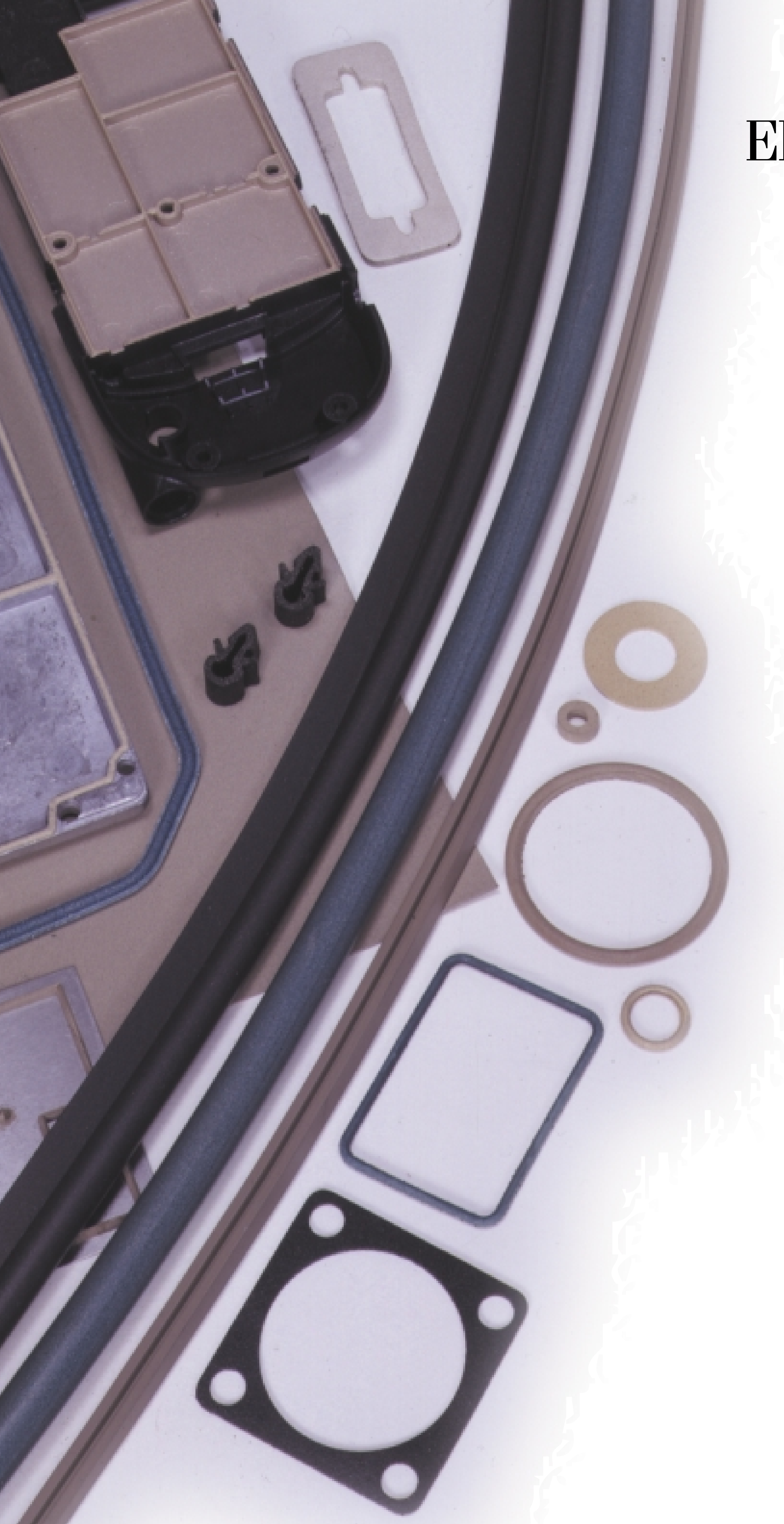
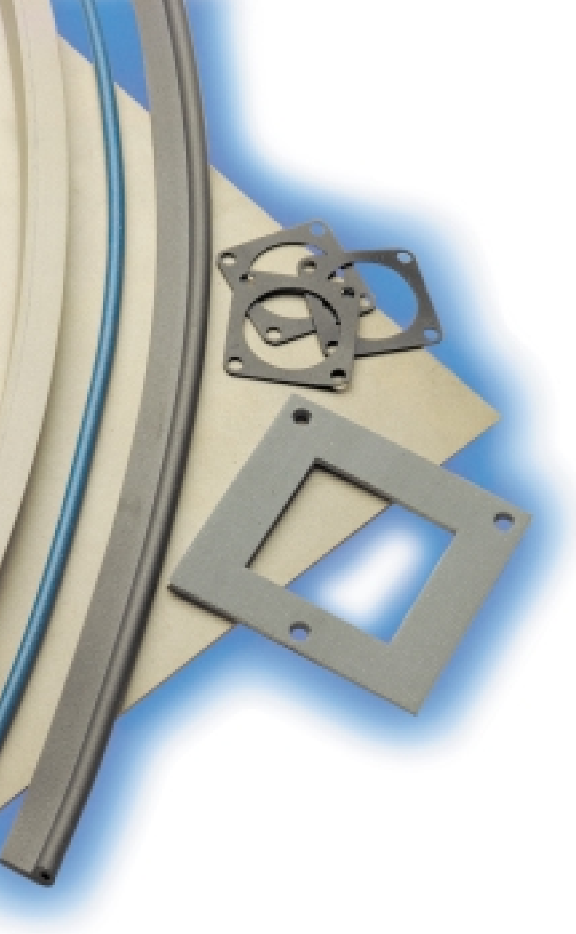
Elastomeric EMI Shielding Solutions

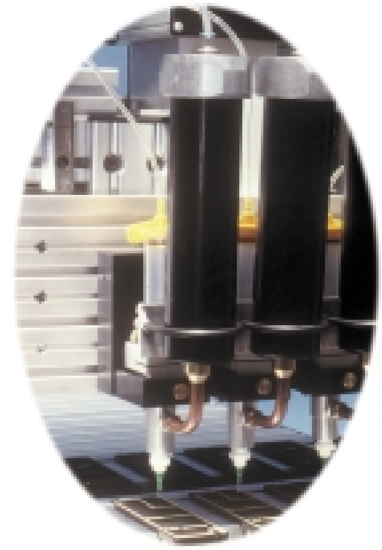


Laird TECHNOLOGIES



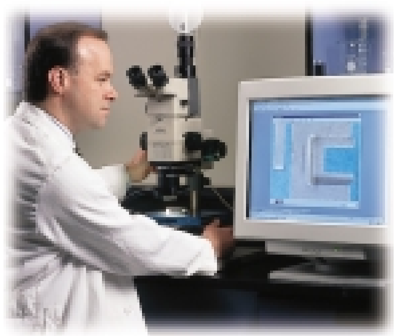
From concept to compliance, over 30 years of elastomer experience

Electrically conductive elastomers provide environmental sealing, and excellent mechanical and electro-magnetic shielding properties. They are ideal for applications that demand both environmental sealing and EMI shielding, and can be used in a wide range of operating temperatures. Laird Technologies offers a wide variety of conductive filler materials in extruded, molded die-cut, dispensed form-in-place, printed and coated formats. We are constantly formulating new and custom compounds to provide you with more design options to meet your needs.



Computerized XYZ form-in-place dispensing machines deposit conductive elastomer compounds onto miniaturized thin wall multicompartment housing covers.

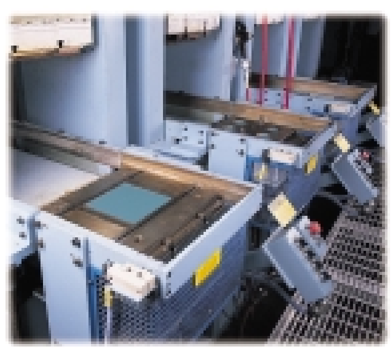
High-volume production processes use a 60-ton injection molding press with a cold runner system for multi-cavity molds to reduce cycle times and material loss.



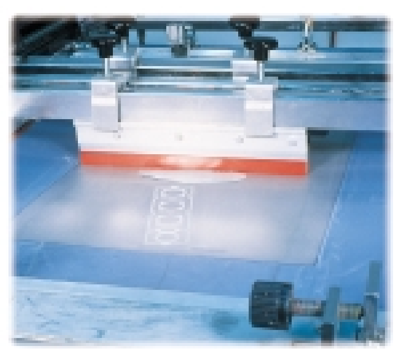
The stereomicroscope, equipped with a digital camera, captures magnified images of products for a better understanding of product characteristics.

Molds filled with EcE compound are loaded and unloaded during the curing cycle by a ten-station rotary press custom designed for a more flexible and cost-effective process.

Extrusion presses produce a multitude of conductive elastomer profiles in 40 different compounds which are used in both military and commercial applications.



Molding of EcE compounds is controlled from design through fabrication, from single cavity prototype to multi-cavity production or compression type molds.



Screen printing conductive elastomer compounds onto metal or metalized plastic panels provides a low profile, intricate shaped EMI gasket while bonding securely to the panel surface.






The following information on material selection is presented to help the designer understand the unique world of electrically conductive elastomers. The information is only intended to guide the designer around the most frequent trouble spots. Design engineers are encouraged to contact Laird Technologies for help with specific design applications.

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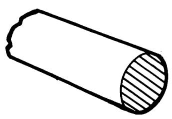
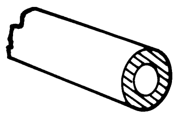
Electrically Conductive Elastomers

ElectroSeal Conductive Elastomers



O-Strips
Page 22



O-StripTubing
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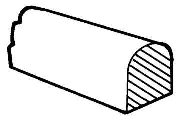

D-Strips
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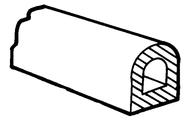

Hollow D-Strips
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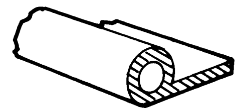

P-Strip Tubing
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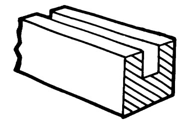

Channel Strips
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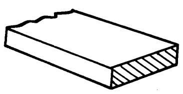
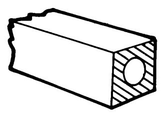
ElectroSeal Conductive Elastomers
(Continued)



Rectangular Strips



Hollow Rectangular Strips

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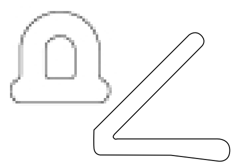
ElectroSeal Custom Extrusions



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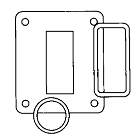
ElectroSeal Conductive Elastomer Fabricated Components



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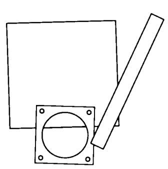
Metal Impregnated Materials



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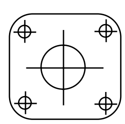
MIL Connector Gaskets



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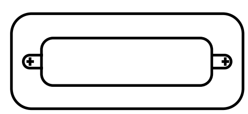
"D" Subminiature Connector Shields



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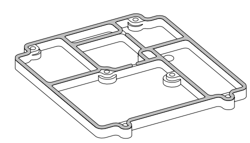
Form-in-Place EMI Dispensed Gaskets



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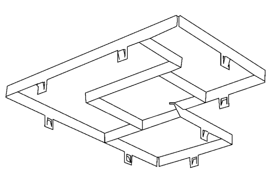
Mold-in-Place Printed Circuit Board Shielding



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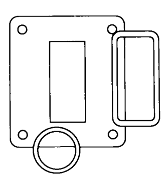
ElectroCoat



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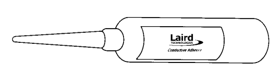
ElectroBond and ElectroPoxy Electrically Conductive Adhesives



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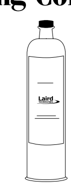
ElectroCaulk EMI Caulking Compound



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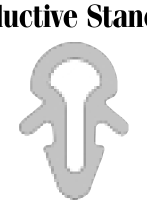
Board to Chassis Conductive Stand-off



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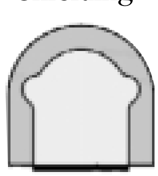
EcE Backplane Shielding



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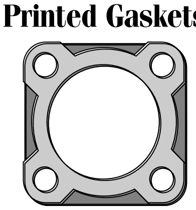
ElectroPrint Conductive Printed Gaskets



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Part Number Cross Reference

When ordering, please call our sales department to confirm availability and lead times.

Elastomeric EMI Shielding

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8408-02XX-XX	ELECTROMET METAL IMPREGNATED MATERIALS	SHEETS	Page 33
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8416-0120-57	ELECTROMET WOVEN WIRE SILICONE IMPREGNATED	Al/Neoprene	Page 34
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8516-0204-XX	"D" SUBMINIATURE CONNECTOR SHIELDS	37 PINS	Page 37
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8516-0208-XX	"D" SUBMINIATURE CONNECTOR SHIELDS	9 PINS	Page 37
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8516-0210-XX	"D" SUBMINIATURE CONNECTOR SHIELDS	25 PINS	Page 37
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8569-0131-XX	BOARD TO CHASSIS CONDUCTIVE STAND-OFF		Page 46
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8800-0004-XX	ELECTROCAULK EMI CAULKING COMPOUND	4 OZ. (118 cc) CARTRIDGE	Page 45
8800-0008-XX	ELECTROBOND ELECTRICALLY CONDUCTIVE ADHESIVE	8 OZ. (237 cc) CARTRIDGE	Page 44
8800-0008-XX	ELECTROCAULK EMI CAULKING COMPOUND	8 OZ. (237 cc) CARTRIDGE	Page 45
8800-0016-XX	ELECTROBOND ELECTRICALLY CONDUCTIVE ADHESIVE	16 OZ. (473 cc) CARTRIDGE	Page 44
8800-0016-XX	ELECTROCAULK EMI CAULKING COMPOUND	16 OZ. (473 cc) CARTRIDGE	Page 45
8800-4XA1-77	ELECTROPOXY ELECTRICALLY CONDUCTIVE ADHESIVE	TWO 1-OZ. (30 cc) JARS	Page 44
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Elastomeric EMI Shielding

Overview

The electrically conductive elastomers are based on dispersed particles in elastomers, oriented wire in solid or sponge elastomers, impregnated wire mesh screens or expanded metals. They provide highly conductive, yet resilient gasketing materials for EMI sealing as well as pressure and environmental sealing.

Conductive elastomers are used for shielding electronic enclosures against electromagnetic interference (EMI). Usually, the shielding system consists of a conductive gasket sandwiched between a metal housing and lid. The primary function of these gaskets is to provide sufficient electrical conductivity across the enclosure/gasket/lid junction to meet grounding and EMI shielding requirements, as well as prevent intrusion of the fluids into the electrical components.

Laird Technologies offers conductive elastomers in the following forms:

1. ElectroSeal dispersed filler particles in elastomers
2. ElectroMet oriented wire in solid and sponge elastomers, and impregnated wire mesh and expanded metals

ElectroSeal™ Gasket Introduction

Conductive elastomer gaskets are EMI shielding and sealing devices made from highly conductive, mechanically resilient and conformable vulcanized elastomers. They are available in the following types:

1. Flat gaskets or die-cuts
2. Molded shapes such as O-rings or intricate parts
3. Extruded profiles or strips
4. Vulcanized-to-metal covers or flanges
5. Co-molded or reinforced seals
6. Form-in-place gaskets

When any two flat, but rigid surfaces are brought together, slight surface irregularities on each surface prevent them from meeting completely at all points. These irregularities may be extremely minute, yet may provide a leakage path for gas or liquid under pressure, and for high frequency electromagnetic energy. This problem remains in flange sealing even when very high closure force is applied. However, when a gasket fabricated of resilient material is installed between the mating surfaces, and even minimal closure pressure is applied, the resilient gasket conforms to the irregularities in both mating surfaces. As a result, all surface imperfections and potential leak paths across the joint area are sealed completely against pneumatic and fluid pressure or penetration by environmental gases. If the gasket is conductive as well as resilient, with conductive matrix distributed throughout its total volume in mesh or particle form, the joint can be additionally sealed against penetration by, or exit of, electromagnetic energy.

Design Considerations

The design requirements of the installation will usually narrow the choice considerably, particularly if the basic geometry of the enclosure is already established, or if military EMI shielding specifications are involved. In addition to choices of size and shape dictated by the enclosing structure and the joint geometry itself, the following four factors greatly influence the suitability of EMI gasket materials: shielding effectiveness, closure force, percent gland fill and compression/deflection.

Shielding Effectiveness

Available EMI gasket materials vary greatly in their ability to exclude or confine electromagnetic energy. The intensity and frequency of the interference present, the predominance of electrical (E) or magnetic (H) fields, and system power and signal attenuation requirements will automatically exclude certain types of EMI shielding materials. Variations in shielding effectiveness requirements are one reason why Laird Technologies offers more than 100 ElectroSeal conductive elastomer formulations. The relative shielding performance of standard ElectroSeal conductive elastomers (at various frequencies) is provided in the Material Compounds Chart on pages 14 through 17.

Closure Force Requirements

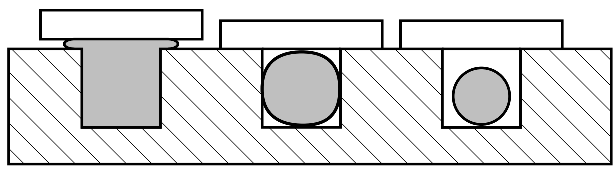
Solid conductive elastomer materials such as ElectroSeal stand up better to high closure forces, environmental pressures, and repeated opening and closing of the joint. Unlike sponge elastomers, solid conductive elastomers do not actually compress. They accommodate pressures by changing shape, rather than volume. This is an important difference in flange joint design requirements between the two material types, since additional gland volume must be allowed for the potential expansion of the elastomer under heat and/or pressure. Greater flange strength must often be provided to allow for increased closure force requirements. If low closure force is a consideration, however, the use of hollow extruded profiles such as the ElectroSeal hollow "O" and hollow "D" in conjunction with softer durometer elastomers will dramatically reduce closure force requirements.

Percent Gland Fill (Volume/Void Ratio)

Design of an elastomeric O-ring gland, or groove and contacting surfaces which make up the seal assembly, is as important as percent gland fill. For most static seal applications, it is necessary to calculate the area of the seal and the gland it will occupy, to determine whether the latter is large enough to receive the ring. Always try to avoid designs that stretch the elastomer more than 5%. If the seal element is stretched or compressed more than one or two percent, calculation based on the volume should be used unless volume swell is a factor.

Irrespective of whether the calculations are based on volumes or cross-sectional areas, it is important to compare the largest possible seal cross-sectional area with the smallest gland, taking all tolerances into consideration. Never allow groove and seal tolerances to create an "overfilled" groove condition. Sufficient volume must be provided within the groove area to provide for a 90% to 95% gland fill. Figure 1 shows underfilled, overfilled, and optimum filled grooves.

Figure 1. Groove Fill Levels



Guidelines for Groove Dimensions:

As a general rule we recommend a gland fill of 85% – 95% for optimum shielding effectiveness. However, for critical applications that require both shielding and environmental sealing, a 95% gland fill is suggested. For applications that require special design, please contact Laird Technologies applications engineering staff.

Recommended groove dimensions are provided on page 21 and page 22 respectively for the solid D and solid O extruded profiles.

Compression/Deflection

Compression/deflection data provide the engineer or designer with a qualitative comparison of the deformability of different profiles of conductive elastomers. Deflection is defined as the change in the cross-sectional height of a gasket under compressive load and is a function of material hardness and profile.

The recommended deflection ranges of various conductive elastomer profiles are shown in Table 1. In no case however, should the amount of actual deflection be less than 10% for ElectroSeal materials. Remember that the minimum unevenness of the mating flanges must be taken into consideration in determining the original (uncompressed) and installed (compressed) height of the seal. Note that wall thickness of hollow profiles has a major effect on deflection.

Table 1. Recommended Deflection for ElectroSeal Profiles

Cross Section Shape	Deflection
Flat Strip	5-10 Percent
Solid O	20-25 Percent
Solid D	15-20 Percent
Hollow O	20-50 Percent
Hollow D	25-50 Percent
Hollow P	25-50 Percent
Interference Fit	15-25 Percent

Note: Selection of a proper profile has a bearing on the design and the performance of an EMI gasket.

Service Life

Three fundamental factors are involved when considering the service life of an EMI gasket:

1. The presence of detrimental chemicals and fluids, ozone aging and temperature extremes.
2. The number of times the joint will be opened and closed during the projected operating life of the equipment.
3. Potential exposure to inadvertent damage during initial installation and future maintenance.

Environmental Considerations

Proper material selection for effective EMI shielding depends on the total environmental envelope within which the seal/shield will be expected to function. The material selection process should begin with a careful analysis of the following major environmental conditions:

- Temperature
- Aging/Shelf Life
- Pressure/Vacuum
- Fluid Compatibility
- Galvanic Compatibility

Temperature

Temperature, though seemingly elementary, is often the most misunderstood and exaggerated of all sealing environment parameters; hence, it is all too often over-specified.

Low Temperature

Low temperature induced changes in the elastomer properties are generally physical in nature. As the temperature decreases below allowable limits, the elastomeric properties are lost and the material becomes very hard and brittle. Duration of the effects of low temperature exposure is not significant and the original properties are regained upon resumption of moderate temperatures.

High Temperature

High temperatures also affect the properties of elastomers in the same way as the low temperatures. As the temperature begins to rise, the elastomer will soften, lowering its extrusion resistance. Tensile strength and modulus also decrease under high temperatures, and elongation is increased. But these initial changes reverse if exposure to high temperatures is brief. Changes due to prolonged high temperature exposure are chemical in nature rather than physical, and are not reversible.

The temperature capabilities of various ElectroSeal elastomers are shown in Table 2.

Table 2. Temperature Capabilities of Principal ElectroSeal Elastomers

Elastomer Type	Low Temperature (TR-10)	Upper Temperature (1000 Hrs)
EPDM	-58°F (-50°C)	257°F (125°C)
Silicone	-85°F (-65°C)	392°F (200°C)
Fluorosilicone	-85°F (-65°C)	347°F (175°C)
Fluorocarbon	14°F (-10°C)	392°F (200°C)

Aging/Shelf Life

Another major factor in the selection of any elastomer destined for sealing/shielding service is time, or more properly, seal life. The expected life of a seal may involve only a few seconds in the case of some highly specialized seals used in solid propellant rocket casings, to as much as 10 to 20 years and beyond in the case of seals used in deep-space vehicles.

Deterioration with time or aging relates to the type of polymer and storage conditions. Exposure may cause deterioration of elastomers whether installed or in storage. Resistance to deterioration in storage varies greatly between the elastomers. Military Handbook 695 (MIL-HDBK-695) divides synthetic elastomers in the following groups according to age resistance as shown in Table 3.

Table 3. Age Resistance of Principal ElectroSeal Elastomers

Base Polymer	ASTM Designation	Shelf Life (Years)
Ethylene Propylene Diene Monomer	EPDM	5 to 10 Years
Silicone	MQ, VMQ, PVMQ	Up to 20 Years
Fluorosilicone	FVMQ	Up to 20 Years
Fluorocarbon	FKM	Up to 20 Years

Pressure Vacuum

Conductive elastomer seals are rarely used for high-pressure systems, with the exception of waveguide seals. Pressure has a bearing on the choice of material and hardness. Low durometer materials are used for low pressure applications, whereas high pressure may require a combination of material hardness and design.

Outgassing and/or sublimation in a high vacuum system can cause seal shrinkage (loss of volume), resulting in a possible loss of sealing ability. When properly designed and confined, an O-ring, molded shape, or a molded-to-the-cover plate seal can provide adequate environmental sealing as well as EMI shielding for vacuum (to 1×10^{-6} Torr) applications.

Fluid Compatibility

The primary function of elastomeric EMI seals is to provide sufficient electrical conductivity across the enclosure/port/flange junction, while at the same time provide at least minimal environmental sealing capability. Consideration must be given to the basic compatibility between the elastomer seal/shield element and any fluids with which it may come in prolonged contact. Table 4 lists the general reaction to common fluid media for the polymer types commonly used in ElectroSeal conductive elastomers. Note that any proposed conductive material and design should be thoroughly tested by the user under all possible conditions prior to production. The complex chemistry involved in the combination of the polymer and metallic fillers in conductive elastomers makes it imperative that such tests be conducted to determine suitability for use with a given fluid.

Table 4. Resistance of Principal ElectroSeal Elastomers to Fluids

Fluid	Silicone	Fluorosilicone	Fluorocarbon	EPDM
Impermeability to Gases	Poor	Fair	Good	Good
Ozone and Ultraviolet	Excellent	Excellent	Excellent	Excellent
ASTM 1 Oil	Fair	Good	Excellent	Don't use
Hydraulic Fluids (Organic)	Fair	Good	Excellent	Don't use
Hydraulic Fluids (Phosphate ester)	Fair	Fair	Good	Excellent
Hydrocarbon Fuels	Don't use	Good	Excellent	Don't use
Dilute Acids	Fair	Good	Excellent	Good
Concentrated Acids	Don't use	Don't use	Fair	Fair/Good
Dilute Bases	Fair	Good	Excellent	Excellent
Concentrated Bases	Don't use	Don't use	Fair	Good
Esters/Ketones	Don't use	Don't use	Don't use	Excellent
DS-2 (Decontaminating Fluid)	Poor	Poor	Fair	Good
STB (Decontaminating Fluid)	Good	Good	Good	Good
Low Temperature	Excellent	Excellent	Fair/Poor	Excellent
High Temperature	Excellent	Good	Excellent	Good
Compression Set	Good	Good	Excellent	Good
Radiation Resistance	Good	Poor	Poor	Good

Galvanic Compatibility

Compatibility between the gasket and the mating flanges is another area which must be given proper attention when designing a gasket for sealing/shielding. This problem can be minimized by various means, the simplest and most effective of which is proper gasket and flange design. This must be coupled with the judicious selection of a gasket material compatible with the mating surfaces. A large difference in corrosion potential between the mating surface and the conductive elastomer and the presence of a conductive electrolyte, such as salt water or a humid environment, will accelerate galvanic corrosion. Under dry conditions, such as the typical office environment, there will be little danger of galvanic corrosion. However, when the gasket is exposed to high humidity or salt-water environments, galvanic corrosion will occur between dissimilar metals. The likelihood of galvanic corrosion increases as the potential difference between the mating surface and the elastomer increases. The charts on pages 54 and 55 indicate which mating surfaces and elastomer combinations minimize the corrosion potential. In addition, the less permeable elastomers, such as EPDM and fluorosilicone, limit galvanic corrosion by restricting the access of the electrolyte to the conductive fillers in the gasket. For further details on galvanic corrosion of elastomeric materials, see pages 50 through 55.

Material Selection Guide

Laird Technologies offers a series of products to meet a wide range of customer requirements for military and commercial applications. The classifications of the most common materials are based on cost and specific applications and are outlined in Tables 5, 6 and 7. For a complete listing of all available material compounds, see pages 14–17.

ElectroSeals for Military and Aerospace Applications

The Military Grade materials are qualified to MIL-DTL-83528 specifications and provide excellent moisture and pressure sealing, including outgassing requirements for outer space applications. These materials are offered in a variety of forms and shapes.

Table 5. ElectroSeals for Military and Aerospace Applications

EcE Material Number			**80**	**81**	**82**	**83**	**84**	**85**	**88**	**89**	**94**	**97**	**98**	**99**
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			SIL	SIL	SIL	SIL	SIL	SIL	FSIL	FSIL	SIL	SIL	SIL	FSIL
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Cu	Ag/Al	Ag	Ag	Ag/Ni	Ag/G	Ag/Cu	Ag/Al	Ag/Cu	Ag	Ag	Ag
Color			Tan	Tan	Beige	Beige	Tan	Tan	Tan	Blue	Tan	Tan	Beige	Beige
MIL-DTL-83528C MATERIAL TYPE			A	B	E	J	L	M	C	D	K	H	G	F
Electrical Properties	Tol.	Test Method												
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.004	0.008	0.002	0.010	0.005	0.006	0.010	0.012	0.005	0.005	0.007	0.002
Shielding Effectiveness (dB) 10 GHz (Plane Wave)	Min.	MIL-DTL-83528C (PARA 4.5.12)	120	100	120	80	100	100	110	100	120	120	120	110
Specific Gravity	± 0.25	ASTM D792	3.40	2.00	3.50	1.80	4.00	1.90	4.10	2.20	3.60	3.70	4.30	4.10
Hardness (Shore A)	± 7	ASTM D2240	65	65	65	50	75	65	75	70	85	80	80	75

ElectroSeals for Commercial Applications

Commercial grade materials are offered in a variety of fillers to provide cost-effective solutions for industrial and commercial applications.

Table 6. ElectroSeals for Commercial Applications

EcE Material Number			**10**	**11**	**16**	**17**	**22**	**24**	**53**	**87**	**92**	**93**
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			SIL	FSIL	SIL	SIL	SIL	FSIL	TPR	SIL	FSIL	SIL
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Al	Ag/G	Ag/G	Ag/Al	Ni/C	Non-Conductive	Ni/C	C	Ni/C	Ni/C
Color			Blue-Green	Tan	Blue	Blue	Tan	Blue	Dk.Gray	Black	Dark Gray	Black
MIL-DTL-83528C MATERIAL TYPE												
Electrical Properties	Tol.	Test Method										
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.004	0.010	0.050	0.050	0.100	N/A	0.030	5.000	0.100	0.100
Shielding Effectiveness (dB) 10 GHz (Plane Wave)	Min.	MIL-DTL-83528C (PARA 4.5.12)	110	90	80	80	90	N/A	80	30	80	100
Specific Gravity	± 0.25	ASTM D792	1.90	2.00	1.70	1.80	2.10	1.20	1.70	1.30	2.20	1.90
Hardness (Shore A)	± 7	ASTM D2240	45	75	55	55	65	80	55	70	75	55

ElectroSeals for Special Applications

Silver-coated aluminum filled materials are generally more corrosion-resistant than silver or silver-plated copper materials. Nickel-coated graphite materials are very cost-effective and lightweight for moderately corrosive environments. However, EcE 50 silver-plated aluminum is recommended for aerospace and military applications subject to harsh, corrosive environments. EcE 14 is an inert aluminum-filled silicone recommended for harsh galvanic environments. EPDM-based materials are recommended for low permeability, abrasion resistance, and Nuclear/Biological/Chemical (NBC) environments. Fluorocarbon based materials have excellent resistance against oils, hydraulic fluids and hydrocarbon fuels, and are recommended for down-hole and automotive applications.

Table 7. ElectroSeals for Special Applications

EcE Material Number			**13**	**14**	**20**	**50**	**90**	**91**	**95**	**96**
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			EPDM	SIL	FC	FSIL	FSIL	EPDM	EPDM	EPDM
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			C	IA	Ag/Ni	Ag/Al	Ag/Ni	Ag/Ni	Ni/C	Ag/Al
Color			Black	Black	Tan	Tan	Tan	Tan	Black	Tan
MIL-DTL-83528C MATERIAL TYPE										
Electrical Properties	**Tol.**	**Test Method**								
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	20.000	5.000	0.010	0.012	0.005	0.007	0.100	0.010
Shielding Effectiveness (dB) 10 GHz (Plane Wave)	Min.	MIL-DTL-83528C (PARA 4.5.12)	30	70	100	95	100	100	70	90
Specific Gravity	± 0.25	ASTM D792	1.20	2.20	4.80	2.10	4.30	3.70	2.20	2.20
Hardness (Shore A)	± 7	ASTM D2240	80	75	90	75	75	80	80	80

EMI Gasket Mounting Techniques

Common EMI gasket mounting techniques are:

Positioning in a Groove

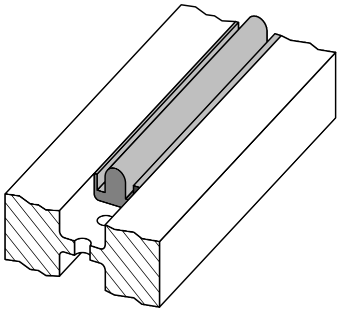
This is a highly recommended method if a suitable groove can be provided at a relatively low cost. Placing the EMI gasket in such a groove provides several advantages:

a. metal-to-metal contact of mating flange surfaces provides a compression stop and prevents over-compression of the gasket material;

b. is cost-effective by reducing assembly time;

c. best overall seal for EMI, EMP, salt fog, NBC, and fluids by providing metal-to-metal flange contact and reducing exposure of the seal element to attack by outside elements.

Figure 2. Seal Captured in a Groove



Interference Fit Applications

Allow 0.005 in. (0,1 mm) to 0.100 in. (2,5 mm) interference for part to hold and eliminate the need for adhesive. Groove depth should be set to ensure that the channel is not over-filled.

Water Tight Applications

Fill channel with as much material as possible, taking tolerances into account. Use caution to avoid overfill conditions.

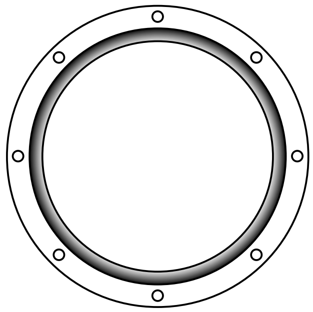
Bonding with Adhesives

The EMI gasket may be attached to one of the mating flanges by the application of pressure sensitive or permanent adhesives. A suitable conductive adhesive is always preferable over a nonconductive adhesive for mounting EMI gaskets as they can provide adequate electrical contact between the EMI gasket and the mounting surface.

Bolt-Through Holes

This is a common and inexpensive way to hold an EMI gasket in position. Locator bolt holes can be accommodated in the tab or in rectangular flat gaskets as shown in Figure 3.

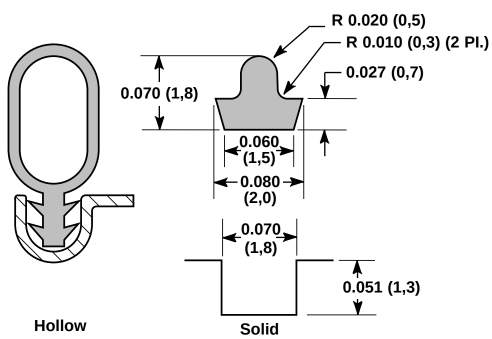
Figure 3. Bolt-Through Holes



Interference Fit

For applications such as face seals or where the gasket must be retained in the groove during assembly, interference fit is an excellent and inexpensive choice. The gasket is simply held in the groove or against a shoulder by mechanical friction as shown in Figure 4.

Figure 4. Interference Fit Profile in a Groove

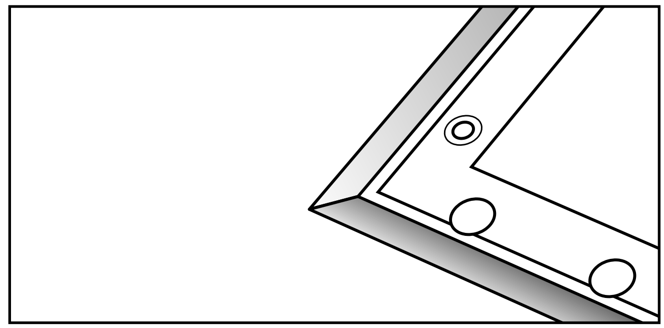


Vulcanized Mounting

In this case, the seal element is vulcanized directly to the metal flange or cover under heat and pressure. The vulcanized-to-the-metal mounting offers a homogeneous one-piece gasket with superior conductivity between the gasket and the metal.

Laird Technologies provides EMI seals bonded to covers and retainers. Such devices may have the conductive element bonded in a groove or vulcanized to the edge of a thin sheet metal retainer. Figure 5 shows a vulcanized mounted and frame mounted gasket.

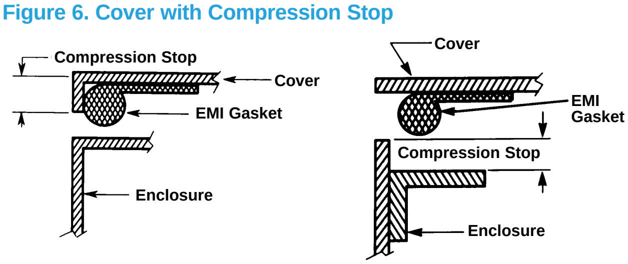
Figure 5. Vulcanized Mounted and Frame Mounted Gasket



Friction, Abrasion and Impact Considerations

The physical positioning of EMI gaskets in an environment where friction, abrasion and impact are possible needs special consideration. EMI gaskets in such an environment should be positioned so that they receive little or no sliding or side-to-side motion when being compressed. Examples of common attachments for access door gaskets are shown in Figure 6.

Figure 6. Cover with Compression Stop



Mounting Tips

Care should be taken to avoid excess handling of conductive elastomers, including excessive stretching, bending or exposure to grease.

All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroSeal™ Conductive Elastomer EMI Shielding

Laird Technologies electrically conductive elastomer products are ideal for both military and commercial applications requiring both environmental sealing and EMI shielding. Compounds can be supplied in molded or extruded shapes, sheet stock, custom extruded, or die-cut shapes to meet a wide variety of applications.

Our conductive extrusions offer a wide choice of profiles to fit a large range of applications. The cross-sections shown on the following pages are offered as standard. Custom dies can be built to accommodate your specific design.

- Available in a wide variety of conductive filler materials
- Shielding effectiveness up to 120 dB at 10 GHz

Sheet Material

Table 1 lists thicknesses and sizes for our molded sheet material, while Table 2, pages 14–17, shows the compounds available for all of our conductive silicone elastomers.

Table 1.

Thickness/Tolerance	10 X 10 Sheet	10 X 15 Sheet	15 X 20 Sheet	18 X 18 Sheet
0.020 ± 0.004 (0,5 ± 0,1)	8860-0020-100-XX	8860-0020-150-XX	8860-0020-300-XX	N/A
0.032 ± 0.005 (0,8 ± 0,1)	8860-0032-100-XX	8860-0032-150-XX	8860-0032-300-XX	8860-0032-324-XX
0.045 ± 0.005 (1,1 ± 0,1)	8860-0045-100-XX	8860-0045-150-XX	8860-0045-300-XX	8860-0045-324-XX
0.062 ± 0.007 (1,5 ± 0,2)	8860-0062-100-XX	8860-0062-150-XX	8860-0062-300-XX	8860-0062-324-XX
0.093 ± 0.010 (2,3 ± 0,3)	8860-0093-100-XX	8860-0093-150-XX	8860-0093-300-XX	8860-0093-324-XX
0.100 ± 0.010 (2,5 ± 0,3)	8860-0100-100-XX	8860-0100-150-XX	8860-0100-300-XX	8860-0100-324-XX
0.125 ± 0.010 (3,2 ± 0,3)	8860-0125-100-XX	8860-0125-150-XX	8860-0125-300-XX	8860-0125-324-XX

How to Specify EcE

Decide on molded sheet stock or extruded shapes. Select the desired configuration and dimensions from Table 1 (for sheet stock) or Figures 1–8 (for extruded shapes). Select the desired material from Table 2. Insert material number from Table 2, pages 14–17, in place of the letters XX in the Laird Technologies part number.

Example

1. From Figure 1, on page 18, for a rectangular strip measuring 0.500 in. (12,7 mm) x 0.075 in. (1,9 mm), part number is 8861-0130-XX.
2. From Table 2, on page 16, for silver-nickel filler, material number is 84.
3. Ordering part number is 8861-0130-84*.

Note: Rectangular and D-shaped extrusions can be supplied with pressure sensitive adhesive tape.

*If pressure sensitive adhesive is required, replace the fifth digit with a 9 (i.e. 8861-9130-84).

All dimensions shown are in inches (millimeters) unless otherwise specified.

Table 2. Electrically Conductive Elastomers Material Compounds

EcE Material Number			**10**	**11**	**12**	**13**	**14**	**16**	**17**	**18**	**19**	**20**
MIL-DTL-83528C Material Type												
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			SIL	FSIL	SIL	EPDM	SIL	SIL	SIL	SIL	SIL	FC
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Al	Ag/G	Ni/C	C	IA	Ag/G	Ag/Al	Ag/Ni	Ag/G	Ag/Ni
Color			Blue-Green	Tan	Gray	Black	Black	Blue	Blue	Tan	Tan	Tan
Electrical Properties	**Tol.**	**Test Method**										
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.004	0.010	0.100	30.000	5.000	0.050	0.050	0.003	0.005	0.010
Shielding Effectiveness (dB)	Min.	MIL-DTL-83528C										
200 KHz (H-Field)		(PARA 4.5.12)	65	60	70	30	45	50	50	75	N/A	60
100 MHz (E-Field)		MIL-STD-285	120	100	100	70	100	100	100	120	110	110
500 MHz (E-Field)			115	100	120	60	80	100	100	120	100	100
2 GHz (Plane Wave)			115	90	100	50	70	90	90	110	100	100
10 GHz (Plane Wave)			110	90	70	30	70	80	80	100	90	100
Electrical Stability												
After Heat Aging (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.15)	0.007	0.015	0.150	40	10	0.050	0.050	0.007	0.020	0.020
After Break (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.9)	0.010	0.015	0.150	N/A	10	0.050	0.050	N/A	N/A	0.020
During Vibration	Max.	MIL-DTL-83528C	N/A	0.015	0.150	N/A	N/A	N/A	N/A	N/A	N/A	N/A
After Vibration (ohm-cm)		(PARA 4.5.13)	N/A	0.010	0.100	N/A	N/A	N/A	N/A	N/A	N/A	N/A
After Exposure to EMP (ohm-cm) (0.9 KAmp/inch of perimeter)	Min.	MIL-DTL-83528C (PARA 4.5.16)	N/A	N/A	0.150	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Physical Properties												
Specific Gravity	± 0.25	ASTM D792	1.90	2.00	2.30	1.20	2.20	1.70	1.80	2.80	1.80	4.80
Hardness (Shore A)	± 7	ASTM D2240	45	75	60	80	75	55	55	40	45	90
Tensile Strength (PSI)	Min.	ASTM D412	160	200	150	2000	200	150	150	180	140	600
Elongation (%)	Min./Max.	ASTM D412	80/100	60/200	50/200	100/400	100/300	50/150	50/150	100/300	100/300	50/200
Tear Strength (PPI)	Min.	ASTM D624 (DIE C)	25	30	40	100	35	20	20	35	30	70
Compression Set (%)	Max.	ASTM D395	30	30	30	30	30	35	30	30	30	35
Upper Operating Temperature (°C)	Max.	ASTM D1329	160	160	160	125	160	160	160	N/A	N/A	160
Lower Operating Temperature (°C)	Min.		-55	-50	-55	-40	-55	-50	-50	N/A	N/A	-20
Compression/Deflection (%)	Min.	ASTM D575	3	3	3	3	3	8	8	N/A	N/A	3
Fluid Immersion[a]		MIL-DTL-83528C (PARA 4.6.17)	N/S	SUR	N/S	N/A	N/S	N/S	N/S	N/S	N/S	SUR
Recommended Application												
Molded Sheet/Die Cut Parts			X	X	X	X	X	X	X	X	X	X
Extruded Profiles			X	X	X	X	X	X		X	X	
Metal/Elastomer Seals												
O-Rings/Molded Shapes			X	X	X	X	X	X[b]	X[b]	X	X	

Compounds not available in all profiles. Contact Application Engineering Department for assistance.

NOTES:
N/A = Not Applicable or Not Tested to Specification
N/S = Not Survivable
S = Survivable
a: Tested to specific fluids per MIL-DTL-83528C PARA 4.6.17
b: Needs special tooling for molded shapes and O-rings
c: Extruded profiles made from CP665X
d: Expanded copper foil reinforced available in 0.027 ± 0.005 inch sheet stock only
e: Available in selective profiles. Contact Application Engineering Department for assistance.

Table 2. Electrically Conductive Elastomers Material Compounds (continued)

EcE Material Number			21	22	23	24	50	51	52	53	54	55
MIL-DTL-83528C MATERIAL TYPE												
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			SIL	SIL	FSIL	FSIL	FSIL	EPDM	SIL	TPR	TPR	SIL
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Cu	Ni/C	Non-Conductive	Non-Conductive	Ag/Al	Ag/Al	Ag/G	Ni/C	Ag/G	Ni/C
Color			Orange-Red	Black	Blue	Blue	Tan	Tan	Tan	Dark Gray	Tan	Dark Gray
Electrical Properties	**Tol.**	**Test Method**										
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.003	0.100	N/A	N/A	0.012	0.020	0.010	0.030	0.010	0.050
Shielding Effectiveness (dB)	Min.	MIL-DTL-83528C										
200 KHz (H-Field)		(PARA 4.5.12)	70	50	N/A	N/A	55	70	65	50	50	80
100 MHz (E-Field)		MIL-STD-285	115	100	N/A	N/A	110	100	120	100	100	90
500 MHz (E-Field)			115	100	N/A	N/A	110	120	115	100	100	90
2 GHz (Plane Wave)			110	90	N/A	N/A	100	100	115	90	90	90
10 GHz (Plane Wave)			110	90	N/A	N/A	95	70	110	80	80	80
Electrical Stability												
After Heat Aging (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.15)	0.010	0.150	N/A	N/A	0.015	N/A	0.015	0.050	0.050	0.050
After Break (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.9)	0.006	0.150	N/A	N/A	0.015	N/A	0.010	0.050	0.050	0.050
During Vibration	Max.	MIL-DTL-83528C	0.010	0.100	N/A	N/A	0.015	N/A	N/A	N/A	N/A	N/A
After Vibration (ohm-cm)		(PARA 4.5.13)	0.008	0.100	N/A	N/A	0.012	N/A	N/A	N/A	N/A	N/A
After Exposure to EMP (ohm-cm) (0.9 KAmp/inch of perimeter)	Min.	MIL-DTL-83528C (PARA 4.5.16)	N/A	N/A	N/A	N/A	0.015	N/A	N/A	N/A	N/A	N/A
Physical Properties												
Specific Gravity	± 0.25	ASTM D792	2.10	2.10	1.20	1.20	2.10	2.30	1.90	1.70	1.80	2.80
Hardness (Shore A)	± 7	ASTM D2240	60	65	70	80	75	60	70	55	55	65
Tensile Strength (PSI)	Min.	ASTM D412	500	200	400	400	200	150	160	150	150	250
Elongation (%)	Min./Max.	ASTM D412	100/300	100/300	100/400	100/400	60/260	50/200	80/100	50/150	50/150	100/300
Tear Strength (PPI)	Min.	ASTM D624 (DIE C)	35	30	60	60	35	80	25	20	20	35
Compression Set (%)	Max.	ASTM D395	45	30	30	30	30	30	30	35	30	30
Upper Operating Temperature (°C)	Max.	ASTM D1329	160	160	160	160	160	160	160	160	160	160
Lower Operating Temperature (°C)	Min.		-50	-50	-50	-50	-55	-45	-55	-50	-50	-50
Compression/Deflection (%)	Min.	ASTM D575	4	3	N/A	N/A	3	8	3	8	8	8
Fluid Immersion[a]		MIL-DTL-83528C (PARA 4.6.17)	N/S	N/S	SUR	SUR	SUR	N/S	N/S	N/S	N/S	N/S
Recommended Application												
Molded Sheet/Die Cut Parts			X	X	X	X	X	X	Injection Mold	Injection Mold	Injection Mold	Injection Mold
Extruded Profiles			X	X			X	X	X	X	X	X
Metal/Elastomer Seals			X									
O-Rings/Molded Shapes			X	X		X	X	X	X	X	X	X

Compounds not available in all profiles. Contact Application Engineering Department for assistance.

NOTES:
N/A = Not Applicable or Not Tested to Specification
N/S = Not Survivable
S = Survivable
a: Tested to specific fluids per MIL-DTL-83528C PARA 4.6.17
b: Needs special tooling for molded shapes and O-rings
c: Extruded profiles made from CP665X
d: Expanded copper foil reinforced available in 0.027 ± 0.005 inch sheet stock only

Table 2. Electrically Conductive Elastomers Material Compounds (continued)

EcE Material Number			**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**
MIL-DTL-83528C MATERIAL TYPE			**A**	**B**	**E**	**J**	**L**	**M**			**C**	**D**
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			SIL	SIL	SIL	SIL	SIL	SIL	SIL	SIL	FSIL	FSIL
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Cu	Ag/Al	Ag	Ag	Ag/Ni	Ag/G	Ni/C	C	Ag/Cu	Ag/Al
Color			Tan	Tan	Beige	Beige	Tan	Tan	Dark Gray	Black	Tan	Blue
Electrical Properties	**Tol.**	**Test Method**										
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.004	0.008	0.002	0.010	0.005	0.006	0.100	5.000	0.010	0.012
Shielding Effectiveness (dB)	Min.	MIL-DTL-83528C										
200 KHz (H-Field)		(PARA 4.5.12)	70	70	70	60	75	50	70	30	70	70
100 MHz (E-Field)		MIL-STD-285	120	115	120	100	110	100	95	70	120	110
500 MHz (E-Field)			120	110	120	100	110	100	90	60	120	105
2 GHz (Plane Wave)			120	105	120	90	105	100	80	40	115	100
10 GHz (Plane Wave)			120	100	120	80	100	100	75	30	110	100
Electrical Stability												
After Heat Aging (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.15)	0.010	0.010	0.010	0.015	0.010	0.015	0.200	7.000	0.015	0.015
After Break (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.9)	0.008	0.015	0.010	0.020	0.010	0.009	0.150	7.000	0.015	0.015
During Vibration	Max.	MIL-DTL-83528C	0.006	0.012	0.010	0.015	0.010	0.009	N/A	N/A	0.015	0.015
After Vibration (ohm-cm)		(PARA 4.5.13)	0.004	0.008	0.002	0.010	0.005	0.006	N/A	N/A	0.010	0.012
After Exposure to EMP (ohm-cm) (0.9 KAmp/inch of perimeter)	Min.	MIL-DTL-83528C (PARA 4.5.16)	0.010	0.010	0.010	0.015	0.010	0.015	N/A	N/A	0.015	0.015
Physical Properties												
Specific Gravity	± 0.25	ASTM D792	3.40	2.00	3.50	1.80	4.00	1.90	2.40	1.30	4.10	2.20
Hardness (Shore A)	± 7	ASTM D2240	65	65	65	50	75	65	75	70	75	70
Tensile Strength (PSI)	Min.	ASTM D412	200	200	300	150	200	200	200	700	180	180
Elongation (%)	Min./Max.	ASTM D412	100/300	100/300	100/300	50/250	100/300	100/300	70/300	100/300	100/300	60/260
Tear Strength (PPI)	Min.	ASTM D624 (DIE C)	25	30	50	20	30	30	35	50	30	30
Compression Set (%)	Max.	ASTM D395	32	32	45	35	32	30	40	45	35	30
Upper Operating Temp.(°C)	Max.	ASTM D1329	125	160	160	160	125	160	160	160	125	160
Lower Operating Temp. (°C)	Min.		-55	-55	-55	-55	-55	-55	-55	-55	-55	-55
Compression/Deflection (%)	Min.	ASTM D575	3.5	3.5	2.5	8.0	3.5	3.5	3.5	3.5	3.5	3.5
Fluid Immersion[a]		MIL-DTL-83528C (PARA 4.6.17)	N/S	N/S	N/S	N/S	N/S	N/S	N/S	N/S	SUR	SUR
Recommended Application												
Molded Sheet/Die Cut Parts			X	X	X	X	X	X	X	X	X	X
Extruded Profiles			X	X	X	X	X	X	X	X[c]	X	X
Metal/Elastomer Seals			X	X	X		X		X		X	X
O-Rings/Molded Shapes			X	X	X	X[b]	X	X	X	X	X	X

Compounds not available in all profiles. Contact Application Engineering Department for assistance.

NOTES:
N/A = Not Applicable or Not Tested to Specification
N/S = Not Survivable
S = Survivable
a: Tested to specific fluids per MIL-DTL-83528C PARA 4.6.17
b: Needs special tooling for molded shapes and O-rings
c: Extruded profiles made from CP665X
d: Expanded copper foil reinforced available in 0.027 ± 0.005 inch sheet stock only

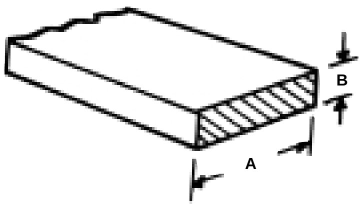
Table 2. Electrically Conductive Elastomers Material Compounds (continued)

EcE Material Number			**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**
MIL-DTL-83528C MATERIAL TYPE							**K**			**H**	**G**	**F**
Elastomer Type: Silicone=SIL, Fluorosilicone=FSIL Fluorocarbon=FC, Thermoplastic Rubber=TPR Ethylene Propylene Diene Monomer=EPDM			FSIL	EPDM	FSIL	SIL	SIL	EPDM	EPDM	SIL	SIL	FSIL
Filler Material: Silver=Ag, Copper=Cu, Aluminum=Al Nickel=Ni, Glass=G, Inert Coated Aluminum=IA Nickel-coated Graphite=Ni/C, Carbon=C			Ag/Ni	Ag/Ni	Ni/C	Ni/C	Ag/Cu	Ni/C	Ag/Al	Ag	Ag/Cu with expanded metal foil	Ag
Color			Tan	Tan	Dark Gray	Black	Tan	Black	Tan	Tan	Tan	Beige
Electrical Properties	**Tol.**	**Test Method**										
Volume Resistivity (ohm-cm) (as supplied)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.005	0.010	0.100	0.100	0.005	0.150	0.010	0.005	0.007	0.002
Shielding Effectiveness (dB)	Min.	MIL-DTL-83528C										
200 KHz (H-Field)		(PARA 4.5.12)	75	60	50	50	70	50	50	70	70	70
100 MHz (E-Field)		MIL-STD-285	110	110	100	100	120	80	100	120	120	120
500 MHz (E-Field)			110	100	100	100	120	70	100	120	120	120
2 GHz (Plane Wave)			105	100	100	100	120	70	90	120	120	110
10 GHz (Plane Wave)			100	100	100	100	120	70	90	120	120	110
Electrical Stability												
After Heat Aging (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.15)	0.010	N/A	0.200	0.200	0.010	N/A	N/A	0.008	0.010	0.010
After Break (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.9)	0.010	0.050	0.200	0.200	0.010	N/A	N/A	0.005	N/A	0.010
During Vibration	Max.	MIL-DTL-83528C	0.010	N/A	0.200	0.200	0.010	N/A	N/A	0.006	0.010	0.010
After Vibration (ohm-cm)		(PARA 4.5.13)	0.005	N/A	0.100	0.100	0.005	N/A	N/A	0.005	0.007	0.002
After Exposure to EMP (ohm-cm) (0.9 KAmp/inch of perimeter)	Min.	MIL-DTL-83528C (PARA 4.5.16)	0.010	N/A	0.100	0.100	0.015	N/A	N/A	0.008	0.010	0.010
Physical Properties												
Specific Gravity	± 0.25	ASTM D792	4.10	3.70	2.20	1.90	3.60	2.20	2.20	3.70	4.30	4.10
Hardness (Shore A)	± 7	ASTM D2240	75	80	75	55	85	80	80	80	80	75
Tensile Strength (PSI)	Min.	ASTM D412	300	200	150	150	400	200	200	400	600	250
Elongation (%)	Min./Max.	ASTM D412	100/300	100/350	60/250	100/300	100/300	70/260	70/260	100/300	20/NA	100/300
Tear Strength (PPI)	Min.	ASTM D624 (DIE C)	50	60	40	30	40	60	60	60	70	40
Compression Set (%)	Max.	ASTM D395	25	40	30	30	35	40	40	60	N/A	60
Upper Operating Temperature (°C)	Max.	ASTM D1329	160	125	160	160	125	125	160	160	125	160
Lower Operating Temperature (°C)	Min.		-50	-40	-55	-55	-45	-40	-40	-55	-45	-65
Compression/Deflection (%)	Min.	ASTM D575	3.0	3.0	5.0	8.0	2.5	3.0	3.0	2.5	2.5	3.5
Fluid Immersion[a]		MIL-DTL-83528C (PARA 4.6.17)	SUR	N/A	SUR	N/S	N/S	N/A	N/A	N/S	N/S	SUR
Recommended Application												
Molded Sheet/Die Cut Parts			X	X	X	X	X	X	X	X	X[d]	X
Extruded Profiles			X		X	X	X	X[e]	X[e]	X		X
Metal/Elastomer Seals			X	X					X	X		X
O-Rings/Molded Shapes			X	X	X	X	X	X	X	X		X

Compounds not available in all profiles. Contact Application Engineering Department for assistance.

NOTES:
N/A = Not Applicable or Not Tested to Specification
N/S = Not Survivable
S = Survivable
a: Tested to specific fluids per MIL-DTL-83528C PARA 4.6.17
b: Needs special tooling for molded shapes and O-rings
c: Extruded profiles made from CP665X
d: Expanded copper foil reinforced available in 0.027 ± 0.005 inch sheet stock only

Figure 1.
Rectangular Strips



Tolerances All Profiles

Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

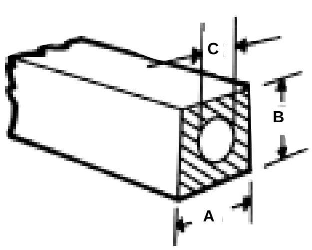
Rectangular Strips

MIL-DTL-85328 Part Number	Part Number	Nominal Dimensions	
		A	B
M83528/009X001	8861-0100	0.063 (1,6)	0.042 (1,1)
	8861-0179	0.079 (2,0)	0.039 (1,0)
	8861-0181	0.079 (2,0)	0.059 (1,5)
M83528/009X002	8861-0105	0.095 (2,4)	0.062 (1,6)
M83528/009X003	8861-0110	0.120 (3,0)	0.075 (1,9)
M83528/009X004	8861-0115	0.125 (3,2)	0.062 (1,6)
	8861-0180	0.126 (3,2)	0.039 (1,0)
	8861-0191	0.126 (3,2)	0.126 (3,2)
M83528/009X005	8861-0120	0.156 (4,0)	0.062 (1,6)
	8861-0121	0.187 (4,8)	0.125 (3,2)
	8861-0167	0.188 (4,8)	0.062 (1,6)
	8861-0193	0.189 (4,8)	0.189 (4,8)
M83528/002X006	8861-0125	0.250 (6,4)	0.062 (1,6)
	8861-0173	0.250 (6,4)	0.125 (3,2)
	8861-0174	0.250 (6,4)	0.188 (4,8)
	8861-0136	0.250 (6,4)	0.200 (5,1)
	8861-0175	0.252 (6,4)	0.031 (0,8)
	8861-0194	0.252 (6,4)	0.252 (6,4)
	8861-0127	0.375 (9,5)	0.375 (9,5)
	8861-0183	0.378 (9,6)	0.063 (1,6)
	8861-0176	0.472 (12,0)	0.031 (0,8)
	8861-0172	0.500 (12,7)	0.020 (0,5)
	8861-0131	0.500 (12,7)	0.042 (1,1)

Rectangular Strips (continued)

MIL-DTL-85328 Part Number	Part Number	Nominal Dimensions	
		A	B
	8861-0182	0.500 (12,7)	0.059 (1,5)
M83528/009X007	8861-0130	0.500 (12,7)	0.075 (1,9)
	8861-0188	0.500 (12,7)	0.094 (2,4)
M83528/009X008	8861-0135	0.500 (12,7)	0.125 (3,2)
M83528/009X009	8861-0140	0.500 (12,7)	0.188 (4,8)
	8861-0177	0.500 (12,7)	0.031 (0,8)
	8861-0190	0.591 (15,0)	0.118 (3,0)
	8861-0185	0.748 (19,0)	0.075 (1,9)
	8861-0142	0.750 (19,1)	0.040 (1,0)
	8861-0141	0.750 (19,1)	0.042 (1,1)
M83528/009X010	8861-0145	0.750 (19,1)	0.062 (1,6)
	8861-0184	0.827 (21,0)	0.071 (1,8)
	8861-0189	0.827 (21,0)	0.094 (2,4)
	8861-0178	0.827 (21,0)	0.031 (0,8)
	8861-0187	0.874 (22,0)	0.091 (2,3)
M83528/009X011	8861-0150	0.880 (22,4)	0.062 (1,6)
	8861-0103	0.984 (25,0)	0.043 (1,1)
	8861-0169	1.00 (25,4)	0.062 (1,6)
	8861-0192	1.00 (25,4)	0.126 (3,2)
M83528/009X012	8861-0155	1.00 (25,4)	0.250 (6,4)
	8861-0186	1.00 (25,4)	0.079 (2,0)
M83528/009X013	8861-0160	1.18 (30,0)	0.062 (1,6)

Figure 2.
Hollow Rectangular Strips

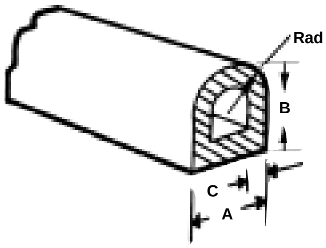


Hollow Rectangular Strips

Part Number	Nominal Dimensions		
	A	B	C
8862-0111	0.060 (1,5)	0.060 (1,5)	0.031 (0,8)
8862-0112	0.125 (3,2)	0.125 (3,2)	0.078 (2,0)
8862-0113	0.200 (5,1)	0.130 (3,3)	0.090 (2,3)
8862-0114	0.250 (6,4)	0.250 (6,4)	0.156 (4,0)
8862-0115	0.303 (7,7)	0.252 (6,4)	0.126 (3,2)
8862-0100	0.330 (8,4)	0.305 (7,7)	0.125 (3,2)
8862-0118	0.350 (8,8)	0.350 (8,9)	0.150 (3,8)
8862-0105	0.375 (9,5)	0.375 (9,5)	0.188 (4,8)
8862-0116	0.375 (9,5)	0.250 (6,4)	0.201 (5,1)
8862-0119	0.375 (9,5)	0.375 (9,5)	0.281 (7,1)
8862-0117	0.375 (9,5)	0.305 (7,7)	0.126 (3,2)
8862-0120	0.402 (10,2)	0.402 (10,2)	0.201 (5,1)
8862-0121	0.413 (10,5)	0.453 (11,5)	0.323 (8,2)
8862-0122	0.425 (10,8)	0.425 (10,8)	0.209 (5,3)

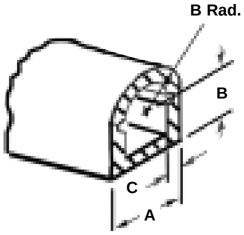
All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 3a.
Hollow D-Strip



View A

Figure 3b.



View B

Tolerances All Profiles

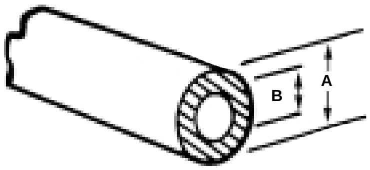
Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

Hollow D-Strips

MIL-DTL-83528	Part	Dimensions				
Part Number	Number	A	B	Rad	C	View
	8866-0159	0.059 (1,5)	0.063 (1,6)	0.029 (0,7)	0.012 (0,3)	A
	8866-0080	0.093 (2,4)	0.093 (2,4)	0.046 (1,2)	0.040 (1,0)	A
	8866-0135	0.093 (2,4)	0.093 (2,4)	0.046 (1,2)	0.027 (0,7)	A
	8866-0160	0.098 (2,5)	0.098 (2,5)	0.049 (1,2)	0.020 (0,5)	A
	8866-0130	0.100 (2,5)	0.094 (2,4)	0.050 (1,3)	0.025 (0,6)	A
	8866-0162	0.109 (2,8)	0.125 (3,2)	0.054 (1,4)	0.024 (0,6)	A
	8866-0163	0.146 (3,7)	0.146 (3,7)	0.073 (1,9)	0.016 (0,4)	A
M83528/007X001	8866-0100	0.156 (4,0)	0.156 (4,0)	0.078 (2,0)	0.045 (1,1)	A
	8866-0111	0.156 (4,0)	0.156 (4,0)	0.078 (2,0)	0.027 (0,7)	A
	8866-0161	0.157 (4,0)	0.122 (3,1)	0.078 (2,0)	0.043 (1,1)	A
	8866-0103	0.158 (4,0)	0.240 (6,1)	0.079 (2,0)	0.040 (1,0)	A
	8866-0136	0.160 (4,1)	0.120 (3,0)	0.080 (2,0)	0.025 (0,6)	A
	8866-0164	0.173 (4,4)	0.189 (4,8)	0.086 (2,2)	0.031 (0,8)	A
M83528/007X002	8866-0105	0.187 (4,8)	0.187 (4,8)	0.093 (2,4)	0.050 (1,3)	A
	8866-0165	0.236 (6,0)	0.252 (6,4)	0.012 (0,3)	0.039 (1,0)	A
	8866-0131	0.250 (6,4)	0.145 (3,7)	0.125 (3,2)	0.030 (0,8)	A
	8866-0050	0.250 (6,4)	0.250 (6,4)	0.125 (3,2)	0.050 (1,3)	B
M83528/007X007	8866-0110	0.250 (6,4)	0.250 (6,4)	0.125 (3,2)	0.065 (1,7)	A
	8866-0167	0.295 (7,5)	0.311 (7,9)	0.147 (3,7)	0.039 (1,0)	A
M83528/007X005	8866-0120	0.312 (7,9)	0.312 (7,9)	0.112 (2,8)	0.062 (1,6)	A
M83528/007X004	8866-0116	0.312 (7,9)	0.312 (7,9)	0.156 (4,0)	0.062 (1,6)	B
	8866-0127	0.325 (8,3)	0.575 (14,6)	0.287 (7,3)	0.080 (2,0)	A
	8866-0168	0.358 (9,1)	0.374 (9,5)	0.179 (4,5)	0.039 (1,0)	A
	8866-0166	0.374 (9,5)	0.252 (6,4)	0.187 (4,8)	0.039 (1,0)	A
	8866-0134	0.375 (9,5)	0.250 (6,4)	0.090 (2,3)	0.050 (1,3)	B
	8866-0137	0.375 (9,5)	0.250 (6,4)	0.187 (4,8)	0.032 (0,8)	A
	8866-0169	0.421 (10,7)	0.427 (10,8)	0.210 (5,3)	0.039 (1,0)	A
	8866-0126	0.480 (12,2)	0.335 (8,5)	0.240 (6,1)	0.035 (0,9)	A
M83528/007X006	8866-0125	0.487 (12,4)	0.324 (8,2)	0.244 (6,2)	0.062 (1,6)	A
	8866-0148	0.488 (12,4)	0.312 (7,9)	0.244 (6,2)	0.055 (1,4)	A
	8866-0139	0.488 (12,4)	0.324 (8,2)	0.244 (6,2)	0.063 (1,6)	A
	8866-0129	0.500 (12,7)	0.312 (7,9)	0.250 (6,4)	0.050 (1,3)	A
	8866-0061	0.575 (14,6)	0.325 (8,3)	0.078 (2,0)	0.043 (1,1)	A
	8866-0155	0.625 (15,9)	0.400 (10,2)	0.312 (7,9)	0.057 (1,4)	A

All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 4.
O-Strip Tubing



Tolerances All Profiles

Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

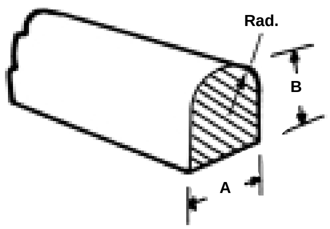
O-Strip Tubing

MIL-DTL-85328 Part Number	Part Number	Nominal Dimensions A	Nominal Dimensions B
	8864-0136	0.085 (2,2)	0.035 (0,9)
	8864-0060	0.085 (2,2)	0.040 (1,0)
	8864-0173	0.085 (2,2)	0.050 (1,3)
	8864-0156	0.090 (2,3)	0.040 (1,0)
	8864-0161	0.090 (2,3)	0.045 (1,1)
	8864-0090	0.090 (2,3)	0.050 (1,3)
M83528/011X007	8864-0095	0.103 (2,6)	0.040 (1,0)
	8864-0142	0.103 (2,6)	0.050 (1,3)
	8864-0172	0.110 (2,8)	0.062 (1,6)
	8864-0153	0.115 (2,9)	0.062 (1,6)
M83528/011X001	8864-0100	0.125 (3,2)	0.045 (1,1)
M83528/011X006	8864-0101	0.125 (3,2)	0.062 (1,6)
	8864-0102	0.130 (3,3)	0.062 (1,6)
	8864-0104	0.145 (3,7)	0.070 (1,8)
	8864-0171	0.149 (3,8)	0.125 (3,2)
M83528/011X002	8864-0105	0.156 (4,0)	0.050 (1,3)
	8864-0163	0.156 (4,0)	0.062 (1,6)
	8864-0139	0.168 (4,3)	0.069 (1,8)
	8864-0162	0.177 (4,5)	0.092 (2,3)
M83528/011X008	8864-0143	0.177 (4,5)	0.079 (2,0)
	8864-0168	0.188 (4,8)	0.120 (3,0)
	8864-0147	0.216 (5,5)	0.125 (3,2)
	8864-0167	0.228 (5,8)	0.169 (4,3)
M83528/011X003	8864-0110	0.250 (6,4)	0.125 (3,2)
	8864-0160	0.312 (7,9)	0.188 (4,8)
M83528/011X004	8864-0120	0.312 (7,9)	0.192 (4,9)
	8864-0144	0.330 (8,4)	0.250 (6,4)
	8864-0050	0.375 (9,5)	0.235 (6,0)
M83528/011X005	8864-0125	0.375 (9,5)	0.250 (6,4)
	8864-0127	0.400 (10,2)	0.200 (5,1)
	8864-0170	0.422 (10,7)	0.319 (8,1)
	8864-0166	0.490 (12,4)	0.414 (10,5)
	8864-0140	0.513 (13,0)	0.190 (4,8)
	8864-0135	0.513 (13,0)	0.438 (11,1)
	8864-0055	0.550 (14,0)	0.447 (11,4)
	8864-0159	0.623 (15,8)	0.366 (9,3)
	8864-0053	0.630 (16,0)	0.375 (9,5)

All dimensions shown are in inches (millimeters) unless otherwise specified.

D-Strips

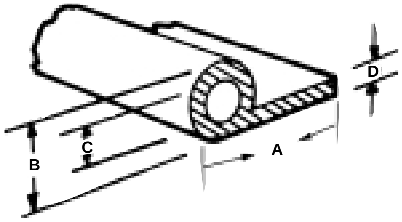
Figure 5.
D-Strips



MIL-DTL-83528 Part Number	Part Number	Dimensions			Recommended Groove Dimensions (±0.002)	
		A	B	Rad	Width	Depth
	8865-0100	0.055 (1,4)	0.064 (1,6)	0.031 (0,8)	0.067 (1,7)	0.053 (1,3)
MB83528/003X001	8865-0105	0.062 (1,6)	0.068 (1,7)	0.031 (0,8)	0.074 (1,9)	0.057 (1,4)
MB83528/003X005	8865-0120	0.062 (1,6)	0.100 (2,5)	0.031 (0,8)	0.076 (1,9)	0.084 (2,1)
MB83528/003X010	8865-0140	0.075 (1,9)	0.178 (4,5)	0.089 (2,3)	0.093 (2,4)	0.150 (3,8)
MB83528/003X004	8865-0116	0.093 (2,4)	0.093 (2,4)	0.047 (1,2)	0.109 (2,8)	0.077 (2,0)
MB83528/003X002	8865-0110	0.094 (2,4)	0.078 (2,0)	0.047 (1,2)	0.109 (2,8)	0.065 (1,7)
MB83528/003X008	8865-0135	0.118 (3,0)	0.156 (4,0)	0.059 (1,5)	0.140 (3,6)	0.131 (3,3)
MB83528/003X007	8865-0130	0.122 (3,1)	0.135 (3,4)	0.061 (1,5)	0.141 (3,6)	0.113 (2,9)
MB83528/003X006	8865-0125	0.150 (3,8)	0.110 (2,8)	0.075 (1,9)	0.165 (4,2)	0.092 (2,3)
MB83528/003X009	8865-0136	0.156 (4,0)	0.156 (4,0)	0.078 (2,0)	0.180 (4,6)	0.131 (3,3)
MB83528/003X003	8865-0115	0.178 (4,5)	0.089 (2,3)	0.039 (1,0)	0.182 (4,3)	0.074 (1,9)
MB83528/003X011	8865-0144	0.188 (4,8)	0.188 (4,8)	0.094 (2,4)	0.220 (5,6)	0.160 (4,1)
MB83528/003X012	8865-0145	0.250 (6,4)	0.250 (6,4)	0.125 (3,2)	0.286 (7,3)	0.212 (5,4)

P-Strips

Figure 6.
P-Strips



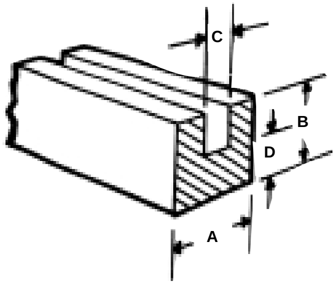
MIL-DTL-83528 Part Number	Part Number	Dimensions			
		A	B	C	D
	8867-0152	0.250 (6,4)	0.125 (3,2)	0.079 (2,0)	0.040 (1,0)
	8867-0149	0.252 (6,4)	0.039 (1,0)	0.028 (0,7)	0.016 (0,4)
	8867-0150	0.252 (6,4)	0.063 (1,6)	0.031 (0,8)	0.016 (0,4)
	8867-0151	0.252 (6,4)	0.079 (2,0)	0.035 (0,9)	0.016 (0,4)
	8867-0136	0.275 (7,0)	0.140 (3,6)	0.085 (2,2)	0.030 (0,8)
	8867-0147	0.290 (7,4)	0.095 (2,4)	0.062 (1,6)	0.025 (0,6)
	8867-0156	0.374 (9,5)	0.252 (6,4)	0.150 (3,8)	0.063 (1,6)
	8867-0153	0.375 (9,5)	0.187 (4,8)	0.131 (3,3)	0.040 (1,0)
	8867-0148	0.375 (9,5)	0.125 (3,2)	0.045 (1,1)	0.062 (1,6)
	8867-0144	0.390 (9,9)	0.200 (5,1)	0.103 (2,6)	0.062 (1,6)
	8867-0128	0.415 (10,5)	0.200 (5,1)	0.060 (1,5)	0.062 (1,6)
	8867-0141	0.425 (10,8)	0.250 (6,4)	0.151 (3,8)	0.050 (1,3)
M83528/008X007	8867-0101	0.475 (12,1)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0135	0.480 (12,2)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0154	0.500 (12,7)	0.189 (4,8)	0.126 (3,2)	0.063 (1,6)
	8867-0127	0.500 (12,7)	0.200 (5,1)	0.076 (1,9)	0.062 (1,6)
M83528/008X002	8867-0105	0.500 (12,7)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
	8867-0132	0.500 (12,7)	0.250 (6,4)	0.150 (3,8)	0.062 (1,6)
	8867-0157	0.500 (12,7)	0.250 (6,4)	0.194 (4,9)	0.050 (1,3)
	8867-0159	0.563 (14,3)	0.312 (7,9)	0.186 (4,7)	0.063 (1,6)
	8867-0126	0.600 (15,2)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
M83528/008X003	8867-0110	0.625 (15,9)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
M83528/008X004	8867-0120	0.625 (15,9)	0.250 (6,4)	0.150 (3,8)	0.062 (1,6)
	8867-0161	0.626 (15,9)	0.375 (9,5)	0.295 (7,5)	0.055 (1,4)
	8867-0142	0.630 (16,0)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0102	0.640 (16,3)	0.208 (5,3)	0.080 (2,0)	0.072 (1,8)
	8867-0155	0.650 (16,5)	0.201 (5,1)	0.079 (2,0)	0.063 (1,6)
	8867-0160	0.748 (19,0)	0.354 (9,0)	0.228 (5,8)	0.063 (1,6)
	8867-0140	0.750 (19,1)	0.250 (6,4)	0.187 (4,8)	0.062 (1,6)
	8867-0158	0.752 (19,1)	0.252 (6,4)	0.189 (4,8)	0.063 (1,6)
	8867-0163	0.752 (19,1)	0.392 (10,0)	0.312 (7,9)	0.045 (1,1)
	8867-0165	0.752 (19,1)	0.437 (11,1)	0.347 (8,8)	0.060 (1,5)
M83528/008X006	8867-0130	0.780 (19,8)	0.360 (9,1)	0.255 (6,5)	0.070 (1,8)
M83528/008X001	8867-0100	0.850 (21,6)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0166	0.874 (22,2)	0.500 (12,7)	0.400 (10,2)	0.065 (1,7)
M83528/008X008	8867-0137	0.875 (22,2)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
M83528/008X005	8867-0125	0.875 (22,2)	0.312 (7,9)	0.187 (4,8)	0.062 (1,6)
	8867-0162	1.000 (25,4)	0.374 (9,5)	0.255 (6,5)	0.063 (1,6)
	8867-0164	1.043 (26,5)	0.433 (11,0)	0.307 (7,8)	0.063 (1,6)

Tolerances All Profiles

Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 7.
Channel Strips



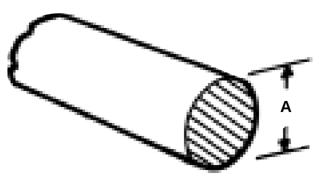
Tolerances All Profiles

Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

Channel Strips

MIL-DTL-83528	Part	Dimensions			
Part Number	Number	A	B	C	D
M83528/010X001	8868-0100	0.100 (2,5)	0.100 (2,5)	0.034 (0,9)	0.033 (0,8)
	8868-0076	0.110 (2,8)	0.126 (3,2)	0.026 (0,7)	0.060 (1,5)
	8868-0055	0.114 (2,9)	0.082 (2,1)	0.030 (0,8)	0.026 (0,7)
	8868-0104	0.126 (3,2)	0.078 (2,0)	0.048 (1,2)	0.039 (1,0)
M83528/010X002	8868-0105	0.126 (3,2)	0.110 (2,8)	0.025 (0,6)	0.050 (1,3)
	8868-0077	0.126 (3,2)	0.157 (4,0)	0.053 (1,3)	0.028 (0,7)
M83528/010X003	8868-0110	0.126 (3,2)	0.225 (5,7)	0.020 (0,5)	0.075 (1,9)
	8868-0066	0.140 (3,6)	0.161 (4,1)	0.040 (1,0)	0.081 (2,1)
	8868-0060	0.145 (3,7)	0.090 (2,3)	0.050 (1,3)	0.045 (1,1)
	8868-0056	0.156 (4,0)	0.114 (2,9)	0.030 (0,8)	0.062 (1,6)
M83528/010X004	8868-0115	0.156 (4,0)	0.156 (4,0)	0.062 (1,6)	0.047 (1,2)
	8868-0078	0.156 (4,0)	0.156 (4,0)	0.076 (1,9)	0.046 (1,2)
	8868-0079	0.157 (4,0)	0.189 (4,8)	0.063 (1,6)	0.063 (1,6)
	8868-0080	0.157 (4,0)	0.190 (4,8)	0.059 (1,5)	0.048 (1,2)
	8868-0083	0.157 (4,0)	0.197 (5,0)	0.055 (1,4)	0.091 (2,3)
	8868-0067	0.175 (4,4)	0.500 (12,7)	0.047 (1,2)	0.075 (1,9)
M83528/010X005	8868-0120	0.175 (4,4)	0.156 (4,0)	0.047 (1,2)	0.075 (1,9)
	8868-0081	0.189 (4,8)	0.189 (4,8)	0.063 (1,6)	0.063 (1,6)
	8868-0082	0.189 (4,8)	0.189 (4,8)	0.072 (1,8)	0.070 (1,8)
	8868-0072	0.220 (5,6)	0.158 (4,0)	0.094 (2,4)	0.032 (0,8)
	8868-0084	0.250 (6,4)	0.250 (6,4)	0.062 (1,6)	0.062 (1,6)
	8868-0085	0.252 (6,4)	0.252 (6,4)	0.126 (3,2)	0.063 (1,6)
M83528/010X006	8868-0125	0.327 (8,3)	0.235 (6,0)	0.062 (1,6)	0.115 (2,9)
	8868-0086	0.374 (9,5)	0.374 (9,5)	0.157 (4,0)	0.079 (2,0)
	8868-0070	0.395 (1,0)	0.120 (3,0)	0.275 (7,0)	0.060 (1,5)
	8868-0075	0.530 (13,5)	0.130 (3,3)	0.390 (9,9)	0.060 (1,5)

Figure 8.
O-Strips



O-Strips

MIL-DTL-85328 Part Number	Part Number		Recommended Groove Dimensions (±0.002)	
		A	Width	Height
	8863-0184	0.032 (0,8)	0.036 (0,9)	0.026 (0,7)
M83528/001X001	8863-0100	0.040 (1,0)	0.045 (1,1)	0.032 (0,8)
	8863-0186	0.046 (1,2)	0.050 (1,3)	0.036 (0,9)
M83528/001X002	8863-0105	0.053 (1,3)	0.059 (1,5)	0.042 (1,1)
	8863-0187	0.057 (1,4)	0.062 (1,6)	0.048 (1,2)
M83528/001X003	8863-0110	0.062 (1,6)	0.066 (1,7)	0.050 (1,3)
M83528/001X004	8863-0115	0.070 (1,8)	0.076 (1,9)	0.056 (1,4)
M83528/001X005	8863-0120	0.080 (2,0)	0.086 (2,2)	0.064 (1,6)
M83528/001X006	8863-0125	0.093 (2,4)	0.100 (2,5)	0.074 (1,9)
	8863-0196	0.098 (2,5)	0.105 (2,7)	0.078 (2,0)
M83528/001X007	8863-0130	0.103 (2,6)	0.110 (2,8)	0.082 (2,1)
	8863-0135	0.112 (2,8)	0.119 (3,0)	0.089 (2,3)
M83528/001X008	8863-0140	0.119 (3,0)	0.126 (3,2)	0.095 (2,4)
M83528/001X009	8863-0145	0.125 (3,2)	0.133 (3,4)	0.100 (2,5)
	8863-0150	0.130 (3,3)	0.137 (3,5)	0.104 (2,6)
M83528/001X010	8863-0160	0.139 (3,5)	0.147 (3,7)	0.111 (2,8)
	8863-0165	0.150 (3,8)	0.158 (4,0)	0.120 (3,0)
	8863-0170	0.160 (4,1)	0.168 (4,3)	0.128 (3,3)
	8863-0197	0.186 (4,7)	0.197 (5,0)	0.149 (3,8)
M83528/001X011	8863-0183	0.188 (4,8)	0.200 (5,1)	0.150 (3,8)
	8863-0198	0.194 (4,9)	0.209 (5,3)	0.156 (4,0)
	8863-0199	0.197 (5,0)	0.210 (5,3)	0.158 (4,0)
M83528/001X0012	8863-0175	0.216 (5,5)	0.229 (5,8)	0.173 (4,4)
M83528/001X013	8863-0180	0.250 (6,4)	0.267 (6,8)	0.200 (5,1)
	8863-0200	0.256 (6,5)	0.274 (7,0)	0.205 (5,2)
	8863-0201	0.312 (7,9)	0.337 (8,6)	0.250 (6,4)
	8863-0202	0.374 (9,5)	0.400 (10,2)	0.300 (7,6)

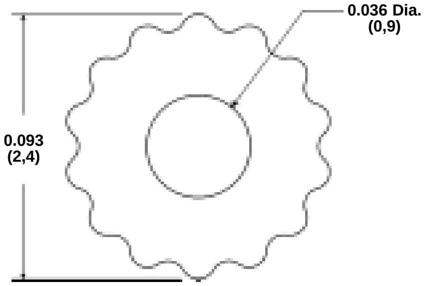
All dimensions shown are in inches (millimeters) unless otherwise specified.

Custom Extrusions

The conductive elastomer profiles shown here are examples of Laird Technologies' ability to offer customers optimum solutions based on engineering analysis of the three major design requirements of electrical, mechanical and environmental.

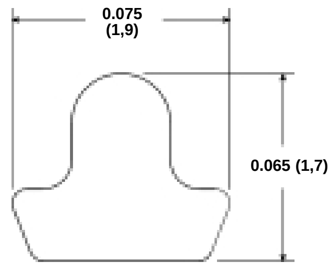
Utilizing the mechanical parameters of the mounting flange width, free height, gap height and closure force, our engineering department can determine the best profile to meet a specific design requirement. When necessary, we can utilize our FEA (Finite Element Analysis) capability to determine the profile based upon the customer's specific design criteria.

Figure 1.



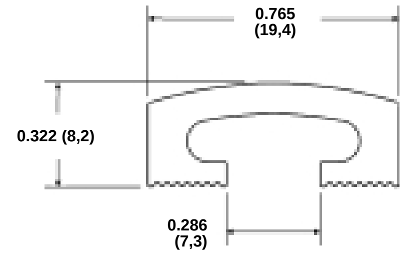
8864-0137-XX

Figure 2.



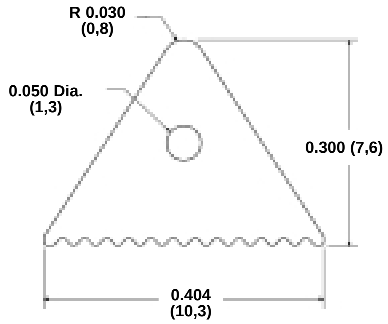
8865-0139-XX

Figure 3.



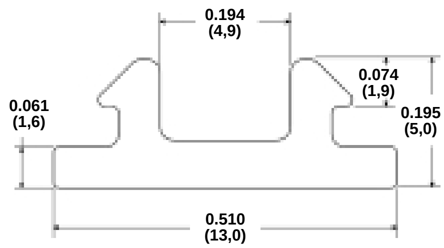
8866-0051-XX

Figure 4.



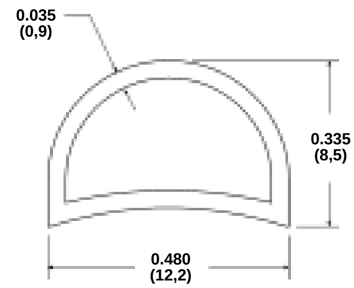
8866-0052-XX

Figure 5.



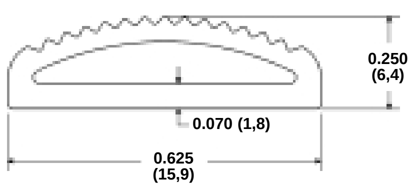
8866-0058-XX

Figure 6.



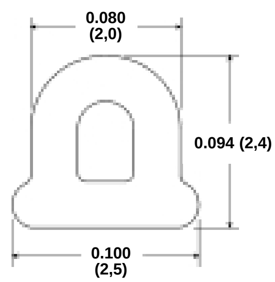
8866-0126-XX

Figure 7.



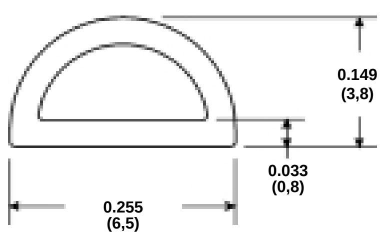
8866-0128-XX

Figure 8.



8866-0130-XX

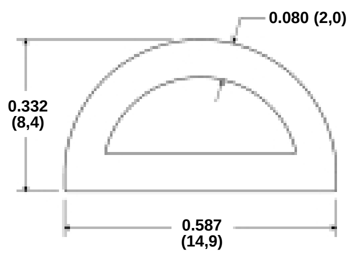
Figure 9.



8866-0131-XX

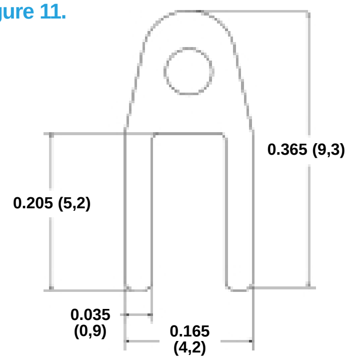
All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 10.



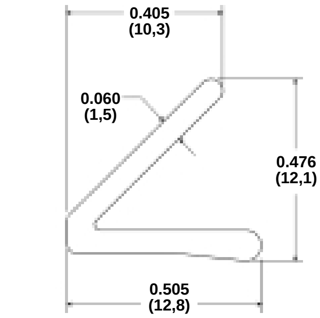
8866-9127-XX

Figure 11.



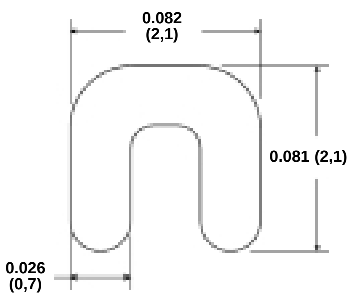
8868-0051-XX

Figure 12.



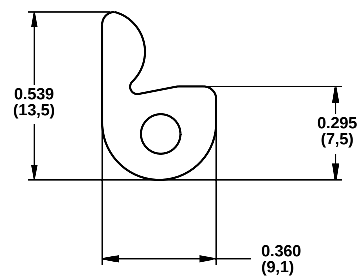
8868-0053-XX

Figure 13.



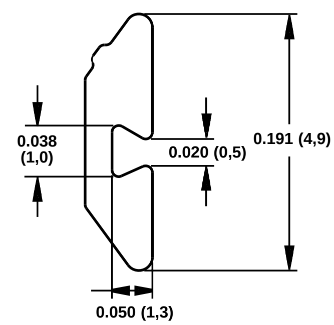
8868-0055-XX

Figure 14.



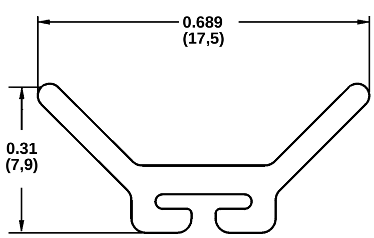
8869-0010-XX

Figure 15.



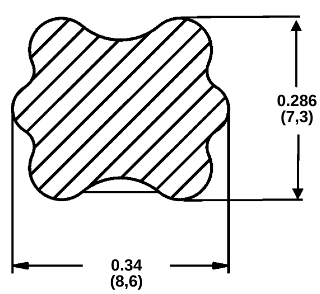
8869-0059-XX

Figure 16.



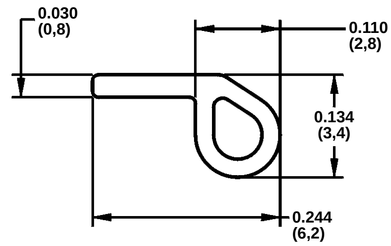
8869-0065-XX

Figure 17.



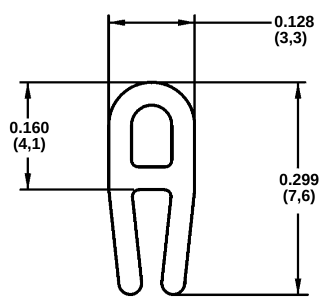
8869-0072-XX

Figure 18.



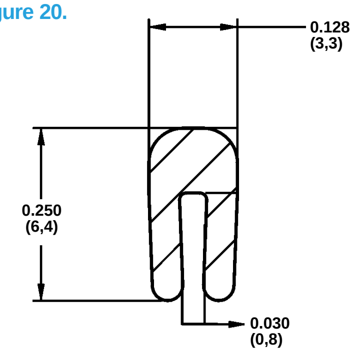
8869-0073-XX

Figure 19.



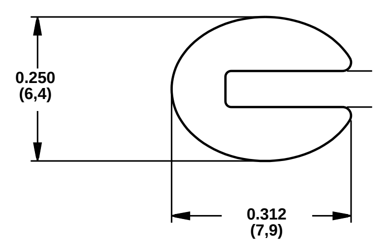
8869-0075-XX

Figure 20.



8869-0076-XX

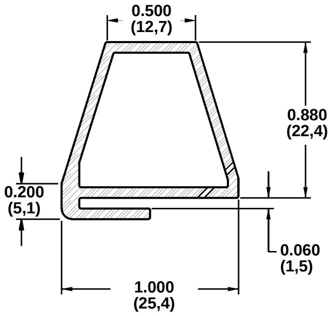
Figure 21.



8869-0080-XX

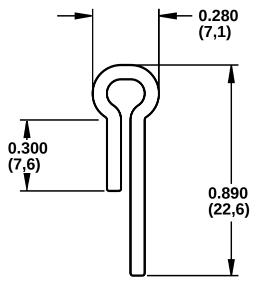
All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 22.



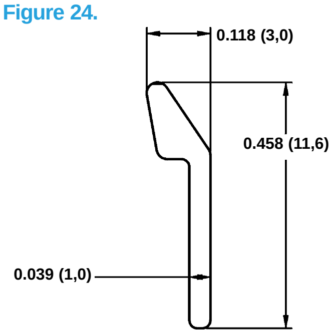
8869-0083-XX

Figure 23.



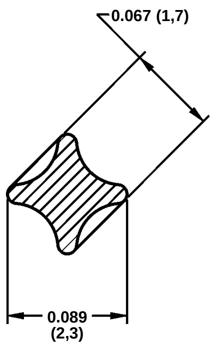
8869-0084-XX

Figure 24.



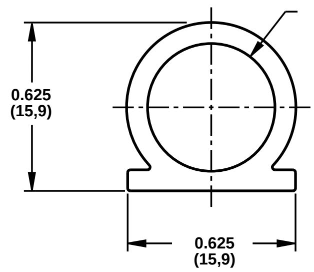
8869-0085-XX

Figure 25.



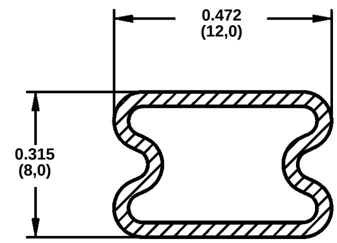
8869-0087-XX

Figure 26.



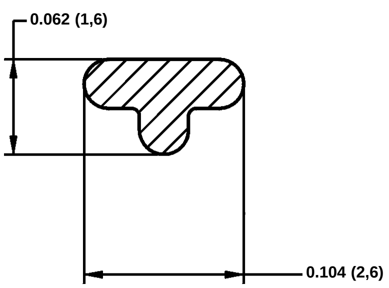
8869-0100-XX

Figure 27.



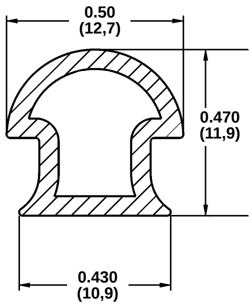
8869-0103-XX

Figure 28.



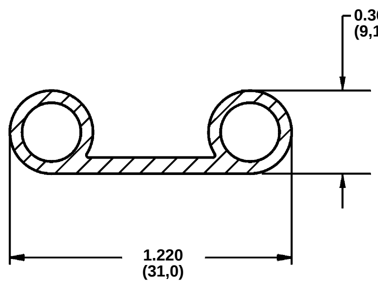
8869-0107-XX

Figure 29.



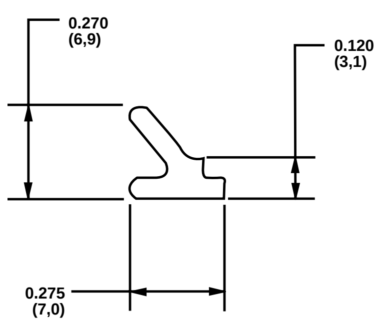
8869-0108-XX

Figure 30.



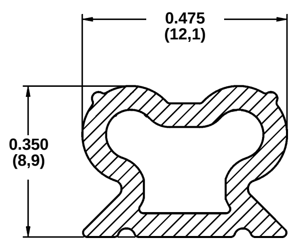
8869-0109-XX

Figure 31.



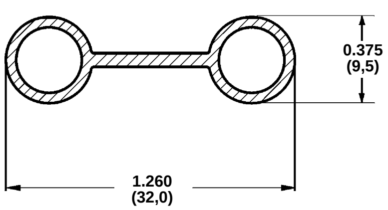
8869-0112-XX

Figure 32.



8869-0114-XX

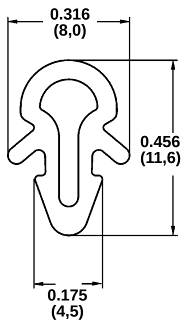
Figure 33.



8869-0115-XX

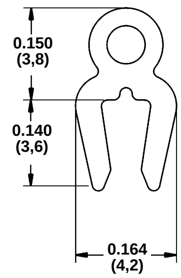
All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 34.



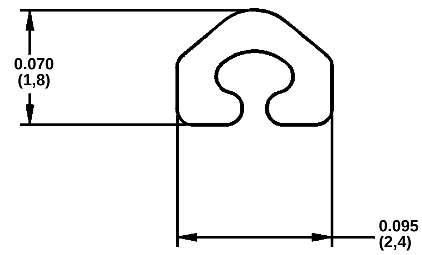
8869-0119-XX

Figure 35.



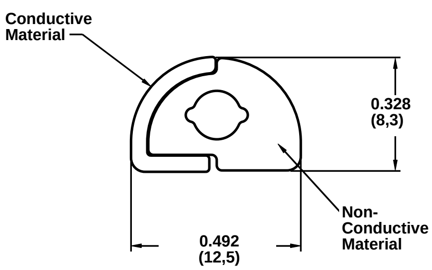
8869-0120-XX

Figure 36.



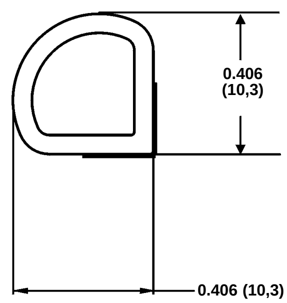
8869-0124-XX

Figure 37.



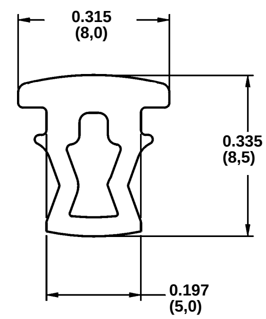
8869-0126-XX

Figure 38.



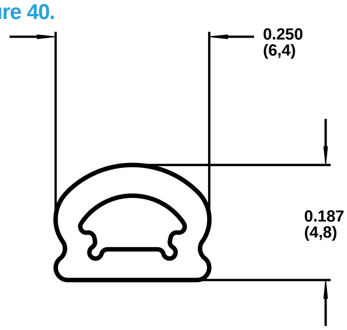
8869-0129-XX

Figure 39.



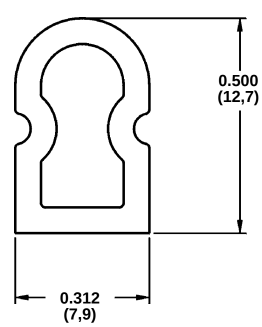
8869-0130-XX

Figure 40.



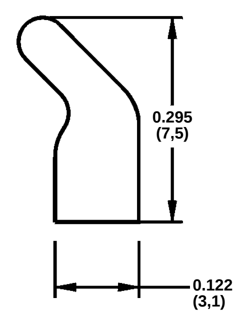
8869-0149-XX

Figure 41.



8869-0150-XX

Figure 42.



8869-0151-XX

All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroSeal Conductive Elastomer Fabricated Components

Overview

Laird Technologies provides a full line of fabricated conductive elastomers. These products are offered in a wide range of materials to meet your particular application. In addition to the standard components shown, Laird Technologies can supply molded and vulcanized EcE gaskets to meet custom configurations required to package electronic components in either cast or sheet metal enclosures.

Molded O-Rings

O-rings, when installed in a groove design that allows 10%–20% compression and 80%–95% gland fill, will provide both an EMI and moisture seal. Custom tools can be fabricated for prototypes and production quantities when diameters are larger than 2.000 in. (50,8 mm). Round strips can also be vulcanized to create O-rings to include parts with diameters larger than 3.000 in. (76,2 mm). Consult Laird Technologies sales department for sizes not shown in this catalog.

Flat Washers

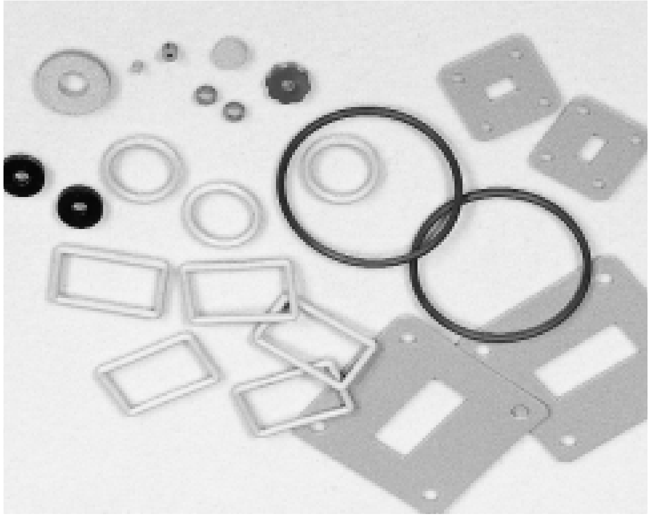
Table 3 shows some of the standard sizes of washers that can be die-cut from sheet material. Besides the circular shape, intricate shapes can be designed and die-cut to meet custom requirements.

Molded D-Rings

Tables 4, 5 and 6 show standard sizes of molded rings. These components, as in the O-rings above, can be supplied spliced and vulcanized to dimensions in excess of two inches I.D.

Flat Waveguide Gaskets

The die-cut gaskets shown in Tables 7 and 8 are designed to provide effective EMI shielding and pressure sealing for choke cover and contact flanges. Gaskets shown in this table can be supplied from the sheet materials shown in Table A.



Sheet Material

Table A lists thicknesses and sizes for our molded sheet material, while Table 2, pages 14–17, shows the compounds available for all of our conductive silicone elastomers.

Table A.

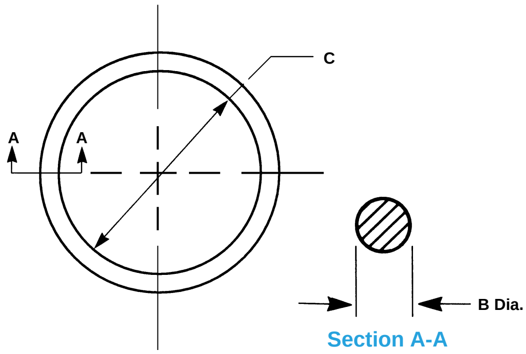
Thickness/Tolerance	10 X 10 Sheet	10 X 15 Sheet	15 X 20 Sheet	18 X 18 Sheet
0.020 ± 0.004 (0,5 ± 0,1)	8860-0020-100-XX	8860-0020-150-XX	8860-0020-300-XX	N/A
0.032 ± 0.005 (0,8 ± 0,1)	8860-0032-100-XX	8860-0032-150-XX	8860-0032-300-XX	8860-0032-324-XX
0.045 ± 0.005 (1,1 ± 0,1)	8860-0045-100-XX	8860-0045-150-XX	8860-0045-300-XX	8860-0045-324-XX
0.062 ± 0.007 (1,5 ± 0,2)	8860-0062-100-XX	8860-0062-150-XX	8860-0062-300-XX	8860-0062-324-XX
0.093 ± 0.010 (2,3 ± 0,3)	8860-0093-100-XX	8860-0093-150-XX	8860-0093-300-XX	8860-0093-324-XX
0.100 ± 0.010 (2,5 ± 0,3)	8860-0100-100-XX	8860-0100-150-XX	8860-0100-300-XX	8860-0100-324-XX
0.125 ± 0.010 (3,2 ± 0,3)	8860-0125-100-XX	8860-0125-150-XX	8860-0125-300-XX	8860-0125-324-XX

How to Specify

1. Determine the standard Laird Technologies part number from Tables 1–8 based upon configuration.
2. Select the material compound from Table 2, pages 14–17, and replace the XX with the two-digit material designation.
3. Submit the complete part number to Laird Technologies for pricing and delivery information.

All dimensions shown are in inches (millimeters) unless otherwise specified.

Molded EMI O-Rings



Section A-A

Tolerances: Table 1 and Table 2

Inner Dimensions: C	Tolerances
0.100 to 1.500 (3 to 38)	± 0.010 (0,3)
1.501 to 2.500 (38 to 64)	± 0.015 (0,4)
2.501 to 4.500 (64 to 114)	± 0.020 (0,5)
4.501 to 7.000 (114 to 178)	± 0.025 (0,6)
over 7.000 (178)	± 0.35% nom. dim.
Cross Section Dimensions: B	
0.000 to 0.070 (0,0 to 1,8)	± 0.003 (0,1)
0.071 to 0.200 (1,8 to 5,1)	± 0.005 (0.1)
0.201 to 0.400 (5,1 to 10,2)	± 0.006 (0,2)

Table 1. MIL-DTL-83528 Series

MIL-DTL-83528	Laird Technologies	Dimensions	
Part No.	Part No.	C	B
	8563-0322-XX	0.050 (1,3)	0.063 (1,6)
	8563-0258-XX	0.143 (3,6)	0.070 (1,8)
M83528/002X007	8563-0068-XX	0.145 (3,7)	0.070 (1,8)
	8563-0143-XX	0.150 (3,8)	0.062 (1,6)
	8563-0193-XX	0.171 (4,3)	0.139 (3,5)
	8563-0334-XX	0.176 (4,5)	0.070 (1,8)
	8563-0326-XX	0.260 (6,6)	0.030 (0,8)
	8563-0343-XX	0.270 (6,9)	0.070 (1,8)
M83528/005X006	8563-0106-XX	0.295 (7,5)	0.048 (1,2)
	8563-0336-XX	0.300 (7,6)	0.093 (2,4)
M83528/002X011	8563-0069-XX	0.301 (7,6)	0.070 (1,8)
	8563-0209-XX	0.312 (7,9)	0.062 (1,6)
	8563-0259-XX	0.334 (8,5)	0.070 (1,8)
M83528/002X012	8563-0070-XX	0.364 (9,2)	0.070 (1,8)
	8563-0243-XX	0.415 (10,5)	0.057 (1,4)
M83528/002X013	8563-0071-XX	0.426 (10,8)	0.070 (1,8)
M83528/005X008	8563-0108-XX	0.446 (11,3)	0.051 (1,3)
	8563-0171-XX	0.480 (12,2)	0.050 (1,3)
	8563-0728-XX	0.482 (12,2)	0.070 (1,8)
M83528/002X014	8563-0072-XX	0.489 (12,4)	0.070 (1,8)
	8563-0196-XX	0.492 (12,5)	0.070 (1,8)
	8563-0327-XX	0.500 (12,7)	0.100 (2,5)
M83528/002X015	8563-0073-XX	0.551 (14,0)	0.070 (1,8)
M83528/005X016	8563-0116-XX	0.610 (15,5)	0.070 (1,8)
M83528/002X114	8563-0091-XX	0.612 (15,5)	0.103 (2,6)
	8563-0285-XX	0.632 (16,1)	0.062 (1,6)
M83528/005X017	8563-0117-XX	0.635 (16,1)	0.070 (1,8)
M83528/005X011	8563-0111-XX	0.648 (16,5)	0.063 (1,6)
M83528/002X017	8563-0074-XX	0.676 (17,2)	0.070 (1,8)
	8563-0211-XX	0.676 (17,2)	0.070 (1,8)
M83528/002X018	8563-0075-XX	0.739 (18,8)	0.070 (1,8)
	8563-0218-XX	0.755 (19,2)	0.097 (2,5)
M83528/002X019	8563-0076-XX	0.801 (20,3)	0.070 (1,8)
	8563-0212-XX	0.801 (20,3)	0.070 (1,8)
M83528/002X020	8563-0077-XX	0.864 (21,9)	0.070 (1,8)
	8563-0344-XX	0.921 (23,4)	0.139 (3,5)
M83528/002X021	8563-0078-XX	0.926 (23,5)	0.070 (1,8)
M83528/002X022	8563-0079-XX	0.989 (25,1)	0.070 (1,8)
	8563-0213-XX	0.989 (25,1)	0.070 (1,8)
	8563-0279-XX	1.000 (25,4)	0.250 (6,4)
	8563-0295-XX	1.046 (26,6)	0.070 (1,8)
	8563-0062-XX	1.100 (27,9)	0.070 (1,8)
M83528/002X024	8563-0080-XX	1.114 (28,3)	0.070 (1,8)
M83528/005X013	8563-0113-XX	1.182 (30,0)	0.068 (1,7)
	8563-0230-XX	1.230 (31,2)	0.139 (3,5)
M83528/002X026	8563-0089-XX	1.239 (31,5)	0.070 (1,8)
	8563-0161-XX	1.239 (31,5)	0.070 (1,8)
M83528/002X126	8563-0094-XX	1.362 (34,6)	0.103 (2,6)
M83528/002X028	8563-0090-XX	1.364 (34,6)	0.070 (1,8)
	8563-0163-XX	1.364 (34,6)	0.070 (1,8)
	8563-0165-XX	1.366 (34,7)	0.070 (1,8)
	8563-0324-XX	1.463 (37,2)	0.080 (2,0)
	8563-0284-XX	1.484 (37,7)	0.211 (5,4)
M83528/002X128	8563-0095-XX	1.487 (37,8)	0.103 (2,6)
	8563-0164-XX	1.487 (37,8)	0.103 (2,6)
	8563-0166-XX	1.489 (37,8)	0.070 (1,8)
	8563-0162-XX	1.602 (40,7)	0.103 (2,6)
M83528/005X022	8563-0122-XX	1.612 (40,9)	0.103 (2,6)
	8563-0158-XX	1.612 (40,9)	0.103 (2,6)
M83528/002X132	8563-0096-XX	1.737 (44,1)	0.103 (2,6)
	8563-0160-XX	1.737 (44,1)	0.103 (2,6)
	8563-0167-XX	1.739 (44,2)	0.070 (1,8)
M83528/005X023	8563-0123-XX	1.790 (45,5)	0.103 (2,6)
	8563-0157-XX	1.799 (45,7)	0.103 (2,6)
	8563-0178-XX	1.800 (45,7)	0.080 (2,0)
M83528/002X134	8563-0097-XX	1.862 (47,3)	0.103 (2,6)
	8563-0168-XX	1.989 (50,5)	0.070 (1,8)
	8563-0280-XX	2.000 (50,8)	0.250 (6,4)
	8563-0159-XX	2.050 (52,1)	0.103 (2,6)
	8563-0125-XX	2.059 (52,3)	0.160 (4,1)
	8563-0192-XX	2.114 (53,7)	0.070 (1,8)
	8563-0054-XX	2.120 (53,8)	0.119 (3,0)
	8563-0145-XX	2.143 (54,4)	0.125 (3,2)
	8563-0061-XX	2.218 (56,3)	0.070 (1,8)
	8563-0228-XX	2.364 (60,0)	0.070 (1,8)
M83528/002X142	8563-0098-XX	2.367 (60,1)	0.103 (2,6)
	8563-0240-XX	2.436 (61,9)	0.053 (1,3)
	8563-0227-XX	2.509 (63,7)	0.101 (2,6)
	8563-0232-XX	2.614 (66,4)	0.070 (1,8)
	8563-0338-XX	2.638 (67,0)	0.062 (1,6)
	8563-0142-XX	2.683 (68,1)	0.119 (3,0)
	8563-0055-XX	3.070 (78,0)	0.080 (2,0)
	8563-0060-XX	3.071 (78,0)	0.070 (1,8)
	8563-0180-XX	3.158 (80,2)	0.062 (1,6)
	8563-0241-XX	3.209 (81,5)	0.070 (1,8)
	8563-0188-XX	3.225 (81,9)	0.216 (5,5)
	8563-0271-XX	3.237 (82,2)	0.032 (0,8)
	8563-0242-XX	3.356 (85,2)	0.053 (1,3)
	8563-0144-XX	3.425 (87,0)	0.160 (4,1)
	8563-0262-XX	3.460 (87,9)	0.103 (2,6)
	8563-0136-XX	3.559 (90,4)	0.139 (3,5)
	8563-0216-XX	3.806 (96,7)	0.125 (3,2)
	8563-0281-XX	3.989 (101,3)	0.070 (1,8)
	8563-0274-XX	4.450 (113,0)	0.070 (1,8)
	8563-0139-XX	4.690 (119,1)	0.062 (1,6)
	8563-0190-XX	4.739 (120,4)	0.070 (1,8)
	8563-0056-XX	5.240 (133,1)	0.070 (1,8)
	8563-0282-XX	5.394 (137,0)	0.103 (2,6)

All dimensions shown are in inches (millimeters) unless otherwise specified.

Table 1. MIL-DTL-83528 Series (continued)

MIL-DTL-83528 Part No.	Laird Technologies Part No.	Dimensions C	B
	8563-0186-XX	5.500 (139,7)	0.070 (1,8)
	8563-0329-XX	5.625 (142,9)	0.062 (1,6)
	8563-0124-XX	5.700 (144,8)	0.080 (2,0)
	8563-0231-XX	5.735 (145,7)	0.103 (2,6)
	8563-0315-XX	5.858 (148,8)	0.070 (1,8)
	8563-0293-XX	5.875 (149,2)	0.040 (1,0)
	8563-0174-XX	5.900 (149,9)	0.070 (1,8)
	8563-0058-XX	5.930 (150,6)	0.150 (3,8)
	8563-0185-XX	6.000 (152,4)	0.103 (2,6)
	8563-0177-XX	6.100 (154,9)	0.080 (2,0)
	8563-0234-XX	6.312 (160,3)	0.070 (1,8)
	8563-0303-XX	6.793 (172,5)	0.119 (3,0)
	8563-0176-XX	7.020 (178,3)	0.080 (2,0)
	8563-0124-XX	7.090 (180,1)	0.065 (1,7)
	8563-0342-XX	7.322 (186,0)	0.103 (2,6)
	8563-0226-XX	7.491 (190,3)	0.070 (1,8)
	8563-0175-XX	7.500 (190,5)	0.125 (3,2)
	8563-0179-XX	7.750 (196,9)	0.103 (2,6)
	8563-0283-XX	8.563 (217,5)	0.103 (2,6)
	8563-0323-XX	8.750 (222,3)	0.250 (6,4)
	8563-0341-XX	9.196 (233,6)	0.103 (2,6)
	8563-0263-XX	9.370 (238,0)	0.103 (2,6)
	8563-0059-XX	9.612 (244,1)	0.070 (1,8)
	8563-0191-XX	9.737 (247,3)	0.103 (2,6)
	8563-0198-XX	9.904 (251,6)	0.062 (1,6)
	8563-0187-XX	9.984 (253,6)	0.139 (3,5)
	8563-0339-XX	10.303 (261,7)	0.103 (2,6)
	8563-0137-XX	10.412 (264,5)	0.125 (3,2)
	8563-0160-XX	10.483 (266,3)	0.139 (3,5)
	8563-0189-XX	10.660 (270,8)	0.103 (2,6)
	8563-0184-XX	10.680 (271,3)	0.103 (2,6)
	8563-0235-XX	11.567 (293,8)	0.150 (3,8)
	8563-0141-XX	12.016 (305,2)	0.125 (3,2)
	8563-0236-XX	12.350 (313,7)	0.150 (3,8)
	8563-0140-XX	12.812 (325,4)	0.125 (3,2)
	8563-0264-XX	13.800 (350,5)	0.103 (2,6)
	8563-0057-XX	13.960 (354,6)	0.150 (3,8)
	8563-0302-XX	14.685 (373,0)	0.119 (3,0)
	8563-0182-XX	24.190 (614,4)	0.080 (2,0)
	8563-0307-XX	26.280 (667,5)	0.112 (2,8)

O-rings with a diameter less than 3" (76,2 mm) will be molded. O-rings with a diameter of 3" (76,2 mm) or more may be molded or spliced.

Table 2. MIL-DTL-83528/013 Jam Nut Seals

Shell Size	Laird Technologies Part No. MIL-DTL-38999/MIL-DTL-26482	MIL-DTL-81511	Dimensions C	B
6	8563-0073-XX		0.551 (14,0)	0.070 (1,8)
8	8563-0074-XX		0.676 (17,2)	0.070 (1,8)
8		8563-0075-XX	0.739 (18,8)	0.070 (1,8)
9, 10	8563-0076-XX		0.801 (20,3)	0.070 (1,8)
9, 10		8563-0077-XX	0.864 (21,9)	0.070 (1,8)
11, 12	8563-0079-XX		0.989 (25,1)	0.070 (1,8)
13, 14	8563-0080-XX	8563-0080-XX	1.114 (28,3)	0.070 (1,8)
15, 16	8563-0089-XX	8563-0089-XX	1.239 (31,5)	0.070 (1,8)
17, 18	8563-0090-XX	8563-0090-XX	1.364 (34,6)	0.070 (1,8)
19, 20	8563-0095-XX		1.487 (37,8)	0.103 (2,6)
23, 24	8563-0096-XX		1.737 (44,1)	0.103 (2,6)

Flat Washer Gaskets

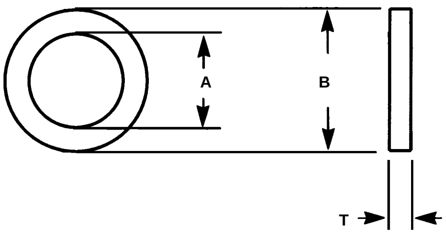


Table 3. MIL-DTL-83528 Series

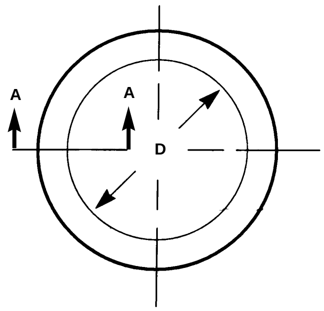
MIL-DTL-83528 Part No.	Laird Technologies Part No.	Dimensions A	B	T
	8560-0490-XX	0.079 (2,0)	0.590 (15,0)	0.010 (0,3)
	8560-0231-XX	0.120 (3,0)	0.260 (6,6)	0.030 (0,8)
	8560-0234-XX	0.171 (4,3)	0.390 (9,9)	0.060 (1,5)
	8560-0406-XX	0.180 (4,6)	0.220 (5,6)	0.020 (0,5)
	8560-0364-XX	0.192 (4,9)	0.625 (15,9)	0.032 (0,8)
	8560-0233-XX	0.218 (5,5)	0.468 (11,9)	0.030 (0,8)
M83528/012X001	8560-0097-XX	0.250 (6,4)	0.625 (15,9)	0.032 (0,8)
M83528/012X002	8560-0142-XX	0.250 (6,4)	0.625 (15,9)	0.062 (1,6)
	8560-0158-XX	0.250 (6,4)	0.562 (14,3)	0.060 (1,5)
	8560-0229-XX	0.250 (6,4)	0.420 (10,7)	0.090 (2,3)
	8560-0277-XX	0.250 (6,4)	0.420 (10,7)	0.093 (2,4)
	8560-0435-XX	0.250 (6,4)	0.750 (19,1)	0.032 (0,8)
	8560-0139-XX	0.261 (6,6)	0.650 (16,5)	0.060 (1,5)
	8560-0052-XX	0.305 (7,7)	0.625 (15,9)	0.053 (1,3)
	8560-0096-XX	0.312 (7,9)	0.437 (11,1)	0.030 (0,8)
	8560-0299-XX	0.319 (8,1)	0.422 (10,7)	0.075 (1,9)
	8560-0242-XX	0.350 (8,9)	0.885 (22,5)	0.060 (1,5)
	8560-0157-XX	0.360 (9,1)	0.687 (17,5)	0.060 (1,5)
M83528/012X004	8560-0143-XX	0.375 (9,5)	0.750 (19,1)	0.062 (1,6)
M83528/012X003	8560-0098-XX	0.375 (9,5)	0.750 (19,1)	0.031 (0,8)
	8560-0331-XX	0.375 (9,5)	0.750 (19,1)	0.032 (0,8)
	8560-0444-XX	0.380 (9,7)	0.960 (24,4)	0.065 (1,7)
	8560-0200-XX	0.433 (11,0)	0.508 (12,9)	0.045 (1,1)
	8560-0217-XX	0.447 (11,4)	0.550 (14,0)	0.075 (1,9)
M83528/012X005	8560-0099-XX	0.500 (12,7)	0.656 (16,7)	0.031 (0,8)
M83528/012X007	8560-0100-XX	0.500 (12,7)	0.875 (22,2)	0.031 (0,8)
M83528/012X006	8560-0144-XX	0.500 (12,7)	0.656 (16,7)	0.062 (1,6)
M83528/012X008	8560-0145-XX	0.500 (12,7)	0.875 (22,2)	0.062 (1,6)
	8560-0330-XX	0.500 (12,7)	0.656 (16,7)	0.032 (0,8)
	8560-0311-XX	0.641 (16,3)	0.703 (17,9)	0.032 (0,8)
	8560-0443-XX	0.785 (19,9)	0.900 (22,9)	0.020 (0,5)
	8560-0505-XX	0.800 (20,3)	1.000 (25,4)	0.156 (4,0)
	8560-0453-XX	0.890 (22,6)	1.250 (31,8)	0.062 (1,6)
	8560-0156-XX	0.925 (23,5)	1.195 (30,4)	0.062 (1,6)
	8560-0126-XX	1.260 (32,0)	1.431 (36,3)	0.090 (2,3)
	8560-0319-XX	1.891 (48,0)	1.984 (50,4)	0.045 (1,1)

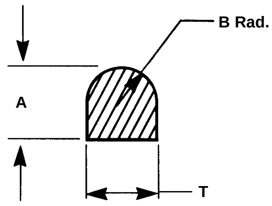
Tolerances Flat Washer Gaskets (All Dimensions)

Dimensions	Tolerance
Under 0.101 (0,0 to 2,6)	± 0.005 (0,1)
0.101 to 0.200 (2,6 to 5,1)	± 0.010 (0,3)
0.201 to 0.500 (5,1 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

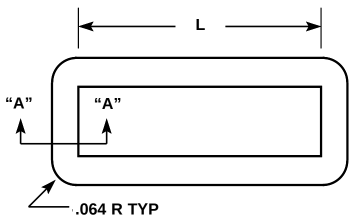
All dimensions shown are in inches (millimeters) unless otherwise specified.

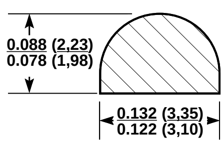
Molded Waveguide Gaskets



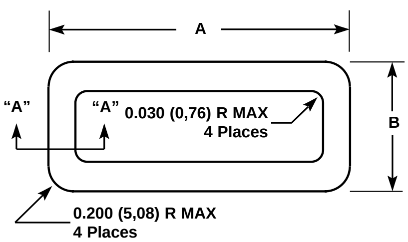


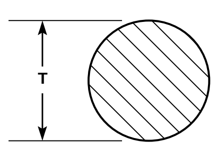
Section A-A





Section A-A





Section A-A

Tolerances "D" Section Profiles

Dimensions	Tolerance
Under 0.101 (2,6)	± 0.005 (0,1)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

Table 4. Circular "D" Section

MIL-DTL-83528	Laird Technologies	Nominal Dimensions			
Part No.	Part No.	A	B	D	T
M83528/013X002	8563-0126-XX	0.056 (1,4)	0.041 (1,0)	0.410 (10,4)	0.082 (2,1)
M83528/013X004	8563-0127-XX	0.048 (1,2)	Full Radius	0.587 (14,9)	0.078 (2,0)
M83528/013X006	8563-0128-XX	0.125 (3,2)	Full Radius	0.885 (22,5)	0.155 (3,9)
M83528/013X008	8563-0129-XX	0.065 (1,7)	0.049 (1,2)	1.122 (28,5)	0.099 (2,5)
M83528/013X011	8563-0131-XX	0.088 (2,2)	Full Radius	1.340 (34,0)	0.095 (2,4)
M83528/013X012	8563-0130-XX	0.077 (2,0)	Full Radius	1.310 (33,3)	0.115 (2,9)
M83528/013X014	8563-0132-XX	0.085 (2,2)	Full Radius	1.392 (35,4)	0.095 (2,4)
M83528/013X017	8563-0133-XX	0.078 (2,0)	Full Radius	1.550 (39,4)	0.105 (2,7)
M83528/013X036	8563-0134-XX	0.188 (4,8)	Full Radius	3.910 (99,3)	0.240 (6,1)

Table 5. Rectangular "D" Section

MIL-DTL-83528	Laird Technologies	Width Dimensions		Length Dimensions	
Part No.	Part No.	Min.	Max.	Min.	Max.
M83528/006X001	8563-0253-XX	0.285 (7,2)	0.295 (7,5)	0.983 (25,0)	0.993 (25,2)
M83528/006X002	8563-0254-XX	0.485 (12,3)	0.495 (12,6)	0.983 (25,0)	0.993 (25,2)
M83528/006X003	8563-0255-XX	0.619 (15,7)	0.629 (16,0)	1.243 (31,6)	1.243 (31,6)
M83528/006X004	8563-0256-XX	0.815 (20,7)	0.845 (21,5)	2.985 (75,8)	3.015 (76,6)
M83528/006X005	8563-0257-XX	1.325 (33,7)	1.355 (34,4)	5.265 (133,7)	5.295 (134,5)

Table 6. Rectangular "O" Section

MIL-DTL-83528	Laird Technologies	Dimensions		
Part No.	Part No.	A	B	T
M83528/013X013	8563-0248-XX	1.368 (34,7) ± 0.012 (0,3)	0.868 (22,0) ± 0.010 (0,3)	0.103 (2.6) ± 0.003 (0,1)
M83528/013X018	8563-0249-XX	1.616 (41,0) ± 0.015 (0,4)	0.991 (25,2) ± 0.010 (0,3)	0.103 (2,6) ± 0.003 (0,1)
M83528/013X023	8563-0250-XX	11.866 (301,4) ± 0.015 (0,4)	1.116 (28,3) ± 0.012 (0,3)	0.103 (2,6) ± 0.003 (0,1)
M83528/013X030	8563-0251-XX	2.449 (62,2) ± 0.020 (0,5)	1.449 (36,8) ± 0.013 (0,3)	0.139 (3,5) ± 0.004 (0,1)
M83528/013X037	8563-0252-XX	3.451 (87,7) ± 0.024 (0,6)	1.951 (49,6) ± 0.004 (0,1)	0.139 (3,5) ± 0.004 (0,1)

All dimensions shown are in inches (millimeters) unless otherwise specified.

Rectangular Waveguide Gaskets

Figure 1.

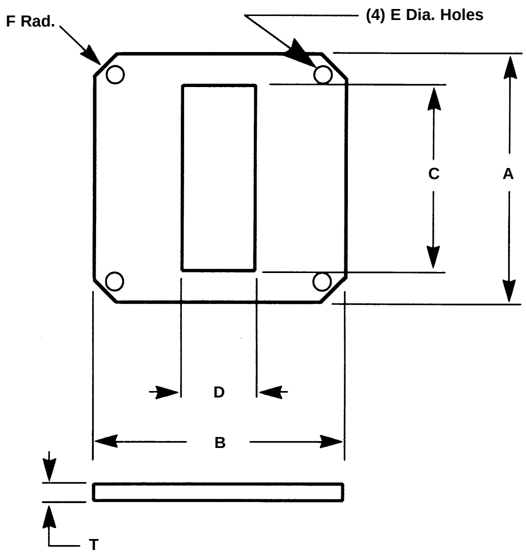


Figure 2.

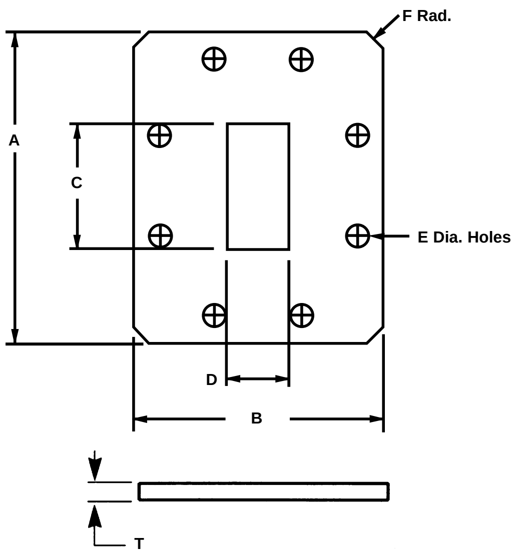


Table 7. Rectangular Waveguide Gaskets

MIL-DTL-83528 Part No.	Laird Technologies Part No.	Dimensions A	B	C	D	E	T	F Radius
Tolerance:		± 0.015 (0,4)	± 0.015 (0,4)	± 0.015 (0,4)	± 0.015 (0,4)	± 0.010 (0,3)	± 0.003 (0,1)	± 0.010 (0,3)
M83528/013X001	8560-0104-XX Fig. 1	± 0.750 (19,1)	± 0.750 (19,1)	± 0.145 (3,7)	± 0.285 (7,2)	± 0.116 (2,9)	± 0.027 (0,7)	± 0.469 (11,9)
M83528/013X003	8560-0105-XX Fig. 1	0.875 (22,2)	0.875 (22,2)	0.175 (4,4)	0.425 (10,8)	0.116 (2,9)	0.027 (0,7)	0.563 (14,3)
M83528/013X005	8560-0106-XX Fig. 1	1.313 (33,4)	1.313 (33,4)	0.630 (16,0)	0.320 (8,1)	0.140 (3,6)	0.027 (0,7)	0.875 (22,2)
M83528/013X007	8560-0103-XX Fig. 1	1.496 (38,0)	1.496 (38,0)	0.760 (19,3)	0.385 (9,8)	0.155 (3,9)	0.027 (0,7)	0.450 (11,4)
M83528/013X009	8560-0107-XX Fig. 1	1.625 (41,3)	1.625 (41,3)	0.905 (23,0)	0.405 (10,3)	0.169 (4,3)	0.027 (0,7)	0.469 (11,9)
M83528/013X010	8560-0112-XX Fig. 2	1.594 (40,5)	2.094 (53,2)	0.405 (10,3)	0.905 (23,0)	0.169 (4,3)	0.027 (0,7)	0.250 (6,4)
M83528/013X015	8560-0108-XX Fig. 1	1.875 (47,6)	1.875 (47,6)	1.130 (28,7)	0.505 (12,8)	0.180 (4,6)	0.027 (0,7)	1.150 (29,2)
M83528/013X016	8560-0113-XX Fig. 2	1.750 (44,5)	2.500 (63,5)	0.505 (12,8)	1.130 (28,7)	0.171 (4,3)	0.027 (0,7)	0.250 (6,4)
M83528/013X020	8560-0114-XX Fig. 2	1.937 (49,2)	2.687 (68,3)	0.633 (16,1)	1.380 (35,1)	0.206 (5,2)	0.027 (0,7)	0.250 (6,4)
M83528/013X021	8560-0121-XX Fig. 2	1.531 (38,9)	2.281 (57,9)	0.632 (16,1)	1.382 (35,1)	0.150 (3,8)	0.027 (0,7)	0.125 (3,2)
M83528/013X024	8560-0115-XX Fig. 2	2.438 (61,9)	3.188 (81,0)	0.805 (20,4)	1.600 (40,6)	0.257 (6,5)	0.027 (0,7)	0.313 (8,0)
M83528/013X025	8560-0122-XX Fig. 2	1.750 (44,5)	2.500 (63,5)	0.800 (20,3)	1.600 (40,6)	0.160 (4,1) 0.150 (3,8)	0.027 (0,7)	0.125 (3,2)
M83528/013X027	8560-0116-XX Fig. 2	3.500 (88,9)	2.500 (63,5)	1.880 (47,8)	0.880 (22,4)	0.226 (5,7)	0.027 (0,7)	0.313 (8,0)
M83528/013X028	8560-0123-XX Fig. 2	1.764 (44,8)	2.781 (70,6)	0.882 (22,4)	1.882 (47,8)	0.156 (4,0) 0.141 (3,6)	0.027 (0,7)	0.125 (3,2)
M83528/013X031	8560-0117-XX Fig. 2	2.750 (69,9)	3.875 (98,4)	1.155 (29,3)	2.300 (58,4)	0.270 (6,9)	0.027 (0,7)	0.312 (7,9)
M83528/013X032	8560-0124-XX Fig. 2	2.000 (50,8)	3.156 (80,2)	1.555 (39,5)	2.300 (58,4)	0.150 (3,8)	0.027 (0,7)	0.125 (3,2)
M83528/013X034	8560-0118-XX Fig. 2	4.500 (114,3)	3.000 (76,2)	2.850 (72,4)	1.350 (34,3)	0.266 (6,8)	0.027 (0,7)	0.313 (8,0)
M83528/013X035	8560-0125-XX Fig. 2	3.884 (98,7)	2.344 (59,5)	2.850 (72,4)	1.350 (34,3)	0.172 (4,4) 0.188 (4,8)	0.027 (0,7)	0.125 (3,2)
M83528/013X038	8560-0119-XX Fig. 2	3.750 (95,3)	5.440 (138,2)	1.710 (43,4)	3.410 (86,6)	0.265 (6,7) 0.250 (6,4)	0.027 (0,7)	0.250 (6,4)
M83528/013X039	8560-0109-XX Fig. 2	3.750 (95,3)	5.438 (138,1)	1.710 (43,4)	3.410 (86,6)	0.266 (6,8)	0.027 (0,7)	0.250 (6,4)
M83528/013X040	8560-0110-XX Fig. 2	4.188 (106,4)	6.344 (161,1)	2.160 (54,9)	4.310 (109,5)	0.266 (6,8) 0.281 (7,1)	0.027 (0,7)	0.250 (6,4)
M83528/013X041	8560-0120-XX Fig. 2	6.344 (161,1)	4.188 (106,4)	4.310 (109,5)	2.160 (54,9)	0.266 (6,8)	0.027 (0,7)	0.250 (6,4)
M83528/013X042	8560-0111-XX Fig. 2	5.438 (138,1)	8.688 (220,7)	3.260 (82,8)	6.510 (165,4)	0.250 (6,4) 0.328 (8,3)	0.027 (0,7)	0.250 (6,4)

Note: Compound 98 is silicone material filled with Ag/Cu and expanded metal. See Material Compounds chart on pages 14 –17 for compound properties.

All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroSeal Conductive Elastomer Fabricated Components

The waveguide gaskets listed in the Waveguide Gasket Selection Guide will fit standard UG, CPR and CMR flanges. The letters (A, B, C, D, E) shown in the "Gasket Config." column correspond to the MIL-DTL-83528/013 part configurations as follows:

Type A — Square & Rectangular Die-Cut Gaskets
Type B — Circular Die-Cut Gaskets
Type C — Molded Rectangular "O" Cross Section
Type D — Molded Circular "O" Cross Section
Type E — Molded Circular "D" Cross Section

Table 8. Waveguide Gasket Selection Guide

Frequency Range GHz	Band	EIA Waveguide Size	Designation MIL-W	Flange Description			Flange Type	Gasket Config.	Laird Technologies Part No.	MIL-DTL-83528/013 Page No.
				UG	CPR	CMR				
26.5 - 40.0	Ka	WR28	RG-96U (Silver)	UG-599/U			Cover	A	8560-0104-XX	001 (1)
				UG-600A/U			Choke	E	8563-0126-XX	002
18.0 - 26.5	K	WR42	RG-53/U (Brass) RG-121/U (Aluminum)	UG-595/U UG-597/U			Cover	A	8560-0105-XX	003 (1)
				UG-596A/U UG-598A/U			Choke	E	8563-0127-XX	004
12.4 - 18.0	Ku	WR62	RG-91/U (Brass) RG-107/U (Silver)	UG-419/U			Cover	A	8560-0106-XX	005 (1)
				UG-541A/U			Choke	E	8563-0128-XX	006
10.0 - 15.0		WR75		UG			Cover	A	8560-0103-XX	007
					CPR-75F		Choke	E	8563-0129-XX	008
8.2 -12.4	X	WR90	RG-52/U (Brass) RG-67/U (Aluminum)	UG-39/U UG-135/U			Cover	A	8560-0107-XX	009
				UG-1736/U UG-1737/U	CPR-90F		Flat Contact	A	8560-0112-XX	010 (2)
				UG-136A/U UG-40A/U			Choke	E	8563-0131-XX	011
				UG-136B/U UG-40B/U			Choke	E	8563-0130-XX	012
				UG-1360/U UG-1361/U	CPR-90G		Contact	C	8563-0248-XX	013
7.0 - 11.0		WR102		UG-1494/U			Choke	E		014
7.05 - 10.0	X1	WR112	RG-51/U (Brass) RG-68/U (Aluminum)	UG-51/U UG-138/U			Cover	A	8560-0108-XX	015
				UG-1734/U UG-1735/U	CPR-112F		Flat Contact	A	8560-0113-XX	016
				UG-52B/U UG-137B/U			Choke	E	8563-0133-XX	017
				UG-1358/U UG-1359/U	CPR-112G		Contact	C	8563-0249-XX	018
5.85 - 8.2	Xb	WR137	RG-50/U (Brass) RG-108/U (Aluminum)	UG-344/U UG-138/U			Cover	B	—	019
				UG-1732/U UG-1733/U	CPR-137F		Flat Contact	A	8560-0114-XX	020 (1)
						CMR-137	Flat Contact	A	8560-0121-XX	021(1)
				UG-343B/U UG-440B/U			Choke	D	8560-0246-XX	022
				UG-1356/U UG-1357/U	CPR-137G		Contact	C	8563-0250-XX	023
4.9 - 7.05		WR159		UG-1730/U UG-1731/U	CPR-159F		Flat Contact	A	8560-0115-XX	024 (1)
						CMR-159	Flat Contact	A	8560-0122-XX	025 (1)
3.95 - 5.85	C	WR187	RG-49/U (Brass) RG-95/U (Aluminum)	UG-149A/U UG-407/U			Cover	B	—	026
				UG-1728/U UG1729/U	CPR-187F		Flat Contact	A	8560-0116-XX	027 (1)
						CMR-187	Flat Contact	A	8560-0123-XX	028 (1)
				UG-148C/U UG-406B/U			Choke	D	8560-0247-XX	029
				UG-1352/U UG-1353/U	CPR-187G		Contact	C	8563-0251-XX	030
3.30 - 4.90		WR229		UG-1726/U UG-1727/U	CPR-229F		Flat Contact	A	8560-0117-XX	031 (1)
						CMR-229	Flat Contact	A	8560-0124-XX	032 (1)
2.6 - 3.95	S	WR284	RG-48/U (Brass) RG-75/U (Aluminum)	UG-53/U UG-584/U			Cover	B	—	033
				UG-1724/U UG-1725/U	CPR-248F		Flat Contact	A	8560-0118-XX	034 (1)
						CMR-284	Flat Contact	A	8560-0125-XX	035 (1)
				UG-54B/U UG-585A/U			Choke	E	8563-0134-XX	036
				UG-1348/U UG-1349/U	CPR-284G		Contact	C	8563-0252-XX	037
2.2 - 3.3		WR340	RG-112/U (Brass) RG-112/U (Aluminum)	UG-533/U UG-554/U			Flat Contact	A	8560-0119-XX	038 (1)
					CPR-340F		Flat Contact	A	8560-0109-XX	039 (1)
1.7- 2.6	W	WR430	RG-104/U (Brass) RG-105/U (Aluminum)	UG-435A/U UG-437A/U			Flat Contact	A	8560-0110-XX	040 (1)
					CPR-430F		Flat Contact	A	8560-0120-XX	041 (1)
1.12 - 1.7	L	WR650	RG-69/U (Brass) RG-103/U (Aluminum)	UG-417A/U UG-418A/U			Flat Contact	A	8560-0111-XX	042 (1)

Refer to page 31, Figures 1 and 2 for flange design.

ElectroMet™ Oriented Wire

ElectroMet oriented wire gaskets are EMI shielding and sealing composites. Monel® or aluminum wires embedded in the elastomer and oriented perpendicular to the mating surfaces provide the EMI sealing. Solid or sponge silicone provides the weather sealing; however, solid silicone weather seals are recommended for high-pressure applications. Silicone based oriented wire composites are capable of withstanding temperature ranges from –70°F to 500°F (–56°C to 260°C).

Oriented wire materials are available in sheet or strip form with a minimum thickness of 0.032 in. (0,8 mm). Material specifications and information for standard sheets and strips are provided in Tables 1 through 3.

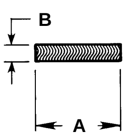
Table 1.

Material Code	Elastomer	Wire Specification
55	Silicone Sponge Per AMS 3195	Monel: Alloy Per QQ N281 Dia. 0.0045 (0,114)
56	Silicone Solid Per ZZR765 Class 2b Grade 40	Monel: Alloy Per QQ N281 Dia. 0.0045 (0,114)
58	Silicone Sponge Per AMS 3195	Aluminum: Alloy 5056 Per AMS 4182 Dia. 0.005 (0,127)
59	Silicone Solid Per ZZR765 Class 2b Grade 40	Aluminum: Alloy 5056 Per AMS 4182 Dia. 0.005 (0,127)

Note: Wire density per sq. in.: 700–900; per sq. cm 108–139

Table 2. ElectroMet Sheet Materials

End View:



Part No.	Dimensions A. Width	Dimensions B. Thickness
8408-0296-XX	0.750 (19,1)	0.125 (3,2)
8408-0200-XX	3.000 (76,2)	0.032 (0,8)
8408-0203-XX	3.000 (76,2)	0.045 (1,1)
8408-0206-XX	3.000 (76,2)	0.062 (1,6)
8408-0209-XX	3.000 (76,2)	0.093 (2,4)
8408-0212-XX	3.000 (76,2)	0.125 (3,2)
8408-0213-XX	3.000 (76,2)	0.187 (4,8)
8408-0215-XX	4.500 (114,3)	0.032 (0,8)
8408-0218-XX	4.500 (114,3)	0.045 (1,1)
8408-0221-XX	4.500 (114,3)	0.062 (1,6)
8408-0224-XX	4.500 (114,3)	0.093 (2,4)
8408-0227-XX	4.500 (114,3)	0.125 (3,2)
8408-0230-XX	6.000 (152,4)	0.032 (0,8)
8408-0233-XX	6.000 (152,4)	0.045 (1,1)
8408-0236-XX	6.000 (152,4)	0.062 (1,6)
8408-0239-XX	6.000 (152,4)	0.093 (2,4)
8408-0242-XX	6.000 (152,4)	0.125 (3,2)
8408-0245-XX	9.000 (228,6)	0.032 (0,8)
8408-0248-XX	9.000 (228,6)	0.045 (1,1)
8408-0251-XX	9.000 (228,6)	0.062 (1,6)
8408-0254-XX	9.000 (228,6)	0.093 (2,4)
8408-0257-XX	9.000 (228,6)	0.125 (3,2)

How to Specify

1. For PSA, change the fifth digit to 9 for items with tape. Example: 8408-0200-59 becomes 8408-9200-59.
2. Replace XX with material code from Table 1.

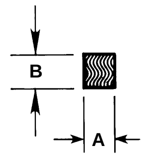
   Example: To request a 3.0 in. (76,2 mm) wide x 0.032 in. (0,8 mm) thick strip with aluminum wire in solid silicone sponge, use 8408-0200-59.

For further information or for product samples, please contact Laird Technologies sales department.

Monel® wire is bonded into a silicone elastomer for uniform surface and multiple "spring" effect with each contact point.

Table 3. ElectroMet Strip Materials

End View:



Part No.	Dimensions A. Width	Dimensions B. Thickness
8408-0100-XX	0.125 (3,2)	0.062 (1,6)
8408-0138-XX	0.125 (3,2)	0.062 (1,6)
8408-0102-XX	0.125 (3,2)	0.125 (3,2)
8408-0120-XX	0.125 (3,2)	0.125 (3,2)
8408-0130-XX	0.125 (3,2)	0.250 (6,4)
8408-0151-XX	0.187 (4,8)	0.020 (0,5)
8408-0105-XX	0.187 (4,8)	0.062 (1,6)
8408-0141-XX	0.187 (4,8)	0.125 (3,2)
8408-0127-XX	0.187 (4,8)	0.187 (4,8)
8408-0110-XX	0.250 (6,4)	0.062 (1,6)
8408-0290-XX	0.250 (6,4)	0.093 (2,4)
8408-0123-XX	0.250 (6,4)	0.125 (3,2)
8408-0133-XX	0.250 (6,4)	0.250 (6,4)
8408-0111-XX	0.312 (7,9)	0.062 (1,6)
8408-0124-XX	0.312 (7,9)	0.125 (3,2)
8408-0140-XX	0.312 (7,9)	0.250 (6,4)
8408-0137-XX	0.375 (9,5)	0.032 (0,8)
8408-0115-XX	0.375 (9,5)	0.062 (1,6)
8408-0139-XX	0.394 (10,0)	0.032 (0,8)
8408-0143-XX	0.500 (12,7)	0.032 (0,8)
8408-0116-XX	0.500 (12,7)	0.062 (1,6)
8408-0293-XX	0.500 (12,7)	0.093 (2,4)
8408-0126-XX	0.500 (12,7)	0.125 (3,2)
8408-0289-XX	0.500 (12,7)	0.187 (4,8)
8408-0118-XX	0.625 (15,9)	0.062 (1,6)
8408-0144-XX	0.625 (15,9)	0.062 (1,6)
8408-0134-XX	0.625 (15,9)	0.093 (2,4)
8408-0128-XX	0.625 (15,9)	0.125 (3,2)
8408-0117-XX	0.750 (19,1)	0.062 (1,6)
8408-0135-XX	0.750 (19,1)	0.250 (6,4)
8408-0147-XX	1.000 (25,4)	0.062 (1,6)
8408-0294-XX	1.000 (25,4)	0.093 (2,4)
8408-0148-XX	1.000 (25,4)	0.125 (3,2)

Compression-Deflection for Solid Silicone

Material Thickness	Compression Force PSI (MPa) At Deflection Of: 5%	*10%	15%	20%
0.045 (1,1)	40 (0,3)	100 (0,7)	155 (1,1)	280 (1,9)
0.062 (1,6)	85 (0,6)	165 (1,1)	240 (1,7)	345 (2,4)
0.125 (3,2)	115 (0,8)	180 (1,2)	245 (1,7)	290 (2,0)

Tolerance

Size Range	Width	Thickness
To 0.062 (1,6)	N/A	+0.010 (+0,3) / – 0.005 (–0,1)
0.070 to 0.250 (1,8 to 6,4)	± 0.015 (0,4)	± 0.010 (0,3)
0.251 to 0.375 (6,4 to 9,5)	± 0.030 (0,8)	± 0.015 (0,4)

*Recommended

Note: Compression force for silicone sponge is approximately 15 psi to 75 psi. Silicone sponge density is 0.02 lb/in^3.

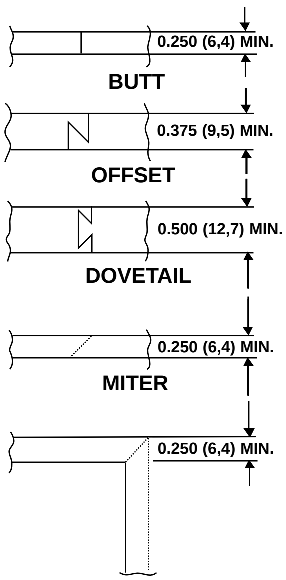
All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroMet Oriented Wire (continued)

Splicing Techniques

Oriented wire can be supplied as a one-piece gasket. Gasket sizes are available up to 9 in. (228,6 mm) X 36 in. (914,4 mm) frame size. Larger gaskets are normally spliced using one of the splicing techniques shown in Figure 1. These splicing methods minimize elastomer waste when compared to jointless gasket design. In preparing drawings, designate the splicing method and locations if splices are permitted.

Figure 1. Four Basic Splicing Techniques



Die-Cut Gasket

Oriented wire can be supplied as a die-cut gasket in various configurations. Gasket sizes are available up to 9 in. (228,6 mm) X 36 in. (914,4 mm). Several of the most common die-cut gaskets are for cable connectors and Sub-D connectors shown in Figures 2a and 2b.

Figure 2a. Cable Connector

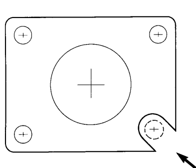
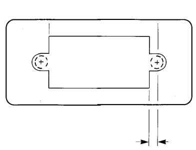
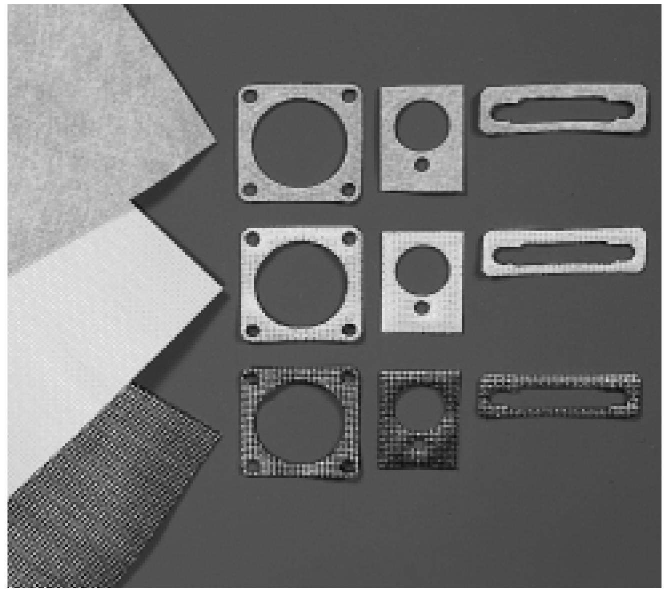


Figure 2b. Sub-D Connector





ElectroMet Impregnated Woven Wire and Expanded Metal

ElectroMet impregnated wire mesh and expanded metal gaskets are available in thin sheet form. EMI shielding is provided by woven aluminum mesh or expanded metals. Pressure sealing is provided by neoprene or silicone elastomer impregnated in the mesh. Fluorosilicone is also available for specific applications that require resistance to oils, hydraulic fluids and hydrocarbon fuels.

Table 1. Material Selection

Part No.	Thickness	Width	Material Description	Material Specifications: Metal Filler	Material Specifications: Elastomer Filler	Color
8416-0120-57	0.020 ± 0.004 (0,5 ± 0,1)	8.0 (203,2)	Woven Wire Neoprene Impregnated	Aluminum 5056 Alloy Per AMS 4182	Neoprene Per AMS 3222	Black
8416-0120-23	0.020 ± 0.004 (0,5 ± 0,1)	8.0 (203,2)	Woven Wire Silicone Impregnated	Aluminum 5056 Alloy Per AMS 4182	Silicone Per ZZR 765, Class 2B, Grade 50	Gray
8416-0320-21	0.020 ± 0.004 (0,5 ± 0,1)	8.0 (203,2)	Expanded Metal with Elastomer	Aluminum Alloy QQ-A-250	Silicone Per ZZR 765, Class 2B, Grade 50	Gray
8416-0330-21	0.030 ± 0.004 (0,8 ± 0,1)					
8416-0320-22	0.020 ± 0.004 (0,5 ± 0,1)	8.0 (203,2)	Expanded Metal with Elastomer	Monel® per QQ-N-281B	Silicone Per ZZR 765, Class 2B, Grade 50	Gray
8416-0330-22	0.030 ± 0.004 (0,8 ± 0,1)					

All dimensions shown are in inches (millimeters) unless otherwise specified.

Metal Impregnated Materials

MIL Connector Gaskets

Laird Technologies offers a broad range of EMI gasket materials to fit the shell sizes of standard MIL connectors.

- Gaskets are available in a wide range of materials that can provide shielding or a combination of RF shielding and environmental sealing
- Standardized to fit all MIL connectors
- Test results indicate shielding effectiveness of 100 dB or greater for these connector gaskets

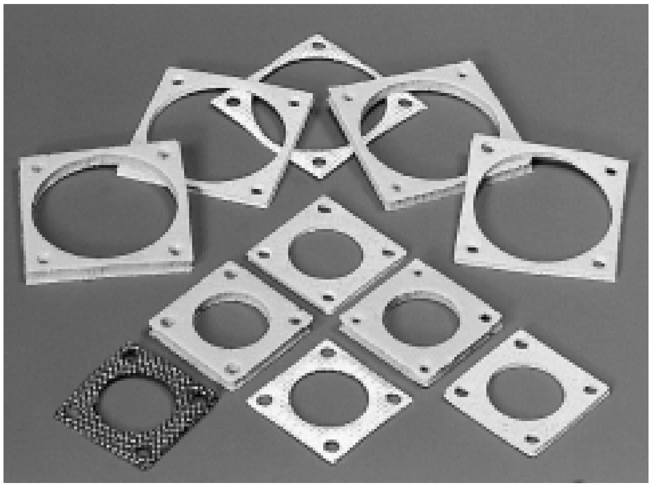


Table 1. Material Selection Guide

Material Specifications						Material Characteristics — Legend: G = Good, F = Fair, P = Poor								
Material Code	Material Description	Metal Filler	Elastomer Filler	Color	Thickness	Shielding Effectiveness	Seal Drip Proof	Fluids JP4 Hydraul	Salt Fog	Outer Space	Temp -40°F +250°F	Temp -65°F +500°F	Surface Flatness <0.010	Surface Flatness >0.010
57	Woven Wire Neoprene Impregnated	Aluminum Alloy 5056 Per AMS 4182	Neoprene Per AMS 3222	Black	0.020 ± 0.004 (0,5 ± 0,1)	F	P	P	P	F	G	P	F	P
23	Woven Wire Silicone Impregnated	Aluminum Alloy 5056 Per AMS 4182	Silicone Per ZZR 765, Glass 2B, Grade 50	Gray	0.020 ± 0.004 (0,5 ± 0,1)	F	P	P	P	F	G	G	F	P
56	Oriented Wire in Solid Silicone	Monel® Alloy Per QQN 281	Silicone Per ZZR 765, Class 2B, Grade 50	Gray	0.062 ± 0.005 (1,6 ± 0,1)	G	G	P	F	F	G	G	G	G

Note: Holes closer to edges than 2x material thickness will be made as "u" slots at Laird Technologies option.

How to Specify

1. From Table 2a–3 (next page), match base part number to shell size used.
2. From Table 1, determine material code based on characteristics which best meet design requirements.
3. Insert material code in place of the XX from base part number.

Example: Base part number for shell size 8 in Table 2a is 8516-0101-XX; material code chosen from Table 1 is -57: part number is 8516-0101-57.

All dimensions shown are in inches (millimeters) unless otherwise specified.

MIL Connector Gaskets (continued)

Table 2a. AN Connector Gasket Per MIL-C-5015 MS3102

	Dimensions (See Figure 1)				
Shell Size	**A**	**B**	**C**	**D**	**Base Part No.**
8	0.594 (15,1)	0.500 (12,7)	0.875 (22,2)	0.172 (4,4)	8516-0101-XX
10	0.719 (18,3)	0.625 (15,9)	1.000 (25,4)	0.172 (4,4)	8516-0102-XX
12	0.813 (20,7)	0.750 (19,5)	1.094 (27,8)	0.172 (4,4)	8516-0103-XX
14	0.906 (23,0)	0.875 (22,2)	1.188 (30,2)	0.172 (4,4)	8516-0104-XX
16	0.969 (24,6)	1.000 (25,4)	1.281 (32,5)	0.172 (4,4)	8516-0105-XX
18	1.063 (27,0)	1.125 (28,6)	1.375 (34,9)	0.203 (5,2)	8516-0106-XX
20	1.156 (29,4)	1.250 (31,8)	1.500 (38,1)	0 .203 (5,2)	8516-0107-XX
22	1.250 (31,8)	1.375 (34,9)	1.625 (41,3)	0.203 (5,2)	8516-0108-XX
24	1.375 (34,9)	1.500 (38,1)	1.750 (44,5)	0.203 (5,2)	8516-0109-XX
28	1.563 (39,7)	1.750 (44,5)	2.000 (50,8)	0.203 (5,2)	8516-0110-XX
32	1.750 (44,5)	2.000 (50,8)	2.250 (57,2)	0 .219 (5,6)	8516-0111-XX
36	1.938 (49,2)	2.188 (55,6)	2.500 (63,5)	0.219 (5,6)	8516-0112-XX
37	1.938 (49,2)	2.188 (55,6)	2.500 (63,5)	0.219 (5,6)	8516-0113-XX
40	2.188 (55,6)	2.438 (61,9)	2.750 (69,9)	0.219 (5,6)	8516-0114-XX
44	2.375 (60,3)	2.781 (70,6)	3.000 (76,2)	0.219 (5,6)	8516-0115-XX
48	2.625 (66,7)	3.031 (77,0)	3.250 (82,6)	0.219 (5,6)	8516-0116-XX

Table 2b. PT, PC, and JT Connector Gasket Per MIL-C-26482 MS3110, 3112, 2119, 3120

	Dimensions (See Figure 1)				
Shell Size	**A**	**B**	**C**	**D**	**Base Part No.**
6	0.469 (11,9)	0.375 (9,5)	0.688 (17,5)	0.130 (3,3)	8516-0117-XX
8	0.594 (15,1)	0.500 (12,7)	0.812 (20,6)	0.130 (3,3)	8516-0118-XX
10	0.719 (18,3)	0.625 (15,9)	0.938 (23,8)	0.130 (3,3)	8516-0119-XX
12	0.813 (20,7)	0.750 (19,1)	1.031 (26,2)	0.130 (3,3)	8516-0120-XX
14	0.906 (23,0)	0.875 (22,2)	1.125 (28,6)	0.130 (3,3)	8516-0121-XX
16	0.969 (24,6)	1.000 (25,4)	1.219 (31,0)	0.130 (3,3)	8516-0122-XX
18	1.063 (27,0)	1.125 (28,6)	1.312 (33,3)	0.130 (3,3)	8516-0123-XX
20	1.156 (29,4)	1.250 (31,8)	1.438 (36,5)	0.130 (3,3)	8516-0124-XX
22	1.250 (31,8)	1.375 (34,9)	1.563 (39,7)	0.130 (3,3)	8516-0125-XX
24	1.375 (34,9)	1.500 (38,1)	1.688 (42,9)	0.130 (3,3)	8516-0126-XX

Table 2c. Gaskets for Bendix SP Connectors

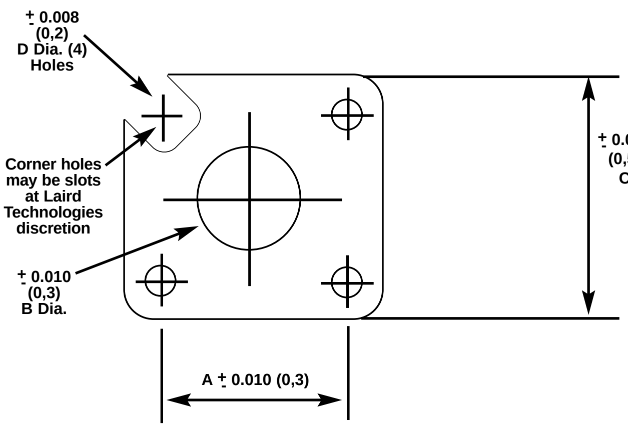
	Dimensions (See Figure 1)				
Shell Size	**A**	**B**	**C**	**D**	**Base Part No.**
6	0.641 (16,3)	0.375 (9,5)	0.963 (24,5)	0.160 (4,1)	8516-0127-XX
8	0.734 (18,6)	0.500 (12,7)	1.047 (26,6)	0.160 (4,1)	8516-0128-XX
10	0.812 (20,6)	0.625 (15,9)	1.125 (28,6)	0.160 (4,1)	8516-0129-XX
12	0.938 (23,8)	0.750 (19,1)	1.250 (31,8)	0.160 (4,1)	8516-0130-XX
14	1.031 (26,2)	0.875 (22,2)	1.344 (34,1)	0.160 (4,1)	8516-0131-XX
16	1.125 (28,6)	1.000 (25,4)	1.437 (36,5)	0.160 (4,1)	8516-0132-XX
18	1.203 (30,6)	1.125 (28,6)	1.516 (38,5)	0.160 (4,1)	8516-0133-XX
20	1.297 (32,9)	1.250 (31,8)	1.672 (42,5)	0.160 (4,1)	8516-0134-XX
22	1.375 (34,9)	1.375 (34,9)	1.750 (44,5)	0.160 (4,1)	8516-0135-XX

Table 2d. RF Connectors

	Dimensions (See Figure 1)				
Shell Size	**A**	**B**	**C**	**D**	**Base Part No.**
BN	0.500 (12,7)	0.437 (11,1)	0.687 (17,5)	0.109 (2,8)	8516-0136-XX
BNC	0.500 (12,7)	0.437 (11,1)	0.687 (17,5)	0.109 (2,8)	8516-0137-XX
C	0.719 (18,3)	0.625 (15,9)	1.000 (25,4)	0.172 (4,4)	8516-0138-XX
HN	0.906 (23,0)	0.750 (19,1)	1.188 (30,2)	0.140 (3,6)	8516-0139-XX
LC	1.437 (36,5)	1.250 (31,8)	2.000 (50,8)	0.257 (6,5)	8516-0140-XX
N	0.719 (18,3)	0.625 (15,9)	1.000 (25,4)	0.172 (4,4)	8516-0141-XX
UHF	0.969 (24,6)	1.000 (25,4)	1.281 (32,5)	0.172 (4,4)	8516-0142-XX

All dimensions shown are in inches (millimeters) unless otherwise specified.

Figure 1.



Note: Holes closer to edges than 2x material thickness will be made as "u" slots at Laird Technologies option.

Table 3. MIL-DTL-83528-004 Connectors

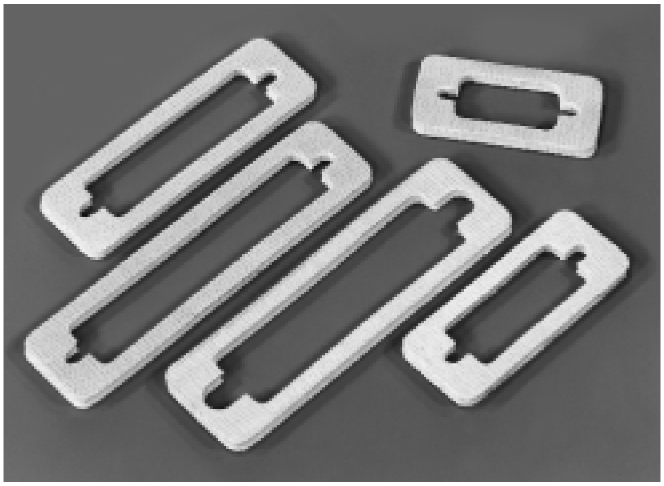
MIL-DTL-83528-004-XXXX	Shell Size	Laird Technologies Part No.	A Hole Spacing ± 0.010	B Inside Dia. ± 0.010	C Outside ± 0.020	D Hole Dia. ± 0.008
1	6	8516-0143-XX	0.469 (11,9)	0.375 (9,5)	0.738 (18,7)	0.141 (3,6)
2	8	8516-0144-XX	0.594 (15,1)	0.630 (16,0)	0.840 (21,3)	0.135 (3,4)
3	8	8516-0145-XX	0.594 (15,1)	0.568 (14,4)	0.812 (20,6)	0.125 (3,2)
4	8	8516-0146-XX	0.594 (15,1)	0.500 (12,7)	0.875 (22,2)	0.156 (4,0)
5	9, 10	8516-0147-XX	0.719 (18,3)	0.750 (19,1)	0.965 (24,5)	0.135 (3,4)
6	10	8516-0148-XX	0.719 (18,3)	0.680 (17,3)	0.937 (23,8)	0.125 (3,2)
7	10S, SL	8516-0149-XX	0.719 (18,3)	0.625 (15,9)	1.000 (25,4)	0.156 (4,0)
8	11, 12	8516-0185-XX	0.812 (20,6)	0.875 (22,2)	1.060 (26,9)	0.141 (3,6)
9	12, 12S, SL	8516-0151-XX	0.813 (20,7)	0.750 (19,1)	1.094 (27,8)	0.141 (3,6)
10	13, 14	8516-0152-XX	0.906 (23,0)	01.005 (25,5)	1.153 (29,3)	0.135 (3,4)
11	14	8516-0153-XX	0.906 (23,0)	0.938 (23,8)	1.125 (28,6)	0.125 (3,2)
12	14, 14S	8516-0154-XX	0.906 (23,0)	0.875 (22,2)	1.188 (30,2)	0.156 (4,0)
13	15, 16	8516-0155-XX	0.969 (24,6)	1.135 (28,8)	1.258 (32,0)	0.156 (4,0)
14	16	8516-0156-XX	0.969 (24,6)	1.063 (27,0)	1.250 (31,8)	0.125 (3,2)
15	16, 16S	8516-0157-XX	0.969 (24,6)	1.000 (25,4)	1.281 (32,5)	0.156 (4,0)
16	17, 18	8516-0158-XX	1.062 (27,0)	1.260 (32,0)	1.351 (34,3)	0.156 (4,0)
17	18	8516-0159-XX	1.062 (27,0)	1.189 (30,2)	1.343 (34,1)	0.125 (3,2)
18	18, 18S	8516-0160-XX	1.062 (27,0)	1.135 (28,8)	1.375 (34,9)	0.156 (4,0)
19	19, 20	8516-0161-XX	1.156 (29,4)	1.375 (34,9)	1.500 (38,1)	0.141 (3,6)
20	20	8516-0162-XX	1.156 (29,4)	1.312 (33,3)	1.467 (37,3)	0.125 (3,2)
21	20	8516-0163-XX	1.156 (29,4)	1.250 (31,8)	1.500 (38,1)	0.172 (4,4)
22	21, 22	8516-0164-XX	1.250 (31,8)	1.500 (38,1)	1.625 (41,3)	0.141 (3,6)
23	22	8516-0165-XX	1.250 (31,8)	1.437 (36,5)	1.562 (39,7)	0.125 (3,2)
24	22	8516-0167-XX	1.250 (31,8)	1.375 (34,9)	1.625 (41,3)	0.172 (4,4)
25	23, 24	8516-0168-XX	1.375 (34,9)	1.625 (41,3)	1.750 (44,5)	0.172 (4,4)
26	24	8516-0169-XX	1.375 (34,9)	1.563 (39,7)	1.703 (43,3)	0.152 (3,9)
27	24	8516-0403-XX	1.375 (34,9)	1.500 (38,1)	1.750 (44,5)	0.203 (5,2)
28	25	8516-0170-XX	1.500 (38,1)	1.750 (44,5)	1.875 (47,6)	0.172 (4,4)
29	28	8516-0171-XX	1.562 (39,7)	1.750 (44,5)	2.000 (50,8)	0.203 (5,2)
30	32	8516-0404-XX	1.750 (44,5)	2.000 (50,8)	2.250 (57,2)	0.219 (5,6)
31	36	8516-0172-XX	1.938 (49,2)	2.250 (57,2)	2.500 (63,5)	0.219 (5,6)
32	40	8516-0173-XX	2.188 (55,6)	2.500 (63,5)	2.750 (69,9)	0.219 (5,6)
33	44	8516-0405-XX	2.375 (60,3)	2.781 (70,6)	3.000 (76,2)	0.219 (5,6)
34	48	8516-0406-XX	2.625 (66,7)	3.031 (77,0)	3.250 (82,6)	0.219 (5,6)
35	3	8516-0407-XX	0.500 (12,7)	0.437 (11,1)	0.800 (20,3)	0.135 (3,4)
36	3	8516-0408-XX	0.500 (12,7)	0.437 (11,1)	0.687 (17,5)	0.135 (3,4)

Note: Material thickness 0.032 (0,8) ± 0.005 (0,1) unless otherwise specified.

For sizes not shown, please contact our sales department for ordering information.

“D” Subminiature Connector Shields

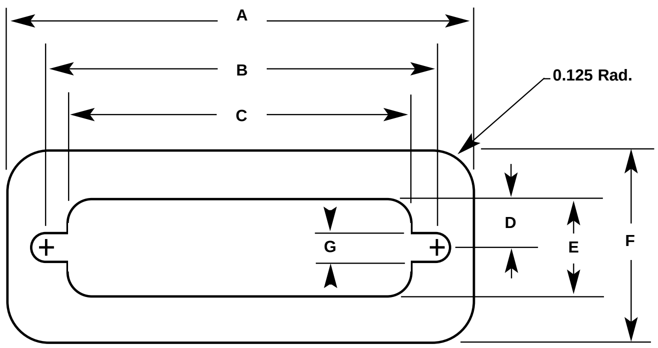
- Available in 9 pin to 50 pin “D” Connector styles
- Versatile front or rear mounting
- Custom shapes and designs available



“D” Connector Series Dimensions for Elastomers

Part No.	Thickness	# Pins	A	B	C	D	E	F	G
Tolerance:			± 0.015	± 0.010	± 0.015	Ref.	± 0.010	± 0.015	± 0.010
			(0,4)	(0,2)	(0,4)		(0,3)	(0,4)	(0,3)
8516-0208-XX	0.030 (0,8)	9	1.410	0.980	0.780	0.220	0.440	0.690	0.130
8516-0201-XX	0.060 (1,5)		(35,8)	(24,9)	(19,8)	(5,6)	(11,2)	(17,5)	(3,3)
8516-0209-XX	0.030 (0,8)	15	1.740	1.310	1.110	0.220	0.440	0.690	0.130
8516-0203-XX	0.060 (1,5)		(44,2)	(33,3)	(28,2)	(5,6)	(11,2)	(17,5)	(3,3)
8516-0210-XX	0.030 (0,8)	25	2.280	1.850	1.650	0.220	0.440	0.690	0.130
8516-0202-XX	0.060 (1,5)		(57,9)	(48,0)	(41,9)	(5,6)	(11,2)	(17,5)	(3,3)
8516-0211-XX	0.030 (0,8)	37	2,930	2.500	2.290	0.220	0.440	0.690	0.130
8516-0204-XX	0.060 (1,5)		(74,4)	(63,5)	(58,2)	(5,6)	(11,2)	(17,5)	(3,3)
8516-0212-XX	0.030 (0,8)	50	2.840	2.410	2.110	0.280	0.550	0.800	0.240
8516-0205-XX	0.060 (1,5)		(72,1)	(61,2)	(53,6)	(7,1)	(14,0)	(20,3)	(6,1)

To order replace XX with material code from the Material Compounds chart on pages 14–17.



All dimensions shown are in inches (millimeters) unless otherwise specified.

Introduction

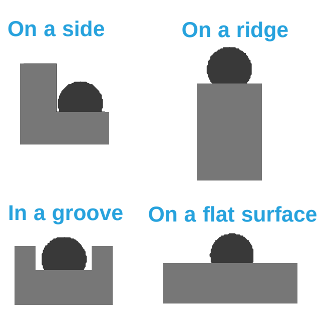
Laird Technologies form-in-place is an automated system for dispensing conductive elastomer EMI shielding and grounding gaskets onto metal or plastic substrates. Form-in-place is particularly well suited for cellular phones, PDAs, PC cards, telecom base stations, radios, and many other compartmentalized cast or plastic enclosures and packaged electronic assemblies.

Utilizing programmable 3-axis CNC dispensing equipment, the compound is dispensed accurately onto the substrate and creates a secure bond during the curing process. The repeatable computer-controlled dispensing pattern insures consistency between parts and rapid part program changes. In addition, it supports all levels of volume — from prototyping to high-volume electronic component production — via the use of one or multiple dispensing heads. The system is programmed to apply custom gasket configurations onto parts, to form multiple levels on the part, and on slopes up to approximately 70°.

Laird Technologies Series SN compounds are Room Temperature Vulcanizing (RTV) elastomers filled with proprietary conductive particles. Dispensed gasket beads may be handled in 3 hours, and are fully cured in 24 hours. Curing may be accelerated with additional humidity and temperature. The compounds have a working compression range from 10% to 50% of the gasket height, with a recommended design compression of 30% against a mechanical compression stop. Our product is designed to support low closure forces and is compatible with plastic, metal, and plated or chromate finished substrates. The required force to compress a given bead is a function of the compound and the gasket size; i.e. smaller gaskets require less force than larger gaskets. Please refer to our technical data for details.

Gaskets are dispensed on substrates within a placement tolerance of ± 0.001 inches and gasket cross-sectional tolerances from ± 0.003 inches. Refer to Table 1 on page 39 for typical gasket dimensions and tolerances. As a normal course of equipment operations, starting points and termination ends of the gaskets will have profiles that are approximately 25% larger than the running gaskets.

Typical Application for Form-In-Place Gaskets:



All dimensions shown are in inches (millimeters) unless otherwise specified.

Automated dispensing of compound is controlled by sophisticated computer software, which is user-friendly and easy to work with.

Form-In-Place Gasketing Features and Benefits

- Form-in-place gasketing offers a total cost savings in the form of reduced raw materials, labor or assembly time
- Room temperature cure gasketing materials eliminate the need for costly heat curing systems, allowing the use of inexpensive plastic or metal substrates
- Single-component compounds eliminate the need for mixing ingredients, thereby shortening production cycles and eliminating related waste
- Easy to program operating system allows for quick part-to-part change-over, minimal tooling investment for new designs, and prototype development in 24 to 48 hours
- High shielding effectiveness: 85–100 dB up to 10 GHz
- The dispensing system supports prototyping and high volume production schedules in a space saving 4' x 3' [12 sq. ft.] (1,2 m x 0,9 m [1,1 sq. m]) footprint
- Form-in-place gaskets provide more critical packaging space for board level components and smaller package dimensions
- Excellent adhesion on a wide variety of metal and plastic substrates including:
  - aluminum and other casting alloys
  - stainless steel
  - nickel copper plating (on plastics)
  - copper, silver, and nickel filled paint (on plastics)
- Low compression force makes SN compounds an excellent selection where the mating surfaces lack mechanical stiffness

Shielding Effectiveness per MIL-STD-285 (mod.)
Form-in-Place @ 50% Compression

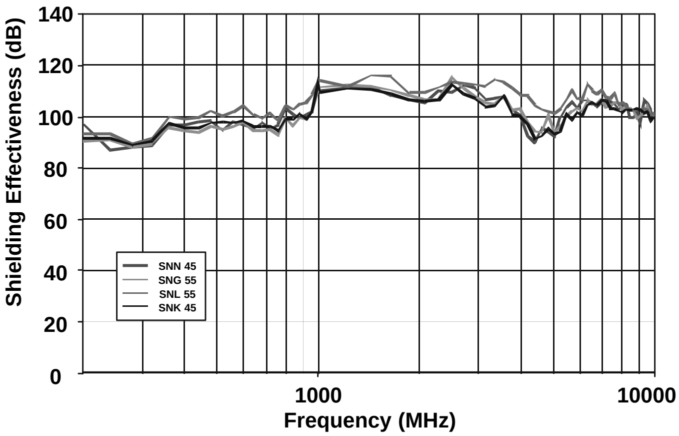


Table 1. Typical Bead Dimensions

Height	Width	Minimum Landing Area
0.014 ± 0.003 (0,4 ± 0,1)	0.015 ± 0.003 (0,4 ± 0,1)	0.020 (0,5)
0.015 ± 0.003 (0,4 ± 0,1)	0.020 ± 0.003 (0,5 ± 0,1)	0.025 (0,6)
0.020 ± 0.003 (0,5 ± 0,1)	0.024 ± 0.003 (0,6 ± 0,1)	0.029 (0,7)
0.027 ± 0.004 (0,7 ± 0,1)	0.030 ± 0.004 (0,8 ± 0,1)	0.036 (0,9)
0.030 ± 0.004 (0,8 ± 0,1)	0.034 ± 0.004 (0,9 ± 0,1)	0.040 (1,0)
0.040 ± 0.004 (1,0 ± 0,1)	0.048 ± 0.005 (1,2 ± 0,1)	0.055 (1,4)
0.045 ± 0.005 (1,1 ± 0,1)	0.059 ± 0.006 (1,5 ± 0,2)	0.067 (1,7)
0.055 ± 0.006 (1,4 ± 0,2)	0.075 ± 0.007 (1,9 ± 0,2)	0.084 (2,1)

Table 2. Material Specifications

Compound	Test Methods	SNC 40	SNN 45	SNK 45	SNL 55	SNG 55	SNN SF
Elastomer		Silicone	Silicone	Silicone	Silicone	Silicone	Polyether
Filler		Silver/Ceramic	Silver/Nickel	Silver/Copper	Silver/Aluminum	Silver/Glass	Silver/Nickel
Color		Beige	Beige	Beige	Beige	Beige	Gray
Electrical Properties							
Volume Resistivity (ohms-cm) max	MIL-DTL-83528 PARA 4.5.10	0.080	0.005	0.006	0.008	0.009	0.015
Shielding Effectiveness	MIL-DTL-83528 PARA 4.5.12						
200 MHz to 10 GHz		80 – 100 dB	90 – 110 dB	85 – 110 dB	87 – 120 dB	85 – 110 dB	90 – 110 dB
Physical Properties							
Specific Gravity (g/cm^3)	ASTM D792	0.95 ± 0.1	2.9 ± 0.2	2.5 ± 0.2	1.9 ± 0.2	1.8 ± 0.15	3.3 ± 0.2
Hardness Shore A	ASTM D2240	43 ± 5	48 ± 5	48 ± 5	57 ± 5	54 ± 5	62 ± 5
Compression set	ASTM D395 Method B	<20%	<20%	<20%	<20%	<20%	<45%
Compression/Deflection	ASTM D575						
@20% lb/in (N/cm)		2.6 (4.6) [a]	0.8 (1,4) [b]	1.2 (2,1) [b]	1.8 (3,15) [b]	1.8 (3,15) [b]	1.9 (3,3) [b]
@40% lb/in (N/cm)		9.2 (16.1) [a]	4.4 (7,7) [b]	4.5 (7,88) [b]	4.7 (8,2) [b]	5.5 (9,6) [b]	6.7 (11,7) [b]
Elongation at Break		150%	200%	100%	100%	200%	50%
Adhesion on Aluminum, PSI (N/cm2)	LT LCE PRO16	150 (>100)	170 (>120)	150 (>100)	150 (>100)	120 (>80)	150 (>100)
Temperature Range		-58°F to 257°F (-50°C to 125°C)					-58°F to185°F
Curing Requirements							
Cure Conditions		68°F to 86°F (20°C to 30°C), 50% Relative humidity					
Cure Time Before Handling		2-3 hours					
98% Cure		12 hours					
Complete Cure		24 hours					
Storage and Use							
Prior to Using		Allow product to stand 3 – 4 hours at room temperature					
Short Term Storage		Approximately five days when cartridge is in use.					
Long Term Storage		3 months from date of manufacture when stored at –13°F to 41°F (–25°C to 5°C)					
Packaging							
Syringe Size 30 cc		28 g ± 5	87 g ± 10	75 g ± 10	57 g ± 10	54 g ± 10	N/A
Syringe Size 55 cc		52 g ± 10	160 g ± 10	138 g ± 10	105 g ± 10	99 g ± 10	N/A
Cartridge Size 300 cc		280 g ± 20	870 g ± 30	720 g ± 30	520 g ± 25	500 g ± 25	1000 g ± 30
Cartridge Size 1000 cc		930 g ± 30	2.9 kg ± 0.1	2.5 kg ± 0.1	1.9 kg ± 0.1	1.8 kg ± 0.1	3.3 kg ± 0.1

[a] Compression/deflection bead size 0.055" x 0.075" (1,4 mm x 1,9 mm)
[b] Compression/deflection bead size 0.020" x 0.025" (0,5 mm x 0,6 mm)

Table 3. Accelerated Cure at Higher Temperatures

Conditions	50% Relative Humidity, 0.024 in. (0,6 mm) bead		
Temperature °F (°C)	73 (23)	140 (60)	185 (85)
Time for 98% Cure (Hr.)	12	2	1

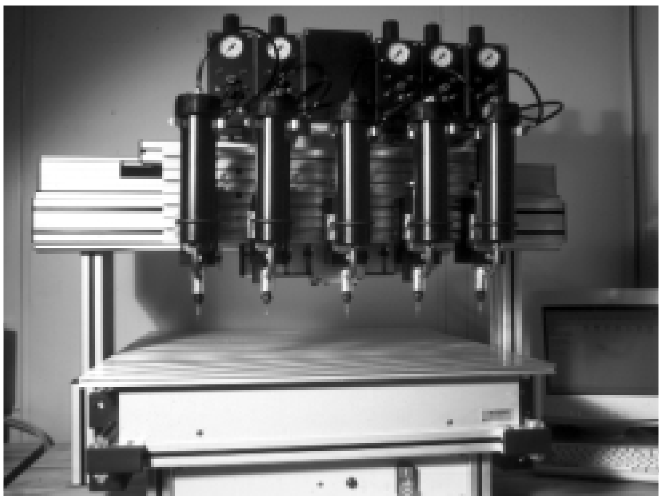
All dimensions shown are in inches (millimeters) unless otherwise specified.

Programming Software

Programming of the dispensing equipment can be facilitated utilizing part samples or part drawings. We also support the following CAD formats: AutoCAD®, DXF®, IGES®, Pro/ENGINEER®.

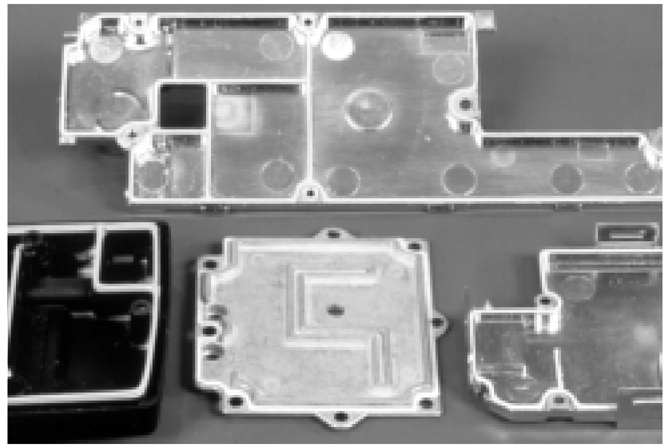
The software is user-friendly and includes several useful tools to simplify the path programming. These include scaling, symmetries, rotation, segment ends definition, and robotic dispensing instructions.

All production parameters are controlled by the software to include dispensing speed, start point, number of parts on the pallet, time needed to process one part, and automatic shut-down for cartridge reloading.



Exceptional Quality

All material undergoes batch testing before application to guarantee superior mechanical and electrical properties. All dispensed products are manufactured to the exacting requirements of our ISO 9001 certified facility.



Laird Technologies form-in-place gasketing is ideal for hand held electronics applications.

Packaging

To prevent damage to the substrate and gasket, and to facilitate handling, parts should be shipped in trays. Parts should be held securely to the tray to prevent movement during shipping, and packaged to avoid contact with each other. If required, Laird Technologies can design special packaging and trays to suit your specific part requirements.

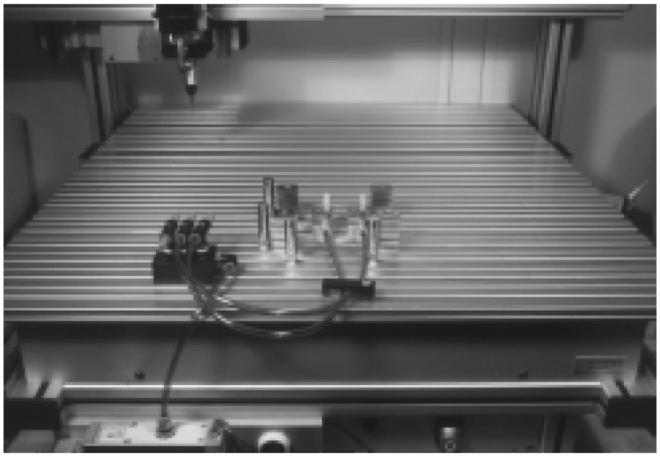
Ordering Options

To optimize the cost savings of form-in-place gasketing, Laird Technologies offers three ways for you to benefit from this technology.

1. Laird Technologies will sell the form-in-place equipment and conductive compounds to you for in-house dispensing. Laird Technologies' technical support services include programming, material handling, equipment installation, and maintenance recommendations.
2. Laird Technologies can provide our compounds for use with other dispensing systems, if compatible.
4. Laird Technologies will receive your housings, substrates, or enclosure panels and dispense the gasketing onto the part.

Form-In-Place Universal Component Positioning and Hold Fixture Part No. 8558-0100-0

To reduce the need for fixture fabrication to position and clamp the housing to the table of the dispensing machine, Laird Technologies offers a universal kit consisting of a vacuum hold down, leveling jacks, and positioning pins. When adapted to the dispensing machine table, the components in the kit can be used for engineering samples, pre-production, or production lot dispensing of the conductive compound on to the housing. In addition to the hardware shown in the picture above, the kit is provided with easy-to-follow set-up instructions for adaptation to a specific application.



Fixture Set-up on Dispensing Machine

How To Order

When ordering compounds select the SN compound number from the chart below. Reference the table on page 39 for the respective container size (cc).

SNN 45	SNK 45	SNL 55	SNG 55	SNN SF	SNC 40
SNN45-300	SNK45-300	SNL55-300	SNG55-300	SNNSF-300	SNC40-300
SNN45-1000	SNK45-1000	SNK55-1000	SNG55-1000	SNNSF-1000	SNC40-1000

For dispensed gaskets, the part number will be assigned by our sales department.

Part numbering for dispensing equipment will be assigned by our sales department.

Laird Technologies' engineering and sales staff is on hand to discuss these options with you and help you make the best choice based upon your manufacturing needs and volume.

Mold-In-Place Printed Circuit Board Shielding

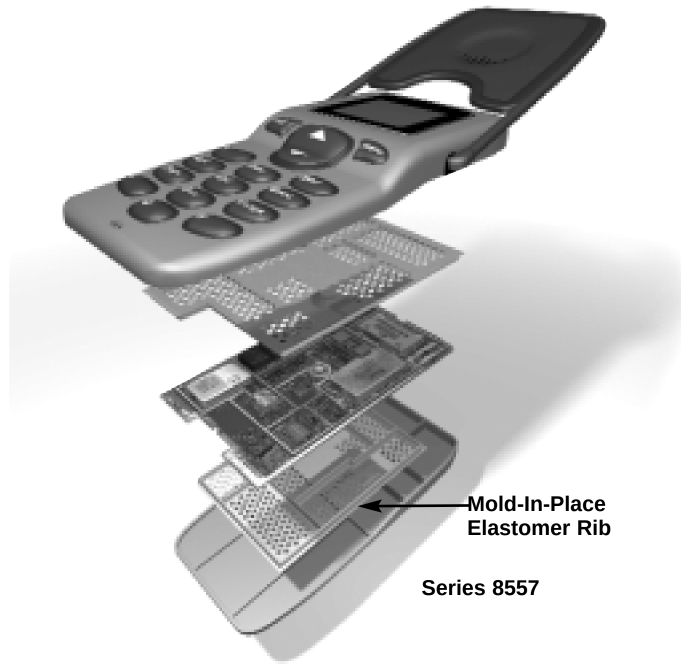
Laird Technologies introduces its Series #8557 mold-in-place capabilities for printed circuit board shielding applications. Based upon each specific design application, a molded-in-place rib pattern, made of silver or silver coated particles in a silicone base, can be applied to any metal substrate creating a multi-compartment, shielded enclosure. During installation, the shield is sandwiched between one side of the printed circuit board and the housing. As the housing is assembled, the mold-in-place ribs are compressed, providing the shield. Access to the components is accomplished by simple disassembly of the housing.

The mold-in-place rib enclosure design is ideally suited for portable devices, hand held computers, and wireless communications devices.

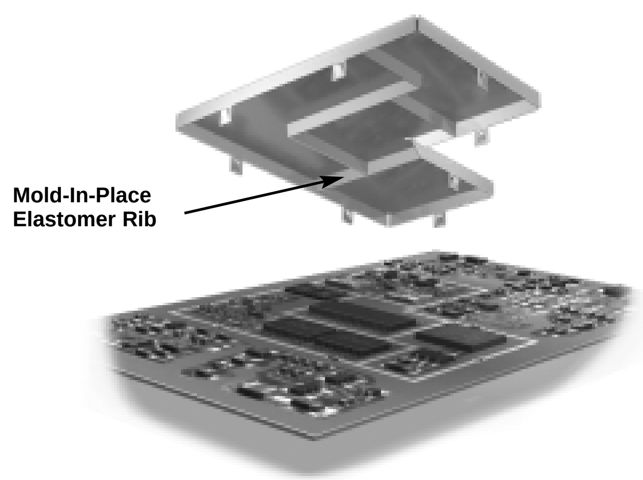
- Replaces multiple soldered printed circuit board shield cans with a single piece approach
- Ideal for hand held devices where space is at a premium
- The metal substrate acts as a shielded enclosure allowing the use of a non-conductive housing
- Metal component can be custom designed in various shapes, mounting tabs, and heights
- Elastomer mold-in-place ribs can be provided with a tapered design to lower compression force
- Available in other material compounds, consult sales

Laird Technologies can custom mold-in-place on your provided substrates, or you can utilize our vast metal stamping technology and have us manufacture the substrate.

To order, please specify desired rib pattern and provide a layout of the designed matching ground traces on the printed circuit board.



Cell Phone Exploded View



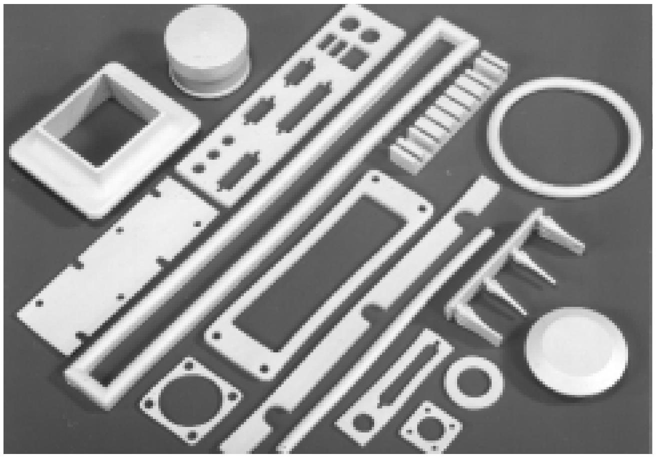
Printed Circuit Board Exploded View

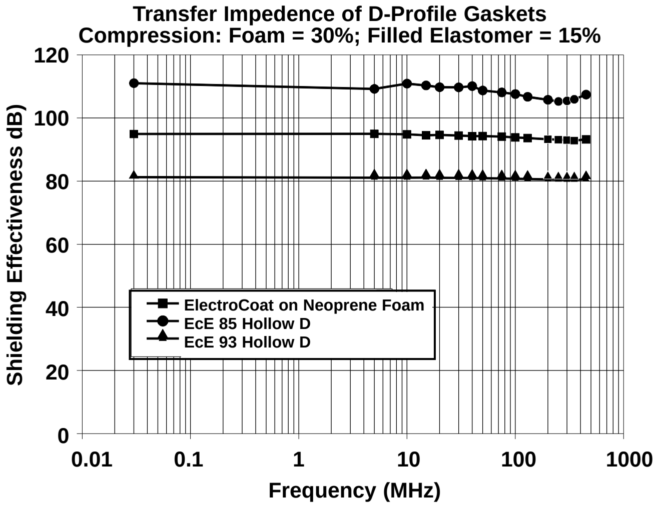
All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroCoat™

ElectroCoat is a thin, flexible surface coating consisting of a silver-filled silicone elastomer. The versatile coating can be easily applied to die-cut or molded foams for both gasket and non-gasket applications. It can also be applied to molded or extruded elastomers, other polymers, and a wide range of other materials.

- Excellent shielding effectiveness — greater than 90 dB measured by transfer impedance
- Solid, continuous, conductive coating over the entire gasket surface, including the inner die-cut surfaces of foam gaskets
- Coated foam gaskets have very low compression force
- Exceptionally wide compression range from 10% to 70% deflection to accommodate uneven gaps in enclosure housings
- Flexible coating withstands gasket compression with no decrease in shielding effectiveness after 1000 cycles of 40% compression
- Extruded profiles shown on pages 18–22 are available with neoprene core.





Ordering Information

1. Determine if PSA is needed. If so, replace the 5th digit in the part number with “9”.
2. Select desired core material from Table 1 and insert in place of YY.
3. Select two digit ElectroCoat from Table 2 and insert in place of ZZ.
4. A unique custom identification number will be assigned by sales.

8550-XXXX-YY-ZZ
- ZZ → ElectroCoat (Coating Material)
- YY → Core Material*
- XXX → Unique identification number assigned by Laird Technologies
- X → 9 w/PSA
- 8550 → Standard Series Number

Example: 8550-9XXX-50-10 is a silver/silicone ElectroCoat with a silicone foam core and PSA.

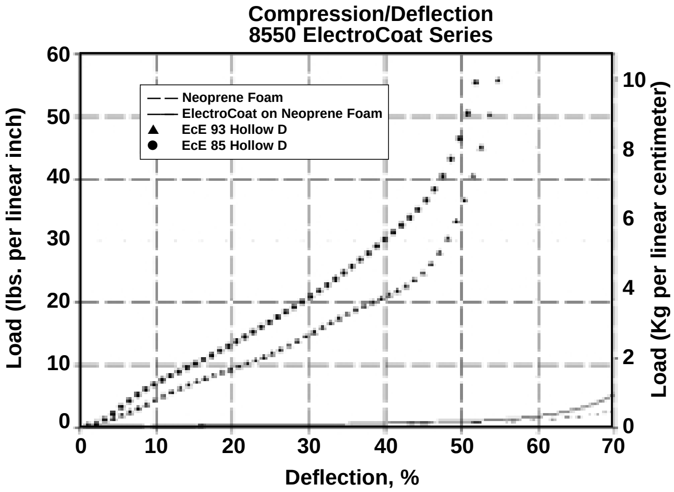


Table 1.

YY #	Core Material*
50	Silicone Foam
51	Solid Silicone
52	Neoprene Foam

Table 2.

ZZ Coating #	Material
10	Silver/Silicone

*Other core materials may be available. Consult Laird Technologies sales department.

ElectroBond™ Electrically Conductive Adhesive

ElectroBond electrically conductive adhesives are single component RTV (room temperature vulcanizing) adhesive systems designed for bonding conductive elastomer gaskets to metal flanges, or for providing EMI and environmental protection as a sealant. These materials form a cured skin within 30 minutes after exposure to atmospheric moisture without forming any corrosive byproducts. However, a full cure at room temperature is obtained after one week at 45% minimum relative humidity. Since the cure is caused by atmospheric moisture, ElectroBond is recommended in applications where the bond thickness is under 0.020 (0,5).

ElectroBond is a solvent-free adhesive/sealant and cures with little or no shrinkage. Bonds remain flexible and conductive, and can be used in environments where temperatures range from –70°F to 350°F –57°C to 177°C) without degradation of physical or electrical properties. ElectroBond is a thixotropic paste that can be applied to vertical surfaces without any sagging.

ElectroBond is offered in a wide variety of fillers to provide maximum conductivity and compatibility with mounting surfaces.

ElectroBond has excellent adhering properties. However, metallic surfaces may require priming with ElectroBond 8800 Primer for optimum adhesion. ElectroBond 8800 Primer is supplied as part of the package.

Table 1.

Material Description			80	81	85	93	4 X A1
Number of Components			1	1	1	1	2
Polymer	Sil: Silicone		Sil	Sil	Sil	Sil	Epoxy
Filler	Ag: Silver, Cu: Copper, G: Glass Al: Aluminum, Ni: Nickel C: Carbon		Ag/Cu	Ag/Al	Ag/G	Ni/C	Ag
As Supplied							
Property	Units/Tol.	Test Method					
Appearance		Visual	Thixotropic Paste	Thixotropic Paste	Thixotropic Paste	Thixotropic Paste	Thixotropic Paste
Color		Visual	Tan	Tan	Tan	Dk. Gray	Beige
Specific Gravity		ASTM D792	3.20 ± 0.20	2.20 ± 0.20	2.10 ± 0.20	2.50 ± 0.20	2.40 ± 0.20
Cured Characteristics							
Durometer	Shore A, ± 5	ASTM D2240	70	65	65	70	100 (hard)
Peel Strength	PPI (KN/m), Min.	ASTM D1876	4.0 (0,7)	4.0 (0,7)	4.0 (0,7)	4.0 (0,7)	10 (1,8)
Lap Shear	PSI (MPA),	ASTM D1002	150 (1.03) Min.	175 (1.21) Min.	125 (0.86) Min.	130 (0.9) Min.	1000 (6,9) Min.
Volume Resistivity	Ohm-cm, (Max.)	Per MIL-DTL-83528C Para 4.5.10	0.01	0.04	0.05	0.10	0.0001
Service Temp.	°F (°C)		–67 to 347°F (–55 to 175°C)	–67 to 347°F (–55 to 175°C)	–67 to 347°F (–55 to 175°C)	–67 to 347°F (–55 to 175°C)	–60 to 300°F (–50 to 150°C)
Shelf Life	Months	From Date of Shipment in Original Container	6	6	6	6	6
Coverage	FT/#M/KG Diameter Bead	0.125 (3,175)	60 (40)	85 (58)	90 (60)	75 (51)	30 sq. in. (200 cm²) max

ElectroPoxy™ Electrically Conductive Adhesive

ElectroPoxy (4 x A1) electrically conductive adhesive is a dual-component system designed for bonding metal gaskets to flanges and maintaining their overall shielding effectiveness. It can also be used to repair printed circuit boards, restore the continuity of electrical circuits, attach electrical wires to delicate components and bond conductive textiles to metal. ElectroPoxy features include:

- Pure silver particle filler for high conductivity
- Effective over a wide temperature range from –60°F to 300°F (–50°C to 150°C).
- May be cleaned in uncured state with isopropyl alcohol

ElectroPoxy components are supplied in two 1-ounce (30 cc) jars. The contents of each are mixed in a 1:1 ratio to obtain a thick paste that can be applied where necessary. Curing may take place at room temperature or up to 212°F (100°C) to produce a very strong and highly conductive bond. Curing times are as follows:

Room Temperature — 24 to 36 hours
145°F (65°C) — 4 hours
212°F (100°C) —15 minutes

Please call Laird Technologies for further application and handling directions.

Ordering Information

Material Type	Container Size	Part No.
ElectroBond	4 Ounce (118 cc) Cartridge	8800-0004-XX
ElectroBond	8 Ounce (237 cc) Cartridge	8800-0008-XX
ElectroBond	16 Ounce (473 cc) Cartridge	8800-0016-XX
ElectroPoxy	Two 1-Ounce (30 cc) Jars	8800-4XA1-77

Example (ElectroBond only)

8800-00XX-XX

→ Material Code from Table 1
→ Laird Technologies number assigned to specific size ordered
→ Standard Series Number

All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroCaulk™ EMI Caulking Compound

ElectroCaulks are single component electrically conductive sealants for shielding of structures, cabinets, and conduits against electromagnetic interference (EMI). ElectroCaulks are based on silver-plated copper, silver-plated aluminum, silver-plated glass, and nickel-coated graphite filled silicone, or silver-coated aluminum and nickel-coated graphite filled polyisobutylene. ElectroCaulks are based on stable fillers and can be used within the recommended temperature range (see material specification) without any degradation in electrical or physical properties.

ElectroCaulks are thixotropic pastes with high tack and nonhardening properties and perform exceptionally well under vibratory conditions and against warping and displacement caused by temperature variation. ElectroCaulks adhere to most surfaces and can be applied to vertical or overhead surfaces without sagging or running.

ElectroCaulks are easy to apply with standard cartridge caulking guns and dispensing equipment, such as syringes or hand application with putty knife or spatula. ElectroCaulks have excellent adhering properties and can be used without any primer. However, metallic surfaces may require priming with ElectroBond 8800 Primer with silicone based sealants. Polyisobutylene based sealants are recommended for those applications which require painted surfaces or cannot use silicones. ElectroCaulks are available in 4, 8, and 16 ounce cartridges.

Table 1.

Material Description			41	42	43	44	45	46
Polymer	Sil: Silicone, PIB: Polyisobutylene		Sil	Sil	Sil	Sil	PIB	PIB
Filler	Ag: Silver, Al: Aluminum, G: Glass, Ni: Nickel, C: Graphite, Cu: Copper		Ag/Cu	Ag/Al	Ag/G	Ni/C	Ag/Al	Ni/C
As Supplied								
Property	Units	Test Method						
Appearance	Visual	Thix: Thixotropic	Thix	Thix	Thix	Thix	Thix	Thix
Color	Visual		Gray	Tan	Tan	Dk.Gr.	Tan	Dk.Gr.
Density	Gm/cc		2.10	2.00	1.90	1.80	1.90	1.80
Tack-Free Time	Hours		0.50	0.50	0.50	0.50	0.50	0.50
Shrinkage	%		25	20	20	25	20	25
Coverage	Feet		90	95	100	105	100	105
Shelf Life	Months		6	6	6	6	6	6
R.T. Cure	Hours		24	24	24	24	24	24
Cured Characteristics								
Volume Resis. As supplied	Ohm-cm (Max.)	L/T QA	0.01	0.01	0.05	0.10	0.01	0.01
Volume Resis. After 48 Hours @ (F/C)	Ohm-cm (Max.)	L/T QA	0.01 300/ 150	0.01 300/ 150	0.05 300/ 150	0.10 300/ 150	0.01 250/ 121	0.10 250/ 121
Shielding Effec.	dB, Min.	MIL-DTL-83528	100	90	90	70	90	70
Service Temperature	°F	L/T QA	-55/ 300	-55/ 300	-55/ 300	-55/ 300	-50/ 250	-50/ 250

Application Directions

1. ElectroCaulks are thick pastes and the fillers have a tendency to settle. Roll the cartridges before use.
2. Clean the seams or joints of grease and/or foreign material with solvents such as toluene, xylene or MEK and allow to dry.
3. Trim nozzle to the desired bead size.
4. Place cartridge into a standard caulking gun.
5. Apply a uniform bead of ElectroCaulk to the mating surfaces prior to assembling or rivetting.

Note: Xylene, toluene or MEK are recommended solvents for cleaning or thinning.

Ordering Information

Material Type	Container Size	Part No.
ElectroCaulk XX	4 Ounce (118 cc) Cartridge	8800-0004-XX
ElectroCaulk XX	8 Ounce (237 cc) Cartridge	8800-0008-XX
ElectroCaulk XX	16 Ounce (473 cc) Cartridge	8800-0016-XX

8800-00XX-XX

- XX → Material Code from Table 1
- 00XX → Laird Technologies number assigned to specific size ordered
- 8800 → Standard Series Number

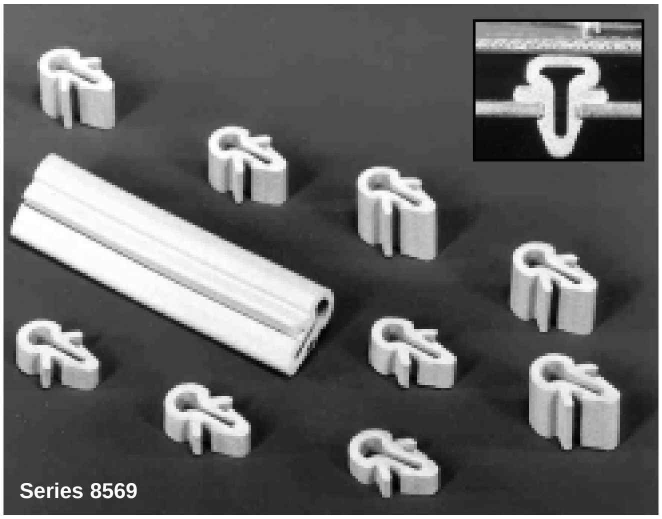
The properties and performance of ElectroCaulks may vary depending upon the specific application and, therefore, Laird Technologies can not guarantee that this product will meet the published specifications in each customer's individual application. The user should conduct his own test for the suitability of ElectroCaulks for a particular application.

All dimensions shown are in inches (millimeters) unless otherwise specified.

Board to Chassis Conductive Stand-Off

Laird Technologies offers a multi-functional grounding device that provides electrical contact between the bottom of printed circuit boards and enclosure housings. The snap in feature allows for easy assembly and secure retention. Once inserted, the part makes contact with the base of the printed circuit board on a grounding pad or trace, assuring superior grounding.

- Solves EMI and/or ESD problems via superior grounding (maximum 0.8 Ohm DC resistance)
- Provides damping of vibration and spacing between grounded surfaces
- Available in two standard lengths (custom lengths also available)
- Design of part facilitates simple robotic automation
- Minimum compression force required within operating range (see chart below)



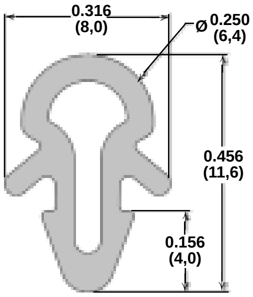
Ordering Information

Select part from table below. Insert desired compound number in place of XX. Custom lengths are also available.

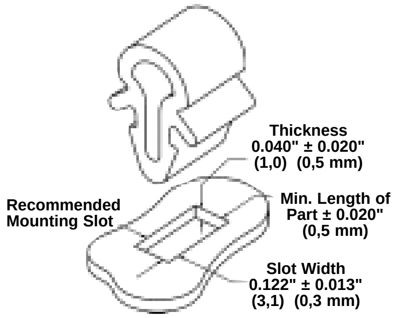
Part No.	Length
8569-0127-XX	0.250 (6,4)
8569-0131-XX	0.125 (3,2)

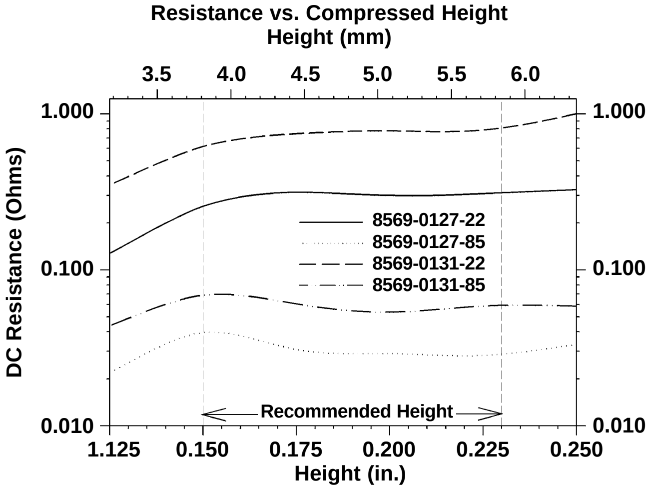
EcE Compound 85	EcE Compound 22
Silver/Glass	Nickel/Graphite

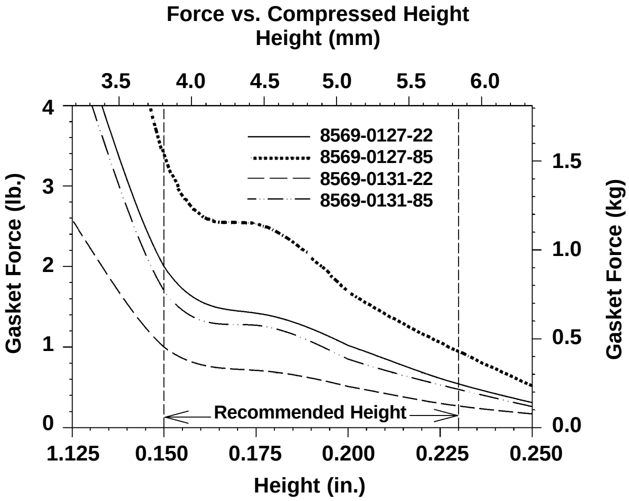
Profile Dimensions



Mounting Information







All dimensions shown are in inches (millimeters) unless otherwise specified.

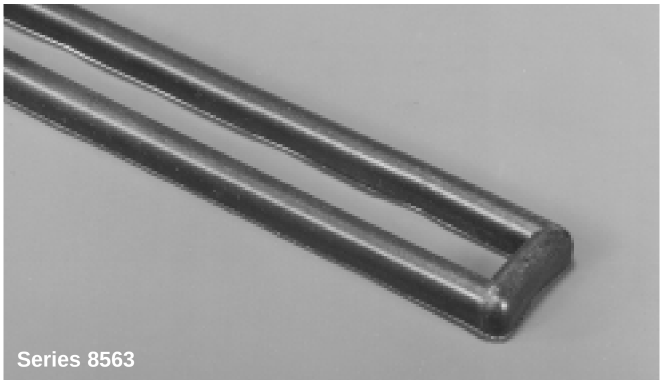
Electrically Conductive Elastomer Backplane Shielding

Laird Technologies introduces a new line of backplane shielding: a low compression force frame gasket. The low compression force is achieved by combining an electrically conductive elastomer layer over a low density foam insert. The gaskets are supplied with pressure sensitive adhesive (PSA) to facilitate quick and easy mounting.

These picture frame gaskets are mounted around the connectors of a backplane (see Figure 1). The printed circuit board housing is then inserted into these connectors, thereby engaging the gaskets.

- Mold process eliminates vulcanized corners, typically subject to stress and potential EMI leakage
- Combination of foam core with outer conductive layer a low compression force gasket design with a wide operating range
- Available in a wide variety of elastomer compounds to ensure galvanic compatibility
- High attenuation alternative to stamped metal backplane shielding
- Maintains physical and electrical properties after thermal and high cycle tests

To order, specify length, width, height, profile cross-section size, and material compound. See Material Compounds chart on pages 14–17.



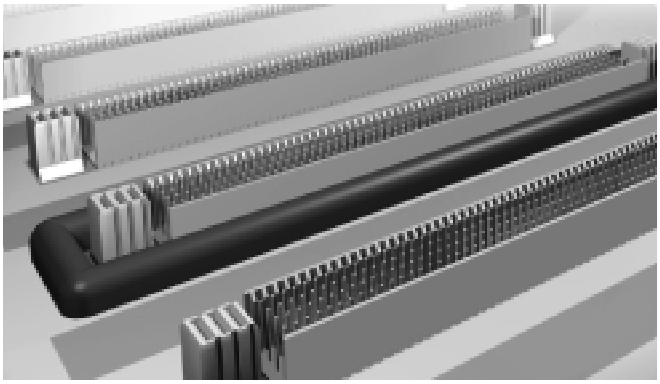
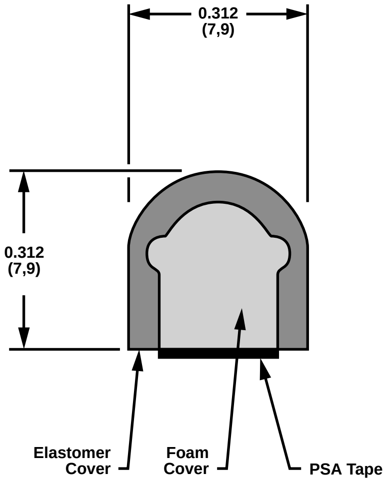


Figure 1.



All dimensions shown are in inches (millimeters) unless otherwise specified.

ElectroPrint™ Conductive Printed Gaskets

Laird Technologies offers the technique of printing conductive elastomers as a very cost-effective method of producing gaskets. The printed process produces a highly selective deposit resulting in negligible waste.

- Raised beads improve stress contact
- Component hardware (panels, covers, etc.) can have the gasket printed directly onto the relevant surface, greatly decreasing assembly time
- Environmental sealing from a conventional elastomer can be incorporated into one gasket
- Compression stops can be designed for controlled compression

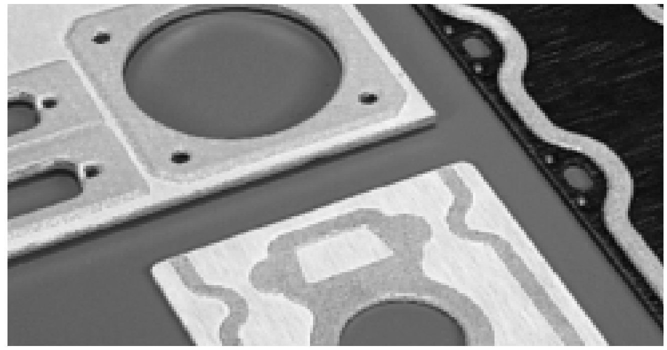
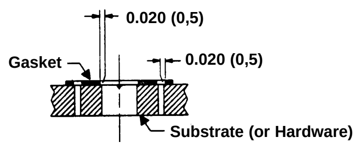


Figure 3.



Configurations

Printed Gasket on Substrate

This particular type of gasket is an extremely cost-effective method of producing gaskets of all shapes and sizes. The gasket is simply printed on a substrate material. Typical thickness is 0.020 (0,5); maximum thickness is 0.040 (1,0). The substrate can be any of a variety of materials (metallic, plastic, glass, etc.) provided they are flat and able to withstand the curing temperature of the printed polymer.

Print On Components

Printing onto component hardware can lead to significant benefits in terms of handling, ease of assembly, serviceability, and cost.

Printed Gasket with Raised Bead

A feature that is unique to printed gaskets is the ability to add a raised bead to improve the sealing characteristics. (See Figure 2.)

Figure 1.

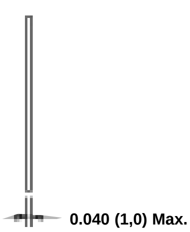
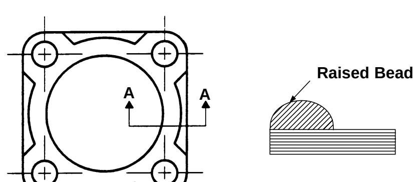


Figure 2.



Section A-A

All dimensions shown are in inches (millimeters) unless otherwise specified.

Printed gaskets can have a variety of forms from simple pure prints to complex subassemblies. However, there are certain rules that apply to the profile and positioning of the bead and its base which are indicated below:

1. Beads have a distinct relationship between height and width. Therefore, to achieve optimum performance, the bead width should be between 0.080 (2,0) – 0.200 (5,0).
2. Adjacent beads should be separated by a least 0.040 (1,0). A minimum clearance allowance of 0.020 (0,5) should be provided from the edge of the component, including mounting holes and cut-outs (see Figure 3). Raised stress beads shown in Figure 2 can be deposited to a height of 0.012 (0,3) – 0.020 (0,5).

Table 1. Printed Electrically Conductive Material Codes

EcE Material Number			26	27	29	30
Elastomer Type			SIL	SIL	SIL	SIL
Filler Material			Ag/Cu	Ag/Al	Ag/Gl	Ni/ Graphite
Electrical Properties	**Tol.**	**Test Method**				
Volume Resistivity (ohm-cm)	Max.	MIL-DTL-83528C (PARA 4.5.10)	0.010	0.010	0.050	0.100
Shielding (dB)	Min.	SAE ARP 1705				
200 KHz (H-Field)			70	70	60	50
100 MHz (E-Field)			100	100	90	80
500 MHz (E-Field)			100	100	90	70
1 GHz (Plane Wave)			90	90	80	60
Physical Properties	**Tol.**	**Test Method**				
Specific Gravity	± 0.25	ASTM D792	3.5	2.0	2.0	3.0
Hardness (Shore D)	± 5	ASTM D224	75	70	75	70
Tensile Strength			210	200	580	430
Compression Set (%)	Max.	ASTM D395	35	35	35	35
Upper Operating Temp °F (°C)	Max.	ASTM D 1329	320°F (160°C)	320°F (160°C)	320°F (160°C)	320°F (160°C)

How to Order:

8559-XXXX-26

- Material Code from Table 1
- Laird Technologies number assigned to specific customer component
- Standard Series Number

Galvanic Corrosion

Corrosion can manifest itself in many forms. Some common forms are galvanic, pitting, and crevice corrosion. However, galvanic corrosion is the major concern in shielding applications. Galvanic corrosion is driven by the interaction of the gasket and the electronic enclosure, since in a shielded joint there are often two dissimilar materials in intimate contact.

Basic Galvanic Conditions

There are three conditions that must exist for galvanic corrosion to occur:

1. Two electrochemically dissimilar materials present
2. An electrically conductive path between the two materials
3. An ionic conduction path (typically a corrosive environment) between the materials

If any of these three conditions is missing, galvanic corrosion will not occur. If we examine each of these conditions in detail, we will not only understand galvanic corrosion, but also know how to prevent it.

Electrochemically Dissimilar Metals

Of the three conditions necessary for galvanic corrosion, the most important is the electrochemical difference between metals. Commonly available materials have different electrochemical potentials; even pure metal at the microscopic level. This is why a block of steel sitting by itself corrodes. The order in which metals will corrode is always from the most anodic (active) to the most cathodic (noble). This means that when two dissimilar metals are put together, only the more anodic metal will corrode. This method is used extensively in preventing corrosion by plating a more anodic metal over a more cathodic metal. The more anodic metal will then sacrifice itself (corrode first) and protect the metal underneath from corrosion. This is the reason for the good corrosion resistance of zinc plated steel. Even when scratched, the zinc coating that surrounds the scratch protects the exposed steel from corroding until the zinc near the scratch is consumed.

Electrical Conduction

The second condition required for galvanic corrosion, electrical conduction, is the hardest to prevent. Metals are all good conductors of electricity, and most joints between metals are made with metal fasteners. The amount of electrical current that flows is dependent on the rate of corrosion, but in most cases is very small. Dramatically reducing the conductivity of an electrical path between two metals has little effect on the corrosion rates except where very strong electrolytes are involved. Generally, effective RF joints depend on having very high conductivity; therefore, reducing conductivity to decrease corrosion may greatly reduce shielding effectiveness. Some new research has produced materials that are good RF conductors, but poor D.C. conductors. These materials may be able to reduce corrosion and still maintain high shielding levels. Laird Technologies is in the forefront of this research.

An Ion Conduction Path

The ionic conduction medium that is most responsible for corrosion is water. There are other ionic conductors such as moist air, but the majority of corrosion problems will be caused by water or water-based solutions. The basic principle is that the metals are slightly soluble in water. You can sometimes taste a metallic taste in water, especially if the water is a little acidic. In a good ionic conductor like salt water, or water with a high acid content, the ions are relatively stable, and more metal will dissolve into the water. A good ionic conductor like salt water will also allow dissolved ions to move freely in the solution. The dissolved ions tend to migrate through the water toward the electrode of opposite polarity. The positively charged ions will migrate towards the cathode while the negatively charged ions will migrate towards the anode. The only way to totally prevent dissolved ions from migrating is to interrupt their path, such as with a vacuum or by maintaining them at very low temperatures. The speed at which they migrate can also be reduced by many orders of magnitude by using poor ionic conductors as barriers. Placing metals in dry air, or coating the metals with a poor ionic conductor such as paint, greatly reduces corrosion rates. Some metals form their own barriers that prevent or restrict ion migration. For example, under normal atmospheric conditions aluminum corrodes in air, producing a thin coating of aluminum oxide. The aluminum oxide is an extremely poor ionic conductor and chokes off the flow of oxygen to the aluminum metal beneath the oxide coating. This demonstrates how by-products of corrosion can dramatically reduce corrosion rates.

As in the above example of zinc coating on steel, the anodic material does not need to completely cover the more cathodic material to offer protection. It only needs to be close by. The effective distance between the anodic metal and the cathodic metal depends on the environment. This distance is generally dependent on the conductivity of the electrolyte. In the case of typical electronic equipment this distance is usually the size of the microdroplets of water formed by condensation. In severe environments, this distance can be 0.250 in. (6,4 mm) or more.

Galvanic Corrosion of Electrically Conductive Elastomers

The galvanic series provides a relative ranking for selecting compatible metallic couples. However, electrically conductive elastomers are a composite material that behaves differently from metals due to diffusion rates and elastomeric nature of the gaskets. In addition, the presence of corrosion inhibitors which continuously coat the exposed flanges also affects the corrosion rate. Therefore, the direct application of the metallic-based galvanic series to the conductive elastomers could be misleading. The corrosion behavior of the conductive elastomers is affected by the nature of the filler particles, the permeability of the elastomer matrix, and the presence of corrosion inhibitors.

Electrically conductive elastomers are effective shielding materials because they provide good attenuation to electromagnetic radiation, while at the same time providing an environmental seal. When conductive elastomers are assembled in an enclosure, they are in intimate contact with some type of metal flange and readily conduct current. These two conditions, intimate contact with a metallic substrate and electrical conductivity, create a galvanic couple. Significant corrosion of one of the components of this couple can occur under suitable conditions of: 1) conductive environment (i.e., salt water, acid, etc.) and 2) corrosion potential difference between the elastomer-metal couple (the difference between the Electromotive Force (EMF) values of the two materials). If the elastomer corrodes, an insulating corrosion product is formed that reduces the conductivity of the elastomer. On the other hand, if the metal substrate corrodes, the metal loss could threaten the integrity of the flange and the corrosion products could adversely effect the performance of the elastomer. When designing the enclosure it is important to avoid conditions that can lead to significant corrosion. The following data are intended to be a guide to help in choosing the appropriate type of couple(s) so as to avoid or minimize these conditions.

Corrosion Test — To evaluate the impact of corrosion on the elastomer/metal galvanic couples test samples were exposed to 500 hours of salt spray in accordance with missile specification MIS-47057. The test fixtures were assembled as per Figure 1. The dimensions of the electrically conductive elastomer washers are shown in Figure 2 and the metal coupons are shown in Figure 3. The volume resistivity of the elastomers and the weight of the metal coupons were measured before, and then again after the salt spray test. From this data, the change in volume resistivity for the elastomer and the weight loss for the metal coupons were calculated. With these two pieces of data it is possible to assess the compatibility of the various elastomer/metal couples. This information can then be used as a design guidance tool to determine which combinations of conductive elastomer gasket and metal flange are appropriate for a particular application. The following corrosion data indicate the performance of the galvanic couples in a very corrosive environment and thus represent a worst-case scenario.

Weight Loss of Metal Coupons (Part 1 of Galvanic Couple) — Five different metallic materials were evaluated. The five metallic materials included chromated aluminum, Galvalume® (a 55% Al-45% Zn hot-dip coated steel), tin plated steel, zinc plated steel and stainless steel (Table 1). These materials represent some of the common types of sheet metal used to manufacture enclosures.

Figure 1. Test Assembly per MIS-47057

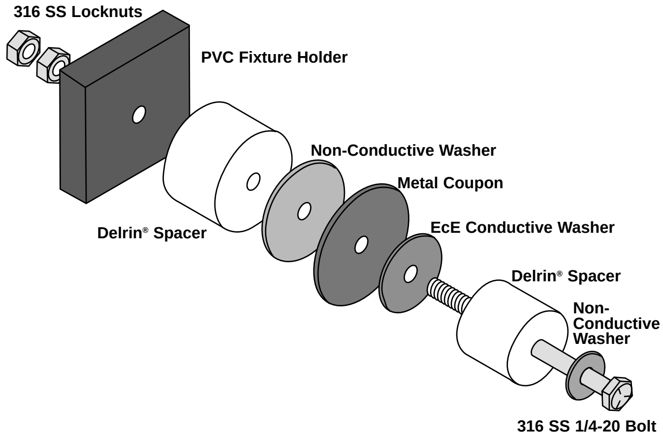


Figure 2. Conductive Washer

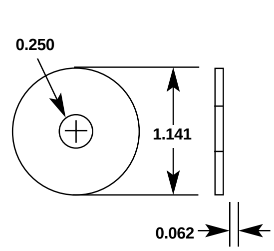


Figure 3. Metal Coupon

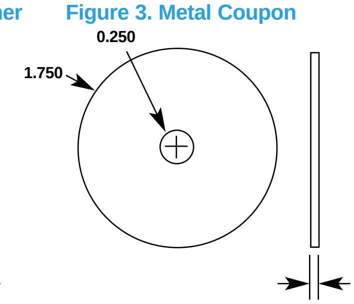


Table 1. Metal Coupons Tested

Metal Coupon	Base Metal	Coating
Aluminum	6061-T6	Chromate
Galvalume®	1006	55% Al-45% Zn hot-dip coated
Tin Plated Steel	1010	Electroplated Tin
Zinc Plated Steel	1010	Electroplated Zinc
Stainless Steel	304	None

The percent weight loss was calculated for all of the metal coupons according to equation 1.

Equation 1.

$$\%\ \text{Weight Loss} = \frac{\text{Weight}_{\text{Before}} - \text{Weight}_{\text{After}}}{\text{Weight}_{\text{Before}}} \times 100\% \quad (1)$$

In equation 1, Weight Before is the weight of the metal coupon before the test and Weight After is the weight after the test once the corrosion products were removed. In Table 3 (page 55), a corrosion performance rating was developed from this data for the metal coupon part of the galvanic couple only. This table does not provide any information on how the elastomer part of the galvanic couple will hold-up. The corrosion performance ratings, color coded for ease of recognition with a legend, are provided below the table. The divisions for the corrosion performance ratings were established by visual assessment to differentiate significant differences of metal loss on the coupons. The elastomer compound numbers are listed in columns across the top of the table, including the elastomer and filler material. The metal coupons are listed in rows along the side of the table. The intersection of a row and a column gives the weight loss rating for the metal coupon when used with that particular elastomer.

For the galvanic couples in which the metal coupon experiences little weight loss (yellow rating), the metal coupon is probably the cathode (electrode where reduction occurs) and/or the couple has a small potential difference. In this case the metal substrate would not experience much corrosion, even in very corrosive environments. At the other extreme, the galvanic couples in which the metal coupon experiences a large weight loss (dark green rating), the metal coupon would be the anode (electrode where oxidation occurs). In this case the metal substrate would experience extensive corrosion in the very corrosive environments. A large metal coupon weight loss (dark green rating) does not preclude the use of this galvanic couple, but in the design it would be critical to look at the relative anode (metal) to cathode (elastomer) areas, the thickness of the flange and the corrosiveness of the environment. It is not recommended that the galvanic couples with an extreme metal coupon weight loss rating (gray) be used under any conditions.

Volume Resistivity of Conductive Elastomers (Part 2 of Galvanic Couple) — Conductive elastomers are essentially a composite material made up of an elastomer matrix and small filler particles, usually metallic. Even the filler particles can have a composite nature since many are coated. This composite structure can result in a corrosion behavior that may not follow the well known galvanic series. The elastomer compounds that were evaluated are listed in Table 2.

Table 2. Elastomers Tested

Elastomer	Filler
Silicone	Inert Al
Silicone	Ag Plated Cu
Silicone	Ag Plated Al
Silicone	Ag Plated Ni
Silicone	Ag Plated Glass
Fluorosilicone	Ag Plated Al
Fluorosilicone	Ni Plated Graphite
Silicone	Ni Plated Graphite
EPDM	Ag Plated Al

When exposed to a corrosive environment one of the most important characteristics of a conductive elastomer is its ability to maintain its initial shielding effectiveness. As corrosion products form in the elastomer it usually results in a loss of shielding effectiveness. Generally, as shielding effectiveness decreases there is a tendency for the conductivity of the elastomer to decrease (or resistance to increase). To assess the effect of very corrosive environments on the elastomer part of the galvanic couples, the volume resistivities of the elastomers were measured before and after the corrosion test. In Graphs 1–5 on page 54, a side-by-side comparison is presented for each elastomer of its volume resistivity before and after exposure to the corrosive environment. The change in volume resistivity is the difference between these bars (before and after). It is important to note that the Y-axis is a log scale. Each chart corresponds to a different metallic substrate. The change was usually positive which means a loss in conductivity. These charts do not provide any information on how the metal coupon part of the galvanic couple will hold up.

For some of the elastomers, the increase in the volume resistivity is large. In these cases, the conductive elastomer was probably the anode. This condition results in a significant amount of corrosion of the elastomer filler particles, which makes it much less conductive. At the other extreme there were a number of elastomers in which there was only a very small percent increase in volume resistivity. In these cases, the conductive elastomer was probably the cathode or the galvanic couple had a very small corrosion potential difference. Under these conditions there was very little loss of conductivity after exposure to a corrosive environment.

Design Considerations — When choosing a conductive elastomer for a particular design, especially in a potentially corrosive environment, it is important to look at shielding requirements and the type of galvanic couple that will be created. In deciding which couple best serves the design requirements two factors will have to be considered:

1. The impact of the galvanic couple on the enclosure material (Table 3).
2. The impact of the galvanic couple on the volume resistivity of the elastomer, Graphs 1–5 on page 54.

The impact of the galvanic couple on the corrosion of the enclosure material can be gauged by the metal coupon weight loss rating on Table 3 (page 55). As the color changes, the flange area on the enclosure will experience increasing amounts of corrosion.

Metal substrate factors to consider when choosing a elastomer/metal couple:

- Allowable enclosure material(s)
- Effect of weight loss/corrosion on the function of the enclosure
- Area of exposed enclosure material close to elastomer

The impact of corrosion on the shielding effectiveness of the elastomer can be gauged by the change in volume resistivity, see Graphs 1–5 on page 54. The greater the increase in volume resistivity after exposure to a corrosive environment the greater should be the drop-off in shielding effectiveness.

Elastomer factors to consider when choosing an elastomer/metal couple:

- Shielding requirements
- Change in volume resistivity of elastomer in corrosive environments
- Environmental sealing requirements
- Required compression properties

How to Use the Charts — When deciding on a conductive elastomer, it is important to examine the potential impact of galvanic corrosion. From a corrosion standpoint, the best design is an elastomer/metal flange galvanic couple that will result in the lowest corrosion rate. The charts (Table 3 and Graphs 1–5) in this section are intended to be used as a guide for choosing the least corrosive galvanic couple (other design considerations should also be taken into account when using these charts, such as restrictions on enclosure materials and environmental sealing requirements). To arrive at the best choice(s) for a particular application the impact of corrosion on both halves of the galvanic couple must be examined. One half is the weight loss on the metal substrate and the other half is the change in volume resistivity for the elastomer. The combined effect will dictate the corrosion performance of the galvanic couple/finished component.

In Table 3, pick out the appropriate row(s) based on the choice of the enclosure material(s) and then note the elastomer compound(s) that has the lowest metal coupon weight loss. Then go to the appropriate Graphs 1–5, based on the metal substrate(s) of choice, and find the change in volume resistivity for the elastomer compound(s) that you have just identified from Table 3. The elastomers that have the lowest change in volume resistivity will represent the elastomer/metal substrate combination(s) that will create the least corrosive couple. If a combination of metal substrate with a very low weight loss and elastomer with a very small change in volume resistivity is not identified, then a compromise will have to be made. In that case go through the same process but, now look at metal substrates with slightly higher weight losses and/or elastomers with slightly larger changes in volume resistivity. After a candidate is selected it is always best to test the elastomer(s) in the specific application.

Example

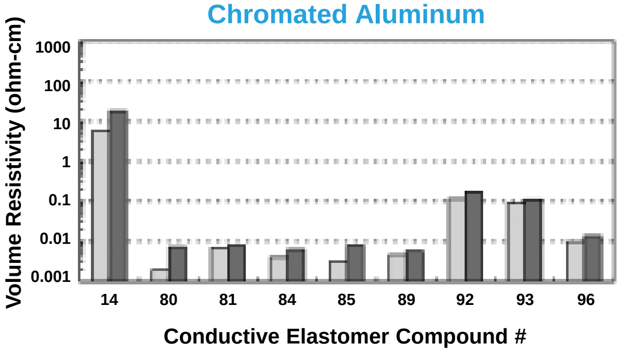
Assume the enclosure is aluminum.

1. From the aluminum row in Table 3, elastomer compounds #14, 89 and 96 will cause the lowest weight loss on the aluminum metal substrate.
2. From Graph 1 (Chromated Aluminum) compound #89 has the lowest change in volume resistivity and 96 is a close second (compound #14 has extremely large changes in volume resistivity).
3. As long as the elastomer matrix and initial attenuations are acceptable, choose either compound #89 or 96.

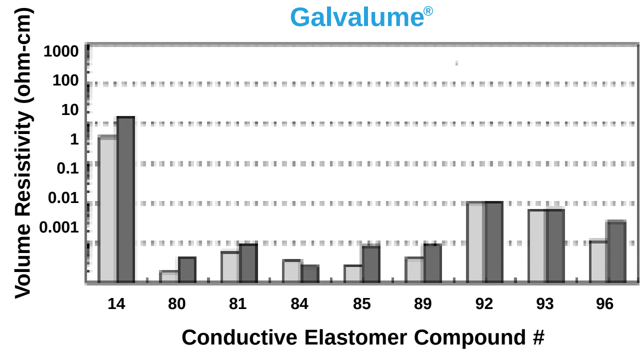
Elastomer Volume Resistivity

(Salt spray is considered a very corrosive environment and represents a worst-case scenario)

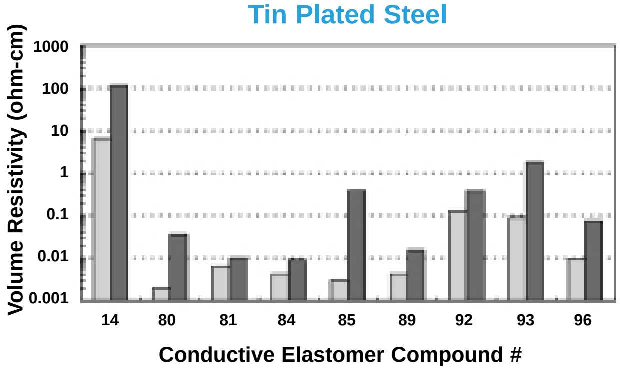
Graph 1
Chromated Aluminum



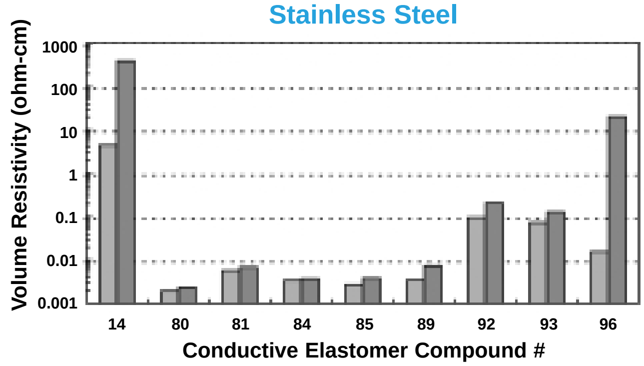
Graph 2
Galvalume®



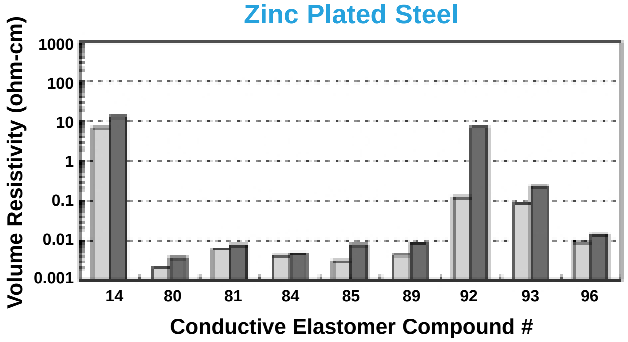
Graph 3
Tin Plated Steel



Graph 4
Stainless Steel



Graph 5
Zinc Plated Steel



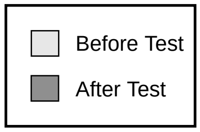
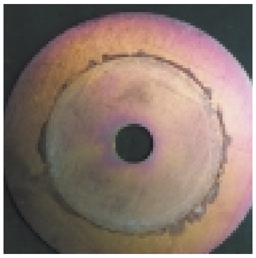


Table 3. Metal Coupon Weight Loss Rating*

	Compound Number: Elastomer and Filler Material								
Metal Substrate	14 Sil Inert Al	80 Sil Ag/Cu	81 Sil Ag/Al	84 Sil Ag/Ni	85 Sil Ag/Glass	89 Fsil Ag/Al	92 Fsil Ni/Graphite	93 Sil Ni/Graphite	96 EPDM Ag/Al
Chromated Al									
Galvalume®									
Tin Plated Steel									
Zinc Plated Steel									
Stainless Steel									



Little to no weight loss on metal coupon; less than 0.25%. Acceptable in all environments.

Moderate amount of weight loss on metal coupon; between 0.25% and 0.50%. May not be acceptable in very corrosive environments.

Substantial amount of weight loss on metal coupon; between 0.50% and 1.25%. Not acceptable in corrosive environments; for less corrosive applications consult with Laird Technologies applications engineer.

Extreme amount of weight loss on metal coupon; greater than 1.25%. Not recommended in any environments.

*This chart to be used in conjunction with Graphs 1–5 on page 54.

With over sixty years of expertise and extensive manufacturing capabilities, Laird Technologies has everything you need to solve your EMI problems — from a wide range of shielding products to design and testing services. Our product line and global presence are unrivaled in the industry. Our services, which include parametric solid modeling, nonlinear FEA and prototyping, are all delivered with the quality and attention to detail that have made us certified vendors for world-class customers. We have the latest technologies as well as the experts needed to solve your EMI problems.

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