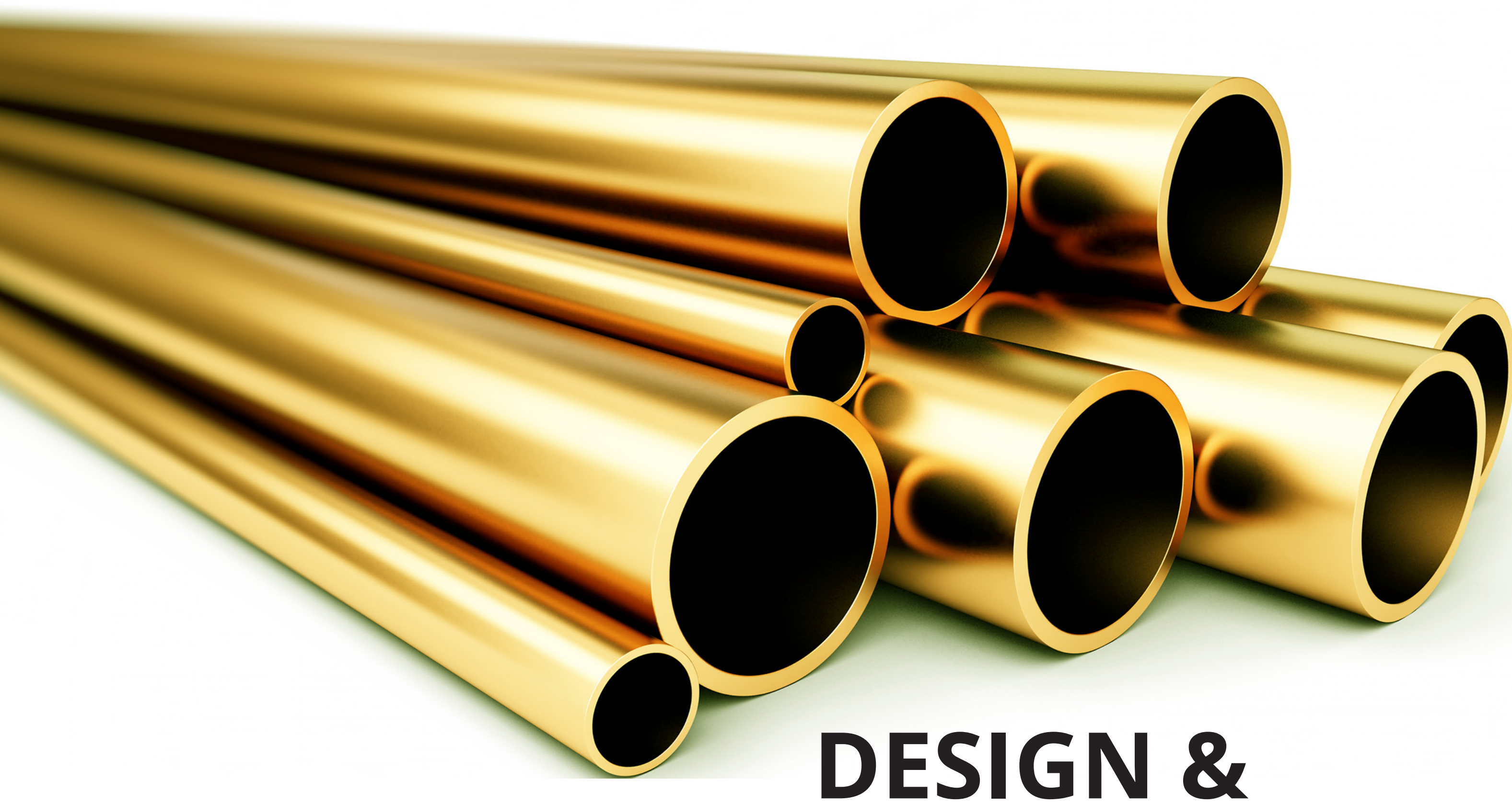
Providers of

HYDRAULIC & PNEUMATIC INSTRUMENTATION TUBE



DESIGN & INSTALLATION GUIDE

Tungum Tubing: Design and Installation

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 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 emphasizes 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, we are always available to advise on specific matters.

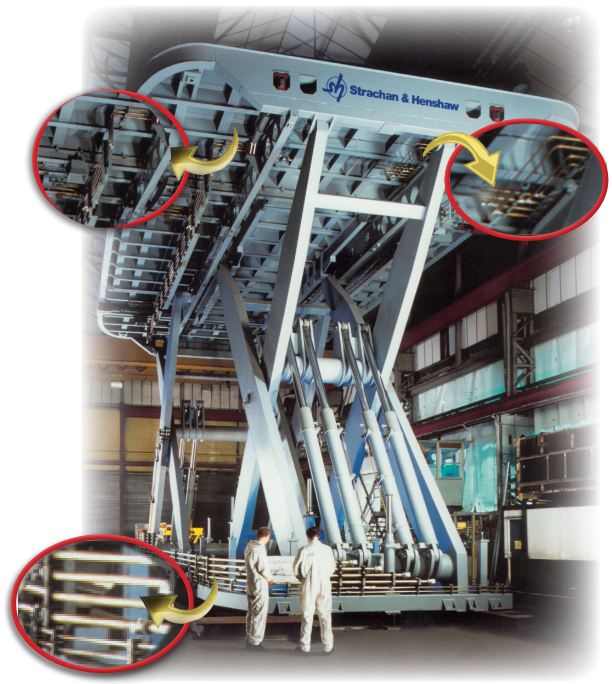
NOTES ON INSTALLING TUNGUM TUBE

- 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 that do not harm 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.

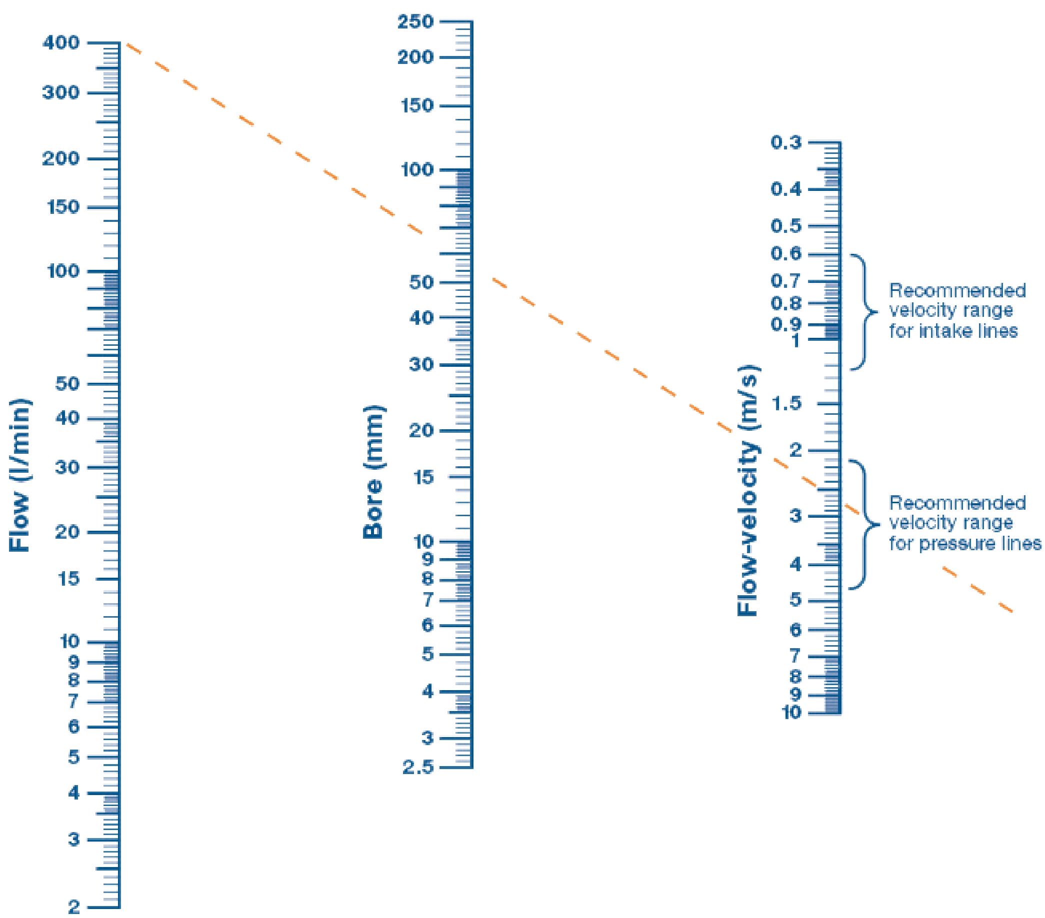
All business undertaken by T2 Alloys Limited is subject to their standard Conditions of Sale, copies of which are available online and on request.

Tube Bore Size for Hydraulic Circuits



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 center.

This nomograph does not allow for energy loss due to surface friction, changes in flow area and direction. The adoption of TUNGUM alloy tube will minimize friction losses due to the material's inherently clean and smooth bore.



Calculating Tube Wall Thickness and Maximum Working Pressure

Several formulae can be employed for calculating the wall thickness of tubes to withstand internal pressure. The following is based on ASME B31-3 paragraph 304.1.2 and is as follows:

$$t = \frac{PD}{2(SEW+PY)}$$

Solve for maximum pressure P:

$$P = \frac{2tSEW}{D-2tY}$$

According to ASTM B706-18 (2018) Table 5, tube depending on size and wall thickness will have a wall thickness tolerance (WTT). Taking a conservative approach and assuming a negative tolerance, the “t” in the above equation shall be reduced by the appropriate WTT.

The resulting formula including WTT will reduce MWP, “P” as show below.

$$P = \frac{2(t-WTT)SEW}{D-2(t-WTT)Y}$$

Design Code:	ASME B31.3
Piping Spec:	Tungum
Material (ASTM)	B706-18 (2018)
ASME Class	N/A
Design Temperature (T)	100°F

Material Coefficient Y	0.4
Quality Factor E	1
t = pressure design wall thickness, inch	Per calc
P = internal design gage pressure, psig	Per calc
D = outside diameter of tube, inch	Per calc
Allowable Stress (Pro. Code Case 191, Jan 2015 (based on Code Case #2783, Sept 2013)	20000 psi
Weld Joint Strength Reduction Factor	1
WTT=Wall Thickness Tolerance per ASTM B706	

Please visit www.t2alloys.com for an easy to use calculator.

Cutting, Bending and Installation

Cutting Tungum Tubing

The preferred method is to use a saw, not a 'tube cutter' and make sure the end is cut square to the tube axis. Cutting with a tube cutter can work harden and deform the cut end excessively depending on the cutting pressure applied. Tube cutters should be avoided if further deformation is needed, such as the formation of a 37° flare, as the combination of an aggressive cut along with the flaring of the end could lead to splitting.

After saw cutting, deburr the tube internally and externally, and make sure all swarf is removed. Again, be sure to apply minimal force to avoid the aggressive removal of material which could lead to thinning of the tube end.

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.

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.

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.

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.

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 OD Size	inches mm	1/8 - 5/16" 3mm-8mm	3/8"- 3/4" 10mm - 20mm	1"- 2" 25mm - 50mm
Clamping Distance	inches mm	20"- 30" 500mm -750mm	30"- 40" 750mm -1150mm	45"- 70" 1150mm -1800mm

Tungum Tubing: Design and Installation

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 OD	up to 1/4” 6mm diameter	over 1/4” (6mm) up to 5/8” (16mm) diameter	over 5/8” (16 mm) diameter
Preferred clearance between mating parts	002”-.005” 0.05mm-0.13mm	.004” - .006” 0.10mm-0.15mm	.005” - .010” 0.13mm-0.25mm

Brazing Materials

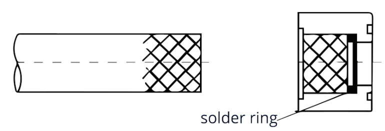
Use a good quality brazing alloy, to British Standard 1845 now BS EN ISO 17672:2016; 1977 Grade ‘AG1’ (Melting Temperature: 620/630ºC or Grade ‘AG2’ (Melting temperature: 608/617ºC). In confined spaces, or, if preferred, a cadmium-free solder, typically Grade ‘AG14’ (Melting temperature: 630/660ºC may 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 to distribute the flux evenly.

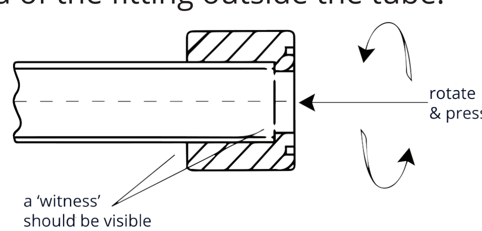


Apply heat by moving the flame round and heat the mass of the fitting rather than the tube.

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.

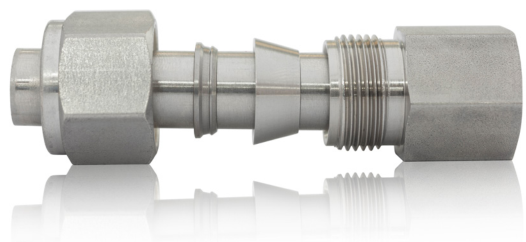


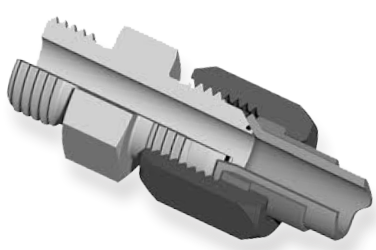
Fittings

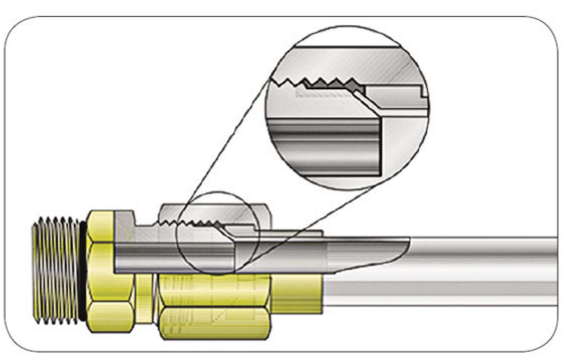
Tungum is compatible with most type of fittings. Both brass 37° flared fittings and 316 stainless steel compression fittings are commonly used with Tungum as both provide a long lasting, cost-effective system. Regarding 316 stainless steel fittings, history in use and extensive testing has proven that there are no long-term galvanic corrosion issues between the two. This is due to the similar nobility of the two alloys with respect to the galvanic scale. Considering Tungum is a brass alloy, typical brass fittings have the same nobility therefore no difference in voltage potential exists between the two.

Compression Fittings

Always follow the fitting manufacturers instruction. Assembling this type of fitting with Tungum is no different than any other material. Good working practice is to check that the ferrules are correctly oriented prior to assembly. Also, check that the tube is cut square and deburred prior to assembly. Typical assembly instructions require that you seat the tube fully into the fitting followed by hand tightening of the fitting nut. Mark the position of the nut in relation to the body and tighten the nut per the manufacturer's instructions which is typically 1-1/4 turns of the nut from the marked position. Be aware that smaller tube sizes may require less turns to fully tighten the nut.





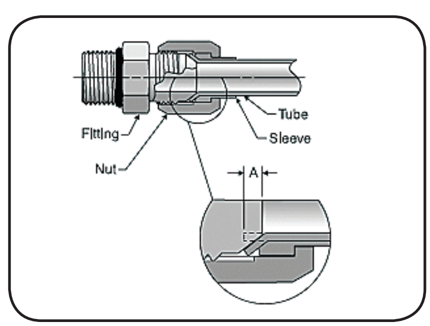


The 37° flare is the world's most widely used flare fitting which consists of a fitting body, sleeve and nut. Photo courtesy of Parker Hannifin Corporation.

Flared Fittings

Brass, 37° flared fittings are commonly used. This requires the end of the tube to be flared before assembly. Tungum is a very ductile material and is ideal for flaring given the correct tooling is used.

To form the flared end, first check that the end of the tube is cut square and free from burrs and machining debris. Saw cutting is preferable as it limits the amount of cold work on the end of the tube which will help to avoid cracking and splitting during the flaring process. Always follow the tooling manufactures instructions and remember to install the nut prior to flaring. Once complete, inspect the flare for cracks or splits. The flare should be smooth and free from imperfections as this is where the seal to the fitting takes place.



T2 Alloys

Providers of

Tungum®

HYDRAULIC & PNEUMATIC INSTRUMENTATION TUBE

Telephone
+44 (0)1684 271290

Fax
+44 (0)1684 291714

Address
T2 Alloys Limited
200A Ashchurch Business Centre
Alexandra Way
Tewkesbury
Gloucestershire
GL20 8TD
United Kingdom

Email
sales@t2alloys.com

Website
www.t2alloys.com

Company Registration #
11183768

ABS DESIGN ASSESSED

Achilles FPAL MEMBER

QUALITY SYSTEM CERTIFICATION DNV·GL ISO 9001:2015

NORSOK • NORSOK • NORSOK M-650 Approved

Issue 2019:1