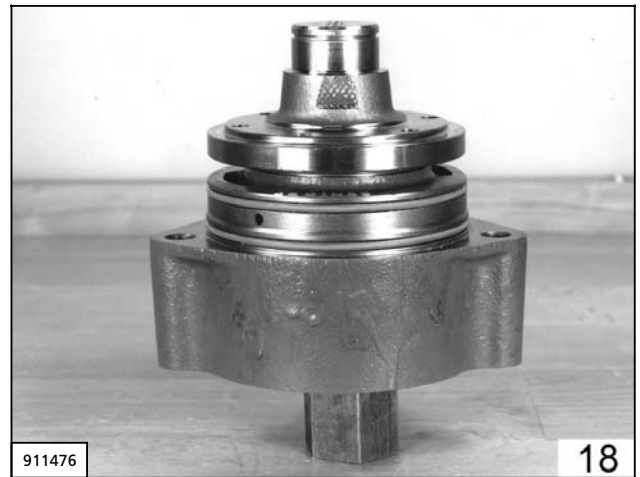
The lubricating pockets of the thrust washers have to be towards the thrust surface (hub-threaded ring).

Screw ring nut on hub and torque ring nut with special wrench.

For proper torque see Engine Specifications.



Remove injection pump drive assembly from vise and place pump drive hub on a support with splined shaft pointing down.



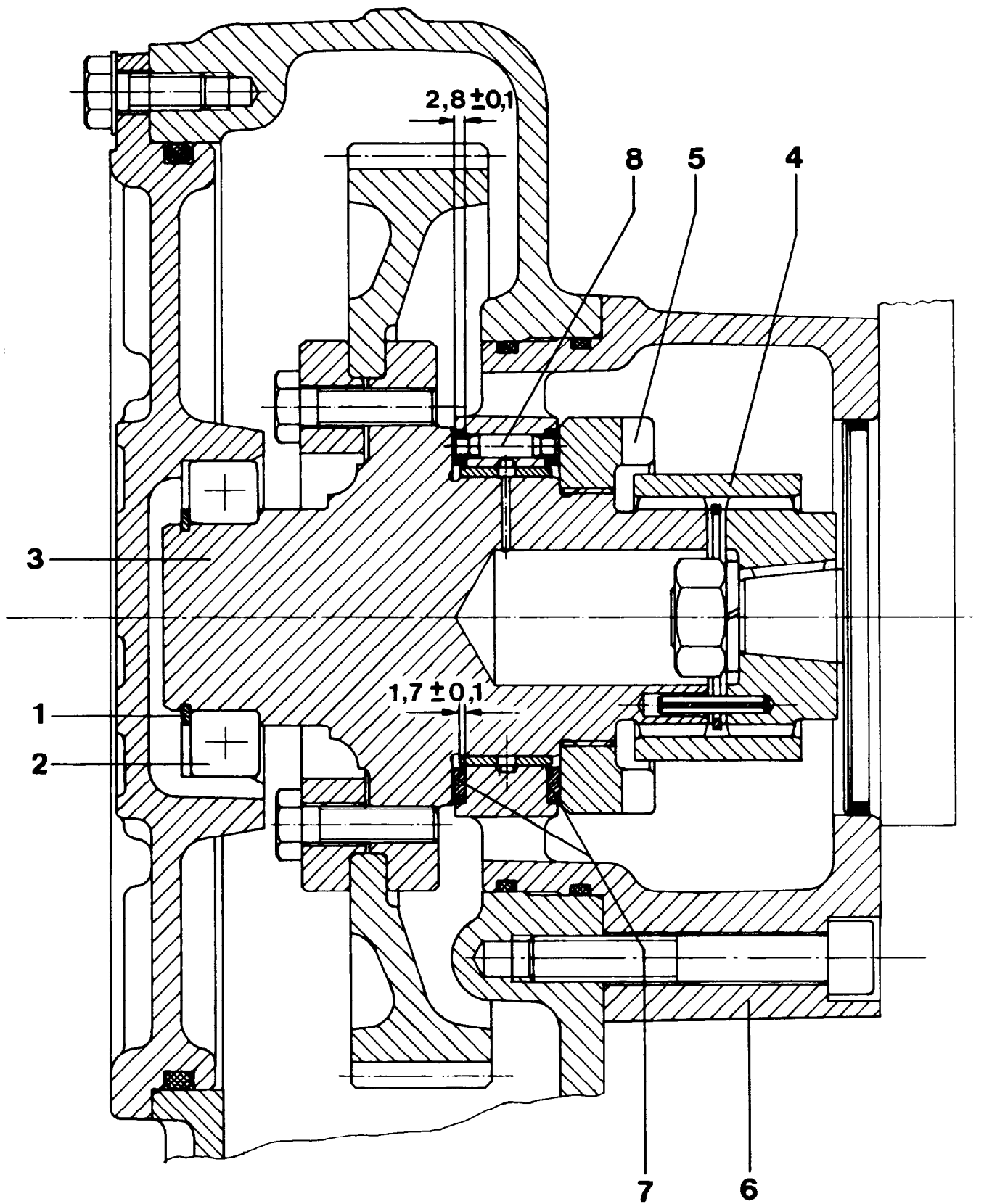
Place ball bearing on lubricated hub seat and press bearing into location with punch, special tool no. 84.

Secure ball bearing with retaining ring.



Place coupling on hub. Spin and check pump drive assembly for proper operation and noise.





Fuel Injection Pump Drive Disassembly, Inspection and Assembly (without automatic timing advance unit)

from Engine no. 85 01 0270

Special tools no. 33, 80, 84

Disassembly and Inspection:

Injection pump drive has been removed, see sub group 7.05.

For sectional drawing, see back of page 7.11.03.

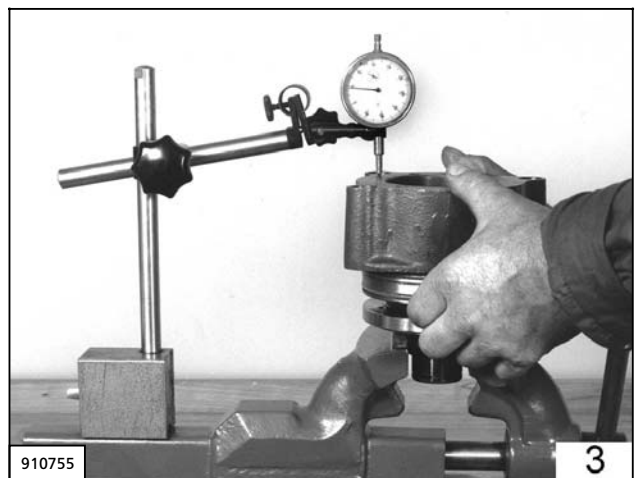
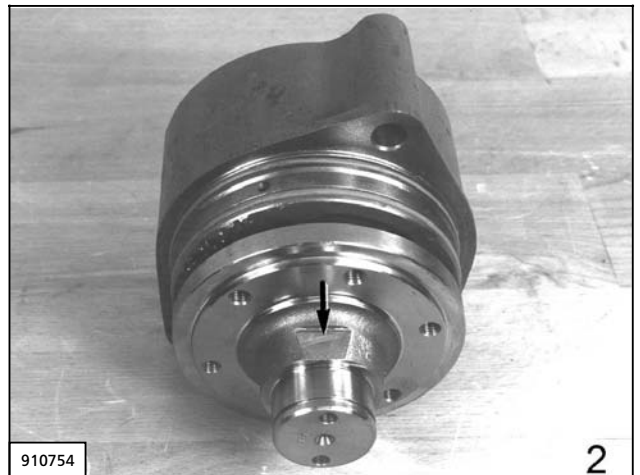
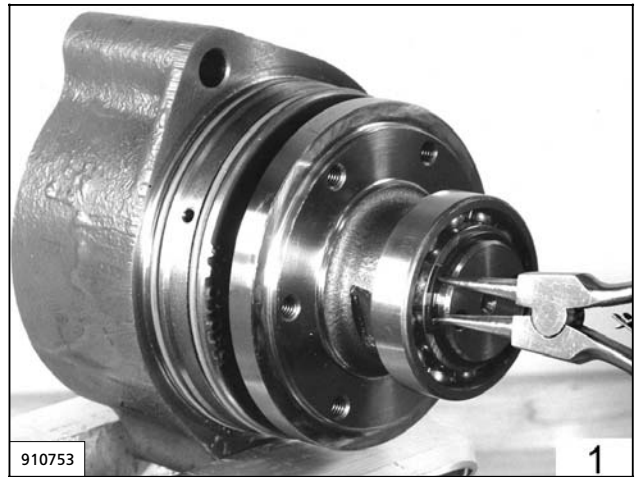
Remove retainer snap ring 1 and pull off ball bearing 2 with standard puller.

At the flats, clamp hub 3 into a vise.

Measure axial clearance between hub 3 and thrust washers 7.

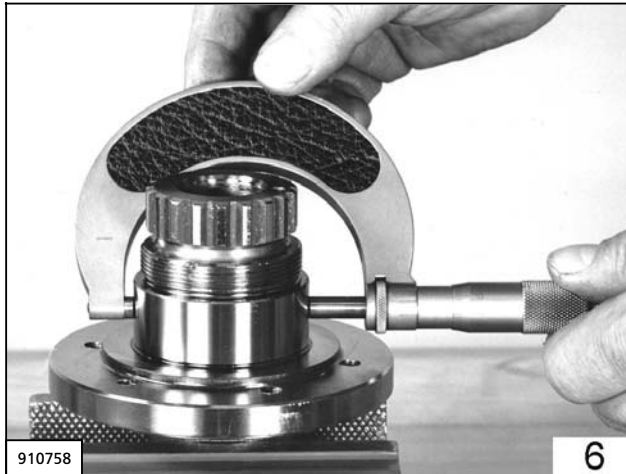
For permissible clearance, see Engine Specifications.

Remove coupling sleeve 4. With ring nut wrench, special tool no. 33, remove ring nut 5.





Remove pump carrier with thrust washers 7 from hub 3. Clean all components and check lubrication bores for restrictions.



Visually inspect bearing surface on hub shaft for damage. Measure diameter of bearing surface section of hub shaft. For proper dimension, see Engine Specifications.

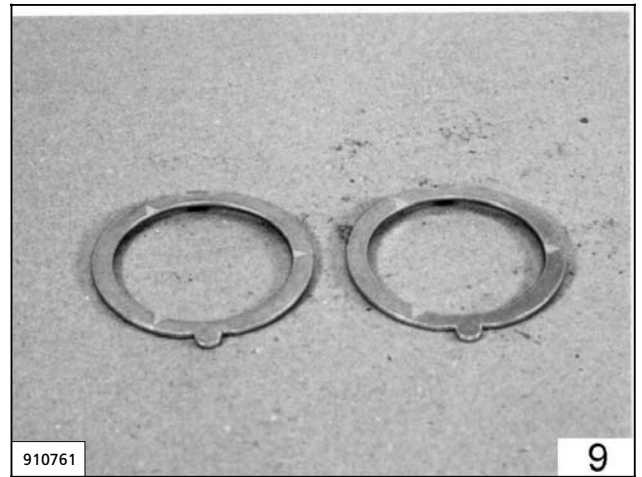


Visually check thrust washer contact surface at the hub for damage.

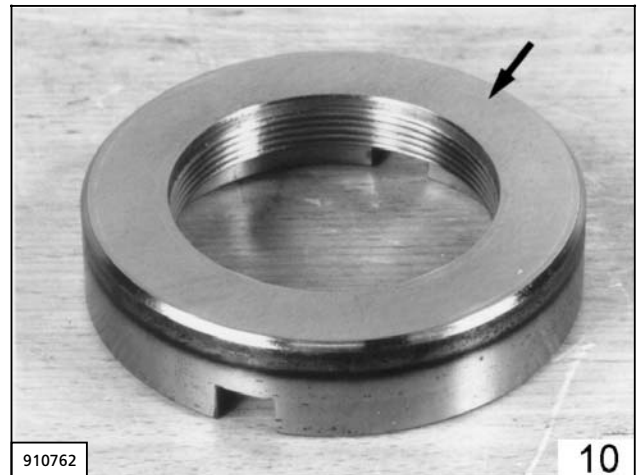


In the pump carrier, visually check bearing bushing for damage. Measure diameter with an inside micrometer. For proper dimensions, see Engine Specifications.

Visually check thrust washer surfaces and retaining tangs for wear or damage.



Visually check thrust washer contact surfaces of the ring nut for wear or damage.



By hand, spin the ball bearing and check for clearance and abnormal sounds.

Note:

Components showing damage, excessive wear or not meeting specifications must be replaced.



Replace Pump Carrier Bearing Bushing:

With a punch, special tool no. 80, tap out the bearing bushing from the pump carrier.



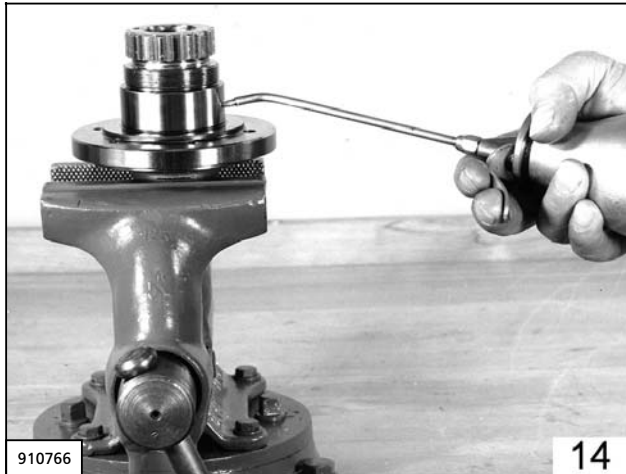


Coat new bushing with oil and tap into pump carrier with punch.

See installation dimension at back of page 7.11.03

Note:

The bushing will assume the correct dimension. Do not machine after installation.

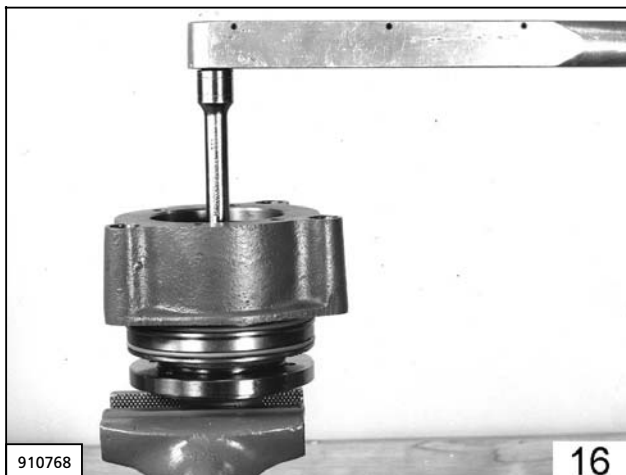


Assembly:

At the flats, clamp hub into a vise. Lightly oil bearing surface section of the hub shaft.



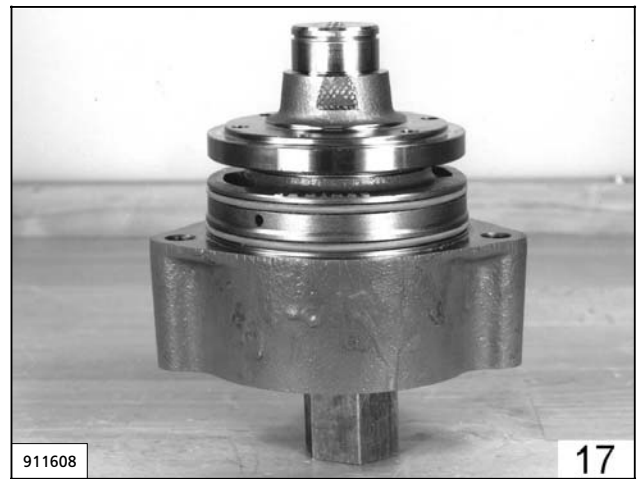
Place thrust washers with retaining tangs into pump carrier and lightly oil contact surfaces. Place pump carrier on hub.



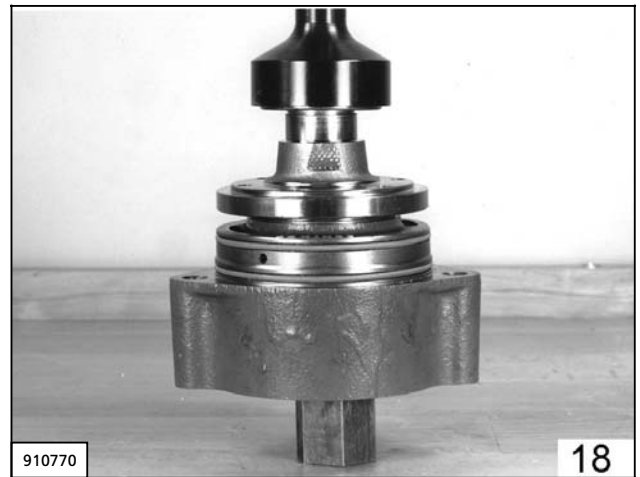
Thread ring nut on hub and tighten with ring nut wrench.

For proper torque, see Engine Specifications.

Remove injection pump drive from vise and, with the splined shaft end down, support the drive so that the housing hangs free.

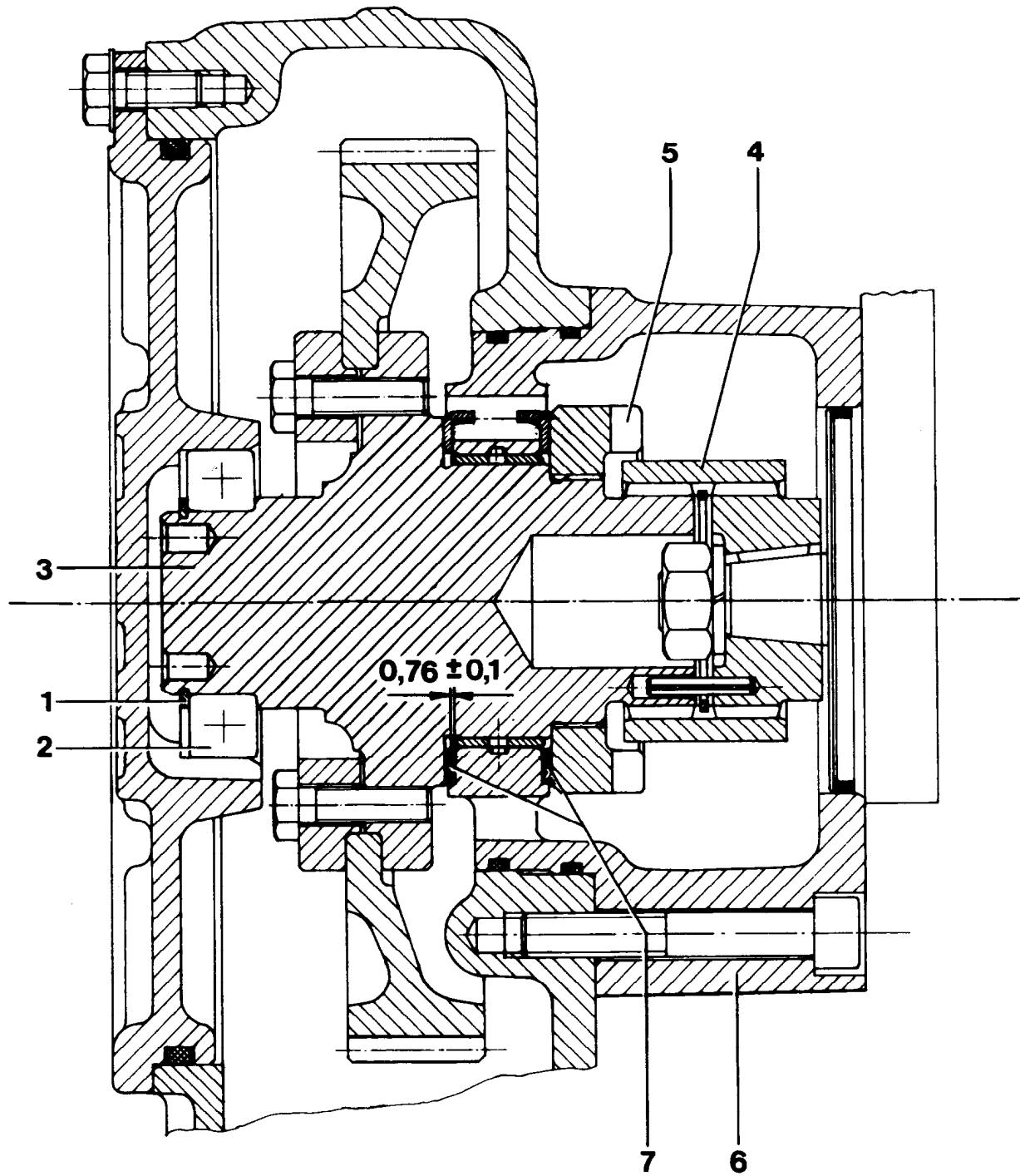


With punch, special tool no. 84, tap ball bearing on lightly oiled hub shaft. Replace retainer snap ring.



Place coupling sleeve on hub and check injection pump drive for free movement by turning shaft.





Remove and install injection pump, Injection pump type "H-RP43" (control sleeve fuel injection pump) with "EDC" (Electronic regulation)

Special tool No. 15, 29.1.

Removal:

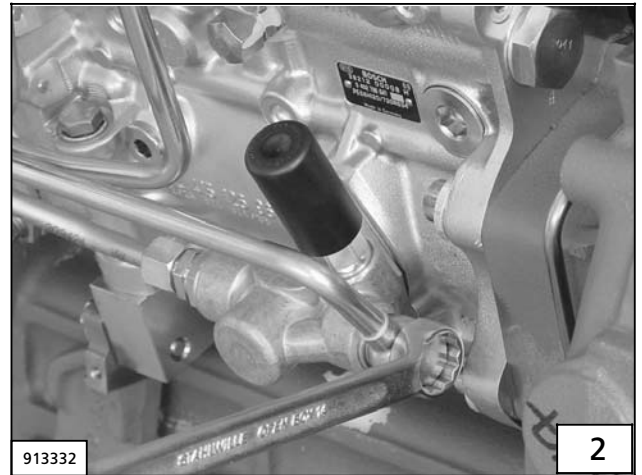
Disconnect the electrical plug connection between the cable from the injection pump regulator (EDC) and the cable from the engine control unit.

Note:

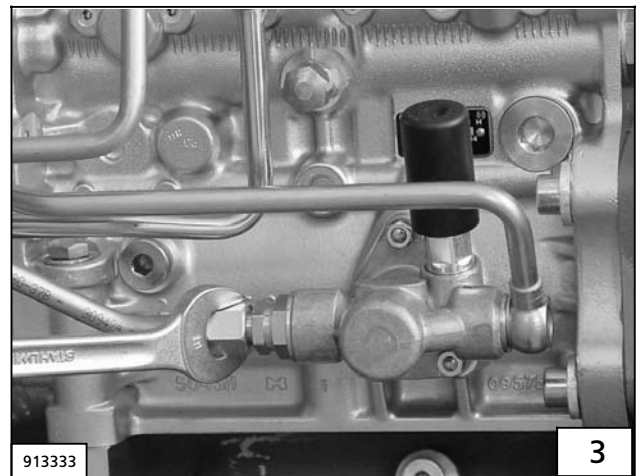
The injection pump may not be energized. Turn the ignition off on the machine.



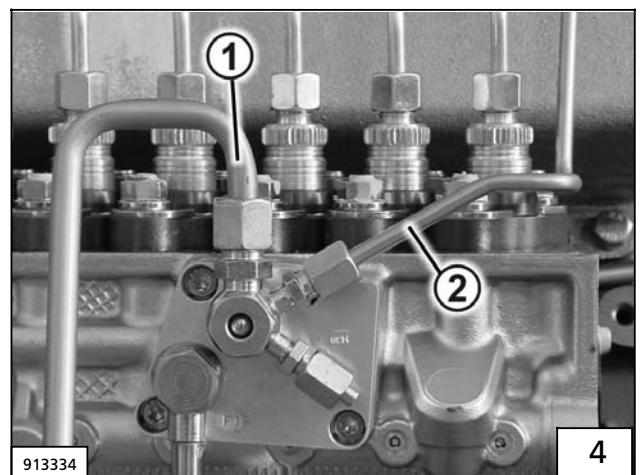
Remove the fuel line from the fuel prefilter to the fuel pump from the fuel pump.

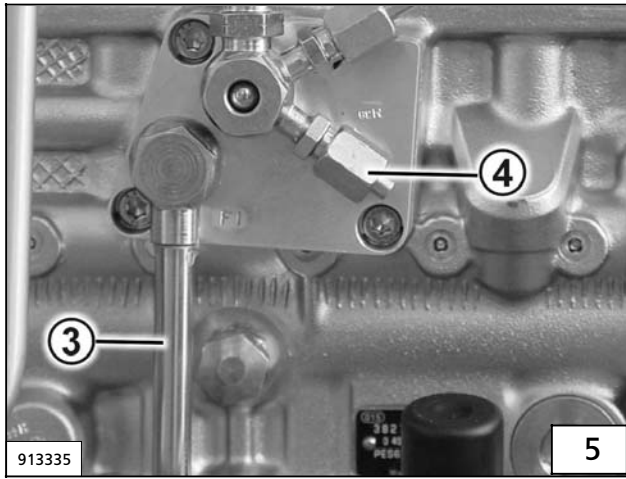


Remove the fuel line from the fuel pump to the fuel fine filter from the fuel pump.

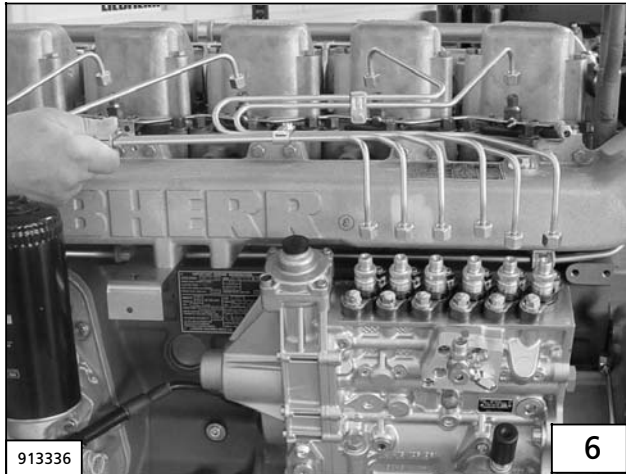


Remove fuel return line 1 to the tank and leak oil return line 2 from the injection valves from the injection pump or from the ring fitting.

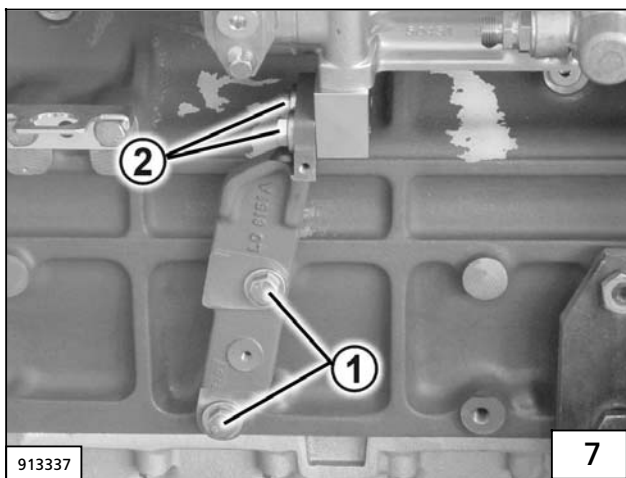




Remove the fuel line 3 from the fuel fine filter to the injection pump and fuel line 4 to the solenoid valve on the injection pump.



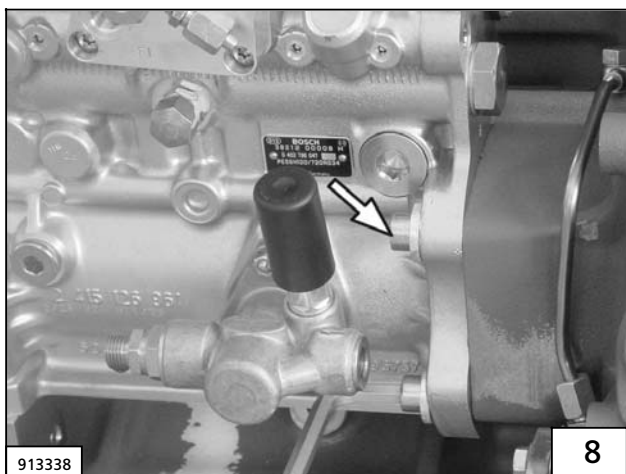
Unscrew and remove the injection lines on the injection pump and the injector valves.



Note:

On 6 cylinder engines the support of the injection pump to the crankcase must be removed as well.

Remove screws 1 of the support on the crankcase, untie screws 2 between bracket and support.

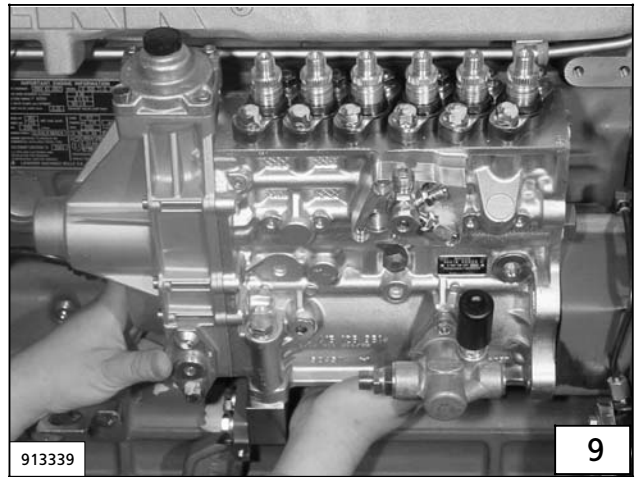


Untie and remove screws from the flange on the injection pump.

Remove injection pump from the component carrier.

Note:

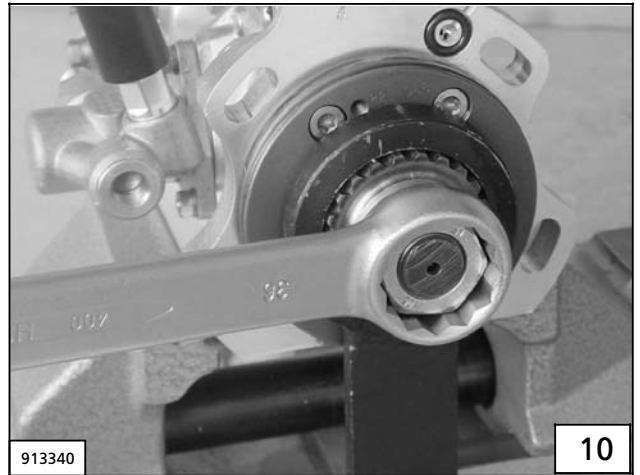
Remove injection pump support with the injection pump if installed, see picture 7.



Put injection pump into an vice with protecting jaws.

Hold tight toothed shaft with holding device, special tool No. 15.

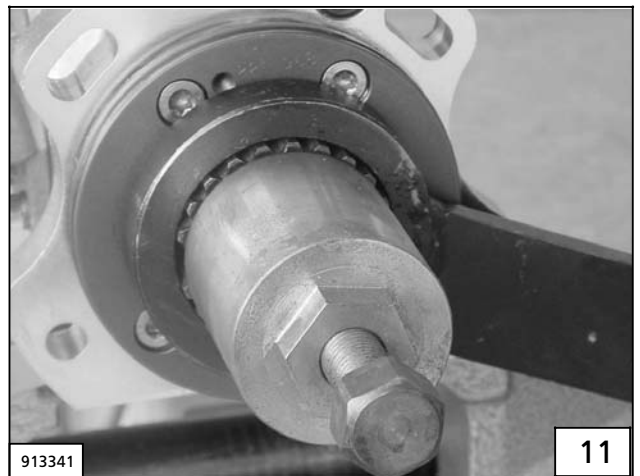
Untie nut and remove.



Remove holding device, screw puller, special tool No. 29.1 into toothed shaft and pull toothed shaft from the drive shaft.

Note:

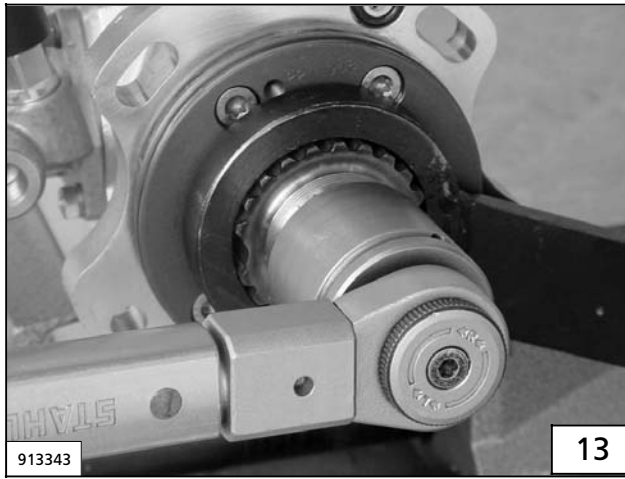
Observe the woodruff key in the drive shaft.



Note:

If a pump support is installed remove from the injection pump, see picture 7.

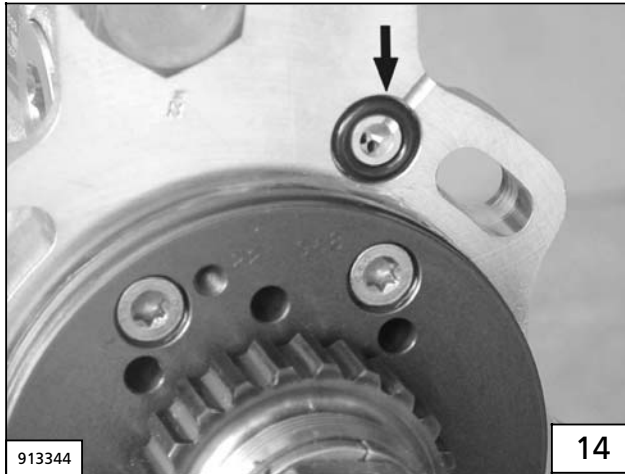




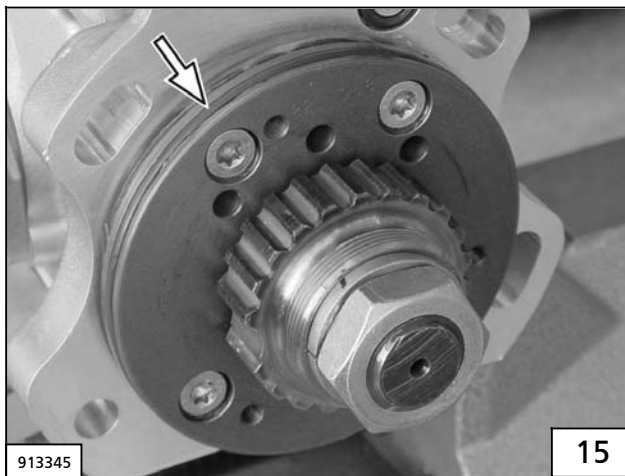
Installation:

Place the injection pump in vise, push the gear shaft over the woodruff key onto the drive shaft. Apply retaining compound (Loctite 270) to the tread on the drive shaft, add the spring and screw on the nut. Hold the gear shaft with the retaining device, special tool No. 15 and tighten the nut.

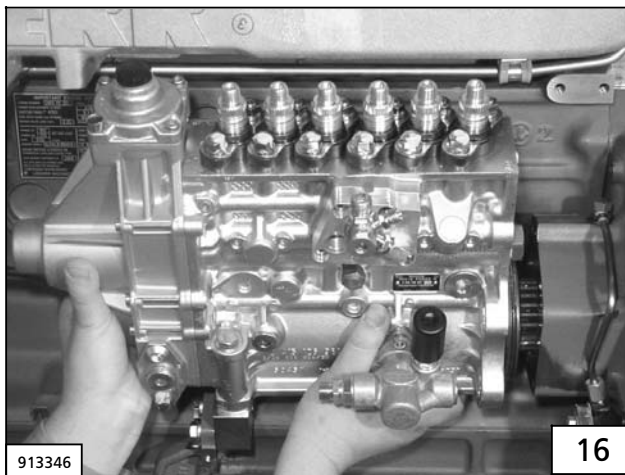
For tightening torque, see Technical Data.



Using grease install new O-ring into groove of injection pump for the lube oil entrance to the injection pump.



Install and lubricate new O-ring on the injection pump flange.



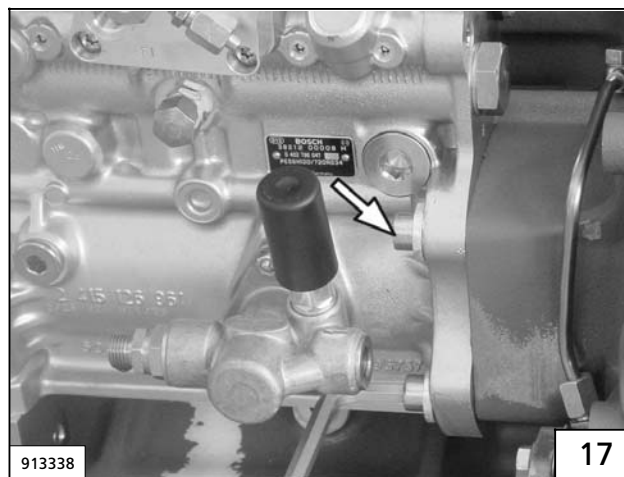
Install the injection pump with the toothed shaft into drive hub so that the notch in the toothed shaft (missing tooth) and the tooth gap closed by a tension pin in the hub align.

Install injection pump into the component carrier.

Screw in and tighten mounting screws.

Note:

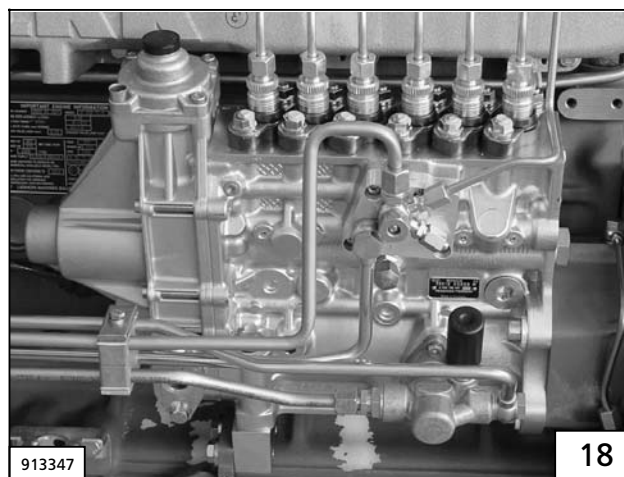
If a pump support is installed, see picture 7, install and tighten screws 1 on the crankcase and the tighten screws 2.



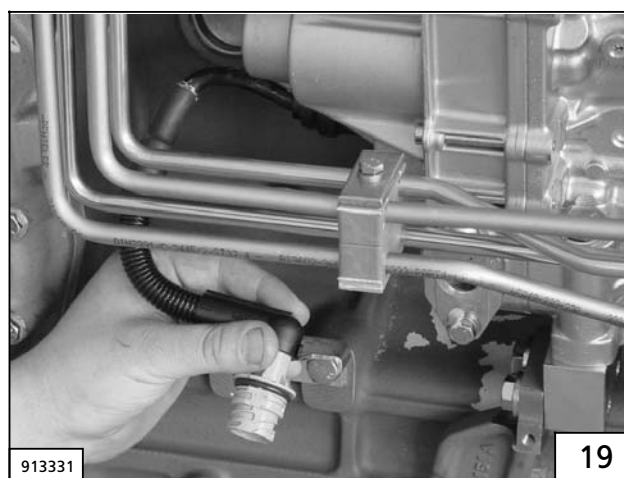
Install fuel injection lines, fuel lines to the solenoid valve, fuel return lines to the tank, leak oil return line, fuel lines from the fuel filter and fuel lines on the fuel lift pump using new gasket rings.

Check begin of delivery and adjust, see sub group 2.19.

Bleed fuel system, see sub group 7.22.



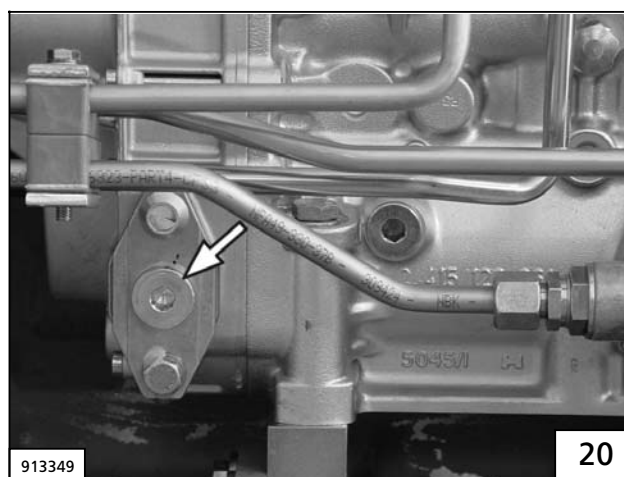
Connect the electrical plug connection between the cable from the injection pump regulator (EDC) and the cable from the engine control unit.

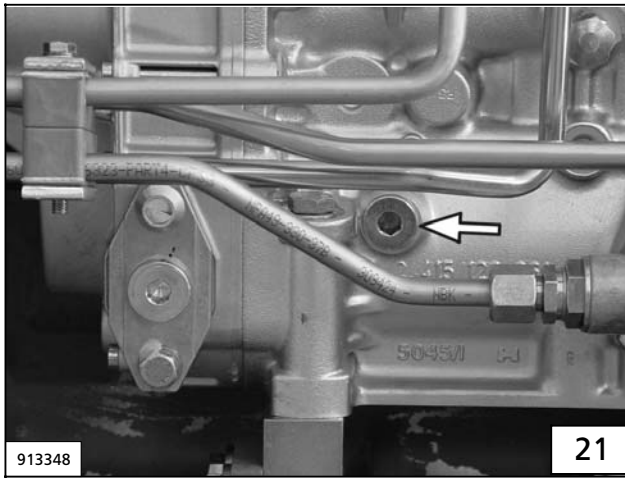


Important:

Before using the new injection pump, make sure it is filled with engine oil.

EDC regulator: Add approx. 0,1 Liter of engine oil. See fig. 20 for filling point.





Injection pump:

Add approx. 0,6 liters of engine oil. See fig. 21 for filling point.

Injection pump overflow valve / replacement and inspection

Note:

The overflow valve maintains a fuel pressure of approx. 0.5 to 2 bar.

A defective or leaking overflow valve can cause the engine to run erratic, shut down, skip or have reduced output. In case of fuel tanks located below the level of the injection pump, it is possible that starting difficulties occur (because the prime is lost) or that the fuel system must be bled.

Removal:

Remove the fuel leak line coming from the fuel injectors at the overflow valve.



Remove the overflow valve from the injection pump.

Inspection:

Check the overflow valve with pressurized air for leaks.

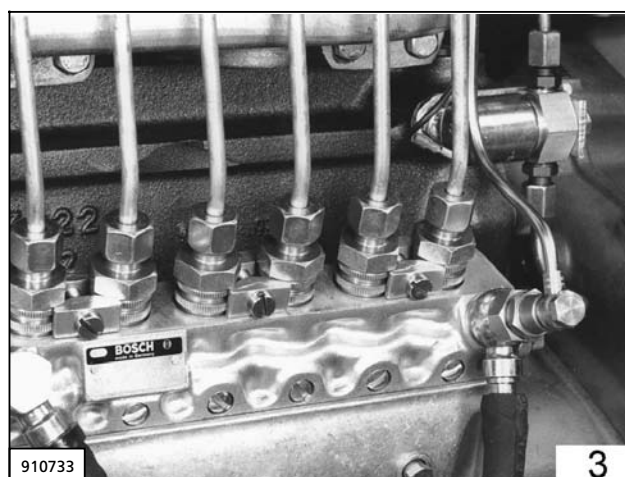
Press on the ball to check if the valve operates properly and if the ball is seated correctly (visual check).



Note: Replace worn, damaged valves!

Installation:

Install the inspected or new overflow valve with new seal rings into the injection pump. Connect fuel leak return line with new seal rings. Check for leaks.



Fuel injector removal and installation

Use special tools No. 18, 19

Removal:

Clean area around fuel injectors / fuel injector lines.

Remove the high pressure fuel supply line on the fuel injector.

Note:

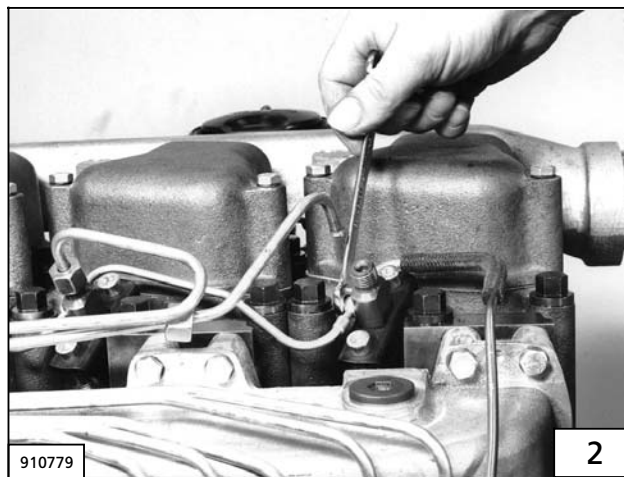
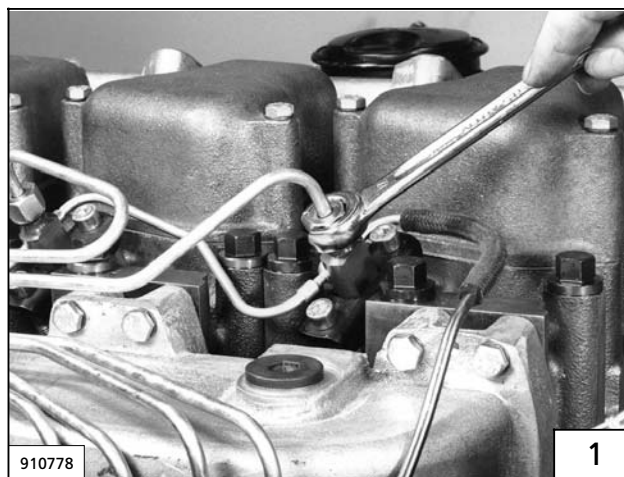
At the A5_motors the injection valve of cylinder 1 is equipped with a stylus trajectory tracer.

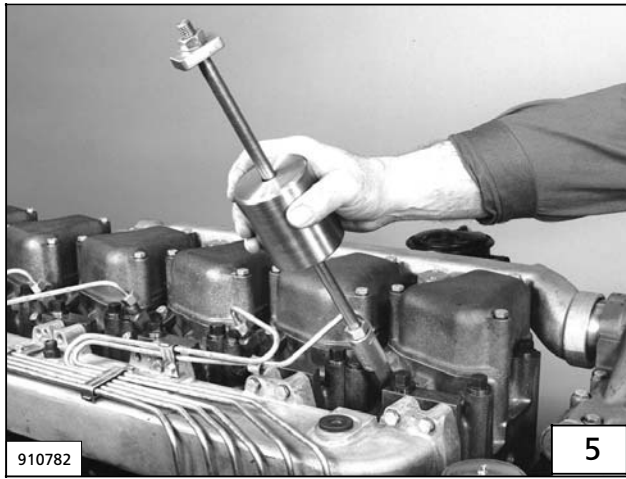
To demount and mount the injection valve, draw off resp. plugin the cable plug.

Remove the fuel overflow line from the fuel injectors.

Loosen and remove the screws on the fuel injector retainer screws. Remove the retainer and the spacer.

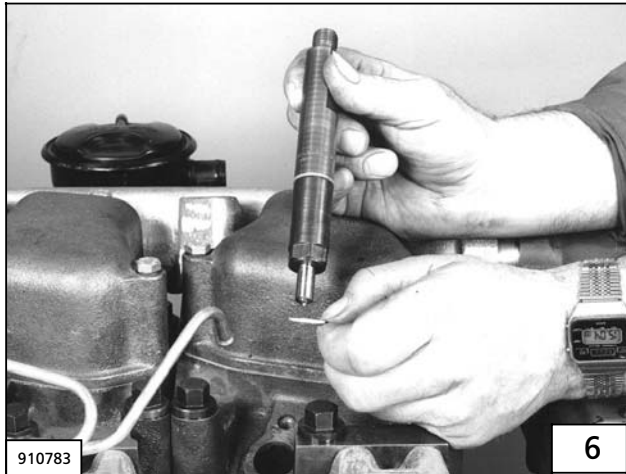
Loosen the fuel injector by turning the injector in the cylinder head with an open end wrench.





Attach the slide hammer, special tool No. 18 and 19 to the injector. Carefully knock the injector out of the cylinder head.

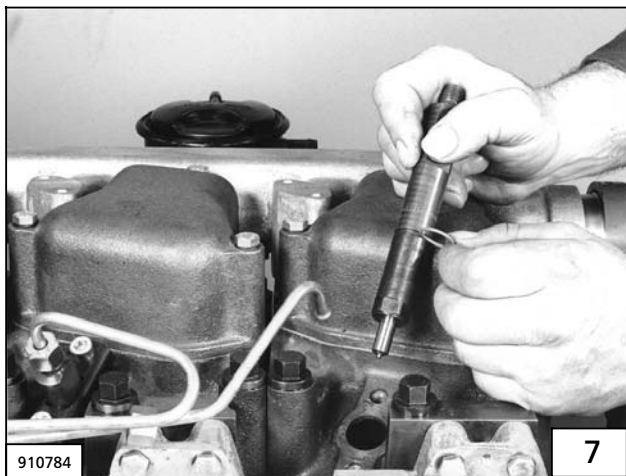
Note: Be careful not to drop dirt into the hole.



Remove the seal ring from the fuel injector. If the seal remains in the cylinder head, remove seal with a bent wire.

Check, adjust and test the fuel injector, see sub group 2.21.

Note: Be certain that all old seal rings are removed.

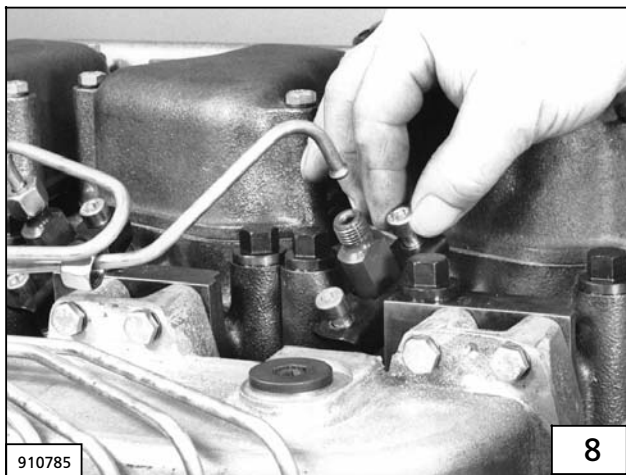


Installation:

Install a new O-ring on the fuel injector. Attach a new seal ring with grease on the fuel injector.

Lubricate the fuel injector on the outside with grease.

Note: Be careful not to damage the injector tip.



Carefully insert the fuel injector into the bore.

Install the spacer and fuel injector retainer and screws. Tighten / torque screws.

For tightening torques, see Technical Data.

IMPORTANT:

The leak oil connections on the fuel injectors must point to the flywheel side (see exception). On the new "E" engines, the leak line connection points toward the injection pump.

Install leak overflow line with new seal rings.

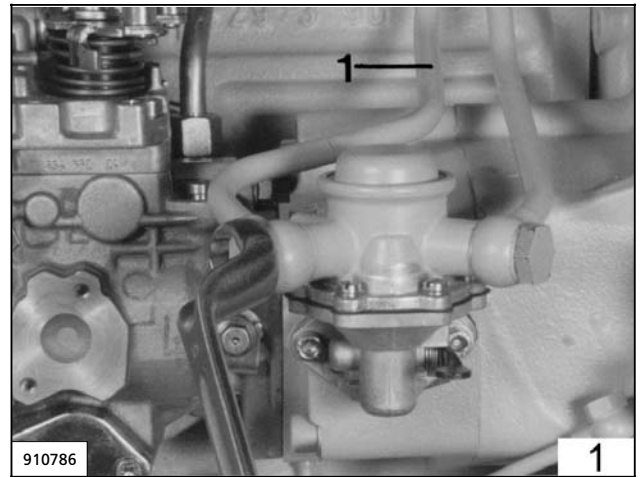
Install fuel injector line.

Fuel pump removal and installation

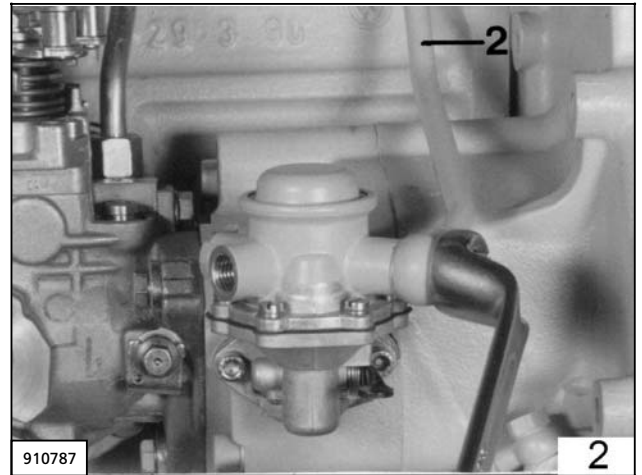
Removal:

Remove the fuel line 1 from the pre-filter to the fuel pump.

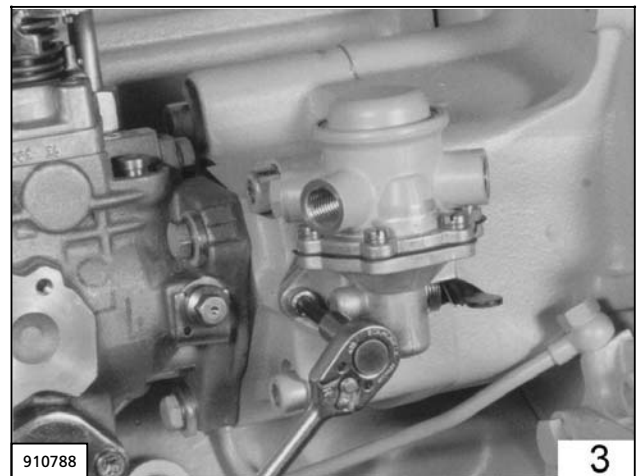
Note: Fuel pump type may vary from the type shown on this page.



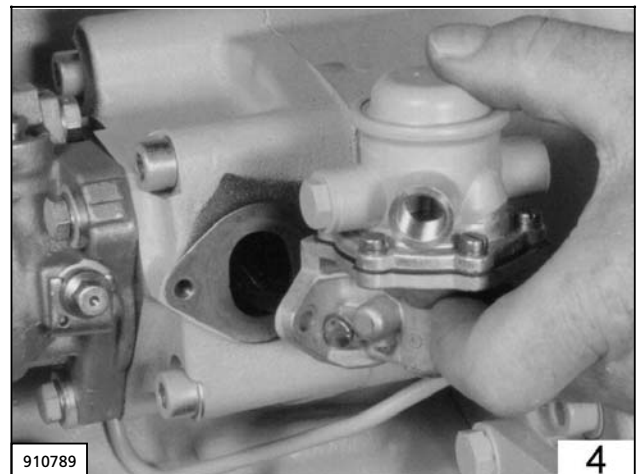
Remove the fuel line 2 from the fuel pump to the fine filter.

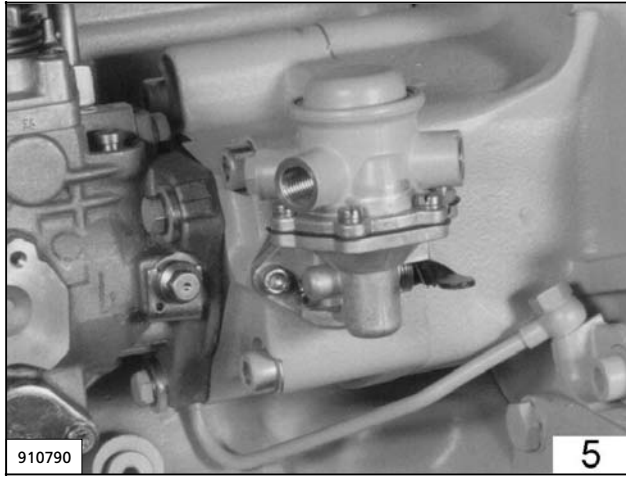


Loosen and remove the mounting screws on the fuel pump .



Remove the fuel pump from the pump carrier.

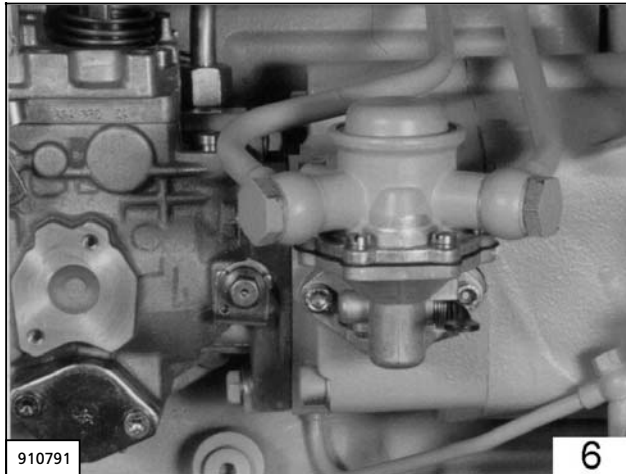




Installation:

Install the fuel pump with a new O-ring on pump carrier.

Install and tighten the screws.



Install fuel supply lines from the pre-filter to the fuel pump and from the fuel pump to the fine filter, using new seal rings.

Bleed the fuel system, see sub group 7.23.

Bleeding the Fuel System

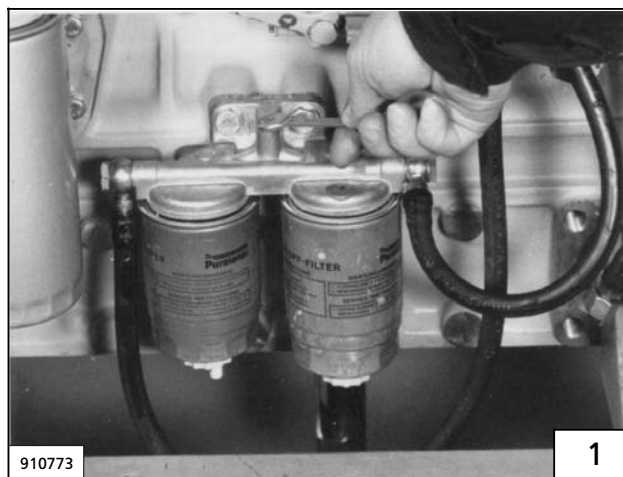
Open the shut off valve (if installed) on the fuel tank.

Loosen the bleeches screw on the fuel filter.

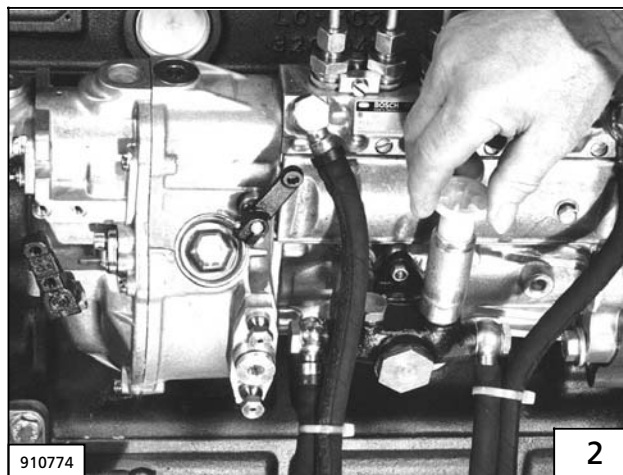
Note:

If the fuel prefilter is mounted between fuel tank and fuel pump, do not open the release screw at the fuel pre filter.

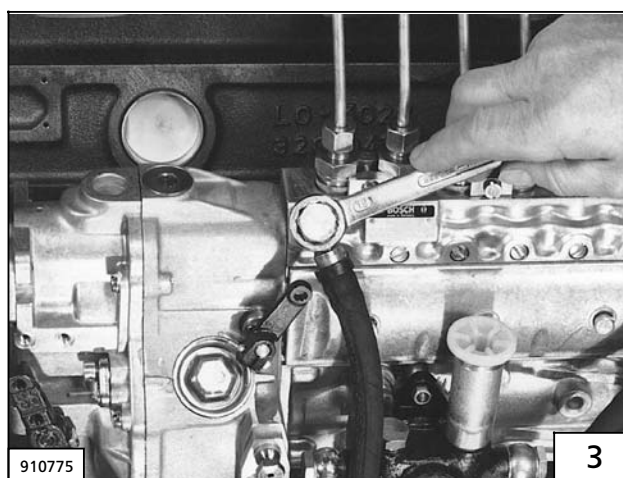
Only open the release screw at the fuel fine filter.



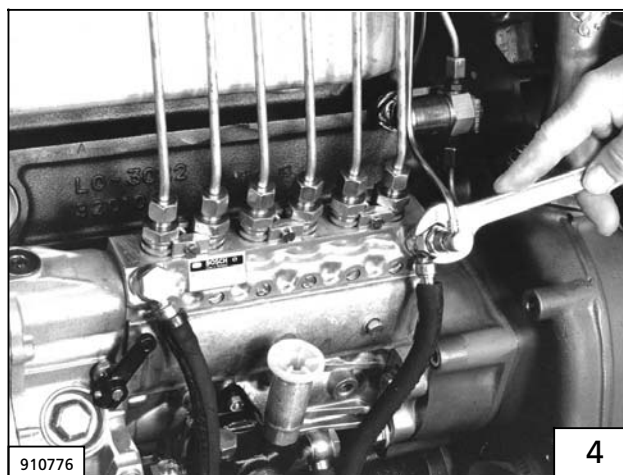
Pump the handle until all air has escaped and only fuel flows at the bleeder screw. Retighten the bleeder screw.

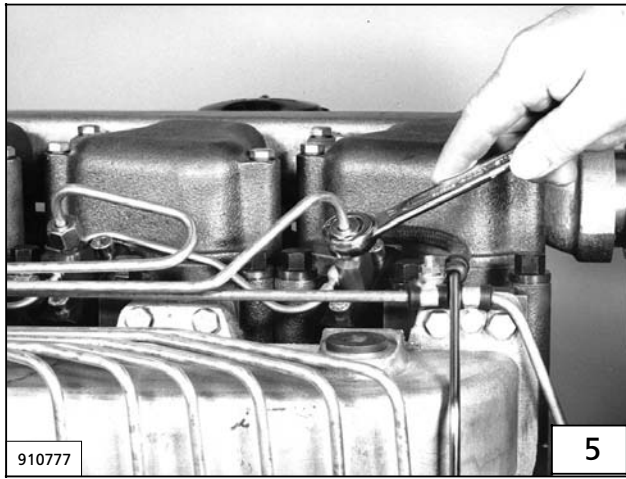


Loosen the fuel line from the filter and actuate the hand pump until there are not more air bubbles in the fuel. Retighten the fuel line.



Loosen the leak oil return line and the overflow valve, actuate the hand pump until there are no more air bubbles in the fuel. Retighten the overflow valve and line.





Loosen the union nut on the injection valves, actuate the starter until there are no more air bubbles in the fuel. Retighten the nut.

Start the engine and repeat the bleeding procedure if necessary.

Bleeding the fuel system

Distributor (VE) fuel injection pump

If installed, open the shut off valve on the fuel tank.

Loosen the bleeder screws on the fuel fine filters.



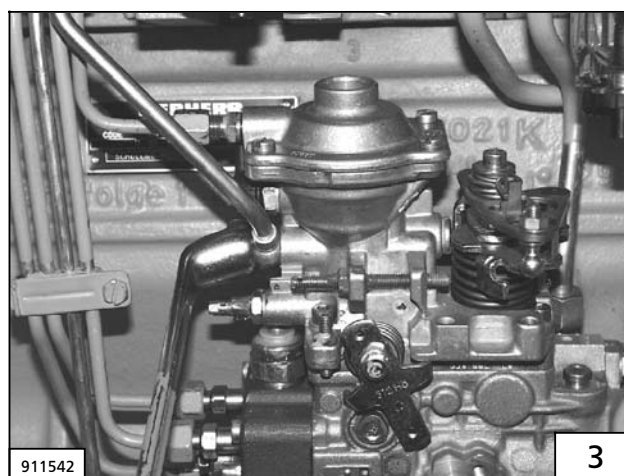
Actuate the lever on the fuel pump until clean fuel free of air bubbles appears.

Tighten the bleeder screws on the fine filters .



Loosen the fuel return line to the tank on the fuel pump.

Actuate the lever on the fuel pump until clean fuel free of air bubbles appears. Tighten the fuel line.



Loosen the union nuts on the fuel injector lines at the fuel injectors.

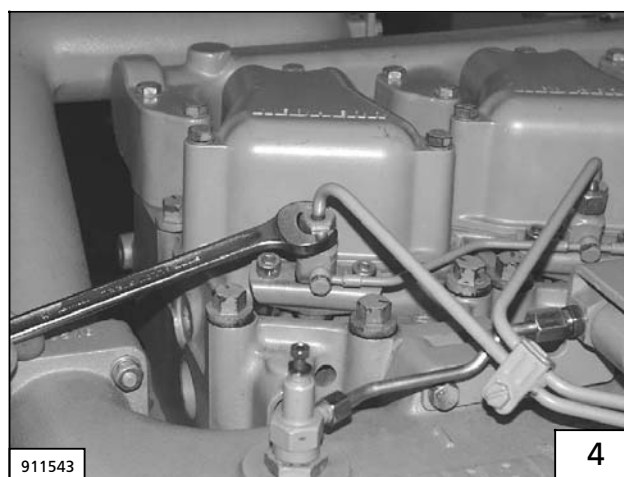
Note: To prevent the engine from starting, engage engine shut off / mechanical or electrical.

Actuate the starter until clean fuel free of air bubbles appears. Tighten the union nuts.

Start the engine and check the connections for leaks.

Note:

In case of starting problems, repeat the bleeding procedure, as necessary.



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8.15	Starter Motor Removal and Installation	
8.18	Hydraulic Pump Removal and Installation	
8.22	Hydraulic Pump Drive Removal and Installation (Installation on flywheel housing)	
8.23	Hydraulic Pump Drive Removal and Installation, Drive Shiftable (Installation on flywheel housing).	
8.24	Hydraulic pump drive removal and installation (Installation on drive gear box for fan drive)	
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8.28	Hydraulic Pump Drive Disassembly, Inspection and Assembly	Up to Engine No. 85 01 0266
8.29	Hydraulic Pump Drive Removal and Installation, Inspection and Repair	From Engine No. 85 01 0267
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8.50	Oil cooler plate, oil filter - oil cooler bypass valve and oil cooler removal and installation (Remote lube oil filter installation)	

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type
		D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
Datum/Edition/Date	Pumps/ Add-on Components	Blatt/Page/Feuille
05 / 2003		8.00

Sub Group Index

8.52	Exhaust Manifold Removal and Installation
8.55	Air Intake Manifold Removal and Installation
8.58	Coolant Manifold Removal and Installation
8.65	Engine brake removal and installation

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type
Datum/Edition/Date	Pumps/ Add-on Components	D 904 / 914 / 924 906 / 916 / 926
05 / 2003		Ab/from/à partir de
		Blatt/Page/Feuille
		8.00-01

Air compressor removal and installation

Use special tool No. 16

Removal:

Disconnect air intake line and pressure line on air compressor head.

Note:

Port indication on air compressor head

- 0 = Suction connection
- 2 = Pressure connection

Remove the lube oil supply line from the air compressor housing.

Note:

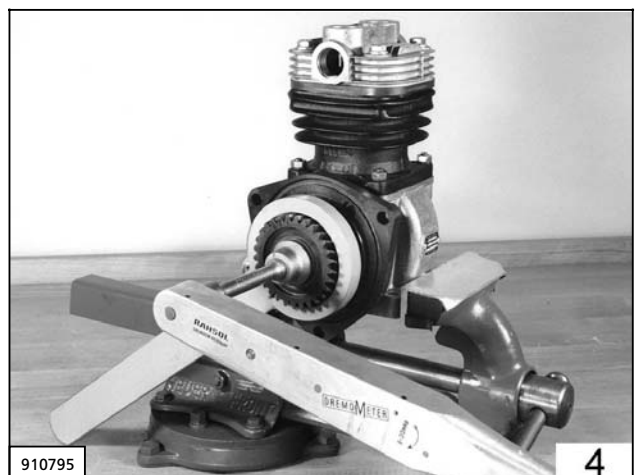
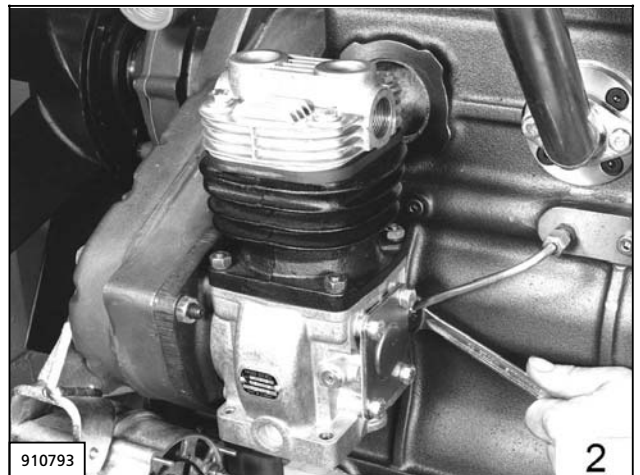
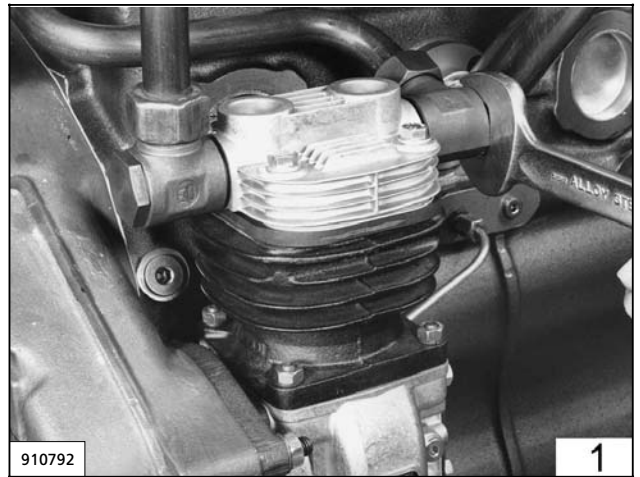
For air compressors cooled with coolant, remove the coolant supply line and the coolant return line from the air compressor head and from the engine.

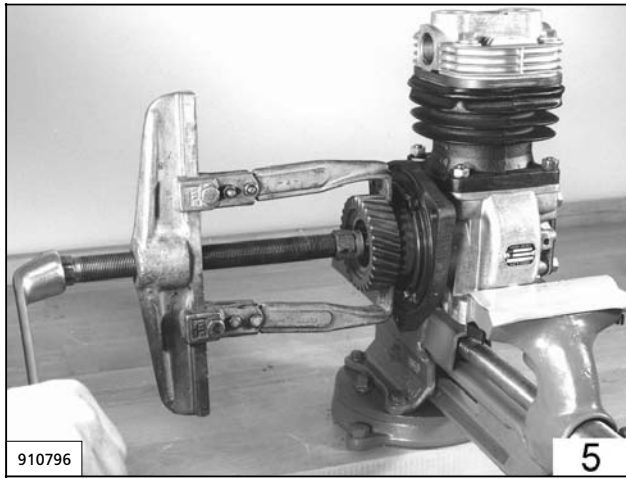
Drain the coolant, see sub group 2.01.

Remove the three mounting nuts on the flange.

Remove the air compressor from the timing gear cover.

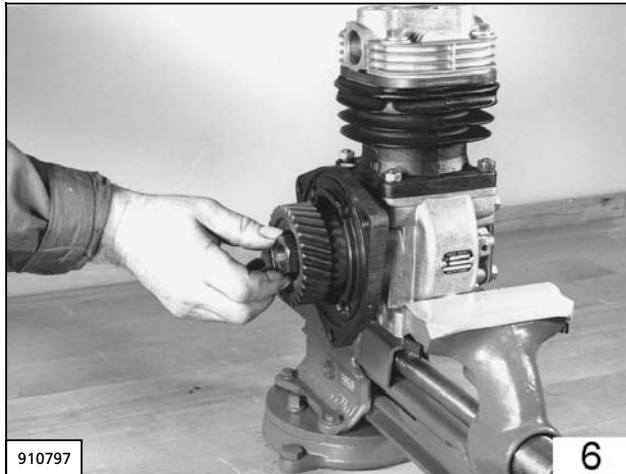
Clamp the air compressor in a vise with protective jaw covers. Hold the gear with the retaining device, special Tool No. 16, loosen and remove nut with the spring washer.





Remove holding device and remove drive gear from drive shaft with standard gear puller.

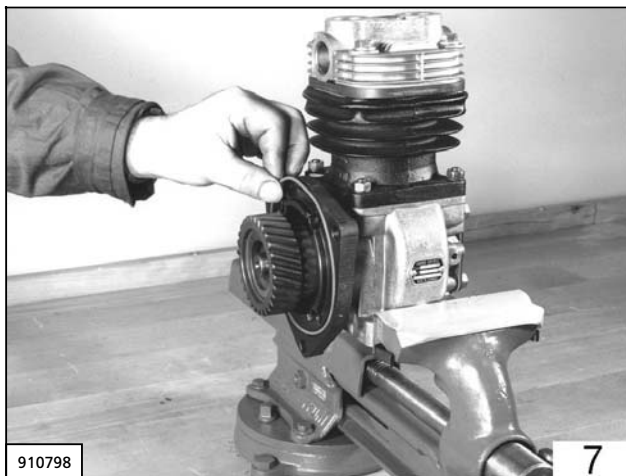
Remove O-ring from air compressor mounting flange and clean flange mounting surface.



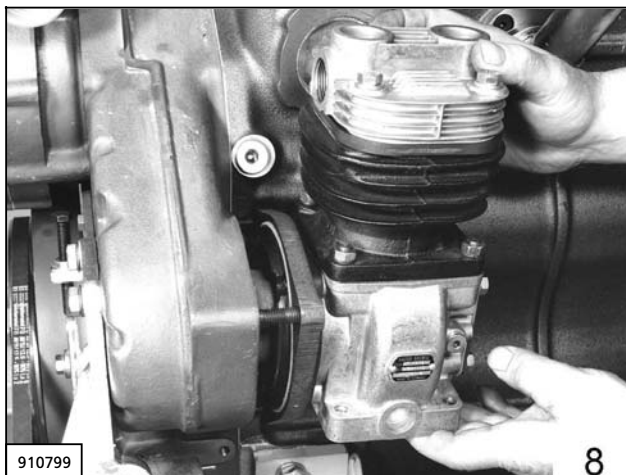
Air Compressor Installation:

Place air compressor in vise. To avoid damage use protective jaw covers. Place drive gear lock washer on drive shaft. Screw lock nut on drive shaft on torque lock nut to specification.

See Engine Specification for proper torque.



Lubricate new O-ring with grease and place O-ring in groove on air compressor mounting flange.



Remove air compressor from the vise and insert it into the timing case. Make sure the gears mesh! Install and tighten nuts.

Connect lube oil supply line, air intake line and pressure line, using new seals.

For air compressors cooled with coolant, install the coolant supply line and the coolant return line to the air compressor head and the engine.

Add coolant, see sub group 2.01.

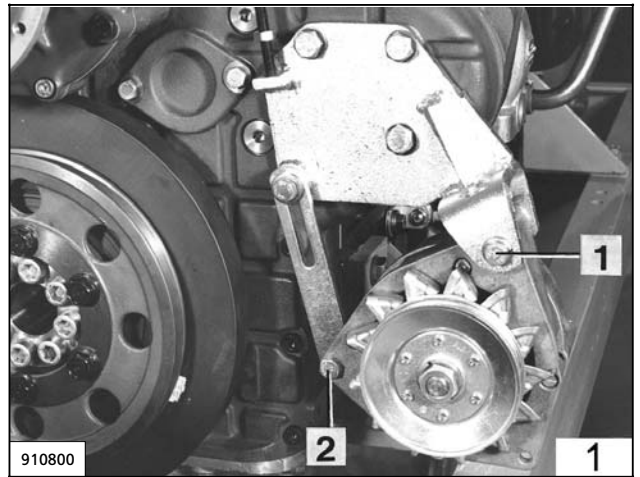
Alternator Removal and Installation

Alternator 28 Volt, 27Ampere

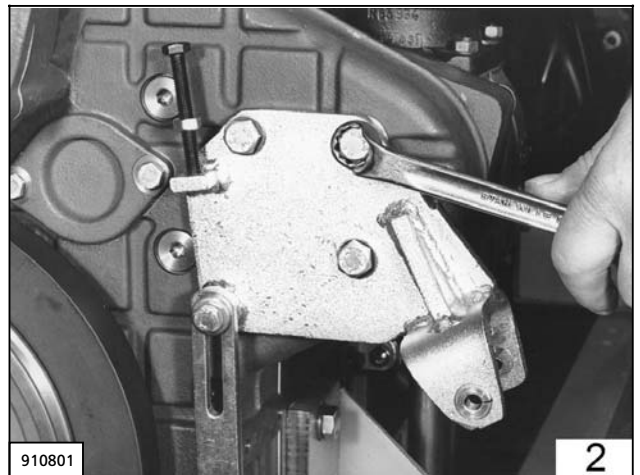
Alternator Removal:

To remove the V-belt, see sub group 2.27.

Disconnect all electrical wires from alternator.
Remove alternator mounting bolts Pos. 1 and Pos. 2. Remove alternator from alternator bracket.

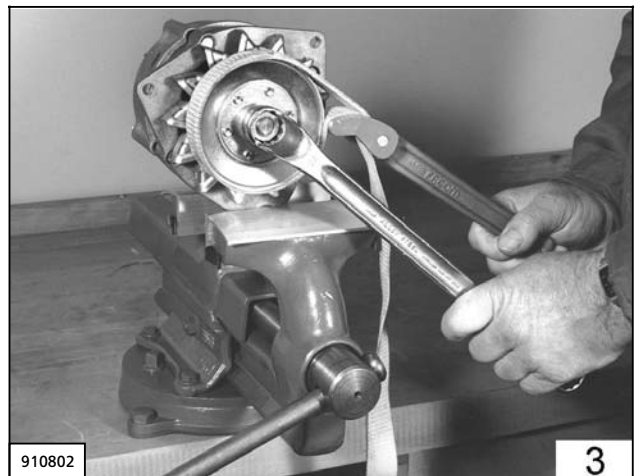


Loosen and remove alternator bracket mounting bolts. Remove bracket from timing and accessory drive gear housing.



Clamp alternator into a vise equipped with protective jaw covers. Hold pulley with strap-type oil filter wrench. Loosen the M 14 x 1.5 nut and remove it.

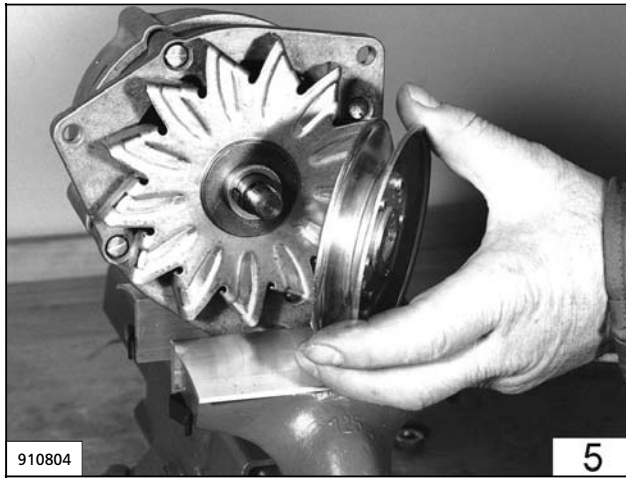
Remove lock washer, pulley, spacer, washer and fan wheel. Do not lose the woodruff key.



If the alternator shaft has an inside hex socket and an M 16 x 1.5 thread, place an inside socket (Allen) wrench in the socket to hold the shaft. Loosen and remove nut. Remove lock washer, pulley, spacer, washer and fan wheel.

This type alternator has no woodruff key.





Alternator Installation:

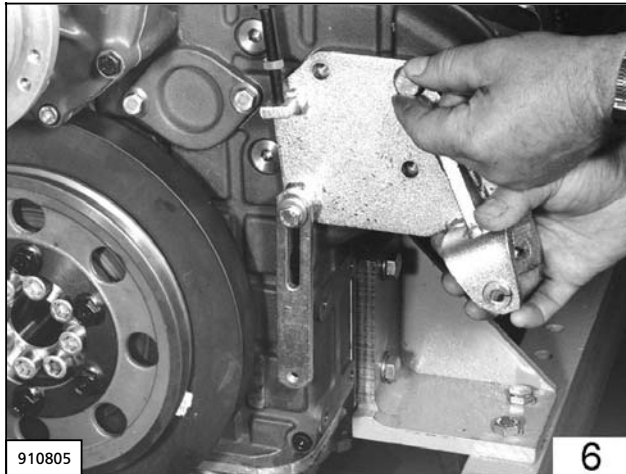
Place alternator in a vise. Push fan wheel, washer, spacer and pulley over the woodruff key.

If the shaft has a M 16 x 1.5 thread, there is no woodruff key.

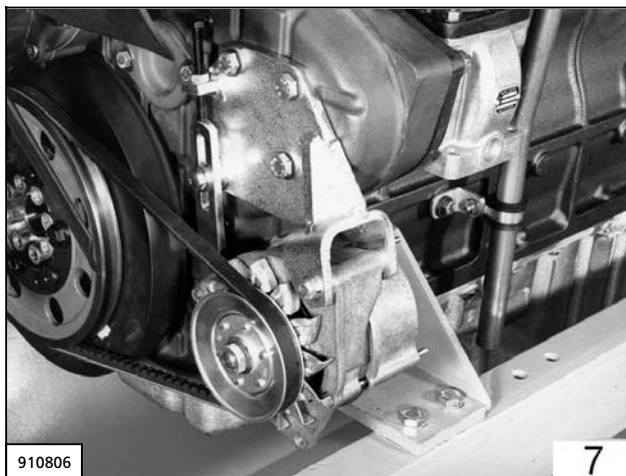
Install lock washer and tighten nut slightly.

Hold pulley with strap-type oil filter wrench (or inside socket wrench) and torque nut to specifications.

For torque values M 14 x 1.5 and M 16 x 1.5 nut, see Engine Specifications.



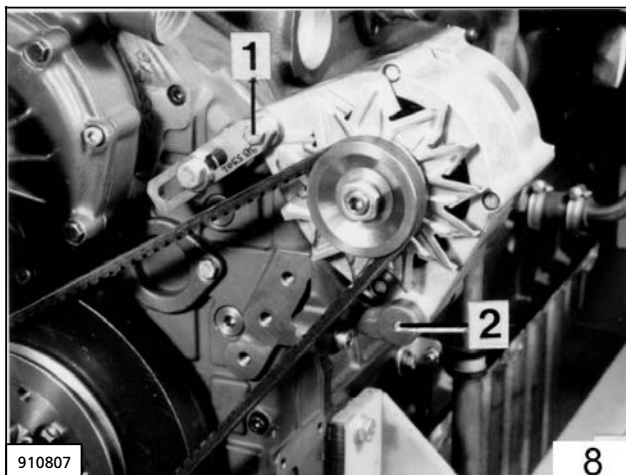
Install alternator bracket with mounting bolts to timing and accessory drive gear housing.



Tighten alternator to alternator bracket with mounting bolts and place V-belt on pulley.

To adjust alternator V-belt tension see sub group 2.27.

Reconnect all electrical wires to proper terminals on alternator.



Remove and Install Alternator

Alternator 28 Volt, 55 Ampere.

Removal:

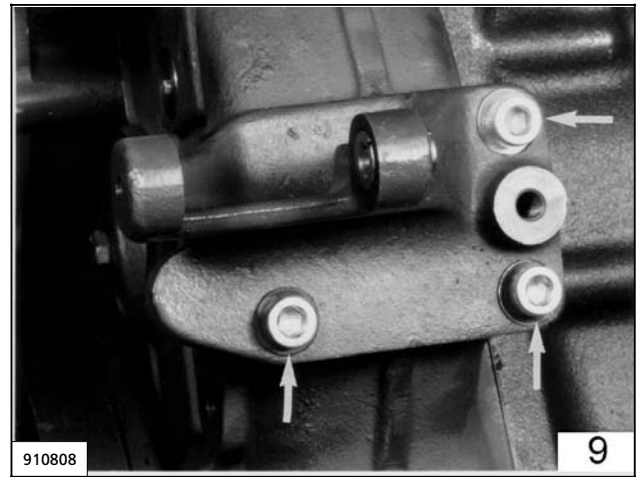
Remove V-belt - see sub group 2.27.

Disconnect all electrical wires from the alternator.

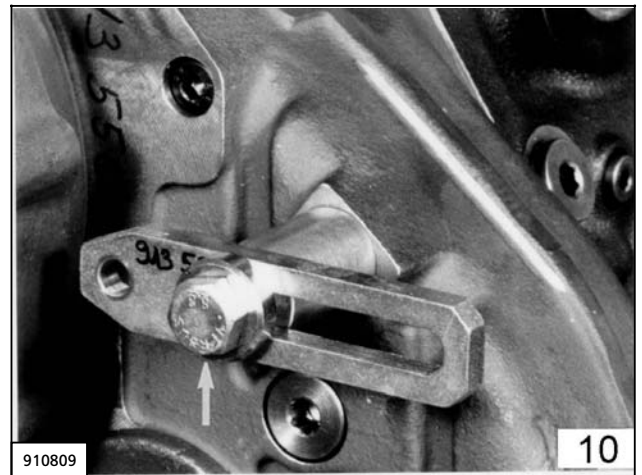
Loosen screw 1 (hold nut) and remove.

Remove screw 2 and lift off alternator.

Loosen screws at the alternator bracket and remove. Remove alternator bracket.

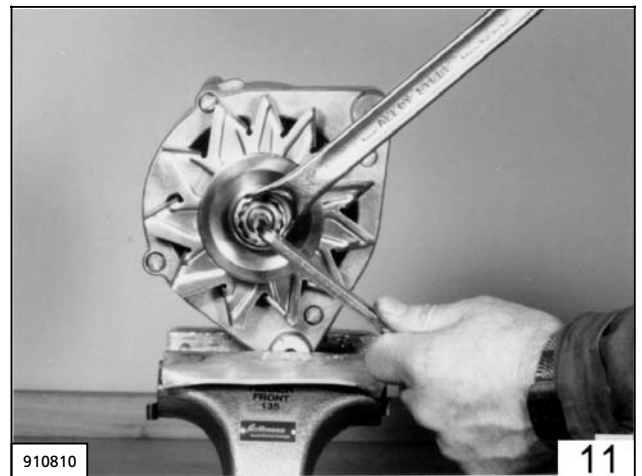


At the timing gear box, loosen and remove the tension bracket screw. Remove tension bracket and spacer.



Clamp alternator into a vise equipped with protective jaw covers. Place an inside socket (Allen) wrench in the socket to hold the shaft. Loosen and remove nut. Remove lock washer, pulley, spacer and fan.

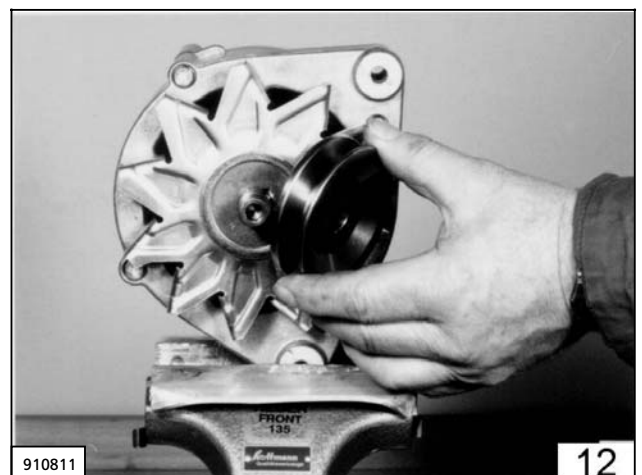
Do not lose the woodruff key.

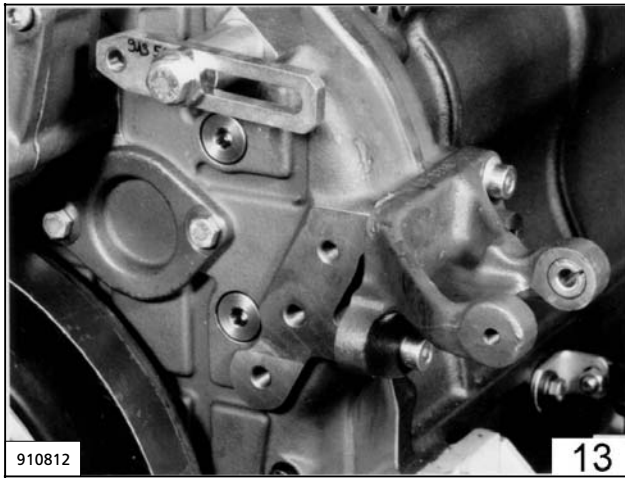


Installation:

Place alternator in a vise. Push fan, spacer and pulley over woodruff key onto the shaft. Replace lock washer and start nut on threads. Insert socket wrench into socket to hold shaft and tighten nut.

For torque value, see Engine Specifications.





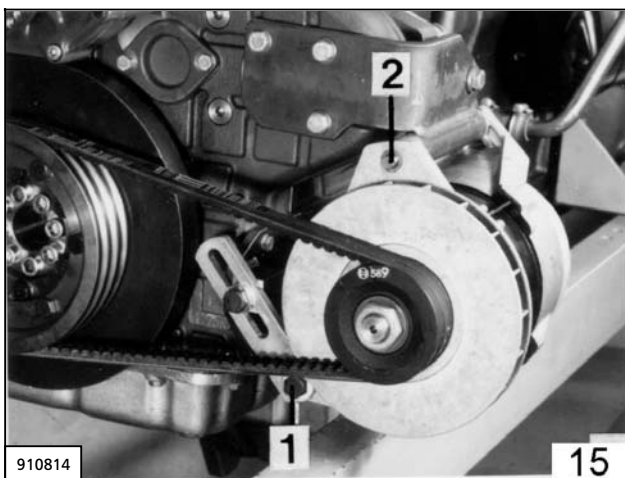
Install alternator bracket to timing gear case with screws. Attach tension bracket and spacer to timing gear case with screw.



Install alternator to the bracket and the tension bracket. Replace V-belt and adjust to proper tension.

To replace and adjust V-belt, see sub group 2.27.

Reconnect all electrical wires.



Remove and Install Alternator

Alternator 28 Volt, 95 Ampere

Removal:

Remove V-belt see, sub group 2.27.

Disconnect electrical wires from alternator.

If installed, remove hose from cooling air flange.

Remove screws 1 and 2. Lift off alternator.

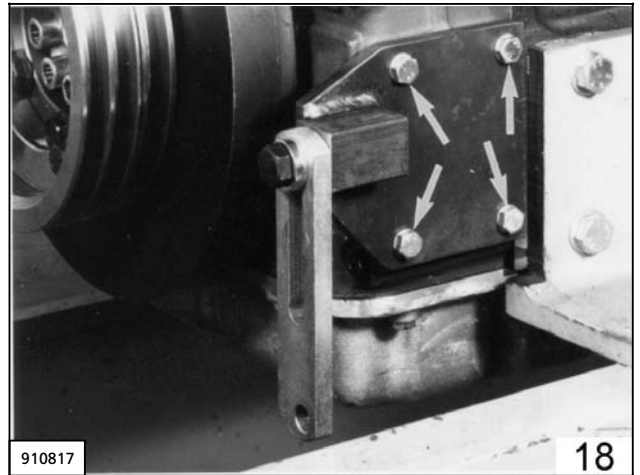


Remove screws from alternator bracket and remove bracket.

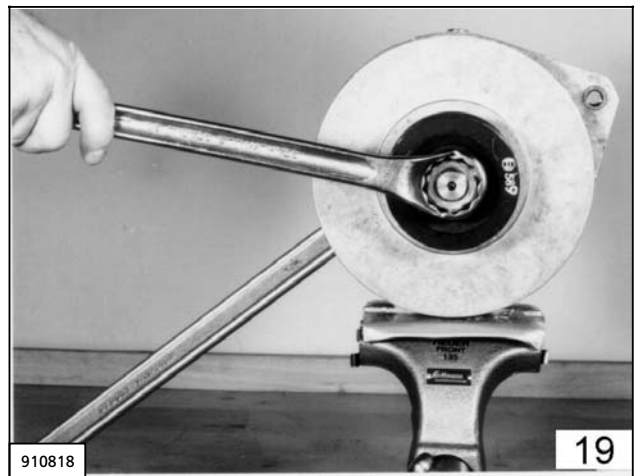
At the bracket mounting plate, remove nuts. Remove mounting plate.



At the mounting bracket, remove screws holding the tension bracket. Remove mounting bracket together with tension bracket.



Place alternator in a vise equipped with protective jaw covers. Hold fan with pry bar, loosen nut and remove. Remove lock washer, pulley, woodruff key and fan.

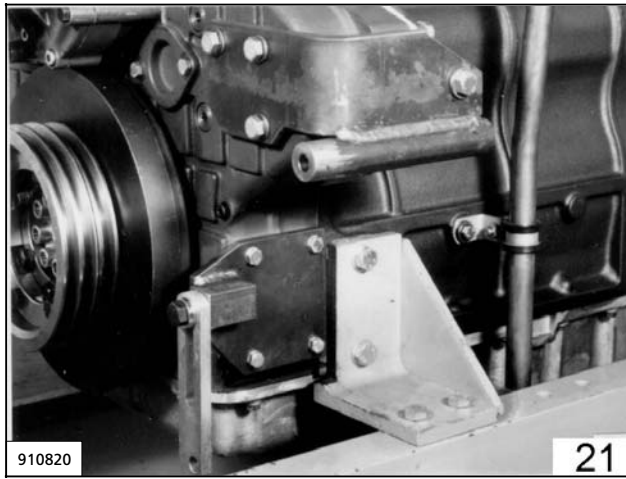


Installation:

Place alternator in vise. Push fan onto shaft and insert woodruff key. Push pulley over the woodruff key onto the shaft, replace lock washer and nut. Hold fan with pry bar and tighten nut.

For torque value, see Engine Specifications.





Reinstall bracket for tension bracket. Attach mounting plate and alternator bracket with screw and nuts to the timing gear box.



Install alternator, replace V-belt and adjust to proper tension.

To replace and adjust the V-belt, see sub group 2.27.

Reconnect all electrical wires.

If installed, attach hose to cooling air hose flange.

Air conditioner compressor and alternator removal and installation, tension pulley disassembly and assembly

Up to engine No. 2000 01 0069

Removal:

Remove V-belt, see sub group 2.28.

Remove mounting screws from the air conditioning compressor on the mounting bracket.

Remove the air conditioning compressor from the mounting bracket.



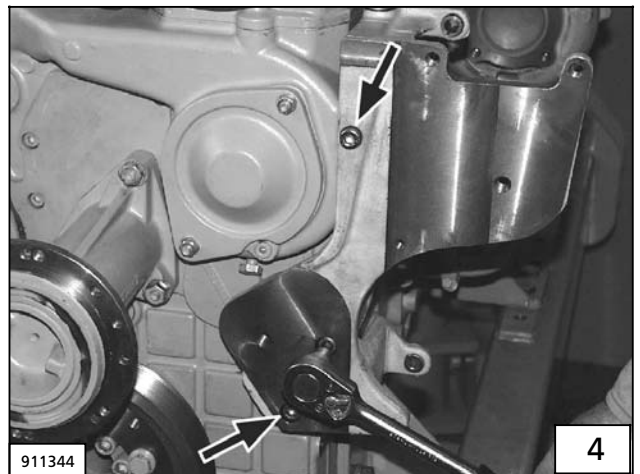
Remove the mounting screws for the alternator on the mounting bracket and remove the alternator .

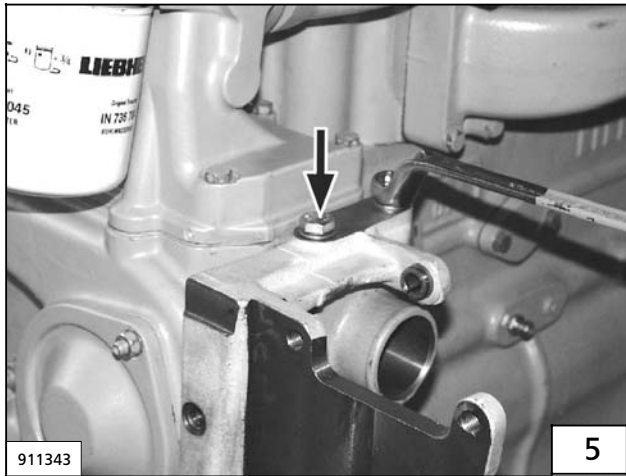


Remove the mounting screws for the tension pulleys and remove them from the mounting bracket.



Remove the three front mounting screws from the mounting bracket to the timing gear cover.

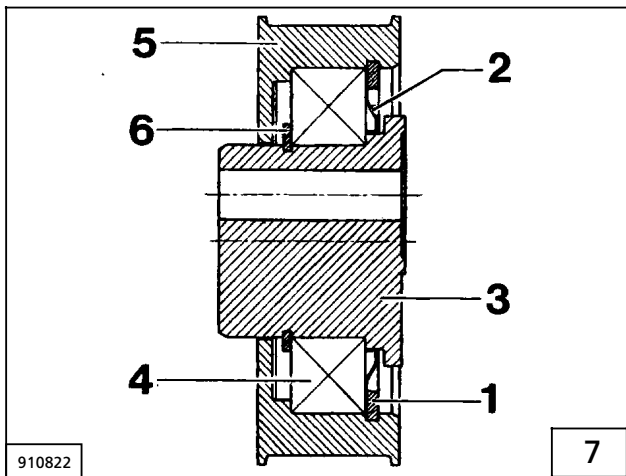




On the top of the timing gear cover, remove the two screws.

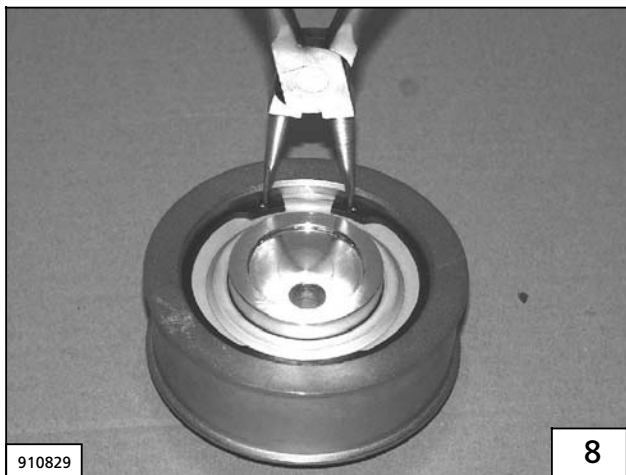


Remove the mounting bracket from the timing gear cover.



Disassemble tension pulley:

For drawing, see fig. 7.

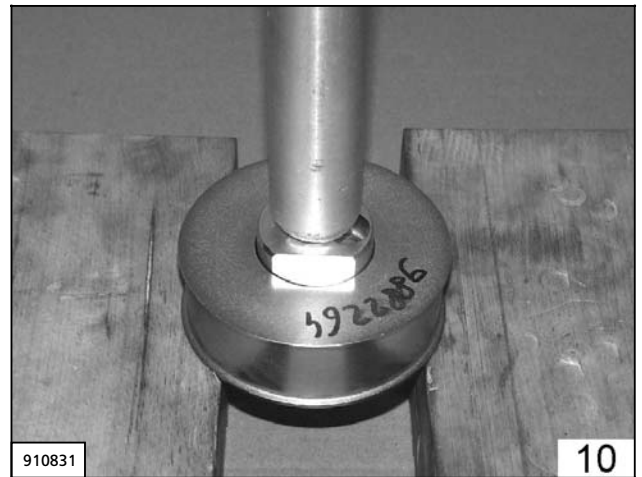


Remove the snap ring 1.

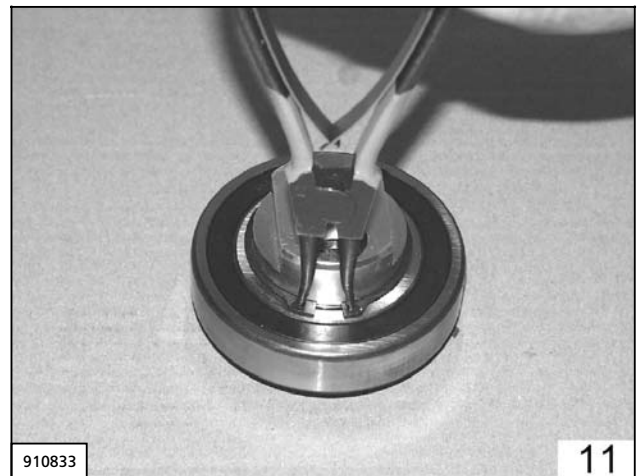
Remove the protective ring 2 .



Place the pulley on a level surface between two blocks as shown in fig. 10 and drive the pulley shaft 3, with ball bearing 4 from the pulley 5 by hitting the pulley shaft 3 with a soft (brass) punch.



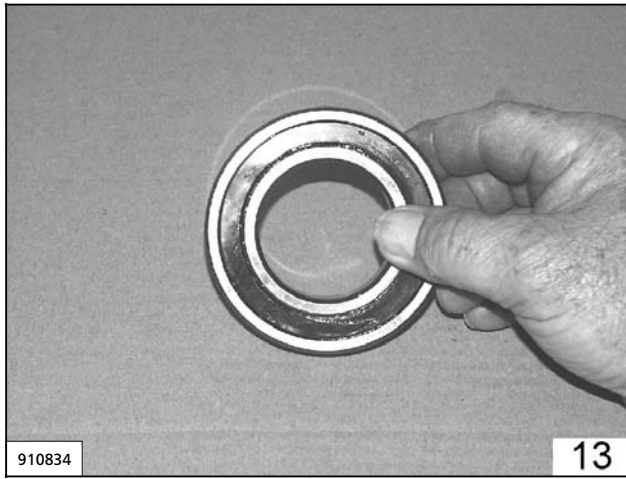
Remove the snap ring 6.



Place the ball bearing 4 on a level surface between two blocks as shown in fig. 12 and drive the ball bearing 4 from the pulley shaft 3 by hitting the pulley shaft 3 with a soft (brass) punch.

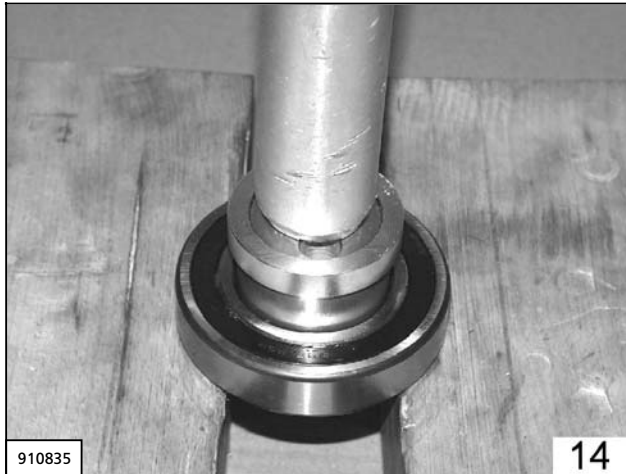
Clean all parts.





Check the ball bearing 4 for play and noise (wear) (visual and sound check).

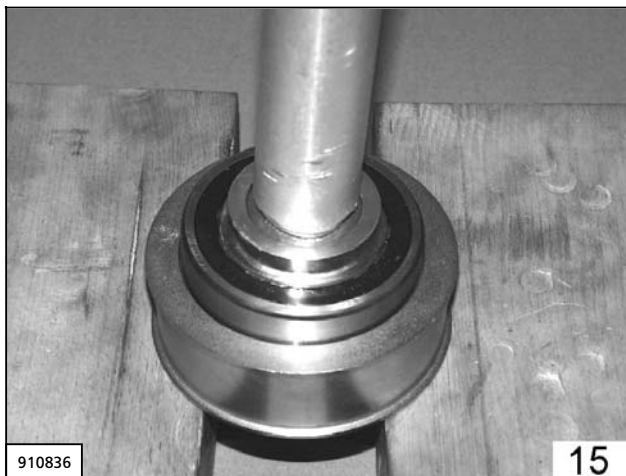
Replace worn and damaged parts .



Tension pulley assembly:

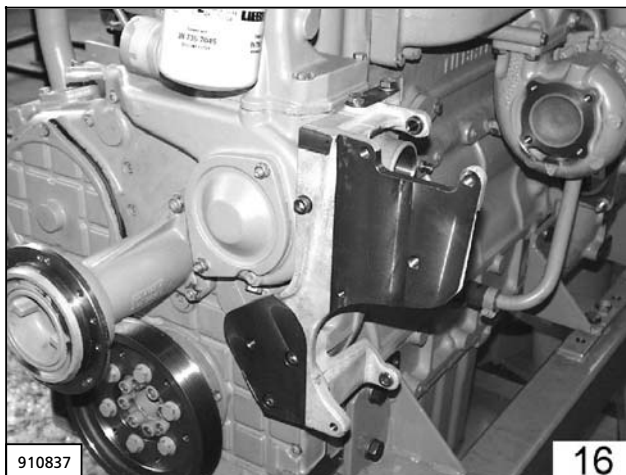
Press the ball bearing 4 onto the pulley shaft 3 until bearing is seated on the shoulder.

Install the snap ring 6.



Push the pulley shaft 4 with ball bearing 4 into pulley 5 until it is seated.

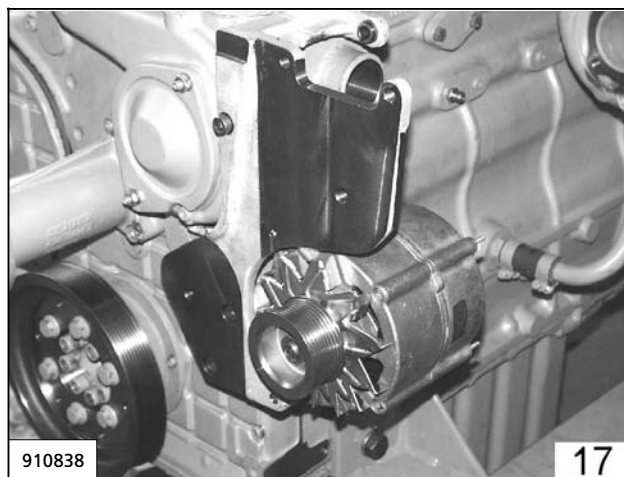
Install the protective ring 2 and the snap ring 1.



Installation:

Install bracket to timing gear cover.

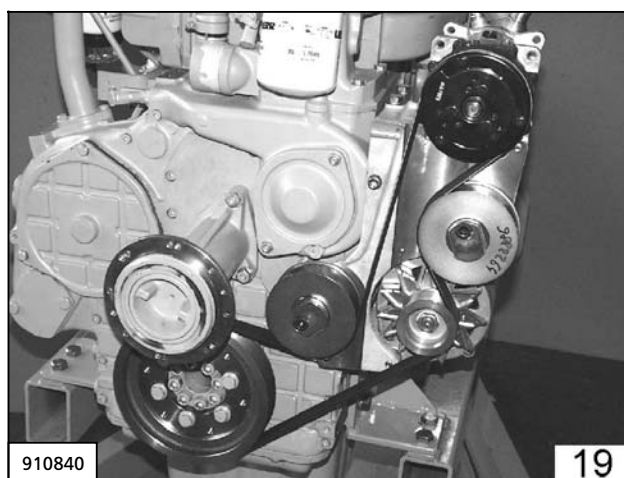
Install the alternator on the mounting bracket.



Install the air conditioning compressor on the mounting bracket.



Install the pulleys on the mounting bracket.
Install and tension the V-belt, see sub group 2.28



Air conditioner compressor and alternator removal and installation, tension pulley disassembly and assembly

From engine No. 2000 01 0070

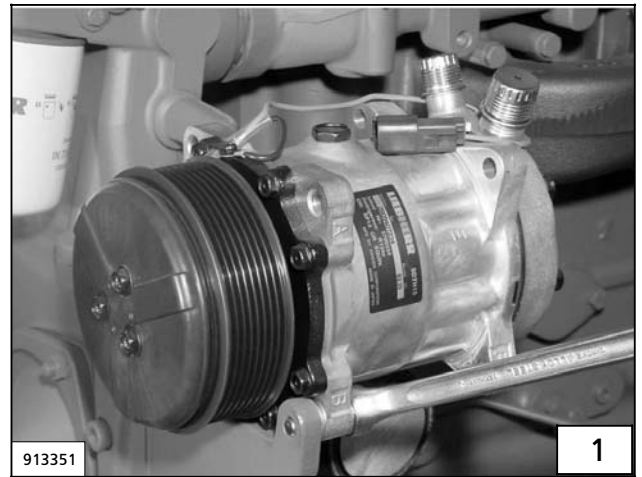
Removal:

Remove V-belt, see sub group 2.28.

Remove the connections on the air conditioner compressor.

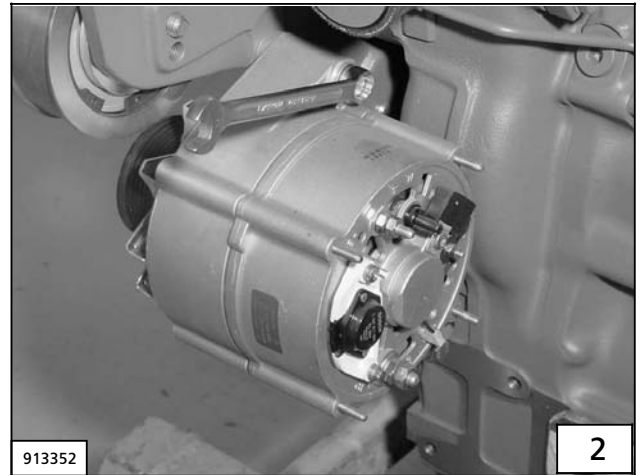
Remove mounting screws from the air conditioning compressor on the mounting bracket.

Remove the air conditioning compressor from the mounting bracket.



Disconnect the electrical connections from the alternator.

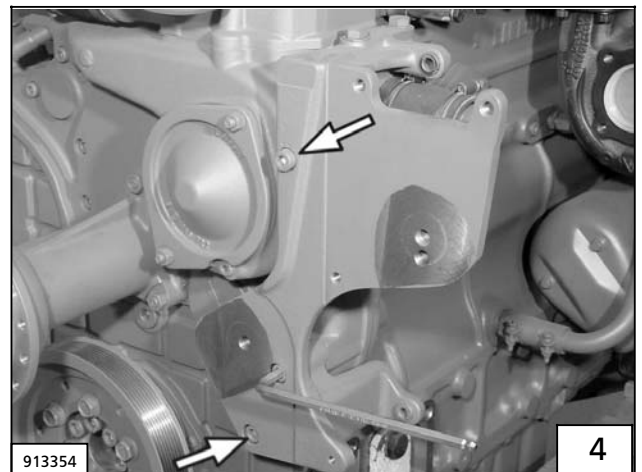
Remove the mounting screws for the alternator on the mounting bracket and remove the alternator.

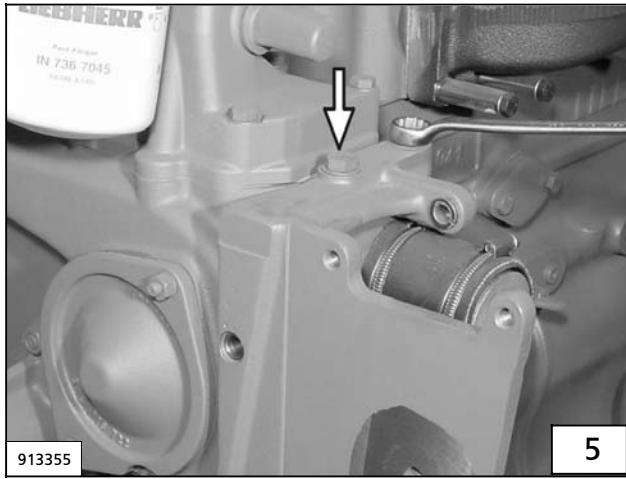


Remove the mounting screws for the tension pulleys and remove them from the mounting bracket.



Remove the three front mounting screws from the mounting bracket to the timing gear cover.

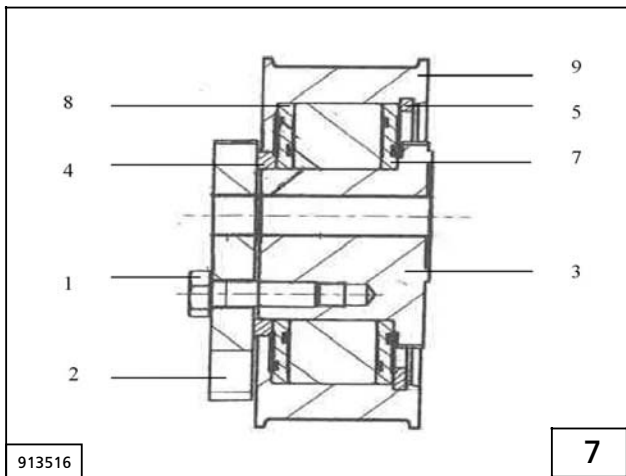




On the top of the timing gear cover, remove the two screws.

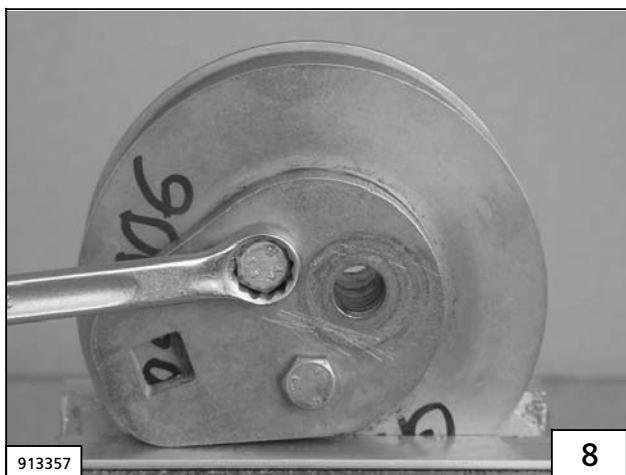


Remove the mounting bracket from the timing gear cover.



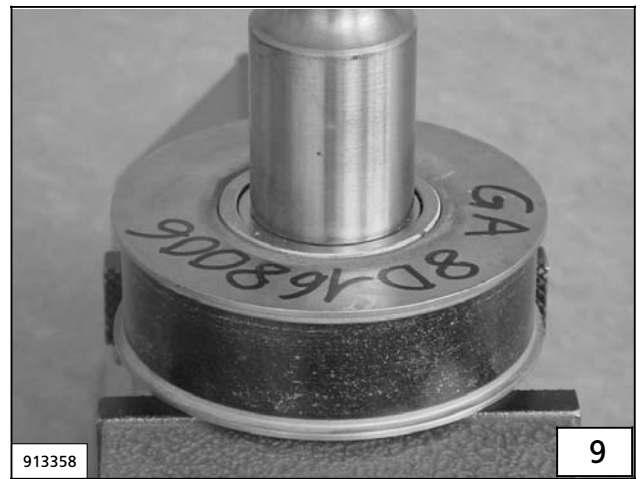
Disassembly tension pulley:

For drawing, see fig. 7.



Remove screws 1 and remove clamping latch 2.

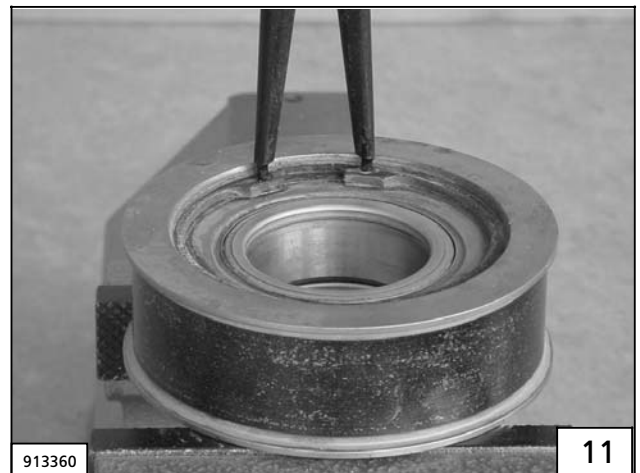
Place the pulley on a level surface and push out the pulley shaft 3.



Remove the pressure ring 4.



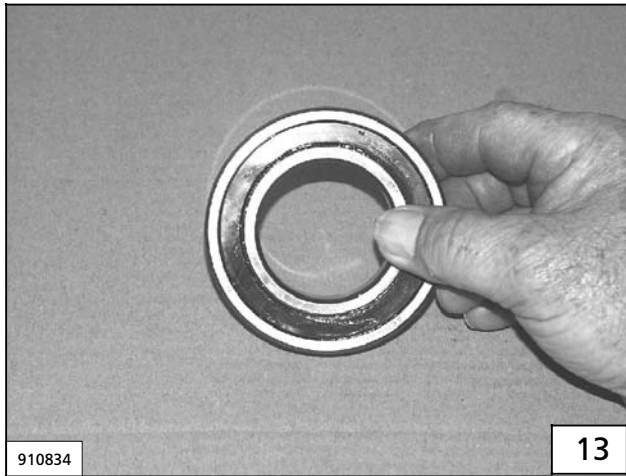
Remove the snap ring 5.



Place the pulley on a level surface and push out the ball bearing 6 and guard ring 7, 8 from the pulley with a soft punch.

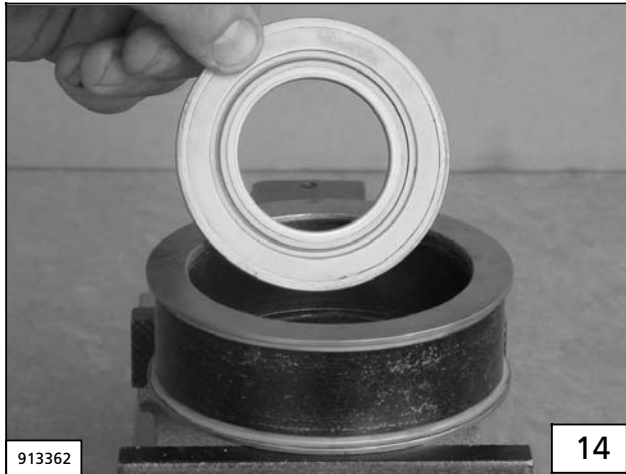
Clean all parts.





Check the ball bearing 6 for play and noise (wear) (visual and sound check).

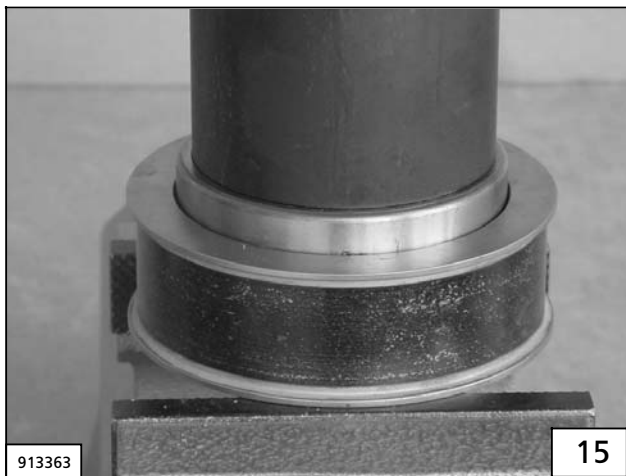
Replace worn and damaged parts .



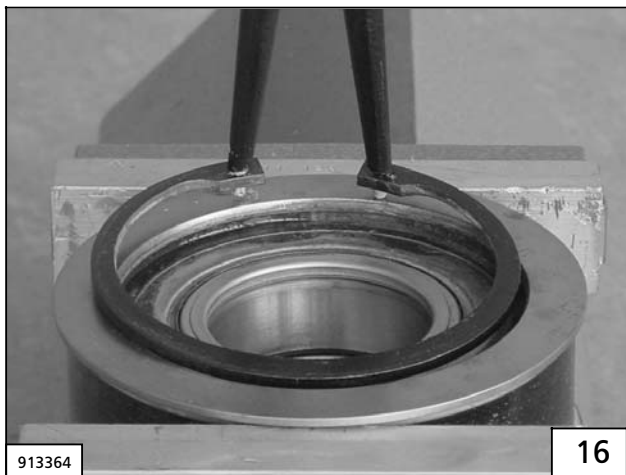
Tension pulley assembly:

Grease lightly the pulley washer 9 on the inside.

Put in guardring 8 in the pulley washer 9.

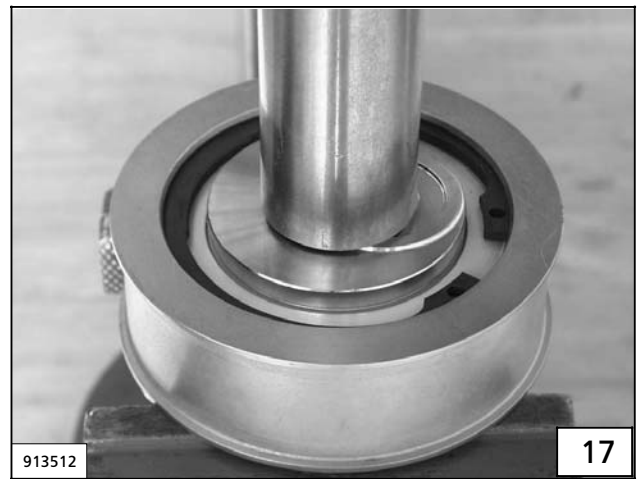


Press the ball bearing 6 into the pulley washer 9.



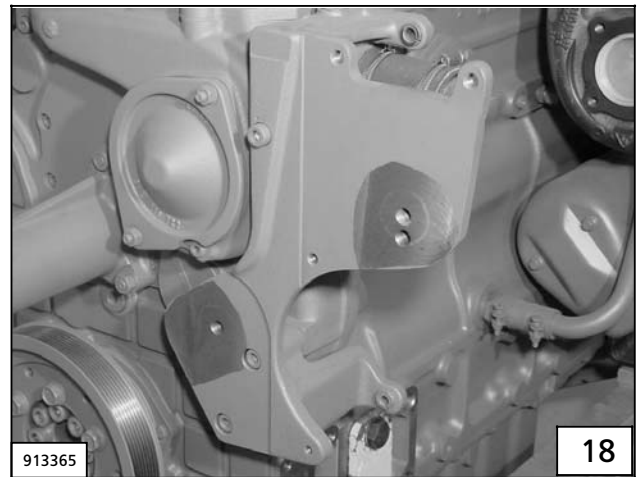
Put in guardring 7 and install the snapping 5.

Push the pulley shaft 3 into pulley until it is seated.
Put on pressure ring 4, install claming latch 2 and
tight with screws 1.

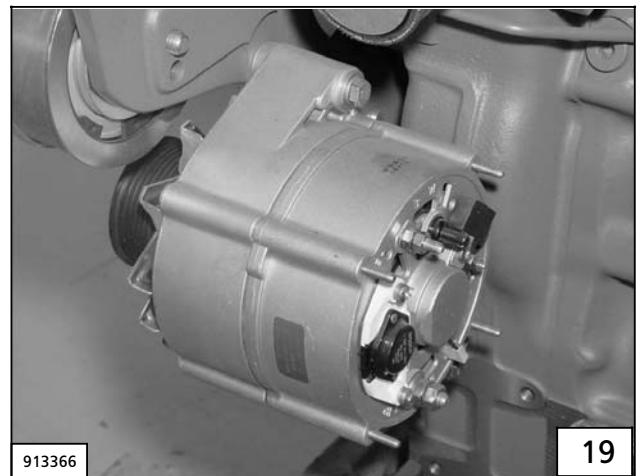


Installation:

Install bracket to timing gear cover.



Install the alternator on the mounting bracket.
Connect the electrical connection on the alternator.



Install the air conditioning compressor on the
mounting bracket.
Attach the connections on the air conditioner
compressor.





Install the pulleys on the mounting bracket.

Install and tension the V-belt, see subgroup 2.28.

Air conditioner compressor and alternator removal and installation (Dayco - fastening device)

Removal:

Remove V-belt, see sub group 2.29.

Remove the connections on the air conditioner compressor.

Remove mounting screws from the air conditioning compressor on the mounting bracket.

Remove the air conditioning compressor from the mounting bracket.



Disconnect the electrical connections from the alternator.

Remove the mounting screws for the alternator on the mounting bracket and remove the alternator.



Loosen and remove the mounting screws for the tensioning device.

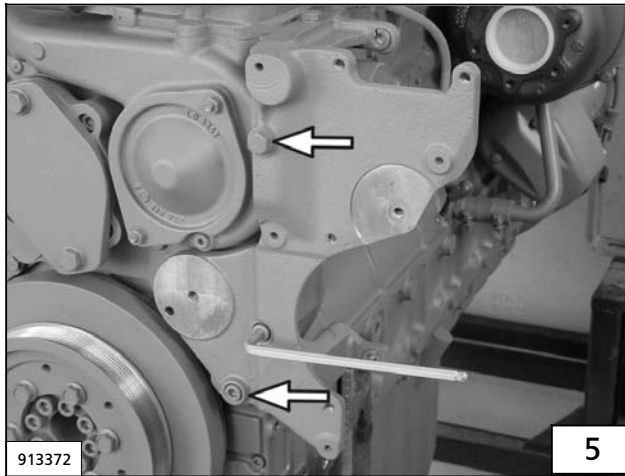
Remove the tensioning device from the mounting bracket.



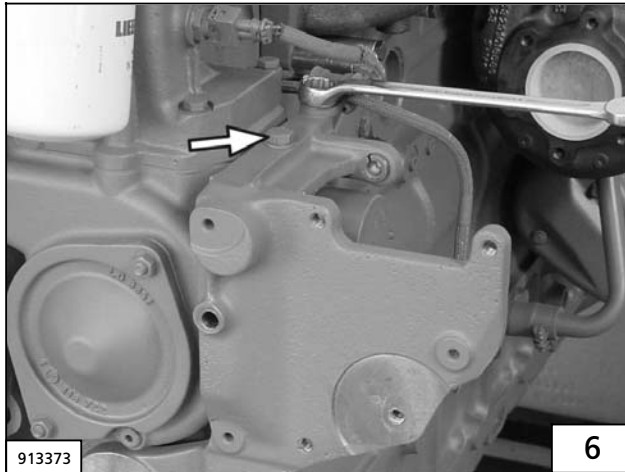
Loosen and remove the mounting screw for the change over pulley.

Remove the change over pulley from the mounting bracket.

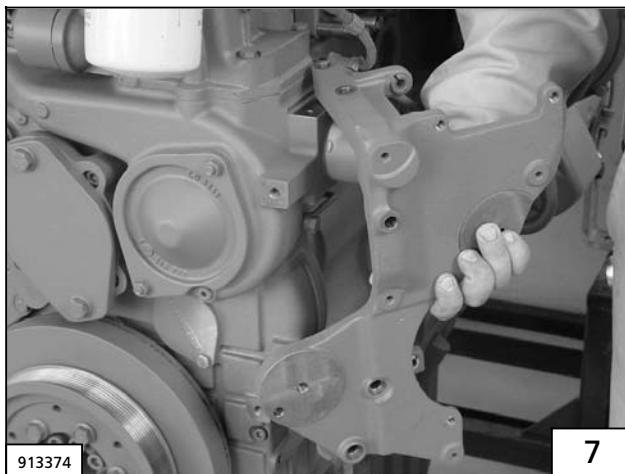




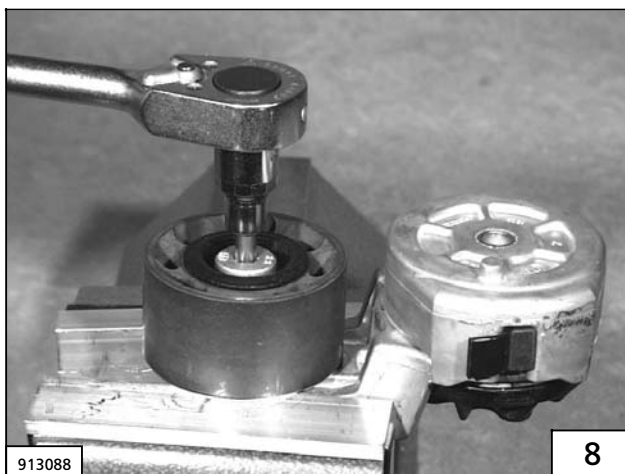
Remove the three front mounting screws from the mounting bracket to the timing gear cover.



On the top of the timing gear cover, remove the two screws.



Remove the mounting bracket from the timing gear cover.

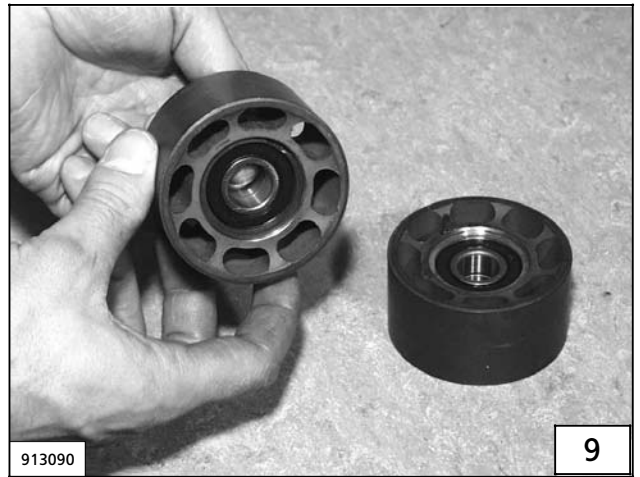


Place the tensioning device into a bench vise with protective jaw covers.

Loosen and remove the screw, remove the tension pulley.

Check the tension pulley and the change over pulley for play and quiet run (visual and sound check).

Replace defective pulleys.

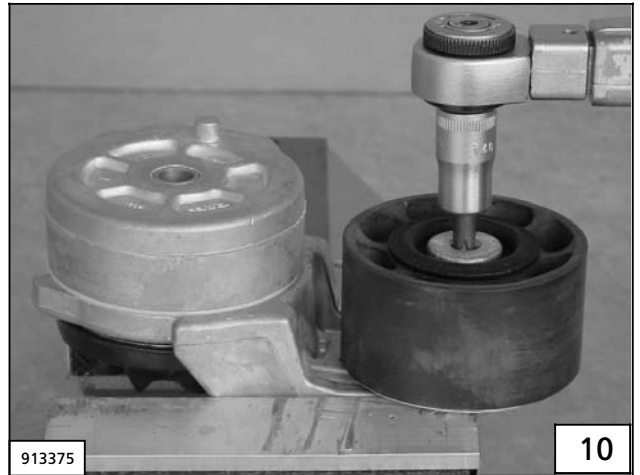


Installation:

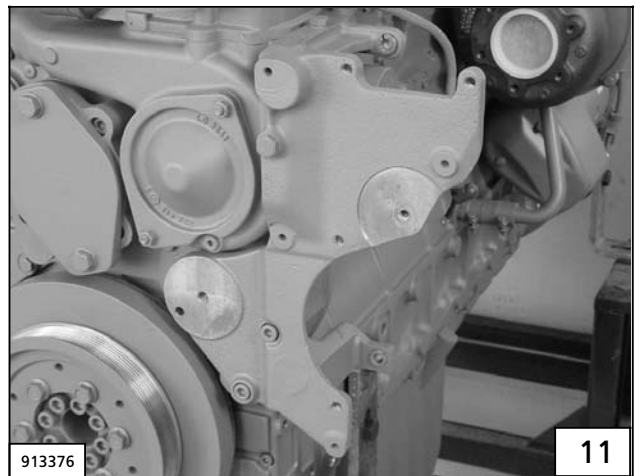
Place the tensioning device into a bench vise with protective jaw covers.

Attach the tension pulley, install the screw and tighten.

For tightening torque, see Technical Data.

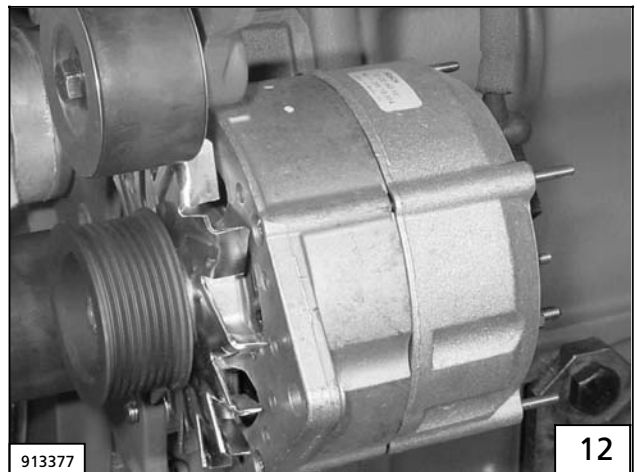


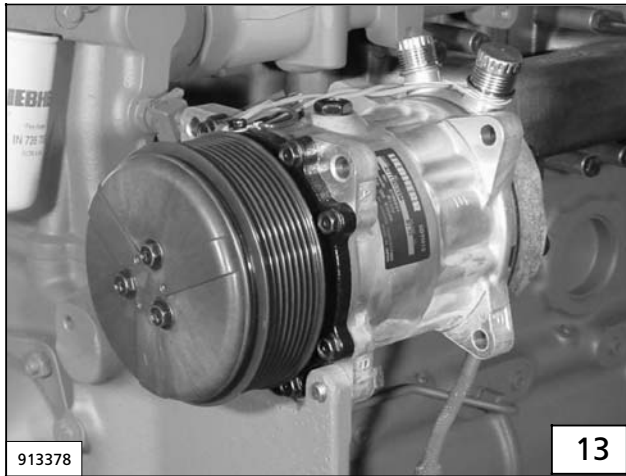
Install bracket to timing gear cover.



Install the alternator on the mounting bracket.

Connect the electrical connections on the alternator.





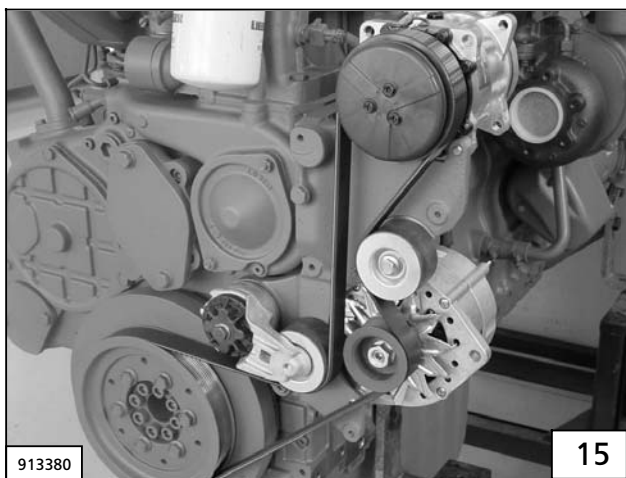
Install the air conditioning compressor on the mounting bracket.

Attach the connection on the air conditioner compressor.



Install the change over pulley and the tensioning device, install the screw and tight.

For tightening torque, see Technical Data.



Place the V-belt, see sub group 2.29.

Starter removal and installation

Removal:

Disconnect the battery.

Disconnect the electrical connections on the starter.

CAUTION: Observe battery safety guidelines!

Remove mounting nuts.

Remove the starter from the studs on the flywheel housing.

Note:

Starters which are sealed to the flywheel housing are fitted with an O-ring on the starter mounting flange.

Check O-ring, replace, if necessary. Lube O-ring lightly with grease before installation.

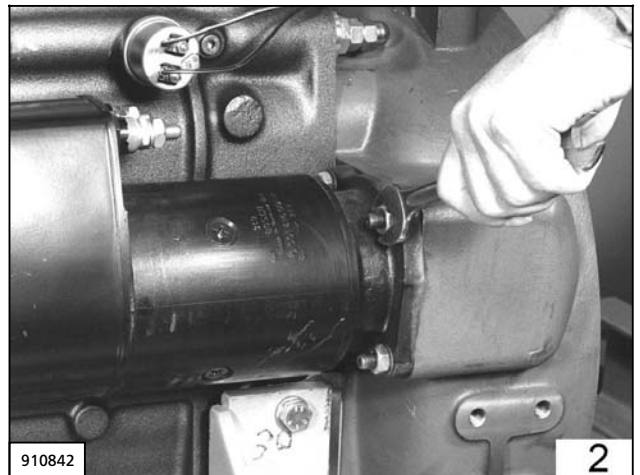
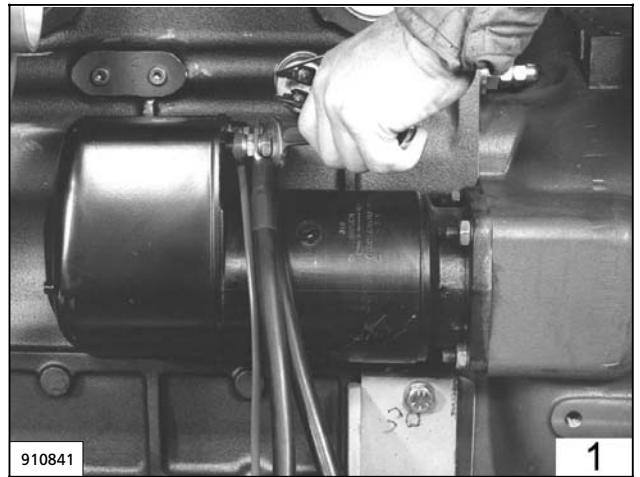
Installation:

Push the starter over the studs onto the flywheel housing. Install and tighten the nuts.

Attach electrical connections on the starter.

Reconnect the battery cables.

CAUTION: Observe safety guidelines!



Hydraulic Pump Removal and Installation

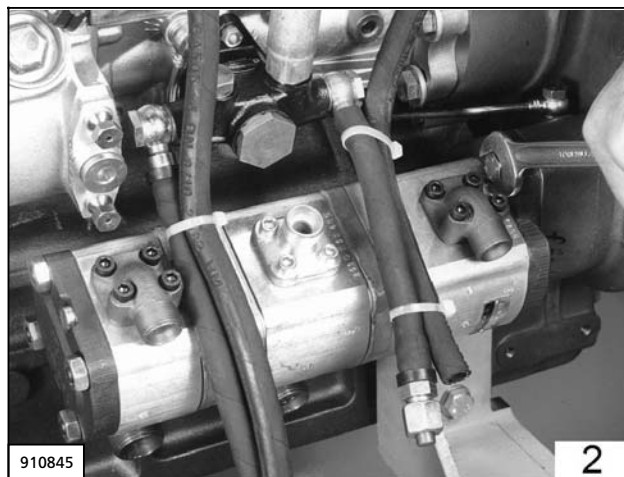
Installation with Intermediate Flange at the Injection Pump-side of the Timing Gear Box (Flange Pump)

Hydraulic Pump Removal:

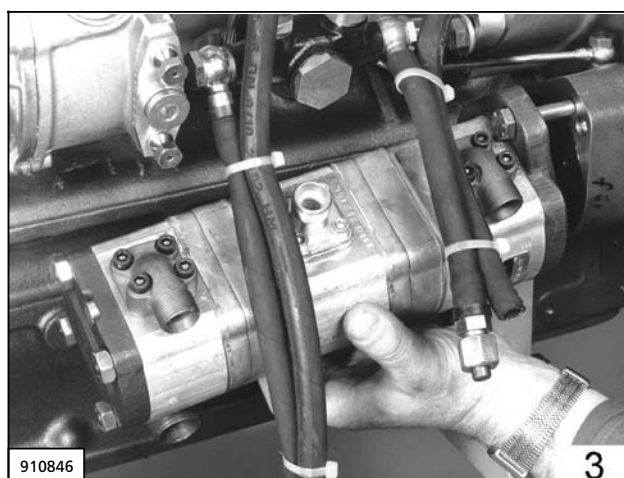
Mark and disconnect hydraulic lines from hydraulic pump.



Unscrew and remove pump flange mounting bolts.



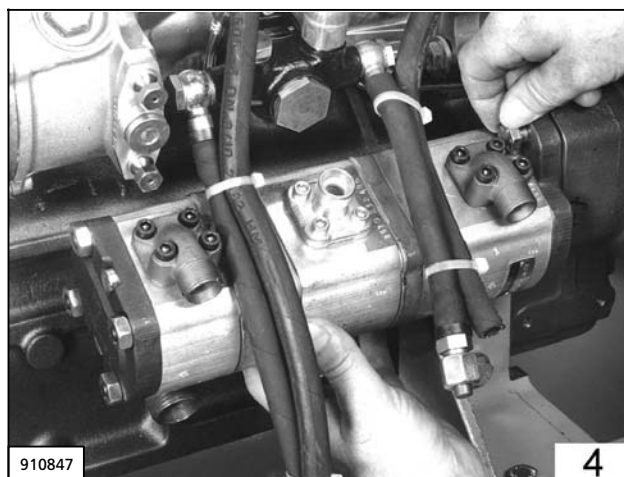
Remove hydraulic pump from intermediate flange. Clean hydraulic pump flange and intermediate flange mounting surfaces.

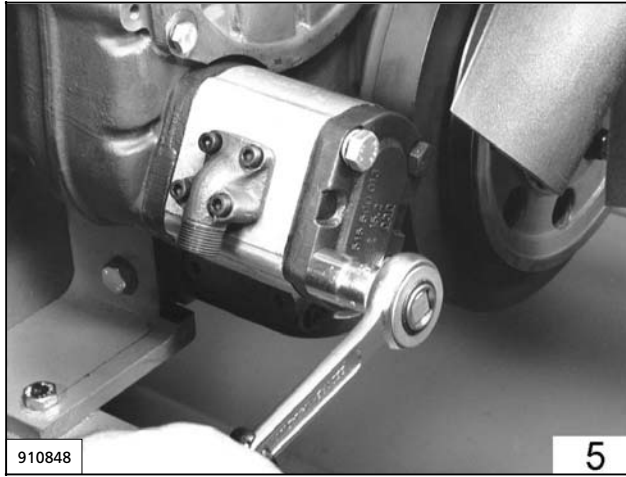


Hydraulic Pump Installation:

Place new gasket on pump flange surface and insert hydraulic pump with splined shaft into gear wheel hub and intermediate flange. Screw in and torque pump flange mounting bolts.

Reconnect hydraulic lines to the proper hydraulic connections.





Installation at the Radiator Fan-side of the Timing Gear Box

up to Engine no. 85 01 0266

Hydraulic Pump Removal:

Loosen hydraulic pump mounting screws and remove them.



Remove hydraulic pump from timing and accessory drive gear box.



In case the splined bushing was removed while pulling the hydraulic pump, take splined bushing from pump shaft and place it back on splined shaft in timing and accessory drive gear box.

Clean mounting surface on hydraulic pump flange as well as on timing and accessory drive gear box.



Hydraulic Pump Installation:

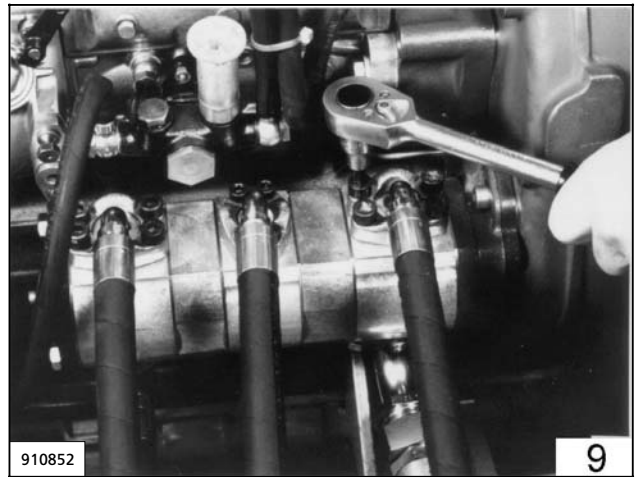
Place new gasket in pump flange surface and insert hydraulic pump with splined shaft into drive coupling in timing and accessory drive gear box. Screw in and torque pump flange mounting bolts.

Reconnect hydraulic lines to the proper hydraulic connections.

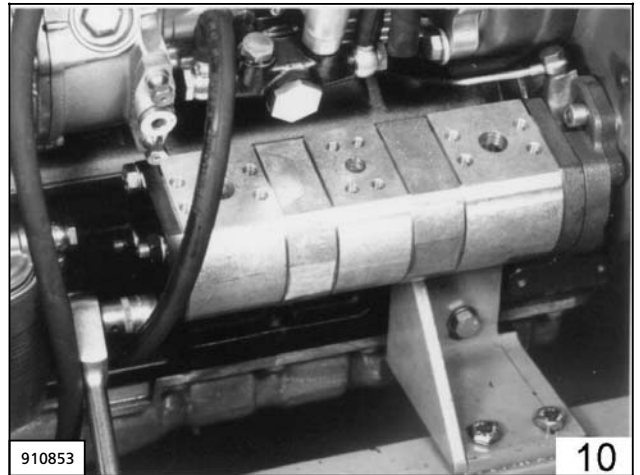
Installation with Intermediate Flange at the Injection Pump-side of the Timing Gear Box (Bolt-Through Pump)

Removal:

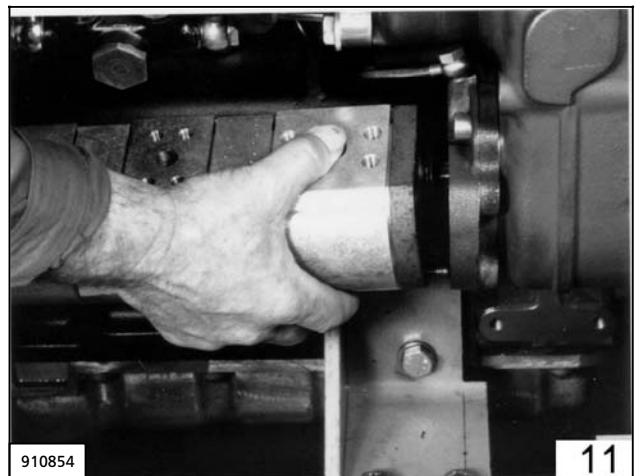
Disconnect the hydraulic lines at the hydraulic pump.



At the hydraulic pump, loosen and remove mounting screws.

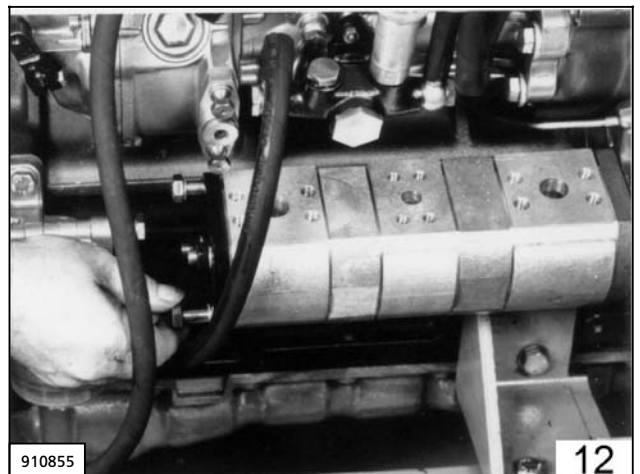


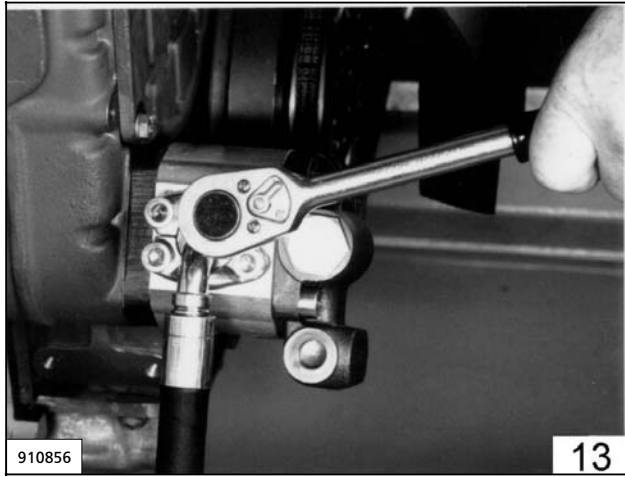
Pull hydraulic pump from the intermediate flange. Clean mating surfaces at the intermediate flange and at the hydraulic pump.



Installation:

With a new gasket, place pump into the splined hub and the intermediate flange. Install screws and tighten. Reconnect hydraulic lines.



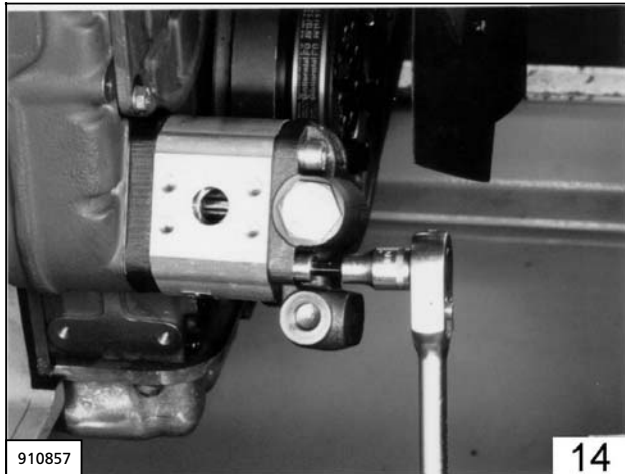


Installation at the Radiator Fan-side of the Timing Gear Box

from Engine no. 85 01 0267

Removal:

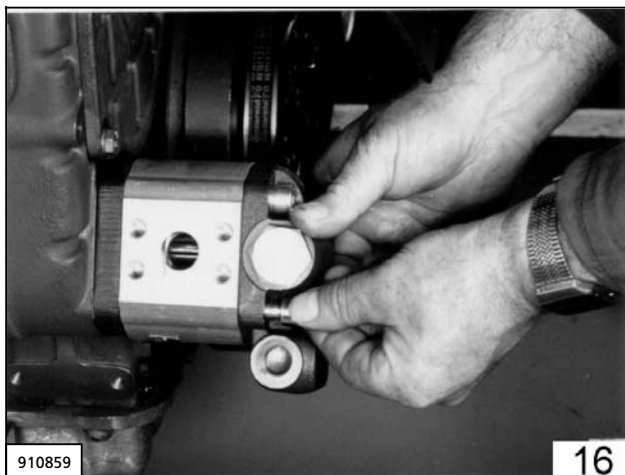
Disconnect the hydraulic lines at the hydraulic pump.



At the hydraulic pump, loosen and remove mounting screws.



Pull hydraulic pump from the timing gear box. Clean mating surfaces at timing gear box and hydraulic pump.



Installation:

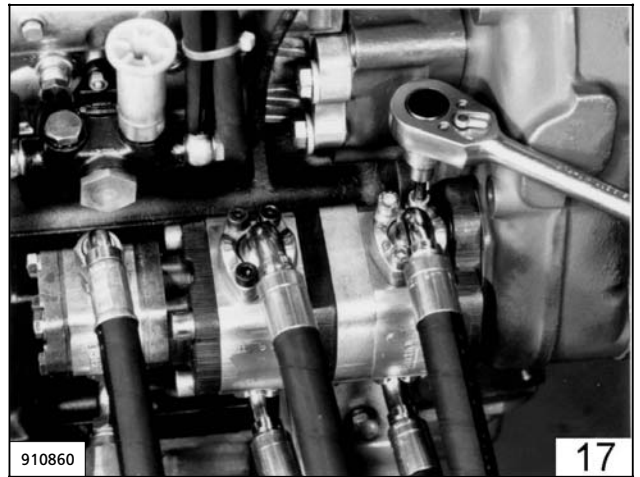
With a new gasket, place pump into the splined hub and the timing gear box. Install screws and tighten. Reconnect hydraulic lines.

**Installation at the Injection Pump-side of the
Timing Gear Box - without Intermediate Flange**

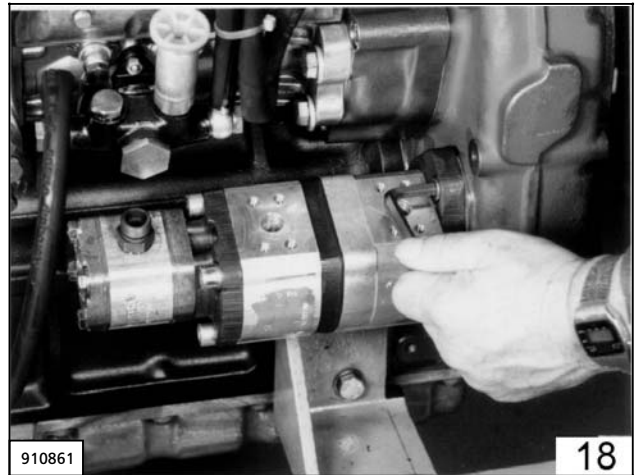
Special tool no. 16

Removal:

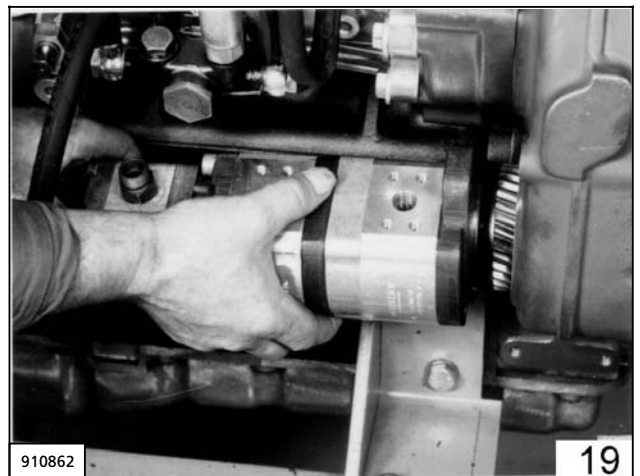
Disconnect the hydraulic lines at the hydraulic pump.



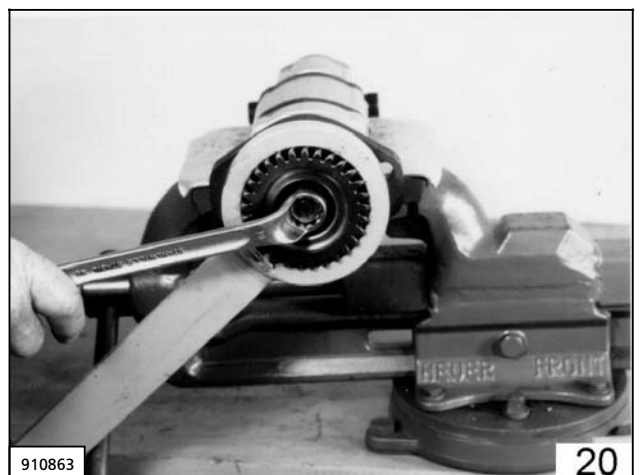
At the hydraulic pump, loosen and remove mounting screws.

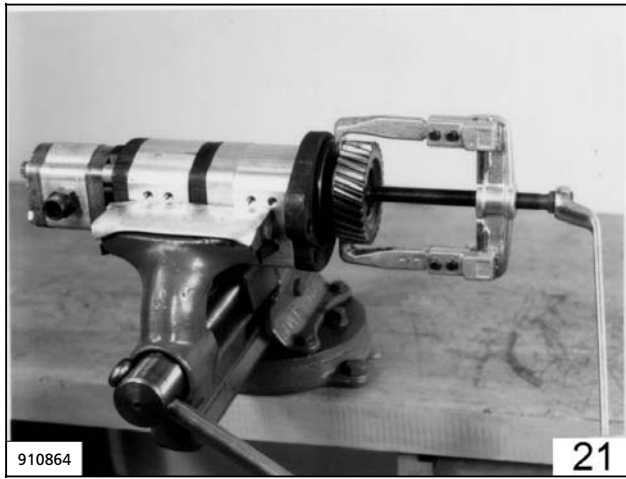


Pull hydraulic pump from the timing gear box.



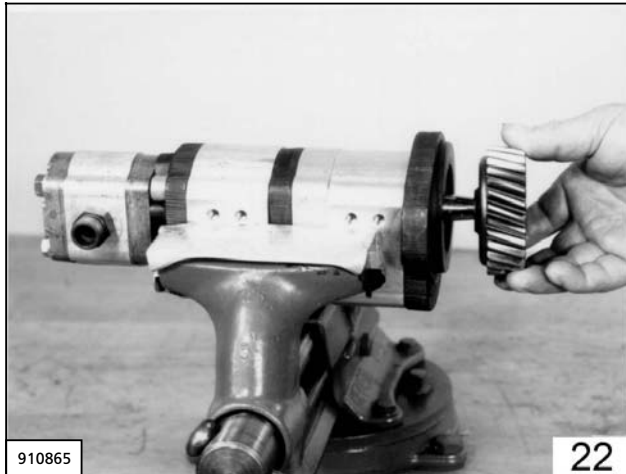
Place hydraulic pump into a vise equipped with protective jaw covers. Hold the gear wheel with special tool no. 16. Loosen nut and remove together with lock washer.





Pull off gear wheel with standard puller.
Do not lose the woodruff key.

Clean mating surfaces at the timing gear box and the hydraulic pump.



Installation:

Place hydraulic pump in a vise and push gear wheel over the woodruff key on to the shaft. Install lock washer and nut. Hold gear wheel with special tool and tighten nut.

For proper torque, see Engine Specifications.

Remove hydraulic pump from vise. With a new gasket, insert pump into timing gear box. Make sure that the gear wheel teeth mesh properly. Install screws and tighten.

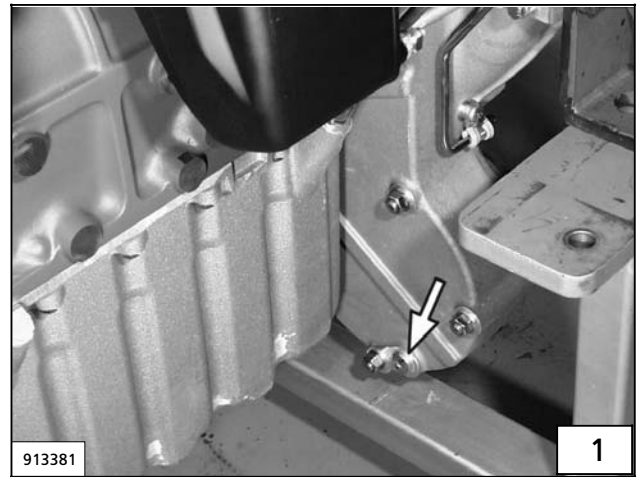
Reconnect hydraulic lines.

Hydraulic pump drive removal and installation (Installation on flywheel housing)

Removal:

Hydraulic pumps are removed.

Remove oil drainplug on flywheel housing and drain oil.



Remove the lube oil supply tube from the crankcase to the hydraulic pump drive.

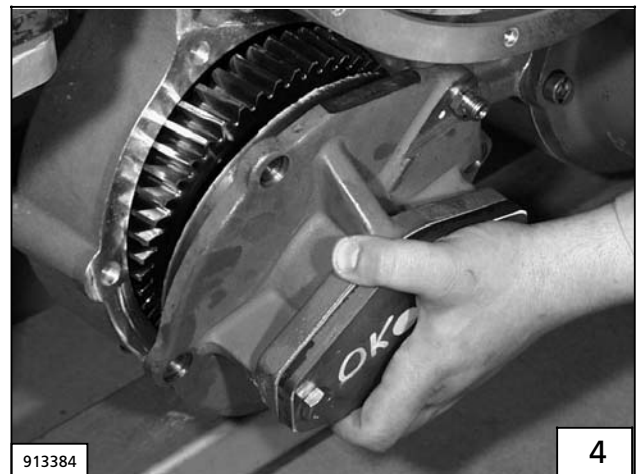


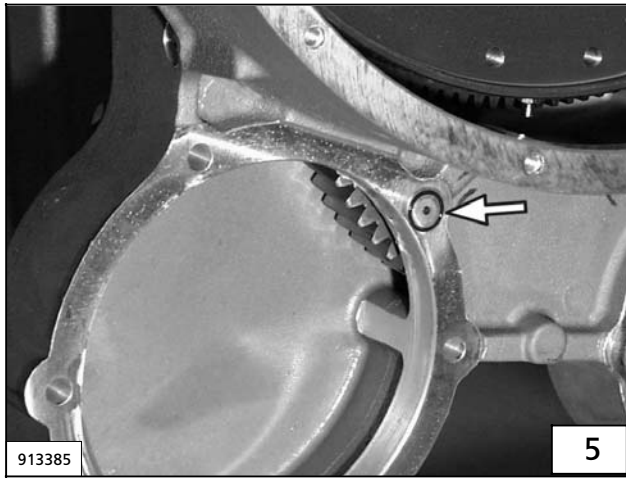
Loosen and turn out screws on the drive, hold nut on the flywheel housing.



Remove drive from flywheel housing.

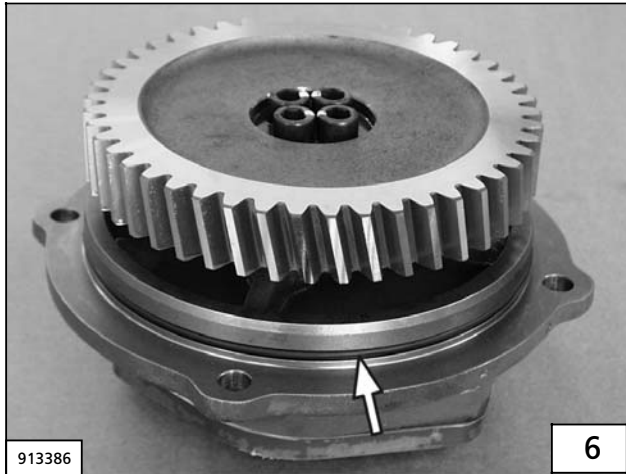
Clean the flange surface, bore hole and nut for O-ring on the lubrication bore hole on the flywheel housing.





Installation:

With using grease install new O-ring into groove on the lubrication bore hole in the flywheel housing.



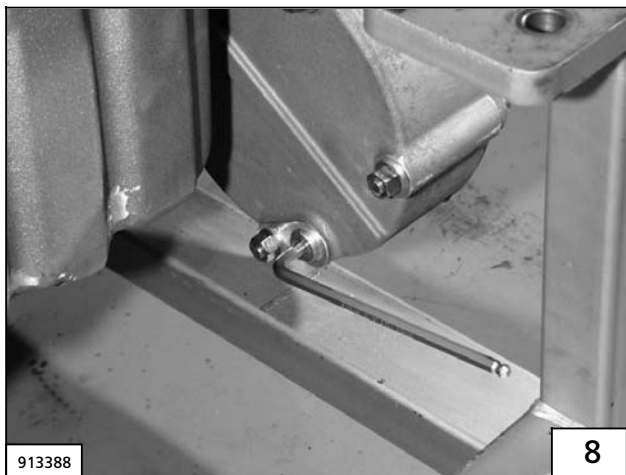
Clean hydraulic pump drive and install new O-ring. Grease the O-ring lightly.



Push in the drive of flywheel housing (watch tooth mesh).

Install screws and nuts and tighten.

Install lube oil tube



Install and tighten oil drain plug.

Fill approx. 1 Liter engine oil through oil filler neck.

Install hydraulic pumps.

Note:

After installation start engine, turn the engine off and check the engine oil level.

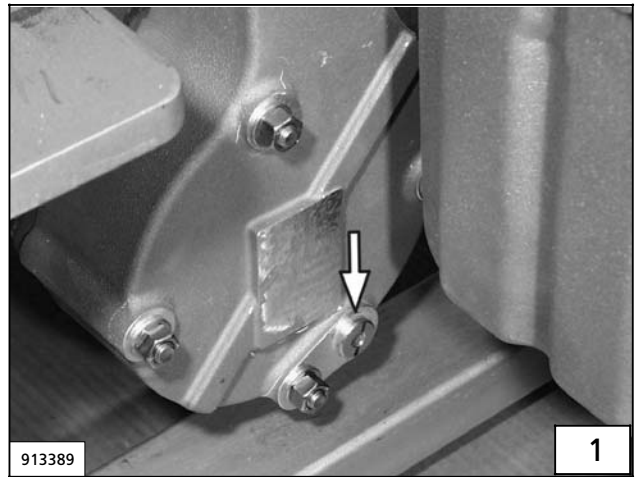
If necessary correct the oil level.

Hydraulic pump drive removal and installation, drive shiftable (Installation on flywheel housing)

Removal:

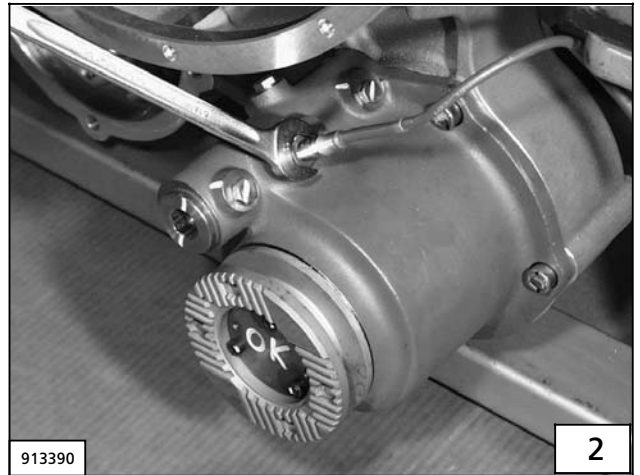
Hydraulic pumps are removed.

Remove oil drain plug on flywheel housing and drain oil.

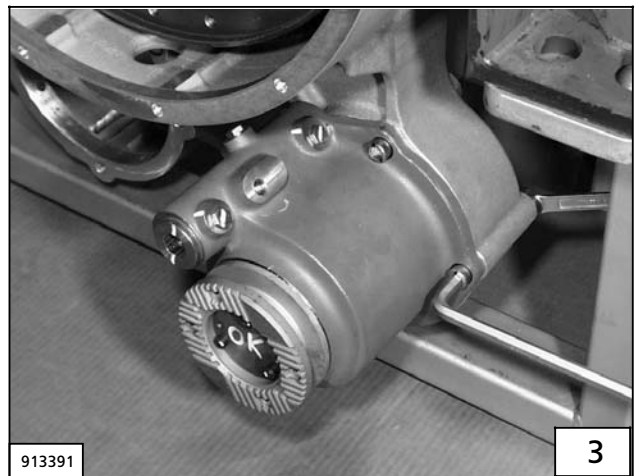


Remove air pressure lines.

Disconnect cable to the proximity switch, loosen lock nut and unscrew proximity switch from drive.

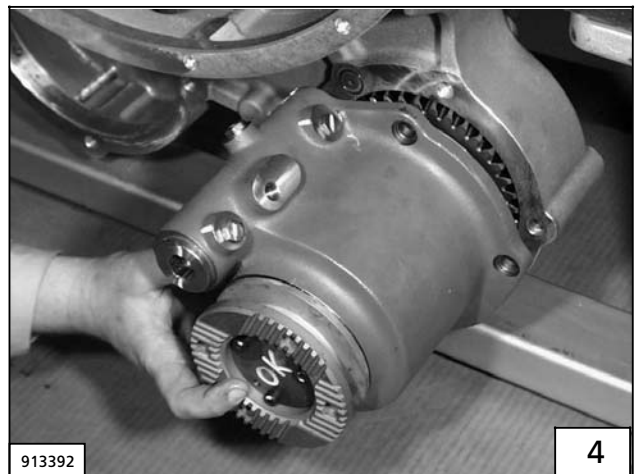


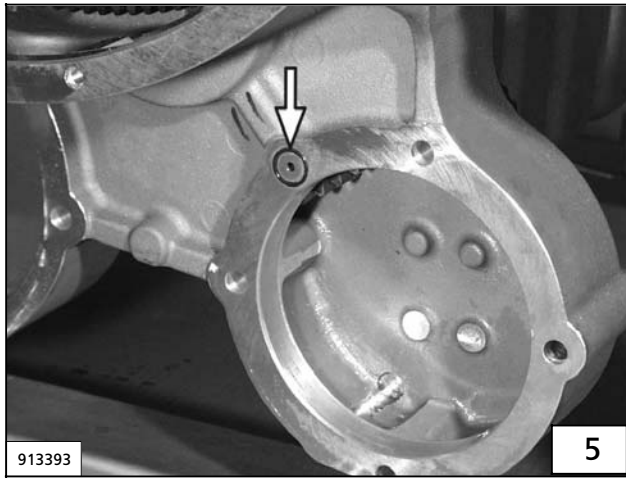
Loosen and turn out screws on the drive, hold nut on the flywheel housing.



Remove drive from flywheel housing.

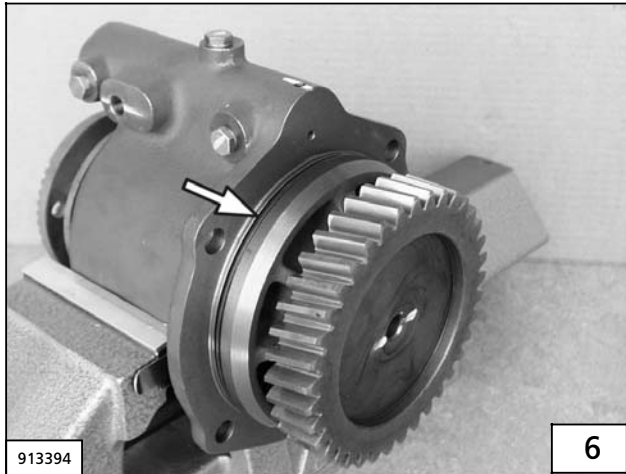
Clean the flange surfaces, bore hole and nut for O-ring on the lubrication bore hole on the flywheel housing.



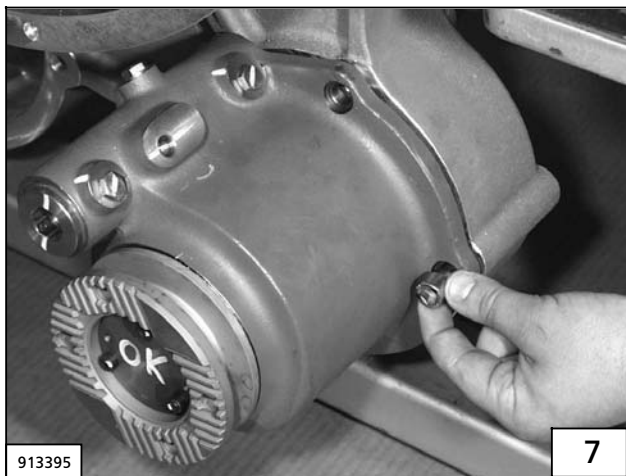


Installation:

With using grease install new O-ring into groove on the lubrication bore hole in the flywheel housing.

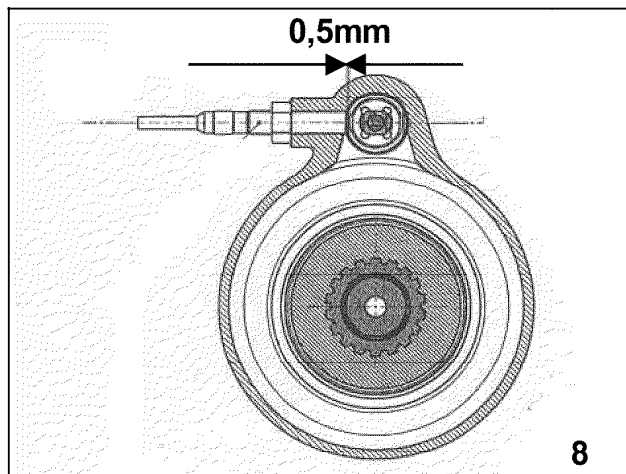


Clean hydraulic pump drive and install new O-ring.
Grease the O-ring lightly.



Push in the drive of flywheel housing (watch tooth mesh).

Install screws and nuts and tighten.



Install oil pressure lines.
Insert proximity switch and adjust.

Adjusting device:

The proximity switch must be set to the measurement given in fig. 8.

Bring the drive with air pressure in a connected condition

Turn in the proximity switch to maximum.
Turn back half turn, is 180° (0,5 mm) and tighten lock nut. Attach cable.

Install and tighten oil drain plug.

Fill approx. 1 Liter engine oil through oil filler neck.

Install hydraulic pumps.

Note:

After installation start engine, turn the engine off and check the engine oil level.

If necessary correct the oil level.



Hydraulic pump drive removal and installation, (Installation on drive gear box for fan drive).

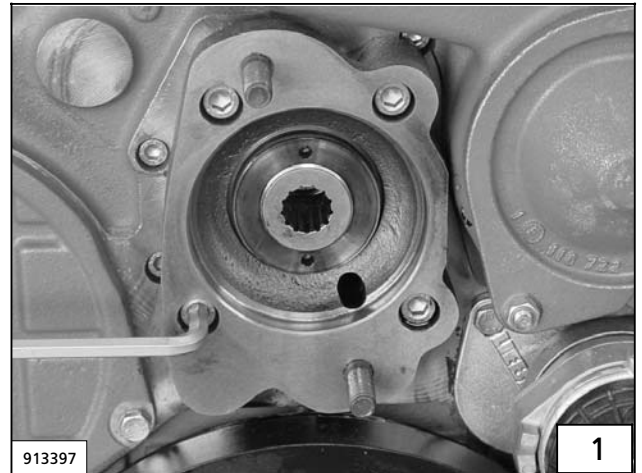
Note:

On engines, where the fan is installed away from the engine, a hydraulic pump drive can be installed on the drive gear box instead of the fan drive.

Removal:

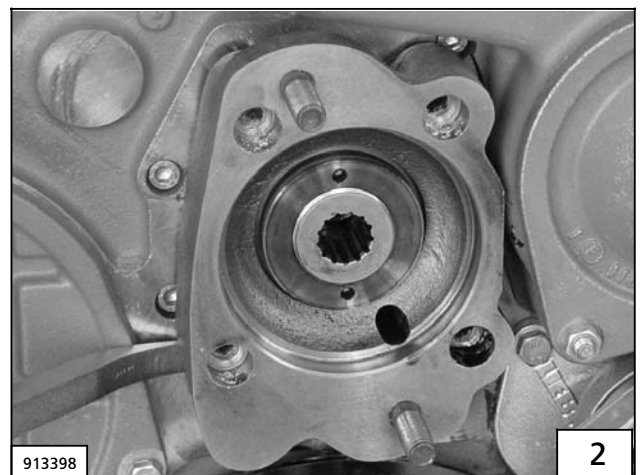
Hydraulic pumps are removed.

Loosen and remove screws on drive.



Remove drive from drive gear box.

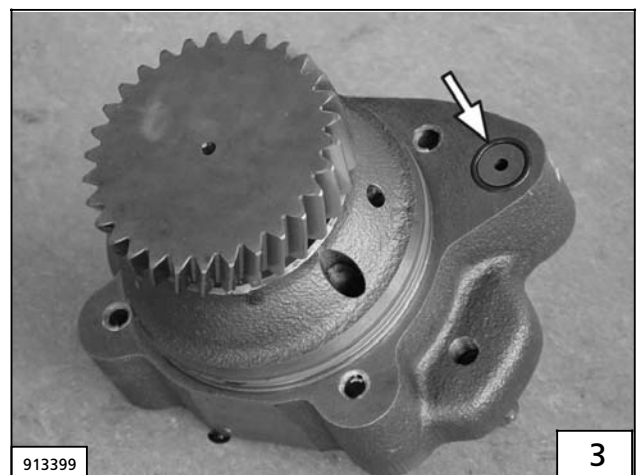
Clean installation surface from bore hole on drive gear box.



Installation:

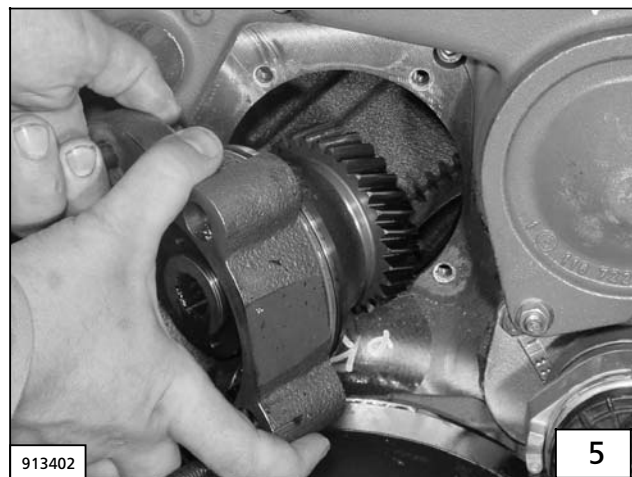
Clean hydraulic pump drive.

Insert new O-ring with grease into the groove on the lube oil bore hole on the drive.





Insert new O-ring with grease on drive flange.



Push drive into drive gear box (watch tooth mesh).

Insert and tighten screws.

Install hydraulic pumps.

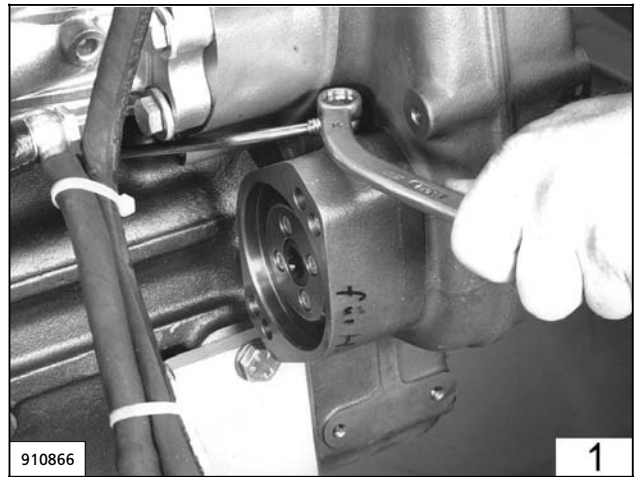
Hydraulic Pump Drive Removal and Installation

up to Engine no. 85 01 0266

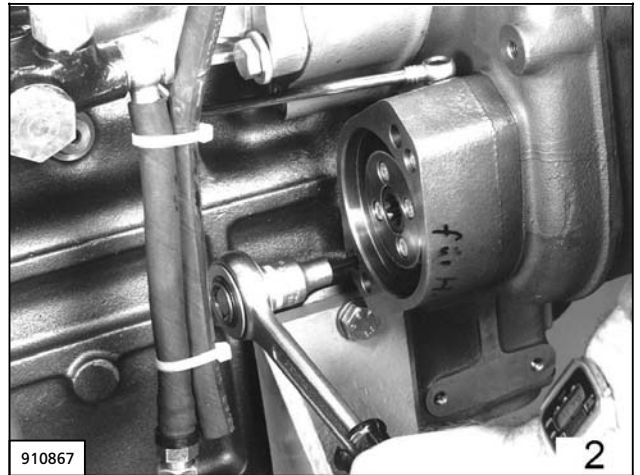
Pump Drive Removal:

Remove hydraulic pumps as described in sub group 8.18.

Remove lubrication lines from intermediate flange on timing and accessory drive gear box.



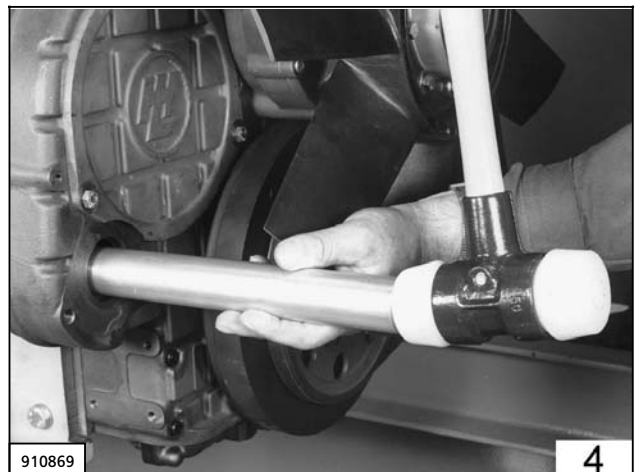
Loosen and remove pump drive mounting bolts on intermediate flange.

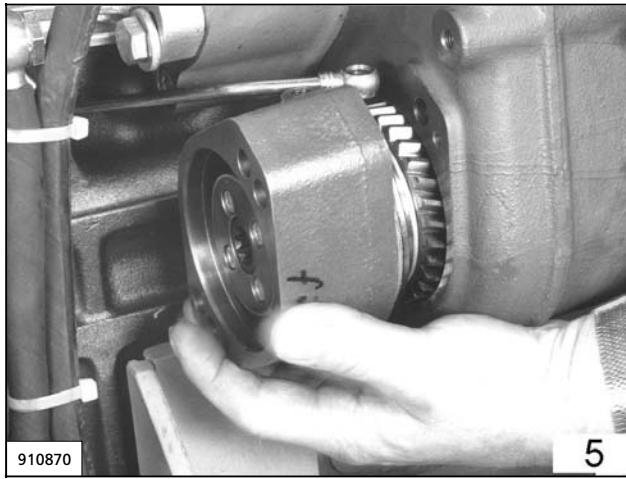


Place soft-metal punch against splined drive shaft and knock pump drive assembly out of the timing and accessory drive gear box.

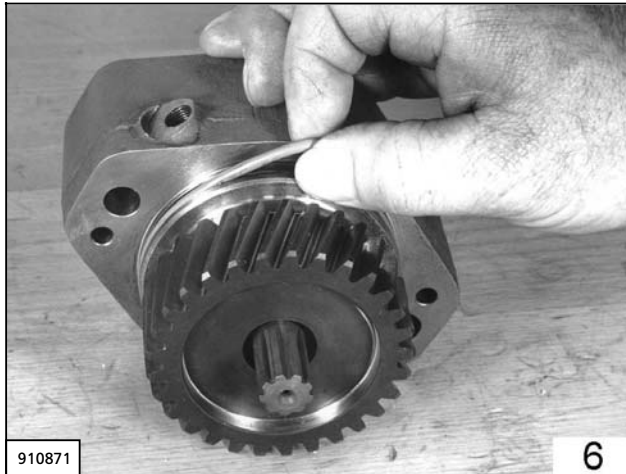


Remove drive coupling from splined drive shaft.



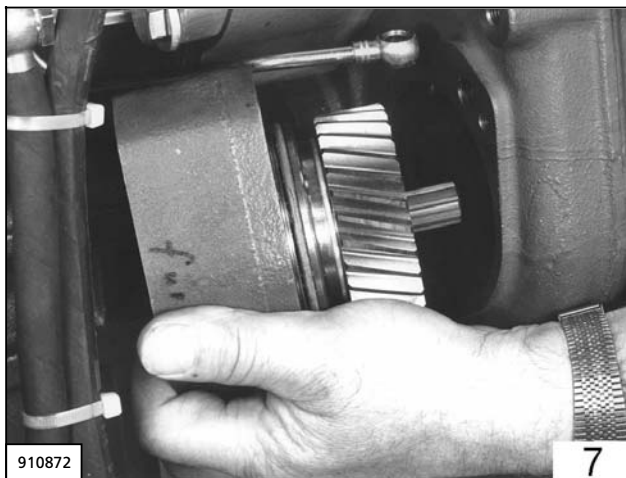


Remove hydraulic pump drive from timing and accessory drive gear box.



Pump Drive Installation

Place new O-ring in groove on intermediate flange and lubricate O-ring with engine oil.



Place pump drive on timing and accessory drive gear box. Turn pump drive gear wheel until it meshes with the gear wheel in the timing and accessory drive gear box and push pump drive into its final position. Screw in and torque pump drive mounting bolts on intermediate flange. Place drive coupling on splined drive shaft. Reconnect lubrication lines with new gaskets to respective ports in intermediate flange.

Hydraulic pump drive disassembly inspection and assembly (Installation on flywheel housing).

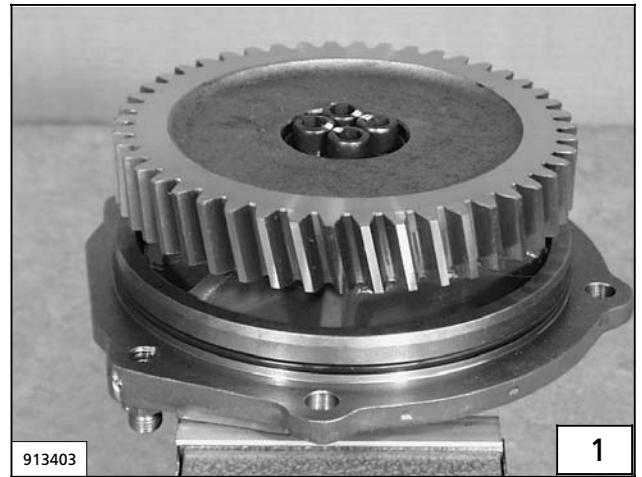
Use special tools Nr. 81

Disassembly and inspection:

Hydraulic pump drive is removed, see sub group 8.22.

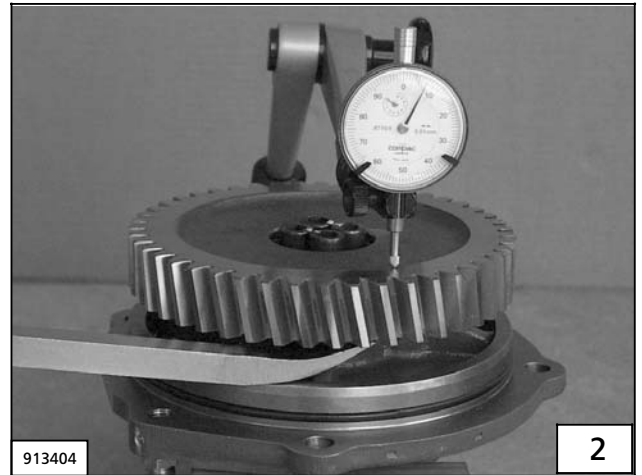
For drawing, see page 8.26.02 (rear/back)

Place the drive into a vise with protective jaws.



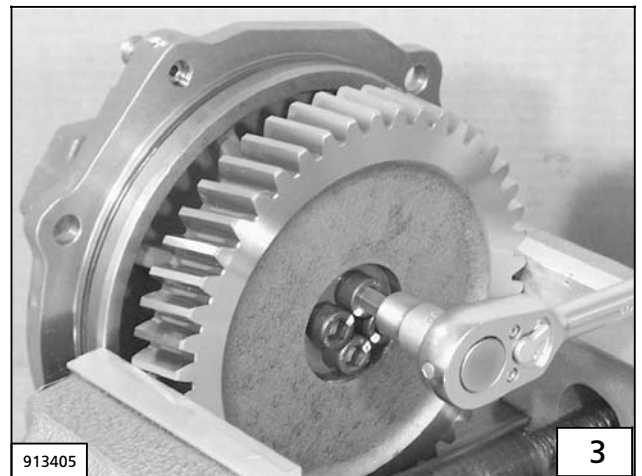
Check the axial play with a commercial dial gauge.

For dimension, see Technical Data.

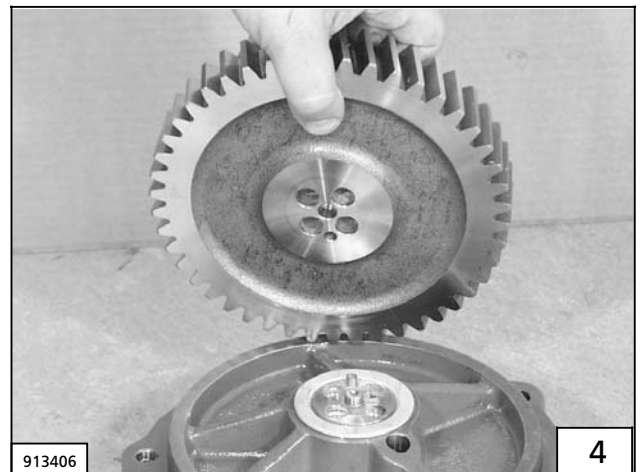


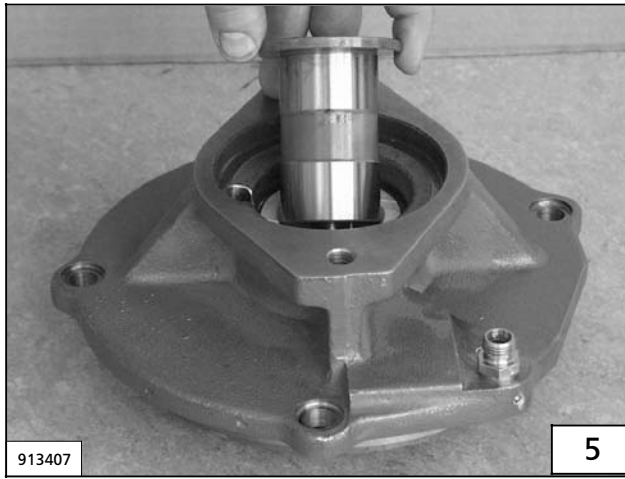
Place gear 2 into a vise with protective jaws.

Loosen and remove screws 3.



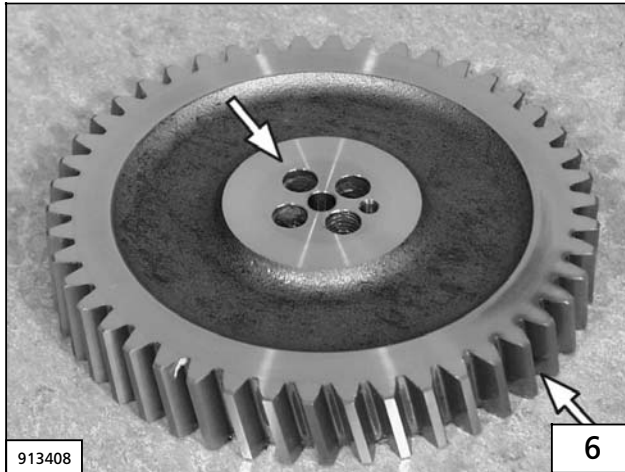
Remove the gear 2 from the hub 4.





Pull hub 4 from housing 1.

Clean all parts and check oil bores to be certain they are clear.



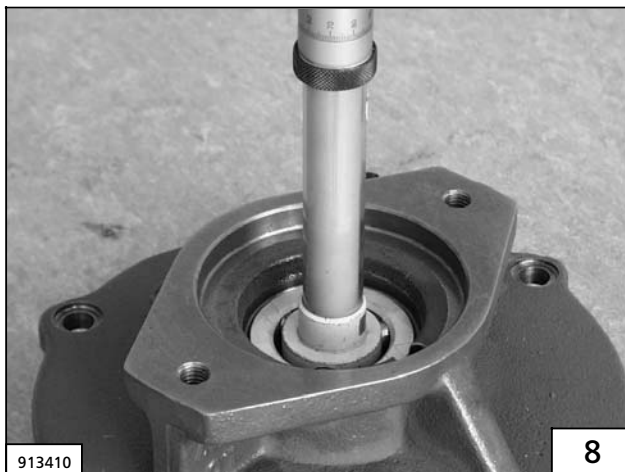
On gear 2, visually check the running surface for collar bushing 6 and the gear teeth for damage.



Visually check running surfaces for collar bushings 5, 6 and collar bushing 5 on hub 4 for damage.

Measure pin diameter.

For dimensions, see Technical Data.



Visually check collar bushings 5, 6 in housing 1 for wear.

Measure dimension with dial gauge.

For dimensions, see Technical Data.

Note:

Replace any item which falls outside the required tolerances or is damaged.

Replacement of collar bushing in housing:

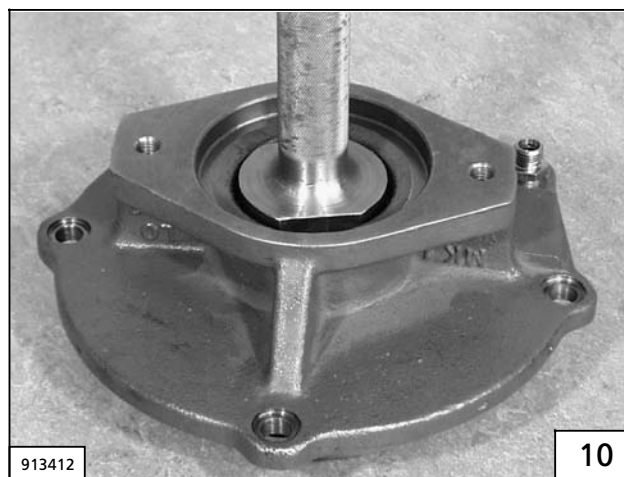
Place the housing 1 on a support and drive the collar bushing 6 out with a punch.
Turn the housing 1 over and press out the collar bushing 5 with a punch, special tool No. 81.



Cool new collar bushings 5, 6 in liquid nitrogen to -175°C to -190°C (-350°F to -375°F) and press flush into housing 1 with punch, special tool No. 81.

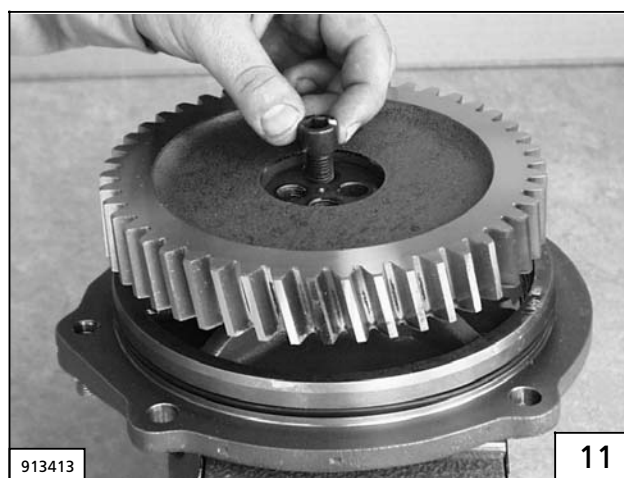
Note:

Collar bushings 5, 6 are finished collar bushings and should not be remachined.



Assembly:

Place housing 1 in a vise and lubricate collar bushings 5, 6 with oil. Place hub 4 in the housing. Place gear 2 on hub 4 and adjusting pin 7. Apply a retention fluid (Loctite 262) on the screws 3, insert and lightly tighten.

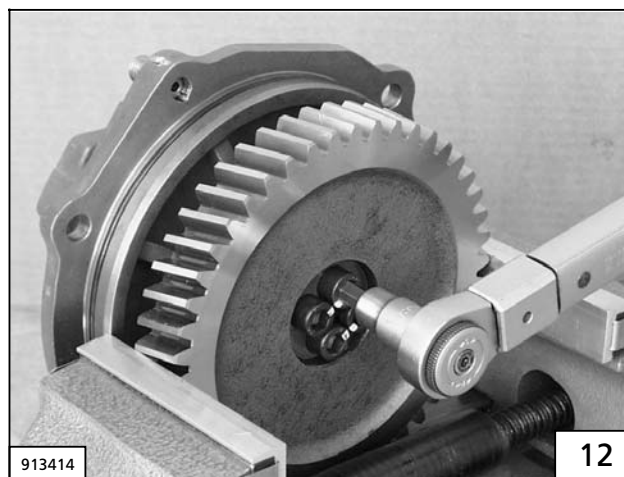


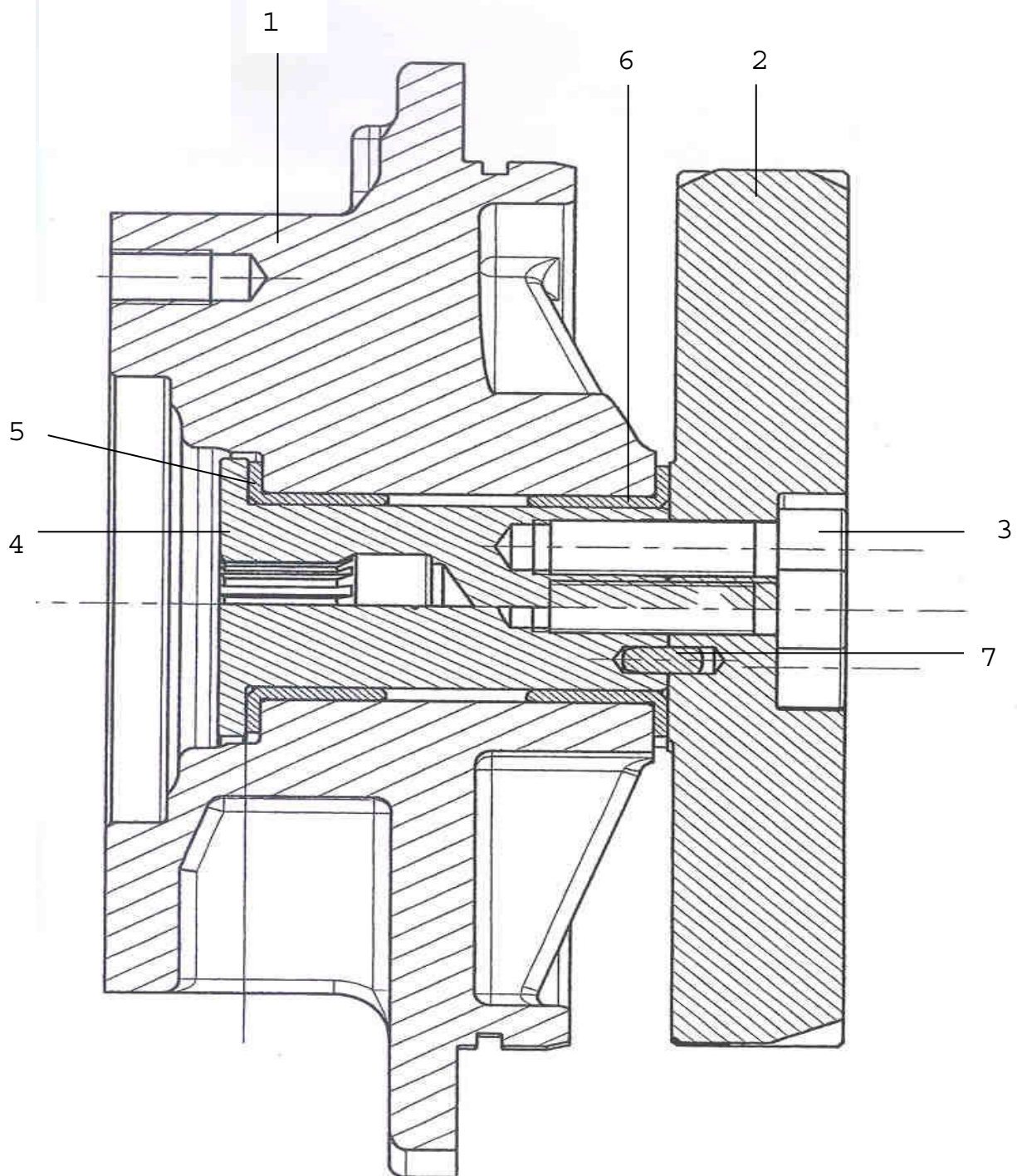
Place gear 2 into a vise with protective jaws and tighten screws 3.

Important:

After each installation or repair, check the axial play of the hydraulic pump drive (see fig. 2)

For dimensions, see Technical Data.





Hydraulic pump drive disassembly, inspection and assembly drive shiftable (Installation on flywheel housing).

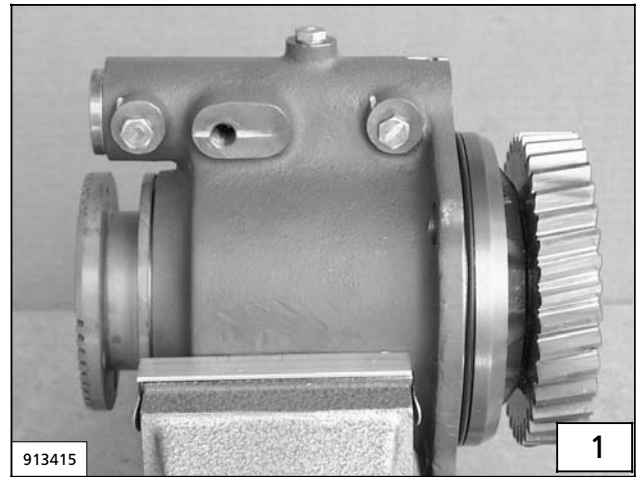
Use special tool No. 37, 79, 80, 93

Disassembly and inspection:

Hydraulic pump drive is removed, see sub group 8.23.

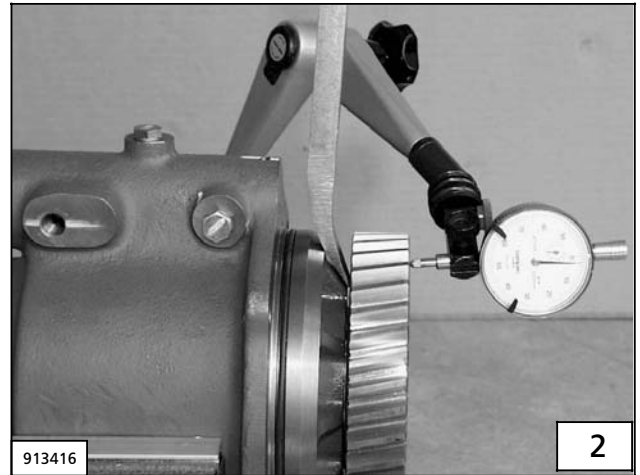
For drawing, see page 8.27.06.

Place the drive into a vise with protective jaws.



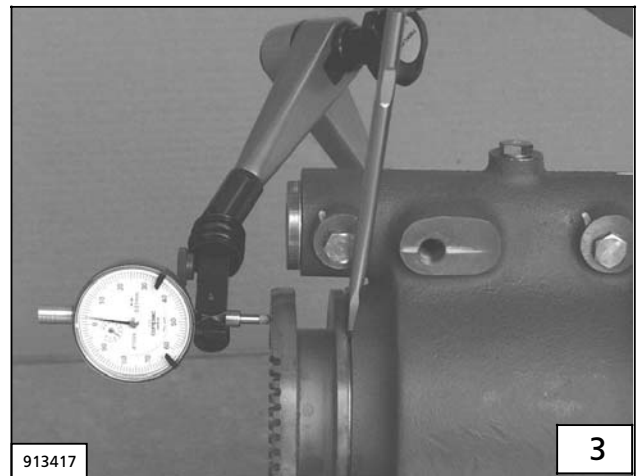
Check axial play with commercial dial gauge on the side from the gear.

For dimensions, see Technical Data.



Check axial play on the power take-off side.

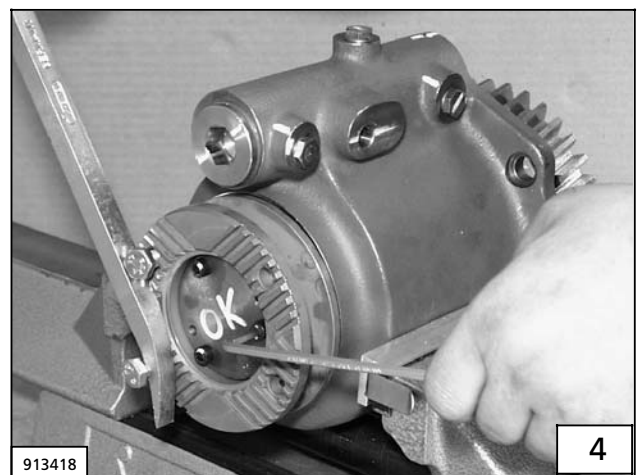
For dimensions, see Technical Data.

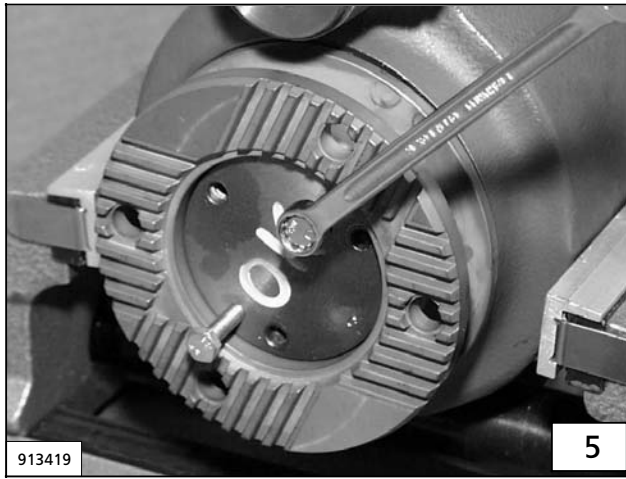


Place the drive on serrated shaft 7 into a vise with protective jaws.

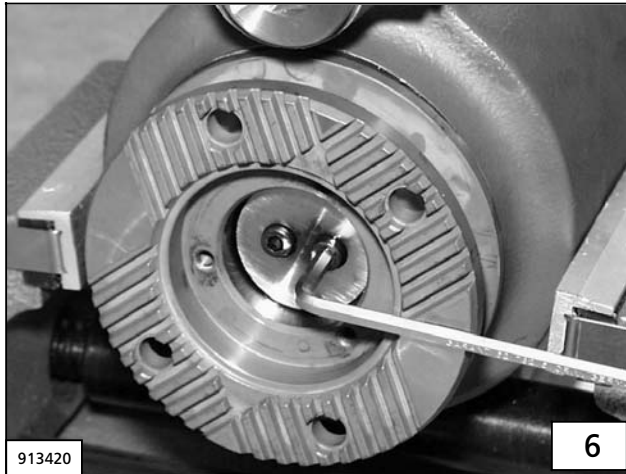
Place two screws M10 into bores from connecting flange 1 and hold on with fitting lever.

Loosen and remove screws 2.





Turn two screws M6 x 25 into the threads on sealing cover 3 and remove cover from connecting flange 1.



Loosen and remove screws 4.
Remove thrust ring 5.

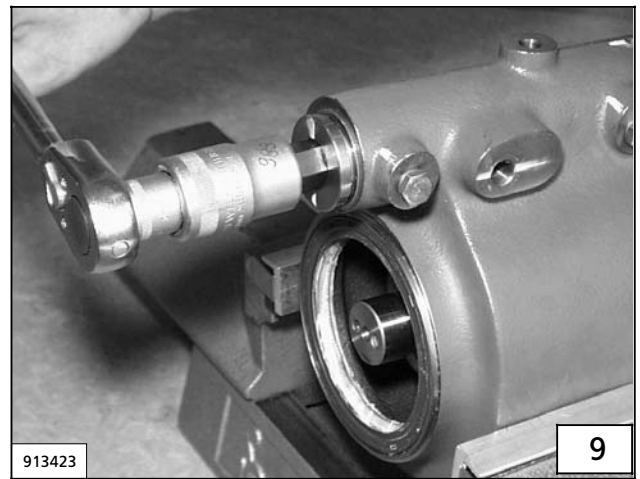


Remove connecting flange 1 from housing 6 and from the serrated shaft 7.

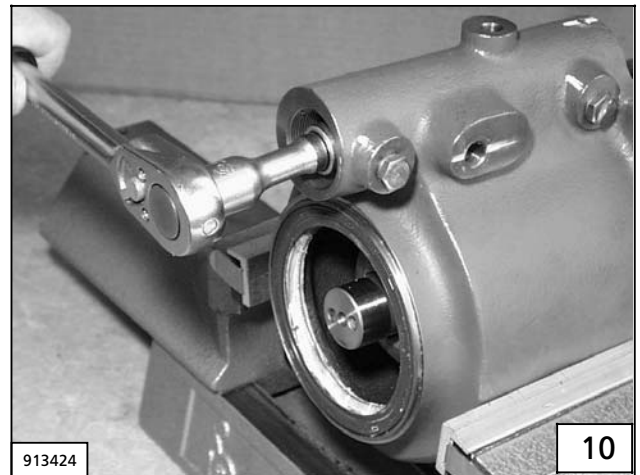


Remove plug 8 and seal ring 9.
Remove spring 10 and take ball 11 with a magnet from the bore hole.

Remove plug 12 and seal ring 13.



Loosen and remove screw 14 and seal ring 15



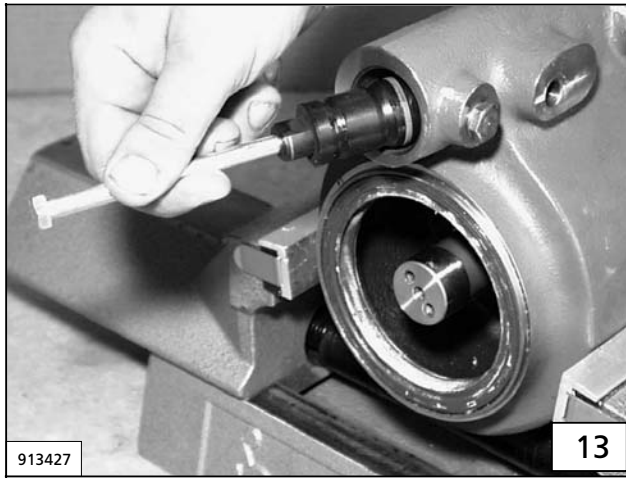
By pushing against the shifting fork 16, piston 17 must be loosened from piston 18.

Remove piston 17 from the bore hole on housing 6.



Release the shifting fork 16 from piston 18 and remove with clutch ring 19 from housing 6.

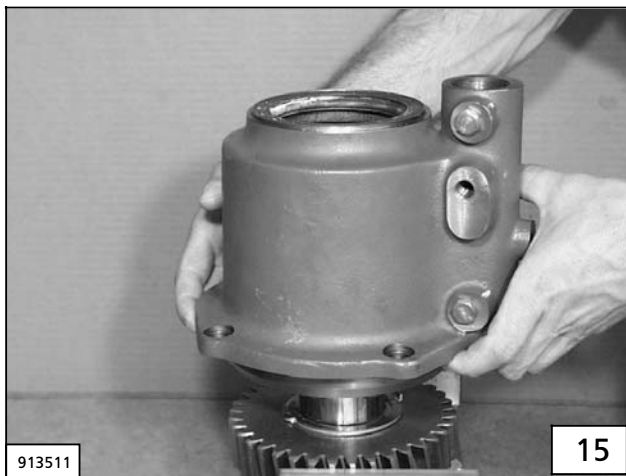




Install in piston 18 a long screw (M8) and pull the piston 18 from the bore hole in housing 6.



Loosen and remove the double hole nut 20 with a journal wrench, special tool No. 37.



Remove housing 6 from serrated shaft 7.



Release shaft seal ring 21 from housing.

Clean all parts, check bore holes to ensure they are clean.

Visually check on serrated shaft 7 the running surfaces for bushings 22, 23 and collar bushings 24, 25.

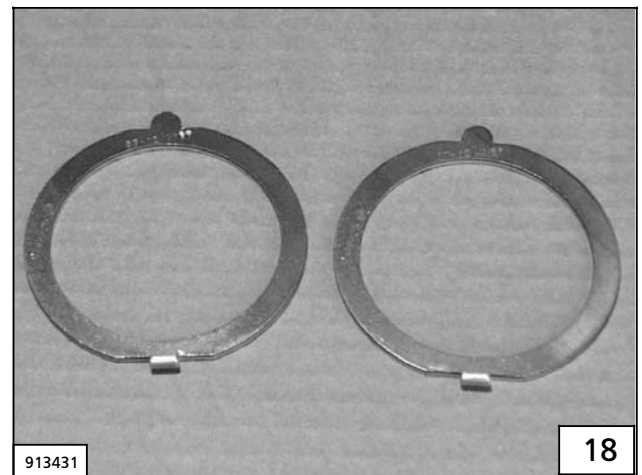
Visually check the running surface for thrusting 26 and collar bushings 24 as well as the splines for damage.

Measure pin diameter.

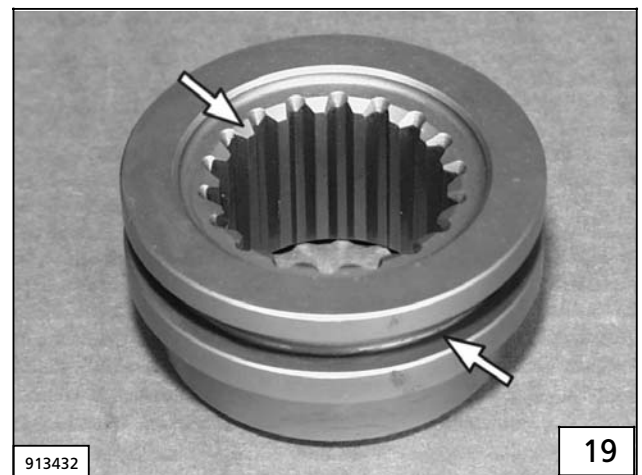
For dimension, see Technical Data.



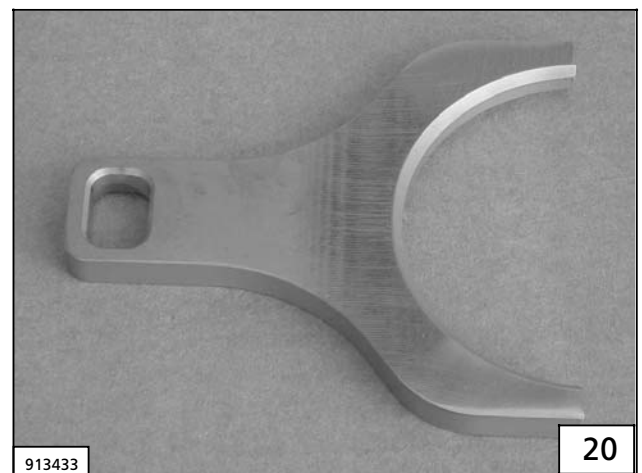
On thrust rings 26, 27, visually check the running surfaces and the retainer tabs for wear.



Visually check the inner splin and thrust surfaces for the shifting fork 16 on clutch ring 19 for damage.



On the shifting fork 16, visually check the thrust surfaces of clutch ring 19 for wear.





Visually check bushings 22, 23 in housing 6 for damage.

Measure with dial gauge.

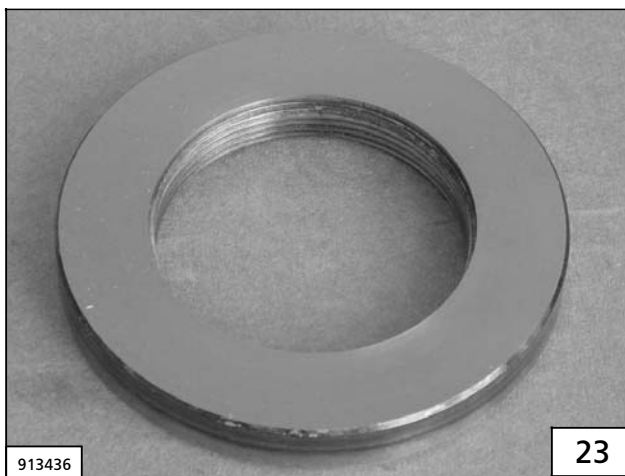
For dimensions, see Technical Data.



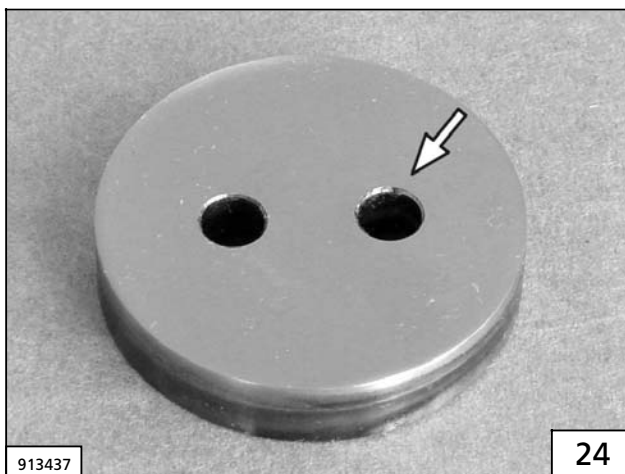
Visually check collar bushings 24, 25 in connecting flange 1 for damage.

Measure with dial gauge.

For dimensions, see Technical Data.



On the double hole nut 20, check thrust surface for thrust ring 27 visually for wear.



Visually check running surface for collar bushing 25 on thrust ring 5.

Note:

Replace all parts which fall outside the required tolerance or are damaged.

Replacement of bushings in housing 6

Drive bushings 22, 23 with punch, special tool No. 80 from housing 6.



Cool new bushings 22, 23 in liquid nitrogen to -175°C to -195°C (-280°F to -320°F) and drive them with a punch, special tool No. 80 into housing 6 until they are flush and seated

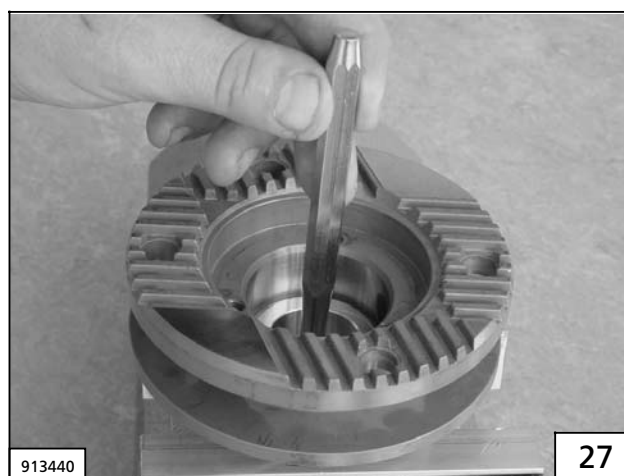
Note:

Bushings 22, 23 are finished bushings and should not be remachined.



Replacement collar bushings in connecting flange 1:

Drive collar bushings 24, 25 with punch from connecting flange 1.

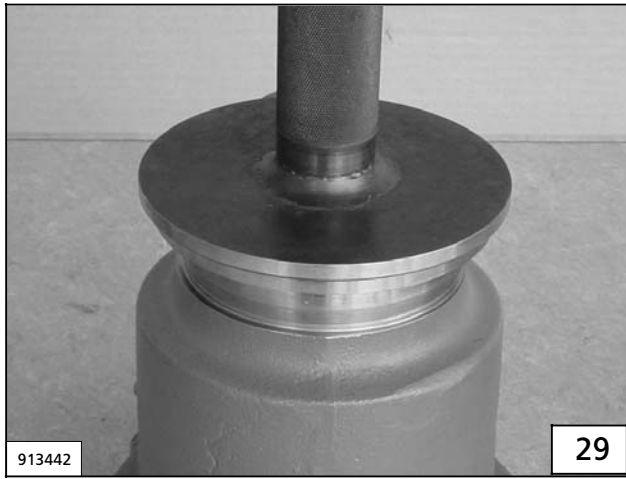


Cool new collar bushings 24, 25 in liquid nitrogen to -175°C to -195°C (-280°F to -320°F) and drive them with a punch, special tool No. 93 into connecting flange 1 until they are flush and seated.

Note:

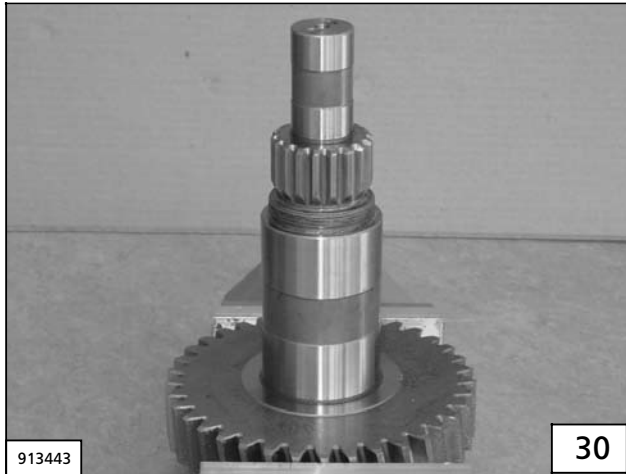
Collar bushings 24, 25 are finished bushings and should not be remachined.





Press in a new shaft seal ring 21 with a punch, special tool No.79 into housing 6 until it is fully seated.

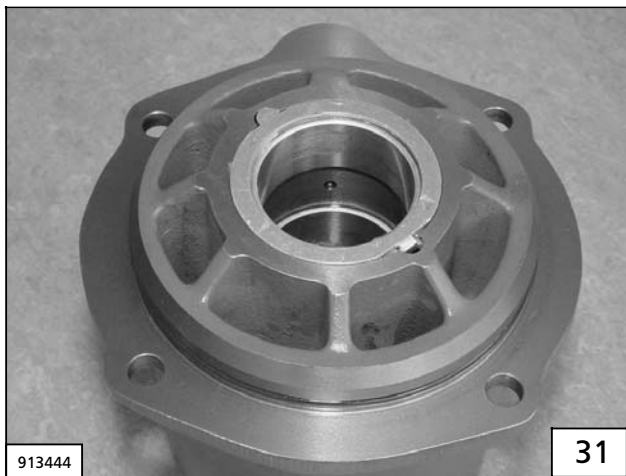
Lightly grease the sealing lip of the seal ring 21.



Assembly:

Place the serrated shaft 7 into a vise with protective jaws.

Lubricate contact surfaces and rolling surfaces with oil.



Grease thrust rings 26, 27 and insert into housing 9.

Note the position of the retainer tabs.



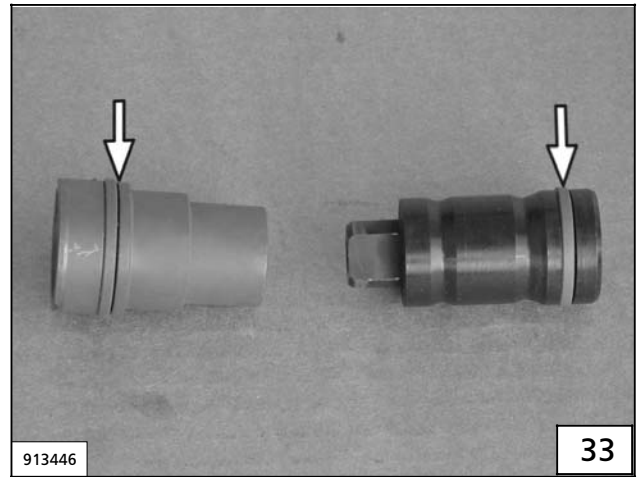
Push housing 6 onto serrated shaft 7.

Apply Loctite 243 to threads of double hole nut 20. Install double hole nut 20 of serrated shaft 7 and tighten with a journal wrench, special tool No. 37

For tightening torque, see Technical Data.

Place new O-rings 28, 29 and new seal rings 30, 31 in grooves of piston 17, 18.

Lightly grease the piston and seal rings.



Push the piston 18 with a long screw (M8) into the bore of housing 6. Set the coupling sleeve 19 onto the shifting fork 16. Push the shifting fork 16 with coupling sleeve 19 onto piston 18 and serrated shaft 7.



Insert piston 17 into the bore hole and push onto piston 18.

Install new seal ring 15 on screw 14, turn screw 14 into piston 18 and tighten.



Install plug 12 with new sealring 13 into bore hole and tighten.

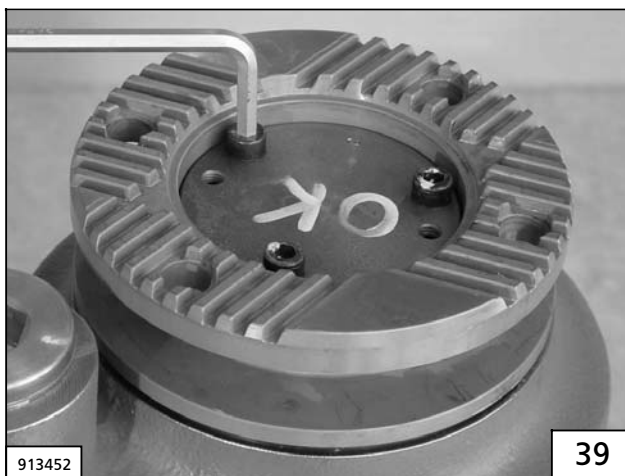




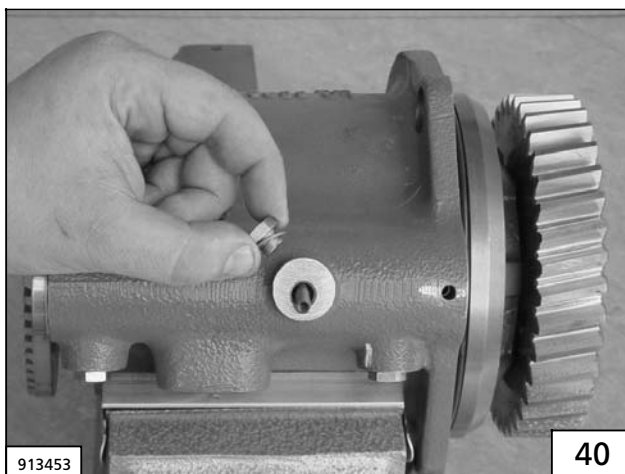
Lubricate collar bushings in connecting flange 1 with oil. Install connecting flange 1 onto serrated shaft 7 or into coupling sleeve 19.



Install thrust ring 5, apply Loctite 243 to the threads of the screws 4, install, tighten and torque screws.



Install new O-ring 32 on sealing cover 3, lubricate O-ring with oil and push sealing cover 3 into connecting flange 1. Install the screws 2 and tighten.



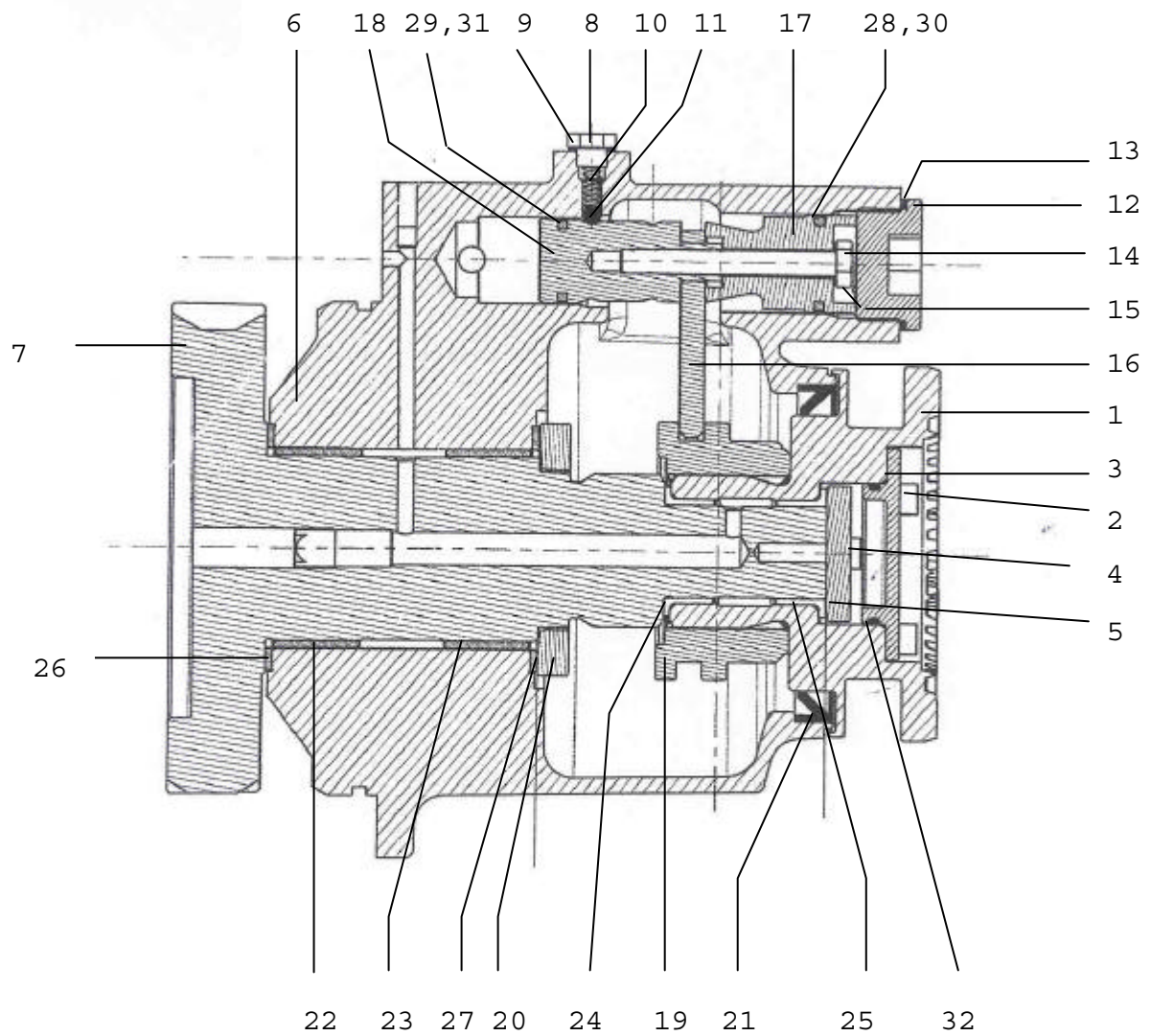
Install ball 11 and spring 10, install plug 8 with new seal ring 9 and tighten.

Remove hydraulic pump drive and check operation by turning.

Important:

After each installation or repair, check the axial play of the hydraulic pump drive, see fig. 2, 3).

For dimensions, see Technical Data.



Hydraulic Pump Drive Disassembly Inspection and Assembly

up to Engine no. 85 01 0266

Use special tool no. 16

Pump Drive Disassembly and Inspection:

Remove hydraulic pump drive as described in sub group 8.25.

For component positioning see back page 8.28.02.

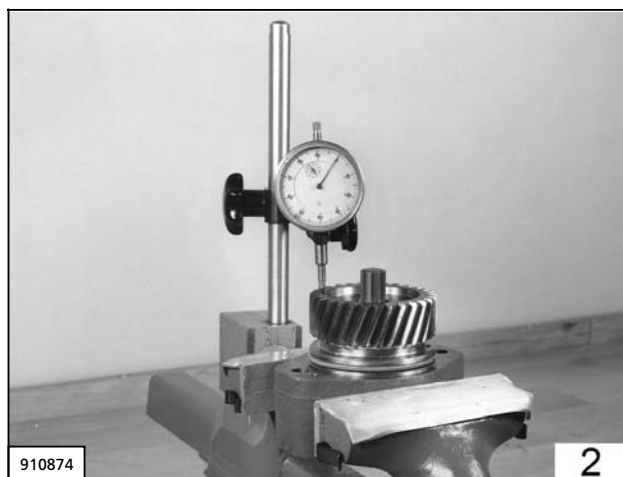
Place intermediate flange in vise. To avoid damage use protective jaw covers.

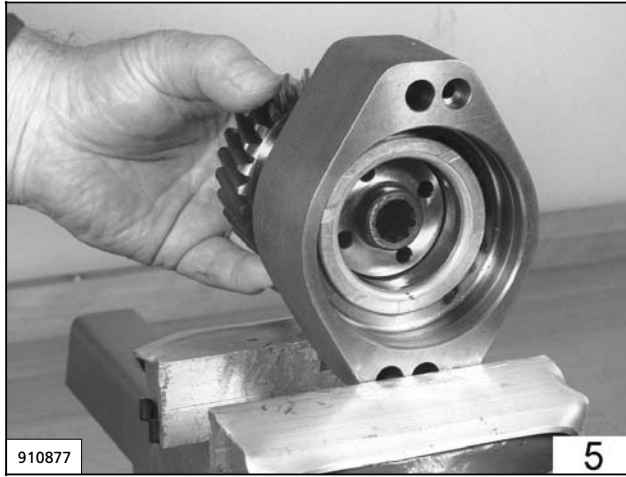
Measure axial play between gear wheel Pos. 2 and flange type bushing Pos. 3.

See Engine Specifications for correct play.

Remove splined drive shaft Pos. 4 from gear wheel Pos. 2.

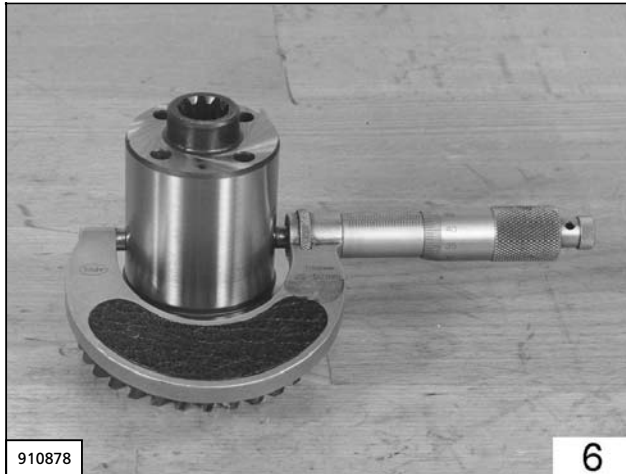
Hold gear wheel Pos. 2 in place with holding device, special tool no. 16, loosen and remove mounting bolts Pos. 5.





Remove thrust washer Pos. 6 and gear wheel Pos. 2 from intermediate flange.

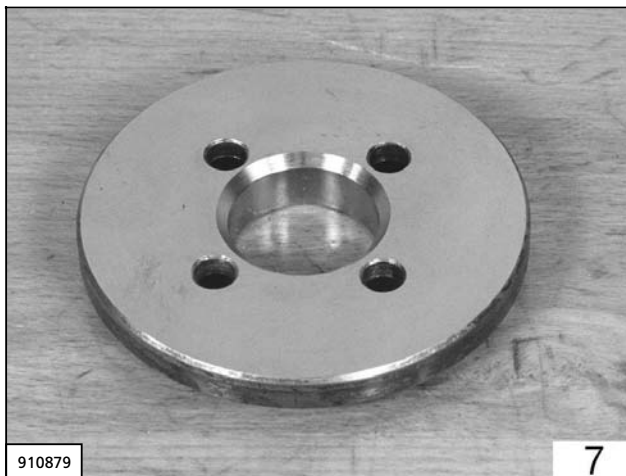
Clean all components and check lubrication bores for possible desposits.



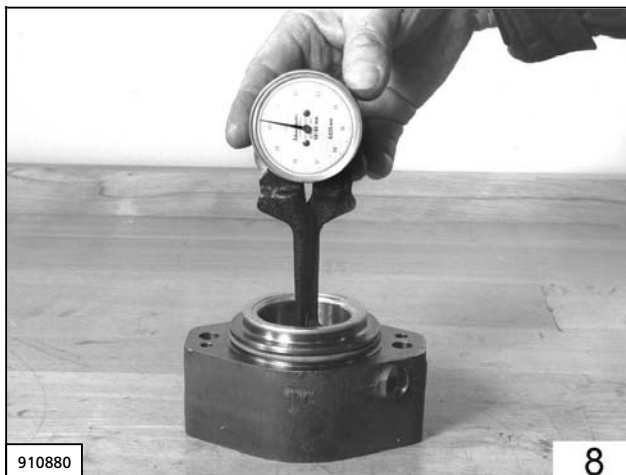
Visually check contact surfaces on thrust washer and gear wheel for wear and damage.

Measure journal diameter.

See Engine Specification for correct dimension.



Visually check contact surfaces on thrust washer and flange-type bushing for wear and damage.



Visually check bore for wear and damage and measure inside diameter on flange-type bushing in intermediate flange.

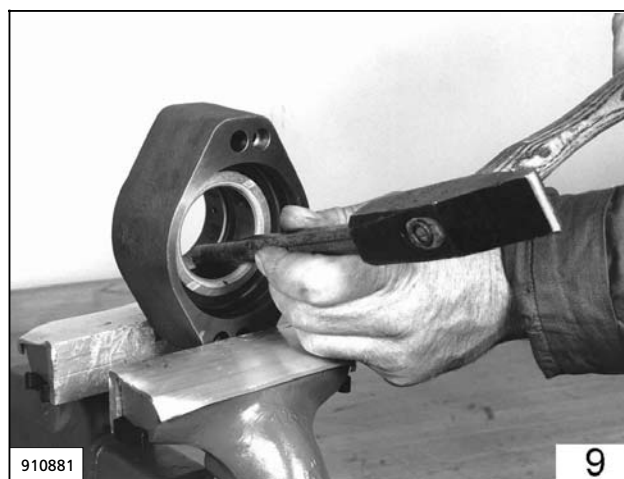
See Engine Specifications for correct dimension.

Note:

Components that are not within specifications, show wear or damage must be replaced.

Intermediate Flange Bushing Replacement:

Remove flange-type bushing with punch plate from intermediate flange.



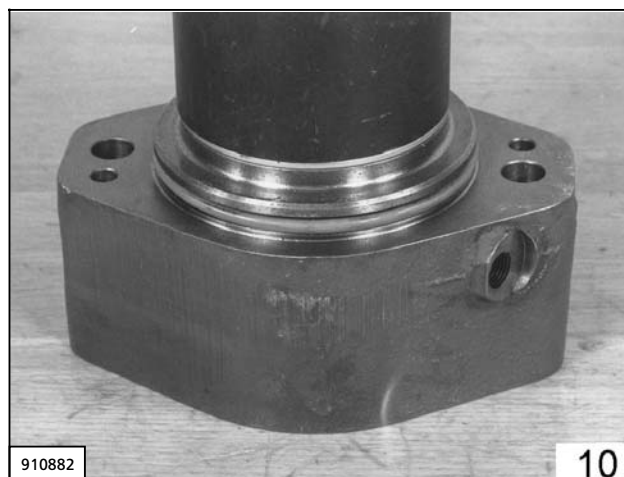
Bushing Installation:

Installation Method 1:

Cool down new flange-type bushing in liquid nitrogen to a temperature between -350°F and -375°F (-175°C and -190°C). Place bushing on intermediate flange and install bushing with punch plate.

Install Method 2:

Heat up intermediate flange in oven to approx. +392°F (+200°C). Place new flange-type bushing on intermediate flange and install bushing with punch plate.



Important:

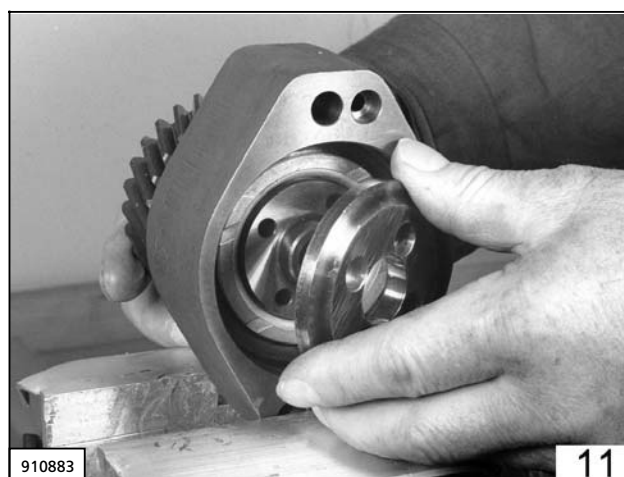
Do not damage the thrust washer contact surface on flange-type bushing during installation!

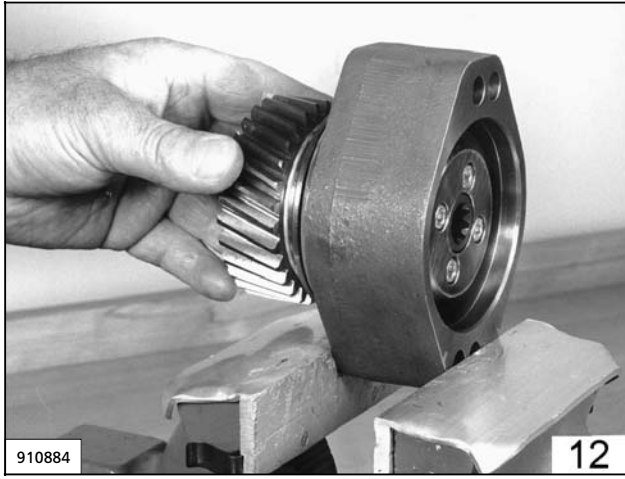
After installation these flange-type bushings have to be remachined.

For measures see page 8.28.02 (reverse).

Pump Drive Assembly:

Place intermediate flange Pos. 1 in vise. To avoid damage use protective jaw covers. Lubricate flange-type bushing with engine oil. Place gear wheel Pos. 2 into intermediate flange. Place thrust washer Pos. 6 on gear wheel in intermediate flange. Screw in mounting bolts. Pos. 5.

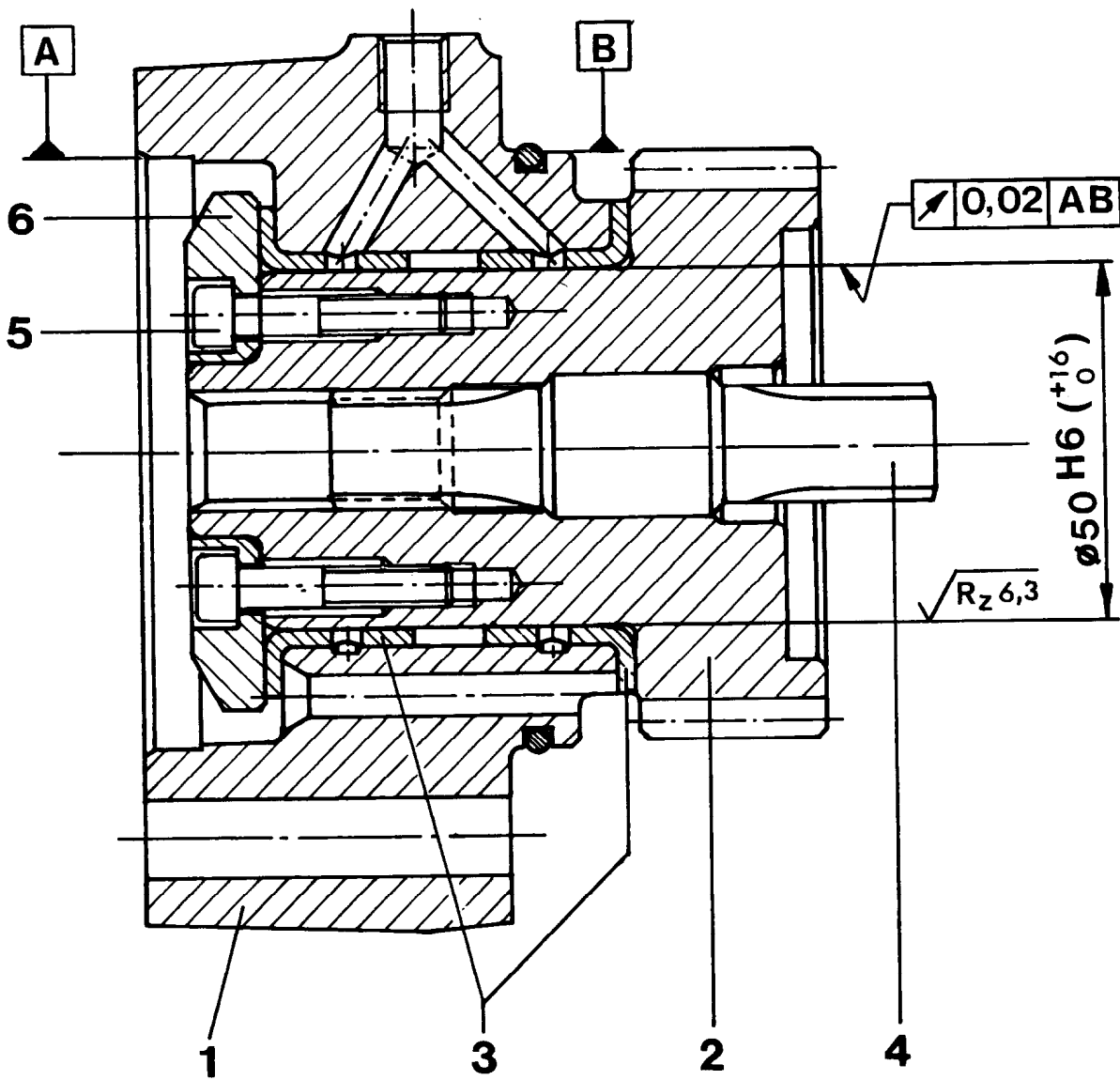




Hold gear wheel Pos. 2 in place with holding device and torque mounting bolts Pos. 5.

Remove holding device and place splined drive shaft Pos. 4 into splined bore from gear wheel Pos. 2.

Check hydraulic pump drive operation by turning the drive shaft.



Hydraulic Pump Drive Removal, Installation, Disassembly, Inspection and Repair

from Engine no. 85 01 0267

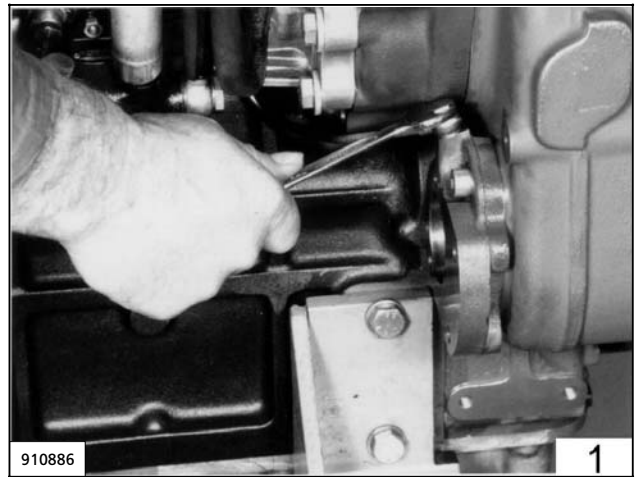
Special tool no. 81

Removal:

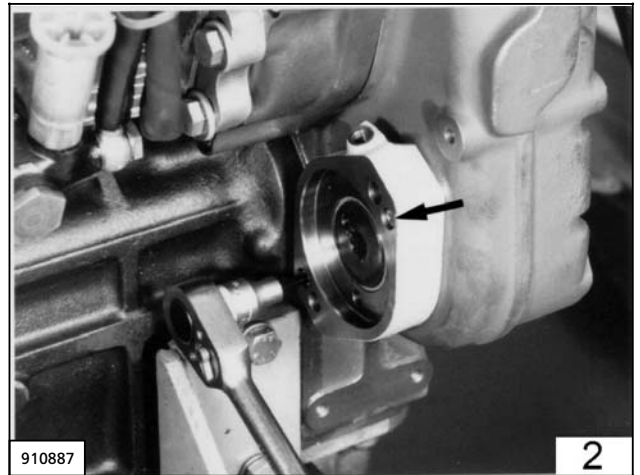
Hydraulic pumps are removed, see sub group 8.18.

For sectional drawing, see page 8.29.03.

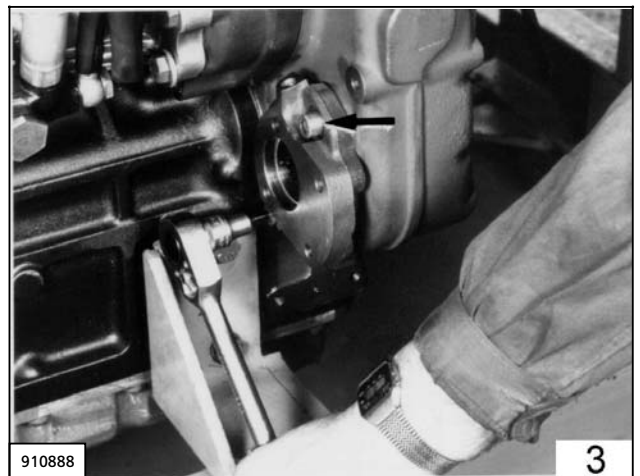
Remove lubrication oil line 1 from intermediate flange 2.



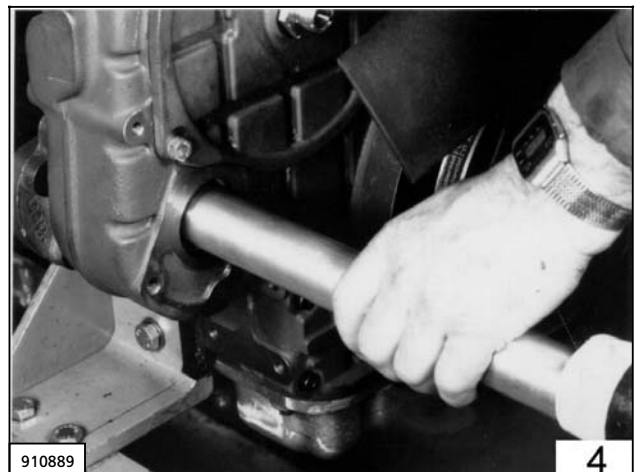
At the hydraulic pump drive for the flange pump, loosen and remove the two M 6 socket head screws.

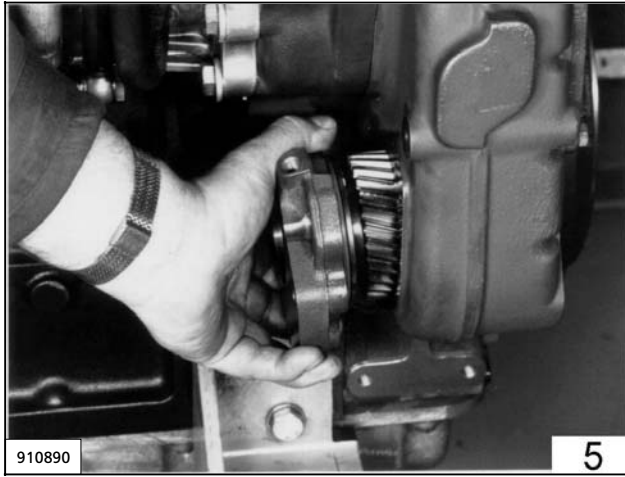


At the hydraulic pump drive for the bolt-through pump, loosen and remove the two M 10 socket head screws.



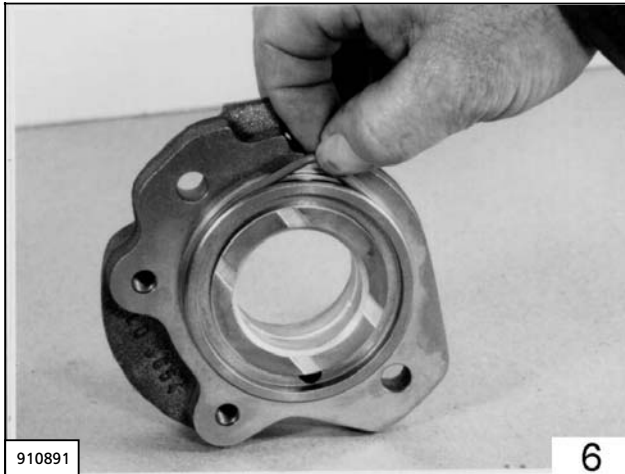
Place a soft-metal punch on gear wheel 3 and tap out intermediate flange 2 and gear wheel from timing gear box.





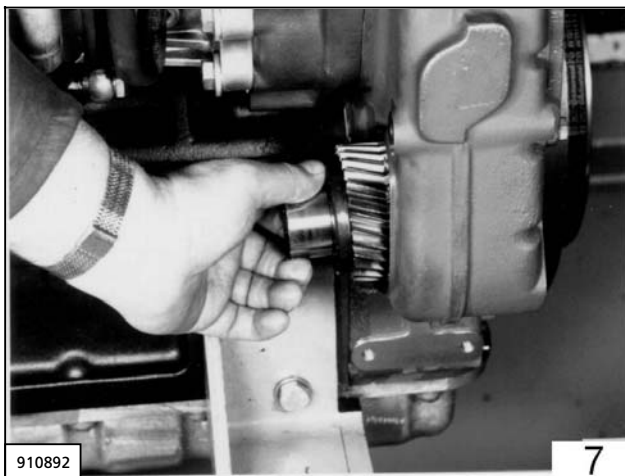
Remove intermediate flange 2 and gear wheel 3 from the timing gear box.

Clean all components and check lubrication bores in intermediate flange 2 and gear wheel 3 for restrictions.



Installation:

Place new O-ring into the groove at the intermediate flange 2 and oil lightly.



Insert gear wheel 3 in the timing box into the lubricated bushing 4. Make sure the gear teeth mesh properly.

Important:

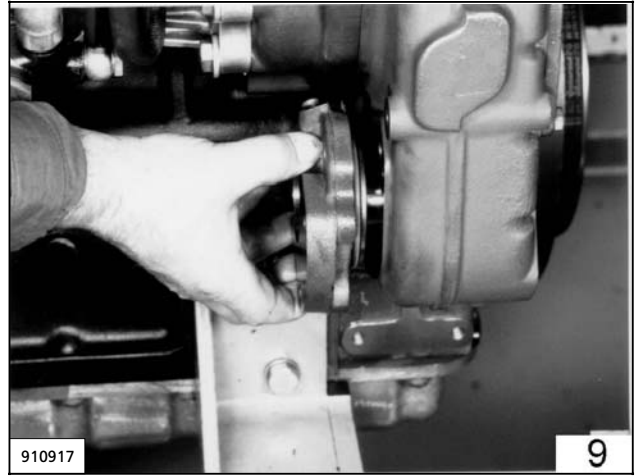
The lube oil channel plug 6 on gear 3 must point towards the injection pump side, due to the additional lube oil channel 7 for the splines of the hydraulic pump drive. Install only gears with this lube oil channel.



Important:

Gear 3 without the lube oil channel plug 6 features a groove. When installing the gear, this groove must point towards the injection pump side.

Lightly oil intermediate flange 2 and bushing 5. Push intermediate flange on gear wheel 3 and into the timing gear box. Install socket head screws and tighten. Install lubrication line 1 with new seal rings.

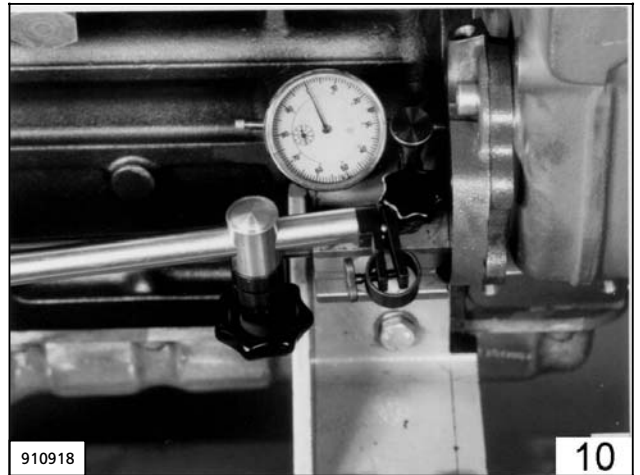


Inspection and Repair:

Inspection:

Measure axial clearance with the hydraulic pump drive installed.

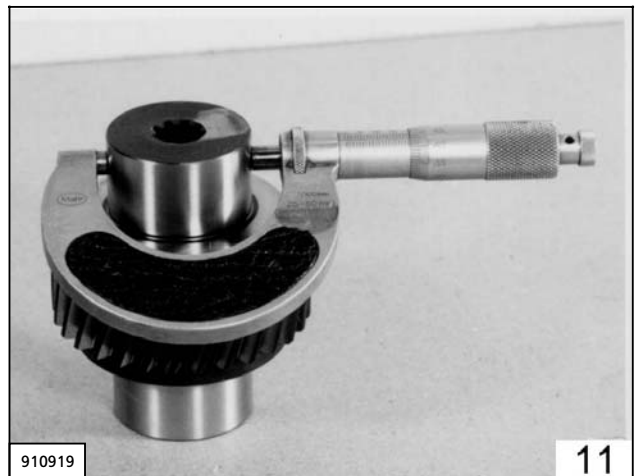
For permissible clearance, see Engine Specifications.



Remove hydraulic pump drive. Visually inspect gear wheel 3, bearing bushings and contact surfaces for wear or damage.

Measure diameter of shaft bearing surface.

For proper value, see Engine Specifications.



Visually check collar bushings 4 and 5 in the intermediate flange 2 and in the timing gear box for wear.

Measure diameter with inside micrometer.

For proper value, see Engine Specifications.

Note:

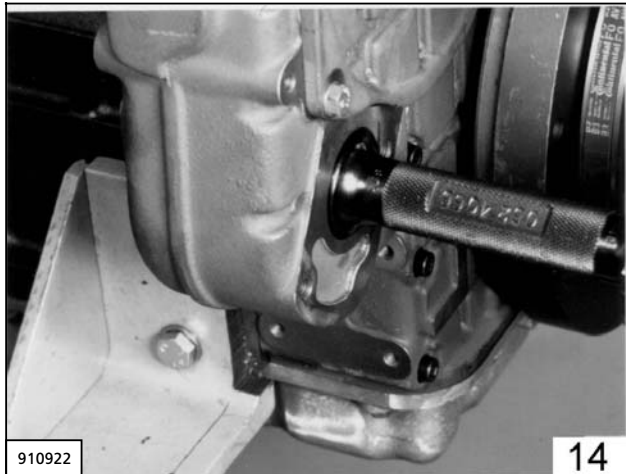
Components showing damage, excessive wear or not meeting specifications must be replaced.





Bushing Replacement at the Intermediate Flange and at the Timing Gear Box

Place intermediate flange 2 on a level surface and tap out collar bushing 5 with punch, special tool no. 81.



Tap out collar bushing 4 from timing gear box with punch, special tool no. 81.



Tap in new bushings with punch, special tool no. 81, into intermediate flange or timing gear box.

Method 1:

Chill bushing in liquid nitrogen to -150°C (-240°F) and install.

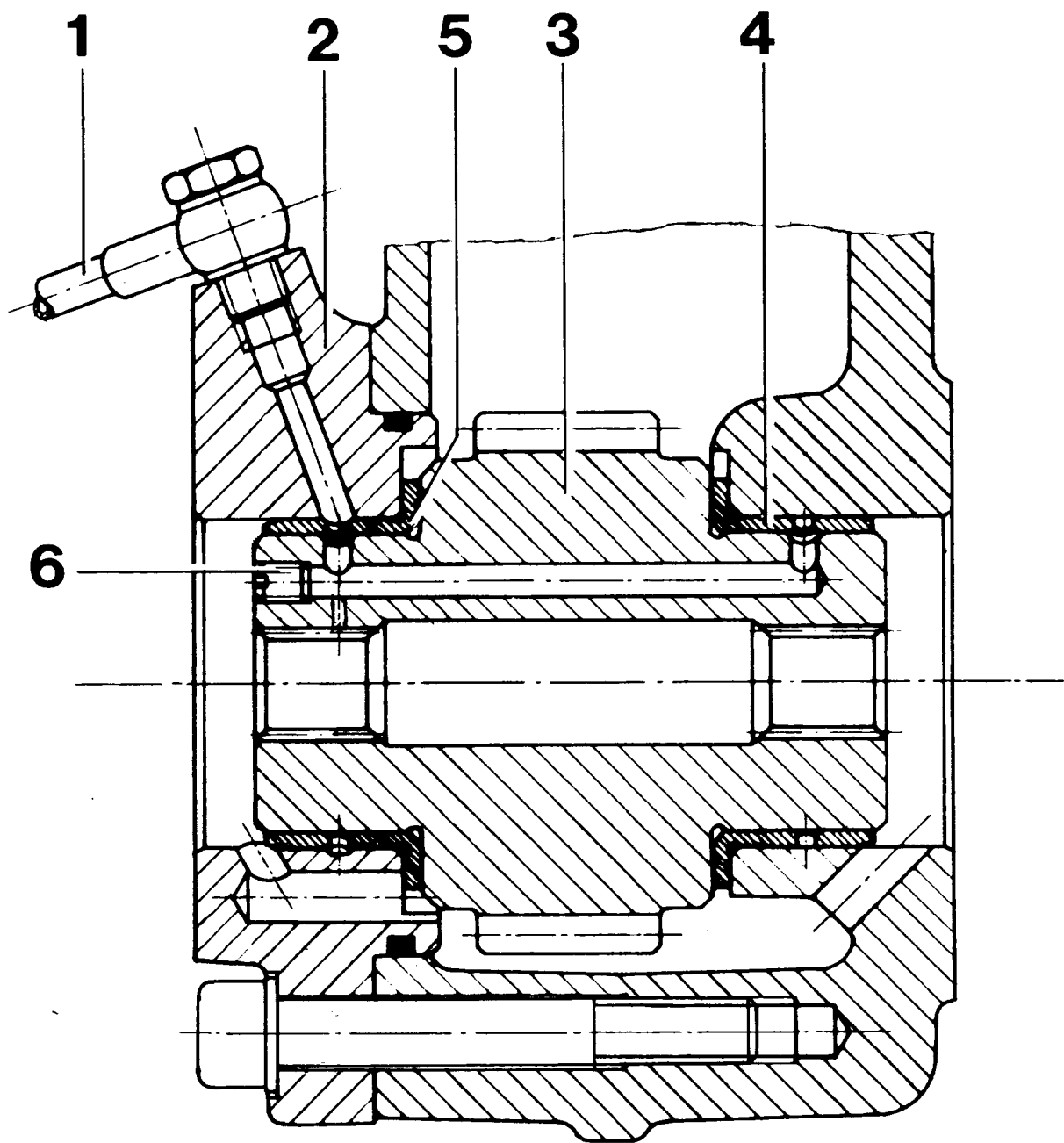
Method 2:

Heat intermediate flange 2 in an oven to $+160^{\circ}\text{C}$ ($+300^{\circ}\text{F}$) and install.

Important:

Do not damage the bearing surface of the bushing during installation.

Do not machine the bushings after installation. They will assume the correct dimension.



Hydraulic pump drive disassembly, inspection and assembly (Installation on drive gear box).

Use special tool No. 81.

Disassembly and inspection:

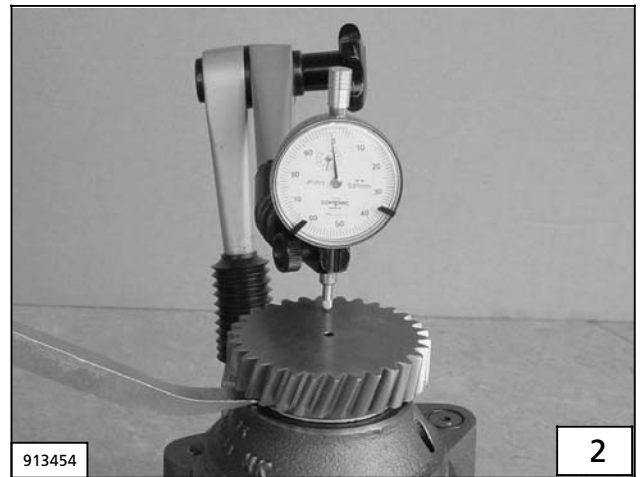
Hydraulic pump drive is removed, see sub group 8.24.

For drawing, see page 8.30.02 (rear/back)

Place the drive into a vise with protective jaws.

Check the axial play with a commercial dial gauge.

For dimension, see Technical Data.

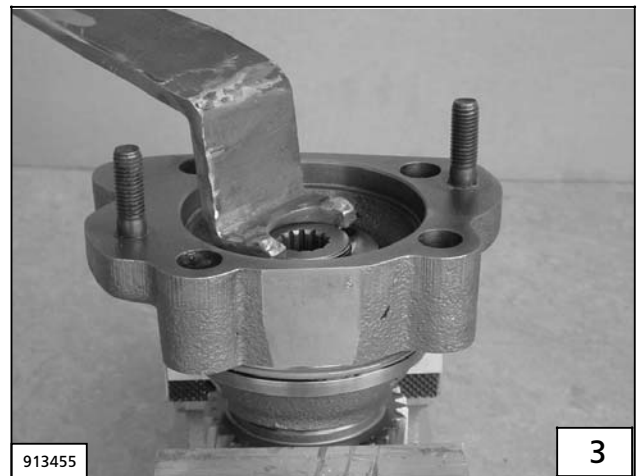


Place the gear of hub 2 into a vise with protective jaws.

Loosen and remove the double hole nut 3 with a commercially available wrench DIN 3116 - C50.

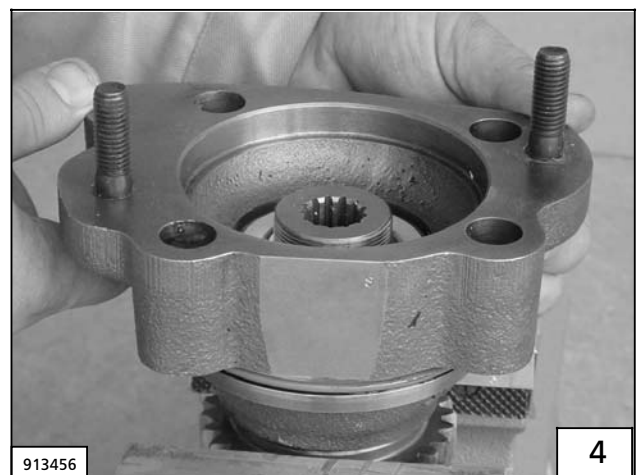
Important:

The double hole nut 3, has left - handed thread.



Pull housing 1 from hub 2.

Clean parts and check oil bores to be certain they are clear.

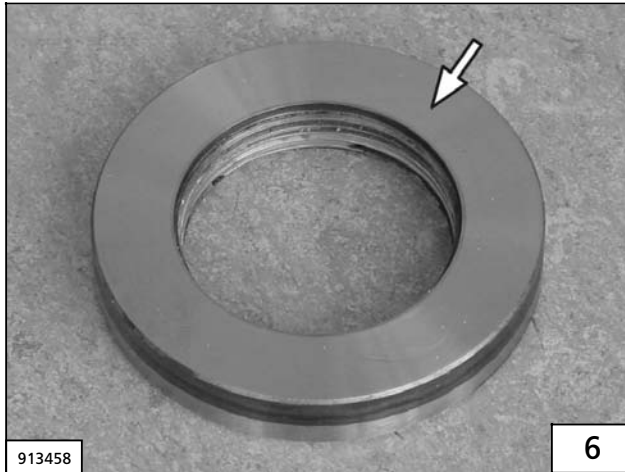




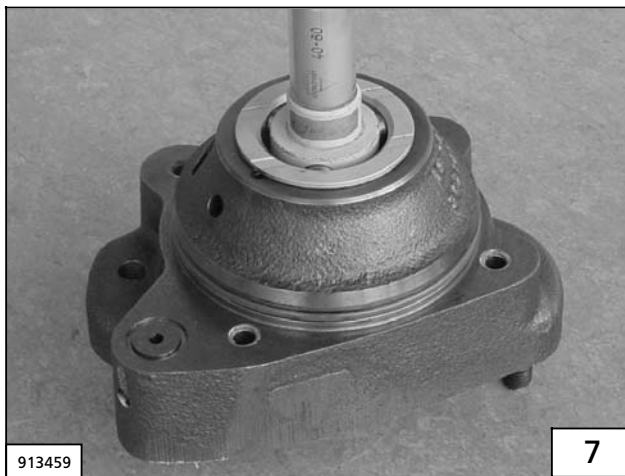
Visually check the running surfaces for the collar bushings 4, 5 as well as the teeth and splines on hub 2 for damage.

Measure pin diameter.

For dimensions, see Technical Data.



On the double hole nut 3, check thrust surface for collar bushing 4 visually for wear.



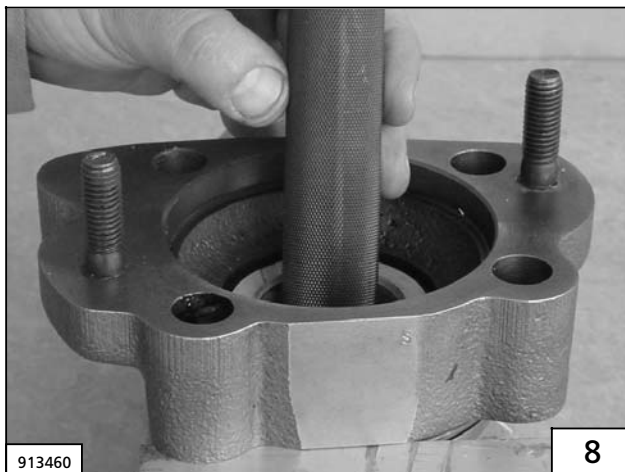
Visually check collar bushings 4, 5 in housing 1 for wear.

Measure with bore gauge.

For dimensions, see Technical Data.

Note:

Replace any part which falls outside the required tolerance or is damaged.



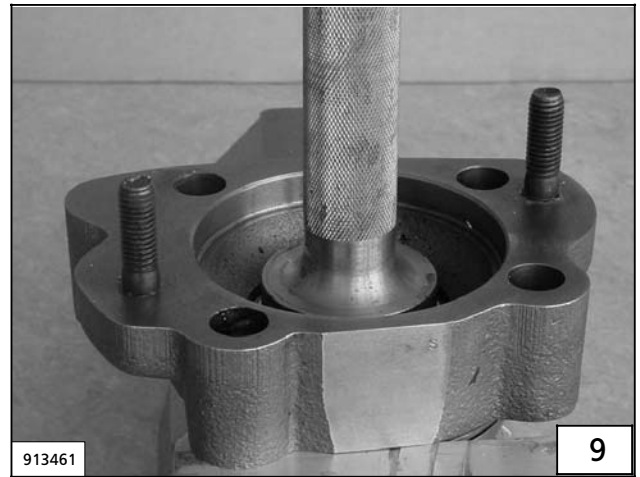
Replacement of collar bushings in housing:

Place the housing 1 on a support, and drive the collar bushing 5 out with a punch. Turn the housing 1 over and press out the collar bushing 4 with a punch, special tool No. 81.

Cool collar bushings 4, 5 in a liquid nitrogen to -175°C to -190°C (-350°F to -375°F) and press flush into housing 1 with punch, special tool No. 81.

Note:

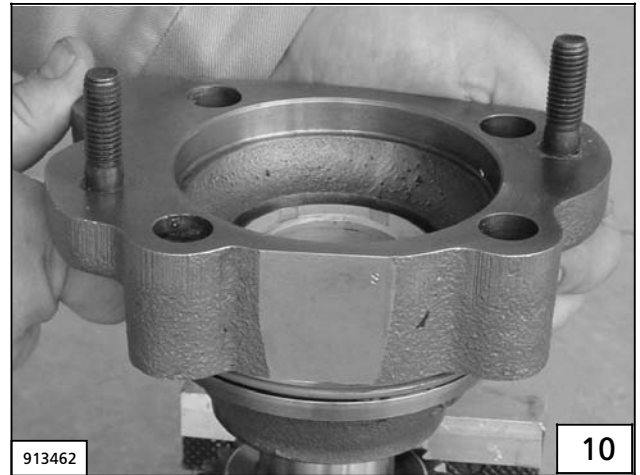
Collar bushings 4, 5 are finished bushings and should not be remachined.



Assembly:

Place hub 2 in a vise using protective jaws and lubricate the running surfaces lightly with oil.

Push housing 1 onto hub 2.



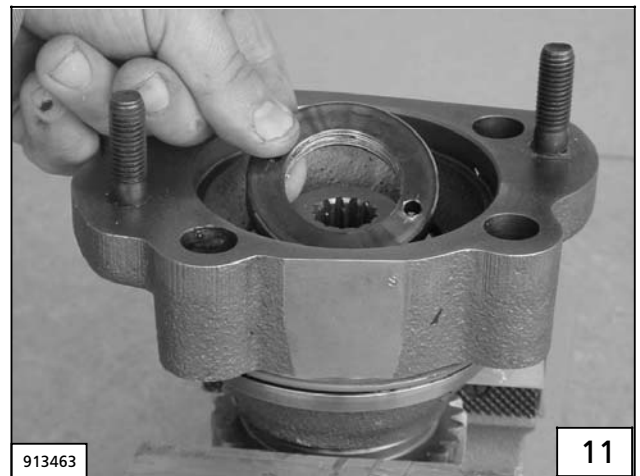
Apply Loctite 243 to threads of hub 2. Install double hole nut 3 and tighten with commercially available wrench DIN 3116 - C 50.

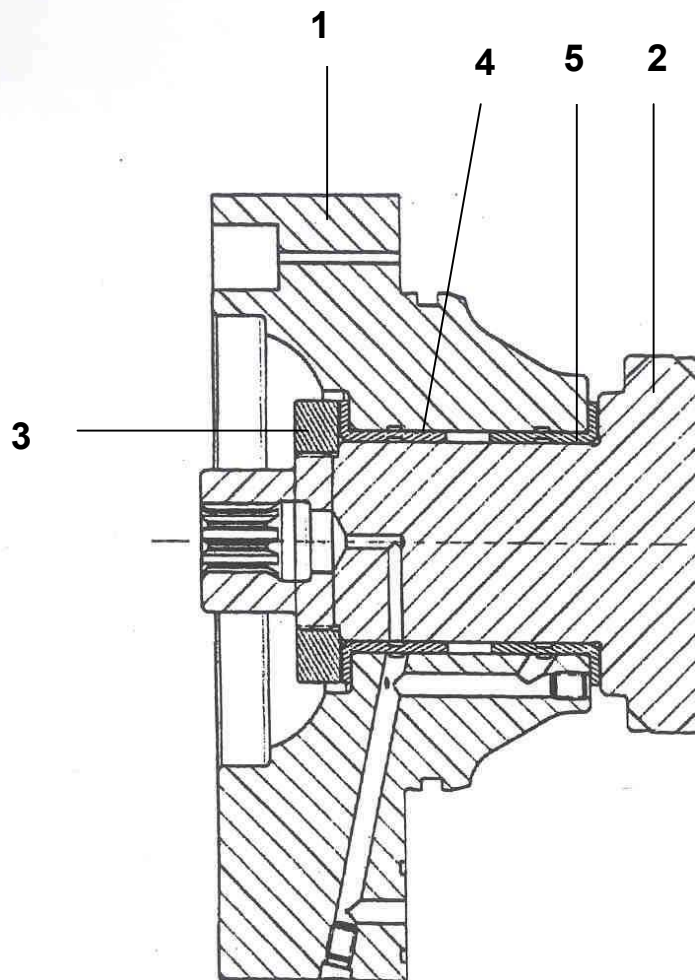
For tightening torque, see Technical Data.

Important:

After each installation or repair, check the axial play of the hydraulic pump drive (see fig. 2)

For dimensions, see Technical Data.





Oil Pan Removal and Installation

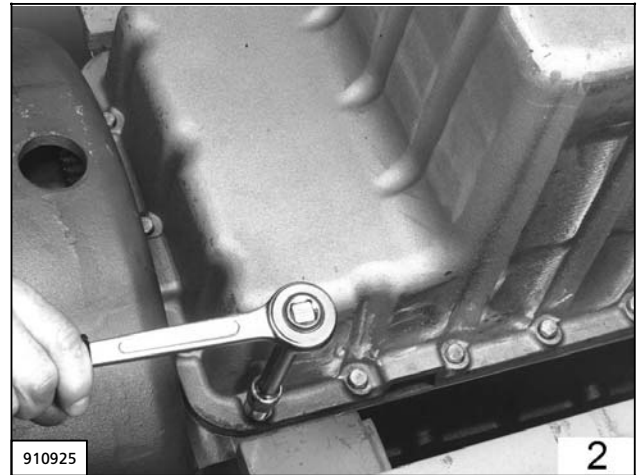
Oil Pan Removal:

Drain engine oil as described see sub group 2.01.

Remove engine oil dipstick from guide tube.
Unscrew guide tube from engine oil pan.



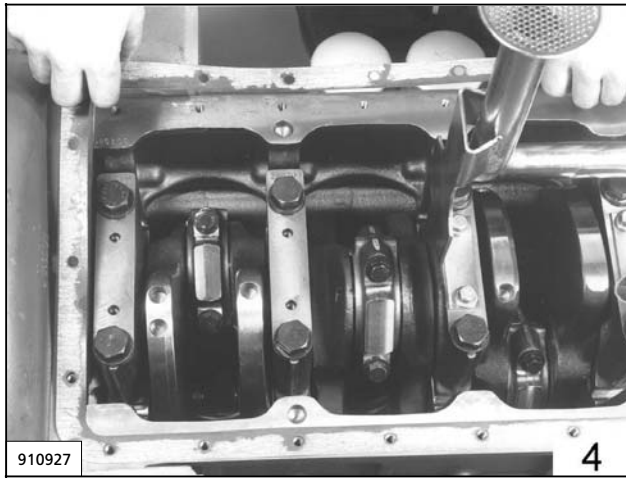
Loosen and remove oil pan mounting bolts.



Remove oil pan from crankcase.



Clean mounting surfaces on crankcase, timing and accessory drive gear box and flywheel housing.
Clean oil pan mounting surface. Wash and rinse entire oil pan.



Oil Pan Installation:

Place new gasket on oil pan mounting surface. Position oil pan with gasket on engine crankcase, screw in and torque oil pan mounting bolts. Screw in dipstick guide tube and insert dipstick in guide tube.

Refill engine with engine oil as described , see sub group 2.01.

Lubrication Oil Lines Removal and Installation

Note:

Depending on the oil pan option and the required tilt angle of the engine, there can be, besides the standard lube oil pressure pump, a lube oil suction pump installed as well. The number of lube oil lines will vary accordingly.

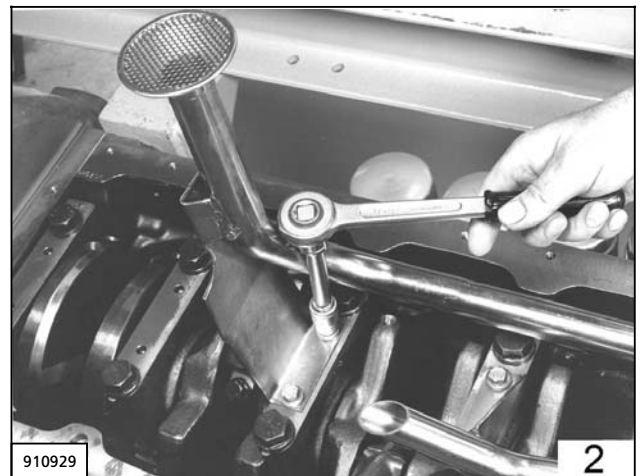
Lube Oil Line Removal:

Remove engine oil pan as described in sub group 8.32.

Loosen and remove lube oil line mounting bolts from lub oil pump.



Remove lube oil line assembly from crankcase. Clean mounting surfaces on lube oil pump and lub oil line assembly.



Unscrew and remove lube oil line bracket mounting bolts from crankcase.



Lube Oil Line Installation:

Place lube oil line with new gasket on lube oil pump port. Screw lube oil mounting bolts into lube oil pump (do not torque bolts at this time!).

Screw in and torque lube oil line bracket mounting bolts to crankcase.

Torque lube oil line mounting bolts on lube oil pump.

Lubrication Oil Pump Removal Installation and Inspection

Note:

Depending on the oil pan option and the required tilt angle of the engine, there can be, besides the standard lube oil pressure pump, a lube oil suction pump installed as well.

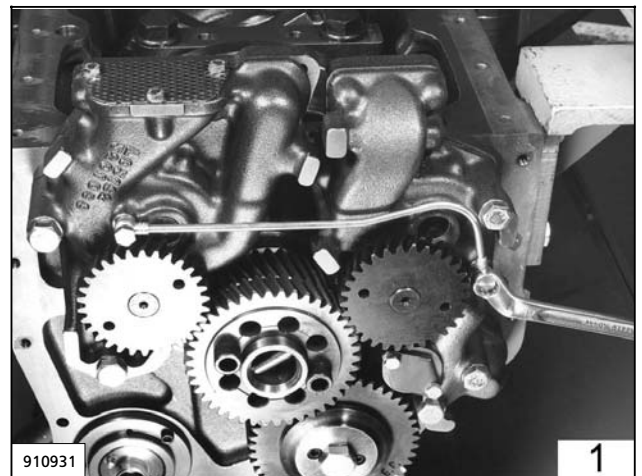
Lube Oil Pump Removal:

Remove timing and accessory drive gear box as described in sub group 9.00.

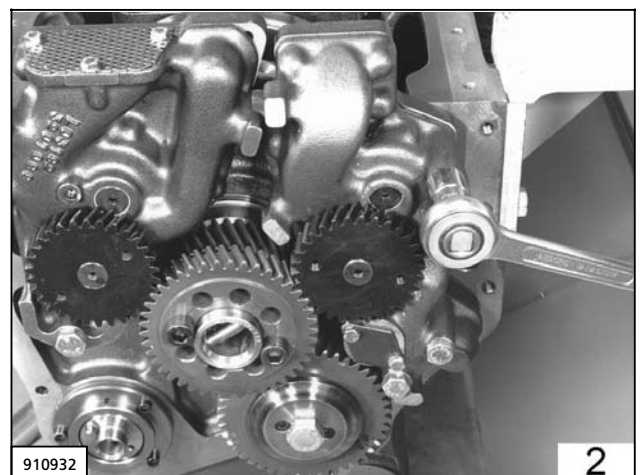
Remove engine oil pan as described in sub group 8.32.

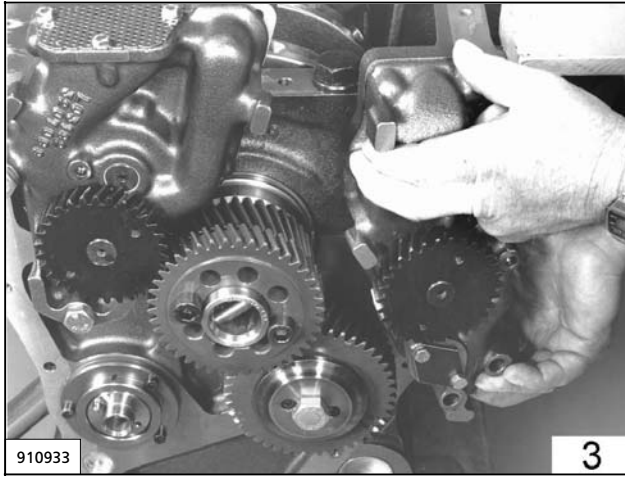
Remove lube oil lines as described in sub group 8.35.

Remove lube oil line connecting lube oil pressure and lube oil suction pump (Not required if there is no lube oil suction pump installed).

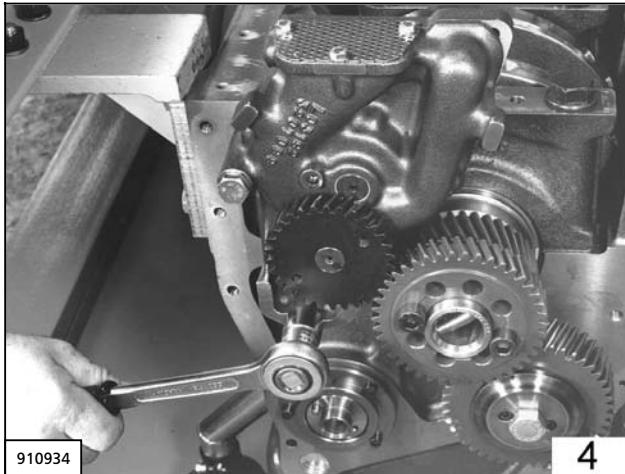


Unscrew and remove lube oil pressure pump mounting bolts.





Remove lube oil pressure pump from crankcase.



Unscrew lube oil suction pump mounting bolts.



Remove lube oil suction pump from crankcase.



Lube Oil Pump Installation:

Position lube oil pressure pump in crankcase with pump drive gear wheel meshing gear wheel on crankshaft. Screw in pump mounting bolts and tighten bolts slightly. Measure backlash between gear wheel teeth with feeler gauge and adjust backlash by shifting the lube oil pump while turning the drive gear. Torque pump mounting bolts to specifications.

See Engine Specifications for proper backlash and torque settings.

Position lube oil suction pump in crankcase with pump drive gear meshing with gear on crankshaft. Screw in pump mounting screws and tighten bolts slightly. Measure backlash between gear teeth with feeler gauge and adjust the backlash by moving the lube oil pump while turning the drive gear. Torque pump mounting screws to specification.

See Technical Data for proper backlash and torques.



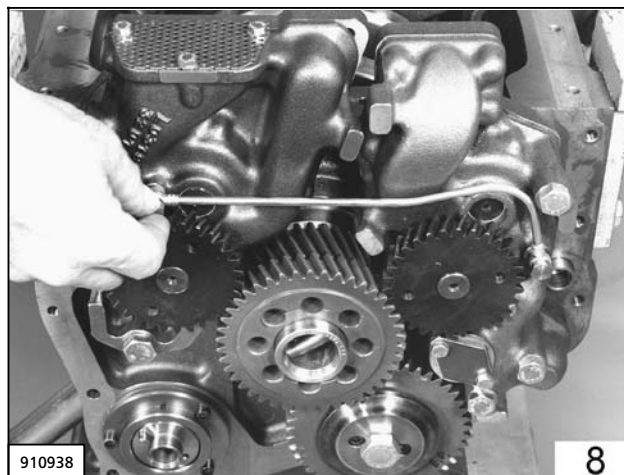
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7

Install lube oil line between lube oil pressure and suction pump, using new seals.

Note:

Install the screws with Loctite 262 or Omnifit 100 M.



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8

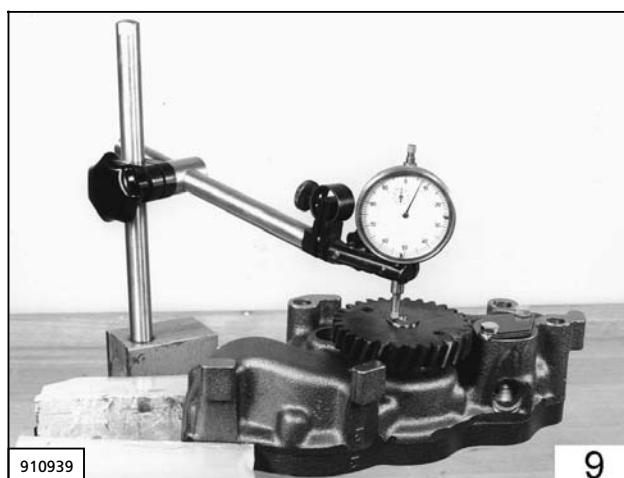
Inspection:

Place lube oil pump in vise. Measure axial play of drive shaft with dial gauge.

See Technical Data for measurements.

Note:

If the axial play is not between the limits given on the Technical Data chart, replace the pump. If the pump needs to be replaced, note the pump gear width measurement engraved on the pump housing.



910939

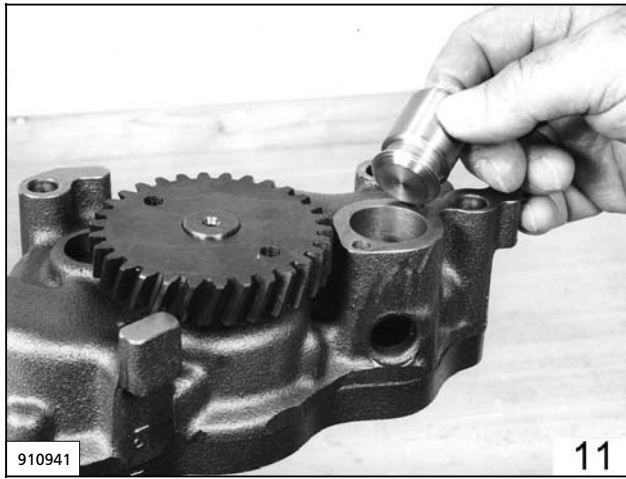
9

Remove the retaining plate for the oil pressure relief valve on the lube oil pressure pump. Remove spring and plunger from pump housing.



910940

10

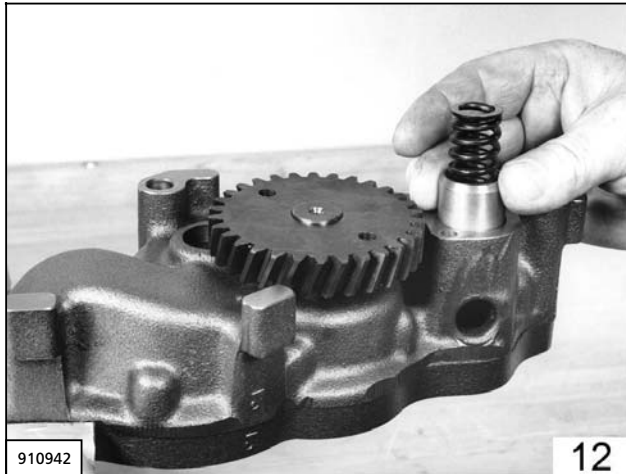


Visually check plunger and plunger seat in pump housing for wear or damage.

Note:

See Engine Specifications for correct oil pressure relief valve setting and the required output of the lube oil pumps.

Consider pump gear width as embossed in the pump housing when checking for the correct lube oil pump output.



Reinstall relief valve with mounting flange to lube oil pressure pump.

Piston Cooling Nozzle Removal, Installation and Inspection

Nozzle Removal:

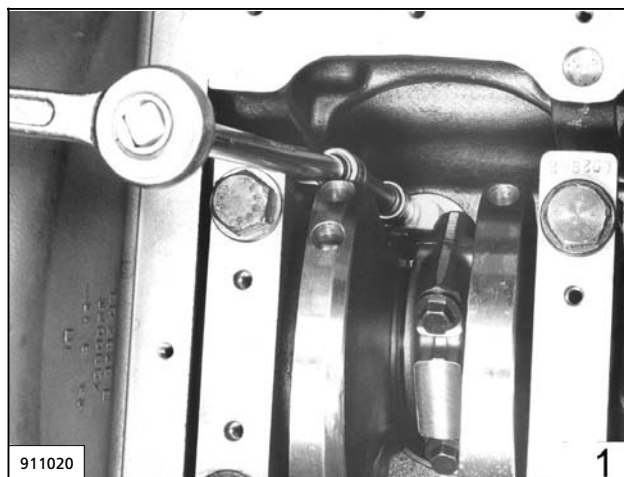
Remove oil pan as described in sub group 8.32.

Unscrew piston cooling nozzle mounting bolt and remove bolt with magnet rod.

Note:

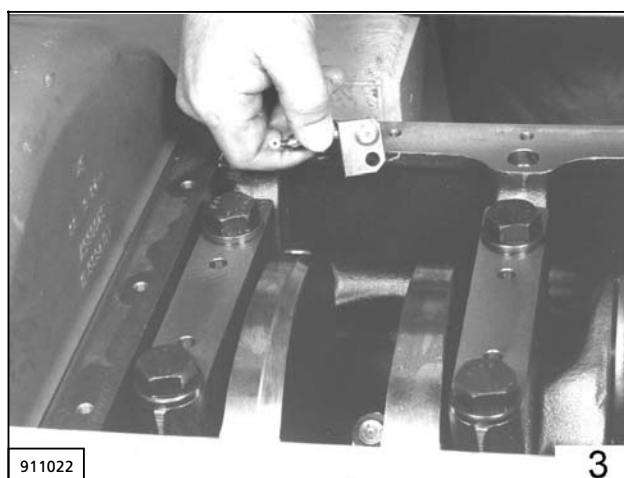
Reposition crankshaft balancing weights and connecting rod at cylinder concerned to gain easy access to piston cooling nozzle.

Remove piston cooling nozzle and pressure relief valve with needle-nose pliers from crankcase.



Nozzle Installation:

Place pressure relief valve and piston cooling nozzle into crankcase. Screw in and torque nozzle mounting bolt.



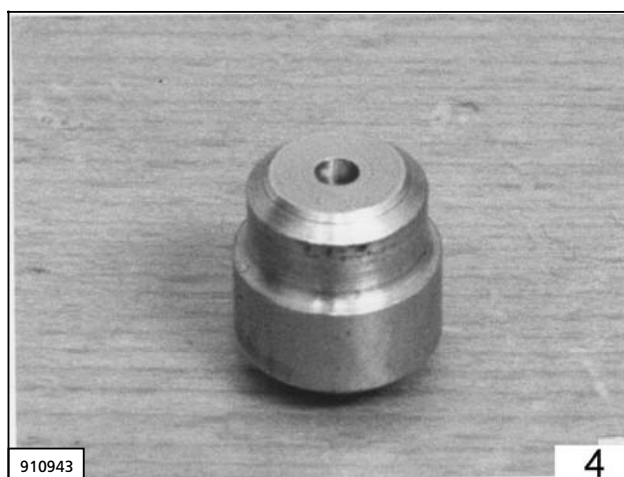
Nozzle Inspection:

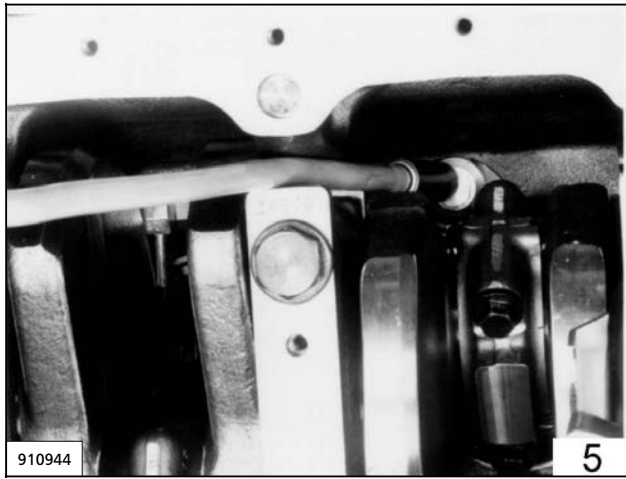
The piston cooling nozzle must be removed from crankcase as described above.

Remove pressure relief valve cartridge from piston cooling nozzle. Check nozzle bore for any deposit and clean nozzle if required.

Check relief valve operation by depressing the ball against spring and visually check ball seat in cartridge.

See Engine Specifications for proper relief valve setting.





Piston Cooling Nozzle Removal, Installation and Inspection

from Engine no. D 904 84 01 0066
D 906 84 02 0040

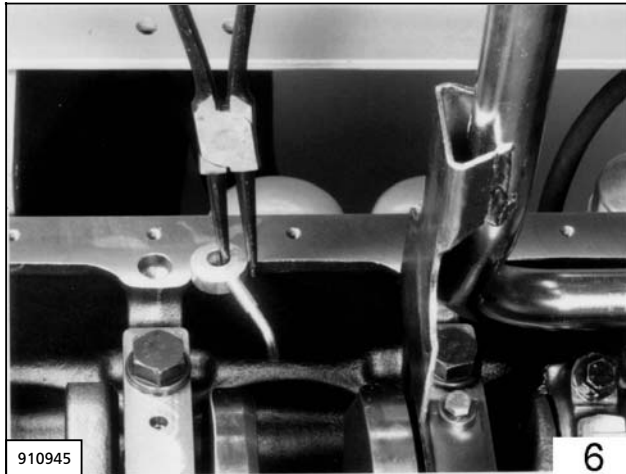
Nozzle Removal:

Remove oil pan as described in sub group 8.32.

Unscrew relief valve cartridge at piston cooling nozzle and remove cartridge with magnet rod from crankcase.

Note:

Turn crankshaft to gain easy access to piston cooling nozzle.

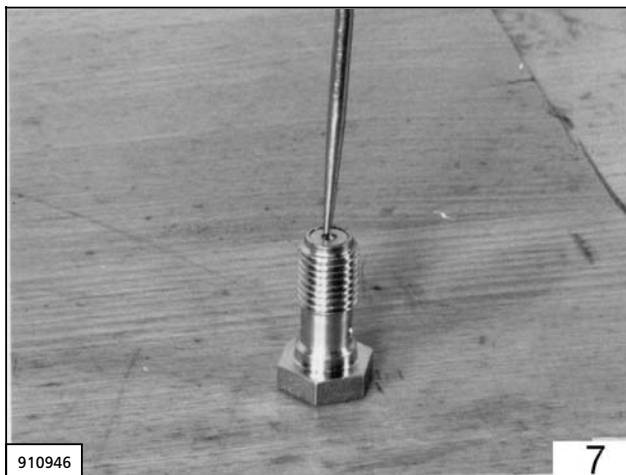


Remove piston cooling nozzle with needle nose pliers from pins in crankcase.

Installation:

Push piston cooling nozzle on roll pins in crankcase. Apply locking compound to threads of relief valve (Loctite 262, Omnifit 100 M, etc.). Install relief valve and tighten.

For proper torque, see Engine Specifications.



Nozzle Inspection:

The piston cooling nozzle must be removed from crankcase as described above.

Check nozzle orifice for any deposit and clean nozzle if required.

Check relief valve operation by depressing the ball against spring and visually check ball seat in cartridge.

See Engine Specifications for proper relief valve setting.

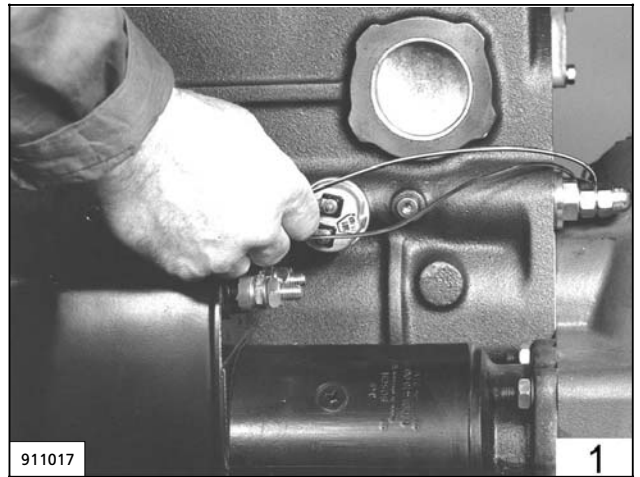
Oil Pressure Sending Unit Replacement

Note:

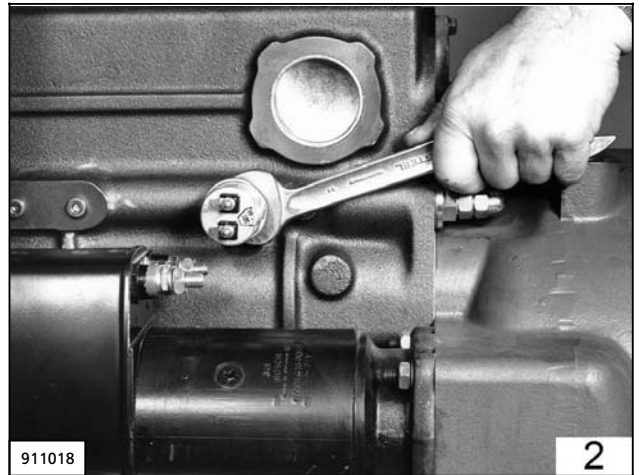
The oil pressure sending unit can be defective when the indication on the oil pressure gauge is not within the specified pressure range.

See Engine Specification for proper oil pressure levels.

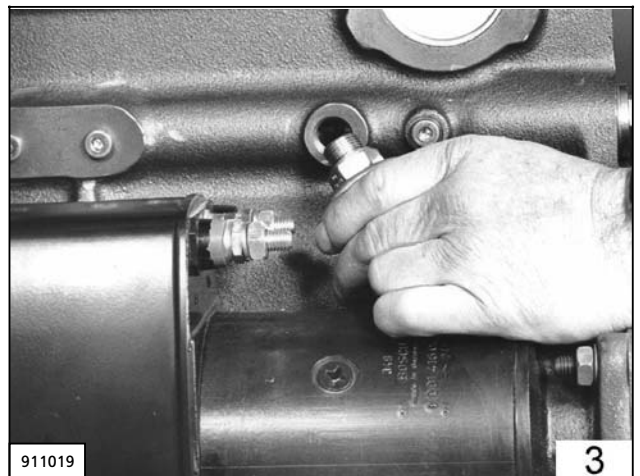
Remove wire from oil pressure sending unit terminal.



Unscrew and remove oil pressure sending unit from crankcase.



Screw new oil pressure sending unit with new seal ring into crankcase. Reconnect wire to sending unit terminal.

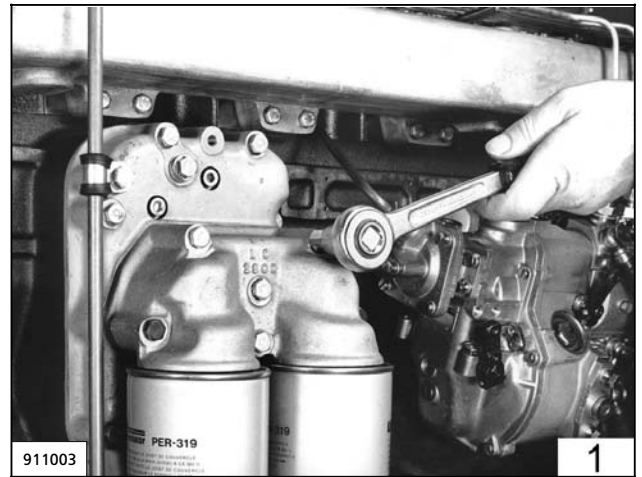


Oil Filter Mounting Base, Bypass Valve and Oil Cooler Removal and Installation - Filter Installed Downward

Oil Filter Mounting Base Removal and Installation:

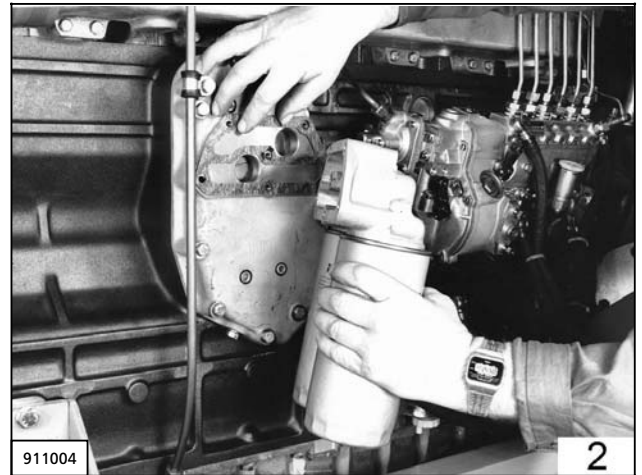
Filter Base Removal:

Remove filter mounting base screws.



Remove oil filter mounting base, complete with lube oil filter cartridge from oil cooler plate.

Clean sealing surface on filter base and oil cooler plate.



Filter Base Installation:

Install oil filter base, complete with oil filter cartridge and new seal to oil cooler plate.



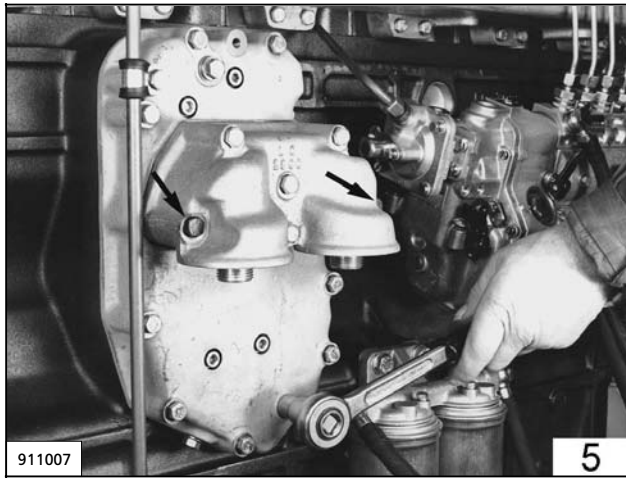
Oil Filter and Oil Cooler Bypass Valve Removal and Installation:

Removal:

Drain coolant from cooling system, see sub group 2.01.

Remove oil filter cartridges.





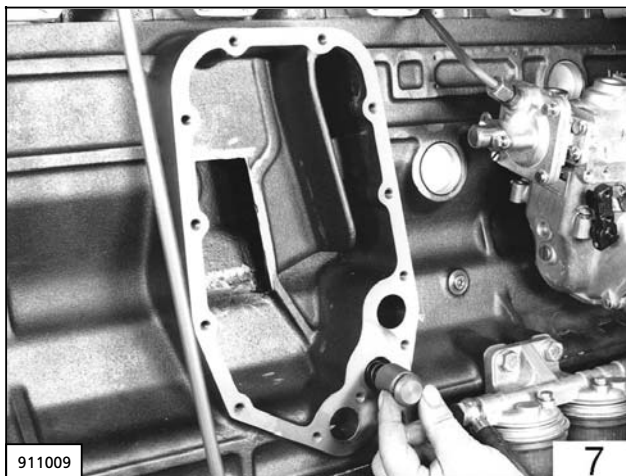
Unscrew and remove oil cooler plate mounting bolts.

Note:

To remove oil cooler plate/oil filter assembly from engine block, only the two outside filter base mounting bolts must be removed (see arrows).

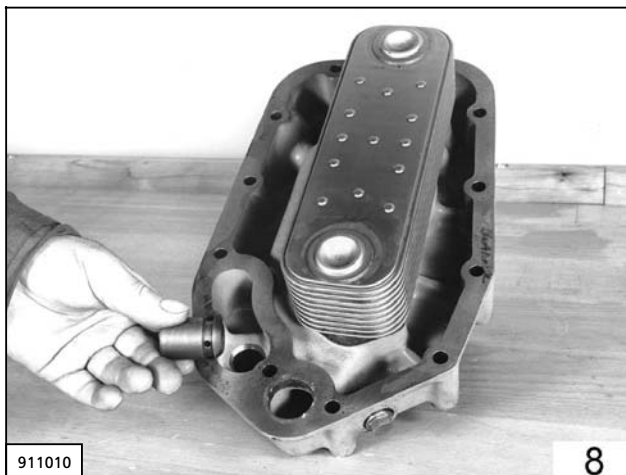


Remove entire oil cooler plate/oil filter assembly from engine block.



Remove bypass-valve spring and plunger from engine block.

Clean all components as well as mounting surfaces on engine block and oil cooler plate.



Visually check bypass-valve plunger and plunger seat in oil cooler plate for wear and damage.

Measure valve spring length.

See Engine Specification for proper dimensions.

Note:

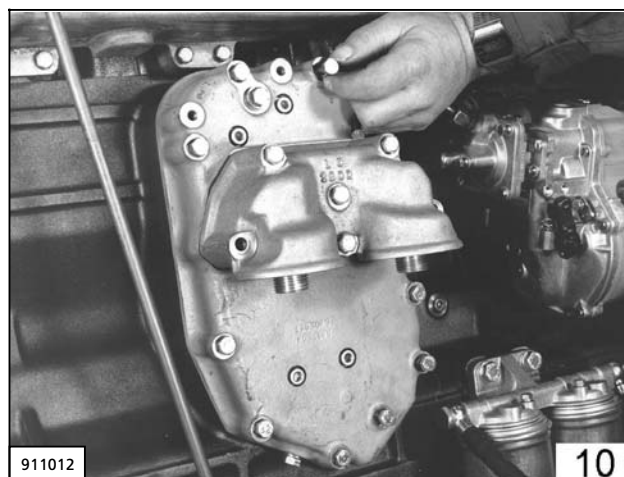
See Engine Specification for proper bypass-valve pressure setting.



Bypass-Valve Installation:

Properly place bypass-valve spring and plunger into engine block. Place entire oil cooler plate/oil filter assembly with new gasket on engine block. Screw in and torque oil cooler plate mounting bolts. Lubricate oil filter cartridge seal rings with engine oil and screw both cartridges to oil filter base. Tighten oil filter cartridges with both hands.

Refill cooling system with coolant as described see sub group 2.01.

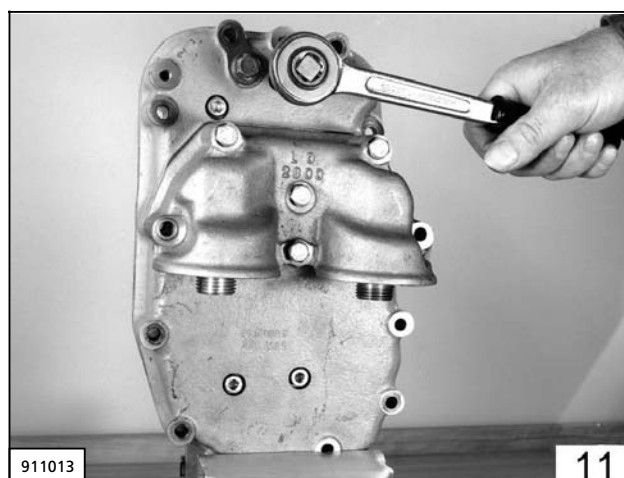


Oil Cooler Removal and Installation

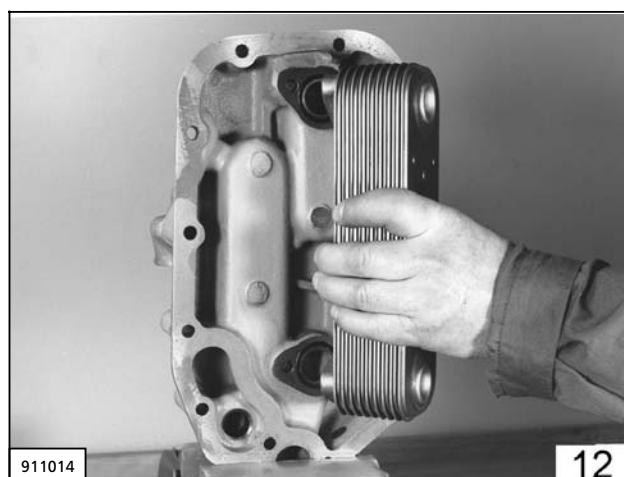
Oil Cooler Removal:

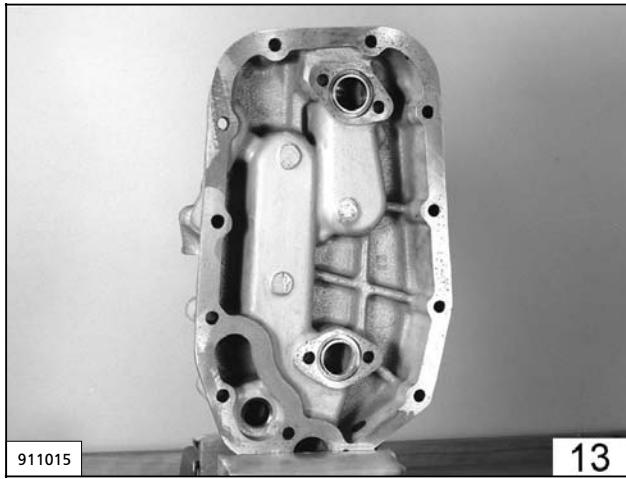
Remove oil cooler plate as described on page 8.48.01 under bypass-valve removal.

Unscrew and remove oil cooler mounting bolts from oil cooler plate.



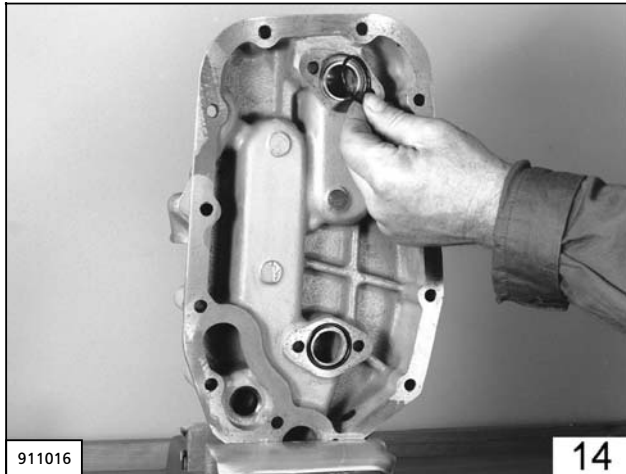
Remove oil cooler from oil cooler plate.





Oil Cooler Installation:

Clean O-ring grooves and mounting surfaces on oil cooler plate.



Coat new O-ring with grease and place them into the grooves in the oil cooler cover plate. Apply sealing compound (Hylomar SQ 32 M, Omnivisc 1050, Reinzoplast, etc.) to the cooler core mounting flange at the oil cooler cover plate.

Install oil cooler to oil cooler plate with oil cooler mounting bolts. Torque mounting bolts.

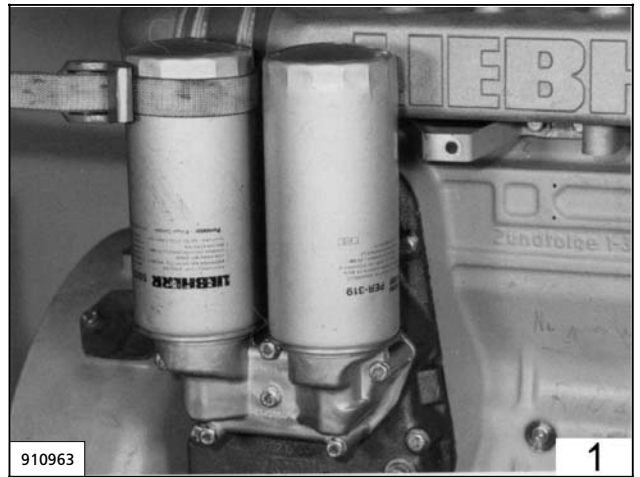
Install oil cooler plate to engine block as described on page 8.48.01 (bypass-valve installation).

Oil Filter Mounting Base, Bypass Valve and Oil Cooler Removal and Installation (Filter installed upward):

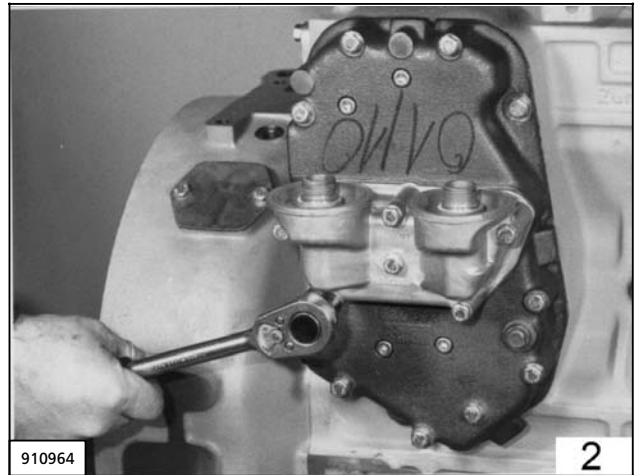
Oil Filter Mounting Base Removal and Installation:

Removal:

Remove lube oil filter cartridges from mounting base.



Remove screws on oil filter mounting base.



Remove mounting base from oil cooler plate.

Clean sealing surface of oil filter mounting base and oil cooler plate.

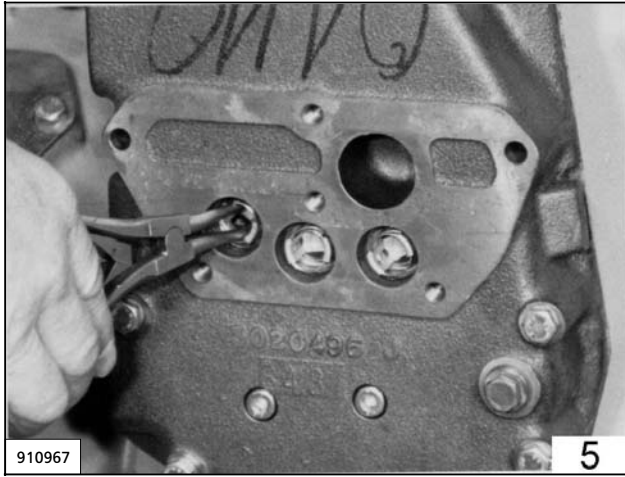


Check valves for easy movements and leaks.

Note:

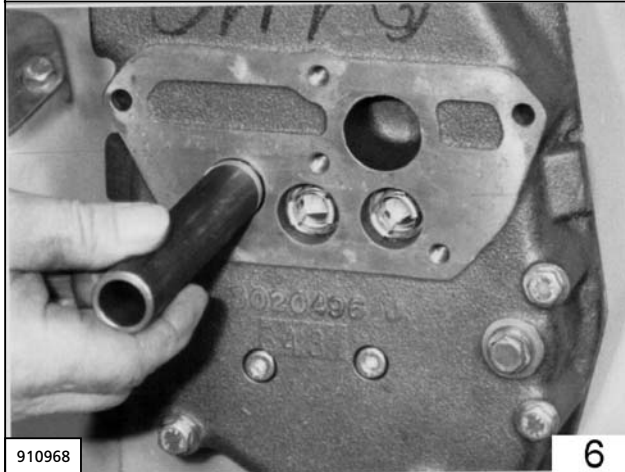
If valves move hard or leak (no oil in filter mounting base and in oil filters), the valves must be replaced.





To replace valves:

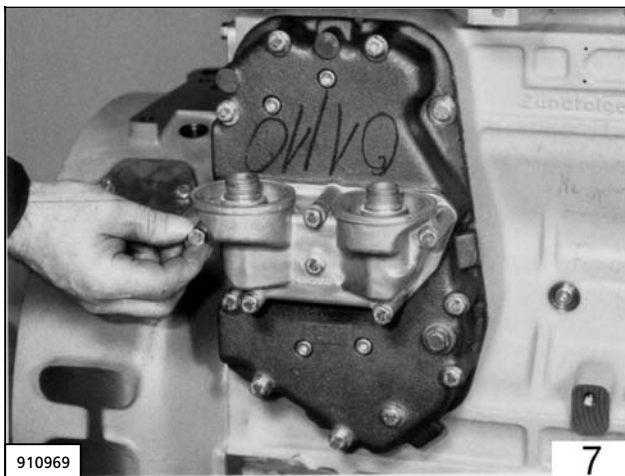
Pull valves with pliers from oil cooler plate. Clean valve seats in the oil cooler plate, remove any remaining oil or dirt.



Apply Loctite 648 or Omnifit 230 M to valve seats in oil cooler plate. Insert valves all the way into oil cooler plate using a properly sized tube.

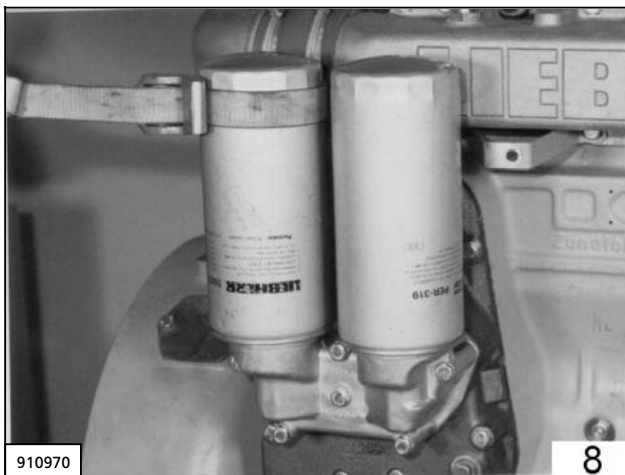
Note:

After inserting the seal, when the sealing compound is hard, check the valves for free movement.



Installation:

Install the oil filter mounting base to the oil cooler plate, using new seal.



Bypass Valve Removal and Installation:

Removal:

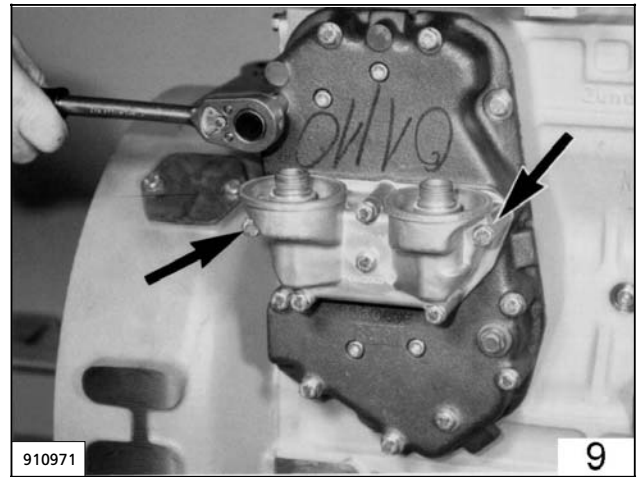
Drain coolant, see sub group 2.01.

Remove lube oil filter cartridges.

Remove screws on oil cooler plate.

Note:

Only remove the two outside screws (see arrows) on the oil filter mounting base.



Remove oil cooler plate complete with mounting base from crankshaft housing.

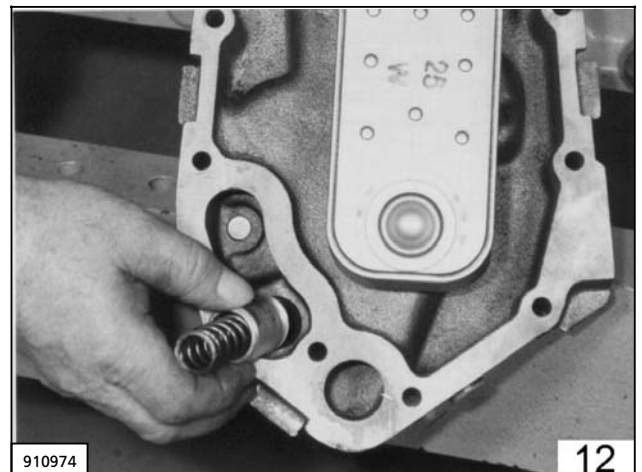


Remove spring and plunger of bypass valve from crankshaft housing.

Clean all parts and sealing surface on crankshaft housing and oil cooler plate.



Visually check piston and sealing surface in oil cooler plate for wear.



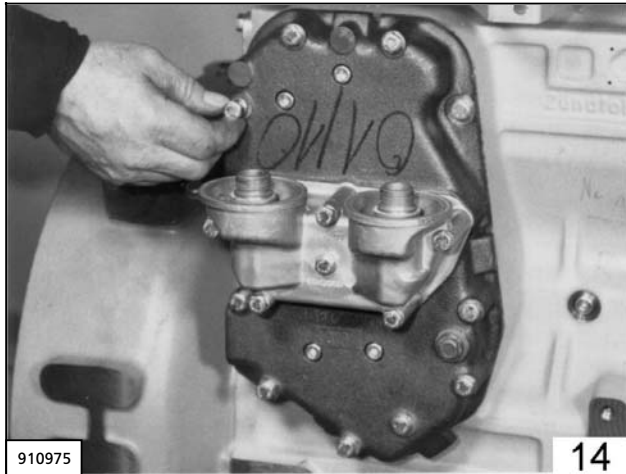


Measure length of valve spring.

See Technical Data for proper dimension.

Note:

Check Technical Data for bypass valve setting.

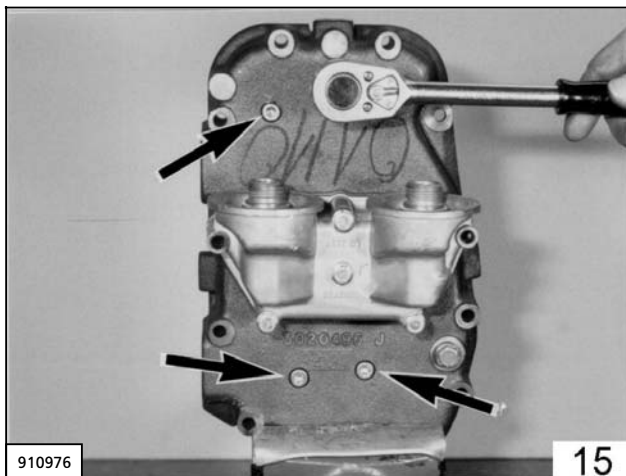


Bypass valve Installation:

Properly place bypass valve spring and plunger into engine block. Place entire oil cooler plate/oil filter assembly on engine block, using new gasket.

Screw in and torque oil cooler plate mounting screws. Lubricate oil filter cartridge seal rings with engine oil and screw both cartridges to oil filter base. Tighten oil filter cartridges with both hands.

Fill cooling system with coolant, see sub group 2.01.

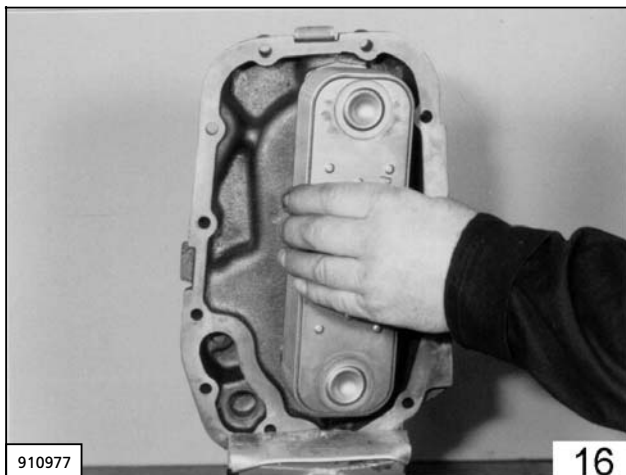


Oil Cooler Removal and Installation:

Oil Cooler Removal:

Remove oil cooler plate as described on page 8.49.01 / 8.49.02 - Bypass valve removal.

Remove oil cooler mounting screws from oil cooler plate.

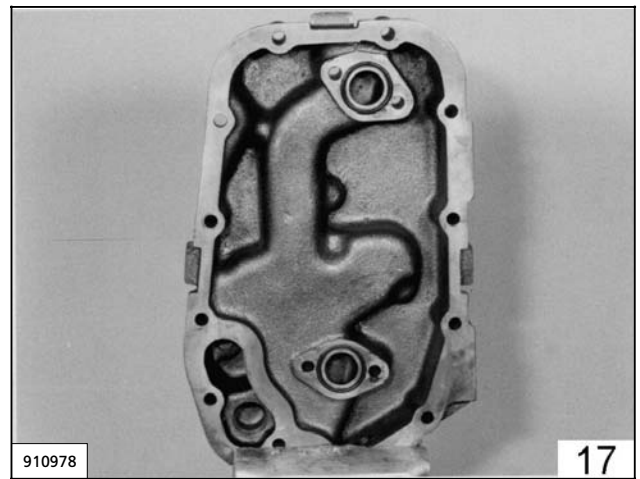


Remove oil cooler from plate.

Installation:

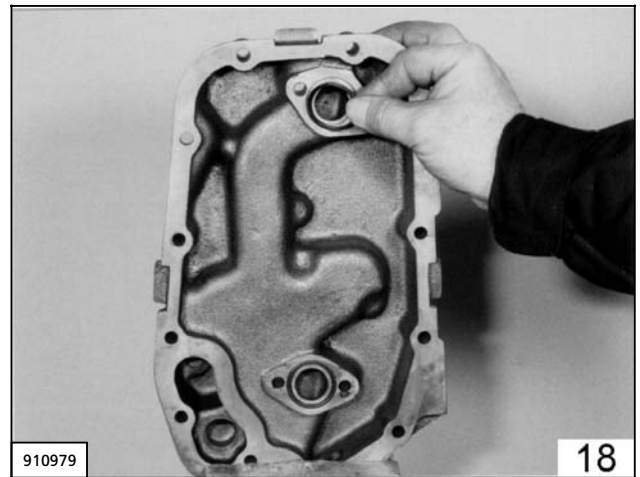
Clean grooves for O-rings in oil cooler plate.

Clean sealing surfaces on oil cooler plate and oil cooler.



Apply grease to new O-rings and insert them in the grooves on the oil cooler plate.

Apply sealing compound, such as Hylomar SQ 32/M, Omnivisc 1050 or Reinzoplast to installation flange for the oil cooler and on the oil cooler plate.



Install oil cooler on oil cooler plate.

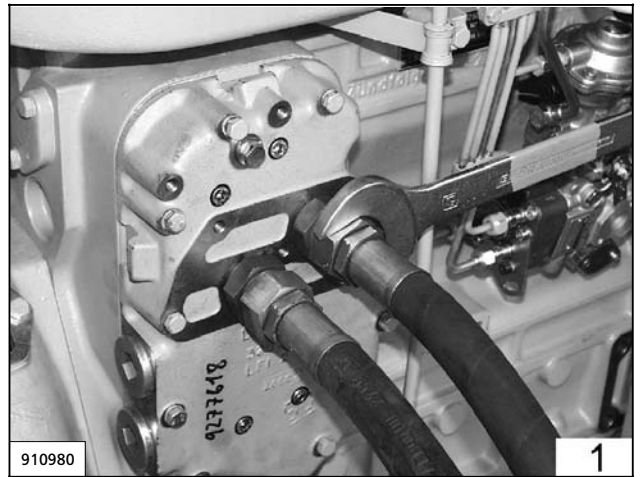
Install oil cooler plate, see filter and bypass valve removal and installation, sub group 8.49.01 / 8.49.02.

**Oil cooler housing, oil filter / oil cooler bypass valve
and oil cooler removal and installation
(Remote mounted oil filter (s))**

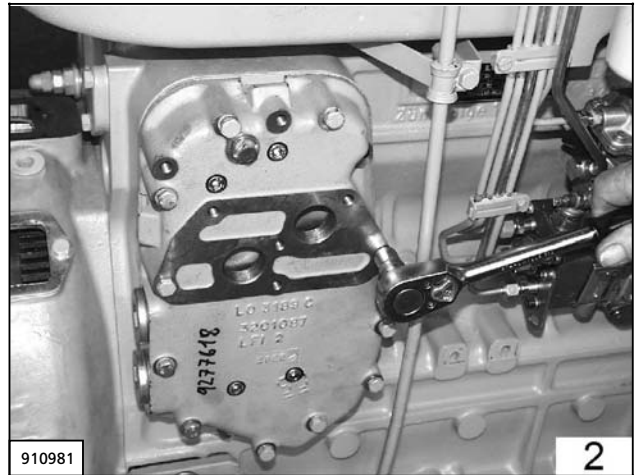
Oil cooler housing removal:

Drain the coolant, see sub group 2.01.

Remove the oil lines on the oil cooler housing.



Loosen and remove oil cooler housing mounting screws.

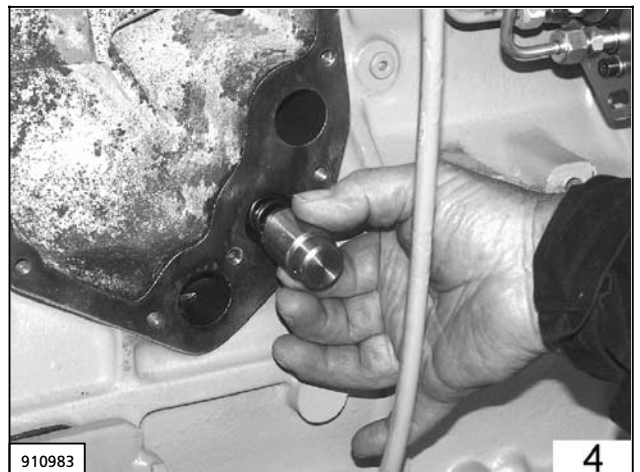


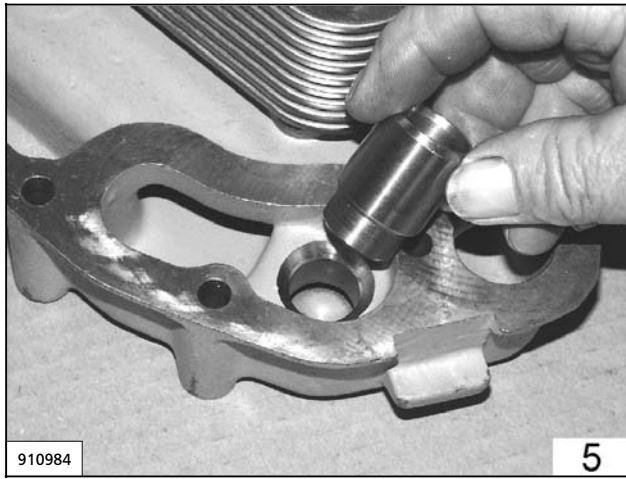
Remove the oil cooler housing, complete with oil cooler from crankcase.



Remove the spring and piston of the cooler bypass valve from the crankcase.

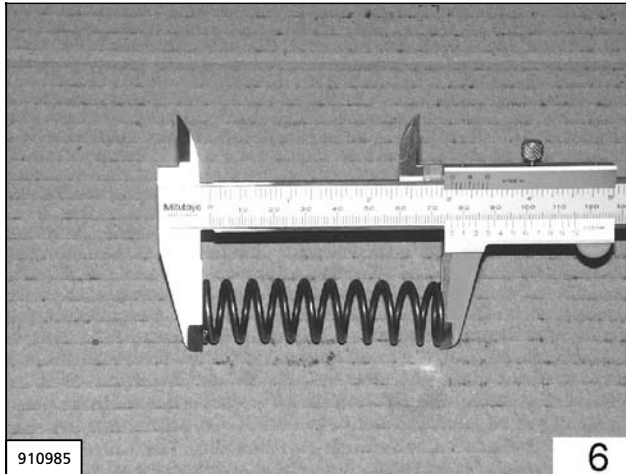
Clean all parts, clean the sealing surfaces on the crankcase and oil cooler housing.





Check the seat of the piston and the seat for the piston in the oil cooler housing for wear (visual inspection).

Replace worn or damaged piston.

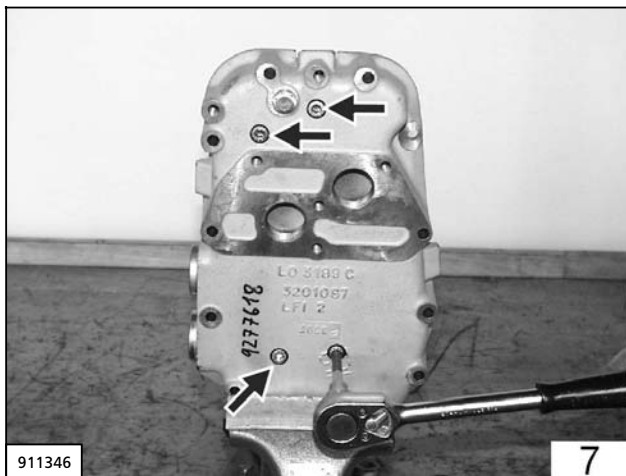


Measure the length of the spring.

For dimension, refer to Technical Data - group 1.

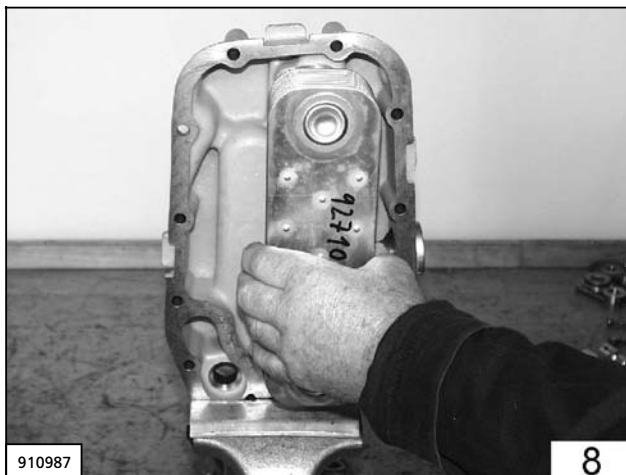
Note:

For opening pressure of the bypass valve, see Technical Data - group 1.



Oil cooler removal and installation:

Remove the screws for the engine oil cooler on the oil cooler housing.



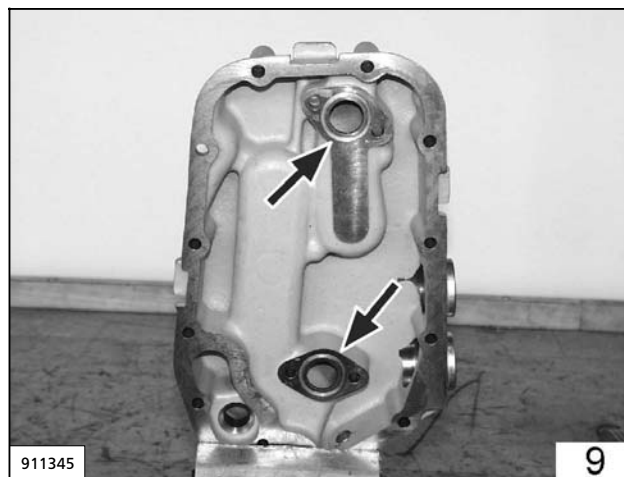
Remove the oil cooler from the oil cooler housing.

Clean the grooves for the O-rings in the oil cooler housing.

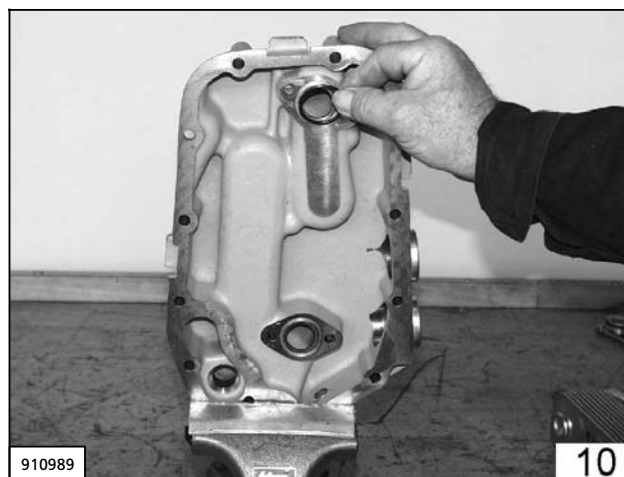
Clean the sealing surfaces on the oil cooler housing and the oil cooler.

Note:

If oil is found in the coolant, it may be necessary to check the cooler housing for cracks using air pressure.



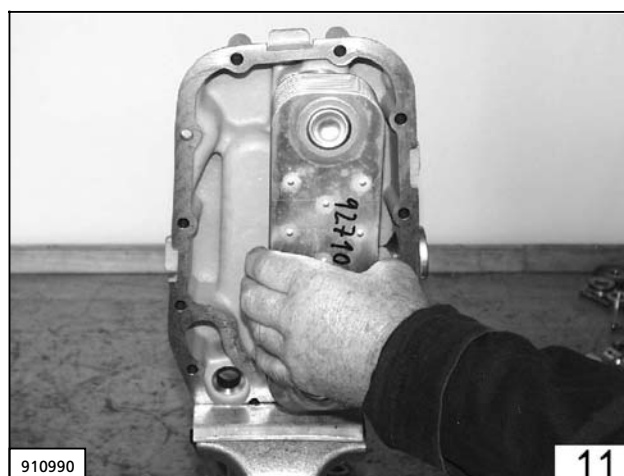
Lubricate new O-rings with grease and place them into the grooves of the oil cooler housing. Apply sealing compound (Hylomar SQ 32/Reinzoplast) to the oil cooler mounting flange in the oil cooler housing.



Install the oil cooler to the oil cooler housing with screws.

Note:

If the oil cooler was removed after an engine failure and the system was contaminated with metal, the oil cooler should be replaced.

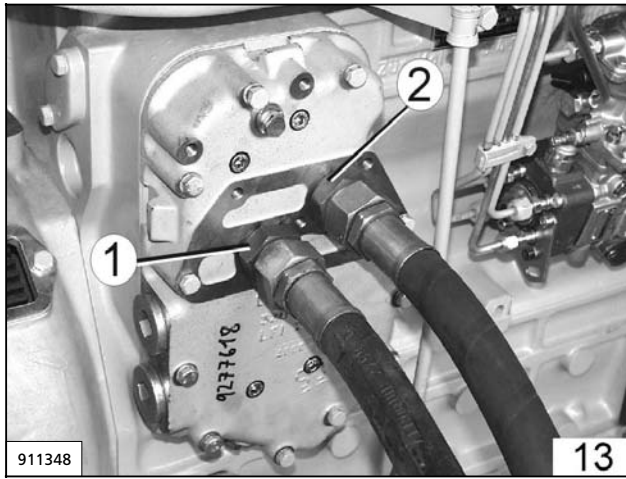


Install the oil cooler housing:

Insert the spring into the crankcase bore and add the piston.

Using a new gasket, install the oil cooler assembly to the crankcase. Install and torque screws.





Install the lube oil lines with new seal rings to the oil cooler housing.

Important:

DO NOT reverse the oil line connections on the oil cooler housing when installing the oil lines.

1 = Connection to lube oil filter

2 = Connection from lube oil filter

Exhaust Manifold Removal and Installation

Exhaust Manifold Removal:

Remove exhaust pipe from exhaust manifold.

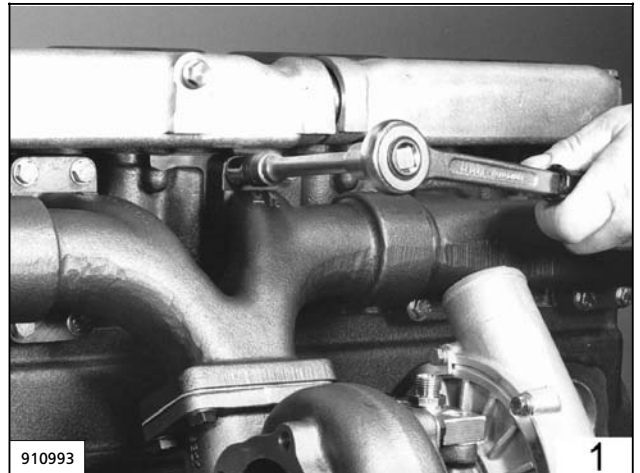
On turbocharged engines remove air intake line and exhaust pipe from turbocharger.

Remove lubrication oil lines from turbocharger.

See also sub group 10.11.

Remove crankcase breather and air intake manifold tube mounting clamps on turbocharged engines.

Unscrew and remove exhaust manifold mounting bolts.

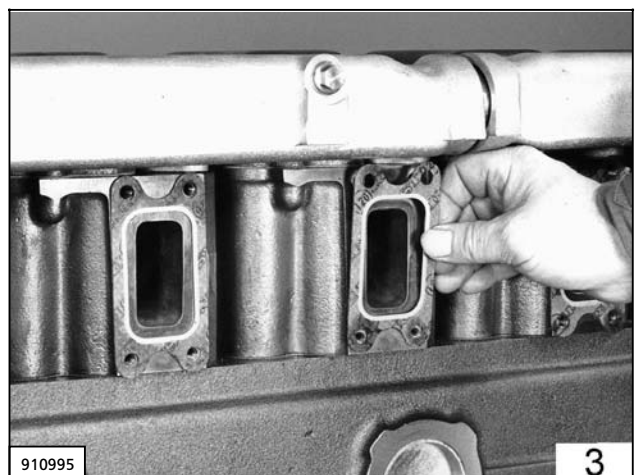


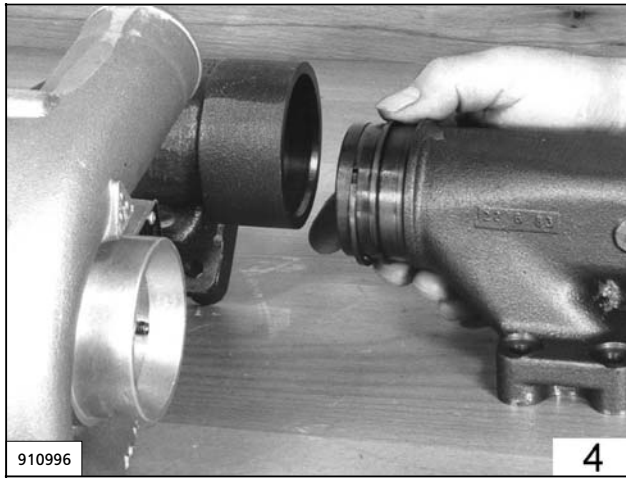
Remove exhaust manifold from cylinder heads.

On turbocharged engine remove exhaust manifold and turbocharger assembly.



Remove gaskets and clean mounting surfaces on cylinder heads and exhaust manifold.

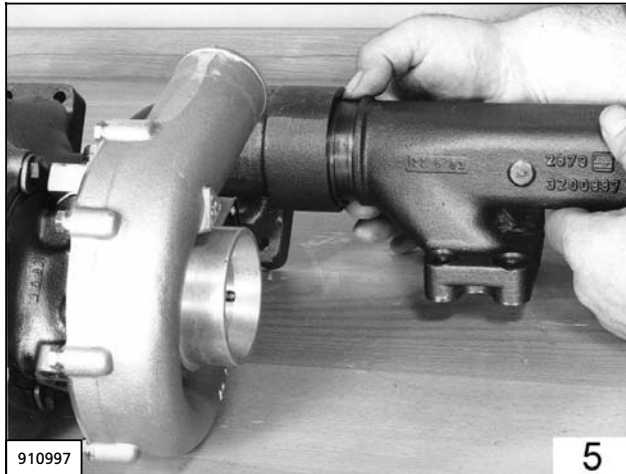




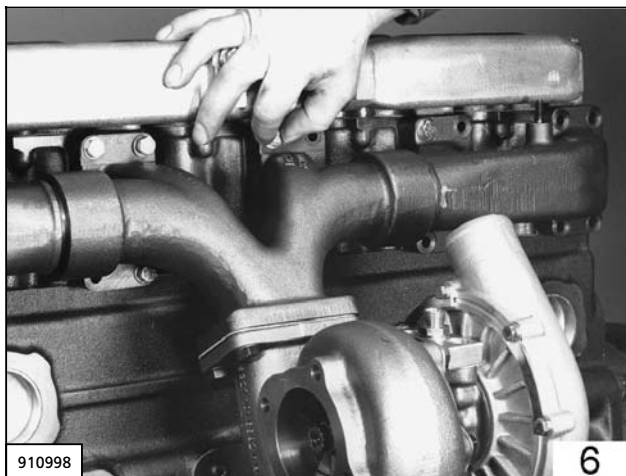
Disassemble exhaust manifold sections and inspect metal seal rings for free movement.

Note:

In case the metal seal rings are seized in their grooves at the exhaust manifold connections, remove the rings and clean the grooves. Install new metal seal rings if required.



Stagger metal seal ring gaps and reassemble exhaust manifold sections.



Exhaust Manifold Installation:

Place exhaust manifold with new gasket on cylinder heads. Screw in and torque exhaust manifold mounting bolts.

Install crankcase breather mounting clamp and exhaust pipe.

On turbocharged engines install air intake line, exhaust pipe and air intake manifold tube to turbocharger.

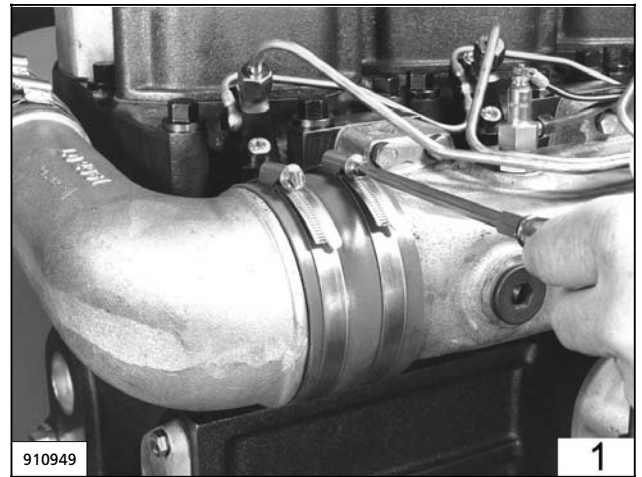
Reinstall lubrication oil lines to turbocharger.

See also sub group 10.11.

Air Intake Manifold Removal and Installation

Air Intake Manifold Removal:

Remove air intake line or turbocharger (on turbocharged engines) from air intake manifold tube.



Disconnect and remove fuel supply lines from injection pump and fuel injectors.



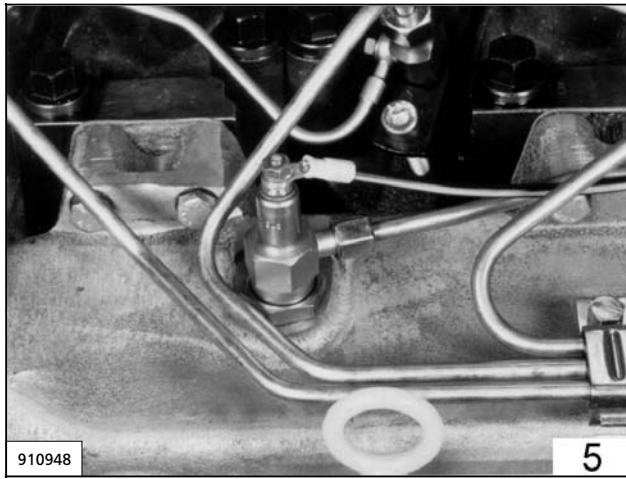
Disconnect and remove fuel overflow line from fuel injectors and injection pump.



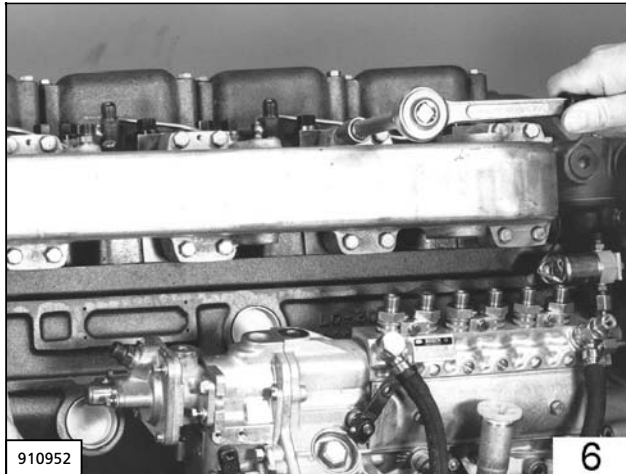
Remove air compressor intake line and crankcase breather line on natural aspirated engines.

On turbocharged engines remove pressure sensing line to aneroid (see sub group 10.20).



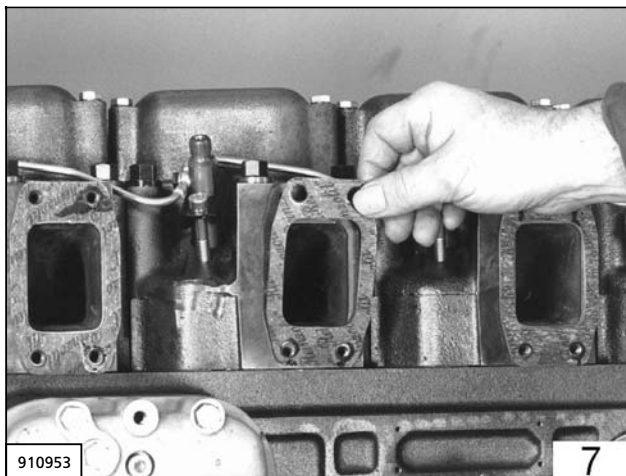


Disconnect and remove electrical wire and fuel supply line from preheater glow plug.



Unscrew and remove air intake manifold mounting bolts.

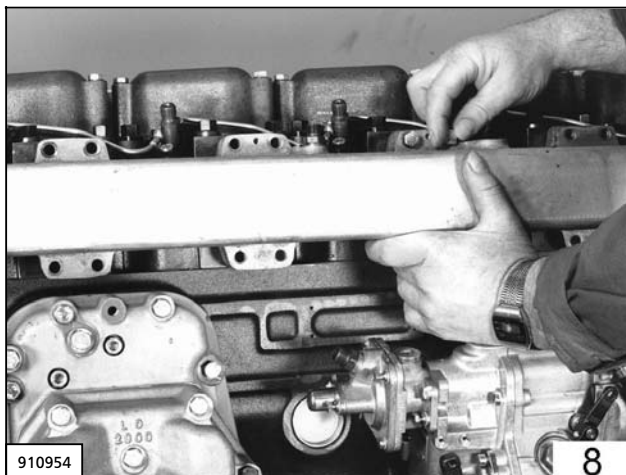
Remove air intake manifold from cylinder heads.



Remove gaskets and clean mounting surfaces on cylinder heads and air intake manifold.

Important:

Cautiously inspect the air intake manifold and the air intake canals on all cylinder heads and remove any dirt or other deposits.



Air Intake Manifold Installation:

Place air intake manifold with new gaskets on cylinder heads. Screw in and torque air intake manifold mounting bolts. Install and reconnect pressure sensing line to aneroid (on turbocharged engines), air compressor intake line, crankcase breather line and fuel overflow line to injectors and fuel supply line to preheater glow plug. Reconnect electrical wire to preheater glow plug. Install and reconnect fuel supply lines to fuel pump and fuel injectors.

Coolant Manifold Removal and Installation

Use special tool no. 76.

Coolant Manifold Removal:

Drain coolant from cooling system as described see sub group 2.01.

Remove crankcase breather tube and mounting clamp from engine block.

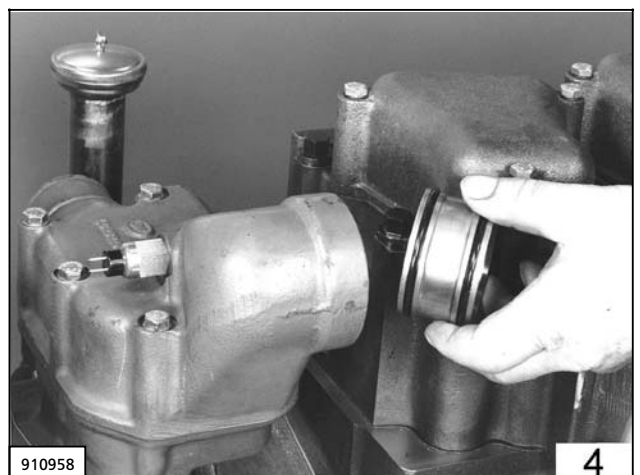
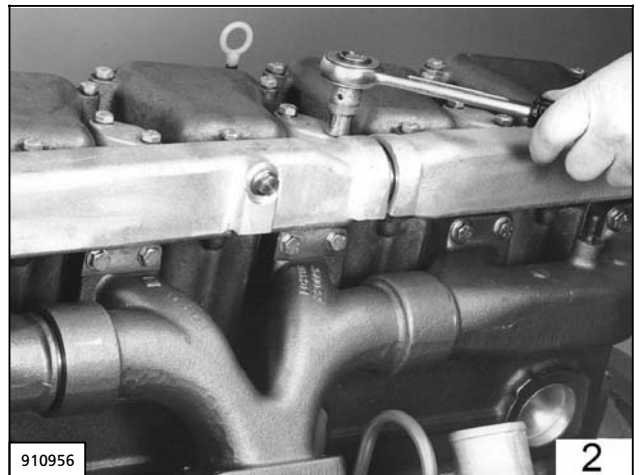
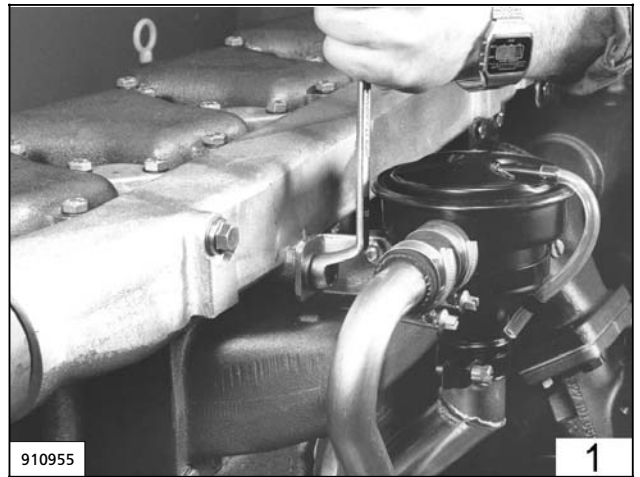
On turbocharged engines remove air intake manifold tube between turbocharger and air intake manifold.

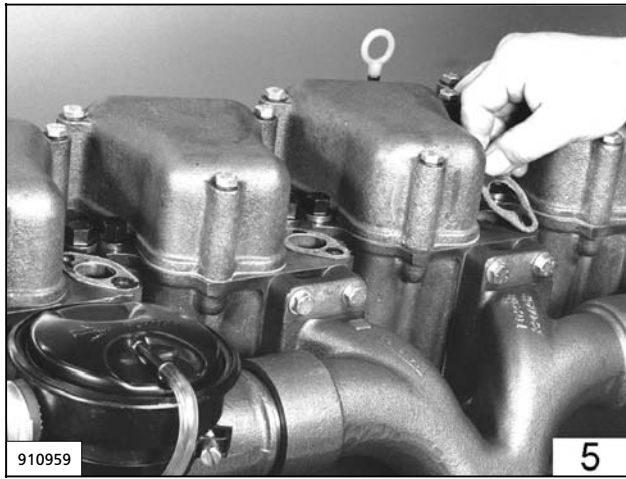
Unscrew and remove coolant manifold mounting bolts.

Remove coolant manifold from thermostat housing cover and remove manifold connector from thermostat housing cover.

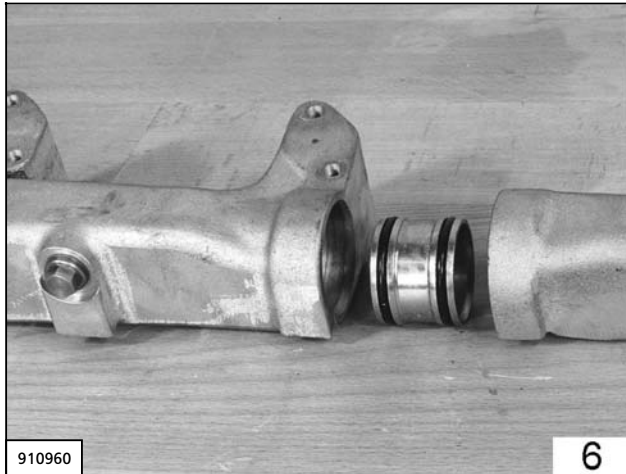
Clean manifold connector, replace O-rings on connector and lubricate O-rings with engine oil.

Clean connection bores in thermostat housing cover and coolant manifold.





Remove coolant manifold gaskets and clean mounting surfaces on cylinder heads and coolant manifold.



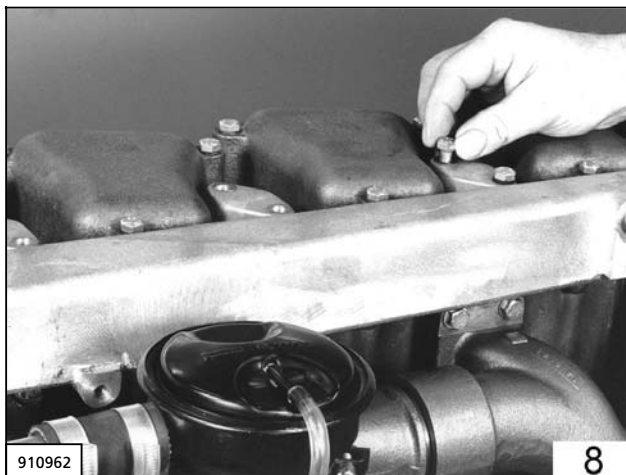
Take apart coolant manifold sections (on 6-cylinder engines) and remove manifold sections connector. Clean connection bores in both manifold sections. Clean manifold section connector, replace O-rings on connector and lubricate O-rings with engine oil. Reassemble coolant manifold.



On one-piece coolant manifold for the 4-cylinder engine, remove freeze plug only when leaking. To install new plug, coat with sealing compound (Loctite 270 (US=271), Omnifit 200 M, etc.) and install with punch, special tool no. 76.

Note:

On later engines, the one-piece coolant manifold does not have a freeze plug. The opening is permanently sealed during the casting process.



Coolant Manifold Installation:

Place manifold connector into thermostat housing cover.

Place coolant manifold on connector and position manifold with new gaskets on cylinder heads. Screw in and torque coolant manifold mounting bolts. Reinstall crankcase breather tube and mounting clamp. Reinstall air intake manifold tube between turbocharger and air intake manifold.

Refill cooling system with coolant as described see sub group 2.01.

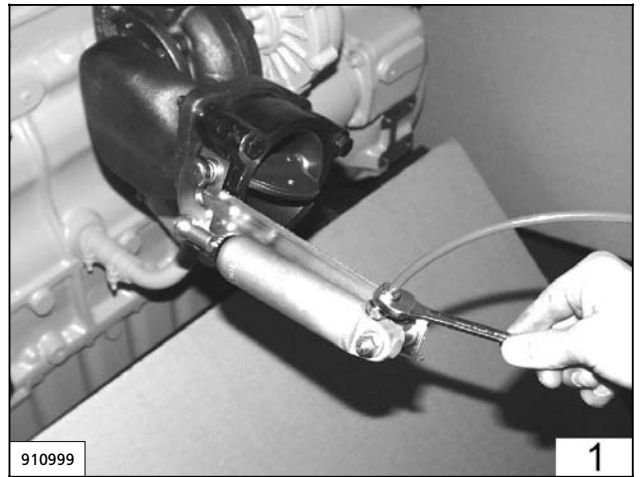
Engine brake removal and installation

Note:

The engine brake is installed in the exhaust line from the turbocharger to the muffler.

Removal:

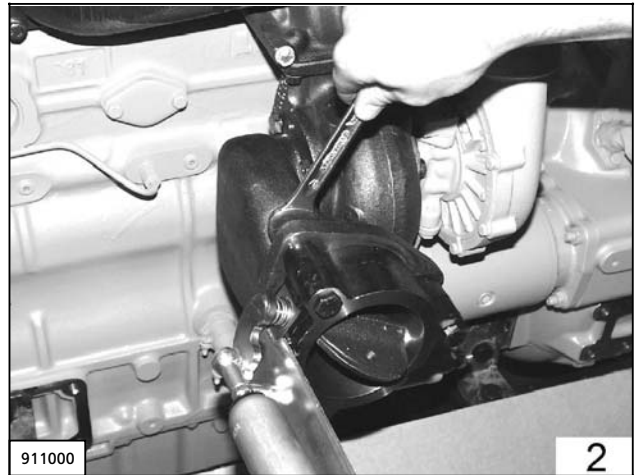
Disconnect the air supply line on the air pressure cylinder.



Remove the screws from the exhaust line on the engine brake.

Note:

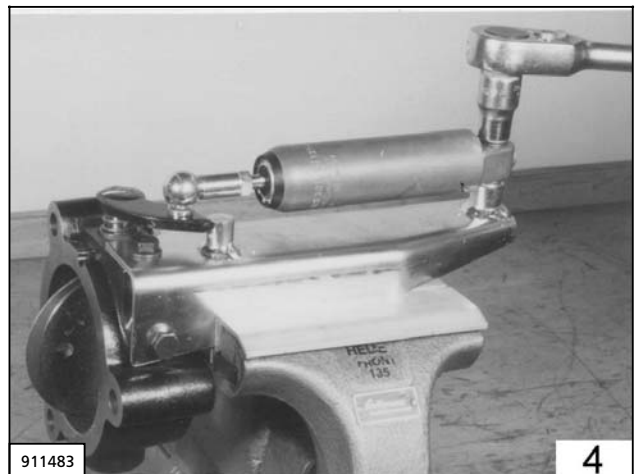
Depending on the version, the engine brake may be mounted with screws or with screws and nuts.

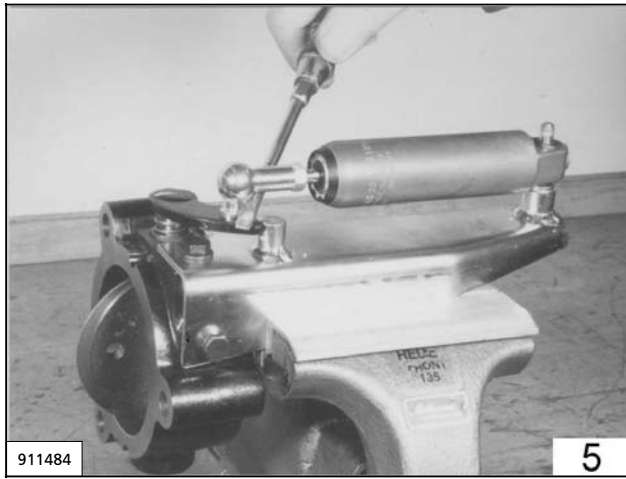


Remove the engine brake with the air cylinder.

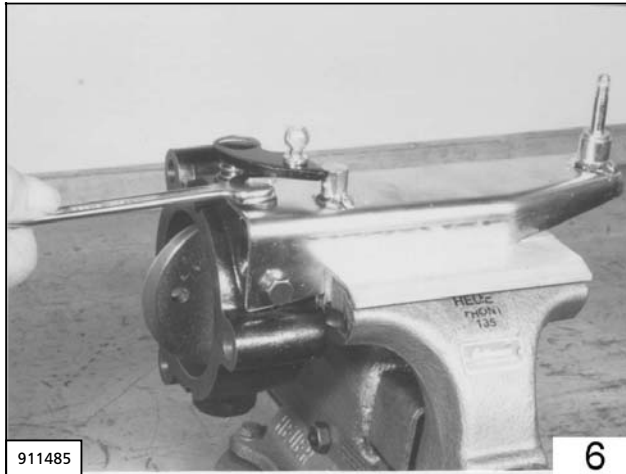


Remove the safety on the ball joint. Remove the nut on the air cylinder bracket mount.





Pry the air cylinder from the bracket and the ball socket from the ball pin on the engine brake, remove the cylinder.



Remove the screws on the bracket and remove the bracket from the engine brake.

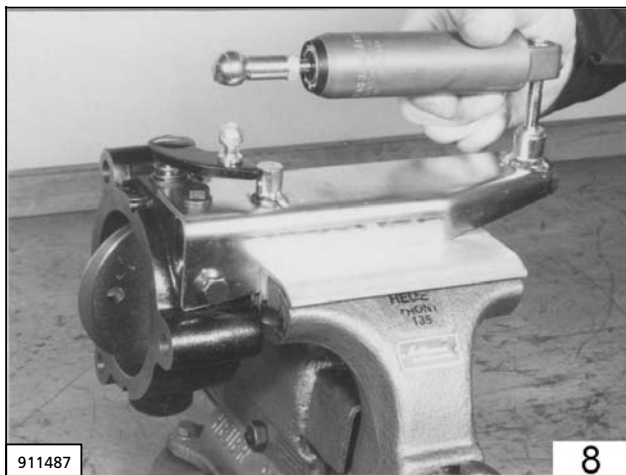
Clean all parts, clean the sealing flange on the engine brake and exhaust line.

On the engine brake, check the flap for easy movement.



Installation:

Attach the bracket on the engine brake, install and tighten screws.



Press the air cylinder on the bracket and ball pin.

Install and tighten nuts.

Install the safety on the ball joint.

Important:

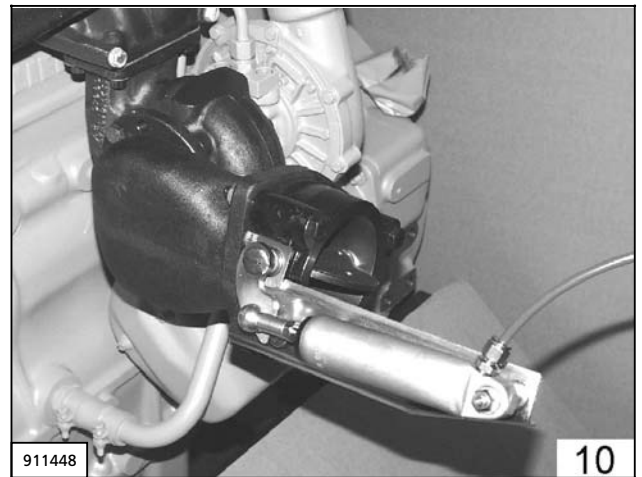
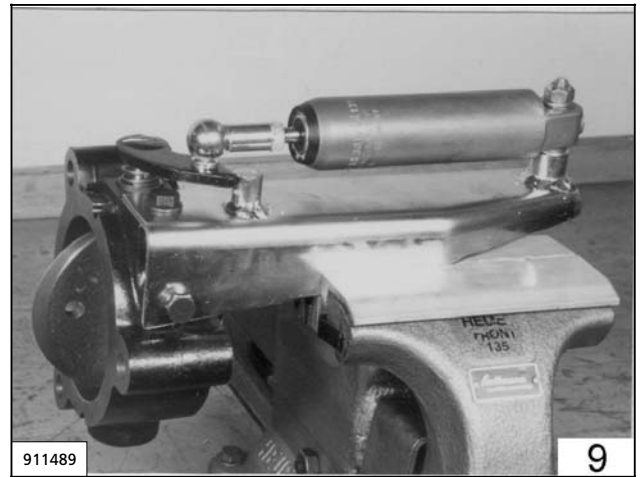
Adjust the engine brake before attaching the air cylinder.

The flap of the engine brake must be in the full open position and the actuating lever must touch the stop pin on the bracket. On the air cylinder, adjust the ball joint in such a way that the air cylinder is pretensioned in this position by 1.5 to 2 mm.

Actuate the air cylinder with air and check if the flap is fully closed.

Install the engine brake complete with new seals to the exhaust line. Install or insert the screws or bolts and install the nuts. Tighten all screws / nuts.

Install the air supply line to the air cylinder.



Sub Group Index

9.01	Timing and Accessory Drive Gear Box Removal and Installation	
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9.05	Intermediate Gear Removal, Disassembly, Inspection Assembly and Installation	Up to Engine No. 85 01 0195
9.06	Intermediate Gear Removal, Disassembly, Inspection Assembly and Installation	From Engine No. 85 01 0196
9.07	Intermediate Gear Removal, Disassembly, Inspection Assembly and Installation	From Engine No. 97 02 2023
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LIEBHERR	Benennung/Description/Dénomination	Typ Model Type	D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de	
Datum/Edition/Date	Disassembly / Assembly of Basic Engine	Blatt/Page/Feuille	
05 / 2003		9.00	

Timing and Accessory Drive Gear Box Removal and Installation

Use special tools no. 13, 31 and 63

Gear Box Removal:

Drain engine oil as described see sub group 2.01.

Drain engine coolant as described see sub group 2.01.

Accessory and component removal:

Remove fuel injection pump as described in sub group 7.01.

Remove hydraulic pump as described in sub group 8.18.

Remove hydraulic pump drive as described in sub group 8.25 / 8.29.

Remove air compressor as described in sub group 8.01.

Remove alternator as described in sub group 8.05.

Remove fan and fan hub as described in sub group 5.01.

Remove coolant pump as described in sub group 5.10.

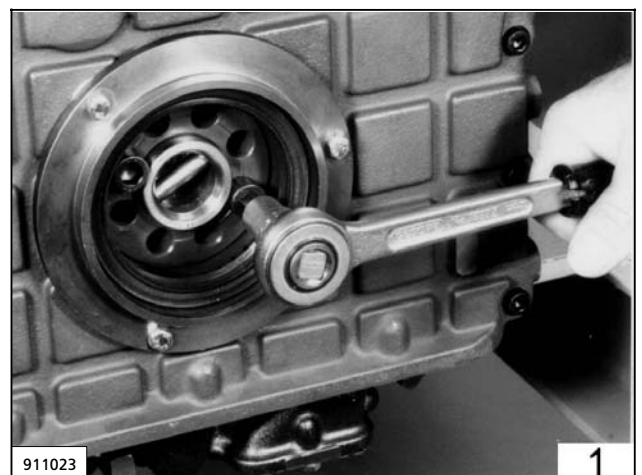
Remove pulley and vibration damper as described in sub group 5.20.

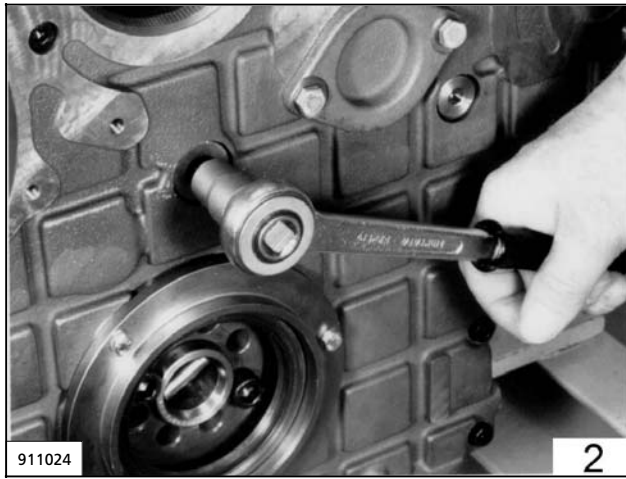
Remove hub from crankshaft, see sub group 5.25.

Remove tachometer drive (if installed), see sub group 5.28, 5.29.

Remove oil pan as described in sub group 8.32.

Retain lube oil pump gear wheel and crankshaft gear wheel in position, using two Allen head screws, M12 x 1,5 x 85 mm.





Remove plug on access bore to camshaft gear wheel and intermediate gear wheel contact.



Remove plugs on two access bores to rear timing and accessory drive gear box mounting bolts.



Remove injection pump drive cover mounting bolts, pull and remove cover from timing and accessory drive gear box.



Remove cover plate mounting bolts on access bore to camshaft gear wheel mounting bolt. Pull off and remove cover plate from timing and accessory drive gear box.

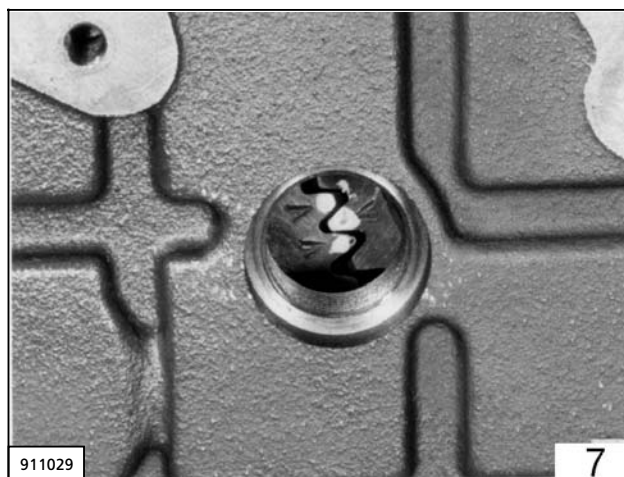
Place turning tool with handle, special tool no. 31, on crankshaft and turn crankshaft until marked gear wheel tooth of the injection pump drive is positioned between the two marked teeth on the intermediate gear wheel.

See also sub groups 7.05 and 9.25.



In this crankshaft position check if the marked camshaft gear wheel tooth is positioned between the two marked teeth on the intermediate gear wheel.

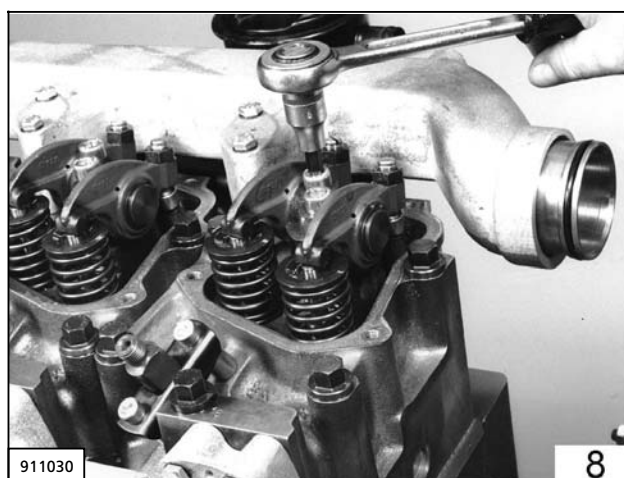
See also sub group 9.25.



Remove valve covers and loosen mounting bolts on rocker lever supports until there is no more pretension on valve tappets and push rods.

Note:

It is strongly recommended to remove the pretension on tappets and push rods for the installation of the camshaft gear wheel.



Place proper socket through access bore and camshaft gear wheel opening into rear mounting bolt head of the timing and accessory drive gear box. Use socket to hold camshaft gear wheel in place.

Note:

In case the camshaft gear wheel opening does not line up with the access bore, repositioning of the gear wheel by turning the crankshaft might become necessary.





Unscrew and remove camshaft gear wheel mounting bolt through access bore.



Unscrew and remove the two rear timing and accessory drive gear box mounting bolts through access bores.



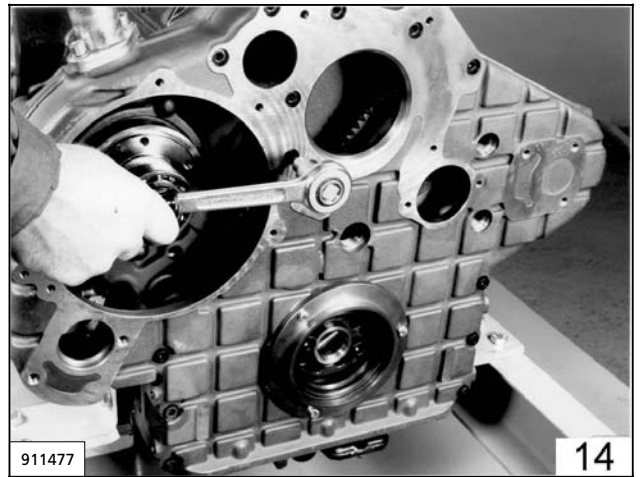
Recheck tooth markings on gear wheel contacts for proper position. In case the gear wheel marks do not match, turn crankshaft to position gear wheels as required.

Remove fuel injection pump drive gear wheel from timing and accessory drive gear box as described in sub group 7.05.

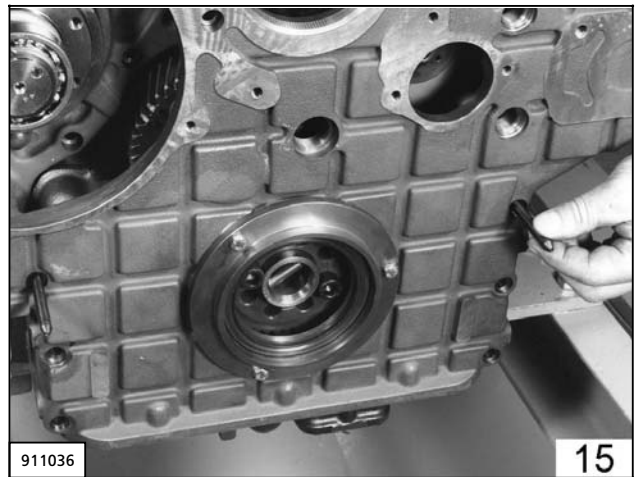


Unscrew and remove the two rear timing and accessory drive gear box mounting bolts located next to the fuel injection pump drive.

Unscrew and remove the front timing and accessory drive gear box mounting bolts.



Install two guide pins, special tool no. 63, in respective timing and accessory drive gear box bores as shown.



Using a rubber or plastic hammer, knock timing and accessory drive gear box loose and remove gear box with camshaft gear wheel from engine block.

Wash all components and clean all mounting surfaces.

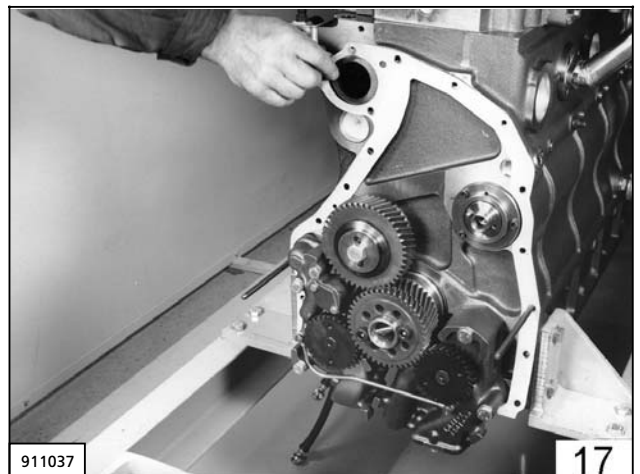
Clean O-ring groove in timing and accessory drive gear box.

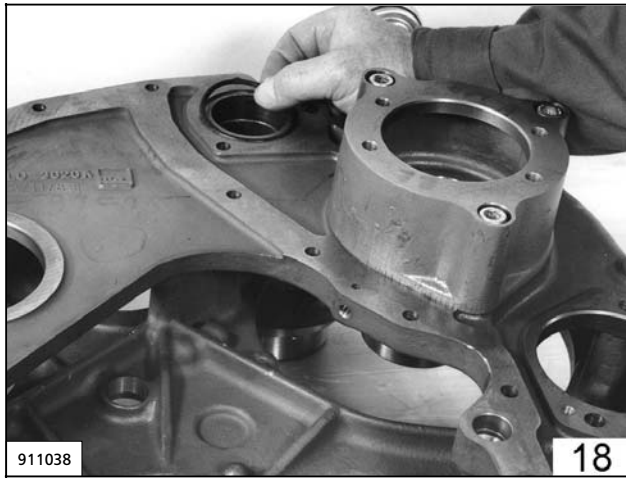


Gear Box Installation:

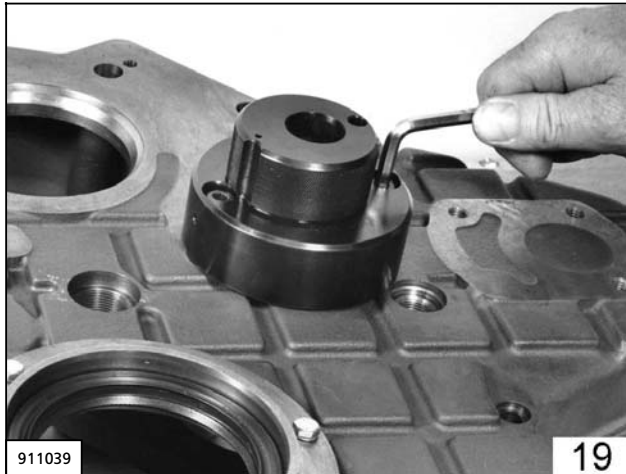
Install two guide pins, special tool no. 63, in respective timing and accessory drive gear box bores.

Place new gasket on gear box mounting surface on engine block.





Lubricate new O-Ring with grease and insert O-Ring in groove on timing and accessory drive gear box.



Bolt camshaft gear wheel mounting fixture, special tool no. 13, to timing and accessory drive gear box. The offset center bore in mounting fixture must be located closer to gear box center line.



Remove eccentric section on mounting fixture from retaining pin, turn section 180 degrees and place section back on mounting fixture.

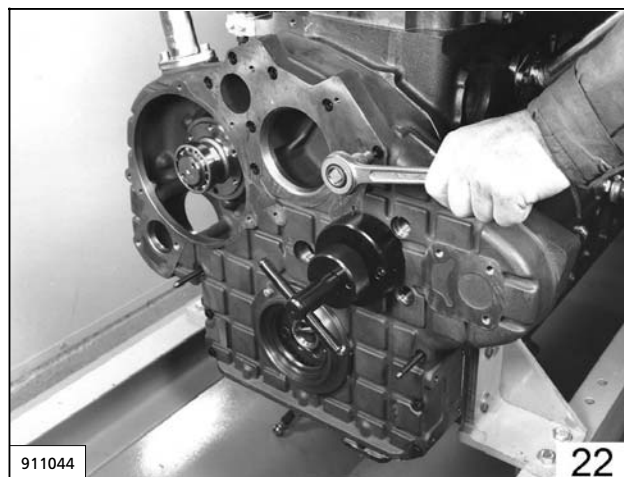


Insert T-handle mandrel in offset bore on mounting fixture and place camshaft gear wheel on mandrel.

Note:

Position camshaft gear wheel that the marked gear wheel tooth points toward the center of the intermediate gear wheel location.

Place timing and accessory drive gear box over guide pins, pressfit bushing and camshaft thrust washer seat on engine block. Insert and torque front gear box mounting bolts. Remove guide pins, screw in and torque remaining front mounting bolts.



Turn eccentric section with attached camshaft gear wheel counterclockwise while checking marked gear wheel tooth position through inspection bore. Make sure that marked gear wheel tooth is positioned between the corresponding intermediate gear wheel teeth marks. Turn eccentric section until it snaps into position at retaining pin on mounting fixture.



Screw T-handle mandrel into camshaft bore and turn camshaft slowly with mandrel while pulling on T-handle slightly. Turn camshaft until dial pin on camshaft is positioned over and inserted in bore on camshaft gear wheel.



Unscrew and remove T-handle mandrel from camshaft and mounting fixture.

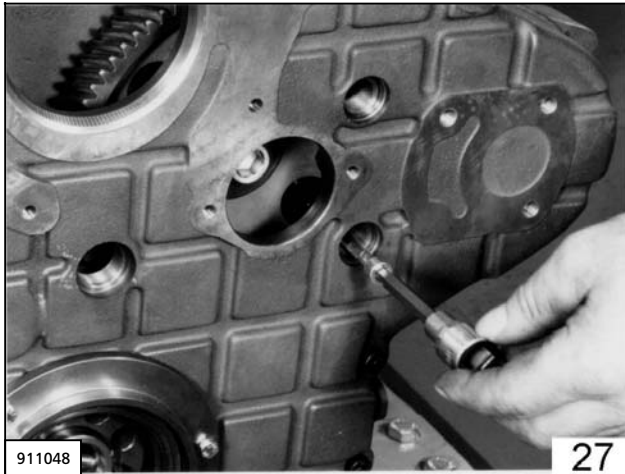
Unbolt mounting fixture from timing and accessory drive gear box.

Again, ensure that the dial pin rests in the gear wheel bore and marked teeth on camshaft and intermediate gear wheels mesh properly.





Apply locking compound (Loctite 242/243) to the threads of the camshaft gear mounting screw, install the screw and tighten lightly.



Insert both rear timing and accessory drive gear box mounting bolts through access bores and camshaft gear wheel opening.

Screw in and torque mounting bolts. Turn crankshaft to proper position in case the camshaft gear wheel opening does not line up with the access bore in the gear box.



Place proper socket through access bore and camshaft gear wheel opening into rear gear box mounting bolt head. Use socket to hold camshaft gear wheel in place. Final torque camshaft gear wheel mounting bolt.

See Engine Specifications for required torque.



Insert and torque the two remaining rear timing and accessory drive gear box mounting bolts located next to the fuel injection pump drive.

Insert fuel injection pump drive in timing and accessory drive gear box and position pump drive gear wheel that the marked tooth is positioned between the two marked intermediate gear wheel teeth. Turn crankshaft to reposition gear wheel if required. Screw in and torque pump drive mounting bolts.

See also sub group 7.05.



Install cover plate on access bore to camshaft gear wheel mounting bolt. Install plugs on access bores to the camshaft gear wheel and intermediate gear wheel contacts as well as to the two rear gear box mounting bolts.

Reinstall rocker lever supports, adjust valve clearance and install valve covers with new valve cover gaskets.

Check and if required adjust valve clearance as described in sub group 2.15.

Reinstall all accessories and optional drives to timing and accessory drive gear box.

Check and if required adjust fuel delivery begin as described in sub group 2.19.

Reinstall injection pump drive cover with new O-ring to timing and accessory drive gear box.

Bleed fuel system as described in sub group 7.22.

Refill engine with engine oil as described see sub group 2.01.

Refill cooling system with water / anti-freeze solution as described see sub group 2.01.

Timing and Accessory Drive Gear Box Removal and Installation

Use special tools no. 13, 26, 28, 31 and 63.

Gear Box Removal:

Drain engine oil as described see sub group 2.01.

Drain engine coolant as described see sub group 2.01.

Remove coolant hoses from timing and accessory drive gear box.

Accessory and component removal:

Remove fuel injection pump as described in sub group 7.02, 7.03.

Remove hydraulic pumps as described in sub group 8.18.

Remove hydraulic pump drive as described in sub group 8.29.

Remove air compressor as described in sub group 8.01.

Remove alternator as described in sub group 8.05.

For air conditioner compressor and alternator removal, see sub group 8.10

Remove fan and fan hub as described in sub group 5.02.

Remove coolant pump as described in sub group 5.11, 5.12, 5.13.

Remove thermostat housing cover as described in sub group 2.32.10.

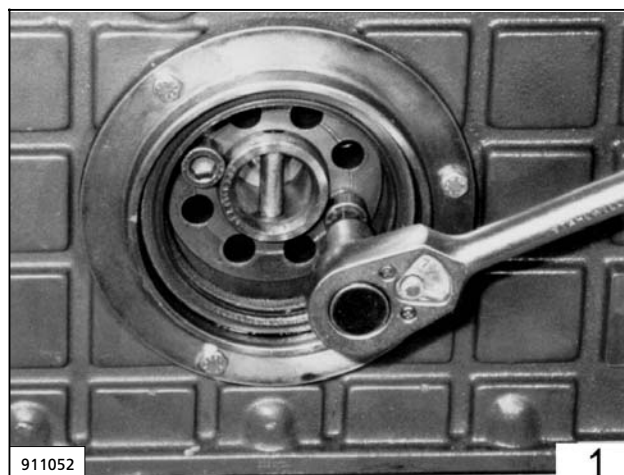
Remove pulley and vibration damper as described in sub group 5.20.

Remove hub from crankshaft, see sub group 5.25.

Remove tachometer drive (if installed), see sub group 5.29.

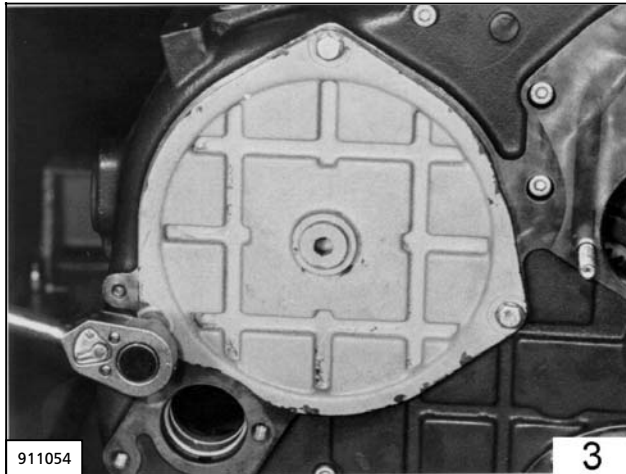
Remove oil pan as described in sub group 8.32.

Retain lube oil pump gear wheel and crankshaft gear wheel in position, using two Allen head screws, 12 x1,5 x 85 mm.

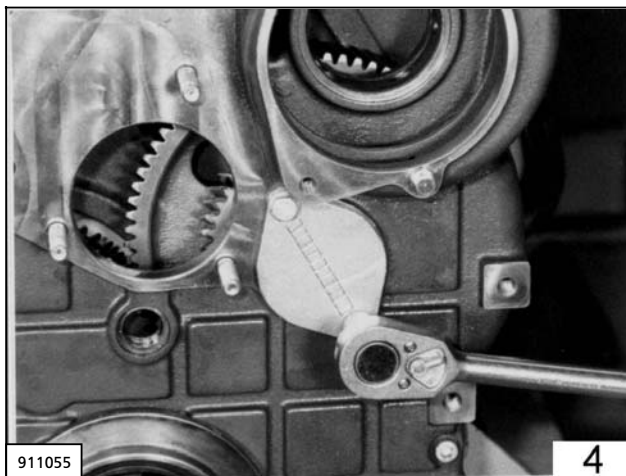




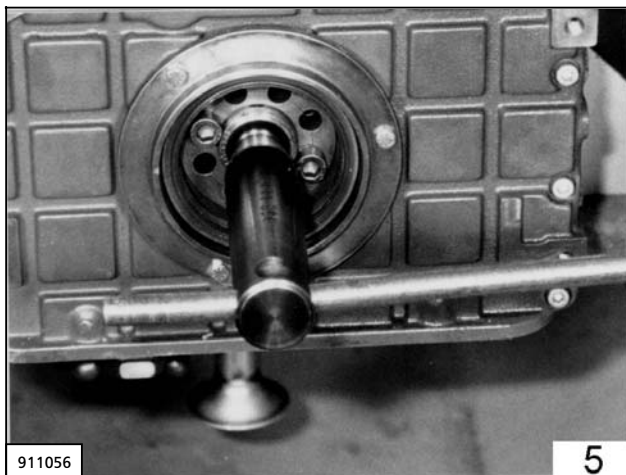
Remove plug on inspection bore for camshaft gear wheel and intermediate gear wheel contact.



To remove cover for injection pump drive, remove screws and push cover from timing and accessory drive gear box.



To remove cover for camshaft gear wheel, remove mounting screws and push cover from timing case cover.



Install T-handle mandrel, special tool no. 31 on the crankshaft. Turn the crankshaft until the marked gear wheel tooth of the injection pump drive is positioned between the two marked teeth on the intermediate gear.

See sub group 7.06 and 9.26.

In this crankshaft position, check through the inspection bore hole if the marked tooth from the crankshaft gear wheel in position between the two marked teeth on the intermediate gear wheel.

See sub group 9.26.



Remove valve covers and loosen rocker lever supports until the valve tappets and push rods are released.

Note:

We strongly recommend to release the pretension on tappets and push rods before installing the camshaft gear.

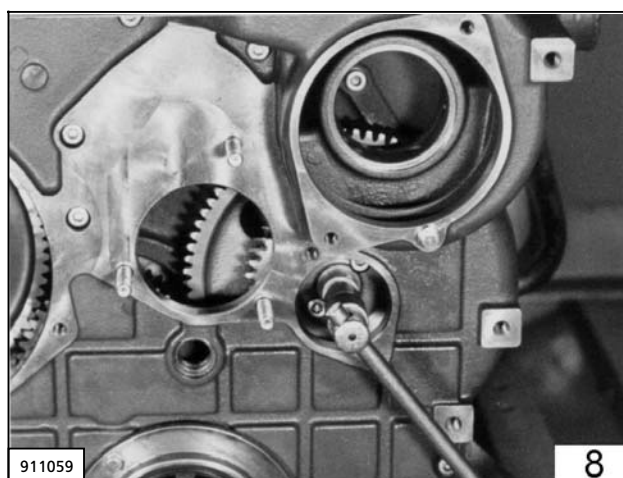


Remove the screw on the cam shaft gear.

To loosen the screw, prevent the engine from turning by inserting a suitable tool (breaker bar) into the flywheel at the timing cover or use special tool, as shown in fig. 5).

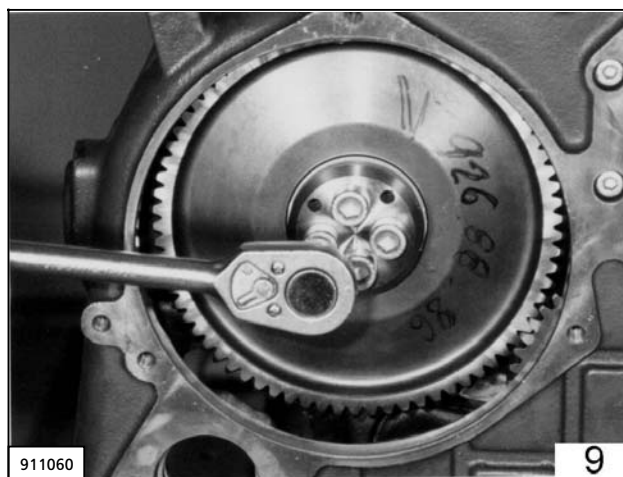
Important:

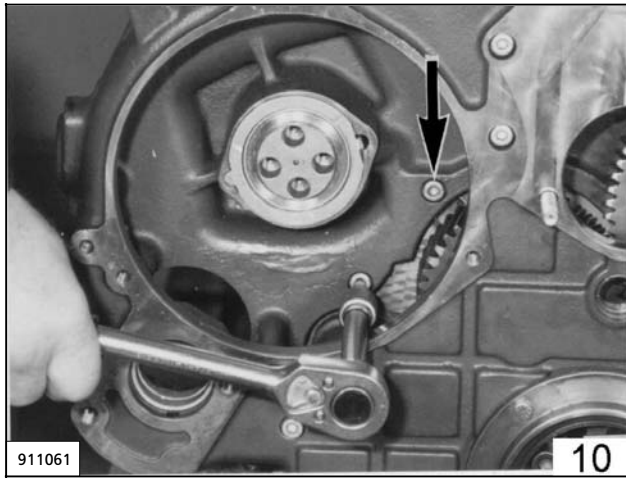
When loosening camshaft gear retainer screw M 20x1.5 which is a socket head screw requiring a 17 mm Allen wrench, the camshaft must be prevented from turning by installing a 36 mm wrench to the flat surfaces of the camshaft located between the last and next to last camshaft bearing as seen from the fan side.



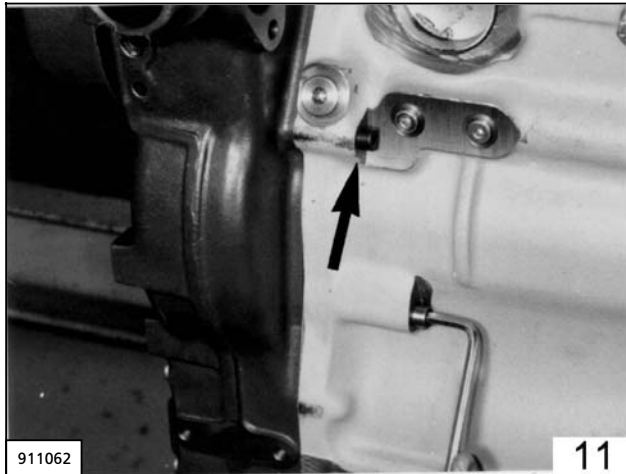
Remove the gear from the injection pump drive.

See sub group 7.06

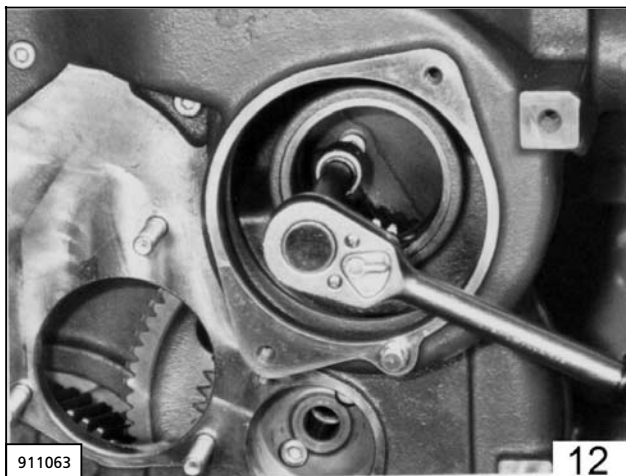




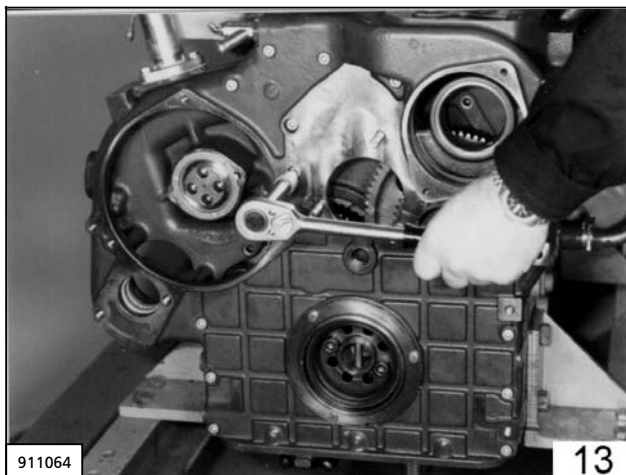
Remove the two inner mounting screws on the timing and accessory drive gear box located next to the injection pump drive.



Remove the two outer mounting screws from crankshaft to timing case on the reverse side of the timing case.

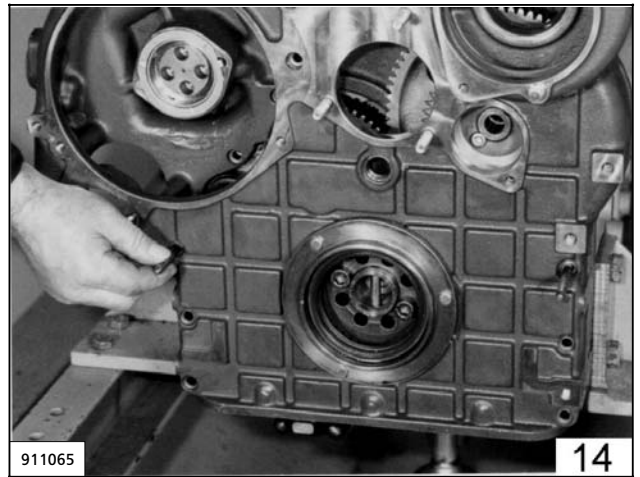


Remove the inner mounting screw behind the coolant pump housing.



Loosen and remove all front mounting screws.

Insert two pins, special tool no. 63, into opposite threads.



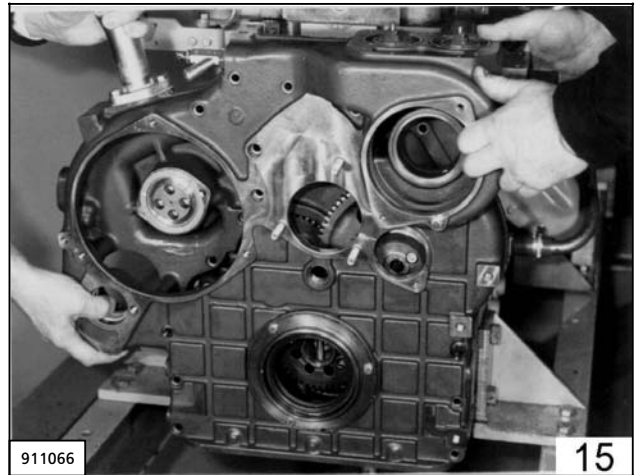
Loosen the crankshaft housing with a rubber hammer from the timing case and remove together with the camshaft gear.

Note:

When removing the timing case, hold the camshaft gear with your hand.

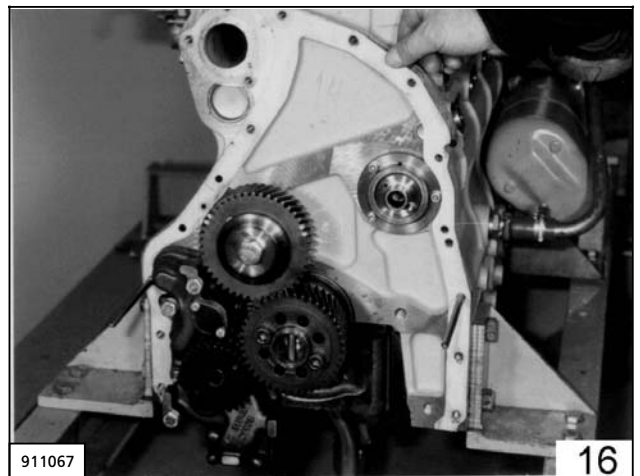
Clean all parts and sealing surfaces.

Clean the groove for the O-ring in the timing case.



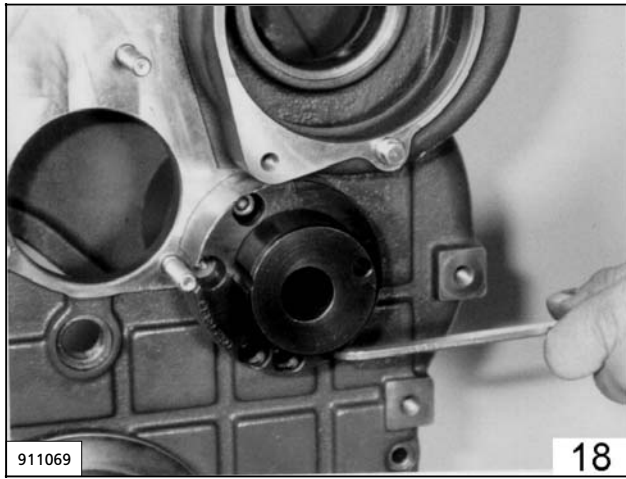
Installation:

Install two mounting pins, special tool 63, into opposite threads in crankshaft housing. Install new gasket.



Lubricate new O-ring with grease and insert in groove in timing case cover.



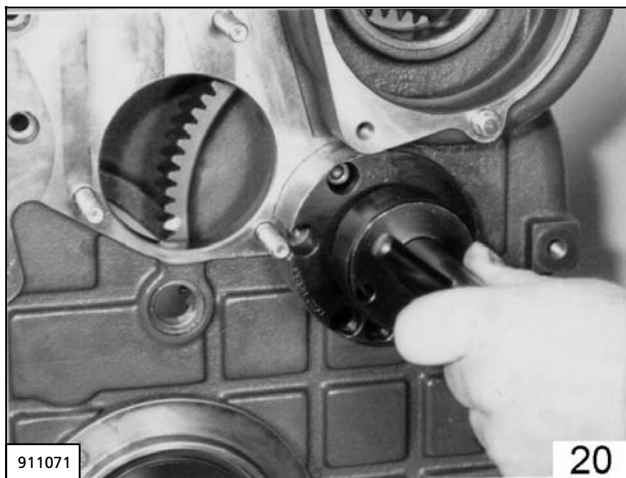


Installation of assembly tool for camshaft gear:

Install special tool no. 13 on timing and accessory drive. The arrow "UP" on the assembly tool must point to the upper edge of the timing and accessory drive.



Pull the eccentric pin from the assembly tool and turn by 180°.

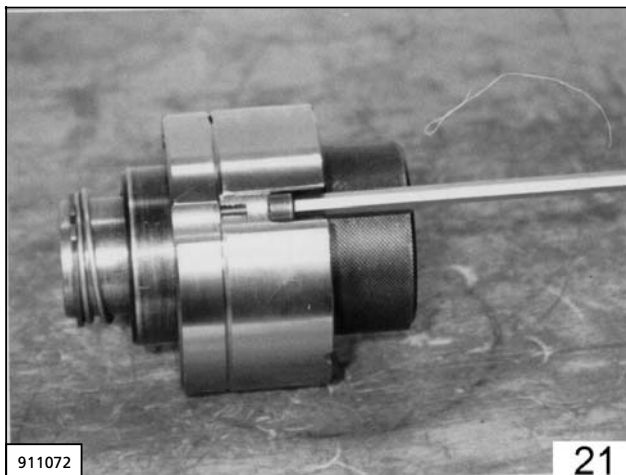


Insert the centering pin (special tool No. 13) and push the camshaft gear onto the pin.

Important:

For camshaft gear connections with M10x1.5 socket head screw and 17 mm Allen wrench, push the camshaft gear together with lock ring onto the centering pin.

For this purpose, use centering pin, special tool No. 28 and intermediate ring, special tool No. 26.



Installation of assembly tool for camshaft gear with fan drive gear:

Install intermediate ring, special tool no. 26, to assembly tool, special tool no. 13.

Note;

The recesses for the dowel pin must align.

Install assembly tool with intermediate ring to timing and accessory drive gear box. The arrow "UP" must point to the upper edge of the gear box.

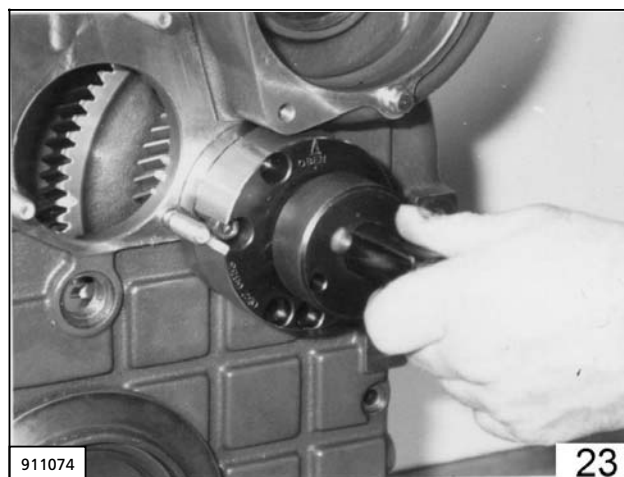
Pull the eccentric pin from the lock pin and turn by 180°.



Insert a capstan head screw and push the camshaft gear wheel with fan drive gear onto the capstan head screw.

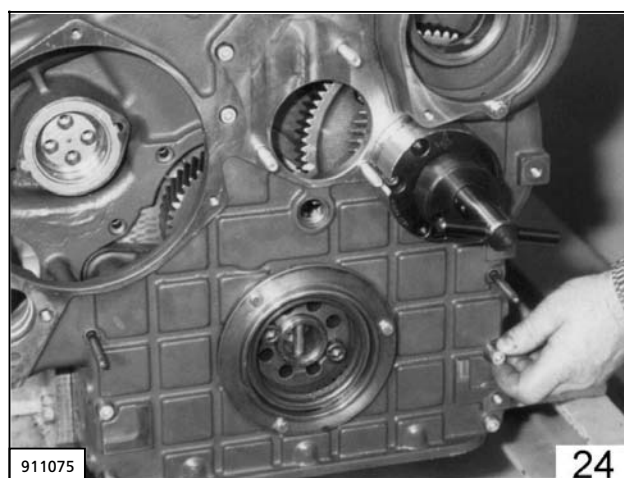
Important:

For camshaft gear connection with M 20x1.5 socket head screw and 17 mm Allen wrench size use centering pin - special tool No. 28.

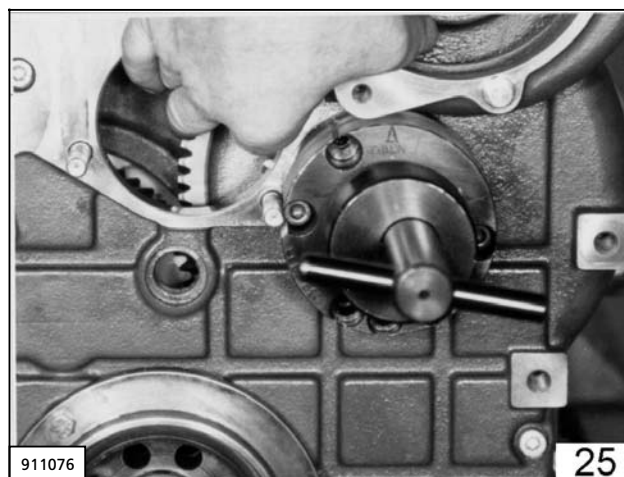


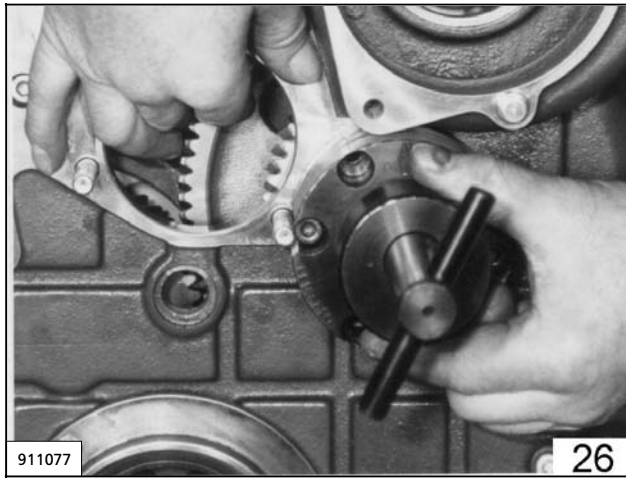
Install timing and accessory drive gear to crankshaft housing:

Push timing and accessory drive onto installation pin and centering on camshaft thrust ring. Install the front mounting screws and tighten them. Remove installation pins, install screws and tighten them.



Turn camshaft gear wheel until the marked tooth points in direction of the marked tooth on the intermediate gear.





Turn the eccentric pin of the assembly tool in direction of the center axle of the timing and accessory drive case. At the same time, look through the inspection bore and check if the marked gear teeth mesh. If necessary, turn the camshaft gear slightly. Allow the eccentric pin to snap into the lock pin. Guide the camshaft gear wheel into the gear of the intermediate gear and into the pin of the camshaft.



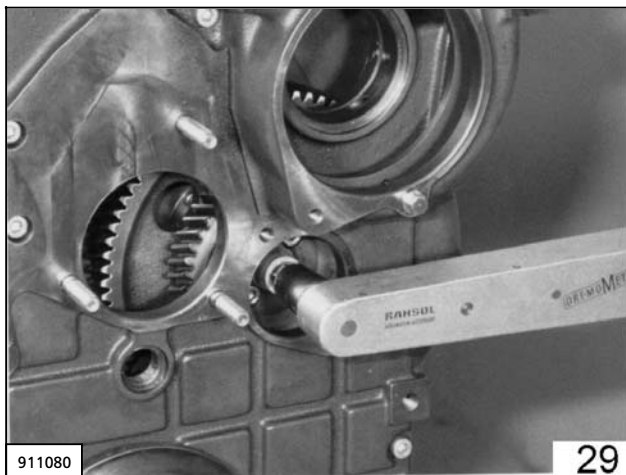
Important:

If the pin of the camshaft does not notch into the bore in the camshaft gear wheel, turn the capstan head screw into the camshaft and slightly turn the camshaft until the pin snaps into the lock pin.



Remove the capstan head screw, remove the assembly tool and remove the intermediate ring on camshaft gears with fan drive gear.

Check again if the pin is inserted and if the gear markings of camshaft and intermediate gear match.



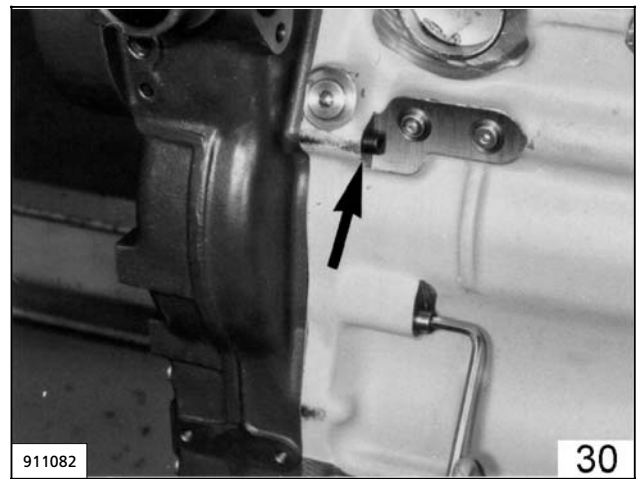
Apply locking compound (Loctite 242/243) to the threads of the camshaft gear mounting screw and install the screw. To tighten the screw, prevent the engine from turning by inserting a suitable tool (breaker bar) into the flywheel at the timing cover or use special tool, as shown in fig. 5).

For tightening torque, see Technical Data.

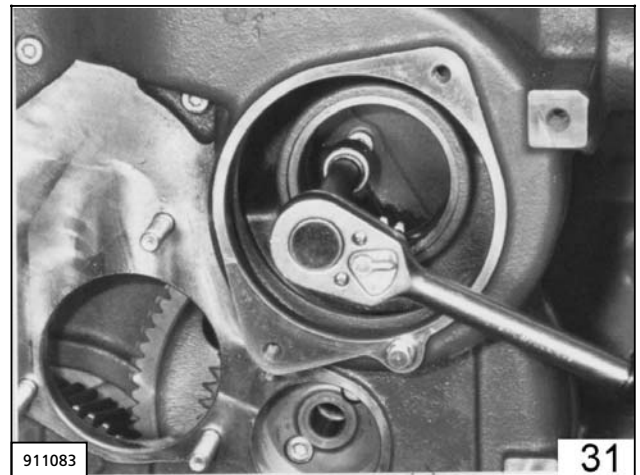
Important:

When tightening camshaft gear retainer screw M 20x1.5 which is a socket head screw requiring a 17 mm Allen wrench, the camshaft must be prevented from turning by installing a 36 mm wrench to the flat surfaces of the camshaft located between the last and next to last camshaft bearing as seen from the fan side.

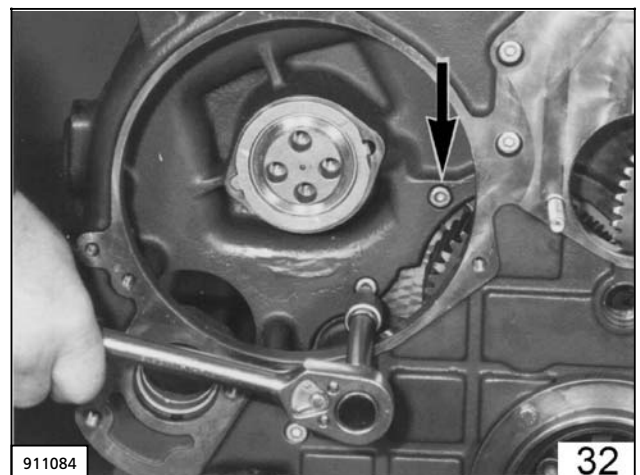
Insert and tighten the two outer mounting screws from crankshaft housing to timing case on the back of the timing and accessory drive gear case.



Install and tighten the inner mounting screws behind the coolant pump housing.



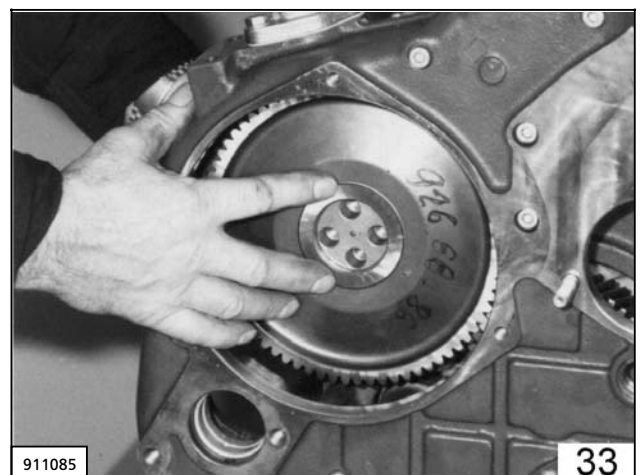
Install and tighten the two inner mounting screws close to the injection pump drive.



Install and tighten the injection pump drive gear wheel. Pay attention to the markings.

See sub group 7.06.

For tightening torque, see Technical Data.



Mount the cover for the camshaft gear wheel, tighten mounting screws, install plug for inspection bore.

Tighten the rocker lever supports, adjust valves and mount valve covers, using a new gasket.

Adjust valve play, see sub group 2.15.

Install all components, see sub group - Removal.

Install begin of delivery, see sub group 2.19.

Mount cover for injection pump drive, using new O-ring.

Bleed the fuel system, see sub group 7.22, 7.23.

Add engine oil, see sub group 2.01.

Install coolant hoses.

Add coolant, see sub group 2.01.

Intermediate Gear Wheel Removal, Disassembly, Inspection, Assembly and Installation

Up to Engine no. 85 01 0195

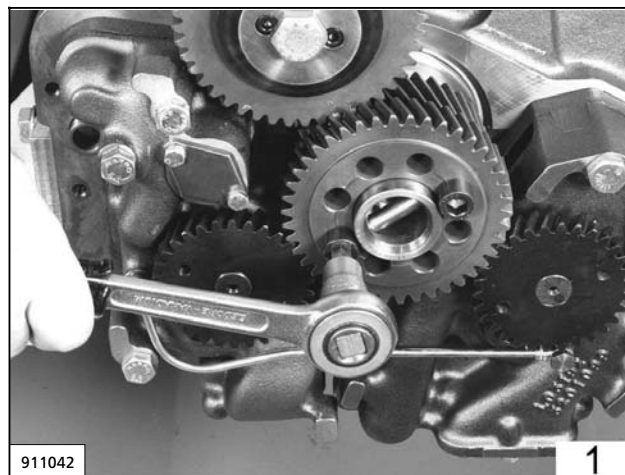
Use special tool no. 81.

Gear Wheel Removal:

Remove timing and accessory drive gear box as described in sub group 9.01.

See back page 9.05.03 for positioning of the individual gear wheel assembly components.

Unscrew and remove two temporarily installed retaining screws (see back page 9.01.01, fig. 1) at pump drive gear wheel and remove lub oil pump drive gear wheel from crankshaft.



Check if marked tooth on crankshaft gear wheel is positioned between marked intermediate gear wheel teeth.

Turn crankshaft to required position if marked gear wheel teeth are not aligned.

Note:

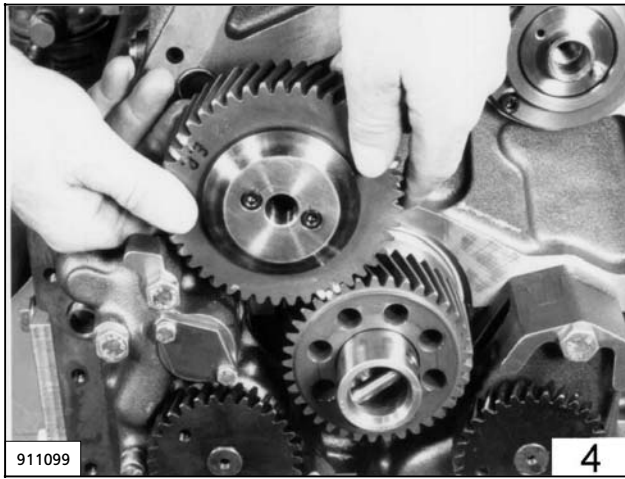
The teeth marked on the intermediate gear wheel are identified with the letters "KW" - (Kurbelwelle = crankshaft).

See also sub group 9.25.

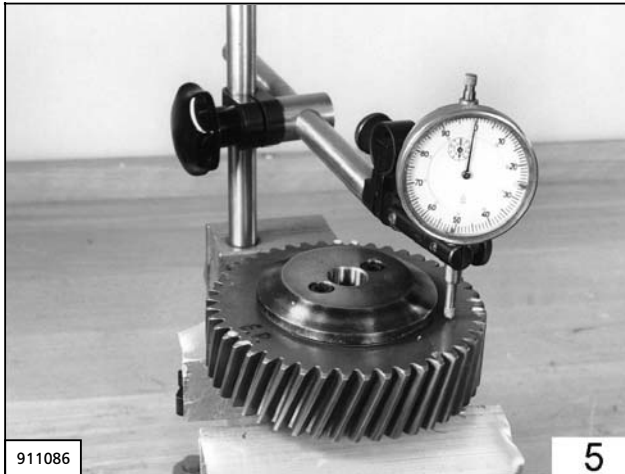
Since the gear wheel teeth marks must match for the removal of the timing and accessory drive gear box from the engine block, the gears should already be in the proper position.

Unscrew and remove intermediate gear wheel mounting screws Pos. 1.





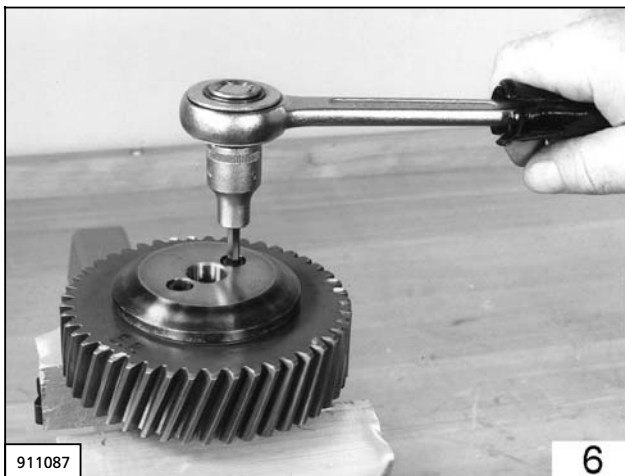
Remove intermediate gear wheel assembly from engine block.



Gear Wheel Disassembly, Inspection and Assembly:

Place gear wheel in vise. Use protective jaw covers to avoid damage. Measure axial gear wheel play on assembly.

See Engine Specifications for proper axial play.

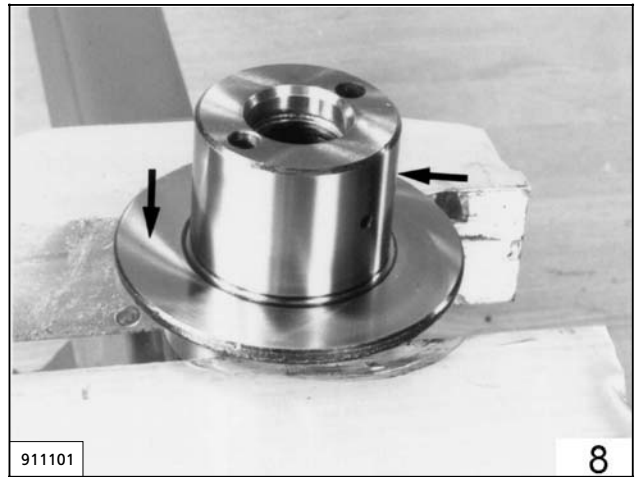


Unscrew and remove retaining plate mounting bolts Pos. 2.

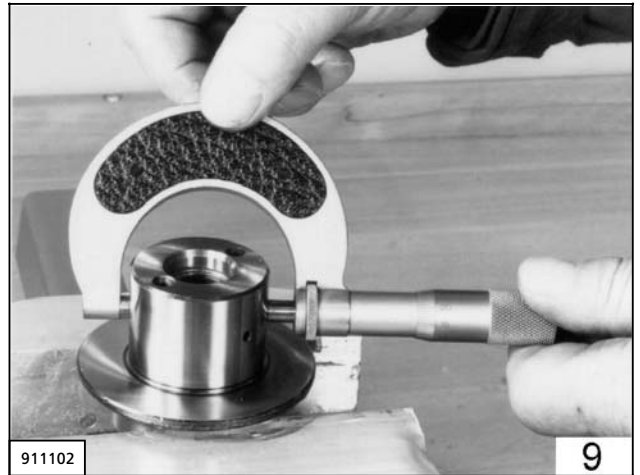


Remove retaining plate Pos. 3 and gear wheel Pos. 4 complete with thrust washers Pos. 5 and bushing Pos. 7 from hub Pos. 6. Clean all components and check lubrication bores for deposits.

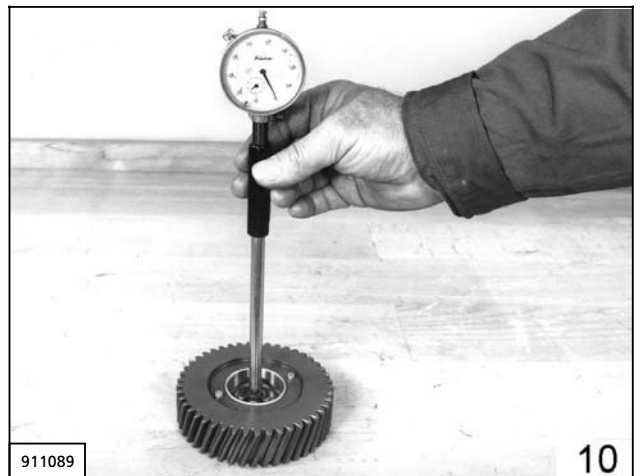
Visually check contact surfaces on hub to bushing Pos. 7 and thrust washer Pos. 5 for wear or damage.



Measure hub shaft diameter.
See Engine Specifications for proper dimension.



Visually check bushing bore for wear or damage.
Measure bushing inside diameter with dial gauge.
See Engine Specifications for proper dimension.

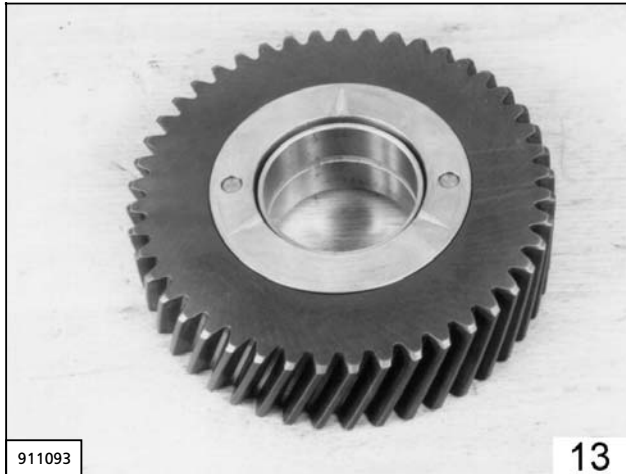


Visually check thrust washers for wear or damage.





Visually check contact surface on retaining plate to thrust washer for wear or damage.



Place thrust washers over dial pins Pos. 8 on gear wheel and visually check dial pins as well as thrust washer bores for wear.

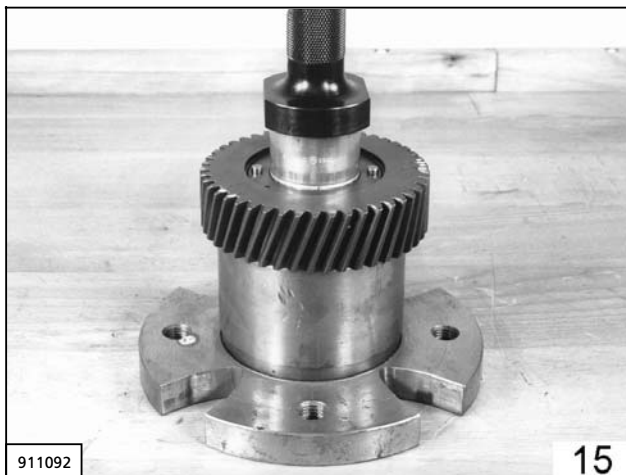
Note:

Any component that is damaged or does not conform with the required dimensions as specified must be replaced.



Gear Wheel Bushing Replacement:

Place gear wheel Pos. 4 on level support and knockout bushing Pos. 7 with punch, special tool no. 81.



Lubricate new bushing with engine oil, place bushing over gear wheel bore and knock it in to required location.

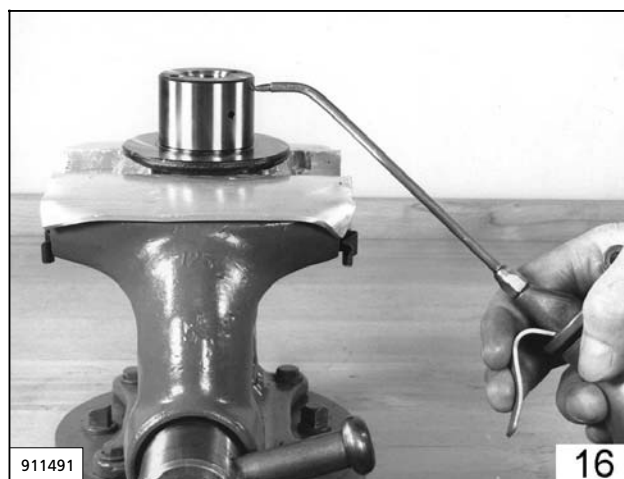
See back page 9.05.03 for proper measurement.

Note:

The bushing is manufactured to maintain the proper inside diameter after installation. There is no need to remachine the bushing bore.

Gear Wheel Assembly:

Place hub Pos. 6 in vise. Use protective covers to avoid damage. Lubricate hub shaft with engine oil.



Place thrust washers Pos. 5 over dial pins Pos. 8 on gear wheel Pos. 4, lubricate thrust washer surfaces with engine oil and place gear wheel with thrust washers on hub.

Important:

With the thrust washers placed on the gear wheel, the lubrication grooves on the thrust washers must be located toward the contact surfaces on hub and retaining plate.



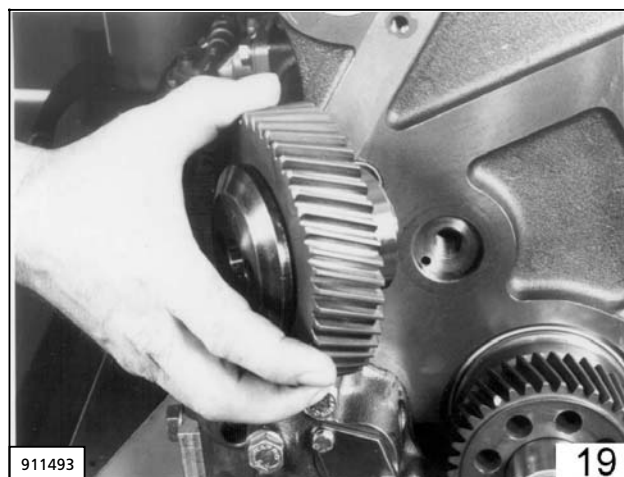
Place retaining plate Pos. 3 on hub Pos. 6 and install retaining plate with mounting bolts Pos. 2.

Spin gear wheel Pos. 4 and check for free movement.



Gear Wheel Installation:

Place gear wheel assembly with hub into engine block bore. Ensure that the marked crankshaft gear wheel tooth is positioned between the marked intermediate gear wheel teeth.

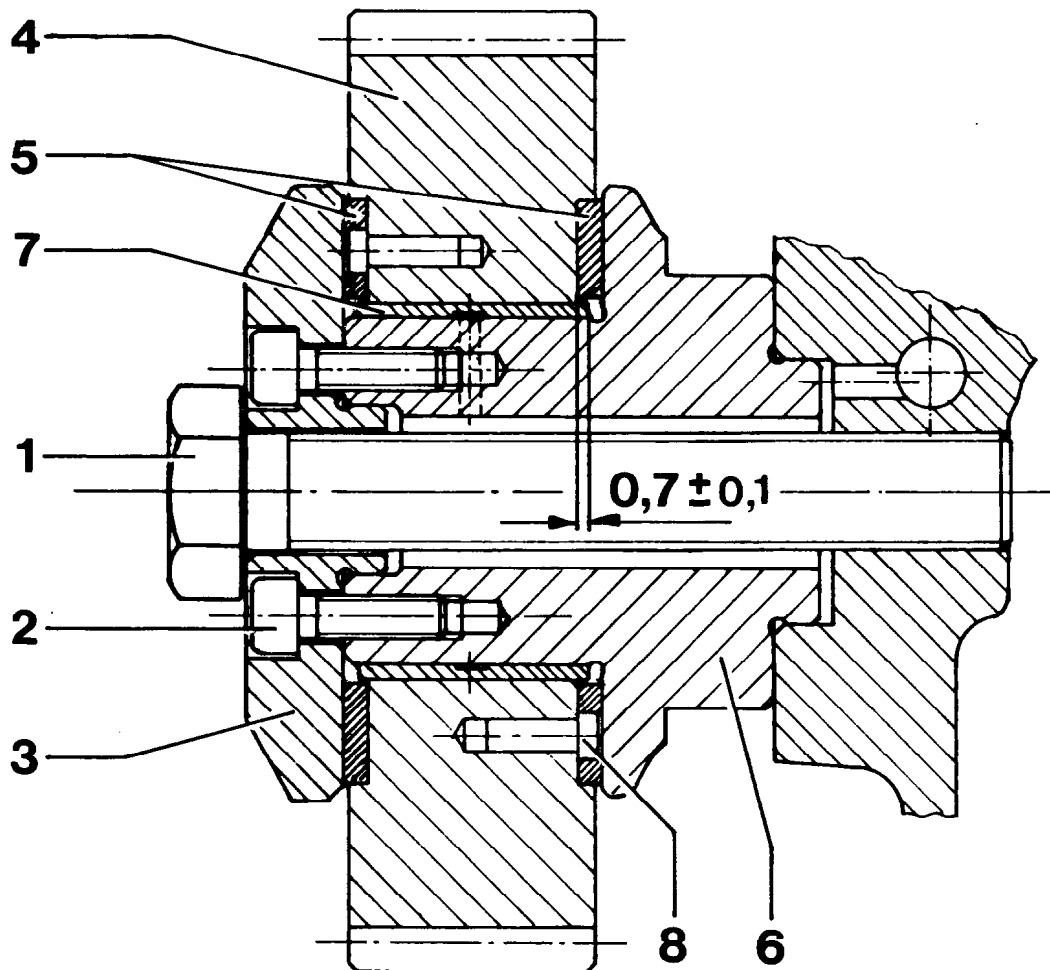




Apply a locking compound (Loctite 242/243) to the threads of screw 1, install the screw and tighten.

For tightening torque, see Technical Data.

Install the timing gear cover, see sub group 9.01.



Intermediate Gear Removal, Disassembly, Inspection, Assembly and Installation

From engine no. 85 01 0196

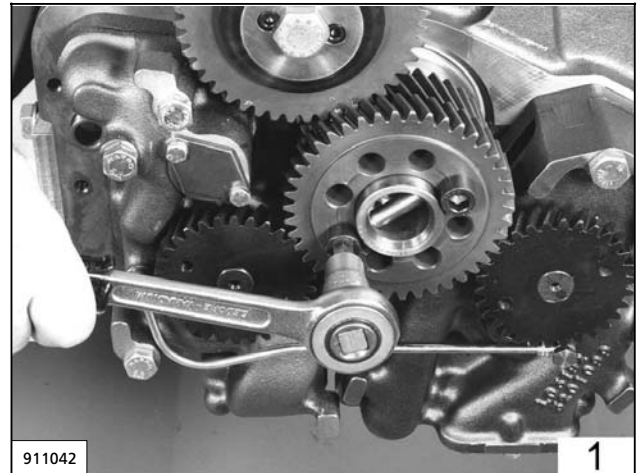
Special tool no. 81

Removal:

Remove timing case cover, see sub group 9.01, 9.02.

For position, see page 9.06.03 (reverse page).

Remove both assembly screws (see sub group 9.01.01 / 9.02.01, fig. 1) from lube oil pump gear and remove lube oil pump gear from crankshaft.



Check if the marked teeth from the intermediate gear and the marked tooth from the crankshaft gear mesh.

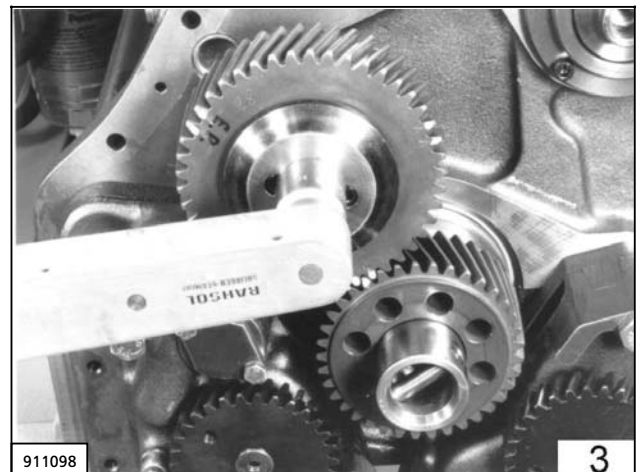
Note:

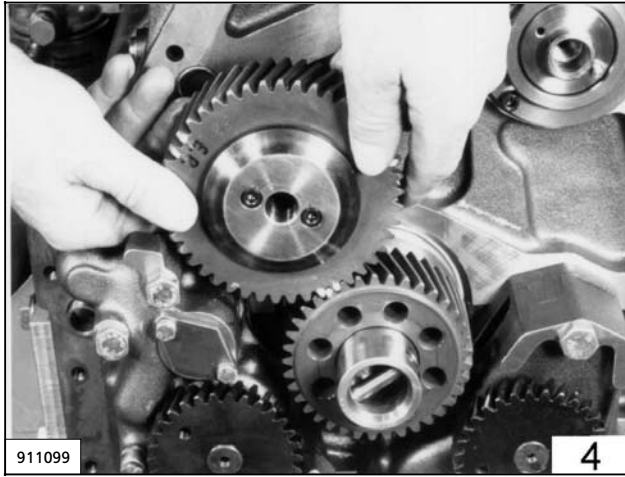
The teeth on the intermediate gear are marked with KW (for crankshaft) see also sub group 9.25, 9.26.

Since the gear markings must match when the timing case cover is removed, they usually will not have to be turned again.

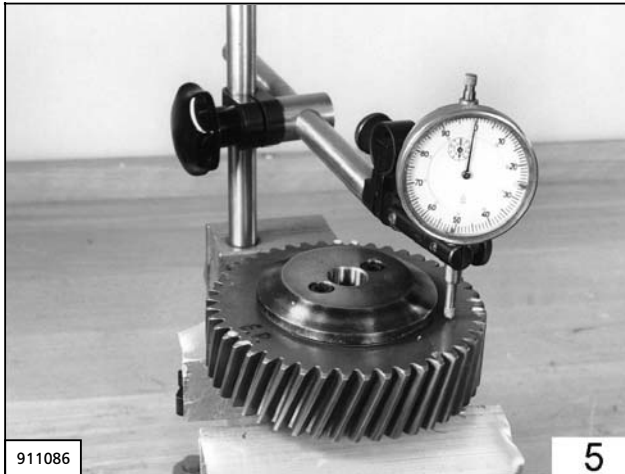


Loosen screw 1 on intermediate gear and remove.





Pull intermediate gear from engine block.

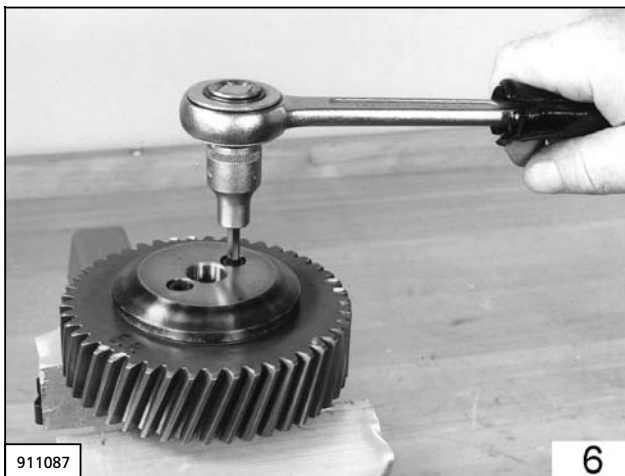


Disassembly, Inspection and Assembly:

Clamp intermediate gear into a vise equipped with protective jaw covers.

Measure axial clearance.

For proper clearance, see Engine Specifications.



Loosen and remove screws 2.

Note:

At version "A" (see drawing at back of page 9.06.03), there are no screws 2.

The thrust plate 3 is held in place by screw 1 only.

On this version gear, measure axial clearance with the gear installed.



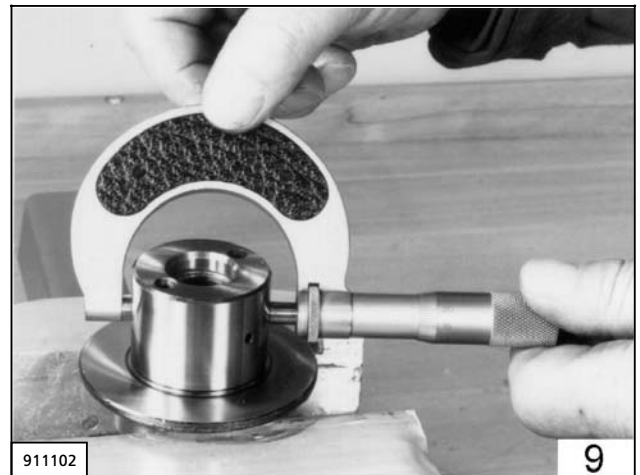
Remove thrust plate 3 and gear 4 together with thrust washers 5 from hub 6.

Clean all components, check oil bores for restrictions.

Visually inspect contact surfaces for bearing bushing 7 and thrust washers 5 at the hub for damage.



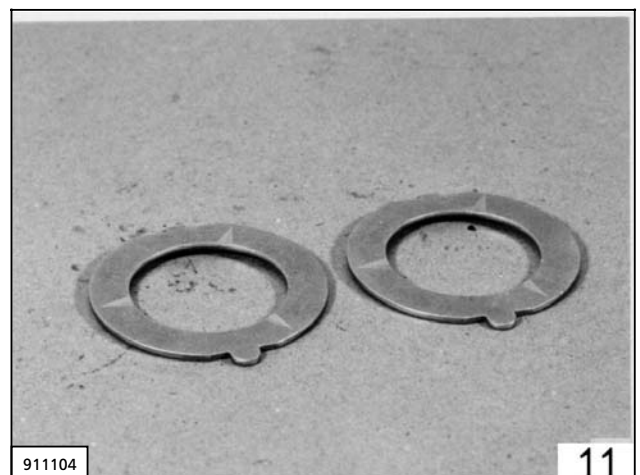
Measure bearing surface diameter at hub shaft. For proper value, see Engine Specifications.



Visually check bearing bushing in gear for damage. Measure diameter with inside micrometer. For proper values, see Engine Specifications.



At the thrust washers, visually check contact surfaces and retaining tangs for damage or wear.

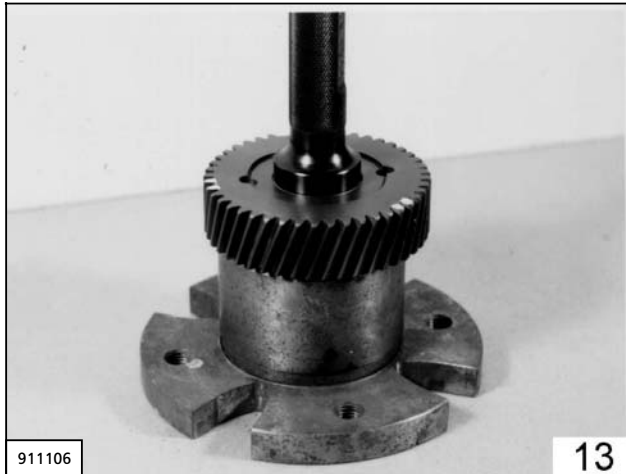




At thrust plate 3, check contact surface for thrust washer visually for damage.

Note:

Components showing damage, excessive wear or not meeting specifications must be replaced.



Gear Bushing Replacement:

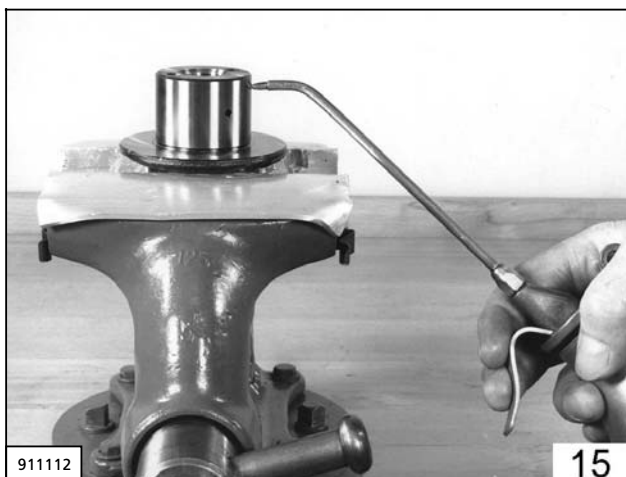
Place gear 4 on a level surface and remove bushing 7 with punch, special tool no. 81.



Lightly oil new bushing and tap into the gear with punch until flush with face of gear.

Note;

The bushing will assume the proper dimension.
Do not machine after installation.



Assembly:

Clamp hub 6 into a vise equipped with protective jaw covers. Oil bearing surface for bushing.

Insert thrust rings 5 with retainers into gear 4, oil running surface and push gear onto hub.



Push thrust plate 3 onto hub 6 and tighten with screws 2.

Turn gear 4 to check if it moves easily.

Important:

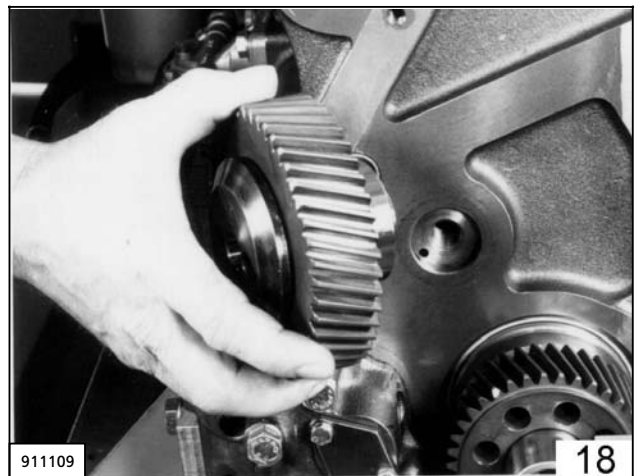
On version "A" (see reverse page 9.06.03), tighten screw 1 first and then check if the gear 4 moves easily.



Installation:

Push intermediate gear into the gear of the crankshaft gear and into recess in the crankshaft housing.

Note gear markings!

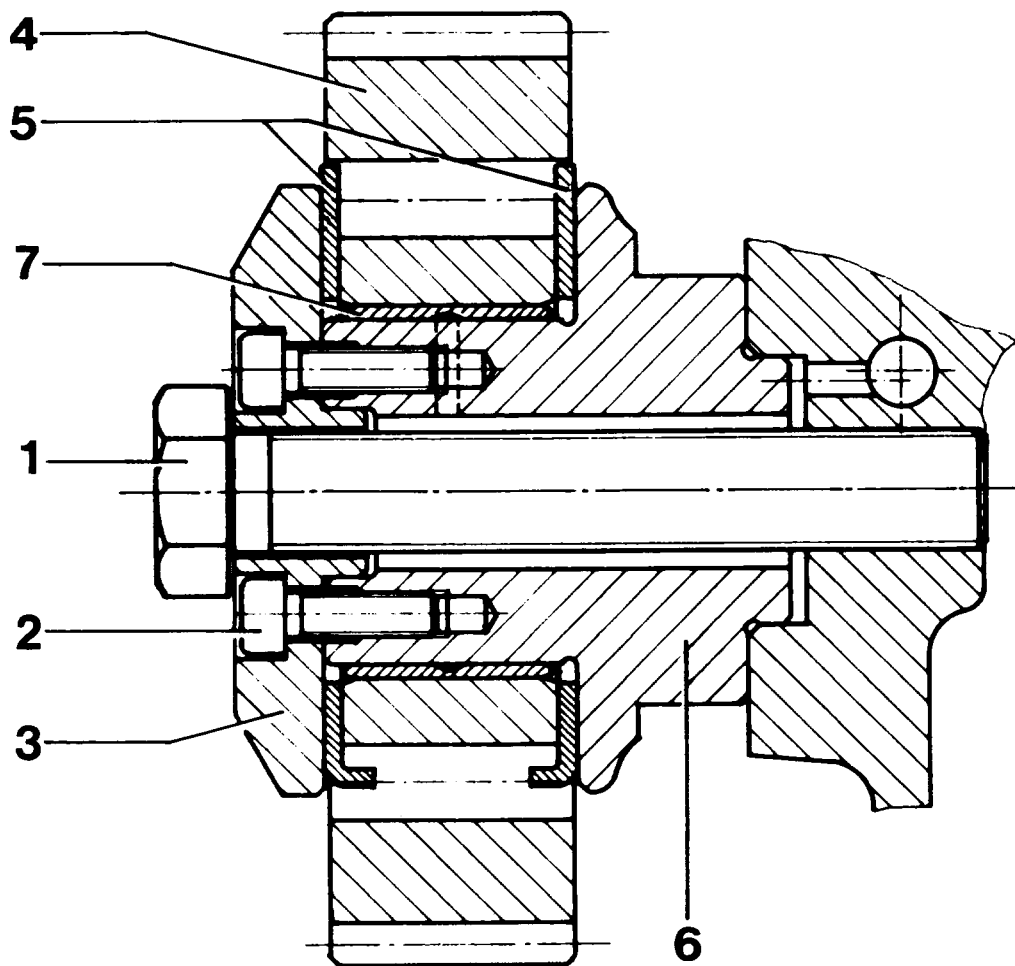


Apply a locking compound (Loctite 242/243) to the threads of screw 1, install the screw and tighten.

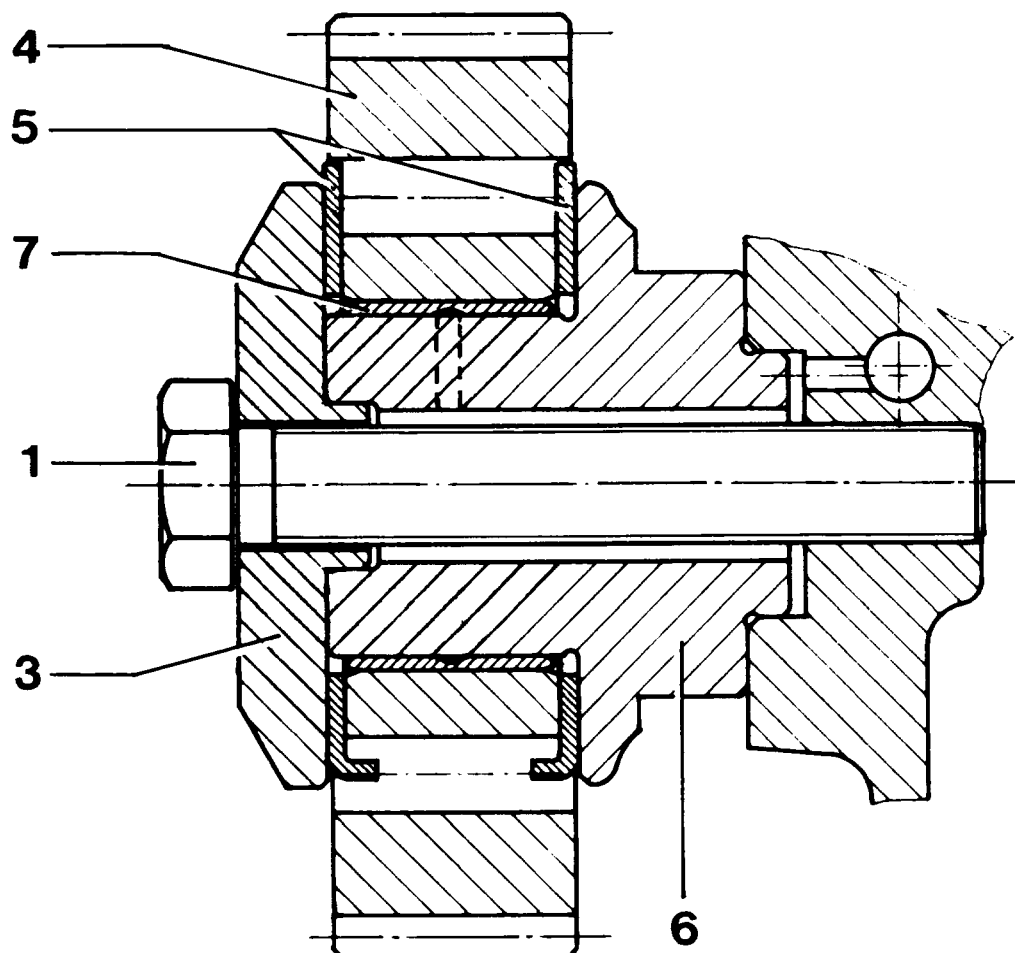
For tightening torque, see Technical Data.

Install timing gear cover, see sub group 9.01, 9.02.





Ausführung "A" Version »A«



Intermediate gear removal, disassembly, inspection, assembly and installation

From engine S/N 97 02 2023

Use special tool No. 81

Removal:

Remove timing gear cover, see sub group 9.01, 9.02.

For drawing, see page 9.07.03 (reverse side)

Remove the two temporary mounting screws (see sub group 9.01.01/9.02.01, fig. 1) on the lube oil pump gear and remove the lube oil pump gear from the crankshaft.



Check if the marked teeth from the intermediate gear align with the marked tooth from the crankshaft gear.

Note:

The teeth on the intermediate gear are marked with KW (Kurbelwelle = crankshaft), see also sub group 9.25, 9.26.

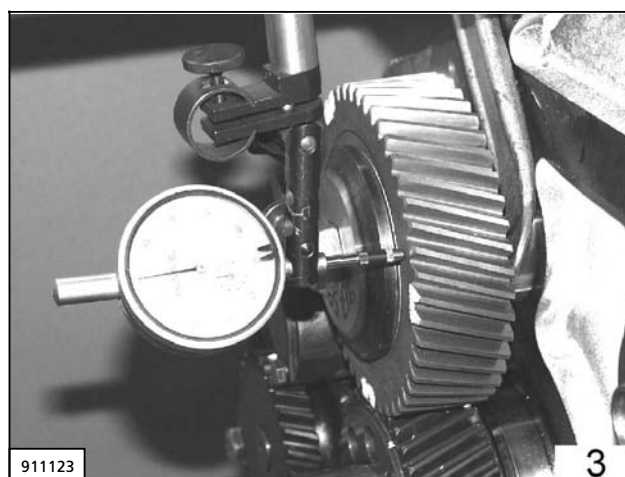
When removing the timing gear cover, the gear marks must match and normally do not need to be aligned.

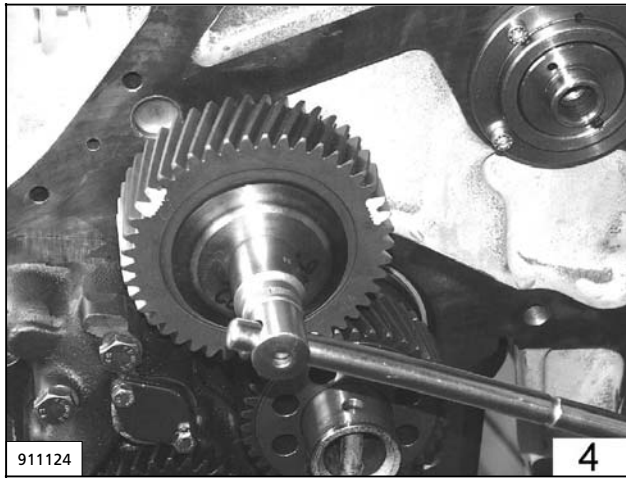


Check the axial play:

Use a commercially available dial gauge holder with dial gauge and position the gauge onto gear 2. Preload and zero the dial gauge. Move the gear 2 in axial direction and read the axial play.

For dimensions, see Technical Data.

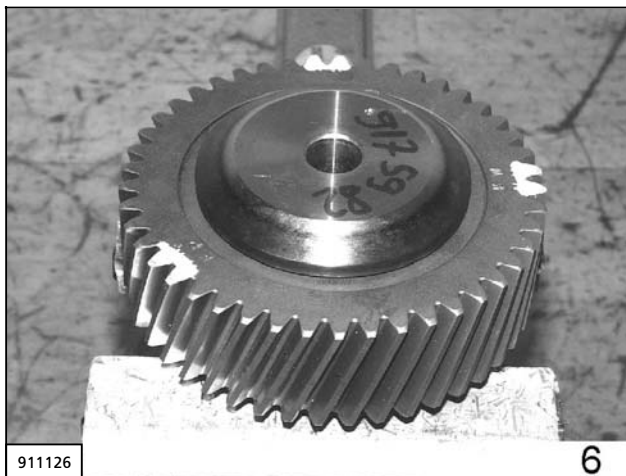




Loosen and remove the screw 1 on the intermediate gear.

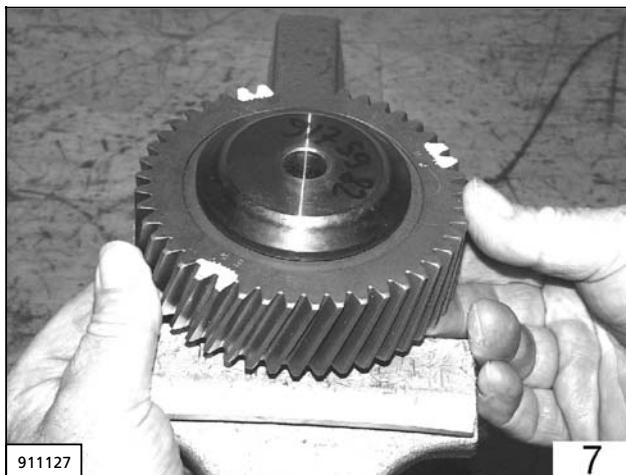


Remove the complete intermediate gear from the crankcase.



Disassembly, inspection and assembly:

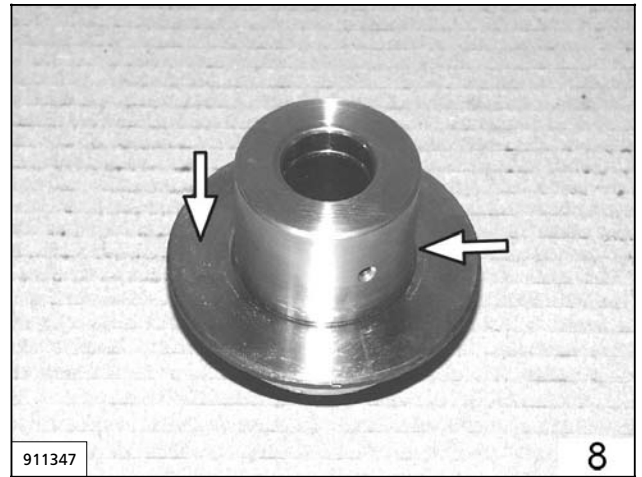
Place the intermediate gear on hub 3 into a vise with protective jaw covers.



Remove the thrust washer 4 and the gear 2 complete with thrust rings 5, 6 from hub 3 .

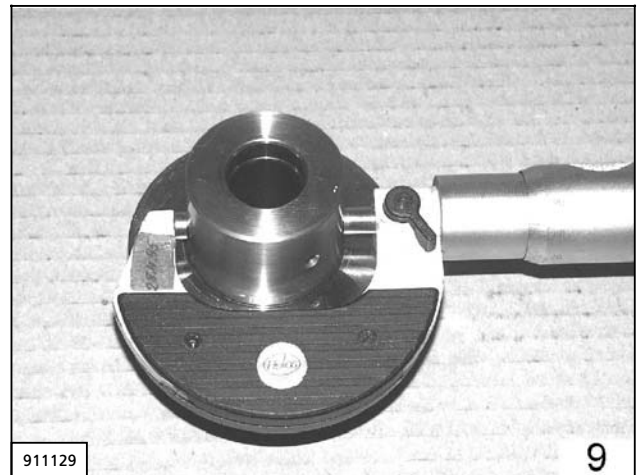
Clean all parts, check the lube oil bore to ensure it is clear.

Check the running surfaces for the bearing bushing 7 and thrust ring 6 on hub 3 for wear and damage (visual inspection).



Measure the bearing pin diameter on hub 3 with a micrometer.

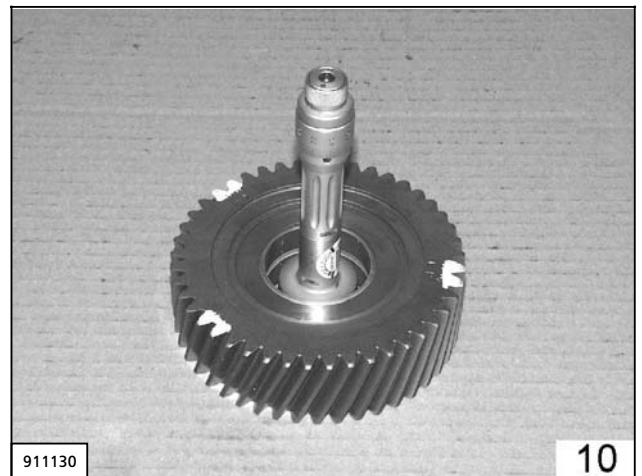
For dimensions see Technical data.



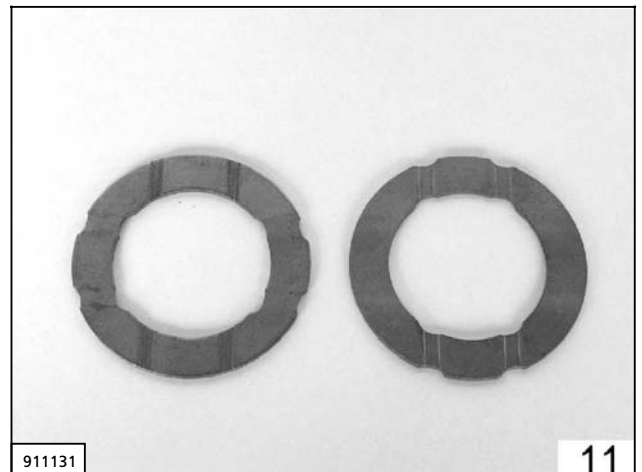
Check the bearing bushing 7 and thrust surfaces for thrust rings 5, 6 on gear 2 for wear and damage (visual inspection).

Measure the bore of bearing bushing 7 with an inside micrometer.

For dimensions see Technical data.



On thrust rings 5, 6, check the running surfaces for wear (visual inspection).





Check the running surface for thrust ring 5 on thrust washer 4 for wear and damage (visual inspection).

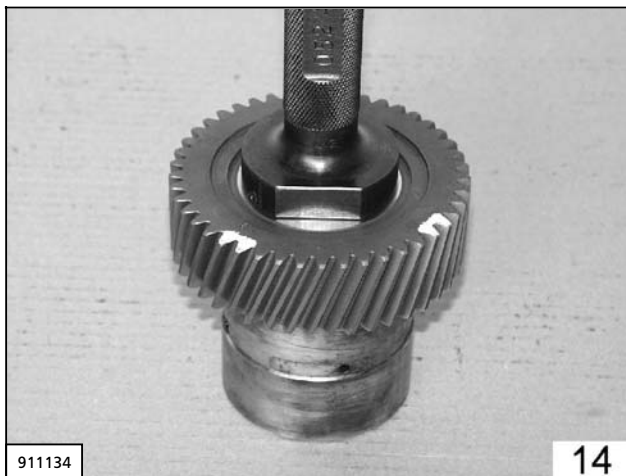
Note:

Any parts which are outside the given tolerances or are worn or damaged must be replaced.



Replace the bearing bushing 7 in gears:

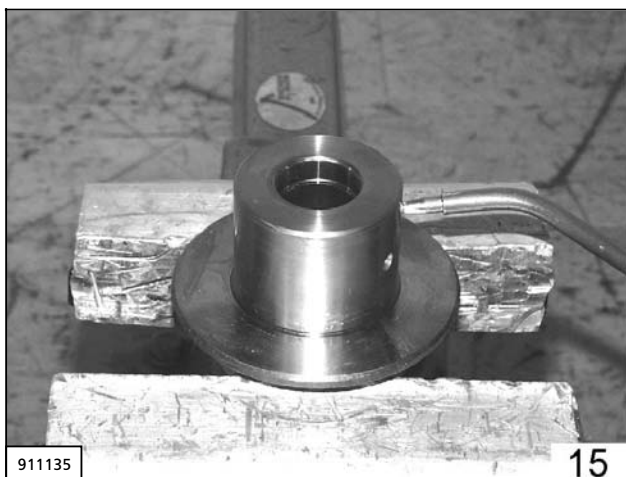
Place gear 2 on a level surface and push the bearing bushing 7 out with a punch, special tool No. 81 .



Lubricate a new bearing bushing 7 with oil and press with punch, special tool No. 81 into the gear 2 until flush.

Note:

The bearing bushing 7 is pre-machined and does not need to be remachined when installed.



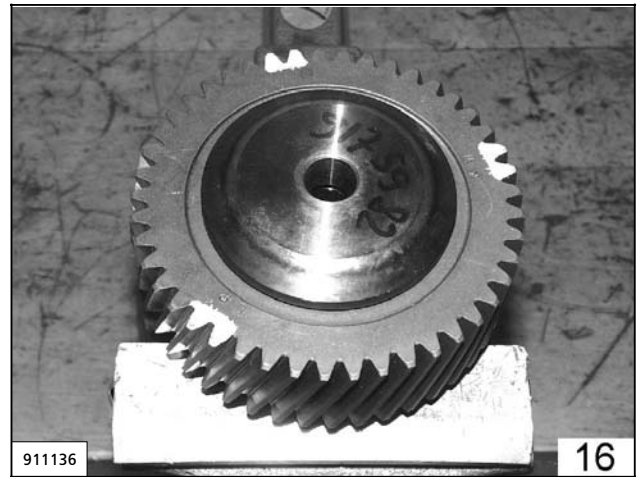
Assembly:

Insert hub 3 into a vise with protective jaw covers, lubricate the running surface for the bearing bushing 7 with oil.

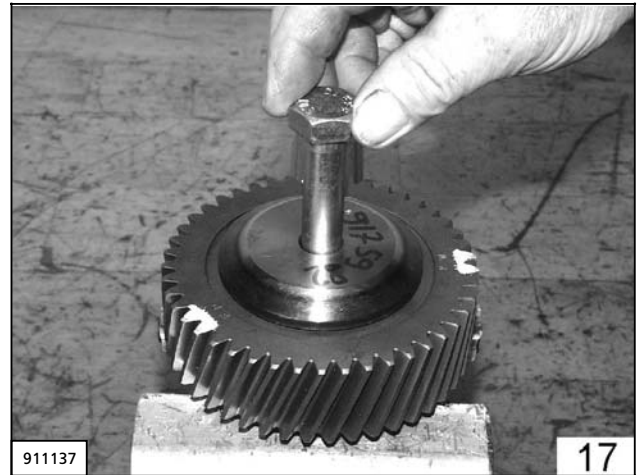
Insert the thrust rings 5, 6 with grease into the gear 2 and push gear 2 onto hub 3. Attach the thrust washer 4.

Important:

The tooth markings on gear 2 must point in the direction of the thrust washer 4.



Apply a locking compound (Loctite 242/243) to the threads of screw 1 and slide the screw into the intermediate gear.



Installation:

Slide the intermediate gear into the crankshaft gear and into the recess in the crankcase.

Be certain that the marks on the intermediate gear line up with the mark on the crankshaft gear!



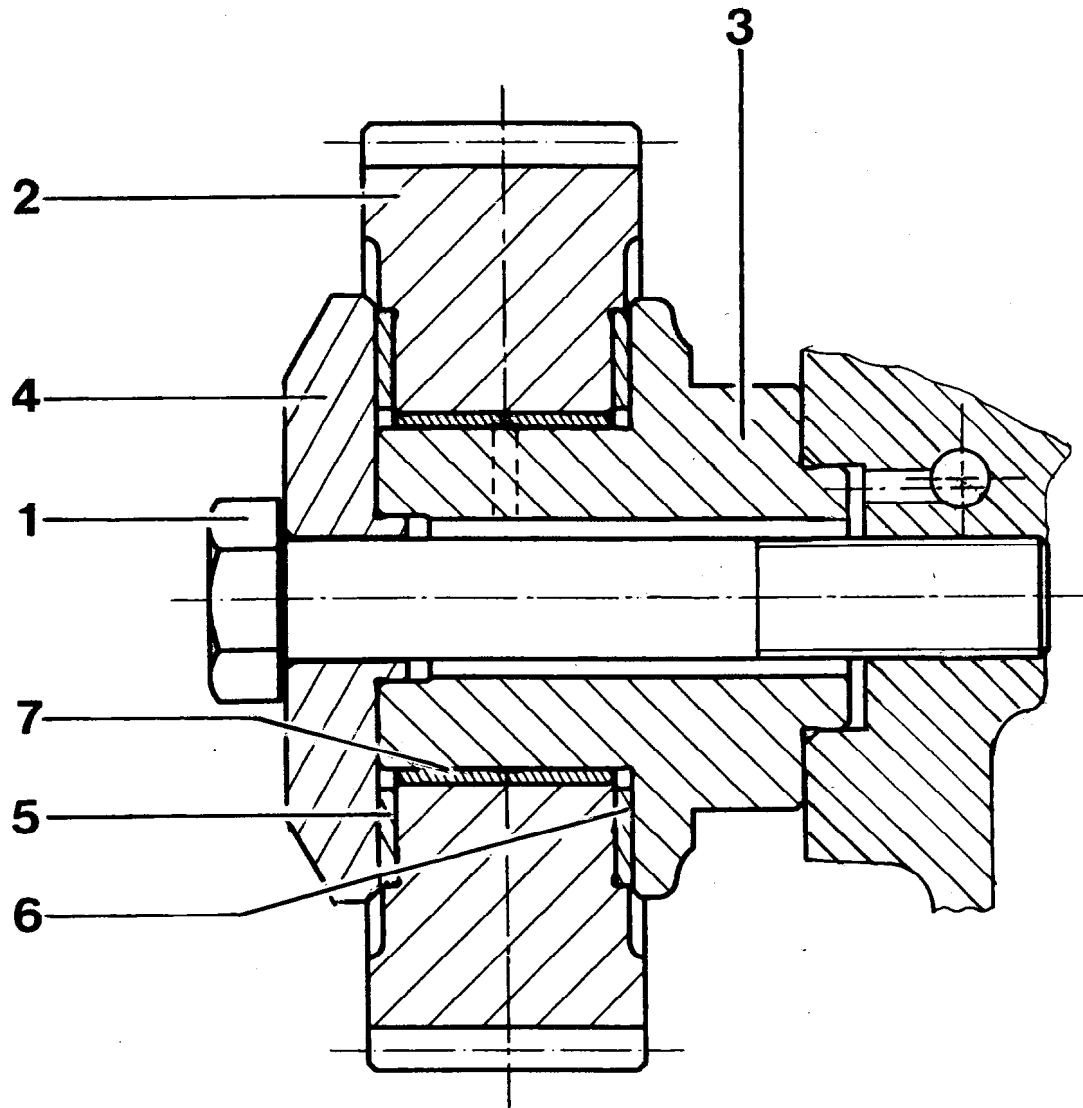
Insert and tighten screw 1.

For tightening torque, see Technical Data.

Check gear for easy movement, check axial play of gear 2 after tightening.

Install the timing gear cover, see sub group 9.01., 9.02.





Flywheel Housing Removal and Installation

Use special tool no. 61

Flywheel Housing Removal:

Drain engine oil as described see sub group 2.01.

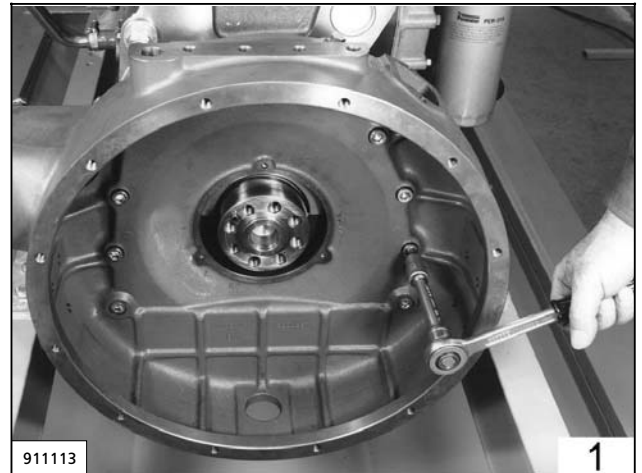
Remove oil pan as described in sub group 8.32.

Remove flywheel as described in sub group 6.01.

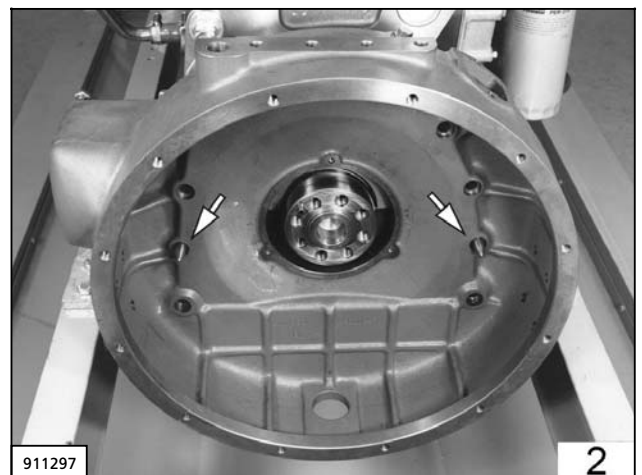
Remove rear crankshaft sea as described in sub group 6.08.

Remove starter motor as described in sub group 8.15.

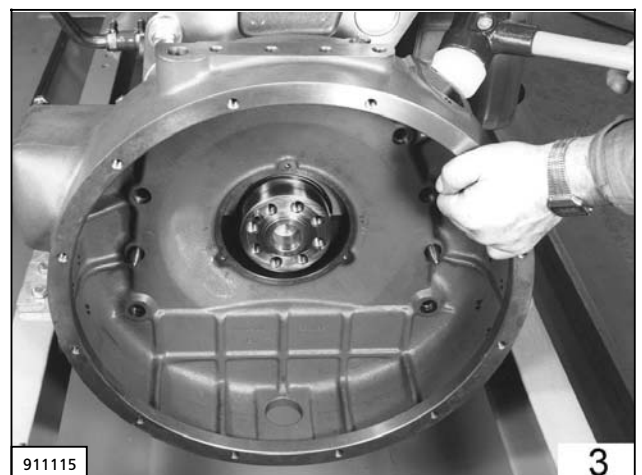
Unscrew and remove flywheel housing mounting bolts.



Install two guide pins, special tool no. 61, in respective flywheel housing bores as shown.



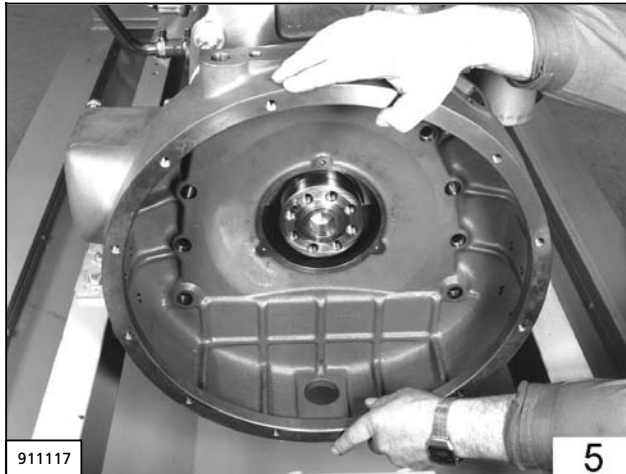
Using a rubber or plastic hammer, knock flywheel housing loose and remove housing from engine block. Clean mounting surfaces on engine block and flywheel housing.



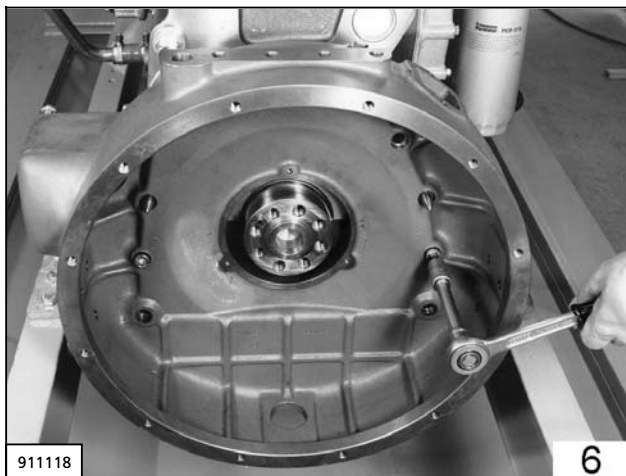


Flywheel Housing Installation:

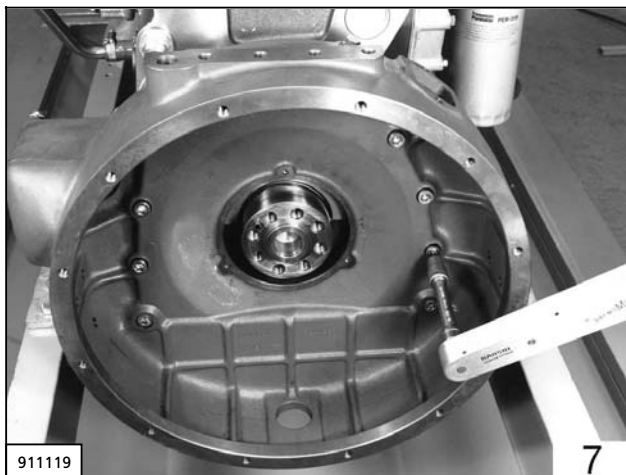
Place new gasket over both guide pins and press-fit bushings on engine block.



Place flywheel housing over both guide pins and press-fit bushings on engine block.



Screw in two flywheel mounting bolts in opposite location and pretorque mounting bolts slightly.



Remove both guide pins and screw in remaining mounting bolts. Torque all flywheel housing mounting bolts in the sequence as shown in fig. 8.

See Engine Specification for proper torque.

Note:

The top center bolts (Pos. 11, Fig. 8) is shorter than the other flywheel housing mounting bolts.

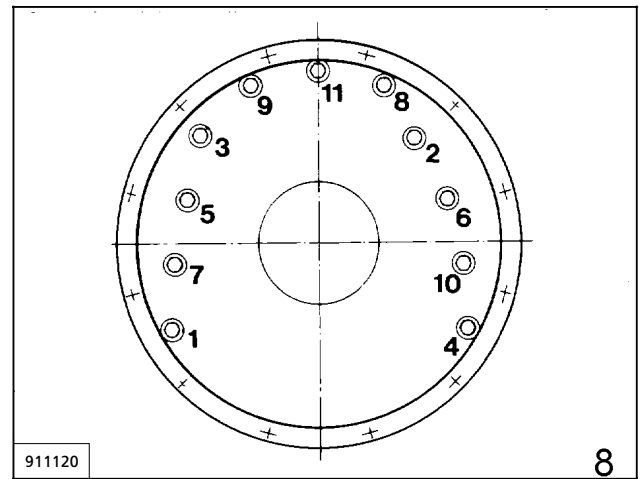
Reinstall rear crankshaft seal as described in sub group 6.08.

Reinstall flywheel as described in sub group 6.01.

Reinstall starter motor as described in sub group 8.15.

Reinstall oil pan as described in sub group 8.32.

Refill engine with engine oil as described see sub group 2.01.



Flywheel housing and gear for hydraulic pump-auxiliary drive on crankshaft removal, inspection and installation.

Use special tool No. 62.

Removal:

Hydraulic pump drives are removed, see sub group 8.22, 8.23.

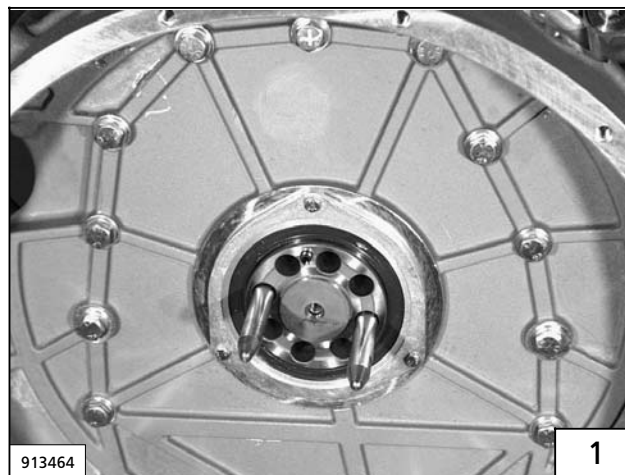
Drain engine oil, see sub group 2.01.

Remove flywheel, see sub group 6.01.

Remove crankshaft seal, see sub group 6.08.

Remove starter, see sub group 8.15.

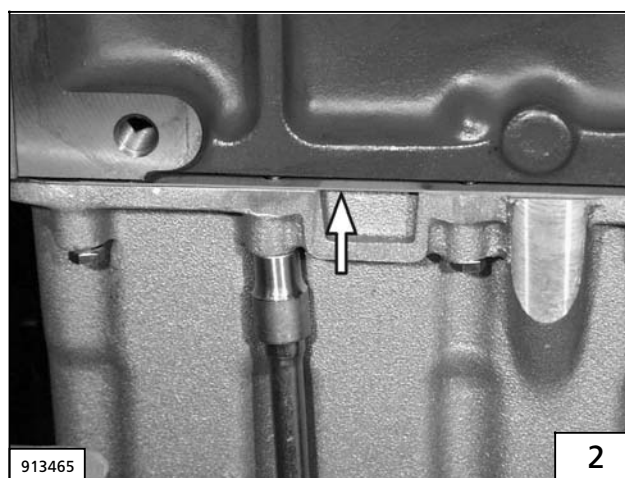
Install two guide pins, special tool No. 62 into the crankshaft.



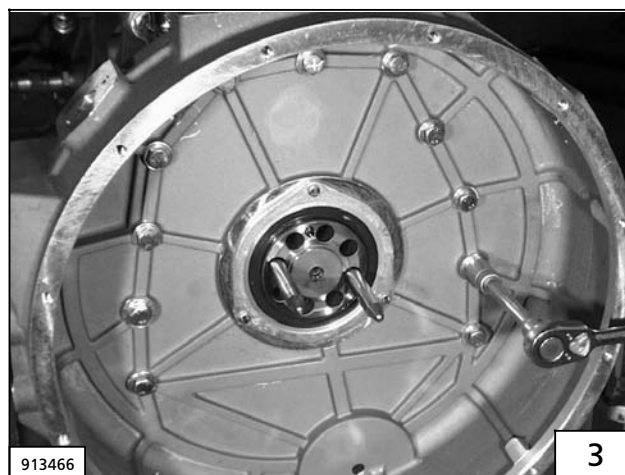
Unscrew the bolts from the oil pan so that the oil pan and the seal can be lowered for about 10 mm.

Note:

Acting this way the oil pan doesn't have to be removed.



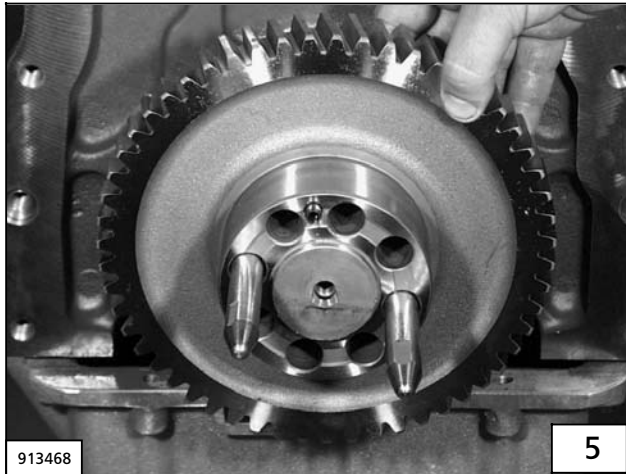
Loosen and remove screws on flywheel housing.



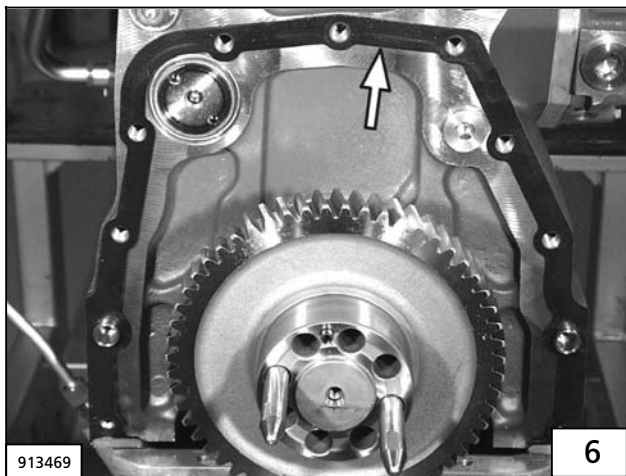


Loosen the flywheel housing from crankcase with a plastic hammer.

Remove flywheel housing from the line-up sleeves in crankcase. Turn lightly in direction of oil pan engine and remove.



Remove gear for the hydraulic pump auxiliary drive from the crankshaft.



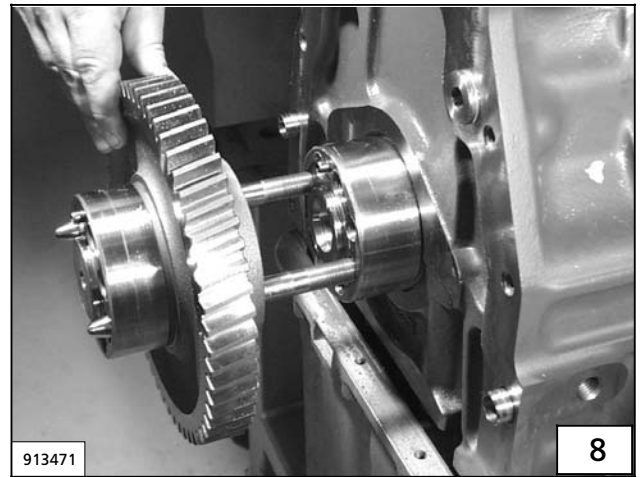
Remove gasket from the line-up sleeves.
Clean mounting surfaces on crankcase and flywheel housing.



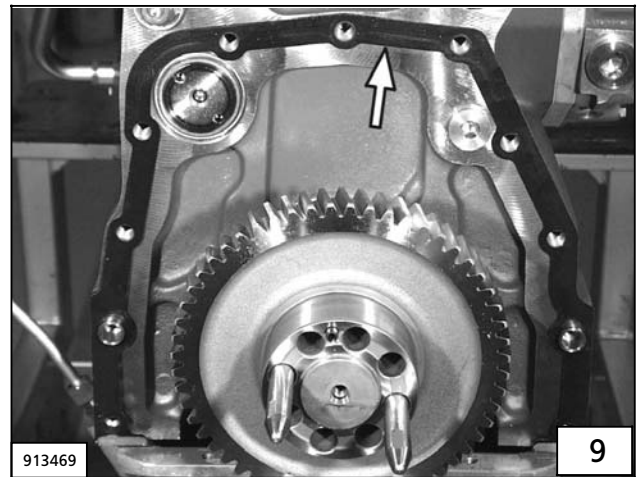
Installation:

Install new O-ring in the gear and lubricate lightly with oil.

Push gear over the mounting studs onto the crankshaft.



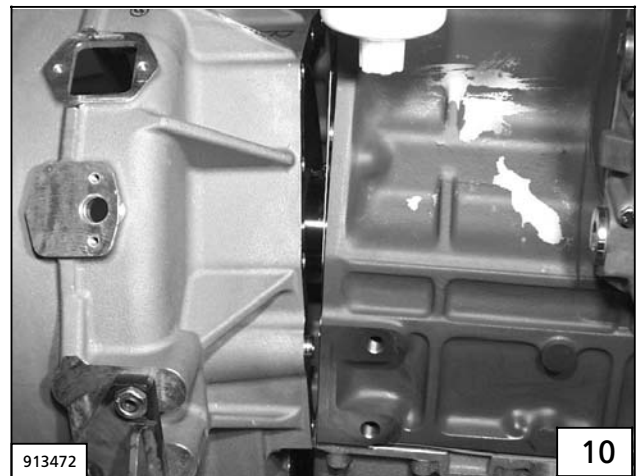
Attach new gasket over the line-up sleeves on the crankcase.



Push flywheel housing over the line- up sleeves onto the crankcase.

Note:

Watch surface contact of the tooth of intermediate gear in the flywheel housing and gear onto crankshaft.



Insert and tighten screws.

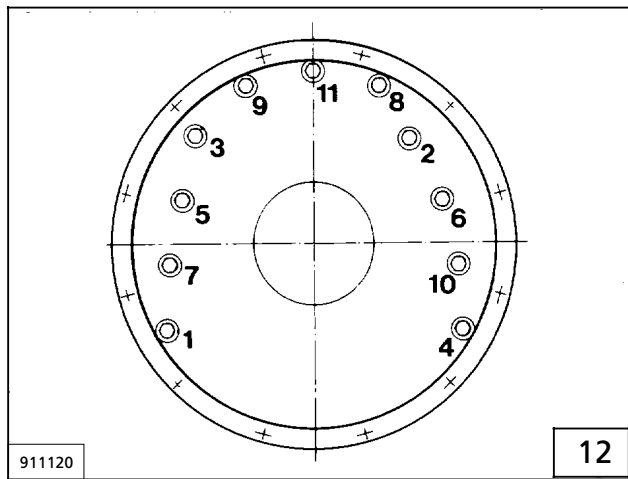
For sequence, see fig. 12.

For tightening torque, see Technical Data.

Note:

The top center bolts (Pos.11, Fig. 12) is shorter than the other flywheel housing mounting bolts.





Tighten the oil pan screws.



Install crankshaft seal, flywheel, starter and oil pan.

Install hydraulic pump drives.

For sub group, see page 9.11.01 (Removal)

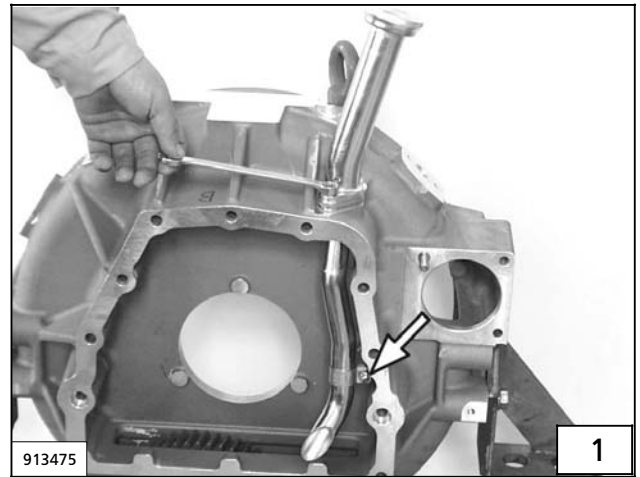
To add engine oil, refer to sub group 2.01.

Gear for hydraulic pump - auxiliary drive in flywheel housing removal, inspection and installation.

Use special tool No. 80.

Flywheel housing is removed, see sub group 9.11.

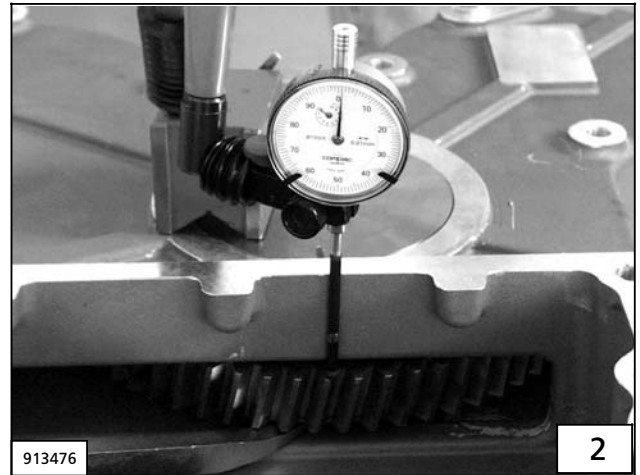
Remove the oil filler neck from the flywheel housing.



Check axial play:

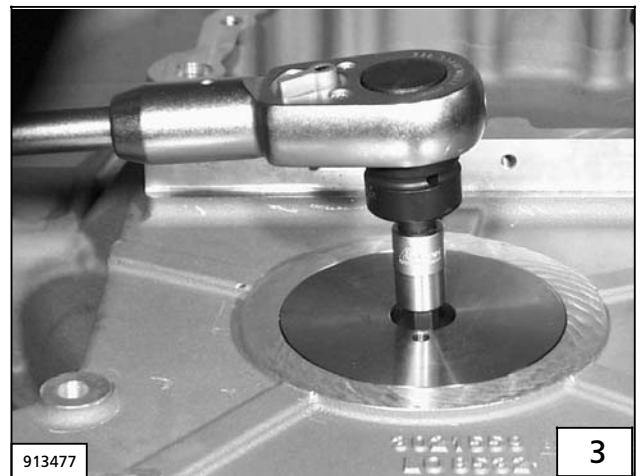
Check axial play on gear with a commercial dial gauge.

For dimensions, see Technical Data.

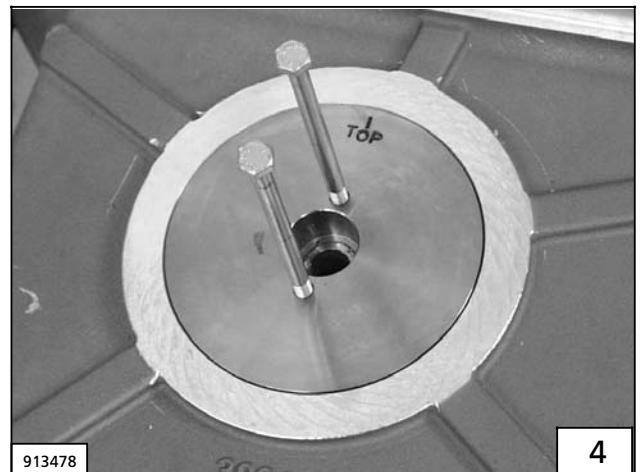


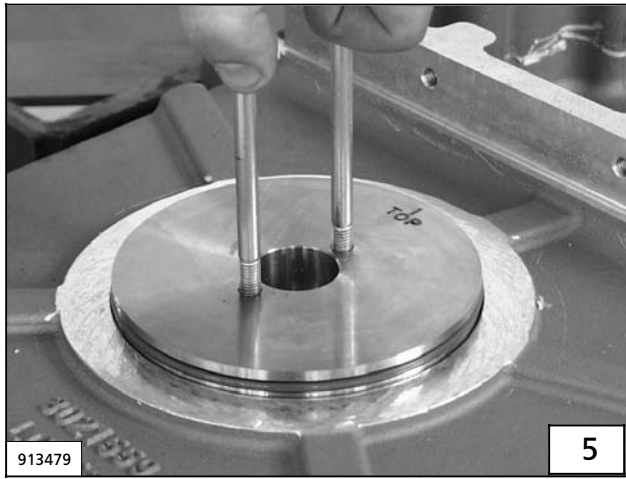
Removal:

Loosen and remove the screw on the intermediate hub.

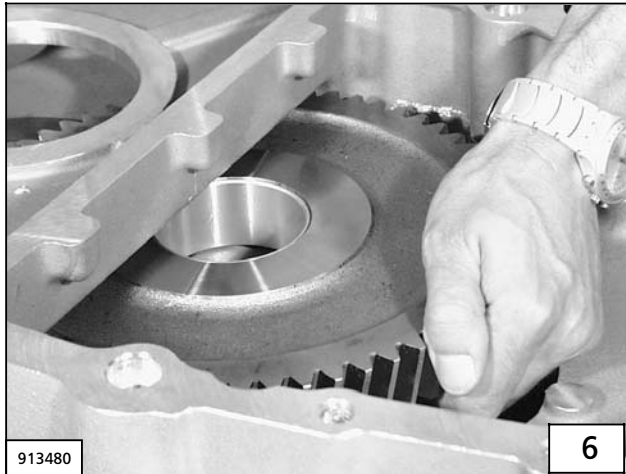


Install two screws M8 into the threads from the intermediate hub.

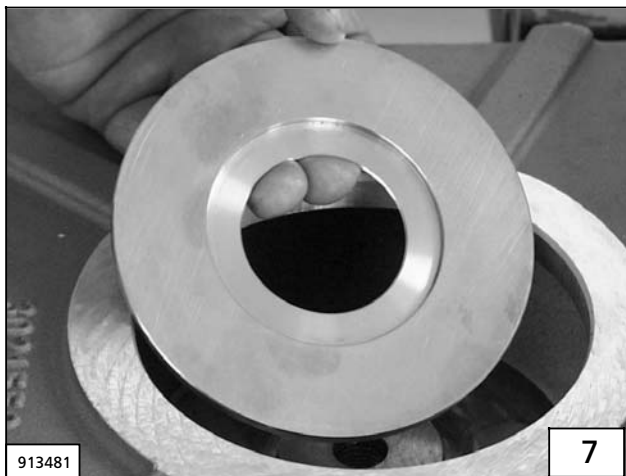




Turn the two screws and push intermediate hub out of flywheel housing.

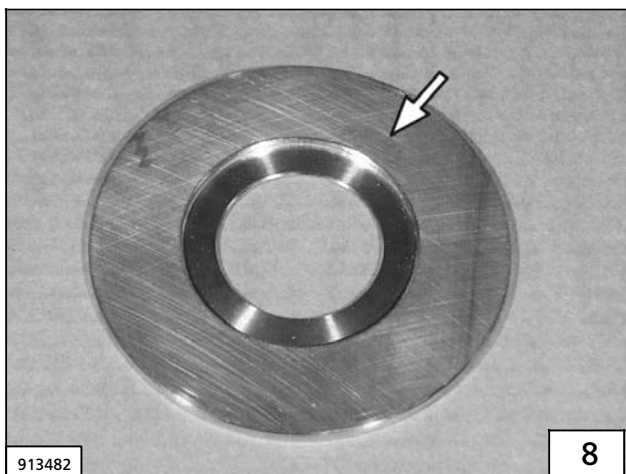


Pull the gear out from the flywheel housing.



When thrust washer of the backside remains into the flywheel housing, remove thrust washer out of flywheel housing.

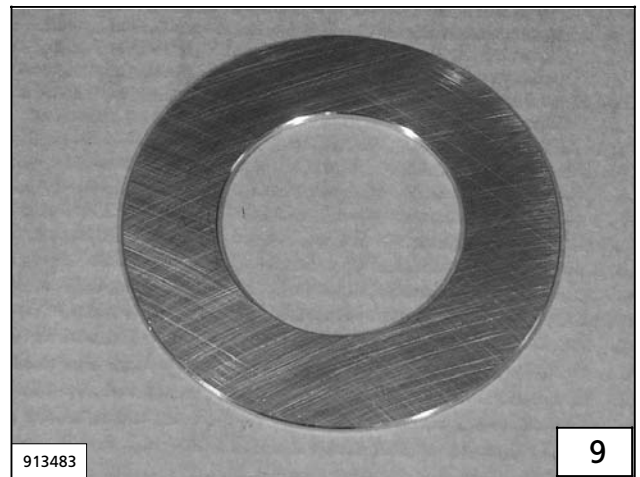
Clean all parts and check oil bores to be certain they are clear.



Inspection:

Visually check the running surface of the gear of backside thrust washer for damage.

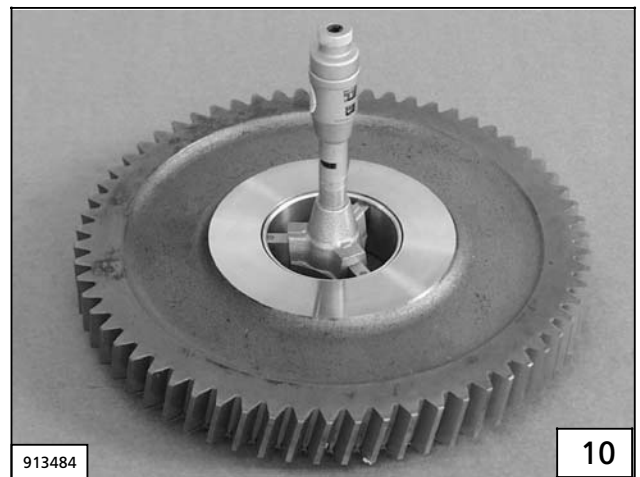
Visually check the running surface of frontside thrust washer for damage.



On gear, check the running surface for thrust washer, teeth and bushing for damage (visually check).

Measure gear bushing with bore gauge.

For dimensions, see Technical Data.



On intermediate hub, visually check the running surface for frontside thrust washer for damage.

Measure pin diameter

For dimension, see Technical Data.

Note:

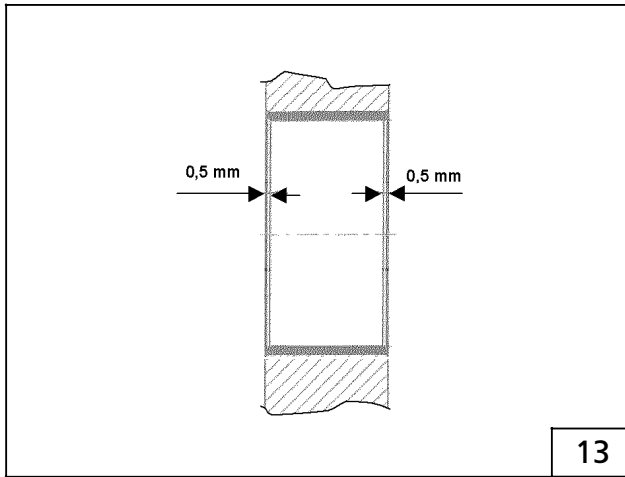
Replace all parts which fall outside the required tolerance or are damaged.



Replace bushing in gear:

Place gear onto a level support and push bushing with a punch, special tool No. 80 from the gear.





Cool new bushing in liquid nitrogen to -175°C to -195°C (-260°F to -320°F) and drive them with a punch, special tool No. 80 into the gear to the dimension given in fig. 13.

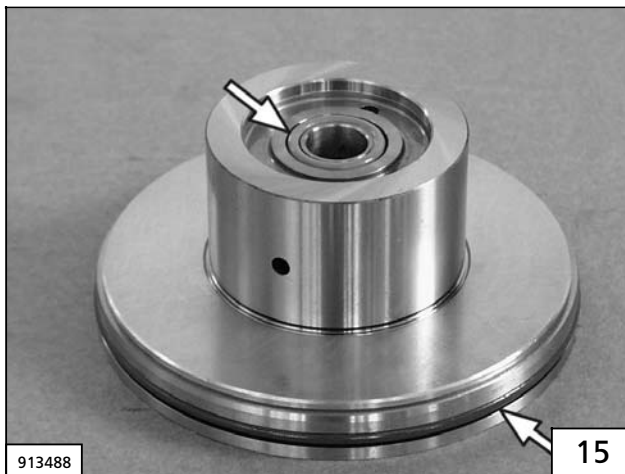
Note:

Bushing is finished bushing and should not be remachined.



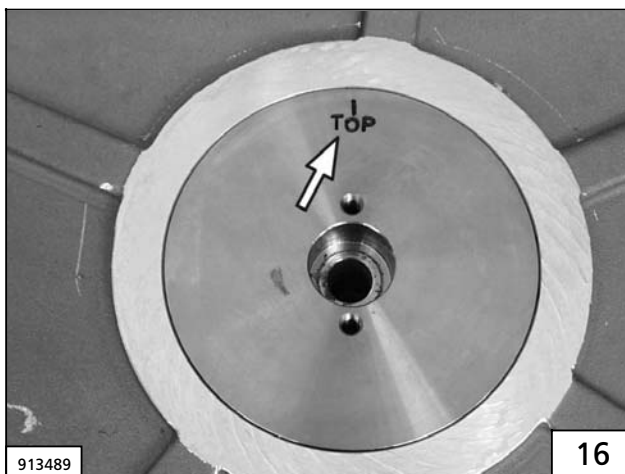
Installation:

Grease lightly backside of thrust washer and install hub into flywheel housing.



Insert with lightly grease two new O-rings on intermediate hub.

Grease lightly frontside thrust washer and install on intermediate hub.



Install gear into flywheel housing and push intermediate hub through gear into flywheel housing.

Important:

The top mark on the intermediate hub must point at the above side from the flywheel housing.

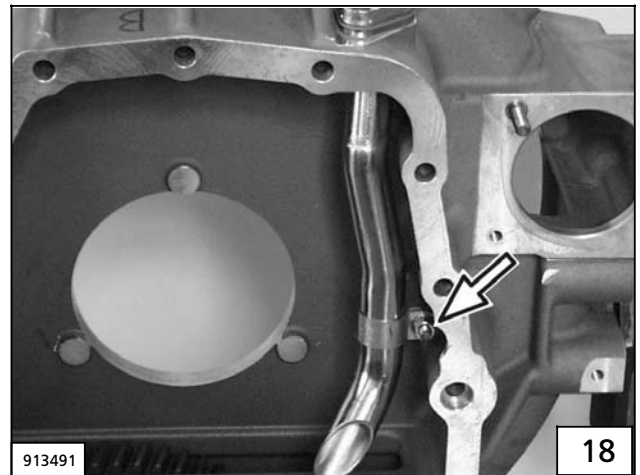
Apply a locking compound (Loctite 243) to the threads of screw, install the screw and tighten.



Install the oil filler neck with new gasket on flywheel housing.

Note:

Install nut for clamping collar with locking compound (Loctite 270) (see arrow).



Important:

After each installation or repair, check the axial play of the gear, see fig. 2.

For dimensions, see Technical Data.

Install flywheel housing, see group 9.11.

Crankshaft Removal and Installation:

Special tools no. 31, 32, 62.

Removal:

Remove timing case cover, see sub group 9.01, 9.02.

Remove lube oil lines, see sub group 8.35.

Remove lube oil pump, see sub group 8.40.

Remove flywheel housing, see sub group 9.10.

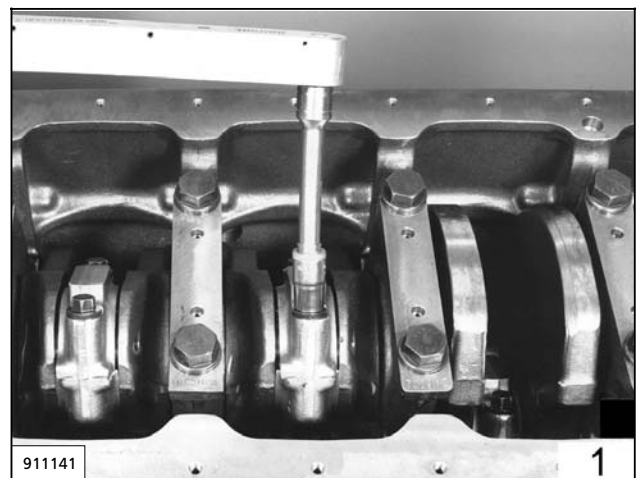
Remove injection valves, see sub group 7.18.

Note:

If only the crankshaft needs to be removed, it is sufficient to remove the injection valves. Then the pistons can be pushed into the cylinder bushing with the connecting rod.

If cylinder head, piston and cylinder bushing must be removed also (engine completely disassembled), see main group 3.00.

First loosen all rod screws, then remove them one after the other. Mount turning pin, special tool no. 31, on crankshaft. Push rod through the turn crankshaft until the appropriate rod screw is positioned properly.

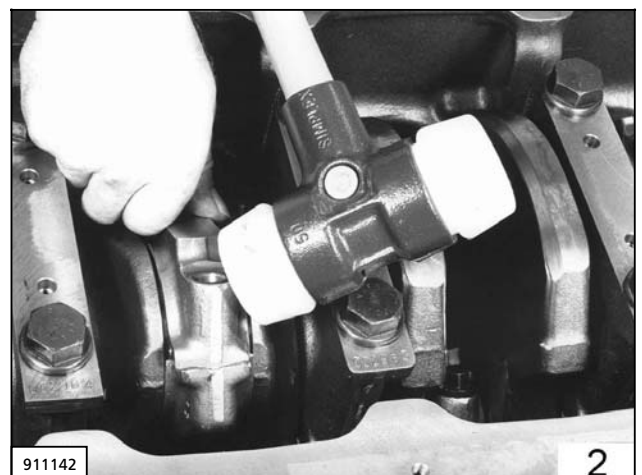


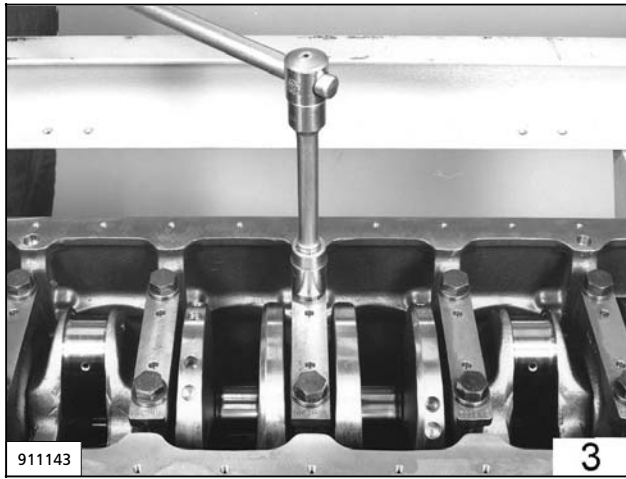
Loosen connecting rod cover with rubber mallet and remove it. Note the marking of the cover!

See sub group 3.18 and main group 1.00 (engine number).

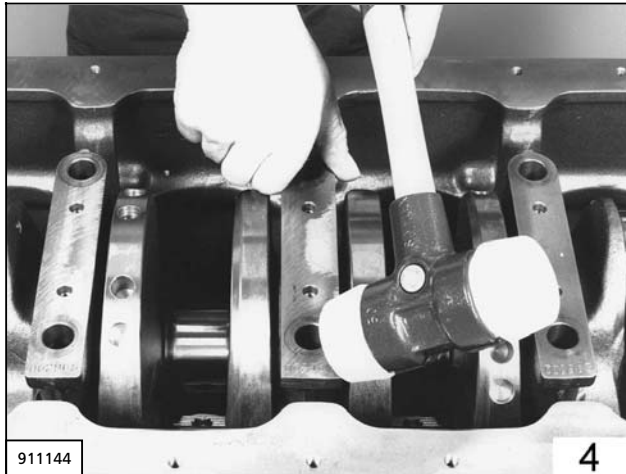
Note;

Push every connecting rod with piston back into the cylinder bushing after removing the rod cover. When turning the crankshaft, make sure that the rod bearing pin is not damaged by the bottom of the rod!





Unscrew and remove crankshaft main bearing and thrust bearing cap mounting bolts.

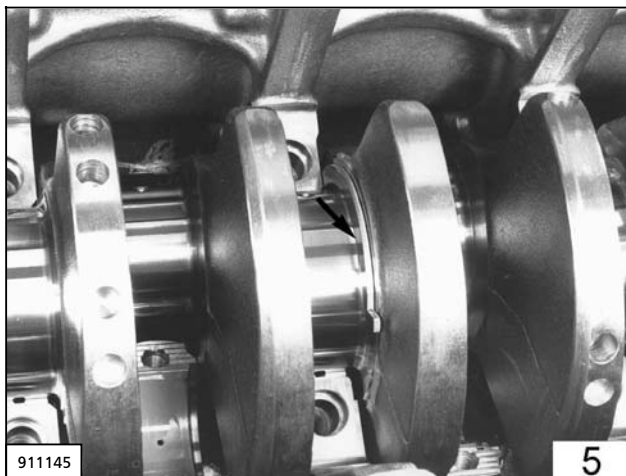


Use rubber or plastic hammer to loosen bearing caps and remove main bearing caps with shells from crankcase. Remove thrust bearing cap with both thrust washers

Important:

The bearing caps are identified in numbering sequence starting at the flywheel and on the left-hand side of the caps with the engine block turned upside down.

See also main group 1.00 for numbering sequence.

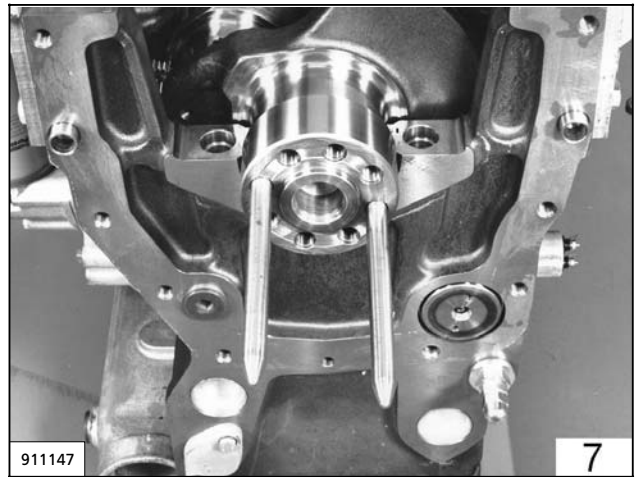


After the thrust bearing cap is removed, rotate remaining thrust washers and remove washers from crankcase.



Remove lubrication oil pump drive gear wheel and crankshaft gear wheel from crankshaft.

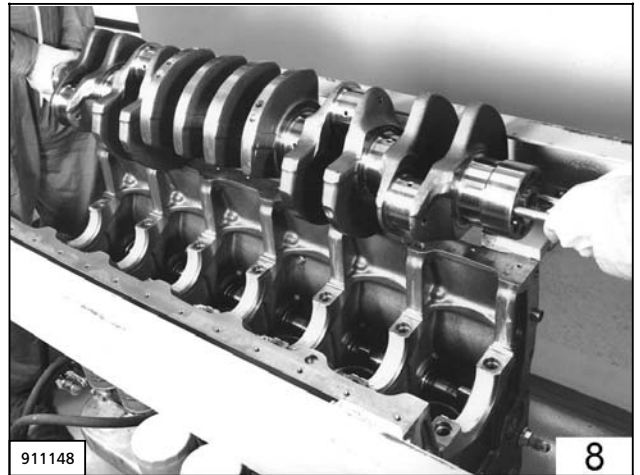
Install two guide pins, special tool no. 62, on crankshaft at the flywheel connection as shown.



Hold crankshaft on front end as well as on guide pins at the flywheel connection and simultaneously lift crankshaft on both ends out of crankcase bearings.

Inspect crankshaft as described in sub group 4.05.

Inspect crankcase, main bearings and thrust bearing as described in sub group 4.01.



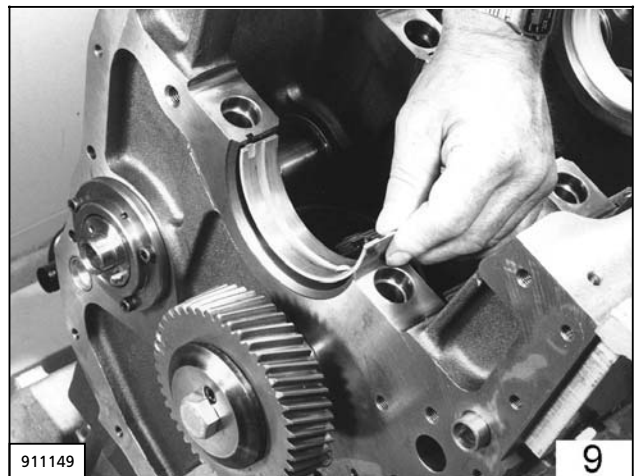
Crankshaft Installation:

Place main bearing half-shells into proper location in crankcase and lubricate bearing shells with engine oil.

Important:

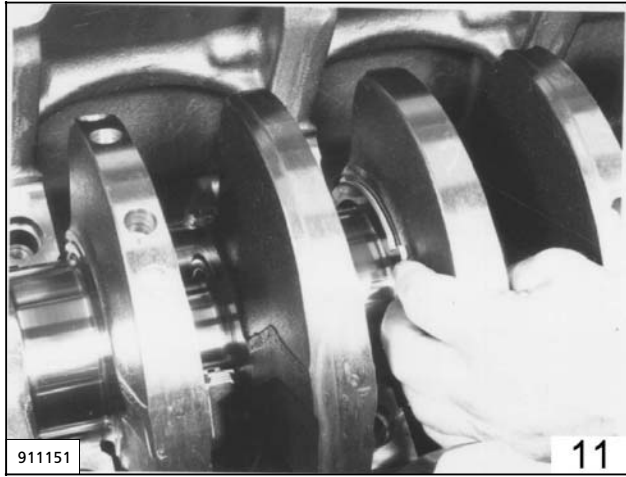
In case the old bearings are reused, install bearing shells in matched pairs and into their proper location as marked during disassembly.

Do not mix-up the individual bearing shells. The main bearing half-shells for the crankcase have one tang, while the main bearing half-shells for the bearing caps have two tangs.

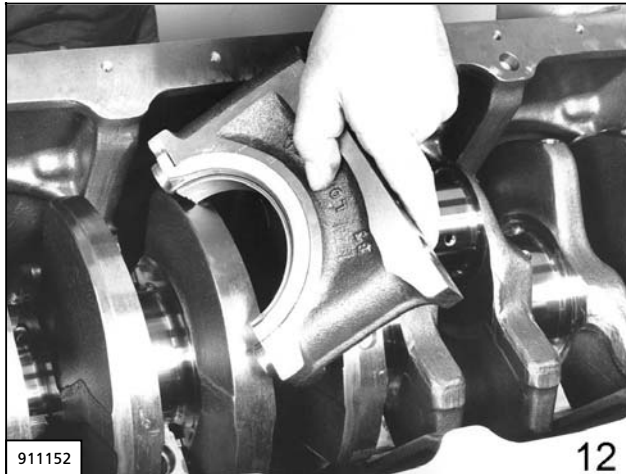


Lubricate main bearing journals and connecting rod pins on crankshaft with engine oil. Cautiously place crankshaft into crankcase bearings.



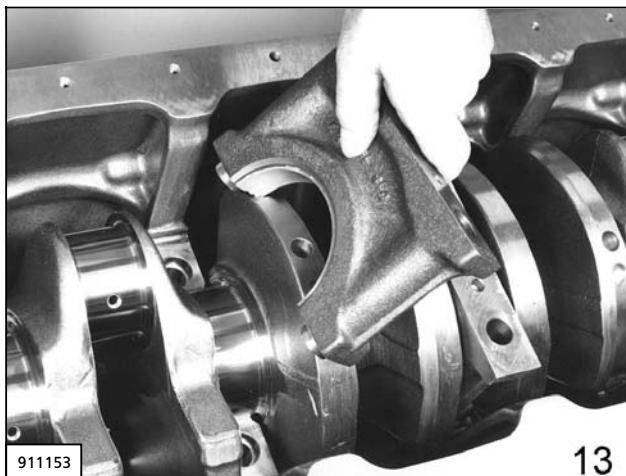


Place both thrust washers into thrust bearing mount in crankcase. Rotate thrust washers into their proper position.



Lubricate both remaining thrust washers with grease and place thrust washers on thrust bearing cap. Lubricate bearing shell with engine oil and place bearing cap with shell and thrust washers on thrust bearing mount in crankcase.

(Check for proper number identification!)



Place bearing shells in respective main bearing caps, lubricate bearing shells with engine oil and place bearing caps as identified in number sequence on respective main bearing mounts in crankcase.



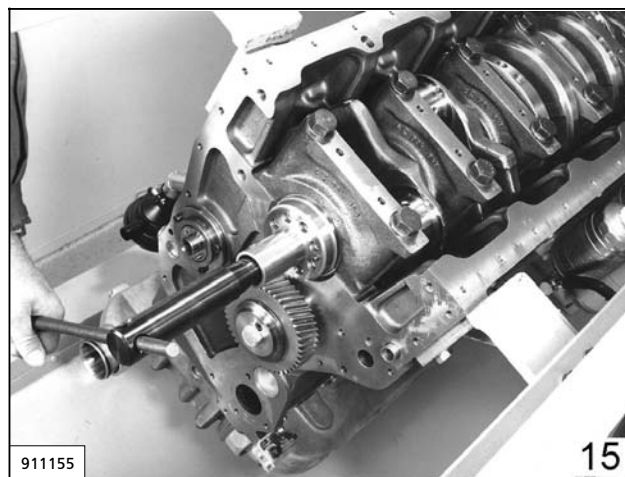
Screw in bearing cap mounting bolts and pretorque bolts with angle indicator, special tool no. 32.

See Engine Specification for proper pretorque.

Unscrew and remove both guide pins from crankshaft and rotate crankshaft with turning tool in both directions to check crankshaft for free movement.

Important:

Turn crankshaft cautiously in order not to damage the connecting rod pins on the crankshaft due to contact with any of the connecting rods.



Place connecting rods, one after the other, against respective rod pin on crankshaft, lubricate matching bearing cap shell with engine oil and line-up bearing cap with connecting rod. Screw in bearing cap mounting bolts and pretorque bolts slightly. Rotate crankshaft with turning tool as required to install next connecting rod.

Important:

Ensure that the bearing shell tangs are resting properly in the connecting rod bearing support and the bearing cap grooves. Line-up bearing cap and connecting rod with its markings matching. See also sub group 3.18 and main group 1.00 for numbering sequence.

Measure bearing cap mounting bolt length, compare measurement with dimensions given in Engine Specifications. Stretched mounting bolts must be replaced.

See also sub group 3.18.



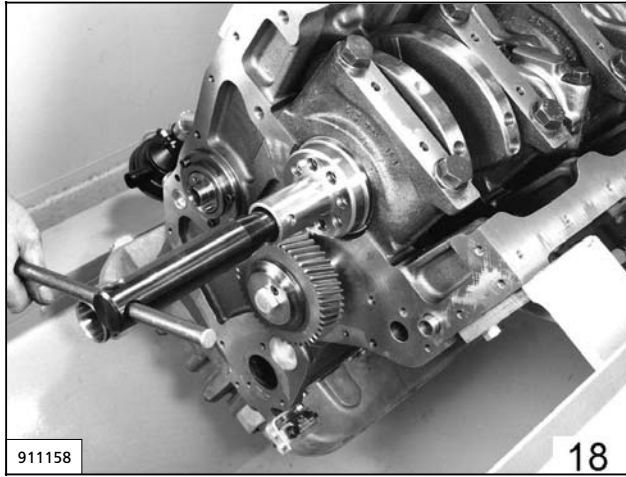
Pretighten screws with torque angle indicator, special tool no. 32.

Tightening torque, see Technical Data.

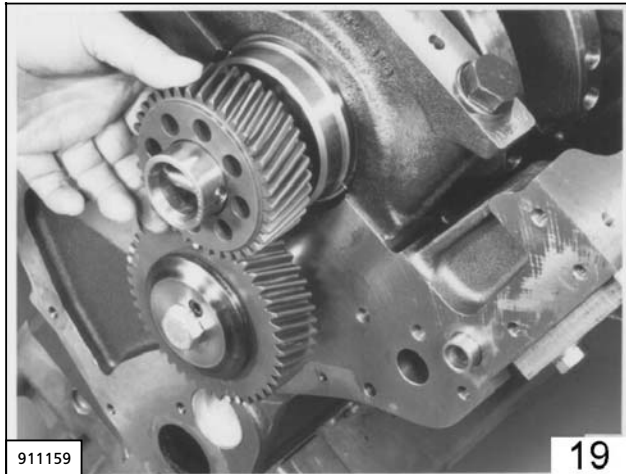
Note:

To tighten the screws, turn the crankshaft to the proper position on the rotating pin.





After tightening the screws, turn the crankshaft with the rotating pin to check for free movement.

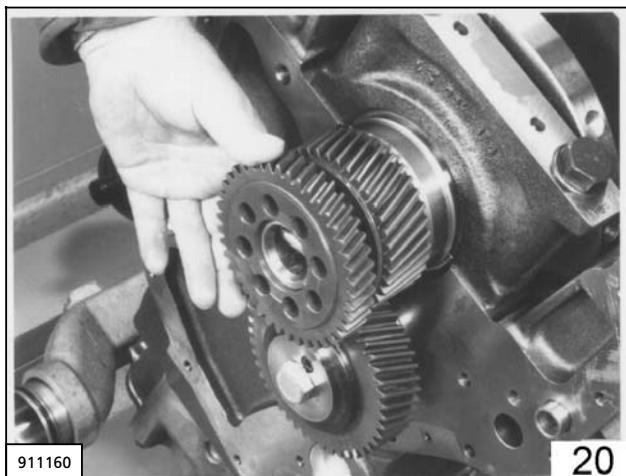


Push the crankshaft gear on the pin on the crankshaft and push it into the intermediate gear. Note the markings!

Note:

The crankshaft gear is marked on one tooth. The intermediate gear is marked with a KW (crankshaft).

See also sub group 9.25 and 9.26.



Push the lube oil pump drive gear onto the crankshaft. See fig. 20.

Install lube oil pump, lube oil lines, timing case, flywheel housing and injection valves.

See sub group 9.15.01 - Removal.

Camshaft and Push Rod Removal and Installation:

Removal:

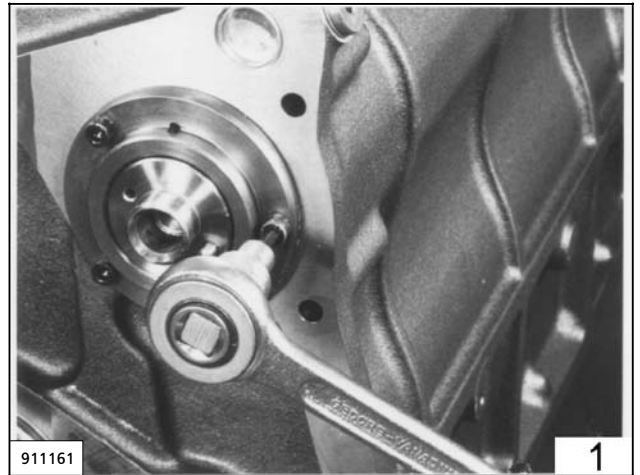
Removal timing case, see sub group 9.01, 9.02.

Remove rocker arm mount and push rods, see sub group 3.01.

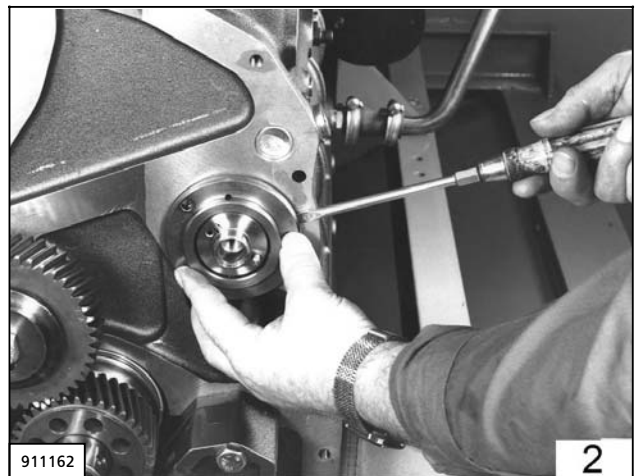
Note:

In order not to have to remove the crankshaft when installing and removing the camshaft, fashion two hooks approx. 500 mm long with 5 - 6 mm diameter to use as a tool.

Loosen the screws on the camshaft thrust ring and remove.



Push thrust ring from crankshaft housing and from camshaft.

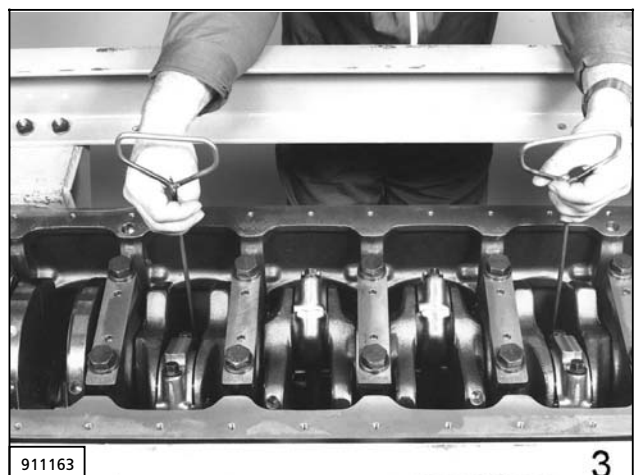


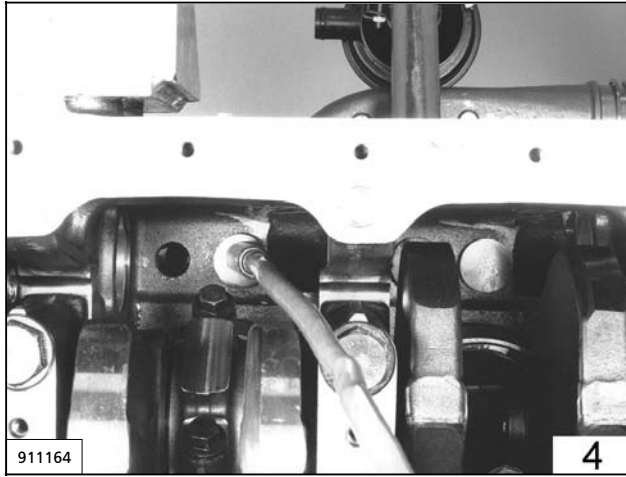
Hold up the camshaft in the crankshaft housing with the two hooks and pull it out carefully, making sure not to damage the bearing points. Change hook position in between!

Clean the camshaft, check oil bore holes for obstructions.

Check camshaft and bearing, see sub group 4.10.

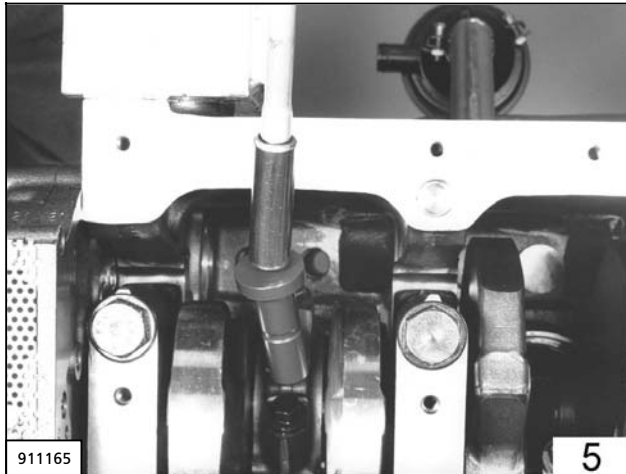
Replace camshaft bushings, see sub group 4.12.





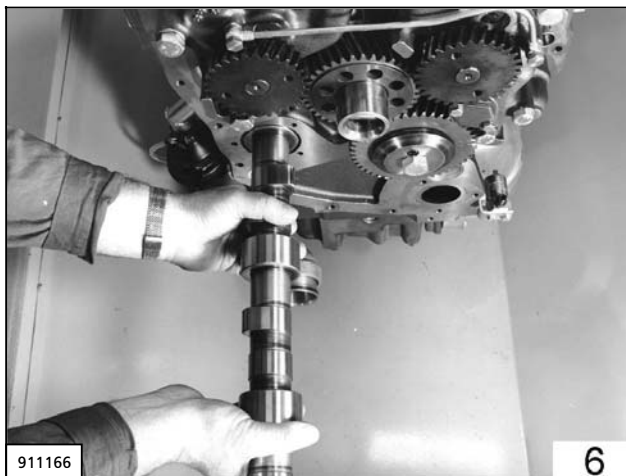
Remove plunger with magnetic rod from bores in the crankshaft housing.

Clean and check rod, see sub group 3.12.



Installation:

Lightly oil plunger and reinsert with magnetic rod into bores in crankshaft housing.



Lightly oil camshaft on bearing points and carefully insert into bearing, using the two hooks.

Be careful not to damage the shaft!



Push thrust ring onto camshaft and into crankshaft housing and tighten with screws.

Turn the camshaft to check for easy movement.

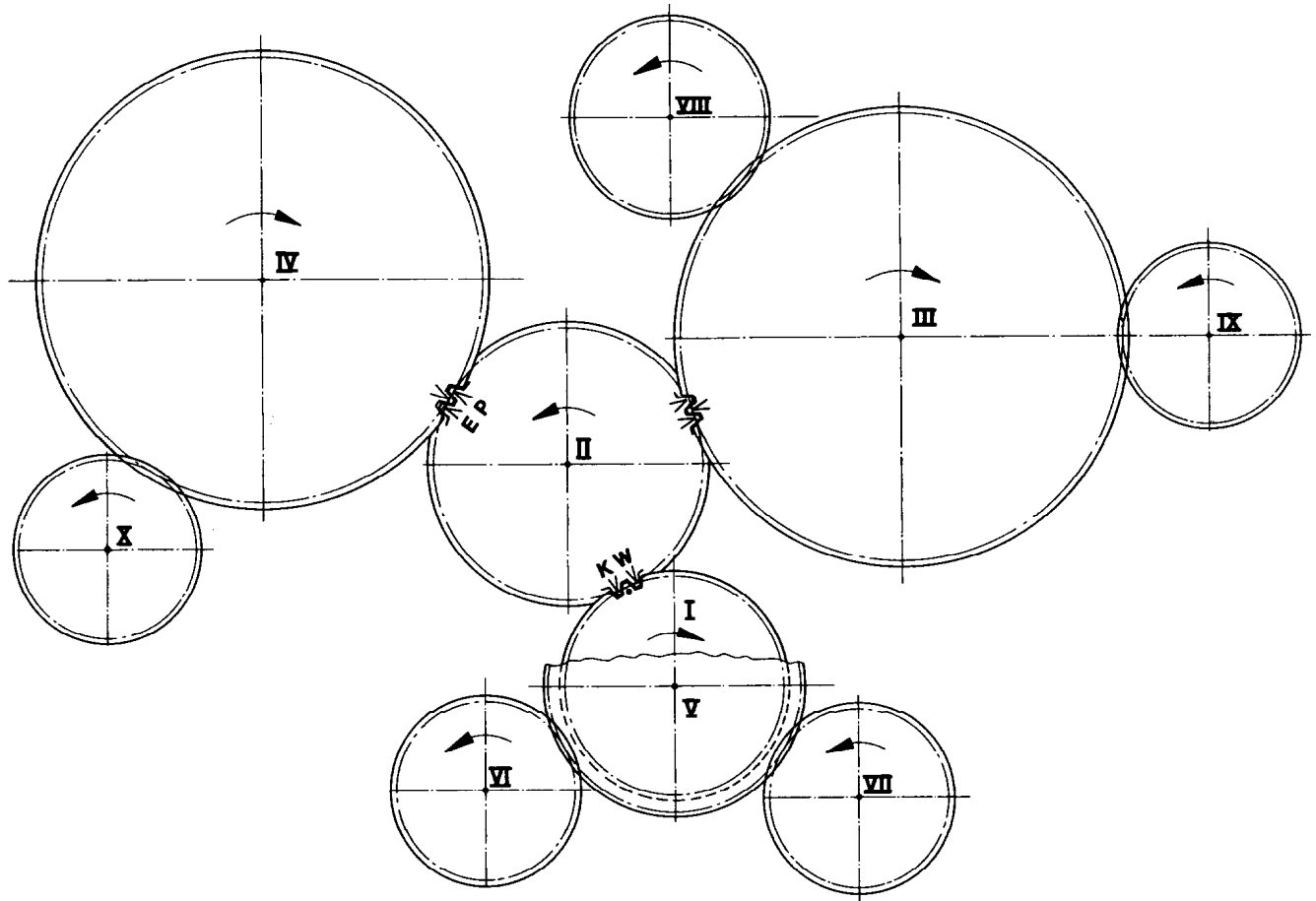
Install timing case, see sub group 9.01 and 9.02.

Install push rods and rocker lever mounts, see sub group 3.01.

Check valve play, see sub group 2.15.

Timing and Accessory Drive Gear Train

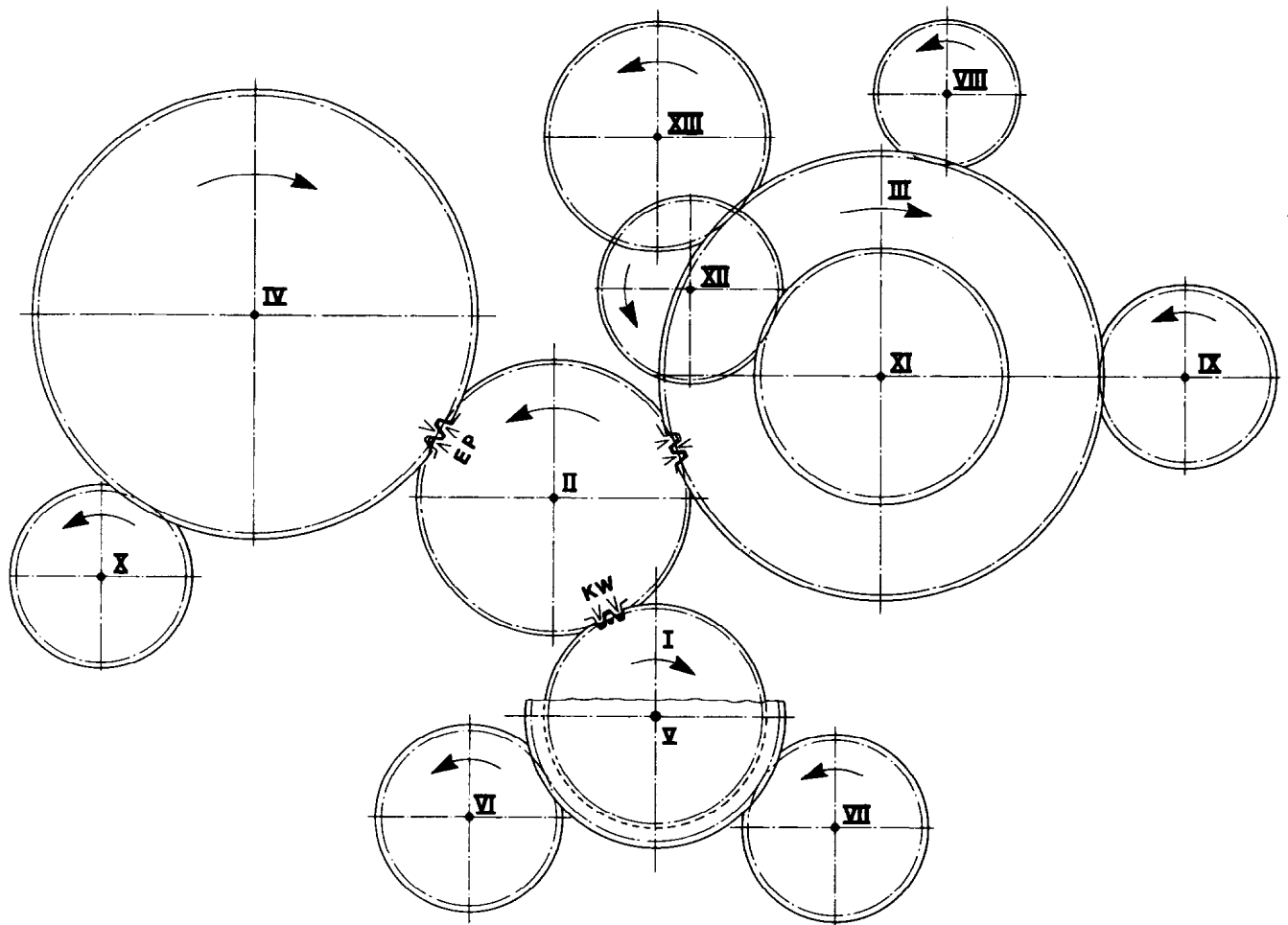
The direction of rotation of the individual gear wheels are seen by facing the engine from the front.



- I Crankshaft gear wheel
- II Intermediate gear wheel
- III Camshaft drive gear wheel
- IV Fuel injection pump drive gear wheel
- V Lubrication oil pump drive gear wheel
- VI Lubrication oil pressure pump drive gear wheel
- VII Lubrication oil suction pump drive gear wheel
- VIII Coolant pump drive gear wheel
- IX Air compressor drive gear wheel
- X Hydraulic pump drive gear wheel

Gear drive (coolant pump integrated in timing and accessory drive case)

Direction of rotation as seen from fan side to engine



- I Crankshaft gear
- II Intermediate gear
- III Camshaft gear
- IV Gear - Injection pump drive
- V Gear - Lube oil pump drive
- VI Gear - Lube oil pressure pump
- VII Gear - Lube oil suction pump
- VIII Gear - Coolant pump
- IX Gear - Air compressor
- X Gear - Hydraulic pump drive
- XI Gear for Fan drive on camshaft
- XII Gear - Fan drive
- XIII Gear - Fan drive

Note:

The fan drive can be different, depending on engine type.

Version A : Gear III and gear XIII

Version B : Gear XI and gear XII

Gears XI, XII and XIII can be a different size, depending on engine RPMs.

Coolant and oil plug resealing on crankshaft housing:

Use special tools no. 73, 75 and 77.

Note:

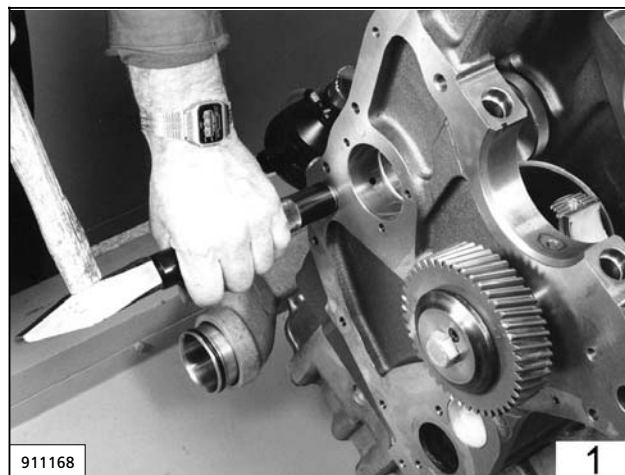
Replace plugs only if they leak.

On the engine block front behind the timing and accessory drive gear box, there are two lubrication oil bores, which are closed with 0.945 inch (24mm) diameter plugs.

Remove timing case, see sub group 9.01, 9.02.

Punch out freeze plug, install new plug using sealing compound (Loctite 648 or Omnifit 230 M).

Knock in place with punch, special tool no. 73.



On the right hand side of the engine block, viewed from the flywheel side, are two coolant bores, which are closed with 1.772 inch (45 mm) diameter plugs. The same size plug is used to cover the lower coolant bore in the rear engine block and next to the flywheel side and the bore to the valve drive cavity and the coolant bore on the engine block front behind the timing and accessory drive gear box.

(The timing case must be removed, see sub group 9.01, 9.02.



If the plugs on the coolant bores must be changed, drain the cooling system, see sub group 2.01.

If the side plugs on the coolant channels must be changed, remove the injection pump, see sub group 7.01, 7.02, 7.03.

Replace plugs as described next to fig. 1.

Use a punch to install plugs (special tool no. 75).



On the left-hand side of the engine block, viewed from the flywheel side, there are bores to the valve drive cavity closed up with plugs 2.48 inch (63 mm) in diameter.

If required, replace plugs as described next to fig. 1.

Use punch plate, special tool no. 77, to knock plugs into place.

Sub Group Index

10.01	Guidelines for serving turbocharged engines
10.02	Recommendations - Operation and Maintenance
10.03	Possible malfunctions on turbocharged Diesel engines without pressure sensing control valve
10.05	Schematic of turbocharged, 6 cylinder, 4 cycle Diesel engines
10.07	K2 Turbocharger, sectional and exploded view
10.11	Turbocharger, Removal and installation
10.15	Repair instructions, K1 / K2 turbocharger
10.16	Repair instructions, Schwitzer turbocharger
10.20	Injection pump with load pressure dependent full load stop (LDA)

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type
		D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
Datum/Edition/Date	Turbocharger	Blatt/Page/Feuille
01.99		10.00

TIPS ON TURBO ENGINES, FOR SERVICE PERSONNEL



Valid: 5900 008 2557 11.83 E
Replaces: 5900 900 0055 01.72 E

The output of the engine is determined by the mass of air and the burnt fuel quantity.
The turbocharger improves this output at unchanged swept volume by supplying more air to the engine.

The hot gases coming from the combustion chamber drive the rotor of the turbocharger via the turbine which is situated at one end of the shaft. The compressor wheel at the other end draws in fresh air and forces it into the combustion chamber. The greater the mass of air the more fuel can be burnt and the higher the output realized.

Main advantages of turbocharged engines, compared to naturally aspirated engines of the same output and otherwise identical conditions:

- better power-to-weight ratio
- smaller volume
- reduced specific fuel consumption
- considerably reduced power losses at high altitudes
- reduced noise level
- better torque

1. Matching the turbocharger to the engine

The turbocharger which are required to determine the engine data are selected by the engine manufacturer.

1.1 Matching the compressor

The compressor is rated according to the air which the turbocharged engine requires for the realization of the specified data.

1.2 Matching the turbine

Matching of the turbine is based upon the mass flow and drive power required for the compressor. The size of the turbine housing results from this data.

The turbocharger specification stipulated by the engine manufacturer may not be changed.

1.3 Boost pressure control

Due to the large speed ranges of passenger car engines, the boost pressure must be controlled, as certain pressure peaks are, apart from high torques at low and mean speeds, required in the rated power range. In the control range, a boost pressure control valve by-passes a part of the exhaust gas flow around the turbine. By selecting the spring constant and prestressing the spring, the commencement of by-passing and boost pressure control can be determined.

2. Fuel supply and ignition

The fuel supply and ignition units (ignition unit, carburetor unit, ignition point and commencement of supply) and the turbocharger are rated for the specific engine specification and determine the emission properties of the engine as well as output and exhaust gas temperature.

Changes of fuel supply and ignition are prohibited and may result in damage to the engine.

3. Control systems

Boost pressure control valve, boost pressure control switch and speed limiter monitor and control the systems. Changes may reduce the life of the engine.

4. Air filters

The air filter is suitable for the larger air quantity of the turbocharged engine. If a different filter is installed, this will reduce the intake resistances.

Only use air filters specified by the engine manufacturer.

5. Charge air coolers

The charge air cooler is an integral component of the charging system. It reduces the temperature of the air supplied to the engine.

Only use charge air coolers specified by the engine manufacturer.

6. Exhaust system

Also the exhaust system has been rated for the larger exhaust gas stream of the turbocharged engine. Changes resulting in a higher flow resistance reduce the turbine output and thus the engine performance. They also result in higher exhaust gas temperatures.

Do not carry out changes at the exhaust system.

7. Exhaust brake

Faulty functioning of the exhaust brake results in power loss and higher exhaust gas temperature, as the turbine output will be affected.

Perfect functioning of the throttle is imperative

8. Oil circuit

8.1 Oil supply

Lubrication of the turbocharger is provided by connection to the engine oil unit. Subsequent changes to the serially installed circuit may jeopardize the lubrication of the turbocharger and should therefore definitely be avoided.

Only use original seals and pipes.

8.2 Oil filter

The oil filter system has been adapted to the turbocharged engine by the engine manufacturer.

When changing filters, the specifications of the engine manufacturer must be maintained.

Only use original oil filters.

Turbochargers can only be repaired by specialized workshops authorized to do so, as special tools and expert knowledge are required.

RECOMMENDATIONS FOR OPERATION AND MAINTENANCE



Valid: 5900 008 2556 03.84 E
Replaced: 5900 008 2527 03.79 E

The Engine Manufacturer's recommendations for Operation and Maintenance shall be authoritative for the operation of Turbocharged Engines. Special attention should be paid to:

1. Operation Recommendations

- When the engine is started a full load should not be put on right away. We recommend that after the engine has been left to idle for a short time, it is then warmed up at medium speeds and with a medium load.
- After the engine has been operating at full load for a longer period of time, we recommend a short idling time before switching off, in order to avoid heat accumulating.

2. Maintenance Recommendations

- Turbochargers and boost pressure control valves do not require any maintenance.
- Engine oil has to be changed regularly in accordance with the Engine Manufacturer's Instructions.
- Maintenance work has to be carried out regularly on the oil filter and air filter systems, in accordance with the Engine Manufacturer's Instructions.
- Checks have to be made on the oil, air and exhaust piping, as well as, on all other connections and seals, to ensure that they are still tight and no damage has occurred.
- When carrying out maintenance work on the engine (e.g. adjusting valves), in most cases the piping leading from or to the turbocharger must be removed. Close the piping openings on the turbocharger. Before fitting, clean the piping carefully.
- When fitting the turbocharger to the engine, fill the bearing housing with clean oil and before fitting make absolutely sure that all piping connected to the turbocharger is cleaned carefully.

If this advice is followed a turbocharged engine has, from the experiences which we have had, the same lifespan as a naturally aspirated engine.

POSSIBLE DISTURBANCES IN TURBOCHARGED DIESEL ENGINES WITHOUT BOOST PRESSURE CONTROL VALVES



Valid: 5900 008 2553 01.84 E
 Replacing: 5900 900 0057 05.72 E

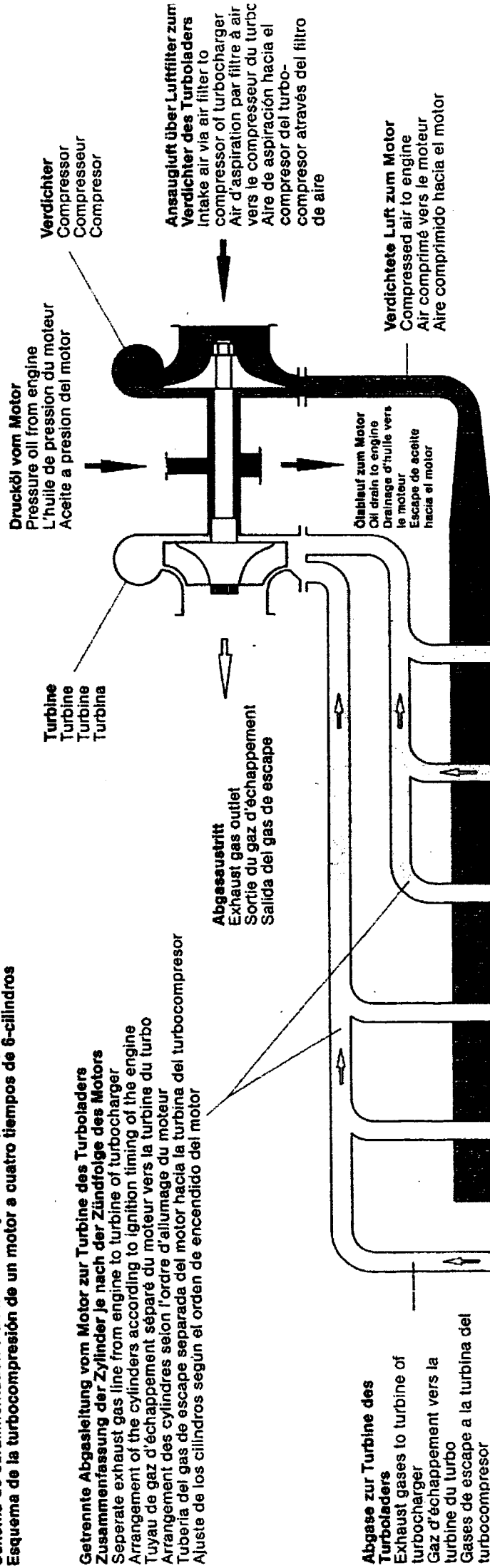
Type of disturbance	Possible cause	Remedy
1. Lack of power boost pressure too low	1.0 Air filter system dirty. Suction and pressure pipes deformed and/or leaking	Examine filter system, service or replace filter if required. Check and repair or replace pipes, tighten untight joints
	1.1 Too high flow resistance in the exhaust gas system and/or leakages upstream of turbine	Check exhaust brake, pipes, gaskets and silencers, carry out repairs required
	1.2 Injection unit and/or fuel system defective	Check setting values and function, correct if required
	1.3 Compression too low	Check valves, cylinders and pistons, service or replace defective parts if required
	1.4 Charge air cooler dirty	Clean unit and replace if necessary
	1.5 Turbocharger defective, wheels rubbing on housing walls	Examine turbocharger, repair or replace if necessary
2. Power and/or boost pressure too high	2.0 Injection unit defective	Check setting values and function and correct if required
3. Black exhaust smoke	See points 1.0, 1.3, 1.4, 1.5, 2.0	
4. Blue exhaust smoke	4.0 Worn valve guides and/or piston rings	Measure blow-by volume at crankcase outlet, overhaul engine if required
	4.1 Compressor-side and/or turbine-side sealing in the turbocharger defective	Examine turbocharger, repair or replace it as required
	4.2 Turbocharger oil drain pipe clogged and/or deformed	Clean oil drain pipe, repair if necessary
	4.3 See 1.0	
5. Oil leakage at turbocharger	5.0 Oil feed pipe and/or oil drain pipe loose and leaking	Clean turbocharger, check for leakages and rectify
	5.1 Leakage at connection between compressor and bearing housings	Repair or replace turbocharger

SCHEMA DER TURBOAUFLADUNG EINES 6-ZYLINDER-VIERTAKTMOTORS



Turbocharging scheme of a 6-cylinder four stroke engine
Schéma de suralimentation d'un moteur 6-cylindres à quatre temps
Esquema de la turbocompresión de un motor a cuatro tiempos de 6-cilindros

Getrennte Abgasleitung vom Motor zur Turbine des Turboladers
Zusammenfassung der Zylinder je nach der Zündfolge des Motors
Separate exhaust gas line from engine to turbine of turbocharger
Arrangement of the cylinders according to ignition timing of the engine
Tuyau de gaz d'échappement séparé du moteur vers la turbine du turbo
Arrangement des cylindres selon l'ordre d'allumage du moteur
Tubería del gas de escape separada del motor hacia la turbina del turbocompresor
Ajuste de los cilindros según el orden de encendido del motor

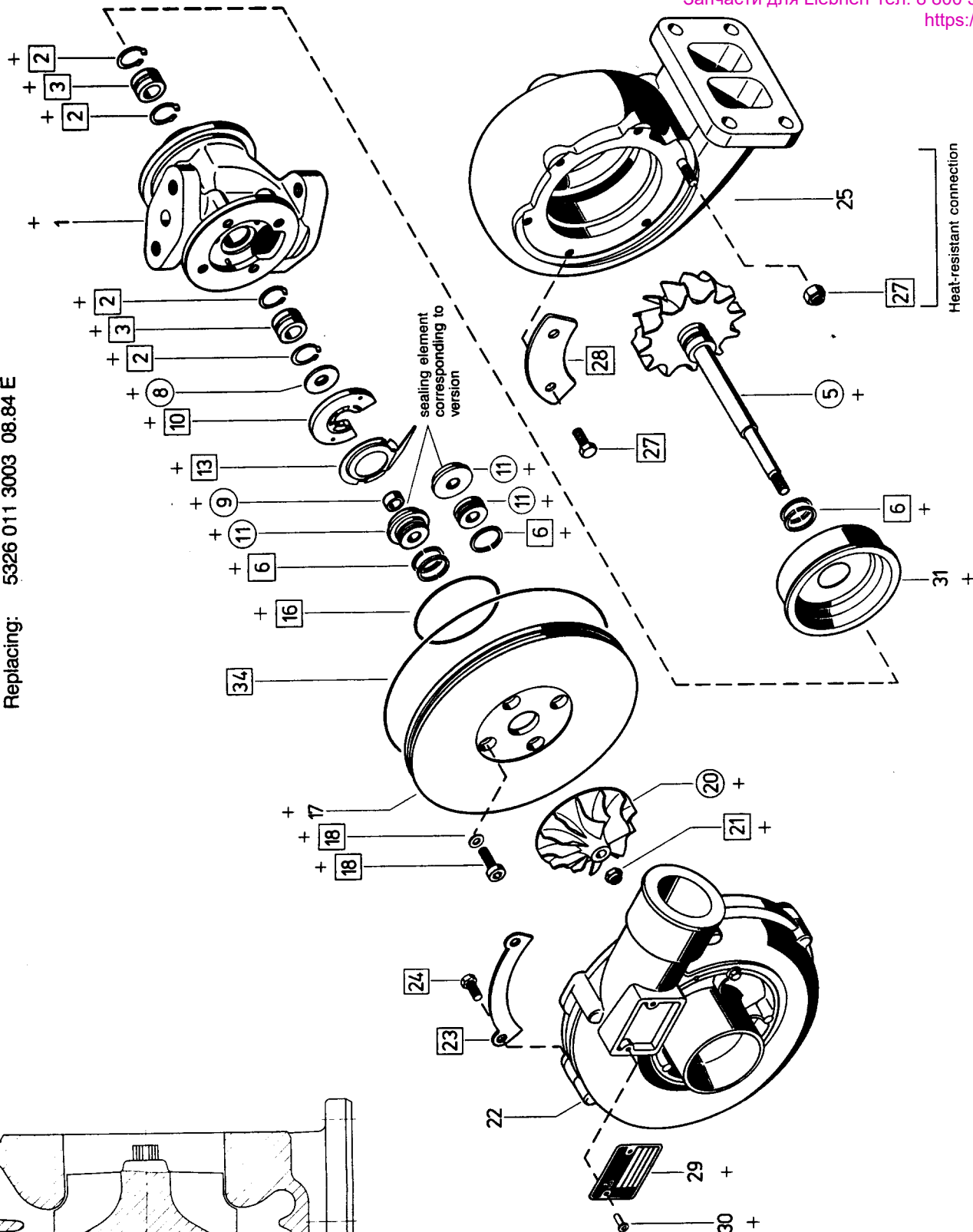
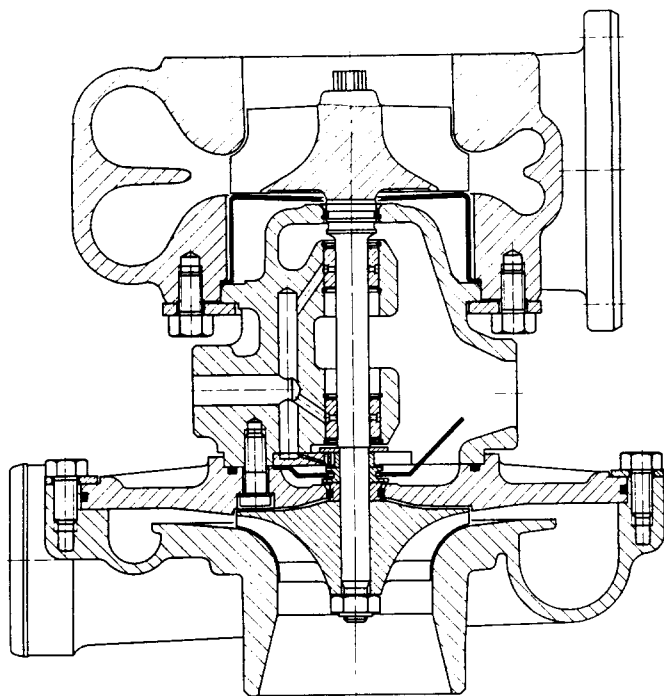


SERIES K2

Turbine housing twin-flow



Valid: 5326 011 3003 04.87 E
Replacing: 5326 011 3003 08.84 E



Pos. Description of parts

- 1 Bearing housing
- 2 Snap ring
- 3 Bearing bush
- 5 Shaft & Turbine wheel assy.
- 6 Piston rings
- 8 Thrust ring
- 9 Spacer sleeve
- 10 Thrust bearing
- 11 Flinger sleeve
- 13 Oil deflector ring
- 16 O-Ring
- 17 Backplate
- 18 Bolt, cyl.
- 18 Washer
- 20 Compressor wheel
- 21 Shaft nut
- 22 Compressor housing
- 23 Clamp plate/compressor side
- 24 Bolt, hex.
- 25 Turbine housing
- 27 Bolt, hex.
- 27 Nut, hex.
- 28 Clamp plate/turbine side
- 29 Nameplate
- 30 Blind rivet
- 31 Heat shield
- 34 O-Ring

Overhaul kit
Core assembly
Rotor assembly

□ + ○

Turbocharger removal and installation

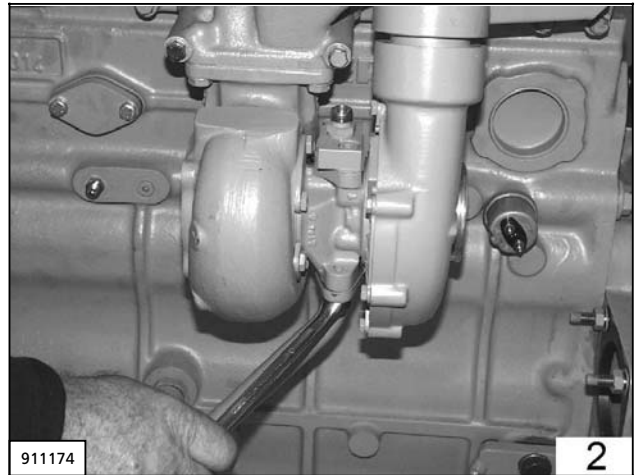
Removal:

Remove intake and exhaust lines or hoses from the turbocharger.

Remove oil supply line.



Remove oil return line.



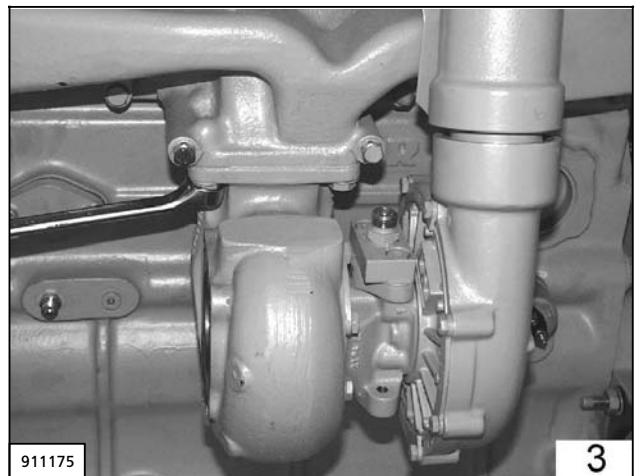
Remove mounting screws on exhaust manifold.

Remove turbocharger.

Note:

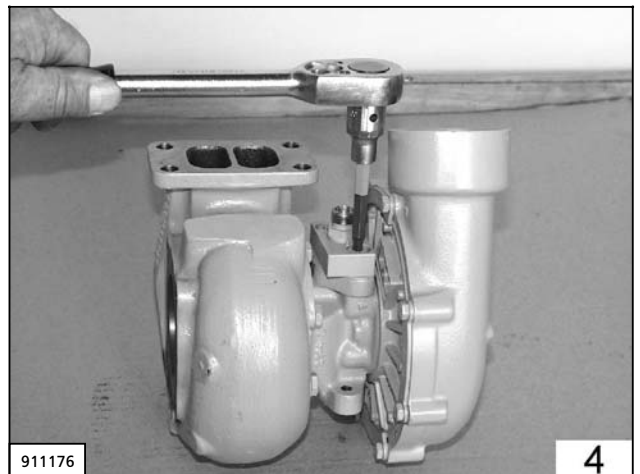
If equipped with an air supply line to the engine or an intercooler connection to the turbo charger, install new O-rings to the connector .

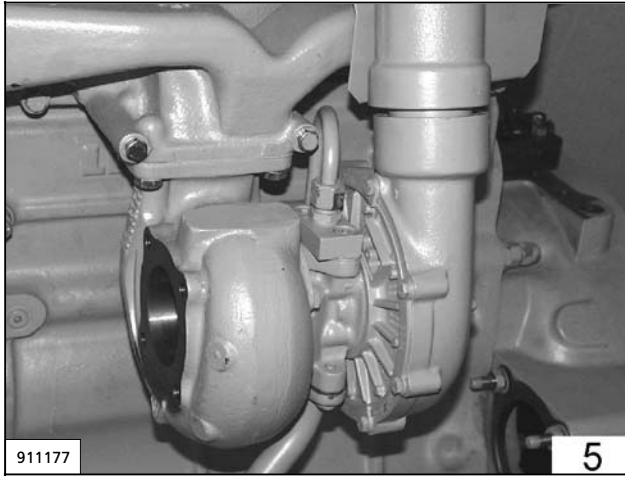
For installation with rubber sleeve, loosen the hose clamps and push the rubber sleeve back.



Remove the sealing flange for the oil supply line to the turbocharger.

Clean all parts.





Installation:

Install the sealing flange for the oil supply line with new seal to the turbocharger.

Push the turbocharger into the connector of the air supply line and attach with a new seal to exhaust manifold. Install new mounting screws and tighten.

Install oil supply and oil return line.

Important:

Before installing the oil supply line, fill the turbocharger with clean engine oil.

For installations with rubber sleeve, attach the rubber sleeve and tighten the hose clamps.

Install intake hoses or lines and exhaust pipes to the turbocharger.

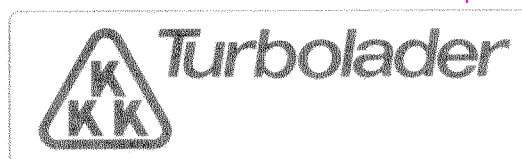
Note:

Always replace old or brittle rubber sleeves, check intake and exhaust hoses / pipes for cracks.

REPAIR INSTRUCTIONS

SERIES K1/K2

uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

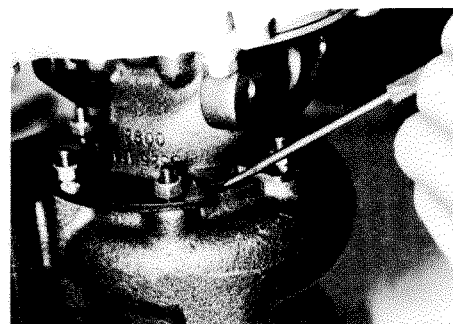
DO NO REPAIRS WITHOUT HAVING AN ORIGINAL SET OF KKB SPARES!

The numbers in brackets are the item nos. of the parts concerned. (See: Turbocharger parts description and sectional illustrations).

1. DISMANTLING

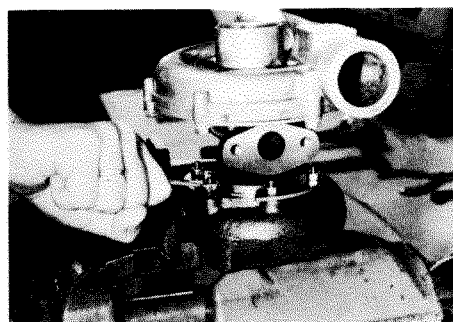
1.1 Turbine housing (25) and compressor housing (22).

- Mark the position of the housing with respect to the bearing housing (1) and backplate (17). **Illustration 1.1.1**



1.1.1

- Using a vice, clamp the turbine housing (25) at the gas inlet flange. (Use vice jaw guards).
- Remove the fixings (23, 24, 27, 28) from the compressor housing (22) and turbine housing (25). **Illustration 1.1.2**
- Remove the turbine housing (25) (when tight, use rust remover or heat at the tight sections)
- Remove the compressor housing (22), when tight loosen, using rubber hammer.



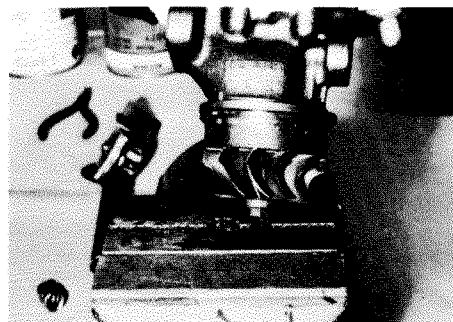
1.1.2

ATTENTION:

Danger of blade damage when tilted.

1.2 Compressor Wheel (20)

- Clamp the hub of the shaft and turbine wheel assy. (5) in the special vice jaw plates (See: Repair Tools). **Illustration 1.2.1**



1.2.1

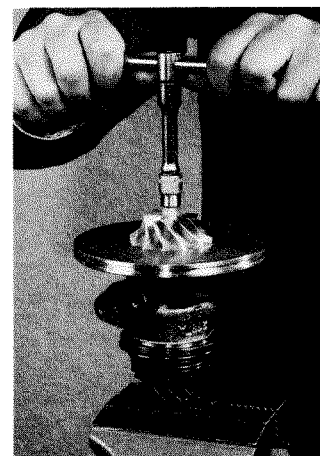
- Remove the shaft nut (21), using T spanner.
- When the shaft nut is jammed heat to a max. temperature of 130 °C, using hot air blower (See: Repair Tools; the threads of the shaft and turbine wheel assy. (5) must be protected from overheating during this process).

Illustration 1.2.2

ATTENTION:

Shaft nut (21) is secured with LOCTITE 640.

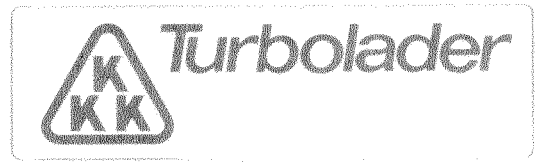
Take care to incur no bending effects on shaft during shaft nut removal.



1.2.2

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

- Heat compressor wheel (20) to a max. temp. of 130 ° C, using hot air blower (See: Repair Tools) (Protect the rotor threads from overheating), and carefully push out shaft and turbine wheel assy. (5), using a press (a vertical drilling machine).

Illustrations 1.2.3, 1.2.4

ATTENTION:
Fit heat shield (31) concentrically.

1.3 Bearing Housing (1)

- Carefully remove the shaft and turbine wheel assy. (5) from the bearing housing (1).
- Remove piston rings (6) from shaft and turbine wheel assy. (5).

Illustration 1.3.1

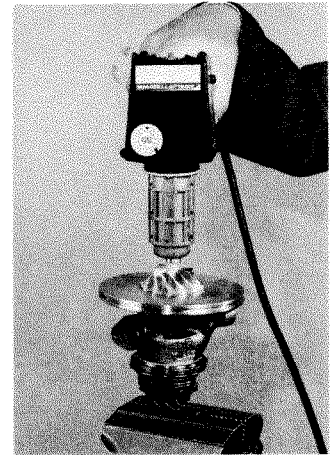
- Remove heat shield (31).
- Clamp bearing housing (1) in vice between the oil feed and return flanges.

REMARK: Use vice jaw guards.

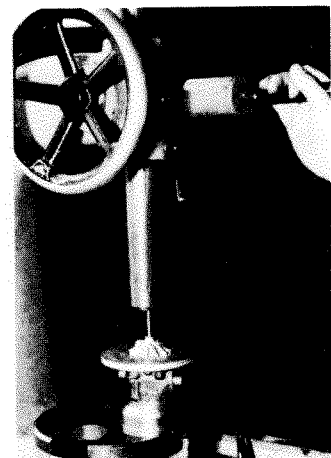
- Remove the fixing screws (18).

Illustration 1.3.2

ATTENTION:
Fixing screws (18) are secured with LOCTITE 640.



1.2.3



1.2.4



1.3.2



1.3.1

REPAIR INSTRUCTIONS

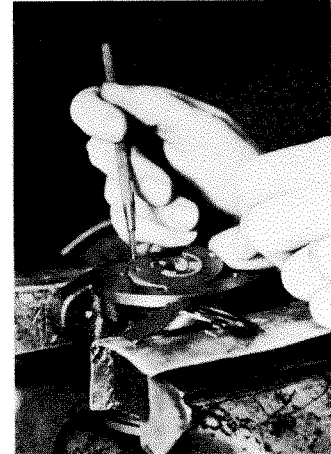
SERIES K1/K2 uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

- Remove backplate (17) from bearing housing (1).
- Press flinger sleeve (11) out of backplate (17).
- Remove O-rings (16, 34), from backplate.
- Remove piston rings (6) from flinger sleeve (11).
- Remove oil deflector ring (11), oil deflector (13) and thrust bearing (10) from bearing housing (1).

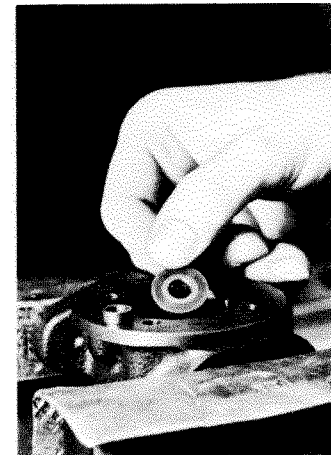
Illustration 1.3.3



1.3.3

- Remove spacer sleeve (9) and thrust ring (8) from bearing housing (1).

Illustration 1.3.4



1.3.4

- Remove snap rings (2) and bearings (3). (For snap ring pliers see: Repair Tools).

Illustrations 1.3.5, 1.3.6



1.3.6



1.3.5

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



Turbolader

Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

2. CLEANING AND INSPECTING OF THE PARTS.

2.1 Cleaning of the parts

- Carefully clean all parts: housings (1, 25), shaft and turbine wheel assy. (5), compressor wheel (20), backplate (17) and heat shield (31) must be wet sandblasted.
- Clean compressor housing (22) with kerosene or a similar agent.
- Threads of the shaft and turbine wheel assy: remove the LOCTITE residues!

ATTENTION:

The bearing holes and piston ring sealing surfaces of the bearing housing (1), the shaft of the shaft and turbine wheel assy. (5) and the piston ring sealing surface of the backplate (17), must be protected from the blasting medium.

2.2 Checking the parts

2.2.1 Visual check

- Examine housings (1, 22, 25), heat shield (31) and turbine and compressor wheels (5, 20) for cracks, any foreign matter and scratches. Inspect the oil feed holes in the bearing housing (1) for foreign matter. Inspect piston ring sealing surfaces and bearing areas for damage.
- Examine the turbine housing (25) for scaling.
- Examine the gas inlet and outlet flanges of the turbine housing (25) for distortion.
- Examine the turbine and compressor wheels (5, 20), for bent or broken blades and the shaft for scoring at the bearing seats.

LIMITS OF REUSAGE:

Wear parts which have excessive wear (see: permissible wear), as well as rotating parts with cracks must be replaced.

Turbine housing: Radial cracks up to 10 mm long are permissible in the vicinity of the tongue and the partitioning wall.

Illustrations 2.2.1.1, 2.2.1.2

Cracks which are fully through the material are not permissible.

Light scratching at the contour is permissible.

When scaling occurs at bridge of the gas inlet flange and contour, the part must be replaced.

When deformation occurs at the gas inlet and outlet flanges, such parts must be replaced.

Compressor housing

Check compressing housing (22) for scratching at contour and deformation.

REMARK: Scratching up to 0,2 mm is permissible.

Illustration 2.2.1.3

ATTENTION: Replace deformed compressor housings (22).

Shaft and turbine wheel assembly: Do not straighten any bent blades. When blades are bent, the shaft and turbine wheel assy. must be replaced. Turbine and compressor wheels resp., with rubbing traces and shaft and turbine wheel assy. with bearing areas with scoring are to be replaced.

2.2.2 Checking of dimensions

- Place the shaft and turbine wheel assy. (5), supported at the bearing points, in the twin V-blocks (See "Repair tools").
- Set the clock gauge feeler on the shaft, 5 mm from the compressor wheel end of the shaft.
- During measurement, press shaft firmly into V-blocks, distributing the pressure equally.
- When it is more than 0.008 mm out of truth, replace the shaft and turbine wheel assy. (5).

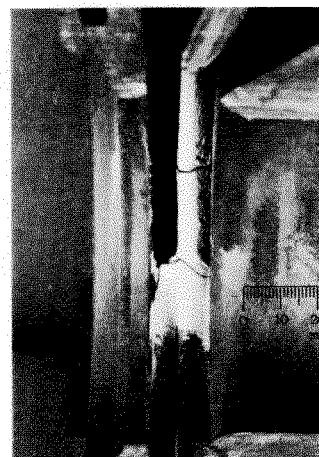
Illustration 2.2.2

2.3 Dynamic balancing check of rotor assy.

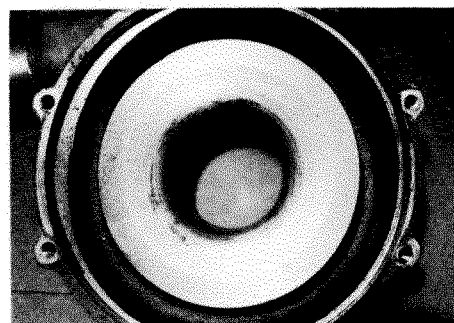
- When the rotating parts are be used again a dynamic balance check is necessary. Refer to the service information leaflet, code no: 7/03/007.



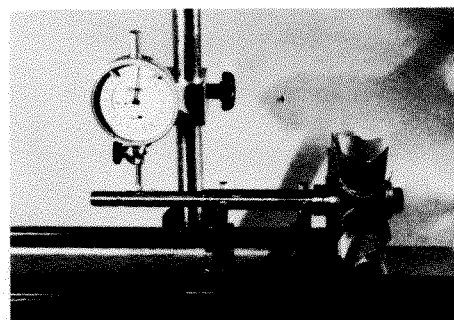
2.2.1.1



2.2.1.2



2.2.1.3



2.2.2

REPAIR INSTRUCTIONS

SERIES K1/K2

uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

3. ASSEMBLY

- ABSOLUTE CLEANLINESS IS NECESSARY
- The following bearing parts must be oiled before fitting:
 - Bearing seat of the shaft
 - Bearings (3)
 - Thrust bearing (10)
 - Flinger sleeve (11)
 - Oil deflector ring (11)
 - Thrust ring (8)
 - Piston rings (6)
 - Spacer sleeve (9)

3.1 Bearings (3)

- Fit bearings (3) and snap rings (2) in the bearing housing.

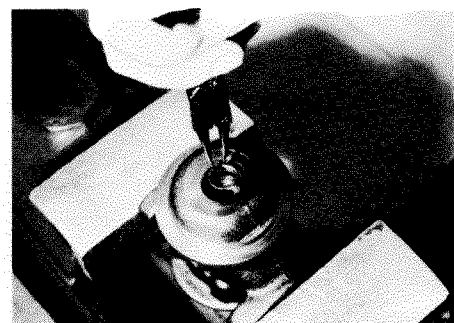
Illustrations 3.1.1–3.1.3

ATTENTION:

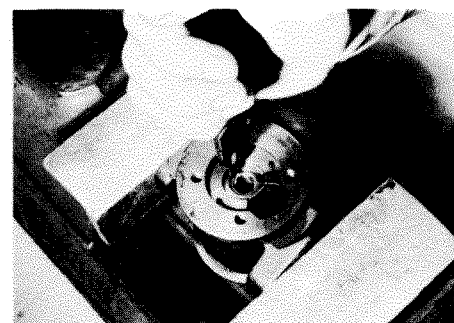
During installation of bearings, particular attention should be paid to cleanliness.



3.1.1



3.1.2



3.1.3

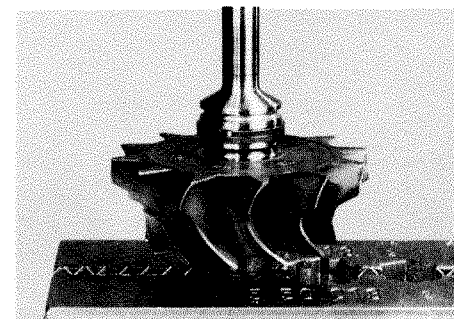
3.2 Bearing housing (1)

- Clamp shaft and turbine wheel assy. (5) in the vice jaw plates equipped with the six/twelve edged cutouts.
- Fit the one/two piston rings (6) to shaft and turbine wheel assy. (5). Attention must be paid to concentricity.
The piston ring slots must be positioned at 180 ° to another.

Illustration 3.2.1

ATTENTION:

The yellow colored piston ring (6) is to be fitted on the turbine side.



3.2.1

REPAIR INSTRUCTIONS

SERIES K1/K2

uncontrolled



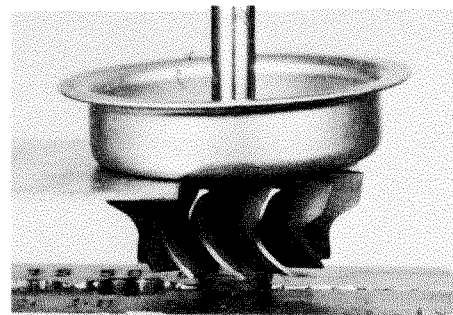
Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

- Place heat shield (31) concentrically on shaft and turbine wheel assy. (5).

For K1:

- Insert a strip of sheet metal 1 mm thick between heat shield and turbine wheel backside (to ensure that the piston ring is guided inside the bearing housing bore).

Illustration 3.2.2



3.2.2

- Guide bearing housing (1) carefully onto rotor shaft.

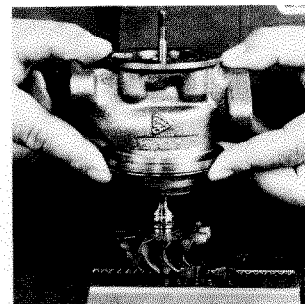
For K1:

- Install the oil inlet at 90° to the piston ring slot

Illustration 3.2.3

CHECK:

Piston rings (6) are properly seated, when heat shield (31) and bearing housing (1) turn freely.



3.2.3

- Guide thrust ring (8) and spacer sleeve (9) onto rotor shaft.

Illustration 3.2.4

- Place thrust bearing (10) in bearing housing (1).

Illustration 3.2.5

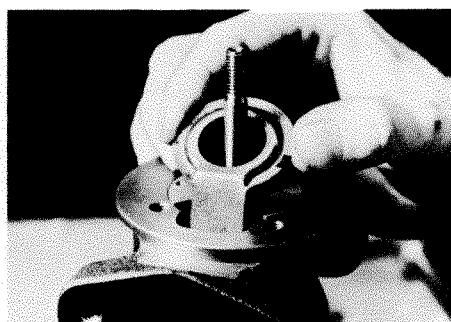
- Place a new oil deflector plate (13) on thrust bearing (10).

Illustration 3.2.6

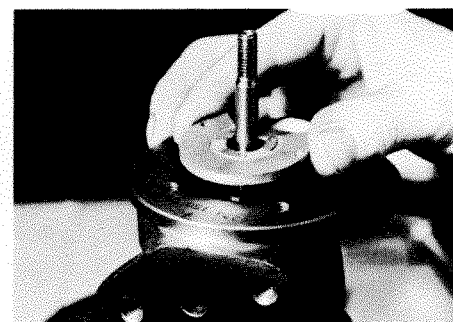
- Arrangement with oil deflector ring:
Guide the oil deflector ring (11) onto the rotor shaft with the large collar at the top.
- Fit one/two piston rings (6) onto flinger sleeve (11). Position piston ring slots at 180° to one another.



3.2.4



3.2.5



3.2.6

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

- Insert flinger sleeve (11) with chamfer in the direction of the back of the compressor wheel, complete with piston rings (6) into backplate (17). When necessary press piston rings together using screw driver.

Illustration 3.2.7

- In the case of a split flinger sleeve: insert flinger sleeve with smaller collar into backplate, pressing it in the direction of the thrust bearing.

ATTENTION for samples with 1 position ring:

When installing the flinger sleeve position the piston ring such that the piston ring joint is displaced by 90° to the oil feed/oil return when fitting the backplate.

- Sealing backplate (17) to bearing housing: Coat seating face of backplate (17) with LOCTITE 573.
- For constructions with O-ring seals, coat the O-ring (16) with acid-free grease, e.g. SKF ball bearing grease and place in groove provided.
- Place backplate (17) in the position marked on bearing housing.
- Fix backplate (17) to bearing housing (1), using the screws (18) and washers (18). The screws must be secured with LOCTITE 640.
- For tightening torques see: Data Sheet.

3.3 Compressor Wheel (20)

- Heat compressor wheel (20) to a max. temp. of 130 °C, using hot air blower (See: Repair Tools), or, in a warm/dry oven.
- Oil the compressor wheel seat of the shaft (e.g., with Shell Ensio 20 W 20).
- Push warm compressor wheel (20) onto shaft and turbine wheel assy. and, within 5 minutes, tighten a new shaft nut to tightening torque after preheating. After a total cooling time of min. 10 minutes bring up LOCTITE 640 (see mounting sketch), loosen the shaft nut (1 or 2 turns) and tighten to the specified torque and angle setting.

Illustration 3.3.1

- For tightening torques and angle settings see: Data Sheet.

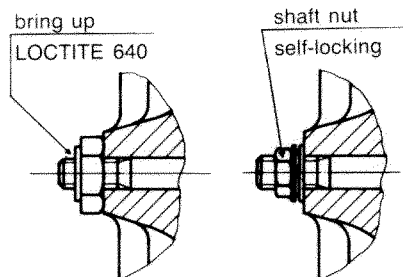
ATTENTION:

When tightening shaft nut take care that no bending effects occur at shaft.

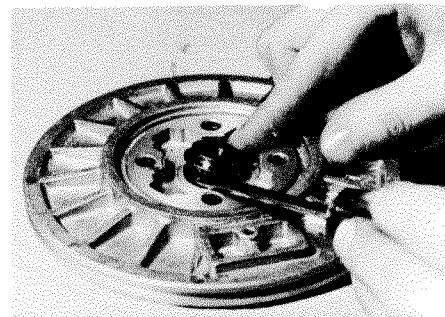
CHECK:

Piston ring (6) on turbine side is properly seated when heat shield (31) and bearing housing (1) turn freely after assembly of compressor wheel.

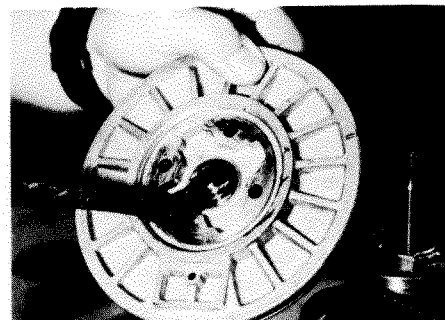
- Plug shaft nut and projecting threads of shaft with security paint.
- Measure the axial and radial plays (See: Determination of bearing play).



Mounting sketch of the shaft nut



3.2.7



3.2.8



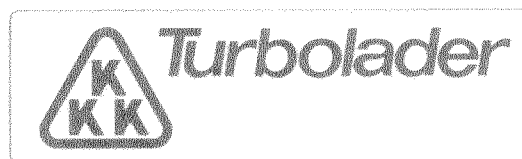
3.2.9



3.3.1

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

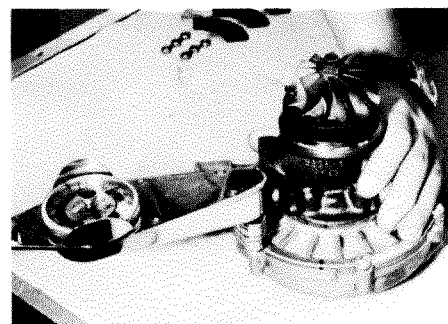
3.4 Compressor housing (22)

- Coat O-ring (34) with brake cylinder paste, e.g. ATE and place in groove in backplate (17).
- Fit compressor housing (22) to backplate (17) in the position marked, using corresponding fixing components (23, 24).

Illustration 3.4.1

- When a new housing is being used, refer to the application list for the flange positions.

For tightening torques, see: Data Sheet.



3.4.1

ATTENTION:
Avoid tilting when positioning housing (22).

3.5 Turbine housing (25).

Instal turbine housing (25) in the position marked, using corresponding fixing components (27, 28).

ATTENTION:
Avoid tilting when positioning housing (25).

- Coat fixing screws with heat resistant lubricating paste, e.g. NEVER SEEZ.
- When a new housing is being used, refer to the application list for the flange positions.
- For tightening torques, see: Data Sheet.

3.6 Nameplate (29) and plugs.

- For turbochargers which have been repaired the blue nameplate (29) must be replaced by a red one, which is fixed with rivets (30).

Illustration 3.6.1



3.6.1

REPAIR INSTRUCTIONS

SERIES K1/K2

uncontrolled



Valid: 5900 008 25 32 12.91 E
 Cancelled: 5900 008 25 32 07.89 E

4. REPAIR TOOLS.

4.1 Standard tools.

- Ring spanners — 10 mm & 13 mm AF
- Socket spanner — with T extension
10 mm, 12 mm, 14 mm AF
- Torque spanner, Range: 3—23 Nm
Sockets: 10 mm, 12 mm, 14 mm AF
Square-drive hexagon socket wrench $\frac{3}{8}$ ''
- Torque spanner MANOSKOP 8—32 Nm
- Snap ring pliers
KKK Order No: 1550 155; Points: 0,7 mm
- Screw driver, hammer, rubber hammer,
vice jaw guards.
- Dial gauge: Scale increment 0,01 mm
Corresponding to clock gauge DIN 878, A1
- Dial gauge: Precision indicator 0,001 mm
Corresponding to clock gauge DIN 879, B1-20

4.2 Special tools.

- Connecting piece, KKK No: 550 61 010
Insert M6, KKK No: 550 61 001
Insert M5, KKK No: 550 61 003
- Socket insert (open-ended) for the MANOSKOP
torque spanner 10 mm, 13 mm AF
KKK No: 550 76 002 (10 mm AF)
KKK No: 550 76 003 (13 mm AF)
- Hot air blower
e. g. Co. Leister: Leister Hot Air Tool
Type „Ghibli 2“
Order No: 08 L 130
- Transition piece with angle settings, $\frac{1}{2}$ '' drive.
- Vice jaw plates, Drg. No: 1550013
- Inspection device, Drg. No: 1582036
- Support tube
K14: Di = 54 mm, 100 mm long
K16: Di = 59 mm, 100 mm long
K24/K26: Di = 66 mm, 100 mm long
K27: Di = 84 mm, 100 mm long
K28: Di = 94 mm, 100 mm long
- Punch $\varnothing$ 5.2 mm (K1)
- Punch $\varnothing$ 6.8 mm (K2)

To loosen compressor and turbine housing
fixing screws.

To loosen shaft nut.

To tighten shaft nut and fixing screws.

To extract and fit bearing snap rings.

Auxiliary tools.

To check radial and axial play.

To check trueness of shaft and turbine
wheel assy.

To loosen and tighten fixings for back-
plate.

To tighten the fixing screws
on the turbine side.

To fit and remove compressor wheel.

To tighten shaft nut.

To clamp hub of shaft and turbine wheel
assy. during repair.

To check trueness of shaft and turbine
wheel assy.

To support the cartridge assy.
when compressor wheel seizes.

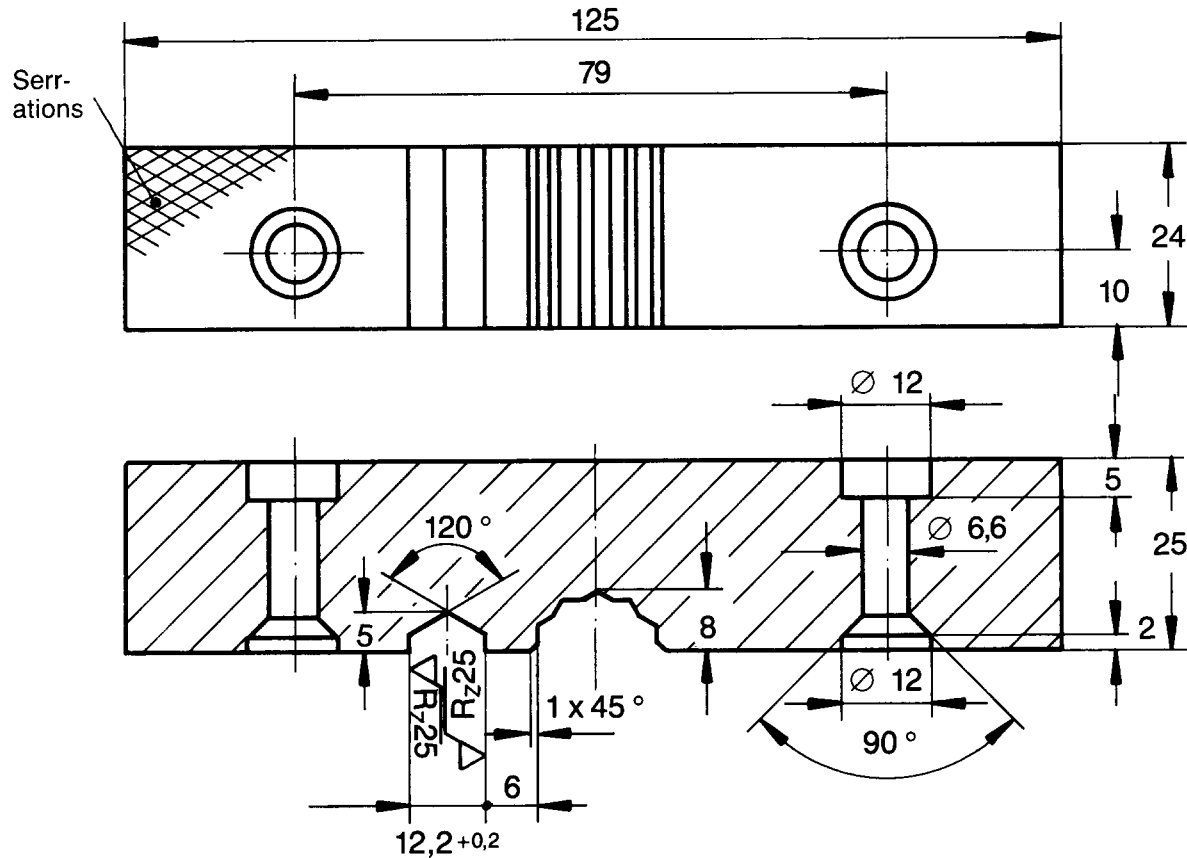
Used together with the supporting tube to
dismantle the shaft and turbine wheel
assy. when compressor wheel seizes.

REPAIR INSTRUCTIONS

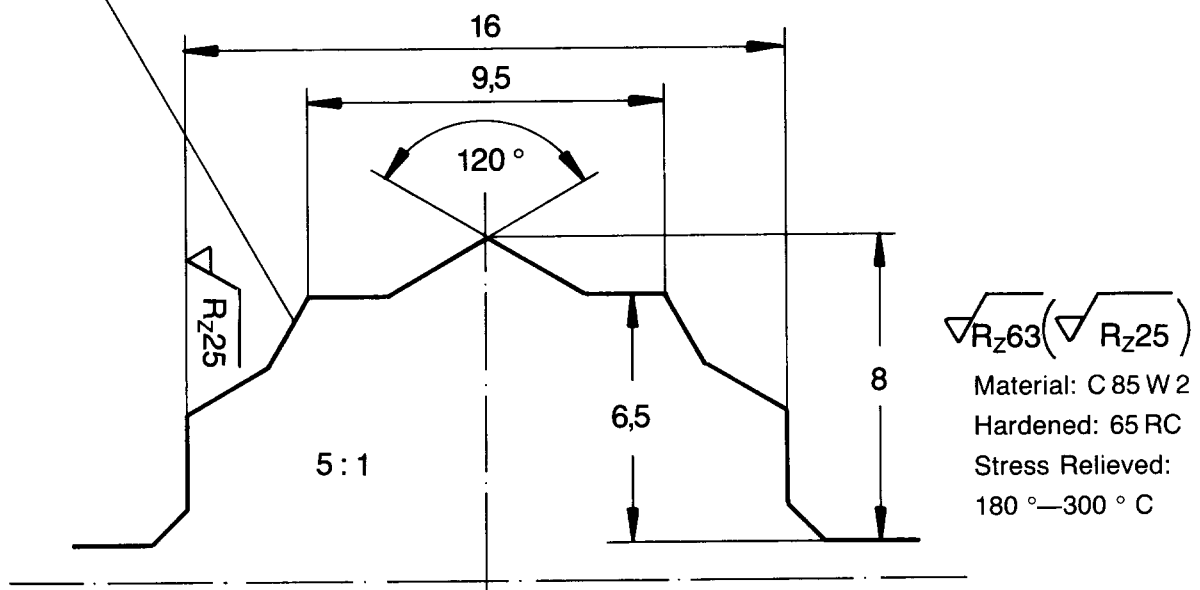
SERIES K1/K2 uncontrolled

Valid: 5900 008 25 32 12.91 E
 Cancelled: 5900 008 25 32 07.89 E

Vice Jaw Plates (15 500 13)



fitted to suit the rotor



REPAIR INSTRUCTIONS

SERIES K1/K2

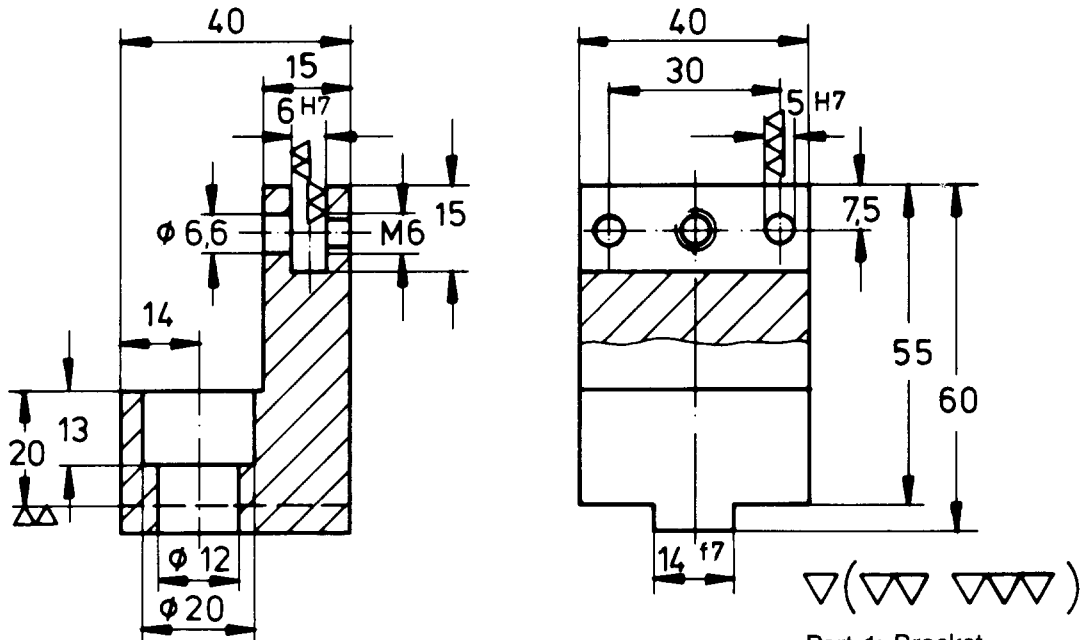
uncontrolled



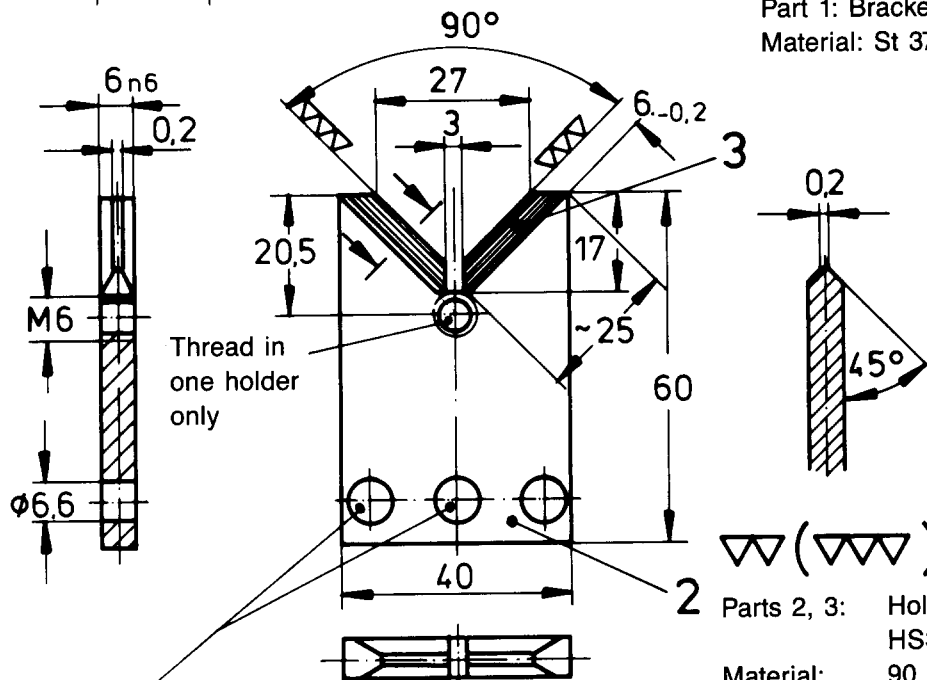
Valid: 5900 008 25 32 12.91 E

Cancelled: 5900 008 25 32 07.87 E

Inspection device for checking rotor truth (1582036)



Part 1: Bracket
Material: St 37



Parts 2, 3: Holder with soldered
HSS-Prisms
Material: 90 Mn V8
Hardened: 60 RC
Stress relieved: 265 ° C

Holes to suit part 1
part 2 hard soldered to part 3

REPAIR INSTRUCTIONS

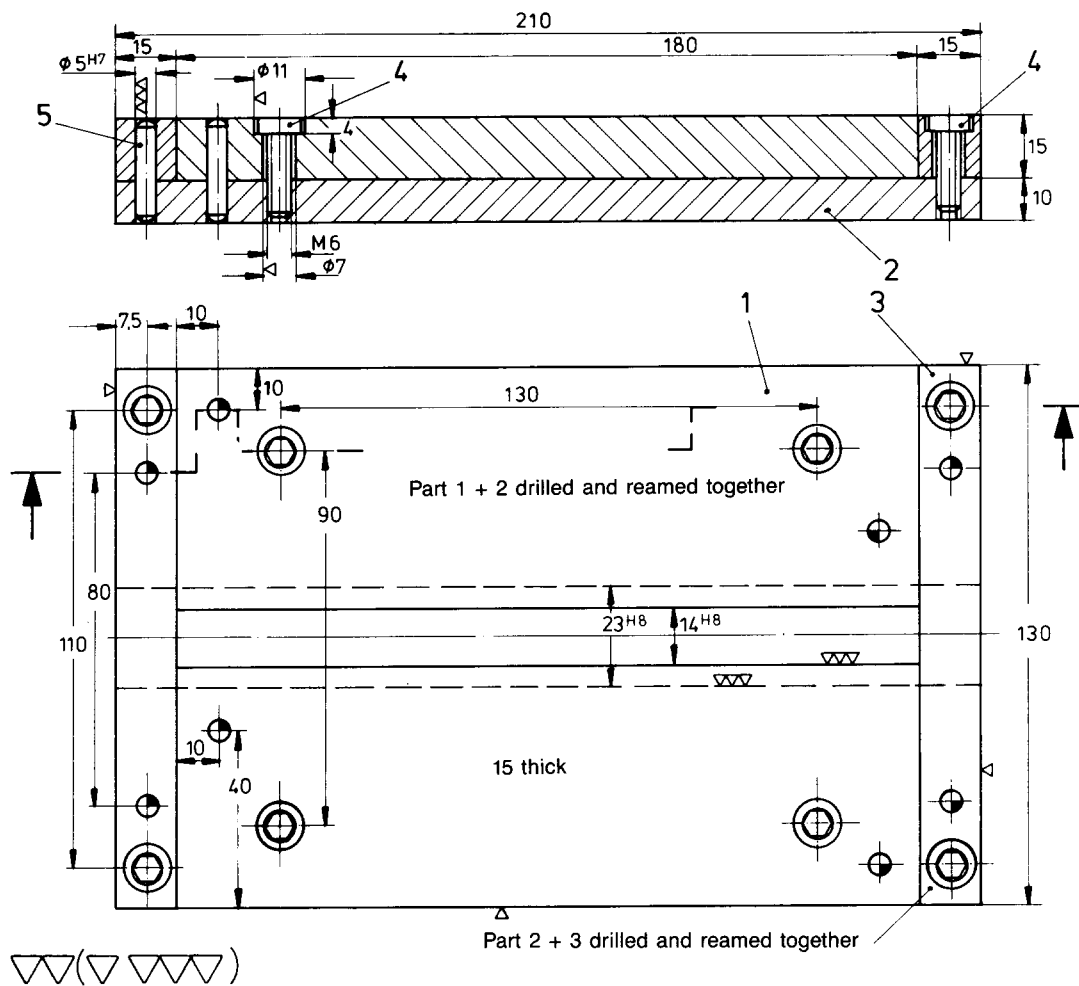
SERIES K1/K2

uncontrolled



Valid: 5900 008 25 32 01.92 E
 Cancelled: 5900 008 25 32 07.89 E

Inspection device for checking rotor truth (1582036)



Pos.	Piece	Description	Material	Dimension	DIN
1	2	flat steel	St-50K	180 x 60 x 15	17 100
2	2	flat steel	St-50K	210 x 60 x 10	17 100
3	2	flat steel	St-50K	130 x 15 x 15	17 100
4	10	socket head screw	10.9	M6 x 18	7 984
5	8	cylindrical stud	St-50K	5m6 x 20	7
6	2	T-tongue	St-50K	14	508
7	2	socket head screw	10.9	M12 x 25	912
8	4	cylindrical pin	St-50K	5m6 x 15	7

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



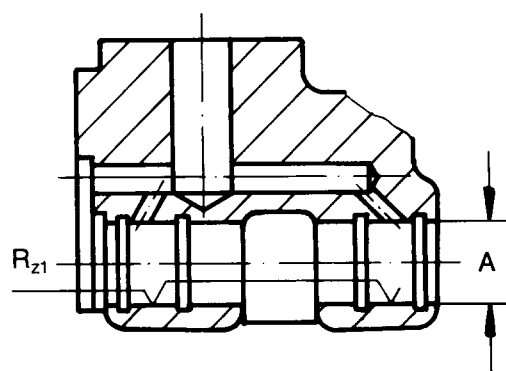
Turbolader

Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

Admissible Wear Dimensions

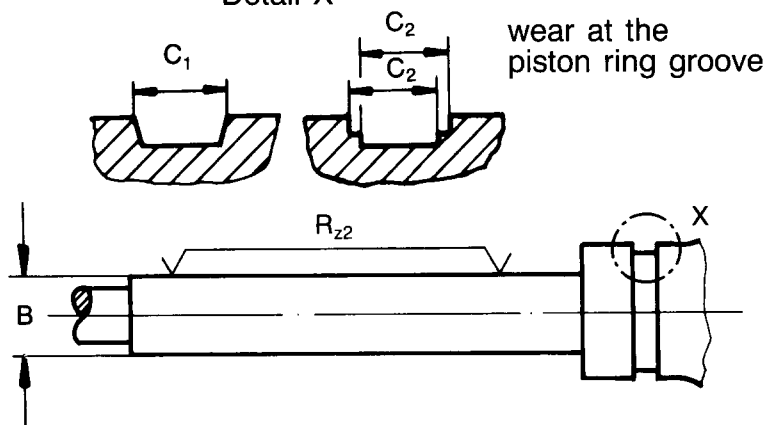
**piston rings and
bearing bushes must
always be replaced**

bearing housing



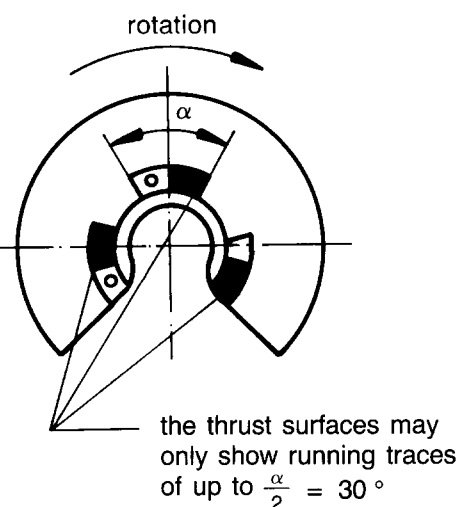
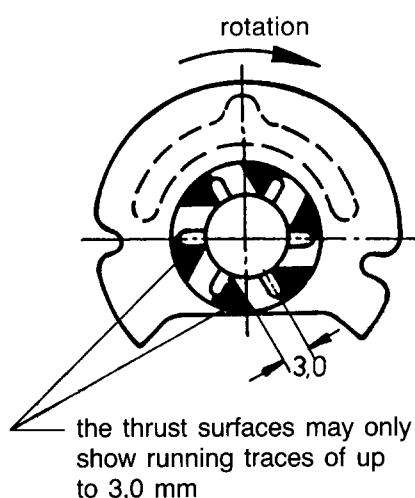
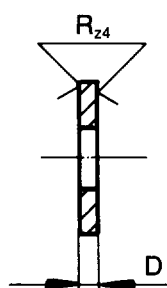
shaft and turbine wheel assy

Detail X



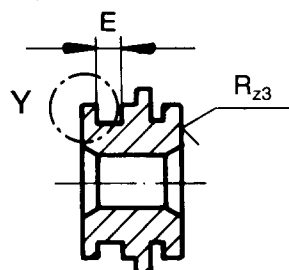
thrust bearing

thrust ring

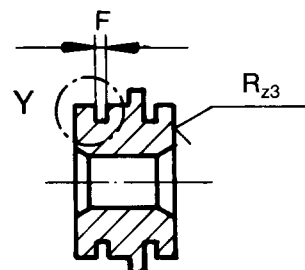


flinger sleeve

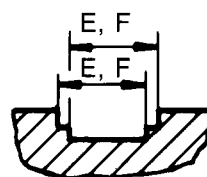
2 piston rings



1 piston ring



Detail Y



wear at the
piston ring
groove

dimensions A to F in mm
 R_{z1} to R_{z4} in μm .

Series	A	B	C ₁	C ₂	D	E	F	R _{z1}	R _{z2}	R _{z3}	R _{z4}				
K 1 / K 2	13,091	8,469	1,49	1,54	1,47	—	1,54	4	1,6	4	4				
K 2	16,064	9,95	2,89	2,94	1,47	2,94	1,54	4	1,6	4	4				

REPAIR INSTRUCTIONS

SERIES K1/K2

uncontrolled



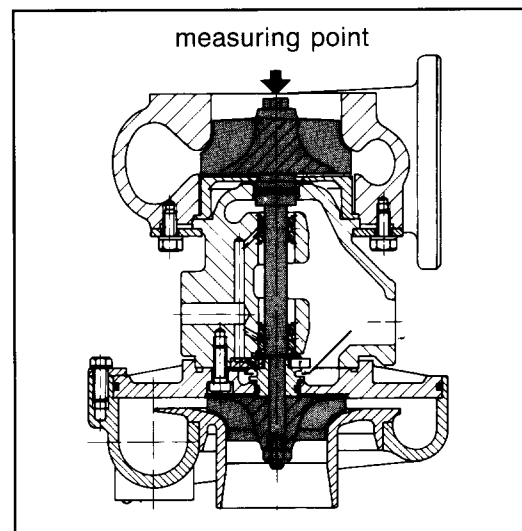
Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

Determination of Bearing Play

1. Measuring the axial play

- Place measuring point of clock gauge on top face of turbine wheel hub.

Illustration 1.1



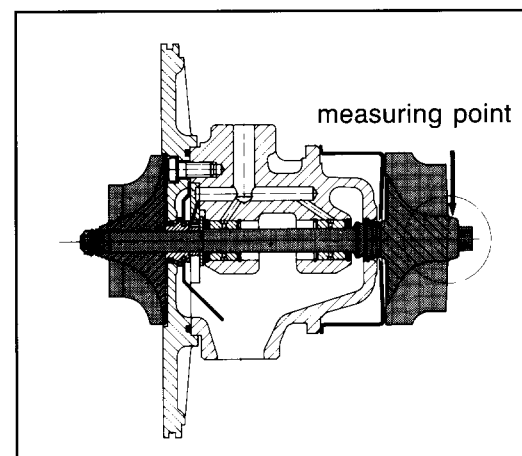
1.1

- Press down shaft and turbine wheel assy. and set the clock gauge at "O".
- Press shaft and turbine wheel assy. against clock gauge and note indicator "throw".
- The permissible axial plays can be seen in the data sheet.

2. Measuring the radial play

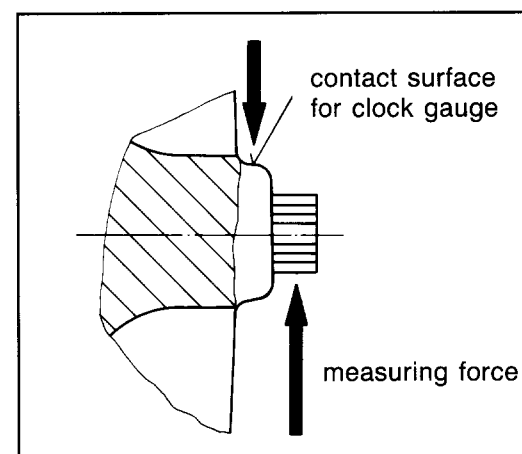
- Determination of radial play is only necessary at turbine side.
- Place clock gauge measuring point on the centre of the cone on the turbine wheel.

Illustrations 2.1, 2.2



2.1

- Pull turbine wheel downwards using spring scale. Measuring force: 50 N. Set clock gauge at "O"!
- Pull turbine wheel upwards using spring scale. Measuring force 50 N.
- Note the clock gauge "throw".
- Take this measurement again, with shaft and turbine wheel assy. turned through 90 °.
- The permissible radial plays can be seen in the data sheet.



2.2

REPAIR INSTRUCTIONS

SERIES K1/K2 uncontrolled



Valid: 5900 008 25 32 12.91 E
Cancelled: 5900 008 25 32 07.89 E

Data Sheet

1. Tightening torques in Nm

part			size	K 14/16	K 24	K 26	K 27	K 28	K 29	
shaft nut	AF 10/12 mm self-locking M6	tightening torque after preheating	—	5 ⁺²				—		
		tightening torque	—	12 ⁺¹				—		
	AF 10/12 mm M6	tightening torque after preheating	—	7 ⁺²			—	—		
		tightening torque + angle setting	—	5 ^{+60° -5°}			—	—		
	AF 14 mm M6	tightening torque after preheating	—		7 ⁺²					
		tightening torque + angle setting	—		5 ^{+60° -5°}					
	AF 15 mm M7 (left)	tightening torque after preheating	—			7 ⁺²	—			
		tightening torque + angle setting	—			5 ^{+50° -5°}	—			
	AF 10 mm M5	tightening torque after preheating	5 ⁺²		—					
		tightening torque	6 ^{+0,5}		—					
backplate fixing without washer			—	8				—		
backplate fixing with washer			6	10						
compressor housing			7							
turbine housing (M 6)			8			—				
turbine housing (M 8)			20							

2. Axial play in mm

size	K 14/16	K 24	K 26	K 27	K 28	K 29	
max. play	0,10	0,16			—	—	

3. Radial play in mm

size	K 14/16	K 24	K 26	K 27	K 28	K 29	
max. play	0,35	0,40		0,43		—	

Repair instructions

Turbocharger - Made by Schwitzer

To determine the bearing plays:

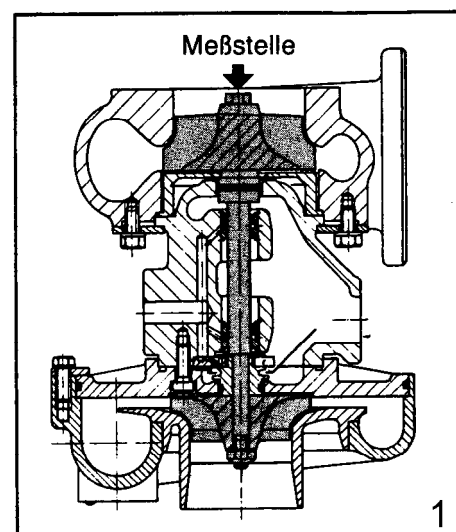
Measure axial play:

Set the needle of the dial gauge on the front onto the turbine wheel hub.

Push the shaft down and set the dial gauge to "0"!

Push the shaft up against the dial gauge and note the deflection of the gauge.

Refer to page 10.16.02 for permissible axial plays.



Measure radial play:

The radial play needs to be checked only on the **compressor side**.

Set the needle of the dial gauge in the center of the hex nut of the compressor wheel.

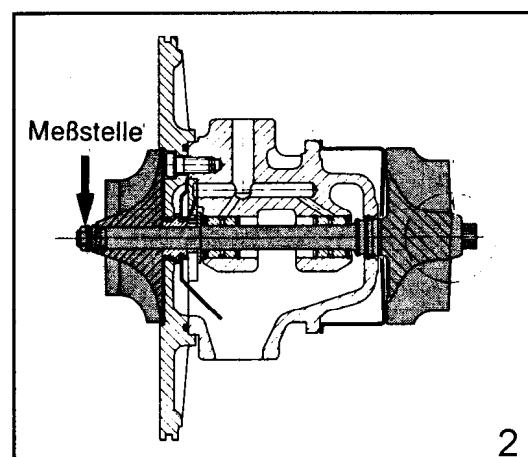
Push the compressor wheel hub downward with a spring scale. Test force: 50 N. Set dial gauge to "0"!

Pull the compressor wheel hub upward with a spring scale. Test force: 50 N.

Note the deflection of the gauge.

Turn the shaft by 90° and repeat this test.

Refer to page 10.16.02 for permissible radial plays.



Repair instructions

Turbo charger - Made by Schwitzer

Data page:

Axial play in mm

Size	S 1A	S 1B	S 2A	S 2B	S 3A	S 4T
max. play	0,14				0,17	0,20

Radial play in mm

Size	S 1A	S 1B	S 2A	S 2B	S 3A	S 4T
max. play	0,61	0,51	0,82	0,95	0,70	0,72

Injection pump with load pressure dependent full load stop (LDA)

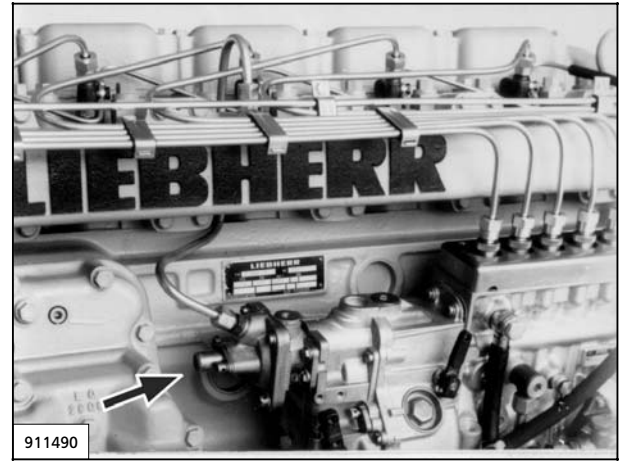
on turbocharged engines, the full load quantity of the injection pump is matched to the charge pressure of the turbocharger.

However, in the lower RPM range, the charge pressure is lower and therefore the weight of air in the engine cylinders is also lower.

For that reason, the full load quantity must also be matched to the reduce the weight of air.

This is done by the charge pressure dependent full load stop (LDA).

Connect with an air line to the air intake manifold, it reduces the full load in the lower speed range, from a certain (selectable) charge pressure on.



Untergruppen - Verzeichnis

Sub-Group Index

Désignation des sous-groupes

11.01	Meß- und Prüfwerkzeuge Measuring and testing tools Outillages de mesure et de contrôle
11.05	Ein- und Ausziehvorrichtungen, Montageeinrichtungen Removal, installation and assembly fixtures and tools Dispositifs de pose et d`extraction, dispositifs de montage
11.08	Montagehilfe und Spezialschlüssel Assembly and installation aids, special wrenches Accessoires de montage et cles spéciales
11.12	Zylinderkopfbearbeitungs-Werkzeug Cylinder head remachining tools Outillages d`usinage de culasse
11.15	Montagehülsen und Montagebolzen Installation bushings and guide pins Douilles et axes de montage
11.18	Ein- und Ausschlagdorne, Stempel Removal and installation punches and punchplates Mandrins d`extraction et de pose, tampons

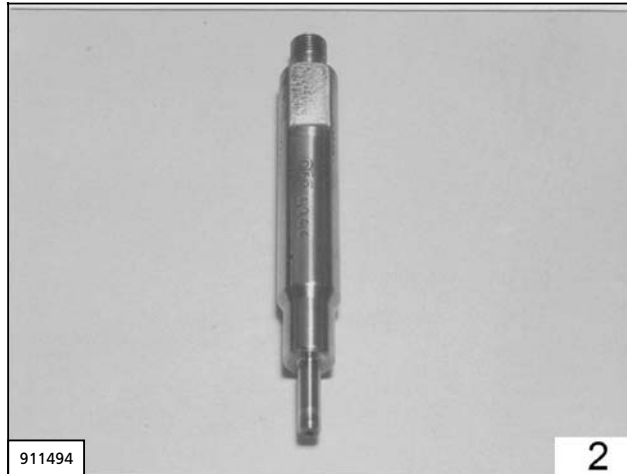
LIEBHERR	Benennung/Description/Dénomination Sonderwerkzeug Special tools Outillage spécial	Typ Model Type D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.00
Datum/Edition/Date 05 / 2003		

Notizen / Notes / Notices

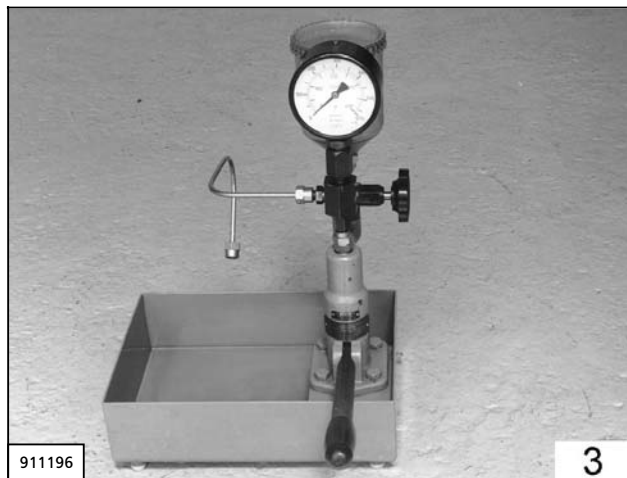
LIEBHERR	Benennung/Description/Dénomination Mess- und Prüfwerkzeuge Measuring and testing tools Outillages de mesure et de contrôle	Typ Model D 904 / 914 / 924 Type 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.01
Datum/Edition/Date 05 / 2003		



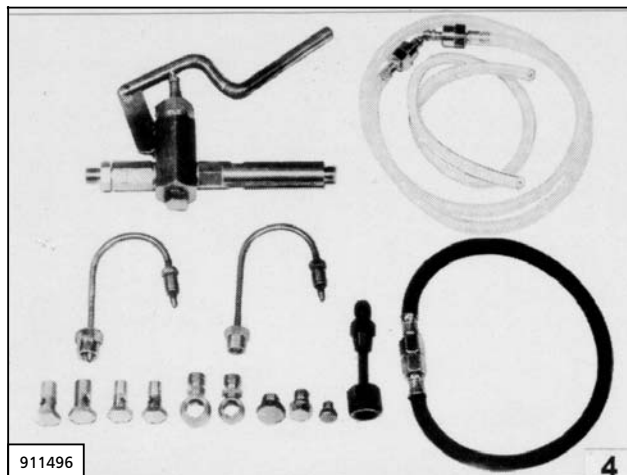
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1	8008782	X	X	X	X	X	X	X	X



2	0524044	X	X	X	X	X	X	X	X
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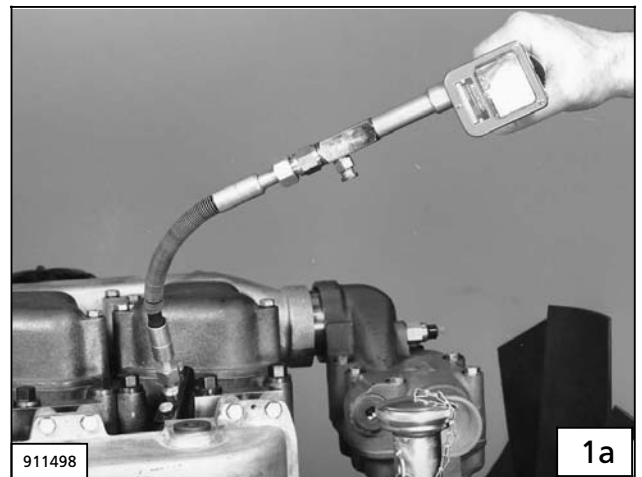


3	7361236	X	X	X	X	X	X	X	X
---	---------	---	---	---	---	---	---	---	---



4	7009318	X	X	X	X		X		
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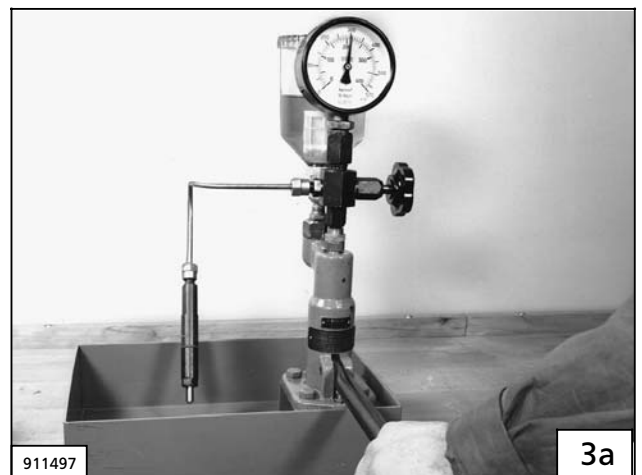
Benennung Description Dénomination
Kompressions - Druckprüfer
Compression tester
Compressiomètre



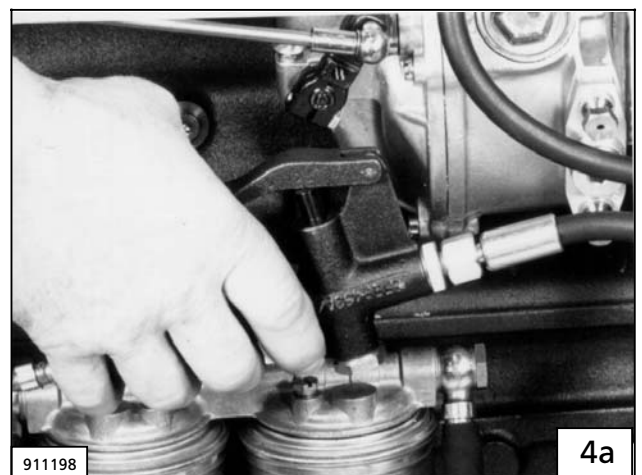
Anschlußstück für Kompressions - Druckprüfer
Adapter for compression tester
Raccord pour le manomètre-enregistreur de la pression de compression

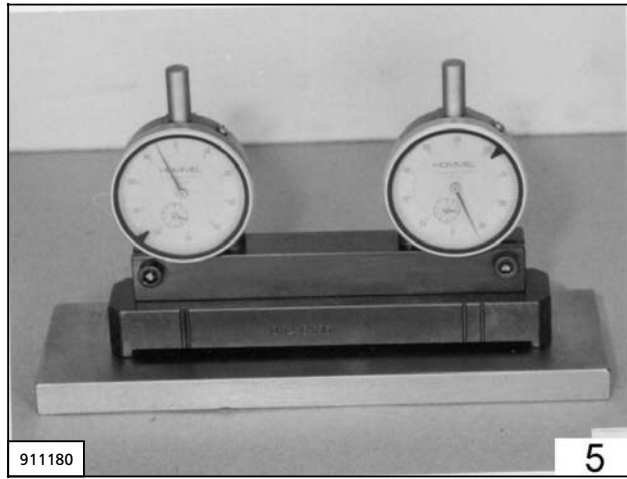


Düsenprüfgerät
Injector testing device
Pompe à vérifier les injecteurs

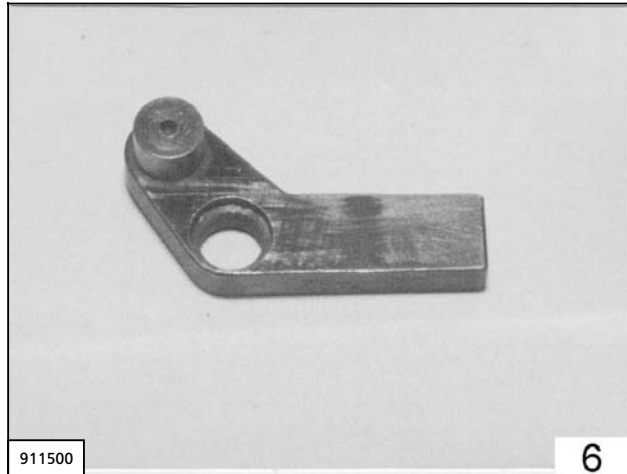


Hochdruck - Handförderpumpe
High pressure hand-pump
Pompe manuelle HP pour le contrôle

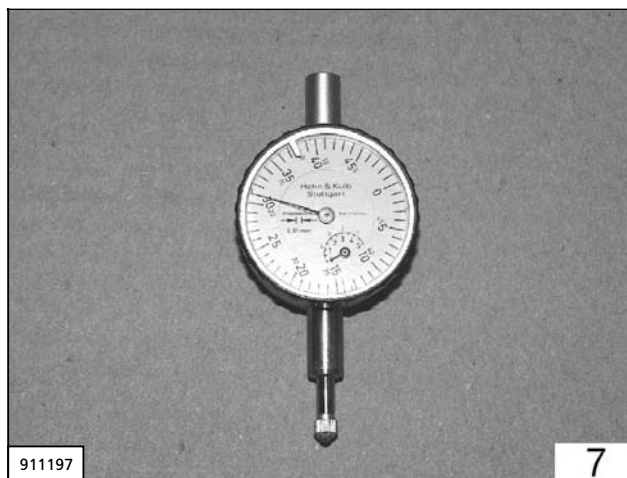




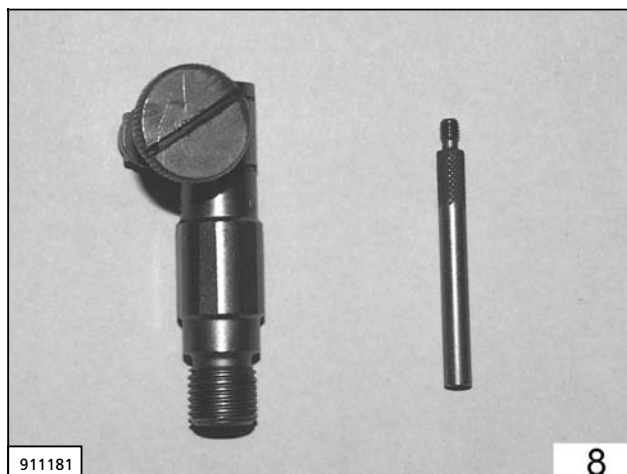
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
5	0526856 ersetzt replaces remplace par 0524064	X	X	X	X	X	X	X	X
		X	X						



6	0527462			X			X		
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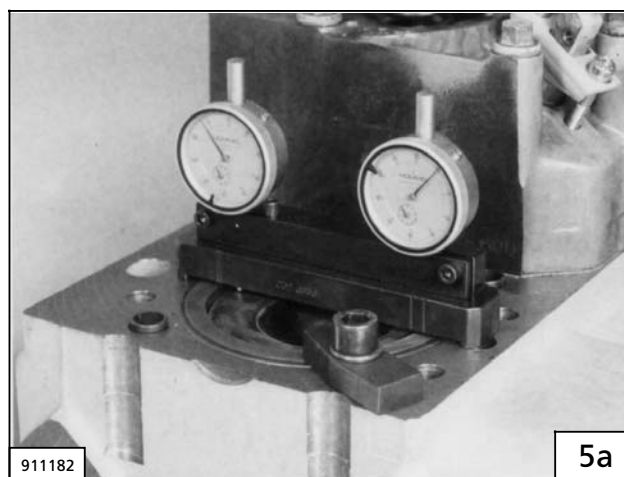


7	7022418					X			
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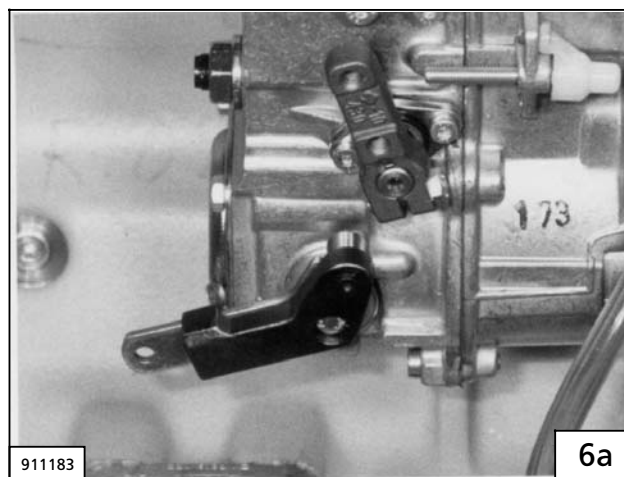
8	7022420					X			
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Benennung Description Dénomination
Messuhrhalter für Kolbenabstand - Messung Dial gauge holder to measure piston clearance Support de comparateur pour contrôle de l'espace neutre



5a

Haltevorrichtung für Ausschaltung - Startmenge bei MW - Einspritzpumpe Holding fixture to eliminate supplementary feed on MW-injection pumps Dispositif de blocage pour neutralisation de la suralimentation au démarrage sur pompe à injection MW
--



6a

Meßuhr für Förderbeginn-Einstellung "VE" Einspritz- pumpe Dial gange to delivery begin ajustement "VE" injection pump Indicateur de mesure pour ajustage début d` extraction "VE" pompe d`injection
--

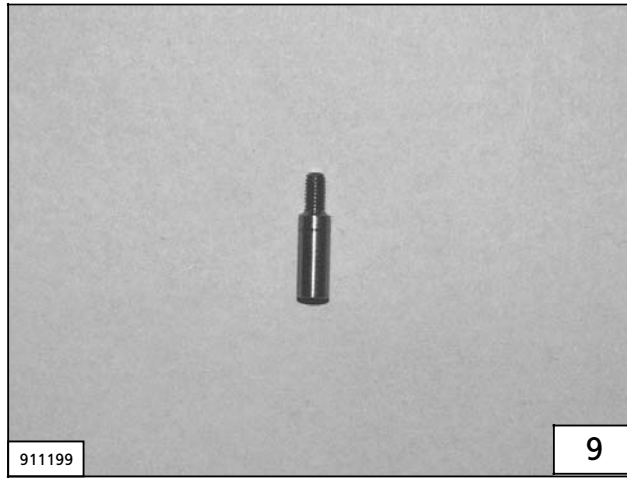


7a

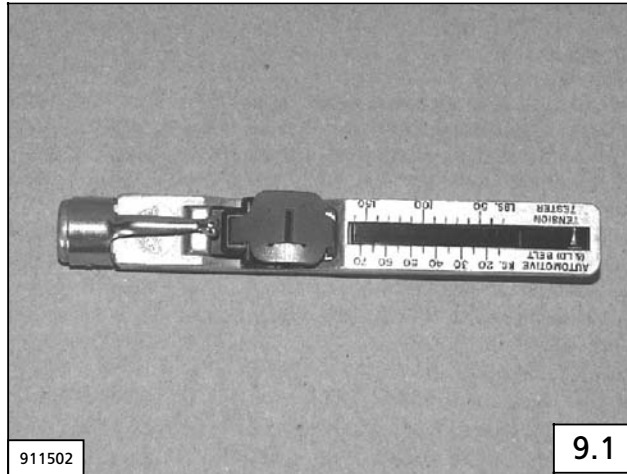
Meßvorrichtung für Förderbeginn-Einstellung "VE" Einspritz- pumpe Dial fixture to delivery begin ajustement "VE" injection pump Appareil de mesure pour ajustage début d` extraction "VE" pompe d`injection
--



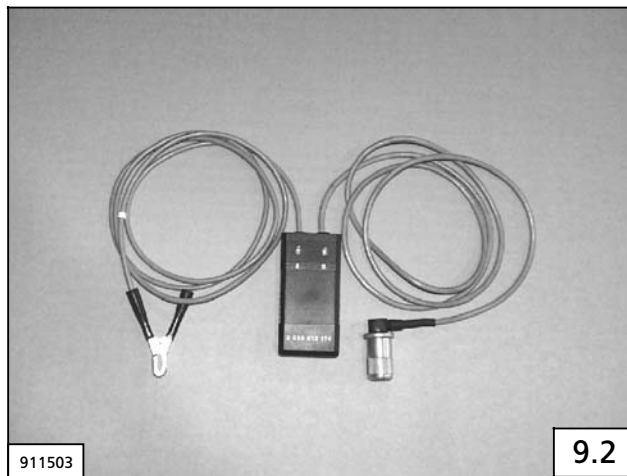
8a



Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
9	7022419					X			

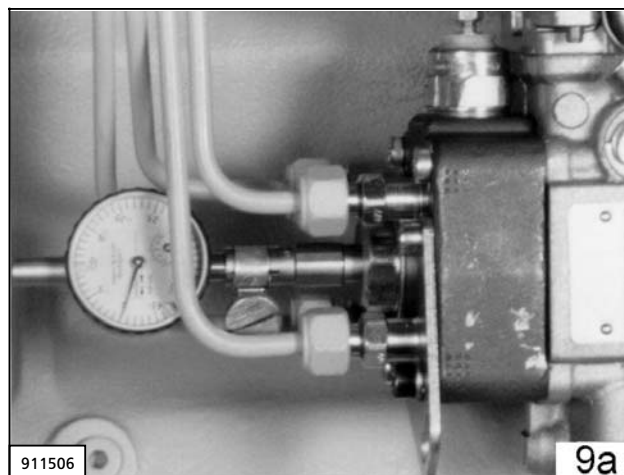


9.1	8042829					X	X	X	X
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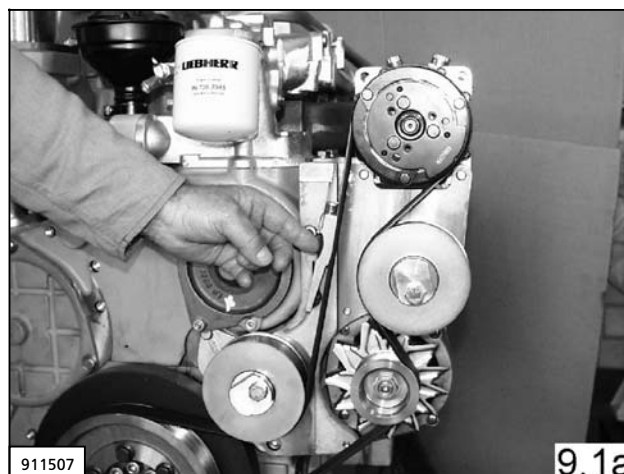


9.2	6004308							X	X
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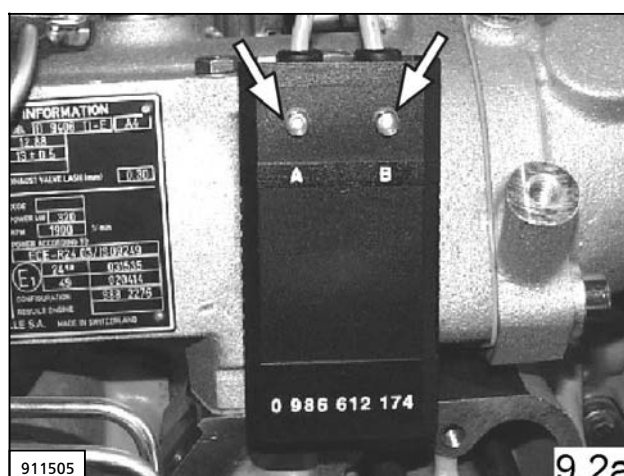
Benennung Description Dénomination
Zwischenstück für Förderbeginn-Einstellung "VE" Einspritzpumpe Intermediate piece to delivery begin adjustment "VE" injection pump Pièce intermédiaire pour ajustage début d` extraction "VE" pompe d`injection



Keilriemen - Meßgerät - Kriket 2 für Messung - Keilriemenspannung V- Belt Measuring Tool Kriket 2 to measure V-Belt tension Outillage Kriket 2 mesure de la tension de courroie

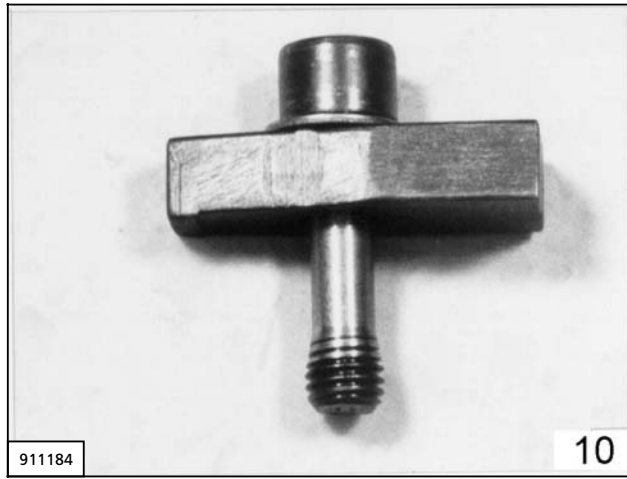


Lichtsignalgeber für Förderbeginn - Einstellung Elektronische Regelung Light - Impulse Transmitter for adjustment of delivery begin on electronic - Regulators Signal Lumineux pour le réglage du début d`in- jection (régulateur) électronique EDC

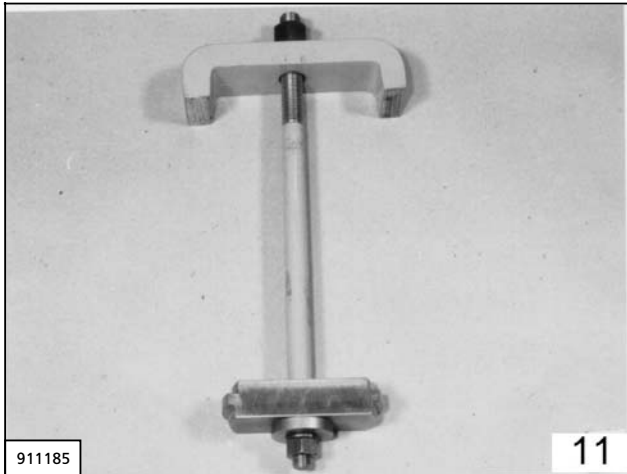


Notizen / Notes / Notices

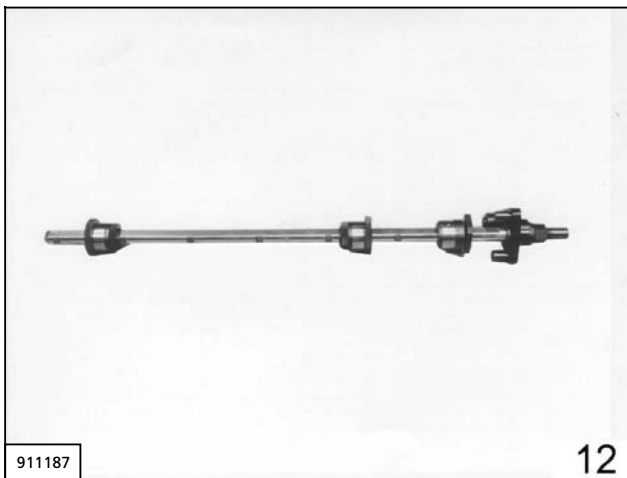
LIEBHERR	Benennung/Description/Dénomination Ein- und Ausziehvorrichtungen, Montageeinrichtungen Removal, installation and assembly fixtures and tools Dispositifs de pose, et d'extraction, Dispositifs de montage	Typ Model Type	D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de	
		Blatt/Page/Feuille 11.05	
Datum/Edition/Date 05 / 2003			



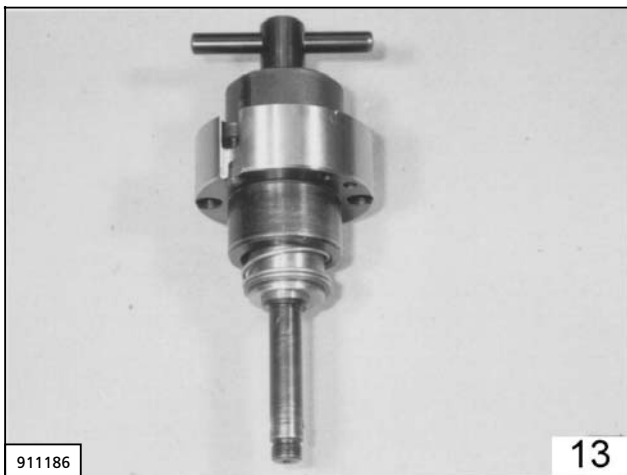
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
10	0524065	X	X	X	X	X	X	X	X



11	0526855 ersetzt replaces remplace par 0524051	X	X	X	X	X	X	X	X
		X	X						



12	0524052	X	X	X	X	X	X	X	X
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13	0526853 ersetzt replaces remplace par 0523465	X	X	X	X	X	X	X	X
		X	X						

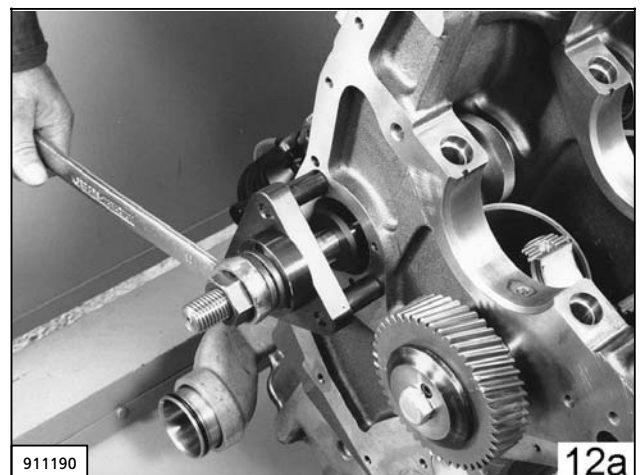
Benennung Description Dénomination
Haltevorrichtung für Zylinderlaufbuchse Holding device for cylinder liner Outillage de maintien de chemise



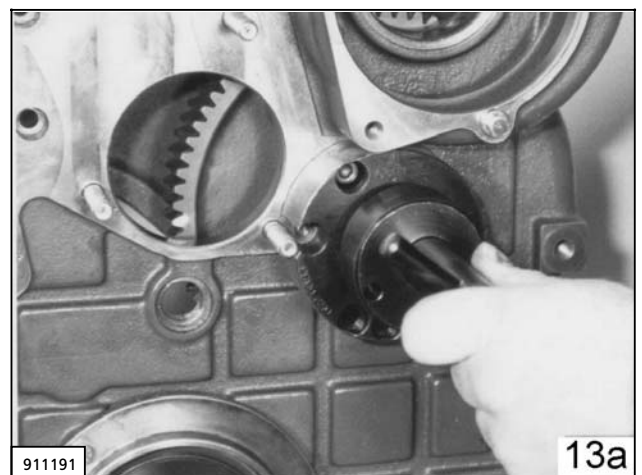
Ausziehvorrichtung für Zylinderlaufbuchse Cylinder liner puller Extracteur de chemise

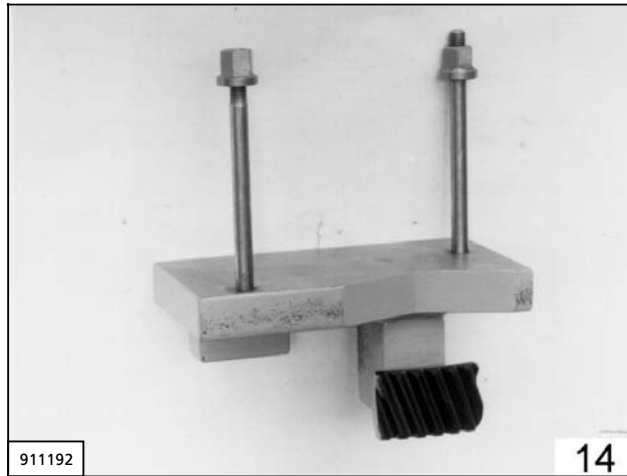


Ein- und Ausziehvorrichtung für Nockenwellenlagerbuchsen Removal and installation device for camshaft bushings Dispositif de pose et d'extraction des coussinets d'arbre à cames
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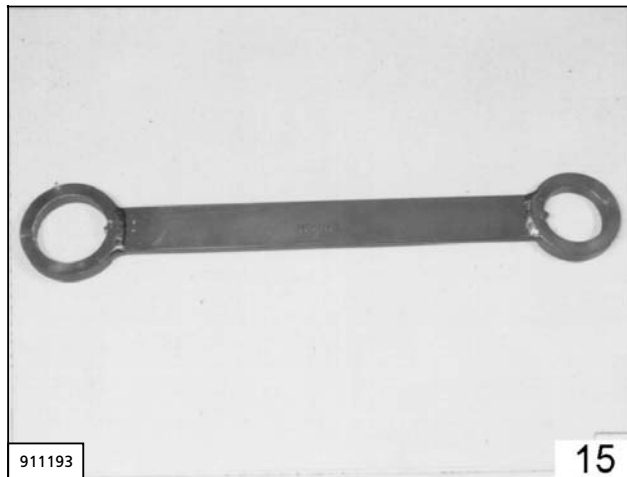


Montagevorrichtung für Nockenwellenzahnrad Mounting fixture for camshaft gear wheel Dispositif de montage de pignon d'arbre à cames

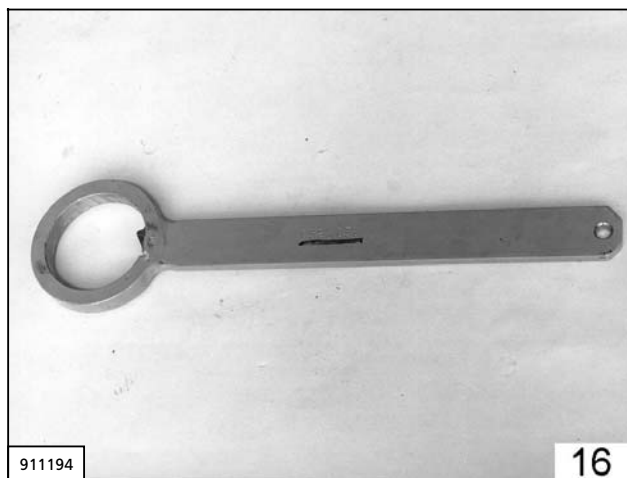




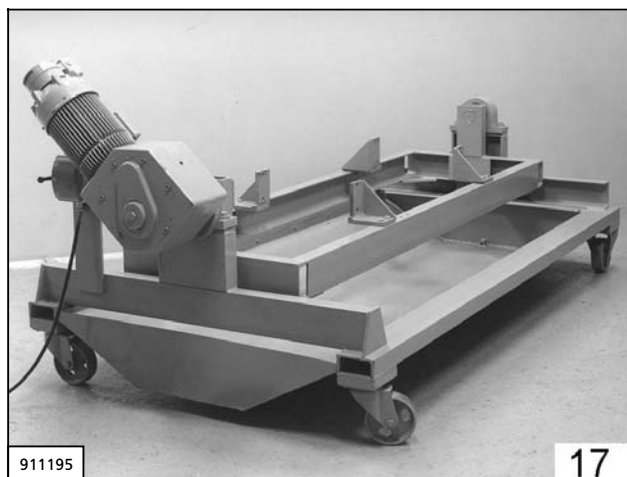
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
14	0523467	X	X	X					



15	0526857	X	X	X	X	X	X	X	X
	ersetzt replaces remplace par								
	0524067	X	X						

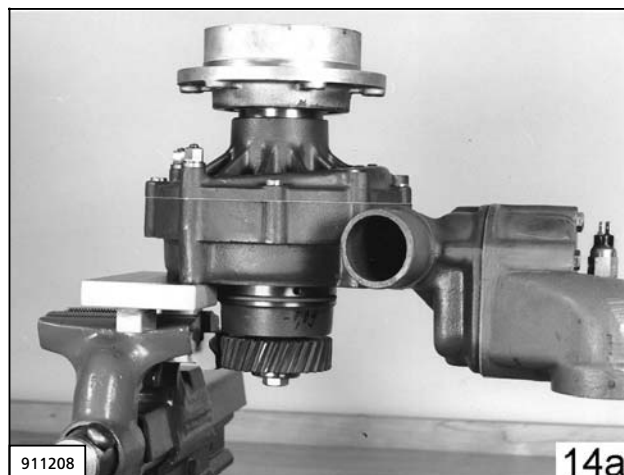


16	0524058	X	X	X	X	X	X	X	X
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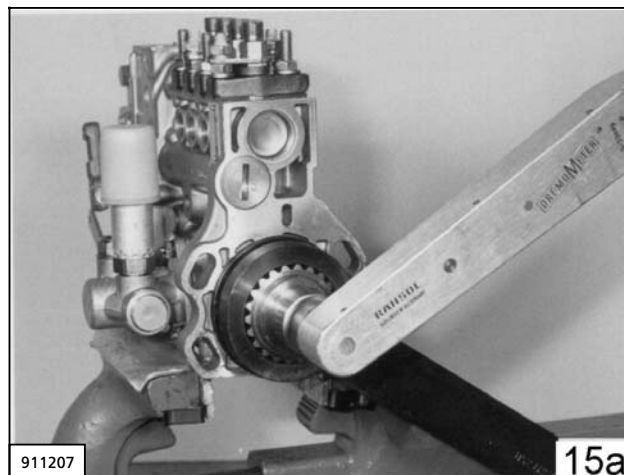
17	0522444	X	X	X	X	X	X	X	X
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Benennung Description Dénomination
Montagebock für Kühlmittelpumpe
Assembly fixture for coolant pump
Dispositif de bridage de pompe à eau



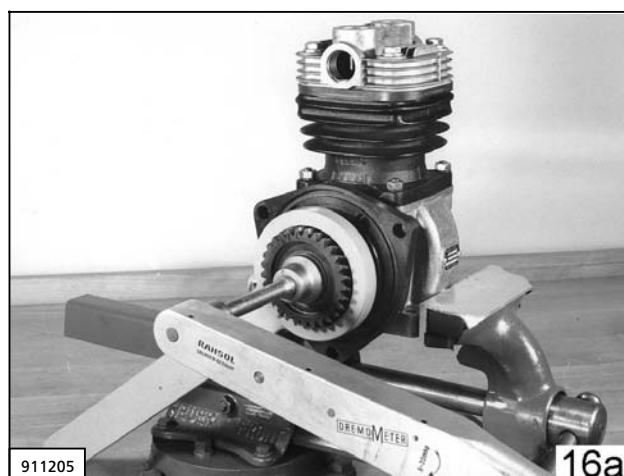
14a

Haltevorrichtung für Einspritzpumpenzahnrad
Holding device for splined shaft adapter on injection pump
Dispositif de blocage du pignon de pompe d`injection



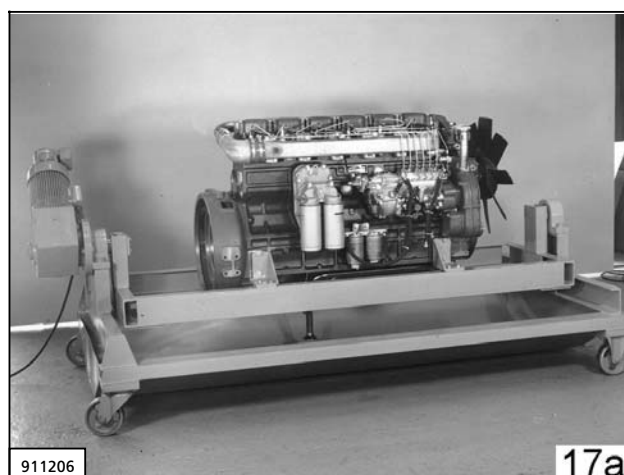
15a

Haltevorrichtung für Luftpresserzahnrad und Hydraulikpumpenantrieb-Zahnrad
Holding device for air compressor and hydraulic pump drive gear
Dispositif de blocage du pignon de compresseur et de pompe hydraulique

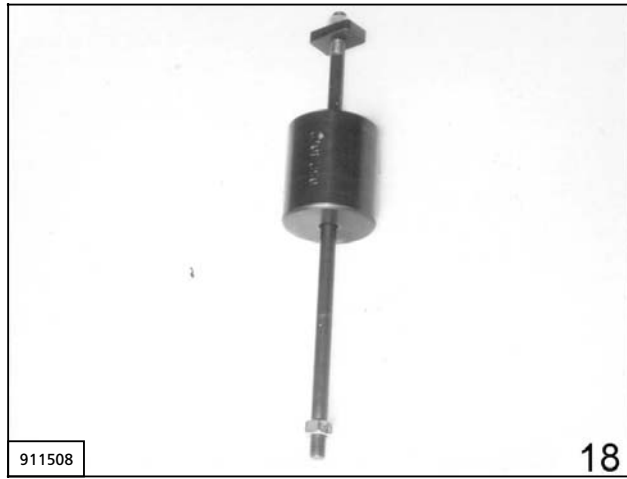


16a

Montagebock für Motor
Engine stand
Support de montage du moteur



17a



Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
18	0524072	X	X	X	X	X	X	X	X



19	0524029	X	X	X	X	X	X	X	X
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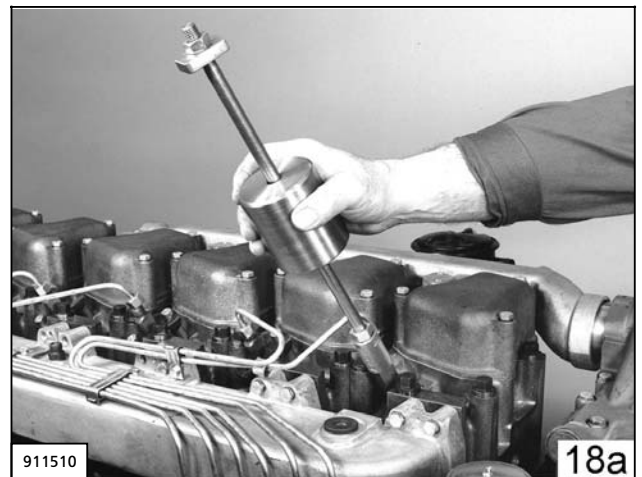


20	0524146	X	X						
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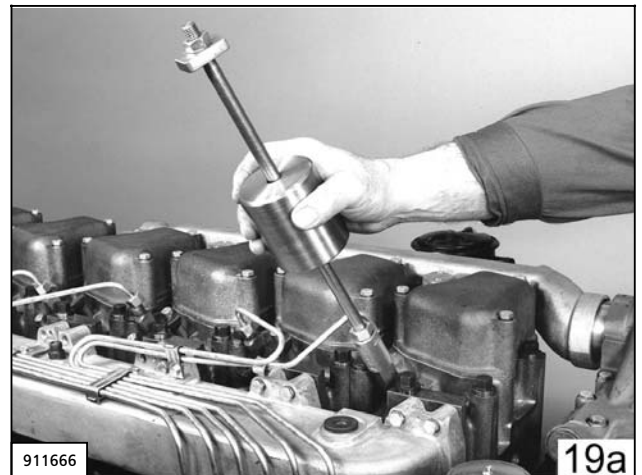


21	0701650	X	X	X	X	X	X	X	X
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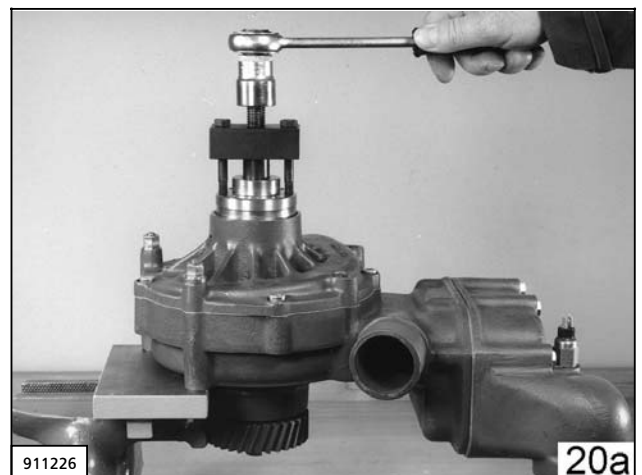
Benennung Description Dénomination
Ausziehvorrichtung für Einspritzventil Injector puller Extracteur d`injecteur



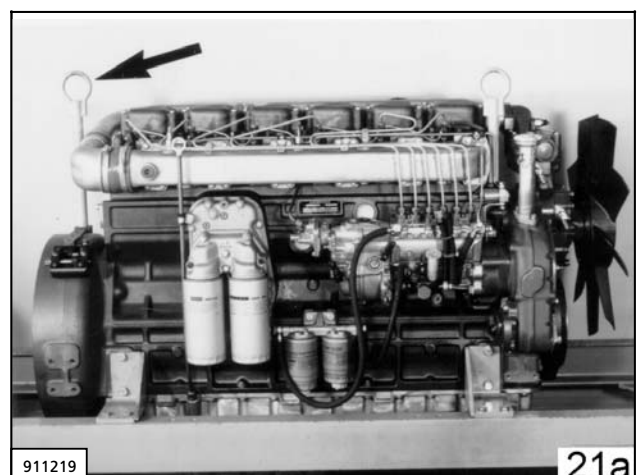
Adapter für Ausziehvorrichtung-Einspritzventil Adapter for injector puller Adaptation pour extracteur d`injecteur
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Abzieher für Nabe an der Kühlmittelpumpe Hub puller for coolant pump disassembly Arrache-moyeu de pompe à eau
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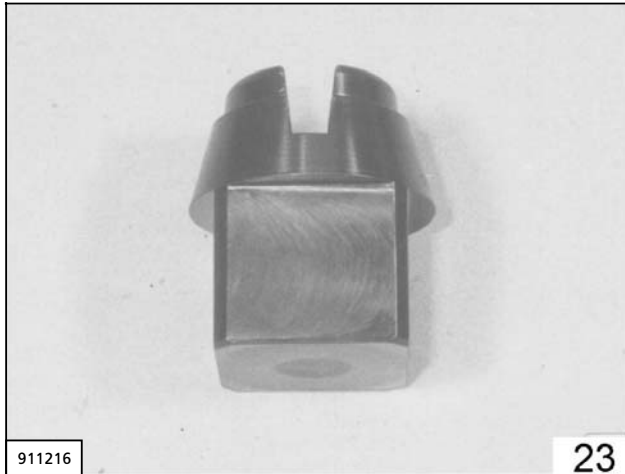


Ösenschraube für Motor - Montage Eyebolt for Engine - assembly Vis de suspension de montage du moteur
--

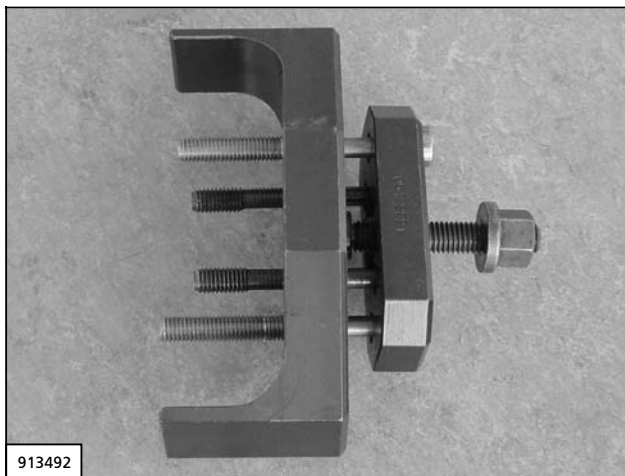




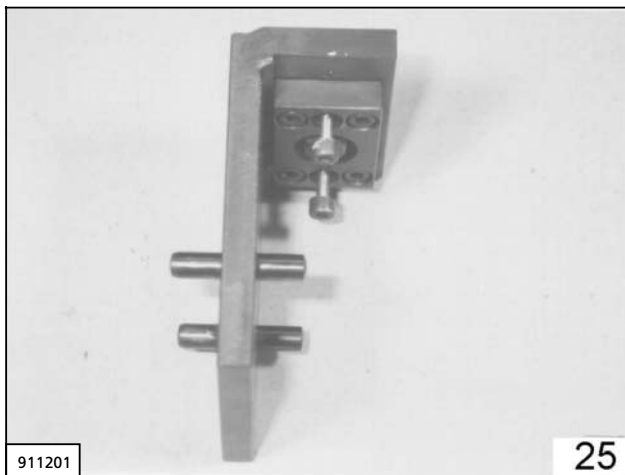
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
22	0701651	X	X	X	X	X	X	X	X



23	0526858		X	X	X	X	X	X	
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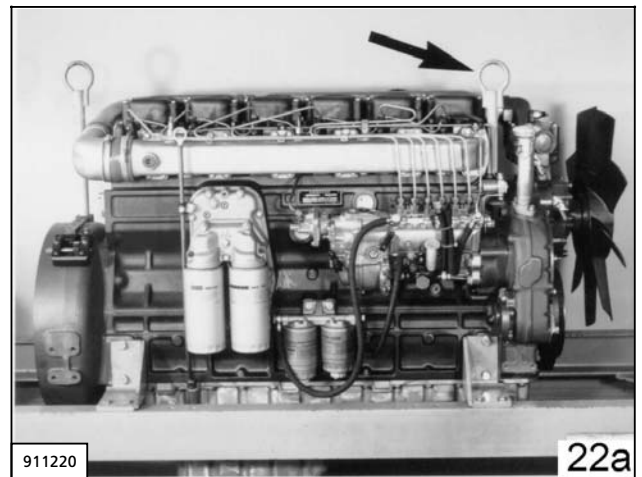


24	0542221 ersetzt replaces remplace par 0526860		X	X	X	X	X	X	X
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25	0526861		X	X	X	X	X	X	
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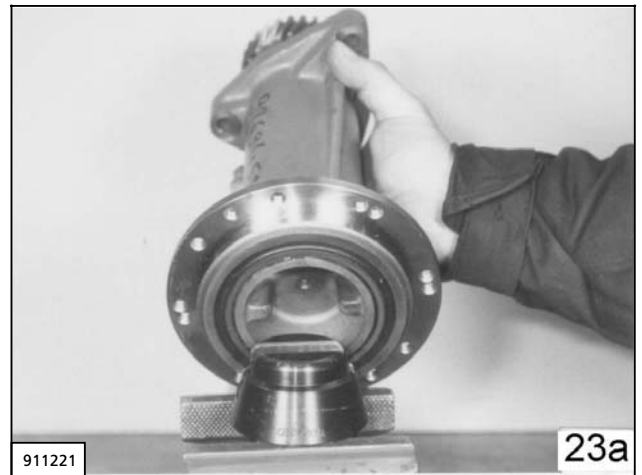
Benennung Description Dénomination
Ösenschraube für Motor-Montage Eyebolt for Engine-assembly Vis de suspension de montage du moteur



911220

22a

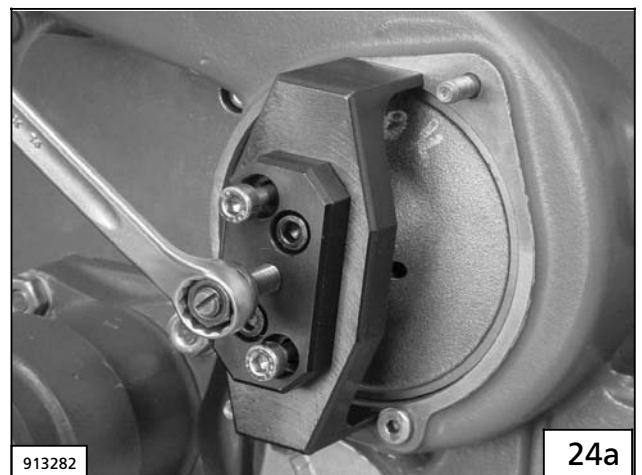
Haltevorrichtung für Lüfterantrieb Holding device for fan drive Dispositif de blocage de l'entraînement du ventilateur
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911221

23a

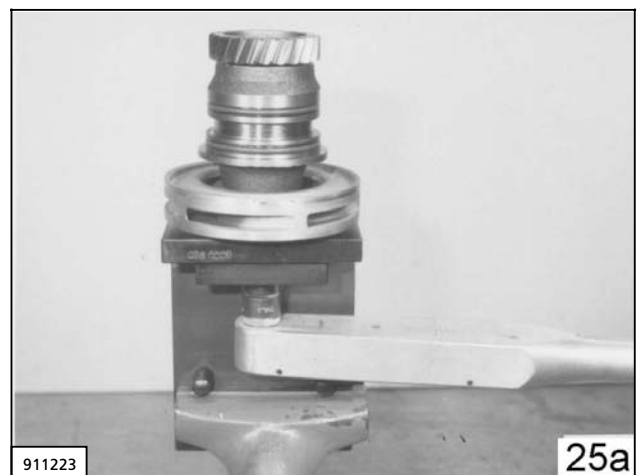
Ausziehvorrchtung für Kühlmittelpumpe (Kühlmittelpumpe im Aggregateträger integriert) Coolant pump puller (Coolant pump integrated in accessory drive gear box) Extracteur pour pompe à eau (pompe intégrée dans le carter de distribution)



911282

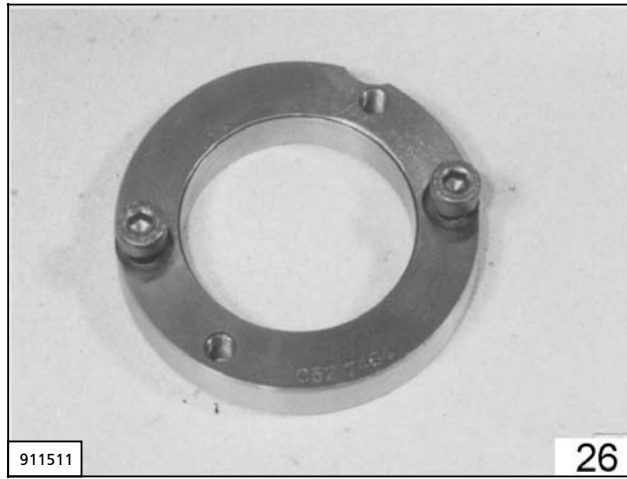
24a

Halte- und Abziehvorrchtung für Laufrad an der Kühlmittelpumpe (Kühlmittelpumpe im Aggregateträger integriert) Holding and pulling device for impellerwheel on coolant pump (Coolant pump integrated in accessory drive gear box) Dispositif de blocage et d'extraction pour rotor de pompe à eau (pompe intégrée dans le carter distribution)
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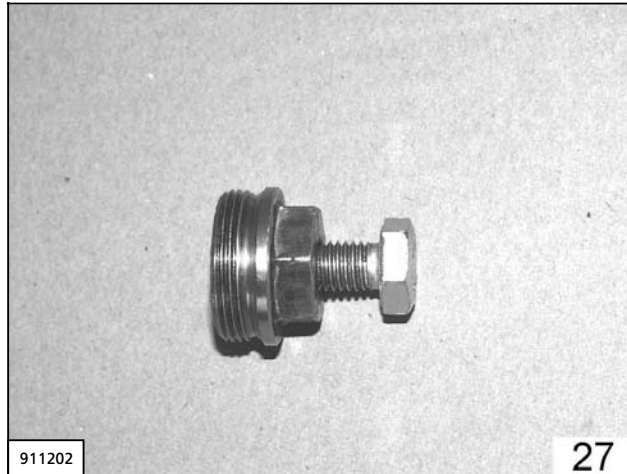


911223

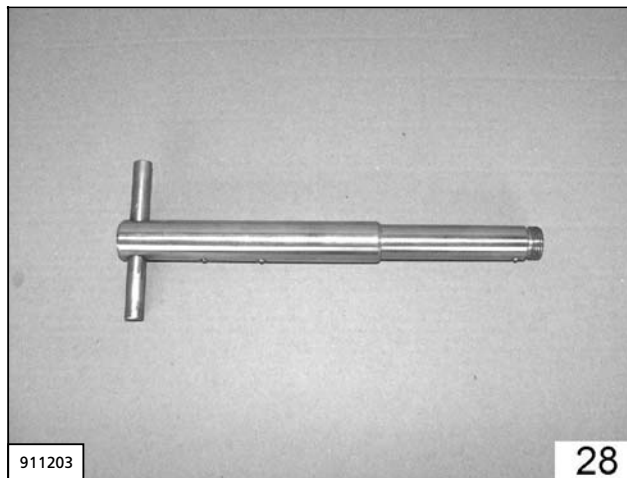
25a



Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
26	0527464		X	X	X	X	X	X	X



27	0541353					X			
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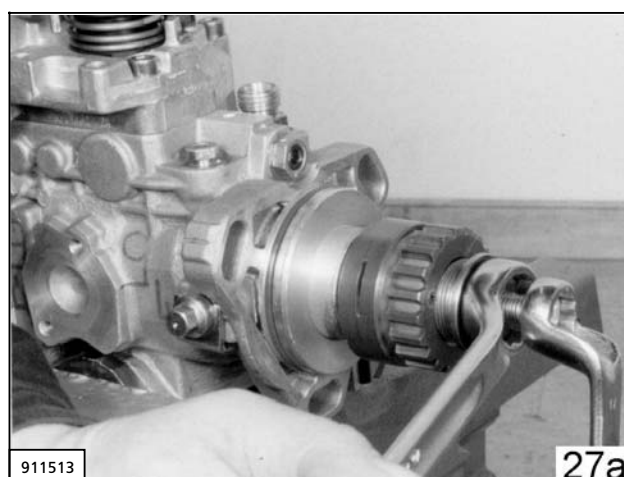


28	0541543					X	X	X	X
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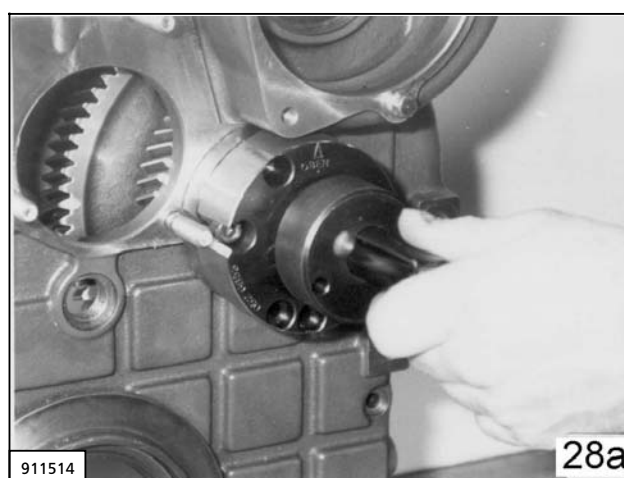
Benennung Description Dénomination
Zwischenring für Montagevorrichtung-Nockenwellenzahnrad bei Anbau Lüfterantrieb-Zahnrad Spacer for camshaft gear mounting fixture when mounting fan drive gear Bague intermédiaire pour dispositif de montage du pignon d'arbre à cames lors de la pose du pignon d'entraînement du ventilateur



Abzieher für Einspritzpumpen-Zahnrad "VE"-Einspritz- pumpe Hubpuller for gear wheel of "VE" injection pump Démonte-roue pour roue dentée de la pompe injection "VE"



Knebelschraube für Montagevorrichtung-Nockenwellenzahnrad bei Nockenwellenzahnrad-Befestigung mit Innensechskantschraube SW 17 und Gewinde M 20x1,5 Tommy screw for mounting device for camshaft gear in case of camshaft gear mounting fixture with hexagonal screw with recessed hole SW 17 and thread M 20x1,5 Vis à garret pour dispositif d'installation du pignon d'arbre à cames lors de fixation du pignon d'arbre à cames par vis à six pans creux SW 17 et filet M 20x1,5



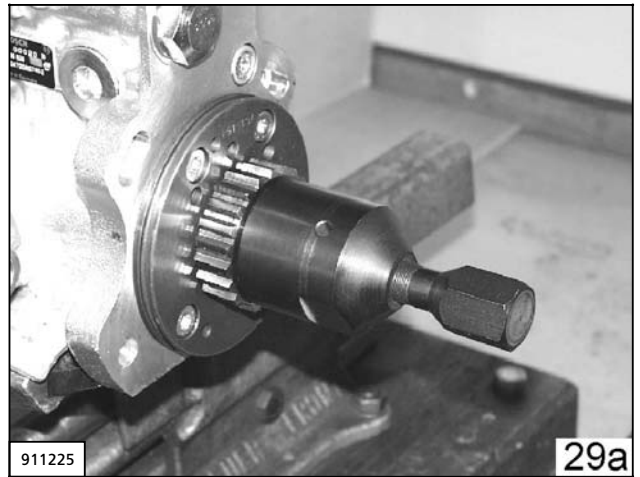


Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
29	0528473						X	X	

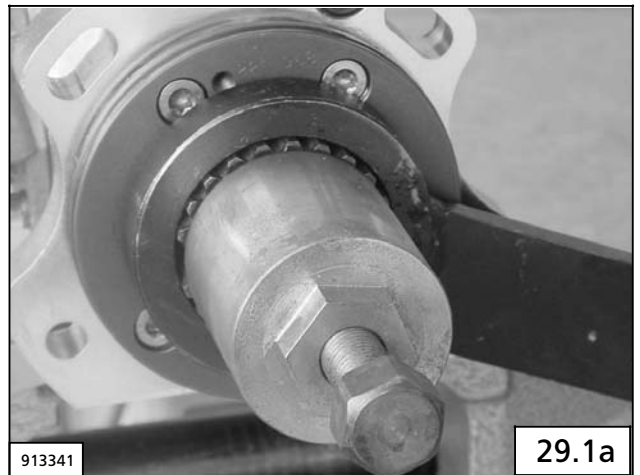


29.1	0542220								X
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Benennung Description Dénomination
Abzieher für Einspritzpumpen-Zahnrad Puller for injection pump gear Extracteur de pignon d'entraînement de pompe à injection.

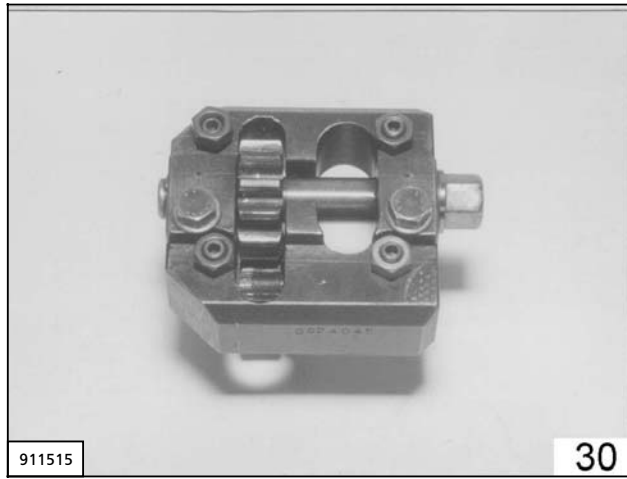


Abzieher für Einspritzpumpen-Zahnrad an Hubschieber- Einspritzpumpe (H-RP43) Puller for injection pump gear on control-sleeve injection pump (H-RP43) Extracteur de pignon d'entraînement de pompe à injection en ligne à tivoirs (H-RP43)



Notizen / Notes / Notices

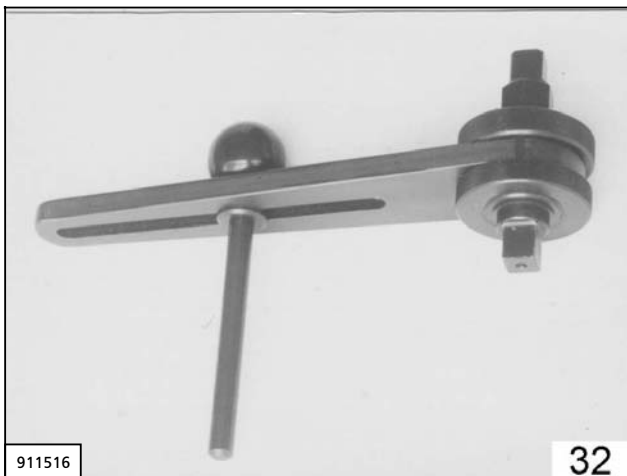
LIEBHERR	Benennung/Description/Dénomination Montagehilfen und Spezialschlüssel Assembly and installation aids, special wrenches Acessoires de montage et de spéciales	Typ Model Type D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.08
Datum/Edition/Date 05 / 2003		



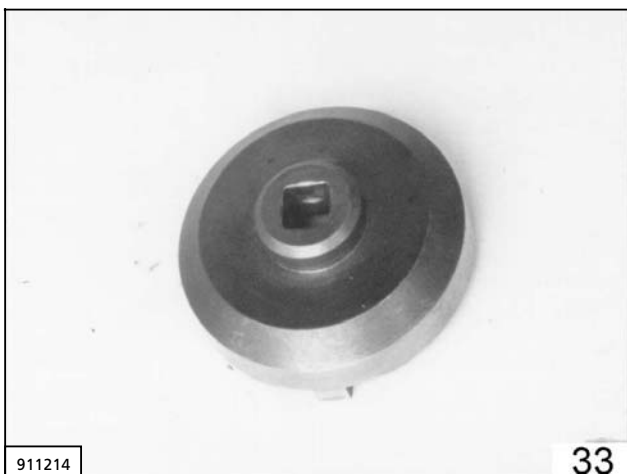
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
30	0524045	X	X	X	X	X	X	X	X



31	0524143	X	X	X	X	X	X	X	X
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32	0524062	X	X	X	X	X	X	X	X
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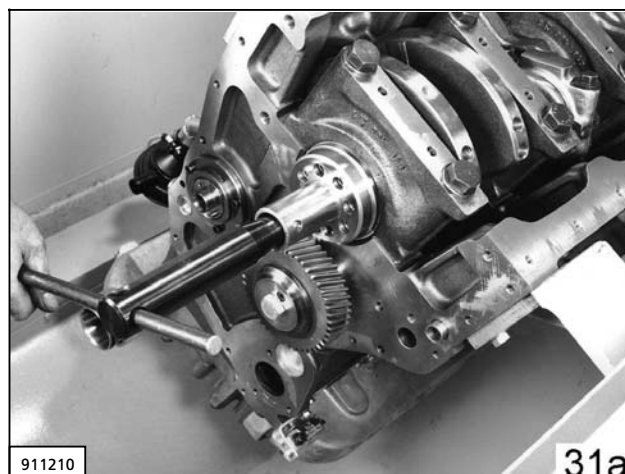


33	0523462	X	X	X					
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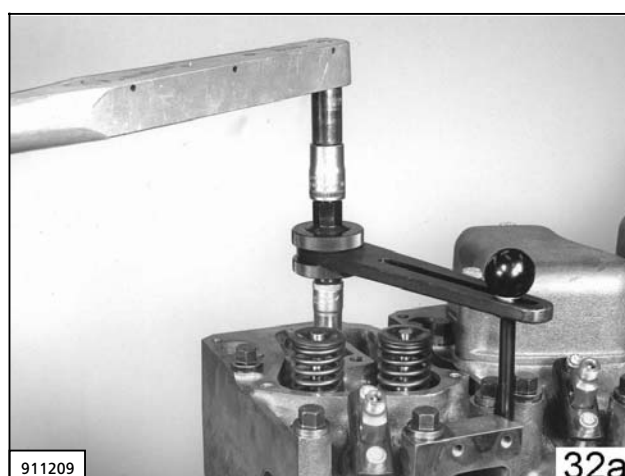
Benennung Description Dénomination
Drehvorrichtung Anbau am Schwungradgehäuse Hand-crank to turn fly wheel Dispositif de virage à monter sur le carter de volant



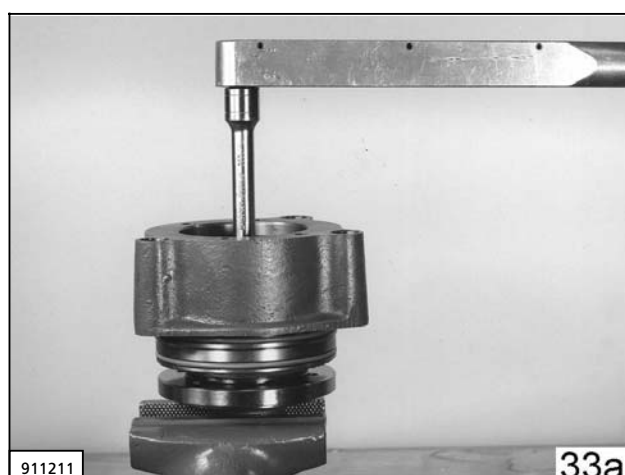
Drehzapfen zum Drehen an der Kurbelwelle Turning tool with handle Mandrin de virage du vilebrequin
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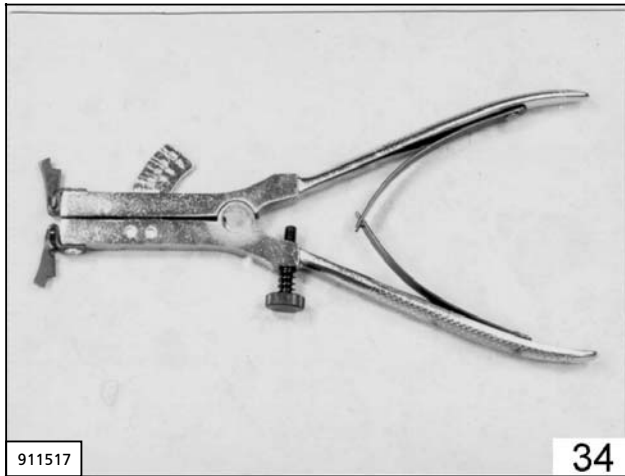


Drehwinkelanzug - Vorrichtung für Zylinderkopf, Hauptlager und Pleuellager Torque angle indicator for cylinder head, crankshaft and connecting rod bearing installation Dispositif à cadran gradué indiquant l'angle de serrage des vis de culasse, de palier, de vilebrequin et de bielle.

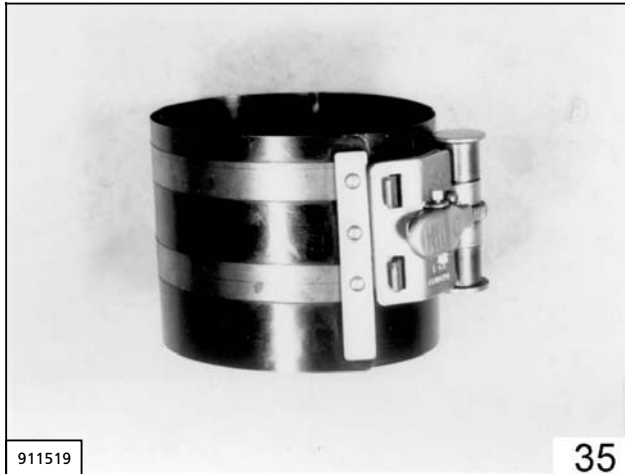


Nutenschlüssel für Einspritzpumpen-Antrieb Wrench to disassemble and assemble injection pump Clé à ergots pour entrainement de pompe d`injection
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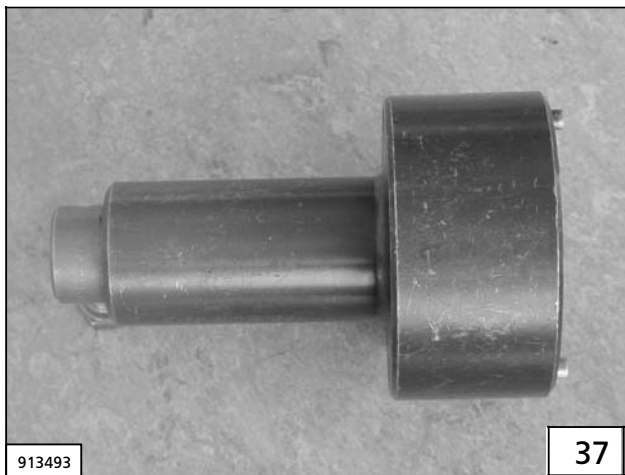
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
34	7009319	X	X	X	X	X	X	X	X



35	8000592	X	X	X	X	X	X	X	X
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36	0524144	X	X	X					
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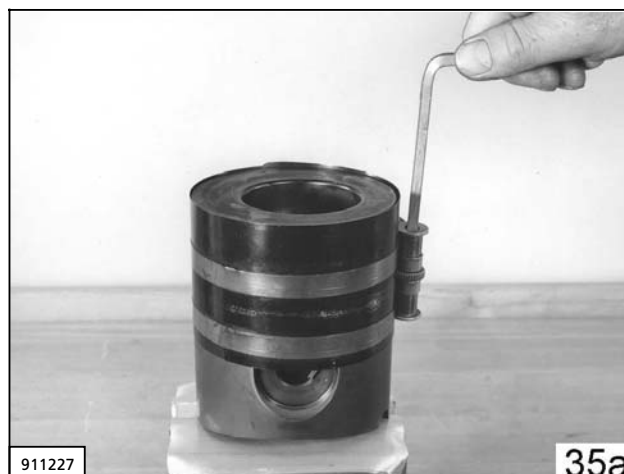


37	706054601					X	X	X	X
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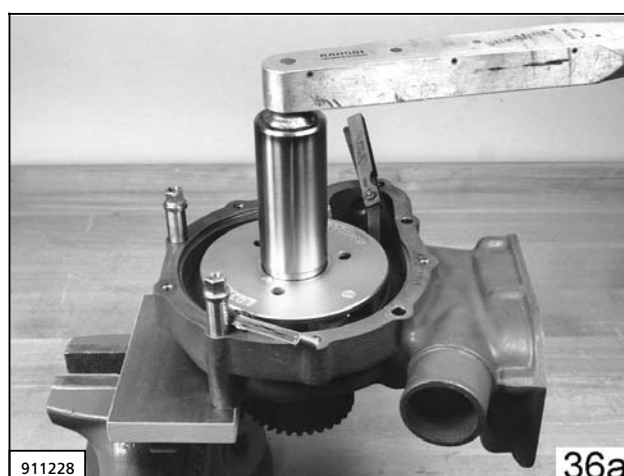
Benennung Description Dénomination
Kolbenringzange
Piston ring pliers
Pince à segment



Kolbenringspannband
Piston ring compressor
Sangle à comprimer les segments



Nutenschlüssel für Schaufelradbefestigung (Kühlmittelpumpe)
Wrench to install coolant pump impeller wheel
Douille à ergots pour blocage de la roue à aubes (Pompe à eau)

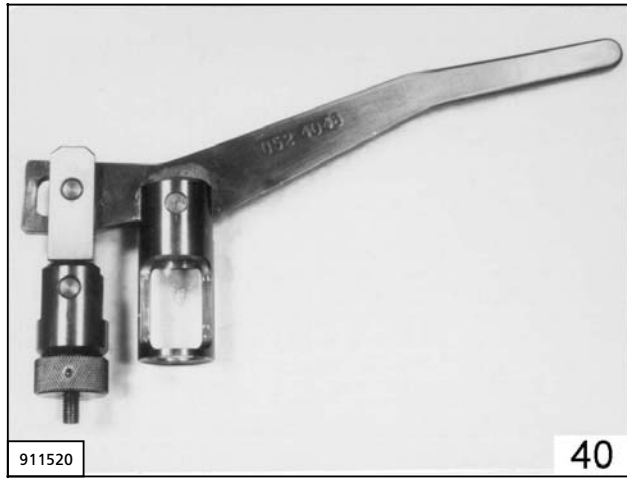


Zapfenschlüssel für Zweilochmutter (schaltbarer Hydraulik- pumpen-Nebenantrieb)
Journal key for two-holenut (shiftable hydraulic pump auxiliary drive).
clè pivot avec deux trous écrou (entraînement auxiliaire de pompe hydraulique enbrayable).

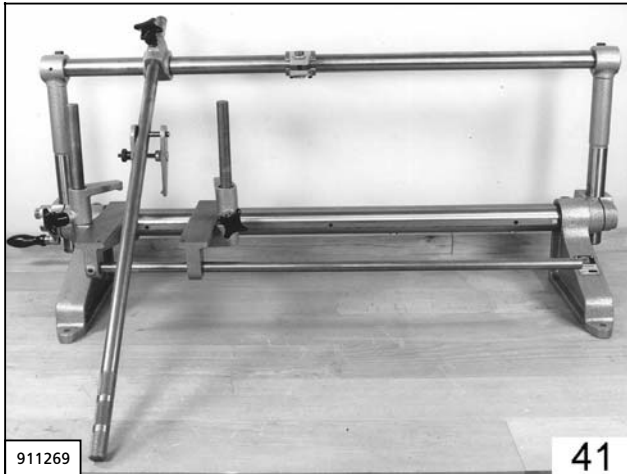


Notizen / Notes / Notices

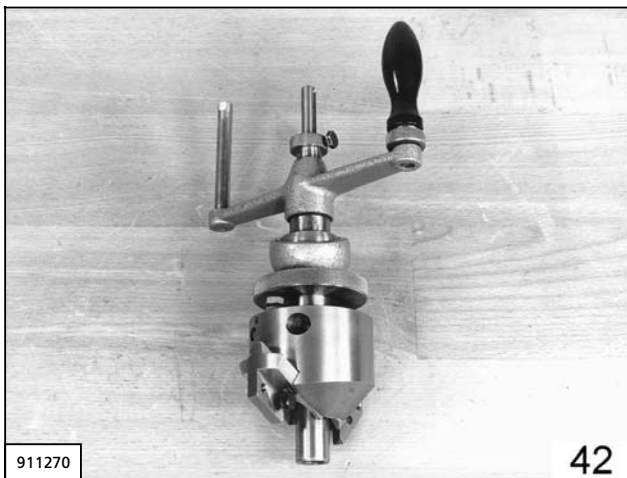
LIEBHERR	Benennung/Description/Dénomination Zylinderkopfbearbeitungs - Werkzeug Cylinder head remachining tools Outillages d`usinage de culasse	Typ Model D 904 / 914 / 924 Type 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.12
Datum/Edition/Date 05 / 2003		



Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
40	0524048	X	X	X	X	X	X	X	X



41	7009320	X	X	X	X	X	X	X	X
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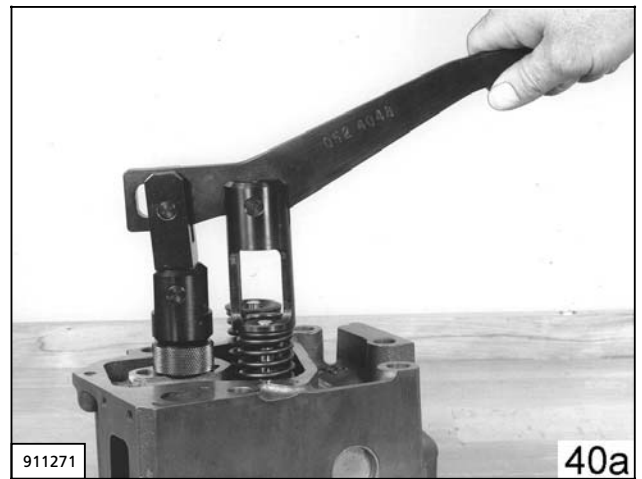


42	7009321	X	X	X	X	X	X	X	X
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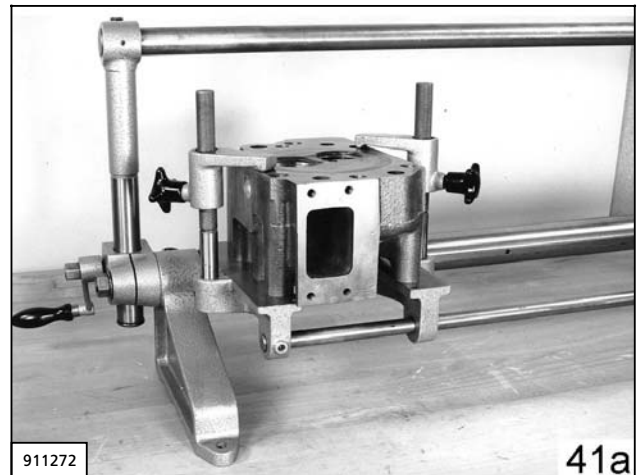


43	7009322	X	X	X	X	X	X	X	X
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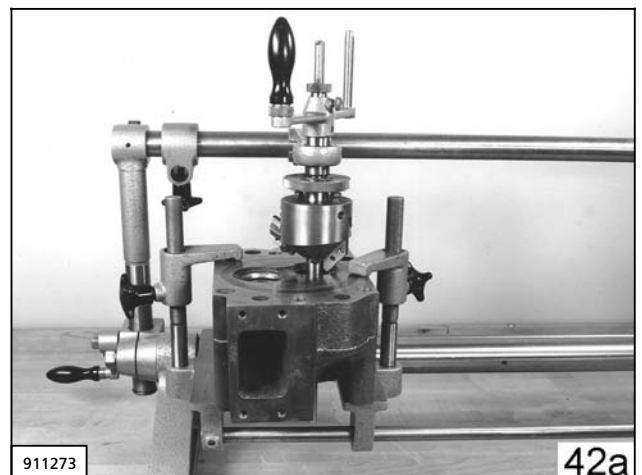
Benennung Description Dénomination
Ventilknecht für Montage der Ventile Valve spring compression tool Dispositif de compression des ressorts de soupape



Ventilknecht zum Aufspannen des Zylinderkopfes Cylinder head fixture to rebuild cylinder head Dispositif de bridage de culasse

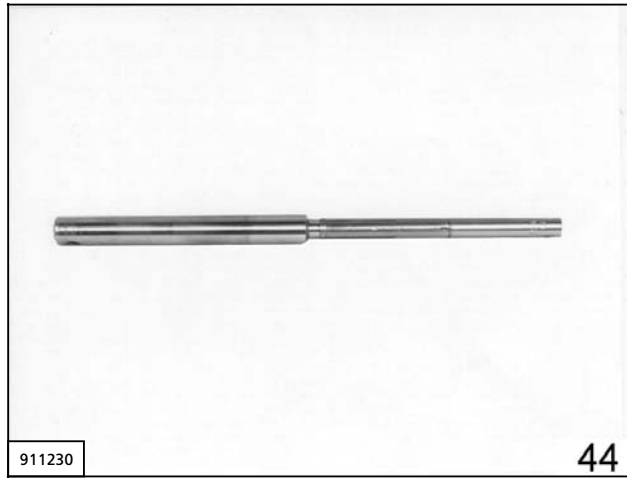


Ventilsitz - Drehwerkzeug zum Bearbeiten der Ventilsitze Valve seat cutting head to remachine valve seats Dispositif d'usinage des sièges de soupape

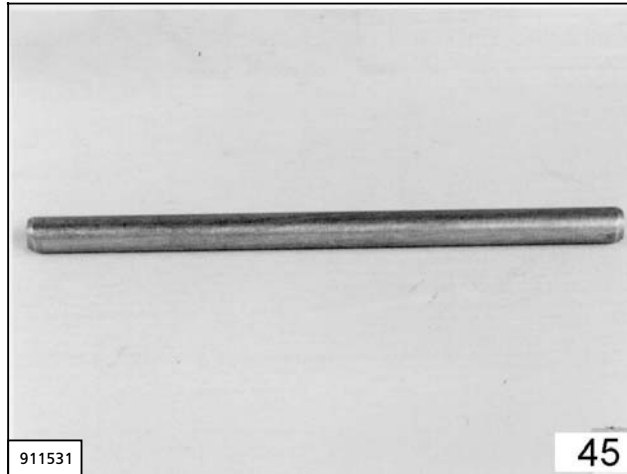


Dreischneidenstahl zum Bearbeiten der Ventilsitze (45°) Multiple edge cutting tool to remachine valve seats (45° degrees) Outil à trois tailles pour l'usinage des sièges de soupape (45° degrés)

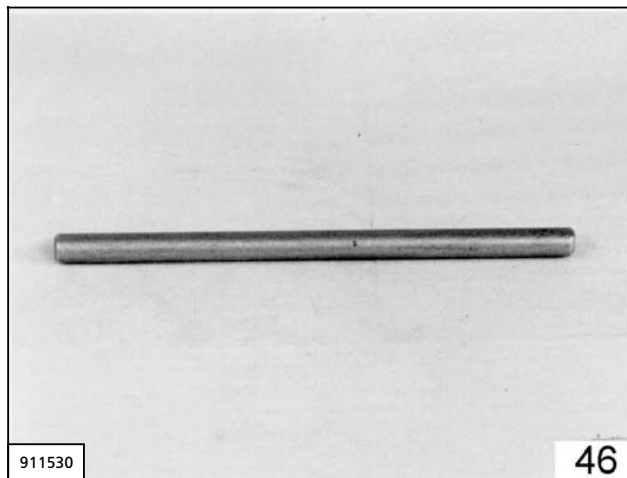




Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
44	7009323	X	X	X	X	X	X	X	X



45	7009324	X	X	X	X	X	X	X	X
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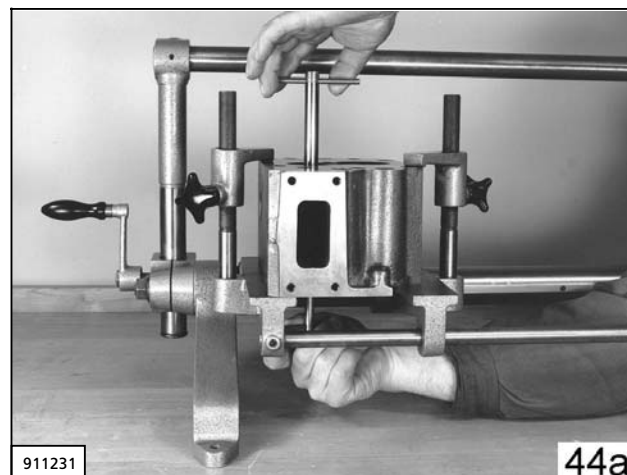


46	7009325	X	X	X	X	X	X	X	X
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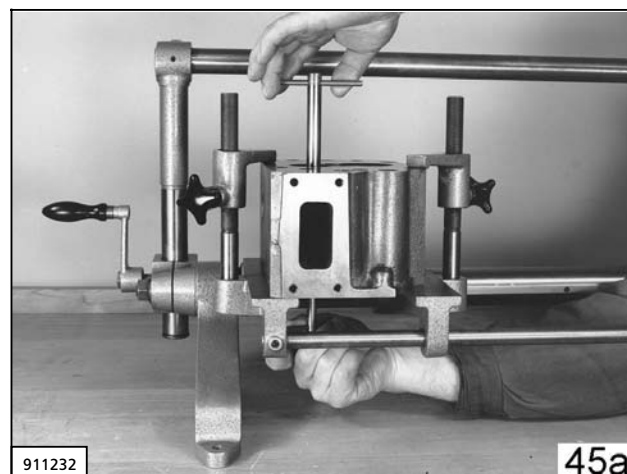


47	7009326	X	X	X	X	X	X	X	X
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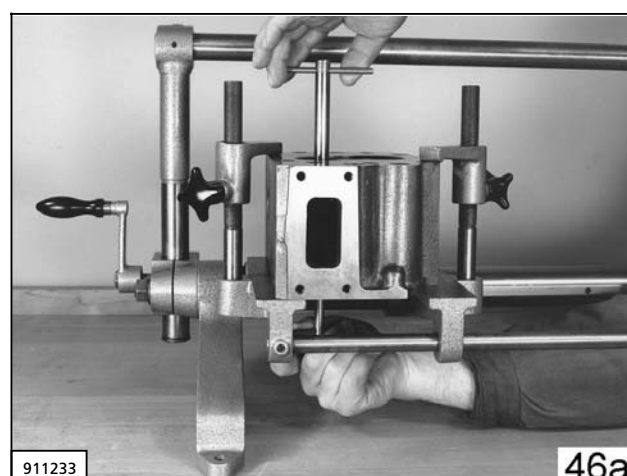
Benennung Description Dénomination
Pilot komplett zum Aufspannen der Drehwerkzeuge Pilot shaft to guide valve seat cutting head Mandrin de centrage du dispositif d'usinage des sièges de soupape



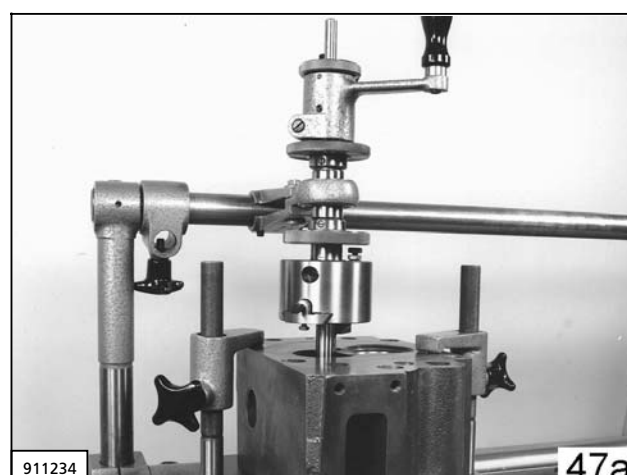
Stellstift 6 mm zum Spannen und Lösen des Piloten Pilot shaft rod (6 mm DIA) to secure and remove pilot shaft Axe de positionnement 6 mm pour la pose et la dépose du mandrin de centrage

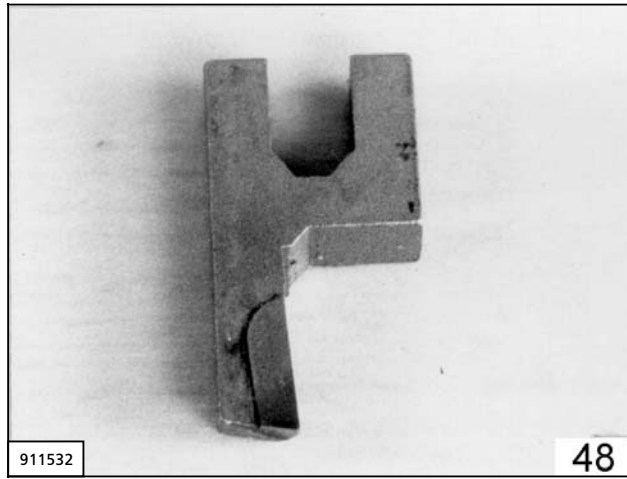


Stellstift 4,5 mm zum Spannen und Lösen des Piloten Pilot shaft rod (4,5 mm DIA) to secure and remove pilot shaft Axe de positionnement 4,5 mm pour la pose et la dépose du mandrin de centrage

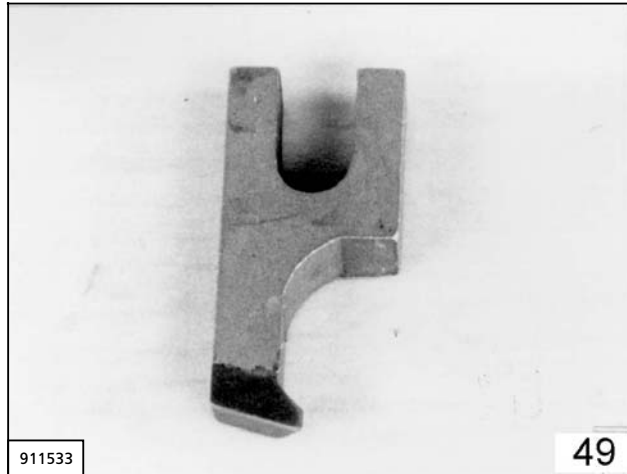


Ringsitz - Drehwerkzeug zum Ausdrehen der Bohrungen für Ventilsitze Valve ring seat cutting head to remachine ring seat bores Dispositif d'usinage des lamages centreurs des sièges de soupape
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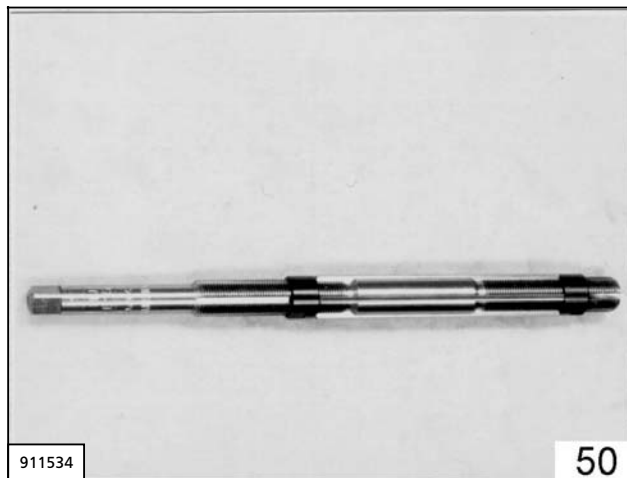




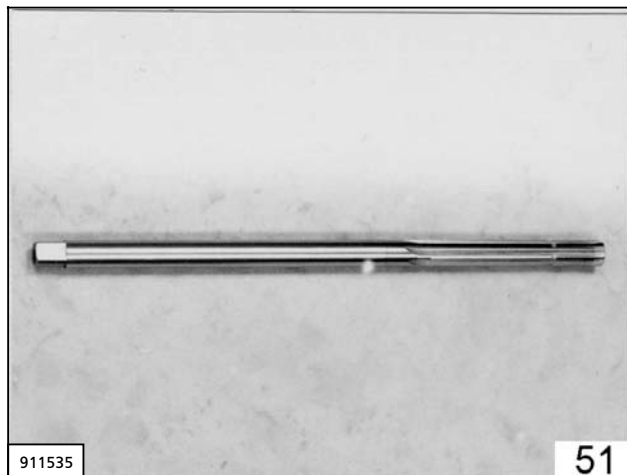
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
48	7009327	X	X	X	X	X	X	X	X



49	7009328	X	X	X	X	X	X	X	X
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50	7009329	X	X	X	X	X	X	X	X
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51	7009330	X	X	X	X	X	X	X	X
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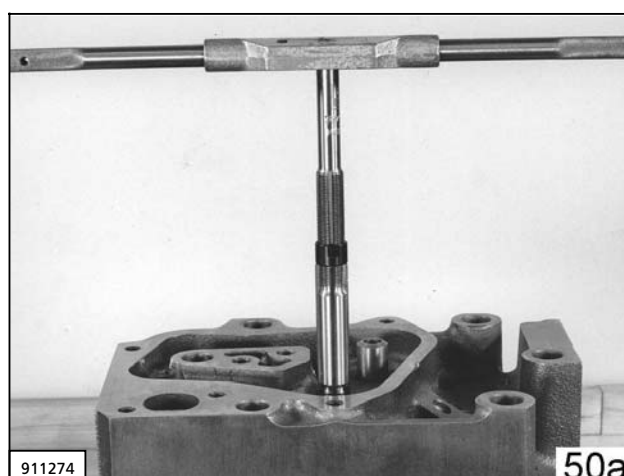
Benennung Description Dénomination
Drehstahl zum Ausdrehen der Bohrungen für Ventilsitze
Cutting tool to remachine ring seat bores
Outil d'usinage des lamages-centreurs de sièges de soupape



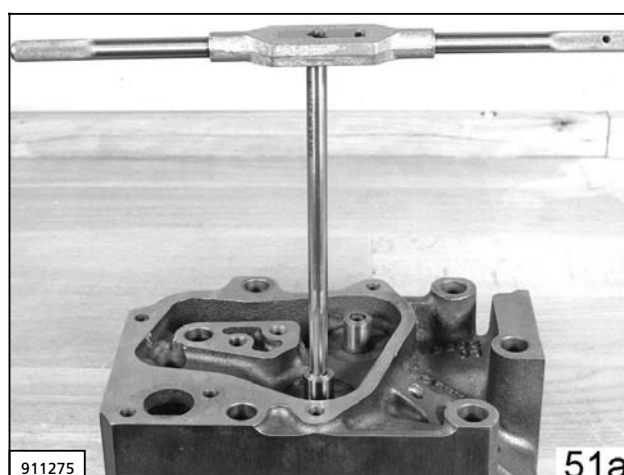
Drehstahl zum Eindrehen einer Ringnut in die Ventilsitzringe
Cutting tool to cut groove in valve seat rings
Outil d'usinage de la gorge dans les sièges de soupape

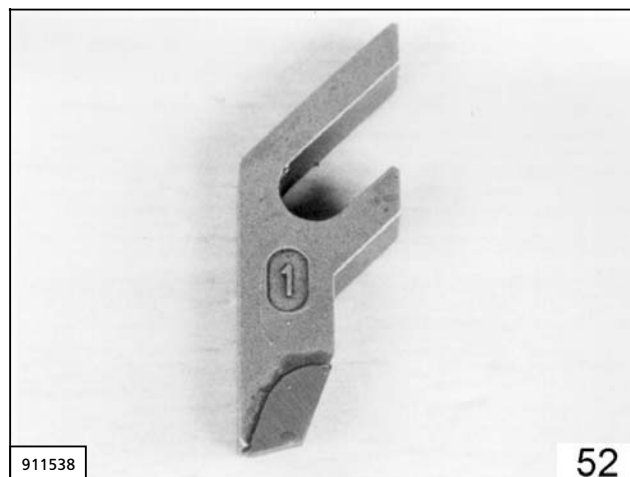


Reibahle zum Ausreiben der Ventilfeührungs- Bohrungen
Reamer to remachine valve guide bores in cylinder head
Alésoir pour passages de guides de soupape



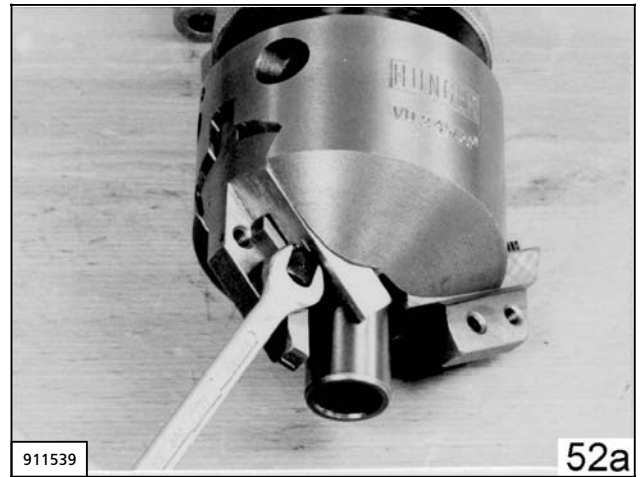
Reibahle zum Nachreiben der Ventilfeührungen
Reamer to remachine valve guide bores
Alésoir pour guides de soupape





Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
52	8041388	X	X	X	X	X	X	X	X

Benennung Description Dénomination
Dreischneidenstahl zum Bearbeiten der Ventilsitze (30°)
Multiple edge cutting tool to remachine valve seats (30 degrees)
Outil à trois tailles pour l`usinage des sièges de soupape (30 degrés)

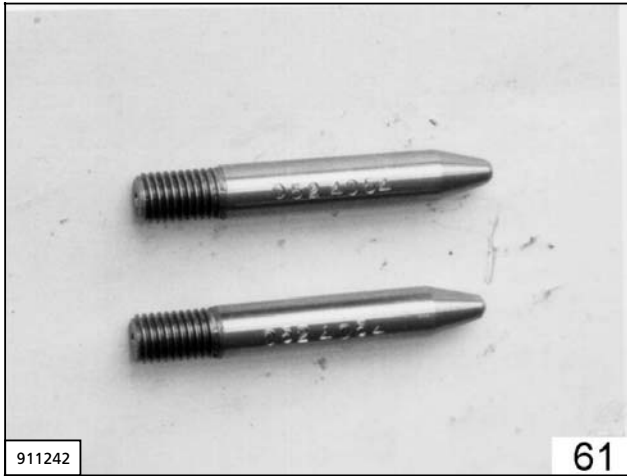


Notizen / Notes / Notices

LIEBHERR	Benennung/Description/Dénomination Montagehülsen und Montagebolzen Installation bushings and guide pins Douilles et axes de montage	Typ Model Type D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.15
Datum/Edition/Date 05 / 2003		



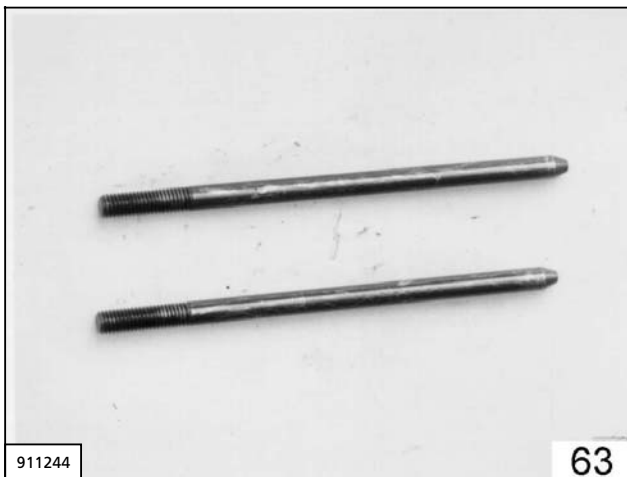
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
60	0523460	X	X	X	X	X	X	X	X



61	0524054	X	X	X	X	X	X	X	X
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62	0524055	X	X	X	X	X	X	X	X
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63	0524059	X	X	X	X	X	X	X	X
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**Benennung
Description
Dénomination**

Montagehülse
für Kurbelwellendichtring auf der
Schwungradseite

Installation bushing to install rear crankshaft seal

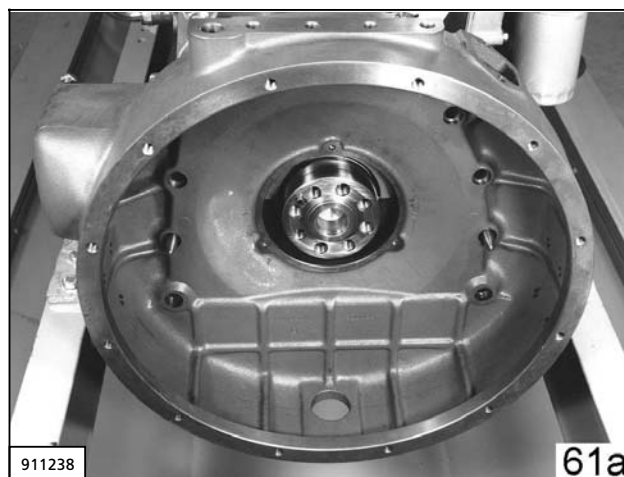
Douille de montage du joint à lèvres sur le
vilebrequin côté volant



Montagebolzen
für Schwungradgehäuse

Guide pins to remove and install
flywheel housing

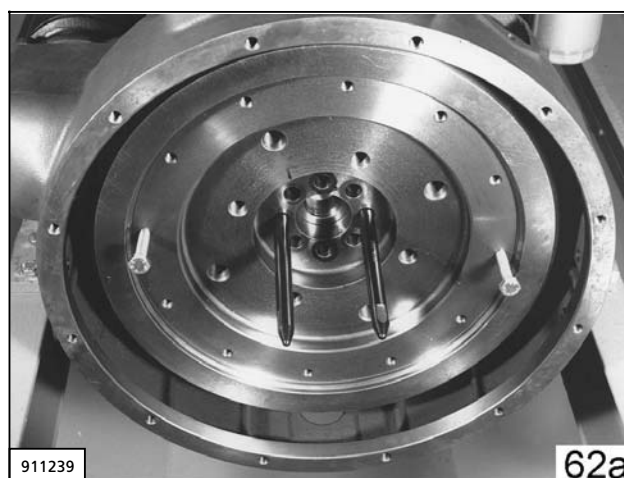
Mandrin de montage du carter
de volant



Montagebolzen
für Schwungrad

Guide pins to remove and install flywheel

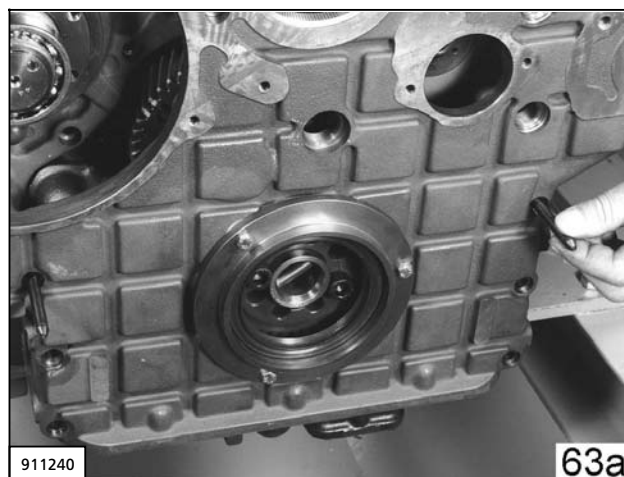
Mandrin de montage volant

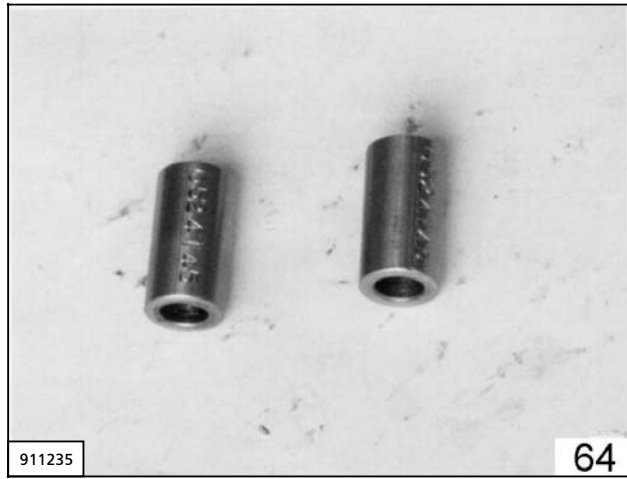


Montagebolzen
für Aggregateträger

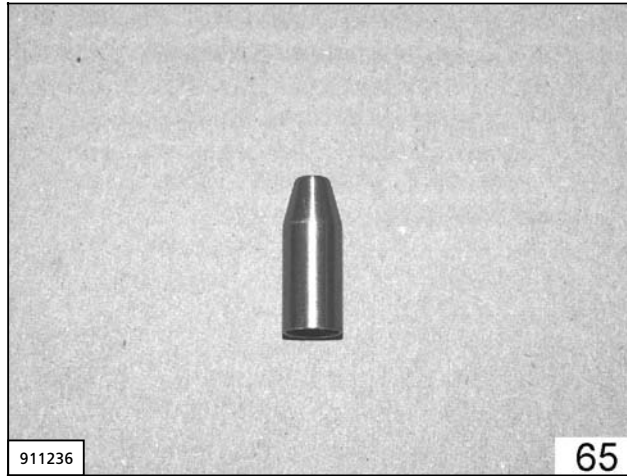
Guide pins to remove and install
the timing and accessory drive gear box

Mandrin de montage du porte-accessoires

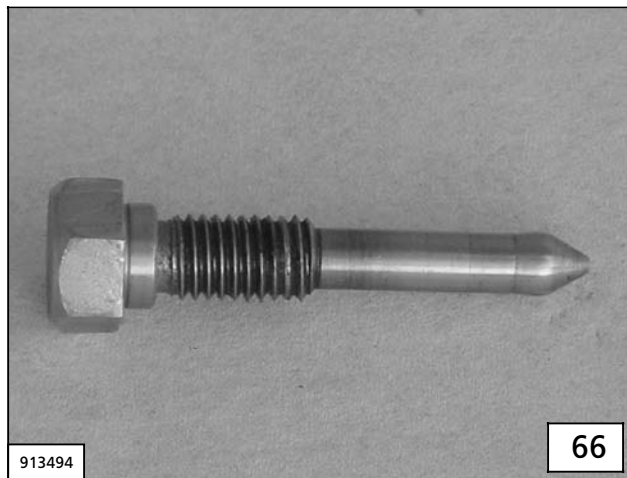




Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
64	0524145	X	X	X					



65	0529454			X	X	X	X	X	X
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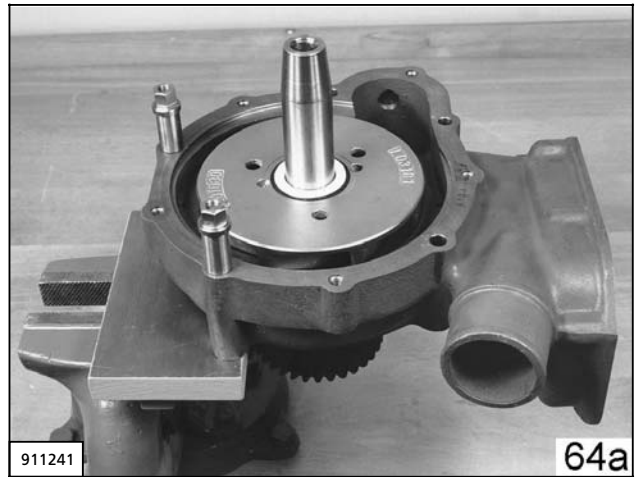
66	0542744		X	X	X	X	X	X	X
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**Benennung
Description
Dénomination**

Montagebuchsen
für Kühlmittelpumpe-Montagebock

Installation bushing for coolant pump assembly fixture

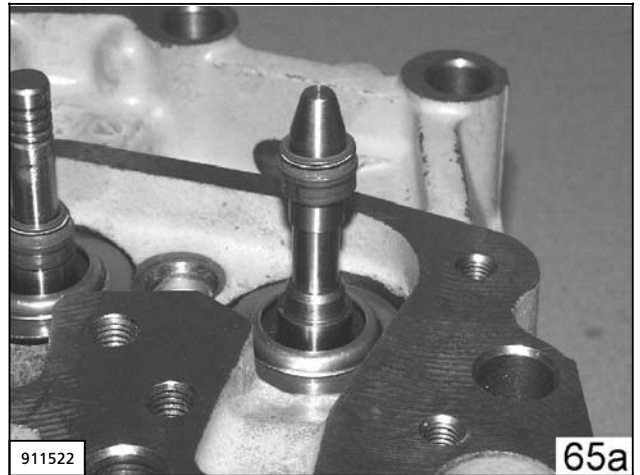
Douilles de montage pour pompe à eau dispositif de bridage



Montagehülse
für Ventilschaftdichtringe

Mounting sleeve for valve shaft seal rings

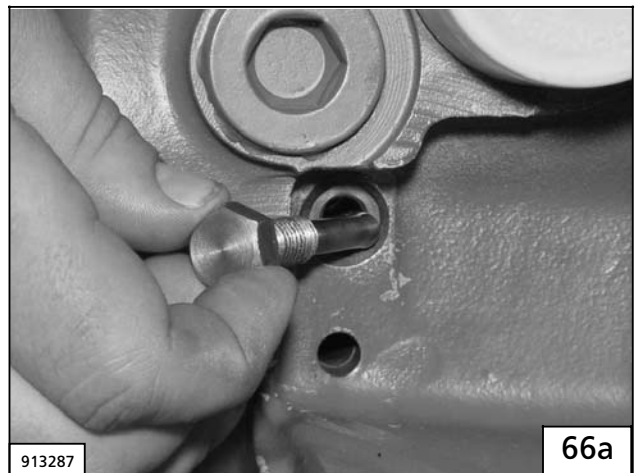
Douille de montage de joint pour queue de soupape



Fixierschraube
für Kühlmittelpumpen-Montage

Fixing screw for coolant pump assembly

Vis de fixation de montage pour pompe à eau

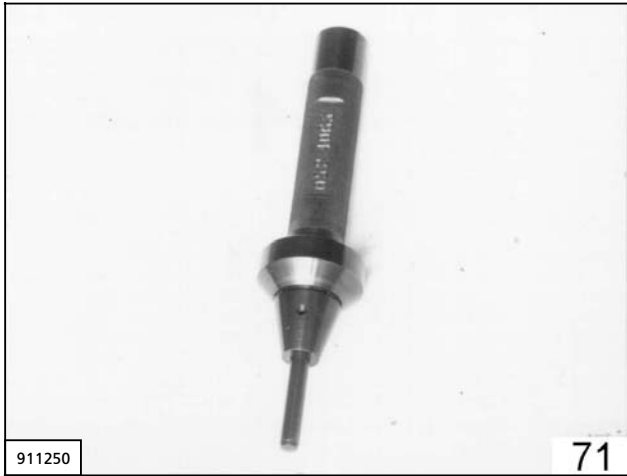


Notizen / Notes / Notices

LIEBHERR	Benennung/Description/Dénomination Montagehilfen und Spezialschlüssel Assembly and installation aids, special wrenches Acessoires de montage et de spéciales	Typ Model Type D 904 / 914 / 924 906 / 916 / 926
		Ab/from/à partir de
		Blatt/Page/Feuille 11.18
Datum/Edition/Date 05 / 2003		



Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
70	0524047	X	X	X	X	X	X	X	X



71	0524063	X	X	X	X	X	X	X	X
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72	0524049	X	X	X	X	X	X	X	X
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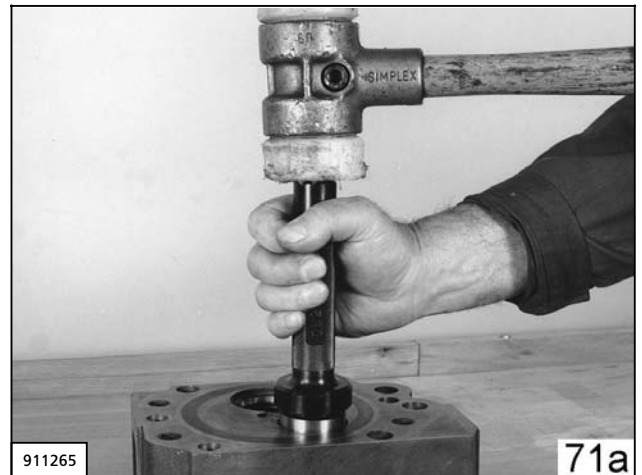


73	0523624	X	X	X	X	X	X	X	X
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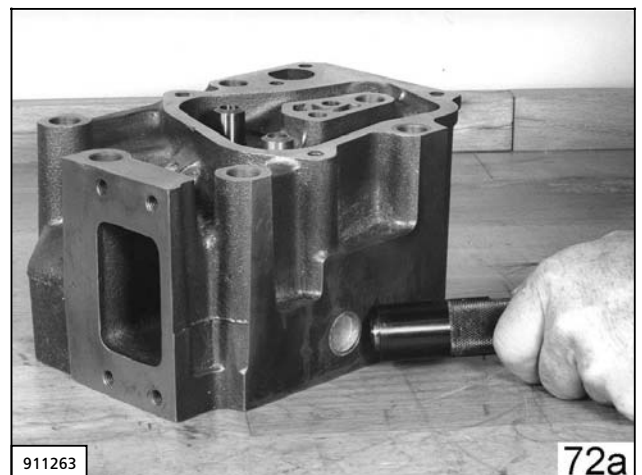
Benennung Description Dénomination
Stempel für Ventildführungen Punch to remove and install valve guides Tampon pour guides de soupape



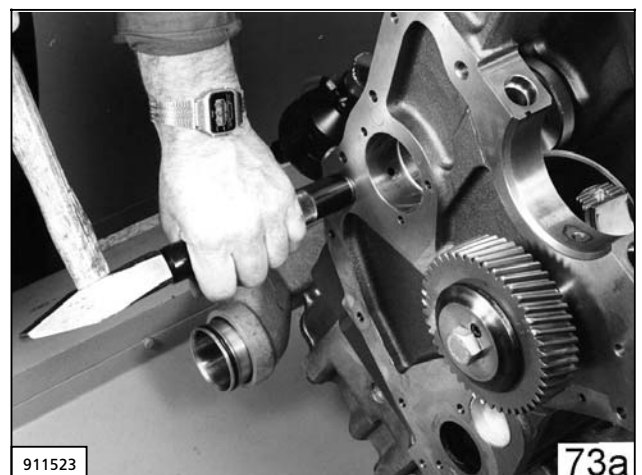
Stempel für Ventilsitzringe Punch to install valve seat rings Tampon pour sièges de soupape



Stempel für Verschlußdeckel Ø 22 mm im Zylinderkopf und Lagerbuchsen Kühlmittelpumpe Punch to install plug (22 mm DIA) on cylinder head and bushings coolant pump Tampon pour bouchon Ø 22 dans la culasse et bagues pompe à eau
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Stempel für Verschlußdeckel Ø 24 mm im Kurbelgehäuse Punch to install plug (24 mm DIA) on engine block Tampon pour bouchon Ø 24 dans le bloc moteur





Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
74	0524050	X	X	X	X	X	X	X	X



75	0522552	X	X	X	X	X	X	X	X
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76	0524061	X	X						
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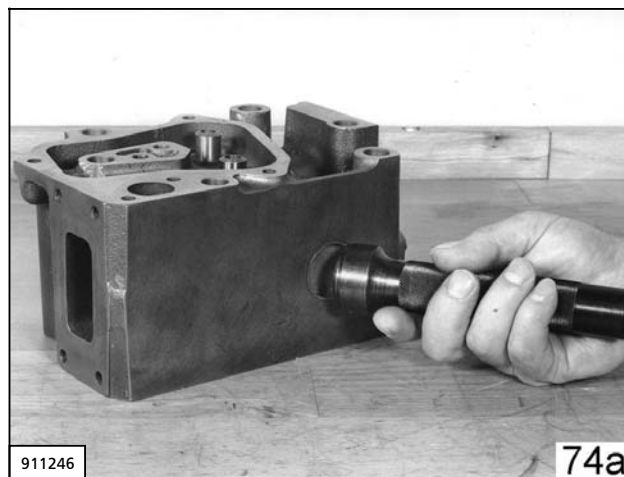
77	0523625	X	X	X	X	X	X	X	X
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**Benennung
Description
Dénomination**

Stempel
für Verschlußdeckel Ø 36 mm
im Zylinderkopf

Punch to install plug (36 mm DIA)
on cylinder head

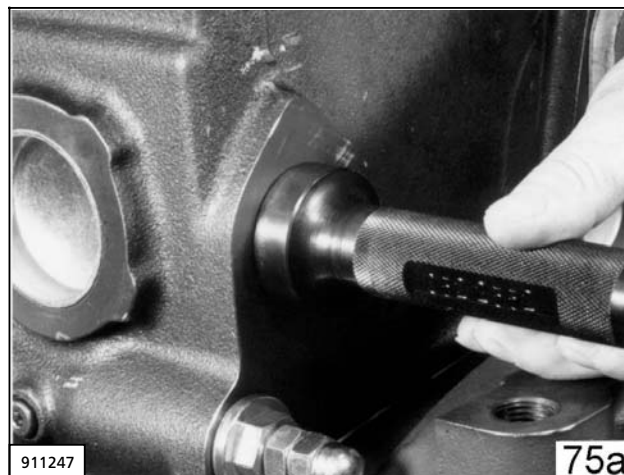
Tampon pour bouchon Ø 36 dans la culasse



Stempel
für Verschlußdeckel Ø 45 mm
im Kurbelgehäuse

Punchplate to install plug (45 mm DIA)
on engine block

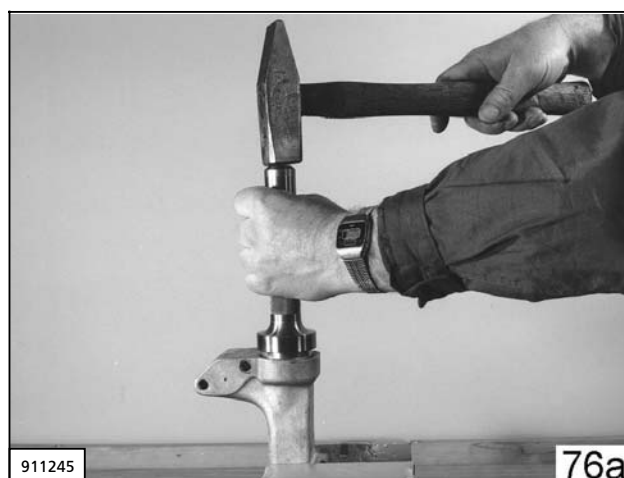
Tampon pour bouchon Ø 45 dans le
bloc moteur



Stempel
für Verschlußdeckel Ø 48 mm in der
Kühlmittelsammelleitung

Punchplate to install (48 mm DIA) on coolant
manifold

Tampon pour bouchon Ø 48 dans le collecteur de
réfrigérant



Stempel
für Verschlußdeckel Ø 63 mm im Kurbelgehäuse

Punchplate to install plug (63 mm DIA) on engine
bloc

Tampon pour bouchon Ø 63 dans le bloc moteur





Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
78	0523639	X	X	X	X	X	X	X	X



79	0524053	X	X	X	X	X	X	X	X
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80	0524056	X	X	X	X	X	X	X	X
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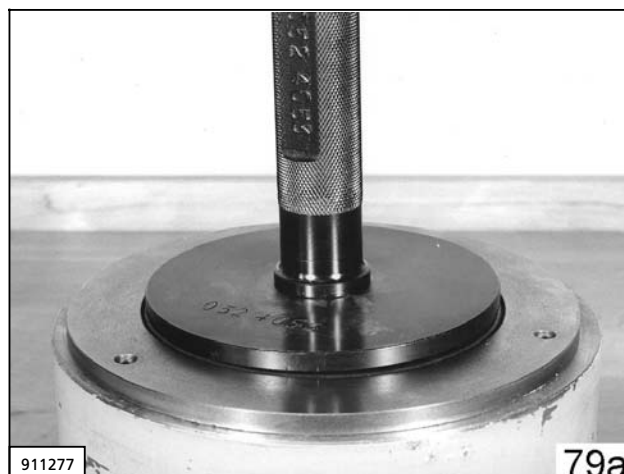


81	0524066	X	X	X	X	X	X	X	X
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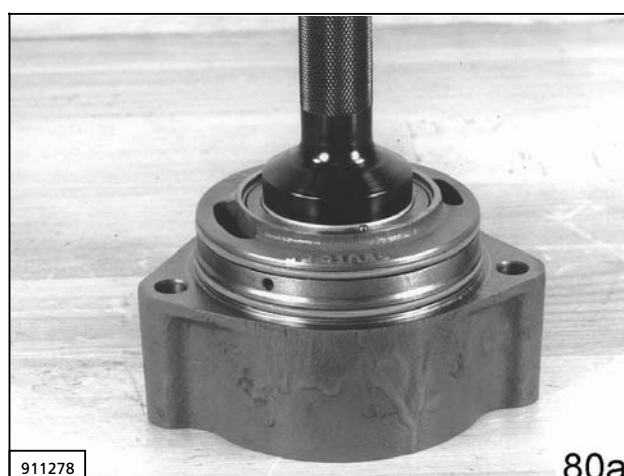
Benennung Description Dénomination
Stempel für Ventilsitz am Endregelventil Punch to install oil pressure relief valve seat Tampon pour siège de clapet de pression d`huile



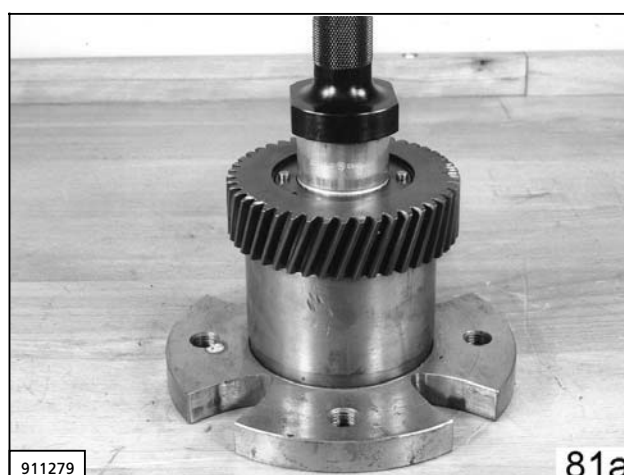
Stempel für Kurbelwellenabdichtungen Punchplate to remove and install crankshaft seals Tampon pour joints de vilebrequin
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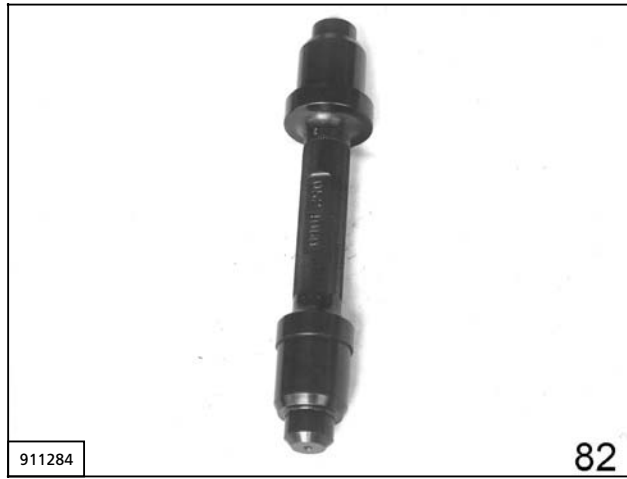


Stempel für Einspritzpumpen-Antrieb Punch to remove and install injection pump carrier bushing Tampon pour entraînement de pompe d`injection
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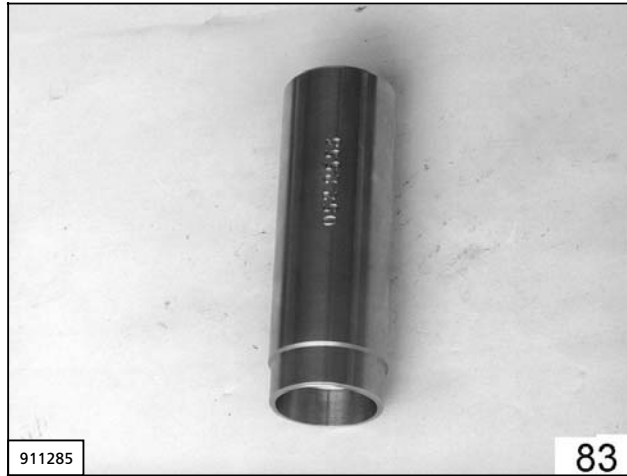


Stempel für Zwischenrad und Hydraulikpumpen-Antrieb Punch to remove and install intermediate gear wheel bushing and hydraulic pump drive Tampon pour pignon intermédiaire et pour entraînement de pompe hydraulique





Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
82	0524060	X	X	X	X	X	X	X	X



83	0522553	X	X	X					
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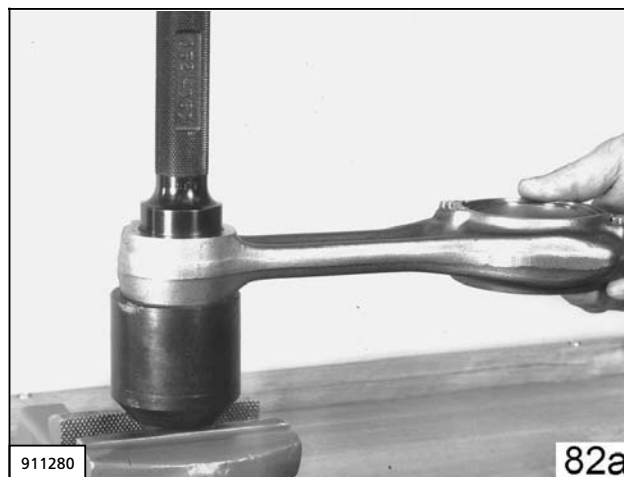


84	0524057	X	X	X					
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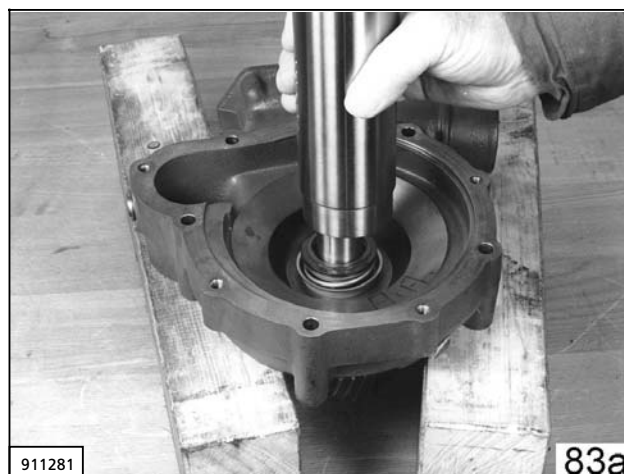


85	0524142	X	X	X	X	X	X	X	X
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Benennung Description Dénomination
Stempel für Kolbenbolzenbuchse Punch to remove and install connecting rod bushing Tampon pour chemise de piston



Stempel für Gleitringdichtungen in der Kühlmittelpumpe Punch to install coolant pump glide ring seal Tampon pour joints mécaniques de pompe à eau

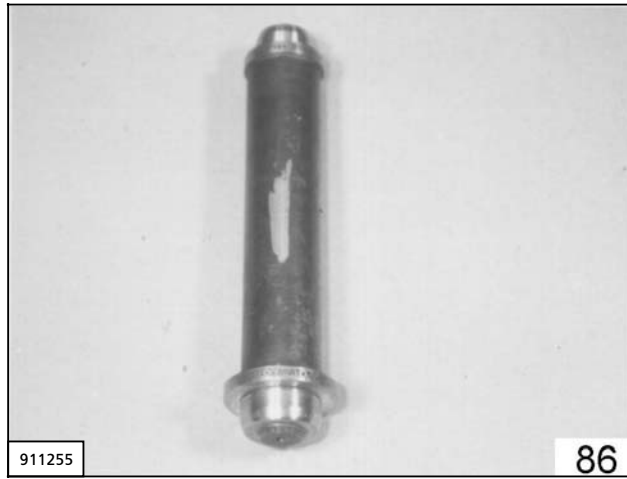


Stempel für Kugellager Einspritzpumpen-Antrieb und Kühlmittelpumpe Punch to install ball bearings in coolant pump and injection pump drive assembly Tampon pour roulement à billes d'entraînement de pompe d'injection et de pompe à eau
--



Stempel für Dichtring und Kugellager an der Kühlmittelpumpe und Kugellager Lüfterantrieb Punch to install coolant pump ball bearing and shaft seal as well as ball bearing on fan drive Tampon pour joint d'étanchéité et roulements à billes de pompe à eau et d'arbre d'entraînement du ventilateur

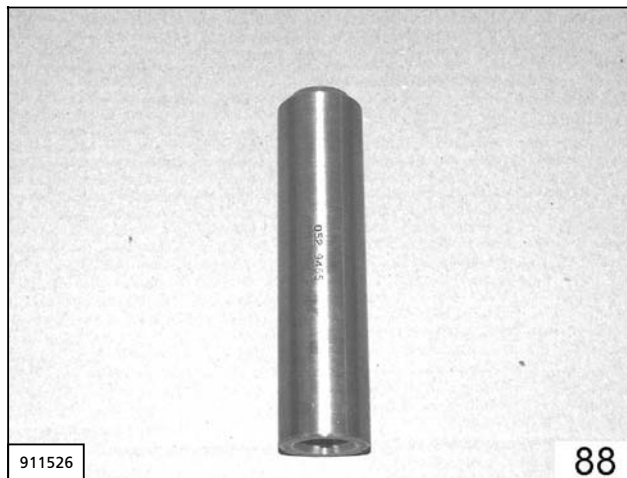




Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
86	0526859		X	X	X	X	X	X	X



87	0526862		X	X	X	X	X	X	X
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88	0529455			X	X	X	X	X	X
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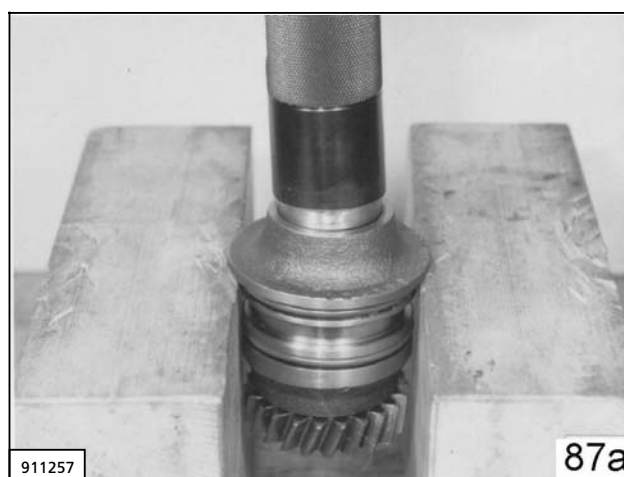


89	0528475			X	X	X	X	X	X
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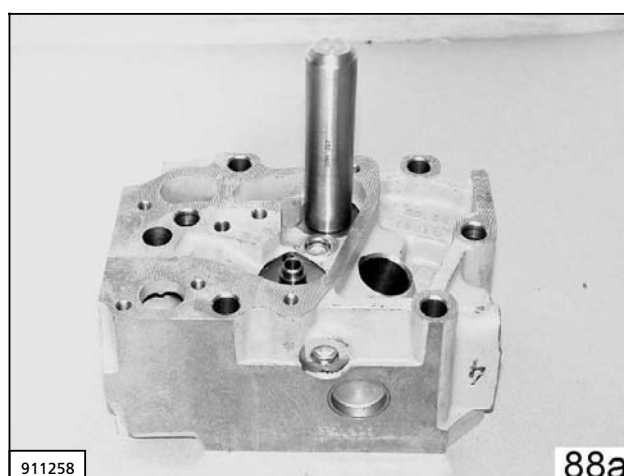
Benennung Description Dénomination
Stempel für Dichtring im Lüfterantrieb und Kühlmittelpumpe (Kühlmittelpumpe im Aggregateträger integriert) Punch for seal ring in fan drive and coolant pump (Coolant pump integrated in accessory drive gear box) Tampon pour joint d'étanchéité de l'entraînement du ventilateur et de la pompe à eau (pompe intégrée dans le carter de distribution)



Stempel für Gleitringdichtung in der Kühlmittelpumpe (Kühlmittelpumpe im Aggregateträger integriert) Punch for glide ring seal on coolant pump (Coolant pump integrated in accessory drive gear box) Tampon pour joints mécaniques de pompe à eau (pompe intégrée dans le carter de distribution)

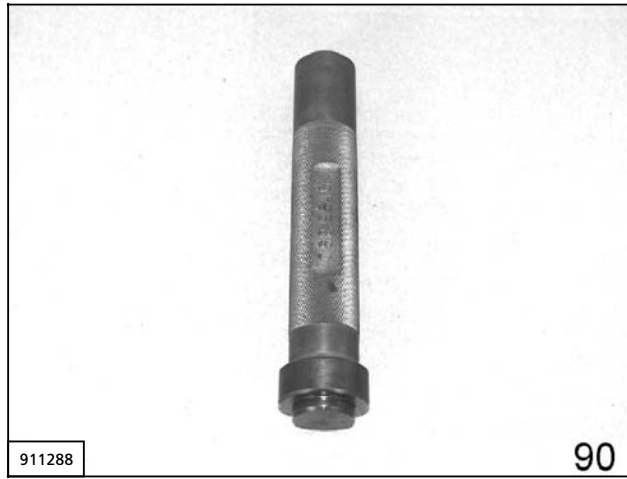


Stempel zum Einschlagen von Ventilfehrungen für Ventilschaftdichtringe Punch for drive in of valve guides for valve shaft seal rings Tampon de montage de joint pour guide de soupape

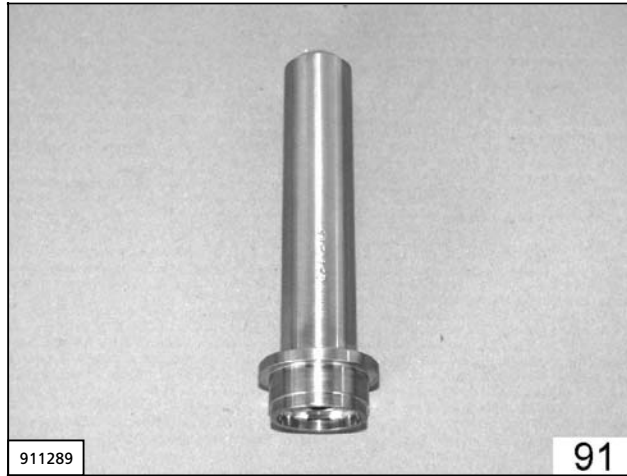


Stempel für Dichtring im Lüfterantrieb Punch for seal ring in fan drive Tampon pour joint d'étanchéité de l'entraînement du ventilateur





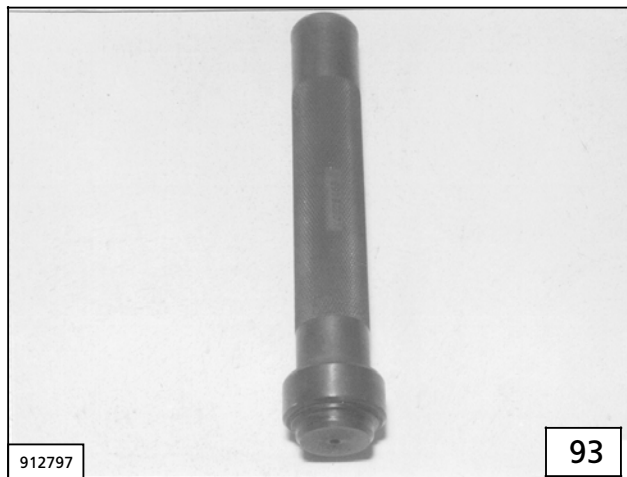
Nr. No. Nr.	Ident-Nr. Order-Nr. Nr.-Code	D 904/906 NA	D 904/906 TB / T / TI	D 914/916 T / TI	D 926 TI	D 924/926 T-E A1	D 924/926 T/TI-EA2/3	D 924/926 TI-E A4	D 924/926 TI-EA5
90	0529546		X	X	X	X	X		



91	0541544					X	X	X	X
----	---------	--	--	--	--	---	---	---	---



92	0542224		X	X	X	X	X	X	X
----	---------	--	---	---	---	---	---	---	---



93	0528468					X	X	X	X
----	---------	--	--	--	--	---	---	---	---

Benennung Description Dénomination
Stempel für Dichtring in der Kühlmittelpumpe (Kühlmittelpumpe im Aggregateträger integriert) Punch for seal ring in coolant pump (coolant pump integrated in accesory drive gear box) Tampon pour joint d`étanchéité de l` entraînement de la pompe d`eau (pompe intégrée dans le carter de distribution)



Stempel für Dichtring in der Kühlmittelpumpe, Lagerung mit Bundlager Punch for seal ring in coolant pump, bearing with flange bushing Tampon pour joint d`étanchéité de l` entraînement de la pompe d`eau, avec palier boudin



Stempel für Gleitring-Kassettdichtung in der Kühlmittelpumpe, Lagerung mit Bundlager Punch for modular glidering seal on coolant pump, bearing with flange bushing Tampon de montage de la garniture-mécanique de pompe à eau, avec palier boudin



Stempel für Bundlager im Hydraulikpumpen-Antrieb Punch to remove and install hydraulic pump drive flanged bushing Tampon de démontage et montage de douille à collet pour entraînement de pompe hydraulic auxiliaire
--



Untergruppen - Verzeichnis Sub-Group Index Désignation des sous-groupes

12.01 **Engine control equipment removal and installation**

LIEBHERR	Benennung/Description/Dénomination	Typ Model Type
	Electronic	D 904 / 914 / 924
Datum/Edition/Date	engine governor (EMR)	Ab/from/à partir de
05 / 2003		Blatt/Page/Feuille
		12.00

Engine control equipment removal and installation

Important:

By changing an engine control equipment it is imperative to choose a new part with the same Ident no. The Ident No. can be found on the identification plate fixed on the protecting sheat of the engine control equipment.

Note:

When remove engine or control equipment the ignition must be out and the control equipment currentless.

Connection, Disconnection of engine control equipment by mounting, removing the engine:

Disconnecting:

Note:

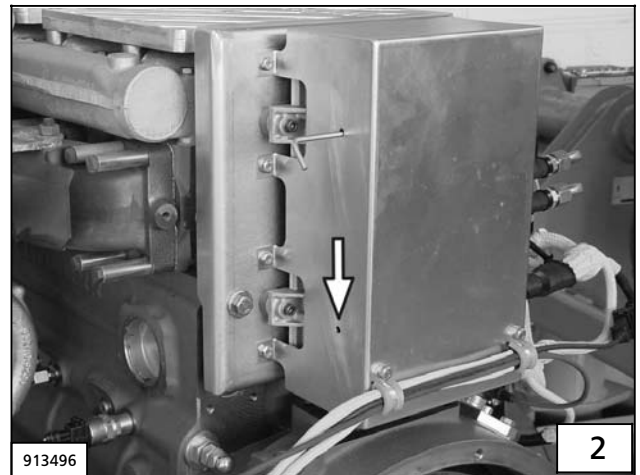
To remove the engine, stake out the 2 plugs on the control equipment.

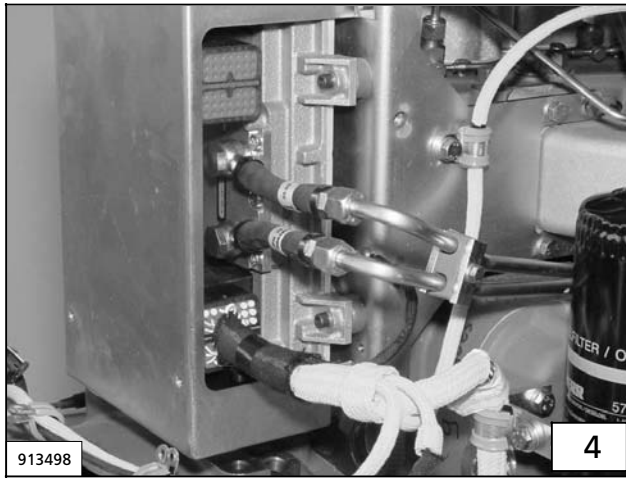
Turn out the hollow screws on both plugs with a long hexagonal screw driver (with over 4 mm) through the holes into the protecting sheet (see fig. 6).

Note:

The hollow screws are secured with locking washers so they can't drop by turning out.

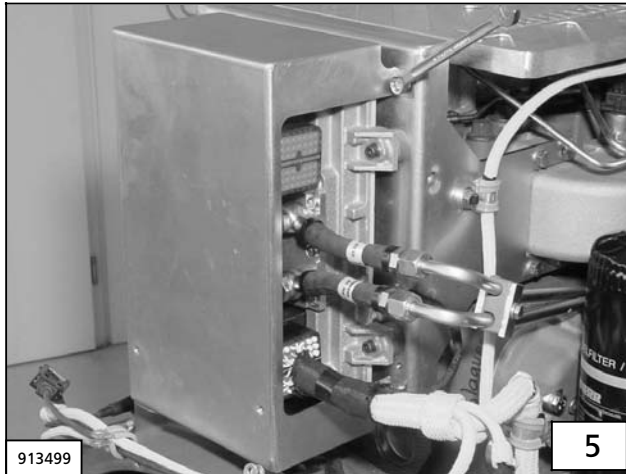
Stake out carefully the 2 plugs on the control equipment.





Connecting:

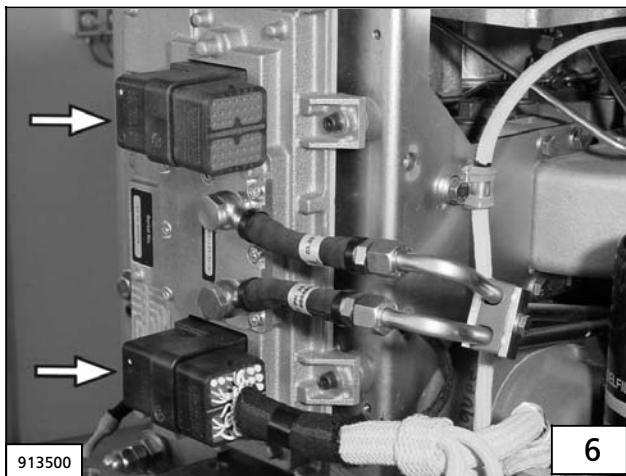
After mounting the engine, slip on carefully the 2 plugs and tighten the hollow screws.



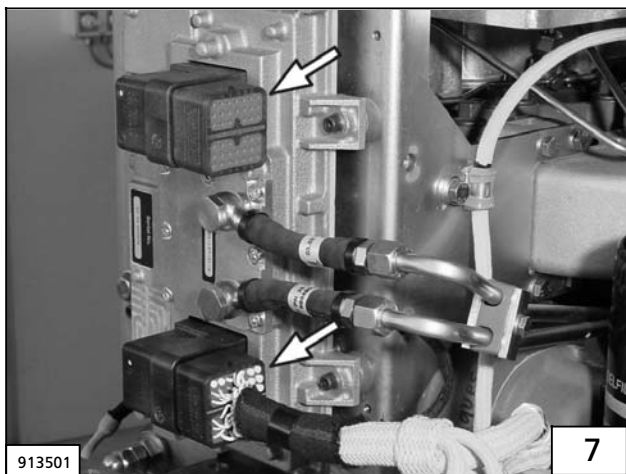
Removing the control equipment:

Close the shut off valves (if existing) on both fuel lines to the control equipment respectively on the fuel tank.

Turn out the holding screws for protecting sheet and remove it from the control equipment.

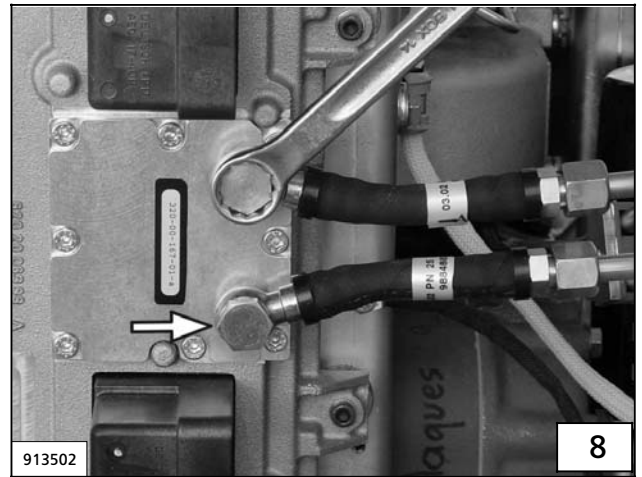


Disengage and turn out the both hollow screws from the plugs with the hexagonal screw driver (with over 4 mm).

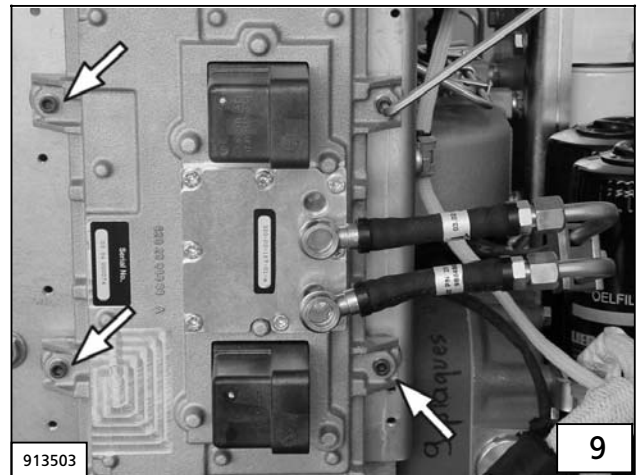


Stake out carefully both plugs from control equipment.

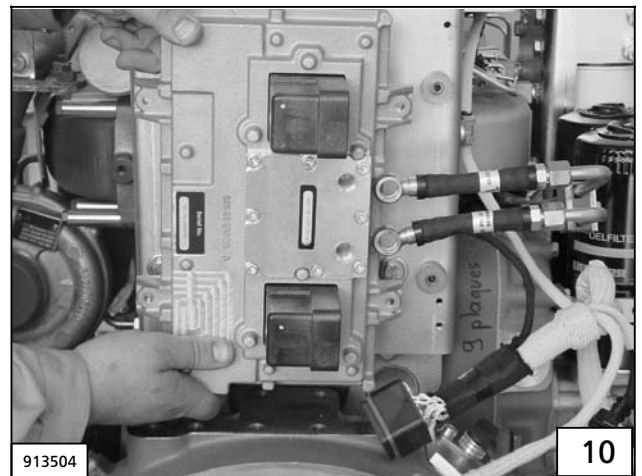
Remove on the fuel cooler the fuel lines from the control equipment.



Disengage and turn out the screws between control equipment and carrier (holding) plate by countering the nuts.



Remove the control equipment from carrier plate.



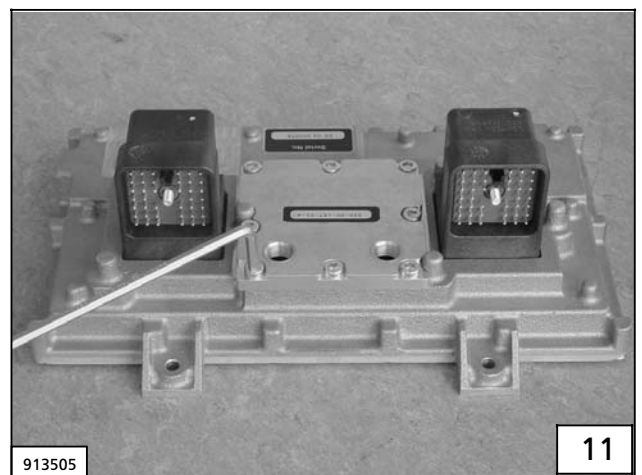
Mounting and removing the fuel cooler on the control equipment:

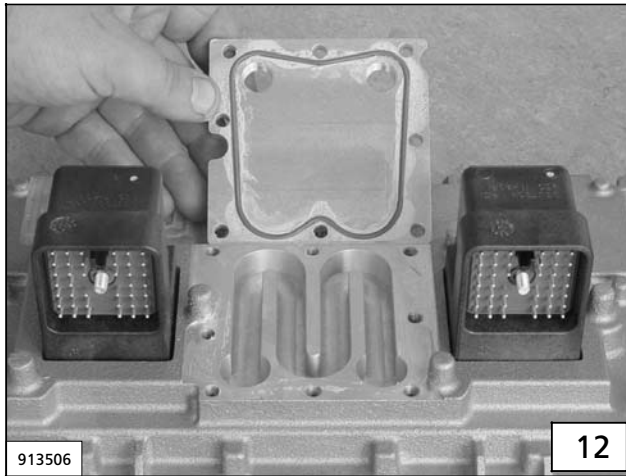
Removing:

Note:

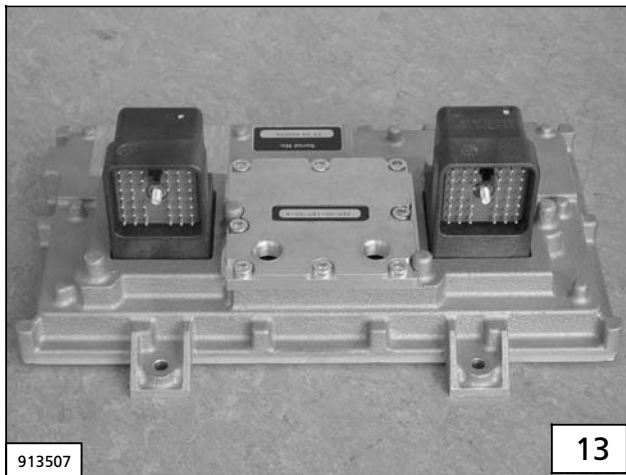
To remove the fuel cooler (if leaky) from the control equipment if is not necessary to remove the control equipment from the engine.

Turn out the screws between fuel cooler and control equipment.



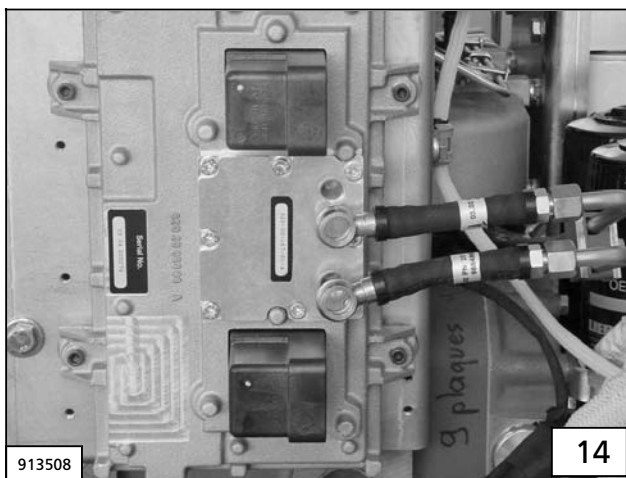


Remove the fuel cooler from control equipment.



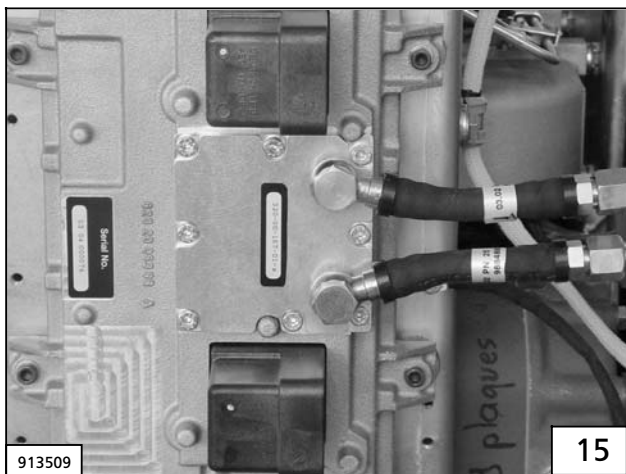
Mounting:

Install fuel cooler on the control equipment and tighten the screws.



Mounting of control equipment:

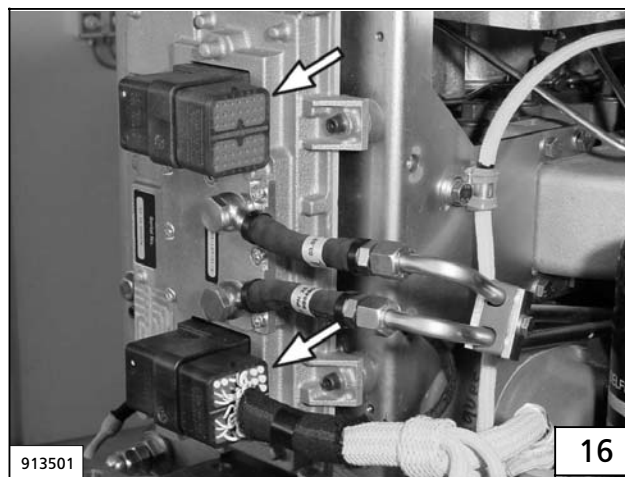
Install control equipment on the carrier plate, mount and tighten the rubber buffer, washers, bushes, screws and nuts.



Mount the fuel lines with new sealing rings on the control equipment.

Open the shut off valve (if existing).

Slip on carefully the 2 plugs and tighten the hollow screws.



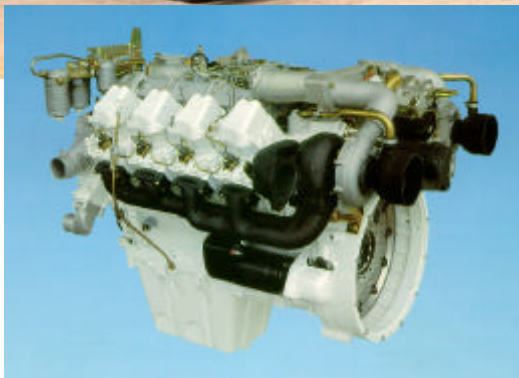
Mount protecting sheet and tighten with screws.





System description
electronic engine speed regulation for
LIEBHERR-construction machinery

LIDEC
DC 5-00



LIEBHERR



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1 Foreword

This description serves as a summary for design and operation of the electronic speed regulator for construction machinery, DC 5-00 of the LIDEC-series (Liebherr Diesel Engine Control), for **LIEBHERR**-diesel engines, types D 924TIE A4, D 926TIE A4, D 9406TIE A4 and D 9408TIE A4.

Furthermore, the most important functions of the DC 5-00 are explained and notes are given concerning trouble-shooting, error diagnosis and remedy.

1.1 EDC/LIDEC description



Injection pump featuring electronically adjustable actuator form modification of the injection quantity via an electronic control unit

Electronic
Diesel
Control
EDC



Electronic control unit for LIEBHERR-diesel engines for control of in-line injection pumps featuring EDC

Liebherr
Diesel
Engine
Control
LIDEC

1.2 Identification plate

LIEBHERR	Motor-ID :	9077118
Machines Bulle SA	Motor-SN :	2003 12 0195
	Regler-ID :	9076487
DC5-00	HW-Version :	0 SPF01
D 9408 TI-E A4	SW-Version :	07.0.01
CE	Regler-SN :	2003 0320

Engine ID : Engine identification number

Engine-SN : Engine serial number

Regulator-ID : Regulator identification number

HW version : Hardware version

0SPF01 Specification number, changes each time an identification number is modified, a new software and/or data record is loaded.

SW -Version : Software Version

Regulator-SN : Regulator serial number (continuous)

2 Notes

This documentation is the property of:

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- Switzerland -

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Issued, 13.06.03

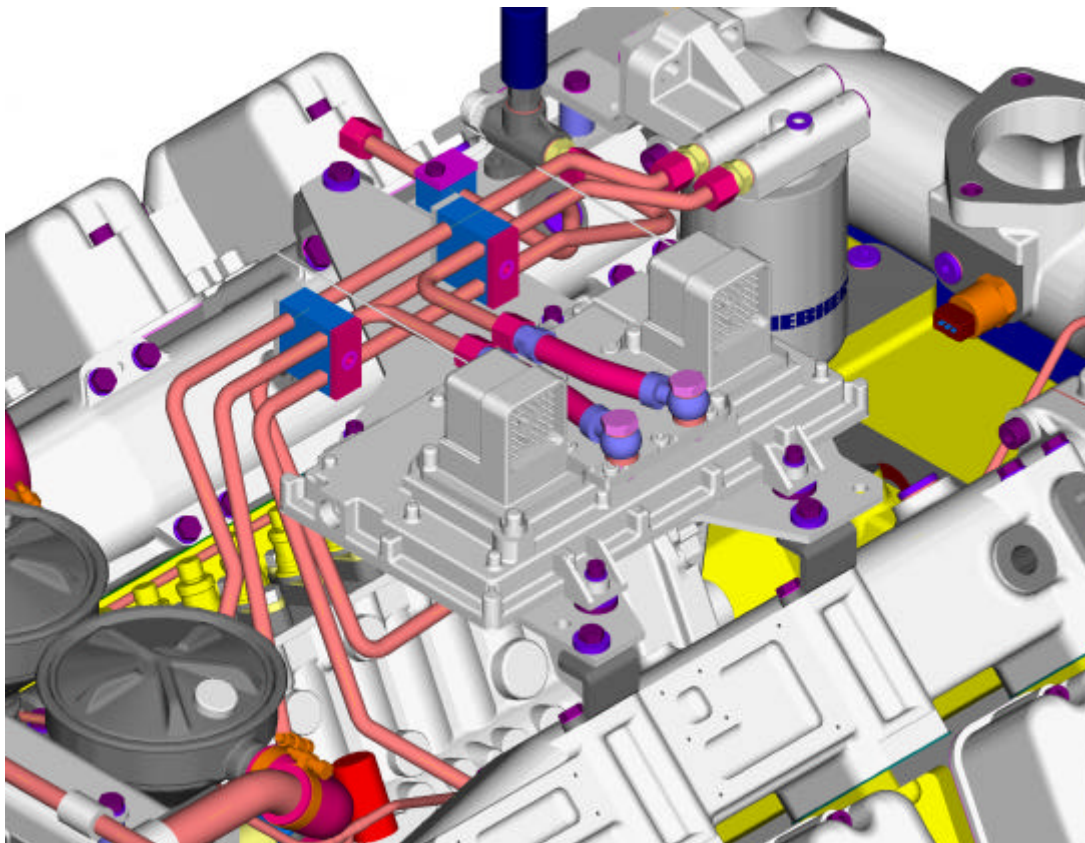
3 Overall system

3.1 Application areas

The electronic speed regulator LDEC DC 5-00 is installed in the construction machinery for the regulation, monitoring and protection of **LIEBHERR** diesel engines.

The regulator was specially designed and developed to combat the prevailing, coarse environmental and operational conditions which the construction machinery is subjected to and is thus capable of coping with these special demands via specially designed features, such as integrated fuel cooling and rugged mechanical housing, as well as various properties, including for example the switchable emergency-operation function.

Aside from the functions of the mechanical regulator (all-speed regulation, torque limitation, charge-air dependent reduction of injection quantity), the DC 5-00 features a multitude of other functions for regulation, monitoring and protection of the diesel engine.



D 9408 TIE A4 featuring regulating assembly on engine

3.2 Summary

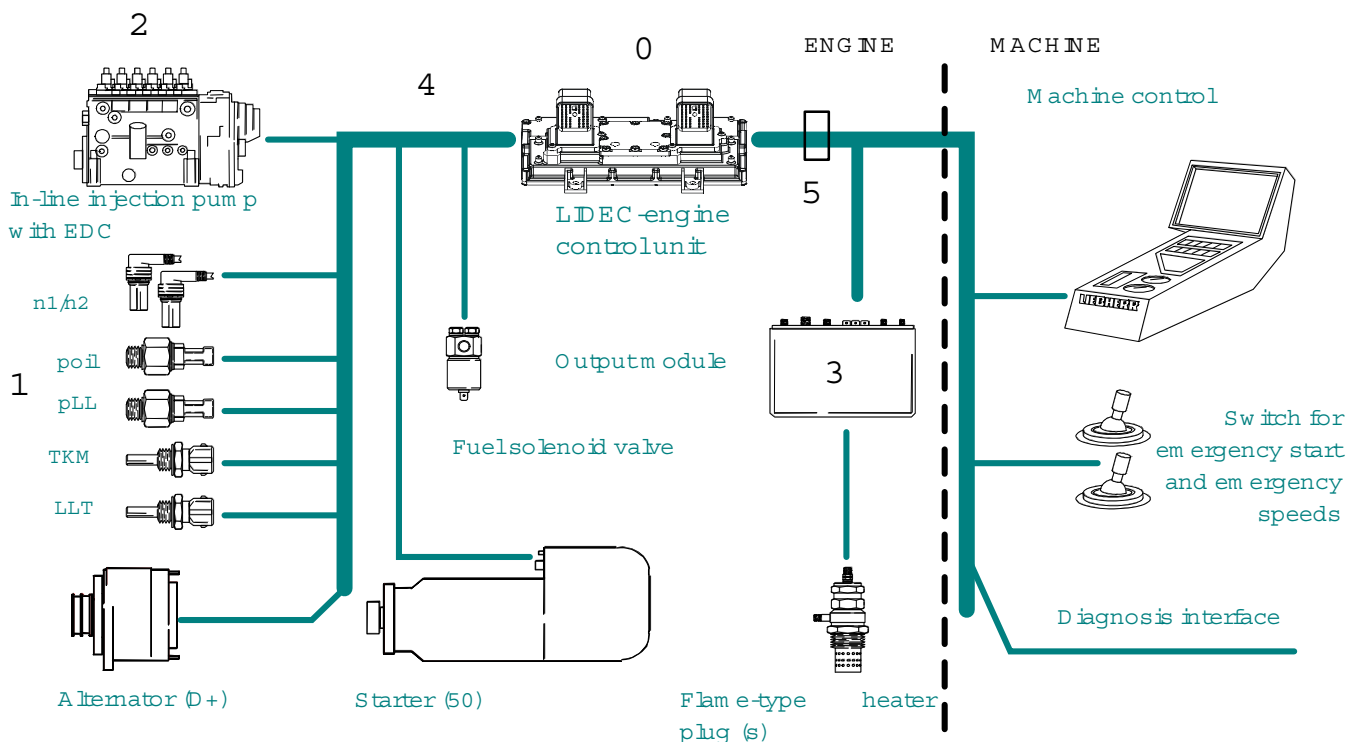
The LDEC system s are comprised essentially of the following components:

- 0 Electronic regulator
- 1 Sensors
- 2 Injection pump featuring electr. actuator (Bosch EDC , Electronic Diesel Control)
- 3 Relay for cold-start control
- 4 Engine wire harness
- 5 Engine interface plug for quick and efficient connection to the machine

All components necessary for engine regulation are connected to the DC 5-00 via a wire harness mounted to the engine.

The wiring on the machine side is done by the machine manufacturer.

The interface between machine and engine electronics is established via the engine wire harness with two engine control unit plugs.



3.3 Description

The electronic regulator is supplied with all the important physical values measured by the engine via the different sensors mounted on the engine.

Using the information concerning the respective, actual engine operating condition, as well as the values (nominal values) of the superior machine control, the electronic regulator operates the control magnet in the EDC-actuator of the injection pump. The EDC actuator then meters the fuel injection quantity currently required by changing the position of the control rod.

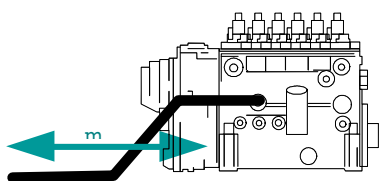
The path sensor in the EDC-actuator reports the position of the control rod back to the electronic regulator, allowing if necessary a control rod regulation. A suitably sized reset spring in the EDC-actuator ensures that the control rod is brought back into the zero position when the engine stops. The electronic regulator LDEC DC 5-00 features a multitude of monitoring and protection functions as well as emergency-operating properties, guaranteeing as error-free an operation of the engine as possible.

Activation of the electronic function of the DC 5-00 is done via the ignition switch (terminal 15).

The DC 5-00 is programmed on the production testbench with basic data and then engine-specifically tested and set. The engine-specific data record resulting thereof includes the serial number of the respective engine and is firmly allocated to it.

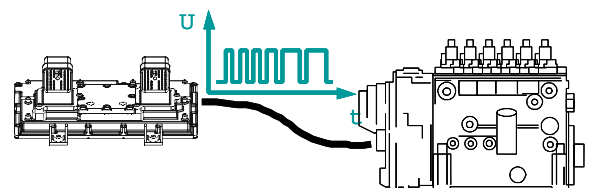
Various customer-specific functions of the electronic regulator can thus also be taken into consideration.

Conventional in-line injection pump:
 Regulating path specification mechanical or electro-mechanical („E-throttle“)



Mechanical control of the control rod via a centrifugal regulator. Thus, preset regulator characteristics, as well as P-grade and performance adjustment via the mechanics.

In-line injection pump with EDC:
 Regulating path specification electronic



Control of an electromagnet in the EDC-actuator for regulating path specification. The regulator characteristics are specified by the control unit and can be programmed.

3.4 Features

In addition to the **LIEBHERR** diesel engine featuring factory-installed, fuel-cooled, electronic regulator and corresponding engine wire harness, the following components are necessary for machine operation:

Power supply (battery 24 V_{DC})

Ignition switch

Switch for emergency operation functions

Operating and control unit (CAN-Bus)

Diagnosis interface in accordance with ISO 9141

Output relay module

4. Functions

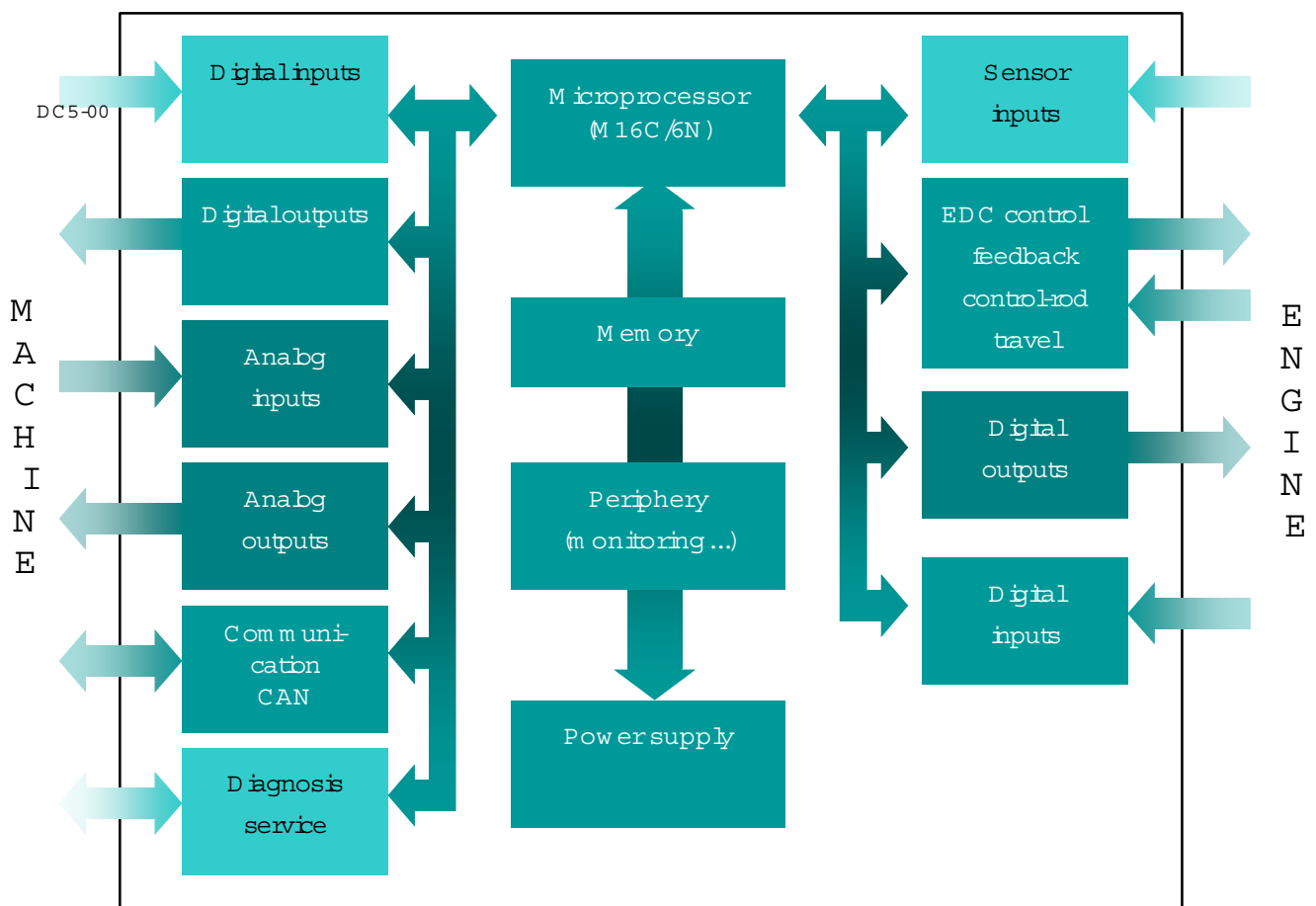
4.1 General

The electronic regulator LDEC DC 5-00 features a multitude of diverse functions for regulation and control of the **LIEBHERR** diesel engines, which may in some cases be activated via external switches, and in some cases via internal parameters in the regulator itself.

The exchange of measured values, signals and data is resulted between engine and machine, either digitally analogous or pulse-length modulated (PWM).

Activation and / or utilisation of the different functions depends on the application being undertaken by the engine and the machine.

As a rule, the main functions of the electronic regulator DC 5-00 are essentially engine speed (injection quantity), the engine monitoring, the engine protection, communication with the machine control and the diagnosis interface.



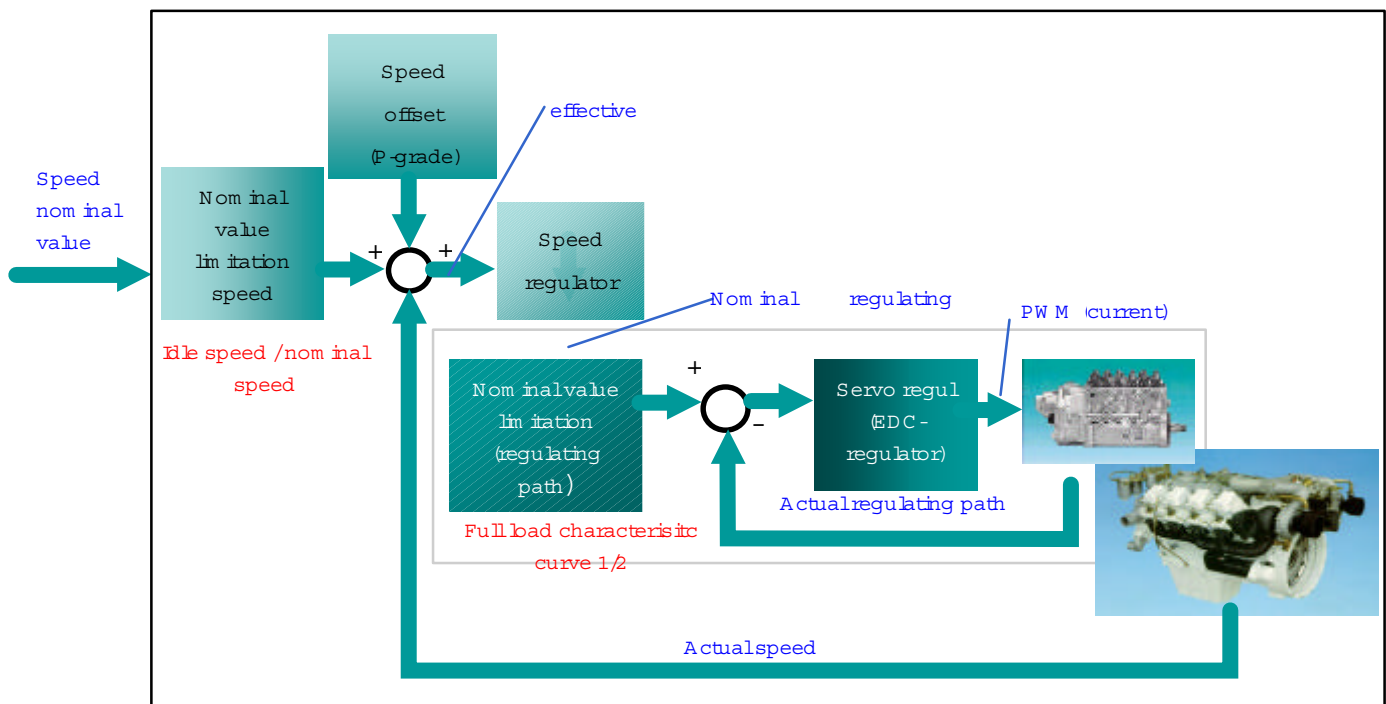
Control unit

4.2 Speed regulation

Due to its specific utilisation in construction machinery, the electronic regulator DC 5-00 has been designed as a pure all-speed regulator.

This type of regulation allows a pre-set speed (nominal value) to be regulated constantly over the entire permissible load range of the engine.

With the specification of any required P-grade within the range of 0...25%, the speed of the electronic regulator, similar to the mechanical regulator, can be defined with the engine in unloaded or fully loaded condition (refer to chapter on P-grade).



4.3 Key switch, ignition

The electronic regulator is switched on and off via the key switch (terminal 15). Switching off the key switch (ignition) with the engine running also causes the engine to shut down (controlled in zero position) and all regulating functions are no longer available.

4.4 Engine Start/Stop

Start-up of the engine results in regular operational mode with ignition switched on (key switch in start position) via the module mounted on the machine, which transmits a start authorisation to the regulator via CAN-Bus. The engine stop also results via the CAN-Bus, by withdrawing the engine release (machine module) or by switching the ignition to „Off“.

Should CAN-Bus fail with the ignition switched on, the engine may also be started via the emergency operation switch (EMERGENCY START) (refer to chapter, Emergency operation).

Shutting down the engine is then only possible by switching off the ignition via the key switch or emergency switch (Emergency off).

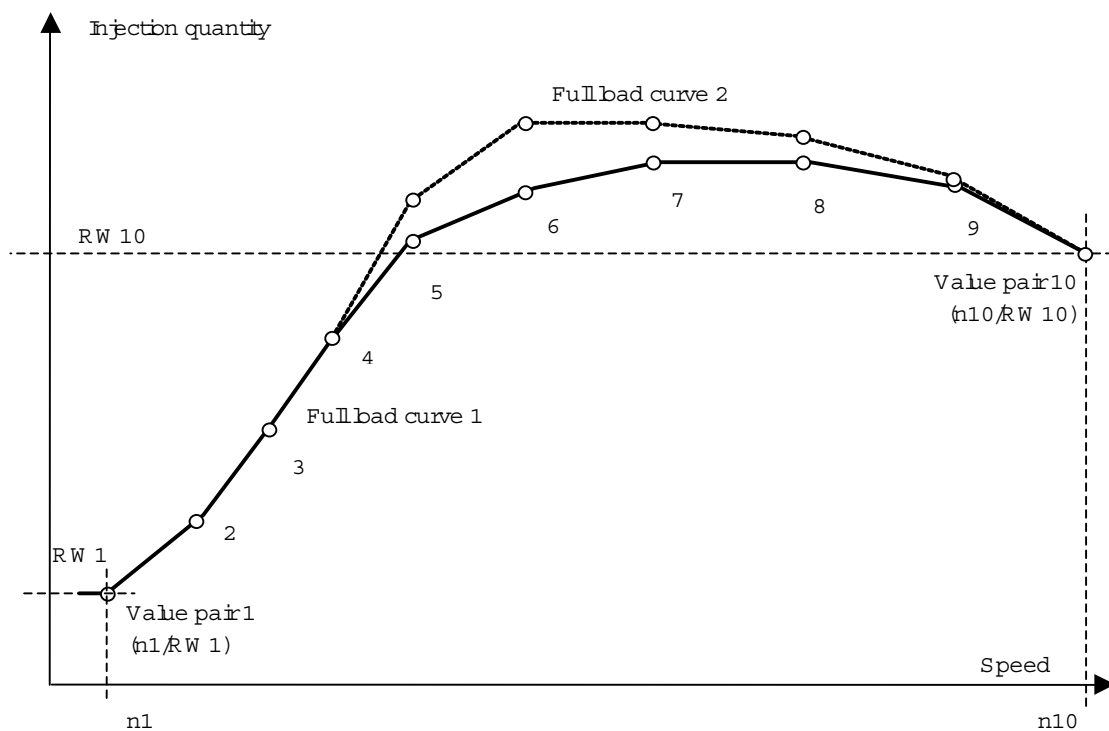
4.5 Nominal value specification

The speed nominal specification for the electronic regulator in regular operation is carried out by the superform machine control via the CAN-Bus.

In emergency operation the speed nominal value is specified via the emergency speed switch.

4.6 Full load characteristic curves

The maximum injection quantities, or rather the maximum regulating path, is limited („full load curve“) depending upon speed.



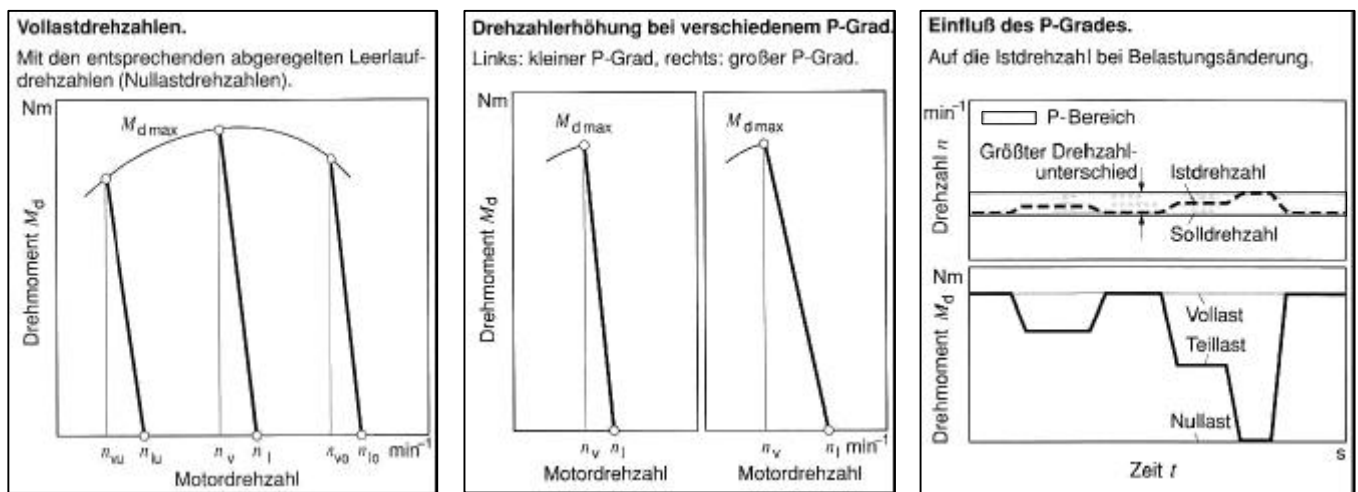
To allow adaptation of the performance or torque pattern during varying operating conditions (e.g. travel or digging operation), two different full load curves are programmed in the electronic regulator DC 5-00, and may be adjusted independently from each other.

The change between the two full load curves is done via the CAN-Bus to the regulator.

4.7 P-grade

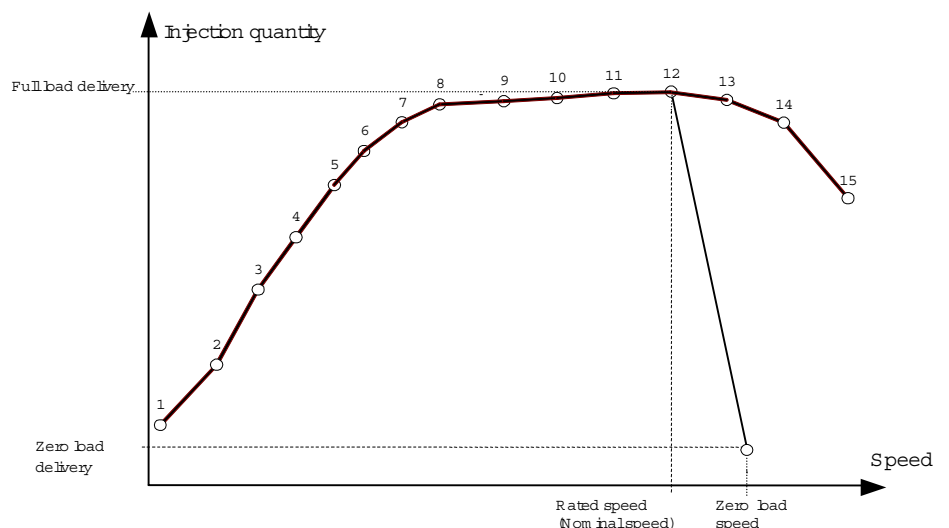
What is a P-grade?

Every engine features a torque nominal curve in accordance with its load capacity. A specific maximum torque is allocated to each speed. If the engine load is reduced to minimum without the control lever position being changed, the speed may only be increased within the control range by a permissible rate specified by the engine manufacturer. The speed increase is proportional to the change in load, thus the greater the decrease in load, the higher the speed. This is therefore known as a proportional P-grade or regulators featuring P-characteristics. The P-grade of the regulator relates in general and is calculated to the upper full load speed (equals nominal speed). In general a stable behaviour of the entire regulating circuit (regulator, engine and driven machine or vehicle) can be achieved via an increased P-grade. On the other hand, the P-grade is limited by the operating conditions.



There are two separate P-grades for the full load characteristic curves (curves 1 and 2). Switch-over of the P-grade is synchronised with switch-over of the full load curve. As opposed to the mechanical regulator, the electronic regulator DC 5-00 allows the opportunity of working with a P-grade of 0%. As a P-grade of 0% is undesirable in many cases, and especially in construction machinery featuring horsepower controlled regulation, this can be programmed freely within the range of 0..25% in the regulator.

The difference in speed between fully loaded and unloaded engines remains constant throughout the entire speed range, while the P-grade changes constantly. The P-grade is programmed in the regulator and can not be externally modified.

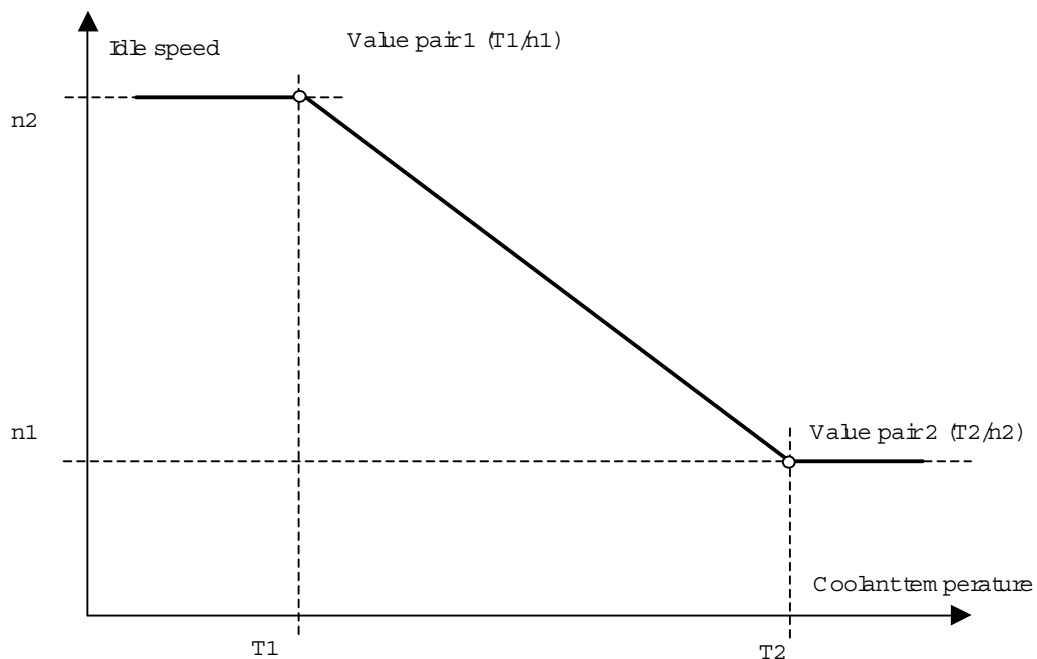


4.8 Display and control functions

All engine-relevant data and measured values, as well as those recorded by the regulator are displayed via CAN. The values listed below can be checked in either the display or in the DC-Desk. They are:

1. Oil pressure
2. Charge air temperature
3. Charge air pressure
4. Coolant temperature
5. Engine nominal and actual speed
6. Battery voltage
7. Condition of flame start unit
 - Starter
 - Solenoid valve
 - Flame-type glow plug(s)
8. Error reports

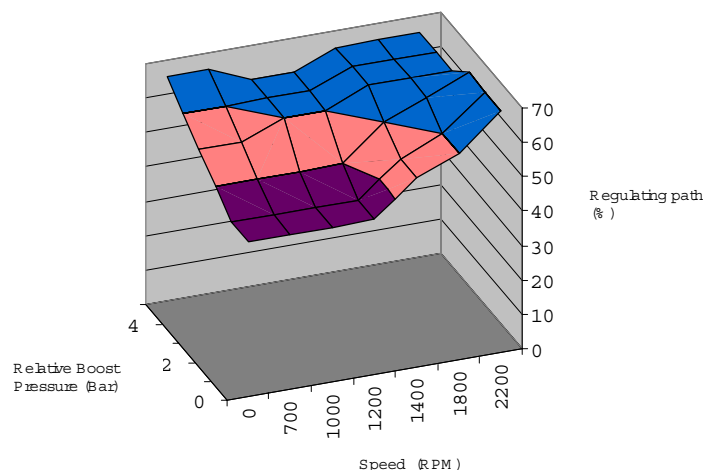
4.9 Temperature-dependent low idle speed increase



The idle speed (low engine speed without load) is increased in accordance with the coolant temperature in order to obtain a constant idle speed even at low temperatures and to ensure quicker engine warm-up.

4.10 Charge air pressure and speed-dependent fuel injection quantity limitation

In the lowerspeed range (down to approx. 1500 rpm), the smoke output is limited via the boost pressure-dependent fuel injection quantity limitation (LDA-function). If the speed exceeds 1500 rpm, the injection quantity limitation no longer applies (smoke limitation). The dynamic response behaviour of the machine has thus been improved. As opposed to mechanical regulation, the full injection quantity is considered and then reduced as required.

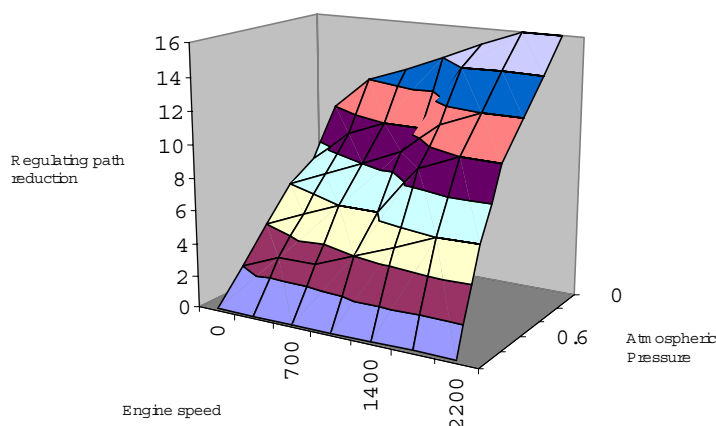


The relative charge air pressure is calculated with the atmospheric pressure and the absolute charge air pressure:

$$P_{\text{relativ}} = P_{\text{absolut}} - P_{\text{atm}}$$

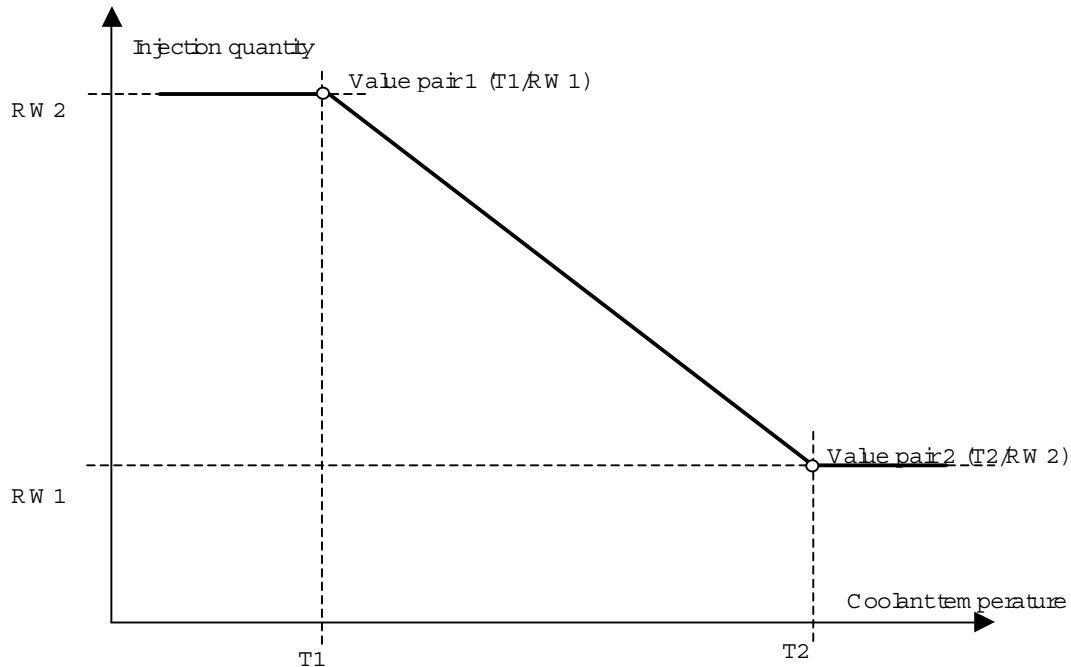
4.11 Atmospheric pressure and speed-dependent injection quantity reduction

At high altitudes, there is less air mass being sucked in due to the reduced air density. The injected full load quantity can not be combusted. Smoke formation is a result and the engine temperature rises. A further problem is presented by the exhaust turbo-charger, as it runs the risk of overspeeding as a result of the reduced air density/exhaust back pressure and constant injection quantity. To avoid this a fuel injection reduction is absolutely necessary. The injection quantity (reduction) is adjusted automatically to the respective prevailing atmospheric pressure (ambient pressure) in the pre-programmed characteristic curves via an atmospheric pressure sensor installed in the regulator (DC5).



Reduction in performance (%)		Speed (l/min)				
		1000	1300	1600	1900	2100
Atmospheric pressure (mbar) height above sea level* (m)	550 4850*	23.1	24.1	24.4	24.4	23.3
	620 3950*	19.5	19.6	19.1	19.1	18.0
	690 3100*	14.2	14.8	13.9	13.6	12.6
	770 2250*	10.0	10.1	8.9	8.4	7.2
	840 1550*	0.0	0.0	0.0	0.0	0.0

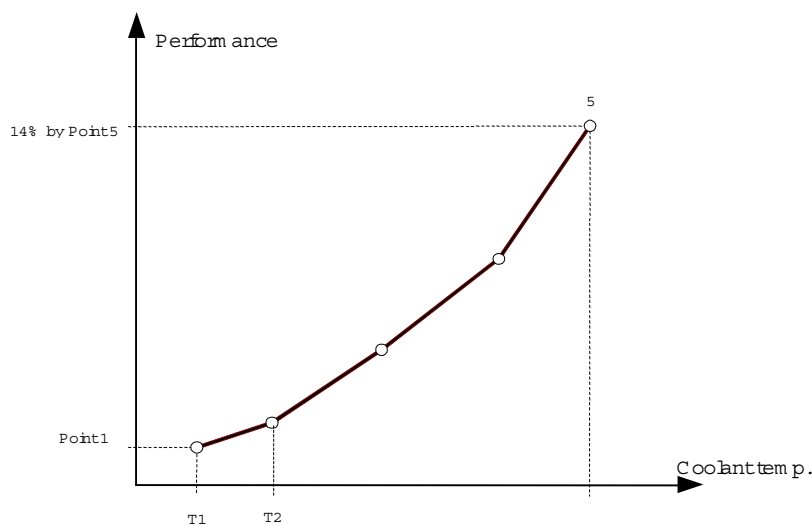
4.12 Temperature-dependent start-up fuel quantity setting



To always guarantee an optimum start-up even at low temperatures and to reduce smoke when starting up at high temperatures, the electronic regulator DC 5 features a temperature-dependent adjustment of the fuel injection quantity when the engine is started.

This is defined by two values which determine the injection quantity with the engine cold and the injection quantity with the engine warm. A linear interpolation of the values (calculated injection quantity) is given between these two points.

4.13 Coolant temperature-dependent performance reduction



For reasons of safety, a reduction in output is undertaken by the regulator whenever the coolant temperature rises too high.

A nominal curve with 5 pairs of values (coolant temperature in °C, and performance reduction in % of the full load curve reduction) is available.

Example:

T1	= 100 °C	= 0% reduction
T2	= 101 °C	= 3% reduction

4.14 Charge air temperature-dependent performance reduction

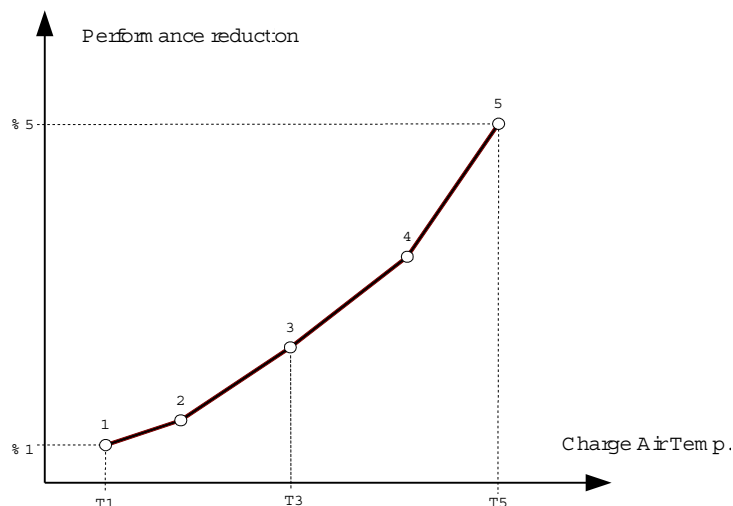
For reasons of safety, the regulator must undertake a reduction of performance whenever the charge air temperature rises too high.

A nominal curve with 5 pairs of values (charge air temperature in °C, and output reduction in % of the full load curve reduction) is available.

Example:

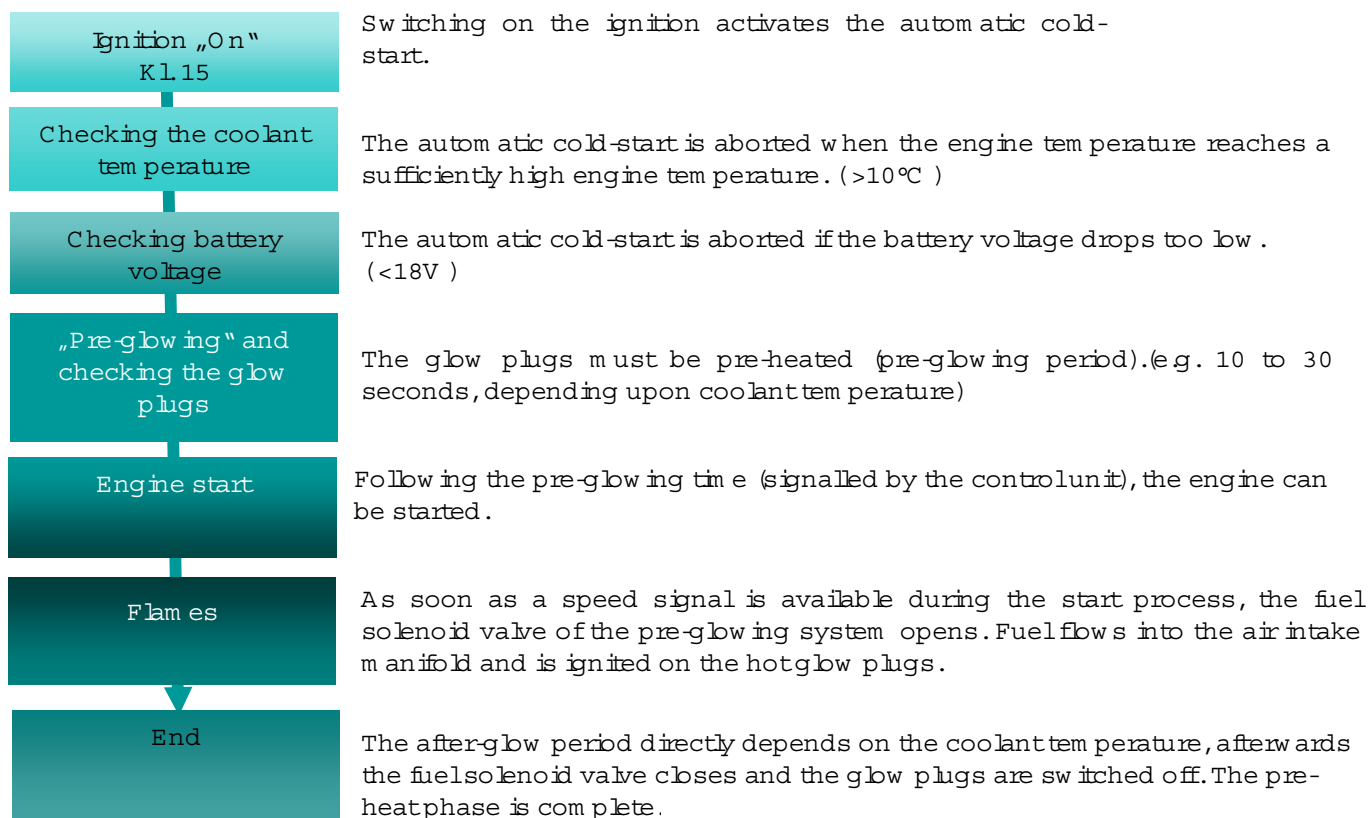
T1 = 75°C = 0% reduction

T3 = 90°C = 17% reduction



4.15 Automatic cold-start (with flame start unit)

The automatic cold-start (intake air pre-heating) serves to improve the cold-start and smooth-running behavior of the engine during the start-up and warm-up phases. The smoke emission (white smoke) during the cold-start can even be reduced. The engine operating temperature can be achieved quicker due to the pre-warmed intake air. A premature engine start is possible at any time, even before the pre-glowing time is finished.



4.16 Emergency operation

It is possible to activate the emergency operation with the engine standing still using the emergency start switch (see connecting diagram). The engine can then be restarted and set between two speed specifications using the emergency speed switch.

In case of defect or failure of CAN-communication while the engine is running, two different program versions are available. The first version, (for LFR only) will automatically store the data last received should the CAN-communication fail. The regulator DC 5-00 continues to use these values until the engine is shut off. The second version (LWN) ensures that the engine is stopped if a defect occurs or if the CAN-communication fails with the engine running. All monitoring carried out by the control unit, as well as error memory, also remains active if communication breaks down.

4.17 Engine protection functions

To guarantee optimum protection of the engine against damage, a multitude of protective mechanisms have been integrated into the regulator DC 5-00.

Depending on the significance of the error which has occurred, the respective protective mechanism of the regulator, transmission of a warning signal via the CAN-Bus and memory of the error in the electronic regulator is induced, or an immediate engine stop is triggered.

4.17.1 Second speed input

For safety reasons, two identical speed sensors are available for recording engine speed. The first speed sensor is the working sensor which is automatically switched over to the second speed sensor should the working sensor fail. The engine is not switched in this case and continues operation without limitations.

The electronic regulator creates a respective error signal, which is memorized internally in the regulator and visualized on the display via the CAN-Bus.

4.17.2 Overspeed protection

The overspeed protection is ensured by a maximum permissible engine speed which can be programmed in the regulator.

If this speed is exceeded, the engine is shutdown immediately by the EDC-actuator.

5. Parameters

This parameter list can be displayed through the diagnostic interface with the communications software DC-Desk.

5.1 Listing of measuring values

2000	Speed			
	Level:	1	Current speed value	
	Range:	0..4000 m in ⁻¹		
2001	SpeedPickUp1			
	Level:	1	Current speed measuring value from inductive pick-up	
	Range:	0..4000 m in ⁻¹	1	
2002	SpeedPickUp2			
	Level:	1	Current speed measuring value from inductive pick-up	
	Range:	0..4000 m in ⁻¹	2	
2003	SpeedPickUp1Value			
	Level:	4	Unfiltered speed measuring value from inductive pick-up	
	Range:	0..4000 m in ⁻¹	up 1	
2004	SpeedPickUp2Value			
	Level:	4	Unfiltered speed measuring value from inductive pick-up	
	Range:	0..4000 m in ⁻¹	up 2	
2005	PickUp20 r1Active			
	Level:	1	Inductive pick-up check	
	Range:	0/1	0 = pick-up 1 active	
			1 = pick-up 2 active	
2010	SpeedSetpMin			
	Level:	4	Current nominal value minimum speed	
	Range:	0..4000 m in ⁻¹		
2013	SpeedSetpMax			
	Level:	4	Current nominal value maximum speed	
	Range:	0..4000 m in ⁻¹		
2025	SpeedGradient			
	Level:	4	Current speed change per second	
	Range:	-4000..+4000 m in ⁻¹ /s		
2031	SpeedSetp			
	Level:	1	Determined speed nominal value with P-grade	
	Range:	0..4000 m in ⁻¹		
2032	SpeedSetpRamp			
	Level:	1	Determined speed nominal value according to speed	
	Range:	0..4000 m in ⁻¹	ramp	
2033	SpeedSetpSelect			
	Level:	1	Adjusted speed nominal value via external set value	
	Range:	0..4000 m in ⁻¹	potentiometer or switch e.g. low idle speed or fixed speed	

2040	DroopOffset	1	Speed deviation as a result of P-grade
	Level:	1	
	Range:	-2000..+2000 m in ⁻¹	
2100	PID_CorrFactor	1	Determined PID -correcting factor
	Level:	1	
	Range:	0..400 %	
2110	FuelSetpSpeedGov	3	Filling nominal value calculated by the speed regulator
	Level:	3	
	Range:	0..100 %	
2114	FuelSetpointUnlimited	3	Unlimited filling nominal value
	Level:	3	
	Range:	0..100 %	
2115	SpeedGov:P-Part	1	Current proportional share of the speed regulator
	Level:	1	
	Range:	-100..100 %	
2116	SpeedGov:I-Part	1	Current integral share of the speed regulator
	Level:	1	
	Range:	0..4000 m in ⁻¹	
2117	SpeedGov:D-Part	1	Current derivative share of the speed regulator
	Level:	1	
	Range:	-100..100 %	
2120	DroopPresent	1	Current P-range, with which the regulator is operating at the moment
	Level:	1	
	Range:	-100..+100 %	
2200	Torque	1	Current engine torque
	Level:	1	
	Range:	0..3000 Nm	
2201	TorqueMax	1	Current maximum engine torque
	Level:	1	
	Range:	0..3000 Nm	
2202	TorqueRel	1	Current relevant engine torque in relationship to 2201 TorqueMax
	Level:	1	
	Range:	0..100 %	
2250	EngineStartCounter	1	Engine start counter
	Level:	1	
	Range:	0..65535	
2300	ActPos	1	Current actuator position (filling)
	Level:	1	
	Range:	0..100 %	
2330	ActPosSetpoint	1	Regulating path nominal value for the actuator
	Level:	1	
	Range:	0..100 %	
2340	ActPosAtZeroFuel	1	Current zero flow rate
	Level:	1	
	Range:	0..100 %	

2350	FuelQuantity	Level: 1	Current injection quantity
		Range: 0..100 %	
2400	ALCANOnline	Level: 1	General condition Can-Bus with AMET-, LWN- and KEE-protocol
		Range: 0..1	
2401	ALCANTxBufferState	Level: 1	Status of CAN-transmission buffer with AMET-, LWN- and KEE-protocol
		Range: 0..FFFF Hex	
2402	ALCANRxTimeout	Level: 1	Status of CAN-Reception-Timeout-Monitoring with AMET-, LWN- and KEE-protocol
		Range: 0..FFFF Hex	
2403	ALCANBaudrate	Level: 1	Current Baud rate with AMET-, LWN- and KEE-protocol
		Range: 0..1000	
2410	ALCANSpeedSetp	Level: 1	Current set nominal speed via AMET-, LWN- and KEE-protocol
		Range: 0..4000 m in ⁻¹	
2411	ALCANSpeedSetpMin	Level: 1	Current minimum nominal speed via AMET-, LWN- and KEE-protocol
		Range: 0..4000 m in ⁻¹	
2412	ALCANSpeedSetpMax	Level: 1	Actual maximum nominal speed via AMET-, LWN- and KEE-protocol
		Range: 0..4000 m in ⁻¹	
2413	ALCANSpeedSetpActive	Level: 1	Activity display for set nominal specification via AMET-, LWN- and KEE-protocol
		Range: 0/1	
2414	CANFanSpeed	Level: 1	Fan speed specification via LWN- and KEE-protocol
		Range: 0..100 %	
2415	CANFanPWM	Level: 1	Fan-PWM-specification via LWN- and KEE-protocol
		Range: 0..100 %	
2416	CANFanSetpActive	Level: 1	Activity display of fan nominal value specification via LWN- and KEE-protocol
		Range: 0/1	
2700	FuelLimitMin	Level: 1	Current lower filling limit value
		Range: 0..100 %	
2701	FuelLimitMax	Level: 1	Current upper filling limit value
		Range: 0..100 %	
2702	FuelLimitStart	Level: 1	Current filling limit value via start filling limitation
		Range: 0..100 %	
2703	FuelLimitSpeed	Level: 1	Current filling limit value via speed-dependent filling limitation
		Range: 0..100 %	

2704	FuelL in itBoost		
	Level:	1	Current filling limit value via boost pressure-dependent filling limitation
	Range:	0..100 %	
2710	FuelL in itM inActive		
	Level:	1	Display indicating whether filling at lower limitation
	Range:	0/1	
2711	FuelL in itM axActive		
	Level:	1	Display indicating whether filling at upper limitation
	Range:	0/1	
2712	StartL in itActive		
	Level:	1	Display indicating whether filling is limited by start
	Range:	0/1	filling limitation
2713	SpeedL in itActive		
	Level:	1	Display indicating whether filling is limited by speed-
	Range:	0/1	dependent filling limitation
2714	BoostL in itActive		
	Level:	1	Display indicating whether filling is limited by boost
	Range:	0/1	pressure-dependent filling limitation
2715	CoolantTem pRedActive		
	Level:	1	Display indicating whether filling is reduced by
	Range:	0/1	influence of the coolant temperature
2716	Ch airTem pRedActive		
	Level:	1	Display indicating whether filling is reduced by
	Range:	0/1	influence of the charge air temperature
2717	EcyM odeRedActive		
	Level:	1	Display indicating whether filling is reduced as a result
	Range:	0/1	of emergency operation
2718	AmbPressRedActive		
	Level:	1	Display indicating whether filling is reduced by
	Range:	0/1	influence of the ambient pressure
2810	SwitchEngineStart		
	Level:	1	Switch condition "Engine start"
	Range:	0/1	
2811	SwitchIdleSpeed		
	Level:	1	Switch condition "Idle speed"
	Range:	0/1	
2812	SwitchSpeedFix		
	Level:	1	Switch condition "Fixed speed"
	Range:	0/1	
2813	SwitchSpeedRange20 r1		
	Level:	1	Switch condition "Speed range 1/2"
	Range:	0/1	
2814	SwitchSpeedLimit20 r1		
	Level:	1	Switch condition "Speed limitation 1/2"
	Range:	0/1	

2815	Sw itchD roop20 r1		
	Level:	1	Sw itch condition "P-range 1/2"
	Range:	0/1	
2816	Sw itchTestBed		
	Level:	1	Sw itch condition "Test-bench operation"
	Range:	0/1	
2817	Sw itchSupvF LG low Plug		
	Level:	1	Sw itch condition "M onitoring flam e-type glow plug"
	Range:	0/1	
2818	Sw itchSupvC ooL level		
	Level:	1	Sw itch condition "M onitoring coolant level"
	Range:	0/1	
2819	Sw itchSupvA irFilter		
	Level:	1	Sw itch condition "M onitoring air filter"
	Range:	0/1	
2820	Sw itchEngineStop		
	Level:	1	Sw itch condition "Engine stop" via CAN
	Range:	0/1	
2821	Sw itchEngineR elease		
	Level:	1	Sw itch condition "Engine release" via CAN
	Range:	0/1	
2851	D igitalD ut1		
	Level:	1	C ondition of digital output 1
	Range:	0/1	
2852	D igitalD ut2		
	Level:	1	C ondition of digital output 2
	Range:	0/1	
2853	D igitalD ut3		
	Level:	1	C ondition of digital output 3
	Range:	0/1	
2854	D igitalD ut4		
	Level:	1	C ondition of digital output 4
	Range:	0/1	
2855	D igitalD ut5		
	Level:	1	C ondition of digital output 5
	Range:	0/1	
2856	D igitalD ut6		
	Level:	1	C ondition of digital output 6
	Range:	0/1	
2857	D igitalD ut7		
	Level:	1	C ondition of digital output 7
	Range:	0/1	
2858	D igitalD ut8		
	Level:	1	C ondition of digital output 8
	Range:	0/1	

2859	D igitalO ut9		
	Level:	1	Condition of digital output 9
	Range:	0/1	
2860	D igitalO ut10		
	Level:	1	Condition of digital output 10
	Range:	0/1	
2861	D igitalO ut11		
	Level:	1	Condition of digital output 11
	Range:	0/1	
2871	E rrTypeD igitalO ut1		
	Level:	1	Error recognition of digital output 1
	Range:	0/1	
2872	E rrTypeD igitalO ut2		
	Level:	1	Error recognition of digital output 2
	Range:	0/1	
2873	E rrTypeD igitalO ut3		
	Level:	1	Error recognition of digital output 3
	Range:	0/1	
2874	E rrTypeD igitalO ut4		
	Level:	1	Error recognition of digital output 4
	Range:	0/1	
2875	E rrTypeD igitalO ut5		
	Level:	1	Error recognition of digital output 5
	Range:	0/1	
2876	E rrTypeD igitalO ut6		
	Level:	1	Error recognition of digital output 6
	Range:	0/1	
2877	E rrTypeD igitalO ut7		
	Level:	1	Error recognition of digital output 7
	Range:	0/1	
2878	E rrTypeD igitalO ut8		
	Level:	1	Error recognition of digital output 8
	Range:	0/1	
2879	E rrTypeD igitalO ut9		
	Level:	1	Error recognition of digital output 9
	Range:	0/1	
2880	E rrTypeD igitalO ut10		
	Level:	1	Error recognition of digital output 10
	Range:	0/1	
2881	E rrTypeD igitalO ut11		
	Level:	1	Error recognition of digital output 11
	Range:	0/1	
2882	E rrTypeD iagnosisPort		
	Level:	1	Error recognition of diagnosis port
	Range:	0/1	

2900	SetpointExtem		
	Level:	1	Current value of nominal speed transmitter
	Range:	0..100 %	
2901	OilPressure		
	Level:	1	Current value of oil pressure
	Range:	0..10 bar	
2902	BoostPressure		
	Level:	1	Current value of boost pressure
	Range:	0..5 bar	
2905	Alternator		
	Level:	1	Current value of alternator voltage
	Range:	0..37,2 V	
2908	CoolantTemp		
	Level:	1	Current value of coolant temperature
	Range:	-100..+1000 °C	
2909	ChargeAirTemp		
	Level:	1	Current value of charge air temperature
	Range:	-100..+1000 °C	
2930	AmbientPressure		
	Level:	1	Current value of ambient pressure
	Range:	150..1150 m bar	
2931	BoostPressureRelative		
	Level:	1	Current relative value of boost pressure
	Range:	0..5 bar	
3000	ConfigurationError		
	Level:	1	System configuration error display
	Range:	0..255	
3001	ErrPickUp1		
	Level:	1	Error display of speed sensor 1
	Range:	0/1	
3002	ErrPickUp2		
	Level:	1	Error display of speed sensor 2
	Range:	0/1	
3003	ErrPickUp2>PickUp1		
	Level:	1	Error display measuring value speed sensor 2 >
	Range:	0/1	measuring value speed sensor 1
3004	ErrOverSpeed		
	Level:	1	Error display when overspeeding
	Range:	0/1	
3005	ErrFlameStartUnit		
	Level:	1	Error display for flame start unit
	Range:	0/1	
3006	ErrFlameGlowPlug		
	Level:	1	Error display for flame-type glow plug
	Range:	0/1	

3007	ErrM agneticV alve	1	Enordisplay for solenoid valve
	Level:	0/1	
	Range:		
3008	ErrStarter	1	Enordisplay for starter
	Level:	0/1	
	Range:		
3009	ErrFanPropulsion	1	Enordisplay for fan drive
	Level:	0/1	
	Range:		
3010	ErrSetpointExtLow	1	Error display nominal speed transmitter below lower error threshold
	Level:	0/1	
	Range:		
3011	ErrOilPressSensLow	1	Error display oil pressure sensor below lower error threshold
	Level:	0/1	
	Range:		
3012	ErrBoostPressSensLow	1	Error display boost pressure sensor below lower error threshold
	Level:	0/1	
	Range:		
3015	ErrAlternatorLow	1	Error display alternator voltage below lower error threshold
	Level:	0/1	
	Range:		
3018	ErrCoolTempSensLow	1	Error display coolant temperature sensor below lower error threshold
	Level:	0/1	
	Range:		
3019	ErrChargeAirTempSensLo	1	Error display charge air temperature sensor below lower error threshold
	Level:	0/1	
	Range:		
3020	ErrSetpointExtHigh	1	Error display nominal speed transmitter above upper error threshold
	Level:	0/1	
	Range:		
3021	ErrOilPressSensHigh	1	Error display oil pressure sensor above upper error threshold
	Level:	0/1	
	Range:		
3022	ErrBoostPressSensHigh	1	Error display boost pressure sensor above upper error threshold
	Level:	0/1	
	Range:		
3025	ErrAlternatorHigh	1	Error display alternator voltage above upper error threshold
	Level:	0/1	
	Range:		
3028	ErrCoolTempSensHigh	1	Error display coolant temperature sensor above upper error threshold
	Level:	0/1	
	Range:		
3029	ErrChargeAirTempSensHigh	1	Error display charge air temperature sensor above upper error threshold
	Level:	0/1	
	Range:		

3030	ErrAcceleratorW am		
	Level:	1	Error display for accelerator monitoring
	Range:	0/1	
3031	ErrOilPressureW am		
	Level:	1	Display of oil pressure warning
	Range:	0/1	
3032	ErrCoolantLevelW am		
	Level:	1	Display of coolant level warning
	Range:	0/1	
3033	ErrAirFilterW am		
	Level:	1	Display of air filter warning
	Range:	0/1	
3035	ErrAlternatorW am		
	Level:	1	Display of alternator warning
	Range:	0/1	
3038	ErrCoolantTempW am		
	Level:	1	Display of coolant temperature warning
	Range:	0/1	
3039	ErrChargeAirTempW am		
	Level:	1	Display of charge air temperature warning
	Range:	0/1	
3041	ErrOilPressureEcy		
	Level:	1	Display of oil pressure-emergency cut-off
	Range:	0/1	
3042	ErrInternalTemp1W am		
	Level:	1	Display of warning internal temperature 1
	Range:	0/1	
3043	ErrInternalTemp2W am		
	Level:	1	Display of warning internal temperature 2
	Range:	0/1	
3048	ErrCoolantTempEcy		
	Level:	1	Display of coolant temperature-emergency cut-off
	Range:	0/1	
3049	ErrChargeAirTempEcy		
	Level:	1	Display of charge air temperature-emergency cut-off
	Range:	0/1	
3050	ErrFeedback		
	Level:	1	Error in returning the actuator
	Range:	0/1	
3053	ErrActuatorDiff		
	Level:	1	Difference between nominal regulating path and current
	Range:	0/1	regulating path too great
3056	ErrFeedbackRef		
	Level:	1	Reference value error for actuator return
	Range:	0/1	

3058	ErrAmplifier	Level: 1	Error in amplifier
	Range: 0/1		
3059	ErrFeedbackAdjust	Level: 1	Error in automatic calibration or with entry of the
	Range: 0/1		return reference values
3060	ErrPowerSupplyLow	Level: 1	Error display power supply below lower error threshold
	Range: 0/1		
3061	Err7.5V SupplyLow	Level: 1	Error display power supply 7.5 V below lower error
	Range: 0/1		threshold
3062	ErrEDC SupplyLow	Level: 1	Error display power supply for EDC feedback below
	Range: 0/1		lower error threshold
3063	ErrRef1Low	Level: 1	Error display reference voltage for analog input 1 and
	Range: 0/1		temperature input 1 below lower error threshold
3064	ErrRef2Low	Level: 1	Error display reference voltage for analog input 2 and
	Range: 0/1		temperature input 2 below lower error threshold
3065	ErrRef3Low	Level: 1	Error display reference voltage for analog input 3 and
	Range: 0/1		temperature input 3 below lower error threshold
3066	ErrRef4Low	Level: 1	Error display reference voltage for analog input 4 and
	Range: 0/1		temperature input 4 below lower error threshold
3067	ErrIntemTemp1SensLow	Level: 1	Error display internal temperature 1 below lower error
	Range: 0/1		threshold
3068	ErrIntemTemp2SensLow	Level: 1	Error display internal temperature 2 below lower error
	Range: 0/1		threshold
3069	ErrAmbiPressSensLow	Level: 1	Error display ambient pressure below lower error
	Range: 0/1		threshold
3070	ErrCanBus	Level: 1	Error display of CAN-Bus
	Range: 0/1		
3071	ErrCanComm	Level: 1	Error display of CAN-communication
	Range: 0/1		
3076	ErrParamStore	Level: 1	Error display during programming of ROM
	Range: 0/1		

3077	ErrProgram Test	Level: 1	Enordisplay during test of the checksum
	Range: 0/1		
3078	ErrRam Test	Level: 1	Enordisplay of the RAM test
	Range: 0/1		
3079	ErrDigitalOut	Level: 1	Enordisplay of digital outputs
	Range: 0/1		
3080	ErrPowerSupplyHigh	Level: 1	Enordisplay power supply above upper error threshold
	Range: 0/1		
3081	Err7.5V SupplyHigh	Level: 1	Error display power supply 7.5 V above upper error threshold
	Range: 0/1		
3082	ErrEDC SupplyHigh	Level: 1	Enordisplay power supply for EDC return above upper error threshold
	Range: 0/1		
3083	ErrRef1High	Level: 1	Error display reference voltage for analog input 1 and temperature input 1 above upper error threshold
	Range: 0/1		
3084	ErrRef2High	Level: 1	Error display reference voltage for analog input 2 and temperature input 2 above upper error threshold
	Range: 0/1		
3085	ErrRef3High	Level: 1	Error display reference voltage for analog input 3 and temperature input 3 above upper error threshold
	Range: 0/1		
3086	ErrRef4High	Level: 1	Error display reference voltage for analog input 4 and temperature input 4 above upper error threshold
	Range: 0/1		
3087	ErrIntTemp1SensHigh	Level: 1	Error display internal temperature 1 above upper error threshold
	Range: 0/1		
3088	ErrIntTemp2SensHigh	Level: 1	Error display internal temperature 2 above upper error threshold
	Range: 0/1		
3089	ErrAmbiPressSensHigh	Level: 1	Error display ambient pressure above upper error threshold
	Range: 0/1		
3090	ErrData	Level: 1	Enordisplay of data sentence
	Range: 0/1		
3092	ErrConfiguration	Level: 1	Enordisplay of configuration error 3000
	Range: 0/1		

3093	ErrStack		
	Level:	1	Error display of "Stack-Overflow" error
	Range:	0/1	
3094	ErrIntern		
	Level:	1	Error display for internal software error
	Range:	0/1	
3099	EEPROM ErrorCode		
	Level:	1	Error recognition for faulty setup of EEPROM -pages
	Range:	0..255	
3101	SErrPickup1		
	Level:	1	Counter for incidence of 3001 ErrPickUp1
	Range:	0..255	
3102	SErrPickup2		
	Level:	1	Counter for incidence of 3002 ErrPickUp2
	Range:	0..255	
3103	SErrPickUp2>PickUp1		
	Level:	1	Counter for incidence of 3003 ErrPickUp2>PickUp1
	Range:	0..255	
3104	SErrOverSpeed		
	Level:	1	Counter for incidence of 3004 ErrOverSpeed
	Range:	0..255	
3105	SErrFlameStartUnit		
	Level:	1	Counter for incidence of 3005 ErrFlameStartUnit
	Range:	0..255	
3106	SErrFlameGlowPlug		
	Level:	1	Counter for incidence of 3006 ErrFlameGlowPlug
	Range:	0..255	
3107	SErrMagneticValve		
	Level:	1	Counter for incidence of 3007 ErrMagneticValve
	Range:	0..255	
3108	SErrStarter		
	Level:	1	Counter for incidence of 3008 ErrStarter
	Range:	0..255	
3109	SErrFanPropulsion		
	Level:	1	Counter for incidence of 3009 ErrFanPropulsion
	Range:	0..255	
3110	SErrSetpointExtLow		
	Level:	1	Counter for incidence of 3010 ErrSetpointExtLow
	Range:	0..255	
3111	SErrOilPressSensLow		
	Level:	1	Counter for incidence of 3011 ErrOilPressSensLow
	Range:	0..255	
3112	SErrBoostPressSensLow		
	Level:	1	Counter for incidence of 3012 ErrBoostPressSensLow
	Range:	0..255	

3115	SErrAltematorLow		
	Level:	1	Counter for incidence of 3015 ErrAltematorLow
	Range:	0.255	
3118	SErrCoolTempSensLow		
	Level:	1	Counter for incidence of 3018 ErrCoolTempSensLow
	Range:	0.255	
3119	SErrCharAirTempSensLo		
	Level:	1	Counter for incidence of 3019 ErrCharAirTempSensLo
	Range:	0.255	
3120	SErrSetpointExtHigh		
	Level:	1	Counter for incidence of 3020 ErrSetpointExtHigh
	Range:	0.255	
3121	SErrOilPressSensHigh		
	Level:	1	Counter for incidence of 3021 ErrOilPressSensHigh
	Range:	0.255	
3122	SErrBoostPressSensHi		
	Level:	1	Counter for incidence of 3022 ErrBoostPressSensHi
	Range:	0.255	
3125	SErrAltematorHigh		
	Level:	1	Counter for incidence of 3025 ErrAltematorHigh
	Range:	0.255	
3128	SErrCoolTempSensHigh		
	Level:	1	Counter for incidence of 3028 ErrCoolTempSensHigh
	Range:	0.255	
3129	SErrCharAirTempSensHi		
	Level:	1	Counter for incidence of 3029 ErrCharAirTempSensHi
	Range:	0.255	
3130	SErrAcceleratorWam		
	Level:	1	Counter for incidence of 3030 ErrAcceleratorWam
	Range:	0.255	
3131	SErrOilPressureWam		
	Level:	1	Counter for incidence of 3031 ErrOilPressureWam
	Range:	0.255	
3132	SErrCoolantLevelWam		
	Level:	1	Counter for incidence of 3032 ErrCoolantLevelWam
	Range:	0.255	
3133	SErrAirFilterWam		
	Level:	1	Counter for incidence of 3033 ErrAirFilterWam
	Range:	0.255	
3135	SErrAltematorWam		
	Level:	1	Counter for incidence of 3035 ErrAltematorWam
	Range:	0.255	
3138	SErrCoolantTempWam		
	Level:	1	Counter for incidence of 3038 ErrCoolantTempWam
	Range:	0.255	

3139	SErrChargeA irTempW am		
	Level:	1	Counter for incidence of 3039 EnrChargeA irTempW am
	Range:	0.255	
3141	SErrOilPressureEcy		
	Level:	1	Counter for incidence of 3041 EnrOilPressureEcy
	Range:	0.255	
3142	SErrIntemTemp1W am		
	Level:	1	Counter for incidence of 3042 EnrIntemTemp1W am
	Range:	0.255	
3143	SErrIntemTemp2W am		
	Level:	1	Counter for incidence of 3043 EnrIntemTemp2W am
	Range:	0.255	
3148	SErrCoolantTempEcy		
	Level:	1	Counter for incidence of 3048 EnrCoolantTempEcy
	Range:	0.255	
3149	SErrChargeA irTempEcy		
	Level:	1	Counter for incidence of 3049 EnrChargeA irTempEcy
	Range:	0.255	
3150	SErrFeedback		
	Level:	1	Counter for incidence of 3050 EnrFeedback
	Range:	0.255	
3153	SErrActuatorDiff		
	Level:	1	Counter for incidence of 3053 EnrActuatorDiff
	Range:	0.255	
3156	SErrFeedbackRef		
	Level:	1	Counter for incidence of 3056 EnrFeedbackRef
	Range:	0.255	
3158	SErrAmplifier		
	Level:	1	Counter for incidence of 3060 EnrAmplifier
	Range:	0.255	
3159	SErrFeedbackAdjust		
	Level:	1	Counter for incidence of 3059 EnrFeedbackAdjust
	Range:	0.255	
3160	SErrPowerSupplyLow		
	Level:	1	Counter for incidence of 3060 EnrPowerSupplyLow
	Range:	0.255	
3161	SErr7.5V SupplyLow		
	Level:	1	Counter for incidence of 3061 Enr7.5V SupplyLow
	Range:	0.255	
3162	SErrEDC SupplyLow		
	Level:	1	Counter for incidence of 3062 EnrEDC SupplyLow
	Range:	0.255	
3163	SErrReflLow		
	Level:	1	Counter for incidence of 3063 EnrReflLow
	Range:	0.255	

3164	SErrRef2Low		
	Level:	1	Counter for incidence of 3064 EnrRef2Low
	Range:	0.255	
3165	SErrRef3Low		
	Level:	1	Counter for incidence of 3065 EnrRef3Low
	Range:	0.255	
3166	SErrRef4Low		
	Level:	1	Counter for incidence of 3066 EnrRef4Low
	Range:	0.255	
3167	SErrIntTemp1SensLow		
	Level:	1	Counter for incidence of 3067 EnrIntTemp1SensLow
	Range:	0.255	
3168	SErrIntTemp2SensLow		
	Level:	1	Counter for incidence of 3068 EnrIntTemp2SensLow
	Range:	0.255	
3169	SErrAmbiPressSensLow		
	Level:	1	Counter for incidence of 3069 EnrAmbiPressSensLow
	Range:	0.255	
3170	SErrCanBus		
	Level:	1	Counter for incidence of 3070 EnrCanBus
	Range:	0.255	
3171	SErrCanComm		
	Level:	1	Counter for incidence of 3071 EnrCanComm
	Range:	0.255	
3176	SErrParamStore		
	Level:	1	Counter for incidence of 3076 EnrParamStore
	Range:	0.255	
3177	SErrProgramTest		
	Level:	1	Counter for incidence of 3077 EnrProgramTest
	Range:	0.255	
3178	SErrRAMTest		
	Level:	1	Counter for incidence of 3078 EnrRAMTest
	Range:	0.255	
3179	SErrDigitalOut		
	Level:	1	Counter for incidence of 3079 EnrDigitalOut
	Range:	0.255	
3180	SErrPowerSupplyHigh		
	Level:	1	Counter for incidence of 3080 EnrPowerSupplyHigh
	Range:	0.255	
3181	SErr7.5VSupplyHigh		
	Level:	1	Counter for incidence of 3081 Enr7.5VSupplyHigh
	Range:	0.255	
3182	SErrEDCSupplyHigh		
	Level:	1	Counter for incidence of 3082 EnrEDCSupplyHigh
	Range:	0.255	

3183	SErrRef1H igh		
	Level:	1	Counter for incidence of 3083 EnrRef1H igh
	Range:	0.255	
3184	SErrRef2H igh		
	Level:	1	Counter for incidence of 3084 EnrRef2H igh
	Range:	0.255	
3185	SErrRef3H igh		
	Level:	1	Counter for incidence of 3085 EnrRef3H igh
	Range:	0.255	
3186	SErrRef4H igh		
	Level:	1	Counter for incidence of 3086 EnrRef4H igh
	Range:	0.255	
3187	SErrIntTem p1SensH igh		
	Level:	1	Counter for incidence of 3087 EnrIntTem p1SensH igh
	Range:	0.255	
3188	SErrIntTem p2SensH igh		
	Level:	1	Counter for incidence of 3088 EnrIntTem p2SensH igh
	Range:	0.255	
3189	SErrAmbiPressSensH igh		
	Level:	1	Counter for incidence of 3089 EnrAmbiPressSensH igh
	Range:	0.255	
3190	SErrData		
	Level:	1	Counter for incidence of 3090 EnrData
	Range:	0.255	
3192	SErrConfiguration		
	Level:	1	Counter for incidence of 3092 EnrConfiguration
	Range:	0/1	
3193	SErrStack		
	Level:	1	Counter for incidence of 3093 EnrStack
	Range:	0.255	
3194	SErrIntern		
	Level:	1	Counter for incidence of 3094 EnrIntern
	Range:	0.255	
3195	SExceptionNum ber		
	Level:	1	Error num ber for softw are error
	Range:	0.65535	
3196	SExceptionAddrLow		
	Level:	1	Low er extended error num ber for softw are error
	Range:	0000..FFFF Hex	
3197	SExceptionAddrH igh		
	Level:	1	Upper extended error num ber for softw are error
	Range:	0000..FFFF Hex	
3198	SExceptionFlag		
	Level:	1	Recognition for extended error num ber for softw are error
	Range:	0000..FFFF Hex	

3360	FSU Phase			
	Level:	1	Sequence phase of flame start unit	
	Range:	0..255		
	Phases of flame start unit without error recognition:			
	FSU Phase 0		Initialisation	
	FSU Phase 1		Pre-glowing	
	FSU Phase 2		Start standby period	
	FSU Phase 3		Safety shut-off period	
	FSU Phase 4		After-glow period	
	FSU Phase 5		Function ended correctly	
	FSU Phase 8		Engine start during the pre-glowing phase	
	FSU Phase 9		The engine was not started while ready to start	
	FSU Phase 10		The engine could not be started while ready to start	
	Phases of flame start unit with error recognition:			
	FSU Phase 6		Power supply too low	
	FSU Phase 7		Flame-glow plugs faulty	
3361	FSU Current Wait Time			
	Level:	1	Current waiting time of the flame start unit	
	Range:	0..1000 s		
3362	FSU Preheat Time			
	Level:	1	Current pre-heat time of the flame start unit	
	Range:	0..1000 s		
3365	FSU Flame Glow Plug			
	Level:	1	Control of the flame-glow plug of the flame start unit	
	Range:	0/1		
3366	FSU Status Lamp			
	Level:	1	Control of the status lamp of the flame start unit	
	Range:	0/1		
3367	FSU Magnetic Valve			
	Level:	1	Control of the solenoid valve of the flame start unit	
	Range:	0/1		
3368	FSU Starter			
	Level:	1	Control of the starter of the flame start unit	
	Range:	0/1		
3375	FSU Speed Gradient			
	Level:	1	Start speed gradient of the flame start unit	
	Range:	-4000..4000 m in ⁻¹ /s		
3376	FSU Gradient Supervise			
	Level:	1	Monitoring of the start speed gradients of the flame start unit active	
	Range:	0/1		
3377	FSU Charge Air Temp Freeze			
	Level:	1	Frozen charge air temperature before activation of the flame start unit	
	Range:	-100..1000 °C		

3378	FSUChairFreezeActive	Level: 1 Range: 0/1	Utilisation of the frozen charge air temperature active
3380	StarterTimeOutActive	Level: 1 Range: 0/1	Restart lock function active
3400	FanTemperatureDifference	Level: 1 Range: 0..1100 °C	Temperature difference for fan drive
3401	FanSpeed	Level: 1 Range: 0..100 %	Fan speed
3402	FanPWMOut	Level: 1 Range: 0..100 %	Fan-PWM-output
3403	FanDignotHighSide	Level: 1 Range: 0/1	Fan-High-Side-Control
3510	AnalogIn1	Level: 1 Range: 0..100 %	Standardized value of analog input 1
3511	AnalogIn1_Value	Level: 1 Range: 0..65535	Non-standardized value of analog input 1
3520	AnalogIn2	Level: 1 Range: 0..100 %	Standardized value of analog input 2
3521	AnalogIn2_Value	Level: 1 Range: 0..65535	Non-standardized value of analog input 2
3530	AnalogIn3	Level: 1 Range: 0..100 %	Standardized value of analog input 3
3531	AnalogIn3_Value	Level: 1 Range: 0..65535	Non-standardized value of analog input 3
3540	AnalogIn4	Level: 1 Range: 0..100 %	Standardized value of analog input 4
3541	AnalogIn4_Value	Level: 1 Range: 0..65535	Non-standardized value of analog input 4
3550	AnalogIn5	Level: 1 Range: 0..100 %	Standardized value of analog input 5

3551	AnalogIn5_Value			
	Level:	1	Non-standardized value of analog input 5	
	Range:	0..65535		
3560	AnalogIn6			
	Level:	1	Standardized value of analog input 6	
	Range:	0..100 %		
3561	AnalogIn6_Value			
	Level:	1	Non-standardized value of analog input 6	
	Range:	0..65535		
3570	TempIn1			
	Level:	1	Standardized value of temperature input 1	
	Range:	-100..+1000 °C		
3571	TempIn1_Value			
	Level:	1	Non-standardized value of temperature input 1	
	Range:	0..65535		
3575	TempIn2			
	Level:	1	Standardized value of temperature input 2	
	Range:	-100..+1000 °C		
3576	TempIn2_Value			
	Level:	1	Non-standardized value of temperature input 2	
	Range:	0..65535		
3580	TempIn3			
	Level:	1	Standardized value of temperature input 3	
	Range:	-100..+1000 °C		
3581	TempIn3_Value			
	Level:	1	Non-standardized value of temperature input 3	
	Range:	0..65535		
3585	TempIn4			
	Level:	1	Standardized value of temperature input 4	
	Range:	-100..+1000 °C		
3586	TempIn4_Value			
	Level:	1	Non-standardized value of temperature input 4	
	Range:	0..65535		
3600	PowerSupply			
	Level:	1	Current value of power supply	
	Range:	0..55 V		
3601	Supply7.5V			
	Level:	1	Current value of power supply 7.5 V	
	Range:	0..10 V		
3602	PowerSupplyEDCFeedb			
	Level:	1	Current value of power supply of EDC -return	
	Range:	0..10 V		
3603	5VRefAnalog/TempIn1			
	Level:	1	Current value of reference voltage of the analog input 1	
	Range:	0..7,35 V	and temperature input 1	
3604	5VRefAnalog/TempIn2			
	Level:	1	Current value of reference voltage of the analog input 2	
	Range:	0..7,35 V	and temperature input 2	

3605	5VRefAnalog/TempIn3		
	Level:	1	Current value of reference voltage of the analog input 3
	Range:	0..7,35 V	and temperature input 3
3606	5VRefAnalog/TempIn4		
	Level:	1	Current value of reference voltage of the analog input 4
	Range:	0..7,35 V	and temperature input 4
3607	InternalTemp1		
	Level:	1	Current value of internal temperature 1
	Range:	-50..+150 °C	
3608	InternalTemp2		
	Level:	1	Current value of internal temperature 1
	Range:	-50..+150 °C	
3611	FeedbackDigitalOut1		
	Level:	1	Current value of feedback input of digital output 1
	Range:	0/1	
3612	FeedbackDigitalOut2		
	Level:	1	Current value of feedback input of digital output 2
	Range:	0/1	
3613	FeedbackDigitalOut3		
	Level:	1	Current value of feedback input of digital output 3
	Range:	0/1	
3614	FeedbackDigitalOut4		
	Level:	1	Current value of feedback input of digital output 4
	Range:	0/1	
3615	FeedbackDigitalOut5		
	Level:	1	Current value of feedback input of digital output 5
	Range:	0/1	
3616	FeedbackDigitalOut6		
	Level:	1	Current value of feedback input of digital output 6
	Range:	0/1	
3617	FeedbackDigitalOut7		
	Level:	1	Current value of feedback input of digital output 7
	Range:	0/1	
3618	FeedbackDigitalOut8		
	Level:	1	Current value of feedback input of digital output 8
	Range:	0/1	
3619	FeedbackDigitalOut9		
	Level:	1	Current value of feedback input of digital output 9
	Range:	0/1	
3620	FeedbackDigitalOut10		
	Level:	1	Current value of feedback input of digital output 10
	Range:	0/1	
3621	FeedbackDigitalOut11		
	Level:	1	Current value of feedback input of digital output 11
	Range:	0/1	
3622	FeedbackDiagnosPort		
	Level:	1	Current value of feedback input of diagnosis port
	Range:	0/1	

3641	AnalogOut_Value		
	Level:	1	Current value of analog output
	Range:	0..100 %	
3800	EmergencyAlarm		
	Level:	1	Display of emergency alarm
	Range:	0/1	
3801	CommonAlarm		
	Level:	1	Display of common alarm
	Range:	0/1	
3802	EngineStop		
	Level:	1	Display indicating that the engine will be brought to a
	Range:	0/1	standstill via internally or externally mounted engine-stop
3803	EngineStopped		
	Level:	1	Display indicating that the engine is shut down
	Range:	0/1	
3804	EngineStarting		
	Level:	1	Display indicating that the engine is being started
	Range:	0/1	
3805	EngineRunning		
	Level:	1	Display indicating that the engine is running
	Range:	0/1	
3806	EngineReleased		
	Level:	1	Display indicating that fuel supply has been initiated
	Range:	0/1	
3810	EngineMode:TestBedOn		
	Level:	6	Engine mode: Test-bench operation
	Range:	0/1	
3811	EngineMode:LWNCanOn		
	Level:	6	Engine mode: LWN CAN-control
	Range:	0/1	
3812	EngineMode:KEECanOn		
	Level:	6	Engine mode: KEE CAN-control
	Range:	0/1	
3813	EngineMode:CanModeOn		
	Level:	6	Engine mode: CAN-operation active
	Range:	0/1	
3814	EngineMode:EcyModeOn		
	Level:	6	Engine mode: Emergency operation active
	Range:	0/1	
3820	LMBSPFNumber		
	Level:	1	SPF-number
	Range:	1..7	
3821	LMBProductionYear		
	Level:	1	Year of production
	Range:	1..7	
3822	LMBHHardwareVersion		
	Level:	1	Hardware version
	Range:	1..7	

3823	LM BSoftw areV ersion	Level: 1	Softw are version
	Range: 1..7		
3824	LM B IdentN um berH igh	Level: 1	Identification num ber of upperpart
	Range: 1..7		
3825	LM B IdentN um berLow	Level: 1	Identification num ber of low erpart
	Range: 1..7		
3826	LM B SerialN um berH igh	Level: 1	Serial num ber of upperpart
	Range: 1..7		
3827	LM B SerialN um berLow	Level: 1	Serial num ber of low erpart
	Range: 1..7		
3828	LM B EngineN um berH igh	Level: 1	Engine num ber of upperpart
	Range: 1..7		
3829	LM B EngineN um berLow	Level: 1	Engine num ber of low erpart
	Range: 1..7		
3830	Phase	Level: 1	Current stage of speed regulator
	Range: 0..9		
3840	H ardwareV ersion	Level: 1	V ersion num ber of the control unit hardw are
	Range: 00.00..99.99		
3841	AddH ardwareV ersion	Level: 1	A dditional version num ber of the control unit hardw are
	Range: 00.00..99.99		
3842	Softw areV ersion	Level: 1	V ersion num ber of the softw are
	Range: 0000.00.00...6552.99.99		4- characters custom er identification num ber, 2- characters version, 2- characters m odifications index
3843	BootSoftw areV ersion	Level: 1	V ersion num ber of boot softw are
	Range: 65.0.00...65.5.35		
3844	SerialD ate	Level: 1	Serial date of control unit hardw are
	Range: 0000..9912		
3845	SerialN um ber	Level: 1	Serial num ber of control unit hardw are
	Range: 00000..65535		
3850	Identifier	Level: 1	Identification num ber of the PC -program \m anual
	Range: 0..65535		program m er

3851	LastIdentifier	Level: 1	Identification number of the PC-program \n annual program mer of the last saved param eter modification
	Range: 0..65535		
3865	CalculationTime	Level: 1	Required calculation time of the main processor
	Range: 0..15.625 ms		
3870	Timer	Level: 1	Internal millisecond timer
	Range: 0..65.535 ms		
3871	OperatingHourMeter	Level: 1	Hour share of Engine operating hour meter
	Range: 0..65535 h		
3872	OperatingSecondMeter	Level: 1	Second share of Engine operating hour meter
	Range: 0..3599 s		
3895	RAM TestAddr	Level: 6	Value of the currently tested memory address
	Range: 0000..FFFF Hex		
3896	RAM TestPattern	Level: 6	Test pattern of the currently tested memory address
	Range: 0000..FFFF Hex		
3897	CStackTestFreeBytes	Level: 6	Display of free bytes in the C-stack memory
	Range: 0000..FFFF Hex		
3898	IStackTestFreeBytes	Level: 6	Display of free bytes in the I-stack memory
	Range: 0000..FFFF Hex		
3905	ServoPIDCorr	Level: 6	Correction factor for the PID parameter of the servo-circuit
	Range: 0..400 %		
3906	ServoStateStatic	Level: 6	Correction factor for the PID parameter of the servo-circuit
	Range: 0/1		
3916	ServoCurrentSetpoint	Level: 1	Nominal value for the current running through the actuator
	Range: -100..100 %		
3950	Feedback	Level: 1	Non-standardized value of the feedback
	Range: 0..65535		
3955	FeedbackReference	Level: 1	Non-standardized value of the reference solenoid
	Range: 0..65535		
3960	FeedbackCorrection	Level: 1	With the reference corrected value of the feedback
	Range: 0..65535		

5.2 Error code

In the following error parameter lists, the causes of the individual errors, as well as the reaction of the regulator, are described. Additionally, action to be taken to remedy the error are specified. The error is entered in the current error memory from parameter number 3000 and up, and at the same time counted upwards in the permanent error memory starting with parameter number 3100.

The errors are sorted in ascending order in accordance with the numbers, where the left-hand parameter is the current error of the temporary error memory and the right-hand parameter is the respective parameter of the permanent error memory. The regulator only reacts to current errors, and the permanent error memory serves solely for the collection of any occurred errors.

3001 ErrPickUp1

3101 SErrPickUp1

- Cause:**
- Inductive pick-up failed.
 - Inductive pick-up 1 is too far away from the flywheel.
 - Inductive pick-up 1 transmitting additional error pulses.
 - The wire from inductive pick-up 1 has been interrupted.
 - Inductive pick-up 1 has been incorrectly mounted.
 - Inductive pick-up 2 transmitting a greater value than pulse recorder 1
 3003 ErrPickUp2 > PickUp1 = 1
- Reaction:**
- Regulator continues with inductive pick-up 2, if available.
 - Emergency shut-down, if inductive pick-up 2 not available or failed.
- Action:**
- Check distance of inductive pick-up 1 to flywheel.
 - Check preferred direction of inductive pick-up.
 - Check wire to inductive pick-up 1.
 - Check inductive pick-up 1, replace as required.

3002 ErrPickUp2

3102 SErrPickUp2

- Cause:**
- Inductive pick-up 2 failed.
 - Inductive pick-up 2 is too far away from the flywheel.
 - Inductive pick-up 2 transmitting additional error pulses
 - The wire from inductive pick-up 2 has been interrupted.
 - Inductive pick-up 2 has been incorrectly mounted.
- Reaction:**
- Regulator continues with inductive pick-up 1.
 - Emergency shut-down, if inductive pick-up 1 has also failed.

- Action:
- Check distance of inductive pick-up 2 to flywheel.
 - Check preferred direction of inductive pick-up.
 - Check wire to inductive pick-up 2.
 - Check inductive pick-up 2, replace as required.

3003 ErrPickUp2>PickUp1

3103 SErrPickUp2>PickUp1

- Cause:
- Inductive pick-up 2 transmitting a greater value than inductive pick-up 1
- Reaction:
- Inductive pick-up 1 is regarded as being faulty, 3001 ErrPickUp1 = 1
 - Regulator continues with inductive pick-up 2.
 - Emergency shut-down, if inductive pick-up 2 has also failed.
- Action:
- Check distance of inductive pick-up to flywheel.
 - Check preferred direction of inductive pick-up.
 - Check wire to the inductive pick-up.
 - Check inductive pick-up, replace as required.

3004 ErrOverSpeed

3104 SErrOverSpeed

- Cause:
- Speed of the engine was/is exceeding the overspeed.
- Reaction:
- Emergency shut-down
- Action:
- Check parameter for overspeed (21 SpeedOver).
 - Check speed setting.
 - Check PID-setting.
 - Check mechanics, connecting rod may be jammed.
 - Check actuator
 - Check wire to actuator
 - Replace actuator
 - Check inductive pick-up, it may be transmitting an incorrect speed.
 - Check number of teeth (1 TeethPickUp1 and 2 TeethPickUp2).
 - Check whether overspeed has occurred on vehicles as a result of downhill travelling.

3010 ErrSetpointExtLow	3110 SErrSetpointExtLow
3011 ErrOilPressSensLow	3111 SErrOilPressSensLow
3012 ErrBoostPressSensLow	3112 SErrBoostPressSensLow
3015 ErrAlternatorLow	3115 SErrAlternatorLow
3018 ErrCoolTempSensLow	3118 SErrCoolTempSensLow
3019 ErrCharAirTempSensLo	3119 SErrCharAirTempSensLo

Cause: An error has occurred at the respective sensor input (e.g. short-circuit against earth or broken wire).

Reaction: - Error may rectify itself depending upon respective selection if the regulator measuring values are once again within the error limits.

Action: - Check the sensor wire for short-circuit or wire break.
- Check the respective sensor, replace as required.
- Check the lower error limits for this sensor.

3020 ErrSetpointExtHigh	3110 SErrSetpointExtHigh
3021 ErrOilPressSensHigh	3111 SErrOilPressSensHigh
3022 ErrBoostPressSensHi	3112 SErrBoostPressSensHi
3025 ErrAlternatorHigh	3115 SErrAlternatorHigh
3028 ErrCoolTempSensHigh	3118 SErrCoolTempSensHigh
3029 ErrCharAirTempSensHi	3119 SErrCharAirTempSensHi

Cause: An error has occurred at the respective sensor input (e.g. short-circuit against UBatt or broken wire).

Reaction: - Error may rectify itself depending upon respective selection if the regulator measuring values are once again within the error limits.

Action: - Check the sensor wire for short-circuit or wire break.
- Check the respective sensor, replace as required.
- Check the upper error limits for this sensor.

3030 ErrAcceleratorWam	3130 SErrAcceleratorWam
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Cause: Pedal unit faulty

Reaction: - Error report.
- Error disappears by itself if the pedal unit is operating trouble-free.

Action: - Check the accelerator pedal.
- Check the idle speed switch.
- Check the accelerator pedal wire.
- Check the idle speed switch wire.

3031 ErrOilPressureW am

3131 SErrOilPressureW am

Cause: The oil pressure dropped below the speed-dependent oil pressure warning nominal curve.

Reaction: - Error report.
 - Error disappears by itself if the oil pressure is once again above the oil pressure warning nominal curve.

Action: - Check the engine (oil level, oil pump, ...).
 - Check the oil pressure sensor.
 - Check the oil pressure sensor wire.
 - Check the oil pressure warning nominal curve.
 (speed-dependent oil pressure monitoring)

3032 ErrCoolantLevelW am

3132 SErrCoolantLevelW am

Cause: The digital input "Coolant level monitoring" is active.

Reaction: - Error report.
 - Error disappears by itself if the coolant level is once again above the warning threshold.

Action: - Check the coolant level.
 - Check the coolant level sensor.
 - Check the coolant level sensor wire.
 - Check the warning threshold

3033 ErrAirFilterW am

3133 SErrAirFilterW am

Cause: The digital input "Air filter monitoring" is active.

Reaction: - Error report.

Action: - Check the air filter.

3035 ErrAlternatorW am

3135 SErrAlternatorW am

Cause: The alternator voltage dropped below the warning threshold.

Reaction: - Error report.
 - Error disappears by itself if the alternator voltage is once again above the warning threshold + hysteresis.

Action: - Check the alternator.
 - Check the connection between alternator and battery.
 - Check the connection between alternator and control unit.
 - Check the warning threshold

3038 ErrCoolantTempW am

3138 SErrCoolantTempW am

Cause: The coolant temperature has exceeded the warning threshold.

Reaction: - Error report.
 - Error disappears by itself if the coolant temperature is once again below the warning threshold.

Action: - Check the coolant.
 - Check the coolant sensor.
 - Check the coolant sensor wire.
 - Check the warning threshold

3039 ErrChargeAirTempW am

3139 SErrChargeAirTempW am

Cause: The charge air temperature has exceeded the warning threshold.

Reaction: - Error report.
 - Error disappears by itself if the charge air temperature is once again below the warning threshold.

Action: - Check the charge air.
 - Check the charge air sensor.
 - Check the charge air sensor wire.
 - Check the warning threshold

3041 ErrOilPressureEcy

3141 SErrOilPressureEcy

Cause: The oil pressure dropped below the speed-dependent oil pressure EMERGENCY - OFF-nominal curve.

Reaction: - Emergency shut-down

Action: - Check the engine (oil level, oil pump, ...).
 - Check the oil pressure sensor.
 - Check the oil pressure sensor wire.
 - Check the oil pressure EMERGENCY - OFF-nominal curve.

3042 ErrIntemTemp1W am

3142 SErr IntemTemp1W am

Cause: The internal temperature 1 has exceeded the warning threshold.

Reaction: - Error report.
 - Error disappears by itself if internal temperature 1 is once again below the warning threshold.

Action: -

3043 ErrInternTemp2Warning

3143 SErrInternTemp2Warning

Cause: The internal temperature 2 has exceeded the warning threshold.

Reaction: - Error report.
- Error disappears by itself if the internal temperature 2 is once again below the warning threshold.

Action: -

3048 ErrCoolantTempEcy

3148 SErrCoolantTempEcy

Cause: The coolant temperature has exceeded the shut-down threshold.

Reaction: - Emergency shut-down.

Action: - Check the coolant.
- Check the coolant sensor.
- Check the wire for the coolant sensor.
- Check the shut-down threshold

3049 ErrChargeAirTempEcy

3149 SErrChargeAirTempEcy

Cause: The charge air temperature has exceeded the shut-down threshold.

Reaction: - Emergency shut-down.

Action: - Check the charge air.
- Check the charge air sensor.
- Check the wire for the charge air sensor.
- Check the shut-down threshold

3050 ErrFeedback

3150 SErrFeedback

Cause: Error in the return system of the actuator, actuator not connected.

Reaction: - Regulator can not be activated.
- Emergency shut-down.

Action: - Check the return wire to actuator.
- Check the actuator, replace as required.
- Check the error limits for the return system :
1952 FeedbackErrLow /1953 FeedbackErrHigh

3053 ErrorActuatorDiff

3153 SErrActuatorDiff

- Cause:** The difference between the nominal regulating path and actual regulating path over a specific period is greater than a default value. This will occur when the injection pump, the throttle valve, the connecting rod or the actuator become jammed or are not connected.
- Reaction:**
- Error report.
 - Error disappears by itself if the difference is once again below 10 % .
- Action:**
- Check injection pump or throttle valve, replace as required.
 - Check mechanical parts (rods).
 - Check wire to adjustment device.
 - Check actuator, replace as required.

3056 ErrorFeedbackRef

3156 SErrFeedbackRef

- Cause:** Error in the return system of the actuator, actuator not connected.
- Reaction:**
- Regulator can not be activated.
 - Emergency shut-down.
- Action:**
- Check the return wire to the actuator.
 - Check the actuator, replace as required.
 - Check the error limits for the reference of the feedback:
1956 FeedbackRefErrLow / 1957 FeedbackRefErrHigh

3058 ErrorAmplifier

3158 SErrAmplifier

- Cause:** The high current monitoring has detected an error on the amplifier.
- Reaction:**
- Regulator can not be activated.
 - Emergency shut-down.
- Action:**
- Check the power supply and supply lines to the actuator.

3059 ErrorFeedbackAdjust

3159 SErrFeedbackAdjust

- Cause:** Automatic calibration of the actuator could not be carried out, incorrect entry of reference values for the actuator
- Actions:**
- Check the power supply and supply lines to the actuator.
 - Check the return wire to the actuator.
 - Check the actuator, replace as required.
 - For actuators with 2-quadrant operation, the engine-stop switch must be open (display parameter 2810 SwitchEngineStop = 0), to allow the automatic calibration to be carried out.

- Check reference values and error limits for the return.

-error limits

1952 FeedbackErrorLow = 0

1953 FeedbackErrorHigh = 65535

1956 FeedbackRefErrorLow = 0

1957 FeedBackRefErrorHigh = 65535

for the feedback, store values storing of data, start regulator again via Reset and carry out automatic calibration again.

- Reset error limits

3060 ErrPowerSupplyLow

3160 SErrPowerSupplyLow

Cause: The power supply for the regulator is below 9 V .

Reaction: - Error report.

- Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check voltage supply.

3061 Err7.5V SupplyLow

3161 SErr7.5V SupplyLow

Cause: The power supply 7,5 V is below 7 V .

Reaction: - Error report.

- Error disappears by itself in case the voltage is once again in the normal range.

Action: - Start regulator again via Reset of the control unit.

- Notify LIEBHERR AFTER -SALES-SERVICE .

3062 ErrEDC SupplyLow

3162 SErrEDC SupplyLow

Cause: The power supply for the EDC -feedback is below 4,5 V .

Reaction: - Error report.

- Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check power supply.

3063 ErrRef1Low

3163 SErrRef1Low

3064 ErrRef2Low

3164 SErrRef2Low

3065 ErrRef3Low

3165 SErrRef3Low

3066 ErrRef4Low

3166 SErrRef4Low

Cause: The reference voltage for the analog input 1 to 4 or temperature input 1 to 4 is below 4,5 V .

Reaction: - Error report.
- Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check reference voltage.

3067 ErrIntTem p1SensLow

3167 SErrIntTem p1SensLow

3068 ErrIntTem p2SensLow

3168 SErrIntTem p2SensLow

Cause: The internal temperature is not within the permissible range.

Reaction: - Error report.
- Error disappears by itself in case the voltage is once again in the normal range.

3069 ErrAmbiPressSensLow

3169 SErrAmbiPressSensLow

Cause: The internal measured ambient pressure is not within the permissible range.

Reaction: - Error report.
- Error disappears by itself in case the voltage is once again in the normal range.

3070 ErrCanBus

3170 SErrCanBus

Cause: The CAN -controller for CAN -Bus is transmitting errors such as BusStatus, ErrorStatus or DataOverrun. Despite reinitialization of the controller the error cannot be eliminated permanently.

Reaction: - Application-dependent

Action: - Check CAN -module
- Check CAN -connection.

3071 ErrCanComm

3171 SErrCanComm

Cause: An overflow has occurred in the receiving buffer or a transmission cannot be installed in the CAN -Bus

Reaction: - Application-dependent

Action: - Check CAN -module
- Check CAN -Connection

3076 ErrParam Store

3176 SErrParam Store

Cause: An error has occurred during program m ing of the perm anentm em ory for the regulator.

Reaction: - Engine can not be started.
- Em ergency shut-down .

Action: - Start regulator again via Reset of the control unit.
- Notify LIEBHERR AFTER -SALES-SERVICE .

3077 ErrProgram Test

3177 SErrProgram Test

Cause: The constantm onitoring of the program m em ory is transm itting an error

Reaction: - Engine can not be started.
- Em ergency shut-down .

Action: - Start regulator again via Reset of the control unit.
- Notify LIEBHERR AFTER -SALES-SERVICE .

3078 ErrRAM Test

3178 SErrRAM Test

Cause: The constantm onitoring of the working m em ory is transm itting an error

Reaction: - Engine can not be started.
- Em ergency shut-down .

Action: - Note values of param eters 3895 RAM TestAddrH igh and 3896
RAM TestAddrLow
- Start regulator again via Reset of the control unit.
- Notify LIEBHERR AFTER -SALES-SERVICE .

3079 ErrDigital Out

3179 SErrDigital Out

Cause: An error has occurred on one of the digital outputs.

Reaction: - Error report.
- Enor disappears by itself if the digital output is once again w ithout error

Rem edy: - Check digital outputs.
- The actual output value is in 2851 D igital Out1 to 2861 D igital Out11.
- The read back value is in 3611 FeedbackD igital Out1 to 3622 FeedbackD iagnosisPort.
- The inform ation concerning which error recognition was detected is in 2871 ErrTypeD igital Out1 to 2882 ErrTypeD iagnosisPort. This inform ation is issued in D cDesk 2000 in clear text in the error diagram .

Configuration of ErrTypeDigitalOut:

Bit 0: Short-circuit against battery voltage

Bit 1: Short-circuit against earth

Bit 2: open or short-circuit against battery voltage

Bit 3: open or short-circuit against earth

3080 ErrPowerSupplyHigh

3180 SErrPowerSupplyHigh

Cause: The power supply for the regulator is above 32 V .

Reaction: - Error report.
 - Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check power supply.

3081 Err7.5V SupplyHigh

3181 SErr7.5V SupplyHigh

Cause: The power supply 7,5 V is above 8 V .

Reaction: - Error report.
 - Error disappears by itself in case the voltage is once again in the normal range.

Action: - Start regulator again via Reset of the control unit.
 - Notify LIEBHERR AFTER -SALES-SERVICE .

3082 ErrEDC SupplyHigh

3182 SErrEDC SupplyHigh

Cause: The power supply for the EDC -feedback is above 4,5 V .

Reaction: - Error report.
 - Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check power supply.

3083 ErrRef1High

3183 ErrRef1High

3084 ErrRef2High

3184 ErrRef2High

3085 ErrRef3High

3185 ErrRef3High

3086 ErrRef4High

3186 ErrRef4High

Cause: The reference voltage for the analog input 1 to 4 or temperature input 1 to 4 is above 5,5 V .

Reaction: - Error report.
 - Error disappears by itself in case the voltage is once again in the normal range.

Action: - Check reference voltage.

3087 ErrIntTem p1SensH igh

3187 SErrIntTem p1SensH igh

3088 ErrIntTem p2SensH igh

3188 SErrIntTem p2SensH igh

Cause: The internal temperature is not within the permissible range.

Reaction: - Error report.
- Error disappears by itself in case the temperature is once again in the normal range.

3089 ErrAmbiPressSensH igh

3189 SErrAmbiPressSensH igh

Cause: The internal measured ambient pressure is not within the permissible range.

Reaction: - Error report.
- Error disappears by itself in case the ambient pressure is once again in the normal range.

3090 ErrData

3190 SErrData

Cause: No data located, or the checksum concerning the data is incorrect.

Reaction: - Engine can not be started.
- Regulator operating with standard parameters

Action: - Check data for correct setting, Storing of data parameter and start regulator again via Reset of the control unit.

Note: The error only occurs during parameter setting and storing.

3092 ErrConfiguration

3192 SErrConfiguration

Cause: Error in the configuration of the control unit

Reaction: - Error display.

Action: - Check data for correct setting

3000 Configuration - Error	Error description
5	Frequency output 1 configured, but digital output 8 being utilised
6	Frequency output 2 configured, but digital output 9 being utilised
20	PW M -input 1 configured, but digital input 1 being utilised
25	PW M -output 1 configured, but digital output 10 being utilised
26	PW M -output 2 configured, but digital output 9 being utilised
30	D igital input 1 configured, but PW M -input 1 being utilised
35	Frequency output 2 configured, but PW M -output 2 being utilised

36	D igital output 10 configured, but PW M -output 1 being utilised
40	A current sensor or voltage sensor was allocated to the 37 V -channel or a tem perature channel
41	The alternator input w as allocated to a destination other than the 37 V -channel
42	A tem perature sensor w as allocated a destination other than the tem perature channel
50	Fan control required, but PW M -output or H igh-Side-Sw itch not allocated .
51	Flam e start unit required, but flam e-type glow plug or solenoid valve not allocated
52	M onitoring of the flam e-type glow plug required, but m onitoring input not allocated
53	M onitoring of the pedal unit required, but the respective analog and digital inputs not allocated
60	M axim um curve offset greater than m axim um perm issible value

3093 ErrStack

3193 SErrStack

Cause: Internal program or calculation error, so-called "Stack-O verflow " error

Reaction: - Engine can not be started.
- Em ergency shut-down .

Action: - Note value of param eter 3897 StackTestFreeBytes and NO TIFY LIEBHERR AFTER -SALES-SERV ICE .
- Start regulator again via Reset of the control unit.

3094 ErrIntern

3194 SErrIntern

3195 SExceptionN um ber

3196 SExceptionA ddrLow

3197 SExceptionA ddrH igh

3198 SExceptionF lag

Cause: Internal program or calculation error, so-called "EX CEPTION " error

Reaction: - Engine can not be started.
- Em ergency shut-down .

Action: - Note values of param eter 3195 ExceptionN um ber, 3196 ExceptionA ddrLow ,
3197 ExceptionA ddrH igh and 3198 ExceptionF lag and NO TIFY LIEBHERR AFTER -SALES-SERV ICE .
- Start regulator again via Reset of the control unit.

3099 EEPROM ErrorC ode

Cause: Internal error in the arrangement of the EEPROM -pages

Reaction: - Error report.

Action: - Note value of parameter and NOTIFY LIEBHERR AFTER -SALES-SERVICE .
- Start regulator again via Reset of the control unit.

Bit	Error description	Consequence
0	Bootloaderpage faulty	Program remains in the Bootloader, it is not possible to start the engine.
1	NM Ipage faulty	The operating hours will be deleted.
2	Operating data page faulty	The operating hours will be deleted.
3	Serial number page faulty	The serial number of the control unit can not be displayed.
4	Error memory pages faulty	The error memory will be deleted.
5	Parameter memory pages faulty	Standard data is used, it is not possible to start the engine.
6	Exception memory page faulty	An exception can not be displayed.
7	Environmental data page faulty	The error memory will be deleted.

Note regarding error 3079 ErrDigitalOut :

- Should this error be initiated, it means that an error has occurred on at least one of the digital outputs. It is possible to determine where the error has occurred via measuring values 2871 to 2881. If the measuring value = 0 there is no error on the output, and if it ≠ 0 there is indeed an error on the output. Cause of error : engine control unit, connected parts or cabling.

Heinzmann-Error number	Affected parts
2871 ErrTypeDigitalOut1	Not used
2872 ErrTypeDigitalOut2	Flame-type glow plugs-control (relay or BERU-module)
2873 ErrTypeDigitalOut3	Solenoid valve
2874 ErrTypeDigitalOut4	Not used
2875 ErrTypeDigitalOut5	Starter
2876 ErrTypeDigitalOut6	Not used
2877 ErrTypeDigitalOut7	Flame start lamp
2878 ErrTypeDigitalOut8	Speed output
2879 ErrTypeDigitalOut9	Not used
2880 ErrTypeDigitalOut10	Not used
2881 ErrTypeErrorLampe	Error lamp
2882 ErrTypeDiagnosisPort	Supply of diagnosis interface



IM P O R T A N T : The electronic regulator DC 5-00 only shuts down the engine by itself only if so-called fatal errors occur. These can be recognised in the chart above by the reactions attribute „Emergency shut-down“. For all other occurring errors, it is the sole responsibility of the superior control or the user to carry out the respective action for the prevention of damage to persons, the machine or the engine!

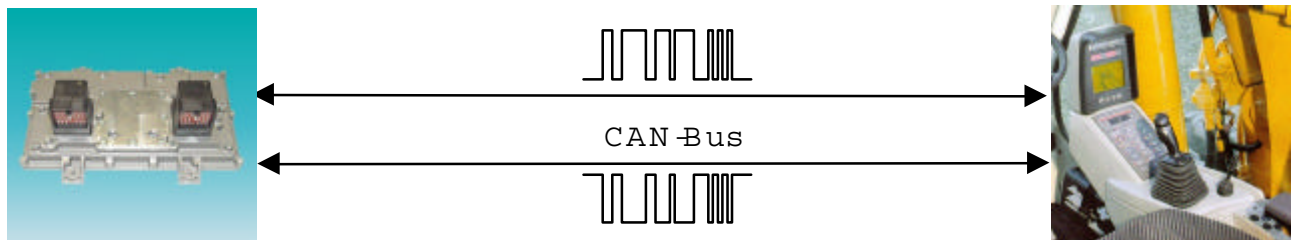
6. Interfaces

6.1 Diagnosis

A readout of measuring values and error reports via the diagnostic interface of the electronic regulator DC 5-00 is possible using a PC /Laptop and the diagnostic software DC-DESK.

6.2 CAN-Bus (ISO 11898)

CAN = **C**ontroller **A**rea **N**etwork
(Network of micro-controllers)



Communication (data exchange) between the control of the machine and the engine control unit is realized via the **CAN**-Bus

The CAN-Bus interface has been designed in accordance with ISO 11898 and operates at transfer rates between 125kB it/s...1MB it/s.

The **LIEBHERR**-standard protocol for construction machinery is applied as a communication protocol, especially designed for this purpose.

The overall data exchange between engine regulator and the other components in the machine (e.g. load limit regulation) is done via the CAN-Bus interface. Likewise, the control of the engine is done exclusively via the CAN-Bus from the superior control in the machine (sole exception: emergency operation functions).



7. Diagnosis and troubleshooting

Various measuring values and memory of the electronic regulator DC 5-00 can be read out and evaluated via the diagnostic program DC-DESK.

The possibilities for diagnostic and parameterisation of the regulator are hereby determined by four different access levels of the respective user.

The four access levels are:

- ◆ Levels 1 or 3 for diagnostic and troubleshooting of the ultimate customer:
These access levels allow display of the most important operating values (e.g. set values and actual values for speed and primary route) and errors. Intervention in the regulation and engine data is not possible.
- ◆ Level 4 for the production line testbench of the engine manufacturer:
The engine manufacturer can set the engine output within the permissible range. Furthermore, the parameters can be set to the specifications of the ultimate customer.
- ◆ Level 5 for the research testbench of the engine manufacturer:
With the exception of a few special parameters, such as the values of the servo-circuit for example, and a few safety limits, all interventions are permissible here.
- ◆ Level 6 for the electronic development of the engine manufacturer:
In this level all available parameters to program the regulator are available.

With the program DC-DESK, the user can determine and record current measuring values and errors concerning the engine via PC during operation („Online“), and thus draw conclusions regarding engine behaviour, allowing any measures which may be required, to be taken.

The serial interface of the PC, with DC-DESK software installed, can be connected to the electronic regulator via a special interface cable (can be ordered from Liebherr Machines Bull SA). Correspondence between PC and regulator is done via a protocol specially synchronised for this purpose.

For further information concerning operation and functioning of the diagnostic software, the respective documentation can be acquired from **LIEBHERR** Machines Bull SA (Switzerland).



IMPORTANT: DC-Desk may only be used in conjunction with the respective communications cable.

7.1 Error memory

Each error is deposited in the temporary (RAM) as well as in the permanent (EEPROM) error memory in accordance with two different protocols.

Temporary error memory

The active errors are stored in the temporary error memory. If an error is no longer active, it will be deleted from temporary memory. The temporary error memory is deleted upon deactivation of the regulator.

Permanent error memory

The errors are stored in the permanent error memory in a table (as follows). This table includes additional abundant information concerning each error stored.

Error	Error counter	Operating hours with first occurrence of the error	Operating hours with last occurrence of the error	RPM with last occurrence of the error	Engine phase with last occurrence of the error
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7.2 Startphases

It is practical for diagnosis to take the respective startphase in which the error code occurred, into account.

The remaining limiting functions of the regulator are deactivated during the startphase in order that the start-up supply limitation can be freely parameterised (independent of the position of the accelerator pedal or the throttle lever).

This should be considered an aid since the possibility is given that certain error codes occur in specific startphases.

The individual phases of the start and the speed regulator are displayed via parameter 3830 Phase:

- 0: Waiting for engine start
- 1: Startphase 1, fixed start-up supply limitation
- 2: Startphase 2, variable start-up supply limitation
- 3: Startphase 3, temperature-dependent start-up supply limitation
- 4: Speed regulator active, limiting functions inactive
- 5: Speed regulator active, limiting functions active
- 6: Speed regulator active, lower limitation active
- 7: Speed regulator active, upper limitation active
- 8: Automatic calibration
- 9: Positioning operation

8. Repairs

All components used for the electronic regulation which become faulty must be replaced with original spare parts. These can be obtained individually with details of the respective order number from **LIEBHERR** Machines Bulle SA (Switzerland).

Since the electronic regulator DC 5-00 is a control unit specified to the engine type with a specific data sentence, the following details must be supplied for the delivery of spare parts:

- Identification number of the engine (engine ID, on the regulator identification plate, or on the engine identification plate under „Configuration“)
- Identification number of the regulator (regulator ID, on the regulator identification plate)

9 Installation

9.1 General

Since the electronic regulator LDEC DC5-00, as well as all necessary accessories and attachments (with the exception of the output relay module), are mounted to the engine and completely wired when the **LIEBHERR** diesel engine is delivered, no further assembly measures must be undertaken by the ultimate customer.

Only the wiring and assembly of the output relay module on the vehicle (not near the engine!) and connection between machine electronics and engine electronics must be established via both interface plugs on the engine.

Caution:

- When carrying out electrical wiring tasks to the machine, it is imperative that connection to the engine electronics are disconnected via both plugs, otherwise damage cannot be ruled out!
- Individual sensors or actuators may not be used for test or inspection purposes, neither are they to be connected to external power sources, but rather only in connection with electronic regulator LDEC DC5-00, otherwise there is a risk of destruction or possibly abnormal behaviour of the engine.
- The electronic regulator DC5-00 features short-circuit as well as reverse polarity prevention devices. It is imperative that incorrect connection of poles or short-circuit on the control unit is avoided to rule out damage entirely.

For further information, please contact **LIEBHERR** Machines Bulle SA (Switzerland).

9.2 Replacing the electronic regulator LDEC (control unit) or injection pump with EDC-regulator

When replacing electronic regulator LDEC DC 5 (control unit) or injection pump with EDC-regulator, the work procedure described here must be taken into account!

9.2.1 General

This work procedure describes the approach to replace an injection pump with EDC-actuator or the respective electronic engine control unit with Liebherr-diesel engines, types D924TIE A4, D926TIE A4, D9406TIE A4, D9408TIE A4 featuring engine control units, type LDEC DC 5 in construction machinery.

9.2.2 Notes on safety

The notes on safety for the valid After-Sales-Service, service instructions and operating instructions for Liebherr-diesel engines, as well as the valid safety guidelines for the respective country must be adhered to in all situations.

All tasks to the EDC pump and/or engine control unit should be carried out exclusively by qualified, Liebherr-trained personnel.

All tasks to the EDC pump and/or engine control unit should be carried out exclusively with the engine shutdown.

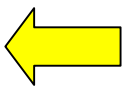
For every task to the EDC pump and/or engine control unit, first ensure that all terminals for both components have been separated from the power supply (battery).

9.2.3 General information

The following explanation is universally applicable. Should there be any doubt, or should you have any specific questions concerning the topics outlined please contact Liebherr-After-Sales-Service before carrying out any tasks. Unnecessary tasks, time and possibly loss of warranty, as well as additional costs resulting from work having been performed inappropriately can be avoided.

When assembling/disassembling the components please follow the explanations made precisely and observe additional notes. They are designed to assist you in the professional execution of the tasks.

Comments on assembly or further notes are indicated with an arrow.



Important notes which must absolutely be read and adhered to are indicated with a Stop sign.



9.3 Replacing the injection pump with EDC - actuator

Replacement of an injection pump with EDC - actuator is done as follows:

- Separation of terminals from engine control unit and injection pump from the power supply (battery) of the machine.
- Disassembly of the plug of the injection pump with suitable tool.
- Disassembly of the injection pump.
 - Installation of the new injection pump.

NOTE:

For disassembly and installation of the injection pump, note the respective instructions of the Liebherr company concerning the diesel engine.

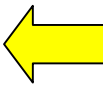
- Assembly of the plug for the injection pump with suitable tool.

IMPORTANT INFORMATION:

The plug must be inspected visually for any defects and/or leaks before assembly. Should defects and/or leaks be detected, the plug should be replaced immediately! The plug of the injection pump must be assembled with the utmost care. If the plug is inserted with an angle onto the threaded connection of the injection pump, and then tightened with force, destruction or permanent damage of the threaded connection on the injection pump is the result.

After assembly the plug of the injection pump should be tight (imperative that this is checked by pulling lightly on the plug!). A loose plug can cause functional errors, and thus lead to a sudden shut-down of the engine! If the plug is not sitting securely on the injection pump, it must be tightened, or remounted to ensure correct seating!

- Start the engine and check correct function.
- Return the replaced injection pump to LIEBHERR Machines Bulle SA.
- Automatic calibration, see chapter 9.5



9.4 Replacing engine control unit DC 5

9.4.1 General information

Engine control unit, type LDEC DC 5 includes data records which are synchronised perfectly to the respective engine, ensuring the best possible power output and an optimum operational behaviour of the engine.

IMPORTANT INFORMATION:

For the aforementioned reasons, never install an engine control unit which has been designated as a replacement unit for a different engine, or a different engine type. Serious damage to the engine, danger to other persons, as well as to yourself, and complete loss of all warranty claims against LIEBHERR Machines Bulle SA can thus be avoided!

Should you require an engine control for replacement, please contact LIEBHERR Machines Bulle SA with the following details:

- Engine type



- Engine identification number or engine control unit identification number

You will receive a new engine control unit immediately from LIEBHERR Machines Bulle SA with a „specific data record“, which guarantees you full functionality of the machine.

9.4.2 Replacing units with engine assembly (fuel-cooled)

Whether or not an engine control unit with fuel-cooling is concerned, can be easily recognised as the engine control unit is mounted directly to the engine.

Replacement of an engine control unit with fuel-cooling for injection pumps featuring EDC-actuator is done as follows:

- Disconnect battery main switch.
- Disconnect all terminals of the engine control unit from the power supply (battery) of the machine.
- Close fuel supply to the engine.

NOTE:

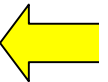
Also note the respective instructions of the Liebherr company concerning the diesel engine.

- Separation of the supply - and return line of the fuel-cooling from the cooler.
IMPORTANT INFORMATION:
Do not dismantle the cooling element from the engine control unit!
- Remove the plug for the engine control unit with the utmost care.
IMPORTANT INFORMATION:
- Disassembly of the engine control unit with suitable tool.
- Installation of the new engine control unit with suitable tool.
- Connection of supply line and return line of the (fuel-cooling) to the cooling element.
- Re-establish fuel supply to the engine.

NOTE:

Note respective instructions concerning the diesel engine in the Liebherr company workshop manual.

- Careful assembly of the plug of the engine control unit.
IMPORTANT INFORMATION:
The plug must be inspected visually for any defects and/or leaks before they are installed. Should defects and/or leaks be determined, the plug must be replaced immediately!
The plugs of the engine control units have been provided with a small nut on the underside, in order to avoid the connection to the wrong side of the engine control. Do not force the plug when installing. If insertion can not be carried out with ease, first check whether the plug has been installed on the correct side, and whether the face side is positioned correctly.
- Start the engine and check for proper function.
- Return the replaced engine control unit to LIEBHERR Machines Bulle SA.



9.5 Automatic tuning

Whenever the regulator and/or the injection pump is replaced, Liebherr recommend that an automatic tuning be carried out. Automatic tuning guarantees optimum synchronisation between injection pump (adjustment device) and the regulator. Please note that the automatic tuning must be carried out at a cooling water temperature of 20°C or more (higher) in order that faults can be avoided (jamming of the control rods, resistances of adjustment device, temperature-dependent variations, etc.). If no automatic tuning is carried out after replacing the E-pump or the regulator it is possible that the control rod is not precisely positioned and may thus cause a slight deviation in output.

With automatic calibration, the regulator measures the reference values of its own accord. The regulator also powers the adjustment device for a certain time, in order that the minimum and maximum positions are safely reached, and then measures the reference values. The measured values are entered in the respective parameters and become immediately available.

The automatic tuning can be triggered upon request via the PC.

Note: If a serious error has occurred, synchronisation of the automatic adjustment device is not initiated.



10 Technical data

10.1 Sensors

10.1.1 Pressure sensors

Oil pressure sensor

Relative pressure sensor 0-10 Bar

Pressure range :	0 to 10 bar relative
Power supply :	5.00 V _{DC}
Built-in reverse polarity :	16.00 V _{DC}
Test pressure :	20 bar
Burst pressure :	30 bar
Output voltage :	0.5 V _{DC} @ 0 bar / 4.5 V _{DC} @ 10 bar linear
Maximum current :	5 mA
Output impedance :	100 Ω max.
Operating temperature :	-40 to +125 °C
Storage temperature :	-54 to +150 °C
Vibrations :	20 g Peak to peak Sinus (10 to 2000 Hz)
Shock :	75 g ½ Sinus
Threaded joint outer thread :	M 14 x 1.5
Electrical connection :	Junior PowerTiner (AMP)

Charge air pressure sensor

Absolute pressure sensor 0.5 - 4.5 bar

Pressure range :	0.5 to 4.5 bar absolute
Power supply :	5.00 V _{DC}
Built-in reverse polarity :	16.00 V _{DC}
Test pressure :	7 bar
Burst pressure :	10 bar
Output voltage :	0.5 V _{DC} @ 0.5 bar / 4.5 V _{DC} @ 4.5 bar linear
Maximum current :	5 mA
Output impedance :	100 Ω max.
Operating temperature :	-40 to +125 °C
Storage temperature :	-54 to +150 °C
Vibrations :	20 g Peak to peak Sinus (10 to 2000 Hz)
Shock :	75 g ½ Sinus
Threaded joint outer thread :	M 18 x 1.5
Electrical connection :	Junior PowerTiner (AMP)

Internal ambient pressure sensor

Integrated in the regulator

Pressure range :	15... 115 kPa
Power supply :	4.85... 5.35 V _{DC}
Power consumption :	7 ... 10 mA
Precision (0 to 85°C) :	± 1.5 %
Sensitivity :	45.9 mV /kPa
Maximum pressure :	400 kPa
Burst pressure :	1000 kPa
Operating and storage temperature :	-40° to +120°C

10.1.2 Temperature sensors

Coolant temperature sensor

Type, NTC

Temperature range :	-40°C to +130°C	
Storage temperature :	-40°C to +150°C	
Nominal values :	$R_{-30} = 26.114 \text{ k}\Omega$	NTC -curve
	$R_{20} = 2.5 \text{ k}\Omega$	
	$R_{130} = 89 \text{ }\Omega$	
Temperature tolerance :	20°C ± 1.2 °C	
	100°C ± 3.4 °C	
Outer thread :	M 14*1.5	
Electrical connection :	Junior PowerTiner (AMP)	

Charge air temperature sensor

Temp. sensor type NTC

Temperature range :	-20°C to +130°C	
Storage temperature :	-40°C to +150°C	
Nominal values :	$R_{-20} = 271.2 \text{ k}\Omega$	NTC -curve
	$R_{25} = 30 \text{ k}\Omega$	
	$R_{130} = 0.9 \text{ k}\Omega$	
Temperature tolerance :	± 0.5 %	
Outer thread :	M 14*1.5	
Electrical connection :	Junior PowerTiner (AMP)	

10.2 Speed sensor (inductive pick-up)

AB electronic inductive sensor for diesel engine

Operating temperature :	-40°C to +150°C
Oscillation band :	10... 500 Hz, 25g
Inner resistance :	$540 \Omega \pm 10\%$ at 20°C, $TK = +0.395 \% / K$
Inductivity :	220 mH $\pm 20\%$
Output voltage:	with $a=1.5\text{ mm}$, $R_L=10\text{ k}\Omega$ (a : distance; R_L : load resistance) $V_{SS}=17$ to 73 V for $F=0.5$ to 5 kHz
Electrical connection :	Junior PowerTiner (AMP)

10.3 Regulator/engine control unit

Power supply :

For $U_{batt} = 0... 9\text{ V}_{DC}$:	Undervoltage, the regulator is switched off. To prevent defects or damage to components.
For $U_{batt} = 9... 32\text{ V}_{DC}$:	The equipment must be fully operative.
For $U_{batt} = 32... 54\text{ V}_{DC}$:	Overvoltage, the regulator is switched off. To prevent defects or damage to components.

Current consumption :

Peak current :	not yet defined
Operation :	not yet defined

Temperature range

Operating ambient temperature range of the regulator:

- -40...+ 85 °C without fuel-cooling
- -40...+120 °C with fuel-cooling

Storage temperature :

- -40...+130 °C

Brief increases in ambient temperature (with regulator switched off) up to +130 °C may not lead to any damage.

Vibration and shock

In accordance with DIN EN 60068-2-6:

Test 20g 10-500 Hz RMS

Shock: 30g, 11ms, half-sinus

Vibrations: 10-20 Hz, 2mm

20-64 Hz, 0,24 m /s
 64-2000 Hz, 10g : in all levels
 64-2000 Hz, 15g : in all levels

Resistance against fluids

Resistance against the fluids listed below is guaranteed during sprinkling (5 sec.) and subsequent storage at 80°C:

- Diesel fuel in accordance with DIN EN 590
- Engine lube-oil
- Hydraulic oil
- Degreaser
- 2 component paint

10.4 Plugs

X1 (vehicle plug):	Plug:	Deutsch AEC 16-40 SBE
	Contact:	Deutsch Solid Socket 0462-201-16141, 0.5-1.0mm ² Deutsch Solid Socket 0462-209-16141, 1.0-2.0mm ²
	Dummy plug:	Deutsch 114017
X2 (engine plug):	Plug:	Deutsch AEC 16-40 SAE
	Contact:	Deutsch Solid Socket 0462-201-16141, 0.5-1.0mm ² Deutsch Solid Socket 0462-209-16141, 1.0-2.0mm ²
	Dummy plug:	Deutsch 114017
X3:	Plug:	AMP JPT 2 way 282189-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²
	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
X4:	Plug:	AMP JPT 2 way 282189-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²
	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
X5:	Plug:	AMP JPT 3 way 282191-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²
	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
X6:	Plug:	AMP JPT 3 way 282191-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²
	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
X7:	Plug:	AMP JPT 3 way 282191-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²

	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
	Dummy plug:	AMP 828922-1
X8:	Plug:	AMP JPT 3 way 282191-1
	Contact:	AMP JPT 929939-3 or 929940-3, 0.5-1mm ²
	Single-wire seal:	AMP 828904-1, with wire Ø 1.2-2.1mm or 828905-1, with wire Ø 2.2-3.0mm
	Dummy plug:	AMP 828922-1
X9:	Plug:	Bosch 7 pol 0 281 002 052
	Contact:	Bosch 1 284 485 212
	Dummy plug:	Deutsch 114017
X10: (with V-engines only)	Plug:	Deutsch DTP04-2P-C015
	Contact:	Deutsch Solid Pin 0460-204-12141, 2.0-3.0mm ²
	Pin plug-wedge :	W P2P
	Dummy plug:	Deutsch 114017
X11:	Plug:	Deutsch DTP04-4P-C015
	Contact:	Deutsch Solid Pin 0460-204-12141, 2.0-3.0mm ²
	Pin plug-wedge :	W P4P
	Dummy plug:	Deutsch 114017
X12:	Plug:	Deutsch DTP06-4S-C015
	Contact:	Deutsch Solid Socket 0462-203-12141, 2.0-3.0mm ²
	Pin plug-wedge :	W P4S
	Dummy plug:	Deutsch 114017
X13: (with V-engines only)	Plug:	Deutsch DTP06-2S-C015
	Contact:	Deutsch Solid Socket 0462-203-12141, 2.0-3.0mm ²
	Pin plug-wedge :	W P2S
	Dummy plug:	Deutsch 114017
X14:	Plug:	Deutsch DT06-4S-C015 or -CE06 or -CE01 of the -CE05
	Contact:	Deutsch Solid Socket 0462-201-16141, 0.5-1.0mm ²
	Pin plug-wedge :	W 4S or W 4S-P012
	Dummy plug:	Deutsch 114017
X15:	Plug:	AMP FASTN-FASTON 925276-0
	Contact:	AMP FASTN-FASTON 160928-2, 0.5-1.0mm ²
CASE:	Pipe type wire plug:	E-CU Pipe in accordance with DIN 40500
	wire plug size:	2.5mm ² / bore Ø 6mm
KL50:	Pipe type wire plug:	E-CU pipe in accordance with DIN 40500 or
	Angle type cable lig:	E-CU pipe 90° in accordance with DIN 40500
	wire plug size:	2.5mm ² / bore Ø 6mm

M V:	Flat-type plug: Wire plug size: Plug sleeve housing:	without grid in accordance with D N 46247 6,3 ; >1-2 5m m ² Natural pol
D +:	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 4m m ² /bore Ø 4m m
FG K1:	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 6m m ² /bore Ø 5m m
FG K2: (with V-engines only)	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 6m m ² /bore Ø 5m m
R-FG K1:	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 V-engines: 6m m ² /bore Ø 5m m R-engines: 2 5m m ² /bore Ø 5m m
R-FG K2:	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 V-engines: 6m m ² /bore Ø 5m m R-engines: 2 5m m ² /bore Ø 5m m
R-30:	Pipe type wire plug: Wire plug size:	E-CU Pipe in accordance with D N 40500 16m m ² /bore Ø 6m m

10.5 Tools

X1,X2:	Pliers: Extraction tool:	Deutsch HDT-48-00 Deutsch 0411-336-1605
X3,X4,X5,X6,X7,X8:	Pliers: Female die: Extraction tool:	AM P 169400-0 AM P 734253-0 AM P 726503 or 726519
X10,X11,X12,X13, X14:	Pliers:	Deutsch HDT-48-00
X15:	Pliers: Female die: Extraction tool:	AM P 169400-0 AM P 169628-0 AM P 725864-1

10.6 Connection diagrams

Diagram s 1 and 2 for in-line engines D 924 TIE A4 and D 926 TIE A4

Diagram s 3 and 4 for V-engines D 9406 TIE A4 and D 9408 TIE A4

10.7 Pin configuration for vehicle plug

Pin	Configuration	Pin	Configuration	Pin	Configuration	Pin	Configuration
1	D_GND	11	PRUEF	21	KMST	31	RS232_R
2	TA5	12	CASE	22	NOTDRZ	32	PS+
3	OA1	13	LUEF_GND	23	FGK	33	CANOB_L
4	SW V	14	SCL	24	RV	34	CANOA_L
5	SW V_REF	15	SCK	25	SFM	35	PS-
6	SW V_GND	16	LGS	26	DRZA	36	PS-
7	FEHL_L	17	LFU	27	CANOB_H	37	RS232_T
8	TE2-	18	NOTSTRT	28	CANOA_H	38	PS+
9	TE2+	19	LUEF	29	D_PS+	39	CANOB_GND
10	DA	20	FSA_L	30	RS232_GND	40	CANOA_GND

10.8 Pin configuration for engine plug

Pin	Configuration	Pin	Configuration	Pin	Configuration	Pin	Configuration
1	OLD -	11	NDB2 (GND)	21	N.C.	31	LLD+
2	OLDV	12	ODI	22	Volbr.-	32	CAN-GND
3	OLD+	13	EDC_REF	23	CASE	33	CAN-H
4	NDA1(+)	14	KMT-	24	TE1-	34	OD6
5	NDA2(+)	15	KMT+	25	TB1+	35	DR -
6	GND	16	BI	26	OD9	36	DRV
7	EDC_MS	17	MV	27	GND	37	DR+
8	LLT	18	Volbr.+	28	SO	38	CAN-L
9	LLT+	19	EDC_MA	29	LLD -	39	POWERGND
10	NDB1 (GND)	20	D+	30	LLDV	40	POWERGND

N.C. = Not Connected

LIEBHERR Machines Bulle SA	Fehlerdiagnose	Von: BE-MD4 / DUJ Nr.: MD4-
Dieselmotoren Elektronikentwicklung		Datum : 09.07.2002 Geändert:

Notice: The current list can be obtained in Outlook under „Public file/companies/LMB / After-Sales-Service/EDC / Error diagnosis“

11 Error diagnosis

Diesel engine problems or –protection	Possible causes
Starter not turning (after ignition off / ignition on)	• CAN-communication between control and engine control unit • Starter-Control defect, starter defect, wiring engine control unit / starter • power supply too low • Internal engine control unit error (hardware / software / parameter)
Starter turning, but no diesel injection in the engine	• Pick-up 1 & 2 defect, wiring engine control unit / Pick-up, Pick-up assembly on flywheel not correct, Starter teeth on the flywheel broken or worn • Diesel injection pump mechanical/electrical damage or wiring engine control unit / injection pump • Internal engine control unit error (hardware / software / parameter)
Emergency shut-down (following successful start)	• Pick-up 1 & 2 defect, wiring engine control unit / Pick-up, Pick-up assembly on flywheel not correct, Starter teeth on the flywheel broken or worn • Diesel injection pump mechanical/electrical damage or wiring engine control unit / injection pump • Diesel engine overspeed • CAN-communication between control and engine control unit lost (optional) • Power supply (battery / alternator) too high or too low • Internal engine control unit error (hardware / software / parameter)
Reduction in output	• Excess temperature (charge air or coolant) • Machine running in emergency operation • Machine running in high altitudes (turbo-charger protection) • Charge air pressure or ambient air pressure from engine control unit measured incorrectly (can be read on the display) following damage to the sensor or to wiring • Charge air or coolant temperature from engine control unit measured incorrectly (can be read on the display) following damage to the sensor or to wiring