MCP
low melting-point alloys
for

TUBE and SECTION BENDING

Trouble with maintaining the profile?
Kinks on the inside of the bend?
Lost concentricity? Deformed annular gap?

No such problems with MCP fusible alloys ...

Sections, plain or complex - walls, thick or thin
Any metal ductile enough for bending, and
using conventional bending equipment and tooling

TUBE AND SECTION BENDING WITH LOW MELTING-POINT ALLOYS

The MCP low melting-point alloys recommended for tube and section bending have casting and mechanical properties specially suited to the optical industry.

ISO 9002 : 1994
Cert. no. FM 26958

MCP QUALITY

The alloys are produced from high-grade constituents, following strict specifications. Quality is monitored by an accredited system conforming to ISO 9002.

WORKPIECE SUPPORT FEATURES

The recommended MCP low melting-point alloys have mechanical properties that are unusually well suited to the task of support during bending. It is possible to maintain a constant cross-section during the process, which may be used successfully on sections at least as large as 120mm square.

It is also possible to preserve a uniform annular gap while avoiding wrinkling in bending concentric tubes, for which purpose the alloy replaces sand, shot or ice as the filler. The low melting-points ensure that the profile, tube or section is neither damaged nor distorted during filling and melt-out.

STABILITY AND DURABILITY

With proper attention to usage, the MCP low melting-point alloys can be re-used continually over periods extending into years. If the composition is found to have drifted away from the original specification, it can usually be corrected in-house by the user. For this purpose, a testing service is available at the Wellingborough production laboratory. The corrective amounts of constituents can be supplied as a specially formulated alloy.

CHOICE OF ALLOY

ALLOY DESIGNATION	MELTING POINT	CONSTITUENTS Bi	Pb	Sn	Cd	In	INDICATIONS FOR USE
MCP 70	70-75°C (158-167°F)	✓	✓	✓	✓		Needs immediate quenching after the filling. The low melting-point allows use of hot water for melting out.
MCP 79	79°C (174°F)	✓		✓		✓	As MCP 70, but lead- and cadmium-free.
MCP 124	124°C (255°F)	✓	✓				Suitable for larger sections. Requires no quenching, but the higher melt-out temperature means that an oil or other high boiling-point fluid is needed.

EQUIPMENT

A range of MCP melting pots and tanks with volumes up to 15 litres is available from stock. For your specific purpose, MCP can also design and supply equipment for melting, dispensing and recovery, able to cope with low volume, high precision work (e.g. wave guides) and large section, high volume, precision bending (such as aluminium structural profiles).

SAFETY AND THE ENVIRONMENT

The recommended alloys are not classified as 'dangerous' for either carriage or supply. They are easy to handle, and quite safe when the rules for normal handling are observed. As well as the standard Safety Data Sheet, a helpful Product Information Leaflet, giving practical advice on usage, is provided with every order acknowledgement.

How MCP Bending Alloys Work

1) Preparation The bore of the tube must be cleaned free from dirt, rust, scale and grease. Any form of dry cleaning can be used but pickling or wet treatments should be avoided as they may affect the performance of the oil film (see step NOTE: It is important that the tube is capable of taking the bend required. No supporting medium will help a tube which has not been properly annealed. If in doubt, check with the tube supplier.

2) Oiling To prevent alloy adhering to the bore of the tube after the melting-out operation, a continuous thin film of oil should be deposited on to the bore wall. This is best obtained by plugging one end of the tube filling with a straight mineral oil such as Shell Vitrea 27 and then drained to leave just a thin film. Motor oils are not suitable for this purpose, but soluble soaps can be used as an alternative.

3) Pre-heating Tubes must be warmed in order to prevent premature chilling of the alloy before the tube is completely filled. Water is a good medium for this operation but care must be taken to prevent water entering the tube.

4) Loading Molten MCP 70 alloy should be poured smoothly and steadily into the tube to fill completely in one operation. An alloy temperature of 85°C to 90°C is ideal for most sizes of tube but this may be increased for the smaller bore sizes 1/4" (6mm) and below.

5) Quenching This is a most important step as quenching ensures that the alloy is in its most suitable condition for bending. It must be carried out immediately after the alloy has been poured, and before it has solidified. The operation should ideally be carried out in a tank of circulating cold water and the tubes lowered in carefully to prevent movement of the alloy whilst molten. Tubes should not be removed until the alloy is completely solid and this could take approximately 15 minutes for a 1" (25 mm) tube.

6) Bending Allow the tube to reach ambient shop temperature after quenching. Slight warming (to 30°C maximum) may be necessary in very cold conditions. Bending should be carried out slowly and smoothly avoiding shock loading, using any of the conventional bending techniques.

7) **Bending** Allow the tube to reach ambient shop temperature after quenching. Slight warming (to 30°C maximum) may be necessary in very cold conditions.

8) Cleaning The unloaded tube should be left in the quenching tank for at least two minutes. This is necessary to ensure that no liquid droplets of alloy remain in the tube. A tight fitting pull-through passed 2 or 3 times from each end of the tube should leave the bore completely clean.

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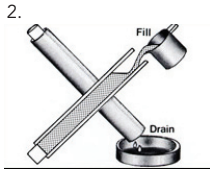

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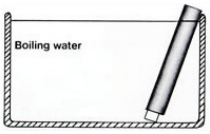

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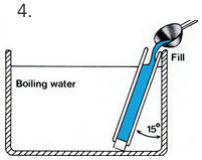

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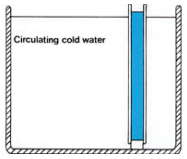

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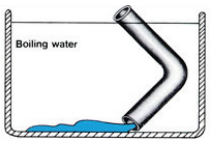

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Low Melting Point Bismuth Alloys

Low melting point, or fusible, alloys melt in the unusually low range of 117°F to 300°F. Containing bismuth, which expands on solidification, the alloys retain this distinct property. By adjusting composition, it is therefore possible to produce a series of alloys which have dimensional stability on casting, or have a significant degree of growth… as much as 0.005 inches per inch. Similarly, an infinite variety of melting points can be produced. Normally METSPEC alloys are used by simple gravity casting, but they are also pressure cast or sprayed. And, being stable metals, can be remelted and used again and again.

Positioning/Locating: When two parts have to be mated together in an exact relationship, there is NO BETTER METHOD than the use of METSPEC expanding fusible alloy. When any of the expanding METSPEC alloys is cast into a cavity it will exert outward pressure on the walls. Such close fitting between one part and another cannot be surpassed by the finest toolmakers. The necessity for expensive jigs or handwork, where very precise location is required, can be avoided by setting up the operative part in an oversize hole in the other, and by filling the gap quickly and precisely with a METSPEC alloy. The location of parts with a complicated section (e.g. blanking punches) is simplified greatly.

Holding: If an irregular part must be worked, a symmetrical block of METSPEC alloy cast around the piece will hold it rigidly while it is being machined. When the work is done, the alloy can be melted away in hot water. As another example, prescription optical lenses must be supported over their entire surface when they are ground and polished. The holding device must conform accurately to each individual lens. The high fluidity, low melting point and dimensional stability of METSPEC fusible alloys makes them ideal.

Supporting: Hollow parts and thin sections can be difficult to work because they are not strong enough to withstand the load imposed by machining. This problem is overcome by filling the workpiece with METSPEC alloy, forming a solid block. Another useful © advantage is that burrs are avoided because of perfect support by the alloy. Easy recovery of the alloy from the swarf makes the process inexpensive. In the same way, tubes and open sections can be loaded with a METSPEC fusible alloy before forming. They then behave as though solid and can be bent without rippling or flattening.

Joining: METSPEC alloys which contain tin and indium will wet other metals, and can be used like conventional solders with flux. Indium has the property of wetting glass, quartz, glazed ceramics and mica ... and when alloyed with tin, it makes an excellent joint between these materials and ANY solderable metal.

Forming: When conventional toolmaking techniques are too costly or slow, use METSPEC fusible alloys. Sheet metal forming tools are a good example, along with jigs and fixtures, dies for wax and plastic injection molding, blow molding, vacuum forming tools and molds for resin or plaster.

Dimensional stability and low melting points which are essential for fusible cores are available in METSPEC alloys, and they are widely used for high precision electroforming mandrels or coring cast resins and reinforced plastics.

Duplicating/Imaging: The difficulty of visualizing cavities as solid forms or reverse engravings in their true perspective is usually overcome by proof casting. Inspection of a diesinker's work is best done by casting a METSPEC alloy into the die, obtaining an exact reverse reproduction. They are used widely in dieshops and toolrooms where accuracy is a must.

Annealing: METSPEC alloys maybe used as furnace seals, heat treating baths or as heat transfer media.

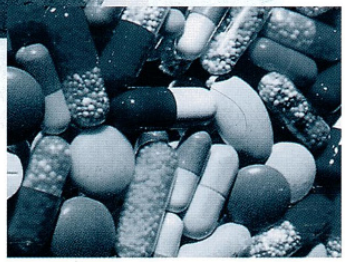
Fusible Core:
Fusible alloys provide a wonderful alternative to the lost wax process for reproducing intricate internal details, for example the inlet manifold for an internal combustion engine. The alloy is cast or formed into the shape required which is then over molded with plastic. The alloy is easily removed by melting at low temperatures.

MCP Metalspecialties, Inc.

specializes in the minor metals, their alloys and chemicals. Minor metals, such as Bismuth, Indium, and Gallium are by-products in the refining of better known metals, e.g., Lead, Copper and Zinc.

Products	• Metals • Alloys. METSPEC • Chemicals
Quality	• USA, UK and German Plants ISO 9002 approved
Service	• Reliable, just in time deliveries • Stock for blanket orders • Reclaim and repurchase
Experience	• Over 100 years

METSPEC Alloys' unique properties are ideal for dealing with difficult production problems of gripping awkwardly shaped components, such as turbine and jet engine blades during machining.



METALS

MCP Metalspecialties, Inc. offers a wide range of refined metals for use in a multitude of industries. These metals are refined and manufactured into an extensive range of alloys, additives and chemical compounds for various demanding industrial applications.

		Grades				
Elements	**Commercial**	**3N**	**4N**	**5N**	**6N**	**7N**
Antimony	99.65			☆		
Arsenic				☆	☆	
Bismuth	99.99, 99.997			☆		
Boron	99.5			☆		
Cadmium	99.95		☆	☆		
Chromium	99.5		☆			
Cobalt	99.93					
Gallium	99.99	☆	☆	☆	☆	☆
Germanium				☆	☆	
Indium	99.99		☆	☆	☆	☆
Lead	99.99	☆	☆			
Manganese	99.7					
Nickel	99.95					
Phosphorus, Red					☆	
Rhenium	99.99		☆			
Selenium	99.5		☆	☆		
Silicon	99.99		☆			
Tellurium	99.5		☆	☆		
Tin	Grade A:99.85 min.		☆	☆		
Zinc	99.99		☆	☆	☆	

Fabricated 99.99% Indium

Wire	0.040" to 0.40" diameter
Sheet	0.005" to 0.010" thick
Ribbon	up to 3 feet long

The efficacy of Bismuth salts was established in the 17th Century and they are still used actively today as some of the most effective ingredients for gastric ailment remedies.

ALLOYS

Low temperature or fusible alloys are sold under the METSPEC trade name.

Special Properties.
The standard alloys can be liquid at temperatures as low as 117°F and are based on bismuth, which has the unusual property of expanding when it solidifies. Other metals, except for antimony, contract, so alloys can be designed to expand, contract or occupy a similar volume to the melt from which they have solidified.

For the most part, Bismuth-based fusible alloys continue to grow slightly for some time after casting, sometimes after an initial period of shrinking. This often valuable property is caused by slow changes in the crystal structure within the casting--in fact, by a process of annealing.

Alloys molten at room temperature can also be made.

Technical Data.
The METSPEC fusible range contains a basic core of the nine alloys mentioned in the table of applications.

Write/phone/fax today for the METSPEC Applications Specific Leaflet.

Application	Low melting point	Precise melting point	Dimensional stability	Growth/ shrinkage	Low viscosity	Opacity to radiation	Electrical conductivity	Spray capability	Recommended METSPEC Alloy
Optical lens blocking	✓	✓	✓	✓	✓		✓		117, 136, 158
Radiation shielding	✓				✓	✓		✓	158, 203
Fusible core technology	✓	✓	✓	✓	✓		✓		136, 203, 281, 390
Workholding & support	✓		✓	✓	✓		✓		281
Tube & section bending	✓				✓		✓		158, 174, 255
Sheet metal or composite forming	✓		✓	✓	✓		✓		281
Thermal safety devices	✓	✓							specific to case
Mold and die making	✓		✓		✓		✓	✓	281, 281/338, 390
Pattern making & copying	✓		✓		✓		✓		281, 281/338, 390
Proof casting	✓		✓		✓				255, 281/338
Magnetic/electrode anchoring	✓			✓	✓	✓	✓	✓	281
Specialized soldering	✓	✓	✓				✓		specific to case

MASTER ALLOYS

Master alloys are used to add one of the metals to the melt containing the other metal.

- Bismuth-Manganese
- Bismuth-Tellurium
- Ferro-Boron
- Ferro-Selenium
- Tellurium-Copper
- Others by request
- Selenium-Antimony
- Selenium-Arsenic
- Ferro-Titanium
- Ferro-Tellurium
- Tellurium-Manganese-Iron

CHEMICALS

MCP Metalspecialties, Inc. offers an extensive range of chemicals of Bismuth and Indium...

- Bismuth Oxide
- Bismuth Subnitrate
- Bismuth Subgallate
- Bismuth Subcarbonate
- Bismuth Subsalicylate
- Bismuth Subcitrate
- Bismuth Oxychloride
- Indium Hydroxide
- Indium Trichloride
- Indium Acetate
- Indium Oxide

Applications include pharmaceuticals, glass frits, ceramics, alkaline batteries, electronic displays, plastics and pigments.

	METSPEC 117	METSPEC 136	METSPEC 158	METSPEC 158/190	METSPEC 255	METSPEC 281	METSPEC 281/338
Melting Point or Range—°F	117	136	158	158-190	255	281	281-338
—°C	47.5	58	70	70-88	124	138.5	138.5-170
Density—(LB/IN³)	0.34	0.33	0.35	0.36	0.39	0.31	0.30
—(GM/CM³)	9.36	9.23	9.67	9.98	10.73	8.58	8.21
Specific Heat (CAL/GM°C)							
—Solid	0.039	0.040	0.035	0.036	0.030	0.040	0.043
—Liquid	0.047	0.048	0.044	0.043	0.037	0.048	0.051
Heat of Fusion (CAL/GM)	8.8	6.9	9.5	8.2	5.0	10.7	10.6
Coefficient of Thermal Expansion (x10⁻⁶/°C)	25	23	22	24	21	15	15
Thermal Conductivity (CAL/S CM°C)							
—Solid	0.035	0.024	0.043	0.041	0.022	0.044	0.071
Electrical Conductivity (% of Pure Copper)	3.34	2.43	4.17	4.27	1.95	5.00	7.77
Resistivity (MICROHM-CM)	55.0	78.8	48.0	46.7	98.7	59.0	34.0
Brinell Hardness (2mm ball, 4 kg load)	14.5/16.5	14/16.5	13/14.5	12/15	14/15	23/23	23.5/24
Tensile Strength (LBS/IN²)	4868-5337	5621-5706	2668-3775	3108-4471	4514-6898	8701-9013	8459-9041
Maximum Sustained Load (LBS/IN²)—30 Secs	—	—	10,000	9,000	8,000	15,000	15,000
—300 Secs	—	—	4,000	3,800	4,000	9,000	9,500

GROWTH and SHRINKAGE

Cumulative changes, inches per inch, relative to cold mold dimensions. Test bar—½ x ½ x 10 inches.

	METSPEC 117	METSPEC 136	METSPEC 158	METSPEC 158/190	METSPEC 255	METSPEC 281	METSPEC 281/338
Time after casting							
6 minutes	−.00025	−.00005	+.00490	+.00045	−.00115	−.00010	+.00030
20 minutes	−.00030	−.00005	+.00565	+.00255	−.00100	.00000	+.00035
1 hour	−.00025	−.00005	+.00570	+.00285	−.00045	+.00015	+.00060
8 hours	−.00020	−.00005	+.00600	+.00305	+.00105	+.00045	+.00095
1 day	−.00015	+.00005	+.00615	+.00310	+.00165	+.00060	+.00105
1 month	+.00025	+.00080	+.00635	+.00345	+.00340	+.00090	+.00120

What MCP Metalspecialties means to you...

☆ Reliability

Our on-time deliveries that are reliable and consistent.

☆ Quality

Metals and alloys and chemicals manufactured to ISO 9002. Bismuth chemicals are also manufactured in an FDA inspected plant.

☆ Experience

The MCP Group offers 100 years of leadership and experience in refining, alloying and the chemistry of minor metals.

☆ Technical Support

Separate leaflets are available on request.

☆ Our products are Recyclable

A reclaim or repurchase program on our products is available to our customers.

☆ Integrity

MCP Metalspecialties' unswerving commitment to both integrity and customer service is the company's hallmark. Our technical staff work closely with customers... creating a range of products and processes that meet the increasingly complex demands of the industrial world. Your requests for information and products are met with accurate rapid response.

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