

Brass Tube for Designers and Manufacturers

(Dorset Tube)

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THE COMPANY

The Dorset Tube Company Limited has two sister operations in the UK: Cole Tubes Limited in Wokingham, Berkshire and Evered in Birmingham. These three will consolidate into a purpose built factory in Poole during 2001 and will continue to manufacture a range of non-ferrous tube products.

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A PLEA:

Please think about the manufacturing process when you are designing!

I have recently spent twelve weeks discussing a rectangular tube with a client: the maximum length we can make, material specification, tolerances and delivery period.

I have just found out that the end use is as a specialist architectural feature and the designer has given no consideration as to the HOW, just the WOW.

Don't let it become a constraint to your creativity but it does help us achieve your designs in practice. Rather, it is better to work with both the limits and possibilities in mind and to do so in conjunction with us.

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OUTLINE OF THE SEAMLESS TUBE MANUFACTURING PROCESS

The majority of brass is manufactured from a mixture of recycled or scrap material with pure metal and alloy additions to adjust the melt composition & meet specifications. High purity specifications may result from 100% virgin or certified raw materials. **Casting** can either be semi-continuous or into single or multiple **billet** moulds of just a few kilos.

When cool the billet may be machined to clean the outer surface and may also be bored out before being reheated and **extruded** into **seamless tube shell**. Typical tube shell extrusions are in the order of 100 mm diameter with a 15 mm wall and may be 100 m long.

The first cold work step may be **pilgering**, a cold forging process that can accomplish large area reductions, followed by a series of lesser reductions on straight draw benches or coil drawing lines.

Annealing, a softening heat treatment, is necessary between cold working stages. Final sizing and shaping may be followed by a lower temperature **stress relieving** heat treatment to reduce the tendency to corrode and crack in service. Both these heat treatments need to be undertaken in a controlled furnace atmosphere in order to reduce oxidation and the possibility of deleterious carbon films.

WELDED TUBE

Welded tube is manufactured from strip and has the benefit of this relatively cheaper cold working process but the disadvantage of needing high volume applications.

Precision rolled strip can be made to thin gauge and subsequent roll-forming and welding operations automated. Welded tube is widely used for high volume decorative purposes where strength and proven integrity is less of an issue.

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THE COLD DRAWING PROCESS

Tube is drawn over hard tooling which controls its size and shape. Typically tooling is made from tungsten carbide, diamond or ceramic supported in steel bolsters. Alternatively chromium plated steel can be used for a quick tool or short trial run. Tooling consists of two components:

- the **die** - either solid or adjustable - controlling outside dimensions
- the **plug** - either fixed or floating - controlling inside dimensions

As can be seen in the figure (above), the finishing size is usually - but not always - smaller than the starting size, and this requires the tip to be worked down to a smaller diameter in order for it to pass through the die; this is called **pointing**, **tagging** or **swaging**. There are some examples on display.

The drawing process requires **lubrication** which may be as simple as tallow or as complex as a modern water based soap or synthetic boundary condition lubricant. When the plug has been fitted into the tube bore and the tag introduced through the die, the tube is gripped by a set of jaws and pulled through the tooling set. Reduction in material cross sectional area will be in the order of 10 to 50% depending upon the alloy and condition.

Drawing may be done on a traditional continuous chain or hydraulically operated straight **bench**, or a rotating **spinner block**. This latter process is semi-continuous, has the advantage of speed and efficiency but only comes into its own for volume work.

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FROM OUR LITERATURE

ALLOY	TYPE	BSI	ISO	UNS	NAME
Copper Nickel:	90/10	CN102	CuNi10Fe1Mn	UNS C70600	90/10 Copper Nickel
	70/30	CN107	CuNi30Mn1Fe	UNS C71500	70/30 Copper Nickel
	66/2/2	CN108	CuNi30Fe2Mn2	UNS C71640	66/2/2 Copper Nickel
Brass:	90/10	CZ101	CuZn10	UNS C22000	Gilding Metal
	70/30	CZ106	CuZn30	UNS C26000	Cartridge Brass
	70/30	CZ126	CuZn30As	-	Arsenical Brass
	63/37	CZ108	CuZn37	UNS C27200	Common Brass
		CZ110	CuZn22Al2	UNS C68700	Aluminium Brass
		CZ111	CuZn28Sn1	UNS C44300	Admiralty Brass
		CZ112	CuZn38Sn1	-	Naval Brass
	CZ119	CuZn37Pb2	UNS C35600	2% Leaded Brass	
Bronze:	95/5	PB102	CuSn5	UNS C51000	Phosphor Bronze
	92/8	PB104	CuSn8	-	Phosphor Bronze
Copper:	99.90	C101	Cu-ETP	UNS C11000	Electrolytic, HC
	99.95	(C103)	Cu-OF	UNS C10200	OFHC
	99.85	C106	Cu-DHP	UNS C12200	Phosphorus Deoxidised
	99.99	(C110)	SE-Cu/Cu-OFE	-	Special Electronic
	98/2	CB101	CuBe1.7	UNS C17200	Beryllium Copper
Aluminium & Alloys	1050		Aluminium and aluminium alloy is available as high precision DRAWN tube which is manufactured on site to very high tolerances.		
	1200				
	2014A		We can also supply precision EXTRUDED special profiles in many alloys.		
	3003				
	5083				
			6060, 6061, 6063, 6083		
Naval Engineering Specification (NES837, NES779, NES780, NES831) and USA MIL-Spec release materials					
Other alloys:	<input checked="" type="checkbox"/> Invar ¹ / Nilo ² - iron/nickel alloys		<input checked="" type="checkbox"/> Monel ² 400 & 404 – nickel/copper alloys		
(examples)	<input checked="" type="checkbox"/> Kovar ¹ / NiloK ² - cobalt/iron alloys		<input checked="" type="checkbox"/> various stainless steels		
	<input checked="" type="checkbox"/> Mu metal	<input checked="" type="checkbox"/> gold	<input checked="" type="checkbox"/> fine silver	<input checked="" type="checkbox"/> coin silver	<input checked="" type="checkbox"/> tantalum

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It seems facile to point out that tube has a hole up the middle - by definition - but this is a design feature that may be vital to the functioning of a particular component. Or not of course: you could consider using tube just because it is lighter. The cold working of brass results in the refinement of its metallurgical structure - grains are broken down and become aligned in the longitudinal direction. This provides for a generally better and stronger structure.

If considered necessary, individual tube strength or integrity may be evaluated by hydrostatic or pneumatic pressure testing and through thickness quality by various mechanical and electronic tests.

Shape is a definite design point.

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By using shaped tools and even rotating or mechanically driven tooling, it is possible to manufacture various non-round profiles.

Tools need to be strong enough to withstand the stresses imposed on them by sharp corners and re-entrant curves and this is often the limiting factor in profile design - just as it is in the extrusion industry.

It is less easy to work the harder brasses (more zinc and other strengthening alloying additions), but quite severe deformations are possible.

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EXAMPLE

This electric motor brush holder combines the requirements of two functions and can readily be manufactured from tube.

In addition the brass chosen is both hard wearing and light in structure.

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OTHER ADVANTAGES

In addition to the various shapes possible, the ability to produce relatively light walls is a major advantage over cast and machined components. This means that the considerations of reduced material cost may outweigh the costs of slower processing.

The final sizing and heat treatment stage of manufacture can be designed to impart particular strength or temper characteristics to the tube.

Whilst the tube drawing process is relatively expensive compared to extrusion, once certain volumes of a part are required, tube will become the more cost-effective option.

EXAMPLE

One example is the crimp ferrule. This is used for firmly attaching cables to connectors and is produced in the order of millions per week. The desired combination of material strength, condition, wall thickness, tolerances and cost requires that these be manufactured from tube.

A tube can easily have a longer bore than a machined component but it can also then be manipulated fairly readily to make a bend, coil or more complex shape that could not easily be machined.

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Design considerations go hand-in-hand with manufacturing possibilities. We encourage discussion and partnership between designers from the early stages of the process. These examples are from our Group literature; a copy of our **Designer's Guide** is available at our display.

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Manipulated tube components may offer the only way to manufacture some designs.

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YOUR PRESENTER

Mark Tur is a professional Metallurgist and Chartered Engineer. He has always worked in the field of non-ferrous metals: copper, cobalt, nickel and aluminium alloys. He has worked in and managed large and small foundries, welding and machine shops and both developed and advised on Product and Business Development plans in a wide variety of metal processing industries.

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