TUNGUM

DESIGN AND WORKSHOP GUIDE FOR ALLOY TUBING

- An introduction to Tungum Alloy
- System Design and Layout
- How to choose tube sizes
- Design and Workshop Do's and Don'ts
- Cutting, bending and fitting tube
- Mechanical Couplings on Tubing
- Silver soldering Tungum Alloy

TUNGUM ALLOY TUBING

INTRODUCTION

The integrity of a hard-piped hydraulic or pneumatic circuit is of vital importance. Too often, the lay-out of pipe-runs is an afterthought, jeopardising the leak-proof capability and component access of the system.

This guide has been produced to help overcome potential pitfalls and enable the engineer to produce a reliable, maintenance-free system. The high strength, corrosion resistance and durable characteristics of TUNGUM Alloy Tubing contributes greatly towards achieving these standards.

TUNGUM ALLOY

TUNGUM ALLOY is a specialist material that, when used correctly, will produce outstanding results in rigorous applications.

- High strength-to-weight ratio
- Excellent corrosion resistance, ductility and fatigue resistance properties
- Non-magnetic and non-sparking properties
- Excellent cryogenic characteristics
- The ability to be precipitation hardened, enabling its physical properties to be increased or decreased to suit the application.

When used in high pressure hydraulic or pneumatic circuits, these features, together with inherent 'clean bore' characteristics, combine in affording an easily constructed, high integrity system, requiring a minimum of purging and no external protective treatment.

CONTENTS

SPECIFICATIONS AND APPROVALS

All Tungum Alloy Tubes consist of basically the same chemical composition (Table 1) but are manufactured to meet the demands of various specifications.

The following standards refer to Tungum Alloy Tubing:

- HOUSE SPECIFICATION TCL100 'Tungum tubing for general use' exceeds the minimum requirements of BS2871 part 2 (CZ127). The specification is available in three ratings:
  TCL100A: Eddy Current. Tested-Standard Specification
  TCL100B: tested to 310 BAR (4500psi)
  TCL100C: tested to 465 BAR (6750 psi)

NOTE: The above are pre-delivery test pressure levels. They do not determine the working pressure capability of any given tube size.

- BRITISH STANDARDS 1306, (2871 Part 2), 12449 CW 700R. Metric-Identified as ALLOY CZ.127
- AMERICAN STANDARD A.S.T.M B706-00. Identified as Copper Alloy UNS C69100
- FRENCH NATIONAL STANDARD UZ.15.NS.
- MINISTRY OF DEFENCE SPECIFICATIONS:
  Aviation: DTD.5019 (for high pressure systems)
  DTD.253A (for low pressure systems)
  Navy: NES.749 part 3
  Army: AFS.4000

Table 1. CHEMICAL COMPOSITION

	Per cent	
Element	**Min**	**Max**
Copper	81.00	86.00
Aluminium	0.70	1.20
Nickel	0.80	1.40
Silicon	0.80	1.30
Iron		0.25
Lead		0.05
Tin		0.10
Manganese		0.10
Total other impurities		0.50
Zinc	The remainder	

Table 2. AVERAGE PHYSICAL PROPERTIES OF TUNGUM ALLOY TO SPECIFICATION TCL100

Min.Ultimate Tensile Strength:	430N/mm^2 (27.84 tons per sq in)
Minimum 0.2% Proof Stress:	223N/mm^2 (14.42 tons per sq in)
*Design Stress, 4:1 safety factor:	105N/mm^2 (6.8 tons per sq in)
Hardness:	140VH5 Max.
Elongation (Average):	45 per cent
Magnetic Permeability:	1.0015 max.
Temperature coefficient:	0.000748 per °C
Weight:	8.52 x 10^{-6} Kg/mm^3 (0.308lb per cu in)

**As allowed by BS:1306, 1975*

More information on Tungum Alloy Tubing is available on request.

THE DESIGN STAGE

Careful consideration is required if you are to realise the full potential of high strength tubing such as TUNGUM alloy. The choice of material and layout of pipe runs should be considered at the earliest possible stage and not as an afterthought.

Here is a designers guide for ensuring cost-effective and efficient hard-piped systems:

a) Establish Operating Parameters

- Operating Environment
- Intended life/required long term system cleanliness
- Required reliability and ease of maintenance, including access to valves, etc
- Type of system – liquid or gas

b) Select the required tube section by establishing;

- The material standard, type and grade
- The wall thickness and outside diameter
- The o/d tolerance and surface finish
- The hardness and heat treatment conditions
- The material traceability and test condition

The superior strength of Tungum Alloy allows the wall of the tubing to be thinner. This means that the overall diameter can be smaller giving many benefits for the user:

- **Cost effective** use of tubing with easier manipulation and fabrication
- **Simplified handling** during construction
- **Savings** through the use of smaller couplings and clamps
- **Smaller, neater,** more compact systems

Remember also that corrosion resistant tubes like TUNGUM make painting unnecessary and shorten system-commissioning duration through lower flushing times.

DEFINITIONS

Working Pressure: The maximum pressure at which the system operates in a given application

Test Pressure: Usually the pressure to which a system is submitted prior to commissioning, generally 1.5 x working pressure for hydraulic systems, sometimes 2 x working pressure for pneumatic circuits, but always less than 'Proof' pressure (see below)

Proof Pressure: The pressure at which permanent plastic deformation occurs. In tubing it is the point where irreversible increase in diameter occurs

Relief Valve Pressure: The pressure a which a system's relief (or safety) valve is set, often about 10% above the system working pressure

Burst Pressure: The pressure, at which fracture occurs resulting in loss of fluid or gas

Operating Temperature: The temperature of the system, usually in its normal working condition

Safety Factor: Usually considered to be the relationship between the working pressure and the burst pressure, generally 4:1 for copper-based alloys, including Tungum; 3;1 minimum for steels

TUBE BORE SIZE FOR HYDRAULIC CIRCUITS

The following nomograph (Fig.1) shows the relationship between flow, tube bore and flow velocity. For example, line up the FLOW RATE on the left hand column and the desired FLOW VELOCITY on the right hand to give the approximate TUBE BORE SIZE in the centre.

This nomograph does not allow for energy loss due to surface friction, changes in flow area and direction. The adoption of TUNGUM Alloy tubing will minimise friction losses due to the material's inherently clean and smooth bore. There are more accurate methods of calculating tube bore, e.g., the 'equivalent length' method.

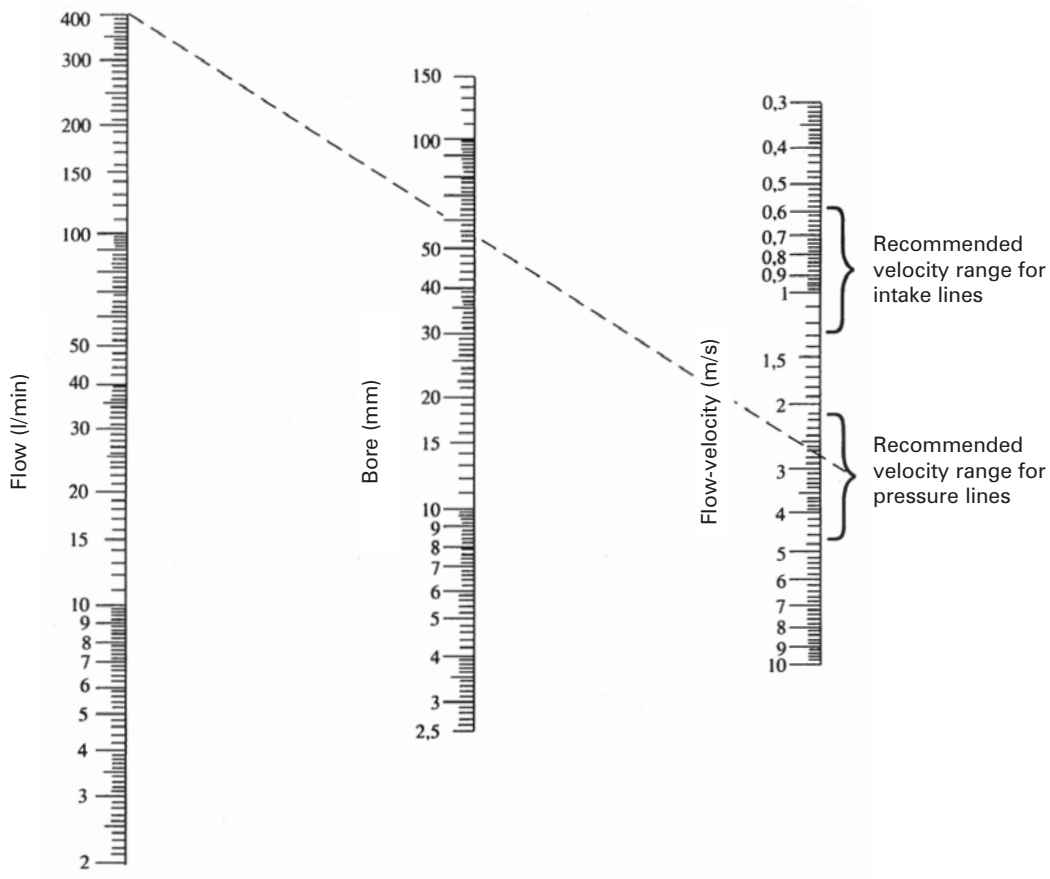


Fig 1.

CALCULATING TUBE WALL THICKNESS

A number of formulae can be employed for calculating the wall thickness of tubes to withstand internal pressure.

Barlow's Formula

$$P = \frac{20 \times S \times t}{D} \quad \text{or} \quad t = \frac{P \times D}{20 \times S}$$

Lame's Formula

$$P = \frac{10S\,(R^2 - r^2)}{(R^2 + r^2)} \qquad R = \frac{r\,(10S + P)}{(20s - P)}$$

P	Internal Pressure	bar
S	Permissible Stress	N/mm²
t	Wall Thickness	mm
D	Outside Diameter	mm
d	Inside Diameter	mm
R	Outside Radius	mm
r	Inside Radius	mm

Lame's formula is considered more accurate for thick wall tubes where high pressures are used.

For Copper and Copper Alloy (including TUNGUM) high pressure tubes, BS1306 1975 modifies the Barlow formula and defines permissible design stresses for various copper alloys:

$$t = \frac{P \times D}{P + 20S} \quad \text{or} \quad P = \frac{20S \times t}{D - t}$$

Where S=Permissible design stress but equates to 0.25 x Minimum U.T.S. – N/mm²

Note: Where rigid tube is to be bent, a reduction in permissible stress of 12.5% should be made. In addition, the above formula does not consider manufacturing tolerances (usually 10%) or corrosion allowances.

When sizing TUNGUM Alloy Tubing from our main catalogue, the working pressure rating of each size can be obtained by dividing the stated 'minimum theoretical burst pressure' by 4, i.e. the tube 'operates at a 4;1 safety factor to burst'. This is in accordance with British Standards practice for copper-based alloy tubes.

LAYOUT AND SHIELDING

Tube runs should have adequate protection against accidental damage. Tubing should never be a stressed component in a structure. Oxygen lines should not be routed near hydraulic equipment or flammable substances.

CLAMPING

Design a clamping arrangement into the system which will not crush, flatten or allow vibration to wear away the tube at the clamp. Use clamps, which are 'kind' to the tubing. Do not attach hard piping directly to vibrating or flexibly mounted equipment. Adequately support 'in line' accessories, e.g., valves, filters etc.

Typical clamping distances are as follows:

Table 3

Tube O/D size	inches mm	1/8 – 5/16 3 – 8	3/8-3/4 10-20	1-2 25-50
Clamping Distance	inches mm	20 30 500-750	30-45 750-1150	45-70 1150-1800

Shorten distances where excessive vibration exists.

Good clamping practice reduces vibrational pick-up at concentrated stress areas in couplings.

JOINTS AND CONNECTORS

It is imperative that the chosen couplings suit the intended application in all respects. Manufacturers' catalogues and data sheets should be consulted, with any doubt being resolved by direct contact with the maker's representative. Both the mechanical suitability and material compatibility of the couplings to the tube must be satisfactorily resolved at the design stage.

The various types of commonly used connectors are discussed in the 'Workshop Practice' section of this brochure.

CONNECTOR LAYOUT

Study the circuit diagram and equipment to be inter-connected with the aim of using the least number of connectors possible and maintaining component accessibility, .

Determine the pipe terminal points and from these decide the best pipe route.

Consider other pipe routes at the same time and avoid likely vibration points in each route. Group up pipe runs in multiples for neat appearance, to save space and enable combination pipe clamping.

Stagger joints for spanner access.

Eliminate elbow joints wherever possible by bending tubing and aim to use the same bend radius throughout the system.

THE ‘DO’S FOR COST-EFFECTIVENESS AND INTEGRITY

At the design stage

- ✓ Think about Pipe Runs throughout the Design Stage
- ✓ Use bends generously and connectors only where unavoidable
- ✓ Design Pipe Runs with the same radius for each bend
- ✓ Ensure inline equipment is adequately supported on the main structure
- ✓ Ensure Pipe Runs give easy maintenance access to equipment
- ✓ Arrange for adequate support of Pipe Runs
- ✓ Select pipe clamps with plastic liners, which are ‘kind’ to tube
- ✓ Select correct tube wall, sufficient for system pressure

During installation

- ✓ Maintain a clear workspace with tools conveniently to hand
- ✓ Use only the correct tubes for the job
- ✓ Understand the planned Pipe Runs and coupling instructions
- ✓ Ensure pipes fit the designed runs from point to point
- ✓ Leave adequate distances between bends
- ✓ Protect Pipe Runs
- ✓ Bend or flare tubing cold
- ✓ Ensure complete cleanliness, especially when soldering
- ✓ Adhere to couplings manufacturer’s instructions

THE 'DON'T'S WHICH WASTE TIME AND IMPAIR EFFICIENCY

- ✗ Consider Pipe Runs as an afterthought
- ✗ Use connectors for every change of Pipe Run direction
- ✗ Vary bend radii unless unavoidable
- ✗ Hang filters, valves or heavy objects on to pipework
- ✗ Have Pipe Runs interfering with valve operation, etc, or bury important equipment with Pipe Runs, or obscure pipes with other pipes
- ✗ Allow pipework to go unsupported or be susceptible to violent vibration
- ✗ Select sharp, unshaped, corrodible, loose-fitting, all-metal clamps which will wear into tubing
- ✗ Over pressurise tube during tests, or exceed 85%, of proof pressure of weakest tube in the system.
- ✗ Work in constricted and cluttered area
- ✗ Adapt worn and incorrect tools
- ✗ Learn about the job as work proceeds
- ✗ Strain, pull, stretch or twist into terminal connections or alter pipe runs after connectors have been tightened
- ✗ Arrange bends very close up together
- ✗ Use tubing as foot or hand holds
- ✗ Heat tubing to bend or flare (Particularly important to Tungum)
- ✗ Allow contaminants to impair workmanship
- ✗ Guess how to assemble couplings

CUTTING AND BENDING TUNGUM TUBING

At the outset, aim to carry out tube fabrication and erection in as clean conditions as possible, with quality tools in good condition, readily to hand. Cleanliness is the secret of achieving leak-proof joints.

Cutting Tungum Tubes

Use a saw, not a 'Tube cutter' and make sure the end is cut square to the tube axis, After cutting, deburr the tube internally and externally, and make sure all swarf is removed.

Various types of deburring tool are available but the simplest is the end of a triangular file. Uneven deburring could cause problems if the tube end is later to be flared or formed.

The Planning of Tube Bends

It is conventional to refer to the centre line radius (CLR), which is the radius of bend to the centre line of the tube. This radius is expressed as a multiple of the tube outside diameter (O/D). For ease of working, and to reduce turbulence, the radius should be as large as possible. Bends with a CLR of less than 3D should be avoided where possible.

If bends of less than 3D have to be made, then local stress relieving may be necessary.

Ovality

A round section tends to become oval during bending. Ovality on bends significantly reduces the fatigue life and effective bore size of a tube and should be controlled to acceptable limits, approx. 5% maximum.

Ovality can be reduced to a minimum by the correct use of mandrels during bending. The various types and use of mandrels will be found in the bending machine manufacturer's manual.

Ovality limits vary between 10% and 2% but 5% is a common standard. To achieve an adequate standard, always use correctly sized tools, formers and clamps.

Thinning of Bends

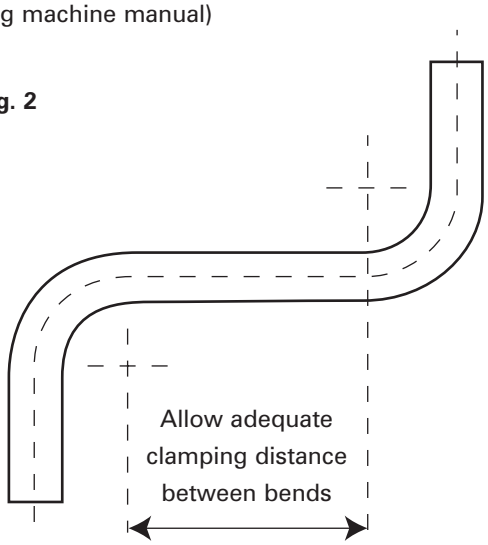
The other effect of bending a tube is to reduce the thickness of the wall on the outside of the bend. This effect should be allowed for when initially choosing the thickness of the tube to be employed.

A factor of '1.13 x the selected tube wall' is sufficient to cover thinning on bends having 3D radius or greater.

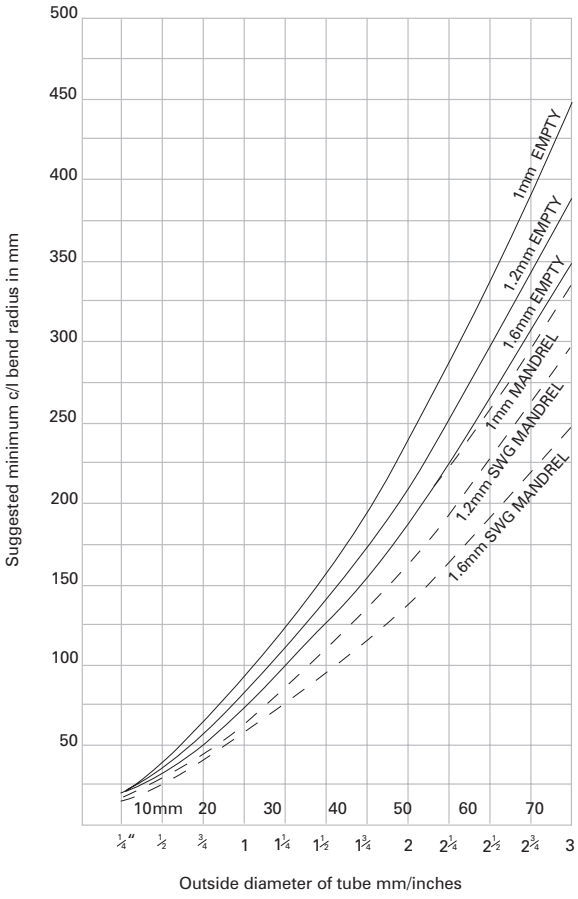
Spacing of Bends

Avoid compound bends. They are difficult to make and require extensive modifications to normal bending equipment. Sufficient space for clamping should be allowed between bends on the same pipe. (This is normally covered in the bending machine manual)

Fig. 2



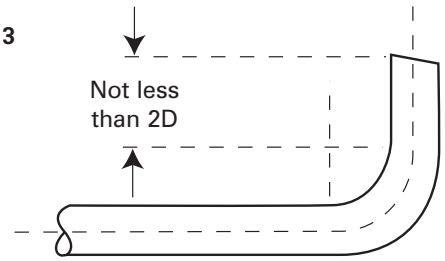
Minimum Bending Radii



The effect of Bending near the end of the tube

Bends near the end of the tube will tend to draw the face of the tube out of square. Sufficient length must be left so that the tube can be cut square.

Fig. 3



If the tube bend has to be fitted into a connector, ensure that there is sufficient straight to allow the tube to fit correctly into the connector. Check that the tube is round before assembling the connector.

Selection of Tooling

Always select formers, clamps, wipers and mandrels (where used) of the correct size for the tube being bent. Never use metric sized tooling on imperial sized tube and visa versa.

Maintaining Roundness

This is usually achieved by means of a mandrel. There are various types, the simplest being a straight bar with a radiused end matching the tube bore. A more sophisticated type has a chain of balls mounted flexibly at the end so that the tube roundness is maintained as the bend is being formed. This is also necessary for small radius bends.

Filling of Tubes

Before precision bending was widely available, it was common practice to fill large diameter, thin wall tubes with either a resin or low melting point alloy before bending. The idea was that the tube could then be treated like a solid bar and would deform only minimally around the bend.

It is extremely difficult however, to thoroughly clean the tubes after such filling. With modern hydraulic and gas systems requiring inherently clean tubing, this practice is not to be recommended.

Wrinkles on inside of bend

These are invariably due to incorrect setting of the bending machine. Refer to maker's instructions for corrective action.

Note
Do not heat TUNGUM Alloy Tubes before bending. If very tight bends have to be made, or the tube is to be subjected to considerable vibration, then it is recommended that it should be stress relieved by heating to 300ºC for 60 minutes, then allowed to cool gradually in air.

Types of Tube Bending Equipment

Here, we give only a general guide to the type of equipment available. In all cases, the bending machine manufacturer's instructions should be followed.

Compression and Press Benders are usually transportable and are therefore useful for onsite work or when short runs are required. Generally they do not produce such good or accurate bends as draw benders.

Draw benders vary from small hand operated machines to large power assisted apparatus, some with sophisticated CNC control. Draw benders are used mainly for precision and repetition bending work.

Type 1 - Basic Compression Bender

A wiper shoe wraps the tube around a stationary form die.

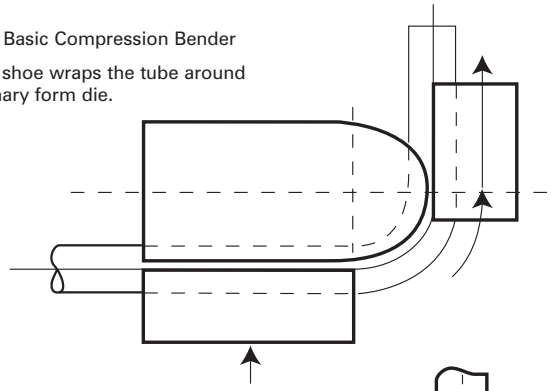
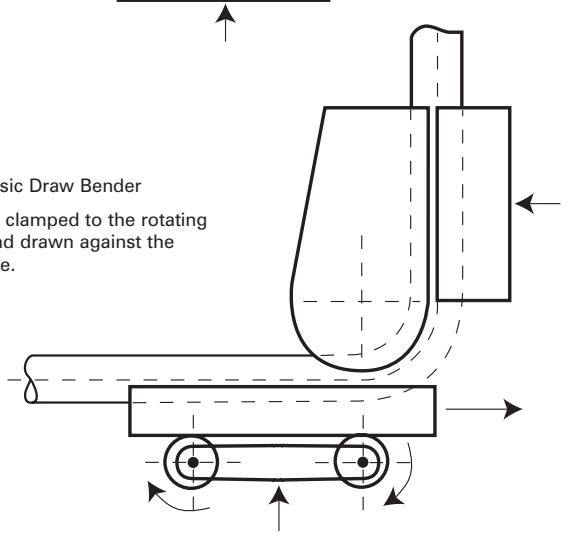


Fig. 4

Type 2 - Basic Draw Bender

The tube is clamped to the rotating form die and drawn against the pressure die.



Type 3 - Press Bender (not illustrated)

A simple bender in which a hydraulically actuated former pushes the tubing between two spaced rollers. Limited in its scope of work

SOLDERED/BRAZED JOINTS ON TUNGUM ALLOY TUBING

Silver Soldered Joints (Brazing)

It is assumed that the operator has some knowledge of silver soldering (brazing), in which case there should be no problems in using TUNGUM Alloy, provided simple precautions are taken.

The main points to be considered are:

Clearances between mating parts: These are the responsibility of the designer.

Cleanliness: In making joints in any metals, the parts must be clean, free from grease and oil and with all burrs removed.

Temperature: The optimum temperature is 650°C/700°C which should be applied for as short a time as it is necessary to make a good joint. The temperature may be judged roughly when the metal shows dull red in subdued daylight. For more accuracy, thermally sensitive crayons may be used.

If TUNGUM Alloy has been overheated, or the heat applied for an abnormally long period of time, it may result in some reduction in strength of the material. This should be taken into consideration at the design stage, in terms of the wall thickness required for the service.

Alternatively, it is a special feature of TUNGUM that original properties may be restored by a precipitation hardening treatment of a 'soak' at 475°C/525°C for one hour, followed by air cooling.

For operators wanting to gain experience in good technique, we can arrange one-day courses. Obviously, short periods of demonstration and practice are of much greater value than the written word.

Table 4 Clearance

Tube O/D	Up to 1/4" (6mm) dia.	Over 1/4" (6mm) dia. Up to 5/8" (16mm) dia.	Over 5/8" (16mm) dia.
Preferred clearances between the mating parts are:	.002"- .005" 0.05mm - 0.13mm	.004" - .006" 0.10mm - 0.15mm	.005" - .010" 0.13mm - 0.25mm

Brazing Materials

Use a good quality brazing alloy, to British Standard 1845; 1977 Grade 'AG1' (Melting Temperature: 620/630°C or Grade 'AG2' (Melting temperature: 608/617°C). In confined spaces, or, if preferred, a cadmium-free solder, typically Grade 'AG14' (Melting temperature: 630/660°C may be used.

IMPORTANT: use a solder, which enables the temperature of the metal to be kept below 700°C while the joint is being made.

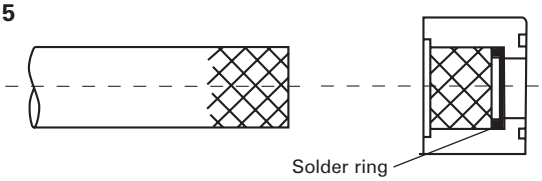
Method of Brazing

Thoroughly clean and deburr the end of the tube and the fitting, and remove all debris.

Mix to a thick paste 'Easyflo' (or equivalent) powder and water, or use a ready-mixed flux paste, applying it to the outside of the tube and the inside of the fitting.

Put a solder ring of appropriate size and thickness in the fitting (fig.5). Fit the fitting to the tube, and, if possible rotate it to distribute the flux evenly.

Fig. 5



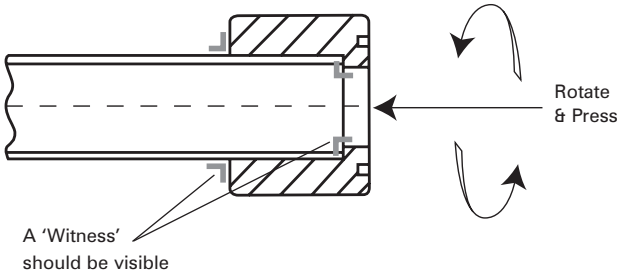
Apply heat by moving the flame round and heat the mass of the fitting rather than the tube.

As soon as the solder has melted, press the fitting onto the tube, ensuring that it makes contact with the step, and rotate it to spread the solder evenly (Fig.6).

At this stage, a witness of solder should appear, then remove the flame.

If it appears that there is insufficient solder, reheat and apply more from a stick.

Fig. 6



As soon as practical after brazing, the flux should be cleaned off. This may be done in various ways, the simplest being with hot water and a wire brush. Alternatively, sophisticated methods of machine cleaning and ultrasonics may be employed.

A good finished joint will show a witness of solder in a complete circle, on the end of the tube, inside the fitting and round the end of the fitting outside the tube.

MECHANICAL JOINTS ON TUNGUM ALLOY TUBING

There are three main categories of mechanical joint for tubing, as set out in BS4368, Parts 1 to 4. Other types, such as cryogenic shrinkable sleeves and, equally practicable, swage couplings (though not included) may be considered.

A good mechanical coupling should:

a) Allow pressure-tight joints to be made easily.

b) Not create undue stresses in the tube.

c) Not transmit torque to the tube during fitting.

d) Be capable of many pressure-tight reconnections.

e) Be able to withstand the same environment as the tube.

Coupling Material

Make sure that the coupling material is compatible both with the tube and with the environment in which it is to work. Couplings and tubes of significantly dissimilar metals may be subject to galvanic or crevice corrosion attack in certain environments. As parts of the coupling will also be in contact with the internal fluid, this compatibility should also be checked.

In cases where tightening the coupling nut is intended to swage or 'bite' the tube, care should be taken in selecting the fitting and its material of manufacture. Soft or inadequate fittings should not be used on Tungum tubing.

Selection of Coupling Type

Tungum Alloy tubing may be joined by several types of tube coupling but, obviously, some are better than others. The designer should check that the proposed coupling will meet the requirements of the system and that clear instructions are provided for correct assembly. Too often, leaking joints are the result of failure to employ the correct assembly procedure for the particular coupling being fitted. Correct assembly procedure is vital to the success of any system.

The following recommendations may supplement those made by the coupling manufacturer:

Preparing the Tube End

Saw the end of the tube squarely, (do not use tube cutter). Deburr and remove all swarf from the outside and within the bore. If a coupling with an 'O' ring seal is to be used, it is advisable to chamfer the outer edge of the tube to allow a lead in. Check that there are no scratches or deep draw marks in the '0' ring sealing area, which may give rise to leak paths or damage the '0' ring during assembly.

Assembly of Couplings

1. Follow the manufacturer's assembly instructions and check that the coupling is the correct size for the tube.
2. When using 'Bite' or 'Swage' type couplings, ensure that the metal sealing rings or ferrules are of a harder material than Tungum, and that they suit the fitting itself.
3. With couplings having one or more sealing rings or ferrules on the tube end, ensure that:
   a) none have been left out
   b) they are assembled in the correct order.
   c) They have not been positioned 'back to front'.

Tightening couplings

When tightening compression couplings, ensure that the high torque necessary for most types is not transmitted into the tube. The coupling body should be held firmly while the nut is being tightened.

The larger the coupling, the greater the torque required to tighten it. Make use of the aids marketed by some coupling manufacturers, e.g. the pre-swaging tools for the larger sizes of twin-ferrule fittings.

The Flaring or Belling of Tungum Alloy Tubing

Leaking joints with flared type couplings are usually due to incorrect tube preparation. TUNGUM Alloy is a ductile material and leak-proof joints can easily be made, providing the correct dies and probes are used, and the metal is formed as rapidly as possible.

The end-forming tool (Rotary or Percussion) should be in good condition and the correct size for the tube being worked. Correct tube end preparation (See 'Preparing the Tube End') is particularly important for this operation in which a tube cutter must not be used to trim the tube. The seal on a flared joint is made by an annular line contact. It is therefore important that the inside surface of the flare should be smooth.

Summary

The purpose of this manual is to show users that TUNGUM ALLOY TUBING is a straightforward and trouble-free material to deal with, provided that good engineering principles and common sense are used. It also emphasises that where other materials and manufacturers' parts are used, the appropriate instructions supplied with them should be followed.

Provided good engineering principles and common sense are applied, Tungum's special combination of high strength and ductility render it one of the easier materials to use on even the most complex system.

We have attempted to cover the most common situations likely to be encountered. In the event of any problems arising, our Design Engineers are always available to advise on specific matters.

Should you decide not to 'Do it Yourself', we would be most happy to receive your enquiries for anything from simple pipe manipulation through to complex complete installations from Tungum and/or other materials. A brief summary of our Quality Assured manufacturing capability is outlined overleaf.

TUNGUM ALLOY TUBING

THE COMPLETE PIPEWORK SERVICE

TUNGUM LIMITED has been active in the manufacture and supply of high quality pipework for over 70 years, supplying Tungum Alloy tube and fittings plus pipe manipulations and assemblies from all materials. The products are used in a wide range of safety critical applications in the high-pressure gas, medical, offshore oil, aircraft, railway, defence systems and nuclear power plants.

Tungum also have a division comprising personnel with extensive experience in the specialised field of installing high and low pressure distribution and control systems (both hydraulic and pneumatic). This division, backed up by the existing skills and manufacturing capabilities of the Tungum organisation enables the Company to offer a complete service of design, manufacture and where appropriate, on-site systems installation.

MANUFACTURING CAPABILITIES

Our manufacturing capability includes:

- Full range of CNC tube bending machines backed up by computerised non-contact measuring and checking equipment.
- Modern well-equipped machine shop including CNC vertical machining centres and a range of turning centres culminating in the very latest Nakumura Tome twin-spindle technology.
- Comprehensive assembly facilities including; brazing, silver soldering and most welding techniques. Third party approvals held.
- Oxygen cleaning facility for high pressure gas manifolds, control panels etc.
- Highly skilled, experienced and motivated workforce.

QUALITY ASSURED MANUFACTURE

Most of Tungum's products are used in safety critical applications, which necessitates the highest standards of quality assurance prior to, and at all stages of manufacture.

Tungum are registered to BS EN ISO 9001: 2000 with Lloyds Register Quality Assurance, (L.R.Q.A.)

The scope of approval under Certificate No.860743 is as follows:-

Design, manufacture and installation of high and low pressure hydraulic and pneumatic control and distribution systems. Manufacture of pipe assemblies, associated components and high pressure gas fittings. Procurement and stockholding of Tungum alloy tube, bar and forgings.

CUSTOMER APPROVALS INCLUDE:

- Air Products
- BOC
- BP
- Bombardier
- Kohler
- MOD
- National Power & Powergen
- Shell
- Spirax Sarco

For more information on any of our products and services please contact our Sales department on 01684 271290 or visit our website www.tungum.co.uk

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