AP 101A-0300-1

(Formerly AP 101A-0300-1A)

AIRCRAFT PIPELINES AND PIPELINE COMPONENTS

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

Frank Cooper.

Ministry of Defence

Sponsored for use in the

ROYAL NAVY by DGA(N)
ARMY SERVICE by DEME(A)
ROYAL AIR FORCE by D Air Eng (RAF)

Publications authority: ATP/MOD(PE)

Service users should send their comments through
the channel prescribed for the purpose in:
Naval Aircraft Maintenance Manual(RN)
EMER Aircraft A040 (ARMY)
AP 100B-01 Order 0504 (RAF)

AMENDMENT RECORD

Amdt	Incorporated by	Date
1		
2	Issued	
3	~~Incorporated Mar. 79~~	
4		
5		
6		
7	[illegible]	21/10/80
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		

Amdt	Incorporated by	Date
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		
63		
64		
65		
66		
67		
68		

CONTENTS

Chapter 1

MARKING OF PIPING ON AIRCRAFT

CONTENTS

ILLUSTRATIONS

TABLE

Introduction

1. For identification purposes, all pipe-lines in aircraft are marked at convenient intervals and where they pass through a structure such as a bulkhead; thus all piping can be traced throughout its length, with no possibility of confusion with other pipes in the system.

2. The identification markers are placed at both ends of a pipe-line component, at approximately 2 ft. intervals along a pipe run, and adjacent to each service point or inspection cover. To prevent the over use of these markers, where long pipe runs are easily viewed markers are located at intervals which ensure that at least one is visible from all viewing positions. Similarly where a readily traced pipe-line of less than 2 ft. length is installed only one marker need be used.

3. The standard method used for marking aircraft pipe-lines is to B.S.I. specification 3M.23, which complies with the international standard, using symbols. On aircraft produced before 1949 the identification is by means of coloured bands.

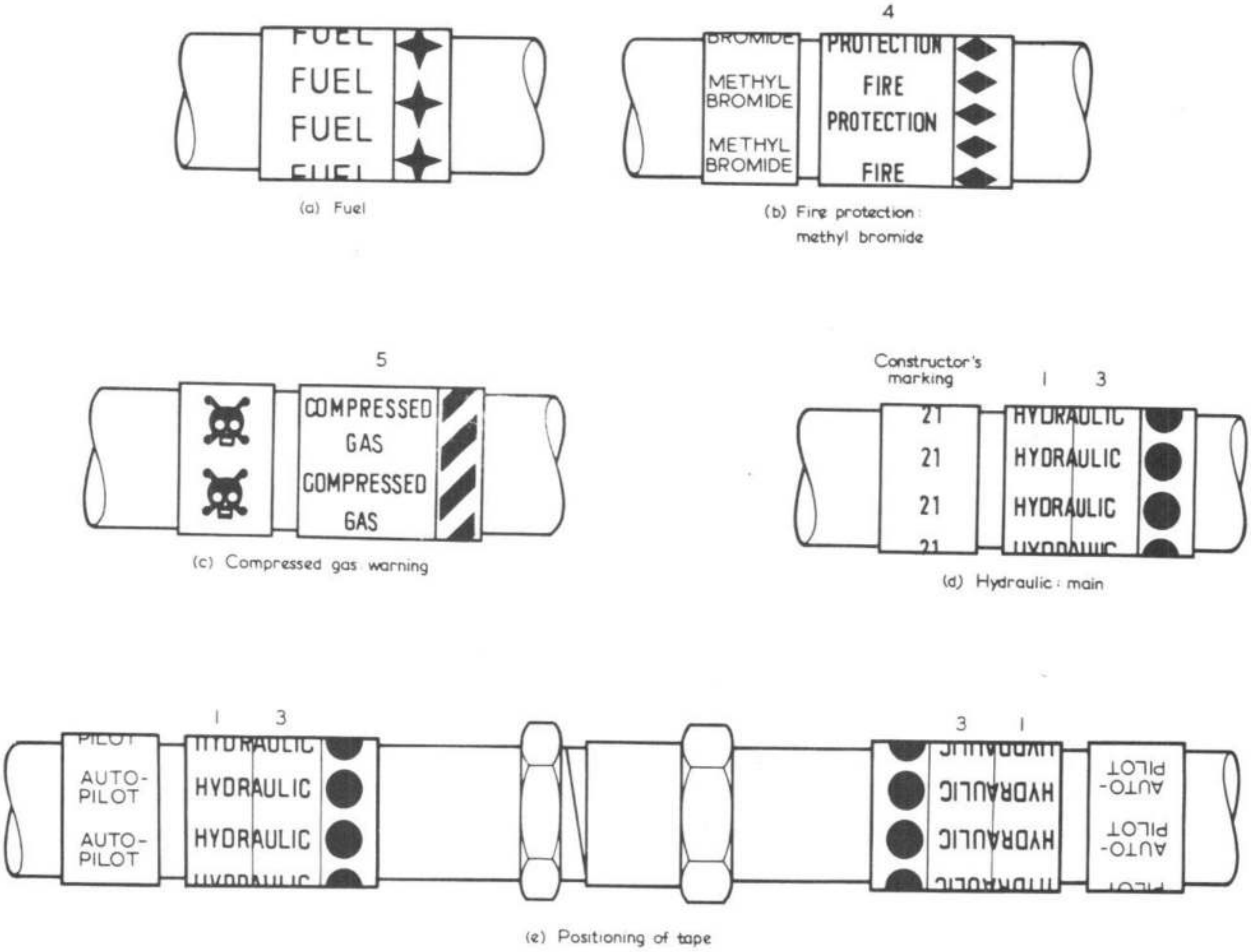


Fig. 1. Typical application

IDENTIFICATION MARKER

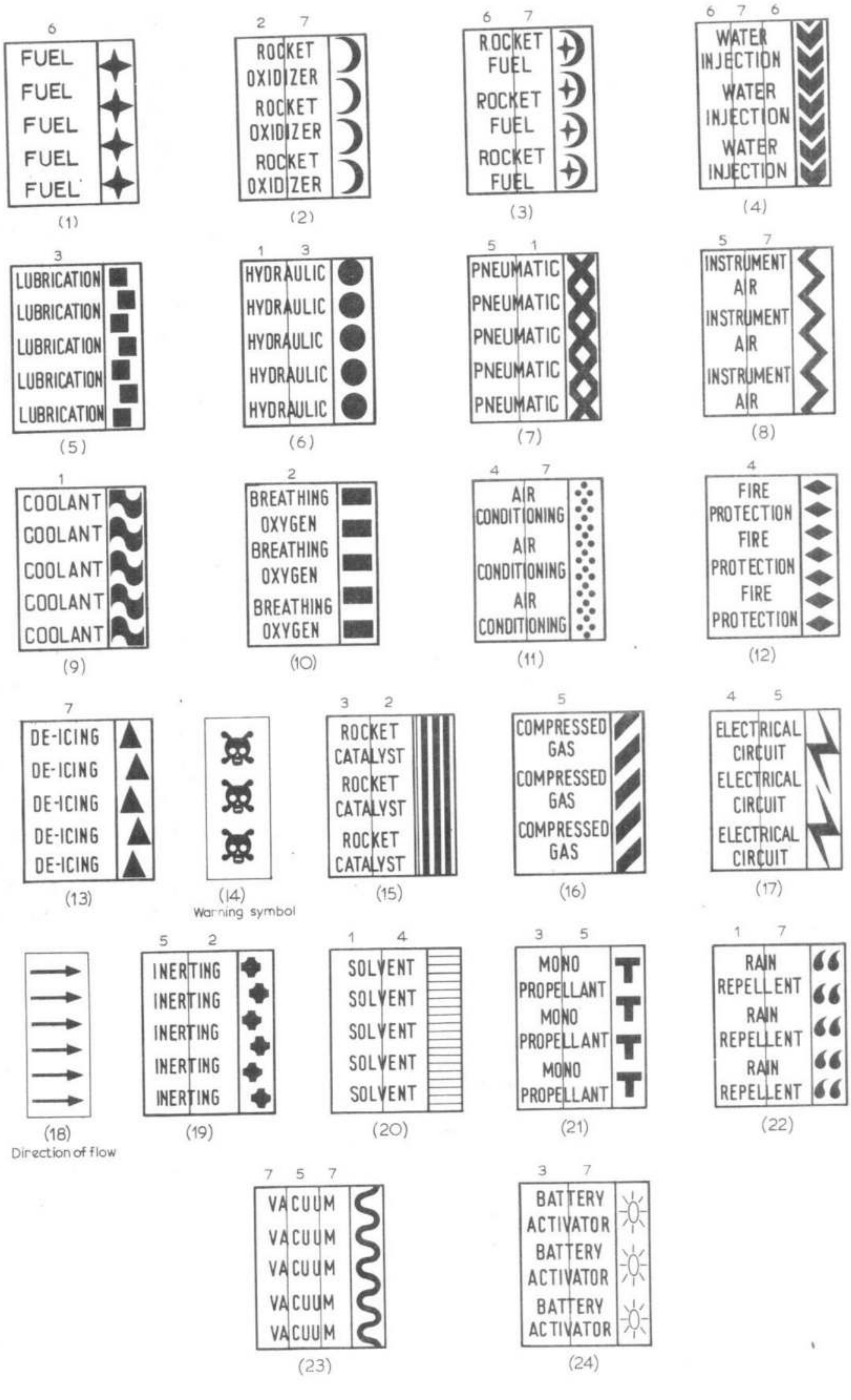
Basic identification

4. Pipe-lines from the various systems are marked with the appropriate marker; this includes filter lines, pressure transmitter lines, priming lines and drain lines from the main or related equipment. In cases where no standard marking is available e.g. drinking water, the pipe will be identified by markers bearing the name of the function only.

TABLE 1

Standard colours used in markers, fig.2

	Colour	British Standard No. BS 381C
1	Blue	166
2	Green	218
3	Yellow	309
4	Brown	412
5	Orange	592
6	Red	538
7	Grey	631



NOTE 1. The numbers above the markers are the serial numbers of the colours as given in Table 2 and Appendix A.
NOTE 2. Enlargements of the symbols, showing dimensions, are available from the British Standards Institute.

Fig.2 Identification markers

Supplementary identification

5. Where it is necessary to identify the specific function of a pipe-line in the system, sub-division of the main function is made by adding additional words describing the specific function, e.g. Methyl bromide, Auto pilot. These additional words, in black on a white background, are located on a narrow marker alongside the left-hand edge of the basic identification marker, fig.1.

Warning symbol

6. When the contents of a pipe-line is considered to be dangerous to maintenance personnel, a marker bearing the skull and cross bones symbol, fig.1, is applied adjacent to the identification marker.

Additional markings

7. Where pipelines are manufactured for uni-flow systems, flow direction markers bearing flow direction arrows must be fitted, see marker (18) on fig.2 Additional identification of pipelines may be made by using contractors markings, see fig.1 (black figures on a white background).

COLOUR BAND MARKINGS

8. Although this type of marking is now obsolete it may still be encountered on certain older types of aircraft. The marking consists of coloured rings, single or in groups, and a reference number (fig.3). The reference number when used in conjunction with the relevant aircraft Vol.1, enables any point on the system to be located.

Application

9. The coloured markings are applied by the use of one of the following:-

(1) Pigmented varnish (D.T.D.260).

(2) Approved transfers coated with clear varnish to B.S. Specification X.17.

(3) Approved adhesive paper bands coated with clear varnish B.S.S. X.17 after affixing to the pipe.

(4) Approved coloured self-adhesive paper bands.

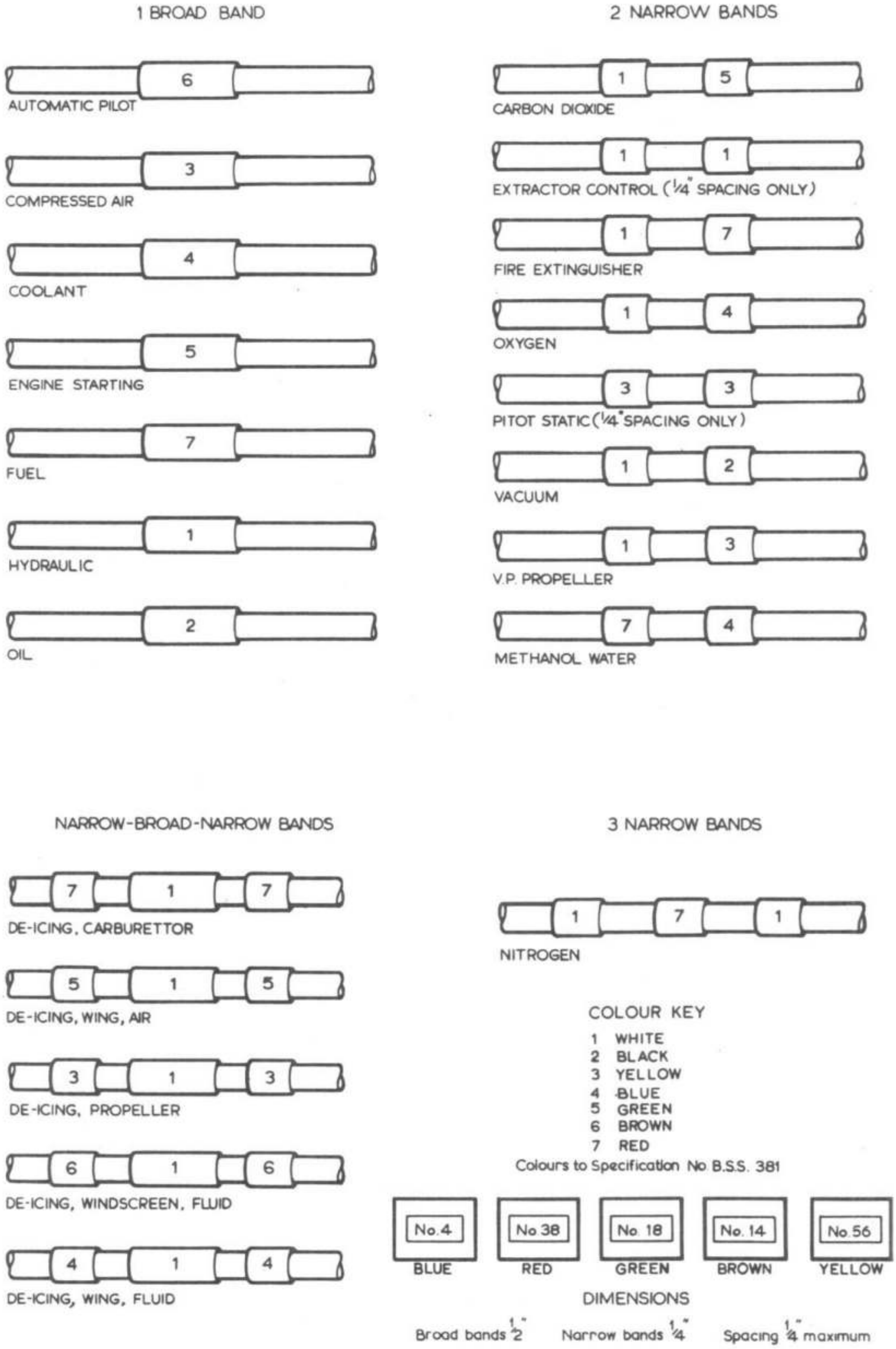


Fig. 3. Identification of pipe-line by coloured bands

Chapter 2

METAL TUBING FOR AIRCRAFT RIGID PIPELINES
(Completely revised)

CONTENTS

Introduction

1 Metal tubing for use on aircraft is listed in AP 1086, Sect.30A and B, and is available to the Services in various sizes and materials conforming to BS and DTD Specifications, a list of which will be found in AP 1464B, Vol.1, Part 2, Sect.5, Chap.2. New tubing is marked for the purpose of identification and the marking conforms to the Standard Colour Scheme as laid down in AP 1464B, Vol.1, Part 2, Sect.5, Chap.2 This marking has no relation to the marking of pipelines installed in aircraft, particulars of which will be found in Chap.1, of this publication. The information in this particular chapter applies to pipelines in aircraft and is therefore subject to limitations which might not apply to pipelines used for ground equipment.

2 Metal tubing on aircraft must conform to the correct specification requirements and its use must be approved for inclusion in the particular system of service in which it is to be installed. The characteristics of the tubing as supplied should be ascertained before use, for example whether it has been normalised or annealed, anodised, internally or externally varnished etc. Any tubing which has been specially heat-treated or coated should be protected as much as possible during subsequent working to preserve its original qualities. Damaged or defective tubing must not be used in any of the systems in an aircraft, therefore care should be taken in handling and storing new tubing (AP 830, Vol.2, Leaflet A1).

3 When metal tubing has been coiled for convenience of packing, etc., care should be taken when uncoiling it to prevent twisting; the free end should be held whilst the whole coil is rotated and the coil unwound gradually. Coiled tubing must not be pulled out in the form of a spiral in an attempt to straighten it.

4 The working of metal tubing for use on aircraft is subject to limitations depending upon the material of which it is made and the purpose for which it is to be used, therefore the various types of tubing most commonly used are described separately under appropriate headings in subsequent paragraphs.

5 Tubing used for structural purposes in airframes is not covered in this chapter and detailed instructions for the working and use of this class of tubing will be found in the repair schemes in the aircraft servicing manual for the particular type of aircraft.

6 It should be noted that no soldered joints are permissible in any pipelines forward of the fireproof bulkhead.

7 Where it is necessary to manufacture a replacement pipe, it is essential to use tubing of the same type and specification as the original. The replacement pipe should be manufactured from the relevant engineering drawings, if no drawings are available the damaged of defective pipe is to be removed from the aircraft and used as a template for the new pipe. When a suitable length of tubing has been obtained it is to be cleaned and inspected to ensure that no damage exists. When cutting a section from a length of piping ensure that the identification marking if removed, is replaced on the remaining length of tubing. In order to prevent premature failure due to fatigue great care must be taken to avoid scratching or scoring of the tube when handling or during local manufacture of replacement piping.

8 Light-alloy and copper tubing is easily damaged by handling during transport or when storing, and care must be taken to avoid damage to the tubing or to its protective coating.

Tube bending

9 Bends in tubing should generally be made on a tube-bending machine, using a guide and a former to suit the diameter of the tubing, the stops being adjusted to the desired length of arc of the bend. Tube-bending machines are described in AP 119G-0104-1. Long, easy bends can generally be made by hand for sizes of tubing of any material up to ½ in. in dia. More acute bends, and bend in tubes of larger diameter must be made on a tube-bending machine.

10 There are two types of hand-operated bending machine in current service which cater for the full range of tubing in imperial and metric sizes. The first type of machine, which employs the 'compression'method, is used for bending tubes without supporting the tube internally and tubing up to ½ in. outside diameter can be bent satisfactorily in the majority of cases. The second type, called the 'mandrel' bending machine,which employs the 'draw' method, gives the best results on small tubes and is also essential for bending large diameter tubing.

11 The mean bend radius in rigid pipelines should not be less than four times the diameter of the tube. Bends must conform to the original layout taken from a template or from the relevant engineering drawings. Bends of an inverted U-shape are to be avoided in tubing carrying oil, fuel or other liquid because of the possibility of air-locks forming. When the original pipelines are not available for use as a pattern, a length of soft copper wire can be used to simulate the pipeline run.

12 Because of the difficulty in ensuring the complete removal of filler material the filling of tubing prior to bending is prohibited. Fine sand may be used in an emergency only, but after bending all traces must be removed taking care not to score the inside of the tube. The tube must be washed out thoroughly and dried using a stream of dry air.

WARNING ...

OIL MUST NO BE USED ON TUBING FOR OXYGEN PIPELINES UNLESS AFTER MANUFACTURE THE TUBE IS THOROUGHLY DEGREASED INSIDE AND OUTSIDE USING AN APPROVED METHOD

13 It is important that the correct heat treatment is applied to the tube material before and after bending, if required. Failure to apply the correct treatment may result in embrittlement and failure of the material.

Local manufacture of rigid pipelines

14 Replacement pipelines must be manufactured in accordance with the relevant engineering drawings. If no drawings are available the following procedure, para.15 to 20 inclusive must be followed.

15 The original damaged pipeline must be carefully removed from the aircraft ensuring that the lay of the pipe is not disturbed and may be measured by passing a piece of cord through the inside of the pipe and marking the cord to coincide with the pipe ends. An extra allowance must be added to the measured cord length to cater for cord path discrepancy. The greater the number of bends the greater the required allowance.

16 A suitable length of tube material corresponding to the same specification, outside diameter and wall thickness as the damaged pipe must be selected and checked to ensure it is damage free.

17 Several bases magnetic, see fig.1, located on a flat steel surface are used to support and locate the damaged pipe. The locations are positioned near the bends of the pipe so that a comparison in shape can be made, at any stage in manufacture, between the old and new pipelines.

18 To achieve the required accuracy for the new pipeline during bending it must be located on the vee supports of the bases magnetic so that it can be directly compared with the contour of the damaged pipelines, see fig.2. The completed new pipeline must compare accurately with the shape and dimensions of the damaged pipeline.

19 Excess material must be trimmed off the ends of the new pipeline ensuring that the ends are square and de-burred.

20 Finally the new pipeline must be thoroughly cleaned using white spirit both internally and externally. A suitable fluff free pull-through must be used to ensure all contamination is removed from inside the pipe.

Steel and stainless steel tubing

21 Steel and stainless steel tubing is available in various grades and sizes and is used mainly in high pressure systems. The application of heat is usually required during the process of bending steel but stainless steel is mainly provisioned in annealed condition.

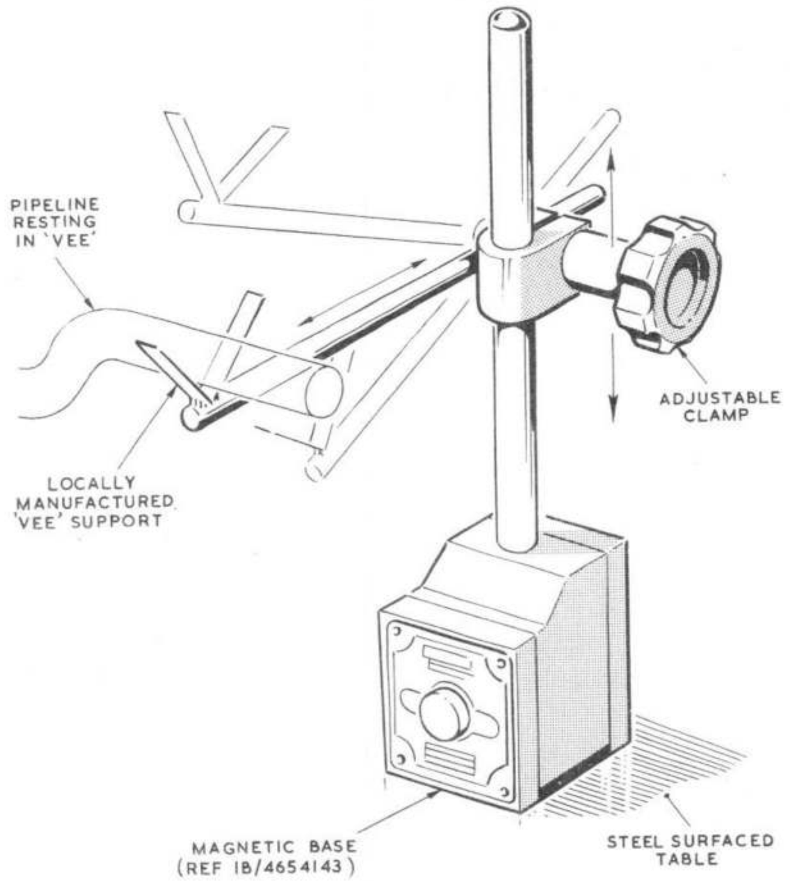


Fig.1 Base magnetic

22 Before applying heat to steel tubing reference must be made to the appropriate specification for information on its heat treatment. High tensile steel tubing is susceptible to failure by intercrystalline penetration of solders particularly when the material is under stress. Therefore sweating or soldering of such material is prohibited.

23 Stainless steel, although generally corrosion resistant may corrode when in contact with certain materials particularly at high temperatures. At no time must poly-chloroprene rubber, used for packing and sleeving, be used in contact with stainless steel as corrosion will occur after a prolonged period.

Nimonic 75 tubing

24 Nimonic 75 tubing is available in sizes up to 25 mm inside diameter. It offers high strength combined with light weight and high corrosion resistance.

25 Nimonic 75 is a nickel-chromium alloy; tubing is manufactured by hot drawing giving a strong circular seamless cross-section ideal for high pressure pipelines.

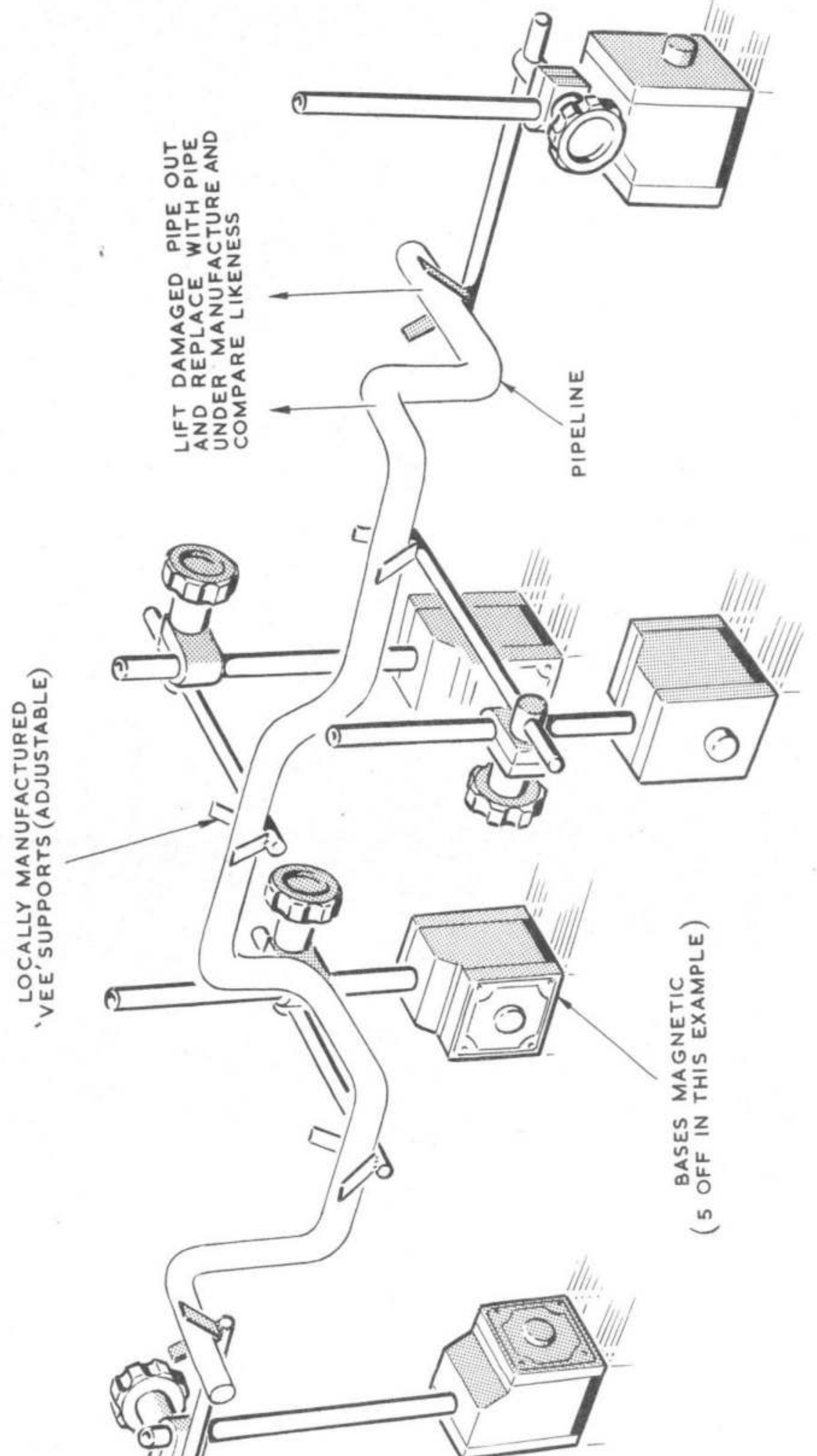


Fig.2 Establishment of 3-dimensional profile

Duralumin tubing

26 Duralumin tubing is available in sizes from $^3/_{16}$ to $2\frac{1}{2}$ in. Care must be taken when using tubing for fuel, oil, water, ethylene glycol, air or oxygen, to ensure that it is perfectly clean internally. It is desirable that tubing should be solution-treated immediately, or not more than two hours before flaring. To remove stresses set up during working, all tubes should be finally solution treated after flaring.

27 When installing Duralumin tubing, only specified couplings should be used and contact with other fittings made of copper, brass, tungum and steel should be avoided. Approved packings for use between clips and Duralumin pipes are vulcanised fibre to D.T.D.37, varnished cork jointing material (Langite), and varnished cambric (Systoflex). Where rubber connections are used, that portion making contact with the rubber must be treated with pigmented oil varnish to D.T.D.260.

Aluminium tubing

28 Aluminium tubing is available in sizes ranging from $^3/_{16}$ to 3 in. outside diameter. When used for any purpose on aircraft, aluminium tubing must be protected externally from corrosion by an approved process, tubes supplied in coils need not be anodised, but must be treated externally with an approved protective coating; other tubing must be anodised and organically protected externally. Tubing used for the conveyance or liquids or gasses must not be protected internally by organic (i.e. non-electrolytic) means.

Aluminium-alloy tubing

29 Aluminium-alloy tubing, as distinct from duralumin, is employed in certain positions in the various systems on aircraft. The tubing most generally used in this category is to B.S. 2L.56, which can be bent freely and ends flared for use with A.G.S. metal couplings.

30 Aluminium-alloy tubing to B.S. 2L.55, is used in some hydraulic systems; the composition of this tubing is similar to B.S. 2L.56, but is hard drawn and cannot therefore be flared at the ends for use with standard metal couplings.

31 To avoid corrosion caused by electrolytic action, only approved materials are to be used between aluminium alloy tubing and the securing clips. The materials, approved for packing purposes are varnished Langite, Systoflex, and red fibre; leather must not be used. The packing material and the clips should not be secured in position until it has been ascertained that the anti-corrosion treatment of the pipe is complete.

Tungum (aluminium-nickel-silicon brass) tubing

32 Tungum (aluminium-nickel-silicon brass) tubing is used in the fuel, air and hydraulic systems of several types of aircraft. It is made to various DTD specifications as medium or high-pressure tubing. Tungum tubing is supplied in the annealed condition and should be bent in this state without the application of heat. When the tubing has become hardened as a result of cold-working, stresses can be removed by heating at a carefully controlled temperature of 400 deg.C. for a period of one hour, after which it may be cooled by any convenient method.

33 Any fittings to be secured to tungum tubing should be silver-soldered in position. The solder used should have a working temperature of approximately 630 deg.C.; calcined borax should be used as a flux and this may be prepared by heating ordinary dry borax with a blow-lamp flame until ebullition ceases; the white deposit should then be powdered and used dry, or as a thick paste mixed with clean water. An oxy-acetylene flame should not be used when heating tungum tubing, as there is danger of oxidising the metal. Tungum tubing, however, may be oxy-acetylene welded, but such work must only be undertaken by qualified personnel.

34 After bending or silver-soldering operations have been completed, the pipe should be cleaned by immersion for 15 minutes in a solution of nitric acid (1 part), sulphuric acid (2 parts) and water (30 parts). The pipe should be removed from the bath, washed thoroughly in cold water and then in hot water. After washing, the pipe should be finally polished on a buffing machine.

35 Tungum pipe-lines should not be run in contact with aluminium-alloy spars, etc., when replacements are being effected, and indirect contact through moisture or water should be prevented. An approved packing for use between anchoring clips and the pipe is 80 mesh tinned brass gauze.

Pressure tests on rigid pipelines

36 Tests on pipelines must be made after they have been disturbed. All joints must be examined for leaks while the system is pressurized and each part of a pipeline system must be tested at the respective pressure indicated in the relevant aircraft servicing manual.

37 Before fitting a section of pipeline into an aircraft the pipe must be tested to ensure that no obstructions exist, followed by a pressure test to one and a half times the system pressure using nitrogen or system fluid.

Flow test in fuel pipelines

38 After installing fuel pipelines a flow test must be made to ensure that the system is free from restriction. Instructions for fuel flow testing are contained in the relevant aircraft servicing manual.

Note ...

Fuel collected during flow tests must not be returned to the aircraft tanks.

Pressure tests in fuel pipelines

39 To reduce the risk of leakage in the fuel system, all fuel pipelines must be tested in accordance with the following requirements:-

39.1 Engine-driven pump suction system. Pipelines from the tank outlet to the inlet of the engine-drive pump, including all cocks, filters and other accessories, must be pressure tested to at least 20 lbf/in^2.

39.2 Remote fuel pump installations. Pipelines from the remote pump outlet to the inlet of the engine-driven pump, including all cocks, filters and other accessories, must be pressure tested to twice the maximum delivery of the remote pump used, or to 30 lbf/in^2, whichever is the greater.

39.3 Fuel pressure gauge pipe and fittings. Test to twice their maximum operating pressure.

Note ...

Where authorised, the remote fuel pump may be employed for obtaining the required pressure.

Chapter 3

STAINLESS STEEL TUBING FOR AIRCRAFT PIPELINES

(Completely revised)

CONTENTS

Introduction

1 Stainless steel tubing is used basically on high pressure systems or where pipes are exposed to conditions likely to cause corrosion, but may have a wider application in certain types of aircraft.

2 To prevent wastage during the manufacture of piping it is possible to calculate the length of tubing required by adding the length of straight sections to the calculated length of materials used in bends. This calculation is made by multiplying the radius of bend by the angle of bend, in degrees, times the constant 0·01745. The radius of curvature is measured to the centre of the pipe. It is important when using a bending machine that at least 2·5 times the pipe diameter is left between the pipe end and the bend, in order to prevent flattening of the tube.

Tube bending

3 Bending of stainless steel pipes is to be carried out as detailed in Chapter 2.

Springs

4 On larger diameter pipes, bending springs may be used when available. When using springs care must be taken to prevent score marks occurring during insertion and removal.

Sand filler

5 When tube-bending machines or springs are not available fine sand may be used. The sand must be dry and free from impurities. Plug one end of the tube and maintain in a vertical position while sand is poured in. This should be done a little at a time, light tapping or vibration being applied after each addition of sand in order to pack it down. On completion of the filling operation the open end is to be capped. When bending has been completed all traces of sand must be removed, care being taken not to score the tube. Wash out the tube and dry with a stream of dry air.

Tube flaring

6 Flaring of stainless steel tubing may be produced by the direct pressure of a mandrel or punch, or by the use of a rotary action flaring tool see 'primary method', para.7. Flaring tools listed in AP 1086 will produce satisfactory 32 degree flare, but the flare is more easily achieved by driving a mandrel or punch into the tube. Where suitable flaring tools are not available a locally manufactured hinged block and punch may be used, see para.12 and fig.10.

Primary method (as used by the Royal Navy)

7 Flares are produced in stainless steel and light alloy tubing, if required, to Imperial 32 degree and American 37 degree specifications using the cold rolling process. A flaring tool Ref.FS R5180-799-8860-S231, see fig.1, enables tubing to be squared, deburred and flared. An adaptor set Ref. NATEC ISSM 1151 is used to produce the 32 degree flare and a range of die blocks are used to produce the 37 degree flare.

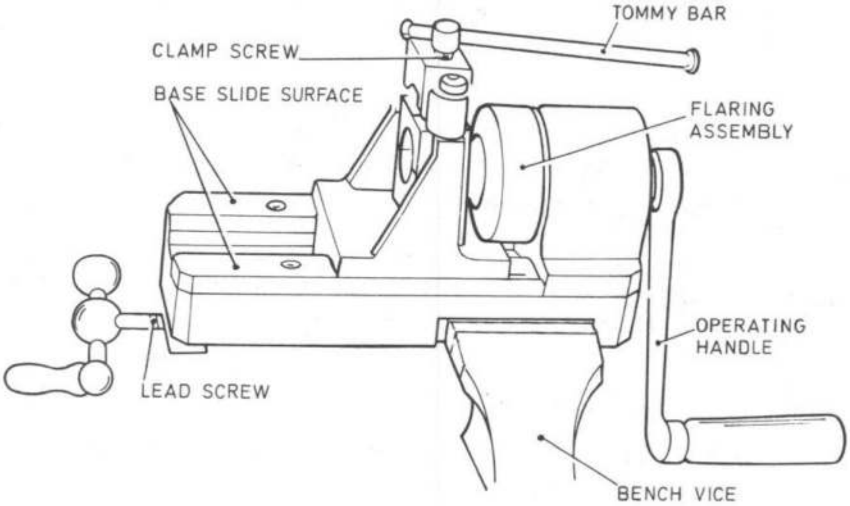


Fig.1 Flaring tool

8 The flaring tool is used as follows:-

8.1 Cutting tubing. Cut tube clearly using a hacksaw with a fine toothed blade.

8.2 Mounting the flaring tool.

8.2.1 Clamp the base of the tool securely in a bench vice, see fig.1.

8.2.2 Assemble operating handle to the spindle and tighten the retaining thumb screw.

8.2.3 Slacken the lead screw. Hold the flaring assembly, see fig.2, and turn operating handle anti-clockwise until assembly can be removed from the spindle opening.

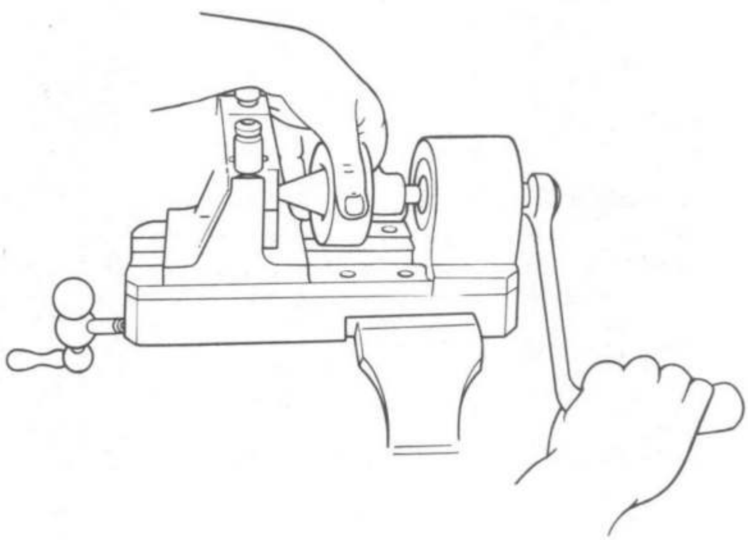


Fig.2 Removal of flaring assembly

8.3 Tool lubrication. Before use ensure that all mating surfaces are thoroughly clean then apply a light film of standard lubricating oil to the base slide surfaces, lead screw and clamp screw.

8.4 Clamping the tube.

8.4.1 Slacken the clamp screw completely and open the clamp.

8.4.2 Place two halves of jaws corresponding to the size of the tubing to be flared in the clamping slide with the chamfered side of jaws facing spindle, see fig.3

8.4.3 Swing the clamp into the closed position.

8.4.4 Insert tubing into jaws so that the end extends towards the spindle at approximately ½ inch beyond the face of the jaws.

8.4.5 Tighten the clamp and slacken the lead screw.

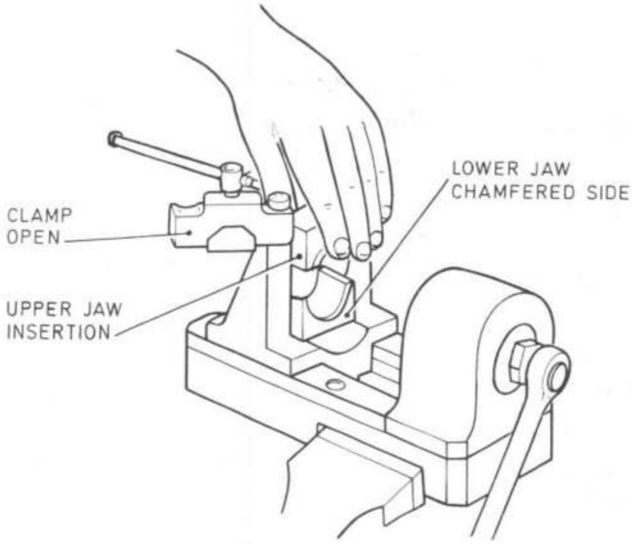


Fig.3 Clamp carriage

8.5 Squaring the tube

8.5.1 Insert squaring tool into the spindle opening, see fig.4. A pin on the shaft end locates in a hole at the bottom of the spindle opening to prevent the squaring tool from turning.

8.5.2 Advance the tube into the squaring tool slowly by advancing the lead screw, at the same time turning the spindle operating handle clockwise. Continue this operation until face of tube is completely square. Do not remove any more material than is necessary.

8.5.3 Withdraw the clamp carriage.

8.5.4 Remove the squaring tool from the spindle.

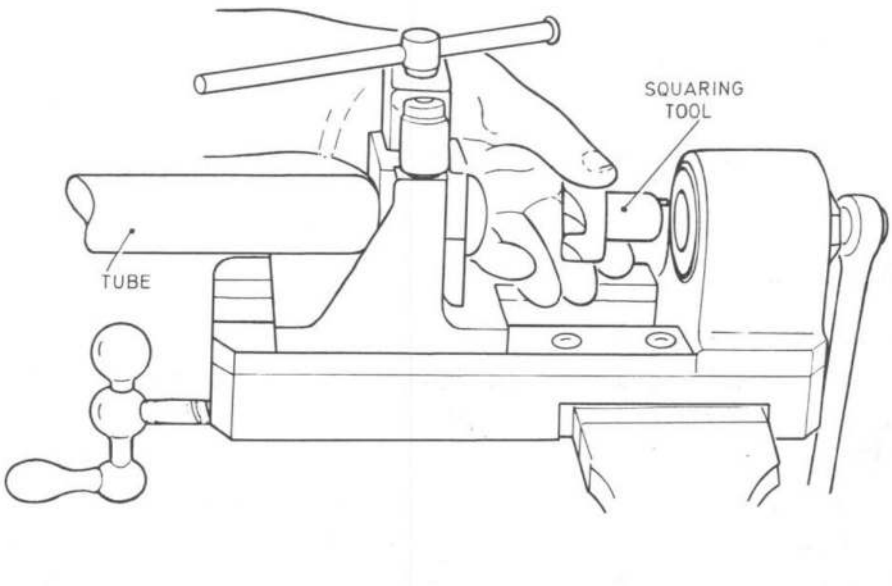


Fig.4 Inserting squaring tool

8.6 Internal deburring

8.6.1 Select the correct internal deburring tool. Small tool is used for ⅛ to ½ inch outside diameter tubes, large tool is used for ⅝ to 1½ inch outside diameter tubes.

8.6.2 Place the deburring tool in the spindle opening, see fig.5. A pin on the shaft end locates in a hole at the bottom of the spindle opening to prevent the deburring tool from turning.

8.6.3 Advance the clamp carriage until the tube abuts with the face of the cutter. The deburring tool is sprung loaded to prevent over-feeding.

8.6.4 Advance the clamp carriage an additional one revolution of lead screw. This sets up the automatic pressure feed.

8.6.5 Turn the spindle operating handle four to five revolutions without advancing the clamp carriage further.

8.6.6 Withdraw the clamp carriage completely and remove the internal deburring tool from the spindle opening.

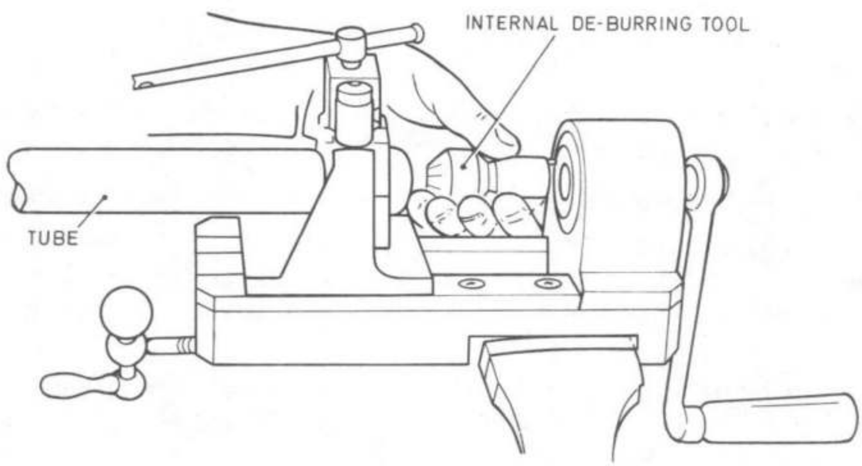


Fig.5 Inserting internal deburring tool

8.7 External deburring

8.7.1 Place external deburring tool in spindle opening. A pin on the shaft end locates in a hole at the bottom of the spindle opening to prevent external deburring tool from turning.

8.7.2 Raise the spring loaded file segment and hold, advance the clamp carriage until the end of the tube is approximately in the centre of the file, see fig.6.

8.7.3 Release the file segment and turn the spindle operating handle until deburring is completed.

8.7.4 Withdraw the clamp carriage and remove the external deburring tool from the spindle opening.

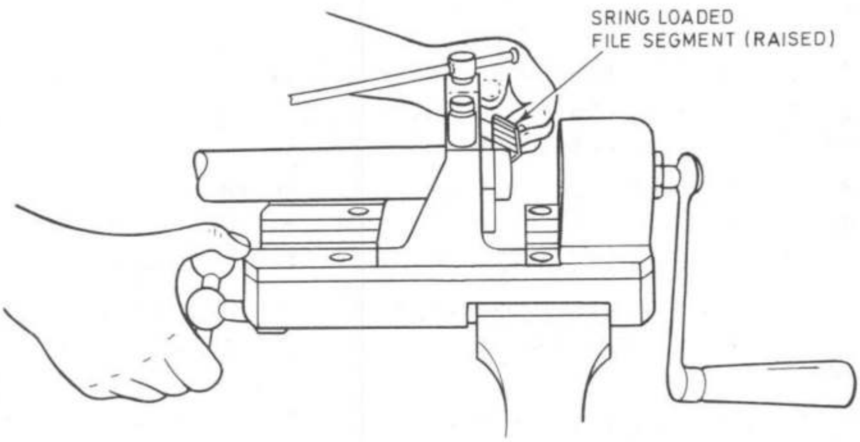


Fig.6 External deburring tool

8.8 Positioning the tube.

8.8.1 Slacken the clamping screw completely and swing clamp into the open position as shown in fig.3.

8.8.2 Remove the tube from the jaws.

8.8.3 Remove all swarf from the jaw holder slide, jaws and end of tube to be flared.

8.8.4 Replace jaws and insert the tube so that the end extends approximately $\frac{1}{4}$ inch beyond the face of the jaws.

8.8.5 Swing the clamp screw into position but do not tighten.

8.8.6 The two tube stop gauges supplied with the flaring tool are marked on their shanks with the appropriate sizes and wall thicknesses of tubing. Select the proper stop gauge and insert in the spindle opening as shown in fig.7.

8.8.7 Advance the clamp carriage until the face of the tube stop gauge contacts the face of the jaws. This operation moves the tube back to the correct depth for flaring.

8.8.8 Clamp the tubing securely in position.

8.8.9 Withdraw the clamp carriage completely and remove the tube stop gauge from the spindle opening.

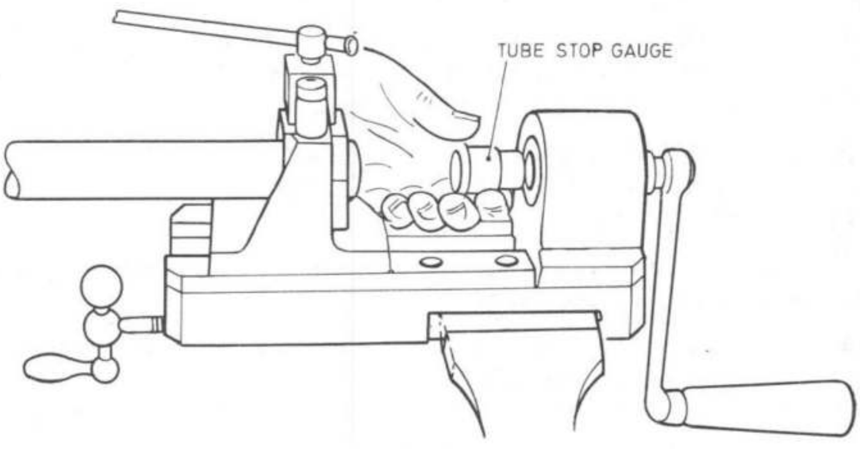


Fig.7 Inserting stop gauge

8.9 Flaring the tube.

8.9.1 Inspect the screw threads and cone surface of the flaring tool and ensure that they are free of swarf.

8.9.2 Insert the flaring tool assembly into the spindle opening as shown in fig.8. Engage the screw thread and hand tighten.

8.9.3 Advance the clamp carriage and at the same time turn the spindle operating handle clockwise.

8.9.4 As soon as the end of the tube abuts with the flaring cone continue to advance the clamp carriage slowly. It is important not to force the tube onto the revolving flaring cone, the best results being obtained with a feed rate of one quarter turn of lead screw to one turn of the spindle operating handle.

8.9.5 As soon as a resistance is felt to the feed the flare is complete and the flare will contact the clamp jaw chamfer at this stage.

8.9.6 Withdraw the clamp carriage while still revolving the spindle operating handle until the cone is clear of the flare surface on the tube. This operation will ensure a flawless concentric flare.

8.9.7 Slacken the clamping screw and swing the clamp into the open position.

8.9.8 Remove the tube.

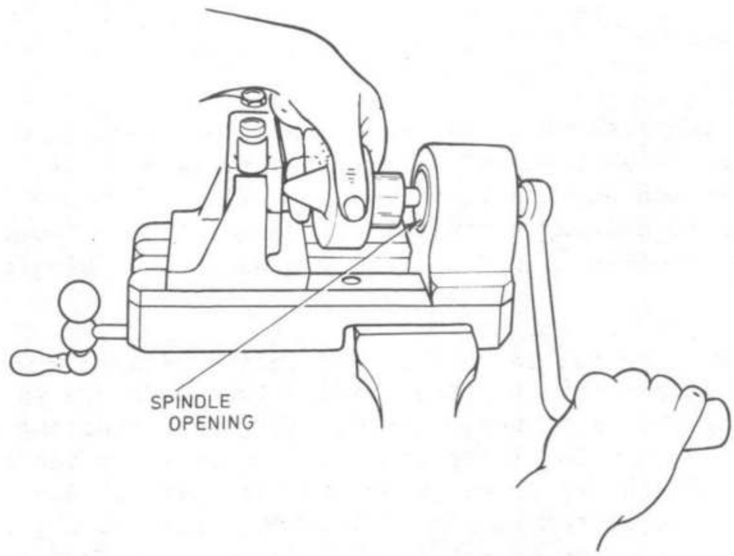


Fig.8 Inserting flaring tool assembly

8.10 Inspection of flare.

8.10.1 To inspect the Imperial 32 degree AGS flare use the procedure covered by Chap.5, para.6.

8.10.2 To inspect the American 37 degree flare use the flare OD gauge supplied with the flaring tool. The gauge has GO and NO GO openings for checking flares on each size of tube within the range of the tool, see fig.9.

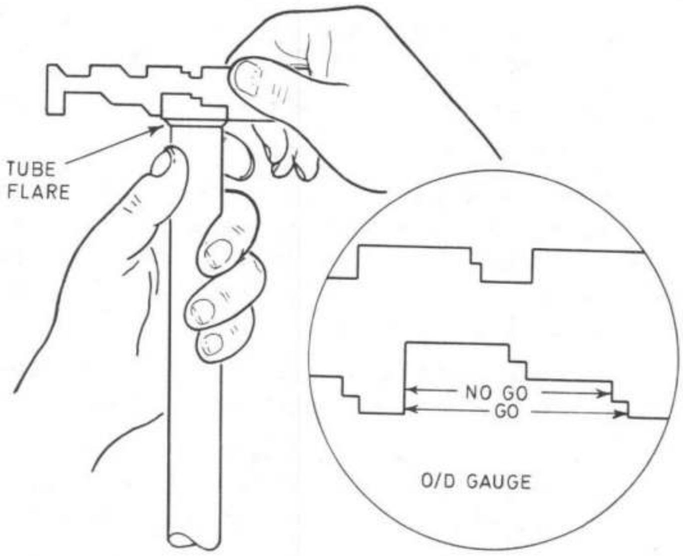


Fig.9 Use of flare guage

Secondary method

9 Flaring of stainless steel tubing may also be produced by the direct pressure of a mandrel or punch. The rotary flaring tools listed in AP 1086 will produce satisfactory 32 degree flares but the flare is more easily achieved by driving a mandrel or punch into the tube. Where suitable flaring tools are not available a locally manufactured hinged block and punch, para.12 may be used.

10 The tube is to be cut to the correct length using a sawing vice and hacksaw fitted with a fine toothed blade. Tube ends are to be squared using a squaring tool see Chap.5, on completion of squaring the tube is to be deburred and cleaned. The inner and outer surfaces of the tube at the location to be flared are to be inspected for damage. Any score marks or surface damage must be removed by burnishing before attempting to flare. Before commencing flaring operation the correct union nut and collar must be placed on the tube.

11 Clamp the tube firmly into the jaws of the flaring tool and accurately align the mandrel with the tube. Drive the mandrel until the correct flare is obtained, taking care that the tube is not being forced back through the clamping jaws. Remove the clamp and clean. Using a magnifying glass, carefully inspect the flare for signs of splitting or other damage. If the flared tube has been damaged it must be rejected.

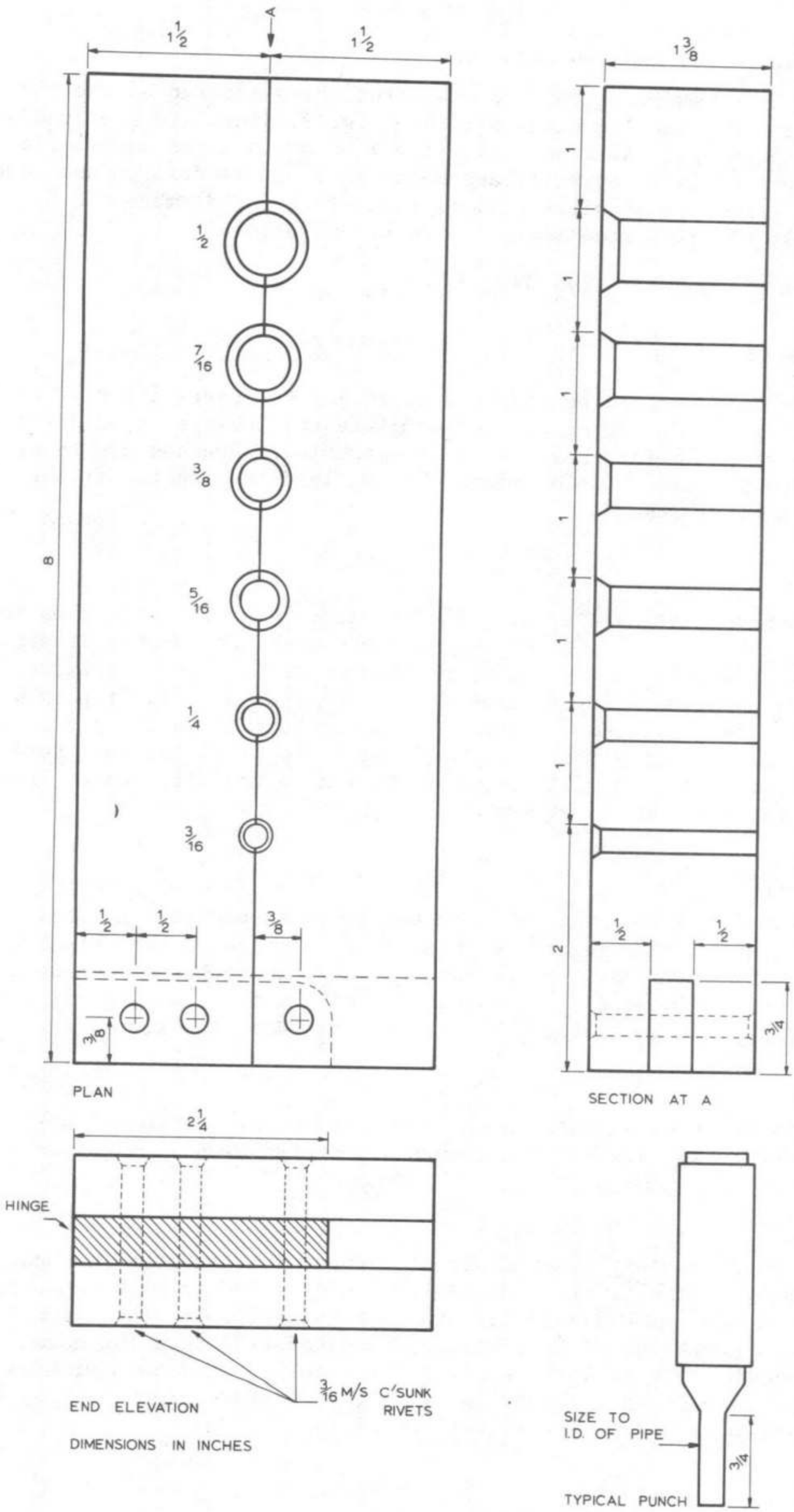


Fig.10 Hinged flaring tool and punches

Hinged flaring tool and punches

12 This tool is manufactured from two steel bars slotted at one end to accommodate a rectangular hinge bar, see fig.10. They are rivetted to the bar using three $^{3}/_{16}$ in. c/sunk rivets one of which forms the pintle of the hinge. The tool is temporarily assembled while it is drilled and countersunk to accept a range of pipeline from $^{3}/_{16}$ in. to $\frac{1}{2}$ in. diameter (O.D.). Countersinks for 32 degree flare are to be as follows:-

Pipe O.D. inch	$^{3}/_{16}$	$^{1}/_{4}$	$^{5}/_{16}$	$^{3}/_{8}$	$^{7}/_{16}$	$^{1}/_{2}$
C/sink mouth	$^{9}/_{32}$	$^{3}/_{8}$	$^{7}/_{16}$	$^{1}/_{2}$	$^{6}/_{1}$	$^{11}/_{16}$

The tool is to be tested against actual tubing to ensure it grips without causing damage or distortion. When complete the tool is to be dismantled and case hardened before being finally assembled. Punches are to be manufactured for each size of flare, having lead-in pins to fit the I.D, of the tube to be flared.

Fitting

13 On completion of manufacture, the pipeline is to be offered up to the system to ensure that it is an exact fit and does not require drawing into position by the union nuts. Under no circumstances is the pipeline to be forced into position. If not a good fit, the pipe should, if possible be returned for further modification. In cases where it is not possible to modify the pipe to give the correct fit it is to be discarded. Forcing pipelines into position will result in strain on the flare which may cause premature failure due to fatigue.

Pipe testing

14 When completed the pipe is to be tested to ensure that no obstructions exist and that no leakage occurs when it is subjected to 1·5 times its normal working pressure. In the case of fuel pipes they must also be given a fuel flow test (Chap.2). On completion of the pipe testing, it is to be thoroughly cleaned and dried before being fitted to the aircraft.

Note ...

If the pipe is to be used in an oxygen system it is to be thoroughly degreased inside and out, to remove any traces of oil or grease.

Pressure test

15 The pipe is loosely blanked off at one end and the other end connected to a suitable hydraulic rig. Hydraulic fluid is fed into the tube until it seeps out at the blanked end, thus forcing the air out. The blank is then tightened in position. A hydraulic pressure of 1·5 times the normal pressure of the pipe is to be applied for a period of 2 to 3 minutes. The pipe is then inspected for any leakage. Low pressure piping may be tested using nitrogen or air as detailed in Chapter 2.

Chapter 4

HOSE AND HOSE ASSEMBLIES FOR FUEL, OIL, PNEUMATIC AND HYDRAULIC SYSTEMS

CONTENTS

TABLES

ILLUSTRATIONS

Introduction

▶ 1 This chapter describes the main types of flexible hose used for aircraft fuel, oil, pneumatic and hydraulic systems and Installation and precaution notes are given where appropriate. The manufacture of the hoses is by one of two methods:-

1.1 Method one covers hoses which cannot normally be manufactured at unit level but are supplied as made-up items termed 'hose assemblies'.

1.2 Method two covers hoses with re-usable end fittings and these are completely covered in AP 101A-0301-1.

2 The specific type of hose to be used in a particular aircraft is indicated in the relevant aircraft servicing manual. Where the substitute of existing metal tubing by hoses is authorized, instruction is given in the topic 2 leaflet of the relevant aircraft air publication. ◀

3 Different types of hose are designed for specific purposes; the lining is impervious to the liquid which the hose is intended to carry. Hose must also be capable of withstanding internal pressure and heat in accordance with the relevant specification.

4 Hose construction varies according to whether it is intended for use forward or to the rear of the fireproof bulkhead. Hose used forward of the fireproof bulkhead has an outer covering of fireproof material; hose for use to the rear of the bulkhead is, usually, non fire-resisting. The main reason for not using fire-resisting hose throughout is that the increased weight factor would not justify the possible advantages.

5 Hose, in most instances, is supplied in defined lengths with the end fittings attached under an assembly reference number. These made-up items are referred to as 'hose assemblies'. Material held in bulk, without end fittings attached, is termed 'hose'. Hose assemblies facilitate replacement but, in certain circumstances, it may be necessary to make up hose locally to specified lengths. Hose and end fittings must then be obtained from bulk supply and the assembly made up by Service personnel.

Service life of hose

6 Provided the instructions in para.29 have been complied with, hose held in Stores is not generally subject to any life limitation. This also applies to hose assemblies installed in stored aircraft, where the hose is in its normal position with no open ends. Special instructions may, however, be issued to cover specific types of hose and hose assemblies.

Markings on hose

7 The date of manufacture is indicated in various ways according to the type or construction of the hose. The date is either printed on the exterior surface or stamped on a metal tab secured to the hose.

8 In some instances the maximum working pressure is also indicated on the exterior of the hose; the test pressure is generally taken to be one-and-a-half times that of the maximum working pressure.

9 Hose assemblies bear an additional marking which denotes the maker's drawing number for that particular item. This number may be incorporated on the tab bearing the date stamp, printed on the hose or on adhesive tape affixed to the hose. Stores demands for new assemblies must quote this number.

10 Some hoses have a continuous white or coloured marking along their length, which in addition to being an identification marking, serves to indicate that the hose is not twisted during installation.

WARNING ...

HOSE WHICH HAS TAKEN A PERMANENT SET DUE TO HIGH TEMPERATURE CONDITIONS OR OTHER CAUSE, MUST NOT BE STRAIGHTENED BUT RENEWED. THE RENEWAL IS TO BE IN ACCORDANCE WITH ANY LOCAL INSTRUCTIONS.

NOTES ON INSTALLATION PROCEDURE AND PRECAUTIONS

Pre-installation examination and tests

11 Prior to installing a new fuel pipe or replacing one which has been removed, the pipe must be flushed through with clean kerosene to remove any foreign matter. Particular care is necessary with fuel hoses containing an internal wire helix, such as Superflexit. Hose most likely to give trouble from this cause are those on the engine side of the fuel filter.

12 Hose assemblies which have been made up locally must, wherever possible, be tested under pressure for leakage, and a test must also be made for electrical continuity (where applicable). The pressure test must be made with the fluid which the particular hose is intended to carry. This does not apply to hose for fuel systems; these should be tested with kerosene which is safer and more searching.

13 To test an assembly, one and is loosely blanked and fluid is pumped into the opposite end. When the fluid begins to seep out of the loosely blanked end, the blanking device is tightened to ensure a complete seal. The pressure of the fluid in the hose is then increased to one-and-a-half times the working pressure; the assembly must withstand this pressure, without leaking, for two or three minutes.

14 Hose assemblies for low pressure pneumatic systems are tested by being connected to a compressed air system and immersed in water. Any leak in the assembly is indicated by a stream of air bubbles in the water. These must not be confused with bubbles which rise intermittently, caused by the escape of air trapped between the layers of the hose during manufacture. To save time, several assemblies can be tested as one by the use of double-ended connectors to join them together. Hose assemblies for high-pressure pneumatic systems are tested as described in para.13 using water as the fluid under pressure. After testing, pneumatic hoses must be thoroughly dried with an air jet.

Visual test

15 Every hose assembly must be examined to ensure that the bore is free from obstruction and foreign matter. A satisfactory visual examination can

be made by laying the hose in a length of angle iron so that it is perfectly straight, and looking through the bore of the hose at one end while a bright light or a reflector is placed at the other end.

Ball or bobbin test

16. The ball test is useful for testing the bore of a length of hose for obstruction or restriction, which may not be revealed by visual examination. A bearing ball is required which will just pass through the end of the fitting assembly. The assembly is hung vertically and the ball is dropped into the top end. If the ball passes through the hose freely the bore is free from obstruction. If the ball does not pass through freely the faulty length must be discarded and a replacement assembly obtained.

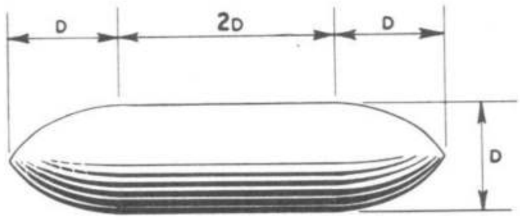


Fig.1 Bobbin for hose bore test

17. If a suitable bearing ball is not available the test can be done by using a metal bobbin similar to that illustrated in fig.1. This can be made locally. The dimension D must allow the bobbin to pass without force, through the end fittings of the hose. It is impossible to make a bobbin test on hose assemblies which have angled end fittings.

Layout of hose lines

18. When hose assemblies are to be renewed, the layout of the particular system must be studied and followed, and the hose protected and supported as detailed in the approved drawing for the type of aircraft. If a layout drawing is not available, the assembly must follow the same run and be supported in the same manner as the hose that has been removed.

Avoiding tension and twisting

19. Hose must not be installed in a state of tension in any part of its length. It is essential that the hose is supported in such a manner that the end fittings are relieved of the weight of the hose and of its contents.

20. The greatest care must be taken to avoid twisting hoses when installing them in aircraft and when making and breaking a joint as otherwise the linings may become damaged or distorted. These defects may not become apparent until the fluid seeps between the layers of the hose, disintegrating the cement and causing leakage or a restriction in the flow of the liquid. In any instance where there is doubt as to the condition of the lining, whatever may have been the cause, a new hose assembly must be fitted. This is all the more important if facilities are not available to make adequate tests of suspect hose assemblies.

21. No difficulty will be experienced in avoiding twists when installing or removing hose assemblies if three important principles are observed. These are (1) that the hose is held firmly when the union nut of the end fitting is being tightened or loosened, (2) that no abnormal effort is applied with spanners, and (3) that the identification line marking (which is on most hose assemblies) is straight throughout its length.

22. Newly-made end-fitting joints may require re-tightening after the first few hours of flying time. Union nuts and hose clips must, therefore, be examined for tightness after a short 'bedding-in' period.

Protection against chafing

23. Adequate precautions must be taken to ensure that there is no possibility of the hose being damaged through chafing against adjacent metal fittings, sharp corners, etc. Usually it is possible to so arrange hose supports that there is no likelihood of excessive flexing. Hose supports, properly positioned, should obviate any need to wrap the hose with protective material.

Blistered outer covering

24. Blisters sometimes appear in the outer coverings of high pressure pneumatic or hydraulic hose. These blisters do not necessarily affect the serviceability of the hose, and all instances of blistering must be checked as follows:-

Pneumatic hose

25. Remove the hose from the aircraft and carefully puncture the blister with a needle. This should result in the outer covering returning to its normal contour. Test the hose by applying 1½ times maximum working pressure, preferably under water. When the tube is first pressurised air bubbles may emerge due to residual air inside the blister being forced out. This stream of bubbles should diminish and disappear. A constant flow of air bubbles indicates unserviceability and the hose must be scrapped. If there is no sign of air leakage, the hose may be considered serviceable.

Hydraulic hose

26. Puncture the blister as for pneumatic hose and observe the result. If liquid emerges the hose must be rejected. If only air emerges the hose must be fluid pressure-tested to 1½ times maximum working pressure and if no further leakage occurs it may be regarded as serviceable.

Minimum bend radius

27. Some hose assemblies are used in positions where flexing takes place (for example, in the hydraulic pipe-lines to bomb doors and under-carriage legs). Two classes of minimum bend radius, vibrating and flexing, are listed in each hose installation data table because hose may safely be installed with smaller bend radii when no movement or stress is present, other than that resulting from normal aircraft vibration.

Hose assembly lengths

28. All hose assemblies are measured for length from the nipple extremities of the two end fittings. The three types of end fittings available and the effective hose assembly lengths are illustrated in fig.2.

Storage

29. When hose is stored, if it is not contained in a sealed carton, the ends must be sealed with adhesive tape. If it is in unit lengths, the unions must be fitted with blanking caps to prevent the entry of moisture and foreign matter. Seals must be renewed whenever lengths are cut from stock. Hose must be stored away from direct sunlight and in a cool, dry environment.

Note...

Ageing cracks may develop in the neoprene outer cover of Dunlop flexible hoses. Hoses with ageing cracks can be considered serviceable provided the wire braiding is not exposed and they satisfy the requirements of para.11 to 15 and a pressure test to 1½ times the maximum working pressure (Table 1).

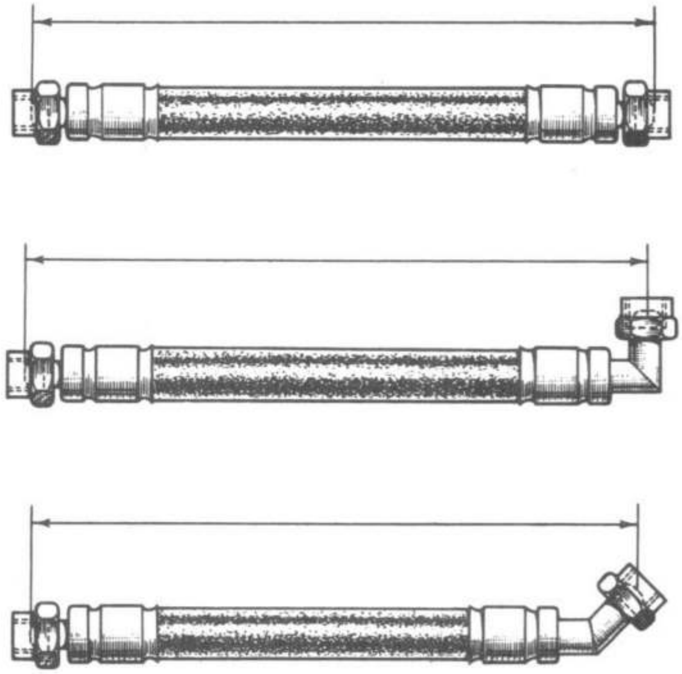


Fig.2 Effective lengths of hose assemblies

DUNLOP HIGH-PRESSURE HOSE

Purpose and description

30. Dunlop high-pressure fireproof hose can be used in aircraft for the systems mentioned in Table 1. This hose can be installed forward of the fireproof bulkhead.

31. This hose is reinforced by one or two layers of high-tensile steel wire. The closely-woven steel ply gives the hose its mechanical strength against tensile and bursting loads, and reduces volumetric expansion to negligible proportions.

Attachment of end fittings (fig.3)

32. The end fittings are entirely of steel and provide standard nut and nipple couplings, but they can only be fitted by the manufacturers. The assemblies are supplied in lengths up to 15 feet.

Installation notes

33. The electrical resistance of the hose must not exceed 0·05 ohm between bonding points or 0·025 ohm per foot run, whichever is the greater. Other installation data are contained in Table 1.

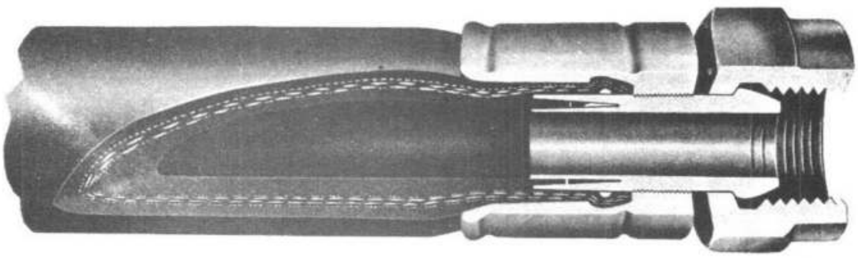


Fig.3 Dunlop hose and straight end fitting

SILVOFLEX AND AVICA (WEATHERHEAD) HOSE

Purpose and description

34. Silvoflex and Avica hoses are identical in construction and purpose, the only difference being in the name on the exterior.

35. The hoses can be used in any of the normal aircraft systems, including those forward of the fireproof bulkhead, in accordance with the details in Table 2 which specifies the type of hose to be used in any particular system.

36. The general construction of the steel wire braid reinforced types is illustrated in fig.4 and 5. The lining tube and the outer cover are made of dissimilar synthetic rubbers. The lining is oil-resisting and the outer cover has additional fire-resisting qualities.

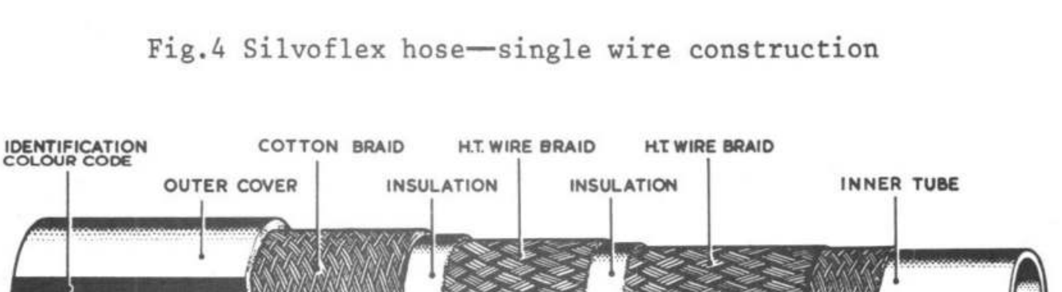


Fig.4 Silvoflex hose—single wire construction

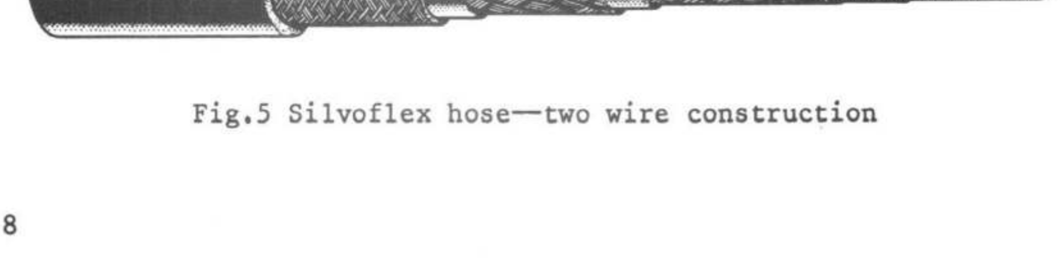


Fig.5 Silvoflex hose—two wire construction

Attachment of end fittings

37. A special swaging machine is used by the manufacturers to attach the end fittings (fig.6 and 7), and hose assemblies are therefore supplied as complete units.

Installation notes

38. A colour code on the exterior of the hose is provided for identification purposes; it consists of one or two lines running parallel to the axis of the hose, and indicates single steel wire braid or two steel wire braid reinforcement. White or green lines indicate a hycar inner lining with a neoprene outer cover, and red lines indicate a neoprene inner lining with a neoprene outer cover. Green lines also indicate added fire-resisting qualities. Some of the smaller sizes have an additional inter-layer of asbestos. Details of the colour code and other installation data are contained in Table 2.

39. Ageing cracks may develop in the neoprene outer cover of Silvoflex and Avica hoses. This is a condition which is accelerated by the state of tension over long periods due to curvature of assembly.

40. Hoses with ageing cracks in the outer cover can be considered serviceable provided the steel wire braid is not exposed and that they satisfy the requirements of para.11 to 15 including a pressure test to 1½ times the maximum working pressure (Table 2).

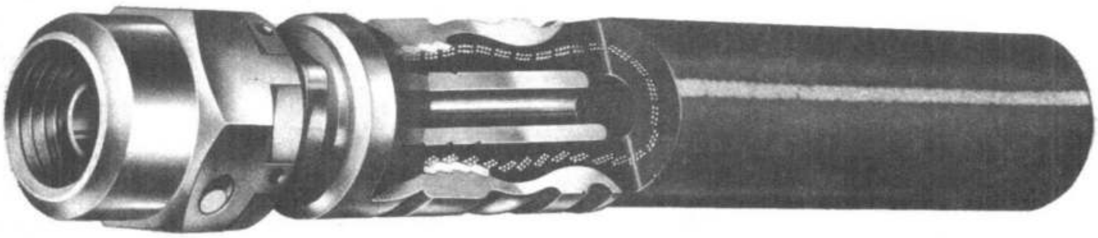


Fig.6 Silvoflex hose and straight end fitting

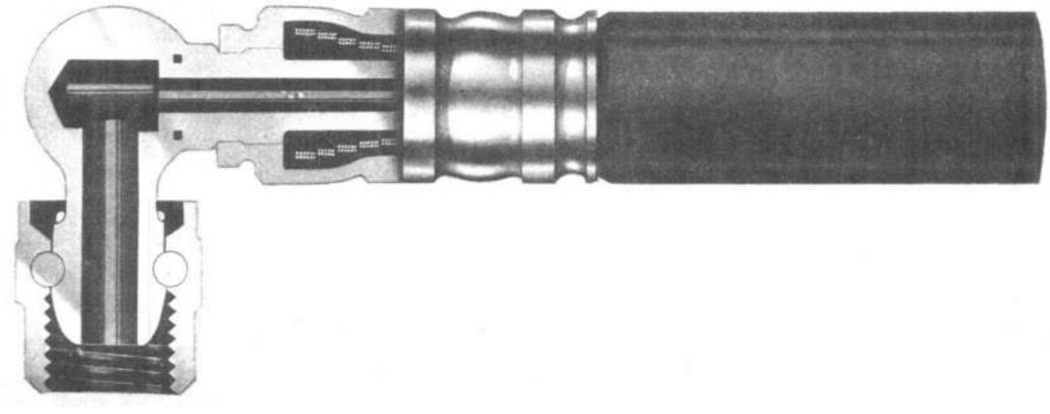


Fig.7 Silvoflex hose and 90 deg end fitting

FLYLITE NO.F.1 HOSE

Purpose and description

41. Flylite No.F.1 is a fire-resisting hose used in aircraft fuel systems forward of the bulkhead and up to 4in. beyond it, or inside power unit

envelopes and up to 4in. outside the envelope firewall. It is authorised for a maximum pressure of 50 lb/in^2.

42. An inner tube of synthetic rubber is wrapped with a layer of asbestos cloth, and built around this are succeeding layers of synthetic rubber and steel wire braid (fig.8). Following these are layers of asbestos cloth impregnated with synthetic rubber and overwound with a coarse-pitch helix of steel wire. The whole is covered with an outer layer of synthetic rubber and subjected to a process of vulcanisation which bonds the layers together.

Attachment of end fittings

43. The end fittings for this hose have a standard nipple and union nut coupling. As with other types of fireproof hose, the end fittings can only be fitted by the makers, and hose assemblies are, therefore, issued in individual unit lengths.

Installation notes

44. Installation data and other information concerning Flylite No.F.1 hose are given in Table 3.

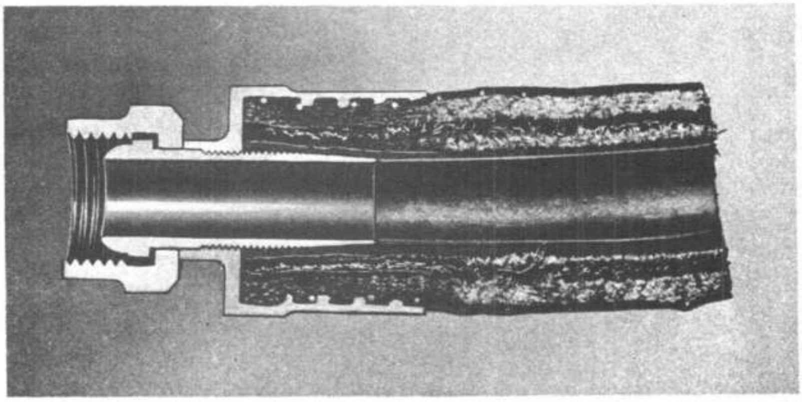


Fig.8 Flylite No.F.1 hose and straight end fitting

FLYLITE NO.4 HOSE

Purpose and description

45. Flylite No.4 hose (fig.9) is a non-fireproof type, suitable for use in fuel and oil systems aft of the fireproof bulkhead. The hose is designed to withstand a maximum internal pressure of 50 lb/in^2.

46. This hose can be easily identified since it is spirally grooved externally. The bore is smooth. The hose is reinforced with fabric and has a spiral wire made of regenerated cellulose which is embedded in the synthetic rubber to give additional resistance to external pressures. The use of non-metallic wire avoids the necessity for electrical bonding.

Attachment of end fittings

47. The A.G.S. (Flylink) end fitting (fig.9) is made of anodized aluminium and consists of a ferrule, union nut and nipple. The ends can be fitted to

and, if necessary, removed from the hose by Service personnel using a tool (fig.10) and a standard spanner.

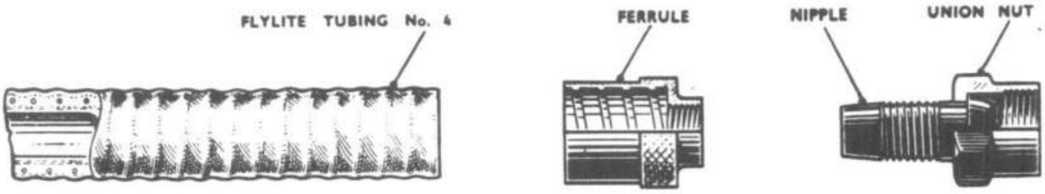


Fig.9 Flylite No.4 hose and A.G.S. (Flylink) end fitting

48. Assembly tools for A.C.S. (Flylink) end fittings are provisioned in various sizes according to the bore size of the hose (Table 3).

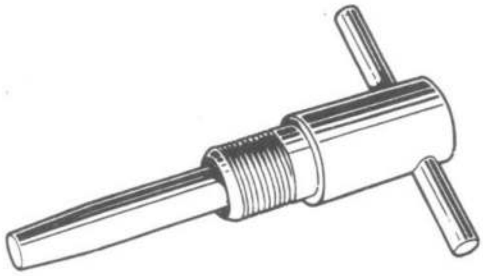


Fig.10 A.G.S. (Flylink) end fitting assembly tool

49. To attach an end fitting, proceed as follows:-

(1) Cut the end of the hose, at right-angles to its centre line, with a sharp knife lubricated with water.

(2) Apply lubricating oil to the outer surface of the hose to the depth of the ferrule and to the inner surface of the ferrule.

(3) Screw the ferrule on to the end of the hose with a left-hand thread action (fig.11A) until the end of the hose butts against the inner shoulder of the ferrule.

(4) Apply lubricating oil to the bore of the hose to a distance equal to the length of the nipple, and also to the thread in the neck of the ferrule.

(5) Slide the nipple on to the tool (fig.11B) followed by the nut (fig.11C) and screw the nut up tightly.

(6) Grip the knurled portion of the ferrule firmly and insert the tool in the bore of the hose, as far as it will go, with gentle pressure. Engage the thread of the nipple with that of the ferrule, and screw home tightly (fig.11D).

Note...

The risk of a cross-thread will be minimised if, before the thread is engaged, the nipple is turned counter-clockwise until a faint click is felt.

(7) Unlock the tool by slackening the union nut and unscrew the tool out of the tube (fig.11E).

50. It is essential that lubricating oil is applied as specified in the previous paragraph, otherwise difficulty will be experienced in the removal of the end fitting.

51. If a vice is used to grip the knurled portion of the ferrule, only moderate pressure must be applied and fibre, wood or similar material must be used as vice clamps.

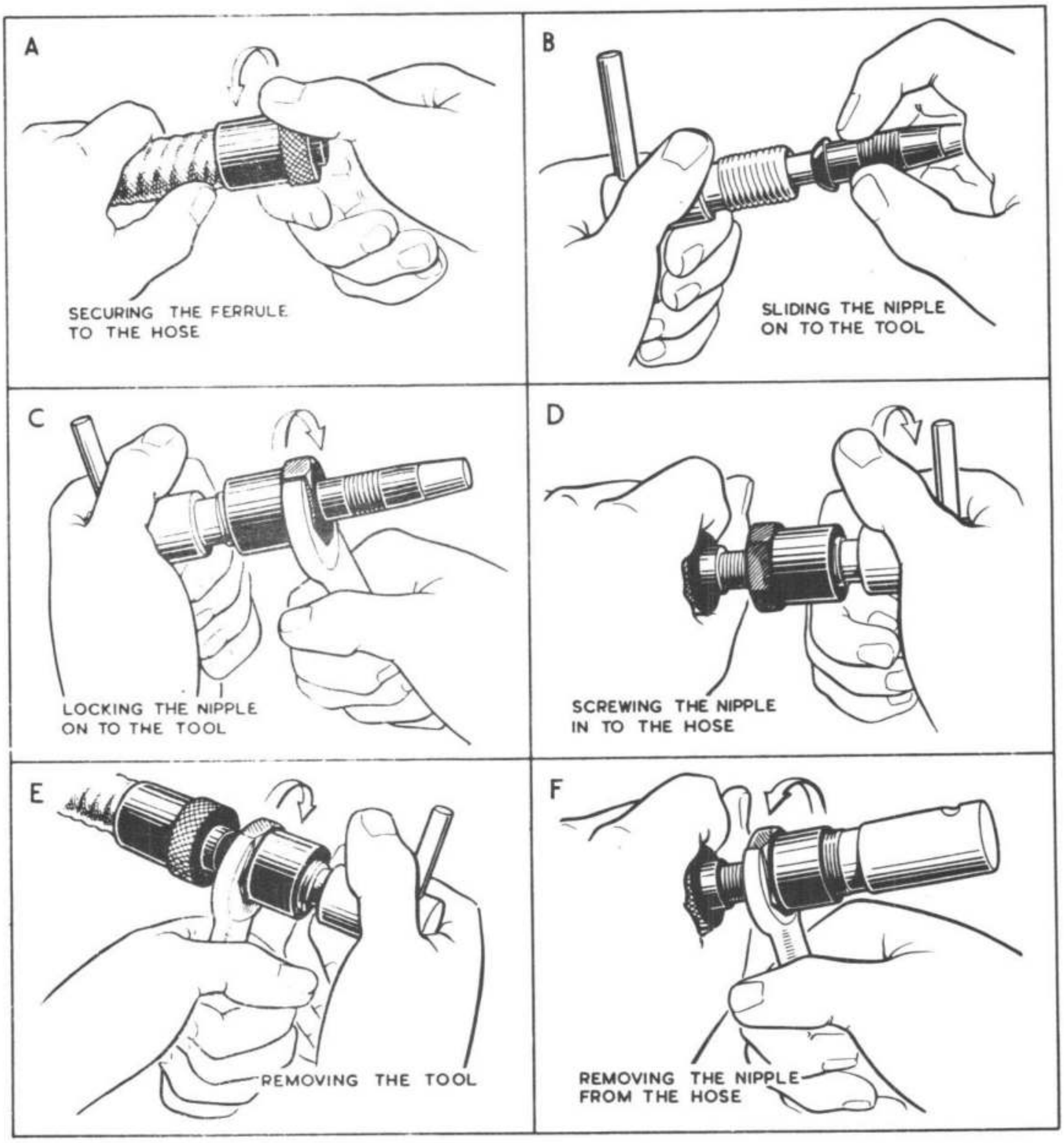


Fig.11 Attachment and removal of A.G.S. (Flylink) end fitting

Removal of end fittings

52. To remove an end fitting proceed as follows:-

(1) Insert the tool into the end fitting and bore of the hose and screw tightly into the union nut.

(2) Grip the ferrule firmly (in a vice if necessary) and unscrew the tool and union nut with a spanner on the nut (fig.11F). This will remove the nipple from the hose and free the nut.

Note...

Do not attempt to turn the tool and union nut by the tommy bar in the tool.

(3) Unscrew the ferrule from the hose with a left-hand thread action.

Installation notes

53. Installation data and other information concerning Flylite No.4 hose can be found in Table 3.

Use of standard A.G.S. end fittings

54. When Flylite No.4 hose is used as a direct replacement for Lockheed Avery Type 11 or Flexatex hose already installed with A.G.S. clips, it may be used with the standard A.G.S. end fittings and A.G.S.605 hose clips. The hose must be a good push fit over the end of the fitting. A split ring of aluminium alloy of suitable gauge must be placed over the corrugated surface of the hose to form a foundation for the clip. The gap in the split ring must be wide enough to prevent the ends from meeting when the clip is tightened.

AVERY TYPE 7 HOSE

Purpose and description

55. Avery Type 7 hose is fire-resisting and can be used forward of the fireproof bulkhead for fuel, oil and hydraulic systems. For installation data refer to Table 4.

56. The construction of this hose, which has one ply of closely-braided high tensile steel wire, is similar to that of other fire-resisting hose.

Attachment of end fittings

57. Assemblies are supplied to specified lengths complete with end fittings according to the aircraft and system for which they are intended.

Installation notes

58. Avery Type 7 hose is identified by a metal band on which are indicated the type of ends fitted and the hose length and bore size. Also on the exterior of the hose is stamped the date of manufacture; the first two figures indicates the year, followed by a letter which denotes the month (for example 71A would indicate January 1971). The letter 'G' will be omitted to prevent it being mistaken for a figure 6. Other installation data are contained in Table 5.

AVERY TYPE 2 HOSE

Purpose and description

59. Avery Type 2 hose (fig.12) can be used for pneumatic, hydraulic and engine oil systems. These hoses must be used to the rear of the fireproof bulkhead only (Table 4).

60. A lining of synthetic rubber is covered by, and reinforced with, successive plies of braided cotton yarn impregnated with synthetic rubber.

The whole is subjected to a vulcanising process which bonds the plies together. The exterior covering of the hose is treated to resist tropical fungus.

Attachment of end fittings

61. End fittings are attached by the manufacturers and made-up assemblies are supplied.

Installation notes

62. This hose is identified by a metal band and the date of manufacture is printed on the exterior surface of the hose.

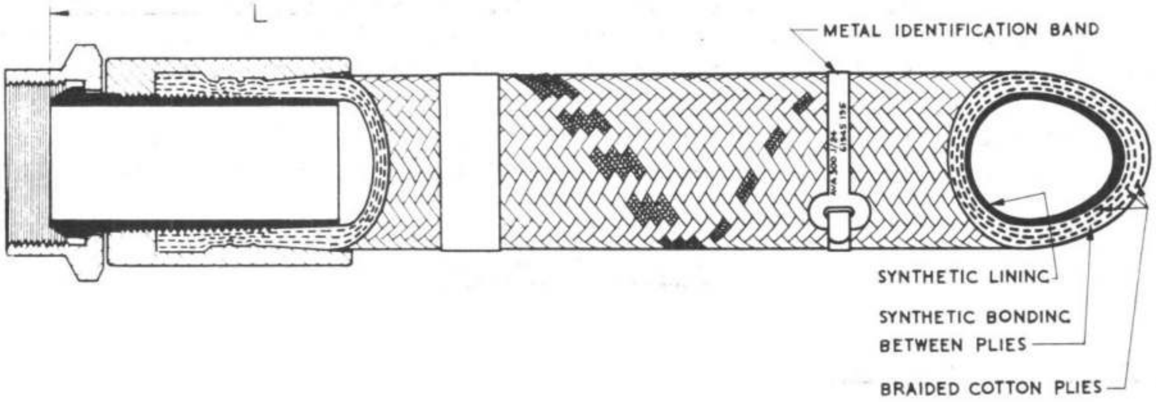


Fig.12 Avery Type 2 hose construction and end fitting

AVERY TYPE 5 HOSE

Purpose and description

63. Avery Type 5 is a high-pressure hose of 3/8in.dia. bore, for use in pneumatic and hydraulic systems to the rear of the fireproof bulkhead.

64. The construction of this hose is shown in fig.13. The plies are bonded together by synthetic rubber and vulcanisation.

Attachment of end fittings

65. All end fittings are attached to the hose by the manufacturers and assemblies are supplied for installation in aircraft.

Installation notes

66. The identification and date of manufacture markings are similar to those of Avery Type 7 hose. For other installation data refer to Table 4.

LOCKHEED A.D.S.262 AND 281 HOSES

Purpose and description

67. Lockheed A.D.S.262 and 281 hoses are similar in construction to the Avery Type 2 hose described in para.59 and 60. They will, however, withstand a higher working pressure than the Avery Type 2 hose and are not treated to

resist tropical fungus. The A.D.S.262 hose is supplied in 1/4in. bore, and A.D.S.281 in 1/8in. bore sizes. Both hoses are used in aircraft hydraulic systems only.

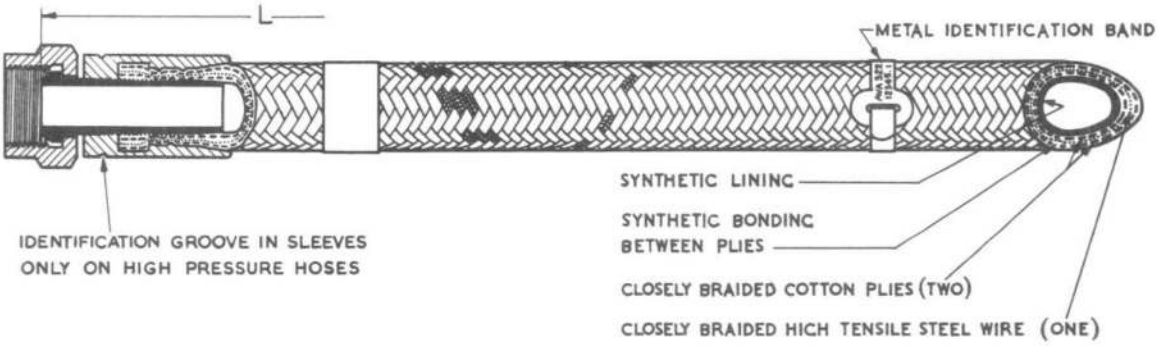


Fig.13 Avery Type 5 hose construction and end fitting

Attachment of end fittings

68. The hose is made up to predetermined lengths with end fittings attached by contractors. A typical assembly is illustrated in fig.14.

Installation notes

69. Lockheed A.D.S.262 and A.D.S.281 hoses can be identified by an inscribed metal disc secured to the hose by wire, and the date of manufacture is printed on the exterior surface of the hose. Refer to Table 4 for installation data.

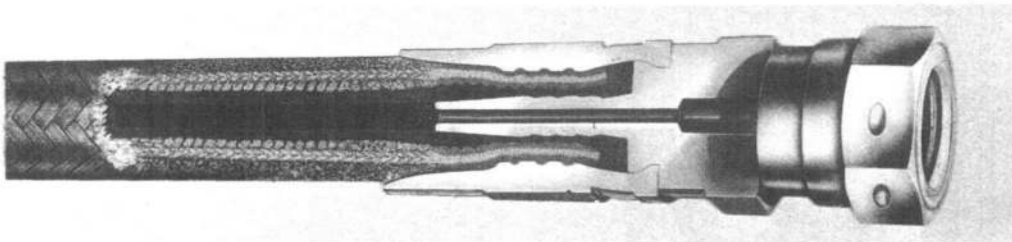


Fig.14 Lockheed A.D.S.262 hose and straight end fitting

AVERY TYPE 11 HOSE

Purpose and description

70. Avery Type 11 hose is a non-fireproof hose suitable for use in fuel systems to the rear of the fireproof bulkhead.

71. The hose is of synthetic rubber with successive plies of braided cotton. The hose is tropicalised. The 1/2in. to the 1 1/4in. bore sizes have three plies and the 1½in. bore hose has four plies of braided cotton.

72. If the Type 11 hose is not available Flylite No.4 hose (para.45 to 54) or Superflexit Type V.P. hose (para.75 to 80) may be used instead.

Attachment of end fittings

73. Standard A.G.S. end fittings must be used with Avery Type 11 hose and assemblies can be made as required by Service personnel. The following is the sequence of operations for attaching the end connections to the hose:-

(1) Cut the hose squarely to the length required with a sharp knife lubricated with water. No other tool must be used for this purpose.

(2) Thread the union nut on to the nipple portion of the assembly, then screw the nut on to an adapter so that the union nut and nipple are held securely.

(3) Grip the adapter lightly in a vice. Ensure that the end of the nipple shank is radiused to not less than 0·02in. and remove any burrs that may be on the shank.

(4) Clean the surface of the nipple shank and the end of the hose bore. Engage the hose on to the shank and with a slight rotary motion, force the hose on the shank until the shoulder of the shank lightly compresses the end of the hose. When an unshouldered connection is used, the hose insert length must be as specified in fig.21. Lubricating oil smeared on the shank will facilitate the fitting operation.

(5) Secure the hose in position with an A.G.S.605 hose clip having previously fitted a wrapping of tape (Ref.No.5F/454 or similar) around the hose under the clip. The position at which the clip must be fitted is shown in fig.21. Care must be taken not to over-tighten the clip.

Installation notes

74. Type 11 hose is supplied in lengths up to a maximum of 14 ft. and is used with standard A.G.S. end connections and A.G.S.605 clips. The particulars contained in fig.21 for fitting end connections apply to Type 11 hose also. Other installation data are contained in Table 5.

SUPERFLEXIT TYPE V.P. HOSE

Purpose and description

75. Superflexit Type V.P. hose (A in fig.15) is supplied in bulk lengths and assemblies are made as required by unit personnel. This type of hose can be used in aircraft fuel and oil systems to the rear of the fireproof bulkhead, but should it not be available Flylite No.4 hose described in para.45 to 54 can be used as a substitute. Type V.P. is the manufacturer's code marking. The letter 'V' denotes 'aircraft', and the letter 'P' denotes 'Paulin', which is a closely woven canvas used as an outer covering for the hose.

76. The hose is obtainable coloured red or black so that a distinction can be made between the hose used in oil systems (red) and fuel systems (black). Both hoses are identical in structure. They will withstand a maximum working pressure of 100 lb/in^2 and a maximum temperature of 100 deg.C.

77. The hose comprises a helix of tinned copper wire covered with a longitudinal wrapping of specially treated thin cellulose sheet, two layers of calico, and a layer of thin synthetic rubber sheet. An external covering of oil-dressed canvas (red or black) is wrapped on, followed by a bonding wire wound in a spiral of wide pitch. Lastly, an external reinforcing wire is wound over the canvas covering and bonding wire.

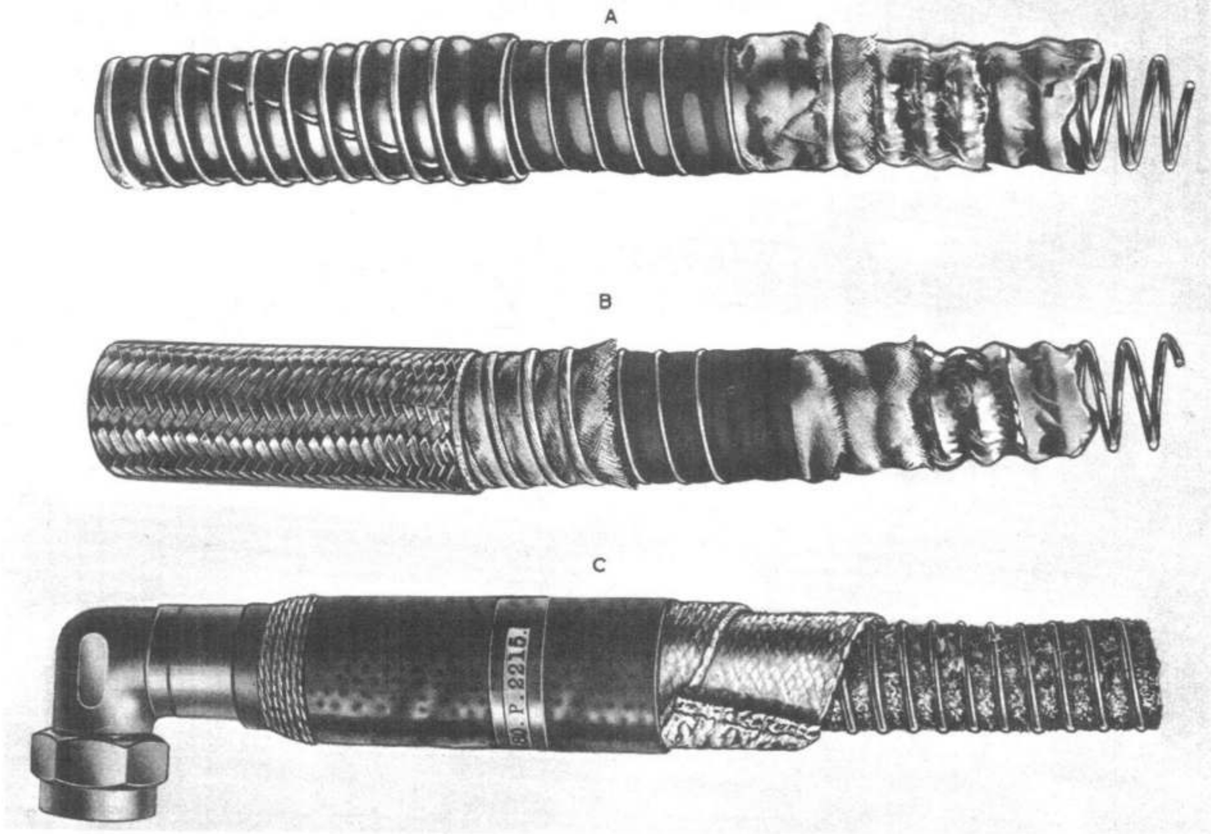


Fig.15 Superflexit hoses

Attachment of end fittings

78. A.G.S. unions, Series 808 (brass) or 770 (light-alloy), are used with Superflexit hose. The sequence of operations for the attachment of end connections is as follows:-

(1) Measure the length of hose required, making an allowance for the length of the body of the union.

(2) Cut through the outer reinforcing wire with wire cutters.

(3) Cut the hose squarely with a sharp knife lubricated with water.

(4) Bend the hose and cut the inner reinforcing wire with wire cutters.

(5) Cut both the inner and outer wires back a quarter of a turn.

(6) Trim the ragged ends of the hose with scissors.

(7) Screw the union nut on to an adapter so that the nipple is held rigidly, then grip the adapter in a vice.

(8) Fit the sleeve, supplied with the A.G.S. union, on to the end of the hose. Make sure that the hose butts against the sleeve shoulder.

(9) Screw the hose end on to the body of the union 1½ turns, making sure that the inner reinforcing wire engages in the body spiral groove.

(10) Coat the exposed portion of the union body with engine jointing compound (Ref.No.33C/523). No compound must enter the bore of the hose that extends beyond the end of the union body.

(11) Grip the hose by hand and screw the hose on to the union body as far as possible. Then wrap a leather strap spanner, similar to that illustrated in fig.16, around the sleeve and hose and screw the hose in a clockwise direction until the sleeve butts against the shoulder of the union. It is important that the sleeve on the hose remains in close contact with the end of the hose while the hose is being rotated on to the body of the union.

(12) When the end of the tube and the sleeve have reached the shoulder of the union, about one turn more must be given to ensure tight contact with the union. The amount of this last turn can be judged by experience, but it is better to under-turn the hose than the reverse.

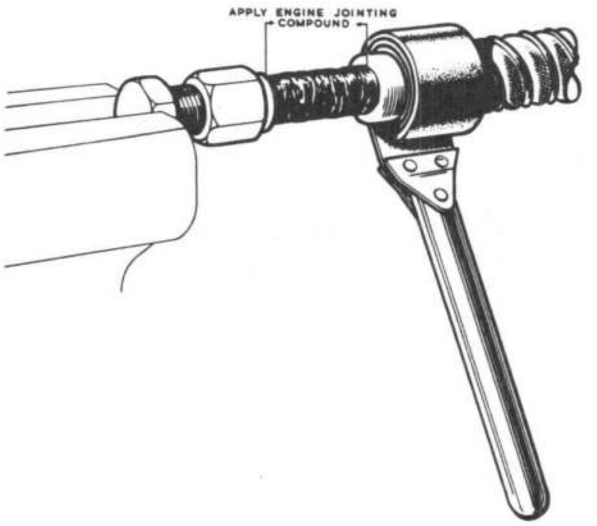


Fig.16 Screwing hose on to a nipple

Testing a hose assembly

79. All hose assemblies made by Unit personnel must be tested before installation. The hoses, however, should not be tested until 24 to 28 hours have elapsed after the fitting of end connections, so that the jointing compound is allowed to set. Test the hose assembly using a rig similar to that in fig.17; the reservoir of this rig is filled with kerosene in sufficient quantity to fill the hose under test. If only one hose assembly requires testing and no test rig is available, it will be sufficient if one union is screw plugged, the hose filled with kerosene and the other end of the hose connected to an air line which incorporates a valve and a pressure gauge. The air pressure for a new hose assembly under test is 100 lb/in^2 for two minutes, and for a reconditioned hose 50 lb/in^2 for two minutes. Finally, test the hose for electrical continuity, using a Multimeter or a lamp and battery not exceeding 12V.

Installation notes

80. The hose assembly must be carefully examined before installation to ensure that the bore is clean and unobstructed and that the seating and threads of the union nuts are in good condition. Other installation data are contained in Table 6.

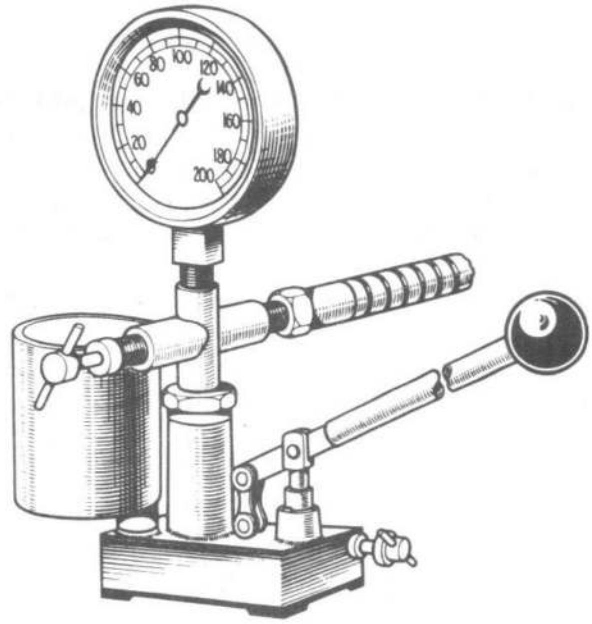


Fig.17 Hose assembly test rig

SUPERFLEXIT TYPE V.M. HOSE

Purpose and description

81. Superflexit Type V.M. hose (B in fig.15) is similar to Type V.P. except that instead of an outer covering of oil-dressed canvas and a spirally wound outer reinforcing wire, a further layer of aero fabric is wrapped over the layer of synthetic rubber. On this is wound a strand of soft string. Lastly, an outer covering of fine tinned copper wire is braided over the fabric to give the hose extra strength and protection. The code letters V.M. denote 'aircraft—metal braided'.

82. Type V.M. hose can be used in fuel and oil systems to the rear of the fireproof bulkhead and, being metal braided, can be installed in congested areas where contact with other components is possible.

Attachment of end fittings

83. End connections similar to those quoted for use with Type V.P. hose are used also for the Type V.M. hose; the sequence of operations for their attachment (para.78) also applies. Type V.M. hose assemblies should be tested and examined as described in Para.79 and 80.

Installation notes

84. Metal braided hoses, being heavier than those of non-metallic construction, are only installed where an additional wear safety-factor is required. They should not be used where flexing may also incur twisting, as the braid resists any twisting action which, if continually applied, would ultimately fracture the braid. The installation data in Table 6 also apply to Type V.M. hoses.

SUPERFLEXIT FIREPROOF HOSE

Purpose and description

85. Superflexit fireproof hose (C in fig.15) sometimes referred to as 'lagged' Superflexit, is similar in construction to Type V.P. hose except that over the outer helix of reinforcing wire there are two separate coverings of 1in.wide asbestos tape, the top tape covering the butt joints of the under wrapping. The ends of the tape are bound with varnished asbestos string.

86. The external covering is a maroon-coloured seamless P.V.C. sheathing which provides a smooth glossy fireproof finish.

87. The end fittings, method of attachment, test procedure and installation data quoted for Type V.P. hose also apply. The lagged hose, being fireproof, can be used forward of the fireproof bulkhead.

FLEXATEX TYPE C.6 HOSE

Purpose and description

88. Flexatex C.6 hose is used in aircraft systems to the rear of the fireproof bulkhead. It is designed to withstand a maximum working pressure of 30 lb/in^2 at ambient temperatures up to 85 deg.C., and may be installed on either the pressure or the suction side of the fuel pump.

89. The construction of the hose varies according to its bore size. Fig.18 illustrates the construction for bore sizes upwards of 7/16in.dia. The inner layer of the hose is an extruded tube of polyvinylchloride around which is a strand of regenerated cellulose monofil wire and a 4 oz. fabric strip. The wire lies between the overlaps of the fabric strip. A strand of string is wound over the fabric in the space between the turns of the wire. The outer layer is a thinner extruded tube of polyvinylchloride. The exterior surface has a helical groove.

90. The construction of the smaller sizes (1/4in. to 3/8in. bore) is illustrated in fig.19). The hose consists of a thick extruded tube of polyvinylchloride corrugated to allow bending without kinking.

91. If Type C.6 hose is not available, Flylite No.4 hose (para.45 to 54) or Superflexit Type V.P. hose (para.75 to 80) may be used instead.

Attachment of end fittings

92. Only A.G.S. end connection assemblies may be used with Flexatex C.6 hose. The A.G.S. series numbers to suit the various sizes of this hose are tabulated in Table 7. The sequence of operations for attaching the end connections to the hose is as follows:-

(1) Measure the length of hose required, plus 5 per cent allowance for shrinkage. Cut the hose straight across with a sharp knife lubricated with water. No other tool is to be used for this purpose.

(2) Thread the union nut on to the nipple and screw the union nut on to an adapter so as to hold the nut and nipple firmly in position.

(3) Grip the adapter lightly in a vice. Ensure that the shank of the nipple is radiused to not less than 0·02in and remove any burrs that may be on the shank.

(4) Clean the shank of the nipple portion and the end of the hose bore. Engage the hose bore on to about 1/4in. of the shank.

(5) Smear the exposed portion of the shank with Linatex No.4 Cement (Ref.No.33C/302). It is essential that the entering end of the shank be left uncemented so that no trace of the cement can enter the free portion of the hose bore.

(6) Immediately force the hose on to the shank with a rotary movement until the shoulder of the shank lightly compresses the end of the hose or, where an unshouldered connection is used, to the length specified in fig.21 in conjunction with Table 7.

(7) Secure the hose in position with an A.G.S.605 hose clip, having previously fitted a wrapping of tape (Ref.No.5F/454 or similar) around the hose under the clip. The position at which the clip is to be fitted is shown in fig.21. Care must be taken not to overtighten the clip, as otherwise the hose material will tend to 'flow' from under the clip. The hose may be installed not less than five minutes after the joint has been made.

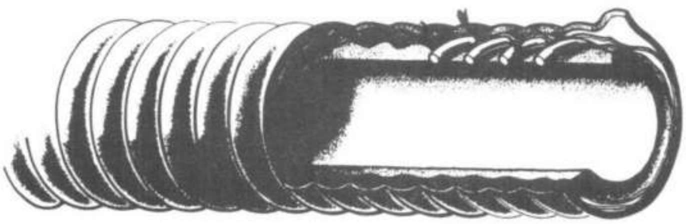


Fig.18 Flexatex C.6 hose (7/16 - 1½in. bore sizes)

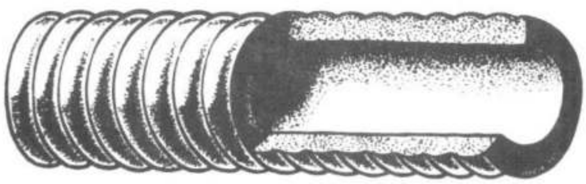


Fig.19 Flexatex C.6 hose (1/4 - 3/4in. bore sizes)

Installation notes

93. The hose is supplied in various lengths, up to 14 ft. 6in. for the larger bore sizes, and in 9 ft. 6in. lengths for the 1/4 and 5/16in. sizes, from which the length required for installation can be cut. Lengths of the hose are joined by standard A.G.S. end connections but in emergency rigid metal pipes may be connected with short lengths of Flexatex C.6 hose provided the ends of the pipes are radiused.

94. To obviate the effects of hose shrinkage due to temperature changes and the action of fuel on the hose material an allowance of 5 per cent over the length of the hose between its two end connections must always be added to the actual required length when making hose replacements. This will prevent

tensioning of the hose and any tendency to pull away from end connections because of shrinkage.

95. The following instructions must be observed when replacement lengths of hose are installed in aircraft:-

(1) The hose must not be subjected to a bend radius smaller than the minimum bend radius quoted in Table 7.

(2) It is essential that the hose is installed free from all tensional and torsional loads.

(3) No length of more than 18in. is to be left unsupported. If a standard A.G.S. hose supporting clip is not available, a sling of tape (Ref.No.5F/454 or similar) must be used to support the hose from any convenient fitting or aircraft member.

(4) The hose must be installed so that it does not come in contact with a vibrating surface. The hose must not be wrapped with any material unless so specified by the manufacturers or by modification action.

(5) Electrical bonding is required only for the metal end connections.

96. Type C.6 hose can be identified by its maroon colour and by figures indicating the month and year of manufacture followed by the continuous marking FLEXATEX C.6.

AVIOFLEXUS HOSE

Purpose and description

97. Avioflexus hose (fig.20) is used in aircraft pneumatic and oil systems to the rear of the fireproof bulkhead. The hose consists of a flexible metal tube covered by layers of thin cellulose material; a helical winding of string presses the cellulose covering on to the metallic tube. This is followed by a covering of synthetic rubber, and the outer covering comprises a fine metal wire braiding. Some of the larger diameter hose sizes are reinforced with a cotton braiding underneath the outer metallic covering. The hose will withstand temperatures up to 140 deg. C.

98. If Avioflexus hose is not available for replacement purposes, Flylite No.4 hose (para.45 to 54) or Superflexit Type V.P. hose (para.75 to 80) may be used instead.

Installation notes

99. When screwing up or unscrewing the union nuts of the end fittings, it is most important to prevent the hose from turning with the union nut. The union nut must be held firm with a spanner whilst the adapter is loosened or tightened with another spanner.

100. Installation data and other information concerning Avioflexus hose are contained in Table 8.

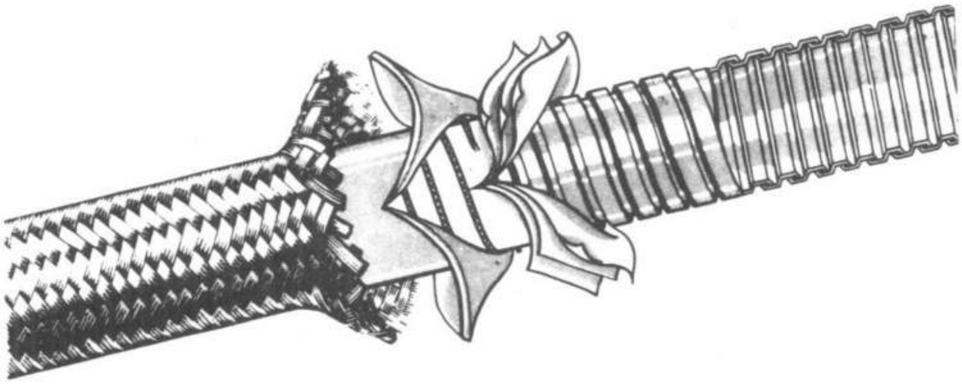


Fig.20 Avioflexus hose construction

TABLE 1

Installation data for Dunlop hose

Type	Bore (in.)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)		Identification
					Flexing	Vibrating	
Single wire reinforcement (W.H.2/1)	5/32	Pneumatic	1,000	Fwd.	3	1.1/2	Continuous marking along length of hose—colour, brown
		Hydraulic	3,000	Fwd.			
	1/4	Pneumatic	1,000	Fwd.	4	2	
		Fuel	2,000	Fwd.			
		Oil	300	Fwd.			
		Hydraulic	3,000	Fwd.			
	3/8	Pneumatic	1,000	--	5	2.1/2	
		Fuel	2,000	Fwd.			
		Oil	300	Fwd.			
		Hydraulic	3,000	Fwd.			
	1/2	Fuel	2,000	Fwd.	6	3.1/4	
		Oil	300	Fwd.			
		*Prop.control	1,200	--			

*For installations with a maximum oil temperature of 120 deg.C.

TABLE 1 (cont.)

Type	Bore (in.)	System	Maximum working pressure (lb/in²)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose) Flexing	Vibrating	Identification
Single wire reinforcement (W.H.2/1)	5/8	Fuel	2,000	Fwd.	7.1/2	4	Continuous marking along length of hose— colour, brown
		Oil	300	Fwd.			
		*Prop.control	1,200	Fwd.			
		Hydraulic	500	Fwd.			
	3/4	Fuel	1,600	Fwd.	8.1/2	4.1/2	
		Oil	300	Fwd.			
		*Prop.control	1,200	Fwd.			
		Hydraulic	500	Fwd.			
	1	Fuel	1,000	Fwd.	11	6	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	1.1/4	Fuel	1,000	Fwd.	13	7	
		Oil	300	Fwd.			
		Hydraulic	200	Fwd.			

*For installations with a maximum oil temperature of 120 deg.C.

TABLE 1 (cont.)

Type	Bore (in.)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)		Identification
					Flexing	Vibrating	
	1.1/2	Fuel	1,000	Fwd.	15.1/2	8	Continuous marking along length of hose—colour, brown
		Oil	300	Fwd.			
		Hydraulic	200	Fwd.			
Two-wire reinforcement (W.H.2/2)	1/2	Hydraulic	3,000	Fwd.	6	3.1/2	

TABLE 2

Installation data for Silvoflex and Avica (Weatherhead) hose

Type	Bore (in)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose) Flexing	Vibrating	Identification
Single wire reinforcement (971/07/1 or 3N)	1/4	Fuel	2,000	Fwd.	4	2	One green line and the word FIREPROOF in green
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	3/8	Fuel	1,500	Fwd.	5	2.1/2	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
Single wire reinforcement (971/05/1 or 3N)	5/32	Hydraulic	500	Rear	3	1.1/2	One white line
	1/4	Oil	300	Rear	4	2	
		Hydraulic	500				
	3/8	Oil	300	Rear	5	2.1/2	
		Hydraulic	500				
Single wire reinforcement (971/07S/1 or 3N)	1/2	Fuel	1,500	Fwd.or rear	6	3	One green line and the word FIREPROOF in green
		Oil	300	Fwd.or rear			
		*Prop.control	1,200	Fwd.or rear			
		Hydraulic	3,000	Fwd.or rear			

*For installations with a maximum oil temperature of 120 deg.C.

TABLE 2 (cont.)

Type	Bore (in)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in.to centre line of hose)		Identification
					Flexing	Vibrating	
Single wire reinforcement (971/07S/1 or 3N)	5/8	Fuel	1,500	Fwd.or rear	7.1/2	4	One green line and the word FIREPROOF in green
		Oil	300	" "			
		*Prop.control	1,200	" "			
		Hydraulic	500	" "			
	3/4	Fuel	1,000	Fwd.or rear	9	5	
		Oil	300	" "			
		*Prop.control	1,200	" "			
		Hydraulic	500	" "			
	1	Fuel	800	Fwd.or rear	11	6	
		Oil	300	" "			
		Hydraulic	500	" "			
	1.1/4	Fuel	800	Fwd.or rear	13	7	
		Oil	300	" "			
		Hydraulic	200	" "			
	1.1/2	Fuel	200	Fwd.or rear	15.1/2	8	
		Oil	300	" "			
		Hydraulic	200	" "			

*For installations with a maximum oil temperature of 120 deg.C.

TABLE 2 (cont.)

Type	Bore (in.)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose) Flexing	Minimum bend radius (in. to centre line of hose) Vibrating	Identification
Two-wire reinforcement (965/07/1) fwd. of bulkhead and (965/05/1) aft of bulkhead	1/4	Hydraulic	3,000	Fwd.	4	2	Two green lines and the word FIREPROOF in green for two-wire reinforcement (965/07/1)
		Hydraulic	3,000	Rear			
	3/8	Hydraulic	3,000	Fwd.	5	2.1/2	
		Hydraulic	3,000	Rear			
	1/2	Hydraulic	3,000	Fwd.	6	3	
		Hydraulic	3,000	Rear			
	2	Oil	300	Fwd.	14	9	Two white lines interrupted with the letters B.T.R. for two-wire reinforcement (965/05/1)
		Oil	300	Rear			
Cotton braided (1054)	5/32	Pneumatic	200	---			One red line, interrupted with the word INSTRUMENT
	1/4	Pneumatic	200	---	4	4	
	3/8	Pneumatic	200	---			

TABLE 3

Installation data for Flylite hose and A.G.S. (Flylink) end fittings

Bore (in.)	Type of hose	System	Maximum working pressure (lb/in²)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)		End fitting A.G.S.No.			Assembly tool Stores Ref.	Hose identification
					Flexing	Vibrating	Union	Tail-piece	Ferrule		
	No.F.1			Fwd.			---	---	---		
1/4		Fuel	50		5	2.1/2				1C/6185 No.1	Type No.F.1
	No.4			Rear			1231B	1232B	1233B		Marked with a
	No.F.1			Fwd.			---	---	---		yellow strip
3/8		Fuel	50		5.1/2	2.3/4				1C/6186 No.2	with the words
	No.4			Rear			1231C	1232C	1233C		'Flylite No.1'
	No.F.1			Fwd.			---	---	---		
1/2		Fuel	50		6	3				1C/6187 No.3	
	No.4			Rear			1231D	1232D	1233D		
	No.F.1			Fwd.			---	---	---		
5/8		Fuel	50		6.1/2	3.1/4				1C/6188 No.4	Type No.4
	No.4			Rear			1231E	1232E	1233E		
	No.F.1			Fwd.			---	---	---		External
3/4		Fuel	50		7	3.1/2				1C/6189 No.5	finish is
	No.4			Rear			1231F	1232F	1233F		grooved
	No.F.1			Fwd.			---	---	---		spirally
1		Fuel	50		8	4				1C/6190 No.6	
	No.4			Rear			1231H	1232H	1233H		

TABLE 3 (cont.)

Bore (in)	Type of hose	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)		End fitting A.G.S.No.			Assembly tool Stores Ref.	Hose identification
					Flexing	Vibrating	Union	Tail-piece	Ferrule		
1.1/4	No.F.1	Fuel	50	Fwd.	10	5	---	---	---	1C/6191 No.7	
	No.4			Rear			1231J	1232J	1233J		
1.1/2	No.F.1	Fuel	50	Fwd.	12	6	---	---	---	1C/6192 No.8	
	No.4			Rear			1231K	1232K	1233K		
2	No.F.1	Fuel	50	Fwd.	16	8	---	---	---	1C/6193 No.9	
	No.4			Rear			1231M	1232M	1233M		

TABLE 4

Installation data for Avery and Lockheed A.D.S. hoses

Type	Bore (in)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in.to centre line of hose)		Identification
					Flexing	Vibrating	
No.7	5/32	Oil	300	Fwd.	4	2	The name LOCKHEED, the hose type number, and the date of manufacture are printed on each assembly
	1/4	Fuel	1,800	Fwd.	5	2.1/2	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	3/8	Fuel	1,800	Fwd.	6	3	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	1/2	Fuel	1,550	Fwd.	8	4	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	5/8	Fuel	1,550	Fwd.	10	5	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	3/4	Fuel	1,550	Fwd.	12	6	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
	1	Fuel	600	Fwd.	14	7	
		Oil	300	Fwd.			
		Hydraulic	500	Fwd.			
No.2	1/8	Pneumatic	1,000	---	4.1/2	2.1/4	Metal identification band, stamped to indicate hose size, hose length and type of end fittings
		Hydraulic	500	Rear			
	1/4	Oil	300	Rear	5	2.1/2	
		Pneumatic	1,000	---			
		Hydraulic	500	Rear			
	3/8	Oil	300	Rear	5.1/2	2.3/4	
		Hydraulic	500	Rear			

TABLE 4 (cont.)

Type	Bore (in)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in.to centre line of hose)		Identification
					Flexing	Vibrating	
No.2	1/2	Oil	300	Rear	6	3	Metal identification band, stamped to indicate hose size, hose length and type of end fittings
		Hydraulic	500	Rear			
	5/8	Oil	300	Rear	6.1/2	3.1/4	
		Hydraulic	500	Rear			
	3/4	Oil	300	Rear	7	3.1/2	
		Hydraulic	500	Rear			
	1	Oil	300	Rear	9	4.1/2	
		Hydraulic	500	Rear			
	1.1/4	Oil	300	Rear	11	5.3/4	
		Hydraulic	200	Rear			
	1.1/2	Oil	300	Rear	16	8	
		Hydraulic	200	Rear			
No.5	3/8	Pneumatic	1,000	---	9	4.1/2	
		Hydraulic	3,000	Rear			
A.D.S. No.262	1/4	Hydraulic	3,000	Rear	6	3	Metal disc wired to hose
A.D.S. No.281	1/8	Hydraulic	3,000	Rear			

TABLE 5

Installation data for Avery Type 11 hose

Bore (in.)	Outside dia. (in.)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)		Identification	End fittings
					Flexing	Vibrating		
1/4	0.53	Fuel	75	Rear	5	2.1/2		
3/8	0.71	"	"	"	5.1/2	2.3/4		
1/2	0.99	"	"	"	7	3.1/2		
5/8	1.13	"	"	"	8	4		
3/4	1.28	"	"	"	9	4.1/2	Bands of	Standard
7/8	1.38	"	"	"	11.1/2	5.3/4	Lassolatic tape	A.G.S.
1	1.54	"	"	"	13.1/2	6.3/4	marked	series
1.1/4	1.77	"	"	"	16	8	'A.V.A.342 L.P.fuel	
1.1/2	2.09	"	"	"	25	12.1/2	NOT FIRE	
							RESISTING'	

TABLE 6

Installation data for Superflexit V.P., V.M., and Fireproof hoses

Bore (in.)	Outside dia. (in.)	System	Maximum working pressure (lb/in^2)	Forward of rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose) Flexing	Vibrating	Identification	End fittings
1/8	0.48	Fuel and oil	100	Rear	2	1	All assemblies made by the manufacturers have bands of Lassolatic tape showing Month and Year of issue	A.G.S. series 808 (brass) or series 707 (light alloy)
1/4	0.62	" "	"	"	2.3/4	1.3/8		
3/8	0.78	" "	"	"	4	2		
1/2	0.09	" "	"	"	4.1/4	2.1/8		
5/8	1.02	" "	"	"	4.3/4	2.3/8		
3/4	1.14	" "	"	"	5.1/2	2.3/4	V.P. and V.M. hose can be recognised by the external helix of wire	These are supplied with sleeves
7/8	1.33	" "	"	"	6.1/4	3.1/8		
1	1.41	" "	"	"	7.1/4	3.5/8		
1.1/4	1.81	" "	"	"	10.1/4	5.1/8	Fireproof hose can be recognised by the smooth maroon colour of the external finish	
1.1/2	1.92	" "	"	"	11	5.1/2		

Superflexit Fireproof hose can be used forward of the fireproof bulkhead

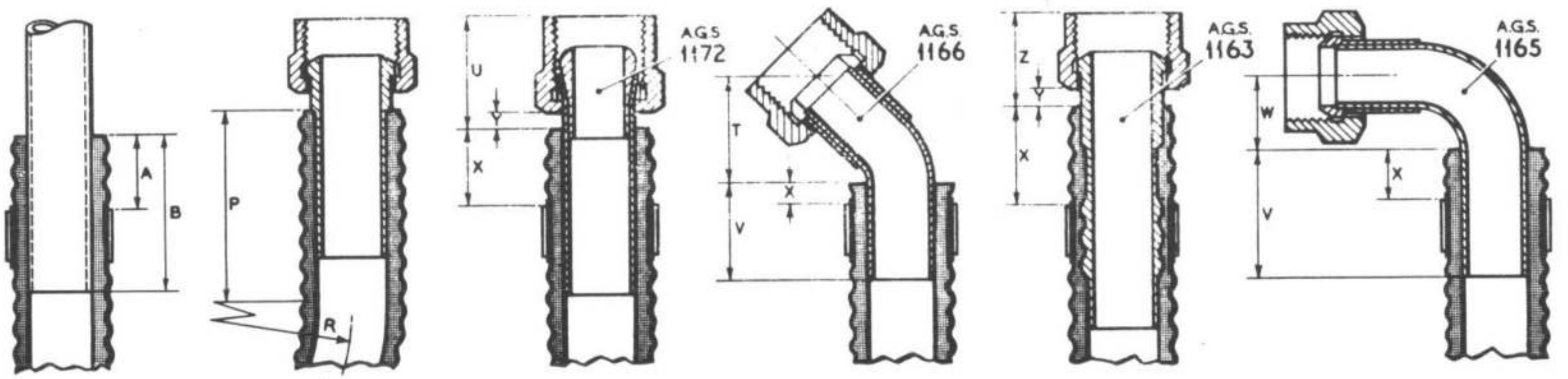


Fig.21 End connections for Flexatex C6 hose

TABLE 7

Installation data for Flexatex C.6 hose

Bore (in)	Outside dia. (in)	End fitting used (complete)				Dimensions (in)										Minimum bend radius (in. to centre line of hose)	
		A.G.S. 1163/	A.G.S. 1165/	A.G.S. 1166/	A.G.S. 1172/	P	T	U	V	W	X	Y	Z	A	B	Flexing	Vibrating
1/4	0·650	B	B	B	B	2	13/32	51/64	1.1/4	1/4	13/16	0·15	7/16	0·37	1	2·6	1·3
5/16	0·713	--	BB	BB	BB	2	9/16	51/64	1.1/2	13/32	13/16	0·15	--	--	--	3·2	1·6
3/8	0·775	C	C	C	C	2	23/32	13/16	1.3/4	13/32	13/16	0·15	31/64	0·37	1	3·8	1·9
7/16	0·938	--	CC	CC	CC	2	13/16	53/64	1.3/4	17/32	13/16	0·15	--	--	---	4·4	2·2
1/2	1	D	D	D	D	2.1/4	1/32	27/32	1.3/4	21/32	13/16	0·15	17/32	0·5	1.1/4	5	2·5
5/8	1·125	E	E	E	E	2.1/4	1.1/8	15/16	1.3/4	21/32	13/16	0·20	39/64	0·5	1.1/4	6	3
3/4	1·25	F	F	F	F	2.1/2	1.1/4	61/64	1.3/4	21/32	13/16	0·20	5/8	0·62	1.1/2	7·2	3·6
7/8	1·375	G	G	G	G	2.1/2	1.7/8	31/32	1.3/4	1.1/4	13/16	0·20	5/8	0·62	1.1/2	8·2	4·1
1	1·5	H	H	H	H	2.1/2	2	1.1/32	1.3/4	1.1/4	13/16	0·25	3/4	0·62	1.1/2	9·4	4·7
1.1/8	1·625	--	--	--	--	--	--	--	--	--	1	--	--	--	--	12·8	6·4
1.1/4	1·75	J	J	J	J	3	2.1/4	$1^3/32$	2	1.1/4	$1^3/16$	0·25	13/16	0·75	2	14	7
1.1/2	2	K	K	K	K	3	2.3/8	$1^5/32$	2	1.1/2	1.1/4	0·25	13/16	0·75	2	20	10

TABLE 8

Installation data for Avioflexus hose

Bore (in.)	System	Maximum working pressure (lb/in^2)	Forward or rear of fireproof bulkhead	Minimum bend radius (in. to centre line of hose)	
				Flexing	Vibrating
3/16		275	Rear	5	2.1/2
1/4		250	"	6	3
5/16		220	"	7.1/2	3.3/4
3/8		200	"	8	4
1/2	Oil	175	"	10.1/2	5.1/4
5/8	and	160	"	13	6.1/2
3/4	pneumatic	150	"	14	7
7/8		130	"	14.1/2	7.1/4
1		125	"	16	8
1.1/4		110	"	18	9
1.1/2		100	"	20	10

Chapter 5

STANDARD COUPLINGS FOR AIRCRAFT METAL PIPE-LINES

CONTENTS

ILLUSTRATIONS

Introduction

1. Metal couplings for joining pipe-lines in aircraft usually comprise some form of threaded coupling nut in association with a collar, or an adapter nipple and a collar. It was usual, formerly, for the metal coupling to be

made of material similar to that of the pipe-lines to be joined so as to avoid electrolytic action between the adjacent surfaces of dissimilar metals. Now, however, the material used depends upon the application; light alloy to BS L85 for low-pressure systems, non-corrodible steel for Naval use, and stainless steel for modern high-pressure systems. These metals have been found to give satisfactory results when used in conjunction with any of the metals commonly used for aircraft pipe-lines. Standard couplings are listed in AP1086, Sect. 28F.

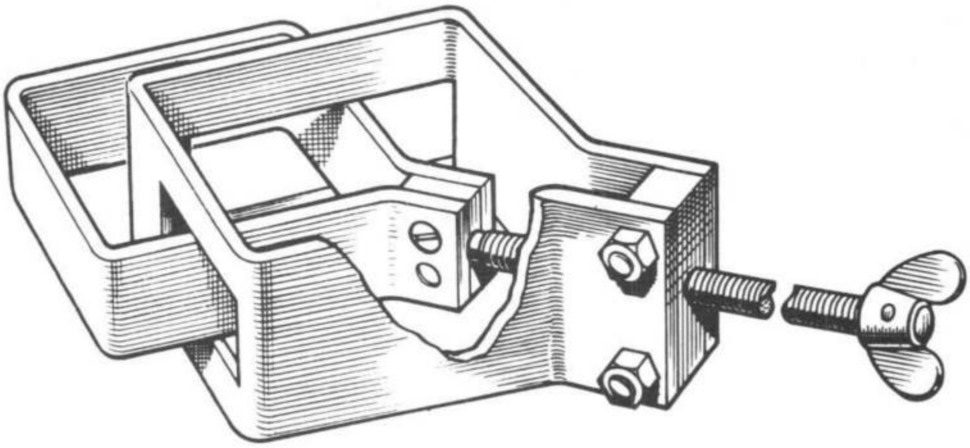


Fig.1 Tube end squaring tool

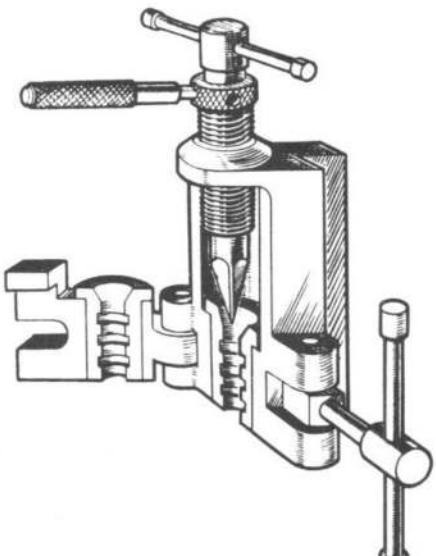


Fig.2 Tube end flaring tool

DESCRIPTION

PIPE PREPARATION

General

2. The standard types of pipe couplings require the pipe ends to be flared so that a joint capable of withstanding high mechanical and hydraulic pressures can be obtained. Special tools are necessary for squaring and

flaring the ends of the tube as follows:

Tool	Ref. No.
Squaring tool, tube ends	-
Flaring tool, tube ends (tubes $^1/_8$in. to $^1/_2$in. o.d.	IC/5506
Flaring tool, tube ends (tubes $^5/_8$in. to $1^1/_4$in. o.d.	IC/5509

Use of the tube end squaring tool (fig.1)

3. The tube end squaring tool consists of two rectangular parts, one sliding within the other and operated by a traversing screw. In use the tool is placed over the end of the tube to be squared so that the tube is enclosed in the space formed by the two rectangular parts of the tool. Position the tool near enough to the end of the tube to act as a guide for the saw or file being used to square up the end without distorting the tube. Next, saw or file the end of the tube so that it is level with the tool face. Unclamp the tube and remove any burrs from the squared end.

Note...

When handling soft metal, such as light alloy to BS L85, thin strips of fibre packing must be positioned between the tube and the clamping surfaces of the tool. Oil the end of the traversing screw and the thread. Take care not to distort the tool.

Use of the tube end flaring tool (figs.2 and 3)

Note...

This process must not be used for stainless steel, refer instead to Chap.3 of this publication.

4. For tubes having outside diameters of $^1/_8$in. to $^1/_2$in. the flaring tool reference number IC/5506 must be used; for tubes having outside diameters of $^5/_8$in. to $1^1/_4$in. the flaring tool reference number IC/5505 is required. Sets of half-bushes, in pairs covering the range of tube sizes quoted, are provided with each tool.

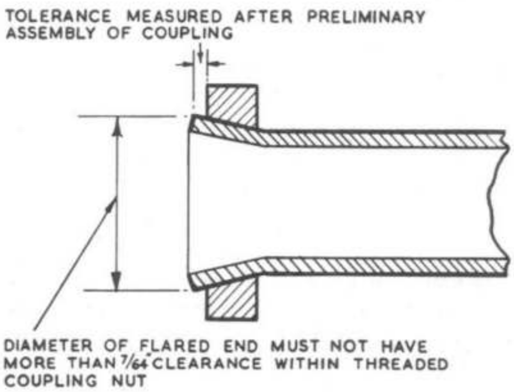


Fig.3. Tolerance on flared end of tube

5. The sequence of operations for flaring a tube end is as follows:

(1) Ensure that the previously squared tube end is free from burrs.

(2) Place the appropriate sleeve or union nut and collar correctly on the tube.

(3) Choose a pair of half-bushes of the correct size and insert them in the tool.

(4) Remove any oil or grease from the bush and tube nut.

(5) Clamp the tool on the tube so that the end of the tube is level with the outer face of the countersunk end of the split bush.

(6) Using a tommy bar, screw in the threaded sleeve until the cone spindle begins to force the tube wall outwards towards the countersunk bore of the bush.

(7) At this stage rotate the cone spindle by the handle provided and, at the same time, gradually advance the cone with the aid of the tommy bar until the tube end is flared to the limit imposed by the bush.

(8) Unclamp the tube and examine the flared end for concentricity and freedom from fracture or other damage. Check the tolerance on the flared end as shown in para.6.

Note...

A slow forward feed of the cone spindle, and generous use of the rotating handle will assist in the obtaining of flawless, uniform results.

6. The amount of flare on the tube end can be checked as follows:

(1) Assemble and tighten the required coupling on the flared end.

(2) The flared end of the pipe should enter the union nut with not more than $^{7}/_{64}$in. clearance (fig.3).

(3) Dismantle the coupling and slide the collar as far as it will go towards the flared end (fig.3).

(4) Measure the distance from the end of the pipe to the collar face, the following tolerances being permissible:

Outside diameter of tube	Tolerance
◀ $^{3}/_{16}$ to $^{1}/_{4}$in. ▶	0·010 to 0·020in.
$^{5}/_{16}$ to $^{3}/_{8}$in.	0·020 to 0·030in.
$^{7}/_{16}$ to $2^{1}/_{2}$in.	0·030 to 0·050in.

Note...

For correct coupling the sleeve must seat squarely on the flared end of one pipe whilst the union nut must be pushed up to the collar on the other pipe end and rotate freely round it.

STANDARD COUPLINGS

Pipe to pipe (fig.4)

7. One form of coupling is now standard for the direct coupling of lengths of metal tubing used in aircraft pipe-lines. The coupling is made in a range

PSG/33064/176688/933/APR.75/1731

of sizes suitable for pipes from 1/8in. to 2in.o.d. and comprises a sleeve, a coupling nut, a collar and an adapter nipple (fig.4(A)). To couple the two pipes, the sleeve is pushed over one pipe end, and the union nut and collar over the other pipe end. Both ends are then flared with the flaring tool. An adapter nipple is then fitted in the pipe end on which are the union nut and collar. The nut is then screwed on to the sleeve, thereby pulling the flared pipe ends into tight contact with the coned surface of the adapter nipple. Before the pipe coupling is regarded as satisfactory, it must be taken apart and the extension of the pipe end beyond the collar measured as described in para.6.

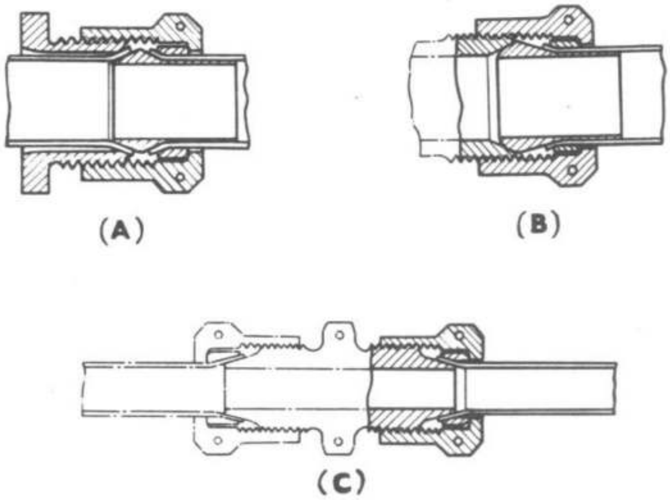


Fig.4 Standard metal couplings

8. When tightening the pipe couplings, the components of which are made of light alloy (BS L85), avoid overstressing the screw threads of the sleeve and union nut by excessive tightening. If the pipes have been flared, and the coupling assembled correctly, a pressure-tight joint will be made without difficulty.

Note...

The couplings in the range 1/8in. to 2in. o.d. are easily overtightened and careful avoidance of overstressing must be made. Special care in this respect must be exercised when tightening the 1/8in. and 3/16in. o.d. sizes.

Pipe to internally-coned adapter (fig.4)

9. This type of coupling (fig.4(B)) provides a means of connecting a pipe to an externally-threaded adapter which is countersunk at the mouth. The coupling comprises a union nut, a collar and a spherical-ended adapter nipple. To assemble the coupling, the nut and collar are pushed over the pipe end which is then flared. The skirt of the nipple is placed in the flared pipe and the union nut screwed on to the externally-threaded adapter until the nipple is tightly gripped between the collar and the internally-coned surface of the adapter. To ensure that the flaring of the pipe is satisfactory, dismantle the coupling and examine it as described in para.6.

Pipe to externally-coned adapter (fig.4)

10. This type of coupling (fig.4(C)) provides a means of connecting a pipe to an adapter having an externally-coned nozzle, and comprises a union nut and collar only. To assemble the coupling, the nut and the collar are pushed over

the pipe end which is then flared. The flared end is pushed over the conical end of the adapter and the union nut is tightened, thus compressing the flared pipe between the collar and the coned adapter. The coupling must be dismantled and examined as previously described.

Standard adapters (fig.5)

11. The standard adapter (fig.5(a)) is a double-ended fitting with a central hexagonal collar to enable it to be held securely in the jaws of a spanner whilst pipe connections are made at either end. Standard adapters are threaded externally and are coned internally or externally at each end. The range of adapters comprises fittings with both similar (fig.5(a)) and dissimilar (fig.5(b)) ends to enable various types of pipe fittings to be coupled when required. Adapters are normally made of light alloy to BS L85.

Standard hexagonal fittings for bulkheads (fig.5)

12. Hexagonal fittings for bulkheads (fig.5(c)) are similar to standard adapters except that, at one end, a longer threaded portion accommodates a nut which is used to clamp the fitting to a bulkhead through which the pipeline must pass. Two washers are provided to prevent the hexagon collar and the nut from being tightened against the surfaces of the bulkhead. Bulkhead fittings are made of light alloy to BS L85 normally and are obtainable with similar or dissimilar ends. This type of fitting must be held with a spanner to prevent rotation when connecting or disconnecting pipes.

Standard flanged fittings for bulkheads (fig.5)

13. Flanged bulkhead fittings (fig.5(d)) are similar to the hexagonal type except that each comprises one fixed and one loose flange, each with bolt holes, to enable the fitting to be mounted rigidly on the bulkhead. In addition to the externally and internally-coned fittings, a flanged fitting is available which has a long internally threaded body in which a banjo union can be screwed (fig.5(e)).

Standard banjo unions (fig.5)

14. The standard banjo union comprises an externally-threaded hollow screw fitted into a single or double-ended pipe connection to which it is sealed top and bottom by bonded seals or soft metal joint rings. Banjo unions are made in a range to suit pipe sizes from 1/8 to 1.1/4in. o.d. and are normally made of light alloy to BS L85. Fig.5(f), (g) and (h) show the various types of banjo unions, each of which may have either internally or externally-coned connections.

Standard pipe unions (fig.6)

15. A series of elbows, T-pieces and four-way pipe unions having connections which are either similar or dissimilar in type and size, are illustrated in fig.6.

Standard end plugs and caps (fig.7)

16. When it is desired to blank off a section of a system, it is normal practice to do so at a union body or at a component; pipe couplings, nipple plugs and cone caps to AGS1140 and AGS1159 (fig.7) are available for the purpose. If, however, it is desired to blank off a pipe on which is fitted an inner sleeve, an adapter nipple must be used in conjunction with a cap cone and an outer sleeve (fig.7(d)).

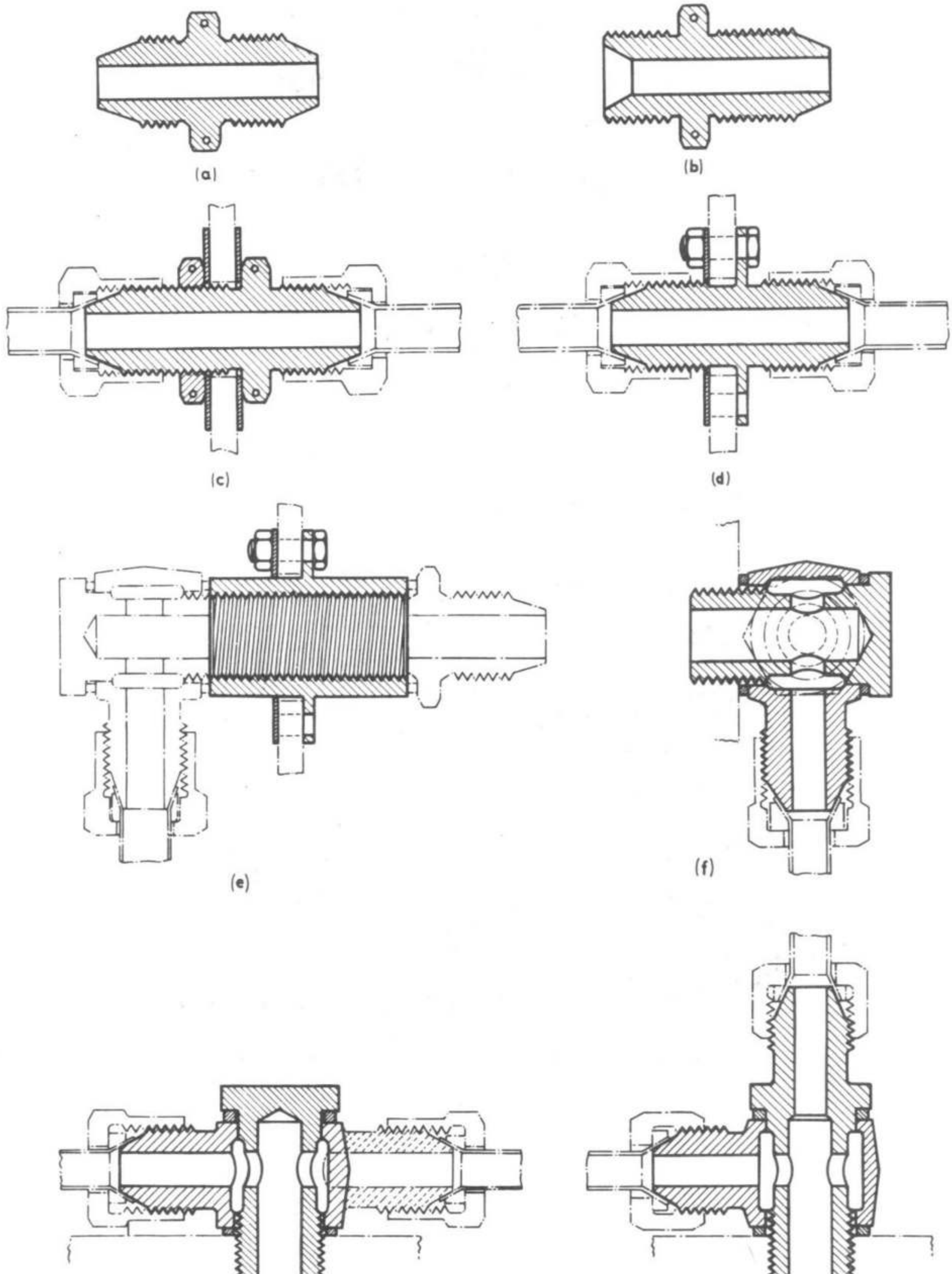


Fig.5 Bulkhead pipe fittings and banjo-type couplings

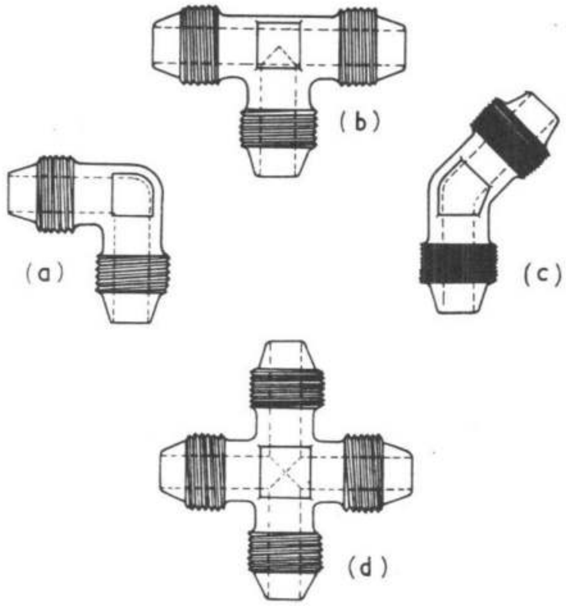


Fig.6 Standard pipe unions

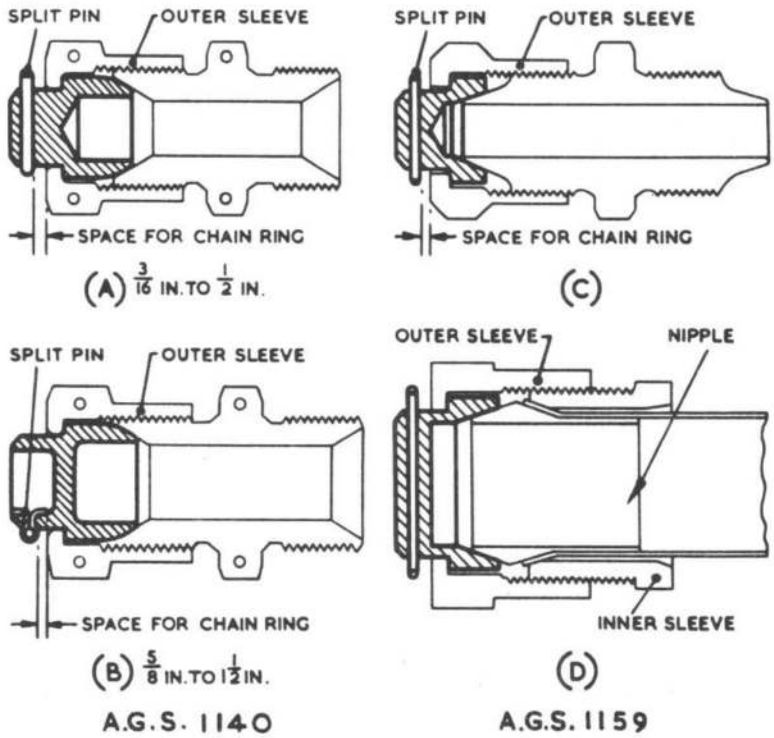


Fig.7 Plugs and caps for pipe ends

17. The working pressure of the plugs and cone caps are as follows:

Size	Pressure
Up to 1/2in. BSP	3000 lb/in^2
5/8in. to 1in. BSP	500 lb/in^2
1.1/4in. BSP	200 lb/in^2

Making a joint with standard couplings

18. Before any connection of rigid pipes is made, the flared ends must be examined for cracks (especially at the base of the flare), thinning (due to faulty flaring or subsequent tightening), or other damage which may cause fracture of the pipe or a faulty connection; the pipe ends and all the coupling parts must be perfectly clean when a joint is to be made. With the exception of oxygen pipe-lines, lubricant molybdenum disulphide anti-seize compound to DTD5530, Nato symbol S-722, (Ref.no.34B/9437518) or system fluid as described in AP1803A, Vol.1, Sect.2. Chap.1) must be applied when assembling all standard metal couplings. For oxygen pipe-lines, coupound anti-seize, Nato symbol S-717 (Ref.no. 34B/2202430) must be used.

19. Two set-spanners must be used when tightening or loosening joints; an adjustable spanner must not be used except in an emergency. When a joint has been made it must be tested for leaks, if possible under working conditions. Do not attempt to cure a leak by tightening further the union nut until the coupling has first been dismantled and examined for a cause of leakage, e.g. damage or burrs on the flared pipe end or on the adapter nipple. Any defects must be corrected before reassembling the coupling.

COUPLING SECURITY

Use of locking wire

20. Where there is provision for the use of locking wire all such couplings must be locked, after the joints have been made satisfactorily, with non-corrodible steel wire. The gauge of the wire may vary for the different sizes of coupling, and may be 16, 18 or 20 s.w.g. The sizes of the wire holes in some fittings may also vary; in such cases, the gauge of wire which will pass through the smallest hole must be used, after a check has been made that the size variation is not due to damage or an obstruction in the hole. The wire must be given at least half-a-turn round a coupling and must be threaded through the hole provided in the direction that will prevent the union nut or sleeve from unscrewing. Alternatively the wire may be connected to some external, rigid, point to ensure that the coupling is effectively locked. Finally the ends of the wire are to be securely clinched.

21. Another form of wire locking is provided by a union nut in which a groove has been machined close to the end of the hexagon; each corner of the hexagon is closed across the groove and thus provides six positions through which the locking wire can be threaded.

22. Union nuts and bodies must be individually connected to some external rigid point, so that it is impossible for the component to move in relation to that point. However, provided that no relative movement is possible, the nut, body and external rigid point may be connected by a single circuit of the locking wire if necessary.

23. No attempt must be made to drill couplings without locking-wire holes but when renewal is necessary, preference must be given to pre-drilled replacements, particularly if the joint is forward of the fireproof bulkhead.

Note...

> It is essential that, when locking couplings employing any form of adapter, the adapter itself is locked securely to some external rigid point, e.g. on a bulkhead adapter a locking plate secured to the bulkhead may be used, or the adapter may be wire-locked to a small lug bolted to the bulkhead. When the standard adapter is used (fig.5(a)) it must be locked to a suitable rigid point close to the pipe run. When locking the unions themselves, it is preferable to anchor the wire to some external point (para.22), but if necessary the unions may be locked to the adapter in the manner described in para.20.

Locking-wire tool (fig.8)

24. A locking-wire tool which can be made up by units is shown in fig.8. The tool is made from 10 s.w.g. steel wire, one end being doubled over as shown and the other being formed into a tang and fitted with a small handle. By means of this tool, locking wires can be quickly and neatly secured. The tool is particularly useful for locking couplings which are not easily accessible. Use the tool as follows:

(1) Take a length of locking-wire and pass one end through the hole in the union nut to be locked.

(2) Draw the ends of the wire together and place the hook end of the tool over them at a pre-determined distance from the nut.

(3) Bend the wires at a right-angle; twist the tool until the wires are twisted the required amount. Then pass the free ends through the opposite nut and repeat the twisting operation.

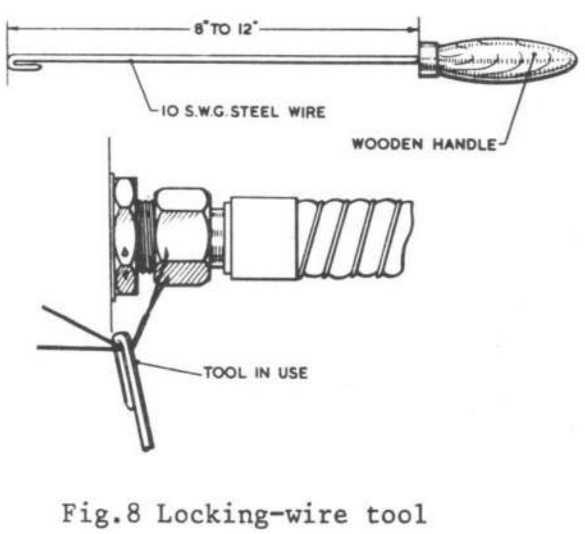


Fig.8 Locking-wire tool

SPECIAL TYPES OF COUPLING

Low-pressure pipe couplings (fig.10)

25. This type of coupling (fig.10) is available for straight, "T", or elbow unions, and incorporates a rubber ring which is compressed around the end of the pipe by the pressure exerted by the union nut. The end of the pipe, which is cut off square and is unflared, abuts against a shoulder in the body

17. The working pressure of the plugs and cone caps are as follows:

Size	Pressure
Up to 1/2in. BSP	3000 lb/in^2
5/8in. to 1in. BSP	500 lb/in^2
1.1/4in. BSP	200 lb/in^2

Making a joint with standard couplings

18. Before any connection of rigid pipes is made, the flared ends must be examined for cracks (especially at the base of the flare), thinning (due to faulty flaring or subsequent tightening), or other damage which may cause fracture of the pipe or a faulty connection; the pipe ends and all the coupling parts must be perfectly clean when a joint is to be made. With the exception of oxygen pipe-lines, lubricant molybdenum disulphide anti-seize compound to DTD5530, Nato symbol S-722, (Ref.no.34B/9437518) or system fluid as described in AP1803A, Vol.1, Sect.2. Chap.1) must be applied when assembling all standard metal couplings. For oxygen pipe-lines, coupound anti-seize, Nato symbol S-717 (Ref.no. 34B/2202430) must be used.

19. Two set-spanners must be used when tightening or loosening joints; an adjustable spanner must not be used except in an emergency. When a joint has been made it must be tested for leaks, if possible under working conditions. Do not attempt to cure a leak by tightening further the union nut until the coupling has first been dismantled and examined for a cause of leakage, e.g. damage or burrs on the flared pipe end or on the adapter nipple. Any defects must be corrected before reassembling the coupling.

COUPLING SECURITY

Use of locking wire

20. Where there is provision for the use of locking wire all such couplings must be locked, after the joints have been made satisfactorily, with non-corrodible steel wire. The gauge of the wire may vary for the different sizes of coupling, and may be 16, 18 or 20 s.w.g. The sizes of the wire holes in some fittings may also vary; in such cases, the gauge of wire which will pass through the smallest hole must be used, after a check has been made that the size variation is not due to damage or an obstruction in the hole. The wire must be given at least half-a-turn round a coupling and must be threaded through the hole provided in the direction that will prevent the union nut or sleeve from unscrewing. Alternatively the wire may be connected to some external, rigid, point to ensure that the coupling is effectively locked. Finally the ends of the wire are to be securely clinched.

21. Another form of wire locking is provided by a union nut in which a groove has been machined close to the end of the hexagon; each corner of the hexagon is closed across the groove and thus provides six positions through which the locking wire can be threaded.

22. Union nuts and bodies must be individually connected to some external rigid point, so that it is impossible for the component to move in relation to that point. However, provided that no relative movement is possible, the nut, body and external rigid point may be connected by a single circuit of the locking wire if necessary.

23. No attempt must be made to drill couplings without locking-wire holes but when renewal is necessary, preference must be given to pre-drilled replacements, particularly if the joint is forward of the fireproof bulkhead.

Note...

It is essential that, when locking couplings employing any form of adapter, the adapter itself is locked securely to some external rigid point, e.g. on a bulkhead adapter a locking plate secured to the bulkhead may be used, or the adapter may be wire-locked to a small lug bolted to the bulkhead. When the standard adapter is used (fig.5(a)) it must be locked to a suitable rigid point close to the pipe run. When locking the unions themselves, it is preferable to anchor the wire to some external point (para.22), but if necessary the unions may be locked to the adapter in the manner described in para.20.

Locking-wire tool (fig.8)

24. A locking-wire tool which can be made up by units is shown in fig.8. The tool is made from 10 s.w.g. steel wire, one end being doubled over as shown and the other being formed into a tang and fitted with a small handle. By means of this tool, locking wires can be quickly and neatly secured. The tool is particularly useful for locking couplings which are not easily accessible. Use the tool as follows:

(1) Take a length of locking-wire and pass one end through the hole in the union nut to be locked.

(2) Draw the ends of the wire together and place the hook end of the tool over them at a pre-determined distance from the nut.

(3) Bend the wires at a right-angle; twist the tool until the wires are twisted the required amount. Then pass the free ends through the opposite nut and repeat the twisting operation.

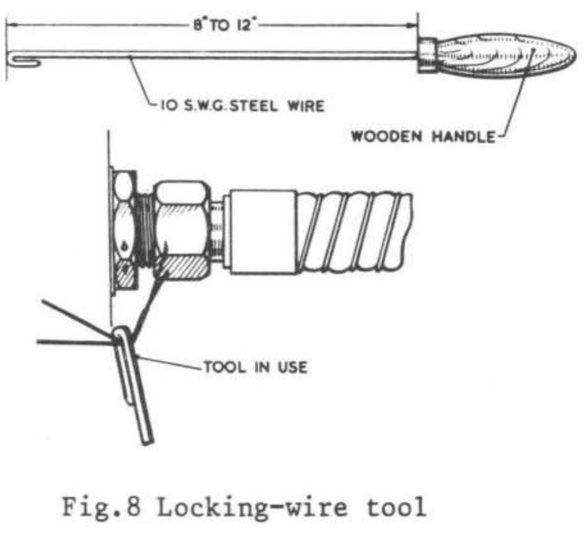


Fig.8 Locking-wire tool

SPECIAL TYPES OF COUPLING

Low-pressure pipe couplings (fig.10)

25. This type of coupling (fig.10) is available for straight, "T", or elbow unions, and incorporates a rubber ring which is compressed around the end of the pipe by the pressure exerted by the union nut. The end of the pipe, which is cut off square and is unflared, abuts against a shoulder in the body

of the union. The coupling (AGS838) is used in certain low-pressure pipe-lines and vent connections.

Low-pressure pipe couplings coned rubber sleeve type (fig.9)

26. This type of coupling (fig.9) comprises a conical-ended rubber sleeve, the smaller end of which fits the chamfered recess in an externally- threaded metal fitting. The metal pipe, passing through the rubber sleeve, enters a counterbore in the metal fitting, and a coupling nut enclosing the rubber sleeve screws on to the fitting so as to compress the rubber against the tube and make an air-tight joint. This coupling is designed for use in pneumatic brake systems and it must be ensured, when assembling, that the pipe end is correctly positioned and is in contact with the shoulder in the union.

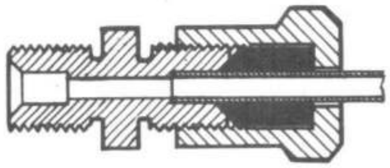


Fig.9 Pneumatic brake pipe coupling

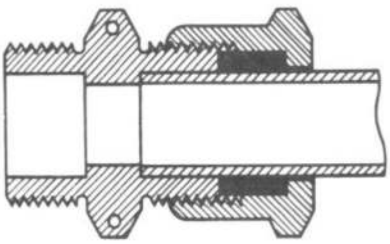


Fig.10 Low-pressure pipe coupling

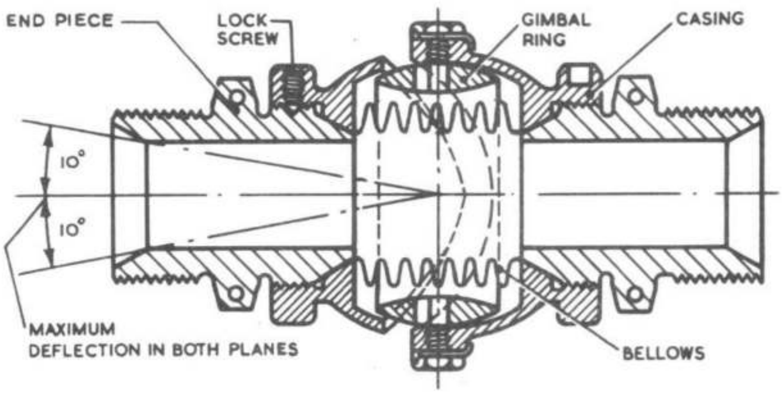


Fig.11 All-metal flexible fireproof coupling

Metal couplings for flexible hose

27. Various types of metal couplings are available for use with flexible hose. Some of these end fittings are AGS parts whilst others are peculiar to the type of flexible pipes to which they are fitted.

All-metal flexible fireproof couplings (fig.11)

28. An all-metal flexible coupling (fig.11) may be incorporated in a rigid pipeline in a coolant, oil, fuel, or air system; the available range will

accommodate pipes from 3/8in. to 3in. diameter. The purpose of the coupling is to absorb movement due to vibration and thus prevent its transmission to the rigid pipe-lines and their unions which might, in time, suffer fatigue or other damage; it is normally installed at both ends of pipes subject to vibration.

29. The effect of the design is to produce a universal joint through which coolant, oil, fuel, or air may pass. It comprises basically, two casings and a gimbal ring; through the centre is a bellows, each end of which is flared and held in position by the conical ends of special end pieces which are themselves screwed and coned for standard AGS fittings. In use the casings hinge through two planes and flexibility is imparted to the pipe-line union by the bellows.

30. When attaching or detaching an AGS fitting, the coupling must be held by the hexagon on the end piece to avoid damage to the locking screw and the casing with consequent loosening of the bellows.

Note...

Some couplings have a hexagon incorporated in each casing, these must not be used for holding the coupling.

Chapter 6

ROTARY COUPLINGS FOR AIRCRAFT METAL PIPE-LINES

Part Nos.10-20P 2325A (Port), 10-20P 2326A (Starboard)
10-20P 2069A (Port), 10-20P 2070A (Starboard)
10-20P 3357A (Port), 10-20P 3352A (Starboard)

CONTENTS

ILLUSTRATIONS

Introduction

1. Rotary couplings are provided in the fuel system of an aircraft, at the wing fold, to ensure a positive means of supplying and feeding fuel to and from the outer wing tanks; similar couplings are used in the vent and recirculation systems. The part numbers for the couplings are allocated as follows:-

System	Part Nos.	
	Port wing	Starboard wing
Fuel pressure feed pipe couplings	10-20P 2325A	10-20P 2326A
Vent pipe couplings	10-20P 2069A	10-20P 2070A
Recirculation pipe couplings	10-20P 3357A	10-20P 3352A

2. The vent pipe couplings are similar to those for fuel pressure feed with a Flexibox mechanical seal fitted in the drum of each coupling. The recirculation couplings are more simply constructed. Instructions for the disconnection of rotary couplings from their associated pipe-lines are contained in AP 4647A, Vol.1.

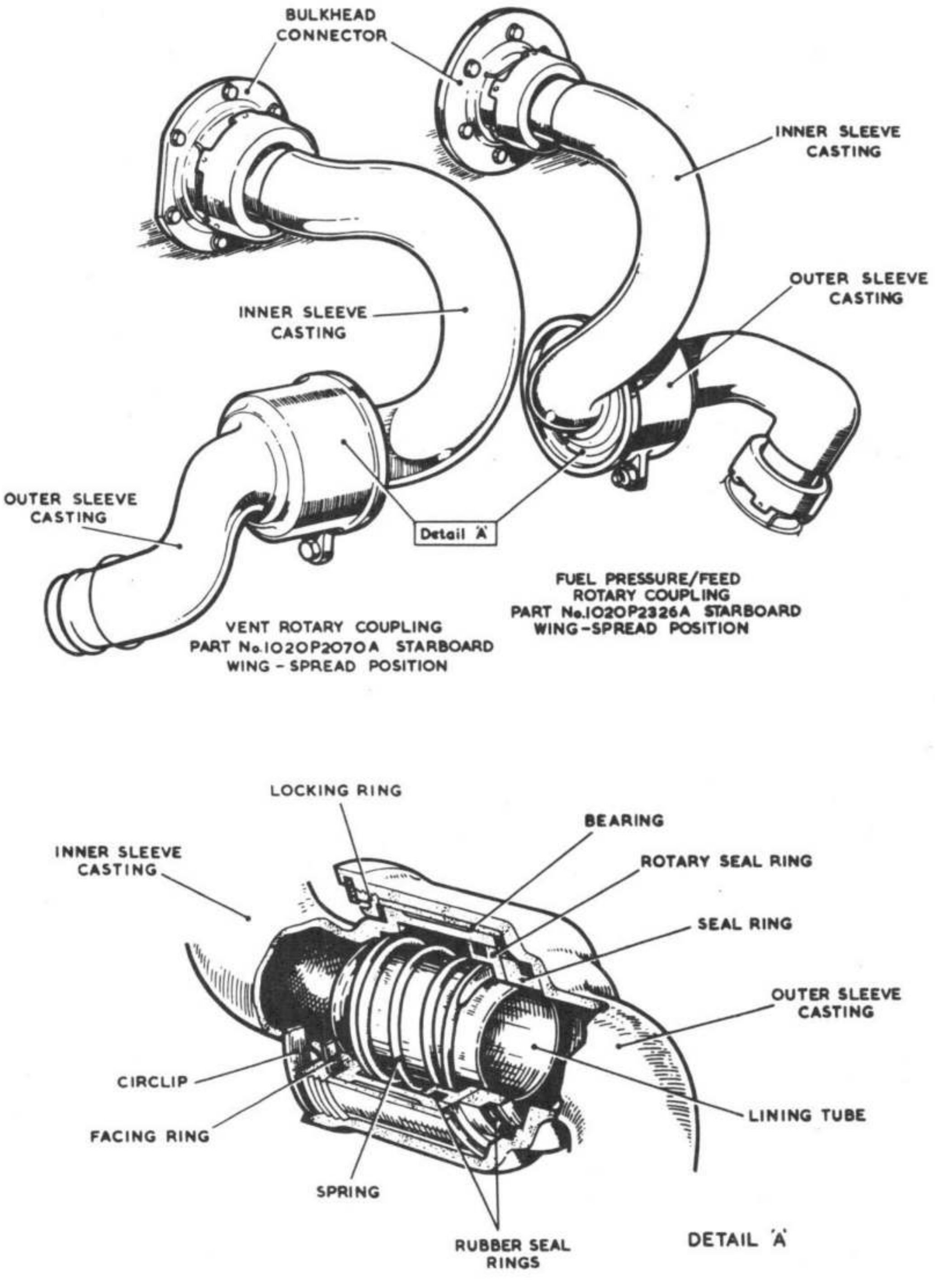


Fig.1 Fuel pressure/feed and vent rotary couplings

DESCRIPTION

General (fig. 1 and 3)

3. Rotary couplings for fuel pressure feed and vent pipe-lines consist of two main components, the inner and outer sleeve castings; the castings of the fuel system couplings differ in shape from those of the vent system and each system is provided with port and starboard versions. At the joint of these components the outer sleeve casting, the static member, is formed into a drum in which the boss of the inner sleeve casting, the rotary member, is retained by a locking ring and locked by a circlip. In order to effect a leakproof

joint under rotary conditions a mechanical seal, consisting of a spring-loaded rotary seal ring, is housed within the boss. The face of this seal ring is driven by the spring against the face of a compounded carbon sealing ring housed in the drum. Close contact between these true faces prevents leakage. The boss is aligned within the drum by two raised bearing surfaces on the interior of the boss, which is a push fit inside a bearing sleeve. This sleeve, in turn, is a drive fit inside the wall of the drum. Leakage is further prevented by the fitting of synthetic rubber seal rings, one in a groove around the skirt of the rotary seal ring is in contact with the bearing sleeve, whilst a static ring resiliently supports the carbon seal within the drum. A PTFE facing ring makes a leakproof joint between the locking ring and a shoulder on the boss. To assist in the speedy transfer of fuel, the interior of the boss is fitted with a lining tube belled at one end. The belled end is housed in a recess at the inner end of the boss.

4. Rotary couplings for the recirculation pipe-line consist of a pipe and spindle assembly contained within an outer casting. The pipe and spindle assembly sections are welded together at right angles, and the spindle is provided with four slotted ports to allow the necessary fuel circulation. An inner and outer bush are housed in the drum of the outer casting to align the spindle assembly. To ensure a leakproof joint one synthetic rubber seal ring is used, fitted in a groove on the spindle. This ring is in close contact with the interior machined surface of the outer casting drum. When assembled, the spindle is retained in the outer casting drum by a circlip secured in a groove on the outer bush.

SERVICING

Dismantling

5. Dismantle the couplings as follows:-

Fuel and vent system rotary couplings

(1) Remove the circlip and unscrew the locking ring.

(2) Extract the inner sleeve casting, complete with the lining tube and rotary seal ring assembly. The end of the spring is an interference fit in the inner end of the boss.

(3) Lift out the carbon seal ring and the rubber seal ring from the drum.

Recirculation rotary coupling

(4) Remove the circlip.

(5) Extract the pipe and spindle assembly complete.

Examination

6. Examine all the parts for wear and tear, and the mechanical seal for the penetration of grease. This condition may be found on earlier types, where the drums have been fitted with a grease nipple, and is caused by over-lubrication. The mechanical seal must be free from grease. Excessive greasing in detrimental to the satisfactory operation of the couplings, possibly resulting in a fuel leak. Clean the parts thoroughly before assembling and renew the rubber seals.

Assembly

7. Assemble or reassemble couplings as follows:-

Fuel and vent system rotary couplings

(1) Replace the rubber seal on the recess of the bottom face of the carbon seal ring and insert the assembly in the bottom end of the drum, with the true face of the seal ring upwards.

(2) Replace the rubber seal in the groove of the rotary seal ring. Smear the bearing surfaces of the boss and the bearing sleeve in the drum with grease Nato symbol G-287 (Ref.No.34B/2241973).

(3) Fit the boss assembly within the drum and compress the spring. Engage the locking ring, ascertaining that the facing ring is seating properly. Tighten the locking ring and replace the circlip. Check that the torque required to swivel the coupling does not exceed 3·8 lb/in. when tested on a rig similar to that shown in fig.2. Adjust the tightness of the locking ring as necessary.

Recirculation rotary coupling

(4) Replace the rubber seal ring on the groove of the spindle.

(5) Smear the bearing surfaces with grease Nato symbol G-287 (Ref.No. 34B/2241973).

(6) Fit the spindle within the drum of the outer casting and replace the circlip.

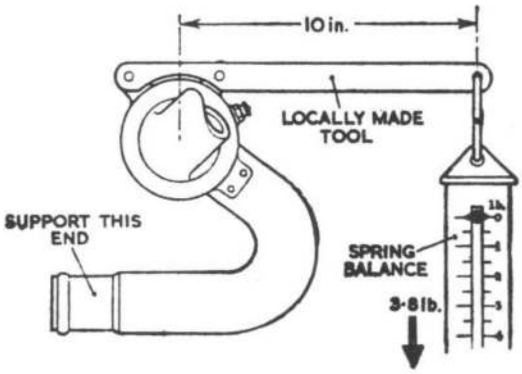


Fig.2 Torque testing

Testing

8. The following test must be applied before a rotary coupling is installed in an aircraft fuel system, or at any time when the serviceability of the unit is in doubt. The test pressures to be used are as follows:-

Fuel feed coupling	112 lb/in^2
Vent coupling	12 lb/in^2
Recirculation coupling	50 lb/in^2

Pressure test

(1) Blank off the end of one casting and fill the assembly with kerosine.

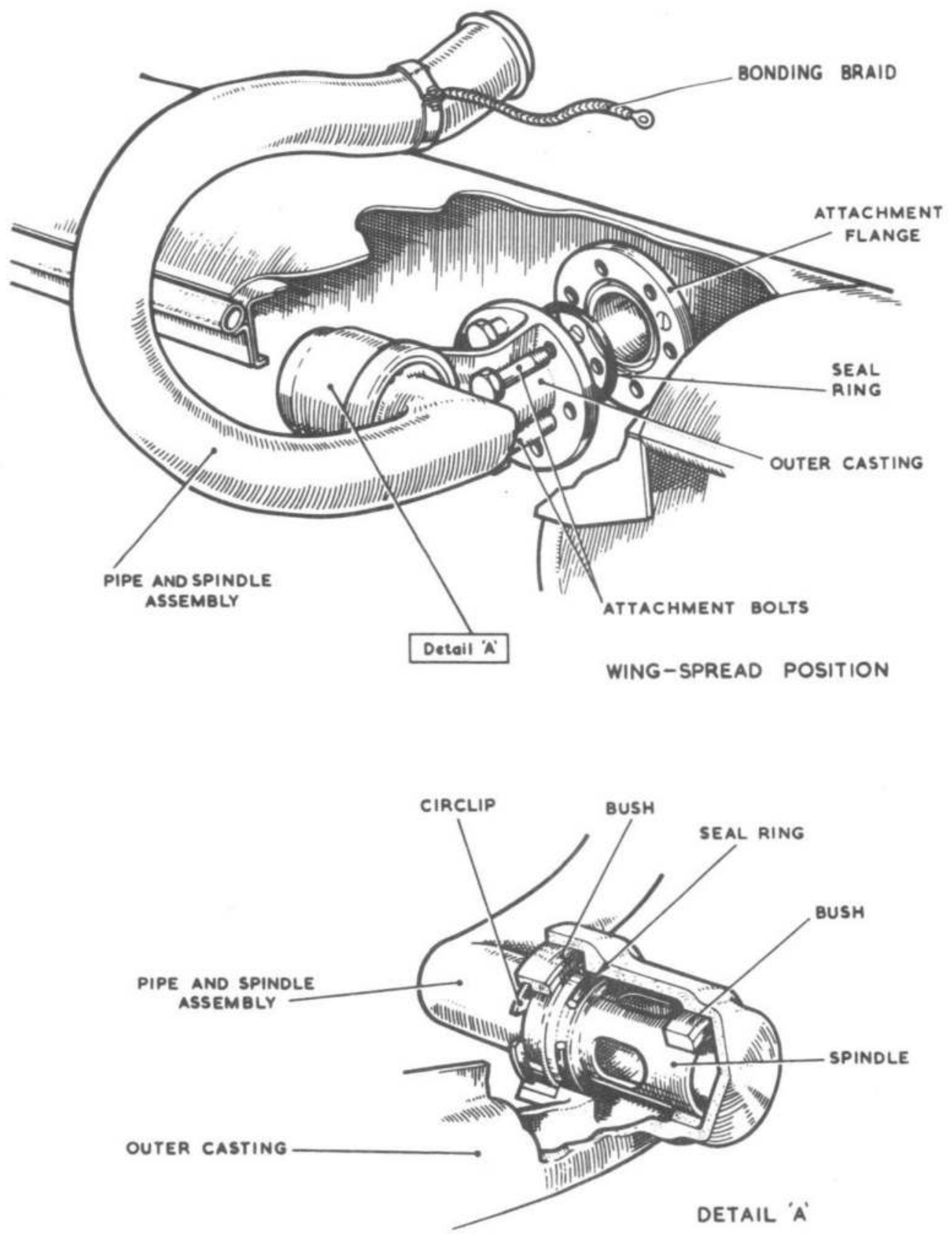


Fig.3 Fuel recirculation rotary coupling, Part No.10-20P 3357A(Port)

(2) Fit a pressurising adapter to the end of the other casting, top up with kerosine and connect the adapter to the test panel of the test rig static pressure gallery.

(3) Slowly operate the hand pump until the specified test pressure is indicated. There must be no leakage from the coupling.

(4) After a satisfactory test, release the pressure and drain away the kerosine.

(5) Remove the coupling from the test panel, and the test equipment from the coupling. Blank off the ends of the castings to exclude dust.

Chapter 7

HOSE CLIPS AND JOINTS

CONTENTS

ILLUSTRATIONS

Introduction

1. This chapter describes the standard hose clips which are used when joining the ends of two metal pipes with a length of rubber hose and gives detailed instructions for making a flexible joint. This type of flexible joint is only used to the rear of the fireproof bulkhead or outside the power unit envelope firewall. Normally the joint is made by assembling a suitable length of hose over the beaded ends of metal pipes and compressing the ends of the hose with adjustable clips. Stores Reference Numbers (Section 28E) for various types and sizes of clip are to be found in A.P.1086.

A.G.S.605 and 1000, TYPE J

Description

2. The A.G.S.605 hose clip (fig.1) is similar to and interchangeable with A.G.S.1000. It is standard for use with all pipes except light-gauge low-pressure pipes, and is available in a range of sizes to fit pipes of 0·5 to 5·0in o.d.

3. The clip is of the single band type and is fitted with an adjusting screw mounted in a housing welded to one end of the head. The other end of the band has a series of evenly-spaced slots or serrations which engage with the screw thread. By turning the screw the clip can be adjusted and tightened.

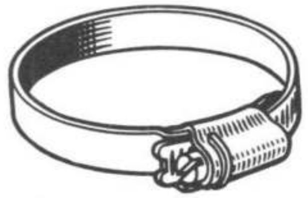


Fig.1 A.G.S.605, Type J hose clip

Fitting

4. The clip must be positioned on the rubber tubing before the tubing is fitted over the pipe ends. The clip must then be screwed up tightly, taking care not to strip the screw thread or to damage the housing or the slots in the band.

LINOLITE C.C.

Description

5. The Linolite C.C. hose clip (fig.2) is standard for use only with light-gauge, low-pressure pipes. It is not approved for use with the A.G.S.1100 series of Flexatex hose fittings or Avimo couplings. It is provided for pipes ranging from 0·375 to 6·0in.o.d. and for a pipe 10·0 in. o.d.

Note...

Where Linolite C.C. hose clips are already fitted to other than light-gauge, low pressure pipelines and are satisfactory in service, they must continue in use until unserviceable. They must then be replaced with A.G.S.605, A.G.S.606 or A.G.S.1000 clips.

6. The Linolite C.C. clip is of the single-turn band type. The head of the band or strap is doubled back over a square flat washer and spot-welded. The holes in the strap are punched from both sides into the hole in the square washer, thus holding it in position and forming a reinforced end. A retaining link is fitted to the strap to receive the tail-end of the strap when the clip is assembled. The join in the link must always be positioned next to the hose.

7. The strap is provided with a saddle which has a fixed bridge piece and a swivelling yoke. A spigot-ended screw is fitted into the yoke. The head of the screw is provided with a screwdriver slot and the first thread is upset to prevent the screw from coming out of the yoke. The saddle is made in two sizes. The small size has a 2 B.A. screw and is used only for the Size 1 hose clip. The large size has a 1/4in.Whitworth screw and is used for Sizes 2 and 3 hose clips.

Fitting

8. The clip must be assembled as follows:-

(1) Engage the hole in the strap head with the spigot-end of the screw, which must be screwed out as far as the first thread (fig.2, sketch A).

(2) Slip the retaining link over the free end of the strap and hold it in approximately its final position at about 280 deg.from the saddle (sketch B). The join in the link must be next to the hose.

(3) Pass the free end of the strap round the hose, through the opening in the saddle between the yoke and the fixed bridge-piece (sketch B) and pull it tight. Bend the end of the strap back over the bridge-piece. The clip must now be reasonably tight on the hose without obvious slack.

(4) Thread the free end of the strap through the retaining link and bend it back again. Cut the end of the strap off to a convenient length (sketch C).

(5) Tighten the clip with a screwdriver. If the head of the strap does not ride smoothly over the bridge of the saddle while the screw is turned, force the head of the screw downwards to raise the strap-head clear of the obstruction. Tighten the screw to the requisite tension.

Note...

Hose clips that are to be fitted in difficult positions in confined spaces must be made up on a mandrel of the same outside diameter as the hose for which the clip is required.

Removal and re-fitting

9. The clip can be readily removed from the hose during dismantling operations. The screw must be slackened back to the first thread and the strap head pushed off the spigot-end of the screw (sketch D) after which the head of the screw (sketch E) must be raised and the yoke and saddle levered clear of the strap head. The clip can now be released.

10. When a built-up hose clip is being refitted, it must be positioned on the hose and the strap head forced into position between the yoke and the bridge piece. To do this, the saddle must be raised so that the spigot end of the screw can be inserted behind the strap head and the screw then used to lever the yoke over the strap head. Finally the clip must be tightened to the requisite tension.

A.G.S.606

Description

11. The A.G.S.606 hose clip (fig.3) is a light form of clip for use with small pipes of up to 1 in. outside diameter where the A.G.S.605 or Linolite C.C.clip is unsuitable or unnecessarily bulky. Sizes range from 5/16 to 1·0in i.d.

12. The clip consists of a contractile brass channelled band encircled by a tempered steel ring. The ends of the steel ring are looped to take an adjusting screw and a forked locknut.

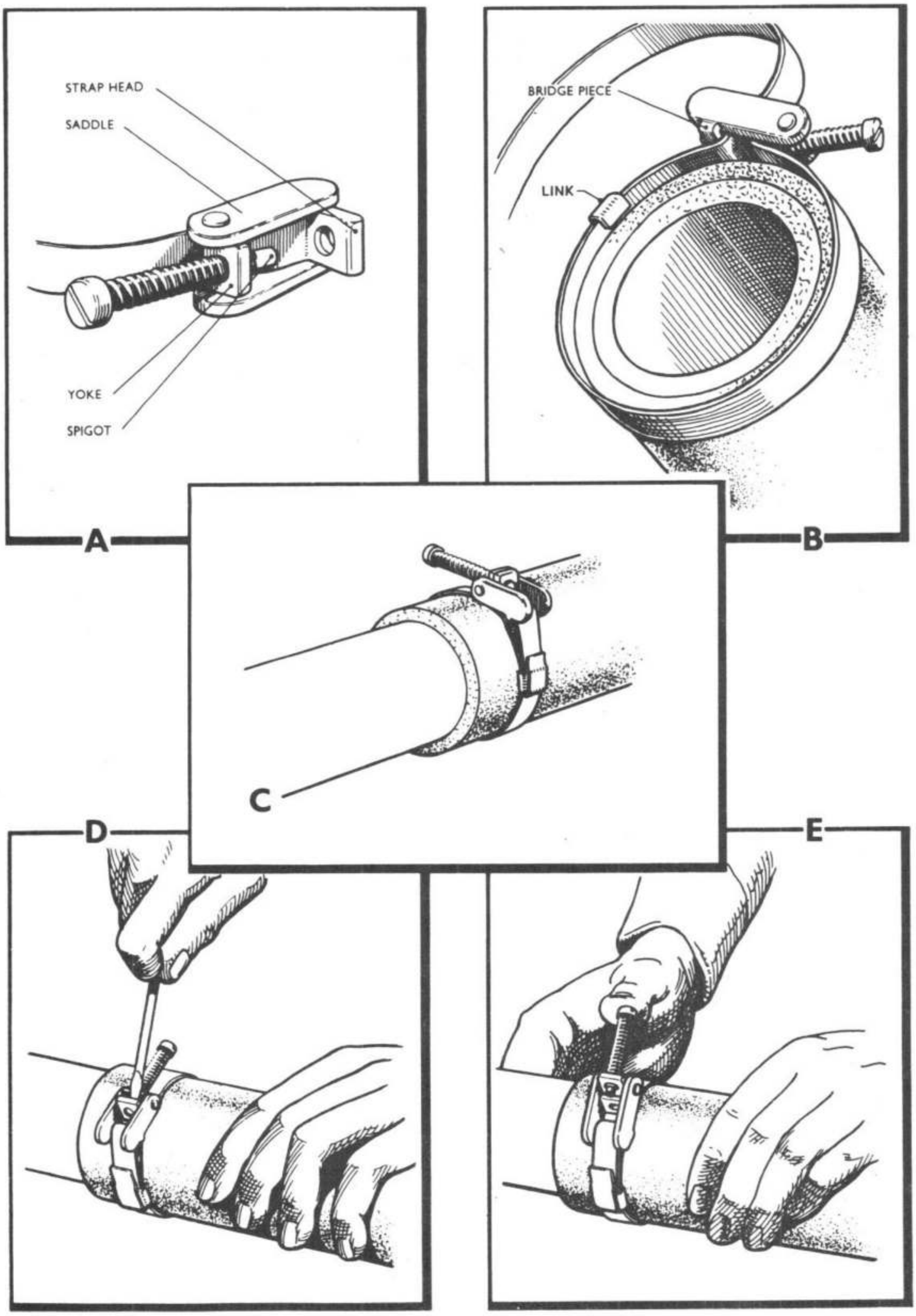


Fig.2 Fitting Linolite C.C. hose clip

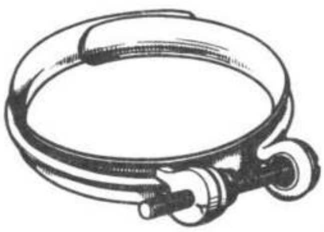


Fig.3 A.G.S.606 hose clip

Fitting

13. The adjusting screw must be unscrewed until the clip is opened sufficiently to slip over the rubber tubing. The tubing must then be pushed over the pipe end and the clip positioned on the end of the rubber tubing. The adjusting screw must be tightened so that the band is reduced in diameter and the rubber tubing compressed. If the looped ends of the steel ring meet when the adjusting screw is tightened, the clip is too large for the tubing and a smaller clip must be fitted.

Note...

The clip must not be sprung over the rubber tubing as this would cause distortion. Ensure that the forked locknut is correctly positioned over the steel ring.

MAKING A JOINT

14. If new hose connections prove difficult to fit, they may be lubricated with their working medium i.e. glycol or water for coolant hoses, oil for oil hoses. Oil is not to be used on hoses for cooling system. Local over-heating will be caused if even a small quantity gets into the coolant and the interior of the hose may be damaged if it is of the Spencer Moulton type. No grease of any description is ever to be used as it provides a leakage path. Stainless steel pipes must be sandblasted at the ends to reduce the possibility of leakage.

15. Hoses must be fitted so that the gap between the ends of the metal pipes is not less than 0·25in. or more than 0·50in. Advantage may be taken of this tolerance to obtain the maximum clearance between pipes and adjacent components. A general clearance of 0·50in. should be aimed at, although smaller clearances are permissible on pipes subject to little relative movement. The main coolant pipe from the radiator to the pump on all types of engine change units is frequently found to have insufficient clearance; this can generally be overcome by correctly positioning the pipes within the hoses. Care must be taken to ensure that the pipes are in alignment and that the ends are free from any damage likely to cut the bore of the hose.

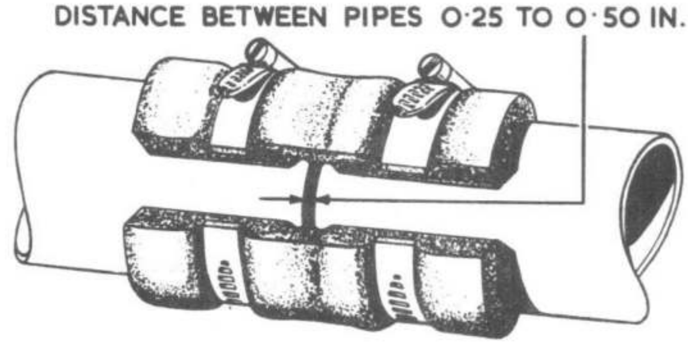


Fig.4 Typical hose joint

16. In particular, when making a joint in a cooling system with onion rubbers, it is essential that each packing piece is located so that the corrugation fits into the corresponding groove in the rubber (fig.5). If this is not done, the edge of the packing piece will bite into the rubber and severely strain it internally over the beading on the pipe end causing fracture of the rubber with consequent loss of coolant and severe damage to the engine. When correctly positioned, the packing piece overhangs the edge of the rubber; it must not be flush.

17. The clip must be placed squarely on the hose in the centre of the packing piece and tightened using a torque screwdriver with a torque of 20 lb/in. for the K.B. type of hose (black with two yellow bars), and 25 lb/in. for the Spencer Moulton type of hose (which has external cord braiding).

18. It is most important, particularly with the Spencer Moulton hose, that clips are re-tightened after the first ground run of the engine, as this causes some settling of the rubber and slackening of the clips. Excessive initial tightening, to avoid re-tightening after ground run, is useless and dangerous. The re-tightening must be done with the hose as cool as possible and any checks on hose clips must be done when they are in a cold condition i.e. below 50 deg.C. This is because the rubber is less plastic when cool. With K.B. hoses at temperatures above 70 deg.C it may be impossible to apply a torque of 20 lb/in.

19. Clips fitted to Spencer Moulton hose should not require further tightening more frequently than every 200 hours. This period may be increased depending on local operating conditions.

20. Clips on synthetic rubber hoses in cooling systems require fairly frequent re-tightening when used on engine change units in extremely cold regions. However, the majority of bursts and leaking hoses are caused by too frequent re-tightening which must be avoided because even if the hose is not weakened to the extent that its bursting point is below the system's working pressure, its life will be greatly reduced.

21. On no account must screwdrivers etc. be used to remove hoses, as damage to the pipe connection will result. Hoses must be removed after being cut along their length, taking care not to damage the pipe beneath. In no circumstances must a used hose be re-fitted; it is impossible to re-marry indentations in the pipe end fittings and the hose correctly.

22. Any bonding on a joint must be replaced in a tight and serviceable condition.

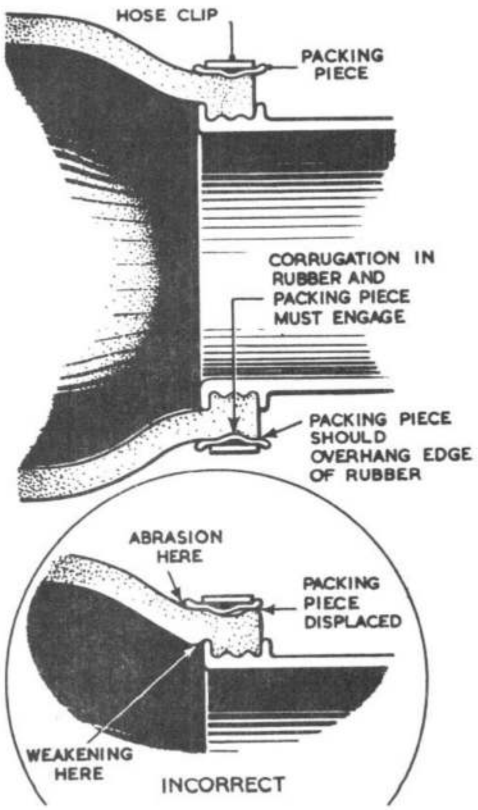


Fig.5 Fitting onion rubbers

Chapter 8

SELF-SEALING COUPLINGS FOR AIRCRAFT METAL PIPE-LINES

LIST OF SUB-CHAPTERS

Chapter 8-1

SELF-SEALING COUPLINGS LOCKHEED AVERY TYPE

CONTENTS

TABLES

ILLUSTRATIONS

Introduction

1. The Lockheed Avery Type of self-sealing couplings are used in aircraft to allow fuel, oil, hydraulic, and other fluid pipelines to be disconnected and reconnected without loss of fluid, and without introducing air into the system. They make it unnecessary to drain the system prior to disconnecting pipelines, irrespective of whether the system is pressurised or not. The couplings also eliminate the necessity of bleeding a system of air when a joint is uncoupled, or of having to prime a system after an engine change.

DESCRIPTION

General (Figs.1 and 2)

2. The Avery self-sealing coupling (fig.1) comprises three main component parts, a fixed half-coupling, a union half-coupling and a tube nut. Each half-coupling contains a valve and a valve spring, the valve preventing the escape of any liquid or the ingress of air when the two halves of the coupling are separated. When the tube nut is screwed on to the fixed half-coupling,

the union half-coupling is drawn towards the fixed half, and the two valve heads press against each other. The component parts of the self-sealing coupling are illustrated in fig.2.

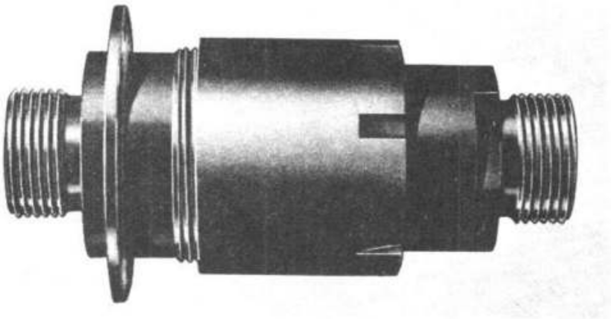


Fig.1 Flanged self-sealing coupling

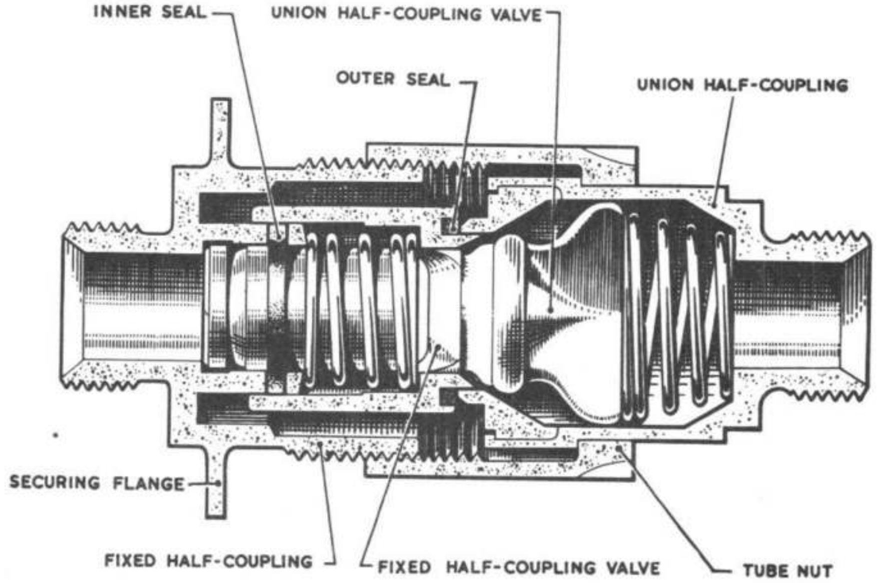


Fig.2 Sectioned coupling (valves partially open)

3. The valve in the fixed half-coupling does not move, but the pressure exerted by the tube nut forces the valve seating away from the valve head and compresses the spring. At the same time the head of the valve exerts an increasing pressure against the opposite valve head which is forced away from its seating and contracts its spring. In the completely coupled position both valves are open to the maximum extent, and the two valve springs are fully compressed. In this position there is a free passage around the valve heads equivalent to the full cross-sectional area of the pipe. The tube nut has external castellations at one end for 'C' type spanner manipulation.

4. When unscrewing the tube nuts, the pressure against the two valve heads is gradually released, and the valve spring in the union half-coupling forces the valve head against its seating, and the valve seating in the fixed half-coupling is forced against the valve head. This ensures a complete fluid and air seal of both half-couplings. Further unscrewing of the tube nut separates the two halves of the coupling.

WARNING...

WHEN MAKING OR BREAKING THE JOINT OF A SELF-SEALING COUPLING, GREAT CARE MUST BE TAKEN TO AVOID ROTARY MOVEMENT BETWEEN THE TWO HALVES, OTHERWISE THE SEATING FOR THE VALVE IN THE UNION HALF-COUPLING MAY DAMAGE THE SEAL IN THE FIXED HALF-COUPLING AND PREVENT AN OIL-TIGHT JOINT BEING OBTAINED.

Types and sizes (figs.3 and 4)

5. The fixed half-coupling is either flanged or studded according to installation requirements. The flanged type can be secured to a bulkhead or to a bracket as illustrated in fig.3, and the studded half-coupling (fig.4) can be screwed on to a rigid supporting body such as a pump casting or similar component.

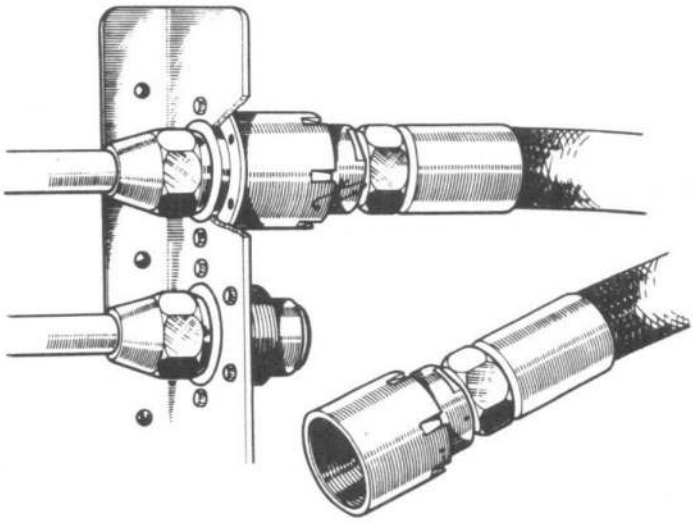


Fig.3 Flanged self-sealing couplings installed

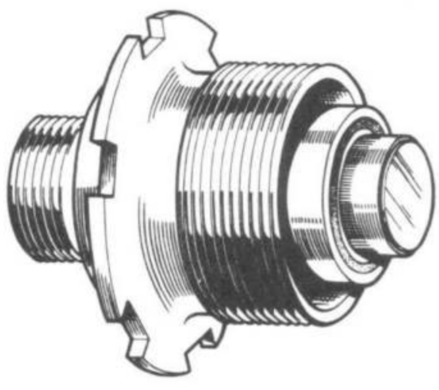


Fig.4 Studded half-coupling

6. Union half-couplings are made in one type only for each size coupling, and will connect to either a flanged or studded half-coupling. The inlet ends of couplings can be connected to hose or rigid pipeline unions fitted with standard AGS pipe or hose nipples. The screw threads of the end portions conform to the BSP gauge for each size of coupling, i.e. a 3/8in. thread connection is used for a 3/8in. coupling. Couplings are supplied in two grades,

one for low-pressure and one for medium-pressure fluid systems. The diameters, working pressures, gradings and other data for self-sealing couplings are contained in Table 1.

7. Self-sealing couplings are manufactured mainly from light-alloy metal. The two springs and the valve in the fixed half-coupling are the only component parts made from steel.

Blanking caps (fig.5)

8. When the two halves of an installed coupling have been separated, making a break in the aircraft pipeline system, blanking caps (fig.5) must be fitted to each half-coupling. The caps will protect the threads and the valve heads from accidental damage, prevent the deposition of dust and other foreign matter, and form an independent pressure seal.

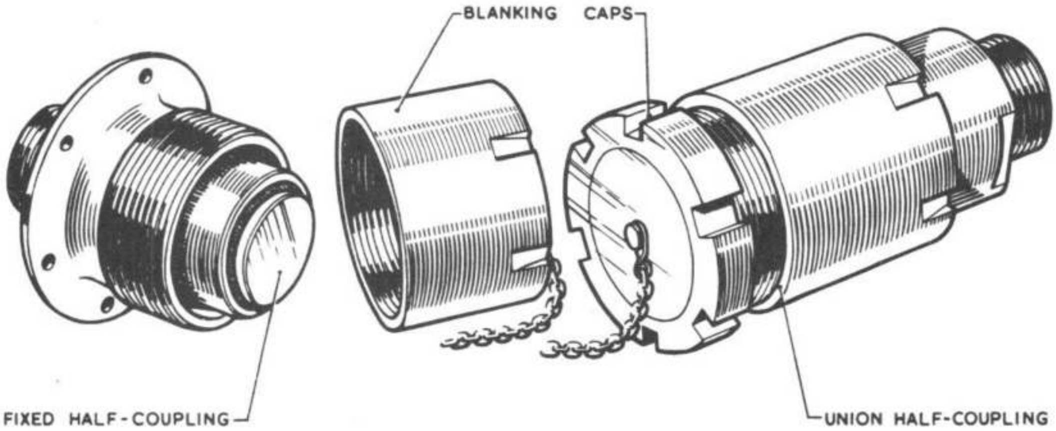


Fig.5 Blanking caps

SERVICING

Minor repairs

9. Normally the self-sealing couplings are not repairable as the valve housing of each half-coupling is swaged during assembly and cannot be dismantled. Any sign of fluid leakage which persists after the pipe or hose unions and the tube nut have been checked for tightness may necessitate fitting a new half or a complete coupling. The leakage will probably be due to a faulty valve spring or a defective outer seal in the fixed half-coupling (fig.2).

10. If renewal of the outer seal should be necessary the rubber seal must be removed from the groove in the fixed half-coupling and a new seal pressed into position, using the appropriate assembly tool. Refer to Table 2 for the size of the faulty coupling to ascertain the correct seal and tool required for the renewal.

11. Leakage is also possible if the head of the union half-coupling, which mates with the seal, becomes defaced. In this case a new half-coupling must be fitted.

TABLE 1

Self-sealing couplings and blanking caps

Size of coupling BSP (in)	Pressure grade	Max. working pressure	Flanged half-coupling		Stud half-coupling		Union half-coupling		Alloy Part No.	Steel Part No.
			Half-coupling Part No.	Blanking cap Part No.	Half-coupling Part No.	Blanking cap Part No.	Half-coupling Part No.	Blanking cap Part No.		
1/8	Medium	3000	AVA1150A	AVA64-7A	AVA1151A	AVA64-7A	AVA57A	AVA63A	AVA62A	AVA65A
1/4	Medium	3000 4000	AVA1150B AVA551B	AVA64-7B AVA552B	AVA1151B	AVA64-7B	AVA57B	AVA63B	AVA62B	AVA65B
3/8	Medium	3000 4000	AVA1150C AVA551C	AVA64-7C AVA552C	AVA1151C	AVA64-7C	AVA57C	AVA63C	AVA62C	AVA65C
1/2	Medium	3000 4000 4000	AVA1150D AVA551D AVX3393*	AVA64-7D AVA552D AVA64-7D	AVA1151D	AVA64-7D	AVA57D	AVA63D	AVA62D	AVA65D
5/8	Low	1200	AVA1152E	AVA64-7E	AVA1151E	AVA64-7E	AVA57E	AVA63E	AVA62E	AVA65E
3/4	Low	1200	AVA1152F	AVA64-7F	AVA1151F	AVA64-7F	AVA57F	AVA63F	AVA62F	AVA65F
1	Low	1200	AVA1152H	AVA64-7H	AVA1151H	AVA64-7H	AVA57H	AVA63H	AVA62H	AVA65H
$1^1/_4$	Low	500	AVA1152J	AVA64-7J	AVA1151J	AVA64-7J	AVA57J	AVA63J	AVA62J	
$1^1/_2$	Low	250	AVA1152K	AVA64-7K	AVA1151K	AVA64-7K	AVA57K	AVA63K	AVA62K	

* Note...

Similar to AVA1150D except made of steel instead of light-alloy.

TABLE 2

Rubber seals and associated fitting tools

Size of coupling BSP(in)	Sect.27M Ref.No.	Seals AVA	Tools ARD
1/8	9815	1146A	1742A
1/4	9816	1146B	1742B
3/8	9817	1146C	1742C
1/2	9818	1146D	1742D
5/8	9819	1146E	1742E
3/4	9820	1146F	1742F
1	9821	1146H	1742H
1 1/4	9822	1146J	1742J
1 1/2	9823	1146K	1742K

12. The tube nut is wire-locked to the union half-coupling when the coupling is assembled. Component parts, blanking caps, and 'C' spanners for each size of coupling are referenced in AP4515F, Vol.3.

Chapter 8-2

QUICK-RELEASE SELF-SEALING COUPLINGS TYPES BSCV,BSCS,HSCV and HSCV

CONTENTS

ILLUSTRATIONS

Introduction (fig. 1, 2 and 5)

1. The BSC and HSC Series of quick-release, self-sealing couplings (fig. 1 and 2) are designed for use on aircraft hydraulic, fuel and oil systems. When connected, these couplings permit a free flow of system fluid; on separation, the open ends close automatically to prevent loss of fluid. A series of protective covers, the SPC Series (fig.5), is also provided to prevent damage to the sealing face of any coupling not in use.

2. Each complete coupling comprises a bulkhead assembly, which may incorporate a bulkhead attachment flange, and a hose assembly, types BSC and HSC respectively. The BSCS and HSCS Series are normal couplings, whilst the BSCV and HSCV Series are especially designed to reduce the trapping of air during mating operations to a minimum. The 'V' (vented) Series of couplings are for use where it is important to have an air free system. The SPC Series protective covers are all similar in construction to each other, the only difference being the size of the bore.

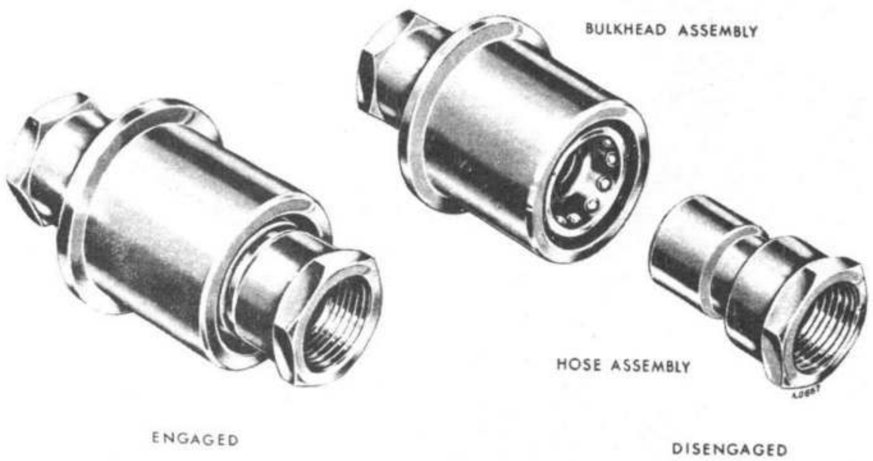


Fig.1 Typical quick-release self-sealing couplings

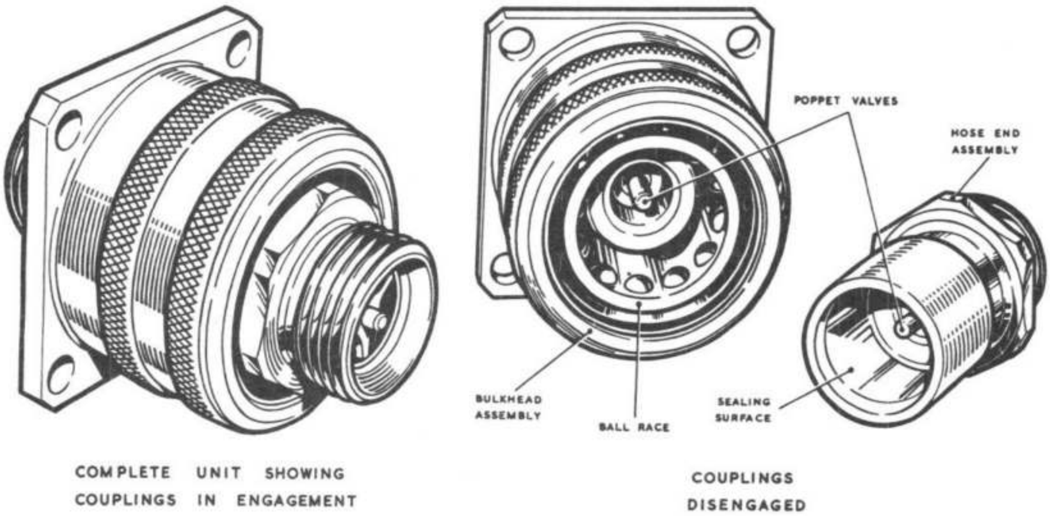


Fig.2 Typical coupling with bulkhead attachment flange

3. The type and number of the unit, e.g BSCS 108, identifies the specific installation and the calibration code to which the unit must be tested. The couplings cover a range of sizes to suit the various sizes of hose.

DESCRIPTION

Bulkhead couplings (BSC types) (figs.3 and 4)

4. The BSCV, Vented, type of bulkhead assembly (fig.3) consists of a collet housing a spring-loaded sliding cage retainer into which a coupling is screwed, coupling and cage retainer being held in the collet by a jump ring. The coupling is spring-loaded against a sliding cage assembly, one end of which is flanged and housed in the cage retainer whilst the other end accommodates a ring of ball bearings.

5. A spring-loaded sliding valve seat is accommodated in the bore of the coupling and rests upon a valve screwed into the coupling. A leakproof seal is formed by a rubber seal on the valve seat contacting the face of the valve. Holes formed in the valve stem provide an outlet for the liquid.

6. The BSCS, non-vented, type of bulkhead assembly (fig.4) is similar in construction to the BSCV type, the main difference being in the arrangement of the valve.

7. The valve seat in the BSCS type is formed in the bore of the coupling. The spring-loaded valve operates in a guide which is retained in the bore by a jump ring. An extension pin is formed on the end of this valve. Sealing is achieved by means of a rubber seal on the face of the valve mating on the valve seat.

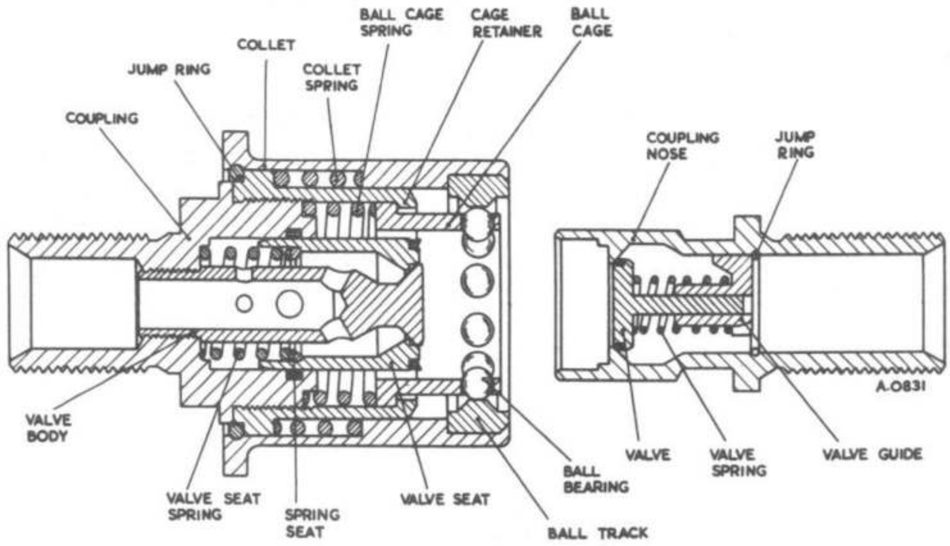


Fig.3 Schematic diagram (vented type)

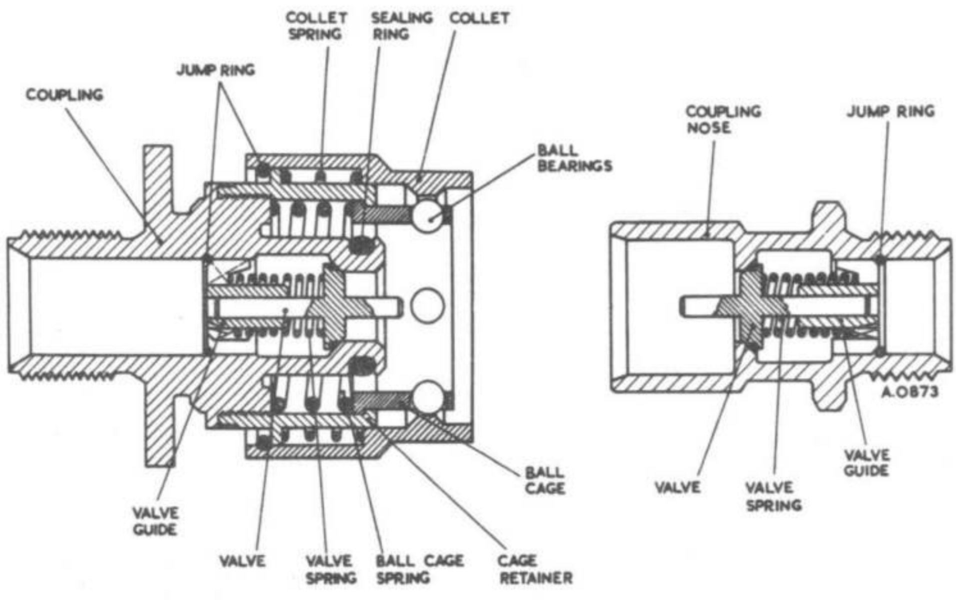


Fig.4 Schematic diagram (non-vented type)

<u>Hose end couplings (HSC types)</u> (figs.3 and 4)

8. The hose end assemblies, HSCV and HSCS Series (figs.3 and 4) are both similar in construction, consisting of a coupling nose bored to house a spring-loaded sliding valve the face of which accommodates a rubber seal. A leak-proof seal is effected by the valve being retained upon a valve seat

formed in the coupling nose.

9. The coupling may be threaded at its outer end, or provision made to accept an adapter for the attachment of the hose. The valves of these assemblies are similar to the bulkhead assembly valves, the non-vented type (fig.4) being formed with an extension pin. The hose of the coupling is suitably machined to mate into the bulkhead assembly to form a seal.

Quick-release protective covers SPC Series (fig.6)

10. Each quick-release protective cover (fig.6) consists of a spring-loaded sliding sleeve one end of which is sealed. The spring is accommodated between the sleeve and the body, and held in position by a retaining ring and a jump ring.

11. The length of travel of the sliding sleeve is limited by the retaining ring contacting a stop formed in the body. The bore of the sleeve is grooved circumferentially to accommodate a sealing ring which provides a cushion between the coupling and the protective cover in the event of shock. Four steel balls are located in recesses formed in the entry of the sleeve to provide the mechanism for retaining the cover on the coupling.

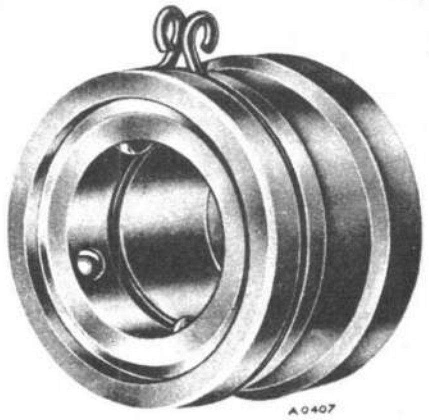


Fig.5 Protective cover (SPC Series)

OPERATION

General

12. A correctly mated coupling is locked automatically by the action of the balls of the spring-loaded ball cage locating in the machined stop of the hose end assembly.

13. To uncouple the assembly an axial movement aft is required, and this can be carried out under pressure. The springs beneath the valve and the valve seat return them to their respective mating surfaces, thereby preventing loss of fluid from the pipeline.

Vented types (fig.3)

14. When the assemblies are engaged, the coupling nose encases the end of the assembly. At the same time the valves come into contact and the hose end assembly valve is lifted from its seat to form a free-flowing passage through the coupling.

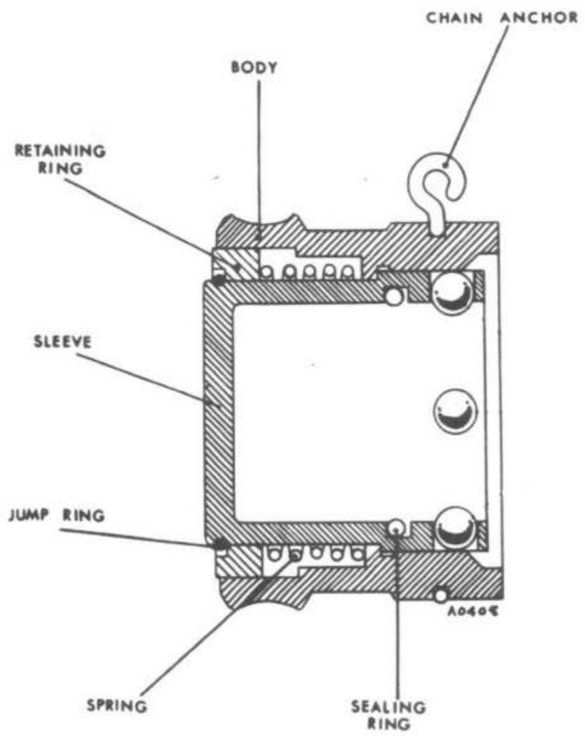


Fig.6 Schematic diagram protective cover

Non-vented types (fig.4)

15. On mating this type of coupling, the coupling nose encases the end of the assembly. At the same time the extension pins of the two valves come into contact so that the valves are lifted from their seats and a free-flowing passage is formed.

Protective covers (fig.6)

16. Hand pressure, applied to the sealed end of the cover sleeve, will overcome the loading of the spring and allow the sleeve to move forward until the balls are fully floating in their recess between the sleeve and the body. The length of travel of the sleeve prevents the balls from coming out.

17. In this attitude the cover can be placed over the hose assembly, and release of pressure on the sleeve will cause the spring to position the sleeve so as to enable the balls to grip in the stop formed on the hose assembly.

18. To release the cover an axial movement aft is required, as for uncoupling, and an anchor is provided on the cover for the attachment of a chain to retain the cover in an accessible position.

INSTALLATION AND SERVICING

All types

19. Installation details are contained in the relevant Air Publication.

Once the couplings are installed, no servicing is necessary normally except for routine examination for leaks in accordance with the relevant schedules. When necessary, inhibiting is to be carried out in accordance with the instructions contained in AP4471A using oil Nato symbol O-135 (Ref.no. 34B/9105055), or oil Nato symbol O-134 (Ref.no. 34D/9431324).

Chapter 8-3

SELF-SEALING COUPLING UNITS PART NUMBERS C17316 and C17317

CONTENTS

ILLUSTRATIONS

Introduction (figs.1 and 2)

1. The Coupling Units Part Nos. C17316 and C17317 have been designed to provide self-sealing couplings for aircraft hydraulic pipelines which can be connected or disconnected by hand whilst under pressure.

2. When properly connected they provide for a flow of fluid, when disconnected the open ends are automatically sealed to prevent loss of the system fluid. The two halves of each coupling unit are designed to reduce the trapping of air to a minimum whilst they are being connected or disconnected.

DESCRIPTION

Identification

3. Each coupling is identified by its basic part number followed by a numeral after a stroke, e.g. Part No. C17316/6. The numeral following the stroke indicates the size of the coupling and represents multiples of 1/16in. Hence the range "/6,/8,/10" corresponds to the 3/8in, 1/2in, and 5/8in. range of couplings.

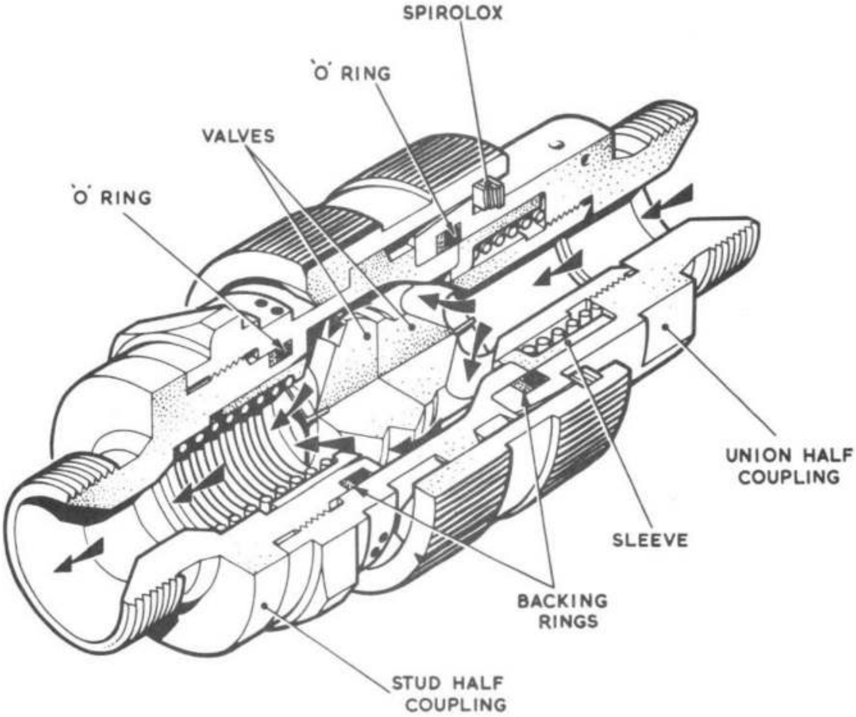


Fig.1 Coupling unit, Part No. C17316

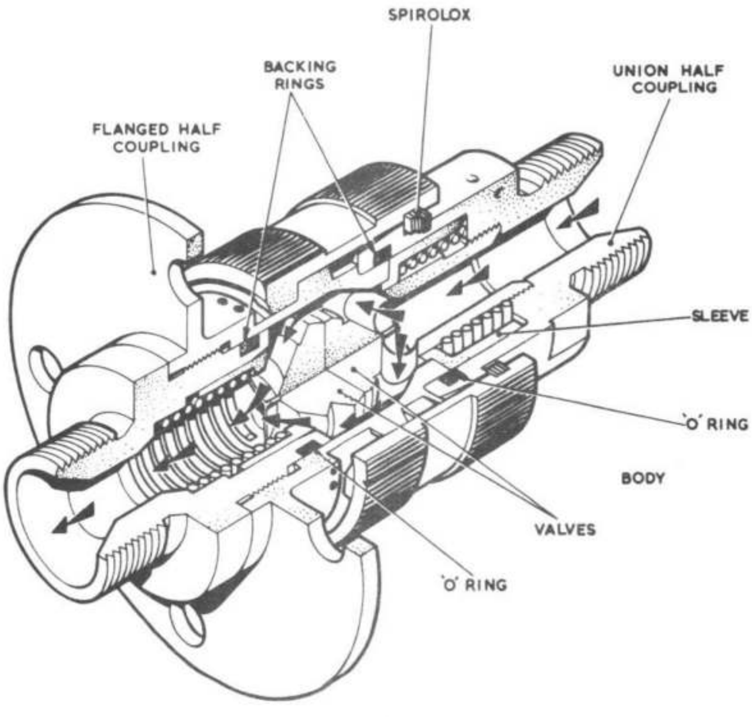


Fig.2 Coupling unit, Part No. C17317

Special features

4. The coupling units have a number of special features which are as follows:-

(1) When connected, the lock is engaged automatically.

(2) There is no intermediate position so, when connected, the coupling cannot be partially opened with consequent loss of system fluid or pressure.

(3) Positive visual indications are provided for checking that connection is complete and the lock engaged.

(4) Accidental disconnection is impossible.

(5) Each assembly carries clear instructions for connection and disconnection.

(6) The seals cannot be damaged whilst the two halves are being rotated during connection or disconnection.

Stud type coupling unit (figs.1, 3 and 4)

5. The stud type coupling unit (fig.1), Part No. C17316, consists of a stud half-coupling (fig.3), Part no. C17318, and a union half-coupling (fig.4), Part No. C17319, which is common to both stud and flanged types.

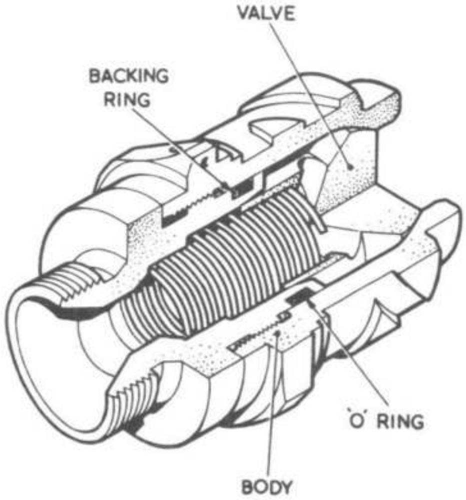


Fig.3 Stud half-coupling

6. The stud half-coupling consists of a body into which is screwed an adapter. A spring-loaded valve is fitted inside the adapter and the coupling end of the body is machined to form a three-start quick lead thread.

Flanged type coupling unit (figs.2, 4 and 5)

7. The flanged type coupling unit (fig.2), Part No. C17317, consists of a flanged half-coupling (fig.5), Part No. C17320, and a union half-coupling.

8. The flanged half-coupling is for bulkhead mounting by means of holes drilled in the integral flange round the body. Except for this it is basically the same as the stud half-coupling and the end of the body is machined to form a three-start quick lead thread.

Union half-coupling (fig.4)

9. The union half-coupling (fig.4), Part No. C17319, is used with both the other types of half-coupling. It comprises a body, a sleeve, and a tubular valve; a union nut is secured to the body by a Spirolox circlip. The tubular

valve fits inside the sleeve and is screwed inside the body. The sleeve is spring operated so as to cover the ports in the tubular valve whilst the half-coupling remains disconnected.

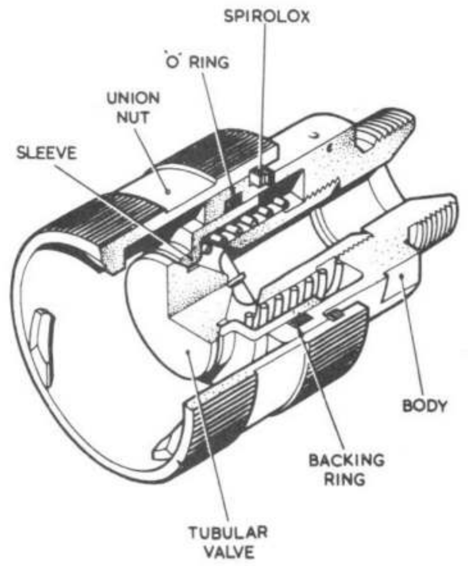


Fig.4 Union half-coupling

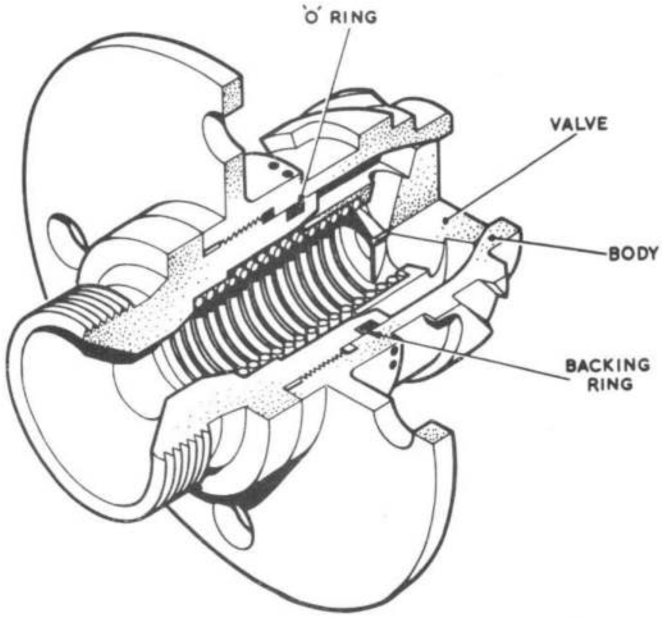


Fig.5 Flanged half-coupling

Construction

10. The valves and bodies of the half-couplings are lapped to reduce to a minimum leakage or intake of air whilst the unit is being connected or disconnected under pressure. In addition the faces of the valves of both the union and the stud half-couplings, together with the mating faces of the bodies of all three types of half-coupling, are also lapped to reduce leakage under similar conditions. Sealing of the couplings in use is achieved by means of 'O' rings fitted in each of the half-couplings.

Principle of operation

11. The two halves of a coupling are brought together by rotation of the union nut. The body of the stud or the flanged half-coupling (as appropriate) forces back the sleeve of the union half-coupling to expose the ports in the tubular valve. As the rotation continues, the tubular valve face comes into contact with the face of the valve of the stud or flanged half-coupling, which is then pushed back against its spring to uncover its valve ports. Thus, when the coupling is completely made, there is a free passage through the valves (fig. 1 and 2) for the flow of hydraulic fluid.

Protective caps (fig.6)

12. Standard AGS protective caps are provided to prevent damage to the external male threads of the half-couplings, and to prevent the ingress of dust or other foreign matter when the couplings are not in use.

13. In addition, pressure sealing caps, Part No. C17321, are provided as a further precaution. They are fitted to the stud and flanged half-couplings which, although installed in an aircraft, may not be in use. They safeguard against the loss of pressure and fluid in the event of valve failure in the coupling.

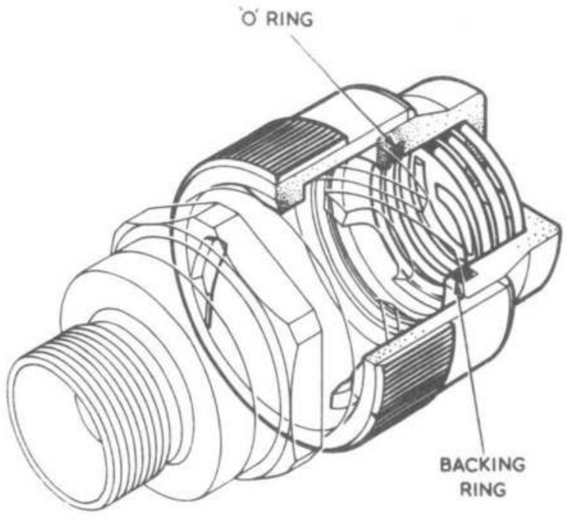


Fig.6 Pressure sealing cap

14. A pressure sealing cap (fig.6) consists of a cover and body with an internal three-start quick lead thread and a sleeve. To the end of the cover body an end piece is fitted inside which is a synthetic rubber 'O' ring and a spring. The pressure sealing cap is screwed to the stud or flanged half-coupling when the assembly is disconnected whilst under pressure and is held firmly in position by the action of its internal spring.

Chapter 9

POLYTHENE TUBING

Introduction

1. Polythene tubing of $\frac{3}{8}$in. inside diameter and 1/16in. wall is used in aircraft drainage systems e.g. for drainage of cabin moisture.

DESCRIPTION

2. The tubing is light, flexible, easy to handle and a good thermal insulator.

Cold bends

3. A natural bow in the tube may be restrained between two attachment points with hose clips but, owing to the elasticity of the material, the tube will revert to its original position when the hose clips are removed.

Hot bends

4. A permanent bend may be formed by either of the following methods. In both instances the bore must be supported by a bending spring or other suitable device, to prevent distortion.

(1) Insert the supporting device into the tube which must be immersed in boiling water, then bent to the required shape. This shape must be retained, in a jig if necessary, until the tube is cool, when the support may be withdrawn. Bends made by this method will spring back slightly and due allowance should be made.

(2) Insert the support into the tube which must be heated in a bath of glycerine or a strong solution of calcium chloride at 105 to 108 deg.C. Bend the tube as required, allow it to cool, in a jig if necessary, then withdraw the support. Bends made by this method are almost free from stress.

Metal junctions

5. To avoid cracking the tube when fitting a metal pipe or junction, immerse the end in clean hot water at 90 to 95 deg.C, then fit the tube to the pipe or junction immediately.

6. Fit hose clips but do not overtighten.

Chapter 10

FLEXIBLE COUPLINGS FOR AIRCRAFT METAL PIPE-LINES

LIST OF SUB-CHAPTERS

Chapter 10-1

HIGH-PRESSURE SEMI-FLEXIBLE COUPLINGS AVIMO TYPE

CONTENTS

ILLUSTRATIONS

Introduction

1. The Avimo Coupling is designed for incorporation in aero-engine installations, where it is used to connect high-pressure pipe-lines in a semi-flexible manner. It is available in a range of sizes suitable for connecting pipes of between ½in. and 3 1/4in. outside diameter. The coupling is used in engine service pipe-lines carrying water, glycol or oil at pressures of up to 60 lb/in^2 and at temperatures of up to 130 deg.C.

DESCRIPTION

General (fig.1)

2. The standard version of the coupling consists of the following parts

(1) Two sleeves, corrugated at one end, made of material suitable for welding or sweating on to the ends of the tubes which are to be connected.

(2) A neoprene (synthetic rubber) collar which fits over the adjacent ends of the two sleeves, covering their corrugations.

(3) Two semi-circular flanged and ribbed packing pieces which encase the neoprene collar, lip over the outer shoulders of the two sleeves, and distribute radial pressure evenly around the coupling.

(4) A worm drive hose-clip, usually of the "Jubilee" or "Supergrip" type which encircles the whole assembly, clamping the packing pieces together and causing the corrugations of the sleeves to bed down into the neoprene collar.

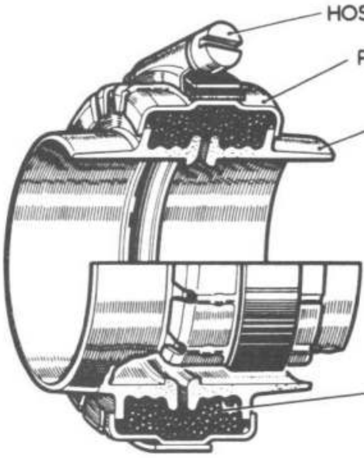


Fig.1 Avimo coupling (standard version)

3. This chapter deals only with the standard or basic model of the coupling but it should be noted that special applications of the Avimo principle exist where, for example, the pipe passes through a bulkhead and a connection is required at each side, or where the corrugated sleeve is incorporated in the design of another part. In all instances however, the principle of the coupling remains unchanged.

Dismantling

4. The sequence of operations for dismantling the Avimo coupling is as follows:-

(1) Remove the hose clip and clip and packing pieces.

(2) Exert a firm pull at each side of the coupling simultaneously. This will cause the neoprene collar to slip off one of the sleeves, it can then be prised off the other sleeve with the fingers. Difficulty will sometimes be experienced however in removing the collar where the coupling is used in pipe-lines which work at high temperatures, as it may adhere to the sleeves quite firmly due to a slight vulcanisation between the surfaces. It may then be necessary to ease away the collar from the metal by running a thin tool, such as a small screwdriver, around under it. Great care must be taken in the operation to avoid cutting the collar or bruising the sleeve corrugations.

Assembly

5. The coupling is assembled or re-assembled as follows:-

(1) Place the neoprene collar over one of the sleeves, then ease it on to the other when the two are butted together.

(2) Next place the packing pieces over the collar in positions diametrically opposite each other, so that the clearance at each side between their ends is equal. The amount of this clearance must be between 1/32in. and 3/16in. before tightening up the hose clip.

(3) Position the hose clip centrally around the packing pieces. Where the jubilee type clip is used in conjunction with packing pieces which have the raised ribs running uninterrupted across their widths, care must be taken to ensure that the screw box of the clip rests across two of them when tightened; otherwise the tabs which hold the screw box in position on the band, will be pulled from their locating holes and failure of the clip may result. As the efficiency of the coupling rests largely upon the effectiveness of the clip, it is essential that this be screwed up tightly, taking care not to strip either the thread of the screw or the nut, screw box or band slots in which it actuates.

SERVICING

Leakages

6. Where leakages occur they will usually be found to be of a major nature, due to the hose clip bursting and a consequent blowing out of the neoprene collar. Bleed leaks normally occur only through some small cut or split in the neoprene collar itself. In all cases the faulty or damaged item must be renewed.

Chapter 10-2

MIFLEX COUPLINGS AC4030 SERIES

CONTENTS

TABLES

ILLUSTRATIONS

Introduction (fig. 1, 3, 4 and 5)

1. Miflex Couplings Type AC4030 Series are used to provide a flexible connection between two pipe-lines, or between a pipe-line and an end fitting of a component. The pipe ends must be beaded for use with these couplings (fig.1). Pipe sizes from 1/4in.o.d. to 3½in.o.d. and a range of coupling types are covered by the Series (fig. 3-5). These may vary to suit the medium for which the pipe-line is used (see para.6).

DESCRIPTION

General (fig. 1 and 2)

2. Each coupling consists of a body, two split gland washers, two 'O' rings, a centre split retaining sleeve, a nut and a circlip locking ring (fig.1). This engages in slots on the body and the nut, to lock them together when the coupling is assembled on the pipe and/or component. The 4BA tapped hole in

the nut is for bonding purposes, to link the pipe held in the nut assembly to the pipe held in the body assembly, via the nearest of the 4BA tapped holes in the projections round the body.

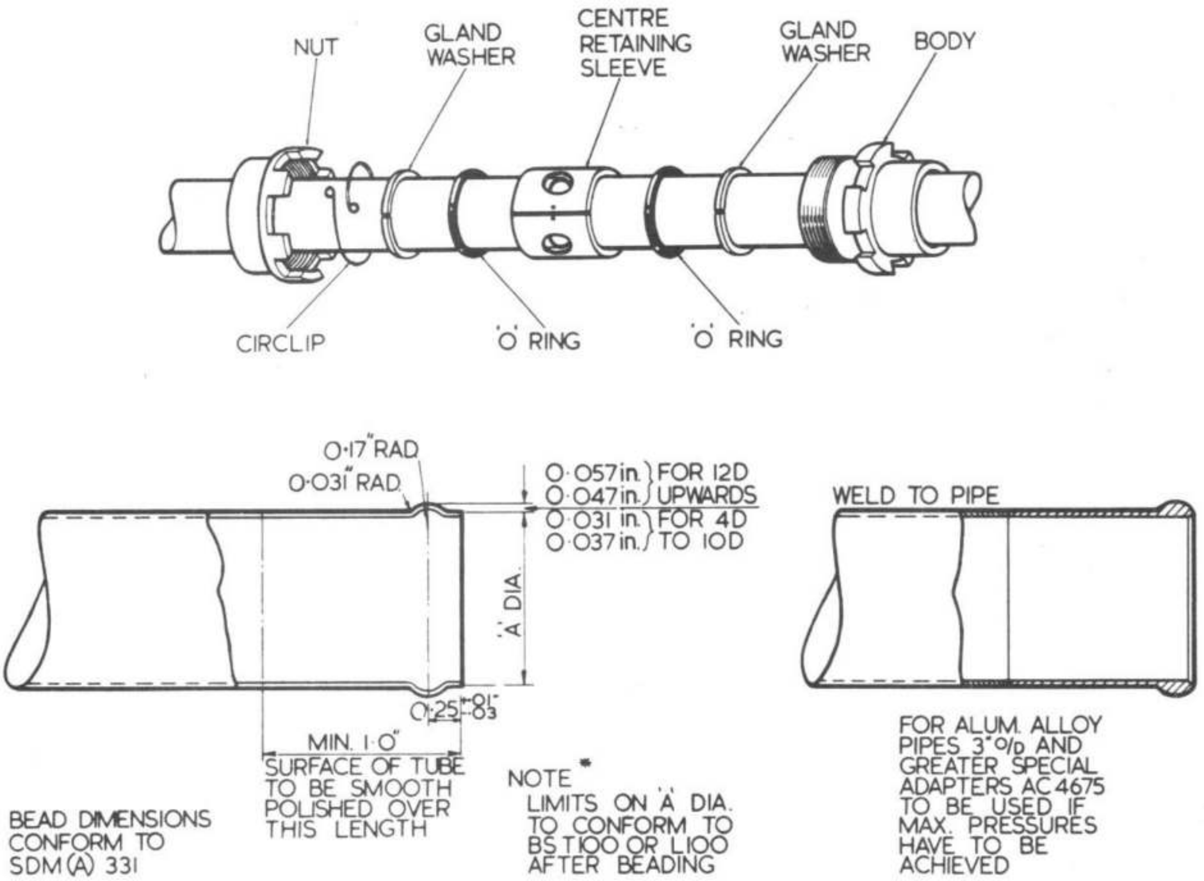


Fig.1 Pipe and coupling components

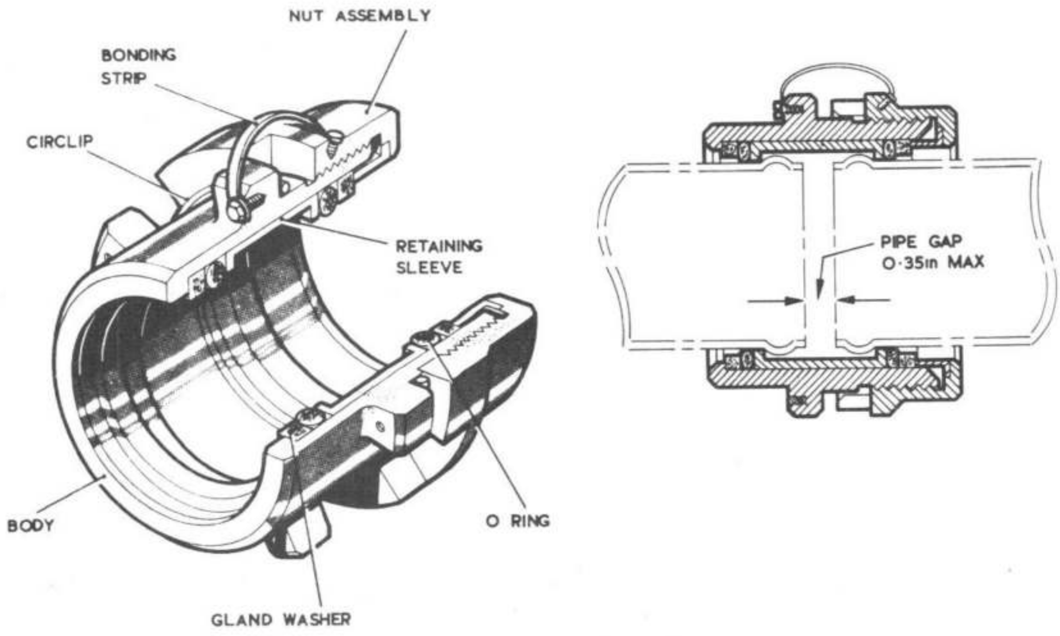


Fig.2 Coupling and position of pipes

Operation (fig.2)

3. As the nut is tightened on the body it compresses the 'O' rings between the gland washers and the centre retaining sleeve. The 'O' rings expand and form a seal between the outer surface of the pipe and the bore of the body, as shown in fig.2. Fig.2 also shows the maximum permissible gap, of 0.35in, between the ends of the pipes.

4. The coupling is leak-proof under static conditions with an internal working pressure of -11 lb/in^2 to +125 lb/in^2 for fuels, and from 0 lb/in^2 to 100 lb/in^2 for air, with a maximum angular misalignment of four degrees.

5. The coupling is leakproof under dynamic conditions with an internal working pressure of -4 lb/in^2 to +15 lb/in^2, a maximum misalignment of two degrees, and an axial movement of 0.35in. It will operate through a temperature range of -50 deg.C to +70 deg.C for most uses but with air the upper temperature range may be extended to 280 deg.C.

Seal identification

6. Details of the seals used in the various pipe systems are given in Table 1.

TABLE 1

Allocation of seals for systems use

Seal No.	System use
AC/B/4038	AVTAG DERD2454 (Nato symbol F-40)
	AVTAG DERD2486 (Nato symbol F-45)
	Oil DERD2487 (Nato symbol O-149)
	AVTUR50 DERD2494 (Nato symbol F-35)
	AVCAT48 DERD2498 (Nato symbol F-44)
	Oil DTD585 (Nato symbol H-515)
	Hydraulic fluid SKYDROL 500
	Nitrogen and oxygen
AC/B/4047	Hot air (max.temp.280 deg.C)

SERVICING

Dismantling of couplings and renewal of 'O' rings

7. Dismantle the coupling as follows:-

(1) Remove the bonding strip.

(2) Spring the circlip locking ring free from its slots.

(3) Unscrew the nut from the body, then slide the nut and body along the pipe clear of the retaining sleeve.

(4) Using circlip pliers if necessary, spring the centre retaining sleeve over the beads and slide it along the pipe. Remove the 'O' ring.

(5) Spring the centre retaining sleeve over the beads to the other pipe, then remove the other 'O' ring.

(6) If it is necessary to renew any of the metal components of the coupling, the whole pipe section must be uncoupled so that a small length of the pipe may be removed to allow the renewal of the faulty component. If the pipe is too short for cutting, then it will be necessary to make up a complete new section with new couplings.

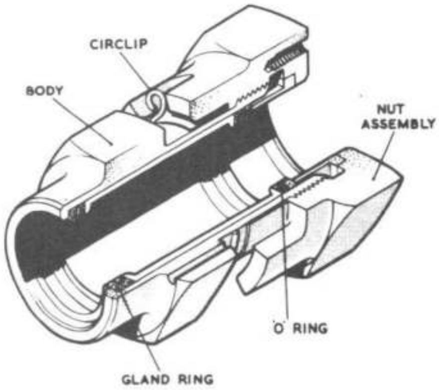


Fig.3 Standard pipe coupling

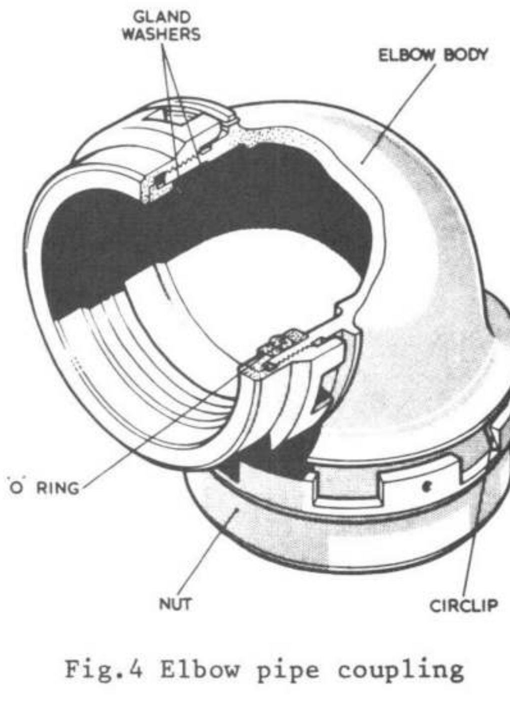


Fig.4 Elbow pipe coupling

<u>Assembly</u> (fig.1)

8. Assemble the coupling on a pipe-line as follows:-

(1) Slide the coupling body on one pipe end.

(2) Slide the coupling nut on the other pipe end.

(3) Fit a gland washer to each pipe, using circlip pliers if necessary.

(4) Lubricate the 'O' rings with the fluid in the system to be sealed and fit one on to each pipe.

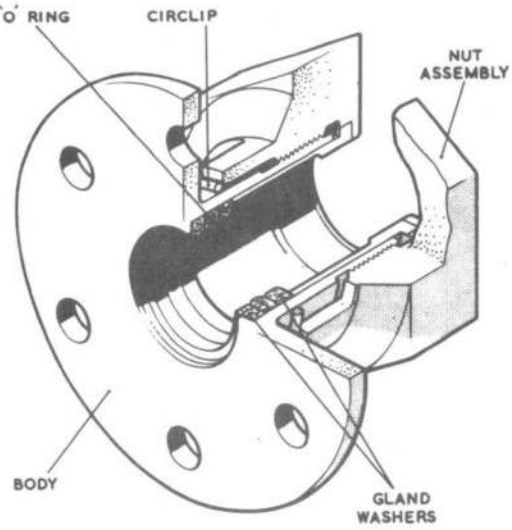


Fig.5 Termination pipe coupling

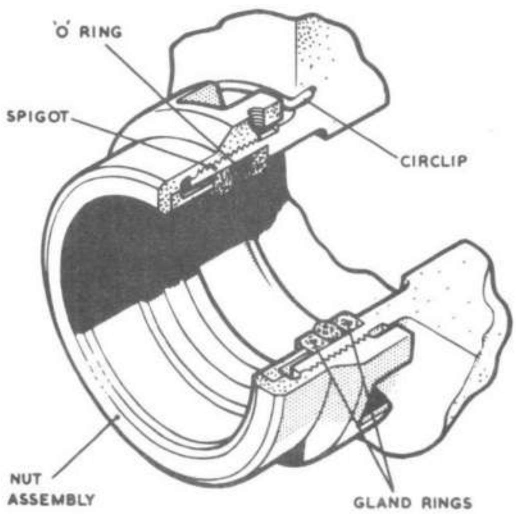


Fig.6 Boss coupling

(5) Shape the ends of the two pipes (fig.1) as detailed in SDM(A)331, so that the beads are formed to fit against the shoulders of the coupling nut and body.

(6) Using circlip pliers if necessary, fit the centre retaining sleeve over the beads on both the pipe ends as shown in fig.1.

(7) Lightly smear the threads on the body and nut with graphited grease Ref.No. 34B/9100528 (Nato symbol S-720).

(8) Slide the coupling body and nut together and engage the threads carefully. Screw the nut on to the body by hand until, by feel, the compression of the 'O' ring begins. Apply a further half-turn to tighten.

(9) Lock the coupling by allowing the circlip lugs to spring into the nearest locking slots on the nut and body. A slight unscrewing movement is then necessary to establish the correct locking position.

(10) Replace the bonding strip to link the nut and body (see para.2).

Fault finding

9. After assembly or reassembly, and as detailed in the aircraft schedule, all couplings in a system must be checked for leaks and security. Table 2 is given as a guide to fault-finding.

TABLE 2

Fault finding

Fault	Cause	Rectification
Fluid leaks	(1) Scored, trapped or distorted 'O' rings	(1) Renew 'O' rings
	(2) Perished 'O' rings due to contamination by incorrect fluid from external or internal sources	(2) Renew 'O' rings. Check metal parts for corrosion or damage
	(3) Scored, dented or distorted pipe end	(3) Renew pipe

Chapter II

FLEXIBLE METALLIC HOSE ASSEMBLIES

CONTENTS

TABLES

ILLUSTRATIONS

ILLUSTRATIONS (cont...)

Introduction

1. This chapter describes the various types of flexible metallic hose used on aircraft. Metallic hose is used in a number of aircraft systems such as, gun heating, thermal de-icing, cabin pressurisation, and engine and fuel systems. In heating systems, hot air is bled from the jet engine, and this temperature is beyond that at which rubber hose can be used. Another application for metallic hose is in systems which use corrosive liquids or gases.

2. The hose is supplied in defined lengths with end fittings attached, and each length is given an assembly reference number. These made up items are usually referred to as 'hose assemblies'. Metallic hose is not supplied in bulk without end fittings.

End fittings

3. Various types of end fittings are used and these are shown with their related hoses in para. 25-51.

Storage

4. Hose assemblies not in sealed cartons or transparent envelopes must, when stored, have their ends sealed with blanking plugs or adhesive tape. Additional instructions on the storage of hose assemblies are given in A.P.830, Vol.2.

Service life of stored hose

5. Stored hose assemblies are not normally subject to any life limitation. This also applies to hose assemblies fitted to stored aircraft where the assembly is in its normal position with no open ends.

Markings on hose

6. Metallic hose assemblies usually have a metal tag or label clipped around the hose. On this is stamped the part number of the assembly, the date of manufacture, the manufacturer's name, and the inspector's stamp. Another method of identification is an adhesive tape with the identification data printed on it.

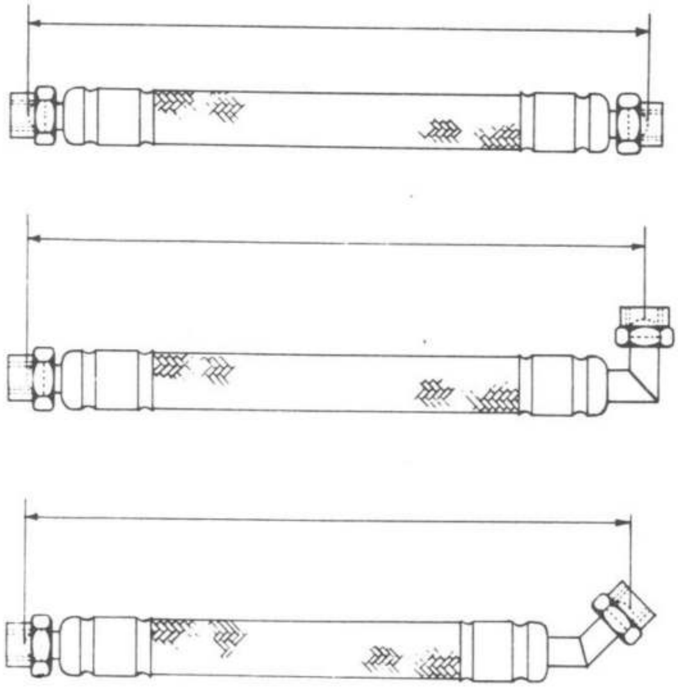


Fig.1 Effective lengths of hose assemblies

INSTALLATION NOTES

Installation techniques

7. Flexible metallic hoses should be installed with reference to the minimum bend radius specified in the installation table. This minimum bend radius is measured to the centre line of the hose and hoses which are forced beyond the minimum bend radius, will be damaged. Figure 2 details some examples between correct and incorrect installation.

8. Flexible metallic hoses are free to flex radially but are torsionally rigid. Twisting of the hoses can cause damage and care should be taken to arrange hoses so that movement takes place in one plane only. Figure 3 details some examples between correct and incorrect installations with reference to single plane movement.

Pre-installation procedures and checks

9. Before a hose assembly is installed, the following procedures should be followed and the checks detailed should be carried out:-

(1) Ensure that the assembly has the correct part number for the specific installation.

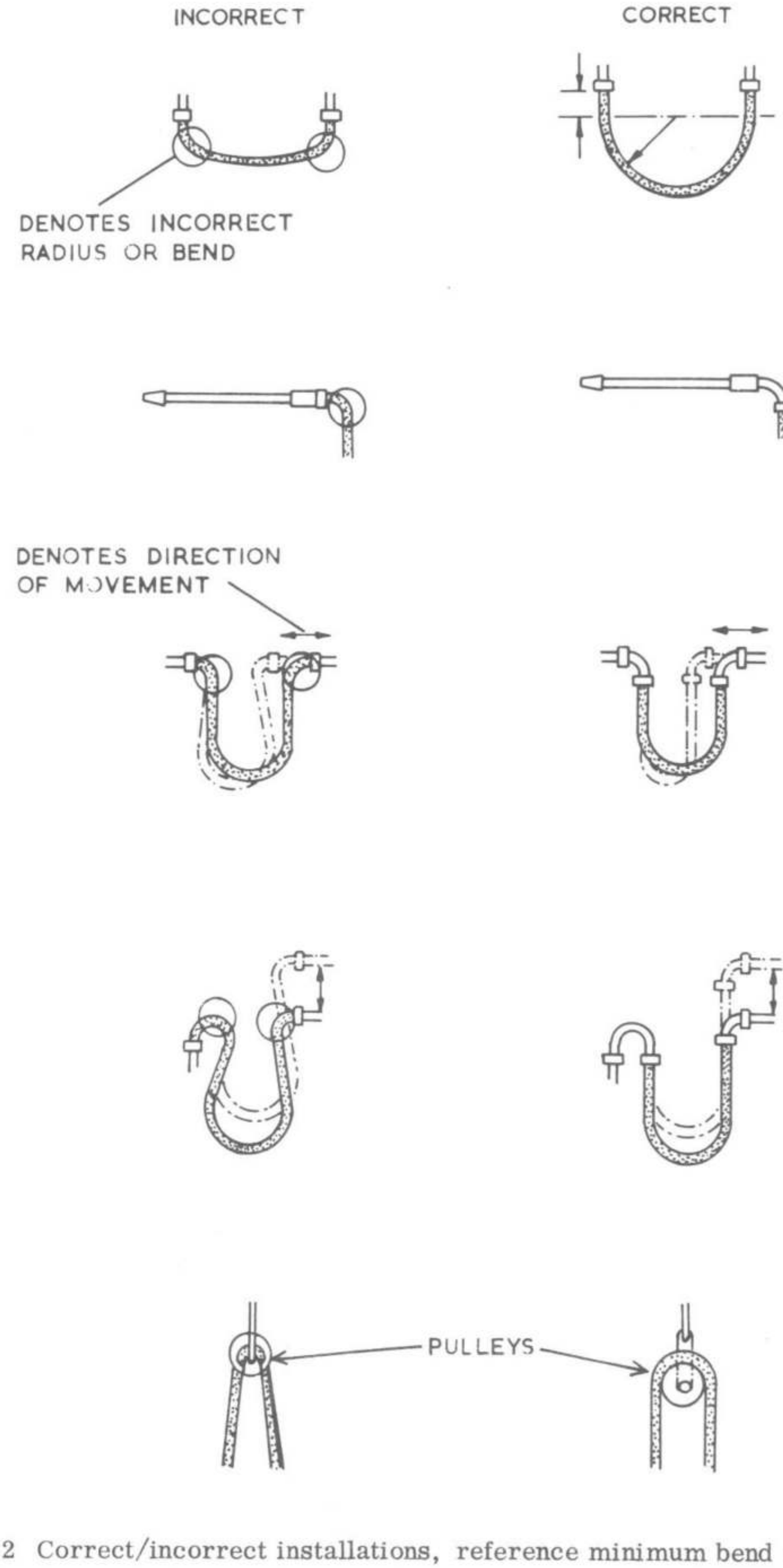


Fig.2 Correct/incorrect installations, reference minimum bend radius

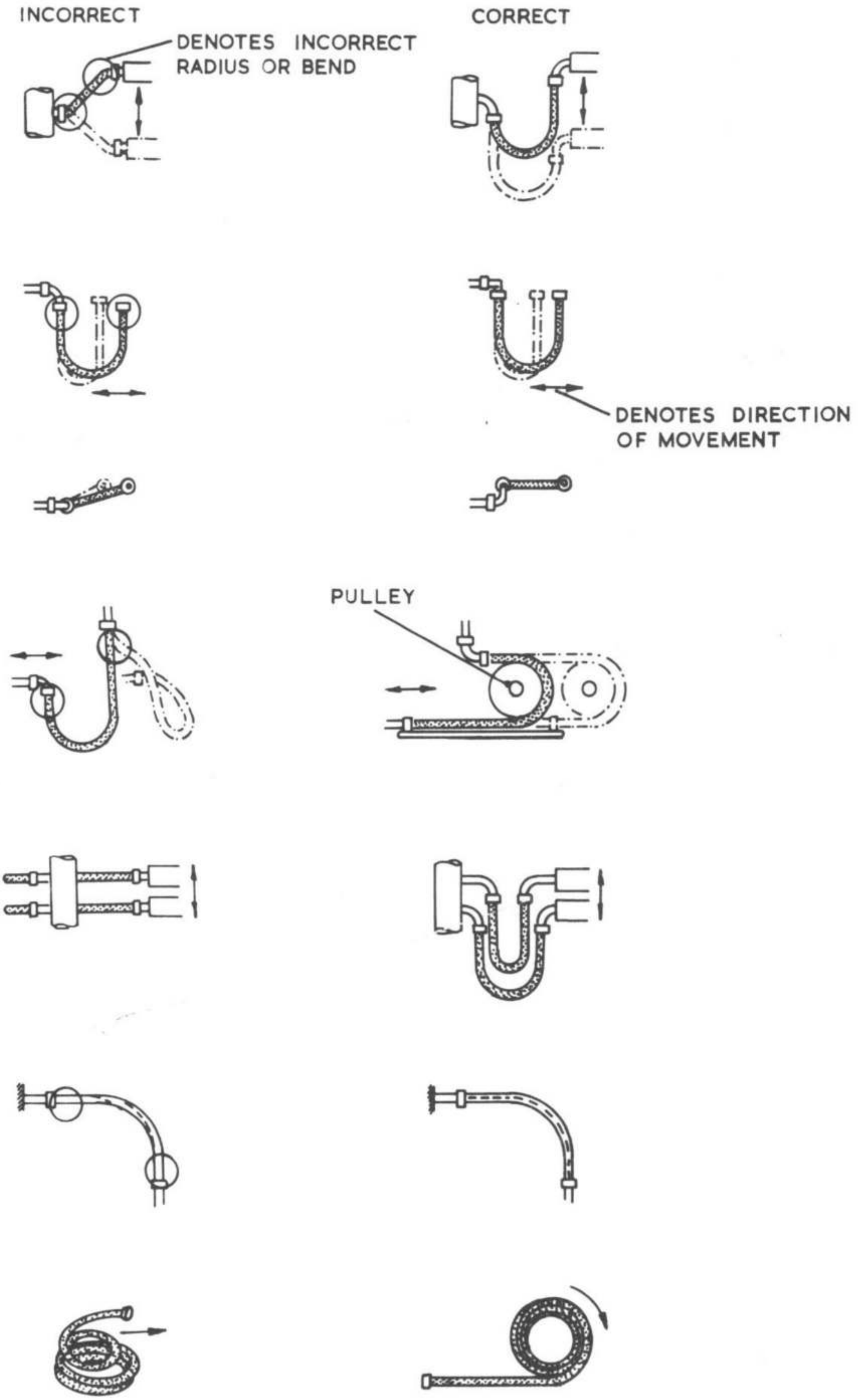


Fig.3 Correct/incorrect installations, reference single plane movement

(2) Visually examine the hose for any external damage or defects.

(3) Remove the blanking plugs or tape and ensure that the end fittings are undamaged and free from corrosion.

(4) Examine the internal diameter throughout its length for corrosion.

(5) Refer to engine/aircraft manufacturer's Maintenance Manual to ascertain if pre-installation pressure test is required. Where specified, carry out pressure test in accordance with instructions.

(6) Allow a straight run of at least twice the internal diameter before commencing a bend, ensure that bends are of a smooth contour and are never less than the minimum specified for the type of internal diameter size (refer to installation tables).

CAUTION...

Stainless steel flexible metallic hose assemblies are thin-walled and highly stressed and must not be subjected to repeated flexing or mishandling in any way.

(7) Except where special spanners are specified, spanner lengths should conform to normal aircraft practice and the nut should be tightened to the torque specified by engine/aircraft manufacturer. On no account allow assemblies to twist when tightening nuts; certain assemblies have a yellow line along their length for visual indication of twisting.

(8) Refer to para. 9 when removing and installing engine change units (ECU) to avoid unnecessary damage to hose assemblies, especially those which connect between engine and airframe. Where possible, remove such assemblies before the ECU is removed and fit them after the ECU has been installed, thus avoiding the possibility of damage to an assembly by being trapped by the ECU, resulting from taping an assembly out of the way.

(9) Ensure that any clips or similar supporting devices are correctly fitted and that the hose assembly is clear of all other components.

(10) Observe scrupulous cleanliness at all times.

Installation of hoses with swivel nut terminations

10. The following procedures should be carried out:-

(1) If specified in engine/aircraft manual, lubricate threads to which assembly is to be connected.

(2) Offer up assembly and set to correct route, screw nuts finger tight, ensuring that the assembly is free from strain.

(3) Taking great care not to twist the assembly, fully tighten the nuts. Where provision is made for two spanners, hold the coupling with one spanner and tighten the nut with the other.

(4) Ensure that the assembly is clear of other components, then wire-lock nuts in approved manner, using correct locking wire.

(5) Fit clips or other supporting devices at specified positions on the assembly and secure to the installation, ensuring that any required movement of the assembly is not restricted and that the route is not deformed.

Installation of hoses with fixed or V-flange end fittings

11. The following procedures should be carried out:-

(1) Place the correct type and size of seal or gasket in the flange grooves or flange face and align assembly and installation flanges. If the flanges incorporate locating spigots, ensure that they are engaged correctly.

(2) Fit clamps or other coupling components around flanges and tighten according to appropriate manufacturers' instructions.

(3) Fit clips or other supporting devices at specified positions on the assembly and secure to the installation, ensuring that any required movement of the assembly is not restricted and that the route is not deformed.

Checks and tests after installation

12. The following tests and checks should be carried out after installation:-

(1) Check the electrical resistance using a multimeter between assembly coupling and components to which they are connected. Resistance should not exceed 0·050 ohms. On fuel systems a safety ohmeter (Ref. No. 56/9018429) must be used for this purpose.

(2) If required by the engine/aircraft maintenance manual, pressure test the system in which the assembly has been incorporated.

(3) The newly-fitted assembly must be supported as detailed in the layout drawing for the system or, if this is not available, in the same manner as the hose which it replaces. Excessive loading on the end fittings must be avoided.

(4) The hose must not be in tension in any part of its length.

SERVICING

Examination for damage in situ

13. Metallic hose is subject to forms of damage which differ from those applicable to non-metallic hoses. At the servicing periods, each hose assembly is to be examined for the following forms of damage, all of which are causes for rejection or further examination of the hose. Some results of damage are illustrated in fig.4 and 5.

(1) Signs of distortion such as the wire braiding being pulled away from the end fitting (fig.4).

(2) Chafing of the hose with adjacent components. The type of damage caused is shown in fig.4B and fig.5.

(3) Signs of twisting, this is usually visible as distortion of the wire braid in a helical direction.

(4) Corrosion on the end fitting and the braid.

(5) Visible cracks or fractures in the hose or end fittings.

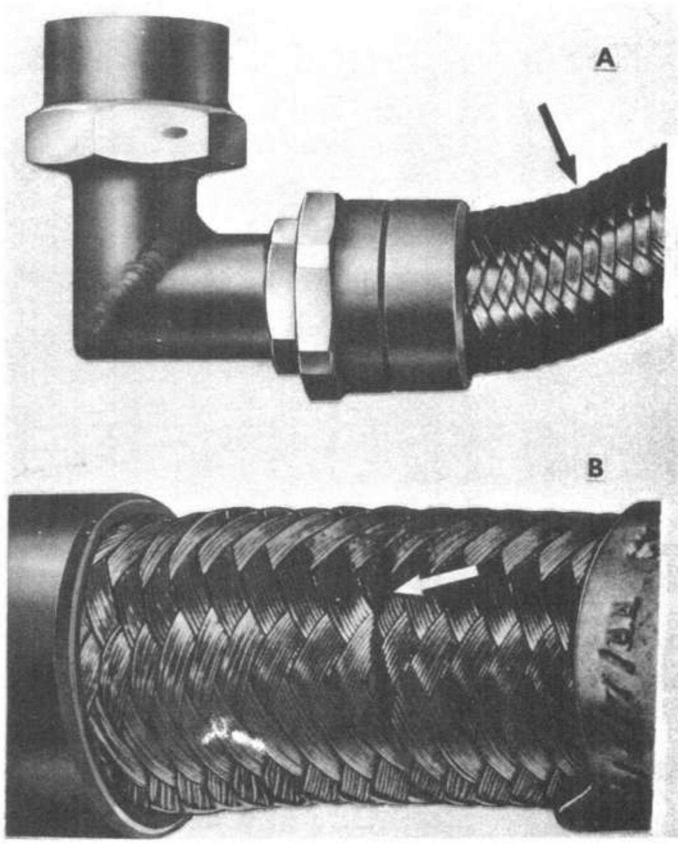


Fig.4 Damage to hose (distortion and chafing)

Examination for damage after removal

14. At the periods stated in the aircraft servicing schedule, or if the serviceability of the hose assembly is suspect and it has been removed for testing, then thoroughly clean the assembly in trichloroethane (Ref. No. 33D/2201949). The EXTERIOR ONLY may be cleaned using a bristle brush to facilitate removal of any dirt etc.

CAUTION...

Do not use the brush to clean the interior surfaces, otherwise damage to hose convolutions may occur when the brush is pushed into the internal diameter of the hose assembly. Ensure that paraffin or petrol does not enter the assembly as its presence may attract and hold dust.

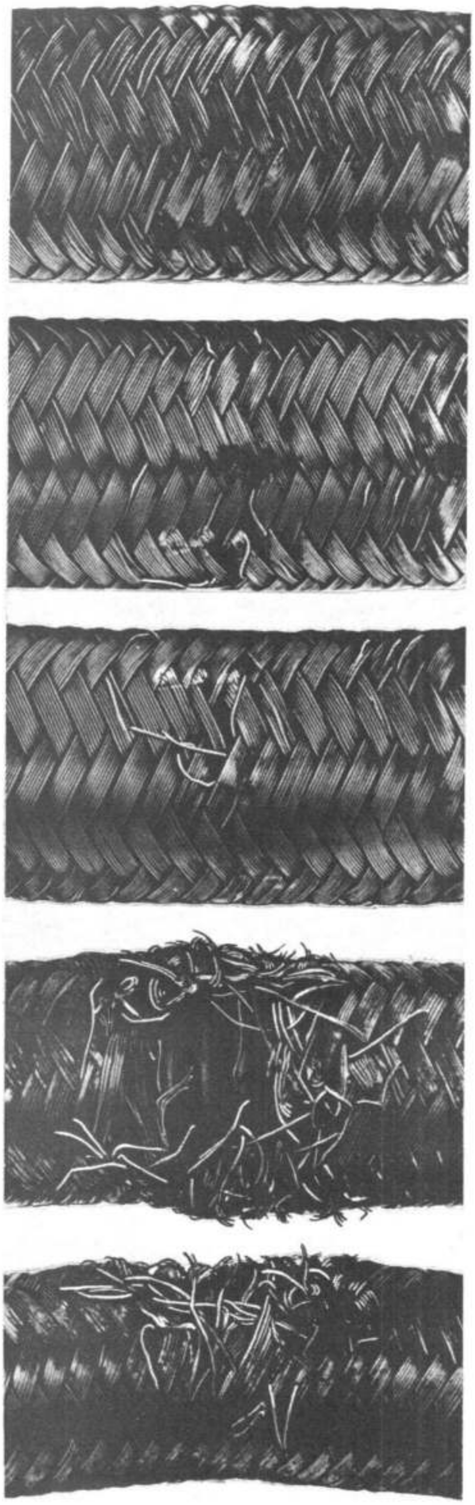


Fig. 5 Damage to hose (dented outer braid, and severe abrasion)

15. Examine the end fittings as follows:-

(1) Examine for evidence of corrosion, particularly in the vicinity of welds. If corrosion is present, reject assembly.

(2) Examine all mating surfaces (spherical and conical form of nipples, cone sealings, flange faces, seal grooves etc) for scoring or other damage. If any damage is considered sufficient to subsequently cause leakage, reject assembly.

(3) Examine all threads for damage.

(4) Examine all welded and silver soldered joints for cracks, pin-holes and other damage.

Note...

Any pressure testing (refer to para.19) should reveal any defects not found visually.

(5) Examine condition of any locking devices, especially for tearing of metal in vicinity of locking wire holes.

16. Examine the flexible hose as follows:-

(1) Examine braid for signs of chafing, broken wires and dents (refer to fig.4), sliding part number band to one side and removing any adhesive identification tape to enable hidden areas to be inspected. If any defects are observed, reject assembly.

Note...

Dents in the outer braid may cause damage to the inner tube and restrict the internal diameter.

(2) Using an illuminated probe, examine interior of hose for damage and corrosion. If any damage or corrosion is found, reject assembly.

(3) Examine for signs of any other defects such as sharp pulling away of hose where it emerges from coupling, bulging or bunching of braid, and twisting (refer to fig.4) resulting from mishandling or incorrect installation. Any defect requires rejection of assembly.

TESTING

17. Scrupulous cleanliness must be observed at all times and care must be exercised to prevent the ingress of foreign matter into assemblies.

Test equipment

18. The following equipment is required for complete examination and testing:-

(1) All assemblies:

(a) Regulated pressure supply (e.g. hand pump) with gauge, using water or a particular fluid as a pressurizing medium.

(b) Electrical probe illuminator, for internal examination of assembly.

(c) Facilities for drying with a continuous blast of hot air over external surfaces and through internal diameter of assembly at a temperature of between 160 and 180 deg C (320 to 356 deg F) for a period of 30 minutes.

(2) Assemblies which convey air under pressure:

(a) Regulated clean, dry compressed air supply with gauge, together with container for water or sufficient depth to enable the assembly to be submerged. The water container must have a heating facility for raising the temperature of water to approximately 27 deg C (80 deg F) to assist dispersion of air trapped in pockets on assembly.

(3) Assemblies capable of an internal diameter test using a ball:

(a) Steel balls of diameters specified in the following table.

TABLE 1

Internal diameter test-ball dimensions

Hose Internal Diameter	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
Ball diameter	0.108 0·106	0.146 0·144	0.200 0·178	0·226 0·224	0·365 0·343	0·490 0·468	0·581 0·559	0·803 0·793	0·990 0·980	1·240 1·230	1·590 1·580

All dimensions are in inches

Pressure tests

19. Where an assembly is considered serviceable after examination, pressure test in accordance with the following instructions:-

(1) All assemblies:

Lay the assembly on a bench in an unrestricted position. Blank off one end of the assembly and connect the other end to a regulated pressure supply as specified in the installation tables.

WARNING...

IF THE HOSE HAS BEEN REMOVED FROM A FUEL OR HEATING SYSTEM, SOFTENED OR DISTILLED WATER IS TO BE USED AS THE PRESSURISING MEDIUM AND, AFTER TESTING, THE ASSEMBLY IS TO BE DRIED IN AN OVEN AT BETWEEN 160 AND 180 DEG C (320 to 356 DEG F), OR A CONTINUOUS BLAST OF HOT DRY AIR IS TO BE PASSED THROUGH AT THIS TEMPERATURE FOR AT LEAST 15 MINUTES. IF THE HOSE HAS BEEN REMOVED FROM A FLUID SYSTEM, (OTHER THAN FUEL), THE SAME FLUID AS IN THE SYSTEM IS TO BE USED AS THE PRESSURISING SYSTEM.

(2) Thoroughly bleed assembly and apply the applicable test pressure for five minutes.

(3) During period of test, observe pressure gauge and watch assembly for signs of leakage, deformation of the hose as pressure is applied, and movement of braid in the vicinity of attachment to the coupling.

20. If the hose has been removed from a pneumatic or an air conditioning system, the test procedure in paras. 18 and 19 is to be used.

21. After successful completion of the hydraulic test detailed in para. 19, test assemblies which convey air under pressure as follows:-

(1) Disconnect the assembly from hydraulic test equipment and shake out moisture from its interior.

(2) Connect assembly to a regulated, clean, dry supply of compressed air. Lay assembly in an unrestricted position in a container of water whose temperature is approximately 27 deg C (80 deg F).

(3) Agitate the hose assembly to free any air bubbles trapped in the braiding, then slowly apply a pressure of one and a half times the working pressure of the hose or 200 lbf/in^2, whichever is the lesser. Maintain the pressure for five minutes.

(4) Check for deformation of hose, movement of the braid in the vicinity of attachment to the coupling and for any signs of leakage. Leaks will be apparent either as a thin trickle or stream of bubbles. Locate exact position of emanation of bubble stream as leaks from test adapters, connections etc. can be mistaken for hose or coupling failures.

22. After completion of the tests, dry in an oven or pass a continous blast of hot dry air at between 160 and 182 deg C, through the hose assembly for at least 30 minutes.

Internal diameter test

23. Test assembly for obstruction by passing a ball of a size appropriate to the internal diameter of the hose (see para.18).

Blanking plugs

24. If, after tests have been completed, the hose assembly is not being immediately installed in a system, threaded end couplings and any other threaded connections are to be fitted with protective caps or plugs, whilst V-flanges and other orifices are to be sealed with adhesive tape.

CAUTION...

Do not use any type of blanking plug or cap which can fragment as particles could pass into the bore of the assembly.

AVICA HOSE ASSEMBLIES

Purpose and description (fig.6)

25. Avica hose is a range of metallic hose assemblies used in varous aircraft systems

such as gun heating, cabin heating, fuel drain lines etc. The hose is of all metal construction as shown in fig.6, and consists of a stainless steel metal corrugated tubing surrounded by one or two stainless steel wire braids. The end fittings are attached to the end of the hose by mechanical means, silver soldering, or welding.

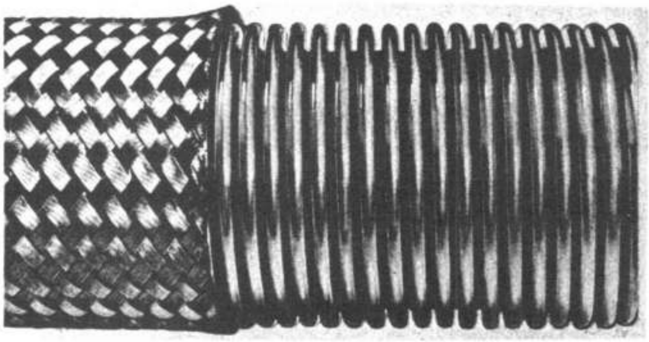


Fig.6 Sectional view of Avica hose

26. There are three basic types of assembly - Type 'W' in which the end couplings are attached to the inner tube by argon arc welding, Type 'BR' where the end couplings are silver soldered to the inner tube, and type 'A' in which the end couplings and the inner hose are connected mechanically. This latter type is now obsolete. As the end couplings differ in design for each method of attachment to the inner hose, identification of the type of any assembly can be established visually. The three types are shown in fig.7. Installation data is provided for types BR and W in Tables 2 and 3 and also paras.10 - 11.

27. Hose assemblies incorporate end fittings with varying forms of termination for connection with other components, i.e. nut/nipple or V-flange at end of straight, mitred angle or swept elbow fitting, standpipe etc. Examples of these are shown in fig.8.

28. Examples of the part numbering system used for standard Avica hose assemblies is shown in fig.9.

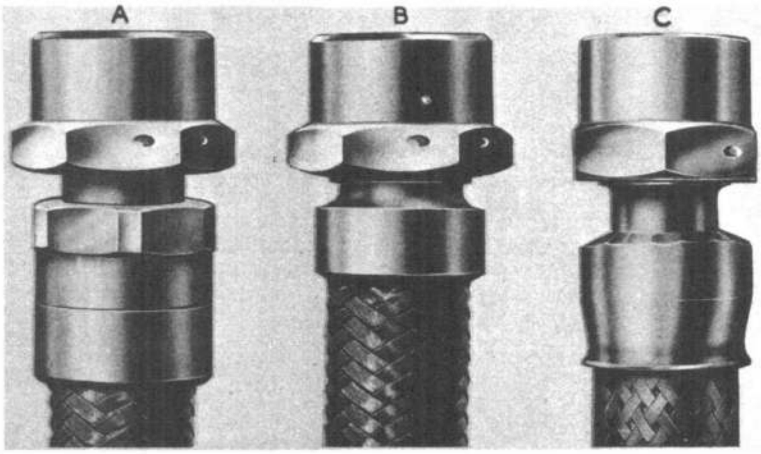


Fig.7 Types of couplings for Avica hoses

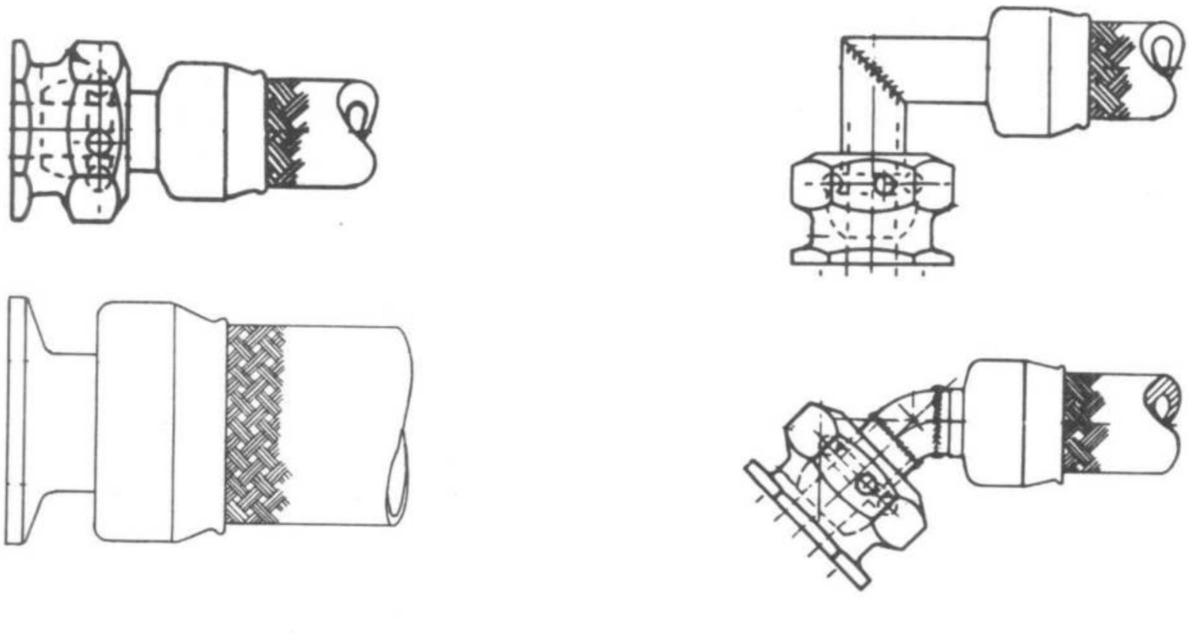


Fig.8 Types of end fitting for Avica hoses

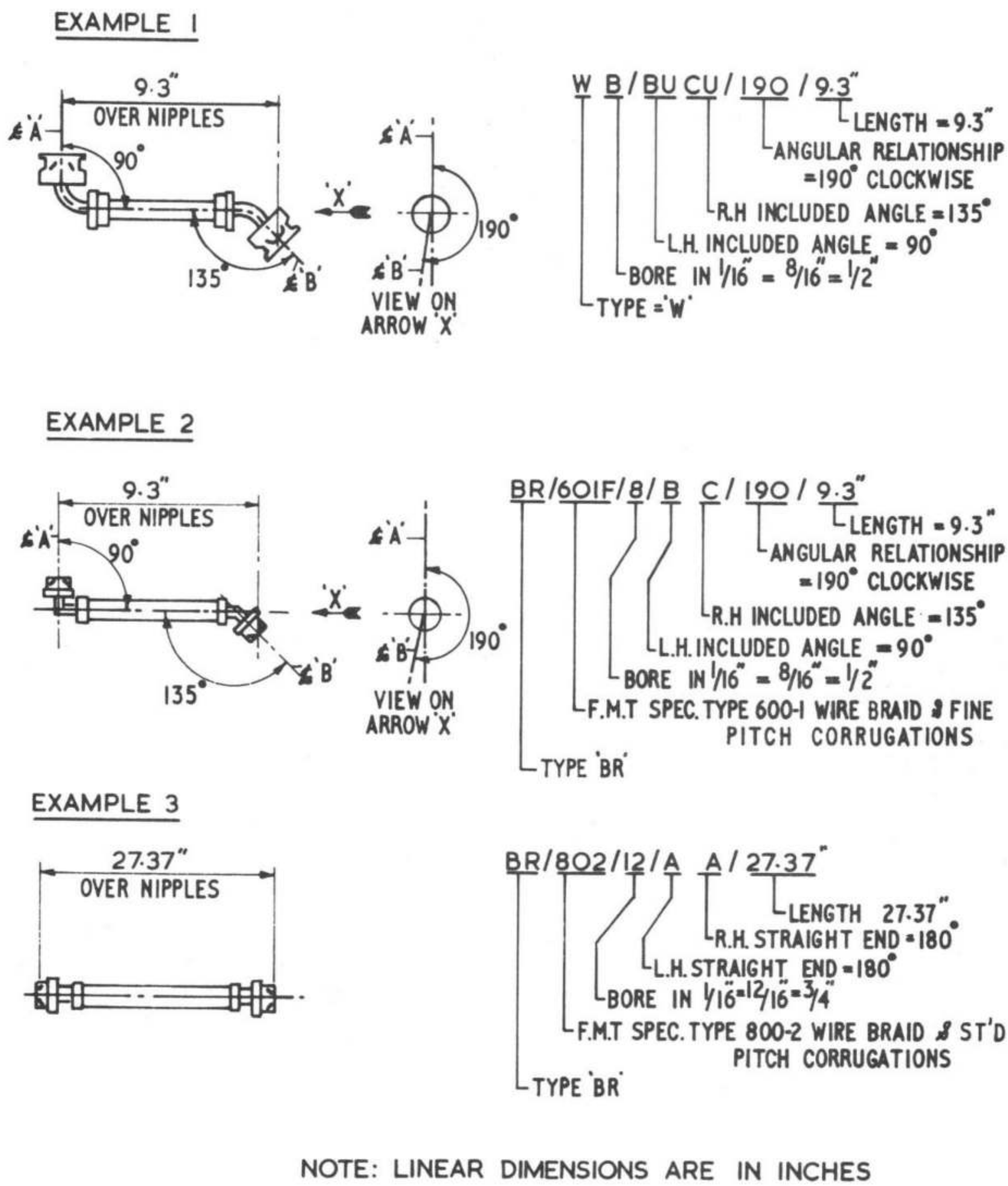


Fig. 9 Part numbering system for Avica hoses

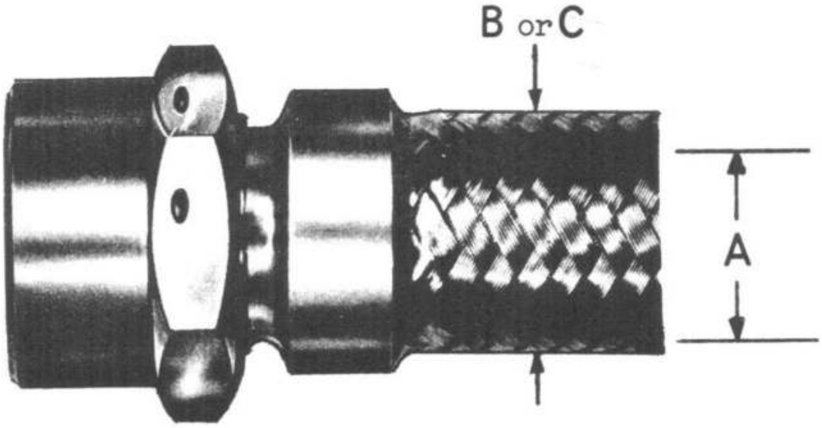


Fig.10 Assembly type BR (Avica) dimensions

TABLE 2

Installation data for Avica type BR assemblies

Diameters (in)			Minimum bend radii (in)		Pressure (lbf/in^2) Working		Test		Max. working temp.
A Internal diameter	B 1 BRAID	C 2 BRAID	1 BRAID	2 BRAID	1 BRAID	2 BRAID	1 BRAID	2 BRAID	
3/16	0·380	0·420	3·00	3·50	500	700	750	1050	
1/4	0·450	0·510	3·00	3·50	500	700	750	1050	
5/16	0·540	0·590	3·50	4·00	400	600	600	900	
3/8	0·600	0·600	4·00	4·00	300	500	500	750	
1/2	0·760	0·800	4·50	4·50	250	400	375	600	
5/8	0·880	0·930	5·00	5·00	200	300	300	450	350 deg C (662 deg F)
3/4	1·080	1·150	5·00	5·00	200	300	300	450	
1	1·310	1·380	6·25	7·00	150	275	225	413	
1 1/4	1·570	1·640	7·00	8·00	100	200	150	300	
1 1/2	1·890	1·960	8·00	9·00	100	150	150	225	
2	2·390	2·470	14·00	16·00	75	125	113	188	

TABLE 2 (cont...)

Diameters (in)			Minimum bend radii (in)		Pressure lbf/in²				Max. working temp.
					Working		Test		
A Internal diameter	B 1 BRAID	C 2 BRAID	1 BRAID	2 BRAID	1 BRAID	2 BRAID	1 BRAID	2 BRAID	
$2\frac{1}{2}$	3·000	3·100	16·00	18·00	60	110	90	165	350 deg C (662 deg F)
3	3.530	3.630	18·00	20·00	60	80	90	120	
$3\frac{1}{2}$	4·100	4·200	24·00	27·00	50	70	75	105	
4	4·600	4·700	26·00	29·00	50	65	75	98	

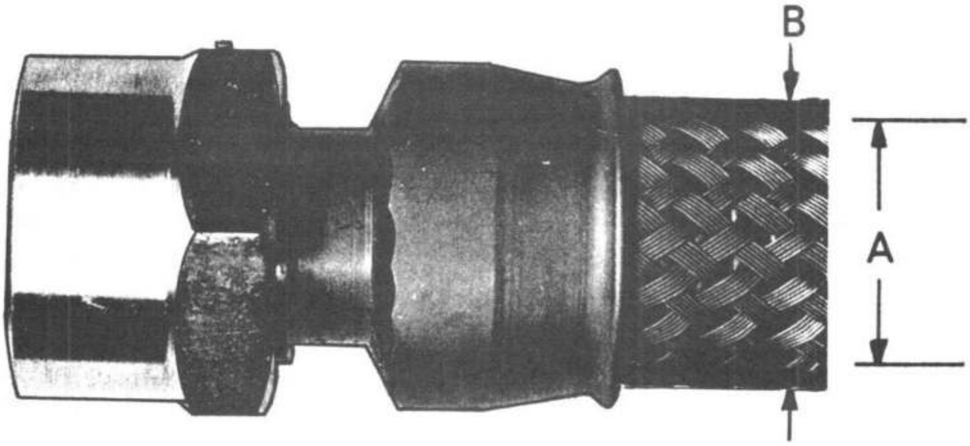


Fig.11 Assembly type W (Avica) dimensions

TABLE 3
Installation data for Avica type W assemblies

Diameters (in) A Internal dia.	B BRAID	Minimum bend radii (in)	Pressure (lbf/in²) Working	Test	Maximum working temperature (under vibro impulse)
$\frac{3}{16}$	0·390	3·000	600	900	400 deg C (725 deg F)
$\frac{1}{4}$	0·470	4·000	600	900	
$\frac{5}{16}$	0·550	5·000	600	900	
$\frac{1}{2}$	0·630	6·000	600	900	
$\frac{5}{8}$	0·780	7·000	600	900	

cont......

TABLE 3 cont...

Diameters A (in) Int. dia.	B BRAID	Minimum bend radii (in)	Pressure (lbf/in^2) Working	Test	Maximum working temperature (under vibro impulse)
5/8	0·930	8·000	500	750	
3/4	1·070	9·000	500	750	400 deg C
1	1·400	10·000	350	525	(725 deg F)
1 1/4	1·690	12·000	300	450	
1 1/2	1·980	13·000	200	300	
2	2·610	15·000	150	225	

SUPERMETALFLEX TYPE FHM HOSE ASSEMBLIES

Purpose and description

29. The Supermetalflex type FHM is a range of flexible metallic hose assemblies used in the various aircraft ancillary systems such as cabin heating, hot air de-icing etc. It is also used on engine fuel, oil and burner systems and applications where constant flexible movement is expected. The maximum temperature at which the assemblies will function to full performance capability is 120 deg C 9240 deg F).

30. The hose is of all metal construction as shown in fig.12 and consists of helically corrugated tubing formed from thin wall metal helically lap seam welded. The metal used in the construction is austenitic titanium stabilised stainless steel. The hose can have wire braid armouring in one or two layers. Standard braiding is stainless steel, optional braiding is available in galvanised steel or phosphor bronze. For tubing with these optional braids, the pressure ratings listed in Table 4 are reduced to 80 per cent of the listed value.

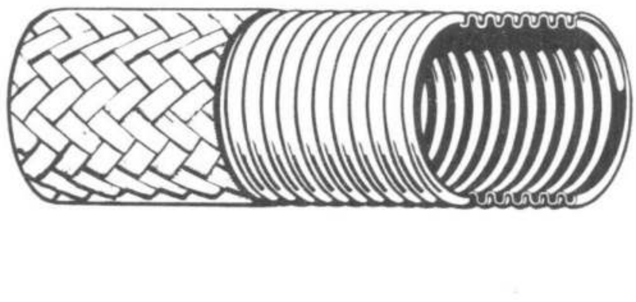


Fig.12 Sectional view of Supermetalflex type FHM

TABLE 4

Installation data for Supermetalflex type FHM assemblies

INTERNAL DIAMETER		EXTERNAL DIAMETER Single Braid		EXTERNAL DIAMETER Double Braid		MAXIMUM WORKING PRESSURE Single Braid		MAXIMUM WORKING PRESSURE Double Braid		MINIMUM BEND RADII Constant Movement		MINIMUM BEND RADII Pre-set for static pipework		IDENTIFICATION
in	mm	in	mm	in	mm	lbf/in^2	kgf/cm^2	lbf/in^2	kgf/cm^2	in	mm	in	mm	
3/16	5	0·37	9·4	0·42	10·7	1800	126·5	2,900	203·8	5	130	1	25	
1/4	6	0·45	12	0·50	13	1400	98·4	2,300	161·7	5	130	1	25	
5/16	8	0·52	14	0·57	15	1100	77·3	1,800	126·5	5½	140	1½	38	
3/8	10	0·60	16	0·65	17	1000	70·3	1,400	98·4	5½	140	1½	38	
1/2	12	0·75	19	0·80	21	900	63·2	1,400	98·4	6	150	2	51	
5/8	16	0·88	23	0·93	24	700	49·2	1,200	84·3	7	180	2	51	Metal
3/4	20	1·07	27	1·14	29	700	49·2	1,100	77·3	8	200	2¾	70	tag giving
1	25	1·31	33	1·38	35	600	42·1	900	63·2	9	230	3½	89	part
1¼	32	1·57	40	1·63	42	450	31·6	700	49·2	11	280	5	125	number
1½	40	1·90	48	1·96	50	350	24·6	550	38·6	14	350	6	152	
2	50	2·42	62	2·51	64	220	15·4	350	24·6	17	430	7	178	
2½	65	3	76	3·10	79	150	10·5	200	14·06	19	480	9	230	
3	75	3·53	90	3·63	92	70	4·9	150	10·5	22	560	10	254	
3½	900	4·1	105	4·2	107	50	3·5	85	5·9	23	590	12	305	
4	100	4·6	117	4·7	120	50	3·5	85	5·9	24	610	14	356	
5	125	5·6	143	5·7	145	50	3·5	75	5·2			16	406	
6	150	6·6	168	6·7	171	40	2·8	60	4·2			18	457	

Note... For test pressures, increase maximum working pressure by 50 per cent.

Installation data

31. Table 4 gives details of the Type FHM installation data, for installation techniques, see paras. 7 - 12.

FHM end fittings

32. FHM end fittings are attached by butt silver brazing or by shielded arc welding. Silver braiding utilises a short sleeve or braid ring and bonds the hose , the braiding and the end connection into a strong integral pressure tight seal. The various types of end fittings are shown in fig.13 to 20.

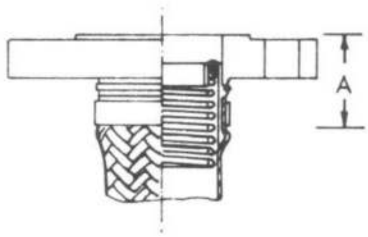


Fig.13 Fixed flange - silver brazed FHM

Series 310 - Fixed Flange - Copper Alloy or Series 330 - Fixed Flange- Carbon Steel- Silver Brazed (fig.13)

Internal diameter	mm	12	20	25	32	40	50	65	75	100	125	150
(nominal)	in	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
Length 'A'	mm	45	50	54	60	70	70	73	76	76	76	76
approximately	in	$1\frac{3}{4}$	2	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3	3	3	3

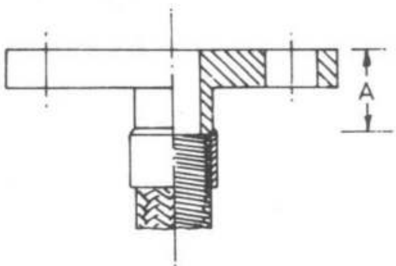


Fig.14 Fixed flange stainless steel welded (FHM)

Series 320 - Fixed Flange - Stainless Steel - Welded (fig.14)

Internal diameter	mm	25	32	40	50	65	75	100	125	150
(nominal)	in	1	1¼	1½	2	2½	3	4	5	6
Length 'A'	mm	50	50	50	54	67	60	70	79	79
approximately	in	2	2	2	2⅛	2¼	2⅜	2¾	3⅛	3⅛

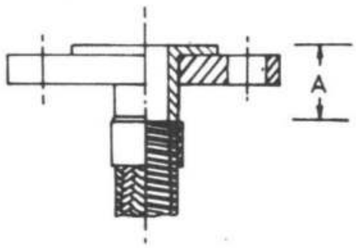


Fig.15 Swivel flange silver brazed (FHM)

Series 480 - Swivel Flange (Carbon Steel - Silver Brazed) or Series 460 Copper Alloy-Silver Brazed - (fig.15)

Internal diameter	mm	12	20	25	32	40	50	65	75	100	125	150
(nominal)	in	½	¾	1	1¼	1½	2	2½	3	4	5	6
Length 'A'	mm	48	54	57	60	70	70	73	76	76	76	76
approximately	in	1⅜	2⅛	2¼	2⅜	2¾	2¾	2⅞	3	3	3	3

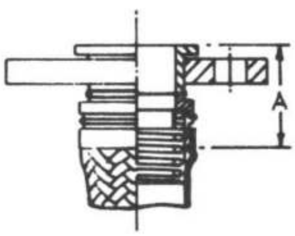


Fig.16 Swivel flange - stainless steel welded

Series 470 - Swivel Flange - Stainless Steel - Welded - (fig.16)

Internal diameter	mm	25	32	40	50	65	75	100	125	150
(nominal)	in	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	4	5	6
Length 'A'	mm	50	50	50	54	57	60	70	79	79
approximately	in	2	2	2	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{3}{4}$	$3\frac{1}{8}$	$3\frac{1}{8}$

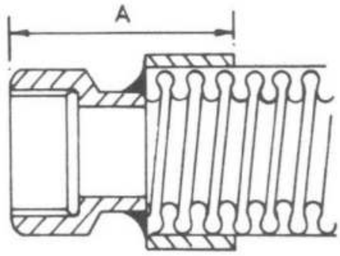


Fig.17 Fixed thread (FHM) copper alloy

Series 610 - Fixed Thread - Copper Alloy - Silver Brazed (fig.17)

Internal diameter	mm	6	10	12	20	25	32	40	50	65	75
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	40	44	48	58	66	66	80	86	90	90
approximately	in	$1\frac{9}{16}$	$1\frac{11}{16}$	$1\frac{7}{8}$	$2\frac{5}{16}$	$2\frac{5}{8}$	$2\frac{5}{8}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{1}{2}$
Maximum across	mm	16	18	24	28	36	47	52	66	76	90
flats	in	0·60	0·71	0·92	1·10	1·39	1·86	2·05	2·57	3·00	3·54

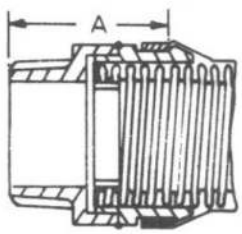


Fig.18 Fixed thread (FHM) stainless steel

Series 620 - Fixed Thread - Stainless Steel - Welded - (fig.18)

Internal diameter (nominal)	mm	25	32	40	50	65	75
	in	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A' approximately	mm	66	66	80	86	90	90
	in	$2\frac{5}{8}$	$2\frac{3}{8}$	$3\frac{1}{8}$	$3\frac{3}{8}$	$3\frac{1}{2}$	$3\frac{1}{2}$
Maximum across flats	mm	36	47	52	66	76	90
	in	1·39	1·86	2·05	2·57	3·00	3·54

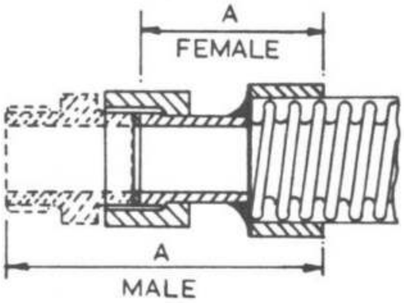


Fig.19 Swivel thread copper alloy (FHM)

Series 620 - Swivel Thread - Copper Alloy - Silver Brazed - (fig.19)

Internal diameter (nominal)	mm	6	10	12	20	25	32	40	50	65	75
	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A' approx- female	mm	38	40	40	57	60	65	83	87	95	95
	in	$1\frac{1}{2}$	$1\frac{9}{16}$	$1\frac{9}{16}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{9}{16}$	$3\frac{1}{4}$	$3\frac{7}{16}$	$3\frac{3}{4}$	$3\frac{3}{4}$
Length 'A' approx - male	mm	57	64	64	86	95	103	127	141	146	146
	in	$2\frac{1}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{3}{8}$	$3\frac{3}{4}$	$4\frac{1}{16}$	5	$5\frac{9}{16}$	$5\frac{3}{4}$	$5\frac{3}{4}$
Maximum across flats	mm	18	21	26	31	40	48	56	67	85	96
	in	0·71	0·82	1·01	1·20	1·57	1·86	2·22	2·62	3·34	3·75

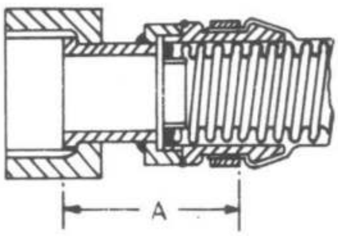


Fig.20 Swivel thread - stainless steel (FHM)

Series 680 - Swivel Thread - Stainless Steel - Welded - (fig.20)

Internal diameter	mm	25	32	40	50	65	75
(nominal)	in	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	60	65	83	87	95	95
approximately	in	$2\frac{3}{8}$	$2\frac{9}{16}$	$3\frac{1}{4}$	$3\frac{7}{16}$	$3\frac{3}{4}$	$3\frac{3}{4}$
Maximum across	mm	40	48	56	67	85	96
flats	in	1·57	1·86	2·22	2·62	3·34	3·75

Identification

33. As all types of this hose are fire resistant, no coloured identification lines are marked on the assemblies. A metal tag or strip is attached to the assembly giving the the part number and date of manufacture.

METALFLEX TYPE MHF (STEEL) HOSE ASSEMBLIES

Purpose and description

34. The Metalflex Type MHF is a range of metallic hose assemblies used for conveying all kinds of fluids at pressure and elevated temperatures in applications where constant regular flexible movement is expected. The maximum temperature at which the assemblies will function to full performance capacbility is 300 deg C (572 deg F).

35. The hose is of all metal construction as shown in fig.21 and consists of a helical carbon steel corrugated tubing formed from longitudinally butt welded tube. It can be supplied with wire braid armouring in one or two layers. Standard braiding is of galvanised steel, optional braiding is available in stainless steel or phosphor bronze.

Installation data

36. Table 5 gives details of the type MHF installation data, for installation techniques see paras. 7 - 12.

TABLE 5

Installation data for Metalflex type MHF assemblies

INTERNAL DIAMETER		EXTERNAL DIAMETER Single Braid (C1)		EXTERNAL DIAMETER Double Braid		MAXIMUM WORKING PRESSURE Single Braid		MAXIMUM WORKING PRESSURE Double Braid		MINIMUM BEND RADIUS Constant Movement		MINIMUM BEND RADIUS Pre-set for static pipework		IDENTIFICATION
in	mm	in	mm	in	mm	lbf/in²	kgf/cm²	lbf/in²	kgf/cm²	in	mm	in	mm	
$\frac{3}{4}$	20	$1\frac{15}{32}$	37	$1\frac{17}{32}$	40	400	28·1	500	35·1	12	305	3	76	
1	25	$1\frac{11}{16}$	43	$1\frac{3}{4}$	45	375	26·2	450	31·6	16	406	4	102	Metal tag
$1\frac{1}{4}$	32	$2\frac{1}{16}$	52	$2\frac{1}{8}$	54	350	24·6	450	31·6	19	483	5	127	giving
$1\frac{1}{2}$	40	$2\frac{1}{2}$	64	$2\frac{9}{16}$	65	300	21	400	28·1	23	584	$6\frac{1}{2}$	165	part number
2	50	$2\frac{31}{32}$	75	$3\frac{3}{32}$	79	200	14·06	300	21	42	1070	$7\frac{1}{2}$	190	etc.
$2\frac{1}{2}$	65	$3\frac{5}{8}$	93	$3\frac{3}{4}$	95	225	8·78	200	14·06			9	230	
3	75	$4\frac{1}{8}$	105	$4\frac{1}{4}$	108	80	5·62	100	7·03			12	305	

Note...

(1) **MHF-C1 Single Braid**

MHF-C2 Double Braid

(2) **For test pressures increase maximum working pressure by 50 per cent.**

MHF end fittings

37. MHF end fittings are attached by butt welding to a short steel sleeve which, in turn, is butt welded to the tubing, braiding being subsequently strapped to the sleeve. The various types of end fittings are shown in figs. 22 to 25.

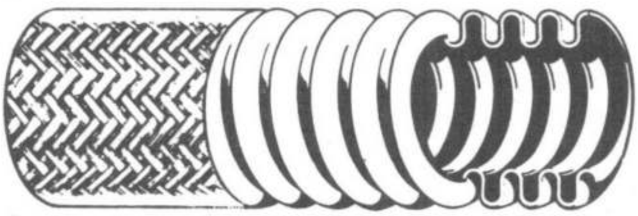


Fig. 21 Sectional view of Metalflex type MHF

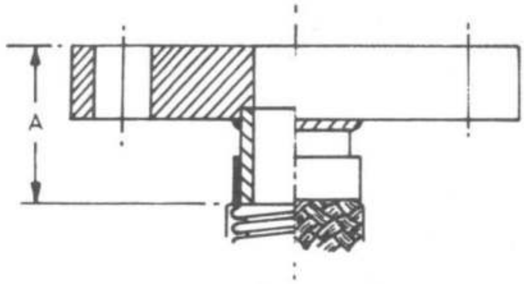


Fig. 22 Fixed flange MHF

Series 300 - Fixed Flange - Carbon Steel (MHF) - (fig. 22)

Internal diameter	mm	20	25	32	40	50	65	75
(nominal)	in	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	38	41	54	57	60	62	68
approximately	in	$1\frac{1}{2}$	$1\frac{5}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{7}{16}$	$2\frac{11}{16}$

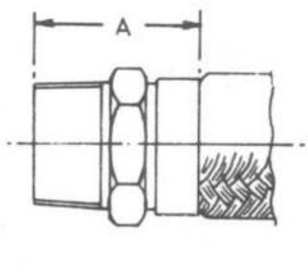


Fig. 23 Fixed thread (male) MHF

Series 600 - Fixed Thread (male) - Carbon Steel (MHF) - (fig.23)

Internal diameter	mm	20	25	32	40	50	65	75
(nominal)	in	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	51	60	67	68	71	84	104
approximately	in	2	$2\frac{3}{8}$	$2\frac{5}{8}$	$2\frac{11}{16}$	$2\frac{13}{16}$	$3\frac{15}{16}$	$4\frac{1}{8}$
Maximum across	mm	28	35	47	52	66	80	93
flats	in	$1\frac{3}{32}$	$1\frac{25}{64}$	$1\frac{55}{64}$	$2\frac{1}{8}$	$2\frac{19}{32}$	$3\frac{5}{32}$	$3\frac{5}{8}$

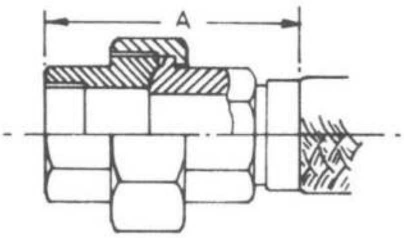


Fig.24 Swivel thread MHF

Series 660 - Swivel Thread - Carbon Steel (MHF) (fig.24)

Internal diameter	mm	20	25	32	40	60	65	75
(nominal)	in	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	94	105	127	137	152	165	181
approximately	in	$3\frac{11}{16}$	$4\frac{1}{8}$	5	$5\frac{3}{8}$	6	$6\frac{1}{2}$	$7\frac{1}{8}$
Maximum across	mm	51	60	70	83	95	124	140
flats	in	2	$2\frac{3}{8}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$	$4\frac{7}{8}$	$5\frac{1}{2}$

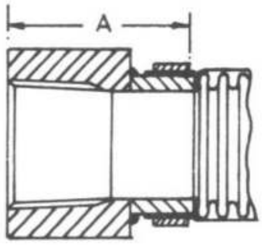


Fig.25 Fixed thread (female) MHF

Series 860 - Fixed Thread (Female) - Carbon Steel (MHF) (Fig.25)

Internal diameter (nominal)	mm	20	25	32	40	50	65	75
	in	3/4	1	1 1/4	1 1/2	2	2 1/2	3
Length 'A' approximately	mm	51	60	67	68	71	84	104
	in	2	2 3/8	2 5/8	2 11/16	2 13/16	3 15/16	4 1/8
Maximum across flats	mm	31	43	48	56	67	85	96
	in	1·20	1·67	1·86	2·22	2·63	3·34	3·75

Identification

38. All types of this hose are fire resistant, no coloured identification lines are marked on the assemblies. A metal tag or strip is attached to the assembly giving the part no. and date of manufacture.

METALFLEX TYPE MHB (BRONZE) HOSE ASSEMBLIES

Purpose and description

39. This range of assemblies is similar to the type MHF (see paras. 30 - 31). The differences are listed below:-

Material	-	phosphor bronze alloy
Braiding	-	phosphor bronze, optional braiding in galvanised or stainless steel
Working temperature	-	200 deg C (392 deg F)

Installation data

40. Table 6 gives details of the Type MHB installation data, for installation techniques, see paras 7 - 12.

MHB end fittings

41. MHB end fittings are attached by silver brazing with a short copper sleeve or braid ring which bonds the tubing, braiding and end connection into a strong pressure and temperature tight seal. The various types of end fittings are shown in figs.26 to 30.

Series 310 - Fixed Flange - Copper Alloy or Series 330 - Carbon Steel - (fig.26)

Internal diameter (nominal)	mm	12	20	25	32	40	50	65	75
	in	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
Length 'A' approximately	mm	45	50	54	60	68	70	73	75
	in	1 3/4	2	2 1/8	2 3/8	2 11/16	2 3/4	2 7/8	3

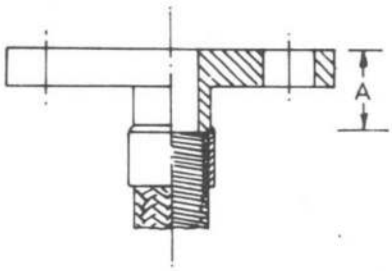


Fig. 26 Fixed flange (MHB)

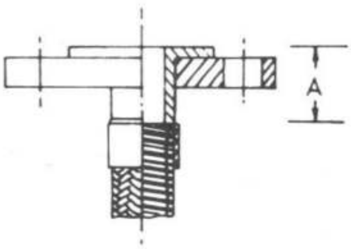


Fig. 27 Swivel flange (MHB)

Series 480 - Swivel Flange - Carbon Steel or Series 460 - Copper Alloy (fig. 27)

Internal diameter	mm	12	20	25	32	40	50	65	75
(nominal)	in	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3
Length 'A'	mm	48	54	57	60	70	70	73	76
approximately	in	$1\frac{7}{8}$	$2\frac{1}{8}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{3}{4}$	$2\frac{7}{8}$	3

TABLE 6

Installation data for Metalflex type MHB assemblies

INTERNAL DIAMETER		EXTERNAL DIAMETER Single Braid		EXTERNAL DIAMETER Double Braid		MAXIMUM WORKING PRESSURE Single Braid		MAXIMUM WORKING PRESSURE Double Braid		MINIMUM BEND RADIUS Constant Movement		MINIMUM BEND RADIUS Pre-set for static pipework		IDENTIFICATION
in	mm	in	mm	in	mm	lbf/in^2	kgf/cm^2	lbf/in^2	kgf/cm^2	in	mm	in	mm	
1/4	6	17/32	14	19/32	15	500	35·1	800	56·2	6	150	1	25	
3/8	10	3/4	20	13/16	21	400	28·1	600	42·1	7	175	2	56	
1/2	12	7/8	22	15/16	24	400	28·1	500	35·1	8	200	2	50	Metal tag
3/4	20	1 11/16	34	1 13/32	36	300	21	400	28·1	10	250	2 1/2	65	giving
1	25	1 11/16	43	1 3/4	45	200	14·06	300	21	10 1/2	265	3 1/2	90	part number
1 1/4	32	2 1/64	52	2 5/64	54	200	14·06	300	21	11	280	4	100	etc.
1 1/2	40	2 27/64	62	2 1/2	64	150	10·05	250	17·5	12	300	4 1/2	115	
2	50	3 1/32	77	3 5/32	80	150	10·6	200	14·06	21	535	5 1/2	140	
2 1/2	65	3 5/8	93	3 3/4	95	100	7·03	160	10·5	24	600	6	150	
3	75	4 1/8	105	4 1/4	108	80	5·62	140	9·84	27	680	6 1/2	165	

Note...

(1) MHB - C1 Single Braid
MHB - C2 Double Braid

(2) For test pressures increase maximum working pressure by 50 per cent.

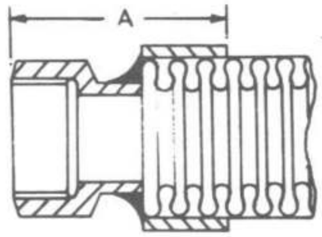


Fig.28 Fixed thread MHB

Series 610 - Fixed Thread - Copper Alloy (MHB) (fig.28)									
Internal diameter (nominal)	mm	6	10	12	20	25	32	40	50
	in	¼	⅜	½	¾	1	1¼	1½	2
Length 'A' approximately	mm	32	35	37	48	53	58	70	71
	in	1¼	1⅜	1 7/16	1⅞	2 1/16	2¼	2¾	2 13/16
Maximum across flats	mm	18	21	26	31	40	48	56	67
	in	0·71	0·82	1·01	1·20	1·57	1·86	2·22	2·62

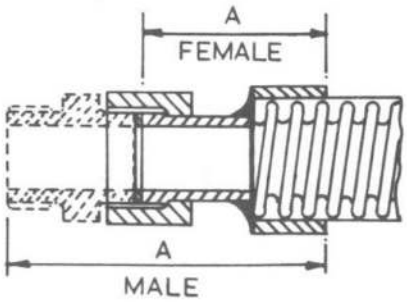


Fig.29 Swivel thread - copper alloy MHB

Series 670 - Swivel Thread - Copper Alloy (MHB) (fig.29)

Internal diameter (nominal)	mm	6	10	12	20	25	32	40	50
	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
Length 'A' approximately	mm	38	40	40	57	60	65	83	87
	in	$1\frac{1}{2}$	$1\frac{9}{16}$	$1\frac{9}{16}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{9}{16}$	$3\frac{1}{4}$	$3\frac{7}{16}$
Maximum across flats	mm	18	21	26	31	40	48	56	67
	in	0·71	0·82	1·01	1·20	1·57	1·86	2·22	2·62

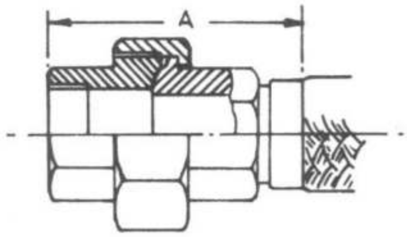


Fig.30 Swivel thread - malleable iron MHB

Series 710 - Swivel Thread - Malleable Iron (MHB) - (fig.30)

Internal diameter (nominal)	mm	6	10	12	20	25	32	40	50
	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$\frac{1}{8}$	2
Length 'A' approximately	mm	59	64	74	88	97	105	115	127
	in	$2\frac{5}{16}$	$2\frac{1}{2}$	$2\frac{7}{8}$	$3\frac{7}{16}$	$3\frac{13}{16}$	$4\frac{1}{8}$	$4\frac{1}{2}$	5
Maximum across flats	mm	31	37	43	51	61	70	83	96
	in	$1\frac{3}{16}$	$1\frac{7}{16}$	$1\frac{11}{16}$	2	$2\frac{3}{8}$	$2\frac{3}{4}$	$3\frac{1}{4}$	$3\frac{3}{4}$

Identification

42. As all types of this hose are fire resistant, no coloured identification lines are marked on the assemblies. A metal tag or strip is attached to the assembly giving the part number and date of manufacture.

JETFLEX TYPE MNM HOSE ASSEMBLIES

Purpose and description

43. The Type MNM Jetflex are a range of metallic hose assemblies used for conveying all kinds of fluids at high pressure and elevated temperatures in applications where constant regular flexing movement is expected. The maximum temperature at which the assemblies will function to full performance capability is 300 deg C (572 deg F).

44. The hose is of all metal construction as shown in fig.31, and consists of annulary corrugated austenitic titanium, stabilised stainless steel tubing formed from longitudinally butt welded rigid tube. It can be supplied with wire braid armouring in one or two layers. Standard braiding is stainless steel, optional braiding is available in galvanised steel or phosphor bronze.

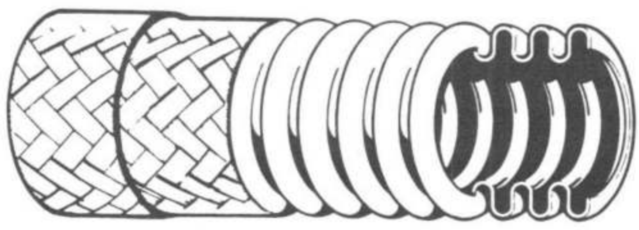


Fig.31 Sectional view of Jetflex type MNM

Installation data

45. Table 7 gives details of the type MNM installation data, for installation techniques, see paras. 7 - 12.

MNM end fittings

46. MNM end fittings are attached by shielded arc welding with a short sleeve or braid ring bonding the tubing, braiding and end connection into an integral pressure and temperature tight seal. Regular threaded connections have a flat seating and heavy duty swivel connections have a spherical seating nipple to mate with the 60 deg inclusive angle of the female cone. Details of the various types of end fitting are given in figs. 32 to 37.

TABLE 7

Installation data for Jetflex type MNM assemblies

INTERNAL DIAMETER		EXTERNAL DIAMETER Single Braid		EXTERNAL DIAMETER Double Braid		MAXIMUM WORKING PRESSURE Single Braid		MAXIMUM WORKING PRESSURE Double Braid		MINIMUM BEND RADIUS Constant Movement		MINIMUM BEND RADIUS Pre-set for static pipework		IDENTIFICATION
in	mm	in	mm	in	mm	lbf/in^2	kgf/cm^2	lbf/in^2	kgf/cm^2	in	mm	in	mm	
¼	6	0·50	12·7	0·55	14	2000	140·6	4000	281·2	8	200	1¾	45	
⅜	10	0·73	18·5	0·79	20·1	1500	305·4	3000	210·9	9	230	2¼	57	Metal tag
½	12	0·90	22·9	0·97	24·6	1500	105·4	3000	210·9	10½	270	2½	64	giving
¾	20	1·27	32·2	1·34	34	1000	70·3	2000	140·6	12	300	3	76	Part Number
1	25	1·54	39·1	1·63	41·4	750	52·7	1500	105·4	14	350	3½	90	

Note...

For test pressures increase maximum working pressure by 50 per cent.

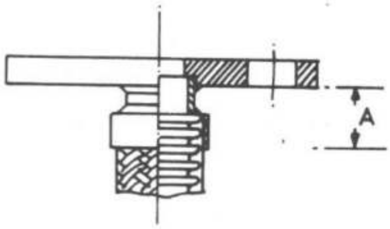


Fig.32 Fixed flange MNM

Series 330 - Fixed Flange - Carbon Steel or Series 340 - Stainless Steel - (fig.32)

Internal diameter	mm	12	20	25
(nominal)	in	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A'	mm	42	45	45
approximately	in	$1\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{3}{4}$

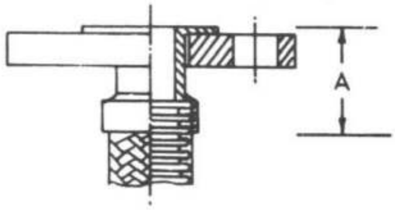


Fig.33 Swivel flange MNM

Series 480 - Swivel Flange - Carbon Steel or Series 490 - Stainless Steel (fig.33)

Internal diameter	mm	12	20	25
(nominal)	in	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A'	mm	45	45	48
approximately	in	$1\frac{3}{4}$	$1\frac{3}{4}$	$1\frac{7}{8}$

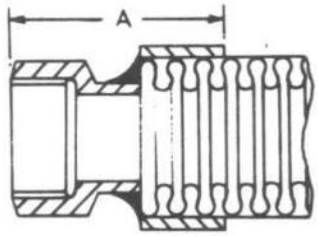


Fig.34 Series 630 and 640 fixed thread (MNM)

Series 630 - Fixed Thread - Carbon Steel - Max. pressure 70·3 kgf/cm^2 (1000 lbf/in^2) - (fig.34)

Internal diameter	mm	6	10	12	20	25
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A'	mm	40	45	50	51	56
approximately	in	$1\frac{9}{16}$	$1\frac{3}{4}$	$1\frac{15}{16}$	2	$2\frac{3}{16}$
Maximum diameter	mm	19	26	32	38	45
	in	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$

Series 640 - Fixed Thread - Carbon Steel - Heavy Duty - (fig.34)

Internal diameter	mm	6	10	12	20	25
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A'	mm	37	42	48	50	58
approximately	in	$1\frac{3}{16}$	$1\frac{5}{8}$	$1\frac{7}{8}$	$1\frac{15}{16}$	$2\frac{1}{4}$
Maximum across	mm	18	21	26	31	43
flats	in	0·71	0·82	1·01	1·20	1·67

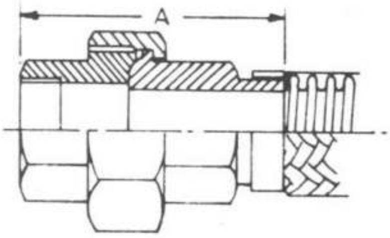


Fig.35 Series 690 swivel thread (MNM)

Series 690 - Swivel Thread - Carbon Steel - Max. pressure 70·3 kgf/cm^2 (1000 lbf/in^2) - (fig.35)

Internal diameter	mm	6	10	12	20	25
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A'	mm	59	64	74	88	97
approximately	in	$2\frac{5}{16}$	$2\frac{1}{2}$	$2\frac{7}{8}$	$3\frac{7}{16}$	$3\frac{13}{16}$
Maximum across	mm	31	34	43	48	57
flats	in	$1\frac{3}{16}$	$1\frac{5}{16}$	$1\frac{21}{32}$	$1\frac{7}{8}$	$2\frac{7}{32}$

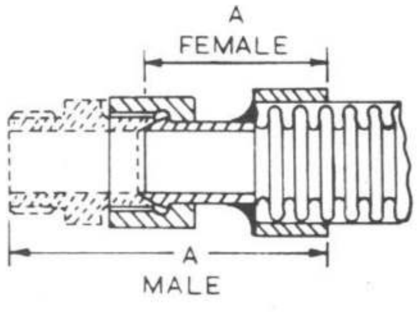


Fig.36 Series 880 and 700 (MNM)

Series 880 - Swivel Thread - Stainless Steel and Series 700 - Carbon Steel - Heavy Duty - (fig.36)

Internal diameter	mm	6	10	12	20	25
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A' approx.	mm	29	35	35	42	43
- Female	in	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{3}{8}$	$1\frac{5}{8}$	$1\frac{11}{16}$
Length 'A' approx.	mm	54	65	65	78	87
- Male	in	$2\frac{1}{8}$	$2\frac{9}{16}$	$2\frac{9}{16}$	$3\frac{1}{16}$	$3\frac{7}{16}$

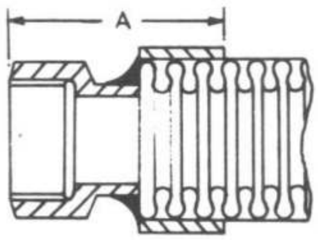


Fig.37 Series 870 fixed thread (MNM)

Series 870 - Fixed Thread - Stainless Steel - (fig.37)

Internal diameter (nominal)	mm	6	10	12	20	25
	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1
Length 'A' approximately	mm	37	42	48	50	58
	in	$1\frac{7}{16}$	$1\frac{5}{8}$	$1\frac{7}{8}$	$1\frac{15}{16}$	$2\frac{1}{4}$
Maximum across flats	mm	18	21	26	36	43
	in	0·71	0·82	1·01	1·20	1·67

Identification

47. As all types of this hose are fire resistant, no colour identification lines are marked on the assemblies. A metal tag or strip is attached to the assembly giving the part number and date of manufacture.

ANFLEX TYPES MNF HOSE ASSEMBLIES

Purpose and description

48. This range of assemblies is similar to the type MNM (see para.43). The differences are listed below:-

Material	-	Carbon Steel
Braiding	-	Galvanised steel, optional braiding is available in stainless steel or phosphor bronze.

Installation data

49. Table 8 gives details of the MNF installation data, for installation techniques, see para. 7 - 12.

MNF end fittings

50. MNF end fittings are attached by butt welding to a short steel sleeve which, in turn, is butt welded to the tubing, the braiding being subsequently strapped to the sleeve. The various types of end fittings are shown in figs.38 to 40.

TABLE 8

Installation data for Anflex type MNF assemblies

INTERNAL DIAMETER		EXTERNAL DIAMETER Single Braid		EXTERNAL DIAMETER Double Braid		MAXIMUM WORKING PRESSURE Single Braid		MAXIMUM WORKING PRESSURE Double Braid		MINIMUM BEND RADIUS Constant Movement		MINIMUM BEND RADIUS Pre-set for static pipework		IDENTIFICATION
in	mm	in	mm	in	mm	lbf/in^2	kgf/cm^2	lbf/in^2	kgf/cm^2	in	mm	in	mm	
¼	6		14		15	550	38·6	800	56·2	6	150	3	75	Metal tag giving part number
⅜	10		20		21	450	31·6	550	38·6	8	200	5	125	
½	12		23	1	25	400	28·1	500	35·1	9	225	6	150	

Note...

For test pressure increase maximum working pressure by 50 per cent.

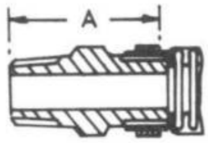


Fig.38 Fixed thread (male) MNF

Series 600 - Fixed thread (Male) - Carbon Steel - (fig.38)

Internal diameter	mm	6	10	12
(nominal)	in	¼	⅜	½
Length 'A'	mm	35	45	50
approximately	in	1⅜	1¾	2
Maximum across	mm	16	18	24
flats	in	0·60	0·71	0·92

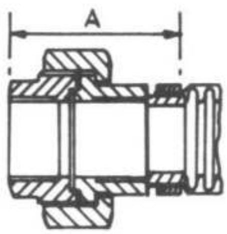


Fig.39 Swivel thread (MNF)

Series 660 - Swivel Thread - Carbon Steel (fig.39)

Internal diameter	mm	6	10	12
(nominal)	in	¼	⅜	½
Length 'A'	mm	52	57	63
approximately	in	2 1/16	2¼	2½
Maximum across	mm	32	37	43
flats	in	1¼	1 7/16	1 11/16

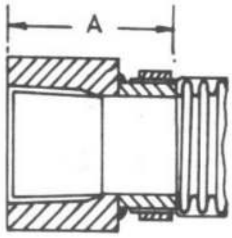


Fig.40 Fixed thread (female) MNF

Series 860 - Fixed Thread (Female) - Carbon Steel (fig.40)

Internal diameter	mm	6	10	12
(nominal)	in	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
Length 'A'	mm	40	44	48
approximately	in	$1\frac{9}{16}$	$1\frac{11}{16}$	$1\frac{7}{8}$
Maximum across	mm	16	18	24
flats	in	0·60	0·71	0·92

Identification

51. As all types of this hose are fire resistant, no coloured identification lines are marked on the assemblies. A metal tag or strip is attached to the assembly giving the part number and date of manufacture.

HANDLING OF DEFECTIVE ASSEMBLIES

52. When returning defective assemblies, treat them as if they were serviceable and not as scrap, as typified by the example shown in fig.41, where a severe pull-away of the tube from the coupling has been caused; such damage may obscure the original reason for rejection.

Note...

It is strongly recommended that assemblies which have been involved in an engine or service failure, should be scrapped as contamination by foreign matter or the imposition of some undue strain may have been induced.

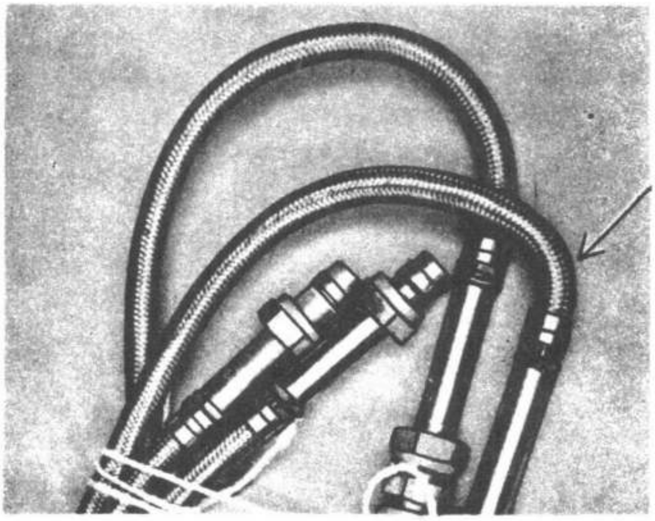


Fig. 41 Permanent damage to tube at position indicated, caused by mishandling

PSG/22699/940060/350/OCT.73/1731