

# Chapter Fifty-one

## FLEXIBLE PIPES

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THIS CHAPTER contains instructions on the installation, periodic inspection, testing, and storage, of all the flexible pipes fitted to the engines covered in this handbook. A complete list of these pipes is given on pages 8, 9 and 10.

The pipes are approved to operate over a temperature range from minus 40 deg. C. to + 150 deg. C., but the hose is necessarily designed to give the most economical life at normal operational conditions, i.e., 70 deg. C. to 90 deg. C.

The service life of a flexible pipe is dependent on a number of widely varying factors such as conditions of operation, proper handling during maintenance of associated engine components, and correct conditions of storage. Flexible pipes may be regarded as having an unrestricted life subject to their satisfactorily meeting the routine servicing requirements specified in sub-para. 1 and 2. During complete overhaul it is standard practice to pressure test all flexible fuel and oil pipes; as described on page 3 of this chapter. During complete overhaul, until all burner feed pipes are fitted with the Palmer Type 200 end fittings introduced by Mod. 1159, any unmodified burner feed pipe which is four years old, or more, should be rejected and replaced by either an unmodified pipe which is less than four years old or by a modified pipe incorporating Palmer Type 200 end fittings. The routine servicing requirements are:—

1. At the specified routine servicing periods, all flexible pipes must be visually examined for signs of the external defects described on page 3.
2. In addition to the visual examination specified in sub-para. 1 above, **all flexible burner feed pipes**, whether fitted to an engine or held as spares, **must be pressure tested on the following occasions** :—

#### A. Operators

- i. *Engines in normal operational use*  
At each combustion chamber servicing period.
- ii. *Spare pipes in Operators' Stores*  
Prior to fitment to an engine if held in store for more than six months.
- iii. *Uninstalled spare engines*  
Prior to installation of the engine if held in store for more than six months.

#### B. Distributing and Servicing Stores

- i. *Spare pipes*  
Prior to issue from stock, if received into stock more than six months previously.
- ii. *Uninstalled and installed engines held in storage*  
Prior to issue of engine or aircraft if held in storage for more than six months.

#### C. Overhaul Depots

During the complete overhaul of an engine all flexible fuel and oil pipes must be pressure tested as described on page 4 of this chapter.

### IDENTIFICATION

The date of manufacture and initial testing is marked on the brass part number identification tag thus—the letter T followed by the month and the year, for example T7/50 indicates that the pipe was manufactured and tested in July, 1950. After re-testing any pipe in accordance with the instructions in this chapter, operators are recommended to mark the pipe in a similar, or some other suitable, manner.

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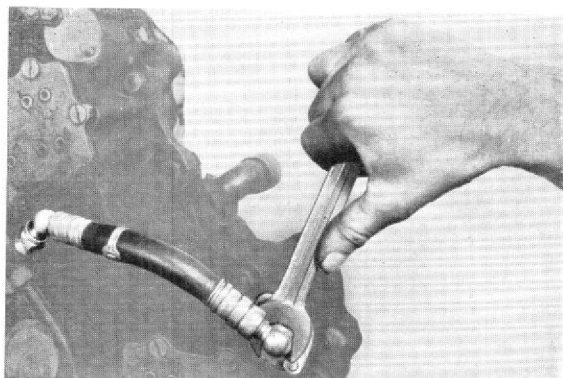


Fig. 1. Tightening the union nut of a flexible pipe using the incorrect method of fitting.

A few of the Palmer flexible pipes in service may bear the following obsolete markings:—

For sizes from  $\frac{5}{8}$  in. bore to  $\frac{3}{4}$  in. bore inclusive, the month of manufacture is represented by the individual letters of the words **BEST COUPLING** for example T-1-C-8 indicates that the pipe was manufactured and tested on 1st May, 1948.

For sizes from  $\frac{1}{2}$  in. bore and over, the year of manufacture is represented by a letter as follows: 1944=A, 1945=B, 1946=C, 1947=D, 1948=E. Therefore, E/9/T indicates that the pipe was manufactured and tested in September, 1948.

The various types of hose used for the flexible pipes may be identified by the number and colour of the thin identification lines that are painted along their length. The following types are used on de Havilland engines:—

| Manufacturer's specification | Identification line/s |
|------------------------------|-----------------------|
| Dunlop WH2/1                 | One brown line        |
| Dunlop WH2/2                 | Two brown lines       |
| Palmer 971                   | One green line        |
| Palmer 965                   | Two green lines       |

#### FITTING AND REMOVING

Before fitting a new or replacement flexible pipe ensure that it bears the correct part number for the installation. Examine the end fittings of the pipe for corrosion or damage which may have occurred in storage or transit. Flush through the bore of the pipe with clean kerosene, petrol, or any of the fuels approved for the engine, and ensure that the end fittings, especially elbows or banjos, are perfectly clean. After flushing, oil pipes should be dried out with dry clean compressed air to avoid fuel contamination of the lubricating oil. Before being fitted to an engine, burner flexible feed pipes which have been in store for a period of six months or more should be pressure tested in accordance with

the instructions given on page 4. If the pipe is not being fitted to the engine immediately, blank off the ends of the pipe with clean blanks.

The serviceability of flexible pipes is considerably affected by the amount they are bent when in position on the engine, and a minimum bending radius is specified for all pipes as follows:—

TABLE OF MINIMUM BENDING RADII  
All dimensions in inches

| BORE           | DUNLOP             |                    | PALMER           |                  |
|----------------|--------------------|--------------------|------------------|------------------|
|                | WH2/1<br>(1 brown) | WH2/2<br>(2 brown) | 971<br>(1 green) | 965<br>(2 green) |
| $\frac{5}{8}$  | 1½                 | 2½                 | 1½               | —                |
| $\frac{1}{2}$  | 2                  | 3                  | 2                | 2                |
| $\frac{3}{8}$  | 2½                 | 3½                 | 2½               | 2½               |
| $\frac{1}{4}$  | 3                  | 4½                 | 3                | 3                |
| $\frac{3}{16}$ | 3¾                 | 5½                 | 4                | 3½               |
| $\frac{1}{8}$  | 4½                 | 7                  | 5                | 4                |
| 1              | 6                  | 10                 | 6                | 5                |
| 1¼             | —                  | —                  | 7                | —                |

Note.—The bore of individual pipes is given in the tables at the end of this chapter.

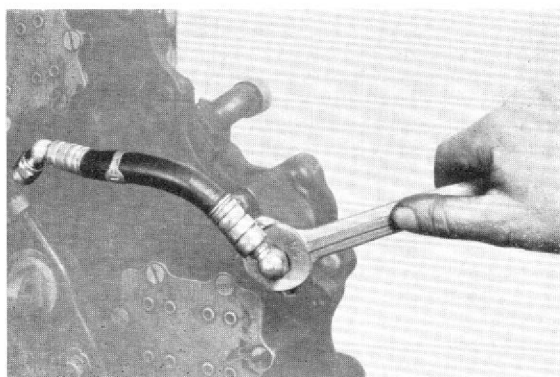


Fig. 2. Bend in flexible pipe caused by using the incorrect method of fitting.

The bending radius must always be kept within the limits, and a sharp bend at the point where the hose enters the end fitting must be avoided. The latter can be caused by using the incorrect method of fitting as illustrated in Fig. 1 and 2; in this case a Goblin burner feed pipe is illustrated. In Fig. 1 the pipe has been loosely assembled and the union nut is being tightened without holding the pipe in position. As the union nut begins to lock, the union also tends to rotate

and bend the pipe as shown in Fig. 2. This method of fitting will result in a pipe failure, such as that illustrated in Fig. 3, after only a short period of engine running.

The correct method of fitting a flexible pipe is as follows. Assemble the pipe loosely, i.e., union



Fig. 3. Failure of flexible pipe caused by using the incorrect method of fitting.

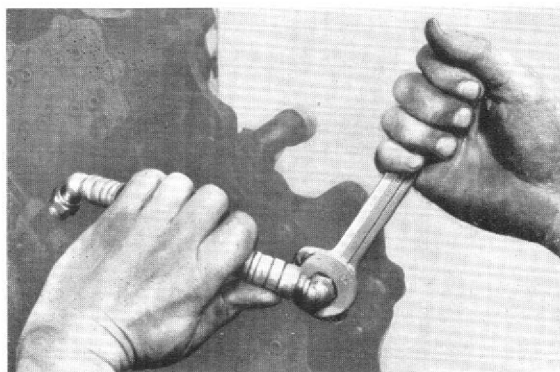


Fig. 4. Correct method of fitting a flexible pipe.

nuts finger-tight, and allow it to take up its natural run. Care must be taken where elbows or special end fittings are concerned that the assembly is fitted the correct way round. Ensure that there are no twists in the pipe; the pipes are marked along their length with thin identification lines so that it will be obvious if they are twisted. Hold the pipe as shown in Fig. 4 and tighten the union nuts, but avoid over-tightening these nuts as this can cause damage to nipple faces and cone seatings. Fig. 5 shows a correctly fitted Goblin burner feed pipe. If clips are employed to support the pipe, care should be taken when fitting them to avoid stressing the hose, particularly adjacent to the end fittings. Suitable packing should be used to prevent the clips from damaging the hose cover. Finally, wire-lock the union nuts.

There will be a considerable reduction in the flexibility of the pipes at very low temperatures, and therefore great care must be exercised when handling them under severe arctic conditions.

If it is necessary to remove a pipe under these conditions, it should be removed whilst warm after an engine run, or after first applying heat from an external source, i.e., warm blanket or similar device. If neither of these methods are possible, disconnect both ends of the pipe and remove it without distortion to the installed shape. Do not bend the pipe with one end anchored whilst it is in the temporary hard state. After removal, the pipe should be kept in a warm place until it is required to refit it.

#### PERIODIC INSPECTION

The following visual checks should be made on all flexible pipes when carrying out a routine engine inspection. If one end of a pipe is disconnected during an inspection it should be properly blanked, and care must be taken to avoid bending the pipe excessively. If a pipe is removed, it should be flushed through before it is refitted.

*End fittings.* Inspect for signs of corrosion,

leakage, cracks or other damage. Where corrosion has caused excessive pitting, especially on the outer ferrule, the pipe should be rejected. Check the pipe for leakage at the end fittings; this condition is normally indicated by a liquid stain at the junction of the hose and ferrule. If this defect is apparent the pipe should be removed and pressure tested as described on this page. Check the general condition of the union nuts, the locking wire holes, and the welded or brazed joints on angle end fittings. If the pipe has been disconnected, check the condition of the union nut threads and the mating faces. The pipe should be rejected if the banjo faces or the spherical or conical nipples are badly scored, dented, or otherwise damaged.

*Kinking.* This defect is usually caused by bad installation, such as bending the pipe through a smaller radius than that specified as the minimum. If the pipe has taken up a permanent set it should be rejected.

*Chafed or cut covers.* The pipe run should be altered if local chafing or cutting of the hose cover is detected so that further damage is avoided. If clips are fitted, care must be taken to avoid stressing the hose, particularly adjacent to the end fittings, and suitable packing should be used to prevent the clips from damaging the cover. If the cover is worn or cut through to the wire braiding, the pipe should be rejected.

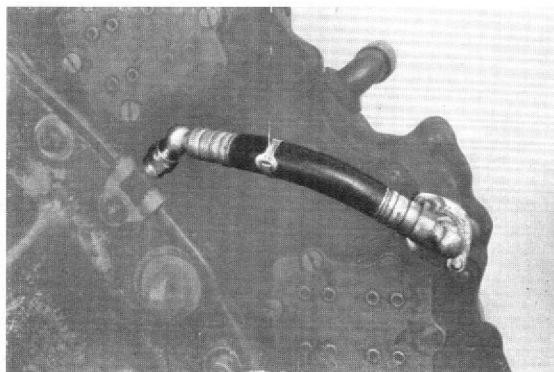


Fig. 5. A correctly fitted flexible pipe.

*Cracked covers.* Deep cracks may develop in the hose cover if the pipe is subjected to abnormal conditions such as excessive heat or local tension due to bad installation. If the cover is cracked through to the wire braiding the pipe should be rejected, but if it is not cracked to this extent, the pipe may remain in service subject to a satisfactory pressure test.

*Surface ageing.* Minute cracks may develop on the surface of the hose cover as a result of surface ageing. No premature failure need be anticipated, as the serviceability of the hose is unimpaired, and periodic inspection will discover if after long periods deeper cracks develop.

*Blistered covers.* Blisters may be caused by the seepage of air or liquid through the wall of the pipe, and they should be carefully punctured with a needle. If air emerges the pipe should be pressure tested and if no further leakage occurs the pipe may be regarded as serviceable, but if liquid emerges the pipe should be rejected.

*Deterioration.* External deterioration is usually denoted by surface hardening and loss of flexibility. If the serviceability of the pipe is in doubt, it should be removed and pressure tested.

#### TESTING

All flexible pipes should be tested at each com-

plete overhaul period of the engine. It is recommended that the burner feed pipes should be tested at each combustion chamber inspection period, and at the other times defined on page 1 in sub-para. 2.

Before carrying out the following tests, the end fittings and hose should be inspected as detailed under Periodic Inspection.

**Pressure test.** The following instructions are based on the de Havilland Gas Turbine Test Specification T.T.S.34, Issue 7, and as these specifications are subject to continual revision it is always desirable to check with The de Havilland Engine

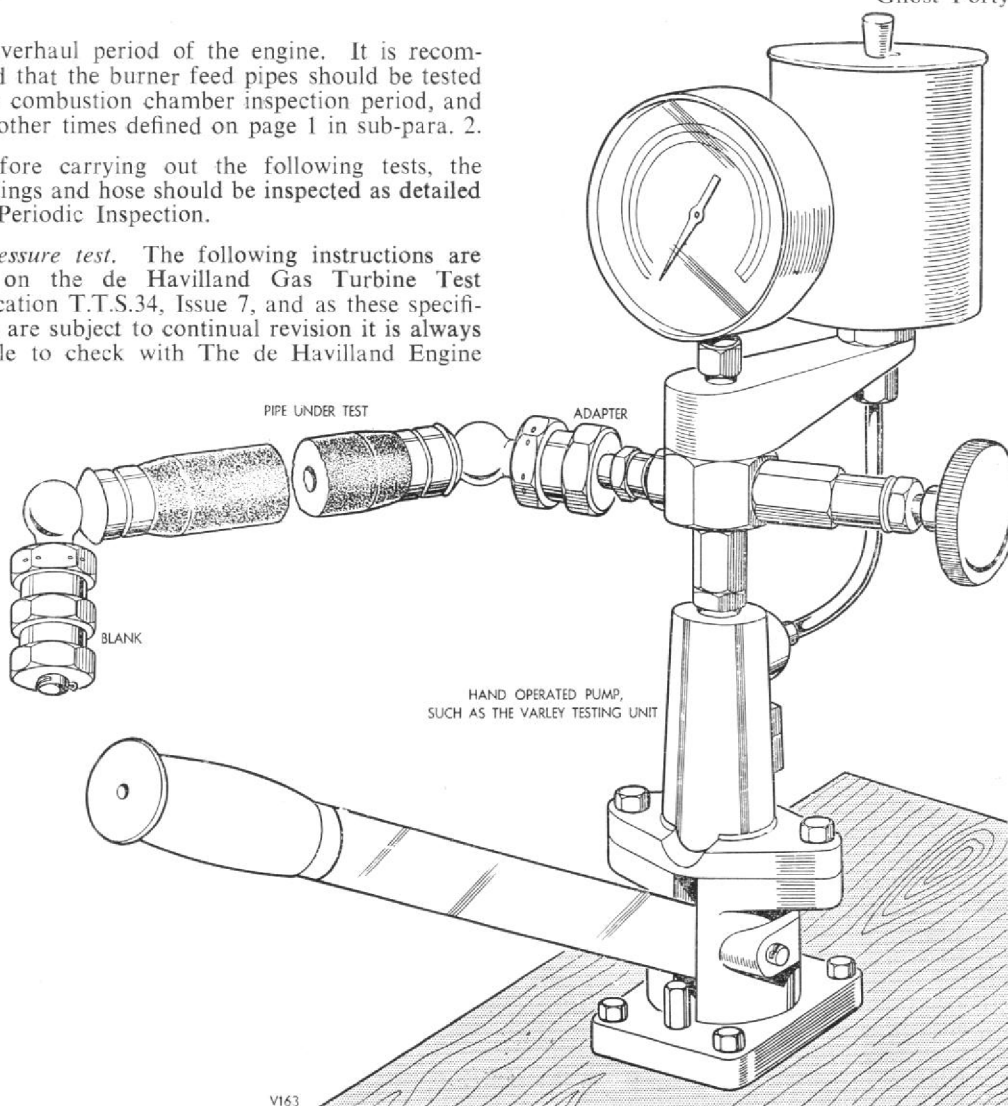


Fig. 6. Hand-operated pump for pressure testing flexible pipes.

Company whether this is the latest specification before commencing the tests.

The equipment necessary to carry out the pressure test consists of a hand pump and a pressure gauge and a set of suitable adapters and blanks. The Varley testing unit illustrated in Fig. 6 is suitable for this test and a list of adapters and blanks is given in the tables at the end of this chapter. Where no adapter or blank exists, a dimensioned sketch from which the item can be manufactured is also given. Pressure test rigs suitable for use at a major overhaul depot are illustrated and described in Chapter 21, pages 24 to 26.

The test fluid should be aviation kerosene to specification D.Eng.R.D. 2482, petrol, or any of the fuels approved for the engine, and it should be used at the prevailing ambient temperature. Alternatively, the test fluid may be water containing not less than 10% and not more than 20% by volume of Shell Dromus Oil B (soluble cutting oil, emulsion in water is white and assists the detection of leaks).

Each flexible pipe should be tested as follows.

Blank off one end of the pipe and, having ensured that the pipe is full of fluid (no air locks), apply the correct fluid pressure as specified in the tables at the end of this chapter. Maintain the pressure for three minutes. During the first two minutes of the test the pipe must be retained in approximately its natural shape; including any permanent set the pipe may have assumed. During the last minute of the test the pipe must be flexed (say five complete flexings) through approximately plus and minus 15 degrees. During this test the pipe is to be carefully examined for leakage. No leakage is permissible.

**Bonding test.** A continuity test should be applied between the end fittings using a lamp and battery, with a voltage not exceeding 2.5 volts, or other approved means. The resistance between the end fittings should not exceed 0.050 ohm, or 0.025 ohm per foot, whichever is the greater.

**Flow test.** On pipes with straight end fittings a flow test is unnecessary, but a visual check should be made through the bore of the pipe to ascertain if any restriction or lining tube damage is present.

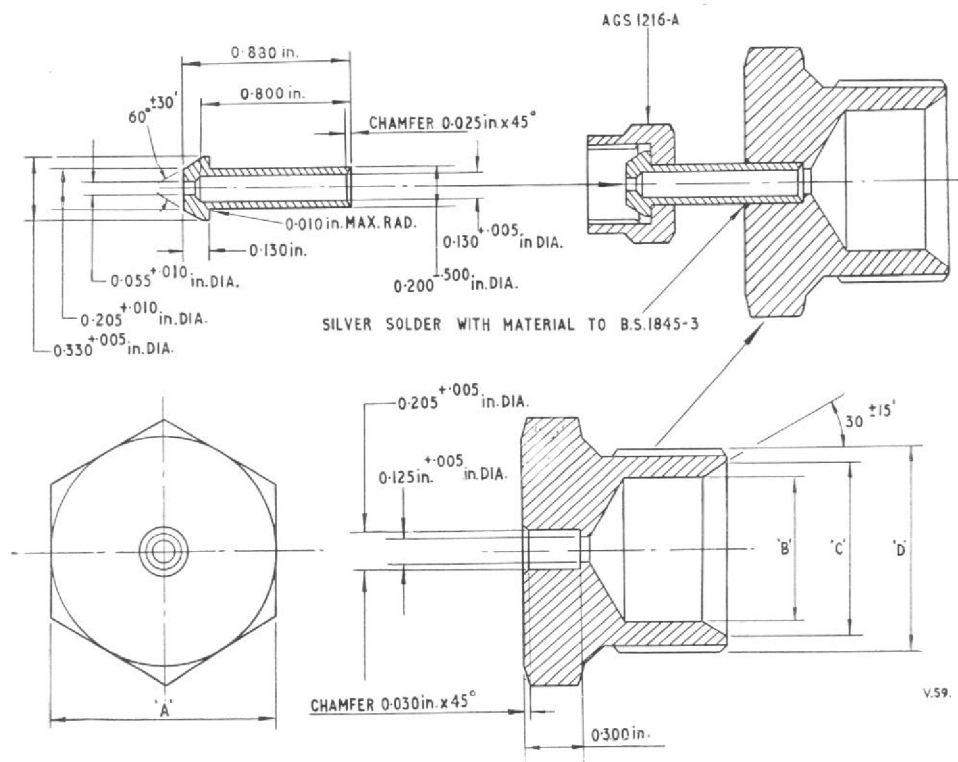


Fig. 7. Adapter for pipes terminating with a union nut ; for dimensions A, B, C, and D, see table below.

Slight irregularities in the bore are attributable to minor manufacturing discrepancies which are of no consequence. On all pipes with angle or banjo end fittings a flow test should be made both ways to check for restriction in the bore. Using the test fluid with a "head" of 12 inches and a vertical feed, the flow should not be less than that specified in the following table.

| Bore<br>in.    | Flow<br>Gallons per minute | Flow<br>Gallons per hour |
|----------------|----------------------------|--------------------------|
| $\frac{5}{16}$ | 0.18                       | 11                       |
| $\frac{1}{4}$  | 0.25                       | 15                       |
| $\frac{3}{8}$  | 0.40                       | 24                       |
| $\frac{1}{2}$  | 0.80                       | 48                       |
| $\frac{5}{8}$  | 1.42                       | 85                       |
| 1              | 1.83                       | 110                      |
| $1\frac{1}{4}$ | 3.75                       | 225                      |
| $1\frac{1}{2}$ | 5.83                       | 350                      |

Note.—The bore of individual pipes is given in the tables at the end of this chapter.

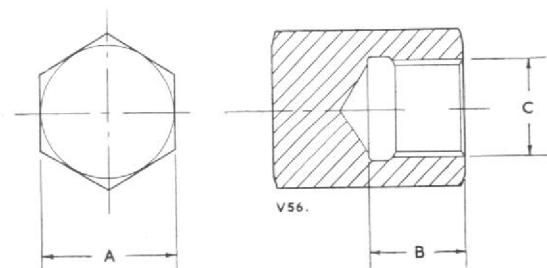


Fig. 8. Cap nut for use in conjunction with banjo bolt and washers for blanking banjo type end fittings ; for dimensions see table in next column.

| Dimensions in ins. |                 |              |                        | Equivalent<br>adapter<br>number |
|--------------------|-----------------|--------------|------------------------|---------------------------------|
| A                  | B               | C            | D                      |                                 |
| 0.715 - .005       | $\frac{9}{32}$  | 0.405 + .010 | $\frac{1}{4}$ B.S.P.   | 601757*                         |
| 0.820 - .005       | $\frac{1}{2}$   | 0.545 + .010 | $\frac{1}{2}$ B.S.P.   | 601760                          |
| 1.100 - .008       | $\frac{5}{8}$   | 0.755 + .010 | $\frac{3}{4}$ B.S.P.   | 601763                          |
| 1.100 - .008       | $\frac{5}{8}$   | 0.825 + .010 | $\frac{1}{2}$          | 601829                          |
| 1.200 - .010       | $\frac{3}{4}$   | 0.900 + .010 | $\frac{3}{4}$ B.S.P.   | 601766                          |
| 1.480 - .012       | $\frac{7}{8}$   | 1.175 + .010 | 1 B.S.P.               | 601769                          |
| 1.860 - .015       | 1 $\frac{1}{4}$ | 1.400 + .010 | 1 $\frac{1}{4}$ B.S.P. | 601832                          |

\* Alternatively use adapter T.77097.

† 0.9375 dia. 20 T.P.I. Whitworth form, effective diameter 0.9055 - .0051 full diameter 0.9301 - .0056 (truncated).

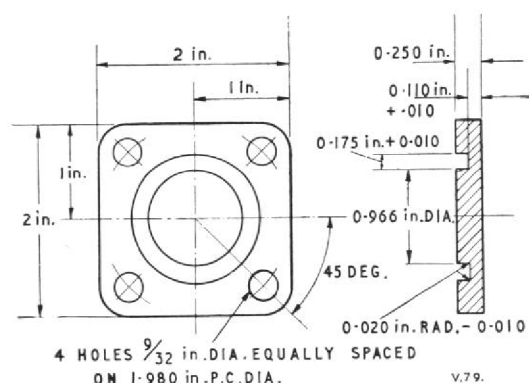
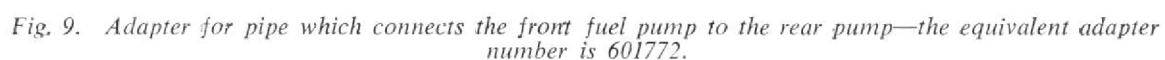
## STORAGE

The pipes should be stored in a dark location, preferably in boxes, where the temperature does not exceed 15 deg. C. They should not be stored in a state of stress, i.e., tightly coiled or piled in such numbers as will cause the bottom layers to be partially flattened, and care should be taken to avoid damage to hose covers by the end fittings. Blanking caps should always be fitted to the ends of the pipes, and these must remain in position until the pipes are required for service.

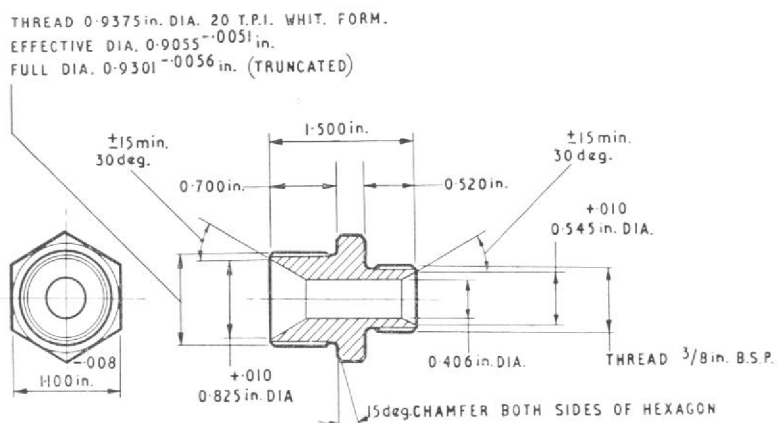
| Dimensions in inches |       |                      | Equivalent<br>cap nut<br>number |
|----------------------|-------|----------------------|---------------------------------|
| A                    | B     | C                    |                                 |
| 0.500 - .005         | 0.525 | $\frac{1}{8}$ B.S.P. | 601790                          |
| 0.710 - .005         | 0.500 | $\frac{1}{4}$ B.S.P. | 601789                          |
| 0.820 - .005         | 0.750 | $\frac{3}{8}$ B.S.P. | —                               |
| 1.100 - .008         | 0.750 | $\frac{1}{2}$ B.S.P. | 601788                          |
| 1.300 - .008         | 0.800 | $\frac{3}{4}$ B.S.P. | 601831                          |

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When making up these adapters and blanks, materials and sections should be chosen with the specified test pressures in mind. All undercuts and corners should be generously radiused. Joint surfaces must be smooth and free from tool marks.



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Fig 12. Special union for blanking manifold pipes—the equivalent union number is 601839.

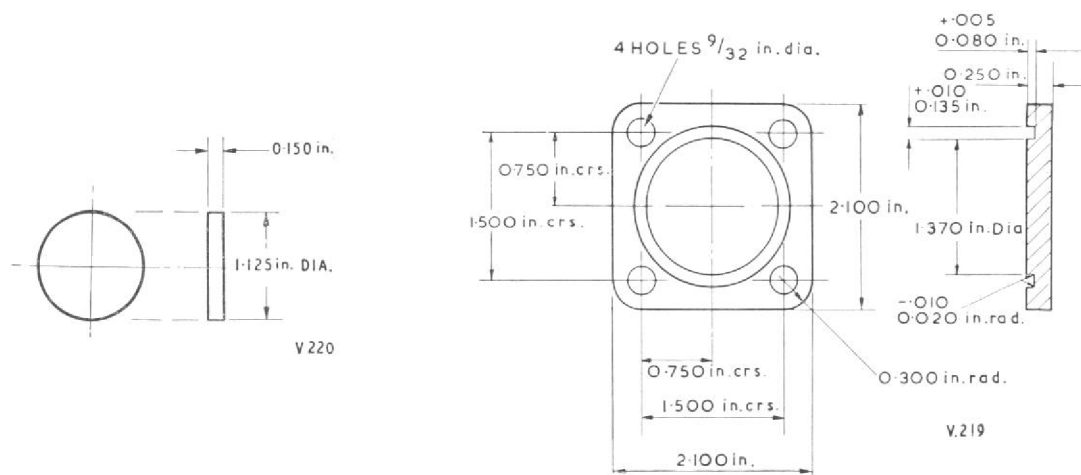


Fig. 13. Special blanking disc for manifold connection pipes—the equivalent blanking disc number is 601840.

Fig. 14. Special blanking plate for feed pipe which connects L.P. filter to fuel pump—the equivalent blanking plate number is 601835.

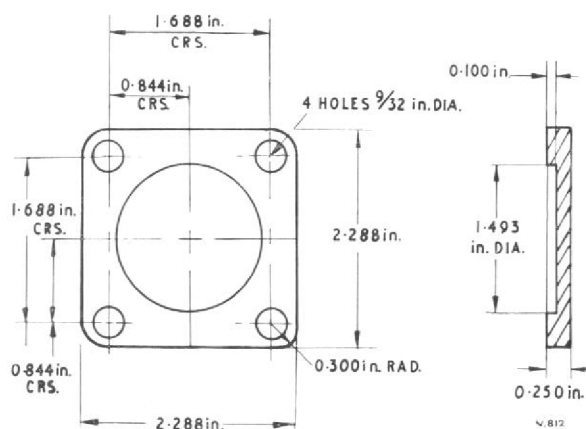


Fig. 15. Blanking plate for H.P. filter pipe, and L.P. filter to pump pipe, Ghost 53 Mk. 1.

## TABLE OF PIPES, ADAPTERS, BLANKS AND PRESSURES

Ghost 48 Mk. 1

All pipes to be tested at overhaul. Only pipes shown in darker type need be tested during routine servicing.

*In this table, the prefix "standard" before a blanking part indicates that that part is a standard engine part listed in the Spare Parts Catalogue; the prefix "special" indicates that that part must be manufactured locally to the dimensions given in this chapter.*

| Pipe                                                      | Bore inches    | Adapter for use with Varley testing unit                              | Blank                                                                                                                                                                                                                                                                                   | Test pressure lb. per sq. in. |
|-----------------------------------------------------------|----------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Front pump to B.P.C., delivery pressure                   | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                                                                       | 3400                          |
| Rear pump to H.P. filter                                  | $\frac{5}{8}$  | 601763<br>$\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.            | Union A.G.S.949/E<br>Blank A.G.S.1197/E<br>Union nut A.G.S.1216/E                                                                                                                                                                                                                       | 3400                          |
| Front pump to rear pump, delivery pressure                | $\frac{1}{2}$  | 601772<br>$\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.            | 2 Banjo bolts A.G.S.1135/E<br>4 Aluminium washers A.G.S.1138/E<br>2 Special $\frac{5}{8}$ " B.S.P. cap nuts 601788                                                                                                                                                                      | 3400                          |
| B.P.C. to A-F.R.C., servo pressure                        | $\frac{5}{32}$ | None required                                                         | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                                                                       | 3400                          |
| Pump to pump, servo pressure                              | $\frac{5}{32}$ | None required                                                         | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                                                                       | 3400                          |
| Front pump to B.P.C., servo pressure                      | $\frac{5}{32}$ | None required                                                         | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                                                                       | 3400                          |
| H.P. filter to control valve                              | $\frac{5}{8}$  | 601763<br>$\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.            | Union A.G.S.949/E<br>Blank A.G.S.1197/E<br>Union nut A.G.S.1216/E                                                                                                                                                                                                                       | 3380                          |
| Control valve to air-fuel ratio control, metered pressure | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                                                                       | 3000                          |
| Control valve to distributor                              | $\frac{5}{8}$  | 601763<br>$\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.            | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B<br>Standard blanking plate 96313<br>Standard seal N.4279<br>2 $\frac{1}{4}$ " B.S.F. bolts 6A1/10E<br>2 $\frac{1}{4}$ " B.S.F. bolts 6A1/3E<br>4 $\frac{1}{4}$ " B.S.F. plain nuts A.16.Y.EP<br>4 Washers A.G.S.162/D | 3000                          |
| Burner Feed                                               | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                                                                       | 2900                          |
| Control valve to B.P.C. to pump, spill                    | $\frac{3}{8}$  | 601760<br>$\frac{1}{8}$ " B.S.P. to $\frac{3}{8}$ " B.S.P.            | Union A.G.S.949/C<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C<br>Special $\frac{1}{4}$ " B.S.P. cap nut 601789<br>2 Standard aluminium washers N.1502<br>Standard banjo bolt N.2270                                                                                                 | 250                           |
| L.P. filter to front pump                                 | 1              | 601769<br>$\frac{1}{8}$ " B.S.P. to 1" B.S.P.                         | Special blanking plate 601828<br>4 $\frac{1}{4}$ " B.S.F. bolts 6A1/3E<br>4 $\frac{1}{4}$ " B.S.F. plain nuts A.16.Y.EP<br>4 Washers A.G.S.162/D                                                                                                                                        | 250                           |
| A-F.R.C. to control valve, spill                          | $\frac{5}{32}$ | None required                                                         | Banjo bolt A.G.S.1135/A<br>2 Aluminium washers A.G.S.1138/A<br>Special $\frac{1}{8}$ " B.S.P. cap nut 601790                                                                                                                                                                            | 250                           |
| Combustion chamber drain                                  | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | 2 Unions A.G.S.949/C<br>2 Blanks A.G.S.1197/C<br>2 Union nuts A.G.S.1216/C                                                                                                                                                                                                              | 250                           |
| Metering pump to No. 10 diffuser bolt                     | $\frac{5}{32}$ | None required                                                         | Standard banjo bolt N.2270<br>2 Aluminium washers N.1502<br>Special $\frac{1}{4}$ " B.S.P. cap nut 601789                                                                                                                                                                               | 250                           |
| Metering pump to front bearing (Pre-mod. 431)             | $\frac{5}{32}$ | None required                                                         | Union A.G.S. 949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                                                                      | 250                           |
| Restrictor to front bearing (Mod. 431)                    | $\frac{5}{32}$ | None required                                                         | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                                                                       | 250                           |

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April, 1957

## TABLE OF PIPES, ADAPTERS, BLANKS AND PRESSURES

Ghost 48 Mk. 2

All pipes to be tested at overhaul. No pipes need testing during routine servicing.

*In this table, the prefix "standard" before a blanking part indicates that that part is a standard engine part listed in the Spare Parts Catalogue; the prefix "special" indicates that that part must be manufactured locally to the dimensions given in this chapter.*

| Pipe                                                                           | Bore<br>inches | Adapter for use with<br>Varley testing unit                           | Blank                                                                                                                                                                                   | Test pressure<br>lb. per sq. in. |
|--------------------------------------------------------------------------------|----------------|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| A-F.R.C. unit to circulating pump and valve group unit                         | $\frac{3}{4}$  | 601766<br>$\frac{1}{8}$ " B.S.P. to $\frac{3}{4}$ " B.S.P.            | Banjo bolt A.G.S.1135/F<br>2 Washers A.G.S.1138/F<br>Special $\frac{3}{4}$ " B.S.P. cap nut 601831                                                                                      | 1700                             |
| Supply pump to A-F.R.C., servo pressure, Mod. 1145, Pre-mod. 1284.             | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 1700                             |
| Supply pump to solenoid valve, servo Pressure, Mod. 1284 Part 2, Pre-mod. 1175 | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 1700                             |
| Circulating pump to solenoid valve, servo pressure, Mod. 1175                  | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 1700                             |
| Supply pump to flow control unit, servo pressure, Mod 1284                     | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 1700                             |
| Solenoid valve to A-F.R.C. servo pressure, Mod. 1284                           | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 1700                             |
| Manifold feed                                                                  | $\frac{5}{8}$  | 601829<br>$\frac{1}{8}$ " B.S.P. to 0.9375"<br>20 T.P.I.              | Special 0.9375" 20 T.P.I. union<br>601839<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C                                                                                               | 1570                             |
| Manifold feed connection                                                       | $\frac{5}{8}$  | 601829<br>$\frac{1}{8}$ " B.S.P. to 0.9375"<br>20 T.P.I.              | Special 0.9375" 20 T.P.I. union<br>601839<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C<br>Washer A.G.S.1186/D<br>Special $1\frac{1}{8}$ " blanking disc 601840<br>Standard nut 94450 | 1570                             |
| Manifold spill                                                                 | $\frac{5}{8}$  | 601829<br>$\frac{1}{8}$ " B.S.P. to 0.9375"<br>20 T.P.I.              | Special 0.9375" 20 T.P.I. union<br>601839<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C                                                                                               | 1270                             |
| Manifold spill connection                                                      | $\frac{5}{8}$  | 601829<br>$\frac{1}{8}$ " B.S.P. to 0.9375"<br>20 T.P.I.              | Special 0.9375" 20 T.P.I. union<br>601839<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C<br>Washer A.G.S.1186/D<br>Special $1\frac{1}{8}$ " blanking disc 601840<br>Standard nut 94450 | 1270                             |
| Feed from L.P. filter to fuel pump                                             | $1\frac{1}{4}$ | 601832<br>$\frac{1}{8}$ " B.S.P. to $1\frac{1}{4}$ " B.S.P.           | Special blanking plate 601835<br>Standard seal N.4583<br>4 $\frac{1}{4}$ " B.S.F. bolts 6A1/3E<br>4 $\frac{1}{4}$ " B.S.F. plain nuts A.16.Y.EP<br>4 Washers A.G.S.162/D                | 250                              |
| Cooling feed from fuel pump to circulating pump                                | $\frac{5}{8}$  | 601763<br>$\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.            | Banjo bolt A.G.S.1135/E<br>2 Washers A.G.S.1138/E<br>Special $\frac{5}{8}$ " B.S.P. cap nut 601788                                                                                      | 250                              |
| Combustion chamber drain                                                       | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | 2 Unions A.G.S.949/C<br>2 Blanks A.G.S.1197/C<br>2 Union nuts A.G.S.1216/C                                                                                                              | 250                              |
| Restrictor to front bearing                                                    | $\frac{1}{4}$  | 601757 or T.77097<br>$\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P. | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                       | 250                              |

For Ghost 53 Mk. 1, see overleaf.

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April, 1957

# TABLE OF PIPES, ADAPTERS, BLANKS AND PRESSURES

Ghost 53 Mk. 1

All pipes to be tested at overhaul. Only pipes shown in darker type need be tested during routine servicing.

*In this table, the prefix "standard" before a blanking part indicates that that part is a standard engine part listed in the Spare Parts Catalogue; the prefix "special" indicates that that part must be manufactured locally to the dimensions given in this chapter.*

| Pipe                                        | Bore inches    | Adapter for use with Varley testing unit                                                                                     | Blank                                                                                                                                                                                                                                  | Test pressure lb. per sq. in. |
|---------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| Pump to H.P. filter                         | $\frac{5}{8}$  | $\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.                                                                             | Special blanking plate<br>Standard seal N.8103<br>4 $\frac{1}{4}$ " B.S.F. bolts 6A1/3E.<br>4 $\frac{1}{4}$ " B.S.F. nuts A.16.Y.EP.<br>4 Washers A.G.S.162/D                                                                          | 3700                          |
| H.P. filter to servo throttle               | $\frac{5}{8}$  | $\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.                                                                             | Banjo bolt A.G.S.1135/E<br>2 Aluminium washers<br>A.G.S.1138/E<br>Special $\frac{5}{8}$ " B.S.P. cap nut                                                                                                                               | 3700                          |
| Pump to B.P.C., servo pressure              | $\frac{5}{32}$ | None required                                                                                                                | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                      | 3700                          |
| Pump to B.P.C., delivery pressure           | $\frac{1}{4}$  | $\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P.<br>alternatively use T.77097                                                | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                      | 3700                          |
| Control valve to A-F.R.C., metered pressure | $\frac{1}{4}$  | $\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P.;<br>alternatively use T.77097                                               | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                      | 3700                          |
| Servo throttle to control valve             | $\frac{5}{8}$  | $\frac{1}{8}$ " B.S.P. to $\frac{5}{8}$ " B.S.P.                                                                             | Union A.G.S.949/E<br>Blank A.G.S.1197/E<br>Union nut A.G.S.1216/E                                                                                                                                                                      | 3500                          |
| Control valve to distributor                | $\frac{5}{8}$  | $\frac{1}{8}$ " B.S.P. female to $\frac{5}{8}$ " B.S.P. female<br>Banjo bolt AGS.1135/E<br>2 Aluminium washers<br>AGS.1138/E | Standard blanking plate 96313<br>Standard seal N.4279<br>4 $\frac{1}{4}$ " B.S.F. bolts 6A1/3E<br>4 $\frac{1}{4}$ " B.S.F. plain nuts A.16.Y.EP.<br>4 Washers A.G.S.162/D<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B              | 3100                          |
| Burner feed                                 | $\frac{1}{4}$  | $\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P.;<br>alternatively use T.77097                                               | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                      | 2800                          |
| L.P. filter to pump                         | $1\frac{1}{4}$ | $\frac{1}{8}$ " B.S.P. to $1\frac{1}{4}$ " B.S.P.                                                                            | Special blanking plate<br>Standard seal N.8103<br>4 $\frac{1}{4}$ " B.S.F. bolts 6A1/3<br>4 $\frac{1}{4}$ " B.S.F. plain nuts A.16.Y.EP.<br>4 Washers A.G.S.162/D<br>Union A.G.S.940/C<br>Blank A.G.S.1197/C<br>Union nut A.G.S.1216/C | 250                           |
| Control valve to pump, spill                | $\frac{3}{8}$  | $\frac{1}{8}$ " B.S.P. to $\frac{3}{8}$ " B.S.P.                                                                             | Banjo bolt A.G.S.1135/C<br>2 Aluminium washers A.G.S.1138/C<br>Special $\frac{3}{8}$ " B.S.P. cap nut                                                                                                                                  | 250                           |
| Restrictor to front bearing                 | $\frac{1}{4}$  | $\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P.;<br>alternatively use T.77097                                               | Union A.G.S.949/A<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                      | 250                           |
| Restrictor to oil pump cover                | $\frac{5}{32}$ | None required                                                                                                                | Union A.G.S.949/A<br>Blank A.G.S.1197/A<br>Union nut A.G.S.1216/A                                                                                                                                                                      | 250                           |
| Expansion chamber drain                     | $\frac{1}{4}$  | $\frac{1}{8}$ " B.S.P. to $\frac{1}{4}$ " B.S.P.;<br>alternatively use T.77097                                               | Union A.G.S.949/B<br>Blank A.G.S.1197/B<br>Union nut A.G.S.1216/B                                                                                                                                                                      | 250                           |

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