Tungum®

INSTRUMENTATION TUBING

Design & Installation ISSUE 2013.1

TUNGUM TUBING DESIGN & INSTALLATION

Tungum Tubing: Design and Installation Introduction

Tungum's special combination of high strength and ductility render it one of the easier materials to use on even the most complex system.

The purpose of this section is to show users that Tungum 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. 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.

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Notes on installing Tungum Tubing pipework

Select the appropriate wall section for the pressure and service.

Design pipe runs to allow access and easy removal of important equipment.

Provide adequate and correctly placed supports; to ensure vibration is controlled to an acceptable level.

Select clamps which are 'kind' to the tube surface, but which grip it tightly.

Employ bends generously using the same radius throughout. Always allow adequate room for clamping between bends.

Ensure each pipe fits correctly without imposing additional loads on couplings/pipe joints.

Protect small diameter pipe runs against being used as ladders or hand hold.

Please note:
Tungum Tubing should not be used in the presence of Acetylene, Ammonia or Mercury.

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Tube Bore Size For Hydraulic Circuits

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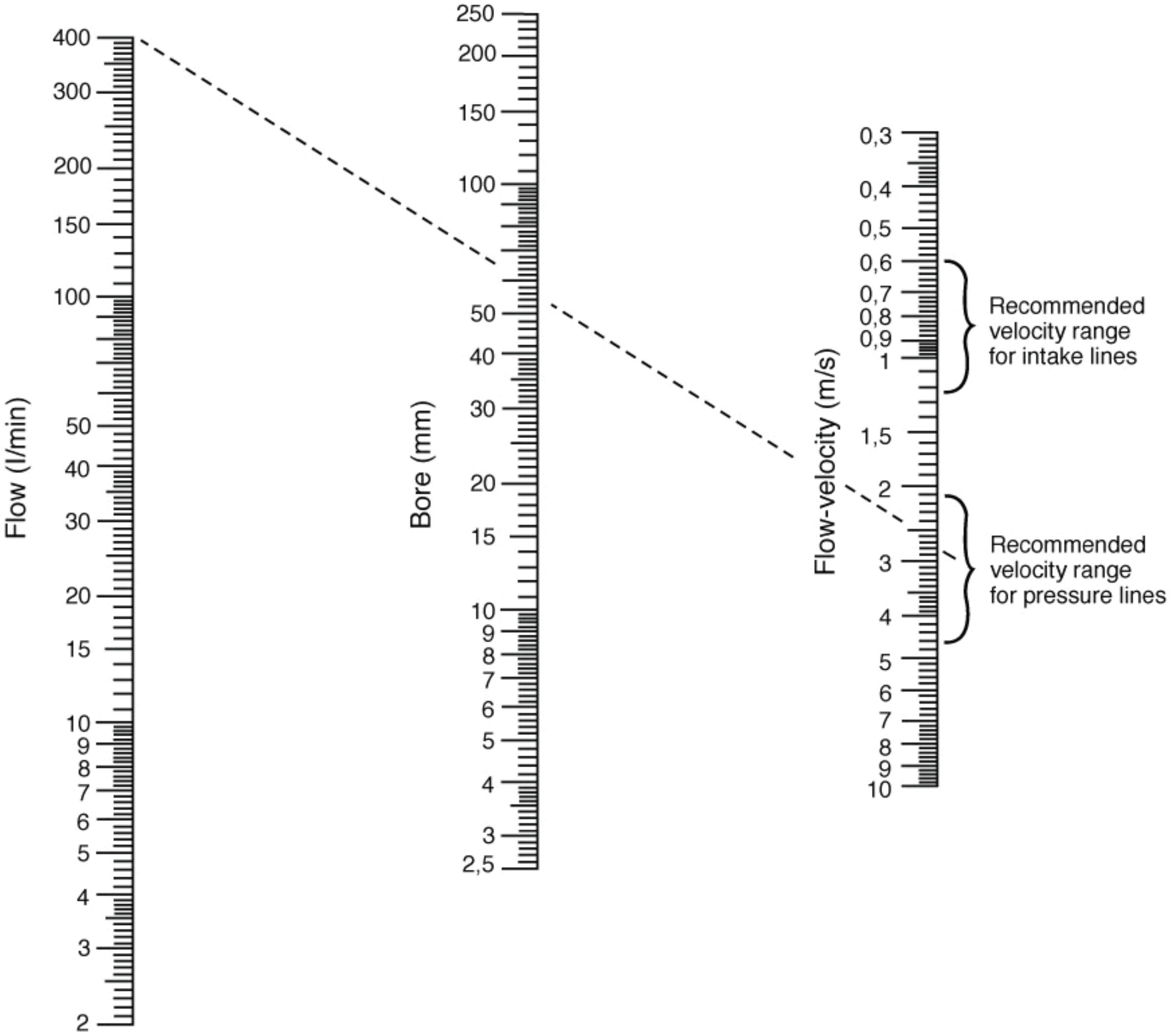
The following nomograph shows the relationship between flow, tube bore and flow velocity. For example, line up the FLOW RATE on the left hand column and the desired FLOW VELOCITY on the right hand to give the approximate TUBE BORE SIZE in the centre.

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.



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Calculating Tube Wall Thickness

A number of formulae can be employed for calculating the wall thickness of tubes to withstand internal pressure. Lame's formula is considered more accurate for thick wall tubes where high pressures are used.

Barlow's Formula $P = \frac{20 \times S \times t}{D}$ or $t = \frac{P \times D}{20 \times S}$

P	Maximum Working Pressure	bar
S	Permissible Stress	N/mm^2
t	Wall Thickness	mm
D	Outside Diameter	mm
d	Inside Diameter	mm
R	Outside Radius	mm
r	Inside Radius	mm

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

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

Where S=Permissible design stress but equates to 0.25 x Minimum U.T.S. – N/mm^2

PERMISSIBLE STRESS

Permissible stress for standard grade Tungum Tube is 117 n/mm^2

Note: The above formula does not consider manufacturing tolerances (usually 10%.)

Corrosion Allowance: As a result of the excellent corrosion resistance characteristics and integrity management feedback received, a corrosion allowance is not generally required for Tungum tubing when used in suitable applications.

The maximum working pressure shown in our size range charts are calculated using a safety factor of 4:1 (i.e. maximum pressure 5,000 psi, therefore a burst pressure of 20,000 psi).

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.

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

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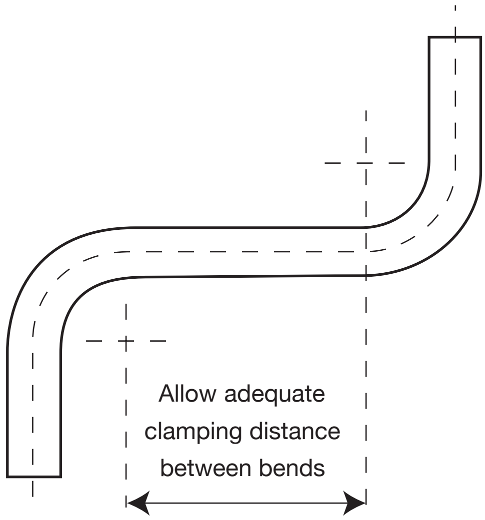
Cutting and Bending

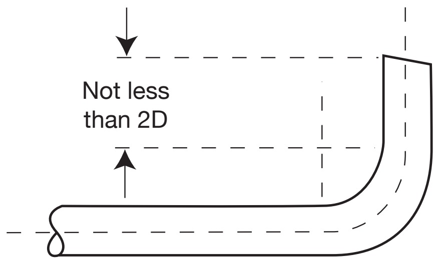


CUTTING TUNGUM TUBING

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.

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.



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.

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. Sufficient space for clamping should be allowed between bends.

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.

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Soldering and Brazing Tungum Tubing

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 650ºC/700ºC 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 . For more accuracy, thermally sensitive crayons may be used.

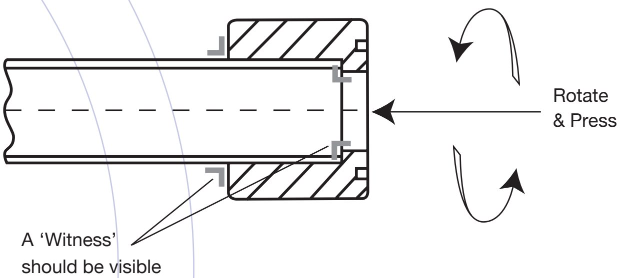
If Tungum Tubing has been overheated, or the heat applied for an abnormally long period of time, it may result in some reduction in strength of the material.

Clearance Table

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: 620/630ºC or Grade ‘AG2’ (Melting temperature: 608/617ºC). In confined spaces, or, if preferred, a cadmium-free solder, typically Grade ‘AG14’ (Melting temperature: 630/660ºC may be used.

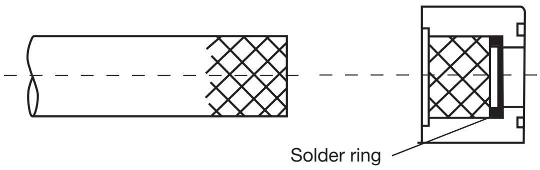


Methods of Brazing

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.

Using a solder wire or a ring of appropriate size and thickness in the fitting (1.5 mm). Fit the fitting to the tube and, if possible, rotate it to distribute the flux evenly.



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.

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.

As soon as possible after brazing, the flux should be cleaned off. This may be done with hot water and a wire brush. 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.

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