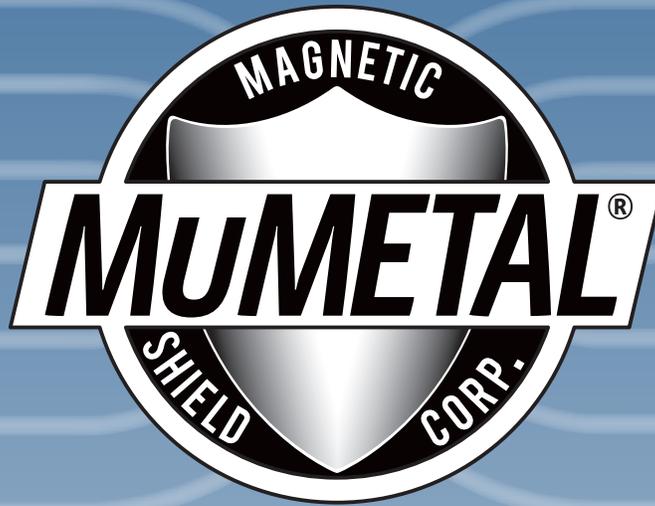


**MOST RECOGNIZED BRAND OF MAGNETIC SHIELDING ALLOY WORLDWIDE**



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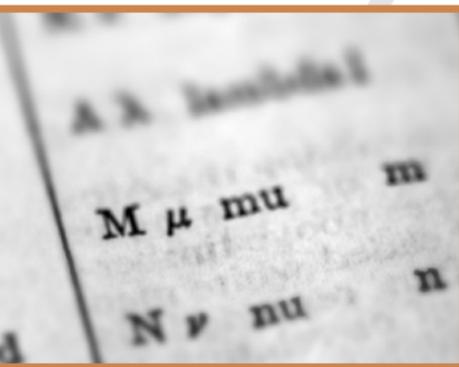
# MuMETAL® ALLOY for FABRICATED SHIELDS

Greek Letter  $\mu$  (Mu) Represents Permeability of Mu-Metal



Stock ZG-206 MuMETAL® Zero Gauss Chamber shown  
Custom sizes & configurations available

## HISTORY OF $\mu$ (Mu) METAL



$\mu$  (Mu) - The 12th letter of the Greek alphabet, is used in physics & engineering formulae to represent permeability, the measure of a material's ability to support the formation, or absorption, of a magnetic field within itself. In other words, permeability ( $\mu$ ) is a value representing the degree of magnetization obtained in a material from an externally applied H-field. Because our alloy provides maximum permeability in magnetic shielding, it has been permanently named after the Greek letter  $\mu$  (Mu). For decades, scientists, engineers, metal suppliers and fabricators have referred to mumetal as the industry standard. However, MuMETAL® is a registered trade name and exclusively available from Magnetic Shield Corporation, a worldwide leader in low-frequency magnetic shielding.

As a leading expert since 1941, Magnetic Shield Corporation has developed thousands of technical solutions, supplied millions of fabricated shields, and refined our shielding materials to be the most effective alloys available. MuMETAL® has been formulated to provide maximum magnetic permeability (highest degree of shielding) for use in most electrical /electronic applications found today, earning its reputation as the most specified shielding alloy by OEMs, fabricators, laboratories & universities, and specialty alloy distributors.

Technical professionals and buyers beware: There are certain foreign and domestic metal companies that misrepresent MuMETAL®. Care must be taken to ensure consistency, quality, and shielding efficiency. Specifying MuMETAL® and Magnetic Shield Corporation as the material of record increases confidence throughout the product life cycle. Long-standing customers have told us MuMETAL® provides consistent results in laboratory evaluation and testing so they insist on MuMETAL® for production parts - this explains why MuMETAL® is used by thousands of customers worldwide.

*When your drawing or specification calls for MuMETAL®, be sure to contact Magnetic Shield Corporation.*

## COMPARE OUR PROPRIETARY BRANDS

Although MuMETAL® is our most widely known brand, Magnetic Shield Corporation offers several other alloys which are used for similar, but different applications. By design, each type of shielding alloy will attract magnetic flux lines of the interfering field to itself and divert the unwanted field away from sensitive areas or components. Considering the source field intensity ( $H_0$ ) and amount of attenuation (reduction) required, the right shielding alloy can now be selected.

MuMETAL® is used primarily in low intensity fields where high attenuation, high initial permeability and high shielding efficiency are desired. Available as stress annealed (partially annealed for ease of machinability) sheet stock is used for fabricated shields such as enclosures, cylinders, cans, channels or 3D boxes. Typically, atmospherically controlled annealing is required after stamping, machining, bending, rolling or welding to provide maximum shielding performance. MuMETAL® Stress Annealed alloy is available in many forms, but most shields are fabricated from our sheet stock in gauges from .014" to .062" thickness [0,36mm to 1,57mm]. MuMETAL® Foil is fully annealed and available in stock gauges from .002" to .010" thickness [0,05mm to 0,25mm].

Co-NETIC® is also used where high attenuation is desired. Available as fully annealed, ready for use in shielding applications, it is used for flat shields such as covers, doors, walls or flat surfaces. Co-NETIC® is fully annealed to exacting specifications in a quality controlled environment which builds grain structure, an important mechanical property for ultimate shielding performance. Co-NETIC® AA Perfection Annealed alloy is available in foil & sheet stock gauges from .002" to .062" thickness [0,05mm to 1,57mm].

NETIC® is often applied in fields of high intensity (strong fields) because of its high magnetic saturation characteristics. NETIC® is commonly used in combination (in layers) with Co-NETIC® or MuMETAL®, with the NETIC® layer placed closest to the source of interference. Used for either fabricated or flat shields, it may be re-annealed for better performance. NETIC® is available in foil & sheet stock gauges from .004" to .095" thickness [0,10mm to 2,41mm].

### PRODUCT RANGE:

Thickness		Stock	MuMETAL®	Co-NETIC® AA	NETIC®
inches	[mm]	Type <sup>(1)</sup>	Stress Annealed <sup>(1)</sup>	Perfection Annealed	Stress Annealed
.002	[0,05]	Foil (coil)	X	X	
.004	[0,10]	Foil (coil)	X	X	X
.006	[0,15]	Foil (coil)	X	X	
.008	[0,20]	Foil (coil)	X		
.010	[0,25]	Foil (coil)	X	X	X
.014	[0,36]	Sheet (flat)	X	X	X
.020	[0,51]	Sheet (flat)	X	X	X
.025	[0,64]	Sheet (flat)	X	X	X
.030	[0,76]	Sheet (flat)	X	X	X
.040	[1,02]	Sheet (flat)	X	X	X
.050	[1,27]	Sheet (flat)	X	X	X
.062	[1,57]	Sheet (flat)	X	X	X
.095	[2,41]	Sheet (flat)			X
.125	[3,18]	Sheet (flat)	special order	special order	special order

<sup>(1)</sup>Various widths & lengths are available from stock. MuMETAL® Foil is fully annealed. Refer to Price Lists for volume-price discounts.

## MUMETAL® ZERO GAUSS CHAMBERS

An example of how MuMETAL® is used to create a low-field environment is seen in one of our most popular research products. Fabricated from MuMETAL® alloy, and field proven to be effective is the Magnetic Shield Corporation Zero Gauss Chamber. These scientifically engineered chambers provide a laboratory work space of extremely low magnetic field.

MuMETAL® Zero Gauss Chambers have been used worldwide by many universities, private research companies, national laboratories and companies required to provide evidence for military or consumer regulatory compliance. Our chambers are preferred because they are made from high permeability ( $\mu$ ) stress annealed MuMETAL®. A consistent, low-field environment is achieved by high attenuation of both DC and AC external magnetic fields. Zero Gauss Chambers are effective because of layering. When two or more concentrically spaced magnetic shields are used in series (one inside the other), the external field is attenuated (reduced) by each layer. Although custom chambers are available in different diameters, lengths, thicknesses and configurations, most applications are solved with one of our standard models.

Our standard Zero Gauss Chambers have three layers of MuMETAL® and are designed to attenuate external fields 1,000 to 1,500 times. In our standard configuration, each of the three magnetic shield layers consists of a cylinder with one closed end and one open end (access opening). A close-fitting, removable cover is provided on the access opening end. Of all geometric shapes, a cylindrical configuration is one of the most effective for absorbing external magnetic flux lines, thus creating an efficient magnetically shielded finite space.

For more information about our MuMETAL® Zero Gauss Chambers, visit [www.magnetic-shield.com](http://www.magnetic-shield.com).

### ZERO GAUSS CHAMBERS:

stock #	MuMETAL®		Work Area (inner chamber)			A = Attenuation <sup>(2)</sup>		
	inches	[mm]	diameter	length	volume	1 Layer	2 Layers	3 Layers
ZG-206	.025	[0,64]	6"	15"	424 in <sup>3</sup>	25	200	1575
ZG-209	.030	[0,76]	9"	27"	1717 in <sup>3</sup>	24	190	1490
ZG-212	.040	[1,02]	12"	36"	4071 in <sup>3</sup>	23	185	1475
ZG-218	.062	[1,57]	18"	54"	13740 in <sup>3</sup>	23	180	1475

<sup>(2)</sup>Attenuation is estimated using a theoretical formula as the ratio of measured field before shielding to that measured after shielding. Typically, attenuation decreases in shields of larger volume, thus thicker layers of MuMETAL® are required. Attenuation ratios above are estimated at room temperature in an Earth field of 0.5 Gauss - actual results will vary in different operating environments.

## MUMETAL® TYPES & SPECIFICATIONS

MuMETAL® is typically stocked in a stress annealed state to allow further fabrication, stamping, severe forming or welding. During fabrication, a material's grain structure is weakened. After final fabrication processes are completed, grain structure is then modified by controlled atmospheric annealing to relieve stress in the material, resulting in larger grain structure, softer temper, and ultimate shielding performance. Although MuMETAL® is available in many forms, most shields are fabricated from foil or sheet stock.

### AVAILABLE PRODUCT TYPES:

Form	Available Thickness		Available Sizes (inches)		Anneal type <sup>(3)</sup>
	inches	[mm]	Width	Length	
Foil <sup>(3)</sup>	.002 to .010	[0,05] to [0,25]	up to 8"	sold per foot	Perfection
Sheet	.014 to .125	[0,36] to [3,18]	up to 24"	up to 120"	Stress
Plate	.125 to 1.00	[3,18] to [25,4]	up to 9"	up to 30"	Stress
Bar	.125 to 2.00	[3,18] to [50,8]	up to 2"	up to 120"	Stress
Rod ( $\emptyset$ )	.040 to 2.00	[1,02] to [50,8]	~	up to 120"	Stress
Wire ( $\emptyset$ )	.005 to .079	[0,13] to [2,00]	~	sold by weight	Stress

<sup>(3)</sup>Foil is offered as Perfection Annealed (fully annealed) only. All other Forms are Stress Annealed and typically require atmospherically controlled, full-anneal after fabrication or welding to provide maximum shielding performance.

### TYPICAL ANNEALED PROPERTIES:

0.2% Yield Strength	49 ksi (338 MPa)
Density	0.316 lb/in <sup>3</sup> (8.25 g/cm <sup>3</sup> )
Tensile Strength	99 ksi (682 MPa)
Electrical Resistivity	47 micro-ohm cm
Elongation	32% in 2" (51 mm)
Grain Size	ASTM 7 or finer
Hardness	15T 85

### TYPICAL MAGNETIC PROPERTIES:<sup>(4)</sup>

DC $\mu$ @ 40 gauss	80,000
DC $\mu$ @ 100 gauss	105,000
DC $\mu$ maximum	350,000
DC $H_c$	0.0005 Oe
DC $B_c$ (gauss)	4,000
AC 60Hz $\mu$ @ 40 gauss	65,000

<sup>(4)</sup>Data are typical of .014" [0,36mm] annealed sample and should not be construed as maximum or minimum values for specification or final design. Data for each material thickness and/or lot may vary.

### SPECIFICATIONS:

MuMETAL® conforms to ASTM A-753, Alloy 4 and MIL N-14411C, Composition 1

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**MuMetal® Official Site**

MuMetal® highest permeability alloy  
In stock at Magnetic Shield Corp.

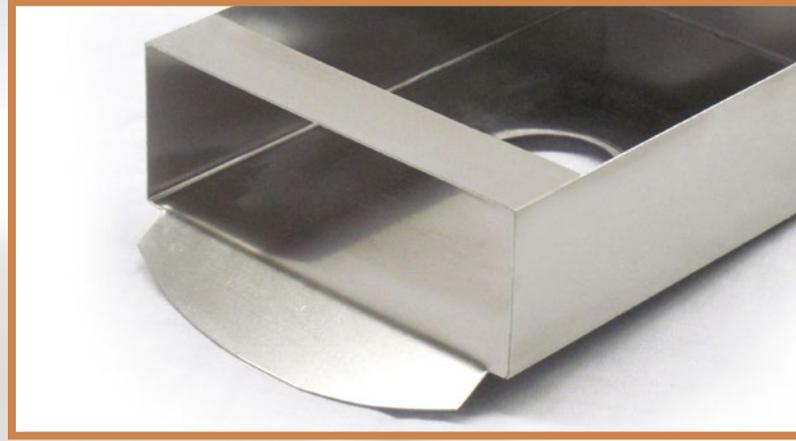
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## FABRICATED SHIELDS & FINISHING

### FABRICATION

When your shield design requires severe forming, stamping and/or welding, specifying MuMETAL® on your drawings insures you will receive the highest level of initial permeability and shielding efficiency available. And, MuMETAL® is formulated and manufactured to exacting standards which allow consistent fabrication and final anneal.

Not only does Magnetic Shield Corporation offer MuMETAL® alloy, we can provide a full range of manufacturing services. From your drawing or sketch, we can waterjet, laser, EDM, shear, slit, punch, blank, stamp, chemical etch, form, bend, roll, spot-weld, heliarc weld, and/or laser weld. Using MuMETAL® alloy, we can produce complete magnetic shields, to your drawings or specifications.



### FINAL ANNEAL

After fabrication, final annealing is required to increase grain structure, which improves shielding efficiency. MuMETAL® magnetic shields are Perfection Annealed (fully annealed in a controlled hydrogen atmosphere) to Magnetic Shield Corporation's exacting standards. Optimum magnetic properties of MuMETAL® are obtained by annealing at a temperature of 2050°F [1121°C], and cooling at a consistent rate which is critical to maintaining grain structure and part dimensions. To insure your shield is annealed properly, we can measure attenuation (a shield's ability to absorb magnetic energy) in our ISO 9001:2008 certified Quality Control Lab. Fully annealed MuMETAL® offers magnetic properties that are considered the best available for most applications worldwide.

### FINISHING

After full anneal, MuMETAL® shielding alloy exhibits a clean, bright surface condition. Also, because of its high nickel content, MuMETAL® alloy is corrosion resistant. Consequently, MuMETAL® alloys are usually used as annealed, without further finishing operations. We do offer a variety of finishing operations including painting, powder coating, polishing and plating to customers requiring additional corrosion resistance or cosmetically pleasing finished parts.

You are invited to call our Engineering Department to discuss your fabrication and finishing requirements. For a prompt and accurate quotation, send a drawing, sketch, or written description to [shields@magnetic-shield.com](mailto:shields@magnetic-shield.com).



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