https://truckmanualshub.com/

Lovol Phaser and 1000 Series

WORKSHOP MANUAL

Phaser	4 and 6 cylinder diesel engines for automotive applications
1000 Series	4 and 6 cylinder diesel engines for agricultural and industrial application

The explanation of the supplement

Version	Description	Date
1	This version includes the following content and the update information of the following content: Unit pump engine. YRZ series of preheating device.	July. 2007

https://truckmanualshub.com/

Contents

General information 10
Specifications 11

SERVICE OPERATIONS

Cylinder head assembly 12
Piston and connecting rod assemblies 13
Crankshaft assembly 14
Timing case and drive assembly 15
Cylinder block assembly 16
Engine timing 17
Aspiration system 18
Lubrication system 19
Fuel system 20
Cooling system 21
Flywheel and housing 22
Electrical equipment 23
Auxiliary equipment 24
List of special tools 25

https://truckmanualshub.com/

https://truckmanualshub.com/

General information 10

Introduction 10.02
Engine views 10.03
Engine identification 10.04

Safety precautions

Safety 10.05
Engine lift equipment 10.06
Viton seals 10.07

https://truckmanualshub.com/

Introduction

This workshop manual has been designed to provide assistance in the service and overhaul of Lovol Phaser and 1000 Series engines.

Most of the general information which is included in the relevant User's Handbook (sections 1 to 9) has not been repeated in this workshop manual and the two publications should be used together.

Where the information applies only to certain engine types, this is indicated in the text.
When reference is made to the "left" or "right" side of the engine, this is as seen from the flywheel end of the engine.

Special tools have been made available and a list of these is given in section 25. Reference to the relevant special tools is also made at the beginning of each operation.

Data and dimensions are included at the end of each section.

Read and remember the "Safety precautions". They are given for your protection and must be used at all times.

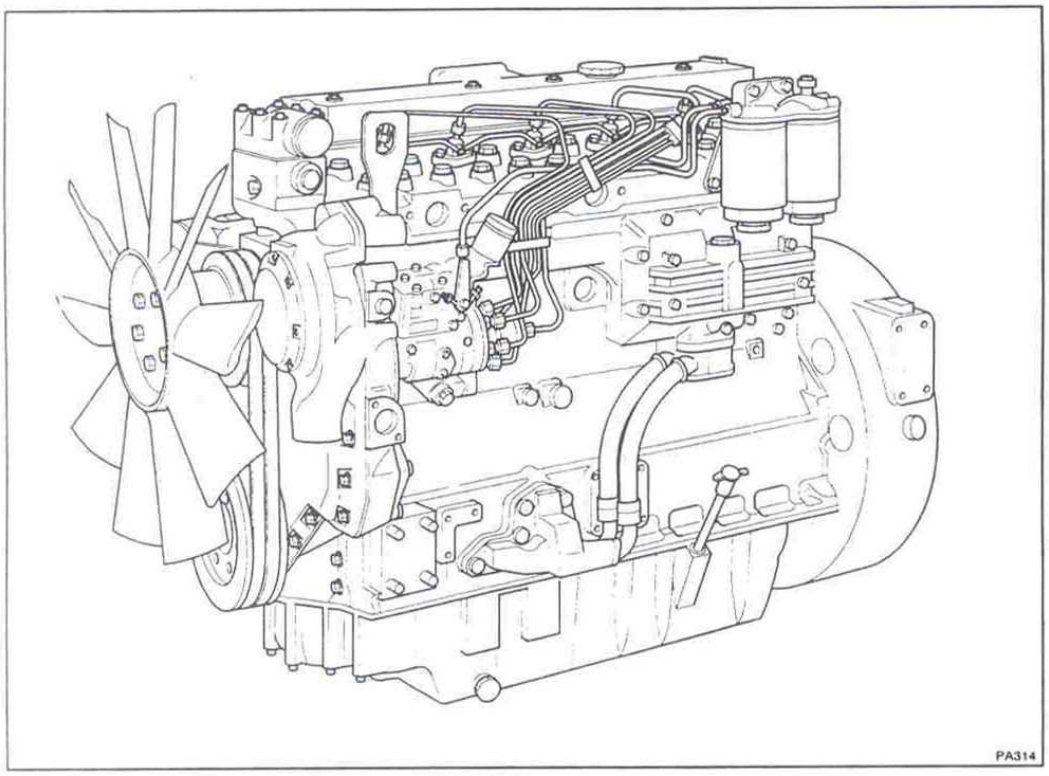
Danger is indicated in the text by two methods:

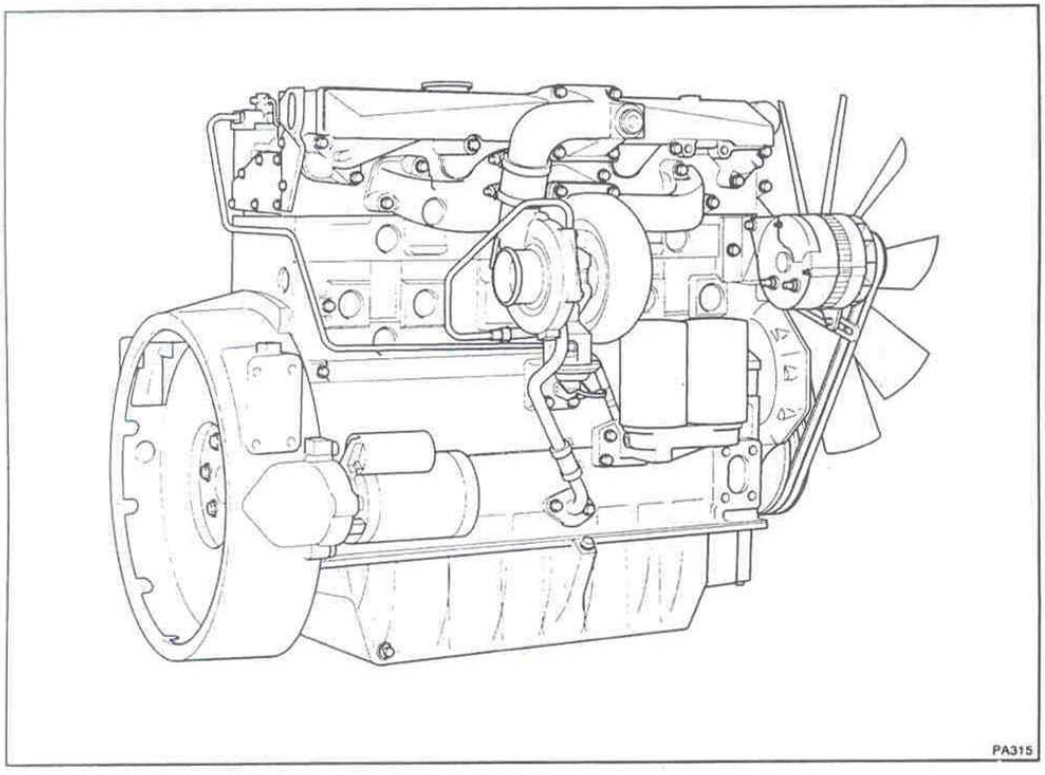
Warning! *This indicates that there is a possible danger to the person.*

Caution: *This indicates that there is a possible danger to the engine.*

Note: Is used where the information is important, but there is not a danger.

https://truckmanualshub.com/





https://truckmanualshub.com/

Engine identification

The Lovol Phaser and 1000 Series engines have been designed for specific applications, as shown below:

- Phaser for automotive applications.
- 1000 Series for agricultural and industrial applications

Each series consists of both four and six cylinder engines, each of which will have four basic engine types - naturally aspirated, compensated, turbocharged and turbocharged/intercooled.

There are different models in each series.

Phaser engines are named according to their approximate power output, for example:

Phaser\110T - four cylinder engine rated at 106 bhp

"T" indicates that the engine is turbocharged.

Phaser\210Ti - six cylinder engine rated at 210 bhp

"Ti" indicates that the engine is turbocharged and intercooled.

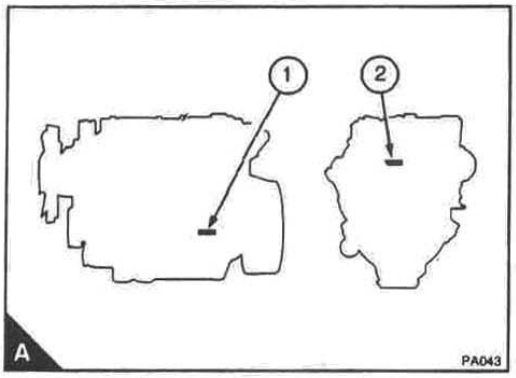
1000 Series engines are identified by a system of numbers and letters, for example:

1006-6TW - six cylinder engine of six litres

"TW" indicates that the engine is turbocharged and intercooled.

In this workshop manual, the different engine types are indicated by their code letters. These are the first two letters of the engine number as indicated below:

Code letters	Engine type
AA	Four cylinder, naturally aspirated
AB	Four cylinder, turbocharged
AC	Four cylinder, compensated
AD	Four cylinder, turbocharged/intercooled
AE	Four cylinder, turbocharged/intercooled designed to conform to the USA emission legislation
AG	Four cylinder, naturally aspirated with belt driven water pump.
AH	Four cylinder, turbocharged with belt driven water pump.
YA	Six cylinder, naturally aspirated.
YB	Six cylinder, turbocharged.
YC	Six cylinder, compensated.
YD	Six cylinder, turbocharged/intercooled.
YE	Six cylinder, turbocharged/intercooled designed to conform to the USA emission legislation



The engine number is stamped on a label which is fastened to the left side (A1) or rear (A2) of the cylinder block.
Further information about the engine number system can be found in the relevant user's handbook.

Note: If you need parts, service or information for your engine, you must give the complete engine number to your Lovol distributor.

https://truckmanualshub.com/

General safety precautions

These safety precautions are important. You must refer also to the local regulations in the country of use. Some items only refer to specific applications.

- Only use these engines in the type of application for which they have been designed.
- Do not change the specification of the engine.
- Do not smoke when you put fuel in the tank.
- Clean away fuel which has been spilt. Material which has been contaminated by fuel must be moved to a safe place.
- Do not put fuel in the tank while the engine runs (unless it is absolutely necessary).
- Do not clean, add lubricating oil, or adjust the engine while it runs (unless you have had the correct training; even then extreme care must be used to prevent injury).
- Do not make adjustments that you do not understand.
- Ensure that the engine does not run in a location where it can cause a concentration of toxic emissions.
- Other persons must be kept at a safe distance while the engine or auxiliary equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation. ***Warning!*** *Some moving parts cannot be seen clearly while the engine runs.*
- Do not operate the engine if a safety guard has been removed.
- Do not remove the filler cap of the cooling system while the engine is hot and while the coolant is under pressure, because dangerous hot coolant can be discharged.
- Do not use salt water or any other coolant which can cause corrosion in the closed circuit of the cooling system.
- Do not allow sparks or fire near the batteries (especially when the batteries are on charge) because the gases from the electrolyte are highly flammable. The battery fluid is dangerous to the skin and especially to the eyes.
- Disconnect the battery terminals before a repair is made to the electrical system.
- Only one person must control the engine.
- Ensure that the engine is operated only from the control panel or from the operators position.
- If your skin comes into contact with high-pressure fuel, obtain medical assistance immediately.
- Diesel fuel and lubricating oil (especially used lubricating oil) can damage the skin of certain persons. Protect your hands with gloves or a special solution to protect the skin.
- Do not wear clothing which is contaminated by lubricating oil. Do not put material which is contaminated with oil into the pockets of clothing.
- Discard used lubricating oil in a safe place to prevent contamination.
- Ensure that the control lever of the transmission drive is in the "out-of-drive" position before the engine is started.
- Use extreme care if emergency repairs must be made in adverse conditions.
- The combustible material of some components of the engine (for example certain seals) can become extremely dangerous if it is burned. Never allow this burnt material to come into contact with the skin or with the eyes.
- Read and use the instructions relevant to lift equipment which are given on page 10.06.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a bath of water. Fit safety wires to secure the plugs which seal the hose connections of a component which is to be pressure tested.
- Do not allow compressed air to contact your skin. If compressed air enters your skin, obtain medical help immediately.
- Turbochargers operate at high speed and at high temperatures. Keep fingers, tools and other objects away from the inlet and outlet ports of the turbocharger and avoid contact with hot surfaces.
- Fit only genuine Lovol parts.

https://truckmanualshub.com/

Safety

Engine lift equipment

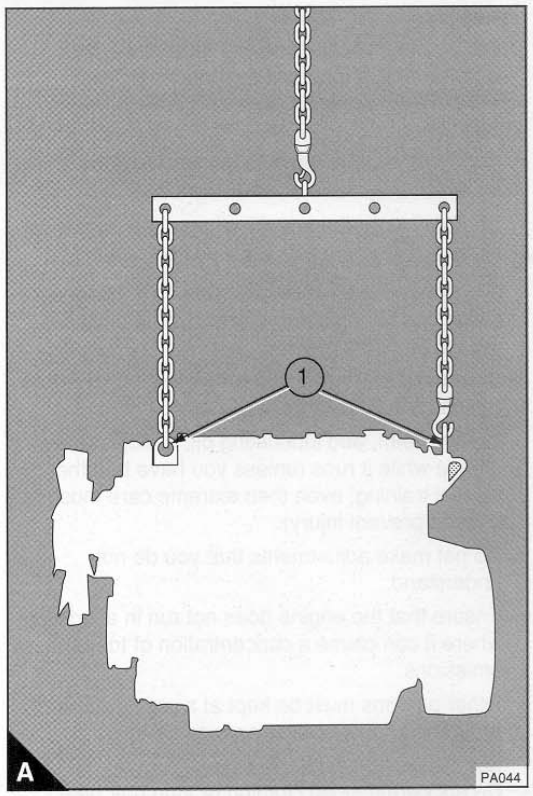
The maximum weight of the engine without coolant, lubricant or a gearbox fitted will vary for different applications. It is recommended that lift equipment of the minimum capacity listed below is used:

Four cylinder engines . . . . . 500 Kg (1100 lbs)

Six cylinder engines . . . . . 600 Kg (1320 lbs)

Before the engine is lifted:

- Always use lift equipment of the approved type and of the correct capacity to lift the engine. It is recommended that lift equipment of the type shown in (A) is used, to provide a vertical lift directly above the engine lift brackets (A1). Never use a single lift bracket to raise an engine.
- Check the engine lift brackets for damage and that they are secure before the engine is lifted. The torque for the setscrews for the engine lift brackets is 44 Nm (33 lbf ft) 4,5 kgf m.
- To avoid damage to the rocker cover, ensure that there is clearance between the hooks and the rocker cover.
- Use lift equipment or obtain assistance to lift heavy engine components such as the cylinder block, cylinder head, balancer unit, flywheel housing, crankshaft and flywheel.



https://truckmanualshub.com/

Safety

Viton seals

Some seals used in engines and in components fitted to engines are made of Viton.

Viton is used by many manufacturers and is a safe material under normal conditions of operation.

If Viton is burned, a product of this burnt material is an acid which is extremely dangerous. Never allow this burnt material to come into contact with the skin or with the eyes.

If it is necessary to come into contact with components which have been burnt, ensure that the precautions which follow are used:

- Ensure that the components have cooled.
- Use Neoprene gloves and discard the gloves safely after use.
- Wash the area with calcium hydroxide solution and then with clean water.
- Disposal of components and gloves which are contaminated must be in accordance with local regulations.

If there is contamination of the skin or eyes, wash the affected area with a continuous supply of clean water or with calcium hydroxide solution for 15-60 minutes. Obtain immediate medical attention.

https://truckmanualshub.com/

https://truckmanualshub.com/

Specifications 11

Basic engine data 11A

Recommended torque tensions 11B

https://truckmanualshub.com/

https://truckmanualshub.com/

Basic engine data 11A

Basic engine data 11A.02

https://truckmanualshub.com/

Basic engine data

Number of cylinders:	
- AA, AB, AC, AD, AE, AG, AH	4
- YA, YB, YC, YD, YE	6
Cylinder arrangement	In-line
Cycle	Four stroke
Direction of rotation	Clockwise from the front
Induction system:	
- AA, AG, YA	Naturally aspirated
- AB, AH, YB	Turbocharged
- AC, YC	Altitude compensated
- AD, AE, YD, YE	Turbocharged/intercooled
Combustion system	Direct injection
Nominal bore	100 mm (3.937 in)
Stroke	127 mm (5.000 in)
Compression ratio:	
- AA, AG, YA	16.5:1
- Certain YA engines	17.5:1
- AB, AC, AD, AH, YB, YC, YD	16.0:1
- AE, YE	17.5:1
- Certain AD engines	17.25:1 or 17.5:1
Cubic capacity:	
Four cylinder engines	4 litres (243 in^3)
Six cylinder engines	6 litres (365 in^3)
Firing order:	
Four cylinder engines	1, 3, 4, 2
Six cylinder engines	1, 5, 3, 6, 2, 4
Valve tip clearance (cold):	
- Inlet	0,20 mm (0.008 in)
- Exhaust	0,45 mm (0.018 in)
Lubricating oil pressure (minimum at maximum engine speed and normal engine temperature):	
- Engines without piston cooling jets	207 kpa (30 lbf/in^2) 2,1 kgf/cm^2
- Engines with piston cooling jets	280 kpa (40 lbf/in^2) 2,8 kgf/cm^2

https://truckmanualshub.com/

Recommended torque tensions 11B

Cylinder head assembly 11B.02
Pistons and connecting rod assemblies 11B.02
Crankshaft assembly 11B.02
Timing case and drive assembly 11B.03
Cylinder block 11B.03
Aspiration system 11B.03
Fuel system 11B.03
Lubrication system 11B.04
Cooling system 11B.04
Flywheel and housing 11B.04
Electrical equipment 11B.04
Auxiliary equipment 11B.05

https://truckmanualshub.com/

Recommended torque tensions

The torque tensions below apply to components lubricated lightly with clean engine oil before they are fitted.

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Cylinder head assembly				
Setscrews, cylinder head	1/2 UNF	(see	section	12)
Fasteners, rocker shaft brackets:				
- Aluminium brackets	M12	40	30	4,1
- Cast iron and sintered steel brackets	M12	75	55	7,6
Cap nuts, rocker cover	M12	20	15	2,1
Cap nuts, aluminium rocker cover (with shim washer)	M12	30	22	3,0
Setscrews, inlet manifold to cylinder head	M10	44	33	4,5
Nuts (plated), exhaust manifold to cylinder head	M10	44	33	4,5
Nuts (non-plated), exhaust manifold to cylinder head	M10	50	37	5,1
Setscrews, engine lift bracket	M10	44	33	4,5
Piston and connecting rod assemblies				
Nuts, connecting rods	1/2 UNF	125	92	12,7
Setscrews, connecting rods	1/2UNF	155	114	15,8
Banjo bolts, piston cooling jets.	3/4 UNF	20	15	2,0
Crankshaft assembly				
Setscrews, main bearings (4 cylinder engines)	5/8 UNF	250	185	26,0
Setscrews, main bearings (6 cylinder engines)	5/8 UNF	265	196	27,0
Setscrews, crankshaft pulley	7/16 UNF	115	85	11,8
Setscrews, viscous damper to crankshaft pulley	M12	75	55	7,6
Cap screws, viscous damper to crankshaft pulley	M8	35	26	3,6
Cap screws, rubber bonded damper to crankshaft pulley	M8	35	26	3,6
Setscrews, rear oil seal housing to cylinder block	M8	22	16	2,2
Torxscrew, rear oil seal housing to cylinder block	M8	22	16	2,2
Cap screws, bridge piece to cylinder block	M6	16	12	1,6
Cap screws, rear oil seal housing to bridge piece	M8	18	13	1,9
Cap screws, rear oil seal housing to bridge piece	M6	13	10	1,3
Torxscrew, rear oil seal housing to bridge piece	M8	18	13	1,9

https://truckmanualshub.com/

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Setscrew, idler gear hub of balancer unit	M12	93	68	9.5
Nut, drive gear of balance weight	1/2 UNF	82	60	8.4
Setscrews, rear cover of balancer frame	M10	54	40	5.5
Setscrews, oil transfer plate (balancer unit)	M10	30	22	3.1
Setscrews, oil pump to balancer frame	M8	27	20	2.8
Setscrews, balancer to cylinder block	M10	54	40	5.5
Timing case and drive assembly				
Setscrews, timing case to cylinder block	M8	22	16	2.2
Setscrews, timing case to cylinder block	M10	44	33	4.5
Setscrews, hub of idler gear	M10	44	33	4.5
Setscrew, camshaft gear	M12	78	58	8.0
Setscrew, camshaft gear (for engines, with 45 mm long setscrew)	M12	100	74	10.0
Setscrews, timing case cover to timing case	M8	22	16	2.2
Nuts, timing case cover to timing case	M8	22	16	2.2
Cylinder block				
Setscrews, fitted instead of piston cooling jets	3/8 UNF	27	20	2.8
Aspiration system				
Nuts, turbocharger to manifold	M10	44	33	4.5
Setscrew, breather cover	M6	9	7	0.9
Fuel system				
Nuts, high-pressure fuel pipes	M12	22	16	2.2
Setscrews, atomiser	M8	12	9	1.2
Setscrews, fuel lift pump	M8	22	16	2.2
Nut for gear of fuel injection pump	M14	80	59	8.2
Capscrew for gear of in-line fuel injection pump: AE, YE engines	M8	44	33	4.5
Nut for hub of in-line fuel injection pump: AE, YE engines	M18	115	84	11.8
Nuts for adaptor plate of in-line fuel injection pump: AE, YE engines	M10	44	33	4.5
Nuts for flange of fuel injection pump	M8	22	16	2.2
Locking screw for Bosch VE fuel injection pump shaft	M10	27	20	2.8
Locking screw for DP 200 fuel injection pump shaft	10 A/F	10	7	1
Nut, Watt unit pump high-pressure oil pump	M14	27	20	2.8
Unit pump flange nut	M10	44	33	4.5
The installation bolt of unit pump oil delivery pump	M8	27	20	2.8

https://truckmanualshub.com/

11B RECOMMENDED TORQUE TENSIONS

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Lubrication system				
Plug, lubricating oil sump	3/4 UNF	34	25	3,5
Setscrews, oil pump to front bearing cap	M8	22	16	2,2
Setscrews, cover for oil pump	M8	28	21	2,9
Fasteners, lubricating oil sump	M8	22	16	2,2
Cooling system				
Setscrews, fan drive housing to timing case	M10	44	33	4,5
Setscrews, fan drive pulley to hub	M8	22	16	2,2
Setscrews, fan drive pulley to hub	M10	44	33	4,5
Setscrews, fan	M8	22	16	2,2
Connector, oil cooler to oil filter head	3/4 UNF	58	42	5.8
Setscrews, coolant pump to timing case	M8	22	16	2,2
Nut, auxiliary coolant pump pulley	1/2 UNF	70	52	7,1
Setscrew, intercooler flange to inlet manifold	M6	7	5	0,7
Setscrew, intercooler body to inlet manifold	M8	22	16	2,2
Flywheel and housing				
Setscrews, flywheel to crankshaft	1/2 UNF	105	77	10,7
Setscrews, cast iron flywheel housing to cylinder block	M10	44	33	4,5
- Stamped 8.8	M12	75	55	7,6
- Stamped 10.9	M10	63	46	6,4
- Stamped 10.9	M12	115	85	11,7
Setscrews, aluminium flywheel housing to cylinder block	M10	70	52	7,1
Setscrews, flywheel housing to cylinder block (paper joint)	M10	70	52	7,1
Electrical equipment				
Fuelled start aid to induction manifold	7/8 UNF	31	23	3,1
Port heater aid to induction manifold	M22	60	44	6,1

https://truckmanualshub.com/

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Auxiliary equipment				
Nut, compressor drive gear:				
- 6,4 mm (0.25 in) thick	3/4 UNF	80	59	8,2
- 10 mm (0.4 in) thick	3/4 UNF	130	95	13,3
Nuts for gears of auxiliary drive assembly:				
- 6,4 mm (0.25 in) thick	3/4 UNF	80	59	8,2
- 10 mm (0.4 in) thick	3/4 UNF	130	95	13,3
Nut for gears of auxiliary drive assembly	M20	130	95	13,3

https://truckmanualshub.com/

https://truckmanualshub.com/

Cylinder head assembly 12

General description 12A.02

Rocker cover

12A-01 To remove and to fit 12A.03

Rocker assembly

12A-02 To remove and to fit 12A.05
12A-03 To dismantle and to assemble 12A.06
12A-04 To inspect and to correct 12A.06

Valve tip clearances

12A-05 To check and to adjust 12A.07

Valve springs

12A-06 To change the valve springs (with cylinder head fitted) 12A.09

Cylinder head assembly

12A-07 To remove and to fit 12A.11

Valves and valve springs

12A-08 To remove and to fit 12A.16
12A-09 To inspect and to correct 12A.17

Valve guides

12A-10 To inspect 12A.18
12A-11 To remove and to fit 12A.19

Cylinder head

12A-12 To inspect and to correct 12A.20
12A-13 To correct a valve seat with a valve seat cutter 12A.21
12A-14 To fit valve seat inserts 12A.22

Data and dimensions 12A.23

https://truckmanualshub.com/

12 CYLINDER HEAD ASSEMBLY

General description

In a diesel engine there is little carbon deposit and for this reason the number of hours run is no indication of when to overhaul a cylinder head assembly. The factors which indicate when an overhaul is necessary are how easily the engine starts and its general performance.

The cylinder head assembly has two valves fitted for each cylinder, each fitted with double or single valve springs, according to the engine application. The double springs have damper coils which are fitted towards the top face of the cylinder head.

In most engines the face angle of the valves is 45°, but some engines have inlet valves with a face angle of 30°. The angle of the valve seats in the cylinder head are either 46° or 31°.

The valves move in phosphated guides which can be renewed. The exhaust valve guide has a counter bore at the bottom and is a little longer than the inlet valve guide.

Both valve stems are fitted with oil seals which fit over the top of the valve guides.

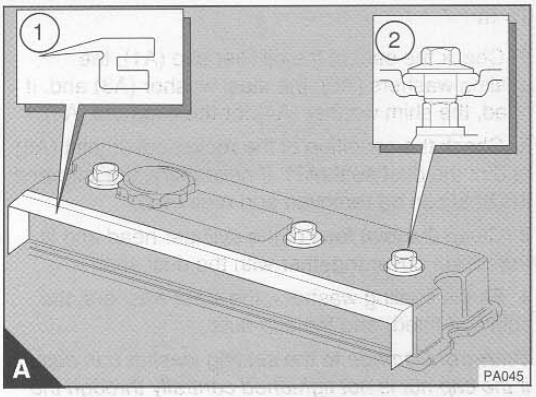
Turbocharged engines and some naturally aspirated engines have valve seat inserts fitted in the cylinder head for both inlet and exhaust valves. Engines which do not have valve seat inserts fitted as standard, in production, can have them fitted in service.

https://truckmanualshub.com/

Rocker cover

To remove and to fit **12A-01**

Engines are supplied with either an aluminium rocker cover (A) or with rocker covers made of a composite material (12A.04/A). The aluminium cover on some engines, has a dust seal which is fitted between the rocker cover and the induction manifold. The dust seal of the composite rocker cover is fixed permanently to the side of the rocker cover with adhesive.



To remove

1 Disconnect the breather pipe.

2 Remove the cap nuts (A2) together with the steel washers and the shim washers (12A-04/A) from the top of the rocker cover.

3 Lift off the rocker cover and the joint. For aluminium covers, remove the rocker cover dust seal (A1).

Caution: *When the rocker cover is fitted, the cap nuts are tightened onto the nuts of the rocker brackets. During removal of the cap nuts, it is possible to loosen the nuts of the rocker brackets. The nuts of the rocker brackets should be tightened to the correct torque every time the cover is removed.*

https://truckmanualshub.com/

To fit

1 Check the seal of the oil filler cap (A1), the sealing washers (A5), the steel washer (A3) and, if fitted, the shim washer (A4) for the cap nuts (A2).

2 Check the condition of the rocker cover joint (A6) and of the dust seal (A7). If necessary, the joint and the seal can be removed and renewed.

3 Clean the joint face of the cylinder head and fit the rocker cover together with the dust seal.

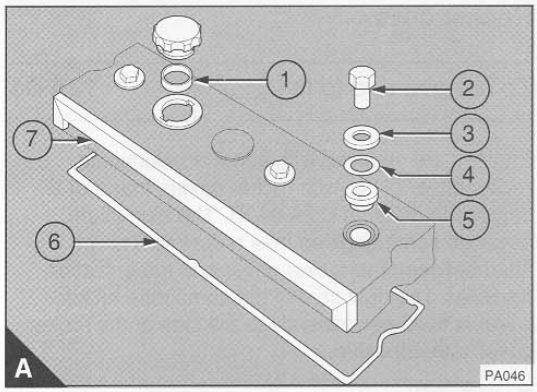
4 Fit the sealing washers, the steel washers, the shims (if fitted) and the cap nuts.

Caution: *Damage to the sealing washer can occur if the cap nut is not tightened centrally through the sealing washer and the rocker cover. If the sealing washer is damaged it must be renewed.*

5 Tighten the cap nuts to 20 Nm (15 lbf ft) 2,1 kgf m.

Notes:

- The latest engines have an additional shim washer (A4) fitted between the cap nut sealing washer and the steel washer for the cap nut. If shim washers are fitted to aluminium rocker covers, tighten the cap nuts to 30 Nm (22 lbf ft) 3,0 kgf m. If shim washers are fitted to composite rocker covers, tighten the cap nuts to 20 Nm (15 lbf ft) 2,1 kgf m.
- Some earlier 1000 Series engines have a rocker cover joint that has a ribbed bottom face. When this joint is fitted, ensure that the flat face of the joint is towards the rocker cover.



https://truckmanualshub.com/

Rocker assembly

To remove and to fit **12A-02**

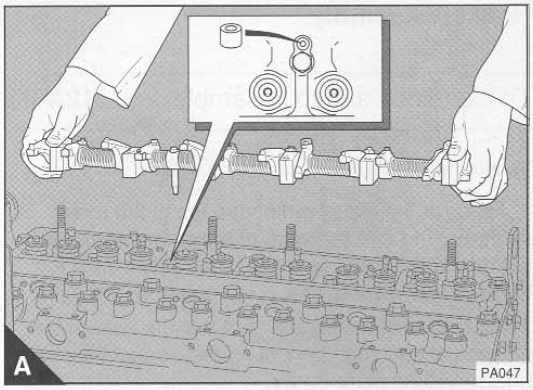
To remove

1 Remove the rocker cover, operation 12A-01.

2 Release evenly and gradually the fasteners of the rocker shaft brackets; begin with the end brackets and move toward the centre. Remove the fasteners and the washers and lift off the rocker assembly.

Note: The washers between the fasteners and the rocker brackets have been removed on the latest engines and new flange faced nuts and setscrews have been fitted.

3 Remove the rubber oil seal (A) from the oil supply connection or from the oil supply hole in the cylinder head.



To fit

1 Fit a new rubber oil seal in the oil supply hole in the cylinder head.

2 Check that the push rods fit correctly in the sockets of the tappets. Fit the rocker assembly; ensure that the oil supply connection is fitted correctly into the oil seal. Check that the ends of the adjustment screws fit correctly in the sockets of the push rods.

3 Fit the washers (if fitted) and fasteners of the rocker shaft brackets and tighten the fasteners evenly and gradually; begin with the inner fasteners and work towards the end fasteners. Tighten the fasteners evenly to the correct torque according to the material of the rockershaft brackets:

Aluminium	40 Nm (30 lbf ft) 4,1 Kgf m.
Cast iron	75 Nm (55 lbf ft) 7,6 Kgf m.
Sintered steel	75 Nm (55 lbf ft) 7,6 Kgf m.

https://truckmanualshub.com/

Rocker assembly

To dismantle and to assemble 12A-03

To dismantle

1 Remove the clips from both ends of the rocker shaft. Ensure that the ends of the rocker shaft are not damaged. Release the location screw (A1) for the oil supply connection.

2 Dismantle the assembly and make a note of the position of each component to ensure that they can be assembled more easily.

To assemble

1 Ensure that the oil holes in the rocker shaft and in the rocker levers are not restricted.

2 Lubricate the components with clean engine lubricating oil before assembly. Assemble the components in the correct order (A) and ensure that the location screw (A1) for the oil supply connection is fitted correctly in the rocker shaft. Fit the clips to the ends of the rocker shaft.

To inspect and to correct 12A-04

To inspect

1 Clean and inspect all the components for wear and any other damage. Check the clearance of the rocker levers on the rocker shaft. If the clearance is larger than 0,13 mm (0.005 in), renew the rocker lever bush and/or the rocker shaft.

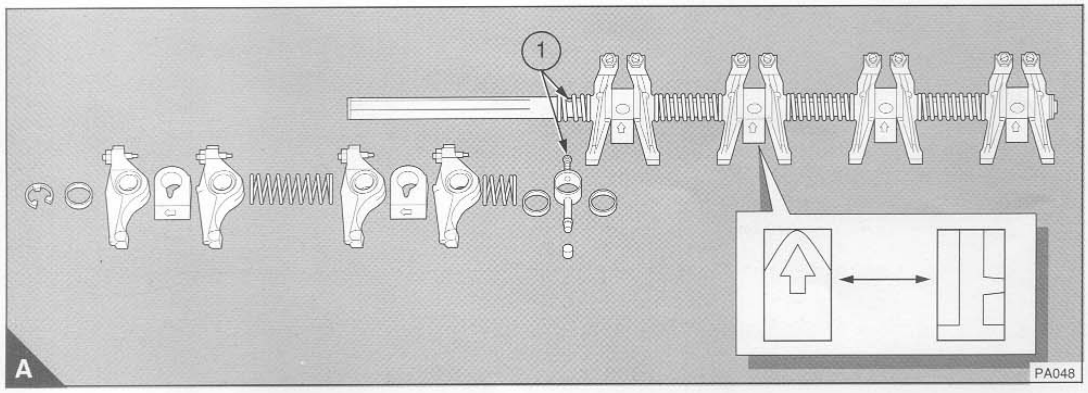
To correct

1 To renew the rocker lever bush, press out the old bush with a suitable mandrel.

2 Align the lubrication hole of the new bush on the same side as the rocker lever lubrication hole and press the bush into position.

3 Ream the bush in the rocker lever to give a clearance on the rocker shaft of 0,03/0,09 mm (0.001/0.004 in). Clean thoroughly the bush and check that the oil hole is free from debris.

Note: The rocker levers used on some low rated engines do not have bushes.



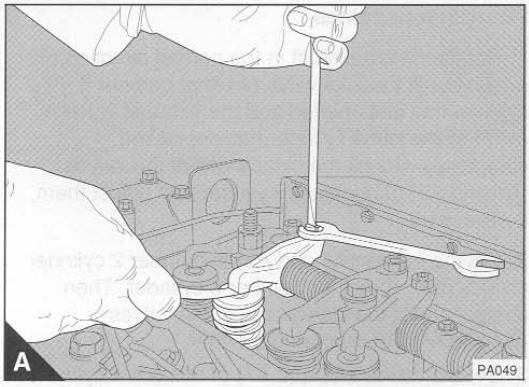
https://truckmanualshub.com/

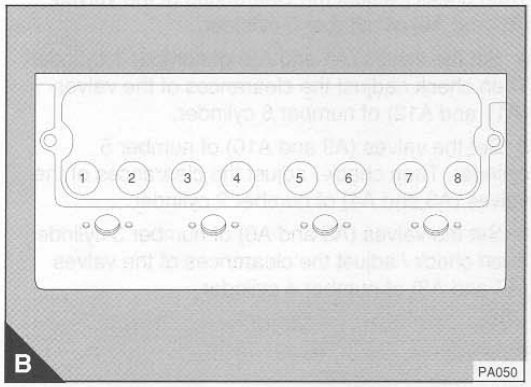
Valve tip clearances

To check and to adjust **12A-05**

Notes:

- The valve tip clearance is measured between the top of the valve stem and the rocker lever (A). With the engine hot or cold, the correct clearances are 0,20 mm (0.008 in) for the inlet valves and 0,45 mm (0.018 in) for the exhaust valves. The valve positions are shown at (B).
- The sequence of valves from number 1 cylinder is shown in the table below. Number 1 cylinder is at the front of the engine.





Four cylinder engines

1 Rotate the crankshaft in the normal direction of rotation until the inlet valve (B8) of number 4 cylinder has just opened and the exhaust valve (B7) of the same cylinder has not closed completely. Check the clearances of the valves (B1 and B2) of number 1 cylinder and adjust them, if necessary.

2 Set the valves (B3 and B4) of number 2 cylinder as indicated above for number 4 cylinder. Then check / adjust the clearances of the valves (B5 and B6) of number 3 cylinder.

3 Set the valves (B1 and B2) of number 1 cylinder. Then check / adjust the clearances of the valves (B7 and B8) of number 4 cylinder.

4 Set the valves (B5 and B6) of number 3 cylinder. Then check / adjust the clearances of the valves (B3 and B4) of number 2 cylinder.

Cylinder and Valve number	1		2		3		4	
	1	2	3	4	5	6	7	8
Valve I = Inlet E = Exhaust	I	E	E	I	I	E	E	I

https://truckmanualshub.com/

Six cylinder engines

1 Rotate the crankshaft in the normal direction of rotation until the inlet valve (A12) of number 6 cylinder has just opened and the exhaust valve (A11) of the same cylinder has not closed completely. Check the clearances of the valves (A1 and A2) of number 1 cylinder and adjust them, if necessary.

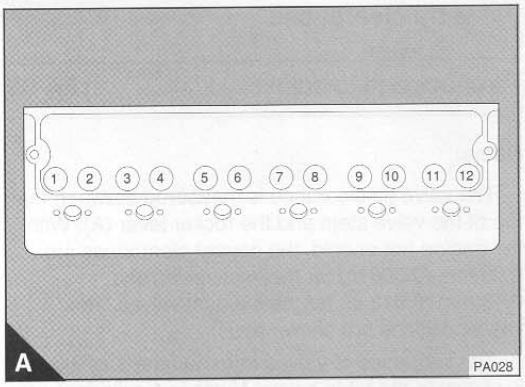
2 Set the valves (A4 and A3) of number 2 cylinder as indicated above for number 6 cylinder. Then check / adjust the clearances of the valves (A9 and A10) of number 5 cylinder.

3 Set the valves (A8 and A7) of number 4 cylinder. Then check / adjust the clearances of the valves (A5 and A6) of number 3 cylinder.

4 Set the valves (A1 and A2) of number 1 cylinder. Then check / adjust the clearances of the valves (A11 and A12) of number 6 cylinder.

5 Set the valves (A9 and A10) of number 5 cylinder. Then check / adjust the clearances of the valves (A3 and A4) of number 2 cylinder.

6 Set the valves (A5 and A6) of number 3 cylinder. Then check / adjust the clearances of the valves (A7 and A8) of number 4 cylinder.



Cylinder and Valve number	1		2		3		4		5		6	
	1	2	3	4	5	6	7	8	9	10	11	12
Valve I = Inlet E = Exhaust	I	E	E	I	I	E	E	I	I	E	E	I

https://truckmanualshub.com/

Valve springs

To change the valve springs (with cylinder head fitted) **12A-06**

Special tools:

Valve spring compressor, PD.6118B

Stud adaptor used with PD.6118B, PD.6118-7

Setscrew adaptor used with PD.6118B, PD.6118-8

Note: Paragraphs 1 to 12 refer to a change of valve springs for a single cylinder.

Warning! *Wear eye protection during this operation.*

1 Remove the rocker cover, operation 12A-01.

2 Rotate the crankshaft in the normal direction of rotation until the inlet valve of the relevant cylinder has just opened and the exhaust valve has not fully closed. In this position the piston will be at approximately top dead centre (TDC).

3 Remove the rocker assembly, operation 12A-02.

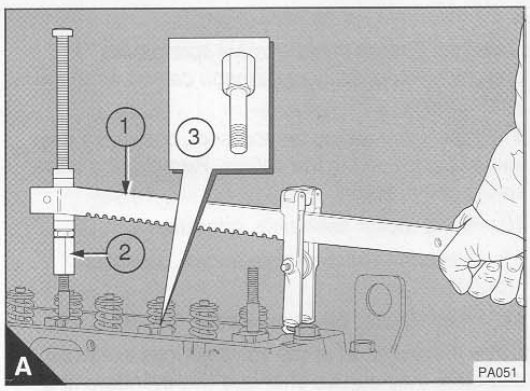
4 Fit the valve spring compressor (A1) and the relevant adaptor (A2 or A3).

5 Compress the valve spring(s) and remove the collets. Ensure that the valve springs are compressed squarely or damage to the valve stem can occur.

Caution: *Do not rotate the crankshaft while the valve springs are removed.*

6 Release the valve spring compressor and remove the valve spring caps and valve spring(s).

7 Put the new valve springs in position. If double valve springs are fitted, ensure that the closed damper coils are towards the cylinder head (12A.16/A4).



https://truckmanualshub.com/

8 Fit the valve spring caps.

Caution: *Ensure that the valve springs are compressed squarely or damage can occur to the valve stem.*

9 Fit the valve spring compressor, compress the valve springs and fit the collets. Remove the valve spring compressor.

10 Fit the rocker assembly, operation 12A-02.

11 Check the valve tip clearances, operation 12A-05.

12 Fit the rocker cover, operation 12A-01.

Note: If other or all of the valve springs are to be changed, they can be changed two cylinders at a time. The pairs of cylinders are:

For 4 cylinder engines: 1 and 4, 2 and 3

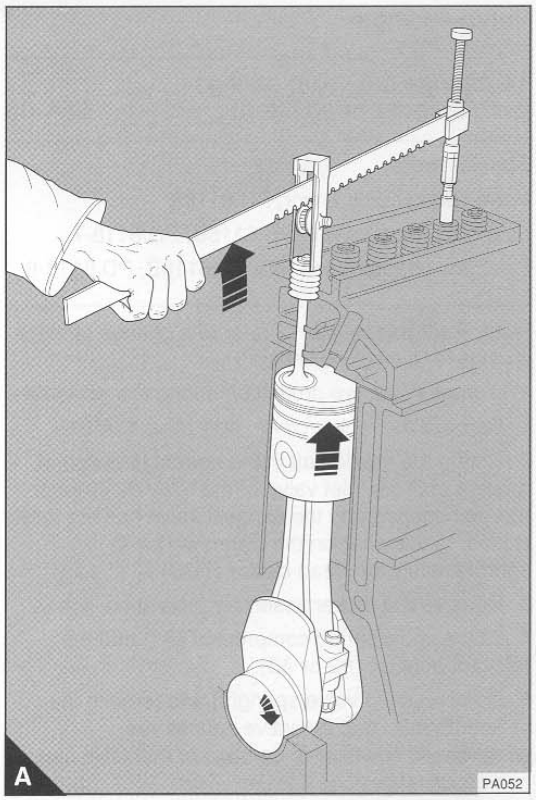
For 6 cylinder engines: 1 and 6, 2 and 5, 3 and 4

If the rocker assembly has been removed, piston TDC can be found as follows:

1 Fit the valve spring compressor and compress the valve springs to open the valve.

2 Rotate the crankshaft, by hand, in the normal direction of rotation until the piston touches the valve.

3 Continue to rotate the crankshaft, and at the same time, release pressure on the valve spring compressor until the piston is at TDC (A).



https://truckmanualshub.com/

Cylinder head assembly

To remove and to fit **12A-07**

To remove

1 Drain the cooling system.

2 Disconnect the battery terminals.

3 Remove the air filter/cleaner hose at the induction manifold.

4 For engines fitted with turbochargers: Remove the air filter/cleaner hose at the compressor inlet of the turbocharger.

5 Remove the pipe which is fitted between the fuelled starting aid in the induction manifold and the fuel filter. Disconnect the electrical connection.

6 For engines fitted with a boost control device: Remove the boost control pipe which is fitted between the induction manifold and the top of the fuel injection pump.

7 Remove the induction manifold.

8 For engines fitted with turbochargers: Disconnect all connections to the turbocharger and remove the turbocharger, operation 18A-01.

9 Remove the exhaust manifold.

10 Remove the low-pressure fuel pipes which are fitted between the fuel injection pump and the fuel filter.

Note: Where a Bosch fuel injection pump is fitted, keep the fuel outlet banjo bolt with the fuel injection pump.

Remove the fuel pipe fitted between the fuel lift pump and the fuel filter. Remove the fuel filter bracket together with the fuel filter.

11 Remove the high-pressure fuel pipes.

Caution: *Where access to the fuel injection pump outlet unions is possible, ensure that a separate spanner is used to prevent movement of the fuel injection pump outlets when the connections of the high-pressure pipes are released. Fit suitable covers to all open connections on the fuel injection pump.*

12 Remove the atomiser leak-off pipe.

13 Remove the atomisers, operation 20A-02. Fit suitable covers to the nozzles and the open connections.

14 If a compressor is fitted: Remove the coolant pipe which is fitted between the cylinder head and the compressor. Then remove the coolant pipe which is fitted between the by-pass connection and the compressor.

15 Release the clip of the coolant by-pass hose at the cylinder head. Release the setscrews and remove the coolant by-pass connection and the hose.

16 Disconnect the coolant temperature sender unit.

17 For turbocharged and some naturally aspirated four cylinder engines: Remove the oil cooler, operation 21A-07A.

18 Remove the rocker cover, operation 12A-01.

19 Remove the rocker assembly, operation 12A-02.

20 Remove the push rods.

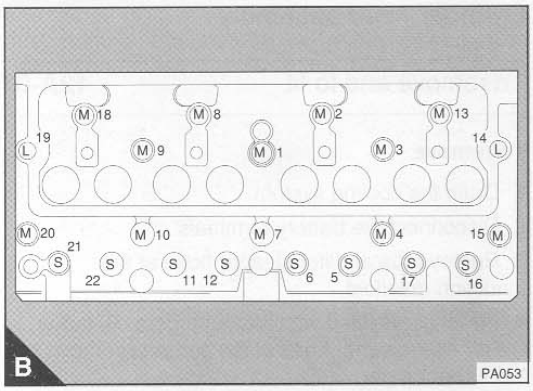
https://truckmanualshub.com/

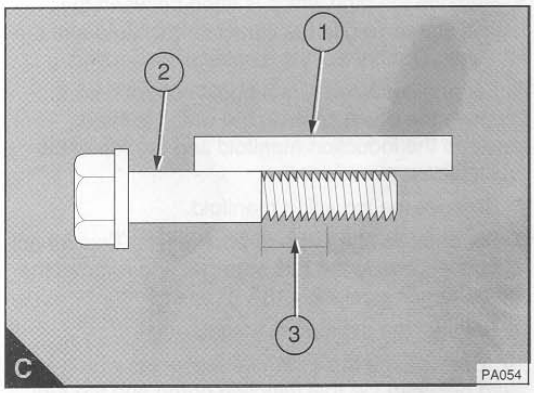
12 CYLINDER HEAD ASSEMBLY

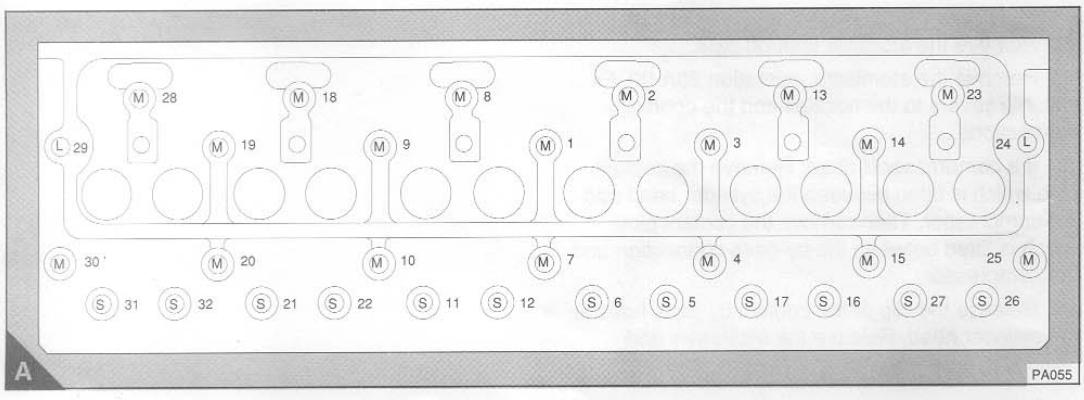
21 Release the cylinder head setscrews evenly and gradually in the reverse sequence to that shown in (A or B). Check the setscrews for distortion with a straight edge (C1) held along the setscrew (C2). If there is a visible reduction in the diameter of the thread (C3) that has not been in engagement with the cylinder block, the setscrew must be discarded.

Caution: *Do not use a lever to separate the cylinder head from the cylinder block.*

22 Remove the cylinder head and put it on a surface that will not damage the face of the cylinder head.







https://truckmanualshub.com/

To fit

Special tools:

Angle gauge, to tighten cylinder head setscrews, MS.1531

1 Clean the bottom face of the cylinder head and top face of the cylinder block. Ensure that there is no debris in the cylinder bores.

Note: Certain engines have two location pins (A1), one at each end of the cylinder head, pressed into the cylinder block to hold the cylinder head gasket in the correct position before the cylinder head is fitted.

Caution:

- *To avoid damage to the cylinder head gasket, ensure that the location pins are* pressed *in the cylinder block before the cylinder head is fitted.*
- *The cylinder head gasket must be fitted without jointing compound.*

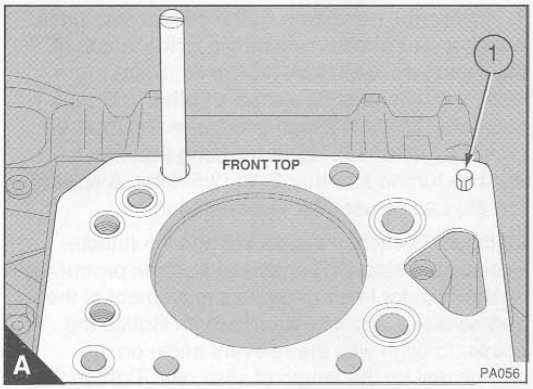
2 Put the cylinder head gasket in position; It is stamped "FRONT TOP" for correct assembly (A).

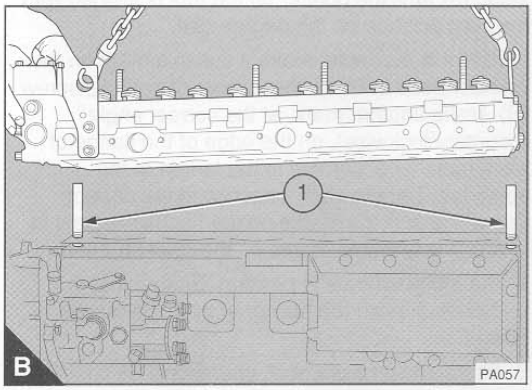
3 To ensure the cylinder head is fitted into the correct position, fit two suitable 1/2 UNF guide studs (B1) in positions 15 and 20 (12A.12/B) or positions 25 and 30 (12A.12/A). Put the cylinder head in position.

4 Lightly lubricate the threads of the cylinder head setscrews and the thrust faces of the setscrew heads. Engage some of the setscrews in their correct positions and remove the guide studs. Engage the remainder of the setscrews in their correct positions.

5 Gradually and evenly tighten the setscrews to 110 Nm (80 lbf ft) 11,1 kgf m in the sequence shown in (12A.12/A or B).

6 Repeat paragraph 5 to ensure that all the setscrews are tightened to the correct torque.



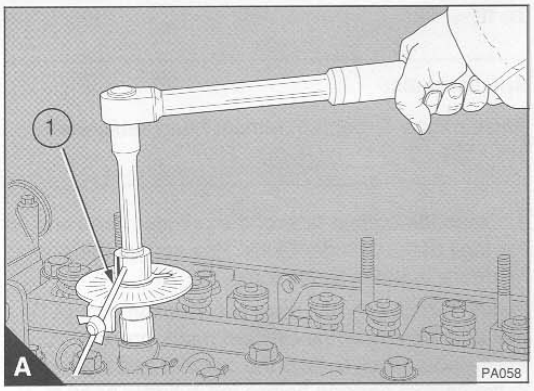


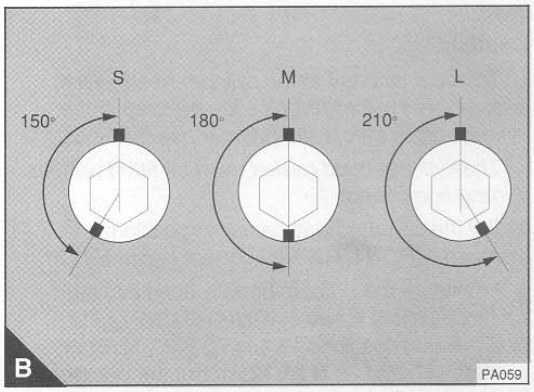
https://truckmanualshub.com/

7 Tighten the setscrews, in the correct sequence, a further part of a turn according to the length of the setscrews, see (12A.12/A or B). Short setscrews (S) must be turned a further 150° (2.5 flats). Medium length setscrews (M) must be turned a further 180° (3 flats). Long setscrews (L) must be turned a further 210° (3.5 flats). A special tool (A) can be used for this operation.

Fit the tool between the socket and the handle. Position the stop (A1) against a suitable protrusion on the cylinder head to prevent movement of the degree dial in a clockwise direction. Rotate the pointer to align with the relevant angle on the degree dial for the length of setscrew. Tighten the setscrew until the pointer on the tool is aligned with the zero position on the degree dial.

If no tool is available, make a suitable mark on the cylinder head in line with a corner of each setscrew (B). Make another mark, at the correct angle (counter-clockwise), on the edge of the flange of each fastener according to the length of the setscrew. Tighten each setscrew in the correct sequence until the marks on the flange are next to, and in line with, the marks on the cylinder head.





8 Put the push rods in position. Ensure that the end of each push rod fits correctly in the tappet socket.

9 Fit the rocker assembly, operation 12A-01.

10 Set the valve tip clearances, operation 12A-05.

11 Fit the atomisers, operation 20A-02.

12 Fit the high-pressure fuel pipes; tighten the connection nuts to 22 Nm (16 lbf ft) 2,2 kgf m.

Caution: *Where access to the fuel injection pump outlet unions is possible, ensure that a separate spanner is used to prevent movement of the fuel injection pump outlets when the connections of the high pressure pipes are tightened.*

13 Fit the fuel filter and the bracket. Fit the low-pressure fuel pipes between the fuel injection pump and the fuel filter.

14 Fit the coolant by-pass connection; tighten the setscrews and hose clip.

15 If a compressor is fitted: Fit the coolant pipe between the cylinder head and the compressor. Then fit the pipe between the coolant by-pass and compressor.

16 For turbocharged and some naturally aspirated four cylinder engines: Fit the oil cooler, operation 21A-07A.

https://truckmanualshub.com/

17 Fit the exhaust manifold. The manifold joints are fitted without jointing compound.

18 For engines fitted with turbochargers: Fit the turbocharger, operation 18A-01.

19 For four cylinder engines: Fit the induction manifold. Ensure that the manifold joints for the front and rear positions are fitted with the notch at the top left when the manifold is fitted to the cylinder head (A). The manifold joint for the centre position can be fitted either way. Fit the joints without jointing compound.

For six cylinder engines: Fit the induction manifold. Ensure that the joints are fitted with the notch at the top and the straight edge towards the centre (B). Fit the joints without jointing compound. Some of the latest six cylinder engines are fitted with a one piece induction manifold joint.

20 Fit the fuel pipe between the fuel filter and the fuel lift pump.

21 Fit the fuel pipe between the fuel filter and the fuelled starting aid in the induction manifold. Connect the electrical connection to the cold start device.

22 For engines fitted with boost control devices: Fit the boost control pipe between the induction manifold and the top of the fuel injection pump.

23 Fit the electrical connection to the coolant temperature sender unit.

24 Connect the coolant outlet and the hoses for the cab heater. Tighten the clips.

25 Fill the cooling system.

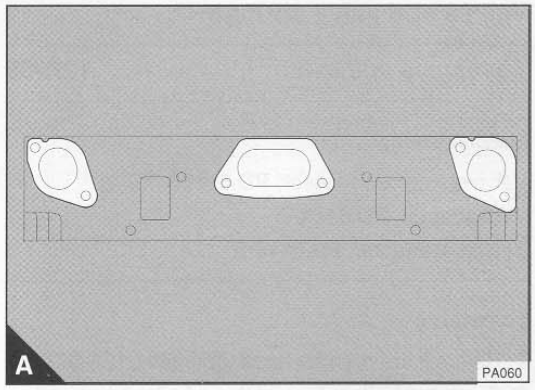
26 Connect the air filter/cleaner.

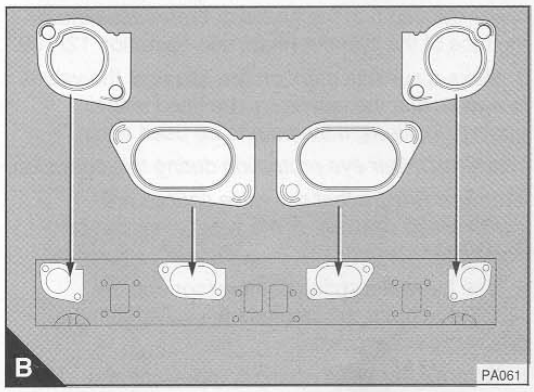
27 Connect the battery.

28 Eliminate air from the fuel system, see section 20.

29 Start the engine and run it at low speed. Check that oil flows from the holes in the rocker levers. If the oil flow is correct, fit the rocker cover, operation 12A-01.

Note: It is not necessary to tighten the cylinder head setscrews again with the engine hot or after a limited period in service.





https://truckmanualshub.com/

Valves and valve springs

To remove and to fit **12A-08**

Special tools:

Valve spring compressor, PD.6118B
Stud adaptor, PD.6118-7
Setscrew adaptor, PD.6118-8

To remove

1 Remove the cylinder head, operation 12A-07.

2 Clean the bottom face of the cylinder head and check the depth of the heads of the valves below the face of the cylinder head, see operation 12A-09.

3 Make a suitable mark on the heads of the valves to ensure that the valves can be fitted in their original positions, if they are to be used again.

Warning! *Wear eye protection during this operation.*

Caution: *Ensure that the valve springs are compressed squarely or the valve stem can be damaged.*

4 Use the valve spring compressor and the relevant adaptor to compress the valve spring(s) and remove the collets.

5 Release the valve spring compressor and remove the valve spring cap, valve spring(s), valve stem seal and the valve seat washer.

6 Repeat items 4 and 5 for the other valves.

To fit

Note: The components of the valve assembly are shown in A. Certain engines are fitted with single valve springs.

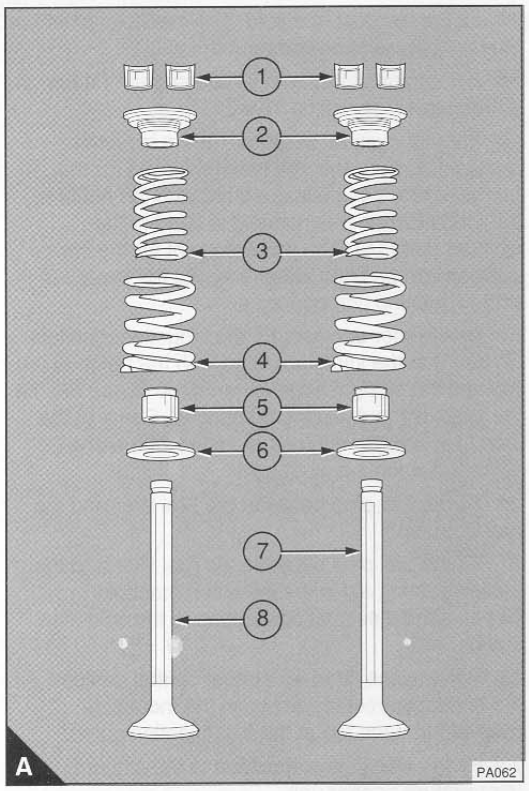
1 Lubricate the valve stems (A7 and A8) with clean engine oil and fit the valves in their respective guides.

2 Fit the spring seat washers (A6). Fit new valve stem seals (A5) on the valve guides. If double valve springs are used, fit the inner and outer valve springs (A3 and A4) on the spring seat washers with their damper coils toward the cylinder head. If single valve springs are used, the spring does not have a damper coil and it can be fitted with either end to the cylinder head. Fit the valve spring caps (A2).

Warning! *Wear eye protection during this operation.*

Caution: *Ensure that the valve springs are compressed squarely or damage can occur to the valve stem.*

3 Use the valve spring compressor and the relevant adaptor to compress the valve spring(s) and fit the collets (A1).



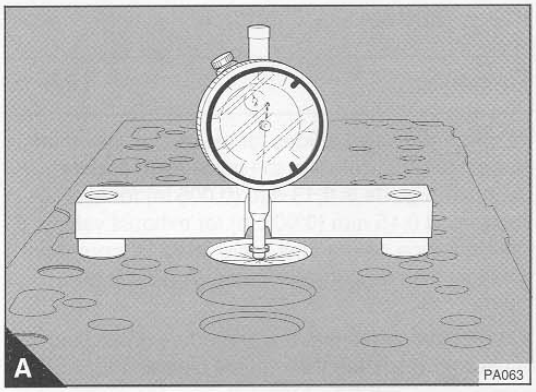
https://truckmanualshub.com/

To inspect and to correct 12A-09

Special tool:

Gauge, valve depth, PD.41D

Dial gauge for use with PD.41D, PD.208



1 Check the depth of the valves below the face of the cylinder head before the valve springs are removed.

2 Ensure that the heads of the valves and the bottom face of the cylinder head are clean.

3 Put the valve depth gauge on the face of the cylinder head and zero the dial gauge.

4 Carefully put the valve depth gauge in position over the head of each valve (A) and make a note of the measurement. The maximum depth, in service, is given in the data and dimensions.

5 If a valve is below the depth limit, check the valve depth with a new valve in position. If the valve depth is still below the limit and a valve seat insert is fitted, the insert must be renewed.

6 Where a valve seat insert is not fitted, the bottom face of the cylinder head can be machined to reduce the valve depth, or an insert can be fitted, operation 12A-14.

Caution: *If the bottom face of the cylinder head is to be machined, ensure that the thickness, of the cylinder head will not be less than 102,48 mm (4.035 in) after the cylinder head has been machined.*

7 Check the valves for cracks. Check the stems of the valves for wear and for correct fit in their valve guides.

8 Check that the seat faces of the valves are not badly burnt or damaged. Seat faces of valves which are damaged can be ground on a special machine. Valves which have only a little damage can be lapped to their valve seats. When new valves are fitted, the valve depths must be checked, see paragraph 1.

9 Check that the load on the valve springs is correct at their fitted length, see the data and dimensions. Fit new valve springs at every complete engine overhaul.

https://truckmanualshub.com/

Valve guides

To inspect **12A-10**

To check the valve guides for wear: The maximum clearance (A5), between the valve stem and the bore of the guide is 0,13 mm (0.005 in) for inlet valves and 0,15 mm (0.006 in) for exhaust valves. If the clearance, with a new valve fitted, is more than the limit, then a new valve guide (A4) must be fitted.

It is recommended that the procedure given below is used to check the valve guide clearance:

1 Put a new valve in the valve guide.

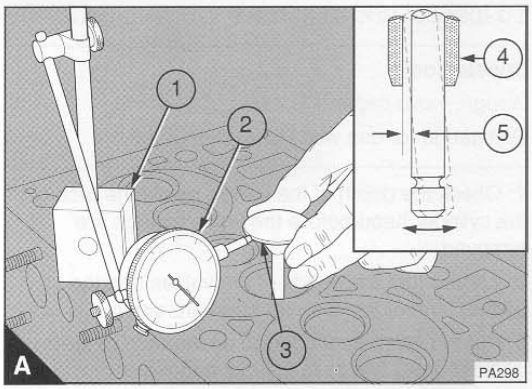
2 Put a dial test indicator with a magnetic base (A1) onto the face of the cylinder head

3 With the valve lifted 15,0 mm (0.6 in) and the gauge (A2) in contact with the edge of the valve head (A3), move the valve radially away from the gauge. With the valve held in this position, set the gauge zero.

4 Move the valve radially across the axis of the cylinder head towards the gauge. Make a note of the reading on the gauge. If the reading is equal to or greater than the data given below, a new valve guide (A4) must be fitted.

Maximum permissible clearance with a valve lift of 15,0 mm (0.6 in) :

- Inlet guide 0,24 mm (0.009 in)
- Exhaust guide 0,32 mm (0.013)



https://truckmanualshub.com/

To remove and to fit 12A-11

Special tools:

Remover/replacer for valve guides (main tool), PD.1D

Adaptor used with PD.1D, PD.1D-1A

Adaptor used with PD.1D and PD.1D-1A, PD.1C-6

To remove

1 Fit the adaptor (A4), PD.1D-1A, into the remover/replacer tool (A3), PD.1D.

2 With the adaptor fitted to the tool, put the spacer (A5) in position on the tool. Pass the adapter through the valve guide and put the spacer and tool in position on the valve seat.

3 Fit the attachment (A7) to secure the adapter to the valve guide.

4 Hold the top handle (A1) and turn the bottom handle (A2) clockwise to pull the valve guide out of the cylinder head.

To fit

1 Clean the parent bore in the cylinder head for the valve guide.

2 Lubricate the outer surface of the new valve guide (B6) with clean engine lubricating oil.

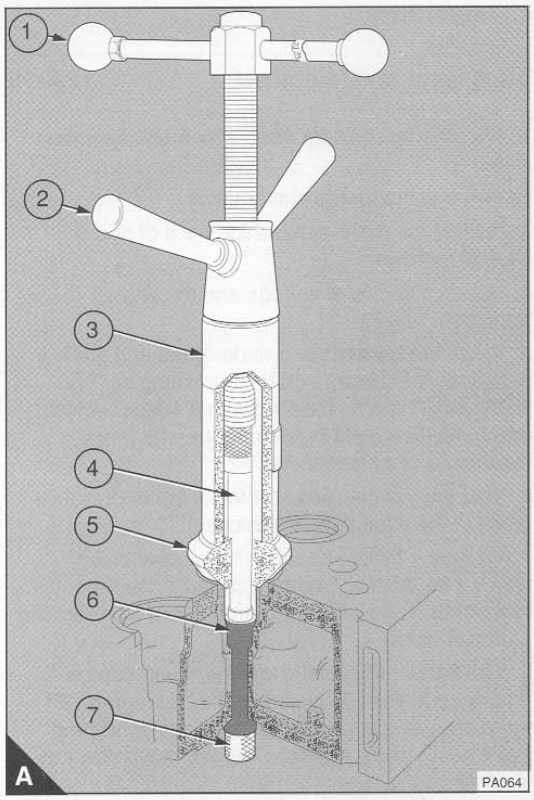
3 Fit the adaptor (B5), PD.1D-1A, into the remover/replacer tool (B3), PD.1D.

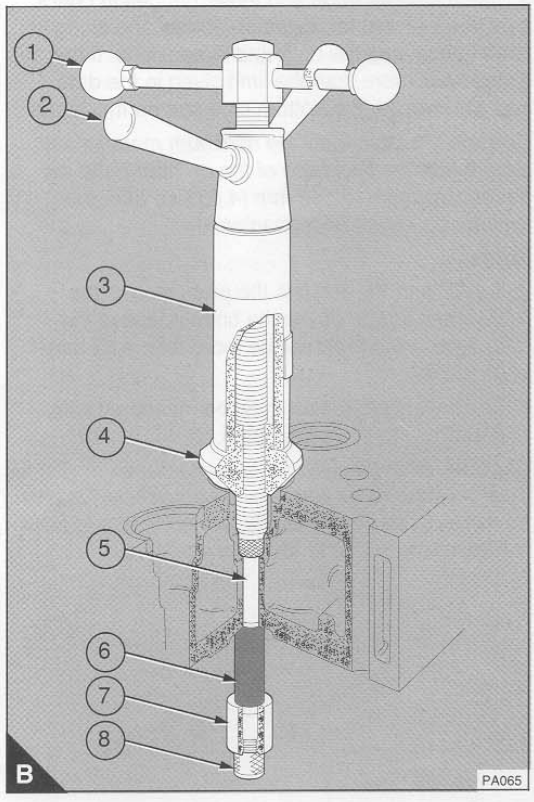
4 With the adapter fitted to the tool, put the spacer (B4) in position on the tool. Pass the adaptor through the cylinder head and put the spacer and tool assembly in position on the valve seat.

5 Put the valve guide in position on the adaptor and fit the distance piece (B7), PD.1C-6. Fit the attachment (B8) to secure the valve guide to the adaptor.

6 Hold the top handle (B1) and turn the bottom handle (B2) clockwise to pull the valve guide until the distance piece contacts the cylinder head.

7 When the valve guide is fitted correctly, the top of the valve guide will have a protrusion of 15,10 mm (0.594 in) above the valve spring seat.





https://truckmanualshub.com/

Cylinder head

To inspect and to correct **12A-12**

1 Remove the cylinder head assembly, operation 12A-07.

2 Remove the thermostat housing.

3 Inspect the cylinder head for signs of gas or coolant leakage.

4 Remove the valve springs and the valves, operation 12A-08.

5 Clean the face of the cylinder head and the passages for coolant and for lubricating oil. The water jacket can be cleaned with a special solvent which must be used in accordance with the manufacturer's instructions.

6 Test the cylinder head for leaks at the pressure given in the data and dimensions.

7 When the cylinder head is thoroughly clean, check it for cracks. Examine carefully the areas around the valve seats and around the holes for the atomiser nozzles.

8 The bottom face of the cylinder head can be machined if: there is distortion, see paragraph 9; there are deep scratches; or, for engines without valve seat inserts, the valve depths are below the service limit.

9 Use a straight edge and feeler gauges to check the cylinder head for distortion across and along its bottom face, see the data and dimensions. If the distortion is more than the limit given in the data and dimensions, the bottom face can be machined.

Caution: *Remove only the minimum material and ensure that the thickness of the cylinder head will not be less than 102,48 mm (4.035 in) after the cylinder head has been machined.*

Notes:

- On AE and YE engines the protrusion of the atomiser nozzle below the bottom face of the cylinder head must not be more than 4,82 mm (0.190 in).
- The nozzle protrusion must be measured with the nozzle seat washer fitted.

Caution: *After the cylinder head has been machined the valve seats must be corrected to give the correct valve head depth. It is advisable to work to the minimum limit to allow for later wear.*

10 Check the valve seats for wear and for damage.

11 Before any work is done on the valve seats, new valve guides must be fitted, operation 12A-11.

12 Where there is little damage, the valve and valve seat can be lapped. When the valve seats are lapped keep the seat as narrow as possible and ensure that all the compound used to lap the valve and the seat is removed.

13 More badly damaged valve seats can be corrected by use of the cutter tool, operation 12A-13, or new inserts can be fitted, operation 12A-14.

https://truckmanualshub.com/

To correct a valve seat with a valve seat cutter 12A-13

Special tools:

Cutter for 46° inlet valve seats, MS.281*

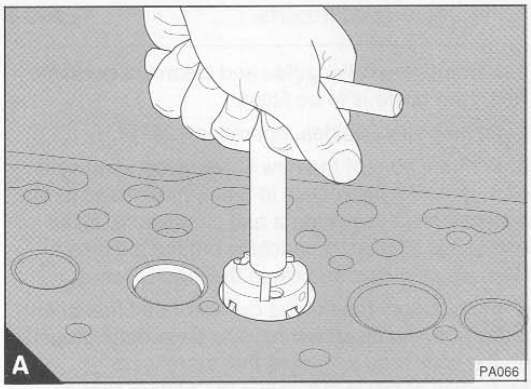
Cutter for 31° inlet valve seats, MS.642

Cutter for exhaust valve seats, MS.275*

Pilot for use with valve seat cutters, MS.150-9.5*

Handle set for use with valve seat cutters, MS.67B*

*Included in set of adjustable cutters for valve seats, MS.73



1 Before any work is done on the valve seats, new valve guides must be fitted, operation 12A-11.

2 Fit the pilot in the valve guide and tighten the pilot.

3 Select the relevant cutter. Set the blades of the cutters to the diameter of the valve seat to be cut. Fit the cutter on the pilot and fit the handle (A). Ensure that the cutter is not allowed to fall on to the seat as this can damage the blades.

4 Carefully turn the cutter in a clockwise direction. Remove only the minimum material to ensure a good seat. Keep the seat as narrow as possible.

5 When the seat is cut, remove the cutter and the pilot. Remove any debris from the area of the valve seat and the port.

6 Fit the valve and lightly lap the valve and the seat.

7 Check that the valve depth is within limits, see data and dimensions.

Note: If a valve seat has become too damaged or too worn to correct, a valve seat insert can be fitted, operation 12A-14. Turbocharged engines and some naturally aspirated engines have valve seat inserts fitted as standard and these inserts can be renewed.

https://truckmanualshub.com/

To fit valve seat inserts 12A-14

1 Remove the valve guide and clean the bore into which the guide is to be fitted.

2 Fit new valve guides, operation 12A-11.

3 With the bore of the new valve guide used as a pilot, machine the recess in the cylinder head to the dimensions shown in data and dimensions at the end of this section, or machine out the old insert. Remove all debris and clean the insert recess.

4 If the bottom face of the cylinder head has been machined, the insert will have to be surface ground on the back face to ensure that there is no protrusion of the insert above the bottom face of the cylinder head. After the back of the insert has been ground, ensure that the outer edge of the back face has a 0,9/1,3 mm (0.035/0.051 in) chamfer at 30° to the vertical.

5 With the bore of the valve guide used as a pilot, and with the rear face of the insert towards the cylinder head, press in the insert with the valve seat insert tool, see data and dimensions. Do not use a hammer on the insert and do not use lubrication. Use a hydraulic press or a hand press in one continuous movement. Ensure that the bottom of the insert is in contact with the bottom of the recess.

6 Cut the valve seat at an included angle of 88° for 46° valve seats or 118° for 31° valve seats, operation 12A-13, and lap the valve on to the valve seat. Ensure that the depth of the valve head below the face of the cylinder head is within the production limits, see data and dimensions. Work as near as possible to the minimum figure to allow for future wear on the valve seat.

https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Cylinder head

Angle of valve seat:	
- Exhaust	46° (88° included angle)
- Inlet	46° (88° included angle) or 31° (118° included angle)
Diameter of parent bore for valve guide	15,87/15,89 mm (0.6247/0.6257 in)
Leak test pressure	200 kPa (29 lbf/in^2) 2,04 kgf/cm^2
Head thickness	102,79/103,59 mm (4.047/4.078 in)
Minimum permissible thickness after head face has been machined	102,48 mm (4.035 in)
- AE, YE engines	See operation 12A-12

Inlet valves

Diameter of valve stem	9,46/9,49 mm (0.3725/0.3735 in)
Clearance in valve guide	0,02/0,10 mm (0.0008/0.0039 in)
Maximum clearance in valve guide	0,13 mm (0.005 in)
Diameter of valve head	44,86/45,11 mm (1.766/1.776 in)
Angle of valve face	45° or 30°
Overall length	122,66/123,07 mm (4.829/4.845 in)
Seal arrangement	Rubber seal fitted to valve guide

Depth of valve head below the face of cylinder head AA, AB, AC, AD**(1)**, AG, AH, YA**(2)**, YB, YC:

Note: The inlet valve depth for certain engine types fitted with valve seat inserts can vary. The complete engine number must be quoted when spare parts are ordered.

- Production limits	1,27/1,60 mm (0.050/0.063 in)
- Service limit	1,85 mm (0.073 in)
(1) AD vehicle applications fitted with an intercooler	1,37/1,68 mm (0.054/0.066 in)
(2) YA engines fitted with original valve seat inserts	1,37/1,68 mm (0.054/0.066 in)

Depth of valve head below the face of cylinder head YD**(1)**:

- Production limits	1,37/1,68 mm (0.054/0.066 in)
(1) Engine build list YD 80571	1,27/1,60 mm (0.050/0.063 in)
- AE, YE engines:	
- Production limits	1,37/1,62 mm (0.054/0.064 in)
- Production limits (for 30° valves)	1,27/1,76 mm (0.050/0.069 in)
- Service limit (for 30° valves)	2,01 mm (0.079 in)

https://truckmanualshub.com/

Exhaust valves

Diameter of valve stem	9,43/9,46 mm (0.371/0.372 in)
Clearance in valve guide	0,05/0,13 mm (0.002/0.005 in)
Maximum clearance in valve guide	0,15 mm (0.006 in)
Diameter of valve head	37,26/37,52 mm (1.467/1.477 in)
Angle of valve face	45°
Overall length	123,07/123,57 mm (4.845/4.865 in)
Seal arrangement	Rubber seal fitted to valve guide

Depth of valve head below face of cylinder head AA, AB, AC, AD(1), AG, AH, YA(2), YB, YC:

Note: The exhaust valve depth for certain engine types fitted with valve seat inserts can vary. The complete engine number must be given when spare parts are ordered.

- Production limits	1,28/1,60 mm (0.050/0.063 in)
- Service limit	1,85 mm (0.073 in)
(1) AD vehicle applications fitted with an intercooler	1,47/1,79 mm (0.058/0.070 in)
(2) YA engines fitted with original valve seat inserts	1,47/1,79 mm (0.058/0.070 in)

Depth of valve head below face of cylinder head AE, YD(1), YE:

- Production limits	1,47/1,79 mm (0.058/0.070 in)
(1) Engine build list YD 80571	1,28/1,60 mm (0.050/0.063 in)

https://truckmanualshub.com/

Maximum permissible distortion of cylinder head (A)

Four cylinder engines

A1 .... 0,08 mm (0.003 in)
A2 .... 0,15 mm (0.006 in)
A3 .... 0,15 mm (0.006 in)

Six cylinder engines

A1 .... 0,13 mm (0.005 in)
A2 .... 0,25 mm (0.010 in)
A3 .... 0,25 mm (0.010 in)

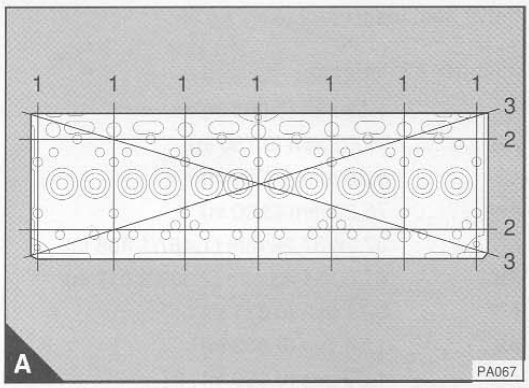
Dimensions of recesses for valve seat inserts (B)

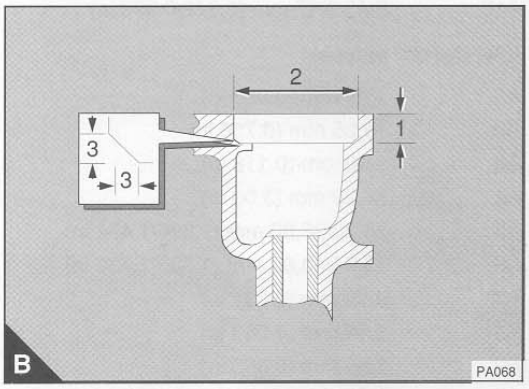
Inlet

B1 .... 7,19/7,32 mm (0.283/0.288 in)
B2 .... 51,22/51,24 mm (2.0165/2.0175 in)
B3 .... Radius 0,38 mm (0.015 in) maximum

Exhaust

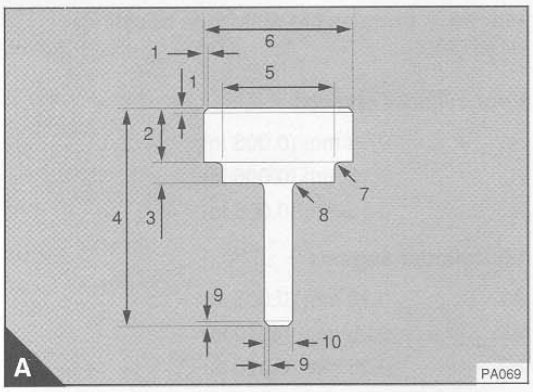
B1 .... 9,52/9,65 mm (0.375/0.380 in)
B2 .... 42,62/42,65 mm (1.6780/1.6790 in)
B3 .... Radius 0,38 mm (0.015 in) maximum





https://truckmanualshub.com/

Valve seat insert tool (A)



Inlet (for 45° valves)

A1 ..... 1,59 mm (0.063 in)
A2 ..... 19,05 mm (0.750 in)
A3 ..... 6,35 mm (0.250 in)
A4 ..... 76,20 mm (3.00 in)
A5 ..... 37,26/37,28 mm (1.467/1.468 in)
A6 ..... 51,00/51,23 mm (2.008/2.017 in)
A7 ..... 0,79 mm (0.031 in)
A8 ..... 1,59 mm (0.063 in)
A9 ..... 1,59 mm (0.063 in)
A10 .... 9,45/9,47 mm (0.372/0.373 in)

Inlet (for 31° valves)

A1 ..... 1,59 mm (0.063 in)
A2 ..... 19,05 mm (0.750 in)
A3 ..... 3,00 mm (0.118 in)
A4 ..... 76,20 mm (3.00 in)
A5 ..... 35,30/35,60 mm (1.390/1.402 in)
A6 ..... 43,94/43,99 mm (1.730/1.732 in)
A7 ..... 0,79 mm (0.031 in)
A8 ..... 1,59 mm (0.063 in)
A9 ..... 1,59 mm (0.063 in)
A10 .... 9,45/9,47 mm (0.372/0.373 in)

Exhaust (for 45° valves)

A1 ..... 1,59 mm (0.063 in)
A2 ..... 19,05 mm (0.750 in)
A3 ..... 7,92 mm (0.312 in)
A4 ..... 76,20 mm (3.00 in)
A5 ..... 32,58/32,84 mm (1.283/1.293 in)
A6 ..... 42,39/42,62 mm (1,669/1.678 in)
A7 ..... 0,79 mm (0.031 in)
A8 ..... 1,59 mm (0.063 in)
A9 ..... 1,59 mm (0.063 in)
A10 .... 9,45/9,47 mm (0.372/0.373 in)

https://truckmanualshub.com/

Valve guides

Inside diameter	9,51/9,56 mm (0.3744/0.3764 in)
Outside diameter	15,90/15,91 mm (0.6260/0.6265 in)
Interference fit of valve guide in cylinder head	0,03/0,07 mm (0.0012/0.0027 in)
Overall length:	
- Inlet	57,94 mm (2.281 in)
- Exhaust	61,10 mm (2.406 in)
Protrusion from bottom of recess for valve spring	15,10 mm (0.594 in)

Double valve springs - outer

Fitted length	35,8 mm (1.41 in)
Load at fitted length	176/195 N (39.5/43.7 lbf) 18/20 kgf
Number of active coils	3.6
Number of damper coils	1
Direction of coils	Left hand - damper coil to cylinder head

Double valve springs - inner

Fitted length	34,0 mm (1.34 in)
Load at fitted length	89/104 N (20/23 lbf) 9/11 kgf
Number of active coils	4.9
Number of damper coils	1
Direction of coils	Right hand - damper coil to cylinder head

Single valve springs

Fitted length	40,0 mm (1.57 in)
Load at fitted length	312/344 N (70.1/77.3 lbf) 31,8/35,1 kgf
Number of active coils	4.5
Number of damper coils	0
Direction of coils	Left hand

https://truckmanualshub.com/

Tappets

Diameter of tappet stem	18,99/19,01 mm (0.7475/0.7485 in)
Diameter of tappet bore in cylinder block	19,05/19,08 mm (0.7500/0.7512 in)
Clearance of tappet in cylinder block	0,04/0,09 mm (0.0015/0.0037 in

Rocker shaft

Outside diameter	19,01/19,04 mm (0.7485/0.7495 in)

Rocker levers and bushes

Diameter of parent bore for bush	22,23/22,26 mm (0.8750/0.8762 in)
Outside diameter of bush	22,28/22,31 mm (0.8770/0.8785 in)
Interference fit of bush in rocker lever	0,020/0,089 mm (0.0008/0.0035 in)
Internal diameter of fitted bush when reamed	19,06/19,10 mm (0.7505/0.7520 in)
Clearance between rocker lever bush and rocker shaft	0,03/0,09 mm (0.001/0.0035 in)
Maximum permissible clearance between rocker lever bush and rocker shaft	0,13 mm (0.005 in)

https://truckmanualshub.com/

Piston and connecting rod assemblies 13

General description 13A.02

Big end bearing

13A-01 To remove and to fit 13A.03
13A-02 To inspect 13A.04

Piston and connecting rod assembly

13A-03 To remove and to fit 13A.05
13A-03A To check the piston height above the cylinder block 13A.08
13A-03B To check the height grade of a Fastram piston 13A.09

Piston rings

13A-04 To remove and to fit 13A.10

Piston and connecting rod assembly

13A-05 To dismantle and to assemble 13A.11

Piston and piston rings

13A-06 To inspect 13A.12

Connecting rod

13A-07 To inspect 13A.13

Small end bush

13A-08 To remove and to fit 13A.13

Piston cooling jets

13A-09 To remove and to fit 13A.14
13A-10 To check the jet alignment 13A.14

Data and dimensions 13A.15

https://truckmanualshub.com/

13 PISTON AND CONNECTING ROD ASSEMBLIES

General description

The pistons used in Phaser and 1000 Series engines have either a "Quadram" (A) or a "Fastram" (B) combustion chamber in the top of the piston. These combustion chambers are designed to give an efficient mix of fuel and air.

The latest engines have pistons, with a "Fastram" combustion chamber and are available with different height grades.

The pistons have two compression rings and an oil control ring. The groove for the top ring has a hard metal insert to reduce wear of the groove. Axial location of the fully floating gudgeon pin is by circlips.

Expansion controlled pistons have a steel insert in the piston skirt.

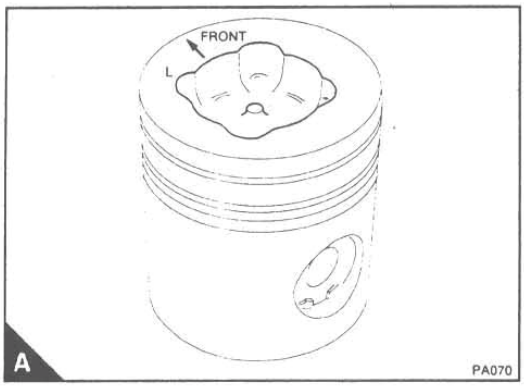
Turbocharged engines which are rated higher than 2300 rev/min have an anodised area on the top face of the piston.

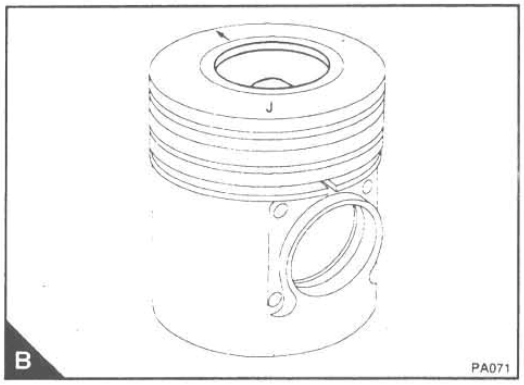
Turbocharged engines have cooling jets fitted in the cylinder block to spray lubricating oil onto the inner surface of the pistons.

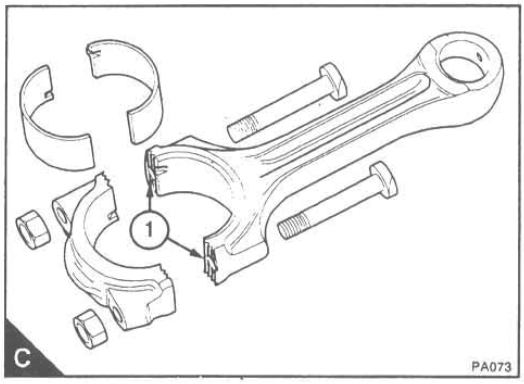
The connecting rods are machined from "H" section forgings of molybdenum steel. The connecting rods of turbocharged engines have wedge shaped small ends. Generally, the location of the bearing caps to the connecting rods is made by serrations (C1) and the cap is retained by two nuts and bolts (C).

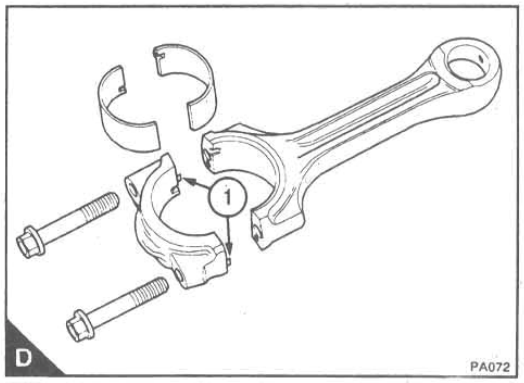
On some turbocharged engines, used in vehicle applications, the location of the bearing cap to the connecting rod is made by dowels (D1) fitted in the bearing cap (D). The faces of these connecting rods and caps are flat and the caps are retained by two setscrews.

Note: Always use the engine identification number to order new parts.









https://truckmanualshub.com/

Big end bearing

To remove and to fit **13A-01**

To remove

1 Drain the engine lubricating oil.

2 Remove the lubricating oil sump, operation 19A-03.

3 Remove the lubricating oil strainer and suction pipe, operation 19A-04 or remove the balancer unit, operation 14A-10.

4 Rotate the crankshaft until the relevant connecting rod is at its lowest position.

5 Release the nuts and remove the bearing cap. Remove the bolts from the connecting rod. If the bearing cap is retained by setscrews, the location of the bearing cap will be by two dowels. To remove these bearing caps, release the setscrews by approximately four rotates. Lightly hit the heads of the setscrews with a soft face hammer to separate the connecting rod from the bearing cap. Remove the setscrews and the bearing cap.

6 Remove the lower half of the shell bearing from the cap, but keep it with its relevant cap.

7 Carefully push the connecting rod up the cylinder bore just enough to allow access to the upper half of the shell bearing. Remove the bearing from the connecting rod. Keep the bearings from the connecting rod and cap together.

Caution: *Do not allow the connecting rod to hit the piston cooling jet, if fitted.*

https://truckmanualshub.com/

To fit

1 Clean the bearing faces of the connecting rod and the crank pin.

2 If the cap has dowels for location on the connecting rod, ensure that the dowel protrusion is 3,0/4,5 mm (0.12/0.18 in) above the butt face. Clean the complete bearing and lubricate the bearing surface and the crank pin with clean engine lubricating oil. Fit the upper half of the shell bearing to the connecting rod; ensure that the location tag is fitted correctly in its recess (A1). Fit the connecting rod to the crankpin; ensure that the assembly number on the connecting rod is on the same side as the other connecting rods.

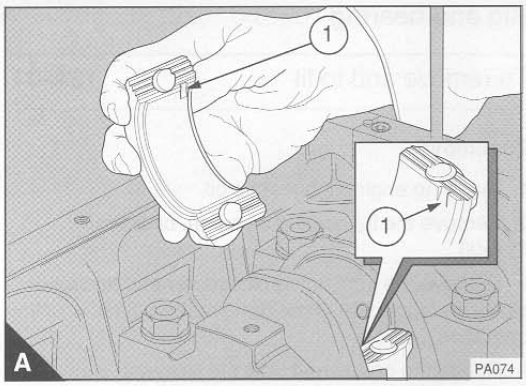
3 Clean, lubricate and fit the lower half of the shell bearings into the cap; ensure that the location tag is fitted correctly in its recess (A1). Fit the connecting rod bolts with the flat side of the head of the bolts towards the connecting rod. Fit the cap to the connecting rod. Ensure that the assembly number on the cap is the same as that on the connecting rod and that both of the assembly numbers are on the same side (B).

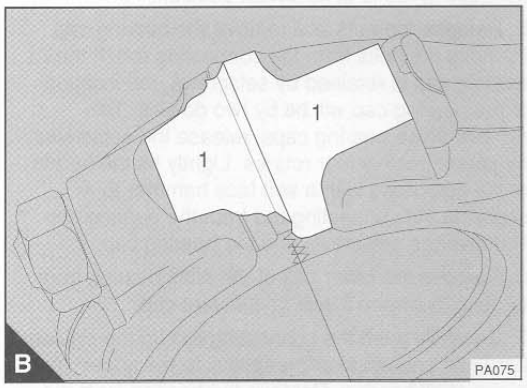
4 Tighten the fasteners gradually and evenly to the recommended torque of 155 Nm (114 lbf ft) 15,8 kgf m for setscrews, or 125 Nm (92 lbf ft) 12,7 kgf m for nuts.

5 Ensure that the crankshaft rotates freely.

6 Fit the lubricating oil strainer and suction pipe, operation 19A-04 or fit the balancer unit, operation 14A-10.

7 Fit the lubricating oil sump, operation 19A-03 and fill the sump to the correct level with lubricating oil of an approved grade.





To inspect 13A-02

Check the bearings and the crank pin for wear or other damage.

https://truckmanualshub.com/

Piston and connecting rod

To remove and to fit **13A-03**

To remove

1 Drain the lubricating oil and the cooling system.

2 Remove the cylinder head assembly, operation 12A-07.

3 Remove all carbon from the top of the bores of the cylinder liners.

4 Remove the lubricating oil sump, operation 19A-03.

5 Remove the lubricating oil strainer and suction pipe, operation 19A-04, or remove the balancer unit, operation 14A-10.

6 Remove the big end caps and the big end bearings from the connecting rods, operation 13A-01.

Caution: *Do not allow the connecting rods to hit the piston cooling jets, if fitted. If a cooling jet is hit, check its alignment, operation 13A-10, and renew it, if necessary.*

7 Turn the connecting rods 90° to prevent contact with the piston cooling jets. Push the pistons and the connecting rods out through the top of the cylinder liners. Keep the bearings and caps together to ensure that they can be fitted in their original positions.

8 Inspect the crank pins for damage.

https://truckmanualshub.com/

To fit

Special tools:

Piston replacer tool, PD.206

1 Ensure that the piston, the cylinder bore, the crank pin and the big end of the connecting rod are clean. Lubricate the piston and the cylinder liner with clean engine lubricating oil.

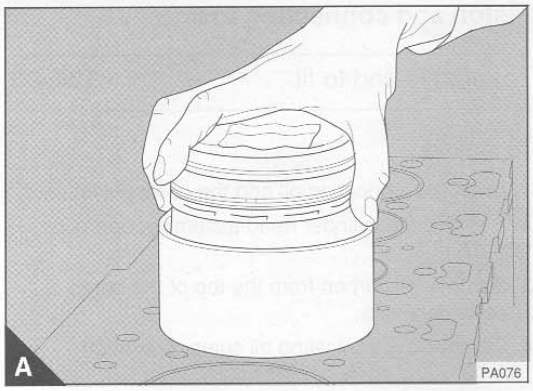
2 Rotate the crankshaft until the relevant crank pin is at its lowest position. Lubricate the crank pin with clean engine lubricating oil.

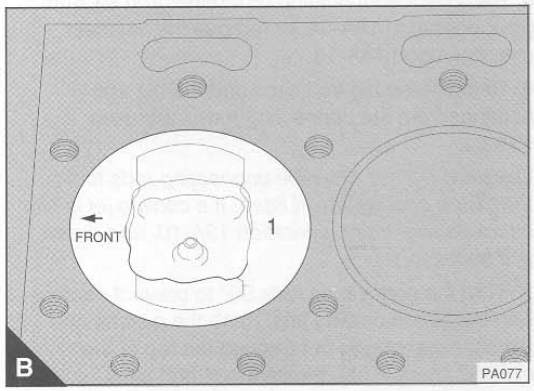
3 Fit the upper half of the shell bearings to the connecting rod. Ensure that the location tag is fitted correctly in its recess. Lubricate the bearing with clean engine lubricating oil.

4 Put the piston replacer tool in position at the top of the relevant cylinder. The tool has a tapered bore to compress the piston rings when the piston and connecting rod assembly is fitted. Ensure that the smaller end of the tapered bore is towards the face of the cylinder block.

5 Put the piston ring gaps 120° apart. Pass the connecting rod through the piston replacer tool and allow the piston to enter the tool. The arrow or "FRONT" mark on the top of the piston must be towards the front of the engine. In this position the combustion bowl in the top of the piston will be towards the fuel injection pump side of the engine.

6 Push the piston and connecting rod assembly through the piston replacer tool (A) and onto the crank pin. If piston cooling jets are fitted, the piston and connecting rod assembly must be rotated to ensure that the connecting rod will not hit the piston cooling jet as the assembly is fitted. When the connecting rod has passed the piston cooling jet, rotate the connecting rod until the arrow or "FRONT" mark on top of the piston is towards the front of the engine (B).





https://truckmanualshub.com/

7 Clean the connecting rod cap and the lower half of the shell bearings. Fit the bearing to the cap; ensure that the location tag is fitted correctly in its recess. Lubricate the bearing with clean engine lubricating oil. Fit the cap and ensure that the assembly number is the same as that on the connecting rod and that the numbers are on the same side. Fit the fasteners; ensure that the flat side of the head of the bolts is towards the connecting rod. When the fasteners are nuts, new nuts must be fitted. Tighten the fasteners gradually and evenly to the recommended torque of 155 Nm (114 lbf ft) 15,8 kgf m for setscrews, or 125 Nm (92 lbf ft) 12,7 kgf m for nuts.

8 Check that the crankshaft will rotate freely.

9 Check the piston height above the top face of the cylinder block, operation 13A-05.

10 Fit the lubricating oil strainer and suction pipe, operation 19A-04 or fit the balancer unit, operation 14A-10.

11 Fit the lubricating oil sump, operation 19A-03.

12 Fit the cylinder head assembly, operation 12A-07.

13 Fill the sump to the correct level with lubricating oil of an approved grade.

14 Fill the cooling system.

https://truckmanualshub.com/

To check the piston height above the cylinder block — 13A-03A

Special tools:

Piston height tool, PD.41D

Dial gauge for use with PD.41D, PD.208

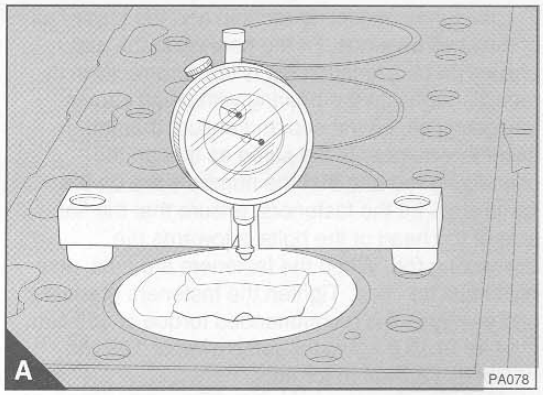
Put the piston height tool on the face of the cylinder block and rotate the gauge dial to the zero position. Rotate the crankshaft until the piston is approximately at top dead centre (TDC). Carefully put the tool over the top of the piston with the plunger of the gauge in contact with the piston above the axis of the gudgeon pin (A). Rotate the crankshaft to bring the piston to its highest position and make a note of the gauge indication.

For engines fitted with "Quadram" pistons, the piston height above the face of the cylinder block should be 0,14/0,36 mm (0.005/0.014 in).

For engines fitted with "Fastram" pistons, grades A to L, the piston height above the top face of the cylinder block should be 0,38/0,50 mm (0.015/0.020 in)

Notes:

- Two "Quadram" piston heights can be used in the factory: "H" - high, "L" - low. In service only "L" pistons are supplied. If an "L" piston is used instead of an "H" piston, the height may be up to 0,19 mm (0.0075 in) below the bottom limit.
- The top of the piston should not be machined.
- If the original piston is used, ensure that it is assembled to the correct connecting rod and is used in the original cylinder.



https://truckmanualshub.com/

To check the height grade of a "Fastram" piston — 13A-03B

For engines fitted with earlier "Fastram "pistons there are five height grades (A to E) of piston in production and in service.

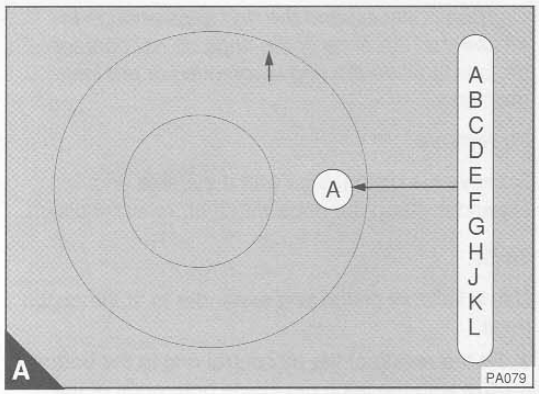
The latest "Fastram" pistons are supplied in six height grades (F to L) in production and in service. Identification of the height grade is by the letter for each piston which is stamped on the top of the piston (A). The letter A or F is the highest grade and letter E or L is the lowest grade. The difference between the grades is 0,045 mm (0.0018 in).

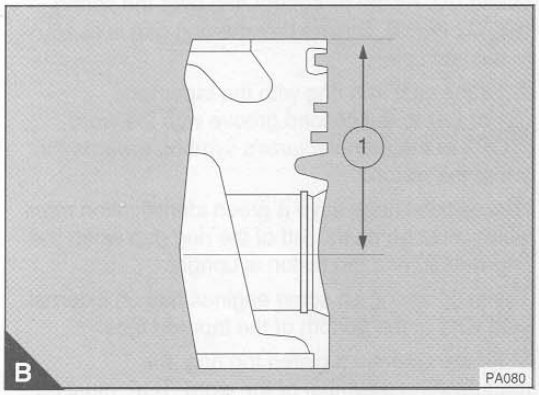
If a new piston is fitted, ensure that it is of the correct height grade. The height grade can be checked by measurement, from the centre of the gudgeon pin to the top of the piston (B1). The dimensions for each grade are listed in the table below:

Piston grade letter	Piston height dimension (mm)	Latest equivalent grade
A*	70,334	G
B*	70,289	H
C*	70,244	J
D*	70,199	K
E*	70,154	L
F	70,391	
G	70,345	
H	70,299	
J	70,253	
K	70,207	
L	70,161	

* Earlier engines

Note: The earlier piston grades A to E are now not supplied as a spare part. The latest equivalent grades G to L shown in the table above are to be used instead.





Piston rings

To remove and to fit — 13A-04

The piston used in the Phaser and 1000 Series engines have two compression rings and an oil control ring. All the piston rings are above the gudgeon pin. Piston rings have different design features. To ensure that the correct type is obtained always use the engine identification number to order new parts.

https://truckmanualshub.com/

Caution: *Only expand the ring gaps enough to ensure that the ends of the rings do not damage the piston when the ring is removed or put into position.*

To remove

Remove the piston rings with a suitable ring expander. Keep the rings with their relevant piston.

To fit

Use a suitable piston ring expander to fit the piston rings.

1 Fit the spring of the oil control ring in the bottom groove with the latch pin inside both ends of the spring (A). Fit the oil control ring over the spring (B2, C2 or D3). Ensure that the ring gap is at 180° to the latch pin.

2 Fit the cast iron ring with the taper face (B1 or C1) to the second groove with the word "TOP", or the manufacturer's symbol, towards the top of the piston.

New second rings have a green identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

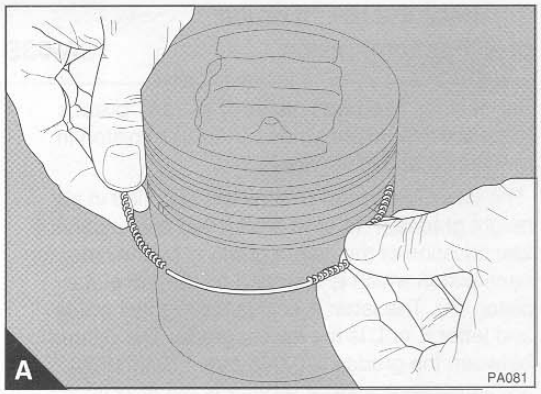
The second ring on some engines has an external step (D2) at the bottom of the tapered face.

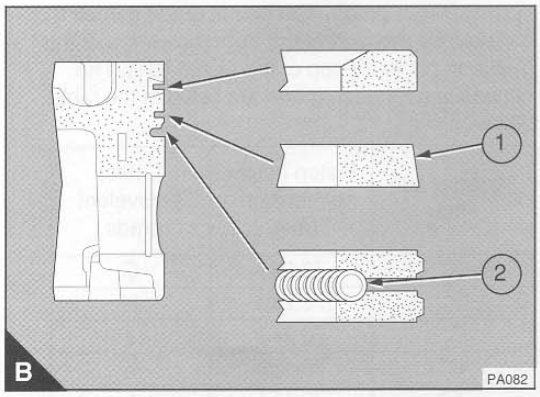
3 Fit the chromium plated top ring, the manufacturer's symbol or the word 'TOP' must be towards the top of the piston.

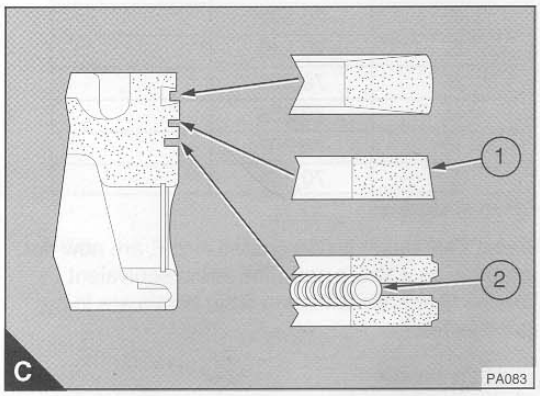
New top rings have a red or blue identification mark which must be on the left of the ring gap when the ring is fitted and the piston is upright.

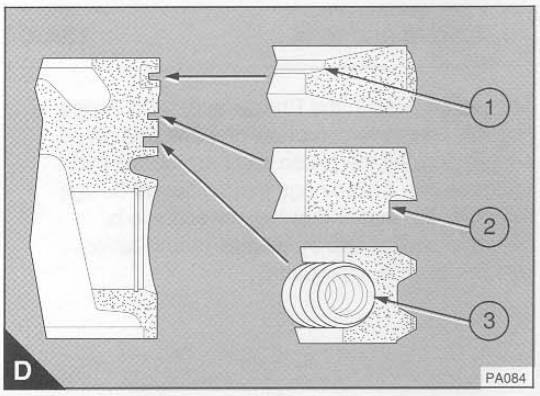
The top ring on some engines has an internal step (D1) on the top face.

4 Ensure that the ring gaps are 120° apart.









https://truckmanualshub.com/

Piston and connecting rod assembly

To dismantle and to assemble **13A-05**

To dismantle

1 Remove the piston rings, operation 13A-04.

2 Remove the circlips which retain the gudgeon pin.

3 Put a mark on the piston to indicate the cylinder number as shown on the connecting rod. Put the mark on the piston on the same side as the mark on the big end to ensure that they are assembled correctly (A).

4 Push the gudgeon pin out by hand. If the gudgeon pin is tight, heat the piston to 40/50°C (100/120°F) for easy removal of the gudgeon pin.

To assemble

1 Clean the bore of the small end bush and lubricate it with clean engine lubricating oil.

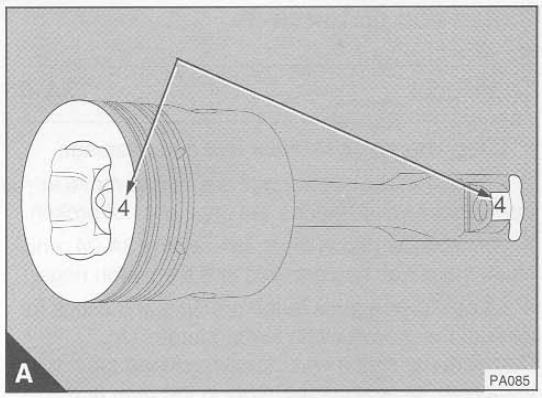
2 Fit a new circlip in the circlip groove of one of the gudgeon pin bosses. Ensure that it fits correctly in the groove.

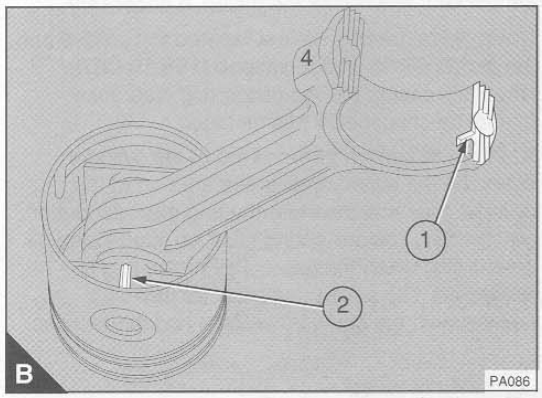
3 With the piston upside down, put the connecting rod in position with the recess for the location of the big end bearing (B1) on the same side as the lug on the gudgeon pin boss (B2). If the original piston is used, ensure that it is assembled to the correct connecting rod and is used in the original cylinder. Engines with "Fastram" pistons have six piston height grades, if a new piston is fitted, ensure that it is of the correct height grade, see operation 13A-03.

4 Lubricate the gudgeon pin bosses with clean engine lubricating oil and push in the gudgeon pin towards the circlip. If the gudgeon pin is a tight fit in the piston, heat the piston to 40/50°C (100/120°F) before the gudgeon pin is fitted.

5 Fit a new circlip in the groove in the other gudgeon pin boss. Ensure that it fits correctly in the groove.

6 Fit the piston rings, operation 13A-04.





https://truckmanualshub.com/

Piston and piston rings

To inspect **13A-06**

1 Check the piston for wear and other damage.

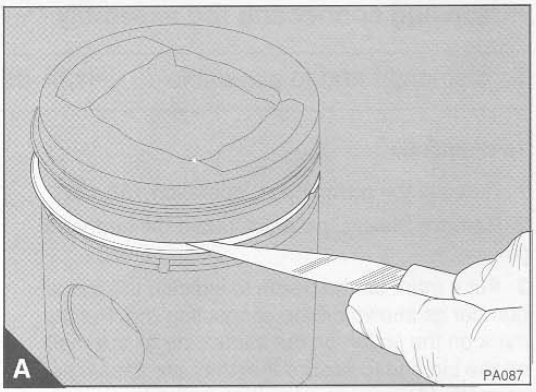
2 Check that the piston rings are free to move in their grooves and that the the rings are not broken.

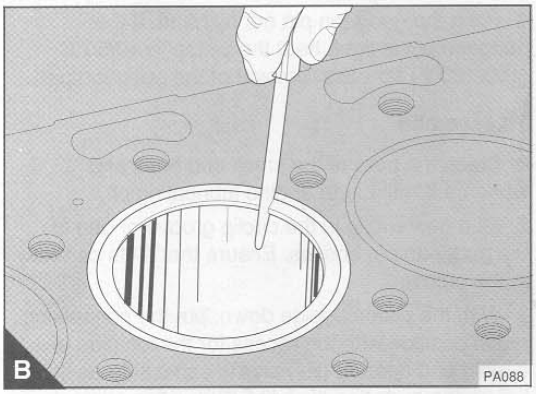
3 Remove the piston rings, operation 13A-04, and clean the piston ring grooves and the piston rings.

4 Fit new piston rings in the grooves and check for wear of the grooves with feeler gauges (A). Compare the piston ring clearance in the groove to that given for new components in the data and dimensions and renew the piston, if necessary.

Note: Some pistons have a tapered top groove and the piston ring is wedge shaped (13A.10 C/D); when this occurs the top piston ring clearance cannot be checked by this method.

5 Clean all carbon from the top of the cylinder liners. Fit the piston rings in the top part of the cylinder liner and measure the ring gap with feeler gauges (B). The coil spring must be fitted to the oil control ring when the gap of this piston ring is measured. The piston ring gaps for new components are given in the data and dimensions.





https://truckmanualshub.com/

Connecting rod

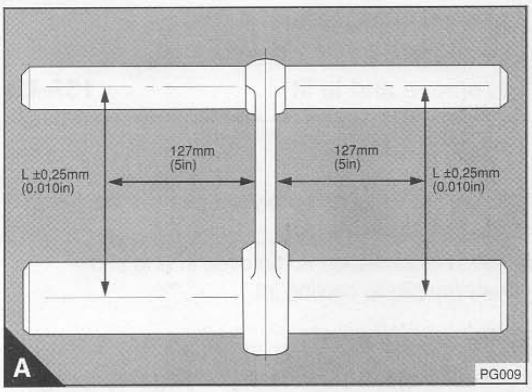
To inspect **13A-07**

1 Check the connecting rod for distortion (A).

Note: The large and small end bores must be square and parallel with each other within the limits of +/- 0,25 mm (0.010 in) measured 127 mm (5.0 in) each side of the connecting rod axis on a test mandrel. With the small end bush fitted, the limits are reduced to +/- 0,06 mm (0.0025 in).

2 Check the small end bush for wear or for other damage and renew it, if necessary.

3 Check the fit of the gudgeon pin in the small end bush and check the gudgeon pin for wear, see the data and dimensions.



Small end bush

To remove and to fit **13A-08**

1 Press out the old bush with a suitable adaptor.

2 Clean the connecting rod bore and remove any sharp edges.

3 Press in the new bush. Ensure that the lubrication hole in the bush is on the same side as, and is aligned with, the hole in the top of the connecting rod.

4 Ream the bush to get the correct clearance between the gudgeon pin and the bush, see the data and dimensions.

Note: On turbocharged engines the small end is wedge shaped. After the small end bush has been fitted, machine the bush to the shape of the small end and remove any sharp edges.

https://truckmanualshub.com/

Piston cooling jets

To remove and to fit 13A-09

To remove

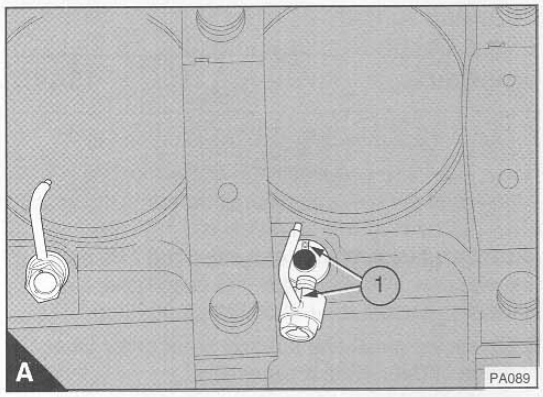
Release the valve assembly and remove the piston cooling jet assembly (A).

Note: The crankshaft is removed in A to show clearly the piston cooling jet.

To fit

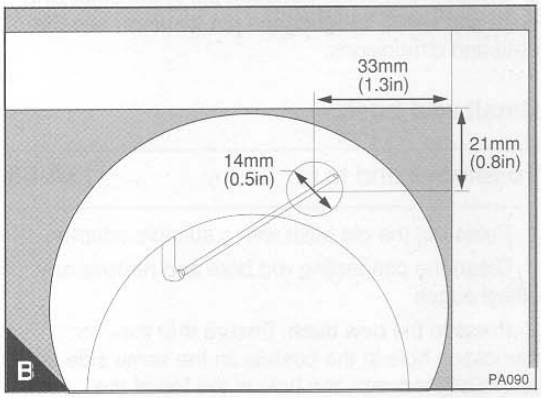
1 Check that the ball moves freely against spring pressure in the valve assembly and that the jet tube is not damaged. Renew the valve assembly and/or the body as necessary.

2 Fit the piston cooling jet; ensure that the assembly is fitted correctly on the dowel in the cylinder block. Tighten the valve assembly to 20 Nm (15 lbf ft) 2,0 kgf m.



To check the jet alignment 13A-10

Insert a 1,70 mm (0.067 in) diameter rod, of suitable length, into the jet. If a suitable rod is not available, reduce the end of a thicker rod to 1,70 mm (0.067 in) diameter for a length of 16,00 mm (0.630 in). When the rod is inserted into the jet it must extend out of the top of the cylinder within the area shown in B.



https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Pistons - Naturally aspirated engines:

Type	"Quadram" combustion bowl, controlled expansion, inserted top ring groove
Diameter of bore for gudgeon pin	34,928/34,934 mm (1.3751/1.3754 in)
Height of piston above top face of cylinder block	0,14/0,36 mm (0.005/0.014 in)
Width of groove for top ring	2,57/2,59 mm (0.101/0.102 in)
Width of groove for second ring	2,55/2,57 mm (0.100/0.101 in)
Width of groove for third ring	4,03/4,06 mm (0.1587/0.1598 in)

Pistons - Turbocharged engines:

Type	"Quadram" combustion bowl, controlled expansion, inserted top ring groove, reduced diameter top land
Diameter of bore for gudgeon pin	38,103/38,109 mm (1.500/1.5004 in)
Height of piston above top face of cylinder block	0,14/0,36 mm (0.005/0.014 in)
Width of groove for top ring	Tapered
Width of groove for second ring	2,56/2,58 mm (0.1008/0.1016 in)
Width of groove for third ring	4,04/4,06 mm (0.1591/0.1598 in)

Pistons - Turbocharged AE, YE, AD* engines:

Type	"Fastram" combustion bowl, controlled expansion, inserted top ring groove, high top ring groove
Diameter of bore for gudgeon pin	39,7003/39,7009 mm (1.5355/1.5358 in)
Difference between height grades	0,046 mm (0.0018 in)
Height of piston above top face of cylinder block	0,38/0,50 mm (0.015/0.020 in)
Width of groove for top ring	Tapered
Width of groove for second ring	2,56/2,58 mm (0.1008/0.1016 in)
Width of groove for third ring	4,04/4,06 mm (0.1591/0.1598 in)

Piston cooling jets - Turbocharged engines:

Valve open pressure	178/250 kPa (26/36 lbf/in^2) 1,8/2,6 kgf/cm^2

* 110 Ti and 135 Ti AD lists are fitted with pistons which are designed for use in emission controlled areas. Some of these pistons are non-expansion controlled.

https://truckmanualshub.com/

Piston rings - Naturally aspirated engines:

Top compression ring	Barrel face, molybdenum insert, with a chamfer at the top of the inner face
Second compression ring	Taper face, cast iron
Oil scraper ring	Coil spring loaded, chromium faced
Width of top ring	2,48/2,49 mm (0.097/0.098 in)
Width of second ring	2,48/2,49 mm (0.097/0.098 in)
Width of third ring	3,98/3,99 mm (0.1566/0.1571 in)
Clearance of top ring in groove	0,08/0,11 mm (0.003/0.004 in)
Clearance of second ring in groove	0,06/0,09 mm (0.002/0.003 in)
Clearance of third ring in groove	0,04/0,08 mm (0.002/0.003 in)
Gap of top ring	0,40/0,85 mm (0.016/0.033 in)
Gap of second ring	0,30/0,76 mm (0.012/0.030 in)
Gap of third ring	0,38/0,84 mm (0.015/0.033 in)

Piston rings - Turbocharged engines:

Top compression ring	Barrel face, molybdenum insert, wedge
Second compression ring	Taper face, cast iron
Oil scraper ring	Coil spring loaded, chromium face
Width of top ring	Wedge
Width of second ring	2,48/2,49 mm (0.097/0.098 in)
Width of third ring	3,98/3,99 mm (0.156/0.157 in)
Clearance of top ring in groove	Wedge
Clearance of second ring in groove	0,07/0,11 mm (0.003/0.004 in)
Clearance of third ring in groove	0,05/0,08 mm (0.002/0.003 in)
Gap of top ring	0,35/0,80 mm (0.014/0.031 in)
Gap of top ring with internal step	0,35/0,70 mm (0.014/0.028 in)
Gap of second ring	0,30/0,76 mm (0.012/0.030 in)
For second rings with external step	0,40/0,85 mm (0.016/0.033 in)
Gap of third ring	0,38/0,84 mm (0.015/0.033 in)

https://truckmanualshub.com/

Connecting rods - Naturally aspirated engines:

Type	'H' section, square shape small end
Location of cap to connecting rod	Serrations
Diameter of parent bore for big end	67,21/67,22 mm (2.6460/2.6465 in)
Diameter of parent bore for small end	38,89/38,92 mm (1.531/1.532 in)
Length between centres	219,05/219,10 mm (8.624/8.626 in)

Connecting rods - Turbocharged engines:

Type	'H' section, wedge shape small end
Location of cap to connecting rod:	
- Vehicle applications	Flat joint face with dowels
- Non-vehicle applications	Serrations
Diameter of parent bore for big end	67,21/67,22 mm (2.6460/2.6465 in)
Diameter of parent bore for small end	42,07/42,09 mm (1.656/1.657 in)
Length between centres	219,05/219,10 mm (8.624/8.626 in)

Connecting rod bearings

Type:	
- Naturally aspirated engines:	Steel back, aluminium/tin bearing material
- Turbocharged engines:	Steel back, lead bronze bearing material with lead finish
Width:	
- Naturally aspirated engines:	31,62/31,88 mm (1.245/1.255 in)
- Turbocharged engines:	31,55/31,88 mm (1.240/1.255 in)
Thickness at centre of bearings:	
- Naturally aspirated engines:	1,835/1,842 mm (0.0723/0.0725 in)
- Turbocharged engines:	1,835/1,844 mm (0.0723/0.0726 in)
Bearing clearance:	
- Naturally aspirated engines:	0,035/0,081 mm (0.0014/0.0032 in)
- Turbocharged engines:	0,030/0,081 mm (0.0012/0.0032 in)
Available undersize bearings	-0,25 mm (-0.010 in); -0,51 mm (-0.020 in); -0,76 mm (-0.030 in)

https://truckmanualshub.com/

Gudgeon pins - Naturally aspirated engines:

Type	Fully floating
Outside diameter	34,920/34,925 mm (1.3748/1.3750 in)
Clearance fit in piston boss	0,003/0,014 mm (0.0001/0.0006 in)

Gudgeon pins - Turbocharged engines:

Type	Fully floating
Outside diameter	38,095/38,100 mm (1.4998/1.5000 in)
- AE, YE and 110 Ti and 135 Ti AD lists	39,694/39,700 mm (1.5628/1.5630 in)
Clearance fit in piston boss	0,003/0,014 mm (0.0001/0.0006 in)

Small end bushes - Naturally aspirated engines:

Type	Steel back, lead-bronze or lead-bronze tin bearing material
Outside diameter	38,94/39,03 mm (1.535/1.536 in)
Inside diameter (reamed)	34,94/34,96 mm (1.3758/1.3765 in)
Clearance between bush in small end and gudgeon pin	0,020/0,043 mm (0.0008/0.0017 in)

Small end bushes - Turbocharged engines:

Type	Steel back, lead bronze bearing material
- AE, YE, and certain AD lists*	Steel back, lead bronze tin bearing materials
Outside diameter	42,16/42,19 mm (1.6600/1.6613 in)
Inside diameter (reamed)	38,12/38,14 mm (1.5008/1.5015 in)
- AE, YE and certain AD lists*	39,719/39,738 mm (1.5637/1.5645 in)
Clearance between bush in small end and gudgeon pin	0,020/0,043 mm (0.0008/0.0017 in)
- AE, YE	0,010/0,035 mm (0.0004/0.0014 in)
Certain AD lists *	0,023/0,044 mm (0.0009/0.0017 in)

*AD lists which are subject to emission legislation

https://truckmanualshub.com/

Crankshaft assembly 14

General description 14A.03

Crankshaft pulley

14A-01A To remove and to fit - four cylinder engine types 14A.04

Crankshaft pulley and damper

14A-01B To remove and to fit - six cylinder engine types 14A.05
14A-01C To inspect 14A.07

Rear oil seal assembly

14A-02A To remove and to fit - engines which have the standard seal . . . 14A.08
14A-02B To remove and to fit - engines which have a flywheel housing that is oil filled 14A.09
14A-03A To renew the rear oil seal - engines which have the standard seal 14A.11
14A-03B To renew the rear oil seals - engines which have a flywheel housing that is oil filled 14A.12

Thrust washers

14A-04 To check crankshaft end-float 14A.14
14A-05 To remove and to fit 14A.15

Main bearings

14A-06 To remove and to fit (with the crankshaft in position) 14A.16
14A-07 To inspect 14A.17

Crankshaft

14A-08 To remove and to fit 14A.18
14A-09 To inspect 14A.21

Continued

https://truckmanualshub.com/

Balancer unit

14A-10	To remove and to fit	14A.22
14A-11	To dismantle and to assemble	14A.23
14A-12	To inspect	14A.28
14A-13	To remove and to fit the needle roller bearings for the drive shaft	14A.29
14A-14	To remove and to fit the bushes for the balance weights	14A.30

Data and dimensions 14A.31

https://truckmanualshub.com/

General description

The crankshaft is a chrome-molybdenum forging which has five main journals for four cylinder engines and seven main journals for six cylinder engines.

End-float is controlled by two half thrust washers on both sides of the centre main bearing.

The main bearings have steel backs with a aluminium/tin bearing material except the centre main bearing of six cylinder engines, which has a bearing material of lead bronze with a lead finish. The main bearing caps are made of cast iron or spheroidal graphite (SG) iron.

Note: The bearing material of all the main bearings used on Phaser 210Ti engines is lead bronze with a lead finish.

The front and the rear oil seals are Viton lip seals with a dust lip to the outside of the main lip and with oil return grooves on the face of the main lip. Engines which have a flywheel housing that is oil filled have an arrangement which uses two "Viton" lip seals. These seals are narrower than the standard seal and are fitted back to back on the crankshaft palm. They do not have a dust lip.

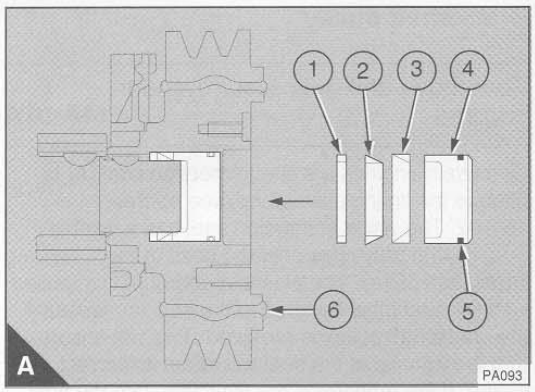
Warning! *Read the safety precautions for "Viton" seals on page 10A.07.*

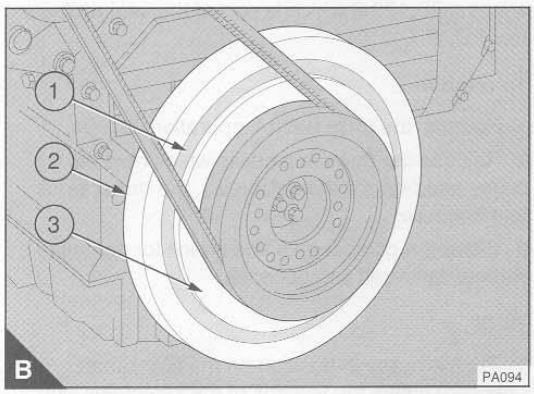
The crankshaft pulley of the four cylinder engine, usually fitted without a damper, is held in position by a plain thrust block and three setscrews. The nose of the crankshaft is serrated for location.

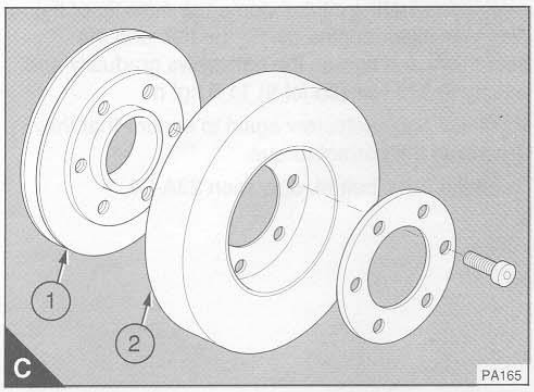
The location of the front pulley of six cylinder engines is by a key in the crankshaft noseand the pulley is held in position by a tapered rings arrangement (A).

An integral damper, with a rubber insert (A6) is built into the pulley of early six cylinder engines and some four cylinder engines. Later six cylinder vehicle engines have a separate plate damper which has an outer plate (B2), bonded by a rubber insert (B1) to an inner plate (B3) and fastened to the rear face of the crankshaft pulley. The latest six cylinder engines have a viscous damper (C2) which is fastened to the front or rear face of the pulley (C1). All of the dampers are designed for the suppression of torsional vibrations in the engine crankshaft.

A balancer unit is fitted to certain four cylinder engines which have rigid mountings or which are part of the chassis or frame. The purpose of the balancer unit is to reduce the effect of the out-of-balance forces to a satisfactory condition.





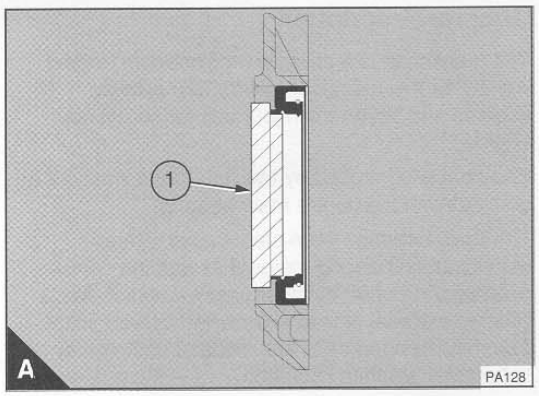


https://truckmanualshub.com/

Crankshaft pulley

To remove and to fit - four cylinder engines 14A-01A

On certain engines a water immersion seal (A) is fitted to the timing case cover, see operation 15A-02. The water immersion seal has a flexible front lip that protrudes onto the boss of the crankshaft pulley. The plastic mandrel (A1) supplied with the seal must be fitted to the seal immediately the crankshaft pulley is removed. This will ensure that the front lip of the seal will retain its correct shape. If the mandrel is not available, use the seal adaptor PD.170-8 which is part of the seal replacer tool PD.170.



To remove

1 Remove the drive belt(s), operation 23A-04.

2 Release the three setscrews which hold the pulley and remove the setscrews, the thrust block and the pulley.

3 Clean the components and check for damage. Renew damaged components.

To fit

1 Put the pulley in position on the crankshaft. Lubricate lightly the threads of the setscrews with engine lubricating oil. Lubricate the main lip of the seal with clean engine oil. Fit the hub and the setscrews and tighten the setscrews gradually and evenly to 115 Nm (85 lbf ft) 11,8 kgf m.

2 Check each setscrew again to ensure that they are still to the correct torque.

3 Fit the drive belt(s), operation 23A-04.

https://truckmanualshub.com/

Crankshaft pulley and damper

To remove and to fit - six cylinder engines **14A-01B**

Consumable products:

Retainer (oil tolerant)

Caution: *A viscous damper (C2) should be renewed if there is impact damage to the outer casing or if there is leakage of the viscous fluid from the cover plate. Check the area around the holes for the damper fasteners for damage.*

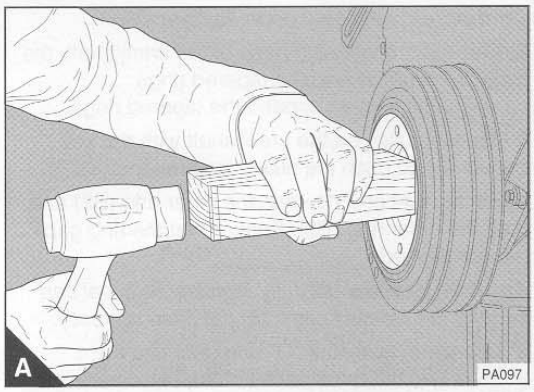
To remove

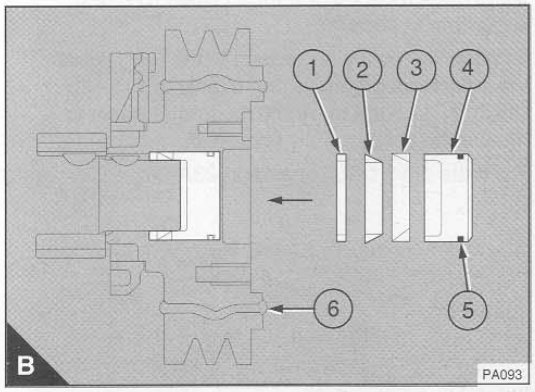
1 Remove the drive belts, operation 23A-04.

Warning! *The crankshaft pulley and damper assembly is heavy and must be given support before removal.*

2 Release the fasteners which secure the clamp ring (C3) for the damper to the pulley, if one is fitted, and remove the damper.

3 Remove the three setscrews and the thrust block (B4). If the pulley is not free, **do not use an extractor to remove the pulley**. Hold a wooden block against the inner hub of the pulley and with a hammer, lightly hit the wooden block towards the rear (A) to loosen the tapered rings.





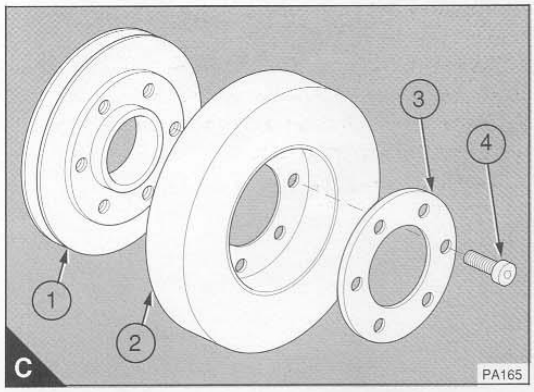
To fit

1 If the damper is fitted to the rear face of the pulley, fit the damper to the pulley with its inner flange against the rear face of the pulley. If a viscous damper is fitted, put the damper in position on the face of the pulley (C1). Fit the clamp ring (C3) or the washers.

Notes:

- On some engines the viscous damper is fitted to the rear of the pulley.
- If a clamp ring with a chamfer on the outside edge of the ring is used, ensure that the chamfer is towards the damper when the ring is fitted. Clamp rings may be fitted to viscous or plate dampers.

Apply Retainer (oil tolerant) to the cap screws (A4) for the clamp ring and tighten the cap screws gradually and evenly to 35 Nm (26 lbf ft) 3,6 kgf m. For viscous dampers fitted with M12 setscrews tighten the fasteners to 75 Nm (55 lb ft) 7,6 kgf m.



https://truckmanualshub.com/

Caution: *Do not use a degreasing solution.*

2 Clean thoroughly the nose of the crankshaft, the bore of the pulley and the tapered rings components. Do not expand the tapered rings.

3 Put the pulley on the crankshaft with the key engaged and push the pulley towards the rear.

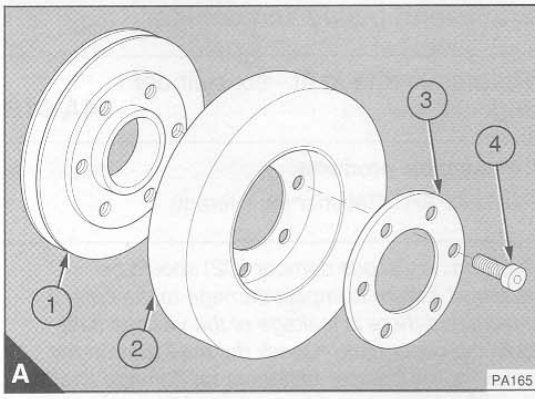
4 Fit the spacer (B1), then the inner ring (B2) and then the outer ring (B3). Ensure that the ring gaps are not aligned.

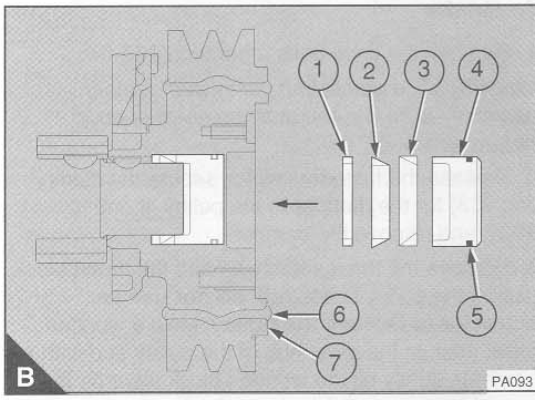
Caution: *Extreme difficulty in pulley removal can occur if the tapered rings are not fitted correctly.*

5 Lubricate lightly the "O" ring (B5) and the threads and the thrust faces of the setscrews with clean engine oil. Put the thrust block (B4) and setscrews in position.

6 While the pulley is pressed to the rear, tighten the setscrews gradually and evenly to 115 Nm (85 lbf ft) 11,8 kgf m. Apply the torque again to ensure the pulley is fully tightened.

7 Fit the drive belts, operation 23A-04.





https://truckmanualshub.com/

To Inspect 14A-01C

1 When an integral pulley and damper (A) or a separate plate damper (B) is fitted. The assembly should be renewed if:,

- The rubber insert (A6) or (B1) between the hub and the outer ring is split.
- The rubber insert is damaged by oil or solvents
- There is movement of the pulley or outer ring on the hub.

Check the area around the holes for the damper fasteners for cracks or wear.

Caution: *Do not use excessive force to lever the damper away from the engine.*

2 Remove any paint or dirt in four positions 90° apart on the face (A7) or (B2) of the damper, above the rubber insert. Use a lever to move the damper forward and eliminate the crankshaft end-float. Fit a dial test indicator on the front cover of the timing case. Measure the alignment of the damper face at four locations, 90° apart. The maximum permissible difference between the maximum and minimum figures obtained is:

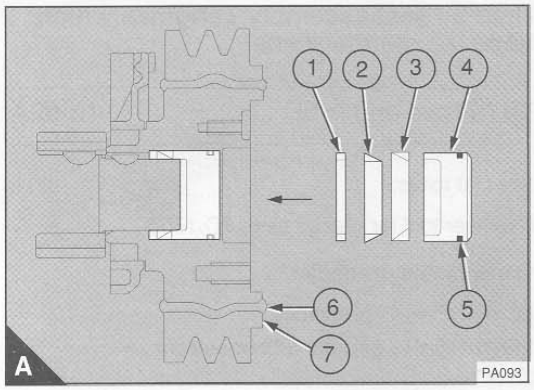
- Integral pulley and damper 0,18 mm (0.007 in).
- Separate plate damper 0,60 mm (0.024 in).

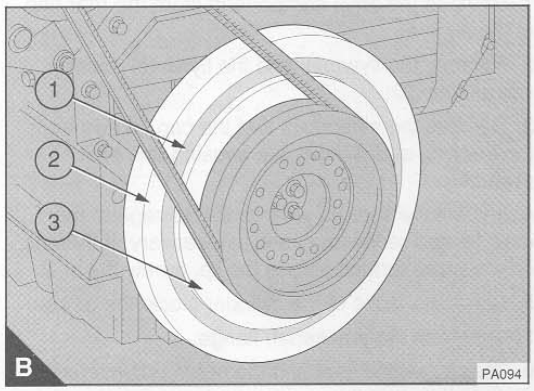
3 Remove any paint or dirt from the circumference of the damper. Fit a dial test indicator on the front cover of the timing case.

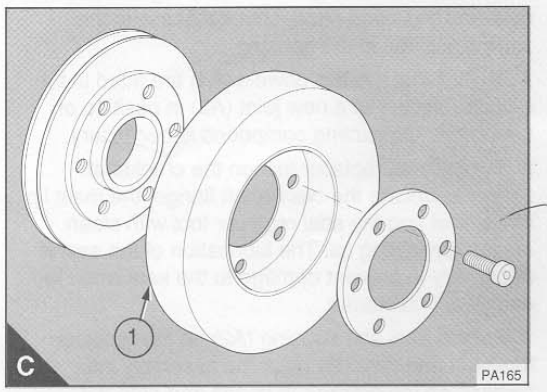
4 Rotate the crankshaft slowly one complete revolution and measure for run-out on the circumference of the damper with the dial test indicator. The maximum permissible difference between the maximum and minimum figures obtained is:

- Integral pulley and damper 0,12 mm (0.005 in).
- Separate plate damper 0,80 mm (0.032 in).

5 A viscous damper (C1) must be renewed if there is impact damage to the outer casing or if there is leakage of the viscous fluid from the cover plate. Check the area around the holes for the damper fasteners for damage.







https://truckmanualshub.com/

Rear oil seal assembly - engines which have the standard seal

To remove and to fit **14A-02A**

Special tools:

Replacer tool for rear oil seal, PD.145D

Consumable products:

Threadlock

Silicone rubber sealant

1 Remove the drive components from the rear end of the engine.

2 Remove the flywheel and the flywheel housing, see section 22.

3 Remove the setscrews and the cap screws from the housing and remove the housing and seal assembly.

4 Inspect the seal for wear or for damage to the main lip and renew the seal, if necessary. If there is only a small scratch across the lip, renew the seal.

5 Clean the faces of the cylinder block, the oil seal housing and the crankshaft flange.

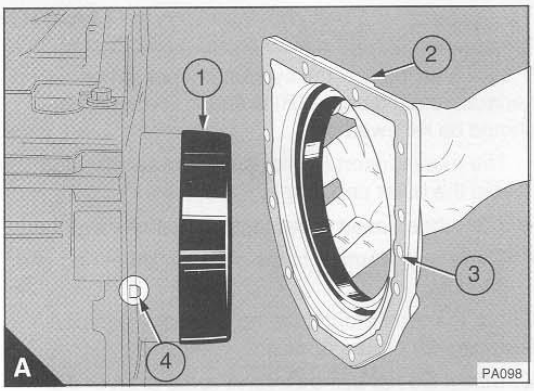
6 Check that the seal and the outer circumference of the crankshaft flange are not damaged. Where a new seal has been fitted, check that it is in the correct position in the housing.

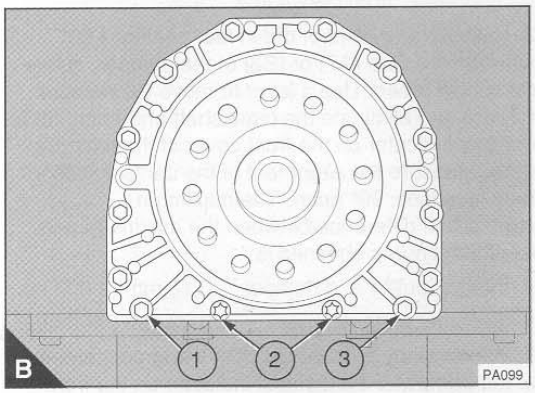
7 Ensure that the two dowels (A4) are fitted in the cylinder block. Put a new joint (A3) in position on the dowels, no jointing compound is necessary.

8 Put the seal replacer tool on the crankshaft flange. Lubricate the crankshaft flange, the main lip of the seal and the seal replacer tool with clean engine lubricating oil. The lubrication of the seal is necessary to prevent damage to the seal when the engine is first started.

9 Put the seal and housing (A2) on the replacer tool (A1) and carefully push the assembly into position on the crankshaft flange and onto the dowels. Remove the tool, fit the setscrews and the cap screws. Tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m and tighten the cap screws to 18 Nm (13 lbf ft) 1,9 kgf m.

Note: On the latest engines two torx screws (B2) are fitted instead of cap screws. Tighten the torx screws to 22 Nm (16 lbf ft) 2,2 kgf m. Two extra setscrews (B1 and B3) have also been fitted to later engines.





https://truckmanualshub.com/

Rear oil seal assembly - engines which have a flywheel housing that is oil filled

To remove and to fit **14A-02B**

Special tools:

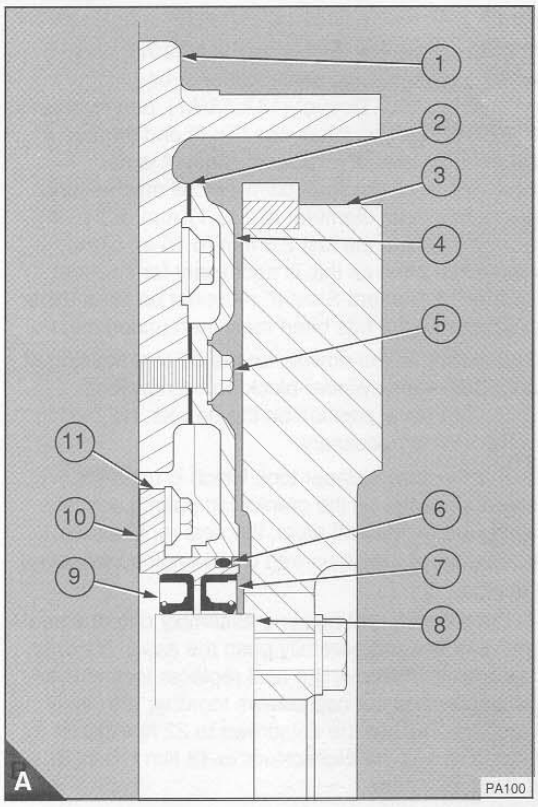
Replacer tool for rear oil seal, PD.145D

Consumable products:

Threadlock

Silicone rubber sealant

This arrangement for the crankshaft rear oil seal is for engines which have a flywheel housing that is filled with oil. This arrangement uses two lip seals which are narrower than the standard seal and are fitted back to back on the crankshaft palm. The front seal (A9) prevents leakage of oil from the engine and the rear seal (A7) prevents leakage of oil from the flywheel housing. A cover (A4) and joint (A2) are used to prevent leakage of oil past the setscrews which retain the flywheel housing (A1) to the rear face of the cylinder block. An "O" ring (A6) is used to seal between the cover and the seal housing. Oil leakage past the "O" ring or one of the oil seals will pass through a hole in the seal housing between the two seals. The oil will then pass through two cast grooves in the front face of the flywheel housing. These grooves are in the 4 o'clock and 8 o'clock positions.



To remove

1 Release the setscrews which retain the flywheel and remove the flywheel (A3).

2 Release the setscrews (A5) which retain the cover (A4) and remove the cover. On later covers their are two integral lugs to enable the use of a lever to remove the cover. Remove the joint (A2) and clean the joint faces of the cover and flywheel housing.

3 Release the setscrews and the cap screws and washers which retain the housing (A11) for the rear oil seals and remove the housing. Clean the joint faces of the seal housing and cylinder block.

https://truckmanualshub.com/

To fit

1 Clean the crankshaft palm (14A.09/A8) and check for wear in the seal location areas. If there is wear, a "Speedi-Sleeve" (14A.13/A1), part number 21825188, can be fitted, see "To fit and remove a "Speedi-Sleeve". If a "Speedi-Sleeve" is not available the crankshaft palm can be machined to give a minimum diameter of 133,17 mm (5.243 in). Do not machine the last 2,5 mm (0.10 in) of the crankshaft palm as this is necessary for flywheel location. A "Speedi-Sleeve" must not be fitted if the crankshaft palm has been machined undersize.

2 Ensure that the dowels for the oil seal housing are fitted in the cylinder block. Put a new joint (14A.09/A10) in position on the dowels, no jointing compound is necessary.

3 Put the seal replacer tool, which is used for standard seals, on the crankshaft palm. Lubricate lightly the crankshaft palm, the seal replacer tool and the lip of the seals with clean engine lubricating oil.

4 Put the seal and housing assembly onto the seal replacer tool and carefully push the assembly onto the dowels. Remove the seal replacer tool, fit the setscrews and the cap screws together with their washers. Tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m and the cap screws to 13 Nm (10 lbf ft) 1,3 kgf m.

5 Fit a new "O" ring (14A.09/A6) in its recess in the seal housing and lightly lubricate it with clean engine oil.

6 Apply a suitable jointing compound to one side of a new cover joint to hold the joint in position. Put the joint in position on the flywheel housing. Put the cover into position on the joint and fit the setscrews. New setscrews have a sealant applied by the manufacturer. If these setscrews are to be used again, the threads of the setscrews and the threads in the flywheel housing must be cleaned. A suitable sealant, for example POWERPART Threadlock, must then be applied to the setscrew threads. Tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf. m.

7 Ensure that the location faces of the flywheel and crankshaft are clean and free from damage. Fit the flywheel and the setscrews together with their washers. Tighten the setscrews to 105 Nm (77 lbf ft) 10,7 kgf m.

8 If the starter motor is removed from the engine, clean the flange face of the starter motor and the face of the flywheel housing. Apply a 2,0 mm (0.080 in) continuous bead Silicone rubber sealant to the flange face of the starter motor near to the spigot before the starter motor is fitted.

Caution: *If the engine is to be operated before oil is added to the flywheel housing, the rear oil seal must not be fitted until after the engine has run.*

https://truckmanualshub.com/

To renew the rear oil seal - engines which have the standard seal 14A-03A

Special tools:

Replacer tool for rear oil seal, PD.145D

There are four positions in which the seal can be fitted in the housing (A).

Position "1" is used in the factory or if a new seal is fitted on a new or reground crankshaft in service.

Position "2" is used when a new seal is fitted in service and the crankshaft flange is worn in position "1".

Position "3" is used when a new seal is fitted in service and the crankshaft flange is worn in positions "1" and "2".

Position "4" can also be used with a new seal in service, if a wet clutch is not used and the crankshaft is new or the crankshaft palm area has been corrected. Ensure that the seal is fitted square in the housing.

If all positions have been used it is permissible to grind the crankshaft flange, see the data and dimensions.

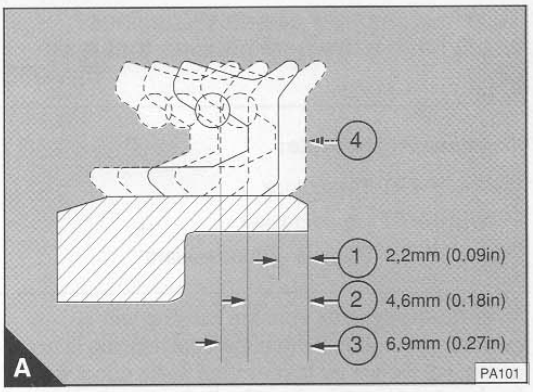
1 Remove the seal and housing assembly, operation 14A-02.

2 Put the engine side of the housing on a suitable support and press out the seal with a suitable adaptor.

3 Lubricate the outer circumference of the seal and the bore of the seal housing with clean engine lubricating oil.

4 Put the engine side of the housing on a suitable support and put the seal into position on the flywheel end of the bore with the spring of the seal towards the housing.

5 Press the seal into the housing to the correct position with the relevant side of the tool

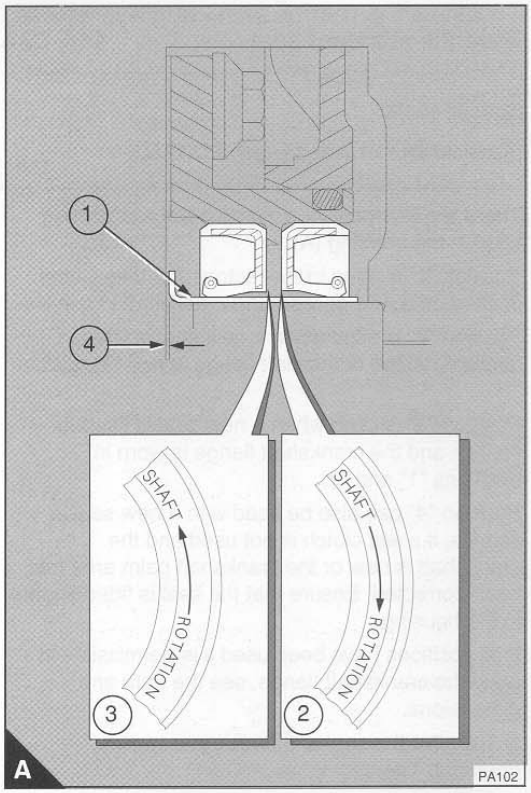


https://truckmanualshub.com/

To renew the rear oil seals - engines which have a flywheel housing that is oil filled 14A-03B

Consumable products:

Threadlock
Liquid gasket
Silicone rubber sealant



1 Remove the seals from the housing with a suitable lever. Ensure that the seal housing is not damaged. Do not try to press the seals out of the housing as there is a shoulder in the housing (A).

2 Clean thoroughly the oil seal housing. Inspect the oil seals for damage. If only a small scratch can be seen across the lip of the seal, do not fit the seal.

3 Before the oil seals are fitted into the housing ensure that the correct seal is fitted to the correct side of the housing. Each of the seals has an arrow (A2) and (A3) on the flat face of the seal. This arrow indicates the correct direction of shaft rotation for the seal.

4 Lubricate lightly the outer circumference of the front oil seal and the bore of the housing for the front seal with clean engine oil.

5 With the flywheel side of the seal housing on a suitable support, press the new front seal into the housing. Use a suitable tool which will apply pressure only to the flat inside face of the seal. Use only enough pressure to ensure that the flat face of the seal is against the shoulder in the housing. Too much pressure could damage the shoulder.

6 Lubricate lightly the outer circumference of the rear oil seal and the bore of the housing with clean engine oil.

7 With the engine side of the seal housing on a suitable support, carefully press the rear oil seal onto the shoulder in the housing with the same tool as for the front seal. Ensure that the seal is against the shoulder in the housing.

Caution: *The rear oil seal must not be fitted if the engine is to be operated before the oil is added to the flywheel housing. The seal must be fitted to the seal housing after the engine has been run.*

https://truckmanualshub.com/

To fit and remove a "Speedi-Sleeve"

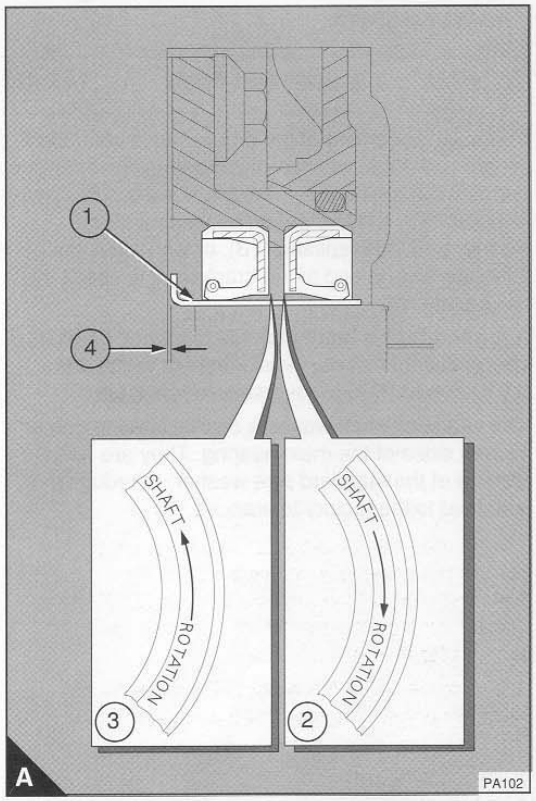
1 Clean the crankshaft palm and remove burrs or rough areas from the crankshaft palm.

2 Ensure that the sleeve (A1) is clean. Apply a narrow bead of Liquid gasket around the bore of the sleeve 5 mm (0.2 in) from the front face of the flange. The sleeve must be fitted not more than five minutes after the Liquid gasket has been applied.

3 Ensure that the crankshaft is fully forward. Use a suitable adaptor and a hammer to carefully drive the sleeve onto the crankshaft palm. The sleeve must be fitted with a clearance of 0,4/0,6 mm (0.016/0.024 in) between the rear face of the cylinder block and the front face of the sleeve flange (A4). Ensure that this clearance is equal all around the flange of the sleeve. Do not try to pull the sleeve backwards as damage could occur to the sleeve.

4 Fit a new joint for the oil seal assembly. Lubricate lightly the sleeve and the lip of the oil seals with clean engine oil and fit the assembly. Fit a new joint to the flywheel housing and fit the cover. Fit the flywheel.

5 To remove a sleeve, make a deep score with a sharp scriber along the full length of the sleeve. Insert the edge of a thin blade at the end of the score mark. Twist the blade to make a split along the score mark and pull the sleeve apart. If only the flange is removed, a recommendation of the sleeve manufacturer is to spread the sleeve. To do this use a small hammer and a suitable punch with a round end. Make one or more lines of small distortions across the full width of the sleeve. This should increase the diameter of the sleeve enough to enable its removal.



https://truckmanualshub.com/

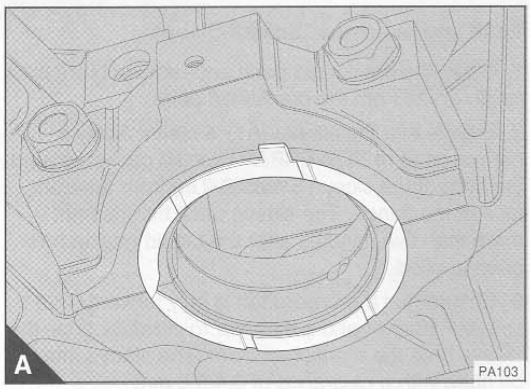
Thrust washers

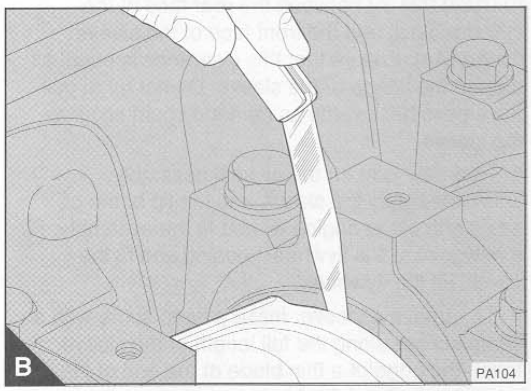
To check crankshaft end-float 14A-04

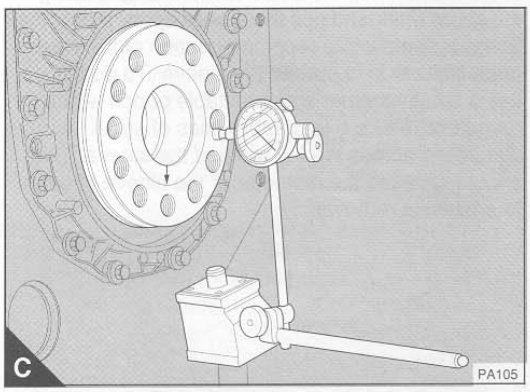
The axial movement of the crankshaft is controlled by two half thrust washers fitted both sides of the centre main bearing (A). The end-float can be checked with a feeler gauge between a thrust washer and the crankshaft (B), or with a dial test indicator on one end of the crankshaft to check the movement (C).

If the end-float is more than the tolerance given in data and dimensions, thrust washers which are 0,019 mm (0.0075 in) oversize can be fitted.

The oversize thrust washers can be fitted to one or to both sides of the main bearing. They are fitted instead of the standard size washer, to reduce the end-float to the factory tolerances.







https://truckmanualshub.com/

To remove and to fit 14A-05

To remove

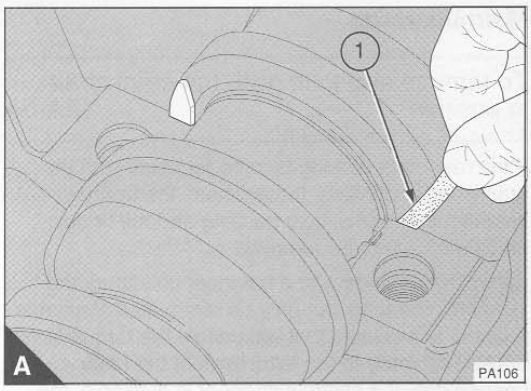
1 Drain the lubricating oil and remove the lubricating oil sump, operation 19A-03.

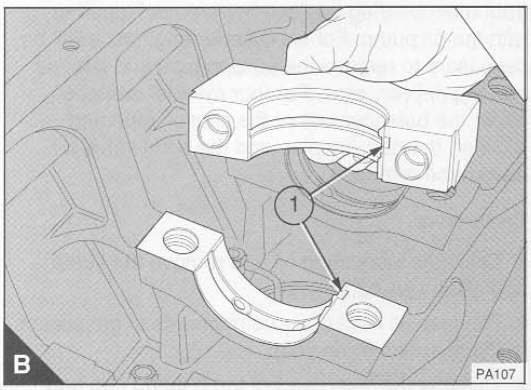
2 If necessary, remove the balancer unit, operation 14A-10.

3 If necessary, remove the lubricating oil strainer and suction pipe, operation 19A-04.

4 Release the setscrews of the centre main bearing and remove the main bearing cap complete with the lower half thrust washers.

5 Press down one end of each upper half thrust washer, with a suitable tool made of a soft material (A1), to slide the washer from its recess. Where necessary, move the crankshaft to the front or to the rear to loosen a tight washer.





To fit

1 Lubricate the thrust washers with clean engine lubricating oil.

2 Slide the upper half thrust washers into their recesses in the cylinder block. Ensure that the sides of the thrust washers which have the grooves are against the crankshaft.

3 Fit the lower half thrust washers to the main bearing cap with the location tags in their recesses.

4 Ensure that the location thimbles are fitted correctly in the main bearing cap or in the cylinder block.

5 Ensure that the bearing is fitted correctly in the cap and that the the bearing and the crankshaft journal are clean. Lubricate the bearing with clean engine lubricating oil.

6 Fit the cap with the location tags of both half of the shell bearings to the same side (B1). Tighten the main bearing setscrews gradually and evenly to 265 Nm (196 lbf ft) 27,0 kgf m for six cylinder engines. 250 Nm (185 lbf ft) 26,0 kgf m for four cylinder engines.

7 Check the crankshaft end-float, operation 14A-04.

8 If necessary, fit the balancer unit, operation 14A-10.

9 If necessary, fit the lubricating oil strainer and the suction pipe, operation 19A-04.

10 Fit the lubricating oil sump, operation 19A-03, and fill it to the correct level with an approved lubricating oil.

https://truckmanualshub.com/

Main bearings

To remove and to fit (with the crankshaft in position) 14A-06

If the rear main bearing is to be removed with the crankshaft in position, the flywheel, the flywheel housing, the rear oil seal housing and the bridge piece will have to be removed.

Except for engines with a balancer unit fitted, the front main bearing can only be removed if a suitable spanner is available that will enable the torque to be applied correctly to the setscrews of the main bearing cap. If a suitable spanner is available, the front main bearing cap can be removed together with the oil pump. For six cylinder engines, it will be necessary to remove the suction pipe and strainer and the delivery pipe. For four cylinder engines, either the balancer unit or the suction pipe and strainer, the delivery pipe and the relief valve will have to be removed.

To remove

1 Drain the lubricating oil and remove the sump, operation 19A-03.

2 Remove all necessary components to get access to the specific bearing cap.

3 Release the setscrews of the bearing cap and remove the bearing cap. Remove the lower half of the shell bearing from the cap.

4 With a suitable tool, push the upper half of the shell bearing from the side opposite to the location tag to remove the bearing tag from its recess in the bearing housing. Carefully rotate the crankshaft to release the bearing from its housing. Keep the bearing halves in their relevant positions.

https://truckmanualshub.com/

To fit

1 Clean the upper half of the shell bearing and lubricate the bearing surface with clean engine lubricating oil.

Caution: *Only the upper half of the bearing has lubrication holes and must be fitted to the side of the cylinder block.*

2 Fit the plain end of the upper half of the bearing between the crankshaft journal and the side of the bearing housing which has the recess for the location tag. Slide the bearing into its housing until the tag on the bearing is fitted correctly in its recess in the housing.

3 Clean the lower half of the bearing and cap, lubricate the bearing surface with clean engine lubricating oil.

4 Fit the bearing into the cap with the tag of the bearing fitted correctly in the recess in the cap.

5 Ensure that the location thimbles are fitted correctly to the cap or to the cylinder block. Fit the bearing cap with the location tags of both bearings on the same side (A1).

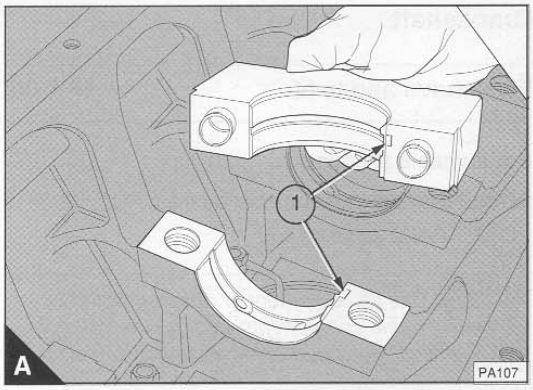
6 Inspect the setscrews for damage and for distortion and renew them if necessary. Lightly lubricate the setscrew threads with clean engine lubricating oil. Fit the setscrews and the washers and tighten the setscrews gradually and evenly to 265 Nm (196 lbf ft) 27,0 kgf m for six cylinder engines and 250 Nm (185 lb ft) 26,0 Kgf m for four cylinder engines.

Note: Washers are not fitted between the setscrews and the bearing caps on the latest engines.

7 Ensure that the crankshaft turns freely. If the thrust washers have been removed and fitted, check the crankshaft end-float, operation 14A-03.

8 Fit all the components which were removed for access to the main bearing cap.

9 Fit the lubricating oil sump, operation 19A-03 and fill it to the correct level with an approved lubricating oil.



To inspect 14A-07

Inspect the bearings for wear and for other damage. If a bearing is worn or damaged, renew both half of the shell bearings and check the condition of the other bearings.

https://truckmanualshub.com/

Crankshaft

To remove and to fit **14A-08**

Consumable products:

Silicone rubber sealant
liquid gasket

Warning! *Use lift equipment or obtain assistance to lift heavy engine components such as the balancer unit, flywheel housing, crankshaft and flywheel.*

To remove

1 Before the engine is removed from the vehicle or from the machine, drain the lubricating oil and the coolant.

2 Remove the lubricating oil sump, operation 19A-03.

3 Remove the fan, the drive belts, the fan drive pulley and housing and the coolant pump, see section 21.

4 Remove the crankshaft pulley, operation 14A-01A or 14A.01B.

5 Remove the alternator and its mounting bracket, see section 23.

6 Remove the compressor and its drive assembly or remove the exhauster, see section 24.

7 Remove the timing case cover, operation 15A-01.

8 Remove the fuel injection pump, see section 20.

9 Remove the timing gears and the timing case, see section 15.

10 Remove the flywheel and the flywheel housing, see section 22.

11 Remove the rear oil seal housing, operation 14A-02A or 14A.02B.

12 If a balancer unit is fitted, remove it, operation 14A-10. If a balancer unit is not fitted, remove the lubricating oil suction pipe and strainer, the lubricating oil pump, the delivery pipe and the relief valve (four cylinder engines) and the lubricating oil crossover pipe, if fitted, see section 19.

13 Remove the bridge piece and the rubber seals. Later engines may not have rubber seals fitted.

14 Remove the caps of the connecting rods. Keep the bearings and caps together. Remove the bolts of the connecting rods and carefully push the pistons into their bores.

https://truckmanualshub.com/

15 Ensure that the tops of the main bearing caps are stamped with their relevant position number. Remove the main bearing caps, the lower half of the shell bearings and the upper and lower thrust washers. Keep the bearings with their relevant caps.

16 Lift out the crankshaft. Remove the upper half of the bearings and keep each bearing with its relevant lower half and cap.

To fit

1 Ensure that all lubricating oil passages are clean and free from restriction.

2 Clean the main bearing housings and the upper half of the bearings. Fit the shell bearings with the location tags fitted correctly in their recesses. Lubricate the bearings with clean engine lubricating oil.

3 Ensure that the main journals of the crankshaft are clean. Put the crankshaft in position on the upper bearings.

4 Clean and lubricate the upper half thrust washers and slide them into their recesses on both sides of the bearing housing. Ensure that the slotted sides of the thrust washers are towards the crankshaft.

5 Clean the bearing caps and the lower half of the bearings. Fit the bearings to the caps with the location tags fitted correctly in their recesses. Lubricate the bearings with clean engine lubricating oil.

6 Clean the lower half thrust washers and lubricate them with clean engine lubricating oil. Fit the thrust washers on both sides of the bearing cap for the centre main bearing.

7 Check that the location thimbles for the main bearing caps are fitted correctly in the caps or in the cylinder block. Fit the bearing caps in their correct positions (as shown by the position number stamped on the top of the cap) with the location tags of the bearings on the same side. In this position the serial numbers stamped on the bearing caps will be in line. The serial number stamped on the bearing caps must be the same as the number stamped on the bottom face of the cylinder block. The third and fifth bearing caps of six cylinder engines are not stamped with a serial number.

https://truckmanualshub.com/

8 Fit the setscrews and the washers to the main bearing caps and tighten the setscrews gradually and evenly to 265 Nm (196 lbf ft) 27,0 kgf m for six cylinder engines and 250 Nm (185 lb ft) 26,0 kgf m for four cylinder engines.

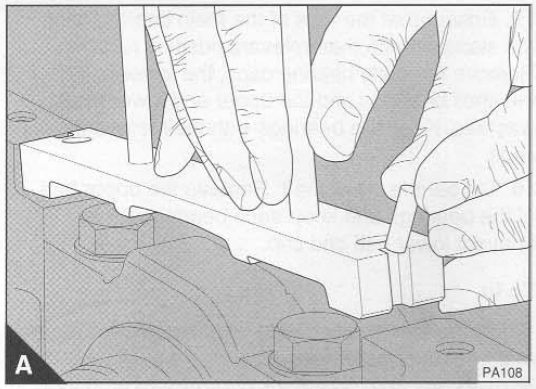
Note: Washers are not fitted between the setscrews and the bearing caps on the latest engines.

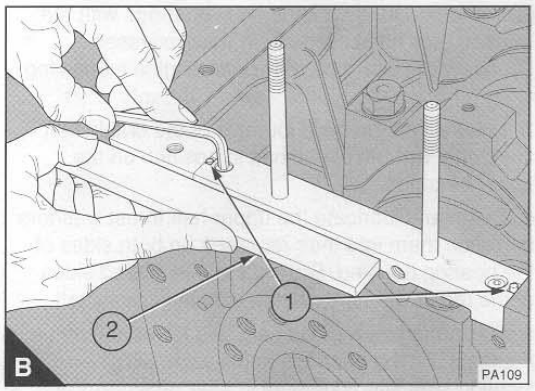
9 For early engines fitted with rubber seals: Clean the bridge piece and the location areas for the bridge piece in the cylinder block. Apply a narrow strip of POWERPART silicone rubber sealant in the corners and around the thread holes of the bridge piece seat in the cylinder block. Fit the bridge piece and the two rubber seals (A). The rubber seals will be a little higher than the bridge piece when they are fitted correctly. Use a straight edge (B2) to ensure that the bridge piece is in line with the rear face of the cylinder block. Tighten the bridge piece cap screws (B1) to 16 Nm (12 lbf ft) 1,6 kgf m.

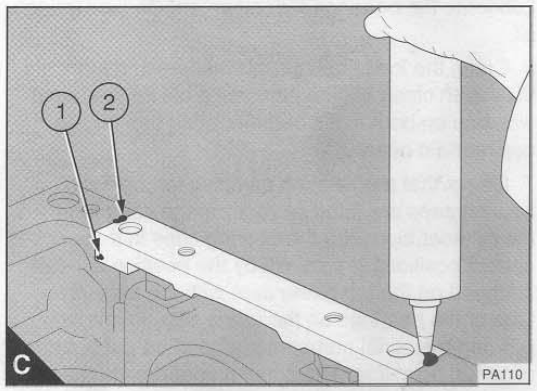
For later engines fitted with POWERPART liquid gasket: A bridge piece has been introduced which uses POWERPART liquid gasket instead of the rubber seal in the groove at each end of the bridge piece. The groove at each end of the new bridge piece is cast and is off-centre. The procedure to fit the new bridge piece is the same as for the earlier bridge piece, except for the instructions given below. Apply a 1/8 in (3.0 mm) bead of POWERPART liquid gasket along the corner in the top of the recess in the cylinder block for the bridge piece.

When the bridge piece is in position and the cap screws have been tightened, inject liquid gasket into the groove (C2) at each end of the bridge piece. Continue to inject sealant until the groove is completely full and the sealant leaves the lower groove (C1) at the front and rear of the bridge piece.

It may be necessary to stop the sealant at one side of the lower groove in order to ensure it will flow from the opposite side of the groove.







https://truckmanualshub.com/

Caution: *When the sump joint is removed, damage can occur to the seal in the grooves of the bridge piece. If the seal is damaged, apply sufficient sealant to completely fill the grooves.*

Note: Most of the latest engines have setscrews in place of studs to fasten the sump to the bridge piece. The threads of the setscrews have a sealant applied by the manufacturer. When the setscrews are to be used again, ensure that the threads of the setscrews and of the bridge piece are clean and a sealant is applied to the threads of the setscrews. These instructions would also apply to studs.

10 Fit the connecting rod caps, operation 13A-01. Rotate the crankshaft two turns to ensure free movement.

11 If necessary, fit the balancer unit, operation 14A-10. If a balancer unit is not used, fit the lubricating oil pump, the lubricating oil suction pipe and strainer, the delivery pipe and the relief valve (four cylinder engines) and if necessary, the lubricating oil crossover pipe, see section 19.

12 Fit the rear oil seal housing, operation 14A-02A or 14A-02B.

13 Fit the flywheel housing and the flywheel, see section 22.

14 Fit the timing case and the timing gears, see section 15.

15 Fit the fuel injection pump, see section 20.

16 Fit the timing case cover, operation 15A-01.

17 Fit the compressor and its drive assembly or fit the exhauster, see section 24.

18 Fit the alternator and its mounting bracket, see section 23.

19 Fit the crankshaft pulley, operation 14A-01A or 14A-01B.

20 Fit the coolant pump, the fan drive pulley and housing, the drive belts and the fan , see section 21.

21 Fit the lubricating oil sump, operation 19A-03.

22 After the engine has been installed, fill the lubricating oil sump to the correct level with an approved oil. Fill the cooling system.

To inspect 14A-09

Check the crankshaft for wear and other damage. The maximum permissible wear and ovality on the crankshaft journals and crank pins is 0,04 mm (0.0016 in).

The main journals and the crankpins of standard size crankshafts can be machined to 0,25mm (0.010 in), 0,50mm (0.020 in) or 0,75 mm (0.030 in) undersize on diameter, see the data and dimensions. Special undersize bearings are available.

If the seal has been used in all of the service positions, the crankshaft palm can be machined to remove the wear marks. Further information can be found in the data and dimensions.

https://truckmanualshub.com/

Signal panel (available for 4 cylinder wit unit pump engine)

To remove and to fit

To remove

1. Put the front end of the crankshaft downward vertically and sturdily.
2. Remove the locking screws of the signal panel.
3. At the symmetrical position near the center, slightly tap the signal panel from below to up at the symmetrical position with 2 copper rods but carefully not tap the tooth in outer rim of the signal panel until the signal panel loose. Carefully not damage the flange at the seventh crank.
4. Remove the signal panel.

To fit

1. Put the front end of the crankshaft downward vertically and sturdily.
2. Tap the location pins into the pinhole at the seventh crank of the crankshaft slightly and leave the location pins 3cm out of the hole; the head of the location pin shall not be deformed.
3. Align the center hole of the signal panel to the flange of the seventh crank; and align the location pinhole of the signal panel to the location pin and then push the signal panel fully onto the position.
4. Tap the signal panel along the rim with the copper rod and ensure the side of the signal panel sticks to the seventh crank closely.
5. Fit the locking screws of the signal panel.

https://truckmanualshub.com/

Balancer unit

To remove and to fit **14A-10**

To remove

1 Drain the lubricating oil from the sump and remove the sump, operation 19A-03.

Warning! *The weight of the unit is approximately 25 kg (55 lb).*

2 Provide a support for the balancer unit before release of the setscrews from the engine.

3 Release the setscrews and lower carefully the balancer unit. Make a note of the positions of the setscrews of different lengths.

To fit

1 Ensure that the contact faces of the cylinder block and of the balancer unit are clean and that the two thimbles (A1) are fitted correctly to the cylinder block.

2 Set the piston of number 1 cylinder to TDC, operation 17A-01.

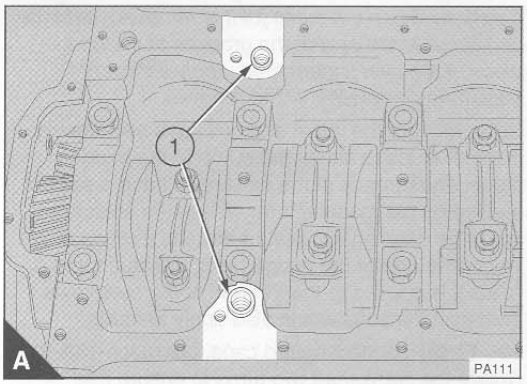
3 Before the balancer unit is fitted, ensure that the flat faces of the balance weights are level with each other (B1) and the weights hang down away from the cylinder block (B2). The timing of the balance weights to the drive shaft is correct when the large hole and small hole in the front of the drive shaft gear are in the positions shown in the illustration (B).

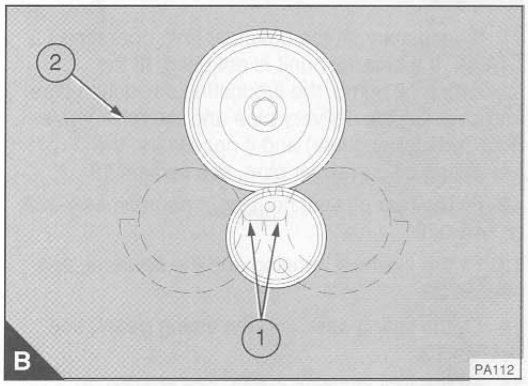
Note: If the gear position shown in (B) cannot be obtained, then the balancer must be partially dismantled and the timing corrected (14A.26/A).

4 Fit the balancer unit to the cylinder block with the correct screws in the centre positions of the balancer frame. Ensure, when the idler and crankshaft gears are in mesh, that the flat faces of the balance weight are level with each other and that they are towards the cylinder block. Check that the balancer unit is fitted correctly on the thimbles and fit the remainder of the setscrews in their correct position. Tighten the setscrews to 54 Nm (40 lbf ft) 5,5 kgf m.

5 Rotate the crankshaft through two turns to ensure that it is free to rotate.

6 Fit the lubricating oil sump, operation 19A-03 and fill the sump to the correct level with an approved oil.





https://truckmanualshub.com/

To dismantle and to assemble 14A-11

Consumable products:
Nutlock

To dismantle

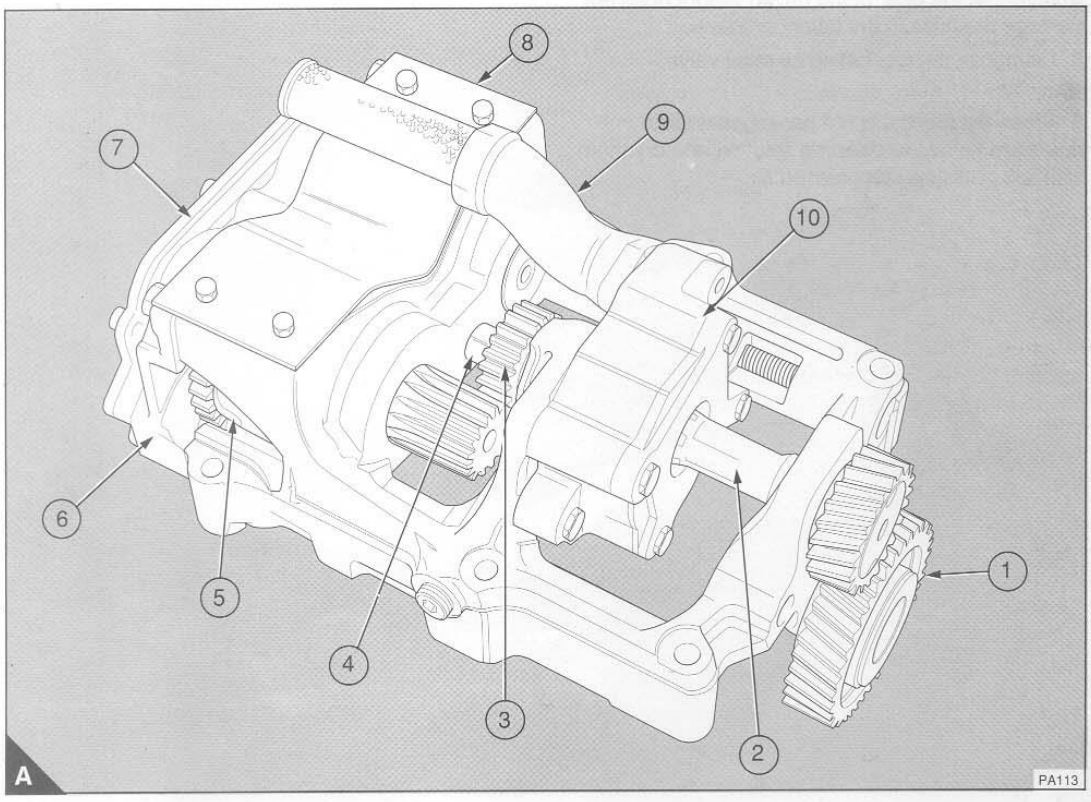
1 Remove the balance weight cover (A8).

2 Release the setscrew and remove the idler gear assembly (A1). Keep the components together as an assembly to protect the needle roller bearing.

3 Prevent movement of the drive shaft (A2) and loosen the nut (A4) of the drive gear for the balance weights (A3). Put a suitable flat distance piece in position between the nut and the balancer frame. Turn the nut until it is against the face of the distance piece. Continue to turn the nut with a suitable spanner until the Loctite seal on the splines of the drive shaft is broken and the gear is loose on the shaft. Remove the nut and the drive gear and remove the drive shaft. Ensure that the needle roller bearings are not damaged when the drive shaft is removed.

4 Release the setscrews which hold the lubricating oil pump and the suction pipe (A10 and A9) to the balancer frame and remove the lubricating oil pump and the suction pipe.

5 Release the setscrews and remove the transfer plate and joint for the lubricating oil (A7) from the rear of the balancer unit. Make a note of the position of the direction arrows on the outside of the transfer plate (14A.26/B or C) to ensure that it can be assembled correctly .



https://truckmanualshub.com/

Notes:

- The latest oil transfer plate is fitted without a joint or sealant; always give the correct engine number when spare parts are ordered.
- There are two plugs in the balancer frame, a short tapered plug with a hexagonal socket head and a long plug with a square socket head. These plugs control the flow of oil through the balancer frame. The position of the plugs is decided by which side of the engine the filter is fitted. When the filter is fitted on the left side, the short plug is fitted in the side of the balancer and the long plug is fitted in the bottom (14A.26/B). When the filter is fitted on the right side of the engine, the short plug is fitted in the bottom of the balancer and the long plug is fitted in the side (14A.26/C).

Caution: *Removal of these plugs can cause damage to the threads in the balancer frame and a new balancer frame would then be necessary. When a balancer unit is to be fitted, ensure that the lubricating oil flow through the balancer frame is correct for the position of the lubricating oil filter.*

6 Release the setscrews and remove the rear cover of the balancer frame (14A.23/A6). A hammer and a suitable drift will be necessary to remove the rear cover from the dowels.

7 Remove the balance weights (14A.23/A5). Ensure that the gear of the driven weight does not damage the bush in the balancer frame.

8 Dismantle the lubricating oil relief valve, operation 19A-09.

9 Clean the lubricating oil passages with an approved kerosene cleaning solution and dry them with low pressure compressed air.

https://truckmanualshub.com/

To assemble

1 Ensure that the location thimble (A8) in the rear of the lubricating oil pump is 5,6/6,4 mm (0.220/0.252 in) above the rear face of the pump. Clean the contact faces of the lubricating oil pump and the balancer frame. Fit the lubricating oil pump (A16) to the balancer frame and tighten the setscrews to 27 Nm (20 lbf ft) 2,8 kgf m.

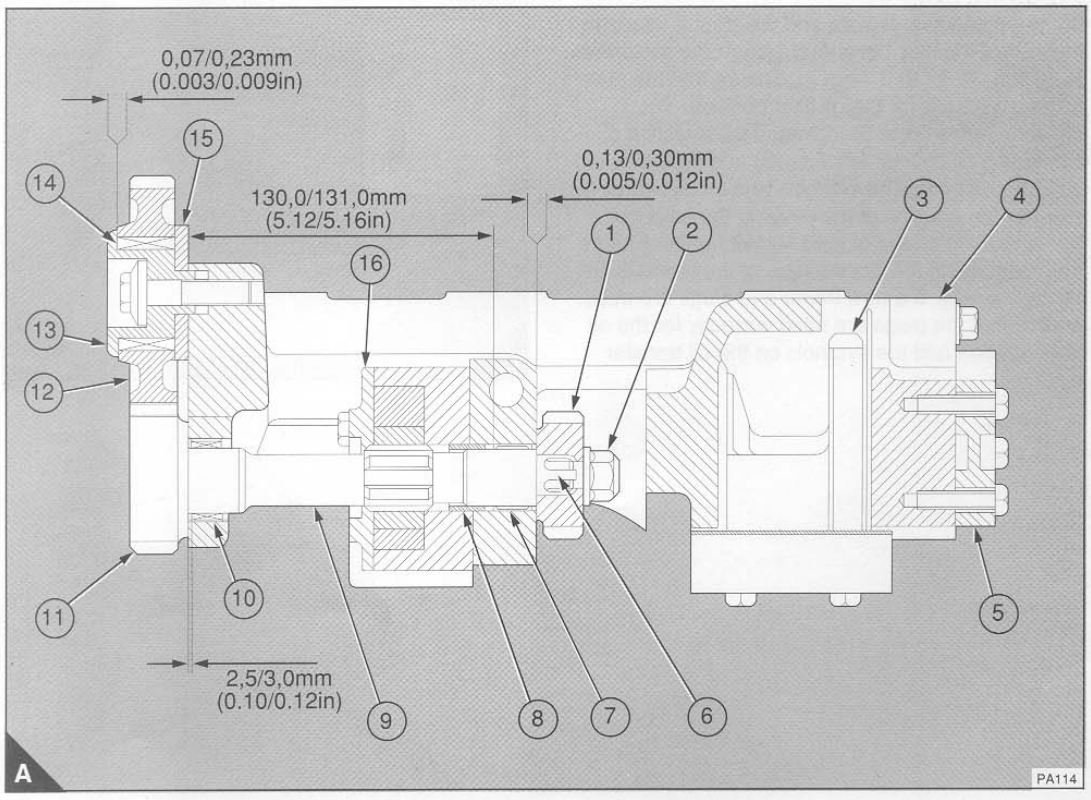
Note: The latest balancers do not have a thimble for the oil pump location. The location of the latest oil pump is by a spigot on the rear face of the pump.

2 Assemble the lubricating oil relief valve, operation 19A-09.

3 Lubricate the needle roller bearings (A7 and A10) with clean engine lubricating oil. Fit the drive shaft (A9) and engage the splines for the lubricating oil pump with the pump rotor. Ensure that the needle roller bearing at the front of the balancer frame is not damaged by the splines on the drive shaft.

4 Clean and dry the splines (A6) and the thread on the end of the drive shaft. Apply a small amount of Loctite Nutlock to the splines and to the thread. Fit the drive gear of the balance weights (A1) with the flat face of the gear towards the rear of the balancer unit. Fit and tighten the nut (A2) to 82 Nm (60 lbf ft) 8,4 kgf m. To tighten the nut, a peg spanner must be made to fit into the two holes in the front of the drive shaft and be suitable for use with a torque wrench. Fit the peg spanner to the front of the drive shaft. Hold the nut with a suitable spanner and apply the torque to the peg spanner.

5 Ensure that the drive shaft turns freely. Check the end-float of the drive shaft with feeler gauges between the front face of the drive gear for the balance weights and the frame (A).

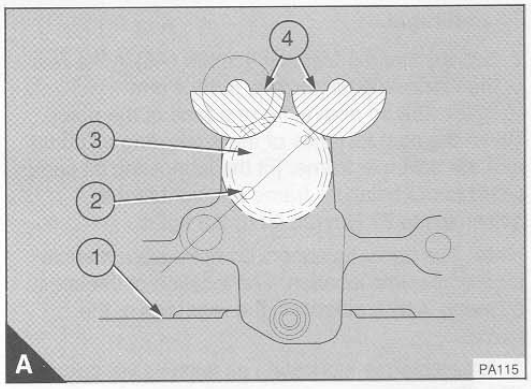


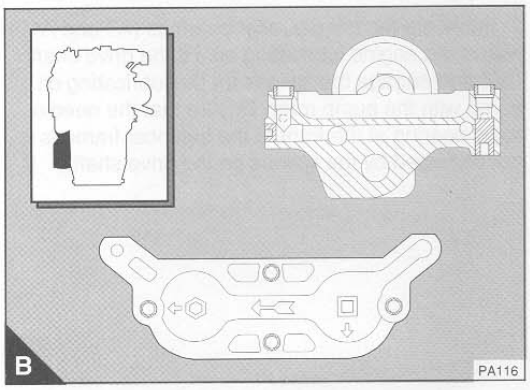
https://truckmanualshub.com/

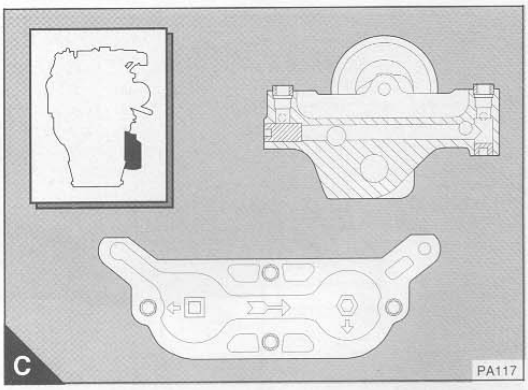
6 Put the balancer frame upside down on the bench (A1). Turn the gear of the drive shaft (A3) until the larger of the two outer holes (A2) - in the front face of the drive gear - is in the position shown in (A). Ensure that the drive shaft will not move from this position. Lubricate the bushes in the rear of the balancer frame with clean engine lubricating oil and fit the balance weights in the position shown in figure A. Ensure that the flats on the balance weights are level with each other (A4). With the balance weights in the correct position, check that the drive shaft is still in the correct position.

7 Fit the two dowels to the rear face of the balancer frame. Lubricate the bushes in the rear cover of the balance frame with clean engine lubricating oil. Put the rear cover (14A.24/A4) in position with the rear spigots of the balance weights in the bushes of the cover. Hit lightly the rear cover with a soft face hammer to fit the cover onto the dowels. Fit the cover setscrews and tighten them to 54 Nm (40 lbf ft) 5,5 kgf m. Check the end-float of the balance weights with feeler gauges between the rear face of the balance weights and the front face of the rear cover (14A.30/B). The correct end-float is given in the data and dimensions. Check the backlash between the drive gear of the balance weights and the driven gear on the balance weight. The correct backlash is given in the data and dimensions.

8 Fit the oil transfer plate and the joint, if fitted, to the rear of the rear cover and tighten the setscrews to 30 Nm (22 lbf ft) 3,1 kgf m. Ensure that the plate is fitted correctly for the oil filter position. The direction arrow (B or C) indicates the direction of lubricating oil flow for left side (B) and right side (C) oil filter positions. The symbols and arrows (B or C) indicate the position of the plugs in the balancer frame and the shape of their socket heads. Ensure that the plug on the bottom face of the frame is just below the face. If a new frame and plugs are used, ensure that the plugs are fitted correctly for the oil filter position and the symbols on the oil transfer plate.





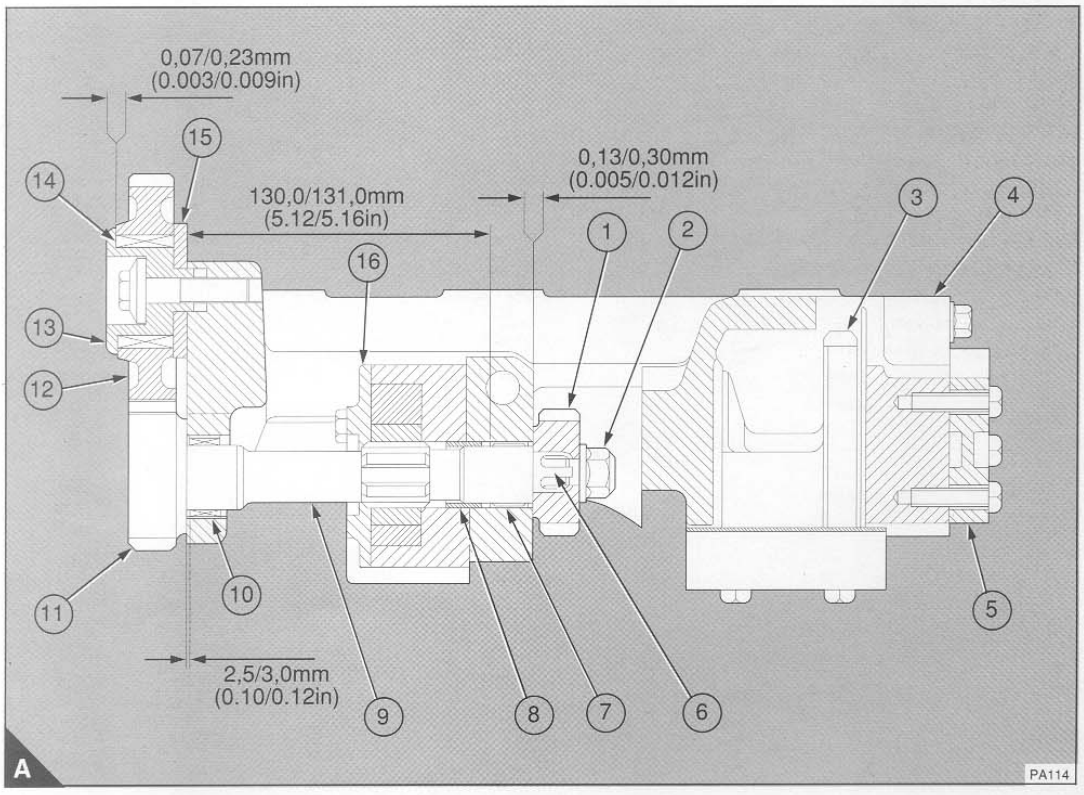


https://truckmanualshub.com/

9 If necessary, press a new bearing (A14) into the idler gear (A12). Lubricate the bearing with clean engine lubricating oil. Fit the hub (A13) into the bearing and fit the thrust washer (A15) onto the rear of the hub. Ensure that the threads of the setscrew are clean and dry. Fit the setscrew through the assembly and apply a small amount of Loctite Nutlock to the thread. Fit the assembly to the front of the balancer unit with the idler gear in mesh with the gear of the drive shaft (A11). Tighten the setscrew to 93 Nm (68 lbf ft) 9,5 kgf m. Check the end-float of the idler gear with a feeler gauge between the front face of the idler gear and the hub (A). Check the backlash between the idler gear and the drive shaft gear. The correct backlash is given in the data and dimensions.

10 Fit the balance weight cover and tighten the setscrews.

11 Fit the suction tube and the joint and tighten the setscrews.



https://truckmanualshub.com/

To inspect 14A-12

1 Clean all the components before inspection.

2 Check the gear teeth and the splines of the drive shaft for wear or other damage. Renew the drive shaft if necessary.

3 Check the idler gear, needle roller bearing, hub and thrust washer for wear or other damage. Renew the components if necessary.

4 Check the drive gear for the balance weights for wear or other damage. Renew the gear if necessary.

5 Check the balance weights for wear or other damage. If either balance weight is worn or damaged, both balance weights must be renewed.

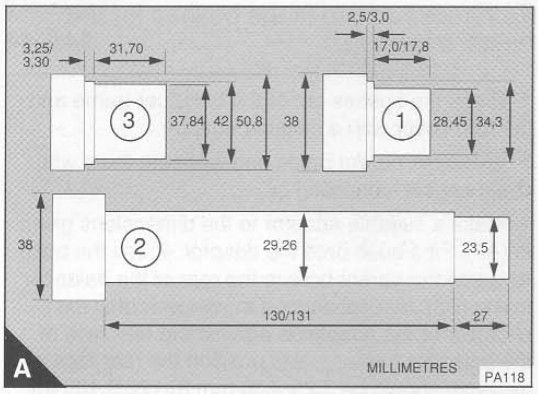
6 Check the needle roller bearings for the drive shaft for wear or other damage. Renew the bearings, operation 14A-13, if necessary.

7 Check the bushes for the balance weights for wear or other damage. Renew the bushes, operation 14A-14, if necessary.

8 To inspect the lubricating oil pump, see operation 19A-07.

https://truckmanualshub.com/

To remove and to fit the needle roller bearings for the drive shaft **14A-13**



1 Press out the bearings with a suitable adaptor.

2 Clean the parent bores and lubricate them with clean engine lubricating oil.

3 Make a suitable adaptor to the dimensions given in (A2). Fit the rear bearing (14A.24/A7) onto the adaptor with the stamped face of the bearing towards the shoulder of the adaptor. Press the bearing into the parent bore in a continuous movement until the shoulder of the adaptor is against the front face of the balancer frame. In this position the front face of the bearing should be 130,0/131,0 mm (5.12/5.16 in) from the front face of the balancer frame (14A.24/A).

4 Make a suitable adaptor to the dimensions given in (A1). Fit the front bearing (14A.24/A10) onto the adaptor with the stamped face of the bearing toward the shoulder. Press the bearing into the parent bore in a continuous movement until the shoulder of the adaptor is against the front face of the balancer frame. In this position the front face of the bearing should be 2,5/3,0 mm (0.01/0.12 in) from the front face of the balancer frame (14A.24/A).

https://truckmanualshub.com/

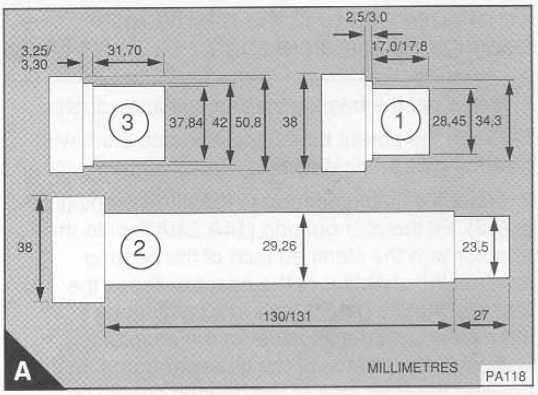
To remove and to fit the bushes for the balance weights 14A-14

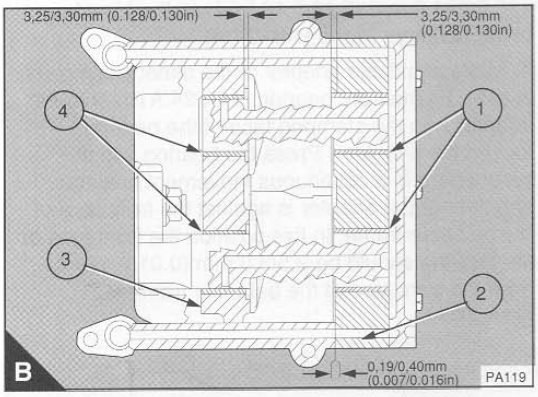
1 Press the bushes out of the balancer frame and the rear cover with a suitable adaptor.

2 Clean the parent bores and lubricate them with clean engine lubricating oil.

3 Make a suitable adaptor to the dimensions given in (A3). Fit a bush onto the adaptor. Press the bush (B4) into the parent bore in the rear of the balancer frame (B3), in a continuous movement, until the shoulder of the adaptor is against the rear face of the balancer frame. In this position the rear face of the bush should be 3,25/3,30 mm (0.128/0.130 in) from the rear face of the balancer frame (B). Repeat this operation for the other bush.

4 Fit a bush (B1) onto the adaptor and put it into position at the front end of one of the parent bores in the rear cover (B2). Press in the bush, in a continuous movement, until the shoulder of the adaptor is against the front face of the rear cover. In this position the front face of the bush should be 3,25/3,30 mm (0.128/0.130 in) from the front face of the rear cover (B). Repeat this operation for the other bush.





https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Crankshaft

Diameter of main journals:	
- Four cylinder engines	76,16/76,18 mm (2.998/2.999 in)
- Six cylinder engines	76,159/76,190 mm (2.9984/2.9996 in)
Maximum wear and ovality on journals and crank pins	0,04 mm (0.0016 in)
Width of front journal	36,93/37,69 mm (1.454/1.484 in)
Width of centre journal	44,15/44,22 mm (1.738/1.741 in)
Width of all other journals	39,24/39,35 mm (1.545/1.549 in)
Diameter of crank pins	63,47/63,49 mm (2.499/2.500 in)
Width of crank pins	40,35/40,42 mm (1.589/1.591 in)
Diameter of flange	133,27/133,37 mm (5.247/5.251 in)
Depth of recess for spigot bearing:	
- Four cylinder engines	20,22/20,98 mm (0.796/0.826 in)
- Six cylinder engines	14,72/15,48 mm (0.579/0.609 in)
Bore of recess for spigot bearing:	
- Four cylinder engines	46,96/46,99 mm (1.849/1.850 in)
- Six cylinder engines	51,97/51,99 mm (2.046/2.047 in)
Crankshaft end-float	0,05/0,38 mm (0.002/0.015 in)
Maximum permissible end-float	0,51 mm (0.020 in)
Fillet radii of journals and crank pins	3,68/3,96 mm (0.145/0.156 in)
Undersize journals and crank pins	-0,25 mm (-0.010 in); -0,51 mm (-0.020 in); -0,76 mm (-0.030 in).

Crankshaft heat treatment:

- Induction hardened	Part numbers 31315662, 31315992, 31315993 and 3131H024
- Nitrocarburised	Part numbers 31315661, 31315991 and 3131H022
- 60 hour Nitride	Part number 3131H021

Crankshaft overhaul

Notes:

- Induction hardened crankshafts need not be hardened after they have been machined undersize.
- Nitrocarburised crankshafts must be hardened again each time they are machined. These crankshafts must be nitrocarburised or, if this process is not available, they can be nitrided for 20 hours. If neither process is available a new crankshaft, or Power Exchange crankshaft, must be fitted.
- Crankshafts which have been nitrided for 60 hours can be reground 0,25 mm (0.010 in) without the need to harden them again.
- Check the crankshaft for cracks before and after it is ground. Demagnetise the crankshaft after it has been checked for cracks.
- After the crankshaft has been machined remove any sharp corners from the lubricating oil holes.
- Surface finish and fillet radii must be maintained.

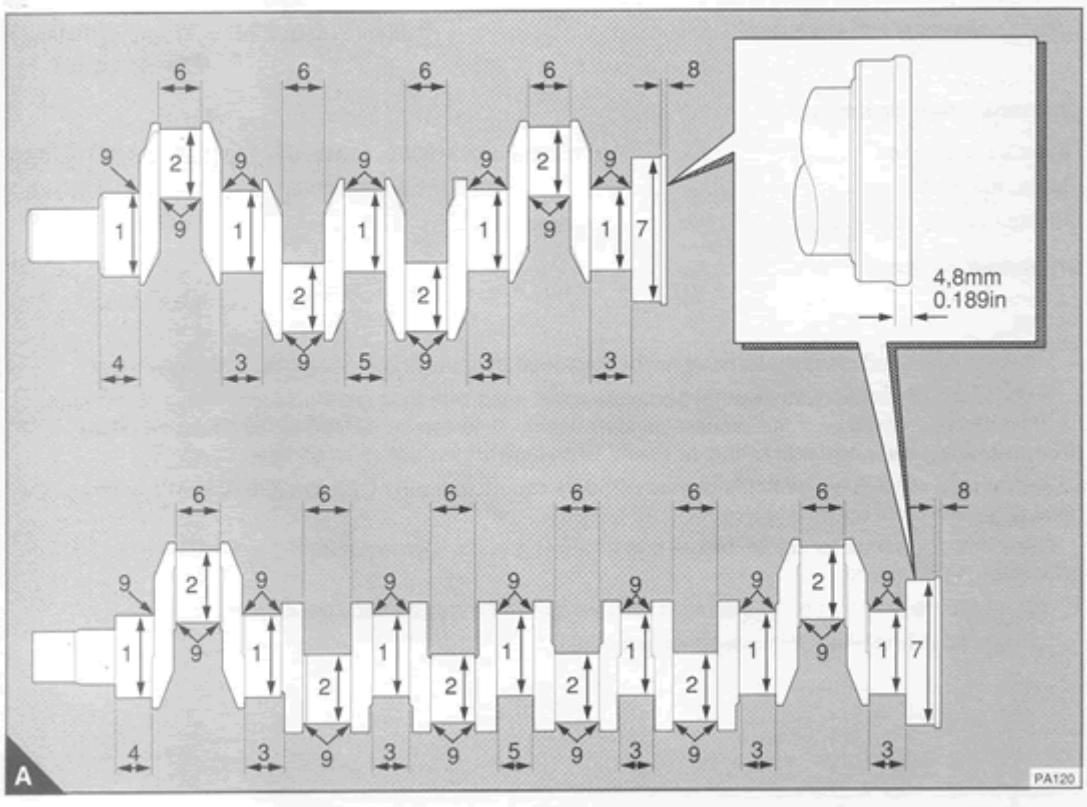
https://truckmanualshub.com/

The finished sizes for crankshaft journals (A) which have been ground undersize are given in the table below:

item	0,25 mm (0.010 in)	0,51 mm (0.020 in)	0,76 mm (0.030 in)
1	75,905/75,926 mm (2.9884/2.9892 in)	75,651/75,672 mm (2.9784/2.9792 in)	75,397/75,418 mm (2.9684/2.9692 in)
2	63,216/63,236 mm (2.4888/2.4896 in)	62,962/62,982 mm (2.4788/2.4796 in)	62,708/62,728 mm (2.4688/2.4696 in)
3	39,47 mm (1.554 in) maximum	-	-
4	37,82 mm (1.489 in) maximum	-	-
5	44,68 mm (1.759 in) maximum	-	-
6	40,55 mm (1.596 in) maximum	-	-
7	133,17 mm (5.243 in) minimum	-	-
8	Do not machine this diameter	-	-
9	3,68/3,96 mm (0.145/0.156 in)	-	-

OD of the Signal panel ·····. ···209. 95/210. 05 mm (8. 266/8. 270 inch)

Surface finish for journals, crank pins and fillet radii must be 0,4 microns (16 micro inches). Surface finish for seal area of crankshaft palm must be 0,4/1,1 microns (16/43 micro inches).



https://truckmanualshub.com/

With the crankshaft on mountings at the front and rear journals, the maximum run-out (total indicator reading) at the journals must not be more than shown below:

Journal	4 cylinder crankshafts	6 cylinder crankshafts
1	Mounting	Mounting
2	0,08 mm (0.003 in)	0,10 mm (0.004 in)
3	0,15 mm (0.006 in)	0,20 mm (0.008 in)
4	0,08 mm (0.003 in)	0,25 mm (0.010 in)
5	Mounting	0,20 mm (0.008 in)
6	-	0,10 mm (0.004 in)
7	-	Mounting

Run-out must not be opposite. The difference in run-out between one journal and the next must not be more than 0,10 mm (0.004 in).

Run-out on the crankshaft pulley diameter, rear oil seal diameter and the rear flange diameter must not be more than 0,05 mm (0.002 in) total indicator reading.

Main bearings

Four cylinder engines:

Type (All bearings) ..... Steel back, 20% tin-aluminium bearing material

Six cylinder engines:

Centre bearing and all Phaser 210Ti bearings ..... Steel back, lead bronze bearing material with lead finish

All other bearings ..... Steel back, 20% tin-aluminium bearing material

Bearing width

Four cylinder engines:

Centre bearing ..... 36,32/36,70 mm (1.430/1.445 in)

All other bearings ..... 31,62/31,88 mm (1.245/1.255 in)

Six cylinder engines:

Centre bearing ..... 36,32/36,70 mm (1.430/1.445 in)

All other bearings ..... 30,86/31,12 mm (1.215/1.225 in)

Bearing thickness at centre

Four cylinder engines:

All bearings ..... 2,083/2,089 mm (0.0820/0.0823 in)

Six cylinder engines:

Centre bearing and all Phaser 210Ti bearings ..... 2,087/2,096 mm (0.0822/0.0825 in)

All other bearings ..... 2,083/2,089 mm (0.0820/0.0823 in)

https://truckmanualshub.com/

Bearing clearance

Four cylinder engines:	
All bearings	0,057/0,117 mm (0.0022/0.0046 in)
Six cylinder engines:	
Centre bearing and all Phaser 210Ti bearings	0,035/0,110 mm (0.0014/0.0043 in)
All other bearings	0,047/0,117 mm (0.0018/0.0046 in)
Available undersize bearings	-0,25 mm (-0.010 in); -0,51 mm (-0.020 in); -0,76 mm (-0.030 in).

Crankshaft thrust washers

Type	Steel back, lead bronze bearing material
Position	Each side of centre main bearing
Thickness:	
- Standard	2,26/2,31 mm (0.089/0.091 in)
- Oversize	2,45/2,50 mm (0.096/0.098 in)

Balancer unit

Diameter of drive shaft for front bearing	28,562/28,575 mm (1.1245/1.1250 in)
Diameter of drive shaft for rear bearing	23,787/23,800 mm (0.9365/0.9370 in)
Number of teeth on gear of drive shaft	21
Backlash from gear of drive shaft to idler gear	0,17/0,29 mm (0.007/0.011 in)
End-float of drive shaft	0,13/0,30 mm (0.005/0.012 in)
Diameter of bore for front bearing of drive shaft	34,912/34,937 mm (1.3745/1.3755 in)
Diameter of bore for rear bearing of drive shaft	29,972/29,993 mm (1.1800/1.1808 in)
Diameter of bore for idler gear	47,64/47,65 mm (1.8755/1.8760 in)
Diameter of hub of idler gear	38,09/38,10 mm (1.4996/1.5000 in)
End-float of idler gear	0,07/0,23 mm (0.003/0.009 in)
Thickness of thrust washer for idler gear	4,14/4,29 mm (0.163/0.169 in)
Number of teeth on idler gear	37
Inside diameter of bushes in balancer frame and end cover (fitted)	38,133/38,174 mm (1.5013/1.5029 in)
Diameter of spigots for balance weights	38,054/38,069 mm (1.4982/1.4988 in)
Fit of spigot in bush	0,064/0,120 mm (0.0025/0.0047 in)
End-float of balance weights	0,19/0,40 mm (0.007/0.016 in)
Backlash of gears on balance weights	0,10/0,27 mm (0.004/0.011 in)
Backlash of drive gear to spline on balance weight	0,05/0,20 mm (0.002/0.008 in)
Number of teeth on drive gear	24
Number of teeth on spline on balance weight	16

https://truckmanualshub.com/

https://truckmanualshub.com/

Timing case and drive assembly 15

General description 15A.02

Timing case cover

15A-01 To remove and to fit 15A.03

Front oil seal

15A-02 To remove and to fit 15A.04

Idler gear and hub

15A-03A To remove and to fit 15A.06

Compressor idler gear

15A-03B To remove and to fit 15A.09

Fuel pump gear

15A-04 To remove and to fit 15A.11

Camshaft gear

15A-05 To remove and to fit 15A.13

Crankshaft gear

15A-06 To remove and to fit 15A.15

Timing case

15A-07 To remove and to fit 15A.16

Camshaft and tappets

15A-08 To remove and to fit 15A.19

Data and dimensions 15A.21

https://truckmanualshub.com/

General description

The timing case (A) is for engines fitted with a gear driven coolant pump. The timing case (B) is for engines fitted with a belt driven coolant pump. The timing case is made of either aluminium or cast iron.

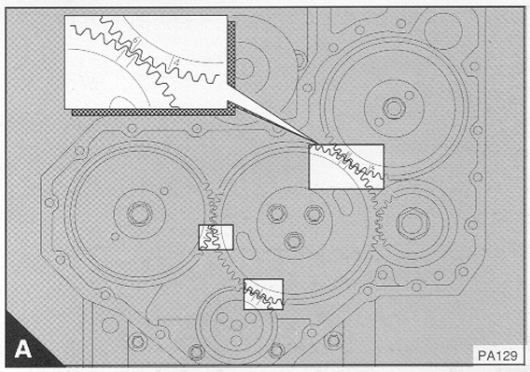
The timing gears on most engines are made of steel, but cast iron gears are used on certain low rated engines. A power take-off is available on the left side of the aluminium timing case or from both sides of the timing case made of cast iron. Some applications that require a power take-off from both sides of the timing case can have an idler gear assembly that uses needle roller bearings.

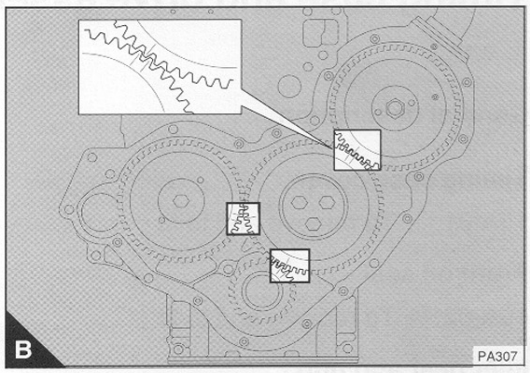
The drive from the crankshaft gear passes through an idler gear to the camshaft gear and to the gear of the fuel injection pump. The drive from the crankshaft gear also passes through a lower idler gear to the gear of the lubricating oil pump or, on some four cylinder engines, to the gear of the balancer unit. The gear driven coolant pump is driven by the gear of the fuel injection pump. The camshaft and the fuel injection pump run at half the speed of the crankshaft.

The aluminium cover of the timing case contains the front oil seal; this is made of vitonand has a dust lip in front of the main lip. On most engines the cover has a noise shield fitted to its front face.

Warning! *read the safety precautions for "Viton" seals on page 10A.08.*

The camshaft is made of cast iron. The cam lobes and the eccentric for the fuel lift pump are chill hardened.





https://truckmanualshub.com/

Timing case cover

To remove and to fit **15A-01**

To remove

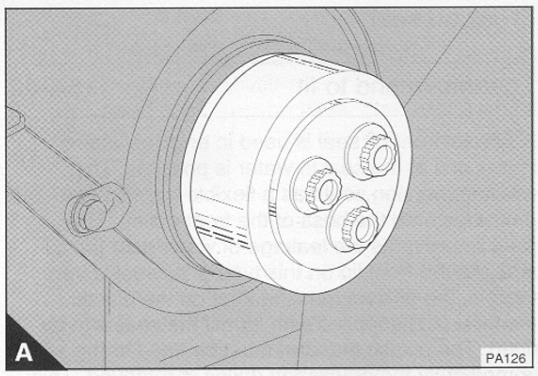
1 Remove the fan, operation 21A-04.

2 Remove the alternator, operation 23A-04.

3 Remove the crankshaft pulley, operation 14A-01.

4 Drain the coolant and remove the coolant pump, see section 21.

5 Release the setscrews and nuts of the cover and remove the cover. There is no need to remove the noise shield from the cover.



To fit

Special tools:

Centralising tool, PD. 163A (6 cylinder engines)

Centralising tool, PD. 162B (4 cylinder engines)

1 Clean the faces of the timing case cover.

2 Put the cover and a new joint in position on the timing case. Loosely fit two setscrews which are in opposite locations to hold the cover in position. Fit the centralising tool in the oil seal housing (A) and use the special washer and the crankshaft pulley setscrews to put the cover in its correct position. Do not overtighten the setscrews. Fit the remainder of the setscrews and nuts and tighten all of the cover fasteners to 22 Nm (16 lbf ft) 2,2 kgf m. Remove the centralising tool.

Caution: *It is important that the cover of the timing case is centred correctly. If the cover is not centred, the backlash between the fuel pump gear and coolant pump gear could be affected. This could cause the seizure of the fuel injection pump.*

3 Fit the coolant pump, see section 21.

4 Fit the crankshaft pulley, operation 14A-01.

5 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

6 Fit the fan, operation 21A-04.

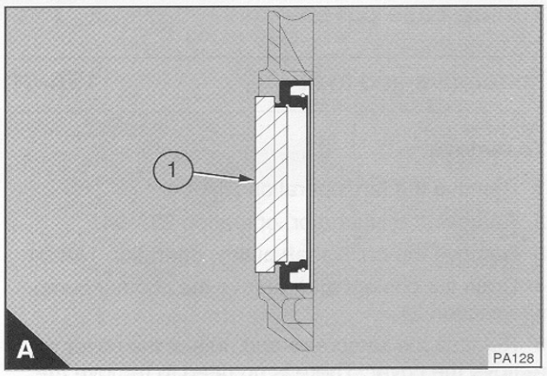
7 Fill the cooling system.

https://truckmanualshub.com/

Front oil seal

To remove and to fit **15A-02**

A special front oil seal is used in engines where immersion of the seal in water is possible. The water immersion seal has a flexible front lip that protrudes onto the boss of the front pulley. This front lip prevents the leakage of water past the oil seal. As the front lip on this type of oil seal is very flexible, the oil seal must be kept on the plastic mandrel (A1) supplied with it until the seal is to be fitted. The plastic mandrel must be fitted to the seal immediately the crankshaft pulley is removed. This will ensure that the front lip of the seal will keep its correct shape.



To remove

1 Remove the fan, operation 21A-04 and the drive belts, operation 23A-03.

2 Remove the crankshaft pulley, operation 14A-01.

3 Remove the oil seal with a suitable lever behind the main lip of the oil seal. Do not damage the edge of the oil seal housing.

To fit

Special tools:

Replacer tool for front oil seal (main tool), PD170

Pressure plate for use with PD.170, PD170-1

Sleeve for use with PD.170, PD170-2

Fastener plate for use with PD.170, PD170-3

Adaptor for standard seal for use with PD.170, PD170-4

Adaptor for water immersion seal for use with PD.170, PD170-8

The standard seal is fitted to a depth of 6,75/7,25 mm (0.266/0.285 in) from the front face of the oil seal housing to the flat front face of the oil seal. If, in service, there is wear in the seal location area of the crankshaft pulley, the oil seal can be fitted to a depth of 9,3 mm (0.366 in). The water immersion seal is fitted to a depth of 8,85/9,35 mm (0.348/0.368 in) and there is no service position.

https://truckmanualshub.com/

1 Clean the oil seal housing. Inspect the new seal for damage. If a scratch can be seen across the lip of the seal, do not fit the seal.

2 Lubricate the outer circumference of the oil seal with clean engine lubricating oil and enter the seal into the housing. Ensure that the spring loaded lip of the oil seal is towards the inside of the timing case cover and that the oil seal is square to the bore of the seal housing. When a water immersion seal is to be fitted, keep the plastic mandrel (B1) in position until it is time to fit the adaptor PD.170-8.

3 Assemble the oil seal replacing tool (A). Fit the fastener plate, PD.170-3, (A3) to the front of the crankshaft. For the standard seal, put the adaptor, PD.170-4, (A5) on the nose of the crankshaft and against the seal. Ensure that the adaptor has the side stamped 9,3 mm towards the seal. When a water immersion seal is to be fitted, remove the plastic mandrel from the seal and fit the adaptor PD.170-8, (A6). When the adaptor is fitted, ensure that the front lip of the seal is fully onto the taper of the adaptor.

Note : The other side of adaptor PD.170-8 can also be used to fit the standard seal.

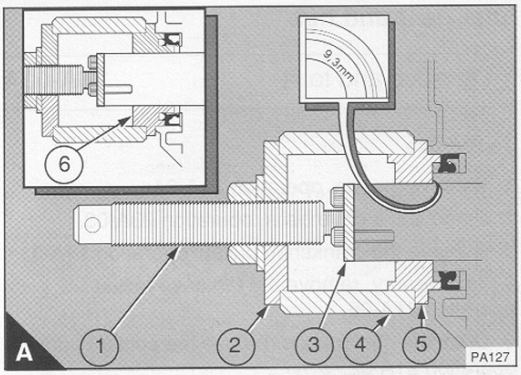
Assemble the pressure plate, PD.170-1, (A2) together with the sleeve, PD.170-2, (A4) onto the threaded bar, PD.170, (A1). Put the tool assembly in position on the adaptor, PD.170-4 or PD.170-8, and tighten the threaded bar onto the stud of PD.170-3 (A3).

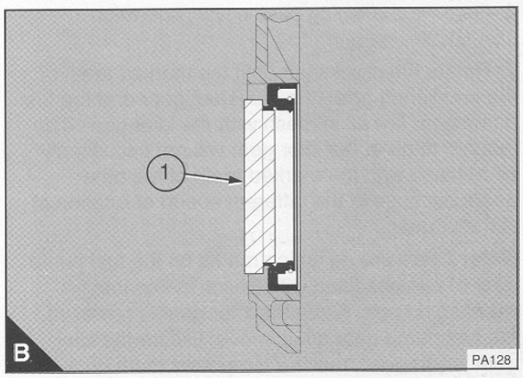
Fit a rod through the hole in the end of the threaded bar to prevent movement of the bar when the nut is tightened. Tighten the nut to push the seal into the housing to the correct depth. If the standard seal is to be pushed in to the service position, turn the nut until the face of PD.170-4 is against the face of the seal housing. If a water immersion seal is to be fitted, the adaptor, PD.170-8, should also be pushed fully onto the face of the seal housing.

4 Remove the replacing tool and lightly lubricate the seal location area of the crankshaft pulley with clean engine lubricating oil. Fit the crankshaft pulley, operation 14A-01. If a water immersion seal has been fitted, either leave the adaptor in position or fit the plastic mandrel until the crankshaft pulley can be fitted.

5 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

6 Fit the fan, operation 21A-04.

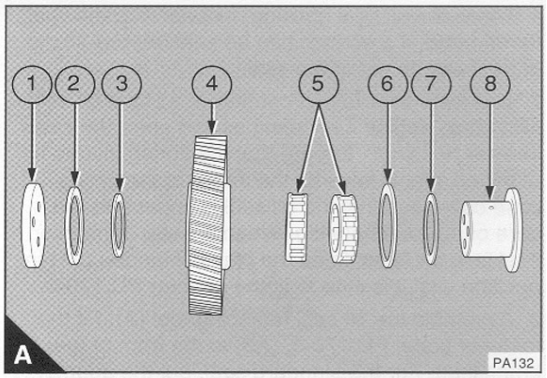




https://truckmanualshub.com/

Idler gear and hub

To remove and to fit **15A-03A**



To remove

1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 Drain the coolant and remove the coolant pump, operation 21A-02.

6 Remove the timing case cover, operation 15A-01.

7 Rotate the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

Note: There are no timing marks on the fuel pump gear of engines fitted with Bosch in-line fuel injection pumps. When the idler gear is removed, the fuel pump gear could move. Before the idler gear is removed, make a temporary mark on a tooth of the fuel pump gear to align with a similar mark on the timing case. It is not necessary to mark the fuel pump gear if it is to be removed, as the timing of the fuel pump will be lost.

8 Release the three setscrews, remove the plate of the idler gear and remove the gear. The drive gear of the fuel injection pump may rotate counter-clockwise when the idler gear is removed.

9 Remove the idler gear hub.

Caution: *Do not turn the crankshaft with the idler gear removed.*

10 For engines that use the idler gear assembly with needle roller bearings - Release the three setscrews, remove the plate of the idler gear (A1). Remove the front thrust washer (A2), the front spacer (A3) and the gear (A4). Remove the two needle roller bearings (A5), if these are to be used again, they should be fitted in their original positions. Remove the rear thrust washer (A6) and the rear spacer (A7). Remove the hub (A8).

https://truckmanualshub.com/

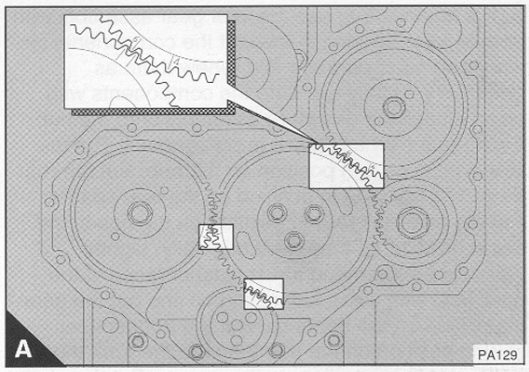
11 Inspect the gear and the bushes for wear and other damage and renew as necessary. The gear and bushes are available as an assembly or separate bushes are available.

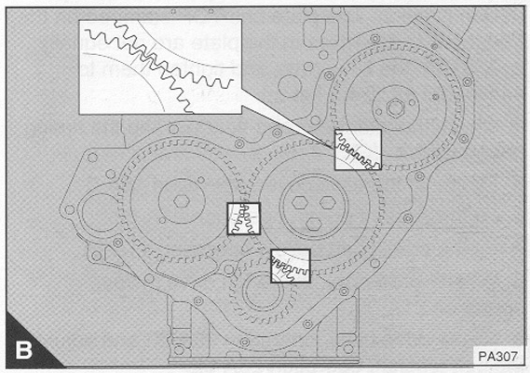
12 If the bushes are to be changed, remove them with a suitable puller. If a puller is not available, machine off the face of one of the bushes and press them out. Press in new bushes, machine the bores to get the correct clearance on the hub and machine the faces to get the correct end clearance, see the data and dimensions.

To fit

1 Use the three idler gear setscrews to ensure the correct position of the idler gear hub with the lubrication hole at the top. Push the hub into position and remove the setscrews.

2 Lubricate the idler gear bushes with clean engine lubricating oil. Align the timing marks on the idler gear with the marks on the crankshaft and camshaft gears. If necessary, rotate the gear of the fuel injection pump clockwise to align the relevant timing mark with the marks on the idler gear and slide the idler gear into position. On engines with gears which do not have timing marks align the temporary mark on the fuel pump gear with the mark on the timing case before the idler gear is fitted. Remove the marks on the fuel pump gear and the timing case after the idler gear has been fitted. Check that all the timing marks are in correct mesh (A), or (B) for engines fitted with a belt driven coolant pump. Fit the plate and the setscrews to the idler gear hub and tighten the setscrews to 44 Nm (33 lbf ft) 4,5 kgf m.





https://truckmanualshub.com/

3 For engines that use the idler gear assembly with needle roller bearings - Inspect the components for wear and other damage and renew them as necessary. Lightly lubricate the components with clean lubricating oil before assembly onto the hub. Fit the hub (A8) as shown in paragraph 1. Put the rear spacer (A7) in position on the hub. Put the rear thrust washer (A6) in position on the rear spacer. Put the bearings (A5) in position on the hub in the same position as they were originally. Lightly lubricate the bore and thrust washer faces of the gear (A4) with clean lubricating oil and put the gear in position on the bearings. Put the front spacer (A3) in position on the hub then put the front thrust washer (A2) in position on the spacer. Put the plate (A1) in position. The plate has TOP stamped on the front face as the holes in the plate are not equally spaced. Fit the setscrews and tighten them to 44 Nm (33 lbf ft) 4,5 kgf m).

4 Check the idler gear end-float (B) and the timing gear backlash (C).

5 Fit the timing case cover, operation 15A-01.

6 Fit the coolant pump, operation 21A-02.

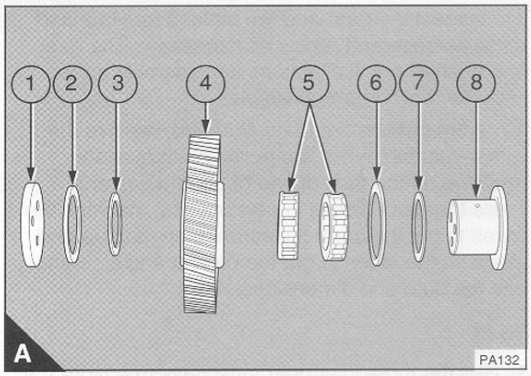
7 Fit the crankshaft pulley, operation 14A-01.

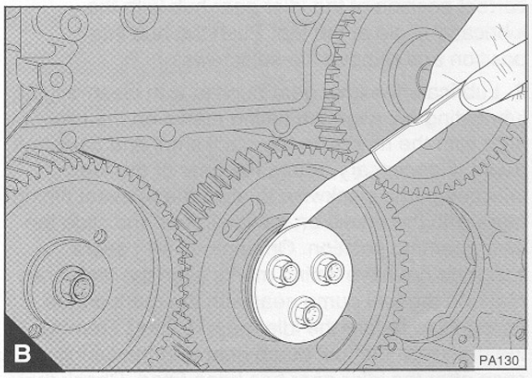
8 Where necessary, fit the fan drive pulley, operation 21A-05.

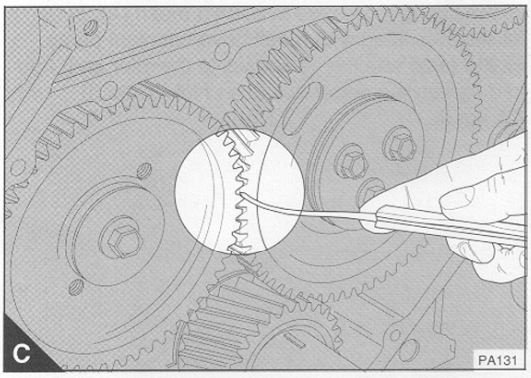
9 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

10 Fit the fan, operation 21A-04.

11 Fill the cooling system.





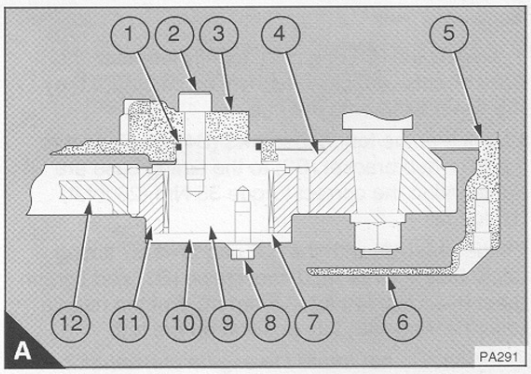


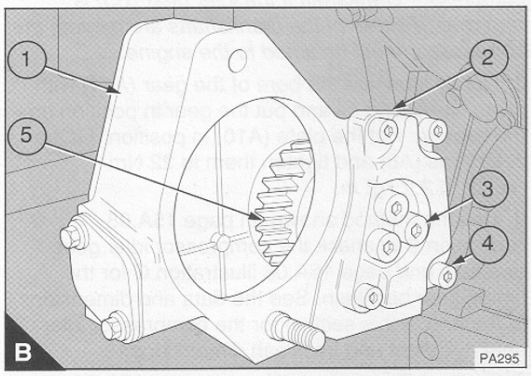
https://truckmanualshub.com/

Idler gear and hub for the compressor

The latest compressor is driven directly from the engine timing case and does not have an auxiliary drive assembly. The engine idler gear (A12) drives the compressor gear (A4) through a separate idler gear (A11/B5) fitted onto a hub (A9). The hub is fastened to the back of the timing case (A5) by a bracket (A3).

The idler gear is fitted on a needle roller bearing (A7) which is fitted onto the hub. The hub has an "O" ring (A1) to prevent oil leakage from the rear of the timing case. The roller bearing and the idler gear are retained on the hub by a plate (A10) which is fastened to the idler hub.





To remove and to fit **15A-03B**

To remove

1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 Drain the coolant and remove the coolant pump, operation 21A-02.

6 Remove the timing case cover (A6), operation 15A-01.

7 Set the piston of number 1 cylinder to TDC, operation 17A-01A/B or 17B-01A/B.

Caution: *Do not rotate the engine crankshaft or the compressor crankshaft if the idler gear is removed. If either of the crankshafts are moved, the compressor must be timed to the engine.*

8 Release the three setscrews (A8). Remove the plate (A10) which retains the idler gear (A11). Remove the gear and the needle roller bearing (A7) from the idler hub (A9).

9 Remove the three cap screws (B3) which fasten the idler hub to the bracket (B2) at the rear of the timing case (B1). Remove the idler gear hub.

10 Remove and discard the "O" ring (A1).

11 Inspect the idler gear, needle roller bearing and idler gear hub for wear and other damage and, if necessary, renew them.

https://truckmanualshub.com/

To fit

1 Renew the "O" ring (A1). Lightly lubricate the components with clean lubricating oil before they are assembled onto the hub.

Check that the four capscrews (B4) which secure the idler hub bracket (B2) to the timing case are tightened to the correct torque 35 Nm (26 lbf ft) 3,5 kgf m.

Fit the hub (A9) with the "O" ring towards timing case. Fit the three M10 capscrews (B3) and tighten them to 60 Nm (44 lbf ft) 6 kgf m). Put the needle roller bearing (A7) into position on the hub.

Caution: *Do not rotate the engine crankshaft or the compressor crankshaft if the idler gear (B5) is removed. If either of the crankshafts are moved, the compressor must be timed to the engine.*

2 Lightly lubricate the bore of the gear (A11) with clean lubricating oil and put the gear in position on the bearing. Put the plate (A10) in position. Fit the setscrews (A8) and tighten them to 22 Nm (16 lbf ft) 2,2 kgf m.

3 Use the method shown on page 15A.08 illustration B to check the compressor idler gear end-float and page 15A.08 illustration C for the timing gear backlash. See the data and dimensions at the end of this section for the compressor idler gear end-float and backlash dimensions.

4 Fit the timing case cover, operation 15A-01.

5 Fit the coolant pump, operation 21A-02.

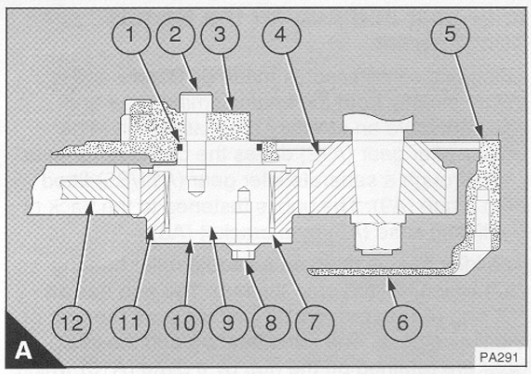
6 Fit the crankshaft pulley, operation 14A-01.

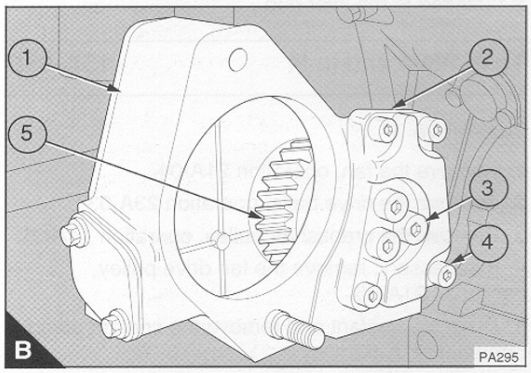
7 Where necessary, fit the fan drive pulley, operation 21A-05.

8 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

9 Fit the fan, operation 21A-04.

10 Fill the cooling system.





https://truckmanualshub.com/

Fuel pump gear

To remove and to fit **15A-04**

To remove

Special tools:

Gear puller, PD.155C

Adaptors for use with PD.155C, PD.155B-5

1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 For gear driven coolant pumps: Drain the coolant and remove the coolant pump, operation 21A-02.

Note: It is not necessary to remove the coolant pump, when the pump is belt driven.

6 Remove the timing case cover, operation 15A-01.

Caution: *For fuel injection pumps fitted with a locking screw. Check that the shaft of the fuel injection pump is not locked, see operations 20D-06B.*

7 Rotate the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

8 Remove the nut and the spring washer from the fuel pump gear.

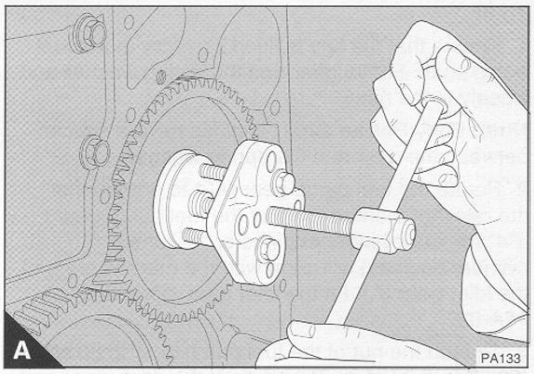
Notes:

- Early Phaser 210 Ti engines have a spacer between the gear and the spring washer.
- On certain engine types where the gear is retained by a plate and four cap screws, release the four cap screws and remove the plate and then the gear. Ensure that the plate does not fall when the cap screws are removed.

9 Remove the idler gear, operation 15A-03.

10 Remove the fuel pump gear with the puller and the adaptors (A). Ensure that the key in the fuel pump shaft is not lost.

11 Inspect the gear for wear and other damage and renew it, if necessary.



https://truckmanualshub.com/

To fit

1 Ensure that the key is fitted correctly in the fuel pump shaft. Fit the gear and the spring washer and loosely fit the nut.

Note: Early Phaser 210Ti engines have a spacer between the gear and the spring washer.

2 Rotate the fuel pump gear (A2) to ensure that the relevant marked tooth of the fuel pump gear ("4" for four cylinder engines or "6" for six cylinder engines) will align with the marked teeth of the idler gear (A). Fit the idler gear, operation 15A-03.

3 Tighten the nut of the fuel pump gear to 80 Nm (59 lbf ft) 8,2 kgf m. The teeth of the drive gear and the idler gear should be fully in mesh when the fuel pump gear is tightened onto the hub of the fuel injection pump.

Note: On engines fitted with in-line fuel injection pump, the pump must be put in the static timing position, see the data and dimensions, before the gear is fitted. For early engines: When the gear is fitted, ensure that the B marked on the gear is to the front. For the latest engines: Ensure that the letter C (A1) and the last four digits of the part number marked on the gear are to the front.

4 If a new gear has been fitted, check the backlash.

5 Fit the timing case cover, operation 15A-01.

6 For gear driven coolant pumps: Fit the coolant pump, operation 21A-02.

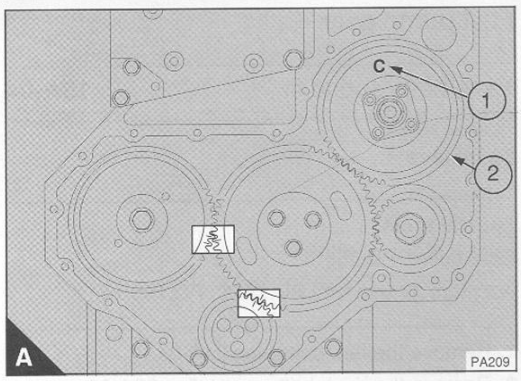
7 Fit the crankshaft pulley, operation 14A-01.

8 If necessary, fit the fan drive pulley, operation 21A-05.

9 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

10 Fit the fan, operation 21A-04.

11 Fill the cooling system.



https://truckmanualshub.com/

Camshaft gear

To remove and to fit **15A-05**

To remove

Special tools:
Gear puller, PD.155C
Adaptors for use with PD.155C, PD.155B-5

1 Remove the fan, operation 21A-04.

2 Remove the drive belts 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 Drain the coolant and remove the coolant pump, operation 21A-02.

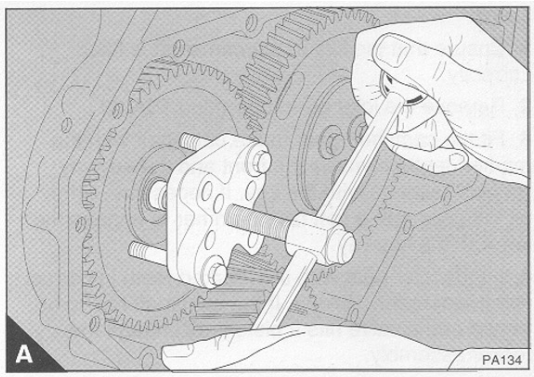
6 Remove the timing case cover, operation 15A-01.

7 Rotate the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

Note: The fuel pump gear used on engine types AE and YE does not have marked teeth.

8 Remove the setscrew and washer of the camshaft gear. Put a suitable adaptor onto the end of the camshaft and remove the gear with the puller and adaptor (A). Ensure that the key in the camshaft is not lost.

9 Inspect the gear for wear and any other damage and renew it, if necessary.



https://truckmanualshub.com/

To fit

1 Ensure that the key in the camshaft is fitted correctly.

2 Remove the idler gear, operation 15A-03.

3 Fit the camshaft gear to the camshaft with the marked teeth towards the front and the keyway correctly aligned with the key. If necessary, lightly hit the gear with a soft face hammer to engage the key into the keyway.

4 Fit the idler gear with the marked teeth in correct mesh, operation 15A-03. If the camshaft has to be turned and a valve hits a piston, disengage the rocker assembly.

5 Fit the washer and the setscrew for the camshaft gear and tighten the setscrew to press the camshaft gear into position. Tighten the setscrew to 78 Nm (58 lbf ft) 8,0 kgf m. If a new camshaft gear has been fitted, check the backlash.

6 Fit the timing case cover, operation 15A-01.

7 Fit the coolant pump, operation 21A-02.

8 Fit the crankshaft pulley, operation 14A-01.

9 If necessary, fit the fan drive pulley, operation 21A-05.

10 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

11 Fit the fan, operation 21A-04.

12 Fill the cooling system.

https://truckmanualshub.com/

Crankshaft gear

To remove and to fit **15A-06**

To remove

1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14-01.

4 If necessary, remove the fan drive pulley, operation 21A-05.

5 Drain the coolant and remove the coolant pump, operation 21A-02.

6 Remove the timing case cover, operation 15A-01.

7 Rotate the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

Note: The fuel pump gear used on engine types AE and YE does not have marked teeth.

8 Remove the idler gear, operation 15A-03.

9 The crankshaft gear is a transition fit on the crankshaft. It may slide off easily or, if it is a tight fit and the gear is to be renewed, it may be necessary to remove the crankshaft, operation 14A-08, to remove the gear safely.

To fit

1 The gear can fit easily, or it may be necessary to heat the gear before it will fit onto the crankshaft. If the gear is to be heated, heat it in an oven to not more than 180°C (226°F). If an oven is not available, heat it in coolant which is at its boiling point. Do not use a flame as this can cause local damage. Fit the gear with the timing marks to the front.

2 Fit the idler gear, operation 15A-03 and ensure that all the timing marks are correctly aligned.

3 Fit the timing case cover, operation 15A-01.

4 Fit the coolant pump, operation 21A-02.

5 Fit the crankshaft pulley, operation 14A-01.

6 If necessary, fit the fan drive pulley, operation 21A-05.

7 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

8 Fit the fan, operation 21A-04.

9 Fill the cooling system.

https://truckmanualshub.com/

Timing case

To remove and to fit **15A-07**

Consumable products:

Jointing compound

Nutlock

To remove

1 Remove the fan, operation 21A-04.

2 Remove the drive belts, operation 23A-03.

3 Remove the crankshaft pulley, operation 14A-01.

4 If necessary, remove the fan drive assembly, operation 21A-05.

5 Drain the coolant and remove the coolant pump, operation 21A-02.

6 Remove the alternator together with its mounting bracket and front support plate.

7 Remove the compressor and drive assembly, operation 24A-01, if fitted.

8 Remove the timing case cover, operation 15A-01.

9 Rotate the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear and the fuel pump gear are all in mesh with the idler gear. The marked teeth of the idler gear will not necessarily be in mesh with the marked teeth of the other gears because of the different speed of rotation of the idler gear.

Note: The fuel pump gear used on engine types AE and YE does not have marked teeth.

10 Remove the fuel injection pump, see section 20.

11 Remove the idler gear, operation 15A-03 and the camshaft gear, operation 15A-05.

12 Remove the setscrews which hold the timing case to the cylinder block and the setscrews which hold the sump to the bottom of the timing case.

13 Remove the timing case and the joint, do not allow the idler gear hub to fall. Ensure that the camshaft thrust washer is not lost.

https://truckmanualshub.com/

To fit

1 Ensure that the sump joint is not damaged. If the joint is damaged, remove the sump and fit it with a new joint after the timing case has been fitted. The front section of the joint can be cut away and the front section of a new joint fitted, without the removal of the sump, but extreme care must be used to prevent possible leaks.

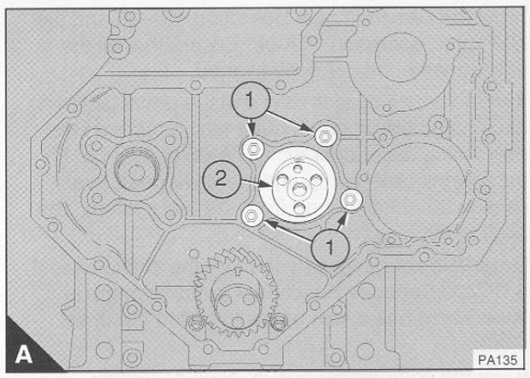
2 If the sump has been removed, fit the idler gear hub (A2) or (B2) to the front of the cylinder block; use the three setscrews of the idler gear to hold the hub in position. Ensure that the oil hole is at the top.

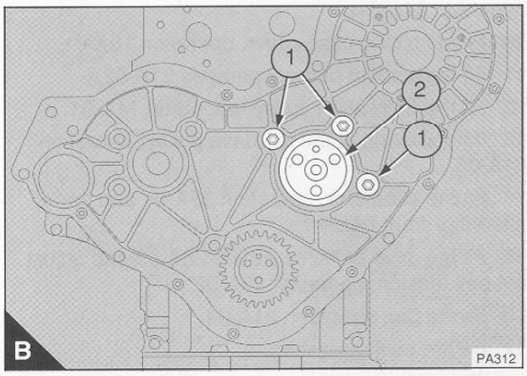
3 Ensure that the thrust washer for the camshaft is in position.

4 Fit a new joint for the timing case to the cylinder block. Cut the bottom ends of the joint to fit correctly. Apply Jointing compound to the bottom ends of the joint.

5 Put the timing case in position. If the sump has not been removed, fit the idler gear hub, see paragraph 2. Fit the four setscrews (A1), or three setscrews (B1) for engines fitted with a belt driven coolant pump, around the idler gear hub. Ensure that the bottom of the timing case is correctly aligned with the bottom of the cylinder block before the setscrews are tightened. Put the fan drive assembly and/or the alternator and its front support plate in position and fit and tighten the remainder of the setscrews of the timing case. If the front support plate has been separated from the alternator bracket, ensure that the right side of the plate is level with the machined face on the cylinder block where the alternator bracket is fitted. If a new timing case is fitted, remove the two studs from the timing case and clean the threads which fit into the timing case. Seal the threads with Nutlock and fit the studs into the new timing case. Remove the setscrews from the idler gear hub.

6 If necessary, fit the lubricating oil sump, operation 19A-03, and fill it to the correct level with an approved oil.





https://truckmanualshub.com/

7 Fit the camshaft gear,operation 15A-05 and the idler gear, operation 15A-03. Ensure that all the timing marks are correctly aligned.

8 If the timing case is new and the previous timing case had a timing mark, put a timing mark on the new timing case, operation 17A-05 or 17B-05. Fit the fuel injection pump and the drive gear, see section 20. Eliminate air from the fuel system, see section 20.

Note: It is not necessary to mark the timing case if Bosch fuel injection pump is fitted which has a lock screw to fasten the drive shaft.

9 Fit the compressor and its drive assembly, operation 24A-01.

10 Fit the timing case cover, operation 15A-01.

11 Fit the coolant pump, operation 21A-02.

12 Fit the crankshaft pulley, operation 14A-01.

13 If necessary, fit the fan drive pulley, operation 21A-05.

14 Fit the alternator, operation 23A-04 and the alternator front bracket.

15 Fit the drive belts, operation 23A-03 and adjust the belt tension, operation 23A-02.

16 Fit the fan, operation 21A-04.

17 Fill the cooling system.

https://truckmanualshub.com/

Camshaft and tappets

To remove and to fit **15A-08**

To remove

1 Before the engine is removed from the vehicle or the machine, drain the lubricating oil and the coolant.

2 Remove the fan, operation 21A-04.

3 Remove the drive belts, operation 23A-03.

4 Remove the crankshaft pulley, operation 14A-01.

5 If necessary, remove the fan drive assembly, operation 21A-05.

6 Drain the coolant and remove the coolant pump, operation 21A-02.

7 Remove the alternator together with its mounting bracket and front support plate.

8 Remove the compressor and its drive assembly or remove the exhauster, see section 24.

9 Remove the timing case cover, operation 15A-01.

10 Remove the timing gears, operations 15A-03, 15A-04 and 15A-05.

11 Remove the fuel injection pump, see section 20.

12 Remove the timing case, operation 15A-07.

13 Remove the rocker cover, the rocker assembly and the push rods, see section 12.

14 Remove the fuel lift pump, operation 20A-03.

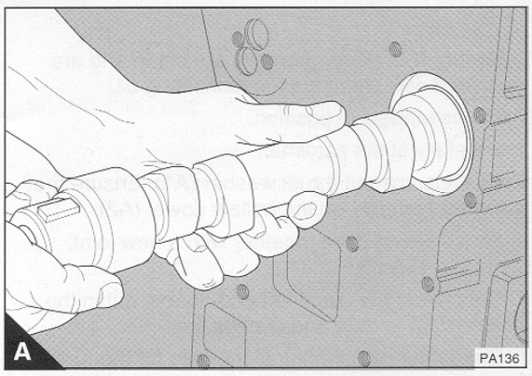
Note: On some AE and YE engines the fuel lift pump is fitted to the fuel injection pump and not to the cylinder block. Where the fuel lift pump is fitted to the cylinder block on these engines, an adaptor is fitted between the lift pump and the cylinder block. The adaptor and lift pump must be removed before the camshaft is removed.

15 Turn the engine upside down and remove the lubricating oil sump, operation 19A-03.

16 Remove the camshaft thrust washer (15A.20/A) and carefully remove the camshaft (A).

17 Remove the tappets.

18 Inspect the camshaft and the tappets for wear and other damage, also inspect the camshaft bush. Renew the components as necessary.



https://truckmanualshub.com/

To fit

1 Ensure that all components are clean and are lubricated with clean engine lubricating oil.

2 Fit the tappets in position.

3 Carefully fit the camshaft.

4 Fit the camshaft thrust washer (A1). Ensure that it is fitted correctly on the hollow dowel (A2).

5 Fit the timing case together with a new joint, operation 15A-07.

6 Check that the camshaft end-float is within the limits shown in data and dimensions.

7 Rotate the camshaft until the cam for the fuel lift pump is at the minimum lift position and fit the fuel lift pump, operation 20A-03.

Note: On some engines fitted with a Bosch in-line fuel injection pump the fuel lift pump is fitted to the fuel injection pump body and not to the cylinder block. Where the fuel lift pump is fitted to the cylinder block on these engines, an adaptor is fitted between the lift pump and the cylinder block. The adaptor and lift pump must be removed before the camshaft is fitted.

8 Turn the engine to an upright position. Rotate the crankshaft until the keyway in the crankshaft is at the top. Fit the timing gears, operations 15A-03, 15A-04 and 15A-05, and ensure that all the timing marks are correctly aligned.

9 Fit the fuel injection pump, see section 20.

10 Fit the push rods and the rocker assembly, see section 12.

11 Set the valve tip clearances, operation 12A-05.

12 Fit the timing case cover, operation 15A-01 and the lubricating oil sump, operation 19A-03.

13 Fit the coolant pump, operation 21A-02.

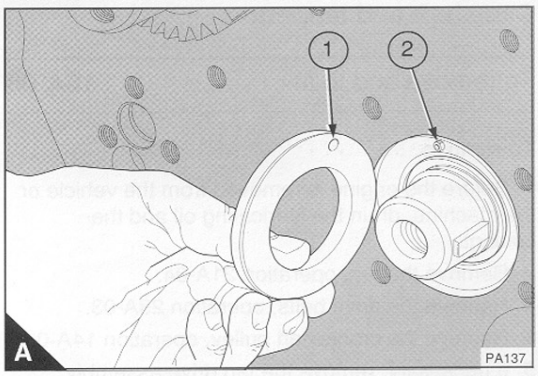
14 Fit the crankshaft pulley, operation 14A-01.

15 If necessary, fit the alternator and its mounting brackets and the fan drive pulley, operation 21A-05.

16 Fit the drive belts, operation 23A-03, and adjust the belt tension, operation 23A-02.

17 Fit the fan, operation 21A-04.

18 After the engine has been installed: Fill the cooling system. Fill the lubricating oil sump to the correct level with an approved lubricating oil. Eliminate air from the fuel system, see section 20.



https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Timing case and drive assembly

Camshaft

Diameter of number 1 journal	50,71/50,74 mm (1.9965/1.9975 in)
Diameter of number 2 journal	50,46/50,48 mm (1.9865.1.9875 in)
Diameter of number 3 journal:	
- Four cylinder engines	49,95/49,98 mm (1.9665/1.9675 in)
- Six cylinder engines	50,20/50,23 mm (1.9765/1.9775 in)
Diameter of number 4 journal:	
- Six cylinder	49,95/49,98 mm (1.9665/1.9675 in)
Clearance of all journals	0,06/0,14 mm (0.0025/0.0055 in)
Cam lift:	
- Inlet	7,62/7,69 mm (0.2999/0.3029 in)
- Exhaust	7,71/7,79 mm (0.3036/0.3066 in)
Maximum permissible ovality and wear on journals	0,05 mm (0.021 in)
End-float:	
- Production limits	0,10/0,41 mm (0.004/0.016 in)
- Service limit	0,53 mm (0.021 in)
Width of spigot for thrust washer	5,64/5,89 mm (0.222/0.232 in)

Camshaft thrust washer

Type	360°
Depth of recess in cylinder block for thrust washer	5,46/5,54 mm (0.215/0.218 in)
Thickness of thrust washer	5,49/5,54 mm (0.216/0.218 in)
Relationship of thrust washer to front face of cylinder block	-0,05/+0,08 mm (-0.002/+0.003 in)

Camshaft gear

Number of teeth	56
Diameter of bore	34,93/34,95 mm (1.3750/1.3760 in)
Outside diameter of hub of camshaft	34,90/34,92 mm (1.3741/1.3747 in)
Clearance fit of gear on hub	0,008/0,048 mm (0.0003/0.0019 in)

Fuel pump gear

Number of teeth	56
Bore:	
- AE, YE	36,00/36,06 mm (1.417/1.419 in)
- All other engine types	Tapered
Clearance fit on hub:	
- AE, YE	0,003/0,075 mm (0.0001/0.0030 in)

https://truckmanualshub.com/

Crankshaft gear

Number of teeth	28
Diameter of bore	47,625/47,650 mm (1.8750/1.8760 in)
Diameter of hub for gear on crankshaft	47,625/47,645 mm (1.8750/1.8758 in)
Transition fit of gear on crankshaft	-0,020/+0,048 mm (-0.0008/+0.0010 in)

Idler gear and hub

Number of teeth	63
Diameter of bore of gear	57,14/57,18 mm (2.2495/2.2512 in)
- with needle roller bearings	69,01/69,03 mm (2.717/2.718 in)
Width of gear and split bush assembly (fitted in position)	30,14/30,16 mm (1.186/1.187 in)
Inside diameter of flanged bushes (fitted in position)	50,78/50,80 mm (1.9999/2.000 in)
Outside diameter of hub	50,70/50,74 mm (1.9960/1.9975 in)
-with needle roller bearing	54,987/55,000 mm (2.1648/2.1654 in)
Clearance of bushes on hub	0,04/0,10 mm (0.0016/0.0039 in)
End float of gear:	
- Production limits	0,10/0,20 mm (0.004/0.008 in)
- with needle roller bearings	0,24/0,33 mm (0.009/0.013 in)
- Service limit	0,38 mm (0.015 in)
Backlash for all gears	0,08 mm (0.003 in) minimum

Idler gear and hub for the Bendix compressor

Number of teeth	32
Diameter of bore of gear	55,010/55,025 mm (2.1657/2.1663 in)
Outside diameter of hub	50,000/49,990 mm (1.9960/1.9975 in)
End float of gear with needle roller bearing fitted:	0,12/0,16 mm (0.005/0.006 in)
Backlash gear	0.07 mm (0.003 in) minimum

https://truckmanualshub.com/

Cylinder block assembly 16

General description 16A.02

Cylinder block

16A-01 To dismantle and to assemble 16A.03
16A-02 To inspect 16A.05

Cylinder liner

16A-03 To inspect 16A.06
16A-04 To remove glaze from the bore 16A.07
16A-05 To remove and to fit 16A.08

Data and dimensions 16A.13

https://truckmanualshub.com/

General description

The cylinder block is made of cast iron and provides a full length support for the dry liners which are also made of cast iron. Production liners are a press fit in the block and service liners are a transition fit. Both types of liners are honed with silicon carbide tools to a specially controlled finish to ensure long life and low oil consumption. The cylinder liners fitted to some engines have a flame ring above the flange. A bush is fitted in the cylinder block for the front camshaft journal and the other camshaft journals run directly in the block.

https://truckmanualshub.com/

Cylinder block

To dismantle and to assemble **16A-01**

Consumable products:

Nutlock

To dismantle

1 Drain the cooling system and the lubricating oil.

2 Remove the engine from the vehicle or machine.

3 Remove the alternator drive belts and the alternator and its mounting brackets, see section 23.

4 Remove the fan, the fan drive and the water pump, see section 21.

5 Remove the compressor or the exhauster, where fitted, see section 24.

6 Remove the fuel filter, the atomisers and the fuel injection pump, see section 20.

7 Remove the lubricating oil cooler, where fitted, operation 21A-07.

8 Remove the lubricating oil filter assembly and the lubricating oil sump, see section 19.

9 If necessary, remove the turbocharger, operation 18A-01.

10 Remove the fuel lift pump, operation 20A-03 or 20B-03.

11 Remove the starter motor, operation 23B-01.

12 Remove the cylinder head assembly, operation 12A-07.

13 Remove the timing case and the timing gears, see section 15. Remove the lubricating oil pump and the pressure relief valve, see section 19, or remove the balancer unit, operation 14A-10.

15 Remove the piston and connecting rod assemblies, operation 13A-04.

16 Remove the camshaft and the tappets, operation 15A-09.

17 Remove the flywheel and the flywheel housing, see section 22.

18 Remove the rear oil seal assembly and the crankshaft, see section 14.

19 Remove the piston cooling jets, operation 13A-09, or remove the setscrews and spacers if jets are not fitted.

20 Inspect the cylinder block, operation 16A-02

https://truckmanualshub.com/

To assemble

1 Clean thoroughly the new cylinder block. Ensure that all the oil passages are clean and free from debris.

2 Remove the threaded plugs from the old cylinder block and clean the threads. Seal the threads with Nutlock, or a similar sealant, and fit the threaded plugs into the new cylinder block.

3 Fit the piston cooling jets, or the spacers and setscrews where jets are not fitted, operation 13A-09.

4 Fit the crankshaft and the rear oil seal assembly, see section 14.

5 Fit the piston and connecting rod assembly, operation 13A-03.

6 Fit the flywheel housing and the flywheel, see section 22.

7 Fit the tappets and the camshaft, operation 15A-08.

8 Fit the lubricating oil pump and the pressure relief valve, see section 19, or fit the balancer unit, operation 14A-10.

9 Fit the timing case and the timing gears, see section 15.

10 Fit the cylinder head assembly, operation 12A-07.

11 Fit the starter motor, operation 23B-01.

12 Fit the fuel lift pump, operation 20A-03 or 20B-03.

13 If necessary, fit the turbocharger, operation 18A-01.

14 Fit the lubricating oil filter assembly and the lubricating oil sump, see section 19.

15 If necessary, fit the lubricating oil cooler, operation 21A-07.

16 Fit the fuel filter, the atomisers and the fuel injection pump, see section 20.

17 If necessary, fit the compressor or the exhauster, see section 24.

18 Fit the fan, the fan drive and the water pump, see section 21.

19 Fit the alternator and its mounting brackets and the alternator drive belts, see section 23.

20 Install the engine into the vehicle or machine.

21 Fill the cooling system.

22 Fill the lubricating oil sump to the correct level with an approved lubricating oil.

23 Eliminate air from the fuel system, see section 20.

https://truckmanualshub.com/

To inspect 16A-02

1 Clean the passages for the coolant and for the oil.

2 Check the cylinder block for cracks and for other damage.

3 The top face of the cylinder block must not be machined as this will affect the liner flange depth and the piston height above the top face of the cylinder block.

4 Check the camshaft bush for wear. If the bush is to be renewed, use a suitable adaptor to press it out of the bore. Ensure that the lubricating oil hole in the new bush will be towards the front of the engine, when fitted. Press in the bush with the oil hole on the same side and aligned with the oil hole in the block until the front end of the bush is aligned with the face of the recess.

https://truckmanualshub.com/

Cylinder liner

To inspect **16A-03**

To ensure the best performance during the life of the engine it is important that worn or damaged cylinder liners are renewed. If a change of liner becomes necessary in service, a service liner is available.

The condition of a cylinder liner is decided by:

- The amount and location of any polished areas.
- Wear.
- Damage to the liner wall.

Notes: It will not be necessary to renew the liners If:

- The honed finish can still be clearly seen.
- The engine performance and oil consumption is acceptable.

To check the condition of a cylinder liner

1 Examine the liner surface for cracks and deep scratches.

2 Check the liner wall for areas where the honed finish has been polished away. Check especially the area around the top of the liner bore just below the carbon ring. In this area, thrust from the top piston ring is at its maximum.

Cautions:

- Damaged or worn liners must be discarded.
- New piston rings must be fitted when the cylinder liner is renewed.
- An engine can have high oil consumption with very little wear of the liner bores, if the surfaces of the liners are glazed.

https://truckmanualshub.com/

To remove glaze from the bore 16A-04

A tool, known as a "Flex-Hone", is available to correct the liner surface. This tool can be used with an electric hand drill at low speed. The pistons and connecting rods must be removed and the piston cooling jets, where fitted, must also be removed. Use covers to protect all engine components from the debris which is caused during the process.

Caution: *Do not use a "Flex-hone" on the cylinder liners of engine types AE and YE.*

1 Grade 80SC Flex-Hone is to be used. A 4 inch or 4 1/8 inch size Flex-Hone can be used according to how badly the bore is glazed.

2 New Flex-Hones must be operated in an old liner before use on an engine to remove all loose material and sharp edges.

3 Lubricate lightly the liner and the Flex-Hone with clean engine lubricating oil.

4 Put the tool in position on top of the liner, but do not press the tool into the liner until the tool is operated.

5 Operate the tool and move it up and down the liner bore once a second for 30-50 seconds. Remove the tool while it rotates.

6 Clean thoroughly the liner bore to remove all dirt from the operation, use a hard brush and kerosene.

7 Dry the liners and remove carefully all the covers used to protect the components. Clean thoroughly all the engine components which have been affected by debris.

8 Fit the piston cooling jets or the plugs. Ensure that new piston rings are fitted when the engine is assembled in accordance with the relevant sections of this workshop manual.

Caution: *After a glazed bore has been corrected, these recommendations are advised for the first 240 km (150 miles) or 5 hours of operation:*

- *Do not operate the engine at full load.*
- *Do not operate the engine at high speed.*
- *Do not allow the engine to run at low idle speed for extended periods.*

https://truckmanualshub.com/

To remove and to fit 16A-05

Special tools:

Remover/replacer for cylinder liner (main tool), PD.150B

Adaptors for use with PD.150B, PD.150B-17

Depth gauge, liner flange, PD.41D

Dial gauge for use with PD.41D, PD.208

Consumable products: (See Section 10)

Retainer (oil tolerant)

Safety Solvent or a similar product

Where several liners are to be removed or a very tight production liner is fitted, a press should be used. Where a single liner is to be removed or the crankshaft is to remain in position, a tool for hand operation is available.

To remove

1 Drain the lubricating oil and remove the lubricating oil sump, operation 19A-03.

2 Remove the cylinder head assembly, operation 12A-07.

3 Remove the piston and connecting rod assembly, see operation 13A-03.

4 Carefully remove the piston cooling jet, where fitted, operation 13A-09.

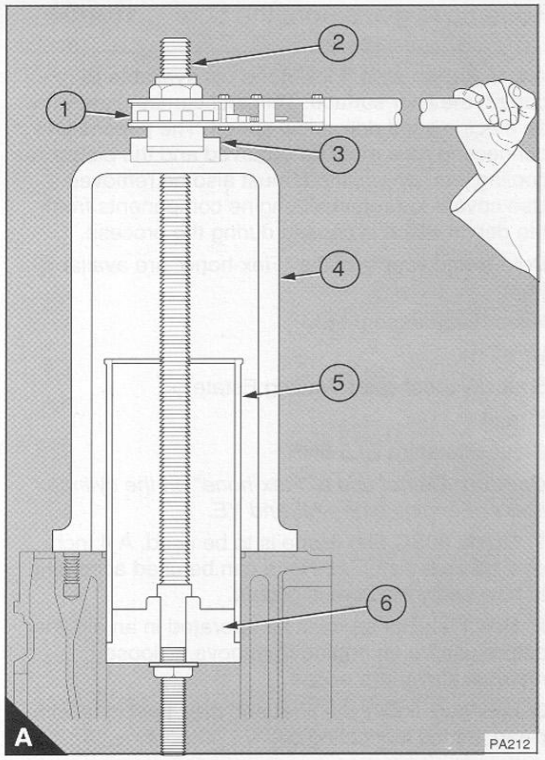
5 Rotate the crankshaft to give access to the cylinder liner. Protect the crank pin.

6 Put the tool (A4) on the top face of the cylinder block and over the centre of the liner (A5). Ensure that the base of the tool is not on top of the liner flange of the next cylinder.

7 Put the bearing (A3) in the recess in the top of the tool with the flat face of the bearing to the bottom of the recess.

8 Fit the threaded rod (A2) through the bearing and the top of the tool until the handle (A1) is in the recess in the top of the bearing. In this position adjust the threaded rod until the end is below the bottom of the cylinder liner. Fit the adaptor PD.150B-17/1 (A6) onto the threaded rod and against the bottom of the cylinder liner. Ensure that the two lugs on the top of the adaptor engage with the flats on the threaded rod. Fit the washer and nut and tighten the nut onto the adaptor.

9 Lubricate the ratchet of the handle and the threaded rod with Shell Spirax oil or an equivalent oil. Operate the handle and pull the cylinder liner out of the top of the cylinder block.



https://truckmanualshub.com/

To fit a service liner

A service liner is a transition fit of +/- 0,03 mm (+/- 0.001 in) in the parent bore. A special tool will not be necessary to fit some liners, but where a liner is a tight fit, tool PD.150B can be used.

Caution: Do not hit a liner with a hammer.

1 Clean thoroughly the parent bore. Clean the top 50 mm (2.0 in) and the recess for the liner flange with Loctite Safety Solvent or a similar product; use it in accordance with the manufacturer's instructions.

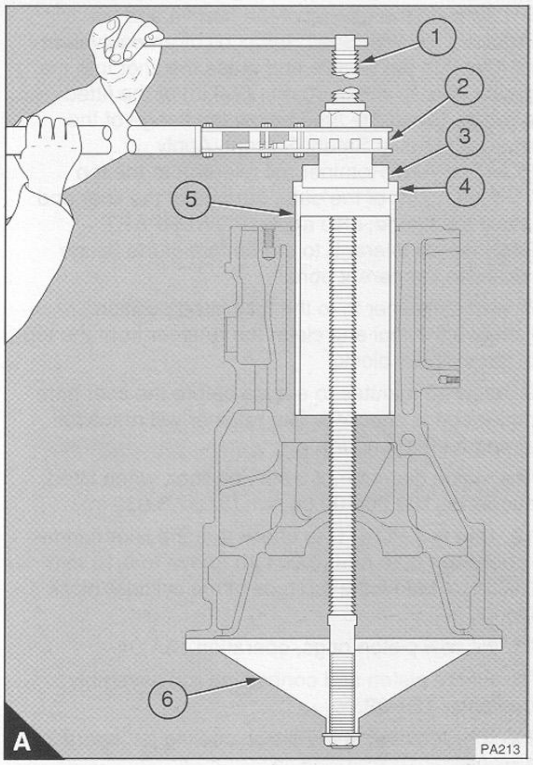
2 Clean thoroughly the outer surface of the liner with Safety Solvent.

3 Lubricate lightly the parent bore with clean engine lubricating oil, except for the top 50 mm (2.0 in).

4 Engage the cylinder liner (A5) into the parent bore; ensure that the liner is vertical. Put the adaptor PD.150B-17/2 (A4) onto the top of the liner with the shoulder of the adaptor on the liner flange. Put the bearing (A3) into position in the recess in the top of the adaptor with the flat face of the bearing to the bottom of the recess.

5 Fit the threaded rod (A1) through the bearing, the adaptor and the liner until the handle is against the recess in the bearing. In this position adjust the threaded rod until the end is below the bottom face of the cylinder block.

6 Fit the adaptor PD.150B/6 (A6) onto the threaded rod; ensure that the flat face of the adaptor is against the bottom face of the cylinder block. Fit the washer and the nut; ensure that the threaded rod is in the centre of the liner and tighten the nut onto the adaptor.



https://truckmanualshub.com/

7 Lubricate the ratchet of the handle and the threaded rod with Shell Spirax oil or an equivalent oil. Operate the handle and press the liner into the parent bore to within 50 mm (2.0 in) of the fitted position. Clean the area below the flange of the liner with Loctite Safety Solvent. Apply POWERPART Retainer (oil tolerant) to the top 25 mm (1.0 in) of the outer surface of the liner and under the flange; also apply POWERPART Retainer (oil tolerant) to the bottom of the flange recess in the parent bore.

8 Press the liner in to the fully fitted position. Remove the tool and clean the retainer from the top of the cylinder block.

9 Allow 15 minutes to elapse before the liner bore dimension is checked. The retainer will reach full strength after 6 hours.

The inside diameter of a service liner, when fitted, should be 100,00/100,06 mm (3.937/3.939 in)

10 Use tool PD.41D to check that the liner flange is between 0,10 mm (0.004 in) above to 0,10 mm (0.004 in) below the top face of the cylinder block (A).

11 Fit new piston rings, operation 13A-04.

12 Fit the piston and connecting rod assembly, operation 13A-03.

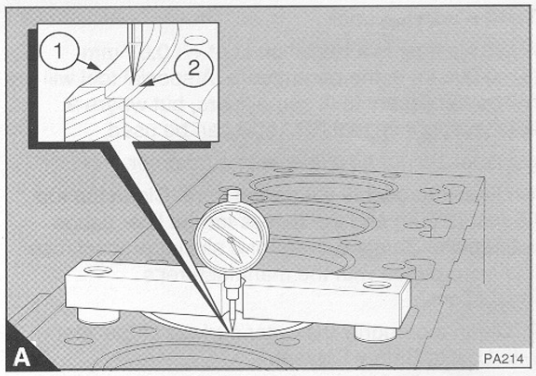
13 If necessary, fit the piston cooling jet, operation 13A-09.

14 Fit the cylinder head assembly, operation 12A-07.

15 Fit the lubricating oil sump, operation 19A-03, and fill it to the correct level with an approved lubricating oil.

Caution: *After a new service liner has been fitted, these recommendations are advised for the first 240 km (150 miles) or 5 hours of operation:*

- *Do not operate the engine at full load.*
- *Do not operate the engine at high speed.*
- *Do not allow the engine to run at low idle speed for long periods.*



https://truckmanualshub.com/

To fit a partially finished liner

The liner is an interference fit in the parent bore. A special tool will be necessary to fit the liners, tool PD.150B can be used. If a liner is a very tight fit it may be necessary to use a hydraulic press.

Caution: *Do not hit a liner with a hammer.*

1 Clean thoroughly the parent bore of the cylinder block with an approved degreasing fluid.

2 Examine the parent bore for damage and corrosion. Damaged cylinder blocks should be discarded.

3 Clean thoroughly the outer surface of the liner with an approved degreasing fluid.

4 Apply a small amount of engine oil around the top of the parent bore to assist the entry of the liner.

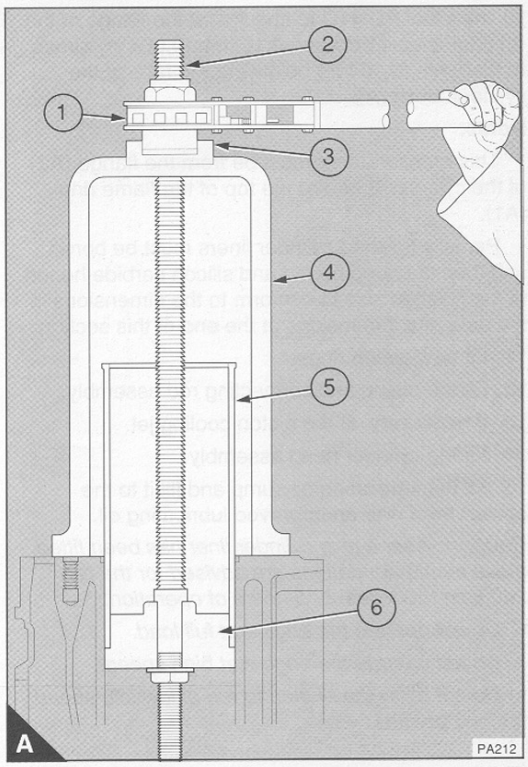
5 Engage the cylinder liner (A5) into the parent bore; ensure that the liner is vertical. Put the adaptor PD.150B-17/2 (A4) onto the top of the liner with the shoulder of the adaptor on the flame ring of the liner. Put the bearing (A3) into position in the recess in the top of the adaptor with the flat face of the bearing to the bottom of the recess.

6 Fit the threaded rod (A2) through the bearing, the adaptor and the liner until the handle (A1) is against the recess in the bearing. In this position adjust the threaded rod until the end is below the bottom face of the cylinder block.

7 Fit the adaptor PD.150B/6 (A6) onto the threaded rod; ensure that the flat face of the adaptor is against the bottom face of the cylinder block as shown (A). Fit the washer and the nut; ensure that the threaded rod is in the centre of the liner and tighten the nut onto the adaptor.

8 Lubricate the ratchet of the handle and the threaded rod with Shell Spirax oil or an equivalent oil. Operate the handle and press the liner into the fully fitted position.

9 Remove the tool PD.150B and thoroughly clean the top of the cylinder block.

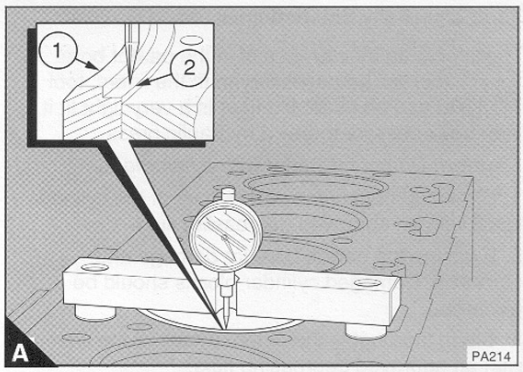


https://truckmanualshub.com/

10 Use tool PD.41D to check that the flange of the cylinder liner is between 0,10 mm (0.004 in) above to 0,10 mm (0.004 in) below the top face of the cylinder block (A).

Notes:

- This measurement must be from the flange (A2) of the cylinder liner, not the top of the flame ring (A1).
- Partially finished cylinder liners must be bored and then diamond honed and silicon carbide honed to the finished size to conform to the dimensions in the data and dimensions at the end of this section.



11 Fit new piston rings.

12 Fit the piston and connecting rod assembly.

13 If necessary, fit the piston cooling jet.

14 Fit the cylinder head assembly.

15 Fit the lubricating oil sump and fill it to the correct level with an approved lubricating oil.

Caution: *After a new cylinder liner has been fitted, these recommendations are advised for the first 240 km (150 miles) or 5 hours of operation:*

- *Do not operate the engine at full load.*
- *Do not operate the engine at high speed.*
- *Do not allow the engine to run at low idle speed for long periods.*

https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Cylinder block assembly

Cylinder block

Height between top and bottom faces	441,12/441,33 mm (17.367/17.375 in)
Diameter of parent bore for cylinder liner	104,20/104,23 mm (4.103/4.104 in)
Depth of recess for flange of cylinder liner	3,81/3,91 mm (0.150/0.154 in)
Diameter of recess for flange of cylinder liner	107,82/107,95 mm (4.245/4.250 in)
Diameter of parent bore for main bearing	80,416/80,442 mm (3.1660/3.1670 in)

Camshaft bore diameter:

- Four cylinder engines:	
Number 1 (for bush)	55,56/55,59 mm (2.188/2.189 in)
Number 2	50,55/50,60 mm (1.990/1.992 in)
Number 3	50,04/50,09 mm (1.970/1.972 in)
- Six cylinder engines:	
Number 1 (for bush)	55,56/55,59 mm (2.188/2.189 in)
Number 2	50,55/50,60 mm (1.990/1.992 in)
Number 3	50,29/50,34 mm (1.980.1.982 in)
Number 4	50,04/50,09 mm (1.970/1.972 in)
Bore of bush for number 1 camshaft journal	50,79/50,85 mm (2.000/2.002 in)

Cylinder liners

Type:	
- Production	Dry, interference fit, flanged
- Service	Dry, transition fit, flanged
- Service	Dry, transition fit, flanged, with flame ring
partially finished liner	Dry, interference fit, flanged, with flame ring
- AE, YE, 110Ti and 135Ti AD lists:	
- Production	Dry, interference fit, flanged, with flame ring
Outside diameter of production liner	104,25/104,28 mm (4.105/4.106 in)
Interference fit of production liner	0,03/0,08 mm (0.001/0.003 in)
Inside diameter of production liner	100,00/100,03 mm (3.937/3.938 in)
Transition fit of service liner	+/- 0,03 mm (+/- 0.001 in)
Inside diameter of service liner (fitted)	100,04/100,063 mm (3.9385/3.9395 in)
Inside diameter of service liner with a flame ring (fitted)	100,00/100,063 mm (3.937/3.939 in)
Maximum permissible wear of liner bore	0,25 mm (0.010 in)
Thickness of flange	3,81/3,86 mm (0.150/0.152 in)
Relative position of top of liner flange to top face of cylinder block	0,10 mm (0.004 in) above 0,10 mm (0.004 in) below

https://truckmanualshub.com/

Partially finished liner

Inside diameter of partially finished liner	99,162/99,415 mm (3.9040/3.9139 in)
Interference fit of partially finished liner in parent bore	0,025/0,076 mm (0.003/0.001 in)
Hone angle (cross hatch)	30°/35°
Final finish grade, silicon carbide (Plateau hone)	0,65/1,3 micrometers
Inside diameter of finished liner	100,00/100,03 mm (3.937/3.938 in)

https://truckmanualshub.com/

https://truckmanualshub.com/

Engine timing 17

Bosch EPVE fuel injection pumps 17A

P7100 AD PE in-line fuel injection pump 17B

Stanadyne fuel injection pump 17C

Four cylinder unit pump 17D

Six cylinder unit pump 17E

https://truckmanualshub.com/

Engines fitted with Bosch EPVE fuel injection pumps 17A

Engine timing

General description 17A.02

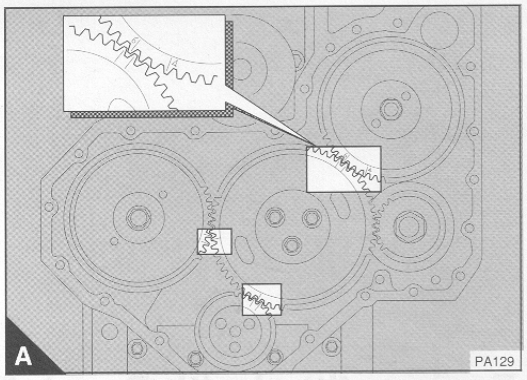
17A-01A To set number 1 piston to TDC on the compression stroke 17A.03
17A-01B An alternative method to set number 1 piston to TDC on the compression stroke 17A.04
17A-02 To check the valve timing 17A.04
17A-03 To check the timing of the fuel injection pump 17A.05
17A-04 To check the timing mark of the fuel injection pump 17A.07
17A-05 To check the engine timing mark 17A.08

Data and dimensions 17A.09

https://truckmanualshub.com/

General description

The timing gears are stamped with timing marks to ensure that they are assembled correctly (A). The stamped teeth of the crankshaft, the camshaft and the fuel pump gears will be in mesh with the idler gear when number 1 piston is at top dead centre (TDC) on the compression stroke. The marked teeth of the idler gear may not necessarily be in mesh in this position, due to the different speeds at which the gears rotate.The fuel pump gear has timing marks for four and six cylinder engines.



Notes:

- The maximum no load speed (B3) set by Lovol may be reset by the equipment manufacturer. If the speed is changed the new speed is shown in the high idle reset position (B4). The original maximum no load speed should be eliminated.
- The adjustment screw for the maximum no load speed, is sealed by the manufacturer. The setting must not be changed, unless approved, as it could affect the warranty of the engine.

https://truckmanualshub.com/

Engine timing

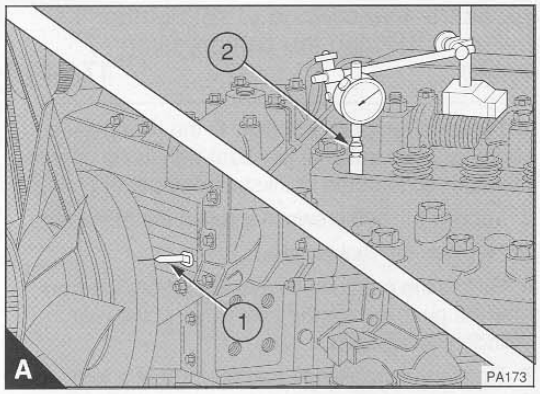
To set number 1 piston to TDC on the compression stroke 17A-01A

Special tools:

Valve spring compressor, PD.6118B

Stud adaptor for use with PD.6118B, PD.6118B-7

Setscrew adaptor for use with PD.6118B, PD.6118B-8



1 Fasten a temporary pointer to the timing case cover with its tip near to the outer edge of the crankshaft pulley or damper (A1).

2 Remove the rocker cover, operation 12A-01.

3 Rotate the crankshaft, clockwise from the front, until the push rod for the inlet valve of the rear cylinder just tightens.

4 Remove the spring clip and the spacer from the front of the rocker shaft. Release the fasteners of the front two pedestals of the rocker shaft and remove the front rocker lever; tighten the fasteners of the rocker shaft pedestals.

5 Remove the valve springs from the front valve with the valve spring compressor PD.6118B and the adaptor PD.6118-7, for pedestal studs, or the adaptor PD.6118-8, for pedestal setscrews.

Caution: *Fit a suitable collar near the top of the valve to hold the valve if the crankshaft is rotated too far.*

6 Allow the valve to be held by the top of the piston.

7 Fasten a dial test indicator with its plunger in contact with the top of the valve stem (A2) and with a reading shown on the gauge. Rotate slowly the crankshaft, clockwise from the front, until the clockwise movement of the dial gauge pointer just stops. Make a suitable mark on the crankshaft pulley or damper to align with the temporary pointer. Continue to rotate the crankshaft, in the same direction, until the gauge pointer just begins to move in a counter-clockwise direction. Make another mark on the pulley or damper to align with the pointer. Mark the centre point between the two marks on the pulley or damper and remove the other two marks.

8 Rotate the crankshaft approximately 45° counter-clockwise from the front and then clockwise until the mark on the pulley or damper is aligned with the pointer. Number 1 piston is now at TDC on the compression stroke.

https://truckmanualshub.com/

An alternative method to set number 1 piston to TDC on the compression stroke 17A-01B

1 Fasten a temporary pointer to the timing case cover (or other suitable position) with its tip near to the outer edge of the crankshaft damper or pulley.

2 Loosen the setscrews that retain the atomisers.

3 Remove the rocker cover.

4 Rotate the crankshaft clockwise, from the front, until the push rod for the inlet valve of the rear cylinder just tightens.

5 Rotate the crankshaft a further 1/8 of a turn clockwise. Insert a suitable lever between the rocker lever and the valve spring cap of number 1 inlet valve. Open the inlet valve and put a spacer approximately 5,0 mm (0.2 in) thick between the valve tip and the rocker lever.

6 Slowly rotate the crankshaft counter-clockwise until the piston makes contact with the open valve. Make a temporary mark on the damper or pulley to align accurately with the tip of the pointer.

7 Rotate the crankshaft clockwise a few degrees and remove the spacer between the valve and the rocker lever. Rotate the crankshaft 1/4 of a turn counter-clockwise. Put the spacer between the valve tip and the rocker lever.

8 Slowly rotate the crankshaft clockwise until the piston makes contact with the open valve. Make another temporary mark on the damper or pulley to align accurately with the tip of the pointer.

9 Make a temporary mark at the centre point between the two marks on the damper or pulley and remove the other two marks. Rotate the crankshaft counter-clockwise 1/8 of a rotate and remove the spacer between the valve and the rocker lever. Slowly rotate the crankshaft clockwise until the mark on the damper or pulley aligns accurately with the tip of the pointer. Number 1 piston is now at TDC on the compression stroke.

To check the valve timing 17A-02

1 Set the piston of number 1 cylinder to TDC on the compression stroke, operation 17A-01A.

2 Remove the dial test indicator from number 1 inlet valve and fit the valve springs and the rocker lever. Ensure that the fasteners for the rocker shaft pedestals are to the correct torque.

3 Rotate the crankshaft, clockwise from the front, until the inlet valve of the rear cylinder is fully open.

4 Set the valve tip clearance of number 1 cylinder inlet valve to 1,5 mm (0.059 in).

5 Rotate the crankshaft, clockwise from the front, until the push rod of number 1 cylinder inlet valve just tightens. In this position, check if the mark on the crankshaft pulley or damper is within +/- 2 1/2° of the temporary pointer. Use the formula below to find the measurement which is equal to 2 1/2° on the pulley or damper.

$$\frac{C \times P}{360}$$

C = circumferance of pulley or damper

P = 2.5 degrees

6 If the timing is more than 2 1/2° out of position, the timing gears are probably not in correct mesh.

Note: One tooth on the camshaft gear is equivalent to 23 mm (0.9 in) at the circumference of a pulley of 203 mm (8 in) diameter. If a large damper is fitted, one tooth on the camshaft gear is equivalent to 35 mm (1.4 in) at the circumference of a damper of 310 mm (12.2 in) diameter, or 37 mm (1.5 in) at the circumference of a damper of 327 mm (12.8 in) diameter.

7 Rotate the crankshaft, clockwise from the front, until the inlet valve of the rear cylinder is fully open. Set the valve tip clearance of the inlet valve of number 1 cylinder to 0,20 mm (0.008 in).

8 Fit the rocker cover, operation 12A-01.

9 Remove the temporary pointer from the timing case and the timing mark from the pulley or damper.

https://truckmanualshub.com/

To check the timing of the - Bosch EPVE fuel injection pump 17A-03

Special tools:

Timing gauge adaptor, MS.107

Spanner for flange nuts of fuel injection pump, PD.239

Note: The procedure given below is suitable for engines fitted with a Bosch EPVE fuel injection pump and have a static timing of 10° or more.

1 Set the piston of number 1 cylinder to TDC on the compression stroke, operation 17A-01. It is not necessary to fit a temporary pointer (17A-01/paragraph 1). Instead, the dial of the dial test indicator (A1) should be set at zero when the clockwise movement of the pointer stops (17A-01/paragraph 7).

2 Remove the high-pressure pipes from the fuel injection pump. Ensure that a spanner is used to prevent movement of the pump outlets when the high-pressure pipes are removed or fitted.

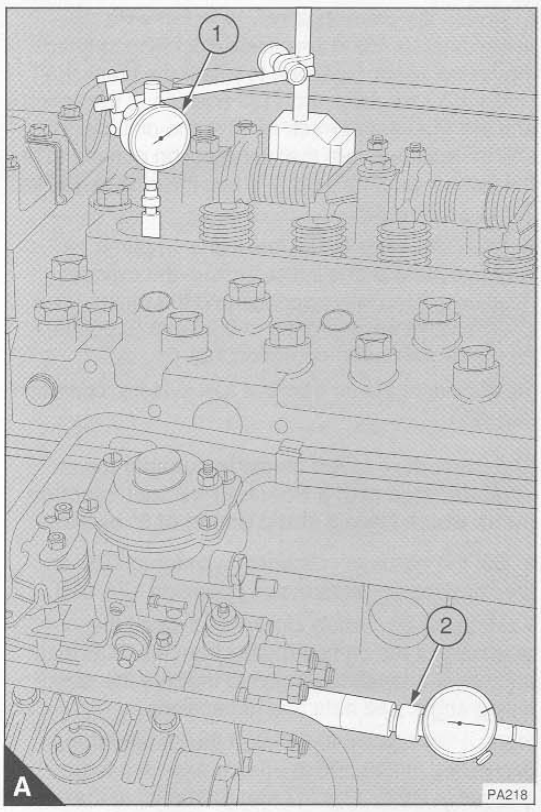
3 Remove the plug and washer from the rear of the fuel pump and fit the adaptor, number MS.107, and a suitable dial gauge (A2). Set the dial gauge to indicate approximately 3,0 mm.

4 Slowly rotate the crankshaft, counter-clockwise from the front of the engine, until the dial gauge indicates that the plunger of the fuel injection pump is at the bottom of its stroke. Set the dial to zero.

5 Slowly rotate the crankshaft clockwise until the dial gauge on the valve stem indicates the correct position of the piston before TDC, see data and dimensions. The timing of the fuel injection pump is correct if the dial gauge on the pump plunger indicates 1,0 mm (0.039 in).

6 If the timing is not correct, disconnect the remainder of the pipes of the fuel injection pump and loosen the setscrew of support bracket for the pump.

7 To correct the timing, hold the fuel injection pump and release the flange nuts; if a compressor is fitted, it will be necessary to use tool number PD.239 to release the flange nuts nearest the cylinder block. If the gauge on the pump plunger indicates more than 1,0 mm (0.039 in), rotate the fuel pump counter-clockwise, from the rear of the fuel pump, until the gauge indication is 1,0 mm (0.039 in). If the gauge indication is less than 1,0 mm (0.039 in), rotate the fuel pump clockwise until the gauge indication is 1,0 mm (0.039 in). Tighten the flange nuts and the setscrew of the support bracket for the pump.



https://truckmanualshub.com/

8 Rotate the crankshaft counter-clockwise approximately 45°, then slowly clockwise to check the timing again. Continue to rotate the crankshaft clockwise and check the TDC position. If the timing and the TDC are correct, remove the dial gauge and the adaptor from the fuel injection pump and fit the washer and the plug. Tighten the plug to 10 Nm 7 lbf ft (1,0 kgf m)

9 Fit all the pipes to the fuel injection pump. Remove the dial test indicator from the cylinder head and fit the valve springs and the rocker lever. Set the valve tip clearance to 0,20 mm (0.008 in). Fit the rocker cover, operation 12A-01.

10 Eliminate the air from the fuel system, operation 20A-08A.

The procedure given below is suitable for engines fitted with a Bosch EPVE fuel injection pump which have a static timing of 9° or less.

1 Set the piston of number 1 cylinder to TDC on the compression stroke, see operation 17A-01B.

2 Measure accurately clockwise around the periphery of the damper/pulley from the TDC mark and make a temporary mark to indicate the static timing angle, see data and dimensions.

Note: 1° is 1,8 mm (0.07 in) at the circumference of a pulley of 203 mm (8 in) diameter. If a large damper is fitted, 1° is 2,7 mm (0.106 in) at the circumference of a damper of 310 mm (12.2 in) diameter or 2,9 mm (0.114 in) for a damper of 327 mm (12.9 in) diameter.

If a pulley of a different size is fitted use the formulea below to find the measurement for the temporary mark for the static timing:

$$\frac{C \times P}{360}$$

C = circumferance of pulley or damper

P = Static timing angle, refer to the data and dimensons

3 Remove the high-pressure pipes from the fuel injection pump and fit the adaptor and dial gauge to the rear of the pump, see paragraphs 2, 3 and 4 of operation 17A-03.

4 Rotate the crankshaft counter clockwise for 1/8 of a turn. Slowly rotate the crankshaft clockwise until the timing mark on the damper/pulley aligns accurately with the tip of the pointer. With the crankshaft in this position, the timing is correct if the dial gauge on the pump plunger indicates 1,0 mm (0.039 in).

5 If the timing is not correct see paragraphs 6 and 7 of operation 17A-03.

6 Rotate the crankshaft 1/8 of a turn counter-clockwise, then slowly clockwise to align the timing mark with the tip of the pointer and check the timing again. If the timing is correct, remove the dial gauge and the adaptor from the rear of the pump. Fit a new washer and the plug and tighten the plug to 10 Nm (7 lbf ft) 1,0 kgf m.

7 Fit the fuel pipes to the fuel pump. Remove the temporary marks from the damper/pulley. Remove the temporary pointer from the timing case. Fit the rocker cover, operation 12A-01.

8 Eliminate the air from the fuel system, operation 20A-08A.

https://truckmanualshub.com/

To check the timing mark of the fuel injection pump 17A-04

Special tools:

Pump timing gauge, MS.107

Universal timing gauge, MS.67B

Gear adaptor for use with MS.67B, PD.67-3

Note: Only early Bosch EPVE pumps have a mark on the flange. The mark was removed when the locking screw was introduced.

1 Remove the fuel injection pump, operation 20A-06A.

2 Fit the adaptor PD.67-3 to the drive shaft of the fuel pump (A) and fasten it with the nut of the fuel pump gear.

3 Release the screw (B3), set the timing tool to the correct angle, see data and dimensions, and tighten the screw.

4 Fit the timing tool to the splined adaptor on the fuel pump drive. Release the screw (B1), slide the pointer (B2) forward until it is over the centre of the fuel pump flange and tighten the screw. Rotate the timing tool and the pump shaft to align the master spline with the number 1 outlet of the pump (outlet "C").

5 Remove the plug and the washer from the centre of the rear of the fuel pump and fit the adaptor MS.107. Fit a dial gauge to the adaptor and set the gauge to indicate approximately 2,0 mm (0.080 in).

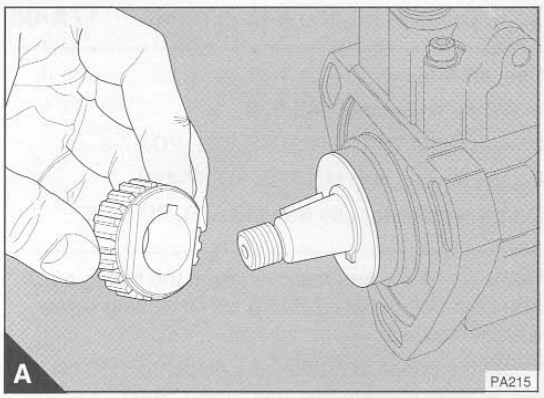
6 With the fuel injection pump held securely, rotate the tool and the drive shaft counter-clockwise, from the drive end, and set the dial gauge to zero when the pump plunger is at its lowest position. Keep the fuel pump secure and rotate the drive shaft clockwise until the gauge indicates 1,0 mm (0.039 in) plunger lift. At this position the slot in the pointer of the timing tool must align with the mark on the flange of the fuel pump.

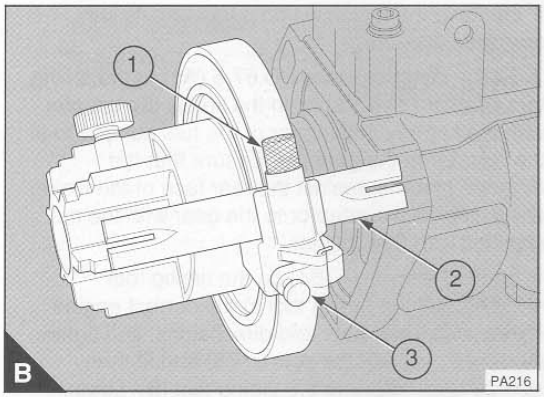
8 If the mark is not correct, remove the timing tool and eliminate the mark on the flange. Fit the timing tool and repeat the above operation to obtain 1,0 mm (0.039 in) plunger lift. With the fuel injection pump and timing tool held securely in the correct position, make a new mark on the flange of the fuel pump, within the slot of the pointer. Release the timing tool and repeat the operation to check that the new mark is correct.

9 Remove the timing tool, splined adaptor and the adaptor and dial gauge. Fit the washer and plug to the rear of the fuel pump.

10 Fit the fuel injection pump, operation 20A-06A.

11 Eliminate air from the fuel system, operation 20A-08A.





https://truckmanualshub.com/

To check the engine timing mark 17A-05

Special tools:

Universal timing tool, MS.67B

Drive adaptor for use with MS.67B, PD.67-2

Pointer for use with MS.67B, PD.67-4

Distance piece for use with MS.67B, PD.67-5

Note: The mark was removed from the timing case when the Bosch EPVE Pump with a locking screw was introduced.

1 Set the piston of number 1 cylinder to TDC on the compression stroke, operation 17A-01.

2 Remove the fuel injection pump and its joint, operation 20A-06A.

3 Fit the distance piece PD.67-5 (A1) to the timing tool adaptor PD.67-2. Align the key in the adaptor with the keyway in the gear of the fuel pump and fit the adaptor to the gear (A). Ensure that the distance piece is against the rear face of the timing case. Secure the adaptor to the gear with the nut supplied with the adaptor.

4 Loosen the screw (B4) on the timing tool MS.67B. Set the timing tool to the correct engine check angle, see data and dimensions, and tighten the screw. Loosen the screw (B5) and fit the splined shaft (B3) into the timing tool (B). Loosen the screw (B2). Fit the 90° pointer PD.67-4 (B1) and tighten the screw.

5 Fit the splined shaft of the timing tool to the adaptor. Slide the timing tool along the splined shaft until it is against the adaptor and tighten the screw (B5).

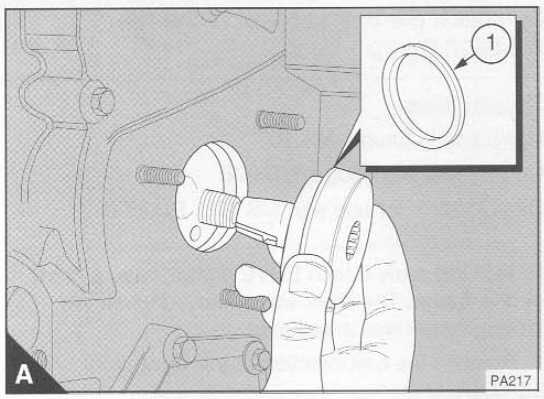
6 Loosen the screw (B2). Slide the pointer forward until the flat face is against the rear face of the timing case and tighten the screw. If the mark on the timing case is correct, the mark will align with the top edge of the pointer (B1). If the mark is not correct, remove the timing tool and eliminate the mark on the timing case. Fit the timing tool. Ensure that the pointer is against the timing case and make a new mark on the timing case along the top straight edge of the pointer.

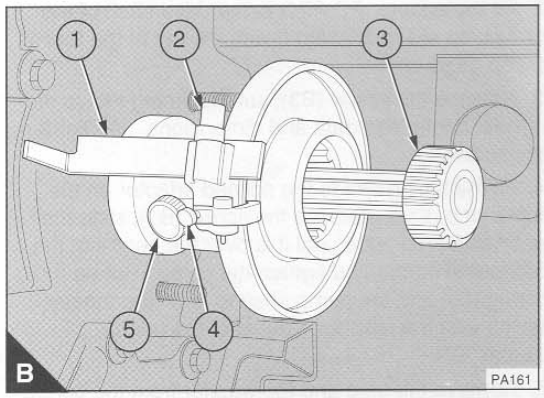
7 Remove the timing tool and the adaptor.

8 Fit the fuel pump together with a new joint, operation 20A-06A.

9 Remove the dial test indicator from the cylinder head and fit the valve springs and the rocker lever. Set the valve tip clearance of number 1 cylinder inlet valve to 0,20 mm (0.008 in). Fit the rocker cover, operation 12A-01.

10 Eliminate air from the fuel system, operation 20A-08A.





https://truckmanualshub.com/

Engines fitted with P7100 AD PB in-line fuel injection pumps 17B

Engine timing

General description 17B.02

17B-01 To set number 1 piston to TDC on the compression stroke refer to 17A.04
17B-02 To check the valve timing ..... refer to 17A.04
17B-03 To check the timing of the fuel injection pump 17B.03

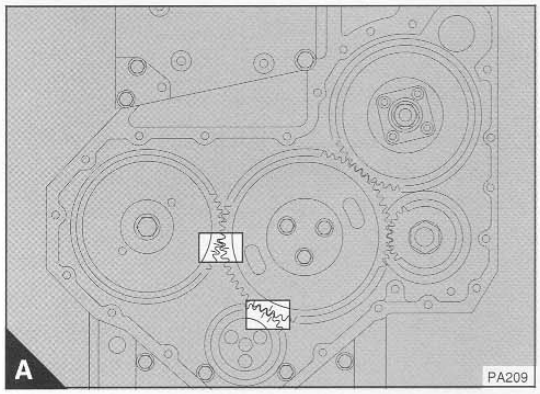
Data and dimensions 17B.05

https://truckmanualshub.com/

General description

The timing gears are stamped with timing marks to ensure that they are assembled correctly (A). The stamped teeth of the crankshaft and camshaft gears will be in mesh with the idler gear when number 1 piston is at top dead centre (TDC) on the compression stroke. The marked teeth of the idler gear may not necessarily be in mesh, in this position, due to the different speeds at which the gears rotate.

There are no timing marks on the fuel pump gear of engine types AE and YE. The gear, which is fastened to a hub on the drive shaft of the fuel injection pump, has slots to allow adjustment to the timing.



Notes:

- The maximum no load speed (B3) set by Lovol may be reset by the equipment manufacturer. If the speed is changed the new speed is shown in the high idle reset position (B4). The original maximum no load speed should be eliminated.
- The adjustment screw for the maximum no load speed, is sealed by the manufacturer. The setting must not be changed, unless approved, as it could affect the warranty of the engine.

For details of the fuel pump code for the engine see the data and dimensions at the end of this section.

https://truckmanualshub.com/

To check the timing of the fuel injection pump — 17B-03

Special tools:

Piston position tool, PD.221

Timing light, KJ37007

1 Remove the rocker cover, operation 12A-01.

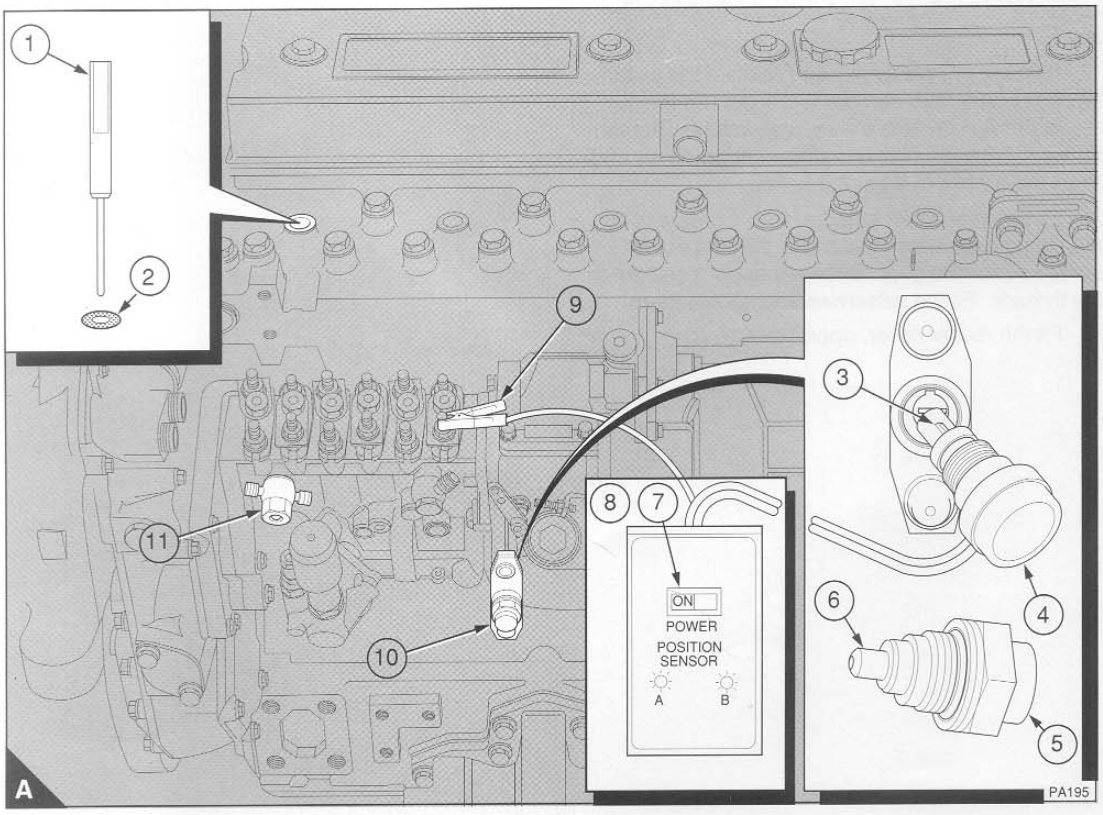
2 Loosen the setscrews which retain the atomisers.

3 Rotate the crankshaft clockwise, from the front, until the push rod for the inlet valve of number 1 cylinder just releases.

Note: A locally made washer (A2) must be fitted onto the piston position probe (A1) when the engine check angle is less than 100 degrees BTDC. See the data and dimensions for details.

4 Remove the atomiser from number 1 cylinder together with its seat washer and put the piston position probe, PD.221, (A1) in its place. Fit the atomiser clamp to the probe and tighten the setscrews gradually and evenly.

5 Remove the cap (A5) and its washer from the timing attachment (A10) on the governor housing. Ensure that the plastic pin (A6) in the cap is not lost. Put the probe (A4) of the timing light, KJ37007, (A8) into the timing attachment. Ensure that the spline (A3) on the probe is at the top and enters the slot in the timing attachment.Tighten the outer body of the probe. Connect the earth cable (A9) to the engine in a place where there will be a good earth connection. Press the switch (A7) on the timing light to the "ON" position.



https://truckmanualshub.com/

Caution: *Ensure that the piston comes lightly into contact with the piston position probe, or both the piston and the probe could be damaged.*

6 Very carefully rotate the crankshaft clockwise until the piston just comes into contact with the piston position probe.

7 The timing is correct when the two lamps on the timing light are illuminated.

If both of the lamps are not illuminated, release the setscrews and remove the gear cover from the timing case cover. Loosen the cap screws which retain the fuel pump gear. Adjust the position of the fuel injection pump hub until both lamps are illuminated. Tighten the cap screws to 35 Nm (26 lbf ft) 3,6 kgf m.

8 To check the timing is correct: Rotate the crankshaft counter-clockwise, from the front of the engine to move the piston away from the probe and repeat paragraphs six and seven above.

9 Press the switch on the timing light to the "OFF" position. Disconnect the earth cable from the engine. Release the outer body of the probe and remove the probe from the timing attachment and remove the timing light.

10 Check that the brass end of the plastic pin can be seen in the cap for the timing attachment. Fit the cap together with a new washer.

Caution: *If the plastic pin is not put into the cap correctly, damage could occur to the fuel injection pump.*

11 Release the setscrews and remove the piston position probe from number 1 cylinder. Fit the atomiser together with a new seat washer. Tighten the setscrews for all of the atomisers gradually and evenly to 12 Nm (9 lbf ft) 1,2 kgf m.

12 Fit the gear cover together with a new joint to the timing case cover. Clean the threads of the setscrews for the gear cover and apply a sealant to the threads. Fit the setscrews and tighten them.

13 Fit the rocker cover, operation 12A-01.

Supplement: To check the timing of the fuel injection pump no timing light

1. Based on the instructions in Page 17A.04 in the Workshop Manual, make marks to indicate the position when the piston of the first cylinder is at top dead center. The marks should be made on the gear housing cover and the pulley respectively.

2. Dismount the high-pressure fuel pipes of the first cylinder, and pull the fuel amount control bar to its maximum position. Turn the crankshaft clockwise viewed from the front end of the engine, until the piston of the first cylinder reaches TDC.

3. Turn the crankshaft anticlockwise at an angle of over 60°. Then turn the crankshaft clockwise slowly, meanwhile observe the fuel level in the fuel outlet valve. As soon as the fuel level begins to fluctuate, indicating the beginning of fuel supply of the first cylinde, you should stop turning the crankshaft. Measure the angle between the line on the gea housing cover and that on the belt pulley, nam y the fuel supply angle. If the latter line is befor the former line, then the fuel is supplied in advance. Otherwise, the fuel supply is retarde

4. If the fuel supply angle is not desirable, then it can be adjusted by using the holes on the flange at pump end after loosening the nuts on the pump bracket and the flange at pump end. The fuel supply angle can be increased by leaning the pump toward the engine. Otherwise it can be decreased. Corresponding to 1mm distance moved by the outer edge of the pump flange, the fuel supply angle will be adjusted at about 1°CA.

5. Once the fuel supply angle becomes suitable, the nuts on the flange at the pump end, and the bolts on the pump bracket, should be screwed down to the required torque. Then repeat step 3 and check the fuel supply angle.

https://truckmanualshub.com/

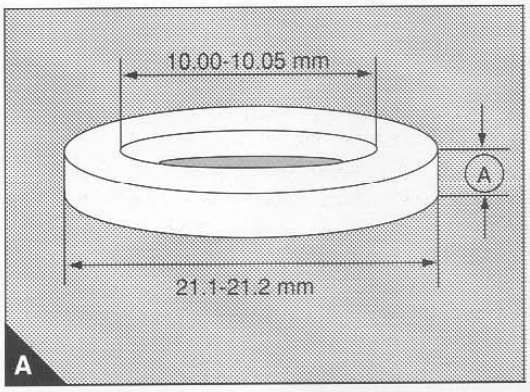
Data and dimensions

in-line fuel injection pump

Direction of rotation from drive end ..... Clockwise
Outlet for number 1 cylinder ..... Drive end of fuel pump

Engine check angle (degrees)	Piston position probe washer thickness (mm)
98	2.302 **(1)**
100	
100	
100	
100	

Table 1



The piston position probe PD 221 is used to set the engine check angle to 100 degrees BTDC.

A locally made washer (A) must be fitted onto the piston position probe when the engine check angle is less than 100 degrees BTDC.

The thickness of the piston position probe washer, dimension A, in illustration (A) for a particular engine is shown in shown in table 1. The general dimensions for the piston position probe washer are also shown in (A).

https://truckmanualshub.com/

https://truckmanualshub.com/

Engines fitted with Stanadyne fuel injection pumps 17C

General description 17C.02

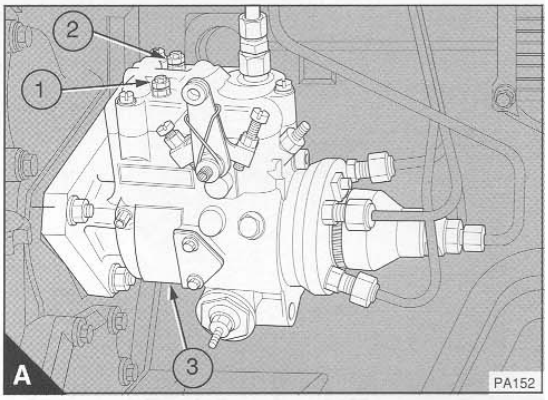
Engine timing

17C-01 To set number 1 piston to TDC on the compression stroke refer to 17A.03
17C-02 To check the valve timing ..... refer to 17A.04
17C-03 To check the timing of the fuel injection pump 17C.03
17C-04 To check the timing mark of the fuel injection pump 17C.04
17C-05 To check the engine timing mark 17C.05

https://truckmanualshub.com/

General description

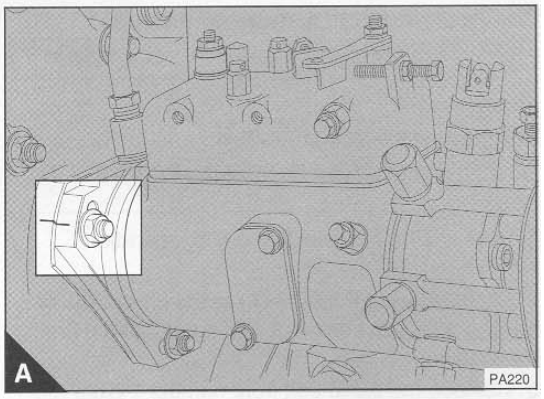
The electrical stop solenoid on these fuel pumps is fitted inside the governor housing. The earth connection (A1) and the electrical connection (A2) are on top of the governor housing.



https://truckmanualshub.com/

To check the timing of the fuel injection pump 17C-03

If the mark on the flange of the fuel injection pump is in line with the mark on the timing case (A), the timing of the fuel injection pump should be correct. If the timing marks are in line and the engine performance indicates that the timing is not correct, check that the marks on the flange and on the timing case are in their correct positions, operations 17C-04 and 17C-05.



https://truckmanualshub.com/

To check the timing mark of the fuel injection pump 17C-04

Special tools:

Universal timing tool, MS.67B

Gear adaptor for use with MS.67B, PD.67-3

1 Remove the fuel injection pump, operation 20A-06D.

2 Fit the adaptor PD.67-3 (A) to the drive shaft of the fuel pump and fasten it with the nut of the fuel pump gear.

3 Remove the banjo bolt from number 1 high-pressure outlet - outlet "W" for four cylinder engines, outlet "Y" for six cylinder engines - and fit a banjo bolt which does not contain a pressure valve.

4 Connect number 1 outlet to an atomiser tester. Operate the hand pump until a pressure of 30 atm (440 lbf in^2) 31 kgf/cm^2 is indicated on the gauge.

5 Loosen the screw (B3) on the timing tool MS.67B and set the timing tool to the correct angle, see data and dimensions. Tighten the screw.

6 Fit the timing tool to the adaptor on the fuel pump drive shaft. Rotate the drive shaft of the fuel pump by hand in the normal direction of rotation - see arrow on pump data plate - until the fuel pressure prevents movement. In this position, the fuel pump is set at the start of injection from number 1 outlet.

7 Loosen the screw (B1). Slide the pointer (B2) forward until it is over the centre of the pump flange and check that the mark on the flange is in the centre of the slot in the pointer.

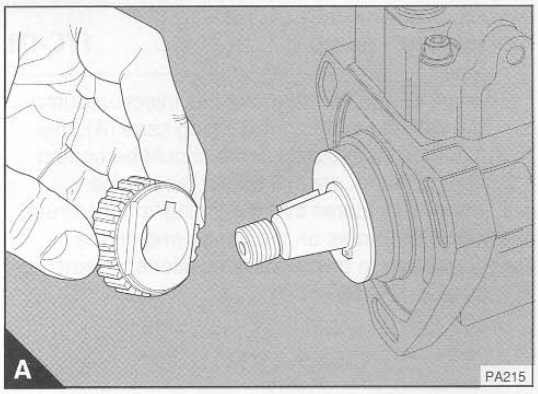
8 If the mark is not correct, remove the timing tool and eliminate the mark. Fit the timing tool and ensure that the fuel pump is at the start of injection for number 1 cylinder. Loosen the screw (B1). Slide the pointer forward to the complete width of the flange and tighten the screw. Make a new mark on the flange of the pump through the slot in the pointer.

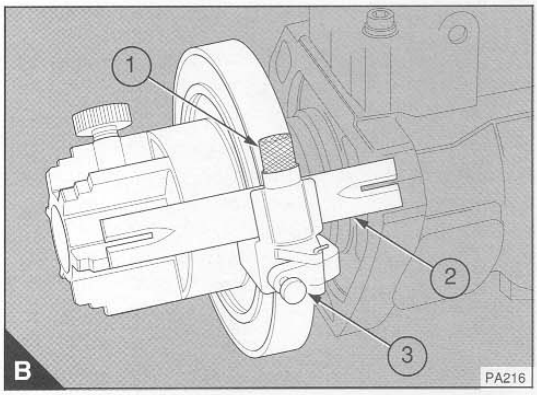
9 Remove the timing tool and the adaptor.

10 Disconnect the atomiser tester and fit the original banjo bolt to number 1 high-pressure outlet.

11 Fit the fuel injection pump, operation 20C-06.

12 Eliminate air from the fuel system, operation 20C-08.





https://truckmanualshub.com/

To check the engine timing mark 17C-05

Special tools:

Universal timing tool, MS.67B

Adaptor for use with MS.67B, PD.67-2

Pointer for use with MS.67B, PD.67-4

1 Set the piston of number 1 cylinder to TDC on the compression stroke, operation 17C-01.

2 Remove the fuel injection pump and its joint, operation 20C-06.

3 Align the key in the adaptor PD.67-2 (A) with the keyway in the gear of the fuel injection pump and fit the adaptor to the gear. Ensure that the adaptor is against the rear face of the timing case. Secure the adaptor to the gear with the nut supplied with the adaptor.

4 Loosen the screw (B4) on the timing tool MS.67B. Set the timing tool to the correct engine check angle, see data and dimensions, and tighten the screw. Loosen the screw (B5) and fit the splined shaft (B3) into the timing tool (B). Loosen the screw (B2). Fit the 90° pointer PD.67-4 (B1) and tighten the screw.

5 Fit the splined shaft of the timing tool to the adaptor. Slide the timing tool along the splined shaft until it is against the adaptor and tighten the screw (B5).

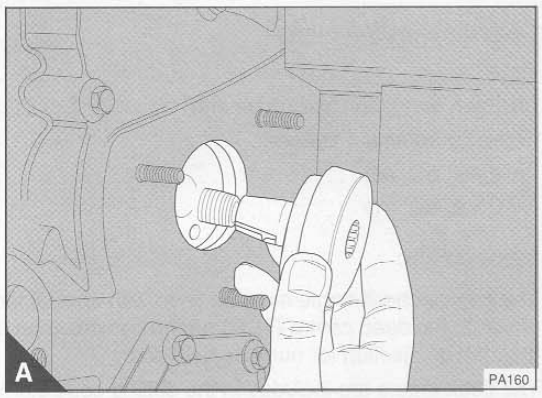
6 Loosen the lock screw (B2). Slide the pointer forward until the flat face is against the rear face of the timing case and tighten the screw. If the mark on the timing case is correct, the mark will align with the top edge of the pointer (B1). If the mark is not correct, remove the timing tool and eliminate the mark on the timing case. Fit the timing tool. Ensure that the pointer is against the timing case and make a new mark on the timing case along the top straight edge of the pointer.

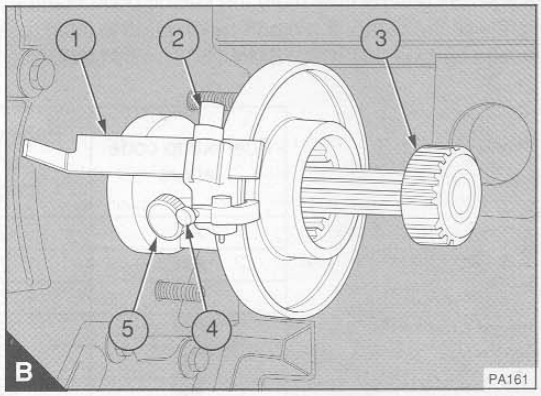
7 Remove the timing tool and the adaptor.

8 Fit the fuel injection pump and a new joint, operation 20C-06.

9 Remove the dial gauge from number 1 cylinder inlet valve and fit the valve springs and the rocker lever. Set the valve tip clearance of number 1 cylinder inlet valve to 0,20 mm (0.008 in). Fit the rocker cover, operation 12A-01.

10 Eliminate air from the fuel system, operation 20C-08.





https://truckmanualshub.com/

https://truckmanualshub.com/

Four cylinder unit pump

General Description..……17D.02
Engine timing
17D-01 Adjust the number 1 piston to the TDP during the compression stroke……refer to 17A.04
17D-02 Check the valve timing…… refer to 17A.04
17D-03 Check the fuel injecting pump timing…….. 17D.03

https://truckmanualshub.com/

General Description:

On Phaser series engines, electronic control unit pump is used and is modified and improved in combustion system to satisfy the emission standard defined in EURO III..

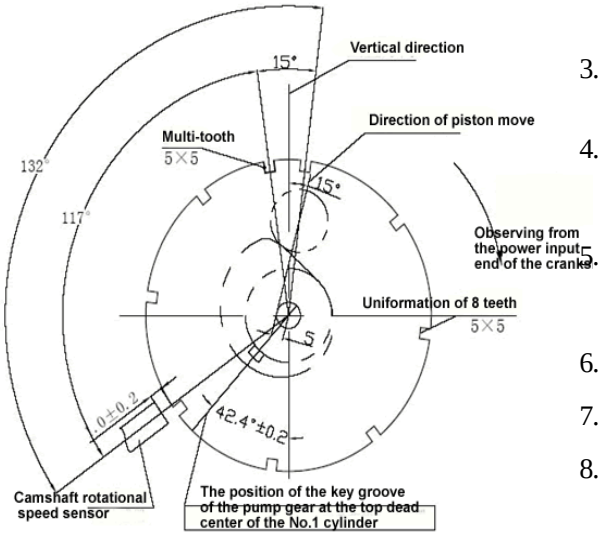
https://truckmanualshub.com/

Engine timing

Check the fuel injecting pump timing 17D-03

Electronic control unit identifies the rotational speed and working phase with rotational speed sensor, so as to ensure the correctness of the injecting timing of fuel system which means ensuring injecting fuel at a suitable time. The phases of the system consist Cam phase and crankshaft phase, see diagram “installation phase scheme” for the detail. The design of phase is based on the TDC of compression stroke of number 1 cylinder during its TDC.

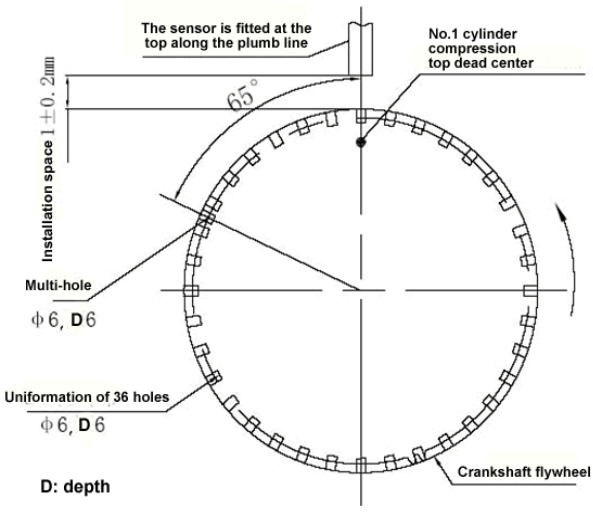
1. Check the crankshaft phase: whether the angel from the multiple holes of signal panel to the probe of rotational speed sensor is 65° along the rotation direction of crankshaft when number 1(engine piston) cylinder is on the TDC of compression stroke.
2. Check the Cam phase: Method 1: when number 1 cylinder (engine piston) is on the TDC of compression stroke, rotate the flywheel along the rotational direction of crankshaft and check the rotation angel of key slot of Cam of injection pump according to related requirement when number 1 cylinder (engine piston) is on the TDC of compression stroke.
3. Method 2: when number 1 cylinder (engine piston) is on the TDC of compression stroke, check the Cam lift value of injection pump according to related requirement (it can be checked with processing pump).



Pump Cam Phase

Technical requirement

1. This diagram shows the state at compression top dead center of number 1 cylinder (the cone surface end of camshaft as the number 1 cylinder).
2. The angel between the installation axial line of the pump (the direction of piston moving) and the vertical direction is 15º.
3. The position of the signal sensor of the camshaft is determined by the user (it can be allocated along the axle direction); the installation hole of the sensor
4. When the number 1 cylinder piston is at the compression top dead center, the angle between the camshaft key groove and the vertical direction is 42.4 ± 0.2º (in the view of pump gear).
5. When the number 1 cylinder piston is at the compression top dead center, the angle between the cam signal panel multihole and the camshaft rotational speed sensor is 117º (in the direction of rotation).
6. The angle between the cam signal panel multihole and the normal hole is 15º.
7. The size of the signal groove of the cam signal panel is as above diagram.
8. The thickness of the cam signal panel is 5m; the jumping distance of the signal panel shall not be above 0.05m when rotating in high-speed.
9. The tolerance of unlabelled angel tolerance adopt GB/T1804-n grade.



Crankshaft phase

Technical requirement

1. When the number 1 cylinder piston is at the compression top dead center, the angle between the camshaft multihole position and the camshaft sensor is 65.
2. The angle between the crankshaft signal panel multihole and the normal hole is 15º.
3. The size of the crankshaft signal hole is φ6 with the hole-depth of 6m.
4. The crankshaft signal sensor is installed right above the flywheel shell (or determined by the user and allocated along the axle direction), the connection between the installation hole and the sensor monitor shall be tangent with the moving direction of the flywheel signal hole (this direction is the signal sensitive direction).
5. The radial jumping range of the flywheel signal panel shall be less than 0.1m.
6. The tolerance of unlabelled angel tolerance adopt GB/T1804-n grade.

https://truckmanualshub.com/

https://truckmanualshub.com/

Six cylinder unit pump

General Description.……17D.02

Engine timing

17E-01 Adjust the number 1 piston to the TDP during the compression stroke .refer to 17A.04

17E-02 Check the valve timing…… refer to 17A.04

17E-03 Check the fuel injecting pump timing…… 17E.03

Engine timing

https://truckmanualshub.com/

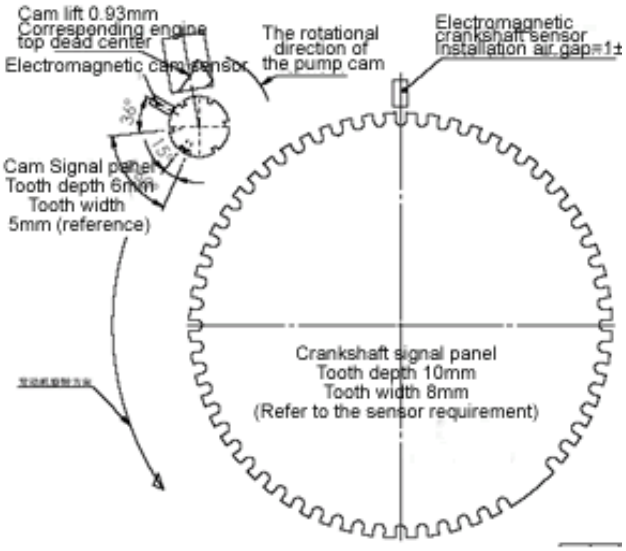
Check the fuel injecting pump timing 17E-03

Check the fuel injecting pump timing

Electronic control unit identifies the rotational speed and working phase with rotational speed sensor, so as to ensure the correctness of the injecting timing of fuel system which means ensuring injecting fuel at a suitable time. The phases of the system consist of Cam phase and crankshaft phase, see diagram “Cam phase and crankshaft phase” for the detail. The design of phase is based on the TDP of compressor of number 1 cylinder during its TDC.

1. Check the crankshaft phase: whether the angel from the slot on the rim of flywheel groove to the probe of rotational speed sensor is 108° along the rotation direction of crankshaft when number 1(engine piston) cylinder is on the TDC of compression stroke.
2. Check the Cam phase: Method 1: when number 1 cylinder (engine piston) is on the TDC of compression stroke, rotate the flywheel along the rotational direction of crankshaft and check the rotation angel of key slot of Cam of injection pump according to related requirement when number 1 cylinder (engine piston) is on the TDC of compression stroke.

Method 2: when number 1 cylinder (engine piston) is on the TDC of compression stroke, check the Cam lift value of injection pump according to related requirement (it can be checked with processing pump).



Pump cam phase and crankshaft phase

Technical requirement

1. During the mechanical installation, ensure the No.1 cylinder lift to be 6.93mm ± 0.05mm which corresponds to the No.1 cylinder compression top dead center;
2. Above relevant sizes of crankshaft and cam signal is the mechanical angle; the signal angel may be diversity due to the installation of the sensor and the affection of the output specification.
3. This diagram can be the design reference of the engine flywheel, which request the center of the electromagnetic sensor align to the center of the thirty sixth groove of the flywheel when the engine is on the top dead center of the No.1 cylinder.

https://truckmanualshub.com/

Aspiration system 18

General description 18A.02

Turbocharger

18A-01 To remove and to fit 18A.03
18A-02 To clean the impeller and the compressor casing 18A.06
18A-03 To remove and to fit the actuator assembly of the waste-gate unit 18A.07
18A-04 To check and to adjust the operation of the waste-gate 18A.08

Turbocharger faults 18A.10

Engine breather systems

18A-05 Open engine breather 18A.12
18A-06 Closed engine breather 18A.13

Data and dimensions 18A.14

EGR inlet system

18A-07 EGR inlet system 18A. 15

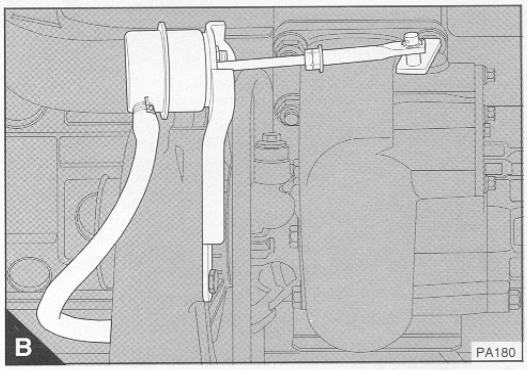
https://truckmanualshub.com/

General description

Warning! *Turbochargers operate at high speed and at high temperatures. Keep fingers, tools and other objects away from the inlet and outlet ports of the turbocharger and avoid contact with hot surfaces.*

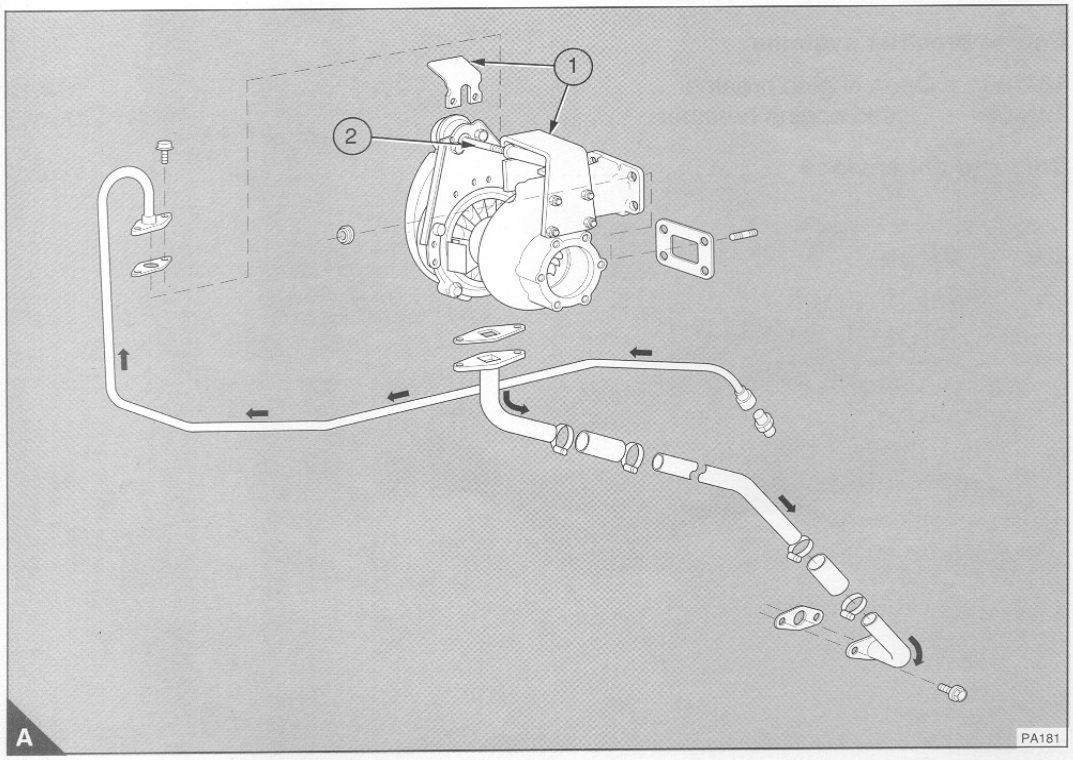
A turbocharger (A), is fitted between the exhaust and induction manifolds. The turbocharger is driven by exhaust gases and supplies air to the engine at more than atmospheric pressure. It is lubricated by oil from the main gallery. The oil passes through the bearing housing of the turbocharger and returns to the lubricating oil sump; arrows are included on the illustration to indicate the typical oil flow.

Some turbochargers are fitted with a waste-gate unit (B). This unit, which is controlled by boost pressure, allows some of the exhaust gases to by-pass the turbine rotor at higher engine speeds. With this arrangement, the turbocharger can be designed to be more effective at lower engine speeds.



A waste-gate guard (A1) is fitted to protect the actuator rod (A2) of some engines.

Always use the manufacturers instructions and specialist assistance to fit the service kit for the turbocharger.



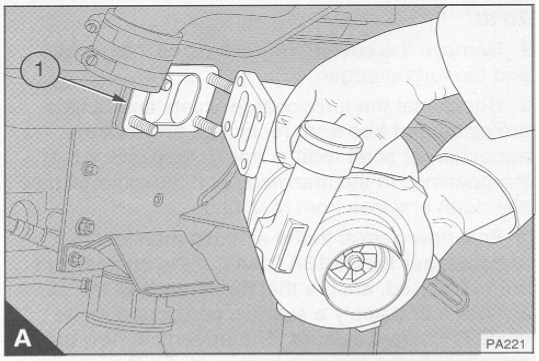
https://truckmanualshub.com/

Turbocharger

To remove and to fit **18A-01**

Consumable products:

Threadlock (pipe)



To remove

1 Thoroughly clean the turbocharger.

2 Remove the air cleaner hose at the compressor inlet.

3 Remove or disconnect the support bracket for the turbocharger. If necessary, remove the heat shield for the fuel lift pump. Remove the exhaust elbow from the turbocharger. Where the elbow has a gasket, release the nuts and remove the elbow and the gasket. Where the elbow has a sleeve, pull the elbow together with the sleeve away from the turbocharger.

4 Release the hose clips and push the hose of the compressor outlet up the elbow of the induction manifold.

5 Release the setscrews from the flange of the oil supply pipe at the top of the bearing housing and the union nut/connection at the other end of the pipe. If the lower section of the oil supply pipe is flexible, use a spanner to hold the hexagon on the pipe while the union connection is removed from the oil filter head/adaptor plate. This will prevent damage to the flexible section of the pipe. If an adaptor is used in the oil filter head/adaptor plate, use a spanner to hold the adaptor when the union nut is released. Remove the pipe and the flange joint.

6 Release the setscrews from the flange of the oil drain pipe at the bottom of the bearing housing. If necessary, release the hose clip(s) from the oil drain pipe and push the hose down. Remove the oil drain pipe and the joint from the flange.

Caution: *If the turbocharger has a waste-gate ensure that the actuator rod of the waste-gate is not used to lift or move the turbocharger. This could damage the waste-gate and affect the calibration.*

7 Release the nuts at the turbocharger to exhaust manifold flange and remove the turbocharger and the gasket. Cover the openings in the manifolds, the turbocharger and the pipes to ensure that dirt, etc. will not enter.

8 Check the air hoses and the oil drain hose for cracks or other damage and renew them, if necessary.

https://truckmanualshub.com/

To fit

1 Remove the covers from the pipes, manifolds and the turbocharger.

2 Check that the turbocharger inlets and outlets are clean and free from restriction and that the turbocharger shaft rotates freely. Also check that the openings in the manifolds and the exhaust pipe are clean and free from restriction.

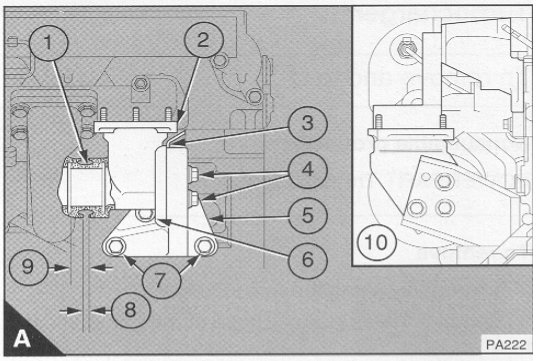
3 Fit a new gasket to the exhaust manifold to turbocharger flange 18A.03/A1. If the original nuts are to be used, ensure that the threads of the studs are clean and apply a suitable compound to the studs to prevent seizure. The threads of new nuts are phosphated to prevent seizure. Fit the turbocharger. Fit the nuts and tighten them to 44 Nm (33 lbf ft) 4,5 kgf m.

4 Lubricate the bearing housing of the turbocharger with clean engine lubricating oil. Fit the oil supply pipe together with a new joint and tighten the flange setscrews. If the lower section of the pipe is flexible, clean the thread of the union connection and apply POWERPART Threadlock (pipe). Ensure that dirt does not enter the oil filter head/adaptor plate. Use a spanner to hold the hexagon on the pipe while the union connection is fitted to the oil filter head/adaptor plate. If an adaptor is used in the oil filter head/adaptor plate, use a spanner to hold the adaptor when the union nut is tightened.

5 Fit the oil drain pipe together with a new joint and tighten the flange setscrews, but do not connect the hose.

6 Where the exhaust elbow has a flange, clean the threads of the studs in the flange of the turbocharger. Apply a suitable compound to the studs to prevent seizure of the nuts. Put a new gasket in position on the flange and fit the elbow. Tighten the nuts to 22 Nm (16 lbf ft) 2,2 kgf m (plated) or 25 Nm (18 lbf ft) 2,5 kgf m (non-plated). Fit or connect the support bracket between the elbow and the cylinder block. Ensure that there is no stress on the exhaust elbow. If necessary fit the heat shield for the fuel lift pump.

7 Where the exhaust elbow (A2) has a sleeve (A1), check that the sleeve protrusion from the end of the elbow is 23 mm (0.90in) (A9).



https://truckmanualshub.com/

8 Fit the elbow in the correct position to the support bracket (A5) and tighten the setscrews (A4) finger tight. Some engines have an aluminium heat shield (A3) between the elbow and the bracket.

9 Fit the sleeve together with the elbow and bracket into the turbocharger outlet. Fit the setscrews (A6 and A7) which hold the bracket to the cylinder block, finger tight. Ensure that the setscrew (A6) has a thick washer fitted between the setscrew and the bracket.

10 Where the elbow is fitted vertically, check that the top face of the elbow flange is at 90° to the outer face of the inlet manifold (A10).

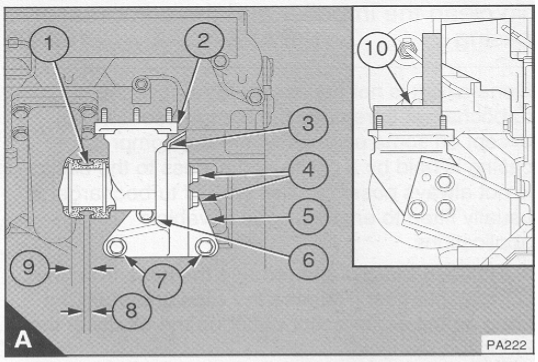
11 Fully tighten the setscrews that hold the bracket to the elbow. Check that there is a gap of 6,5 mm (0.25 in) (A8) between the turbocharger outlet and the end of the elbow. This gap should be equal all around the elbow. Fully tighten the setscrews that hold the bracket to the cylinder block.

12 Where the elbow is fitted vertically, check again that the top face of the elbow flange is at 90° to the outer face of the inlet manifold.

13 Slide the hose on the induction manifold elbow onto the compressor outlet and tighten the hose clips.

14 Check that there is no restriction in the air filter to turbocharger hose. Fit the hose and tighten the clip.

15 Operate the stop control or, where fitted, disconnect the electrical stop control. Operate the starter motor until there is a flow of lubricating oil from the oil drain pipe of the turbocharger. Connect the oil drain pipe. Where fitted, connect the electrical stop control.



https://truckmanualshub.com/

To clean the impeller and the compressor casing 18A-02

Generally, it is not necessary to remove the turbocharger to remove the compressor casing, except on some engines where the compressor casing is held by a circlip and access to the circlip is not always possible. This type of turbocharger is usually fitted to engines used in vehicle applications.

1 Release the clip and remove the hose from the compressor inlet. Release the clips and push the hose on the compressor outlet up the elbow of the induction manifold.

2 Make a reference mark on the compressor casing (A1) and on the bearing housing to ensure correct assembly later.

3 Release the setscrews and remove the lock plates. If the compressor casing is retained by a circlip, remove the circlip. It may be necessary to remove the turbocharger if access to the circlip is not possible. If the turbocharger has a waste-gate unit, remove the actuator and bracket assembly, see operation 18A-03.

Caution: *Be careful not to damage the impeller blades. If the impeller is damaged, the turbocharger must be renewed.*

4 Remove carefully the compressor casing from the turbocharger (A). If the casing is tight, lightly hit it with a soft faced hammer.

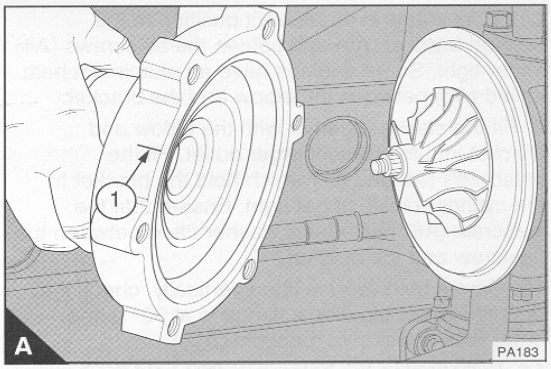
5 Put the compressor casing in a suitable container that contains a non-caustic solution. Allow the dirt to become soft and then clean the casing with a hard brush and/or a soft scraper. Dry the casing with clean, compressed air at low pressure.

6 Clean the impeller with a soft brush.

7 Push carefully the compressor impeller towards the bearing housing and turn the impeller by hand. Check that there is no restriction of movement and that there is no noise which can indicate a fault. If there is a fault, remove the turbocharger for inspection by a specialist.

8 Fit the casing to the turbocharger and align the mark on the casing with the mark on the bearing housing. Fit the lock plates and the setscrews and tighten the setscrews.If the compressor casing of the turbocharger is retained by a circlip, fit the circlip loosely to the bearing housing. Ensure that the flat face of the circlip is toward the compressor casing. Fit the casing to the turbocharger and align the marks on the casing and on the bearing housing. Fit the circlip in its groove. If the turbocharger has a waste-gate unit, fit the actuator and bracket assembly, see operation 18A-03.

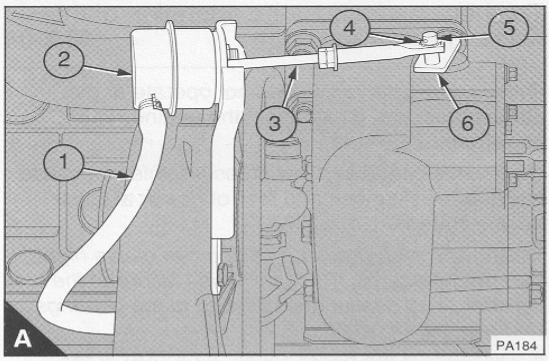
9 Fit the hoses to the compressor inlet and outlet and tighten the clips.



10 If necessary, fit the turbocharger to the engine, operation 18A-01.

https://truckmanualshub.com/

To remove and to fit the actuator assembly of the waste-gate unit 18A-03



It is important that the wastegate actuator setting is not altered. Do not remove the actuator or mounting bracket unless it is necessary to renew the actuator assembly.

If a wastegate actuator or mounting bracket assembly is removed from a turbine or compressor housing it is important that the bracket is fitted into the correct position on the housing.

To remove

1 Disconnect the boost sensor pipe (A1) at the actuator (A2).

2 Remove the clip (A4) which retains the actuator rod (A3) and lift the end of the actuator rod off the pin (A5) of the waste-gate valve.

3 Release the setscrews which retain the actuator bracket to the turbocharger and remove the actuator and bracket assembly.

To fit

1 Put the actuator and bracket assembly in position on the turbocharger and tighten the setscrews.

2 Connect to the actuator (A2) an air supply which can be adjusted accurately and is fitted with an accurate gauge.

3 Operate the arm (A6) of the waste-gate valve by hand to check that the valve is free to move.

4 Push the arm of the waste-gate valve as far as possible toward the actuator and hold the arm in this position. Slowly apply air pressure to the actuator until the end of the actuator rod (A3) will fit easily onto the pin (A5) of the waste-gate valve. Fit the clip (A4). Release the air pressure.

Caution: *Do not apply an air pressure of more than 205 kPa (30 lbf/in^2) 2,1 kgf/cm^2 to the actuator. Higher pressures may damage the actuator.*

5 Check the operation of the waste-gate unit, operation 18A-04.

https://truckmanualshub.com/

To check and adjust the operation of the waste-gate 18A-04

If the waste-gate valve does not operate at the correct pressure, it can affect the engine performance.

If the valve opens at a low pressure, this can cause black exhaust smoke and loss of power at lower engine speeds.

Caution: *A high pressure setting can cause high cylinder pressures. This can cause failure of the cylinder head gasket and damage to the bearings and pistons.*

1 Disconnect the boost sensor pipe (A6) at the actuator. Connect to the actuator an air supply which can be adjusted accurately and is fitted with an accurate gauge.

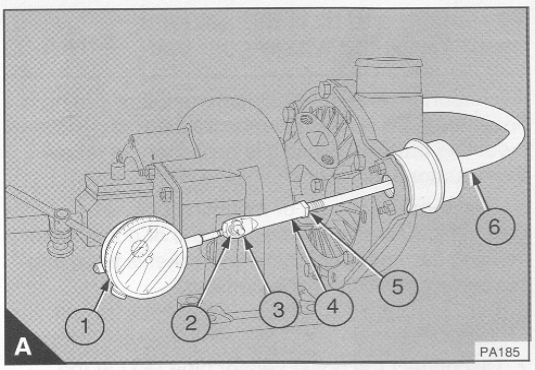
2 Fasten a dial test indicator (A1) to the turbocharger with its plunger in contact with the end of the actuator rod (A4) to measure the axial movement of the rod.

3 Slowly apply air pressure. Check that the pressure necessary to move the rod 1,00 mm (0.039 in), is within the limits shown in the data and dimensions at the end of this section. Ensure that the pointer returns to zero when the pressure is released. Repeat the test several times to ensure that an accurate reading is obtained. It may be necessary to lightly hit the turbine housing with a soft hammer during the test operation.

4 If the operation of the waste-gate is not correct, the actuator rod can be adjusted.

5 Remove the dial gauge from the end of the actuator rod.

6 With the air pressure still applied, release the locknut (A5) on the actuator arm. Remove the clip (A2) and remove the actuator rod from the pin (A3) on the arm of the waste-gate valve.



https://truckmanualshub.com/

7 If the air pressure is too low, rotate the end of the actuator rod to reduce the length of the actuator rod. If the air pressure is too high, rotate the end of the actuator rod to increase the length of the actuator rod. Rotate the end of the actuator rod in half turn increments.

Caution: *Use only the end of the threaded rod to make adjustments. To pull or push the actuator rod could change the calibration of the actuator. The result could be damage to the engine because of too much boost.*

8 Put the actuator rod in position on the pin of the waste-gate arm. Fit the clip. Tighten the locknut. Release the air pressure.

9 Put the dial gauge in position on the end of the actuator rod. Apply air pressure to move the actuator rod 1,00 mm (0.039 in) and check if the air pressure is correct. If the air pressure is not correct, repeat from paragraph 6 of the operation until the correct pressure is obtained.

10 If the air pressure is correct, release the air pressure, remove the test equipment and connect the boost sensor pipe.

https://truckmanualshub.com/

Turbocharger faults

The chart below is given to assist in the correct diagnosis of turbocharger faults.

If the inside of the induction manifold is wet, check that there is not a fuel leak from the fuelled starting aid, if there is one fitted, operation 23C-01.

Problems	Possible causes code numbers
Not enough power	1, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, 21, 22, 25, 26, 27, 28, 34, 35, 36
Black smoke	1, 4, 5, 6, 7, 8, 9, 10, 11, 18, 20, 21, 22, 25, 26, 27, 28, 34, 35, 36
Blue smoke	1, 2, 4, 6, 8, 9, 17, 19, 20, 21, 22, 30, 31, 32, 34
High lubricating oil consumption	2, 8, 15, 17, 19, 20, 28, 29, 31, 32, 34
Too much lubricating oil at turbine end	2, 7, 8, 17, 19, 20, 22, 28, 30, 31, 32
Too much lubricating oil at compressor end	1, 2, 4, 5, 6, 8, 19, 20, 21, 28, 31, 32
Not enough lubrication	8, 12, 14, 15, 16, 23, 24, 29, 32, 33, 37, 38
Lubricating oil in the exhaust manifold	2, 7, 17, 18, 19, 20, 22, 28, 31, 32
Inside of the induction manifold wet	1, 2, 3, 4, 5, 6, 8, 10, 11, 17, 18, 19, 20, 21, 28, 32, 34, 39, 40
Damaged compressor impeller	3, 4, 6, 8, 12, 15, 16, 20, 21, 23, 24, 29, 32, 33, 37, 38
Damaged turbine rotor	7, 8, 12, 13, 14, 15, 16, 18, 20, 22, 23, 24, 25, 27, 29, 32, 33, 37, 38
Rotating assembly does not turn freely	3, 6, 7, 8, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 29, 32, 33, 37, 38
Worn bearings, bearing bores, journals	6, 7, 8, 12, 13, 14, 15, 16, 23, 24, 29, 33, 37, 38
Noise from turbocharger	1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 21, 22, 23, 24, 29, 32, 33, 34, 37, 38
Sludge or carbon deposit in bearing housing	2, 11, 13, 14, 15, 17, 18, 24, 29, 33, 37, 38

https://truckmanualshub.com/

1 Element of the air filter dirty
2 Restricted crankcase breather
3 Element of the air filter missing, leaking or not sealing correctly. Loose connection to turbocharger.
4 Internal distortion or restriction in pipe from air filter to turbocharger.
5 Damaged/restricted crossover pipe, turbocharger to induction manifold.
6 Restriction between air filter and turbocharger.
7 Restriction in exhaust system.
8 Turbocharger loose or clamps/setscrews loose.
9 Induction manifold cracked or loose, flanges distorted.
10 Exhaust manifold cracked or loose, flanges distorted.
11 Restricted exhaust system.
12 Delay of lubricating oil to turbocharger at engine start.
13 Insufficient lubrication.
14 Dirty lubricating oil.
15 Incorrect lubricating oil.
16 Restricted lubricating oil supply pipe.
17 Restricted lubricating oil drain pipe.
18 Turbine housing damaged or restricted.
19 Leakage from turbocharger seals.
20 Worn turbocharger bearings.
21 Excessive dirt in compressor housing.
22 Excessive carbon behind turbine rotor.
23 Engine speed raised too rapidly at initial start.
24 Insufficient engine idle period.
25 Faulty fuel injection pump.
26 Worn or damaged atomisers.
27 Valves burned.
28 Worn piston rings.
29 Lubricating oil leakage from supply pipe.
30 Excessive preservation fluid (on initial engine start).
31 Excessive engine idle period.
32 Restriction in turbocharger bearing housing.
33 Restriction in lubricating oil filter.
34 Wet type air cleaner: Restricted, dirty element, viscosity of oil to low/high.
35 Waste-gate actuator faulty or damaged.
36 Waste-gate valve not free.
37 Engine stopped too soon from high load.
38 Insufficient lubricating oil.
39 Fuel leakage from fuelled starting aid.
40 Crack in backplate of compressor.

https://truckmanualshub.com/

Open engine breather

Open breathers fitted to some 1000 Series engines have a pipe connected to the rocker cover which passes crankcase emissions directly to atmosphere. Other Phaser and 1000 Series engines are fitted with a gauze filter which separates oil particles from the crankcase emissions.

To remove, to fit and to clean **18A-05**

Consumable products:

Silicone rubber sealant

To remove

1 Release the clip, disconnect and remove the pipe from the breather cover. Release the two setscrews (A1). Remove the setscrews and their sealing washers (A2). Remove carefully the cover (A3) with a suitable lever to break the seal between the cover and the body of the breather. Ensure that the lever does not damage the cover. Ensure that the sealing washer under the head of each setscrew is not lost.

2 Use a suitable lever to remove carefully the gauze (A4). Do not damage the gauze.

To clean

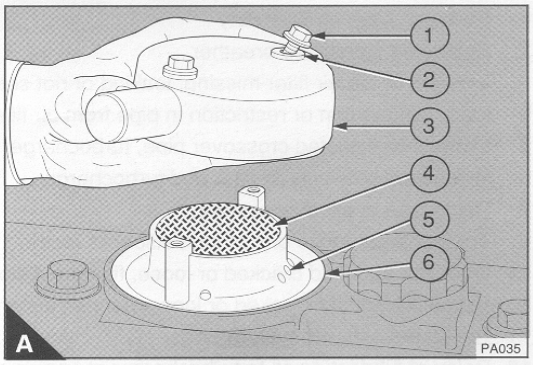
1 Wash the gauze, the cover, and the breather pipe in an approved cleaning fluid and dry them with compressed air at low pressure.

2 Remove the old sealant from the groove (A6) in the body of the breather. Ensure that the old sealant does not enter the engine. Ensure that the holes (A5) in the breather body are not restricted and, if necessary, clean the holes.

To fit

1 Put the gauze carefully into position in the body of the breather. Apply a bead of Perkins silicone rubber sealant to fill the groove in the body of the breather.

2 Put the cover in the correct position on the body of the breather. Inspect the sealing washers and, if necessary, renew them. Fit the sealing washers to the setscrews. Fit the setscrews and tighten them to 9 Nm (7 lbf ft) 0,9 kgf m. Clean off excess sealant from around the cover.



3 Check that there is no restriction in the breather pipe. Fit the breather pipe to the cover and tighten the clip.

https://truckmanualshub.com/

Closed breather system

A closed breather system is fitted to some naturally aspirated 1000 Series engines. The closed breather system has an oil separator which is fastened to the crankcase and a breather valve is fitted between the oil separator and the induction manifold. Crankcase gases pass through the oil separator where oil from the gases is returned to the sump. The crankcase gases then pass through the breather valve to the induction manifold.

To clean the closed breather system — 18A-06

1 Release the hose clips and remove the breather valve (A2).

2 Release the short setscrew (A3) and the long setscrew (A5) and remove the oil separator (A4).

3 Wash the oil separator with approved cleaning fluid and dry it with low pressure air.

Caution: *Do not put the breather valve completely into the cleaning fluid.*

Warning! *Do not direct compressed air at your skin, if compressed air enters your skin obtain medical help immediately.*

4 The breather valve does not normally need to be cleaned. If the inside of the breather valve is to be cleaned, insert an approved cleaning fluid into the valve through the pipe at the bottom. Drain the fluid from the breather valve. Dry the breather valve with low pressure air.

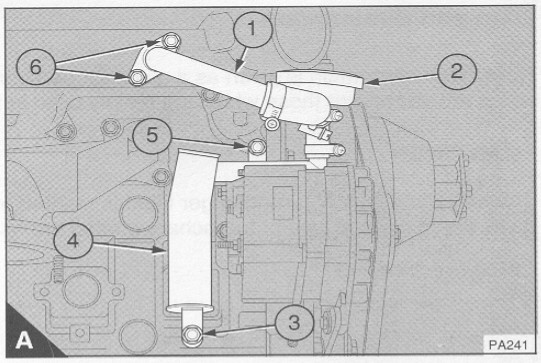
5 Check that the inside of the upper pipe (A1) is clean. If the pipe is not clean, release the flange setscrews (A6) and remove the pipe. Wash the pipe with kerosene and dry it with low pressure air.

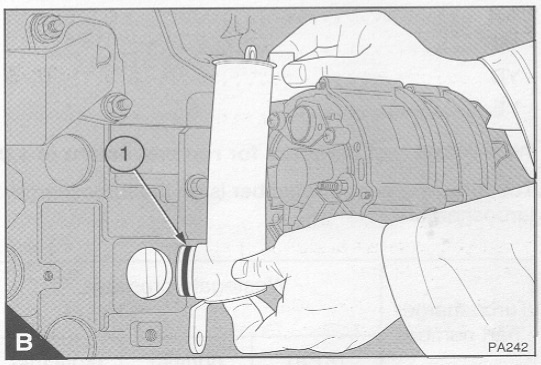
6 Ensure that the contact faces of the upper pipe flange and the induction manifold are clean.

7 Fit the upper pipe complete with a new joint and tighten the flange setscrews.

8 Renew the "O" ring (B1) at the bottom of the oil separator. Clean the bore in the cylinder block for the "O" ring of the oil separator. Lightly lubricate the "O" ring and fit the oil separator to the cylinder block. Fit the setscrews for the oil separator in their correct positions and tighten them.

9 Fit the breather valve and tighten the hose clips.





https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory.

Waste-gate test pressure for rod movement of 1,00 mm (0.039 in)

The turbocharger part number is on the turbocharger identification plate, which is fixed to the body of the turbocharger.

Turbocharger part number	Wastegate pressure			Turbocharger part number	Wastegate pressure		
	(KPa)	(lbf/in²)	(kgf/cm²)		(KPa)	(lbf/in²)	(kgf/cm²)
2674A054	110-120	16.0-17.4	1,12-1,22	2674A079	120-130	17.4-18.9	1,22-1,32
2674A055	120-130	17.4-18.9	1,22-1,32	2674A128	101-109	14.6-15.8	1,02-1,11
2674A056	120-130	17.4-18.9	1,22-1,32	2674A129	101-109	14.6-15.8	1,02-1,11
2674A057	118-126	17.1-18.3	1,20-1,28	2674A130	101-109	14.6-15.8	1,02-1,11
2674A059	118-126	17.1-18.3	1,20-1,28	2674A131	101-109	14.6-15.8	1,02-1,11
2674A062	113-120	16.0-17.4	1,12-1,22	2674A138	113-120	16.4-17.4	1,15-1,22
2674A063	92-98	13.3-14.2	0,93-0,99	2674A139	120-130	17.4-18.9	1,22-1,32
2674A064	110-103	15.9-14.9	1,11-1,04	2674A144	113-120	16.4-17.4	1,15-1,22
2674A067	120-130	17.4-18.9	1,22-1,32	2674A146	113-120	16.4-17.4	1,15-1,22
2674A068	110-103	15.9-14.9	1,11-1,04	2674A149	133-143	19.3-20.7	1,35-1,45
2674A075	118-126	17.1-18.3	1,20-1,28	2674A150	145-155	21.0-22.5	1,47-1,58
2674A077	101-109	14.6-15.8	1,02-1,11				

https://truckmanualshub.com/

EGR Inlet System **18A.07**

To remove and to fit

To remove (when changing EGR valve or EGR cooler)

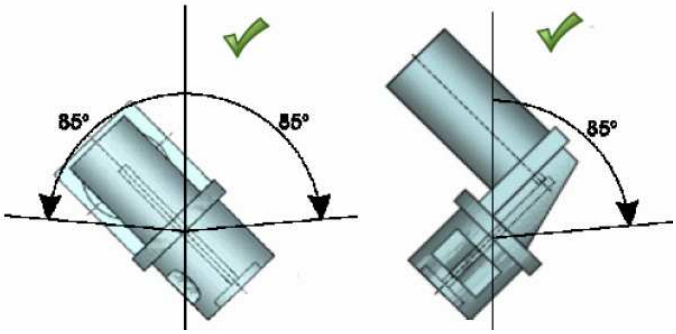
1. Disconnect the inlet and outlet hose of the EGR cooler. Carefully not splash water onto EGR valve and electrical elements.
2. Loose the nut on the inlet and outlet of the EGR cooler, then loose the nut on the bracket of the EGR cooler and finally remove the EGR cooler and its bracket.
3. Put the inlet and outlet of the EGR cooler downward and drain the remaining water in the EGR cooler.
4. Disconnect the wiring harness on the EGR valve. Loose the nut connecting the EGR valve and inlet bend. Remove the EGR valve.

To fit

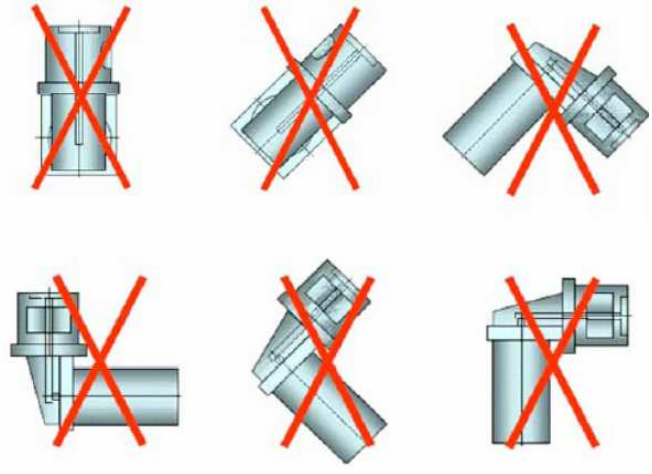
1. Fit the bracket of the EGR cooler on the body. Put the EGR cooler on the bracket and fasten the nut connecting the EGR cooler and the bracket and the EGR tubes on both sides.
2. Connect the inlet and outlet hoses of the EGR cooler.
3. Insert the EGR valve into the hole of the inlet bend. Fasten the nut connecting the EGR valve and inlet bend. Connect the wiring harness of the EGR valve.

Notice:

The exhaust inlet of the EGR valve must be downward and must be the lowest point of the valve. The valve must be installed in the range of ±85° referring to vertical direction, as the following diagram:

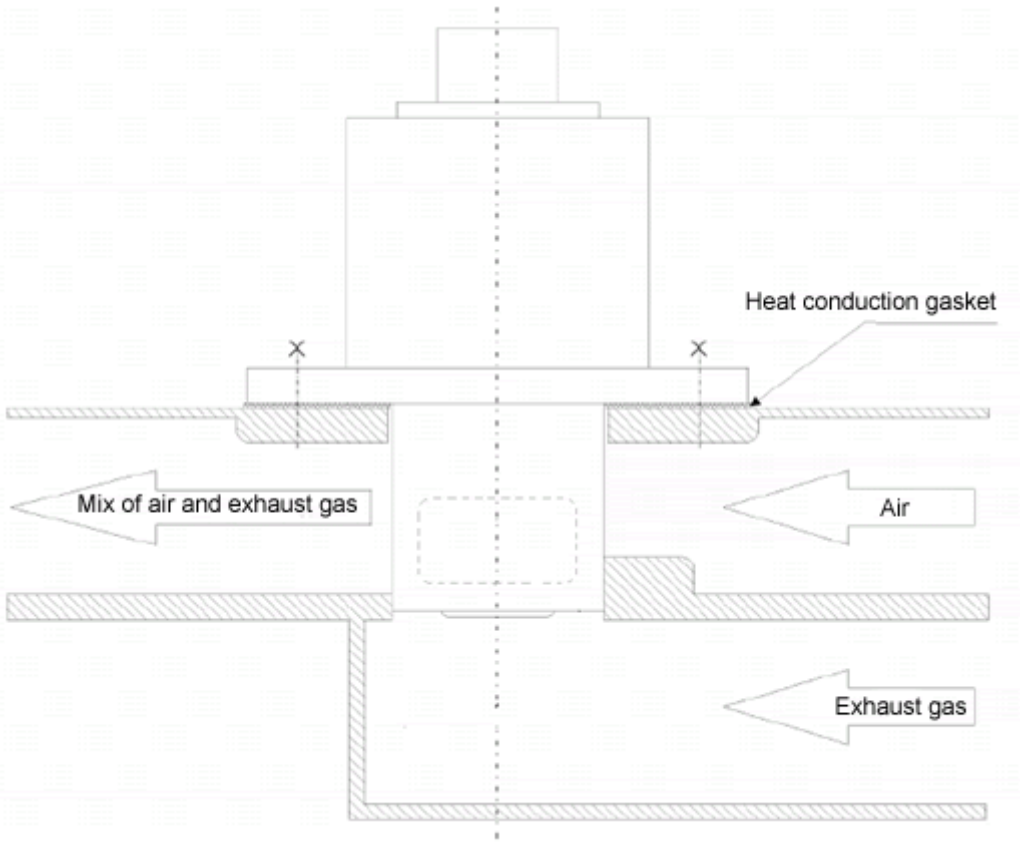


Incorrect installation method：



The arrangement illustration of EGRvalve:

https://truckmanualshub.com/



Fault diagnosis

1. General Description

Dark EGR fault indicator shows that EGR system is working normal. And flashing EGR fault indicator means fault exists in EGR system. EGR fault indicator shows the codes for the types of EGR system fault by a series of short and long signal combination.“0”presents a short signal. “1” presents a long signal. The fault code and the text of the fault name of the EGR system also show in the bottom of the “Data Log” window of the calibration software.

Fault type	Fault item label	Fault code	Fault indicator
Normal EGR system		0000 0000	Dark
Engine’s rotational speed signal is not within the measuring range (too high or too low).	Engine's rotational speed signal	0001 0000	0-1-1
Throttle’s position sensor signal is not within the measuring range.	Throttle’s position sensor	0000 1000	0-1-0
Water temperature sensor signal is not within the measuring range.	Water temperature sensor	0000 0010	0-0-1
The connecting cable of water temperature sensor is broken or the sensor is not installed.	Water temperature sensor	0100 0000	0-0-1
The lift position sensor signal of the EGR valve is not within the measuring range.	Lift position sensor signal of the EGR valve	0010 0000	1-1-0

https://truckmanualshub.com/

2. Fault elimination

Before determining the fault:

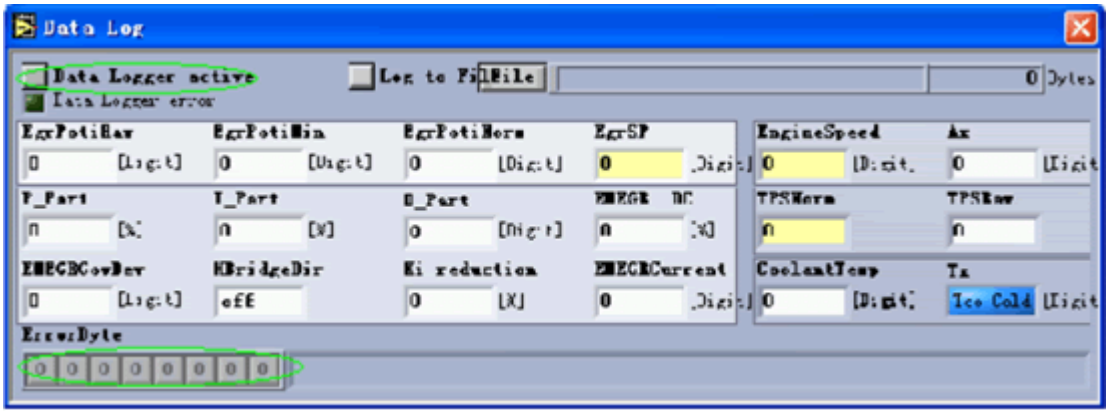
- Ensure the correct installation of each part of the EGR system (ECU, EGR valve, throttle position sensor and water temperature sensor) and the correct installation for acquiring the rotational speed signal and engine pole pair.
- Ensure no open circuit, bonding, false welding and ensure the correct connecting of each part.

Connect the diagnosis plug and the calibration software of the EGR system and turn on the main power.

- If the lamp in the front of the “ECU Monitor” option in the main interface of the calibration software is dark, check no open circuit along the ECU cable and diagnose the connector.



- When the lamp in the front of the “ECU Monitor” option is lit, click the “Data” option in the main interface of the calibration software and the “Data log” window will appear, depicted as the diagram.

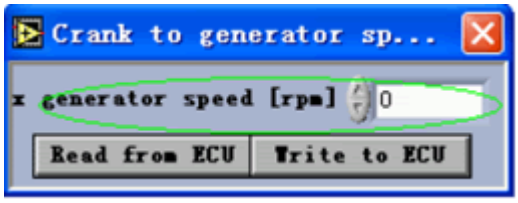


Click the “Data Logger active” option, observe the fault code display area at the bottom of the window and confirm the fault type according the shown fault code and above fault description.

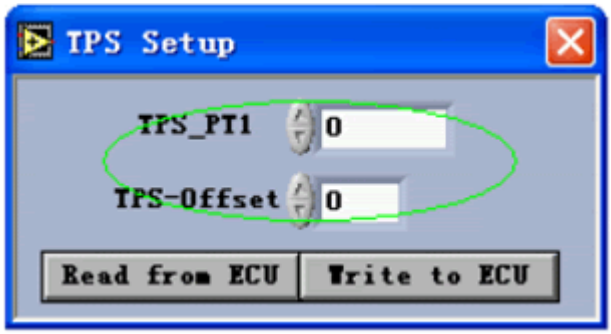
1. Fault code “0000 0000” means normal state of EGR system.
2. Fault code “0001 0000” means a fault in the rotational speed signal of the engine. First determine the wiring of the ECU and engine and check no wrong connection; second, click the “Engine” option in the main interface of the calibration software and the “Crank to generator speed” window appears; change the setting

https://truckmanualshub.com/

of “generator speed” to adjust the shown value in the “Engine Speed” option of “Data log” into a reasonable range.



3. Fault code “0000 1000” means a fault in the throttle signal of the engine.Click the “TPS Setup” option in the main interface of the calibration software and the “TPS Setup” window appears; change the setting of “TPS Setup” to adjust the shown value in the “TPS Norm” option of “Data log” into a reasonable range.



4. Fault code “0010 0000” means a fault in the water temperature signal of the engine and checks no open circuit in the water temperature sensor or the water temperature sensor is not installed.

5. Fault code “0010 0000” means the lift position sensor signal of the EGR valve is not within the measuring range. This fault can only be resolved by resetting the ECU; that is after a period of warming up, the EGR valve can automatically complete the initial setup.

ECU, EGR valve, throttle position sensor and water temperature sensor are all sealing devices and can not be repaired. Any problems occurring, they have to be replaced.

https://truckmanualshub.com/

Lubrication system 19

General description 19A.02

Filter canister

19A-01 To renew 19A.06

Filter head

19A-02 To remove and to fit 19A.07

Sump

19A-03 To remove and to fit 19A.10

Oil strainer and suction pipe

19A-04 To remove and to fit 19A.10
19A-05 To inspect and to correct 19A.11

Lubricating oil pump

19A-06 To remove and to fit 19A.12
19A-07 To inspect 19A.18

Relief valve

19A-08 To remove and to fit 19A.19
19A-09 To dismantle and to assemble 19A.20
19A-10 To inspect 19A.20

Flexible oil pipes

19A-11 To remove, to fit and to inspect 19A.08

Data and dimensions 19A.21

https://truckmanualshub.com/

General description

Four cylinder engine lubrication system (19A.03/A)

Pressure lubrication is supplied by a rotor type pump which is driven through an idler gear from the crankshaft gear. The pump has an inner rotor and an outer rotor which are off-centre to each other. There is a key between the inner rotor and the drive shaft. The inner rotor has six lobes which mesh with the seven lobes of the outer rotor. When the pump rotates, the space between the lobes of the outer rotor which are in mesh increases to cause a suction or decreases to cause a pressure increase. If a balancer unit (19A.04/A) is fitted, the oil pump is fitted to the balancer frame and is driven by the balancer drive shaft.

Lubricating oil (19A.03/A1) from the sump passes through a strainer and pipe to the suction side of the pump.

The lubricating oil (19A.03/A2) passes from the outlet side of the pump through a pipe to a relief valve, which is fitted to the bottom of the left side of the cylinder block. If a balancer unit is fitted, the relief valve is fitted in the frame of the balancer. The relief valves opens if the oil pressure is too high; this allows some of the lubricating oil to return to the sump.

From the relief valve, lubricating oil passes to a plate type oil cooler (some naturally aspirated engines do not have an oil cooler). The oil cooler is either fitted to the left side of the cylinder block and has seven plates, or it is fitted between the oil filter head and the filter canister and has ten plates. Some oil coolers are fitted with a by-pass valve. If cold oil increases the restriction in the cooler, the by-pass valve opens and the oil passes directly from the inlet side to the outlet side of the cooler.

Lubricating oil from the oil cooler, passes to an oil filter. The oil filter can be fitted to the left or right side of the engine. If the filter is fitted to the right side (19A.04/A) of the engine, the oil passes through a pipe connected between the relief valve and the right side of the cylinder block. The oil passes from the pipe through a passage in the right side of the cylinder block to an oil cooler and then to the oil filter. When the oil filter is on the right side of the engine, and an oil cooler is fitted, the oil cooler will be between the oil filter head and the oil filter canister.

The lubricating oil passes from the filter to the pressure rail which is drilled the complete length of the left side of the cylinder block. If the oil filter is on the right side of the engine, the oil passes through a passage drilled across the cylinder block to the pressure rail.

From the pressure rail, lubricating oil passes to the main bearings of the crankshaft and through passages in the crankshaft to the big end bearings. The pistons and the cylinder bores are lubricated by splash and oil mist.

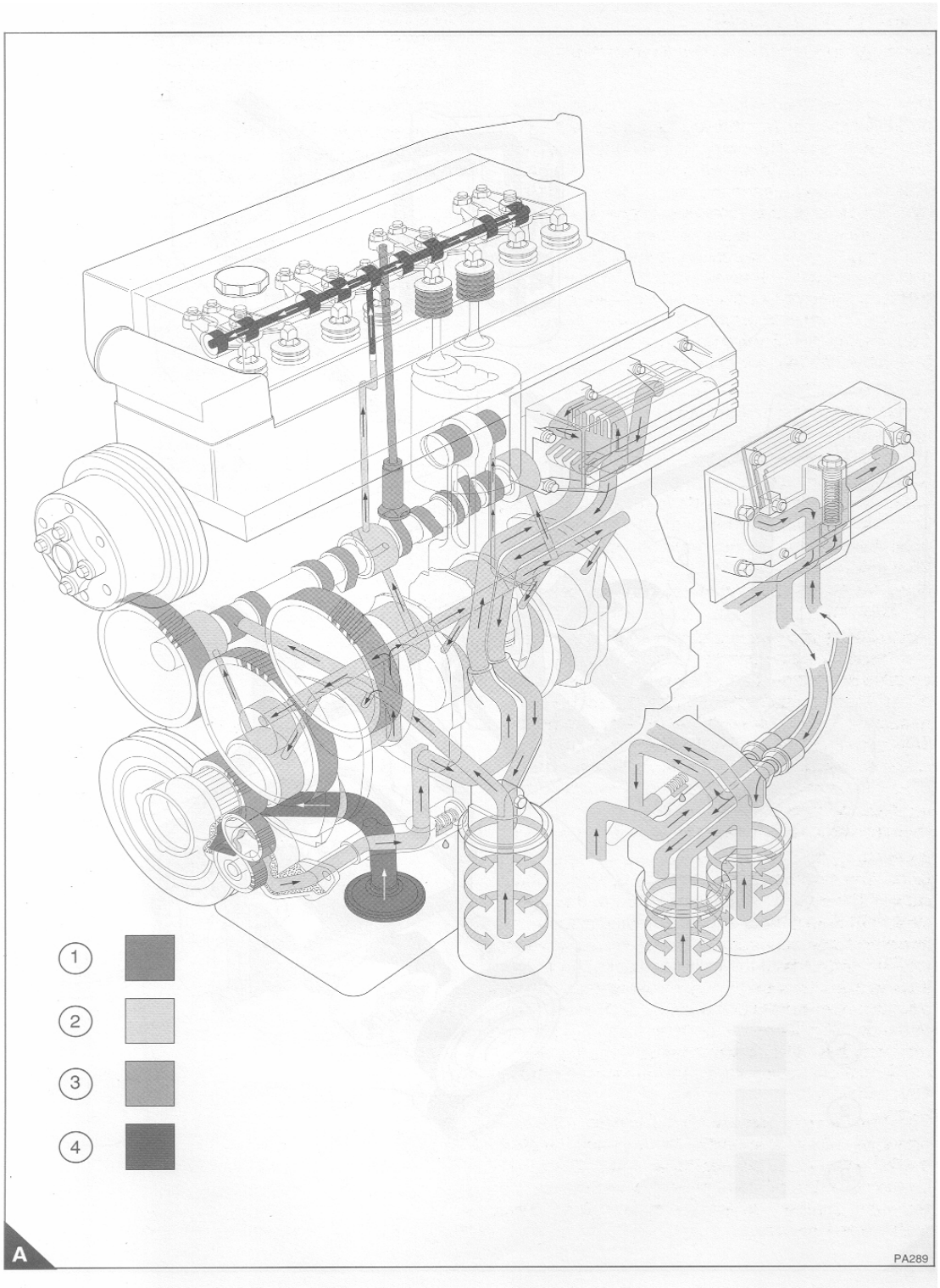
Lubricating oil (19A.03/A3) passes from the main bearings through passages in the cylinder block to the journals of the camshaft. Lubricating oil passes from the centre journal of the camshaft through a passage in the cylinder block and cylinder head to a restriction in the pedestal of the rocker shaft, at a reduced pressure (19A.03/A4), to feed the rocker bushes. The oil passes through a passage in the rocker shaft to the bearings of the rocker levers. The valve stems, valve springs and the tappets are lubricated by splash and oil mist.

The hub of the idler gear is lubricated by oil from the pressure rail and the timing gears are splash lubricated.

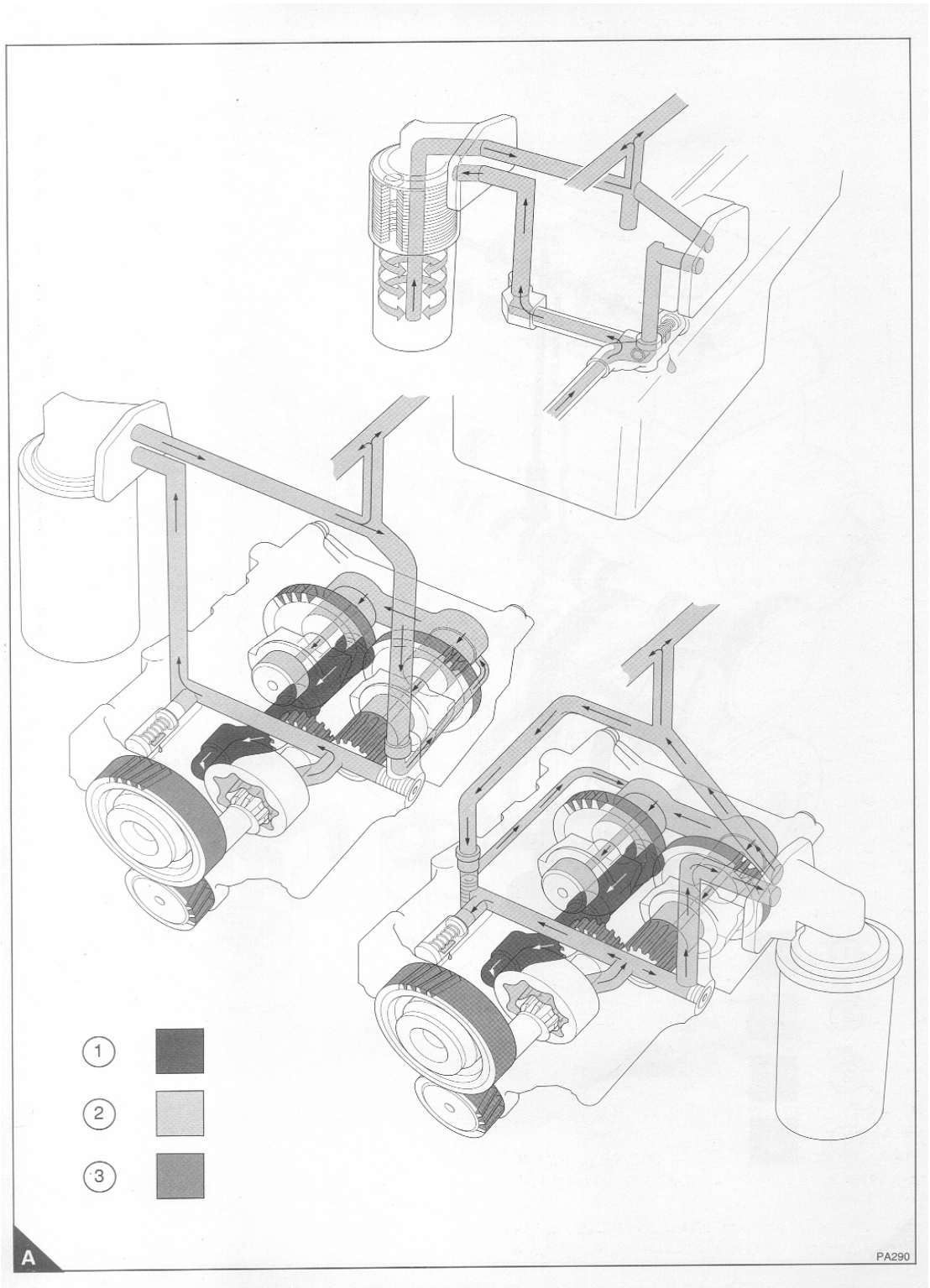
The turbocharger is lubricated by oil after the filter. Oil is supplied from a connection on the right side of the cylinder block through an external pipe to the turbocharger. The oil passes through the turbocharger and returns through a pipe to the sump.

Turbocharged engines have piston cooling jets fitted. These jets are connected to the oil pressure rail and spray lubricating oil inside the pistons to keep them cool.

https://truckmanualshub.com/



https://truckmanualshub.com/



https://truckmanualshub.com/

Six cylinder engine lubrication system (19A.03/A)

The oil pump is similar to that used on four cylinder engines and is also driven through an idler gear from the crankshaft gear. The inner rotor has four lobes and the outer rotor has five lobes.

Lubricating oil from the sump passes through a strainer and pipe to the suction side of the pump.

The oil passes from the outlet side of the pump, through a pipe and a passage in the cylinder block to the oil filter head. The oil then passes through a passage in the filter head and a pipe to a plate type oil cooler, see the offset (19A.03/A), which is an integral part on the left of the cylinder block. On naturally aspirated engines the oil cooler has four plates and on turbocharged engines the cooler has eight plates. The oil cooler is fitted with a by-pass valve. If cold oil increases the restriction in the cooler, the by-pass valve opens and the oil passes directly from the inlet side to the outlet side of the cooler. If the engine is not fitted with an oil cooler, the oil passes from the oil pump to the relief valve.

From the oil cooler, the oil returns through a pipe to the filter head where the oil divides to the relief valve and to the oil filter. The oil filter can be fitted on the left or right side of the engine. If the filter is fitted on the right side of the engine, the oil passes through a pipe connected between the relief valve and the right side of the cylinder block to the oil filter.

The lubricating oil passes from the filter to the pressure rail which is drilled the full length of the left side of the cylinder block. If the oil filter is on the right side of the engine, the oil passes through a passage drilled across the cylinder block to the pressure rail.

From the pressure rail, lubricating oil passes to the main bearings of the crankshaft and through passages in the crankshaft to the big end bearings. The pistons and the cylinder bores are lubricated by splash and oil mist.

Lubricating oil passes from the main bearings through passages in the cylinder block to the journals of the camshaft. Lubricating oil passes, at a reduced pressure, from the second journal of the camshaft through a passage in the cylinder block and cylinder head to the rocker shaft. The oil passes through a passage in the rocker shaft to the bearings of the rocker levers. The valve stems, valve springs and the tappets are lubricated by splash and oil mist.

The hub of the idler gear is lubricated by oil from the pressure rail and the timing gears are splash lubricated.

The turbocharger is lubricated by oil after the filter. Oil is supplied from a connection on the right side of the cylinder block through an external pipe to the turbocharger. The oil passes through the turbocharger and returns through a pipe to the sump.

Turbocharged engines have piston cooling jets fitted. These jets are connected to the oil pressure rail and spray lubricating oil inside the pistons to keep them cool.

https://truckmanualshub.com/

Filter canister

To renew **19A-01**

The filter can have one or two canisters fitted. When two canisters are fitted, both must be renewed at the same time. On some engines an oil cooler (B) is fitted between the filter head and the filter canister. This arrangement is fitted on the left side or the right side of the engine.

On some four and six cylinder engines the adaptor (A1) or (B1) is sealed into the filter head. A new filter head is supplied without the adaptor fitted; if either the adaptor or the filter head is to be renewed, both parts will be necessary.

1 Put a tray under the filter to contain spilt lubricating oil.

2 Remove the filter canister with a strap wrench or a similar tool and then discard the canister.

Note: If the adaptor is to be renewed the thread sealant which is applied to one end during manufacture must be inserted into the filter head.

3 Clean the seal face of the filter head, or the bottom face of the oil cooler.

Caution: *Ensure that the adaptor (A1) or (B1) is secure in the filter head.*

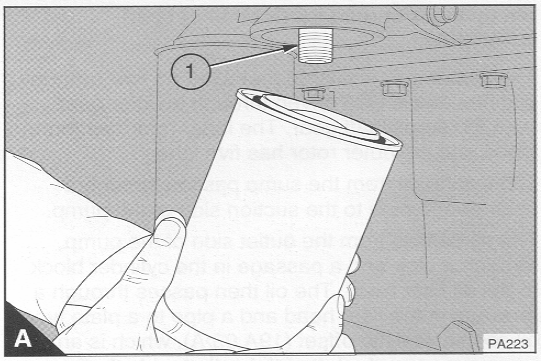
4 Add clean engine lubricating oil to the new canister. Give the oil time to fill the canister through the filter element.

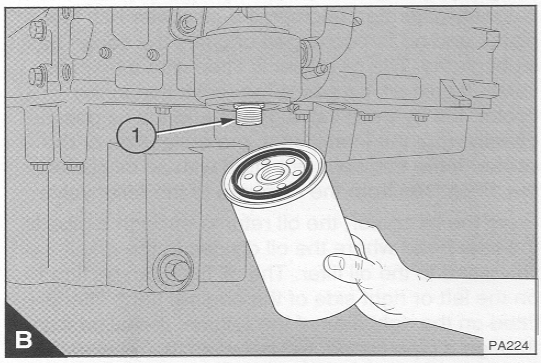
5 Lubricate the top of the canister seal with clean engine lubricating oil.

6 Install the new canister and tighten it by hand only. Do not use a strap wrench.

7 After the lubricating oil has been added to the sump, operate the engine and check for leakage from the filter. When the engine has cooled, check the oil level on the dipstick and add oil to the sump, as necessary.

Caution: *The canister contains a valve and special tube which ensure that lubricating oil does not drain from the filter. Therefore, ensure that the correct Perkins POWERPART canister is used.*





https://truckmanualshub.com/

Filter head

To remove and to fit **19A-02**

1 Put a tray under the filter head to contain spilt lubricating oil.

2 Remove the filter canister(s), operation 19A-01.

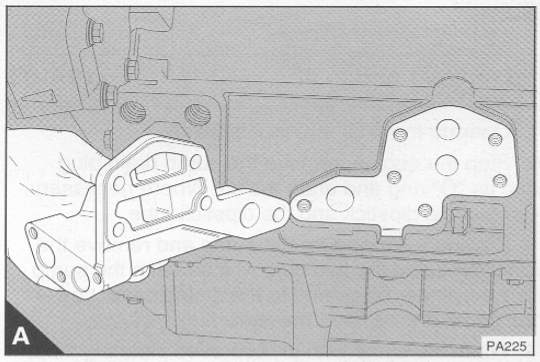
3 If a lubricating oil cooler is fitted, release the setscrews and remove the oil cooler pipes from the filter head. Discard the joint. If the filter head is fitted to the right side of a turbocharged engine, disconnect the oil supply pipe of the turbocharger. Use a spanner on the hexagonal end of the flexible pipe (A1) to hold the pipe while the connection (A2) is released. If an adaptor is used in the filter head, use a spanner to hold the adaptor while the union nut is released.

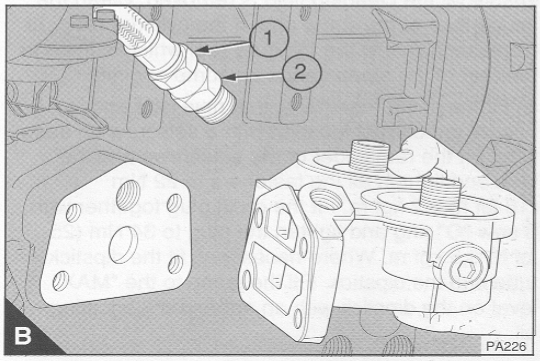
Note: On some engines an oil cooler is fitted between the filter head and the filter canister. To remove the oil cooler, see operation 21A-07C.

4 Release the setscrews or nuts and remove the filter head from the cylinder block (A or B). Discard the joint.

5 Clean the joint face of the filter head and, if fitted, the flange of the oil cooler pipes. Fit the filter head and a new joint. Tighten the setscrews or nuts. If necessary, fit the pipes of the oil cooler and a new joint, operation 19A-11. Tighten the setscrews. Where necessary, connect the oil supply pipe of the turbocharger. If the union connection on the flexible pipe fits into the filter head, clean the thread of the connection and apply a thread sealant. Ensure that dirt does not enter the filter head. Use a spanner to hold the hexagon on the pipe while the connection is fitted to the oil filter head. If an adaptor is used in the filter head, use a spanner to hold the adaptor when the union nut is tightened.

6 Fit new filter canister(s), operation 19A-01.





https://truckmanualshub.com/

Sump

To remove and to fit **19A-03**

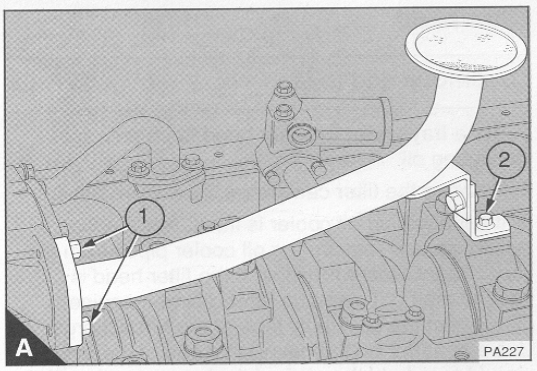
1 Operate the engine until it is warm.

2 Stop the engine, remove the sump drain plug and its "O" ring and drain the oil. Where necessary, remove the dipstick and the dipstick tube.

3 Provide a support for the sump and remove the setscrews and the two nuts which fasten the sump to the cylinder block and to the timing case. Lower the sump and remove the joint.

4 Wash the sump with an approved cleaning fluid, ensure all the cleaning fluid is removed. Clean the flange face of the sump and of the cylinder block. If necessary, renew the felt dust seal which is fitted to the rear of the sump flange on some engines.

5 Fit the sump together with a new joint and ensure the correct location with a setscrew on each side. Fit the remainder of the setscrews and the nuts and tighten all the fasteners to 22 Nm (16 lbf ft) 2,2 kgf m. Fit the drain plug together with a new "O" ring and tighten the plug to 34 Nm (25 lbf ft) 3,5 kgf m. Where necessary, fit the dipstick tube and the dipstick. Fill the sump to the "MAX" level on the dipstick with an approved lubricating oil.



Oil strainer and suction pipe

To remove and to fit **19A-04**

The oil strainer is an integral part of the suction pipe. No regular service is necessary but wash the strainer when it is removed. On four cylinder engines which have a balancer fitted, the suction pipe is normally a short pipe which is fastened to the balancer frame and a pipe bracket is not fitted.

Some four cylinder engines have an oil strainer and suction pipe which are made of a composite material. This arrangement has an "O" ring seal on the flange face of the oil pump instead of a joint.

1 Remove the sump, operation 19A-03.

2 Release the setscrew which holds the bracket to the main bearing cap (A2).

3 Release the setscrews from the flange of the suction pipe (A1). Remove the suction pipe and strainer. Remove and the old joint or the "O" ring. Clean the flange face of the oil pump and of the suction pipe.

https://truckmanualshub.com/

4 Loosely assemble the bracket of the suction pipe to the correct main bearing cap. Fit the suction pipe to the oil pump together with a new joint or an "O" ring. Tighten the setscrews. Tighten the setscrew of the suction pipe bracket. If the clamp type bracket, used on some four cylinder engines, has been removed, ensure that the clamp, the bracket and the pipe are correctly aligned before the setscrews are tightened. Ensure that there is no stress on the suction pipe.

5 Fit the sump, operation 19A-03, and fill it with an approved oil to the "MAX" level on the dipstick.

To inspect and to correct 19A-05

1 Wash the assembly in an approved cleaning fluid and dry it thoroughly.

2 Check the pipe, the strainer and the welded joints for cracks and other damage. Check that the mounting bracket is secure.

3 If the damaged component cannot be welded correctly, renew the assembly.

4 Composite material parts must be renewed if they are cracked or damaged.

https://truckmanualshub.com/

Lubricating oil pump

To remove and to fit **19A-06**

For four cylinder engines fitted with a balancer unit , the oil pump is integral with the balancer unit, see section 14 for removal instructions.

The latest engines have a new lubricating oil pump which has a channel (B1) in the body of the pump. Lubricating oil from the front main bearing passes down the channel in the body of the pump to an oil hole in the idler shaft. The lubricating oil then passes through the hole in the idler shaft to the bush in the idler gear.

To remove

1 Drain the lubricating oil and remove the lubricating oil sump, operation 19A-03.

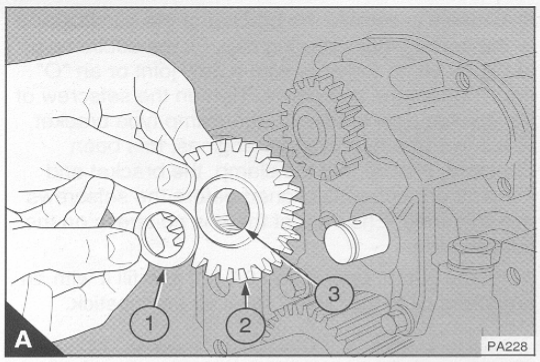
2 Remove the suction pipe and strainer, operation 19A-04.

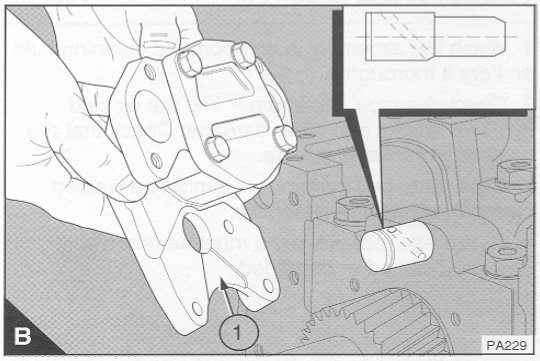
3 For four cylinder engines: Remove the oil pressure relief valve, operation 19A-08, and the delivery pipe. For six cylinder engines: Remove the delivery pipe of the oil pump.

4 The oil pump is fitted to number 1 main bearing cap. The oil pump can be removed with the main bearing cap, if a suitable spanner is available that will enable the torque to be applied correctly to the setscrews of the main bearing cap when it is fitted. If a suitable spanner is not available, the timing case must be removed, operation 15A-08.

5 Release the circlip which retains the idler gear of the oil pump and remove the washer (A1) and the idler gear (A2).

6 Release the setscrews and remove the oil pump (B).





https://truckmanualshub.com/

To fit

1 Fill the oil pump with clean engine lubricating oil. Fit the oil pump to the main bearing cap and tighten the setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.

2 Check the idler gear and the bush for wear and other damage. If the gear and/or bush are damaged, they can be renewed as an assembly or the bush can be renewed as a single item. Check the shaft of the idler gear for wear or other damage. If the shaft is worn or damaged, renew the shaft, see 19A.12. Lubricate the bush (A3) with clean engine lubricating oil and fit the idler gear (A2), the washer (A1) and the circlip. Check that there is a minimum of 0,076 mm (0.003 in) backlash between the oil pump gear and the idler gear (B).

3 If number 1 main bearing cap was removed, lubricate the bearing with clean engine lubricating oil and fit the bearing cap. Tighten the setscrews to 265 Nm (196 lbf ft) 27,0 kgf m. If the timing case was removed, fit the timing case, operation 15A-08. Check that there is a minimum of 0,076 mm (0.003 in) backlash between the oil pump idler gear and the crankshaft gear.

If the latest lubricating oil pump with the oil supply channel 19A.12/B1 is fitted, the end-float for the idler gear is as follows:

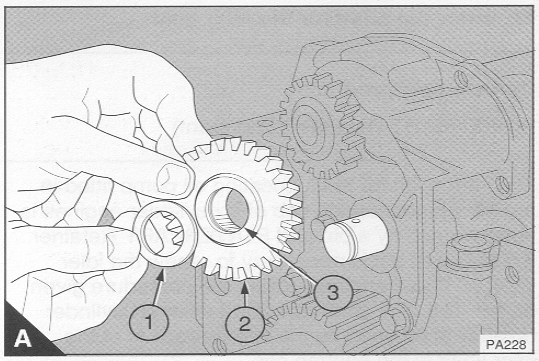
- Four cylinder engines 0,012/0,643 (0.0005/0.0253 in)
- Six cylinder engines 0,020/0,650 (0.0008/0.0256 in)

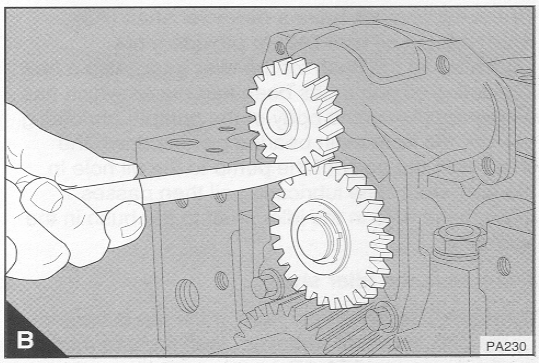
4 Fit the suction pipe and strainer, operation 19A-04.

5 For four cylinder engines: Fit the delivery pipe and oil pressure relief valve, operation 19A-08. For six cylinder engines: Fit the delivery pipe and tighten the setscrews. Use new joints.

Note: An improved delivery pipe has been fitted to six cylinder engines from engine number Y------U503656S. The new pipe, has an elbow and a 12,5 mm (0.5 in) thick flange instead of the two 6 mm (0.24 in) flanges of the earlier pipe. Joints are not used with the new pipe.

6 Fit the lubricating oil sump, operation 19A-03. Fill the sump to the "MAX" mark on the dipstick with an approved lubricating oil.





https://truckmanualshub.com/

To renew the shaft for the idler gear

Consumable products:

Retainer (oil tolerant)

The idler shaft for the lubricating oil pump fitted in the front main bearing cap of six cylinder engines is now retained by a pin and POWERPART Retainer (oil tolerant). If it is necessary to renew the idler shaft on these engines, follow the procedure given below. The idler shaft used on earlier six cylinder engines is retained by the interference fit of the idler shaft in the bearing cap.

The latest engines have a new idler shaft (A3) which has an oil hole (A2) to provide more lubrication to the bush for the idler gear. Also a new lubricating oil pump has been introduced which has a channel (A4) in the body of the pump. Lubricating oil from the front main bearing passes down the channel in the body of the pump to the oil hole in the idler shaft. The lubricating oil then passes through the hole in the idler shaft to the bush in the idler gear.

To remove the idler shaft

Caution: *The pin is very hard; if the tap is broken or the pin cannot be removed, then the alternative method on page 19A.15 must be used to remove the pin.*

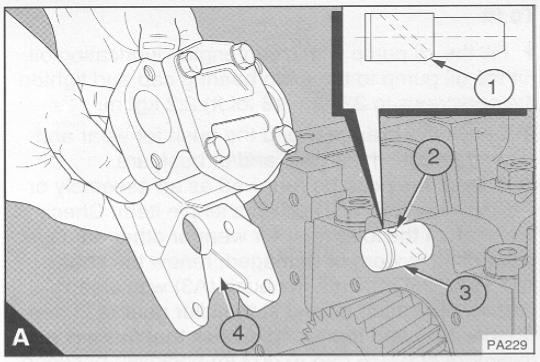
1 Carefully use an M5 X 0,8 mm taper tap to form a chamfer in the end of the pin (A1). Remove the tap.

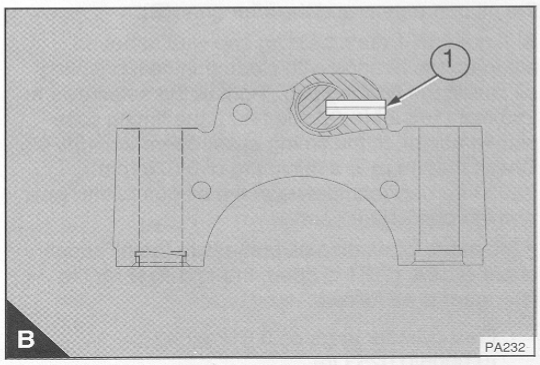
2 Carefully use an M5 X 0,8 mm plug tap to cut not less than three complete threads in the end of the pin. Remove the tap.

3 Obtain the following:

- An M5 X 0,8 mm setscrew, part number 2314E007 or a setscrew which has a thread which is at least 15 mm long.
- An M5 X 0,8 mm nut, part number 2318A601.
- A spacer with a 15,88 mm or 19,05 mm outside diameter and an internal diameter of 8,73 mm which is 9,53 mm long, part number(s), 0920481 or 0330819.

4 Fit the nut fully onto the threads of the setscrew and put the spacer onto the nut.





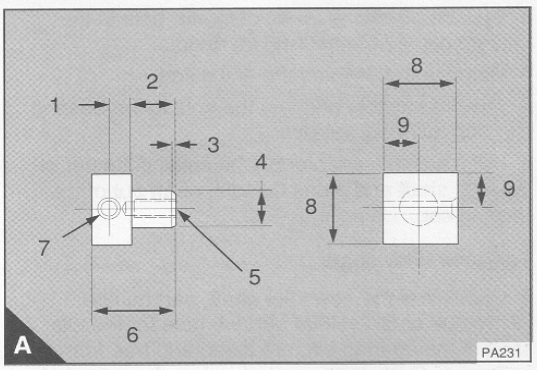
https://truckmanualshub.com/

Caution: *Do not use excessive torque.*

5 Hold the spacer in position and engage the setscrew fully into the threads in the pin.

6 Put the spacer into position centrally over the pin and tighten the nut onto the spacer. Continue to tighten the nut and pull the pin through the spacer. Withdraw the pin enough to pull the pin out of the bearing cap with pliers.

7 Put a suitable adaptor on the small diameter of the idler shaft and press the idler shaft out of the bearing cap.



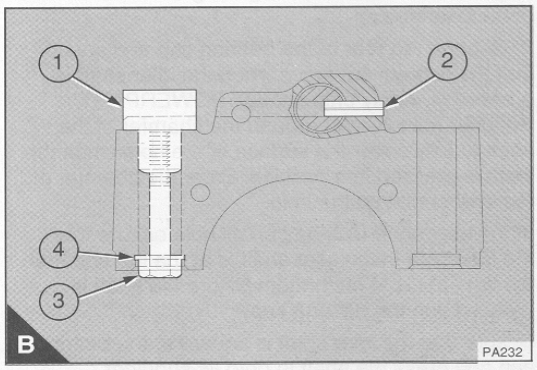
Alternative method to remove the idler shaft

This method to remove the pin from the idler shaft must only be used if the pin cannot be removed by the earlier method.

1 Make a drill guide (A) to the dimensions given below:

A1	8,3 mm (0.327 in)
A2	20,0 mm (0.984 in)
A3	1,0 mm (0.039 in)
A4	16,1/16,4 mm (0.633/0.646 in)
A5	6,9 x 22 mm (0.272 x 0.866 in) diameter hole for 5/16-24 UNF x 18 mm thread
A6	36,0 mm (1.42 in)
A7	6,5/6,6 mm (0.256/0.260 in) diameter hole, countersink 9,0 mm x 900 inclusive
A8	31,75 mm (1.250 in)
A9	15,9 mm (0.626 in)

2 Put the drill guide (B1) into position in the setscrew hole on the opposite side of the bearing cap to the pin (B2). Ensure that the countersink in the guide faces outwards and that the edge of the guide is aligned with the front edge of the bearing cap. Use a 5/16 UNF setscrew (B3) and a plain washer (B4) to retain the guide in position.



https://truckmanualshub.com/

3 Drill a 6,35 mm (0.25 in) diameter hole in the bearing cap 47,0 mm (1.85 in) deep.

4 Remove the drill and the drill guide.

5 Insert a suitable drift into the hole in the bearing cap and drive out the pin.

6 Put a suitable adaptor on the small diameter of the idler shaft and press the idler shaft out of the bearing cap.

To fit the idler shaft

1 Check that the new idler shaft, part number 3271H002 or 3271H004 and the hole for the idler shaft in the bearing cap are clean and free from oil or grease. Remove any rough edges from the hole of the bearing cap.

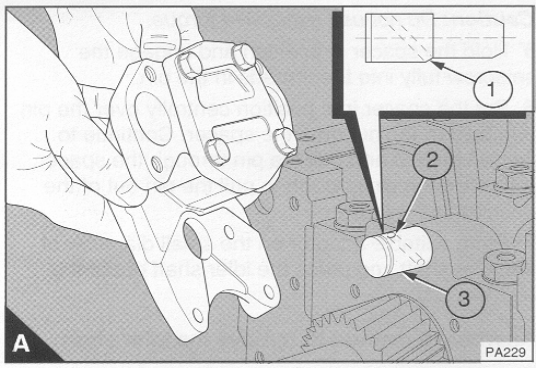
2 Support the rear of the bearing cap and ensure that the cap will not move when the idler shaft is pressed in. Apply only enough POWERPART Retainer (oil tolerant) around the chamfer of the shaft to fully cover the surface of the hole when the shaft is pressed into position. Enter the chamfer of the idler shaft into the hole.

If the idler shaft (A3) has an oil hole ensure that the hole (A2) in the idler shaft is at the top and that the flat (A1) is at the bottom before the shaft is pressed into the bearing cap.

Ensure that the idler shaft is square to the bearing cap and press the shaft in onto its shoulder. Remove the surplus POWERPART Retainer from the idler shaft, the oil hole and the bearing cap before the oil pump is fitted.

3 Use the original hole for the pin in the bearing cap as a guide and drill a 6,35 mm (0.25 in) diameter hole in the idler shaft 9,5 mm (0.37 in) deep.

4 Fit a new pin, part number 2116087, into the bearing cap and idler shaft.



https://truckmanualshub.com/

To fit the idler shaft (where a pin was not fitted originally)

1 Follow the procedure to fit the idler shaft, paragraphs 1 and 2 above.

2 Put the drill guide (A1) into position in the right hand (seen from the front face of the bearing cap) setscrew hole of the bearing cap. Ensure that the countersink in the guide faces outwards and that the edge of the guide is aligned with the front edge of the bearing cap. Use a 5/16 UNF setscrew (A3) and a plain washer (A2) to retain the guide in position.

3 Drill a 6,35 mm (0.25 in) diameter hole in the bearing cap 25,4 mm (1.0 in) deep.

4 Remove the drill and the drill guide.

5 Fit a pin, part number 2116087, into the bearing cap and idler shaft.

To remove and to fit the idler shaft

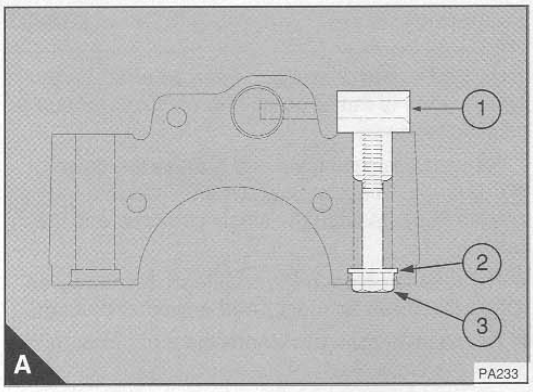
- For four cylinder engines:

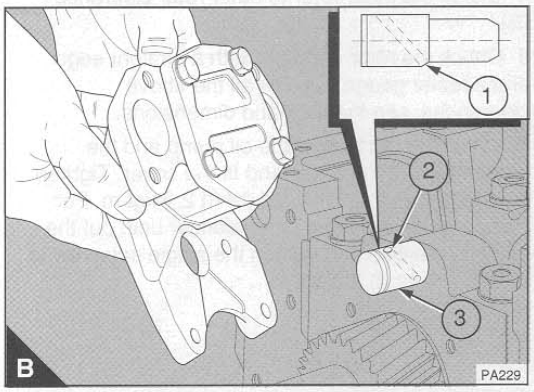
1 Support the front of the bearing cap. Put a suitable adaptor on the small diameter of the idler shaft and press the idler shaft out of the bearing cap.

2 Ensure that the idler shaft and the hole in the bearing cap are clean. Support the rear of the bearing cap and ensure that the cap will not move when the idler shaft is pressed in. Apply retainer to the small diameter of the idler shaft. The idler shaft for four cylinder engines is not retained by a pin.

If the idler shaft (B3) has an oil hole ensure that the hole (B2) in the idler shaft is at the top and that the flat (B1) is at the bottom before the shaft is pressed into the bearing cap.

Enter the chamfer of the idler shaft into the hole. Ensure that the idler shaft is square to the bearing cap and press in the shaft onto its shoulder. Remove the surplus Power part retainer.





https://truckmanualshub.com/

To inspect 19A-07

If any part is worn enough to have an effect on the performance of the oil pump, the complete oil pump must be renewed.

1 Release the setscrews and remove the cover of the oil pump. For pumps which are fitted to a balancer unit, remove the single setscrew and the cover.

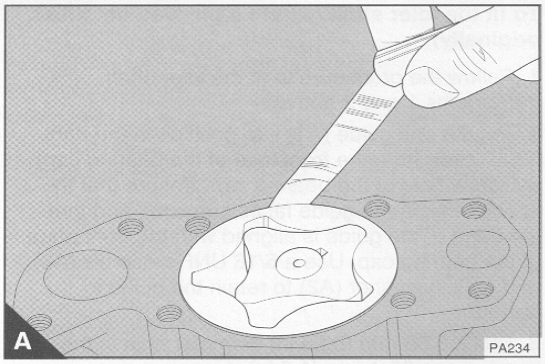
2 Remove the outer rotor and clean thoroughly all the parts. Check for cracks and any other damage.

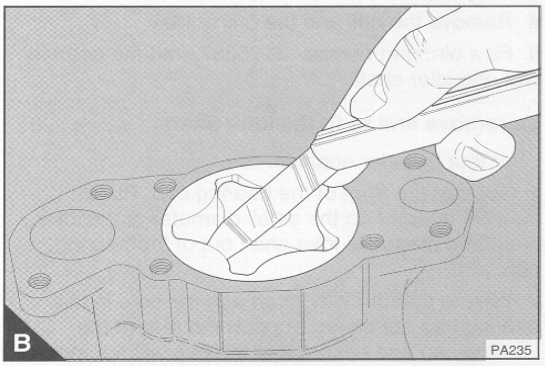
3 Fit the outer rotor and check the outer rotor to body clearance (A).

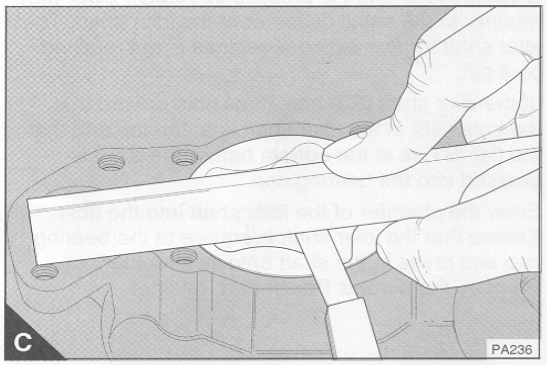
4 Check the inner rotor to outer rotor clearance (B).

5 Check the rotor end-float with a straight edge and a feeler gauge (C). For all the above clearances, see the data and dimensions.

6 Clean the top face of the oil pump and the bottom face of the cover and fit the cover. Tighten the setscrews to 28 Nm (21 lbf ft) 2,9 kgf m. For pumps which are fitted to a balancer unit, put the cover in position and tighten the single setscrew to 22 Nm (16 lbf ft) 2,2 kgf m.







https://truckmanualshub.com/

Relief valve

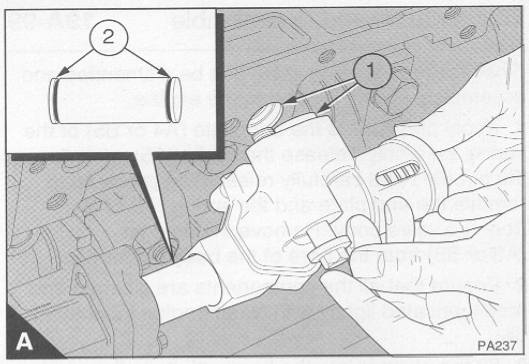
To remove and to fit **19A-08**

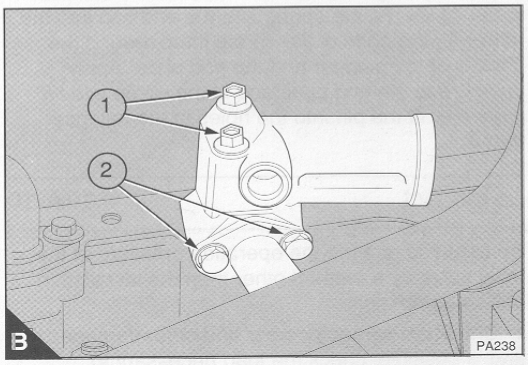
For four cylinder engines which have a balancer unit have a relief valve fitted inside the balancer frame. The relief valve of these engines cannot be removed as an assembly.

1 Drain the lubricating oil and remove the sump, operation 19A-03.

2 For four cylinder engines: Release the setscrew and rotate the relief valve to withdraw the thimble from the cylinder block (A1). Pull the relief valve from the delivery pipe and pull the delivery pipe from the oil pump. Renew the "O" rings (A2). Lightly lubricate the "O" rings with clean engine lubricating oil and push the delivery pipe into the oil pump. Push the relief valve onto the delivery pipe and fit the relief valve to the cylinder block; ensure that the thimble is correctly fitted and tighten the setscrew.

3 For six cylinder engines: Remove the setscrews which fasten the cross flow pipe to the relief valve (B2). The cross flow pipe is only fitted to engines which have the oil filter on the right side of the engine. Remove the flange joint. Release the two setscrews (B1) which fasten the relief valve to the cylinder block and remove the valve. Ensure that the faces of the cross flow pipe and the relief valve are clean. Put the valve in position, complete with a new flange joint. Engage the four setscrews and tighten the flange setscrews and then the valve setscrews.





https://truckmanualshub.com/

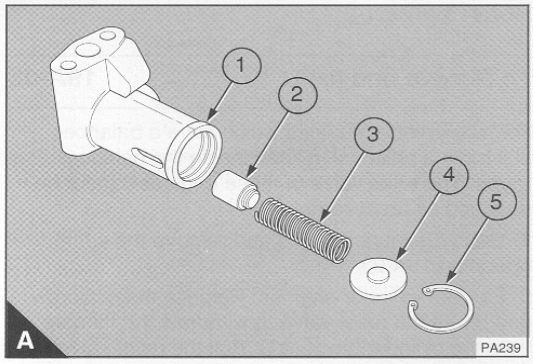
To dismantle and to assemble 19A-09

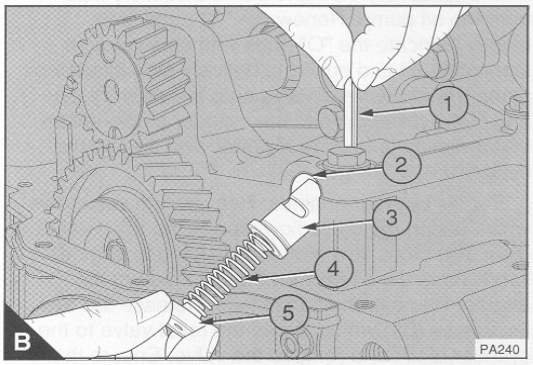
If necessary, the relief valve can be dismantled and assembled while it is fitted to the engine.

1 Apply pressure to the end plate (A4 or B5) of the spring assembly; release the circlip (A5) or remove the pin (B1) and carefully release the pressure to remove the end plate and the spring (A3 or B4) from the valve body. Remove the plunger (A2 or B3) from the bore of the body (A1 or B2).

2 Ensure that all the components are cleaned and then lubricated lightly with clean engine lubricating oil.

3 Fit the plunger into the bore with its hollow end to the inside. Fit the spring and the end cap into the bore with the ends of the spring fitted around the bosses of the plunger and the end plate. Apply pressure to the end plate and fit the circlip into its groove or fit the pin into the holes in the balancer frame.





To inspect 19A-10

Do not try to change the operation pressure of the relief valve by a method other than the installation of new components.

1 Check the spring for wear and other damage and, if possible, check the load necessary to compress the spring to its fitted length, see the data and dimensions.

2 Check the plunger for wear and other damage and ensure that it slides easily in the bore of the relief valve.

3 Check the body and the end plate for wear and other damage.

4 Renew worn or damaged components.

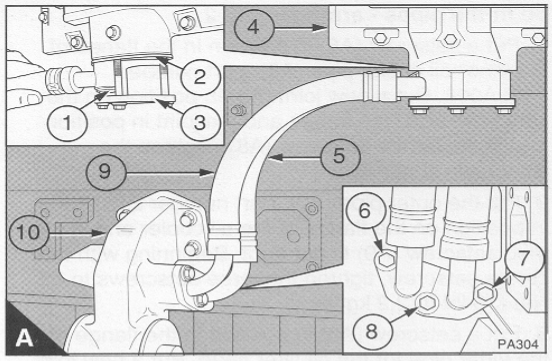
https://truckmanualshub.com/

Flexible oil pipes

The latest oil cooler pipes fitted to 6 cylinder Phaser and 1000 Series engines do not have metal braid and are separate pipes. The part number of the pipes is stamped on a clip which is fastened to one end of each pipe. The pipes are not interchangeable and it is important that the correct pipes are fitted to the particular engine.

To remove, to fit and to inspect 19A-11

There are two arrangements (A) or (B) for the pipes which are used in accordance with the application:



To remove

Warning! *The engine oil may be hot, allow the engine temperature to cool down before the oil pipes are released.*

1 Allow the engine temperature to cool down and put a suitable drip tray under the filter head.

2 Remove the three setscrews which retain the oil pipes to the filter head. Release the oil pipes and allow the oil to drain into the drip tray. Discard the joint.

3 Remove the three setscrews which retain the oil pipes to the oil cooler. Discard the joint.

To fit the pipes - arrangement 1:

1 Put the three setscrews into position in the flange (A3) of the inner pipe (A5), part number 2483A005. Put a new joint (A2) in position on the setscrews.

2 Engage the setscrews by three or four threads in the flange of the oil cooler (A4). Engage the spigot (A1) of the outer pipe (A9), part number 2483A006, in the hole in the flange (A3) of the first pipe, ensure that it fits squarely in the flange.

3 Support the pipes by hand and tighten the centre setscrew finger tight. Tighten the other setscrews until they are finger tight. Ensure that the pipes are as close together as possible, then tighten the setscrews gradually and evenly to 22 Nm (16 lbf ft) 2,2 kgf m.

4 Put a setscrew (A7) in position in the flange of the inner pipe (A5) for the oil filter head (A10). Put a new joint in position on the setscrew. Hold the flange and the joint in position and fit the centre setscrew (A8). Tighten the setscrews finger tight. Put the flange of the outer pipe (A9) in position and fit the third setscrew (A6), tighten it finger tight. Beginning with the centre setscrew, tighten the three setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.

https://truckmanualshub.com/

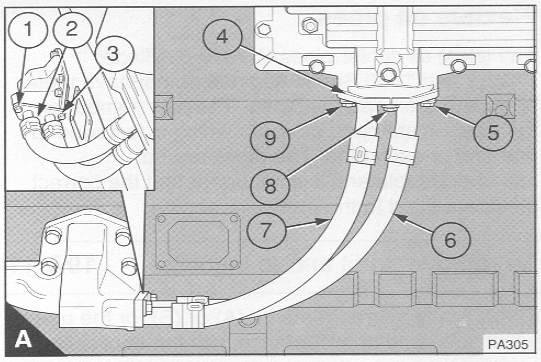
To fit the pipes - arrangement 2

1 Put a setscrew (A5) in position in the flange of the inner oil cooler pipe (A6), part number 2483A004. Put a new joint (A4) in position on the setscrew. Hold the flange and the joint in position and fit the centre setscrew (A8). Tighten the setscrews finger tight.

2 Put the outer pipe (A7), part number 2483A003, in position on the flange of the oil cooler and fit the third setscrew (A9) finger tight. Beginning with the centre setscrew, tighten the three setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.

3 Put a setscrew (A3) in position in the flange of the inner pipe for the oil filter head. Put a new joint in position on the setscrew. Hold the flange and the joint in position and fit the centre setscrew (A2). Tighten the setscrew finger tight.

4 Put the flange of the outer pipe in position and fit the third setscrew (A1), tighten it finger tight. Beginning with the centre setscrew, tighten the three setscrews to 22 Nm (16 lbf ft) 2,2 kgf m.



To Inspect

1 Remove any old pieces of the joint and clean the flange faces of the oil pipes.

2 Throughly clean the oil pipes in an approved detergent cleaning solution.

3 Check the outer cover of the pipes for signs of leakage, cracks or splits. If the outer cover or the flanges are damaged the pipe must be renewed.

https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Lubrication system

Lubricating oil pump - four cylinder engines

Type	Differential rotor, gear driven
Number of lobes	Inner rotor 6, outer rotor 7
Clearance of outer rotor to body:	
- Without balancer unit	0,15/0,34 mm (0.006/0.013 in)
- With balancer unit	0,31/0,45 mm (0.012/0.017 in)
Clearance of inner rotor to outer rotor	0,04/0,13 mm (0.0015/0.0050 in)
End-float of rotor assembly	0,03/0,10 mm (0.001/0.004 in)

Lubricating oil pump - six cylinder engines

Type	Differential rotor, gear driven
Number of lobes:	
- Inner rotor	4
- Outer rotor	5
Clearance of outer rotor to body	0,15/0,34 mm (0.006/0.013 in)
Clearance of inner rotor to outer rotor	0,04/0,13 mm (0.0015/0.0050 in)
End clearance YA, YC:	
- Inner rotor	0,05/0,12 mm (0.002/0.005 in)
- Outer rotor	0,04/0,11 mm (0.0015/0.0044 in)
End clearance (six cylinder turbocharged engines)	
- Inner rotor	0,043/0,118 mm (0.0017/0.0046 in)
- Outer rotor	0,031/0,106 mm (0.0012/0.0042 in)

Idler gear for lubricating oil pump

End float	0,03/0,33 mm (0.001/0.0013 in)
Inside diameter of bush (fitted)	22,23/22,26 mm (0.875/0.866 in)
Outside diameter of idler shaft	22,19/22,21 mm (0.873/0.874 in)
Clearance of bush of idler gear on shaft	0,020/0,066 mm (0.0008/0.0026 in)

Oil pressure relief valve (standard)

Diameter of bore for plunger	18,24/18,27 mm (0.718/0.719 in)
Outside diameter of plunger	18,16/18,18 mm (0.715/0.716 in)
Clearance of plunger in bore	0,06/0,11 mm (0.002/0.004 in)
Length of spring (fitted):	
- Four cylinder engines	59,8 mm (2.4 in)
- Six cylinder engines	55,6 mm (2.2 in)
Load on spring (fitted):	
- Four cylinder engines	15,9/23,1 N (3.6/5.2 lbf) 1,6/2,4 kgf
- Six cylinder engines	12,9/18,6 N (2.9/4.2 lbf) 1,3/1,9 kgf

https://truckmanualshub.com/

Pressure to open valve (Four cylinder engines):	
- Without piston cooling jets	340/395 kPa (49/57 lbf/in²) 3,4/4,0 kgf/cm²
- With piston cooling jets	415/470 kPa (60/68 lbf/in²) 4,2/4,8 kgf/cm²
- Six cylinder engines	345/414 kPa (50/60 lbf/in²) 3,5/4,2 kgf/cm²

Oil pressure relief valve (with balancer)

Diameter of bore for plunger	16,00/16,03 mm (0.630/0.631 in)
Outside diameter of plunger	15,95/15,98 mm (0.628/0.629 in)
Clearance of plunger in bore	0,02/0,08 mm (0.0008/0.003 in)
Length of spring (fitted)	42,7 mm (1.7 in)
Load on spring (fitted):	
- Engines without piston cooling jets	24/30 N (5.4/6.7 lbf) 2,4/3,1 kgf
- Engines with piston cooling jets	34/38 N (7.6/8.5 lbf) 3,5/3,9 kgf
Pressure to open valve:	
- Engines without piston cooling jets	414 kPa (60 lbf/in²) 4,2 kgf/cm²
- Engines with piston cooling jets	523 kPa (76 lbf/in²) 5,3 kgf/cm²

Oil filter

Type	Full flow, screw-on type canister
Pressure to open by-pass valve in filter	55/83 kPa (8/12 lbf/in²) 0,6/0,8 kgf/cm²
Pressure to open by-pass valve in oil cooler	172 kPa (25 lbf/in²) 1,8 kgf/cm²

https://truckmanualshub.com/

Fuel system 20

Bosch EPVE fuel injection pumps 20A

P7100 AD PB in-line fuel injection pump 20B

Stanadyne fuel injection pump 20C

Unit pump 20D

https://truckmanualshub.com/

https://truckmanualshub.com/

Engines fitted with Bosch EPVE fuel injection pumps 20A

General description 20A.02

Fuel filter element

20A-01 To renew 20A.04

Atomisers

Atomiser fault 20A.07
20A-02 To remove and to fit 20A.07

Fuel lift pump

20A-03 To remove and to fit 20A.08
20A-04 To dismantle and to assemble 20A.08
20A-05 To test 20A.10

Fuel injection pump

20A-06A To remove and to fit 20A.11
20A-06B To remove and to fit - pumps fitted with a locking screw 20A.13
20A-06C To set the injection advance device (KSB) 20A.18
20A-07 To adjust 20A.18
20A-08 To eliminate air from the fuel system 20A.20

Data and dimensions 20A.22

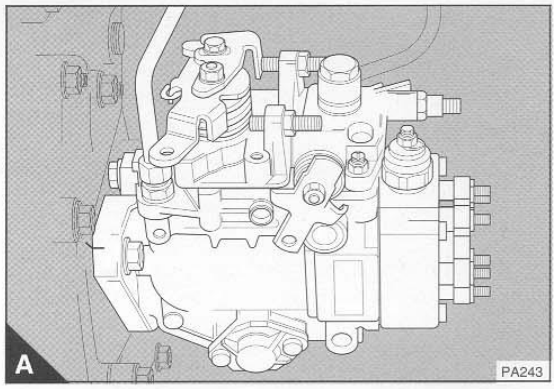
https://truckmanualshub.com/

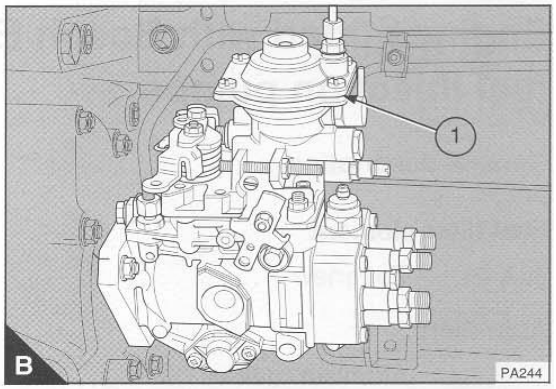
General description

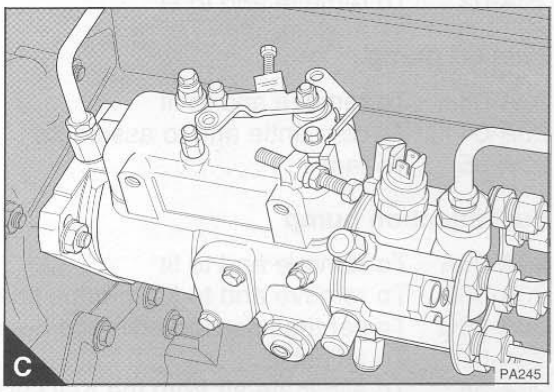
Caution: *It is very important that dirt does not enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After the component has been disconnected, fit a suitable cover to all open connections.*

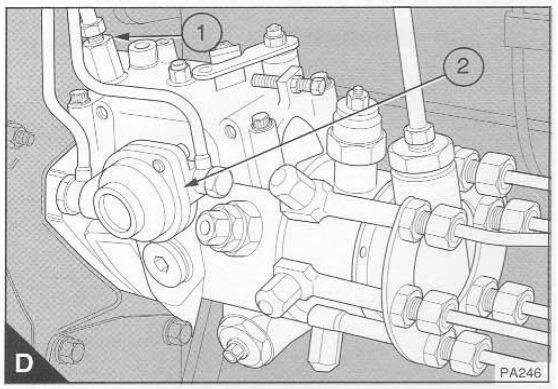
Phaser/1000 Series engines are used for vehicle, agricultural and industrial applications and may have different fuel injection pumps. They use VE P7100 AD PB pump.

Turbocharged engines have pumps with a boost control (B1). Some of the latest fuel pumps have a locking screw to fasten the drive shaft of the pump when the pump is removed from the engine.









https://truckmanualshub.com/

The "low spring" atomisers receive high pressure fuel from the fuel injection pump and inject this fuel into the combustion chamber of the pistons as a very fine spray. The atomisers are set in the factory, but they must be checked in accordance with the preventive maintenance schedules. The pressure at which atomisers operate can be adjusted by a change of shims fitted above the spring.

The fuel injection equipment must only be checked and adjusted by personnel who have had the correct training.

The fuel lift pump is of the diaphragm type and is mechanically driven. It is fitted on the right side of the cylinder block and is driven by an eccentric on the camshaft. The pump is fitted with a priming lever.

https://truckmanualshub.com/

There are three types of fuel filter element in use:

The separate element type (A) or (B) where the filter element is held between the filter head and the bottom cover.

The canister type (C) where the filter element has an internal thread at the top and is fastened to a threaded adaptor in the filter head.

A fuel filter with a quick release canister (D), a quick release clamp ring at the top which is fastened to an external thread on the filter head. Some engines are fitted with a pre-filter of the same type. This filter is fitted next to the main filter, but connected in the fuel system before the fuel lift pump.

Some of the latest engines have a clean side return system. Spill fuel from the fuel injection pump and atomisers is returned directly to the inlet side of the fuel injection pump instead of the fuel filter inlet.

Fuel filter element

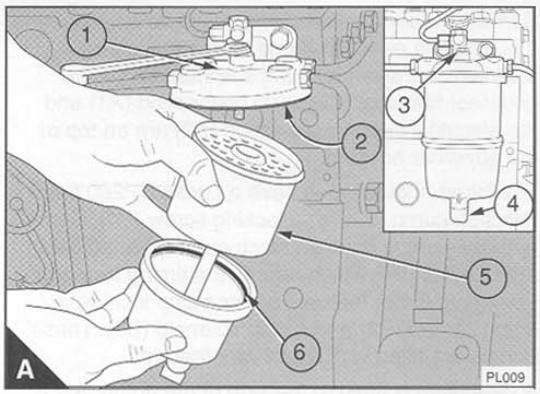
To renew **20A-01**

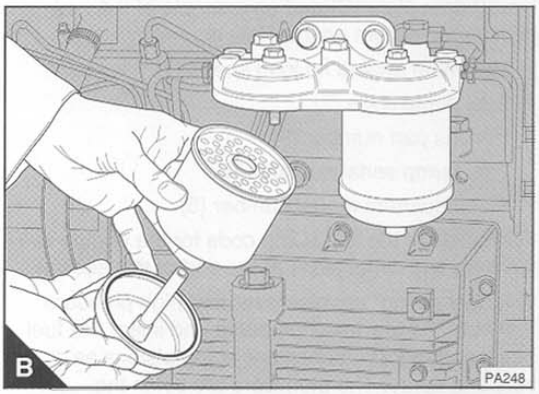
Cautions:

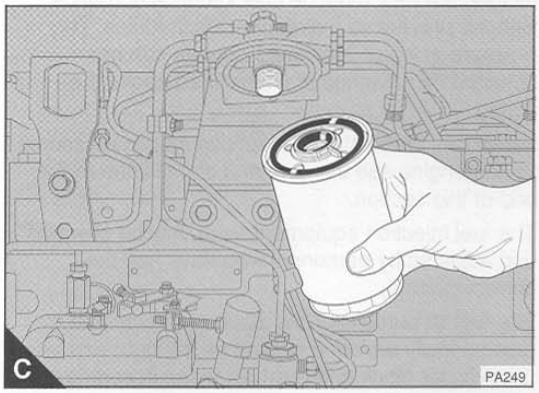
- *It is important that only the genuine* Lovol *fuel filter element is used. The use of a wrong element can damage the fuel injection pump.*
- *Do not allow dirt to enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After a component has been disconnected, fit a suitable cover to all open connections.*

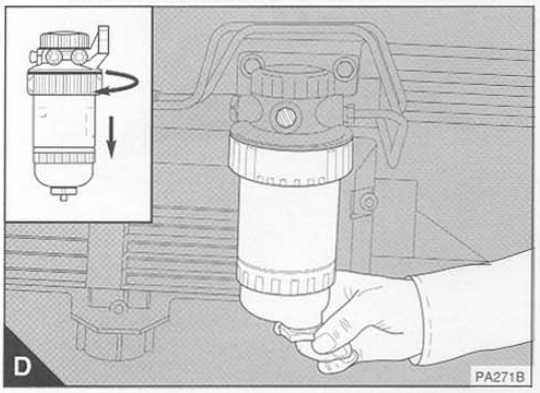
To renew the filter element of the separate element type:

The filter can have one or two elements (A) or (B). When twin elements are fitted, both of the elements must be renewed at the same time.









https://truckmanualshub.com/

1 Clean the outside surfaces of the fuel filter assembly. If a drain tap (A4) or (B1) is fitted to the bottom cover of the filter, drain the fuel from the filter.

2 Hold the bottom cover of the filter element and release the setscrew (A3) which is fitted through the filter head above the centre of each element.

3 Lower the bottom cover of the filter.

4 Remove the element (A5) and discard it.

5 Clean the inside surfaces of the filter head (A1) and bottom filter cover.

6 Fit the new sealing rings (A6) and (A2).

7 Put the bottom cover on the bottom of the new element (A5) and assemble it squarely to the filter head to ensure that the element is fitted in the centre against the joint in the filter head.

8 Hold the assembly in this position and engage and tighten the setscrew.

9 Eliminate all air from the fuel system, operation 20A-08.

To renew the filter element of the canister type:

1 Thoroughly clean the outside surfaces of the fuel filter assembly.

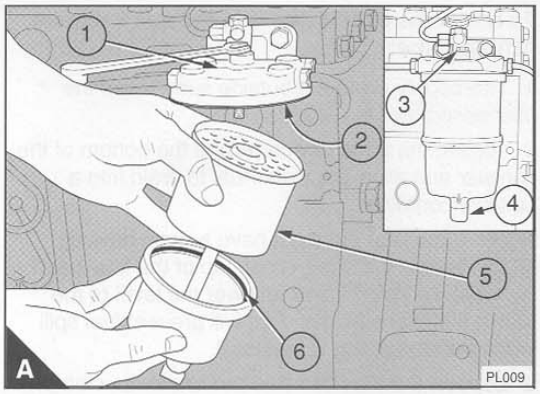
2 Loosen the drain device (B2) at the bottom of the canister and allow the water/fuel to drain into a suitable container.

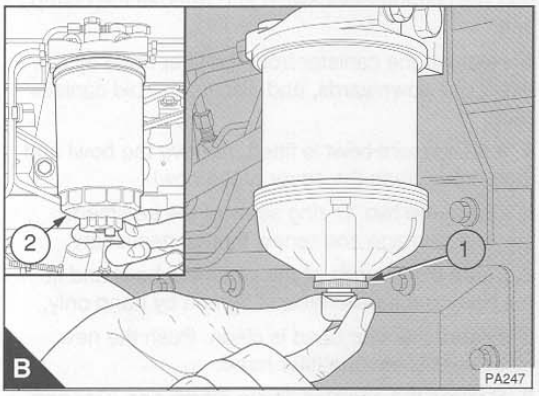
3 Use a strap wrench or similar tool to loosen the filter canister and remove the canister.

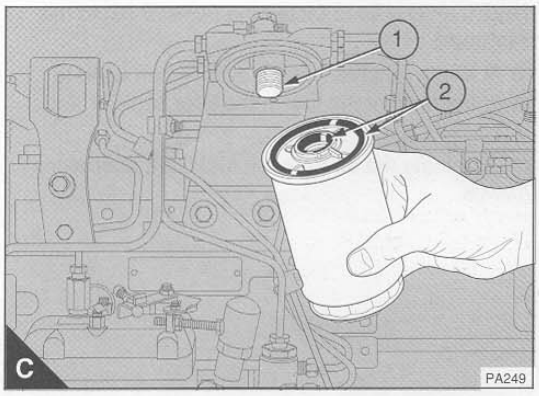
4 Ensure that the threaded adaptor (C1) is secure in the filter head and that the inside of the head is clean.

5 Lubricate lightly the seals (C2) on the top of the new canister with clean fuel. Fit the new canister to the filter head and tighten by hand only.

6 Eliminate the air from the fuel filter, operation 20A-08.







https://truckmanualshub.com/

To renew the filter element of the quick release canister type:

1 Thoroughly clean the outside surfaces of the filter assembly (A).

2 Loosen the drain device (A5) at the bottom of the canister and allow the water/fuel to drain into a suitable container.

Note: If the filter does not have a drain device fitted, release the cap (A1) on top of the filter head. Remove the nylon insert to lower the level of the fuel in the filter canister. This will prevent fuel spill when the clamp ring is released.

3 Support the filter canister and rotate the clamp ring (A2) counter-clockwise and remove the clamp ring.

4 Remove the canister from the filter head by a direct pull downwards, and discard the old canister (A3).

5 If a sediment bowl is fitted, remove the bowl and thoroughly clean the cover of the bowl.

6 Check the two 'O' ring seals of the sediment bowl for damage and renew them if necessary.

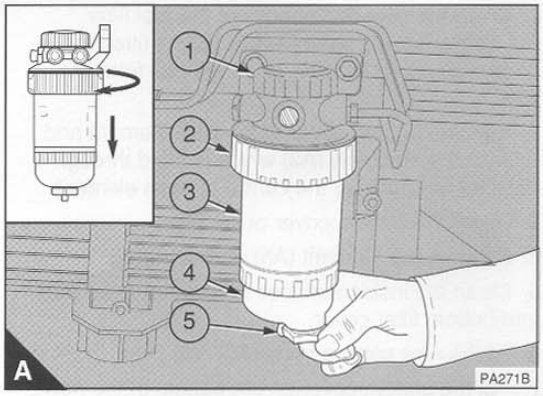
7 Clean the threads of the sediment bowl and fit the bowl to the canister and tighten by hand only.

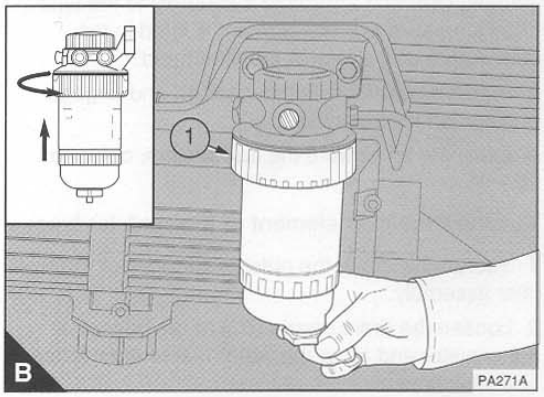
8 Ensure the filter head is clean. Push the new canister fully into the filter head.

9 Support the canister, fit the clamp ring (B1) and rotate it clockwise to fasten the canister (B) to the filter head.

10 If it was removed, fit the nylon insert used to lower the level of the fuel in the filter canister and fasten the cap.

11 Eliminate the air from the fuel filter, operations 20A-08.





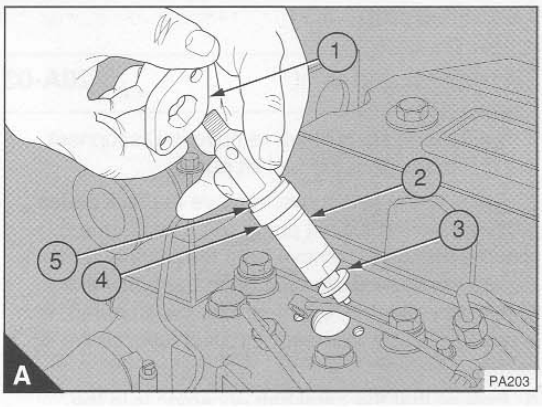
https://truckmanualshub.com/

Atomisers

Atomiser fault

An atomiser fault can be shown by an engine misfire. In order to find which atomiser is defective, operate the engine at a fast idle speed. Loosen and tighten the union nut of the high pressure fuel pipe at each atomiser. When the union nut of the defective atomiser is loosened, it will have little or no effect on the engine speed.

Warning! *Do not let the fuel spray on to your skin!*



To remove and to fit **20A-02**

1 Remove the fuel leak-off pipe.

2 Release the union nuts of the high-pressure pipes from the atomisers and from the fuel injection pump. Hold the pump outlet with a spanner to prevent movement while the union nut of the high-pressure pipe is released at the pump. Do not bend the pipe. If necessary, remove the pipe clamps.

3 Release the setscrews of the atomiser flange and remove the flange (A1), the atomiser (A2) and its seat washer (A3). Remove the dust seal (A4) and the spacer (A5) and fit the spacer and a new dust seal to the new atomiser.

4 Put the new atomiser in position with its spacer, new dust seal and a new seat washer. Fit the flange and engage the flange setscrews. Ensure that the atomiser is not tilted and tighten the setscrews gradually and evenly to 12 Nm (9 lbf ft) 1,2 kgf m.

5 Fit the high-pressure pipes and tighten the union nuts to 18 Nm (13 lbf ft) 1,9 kgf m. Hold the pump outlet with a spanner to prevent movement while the pipe nut is tightened at the pump. If necessary, fit the pipe clamps.

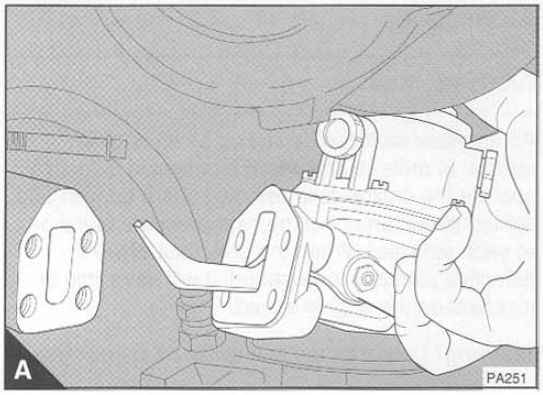
6 Renew the seal washers and fit the leak-off pipe.

7 Operate the engine and check for fuel leakage.

https://truckmanualshub.com/

Fuel lift pump

To remove and to fit 20A-03



1 If a heat shield is fitted, remove it. Disconnect the fuel pipes from the fuel lift pump.

2 Release the setscrews, remove the lock plates and remove the fuel lift pump (A). The lift pump may be difficult to remove from the engine. If this occurs the crankshaft must be rotated until the camshaft eccentric, that operates the lift pump, is in a position which will free the rocker lever of the lift pump.

3 Ensure that the camshaft eccentric is in the minimum lift position before the lift pump is fitted. Clean the joint face of the lift pump and the cylinder block and fit the lift pump together with a new joint. Fit the lock plates and the setscrews and tighten them gradually and evenly to 22 Nm (16 lbf ft) 2,2 kgf m.

4 Connect the fuel pipes and, if necessary, fit the heat shield.

5 Release the vent screw on the fuel filter head and operate the priming lever of the fuel lift pump to eliminate any air between the lift pump and the fuel filter. Operate the lift pump until fuel, free of air, comes from the vent screw. Tighten the vent screw.

6 Operate the engine and check for any fuel or air leakage.

To dismantle and to assemble 20A-04

To dismantle

1 Clean the outside surfaces of the fuel lift pump.

2 Make a mark across the flanges of the two halves of the pump to ensure correct relationship when the pump is assembled.

https://truckmanualshub.com/

3 Remove the cover (A1) and the gauze (A2). Release the setscrews and separate the two halves of the pump.

4 Turn the diaphragm assembly (A5) 90° to release the pull rod from the link arm (A8) and remove the diaphragm assembly. Remove the stem seal (A6), the spring seat washer (A7) and the spring (A12) from the pull rod. The diaphragm and pull rod assembly is renewed as an assembly and no service is possible on the diaphragm.

5 The valves (A4) are peened in and can be removed with a suitable lever. Some of the peened metal will have to be removed before the valves can be removed.

6 To remove the link arm: Hold the rocker lever (A11) in a vice and hit the body of the lift pump with a soft face hammer to release the two retainers (A10). Be careful not to damage the joint face of the pump body. Remove the rocker lever, the pin (A9), the link arm and the return spring. Check the components for wear and other damage.

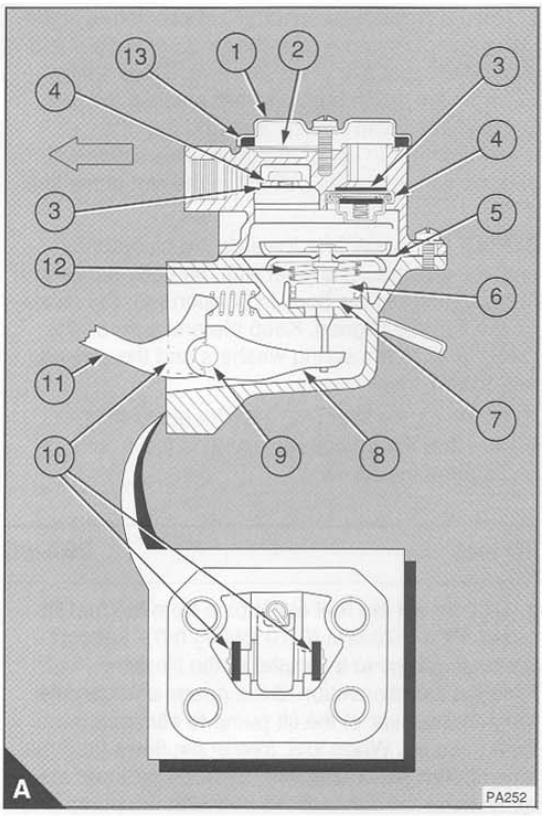
To assemble

1 Thoroughly clean the valve housings. Fit new seat washers (A3) and push the new valves (A4) into position. As the valves are the same, but one valve is fitted in reverse of the other, it is possible to fit the valves upside down. To ensure that the valves are fitted correctly, fit them as shown in A. When the valves are correctly fitted, peen the edge of the valve housings in six places, evenly divided, to keep the valves in position.

2 Fit the rocker lever (A11), pin (A9) and link arm assembly (A8) into the bottom half of the lift pump. Fit the return spring; ensure that the ends of the spring are in their correct location.

3 With a light hammer and a suitable adaptor, fit two new retainers (A10) in their grooves in the casing until they fasten the pin. Peen the open ends of the grooves to fasten the retainers in position.

4 Fit the diaphragm spring (A12) into its location under the diaphragm (A5) and put the spring seat washer (A7) and a new stem seal (A6) into position on the pull rod. Ensure that the small diameter at the top of the seal is on the round section of the pull rod.



https://truckmanualshub.com/

5 Put the diaphragm assembly in position over the lower half of the body with the blade of the pull rod aligned with the slot in the link arm. Press lightly down on the diaphragm until the notch in the pull rod is in the slot in the link arm and turn the diaphragm 90° in either direction. This action will engage and retain the pull rod in the slot of the link arm.

6 Push the rocker arm towards the pump body until the diaphragm is level with the body flange and fit the top half of the body in position with the marks on the flanges aligned. Keep the pressure on the rocker arm; fit the spring washers and the screws and tighten them evenly.

7 Fit the gauze filter (A2) and the cover (A1), ensure that the rubber seal (A13) is fitted correctly and tighten the screw.

To test **20A-05**

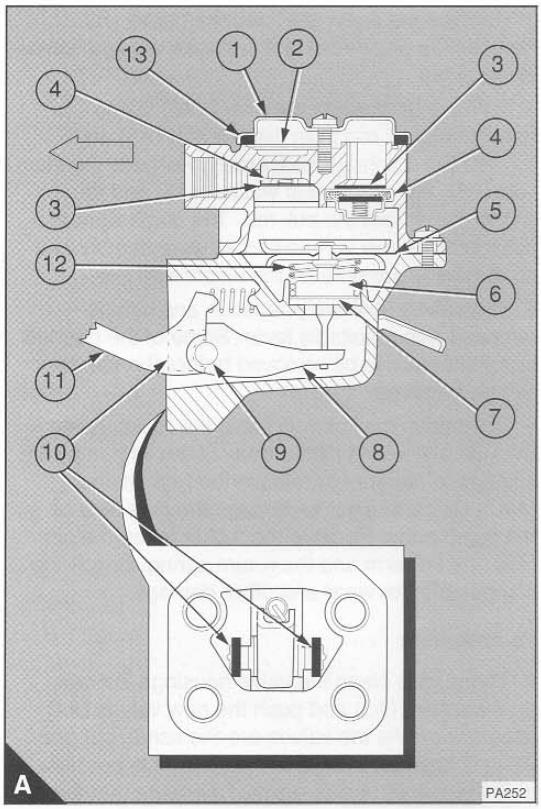
1 Disconnect the fuel outlet pipe from the fuel lift pump. Fit a 0-70 kPa (0-10 lbf/in^2) 0-0,7 kgf/cm^2 pressure gauge to the outlet of the lift pump. Release the connection at the gauge and operate the priming lever of the lift pump to eliminate air from the pipe. When fuel, free of air, flows from the pipe tighten the connection. Ensure that there are no leaks at the connections between the pump and the gauge.

2 Operate the starter motor for 10 seconds with the engine stop control in the stop position or with the stop solonoid disconnected.

3 Note the maximum pressure indicated on the gauge. If the pressure indicated is less than the test pressure shown in the data and dimensions, repair or renew the pump. Also check the rate at which the pressure reduces to half the maximum pressure obtained. If this is less than 30 seconds, repair or renew the pump.

4 Remove the gauge and connect the outlet pipe to the lift pump. Release the vent screw on the fuel filter head and operate the priming lever until fuel, free of air, flows from the vent screw. Tighten the vent screw.

5 Connect the engine stop solonoid.



https://truckmanualshub.com/

Bosch EPVE fuel injection pump without a locking screw

To remove and to fit - Bosch EPVE pump **20A-06A**

To remove

Special tools:

Gear puller, PD.155C

Adaptors for use with PD.155C, PD.155B-5

Spanner for flange nuts of fuel injection pump, PD.239

Universal timing gauge, MS.67B

Gear adaptor for use with MS.67B, PD.67-3

Adaptor for use with MS.67B, PD.67B-1

Pump timing gauge, MS.107

Piston position probe, PD.221

1 Remove all the pipes, disconnect the stop control and the control rod of the fuel injection pump. Ensure that a spanner is used to prevent movement of the fuel pump outlets when the nuts of the high-pressure pipes are released.

2 Remove the gear cover from the cover of the timing case. Remove the gear nut and the spring washer.

3 Rotate the crankshaft until the keyway in the gear of the fuel pump is in the 1 o'clock position (A).

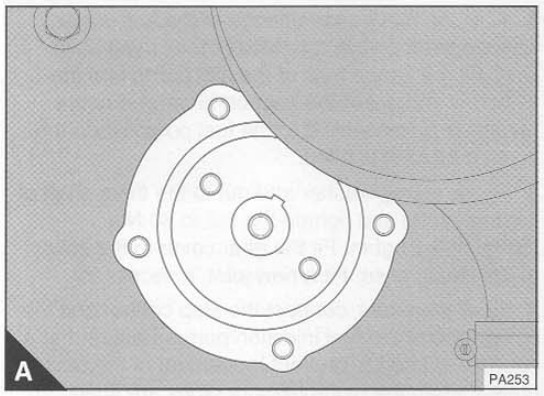
4 Remove the setscrew and the nut of the support bracket below the fuel pump. Release the flange nuts of the fuel pump. If access to the flange nuts of the fuel pump is restricted by, for example, a compressor, use tool PD.239 to release the flange nuts.

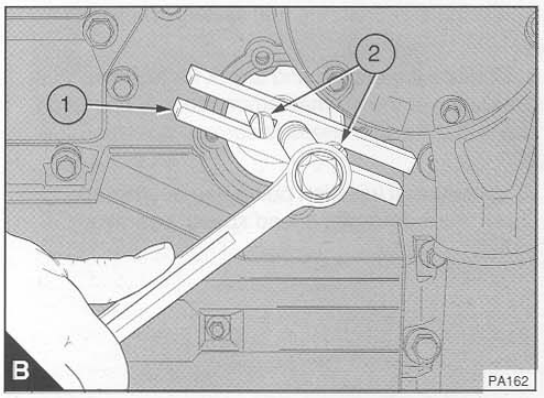
5 Loosen the drive gear of the fuel injection pump with the puller PD.155C (B1) and adaptors PD.155B-5 (B2).

6 Remove the fuel pump; ensure that the key does not fall from the drive shaft.

To fit

1 Rotate the drive shaft of the fuel injection pump clockwise to align the key with the 1 o'clock position of the keyway in the drive gear. In this position there will be no spring pressure on the drive shaft. Ensure that the key is correctly fitted and fit the fuel pump to the gear.





https://truckmanualshub.com/

2 Align the mark on the flange of the fuel pump with the mark on the rear face of the timing case (A1). Fit the flange nuts of the fuel pump and the setscrew and nut of the support bracket. Ensure that force is not applied to the fuel pump when the support bracket is fitted.

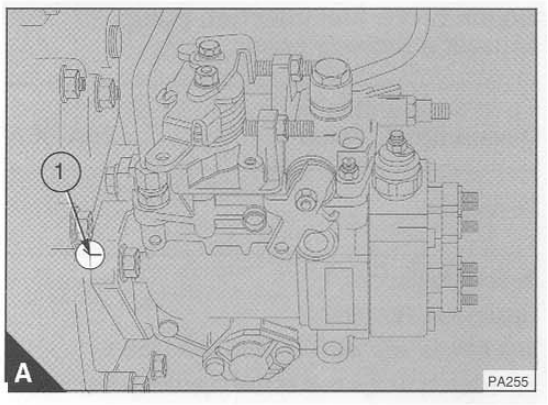
3 Fit the spring washer and nut to the drive shaft of the fuel pump and tighten the nut to 80 Nm (59 lbf ft) 8,2 kgf m. Fit the gear cover to the cover of the timing case. Fit a new joint, if necessary.

4 Fit all the pipes, connect the stop control and the control rod of the fuel injection pump. Ensure that a spanner is used to prevent movement of the pump outlets when the high-pressure pipes are fitted.

5 Eliminate air from the fuel system, operation 20A-08.

6 Operate the engine and check for leakage. With the engine at the normal temperature of operation, check that the idle speed is correct, operation 20A-07.

7 If a new fuel injection pump has been fitted, check the maximum no load speed, operation 20A-07.



https://truckmanualshub.com/

Bosch EPVE fuel injection pump with a locking screw

To remove and fit **20A-06B**

Some Bosch EPVE fuel injection pumps have a locking screw (A2) and a spacer (A3) fitted. The purpose of the locking screw is to fasten the drive shaft of the pump when the pump is removed from the engine.

Caution: *The drive shaft of the pump must not be turned without the spacer in position under the locking screw.*

A new pump will be received with the locking screw fitted and the spacer fastened to the throttle lever by a piece of wire. The new pump is not set to fit immediately onto the engine, but must be set before it is fitted, see page 20A.17.

Engines which have the latest fuel injection pump operate at a static timing very close to TDC.

When the piston is close to TDC there is a relatively large movement of the crankshaft for only a small movement of the piston. For this reason the earlier method of timing, where piston movement is measured, is not sufficiently accurate.

When the piston is further down the cylinder, there is a relatively small movement of the crankshaft for a large movement of the piston. Therefore greater accuracy is possible. For this reason the crankshaft is set at 100° BTDC.

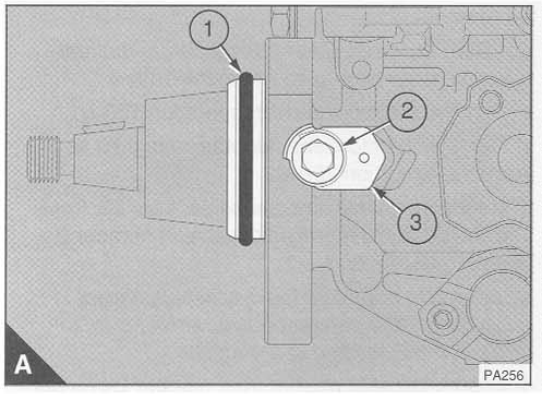
The timing is set on number 2 cylinder as this will put the key in the drive shaft of the pump at the top.

The pump is then set to a suitable angle to allow for the crankshaft angle and the static timing angle.

If the locking screw is used, it is not necessary to set the pump each time it is removed.

There is a timing mark on the pump flange, but not on the timing case.

Some fuel pumps have an "O" ring (A1) fitted in a groove in front of the pump flange. This "O" ring is fitted instead of a joint between the pump flange and the timing case.



https://truckmanualshub.com/

To remove

Caution: *Disconnect the battery before the fuel injection pump is removed from the engine.*

1 Remove the rocker cover, operation 12A-01.

2 Remove the atomisers together with their seat washers, operation 20A-02.

3 Rotate the crankshaft clockwise, from the front, until the push rod for the inlet valve of number 2 cylinder just releases.

Caution: *Do not rotate the crankshaft, except in accordance with paragraph five, when the piston position probe is fitted to the engine.*

4 Ensure the seat washer from number 2 cylinder has been removed and put the piston position probe, PD.221 (A1) into the position for the number 2 cylinder. Fit the atomiser clamp to the probe and tighten the setscrews gradually and evenly. The piston position probe is used to set the crankshaft to 100° BTDC.

5 Slowly rotate the crankshaft clockwise, from the front, until the piston just contacts the piston position probe. The piston will now be set at 100° BTDC on the compression stroke of number 2 cylinder.

Caution: *Ensure that the piston comes lightly into contact with the piston position probe, or both the piston and the probe could be damaged.*

6 Loosen the locking screw and pull out the spacer between the locking screw and the pump body. **Tighten the locking screw** to 27 Nm (20 lbf ft) 2,8 kgf m. Ensure that the spacer is not lost. It is recommended that the spacer is attached to the pump body by locking wire.

Caution: *Do not release the clamp of the KSB cold start device, if one is fitted.*

7 Remove the low pressure pipes and cables from the fuel pump.

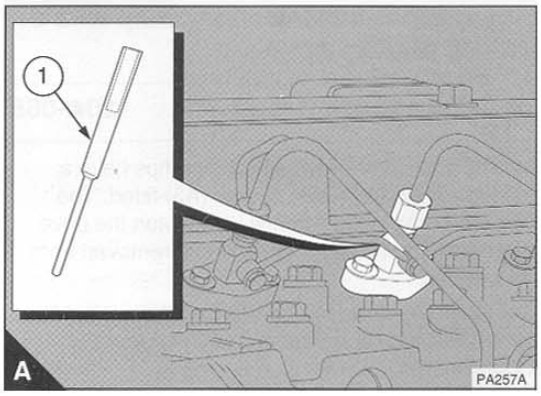
8 Remove the setscrew and the nut of the support bracket below the fuel pump.

9 Release the setscrews and remove the gear cover from the timing case cover. It may be necessary to hit the cover gently with a hide face hammer to release it.

Release the flange nuts of the pump three or four turns.

Remove the nut, washer and the spacer (early Phaser 210Ti engines only) from the drive gear for the pump.

Fit the gear puller PD.155C and loosen the gear on the drive shaft of the pump. If the holes for the puller adaptors in the fuel pump gear are not in the correct position to fit the puller it may be necessary to remove the water pump, operation 21A-03.



Caution: *The crankshaft must not be moved when the pump is not on the engine. Movement of the crankshaft may result in damage to the timing case and make it necessary to time the engine before the pump can be fitted.*

9 Remove the pump from the engine.

Caution: *The fuel injection pump must be set in accordance with the procedure on page 20A.17:*

- *The pump is to be renewed*
- *The pump performance is not correct*
- *The locking screw is released after the pump is removed from the engine.*

https://truckmanualshub.com/

To fit

Cautions:

- *Do not rotate the crankshaft when the piston position probe is fitted to the engine.*
- *Ensure that the spacer, fitted to early 210Ti engines, is in position or the nut will not tighten the gear correctly.*

1 Fit a new joint or the "O" ring (A1) and put the pump into position on the timing case. Ensure that the key is engaged correctly in the keyway of the drive gear.

2 Fit the spacer (early Phaser 210Ti engines only), spring washer and the nut to retain the drive gear. Tighten the nut to approximately 15 Nm (11 lbf ft) 1,5 kgf m.

3 Hold the top of the pump toward the engine to remove the backlash and fit the nuts to the pump flange. Tighten them to 22 Nm (16 lbf ft) 2,2 kgf m.

4 Fit the fastener for the pump bracket, ensure that there is no tension on the pump and tighten the fastener.

5 Release the locking screw (2) and fit the spacer (3), tighten the locking screw to 12 Nm (9 lbf ft) 1,2 kgf m.

6 Remove the piston position probe from the engine and fit the atomiser together with a new seat washer. Fit the remainder of the atomisers. Tighten the setscrews for all of the atomisers.

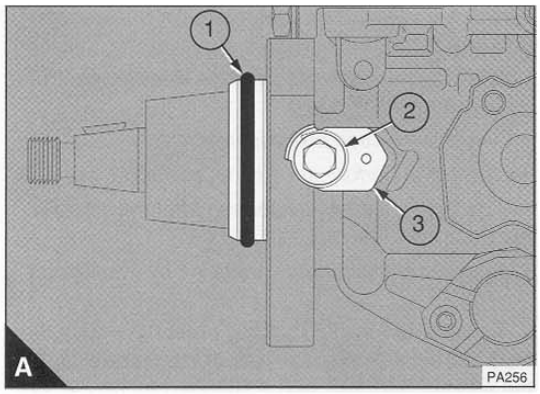
7 Fully tighten the nut for the drive gear to 80 Nm (59 lbf ft) 8,2 kgf m. Fit the gear cover.

8 Fit the pipes and cables to the pump.

9 Eliminate air from the fuel system, operation 20A-08.

10 Fit the rocker cover, operation 12A-01.

11 Operate the engine and check for leakage. With the engine at the normal temperature of operation, check that the idle speed and the maximum no load speed is correct, operation 20A-07.



https://truckmanualshub.com/

To set a Bosch EPVE fuel injection pump with locking screw

Caution: *This procedure must be followed carefully if the fuel injection pump:*

- *The fuel injection pump is new*
- *The pump performance is not correct*
- *The locking screw is released after the pump is removed from the engine.*

1 Hold the pump securely in a vice by the support bracket.

2 **Release the pump locking screw**. Remove the plug and washer from the rear of the pump and fit the adaptor, MS.107, and a suitable dial gauge. Set the dial gauge to indicate approximately 3,0 mm (0.12 in).

3 Fit adaptor, PD.67-3 (C), for the timing tool, MS.67B, to the drive shaft of the pump. Use the nut for the drive gear, tightened finger tight only, to retain the adaptor.

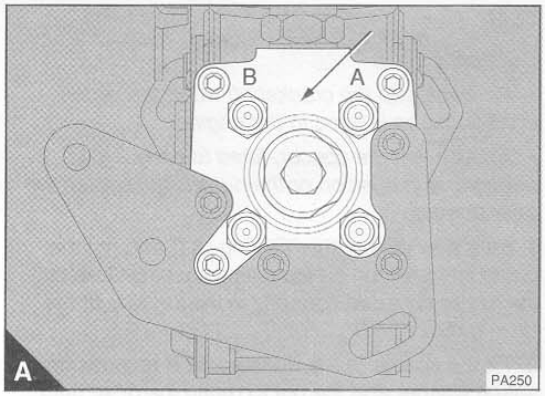
4 Fit the timing tool, MS.67B (D) to the adaptor and fit adaptor PD.67B-1 to the timing tool. PD.67B-1 is used to rotate the timing tool and the shaft of the pump. To rotate the adaptor, it will be necessary to make a suitable bar which uses the three setscrews in the adaptor.

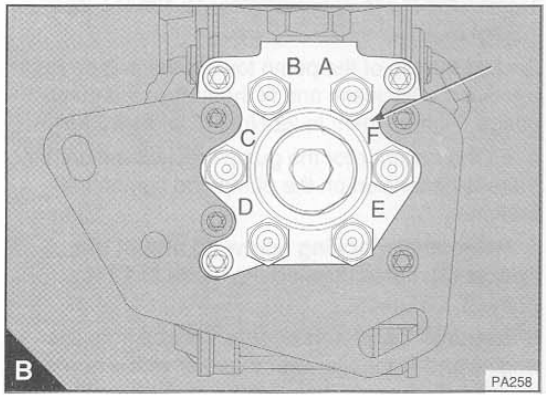
5 Set the injection advance device,if one is fitted,operation 20A-06C

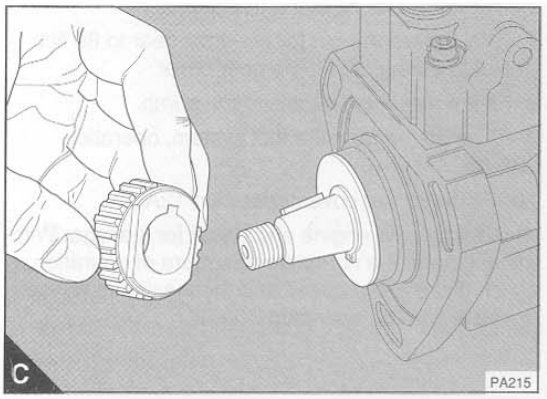
6 Ensure that the keyway in the drive shaft is between outlet A and B for four cylinder engines (A) or outlet A and F for six cylinder engines (B).

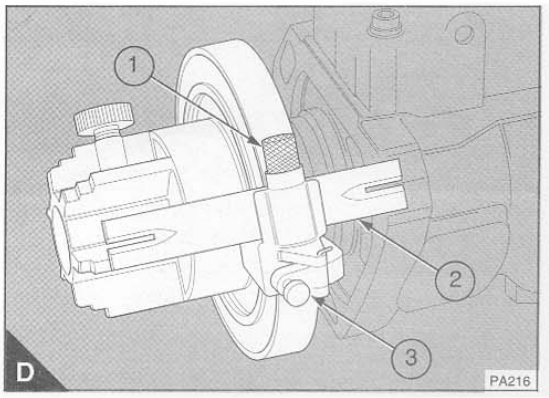
7 Check that the pump plunger is at its lowest position and set the dial of the gauge to zero. There will be no tension on the bar used to turn the pump in this position.

8 Rotate the pump shaft slowly clockwise, from the drive end, until the pointer on the dial gauge indicates 1,0 mm (0.039 in) plunger lift. For engines fitted with fuel pump code TL the plunger lift is 1,25 mm. **Hold the shaft in this position and tighten the pump locking screw**.









https://truckmanualshub.com/

9 Release the locking screw (D3) of the timing tool and move the setting block until the pointer aligns approximately with the centre of the top outer slot in the pump flange. Tighten the screw.

10 Release the locking screw (D1) for the pointer (D2) and slide the pointer forward until the slot in the pointer covers the flange. Tighten the screw.

11 Hold the timing tool against the direction of pump rotation to remove backlash. Mark the pump flange with a scriber along the slot in the pointer.

12 Release the locking screw for the pointer and slide the pointer backwards to cover half of the flange. Tighten the screw.

13 Remove the timing tool and note the angle indicated on the tool.

The cold start device (KSB) must be energised efore the timing is set, see operation 20A-06C.

14 **Release the locking screw on the pump** and allow the pump plunger to return to its lowest position. The dial should return to zero.

15 Fit the timing tool to the pump drive.

16 Rotate the timing tool against the direction of pump rotation until the slot in the pointer is aligned with the mark on the pump flange. **Tighten the pump locking screw**. Check that the key of the pump shaft is aligned with the keyway in the gear.

17 Disconnect the KSB, if one is fitted.

18 Remove the timing tool and adaptor PD.67B-1.

19 Remove the nut and adaptor from the shaft of the pump.

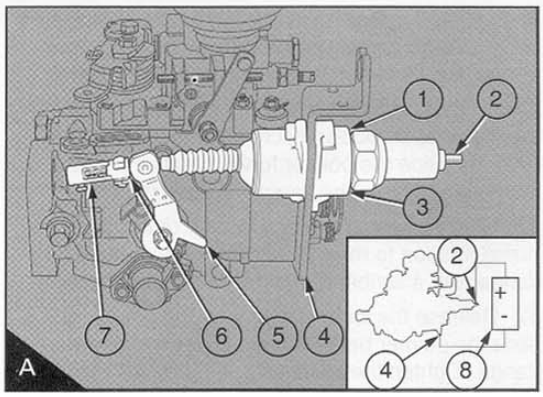
20 Remove the adaptor and dial gauge.

21 Fit the washer and plug to the rear of the pump and tighten the plug to 10 Nm (7 lbf ft) 1,0 kgf m.

22 Fit the pump to the engine, operation 20A-06B.

https://truckmanualshub.com/

To set the injection advance device (KSB) — 20A-06C



Some Bosch EPVE rotary fuel injection pumps have a starting aid (KSB) which advances the injection timing. The device (A) is operated electrically and is connected by a wire to the advance lever (A5) of the fuel injection pump.

When the engine reaches the normal temperature of operation a sender unit in the cooling system energises, to apply 24v to the wax filled element (A3) which operates to retard the timing.

The advance lever of the fuel injection pump is set in the factory to advance the injection timing when the engine is cold. Therefore it will be necessary to energise the KSB if the static timing of the fuel injection pump is to be set:

Caution: *Do not release the clamp (A6) from the KSB wire; this will result in the loss of adjustment set in the factory.*

1 With the fuel injection pump removed from the engine connect a cable from the positive terminal of the battery (A8) to the injection advance device (A2).

2 Connect a cable from the earth terminal of the battery to the fuel injection pump body (A4).

Warning! *Avoid contact with the body of the hot KSB during the pump setting operation.*

3 Allow a minimum of five minutes for the wax in the wax filled element to expand before the static timing is set.

4 Turn the pump shaft in the direction of rotation to move the lever of the advance mechanism, fully towards the clamp (A6), into the fully retarded position. Ensure that there is no tension in the cable of the KSB before the pump is set.

Notes:

- New pumps may be supplied with a special tool fitted to the end of the wire for factory adjustment (A7). This tool must be removed by the release of the screw and discarded to prevent damage to the wire when the engine is running. Cut off excess wire which extends from the end of the clamp and seal the end of the wire.
- If the pump performance is correct and static timing adjustment is not necessary, the pump can be removed and fitted without the requirement to energise the KSB.

https://truckmanualshub.com/

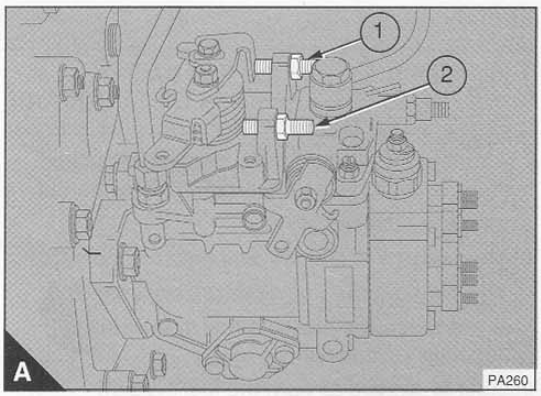
To adjust - Bosch pump 20A-07

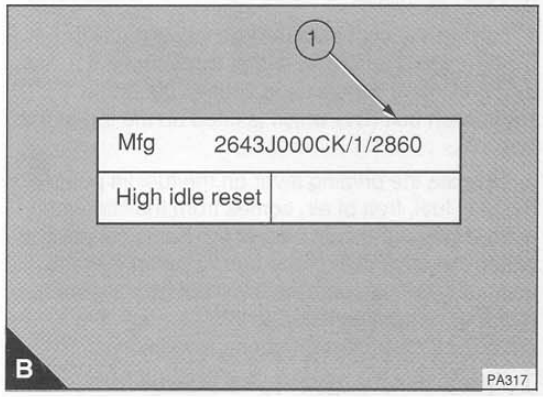
1 Operate the engine until it reaches its normal temperature of operation and check the idle speed. If necessary, adjustment can be made by the inner adjustment screw (A1). Release the locknut and rotate the adjustment screw clockwise to increase the speed, or counter-clockwise to decrease the speed. When the speed is correct, tighten the locknut. The setting of the idle speed can change for different applications. Normally the correct speed will be given in the manufacturer's handbook for the application. If it is not given, apply to your nearest Perkins distributor or to Technical Services Department, Perkins International Ltd, Peterborough, England.

Caution: *The setting for the maximum no load speed can change for different applications. Always check the fuel injection pump data plate (B) fitted to a particular engine, before making any adjustment to the maximum no load speed.*

2 With the engine at its normal temperature of operation, check the maximum no load speed. The maximum no load speed is indicated by the last section of the setting code for the fuel injection pump. The setting code can be found on the data plate (B1) on the side of the fuel pump. A typical setting code is 2643J000CK/1/2860. In this example, the maximum no load speed is 2860 rev/min. If necessary, this speed can be adjusted by the outer adjustment screw (A2). Release the locknut and rotate the adjustment screw counter-clockwise to increase the speed or clockwise to decrease the speed. When the speed is correct, tighten the locknut and seal the screw. The person who fits the pump must ensure that the adjustment screw is suitably sealed against interference after it has been set initially.

The adjustment screw on original fuel pumps is set and sealed by the manufacturer. The setting must not be changed as this could affect the engine warranty.





https://truckmanualshub.com/

Fuel system

To eliminate air from the fuel system - Bosch pump 20A-08

If air enters the fuel system, it must be eliminated from the system before the engine can be started.

Air can enter the system if:

- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

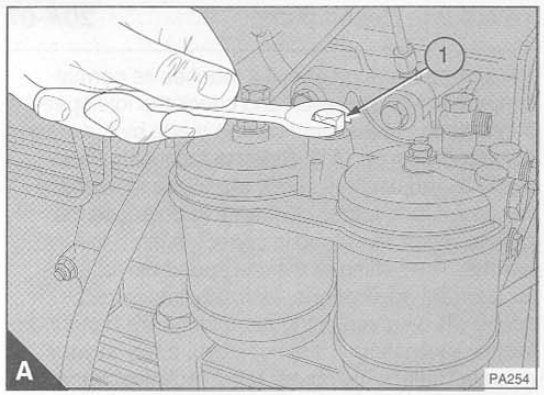
In order to remove air from the fuel system, proceed as follows:

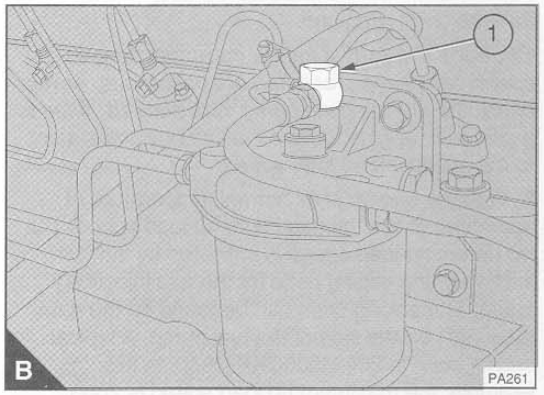
1 Loosen the vent plug (A1) on top of the twin element fuel filter (A) by two or three turns. If a single element filter is used, loosen the banjo connection bolt (B1) which is fitted on the top of the filter (B).

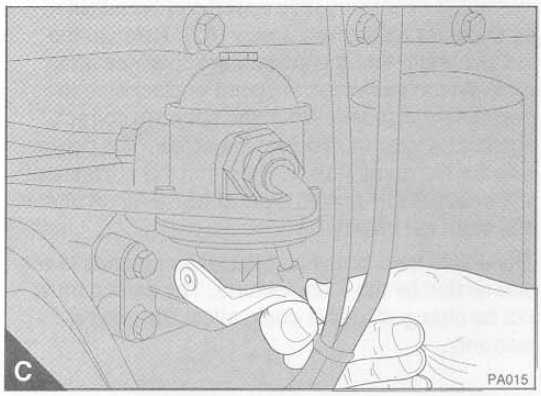
2 Operate the priming lever on the fuel lift pump (C) until fuel, free of air, comes from the filter vent point. Tighten the vent plug or the banjo connection bolt. If the drive cam of the fuel lift pump is at the point of maximum cam lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one revolution.

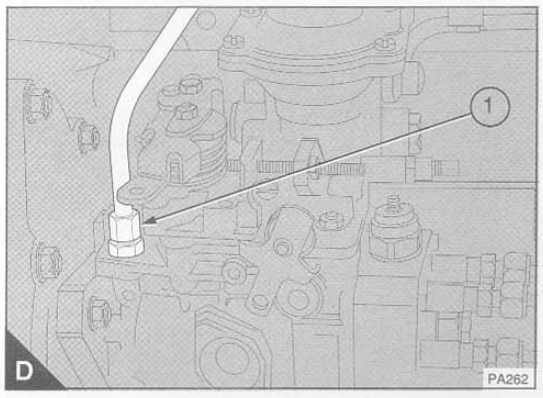
3 Ensure that the manual stop is in the "run" position. If an electrical stop control is used, turn the key of the start switch to the "R" position.

4 Loosen the union nut of the fuel inlet pipe (D1). Operate the priming lever of the fuel lift pump until fuel, free of air, comes from the loose connection. Tighten the union nut.









https://truckmanualshub.com/

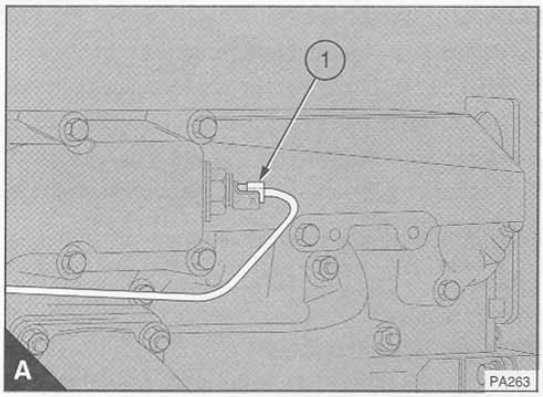
5 Loosen the union nut (A1) at the fuelled starting aid, if one is fitted, and operate the priming lever of the fuel lift pump until fuel, free of air, comes from the connection. Tighten the union nut at the starting aid.

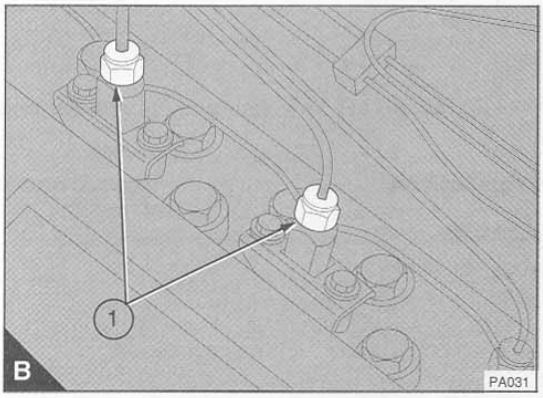
6 Loosen the high-pressure pipe connections (B1) at two of the atomisers.

7 Ensure that the manual stop control, if one is fitted, is in the "run" position. Operate the starter motor until fuel, free from air, comes from the pipe connections.

8 The engine is now ready to start.

Note: If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the suction or low-pressure system.





https://truckmanualshub.com/

Data and dimensions

Fuel lift pump - four cylinder engines

Type	A.C.Delco, type XD
Method of drive	Eccentric on camshaft of engine
Static pressure (no delivery)	42/70 kPa (6/10 lbf/in²) 0,4/0,7 kgf/cm²
Test pressure (75% of minimum static pressure)	31 kPa (4.5 lbf/in²) 0,32 kgf/cm²

Fuel lift pump - Six cylinder engines

Type	A.C.Delco, type LU
Method of drive	Eccentric on camshaft of engine
Static pressure (no delivery)	34,5/55,2 kPa (5/8 lbf/in²) 0,35/0,56 kgf/cm²
Test pressure (75% of minimum static pressure)	26 kPa (3.75 lbf/in²) 0,26 kgf/cm²

Fuel filter

Type	Twin parallel flow or single element

Fuel lift pump - AE, YE - four and six cylinder engines

Type	Bosch, FP/KG24MW304
Method of drive	Eccentric on camshaft of engine or on camshaft of fuel injection pump

Fuel filter

Type	Twin parallel flow or single element

https://truckmanualshub.com/

Engines fitted with an in-line fuel injection pump 20B

General description 20B.02

Fuel filter canister

20B-01 To renew 20B.03

Atomisers

Atomiser fault ..... refer to 20A.07
20B-02 To remove and to fit ..... refer to 20A.07

Fuel lift pump

20B-03 To remove and to fit 20B.04
20B-04 To dismantle and to assemble 20B.05

Fuel injection pump

20B-05 To remove and to fit 20B.06
20B-06 To adjust 20B.09

Fuel system

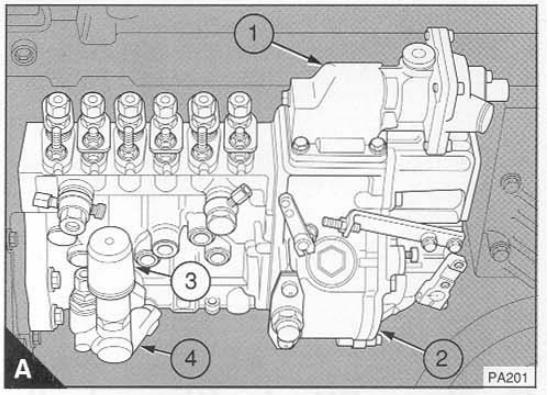
20B-08 To eliminate air from the fuel system 20B.10

Data and dimensions 20B.11

https://truckmanualshub.com/

General description

Caution: *It is very important that dirt does not enter the fuel system. Before a connection is disconnected, clean thoroughly the area around the connection. After the component has been disconnected, fit a suitable cover to all open connections.*



P7100,AD,PB in-line fuel injection pump has a mechanical governor (A2) fitted to the rear of the pump to control engine speed. On top of the governor housing is a boost control (A1). The boost control is a device which is affected by boost pressure (from the turbocharger) and reduces the maximum fuel delivery at lower engine speeds to match the reduced air supply to the cylinders.

The "low spring" atomisers receive high-pressure fuel from the fuel injection pump and inject this fuel into the combustion chamber of the piston as a very fine spray. The atomisers are set in the factory, but must be checked in accordance with the preventive maintenance schedules. The pressure at which atomisers operate can be adjusted by a shim fitted above the spring.

The fuel injection equipment must be checked and adjusted by personnel who have had the correct training.

The plunger type fuel lift pump (A4) can either be on the side of the fuel injection pump, or on the right side of the cylinder block. When the lift pump is fitted to the cylinder block, an adaptor is fitted between the pump and the cylinder block. The fuel lift pump is driven by an eccentric on the camshaft of the fuel injection pump, or by an eccentric on the engine camshaft. The fuel lift pump is fitted with a priming pump (A3).

https://truckmanualshub.com/

Fuel filter canister

To renew **20B-01**

Caution: *It is important that only the correct genuine Lovol fuel filter canister is used. The use of a wrong canister can damage the fuel injection pump.*

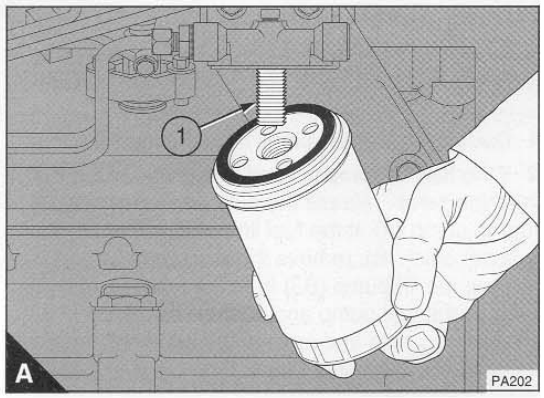
1 Thoroughly clean the outside surfaces of the fuel filter assembly.

2 Use a strap wrench or similar tool to loosen the filter canister and remove the canister.

3 Ensure that the threaded adaptor (A1) is secure in the filter head and that the inside of the head is clean.

4 Lightly lubricate the seal of the new canister with clean fuel. Fit the new canister to the filter head and tighten by hand only.

5 Eliminate the air from the fuel filter, operation 20B-08



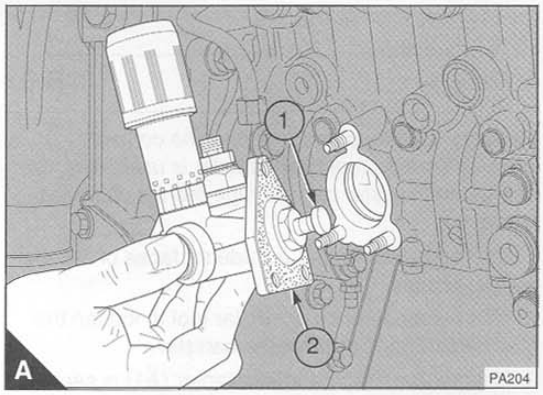
https://truckmanualshub.com/

Fuel lift pump

To remove and to fit **20B-03**

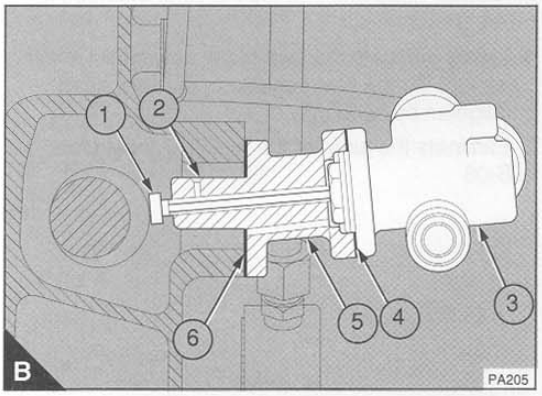
1 Disconnect the fuel pipes from the fuel lift pump.

2 If the fuel lift pump is fitted to the side of the fuel injection pump, release the nuts and remove the fuel lift pump (A). If the fuel lift pump is fitted to the cylinder block (B), remove the setscrews and remove the lift pump (B3) from the adaptor (B5). To remove the fuel pump and adaptor assembly: Release the nuts and remove the assembly from the side of the cylinder block.



To fit the lift pump to the fuel injection pump:

3 Clean the joint face of the fuel lift pump and of the fuel injection pump. Ensure that the eccentric on the camshaft of the fuel injection pump is in the minimum lift position. Fit a new joint (A2) to the lift pump. Check that the push rod (A1) is in position and fit the lift pump the fuel injection pump. Tighten the nuts gradually and evenly to 6 Nm (4 lbf ft) 0,6 kgf m.



To fit the adaptor or the adaptor and lift pump assembly:

4 Clean the joint face of the adaptor and of the cylinder block. Ensure that the eccentric on the engine camshaft is in the minimum lift position. Fit a new joint (B6) to the adaptor. Check that the push rod (B1) is in position. Ensure that the lubrication hole (B2) is at the top and fit the adaptor to the cylinder block. Tighten the nuts gradually and evenly to 22 Nm (16 lbf ft) 2,2 kgf m.

To fit the lift pump to the adaptor:

5 Clean the joint face of the lift pump and of the adaptor. Ensure that the eccentric on the engine camshaft is in the minimum lift position. Fit a new joint (B4) to the lift pump. Fit the lift pump to the adaptor and tighten the setscrews gradually and evenly to 6 Nm (4 lbf ft) 0,6 kgf m.

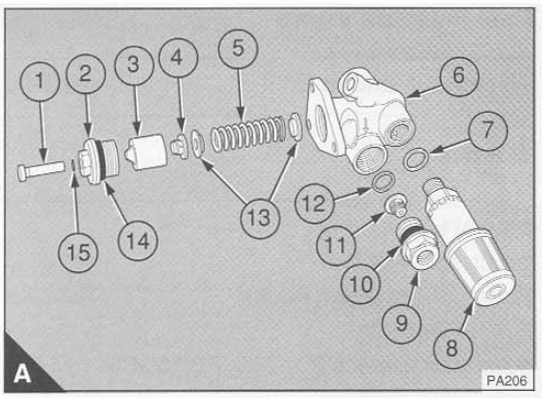
6 Connect the fuel pipes to the lift pump.

5 Release the vent plug on the fuel filter. Operate the priming pump on the fuel lift pump until fuel, free of air, comes from the vent plug. Tighten the vent plug.

7 Operate the engine and check for leakage of fuel or air.

https://truckmanualshub.com/

To dismantle and assemble 20B-04



To dismantle

1 Clean the outside surfaces of the fuel lift pump.

2 Remove the push rod (A1).

3 Release the end nut (A2). Remove the plunger (A3) the suction valve (A4) the spring seat washer (A13) the spring (A5) and the second spring seat washer (A13) from the pump body (A6).

4 Remove the priming pump (A8), if fitted, and the copper washer (A7).

5 Release the delivery valve holder (A9). Remove the delivery valve (A11) and the "O" ring (A12) from the body.

To assemble

1 Thoroughly clean inside the body of the lift pump and ensure that the passages in the body are not restricted. Carefully clean the valves in clean diesel fuel. Inspect each valve for damage to the valve spring and the valve plate. If there is damage, renew the valve.

2 Put a spring seat washer (A13) in position in the pump body. Ensure that the flat face of the washer is toward the bottom of the body. Put the spring (A5) on the spring seat washer and the other spring seat washer (A13) on the spring. Put the suction valve (A4) in position on top of the valve seat washer. Ensure that the large diameter of the valve is toward the spring seat washer. Put the plunger (A3) in position in the pump body over the valve and spring. Renew the "O" ring (A15) which fits inside the end nut and the "O" ring (A14) on the outside of the end nut. Support the pump body, put the end nut in position on the plunger, compress the spring and engage the threads of the end nut with the threads in the pump body. Tighten the end nut to 42 Nm (31 lbf ft) 4,3 kgf m. Put the push rod in position in the end nut.

3 Put a new "O" ring (A12) in position in the pump body. Put the delivery valve (A11) in position on the "O" ring. Ensure that the large diameter of the valve is toward the "O" ring. Renew the "O" ring (A10) on the delivery valve holder (A9). Fit the deliver valve holder and tighten to 42 Nm (31 lbf ft) 4,3 kgf m.

4 Renew the copper washer (A7) and fit the priming pump (A8). Tighten the priming pump to 47 Nm (34 lbf ft) 4,8 kgf m.

https://truckmanualshub.com/

Fuel injection pump

To remove and to fit 20B-05

To remove

Special tools

Piston location monitor

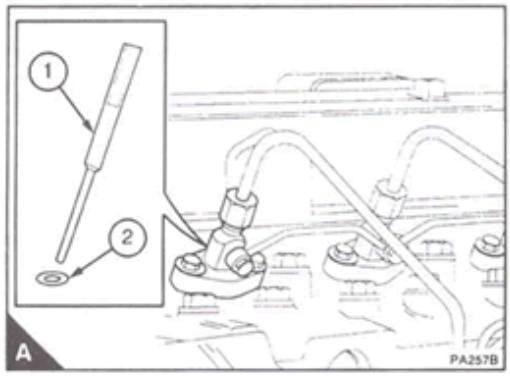
1. Remove rocker arm
2. Loose the fixing screw on atomiser
3. Rotate the crankshaft clockwise at front end until the push rod of number 1 cylinder intake valve.

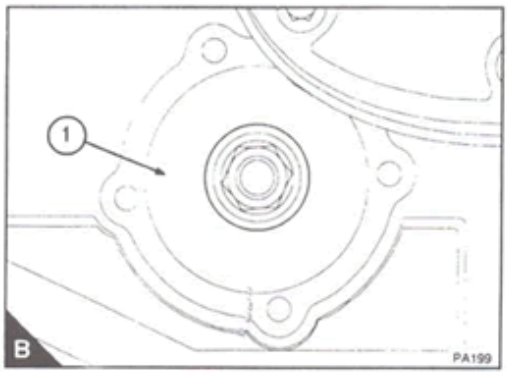
Remark: when the checking angel of engine is less than 100, a self-made washer (A2) must be installed in the piston position monitor (A1). See data and size for the detail.

4. Remove the atomiser and the housing from number 1 cylinder and then place the piston position monitor PD 221(A1) to its position. Fit the atomiser clamp onto the monitor and gradually tighten the location screw uniformly.

Caution: ensure the piston just contacting the piston position monitor to avoid damaging the piston; at the same time, the monitor will bend and result in the incorrect position of the piston.

5. Carefully rotate clockwise the crankshaft until the piston just contacting the piston position monitor.
6. Loose the location screw and remove the gear cover on the timing gear box.
7. Then loose the gear cover screw of fuel pump and remove the nut connecting the injection pump and the gear. （B1）





https://truckmanualshub.com/

8 Remove the high-pressure pipes and the low pressure pipes from the fuel pump. Remove the lubricating oil pipe and the boost control pipe from the fuel pump.

9 Disconnect the stop control/electrical cable and the engine speed control.

10 Four cylinder engines: Loosen the setscrews that retain the pump support bracket to the cylinder block. Remove the nut and bolt from the bracket and remove the spacer between the brackets. Six cylinder engines: Loosen the setscrews that retain the pump support bracket to the cylinder block. Remove the setscrew that holds the support bracket for the pump body to the pump support bracket.

11 To remove the pump. Ensure that the key in the shaft is not lost.

a

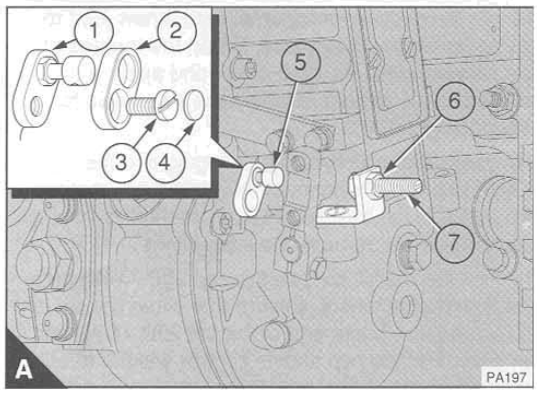
https://truckmanualshub.com/

To fit

1. Install the fuel injection pump on the gear of injection pump and ensure the correct installation of the keys.
2. According to the requirement of relevant torque, install the fuel injection pump on the timing injection pump and install the bracket of injection pump, lubricant pipe and low and high pressure pipes.
3. Install the gear coven on the timing gear chamber.
4. Loose the location screws and remove the piston position monitor from number 1 cylinder and the specific washer(if exist).Gradually tighten the atomiser uniformly to 12 N.m (9lbf)1.2kg.f.m
5. Install rocker arm, see 20B-08.
6. Dispel the air in the fuel system, see 20B-08.
7. Check the fuel injection pump timing according to 17B-03.
8. Run the engine and check the leakage. To run the engine to its normal operation temperature, check the idle speed is normal, see 20B-06.
9. If a new fuel injection pump has been installed, check the maximum load-free speed, see 20B-6.

https://truckmanualshub.com/

To adjust the fuel injection pump 20B-06



1 Operate the engine until it reaches its normal temperature of operation and check the idle speed. If necessary, adjustment can be made by the adjustment screw (A7). Release the locknut (A6) and rotate the adjustment screw clockwise, from the rear, to increase the speed, or counter-clockwise to decrease the speed. When the speed is correct, tighten the locknut. The setting of the idle speed can change for different applications. The correct speed will normally be given in the manufacturer's handbook for the application. If it is not given apply to your nearest Perkins/Detroit Diesel distributor. If further assistance is necessary, apply to the Technical Service Department of either Lovol International Limited.

2 With the engine at its normal temperature of operation, check the maximum no load speed. If necessary, adjustment can be made by the adjustment screw (A5).

For early engines: Remove the lead seal (A4) for access to the lower screw (A3). Release the lower screw and remove the cover (A2). On the latest engines the lead seal, screw and cover have been removed and locking wire fitted to prevent movement of the adjustment screw for the maximum no-load speed. Cut the locking wire and discard the lead seal.

Release the lock nut (A1) and rotate the adjustment screw clockwise, from the rear, to increase the speed, or counter-clockwise to decrease the speed.

When the speed is correct, tighten the locknut. For early engines: Fit the cover, fit and tighten the lower screw. Fit a new lead seal to seal the lower screw. For the latest engines: Renew the locking wire and fit a new lead seal.

Caution: *The setting for the maximum no load speed can change for different applications. Always check the fuel injection pump data plate (B) fitted to a particular engine, before making any adjustment to the maximum no load speed.*

With the engine at its normal temperature of operation, check the maximum no load speed.

The person who fits the pump must ensure that the adjustment screw is suitably sealed against interference after it has been set initially. The adjustment screw on the original fuel pump is set and sealed by the manufacturer. The setting must not be changed as this could affect the engine warranty.

https://truckmanualshub.com/

https://truckmanualshub.com/

To eliminate air from the fuel system 20B-07

If air enters the fuel system, it must be eliminated before the engine can be started.

Air can enter the system if:

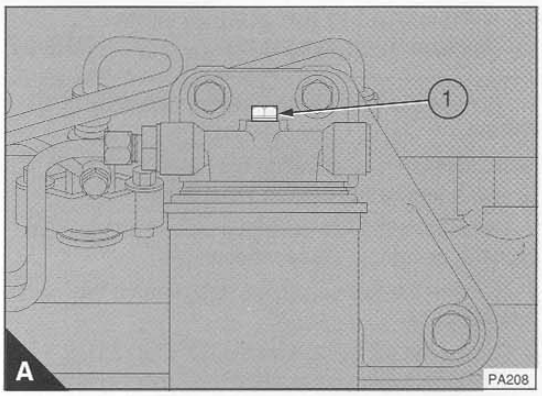
- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

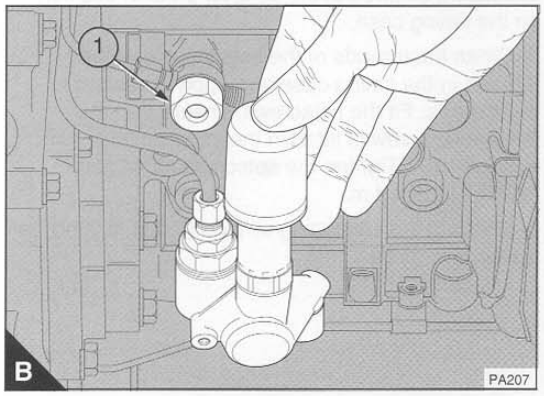
In order to eliminate air from the fuel system, proceed as follows:

1 Loosen the vent plug (B1) on top of the fuel filter by two or three turns. Operate the priming pump (C) of the fuel lift pump until fuel, free of air, comes from the filter vent point. Tighten the vent plug.

2 Loosen the banjo connection bolt (C1) at the drive end of the fuel pump. Operate the priming pump of the fuel lift pump until fuel, free of air, comes from the loosened connection. Tighten the banjo connection bolt.

3 Ensure that the stop control is in the run position and the speed control is in the maximum speed position. Operate the starter motor. When the engine starts, reduce the engine speed. If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system.





https://truckmanualshub.com/

https://truckmanualshub.com/

Data and dimensions

In-line fuel injection pump

Fuel pump type	P7100 AD PB
Direction of rotation from drive end	Clockwise
Outlet for number 1 cylinder	Drive end of fuel pump

Fuel lift pump

Method of drive	Eccentric on camshaft of engine or on camshaft of fuel injection pump

Fuel filter

Type	Twin parallel flow or single element

https://truckmanualshub.com/

https://truckmanualshub.com/

Engines fitted with Stanadyne fuel injection pumps 20C

General description . . . . . refer to 20A.02

Fuel filter element

20C-01 To renew . . . . . refer to 20A.04

Atomisers

Atomiser fault . . . . . refer to 20A.07
20C-02 To remove and to fit . . . . . refer to 20A.07

Fuel lift pump

20C-03 To remove and to fit . . . . . refer to 20A.08
20C-04 To dismantle and to assemble . . . . . refer to 20A.08
20C-05 To test . . . . . refer to 20A.10

Fuel injection pump

20C-06 To remove and to fit 20C.02
20C-07 To adjust 20C.04
20C-08 To eliminate air from the fuel system 20C.05

Data and dimensions . . . . . refer to 20A.22

https://truckmanualshub.com/

To remove and to fit - Stanadyne pump 20C-06

Special tools:

Gear puller, PD.155C

Adaptors for use with PD.155C, PD.155B-5

To remove

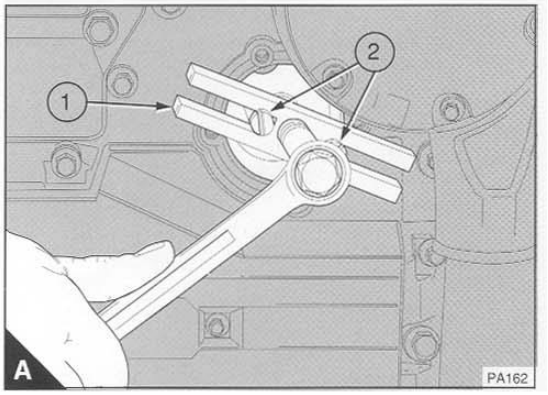
1 Remove the fuel pipes, disconnect the electrical stop control and the control rod of the fuel injection pump.

2 Remove the gear cover from the cover of the timing case. Remove the gear nut and the spring washer.

3 Release the flange nuts of the fuel pump.

4 Loosen the drive gear of the fuel injection pump with the puller PD.155C (A1) and the adaptors PD.155B-5 (A2).

5 Remove the fuel injection pump.



https://truckmanualshub.com/

To fit

1 Fit a new joint (A1) to the timing case. Fit a new "O" ring (A3) to the fuel pump. DB4 fuel pumps are fitted with a rubber seal which has a square shape instead of an "O" ring. When a rubber seal is fitted it is not necessary to fit a joint.

2 Rotate the drive shaft of the fuel pump to align the pin (A2) or key with the keyway in the drive gear. Ensure that the pin or key is correctly fitted and fit the fuel pump to the gear. Fit the spring washer and the nut to retain the drive gear and tighten the nut lightly.

3 Align the mark on the flange of the fuel pump with the mark on the rear face of the timing case (B1). Fit the flange nuts of the fuel pump. Tighten them to 22 Nm (16 lbf ft) 2,2 kgf m.

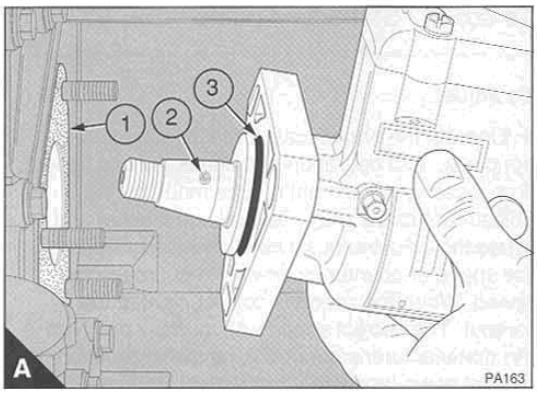
4 Fully tighten the nut for the drive gear to 80 Nm (59 lbf ft) 8,2 kgf m. Fit a new joint for the gear cover and fit the gear cover.

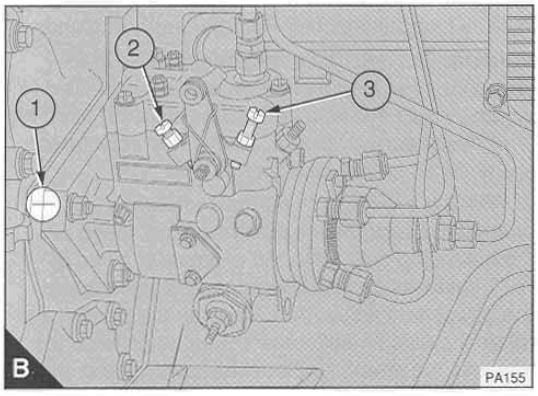
5 Fit the fuel pipes. Connect the electrical stop control and the control rod of the fuel pump.

6 Eliminate air from the fuel system, operation 20C-08.

7 Operate the engine and check for leakage. With the engine at the normal temperature of operation, check that the idle speed is correct, operation 20C-07.

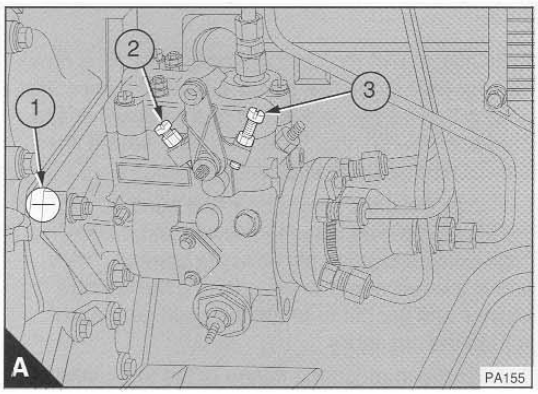
8 If a new fuel pump has been fitted, check the maximum no load speed, operation 20C-07.





https://truckmanualshub.com/

To adjust - Stanadyne pump 20C-07



To adjust

1 Operate the engine until it reaches its normal temperature of operation and check the idle speed. If necessary, adjustment can be made by the adjustment screw (A2). Release the locknut and rotate the adjustment screw clockwise to increase the speed or counter-clockwise to decrease the speed. When the speed is correct, tighten the locknut. The correct speed will normally be given in the manufacturer's handbook for the application.

Caution: *The setting for the maximum no load speed can change for different applications. Always check the fuel injection pump data plate (B) fitted to a particular engine, before making any adjustment to the maximum no load speed.*

2 With the engine at its normal temperature of operation, check the maximum no load speed on the fuel pump data plate. An example is given at (B1); if necessary, this speed can be adjusted by the adjustment screw (A3). Release the locknut and rotate the adjustment screw counter-clockwise to increase the speed, or clockwise to decrease, the speed. When the speed is correct, tighten the locknut and seal the screw. The person who fits the pump must ensure that the adjustment screw is suitably sealed against interference after it has been set initially. The adjustment screw on original fuel pumps is set and sealed by the manufacturer. The setting must not be changed as this could affect the engine warranty.

https://truckmanualshub.com/

To eliminate air from the fuel system Stanadyne pump 20C·08

If air enters the fuel system, it must be eliminated before the engine can be started.

Air can enter the system if:

- The fuel tank is drained during normal operation.
- The low-pressure fuel pipes are disconnected.
- A part of the low-pressure fuel system leaks during engine operation.

In order to eliminate air from the fuel system, proceed as follows:

1 Loosen the vent plug (A1) on the top of the filter head.

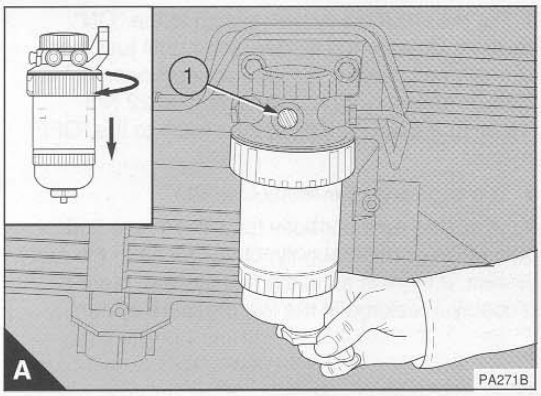
2 Operate the priming lever on the fuel lift pump (B) until fuel, free from air, comes from the filter vent point. Tighten the vent plug.

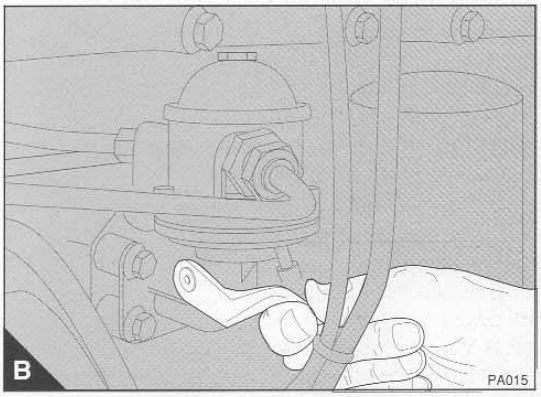
Note: If the drive cam of the fuel lift pump is at the point of maximum cam lift, it will not be possible to operate the priming lever. In this situation, the crankshaft must be rotated one revolution.

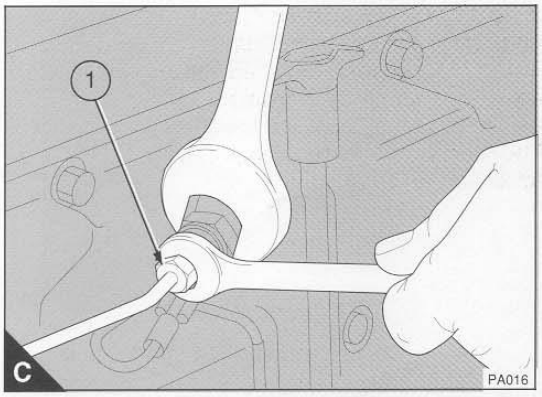
3 If the pipe to the fuelled starting aid has been drained, loosen the union nut (C1) at the fuelled starting aid and operate the lift pump until fuel, free from air, comes from the connection. Tighten the union nut at the starting aid. Use a spanner on the hexagon of the fuelled starting aid to prevent its movement when the union nut is loosened and tightened.

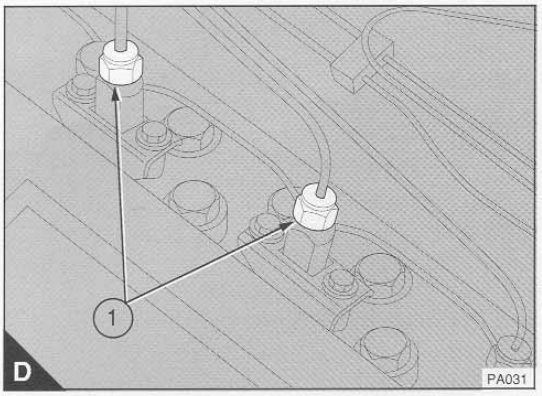
Note: The fuelled starting aid for naturally aspirated engines is fitted at the rear of the induction manifold.

4 Loosen the union nuts (D1) of the high-pressure pipes at two of the atomisers.









https://truckmanualshub.com/

5 Put the electrical system switch to the "ON" position. Operate the starter motor until fuel, free from air, comes from the pipe connections. Tighten the high-pressure pipe connections to 22 Nm (16 lbf ft) 2,2 kgf m. Return the switch to the "OFF" position.

6 The engine is now ready to start.

If the engine runs correctly for a short time and then stops or runs roughly, check for air in the fuel system. If there is air in the fuel system, there is probably a leakage in the low pressure system.

https://truckmanualshub.com/

Engine installed with unit pump **20D**
General Description……..20D.02
Fuel pump
20D-03 Installation……..……..20D.03
Fuel injection pump
20D-04 To remove and to fit……...……..20D.04
Common fault modes and remedy flow……....……20D.07
Maintenance and servicing……..……..…20D.08
Possible reasons and remedy of common faults……..…..……20D.07

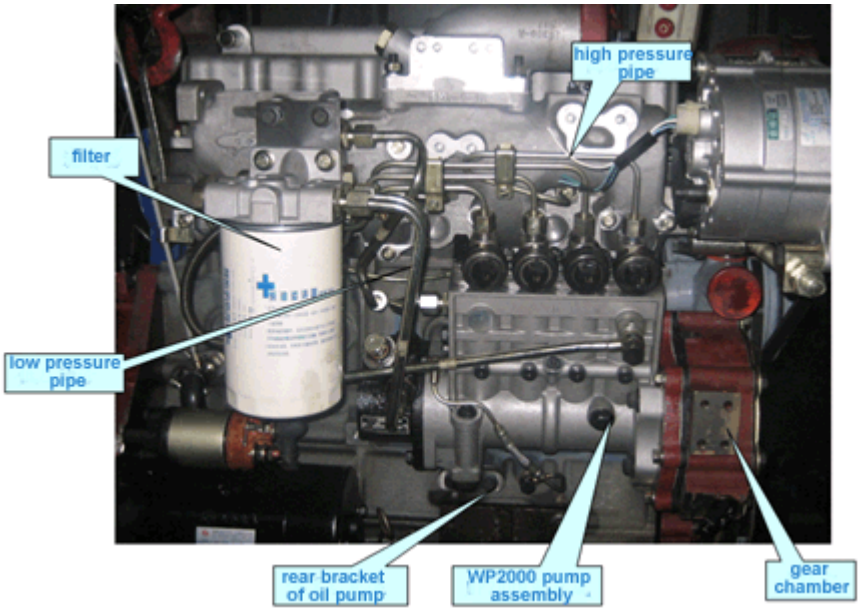
20D FUEL SYSTEM

General Description

The matching condition of unit pump engine: 4-cylinder engine matches Wit unit pump and 6-cylinder engine matches Hengyang unit pump. Now the Wit unit pump is taken as an example to illustrate.

The assemble mode of Wit 4-cylinder pump unit is similar with the P7100 mechanical pump.

It adopts axial positioning on flange surface between gear chambers (flange surface attaching to the surface of gear chamber), radial positioning at bearing cover, the four bolts on flange surface tightened and assistant supporting at rail bracket.



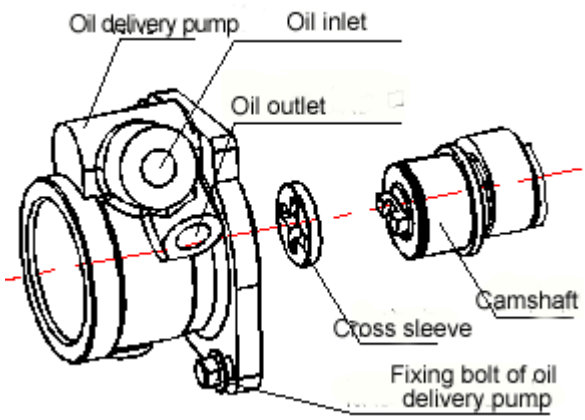
https://truckmanualshub.com/

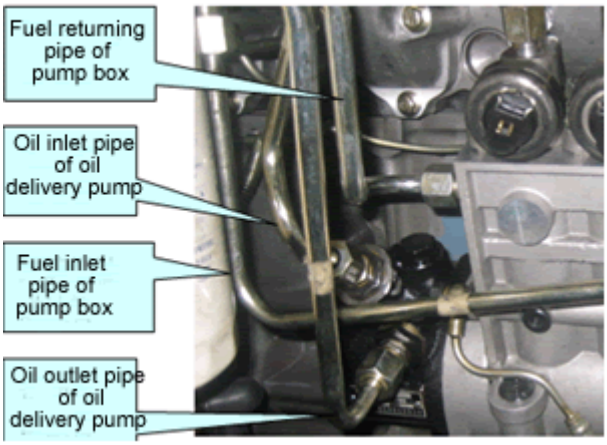
Fuel pump

To remove and to fit 20D-03

The installation of the fuel pump shall be carried out in specific conditions to ensure the cleanness of the assembly. When installing, first link one end of the cross groove of the cross transmission sleeve of the fuel pump to the single-line shape rabbet of camshaft and the another end to the single-line shape rabbet of fuel pump. Pay attention to the installation of O ring on fuel pump, see the left lower diagram. Rotate the fixing bolt(Q1841025TF2 with an tightening torque of ***25 N.m～30N.m***) after the oil delivery pump installed into pump box, then install the oil inlet and oulst connector of the oil delivery pump, see lower right diagram.

Notice: If incorrect connection occurs the engine can not start. After installation, it is not permitted oil seepage and oil leakage at sealing sits and each oil pipe connector.





Fuel injection pump

https://truckmanualshub.com/

To fit **20D-04**

1. Connect the WP2000 pump assembly with the engine。

First connect the bracket and the pump as the lower left diagram. The tightening torque is 25-30N.m and appropriate amount of medium-intensity thread locking fixation adhesive.

Plaster appropriate grease on the guiding flange sealing ring and align the guiding flange to the installation hole on the cover of the engine gear chamber; then push the WP2000 pump assembly into the hole(don't damage the aprons when installing and change the aprons if trimming phenomenon founded, or oil leakage may occur), as the lower right diagram shows.

Connect the four flange bolts and tighten them in the order of 1-2-3-4 as right diagram with a pre-tightening torque of 10-155N.m and final torque of 50-55N.m; the performance grade of the bolts shall be greater than or equal to 8.8.

Connect oil pump bracket and engine.

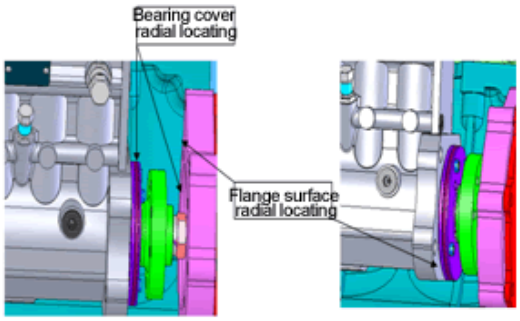
Connect high-pressure oil pipe between the WP2000 pump assembly and the injector with an tightening torque of 25-30N.m;

Install fuel entering and returning oil pipe and engine oil entering and returning oil pipe.

Connect the oil pump gear and other relevant parts to the WP2000 pump assembly, and the installation shall meet the requirement of phase relation diagram.

After the whole installation, no residual installation stress shall exist to affecting the utilization of the pump.





Install rear supporting bracket.

The positioning installation of the flange

2. Harness installation (see 23D.01)
3. Check the installation quality by engine barring; seizure is not permitted.

Notices：

1. Electronic Unit unipump is a kind of precision product; the operator must be familiar with its structure and the function of each parts in it before installing; it must not be dismantled or installed by untrained non-professional staff.
2. The assembly of WP2000 pump assembly shall be carried out in a clean working site so as to ensure the cleanness of the assembly. Before installing and dismantling the injection pump, the outside of the pump must be cleaned up. Generally, it is not permitted to dismantle and change the critical parts of the pump unit. Cleanness and the installation space are also to be paid attention when changing and dismantling oil delivery pump, oil returning valve, temperature sensor and oil pipe and etc When installing oil delivery pump, one end of the cross groove of the cross connecting sleeve of the oil delivery pump shall connect the single-line shape head of the camshaft and the other end shall connect the single-line shape head of the oil delivery pump; at the same time, pay attention to the installation of O ring on the installation face of oil delivery pump.
3. After the installation of WP2000 pump assembly or changing the pump unit,

https://truckmanualshub.com/

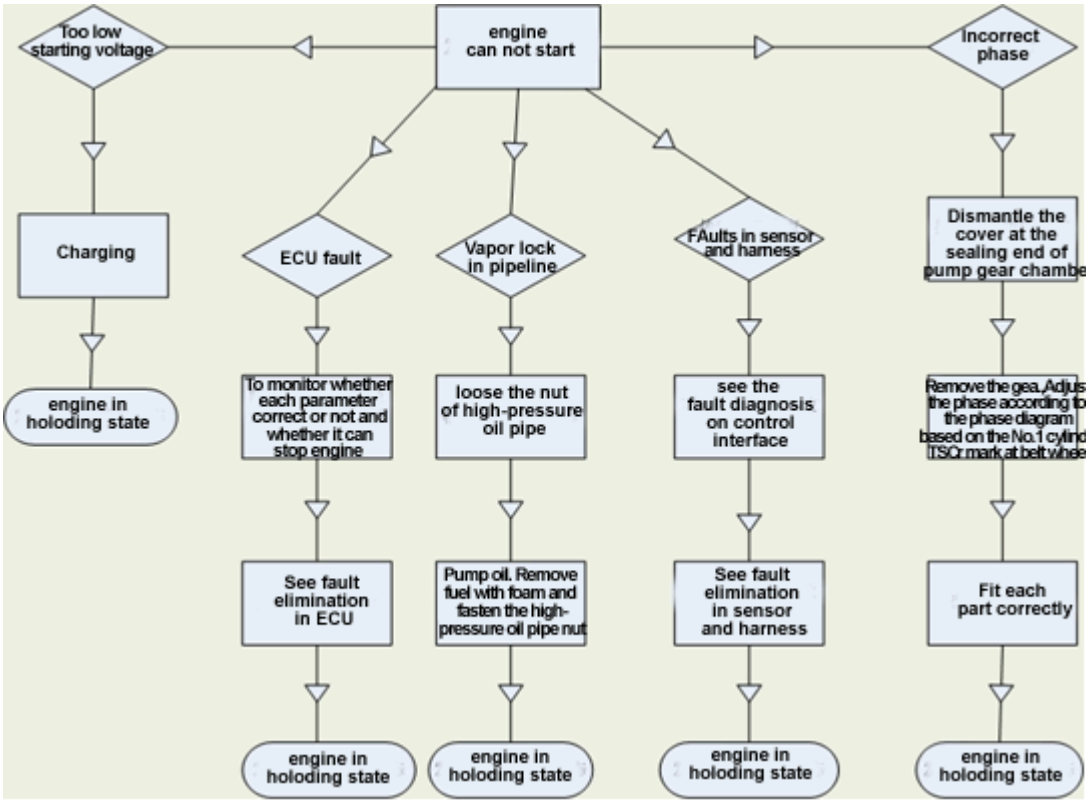
high-pressure oil pipe and fuel entering and returning oil pipe, it shall conduct exhausting treatment before starting engine. At complete vehicle, the exhaust may be carried out with hand pump ; and at engine test bench, the exhaust may be carried out by pulling with dynamometer or loosing the nut of high-pressure oil pipe.

4. When dismantling and installing EUP, a mark must be done on each cylinder to prevent incorrect installation. The dismantlement of EUP can not be carried out without special inspection instruments.
5. After completing the installation of WP2000 pump assembly, no oil seepage, leakage shall occur at each sealing site and each joint of oil pipe during working. Treat it if any problem found.
6. After starting, No abnormal sound is permitted to be heard in WP2000 pump assembly.

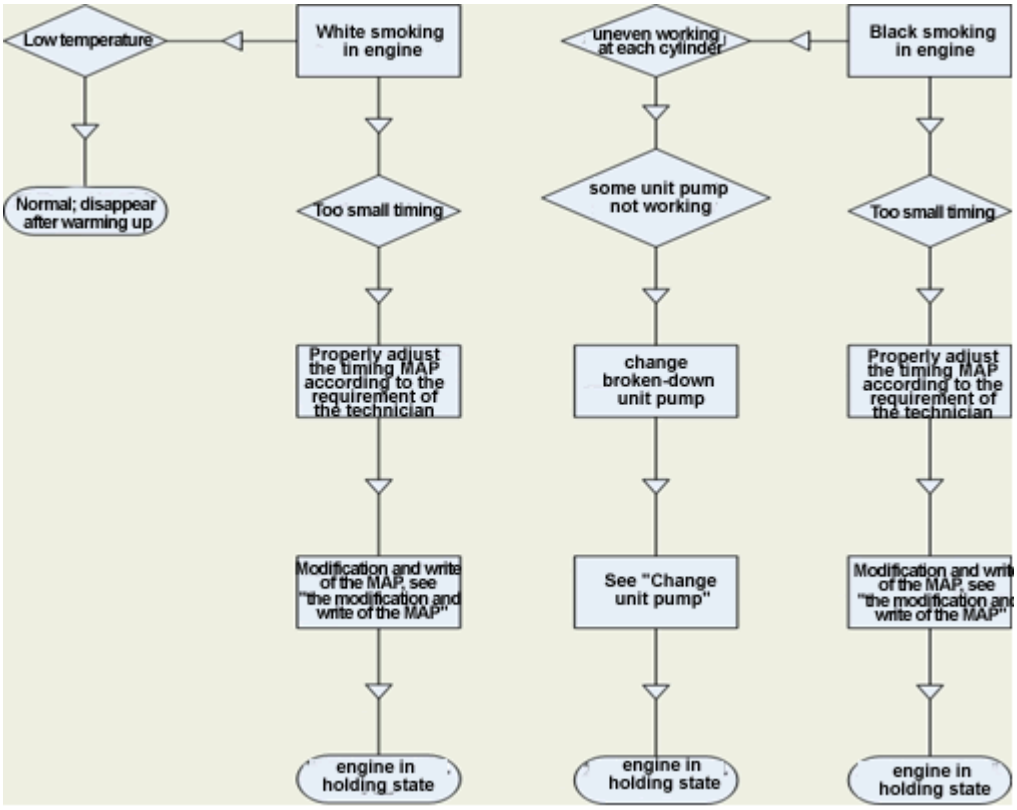
https://truckmanualshub.com/

Common fault modes and the remedy flow

1. Remedy flow for engine not starting

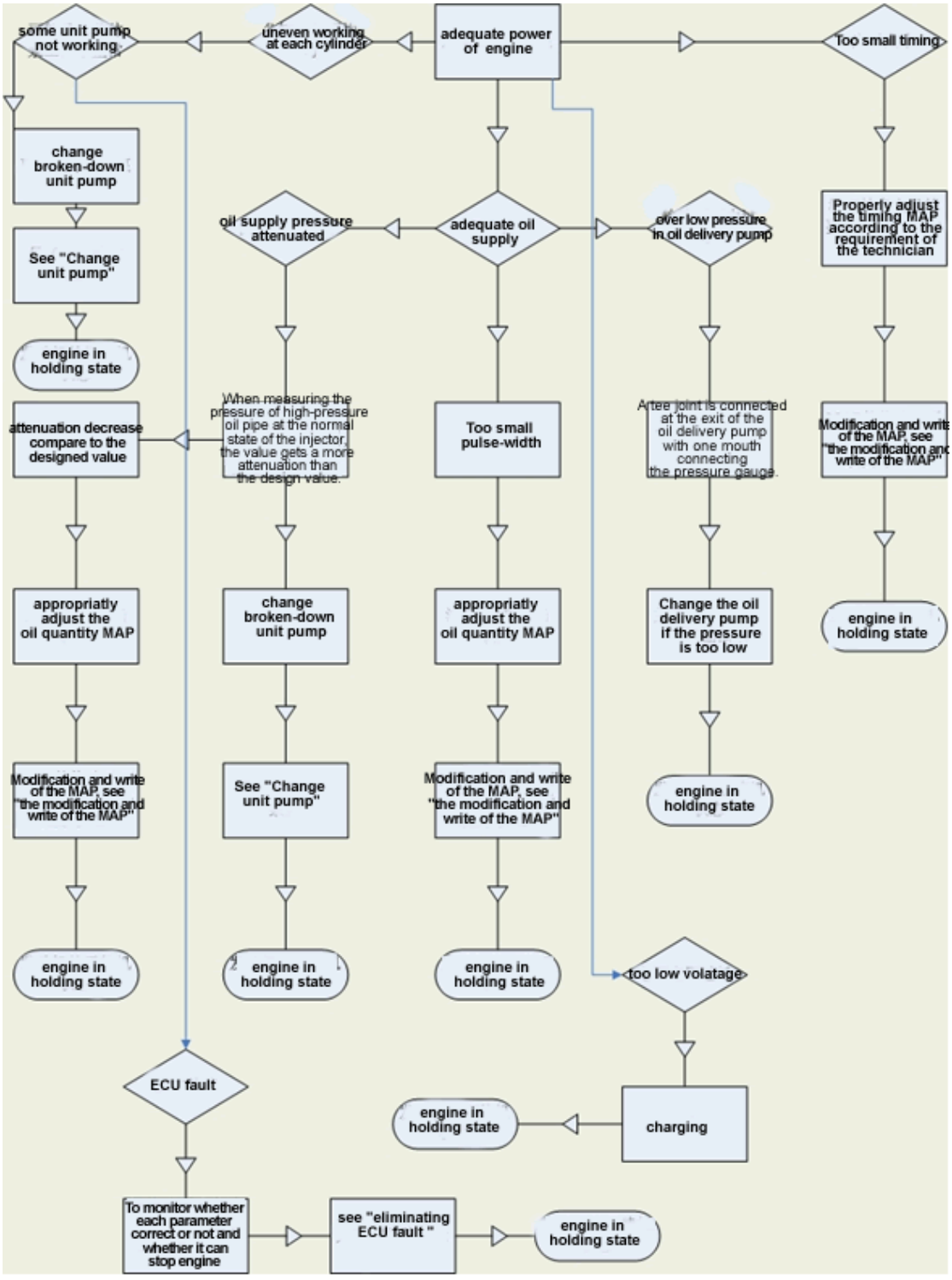


2. Remedy flow for engine smoking



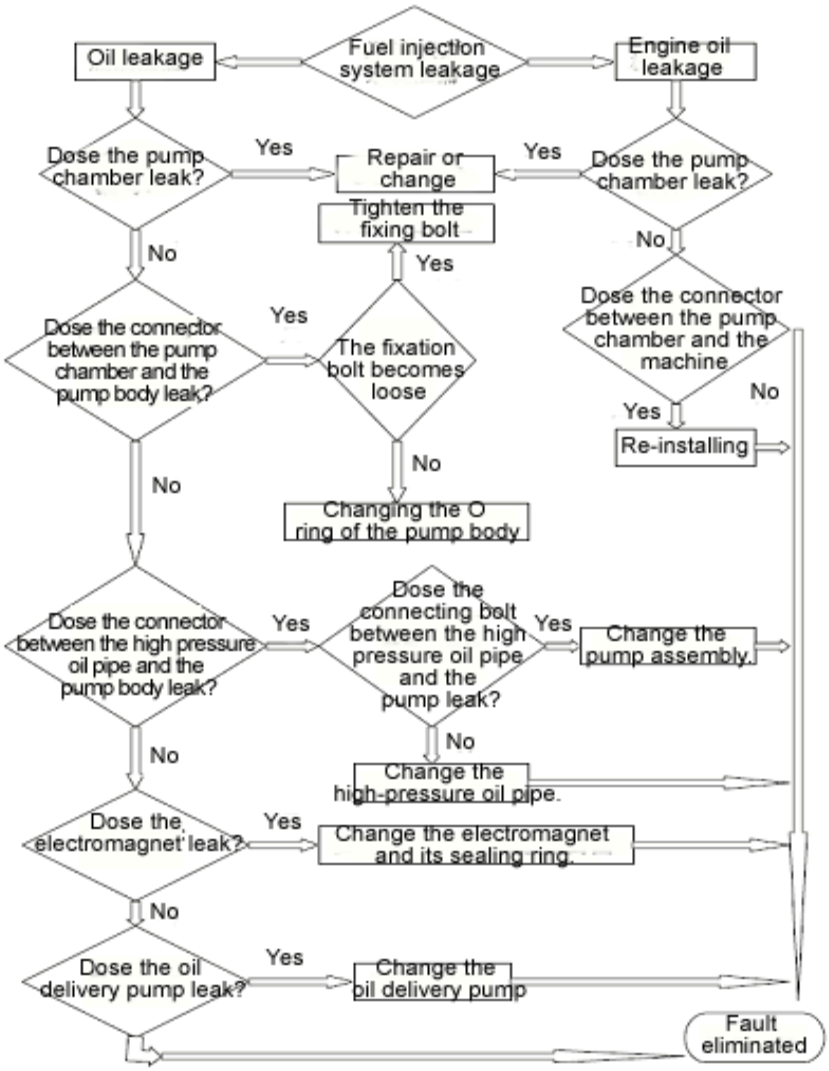
3. Remedy flow for insufficient power output of engine

https://truckmanualshub.com/

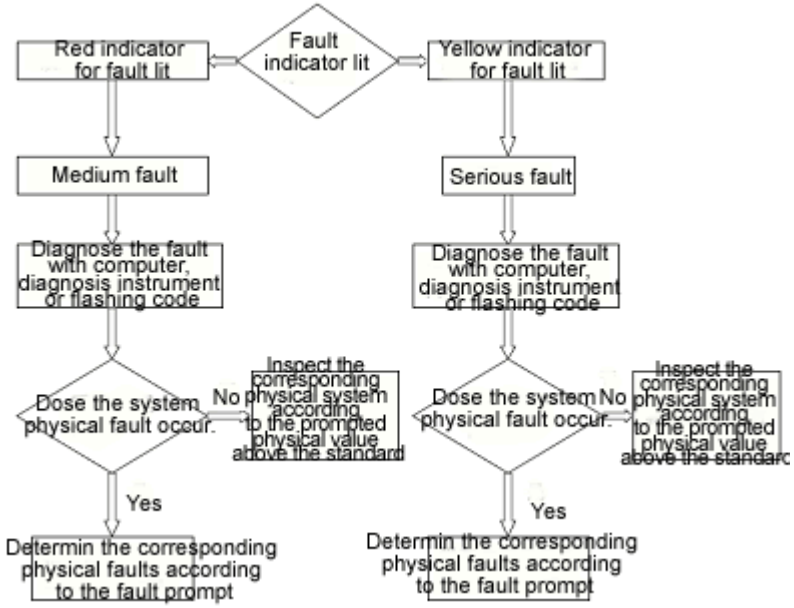


4. Remedy flow for system leakage

https://truckmanualshub.com/

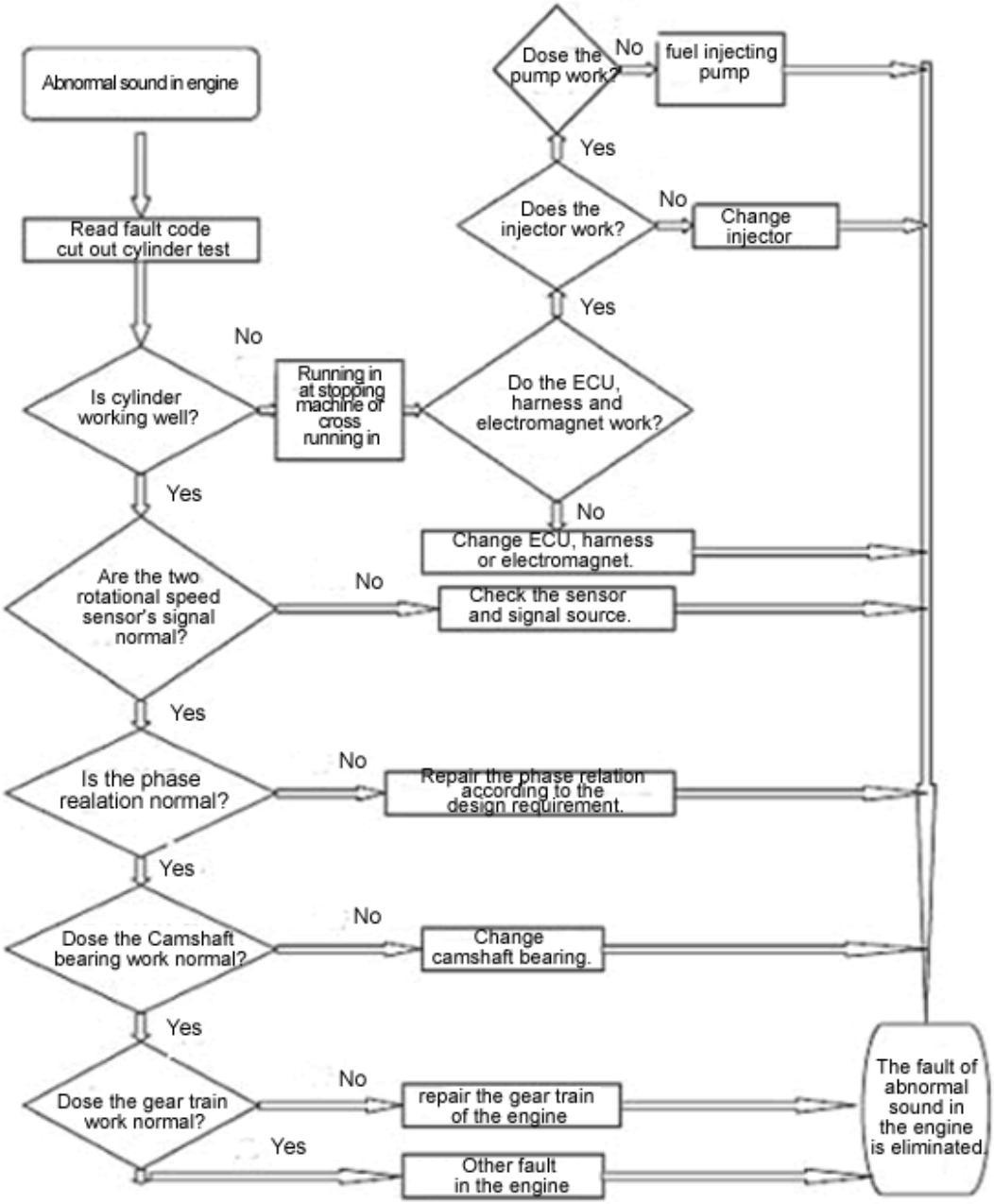


5. Remedy flow for the failure indicator lit



https://truckmanualshub.com/

6. Remedy flow for abnormal sound of engine



https://truckmanualshub.com/

Maintenance and servicing

1. Basic requirements

1） After trial run and running-in, the WP2000 pumps assembly shall be checked and no oil leakage phenomenon shall be seen at each sealing site.

2） Together with the daily maintenance of the engine, the sealing of the WP2000 pumps assembly and the fastening of the bolts shall be checked.

3） Together with the second order servicing requirement, check the installation bolts, electromagnetic bolts and wiring screws to see whether they loose.

2. Notices for maintenance

1） During the installation and dismantlement of the WP2000 pump assembly, pay attention to avoid knocking with other parts and foreign material entering WP2000 pump assemble.

2） Before the installation of WP2000 pump unit, appropriate amount of grease (ZF-1) shall be plastered onto the sealing ring uniformly.

3） The WP2000 pump assembly can not be dismantled or installed by non-professional personnel.

4） When installing WP2000 pump unit, the 2 installing bolts shall be tightened uniformly.

5） The electromagnetic plug shall be reliably linked to avoid short circuit. If the faults of oil leakage, crack, short circuit and etc occur, the electromagnet shall be replaced with a new one and the pertightening torque of the rear cover of the electromagnet shall be 40～45 N·m.

6） The harness shall be changed timely if the electric connection fault, insulting layer damage and fracture due to over bending and extruding are found.

7） The sensors shall be changed if the faults of error signal or no signal in sensors occur.

- **Specific notices**

1） The parts of the WP2000 pump assembly can not be dismantled or changed by non-professional personnel authorized by manufacturer, so as to avoid the changes in its properties.

2） When removing the WP2000 pump unit from pump chamber, the installation bolts shall be loosen for 5-7 teeth and then rotate the camshaft to push the pump unit out.

3） The ECU controller has been conducted by waterproof treatment. If the fault in ECU occurs, it is forbidden to open the ECU controller and it shall be sent to a authorized service site.

https://truckmanualshub.com/

Possible reasons and remedy of common faults

Possible reasons and remedy on the WP2000 pump fuel injection system for the common fault happened in the engine or the finished vehicle.

Fault	Possible reason	Remedy
Oil leakage at the contact interface between the WP2000 pump unit and pump box	1) Fixing bolt loose 2) Black O ring damage	1) Tighten it according to regulation (torque: 40-45 N.m) 2) Change the sealing ring.
Oil leakage at the connection between WP2000 pump assembly and high pressure oil pipe	1) Oil pipe connector loose 2) Oil pipe connectordamage 3 ） WP2000 pump assembly connector damage	1) Tighten it according to regulation (torque: 25～30 N.m) 2) Change oil pipe 3）Change the WP2000 pump assembly and pump unit
Abnormal sound in WP2000 pump	1）incorrect installation of the parts of the WP2000 unit assembly 2）Camshaft and roller damage 3）foreign substance in the pump box	1) Check and reinstall the WP2000 pump assembly 2）Check and change the failure parts 3）Remove the foreign substance and check no damage in the parts.
Starting difficult or not starting of engine	1）Air remains in the fuel cavity 2)Oil pipe damage or air leakage at connector 3 ） Oil pump failure result in adequate oil supply 4）Oil filter blocked or inadequate oil filter flow result in adequate oil supply 5)fuel returning valve failure result in adequate oil absorbing 6）ECU controller damage 7）short circuit or breaking circuit in harness 8）Sensor failure or metal foreign substance in monitor 9 ） Bad injection or too low injection pressure 10）incorrect fuel injection advance angle 11 ） Abnormal power supply in ECU controller 12 ） Problem in the installation space of camshaft rotational speed sensor 13）Fault diagnosis switch turned	1）loose the nut of the oil pipe connector to exhaust air. 2）Check the oil pipe and the connector 3）check and change the oil delivery pump 4）check and change the oil filter 5）check and change the oil returning valve 6）check and change the ECU 7） Check and eliminate faults and check no damage in relevant parts 8）check and change the sensor or remove the foreign substance 9）Wash, examine and repair or change the injector. 10）Adjust the fuel injection advance angle of the electric control system 11）Check the power supply circuit of ECU controller 12）Adjust the installation space of camshaft rotational speed sensor 13）Turn the fault diagnosis switch off and reset it. 14）check and change the harness 15）Tighten, wash or change it 16）Check other parts of the engine.

https://truckmanualshub.com/

	on before starting 14）Harness contact failure 15）the plug of electromagnetic valve becomes loose, dirty and rotted. 16）Other reason	
Stop running of engine	1）Faults in Cam or crankshaft rotational speed sensor 2）Bad or damaged harness contact 3）ECU controller damage 4）multiple pumps unit or injector damage 5）other reasons	1）Check and repair or change the rotational speed sensor 2）Check and repair or change the harness 3）Change the ECU controller 4）Change the failure parts 5）Check other relevant parts of the engine
Engine smoking	1）bad atomization of injector and black smoking 2）Crankshaft rotational speed sensor damage or absorbing iron clips 3）Timing error; Block or blue smoking. 4）ECU controller failure 5）Other reasons in engine	1）Check and repair or change WP2000pump unit or injector 2）Clear up the iron clips or change the crankshaft 3）Change the timing by adjusting the position of the flywheel 4）Change the ECU controller 5）Check other relevant parts of the engine
Insufficient power of engine	1）Damaged oil pipe or air leakage in connector 2）Oil delivery pump failure resulting in adequate oil supply 3）Oil filter blocked or adequate oil filter flow result in adequate oil supply 4）WP2000 pump assembly failure or low performance 5）Crankshaft rotational speed sensor absorbing iron clips or damage 6）Bag contact in the sensor of gas pedal 7）failure in injector 8）Bag contact or damage in the plug of booster pressure sensor 9）Other reasons in engine	1）Check the oil pipe and the connector 2）Check and change the oil delivery pump. 3）Check and change the oil filter 4）Check and change the WP2000 pump assembly 5）Clear up the iron clips or change the crankshaft 6）Check and repair or change the sensor of gas pedal 7）Check and repair or change the failure pats 8）Check the plug of booster pressure sensor or change it 9）Check other relevant parts of the engine

https://truckmanualshub.com/

Cooling system 21

General description 21A.03

Thermostats

21A-01 To remove, to fit and to test 21A.04

Coolant pump

21A-02A To remove and to fit - gear driven 21A.05
21A-02B To remove and to fit - belt driven 21A.06
21A-02C To remove and to fit - auxiliary pump 21A.08
21A-03A To dismantle and to assemble - gear driven 21A.09
21A-03B To dismantle and to assemble - belt driven 21A.14
21A-03C To dismantle and to assemble - auxiliary pump 21A.17

Fan

21A-04 To remove and to fit 21A.20

Fan drive

21A-05 To remove and to fit 21A.20
21A-06 Deleted

Lubricating oil cooler

21A-07A To remove and to fit - four cylinder turbocharged engines 21A.21
21A-07B To remove and to fit - six cylinder turbocharged engines 21A.22
21A-07C To remove and to fit - canister type 21A.23
21A-08A To dismantle and to assemble - four cylinder turbocharged engines 21A.24
21A-08B To dismantle and to assemble - six cylinder turbocharged engines 21A.25

Continued

https://truckmanualshub.com/

Cooler by-pass valve

21A-09 To remove and to fit 21A.25

Intercooler

21A-10 To remove and to fit 21A.26
21A-11 To clean and to inspect 21A.28

Data and dimensions 21A.29

https://truckmanualshub.com/

General description

Coolant from the bottom of the radiator passes through the centrifugal coolant pump, which is fitted onto the front of the timing case to assist the flow of the coolant through the system.

The pump is gear driven from the gear of the fuel injection pump.

On certain applications the pump is driven by a "V" belt from the crankshaft pulley.

From the pump, the coolant passes through a passage in the timing case.

Coolant pumps driven by a "V" belt pass the coolant through the pump body to the front of the cylinder block.

On four cylinder engines the coolant passes through a passage in the left side of the cylinder block to the rear of the cylinder block.

If a lubricating oil cooler is fitted, some of the coolant passes around the element of the cooler and then to the rear of the cylinder block.

If the oil cooler is fitted on the left side of the engine, coolant from the by-pass connection at the rear of the coolant pump passes through a pipe to the oil cooler.

If the oil cooler is fitted to the right side of the engine, a pipe is connected between the thermostat housing and the oil cooler. The coolant passes around the plates of the cooler and passes through a pipe to the cylinder block.

Some four cylinder engines have a plate type oil cooler fitted between the oil filter canister and the oil filter head.

The coolant then passes around the cylinders and up into the cylinder head. The coolant leaves the cylinder head at the front and passes into the thermostat housing.

If the thermostat is closed, the coolant goes directly through a by-pass to the inlet side of the coolant pump. If the thermostat is open, the thermostat closes the by-pass and the coolant passes to the top of the radiator.

On six cylinder engines the coolant divides as it enters the cylinder block. Most of the coolant passes along the right hand side of the cylinder block and around the outside of the cylinders to the rear of the cylinder block.

The remainder of the coolant passes along a passage on the left hand side of the cylinder block to the lubricating oil cooler.

The coolant flows around the element of the lubricating oil cooler to the rear of the cylinder block. The coolant then passes to the rear of the cylinder head.

Coolant passes forward through the cylinder head and into the thermostat housing. These engines have two thermostats. If the thermostats are closed, the coolant goes, through a by-pass, directly to the inlet side of the coolant pump. If the thermostats are open, the coolant passes to the top of the radiator.

https://truckmanualshub.com/

Thermostats

Identification of the thermostat is by the nominal temperature which is stamped on the bypass valve of the thermostat.

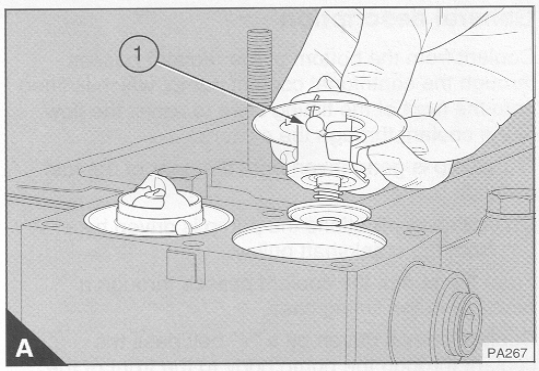
To remove, to fit and to test 21A-01

To remove

1 Drain the cooling system so that the coolant level is below the thermostat position and disconnect the top hose from the coolant outlet connection.

2 Release the setscrews and remove the coolant outlet connection.

3 Remove the thermostat(s) (A).



To fit

1 Ensure that the joint faces of the housing and the outlet are clean and that the jiggle pin(s) (A1) in the thermostat(s) is/are free to move.

2 Put the new thermostat(s) in position in the housing.

3 Fit a new joint and the coolant outlet connection. Tighten the setscrews.

4 Connect the top hose and fill the cooling system.

To test

1 Hang the thermostat in a suitable container filled with coolant.

2 Heat the coolant gradually. Use a thermometer to check the temperature at which the valve starts to open and at which it is fully open. The correct temperatures are given in the data and dimensions.

Caution: *If the thermostat does not operate correctly, it must be renewed. Do not try to adjust the settings.*

https://truckmanualshub.com/

Coolant pump - gear driven

Identification of the coolant pump is by the last four digits of the part number stamped on the front of the pump body.

To remove and to fit 21A-02A

To remove

1 Drain the cooling system and disconnect the hose at the inlet connection of the coolant pump.

2 Release the setscrews from the flange of the coolant by-pass.

3 Release the three setscrews which retain the coolant pump to the cover of the timing case - two from the front and one from the rear.

4 Release the nuts from the rear face of the timing case, which fasten the pump to the timing case, and remove the coolant pump (A). Ensure that the "O" ring (A1) on the cover of the timing case is not lost.

Note: Most of the latest coolant pumps use setscrews instead of studs.

To fit

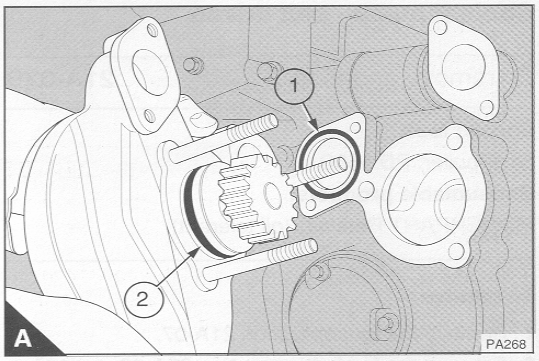
1 Check the "O" rings on the pump body (A2) and on the cover of the timing case (A1) for damage. If either of the "O" rings are damaged, they must be renewed. Ensure that all joint faces are clean.

2 Check the drive gear of the coolant pump for wear or other damage. If the gear is damaged, it must be renewed.

3 Lightly lubricate the "O" ring on the pump body with clean engine lubricating oil. Fit the pump to the timing case cover with its gear in mesh with the gear of the fuel injection pump. The pump is a tight fit in the cover, but can be pulled into position if the nuts for the pump studs are gradually and evenly tightened. Ensure that the "O" ring in the cover remains in position while the pump is fitted.

Note: Most of the latest coolant pumps use setscrews instead of studs. The setscrews have a sealant applied to the threads by the manufacturer. If the original setscrews are to be used again, the threads of the setscrews and the threads in which they will be engaged must be cleaned. A suitable sealant must then be applied to the threads of the setscrews.

4 Fit and tighten the three setscrews which retain the pump to the cover of the timing case - two from the front and one from the rear.



5 Fit a new joint to the flange of the coolant by-pass. Fit the by-pass and tighten the setscrews.

6 Connect the hose to the inlet connection of the coolant pump and fill the cooling system. Operate the engine and check for leakage.

https://truckmanualshub.com/

Coolant pump - belt driven

To remove and to fit **21A-02B**

Special tool:
Gear puller, PD.155C
Consumable products:
Retainer (oil tolerant)

To remove

1 Remove the fan, operation 21A-07.

2 Remove the fan belt, operation 23A-03.

3 Disconnect the hose connections to the coolant pump.

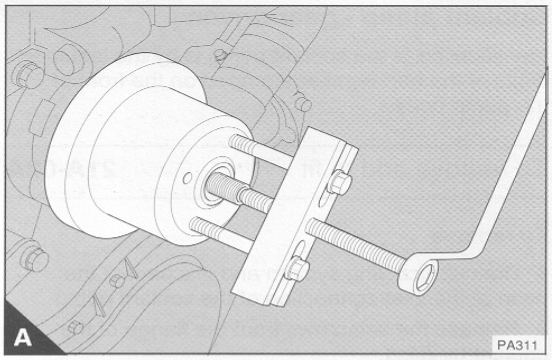
4 Remove the nut, spring washer and plain washer from the pump pulley. It may be necessary to use extractor PD. 155C to remove the pulley from the pump shaft (A).

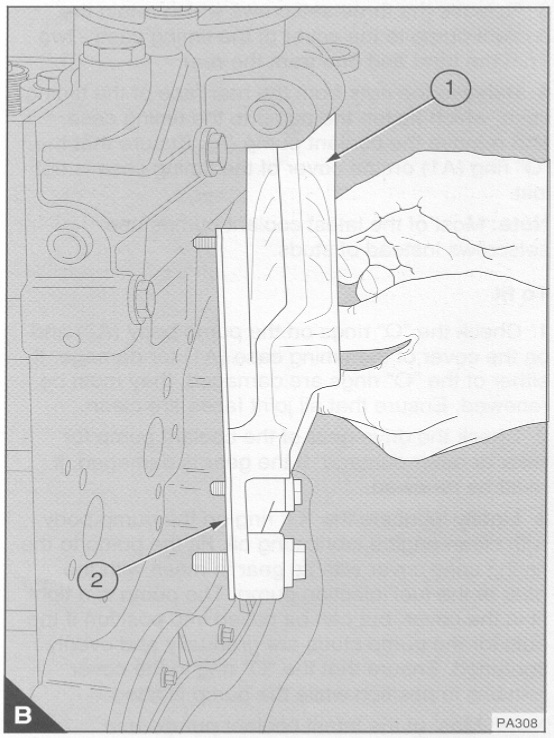
5 If the pump is to be dismantled remove the key from the keyway of the pump shaft.

6 Remove the four setscrews which secure the coolant pump to the rear body of the pump (B) and remove the pump from the engine.

7 Remove the coolant pump and discard the joint.

8 If it is necessary to remove the rear body (B1) of the pump from the cylinder block: Remove the setscrew for the alternator adjustment linkage and the spacer. Remove the four other setscrews and remove the rear body from the cylinder block. Discard the joint (B2).





https://truckmanualshub.com/

To fit

Note: The joints are fitted without jointing compound.

1 If the rear body of the pump (A1) was removed from the cylinder block: Thoroughly clean the joint faces of the cylinder block and pump rear body. Fit a new joint (A2) between the rear body of the pump and the cylinder block.

2 Fit the rear body of the pump and the joint to the cylinder block. Fit the spacer and adjustment linkage for the alternator and tighten the M10 setscrews to 44 Nm (33 lbf ft) 4,5 kgf m and the M12 setscrews to 75 Nm (55 lbf ft) 7,6 kgf m.

3 Thoroughly clean the joint faces of the pump rear body and coolant pump (B2). Fit a new joint (B4) to the coolant the pump.

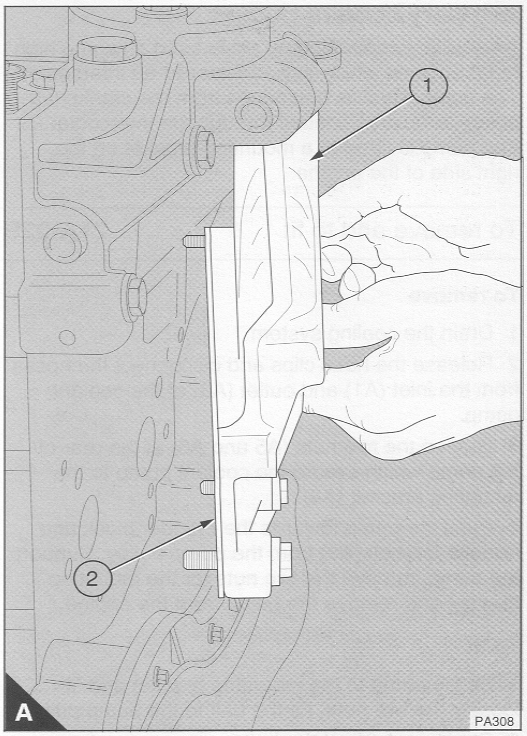
4 Fit the coolant pump and joint to the rear pump body and tighten the four M10 setscrews (B3) to 44 Nm (33 lbf ft) 4,5 kgf m.

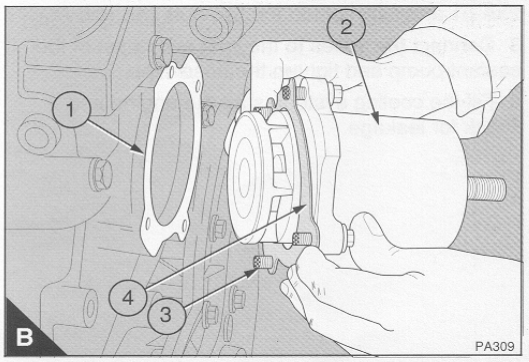
5 Fit the key to the keyway and put the pulley onto the pump shaft. Put the plain washer and the spring washer in position onto the pulley. Fit the nut and tighten it to 82 Nm (60 lbf ft) 8,2 kgf m.

6 Connect the hoses to the coolant pump and tighten the clips.

7 Fit the fan belt, operation 23A-03.

8 Fit the fan, operation 21A-07.

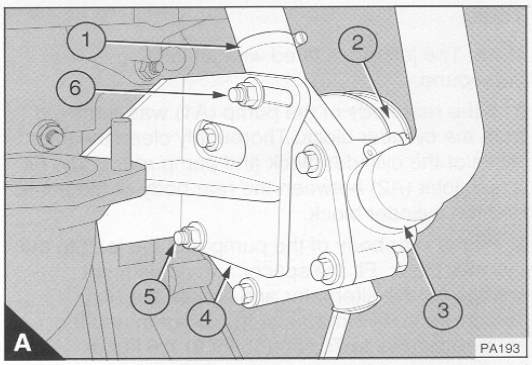




https://truckmanualshub.com/

Auxiliary coolant pump

An auxiliary coolant pump (A) is used on some high rated engines which have a water-to-air intercooler. The pump which is belt driven from the crankshaft pulley, circulates coolant through the intercooler. The pump is fitted to a mounting bracket on the right side of the engine.



To remove and to fit **21A-02C**

To remove

1 Drain the cooling system.

2 Release the hose clips and disconnect the hoses from the inlet (A1) and outlet (A3) of the coolant pump.

3 Loosen the two nuts (A5 and A6) at the rear of the pump which secure the coolant pump to the mounting bracket (A4).

4 Push the pump towards the cylinder block and remove the belt (A2) from the pump pulley. Support the pump, remove the two nuts for the mounting bracket and remove the pump from the engine.

To fit

1 Fit the pump to the mounting bracket and fit loosely the two nuts. Fit the belt to the pump pulley.

2 Check and adjust the belt tension, operation 23A-01 and fully tighten the two nuts (A5 and A6).

3 Connect the hoses to the inlet and outlet of the coolant pump and tighten the hose clips.

4 Fill the cooling system, start the engine and check for leakage.

https://truckmanualshub.com/

Coolant pump - gear driven

To dismantle and to assemble 21A-03A

The coolant pump fitted to the latest engines has a larger bearing assembly which has an integral oil seal. Identification of the new coolant pump is by the last four digits of the part numbers, (4131E008) (4131E011), (4131E014) or (4131E113), stamped on the front of the coolant pump body and by the bearing which extends approximately 5 mm (0.2 in) past the end of the pump body. The gear for coolant pumps part number (4131E014) and (4131E113) has a recess machined into the hub. To dismantle and assemble the pumps fitted to the latest engines, refer to 21A.12.

To dismantle - early engines

Special tool:

Gear puller, MS.99

Consumable products:

Retainer (high strength)

1 Remove the three long studs and the "O" ring (A1) from the pump body (A5).

2 Remove the front cover (A9) and the joint (A10).

3 Remove the gear (A3) with the puller.

4 Use a suitable lever to remove the oil seal (A4) and discard the seal.

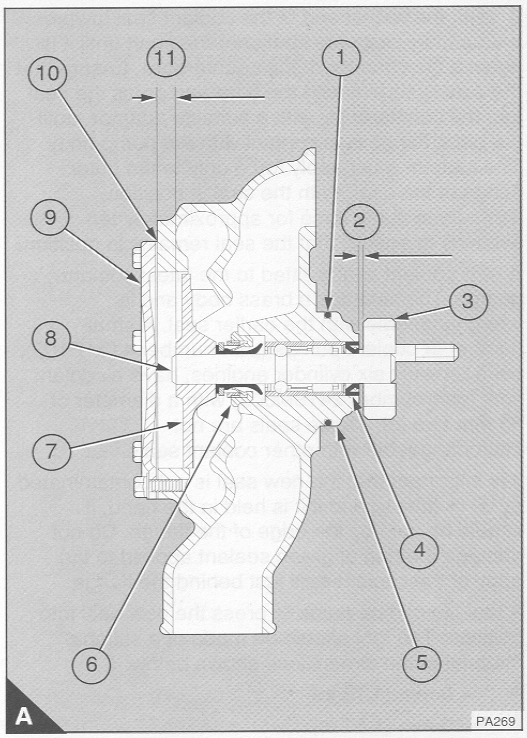
5 If necessary, remove the studs from the pump body. With a suitable support under the impeller end of the body, use a suitable adaptor to press out the shaft and bearing assembly (A8), together with the impeller (A7) and the coolant seal (A6).

6 With a suitable support under the impeller, press the shaft out of the impeller. Discard the impeller, the shaft, the bearing and the coolant seal.

Caution: It is important that all of the components in the coolant pump kit are changed when the pump is serviced. Coolant pump kits include the latest components which may be of a different design to the original components fitted to the engine.

To assemble - early engines

1 Clean thoroughly the inside of the pump body especially the bearing bore and the counterbore for the coolant seal. Both of these bores and their chamfers must be clean and free of corrosion.



2 Apply a thin layer of POWERPART Retainer (high strength) to the outer surface of the bearing, but keep the retainer away from the ends of the bearing. Provide a suitable support under the gear end of the pump body. Put the bearing and shaft assembly (A8) in position with the bearing square to the pump body and the shortest end of the shaft in the pump body. Use a press and a suitable adaptor, which will apply the force to the bearing and not to the shaft, to press in the bearing and shaft assembly. Press in the bearing until the end of the bearing is level with the bottom of the counterbore for the coolant seal. Remove the adaptor and remove all retainer from the end of the bearing.

Caution: *Do not lubricate the coolant seal (A6). It is important that it is not contaminated with oil or grease and, if it is held in the hand, it should be held by the edge of the outside flange.*

https://truckmanualshub.com/

3 With the widest end of the coolant seal towards the bearing, push the seal onto the shaft until it is against the chamfer of the counterbore. Ensure that the seal is square with the bore and press the seal into the counterbore, with a suitable adaptor, until the outer flange is in contact with the pump body. The adaptor must apply force only to the outer flange of the seal. With the seal in position, continue to apply force for approximately ten seconds to ensure that the seal remains in position.

A new coolant seal is fitted to the latest coolant pumps. The seal has a brass body and is interchangeable with the earlier seal. A small number of coolant pumps (part number 4131E103), used on early six cylinder engines, have a coolant seal (part number 2418M003) with a diameter of 38 mm (1.5 in). These seals are not interchangeable with other coolant seals.

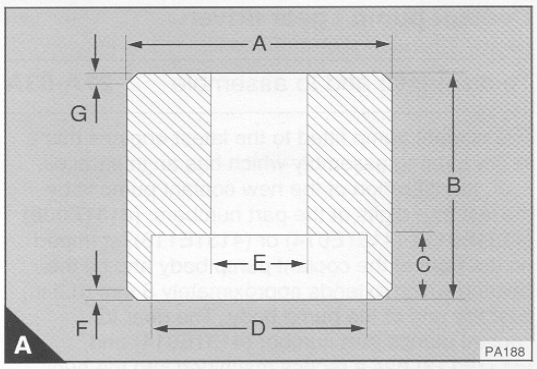
It is important that the new seal is not contaminated by oil or grease and if it is held in the hand, it should be held by the edge of the flange. Do not damage the ring of green sealant applied to the body of the coolant seal just behind the flange.

A tool (A) can be made to press the new seal into position. The tool should be made of a suitable material to the dimensions shown below:

A 44,0 mm (1.73 in)
B 40,0 mm (1.57 in)
C 11,6 mm (0.46 in)
D 35,8 mm (1.41 in)
E 16,1 mm (0.63 in)
F 1,00 mm (0.04 in) at 45°
G 2,00 mm (0.08 in) at 45°

The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.

The tool cannot be used for the 38 mm (1.5 in) seal. Ensure that the hole in the tool is aligned with the shaft as the seal is fitted. With the ring of sealant towards the bearing, use the tool to press the seal onto the shaft until the bottom of the seal flange is in complete contact with the pump body.



https://truckmanualshub.com/

4 Hold the pump with the gear end of the shaft on a suitable support and, with a suitable distance piece and a flat bar, press the impeller (A7) on to the shaft to the dimension (A11) 7,1/7,5 mm (0.28/0.30 in) for coolant pump part number (4131E012) or 6,7/7,0 mm (0.26/0.28 in) for coolant pumps part number (4131E015) and (4131E016). Remove the tool and ensure that the shaft is free to rotate. Remove any excess retainer after the impeller has been fitted.

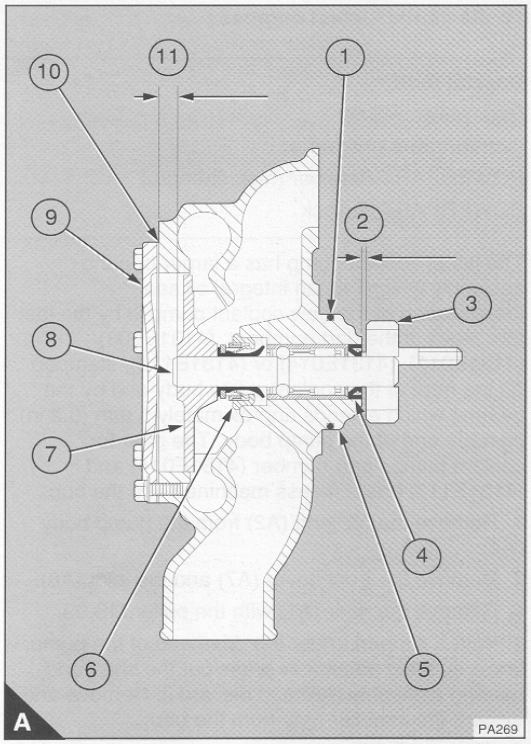
5 Turn the pump over and provide a suitable support for the pump body, remove the studs, if necessary. Lightly lubricate the oil seal (A4) with clean engine lubricating oil. Put the oil seal into position in the pump body with the flat face of the seal towards the bearing. With a suitable adaptor, press the oil seal into the body until the rear of the seal is level with the end of the pump. When the seal is in position, continue to apply force for approximately ten seconds to ensure that the seal remains in position when the force is released.

6 Hold the pump with the impeller end of the shaft on a suitable support. If the original gear is used, POWERPART Retainer (high strength) must be applied to the bore of the gear. Press the gear (A3) onto the shaft to the dimension shown at (A2) 0,6/2,6 mm (0.024/0.102 in) for coolant pumps part number (4131E012), (4131E015) and (4131E016).

Remove all excess retainer after the gear has been fitted.

7 Clean the threads in the front face of the pump body for the setscrews that retain the cover. Fit a new joint (A10) and the cover (A9). Fit the setscrews and tighten them to 9 Nm (6 lbf ft) 0,9 kgf m. If the setscrews are new, a sealant will have been applied to the threads by the manufacturer. If the original setscrews are to be used again, the threads should be cleaned and a suitable sealant applied.

8 Fit a new "O" ring (A1) to the body of the pump.



https://truckmanualshub.com/

To dismantle - latest engines

Special tool:
Gear puller, MS.99
Consumable products:
Retainer (high strength)
Nutlock

The latest coolant pump has a larger bearing assembly which has an integral oil seal. Identification of the new coolant pump is by the last four digits of the part numbers, (4131E008) (4131E011), (4131E014) or (4131E113), stamped on the front of the coolant pump body and by the bearing which extends approximately 5 mm (0.2 in) past the end of the pump body. The gear for coolant pumps part number (4131E014) and (4131E113) has a recess machined into the hub.

1 Remove the "O" ring (A2) from the pump body (A4).

2 Remove the front cover (A7) and the joint (A8).

3 Remove the gear (A1) with the puller MS.99.

4 With a support under the drive end of the pump, use a suitable adaptor to press out the shaft and bearing assembly (A3) and discard it. Remove and discard the impeller (A5) from the body.

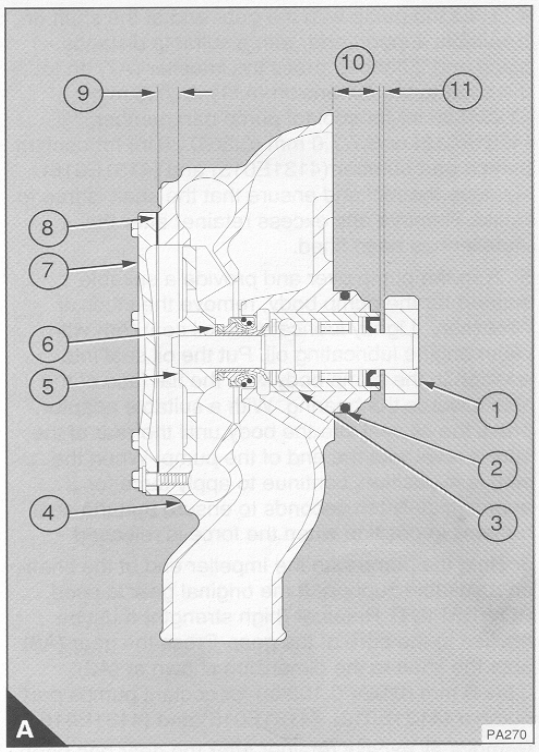
5 With a suitable support under the impeller end of the pump, press out the coolant seal and discard it.

Caution: It is important that all of the components in the coolant pump kit are changed when the pump is serviced. Coolant pump kits include the latest components which may be of a different design to the original components fitted to the engine.

To assemble - latest engines

1 Clean thoroughly the inside of the pump body (A4). Ensure that the bore for the bearing and the chamfer at the coolant seal end of the bore are clean and free from corrosion.

2 Make a suitable adaptor which will apply force to the outer edge of the bearing and not to the shaft. Apply a thin layer of POWERPART Retainer (high strength) to the outer surface of the bearing (A3), but keep the retainer away from the ends of the bearing.



3 Provide a suitable support under the impeller end of the pump body. Put the bearing and shaft assembly in position with the bearing square to the pump body and the longest end of the shaft in the pump body. Use the adaptor to press in the bearing and shaft assembly. Press in the bearing until the rear face of the bearing is 21,0/21,5 mm (0.83/0.85 in) (A10) above the rear face of the pump body

4 If the original gear is used, POWERPART Retainer (high strength) must be applied to the bore of the gear. Press the gear (A1) onto the shaft until the clearance between the front face of the gear and the rear face of the bearing (A11) is 0,47/1,53 mm (0.018/0.060 in) for coolant pumps part numbers, (4131E008) and (4131E011) or 1,07/3,43 mm (0.042/0.14 in) for coolant pumps part numbers, (4131E014) and (4131E113). Remove all excess retainer after the gear has been fitted.

https://truckmanualshub.com/

4 A tool (A) can be made to press the coolant seal into position. The tool should be made of a suitable material to the dimensions listed below:

A 44,0 mm (1.73 in)
B 40,0 mm (1.57 in)
C 11,6 mm (0.46 in)
D 35,8 mm (1.41 in)
E 16,1 mm (0.63 in)
F 1,00 mm (0.04 in) at 45°
G 2,00 mm (0.08 in) at 45°

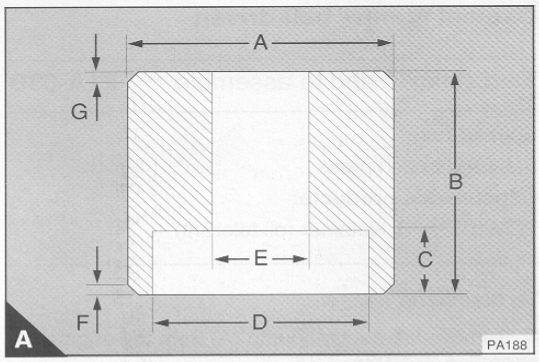
The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.

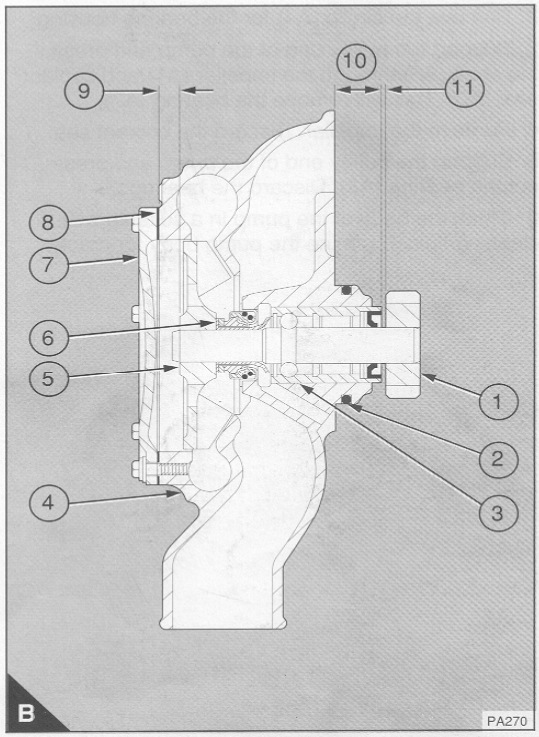
Turn the pump over and support the drive end of the body. Do not lubricate the coolant seal (B6). It is important that the seal is not contaminated by oil or grease and if it is held in the hand, it should be held by the edge of the flange. Do not damage the ring of green sealant applied to the body of the coolant seal just behind the flange. Put the seal into position on the end of the shaft. Ensure that the ring of sealant is towards the bearing. Use the tool to press the seal onto the shaft until the bottom of the seal flange is in complete contact with the pump body.

5 Hold the pump with the drive end of the shaft on a suitable support. With the use of a suitable distance piece and a flat bar, press the new impeller (B5) onto the shaft until the front face of the impeller is 7,1/7,5 mm (0.28/0.30 in) for coolant pump part number (4131E008) and 6,7/7,0 mm (0.26/0.28 in) for coolant pumps part number (4131E011), (4131E014) and (4131E113) below the front face of the pump body (B9). Remove the flat bar and distance piece and ensure that the shaft is free to rotate.

6 Clean the threads in the front face of the pump body. Fit a new joint (B8) and the cover (B7). Fit the setscrews and tighten them to 9 Nm (6 lbf ft) 0,9 kgf m. If the setscrews are new, a sealant will have been applied to the threads by the manufacturer. If the original setscrews are to be used again, the threads should be cleaned and a POWERPART Nutlock applied.

7 Fit a new "O" ring (B2) to the body of the pump.





https://truckmanualshub.com/

Coolant pump - belt driven

To dismantle and to assemble **21A-03B**

Special tool:

Standard bench press

Consumable products:

POWERPART Retainer (oil tolerant)

To dismantle

1 Remove the coolant pump (A) from the engine, operation 21A-03A.

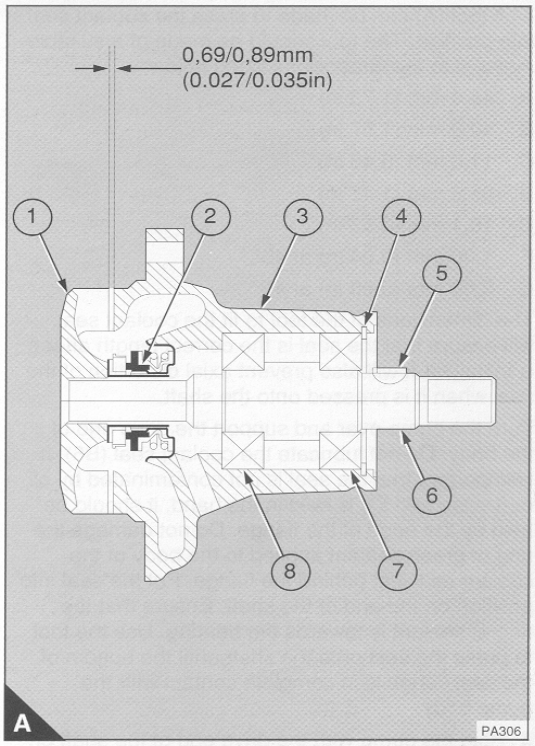
2 Remove the circlip (A4) for the bearing housing.

3 Support the pulley end of the pump and press the shaft (A6) through the impeller (A1) and coolant seal (A2). This will remove the bearing (A7).

4 Remove the impeller. Discard the coolant seal.

5 Support the pulley end of the pump and press out the bearing (A8). Discard the bearings.

6 Clean the body of the pump in a suitable safe cleaning fluid. Examine the pump body for cracks.



https://truckmanualshub.com/

To assemble

The service kit for the pump contains two bearings, the shaft, a circlip and a coolant seal.

Each bearing is pre-packed with grease and sealed. The bearings will not require attention during service.

Support the impeller end of the pump body. Apply a narrow ring of Powerpart Retainer (oil tolerant) to the face of the outer race of each bearing race. Put the bearing (A8) into position on the pump housing. Use a suitable adaptor on the outer race and press the bearing fully into the back of the bearing housing.

2 Support the inner race of the bearing just fitted from the impeller end of the pump body. Use a suitable adaptor which will allow the shaft (A6) to pass through it. Press the new shaft into the bearing until shoulder of the shaft is fully against the inner race of the bearing. Put the bearing (A4) into position on the pump housing and shaft. Use a suitable adaptor on the inner and outer race to ensure the pressure is applied evenly. Press the bearing onto the shaft and housing until the inner race of the bearing is against the shoulder of the shaft. Remove excess retainer and fit the new circlip (A4).

3 Fit a new coolant seal (A2) as follows:

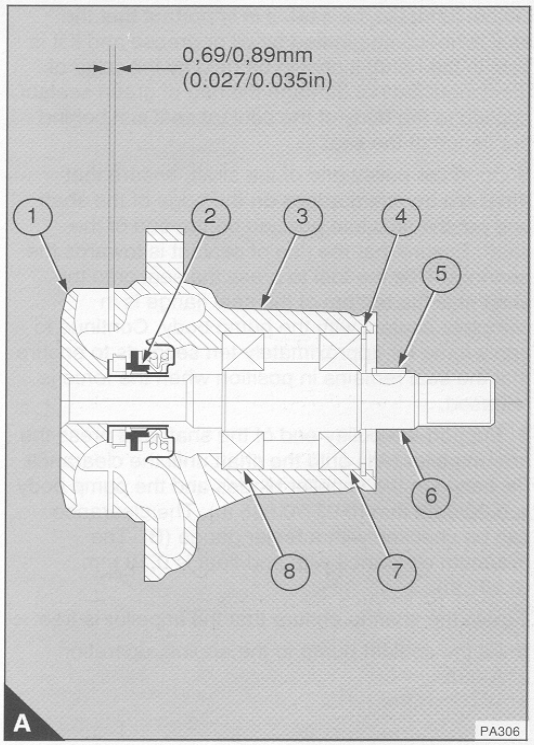
Caution: *It is important that only the tool, shown in (B), is used to fit the new coolant seal.*

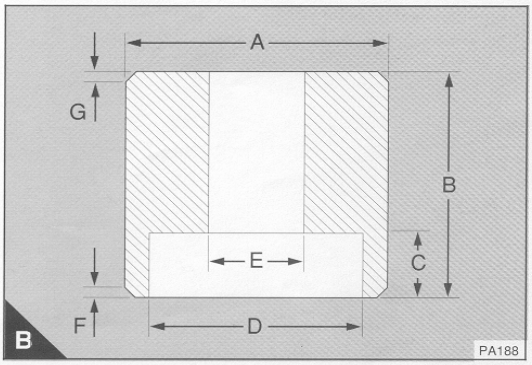
The coolant seal is an interference fit on the shaft and a tool will be necessary to fit the seal correctly.

The tool should be made of mild steel bar to the dimensions shown in (B), listed as follows:

A 44,0 mm (1.73 in)
B 40,0 mm (1.57 in)
C 11,3 mm (0.44 in)
D 37,3 mm (1.47 in)
E 16,1 mm (0.63 in)
F 1,00 mm (0.04 in) at 45°
G 2,00 mm (0.08 in) at 45°

The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.





https://truckmanualshub.com/

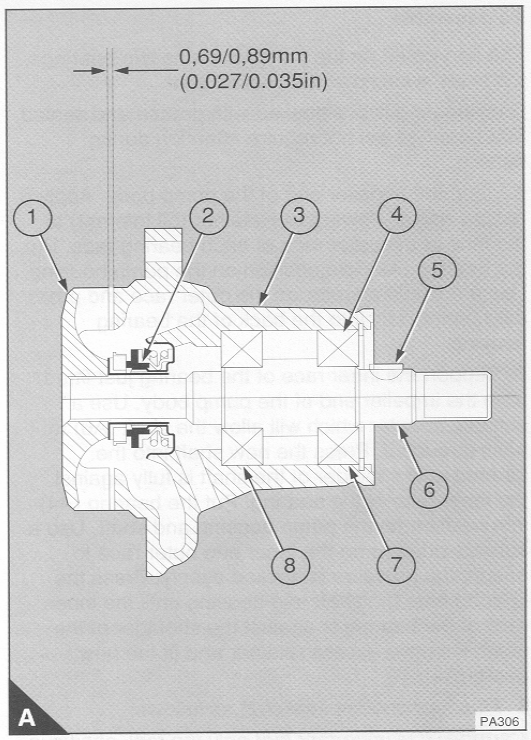
Do not lubricate the seal. It is important that the seal is not contaminated by oil or grease and if it is held in the hand, it should be held by the edge of the flange. Do not damage the ring of green sealant applied to the body of the coolant seal just behind the flange of the seal.

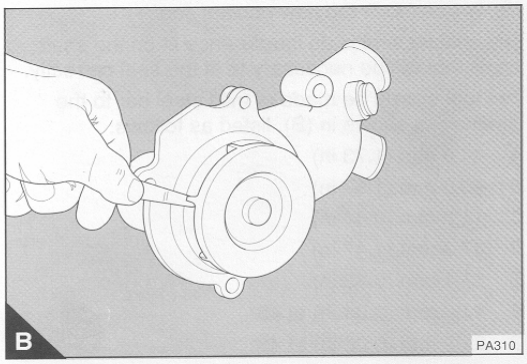
Support the pulley end of the shaft, ensure that there are no sharp edges on the edge of the shaft and put the seal into position on the end of the shaft. Ensure that the ring of sealant is towards the bearings. Use the tool to press the seal onto the shaft until the bottom of the seal flange is in complete contact with the pump body. Continue to apply force for approximately ten seconds to ensure that the seal remains in position when the force is released.

4 Support the pulley end of the shaft and press the new impeller (A1) onto the shaft until the clearance (A) between the impeller blades and the pump body is 0,69/0,89 mm (0.027/0.035 in). The clearance can be checked with a feeler gauge (B). The minimum clearance with end float is 0,19 mm (0.007 in).

Rotate the shaft to ensure that the impeller is free.

5 Fit the coolant pump to the engine, operation 21A-03A.





https://truckmanualshub.com/

Coolant pump - auxiliary

To dismantle and to assemble **21A-03C**

Consumable products:

POWERPART Retainer (oil tolerant)

To dismantle

1 Mark the relative position of the blanking plate (A7) to the pump body before the plate is removed. This will ensure correct assembly.

2 Remove the four setscrews, nuts and washers which retain the blanking plate to the body of the coolant pump and discard the joint (A9).

3 Remove the nut (A1) and washers (A14) and (A2) which secure the coolant pump pulley (A5) to the shaft (A13).

4 Use a suitable puller (B) and remove the pulley from the shaft.

5 Support the impeller end of the pump and press the shaft, together with the coolant seal (A10) and the impeller (A6) out of the body of the pump.

6 Remove the circlip (A3) for the bearing housing.

7 Support the pulley end of the pump and press the bearings (A11 and A12) and distance piece (A4) from the pump body. Discard the bearings.

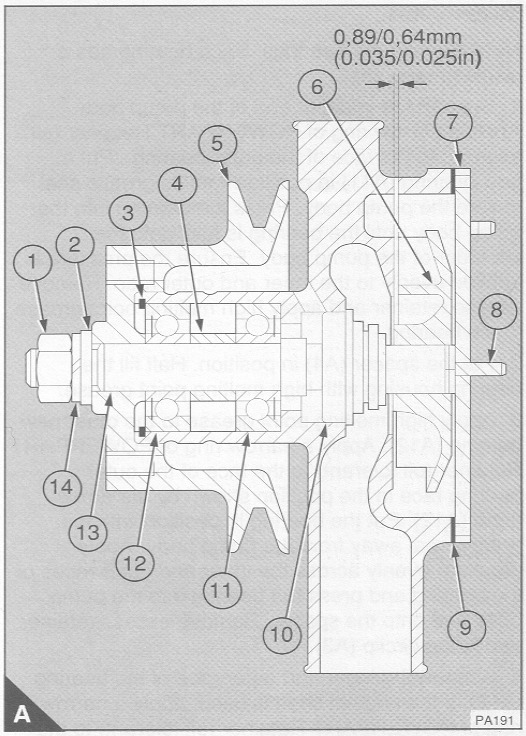
8 Support the impeller and press the shaft from the impeller. Remove and discard the coolant seal.

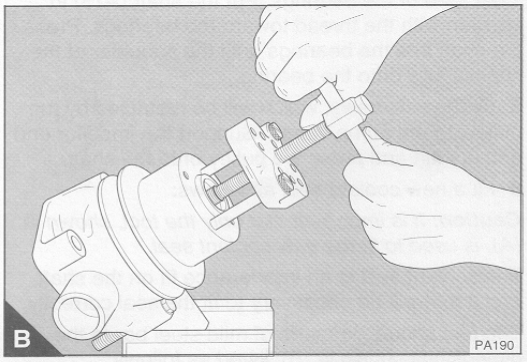
9 Clean the components of the pump in a suitable safe cleaning fluid and inspect the components as follows:

Check the coolant pump shaft for wear. If the shaft is worn it must be renewed.

Check the impeller for cracks and broken blades.

Examine the pump body for cracks.





https://truckmanualshub.com/

To assemble

Note: Renew the bearings. Each bearing has a single grease seal.

1 Support the impeller end of the pump body. Apply a narrow ring of POWERPART Retainer (oil tolerant) to the face of the outer bearing . Put a new bearing (A11) in position with its grease seal toward the pump body. Press the bearing into the pump body until the bearing is fully onto the shoulder of the pump body. Ensure the pressure is applied evenly to the inner and outer race. Remove excess retainer and apply high melting point grease to the bearing.

2 Put the spacer (A4) in position. Half fill the bearing housing with high melting point grease.

3 Apply high melting point grease to the other new bearing (A12). Apply a narrow ring of POWERPART Retainer (oil tolerant) to the face of the outer bearing race in the position shown by the arrow head (A12). Put the bearing in position with the grease seal away from the pump body. Apply pressure evenly across the inner and outer races of the bearing and press the bearing into the pump body and onto the spacer. Remove excess retainer and fit the circlip (A3).

4 Support the inner and outer race of the bearing (A12). If the original shaft is used, apply a narrow ring of POWERPART Retainer (oil tolerant) to the inner race of the bearings. Put the shaft (A13) in position with the thread toward the bearings. Press the shaft into the bearings until the shoulder of the shaft is fully onto the bearing.

5 Fit the setscrews, which will be restricted by the pulley, to the pump flange. Support the impeller end of the shaft and press the pulley onto the shaft.

6 Fit a new coolant seal as follows:

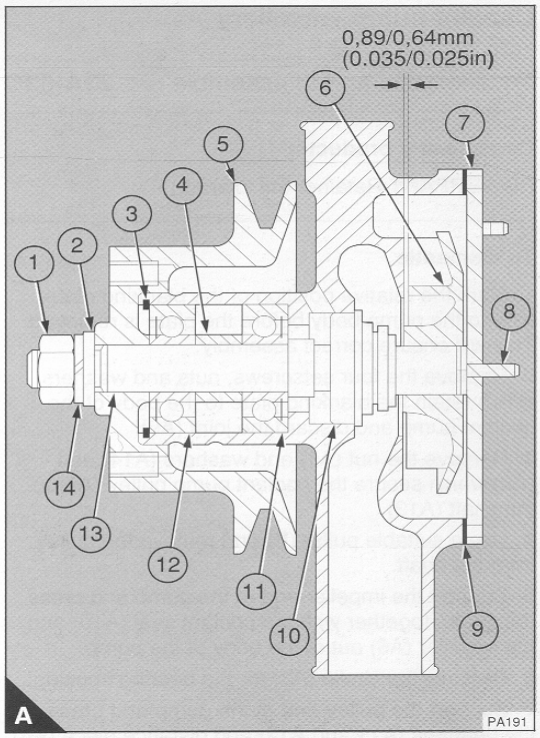
Caution: *It is important that only the tool, shown in (A), is used to fit the new coolant seal.*

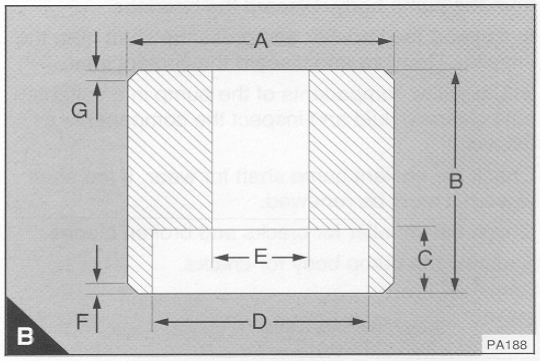
The coolant seal is an interference fit on the shaft and a tool will be necessary to fit the seal correctly.

The tool should be made of mild steel bar to the dimensions shown in (B), listed as follows:

A 44,0 mm (1.73 in)
B 40,0 mm (1.57 in)
C 11,4 mm (0.45 in)
D 37,3 mm (1.47 in)
E 16,1 mm (0.63 in)
F 1,00 mm (0.04 in) at 45°
G 2,00 mm (0.08 in) at 45°

The dimensions of the tool to fit the coolant seal, will ensure that the seal is the correct length after it is installed. It will also prevent axial distortion of the seal when it is pressed onto the shaft.





https://truckmanualshub.com/

Do not lubricate the seal. It is important that the seal is not contaminated by oil or grease. If it is held in the hand, it should be held by the edge of the flange. Do not damage the ring of green sealant applied to the body of the coolant seal just behind the flange of the seal.

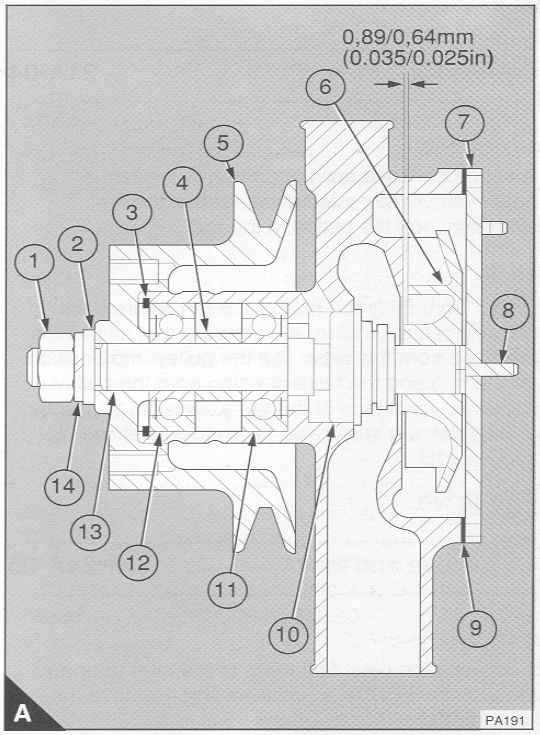
Support the pulley end of the shaft, put the seal into position on the end of the shaft. Ensure that the ring of sealant is towards the bearings. Use the tool to press the seal onto the shaft until the bottom of the seal flange is in complete contact with the pump body. Continue to apply force for approximately ten seconds to ensure that the seal remains in position when the force is released.

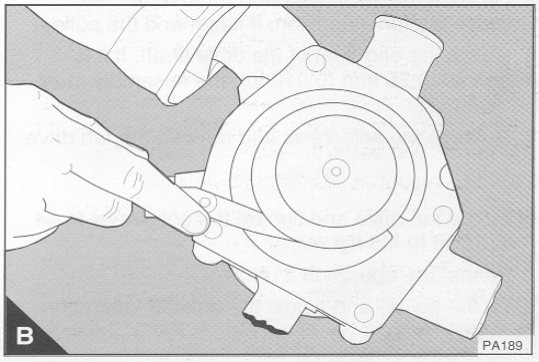
7 Support the pulley end of the shaft and press the impeller onto the shaft until the clearance (A) between the impeller blades and the pump body is 0,64/0,89 mm (0.025/0.035 in). The clearance can be checked with a feeler gauge (B)

Rotate the shaft to ensure that the impeller is free.

8 Put the plain washer (A2) and the spring washer (A14) in position onto the pulley. Fit the nut and tighten it to 82 Nm (60 lbf ft) 8,3kgf m.

9 Renew the joint for the blanking plate and fit the the blanking plate to the pump body. Ensure that the mark on the pump body is aligned with the line on the blanking plate and that the two studs (A8) for the adjustment bracket are at the rear of the plate .





https://truckmanualshub.com/

Fan

To remove and to fit **21A-04**

To remove

Release the setscrews and remove the fan. If necessary, fit the setscrews to retain the fan extension and the pulley to the hub.

To fit

Clean thoroughly the rear of the fan where it fits onto the fan extension. Also ensure that all paint is removed from this area. Put the pulley into position on the hub and the fan extension onto the pulley. Clean the front face of the fan extension. Fit the fan and tighten the setscrews to the torque shown in section 11B.

Fan drive

To remove and to fit **21A-05**

To remove

1 Loosen the pivot fasteners of the alternator and the fasteners of the adjustment link. Remove the drive belt(s).

2 Release the setscrews and remove the fan. Remove the fan extension, if fitted, and the pulley.

3 Check the end-float of the drive shaft. If it is more than 0,25 mm (0.010 in), the assembly must be renewed.

4 Release the setscrews and remove the fan drive.

To fit

1 Fit the fan drive and tighten the setscrews to 44 Nm (33 lbf ft) 4,5 kgf m.

2 Fit the fan, operation 21A-04.

3 Fit the belt(s) and adjust the tension, operation 23A-02.

https://truckmanualshub.com/

Lubricating oil cooler

To remove and to fit - four cylinder turbocharged engines **21A-07A**

To remove

1 Drain the cooling system.

2 Release the support bracket at the cooler (A3).

3 Release the setscrew and nut (A2) which fasten the low-pressure fuel pipes to the top of the cooler.

4 Release the hose clip at the top rear of the cooler (A1).

5 Release the six setscrews (A4) which are fitted below the cover and the setscrew (A4) to the left of the cover. Remove the cooler.

To fit

1 Renew the "O" rings on the inlet connection for the coolant (B3) and the outlet flange for the coolant (B5). Ensure that the joint faces are clean. Renew the joint (B4) for the oil pipe flange.

2 Lightly lubricate the bore of the vent connection (B2) and the "O" ring on the coolant inlet connection with engine lubricating oil.

3 Loosely fit the hose clip to the vent connection.

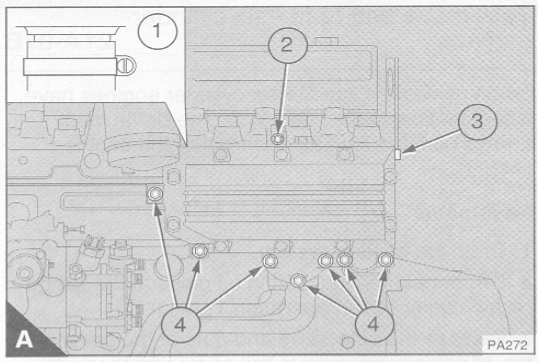
4 Fit the cooler to the engine with the vent (B1) fitted correctly in its connection. Tighten the setscrews and the hose clip of the vent connection.

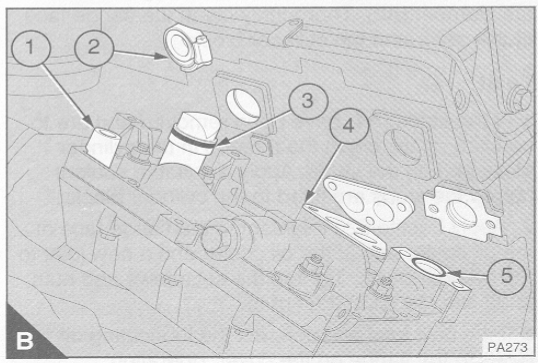
5 Fit and tighten the setscrew of the support bracket.

6 Fit the setscrew and nut which fasten the low-pressure fuel pipes to the top of the oil cooler.

7 Fill the coolant system.

8 Operate the engine and check for leakage of coolant or oil.





https://truckmanualshub.com/

To remove and to fit - six cylinder engines 21A-07B

Some oil coolers fitted to six cylinder engines have a coolant flow baffle fitted (A3). The baffle must always be fitted towards the front of the engine (A1).

To remove

1 Drain the cooling system.

2 Disconnect the lubricating oil pipes at the flange on the cooler cover, operation 19A-11.

3 Release the setscrews and nuts of the cover of the oil cooler and remove the cover together with the element (A2). Thoroughly clean the flange face of the cover and the cylinder block.

To fit

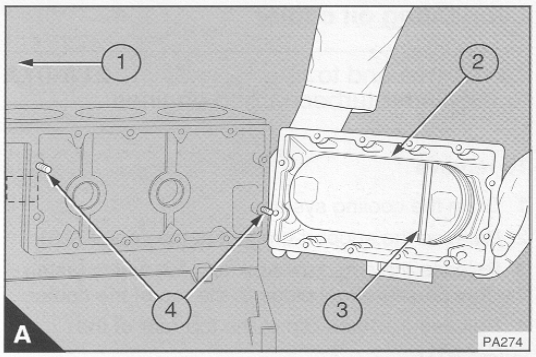
1 If the studs (A4) have been removed and are to be fitted again, clean the threads in the cylinder block and on the studs. Apply a suitable sealant before the studs are fitted to the cylinder block.

2 Apply Loctite 5204 sealant to the flange face of the oil cooler and fit the oil cooler and a new joint to the cylinder block. Tighten the setscrews and nuts to 22 Nm (16 lbf ft) 2,2 kgf m.

3 Fit a new joint and connect the lubricating oil pipes to the flange on the cover, operation 19A-11.

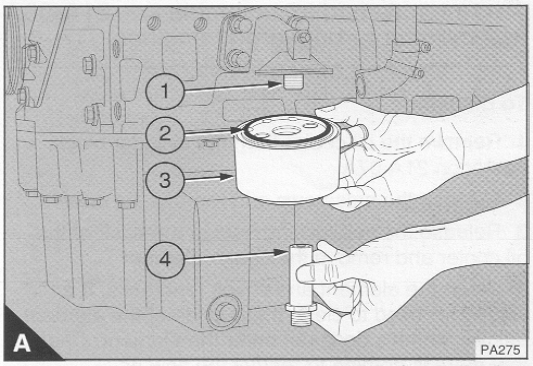
4 Fill the cooling system.

5 Operate the engine and check for oil or coolant leakage.



https://truckmanualshub.com/

To remove and to fit - canister type 21A-07C



To remove

1 Remove the canister of the lubricating oil filter.

2 Drain the cooling system.

3 Release the hose clips of the coolant pipes at the oil cooler. Release the threaded adaptor (A4) from the lubricating oil cooler and pull the oil cooler (A3) from the hose connections.

To fit

1 Clean the filter head.

2 Ensure that the adaptor (A1) is secure in the filter head.

3 Check the seal (A2) on top of the oil cooler for damage and renew the seal if necessary. Lightly lubricate the seal with clean lubricating oil.

4 Push the hose connections for the coolant pipes onto the lubricating oil cooler. Hold the oil cooler (A3) in position against the filter head and fit the threaded adaptor (A4). Tighten the threaded adaptor to 37 Nm (27 lbf ft) 3,8 kgf m. Ensure that the hose connections are fitted correctly and tighten the hose clips.

5 Clean the bottom face of the oil cooler. Fit a new oil filter canister, operation 19A-01.

6 Fill the cooling system.

https://truckmanualshub.com/

To dismantle and to assemble - four cylinder turbocharged engines **21A-08A**

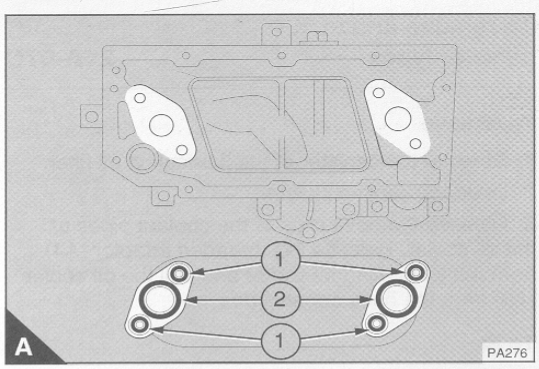
To dismantle

1 Remove the oil cooler from the cylinder block, operation 21A-07A.

2 Release the setscrews and remove the cover.

3 Release the self-locking nuts at the back of the oil cooler and remove the cooler element.

4 Clean the element and check for cracks. If a solution is used to clean the outside of the element, ensure that this does not enter the element. Check that there is nothing to restrict the flow of lubricating oil through the element of the oil cooler. If the inside of the element needs to be cleaned, use a solvent which is suitable for copper. Dry the element with low pressure air and then flush it with clean engine lubricating oil.



To assemble

1 Renew the "O" rings (A1 and A2) on the flanges of the element and the self-locking nuts for the studs.

2 Fit the element to the backplate and tighten the self-locking nuts to 22 Nm (16 lbf ft) 2,2 kgf m.

3 Fit the cover and a new joint to the cooler backplate and tighten the setscrews to 11 Nm (8 lbf ft) 1,1 kgf m.

https://truckmanualshub.com/

To dismantle and to assemble - six cylinder turbocharged engines 21A-08B

Some oil coolers fitted to six cylinder engines have a coolant flow baffle fitted (A2). The baffle must always be fitted towards the front of the engine (A1).

To dismantle

1 Remove the oil cooler, operation 21A-07B.

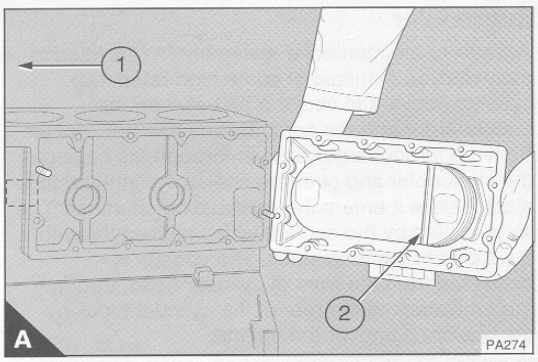
2 Release the nuts on the front of the cover and remove the element of the oil cooler (B).

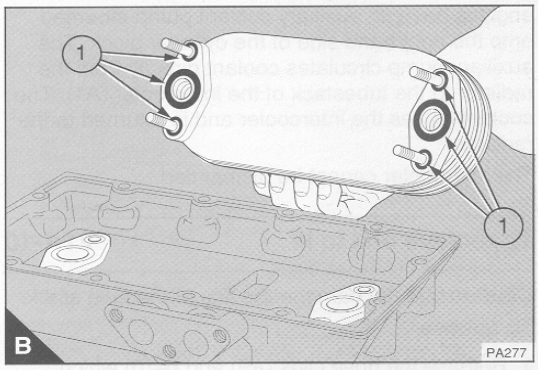
3 Clean the element and check for cracks. If a solution is used to clean the outside of the element, ensure that this does not enter the element. Check that there is nothing to restrict the flow of lubricating oil through the element of the oil cooler. If the inside of the element needs to be cleaned, use a solvent which is suitable for copper. Dry the element with low pressure air and then flush it with clean engine lubricating oil.

To assemble

1 Renew the "O" rings (A1) on the flanges of the element.

2 Fit the element of the oil cooler to the cover and tighten the nuts to 22 Nm (16 lbf ft) 2,2 kgf m.





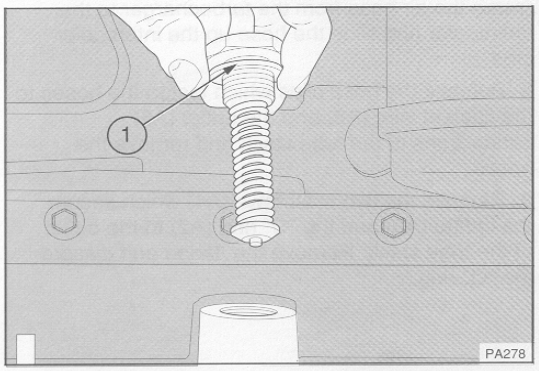
Cooler by-pass valve

To remove and to fit 21A-09

1 Release the hexagonal cap and remove the by-pass valve (C).

2 Check the valve spring and the seat for damage and renew the complete assembly, as necessary.

3 Renew the aluminium washer (C1). Fit the by-pass valve into the oil cooler and tighten the cap to 50 Nm (37 lbf ft) 5,1 kgf m. The by-pass valve is not fitted to the latest oil cooler fitted to most four cylinder engines.



https://truckmanualshub.com/

Intercooler

A water-to-air intercooler assembly (A1) is fitted to the induction manifold of some high rated four cylinder engines to cool the air between the turbocharger and the combustion chamber. Hot air from the turbocharger passes through the casing of the intercooler and over the fins on the integral tube stack before it enters the combustion chamber. The air is cooled by the coolant which passes through the tubes of the tube stack. The coolant is circulated from the front of cylinder head, through the tube stack to the rear of the cylinder block by the coolant pump for the engine.

In addition to the engine coolant pump, certain engines have an auxiliary coolant pump mounted onto the right hand side of the cylinder block. The auxiliary pump circulates coolant directly from the radiator to the tubestack of the intercooler (A1). The coolant leaves the intercooler and is returned to the radiator.

The intercooler cannot be dismantled.

To remove and to fit 21A-10

Caution: *Do not damage the fins of the tube stack.*

To remove

1 Release the hose clips (A9) and (A10) which fasten the air hose from the turbocharger to the intercooler and slide the hose up the intercooler pipe.

2 Release the hose clips which fasten the hoses to the coolant inlet (A6) and the outlet (A5) connections of the tube stack and remove the hoses.

3 Remove the two setscrews (A4) which secure the flange (A3) and the "O" ring (A2) to the outlet of the tube stack. Remove the flange and discard the "O" ring.

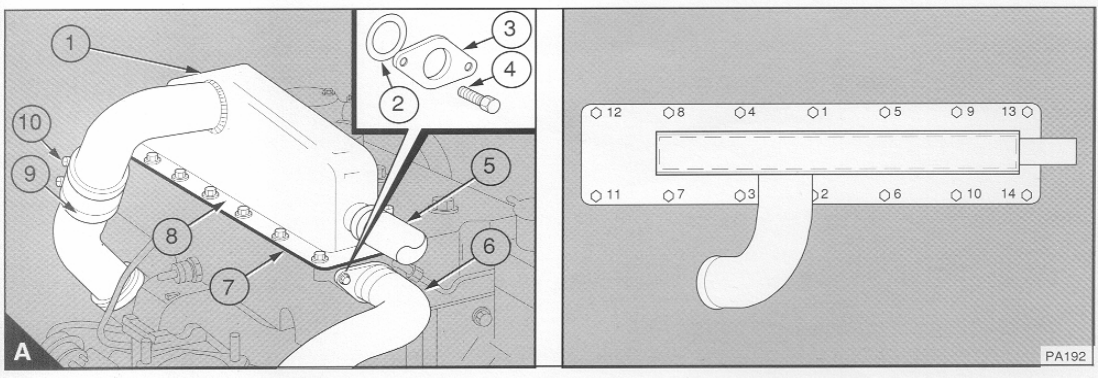
Caution: *Do not use a lever between the face of the flange* (A8) *to separate the intercooler assembly from the induction manifold.*

4 Release the 14 setscrews which secure the intercooler assembly to the induction manifold, in the reverse sequence to that shown in (A).

Caution: *Do not use force to remove the outlet pipe of the tube stack from the induction manifold.*

5 Carefully lift the intercooler assembly enough to allow movement of the intercooler toward the rear of the engine. This will allow clearance of the pipe connection (A6) from the induction manifold. When the pipe is free of the manifold remove the intercooler assembly and discard the joint (A7).

6 Clean and inspect the intercooler assembly, operation 21A-11



https://truckmanualshub.com/

To fit

1 Renew the joint (21A.26/A7) between the flange face of the intercooler and the induction manifold. The joint is fitted dry.

Caution: *Do not use force to fit the outlet pipe of the tube stack into the induction manifold.*

2 Carefully lift the intercooler into the induction manifold. Do not damage the inlet pipe of the tube stack which must be put into position carefully to allow entry into the manifold.

3 Fit the 14 setscrews which secure the intercooler assembly to the induction manifold and apply a torque tension of 22 Nm (16 lb ft) 2,2 kgf m to the fasteners in the sequence shown in (A).

4 Fit a new "O" ring (A2) into the flange. Fit the flange (A3) with the two setscrews (A4) onto the outlet pipe (A6) of the tube stack. Tighten the flange to the manifold and apply a torque tension of 7 Nm (5 lbf ft) 0,7 kgf m.

5 Fit the inlet and the outlet hoses for the tube stack and fasten the hose clips.

6 Fit the air hose from the turbocharger to the intercooler assembly and tighten the hose clips (A9) and (A10).

7 Operate the engine and check for coolant and air leaks.

https://truckmanualshub.com/

To clean

Caution: *Do not clean the tube stack in a caustic cleaning solution.*

1 Thoroughly clean the intercooler body its flange and the flange of the induction manifold with an approved detergent solution.

Warning! *Do not allow compressed air to contact your skin, if compressed air enters your skin obtain medical help immediately.*

2 Soak the fins of the tube stack in an approved detergent degreasing fluid. Allow the excess fluid to drain off and dry the fins with low pressure compressed air.

3 Flush the tube stack with clean coolant through the outlet connection, in the opposite direction of flow.

To inspect

1 Examine the casing of the intercooler for cracks or distortion, especially the flange faces which must be flat to prevent leakage of air.

2 Examine the tube stack for signs of coolant leakage. Also examine the tube stack for damage to the fins, the hose connections, and for cracks. If the tube stack is damaged or blocked it must be renewed.

https://truckmanualshub.com/

Data and dimensions

Note: This information is given as a guide for personnel engaged on engine overhauls. The dimensions which are shown are those which are mainly used in the factory. The information applies to all engines, unless an engine type code is shown.

Coolant pump

Four cylinder engines and early six cylinder engines

Type	Centrifugal, gear driven
Outside diameter of shaft for drive gear	15,91/15,92 mm (0.6262/0.6257 in)
Diameter of bore of drive gear	15,86/15,88 mm (0.6244/0.6252 in)
Interference fit of drive gear on shaft	0,03/0,06 mm (0.0012/0.0024 in)
Diameter of bore of impeller	15,87/15,89 mm (0.6249/0.6257 in)
Outside diameter of shaft for impeller	15,91/15,92 mm (0.6264/0.6268 in)
Interference fit of impeller on shaft	0,02/0,05 mm (0.0007/0.0020 in)
Diameter of bearing	29,99/30,00 mm (1.1807/1.1811 in)
Diameter of bore for bearing	29,96/29,98 mm (1.1795/1.1803 in)
Interference fit of bearing in pump body	0,01/0,04 mm (0.0004/0.0016 in)
Dimension of impeller boss to front face of pump body (fitted) early engines	8,1/8,5 mm (0.319./0.335 in)
Dimension of impeller boss to front face of pump body (fitted) latest engines, impeller part number 3746X071	7,1/7,5 mm (0.28./0.30 in)
Dimension of gear from rear face of pump body (fitted)	0,6/2,6 mm (0.024/0.102 in)

Coolant pump

Six cylinder engines and later four cylinder engines

Type	Centrifugal, gear driven
Outside diameter of shaft	18,95/18,96 mm (0.7460/0.7465 in)
Diameter of bore of drive gear	18,90/18,92 mm (0.7441/0.7449 in)
Interference fit of drive gear on shaft	0,03/0,06 mm (0.0012/0.0024 in)
Diameter of bore of impeller	15,87/15,89 mm (0.6249/0.6257 in)
Outside diameter of shaft for impeller	15,91/15,92 mm (0.6264/0.6268 in)
Interference fit of impeller on shaft	0,02/0,05 mm (0.0007/0.0020 in)
Diameter of bore for bearing	38,06/38,08 mm (1.4983/1.4993 in)
Diameter of bearing	38,09/38,10 mm (1.4995/1.5000 in)
Interference fit of bearing in pump body	0,01/0,04 mm (0.0004/0.0016 in)
Dimension of impeller boss to front face of pump body (fitted)	7,7/8,0 mm (0.303./0.315 in)
Dimension of gear from rear flat face of pump body (fitted)	21,0/21,5 mm (0.827/0.846 in)
Dimension of gear from rear face of bearing (fitted)	0,47/1,53 mm (0.018/0.060 in)

Auxiliary coolant pump - fitted to certain intercooled engines

Type	Centrifugal, belt driven
Outside diameter of shaft for pulley	15,001/15,009 mm (0.5906/0.5909 in)
Inside diameter of bore of pulley	14,935/14,956 mm (0.5879/0.5888 in)
Interference fit of pulley on shaft	0,05/0,07 mm (0.0019/0.0028 in)
Diameter of bore of impeller	15,875/15,893 mm (0.625/0.6257 in)
Outside diameter of shaft	15,9055/15,9182 mm (0.6263/0.6267 in)
Interference fit of impeller on shaft	0,01/0,04 mm (0.0004/0.0016 in)
Impeller to body clearance	0,64/0,89 mm (0.025/0.035 in)