PERKINS ENGINES (STAFFORD) ENGINE DESIGNATIONS 4000 SERIES AND SE SERIES EQUIVALENT TERMS	
4000 SERIES	**SE SERIES**
4012TWG	12SETCR
4012TWG2	12SETCR2
4012TAG	12SETCA
4012TAG1	12SETCA1
4012TAG2	12SETCA2
4012TEG	12SETCW
4012TEG2	12SETCW2
4016TWG	12SETCR
4016TWG2	16SETCR2
4016TAG	16SETCA
4016TAG1	16SETCA1
4016TAG2	16SETCA2
4016TEG	16SETCW
4016TEG2	16SETCW2

⚠ SAFETY PRECAUTIONS

For safe and reliable operation of the engine it is essential that the recommended procedures as outlined in the manual are adhered to, and where necessary the special tools are used. Improper operation or maintenance procedures are dangerous and could result in injury or death.

The operator should check before operation that all the basic safety precautions have been carried out to avoid an accident occurring.

Read and understand all safety precautions and warnings before operating or servicing the engine.

The safety precautions that must be adhered to when operating the engine or carrying out service work are listed below under separate headings together with the relative symbols:

Ensure guards are fitted 	(a) over exposed rotating parts (b) over exposed hot surfaces (c) over exposed air intakes (d) over exposed belts (e) over live electrical terminals, high and low tension
Ensure protection equipment: for hands, ears, eyes, feet etc.  (1) (2) (3) (5) (4)	(a) (1) is worn when using inhibitors (b) (1) is worn when using anti-freeze (c) (1) is worn when taking pressure cap off radiator or heat exchanger filler (d) (5) is worn when working on or underneath engine (e) (3) is worn when using air pressure line (f) (1) is worn when changing lubricating oil/filter (g) (2) is worn when working in enclosed engine room (h) (1) is worn when changing electrolyte in battery (j) (4) is worn always when working on the engine
No smoking or naked flame 	(a) when checking battery electrolyte (b) when working in engine room (c) when operating or servicing engine
Fuel/oil pipes 	(a) check for leaks (b) check for spilt oil (clean up) (c) always use barrier cream on hands
Gas/air pipes 	(a) check for gas/air mixture leaks (b) never run gas engine with failed pressure disc (c) that gas line and valves meet local safety standards (d) that the gas line pressure is correct
Shutdown equipment 	(a) for stopping engine in case of over speed, high water temperature or low oil pressure should be provided (b) for heat sensors, methane and smoke detectors should be provided (if applicable) (c) test that protection system is working correctly (d) Always be in a position to stop engine (even remotely)
Start up 	(a) disconnect battery or any other means in case of accidental start up when working on engine (b) never start engine with governor linkage disconnected (c) do not hold stop lever in run position when starting engine (d) always hold stop lever in stop position when cranking only
Electrical equipment 	(a) check that electrics are earthed to local safety standards (b) disconnect electrical supply to water jacket heater (if fitted) before working on engine (c) take care against electric shocks (d) Never re-adjust settings of electronic equipment without reference to Operation Manual

Freezing or heating component 	(a) Always wear heat resistant gloves and use correct handling equipment
Exhaust system 	(a) check for leaks (b) check for correct ventilation of engine room (c) check that guards are fitted (d) check that diesel exhaust is clear (e) check that pipework allows gas to escape upwards (f) check that pipework is supported
Stop the engine 	(a) before changing lubricating oil (b) before filling radiator or topping up with anti-freeze (c) before repairing engine (d) before adjusting belts (e) before adjusting tappets (f) before changing spark plugs/injectors (g) before changing air/oil/fuel filters (non change-over) (h) before tightening fixing bolts etc
Flammable fluids 	(a) never store near engine (b) never use near naked light
Clothing 	(a) do not wear loose clothing, ties, jewellery etc. (b) always wear steel toe cap shoes (c) always wear head, eye and ear protection (d) always wear overalls (e) always replace spillage contaminated overall immediately
Lifting heavy components 	(a) use correct lifting equipment (b) do not work alone (c) always wear helmet
Viton 'O' rings 	(a) always wear both hand and eye protection when handling 'O' rings which have been exposed to very high temperatures (eg a fire)
De-scaling solution 	(a) always wear both hand and eye protection whilst handling (b) always wear overalls and proper footwear
Handling/cutting gaskets and joints containing asbestos 	(a) always wear respiratory protection (b) always provide dust extract system (c) always dispose of waste in accordance with local/legislative requirement
Waste disposal 	(a) do not leave oily rags on or near the engine (b) do not leave loose items on or near the engine (c) provide fireproof container for oily rags

Most accidents are caused by failure to observe basic precautions, and can be avoided by recognising potentially dangerous situations before an accident occurs.

Stop and isolate the engine, and ensure it cannot be restarted whilst servicing the engine.

Improper operation of the engine is dangerous and could result in injury or death.

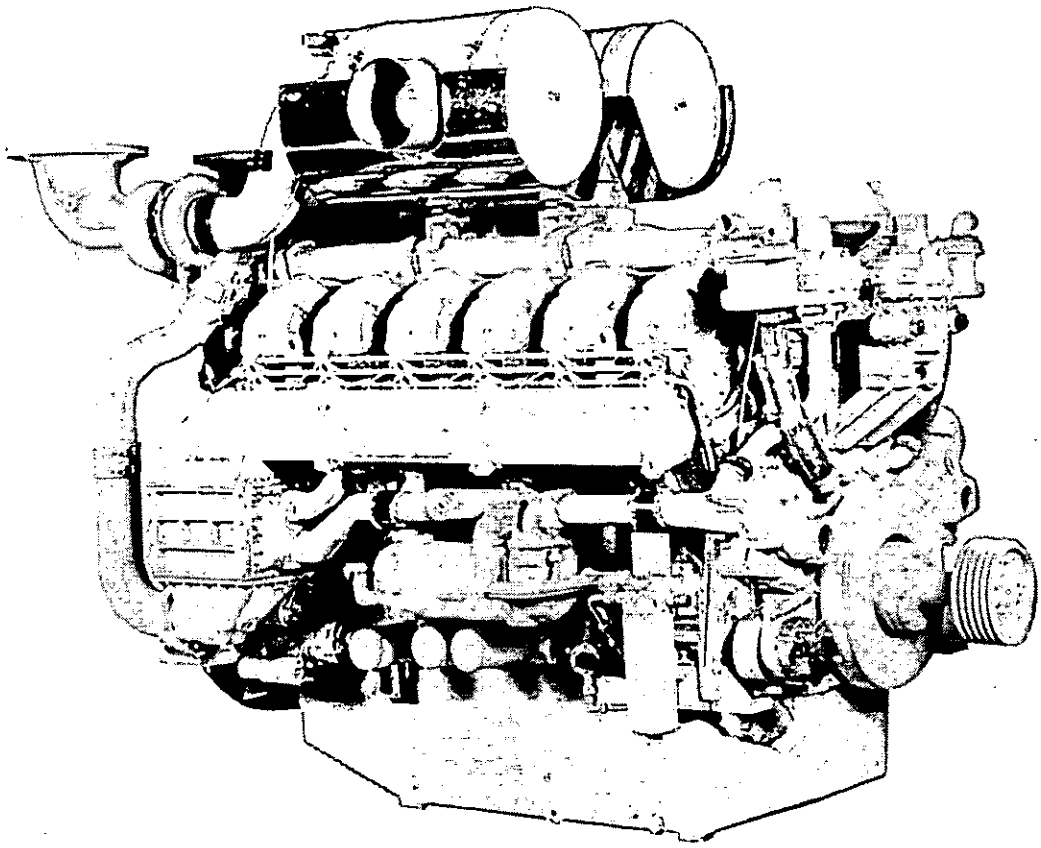
Warnings are outlined in the operation manual and on the engine and are identified by the following symbol.

WARNING USE APPROPRIATE SYMBOL

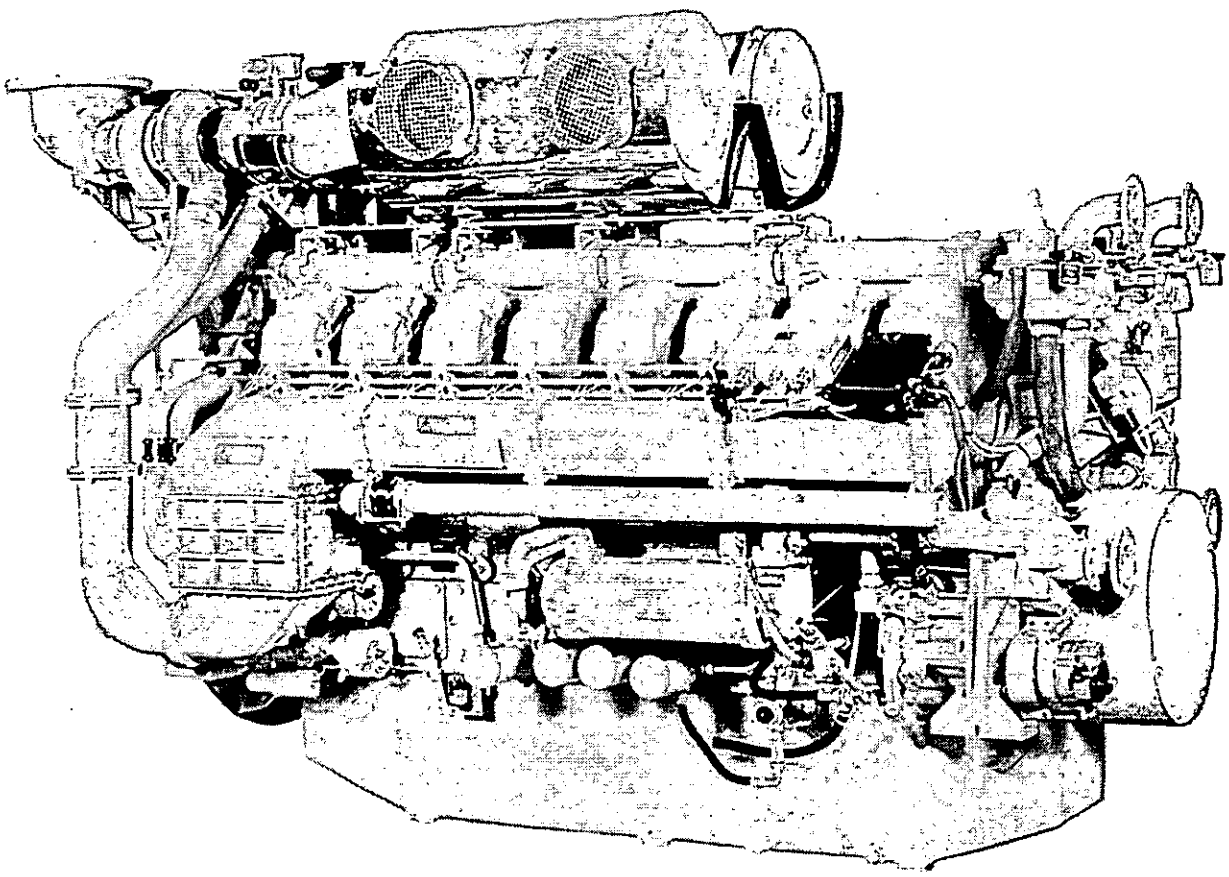
There are many potential hazards that can occur during operation of the engine which cannot always be anticipated. Therefore a warning cannot be included in the manual for every possible circumstance that might involve a potential hazard.

Should a procedure be used not specially recommended then you must satisfy yourself that it is safe and will not damage the engine.

KEY TO SYMBOLS THAT MAY BE FOUND IN THE MANUAL					
	WARNING		NO SMOKING		WEAR EYE PROTECTION
	HIGHLY FLAMMABLE		NO NAKED LIGHT		USE EAR PROTECTORS
	DANGER LIVE WIRES		EMERGENCY STOP		PROTECTIVE FOOTWEAR MUST BE BE WORN
	DANGER HOT SURFACE		GUARDS MUST BE FITTED BEFORE STARTING		WEAR HELMET
	STAND CLEAR SUSPENDED LOADS		DANGER BATTERY ACID		HAND PROTECTION MUST BE WORN



4012TWG



4016TEG

4012TWG 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), jacket water cooled charge air coolers and oil coolers in engine cooling circuit. Earlier engines with vertical air cleaners, later engines with horizontal air cleaners.

4012TWG2 Up rated version of the 4012TWG 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), jacket water cooled charge air coolers and oil coolers in engine cooling circuit. Horizontal air cleaners.

4012TAG 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Earlier engines with vertical air cleaners, later engines with horizontal air cleaners.

4012TAG1 Up rated version of the 4012TAG 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers) air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Horizontal air cleaners.

4012TAG2 Up rated version of the 4012TAG1 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Horizontal air cleaners.

4012TEG 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), raw water cooled charge air coolers with separate water pump and cooling circuit. Oil coolers in engine cooling circuit. Earlier engines with vertical air cleaners, later engines with horizontal air cleaners.

4012TEG2 12 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), raw water cooled charge air coolers with separate water pump and cooling circuit. Oil coolers in engine cooling circuit. Horizontal air cleaners.

4016TWG 16 cylinder "V" form diesel engine, water cooled, turbocharged (four turbochargers), jacket water cooled air coolers and oil coolers in engine cooling circuit. Horizontal air cleaners.

4016TWG2 Up rated version of the 4016TWG 16 cylinder "V" form diesel engine, water cooled, turbocharged (four turbochargers), jacket water cooled charge air coolers and oil coolers in engine cooling circuit. Horizontal air cleaners.

4016TAG 16 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Earlier engines with vertical air cleaners, later engines with horizontal air cleaners.

4016TAG1 Up rated version of the 4016TAG 16 cylinder "V" form diesel engine, water cooled, turbocharged (four turbochargers) air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Horizontal air cleaners.

4016TAG2 Up rated version of the 4016TAG 16 cylinder "V" form diesel engine, water cooled, turbocharged (four turbochargers) air cooled charge air intercooler in radiator. Oil coolers in engine cooling circuit. Horizontal air cleaners.

4016TEG 16 cylinder "V" form diesel engine, water cooled, turbocharged (twin turbochargers), raw water cooled charge air coolers with separate water pump and cooling circuit. Oil coolers in engine cooling circuit. Earlier engines with vertical air cleaners, later engines with horizontal air cleaners.

4016TEG1 AND 4016TEG2 Uprated versions of the 4016TEG 16 cylinder "V" form diesel engine, water cooled, turbocharged (four turbochargers), raw water cooled charge air coolers with separate pump and cooling circuit. Oil cooler in engine cooling circuit. Horizontal air cleaners.

SAFETY

Engine lift equipment

Use only the lift equipment which is designed for the engine.

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.

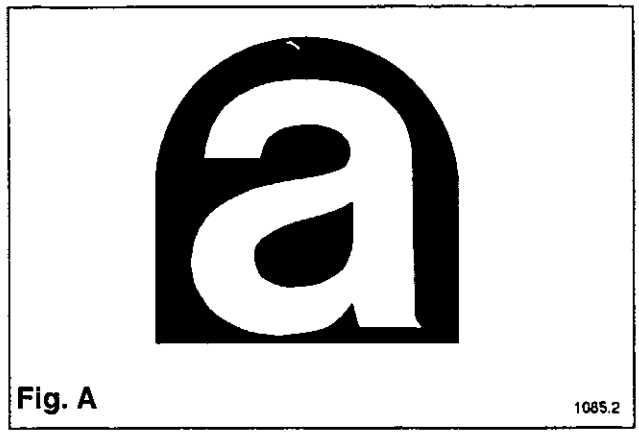


Fig. A 1085.2

Asbestos joints

Some joints and gaskets contain compressed asbestos fibres see **Warning label Fig. A** 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.

Dangers from used engine oils

Prolonged and repeated contact with mineral oil will result in the removal of natural oils from the skin, leading to dryness, irritation and dermatitis. The oil also contains potentially harmful contaminants which may result in skin cancer.

Adequate means of skin protection and washing facilities should be readily available.

The following is a list of 'Health Protection Precautions', suggested to minimise the risk of contamination.

1 Avoid prolonged and repeated contact with used engine oils.

2 Wear protective clothing, including impervious gloves where applicable.

3 Do not put oily rags into pockets.

4 Avoid contaminating clothes, particularly underwear, with oil.

5 Overalls must be cleaned regularly. Discard unwashable clothing and oil impregnated footwear.

6 First aid treatment should be obtained immediately for open cuts and wounds.

7 Apply barrier creams before each period of work to aid the removal of mineral oil from the skin.

8 Wash with soap and hot water, or alternatively use a skin cleanser and a nail brush, to ensure that all oil is removed from the skin. Preparations containing lanolin will help replace the natural skin oils which have been removed.

9 Do NOT use petrol, kerosene, diesel fuel, gas oil, thinners or solvents for washing the skin.

10 If skin disorder appears, medical advice must be taken.

11 Degrease components before handling if practicable.

12 Where there is the possibility of a risk to the eyes, goggles or a face shield should be worn. An eye wash facility should be readily available.

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.

WARNING ⚠ IT IS ESSENTIAL WHEN HANDLING INHIBITORS THAT PROTECTIVE EQUIPMENT IS WORN i.e. GOGGLES, GLOVES, ETC., TO AVOID EYE AND SKIN CONTACT AND INGESTION.

STANDARD EX-WORKS TREATMENT LEVEL A

For UK/European shipment giving up to 6 months shipping and storage protection when transported by container or lorry.

1. The oil and fuel used on engine test give satisfactory protection for 6 months. After test the oil is drained from the sump.
2. The water cooling system is flushed through with a Shell corrosion inhibited anti-freeze at 50% dilution with water.
3. After spray painting to the appropriate standard, all bright surfaces and unpainted metal are treated with Valvoline Tectyl 506 preservative, brushing quality (this includes control linkages, etc.).
4. All openings in the engine (including points where pipework has been removed and air cleaner inlets, etc.), are sealed with plugs or blank flanges.

SPECIAL PRESERVATION LEVEL B

For overseas shipment giving 12 months shipping and storage protection under normal enclosed storage conditions of -15°C to +55°C and up to 90% relative humidity for up to 12 months.

1. The oil used on engine test confers satisfactory protection for 12 months after despatch from the works.
2. The entire fuel system is drained including filters, pump injectors and fuel tank, and replaced by one of the following fluids:-

SHELL 4113 (CONFORMS TO ISO 4113)
GULF DIESEL FLUID 34
CASTROL H91/61
ESSO IL1047

3. The engine is run for ten minutes at idling speed, until the preserving fluid emerges from the injector return connection.
4. During this period two brief accelerations to maximum speed (no load) are made to ensure complete circulation of the preserving fluid, which then remains in the fuel system after the engine has stopped and no further rotation of the engine takes place.
5. The engine oil is then drained from the sump.
6. The water cooling system is flushed through with a Shell corrosion inhibited anti-freeze at 50% dilution with water.
7. After spray painting to the appropriate standard, all bright surfaces and unpainted metal are treated with Valvoline Tectyl 506 preservative, brushing quality (this includes control linkages, etc.).
8. All openings in the engine (including points where pipework has been removed and air cleaner inlets, etc.), are sealed with plugs or blank flanges.

SPECIAL PRESERVATION LEVEL C

For UK or overseas shipment when prolonged storage and protection is required for up to 5 years in temperate, tropical or arctic climates.

Also meets preservation to MOD NES 724 Level J for UK/NW Europe when stored in unheated buildings, or in the open under water-proof covers.

1. After engine test the oil is drained from the sump, filters and oil coolers.
2. The engine is refilled with Crodafluid PQ11 engine preserving oil.
3. The entire fuel system is drained including filters, pump injectors and fuel tank, and replaced by one of the following fluids:-

SHELL 4113 (CONFORMS TO ISO 4113)
GULF DIESEL FLUID 34
CASTROL H91/61
ESSO IL1047

4. The engine is then run for ten minutes at idling speed until the preserving fluid emerges from the injector return connection.
5. During this period, two brief accelerations to a maximum speed (no load) are made to ensure complete circulation of the preserving fluid, which then remains in the fuel system after the engine has stopped. No further rotation of the engine takes place.
6. The engine oil is then drained from the sump.
7. The water cooling system is flushed through with a shell corrosion inhibited anti-freeze at 50% dilution with water.
8. The water pump impellers are sprayed with Crodafluid PM47 oil film rust preventative.
9. After spray painting to the appropriate standard, all bright surfaces and unpainted metal are treated with Valvoline Tectyl 506 preservative brushing quality (this includes control linkages, etc.).
10. Inlet and exhaust manifolds have 5 - 15 milligrammes (depending on engine size) of Shell VPI 260 vapour phase inhibitor placed in them before sealing normally.
11. Air filter bodies are sprayed inside with Crodafluid PQ11 reserving oil.
12. Plastic plugs are fitted to fuel entry points, water connections, spare instrument holes in panels and air filter inlets.
13. Exhaust outlets are fitted with steel blanking plates.
14. Water hoses are treated with silicone grease and wrapped or sleeved with black polythene (silicone rubber hoses need not be treated).
15. Drive belts are removed, wrapped in wax paper, and packed in black polythene with silica gel as desiccant.
16. Starters, alternator, switches, instruments, sensors and wiring are sprayed with ambersil MS4 silicone grease.
17. Pulleys, flywheel, starter ring, pinion, etc., are protected by dipping or painting with Crodafluid PM47 oil film rust preventative.
18. The flywheel housing is fitted with a steel blanking plate.
19. Control panels have desiccants placed inside.
20. The complete engine assembly is sprayed with Crodafluid PW10 wax film rust preventative.

(FOR FURTHER INFORMATION REFER TO INSTALLATION MANUAL TSL4068)

FOUNDATION

The foundation put down to accommodate a unit powered by a diesel engine is of great importance as it must:

i) Support the static weight of the units and any dynamic loads due to the running engine's out-of-balance forces.

ii) Be sufficiently rigid and stable so that distortion will not take place which would affect the alignment of the engine and driven unit.

iii) Absorb vibrations originating from the running units and prevent them being transmitted to the engine room floor, walls, etc.

COOLING SYSTEM

For the satisfactory running of a diesel engine it is essential that the cooling system is efficient and of the correct type for the installation being considered.

The most common system is the utilisation of a mechanically driven water pump to force the coolant through the oil cooler, water jackets, cylinder heads and, in some cases, through a water cooled exhaust manifold.

The hot water from the engine unit enters the header tank of a radiator, passing through its tubes and out to the suction side of the water pump. A pressure of 0.5 to 0.7 bar is maintained in the system by the thermostats. Water passing through the radiator is cooled by pushing air through the matrix by an engine driven fan. (See the appropriate **Engine Water Circulation diagram**).

To obtain extra power from a turbocharged engine, the hot air delivered from the turbo compressor is cooled before entering the engine cylinders.

When this compressed air is cooled by the ambient air, an additional radiator is fitted between the normal water radiator and the fan, which pushes the air through the charge air radiator first and then the water radiator. Large bore pipes connect the turbochargers to the charge air radiator and from it to the inlet manifolds. (See the appropriate **Engine Water Circulation diagram**).

When the charge air is cooled by the engine coolant, the engine driven water pump circulates the coolant through engine mounted charge air coolers, before the air enters the inlet manifolds. (See the appropriate **Engine Water Circulation diagram**).

When the charge air is cooled by raw water, an additional pump is fitted to circulate raw water through the engine mounted charge air coolers, before the air enters the inlet manifolds (see the installation variations of the above including remote mounted radiators, break tanks, cooling towers, heat exchangers and special radiators as described in the **Installation Manual TL4068.**)

EXHAUST SYSTEM

The primary function of the exhaust system is to pipe the exhaust gases from the engine and discharge them, at an acceptable noise level, outside the engine room at a height sufficient to ensure their proper dispersal.

BACK PRESSURE LIMITATION

Diesel engines give optimum performance when the resistance to exhaust gas flow is below a certain limit. Starting at the engine exhaust outlet flange the total exhaust system should not impose back pressure on the engine greater than that recommended. Excessive back pressure will cause incomplete combustion and deterioration in the scavenging of the cylinders. The result will be loss of power, high exhaust temperature and the formation of soot. The soot, if oily, can also affect the turbine of a turbocharger. The oily soot can build up on the turbine blades, harden and, if pieces of carbon break off, the turbine can become unbalanced and cause failure of seals and bearings.

THE MAXIMUM EXHAUST BACK PRESSURE FIGURES FOR 4012/16 ENGINES CAN BE FOUND IN THE PRODUCT INFORMATION MANUAL AND ALSO IN ENGINE DATA SECTION OF THIS MANUAL.

INSTALLATION OF THE EXHAUST SYSTEM

The exhaust system should be planned at the outset of the installation. The main objectives must be to:

i) Ensure that the back pressure of the complete system is below the maximum limit.

ii) Keep weight off the engine manifolds and turbochargers by supporting the system.

iii) Allow for thermal expansion and contraction.

iv) Provide flexibility if the engine set is on anti-vibration mountings.
If the engine is on anti-vibration mountings, there will be lateral movement of the engine exhaust outlet flanges when the engine starts and stops. Flexible elements should therefore be fitted as near to the outlet flanges as is practicable.

v) In a closed engine room or canopy, the exhaust system and silencer must be lagged to reduce heat radiation.

vi) Each engine must have its own separate exhaust system.

ENGINE BREATHER

All engines are fitted with a breather system which prevents a build up of pressure in the crankcase, due to blow-by from the pistons. These fumes contain contaminants from the combustion process and minute globules of oil, so they are passed through a mesh filter which removes most of the oil before the gases are released to atmosphere.

BREATHER INSTALLATION

Breather discharge gases should be ducted out of the engine room, which will be adequately ventilated. The pipe diameter should be equal to or larger than the discharge hose provided with the breather, in order to prevent the crankcase pressure from exceeding 25mm water gauge.

FUEL SYSTEM

There are two basic systems for the installation of the fuel supply. The system chosen will depend on the amount of fuel required per day and if labour is available to carry out simple daily routine jobs.

FUEL TANK - DAILY SERVICE

The tank is usually sized to that the usable fuel content will be 9500/10500 litres. With a generating set having a full load of electrical output of 1200 kW such an amount would last for 20/24 hours with a reserve of approximately 10 hours.

It is preferred that the fuel tank be installed adjacent to the engine on a stand or bulk-head. It is recommended that the tank be so positioned that the minimum level of fuel be higher than the engine injector rail in order to create a positive head and gravity feed to the engine.

WARNING ⚠ SHOULD THE MAXIMUM FUEL LEVEL IN THE TANK BE HIGHER THAN 1.0 m (1.1 lb/in^2) ABOVE THE LEVEL OF THE INJECTORS, THEN AN ISOLATING SOLENOID VALVE MUST BE FITTED IN THE FUEL FEED LINE TO OPEN ON CRANKING, WITH DELAYED CLOSURE ON SHUT DOWN, TO PREVENT FUEL STARVATION.

BULK STORAGE TANK

Large engines or multi-engine installations require a large amount of fuel per hour and to contain the fuel a bulk storage tank is sited near to the engine room.

It may be arranged for the day tank to be manually filled by operating valves and using gravity to transfer the fuel from the bulk tank. However, to be sure that the day tank is regularly being filled, even through a night run, it is usual to have the transfer of fuel done automatically. The capacity of the day tank must be sufficient i.e. a minimum of 14000/18000 litre (3000/4000 gal) for 12/16 cylinder engines respectively, to avoid overheating the fuel in the tank by the excess returning from the engine, which contains 5 - 10 kW of heat, (maximum permissible fuel temperature is 57°C). If this is not possible, the fuel returning from the injectors must be piped directly to the bulk tank.

NOTE: Fuel injection equipment is particularly vulnerable to the effects of water and other contaminants. Fit a primary fuel filter/water separator in the fuel feed line to the engine and incorporate sediment traps in the bulk tanks and day tanks.

SOUND INSULATION

WARNING ⚠ ALWAYS WEAR EYE AND EAR PROTECTION WHEN WORKING NEAR OR IN AN ENGINE ROOM.

NOISE LEVEL

Noise levels are measured in decibels dB - through a frequency range of 31.5 to 16000 Hz and at each octave band centre frequency i.e. 31.5, 63, 125, 250 Hz, etc.

The human ear is responsive to noise levels in the frequency range of 63 to 8000 Hz.

The noise level in dB can be weighted A,B,C and D to suit different requirements.

The accepted norm is the 'A' Weighting as such an overall noise level closely reproduces the response of the human ear. The most commonly accepted readings are 'Sound Pressure Level'.

RECOMMENDATIONS TO CONTAIN NOISE

In an engine room installation where noise levels to the outside have to be controlled, the following factors must be considered:

I) **BUILDING CONSTRUCTION**

Outside walls - should be double brick with a cavity.

Windows - double glazed with an approximate gap of 200 mm between panes.

Doors - double door air-lock or a single door with a wall built outside the door as a noise barrier, to absorb and reflect the noise when the door is opened.

II) **VENTILATION**

Air inlets for engine combustion and cooling air and the air outlet from the radiator fan or extractor fan should be fitted with noise attenuating splitters. These are proprietary items and should be discussed with the manufacturer. Ensure that the splitters do not restrict the air flow, as this puts excessive resistance on the fans.

With the amount of cooling air required on the larger engines, the splitters should be of generous proportions and the building should be adapted so that they fit correctly.

III) The engine set should be mounted on anti-vibration mountings, to prevent vibration being transmitted to the walls, other pieces of equipment, etc. These vibrations often generate noise.

TORSIONAL VIBRATION ANALYSIS CRITICAL SPEED

Torsional vibrations occur in any rotating system. When fitting driven equipment to an engine, particularly single or twin bearing alternators, it is very important to investigate the torsional vibration characteristics of the complete unit.

At certain speeds in the engine running range, these vibrations may be sufficient to fracture the engine crankshaft, flywheel bolts, strip teeth off gear wheels, etc.

The point in the speed range where any of the above hazards can occur is called the **'CRITICAL SPEED'**.

The object of the torsional analysis is to calculate the critical speed points from the magnitude and frequency of the disturbing forces, and ensure that damaging critical speeds are outside the operating range of the engine, and particularly that all is clear within +10% to -5% of the synchronous speed.

There may be some critical speeds in the speed range from starting speed to 95% of synchronous speed, but these may be judged as 'safe', because the critical speed is passed through in a second or so.

However, if due to the application the requirement is an 'all speed' range, then all critical speeds have to be controlled within safe limits.

SETTING ENGINE POWER TO SUIT ACTUAL SITE CONDITIONS

Derating means reducing of the power output of an engine from its maximum rating at normal British temperature and pressure conditions to allow for adverse effects of overseas site conditions e.g. altitude and ambient temperature.

This reduction in power output is achieved simply by reducing the quantity of fuel injected by a readjustment of the fuel stops. Perkins Engines (Stafford) may be unaware of the final destination of an engine at the time of despatch from the works, and the fuel stops will be set for maximum output at normal British temperature and pressure conditions, (i.e. under ISO 3046 standard conditions), which could, due to the actual site conditions, result in severe damage to the engine.

Any engine so supplied must be derated in accordance with the published percentage derating figure as shown in the **Product Information Manual**, by the equipment builder on his premises, or even on site.

To derate, calculate (using the percentage derating figure) the new reduced power output of the engine, and run the engine or generating set on this load.

Reduce the maximum fuel setting position of the fuel stops on both banks **(see Fig. 1 typical installation)** by adjusting in the direction shown. After breaking the lead seals and slackening the locknuts, screw in the stop screws equally until the engine speed **just begins** to fall off. Then screw out the stop screws ¼ turn to restore full operating speed. Retighten the locknuts, relock with wire and apply lead seals to discourage tampering. This adjustment should only be carried out by skilled personnel.

NOTE: For more detailed information on equipment installation please consult the **Installation Manual (Publication TL4068).**

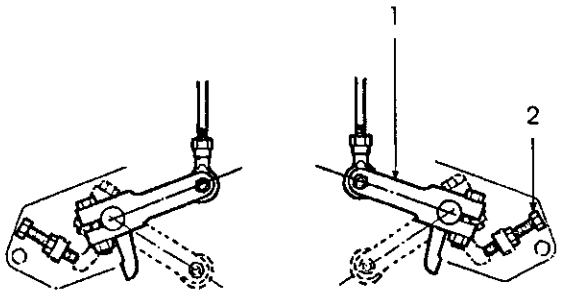


Fig. 1 738

ENGINE ROOM VENTILATION (See installation manual)

The engine room should be fitted with an extractor fan to provide adequate ventilation to dissipate the heat radiated by the engine and other components, and to maintain the temperature of the engine room at a satisfactory level. The ventilation system should also allow sufficient air to be drawn into the engine room to cater for the engine combustion requirements, and also prevent engine noise being transmitted via the ducting.

ELECTRICAL SYSTEM (STARTING AND PROTECTION)

The electrical system should be kept as simple as possible and local starting by key switch on the engine mounted instrument panel is preferred.

In the case of remote starting, the above facility must be isolated to prevent damage by unauthorised persons attempting to start the engine on site.

MAINTENANCE

Sufficient room must be allowed above and around the engine to permit easy access for routine inspection, servicing and maintenance.

Key
(Fig. 1)
1 No Fuel
2 Fuel Stop

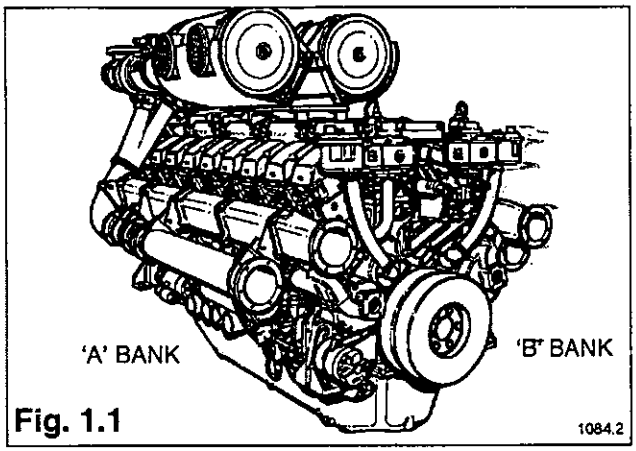


Fig. 1.1

For full technical data please refer to the **Product Information Manual.**

Type: Water-cooled, turbocharged, charge cooled, industrial diesel engine.

RANGE	**4012**	**4016**
Cycle	4 stroke	4 stroke
No. of cylinders	12	16
Configuration	V-form	V-form
Bore	160 mm	160 mm
Stroke	190 mm	190 mm
Total swept volume	45.84 litres	61.123 litres
Compression ratio	13.6:1	13.6:1
Rotation	Anti-clockwise looking on flywheel end	
Firing order	1A-6B-5A-2B-3A-4B-6A-1B-2A-5B-4A-3B	1A-1B-3A-3B-7A-7B-5A-5B-8A-8B-6A-6B-2A-2B-4A-4B
Valve Timing	inlet valve opens 60° BTDC inlet valve closes 46° ABDC	exh valve opens 46° BBDC exh valve closes 60° ATDC
Cylinder numbering	Cylinder 1 furthest from flywheel	
Cylinders designated A are on the right hand side of the engine, when viewed from the fly-wheel end and cylinders designated B are on the left hand side of the engine.		
Valve Clearances	exhaust	0.40 mm (0.016")
(Engine cold)	inlet	0.40 mm (0.016")
Valve dia. (mm) inlet and exhaust	48	48
	(52 on 4012TAG1/2 AND 4016TAG1/2)	
Valve Timing	See Workshop Manual **Sections U4 & U5**	
Injection Timing	See engine nameplate	
Piston Speeds	Engine r/min	m/s (ft/min)
	1000	6.33 (1247)
	1200	7.60 (1496)
	1500	9.50 (1870)
	1800	11.40 (2244)

TYPICAL COOLING SYSTEM

	4012	4016
Approved Coolants)	See **page 28**	

Total water capacity	Ltrs	Gals	Spec	Ltrs	Gals	Spec
	200	44	TAG	255	56.1	TAG
	232	51	TAG1	316	70	TAG1
	232	51	TAG2	316	70	TAG2
	185	40	TWG	95	21	TWG*
	205	45	TWG2	95	21	TWG2*
	82	18	TEG**	108	23.7	TEG**

* Engine only
** Engine with heat exchanger

Max radiator top tank temperature	93°C
Max water temperature into engine	80°C
Thermostat opening temperature	71°C
System pressure	0.5 to 0.7 bar

FUEL SYSTEM

	4012	4016
Approved fuels	See **page 20**	
Minimum size fuel tank	14,000 litres (3,000 gal.)	18,000 litres (4,000 gal.)
Relief valve setting	310 kPA (45 psi)	
Inferior nozzle pressure	225-235 atm	
Injection equipment	Lucas-Bryce unit injector	
Filter/water separator	Spin-on expandable canister(s)	
Fuel lift pump	Maximum suction lift 1 metre	
Fuel flow	20.457 litre/min. (4.5 gpm) @ 1800 r/min	

GOVERNORS

	4012	4016
Type	Electronic	Electronic
Type	Hydraulic	Hydraulic

LUBRICATION SYSTEM

	4012	4016
Recommended oil	See **pages 17 & 18**	
Type of system	Wet sump, external engine mounted oil pump	
Total oil capacity (including cooler and filter)	178 litre (39.2 gal)	238 litre (53 gal)
Sump capacity (dipstick)		
Min.	136 litre (30 gal)	147 litre (33 gal)
Max.	159 litre (35 gal)	214 litre (47 gal)
Crankcase pressure (max)	25 mm (1") water gauge	
Lubricating oil temperature max. to bearings	105°C	
Lubricating oil pressure at 80°C temp. to bearings	0.34 mPa	
Max. oil temperature in sump	115°C	
Min. oil pressure (1500 rpm)(at filter head)	200 kPa (30 lb/in²)	
Oil filter	Disposable canister type	
Oil pump location	'A' Bank	

INDUCTION SYSTEM

	4012	4016
Air cleaners (earlier) (current)	Twin vertical air cleaners Twin horizontal air cleaners	
Type	Paper element	
Air restriction indicator setting	380 mm H_2O	
Turbochargers	x2 off	x4 off

EXHAUST SYSTEM

	4012	4016
Manifold type	Dry or water cooled	
Exhaust outlet flange	Vertical (Twin)	
Mating flange	See **Installation Manual**	
Max. exhaust back pressure	See **Product Information Manual**	
Max. exhaust temperature		

FLYWHEEL

	4012	4016
Drive size	SAE 18"	
	SAE 21" Optional	

FLYWHEEL HOUSING

	4012	4016
SAE size	00	

TYPICAL DRY WEIGHT

	4012	4016
Dry weight (engine)	4360 kg 4012TAG	5500 kg 4016TAG
	4360 kg 4012TAG1	5750 kg 4016TAG1
	4400 kg 4012TAG2	5750 kg 4016TAG2
	4975 kg 4012TWG	5940 kg 4016TWG/2
	5315 kg 4012TWG2	5820 kg 4016TEG
	4680 kg 4012TEG2	
Dry weight engine & tropical radiator	5280 kg 4012TAG	6900 kg 4016TAG
	5760 kg 4012TAG1	8010 kg 4016TAG1
	5800 kg 4012TAG2	8010 kg 4016TAG2
	4995 kg 4012TWG	
	5315 kg 4012TWG/2	
Dry weight engine & heat exchanger	4860 kg 4012TEG	6000 kg 4016TEG

HOLDING DOWN BOLT HOLES

	4012	4016
Hole dia. (Engine feet)	22 mm	
No. off	8	
Hole dia. (Radiator feet)	18 mm x 6 4012TAG	22 mm x 6 4016TAG/2
Turbochargers	22 mm x 6 4012TAG2	
	22 mm x 6 4012TWG/1	

ELECTRICAL SYSTEM

	4012	4016
Voltage	24V	
Alternator	Belt Driven	
Alternator output	30A	
Starter motor	Single CAV (Earlier Engines) Twin Prestolite (Current Engines)	Twin Prestolite
No. of teeth (gear ring)	144 (Early Engines) 156 (Current Engines)	156
No. of teeth (starter pinion)	12	
Battery (lead acid)	24V DC (2 x 12V)	
Capacity down to 0°C (32°F)	286 Ah	

PROTECTION EQUIPMENT

Before resetting protection equipment, it must be established whether special settings (for that individual engine) have been specified in the engine sales contract. This is particularly important with ALL high water temperature settings, and ALL Cogen applications.

Standard settings for protection equipment are as follows:-

	Alarm	Shutdown
High Oil temperature (in sump)	110°C	115°C
Low oil pressure	2.06 bar (30 lb/in²)	1.93 bar (28 lb/in²)
High water temperature		
71°C Thermostat	91°C	96°C
85°C Thermostat	96°C	101°C
96°C Thermostat	100°C	105°C

Caution: The above standard settings do not supersede any settings specified in the engine sales contract.

Overspeed	15% above max. running speed (Except 1800 r/min which is 7%)

AIR STARTING

	4012	4016
Air starter	See **Installation Manual**	
Air starter pressure	150 lb/in^2 (10.34 bar)	
Compressed air supply	170 lb/in^2 (11.72 bar)	

INSTRUMENT PANEL (ENGINE MOUNTED)

	Normal Operation
Oil pressure	Between 276-413 kPa (40-60 lb/in²)
Oil temperature	Between 80-90°C (176-194°F)
Water temperature	Between 65-85°C (149-185°F)
Exhaust temperature	See **Product Information Manual**

COOLANT JACKET HEATING

	4012	4016
Heater	2 x 4 kW	
Voltage	210-250V ac	