

Perkins 1100 Series

Models RE, RF, RG, RH, RJ and RK

WORKSHOP MANUAL

4 cylinder diesel engines for industrial, agriculture and construction applications

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General information

Introduction

This Workshop Manual has been written to provide assistance in the service and overhaul of Perkins 1100 Series 4 cylinder engines. It should be used in conjunction with normal workshop practise and information contained in current service bulletins. Mention of certain accepted practices therefore, has been purposely omitted in order to avoid repetition. For overhaul procedures the assumption is made that the engine is removed from the application.

The engine conforms with USA (EPA/CARB) stage 2 and EEC stage 2 emissions legislation for agriculture, construction and industrial applications.

Most of the general information which is included in the relevant User's Handbook 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 type 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 but, generally, the type of pump fitted is as shown below:

- Delphi - DP210 Series
- Bosch - VP 30
- Bosch - EPVE.

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 Chapter 16, Special tools. Reference to the relevant special tools is also made at the beginning of each operation.

POWERPART recommended consumable products are listed under "POWERPART recommended consumable products" on page 9. Reference to the relevant consumable products is also made at the beginning of each operation.

Data and dimensions are included in Chapter 2, Specifications.

Read and remember the "Safety precautions" on page 5. They are given for your protection and must be used at all times.

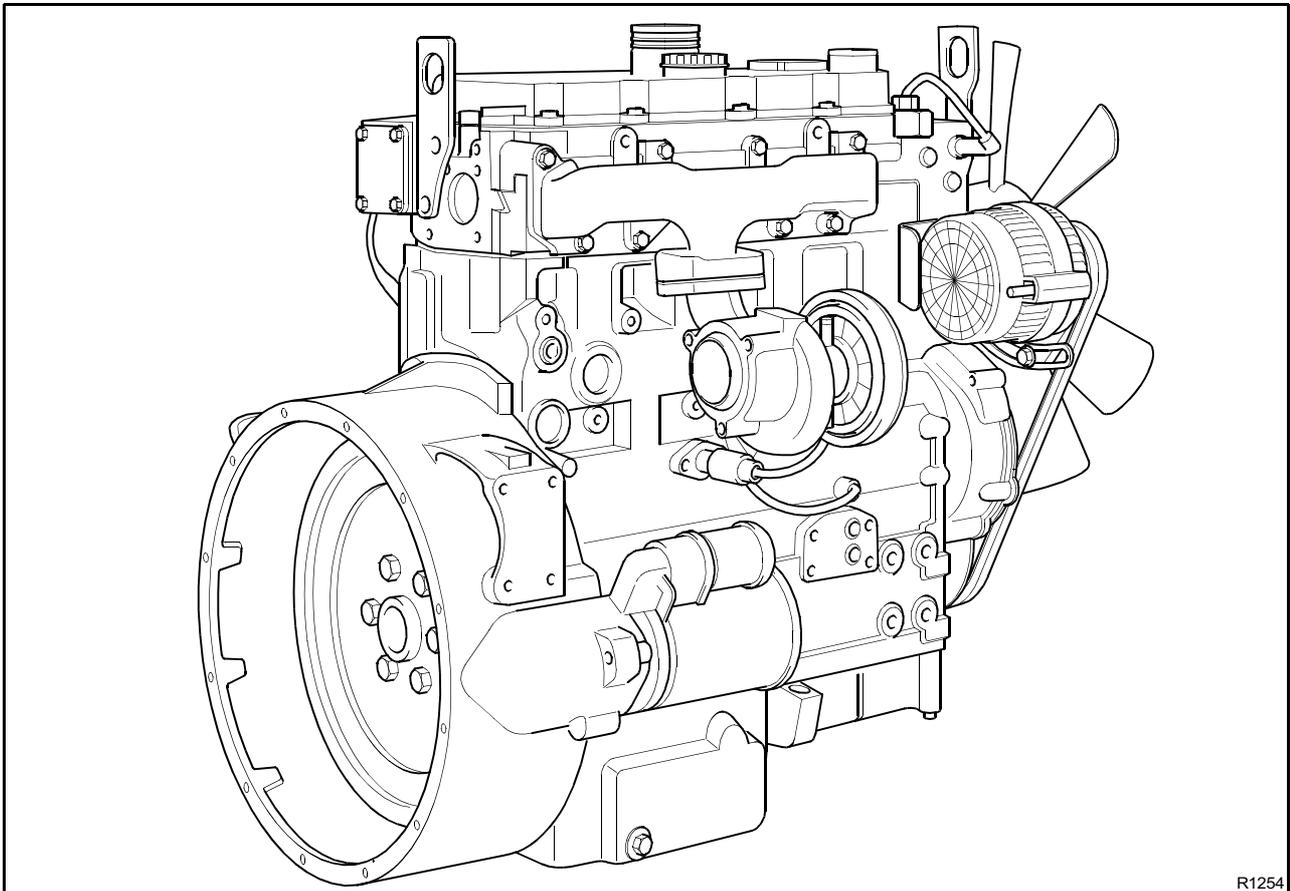
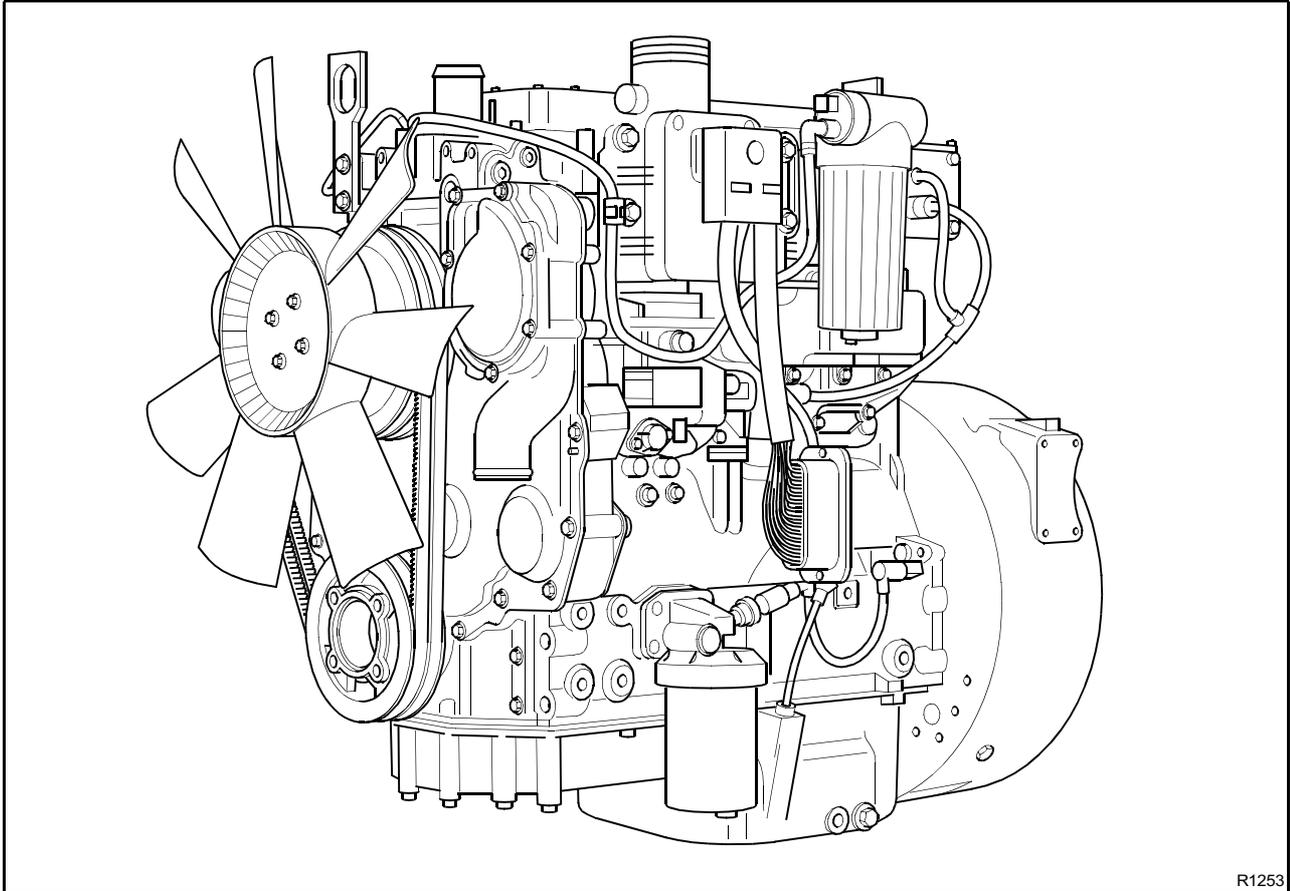
Danger is indicated in the text by two methods:

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.

Engine views



Engine identification

The Perkins 1100 Series 4 cylinder engines have been designed for industrial, construction and agricultural applications. There are a range of four cylinder engines with or without electronics, available in naturally aspirated, turbocharged and air to air charge cooled models.

In this Workshop Manual, the different models are indicated by their code letters. The first two letters of the engine number are indicated below:

RE	Naturally aspirated
RF	Naturally aspirated, electronic
RG	Turbocharged
RH	Turbocharged, electronic
RJ	Turbocharged, charge cooled
RK	Turbocharged, charge cooled, electronic

Continued

The Perkins 1100 Series 4 cylinder engines have been designed for agricultural, industrial and construction applications.

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:

RE.....*U.....*

If you need parts, service or information for your engine, you must give the complete engine number to your Perkins Dealer/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 Dealer/Distributor.

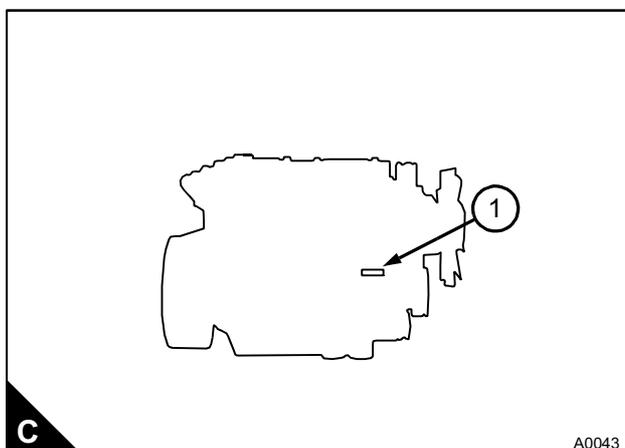
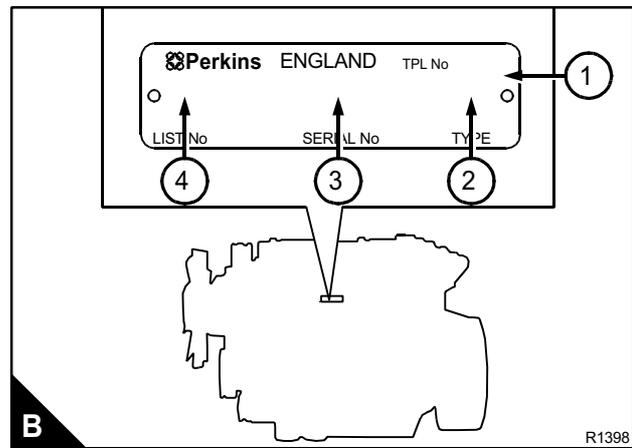
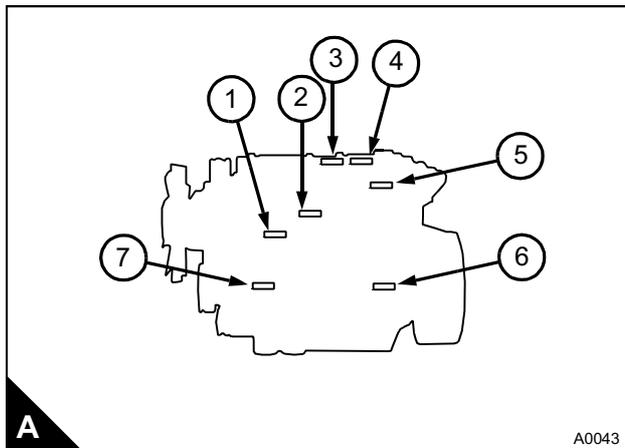
Other identification labels fitted to the engine include:

- A label (A1) with the fuel injection pump part numbers.
- An emissions legislation label (A3), (A6), (A7) and (C1) can be fitted in four different positions on the engine.
- A "Ether" warning label (A5) is fitted on the intake manifold.
- A "caution please read User's Handbook label" (A4) is screen printed into the atomiser cover.

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

The engine serial number plate (B) contains the following information:

- TPL number (1).
- Type (2).
- Serial number (3).
- List number (4).



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 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 operator's 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.
- 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 "Viton seals" on page 8 for safety precautions.
- 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.
- Read and use the instructions relevant to "Engine lift equipment" on page 7.

Continued

- 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

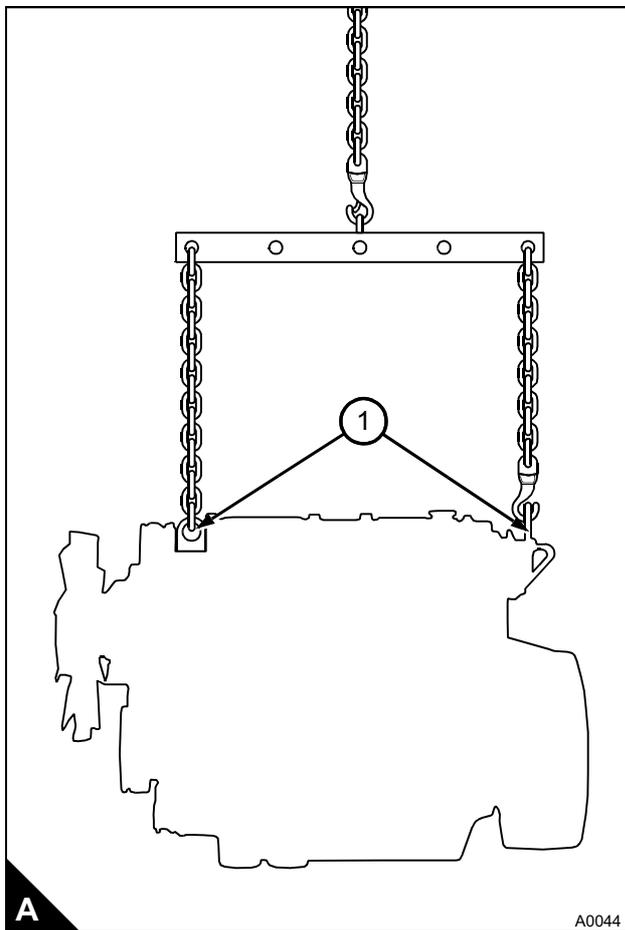
The maximum weight of the engine without coolant, lubricant, or a gearbox fitted will vary for different applications. It is recommended that lift equipment of the minimum capacity listed below is used:

Four cylinder engines	600 kg (1320 lbs)
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Note: 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.

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.



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.

Safety cautions when an engine is cleaned

Care should be taken, when an engine is cleaned with a high pressure cleaning system.

Cautions:

- *Do not wash an engine while it runs or while it is hot. If cold cleaning fluids are applied to a hot engine, certain components on the engine could be damaged.*
- *Leave the engine to cool for at least one hour and disconnect the battery connections before cleaning.*
- *Do not wash any part of the fuel injection pump (FIP), cold start device, electrical shut off solenoid (ESOS) or electrical connectors.*
- *Ensure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system.*

If these cautions are ignored, the engine or certain components could be damaged, fail to operate and also make the manufacturer's warranty invalid.

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 Dealer/Distributor.

POWERPART Antifreeze

Protects the cooling system against frost and corrosion. Part number 21825166.

POWERPART Atomiser thread sealant

To seal the threads of the atomiser into the cylinder head. Part number 21825474.

POWERPART Easy Flush

Cleans the cooling system. Part number 21825001.

POWERPART Gasket and flange sealant

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

POWERPART Gasket remover

An aerosol for the removal of sealants and adhesives. Part number 21820116.

POWERPART Griptite

To improve the grip of worn tools and fasteners. Part number 21820129.

POWERPART Hydraulic threadseal

To retain and seal pipe connections with fine threads. Especially suitable for hydraulic and pneumatic systems. Part number 21820121.

POWERPART Industrial grade super glue

Instant adhesive designed for metals, plastics and rubbers. Part number 21820125.

POWERPART Lay-Up 1

A diesel fuel additive for protection against corrosion. Part number 1772204.

POWERPART Lay-Up 2

Protects the inside of the engine and of other closed systems. Part number 1762811.

POWERPART Lay-Up 3

Protects outside metal parts. Part number 1734115.

POWERPART Metal repair putty

Designed for external repair of metal and plastic. Part number 21820126.

POWERPART Pipe sealant and sealant primer

To retain and seal pipe connections with coarse threads. Pressure systems can be used immediately. Part number 21820122.

Continued

POWERPART Radiator stop leak

For the repair of radiator leaks. Part number 21820127.

POWERPART Red rubber grease

Provides lubrication for the fitting of "O" rings. Part number 21820221.

POWERPART Retainer (high strength)

To retain components that have an interference fit. Part number 21820638.

POWERPART Retainer (oil tolerant)

To retain components that have an interference fit, but is in contact with oil. Part number 21820603.

POWERPART Safety cleaner

General cleaner in an aerosol container. Part number 21820128.

POWERPART Silicone adhesive

An RTV silicone adhesive for application where low pressure tests occur before the adhesive sets. Used for sealing flange where oil resistance is needed and movement of the joint occurs. Part number 21826038.

POWERPART Silicone RTV sealing and jointing compound

Silicone rubber sealant that prevents leakage through gaps. Part number 1861108.

POWERPART Stud and bearing lock

To provide a heavy duty seal to components that have a light interference fit. Part number 21820119 or 21820120.

POWERPART Threadlock and nutlock

To retain small fasteners where easy removal is necessary. Part number 21820117 or 21820118.

POWERPART Universal jointing compound

Universal jointing compound that seals joints. Part number 1861117.

2

Specifications

Basic engine data

Number of cylinders:

RE, RF, RG, RH, RJ, RK. 4

Cylinder arrangement.. In line

Cycle Four stroke

Direction of rotation Clockwise from the front

Induction system:

RE, RF. Naturally aspirated

RG, RH Turbocharged

RJ, RK. Turbocharged, charge cooled

Combustion system. Direct injection

Nominal bore:

RE, RF, RG, RH, RJ, RK. 105 mm (4.133 in)

Stroke 127 mm (5.00 in)

Compression ratio:

RE, RF. 19.3:1

RG, RH, RJ, RK... .. 18.2:1

Cubic capacity:

RE, RF, RG, RH, RJ, RK. 4,4 litres (268 in³)

Firing order:

RE, RF, RG, RH, RJ, RK. 1, 3, 4, 2

Valve tip clearances (cold):

Inlet.. 0,20 mm (0.008 in)

Exhaust 0,45 mm (0.018 in)

Lubricating oil pressure ⁽¹⁾

RE, RF, RG, RH, RJ, RK. 300 kpa (43 lbf/in²) 3,0 kgf/cm²

(1) Minimum at maximum engine speed and normal engine temperature.

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:

- Intake 30° (120° included angle)
- Exhaust 30° (120° included angle)

Leak test pressure 200 kPa (29 lbf/in²) 2,04 kgf/cm²

Head thickness 117,95/118,05 mm (4.643/4.647 in)

Rz and Rmaz to be measured to DIN EN ISO 4287

Surface finish of head face for cylinder head joint. Rz < 15um Rmax < 20um

Permissible wave depth:

Wt < 4um with a wave distance Wd < 2,0 mm

Wt < 6um with a wave distance Wd < 4,0 mm

Wt < 8um with a wave distance Wd < 6,0 mm

Wt < 10um with a wave distance Wd < 8,0 mm

Diameter of parent bore for valve guide:‘

- Intake... .. 13,000/13,027 mm (0.5118/0.5129 in)

- Exhaust 13,000/13,027 mm (0.5118/0.5128 in)

Minimum permissible thickness after head face has been machined 117,20 mm (4.614 in)

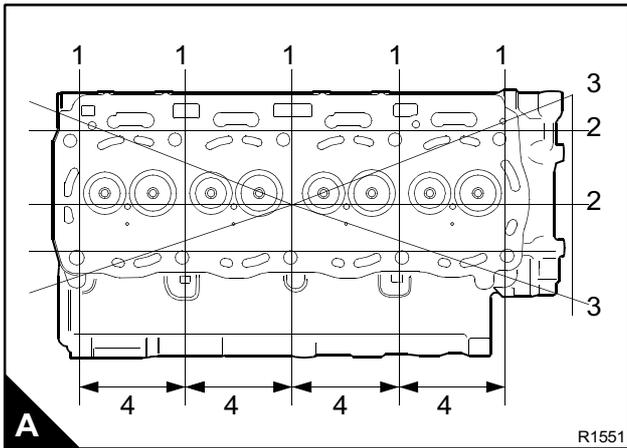
Maximum permissible distortion of cylinder head face

A1... .. 0,03 mm (0.0012 in)

A2... .. 0,05 mm (0.0019 in)

A3... .. 0,05 mm (0.0019 in)

A4... .. 0,03 mm (0.0012 in)



Intake and exhaust valves

Intake valves

Diameter of valve stem 8,953/8,975 mm (0.3525/0.3533 in)
 Clearance in valve guide 0,025/0,069 mm (0.001/0.0027 in)

Maximum permissible clearance in valve guide:

- Production limit.. 0,069 mm (0.0027 in)
 - Service limit... 0,13 mm (0.005 in)

Diameter of valve head 46,20/46,45 mm (1.819/1.829 in)

Angle of valve face 30°

Full length 128,92/129,37 mm (5.076/5.093 in)

Seal arrangement Stem seal with integral seating washer

Depth of valve head below the face of cylinder head:

- Production limits, RE and RF. 0,58/0,84 mm (0.023/0.033 in)

- Service limit, RE and RF 1,09 mm (0.043 in)

- Production limits, RG, RH, RJ, RK.. 1,58/1,84 mm (0.062/0.072 in)

- Service limit, RG, RH, RJ, RK 2,09 mm (0.082 in)

Exhaust valves

Diameter of valve stem 8,938/8,960 mm (0.3519/0.3528 in)

Clearance in valve guide 0,040/0,84 mm (0.0016/0.033 in)

Maximum permissible clearance in valve guide:

- Production limits 0,084 mm (0.003 in)

- Service limit... 0,15 mm (0.006 in)

Diameter of valve head 41,51/41,75 mm (1.634/1.644 in)

Angle of valve face 30°

Full length 128,92/129,37 mm (5.075/5.093 in)

Seal arrangement Stem seal with integral seating washer

Depth of valve head below face of cylinder head:

- Production limits, RE and RF 0,53/0,81 mm (0.021/0.032 in)

- Service limit, RE and RF 1,06 mm (0.042 in)

- Production limits, RG, RH, RJ, RK 1,53/1,81 mm (0.060/0.071 in)

- Service limit, RG, RH, RJ, RK 2,06 mm (0.081 in)

Dimensions of recesses for valve seat inserts

Models RE and RF

Intake

A1.....	9,910/10,040 mm (0.3902/0.3953 in)
A2.....	47,820/47,845 mm (1.8827/1.8837 in)
A3.....	Radius 0,38 mm (0.015 in) maximum

Exhaust

A1.....	9,910/10,040 mm (0.3901/0.3952 in)
A2.....	42,420/42,445 mm (1.6701/1.6711 in)
A3.....	Radius 0,38 mm (0.015 in) maximum

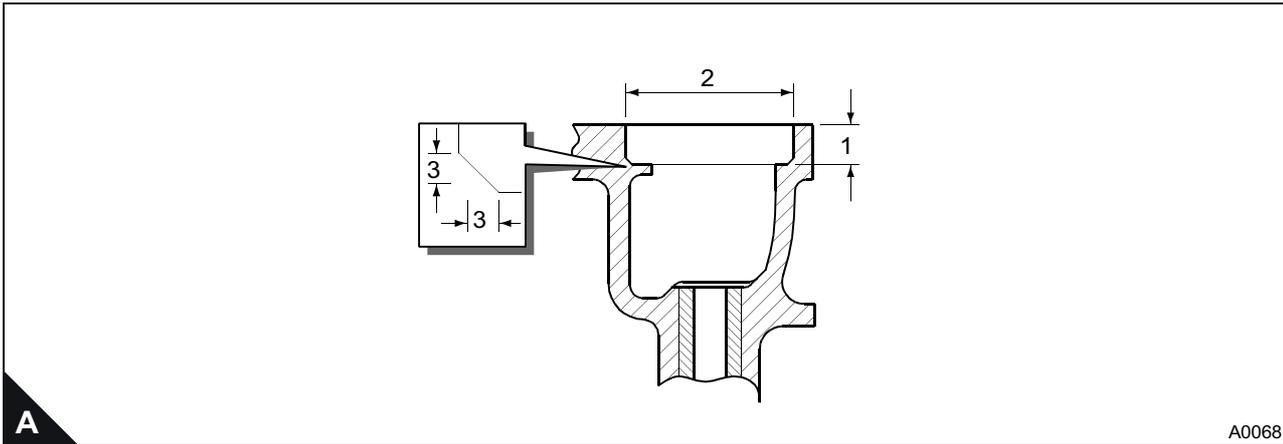
Models RG, RH, RJ and RK

Intake

A1.....	10,910/11,040 mm (0.4295/0.4346 in)
A2.....	47,820/47,845 mm (1.8827/1.8837 in)
A3.....	Radius 0,38 mm (0.015 in) maximum

Exhaust

A1.....	10,910/11,040 mm (0.4295/0.4346 in)
A2.....	42,420/42,445 mm (1.6701/1.6711 in)
A3.....	Radius 0,38 mm (0.015 in) maximum



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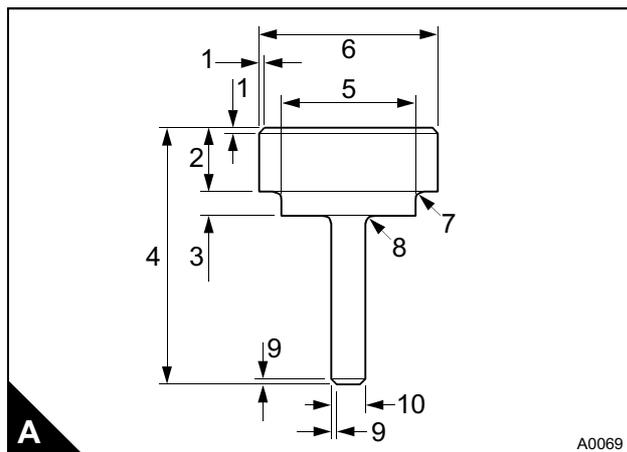
Valve seat insert tool

Intake

A1	1,5 mm (0.06 in)
A2	20 mm (0.800 in)
A3	6,8/7,1 mm (0.267/0.279 in)
A4	.....	100 mm (3.94 in)
A5	.....	38,10/38,30 mm (1.500/1.507 in)
A6	.....	46,25/46,50 mm (1.820/1.830 in)
A7	.....	Radius 1,4 mm (0.055 in) maximum
A8	.....	Radius 1,5 mm (0.06 in)
A9	.....	1,5 mm (0.06 in)
A10	.....	8,77/8,80 mm (0.345/0.346 in)

Exhaust

A1	.....	1,5 mm (0.06 in)
A2	.....	20 mm (0.800 in)
A3	.....	7,2/7,5 mm (0.283/0.295 in)
A4	.....	100 mm (3.94 in)
A5	.....	34,38/34,58 mm (1.353/1.361 in)
A6	.....	41,75/42,00 mm (1.643/1.653 in)
A7	.....	Radius 1,4 mm (0.055 in) maximum
A8	.....	Radius 1,5 mm (0.06 in)
A9	.....	1,5 mm (0.06 in)
A10	.....	8,77/8,80 mm (0.345/0.346 in)



Valve guides and valve springs

Valve guides

Inside diameter of partially finished guide	8,250/8,350 mm (0.3248/0.3287 in)
Inside diameter of finished guide	9,000/9,022 mm (0.3543/0.3552 in)
Outside diameter:	
- Intake	13,034/13,047 mm (0.5131/0.5137 in)
- Exhaust	13,034/13,047 mm (0.5131/0.5137 in)
Interference fit of valve guide in cylinder head	0,007/0,047 mm (0.0003/0.0019 in)
Full length	51,00/51,50 mm (2.008/2.028 in)
Protrusion from bottom of recess for valve spring	12,35/12,65 mm (0.486/0.498 in)

Valve springs

Fitted length:

Models, RE and RF	33,5 mm (1.319 in)
Models RG, RH, RJ and RK	34,5 mm (1.358 in)

Load at fitted length:

Models, RE and RF	254 N (57 lbf) 26,0 kgf
Models RG, RH, RJ and RK	229 N (51 lbf) 23,0 kgf
Number of active coils	3.8
Number of damper coils	0
Direction of coils	Right hand

Tappets, rocker shaft, rocker levers

Tappets

Diameter of tappet stem	18,987/19,012 mm (0.7480/0.7485 in)
Diameter of tappet bore in cylinder block	19,050/19,082 mm (0.7500/0.7513 in)
Clearance of tappet in cylinder block	0,038/0,095 mm (0.0015/0.0037 in)

Rocker shaft

Outside diameter	24,962/24,987 mm (0.9828/0.9837 in)
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Rocker levers and bushes

Diameter of parent bore for rocker lever	25,013/25,051 mm (0.9848/0.9863 in)
Clearance between rocker lever bore and rocker shaft	0,026/0,89 mm (0.0010/0.0035 in)
Maximum permissible clearance between rocker lever bore and rocker shaft	0,17 mm (0.007 in)

Pistons and piston cooling jets

Pistons

Type. "Fastram" combustion bowl, re-entrant angle 80° (turbocharged), 70° (naturally aspirated)

Diameter of bore for gudgeon pin 39,703/39,709 mm (1.5631/1.5633 in)

Height of piston above top face of cylinder block 0,21/0,35 mm (0.008/0.0137 in)

Width of groove for top ring:

- Engine types RE and RF... .. 2,58/2,60 mm (0.1015/0.1023 in)

- Engine types RG, RH, RJ, RK... .. Tapered

Width of groove for second ring... .. 2,54/2,56 mm (0.0999/0.1007 in)

Width of groove for third ring 3,52/3,54 mm (0.1385/0.1393 in)

Piston cooling jets

Valve open pressure 150/250 kPa (22/36 lbf/in²) 1,5/2,5 kgf/cm²

Piston rings

Top compression ring:

- Engine types, RE and RF.. .. Barrel face, molybdenum insert, rectangular

- Engine types RG, RH, RJ, RK... .. Barrel face, molybdenum insert, keystone

Second compression ring Taper face, cast iron, internal bottom chamfer

Oil scraper ring Two piece coil spring loaded, chromium faced

Width of top ring:

- Engine types, RE and RF... .. 2,47/2,49 mm (0.097/0.098 in)

- Engine types RG, RH, RJ, RK... .. Tapered

Width of second ring 2,47/2,49 mm (0.097/0.098 in)

Width of third ring 3,47/3,49 mm (0.1366/0.1374 in)

Clearance of top ring in groove:

- Engine types, RE and RF... .. 0,09/0,13 mm (0.0035/0.0051 in)

- Engine types RG, RH, RJ, RK... .. Wedge

Clearance of second ring in groove. 0,05/0,09 mm (0.002/0.003 in)

Clearance of third ring in groove 0,03/0,07 mm (0.0011/0.0027 in)

Gap of top ring. 0,30/0,55 mm (0.0118/0.0216 in)

Gap of second ring 0,70/0,95 mm (0.0275/0.0374 in)

Gap of third ring... .. 0,30/0,55 mm (0.0118/0.0216 in)

Connecting rods and big end bearings

Connecting rods

Type	'H' shape section, wedge shape small end
Location of cap to connecting rod	Fracture split
Diameter of parent bore for big end	67,21/67,22 mm (2.6460/2.6465 in)
Diameter of parent bore for small end	43,01/43,03 mm (1.693/1.694 in)
Length grades	F, G, H, J, K, L
Length between centres (parent bores)	219,05/219,10 mm (8.624/8.626 in)

Big end bearings

Type:

- Naturally aspirated engines	8 x Steel back, tin/aluminium bearing material
- Turbocharged engines bearing cap	4 x Steel back, tin/aluminium bearing material
- Turbocharged engines bearing rod	4 x Steel back, leaded bronze bearing material
Width	31,55/31,88 mm (1.240/1.255 in)
Thickness at centre of bearings	1,835/1,842 mm (0.0723/0.0725 in)
Bearing clearance	0,030/0,081 mm (0.0012/0.0032 in)
Available undersize bearings	0,25 mm (-0.010 in); -0,50 mm (-0.020 in); -0,75 mm (-0.030 in)

Gudgeon pins and small end bushes

Gudgeon pins

Production:

Type	Fully floating
Outside diameter	39,694/39,700 mm (1.5628/1.5630 in)
Clearance fit in piston boss	0,003/0,015 mm (0.0001/ 0.0006 in)

Small end bushes

Type	Steel back, lead bronze
Outside diameter	43,66/43,84 mm (1.7190/1.7259 in)
Inside diameter	39,723/39,738 mm (1.5638/1.5645 in)
Surface finish grade	Ra 0,8 micrometers
Clearance between bush in small end and gudgeon pin	0,023/0,044 mm (0.0009/0.0017 in)