Design in Brass

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Contents

Introduction

Today's designer has available a very wide range of materials from which to choose. To determine the most cost-effective material for any application is no simple task when costs and performance are properly assessed.

Brass is ideally suited to the manufacture of many components because of the wide variety of forms and sizes available that minimise costs of machining to final dimensions. It has a unique combination of properties: strength, shock resistance, ductility and conductivity combined with good corrosion resistance and other attributes such as superb machinability. Other beneficial properties are good formability, good spark-resistance, low magnetic permeability and toughness retained above and below ambient temperatures.

Unlike plastics, brasses:

- Do not degrade in sunlight
- Do not embrittle following migration of plasticiser
- Do not need expensive moulding tools
- Do not suffer from rapid softening above ambient temperatures
- Do not embrittle below ambient temperatures.

Unlike steels, brasses:

- Do not rust
- Do not corrode under plating
- Do not have poor conductivity
- Do not suffer from rapid formation of an insulating oxide layer.

Specifications for brass usually list such properties as tensile strength, elongation and hardness - the minimum needed to check the reproducibility of each batch. The type of application envisaged will determine which other properties need to be considered.

British/European (CEN) Standards currently contain 57 different compositions of wrought brasses and 14 of the most popular casting brasses. Manufacturers are able to produce materials with properties tailored to suit many different applications.

Brasses are obtainable in a variety of forms to minimise component production costs:

- Rods, profiles, complex sections and hollow bars
- Hot stampings to required shapes and tolerances
- Plate, sheet, strip and foil
- Tube
- Wire
- Castings: die, sand, investment, centrifugal, continuous and pressure die-castings.

Brasses are readily available from many manufacturers and stockists.

Types of Brass

Brasses are copper-based alloys in which the major alloying addition is zinc. The generic term 'brass' covers a wide range of materials with quite different fields of application. Correct choice of brass is therefore important if manufacturing and operating requirements are to be met in the best possible way.

There are two main types of brass. The most used are those containing from 37 % to over 40% of zinc - these are duplex brasses with an alpha/beta structure which has excellent ductility at the hot working temperatures used for extrusion and forging. For the best cold working properties the zinc content of a binary brass should not exceed about 37%, this being the limit of solubility of zinc in copper to retain an all-alpha, single phase structure.

Apart from zinc, small additions (less than 5%) of other alloying elements can be added to modify the properties so that the resulting material is more suitable for specific end-uses.

Free Machining Brass

For many years brass has been the standard material by which machinability of other materials has been judged. Containing 58% copper, the standard free-machining brass has an addition of 3% of lead which is present as finely distributed particles which ease the chipbreaking of the swarf, enabling it to clear from the tool easily. The lead also has some lubricating effect.

Recent improvements in the continuous production of extrusion billets now permit the addition of 4% lead (CW609N), which gives even better machinability and permits the use of higher cutting speeds and feeds or reduces even further the rate at which tools wear. There are many other compositions of free machining brasses available with differing combinations of machinability and ductility.

High Tensile Brasses

The addition of manganese, iron and aluminium in various proportions gives five wrought brasses (CW721R, CW722R, CW705R, CW713R and CW720R) with increased strength, corrosion resistance and wear resistance. These are used for architectural and heavy-duty engineering applications.

Naval Brasses

Naval and Admiralty brasses are sometimes confused because both are copper-zinc alloys to which about 1% of tin is added, the purpose of which is to improve the resistance to corrosion. The Naval brasses are 60/40 type duplex hot working brasses supplied as forgings, plate and extrusions. Admiralty Brass is 70/30 alloy also containing 1% tin.

Dezincification Resistant Brass

In some areas the nature of the supply water causes it to be aggressive to conventional hot-stamped brass water fittings and the use of dezincification-resistant (DZR) brasses is necessary. In the duplex structure the beta phase is attacked preferentially, leaving a coppery-coloured metallic residue and a deposit of zinc compounds of a 'meringue' texture. The addition of arsenic normally inhibits the corrosion of alpha brass but not the beta. The brass designated CW602N was therefore developed to be easily hot stamped as a duplex brass but to be converted to a mainly alpha structure by a subsequent anneal at 500°C. Free-machinability is retained by a lead addition. Water fittings of this material which pass the British Standard dezincification-resistance test are marked with the special symbol 'CR'.

Brasses for Cold Working

The most common brasses for working to sheet, strip, foil and wire are common brass (CW508L) and 70/30 or 'cartridge' brass (CW505L). Having the highest zinc content, common brass is the cheaper and proves adequate for many purposes involving extensive forming such as bending or deep drawing. The 70/30 alloy has better ductility and resistance to stress-corrosion and is also readily available. Gilding metals (CW501L, CW502L and CW503L) contain 10, 15 and 20% of zinc respectively. They have excellent ductility, strength and corrosion resistance. Their colours are frequently chosen for applications from shopfitting trim to costume jewellery.

Casting Brasses

BS EN 1982 includes a range of compositions suitable for sand casting, gravity die-casting and pressure-die casting. As with the wrought brasses, those with the most zinc are cheaper in first cost and have good ductility at room temperature and better corrosion resistance. Lead may be added to improve machinability and tin for extra fluidity and corrosion resistance.

BS EN British/European (CEN) Standards

The European Standards for copper and copper alloys that cover brasses for general engineering purposes are:

BS EN 1982	Ingots and Castings
BS EN 1652	Plate, sheet, strip, and circles for general purposes
BS EN 1653	Plate, sheet and circles for boilers, pressure vessels and hot water storage units
BS EN 1654	Strip for springs and connectors
BS EN 12163	Rod for general purposes
BS EN 12164	Rod for free machining purposes
BS EN 12165	Wrought and unwrought forging stock
BS EN 12166	Wire for general purposes
BS EN 12167	Profiles and rectangular bar for general purposes
BS EN 12168	Hollow rod for free machining purposes.

These cover requirements for compositions, mechanical properties, tolerances and special tests. They will be used when material is ordered from stockists but for economic quantities, manufacturers will be pleased to discuss special requirements. Nearly all manufacturers are approved to supply to the quality assurance requirements of BS EN ISO 9002 if specified at the time of placing the order.

Cost Effective Manufacturing

Design in Extrusions

A very wide variety of solid and hollow rods, bars and special sections are available to suit engineering applications of all types. Designers can choose from standard stock sizes or have special shapes made to close tolerances to suit 'near net shape' requirements that ensure minimum production costs. The brasses available include all the common free-machining materials with variations in ductility to suit the needs for further cold forming together with the other brasses with special properties such as higher tensile strength and improved resistance to corrosion and wear. Where significant machining is required to finish a component, the cost of this can be offset by the value of the recycled swarf.

Design for Hot Stamping

If the product is required with a three-dimensional shape it may be advantageous to consider manufacture by hot stamping which further reduces the costs of machining to size. The die cost is generally not as high as that for injection moulding or die-casting, so minimum economic quantities are lower and the mechanical properties obtained are good. The simplest of dies are in only two parts but for longer runs of complex shapes it is recommended to design more complex dies which can permit rebates in several directions.

Design in Sheet and Strip

Many products can best be designed to be rapidly formed from sheet or strip by blanking, punching, bending and deep drawing. The use of multiple stage transfer presses means that intricate components such as heat exchanger fins, contacts, springs, connectors, lamp caps and sockets can be easily and cheaply produced to close tolerances in quantity. The tempers available range from fully annealed through deep-drawing quality up to hard, spring hard and extra spring hard.

Design in Tube

Brass tubes are manufactured in all the sizes required from the finest of tubes for instrumentation through close tolerance tubes needed in concentric arrangements for extended aerials to the larger sizes used for industrial and marine heat exchangers. Being cold drawn to final size, the mechanical properties available can be significantly enhanced.

Design in Plate

For tube plates for heat exchangers and similar applications, hot rolled plate is available to order in a variety of compositions of brass with corrosion resistance to suit service conditions. Brass plate is suitable for use with tubes of copper, copper alloy and other materials since it is thick in section and has a large surface area permitting design for a long service life despite the possibility of some sacrificial corrosion.

Design in Wire

Wire is available in a variety of cold worked hard tempers to close tolerances for the manufacture of mesh, contacts and springs. The common free-machining brasses are also available coiled in wire forms as feedstock for the manufacture of small diameter turned parts.

Design for Castings

Brass can be cast by all the common foundry methods such as sand and shell mouldings, gravity and pressure die casting and precision castings. The choice of alloy and technique is affected by the usual considerations of applications requirements, size of component and number required. The table gives some guidance and further details are given in BS EN 1982 ‘Ingots and castings’, CDA Publication No 42 'Copper Alloy Castings' or from founders.

Designations, Compositions, Forms Available and Typical Properties of the Brasses

This table summarises the commercially available brasses included in the British/European (CEN) Standards BS EN 1982, BS EN 1652-1654, and BS EN 12163-12168 for copper and copper alloys for general engineering purposes. For simplicity, the selection of brasses includes only those new BS EN materials with close affinity to the previous BS 287x series of brasses. The wide range of properties quoted covers the possibilities of all product forms. For more accurate information regarding individual products reference should be made to the individual standards available from BSI or to the CDA Publication No 117 'Brasses-Design Compendium'. It may be possible to obtain production quantities of some materials in product forms not specified, refer to manufacturers for details.

Machinability Comparisons

From experience gained in production trials, the following metal removal rates are considered practical at the works of Hawke Cable Glands:

Typical Metal Removal Rates (Courtesy Hawke Cable Glands Ltd)

Metal	**BS No**	**Specification Designation**	**Metal Removal Rate (cm^3/min)**
Brass	EN12164	CW609N	133
Aluminium	4300 Pt 5	2001	80
	1474	6082	44
Mild Steel	970 Pt 3	230M07	36
Stainless Steel	970 Pt 3	304S15	6

For further information related to applications contact the manufacturers or Copper Development Association at helpline@copperdev.co.uk.

Designations, Compositions, Forms Available and Typical Properties of Brass

Designation: BS Material Designation Number/Symbol	Old BS No.	Description	Nominal Composition: Cu	Zn	Pb	Sn	Fe	Al	Mn	Other	Availability: Plate Strip etc	Rod	Forging	Wire	Profiles	Hollow Rod	Tube	Typical Mechanical Properties: 0.2% Proof Stress (N/mm²)	Tensile Strength (N/mm²)	Elongation (%)	Hardness (HV)	Remarks	Designation: Old BS No	BS EN Designation Number/Symbol
		Wrought Brasses																						
CW614N/CuZn39Pb3	CZ121-Pb3	Leaded brasses for high speed machining	58	Rem	3	-	-	-	-	0.2	-	Y	Y	Y	Y	Y	Y	150-420	360-580	25-5	100-160	The most suitable materials for high speed machining, the 4% alloy permitting extra high machining speeds. They are used as continuous feed stock in high speed machining operations. They have a limited ability to be cold worked. Also commonly used as hot stamping brasses.	CZ121-Pb3	CW614N/CuZn39Pb3
CW609N/CuZn38Pb4	CZ121-Pb4		58	Rem	4	-	-	-	-	0.2	-	Y	-	Y	Y	Y	-	150-420	360-580	25-5	100-160		CZ121-Pb4	CW609N/CuZn38Pb4
CW603N/CuZn36Pb3	CZ124	Free cutting brasses	61	Rem	3	-	-	-	-	0.2	-	Y	-	Y	Y	Y	Y	160-450	340-580	35-5	90-150	Excellent machinability combined with sufficient ductility for some cold work.	CZ124	CW603N/CuZn36Pb3
CW617N/CuZn40Pb2	CZ122		58	Rem	2	-	-	-	-	0.2	-	Y	Y	Y	Y	Y	Y	150-420	360-580	25-5	100-160	The most popular alloy for hot stamping.	CZ122	CW617N/CuZn40Pb2
CW612N/CuZn39Pb2	CZ128		59.5	Rem	2	-	-	-	-	0.2	Y	Y	Y	Y	Y	Y	-	150-450	360-580	40-5	90-160		CZ128	CW612N/CuZn39Pb2
CW606N/CuZn37Pb2	CZ131/119	Free cutting brasses with improved ductility	61.5	Rem	2	-	-	-	-	0.2	Y	Y	-	Y	Y	Y	-	160-450	300-580	45-5	90-150	The higher copper content and lower lead content of these alloys improves ductility while retaining free machining characteristics. They can be used for cold heading, riveting, etc.	CZ131/119	CW606N/CuZn37Pb2
CW611N/CuZn39Pb1	CZ129		59	Rem	1	-	-	-	-	0.2	-	Y	Y	-	Y	Y	-	150-420	360-580	30-5	90-150	Commonly used for hot stamping.	CZ129	CW611N/CuZn39Pb1
CW624N/CuZn43Pb2Al	CZ130	Brasses for architectural sections	56	Rem	2.3	-	-	0.25	-	0.2	-	-	-	-	Y	-	-	160-200	370-430	35-25	90-120	The aluminium containing alloy has a bright yellow colour on the surface of extruded sections.	CZ130	CW624N/CuZn43Pb2Al
CW720R/CuZn40Mn1Pb1	CZ136		58	Rem	1.5	-	-	-	1	-	-	Y	Y	Y	Y	Y	-	160-350	350-550	20-10	100-170	The manganese containing alloy may be toned to a chocolate brown colour. This gives an accentuated uniform improvement to natural oxidation effects. Also used for valve spindles and nuts in contact with cast iron because of its excellent resistance to seizure.	CZ136	CW720R/CuZn40Mn1Pb1
CW721R/CuZn40Mn1Pb1AlFeSn	CZ114	High tensile brasses	58	Rem	1.2	0.6	0.7	0.8	1.3	-	-	Y	Y	-	Y	Y	-	200-380	450-580	30-15	130-170	The alloying additions produce improved mechanical properties compared with unalloyed brasses of the same copper content. The lead in CW721R improves machinability. Used for fasteners, high pressure gas valves etc.	CZ114	CW721R/CuZn40Mn1Pb1AlFeSn
CW722R/CuZn40Mn1Pb1FeSn	CZ115	High tensile brass soldering quality	57.5	Rem	1.2	0.6	0.7	-	1.3	-	-	Y	Y	-	Y	Y	-	200-380	450-580	30-15	130-170	Similar to CW721R, but the restriction in aluminium content avoids non-wetting problems during soft soldering operations.	CZ115	CW722R/CuZn40Mn1Pb1FeSn
CW713R/CuZn37Mn3Al2PbSi	CZ135	High tensile brass with silicon	58	Rem	0.5	-	-	1.8	2.3	0.8Si	-	Y	Y	-	Y	Y	Y	300-450	500-650	25-8	170-210	Readily hot stamped. The silicon addition gives excellent wear resistance for gear box components.	CZ135	CW713R/CuZn37Mn3Al2PbSi
CW602N/CuZn36Pb2As	CZ132	Dezincification resistant brass	62	Rem	2.2	-	-	-	-	0.1As	-	Y	Y	-	Y	Y	Y	120-200	280-450	40-20	80-140	Brass with good hot ductility which is then heat treated to give excellent resistance to dezincification.	CZ132	CW602N/CuZn36Pb2As
CW712R/CuZn36Sn1Pb	CZ112	Naval brass	62	Rem	0.4	1.3	-	-	-	-	-	Y	Y	Y	Y	-	-	160-360	340-480	30-10	90-150	The tin addition improves corrosion resistance especially in seawater.	CZ112	CW712R/CuZn36Sn1Pb
CW711R/CuZn36Pb2Sn1	CZ134	Leaded brass	60.5	Rem	1.8	0.8	-	-	-	-	-	Y	-	-	-	Y	-	200-400	360-540	30-5	110-160	The leaded version has improved machinability.	CZ134	CW711R/CuZn36Pb2Sn1
CW719R/CuZn39Sn1	CZ133	Naval brass (uninhibited)	60	Rem	-	0.8	-	-	-	-	-	Y	Y	-	Y	-	-	160-360	340-480	30-10	190-210		CZ133	CW719R/CuZn39Sn1
CW610N/CuZn39Pb0.5	CZ137	60/40 brasses	60	Rem	0.5	-	-	-	-	0.2	Y	Y	Y	Y	Y	-	-	150-450	360-580	45-5	90-150	These alloys are very plastic at hot working temperature, therefore very intricate shapes, showing fine surface detail can be produced. They can also be cold worked to a limited extent. Used for tube plates of condensers and similar purposes.	CZ137	CW610N/CuZn39Pb0.5
CW509N/CuZn40	CZ109		60.5	Rem	-	-	-	-	-	0.2	Y	Y	Y	-	Y	-	Y	200-420	340-500	45-2	90-150		CZ109	CW509N/CuZn40
CW502L/CuZn15	CZ102	Gilding metals	85	Rem	-	-	-	-	-	0.1	Y	Y	-	Y	-	-	Y	120-590	260-630	50-2	65-170	This alloy has better corrosion resisting properties than lower copper content alloys. It is used for condenser cooling units, gauges and instrument tubes. The composition is frequently modified by tin additions.	CZ102	CW502L/CuZn15
CW505L/CuZn30	CZ106	70/30 brass (cartridge Brass)	70	Rem	-	-	-	-	-	0.1	Y	Y	-	Y	-	-	Y	130-810	300-830	55-1	65-200	In sheet form this is known as deep drawing brass because it has the maximum ductility of the Cu-Zn alloys. As wire it is suitable for severe cold forming such as heading.	CZ106	CW505L/CuZn30
CW507L/CuZn36	CZ107	2/1 brass	64	Rem	-	-	-	-	-	0.1	Y	Y	-	Y	Y	-	Y	130-800	280-820	50-1	65-190	A good cold working alloy.	CZ107	CW507L/CuZn36
CW508L/CuZn37	CZ108	Common brass	63	Rem	-	-	-	-	-	0.1	Y	Y	Y	Y	Y	-	Y	130-800	280-820	50-1	65-190	General-purpose alloy suitable for simple forming.	CZ108	CW508L/CuZn37
		Cast Brasses																						
CC705S/CuZn33Pb2-C	SCB3	Sand cast brass	64.5	Rem	2	1.5	-	-	-	1.0Ni	-	-	-	-	-	-	-	70	180	12	45	General purpose castings for less onerous duties, gas and water fittings. Good machinability.	SCB3	CC705S/CuZn33Pb2-C
CC765S/CuZn35Mn2Al1Fe1-C	HTB1	Cast high tensile brasses	61	Rem	-	1	1	1.5	2	6.0Ni	-	-	-	-	-	-	-	200	480	18	100	General engineering castings, suitable for all casting methods. Good resistance to corrosion. CC765S frequently used for marine components. CC762S offers good resistance to wear under high load at low speeds, unsuitable for marine applications.	HTB1	CC765S/CuZn35Mn2Al1Fe1
CC762S/CuZn25Al5Mn4Fe3-C	HTB3		63.5	Rem	-	-	3	5	4	3.0Ni	-	-	-	-	-	-	-	480	750	5	190		HTB3	CC762S/CuZn25Al5Mn4Fe3-C
CC752S/CuZn35Pb2Al-C	DZR1	Cast dezincification resistant brass	63	Rem	2	-		-	0.5	0.15As	-	-	-	-	-	-	-	150	300	10	90	Die casting brass with dezincification resistance. Mainly used for water fittings.	DZR1	CC752S/CuZn35Pb2Al-C
CC754S/CuZn39Pb1Al-C	DCB3	Die cast brass	60.5	Rem	1.5	1	-	0.8	-	1.0Ni	-	-	-	-	-	-	-	120	280	10	70	General-purpose die casting brass, used extensively for plumbing fittings.	DCB3	CC754S/CuZn39Pb1Al-C
______/CuZn40Pb	PCB	Pressure die cast brass	58.5	Rem	2	0.5	0.3	0.5	-		-	-	-	-	-	-	-	105	225	33	5	The low copper content gives this alloy greater plasticity immediately after solidification , thus avoiding hot tearing in the metal mould before ejection.	PCB1	______/CuZn40Pb

Case Studies

Machined Brass for High Precision

KeyMed, a division of Olympus Optical Company Limited, have made the internal chassis and focusing mechanism of the company's Series 5 Rigid Borescope in an all brass construction, giving a significant cost and performance advantage, helping them to produce an improved product at a competitive price.

Brass components within a Borescope (KeyMed)

Borescopes give visual access to remote areas and are used for inspecting all manner of plant and equipment, including amongst many others, jet engine turbine blades, heat exchanger tubes, printed circuit boards and pressure vessels.

Brass was initially chosen for the Series 5 because of its machinability, corrosion resistance and strength, but it has been found to have many other advantages. Brass machines considerably faster than stainless steel, the other major contender, giving cost savings of over two thirds on larger more complex component parts, such as the main chassis housing. The majority of components used in the Series 5 control mechanism are complex machined parts, but because brass causes minimal tool wear, the company can maintain the high degree of accuracy and repeatability required to produce a precision optical instrument.

The Series 5 has a number of bearing surfaces. Due to its inherent lubricity, brass on brass is used with only a minimal amount of grease. Previously aluminium was used, but this required a separate "oilite" bearing which added to the cost.

Thin walled brass tube is also used to separate the optical components. These ‘spacers’ having a formed surface, reduce reflections that would otherwise degrade the image quality. Brass sheet is also chemically milled to form precision optical apertures.

Brass Extrusions for 13 amp Plug Pins

British Standard 1363 for 13 amp plugs is a performance specification aimed at electrical reliability and the prevention of overheating likely to cause fires. The way in which manufacturers design to meet these requirements varies significantly but the aims of conformance, reliability and cost-effectiveness are common.

Brass is invariably chosen as the preferred material for the pins because of the ease with which it can be extruded and drawn to shape with a good surface finish, machined and riveted. Its excellent corrosion resistance in service means that it will last indefinitely without a build-up of insulating oxides which give a higher electrical contact resistance causing the risk of overheating and fire. When the cost-effective design of pins and other components is being considered there is useful scope for co-operation between manufacturers and the expert die-designers of the brass manufacturers.

The earlier round-pin plugs were manufactured with their pins turned from round free-machining brass stock. For the rectangular pins of the 13 amp models it is usual for designers to take advantage of the brass manufacturers' ability to produce complex shapes which are, in two of their dimensions, very near to the size of the finished component required. All that is needed is to part off each pin and carry out minimal finish machining.

13-amp plug pins - variety of designs and production techniques used to make a reliable, cost effective safety-critical component

If drilling and tapping is all that is required to form the terminal post then the brass with the best machinability is chosen (CW614N). If it is required that a fuse-holder spring strip is riveted to the top of the pin then a brass with the optimum combination of machinability and ductility is needed. If the fuse is to be gripped at the top of the extruded brass pin itself then the section may be designed with a 'Y' shaped slot present on the extrusion which is closed up during drawing to give the required springy grip to the fuse. Close liaison between designers and the extrusion manufacturers will ensure production of the most cost-effective components.

Brass is compatible with all of the commonly used injection moulding and sleeving plastics in general use. With the combination of good design standard and optimum, reliable materials the performance of the British 13 amp plug will remain amongst the best in the world.

Cable Glands

For use on offshore platforms and similar hostile environments, cable glands must be made of corrosion resistant material and machined to half the normal clearance tolerances to ensure that they are explosion proof. At the factory of Hawke Cable Glands in Manchester, cable glands and other components can be made to customers' choice in brass, aluminium, mild steel or stainless steel. In their experience, the metal removal rates for brass are much greater than for other materials machined, as shown in the table in "Designations, Compositions, Forms Available and Typical Properties of the Brasses".

To avoid bimetallic corrosion problems, cable glands are normally made of free-machining brass for cable entries into cast iron or steel boxes or alternatively of aluminium for use with aluminium boxes. Corrosion considerations exclude the use of free-machining aluminium. The use of mild steel is precluded because of its poor corrosion resistance. While surface protection of mild steel is possible with plating or galvanising, such coatings cannot be applied economically without loss of the required dimensional tolerances and are only of limited lifetime expectancy. The machining of stainless steel is so expensive, that the cost is usually prohibitive.

Cable Glands - material that is initially cheaper becomes more expensive when full production costs are known (Hawke Cable Glands Ltd)

When brass is being machined the reliability of the machine tools is such that one operator can supervise the operation of six lathes. With aluminium, however, the build-up of continuous swarf requires constant attention to keep the tool clear. One operator is therefore required per machine. This consideration, besides the increased downtime caused by faster tool wear, means that the cost of aluminium cable glands is 50% higher than brass.

Brass for Pipe Fittings

The need for long production runs of a variety of relatively small components means that advantage can be taken of hot stampings as starting stock. Strong, ductile and machinable, the stampings are made to close tolerances in order to eliminate unnecessary machining. It is also possible to use one design of stamping as the starting stock for several components that have only minor dimensional differences. Machining costs are minimal and the good value obtained for the swarf keeps total costs low.

The requirements for gas fittings are, like those for electrical services, reliability and safety, combined with economy. The amount of machining needed on each component is significant but in each example it is carried out on one automatic lathe at minimum cost. Some of the fittings are swaged over during assembly, a process that would not be possible with less ductile materials.

Substitution for Plastics

There is a constant need to review design requirements and associated production costings, especially where a variety of materials are available. In order to retain markets the main consideration must be customer satisfaction that is dependent on performance and lifetime costs as well as on the first costs and appearance.

The introduction of plastics for the manufacture of tap tops is now regretted by some manufacturers because of the frequency of claims under warranty due to premature failures. Initially the use of plastics appeared promising because of the apparent ease of replacement of traditional tap top designs with mouldings of novel shape and the availability of decorative electroless coatings designed to give the articles the appearance of metallic quality.

The plastics used for the mouldings have, however, proved very susceptible to stress cracking and failure. The decorative coatings are not durable because of the poor surface adhesion caused by the big difference in thermal expansion characteristics.

Substitutes for plastics - tap tops - material that appears to be a good substitute for brass has its own drawbacks

The ease with which brass can be hot stamped, polished and plated means that modern designs of brass tap tops are available with a lifetime expectancy equal to that of the tap. They are available in plumbers' merchants at the same price as replacements for the inferior plastics ones.

Well designed attractive hot stamped brass tap top is a durable cost effective alternative.

Similar considerations apply to the taps themselves. The fact that stoving enamels are now available in a variety of durable colours and surface textures means that good quality brass taps can be designed and finished to meet any changes in fashion requirements.

Domestic Hardware

For many years brass has been the traditional material for door and window furniture but with changes in fashion other materials have been considered and used. Designers have met these challenges and extensive ranges of brass products of modern and traditional design are now available. These are made at economic costings on the latest production equipment. The use of brass by some designers has helped them achieve design awards recognising their skills.

Recent studies, referred to in CDA Publication No 34 Copper and Human Health, have shown that the copper content of brass is effective as a bacteriacide and hence very effective in minimising the transmission of pathogens. In any environment where health considerations are significant the use of clean brass door furniture is strongly recommended.

The Case for Brass

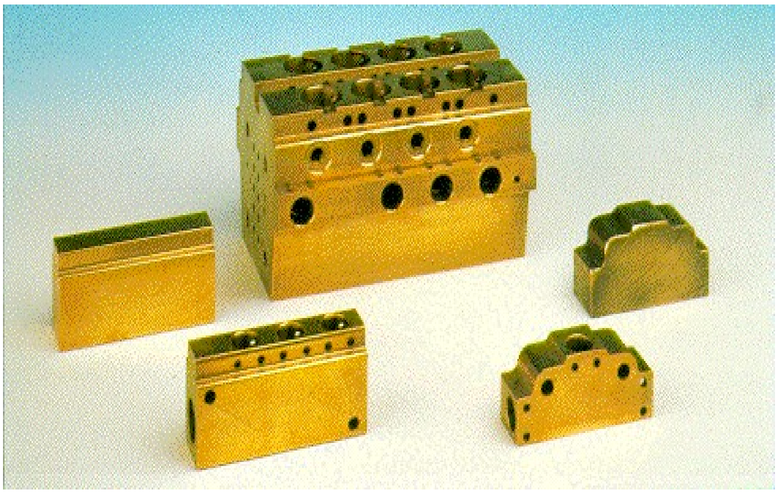
Good strength, ductility, corrosion resistance and spark-resistant properties, combined with ease of manufacture, make brass the ideal choice for use as the material for heavy-duty valve chests used for controlling complex hydraulic roof-supporting equipment. Safety and reliability are essential but in this international market, as elsewhere, competition is strong and costs must be kept to a minimum.

For many years, the manufacturers have been using brass and have been able to make many improvements in their designs. Close liaison has been maintained with suppliers regarding the qualities of brasses required for each application and the ways in which advantage can be taken of improvements in manufacturing techniques. A new design of valve chest made from a large extrusion in high tensile brass is illustrated. It enables many valves to be included in one component, minimising manufacturing costs. The soundness of the extrusion is, of course, vital for reliable operation of the valves and no problems have been experienced.

Close attention to the ways in which designers can take maximum advantage of the capabilities of the brasses is helping this industry to keep ahead of the competition.

The Facts

MECO International



The advantages can be clearly seen from this example of how MECO International used an extruded high tensile brass profile to replace the steel previously used in the manufacture of a typical valve body.

Comparisons per unit manufactured *

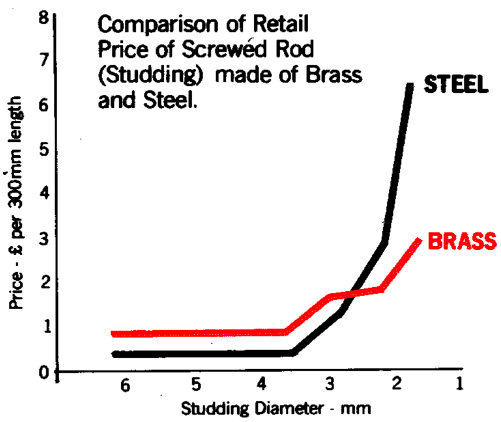
	High Tensile Brass	Steel
Requirements sought		
Relative working pressures	350 bar	350 bar
Non sparking for mining application	Yes	No
Actual cost to MECO per component		
Raw material cost	£6.22	£2.35
Pre-machining cost	-	£3.50
Milling	-	£2.50
Machining operation	£7.90	£11.70
Plating	-	£1.41
TOTAL	£14.12	£21.46

A saving of £7.34 per component was achieved over steel giving an annual saving in the order of £20,000.

(* Comparison costs supplied courtesy of MECO International)

Machining Cost Comparison

The real cost of producing a component is the sum of the cost of the material and the cost of work performed on it. It is obviously false economy to use material of the cheapest first cost if subsequent extra production costs outweigh the savings.



The graph shows typical retail costings of brass and mild steel screwed rod (studding) for sizes from 6mm down to below 2mm diameter. For the larger sizes where the predominant cost is that of the material then the mild steel is cheaper. Below 3mm diameter the ease of machining brass to close tolerances and a good surface finish makes it a cheaper product than the mild steel. While brass is normally specified for the reasons listed previously it can also be preferred simply because it is the cheapest.

The use of some materials can incur very high machining costs. Stainless steel components can be two to five times more expensive than identical items made in brass.

Material Manufacturers:

For Wrought Products

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For Cast Products

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