

# MAGNETIC SHIELD CORP.

Since 1941



# LAB KITS

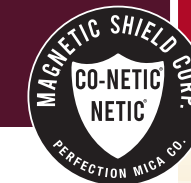


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**EVALUATION KITS FOR**  
**Science**  
**Research**  
**Development**  
**Design**  
**Engineering**  
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# MAGNETIC SHIELDING LAB KITS for Science • Research • Development • Design • Engineering • Construction



Lab Kit Internet Special

Save 10%

INCLUDES LK-110 LAB KIT AND EF-401 GAUSSMETER



PART NO: LK-110-IS SHOWN

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## “HANDS-ON” EVALUATION

Global businesses, engineers, scientists, inventors, educators and homeowners in over 80 countries have used our Lab Kits and shielding materials for hands-on evaluation. Our Lab Kits, which contain various samples of our proprietary shielding alloys and technical information, have helped many individual consumers and technical professionals solve unwanted magnetic interference from low frequency AC source fields (0 Hertz to 100 kiloHertz). Although the evaluation process can vary by application, the following steps are generally followed by all, for “hands-on” evaluation.

### 1. DETERMINE SOURCE OF INTERFERENCE

Internal interference is created by operating components within a system, affecting each other. This can be neutralized by shielding the individual components and confining the magnetic forces they create. External interference is created by a source outside the system which may affect many components or a large area. In this case, the entire unit being affected must be shielded by an enclosure, a chamber, or walls.

### 2. LOCATE & MEASURE THE MAGNITUDE OF INTERFERENCE

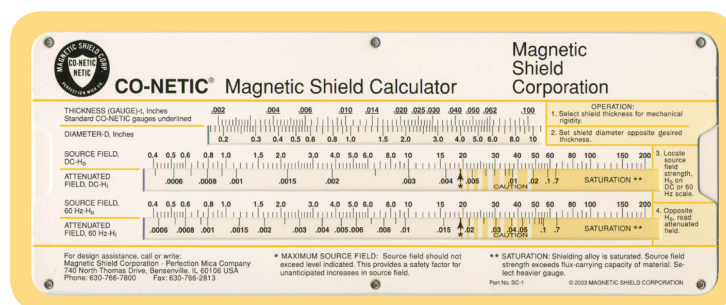
Locating internal or external interference and determining the magnitude (strength) of the interfering field are important in shielding alloy selection. How do you “see” magnetic fields? By using a Gaussmeter, the field strength is measured in “Gauss”, and output into numeric values. For AC fields, use one of our Magnetic Pickup Probes with a digital volt meter (DVM) or oscilloscope, or use one of our Gaussmeters to measure the interfering field strength. These measurement devices are included with certain Lab Kits, or sold separately. Field mapping, or plotting of these measurements, will provide a baseline and help determine effectiveness of your magnetic shield.

To order a Magnetic Pickup Probe or Gaussmeter, see [Contents and Lab Kit Options](#) on the following page.

### 3. CALCULATE SHIELDING REQUIREMENTS

Formulas are used to determine which materials and thicknesses will provide the most effective shielding. The source (interfering) field known as  $H_0$  is measured in Gauss. Knowing  $H_0$ , and estimating the approximate size of your shield, shield thickness can be determined. Certain characteristics of the shielding alloy are given, such as permeability ( $\mu$ ), saturation induction, and flux density (B). Using these formulas can provide theoretical values. See back cover for common formulas.

To simplify these formulas, we have developed the Co-NETIC® Slide-Rule Calculator. Our easy to use calculator provides a quick reference for comparing thickness of Co-NETIC® alloy required to effectively shield the source field ( $H_0$ ) vs. diameter (size) of the magnetic shield you will use (calculated as a theoretical cylinder). The calculator compares the source field ( $H_0$ ) to the attenuated field ( $H_1$ ) in Gauss, for both DC and 60Hz AC fields, and has a scale that covers most common requirements and applications we've seen over past decades. A Slide-Rule Calculator is included with each Lab Kit to aid in material thickness selection.



## MATERIAL SELECTION

By design, each type of shielding alloy will attract magnetic flux lines of the interfering field to its self 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 proper shielding alloy can now be selected.

- ◊ **Co-NETIC®** is used primarily in low intensity fields where high attenuation is desired (high initial permeability & high shielding efficiency). Lab Kits contain our most popular gauges of Co-NETIC® AA Perfection Annealed alloy, which is considered far superior in shielding performance due to its consistent quality, material composition and perfection annealing process.
- ◊ **MuMETAL®** is our trademarked brand and considered the most popular shielding alloy for fabricated shields, worldwide. Typically, final annealing is required after fabrication or welding MuMETAL® Stress Annealed alloy into a cylinder, can, box or enclosure (3D shield).
- ◊ **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®. If used in combination, the NETIC® layer is placed closest to the source of interference, with Co-NETIC® or MuMETAL® layer closest to the component being shielded.

## BUILDING A PROTOTYPE SHIELD

Using our Lab Kits, shielding can be prototyped with everyday common hand-tools, or bench-top and model-shop equipment. Layers of material from a Lab Kit can be added until the unwanted field is reduced (attenuated) to the desired level. Your prototype then serves as a production model. Further changes in layout, field intensity, or component orientation can be easily evaluated without relying on imprecise theoretical formulae. Shield design should consider the following:

### OPTIMAL SHAPES & SIZE:

- ◊ Completely enclosed spherical configuration is theoretically ideal
- ◊ Effective shapes are cylinders, cans and 5-sided boxes
- ◊ Flat shields are effective if L x W extend beyond the field area and the affected component

### EFFECTIVE SHIELD DESIGN:

- ◊ Provide 1/4" gap (air space) between the shield and component to be shielded
- ◊ Enclosure of the component by the magnetic shield should be as complete as possible
- ◊ Shields should be 5 or 6-sided until it can be determined that less enclosure is effective

### LAYOUT AND PATTERNS:

- ◊ Cardboard, or paper templates can be used to check fit before cutting the shielding material
- ◊ Seams and joints should be held to a minimum
- ◊ Overlap material 1/2" to 3/4" at each joint to simulate welded or fabricated joints

### FORMING A PROTOTYPE:

- ◊ Hand forming of shaped shields can be done easily with foil
- ◊ Roll forming may be necessary for cylindrical shapes
- ◊ Right-angle bends should have a min. inside radius two times metal thickness to avoid work-hardening & preserve shield permeability

### JOINING METHODS:

- ◊ Soldering overlapped seams may create a non-magnetic gap
- ◊ Spot-welding is effective to fuse the alloy, making a stronger magnetic path
- ◊ Heliarc welding is optimal. Butt-joints are clean & reduce material use
- ◊ Welding must be followed by re-annealing
- ◊ Pressure Sensitive Tape (included in Lab Kits) is used to join shields or adhere shield to components

## NEXT STEPS

Measure and compare the resulting field strength to your initial results (field mapping). Remember, additional layers of material may be added until the unwanted field is attenuated to the desired level.

**Need more material or larger sizes?** We can shear or slit our stock sizes to meet your needs. Most of our alloys are sold by the foot so you can purchase in small quantity for further evaluation and sampling.

**Need a quote for shield fabrication?** Once your shield design has been proven, send a sketch or drawing to our experienced technical team for review and production quotation. We can provide our stock alloys or finished/fabricated parts, annealed for shielding performance and ready for use. We offer a full line of fabrication capabilities to customers worldwide.

## CONTENTS AND LAB KIT OPTIONS

### LK-110 ~ BASIC KIT

Co-NETIC® AA Perfection Annealed Foil & Sheet \*  
1pc .002" x 15" x 4"  
1pc .004" x 15" x 10"  
1pc .006" x 15" x 8"  
1pc .010" x 15" x 10"  
1pc .025" x 15" x 10"

Co-NETIC® AA Braided Sleeving  
1pc 1/2" ID x 12" long

NETIC® ET  
Tin Plated NETIC® Foil  
1pc .010" x 4" x 15"

NETIC® S3-6 Foil & Sheet  
1pc .004" x 15" x 10"  
1pc .030" x 15" x 10"

1pc 8ft roll double-faced, pressure sensitive tape  
1pc Binder w/technical literature & Slide-Rule Calculator

\*All Co-NETIC® AA material is Perfection Annealed and does not require re-annealing unless severe forming or heliarc welding is performed. For Stress Relieved material, required for stampings, severe forming or heliarc welding, request our MuMETAL® alloy.

### LK-120 ~ EVALUATOR'S KIT

Includes all items in LK-110 listed above, *plus:*  
1pc AC Magnetic Pickup Probe, Model EP-101A

### LK-110-IS ~ INTERNET SPECIAL ~ SAVE 10%

Includes all items in LK-110 listed above, *plus:*  
1pc Single-axis Gaussmeter, Model EF-401

### OPTIONAL GAUSSMETER AND PICKUP PROBES

See back for product information.

## CONTACT US TODAY



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www.magnetic-shield.com



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shields@magnetic-shield.com

“STARTING WITH A LAB KIT INCREASES CONFIDENCE, MINIMIZES TRIAL AND ERROR, AND REDUCES PRODUCT/PROJECT COSTS.”

Mark D. Wickler – President, Magnetic Shield Corporation

## FORMULAS AND DESIGN CONSIDERATIONS

### SATURATION OF SHIELDING MATERIALS

Saturation is the point at which a shielding material is full. No additional flux can be absorbed. In calculating shield design, the flux density (B) should be less than 7,500 Gauss for Co-NETIC® and less than 21,000 Gauss for NETIC® to avoid saturation. If the flux density is greater, thicker material or multiple layers are required. For high attenuation of low to moderate strength fields, a single layer of Co-NETIC® alloy is normally adequate. In high strength fields, light gauge Co-NETIC® may saturate and become less effective. If layers of NETIC® and Co-NETIC® are used in combination, to increase the flux capacity, the NETIC® material should always be placed nearest to the source of interference.

### FLUX DENSITY ~ GAUSS (B)

Flux density of the shield material in Gauss (*ref. Saturation of Shielding Materials above*)

$$B = (1.25 * D * H_0) / t$$

D = diameter of shield (*approx. cylindrical size required to shield affected component*)

H<sub>0</sub> = source (interfering) field in Gauss (*measured at the proposed shield location*)

t = thickness of shielding alloy (*material selected from the Lab Kit*)

### ATTENUATION RATIO OF DESIGNED SHIELD

The shielding efficiency of a magnetic shield is specified as the Attenuation Ratio (reduction ratio). This is the ratio of measured field before shielding to that measured after shielding. Attenuation, measured in decibels (dB), is simply 20 times the logarithm to the base 10 of the shielding ratio.

A properly designed single layer Co-NETIC® shield of small size will easily provide 30 to 40 dB attenuation. Attenuation of 60 dB or more is attained by utilizing multiple layer shielding, such as found by using our three-layer Zero Gauss Chambers.

Typically, attenuation decreases in shields of large volume, unusual shape/configuration, or with large openings (leak points).

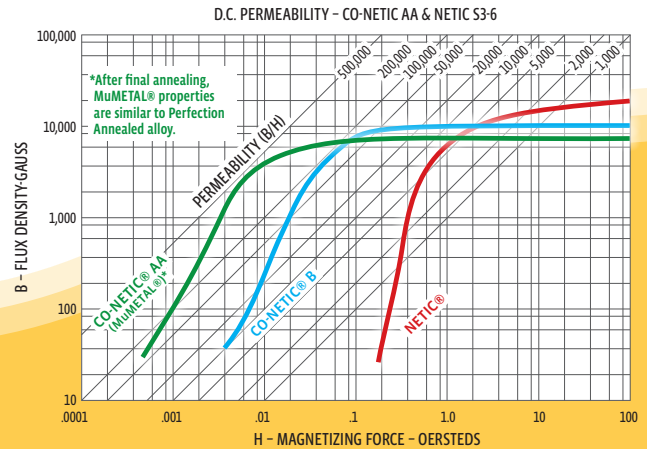
A simple formula for estimating attenuation ratio of a cylindrical shield is:

$$A = (\mu * t) / D$$

μ = known permeability of the shielding alloy (*at flux density B*)

t = thickness of shielding alloy (*material selected from the Lab Kit*)

D = diameter of shield (*approx. cylindrical size required to shield affected component*)



### RADIO FREQUENCY (RF) SHIELDING

Our alloys provide interference control of H-fields, DC or AC to 100 kiloHertz, and differ fundamentally from RF shielding. Shielding for E-fields at radio frequencies (RF) above 100 kiloHertz involves use of high conductivity materials such as Copper, Aluminum or certain conductive coatings.

Because Co-NETIC®, MuMETAL® and NETIC® alloys are also conductive, they can shield high frequency (RF) fields, even though they are formulated specifically for low frequency magnetic fields. When both high frequency and low frequency fields are present, our alloys may be most effective if grounded and designed with proper RF shielding practices.

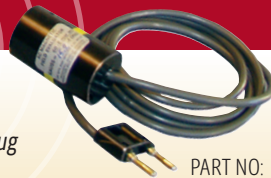
### EP-101 ~ Pickup Probes

Three options available:

**EP-101A** ~ AC Magnetic Pickup Probe  
Axial directional with 2-prong banana plug

**EP-102A** ~ AC Magnetic Pickup Probe  
Axial directional with BNC connector

**EP-102T** ~ AC Magnetic Pickup Probe  
Transverse directional with BNC connector



PART NO:  
EP-101A  
SHOWN

These field evaluator probes can be used with a digital volt meter (DVM) or oscilloscope to measure AC magnetic field intensities and attenuation ratios. These probes are accurate for direct measurements from 10Hz to 3000Hz in Axial or Transverse directions. Each probe is calibrated at Magnetic Shield Corporation.

Note: The EP-101A field evaluator probe is included with Lab Kit LK-120.

### EF-401 ~ Gaussmeter

A cost effective, handheld, single-axis AC magnetic field meter that provides quick & reliable measurements of electromagnetic field (EMF) radiation generated by external sources like power lines, electrical wiring, motors, audio/visual equipment and other devices.



No probe is required – just position this Gaussmeter in the affected area. For detailed specifications and to order, go to: [www.magnetic-shield.com](http://www.magnetic-shield.com). May be purchased separately, or as part of our Internet Special, saving you 10%.