Perkins New 1000 Series

Models AJ to AS and YG to YK

WORKSHOP MANUAL

4 and 6 cylinder diesel engines for industrial and agricultural applications

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PACE

Chapters

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General information

Introduction

This workshop manual has been written to provide assistance in the service and overhaul of Perkins New 1000 Series engines. For overhaul procedures the assumption is made that the engine is removed from the application. The engine conforms with USA (EPA/CARB) stage 1 and EEC stage 1 emissions legislation for agricultural and industrial applications.

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.

The details of some operations will be different according to the of fuel injection pump which is fitted. The specific pump type used can be found by reference to the manufacturer's identification plate on the pump body. Generally, the type of pump fitted is as shown below.

Lucas	DP200 Series
Bosch	EPVE
Stanadyne	DB4

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, where relevant.

POWERPART recommended consumable products are listed on page 21. Reference to the relevant consumable products is also made at the beginning of each operation, where relevant.

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

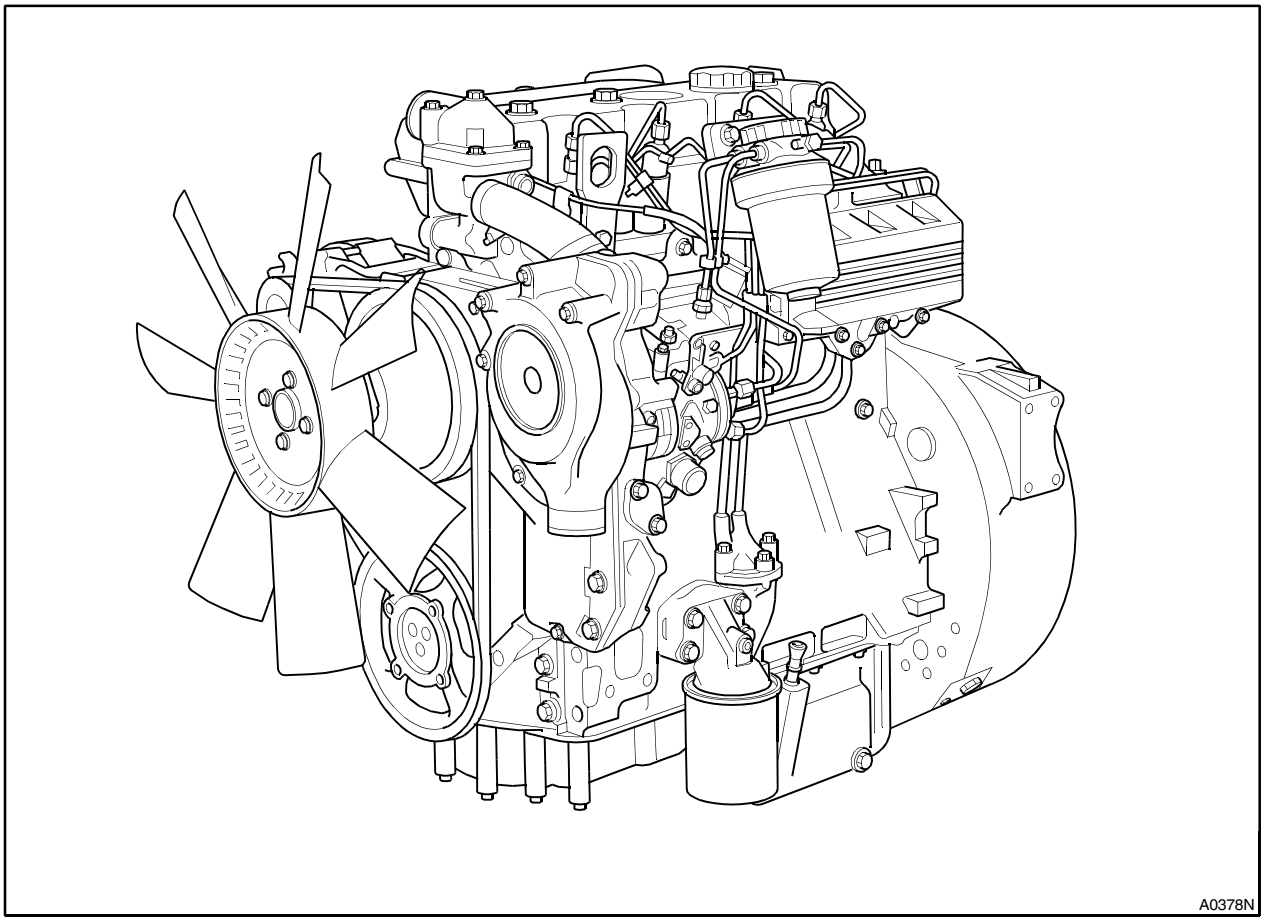
Read and remember the "Safety precautions". They are given for your protection and must be used at all times.

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.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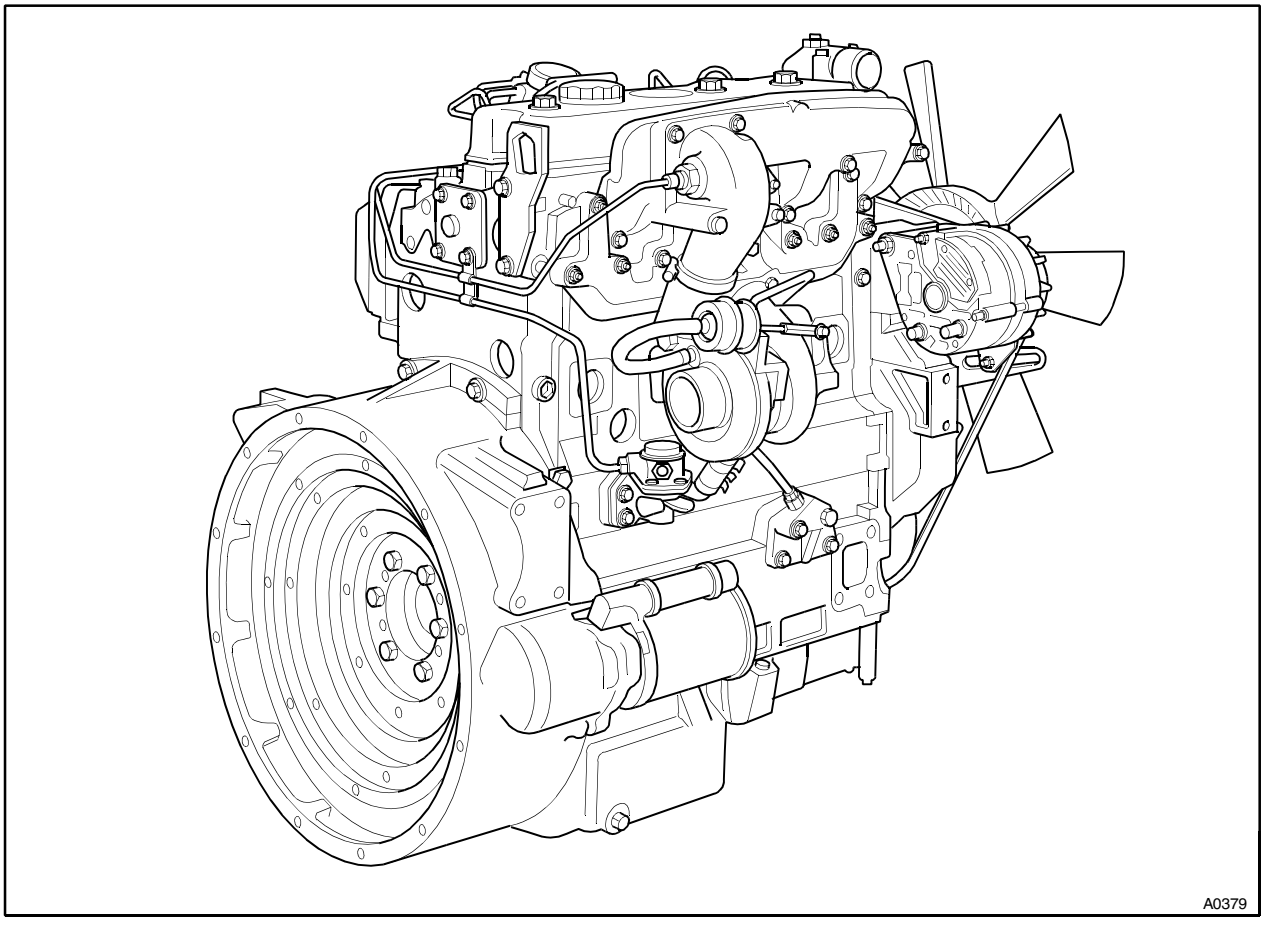
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Engine identification

The Perkins New 1000 Series engines have been designed for industrial and agricultural applications. There are both four and six cylinder engines, each of which will have three basic engine types, naturally aspirated, turbocharged and turbocharged with an intercooler.

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
AJ	Four cylinder, naturally aspirated.
AK	Four cylinder, turbocharged.
AM	Four cylinder, turbocharged and intercooled.
AP	Four cylinder, naturally aspirated, belt driven coolant pump.
AQ	Four cylinder, turbocharged, belt driven coolant pump.
AR	Four cylinder, naturally aspirated, 103 mm cylinder bore.
AS	Four cylinder, naturally aspirated, belt driven coolant pump, 103 mm cylinder bore.
YG	Six cylinder, naturally aspirated.
YH	Six cylinder, turbocharged.
YK	Six cylinder, turbocharged and intercooled.

The correct identification of the engine is by the full engine number.

The engine number is stamped on a label which is fastened to the left side (A2) of the cylinder block. An example of an engine number is:

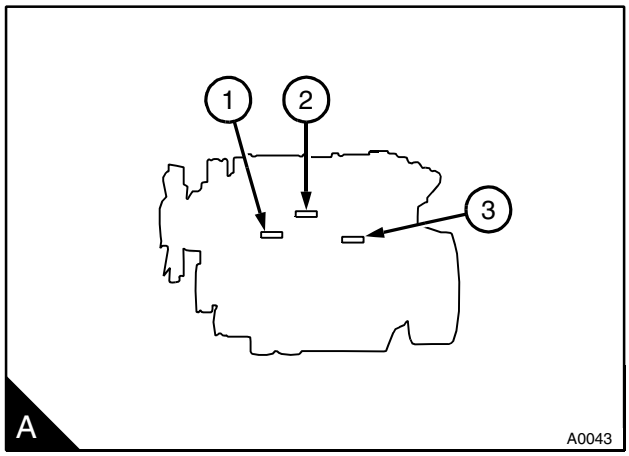
AK80920*U510256B*

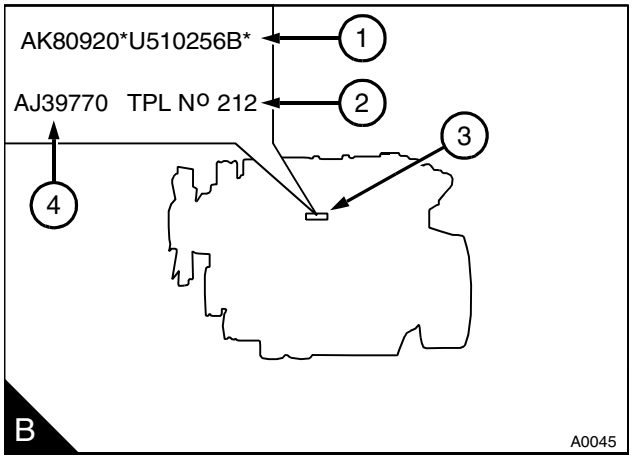
If you need parts, service or information for your engine, you must give the complete engine number to your Perkins distributor. If there is a number in the area of the label marked TPL Nº, then this number must also be given to your Perkins distributor.

Other identification labels fitted to the engine include:

An emissions legislation label (A3) fitted to the side of the cylinder block.

A label (A1) with the fuel injection pump part numbers.





If a short engine has been fitted in service two engine serial numbers and a TPL number are stamped on the engine serial number pad (B3):

Examples of the serial numbers are shown in (B).

If parts for the short engine are needed in service, use the serial number (B4). If parts which were moved from the original engine to the short engine are needed, use the serial number (B1) and the TPL number (B2).

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 or any component 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, see page 20.
- Read and use the instructions relevant to lift equipment which are given on page 19.
- Always use a safety cage to protect the operator when a component is to be pressure tested in a container 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 items away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- Do not clean an engine while it runs. If cold cleaning fluids are applied to a hot engine, certain components on the engine may be damaged.
- Fit only genuine Perkins parts.

Engine lift equipment

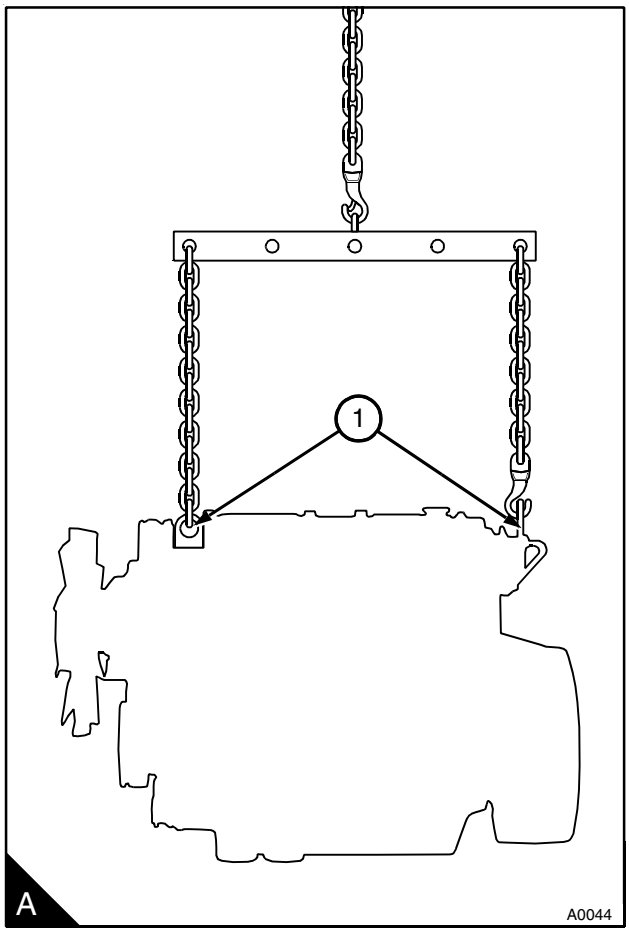
The maximum weight of the engine without coolant, lubricant or a gearbox fitted will vary for different applications. It is recommended that lift equipment of the minimum capacity listed below is used:

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 prevent 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.



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.

POWERPART recommended consumable products

Perkins have made available the products recommended below in order to assist in the correct operation, service and maintenance of your engine and your machine. The instructions for the use of each product are given on the outside of each container. These products are available from your Perkins distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 1 litre 21825166 or 5 litres 21825167, refer to the User's Handbook.

POWERPART Easy Flush

Cleans the cooling system. Part number 2182501

POWERPART Jointing compound

Universal jointing compound which seals joints. Currently Hylomar. Part number 1861155 or 1861117.

POWERPART Silicone rubber sealant

Silicone rubber sealant which prevents leakage through gaps.Currently Hylosil. Part number 1861108.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. Part number 1772204, refer to the User's Handbook.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. Part number 1762811, refer to the User's Handbook.

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115, refer to the User's Handbook.

POWERPART Chisel

Allows easy removal of old gaskets and joints. Currently Loctite chisel. Part number 21825163.

POWERPART Repel

Dries damp equipment and gives protection against corrosion. Passes through dirt and corrosion to lubricate and to assist removal of components. Currently Loctite repel. Part number 21825164.

POWERPART Threadlock

To retain small fasteners where easy removal is necessary. Currently Loctite 222e. Part number 21820222.

POWERPART Studlock

To permanently retain large fasteners and studs. Currently Loctite 270. Part number 21820270.

POWERPART Nutlock

To retain and seal threaded fasteners and cup plugs where easy removal is necessary. Currently Loctite 242e. Part number 21820242

POWERPART Liquid gasket

To seal flat faces of components where no joint is used. Especially suitable for aluminium components. Currently Loctite 518. Part number 21820518

POWERPART Threadlock (hydraulic/pnuematic)

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Currently Loctite 542. Part number 21820542

POWERPART Threadlock (pipe)

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Currently Loctite 575. Part number 21820575.

POWERPART Retainer (oil tolerant)

To retain components which have a transition fit. Currently Loctite 603. Part number 21820603.

POWERPART Retainer (high strength)

To retain components which have an interference fit. Currently Loctite 638. Part number 21820638.

POWERPART Atomiser thread sealant

To seal the threads of the atomiser into the cylinder head. Currently Hylomar Advance Formulation. Part number 21825474.

Continued

POWERPART Compound

To seal the outer diameter of seals. Currently Loctite Forma Gasket No 2. Part number 1861147.

POWERPART Platelock

For tight fitted metal surfaces. Suitable for metal plated surfaces and stainless steel, Currently Loctite 243. Part number 21826039.

POWERPART Gasket eliminator

Improves flange sealing when a gasket is not used. It provides a seal with temperature resistance that is flexible in positions where vibration and pressure occur. Currently Loctite 515. Part number 21826040.

POWERPART Silicone adhesive

An RTV silicone adhesive for application where low-pressure tests occur before the adhesive sets. Used to prevent leakage where movement of the joint occurs. Currently Loctite 5900. Part number 21826038.

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Specifications

Basic engine data

Number of cylinders:
AJ, AK, AM, AP, AQ, AR, AS 4
YG, YH, YK 6
Cylinder arrangement . . . . . In line
Cycle . . . . . Four stroke
Direction of rotation . . . . . Clockwise from the front

Induction system
AJ, AP, AR, AS, YG. . . . . Naturally aspirated
AK, AQ, YH . . . . . Turbocharged
AM, YK . . . . . Turbocharged, intercooled

Combustion system . . . . . Direct injection

Nominal bore
AJ, AK, AM, AP, AQ, YG, YH, YK . . . . . 100 mm (3.937 in)
AR, AS. . . . . 103 mm (4.055 in)

Stroke . . . . . 127 mm (5.00 in)

Compression ratio
AJ, AK, AM, AP, AQ, YG, YH, YK 17.25:1
AR, AS. 18.5:1

Cubic capacity
AJ, AK, AM, AP, AQ . . . . . 4 litres (243 in^3)
AR, AS. . . . . 4,23 litres (258 in^3)
YG, YH, YK . . . . . 6 litres (365 in^3)

Firing order
AJ, AK, AM, AP, AQ, AR, AS 1, 3, 4, 2
YG, YH, YK 1, 5, 3, 6, 2, 4

Valve tip clearances (hot or cold)
Inlet . . . . . 0,20 mm (0.008 in)
Exhaust . . . . . 0,45 mm (0.018 in)

Lubricating oil pressure **(1)**
AJ, AK, AM, AP, AQ, YG, YH, YK . . . . . 280 kPa (40 lbf/in^2) 2,5 kgf/cm^2
AR, AS. . . . . 207 kPa (30 lbf/in^2) 2,1 kgf/cm^2

(1) minimum at maximum engine speed and normal engine temperature

Thread sealant

When setscrews or studs are fitted into holes which are tapped through the cylinder block, a suitable sealant must be used to prevent leakage.

Micro encapsulated anaerobic sealant (M.E.A.S) fasteners have been introduced instead of jointing compounds or other sealants when the fasteners are fitted in through holes into oil or coolant passages. The identification of these fasteners, as supplied, is by a red, blue, or other colour sealant around the fastener threads.

With M.E.A.S. sealed studs, the sealed end must be fitted into the cylinder head / cylinder block etc. Ensure that the threaded holes have a 1,59 mm (0.0625 in) 45° chamfer, to ensure that when the new fasteners are fitted the M.E.A.S. sealant is not removed. If the fasteners have to be removed and fitted again, the threads must be cleaned and a suitable sealant used.

Standard torque tensions

Most of the torque tensions on the engine are standard. Special torque tensions are listed in the separate special torque tables. The standard torque tensions listed in the tables below can be used when a special torque is not necessary.

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

Standard torques for setscrews and nuts

Thread Size	Torque		
	Nm	lbf ft	kgf m
M6 x 1,00	9	7	0,9
M8 x 1,25	22	16	2,2
M10 x 1,50	44	33	4,5
M12 x 1,75	78	58	8.0
M14 x 2,00	124	91	12,6
M16 x 2,00	190	140	19,3

Standard torques for studs (metal end)

Thread Size	Torque		
	Nm	lbf ft	kgf m
M6 x 1,00	5	4	0,5
M8 x 1,25	11	9	1,1
M10 x 1,50	18	14	1,8
M12 x 1,75	25	19	2,5

Standard torques for pipe unions, plugs, and adaptors

Thread Size (Inches)	Torque		
	Nm	lbf ft	kgf m
1/8 PTF	9	7	0.9
1/4 PTF	17	13	1,7
3/8 PTF	30	23	3,0
3/4 PTF	45	35	4,5

Specific torque tensions

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

Special torques for setscrews and nuts

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
Cylinder head assembly				
Setscrews, cylinder head	1/2 UNF	see operation 12-7		
Setscrews, cylinder head (Engine types AR and AS)	M10 1/2 UNF	see operation 12-7		
Fasteners, rocker shaft brackets:				
- Aluminium brackets	M12	40	30	4,1
- Cast iron and sintered steel brackets	M12	75	55	7,6
Cap nuts, composite plastic rocker cover	M12	20	15	2,1
Cap nuts, aluminium rocker cover	M12	30	22	3,0
Setscrews, inlet manifold to cylinder head	M10	44	33	4,5
Fasteners, exhaust manifold to cylinder head	M10	44	33	4,5
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	152	114	15,8
Banjo bolts, piston cooling jets	3/8 UNF	27	21	2,7
Crankshaft assembly				
Setscrews, main bearings	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, crankshaft bonded damper to crankshaft pulley	M8	35	26	3,6
Setscrews, 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	M6	13	10	1,3
Torxscrew, rear oil seal housing to bridge piece	M8	18	13	1,9
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

Special torques for setscrews and nuts

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
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	95	74	9,5
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 jet(s)	3/8 UNF	27	21	2,7
Fuel system				
Nuts, high-pressure fuel pipes	M12	22	16	2,2
Bolt banjo, leak-off connection	M8	9	7	0,9
Gland nut, atomiser body	-	40	30	4,1
Setscrews, for the gear of the fuel injection pump	M10	28	20	2,8
Torxscrew, for the gear of the fuel injection pump	M10	22	16	2,2
Setscrews, fuel lift pump	M8	22	16	2,2
Nuts for flange of fuel injection pump	M8	22	16	2,2
Locking screw of Bosch VE fuel injection pump	M10	27	20	2,8
Locking screw of DP 200 fuel injection pump	10 A/F	10	7	1
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				
Nut, drive pulley for coolant pump (Engine types AP, AQ, AS)	M8	22	16	2,2
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 body of pump (Engine type AS)	M8	29	21	2,9
Screw, cassette type cooler to oil filter head	3/4 UNF	37	29	3,7

Special torques for setscrews and nuts

Description	Thread size	Torque		
		Nm	lbf ft	kgf m
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
- Head stamped 8.8	M12	75	55	7,6
- Head stamped 10.9	M10	63	46	6,4
- Head 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
Aspiration system				
Nuts, turbocharger to manifold	M10	44	33	4,5
Electrical equipment				
Nut, alternator pulley:				
- CAV AC5RA and AC5RS	5/8 UNF	55	40	5,6
- Thin nut A127, and motorola pulley, 22 mm A/F	M17	60	44	6,1
- Thick nut A127, and motorola pulley, 24 mm A/F	M17	80	59	8,2
- Bosch 55A	M14	45	33	4,5
- Bosch 55A	M16	50	37	5,1
- Butec 5524	5/8 UNF	78	58	8,0
Fuelled start aid to induction manifold	7/8 UNF	31	23	3,1
Port heater to induction manifold	M22	60	44	6,1
Nut/screw, starter motor	3/8 UNF	30	23	3,0
Auxiliary equipment				
Nut, compressor drive gear to compressor crankshaft	5/8 UNF	120	93	12,0
Nut, (30 A/F) Compressor gears	M20	130	101	13,0
Cap screw, bracket to idler hub	M10	60	47	6,0
Cap screw, bracket to timing case	M8	35	27	3,5

Compression test data

Tests have shown that many factors affect compression pressures. Battery and starter motor condition, ambient conditions and the type of gauge used can give a wide variation of results for a given engine.

It is not possible to give accurate data for compression pressure, but tests have shown that the results should be within 2000/3500 kPa (300/500 lbf/in^2) 21,0/35,0 kgf/cm^2 for diesel engines.

Compression tests should only be used to compare between the cylinders of an engine. If one or more cylinders vary by more than 350 kPa (50 lbf/in^2) 3,5 kgf/cm^2, then those cylinders may be faulty.

Compression tests should not be the only method used to show the condition of an engine, but they should be used together with other symptoms and tests.

How to do a compression test

Caution: *Before the compression test, ensure that the battery is in good condition and that it is fully charged. Also ensure that the starter motor is in good condition.*

1 Ensure that the valve tip clearances are set correctly.

2 Remove the atomisers.

3 Fit a suitable gauge into the atomiser hole of the cylinder to be tested.

Caution: *Ensure that the engine cannot start:*

4 Disconnect the stop solenoid or put the stop control in the no-fuel position.

5 Operate the starter motor and note the pressure indicated on the gauge.

6 Repeat for each cylinder.

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