# L2 TYPE (Multi-cylinder)

(with supplementary instructions for 1L2 Engine)

ENGINE No...../.....

**IMPORTANT**

**In any enquiry, or order for parts, the number of the engine must be stated in order to ensure prompt attention.**

# GENERAL DIRECTIONS

for the Management and Care of

# GARDNER

# DIESEL ENGINES

Vertical Four-Cycle Compression-Ignition

Airless Fuel Injection

**L. GARDNER & SONS LTD**

BARTON HALL ENGINE WORKS, PATRICROFT, ECCLES, MANCHESTER M30 7WA TEL: 061-789 2201.

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## FOREWORD

THE matter contained in this book, especially the Directions for Running and Care of the Gardner High-Speed Oil Engine, should prove useful to the engineer, particularly so if he has had no previous experience with engines of the compression-ignition type.

They should enable him quickly to trace and remedy any faults that may occur before he has become familiar with the construction and working of the engine.

In reality, the engines are very simple and easy to manage.

If the directions appear to be voluminous, this is solely due to an attempt to anticipate everything that the engineer may want to know.

**IMPORTANT. Variations of fuels do not call for any adjustments whatever to the engine. Please, therefore, refrain from making any and, above all, do not attempt to adjust the Regulating Toothed Quadrants on the injection pumps (inside the inspection cover plate).**

L2 TYPE
(Supplementary Instructions for 1L2 Engines)

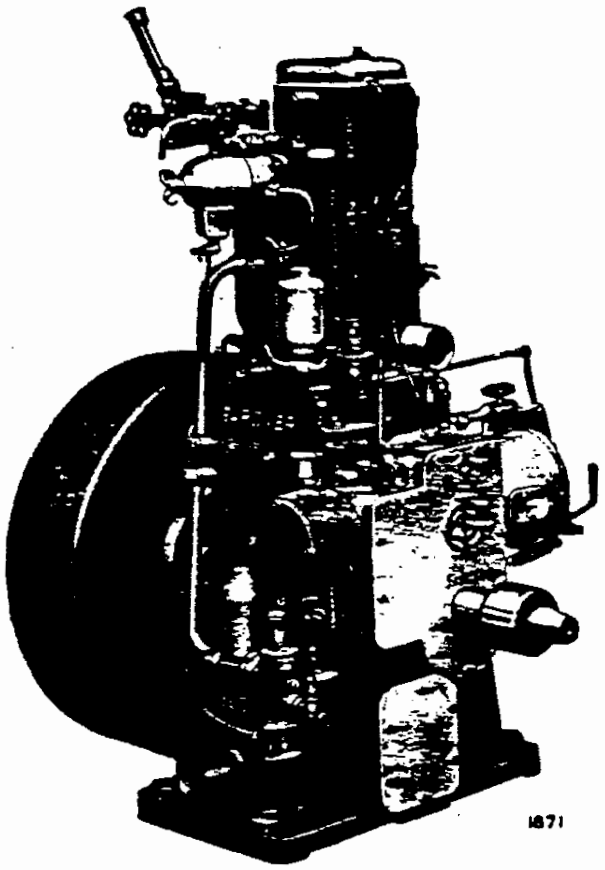
# GENERAL DIRECTIONS

for the Management and Care of

# GARDNER

# OIL ENGINES

**Verticle Four-Cycle Compression-Ignition**
**Airless Fuel Injection**




1L2 Engine


## L. GARDNER & SONS LTD

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## SUPPLEMENTARY INSTRUCTIONS

# GARDNER 1L2 TYPE ENGINES

The following instructions (pages 15 to 51) apply to the 2L2 to 6L2 (two to six cylinder) type Diesel engines which have been out of production for many years. The basic design of the single cylinder type 1L2 engine is, however, the same as that of the 2L2 to 6L2 types and most of the details given in this Instruction Book are also applicable to the single cylinder engine. It will likewise be evident in the reading that certain paragraphs refer only to items which are applicable to the 2L2 to 6L2 engines ; they will obviously not apply to the 1L2 engine.

Improvements and modifications to our present-day LW series, which have the same bore and stroke as the 1L2 engine, have also been applied to the 1L2 unit where desirable and appropriate and most of these modifications, etc., are covered by this supplement. In addition, pages 7 and 8 contain information regarding running clearances, correct tightening torque, etc., for the 1L2 Laboratory Type Engine. Here again, most of these details apply to the standard 1L2 engine.

The main points calling for special attention are given herewith in alphabetical sequence :—

**Big End Bearings.**—*See para. 96.* The earlier 1L2 engines are fitted with connecting rods of round section and have four-bolt type big end bearings. Later engines, and all laboratory type engines, are fitted with " H " type section connecting rods which have two-bolt type big end bearings. It is therefore essential to quote the engine serial number when ordering replacement big-end bearings.

**Crankshaft.**—This engine has been fitted with crankshafts of two types. The crankpin on the current type is $3\frac{1}{16}$" diameter, this shaft was standardised in 1954 when the above mentioned " H " section connecting rod was introduced. Prior to this the crankshaft had a crankpin of $2\frac{7}{8}$" diameter. When a new crankshaft is required we recommend the supply of the latest type together with the latest connecting rod, this is particularly desirable for the laboratory type engine running at 1600 r.p.m.

When fitting a new crankshaft it is necessary to drill a hole in the shaft for the pointed setscrew which secures the crankshaft pinion since this operation cannot be performed before a replacement crankshaft is despatched from the Works. The exact position of the hole must, therefore, be very accurately copied from the old crankshaft and the new crankshaft drilled accordingly. The Works will be pleased to supply a jig screw, twist drill and " Slocombe " centre drill which will be found to facilitate this operation.

**Fuel Injection Pump.**—*See para. 116.* Instructions for fitting of replacement fuel pump :

Rotate engine until fuel pump tappet is resting on base of cam.

Place a gauge of ·090" thickness (·150" for laboratory type engines) on top of the fuel pump tappet adjusting screw. Fit pump and tighten holding down nuts. Under these conditions the line on the fuel pump plunger guide, visible through the sight hole windows in the fuel pump body, should coincide with the line scribed on the side of the window. If these lines are not coincident remove pump, unlock tappet screw lock nut and adjust screw up or down as required, refit pump and check as before. When lines are made coincident remove pump and take away ·090" gauge and refit pump. On no account rotate engine when gauge is in position.

## SUPPLEMENTARY INSTRUCTIONS

# GARDNER 1L2 TYPE ENGINES—*continued*

Having set the tappet in this way fuel injection should commence at 29° before T.D.C. (1,100 r.p.m. engines) or 28½° before T.D.C. (1,000 r.p.m. engines) when rotated in running direction (see laboratory data sheet for timing of such engines). A timing line will be found marked on the rim of the flywheel, this line is to be used in conjunction with the line marked on the crankcase.

Commencement of injection is indicated by coincidence of the above mentioned timing lines on the fuel pump plunger guide and sight windows. On old type pump bodies there may be found two lines, one above the other, in such a case ignore the upper line and work to the lower line. The lower line indicates the position of the ram at which the spill ports are just closed by upward movement of the ram.

Prior to engine No. 93919 the standard 1L2 fuel pump was equipped with a ram of 7·0 mm diameter whilst for the laboratory engine the fuel pump ram dimension was 6·5 mm. All 1L2 engines after and including No. 93919 are equipped with fuel pump rams of 6·5 mm diameter. Prior to 93919 - 7mm ? increment

Injection timing 18° BTDC tappet .140" engine 6.5mm 23° .150"

**Fuel Filters.**—*See paras. 7, 58 to 62.* Both fuel filters now contain a special form of paper filtering element which have, in time, to be discarded and replaced when they become choked. The element in the first filter has a greater area than that fitted to the second filter ; thus the two elements are not interchangeable. The testing of these elements for stoppage or choking of the fuel supply remain as detailed in the paragraphs quoted, but the duty, location, cleanliness of the fuel supply and the fuel system can all have a profound influence on the " clean " life of the filter elements. Under average conditions, however, they should not require replacement before they have been in use for at least 3,000 hours and, generally speaking, the second filter element should have a much longer " clean " life than that of the first filter element.

**Fuel Sprayers.**—*See paras. 5, 6, 34, 63 to 78, 93. 1.* Notwithstanding the remarks contained in all these paragraphs, it should be mentioned that old type 1L2 engines are serviced at these Works with sprayers of type " E1 " and they are so stamped. Current engines of the 1L2 series are fitted with L2 type " K " sprayers, the symbol " K " being stamped on the sprayer body. The laboratory type 1L2 engine is, however, fitted with an LW engine " K " type sprayer (stamped LW.K) which is special for this particular duty engine only. It is not interchangeable with the 1L2 " E1 " or " K " type sprayers, the main difference being the sprayer nozzle cap which is of differing external dimensions that render it an improper fit in the cylinder head of the standard 1L2 engine. All 1L2 sprayers, irrespective of type, have a valve lift of ·008".

**Spring load on sprayer valve.**—*See para. 72.1.* The spring load with the various type sprayers is shown below :—

1L2 Sprayers stamped ' E or E1 ' ... 55 lb. @ 1·320" spring length.

1L2 Sprayer stamped ' E1 or E1K ' or ' LW.K." ... ... ... ... 61·5 lb. @ 1·320" spring length.

## SUPPLEMENTARY INSTRUCTIONS

# GARDNER 1L2 TYPE ENGINES—*continued*

**Lubrication.**—*See paras. 8, 9, 29, 38, 47, 48, 50.1, 51 and 54.* Lubrication in the 1L2 engine is effected by a plunger type pump driven from an eccentric mounted on the gear driven cross shaft which also carries the valve cams. The oil is carried in a sump which is an integral part of the crankcase and is delivered to the main and big end bearings, etc. at a pressure of 25 lb./sq.in. This pressure can be regulated within limits by a spring loaded by-pass valve mounted in the body of a fitting which also carries the lubricating oil pressure gauge. When running at 1,000 r.p.m. the gauge should register 25 lb./sq.in. with the engine hot and this pressure must not be allowed to fall below 18 lb./sq.in. when the engine is operating at 1,000 r.p.m. The lubricating oil is filtered by a wire-mesh strainer of large size fitted in the " floor " of the crankcase and this strainer can be readily removed for cleaning and examination by taking off the crankcase door on either side of the engine. To lift out the strainer all that is necessary is to press the body of the strainer against the loading spring which holds it in position. This strainer, or filter, deals with all lubricating oil circulating through the engine and there is no other form of external lubricating oil strainer or delivery filter. Its location is clearly shown in the drawing of the 1L2 engine at the end of this book.

Low oil pressure may be caused by one or more of the following factors (having first checked the pressure gauge) :—

(1) Some foreign matter trapped under seat of by-pass valve.

(2) Lubricating oil suction strainer which has become choked after long use or after overhaul when fibrous material from wipers is likely to be present.

(3) Use of lubricating oil of viscosity lower than that recommended herein. Oils to S.A.E.5 and S.A.E.10 for instance could cause low oil pressure.

(4) Leakage at one of internal connections on main bearing oil pipes.

(5) Oil viscosity reduced due to dilution by fuel oil. Damaged fuel sprayer or fuel pipe connections could produce a fuel leak, the fuel passing via push rod chamber into crankcase.

(6) Extensive wear or damage in main and/or big end bearings.

Publications Nos. 737.A. and 729.C. included with this Instruction Book contain up-to-date information in respect of correct grades of lubricating oil to be used with all types of Gardner engines including the 1L2. The lubricating oil sump can be drained via the small pipe fitted on the water circulating pump side of the engine. When the sump has been replenished care should be taken to see that the cap is firmly screwed down, that the circular packing is in good condition and that there is no leakage from the cap when the engine is operating.

**Piston Assemblies.**—*See paras. 85.1.* It is desirable to mention that pistons for 1L2 engines differ from the pistons used for 2L2 to 6L2 engines ; there is diversity in the location of the piston pin in relation to the valve seat recesses and 2L2 to 6L2 pistons cannot be used in 1L2 engines and vice versa. In addition, special pistons are fitted to the 1L2 laboratory type engine and they are likewise not interchangeable with those of the standard 1L2 and vice versa.

## SUPPLEMENTARY INSTRUCTIONS

# GARDNER 1L2 TYPE ENGINES—*continued*

**Starting Fuel Plunger.**—*See para. 13.* This device as fitted to the 1L2 engine is of the simple " latch " type which has a limited movement, can be lifted with one finger and drops back into normal operating position as soon as the engine commences to run. The starting device must not be jammed or secured in the lifted position, otherwise the engine will receive much more fuel than it can properly consume, with consequent dirty exhaust, excessive carbon deposits and other evils that are always linked with incomplete fuel combustion. If the headed pin were removed and the " latch " dispensed with this would be disastrous to the proper operation and correct use of the engine.

It is of the greatest importance that the engine serial number be quoted when ordering spare fuel injection pumps. This information will be found stamped on the flat surface at the corner of the crankcase and also on the " latch " type starting device fitted to the fuel pump control rod.

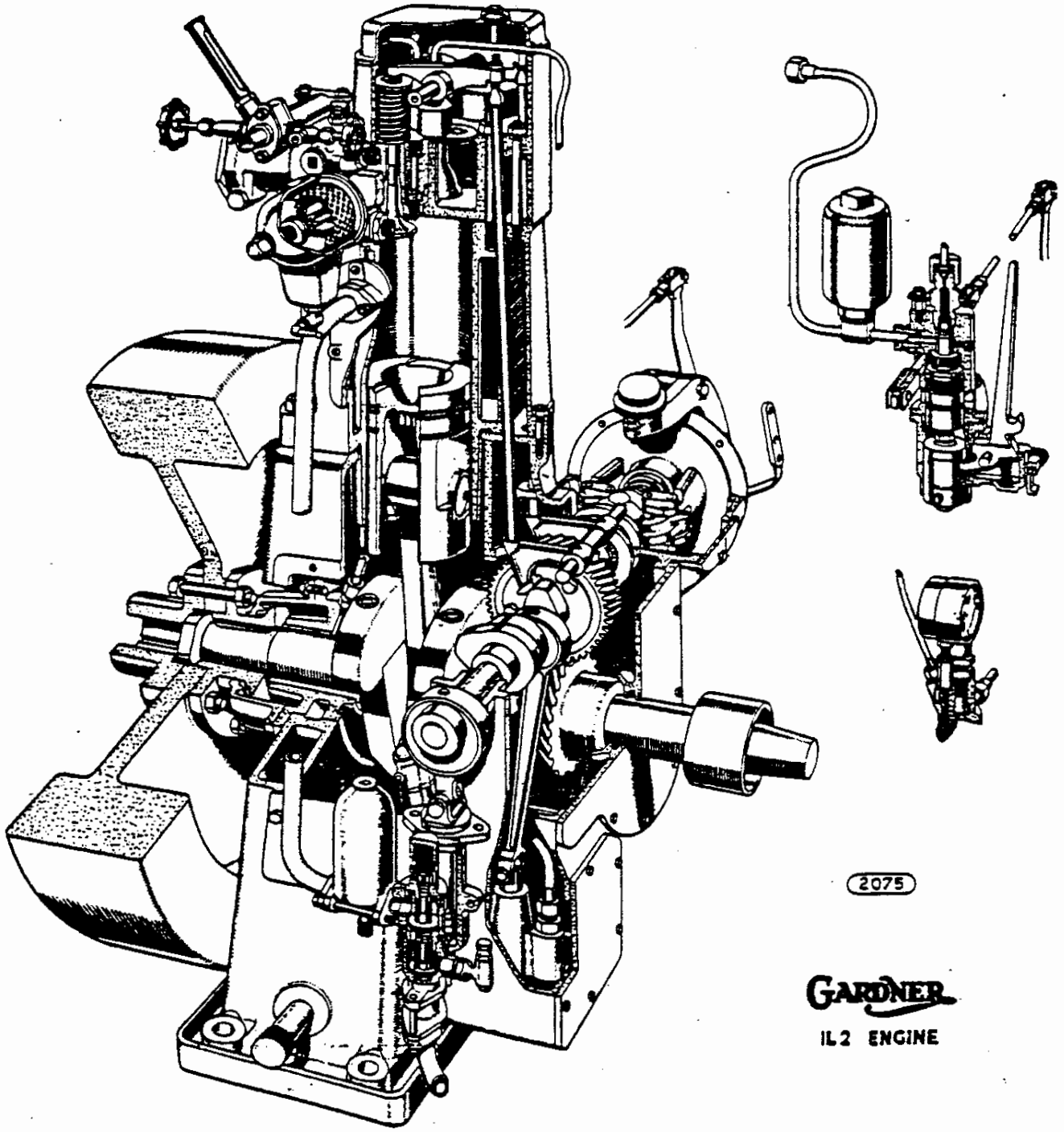
**Timing Marks of Fuel Injection, Top Dead Centre, Timing of Fuel Injection, Timing of Valve and Fuel Injection Pump Camshafts.**—*See paras. 102 to 104.* In the 1L2 engine there is only one camshaft and this carries not only the inlet and exhaust valve cams but also the helical timing gear, the fuel injection pump cam, the eccentric and sheave for the lubricating oil pump operation and the governor body with weights, etc. The centrifugal pattern water circulating pump, when the engine is so equipped, is also driven from the end of the camshaft; when the plunger type water circulating pump is fitted, the camshaft likewise carries the driving eccentric and sheave. With the exception of the centrifugal pattern water circulating pump, all other components are securely fitted to the camshaft and there is little possibility of the parts being re-assembled wrongly provided the usual observations are made before removing the parts should this be necessary at any time. When re-assembling the camshaft in the engine it is, however, necessary to carefully observe that the crankshaft pinion and the camshaft gear mesh correctly as indicated by the drilled " dots " in the teeth of respective gears.

**Water Circulation.**—*See paras. 10, 31, 79.* When a plunger type water circulating pump is fitted to the 1L2 engine the housing of the operating mechanism (an eccentric and sheave as mentioned above) is also equipped with a draining tube located at the bottom of the casing. This tube is intended to drain away any accumulation of water that may seep past the water pump plunger and the tube must on no account be plugged or fitted with a screwed cap. An accumulation of water at this point will wash away the lubricating medium and cause severe wear and damage to the pump eccentric and sheave.

The centrifugal type water circulating pump has a special spring loaded carbon gland, in which the carbon ring is fixed in the pump case and forms a spherical seating for the sealing ring which revolves with the impeller. The impeller spindle is carried on a self-aligning ball bearing which, together with the spherical sealing ring, permits of slight malalignment between the pump and its driving member.
The only attention which the pump requires is the lubrication of the ball bearing. This should be carried out by using not more than one grease cup full per 3,000 hours. Use a good quality calcium base grease having a drop point of 100°C. nominal. Do not fit grease gun nipple in order to use a grease gun. Grease is detrimental to the carbon gland.

GARDNER
L2
TYPE

SUPPLEMENTARY INSTRUCTIONS



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GARDNER
IL2 ENGINE

# 1L2 LABORATORY TYPE ENGINE

RUNNING CLEARANCES . DESIGNED & APPROXIMATE MAXIMUM PERMISSIBLE ETC.
ALSO
CORRECT TIGHTENING TORQUE FOR NUTS ETC.

RUNNING CLEARANCES

| ITEM | METHOD OF MEASUREMENT | DESIGNED | APPROX. MAX. PERMISSIBLE |
|---|---|---|---|
| Con. Rod—Big End—Diametrical | Internal and External Micrometer | ·002125″ | ·004″ |
| " " Side | " " " | ·001″ — ·008″ | — |
| " Small End—Diametrical | Plug Gauge and External " | ·0013″ | ·003″ |
| Main Bearing—Diametrical | " " " " | ·0035″ | ·005″ |
| Crankshaft—Endwise | Dial Indicator | ·004″ — ·006″ | — |
| Valve Stem—Inlet | Plug Gauge and Ext. Micrometer | ·00125″ | ·004″ |
| " Exhaust | " " " | ·00275″ | ·006″ |
| Valve Guide—Inter. fit in head | " " " | ·000825″ | — |
| Valve Seat—Inlet " " | " " " | ·0065″ | — |
| " Exhaust " " | " " " | ·006″ | — |
| " Diameter (45°) Inlet | Scale | 2·00″ | 2·030″ |
| " " (45°) Exhaust | " | 1·75″ | 1·780″ |
| Cyl. Block—Bore before fitting liner | Internal Micrometer | 4·4365″ | — |
| Cyl. Block—Bore of liner after Fitting and Honing to Size | " " | 4·25025″ | — |
| " Surface finish of Honed Bore | "Talysurf"—Microinch | 28 | — |
| Sprayer Valve—Spring Load | Spring Measuring Machine | 61·5 lb. | — |
| Sprayer Valve—Approx. opening Pressure with load of 61·5 lb. with Valve Seat "run" but in good condition. | Hydraulic Pressure Recorder | 1930 lb./□″. | — |
| Sprayer Valve—Lift | Depth Micrometer | ·008″ | — |
| Cylinder Head to Piston Clearance | " " { Cyl. Head Packing ·0625″ / Cyl. Foot ·004″ } | ·0444″ NOMINAL | ·0544″ MAX. ·0364″ MIN. |

# 1L2 LABORATORY TYPE ENGINE

RUNNING CLEARANCES - DESIGNED & APPROXIMATE MAXIMUM PERMISSIBLE ETC.
ALSO
CORRECT TIGHTENING TORQUE FOR NUTS ETC.

CORRECT TIGHTENING TORQUE FOR NUTS ETC.

| NUT | THREAD SIZE | CORRECT TIGHTENING TORQUE LB. INCHES |
|---|---|---|
| Cylinder Head | $\frac{7}{16}$" B.S.F. | 750 |
| Cylinder Foot | $\frac{1}{2}$" B.S.F. | 1500 |
| Connecting Rod Big End—4 Bolt Type | $\frac{7}{16}$" B.S.F. | 720 |
| " " " 2 " " | $\frac{1}{2}$" B.S.F. | 1250 |
| Flywheel Hub—Crankshaft Taper 1 in 12 | $1\frac{1}{4}$" B.S.P. | Position hub firmly on crankshaft taper screw nut firmly to hub and drive nut up 120° with spanner and lead hammer |
| Flywheel Bolts | $\frac{7}{16}$" B.S.F. | 1000 |
| Crankshaft Balance Weight | $\frac{1}{2}$" B.S.F. | 1100 |
| Sprayer Clamp | $\frac{5}{16}$" Whit. | 80 |
| Sprayer Nozzle Cap | $\frac{3}{4}$" – 14 thds. | 380 |
| Sprayer Pipe Union—Pump End | 18 × $1\frac{1}{2}$ m/m. | 450 |
| " " Sprayer End | $\frac{1}{2}$" B.S.P. | 450 |
| " Delivery Stock | $\frac{3}{4}$" B.S.P. | 750 |
| " Leak Stock | $\frac{1}{2}$" B.S.P. | 750 |
| C.A.V. Inj. Pump—Delivery Valve Holder | 20 × $1\frac{1}{2}$ m/m. | 750 |
| Valve Tappet Adjuster | $\frac{5}{16}$" B.S.F. | 200 |
| Fuel Pump Tappet Screw Locknut | $\frac{1}{4}$" – 24 thds. | 300 |
| Governor Body—Pointed Set Screw | $\frac{1}{4}$" – 24 thds. | 550 |
| Valve Cam—Pointed Set Screw | $\frac{1}{4}$" – 24 thds. | 550 |
| Fuel Strainer Cover | $\frac{1}{4}$" Whit. | 180 |

IN. & EX. VALVE TIMING — INLET opens 10° B.T.D.C. EXHAUST opens 50° B.B.D.C.
INLET closes 40° A.B.D.C. EXHAUST closes 15° A.T.D.C.
with .015" clearance between valve and lever.

RUNNING CLEARANCE — INLET .005" } ENGINE
EXHAUST .012" } COLD

LUBRICATING OIL PUMP — NORMAL operating pressure at 1500 R.P.M. 25 LB. } ENGINE
MINIMUM " " at 1500 R.P.M. 20 LB. } HOT
Capacity at 1000 R.P.M. 3·7 pints per min. (Calculated)

FUEL PUMP INJECTION TIMING — PORTS CLOSING
1000 R.P.M. 23°–0′ B.T.D.C.
1500 R.P.M. 25°–30′ B.T.D.C.
1600 R.P.M. 28°–0′ B.T.D.C.

# LUBRICATING OILS PROMOTING CLEAN RUNNING, REDUCED WEAR AND POSSESSING THE ABILITY TO COMBAT THE HARMFUL EFFECTS OF HIGH SULPHUR CONTENT IN FUEL OILS

Of recent years it has become established that the sulphur content of fuel oil has a very important effect on the internal cleanliness and wear rate of an engine—in particular the question of lacquer formation on cylinders and piston rings, etc.—and accordingly the following are our recommendations:—

The use of approved first class detergent oils to any of the following specifications is highly desirable. It is false economy to use the cheaper grades of lubricants.

1) "Supplement 1." (U.S. Army Ordnance—see note overleaf).

2) MIL-L-2104B (U.S. Army Ordnance).

3) DEF-2101-C (British Ministry of Supply).

4) MIL-L-2104A (U.S. Army Ordnance).

Their use is particularly desirable when one or more of the following conditions obtain:—

1) The fuel oil in use contains more than ·3% sulphur.

2) The engine is operating under continuous load (e.g. stationary electricity generating plant).

3) The gross laden weight of a road vehicle in tons (2240 lb/ton), per litre of engine swept volume is in excess of 1·6 approx.

4) High atmospheric, coolant and lubricant temperature.

5) The engine duty is insufficient to promote rapid attainment of optimum coolant temperature (e.g. short haul road delivery vehicles, shunting locomotives, etc.).

Oils to the above specifications possess a remarkable ability to combat the evils of sulphur in the fuel both from a wear (corrosion) and cleanliness point of view (lacquer) and we recommend that use be made of the high quality "Supplement 1" oil wherever possible. This oil promotes the lowest rate of wear and remarkably clean running which likewise applies even when the fuel oil has a low sulphur content. Additionally the lubricating oil consumption rate of an engine is thereby under many conditions considerably reduced.

Should "Supplement 1," however, not be available, oils to the other specifications may be used and the engines are capable of sustained performance under the following conditions:—

| FUEL | OIL | DRAIN PERIODS |
|---|---|---|
| (a) ·8% sulphur fuel of good ignition quality. | (1) "Supplement 1" or MIL-L-2104B | 4000 miles (400 hrs.). |
| | (2) DEF-2101-C or MIL-L-2104A | 3000 miles (300 hrs.). |
| (b) Low sulphur fuel say less than ·3% of good ignition quality. | First class straight oil. | 3000 miles (300 hrs.). |
| (c) Low sulphur fuel say less than ·3% of good ignition quality. | (1) "Supplement 1" or MIL-L-2104B | 6000 miles (600 hrs.). |
| | (2) DEF-2101-C or MIL-L-2104A | 4000 miles (400 hrs.). |

From the foregoing it will be seen that not only do we advocate the use of detergent oils but also the use of detergent oils of the highest quality. We do not, however, do so to the extent of saying that their use is essential, but, nevertheless, the lowest rate of wear, the greatest cleanliness, and the best maintained engine condition are not under any conditions obtainable without them.

In addition, when considering detergent oil versus straight oil the questions of drainage period and lubricating oil consumption assume much importance in arriving at operating costs and we claim that the low lubricant usage rate of our engines enables a high quality lubricant to be considered and also a more frequent drainage period with beneficial results in regard to the removal of internal "wearings."

NOTE: U.S. Army Ordnance Specification 2-104B Supplement 1 is officially obsolete, but oil of "Supplement 1" type is still generally recognized as referring to a superior lubricant.

SPECIAL CAUTION:—

When using a detergent oil for the first time in an engine which has been in service it is advisable to inspect the lubricating oil filter after a short period and pay due regard to engine oil pressure, since oils of this type free deposited carbon, and if the filter does not receive attention it may suddenly, in the case of a dirty engine, become choked.

Lubricant Viscosity. We wish to confirm that use of a lubricant of lower viscosity than quoted in our Engine Manual and Publication Sheet No. 729C, even though it be possessed of modern additives, is not recommended. Whilst such lubricants known in Great Britain as "thin" oils do not materially increase the rate of wear of some engine components they do cause a very greatly increased rate of wear of other parts, amounting in some cases to several times the normal value; they may also at the same time promote unreliability.

Use of lubricant of insufficient viscosity in an engine equipped with correct thermostatic coolant control and operating at normal automotive load factor and duty will cause loss of engine performance and increased fuel usage, apart from loss of performance due to premature wear.