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# Perkins 3000 Series

## WORKSHOP MANUAL

**3012/CV12**

12 cylinder diesel engines for industrial applications

The contents of this manual are applicable to both CV12 and 3000 Series - 3012 engines.

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# Contents

## 10 General information

<b>Introduction</b> .....	13
<b>Bank and cylinder bore identification</b> .....	13
<b>Engine identification</b> .....	13
<b>General safety precautions</b> .....	14
<b>Safety</b> .....	15
<b>Useful information</b> .....	16
<b>Approved lubricants and fluids</b> .....	21

## 11 Specifications

<b>Basic engine data</b> .....	23
<b>Recommended specific applied torques</b> .....	26
<b>Recommended nominal applied torques</b> .....	28

## 12 Cylinder head assembly

<b>General description</b> .....	29
<b>Pedestal rocker cover</b>	
12-1 To remove and to fit .....	31

---

## **Pedestal rocker assembly**

12-2 To remove and to fit ... ..	32
12-3 To dismantle and to assemble ... ..	33

## **Rocker box cover**

12-4 To remove and to fit ... ..	34
----------------------------------	----

## **Rocker box**

12-5 To remove and to fit ... ..	34
12-6 To dismantle and to assemble ... ..	35
12-7 To inspect and to correct ... ..	36

## **Tappet clearances**

12-8 To check and to adjust ... ..	38
------------------------------------	----

## **Cylinder head assembly**

12-9 To remove and to fit ... ..	40
12-10 To dismantle and to assemble . . . . .	44
12-11 To clean and to inspect the cylinder head ... ..	45
12-12 To correct a valve seat ... ..	46
12-13 To remove a valve seat insert ... ..	47
12-14 To fit a valve seat insert ... ..	48
12-15 To inspect the valve guides . . . . .	49
12-16 To renew a valve guide ... ..	50
12-17 To inspect the bridge pieces and guides . . . . .	51
12-18 To renew a bridge piece guide ... ..	51
12-19 To recondition a fuel injector sleeve ... ..	52
12-20 To renew a fuel injector sleeve ... ..	53

## **Valves, valve springs and valve rotators**

12-21 To remove and to fit . . . . .	57
12-22 To inspect and to correct . . . . .	57

## **Push rods**

12-23 To remove and to fit . . . . .	58
12-24 To inspect ... ..	58

## **Fits and clearances - Cylinder heads, rocker assemblies and valves . . . . . 59**

## **Cylinder heads, rocker assemblies and valves (continued) . . . . . 60**

---

## 13 Pistons and connecting rods

<b>General description</b> .....	61
<b>Big end bearings</b>	
13-1 To remove and to fit .....	63
13-2 To inspect .....	64
<b>Piston and connecting rod assembly</b>	
13-3 To remove and to fit .....	65
13-4 To dismantle and to assemble .....	68
<b>Piston rings</b>	
13-5 To remove and to fit .....	70
<b>Piston and rings</b>	
13-6 To inspect .....	71
<b>Connecting rod</b>	
13-7 To inspect .....	71
<b>Fits and clearances - Pistons and connecting rods</b>	
<b>Pistons - 4 rings</b> .....	72
<b>Piston rings</b> .....	72
<b>Pistons - 3 rings</b> .....	74
<b>Piston rings</b> .....	74
<b>Connecting rods</b> .....	76

## 14 Crankshaft assembly

<b>General description</b> .....	77
<b>Crankshaft pulley, damper and alternator pulley</b>	
14-1 To remove and to fit .....	78
<b>Front oil seal</b>	
14-2 To renew .....	79
<b>Rear oil seal</b>	
14-3 To renew .....	81

---

## **Crankshaft**

14-4 To remove and to fit .....	83
14-5 To dismantle and to assemble .....	88
14-6 To clean and inspect .....	88

## **Main bearings and thrust washers**

14-7 To inspect .....	88
-----------------------	----

<b>Fits and clearances</b> .....	89
----------------------------------	----

## **15 Timing gears and timing case**

<b>General description</b> .....	91
----------------------------------	----

### **Timing gears and auxiliary drive shaft**

15-1 To remove and to fit .....	92
15-2 To clean and to inspect .....	98

### **Double idler gear**

15-3 To dismantle and to assemble .....	98
---	----

### **Auxiliary drive gear**

15-4 To dismantle and to assemble .....	98
---	----

### **Timing case**

15-5 To remove and to fit .....	99
15-6 To clean and to inspect .....	100

<b>Fits and clearances</b> .....	101
----------------------------------	-----

## **16 Crankcase and cylinder liners**

<b>General description</b> .....	105
----------------------------------	-----

### **Crankcase**

16-1 To fit to and to remove from a build stand .....	107
16-2 To dismantle and to assemble .....	110
16-3 To clean, to inspect and to correct .....	114
16-4 To test under pressure .....	115

### **Cylinder liner**

16-5 To clean and inspect .....	115
---------------------------------	-----

<b>Fits and clearances</b> .....	116
----------------------------------	-----

---

## 17 Camshafts and engine timing

**General description** ..... 119

### Camshafts

17-1 To remove and to fit ..... 121

17-2 To clean and inspect ..... 125

### Engine timing

17-3 To check the valve timing ..... 126

17-4 To check/adjust the timing of the fuel injection pump ..... 127

**Fits and clearances** ..... 128

## 18 Induction and exhaust system

**General description** ..... 129

### Turbocharger

18-1 To remove and to fit ..... 129

18-2 To dismantle and to assemble ..... 131

18-3 To clean and to inspect ..... 134

### Exhaust manifold

18-4 To remove and to fit ..... 135

### Induction manifold

18-5 To remove and to fit ..... 135

**Fits and clearances** ..... 136

## 19 Lubrication system

**General description** ..... 137

### Lubricating oil sump - early engines

19-1 To remove and to fit ..... 139

19-2 To clean and inspect ..... 139

### Sump adaptor - early engines

19-3 To remove and to fit ..... 139

19-4 To clean and inspect ..... 140

---

## Single piece lubricating oil sump

19-5 To remove and to fit	140
19-6 To clean and inspect	141

## Lubricating oil pump

19-7 To remove and to fit	142
19-8 To dismantle and to assemble	143
19-9 To clean and inspect	144

## Heat exchanger (oil to coolant) - early engines

19-10 To remove and to fit	145
19-11 To dismantle and to assemble	146
19-12 To clean and to inspect	146

## Mounting adaptor for the heat exchanger - early engines

19-13 To remove and to fit	147
----------------------------	-----

## Heat exchanger (oil to coolant)

19-14 To remove and to fit	148
19-15 To dismantle and to assemble	149
19-16 To clean and to inspect	150

## Relief valve

19-17 To remove and to fit	151
----------------------------	-----

# 20 Fuel system

General description	153
---------------------	-----

## Primary fuel filter

20-1 How to clean the primary fuel filter	156
---	-----

## Fuel filter canisters

20-2 How to renew the canisters of the main fuel filter	156
---	-----

## Fuel filter head

20-3 To remove and to fit	157
---------------------------	-----

## Mechanical fuel lift pump

20-4 To remove and to fit	158
20-5 To dismantle and to assemble	159
20-6 To test	160

---

## Fuel injectors

20-7 To remove and to fit .....	161
20-8 To dismantle and to assemble .....	162
20-9 To clean and to inspect .....	163
20-10 To set and to test .....	165

## Fuel injection pump and governor

20-11 To remove and to fit .....	166
20-12 To dismantle and to assemble .....	171
20-13 To inspect .....	187
20-14 To calibrate the fuel injection pump .....	189
20-15 To test the fuel injection pump .....	190

## Sizes of spacers (A) available for the tappets .....

192

## Sizes of lower spring plates (A) available .....

193

## Fuel system

20-16 How to eliminate air from the fuel system .....	194
---	-----

# 21 Cooling system

## General description .....

195

## Radiator

21-1 To remove and to fit .....	197
21-2 To clean and to inspect .....	197

## Thermostats

21-3 To remove and to fit .....	198
21-4 To clean and to inspect .....	198

## Coolant pump

21-5 To remove and to fit .....	199
21-6 To dismantle and to assemble .....	200
21-7 To clean and to inspect .....	202

## Fan

21-8 To remove and to fit .....	203
---------------------------------	-----

## Fan belts and tensioner pulley

21-9 To remove and to fit .....	204
---------------------------------	-----



---

## Fan adaptor

21-10 To remove and to fit . . . . .	205
21-11 To dismantle and to assemble . . . . .	207
21-12 To clean and to inspect . . . . .	210

## 22 Flywheel and flywheel housing

<b>General description</b> . . . . .	211
--------------------------------------	-----

### Flywheel

22-1 To remove and to fit . . . . .	211
22-2 To inspect . . . . .	211

### Starter ring

22-3 To renew . . . . .	212
-------------------------	-----

### Flywheel housing

22-4 To remove and to fit . . . . .	212
-------------------------------------	-----

## 23 Electrical equipment

<b>General description</b> . . . . .	215
--------------------------------------	-----

### Alternator

23-1 To remove and to fit . . . . .	218
23-2 To dismantle and to assemble . . . . .	220
23-3 To clean . . . . .	221
23-4 To inspect and to correct the rotor . . . . .	221
23-5 To remove and to fit the rectifier . . . . .	222
23-6 To test the main diodes with an ohmmeter or a test lamp . . . . .	222
23-7 To test the auxiliary diodes . . . . .	223
23-8 To remove and to fit the D+ and F- wires . . . . .	223
23-9 To check and to renew the carbon brushes . . . . .	223
23-10 To inspect the stator and the housing . . . . .	223
23-11 To inspect the bearings . . . . .	224
23-12 To renew the bearing at the slip ring end . . . . .	224
23-13 To renew the bearing at the drive end . . . . .	224

---

## **Starter motor**

23-14 To remove and to fit .....	225
23-15 To dismantle and to assemble the solenoid switch .....	226
23-16 To dismantle and to assemble the starter motor .....	228
23-17 To clean .....	230
23-18 To inspect and to correct .....	230
23-19 To test .....	231
23-20 To fit the main starter cables .....	232

## **Electrical switches**

23-21 To test .....	233
---------------------	-----

## **Engine stop solenoid (energised to run)**

23-22 To adjust the linkage .....	234
-----------------------------------	-----

## **Early 3012 engines .....**

235

# 24 Auxiliary equipment

## **General description .....**

237

# 25 Running-in and test

## **General information .....**

239

## **Running-in and test**

25-1 To run the engine .....	239
25-2 To check the consumption rate of the engine lubricating oil .....	240

# 26 Special tools

## **List of special tools .....**

241

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# 10

## General information

### Introduction

This workshop manual has been designed to provide assistance in the service and the overhaul of Perkins 3012 (CV12) engines. Most of the general information, which is included in the User's Handbook (Sections 1 to 9), has not been repeated in this Workshop Manual and the two publications should be used together.

Read the 'Safety precautions' and remember them. They are given for your protection and must be applied 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.

### Bank and cylinder bore identification

The left and right sides of the engine are as seen from the rear (flywheel) end. Where reference is made to 'A' and 'B' banks of cylinders: 'A' bank is to the left and 'B' bank to the right when viewed from the front end.

The cylinders are numbered from the front of the crankcase, A1 to A6 and B1 to B6.

To ensure that you use the correct information for your specific engine type, refer to 'Engine identification' below.

### Engine identification

The engine number is stamped on the data plate which is fastened to the right side of the crankcase. For early engines, a typical engine number is 6A27487U 59426V, which consists of these codes:

6A	=	Engine family
27487	=	Engine number
U	=	Country of manufacture
59426	=	Build line number
V	=	Year of manufacture

Engines produced after August 1994, have a new engine number system. For these engines, a typical number is: SGD 12 0012 U 1572 Y, which consists of these codes:

SG	=	Engine application
D	=	Engine type
12	=	Number of engine cylinders
0012	=	Engine specification number
U	=	The country of manufacture
1572	=	Build line number
Y	=	Year of manufacture

Units such as the fuel injection pump and turbochargers have their own data plates.

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

## General safety precautions

### These safety precautions are important.

Reference must also be made to the local regulations in the country of operation.

- 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 caution 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 equipment is in operation.
- Do not permit loose clothing or long hair near moving parts.
- Keep away from moving parts during engine operation. **Warning!** *The fan 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 as dangerous hot coolant can be discharged.
- Fuel and oil pipes MUST be inspected for cracks or damage before they are fitted to the engine.
- 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.
- Be extremely careful if emergency repairs must be made in adverse conditions.
- If your skin comes into contact with high pressure fuel, obtain medical assistance immediately.
- Read and use the instructions relevant to lift equipment which are given on [page 15](#).
- Always use a safety cage to protect the operator when a component is to be pressure tested in a tank 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 a high speed and at high temperatures. Keep fingers, tools and other items away from the inlet and outlet ports of the turbocharger and prevent contact with hot surfaces.
- 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.
- 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.
- 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.
- Fit only genuine Perkins parts.

## Safety

### Engine lift equipment

Use only the lift equipment which is designed for the engine. The part number for the lift adaptor to use for the 3012 engine is: 21825 822.

Use lift equipment or obtain assistance to lift heavy engine components such as the cylinder block, cylinder head, flywheel housing, crankshaft and flywheel.

Check the engine lift brackets for security before the engine is lifted.

### Asbestos joints

Some joints and gaskets contain compressed asbestos fibres in a rubber compound or in a metal outer cover. The 'white' asbestos (Chrysotile) which is used is a safer type of asbestos and the danger of damage to health is extremely small.

Contact with asbestos particles normally occurs at joint edges or where a joint is damaged during removal, or where a joint is removed by an abrasive method.

To ensure that the risk is kept to a minimum, the procedures given below must be followed when an engine which has asbestos joints is dismantled or assembled.

- Work in an area with good ventilation.
- Do NOT smoke.
- Use a hand scraper to remove the joints - do NOT use a rotary wire brush.
- Ensure that the joint to be removed is wet with oil or water to contain any loose particles.
- Spray all asbestos debris with water and place it in a closed container which can be sealed for safe disposal.

### Environmental protection

There is legislation to protect the environment from the incorrect disposal of used lubricating oil. To ensure that the environment is protected, consult your Local Authority who can give advice.



### Viton seals

Some seals used in engines and in components fitted to engines are made from 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 a calcium hydroxide solution and then with clean water.
- Disposal of gloves and components 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 a calcium hydroxide solution for 15-60 minutes. Obtain immediate medical attention.

### To clean components

It is important that the work area is kept clean and that the components are protected from dirt and other debris. Ensure that dirt does not contaminate the fuel system.

Before a component is removed from the engine, clean around the component and ensure that all openings, disconnected hoses and pipes are sealed.

Remove, clean and inspect each component carefully. If it is usable, put it in a clean dry place until needed. Ball and roller bearings must be cleaned thoroughly and inspected. If the bearings are usable, they must be flushed in low viscosity oil and protected with clean paper until needed.

Before the components are assembled, ensure that the area is as free from dust and dirt as possible. Inspect each component immediately before it is fitted, wash all pipes and ports and pass dry compressed air through them before connections are made.

Use suitable gloves for protection when components are degreased or cleaned with trichloroethylene, white spirit, etc. Degreasing solutions which are basically trichloroethane are not recommended.

### Suitable fluids to clean and to protect components

**Warning!** Full information for the use of all the products listed below and for their safe disposal, and especially for the health and safety of the personnel who use them, will be found in the Manufacturer's data.

**Ardrox 667:** Ardrox Limited, Brentford, Middlesex.

**Maxan 774:** Henkel Chemicals Limited, Edgware Road, London.

These products are basically methylene chloride and are safe to use on most metals for the removal of carbon and to remove paint. They can damage rubber and most plastic materials.

#### Method of use

The components to be degreased must be lowered completely into the degreasing solution. Allow enough time to elapse for the components to be thoroughly cleaned. Subsequently, the components must be thoroughly flushed in clean water. In use, maintain a layer of water at least 76 mm (3 inches) deep above the cleaning fluid to ensure that vapour and toxic gases are not released.

**Warning!** Do NOT smoke near the container. Protection for the eyes and for the skin must be used always during the use of these fluids, and the container must be in a place with good ventilation.

**Duroclean 150 powder:** Diversey Limited, Northampton.

This product is basically an alkaline degreasing solution and is safe to use on brass, copper and ferrous metals. It must not be used on aluminium, lead, tin or zinc.

#### Method of use

It is recommended that Duroclean 150 is used with a maximum concentration of 50 grams for each litre of water. The components to be degreased must be lowered completely into the degreasing solution which is heated to 65°C.

Leave to soak until all contamination has been removed.

Subsequently, the components must be thoroughly flushed in clean water. If necessary, a suitable corrosion inhibitor can be added to the last quantity of water.

**Warning!** Protection for the eyes and for the skin must be used always during the use of this product.

**Crodafluid CR2:** Croda Chemicals Limited, Goole, Yorkshire.

This product is basically an acid solution with a corrosion inhibitor. It is used to remove corrosion from components that are made of ferrous metals.

#### Method of use

Crodafluid CR2 must be contained in a tank that is made from a material which is not affected by acid. Before the process begins, the components must be degreased before they are lowered completely into the Crodafluid solution. For medium to heavy deposits of corrosion, the solution can be heated to 70°C. Inspect the components now and then to check the results of the process. Surface corrosion can be removed in a short period of time. The last operation is to wash thoroughly the components in clean water.

**Warning!** Protection for the eyes and for the skin must be used always during the use of this product.

**Diverspray 30:** Diversey Limited, Northampton.

This product is a moderate and basically alkaline compound with corrosion inhibitors. It is either sprayed over the components to clean them, or is contained in a tank, for the immersion and agitation of the components.

Diverspray 30 may be added to water to wash components if a corrosion inhibitor is necessary. It is used after other processes, such as corrosion removal, are finished.

# 10

**NALCO 2568 Powder:** NALCO Limited, PO Box 11, Winnington Avenue, Northwich CW8 4DX

This product (which is supplied only in quantities of 25 kg) is an inhibited sulphamic acid and can be used for the removal of hard deposits from the tube stack of the oil cooler.

**Warning!** *The solution must be made and used in accordance with the manufacturer's instructions.*

The NALCO 2568 powder should be mixed with clean fresh water in the ratio which follows:

15 - 40 kg/Tonne of water

(15 - 40 lb/100 UK gallons of water)

When the action of the solution is finished, dip the tube stack in a solution made from: 0,5 kg (1 lb) of sodium carbonate to 25 litres (5 UK gallons) of hot water. The final operation is to dry the inside of the tubes with compressed air.

## **Oil seals**

Apply petroleum jelly to oil seals before they are fitted, and do not damage the lip of the seal on sharp edges. Unless other specifications apply, fit the seal with the edge of the lip toward the bearing.

## **Hose connections**

Do not use a screwdriver to remove hoses by force because adaptors or pipe connections can be damaged. Cut through the hose and then cut the ends of the hose from the adaptor or pipe connection.

When a new hose is fitted, a suitable rubber lubricant can be used instead of antifreeze, water or french chalk. Never lubricate a hose with oil or grease.

## **Gaskets, joints and 'O' rings**

Discard all used items if an engine or a component is dismantled and fit only new and correct parts.

If a jointing compound is needed, 'Hylomar PL 32' jointing compound is recommended for use, but on metal joints ONLY. Only a thin application is needed, an excessive quantity of compound can restrict the flow of fluids in pipes and passages.

**Caution:** *'Hylomar' jointing compound must NOT be used in contact with any fibre joints as the solvent contained in 'Hylomar' can damage the joint material.*

Apply a small amount of a suitable lubricant to 'O' ring seals to prevent damage during assembly.



## Locking devices

Split pins, lock plates and tab washers which have been used must be discarded. Various methods to retain securely the nuts of an engine are shown (A). Stiffnuts can be used again only if they have not lost their grip and the original torque is needed to turn them.

There must be a minimum protrusion of one full thread of the bolt or stud through the stiffnut when it is tightened fully. Discard all stiffnuts which have nylon or fibre inserts.

## Application of thread locking compounds

Remove all oil, grease and dirt from engine parts before thread locking compounds are applied to them. Most thread locking compounds have a date by which they must be used, ensure that the compounds used are within those dates.

## Fits and clearances

The dimensions given in section 11C are acceptable limits. The components which have measurements within these limits are acceptable for a complete period of service.

Certain components which are worn by more than these limits can be corrected in accordance with a Service Reclamation Scheme (SRS). Information about the Service Reclamation Schemes is available from the Service Department at Perkins Engines (Shrewsbury) Limited.

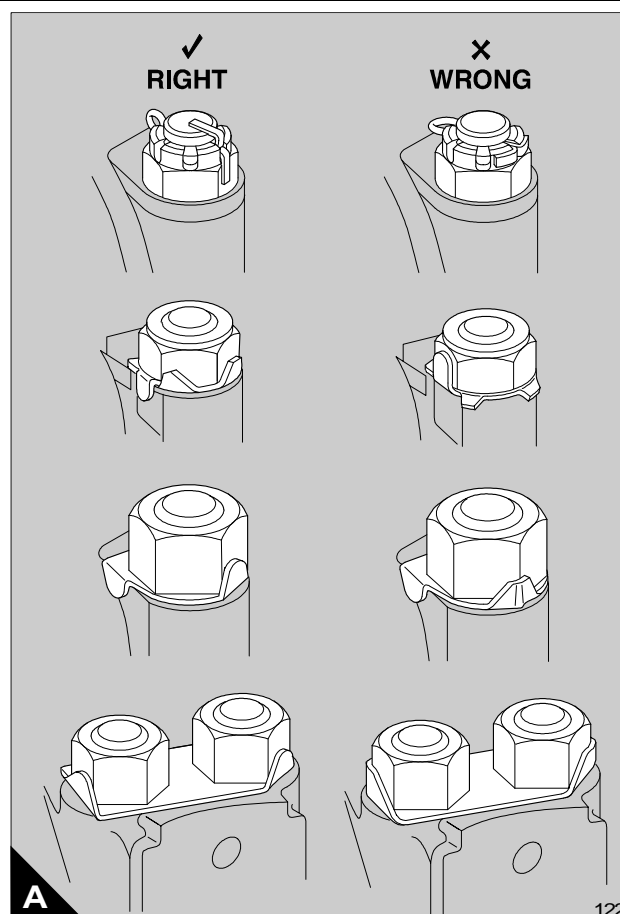
## Applied torques

The specifications for applied torques, which are given in section 11B, apply to some bolts and nuts where damage or failure can occur if they are incorrectly tightened. Where joints are fitted, for example, between the cylinder head and the crankcase, it is also important that bolts and nuts are tightened evenly and gradually as instructed in the assembly sequence. The torque wrenches, listed below, are suitable for the torque load requirements of the 3012/CV12 engine, and are available from Perkins Distributors.

8 to 54 Nm (6 to 40 lbf ft), 21825 846

30 to 150 Nm (20 to 110 lbf ft), 21825 991

70 to 310 Nm (50 to 230 lbf ft), 21825 992



## Checks for cracks

When possible, it is recommended that components which are affected by high stresses such as the crankshaft, the connecting rods, the gears and the cylinder liners are tested for cracks during overhaul. They should also be checked for cracks when they have been affected by an excessive load or impact. It is recommended that ferrous components are tested by the electro-magnetic method if possible. Portable electro-magnetic test equipment is available from Radalloyd Limited, Oadby, Leicester. Non-ferrous components can be tested by the use of a dye penetrant process such as 'Ardrox 996', available from Ardrox Limited, Brentford, Middlesex. The dye penetrant must conform to one of the standards listed below:

MIL-STD 271-E

MIL-L 25135

B.S. 5750

D.T.D. 929

## Exchange units

It is recommended that unserviceable units are returned, as complete as the new exchange unit, with covers fitted to all openings and the joint faces protected. When necessary, protect the unit, both inside and outside, from corrosion.

## Parts

To ensure maximum reliability, fit only genuine PERKINS parts supplied by a PERKINS distributor. These parts are made to the latest specification and have a guarantee for 12 months. The use of parts, such as filter elements, which do not conform to PERKINS standards, may reduce the life of the engine and can affect the warranty.

If you need parts, spares or information for your engine, give the complete engine number to your Perkins distributor. This will ensure that the correct parts can be obtained.

## Approved lubricants and fluids

Equivalent lubricants and fluids of other manufacturers are acceptable

	Product or specification	Manufacturer
<b>Alternator</b>		
Cleaning fluid for diodes	Fluid grade 8-23	Applied Chemicals Limited
Grease for diodes	Silicon MS200, MS4 and MS5	Applied Chemicals Limited
<b>Camshafts</b>		
Anti-seize compound	Rocol J166	Rocol Limited
Anti-scuffing paste	Rocol	
<b>Cooling system</b>		
Lips of oil seal in coolant pump	Shell Alvania R3 Grease	Shell Oils
Hose and 'O' rings	Liner lubricant	Morris's Shrewsbury
Compound for cleaning the system	Lissapol 'N', 1% (10 cc/ltr - 45 cc/lmp. gallon)	I.C.I Limited
	Lissapol 'NDB', 2% (20 cc/ltr - 90 cc/lmp. gallon)	
To remove hard deposits from the oil cooler	NALCO 2568 powder (in 25 kg drums only)	NALCO Limited
<b>Exhaust system</b>		
Anti-seize compound for threads	Copaslip Rocol J166	Slip Group Rocol Limited
<b>Joints</b>		
Jointing compound	Hylomar Silicone Sealant	Marston Bentley Limited Adhesive and Sealants Division, Wigan
Sealant and thread locking	Loctite AVV, 241, 270, 290, 542 and 601	Douglas Kane Sealants Morris's Shrewsbury Shell Oils Various
<b>Lubrication system</b>		
'O' rings and relevant bores	Liner lubricant	Morris's Shrewsbury
<b>Starter motor</b>		
Cleaning fluid for commutators	White spirit	
Lubricant for splines	Aeroshell DID5598	Shells Oils
'O' ring lubricant	Glycerine	
Lubricator wick	Mineral oil SAE 5W/20	Various

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# 11

## Specifications

### Basic engine data

#### Engine

<b>Number of cylinders</b> .....	12
<b>Cylinder arrangement</b> .....	60 degree included angle 'V'
<b>Cycle</b> .....	Four stroke
<b>Induction system</b> .....	Turbocharged and charge cooled
<b>Combustion system</b> .....	Direct injection
<b>Nominal bore</b> .....	135 mm (5.315 in)
<b>Stroke</b> .....	152 mm (5.984 in)
<b>Compression ratio</b> .....	26,11 litres (1593.24 in <sup>3</sup> )
<b>Cubic capacity</b> .....	14.5:1
<b>Firing order</b> .....	A6, B1, A3, B4, A5, B2, A1, B6, A4, B3, A2, B5
<b>Tappet clearances (hot or cold)</b> .....	
Engines before 'build line number' 8281 (6C27437/29):	
Inlet valves .....	0,4 mm (0.016 in)
Exhaust valves .....	0,5 mm (0.020 in)
Engines from 'build line number' 8281 (6C27437/29):	
Inlet valves .....	0,2 mm (0.008 in)
Exhaust valves .....	0,5 mm (0.020 in)
<b>Direction of rotation</b> .....	Anti-clockwise from the rear of the engine
<b>Injection timing</b> .....	As stamped on engine data plate
<b>Rated power output</b> .....	400 to 740 kW
<b>Maximum rated speed</b> .....	1800 rev/min
<b>Dry weight of engine</b> .....	2120 kg (4674 lb)
(Approximate)	
<b>Dry weight of electropak</b>	
(Approximate)	
3012 TG .....	2365 kg (5214 lb)
3012 TAG .....	2315 kg (5103 lb)

# 11

## Cooling system

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Type	Liquid cooled
Coolant pump	Centrifugal unit, gear-driven
<b>Capacities for coolant</b>	
Engine and pipes	68 litres (15 UK gallons)
Engine/radiator pack	122,7 litres (27 UK gallons)
Coolant system pressure	Up to 69 kN/m <sup>2</sup> (10 lbf/in <sup>2</sup> )
Temperature (normal)	70° to 100°C
Thermostats	Two, single element, wax capsule type
Cooling fan	1220 mm (48 in) diameter, 8 blades, belt driven
Approved coolant	See section 5 - 'Engine fluids' in the User's Handbook TSD 3138

## Fuel system

Type	Low-pressure supply to injection pump with return of spill fuel to the tank
Fuel injection pump	12 element in-line unit
Governor	Mechanical, servo assisted, integral with fuel injection pump, constant speed for operation of generators (for other applications, variations are fitted)
Fuel lift pump	Mechanical, operated by camshaft
Fuel supply pressure	140 to 210 kN/m <sup>2</sup> (20 to 30 lbf/in <sup>2</sup> )
Fuel injectors	Axial supply, low spring type, six spray holes
Injection pressure	250 bar (early engines 240 bar)
Main fuel filters	Two screw-on type canisters
Approved fuel	Centrifugal type
Approved fuel	See section 5 - 'Engine fluids' in the User's Handbook TSD 3138

## Lubrication system

**Type** ..... Wet sump

### Capacities

Sump maximum ..... 55 litres (12 UK gallons)

Sump minimum ..... 33 litres (7.3 UK gallons)

System total ..... 73.8 litres (16.2 UK gallons)

### Pressure

Normal load conditions ..... 448 kN/m<sup>2</sup> (65 lbf/in<sup>2</sup>)

Minimum at rated speed ..... 345 kN/m<sup>2</sup> (50 lbf/in<sup>2</sup>)

**Pump** ..... Spur gear type, gear driven

**Pressure relief valve** ..... Spring loaded plunger, not adjustable

Opening pressure ..... 488 kN/m<sup>2</sup> (71 lbf/in<sup>2</sup>)

**Oil-to-coolant heat exchanger** ..... Tube stack and body, with baffle plates

**Filters** ..... Three screw-on type canisters

### Maximum recommended temperature

of oil in sump ..... 125°C

**Approved lubricating oil** ..... See [section 5 - 'Engine fluids' in the User's Handbook TSD 3138](#)

## Induction and exhaust systems

**Aspiration** ..... Pressure charged by two turbochargers

**Air charge coolers** ..... Two, air to air type, integral with radiator

**Air filters** ..... Two, paper element type

## Electrical equipment

**Alternator** ..... 24 volt 40 ampere

**Starter motor** ..... 24 volt - flange fitted (certain engines have two starter motors)

**Stop control** ..... 24 volt, energised-to-run

**Engine protection switches** ..... 24 volt instrument sender/switches for oil pressure, coolant temperature and coolant level

# 11

## Recommended specific applied torques

**Caution:** The torque loads listed below apply to threads in an oil wet condition, unless the use of thread locking compound is recommended.

Application of a torque specification is NOT enough to ensure that the relevant components are retained securely as an assembly. It is important to conform also to the recommendations for assembly and, if given, the sequence in which the bolts or nuts must be tightened. This information is given in the relevant section of this publication.

If a bolt or nut is retained with a locking washer, lock plate or split pin, the specification for a torque load can be exceeded, if necessary, by the MINIMUM amount that is needed for correct assembly.

	Nm	lbf ft	
<b>Alternator</b>			
Nut, pulley	95	70	
<b>Auxiliary drive shaft</b>			
Nut, flange	(18 mm 27 A/F)	200	300
	(22 mm 32 A/F)	300	221
<b>Camshafts</b>			
	200 to 250	148 to 184	
Bolts, camshaft gear	'A' bank	217	160
	'B' bank		
Screws, countersunk head, thrust plate	24	18	
<b>Connecting rods</b>			
Nuts, big end bearing	60	44	
	(Caution - refer to <a href="#">operation 13-1</a> )		
<b>Crankcase</b>			
Bolts, main bearing cap			
Front, centre and rear	177	131	
Others	488	360	
Side bolts, main bearing cap			
Front, centre and rear	114	84	
Others	177	131	
Studs, cylinder head	315	232	
<b>Crankshaft</b>			
Bolts, damper and pulley	80	59	
Cap screws, flywheel	315	232	
<b>Cylinder heads</b>			
Bolts, cylinder head to crankcase			
Bolts in induction ports only	200	148	
All other long bolts	240	148	
	(plus a further 90°)		
Nuts, cylinder head to crankcase (earlier engines)	200	148	
	(plus a further 90°)		
Bolts, rocker box to cylinder head	46	34	
Cap screws, rocker box to cylinder head	35	26	
Bolts, rocker box cover to rocker box	23	17	
Lock nut, adjustment screw, bridge piece	40	30	

	Nm	lbf ft
Lock nut, adjustment screw, tappet	40	30
Bolt, location, rocker shaft	15	11
<b>Coolant Gallery</b>		
Bolts and nuts	23	17
<b>Coolant pump</b>		
Lock nut, bearing	100	74
Nut, drive gear	88	65
<b>Exhaust manifolds</b>		
Bolts	46	34
<b>Fan adaptor</b>		
Nuts, bearing	280	207
<b>Flywheel housing</b>		
Bolts, flywheel housing to timing case	80	59
Bolts, (2) flywheel housing to crankcase (later engines with steel crankcase/timing case joints)	95	70
<b>Fuel filter head</b>		
Bolts, bracket to crankcase		
<b>Fuel injection pump</b>		
Cap screws, adjustable coupling (earlier engines)	70	52
Special bolts, adjustable coupling (later engines)	46	34
Nut, hub, camshaft	149	110
Holders, delivery valve	122	90
Bolts, pump to mounting	46	34
Nuts, coupling, plate, spring	120	88
<b>Fuel injectors</b>		
Cap screws, clamp	60	80
Cap nut, nozzle	80	59
Connection, spill pipe, new type (directly onto fuel injector)	27	20
Connection, spill pipe, new type (directly onto fuel injector)	17	12
<b>Fuel lift pump (mechanical)</b>		
Nut, cam to auxiliary drive shaft	54	40
<b>High pressure fuel pipes</b>		
Nuts, high pressure fuel pipes	45	33
<b>Gears</b>		
Bolts, auxiliary drive gear	58	43
Bolts, compound idler gear	40	30
Bolts, axle, double idler gear	135	100
Bolts, axle, idler gear, main	135	100
Bolt, axle, idler gear, coolant pump	135	100
Bolt, axle, idler gear, oil pump	135	100
<b>Induction manifolds</b>		
Bolts, induction manifolds	46	34



	Nm	lbf ft
<b>Lubricating oil pump</b>		
Bolts, casing	23	17
Nut, drive gear	120	89
<b>Lubricating oil sump</b>		
Bolts	55	41
Insert, drain plug	325	240
Drain plug (sump with insert - early engines only)	115	85
Drain plug (single piece sump without insert)	47	35
<b>Timing case</b>		
Bolts, timing case to crankcase		
Bolts and nut (early engines)	95	70
Bolts and cap screws (later engines)	135	100
Bolts, timing case to sump		
Bolts (early engines)	55	40
Bolts (later engines with steel joints)	75	55

## Recommended nominal applied torques

Where instructions are not given for the correct torque to be applied to nuts and bolts, the figures which follow should be used.

Bolt size	Nm	lbf ft
M5	6	4.5
M6	9.5	7
M8	23	17
M10	46	34
M12	80	59
M14	127	94'
M16	198	146
M18	273	201
M20	387	285
M22	526	388
M24	669	493



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