Chomerics **is the world's largest manufacturer of EMI (electromagnetic interference) shielding materials. Our strengths are service, experience, technology, and unparalleled design capabilities.**

Since 1961, Chomerics has been the primary force in the development and application of conductive elastomer technology in extruded, molded and RTV compound forms and, more recently, Form-in-Place gasketing. Our other products include: metal EMI gasketing • spring finger gaskets • EMI cable shielding • conductive coatings and adhesives • shielding laminates and foil tapes • shielded vents and windows. We also manufacture an innovative line of thermal interface materials.

Chomerics products have been designed into thousands of applications: telecommunications systems, from cellular handsets to base stations and switch gear; information systems, from laptops to mainframes; cables and connectors; process measurement and control equipment; medical devices; military and aerospace applications... and many more.

Our comprehensive compliance and safety testing facilities provide us constant exposure to real-world problems. We meet shielding challenges head on, and respond with effective solutions.

Parker Seals

Chomerics is a division of the Seal Group of the Parker Hannifin Corporation. Parker Seal is one of the world's largest and most experienced manufacturers of elastomer and other sealing and shielding devices.

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www.chomerics.com

CHOMERICS

leader in EMI shielding technology

EMI Shielding Engineering Handbook

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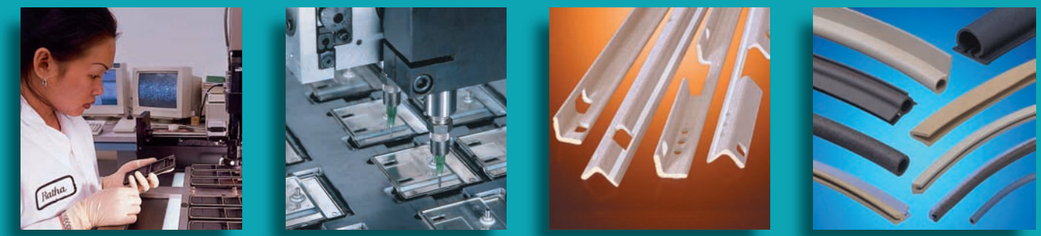

EMI Shielding Engineering Handbook

PRINTED IN U.S.A.

NOVEMBER 2000

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At Chomerics, we strive to provide our customers with the best EMI shielding products and services at the lowest cost, when and where you need them.

The company's growth and the expansion of the products and services provided to our customers are reflected in this EMI/EMC Engineering Handbook. The complete Handbook and additional collateral information may be accessed at our website, **www.chomerics.com.**

Chomerics is truly a global supplier. We now have sales and applications engineering services available in North America, South America, Europe, and Asia. Local manufacturing sites are in operation in most major markets, and more will follow.

Chomerics' growth has been driven by the wireless communications industry, not only resulting in new products and services, but also multi-level, global relationships with customers and other companies in the supply chain. Our *Contract Manufacturing* and *Supply Chain Management* services (pages 6-7) as well as the *automated EMI shielding technologies* and *high-speed conductive coating operations* detailed in the SHIELDING SOLUTIONS FOR WIRELESS APPLICATIONS section (pages 9-26), are available to all Chomerics customers.

Through design support that includes extensive use of simulations, finite element analysis, and other design tools, we continue to assist customers in choosing the right solutions for their applications. Our Applications Engineering organization is available at all times to discuss your needs.

General Ordering Information

SALES FORCE – Chomerics' Sales Offices are supplemented by Territory Sales Managers throughout North America, Europe, Asia and South America. These specialists are able to provide technical information, design assistance, pricing estimates and samples. To obtain the name of your nearest Chomeric's Sales Manager, contact our Sales Offices at the locations on the rear cover, or consult our website: **www.chomerics.com**

AUTHORIZED DISTRIBUTORS, FABRICATORS AND AGENTS – More than 100 global locations are listed on the final pages of this Handbook.

PRICES AND TERMS– Prices and terms for all products will be quoted on request. Tooling and/or set-up charges for custom parts will be specified in the quotation.

PACKAGING – At customer request, shipments are packaged using best commercial practices.

FOB ORIGIN

U.S. FEDERAL SUPPLIER CODE

FSCM 18565
Massachusetts
- *Conductive Elastomers*
- *Adhesives, Sealants, Coatings*
- *Wire Mesh Gaskets*
- *Shielded Vents and Windows*
- *Cable Shielding*
- *Applications Engineering*
- *EMC and Safety Test Services*

FSCM 8W262
New Hampshire
- *Engineered Laminates*
- *Conductive Tapes*
- *Shielded Cable Jackets*
- *Thermal Interface Materials*

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Chomerics' ***commitment to the EMI shielding industry is obvious*** **from our investment in state-of-the-art manufacturing and testing facilities, and by our deployment of sales and technical support personnel across four continents.**

The Company is headquartered in Woburn, Massachusetts along the "high technology" Route 128 belt surrounding Boston. Conductive elastomers, conductive compounds and knitted wire mesh products are manufactured within this technology center. EMC and Safety Test Services also located here include NAVLAP accredited testing facilities.

Engineered shielding laminates are produced at Chomerics' Hudson, New Hampshire plant. Located only 30 minutes from our technology center, our Laminates technical staff works closely with Woburn application and test specialists on complex EMI shielding problems.

In Europe, Chomerics is headquartered in Marlow, England (near London), with manufacturing facilities, including Cho-Form® gasket application lines, as well as applications specialists.

Far East manufacturing and sales support are provided through Parker Hannifin's Asia Pacific subsidiaries in Hong Kong, Taiwan, China, Japan, Korea and Singapore.

In South America, sales support is provided through Parker Chomerics facilities in São Paulo, Brazil.

Woburn, Massachusetts

Hudson, New Hampshire

Marlow, England

Contents

For engineering design assistance or to order any Chomerics product, call:

North America **+(1) 781-935-4850**

Europe **+(44) 1628 404000**

Asia Pacific **+(852) 2 428 8008**

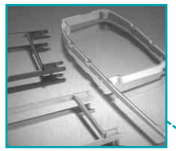
South America **+(55) 11 3917 1099**

Visit our website *www.chomerics.com*

Cost-Effective Solutions for Major Applications

Wireless Handset Shielding and Grounding

Plastic/conductive elastomer spacer gaskets, pg.14



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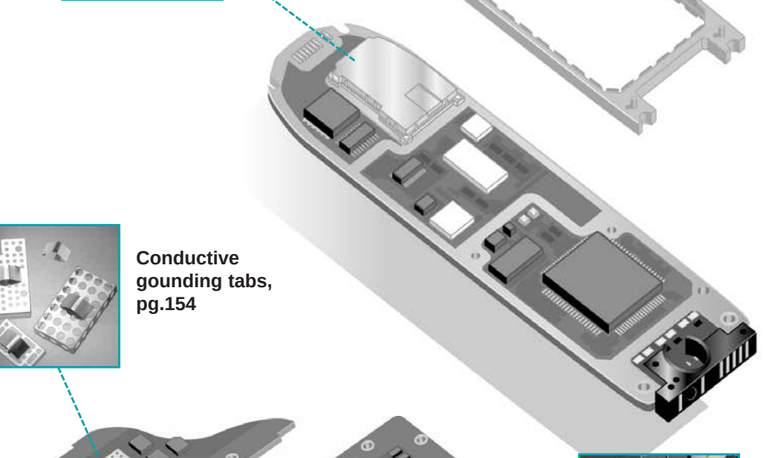

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Form-in-place conductive elastomers, pg.18

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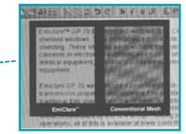
Outdoor Enclosure Shielding

BASE STATIONS



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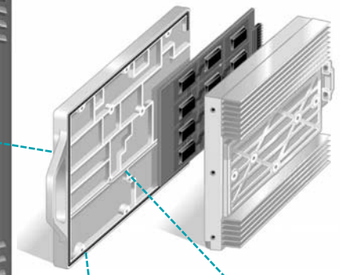

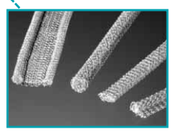

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Extruded conductive elastomers, pg.35

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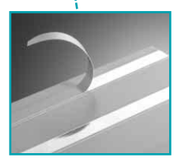

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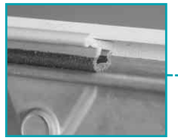

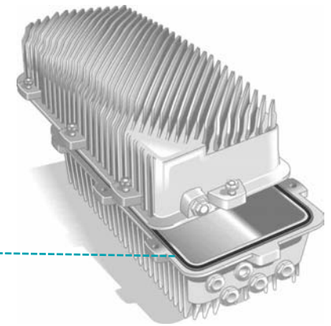

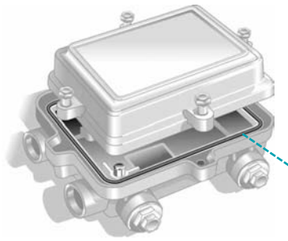

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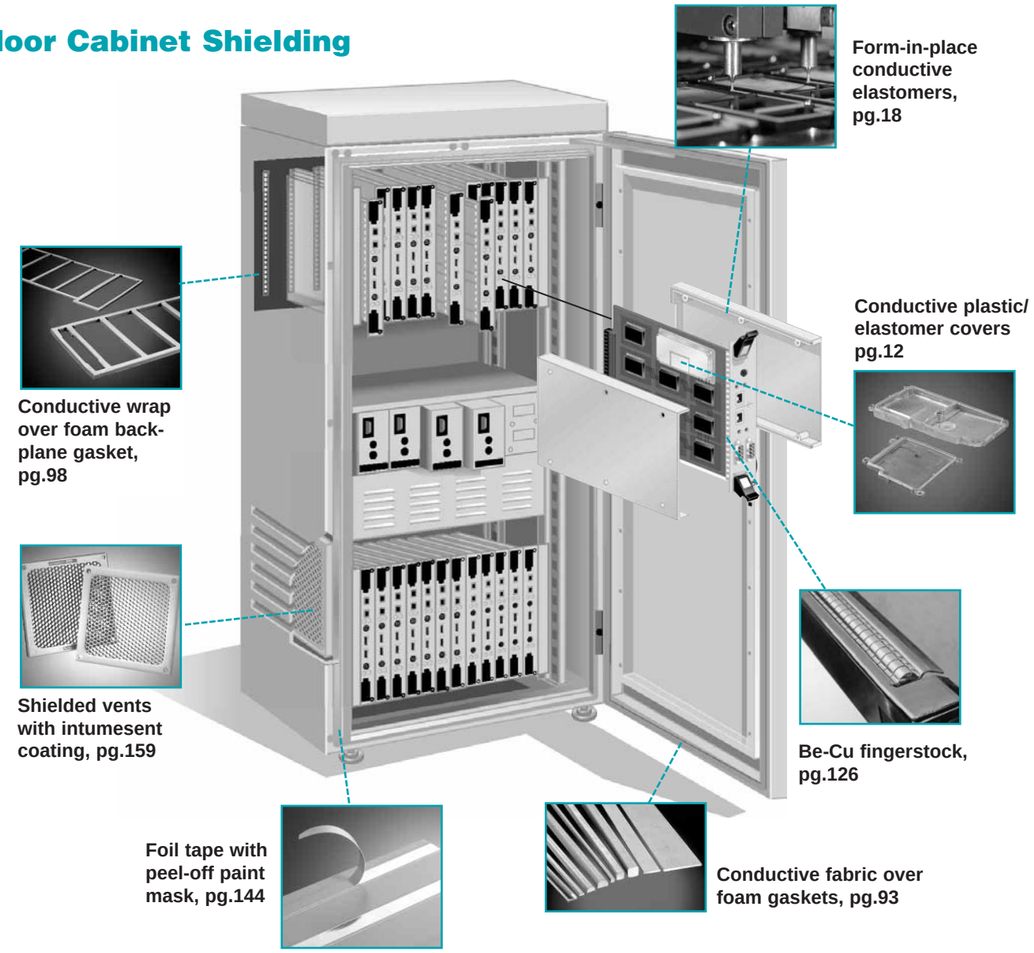
Cost-Effective Solutions for Major Applications *continued*

Indoor Cabinet Shielding



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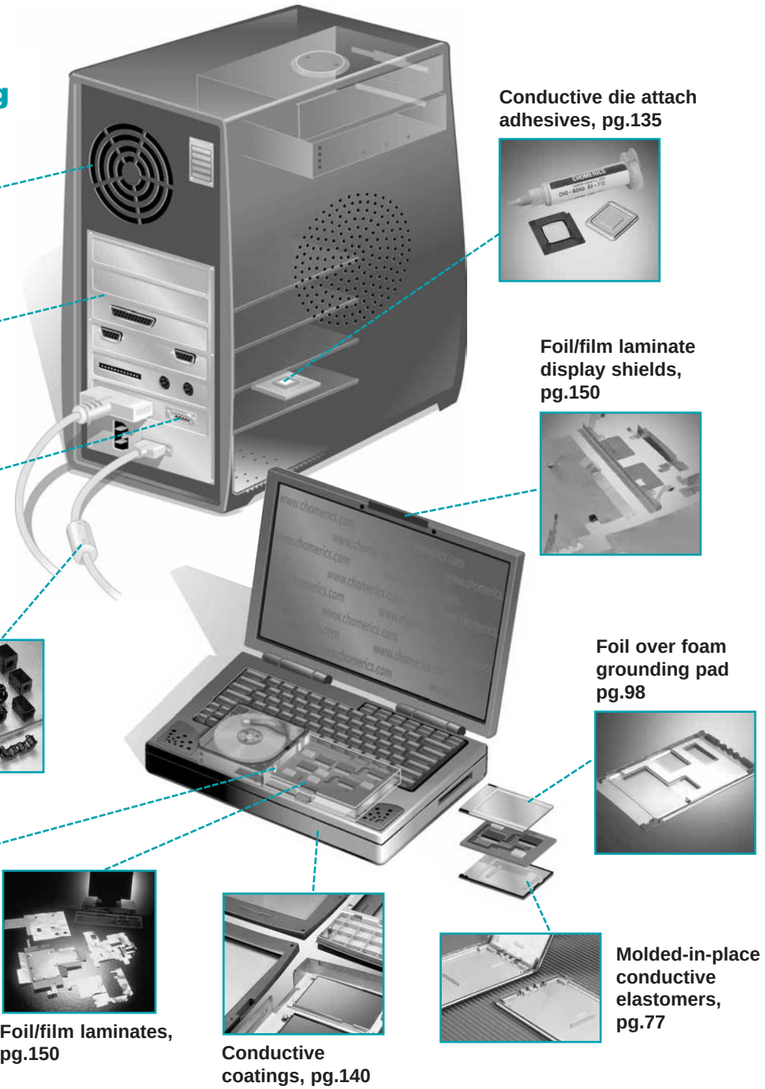

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Conductive fabric over foam grounding pads, pg.154

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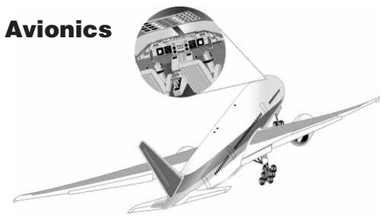
Molded-in-place conductive elastomers, pg.77

Contact Chomerics' Applications Engineering Department for assistance in selecting cost-effective solutions for EMI shielding, grounding and isolation in your application.

Avionics



Naval and Aerospace Electronics

Military Electronics

Automotive Electronics

Medical Electronics

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Contract Manufacturing and Supply Chain Management

Simplify the supply logistics and upgrade the quality of EMI shielded housings and enclosures

More than ever, high-volume electronic device and enclosure manufacturers seek to integrate production processes to the greatest extent possible. For EMI shielded housings and enclosures, choosing Chomerics as the lead vendor to manage the overall supply chain greatly streamlines production and scheduling. It also brings significant cost and quality benefits:

Production times shrink

Eliminate difficult logistics, excessive transportation costs and time lost in moving parts from a housing or enclosure manufacturer to a plating or conductive coating supplier, to an EMI gasketing operation, to a part assembler and finally to the OEM. Instead, Chomerics can handle most secondary operations at one location, trimming time and cost significantly.

Costs are kept under control

With fewer suppliers to manage, and inventory coordinated by Chomerics, fewer in-house resources are required to oversee production. Inventory expense is minimized and costly production downtime is avoided.

Designs are optimized

When Chomerics interfaces with and manages housing suppliers, common preventable design faults that hinder EMI shielding application are avoided. Part tolerances appropriate for maximum throughput are ensured.

Accountability is maximized

Excuses and fingerpointing are eliminated when Chomerics oversees the supply chain and produces complete assemblies to specifications that set performance and quality criteria. Rather than dealing with multiple sources, you negotiate delivery times, tooling cost and price with a single vendor.

International application capabilities bring these services closer

Chomerics operates manufacturing facilities in a growing number of locations around the world, providing our customers with local sales support, quality support and customer service.

Woburn, Massachusetts, USA
Hudson and Dover, New Hampshire, USA
Lancaster, New York, USA
Santa Clara, California, USA
Guadalajara, Mexico
Marlow, Bucks, United Kingdom
Madrid, Spain
Oldenburg, Germany
São Paulo, Brazil
Shanghai, China
Tianjin, China
Osaka, Japan

As production volumes warrant, Chomerics is pleased to evaluate the feasibility of establishing additonal application sites at or near our customers' manufacturing locations.

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As Lead Supplier, Chomerics...

Provides Full-Service Contract Manufacturing and Consignment Inventory

- purchases all sub-components
- performs value-added conductive coating, automated EMI gasketing, manual gasket attachment, shielding laminate, window or honeycomb installation, etc.
- completes secondary assembly operations in-house
- distributes parts to customer locations globally
- establishes consignment inventories as needed

Develops Suppliers

- evaluates and recommends suppliers for castings, injection molded plastic, and electrical components
- implements customers' quality standards up and down the supply chain
- conducts *first article* evaluations with reports
- ensures compliance with customer part approval process

Safely Manages Design Change

- coordinates engineering change orders (ECO)
- implements change in a planned process
- oversees system and supplier-wide implementation
- ensures that suppliers' processes can support change(s)
- controls introduction of change(s) into the supply chain, ensuring traceability in all parts

Facilitates Resolution of all Quality Issues

- establishes agreed-upon visual criteria, testing and inspection techniques
- ensures supplier calibration in periodic review meetings and scheduled joint conferences with all suppliers in the chain
- provides ongoing statistical process control of all suppliers and processes, shared with every member
- maintains documentation that prevents miscommunication

Manages Inventory

- uses forecasting to ensure cost-effective product phase-out without excessive final inventory
- secures just-in-time deliveries throughout the supply chain, including to our customer

Designs Specialized Packaging

- develops compartmentalized plastic or corrugated paper packaging needed to avoid scratches or other cosmetic injuries to parts

Chomerics manages the logistics of supplying high-volume, EMI shielded housings for major telecommunications clients. In one example, cast housings originate with three vendors on two continents. After plating, they converge at our manufacturing location for automated EMI gasketing and contract subassembly operations, and are then shipped to customer destinations in the US, Brazil and Mexico for end-product manufacture.

A full array of contract manufacturing capabilities includes

- *snap-on and mechanical press-fit of components*
- *affixing components with adhesives*
- *installing laminates*
- *installing ground pads*
- *insertion of threaded elements*
- *ultrasonic welding*
- *cosmetic painting*
- *labeling*

...efficiently performed at Chomerics' automated EMI gasketing locations to eliminate unnecessary part transport, handling and lost time.

Chomerics is ready to help you streamline the purchase and production of shielding housings and enclosures. Call today to explore the possibilities.

Seminars & R&D

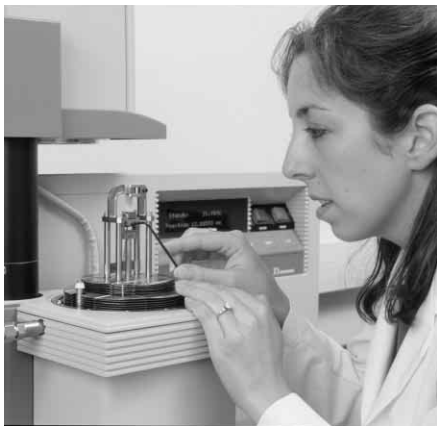
Design Services

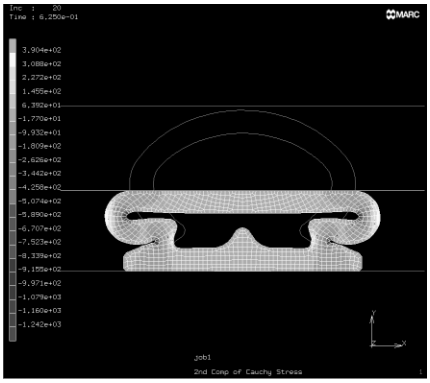
Applications Engineering

Engineers confronted by EMI problems frequently have too narrow a focus, or limited EMI experience, which can lead to ineffective EMI designs. That typically means extra cost in retrofits, "brute force" shielding, and repetitive EMI testing. Chomerics can offer you two options:
1) contact us for an EMI design consultation prior to reaching the prototype stage, or
2) contact us to arrange a technical seminar. With either choice, you will receive the help needed to avoid problems in the design stage and avoid costly retrofits and repetitive testing.

If you're in touch with Chomerics before the prototype stage, we'll optimize the housing design using CAD and modeling to achieve the most cost-effective methods of EMI suppression. Or, if your system is already in production, we'll optimize the EMI design within existing constraints. With thousands of successful applications behind us, you can be assured of meeting system EMI specifications.

Our understanding of the variables involved in most EMI shielding problems enables us to direct electronic packaging designers to the most cost-effective answer to any given set of application requirements. Our "octane" product concept allows selections to be made on the basis of both performance and cost. Pre-production samples can be produced for evaluation in prototype systems.





Finite Element Analysis (FEA)

As the premier manufacturer of sophisticated conductive elastomer seals, Chomerics offers its customers the dramatic time- and cost-saving benefits of Finite Element Analysis (FEA). This advanced computer simulation technology is employed to predict the behavior characteristics of EMI gasket designs, bypassing the development and trial-and-error testing of successive prototypes.

FEA will not only confirm that a proposed design will perform as expected, but allows the design to be optimized. Using complex FEA algorithms for elastomers, critical design information is obtained concerning:

- Deformation
- Load-deflection
- Volume, void ratios, gland fill %
- Stress distribution
- Stability
- Friction force
- Thermal effect
- Material selection
- Seal life

Chomerics' FEA capability is fully integrated into the design process for unusual or complicated EMI gasket configurations. The result is a technically superior solution achieved for our customers more rapidly and cost effectively than ever before.

For assistance, please call our Applications Engineering Department.

EMI Design Seminars

Chomerics offers four technical seminars which provide practical guidelines for solving EMI problems:

- Basic EMI/EMC Design (2, 4 or 8-hour sessions)
- EMC Compliance for Europe CE Mark
- Medical Equipment
- FCC Certification

These are not sales-oriented product exhibits, but comprehensive tutorials emphasizing practical applications rather than shielding theory.

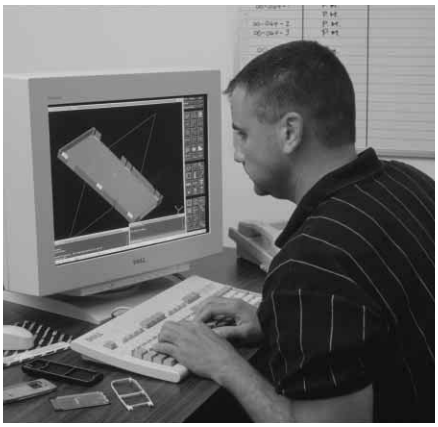
Our seminars are taught by our most experienced technical personnel and are typically presented at customer plants or local conference facilities.

To arrange a seminar, contact your nearest Chomerics Field Sales Engineer or call our Sales Department.

Research & Development

At Chomerics, the Research & Development, Applications Engineering, Manufacturing and Marketing organizations are closely aligned to anticipate and meet the needs of the electronics industry for useful, cost-effective EMI shielding and thermal management products. Chomerics invests in R&D to support our customers in solving unique problems, develop new materials, and expand our core technologies.

Our R&D staff provides not only excellent materials formulation capabilities, but also extensive analytical capabilities that enable us to determine physical, chemical and thermal properties of our materials. These include hardness, compression-deflection behavior, compression set, density, tensile and elongation strengths, thermal conductivity, chemical resistance, and flammability ratings. In addition, our on-site Test Services unit (page 222) provides licensed EMI/EMP testing of our materials.



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Shielding Solutions for Wireless Communications

Chomerics has dramatically expanded its products and services to the wireless communications industry

This section describes key products and services being delivered to wireless communications OEMs as this Handbook was being published. These products and services are steadily growing. If there is more that we could offer, contact us through your local Territory Sales Manager, Distributor Representative, via our web site, or by calling one of our offices directly.

Constructive Involvement at the Design Stage

When contacted during the design phase, Chomerics can make valuable recommendations for optimizing a housing design to achieve the most cost-effective shielding solutions. We provide interactive design assistance using such tools as finite element analysis (FEA) to speed the selection and design of the best solution for shielding, isolation or grounding.

Our expertise helps customers avoid the delays of trial and error prototyping. We also help avoid unnecessary costs that sub-optimal housing designs add in reduced application efficiencies. Chomerics engineers are experienced with such key industry standards as Bellcore GR-1089-CORE and GR-63-CORE, which concern EMC, surge standards, electrical safety and physical protection.

Reliable Supply Chain Management

Chomerics' product selection for wireless shielding is the broadest in the industry. But equally important, Chomerics will combine our materials with others in the supply chain to offer a complete solution. For example, Chomerics acts as lead supplier for shielded housings for mobile phones. We purchase plastic housings, spray them with conductive paint, apply a Cho-Form conductive form-in-place gasket, perform secondary part installation in the housing, and supply the assembly to the end customer.

At our customers' discretion, the conductive coating may be applied by another supplier. Or, the entire supply chain might be located in a Chomerics facility or that of one of our Alliance Partners.

Chomerics manages supply chains, whether they involve a single facility or suppliers around the world. We enjoy close relationships with molded plastic and die-cast metal housing suppliers, as well as plating and conductive paint operations. Parts are delivered to OEM customers, contract manufacturers, or local service centers according to customer preference. Refer to page 6 for additional information on our supply chain management services.

International Application Capabilities

Chomerics operates manufacturing facilities in a growing number of locations around the world, providing our customers with local sales support, quality support and customer service.

Woburn, Massachusetts, USA
Hudson and Dover, New Hampshire, USA
Lancaster, New York, USA*
Santa Clara, California, USA*
Guadalajara, Mexico
Marlow, Bucks, United Kingdom
Madrid, Spain
Oldenburg, Germany
São Paulo, Brazil
Shanghai, China
Tianjin, China
Osaka, Japan*

*Application Partner

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CHO-SHIELD® EMI Shielding Covers

CHO-SHIELD EMI Shielding Covers

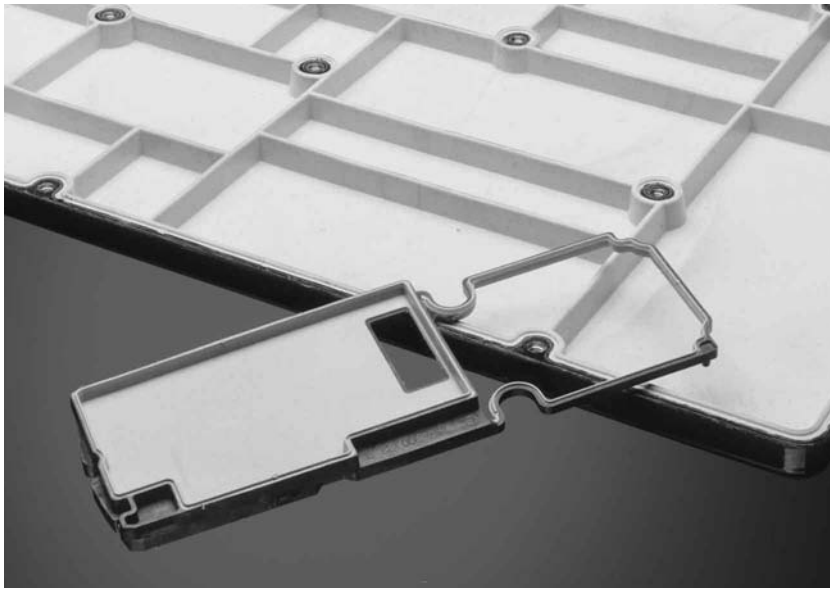
CHO-SHIELD covers are a unique, labor-saving solution for providing EMI shielding and gasketing, as well as circuit-to-circuit cross talk isolation, within electronic enclosures. The CHO-SHIELD cover features custom designed, glass fiber-reinforced polyester plastic, with an integrally molded conductive elastomer as the EMI shield. The elastomer is molded onto both the inside surface of the cover and its side walls, to provide an integral EMI shield. The elastomer can also be molded to form interior walls that provide electromagnetically isolated (shielded) compartments between potentially interfering circuitry.

CHO-SHIELD shielding covers eliminate the need for conductive paints, coatings or platings on plastic covers. They also replace the labor-intensive installation of EMI gaskets to prevent EMI leakage at seams and achieve circuit-to-circuit isolation. They are lightweight, easily installed, and reusable. Metallic inserts can be incorporated to allow easy installation with screws.

The standard conductive elastomer used is Chomerics' popular CHO-SEAL 1310 silver-plated-glass filled silicone elastomer. This material provides >60 dB shielding effectiveness from 200 MHz to 10 GHz. Other conductive elastomers, including CHO-SEAL 1273 and CHO-SEAL S6304, are available for higher shielding values or other properties. Typical elastomer thickness on the face of the plastic cover is 0.020 inch (0.5 mm). Thickness at the distal edges of internal cover walls and ribs is typically 0.070 to 0.125 inch (1.78 to 3.18 mm), providing a resilient, low impedance seal against enclosure walls and flanges.

Ordering Procedure

Fax, e-mail or send a drawing of the enclosure configuration to our Applications Engineering Department, along with your request for a quotation.



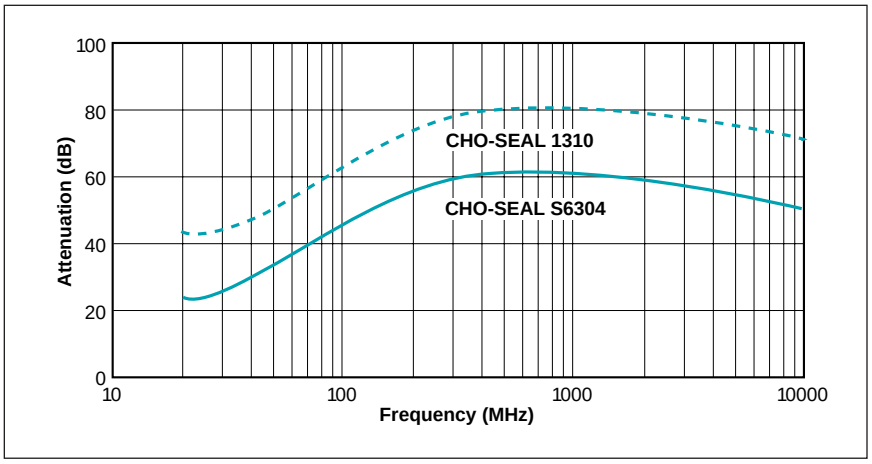


Figure 1 Shielding Effectiveness
CHO-SHIELD Cover with CHO-SEAL 1310 and CHO-SEAL S6304 Conductive Elastomers

Table 1

GLASS FIBER-REINFORCED POLYESTER COVER	
	Typical Value
Specific Gravity	1.89
Flexural Strength, psi	16,000 - 20,000
Compressive Strength, psi	24,000 - 28,000
Tensile Strength, psi	6,000 - 8,000
Impact Strength, notched izod, ft-lb./in.	2.0 - 4.0
Hardness, Barcol	40 - 50
Heat Distortion Temp. 264 psi, °F	500
Flame Resistance 1/16 inch	UL 94V-0

CHO-VER SHIELD™ Covers

CHO-VER SHIELD
EMI Shielding Covers with Over-Molded Conductive Elastomer Gasket

CHO-VER SHIELD EMI shielding covers combine a slim-profile metal or metallized plastic substrate with a low-closure force conductive elastomer gasket over-molded directly onto the substrate. These custom configurations provide economical, easily-installed EMI shielding in cellular handsets, PCs and other high-volume production packages where minimal closure force is available.

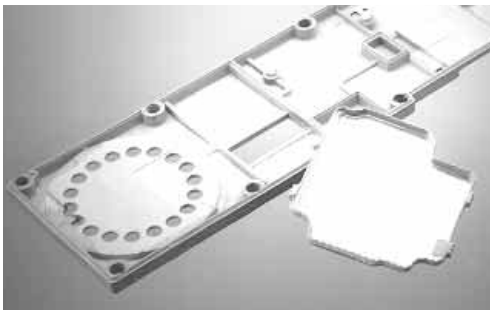
The capability to over-mold a conductive elastomer onto small flanges for consistent, high-quality, high-volume production parts is the result of technology advances pioneered by Chomerics. This capability includes simultaneous molding of the EMI gasket onto opposite sides of the cover.

The over-molded shielding gasket is CHO-SEAL® 1310, a silver-plated-glass filled conductive elastomer, typical properties for which are provided in Table 1, on page 13.

Ideal for High Volume Applications

The CHO-VER SHIELD technology is already providing a highly cost-effective shielding solution in such large-scale production applications as mobile handsets and handheld wireless devices, as well as mobile site equipment, microwave equipment and antennas.

CHO-VER SHIELD covers can be used to shield selected areas of printed circuit boards, eliminating the need to add conductive plating to exterior housing parts of electronic devices. Moreover, CHO-VER SHIELD covers provide an alternative to using solder-mounted metal cans as an EMI shield over components, with the added benefit of easy removal for PCB access during assembly or after testing.



Pins, holes and other locating features are routinely designed into CHO-VER SHIELD EMI covers for fast and precise installation. Both plastic and metal covers can be compartmentalized for shielding internal cross-talk.

Finite element analysis (FEA) is used for the efficient design of gasket cross sections that meet low closure force requirements (see discussion which follows). Interrupted bead gasket designs can lower closure force requirements further, while maintaining the required level of EMI shielding.

Choice of Plastic or Metal

CHO-VER SHIELD covers feature a choice of thermoplastic substrates shown in Table 2, with nickel-copper plating on interior surfaces. Metal CHO-VER SHIELD covers are ordinarily stamped from aluminum, magnesium or stainless steel sheets, as shown in Table 3.

Finite Element Analysis

Chomerics, a division of Parker Hannifin Corporation's Seal Group, is the headquarters of Parker Seal's Elastomer Simulation Group. This unit specializes in elastomer finite element analysis (FEA), using the MARC K6 Series software as a foundation for FEA capability.

Benefits of FEA include:

- Optimizing elastomer gasket designs
- Allowing accurate predictions of alternate design concepts
- Eliminating extensive trial and error prototype evaluation.

Figures 1a & b A typical use of FEA in designing molded gaskets is the evaluation of force and deflection needs for proposed designs. The FEA shown in Figure 1a below predicts the gasket's deflection characteristics and compression requirements. Results are plotted in 1b.

Figure 1a FEA Example of a CHO-VER SHIELD Custom Gasket Profile

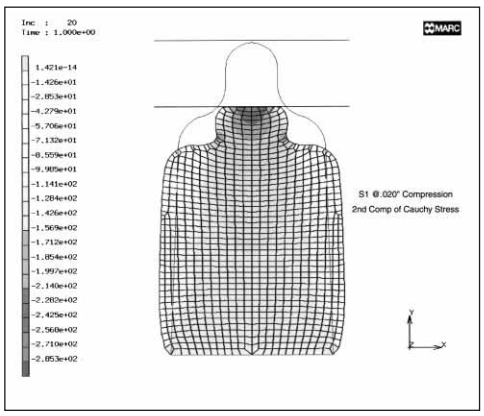


Figure 1b Compression-Deflection Curve Predicted by FEA

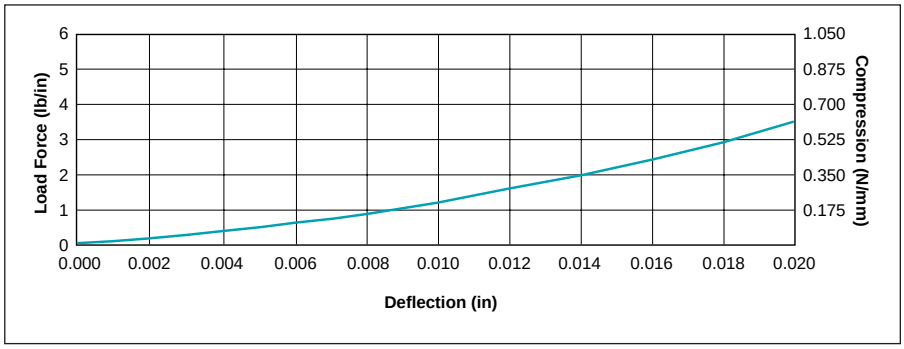


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Table 1

CHO-VER SHIELD COVERS ELASTOMER SPECIFICATIONS		
Property	**Test Procedure**	**CHO-SEAL 1310**
Elastomer Binder	—	Silicone
Conductive Filler	—	Ag/Glass
Volume Resistivity (ohm-cm), max	CEPS-0002*	0.01
Hardness (Shore A)	ASTM 2240	70 ±10
Specific Gravity	ASTM D792	1.8 ±0.25
Tensile Strength, psi, min. (MPa, min)	ASTM D412	200 (1.38)
Elongation, %, min.	ASTM D412	100
Compression Set, 70 hrs. @ 100°C. %, max.	ASTM D395 Method B	35
Shielding Effectiveness 100 MHz (E-Field) 500 MHz (E-Field) 2 GHz (Plane Wave) 10 GHz (Plane Wave)	CHO-TM-TP08*	 100 100 90 80
Volume Resistivity After Heat Aging, ohm-cm, max.	CEPS-0002*	0.01

*Copies of CHO-TM-TP08 (Shielding Effectiveness Test Method for EMI Gaskets) and CEPS-0002 are available from Chomerics

Table 2

TYPICAL PROPERTIES OF THERMOPLASTIC COVERS (without plating)				
Property	**Test Procedure**	**Vectra A130 LCP[1]**	**IXEF 1032 PAA[2]**	**ULTEM 1000 PEI[3]**
Tensile Strength, yield, Type 1, 0.125 inch (3.2 mm), psi (MPa)	ASTM D638	30,000 (207)	40,600 (280)	20,100 (139)
Tensile Elongation, break, Type 1, 0.125 inch (3.2 mm), %	ASTM D638	2.2	1.8	3.0
Flexural Strength, break, 0.125 inch (3.2 mm), psi (MPa)	ASTM D790	37,000 (254)	58,000 (400)	30,000 (207)
Flexural Modulus, 0.125 inch (3.2 mm), psi (MPa)	ASTM D790	2,100,000 (15,000)	3,050,000 (21,000)	900,000 (6,200)
Compression Strength, psi (MPa)	ASTM D695	20,000 (140)	NA	28,700 (198)
Compression Modulus, psi (MPa)	ASTM D695	1,700,000 (12,000)	NA	809,000 (5,575)
Izod Impact, notched, 73°F (23°C), ft-lb/in (J/m)	ASTM D256	2.8 (150)	2.25 (120)	1.6 (85)
HDT, 66 psi (0.45 MPa), 0.250 in., (6.4 mm), unannealed, °F (°C)	ASTM D648	489 (254)	446 (230)	410 (210)
Specific Gravity	ASTM D792	1.61	1.77	1.42
Volume Resistivity, ohm-cm	ASTM D257	10×10^{15}	2.0×10^{15}	70×10^{15}
UL 94V-0 Flame Class Rating, inch (mm)	UL 94	0.018 (0.45)	HB Rated	0.016 (0.40)
Limiting Oxygen Index (LOI), %	ASTM 2863	37	25	50

[1] Celanese AG
[2] Solvay SA
[3] General Electric Co. Note: ULTEM 1000 is used for low quantity prototyping only

Table 3

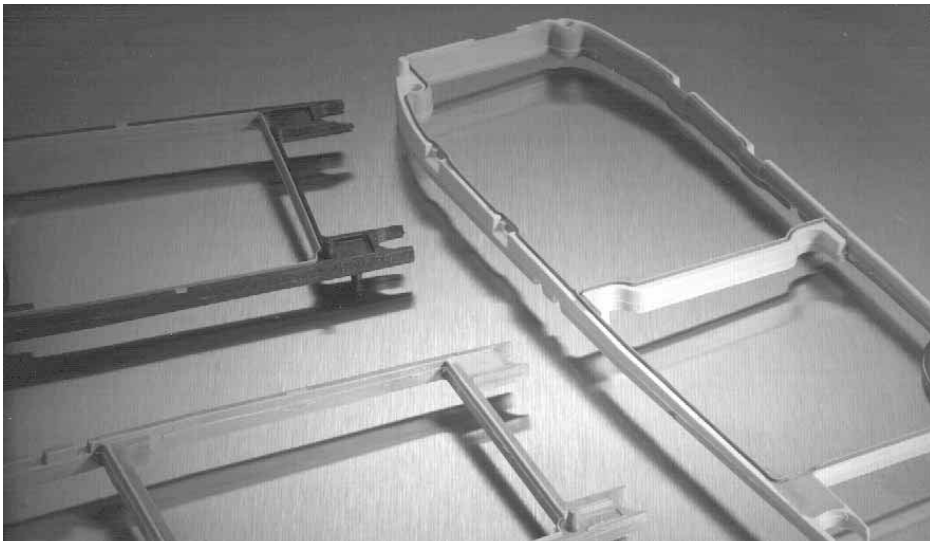
TYPICAL PROPERTIES OF METAL SUBSTRATES				
Property	**Test Procedure**	**Aluminum Die Casting**	**Thixo-Molded Magnesium**	**Stainless Steel**
Alloy Number		A380.0	AZ91D-F	316L
Tensile Strength, yield, psi (MPa)	0.2% offset	23,055 (159)	21,750 (150)	42,800 (295)
Elongation, %, break	in 50 mm	3.5	3	46
Modulus of Elasticity, ksi (GPa)	in tension	10,295 (71)	6,496 (44.8)	29,000 (200)
Fatigue Strength, psi (MPa)	R.R. Moore Test, 5E+8 cycles	20,010 (138)	14,065 (97)	NA
Shear Modulus, ksi (GPa)	—	3,843 (26.5)	2,465 (17)	NA
Electrical Resistivity, ohm-cm	—	0.0000064	0.000017	0.000000074
Density (g/cc)	—	2.76	1.81	NA

NA = Not Applicable Contact Chomerics regarding alternative metal substrates

Contact Chomerics' Applications Engineering to evaluate CHO-VER SHIELD Covers in your application.

EMI Shielding/Grounding Spacer Gaskets

The integrated *conductive elastomer/plastic spacer gasket* is a low cost, easily installed system for providing EMI shielding and grounding in small electronic enclosures.



EMI Spacer Gaskets

The unique design of Chomerics' EMI spacer gaskets features a thin plastic retainer frame onto which a conductive elastomer is molded. The elastomer can be located inside or outside the retainer frame, as well as on its top and bottom surface. EMI spacer gaskets provide a new approach to designing EMI gaskets into handheld electronics such as digital cellular phones. Board-to-board spacing is custom designed to fit broad application needs. Customized cross sections and spacer shapes allow for very low closure force requirements and a perfect fit in any design or device.

Robotic Installation

Spacer gaskets can be installed quickly by robotic application. Integral locater pins in the plastic spacer help ensure accurate positioning in both manual and pick-and-place assembly. Benefits include faster assembly and lower labor costs.

CHO-SEAL® 1310 or 1273 Conductive Elastomers

With EMI spacer gaskets, shielding and grounding are provided by Chomerics' CHO-SEAL 1310 and 1273 conductive elastomers, specifically formulated for custom shape molded parts. They provide excellent shielding and isolation against electromagnetic interference (EMI), or act as a low impedance ground path between PCB traces and shielding media. Physically tough, these elastomers minimize the risk of gasket damage, in contrast to thin-walled extrusions or unsupported molded gaskets.

Silicone-based CHO-SEAL 1310 and 1273 materials offer excellent resistance to compression set over a wide temperature range, resulting in years of continuous service. CHO-SEAL 1310 material is filled with silver-plated-glass particles, while 1273 utilizes silver-plated-copper filler to provide higher levels of EMI shielding effectiveness.

Superior elongation and tensile strength help to prevent tearing in use due to mishandling. Typical properties for CHO-SEAL 1310 and 1273 material are shown on pages 33 and 32 respectively.

High Shielding Performance

CHO-SEAL 1310 material provides more than 80 dB of shielding effectivness from 100 MHz to 10 GHz, while CHO-SEAL 1273 material provides more than 100 dB.

Low Volume Resistivity

Both materials have exceptionally low volume resistivity, which makes them well suited for grounding applications in which a flexible electrical contact is needed.

Low Compression Gasket

Spacer gaskets are typically designed to function under low deflection forces. Chomerics uses design tools such as Finite Element Analysis (FEA) to accurately predict compression-deflection behavior of various cross section options. Refer to page16.

LCP Plastic Spacer

Liquid crystal polymer (LCP) spacers, including those made with Vectra A130 material, provide a

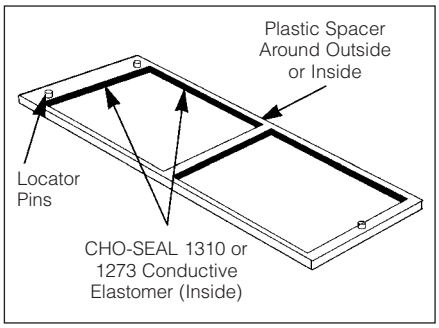


Figure 1 Single Piece EMI Gasket/ Plastic Spacer for Accurate and Low Cost Installation

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stable platform for direct, high precision molding of conductive elastomers. The Vectra A130 material described in Table 1 has excellent heat deflection temperature characteristics (489°F, 254°C). For weight considerations, the LCP has a specific gravity of only 1.61. This plastic is also 100% recyclable.

Typical EMI Spacer Gasket Design Parameters

The EMI spacer gasket concept can be considered using the design parameters shown in Table 2. Some typical spacer gasket profiles are shown below.

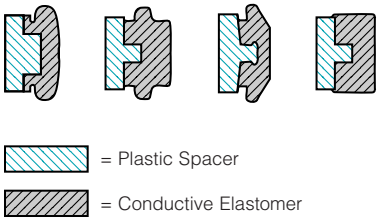

Figure 2 Typical Spacer Gasket Profiles

Applications for EMI Spacer Gaskets

The spacer gasket concept is especially suited to digital and dual board telephone handsets or other handheld electronic devices. It provides a low impedance path between peripheral ground traces on printed circuit boards and components such as:

- the conductive coating on a plastic housing
- another printed circuit board
- the keypad assembly

Typical applications for EMI spacer gaskets include:

- Digital cellular, handyphone and personal communications services (PCS) handsets
- PCMCIA cards
- Global Positioning Systems (GPS)
- Radio receivers
- Other handheld electronics, e.g., personal digital assistants (PDAs)
- Replacements for metal EMI shielding "fences" on printed circuit boards in wireless telecommunications devices

AN EMI SPACER GASKET APPLICATION CASE STUDY

Design Problem

A manufacturer of cellular telephone handsets needed to provide a low impedance connection from the underside of a keyboard assembly to the ground trace on a circuit board.

Design Requirements

- Provide 360° low impedance connection from conductive coating to circuit board ground trace
- Low deflection forces available
- Low cost solution needed
- Sufficient EMI shielding of the handset needed to operate properly and meet commercial EMC regulations

Chomerics Solution

Three possible solutions were considered:

1. A small cross section conductive elastomer with conductive pressure-sensitive adhesive
2. A conductive, form-in-place elastomer
3. *An EMI spacer gasket system was chosen*, based on its ability to meet all of the manufacturer's design requirements. It consisted of a Vectra LCP plastic spacer with Chomerics' CHO-SEAL 1310 silver-plated-glass filled silicone elastomer injection molded onto the inside walls of the plastic frame.

Table 1

LCP PLASTIC SPACER TYPICAL PROPERTIES		
Property	**Test Procedure**	**Vectra A130 LCP[1]**
Tensile Strength, yield, Type 1, 0.125 inch (3.2 mm), psi (MPa)	ASTM D638	30,000 (207)
Tensile Elongation, break, Type 1, 0.125 inch (3.2 mm), %	ASTM D638	2.2
Flexural Strength, break, 0.125 inch (3.2 mm), psi (MPa)	ASTM D790	37,000 (254)
Flexural Modulus, 0.125 inch (3.2 mm), psi (MPa)	ASTM D790	2,100,000 (15,000)
Compression Strength, psi (MPa)	ASTM D695	20,000 (140)
Compression Modulus, psi (MPa)	ASTM D695	1,700,000 (12,000)
Izod Impact, notched, 73°F (23°C), ft-lb/in (J/m)	ASTM D256	2.8 (150)
HDT, 66 psi (0.45 MPa), 0.250 in., (6.4 mm), unannealed, °F (°C)	ASTM D648	489 (254)
Specific Gravity	ASTM D792	1.61
Volume Resistivity, ohm-cm	ASTM D257	10×10^{15}
UL 94V-0 Flame Class Rating, inch (mm)	UL 94	0.018 (0.45)
Limiting Oxygen Index (LOI), %	ASTM 2863	37

[1] Celanese AG

Table 2

DESIGN PARAMETERS	
Maximum overall dimension	18 inch x 18 inch (45.7 cm x 45.7 cm)
Minimum cross section	0.050 inch (1.27 mm)
Minimum plastic cross section	0.020 inch (0.51 mm)
Minimum elastomer cross section	0.015 inch (0.38 mm)
Minimum plastic cross-sectional area	0.001 inch^2 (0.025 mm^2)
Minimum elastomer cross-sectional area	0.0020 inch^2 (0.051 mm^2)
Cross section tolerance (typical)	±0.003 inch (0.076 mm)
Plan view tolerance (typical)	±0.005 inch (0.127 mm)

continued

Finite Element Analysis

Chomerics, a division of the Parker Hannifin Corporation's Seal Group, is the headquarters of Parker Seal's Elastomer Simulation Group. This unit specializes in elastomer finite element analysis (FEA) using MARC K6 series software as a foundation for FEA capability.

Benefits of FEA include:

- Quickly optimizing elastomer gasket designs
- Allowing accurate predictions of alternate elastomer design concepts
- Eliminating extensive trial and error prototype evaluation

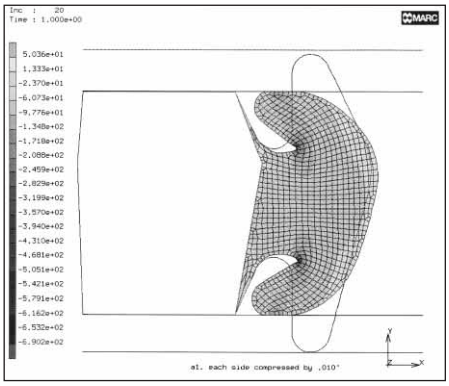

Figure 3 FEA Example of an EMI Spacer Gasket Cross Section

Typical use of FEA in EMI spacer gasket designs is to evaluate the force vs. deflection requirements of alternate designs. For example, one spacer design features a continuous bead of conductive elastomer molded onto a plastic spacer. An alternative design employs an "interrupted bead," where the interruptions (gaps left on the plastic frame) are sized to maintain the required level of EMI shielding. Figure 4 illustrates these alternative designs.

Gasket Deflection

Figure 5 compares the effect of continuous and interrupted elastomer gasket designs in terms of the force required to deflect the conductive elastomer. This actual cellular handset application required a spacer gasket with interrupted bead to meet desired deflection forces.

Chomerics Design and Application Services

Chomerics will custom design a spacer for your application. Advice, analysis and design assistance will be provided by Chomerics Applications and Design engineers at no additional fee. Contact Chomerics directly at the locations listed at the bottom of the page.

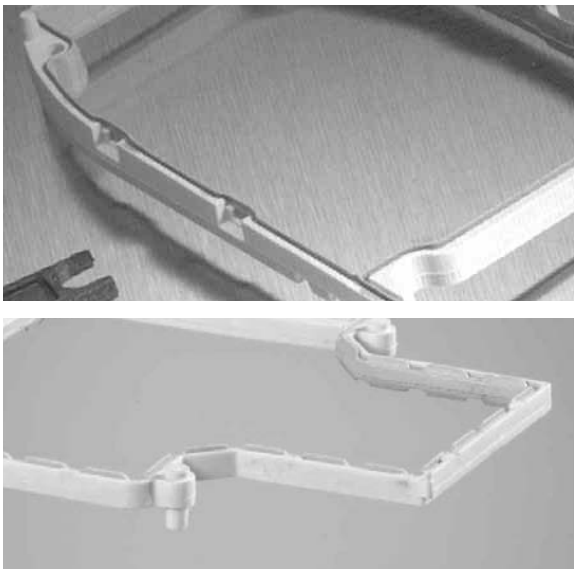

Figure 4 Continuous *(top)* and Interrupted Elastomer Gaskets

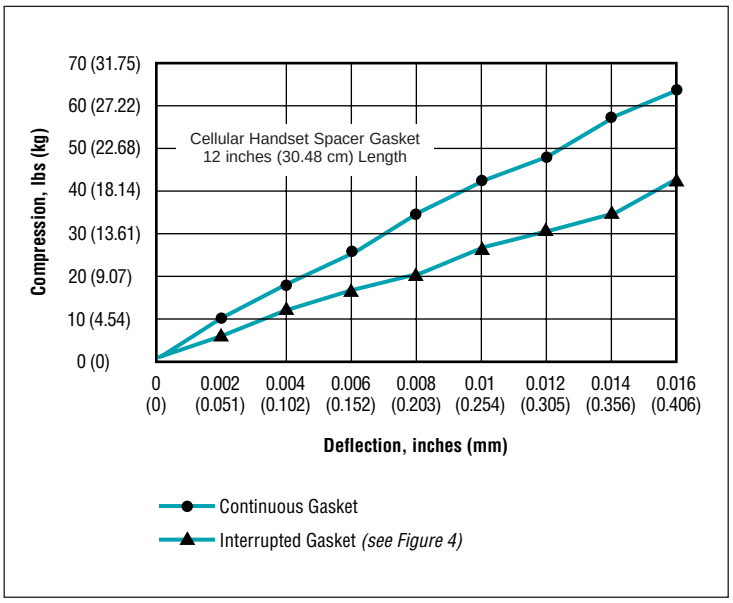

Figure 5 Typical Spacer Gasket Deflection

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Conductive Coating Spray Operations

Fully Automated Conductive Coating of Plastic Housings

Chomerics operates full-service facilities for the application of conductive coatings to our customers' plastic housings. Available as a stand-alone service, this operation is fully integrated with our Cho-Form® automated gasket dispensing operations. As a result, it provides a major logistical advantage that saves time and cost by minimizing part handling and eliminating unnecessary shipments.

High-Speed, 6-Axis Robotic Spray System

Our fully-automated robotic spray technology applies Chomerics' performance proven conductive paints, or customer-supplied coatings, to PC, ABS, Noryl, PVC and PPO substrates. Set up as a continual process, the system delivers completed parts within one hour of the cycle start. Process repeatability is extremely high, with uniform coating to C_{pk} values of 1.3 or greater.

Multi-cavity capacity provides high part density, for production throughput unique to the conductive coating industry. To illustrate the speed and economics of our paint spray operation, for a part approximately 2 x 5 inches (51 x 127 mm) in size, a typical application line can produce over 6 million parts per year.

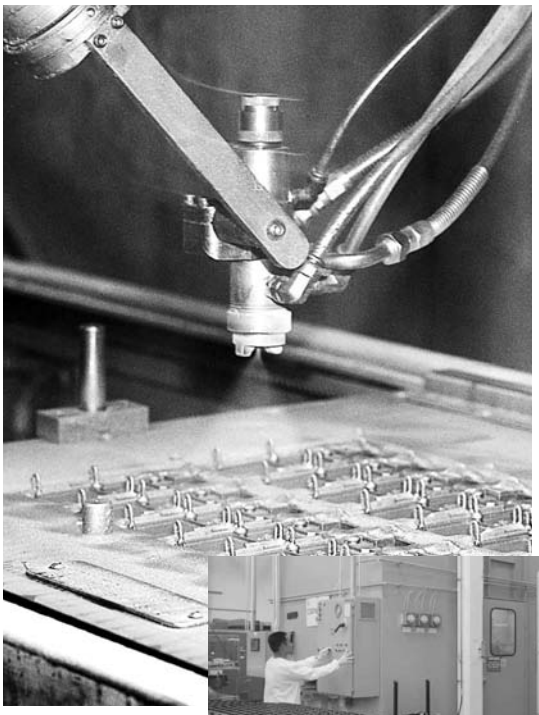
Advanced Coatings

The CHO-SHIELD® conductive coatings used in our spray operations are chosen for their compatibility with Cho-Form gasketing materials and their excellent adhesion to a variety of substrates found in commercial applications. Among the coatings routinely used are CHO-SHIELD 2052, 2054, 2056, and 610. (Refer to the Conductive Compounds section of this catalog for more information).

Clean Separations, Ultra-Thin Paint Layers

Our proprietary mask design produces exceptionally clean paint edges. The result is a conductive coating layer that is both functionally and cosmetically optimized.

The spray technology is sufficiently reliable to hold as little as 0.0008 inch (0.02 mm) thickness for CHO-SHIELD 2056 coating, on up to 0.0015 inch (0.038 mm) for CHO-SHIELD 2052 and other materials, for shielding effectiveness >75 dB. In addition to freeing valuable design space in the device, the extremely thin CHO-SHIELD 2056 layer is cost-effective in achieving desired shielding levels with minimal overspray losses and increased production throughput.



Our 6-axis spray technology holds paint thickness to an ultra-thin 0.0008 inch (0.02 mm), for minimal overspray losses and waste.

Continuous processing with multi-cavity trays delivers completed parts within 1 hour of cycle start, and very high yields

Optimizing the Paint Mask

Through experience, Chomerics has identified several design considerations that produce superior results for conductive coating operations. In particular, mask cut-off features should incorporate bends that optimize spray accuracy by reducing or eliminating overspray transition zones.

Our Applications Engineering department provides valuable mask design assistance that improves efficiency and elevates yields.

Choose stand-alone paint application, or subsequent EMI shielding plus contract manufacturing

When metallizing plastic housings is sufficient for EMI shielding purposes, Chomerics provides these painting operations as a stand-alone service. In other cases, Chomerics manages the entire supply chain from housing acquisition, through conductive coating, EMI gasket application, and secondary assembly steps to produce completed shielded housing assemblies.

Our robotically dispensed Cho-Form gasketing technology is described on the following pages. Supply chain management and contract manufacturing are discussed on page 6.

Chomerics' conductive coating operations include facilities in Woburn, Massachusetts, Guadalajara, Mexico, and São Paulo, Brazil, with additional locations in process.

Cho-Form® Robotically Dispensed Form-in-Place EMI Gasketing

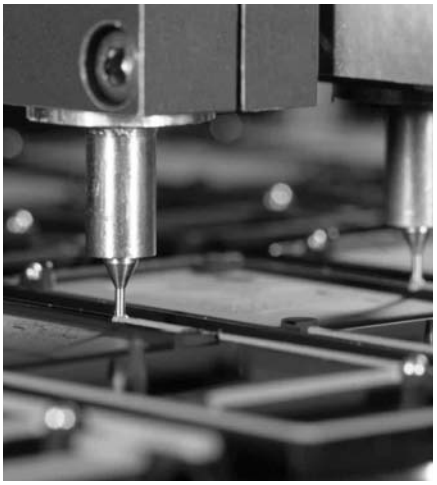
Chomerics' Cho-Form Automated EMI Gasketing System *was developed to meet the growing demand for high-speed, high volume application of conductive elastomer seals to metal or plastic housings. It is ideal for cellular hand-sets, PC cards, compartmentalized enclosures and other tightly packaged commercial electronic devices.*

Cho-Form technology allows dispensing of precisely positioned, conformable gaskets in very small cross sections that free valuable package space. The durable, highly conductive seals have low compression set, ensuring years of effective EMI shielding and mechanical performance.

With gasket dispensing primarily software driven, Cho-Form technology permits rapid prototyping, changes in design, and production scale-up at nominal cost. Its inherent flexibility accommodates batch runs or continuous production, from ten to ten million parts.

Wide acceptance of the Cho-Form automated gasket dispensing system can be attributed to a successful blend of manufacturing and materials expertise. Among its important design and performance benefits are:

- up to 60% space saved — flanges as narrow as 0.020 inch (0.50 mm) can be gasketed
- more than 75 dB shielding effectiveness from 200 MHz to 10 GHz with very small gasket beads
- accuracy for gasket location within 0.001 inch (0.025 mm)
- more than 12 Newtons/cm^2 shear adhesion to common housing substrates and coatings
- highly compressible gaskets, ideal with limited deflection force
- speed — gasketed parts typically prototyped and shipped within several days



Outstanding Production Efficiencies

Cho-Form technology dispenses EMI gasketing at ever-increasing rates in line with our commitment to reduce costs. Our continuous improvement program has enabled us to increase the dispense rate eight-fold in three years, and we pursue additional improvements. The commitment to reducing costs extends to all aspects of the dispensing operation, with the goal of offering superior quality at constantly lower prices.

Excellent Shielding Effectiveness, Even in Small Cross Sections

Shielding effectiveness of Cho-Form gaskets exceeds 85 dB between 200 MHz and 10 GHz. Shielding performance increases with cross sectional dimensions. Results shown for various Cho-Form materials were obtained using very small gaskets, 0.034 inch high by 0.040 inch wide (0.86 mm high by 1.0 mm wide)

Denser Packaging is Possible

Cho-Form gaskets can be applied to walls or flanges as narrow as 0.020 inch (0.50 mm), and don't require mechanical retention. Compared with groove and friction-fit designs, the positional accuracy and self-adhesive properties of Cho-Form

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gaskets will typically save 60% or more space. This frees additional board space, or allows for smaller overall package dimensions.

Small Cross Sections, Complex Geometries

Virtually any gasket bead path can be programmed using Cho-Form application technology. In addition to simple straight lengths, the system applies continuous 360° perimeter gaskets in combination with any required number of internal subpaths that form "T" joints with the perimeter seal. The system produces reliable junctions between bead paths that provide continuous EMI shielding and environmental sealing.

Low Closure Force Not a Problem

Cho-Form gasket materials are ideal for low deflection force designs, or those whose mating surfaces have low mechanical rigidity. Deflection below 10% or above 50% is not recommended. Nominal deflection of 30% and a mechanical compression stop are recommended. An example of typical compression-deflection data for Cho-Form materials appears in Figure 1.

Our exclusive, patented WaveForm™ bead configuration can reduce closure force requirements of the base material by 20 to 40%. Refer to page 21 for more information.

Secure Gasket Adhesion

Cho-Form gaskets exhibit >8-12 N/cm^2 of shear adhesion to a variety of common housing substrates, including

- cast aluminum, magnesium or zinc alloys with various platings*
- nickel-copper plating on plastics
- stainless steel (300 series)
- CHO-SHIELD® 2052, 2054, 2056 or 610 conductive coatings
- vacuum metallized aluminum

* CrO_4, black chrome, black nickel, bright nickel, tin

Gasket Application Fully Programmable in 3 Axes

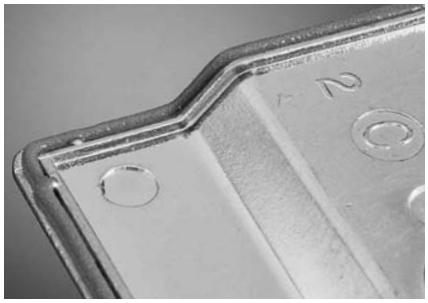
Full 3-axis motion of the Cho-Form application technology accommodates uneven surfaces (with a maximum slope of 80°) common in castings or injection-molded parts. The result is enhanced control of the gasket cross section.

Tight Dimensional Control and "Tail-less" Terminations

Cho-Form gasket beads are dispensed with an accuracy of 0.001 inch (0.025 mm), and a cross-sectional height tolerance of 0.004 inch (0.10 mm).

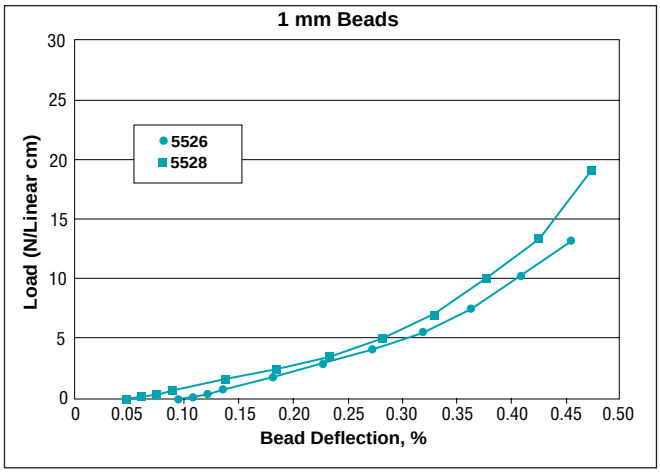
This innovative, proprietary technology produces clean bead ends without the "tail" characteristic of other processes. The key is precise management of the flow rate of material through the nozzle, material viscosity and dispensing speed.

Note: Gasket cross section and tolerances will vary slightly at the site of "start" or "stop" events in the dispense cycle (see page 23).



Gasket application to sloped surfaces is fully programmable

Figure 1 Compression-Deflection Example of Moisture Cure Systems



continued

High Levels of Quality Control

Chomerics performs automated dimensional verification of gasket bead placement and height for statistical process control, using fully programmable optical coordinate measuring technology and vision systems. Electrical resistance of cured gasket material is tested with a multimeter capable of measuring to 0.001 ohm. Typical C_p and C_{pk} values are approximately 1.5.

A Choice of Materials Formulated for Automated Dispensing

Cho-Form materials establish >8-12 N/cm^2 adhesion to many substrates, including magnesium and aluminum alloys and commonly used conductive films such as Ni/Cu plating, vacuum metallized coatings and conductive paints. Producing durable, conformable gaskets, all materials can be applied as beads with cross sections as small as 0.020 inch high and 0.026 inch wide (0.5 mm high and 0.66 mm wide). If design space permits, we recommend using a bead 0.034 inch high and 0.039 inch wide (0.85 mm high and 1.0 mm wide), delivering C_{pk} values >1.33. Bead location accuracy within 0.001 inch (0.025 mm) is possible.

Cho-Form 5513* — Two-component, thermal cure silicone system. Requires a minimum cure temperature of 130°C (266°F). Ag/Cu particle filler makes it the best performing gasket for metallic housings such as aluminum or magnesium castings. Excellent adhesion to a wide variety of substrates, including plated metal film on plastic and conductive paints.

Cho-Form 5518* — Two-component, thermal cure silicone system with Ag/Cu particle filler. Minimum cure temperature is only 85°C (185°F). Formulated for painted, plated or metallized plastic housings that will not withstand higher temperature bake. Also provides excellent adhesion to metallic housings.

Cho-Form 5515* — One-component, thermal cure silicone system, with Ni/Graphite filler. Minimum cure temperature is 100°C (212°F). A low-cost solution for EMI shielding, it is specially formulated to reduce galvanic activity between the housing and EMI gasket, and for use on outdoor applications requiring long-term corrosion resistance.

Cho-Form 5526 — One-part, room-temperature or moisture cure silicone resin with pure silver filler. Provides the lowest possible surface contact electrical resistance with excellent adhesion, compressibility and compression recovery. The ideal choice for higher performance grounding applications or use on semi-conductive surfaces. Suitable for both metallic alloy and plastic housings.

Cho-Form 5528* — One-part, room-temperature or moisture cure silicone resin with Ag/Cu filler. Provides ultra-soft, low closure force gaskets with excellent electrical, mechanical and shielding properties. Compression recovery is comparable to thermal cure systems. Packaging of completed units in 30 minutes can be achieved with accelerated curing at 149°F (65°C) and 85% relative humidity.

*Note concerning material numbers:
Cho-Form 5513 formerly identified as Cho-Form 2.1
Cho-Form 5518 formerly identified as Cho-Form 3.0
Cho-Form 5515 formerly identified as Cho-Form 4.0
Cho-Form 5528 formerly identified as Cho-Form 5.0

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Table 1

TYPICAL PROPERTIES OF CHO-FORM MATERIALS						
Property	**Test Method**	**5513**	**5518**	**5515**	**5526**	**5528**
Base Resin		Silicone (2-part)	Silicone (2-part)	Silicone (1-part)	Silicone (1-part)	Silicone (1-part)
Conductive Filler		Ag/Cu	Ag/Cu	Ni/Graphite	Ag	Ag/Cu
Solvent Level, Wet,%		None	None	None	5-8	None
Cure Mechanism		Heat	Heat	Heat	Moisture	Moisture
Cure Schedule		30 min @ 140°C	30 min @ 85°C 20 min @ 100°C	30 min @ 140°C	72 hrs @ 21°C & 10% RH 24 hrs @ 21°C & 50% RH	72 hrs @ 21°C & 10% RH 24 hrs @ 21°C & 50% RH
Handle Time (min. time to obtain cure sufficient for incidental contact without causing permanent gasket deformation)		NA	NA	NA	20 min @ 65°C & 85% RH 40 min @ 40°C & 50% RH 55 min @ 30°C & 50% RH	20 min @ 65°C & 85% RH 40 min @ 40°C & 50% RH 55 min @ 30°C & 50% RH
Shielding Effectiveness 200 MHz to 10 GHz, 0.034 x 0.040 inch bead (0.86 x 1.02 mm)	MIL-G-83528 Para. 4.6.12, modified specimen 0.85 mm x 1.0 mm bead with plastic bolts	80-100 dB	80-100 dB	75-85 dB	>100 dB	80-100 dB
Volume Resistivity (Initial), ohm-cm, max.	MIL-G-83528 Para. 4.6.11	0.010	0.010	0.200	0.005	0.020
Volume Resistivity (Aged), ohm-cm, max.	MIL-G-83528 Para. 4.6.15	0.020	0.050	0.300	0.010	0.030
Compression Set, 22 hrs. at 85°C (185°F), percent, max.	ASTM D395 Method B[2]	25	35	25	35	35
Tensile Strength, psi (MPa), min.	ASTM D412	250 (1.72)	350 (2.41)	450 (3.10)	80 (0.55)	80 (0.55)
Elongation, percent, min.	ASTM D412	250	225	100	45	45
Specific Gravity, typical	ASTM D792	3.4	3.3	1.8	3.3	2.7
Hardness (Shore A), +15, –10	ASTM D2240	45	45	60	40	35
Typical Adhesion[1], N/cm[2]	WI 038[2]	>8	>8	>8	>12	>12
Use Temperature, °C		85°	85°	100°	85°	85°

[1]Adhesion value dependant on substrate [2]Copy available from Chomerics NA Not Applicable

Chomerics' exclusive Wave-Form™ dispensing...

... maximum shielding with up to 40% reduction in closure force

At no additional cost, our exclusive, patent-pending Wave-Form bead configuration can reduce closure force requirements of the base material by 20 to 40%. Any listed Cho-Form material can be used. Proprietary motion programming produces a dispensed bead with a wave-like pattern.

A key performance benefit of the Wave-Form technology is its negligible impact on shielding effectiveness of the gasket. Moreover, choosing Wave-Form dispensing does not affect production throughput rates.

In a typical comparison, a conventionally dispensed Cho-Form gasket bead requires 4 N/cm of closure force, while the same material dispensed as a Wave-Form bead requires only 2.6 N/cm.

Contact Chomerics' Applications Engineering to evaluate the suitability of Wave-Form dispensing in your application.

continued

Optimizing the design of Cho-Form Shielded Housing Assemblies

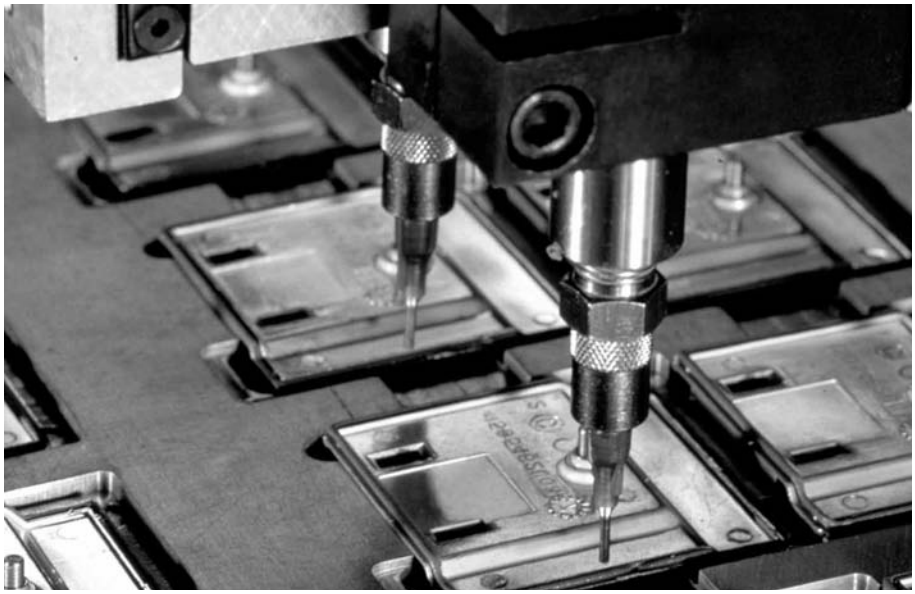
Important Considerations for Optimizing Quality & Production Efficiency

A shielded housing is an assembly whose quality and performance are functions of all the parts and processes used to produce it.

Whenever possible, Chomerics interfaces on behalf of OEM customers with suppliers of die-cast metal and injection-molded plastic housings in advance of tool design and production. Detailed guidance is provided on part and tool design, part reproducibility, locating features, tolerances and surface conditions — issues that are key to the quality and economics of robotic gasket dispensing.

As discussed on page 6, Chomerics can act as lead vendor, managing the entire housing supply chain to ensure the best results for OEM customers.

The following section provides answers to commonly asked questions, and highlights critical design issues that affect production efficiency and cost.



Housing Material Considerations

Plastic Substrate Selection

If the housing is an injection-molded thermoplastic, the gasket cure temperature is an important parameter. Different thermoplastics soften or stress-relieve at different temperatures.

Polycarbonate/ABS blends offer significant process advantages for Cho-Form gasket application. While somewhat more expensive than other plastics, virtually all PC/ABS blends will withstand 85°C (185°F), and therefore allow efficient gasket "quick cure" in-line. In contrast, plastics that require room temperature gasket curing necessitate batch processing, with attendant cost and logistic (time) disadvantages.

For maximum production throughput, Chomerics generally recommends that plastic housings be able to withstand curing at 85°C for up to 40 minutes without deforming.

Surface Preparation

Metal or plastic surfaces to be gasketed with Cho-Form materials should exhibit electrical resistance of <0.01 ohm. They should be clean and free of dirt, oils and organic solvents.

Metallic housings must be treated to remove release agents and machining oils. Aluminum parts should be chromate conversion coated (alodine or irridite) per MIL-C-5541 Class 3. Magnesium parts should be protected with Dow 20 modified chrome pickle or equivalent.

Plastic housings require metallizing, which may be accomplished by plating, aluminum vacuum deposition or conductive paint.

For plating, nickel-copper is preferred. It adheres well, provides 80+ dB of shielding effectiveness, and remains electrically stable over time.

If vacuum deposition is chosen, a nitrogen purge is mandatory to ensure good adhesion.

Differences in commercially available conductive paints necessitates testing them with the selected Cho-Form gasketing material. Chomerics' CHO-SHIELD® 2052, 2054, 2056 and 610 conductive coatings have been formulated to adhere well and be galvanically compatible with Cho-Form materials. The superior performance and batch-to-batch uniformity of these silver-copper-filled paints have been extensively demonstrated in these applications. Their high abrasion resistance provides protection during product assembly and use.

Chomerics applies CHO-SHIELD coatings robotically in-line, as an integrated part of the automated Cho-Form application process. This capability provides significant logistical, time and cost benefits.

Protective Packaging

To avoid cosmetic injuries such as surface scratches, parts should be shipped in compartmentalized plastic or corrugated paper trays. If requested, Chomerics will arrange for specialized packaging to be delivered to the housing manufacturer.

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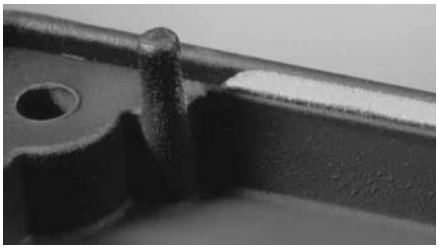
Gasket Design Considerations

Start/Stop Bead Profiles

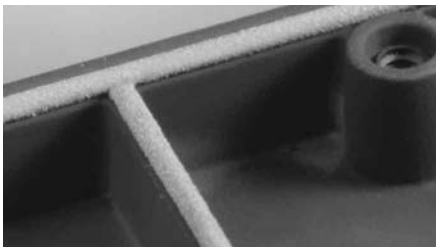
Designers should anticipate slight differences in gasket bead cross section in the start/stop zones compared with the very uniform profile produced during steady-state dispensing of straight runs. Figures 2-5 illustrate the nature of these intrinsic differences and the adjusted tolerances in the initiation and termination zones, which are defined as 0.100 inch (2.54 mm) long.

Engineering drawings should reflect a less well-defined gasket profile in start/stop zones, to facilitate Quality Control inspections of incoming parts. Suggested drawing references appear in Figures 3 and 4.

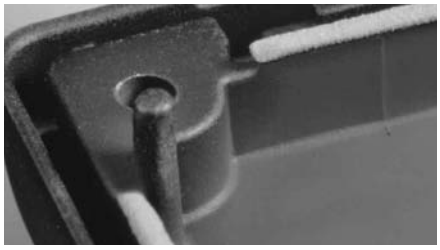
In programming the dispense path, sufficient flexibility exists to minimize the number of start/stop events and to locate such events where the gasket profile is not critical. Part drawings should identify any areas in which the increased cross section tolerances associated with start/stop zones would create a problem.



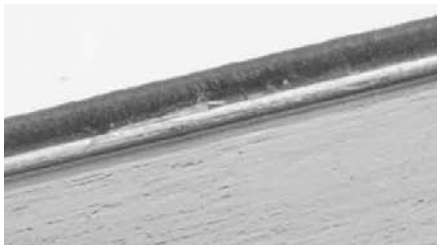
starting event



"T" stop



full circle perimeter stop



straight run stop

Figure 2 Characteristic appearance of start/stop events

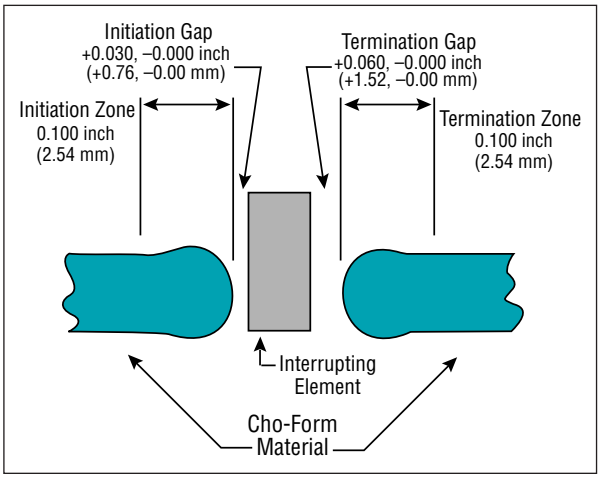
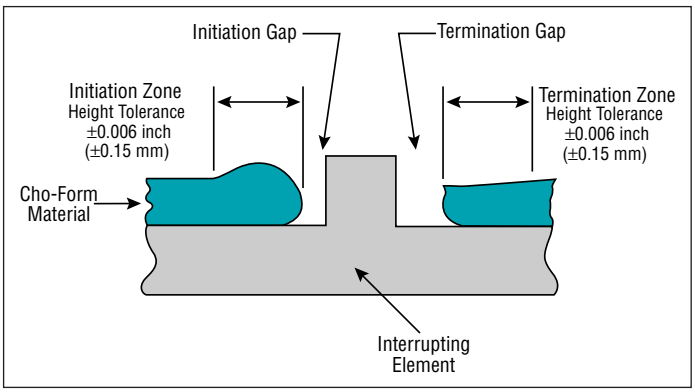


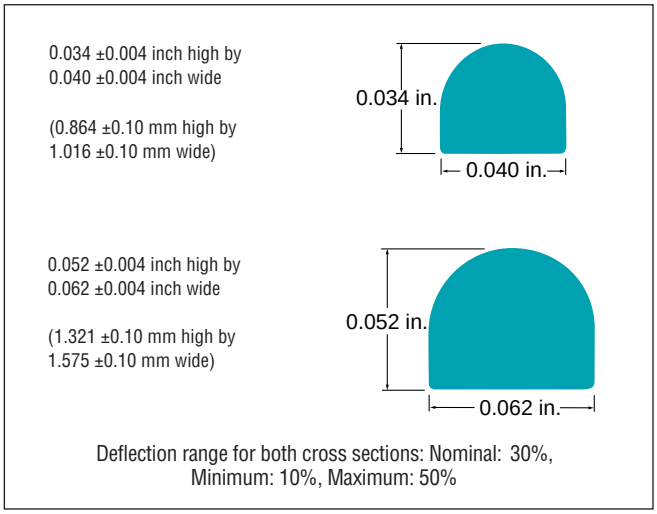
Figure 3 Location tolerances for bead initiation & termination zones (cross-sectional view)

Figure 4 Gasket height tolerances



Cho-Form gasket beads are dispensed with an accuracy of 0.001 inch (0.025 mm) and a straight-run height tolerance of ±0.004 inch (±0.10 mm). The exception is within 0.100 inch (2.54 mm) at the start and end of a bead (initiation zone and termination zone respectively), where ±0.006 inch (±0.15 mm) is the height tolerance.

Figure 5 Suggested cross sections with height-to-width ratio of 0.85



continued

Critical Housing Design Issues

Cho-Form FIP gasket technology accommodates a reasonable degree of variability in housing part dimensions. However, setup and dispensing speed are directly impacted by part uniformity. In addition, the housing design can pose obstacles to efficient gasket dispensing.

The most common avoidable problem is warped or non-uniform housings. If housings are not sufficiently flat and dimensionally uniform, they must be restrained by special alignment and hold-down fixtures, which can add substantial setup time.

For best results and production economics, designs should reflect the following considerations:

Positive Locating Features Speed Production

Parts should be easily fixtured for fast, accurate dispensing

Reproducible positioning of the parts beneath the dispensing head is fundamental to this automated technology. Maximum production speed can be achieved when through-holes are available to pin-position parts on the pallets that transport them to the dispensing head. If through-holes are not available, two sides can be pushed against pallet rails for positioning. This requires hold-down clamps that must be positioned without interfering with the dispensing needle.

Avoid features that complicate design of a locating system

Parting lines in dies or molds can interfere with the establishment of a locating edge. Mold gates, runners or flash can interfere with positioning pins or fixtures.

Part Reproducibility is Critical

Flanges, rails or ribs to be gasketed should have part-to-part location reproducibility (X and Y dimensions) within 0.008 inch (0.20 mm)

Once the dispense path is programmed, all surfaces to be gasketed must be located where the program assumes them to be. Variation greater than 0.008 inch (0.203 mm) will result

in gasket beads dispensed partly on and partly off the intended surfaces.

Housings must be reproducible in the Z axis within 0.012 inch (0.30 mm)

Manufacturing processes for die-cast metal and injection molded plastic housings generally can produce parts with intrinsically reproducible, uniform dimensions in the Z axis.

Several factors determine the gasket bead profile — air pressure in the needle, material viscosity, needle diameter, feed rate and needle height (Z) above the part. Accurate Z-axis programming is central to dispensing an optimum gasket profile. Full 3-axis programmability of the Cho-Form dispensing heads is an important advantage in accommodating the necessary tolerances on the Z-axis position of the surface to be gasketed.

Selection of a housing supplier able to meet the reproducibility requirements for the Z-axis can make a real difference in the quality, speed and economics of gasket dispensing.

Production housing functions as master

The Cho-Form gasket dispensing head is programmed in 3 axes by plotting the path which the needle will follow, using a representative production housing as the master. Programming can account for unintended but consistent deviations in elevation, such as:

- non-parallelism
- non-flatness
- warping

In aggregate, these elevation deviations must be consistent from part to part within 0.012 inch (0.30 mm). If not, special mechanical restraint fixturing will probably be required to ensure accurate gasket dispensing. Fixturing schemes usually entail delay and expense and may also impact production speed.

Parallelism to a defined plane

Using one or more specific part features for locating purposes, housings are mounted on a machined pallet and conveyed to the dispensing head. The pallet surface defines the "datum plane" for Z-axis motion of the dispensing needle.

A Cho-Form gasket can be dispensed onto a part surface of known slope with respect to the datum plane (up to 80°). Application onto a flat surface (i.e., 0° slope) can actually be more difficult than application to a sloped surface if part thickness is not consistent. Variation in overall part thickness will cause the surface to be gasketed to be non-parallel with the datum plane. Z-axis adjustments to the needle's path are programmed using the representative "master" part. However, these variations must be consistent in both location and degree, and within the 0.012 inch (0.30 mm) aggregate allowable tolerance to avoid the need for special fixturing. (Figures 6 a-b.)

Flatness of the surface to be gasketed

Unevenness in flanges, rails or ribs to be gasketed can be programmed into the Z-axis motion of the dispensing head. Again, this Z-axis variation must be consistent from part-to-part within the 0.012 inch (0.30 mm) aggregate tolerance to avoid the need for fixturing. (Figures 7a-b.)

Warping of the housing

As with parallelism and flatness of the surface to be gasketed, warping of the entire part can contribute to a Z-axis variation that exceeds the 0.012 inch (0.30 mm) tolerance for reproducibility. The trend toward smaller electronic packages with thin housing walls makes this a common occurrence. If surfaces for part hold-down are available, this condition can be accommodated by fixturing. However, setup and production time will be affected.

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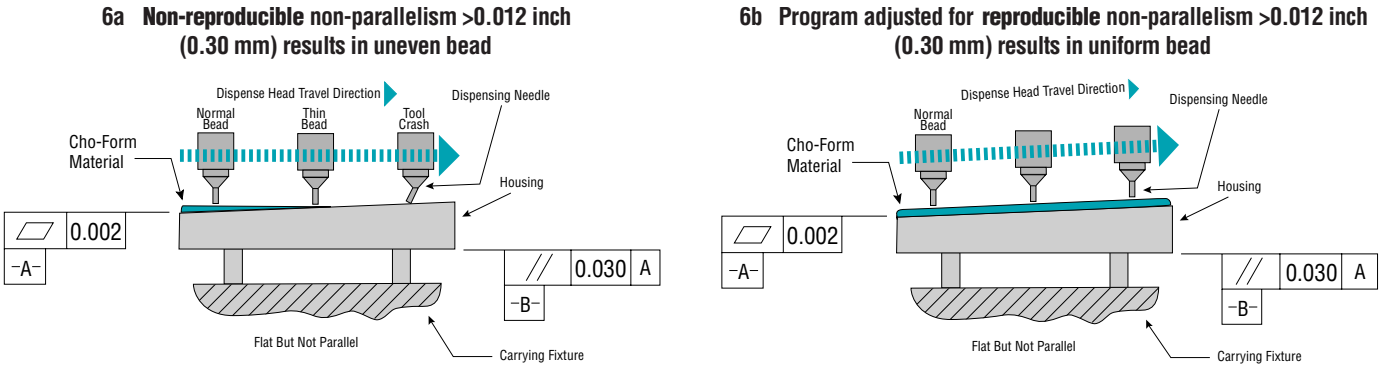


Figure 6 Non-parallelism between receiving surface and pallet surface

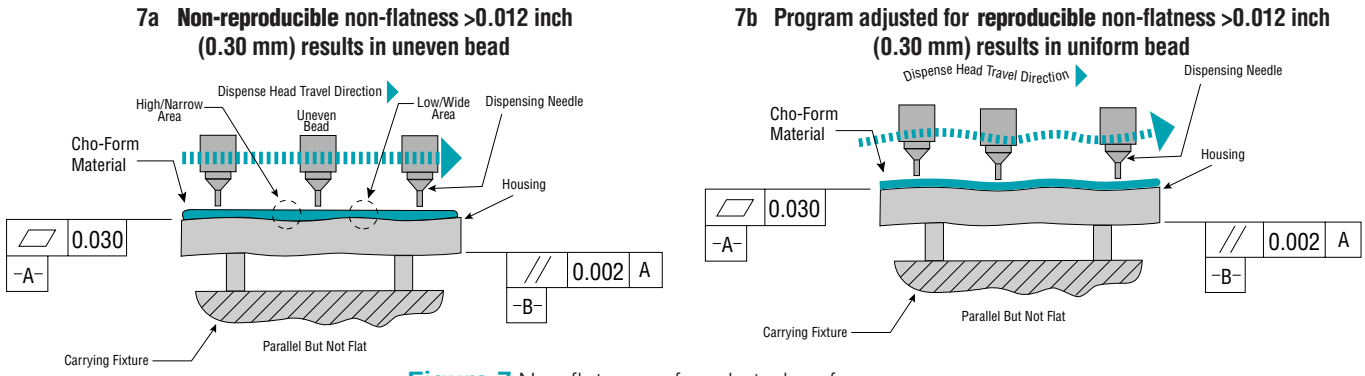


Figure 7 Non-flatness of gasketed surface

Keep the need for part restraint to a minimum

When the part-to-part reproducibility requirement cannot be met, mechanical restraints are fabricated which temporarily flatten the part for proper dispensing of the gasket. Whenever possible, Chomerics exploits design features such as through-holes and edge rails for clamping. If such features do not exist, more complicated fixturing schemes must be designed to induce the necessary flatness, with a corresponding time and cost penalty.

Avoid Z-axis Obstructions

Sidewall proximity to the dispensing needle

Often, a form-in-place EMI gasket is applied along a "ledge" adjacent to a higher sidewall. The dimensional tolerances on ledge and sidewall locations are particularly critical, to avoid sidewall interference with the moving needle (Figure 8).

Side pressure on the needle produces a change in gasket profile. However, because the Cho-Form dispensing head positions the needle with 0.001 inch (0.025 mm) accuracy, this should not be a concern provided that part-to-part dimensional consistency is within 0.010 inch (0.25 mm).

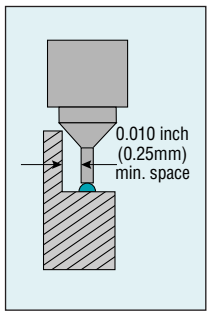


Figure 8 Sidewall interference with dispensing needle

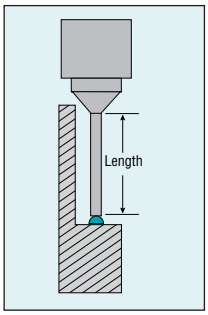


Figure 9 High sidewalls may necessitate longer needles, reducing speed

High sidewalls slow dispensing

High sidewalls adjacent to the gasket dispensing path may require an elongated needle to provide the necessary clearance for the dispensing head (Figure 9). The longer needle adds friction to material flow, reducing dispensing speed by as much as 75%. This can frequently be avoided by positioning high sidewalls on the mating part or by reducing their height.

Through-hole interference

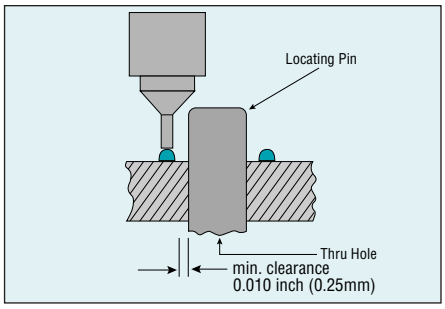


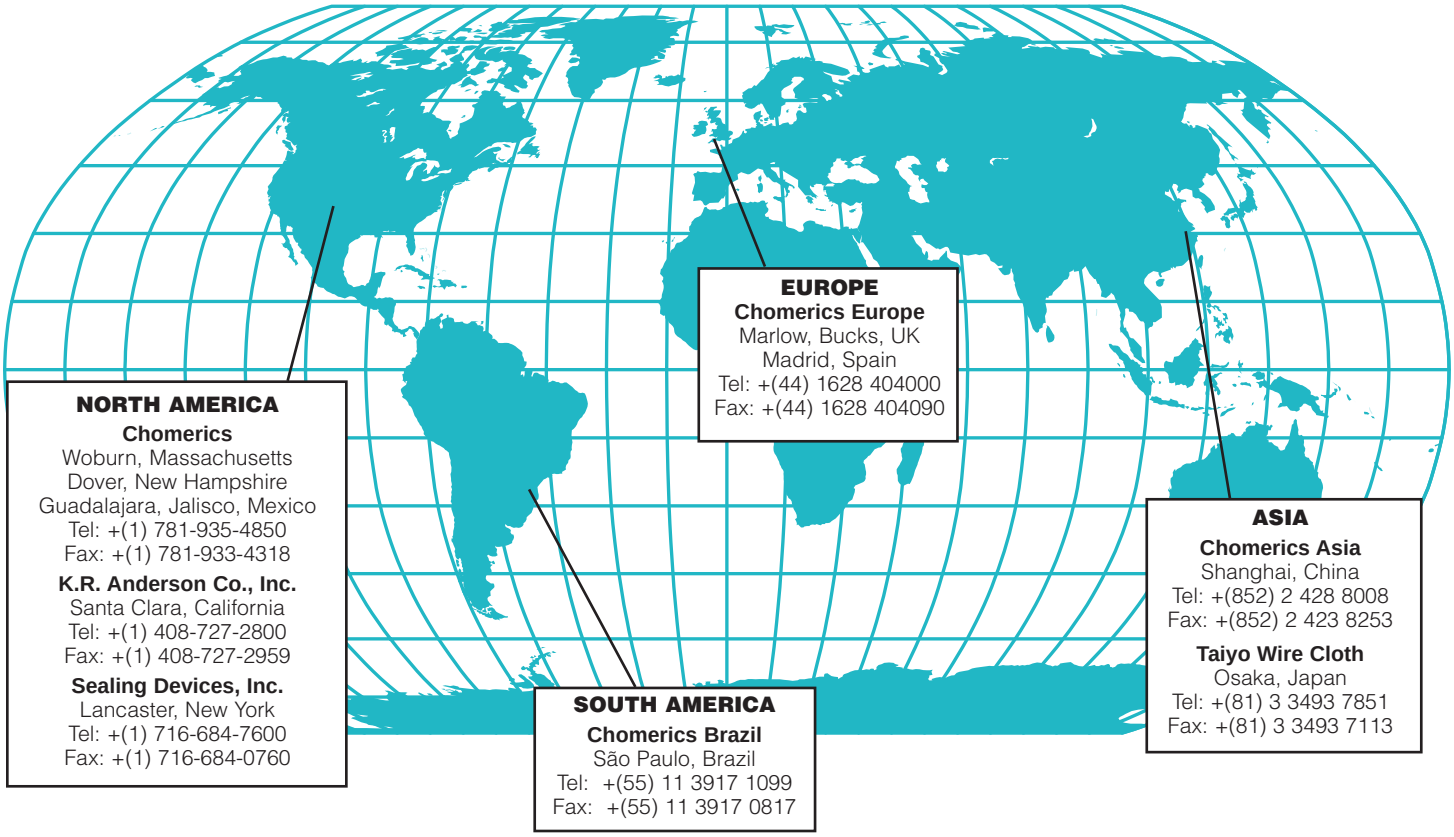
Figure 10 Dispensing path obstructed

In cases where the housing incorporates through-holes used to position the part on its pallet, the holes must not intersect the dispensing path. Clearance of less than 0.010 inch (0.25 mm) could result in screw heads or locating pins obstructing the dispensing needle (Figure 10).

continued

Global Access to Application Sites

A growing network of Cho-Form Application Sites offer automated EMI gasketing, part painting and contract manufacturing services, sometimes at close proximity to customers' own or subcontractor locations:



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Mapping New Sites to Your Operations

Where production volumes warrant, Chomerics is pleased to explore the establishment of EMI gasket dispensing and part painting operations at our customers' locations. Advantages of such an arrangement include:

- meeting in-country content stipulations
- simplified logistics
- local sales support, quality support and customer service

To evaluate the feasibility of establishing Chomerics applications sites at or near your company's operations, contact the Cho-Form Business Unit at our Woburn, Massachusetts headquarters.

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Parker Seals

Conductive Elastomer Gaskets

CHO-SEAL® & CHO-SIL® Conductive Elastomers

Since 1961, Chomerics has invented and extended virtually every aspect of conductive elastomer materials technology — from the earliest silver and silver/copper filled silicones to the latest and more cost-effective silver/aluminum and nickel/graphite composites. Today we offer the most comprehensive selection and highest quality products available anywhere.

Each conductive elastomer consists of a silicone, fluorosilicone, EPDM or fluorocarbon-fluorosilicone binder with a filler of pure silver, silver-plated copper, silver-plated aluminum, silver-plated nickel, silver-plated glass, nickel-plated graphite, or unplated graphite particles.

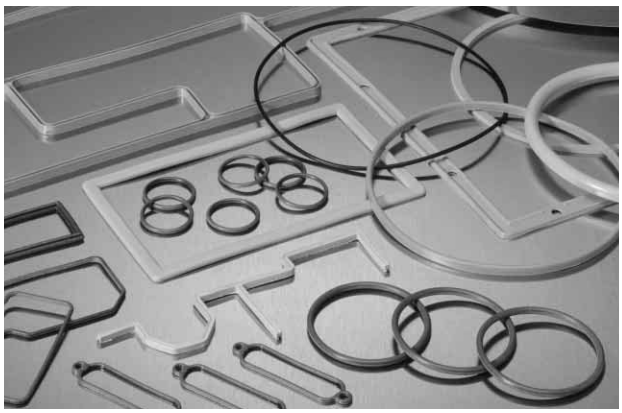
The development of these composites is the result of decades of research and testing, both in the laboratory and in the field. Our proprietary filler powder technology allows us to carefully control the composition, size, and morphology of the conductive particles. Their precise, uniform dispersion within the resinous binders produces materials with stable and consistent electrical and physical properties.

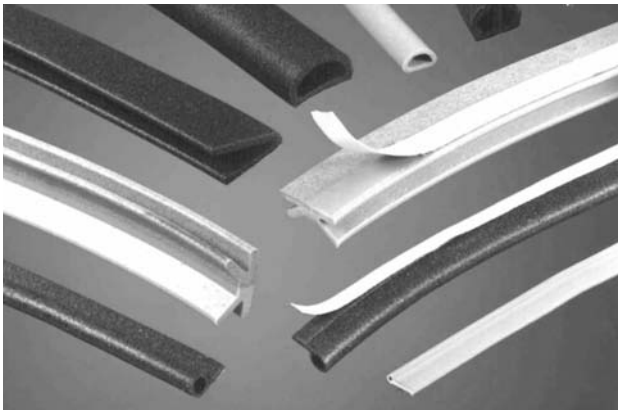
Chomerics' conductive elastomers feature excellent resistance to compression set over a wide temperature range, resulting in years of continuous service. All meet MIL-STD-810 requirements for fungus resistance. In addition to EMI shielding, these materials will provide an environmental or pressure seal if required.

For those materials containing silver, both packaging and storage conditions should be similar to those for other silver-containing components, such as relays or switches. They should be stored in sheet plastic, such as polyester or polyethylene, and kept away from sulfur-containing materials, such as sulfur-cured neoprene, cardboard, etc. To remove dirt, clean the elastomer with water or alcohol containing mild soap (do not use aromatic or chlorinated solvents).

Table 3 on pages 32-34 outlines the properties and specification limits of Chomerics' conductive elastomers. These materials are produced in a virtually unlimited variety of molded, die-cut and extruded shapes and sizes described throughout this section on pages 35-79. Refer also to our EMI Shielding Theory and Design Guide, page 191.

Our Applications Engineering Department is very accessible, and ready to assist with material selection and gasket design. We welcome your inquiry.





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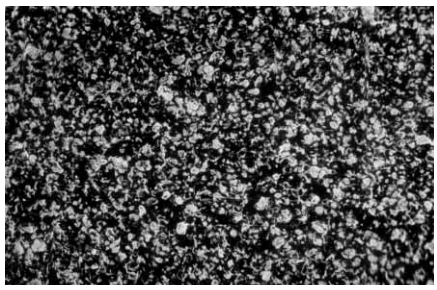
Material Selection

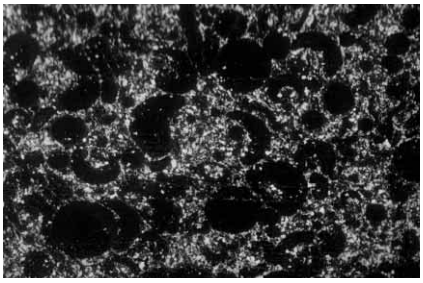
Chomerics' array of conductive elastomers offers true flexibility in selecting the appropriate material for a specific application on the basis of cost and level of attenuation required. Price varies directly with shielding performance.

For most applications, CHO-SEAL materials are preferred over CHO-SIL materials, owing to their superior physical properties and excellent shielding performance. With their reticulate structure, CHO-SIL materials are typically lighter in weight and more compressible.

For military/aerospace applications, we recommend that users of conductive elastomer gaskets specify that materials meet the requirements of MIL-G-83528 and be procured from MIL-G-83528 QPL sources. To avoid the risk of system EMI or environmental seal failure, any change in conductive elastomer seal supplier (including MIL-G-83528 QPL suppliers) should be proceeded by thorough system qualification testing.



Homogeneous Structure: CHO-SEAL materials



Reticulate Structure: CHO-SIL materials

Conductive Elastomer Applications

As a generality, certain types of Chomerics' conductive elastomers are specified more often for military/aerospace applications or for commercial applications. However, there is a considerable overlap, and our Applications Engineering organization will be pleased to assist you with product selection.

Commercial
1291*/1273
S6304, S6305, 6370
1350
1310*/1356**
* *molded parts only*
** *extruded parts only*

Military/Aerospace
1224/1221*
1298*
1215/1217*
1285/1287*
1278**
S6304, S6305, 6370, L6303*
* *fluorosilicone*
** *molded parts only*

Specialty
1501*/1401
1239*/1212*
E6306*, E6434*/E6434E**
V6433*
1485
S6600/S6602*
* *molded parts only*
** *extruded parts only*

Non-Silicone Base Elastomer Fluid Resistance

Certain specialty elastomers (E6306, E6434, E6434E, V6433 and the various fluorosilicone based materials) are offered specifically for their fluid resistance properties. Table 1 shows the qualitative assessment of fluid resistance to various fluids for three non-silicone base elastomers used for Chomerics' conductive elastomers.

Table 1

NON-SILICONE BASE ELASTOMER FLUID RESISTANCE			
	Fluorosilicone	**EPDM**	**Fluorocarbon**
Oil	Good	Do Not Use	Excellent
Hydraulic Fluids (Organic)	Good	Do Not Use	Excellent
Hydraulic Fluid (Phosphate Ester)	Fair	Excellent	Good
Hydrocarbon Fuels	Good	Do Not Use	Excellent
DS2 (NBC Decontamination Fluid)	Poor	Good	Fair/Good
STB (NBC Decontamination Fluid)	Good	Good	Good

continued

Conductive Elastomer Selection Guide

The chart on these pages provides selection guidelines for Chomerics' most general-purpose elastomer EMI gasket materials. With the exception of certain limitations noted under "Remarks", all of these materials are electrically stable over time and provide excellent moisture and pressure sealing. They are all medium-durometer materials and differ mainly in shielding performance and corrosion resistance. (Silver-plated-aluminum filled materials are significantly more corrosion-resistant than silver-plated-copper and silver-plated-nickel filled materials. Refer to the discussion of CHO-SEAL 1298 Corrosion-Resistant EMI Shielding Gasket on page 32.)

Note on Gasket Deflection and Closure Force: We do NOT recommend that material selection be based primarily on hardness. Unlike unfilled elastomers, hardness is not always a good indicator of deflection properties. Gasket shape is generally the most important determinant of deflection under load. For applications requiring large gasket deflection with minimum closure force, select a hollow strip configuration and/or evaluate the use of Chomerics' SOFT-SHIELD® Low Closure Force Gaskets described in the section starting on page 91.

Refer to pages 80-86 for Performance Data and discussion of the following topics: Compression-Deflection, Stress Relaxation, Compression Set, EMP Survivability, Vibration Resistance, Heat Aging, Outgassing, and Volume Resistivity Measurement.

Table 2

ELASTOMERS FOR TYPICAL COMMERCIAL APPLICATIONS			
Material	**Filler and Binder**	**Equipment Shielding Requirements (Typ.)**	**Remarks**
CHO-SEAL 1291 (molded) CHO-SEAL 1273	silver-plated copper in silicone	80-105 dB	Material of choice for high-end commercial applications; highest performance material in non-corrosive environments; tear trim compression and injection molding.
CHO-SEAL S6304, S6305, 6370 CHO-SEAL L6303	nickel-coated graphite in silicone fluorosilicone version	100 dB	Good performance in moderately corrosive environments; material of choice for flange finishes needing "bite-through" for good electrical contact; flame retardant 6370 is UL 94V-0 rated.
CHO-SEAL 1350	silver-plated glass in silicone	80-105 dB	Standard material for high volume injection and compression molding and small extrusions; high performance in non-corrosive environments; moderate physical properties.
CHO-SEAL 1310 (molded) CHO-SIL 1356 (extruded)	silver-plated glass in silicone silver-plated glass in reticulate silicone	80-100 dB	Moderate performance in non-corrosive environments; no corrosion or fluid resistance; material of choice for small, delicate injection-molded parts or larger extrusions.
ELASTOMERS FOR TYPICAL MILITARY/AEROSPACE APPLICATIONS			
Material	**Filler and Binder**	**Equipment Shielding Requirements (Typ.)**	**Remarks**
CHO-SEAL 1224 CHO-SEAL 1221	silver in silicone fluorosilicone version	>120 dB	Highest shielding and through conductivity; higher physical properties; excellent processing for molding and extrusion; reinforced form available.
CHO-SEAL 1298	silver-plated aluminum in fluorosilicone	90-110 dB	High performance in harshest corrosive environments; material of choice for aircraft and marine military applications (see feature on page 32); good physical properties; molded, extruded or reinforced. Best corrosion resistance among Chomerics' conductive elastomers.
CHO-SEAL 1215 CHO-SEAL 1217	silver-plated copper in silicone fluorosilicone version	105-120 dB	Resists highest level of EMP induced current; military gasket of choice in non-corrosive environment; excellent processing for molding and extrusion.

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Table 2 *continued*

ELASTOMERS FOR TYPICAL MILITARY/AEROSPACE APPLICATIONS *continued*			
Material	**Filler and Binder**	**Equipment Shielding Requirements (Typ.)**	**Remarks**
CHO-SEAL 1285 CHO-SEAL 1287	silver-plated aluminum in silicone fluorosilicone version	90-110 dB	Military gasket of choice for corrosive environments; lightweight, 200°C max. use temperature; good EMP resistance; molded, extruded and reinforced.
CHO-SEAL 1278	silver-plated nickel in silicone	>100 dB	High performance in non-corrosive environments; molded parts only; no fluid resistance.
CHO-SEAL S6304, S6305, 6370 CHO-SEAL L6303	nickel-coated graphite in silicone fluorosilicone version	>100 dB	Good performance in moderately corrosive environments; material of choice for flange finishes needing "bite-through" for good electrical contact; flame retardant 6370 is UL 94V-0 rated.
SPECIALTY ELASTOMERS			
Material	**Filler and Binder**	**Equipment Shielding Requirements (Typ.)**	**Remarks**
CHO-SEAL 1501	silver in silicone foam	80-100 dB	Soft (30 Shore A) for low closure force where gasket shape cannot be exploited; low tear strength; no corrosion resistance or fluid resistance; sheet stock only.
CHO-SIL 1401	silver in reticulate silicone	80-100 dB	High performance for non-corrosive environments; soft (45 Shore A) for low closure force where gasket shape cannot be exploited; low tear strength; no fluid resistance.
CHO-SEAL 1239	silver-plated copper in silicone with expanded copper reinforcement	110 dB	Material for waveguide choke, cover, and flange EMI shielding and pressure sealing; maximum heat transfer and minimum outgassing; hard (80 Shore A), high-strength material; available with raised lip around iris opening for high power/ high pressure applications.
CHO-SEAL 1212	silver-plated copper in silicone	120 dB	High strength, hard (80 Shore A) material for waveguide, choke, cover, and flanges with grooves for EMI and pressure sealing.
CHO-SEAL E6434 (molded) CHO-SEAL E6434E (extruded)	silver-plated nickel in EPDM	95 dB 90 dB	Material of choice for high shielding where NBC fluid resistance is needed; high performance in corrosive environments.
CHO-SEAL E6306	nickel-coated graphite in EPDM	>90 dB	Good performance in moderately corrosive environments; excellent NBC fluid resistance; good physical properties.
CHO-SEAL V6433	silver-plated nickel in fluorocarbon	100 dB	Material of choice for extensive fluid resistance; no corrosion resistance.
CHO-SIL 1485	silver-plated aluminum in reticulate silicone	50-100 dB	Moderate corrosion resistance for military applications.
CHO-SEAL S6600 and S6602	carbon in silicone	30-80 dB	Low-end shielding or ESD protection; high tensile strength; no corrosion or fluid resistance.

Table 3

CONDUCTIVE ELASTOMER SPECIFICATIONS (grouped by filler)											
		Test Procedure (Type of Test)	CHO-SEAL 1221	CHO-SEAL 1224	CHO-SIL 1401[d]	CHO-SEAL 1501■	CHO-SEAL 1212■	CHO-SEAL 1215[d]	CHO-SEAL 1217	CHO-SEAL 1239 ■	CHO-SEAL 1273
Conductive Filler			Ag	Ag	Ag	Ag	Ag/Cu	Ag/Cu	Ag/Cu	Ag/Cu	Ag/Cu
Elastomer Binder			Fluoro-silicone	Silicone	Silicone	Silicone	Silicone	Silicone	Fluoro-silicone	Silicone	Silicone
Type (Ref. MIL-G-83528)			Type F	Type E	—	—	Type K	Type A	Type C	Type G	—
Volume Resistivity, ohm-cm, max., as supplied (without pressure-sensitive adhesive) Para. 4.6.11		CEPS-0002[a]	—	—	—	—	—	—	—	—	0.004
		MIL-G-83528	0.002	0.002	0.010	0.03	0.005	0.004	0.010	0.007	—
Hardness (Shore A)		ASTM D2240 (Q/C)	75 ±5	65 ±5	45 ±5	35 ±7	80 ±5	65 ±5	75 ±5	80 ±5	65 ±8
Specific Gravity (±0.25)		ASTM D792 (Q/C)	4.0	3.5 ±0.45	1.6	2.7 (typ.)	3.5	3.5 ±0.45	4.1/3.8[e]	4.75 ±0.75	3.7
Tensile Strength, psi (MPa), min.		ASTM D412 (Q/C)	250 (1.72)	300 (2.07)	200 (1.38)	80 (0.55)	400 (2.76)	200 (1.38)	180 (1.24)	600 (4.14)	175 (1.21)
Elongation, % min. or % min./max.		ASTM D412 (Q/C)	100/300	200/500	75	NA	100/300	100/300	100/300	20/NA	75
Tear Strength, lb/in. (kN/m), min.		ASTM D624 (Q)	40 (7.00)	50 (8.75)	20 (3.50)	20 (3.50)	40 (7.00)	40/25[e]	35 (6.13)	70 (12.25)	—
Compression Set, 70 hrs @ 100°C, % max.[b]		ASTM D395 Method B (Q)	60	45	35	80	35	32	35	NA	32
Low Temperature Flex TR10, °C, min.		ASTM D1329 (Q)	–65	-65	–55	NA	–45	–65	–55	NA	–65
Maximum Continuous Use Temperature, °C[c]		(Q)	160/200	160/200	160/200	160/200	125	125	125	125	125
Shielding Effectiveness (see Note below)		Method (1) CHO-TM-TP08[a]	Method (2)	Method (2)	Method (2)	Method (2)	Method (2)	Method (2)	Method (2)	Method (2)	Method (1)
	200 kHz (H Field)	Method (2) MIL-G-83528 Para 4.6.12 (Q)	70	70	60	60	70	70	70	70	—
	100 MHz (E Field)		120	120	100	100	120	120	120	110	100
	500 MHz (E Field)		120	120	100	100	120	120	120	110	100
	2 GHz (Plane Wave)		120	120	90	90	120	120	115	110	100
	10 GHz (Plane Wave)		120	120	80	80	120	120	110	110	100
Electrical Stability		CEPS-0002[a]	—	—	—	—	—	—	—	—	0.01
	Heat Aging	MIL-G-83528 Para. 4.6.15 (Q/C)	0.010	0.010	0.015	NA	0.010	0.010	0.015	0.010	—
	Vibration Resistance During	MIL-G-83528 (Q) Para. 4.6.13 (Q)	0.010	0.010	0.015	NA	0.010	0.006	0.015	0.010	—
	Vibration Resistance After		0.002	0.002	0.01	0.03	0.005	0.004	0.010	0.007	—
	Post Tensile Set Volume Resistivity	MIL-G-83528 Para. 4.6.9 (Q/C)	0.010	0.010	0.02	NA	0.010	0.008	0.015	NA	—
	EMP Survivability, kA per in. perimeter	MIL-G-83528 Para. 4.6.16 (Q)	>0.9	>0.9	note **f**	>0.3	>0.9	>0.9	>0.9	>0.9	—

dB, min. / ohm-cm, max.

a Copies of CEPS-0002 and CHO-TM-TP08 are available from Chomerics

b Compression set is expressed as a percentage of deflection per ASTM D395 Method B., at 25% deflection. To determine percent recovery, subtract 1/4 of stated compression set value from 100%. For example, in the case of 30% compression set, recover y is 92.5%.

c Where two values are shown: First represents max. operating temp. for conformance to MIL-G-83528 (which requires Group A life t esting at 1.25 times max. operating temp.) Second value represents practical limit for exposure up to 1000 hours (compressed between flanges 7-10%). Single value c onforms to both definitions.

d Extruded version of 1215 was formerly designated 1250; extruded version of 1401 was formerly designated 1405.

e Second value applies to extruded forms only.

f CHO-SIL 1401 degrades electrically after simulated EMP current levels < 0.9 kA per in.

■ Not available in extruded form.
NA Not Applicable
(Q) Qualification
(C) QC Conformance

Note: **It may not be inferred that the same level of shielding effectiveness provided by a gasket material tested in the fixture per M IL-G-83528 Para. 4.6.12 would be provided in an actual equipment flange, since many mechanical factors of the flange design (tolerances, stiffness, fastener location, and size, etc.) could lower or enhance shielding effectiveness. This procedure provides data applicable only to the test fixture design of MIL-G-83528, but which is useful for making comparisons between dif ferent gasket materials.**

CHO-SEAL 1298 Corrosion-Resistant EMI Shielding Gasket

CHO-SEAL 1298 elastomer incorporates unique particle plating and elastomer technology for increased corrosion resistance. When used in conjunction with the CHO-SHIELD 2000 series of corrosion-resistant conductive coatings on aluminum flanges, a *corrosion-proof* EMI flange system is obtained. CHO-SEAL 1298 gasket material is based on a silver-plated-aluminum filler dispersed in a fluorosilicone binder, with corrosion inhibiting additives that contain no chromates. It offers shielding effectiveness of 100 dB at 500 MHz and meets all requirements of MIL-G-83528 Type D (initial and aged). CHO-SEAL 1298 gasket material also has excellent resistance to fluids and fuels commonly used in aviation and industrial applications.

Corrosion Resistance Testing

Chomerics has completed extensive corrosion resistance testing on CHO-SEAL 1298 gasket material using a gravimetric weight loss procedure. A copy of the test method (CHO-TM 100) is available on request from Chomerics. Test fixtures and elastomer samples are also available. Contact Chomerics' Applications Engineering Department for further information.

Lightning Strike Resistance

The survivability of any system to lightning strike is dependent on specific flange design. Lightning strike testing of CHO-SEAL 1298 gasket material has demonstrated

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Table 3 *continued*

CONDUCTIVE ELASTOMER SPECIFICATIONS (grouped by filler)				Test Procedure (Type of Test)	CHO-SEAL 1291■	CHO-SEAL 1278■	CHO-SEAL V6433■	CHO-SEAL E6434■	CHO-SEAL E6434E●	CHO-SEAL 1285	CHO-SEAL 1287	CHO-SEAL 1298	CHO-SIL 1485	CHO-SEAL 1310■
Conductive Filler					Ag/Cu	Ag/Ni	Ag/Ni	Ag/Ni	Ag/Ni	Ag/Al	Ag/Al	Passivated Ag/Al	Ag/Al	Ag/Glass
Elastomer Binder					Silicone	Silicone	Fluorocarbon/ Fluorosilicone	EPDM	EPDM	Silicone	Fluoro-silicone	Fluoro-silicone	Silicone	Silicone
Type (Ref. MIL-G-83528)					—	Type L	—	—	—	Type B	Type D	Type D	—	—
Volume Resistivity, ohm-cm, max., as supplied (without pressure-sensitive adhesive)				CEPS-0002[a]	0.004	—	—	—	—	—	—	—	—	0.01
				MIL-G-83528 Para. 4.6.11	—	0.005	0.006	0.006	0.05	0.008	0.012	0.012	0.02	—
Hardness (Shore A)				ASTM D2240 (Q/C)	70 ±5	75 ±5	85 ±7	75 ±7	80 ±7	65 ±5	70 ±5	70 ±5	60 ±5	70 ±10
Specific Gravity (±0.25)				ASTM D792 (Q/C)	3.45	4.0	4.8	3.9	3.8	1.9	2.0	2.0	1.7	1.8
Tensile Strength, psi (MPa), min.				ASTM D412 (Q/C)	175 (1.21)	200 (1.38)	400 (2.76)	200 (1.38)	200 (1.38)	200 (1.38)	180 (1.24)	180 (1.24)	180 (1.24)	200 (1.38)
Elongation, % min. or % min./max.				ASTM D412 (Q/C)	75	100/300	50	200	100	100/300	60/260	60/260	100	100
Tear Strength, lb/in. (kN/m), min.				ASTM D624 (Q)	—	30 (5.25)	70 (12.25)	75 (13.13)	70 (12.25)	30 (5.25)	35 (6.13)	35 (6.13)	30 (5.25)	
Compression Set, 70 hrs @ 100°C, % max.[b]				ASTM D395 Method B (Q)	32	32	45	40	40	32	30	30	30	35
Low Temperature Flex TR10, °C, min.				ASTM D1329 (Q)	–45	–55	–25	–45	–45	–65	-55	–55	–40	–40
Maximum Continuous Use Temperature, °C[c]				(Q)	125	125	200	100	100	160/200	160/200	160/200	85	160
Shielding Effectiveness (see Note below)	200 kHz (H Field)	dB, min.	Method (1) CHO-TM-TP08[a]		Method (2) —	Method (1) 70	Method (2) —	Method (2) —	Method (1) —	Method (2) 60	Method (2) 55	Method (2) 55	Method (2) 50	Method (1) —
	100 MHz (E Field)				100	120	105	105	90	115	110	110	100	100
	500 MHz (E Field)				100	120	100	100	90	110	100	100	100	100
	2 GHz (Plane Wave)		Method (2) MIL-G-83528 Para 4.6.12 (Q)		100	115	90	85	90	105	95	95	90	90
	10 GHz (Plane Wave)				100 110		90	85	90	100	90	90	80	80
Electrical Stability		ohm-cm, max.	CEPS-0002[a]		0.008	—	—	—	—	—	—	—	—	0.01
	Heat Aging		MIL-G-83528 Para. 4.6.15 (Q/C)		—	0.010	0.008[g]	0.0125[h]	0.05[h]	0.010	0.015	0.015	0.06[g]	—
	Vibration Resistance	During	MIL-G-83528 (Q) Para. 4.6.13 (Q)		—	0.010	NA	NA	NA	0.012	0.015	0.015	0.06	—
		After			—	0.005	NA	NA	0.05	0.008	0.012	0.012	0.02	—
	Post Tensile Set Volume Resistivity		MIL-G-83528 Para. 4.6.9 (Q/C)		—	0.010	—	—	NA	0.015	0.015	0.015	NA	—
	EMP Survivability, kA per in. perimeter		MIL-G-83528 Para. 4.6.16 (Q)		—	>0.9	NA	NA	—	>0.9	>0.9	>0.9	>0.3	—

a Copies of CEPS-0002 and CHO-TM-TP08 are available from Chomerics

b Compression set is expressed as a percentage of deflection per ASTM D395 Method B., at 25% deflection. To determine percent recovery, subtract 1/4 of stated compression set value from 100%. For example, in the case of 30% compression set, recover y is 92.5%.

c Where two values are shown: First represents max. operating temp. for conformance to MIL-G-83528 (which requires Group A life t esting at 1.25 times max. operating temp.) Second value represents practical limit for exposure up to 1000 hours (compressed between flanges 7-10%). Single value c onforms to both definitions.

g Heat aging condition: 200°C/48 hrs.

h Heat aging condition: 100°C/48 hrs.

■ Not available in extruded form.

● Not available in sheet or molded form.

NA Not Applicable

(Q) Qualification

(C) QC Conformance

continued

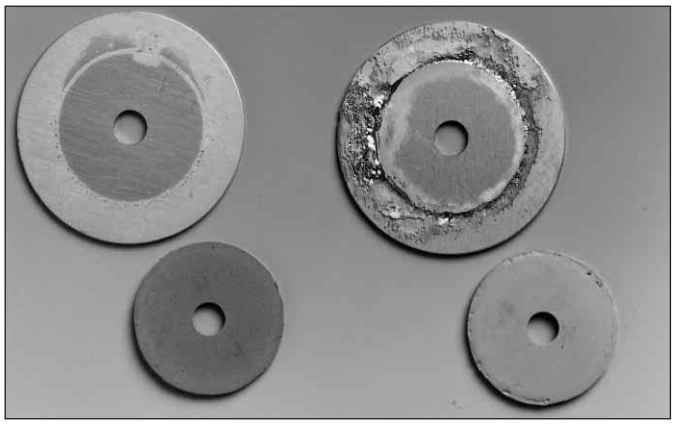
Note: **It may not be inferred that the same level of shielding effectiveness provided by a gasket material tested in the fixture per M IL-G-83528 Para. 4.6.12 would be provided in an actual equipment flange, since many mechanical factors of the flange design (tolerances, stiffness, fastener location, and size, etc.) could lower or enhance shielding effectiveness. This procedure provides data applicable only to the test fixture design of MIL-G-83528, but which is useful for making comparisons between dif ferent gasket materials.**

survivability beyond 5 kA/in. Test data is available on request.

Ordering Information

CHO-SEAL 1298 gaskets are available in all standard forms including molded, die-cut and extruded. The material is also available reinforced with Dupont Dacron® fabric, woven wire mesh and/or 3M Nextel® fabric. See page 76 for more information.

For more information on corrosion control, refer to the EMI Shielding Theory and Design Guide, which begins on page 191.



Comparison of corrosion results obtained from CHO-SEAL 1298 conductive elastomer (left) and pure silver-filled elastomer (right) mated with chromated aluminum for 168 hours of salt fog exposure.

Table 3 *continued*

CONDUCTIVE ELASTOMER SPECIFICATIONS (grouped by filler)											
		Test Procedure (Type of Test)	CHO-SEAL 1350	CHO-SIL 1356●	CHO-SEAL L6303	CHO-SEAL S6304	CHO-SEAL S6305	CHO-SEAL E6306■	CHO-SEAL 6370▲	CHO-SEAL S6600	CHO-SEAL S6602■
Conductive Filler			Ag/Glass	Ag/Glass	Ni/C	Ni/C	Ni/C	Ni/C	Ni/C	C	C
Elastomer Binder			Silicone	Silicone	Fluoro-silicone	Silicone	Silicone	EPDM	Silicone	Silicone	Silicone
Type (Ref. MIL-G-83528)			Type M	—	—	—	—	—	—	—	—
Volume Resistivity, ohm-cm, max., as supplied (without pressure-sensitive adhesive)		CEPS-0002[a]	—	0.05	—	—	—	—	0.1	7.0	8.0
		MIL-G-83528 Para. 4.6.11	0.01	—	0.1	0.1	0.1	5	—	—	—
Hardness (Shore A)		ASTM D2240 (Q/C)	65 ±5	55 ±10	65 ±10	55 ±10	65 ±10	75 ±7	60 ±10	75 ±7	65 ±7
Specific Gravity (±0.25)		ASTM D792 (Q/C)	1.8	1.7	2.2	1.9	2.0	1.9	2.1	1.2	1.2
Tensile Strength, psi (MPa), min.		ASTM D412 (Q/C)	150 (1.03)	100 (0.69)	150 (1.03)	150 (1.03)	200 (1.38)	200 (1.38)	150 (1.03)	650 (4.49)	550 (3.80)
Elongation, % min. or % min./max.		ASTM D412 (Q/C)	75	50	60	100	100	75	100	70	100
Tear Strength, lb/in. (kN/m), min.		ASTM D624 (Q)	30/25[j]	20 (3.50)	35 (6.13)	35 (6.13)	50 (8.75)	70 (12.25)	35 (6.13)	—	—
Compression Set, 70 hrs @ 100°C, % max.[b]		ASTM D395 Method B (Q)	30	35	25	30	30	40	40	45	45
Low Temperature Flex TR10, °C, min.		ASTM D1329 (Q)	–55	–40	–45	–45	–45	–45	–45	–45	–45
Maximum Continuous Use Temperature, °C[c]		(Q)	160	160	150	150	150	100	150	200	200
Shielding Effectiveness (see Note below)		Method (1) CHO-TM-TP08[a]	Method (2)	Method (1)	Method (2)	Method (1)	Method (1)	Method (2)	Method (1)	Method (1)	Method (1)
dB, min.	200 kHz (H Field)		50	—	NA	NA	NA	—	—	—	—
	100 MHz (E Field)		100	65	100	100	100	95	100	80	80
	500 MHz (E Field)		100	65	100	100	100	90	100	80	80
	2 GHz (Plane Wave)	Method (2) MIL-G-83528 Para 4.6.12 (Q)	90	70	100	100	100	85	95	60	60
	10 GHz (Plane Wave)		80	65	100	100	100	85	95	50	50
Electrical Stability		CEPS-0002[a]	—	0.05	0.25[i]	0.25[i]	0.25[i]	—	0.25[i]	7.0	8.0
ohm-cm, max.	Heat Aging	MIL-G-83528 Para. 4.6.15 (Q/C)	0.01	—	—	—	—	10[h]	—	—	—
	Vibration Resistance During	MIL-G-83528 (Q) Para. 4.6.13 (Q)	NA	—	0.1	NS	0.1	NA	—	—	—
	Vibration Resistance After		NA	—	0.1	NS	0.1	NA	—	—	—
	Post Tensile Set Volume Resistivity	MIL-G-83528 Para. 4.6.9 (Q/C)	0.01	—	—	—	—	NA	—	—	—
	EMP Survivability, kA per in. perimeter	MIL-G-83528 Para. 4.6.16 (Q)	NS	—	0.1	0.1	0.1	NA	—	—	—

a Copies of CEPS-0002 and CHO-TM-TP08 are available from Chomerics

b Compression set is expressed as a percentage of deflection per ASTM D395 Method B., at 25% deflection. To determine percent recovery, subtract 1/4 of stated compression set value from 100%. For example, in the case of 30% compression set, recovery is 92.5%.

c Where two values are shown: First represents max. operating temp. for conformance to MIL-G-83528 (which requires Group A life testing at 1.25 times max. operating temp.) Second value represents practical limit for exposure up to 1000 hours (compressed between flanges 7-10%). Single value conforms to both definitions.

h Heat aging condition: 100°C/48 hrs.

i Heat aging condition: 150°C/48 hrs.

j First value represents conformance to MIL-G-83528.

■ Not available in extruded form.

● Not available in sheet or molded form.

NA Not Applicable

NS Not Survivable

(Q) Qualification

(C) QC Conformance

▲ UL 94V-0 Rated

Note: **It may not be inferred that the same level of shielding effectiveness provided by a gasket material tested in the fixture per MIL-G-83528 Para. 4.6.12 would be provided in an actual equipment flange, since many mechanical factors of the flange design (tolerances, stiffness, fastener location, and size, etc.) could lower or enhance shielding effectiveness. This procedure provides data applicable only to the test fixture design of MIL-G-83528, but which is useful for making comparisons between different gasket materials.**

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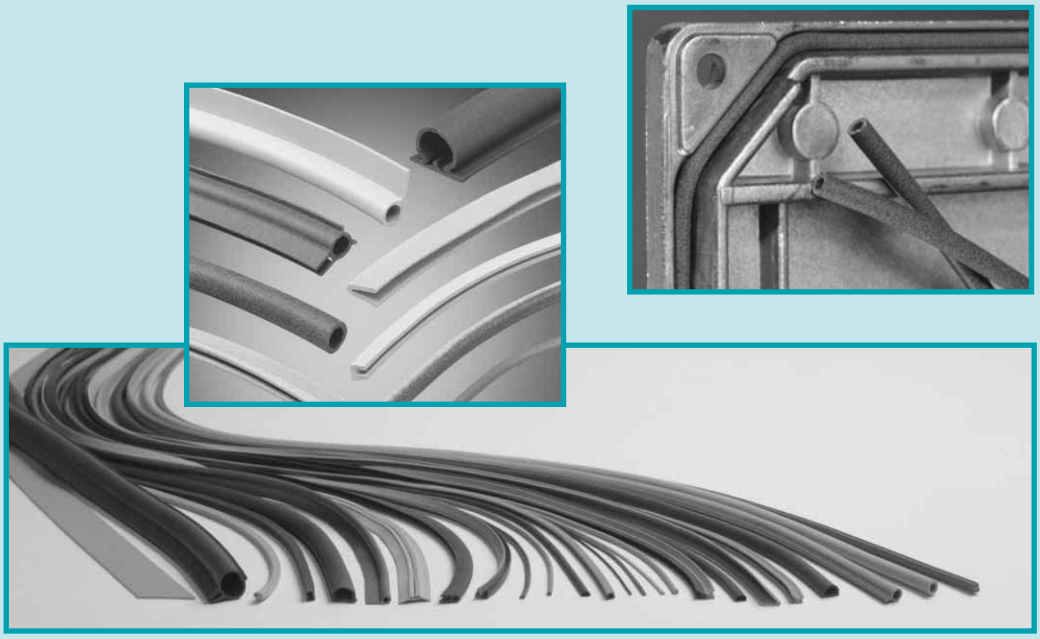
South America **TEL** +(55) 11 3917 1099 **FAX** +(55) 11 3917 0817

Parker Seals

Conductive Elastomer Extrusions...



Availability, Design Flexibility, Cost Effectiveness, Proven Performance.

Once used mainly to shield critical defense and aerospace electronic systems, Chomerics' conductive elastomer extrusions have also become the progressive choice for packaging designers of telecommunications, information technology and industrial equipment.

Conductive elastomers are reliable over the life of the equipment. The same gasket is both an EMI shield and an environmental seal. Elastomer gaskets resist compression set, accommodate low closure force, and help control airflow. They're available in corrosion-resistant and flame-retardant grades. Their aesthetic advantages are obvious.

Almost any elastomer profile can be extruded, with short lead times for prototypes and large orders. Chomerics offers hundreds of standard extrusions, many off-the-shelf from a nearby distributor/ fabricator. Extrusions are readily lathe-cut, spliced, bonded, kiss-cut, or even die-cut to reduce installation labor and conserve material, providing a cost-effective alternative to other methods of EMI shielding and environmental sealing.

Elastomer Extrusions

Standard Extrusions—a huge selection (pages 41-47)

Our elastomer extrusions are hollow or solid strips in sizes ranging from a 0.028 inch (0.71 mm) solid O cross section to a 2.00 inch (50.8 mm) wide flat ribbon. Existing tooling available in hundreds of sizes allows immediate production of standard profiles:

Solid O
Hollow O
Solid D
Hollow D
"Mushroom" D
(U.S. Pat. 06075205)
Solid Rectangle
Hollow Rectangle
Channel
Hollow P
Open V

Standard profiles are efficient for the great majority of applications. Even problematic low closure force can be accommodated by lightweight, hollow gasketing.

There is generally no tooling charge for standard items. If needed, tooling of new dies for standard profiles is relatively inexpensive. Moreover, extrusions minimize material waste and don't require post-manufacture processing to remove flash. Subject only to packaging constraints, extrusions are produced as continuous lengths on reels.

Custom shapes in endless variety (pages 48-54)

Chomerics routinely produces elastomer extrusions in unusual sizes and intricate configurations to meet special needs. Refer to page 48 to explore nearly 200 specialized designs for which tooling already exists. This showcase illustrates the variety and complexity that can be incorporated into extruded elastomers.

Flame-retardant grade CHO-SEAL® 6370

Chomerics introduced the first conductive elastomer with a UL 94V-0 rating* down to 0.014 inch (0.356 mm) thickness. This fully-extrudable material is a corrosion-resistant, nickel-plated-graphite filled composite with shielding effectiveness equivalent to or better than other commercial grade gaskets: 95 dB from 100 MHz to 10 GHz.

UL File # 96ME 17043

Co-Extrusions streamline design, reduce expense (pages 55-57)

Co-extruded gaskets typically feature a conductive CHO-SEAL elastomer in parallel with a non-conductive elastomer that provides additional environmental sealing and corrosion protection. Seam vulcanization ensures long-term integrity.

Co-extruded gaskets permit cost-effective use of existing flange designs, as well as attachment under the less-expensive, non-conductive material. Compared to bonding and mounting separate gaskets, or double-groove designs, co-extruded gaskets offer design, cost and handling advantages.

Full-Service Fabrication

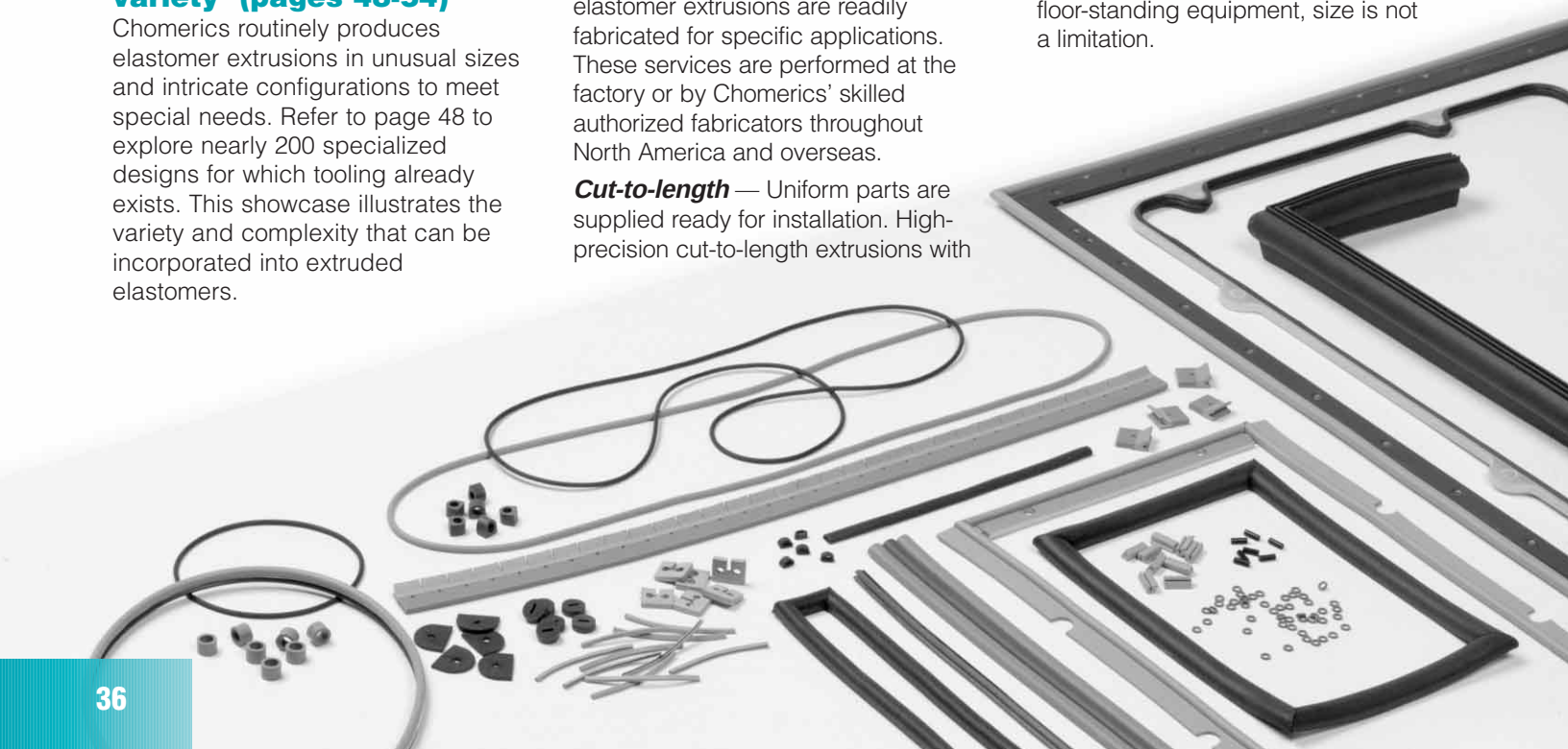
Often cost-competitive for both small and large volumes, conductive elastomer extrusions are readily fabricated for specific applications. These services are performed at the factory or by Chomerics' skilled authorized fabricators throughout North America and overseas.

Cut-to-length — Uniform parts are supplied ready for installation. High-precision cut-to-length extrusions with tolerances similar to molded part tolerances are available using the cutting technology of Parker Seal's JBL Division.

Spliced gaskets — For fabricated gaskets with a minimum inside diameter of 2 inches (51 mm), extruded strips can be spliced to form a continuous seal. Spliced gaskets offer cost savings over molded gaskets without sacrificing performance. In particular, spliced hollow extrusions yield lightweight, low closure force gaskets at considerable savings. For solid extrusions, the splice is often as strong and resilient as the gasket material's tensile specification (except fluorosilicone).

Gaskets spliced by Chomerics or our authorized fabricators feature a vulcanized joint, formed under heat and pressure, that ensures functionality and a more uniform joint compared with adhesive bonding. For use with retention grooves, corner radii must be equal to or greater than 2.5 times the strip width.

Frame assemblies — Chomerics fabricates complete frame/gasket assemblies either in their entirety or using customer-supplied parts. These incorporate vulcanized joints and miters, and often more than one gasket material or profile. With experience ranging from handheld devices to floor-standing equipment, size is not a limitation.



Bonded gaskets — Similar and dissimilar compositions and profiles can be bonded in parallel for special requirements. Capabilities include bonded-in compression stops, holes and other features.

Small, die-cut gaskets from flat extrusions — Standard rectangular extrusions up to 2 inches (51 mm) wide can provide an economical means of producing die-cut gaskets for some applications.

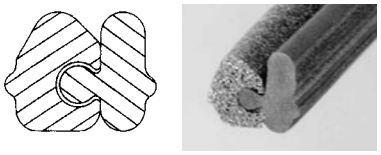
Precision washer cuts — Slicing solid and hollow O-cross sections into disks and washers can save time and cost, with tolerances equivalent to molded parts. For extremely thin parts, <0.060 inch (1.52 mm), Chomerics accesses the advanced production capabilities of Parker Seal's JBL Division (www.parker.com/jbl).

Kiss-cut grounding pads on tape — For manual "peel and stick" or robotic "pick and place" application, grounding pads are readily produced in quantity by kiss-cutting hollow D (or other) extrusions to their PSA release tape. Features such as holes or slots can be incorporated, and co-extrusions may be used. Continuous lengths are supplied on reels.

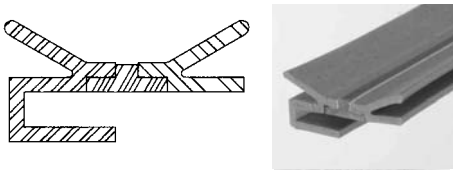
continued

Speed assembly with creative and efficient attachment mechanisms ...

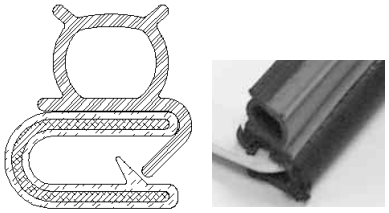
Tight spaces, weight limits and housing material properties are no problem for Chomerics' elastomer extrusions. Standard elastomer extrusions (except O-strips) can be ordered with pressure-sensitive adhesive. Alternative mounting options offer cost-effective choices in materials and assembly, as well as cosmetic appearance. Here are just a few Chomerics designs that eliminate adhesives, screws and rivets, while adding considerable speed to system assembly. Refer also to the Custom Extrusions Showcase, pages 48-57.



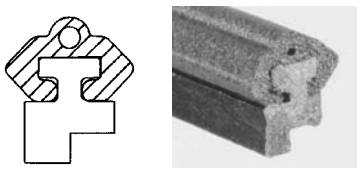
2-Part "Zipper" — Friction-fit designs using two gasket materials — conductive/conductive, conductive/non-conductive, fluorosilicone/silicone, etc. Especially appropriate for nuclear/biological/chemical (NBC) resistant applications or other environmental concerns.



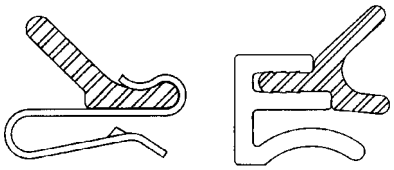
Hollow "E" — Adhesive-free, aesthetic design for attachment beneath an interior door "plate", presenting an easily compressed hollow profile.



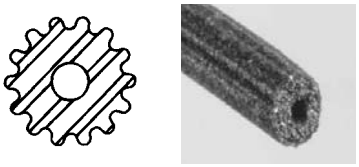
Metal Clip Extrusion — Conductive elastomer with integral metal clip. The clip provides mechanical attachment that conveniently replaces adhesive or bonding measures.



Friction-fit to a packaging feature — Gaskets that mount on integral tangs accommodate thin walls, limited space and intricate package shapes... without glue, rivets or tape.

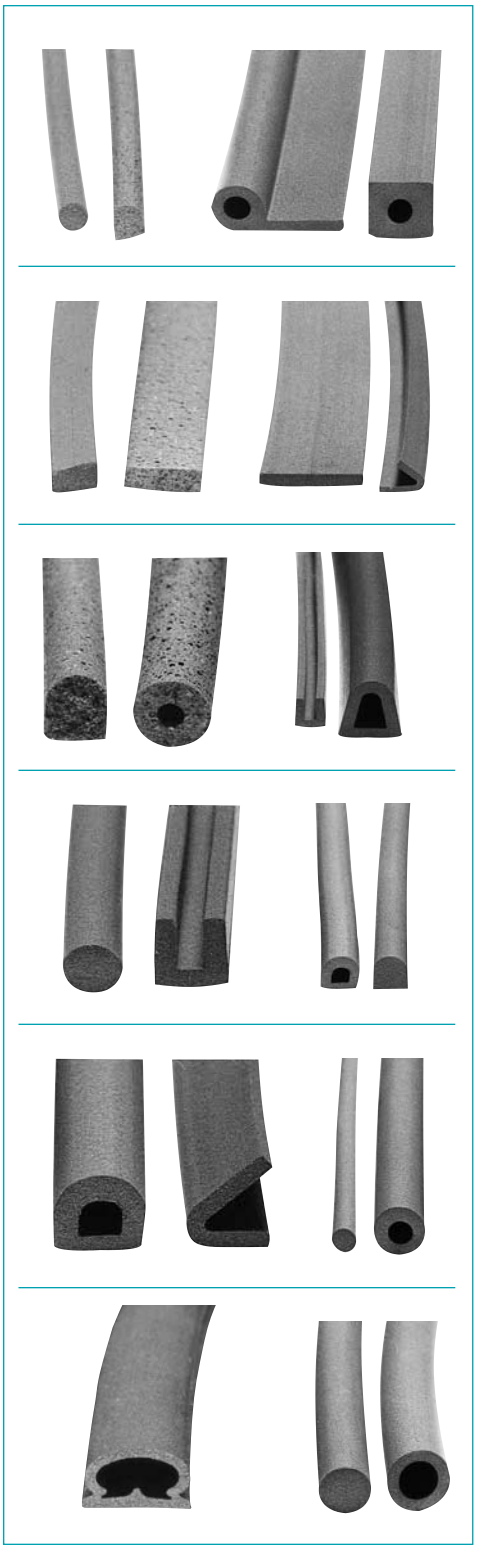


Clip-on Gaskets — Choice of conductive elastomer secured in a rapidly installed, corrosion-resistant, stainless steel spring clip. Integral teeth bite through paint or surface oxides. Plastic clip-on strips are also available. The conductive elastomer extrusion is sandwiched between the enclosure flange and closed cover.



Ribbed Profiles — Friction-fit option for exceptionally secure mounting in grooves, available in a broad range of Chomerics' high performance conductive elastomers.

Our Applications Engineering specialists provide shielding gasket approaches that reduce overall manufacturing costs.



Ordering Procedure

For standard configurations, select the Chomerics part number from Tables 7-16. The last four or five digits designate the material type. Orders must also specify quantity in length (feet or meters). Please note that minimum order quantities may apply. Subject only to packaging constraints, the gaskets are shipped in continuous lengths on reels.

For custom configurations, cut-to-length parts, or spliced strips, drawings must be provided. Part numbers for these will be assigned by Chomerics.

Table 1

EXTRUDED STRIP GASKETS *inch (mm)*	TOLERANCE
Cut Length	
<1.000 (25.40)	±0.010 (0.25)
1.0 to 30.000 (25.40 to 762)	±0.062 (1.58)
> 30.000 (762)	±0.2% Nom. Dim.
Cross Section	
< 0.200 (5.08)	±0.005 (0.13)
0.200-0.349 (5.08-8.86)	±0.008 (0.20)
0.350-0.500 (8.89-12.70)	±0.010 (0.25)
> 0.500 (12.70)	±3% Nom. Dim.

General Tolerances

The table above provides general tolerances for extruded conductive elastomer gaskets. It is important to note that *all flat die-cut, molded, and extruded gaskets are subject to free-state variation in the unrestrained condition*. The use of inspection fixtures to verify conformance of finished parts is common and recommended where appropriate.

Material Selection and Manufacturing Limitations

The extruded strips listed in this section are generally available in the CHO-SEAL and CHO-SIL materials enumerated at the top of the next column, specifications for which are shown on pages 32-34. The physical characteristics of certain materials, however, make them unextrudable in very small sizes. General manufacturing limitations are shown in Table 2 (opposite). Specific material **exceptions (non-availability)** are denoted by numerical superscripts following certain part numbers in Tables 7-16. The superscripts are defined as follows:

Code	Material
1	1215, 1273, S6304, S6305, 6370, S6600
2	1217, 1221, 1224, 1350, L6303
3	1285, 1287, 1298, 1356, 1485
4	1401

Pressure-Sensitive Adhesive (PSA)

Chomerics' extruded conductive elastomer EMI gaskets are available with tenacious, non-conductive pressure-sensitive adhesive (PSA) tape for permanent attachment. Typical properties for this adhesive are shown in Table 3. Peel strength data appears in Table 4. These acrylic pressure-sensitive adhesives do not appreciably affect the through-flange resistance of the EMI gasket (see Table 5). Rapid thermal cycle testing does not affect peel strength (see Table 6).

Pressure-Sensitive Adhesive Widths, inch (mm)

0.090 (2.29)	0.220 (5.08)
0.100 (2.54)	0.250 (6.35)
0.125 (3.17)	0.500 (12.70)
0.160 (4.06)	

In general, pressure-sensitive adhesive requires a minimum of 0.125 inch (3.17 mm) mating surface. For this reason, Chomerics does not ordinarily supply pressure-sensitive adhesive on solid or hollow O-strips.

PSA Ordering Procedure

Pressure-sensitive adhesive may be ordered for any standard extrusion (other than Solid and Hollow O-Strips) which has a 0.125 inch (3.17 mm) mating surface. The standard Part Numbers listed in Tables 9-15 must be modified by Chomerics to designate pressure-sensitive adhesive. Contact us for this information.

continued

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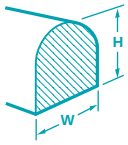
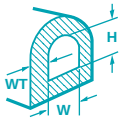
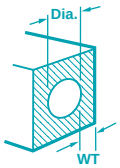
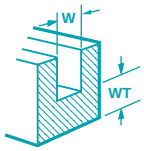
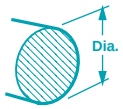
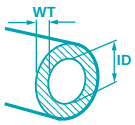
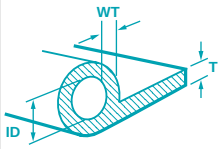
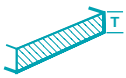
Table 2

EXTRUSION MANUFACTURING GUIDELINES & LIMITATIONS, inches (mm)
Minimum dimensions allowed for manufacturing consistency

	 Solid D		 Hollow D			 Hollow Rect.		 Channel		 Solid O	 Hollow O		 Hollow P			 Rectangular
Mat'l	**H**	**W**	**WT**	**H**	**W**	**Dia.**	**WT**	**WT**	**W**	**Dia.**	**WT**	**ID**	**WT**	**T**	**ID**	**T***
1215	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1217	0.035 (0.89)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.035 (0.89)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1221	0.035 (0.89)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.035 (0.89)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1224	0.035 (0.89)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.035 (0.89)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1273	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1285	0.040 (1.02)	0.040 (1.02)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.040 (1.02)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1287	0.040 (1.02)	0.040 (1.02)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.040 (1.02)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1298	0.040 (1.02)	0.040 (1.02)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.040 (1.02)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1350	0.035 (0.89)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.035 (0.89)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1356	0.040 (1.02)	0.040 (1.02)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.040 (1.02)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
1401	0.062 (1.57)	0.062 (1.57)	0.045 (1.14)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.045 (1.14)	0.045 (1.14)	0.020 (0.51)	0.062 (1.58)	0.045 (1.14)	0.020 (0.51)	0.045 (1.14)	0.045 (1.14)	0.045 (1.14)	0.045 (1.14)
1485	0.040 (1.02)	0.040 (1.02)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.040 (1.02)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
L6303	0.035 (0.89)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.032 (0.81)	0.032 (0.81)	0.020 (0.51)	0.035 (0.89)	0.020 (0.51)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
S6304	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
S6305	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
S6600	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
6370	0.035 (0.89)	0.035 (0.89)	0.020 (0.51)	0.040 (1.02)	0.040 (1.02)	0.020 (0.51)	0.025 (0.64)	0.020 (0.51)	0.020 (0.51)	0.028 (0.71)	0.015 (0.38)	0.020 (0.51)	0.020 (0.51)	0.030 (0.76)	0.045 (1.14)	0.031 (0.79)
E6434E	For Solid O, min. dia. is 0.139 (3.53). For other cross sections, min. wall thickness is 0.062 (1.57). Not all cross sections are available. Contact Applications Engineering.															

*Maximum width of 1.00 (25.4) at minimum thickness of 0.031 (0.79).
Dimensions shown in inches. 1 inch = 25.4 mm.

Consult Chomerics' Applications Engineering Department concerning material compatibility for smaller dimensions and custom extrusions.

(PSA Attachment, continued)

Table 3

PRESSURE-SENSITIVE ADHESIVE TYPICAL PROPERTIES	
Adhesive Description	Pressure-sensitive acrylic with release liner
Service Temperature Range	–20 to +150°F (–29 to +66°C); PSA will function for short periods of time @ 200°F (93°C); ultimate high temperature limit 250°F (121°C)
Shelf Life Conditions	One year at 158°F (70°C)/50% RH
Application Temperature Range	40 to 150°F (4 to 66°C)

Table 4

TYPICAL PEEL STRENGTH *lb/inch (N/mm)*		
Property	**On Aluminum**	**On Steel**
Initial Peel Strength	6.0 (1.05)	6.0 (1.05)
Heat Aged Peel Strength*	5.4 (0.945)	5.4 (0.945)
Humidity Peel Strength**	6.0 (1.05)	6.0 (1.05)

Peel Strength Test Data Per ASTM D1000 (90° peel).
* Heat aging 168 hrs / 158°F (70°C).
** Humidity 168 hrs / 95% RH / 158°F (70°C).

Table 5

TYPICAL THROUGH FLANGE ELECTRICAL RESISTANCE			
Chomerics P/N 10-05-3369-S6304 (Ni/C filled silicone)		**@ 10% deflection**	**@ 25% deflection**
Hollow "D" Shape Extrusion	w/PSA	0.23 ohm	0.14 ohm
	w/out PSA	0.16 ohm	0.14 ohm

Table 6

RAPID THERMAL CYCLING* *lb/inch (N/mm)*		
Conductive Elastomer	**Flange**	**Peel Strength (90°)**
CHO-SEAL 1485 (Silver-Plated-Aluminum-Filled Silicone)	Steel	7.0 (1.23)
	Aluminum	7.0 (1.23)
CHO-SEAL S6304 (Nickel-Plated-Graphite-Filled Silicone)	Steel	6.5 (1.14)
	Aluminum	5.5 (0.96)

*Per ASTM D1000; 5 cycles at –48° to 212°F (–40° to 100°C) with dwell time of 15 minutes at each extreme.

Instructions for Surface Preparation and Installing Gaskets with PSA

Surface Preparation of Metallic Substrates

Optimal performance of the pressure-sensitive adhesive requires that the substrates to which these gaskets must adhere are cleaned prior to application. Chomerics has developed specific, easy-to-follow procedures for preparing the following substrates:

- Phosphate-Coated Steel
- Conversion-Coated Aluminum
- Stainless Steel and Mild Steel

It is essential to follow these cleaning instructions to ensure maximum adhesion of the PSA to metal substrates. *Failure to comply with the appropriate cleaning process could result in poor adhesion. Proper safety precautions should be followed to protect the operator.*

Materials Required:

3M Scotch Brite Pads or equivalent, Rubber Gloves, Safety Glasses, Lint-Free Cotton Wipes; MEK, Acetone or Isopropyl Alcohol (IPA).

Surface Preparation of Conversion-Coated Aluminum and Phosphate-Coated Steel

A. Using a clean, lint-free applicator, moistened with MEK, acetone solvent or IPA, wash the aluminum surface until all traces of contamination have been removed.
B. Clean the surface until the cotton applicator shows no discoloration.
C. If discoloration still exists, continue washing, changing the cotton applicator each time, until clean.

Note: With phosphate coatings, it is very hard to remove all discoloration from the surface so it is ***up to the operator*** *to determine the cleanliness of the surface prior to bonding. Typically, cleaning the surface 3 times is required.*

D. Allow the substrate to dry completely at room temperature. After the cleaning sequence is complete, do not touch the substrate with bare hands.
E. If the cleaned surfaces do not have the PSA applied within an 8-hour period, rewash using the above process.

Surface Preparation of Stainless Steel and Mild Steel

A. Using a 3M Scotch Brite pad or equivalent, lightly abrade the steel surface.
B. Blow the dust residue off the steel surface with oil-free filtered air.
C. Follow Steps A through E from previous section to complete surface preparation.

Gasket Installation Procedure

A. Cut gasket material to specific lengths per drawing. If gasket is one piece (e.g., four corner spliced gasket), pre-fit the assembly to ensure fit and location.
B. Remove a portion of the release liner and position the gasket. Press firmly against gasket to tack in place. Continue pressing along entire length of gasket until it is positioned and aligned to the mating surface.
C. Using a rubber roller, apply moderate pressure to the entire gasket to ensure complete contact between the PSA and substrate.

Note: It is important during this rolling procedure that the operator not apply excessive pressure to the gasket. Extreme pressure will cause the gasket to elongate and creep as it relaxes, which may cause an intermittent bond to the substrate surface.

Optimum Application Temperature

Temperatures below 50°F (10°C) can cause poor gasket adhesion to the substrate. Ideal gasket installation temperature is 72°F (22°C), ambient room temperature. All materials should be stored at this temperature when not in use. Hardware and gasket materials stored below 50°F should be brought to room temperature before installing gasket.

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Parker Seals

Standard Extrusion Sizes

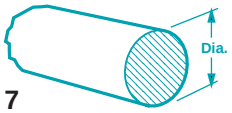

Table 7

SOLID O-STRIPS			
Chomerics P/N* MIL P/N: M83528 001X†-( )	Nominal Dimension [Dia.]	"Rule of Thumb" Groove Dimensions††	
		Depth	Width
19-04-12895-XXXX[2,3,4]	0.028 (0.71)	0.018 (0.46)	0.055 (1.40)
19-04-W993-XXXX[2,3,4]	0.030 (0.76)	0.020 (0.51)	0.056 (1.42)
19-04-12896-XXXX[2,3,4]	0.032 (0.81)	0.022 (0.56)	0.056 (1.42)
19-04-12897-XXXX[2,3,4]	0.033 (0.84)	0.023 (0.58)	0.056 (1.42)
10-04-6386-XXXX (001)	0.040 (1.02)	0.029 (0.74)	0.061 (1.55)
10-04-9139-XXXX	0.048 (1.22)	0.037 (0.94)	0.065 (1.65)
10-04-C317-XXXX	0.050 (1.27)	0.038 (0.97)	0.068 (1.73)
10-04-3560-XXXX (002)	0.053 (1.35)	0.041 (1.04)	0.070 (1.78)
19-04-X294-XXXX	0.060 (1.52)	0.047 (1.19)	0.076 (1.93)
10-04-2561-XXXX (003)	0.062 (1.57)	0.049 (1.24)	0.077 (1.96)
10-04-1687-XXXX (004)	0.070 (1.78)	0.056 (1.42)	0.084 (2.13)
19-04-12898-XXXX	0.074 (1.88)	0.060 (1.52)	0.087 (2.21)
19-04-11228-XXXX	0.075 (1.91)	0.061 (1.55)	0.087 (2.21)
19-04-12899-XXXX	0.077 (1.96)	0.063 (1.60)	0.089 (2.26)
19-04-12900-XXXX	0.079 (2.01)	0.064 (1.63)	0.091 (2.31)
10-04-2657-XXXX (005)	0.080 (2.03)	0.065 (1.65)	0.092 (2.34)
19-04-12901-XXXX	0.085 (2.16)	0.069 (1.75)	0.097 (2.46)
19-04-M394-XXXX	0.090 (2.29)	0.073 (1.85)	0.102 (2.59)
10-04-2865-XXXX (006)	0.093 (2.36)	0.076 (1.93)	0.104 (2.64)
10-04-3509-XXXX	0.100 (2.54)	0.082 (2.08)	0.110 (2.79)
10-04-1720-XXXX (007)	0.103 (2.62)	0.084 (2.13)	0.114 (2.90)
19-04-12902-XXXX	0.106 (2.69)	0.087 (2.21)	0.114 (2.90)

continued

Table 7 *continued*

SOLID O-STRIPS			
Chomerics P/N* MIL P/N: M83528 001X†-( )	Nominal Dimension [Dia.]	"Rule of Thumb" Groove Dimensions††	
		Depth	Width
10-04-2866-XXXX	0.112 (2.84)	0.092 (2.34)	0.121 (3.07)
10-04-3077-XXXX (008)	0.119 (3.02)	0.098 (2.49)	0.128 (3.25)
10-04-2463-XXXX (009)	0.125 (3.18)	0.102 (2.59)	0.135 (3.43)
10-04-2862-XXXX	0.130 (3.30)	0.107 (2.72)	0.138 (3.51)
19-04-12903-XXXX	0.134 (3.40)	0.110 (2.79)	0.143 (3.63)
10-04-1721-XXXX (010)	0.139 (3.53)	0.114 (2.90)	0.147 (3.73)
19-04-12904-XXXX	0.147 (3.73)	0.120 (3.05)	0.156 (3.96)
10-04-3982-XXXX	0.150 (3.81)	0.123 (3.12)	0.158 (4.01)
19-04-12906-XXXX	0.158 (4.01)	0.129 (3.28)	0.166 (4.22)
19-04-12905-XXXX	0.159 (4.04)	0.130 (3.30)	0.167 (4.24)
10-04-3231-XXXX	0.160 (4.06)	0.131 (3.33)	0.168 (4.27)
19-04-12907-XXXX	0.170 (4.32)	0.139 (3.53)	0.178 (4.52)
19-04-F371-XXXX (011)	0.188 (4.78)	0.154 (3.91)	0.195 (4.95)
19-04-12908-XXXX	0.195 (4.95)	0.160 (4.06)	0.201 (5.11)
10-04-2864-XXXX (012)	0.216 (5.49)	0.177 (4.50)	0.227 (5.77)
19-04-12909-XXXX	0.219 (5.56)	0.179 (4.55)	0.231 (5.87)
19-04-11453-XXXX	0.220 (5.59)	0.180 (4.57)	0.232 (5.89)
19-04-12910-XXXX	0.236 (5.99)	0.193 (4.90)	0.247 (6.27)
19-04-12911-XXXX	0.247 (6.27)	0.202 (5.13)	0.258 (6.55)
10-04-3076-XXXX (013)	0.250 (6.35)	0.205 (5.21)	0.260 (6.60)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

†† ***Note:*** The groove dimensions recommended assume groove tolerance of ±0.002 in. (0.05 mm) for standard solid O- and D-strips. Closure for ces are assumed to provide maximum and uniform gasket deflection. If these conditions are not attainable,contact Chomerics' Applications Engineering Department before ordering.

Additional sizes may be available. Please inquire.

continued

(mm dimensions in parentheses)

Table 7 *continued*

SOLID O-STRIPS			
Chomerics P/N* MIL P/N: M83528 001X†-( )	Nominal Dimension [Dia.]	"Rule of Thumb" Groove Dimensions††	
		Depth	Width
10-04-9769-XXXX	0.280 (7.11)	0.230 (5.84)	0.288 (7.32)
19-04-12912-XXXX	0.291 (7.39)	0.238 (6.05)	0.300 (7.62)
19-04-12913-XXXX	0.292 (7.42)	0.239 (6.07)	0.301 (7.65)
19-04-12914-XXXX	0.317 (8.05)	0.260 (6.60)	0.324 (8.23)
19-04-12915-XXXX	0.324 (8.23)	0.265 (6.73)	0.332 (8.43)
19-04-12916-XXXX	0.329 (8.36)	0.270 (6.86)	0.335 (8.51)
19-04-12917-XXXX	0.348 (8.84)	0.285 (7.24)	0.354 (8.99)
19-04-12918-XXXX	0.367 (9.32)	0.301 (7.65)	0.376 (9.55)
19-04-12919-XXXX	0.379 (9.63)	0.310 (7.87)	0.388 (9.86)
19-04-12920-XXXX	0.393 (9.98)	0.322 (8.18)	0.401 (10.19)
19-04-12921-XXXX	0.410 (10.41)	0.336 (8.53)	0.417 (10.59)
19-04-12922-XXXX	0.420 (10.67)	0.344 (8.74)	0.427 (10.85)
19-04-W337-XXXX	0.429 (10.90)	0.351 (8.92)	0.436 (11.07)
19-04-12923-XXXX	0.479 (12.17)	0.392 (9.96)	0.484 (12.29)
19-04-12924-XXXX	0.570 (14.48)	0.467 (11.86)	0.590 (14.99)
19-04-12925-XXXX	0.635 (16.13)	0.520 (13.21)	0.653 (16.59)
19-04-12926-XXXX	0.661 (16.79)	0.542 (13.77)	0.677 (17.20)
19-04-12927-XXXX	0.831 (21.11)	0.681 (17.30)	0.860 (21.84)
19-04-12928-XXXX	0.876 (22.25)	0.718 (18.24)	0.903 (22.94)
19-04-12929-XXXX	0.894 (22.71)	0.733 (18.62)	0.920 (23.37)
19-04-12930-XXXX	0.922 (23.42)	0.756 (19.20)	0.947 (24.05)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

†† ***Note:*** The groove dimensions recommended assume groove tolerance of ±0.002 in. (0.05 mm) for standard solid O- and D-strips. Closure for ces are assumed to provide maximum and uniform gasket deflection. If these conditions are not attainable, contact Chomerics' Applications Engineering Department before ordering.

Additional sizes may be available. Please inquire.

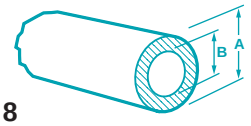

Table 8

HOLLOW O-STRIPS		
Chomerics P/N* MIL P/N: M83528 011X†-( )	Nominal Dimensions	
	A	B
19-04-11285-XXXX[2,3,4]	0.040 (1.02)	0.013 (0.33)
10-04-W201-XXXX[2,3,4]	0.053 (1.35)	0.032 (0.81)
10-04-W137-XXXX[4]	0.060 (1.52)	0.020 (0.51)
10-04-W163-XXXX[2,3,4]	0.062 (1.57)	0.035 (0.89)
19-04-14964-XXXX[4]	0.070 (1.78)	0.020 (0.51)
10-04-W202-XXXX[2,3,4]	0.073 (1.85)	0.049 (1.24)
19-04-13803-XXXX[2,3,4]	0.074 (1.88)	0.040 (1.02)
19-04-15465-XXXX[4]	0.080 (2.03)	0.030 (0.76)
19-04-14206-XXXX[4]	0.080 (2.03)	0.040 (1.02)
19-04-11204-XXXX[4]	0.081 (2.06)	0.020 (0.51)
19-04-12570-XXXX[2,3,4]	0.083 (2.11)	0.050 (1.27)
19-04-11220-XXXX[4]	0.090 (2.29)	0.050 (1.27)
10-04-W267-XXXX[4]	0.090 (2.29)	0.050 (1.27)
10-04-W293-XXXX[2,3,4]	0.090 (2.29)	0.060 (1.52)
10-04-W203-XXXX[2,3,4]	0.093 (2.36)	0.061 (1.55)
19-04-16162-XXXX[2,3,4]	0.100 (2.54)	0.070 (1.78)
19-04-11205-XXXX[4]	0.102 (2.60)	0.039 (0.99)
10-04-8363-XXXX[4] (007)	0.103 (2.62)	0.040 (1.02)
10-04-M211-XXXX[4]	0.103 (2.62)	0.040 (1.02)
19-04-10212-XXXX[4]	0.110 (2.79)	0.045 (1.14)
19-04-11218-XXXX[4]	0.110 (2.79)	0.045 (1.14)
19-04-14120-XXXX[4]	0.110 (2.79)	0.062 (1.57)
19-04-15278-XXXX[4]	0.110 (2.79)	0.068 (1.73)
19-04-12534-XXXX[2,3,4]	0.118 (3.00)	0.079 (2.01)
19-04-11216-XXXX[4]	0.122 (3.10)	0.061 (1.55)
19-04-11287-XXXX[4]	0.122 (3.10)	0.061 (1.55)
10-04-2999-XXXX[4] (001)	0.125 (3.18)	0.045 (1.14)
10-04-8817-XXXX[4] (006)	0.125 (3.18)	0.062 (1.57)
19-04-13564-XXXX[4]	0.125 (3.18)	0.070 (1.78)
10-04-W204-XXXX[4]	0.125 (3.18)	0.078 (1.98)
19-04-11283-XXXX[4]	0.125 (3.18)	0.080 (2.03)
10-04-W775-XXXX[4]	0.125 (3.18)	0.085 (2.16)
10-04-5514-XXXX[4]	0.130 (3.30)	0.045 (1.14)
19-04-16390-XXXX	0.135 (3.43)	0.045 (1.14)
19-04-16009-XXXX[4]	0.135 (3.43)	0.085 (2.16)
19-04-X787-XXXX[2,3,4]	0.135 (3.43)	0.097 (2.46)
19-04-14632-XXXX[4]	0.137(3.48)	0.087 (2.21)
19-04-11289-XXXX[4]	0.145 (3.68)	0.070 (1.78)
19-04-13118-XXXX[4]	0.145 (3.68)	0.080 (2.03)

continued

(mm dimensions in parentheses)

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Table 8 *continued*

HOLLOW O-STRIPS		
Chomerics P/N* MIL P/N: M83528 011X†-( )	**Nominal Dimensions**	
	A	**B**
19-04-14930-XXXX[4]	0.151 (3.84)	0.094 (2.39)
19-04-13545-XXXX[2,3,4]	0.153 (3.89)	0.115 (2.92)
10-04-4180-XXXX (002)	0.156 (3.96)	0.050 (1.27)
10-04-9732-XXXX[4]	0.156 (3.96)	0.080 (2.03)
19-04-11213-XXXX[2,3,4]	0.172 (4.37)	0.140 (3.56)
19-04-11293-XXXX[2,3,4]	0.175 (4.45)	0.144 (3.66)
10-04-8133-XXXX (008)	0.177 (4.50)	0.079 (2.01)
19-04-11415-XXXX	0.177 (4.50)	0.079 (2.01)
19-04-13189-XXXX[4]	0.177 (4.50)	0.110 (2.79)
19-04-11214-XXXX[4]	0.180 (4.57)	0.140 (3.56)
19-04-14537-XXXX[4]	0.189 (4.80)	0.111 (2.82)
10-04-4254-XXXX	0.190 (4.83)	0.080 (2.03)
19-04-12015-XXXX	0.207 (5.26)	0.077 (1.95)
19-04-15435-XXXX	0.207 (5.26)	0.090 (2.27)
19-04-E483-XXXX	0.210 (5.33)	0.093 (2.36)
19-04-15479-XXXX	0.210 (5.33)	0.120 (3.05)
19-04-C627-XXXX	0.216 (5.49)	0.090 (2.27)
10-04-2737-XXXX (003)	0.250 (6.35)	0.125 (3.18)
19-04-15434-XXXX	0.250 (6.35)	0.140 (3.56)
19-04-15443-XXXX[4]	0.250 (6.35)	0.187 (4.75)
19-04-14349-XXXX[4]	0.250 (6.35)	0.200 (5.08)
19-04-W049-XXXX	0.290 (7.36)	0.156 (3.96)
10-04-3221-XXXX	0.290 (7.36)	0.175 (4.45)
10-04-3004-XXXX (004)	0.312 (7.92)	0.192 (4.88)
19-04-13759-XXXX	0.348 (8.84)	0.250 (6.35)
19-04-14292-XXXX	0.373 (9.47)	0.200 (5.08)
10-04-3122-XXXX (005)	0.375 (9.53)	0.250 (6.35)
19-04-14467-XXXX	0.394 (10.01)	0.253 (6.43)
19-04-14290-XXXX	0.404 (10.26)	0.243 (6.17)
19-04-14291-XXXX	0.405 (10.29)	0.223 (5.66)
19-04-12338-XXXX	0.430 (10.92)	0.330 (8.38)
10-04-4034-XXXX	0.437 (11.10)	0.347 (8.81)
19-04-14731-XXXX	0.438 (11.13)	0.275 (6.99)
19-04-14138-XXXX	0.440 (11.18)	0.280 (7.11)
19-04-14261-XXXX	0.461 (11.71)	0.295 (7.49)
19-04-14139-XXXX	0.461 (11.71)	0.315 (8.00)
10-04-3649-XXXX	0.470 (11.94)	0.345 (8.76)
10-04-5572-XXXX	0.500 (12.70)	0.385 (9.78)
19-04-11651-XXXX	0.524 (13.31)	0.315 (8.00)
10-04-4155-XXXX	0.555 (14.10)	0.425 (10.80)
10-04-5515-XXXX	0.562 (14.27)	0.437 (11.10)

continued

Additional sizes may be available. Please inquire.

Table 8 *continued*

HOLLOW O-STRIPS		
Chomerics P/N* MIL P/N: M83528 011X†-( )	**Nominal Dimensions**	
	A	**B**
19-04-13764-XXXX	0.620 (15.75)	0.250 (6.35)
10-04-5516-XXXX	0.620 (15.75)	0.515 (13.08)
19-04-15181-XXXX	0.625 (15.88)	0.250 (6.35)
19-04-14326-XXXX	0.630 (16.00)	0.340 (8.64)
10-04-3652-XXXX	0.650 (16.51)	0.520 (13.21)
19-04-15342-XXXX	1.058 (26.87)	0.918 (23.32)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number , which should be inserted (without parentheses) at end of MIL P/N.

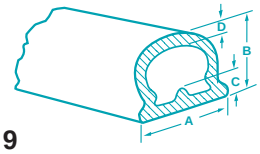

Table 9

"MUSHROOM" D-STRIPS†				
	Nominal Dimensions			
Chomerics P/N*	**A**	**B**	**C**	**D**
19-09-16503-XXXX[4]	0.265 (6.73)	0.312 (7.92)	0.113 (2.87)	0.040 (1.02)
19-09-16802-XXXX	0.315 (8.00)	0.301 (7.65)	0.109 (2.77)	0.053 (1.35)
19-05-14587-XXXX	0.487 (12.37)	0.324 (8.23)	0.115 (2.92)	0.050 (1.27)
19-09-14377-XXXX	0.625 (15.88)	0.375 (9.53)	0.106 (2.69)	0.057 (1.45)
19-09-14926-XXXX	0.625 (15.88)	0.400 (10.16)	0.106 (2.69)	0.057 (1.45)
19-09-15486-XXXX	0.846 (21.49)	0.472 (11.99)	0.120 (3.05)	0.053 (1.35)
19-09-15523-XXXX	0.890 (22.61)	0.730 (18.54)	0.183 (4.65)	0.065 (1.65)

† U.S. Patent No. 06075205

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

Pressure-Sensitive Adhesive *is available on any extrusion with a minimum 0.125 inch (3.17 mm) mating surface. Contact Chomerics to obtain modified Part Numbers. Refer to pages 38 and 40 for details.*

continued

(mm dimensions in parentheses)

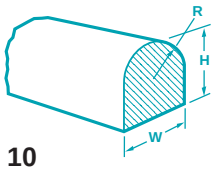

Table 10

SOLID D-STRIPS					
Chomerics P/N* MIL P/N: M83528 003X†-( )	Nominal Dimensions			"Rule of Thumb" Groove Dimensions ††	
	H	W	R (rad.)	Depth	Width
19-05-14769-XXXX[3,4]	0.062 (1.57)	0.035 (0.89)	0.018 (0.46)	0.028 (0.71)	0.076 (1.93)
10-05-5589-XXXX[4]	0.064 (1.63)	0.055 (1.40)	0.031 (0.79)	0.052 (1.32)	0.077 (1.96)
10-05-Z337-XXXX[4]	0.075 (1.90)	0.060 (1.52)	0.030 (0.76)	0.062 (1.57)	0.089 (2.26)
10-05-1362-XXXX	0.068 (1.73)	0.062 (1.57)	0.031 (0.79)	0.056 (1.42)	0.084 (2.13)
19-05-E163-XXXX	0.074 (1.88)	0.062 (1.57)	0.031 (0.78)	0.061 (1.55)	0.088 (2.23)
19-05-12883-XXXX	0.085 (2.16)	0.062 (1.57)	0.031 (0.78)	0.072 (1.83)	0.088 (2.23)
10-05-4699-XXXX	0.100 (2.54)	0.062 (1.57)	0.031 (0.79)	0.085 (2.16)	0.081 (2.06)
19-05-12887-XXXX[4]	0.055 (1.40)	0.064 (1.62)	0.032 (0.81)	0.044 (1.12)	0.101 (2.57)
10-05-E205-XXXX	0.095 (2.41)	0.070 (1.78)	0.035 (0.89)	0.081 (2.06)	0.097 (2.46)
10-05-1363-XXXX (003)	0.089 (2.26)	0.078 (1.98)	0.039 (0.99)	0.074 (1.88)	0.101 (2.57)
19-05-C497-XXXX	0.070 (1.78)	0.080 (2.03)	0.040 (1.02)	0.058 (1.47)	0.116 (2.95)
19-05-E329-XXXX	0.090 (2.29)	0.080 (2.03)	0.040 (1.02)	0.076 (1.93)	0.111 (2.82)
19-05-12888-XXXX	0.081 (2.06)	0.088 (2.23)	0.044 (1.12)	0.068 (1.73)	0.123 (3.12)
19-05-A611-XXXX	0.134 (3.40)	0.091 (2.31)	0.045 (1.14)	0.117 (2.97)	0.118 (3.00)
10-05-3224-XXXX (002)	0.078 (1.98)	0.094 (2.39)	0.047 (1.19)	0.065 (1.65)	0.115 (2.92)
19-05-Z586-XXXX (004)	0.094 (2.39)	0.094 (2.39)	0.047 (1.19)	0.080 (2.03)	0.128 (3.25)
19-05-C128-XXXX	0.115 (2.92)	0.102 (2.60)	0.051 (1.30)	0.099 (2.51)	0.134 (3.40)
10-05-1499-XXXX (008)	0.156 (3.96)	0.118 (3.00)	0.059 (1.50)	0.137 (3.48)	0.136 (3.45)
10-05-A283-XXXX	0.131 (3.33)	0.122 (3.10)	0.061 (1.55)	0.114 (2.90)	0.156 (3.96)
10-05-1364-XXXX (007)	0.135 (3.43)	0.122 (3.10)	0.061 (1.55)	0.118 (3.00)	0.140 (3.56)
19-05-F364-XXXX	0.135 (3.43)	0.124 (3.15)	0.062 (1.57)	0.118 (3.00)	0.158 (4.01)
19-05-F084-XXXX	0.125 (3.18)	0.125 (3.18)	0.062 (1.57)	0.108 (2.74)	0.161 (4.09)

Table 10 *continued*

SOLID D-STRIPS					
Chomerics P/N* MIL P/N: M83528 003X†-( )	Nominal Dimensions			"Rule of Thumb" Groove Dimensions ††	
	H	W	R (rad.)	Depth	Width
10-05-2618-XXXX (006)	0.110 (2.79)	0.150 (3.81)	0.075 (1.91)	0.095 (2.41)	0.165 (4.19)
19-05-F173-XXXX (009)	0.156 (3.96)	0.156 (3.96)	0.078 (1.98)	0.137 (3.48)	0.194 (4.93)
10-05-1577-XXXX (010)	0.175 (4.45)	0.178 (4.52)	0.089 (2.26)	0.154 (3.91)	0.195 (4.95)
19-05-A381-XXXX	0.200 (5.08)	0.187 (4.75)	0.093 (2.36)	0.177 (4.50)	0.228 (5.79)
19-05-12899-XXXX	0.205 (5.21)	0.187 (4.75)	0.093 (2.36)	0.179 (4.55)	0.234 (5.94)
19-05-W469-XXXX (011)	0.188 (4.78)	0.188 (4.78)	0.094 (2.39)	0.166 (4.22)	0.229 (5.82)
19-05-12890-XXXX	0.324 (8.23)	0.487 (12.37)	0.243 (6.17)	0.289 (7.34)	0.577 (14.66)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number , which should be inserted (without parentheses) at end of MIL P/N.

†† ***Note:*** The groove dimensions recommended assume groove tolerance of ±0.002" (0.05 mm) for standard solid O- and D-strips. Closure for ces are assumed to provide maximum and uniform gasket deflection. If these conditions are not attainable, contact Chomerics' Applications Engineering Department before ordering.

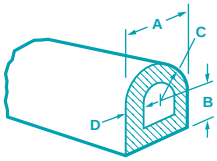

Table 11

HOLLOW D-STRIPS				
Chomerics P/N* MIL P/N: M83528 007X†-( )	Nominal Dimensions			
	A	B	C (rad.)	D
19-05-15343-XXXX	0.125 (3.18)	0.094 (2.39)	0.062 (1.58)	0.040 (1.02)
19-05-14960-XXXX[2,3,4]	0.157 (3.99)	—	0.086 (2.18)	0.020 (0.51)
10-05-6419-XXXX (001)	0.156 (3.96)	0.078 (1.98)	0.078 (1.98)	0.045 (1.14)
10-05-4202-XXXX (002)	0.187 (4.75)	0.093 (2.36)	0.093 (2.36)	0.050 (1.27)
19-05-X254-XXXX[4]	0.187 (4.75)	0.134 (3.43)	0.093 (2.36)	0.040 (1.02)
19-04-11231-XXXX	0.207 (5.26)	0.084 (2.13)	0.103 (2.62)	0.050 (1.27)

Pressure-Sensitive Adhesive *is available on any extrusion with a minimum 0.125 inch (3.17 mm) mating surface. Contact Chomerics to obtain modified Part Numbers. Refer to pages 38 and 40 for details.*

(mm dimensions in parentheses)

Additional sizes may be available. Please inquire.

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Table 11 *continued*

HOLLOW D-STRIPS				
Chomerics P/N* MIL P/N: M83528 007X†-( )	**Nominal Dimensions**			
	A	**B**	**C (rad.)**	**D**
19-05-11440-XXXX[4]	0.246 (6.25)	0.020 (0.51)	0.125 (3.18)	0.030 (0.76)
10-05-6991-XXXX	0.250 (6.35)	0.125 (3.18)	0.125 (3.18)	0.062 (1.57)
10-05-6394-XXXX (007)	0.250 (6.35)	0.125 (3.18)	0.125 (3.18)	0.065 (1.65)
19-05-10277-XXXX[4]	0.296 (7.52)	0.015 (0.38)	0.172 (4.37)	0.030 (0.76)
19-05-L467-XXXX	0.296 (7.52)	0.015 (0.38)	0.172 (4.37)	0.050 (1.27)
10-05-3369-XXXX†† (004)	0.312 (7.92)	0.156 (3.96)	0.156 (3.96)	0.062 (1.57)
10-05-4308-XXXX (003)	0.312 (7.92)	0.156 (3.96)	0.156 (3.96)	0.062 (1.57)
10-05-4318-XXXX** (005)	0.312 (7.92)	0.200 (5.08)	0.112 (2.84)	0.062 (1.57)
19-05-16720-XXXX[4]	0.400 (10.16)	0.025 (0.64)	0.205 (5.21)	0.035 (0.89)
19-05-12066-XXXX	0.487 (12.37)	0.080 (2.03)	0.244 (6.20)	0.045 (1.14)
19-05-16657-XXXX	0.487 (12.36)	0.080 (2.03)	0.244 (6.20)	0.055 (1.40)
19-05-12375-XXXX	0.487 (12.37)	0.080 (2.03)	0.244 (6.20)	0.062 (1.57)
10-05-4542-XXXX (006)	0.487 (12.37)	0.080 (2.03)	0.244 (6.20)	0.080 (2.03)
10-05-C589-XXXX	0.488 (12.40)	0.068 (1.73)	0.244 (6.20)	0.055 (1.40)
10-05-C038-XXXX	0.488 (12.40)	0.080 (2.03)	0.244 (6.20)	0.080 (2.03)
19-05-E429-XXXX	0.502 (12.75)	0.250 (6.35)	0.250 (6.35)	0.061 (1.55)
10-05-4282-XXXX	0.700 (17.78)	0.250 (6.35)	0.350 (8.89)	0.100 (2.54)
19-05-13856-XXXX	0.750 (19.05)	0.375 (9.53)	0.375 (9.53)	0.050 (12.70)
19-05-L362-XXXX	0.750 (19.05)	0.375 (9.53)	0.375 (9.53)	0.075 (1.91)
19-05-W379-XXXX	0.975 (24.77)	0.132 (3.35)	0.488 (12.40)	0.093 (2.36)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

** Dimension "A" measured at bottom (width narrows to become tangent to "C" radius).

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

†† Includes internal radii for low closure properties.

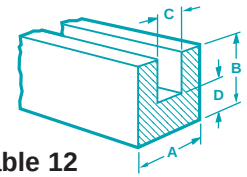

Table 12

CHANNEL STRIPS				
Chomerics P/N* MIL P/N: M83528 010X†-( )	**Nominal Dimensions**			
	A	**B**	**C**	**D**
19-08-14054-XXXX[4]	0.075 (1.91)	0.099 (2.51)	0.025 (0.64)	0.032 (0.81)
10-08-6475-XXXX[4] (001)	0.100 (2.54)	0.100 (2.54)	0.034 (0.86)	0.033 (0.84)
19-08-12880-XXXX[4]	0.126 (3.20)	0.078 (1.98)	0.044 (1.12)	0.048 (1.22)
19-08-12881-XXXX[4]	0.126 (3.20)	0.099 (2.51)	0.047 (1.19)	0.059 (1.50)
10-08-8340-XXXX[4]	0.126 (3.20)	0.097 (2.46)	0.026 (0.66)	0.037 (0.94)
10-08-3215-XXXX (002)	0.126 (3.20)	0.110 (2.79)	0.025 (0.64)	0.050 (1.27)
10-08-4315-XXXX (003)	0.126 (3.20)	0.225 (5.72)	0.020 (0.51)	0.075 (1.91)
19-08-12882-XXXX[4]	0.154 (3.91)	0.154 (3.91)	0.082 (2.08)	0.088 (2.24)
10-08-3157-XXXX (004)	0.156 (3.96)	0.156 (3.96)	0.062 (1.57)	0.047 (1.19)
19-08-12844-XXXX	0.156 (3.96)	0.175 (4.45)	0.046 (1.17)	0.075 (1.90)
10-08-3253-XXXX (005)	0.175 (4.45)	0.156 (3.96)	0.047 (1.19)	0.075 (1.91)
10-08-F815-XXXX	0.188 (4.78)	0.188 (4.78)	0.062 (1.57)	0.062 (1.57)
19-08-12884-XXXX[4]	0.193 (4.90)	0.193 (4.90)	0.128 (3.25)	0.064 (1.62)
19-08-12158-XXXX[4]	0.250 (6.35)	0.250 (6.35)	0.170 (4.32)	0.062 (1.57)
19-08-C929-XXXX	0.250 (6.35)	0.250 (6.25)	0.130 (3.30)	0.062 (1.57)
19-08-12885-XXXX	0.260 (6.60)	0.184 (4.67)	0.140 (3.56)	0.062 (1.57)
19-08-12886-XXXX	0.320 (8.13)	0.315 (8.00)	0.193 (4.90)	0.197 (5.00)
10-08-3872-XXXX** (006)	0.327 (8.31)	0.235 (5.97)	0.062 (1.57)	0.115 (2.92)
19-08-E622-XXXX	0.375 (9.53)	0.500 (12.7)	0.187 (4.75)	0.125 (3.18)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

** Slot not centered. Centerline of slot is 0.167 in. (4.24mm) from left edge.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

continued

Pressure-Sensitive Adhesive *is available on any extrusion with a minimum 0.125 inch (3.17 mm) mating surface. Contact Chomerics to obtain modified Part Numbers. Refer to pages 38 and 40 for details.*

(mm dimensions in parentheses)

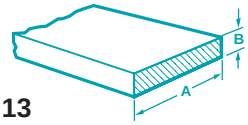

Table 13

RECTANGULAR STRIPS		
Chomerics P/N* MIL P/N: M83528 009X†-( )	**Nominal Dimensions**	
	A	**B**
19-07-12947-XXXX[4]	0.041 (1.04)	0.031 (0.78)
10-07-4272-XXXX[4] (001)	0.063 (1.60)	0.042 (1.07)
19-07-12948-XXXX	0.085 (2.16)	0.085 (2.16)
19-07-F193-XXXX	0.093 (2.36)	0.093 (2.36)
10-07-2981-XXXX (002)	0.095 (2.41)	0.062 (1.57)
19-07-12949-XXXX	0.095 (2.41)	0.062 (1.57)
19-07-Z499-XXXX[4]	0.114 (2.89)	0.039 (0.99)
19-07-Z500-XXXX	0.114 (2.89)	0.091 (2.31)
19-07-11206-XXXX[4]	0.120 (3.05)	0.040 (1.02)
10-07-4014-XXXX (003)	0.120 (3.05)	0.075 (1.91)
10-07-3225-XXXX (004)	0.125 (3.18)	0.062 (1.57)
19-07-12950-XXXX	0.125 (3.18)	0.062 (1.57)
19-07-12951-XXXX	0.126 (3.20)	0.126 (3.20)
10-07-3047-XXXX (005)	0.156 (3.96)	0.062 (1.57)
10-07-C786-XXXX	0.170 (4.32)	0.125 (3.18)
19-07-F463-XXXX	0.188 (4.78)	0.062 (1.57)
19-07-12952-XXXX	0.188 (4.78)	0.080 (2.03)
19-07-12953-XXXX	0.188 (4.78)	0.093 (2.36)
19-07-13026-XXXX	0.188 (4.78)	0.125 (3.18)
19-07-F627-XXXX	0.219 (5.56)	0.156 (3.96)
10-07-3226-XXXX (006)	0.250 (6.35)	0.062 (1.57)
19-07-12954-XXXX	0.255 (6.47)	0.063 (1.60)
19-07-12955-XXXX	0.330 (8.38)	0.305 (7.75)
10-07-F743-XXXX	0.375 (9.53)	0.060 (1.52)
19-07-L463-XXXX	0.390 (9.91)	0.062 (1.57)
19-07-14592-XXXX	0.438 (11.13)	0.188 (4.78)
19-07-12675-XXXX[4]	0.500 (12.70)	0.040 (1.02)
19-07-12200-XXXX	0.500 (12.70)	0.062 (1.57)
10-07-3522-XXXX (007)	0.500 (12.70)	0.075 (1.91)
19-07-12491-XXXX	0.500 (12.70)	0.093 (2.36)
10-07-4217-XXXX (008)	0.500 (12.70)	0.125 (3.18)
10-07-3080-XXXX (009)	0.500 (12.70)	0.188 (4.78)
10-07-B447-XXXX	0.500 (12.70)	0.250 (6.35)
19-07-12956-XXXX	0.508 (12.90)	0.063 (1.60)
19-07-12957-XXXX	0.564 (14.32)	0.127 (3.23)
19-07-12958-XXXX	0.569 (14.45)	0.062 (1.57)
19-07-12877-XXXX	0.620 (15.75)	0.125 (3.18)
19-07-12959-XXXX	0.640 (16.25)	0.060 (1.52)
19-07-15118-XXXX[4]	0.750 (19.05)	0.032 (0.81)
10-07-4483-XXXX (010)	0.750 (19.05)	0.062 (1.57)

continued

Table 13 *continued*

RECTANGULAR STRIPS		
Chomerics P/N* MIL P/N: M83528 009X†-( )	**Nominal Dimensions**	
	A	**B**
19-07-11294-XXXX	0.750 (19.05)	0.062 (1.57)
19-07-11079-XXXX	0.780 (19.81)	0.100 (2.54)
19-07-10959-XXXX[4]	0.870 (22.10)	0.032 (0.81)
19-07-L956-XXXX	0.875 (22.23)	0.312 (7.92)
19-07-14816-XXXX[4]	0.880 (22.35)	0.032 (0.81)
10-07-4523-XXXX (011)	0.880 (22.35)	0.062 (1.57)
19-07-11495-XXXX	0.880 (22.35)	0.125 (3.18)
19-07-8345-XXXX	0.980 (24.89)	0.125 (3.18)
19-07-M327-XXXX[4]	1.000 (25.40)	0.032 (0.81)
19-07-12960-XXXX[4]	1.000 (25.40)	0.033 (0.84)
19-07-11081-XXXX[4]	1.000 (25.40)	0.042 (1.06)
19-07-E431-XXXX	1.000 (25.40)	0.062 (1.57)
19-07-11080-XXXX	1.000 (25.40)	0.090 (2.28)
10-07-3797-XXXX (012)	1.000 (25.40)	0.250 (6.35)
10-07-L525-XXXX	1.120 (28.45)	0.060 (1.52)
10-07-4538-XXXX (013)	1.180 (29.97)	0.062 (1.57)
19-07-12961-XXXX	1.210 (30.73)	0.062 (1.57)
19-07-W391-XXXX	1.600 (40.64)	0.062 (1.57)
19-07-F067-XXXX	2.000 (50.80)	0.062 (1.57)

Note: Some configurations may have a degree of cur vature, making them unsuitable in long lengths. Consult Chomerics Applications Engineering for details.

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number , which should be inserted (without parentheses) at end of MIL P/N.

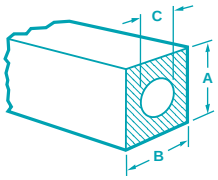

Table 14

HOLLOW RECTANGULAR STRIPS			
	Nominal Dimensions		
Chomerics P/N*	**A**	**B**	**C (dia.)**
19-07-13944-XXXX[2,3,4]	0.100 (2.54)	0.059 (1.50)	0.020 (0.51)
19-07-15804-XXXX[4]	0.126 (3.20)	0.126 (3.20)	0.048 (1.22)
10-07-2998-XXXX	0.305 (7.75)	0.330 (8.38)	0.125 (3.18)
10-07-4481-XXXX	0.375 (9.53)	0.375 (9.53)	0.188 (4.78)
10-07-E263-XXXX	0.500 (12.70)	0.500 (12.70)	0.250 (6.35)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. Refer to page 38.

Additional sizes may be available. Please inquire.

***Pressure-Sensitive Adhesive** is available on any extrusion with a minimum 0.125 inch (3.17 mm) mating surface. Contact Chomerics to obtain modified Part Numbers. Refer to pages 38 and 40 for details.*

(mm dimensions in parentheses)

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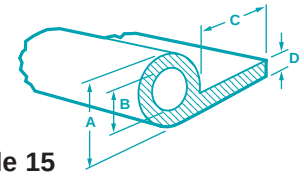


Table 15

HOLLOW P-STRIPS				
Chomerics P/N MIL P/N: M83528 008X†-( )	**Nominal Dimensions**			
	A (dia.)	**B (dia.)**	**C**	**D**
19-06-M151-XXXX[4]	0.125 (3.18)	0.045 (1.14)	0.250 (6.35)	0.062 (1.57)
19-06-Z731-XXXX[4]	0.140 (3.56)	0.100 (2.54)	0.135 (3.43)	0.030 (0.76)
19-06-C442-XXXX[4]	0.164 (4.17)	0.084 (2.13)	0.040 (1.02)	0.095 (2.41)
10-06-M412-XXXX	0.168 (4.26)	0.047 (1.19)	0.200 (5.08)	0.062 (1.57)
19-06-12931-XXXX	0.170 (4.32)	0.060 (1.52)	0.205 (5.21)	0.062 (1.57)
10-06-B227-XXXX[4]	0.190 (4.83)	0.130 (3.30)	0.312 (7.92)	0.062 (1.57)
19-06-13514-XXXX	0.200 (5.08)	0.080 (2.03)	0.125 (3.18)	0.062 (1.57)
10-06-A778-XXXX	0.200 (5.08)	0.080 (2.03)	0.215 (5.46)	0.062 (1.57)
10-06-8737-XXXX	0.200 (5.08)	0.080 (2.03)	0.250 (6.35)	0.062 (1.57)
10-06-8550-XXXX (007)	0.200 (5.08)	0.080 (2.03)	0.275 (6.99)	0.062 (1.57)
19-06-11223-XXXX	0.200 (5.08)	0.080 (2.03)	0.300 (7.62)	0.062 (1.57)
19-06-12942-XXXX	0.200 (5.08)	0.080 (2.03)	0.400 (10.16)	0.062 (1.57)
10-06-8560-XXXX	0.200 (5.08)	0.080 (2.03)	0.425 (10.80)	0.062 (1.57)
10-06-6175-XXXX	0.200 (5.08)	0.080 (2.03)	0.550 (13.97)	0.062 (1.57)
10-06-3599-XXXX (001)	0.200 (5.08)	0.080 (2.03)	0.650 (16.51)	0.062 (1.57)
19-06-13217-XXXX	0.200 (5.08)	0.125 (3.18)	0.650 (16.51)	0.062 (1.57)
10-06-4142-XXXX (002)	0.250 (6.35)	0.125 (3.18)	0.250 (6.35)	0.062 (1.57)
10-06-3300-XXXX (003)	0.250 (6.35)	0.125 (3.18)	0.375 (9.53)	0.062 (1.57)
10-06-6180-XXXX (008)	0.250 (6.35)	0.125 (3.18)	0.625 (15.88)	0.062 (1.57)
10-06-4921-XXXX (004)	0.250 (6.35)	0.150 (3.81)	0.375 (9.53)	0.062 (1.57)
10-06-C716-XXXX	0.254 (6.45)	0.153 (3.88)	0.254 (6.45)	0.062 (1.57)

continued

***Pressure-Sensitive Adhesive** is available on any extrusion with a minimum 0.125 inch (3.17 mm) mating surface. Contact Chomerics to obtain modified Part Numbers. Refer to pages 38 and 40 for details.*

Table 15 *continued*

HOLLOW P-STRIPS				
Chomerics P/N MIL P/N: M83528 008X†-( )	**Nominal Dimensions**			
	A (dia.)	**B (dia.)**	**C**	**D**
10-06-5611-XXXX (005)	0.312 (7.92)	0.187 (4.75)	0.563 (14.30)	0.062 (1.57)
10-06-2750-XXXX (006)	0.360 (9.14)	0.255 (6.48)	0.420 (10.67)	0.070 (1.79)
19-08-L064-XXXX	0.600 (15.24)	0.400 (10.16)	0.350 (8.89)	0.110 (2.79)
19-06-15899-XXXX	0.610 (15.49)	0.350 (8.89)	0.875 (22.23)	0.130 (3.30)
19-06-11384-XXXX	0.750 (19.05)	0.625 (15.88)	0.725 (18.42)	0.062 (1.57)

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.). Smallest sizes may not be extrudable in certain materials. For explanation of superscript codes following XXXX, which indicate non-availability, refer to page 38.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number , which should be inserted (without parentheses) at end of MIL P/N.

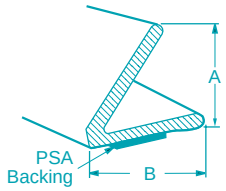


Table 16

V-STRIPS (ADHESIVE INCLUDED)		
Chomerics P/N*	**A**	**B**
19-09-15377-XXXX	0.396 (10.06)	0.375 (9.53)
10-09-W864-XXXX	0.410 (10.41)	0.500 (12.70)
19-09-14645-XXXX	0.600 (15.24)	0.500 (12.70)

Note: Please consult the factory for part numbers when ordering punched strips for fastener installation.

* Replace XXXX with four or five digit material number (1356, 1273, S6305, etc.).

Additional sizes may be available. Please inquire.

(mm dimensions in parentheses)

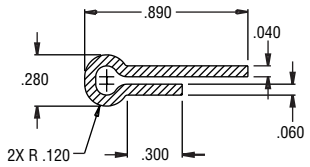
Custom Extrusions

Custom Extrusion Capabilities

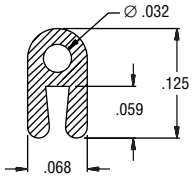
As the world's leading supplier of conductive elastomer gaskets, Chomerics routinely supports its customers by producing extruded gaskets in special configurations. These range from unusual sizes in standard shapes to highly complex designs that meet specialized shielding and environmental sealing requirements.

The following "showcase" includes representative examples of our custom extrusion capabilities. If you are interested in adapting one of these shapes to your design, or developing an altogether new gasket design, contact our Applications Engineering Department. We welcome the opportunity to assist you.

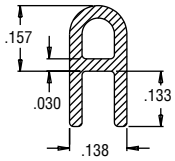
19-09-LF15-XXXX



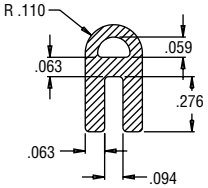
19-09-10076-XXXX



19-09-10645-XXXX



19-09-11540-XXXX



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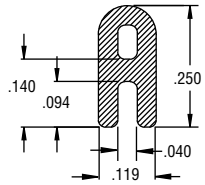

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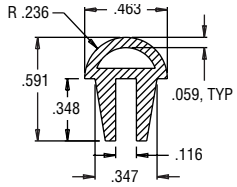

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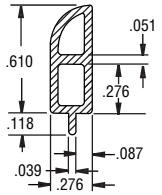

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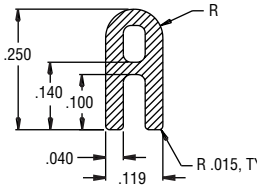

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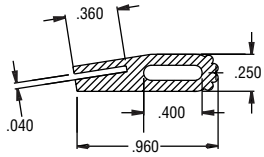

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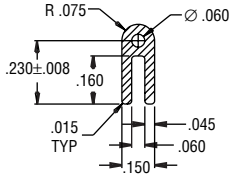
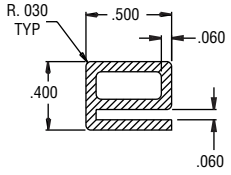


19-09-L913-XXXX



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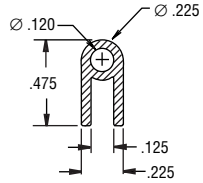

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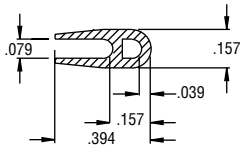

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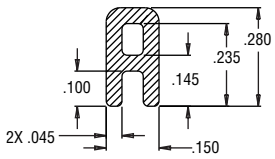

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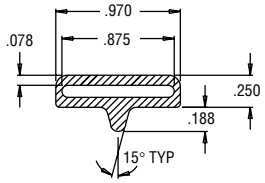

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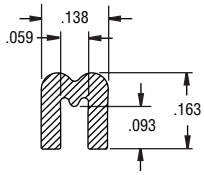

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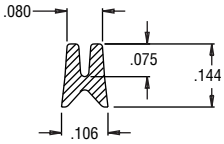

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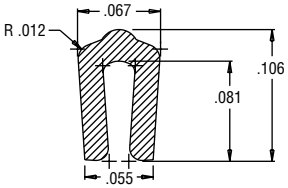

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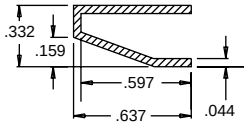

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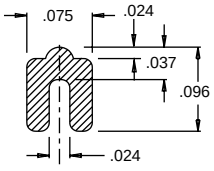

Dimensions shown in inches; 1 in. = 25.4 mm

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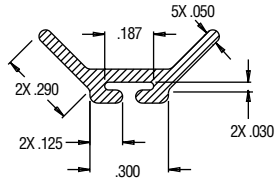
19-09-12023-XXXX



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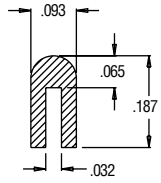

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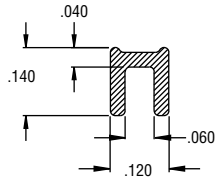

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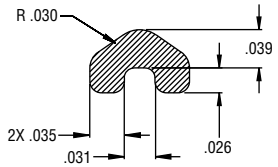

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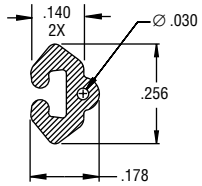

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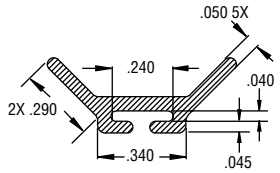

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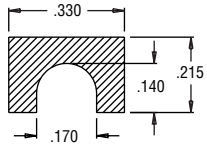

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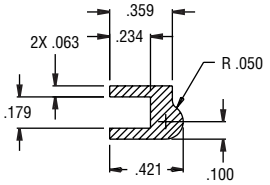

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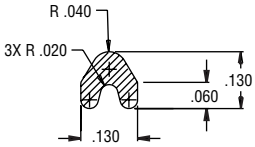

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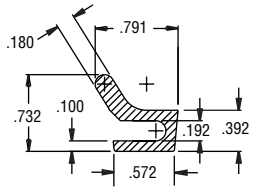

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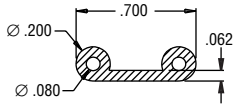

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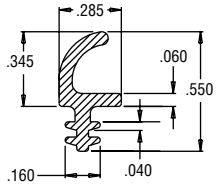

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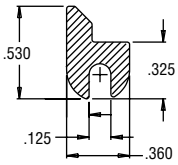

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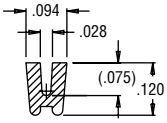

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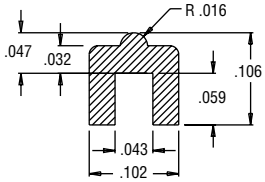

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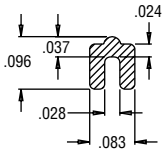

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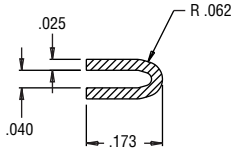

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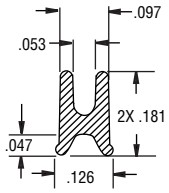

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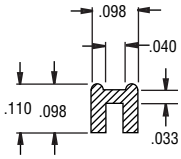

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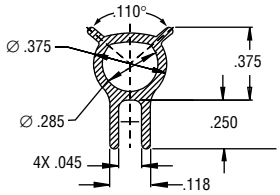

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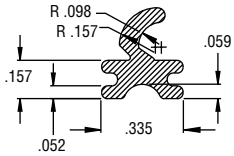

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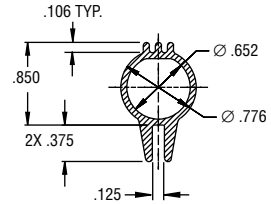

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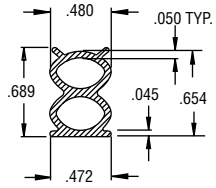

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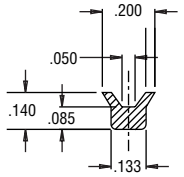

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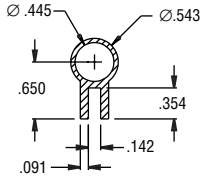

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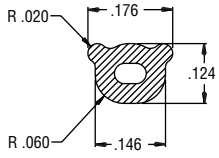

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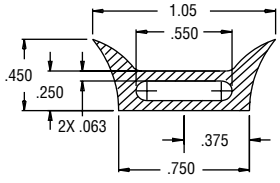

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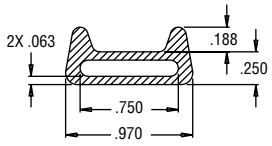

Dimensions shown in inches; 1 in. = 25.4 mm

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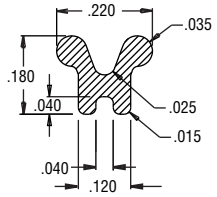

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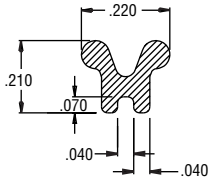

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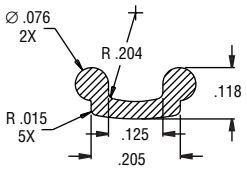

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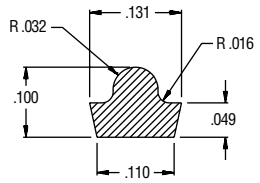

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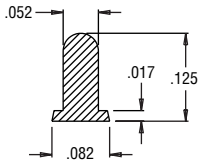

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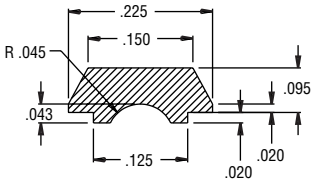

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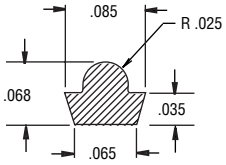

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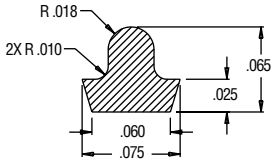

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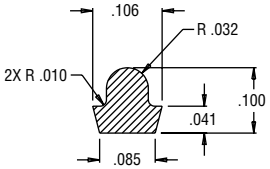

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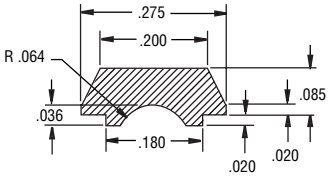

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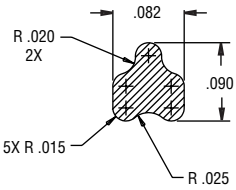

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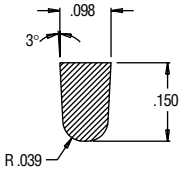

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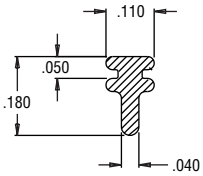

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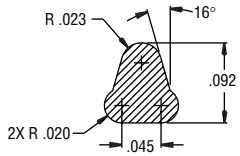

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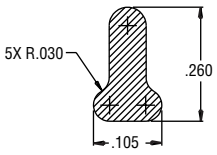

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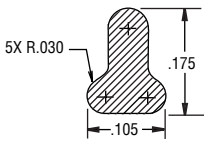

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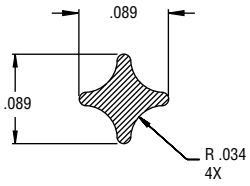

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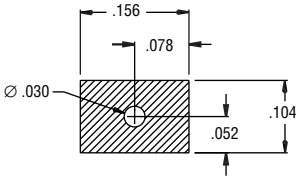

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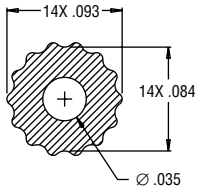

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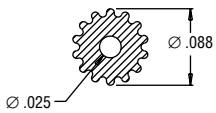

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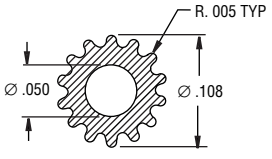

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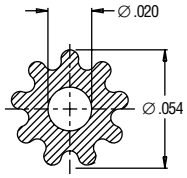

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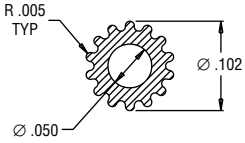

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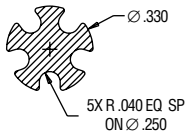

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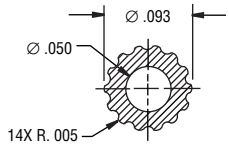

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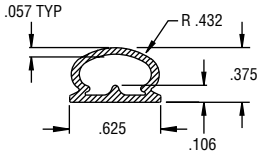

U.S. Patent No.06075205

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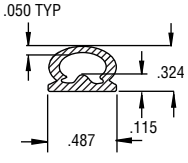

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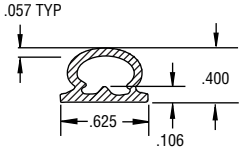

U.S. Patent No.06075205

Dimensions shown in inches; 1 in. = 25.4 mm

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Parker Seals

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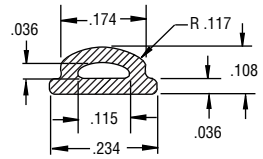

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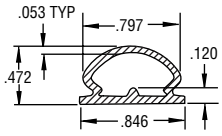

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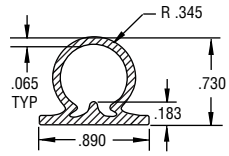

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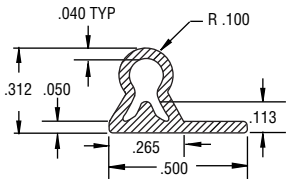

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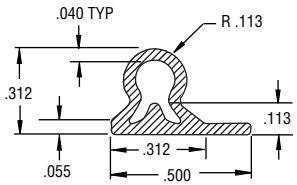

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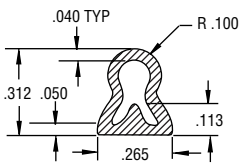

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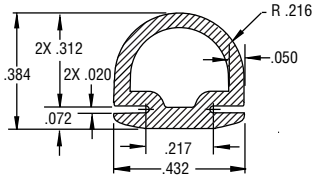

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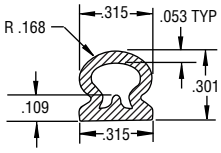

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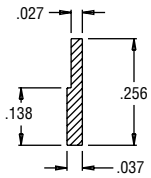

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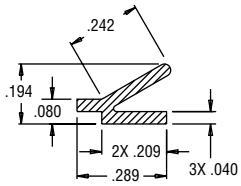

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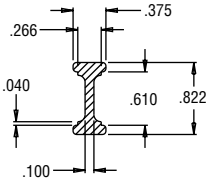

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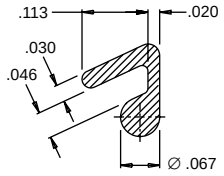

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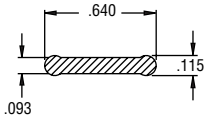

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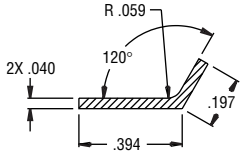

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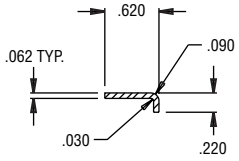

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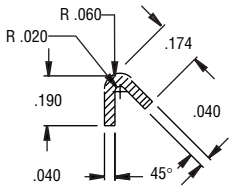

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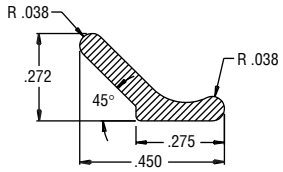

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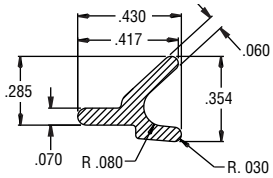

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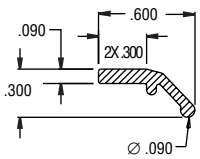

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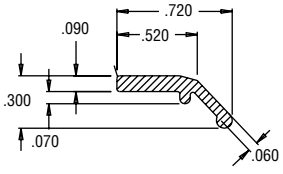

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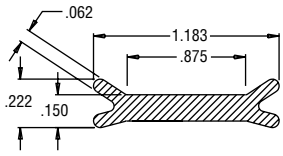

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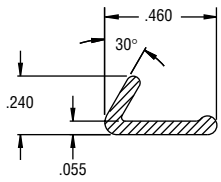

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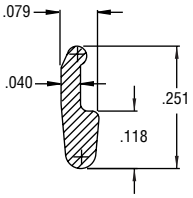

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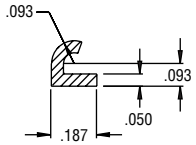

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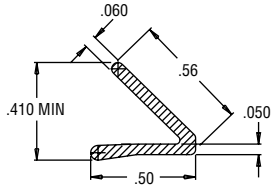

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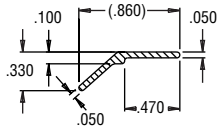

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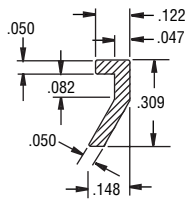

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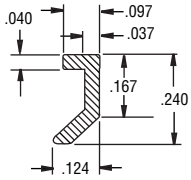

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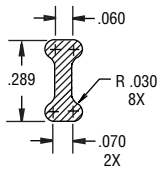

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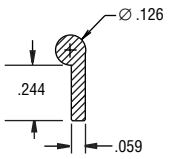

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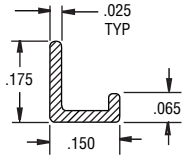

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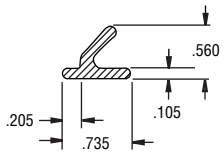

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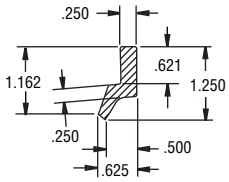

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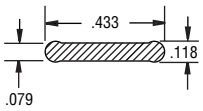

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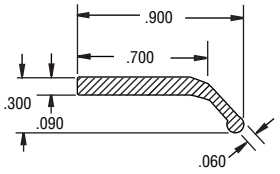

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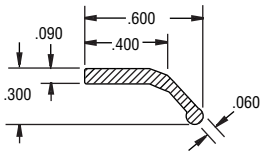

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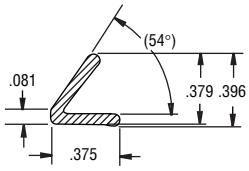

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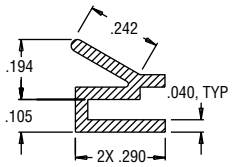

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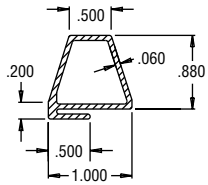

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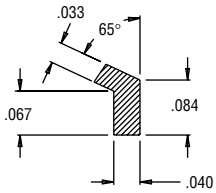

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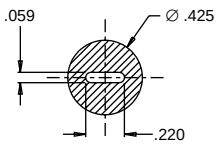

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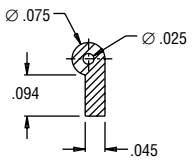

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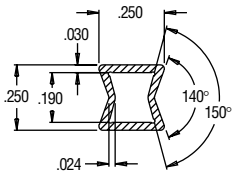

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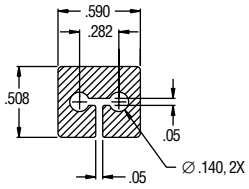

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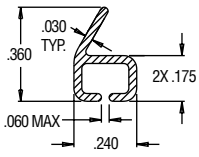

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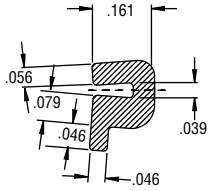

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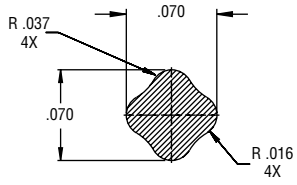

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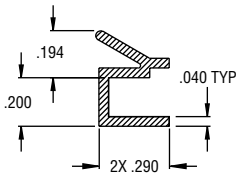

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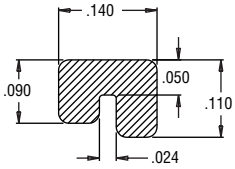

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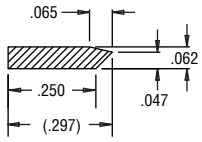

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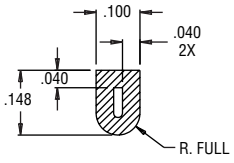

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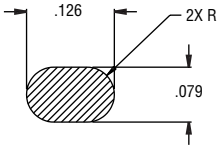

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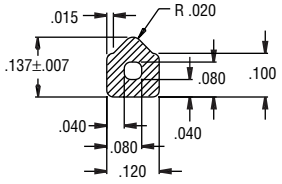

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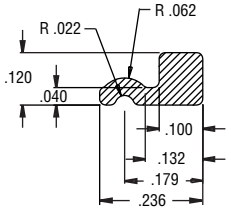

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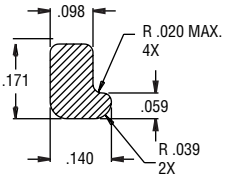

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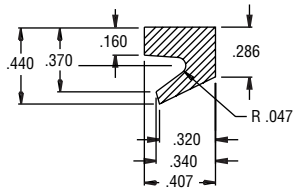

Dimensions shown in inches; 1 in. = 25.4 mm

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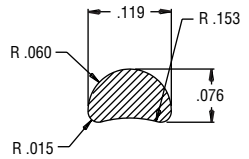

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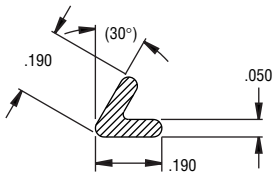

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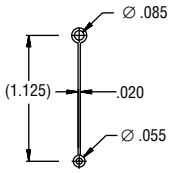

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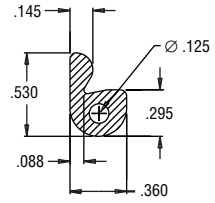

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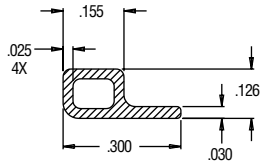

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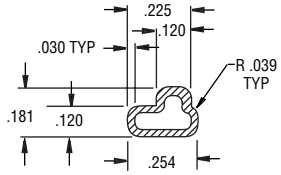

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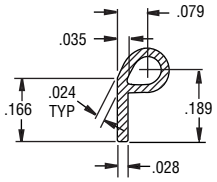

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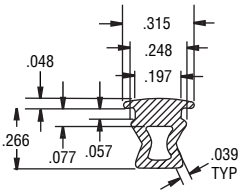

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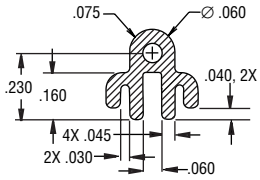

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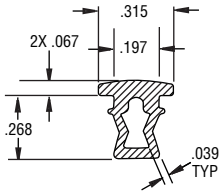

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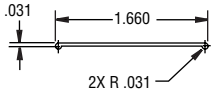

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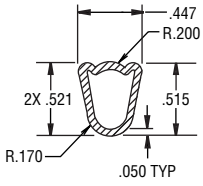

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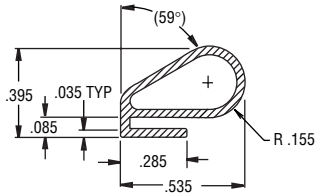

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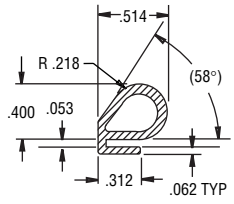

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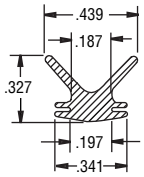

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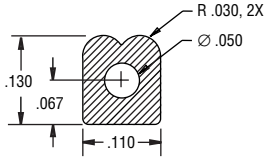

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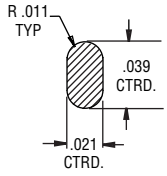

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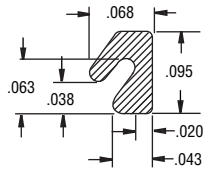

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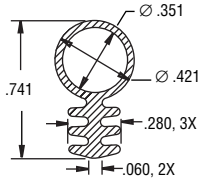

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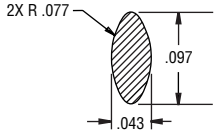

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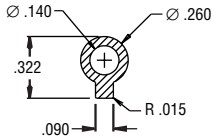

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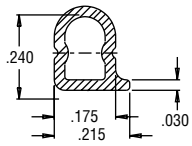

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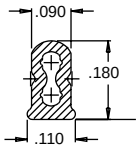

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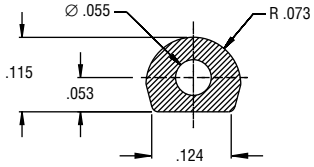

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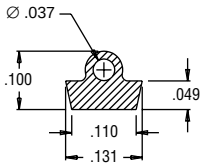

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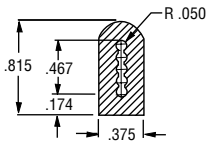

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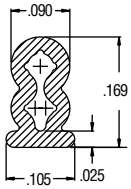

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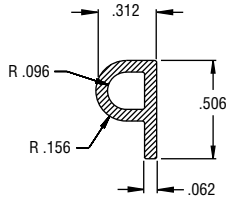

Dimensions shown in inches; 1 in. = 25.4 mm

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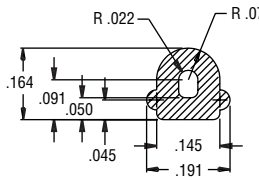

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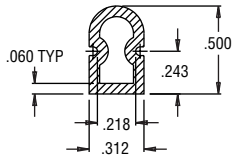

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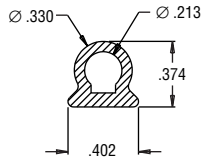

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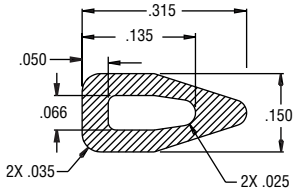

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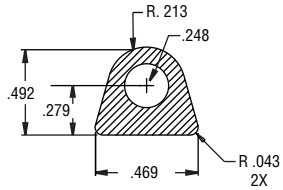

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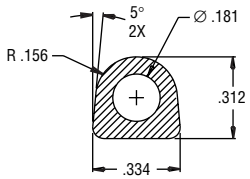

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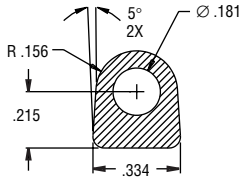

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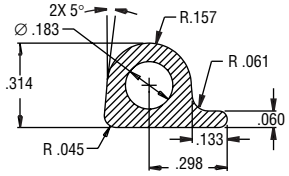

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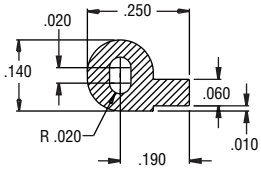

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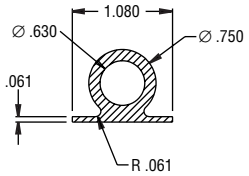

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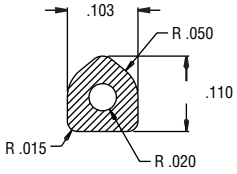

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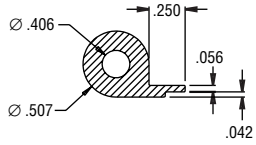

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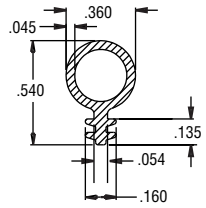

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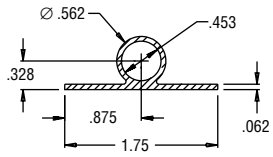

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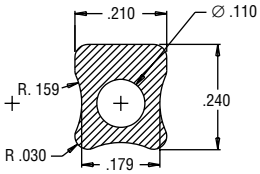

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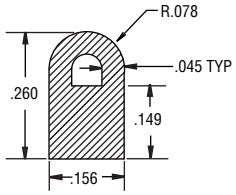

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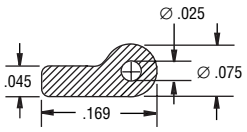

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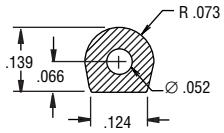

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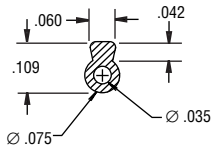

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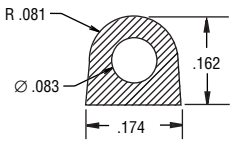

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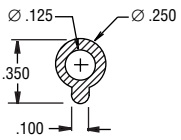

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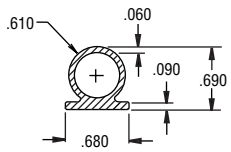

Dimensions shown in inches; 1 in. = 25.4 mm

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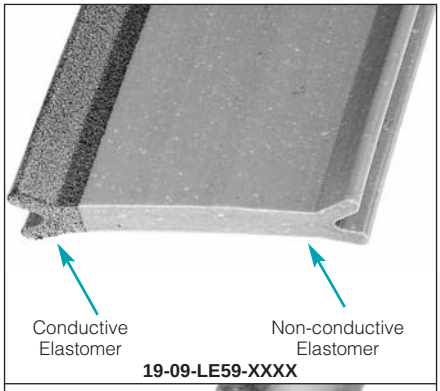
Parker Seals

Co-Extruded Strips



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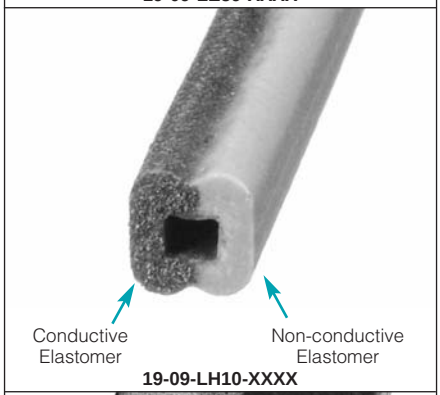

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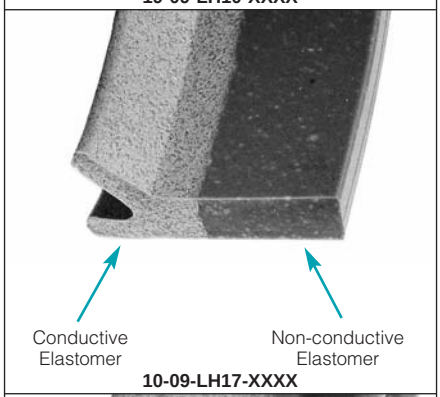

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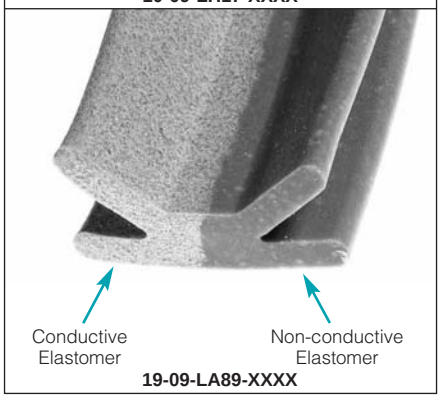

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Co-Extruded Strips

Optimum Shielding Performance Plus Corrosion Prevention

Chomerics manufactures a dual performance extruded gasket in one simple design. By a seam vulcanization process, CHO-SEAL or CHO-SIL conductive elastomers are extruded in parallel with non-conductive elastomers to provide EMI shielding and corrosion protection from one gasket. The outer, non-conductive gasket acts as an extra environmental seal to keep moisture away from the conductive gasket/flange interface. This prevents corrosion of the mating flange in marine or airborne environments. Co-extruded gaskets are also cost-effective, as they permit the use of existing flange designs and provide for gasket attachment via a less expensive non-conductive elastomer. A similar two gasket shielding system requires a costly double groove flange design.

Technically Superior Design

Typical examples of effective co-extruded gaskets include commercial and military communications equipment, rack mounted cabinetry, and aircraft doors and panels. These applications vary in required shielding performance. Each Chomerics co-extruded gasket is engineered in our applications laboratory to match the geometric constraints, closure requirements and shielding performance demanded by the application.

Availability

Many of the gasket cross section shapes and sizes listed on the previous pages can also be co-extruded. Common co-extruded configurations are pictured at left. Also refer to pages 56-57 for a selection of co-extruded shapes currently available. Contact Chomerics to assist you in material selection.

Fast, Easy Conductive Elastomer Gasket Installation with Chomerics Adhesive Tape Attachment

Chomerics has developed a unique adhesive attachment material for CHO-SEAL or CHO-SIL conductive EMI gaskets. This non-conductive pressure-sensitive adhesive (PSA) tape is available on most extruded profiles with a flat tape attachment area, such as D-, P-, K- and rectangular cross sections.

Application: This method of gasket attachment is easy and effective with a clean surface. Simply clean the surface prior to mounting the gasket.* Remove the release film and position the gasket using light pressure. When the gasket is properly positioned, firmly press onto the flange.

Advantages

- Peel strength (90°) in excess of 4.5 pounds per inch of width (ppi)
- Available in continuous length or cut to length. (*Note:* Some cross sections cannot be packaged in continuous lengths.)
- Eliminates fasteners or other adhesives
- Can function as a “third hand” to facilitate difficult installations
- Available with fluorosilicones as a permanent attachment method
- Quick stick – readily adheres to clean surfaces
- Conformable adhesion to curved surfaces
- Resists humidity, moisture, natural elements
- Eliminates solvent emissions and long set-up times

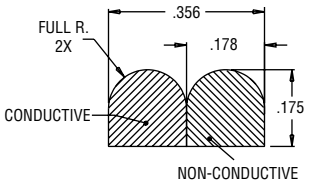
Disadvantages

- Not available on round cross sections
- Not recommended for applications where solvent resistance is essential
- Not recommended for applications where resistance to excessive abuse due to moving parts or traffic is required

continued

* ***Note:*** **Refer to “Surface Preparation of Metallic Substrates” on page 40 for important information on proper cleaning and application. Also request Technical Bulletin 20.**

19-05-10168-XXXX



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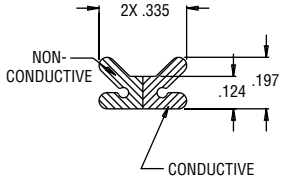

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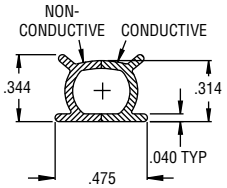

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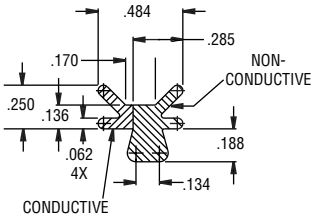

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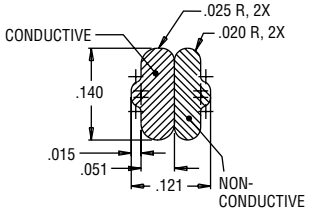

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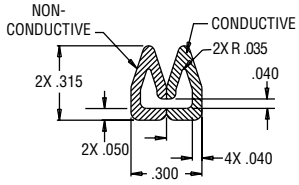

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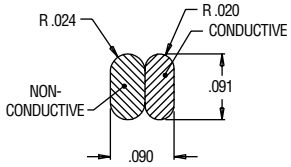
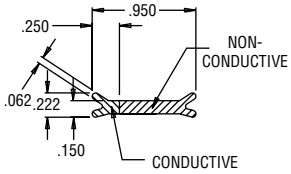


19-09-LE59-XXXX



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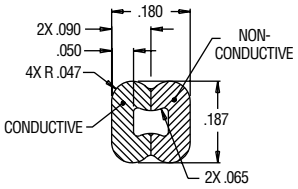
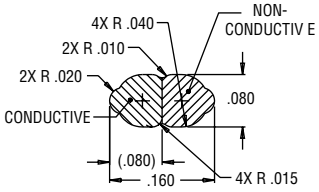


19-18-LH27-XXXX



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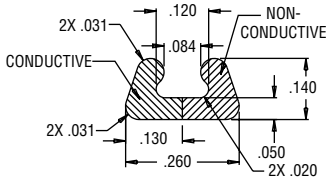

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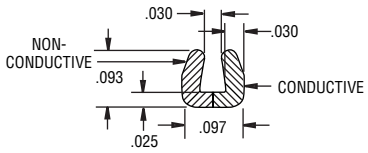

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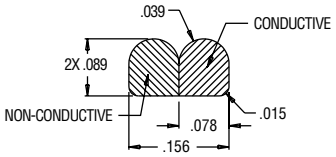

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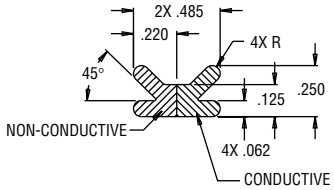

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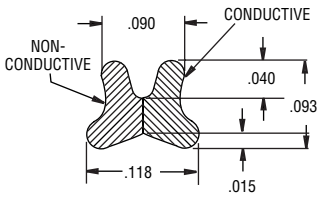

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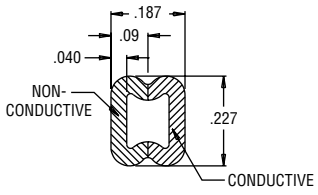

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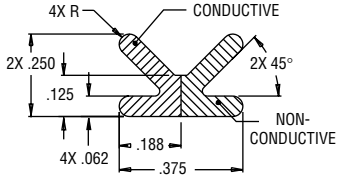
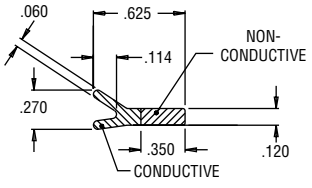


10-09-LH17-XXXX



Dimensions shown in inches; 1 in. = 25.4 mm

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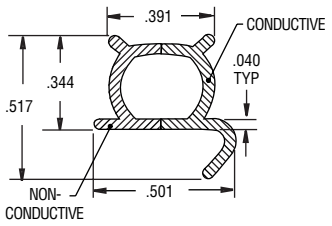
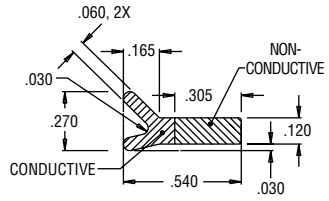
19-18-15351-XXXX



19-18-M391-XXXX



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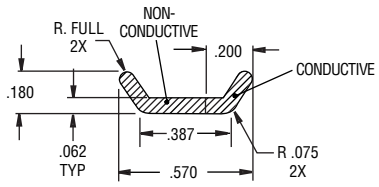

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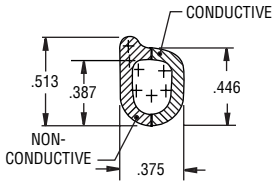

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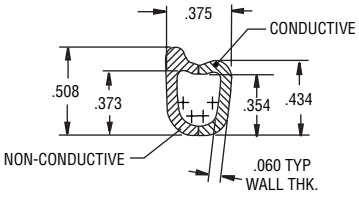

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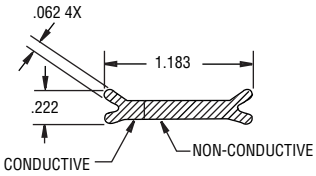

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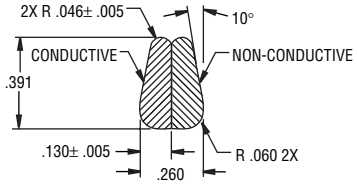
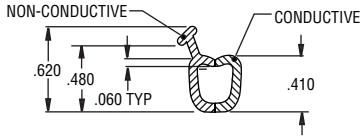
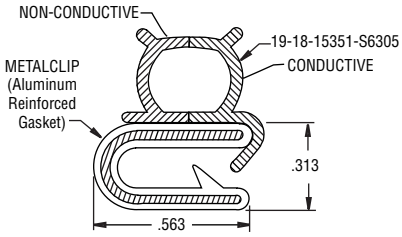


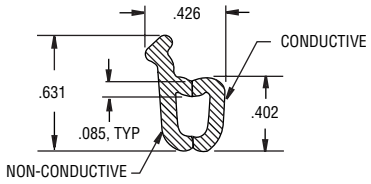
19-18-16064-XXXX



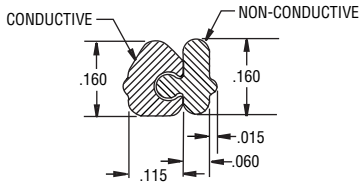
19-24-15407-XXXX Combination Gasket



19-18-14992-XXXX



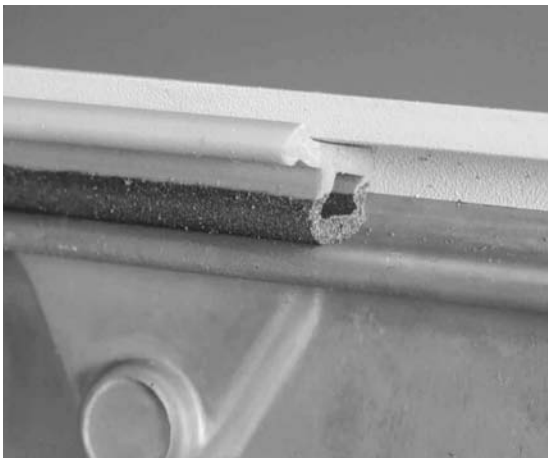
19-24-12391-XXXX Combination Gasket



Dimensions shown in inches; 1 in. = 25.4 mm

Custom Co-Extruded Gaskets

Extruded in parallel, dual conductive/non-conductive gaskets provide optimum EMI shielding and corrosion protection in a single, cost-effective design. For performance and cost advantages of this approach, refer to page 55. To discuss your requirements, contact our Applications Engineering Department.



Sheet Stock & Die-Cut Parts

Sheet Stock

Almost every Chomerics commercial-grade elastomer material is available in sheet form. We are able to meet most requirements with the standard sizes and thicknesses shown in Table 2. For sizes not shown, contact Chomerics' Sales Department.

Adhesive Backing

All standard *silicone* sheets of 0.032 inch (0.81 mm) thickness or greater are available with a thin, non-conductive pressure-sensitive adhesive backing (PSA). This adhesive increases gasket volume resistivity and interface flange resistance, with a corresponding reduction in shielding effectiveness (generally 5-10 dB). Performance and property specifications included in this catalog are for materials without adhesive backing.

Custom Die-Cut Parts

Custom parts can be die-cut by Chomerics or our Authorized Fabricators from any standard sheet stock. Please provide a sketch or drawing (see Table 1 for tolerances). Chomerics' part number for custom die-cut parts is

19-11-XXXX-ZZZZ

where XXXX is a sequential engineering drawing number assigned by Chomerics, and ZZZZ is the material designation (1350, S6304, etc.).

Custom Sheets

For applications where standard CHO-SEAL and CHO-SIL sheets are not suitable, Chomerics can satisfy the following requirements:

1. Special materials can be compounded to provide specific physical or chemical properties.
2. Custom sizes can be molded from 0.020 inch (0.51 mm) to 0.125 inch (3.18 mm) for most CHO-SEAL materials. Minimum thickness for CHO-SIL 1485 is 0.032 inch (0.81 mm).
3. Custom sizes can be cut.

Ordering Procedure

Select the part number from Table 2. The last four or five digits designate the material. For "TA" in the part number, select the desired thickness and adhesive option from the blocks below the table. *For custom sizes or thicknesses, part numbers will be assigned by Chomerics.*

General Tolerances

The following table provides general tolerances for flat die-cut conductive elastomer gaskets. It is important to note that *all flat die-cut, molded, and extruded gaskets are subject to free-state variation in the unrestrained condition*. The use of inspection fixtures to verify conformance of finished parts is common and recommended where appropriate.

Also note that "Overall Dimensions" for flat die-cut gaskets include any feature-to-feature dimensins (e.g., edge-to-edge, edge-to-hole, hole-to-hole).

Table 1

FLAT DIE-CUT GASKETS *inch (mm)*	TOLERANCE
Overall Dimensions	
≤10 (254)	±0.010 (0.25)
>10 to ≤15 (254 to 381)	±0.020 (0.51)
>15 (>381)	±0.20% Nom. Dim.
Thickness	
0.020 (0.51)	±0.004 (0.10)
0.032 (0.81)	±0.005 (0.13)
0.045 (1.14)	±0.006 (0.15)
0.062 (1.57)	±0.007 (0.18)
0.093 (2.36)	±0.010 (0.25)
0.125 (3.18)	±0.010 (0.25)
>0.125 (>3.18)	Contact a Chomerics Applications or Sales Engineer
Hole Diameters >0.060 (1.52) dia. if sheet thickness is...	
≤0.062 (1.57)	±0.005 (0.13)
>0.062 (1.57)	±0.008 (0.20)

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Table 2

STANDARD SHEET STOCK SIZE							
	AVAILABILITY BY THICKNESS						
Part Number*	Sheet Size inches (cm)	0.020 ±0.004 (0.51 ±0.10)	0.032 ±0.005 (0.81 ±0.13)	0.045 ±0.006 (1.14 ±0.15)	0.062 ±0.007 (1.57 ±0.18)	0.093 ±0.010 (2.36 ±0.25)	0.125 ±0.010 (3.18 ±0.25)
40-TA-1010-1212	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1212	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1212	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1212	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-1215	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1215	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1215	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1215	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-2030-1215	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
40-TO-1010-1217	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-1217	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-1217	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1520-1217	15 x 20 (38.1 x 50.8)	NA	NA	NA	✓	✓	✓
40-TO-2030-1217	20 x 30 (50.8 x 76.2)	NA	NA	NA	✓	✓	✓
40-TO-1010-1221	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-1221	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-1221	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1520-1221	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TO-2030-1221	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
40-TA-1010-1224	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1224	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1224	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1224	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-2030-1224	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
40-TA-1010-1273	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1273	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1273	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1273	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-2030-1273	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
40-TA-1010-1285	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1285	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1285	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1285	15 x 20 (38.1 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-2030-1285	20 x 30 (50.8 x 76.2)	✓	✓	✓	✓	✓	✓
40-TO-1010-1287	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-1287	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-1287	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1520-1287	15 x 20 (38.1 x 50.8)	✓	NA	NA	✓	✓	✓
40-TA-1010-1291	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1291	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1291	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1291	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-2030-1291	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
40-TO-1010-1298	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-1298	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-1298	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1520-1298	15 x 20 (38.1 x 50.8)	NA	NA	NA	✓	✓	✓
40-TA-1010-1310	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1310	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1310	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1310	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-2030-1310	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓

✓ Available NA = Not Available
* TA refers to thickness and adhesive options (at right).

For sizes other than those shown, change 5th through 8th digits in Part Number to reflect desired size (e.g., 0415 is a 4 in. x 15 in. size).

THICKNESS, inch (mm)
1 0.020 (0.51)
2 0.032 (0.81)
3 0.062 (1.57)
4 0.093 (2.36)
5 0.125 (3.18)
6 0.045 (1.14)

T A

ADHESIVE (PSA)
0 No Adhesive
1 Adhesive Backing

Adhesive is not available on fluorosilicone materials 1217, 1221, 1287, 1298, E6306, E6434, L6303, and V6433 or on CHO-SEAL 1501, or on any sheets thinner than 0.032 inch (0.81mm).

(mm dimensions in parentheses)

continued

Table 2 *continued*

Part Number*	STANDARD SHEET STOCK SIZE Sheet Size inches (cm)	AVAILABILITY BY THICKNESS 0.020 ±0.004 (0.51 ±0.10)	0.032 ±0.005 (0.81 ±0.13)	0.045 ±0.006 (1.14 ±0.15)	0.062 ±0.007 (1.57 ±0.18)	0.093 ±0.010 (2.36 ±0.25)	0.125 ±0.010 (3.18 ±0.25)
40-TA-1010-1350	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-1350	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-1350	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-1350	15 x 20 (38.1 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-2030-1350	20 x 30 (50.8 x 76.2)	✓	✓	✓	✓	✓	✓
41-TA-1010-1401	10 x 10 (25.4 x 25.4)	NA	✓	✓	✓	✓	✓
41-TA-1015-1401	10 x 15 (25.4 x 38.1)	NA	✓	✓	✓	✓	✓
41-TA-1020-1401	10 x 20 (25.4 x 50.8)	NA	✓	✓	✓	✓	✓
41-TA-1520-1401	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
41-TA-2030-1401	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
41-TA-1010-1485	10 x 10 (25.4 x 25.4)	NA	✓	✓	✓	✓	✓
41-TA-1015-1485	10 x 15 (25.4 x 38.1)	NA	✓	✓	✓	✓	✓
41-TA-1020-1485	10 x 20 (25.4 x 50.8)	NA	✓	✓	✓	✓	✓
41-TA-1520-1485	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
41-TA-2030-1485	20 x 30 (50.8 x 76.2)	NA	✓	✓	✓	✓	✓
43-TO-1010-1501	10 x 10 (25.4 x 25.4)	NA	✓	✓	✓	✓	✓
43-TO-1015-1501	10 x 15 (25.4 x 38.1)	NA	✓	✓	✓	✓	✓
40-TO-1010-E6306	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-E6306	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-E6306	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1010-E6434	10 x 10 (25.4 x 25.4)	NA	✓	✓	✓	✓	✓
40-TO-1015-E6434	10 x 15 (25.4 x 38.1)	NA	✓	✓	✓	✓	✓
40-TO-1020-E6434	10 x 20 (25.4 x 50.8)	NA	✓	✓	✓	✓	✓
40-TO-1010-L6303	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TO-1015-L6303	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TO-1020-L6303	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TO-1520-L6303	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-S6304	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-S6304	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-S6304	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-S6304	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-S6305	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-S6305	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-S6305	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-S6305	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-6370	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-6370	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-6370	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-6370	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TO-1010-V6433	10 x 10 (25.4 x 25.4)	NA	✓	✓	✓	✓	✓
40-TO-1015-V6433	10 x 15 (25.4 x 38.1)	NA	✓	✓	✓	✓	✓
40-TO-1020-V6433	10 x 20 (25.4 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-S6600	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-S6600	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-S6600	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-S6600	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓
40-TA-1010-S6602	10 x 10 (25.4 x 25.4)	✓	✓	✓	✓	✓	✓
40-TA-1015-S6602	10 x 15 (25.4 x 38.1)	✓	✓	✓	✓	✓	✓
40-TA-1020-S6602	10 x 20 (25.4 x 50.8)	✓	✓	✓	✓	✓	✓
40-TA-1520-S6602	15 x 20 (38.1 x 50.8)	NA	✓	✓	✓	✓	✓

✓ Available NA = Not A vailable
* TA refers to thickness and adhesive options (at right).

For sizes other than those shown, change 5th through 8th digits in Part Number to reflect desired size (e.g., 0415 is a 4 in. x 15 in. size).

THICKNESS, inch (mm)
1 0.020 (0.51)
2 0.032 (0.81)
3 0.062 (1.57)
4 0.093 (2.36)
5 0.125 (3.18)
6 0.045 (1.14)

T A

ADHESIVE (PSA)
0 No Adhesive
1 Adhesive Backing

Adhesive is not available on fluorosilicone materials 1217, 1221, 1287, 1298, E6306, E6434, L6303, and V6433 or on CHO-SEAL 1501, or on any sheets thinner than 0.032 inch (0.81mm).

(mm dimensions in parentheses)

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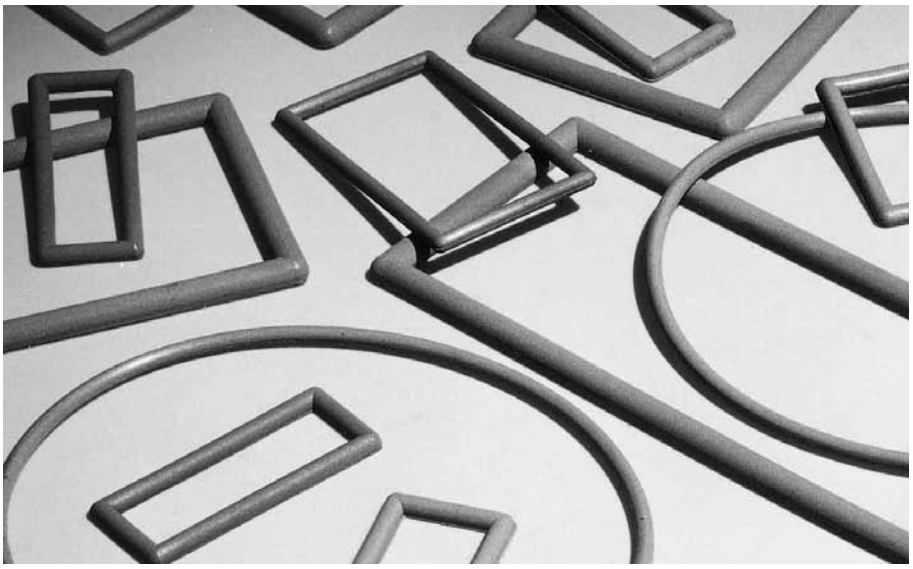
Molded Shapes

Standard Parts

Chomerics produces molded conductive elastomer EMI gaskets in hundreds of standard sizes in the following forms:

- Molded O- and D-rings, flat washers
- Connector Gaskets – Interfacial MS connector seals; D-subminiature rectangular; Jam-nut seals
- Waveguide Gaskets – Molded circular and rectangular (O or D cross section)

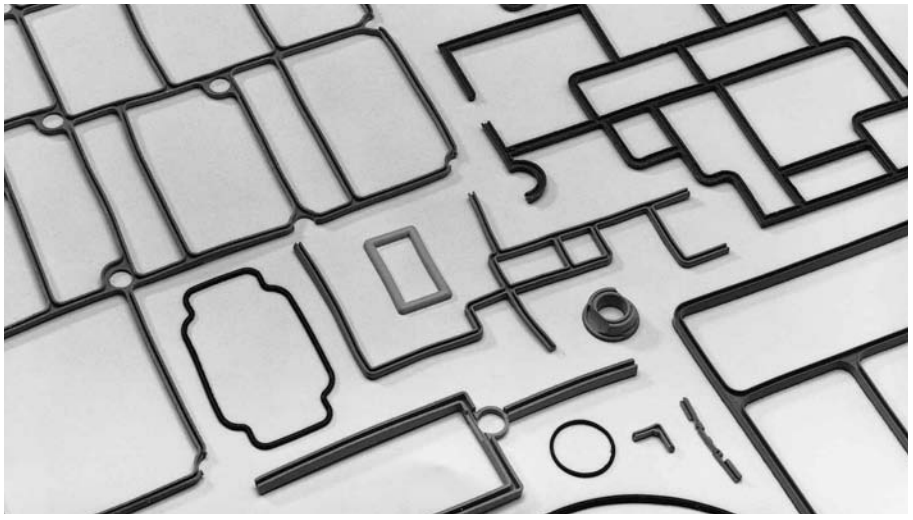
For complete specifications on these standard parts, including material selection, contact our Sales offices listed at the bottom of this page. ***Note:*** *Tooling charges may be incurred for some parts.*



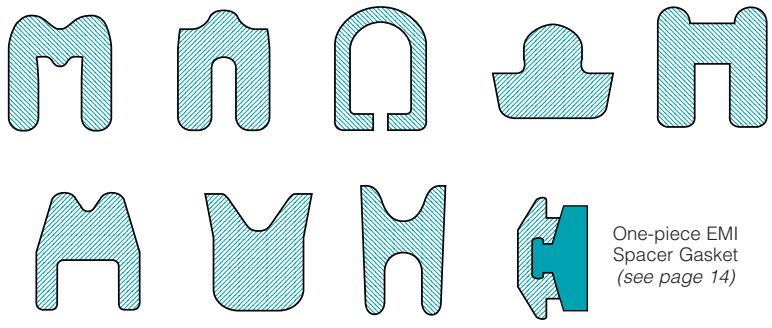
Custom Molded Gaskets

Chomerics can mold conductive elastomer EMI gaskets to fit practically any application. With our range of high quality materials and efficient manufacturing systems we can provide attractive choices in price and performance. Chomerics engineers can rapidly optimize gasket designs, at little or no cost, using tools such as finite element analysis (see next page). Prototype development, tooling and part delivery are each performed to meet our customers' requirements, with adherence to the industry's highest quality standards.

Custom molded elastomer gaskets can include tight corners, retention bumps and other special geometries. Many other features can be added, such as fabric or mesh reinforcement, pressure-sensitive adhesive, fasteners and compression stops. Non-conductive silicone environmental seals can be bonded to or co-molded with conductive EMI shielding elastomers. Representative custom molded elastomer gasket parts are shown here. Contact Chomerics' Applications Engineering Department to discuss how custom molded conductive elastomer shapes can be designed to meet your application requirements.



CROSS SECTIONS OF TYPICAL CUSTOM MOLDED EMI GASKETS



One-piece EMI Spacer Gasket
(see page 14)

continued

General Tolerances

The following table provides general tolerances for molded conductive elastomer gaskets. It is important to note that *all flat die-cut, molded, and extruded gaskets are subject to free-state variation in the unrestrained condition*. The use of inspection fixtures to verify conformance of finished parts is common and recommended where appropriate.

Also note that "Overall Dimensions" for molded gaskets includes any feature-to-feature dimensions (e.g., edge-to-edge, edge-to-hole, hole-to-hole).

Finite Element Analysis

Chomerics, a division of the Parker Hannifin Corporation's Seal Group, is the headquarters of Parker Seal's Elastomer Simulation Group. This unit specializes in elastomer finite element analysis (FEA), using the MARC K6 Series software as a foundation for FEA capability.

Benefits of FEA include:

- Optimizing elastomer gasket designs
- Allowing accurate predictions of alternate design concepts
- Eliminating extensive trial and error prototype evaluation.

Table 1

MOLDED GASKETS *inch (mm)*	TOLERANCE
Overall Dimensions	
0.100 to 1.500 (2.54 to 38.10)	±0.010 (0.25)
1.501 to 2.500 (38.13 to 63.50)	±0.015 (0.38)
2.501 to 4.500 (63.53 to 114.30)	±0.020 (0.51)
4.501 to 7.000 (114.33 to 177.80)	±0.025 (0.64)
>7.000 (>177.80)	±0.35% Nom. Dim.
Cross Section	
0.040 to 0.069 (1.02 to 1.75)	±0.003 (0.08)
0.070 to 0.100 (1.78 to 2.54)	±0.004 (0.11)
0.101 to 0.200 (2.57 to 5.08)	±0.005 (0.13)
0.201 to 0.350 (5.11 to 8.89)	±0.008 (0.20)
Flash Tolerance	0.005 (0.13) Max.Thickness 0.008 (0.20) Max. Extension

Figures 1a-c A typical use of FEA in designing molded gaskets is the evaluation of force and deflection needs for proposed designs. The FEA shown in Figure 1a below, performed on the cross section in 1b, predicts the gasket's deflection characteristics and compression requirements. Results are plotted in 1c.

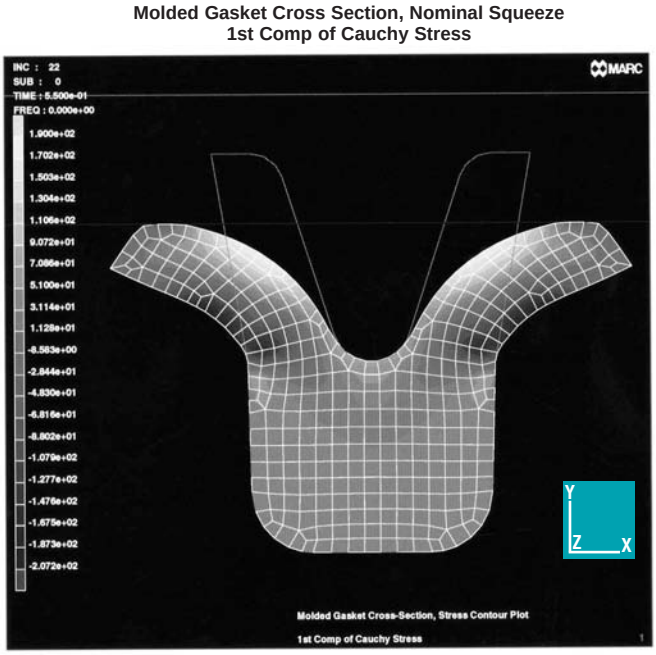
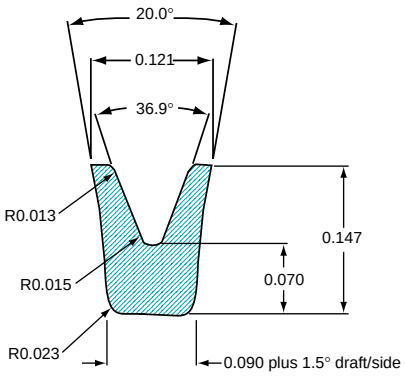


Figure 1a



Gasket Tolerance: ±0.005

Figure 1b

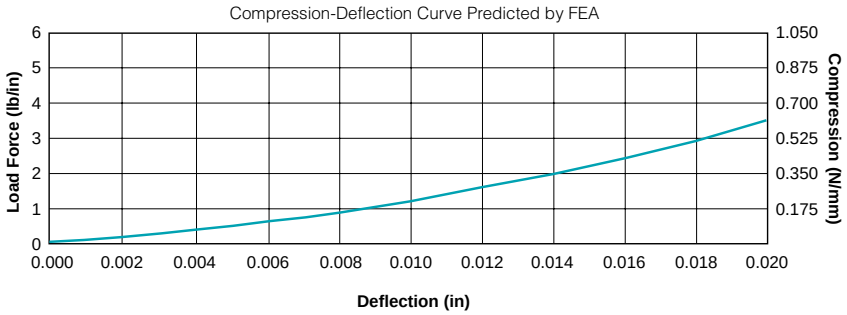


Figure 1c

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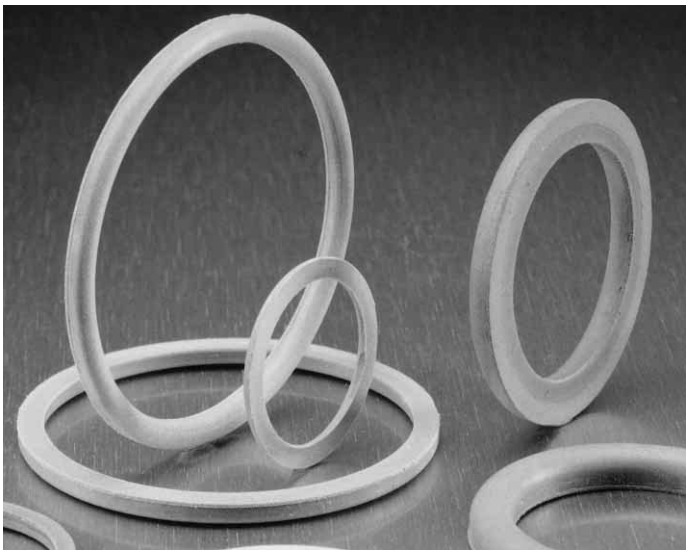
Parker Seals

Molded D- and O-Rings



Molded D- and O-Rings

Chomerics' D-ring and O-ring gaskets provide moisture/pressure sealing and EMI/EMP shielding when compressed in a properly designed groove. They are interchangeable with standard non-conductive seals of the same dimensions. Rings with I.D.s greater than 2 in. (51 mm) can be made by splicing extruded materials rather than by molding if groove corner radii are generous. Consult Chomerics before ordering.

Note: Grooves should be designed to assure 10 to 20% deflection of the gasket, and 100% maximum groove fill when groove dimensions are on the low side of allowable tolerance and gasket dimensions are on the high side.

Table 1

DIMENSIONS	TOLERANCES
Cross Sections	
0.040 to 0.069 (1.02-1.75)	±0.003 (±0.08)
0.070 to 0.100 (1.78-2.54)	±0.004 (±0.10)
0.101 to 0.200 (2.57-5.08)	±0.005 (±0.13)
0.201 to 0.350 (5.11-8.89)	±0.008 (±0.20)
Inside Diameters	
0.100 to 1.500 (2.54 to 38.10)	±0.010 (±0.25)
1.501 to 2.500 (38.13 to 63.50)	±0.015 (±0.38)
2.501 to 4.500 (63.53 to 114.30)	±0.020 (±0.51)
4.501 to 7.000 (114.33 to 177.80)	±0.025 (±0.64)
>7.000 (>177.80)	±0.35% of nom. dim.

Ordering Procedure

Select the part number from Table 2 (D-rings) and Table 3 (O-rings) which follow. The last four digits designate the material. We recommend CHO-SEAL 1215 material for the highest level of shielding effectiveness; CHO-SEAL 1285 material for the best combination of shielding effectiveness, corrosion resistance, weight, cost and temperature range; and CHO-SEAL 1298 for the highest level of corrosion resistance. (For material property specifications, refer to Table 3, pages 32-34.) *Note: Tooling charges may be incurred for some parts.*

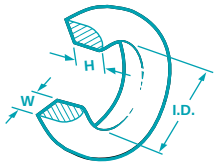


Table 2

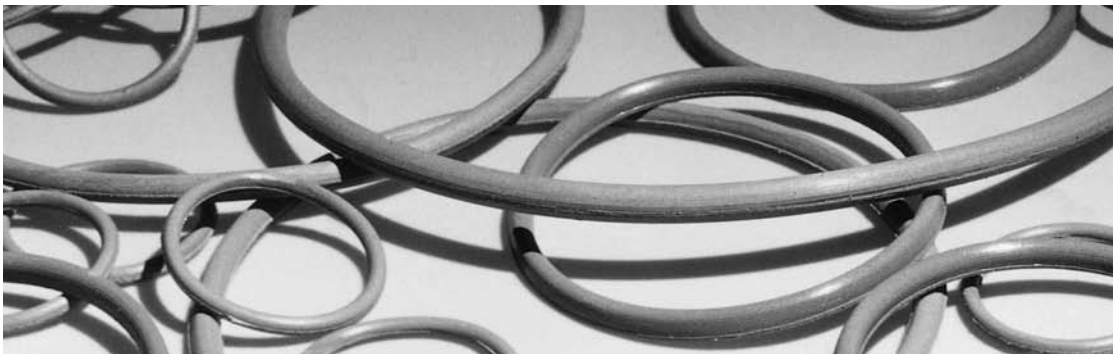
D-RINGS			
Chomerics P/N*	Nominal Dimensions		
	H	W	I.D.
10-01-6515-XXXX	0.048 (1.22)	0.078 (1.98)	0.587 (14.91)
10-01-1238-XXXX	0.059 (1.50)	0.093 (2.36)	2.705 (68.71)
10-01-1239-XXXX	0.059 (1.50)	0.095 (2.41)	3.193 (81.10)
10-01-1240-XXXX	0.061 (1.55)	0.025 (0.66)	0.180 (4.57)
10-01-1241-XXXX	0.061 (1.55)	0.039 (0.99)	0.151 (3.84)
10-01-1628-XXXX	0.062 (1.57)	0.096 (2.44)	1.562 (39.67)
10-01-1154-XXXX	0.062 (1.57)	0.069 (1.75)	0.893 (22.68)
10-01-1375-XXXX	0.066 (1.68)	0.059 (1.50)	0.565 (14.35)
10-01-6525-XXXX	0.067 (1.70)	0.097 (2.46)	1.094 (27.79)
10-01-1142-XXXX	0.069 (1.75)	0.094 (2.39)	1.072 (27.23)
10-01-1188-XXXX	0.070 (1.78)	0.065 (1.65)	0.809 (20.55)
10-01-1623-XXXX	0.073 (1.85)	0.034 (0.86)	0.230 (5.84)
10-01-1143-XXXX	0.076 (1.93)	0.097 (2.46)	1.460 (37.08)
10-01-1601-XXXX	0.076 (1.93)	0.095 (2.41)	1.397 (35.48)
10-01-1144-XXXX	0.076 (1.93)	0.097 (2.46)	1.581 (40.16)
10-01-2238-XXXX	0.076 (1.93)	0.113 (2.87)	1.262 (32.05)
10-01-6540-XXXX	0.077 (1.96)	0.103 (2.62)	1.511 (38.37)
10-01-6535-XXXX	0.083 (2.11)	0.093 (2.36)	1.357 (34.48)
10-01-1187-XXXX	0.101 (2.57)	0.130 (3.30)	0.592 (15.04)
10-01-1131-XXXX	0.118 (2.98)	0.174 (4.42)	1.385 (35.18)
10-01-6520-XXXX	0.125 (3.18)	0.155 (3.94)	0.885 (22.48)
10-01-1264-XXXX	0.123 (3.12)	0.123 (3.12)	0.853 (21.67)
10-01-1766-XXXX	0.125 (3.18)	0.138 (3.51)	2.859 (72.62)
10-01-1120-XXXX	0.130 (7.69)	0.180 (4.57)	3.412 (86.66)
10-01-6565-XXXX	0.188 (4.78)	0.234 (5.94)	3.837 (37.46)

* Last four digits should be used to designate material (1215, 1285, etc.) . For certain materials and configurations, a minimum order requirement may apply .

Additional sizes are available. For custom sizes, drawings must be provided. Part numbers will be assigned by Chomerics.

continued

(mm dimensions in parentheses)



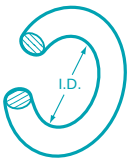


Table 3

O-RINGS			
Chomerics P/N* MIL P/N: M83528/ 00 [ ]X†-( )	MS 29513 MS 9021 Dash No.	Dimensions	
		Cross Section (Diameter)	I.D.
10-00-2231-XXXX [5] (001)	—	0.030 (0.76)	0.442 (11.23)
10-00-2232-XXXX [5] (002)	—	0.030 (0.76)	0.577 (14.66)
10-00-2259-XXXX [5] (003)	—	0.030 (0.76)	0.692 (17.58)
10-00-2233-XXXX [5] (004)	—	0.030 (0.76)	0.817 (20.75)
10-00-1413-XXXX [5] (005)	—	0.039 (0.99)	0.425 (10.80)
10-00-2777-XXXX [5] (006)	—	0.048 (1.22)	0.295 (7.49)
10-00-1406-XXXX [5] (007)	—	0.050 (1.27)	0.533 (13.54)
10-00-1405-XXXX [5] (008)	—	0.051 (1.30)	0.446 (11.33)
10-00-1407-XXXX [5] (009)	—	0.057 (1.45)	0.415 (10.54)
10-00-1376-XXXX [5] (010)	—	0.063 (1.60)	0.541 (13.74)
10-00-1342-XXXX [5] (011)	—	0.063 (1.60)	0.648 (16.46)
10-00-1631-XXXX [5] (012)	—	0.068 (1.73)	0.847 (21.51)
10-00-1770-XXXX [5] (013)	—	0.068 (1.73)	1.182 (30.02)
10-00-1478-XXXX [5] (014)	—	0.068 (1.73)	3.165 (80.39)
10-00-3811-XXXX [2] (007)	007	0.070 (1.78)	0.145 (3.68)
10-00-2226-XXXX [2] (011)	011	0.070 (1.78)	0.301 (7.65)
10-00-5983-XXXX [2] (012)	012	0.070 (1.78)	0.364 (9.25)
10-00-2227-XXXX [2] (013)	013	0.070 (1.78)	0.426 (10.82)
10-00-1980-XXXX [2] (014)	014	0.070 (1.78)	0.489 (12.42)
10-00-0008-XXXX [5] (015)	—	0.070 (1.78)	0.495 (12.57)
10-00-2065-XXXX [2] (015)	015	0.070 (1.78)	0.551 (14.00)
10-00-0010-XXXX [5] (016)	—	0.070 (1.78)	0.610 (15.49)

Table 3 *continued*

O-RINGS			
Chomerics P/N* MIL P/N: M83528/ 00 [ ]X†-( )	MS 29513 MS 9021 Dash No.	Dimensions	
		Cross Section (Diameter)	I.D.
10-00-2085-XXXX [5] (017)	—	0.070 (1.78)	0.635 (16.13)
10-00-1689-XXXX [5] (018)	—	0.070 (1.78)	0.667 (16.94)
10-00-2066-XXXX [2] (017)	017	0.070 (1.78)	0.676 (17.17)
10-00-1690-XXXX (NA)	—	0.070 (1.78)	0.738 (18.75)
10-00-0012-XXXX (NA)	—	0.070 (1.78)	0.735 (18.67)
10-00-2075-XXXX [2] (018)	108	0.070 (1.78)	0.739 (18.77)
10-00-1981-XXXX [2] (019)	019	0.070 (1.78)	0.801 (20.35)
10-00-0014-XXXX [5] (019)	—	0.070 (1.78)	0.860 (21.85)
10-00-2076-XXXX [2] (020)	020	0.070 (1.78)	0.864 (21.95)
10-00-1843-XXXX [2] (021)	021	0.070 (1.78)	0.926 (23.52)
10-00-2068-XXXX [2] (022)	022	0.070 (1.78)	0.989 (25.12)
10-00-2536-XXXX (NA)	—	0.070 (1.78)	1.046 (26.57)
10-00-2029-XXXX (NA)	—	0.070 (1.78)	1.110 (28.19)
10-00-2069-XXXX [2] (024)	024	0.070 (1.78)	1.114 (28.30)
10-00-1844-XXXX NA	—	0.070 (1.78)	1.176 (29.87)
10-00-2084-XXXX [5] (020)	—	0.070 (1.78)	1.230 (31.24)
10-00-2070-XXXX [2] (026)	026	0.070 (1.78)	1.239 (31.47)
10-00-2535-XXXX (NA)	—	0.070 (1.78)	1.296 (32.92)
10-00-2228-XXXX (NA)	—	0.070 (1.78)	1.362 (34.59)
10-00-2071-XXXX [2] (028)	028	0.070 (1.78)	1.364 (34.65)

* Last four digits should be used to designate material (1215, 1285, etc.). For certain materials and configurations, a minimum order requirement may apply.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in bracket is MIL-G-83528B slash sheet. Number in parentheses is MIL-G-83528B dash number. Insert them (without brackets or parentheses) to complete MIL P/N.

(mm dimensions in parentheses)

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Parker Seals

Table 3 *continued*

O-RINGS			
Chomerics P/N* MIL P/N: M83528/ 00[ ]X†-( )	MS 29513 MS 9021 Dash No.	Dimensions	
		Cross Section (Diameter)	I.D.
10-00-0024-XXXX (NA)	—	0.070 (1.78)	1.485 (37.72)
10-00-2677-XXXX (NA)	—	0.070 (1.78)	1.609 (40.87)
10-00-4123-XXXX (NA)	030	0.070 (1.78)	1.614 (41.00)
10-00-2229-XXXX (NA)	—	0.070 (1.78)	1.674 (42.52)
10-00-0028-XXXX (NA)	—	0.070 (1.78)	1.735 (44.07)
10-00-4124-XXXX (NA)	032	0.070 (1.78)	1.864 (47.35)
10-00-0032-XXXX (NA)	—	0.070 (1.78)	1.980 (50.29)
10-00-2230-XXXX (NA)	—	0.070 (1.78)	3.009 (76.43)
10-00-0052-XXXX (NA)	—	0.070 (1.78)	3.170 (80.52)
10-00-2040-XXXX (NA)	043	0.070 (1.78)	3.489 (88.62)
10-00-2320-XXXX (NA)	—	0.076 (1.93)	0.656 (16.66)
10-00-2321-XXXX (NA)	—	0.076 (1.93)	0.779 (19.79)
10-00-1827-XXXX (NA)	—	0.084 (2.13)	0.852 (21.64)
10-00-0044-XXXX (NA)	—	0.084 (2.13)	2.678 (68.02)
10-00-0020-XXXX (NA)	—	0.087 (2.21)	1.250 (31.75)
10-00-0038-XXXX (NA)	—	0.087 (2.21)	2.360 (59.94)
10-00-3550-XXXX (NA)	—	0.094 (2.39)	0.750 (19.05)
10-00-1459-XXXX (NA)	—	0.095 (2.41)	0.897 (22.78)
10-00-1378-XXXX (NA)	—	0.095 (2.41)	1.074 (27.28)
10-00-4452-XXXX (NA)	—	0.100 (2.54)	1.005 (25.53)

Table 4

DIMENSIONS	TOLERANCES
Cross Sections	
0.040 to 0.069 (1.02-1.75)	±0.003 (±0.08)
0.070 to 0.100 (1.78-2.54)	±0.004 (±0.10)
0.101 to 0.200 (2.57-5.08)	±0.005 (±0.13)
0.201 to 0.350 (5.11-8.89)	±0.008 (±0.20)
Inside Diameters	
0.100 to 1.500 (2.54 to 38.10)	±0.010 (±0.25)
1.501 to 2.500 (38.13 to 63.50)	±0.015 (±0.38)
2.501 to 4.500 (63.53 to 114.30)	±0.020 (±0.51)
4.501 to 7.000 (114.33 to 177.80)	±0.025 (±0.64)
>7.000 (>177.80)	±0.35% of nom. dim.

Table 3 *continued*

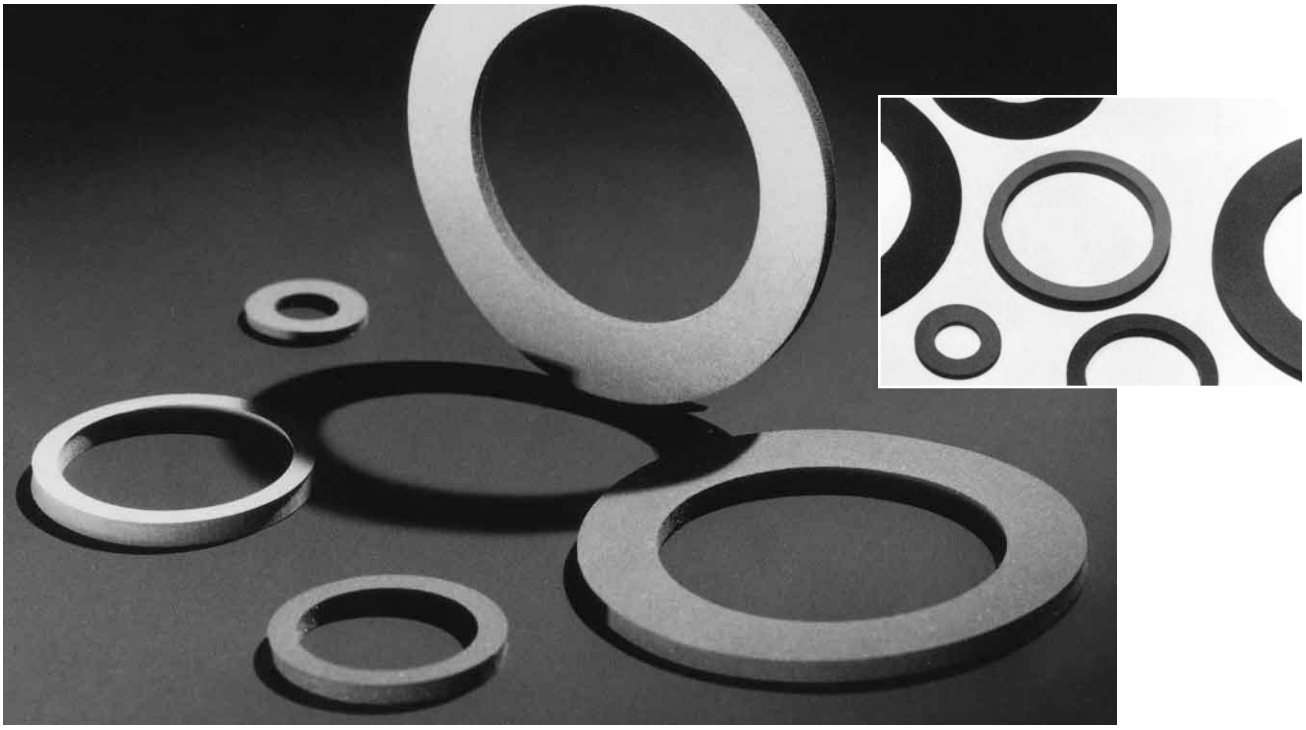
O-RINGS			
Chomerics P/N* MIL P/N: M83528/ 00[ ]X†-( )	MS 29513 MS 9021 Dash No.	Dimensions	
		Cross Section (Diameter)	I.D.
10-00-1754-XXXX (NA)	—	0.101 (2.57)	2.805 (71.25)
10-00-1359-XXXX (NA)	—	0.101 (2.57)	3.153 (80.87)
10-00-1360-XXXX (NA)	—	0.101 (2.57)	3.613 (80.87)
10-00-1921-XXXX [2] (114)	—	0.103 (2.62)	0.612 (15.54)
10-00-1847-XXXX [2] (117)	—	0.103 (2.62)	0.799 (20.29)
10-00-4685-XXXX [5] (021)	—	0.103 (2.62)	1.040 (26.42)
10-00-2086-XXXX (NA)	—	0.103 (2.62)	1.240 (31.50)
10-00-1845-XXXX [2] (126)	—	0.103 (2.62)	1.362 (34.59)
10-00-2072-XXXX [2] (128)	128	0.103 (2.62)	1.487 (37.77)
10-00-1846-XXXX [5] (022)	130	0.103 (2.62)	1.612 (40.94)
10-00-2031-XXXX [2] (132)	132	0.103 (2.62)	1.737 (44.12)
10-00-2087-XXXX [5] (023)	—	0.103 (2.62)	1.790 (45.47)
10-00-2030-XXXX [2] (142)	142	0.103 (2.62)	2.362 (59.99)
10-00-1691-XXXX [2] (155)	—	0.103 (2.62)	3.987 (101.27)
10-00-1573-XXXX (NA)	—	0.115 (2.92)	2.876 (73.05)
10-00-1607-XXXX (NA)	—	0.147 (3.73)	2.265 (57.53)
10-00-1608-XXXX (NA)	—	0.147 (3.73)	3.690 (93.73)
10-00-1782-XXXX (NA)	—	0.188 (4.78)	0.673 (17.09)
10-00-1746-XXXX (NA)	—	0.210 (5.33)	3.475 (12.07)
10-00-1354-XXXX (NA)	—	0.243 (6.17)	3.409 (86.59)
10-00-1747-XXXX (NA)	—	0.394 (10.01)	3.464 (87.99)

* Last four digits should be used to designate material (1215, 1285, etc.). For certain materials and configurations, a minimum order requirement may apply.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in bracket is MIL-G-83528B slash sheet. Number in parentheses is MIL-G-83528B dash number. Insert them (without brackets or parentheses) to complete MIL P/N.

(mm dimensions in parentheses)

Flat Washers



Flat Washers

CHO-SEAL flat washers are stocked in hundreds of different sizes. I.D.s and O.D.s are available in increments of $^{1}/_{64}$ in. (0.41 mm). Some of the more common sizes are listed in Table 1. CHO-SEAL 1215 material provides the highest levels of shielding effectiveness; CHO-SEAL 1285 material the best combination of shielding effectiveness, corrosion resistance, weight, cost and use temperature range; and CHO-SEAL 1298 the highest level of corrosion resistance. Precision flat washers can also be produced by cutting hollow O-shape extrusions (see page 42). Tolerances on I.D. and O.D. would be tighter than those below. For more information, contact Chomerics.

Ordering Procedure

Select the part number from Table 1. The last four digits designate the material.

Consult Chomerics on other available sizes. *For applications requiring a custom part, submit a drawing similar to the figure shown, indicating dimensions A, B and T.*

Note: The $\frac{\text{O.D.} - \text{I.D.}}{2}$ *of a flat washer cannot be less than the thickness of the material. Part numbers for custom parts will be assigned by Chomerics.*

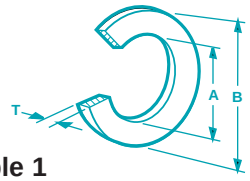


Table 1

FLAT WASHERS			
Nominal Diameters		Thickness T	Chomerics P/N* MIL P/N: M83528/ 012X†-( )
A ±0.015 (0.38)	B ±0.015 (0.38)		
0.250 (6.35)	0.625 (15.86)	0.032 (0.81) 0.062 (1.57)	10-02-1859-XXXX (001) 10-03-1859-XXXX (002)
0.375 (9.53)	0.750 (19.05)	0.032 (0.81) 0.062 (1.57)	10-02-1492-XXXX (003) 10-03-1492-XXXX (004)
0.500 (12.70)	0.656 (16.66)	0.032 (0.81) 0.062 (1.57)	10-02-1388-XXXX (005) 10-03-1388-XXXX (006)
0.500 (12.70)	0.875 (22.23)	0.032 (0.81) 0.062 (1.57)	10-02-1494-XXXX (007) 10-03-1494-XXXX (008)
0.750 (19.05)	1.000 (25.40)	0.032 (0.81) 0.062 (1.57)	10-02-2736-XXXX (009) 10-03-2736-XXXX (010)
1.000 (25.40)	1.438 (36.53)	0.032 (0.81) 0.062 (1.57)	10-02-1493-XXXX (011) 10-03-1493-XXXX (012)

* Last four digits should be used to designate material (1215, 1285, etc.).

† "X" should be replaced by applicable MIL-G-83528B material type (e.g., A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

(mm dimensions in parentheses)

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Parker Seals

Waveguide Gaskets

Waveguide Gaskets

For effective EMI shielding and pressure sealing for choke, cover and contact flanges, Chomerics' waveguide gaskets ensure low insertion, low flange leakage, maximum heat transfer and minimum outgassing. Made from CHO-SEAL 1239 and 1212 conductive elastomers, the gaskets are reusable and will not scar flanges.

Cover flange and flat contact flange gaskets are die-cut from CHO-SEAL 1239 sheet stock 0.027 in. (0.69 mm) thick, ±0.003 in. (0.08 mm). Containing an expanded metal reinforcement to eliminate cold flow, these gaskets can be supplied with a slightly raised lip around the iris opening for high-pressure, high-power applications.

RF/pressure seals for waveguide cover flanges are also available in Gask-O-Seal™ form. Gask-O-Seal waveguide gaskets consist of thin metal retainers which incorporate elastomer seals on each side, and raised knurls which bite into flange surfaces to provide good electrical contact. *For more information on Gask-O-Seal products, contact Parker Hannifin, Cleveland, OH, 1-800-272-7537 and ask for Gask-O-Seal catalog #OSD-6411A.*

Choke flange and grooved contact flange gaskets are molded from CHO-SEAL 1212 material, and are available with O- or D-cross sections.

Properties of CHO-SEAL 1212 and 1239 materials are shown at right and in Table 3 on page 32.

Standard Waveguide Gaskets

The gaskets listed in the following tables will fit the standard UG, CPR, and CMR flanges shown. The numbers 1 through 6 listed in the "gasket configuration" column of the tables indicate the style of gasket, as follows:

- **1** – Die-cut rectangular
- **2** – Die-cut circular
- **3** – Molded rectangular, with "O" cross section
- **4** – Molded circular, with "O" cross section (O-rings)
- **5** – Molded circular, with "D" cross section (D-rings)
- **6** – Molded rectangular, with "D" cross section

Gaskets can also be custom designed to meet special requirements or less frequently used waveguide sizes (from WR 10 to WR 2300). CHO-SEAL 1239 material is not available in sheet form.

Ordering Procedure

For standard gaskets, select the part number from Tables 2-8. *For custom configurations, gasket and waveguide flange drawings must be provided, and part numbers will be assigned by Chomerics.*

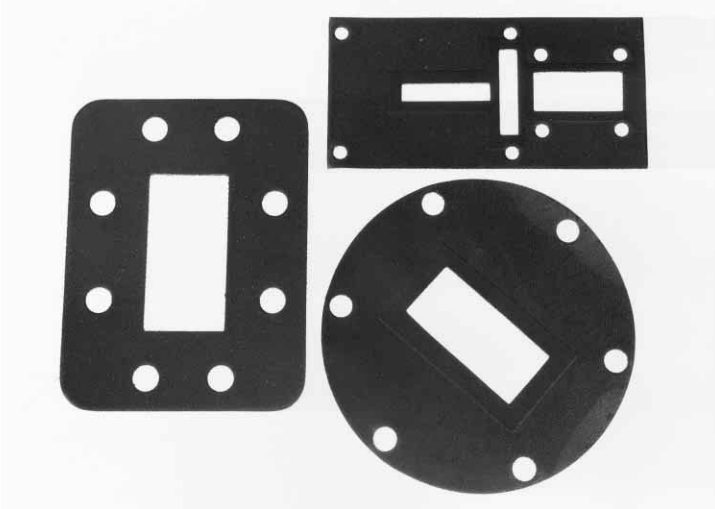

Table 1

SPECIFICATIONS			CHO-SEAL 1212	CHO-SEAL 1239
Type (Ref: MIL-G-83528)			K	G
Volume Resistivity (ohm-cm, max) as supplied (without pressure-sensitive adhesive)			0.005	0.007
Hardness (Shore A ±5)			80	80
Specific Gravity (±0.25)			3.5	4.75 ±0.75
Tensile Strength, psi (MPa), min.			400 (2.76)	600 (4.14)
Elongation (percent, min/max)			100 / 300	20 / NA
Tear Strength, lb/in. (kN/m), min.			40 (7.00)	70 (12.25)
Compression Set, 70 hrs. @ 100°C, % max.			35	NA
Low Temperature Flex, TR10, °C, min.			–45	NA
Maximum Continuous Use Temperature, °C			125	125
Shielding Effectiveness	200 kHz (H Field) 100 MHz (E Field) 500 MHz (E Field) 2 GHz (Plane Wave) 10 GHz (Plane Wave)	dB, min.	70 120 120 120 120	70 110 110 110 110
Electrical Stability	Heat Aging	ohm-cm, max.	0.010	0.010
	Vibration Resistance – During		0.010	0.010
	Vibration Resistance – After		0.005	0.007
	Post Tensile Set Volume Resistivity		0.010	NA
	EMP Survivability (kA per in. perimeter)		>0.9	>0.9

NA = Not Applicable Refer to Table 3, page 32 for Test Procedures

continued

Table 2 Use Table 2 to select part numbers. Refer to Tables 3-8 on following pages for Waveguide Gasket dimensions.

WAVEGUIDE GASKETS										
Frequency Range (GHz)	Band	EIA Waveguide Size	JAN Designation	Flange Description			Flange Type	Gasket Configuration*	Chomerics Part Number	MIL P/N:† M83528/ 013 [ ]-( )
				UG	CPR	CMR				
26.5 → 40.0	K_a	WR28	RG-96/U (Silver)	UG-599/U			Cover	1	20-01-5000-1239**	[G]-(001)
				UG-600A/U			Choke	5	20-02-6510-1212	[K]-(002)
18.0 → 26.5	K	WR42	RG-53/U (Brass) RG-121/U (Aluminum)	UG-595/U UG-597/U			Cover	1	20-01-5005-1239**	[G]-(003)
				UG-596A/U UG-598A/U			Choke	5	20-02-6515-1212	[K]-(004)
12.4 → 18.0	K_u	WR62	RG-91/U (Brass) RG-107/U (Silver)	UG-419/U			Cover	1	20-01-5010-1239**	[G]-(005)
				UG-541A/U			Choke	5	20-02-6520-1212	[K]-(006)
10.0 → 15.0		WR75					Cover Choke	1 5	20-11-1683-1239 20-02-6525-1212	[G]-(007) [K]-(008)
8.2 → 12.4	X	WR90	RG-52/U (Brass) RG-67/U (Aluminum)	UG-39/U UG-135/U			Cover	1	20-11-5015-1239	[G]-(009)
				UG-1736/U UG-1737/U	CPR-90F		Flat Contact	1	20-01-5115-1239**	[G]-(010)
				UG-136A/U UG-40A/U			Choke	5	20-02-6531-1212	[K]-(011)
				UG-136B/U UG-40B/U			Choke	5	20-02-6530-1212	[K]-(012)
				UG-1360/U UG-1361/U	CPR-90G		Contact	3	20-03-6630-1212	[K]-(013)
7.0 → 11.0		WR102		UG-1494/U			Choke	5	20-02-6535-1212	[K]-(014)
7.05 → 10.0	X_1	WR112	RG-51/U (Brass) RG-68/U (Aluminum)	UG-51/U UG-138/U			Cover	1	20-11-5020-1239	[G]-(015)
				UG-1734/U UG-1735/U	CPR-112F		Flat Contact	1	20-01-5120-1239**	[G]-(016)
				UG-52B/U UG-137B/U			Choke	5	20-02-6540-1212	[K]-(017)
				UG-1358/U UG-1359/U	CPR-112G CPR-112G/F		Contact Choke/Flat	3 6	20-03-6635-1212 20-03-3686-1212	[K]-(018) —
5.85 → 8.2	X_b	WR137	RG-50/U (Brass) RG-106/U (Aluminum)	UG-344/U UG-441/U			Cover	2	20-11-5025-1239	[G]-(019)
				UG-1732/U UG-1733/U	CPR-137F		Flat Contact	1	20-01-5125-1239**	[G]-(020)
						CMR-137	Flat Contact	1	20-01-5225-1239**	[G]-(021)
				UG-343B/U UG-440B/U			Choke	4	20-02-6545-1212	[K]-(022)
				UG-1356/U UG-1357/U	CPR-137G CPR-137G/F		Contact Choke/Flat	3 6	20-03-6645-1212 20-03-3731-1212	[K]-(023) —
4.9 → 7.05		WR159		UG-1730/U UG-1731/U	CPR-159F		Flat Contact	1	20-01-5130-1239**	[G]-(024)
						CMR-159	Flat Contact	1	20-01-5230-1239**	[G]-(025)
					CPR-159G		Choke	3	20-03-L767-1212	—
					CPR-159G/F		Choke/Flat	6	20-03-3980-1212	—

* Number corresponds to configuration type, Tables 3-8.

** This gasket will seal a maximum pressure of 20 psi. For systems pressurized above this limit, a high-pressure (raised-lip) version is available. To specify, change 3rd digit in Part Number to 1.

† Letter in bracket is MIL-G-83528B material type (G or K). Number in parentheses is MIL-G-83528B dash number. Insert them (without brackets or parentheses) to complete MIL P/N.

(mm dimensions in parentheses)

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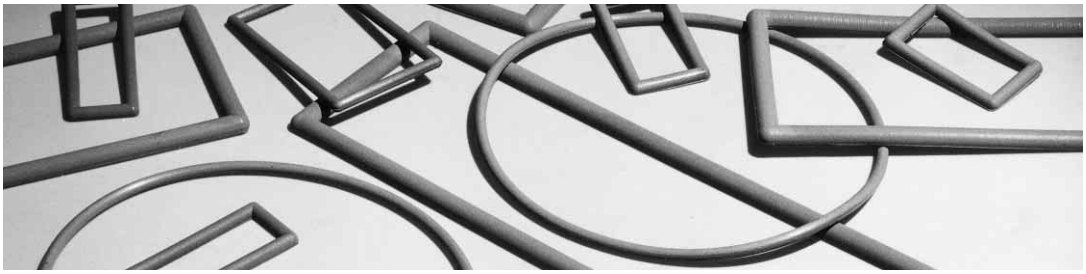


Table 2

continued Use Table 2 to select part numbers. Refer to Tables 3-8 on following pages for Waveguide Gasket dimensions.

WAVEGUIDE GASKETS										
Frequency Range (GHz)	Band	EIA Waveguide Size	JAN Designation	Flange Description			Flange Type	Gasket Configuration*	Chomerics Part Number	MIL P/N:† M83528/ 013 [ ]-( )
				UG	CPR	CMR				
3.95 → 5.85	C	WR187	RG-49/U (Brass) RG-95/U (Aluminum)	UG-149A/U UG-407/U			Cover	2	20-11-5035-1239	[G]-(026)
				UG-1728/U UG-1729/U	CPR-187F		Flat Contact	1	20-01-5135-1239**	[G]-(027)
						CMR-187	Flat Contact	1	20-01-5235-1239**	[G]-(028)
				UG-148C/U UG-406B/U			Choke	4	20-02-6555-1212	[K]-(029)
				UG-1352/U UG-1353/U	CPR-187G		Contact	3	20-03-6655-1212	[K]-(030)
3.30 → 4.90		WR229		UG-1726/U UG-1727/U	CPR-229F		Flat Contact	1	20-01-5140-1239**	[G]-(031)
						CMR-229	Flat Contact	1	20-01-5240-1239**	[G]-(032)
					CPR-229G		Choke	3	20-03-L768-1212	—
2.6 → 3.95	S	WR284	RG-48/U (Brass) RG-75/U (Aluminum)	UG-53/U UG-584/U			Cover	2	20-01-5045-1239**	[G]-(033)
				UG-1724/U UG-1725/U	CPR-284F		Flat Contact	1	20-01-5145-1239**	[G]-(034)
						CMR-284	Flat Contact	1	20-01-5245-1239**	[G]-(035)
				UG-54B/U UG-585A/U			Choke	5	20-02-6565-1212	[K]-(036)
				UG-1348/U UG-1349/U	CPR-284G		Contact	3	20-03-6665-1212	[K]-(037)
2.2 → 3.3		WR340	RG-112/U (Brass) RG-112/U (Aluminum)	UG-533/U UG-554/U			Flat Contact	1	20-01-5050-1239**	[G]-(038)
					CPR-340F		Flat Contact	1	20-01-5150-1239**	[G]-(039)
1.7 → 2.6	W	WR430	RG-104/U (Brass) RG-105/U (Aluminum)	UG-435A/U UG-437A/U			Flat Contact	1	20-01-5055-1239**	[G]-(040)
					CPR-430F		Flat Contact	1	20-01-5155-1239**	[G]-(041)
					CPR-430G		Choke	3††	20-03-1560-1212	—
					CPR-430G/F		Choke/ Flat	6†††	20-03-6685-1212	—
1.12 → 1.7	L	WR650	RG-69/U (Brass) RG-103/U (Aluminum)	UG-417A/U UG-418A/U			Flat Contact	1	20-01-5060-1239**	[G]-(042)

* Number corresponds to configuration type, Tables 3-8.

** This gasket will seal a maximum pressure of 20 psi. For systems pressurized above this limit, a high-pressure (raised-lip) version is available. To specify, change 3rd digit in Part Number to 1.

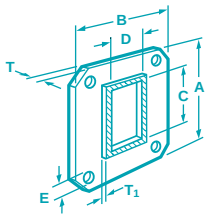
† Letter in bracket is MIL-G-83528B material type (G or K). Number in parentheses is MIL-G-83528B dash number. Insert them (without brackets or parentheses) to complete MIL P/N.

†† Modified "O" cross section. ††† Modified "D" cross section.

continued

(mm dimensions in parentheses)

Typical Waveguide Gasket Configurations



Note: *Raised portion will have a nominal width of 0.187 in. (4.75 mm). Thickness (T_1) is 0.004 in. (0.10 mm) ±0.002 in. (0.05 mm). This raised area applies only to part numbers with a third digit of "1".*

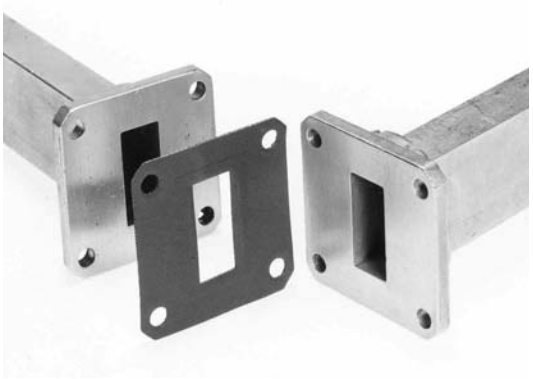


Table 3

CONFIG.1 - DIE-CUT RECTANGULAR						
Dimensions						Chomerics P/N** MIL P/N: M83528/ 013G-( )
A	B	C	D	E*	T	
±0.015 (0.38)	±0.015 (0.38)	+0.015 (0.38) –0.000		±0.010 (0.25)	±.003 (0.08)	
1.496 (38.00)	1.496 (38.00)	0.760 (19.30)	0.385 (9.78)	0.155 (3.94)	0.027 (0.69)	20-11-1683-1239 (007)
0.750 (19.05)	0.750 (19.05)	0.145 (3.68)	0.285 (7.24)	0.116 (2.95)	0.027 (0.69)	20-01-5000-1239 (001)
0.875 (22.23)	0.875 (22.23)	0.175 (4.45)	0.425 (10.80)	0.116 (2.95)	0.027 (0.69)	20-01-5005-1239 (003)
1.313 (33.35)	1.313 (33.35)	0.630 (16.00)	0.320 (8.13)	0.140 (3.56)	0.027 (0.69)	20-01-5010-1239 (005)
1.625 (41.28)	1.625 (41.28)	0.905 (22.99)	0.405 (10.29)	0.169 (4.29)	0.027 (0.69)	20-01-5015-1239 (009)
1.875 (47.63)	1.875 (47.63)	1.130 (28.70)	0.505 (12.83)	0.180 (4.57)	0.027 (0.69)	20-11-5020-1239 (015)
3.750 (95.25)	5.440 (138.18)	1.710 (43.43)	3.410 (86.61)	0.264 (6.71) 0.250 (6.35)	0.027 (0.69)	20-01-5050-1239 (038)
4.188 (106.38)	6.344 (161.14)	2.160 (54.86)	4.310 (109.47)	0.266 (6.76) 0.281 (7.14)	0.027 (0.69)	20-01-5055-1239 (040)
5.438 (138.13)	8.688 (220.68)	3.260 (82.80)	6.510 (165.35)	0.250 (6.35) 0.328 (8.33)	0.027 (0.69)	20-01-5060-1239 (042)
1.594 (40.49)	2.094 (53.19)	0.405 (10.29)	0.905 (22.99)	0.169 (4.29)	0.027 (0.69)	20-01-5115-1239 (010)
1.750 (44.45)	2.500 (63.50)	0.505 (12.83)	1.130 (28.70)	0.171 (4.34)	0.027 (0.69)	20-01-5120-1239 (016)
1.937 (49.20)	2.687 (68.25)	0.633 (16.08)	1.380 (35.05)	0.206 (5.23)	0.027 (0.69)	20-01-5125-1239 (020)
2.438 (61.93)	3.188 (80.98)	0.805 (20.45)	1.600 (40.64)	0.257 (6.53)	0.027 (0.69)	20-01-5130-1239 (024)
3.500 (88.90)	2.500 (63.50)	1.880 (47.75)	0.880 (22.35)	0.266 (6.76)	0.027 (0.69)	20-01-5135-1239 (027)
2.750 (69.85)	3.875 (98.43)	1.155 (29.34)	2.300 (58.42)	0.270 (6.86)	0.027 (0.69)	20-01-5140-1239 (031)
4.500 (114.30)	3.000 (76.20)	2.850 (72.39)	1.350 (34.29)	0.266 (6.76)	0.027 (0.69)	20-01-5145-1239 (034)
3.750 (95.25)	5.438 (138.13)	1.710 (43.43)	3.410 (86.61)	0.266 (6.76)	0.027 (0.69)	20-01-5150-1239 (039)
6.344 (161.14)	4.188 (106.38)	4.310 (109.47)	2.160 (54.86)	0.266 (6.76)	0.027 (0.69)	20-01-5155-1239 (041)
1.531 (38.89	2.281 (57.94)	0.632 (16.05)	1.382 (35.10)	0.150 (3.81)	0.027 (0.69)	20-01-5225-1239 (021)
1.750 (44.45)	2.500 (63.50)	0.800 (20.32)	1.600 (40.64)	0.160 (4.06) 0.150 (3.81)	0.027 (0.69)	20-01-5230-1239 (025)
1.784 (45.31)	2.781 (70.64)	0.882 (22.40)	1.882 (47.80)	0.156 (3.96) 0.141 (3.58)	0.027 (0.69)	20-01-5235-1239 (028)
2.000 (50.80)	3.156 (80.16)	1.155 (29.34)	2.300 (58.42)	0.150 (3.81)	0.027 (0.69)	20-01-5240-1239 (032)
3.844 (37.64)	2.344 (59.54)	2.850 (72.39)	1.350 (34.29)	0.172 (4.37) 0.188 (4.78)	0.027 (0.69)	20-01-5245-1239 (035)

* Hole locations conform to holes in standard waveguide flanges identified in preceding 2 pages. Where two hole diameters are given, flange has holes of two different diameters.

** Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

(mm dimensions in parentheses)

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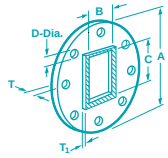


Note: *Raised portion will be a nominal of 0.187 in. (4.75 mm) wide. Thickness (T_1) is 0.004 in. (0.10 mm) ±0.002 in. (0.05 mm). This raised area applies only to part numbers with a third digit of "1".*

Table 4

CONFIG.2 - DIE-CUT CIRCULAR

Dimensions					Chomerics P/N MIL P/N: M83528/ 013G-( )†
A	B	C	D*	T	
±0.015 (0.38)	+0.015 (0.38) −0.000		±.010 (0.38)	±.003 (0.08)	
3.125 (79.38)	0.632 (16.05)	1.382 (35.10)	0.234 (5.94)	0.027 (0.69)	20-11-5025-1239 (019)
3.625 (92.08)	0.882 (22.40)	1.882 (47.80)	0.234 (5.94)	0.027 (0.69)	20-11-5035-1239 (026)
5.312 (134.93)	1.350 (34.29)	2.850 (72.39)	0.290 (7.37)	0.027 (0.69)	20-01-5045-1239 (033)

* Hole locations conform to holes in standard waveguide flanges identified in Table 2 on pages XX-XX.

† Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

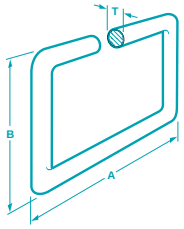


Table 5

CONFIG.3 - MOLDED RECTANGULAR WITH "O" CROSS SECTION

Dimensions				Chomerics P/N MIL P/N:M83528/ 013K-( )†
A	B	T(dia.)	H	
1.368 (34.75)	0.868 (22.05)	0.103 (2.62)	—	20-03-6630-1212 (013)
1.616 (41.05)	0.991 (25.17)	0.103 (2.62)	—	20-03-6635-1212 (018)
1.866 (47.40)	1.116 (28.35)	0.103 (2.62)	—	20-03-6645-1212 (023)
2.449 (62.20)	1.449 (36.80)	0.139 (3.53)	—	20-03-6655-1212 (030)
3.451 (87.66)	1.951 (49.56)	0.139 (3.53)	—	20-03-6665-1212 (037)
2.167 (55.04)	1.372 (34.85)	0.139 (3.53)	—	20-03-L767-1212
2.867 (72.82)	1.722 (43.74)	0.139 (3.53)	—	20-03-L768-1212
5.160 (131.06)	3.010 (76.45)	0.250 (6.35)	0.144 (36.58)	20-03-1560-1212*

† Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

* Modified "O" Cross Section. A and B dimensions shown for this part number are measured from the inside wall.

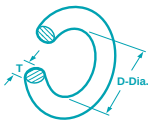


Table 6

CONFIG.4 - MOLDED CIRCULAR WITH "O" CROSS SECTION

Dimensions		Chomerics P/N MIL P/N: M83528/ 013K-( )†
D (I.D.)	T	
2.011 (51.08)	0.123-0.153 (3.12-3.89)	20-02-6545-1212 (022)
2.683 (68.15)	0.115 (2.92)	20-02-6555-1212 (029)

† Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

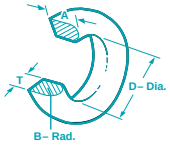


Table 7

CONFIG.5 - MOLDED CIRCULAR WITH "D" CROSS SECTION

Dimensions				Chomerics P/N MIL P/N: M83528/ 013K-( )†
A	B	D (I.D.)	T	
0.056 (1.42)	0.041 (1.04)	0.410 (10.41)	0.082 (2.08)	20-02-6510-1212 (002)
0.048 (1.22)	Full Rad. –	0.587 (14.91)	0.078 (1.98)	20-02-6515-1212 (004)
0.125 (3.18)	Full Rad. –	0.885 (22.48)	0.155 (3.94)	20-02-6520-1212 (006)
0.065 (1.65)	0.49 (1.24)	1.122 (28.50)	0.099 (2.51)	20-02-6525-1212 (008)
0.077 (1.96)	Full Rad. –	1.310 (33.27)	0.115 (2.92)	20-02-6530-1212 (012)
0.088 (2.24)	Full Rad. –	1.340 (34.04)	0.095 (2.41)	20-02-6531-1212 (011)
0.085 (2.16)	Full Rad. –	1.392 (35.36)	0.095 (2.41)	20-02-6535-1212 (014)
0.078 (1.78)	Full Rad. –	1.550 (39.37)	0.105 (2.68)	20-02-6540-1212 (017)
0.188 (4.76)	Full Rad. –	3.910 (99.31)	0.240 (6.10)	20-02-6565-1212 (036)

† Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

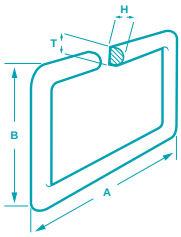


Table 8

CONFIG.6 - MOLDED RECTANGULAR WITH"D" CROSS SECTION

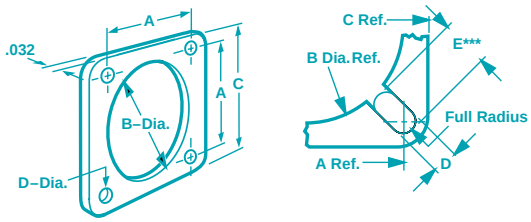
Dimensions				Chomerics P/N
A	B	T(dia.)	H	
1.616 (41.05)	0.991 (25.17)	0.103 (2.62)	0.053 (1.35)	20-03-3686-1212
1.866 (47.40)	1.116 (28.35)	0.103 (2.62)	0.053 (1.35)	20-03-3731-1212
2.167 (55.04)	1.372 (34.85)	0.120 (3.05)	0.060 (1.52)	20-03-3980-1212
5.160 (131.06)	3.010 (76.45)	0.250 (6.35)	0.074 (1.88)	20-03-6685-1212*

* Modified "D" Cross Section. A and B dimensions shown for this part number are measured from the inside wall.

(mm dimensions in parentheses)

Connector Gaskets

MIL-C-38999 Series III and MIL-C-28840



Note: The radius of each corner is equal to $\frac{C-A}{2}$

Mounting Flange EMI Gaskets

Chomerics' die-cut CHO-SEAL gaskets provide EMI shielding and environmental sealing when inserted between a connector flange and a mounting bulkhead. The gaskets described in this section are designed for use with MIL-C-83723, MIL-C-5015, MIL-C-26482, MIL-C-38999 and MIL-C-81511 connectors. They are interchangeable with non-conductive gaskets.

Standard mounting flange gaskets are available in CHO-SEAL 1212 material, for continuous-use

Table 1

MOUNTING FLANGE EMI GASKETS

Shell Size		Configuration Drawing No. (See Ordering Procedure on Next Page)									Dimensions				
		MIL-C-38999 Series				MIL-C-81511		MIL-C-5015 C-83723 NAS-1599	MIL P/N: M83528/		A	B	C	D	E***
No.	Letter		I	II	III	IV	MS90484	MIL-C-28840	MIL-C-26482	004X† –( )	±0.010 (0.25)	+0.020 (0.51) -0.000	±0.015 (0.38)	±0.010 (0.25)	±0.010 (0.25)
6									1946*	(001)	0.469 (11.91)	0.375 (9.53)	0.738 (18.75)	0.141 (3.58)	0.141 (3.58)
8		1947	—	✓	—	—	4690			(002)	0.594 (15.09)	0.630 (16.00)	0.840 (21.34)	0.135 (3.43)	
										(003)	0.594 (15.09)	0.568 (14.43)	0.812 (20.62)	0.125 (3.18)	
									1948	(004)	0.594 (15.09)	0.500 (12.70)	0.875 (22.23)	0.156 (3.96)	
9		1949	✓	—	—	—				(005)	0.719 (18.26)	0.750 (19.05)	0.965 (24.51)	0.135 (3.43)	
	A	C646	—	—	✓	—				(NA)	0.719 (18.26)	0.750 (19.05)	0.965 (24.51)	0.135 (3.43)	0.222 (5.64)
10		1949	—	✓	—	—	4691			(005)	0.719 (18.26)	0.750 (19.05)	0.965 (24.51)	0.135 (3.43)	
										(006)	0.719 (18.26)	0.680 (17.27)	0.937 (23.80)	0.125 (3.18)	
	(S/SL)								1950	(007)	0.719 (18.26)	0.625 (15.88)	1.000 (25.40)	0.156 (3.96)	
11		6961	✓	—	—	✓				(008)	0.812 (20.62)	0.875 (22.23)	1.060 (26.92)	0.141 (3.58)	
	B	C647	—	—	✓	—				(NA)	0.812 (20.62)	0.875 (22.23)	1.060 (26.92)	0.141 (3.58)	0.206 (5.23)
	A							C637		(NA)	0.750 (19.05)	0.875 (22.23)	1.046 (26.57)	0.141 (3.58)	0.163 (4.14)
12		6961	—	✓	—	—				(008)	0.812 (20.62)	0.875 (22.23)	1.060 (26.92)	0.141 (3.58)	
	(S/SL)								1951	(009)	0.813 (20.65)	0.750 (19.05)	1.094 (27.79)	0.156 (3.96)	
13		1953	✓	—	—	✓				(010)	0.906 (23.01)	1.005 (25.53)	1.153 (29.29)	0.135 (3.43)	
	C	C648	—	—	✓					(NA)	0.906 (23.01)	1.000 (25.40)	1.156 (29.36)	0.141 (3.58)	0.206 (5.23)
	B							C638		(NA)	0.843 (21.41)	1.000 (25.40)	1.156 (29.36)	0.141 (3.58)	0.167 (4.24)
14		1953	—	✓	—	—	4692			(010)	0.906 (23.01)	1.005 (25.53)	1.153 (29.29)	0.135 (3.43)	
										(011)	0.906 (23.01)	0.938 (23.83)	1.125 (28.58)	0.125 (3.18)	
	(S)								1952	(012)	0.906 (23.01)	0.875 (22.23)	1.188 (30.18)	0.156 (3.96)	
15		1955	✓	—	—	✓				(013)	0.969 (24.61)	1.135 (28.83)	1.258 (31.95)	0.156 (3.96)	
	D	C649	—	—	✓	—				(NA)	0.969 (24.61)	1.135 (28.83)	1.258 (31.95)	0.156 (3.96)	0.206 (5.23)
	C							C639		(NA)	0.968 (24.59)	1.187 (30.15)	1.281 (32.54)	0.141 (3.58)	0.161 (4.09)
16		1955	—	✓	—	—	4693			(013)	0.969 (24.61)	1.135 (28.83)	1.258 (31.95)	0.156 (3.96)	
										(014)	0.969 (24.61)	1.063 (27.00)	1.250 (31.75)	0.125 (3.18)	
	(S)								1954	(015)	0.969 (24.61)	1.000 (25.40)	1.281 (32.54)	0.156 (3.96)	
17		1957	✓	—	—	✓				(016)	1.062 (26.97)	1.260 (32.00)	1.351 (34.32)	0.156 (3.96)	
	E	C650	—	—	✓					(NA)	1.062 (26.97)	1.260 (32.00)	1.351 (34.32)	0.156 (3.96)	0.222 (5.64)
	D							C640		(NA)	1.015 (25.78)	1.250 (31.75)	1.406 (35.71)	0.141 (3.58)	0.163 (4.14)
18	(S)	1957	—	✓	—	—	4694			(016)	1.062 (26.97)	1.260 (32.00)	1.351 (34.32)	0.156 (3.96)	
										(017)	1.062 (26.97)	1.189 (30.20)	1.343 (34.11)	0.125 (3.18)	
									1956	(018)	1.062 (26.97)	1.135 (28.83)	1.375 (34.93)	0.156 (3.96)	

✓ Available in series designated.
— Not applicable in series designated.
* Shell size 6 not specified in MIL-C-5015.
*** For dimension E, hole is slotted through to B diameter , when $\frac{(1.41xA)-D-B}{2} \leq .032$ in.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g. A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

(mm dimensions in parentheses)

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temperatures to 125°C, and CHO-SEAL 1285 and 1224 materials, for temperatures to 200°C. Because CHO-SEAL 1224 material is filled with pure silver particles, prices are substantially higher than for CHO-SEAL 1212 or 1285 gaskets. In addition to the standard sizes and configurations listed here, connector gaskets and ground planes can be custom designed.

Connector gaskets should be used in conjunction with conductive interfacial EMI seals *(see next page)*.

Ordering Procedure

Standard Sizes: Using Table 1, construct the appropriate part number as illustrated below.

For Custom Gaskets: Drawings must be supplied. Part numbers will be assigned by Chomerics.

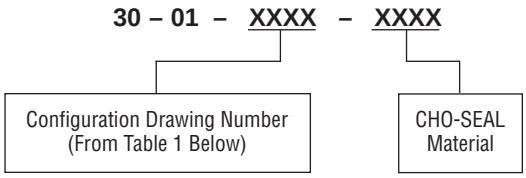

Table 1 *continued*

MOUNTING FLANGE EMI GASKETS

Shell Size		Configuration Drawing No. (See Ordering Procedure above)								Dimensions				
		MIL-C-38999 Series				MIL-C-81511		MIL-C-5015 C-83723 NAS-1599	MIL P/N: M83528/ 004X†	A	B	C	D	E***
No.	Letter		I	II	III	IV	MS90484	MIL-C-28840	MIL-C-26482	–( )	±0.010 (0.25)	+0.020 (0.51) -0.000	±0.015 (0.38)	±0.010 (0.25)	±0.010 (0.25)
19		6962	✓	—	—	✓				(019)	1.156 (29.36)	1.375 (34.93)	1.500 (38.10)	0.141 (3.58)	
	F	C651	—	—	✓	—				(NA)	1.156 (29.36)	1.375 (34.93)	1.500 (38.10)	0.141 (3.58)	0.206 (5.23)
	E							C641		(NA)	1.140 (28.96)	1.437 (36.50)	1.531 (38.89)	0.141 (3.58)	0.158 (4.01)
20		6962								(019)	1.156 (29.36)	1.375 (34.93)	1.500 (38.10)	0.141 (3.58)	
			—	✓	—	—	4695			(020)	1.156 (29.36)	1.312 (33.32)	1.467 (37.26)	0.125 (3.18)	
									1958	(021)	1.156 (29.36)	1.250 (31.75)	1.500 (38.10)	0.172 (4.37)	
21		6963	✓	—	—	✓				(022)	1.250 (31.75)	1.500 (38.10)	1.625 (41.28)	0.141 (3.58)	
	G	C652	—	—	✓	—				(NA)	1.250 (31.75)	1.500 (38.10)	1.625 (41.28)	0.141 (3.58)	0.206 (5.23)
22		6963	—	✓	—	—				(022)	1.250 (31.75)	1.500 (38.10)	1.625 (41.28)	0.141 (3.58)	
							4696			(023)	1.250 (31.75)	1.437 (36.50)	1.562 (39.67)	0.125 (3.18)	
									1959	024)	1.250 (31.75)	1.375 (34.93)	1.625 (41.28)	0.172 (4.37)	
23		6964	✓	—	—	✓				(025)	1.375 (34.93)	1.625 (41.28)	1.750 (44.45)	0.172 (4.37)	
	H	C653	—	—	✓	—				(NA)	1.375 (34.93)	1.625 (41.28)	1.750 (44.45)	0.172 (4.37)	0.259 (6.58)
	F							C642		(NA)	1.281 (32.54)	1.625 (41.28)	1.750 (44.45)	0.141 (3.58)	0.164 (4.17)
24		6964	—	✓	—	—				(025)	1.375 (34.93)	1.625 (41.28)	1.750 (44.45)	0.172 (4.37)	
							4697			(026)	1.375 (34.93)	1.563 (39.70)	1.703 (43.26)	0.152 (3.86)	
									1960	(027)	1.375 (34.93)	1.500 (38.10)	1.750 (44.45)	0.203 (5.16)	
25		6965	✓	—	—	✓				(028)	1.500 (38.10)	1.750 (44.45)	1.875 (47.63)	0.172 (4.37)	
	J	C654	—	—	✓	—				(NA)	1.500 (38.10)	1.750 (44.45)	1.875 (47.63)	0.172 (4.37)	0.259 (6.58)
	G							C643		(NA)	1.392 (35.36)	1.750 (44.45)	1.843 (46.81)	0.172 (4.37)	0.195 (4.95)
28**									1961	(029)	1.562 (39.67)	1.750 (44.45)	2.000 (50.80)	0.203 (5.16)	
29	H							C644		(NA)	1.568 (39.83)	2.000 (50.80)	2.171 (55.14)	0.172 (4.37)	0.195 (4.95)
32**									1962	(030)	1.750 (44.45)	2.000 (50.80)	2.250 (57.15)	0.219 (5.56)	
33	J							C645		(NA)	1.734 (44.04)	2.187 (55.55)	2.356 (59.84)	0.203 (5.16)	0.234 (5.94)
36**									1963	(031)	1.938 (49.23)	2.250 (57.15)	2.500 (63.50)	0.219 (5.56)	
40**									1964	(032)	2.188 (55.58)	2.500 (63.50)	2.750 (69.85)	0.219 (5.56)	
44**									1965	(033)	2.375 (60.33)	2.781 (70.64)	3.000 (76.20)	0.219 (5.56)	
48**									1966	(034)	2.625 (66.68)	3.031 (76.99)	3.250 (82.55)	0.219 (5.56)	

✓ Available in series designated.
— Not applicable in series designated.
** Shell size 28-48 specified in MIL-C-5015.
*** For dimension E, hole is slotted through to B diameter , when $\frac{(1.41xA) - D - B}{2} \leq .032$ in.

† "X" should be replaced by applicable MIL-G-83528B material type (e.g. A, B, C, etc.). Number in parentheses is MIL-G-83528B dash number, which should be inserted (without parentheses) at end of MIL P/N.

continued

(mm dimensions in parentheses)

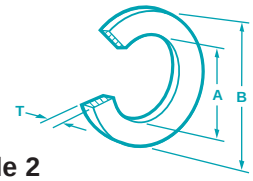

Table 2

INTERFACIAL EMI SEALS					
Shell Size	Part Number*		Nominal Dimensions		
	MIL-C-26482	MIL-C-5015	A(dia.)	B(dia.)	T
8	30-02-2041-XXXX	—	0.319 (8.10)	0.422 (11.23)	0.075 (1.91)
	—	30-02-2050-XXXX	0.328 (8.33)	0.391 (9.93)	0.031 (0.79)
10	30-02-2042-XXXX	—	0.447 (11.35)	0.550 (13.97)	0.075 (1.91)
10S SL	—	30-02-2051-XXXX	0.406 (10.31)	0.469 (11.91)	0.031 (0.79)
12	30-02-2043-XXXX	—	0.547 (13.89)	0.703 (17.86)	0.075 (1.91)
12 12S	—	30-02-2052-XXXX	0.531 (13.49)	0.594 (15.09)	0.031 (0.79)
14	30-02-2044-XXXX	—	0.671 (17.04)	0.828 (21.03)	0.075 (1.91)
14 14S	—	30-02-2053-XXX	0.641 (16.28)	0.703 (17.86)	0.031 (0.79)
16	30-02-2045-XXXX	—	0.797 (20.24)	0.953 (24.21)	0.075 (1.91)
16 16S	—	30-02-2054-XXXX	0.781 (19.84)	0.844 (21.44)	0.031 (0.79)
18	30-02-2046-XXXX	—	0.891 (22.63)	1.047 (2.59)	0.075 (1.91)
	—	30-02-2055-XXXX	0.891 (22.63)	0.953 (24.21)	0.031 (0.79)
20	30-02-2047-XXXX	—	1.039 (26.39)	1.172 (29.77)	0.075 (1.91)
	—	30-02-2056-XXXX	0.984 (24.99)	1.047 (26.59)	0.031 (0.79)
22	30-02-2048-XXXX	—	1.141 (28.98)	1.297 (32.94)	0.075 (1.91)
	—	30-02-2057-XXXX	1.109 (28.17)	1.172 (29.77)	0.031 (0.79)
24	30-02-2049-XXXX	—	1.266 (32.16)	1.422 (36.12)	0.075 (1.91)
	—	30-02-2058-XXXX	1.219 (30.96)	1.281 (32.54)	0.031 (0.79)
28	—	30-02-2059-XXXX	1.455 (36.96)	1.547 (39.29)	0.045 (1.14)
32	—	30-02-2060-XXXX	1.672 (42.47)	1.766 (44.86)	0.045 (1.14)
36	—	30-02-2061-XXXX	1.891 (48.03)	1.984 (50.39)	0.045 (1.14)

*Last four digits should be used to designate material (e.g. 1215, 1217).

Interfacial EMI Seals

The main mating joint of environment-resisting MS connectors is normally provided with a rubber packing ring (MIL-C-26482) or O-ring (MIL-C-5015) to seal moisture from the pin area. CHO-SEAL gaskets are interchangeable with these packing/O-rings and provide EMI shielding in addition to sealing.

Table 3

DIMENSIONS	TOLERANCES
Diameters (A,B)	
<0.500 (12.70) 0.501-1.00 (12.70-25.40) 1.01-1.500 (25.40-38.10) 1.501-2.000 (38.10-50.80)	±0.005 (0.13) ±0.007 (0.18) ±0.010 (0.25) ±0.015 (0.38)
Cross Sections (T)	
<0.060 (1.52) ≥0.060 (1.52)	±0.004 (0.10) ±0.007 (0.18)

Ordering Procedure

Select the part numbers from Table 2. The last four digits designate the material (1215, 1217, etc.). Available in all materials except CHO-SEAL 1239.

(mm dimensions in parentheses)

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Jam Nut EMI Seals

MIL-C-38999, MIL-C-26482, and MIL-C-81511 rear-mounting jam nut receptacles require an MS O-ring as a moisture-pressure seal. When EMI attenuation is also required, CHO-SEAL O-rings should be used. Each is interchangeable with the corresponding MS O-ring. The O-rings are available in CHO-SEAL 1215,1217, etc.

Table 4

DIMENSIONS	TOLERANCES
Inside Diameter (A)	
<1.000 (25.40)	±0.010 (0.25)
1.01-1.500 (25.40-38.10)	±0.010 (0.25)
1.501-2.000 (38.10-50.80)	±0.015 (0.38)
Cross Section Diameter (W)	
<0.100 (2.54)	±0.004 (0.10)
≥0.100 (2.54)	±0.005 (0.13)

Ordering Procedure

Select the part numbers from Table 5. The last four digits designate the material (1215,1217, etc.).

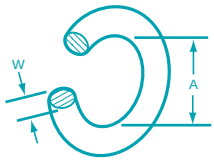


Table 5

Note: Shell sizes shown on this table may be misleading, because slight size variations exist between several series within a given MIL-SPEC. It is recommended that gasket(s) be selected on the basis of gasket dimensions which match groove dimensions.

JAM NUT EMI SEALS					
Shell Size	Chomerics P/N * MIL P/N: M83528/002X† - ( )	MIL-C-38999JS1N1 MIL-C-26482GS1A5	Reference MIL-C-81511FS1	Nominal Dimensions	
				A	W
6	30-03-2065-XXXX (015)	✓	—	0.551 (14.00)	0.070 (1.78)
8	30-03-2066-XXXX (017)	✓	—	0.676 (17.17)	0.070 (1.78)
	30-03-2075-XXXX (018)	—	✓	0.739 (18.77)	0.070 (1.78)
9, 10	30-03-1981-XXXX (019)	✓	—	0.801 (20.35)	0.070 (1.78)
	30-03-2076-XXXX (020)	—	✓	0.864 (21.95)	0.070 (1.78)
11, 12	30-03-2068-XXXX (022)	✓	—	0.989 (25.12)	0.070 (1.78)
13, 14	30-03-2069-XXXX (024)	✓	✓	1.114 (28.30)	0.070 (1.78)
15, 16	30-03-2070-XXXX (026)	✓	✓	1.239 (31.47)	0.070 (1.78)
17, 18	30-03-2071-XXXX (028)	✓	✓	1.364 (34.65)	0.070 (1.78)
19, 20	30-03-2072-XXXX (128)	✓	—	1.487 (37.77)	0.103 (2.62)
21, 22	30-03-1846-XXXX (/005X†-022)	✓	—	1.612 (40.94)	0.103 (2.62)
23, 24	30-03-2031-XXXX (132)	✓	—	1.737 (44.12)	0.103 (2.62)
25	30-03-8800-XXXX (134)	—	—	1.862 (47.30)	0.103 (2.62)

Note: Slight size variations exist between several series within a given MIL-SPEC. It is recommended that gasket(s) be selected on the basis of gasket dimensions which match groove dimensions.

* Last four digits should be used to designate material (1215, 1217, etc.)

† "X" should be replaced by applicable MIL-G-83528B material type (A, B, C, etc.). Number in parentheses is MIL-G-83258B dash number, which should be inserted (without parentheses) at end of MIL P/N.

D-Subminiature Rectangular Gaskets

Subminiature D-style gaskets are used to provide EMI shielding and environmental sealing between connector flanges and their mating surfaces. Chomerics offers these gaskets in a complement of shell sizes from 9 to 50 pin, in a range of CHO-SEAL materials. Table 6 includes dimensions and tolerances.

Ordering Procedure

Select the Chomerics part number from Table 6. The last four digits designate the material (1215, 1217, etc.).

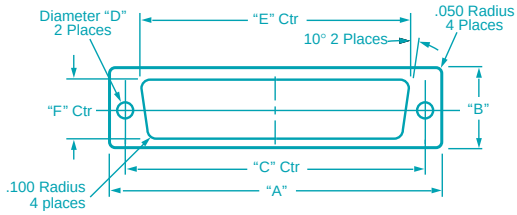


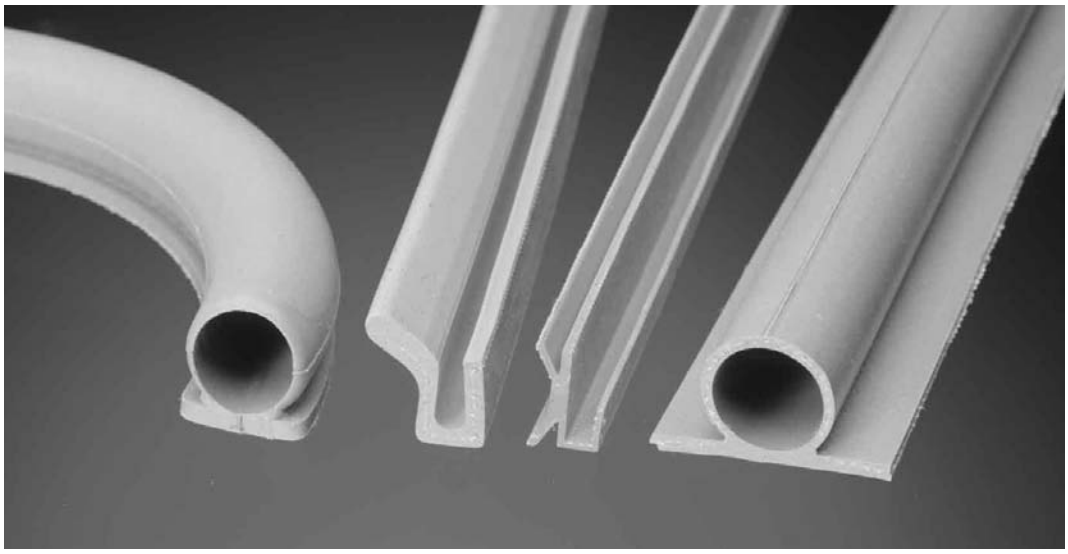
Table 6

D-SUBMINIATURE GASKETS					
Dimension Tolerances	Shell Size				
	9 PIN	15 PIN	25 PIN	37 PIN	50 PIN
"A" Overall Length ±.015 (0.38)	1.213 (30.81)	1.556 (39.52)	2.087 (53.01)	2.729 (69.32)	2.635 (66.93)
"B" Overall Width ±.015 (0.38)	0.594 (15.09)	0.600 (15.24)	0.594 (15.09)	0.594 (15.09)	0.605 (15.37)
"C" Hole to Hole ±.010 (0.25)	0.984 (25.0)	1.312 (33.32)	1.852 (47.04)	2.500 (63.50)	2.406 (61.11)
"D" Hole Diameter ±.010 (0.25)	0.120 (3.05)	0.130 (3.30)	0.120 (3.05)	0.120 (3.05)	0.120 (3.05)
"E" Major Cutout Length ±.015 (0.38)	0.697 (17.70)	1.080 (27.43)	1.583 (40.21)	2.231 (56.67)	2.109 (53.57)
"F" Cutout Width ±.010 (0.25)	0.360 (9.14)	0.370 (9.40)	0.378 (9.60)	0.378 (9.60)	0.466 (11.84)
Cutout Angle Typical	10°	10°	10°	10°	10°
Chomerics Part Number*	30-XX-A779-XXXX	30-XX-A959-XXXX	30-XX-A780-XXXX	30-XX-A781-XXXX	30-XX-LF19-XXXX

*Replace "XX" with "01" [0.032 ±0.005 in. (0.81 ±0.127 mm) thick]; or "06" [0.062 ±0.007 in. (1.57 ±0.178 mm) thick]. Last four digits, "XXXX", should be used to designate material (1215, 1217, etc.)

(mm dimensions in parentheses)

Reinforced Conductive Elastomer Seals



CHO-SEAL Reinforced Conductive Elastomer Seals

CHO-SEAL reinforced conductive elastomer seals consist of a corrosion-resistant CHO-SEAL conductive elastomer base, reinforced with a woven or knitted fabric material. These seals are intended for use in airframe shielding applications. The integrally molded reinforcing material provides improved mechanical properties, resulting in seals which withstand high levels of wear and abuse, while maintaining the electrical properties of the conductive elastomer base material.

CHO-SEAL reinforced seals are used to provide EMI shielding, lightning protection, HIRF protection and radar cross section reduction by maintaining surface electrical continuity at joints, seams and openings in air frames. Typical applications include, but are not limited to, electronic bay doors, wing panel access covers, engine pylons, radomes and nacelle seals. Chomerics can design and develop custom cross sections and shapes to meet specific customer requirements. Finite element analysis modeling is used to predict the seal's force-deflection and other key mechanical properties, to ensure proper performance.

CHO-SEAL 1298, CHO-SEAL 1287 and CHO-SEAL 1285 corrosion-resistant silver-plated-aluminum filled silicones and fluorosilicones are typically used for the conductive elastomer base material. (See page 33 for more information.) Knitted Dacron fabrics are used as reinforcing layers to dramatically increasethe tensile and tear strength of the elastomer without adding weight to the seal. Layers of aluminum or Ferrex* wire mesh are used to provide high current-carrying capability required for lightning strike protection. Other reinforcing materials are available to provide resistance to flame.

For applications on aluminum skins or structures in salt fog environments, Chomerics recommends that mating flange surfaces be protected with CHO-SHIELD® 2001 or 2002 conductive coatings for maximum corrosion protection. (See page 141 for additional information.)

Ordering Procedure

CHO-SEAL Reinforced Conductive Elastomer Seals are produced as custom orders. Contact the Applications Engineering Department to review your requirements.

* Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520, ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

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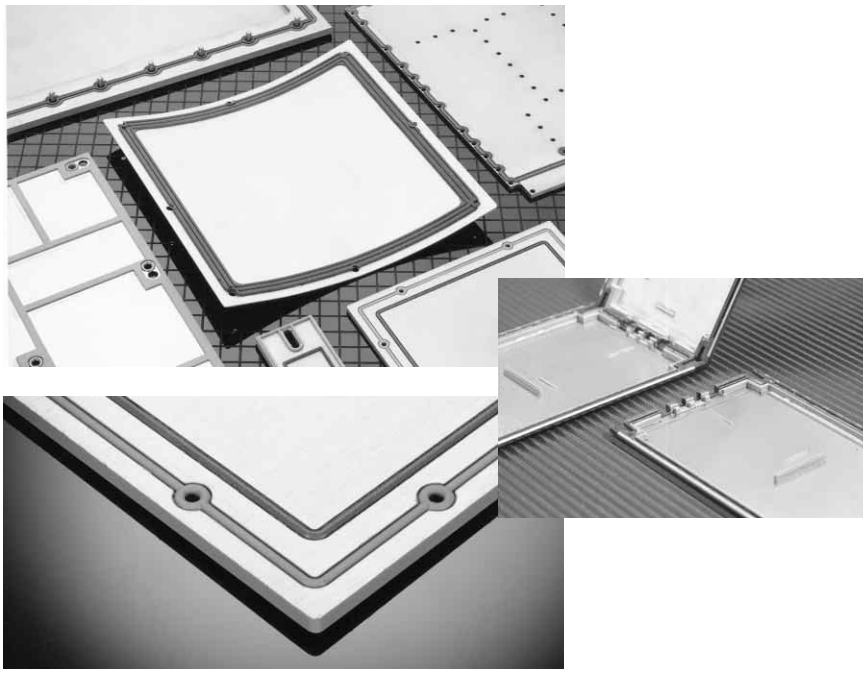
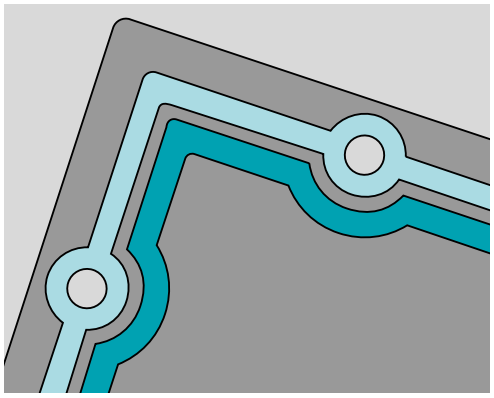
Molded-In-Place Cover Seals

Complete gasket/cover assemblies to customer specification offer optimized shielding and economies of manufacture, installation and maintenance





Molding a non-conductive elastomer to the outboard edge and around bolt holes further protects the inboard conductive elastomer and the enclosure in corrosive environments.

Molded-In-Place Cover Seals

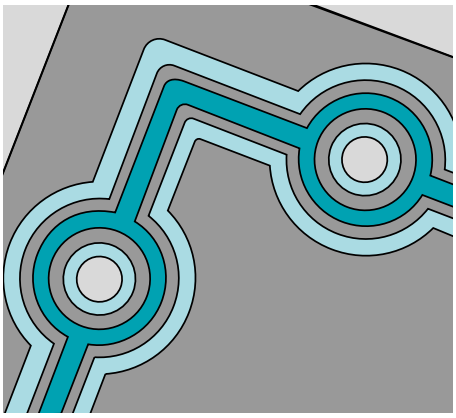
For more than thirty years, Chomerics' conductive elastomer seals have been chosen for airborne, shipboard and ground-based electronics equipment to meet high levels of shielding and environmental sealing requirements. In hundreds of applications, we've molded the conductive elastomer onto covers machined by Chomerics or provided by our customers, to create a permanent seal/cover assembly with significant shielding, installation and maintainability benefits.

Chomerics has in-house CNC machining capability, for fast, economical turn-around of prototypes, and developmental modifications of structural components, as well as full production capacity for components and seal assemblies. Incorporating our corrosion-resistant, silver-plated-aluminum filled silicones and fluoro-silicones, these assemblies are particularly suited to environmentally demanding military/aerospace applications.

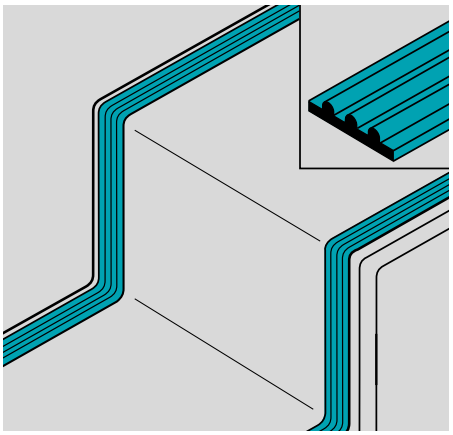
Start with Superior Materials

Our corrosion-resistant CHO-SEAL® 1285 and 1298 silver/aluminum gasket materials provide 90dB of shielding effectiveness at 1 GHz, excellent salt-spray resistance (MIL-STD 810), EMP survivability and a –55° to 200°C use temperature range.

For a discussion of the corrosion resistance properties of CHO-SEAL 1298, see page 33.



This gasket design provides the ultimate protection in harsh environments. A non-conductive elastomer is molded around the bolt holes, and *both* inboard and outboard of the conductive elastomer.



Installing conventional gaskets on enclosure covers with less than 90° bends is extremely difficult. Molding a gasket to this configuration is not only easier, but the elastomer cross section can be designed to provide maximum shielding with a lower closure force *(see inset)*.

continued

Enclosure shielding and environmental sealing performance are improved in a number of ways when conductive elastomer gaskets are molded directly to a flange surface instead of being adhesive bonded or mechanically attached.

A Molded-In-Place gasket permits the optimum seal profile to be formed, achieving more gasket deflection with limited closure force when compared to flat, bonded gaskets. Eliminating the adhesive reduces interface resistance and maximizes shielding effectiveness. It also improves environmental sealing by eliminating the uncontrollable variations in adhesive thickness that often turn theoretically good designs into field failures.

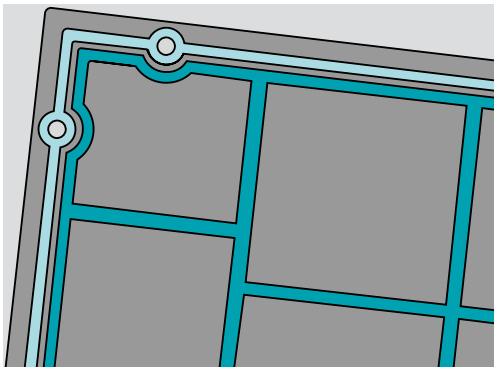
Design and Cost Advantages

Molded-In-Place cover/gasket assemblies offer the following other advantages over extruded or die-cut gaskets:

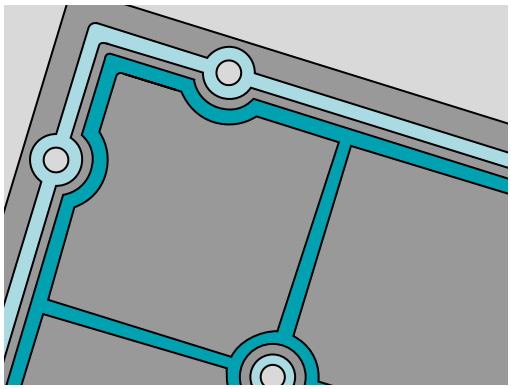
- **Gasket Volume –** typically less seal material is needed compared to die-cut gaskets, thereby reducing costs in many applications.
- **Cross Section Design –** compression/deflection requirements can be met with fewer fasteners, resulting in improved maintainability.
- **Fastener Sealing –** allows fasteners to be designed within or outboard of the gasket more easily, reducing both EMI and moisture leakage into the enclosure through fastener holes.
- **Production Savings –** the gasket, cover and compression stops become a single part, reducing the number of purchased items, inventory and documentation.
- **Installation Savings –** inconsistent and expensive adhesive bonding operations are eliminated.
- **Field Reliability and Maintainability –** damaged gaskets or covers become a 1-part replacement with little potential for error. Also, conductive gaskets will not be replaced mistakenly with ordinary non-conductive gaskets duringroutine maintenance.

Finite Element Analysis (FEA) Optimizes Design

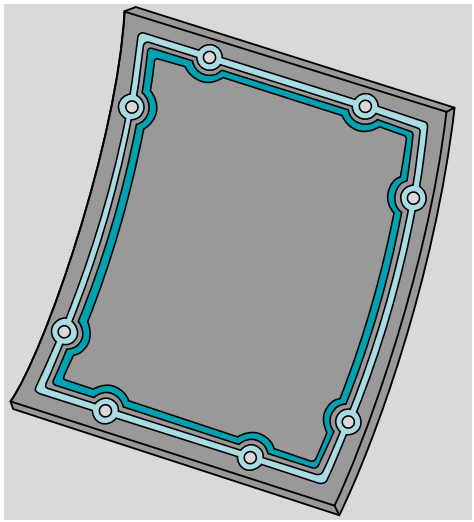
Chomerics has in-house FEA capability that offers significant time



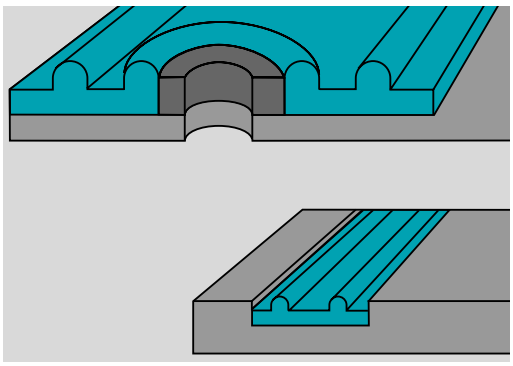
For large, complex gaskets with numerous “T” joints, an extruded gasket can be difficult to manufacture and requires adhesive bonding at every junction. A Molded-In-Place assembly provides a “seamless” gasket regardless of the configuration required.



For electronic enclosures that require various compartments to be shielded from each other, a Molded-In-Place cover assembly provides maximum shielding effectiveness and simple installation.



Enclosure covers with simple and compound curve configurations can also be supplied with Molded-In-Place elastomer gaskets.



Molding-In-Place enables compression stops to be built directly into the gasket, protecting it from over-compression. Additionally, cover assembly shielding and environmental sealing performance can be improved even further by molding the gasket *into a flange or cover groove.*

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Parker Seals

Table 1

ELASTOMER SPECIFICATIONS FOR MOLDED-IN-PLACE COVER SEALS				Test Procedure (Type of Test)	CHO-SEAL 1215	CHO-SEAL 1217	CHO-SEAL 1285	CHO-SEAL 1287	CHO-SEAL 1298
Grade					Military-Aerospace	Military-Aerospace	Military-Aerospace	Military-Aerospace	Military-Aerospace
Type (Ref. MIL-G-83528)					Type A	Type C	Type B	Type D	Type D
Elastomer Binder					Silicone	Fluorosilicone	Silicone	Fluorosilicone	Fluorosilicone
Conductive Filler					Ag/Cu	Ag/Cu	Ag/Al	Ag/Al	Passivated Ag/Al
Volume Resistivity, ohm-cm, max., as supplied (without pressure-sensitive adhesive)				MIL-G-83528 Para. 4.6.11	0.004	0.010	0.008	0.012	0.012
Hardness (Shore A ±5)				ASTM D2240	65	75	65	70	70
Specific Gravity (±0.25)				ASTM D792	3.5±0.45	4.1	1.9	2.0	2.0
Tensile Strength, psi (MPa), min.				ASTM D412	200 (1.38)	180 (1.24)	200 (1.38)	180 (1.24)	180 (1.24)
Elongation, %, min./max.				ASTM D412	100/300	100/300	100/300	60/260	60/260
Tear Strength, lb/in. (kN/m), min.				ASTM D624	40 (7.00)	35 (6.13)	30 (5.25)	35 (6.13)	35 (6.13)
Compression Set 70 hrs @ 100°C, %, max.				ASTM D395 Method B	32	35	32	30	30
Low Temperature Flex, TR10, °C, min.				ASTM D1329	–65	–55	–65	–55	–55
Maximum Continuous Use Temperature, °C*					125	125	160/200	160/200	160/200
Shielding Effectiveness	200 kHz (H Field) 100 MHz (E Field) 500 MHz (E Field) 2 GHz (Plane Wave) 10 GHz (Plane Wave)		dB, min.	MIL-G-83528 Para. 4.6.12	70 120 120 120 120	70 120 120 115 110	60 115 110 105 100	55 110 100 95 90	55 110 100 95 90
Electrical Stability	Heat Aging		ohm-cm, max.	MIL-G-83528 Para. 4.6.15	0.010	0.015	0.010	0.015	0.015
	Vibration Resistance	During		MIL-G-83528 Para. 4.6.13	0.006	0.015	0.012	0.015	0.015
		After			0.004	0.010	0.008	0.012	0.012
	Post Tensile Set Volume Resistivity			MIL-G-83528 Para. 4.6.9	0.008	0.015	0.015	0.015	0.015
	EMP Survivability, kA per in. perimeter			MIL-G-83528 Para. 4.6.16	>0.9	>0.9	>0.9	>0.9	>0.9

* Where two values are shown, first represents max. operating temp. for conformance to MIL-G-83528 (which requires Group A life testing at 1.25 times max. operating temp.) Second value represents practical limit for exposure up to 1000 hours (compressed between flanges 7-10%). Single value c onforms to both definitions.

and cost-saving benefits. This advanced computer simulation technology enables compression/deflection characteristics and other parameters to be evaluated and optimized *during the design phase*, without the delays of trial-and-error prototyping. FEA is routinely employed in the development of Molded-In-Place Cover Seals.

For additional information contact our Applications Engineering Department.

Ordering Information

Chomerics can Mold-In-Place any of the CHO-SEAL conductive elastomers described in Table 1. Select the material that meets the performance criteria for your application.

If you would like Chomerics to supply your total gasket/cover assembly, send a drawing of the enclosure configuration to our Applications Engineering Department, along with your request for a quotation.

If you would like us to mold CHO-SEAL elastomers to an existing cover, send a drawing or actual cover sample for evaluation.

Note: Covers supplied for molding may require modification for tooling interface, and must be unpainted and unplated, but can be finished by Chomerics to your requirements.

Size Limitations

Chomerics can produce Molded-In-Place gasket/panel assemblies in any overall dimension larger than 3/4 x 3/4 in. (19 x 19 mm). Minimum recommended gasket profile cross section is 0.062 in. (1.6 mm), with a minimum thickness of 0.020 in. (0.5 mm) for flat gaskets. Smaller cross sections and thicknesses, although not recommended, can be accommodated.

Table 2 Non-Conductive Environmental Sealing Elastomers
(Molded applications only)

SILICONE PER ZZ-R-765 CLASS 2A AND 2B		FLUOROSILICONE PER MIL-R-25988 TYPE 2, CLASS 1	
Grade	Chomerics Product No.	Grade	Chomerics Product No.
40	2514	40	2524
50	2530	50	2526
60	2515	60	2529
70	2527	70	2534
80	2531	80	2535

Note: Contact Chomerics for information on Qualification and QC Conformance test data.

Performance Data

CONTENTS:

Conductive Elastomers

Compression-Deflection

While standard test procedures have been established for measuring the deflection of elastomers under compressive loads, the practical use of such data is to provide a qualitative comparison of the deformability of different elastomeric materials when in the particular configuration of the test sample.

Solid (non-foam) elastomers are essentially incompressible materials; i.e., they cannot be squeezed into a smaller volume. When a solid elastomer is subject to a compressive load, it yields by deformation of the part as a whole. Because of this behavior, the actual deflection of a gasket under a compressive load depends upon the size and shape of the gasket as well as on its modulus and the magnitude of the load.

The design of a seal should be such that it will be subjected to the minimum squeeze sufficient to provide the required mechanical and electrical performance. The designed deflection of conductive elastomer gaskets should never exceed the maximum deflection limits shown in Table 1.

There is an approximate relationship between the force required to deflect a pure elastomer a given amount, and the hardness of the elastomer. In general, the harder the elastomer, the greater the force required. In the case of Chomerics' metal particle-filled elastomers, this relationship is much less definite, and in some instances, these materials demonstrate deflection/hardness and deflection/thickness behavior contrary to that which would be anticipated for conventional rubber compounds.

The inclusion of metal particles in the elastomer results in a mechanically structured material. This mechanical structure has a marked effect on the deflection of the elastomer under compressive loads, and in some instances, harder materials deflect more than softer materials.

Compressive load-deflection data for many popular conductive elastomer materials and shapes are given in Figures 1-25. (For "line contact" gaskets, it is more convenient to express the load in terms of pounds per linear inch instead of pounds per square inch).

For compression-deflection data on other Chomerics gaskets, contact our Applications Engineering Department.

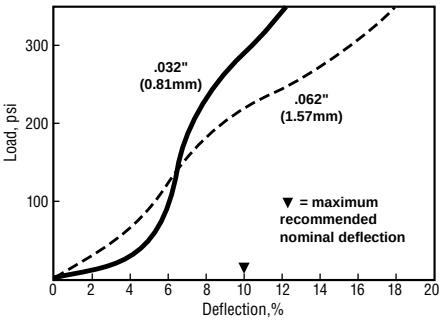

Figure 1 CHO-SEAL 1215 Sheet Stock Compression-Deflection

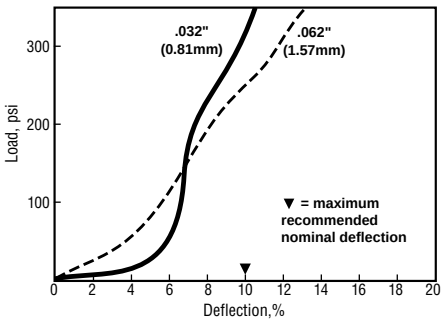

Figure 2 CHO-SEAL 1217 Sheet Stock Compression-Deflection

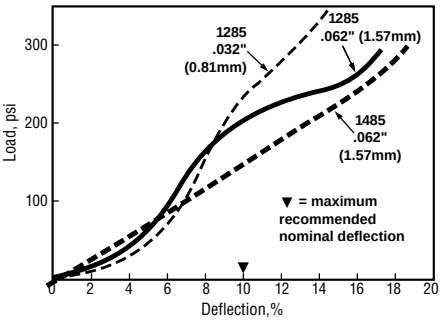

Figure 3 CHO-SEAL 1285 and CHO-SIL 1485 Sheet Stock Compression-Deflection

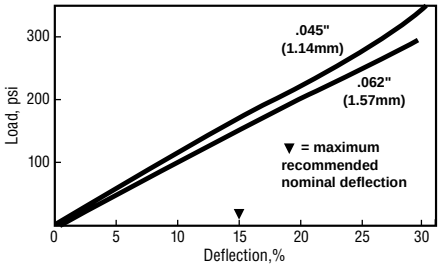

Figure 4 CHO-SIL 1401 Sheet Stock Compression-Deflection

Table 1

RECOMMENDED DEFLECTION FOR VARIOUS CONDUCTIVE ELASTOMER SHAPES

Cross Section Geometry	Minimum Deflection	Nominal Deflection	Maximum Deflection
Solid O	10%	18%	25%
Solid D	8%	15%	20%
Rectangular (including die-cut)	5%	10%	15%
Hollow O, D and P	10%	50% of inside	100% of inside

Note: For increased deflection requirements, Chomerics can provide special shapes.

Unit Conversion Note:

Load, 1 lb./in. = 0.571 Newton
Load, 1 psi = 0.015 Pascal

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South America **TEL** +(55) 11 3917 1099 **FAX** +(55) 11 3917 0817
Parker Seals

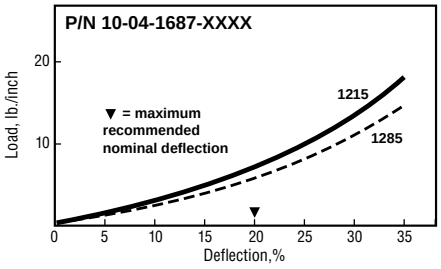

Figure 5 0.070 in. (1.78 mm) Dia. O-Strip Compression-Deflection

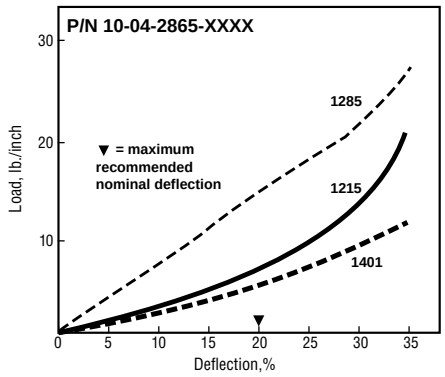

Figure 6 0.093 in. (2.36 mm) Dia. O-Strip Compression-Deflection

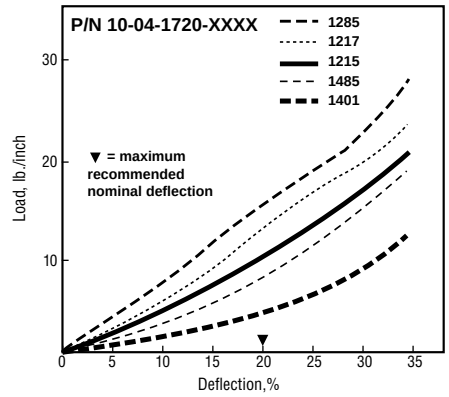

Figure 7 0.103 in. (2.62 mm) Dia. O-Strip Compression-Deflection

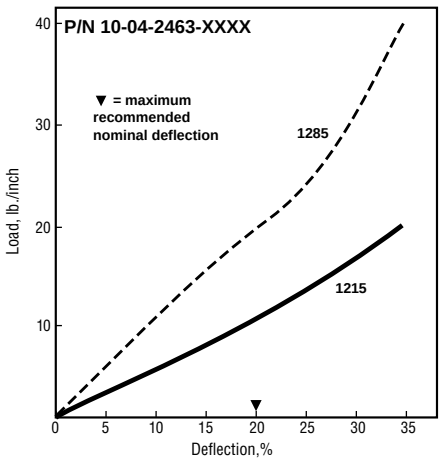

Figure 8 0.125 in. (3.18 mm) Dia. O-Strip Compression-Deflection

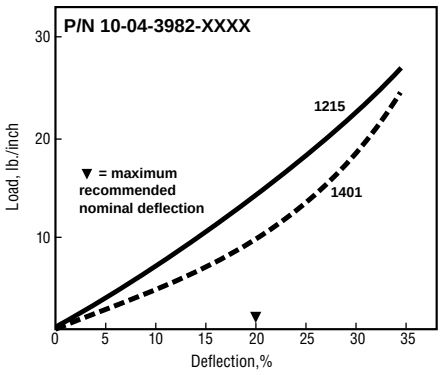

Figure 9 0.150 in. (3.81 mm) Dia. O-Strip Compression-Deflection

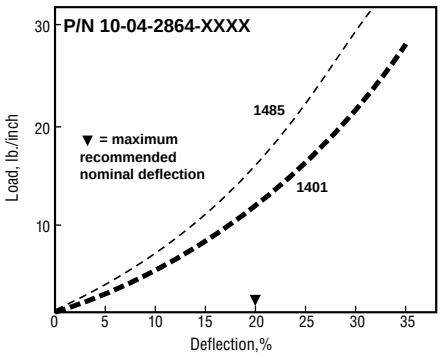

Figure 10 0.216 in. (5.49 mm) Dia. O-Strip Compression-Deflection

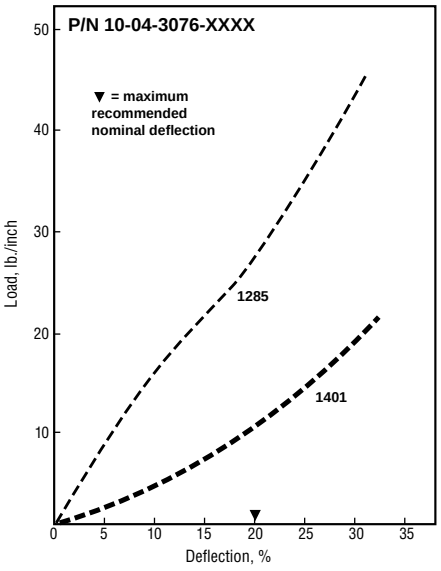

Figure 11 0.250 in. (6.35 mm) Dia. O-Strip Compression-Deflection

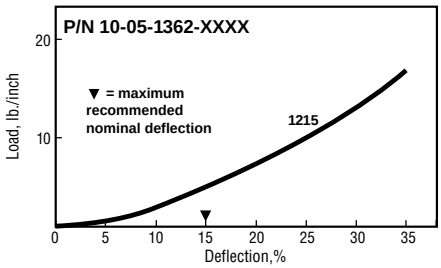

Figure 12 0.068 in. (1.73 mm) High D-Strip Compression-Deflection

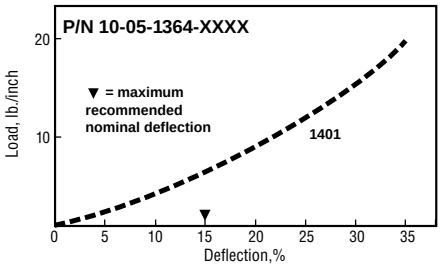

Figure 13 0.135 in. (3.43 mm) High D-Strip Compression-Deflection

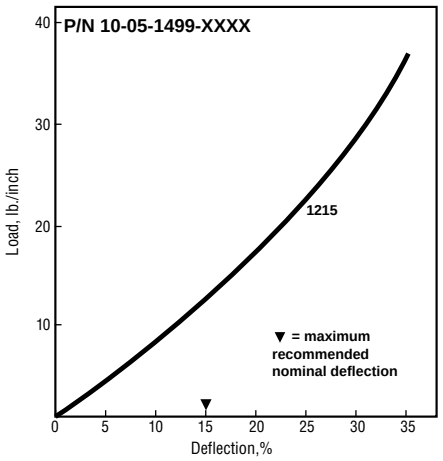

Figure 14 0.156 in. (3.96 mm) High D-Strip Compression-Deflection

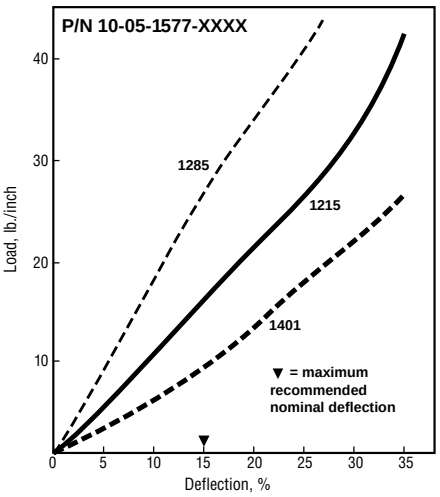

Figure 15 0.175 in. (4.45 mm) High D-Strip Compression-Deflection

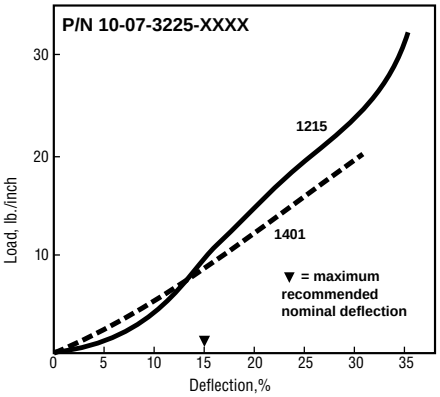

Figure 16 0.125 in. (3.18 mm) Wide Rectangular Strip Compression-Deflection

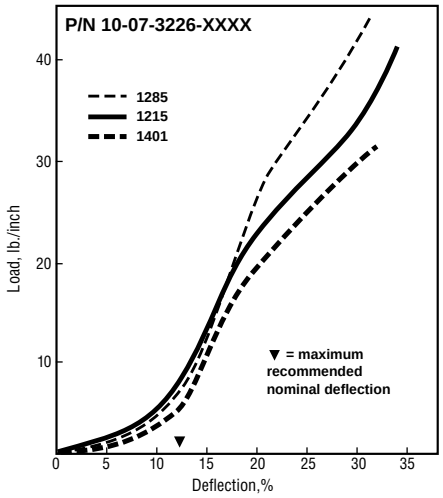

Figure 17 0.250 in. (6.35 mm) Wide Rectangular Strip Compression-Deflection

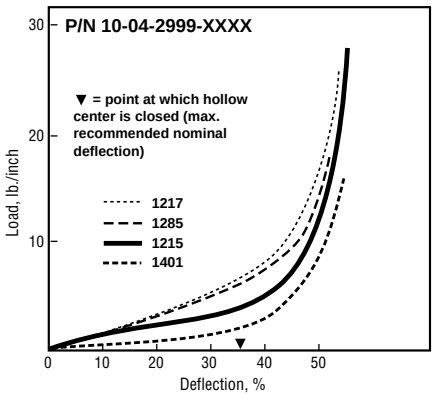

Figure 18 0.125 in. (3.18 mm) Dia. Hollow O-Strip Compression-Deflection

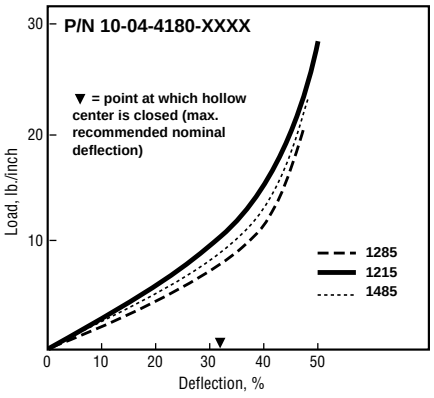

Figure 19 0.156 in. (3.96 mm) Dia. Hollow O-Strip Compression-Deflection

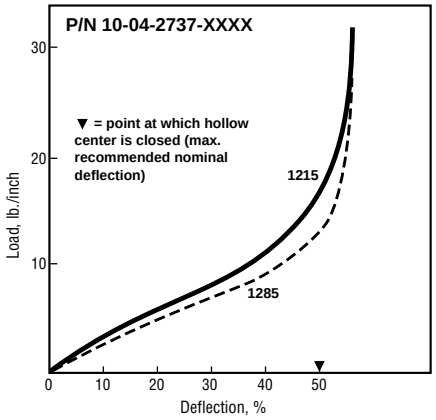

Figure 20 0.250 in. (6.35 mm) Dia. Hollow O-Strip Compression-Deflection

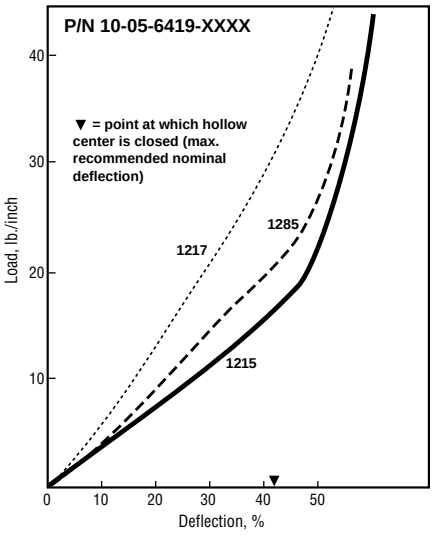

Figure 21 0.156 in. (3.96 mm) High Hollow D-Strip Compression-Deflection

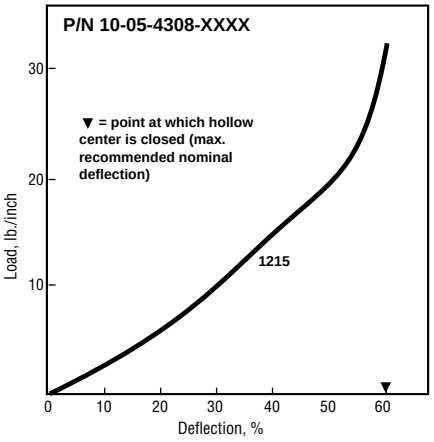

Figure 22 0.312 in. (7.92 mm) High Hollow D-Strip Compression-Deflection

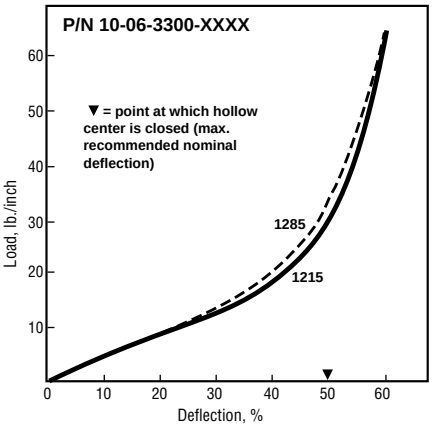

Figure 23 0.250 in. (6.35 mm) Dia. Hollow P-Strip Compression-Deflection

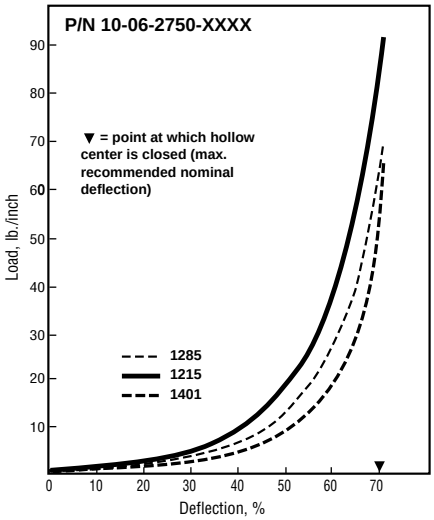

Figure 24 0.360 in. (9.14 mm) Dia. Hollow P-Strip Compression-Deflection

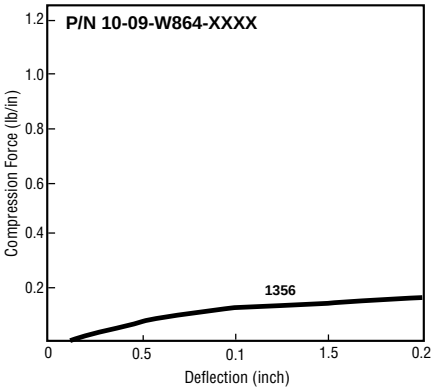

Figure 25 0.410 in. (10.41 mm) High V-Strip Compression-Deflection

Unit Conversion Note:

Load, 1 lb./in. = 0.571 Newton
Load, 1 psi = 0.015 Pascal

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Parker Seals

Stress Relaxation

As important as Compression Set and Compression-Deflection, is the Stress Relaxation characteristic of a gasket.

If a rubber is subject to a compressive load, it will deflect. There is a stress/strain relationship, which for rubbers is generally non-linear except for very small deflections. After the load is applied, a stress decay occurs within the polymer resulting from the internal rearrangement of the molecular structure. An approximate rule is that the relaxed stress for cured silicone will finally settle at 70 to 75 percent of the initial stress.

There are two ways in which a rubber gasket can be loaded to a desired value. One way is to load it to a point, let it relax, and reapply the load to restore the original stress. The next time it will relax, but not so much. If this is repeated a sufficient number of times, the correct static load on the gasket will reach equilibrium.

A more practical way to reach the design value of stress is to load the gasket to 125 percent of its final design value, so that after the relaxation process is completed the gasket will settle to 100 percent of the design load. This is very reproducible.

Figure 26 shows a typical stress relaxation curve for Chomerics' conductive elastomers.

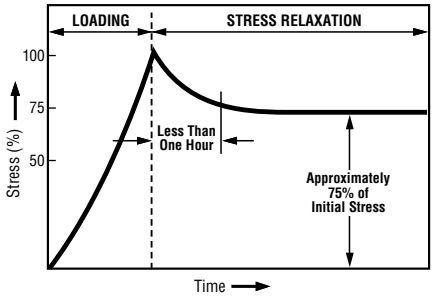
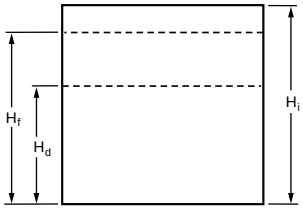


Figure 26 Stress Relaxation

Compression Set

When any rubber is deformed for a period of time, some of the deformation is retained permanently even after the load is removed. The amount of permanent deformation, as measured by ASTM D395, is termed "Compression Set." Compression set is measured under conditions of constant deflection (ASTM D395 Method B) and is normally expressed as a percentage of the initial deflection, *not* as a percentage of the initial height.



H_i = Initial height
H_d = Deflected height (Normally 75% of H_i)
H_f = Final height (After load is removed)

$$\text{Compression Set} = \frac{(H_i - H_f)}{(H_i - H_d)} \times 100\%$$

Figure 27 Formula for Calculation of Compression Set

For gaskets that are used once, or where the gasket/flange periphery relationship is constant (such as a door gasket), compression set is of minor significance if the original load condition and the service temperature are within the design limitations of the gasket material.

For gaskets that are randomly reseated one or more times in normal service life, it is important that the maximum change in gasket thickness does not exceed twice the maximum mismatch between the opposing mating surfaces.

Shielding Effectiveness

Most shielding effectiveness data given in Table 3 of the Conductive Elastomer section (pages 32-34) is based on a MIL-G-83528B test method, with a 24 in. x 24 in. aperture in a rigid enclosure wall and about 100 psi on the gasket. It is a valid and useful way of comparing various gasket materials, but does not reflect the shielding effectiveness one can expect at seams of typical enclosures. CHO-TM-TP08 is a modified version of the MIL test that provides typical values achieved in actual applications. Since many factors will affect the actual shielding effectiveness of an enclosure seam (flange design, stiffness, flatness, surface resistivity, fastener spacing, enclosure dimensions, closure force, etc.), the only way to determine shielding effectiveness for real enclosures is to test them.

Figures 28 and 29 provide data on shielding effectiveness for actual enclosures. The data in Figure 28 shows the difference in attenuation between a shelter door closed with no gasket and the same door closed against a CHO-SEAL 1215 hollow D-strip gasket. Instead of single data points at each frequency tested, a range of data is shown for each frequency, representing the worst and best readings measured at many points around the door. Figure 29 shows the effects of closure force on shielding effectiveness of an enclosure tested at high frequencies (1-40 GHz) using CHO-SEAL 1215 solid D-strip gaskets.

In order to establish reasonable upper limits on gasket resistivity, it is necessary to understand the relationship between flange interface resistance and EMI leakage through the flange. Figure 30 presents this relationship for an aluminum enclosure 3 in. x 3 in. x 4 in. deep, measured at 700 MHz. Die-cut gaskets 0.144 in. wide by 0.062 in. thick, in a wide range of resistivities, were clamped between the gold-plated flanges of this enclosure. Simultaneous measurements of flange interface resistance (all attributable to the gaskets) versus RF leakage through the seam produced a classic S-shaped curve. For the gasket configuration used in this test, the dramatic change in shielding effectiveness occurs between gasket volume resistivities of 0.01 and 0.4 ohm-cm. Since real enclosures do not have gold-plated flanges, but rather have surface finishes (such as MIL-C-5541 Class 3 chromate conversion coatings) which also increase in resistance over time, it is recommended that gasket volume resistivity be specified at 0.01 ohm-cm max. for the life of the equipment.

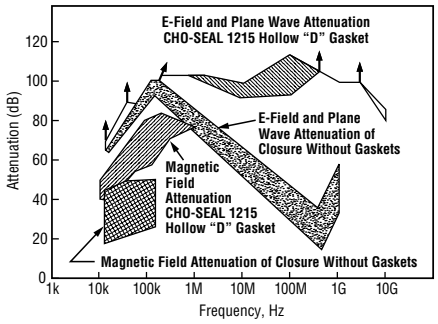


Figure 28 Shielding Effectiveness of a Shelter Door Gasket (14 kHz to 10 GHz)

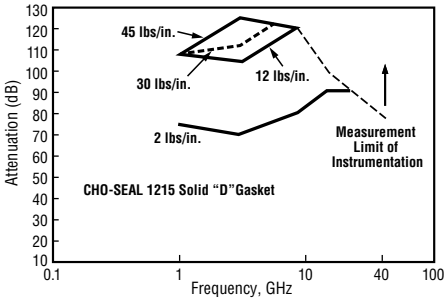


Figure 29 Effect of Closure Force on Shielding Effectiveness (1 GHz to 40 GHz)

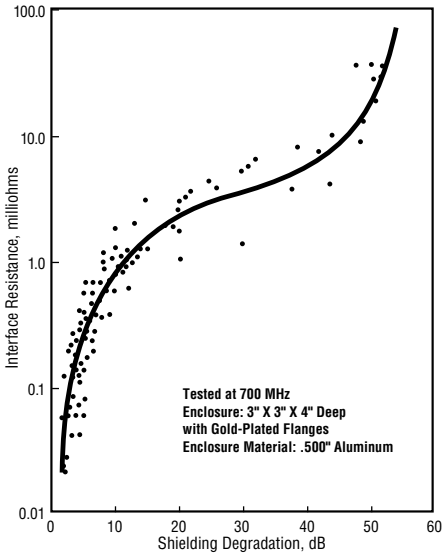


Figure 30 Interface Resistance vs. Shielding Degradation at a Flange Joint

EMP Survivability

In order for an enclosure to continue providing EMI isolation during and after an EMP environment, the conductive gaskets at joints and seams must be capable of carrying EMP-induced current pulses without losing their conductivity. Figure 31 shows the EMP current response of various types of conductive elastomer gaskets. Note that gaskets based on silver-plated-glass fillers (1350) become nonconductive at low levels of EMP current, and should therefore not be used when EMP is a design consideration. Figure 32 is an electron microscope photo which clearly shows the damage mechanism. Silver-plated-copper filled (1215) gaskets have the highest resistance to EMP type currents, showing no loss of conductivity even at 2.5 kA/inch of gasket (peak-to-peak). Pure silver (1224) and silver-plated-aluminum filled (1285) gaskets have less current carrying capability than silver-plated-copper materials, but are generally acceptable for EMP hardened systems (depending on specific EMP threat levels, gasket cross section dimensions, etc.).

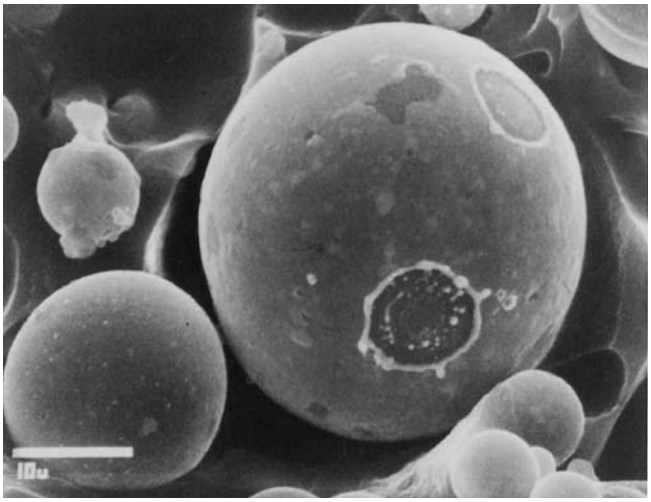


Figure 32 Scanning Electron Microscopy Illustrates EMP Damage Mechanism for Silver/Glass Elastomers

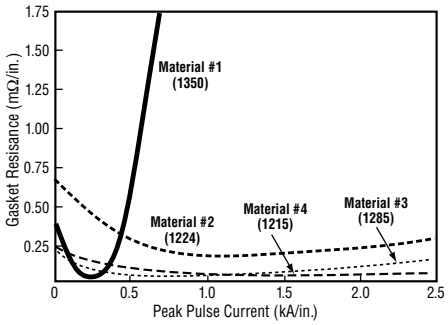


Figure 31 EMP Current Response of Conductive Elastomer Gaskets

Unit Conversion Note:

Gasket Resistance, 1 mΩ/in.= 25.4 Ω/mm
Peak Pulse Current, 1 kA/in.= 25.4 kA/mm

Vibration Resistance

Certain conductive elastomers are electrically stable during aircraft-level vibration environments, while others are not. The key factor which determines vibration resistance is the shape and surface texture of the filler particles. Smooth, spherical fillers (such as those used in silver-plated-glass materials) tend to move apart during vibration, leading to dramatic increases in resistance and loss of shielding effectiveness (although they normally recover their initial properties after the vibration has ended). Rough, less spherical particles resist vibration with very little electrical degradation. Figure 33 shows the effects of vibration on three types of conductive gaskets. Although Chomerics' silver-plated-copper filled 1215 gasket, with rough, irregular particle agglomerations, exhibits excellent stability during vibration, users of conductive elastomers should be aware that smooth, spherical silver-plated-copper fillers can be almost as unstable as silver-plated-glass fillers.

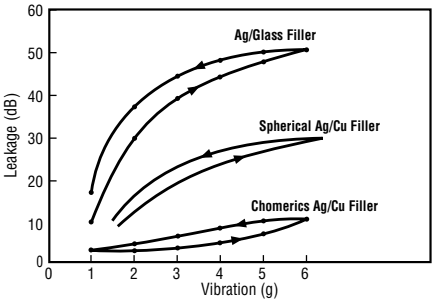


Figure 33 Effects of Vibration on Shielding Effectiveness of Conductive Elastomer Gaskets

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Heat Aging

The primary aging mechanism which affects electrical stability of conductive elastomers is the oxidation of filler particles. For materials based on pure silver fillers, particle oxidation is not generally a problem because the oxide of silver is relatively soft and reasonably conductive. If the filler particles are non-noble (such as copper, nickel, aluminum, etc.) they will oxidize readily over time and become nonconductive. Even silver-plated base metal powders, such as silver-plated-copper or silver-plated-aluminum will become non-conductive over time if the plating is not done properly (or if other processing variables are not properly controlled). These are generally *batch control* problems, with each batch being potentially good or bad.

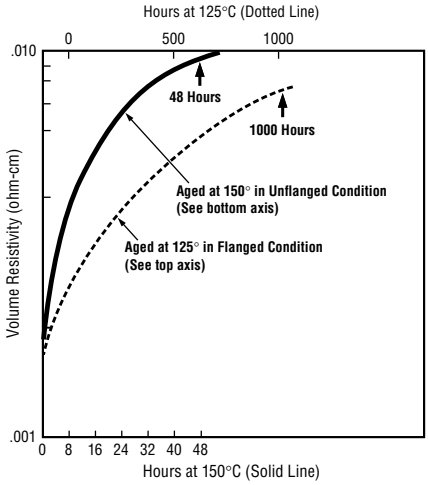

Figure 34 Typical heat aging characteristics of Chomerics' plated-powder-filled conductive elastomers. Flanged 1000-hr test recommended for qualification. Unflanged 48-hr. test recommended for QC acceptance.

The most reliable method of predicting whether a batch will be electrically stable is to promote the rate at which poorly plated or processed particles will oxidize, by heat aging in an air circulating oven. For qualification, 1000 hours (42 days) at maximum rated use temperature (with the gasket sample deflected 7-10% between flanges) is the recommended heat aging test for accelerating the effects of long-term aging at normal ambient temperatures. A quicker heat aging test, which correlates well with the 1000 hour test and is useful for QC acceptance testing, involves a 48 hour/150°C oven bake with the gasket sample on an open wire-grid tray (rather than being clamped between flanges). Figure 34 shows typical data for volume resistivity versus time for each of these tests.

Note: It is essential that no source of free sulfur be placed in the aging oven, as it will cause the material to degrade electrically and mask any oxidation aging tendencies. Common sources of sulfur are neoprenes, most cardboards and other paper products.

Outgassing

Many spacecraft specifications require that nonmetallic components be virtually free of volatile residues which might outgas in the hard vacuum environment of space. The standard test method for determining outgassing behavior is ASTM E595-93, which provides for measurement of total mass loss (TML) and collected volatile condensable materials (CVCM) in a vacuum environment. Data for a number of Chomerics conductive elastomers, based on ASTM E595-93 testing done by NASA Goddard Spaceflight Center, is presented in Table 2. The normal specification limits or guidelines on outgassing for NASA applications are 1% TML max., and 0.1% CVCM max.

Table 2

OUTGASSING DATA FOR CONDUCTIVE ELASTOMERS (PER ASTM E595-93)

Material	Special Post Curing	TML %	CVCM %	NASA GSFC Data Reference
CHO-SEAL 1212	None	0.40	0.13	15140
CHO-SEAL 1215	None	0.45	0.10	15142
CHO-SEAL 1217	None	0.45	0.01	15231
CHO-SEAL 1221	None	0.35	0.02	15249
CHO-SEAL 1224	None	0.41	0.10	15211
CHO-SEAL 1285	None	0.62	0.09	15251
CHO-SEAL 1287	None	0.63	0.03	15165
CHO-SIL 1401	None	0.92	0.37	15213
CHO-SIL 1485	None	0.36	0.08	15167
CHO-SEAL 1501	None	0.50	0.10	15247

Volume Resistivity Measurement

The "standard" test method for volume resistivity of conductive elastomers is ASTM D991. While useful and accurate for measuring anti-static products (such as carbon-filled elastomers), this method has serious shortcomings when used for EMI gasket materials. For example:

a. ASTM D991 cannot be used to measure actual molded parts (such as O-rings). It requires flat sheet samples.

b. Pressure is critical in ASTM D991 measurements.

c. The probe and meter setup of ASTM D991 is not sufficiently portable to make measurements outside a laboratory.

d. The ASTM D991 procedure assumes that surface resistivity is very high (ref. para. 1.2). For EMI gasket materials, whose surfaces must be very conductive, the method cannot distinguish between samples with high and low surface resistivity.

To reduce or eliminate these shortcomings, a modified ASTM D991 procedure has been developed which uses the surface probe and calculation shown in Figure 35. Tests using this probe have been shown to correlate well with ASTM D991 and other 4-point probe methods of measuring volume resistivity. Using this 2-point probe, measured resistance values for EMI gaskets in the 0.002 to 0.02 ohm-cm range are typically 0.01 to 1.0 ohm (depending on cross section). These values can be easily measured on small, under-$500 ohmmeters sensitive down to 10 milliohms. The probe can be used to make accurate volume resistivity measurements on actual gaskets such as molded rings, extruded strips, or custom cross sections. The weight of the probe (200-500 gm) is sufficient to produce accurate and reproducible measurements after a stabilization period of about 15-60 seconds.The addition of 1-2 lbs (450-900 gm) manual force will allow a stabilized resistance value to be reached more quickly.

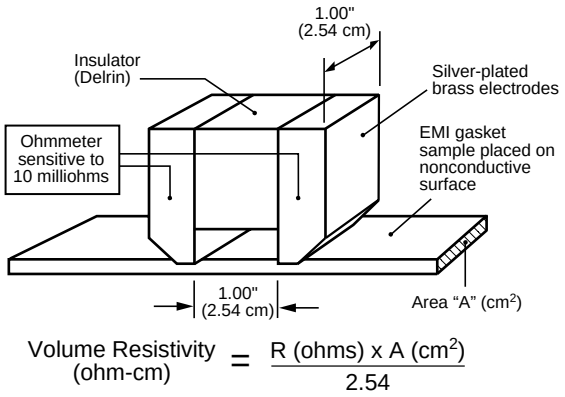

Figure 35 Modified ASTM D991 test probe for measuring volume resistivity of conductive elastomers.

Although the test electrodes shown in Figure 35 are only in contact with one surface of the part or sample being measured, it can be easily shown that in fact a *volume* resistivity is being measured. Start by measuring a flat sheet sample 2 in. x 4 in. x 0.062 in. in size (5.08 cm x 10.16 cm x 1.51 mm). Then cut the sample into two pieces, each 2 in. (5.08 cm) long, and ply them up into one double-thickness sample 0.125 in. (3.02 mm) thick. This plied-up sample will result in a resistance measurement almost exactly half the first measurement. By doubling the cross sectional area "A" (Figure 35), the resistance "R" is halved.

It can also be shown that for materials with one side substantially more conductive than the other, measurement with the probe of Figure 35 will clearly show the difference. Since this is a common problem with poorly-manufactured conductive elastomers ("resin-rich" on one side), it is recommended that random measurements be made on *both* sides of parts during QC or Acceptance testing.

For extremely small gaskets, shorter electrode spacing may be required – such as 0.50 in. (1.27 cm). For a probe with 1.27 cm separation, change the denominator in the equation shown in Figure 35 to 1.27.

The probe of Figure 35 has been specified as the method of measuring volume resistivity of finished parts in MIL-G-83528.

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Part Number Index

The following table identifies the gasket type and page number within this Handbook for standard extruded and molded elastomer parts, custom extrusions and sheet stock.

Table 1

continued

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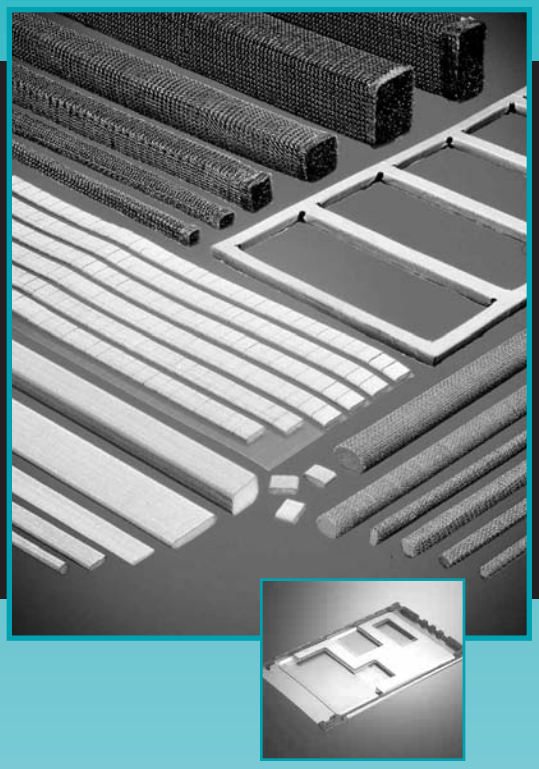
SOFT-SHIELD® Low Closure Force, Foam Core EMI Gaskets



SECTION CONTENTS	PAGE

A choice of low closure force EMI shielding materials...

Material choices that maximize your options... SOFT-SHIELD EMI gasketing products bring new flexibility to shielding decisions. They offer material choices, performance levels, configurations and attachment methods that suit virtually any requirement.

And, minimize your costs... Chomerics' multi-technology approach can help control production costs. Using the right material for a given shielding task eliminates waste and speeds assembly.

SOFT-SHIELD PRODUCT	5000 Series	4000 Series	2000 Series	1000 Series
APPLICATIONS	Continuous EMI gasket, very low closure force gasket, grounding buttons, frame gaskets	Die-cut I/O, backplane, ground plane gaskets, grounding buttons, low cost spliced picture	Continuous EMI gasket, low closure force gasket, electronic enclosures	Continuous EMI gasket, extremely low closure force gasket, electronic enclosures
PROFILES	Asymmetrical or flat rectangular, C, V, P, and D	Flat rectangular	Rectangular, square, and D	Rectangular and square
JACKET/CORE	Nickel-plated-silver nylon rip-stop fabric over urethane, 3-5 lb. (1.4 - 2.3 kg) density	Foil/fabric or conductive fabric over urethane, 20-25 lb. (9.1 -11.4 kg) density	Silver-plated nylon yarn over thermoplastic EPDM foam, 12 lb. (5.5 kg) density	Monel or Ferrex wire over urethane, 4 lb. (1.8 kg) density
ATTACHMENT	Non-conductive PSA	Electrically conductive PSA	Non-conductive PSA	Non-conductive PSA
CUSTOMIZING	Cut-to-length – Kiss-cut – Die-cut – Picture frame – Custom profiles – Mounting clips– Rigid inserts	Cut-to-length – Kiss-cut – Die-cut – Picture frame – Individually wrapped picture frame	Parallel weather seal– Cut-to-length – Picture frame	Large profiles >0.75 x 0.75 in. (19.1 x 19.1 mm) – Custom attachment (push-pin) – Auto-cut – Termination
DISTRIBUTOR AVAILABILITY	Yes, (standard and cut-to-length)	Yes, (standard, cut-to-length, and die-cut)	Yes, (bulk on spools, cut-to-length)	Yes, (bulk on spools, cut-to-length, terminations)
RELATIVE PERFORMANCE RANKING (1=highest)				
SHIELDING EFFECTIVENESS	1	1	2	2
COMPRESSION-DEFLECTION	2	1-3	3	1
UL 94 FLAMMABILITY	V-0 rated version available	V-0 and HB rated versions available	HB	HF-1
COMPRESSION SET	3	1	2	3
DURABILITY, ABRASION, CLOSURE CYCLES	1	1	1	1
FRICTION/SHEAR	1	1	2	2
GROUNDING	2	1	2	1
PRIMARY FEATURES	Superior compression-deflection, many profiles available	Excellent shielding/grounding, durability and low compression set	Good shielding effectiveness up to 10 GHz. Low price.	Excellent compression-deflection, good shielding effectiveness. Lowest price.

Contact Chomerics' Applications Engineering Department for assistance with SOFT-SHIELD product selection.

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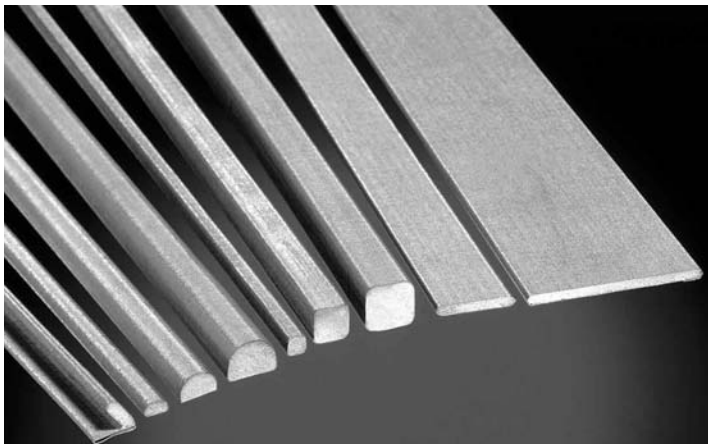
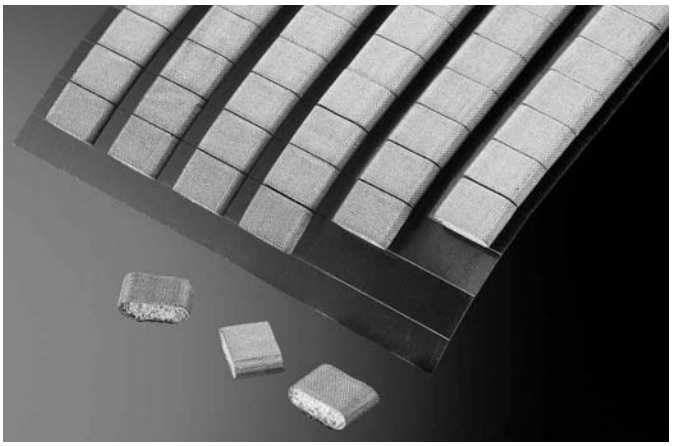
SOFT-SHIELD® 5000 Series





SOFT-SHIELD 5000 Series Conductive Jacket over Foam EMI Gaskets

- Choice of General Duty or UL 94V-0 rated versions
- Typically require <1 lb/in (0.175 N/mm) closure force – 5 times lower than other gaskets
- >90 dB attenuation from 20 MHz to 10 GHz
- Asymmetrical profiles, as well as C, V, P, D shapes
- No performance degradation after 10,000 compression cycles
- Wide release liner for easy removal
- Kiss-cut parts on release sheets for easy "peel-and-stick" grounding applications
- Self-terminating jacket – no sharp edges
- Tested to Bellcore GR-64-Core Airborne Contaminants requirements
- Custom lengths, custom profiles

Unlimited Profiles with Ultra-Low Closure Force

SOFT-SHIELD 5000 Series EMI gaskets are designed to meet the stringent shielding and mechanical performance requirements of today's commercial electronic enclosures, medical electronics, factory automation equipment, reprographics and grounding applications. A growing number of standard profiles and sizes provide flexibility when selecting a gasket for a specific application. Custom profiles or sizes can also be produced.

Each SOFT-SHIELD 5000 Series gasket consists of an electrically conductive fabric jacket over a highly compressible urethane foam core. The nickel-plated, woven nylon rip-stop jacket is self-terminating when cut. Chosen for its excellent compressibility, the foam core typically requires less than 1 lb/in (0.175 N/mm) closure force, making it especially useful for thin-walled plastic enclosures. Standard pressure-sensitive adhesive attachment tape (PSA) makes SOFT-SHIELD 5000 Series gaskets a user-friendly and cost-effective design solution.

Every profile in the SOFT-SHIELD 5000 Series can be provided in a General Duty version or a UL 94V-0 rated version, as needed, with no difference in performance.

Configurations

Gaskets are supplied in standard 8-foot lengths or cut-to-length strips. Depending on the profile, gasketing can also be supplied on spools. For rapid peel-and-stick grounding applications, the material is supplied as kiss-cut parts on polyester film release backers, or as individual pieces.

Chomerics also fabricates single-piece, spliced picture frame gaskets from continuous lengths. With their fully jacketed surfaces, these gaskets are ideally suited for low closure force applications that require 360° EMI shielding, or the ease of installing a one-piece gasket (see next page).

continued

Table 1

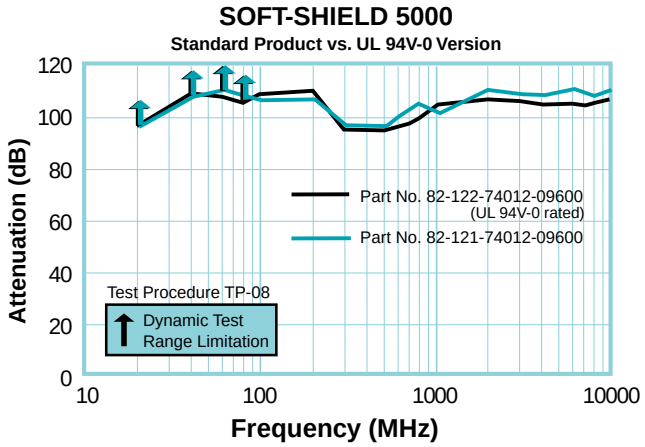
TYPICAL PROPERTIES		
Property	**Test Method**	**SOFT-SHIELD 5000**
Shielding Effectiveness	CHO-TM-TP08	See Figure 1
Compression-Deflection	ASTM C165 (modified)	Request Technical Bulletin 172
Compression Set	ASTM D3574 (modified)	<25%
Electrical Conductivity	CEPS-0002	0.1 ohm/sq., max.
Adhesive Peel Strength	ASTM D1000 (90° Bend)	4 lb/inch (0.7 N/mm), min.
Pressure-Sensitive Adhesive	—	Non-Conductive Adhesive
Operating Temperature Range	—	-40 to +70°C

Foil jacket wrapped version
Our newest material...the SOFT-SHIELD 5500 Series... consists of an aluminum foil jacket over a urethane foam core, offered in continuous lengths in the same profiles as 5000 Series gaskets. Request information.

Table 2

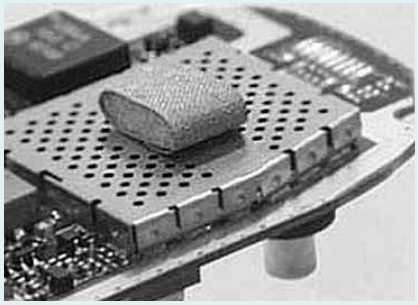
DIMENSIONAL TOLERANCES	
Cross Section inch (mm)	**inch (mm)**
Up to 0.040 (1.02)	±0.010 (0.25)
Above 0.040 (1.02)	±0.020 (0.051)
Cut Length inch (cm)	**inch (mm)**
0.10 to 6.0 (0.25 to 15.2)	±0.030 (0.76)
6.1 to 18.0 (15.5 to 45.7)	±0.060 (1.52)
18.1 to 42.0 (46.0 to 106.7	±0.075 (1.91)
42.1 to 96.0 (107.0 to 243.8)	±0.090 (2.29)
Kiss-Cut	**inch (mm)**
0.04 to 0.12 (1.02 to 3.05)	±0.015 (0.38)
0.121 to 0.40 (3.07 to 10.16)	±0.035 (0.89)

Figure 1 Shielding Effectiveness



Typical Application-Ready Solutions

Mobile phone grounding



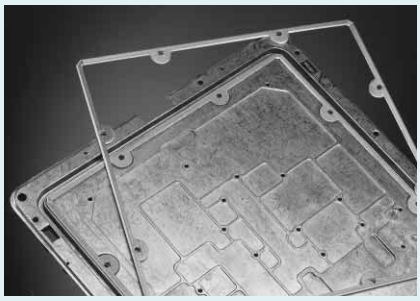
Conditions and Requirements

- minimize through-resistance for optimum grounding
- maximum 0.25 x 0.25 inch footprint
- accommodate 0.040 inch variation in gap
- snap-in plastic cover with 2 lb max. load at 50% gasket deflection
- high volume application

SOFT-SHIELD Gasket Solution

- highly conductive jacket offers low resistance
- standard profile, no customization required
- meets low closure force requirements
- kiss-cut parts on release paper allow quick peel-and-stick installation

Interface between aluminum casting and plastic antenna housing



Conditions and Requirements

- overcome 45 dB leakage problem
- replace multiple strips with single-piece design for ease of installation
- 0.030 inch flatness tolerance on component mating surfaces
- low cost a priority

SOFT-SHIELD Gasket Solution

- effectively shields the interface
- one-piece picture frame gasket with integral notches for fasteners
- meets low closure force requirements
- customized solution that meets cost criteria—lower installed cost

Foil jacket wrapped version
Our newest material...the SOFT-SHIELD 5500 Series... consists of an aluminum foil jacket over a urethane foam core, offered in continuous lengths in the same profiles as 5000 Series gaskets. Request information.

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ORDERING INFORMATION

Referring to Tables 3-6, use the part number shown here to order SOFT-SHIELD 5000 Series gasketing.

8 2 – A B C – X X X X X – Y Y Y Y Y

- **8 2** – Designates SOFT-SHIELD 5000 EMI gaskets
- **A** – Jacket Type
  - 1 Nickel-plated nylon rip-stop fabric
  - 2 Other (to be assigned)
- **B** – PSA Tape Backing
  - 1 No PSA tape
  - 2 PSA tape
- **C** – Gasket Service Rating
  - 1 General duty (urethane foam core)
  - 2 UL 94V-0 rating
- **X X X X X** – Gasket profile (see below)
- **Y Y Y Y Y** – Length in inches x 100, ex., 09600 = 8 ft. (std)

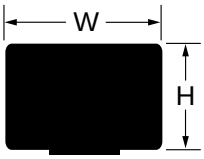
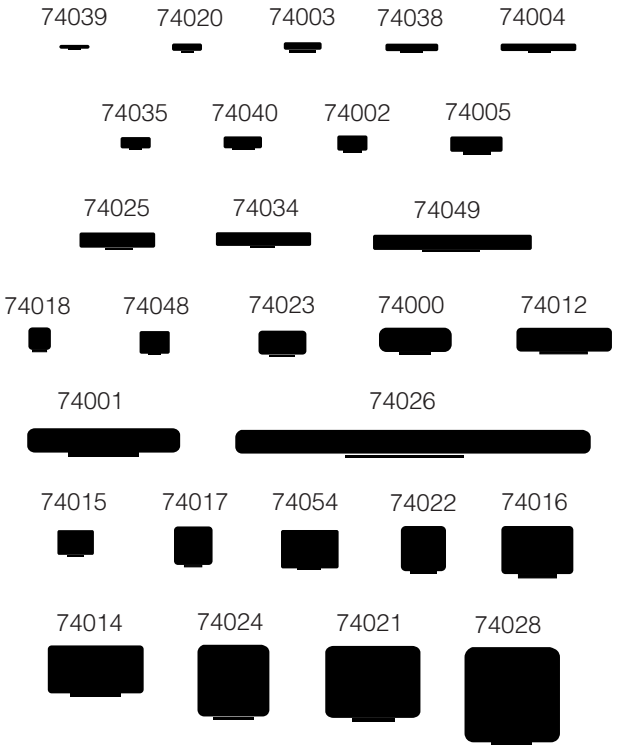


Table 3

RECTANGULAR STRIPS		
Profile Number	**Height**	**Width**
74039	0.020 (0.50)	0.157 (4.00)
74020	0.039 (1.00)	0.157 (4.00)
74003	0.039 (1.00)	0.197 (5.00)
74038	0.039 (1.00)	0.275 (7.00)
74004	0.039 (1.00)	0.394 (10.00)
74035	0.059 (1.50)	0.157 (4.00)
74040	0.062 (1.60)	0.200 (5.00)
74034	0.071 (1.80)	0.551 (14.00)
74002	0.079 (2.00)	0.157 (4.00)
74005	0.079 (2.00)	0.275 (7.00)
74025	0.079 (2.00)	0.394 (10.00)
74049	0.079 (2.00)	0.827 (21.00)
74018	0.118 (3.00)	0.118 (3.00)
74048	0.118 (3.00)	0.157 (4.00)
74023	0.125 (3.18)	0.250 (6.35)
74000	0.125 (3.18)	0.375 (9.53)
74012	0.125 (3.18)	0.500 (12.70)
74001	0.125 (3.18)	0.800 (20.32)
74026	0.125 (3.18)	1.850 (47.00)
74015	0.130 (3.30)	0.190 (4.83)
74017	0.200 (5.08)	0.200 (5.08)
74054	0.200 (5.08)	0.300 (7.60)
74022	0.236 (6.00)	0.236 (6.00)
74016	0.250 (6.35)	0.375 (9.53)
74014	0.250 (6.35)	0.500 (12.70)
74024	0.375 (9.53)	0.375 (9.53)
74021	0.375 (9.53)	0.500 (12.70)
74028	0.500 (12.70)	0.500 (12.70)

APPROX. ACTUAL SIZE



NOTE: Dimensions shown do not include PSA thickness (0.005 inch typically). Actual size shown with PSA strip.

All SOFT-SHIELD 5000 Series profiles can be supplied in either General Duty or UL 94V-0 rated versions.

*Compression-deflection information is available for SOFT-SHIELD 5000 Series profiles. Request Technical Bulletin **172**.*

Foil jacket wrapped version

Our newest material...the SOFT-SHIELD 5500 Series... consists of an aluminum foil jacket over a urethane foam core, offered in continuous lengths in the same profiles as 5000 Series gaskets. Request information.

continued

(mm dimensions in parentheses)

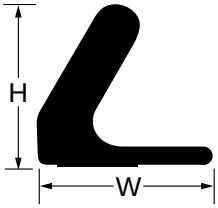
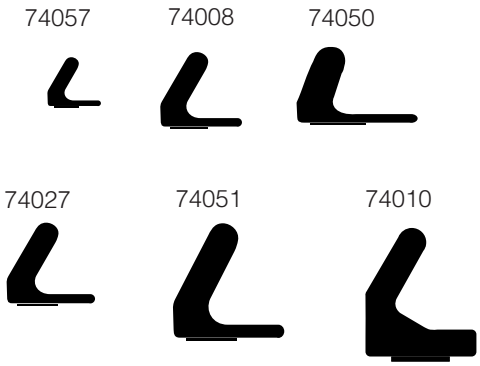
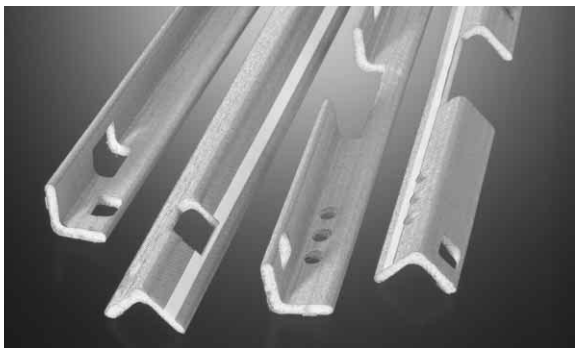


Table 4

C-FOLD STRIPS		
Profile Number	**Height**	**Width**
74057	0.250 (6.35)	0.280 (7.11)
74008	0.385 (9.78)	0.420 (10.67)
74050	0.394 (10.00)	0.630 (16.00)
74027	0.420 (10.67)	0.465 (11.80)
74051	0.591 (15.00)	0.551 (14.00)
74010	0.675 (17.5)	0.580 (14.73)

APPROX. ACTUAL SIZE





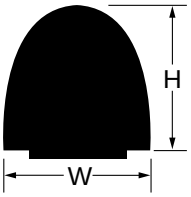
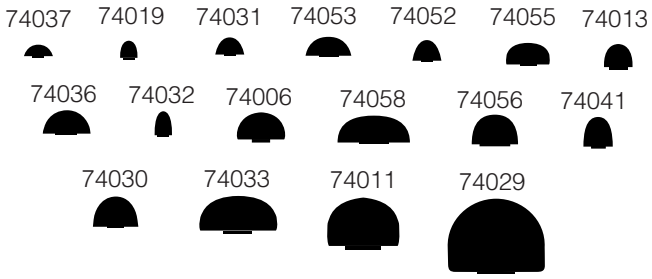


Table 5

D-STRIPS		
Profile Number	**Height**	**Width**
74037	0.060 (1.52)	0.150 (3.80)
74019	0.090 (2.30)	0.090 (2.30)
74031	0.090 (2.30)	0.150 (3.80)
74053	0.100 (2.54)	0.250 (6.35)
74052	0.108 (2.74)	0.150 (3.80)
74055	0.110 (2.79)	0.225 (5.72)
74013	0.120 (3.05)	0.150 (3.80)
74036	0.120 (3.05)	0.250 (6.35)
74032	0.125 (3.18)	0.090 (2.30)
74006	0.140 (3.56)	0.250 (6.35)
74058	0.140 (3.56)	0.380 (9.65)
74056	0.155 (3.94)	0.250 (6.35)
74041	0.157 (4.00)	0.150 (3.80)
74030	0.157 (4.00)	0.236 (6.00)
74033	0.180 (4.57)	0.400 (10.16)
74011	0.250 (6.35)	0.375 (9.53)
74029	0.375 (9.53)	0.500 (12.70)

APPROX. ACTUAL SIZE



*Compression-deflection information is available for SOFT-SHIELD 5000 Series profiles. Request Technical Bulletin **172**.*

Chomerics' Applications Engineering Department welcomes the opportunity to provide assistance with design and prototype fabrication of SOFT-SHIELD 5000 Series EMI Gaskets in custom profiles.

NOTE: Dimensions shown do not include PSA thickness (0.005 inch typically). Actual size shown with PSA strip.
All SOFT-SHIELD 5000 Series profiles can be supplied in either General Duty or UL 94V -0 rated versions.

Foil jacket wrapped version
Our newest material...the SOFT-SHIELD 5500 Series... consists of an aluminum foil jacket over a urethane foam core, offered in continuous lengths in the same profiles as 5000 Series gaskets. Request information.

(mm dimensions in parentheses)

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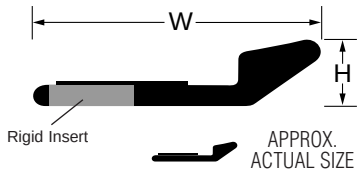
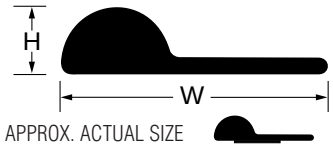
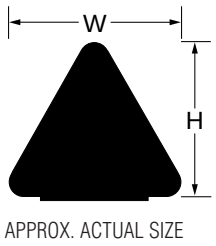
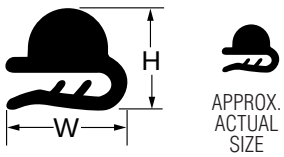
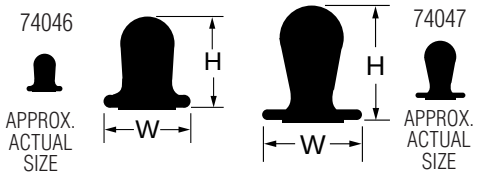
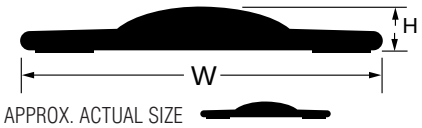
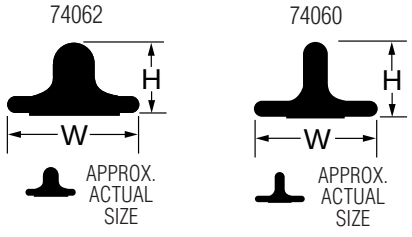
Table 6

OTHER SOFT-SHIELD 5000 GASKET PROFILES			
Profile	**Profile Number**	**Height inches (mm)**	**Width inches (mm)**
	74007	0.106 (2.69)	0.445 (11.30)
	74009	0.130 (3.30)	0.520 (13.20)
	74042	0.782 (19.86)	0.882 (22.40)
	74045	0.242 (6.15)	0.296 (7.52)
	74046 74047	0.200 (5.08) 0.300 (7.62)	0.190 (4.83) 0.270 (6.86)
	74059	0.080 (2.03)	0.675 (17.15)
	74062 74060	0.152 (3.86) 0.152 (3.86)	0.250 (6.35) 0.256 (6.50)

NOTE: Dimensions shown do not include PSA thickness (0.005 inch typically). Actual size shown with PSA strip.

All SOFT-SHIELD 5000 Series profiles can be supplied in either General Duty or UL 94V -0 rated versions.

Foil jacket wrapped version

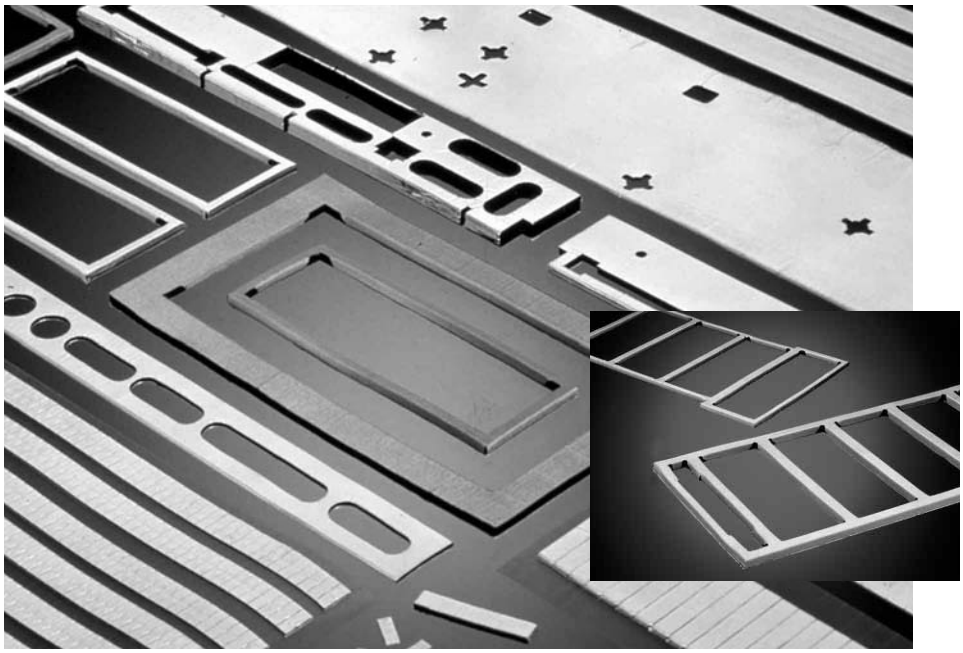
Our newest material...the SOFT-SHIELD 5500 Series... consists of an aluminum foil jacket over a urethane foam core, offered in continuous lengths in the same profiles as 5000 Series gaskets. Request information.

(mm dimensions in parentheses)

SOFT-SHIELD® 4000 Series

SOFT-SHIELD 4000 Series Foil/Fabric over Foam EMI Gaskets

- No loose conductive fibers
- No sharp edges
- Electrically conductive attachment adhesive
- >90 dB attenuation from 10 MHz to 1 GHz
- No degradation in shielding performance after 10,000 deflection cycles
- <25% compression set at 50% deflection (22 hrs. at 70°C)
- Shielding performance of foil, with conformability and toughness of fabric
- Surface resistance <20 milliohms
- UL 94V-0 and UL 94HB* rated versions
- Thin cross sections suitable for back plane I/O and D-subminiature gaskets
- Custom, individually 360° wrapped gaskets available
- Available as "peel-and-stick" grounding contacts



High Performance for Die-Cut, Picture Frame and Backplane Applications

Chomerics' SOFT-SHIELD 4000 Series materials are low-cost, low closure force EMI gaskets that provide effective shielding and grounding of commercial electronic devices, indoor enclosures and industrial equipment. Their availability in thin cross sections makes them an ideal choice for access panel, back plane or I/O connector panel shielding.

Rectangular in cross section, the 4000 Series materials are constructed of a closed cell urethane foam that is machine wrapped with a fabric-reinforced aluminum foil. This combination provides the shielding performance of foil and the conformability and toughness of fabric. Each material includes conductive, pressure-sensitive adhesive on one side, which provides a means of gasket attachment without compromising shielding performance.

The fabric-reinforced foil covering has no loose conductive fibers or sharp edges. Low compression set, low surface resistivities, and durability make 4000 Series gasketing an excellent EMI shielding solution.

Choice of softness level and configuration

The group of five materials in the 4000 Series provides a choice of UL 94V-0 or UL 94HB rated compositions, and a choice of three grades of softness for the foam core.

Gaskets are produced as continuously wrapped solid strips in standard lengths, cut-to-length parts, die-cut parts, and individually 360° wrapped die-cut parts. For rapid peel and stick grounding applications, the materials are available as kiss-cut parts on polyester film release sheets. SOFT-SHIELD 4000 Series materials also can be fabricated as D-subminiature connector gaskets (9-50 pin).

When ordering die-cut gaskets, two wrapping techniques are available:

Standard die-cut parts are produced from any of the five 4000 Series materials. While they are produced from strips that have fully-wrapped outside edges, the parts will have exposed surfaces wherever they have been die-cut.

Custom, individually 360° wrapped gaskets are wrapped after die cutting, ensuring that every surface is covered in the fabric-reinforced foil jacket. Applications for individually wrapped parts include ladder and back plane gaskets in computer storage cabinets. The ultra-soft core in SOFT-SHIELD 4002 and 4004 materials limits their use in individually 360° wrapped gaskets. Contact Chomerics' Applications Engineering Department.

NOTE: For certain applications, Chomerics supplies alternate SOFT-SHIELD 4000 series materials in which a conductive metallized fabric jacket is substituted for the foil jacket. Inquiries are invited.

Compression-Deflection

The three grades of foam used for SOFT-SHIELD 4000 Series gaskets, and a choice of standard thicknesses, provide a range of compression-deflection performance levels to suit the closure force conditions of a given application. Compression-deflection characteristics vary both with the foam core selected and the volume of foil covering in relation to gasket thickness. Ranges are shown in Table 1. Actual compression-deflection values have been determined for each material in each standard profile, and are available on request.

Chomerics' Applications Engineering Department welcomes the opportunity to provide assistance with design and prototype fabrication of SOFT-SHIELD 4000 Series EMI Gaskets.

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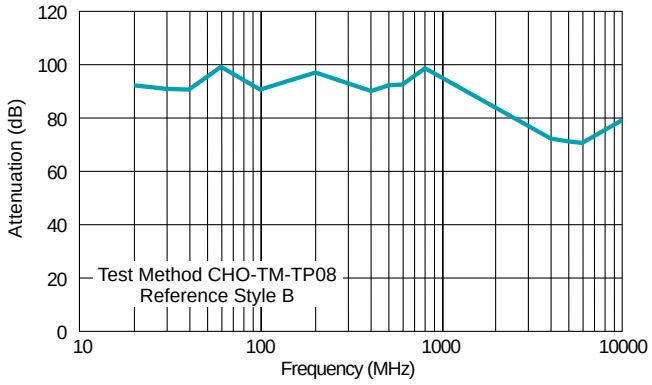
Table 1

TYPICAL PROPERTIES FOR SOFT-SHIELD 4000 GASKETING						
Material	**4000**	**4002**	**4004**	**4006**	**4008**	**Test Method**
Core	PORON[1] Urethane Foam					—
Jacket	Fabric-Reinforced Aluminum Foil				—	
PSA Type	Chomerics Electrically Conductive Acrylic					—
Adhesion	See Table 2					ASTM D1000
Compression-Deflection[2], 25% deflection, psi	<7 to <12	<1 to <4	<1 to <5	<3 to <9	<3 to <8	ASTM D3574 Modified
Compression Set, % @ 25% Deflection	<20					ASTM D395 Method B
Compression Cycling, ohms, 10,000 cycles @ 50% Deflection	Initial 0.006, Final 0.032					—
Operating Temperature, max.	158°F (70°C)					—
Initial PSA Adhesion, lb/in	>2.5					ASTM D1000
EMI Shielding Effectiveness, dB (10 MHz to 1 GHz)	See Figure 1					CHO-TM-TP08[3]
Transfer Impedance	See Figure 2					SAE ARP 1705
Surface Resistivity after Heat Aging, ohms/sq. in. 168 Hours 185°F (85°C) 250°F (121°C) 95% RH/95°F (35°C) 2190 Hours 158°F (70°C)	 Initial 0.009, Final 0.014 Initial 0.007, Final 0.017 Initial 0.007, Final 0.010 Initial 0.010, Final 0.010					CHO-TM-TP57[3]
Abrasion Resistance (Taber Abrader), ohms 500 cycles (500 g on CS wheel)	Initial 0.007, Final 0.010					ASTM D460
UL Flammability	94 HB	94 V-0	94 HB	94 HB	94 V-0	—

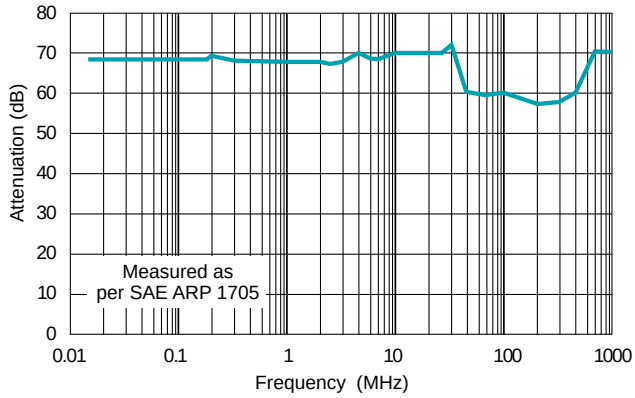
[1] Rogers Corporation
[2] Varies with thickness. Actual compression-deflection values are provided on specification sheet for each material profile..
[3] Copies of Chomerics Test Methods CHO-TM-TP08 and CHO-TM-TP57 are available on request.

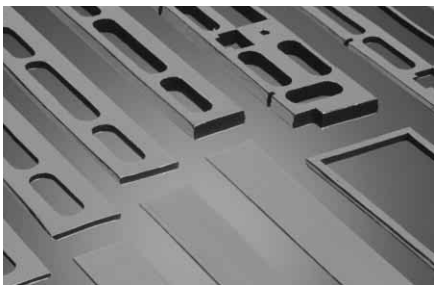
Figure 1 Shielding Effectiveness



Note: *To achieve the shielding effectiveness shown, gasket should be deflected a minimum of 10%.*

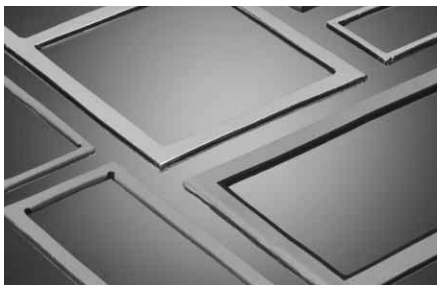
Figure 2 Transfer Impedance





Standard rectangular cross sections available as solid strips or die-cut parts.

Multiple kiss-cut parts on release backers for easy peel-and-stick in grounding applications.



Individually 360° wrapped picture-frame and ladder gaskets available in SOFT-SHIELD 4000, 4006 and 4008 materials.

continued

Table 2

ADHESION* (PEEL STRENGTH), lb/inch (N/m)		
Test Environment	**To Aluminum**	**To Steel**
Ambient Temperature Baked 1 hr. @ 350°F (177°C)	2.5 (438) 4.0 (700)	2.5 (438) 3.9 (682.5)
Baked 1 hr. @ 400°F (204°C)	5.1 (892.5)	5.0 (875)
Baked 48 hrs. @ 350°F (177°C)	3.1 (542.5)	3.0 (525)
Baked 48 hrs. @ 165°F, 95% RH (74°C)	4.1 (717.5)	4.0 (700)

*Tested at ambient temperature per ASTM D1000.

Table 3

DIMENSIONAL TOLERANCES	
Strips	Width: ±1 mm (0.040 in.) Length: ±2 mm (0.080 in.)
Custom Die-Cut	Width: ±1 mm (0.040 in.) Length: ±0.38 mm (0.015 in.) Hole to Hole: ±0.25 mm (0.010 in.) Angular: ±0.5° Datum from a die-cut feature.
Thickness	±10%

Table 4

GASKET SIZE RANGES	
Machine-Wrapped/ Cut-to-Length	**Individually 360° Wrapped**
Width: 12.7 to 152 mm (0.5 to 6.0 in.) Length: up to 1219 mm (up to 48.0 in.)	610 x 610 mm (24.0 x 24.0 in.) maximum size

ORDERING INFORMATION

Referring to Tables 3-5, use the part numbering scheme shown here to order SOFT-SHIELD 4000 Series gasketing in **standard sizes**:

WWWW-XXX-YYYY-ZZZZ

Table 5

WWWW = MATERIAL				
4000	**4002**	**4004**	**4006**	**4008**

XXX = STANDARD THICKNESSES *mm (inch)*			
4000 and 4006		**4008**	
012	1.2 (0.048)	**016**	1.6 (0.064)
019	1.9 (0.075)	**023**	2.3 (0.091)
027	2.7 (0.106)	**031**	3.1 (0.122)
035	3.5 (0.138)	**039**	3.9 (0.154)
067	6.7 (0.264)	**017**	7.1 (0.279)
4002		**4004**	
012	1.2 (0.048)	**009**	0.9 (0.034)
017	1.7 (0.068)	**014**	1.4 (0.054)
023	2.3 (0.091)	**020**	2.0 (0.077)
027	2.7 (0.106)	**024**	2.4 (0.094)
037	3.7 (0.147)	**034**	3.4 (0.133)
047	4.7 (0.187)	**044**	4.4 (0.173)
057	5.7 (0.226)	**054**	5.4 (0.212)
067	6.7 (0.264)	**064**	6.4 (0.250)

YYYY = STANDARD WIDTH *mm (inch)*			
0127	12.7 (0.5)	**0762**	76.2 (3.0)
0210	21.0 (0.825)	**1016**	101.6 (4.0)
0254	25.4 (1.0)	**1270**	127.0 (5.0)
0381	38.1 (1.5)	**1524**	152.4 (6.0)
0508	50.8 (2.0)		

ZZZZ = STANDARD LENGTH *mm (inch)*			
2540	254 (10.0)	**5080**	508 (20.0)

For custom die-cut parts, use the part number **WWWW-XXX-L0000**, for which Chomerics will assign the actual drawing number L0000. Note: Fully-wrapped (360°) custom gaskets are not available in SOFT-SHIELD 4002 or 4004 materials.

D-CONNECTOR GASKETS

Use the following part number system to order D-Connector gaskets in SOFT-SHIELD 4002 material. Dimensions and tolerances are provided in Table 6.

4002 — XXX — YYPIN-LLLLL

Thickness

012 1.2 (0.048)
017 1.7 (0.068)
023 2.3 (0.091)

09PIN-L2780
15PIN-L2781
25PIN-L2782
37PIN-L2783
50PIN-L2784

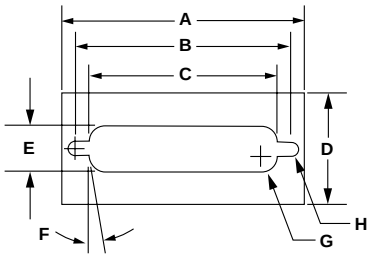


Table 6

D-CONNECTOR GASKETS *inch (mm)*					
Dimension Tolerances	**9 PIN**	**15 PIN**	**25 PIN**	**37 PIN**	**50 PIN**
"A" Overall Length ± 0.015 (0.38)	1.213 (30.81)	1.541 (39.14)	2.088 (53.04)	2.720 (69.09)	2.630 (66.80)
"B" Cutout Length at Slot Centerline ±0.010 (0.25)	0.984 (24.99)	1.312 (33.32)	1.852 (47.04)	2.500 (63.50)	2.406 (61.11)
"C" Cutout Length Excluding Slot ±0.010 (0.25)	0.746 (18.95)	1.074 (27.28)	1.614 (41.00)	2.266 (57.56)	2.158 (54.81)
"D" Overall Width ±0.040 (1.00)	0.700 (17.78)	0.700 (17.78)	0.700 (17.78)	0.700 (17.78)	0.825 (20.96)
"E" Cutout Width ±0.010 (0.25)	0.400 (10.16)	0.400 (10.16)	0.400 (10.16)	0.400 (10.16)	0.500 (12.70)
"F" Angle ±0.5°	2 x 10°	2 x 10°	2 x 10°	2 x 10°	2 x 10°
"G" Cutout Radius ±0.010 (0.25)	4 x 0.140 (3.56)	4 x 0.140 (3.56)	4 x 0.140 (3.56)	4 x 0.140 (3.56)	4 x 0.140 (3.56)
"H" Slot Radius ±0.010 (0.25)	2 x 0.062 (1.57)	2 x 0.062 (1.57)	2 x 0.062 (1.57)	2 x 0.062 (1.57)	2 x 0.062 (1.57)

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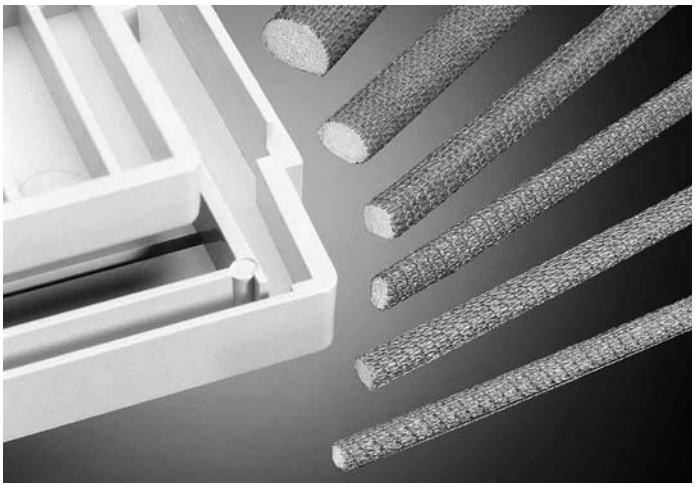
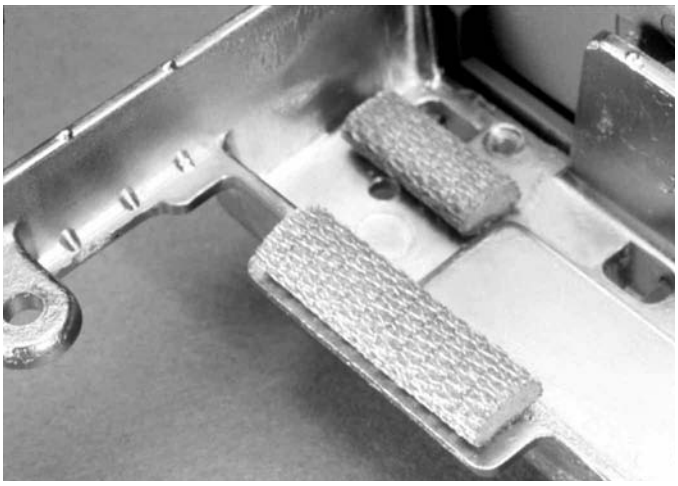
SOFT-SHIELD® 2000 Series





SOFT-SHIELD 2000 Series Conductive Yarn over Foam EMI Gaskets

- >70 dB attenuation from 20 MHz to 10 GHz
- Requires <1 lb/inch (0.175 N/mm) closure force
- No degradation in performance after 10,000 compression cycles
- Self-terminating – simply cut to desired length
- Won't crease or wrinkle in storage
- <25% compression set at 50% deflection, 22 hr. at 158°F (70°C)
- Pressure-sensitive adhesive for quick mounting–extended PSA release liner available
- Rectangular, square or "D" profiles
- Available kiss-cut on film-sheets
- UL 94HB rated

Self-Terminating, Low Closure Force

SOFT-SHIELD 2000 Series gaskets consist of silver-plated nylon yarn knitted as the outer layer over a highly compressible, thermoplastic EPDM foam core. Through a special treatment process, the yarn jacket is secured to the core. This self-terminating outer layer eliminates the need for secondary termination efforts and metal particle debris associated with the cut ends of common wire mesh gaskets.

SOFT-SHIELD 2000 Series gaskets are designed specifically for use in commercial electronic enclosures and metallized plastic housings.

The low closure force characteristic of SOFT-SHIELD 2000 Series gaskets allows enclosures to be designed with fewer fasteners or thinner panels. The knitted conductive layer provides excellent EMI shielding in the 20 MHz to 10 GHz range.

Configurations: Standard SOFT-SHIELD 2000 Series gaskets include both rectangular and D cross sections. Gaskets are provided in bulk on spools or cut to custom lengths. For attachment to flanges or other mounting surfaces, these gaskets are available with pressure-sensitive adhesive for quick, efficient application. Gaskets can also be produced as spliced picture frames.

continued

Figure 1 Compression-Deflection

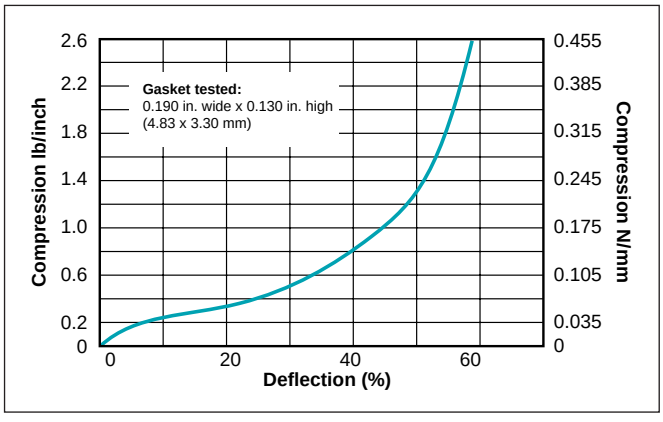
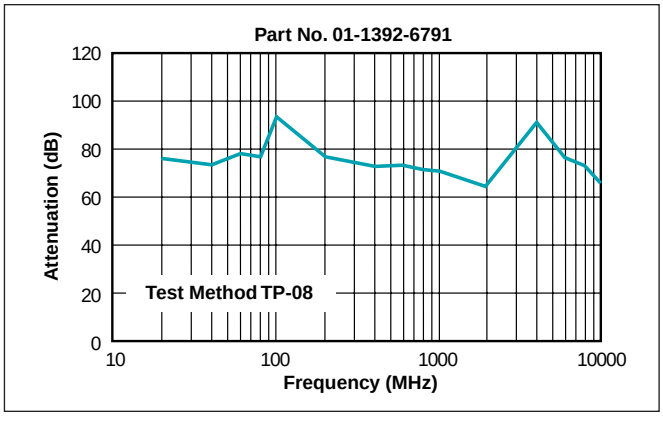


Figure 2 Shielding Effectiveness



ORDERING INFORMATION

Use the following part number to order SOFT-SHIELD 2000 Series gaskets:

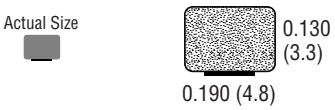
0 1 – 1 3 9 2 – X X X X

Note: Change the 3 to 2 if ordering gaskets without pressure-sensitive adhesive backing.

Gasket profile *(See Table 1)*

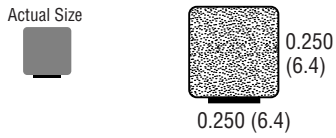
Table 1

6789

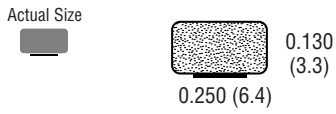


6790

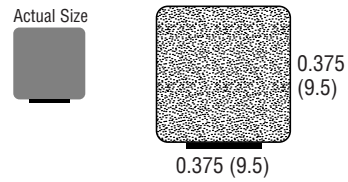
6791



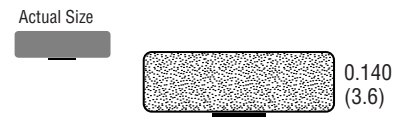
6794



6793



6795



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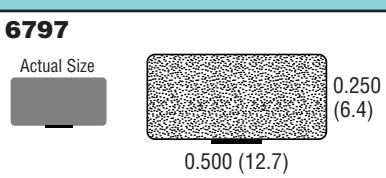

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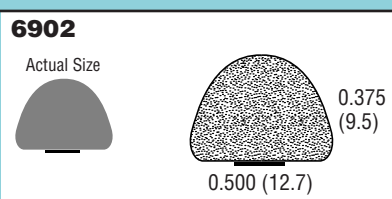

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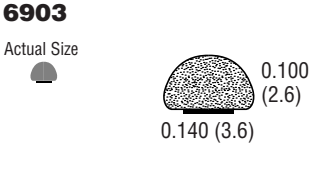

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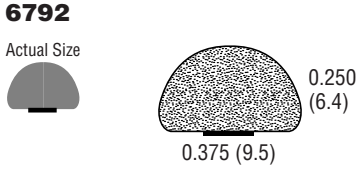

(mm dimensions in parentheses)

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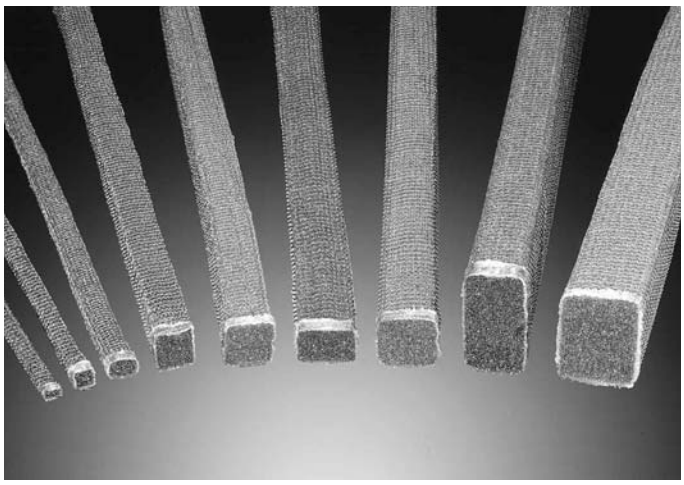
SOFT-SHIELD® 1000 Series



SOFT-SHIELD 1000 Series Knitted Wire over Foam EMI Gaskets

- >70 dB attenuation from 20 MHz to 10 GHz
- Requires only 0.35 lb/inch (0.062 N/mm) closure force
- Only 10-15% compression set at 25% deflection
- UL 94HF-1 flammability (foam core)
- 2.5 - 4.5 lb/inch (0.44 - 0.79 N/mm) gasket peel strength
- Maintains performance after 10,000 compression cycles
- Only 0.93% moisture absorption
- Rectangular and square profiles
- Continuous lengths on reels or cut-to-length and terminated
- U.S. Patent No. 5,028,739

High Durability, Exceptionally Soft

Easy-to-install SOFT-SHIELD 1000 Series gaskets are specially designed for shielding commercial electronic enclosures with tight space constraints or low closure force requirements. They are constructed with a distinctive combination of fine knitted wire mesh over an extremely soft urethane foam core. Standard wire types are monel (nickel-copper alloy) or Ferrex* (tin-plated copper-clad steel).

Standard construction is 0.002 inch (0.05 mm) or 0.0035 inch (0.09 mm) diameter wire with a density of 10-15 knit courses per inch of length (CPI). This combination provides exceptionally low compression force characteristics and excellent shielding. Optional pressure-sensitive adhesive is offered for rapid attachment.

continued

* Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin plate, 2-3% by weight; ASTM B-227 copper cladding, 30-40% by weight; SAE 1010 steel wire, balance by weight.

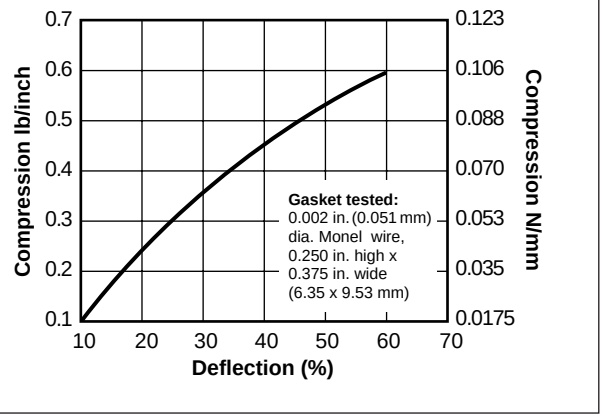


Figure 1 Compression-Deflection

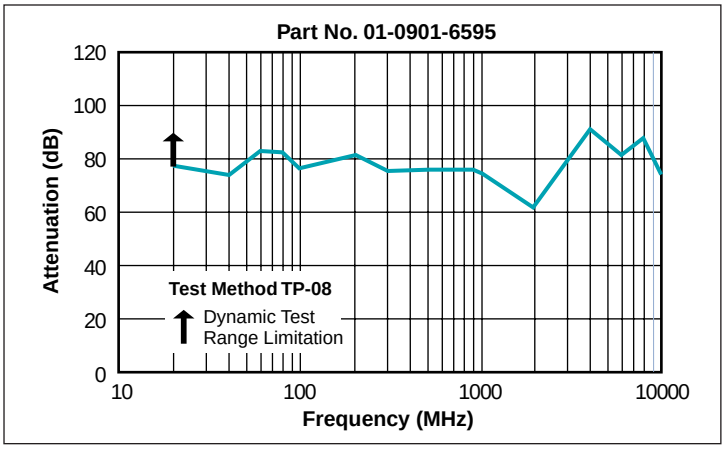


Figure 2 Shielding Effectiveness

Configurations: SOFT-SHIELD 1000 Series gaskets are supplied on continuous rolls, or cut to specified lengths. Chomerics' *"Quick-Cut"* technology allows this knitted wire gasket to be cut-to-length while bonding the wire to the foam core. This prevents fraying of the wire ends while maintaining the gasket's extremely low closure force.

In addition to seven standard cross sections, many custom sizes can be produced without special tooling or setup costs. Custom fabrication includes non-standard cross sections 0.75 x 0.75 inch (19.1 x 19.1 mm) or larger, as well as special attachment mechanisms, including push-pins.

ORDERING INFORMATION

Use the following part numbers to order SOFT-SHIELD 1000 Series gaskets:

(Monel) 01-0901-XXXX (Ferrex)* 01-0904-XXXX

Refer to Table 1 below to replace **XXXX** according to desired gasket dimensions.

Table 1

HEIGHT	WIDTH	WIRE DIAMETER	XXXX
0.125 (3.18)	0.188 (4.78)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6587† 6593 6544† 6601
0.125 (3.18)	0.250 (6.35)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6588† 6594 6572† 6602
0.250 (6.35)	0.250 (6.35)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6589† 6595 6574† 6603
0.375 (9.53)	0.375 (9.53)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6576† 6596 6573† 6604
0.375 (9.53)	0.500 (12.70)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6590† 6597 6548† 6605
0.250 (6.35)	0.375 (9.53)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6591† 6598 6547† 6606
0.500 (12.70)	0.500 (12.70)	0.002 (0.051) 0.002 (0.051) 0.0035 (0.089) 0.0035 (0.089)	6592† 6599 6600† 6607

* Ferrex available only in 0.0035 inch wire diameter. † Supplied without pressure-sensitive adhesive

Chomerics' "Quick-Cut" technology provides terminated custom lengths with non-fraying ends. Available for most cross sections shown here. Contact our Applications Engineering Department.

(mm dimensions in parentheses)

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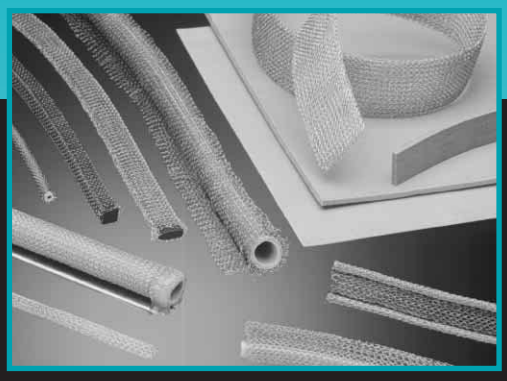
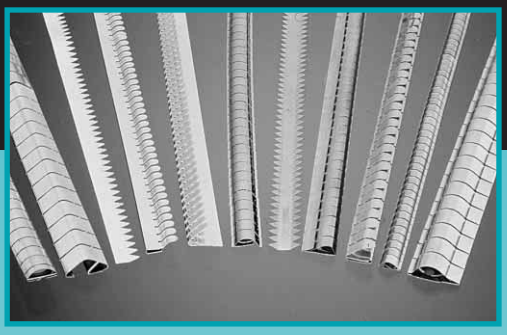
Metal EMI Gaskets, Clip-on Gaskets & Fingerstock





Wire Mesh Gasket Technology

Chomerics offers the broadest range of metal-based EMI gaskets available anywhere.

These products include knitted wire mesh, mesh over elastomer core, oriented wires in elastomers, and metal screen- or expanded foil-impregnated elastomers.

Cost-effective, metal-based shielding products have been used for decades in countless commercial market applications. They typically provide 60 to 100 dB attenuation between 20 MHz and 10 GHz. These composites are also well suited for military-aerospace applications that do not require shielding levels above 80 to 90 dB at frequencies above 1 GHz, or exceptional sealing properties.

For performance information on products listed in this section, refer to the Performance Data Section that begins on page 124.

In addition to hundreds of standard parts listed here, Chomerics routinely supports special needs with custom configurations. With our "octane" product concept, we can direct designers to the most cost-effective, specification-matched metal gasket solution.

"Quick-Cut" Technology

Wire mesh gaskets are available as pre-cut custom lengths that are terminated through a special process which eliminates frayed ends. This technology provides a highly economical, quality solution for cutting and terminating large volumes of parts. Contact our Applications Engineering Department for more information.

STANDARD MATERIAL SPECIFICATIONS

Gasketing Types	ELASTOMERS				METALS		
	Silicone*		Neoprene*		Aluminum	Monel	Ferrex
	Solid	Closed Cell Sponge	Solid	Closed Cell Sponge			
MESH STRIP® (all metal)	—	—	—	—	Alloy 5056 AMS-4182	QQ-N-281 AMS-4730	***
MESH STRIP® (elastomer core)	ZZ-R-765 Class 2B, Grade 40**	AMS-3195	MIL-R-6855 Class II, Grade 40	MIL-R-6130 Type II, Grade A Condition Medium	Alloy 5056 AMS-4182	QQ-N-281 AMS-4730	***
COMBO® STRIP COMBO® Gaskets (mesh/elastomer)	ZZ-R-765 Class 2B, Grade 40	AMS-3195	MIL-R-6855 Class II, Grade 40	MIL-R-6130 Type II, Grade A Condition Medium	—	QQ-N-281 AMS-4730	***
POLASHEET® POLASTRIP® (oriented wire in elastomer)	ZZ-R-765 Class 2B, Grade 40	AMS-3195	—	—	Alloy 5056 AMS-4182	QQ-NN-281 AMS-4730	—
PORCUPINE METALASTIC® (expanded monel in elastomer)	ZZ-R-765 Class 2B, Grade 50	—	—	—	—	QQ-N-281 (expanded)	—
METALASTIC® (woven aluminum in elastomer)	AMS-3302	—	AMS-3222	—	(woven) AMS-4182	—	—
SHIELDMESH® (compressed mesh)	—	—	—	—	Alloy 5056 AMS-4182	QQ-N-281 AMS-4730	***

* Temperature Ranges:
Silicone, solid, COMBO STRIP, POLASTRIP, and POLASHEET: ZZ-R-765, Class 2B, Grade 40. –70° to +500°F (–57° to 260°C).
In PORCUPINE gasketing (Grade 50), –65° to +500°F (–54° to +260°C).
In METALASTIC gasketing, AMS-3302B, –65° to +500°F (–54° to +260°C).
Silicone, sponge, AMS-3195, –80° to +400°F (–62° to +204°C).
Neoprene, solid, MIL-R-6855, Class II, Grade 40, –45° to +220°F (–43° to +104°C). AMS-3222, –40° to + 255°F (–40° to +107C°).
Neoprene, sponge, MIL-R-6130, Type II, Grade A, –30° to +150°F (–34° to +65°C), meets UL 94HF-1 rating.

** Grade may vary depending on part specifications. Contact Chomerics' Applications Engineering Department.

*** Ferrex is Chomerics' tradename for tin-plated, copper-clad steel wire per ASTM B-520, ASTM (QQ-W-343) tin-plated, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

Metal gaskets that include an elastomer can be specified with fluorosilicone on a special order basis. Minimum quantities apply.

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Parker Seals

MESH STRIP™ All Metal Gaskets

MESH STRIP All-Metal Gaskets

MESH STRIP gaskets are compressible, all-metal EMI/EMP strips knitted into rectangular or round cross sections. The knitted wire forms many spring-like interlocked loops, making it highly resilient. Standard MESH STRIP gaskets are knitted from either monel (a nickel-copper alloy) or Ferrex* (tin-plated, copper-clad steel) wire.

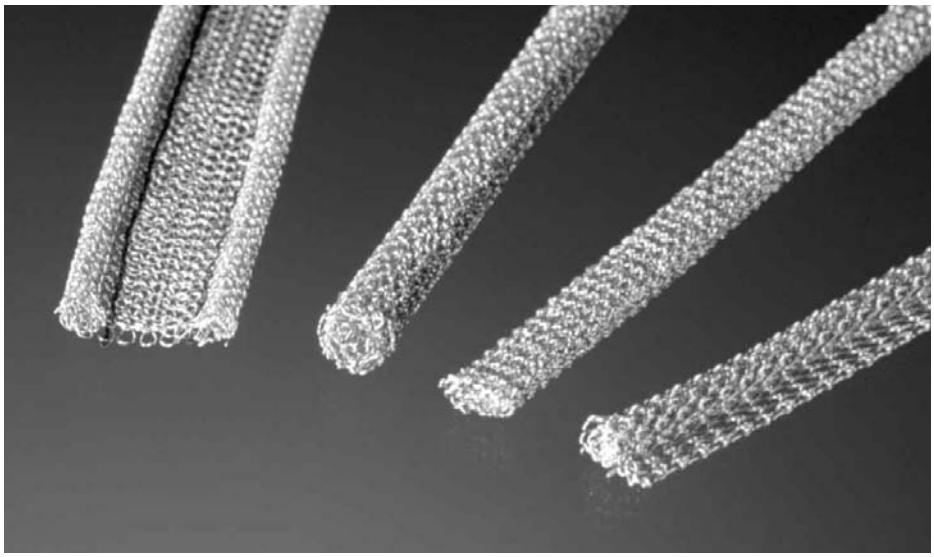
Chomerics also provides SPRINGMESH gaskets, special all-metal spring wire knitted mesh strips in a hollow tube shape with compression-deflection characteristics of 70-80%. *See page 111.*

Other metals and alloys (such as aluminum mesh) are available. Monel is used most frequently due to its good aging properties, excellent tensile strength, and spring-like qualities. Ferrex offers the best EMI shielding performance, especially in H-fields, but has limited corrosion resistance.

All-metal MESH STRIP gasketing cannot provide a pressure or weather seal, and is not recommended for joined gaskets smaller than 2 in. (50.8 mm) x 2 in. (50.8 mm), or 3 in. (76.2 mm) in diameter.

Round cross-sectional gasketing is available with fins which simplify mounting by either riveting, spot-welding, or suitable structural adhesive bonding. The rectangular and round MESH STRIP gaskets can be held in grooves or slots by sidewall friction.

* Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.



Ordering Procedure

MESH STRIP gasketing is supplied on spools in continuous lengths, or can be formed into ready-to-use, one-piece fabricated gaskets.

Standard MESH STRIP – Order by part numbers listed in Tables 2-5, and specify total length required.

Fabricated MESH STRIP Gaskets – Specify material by part number in Tables 2-5. Submit a drawing of the required gasket shape and dimensions. Tolerances for fabricated gaskets are as follows: <5.0 in. ±0.03 in. (<127 mm ±0.76 mm); 5.0–10.0 in. ±0.06 in. (127–254 mm ±1.52 mm); over 10.0 in. (over 254 mm) ±6%.

Custom MESH STRIP shapes are also available.

For additional design assistance, contact Chomerics' Applications Engineering Department.

Table 1 MESH STRIP Cross Section Tolerances

Rectangular Strips
0.062 to 0.188; +0.015, –0.000 (1.57 to 4.78; +0.38, –0.00)
Over 0.188 to 0.375; +0.032, –0.000 (4.78 to 9.53; +0.81, –0.00)
Over 0.375 to 0.500; +0.047, –0.000 (9.53 to 12.70; +1.19, –0.00)
Over 0.500 to 1.000; +0.062, –0.000 (12.70 to 25.40; +1.57, –0.00)
Round Strips
0.062 to 0.125; +0.015, –0.000 (1.57 to 3.18; +0.38, –0.00)
Over 0.125 to 0.188; +0.032, –0.000 (3.18 to 4.78; +0.81, –0.00)
Over 0.188 to 0.375; +0.047, –0.000 (4.78 to 9.53; +1.19, –0.00)
Over 0.375 to 0.750; +0.062, –0.000 (9.53 to 19.05; +0.157, –0.00)
Single or Double Round with Fin (Overall Width)
Under and including 1.00; ± 0.06 (under and including 25.40 ±1.52) Over 1.00; ± 0.12 (over 25.40 ±3.04)

continued

Chomerics' "Quick-Cut" technology provides terminated custom lengths with non-fraying ends. Available for most cross sections shown on next page Contact our Applications Engineering Department.

(mm dimensions in parentheses)

Note: *Contact Chomerics for part numbers of these sizes in aluminum.*

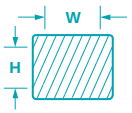


Table 2

RECTANGULAR CROSS SECTIONS			
Height	Width	Part Number	
		Monel	Ferrex
0.062 (1.57)	0.062 (1.57)	01-0101-0408	01-0104-0408
0.062 (1.57)	0.125 (3.18)	01-0101-0218	01-0104-0218
0.062 (1.57)	0.187 (4.75)	01-0101-0213	01-0104-0213
0.062 (1.57)	0.250 (6.35)	01-0101-0144	01-0104-0144
0.062 (1.57)	0.312 (7.92)	01-0101-0777	01-0104-0777
0.062 (1.57)	0.375 (9.53)	01-0101-0149	01-0104-0149
0.062 (1.57)	0.500 (12.70)	01-0101-0780	01-0104-0780
0.062 (1.57)	0.625 (15.88)	01-0101-0812	01-0104-0812
0.062 (1.57)	0.750 (19.05)	01-0101-0258	01-0104-0258
0.062 (1.57)	1.000 (25.40)	01-0101-1539	01-0104-1539
0.093 (2.36)	0.093 (2.36)	01-0101-0424	01-0104-0424
0.093 (2.36)	0.125 (3.18)	01-0101-0377	01-0104-0377
0.093 (2.36)	0.187 (4.75)	01-0101-0203	01-0104-0203
0.093 (2.36)	0.250 (6.35)	01-0101-0167	01-0104-0167
0.093 (2.36)	0.312 (7.92)	01-0101-0332	01-0104-0332
0.093 (2.36)	0.375 (9.53)	01-0101-0197	01-0104-0197
0.093 (2.36)	0.500 (12.70)	01-0101-0285	01-0104-0285
0.093 (2.36)	0.625 (15.88)	01-0101-0238	01-0104-0238
0.125 (3.18)	0.125 (3.18)	01-0101-0199	01-0104-0199
0.125 (3.18)	0.187 (4.75)	01-0101-0177	01-0104-0177
0.125 (3.18)	0.250 (6.35)	01-0101-0153	01-0104-0153
0.125 (3.18)	0.312 (7.92)	01-0101-0336	01-0104-0336
0.125 (3.18)	0.375 (9.53)	01-0101-0192	01-0104-0192
0.125 (3.18)	0.500 (12.70)	01-0101-0286	01-0104-0286
0.125 (3.18)	0.625 (15.88)	01-0101-1607	01-0104-1607
0.125 (3.18)	0.750 (19.05)	01-0101-0251	01-0104-0251
0.125 (3.18)	1.000 (25.40)	01-0101-1092	01-0104-1092
0.156 (3.96)	0.125 (3.18)	01-0101-0194	01-0104-0194
0.187 (4.75)	0.187 (4.75)	01-0101-0168	01-0104-0168
0.187 (4.75)	0.250 (6.35)	01-0101-0958	01-0104-0958
0.187 (4.75)	0.312 (7.92)	01-0101-0516	01-0104-0516
0.187 (4.75)	0.375 (9.53)	01-0101-0217	01-0104-0217
0.187 (4.75)	0.500 (12.70)	01-0101-1639	01-0104-1639
0.187 (4.75)	0.625 (15.88)	01-0101-1815	01-0104-1815
0.187 (4.75)	0.750 (19.05)	01-0101-0547	01-0104-0547
0.187 (4.75)	1.000 (25.40)	01-0101-1817	01-0104-1817
0.250 (6.35)	0.250 (6.35)	01-0101-0169	01-0104-0169
0.250 (6.35)	0.312 (7.92)	01-0101-0581	01-0104-0581
0.250 (6.35)	0.375 (9.53)	01-0101-0310	01-0104-0310
0.250 (6.35)	0.500 (12.70)	01-0101-1523	01-0104-1523
0.250 (6.35)	0.625 (15.88)	01-0101-0818	01-0104-0818
0.250 (6.35)	0.750 (19.05)	01-0101-1530	01-0104-1530
0.250 (6.35)	1.000 (25.40)	01-0101-1598	01-0104-1598
0.312 (7.92)	0.312 (7.92)	01-0101-0390	01-0104-0390
0.375 (9.53)	0.375 (9.53)	01-0101-0265	01-0104-0265
0.375 (9.53)	0.625 (15.88)	01-0101-1816	01-0104-1816

Table 3

ROUND CROSS SECTIONS		
Diameter*	Part Number	
	Monel	Ferrex
0.062 (1.57)	01-0101-0064	01-0104-0064
0.093 (2.36)	01-0101-0056	01-0104-0056
0.125 (3.18)	01-0101-0006	01-0104-0006
0.156 (3.96)	01-0101-0311	01-0104-0311
0.187 (4.75)	01-0101-0020	01-0104-0020
0.250 (6.35)	01-0101-0250	01-0104-0250
0.312 (7.92)	01-0101-0439	01-0104-0439
0.375 (9.53)	01-0101-0017	01-0104-0017
0.437 (11.10)	01-0101-0088	01-0104-0088
0.500 (12.70)	01-0101-0110	01-0104-0110

* For diameters larger than 0.375 (9.53), inquire about Chomerics' exclusive spring core construction.

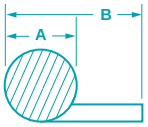


Table 4

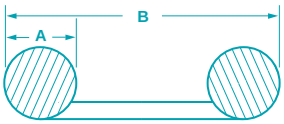
ROUND WITH FIN			
A Diameter*	B Overall Dimension	Part Number	
		Monel	Ferrex
0.062 (1.57)	0.375 (9.53)	01-0101-0983	01-0104-0983
0.062 (1.57)	0.500 (12.70)	01-0101-0756	01-0104-0756
0.062 (1.57)	0.625 (15.88)	01-0101-0091	01-0104-0091
0.062 (1.57)	0.750 (19.05)	01-0101-1160	01-0104-1160
0.093 (2.36)	0.375 (9.53)	01-0101-0826	01-0104-0826
0.093 (2.36)	0.500 (12.70)	01-0101-0977	01-0104-0977
0.093 (2.36)	0.750 (19.05)	01-0101-0998	01-0104-0998
0.125 (3.18)	0.375 (12.70)	01-0101-0008	01-0104-0008
0.125 (3.18)	0.437 (11.10)	01-0101-0076	01-0104-0076
0.125 (3.18)	0.500 (12.70)	01-0101-0060	01-0104-0060
0.125 (3.18)	0.562 (14.27)	01-0101-1161	01-0104-1161
0.125 (3.18)	0.625 (15.88)	01-0101-0061	01-0104-0061
0.125 (3.18)	0.750 (19.05)	01-0101-0079	01-0104-0079
0.156 (3.96)	0.500 (12.70)	01-0101-1162	01-0104-1162
0.156 (3.96)	0.750 (19.05)	01-0101-1163	01-0104-1163
0.187 (4.75)	0.437 (11.10)	01-0101-0075	01-0104-0075
0.187 (4.75)	0.500 (12.70)	01-0101-0092	01-0104-0092
0.187 (4.75)	0.625 (15.88)	01-0101-0058	01-0104-0058
0.187 (4.75)	0.750 (19.05)	01-0101-0051	01-0104-0051
0.187 (4.75)	0.875 (22.23)	01-0101-1164	01-0104-1164
0.250 (6.35)	0.500 (12.70)	01-0101-1331	01-0104-1331
0.250 (6.35)	0.625 (15.88)	01-0101-0109	01-0104-0109
0.250 (6.35)	0.750 (19.05)	01-0101-0106	01-0104-0106
0.250 (6.35)	0.875 (22.23)	01-0101-0534	01-0104-0534
0.250 (6.35)	1.000 (25.40)	01-0101-1330	01-0104-1330
0.312 (7.92)	0.625 (15.88)	01-0101-0530	01-0104-0530
0.312 (7.92)	0.750 (19.05)	01-0101-0362	01-0104-0362
0.312 (7.92)	0.875 (22.23)	01-0101-0592	01-0104-0592
0.375 (9.53)	0.625 (15.88)	01-0101-0568	01-0104-0568
0.375 (9.53)	0.750 (19.05)	01-0101-1191	01-0104-1191
0.375 (9.53)	0.875 (22.23)	01-0101-0009	01-0104-0009
0.375 (9.53)	1.000 (25.40)	01-0101-0270	01-0104-0270
0.437 (11.10)	0.750 (19.05)	01-0101-1192	01-0104-1192
0.437 (11.10)	0.875 (22.23)	01-0101-0098	01-0104-0098
0.437 (11.10)	1.000 (25.40)	01-0101-0274	01-0104-0274
0.500 (12.70)	0.750 (19.05)	01-0101-0789	01-0104-0789
0.500 (12.70)	0.875 (22.23)	01-0101-1193	01-0104-1193
0.500 (12.70)	1.000 (25.40)	01-0101-1040	01-0104-1040

* For diameters larger than 0.375 (9.53), inquire about Chomerics' exclusive spring core construction.

For tolerances, see page 107.

Table 5

DOUBLE ROUND WITH FIN			
A Diameter	B Overall Dimension	Part Number	
		Monel	Ferrex
0.062 (1.57)	0.375 (9.53)	01-0101-6164	01-0104-6164
0.062 (1.57)	0.500 (12.70)	01-0101-0922	01-0104-0922
0.062 (1.57)	0.625 (15.88)	01-0101-0041	01-0104-0041
0.062 (1.57)	0.750 (19.05)	01-0101-1261	01-0104-1261
0.062 (1.57)	0.875 (22.23)	01-0101-1262	01-0104-1262
0.093 (2.36)	0.500 (12.70)	01-0101-6165	01-0104-6165
0.125 (3.18)	0.500 (12.70)	01-0101-0449	01-0104-0449
0.125 (3.18)	0.625 (15.88)	01-0101-0012	01-0104-0012
0.125 (3.18)	0.750 (19.05)	01-0101-0085	01-0104-0085
0.125 (3.18)	0.875 (22.23)	01-0101-0515	01-0104-0515
0.125 (3.18)	1.000 (25.40)	01-0101-0625	01-0104-0625
0.187 (4.75)	0.625 (15.88)	01-0101-0019	01-0104-0019
0.187 (4.75)	0.750 (19.05)	01-0101-0049	01-0104-0049
0.187 (4.75)	0.875 (22.23)	01-0101-0735	01-0104-0735
0.187 (4.75)	1.000 (25.40)	01-0101-0344	01-0104-0344
0.250 (6.35)	0.750 (19.05)	01-0101-0949	01-0104-0949
0.250 (6.35)	0.875 (22.23)	01-0101-1276	01-0104-1276
0.250 (6.35)	1.000 (25.40)	01-0101-0452	01-0104-0452
0.375 (9.53)	1.000 (25.40)	01-0101-1277	01-0104-1277
0.375 (9.53)	1.250 (31.75)	01-0101-1278	01-0104-1278



(mm dimensions in parentheses)

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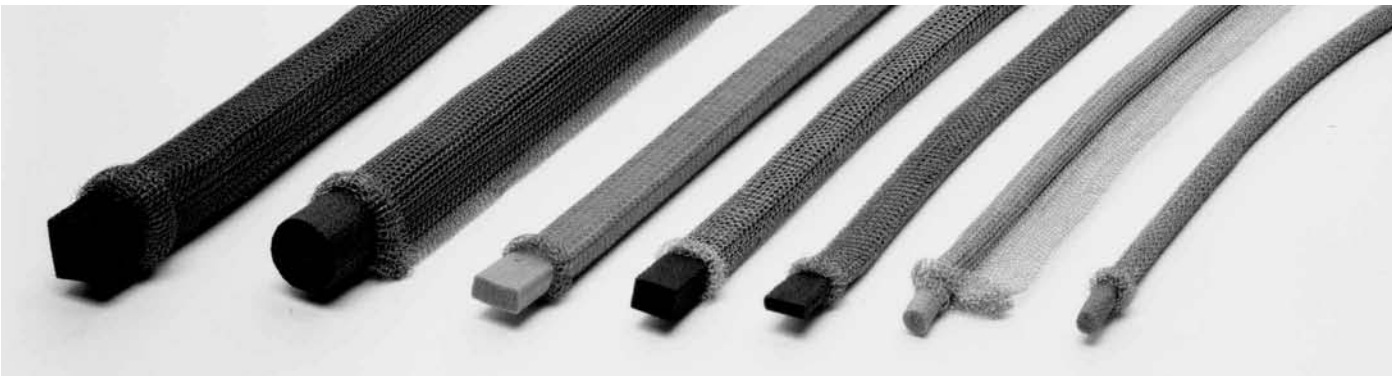
Parker Seals

MESH STRIP™ with Elastomer Core



MESH STRIP with Elastomer Core

Standard MESH STRIP gasketing with elastomer core consists of two layers* of wire mesh knitted around a rectangular or round core of neoprene or silicone. The knitted wire mesh provides the electrical conductivity for EMI/EMP shielding, and the core provides excellent compressibility with a high degree of resilience. Closing force is in the 50-100 psi (0.34-0.69 MPa) range.

Elastomer core MESH STRIP gasketing does not provide pressure sealing, but it does provide a seal against dust, rain, ventilating air and other limited environmental conditions.

The standard wire materials are monel (a nickel-copper alloy) and Ferrex** (tin-plated, copper-clad steel). Other metals and alloys such as aluminum mesh are available. Monel is used most frequently due to its good aging properties, excellent tensile strength and spring-like qualities. Ferrex offers the best EMI shielding performance, especially in H-fields, but has limited corrosion resistance.

Standard core materials include neoprene sponge (MIL-R-6130, Type II), hollow solid neoprene (MIL-R-6855, Class II), closed cell silicone sponge (AMS-3195) and solid silicone hollow tubing (ZZ-R-765, Class 2B).

In addition to the standard configurations listed, almost any elastomer core cross section can be produced, including UL 94V-0 rated core materials.

Also see page 111 for SPRINGMESH® gaskets, an all-metal spring wire hollow tube design with compression-deflection characteristics of 70-80%.

Ordering Procedure

Order by part numbers listed in Tables 2-6, and specify total length required. Gasketing is normally supplied on spools in continuous lengths.

Note: Elastomer core MESH STRIP gasketing is not easily joined into single-piece gaskets. For this reason, gasketing should be factory fabricated to customer specifications.

Fabricated Gaskets – Specify materials by part numbers from Tables 2-6. Submit a sketch of the required gasket dimensions. If possible, include a brief description of the shielding/sealing application.

For additional design assistance, contact Chomerics' Applications Engineering Department.

continued

Table 1 MESH STRIP with Elastomer Core Tolerances

Rectangular Elastomer		
Up to 0.125 (3.18)	+0.031 –0.015	(0.79) (0.38)
Over 0.125 (3.18) to 0.375 (9.53)	±0.031	(0.79)
Over 0.375 (9.53) to 0.750 (19.05)	±0.062	(1.57)
Round Elastomer		
Up to 0.500 (12.70) dia.	±0.031	(0.79)
Over 0.500 (12.70) dia.	±0.047	(1.19)
Overall Width, Round Single-Fin		
Up to 1.00 (25.40)	±0.062	(1.57)
Over 1.00 (25.40)	±0.12	(3.05)

Note: These dimensions and tolerances refer to the elastomer core. Outside dimensions or diameters, including mesh covers, can be up to 0.031 in. (0.79 mm) greater .

* See tables for exceptions.

** Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

Chomerics' "Quick-Cut" technology provides terminated custom lengths with non-fraying ends. Available for most cross sections shown here. Contact our Applications Engineering Department.

(mm dimensions in parentheses)

Note: *Contact Chomerics for part numbers of these sizes in aluminum.*

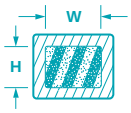


Table 2

RECTANGULAR CROSS SECTIONS/SPONGE CORE

Height*	Width*	Part Number			
		Neoprene Sponge		Silicone Sponge	
		Monel	Ferrex	Monel	Ferrex
0.125 (3.18)	0.125 (3.18)	01-0401-1845	01-0404-1845	01-0501-0319	01-0504-0319
0.125 (3.18)	0.156 (3.96)	01-0401-1518	01-0404-1518	01-0501-0666	01-0504-0666
0.125 (3.18)	0.188 (4.78)	01-0401-1846	01-0404-1846	01-0501-1320	01-0504-1320
0.125 (3.81)	0.250 (6.35)	01-0401-1847	01-0404-1847	01-0501-1853	01-0504-1853
0.188 (4.78)	0.188 (4.78)	01-0401-1848	01-0404-1848	01-0501-1854	01-0504-1854
0.250 (6.35)	0.250 (6.35)	01-0401-1564	01-0404-1564	01-0501-1855	01-0504-1855
0.250 (6.35)	0.375 (9.53)	01-0401-0888	01-0404-0888	01-0501-1856	01-0504-1856
0.250 (6.35)	0.500 (12.70)	01-0401-1849	01-0404-1849	01-0501-1857	01-0504-1857
0.375 (9.53)	0.500 (12.70)	01-0401-0328	01-0404-1328	01-0501-1858	01-0504-1858
0.375 (9.53)	0.625 (15.88)	01-0401-1850	01-0404-1850	01-0501-1859	01-0504-1859
0.500 (12.70)	0.500 (12.70)	01-0401-1851	01-0404-1851	01-0501-1860	01-0504-1860
0.500 (12.70)	0.750 (19.05)	01-0401-1852	01-0404-1852	01-0501-1861	01-0504-1861

Table 3

ROUND CROSS SECTIONS/SPONGE CORE

Diameter*	Part Number			
	Neoprene Sponge		Silicone Sponge	
	Monel	Ferrex	Monel	Ferrex
0.062 (1.57)	01-0401-1890**	01-0404-1890**	01-0501-1890**	01-0504-1890**
0.125 (3.18)	01-0401-0541	01-0404-0541	01-0501-1891	01-0504-1891
0.188 (4.78)	01-0401-0571	01-0404-0571	01-0501-1892	01-0504-1892
0.250 (6.35)	01-0401-0627	01-0404-0627	01-0501-1893	01-0504-1893
0.312 (7.92)	01-0401-0626	01-0404-0626	01-0501-1894	01-0504-1894
0.375 (9.53)	01-0401-1886	01-0404-1886	01-0501-1895	01-0504-1895
0.437 (11.11)	01-0401-0747	01-0404-0747	01-0501-1896	01-0504-1896
0.500 (12.70)	01-0401-0845	01-0404-0845	01-0501-1897	01-0504-1897
0.750 (19.05)	01-0401-0633	01-0404-0633	01-0501-1898	01-0504-1898

**This size has only one mesh layer.

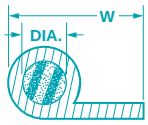


Table 4

SINGLE ROUND WITH FIN/SPONGE CORE

Diameter*	Width Overall	Part Number			
		Neoprene Sponge		Silicone Sponge	
		Monel	Ferrex	Monel	Ferrex
0.125 (3.18)	0.500 (12.70)	01-0401-1862	01-0404-1862	01-0501-0690	01-0504-0690
0.125 (3.18)	0.625 (15.88)	01-0401-1863	01-0404-1863	01-0501-1877	01-0504-1877
0.125 (3.18)	0.750 (19.05)	01-0401-1864	01-0404-1864	01-0501-1878	01-0504-1878
0.188 (4.78)	0.500 (12.70)	01-0401-0630	01-0404-0630	01-0501-1879	01-0504-1879
0.188 (4.78)	0.625 (15.88)	01-0401-1865	01-0404-1865	01-0501-1880	01-0504-1880
0.188 (4.78)	0.750 (19.05)	01-0401-1866	01-0404-1866	01-0501-1881	01-0504-1881
0.250 (6.35)	0.625 (15.88)	01-0401-0819	01-0404-0819	01-0501-1882	01-0504-1882
0.250 (6.35)	0.750 (19.05)	01-0401-1867	01-0404-1867	01-0501-1883	01-0504-1883
0.250 (6.35)	1.000 (25.40)	01-0401-1868	01-0404-1868	01-0501-1884	01-0504-1884
0.500 (12.50)	1.000 (25.40)	01-0401-1869	01-0404-1869	01-0501-1885	01-0504-1885
0.625 (15.88)	1.375 (34.93)	01-0401-1870	01-0404-1870	01-0501-0734	01-0504-0734

(mm dimensions in parentheses)

Table 5

ROUND CROSS SECTIONS/ HOLLOW SILICONE CORE

Diameter*	Part Number	
	Monel	Ferrex
0.188 (4.78)	01-0501-6044	01-0504-6044
0.250 (6.35)	01-0501-6045	01-0504-6045
0.375 (9.53)	01-0501-6112	01-0504-6112
0.500 (12.50)	01-0501-6115	01-0504-6115

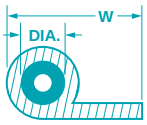


Table 6

SINGLE ROUND WITH FIN/ HOLLOW SILICONE CORE

Diameter*	Width Overall	Part Number	
		Monel	Ferrex
0.188 (4.78)	0.500 (12.50)	01-0501-6105	01-0504-6105
0.250 (6.35)	0.625 (15.88)	01-0501-6110	01-0504-6110
0.375 (9.53)	0.750 (19.05)	01-0501-6113	01-0504-6113
0.500 (12.50)	1.000 (25.40)	01-0501-6114	01-0504-6114

* *These dimensions apply to the elastomer core. Outside dimensions, including mesh covers, can be up to 0.031 in. (0.79 mm) greater. Wall thickness of standard hollow cores is 0.040 in. (1.02 mm).*

For tolerances, see page 109.

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SPRINGMESH® Highly Resilient Gaskets

SPRINGMESH Highly Resilient Gaskets

New knitted wire mesh technology offers the advantages of mesh over core without the bulk and expense of a core. Chomerics' special technique produces a highly resilient, hollow knitted mesh gasket with remarkable recovery even above 70% compression. Compression set is less than 30% at 80% compression.

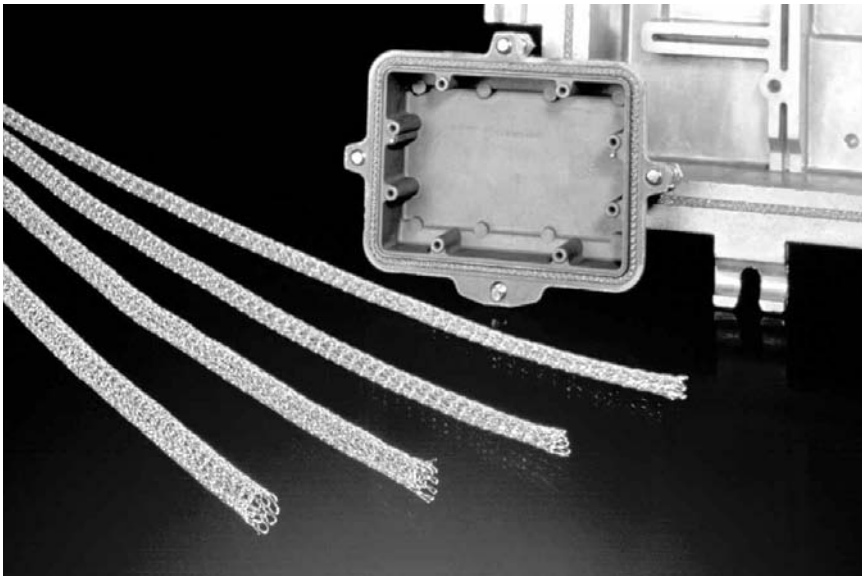
SPRINGMESH gaskets have a round configuration ideally suited for use as a gasket-in-a-groove. They are made from 0.004 inch (0.10 mm) diameter tin-plated steel wire knitted into a hollow cylinder. Two layers of mesh is the preferred design for maximum EMI protection and compression-deflection performance. Custom constructions are available.

Typical applications include cast housings for outdoor CATV boxes, NEMA enclosures with outboard environmental seals, and industrial enclosures.

Ordering Procedure

Standard SPRINGMESH gasketing is sold in bulk and can also be cut to length. Order by part numbers listed in Table 1. In addition to these standard diameters, SPRINGMESH gaskets can be produced in other diameters from 0.062 to 0.375 inch (1.57 to 9.53 mm), for which part numbers will be assigned by Chomerics.

"D" shape configurations with a pressure-sensitive adhesive mounting strip are also available. Contact Chomerics.



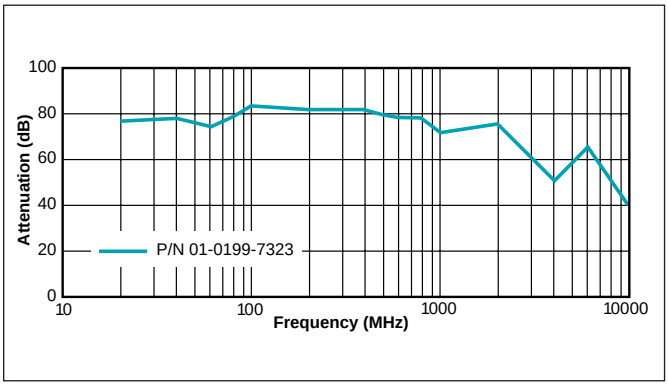


Figure 1 Shielding Effectiveness

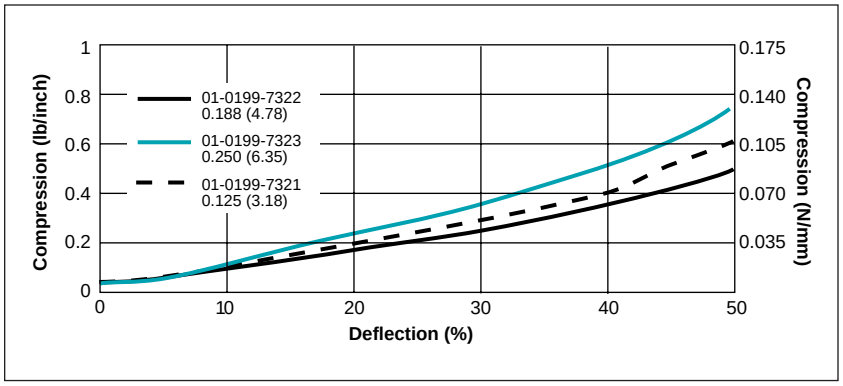


Figure 2 Compression-Deflection

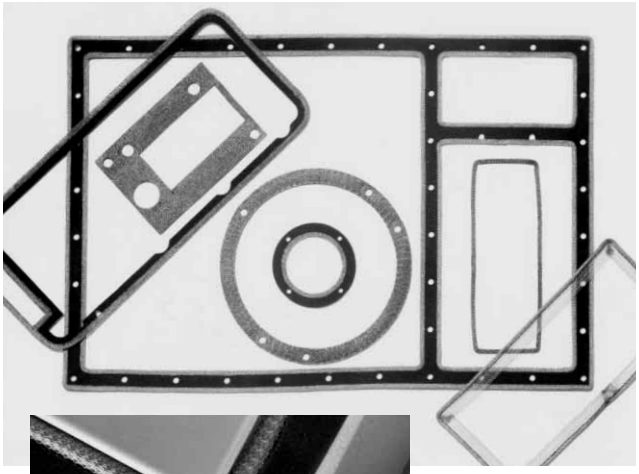
Table 1

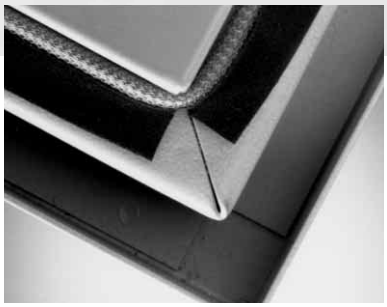
PART NUMBER	DIAMETER	TOLERANCE
01-0199-7298	0.093 (2.36)	+0.020,–0.000 (0.51)
01-0199-7321	0.125 (3.18)	+0.020,–0.000 (0.51)
01-0199-7324	0.156 (3.96)	+0.020,–0.000 (0.51)
01-0199-7322	0.188 (4.78)	+0.020,–0.000 (0.51)
01-0199-7323	0.250 (6.35)	+0.032,–0.000 (0.81)
01-0199-7367	0.375 (9.53)	+0.032,–0.000 (0.81)

Chomerics' "Quick-Cut" technology provides terminated custom lengths with non-fraying ends. Available for most cross sections shown here. Contact our Applications Engineering Department.

(mm dimensions in parentheses)

COMBO® STRIP Gaskets





COMBO STRIP Gaskets

COMBO STRIP gaskets combine MESH STRIP gasketing in parallel with an integral elastomer weather-sealing strip. They are available with or without adhesive backing in a broad range of standard cross sections. Configurations with MESH STRIP gasketing on both sides of the elastomer are also available.

COMBO STRIP gasketing is recommended for applications requiring a weather seal in addition to EMI/EMP shielding. This type of gasketing is also useful in applications requiring shielding only and where the adhesive backing on the elastomer would provide a convenient means of mounting. To obtain a reliable shield and seal, both portions of the COMBO STRIP gasket must come in contact with both mating surfaces.

For applications in which over-compression might cause deterioration of the elastomer seal, metal compression stops may be incorporated within the elastomer portion of the gasket.

The standard EMI/EMP shield in COMBO gasketing is monel or Ferrex* wire, although other metals and alloys (such as aluminum) are available. The standard elastomers are neoprene sponge (MIL-R-6130, Type II), hollow solid neoprene (MIL-R-6855, Class II), silicone sponge (AMS-3195), or solid silicone (ZZ-R-765, Class 2B). Other elastomers, such as fluorosilicones, may be substituted.

For high deflection applications with low closure force, COMBO gaskets with sponge elastomers are recommended. Mesh over elastomer core, in conjunction with a sponge elastomer, can further improve low closure force capabilities. For applications requiring less compressibility, solid elastomers are preferred.

Adhesive Backing

A high tack, long shelf-life acrylic adhesive is available as an option on both neoprene and silicone elastomers.

Compression and Closure Characteristics

For COMBO gasketing with solid elastomer core, the wire mesh is normally 0.031 in. (0.79 mm) higher than the elastomer to assure adequate compression of the mesh. In general, solid elastomer closure pressure is in the 25 to 100 psi (0.17-0.69 MPa) range. For moderate EMI shielding, and when sponge elastomer is used for limited environmental sealing, pressure as low as 10 psi (0.07 MPa) is adequate.

For applications in which sponge elastomer is required, over-compression at the bolt holes can be avoided by bonding washer-type metal compression stops within the seal.

To ensure against over-compression in applications where excessive force is concentrated on the cover gasket, solid metal stops can be bonded into the gasket between bolt holes. The two types of compression stops are illustrated here.

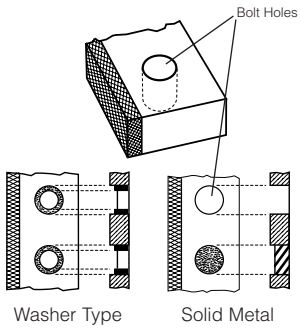


Figure 1 Compression Stops

Ordering Procedure

Standard COMBO STRIP Gasketing: Standard roll length is 25 feet (7.62 meters). Contact Chomerics about custom roll lengths. Order by part numbers from Tables 2 and 3. If no listed part is suitable, specify desired cross section, elastomer material, and EMI mesh material. *Note the following size ranges:*

Mesh dimensions

min. (C) = 0.062 in. (1.57 mm)
(D) = 0.125 in. (3.18 mm)
max. (C) = 0.375 in. (9.53 mm)
(D) = 1.000 in. (25.4 mm)

Elastomer dimensions

min. (A) = 0.062 in. (1.57 mm)
(B) = 0.125 in. (3.18 mm)
max. (A) = 0.375 in. (9.53 mm)
(B) = 1.000 in. (25.4 mm)

For solid elastomers, the mesh material is normally 0.031 in. (0.79 mm) thicker than the elastomer.

* Ferrex® is Chomerics' tin-plated, copper clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

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Parker Seals

Fabricated COMBO GASKETS: Select the appropriate elastomer and wire mesh material, and determine gasket thickness and width. Determine need and type of compression stop. Prepare and submit a drawing of specifications, dimensions, and tolerances to Chomerics' Sales Department.

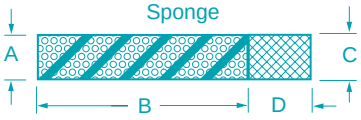
For additional design assistance, contact Chomerics' Applications Engineering Department.

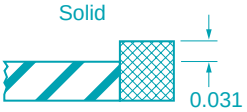
Table 1

COMPRESSION STOP TOLERANCES		
Thickness*	**Aluminum**	**Stainless Steel**
0.040-0.072 (1.02-1.83)	±0.004 (0.10)	±0.006 (0.15)
0.073-0.098 (1.85-2.49)	±0.006 (0.15)	±0.008 (0.20)
0.099-0.130 (2.51-3.30)	±0.008 (0.20)	±0.010 (0.25)
0.131-0.150 (3.32-3.81)	±0.010 (0.25)	±0.012 (0.30)

* Choose standard-gauge sheet material only.

COMBO STRIP Gasketing





Also available with solid neoprene or solid silicone, please inquire.

When using "solid" elastomer, mesh is normally 0.031 in. (0.79 mm) higher because mesh compresses easier than solid elastomer under same pressure.

Table 2

COMBO STRIP GASKETS							
Dimensions, inch (mm)				**Part Number**			
				Neoprene Sponge		**Silicone Sponge**	
A	**B**	**C**	**D**	**Monel**	**Ferrex**	**Monel**	**Ferrex**
0.062 (1.57)	0.250 (6.35)	0.062 (1.57)	0.125 (3.18)	01-0201-1756	01-0204-1756	01-0301-1772	01-0304-1772
0.062 (1.57)	0.375 (9.53)	0.062 (1.57)	0.125 (3.18)	01-0201-1757	01-0204-1757	01-0301-1773	01-0304-1773
0.062 (1.57)	0.500 (12.70)	0.062 (1.57)	0.125 (3.18)	01-0201-1692	01-0204-1692	01-0301-1774	01-0304-1774
0.062 (1.57)	0.625 (15.88)	0.062 (1.57)	0.125 (3.18)	01-0201-1739	01-0204-1739	01-0301-1775	01-0304-1775
0.093 (2.36)	0.250 (6.35)	0.093 (2.36)	0.125 (3.18)	01-0201-1344	01-0204-1344	01-0301-1776	01-0304-1776
0.093 (2.36)	0.375 (9.53)	0.093 (2.36)	0.125 (3.18)	01-0201-1332	01-0204-1332	01-0301-1777	01-0304-1777
0.093 (2.36)	0.500 (12.70)	0.093 (2.36)	0.125 (3.18)	01-0201-1758	01-0204-1758	01-0301-1778	01-0304-1778
0.093 (2.36)	0.750 (19.05)	0.093 (2.36)	0.125 (3.18)	01-0201-1333	01-0204-1333	01-0301-1779	01-0304-1779
0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	0.125 (3.18)	01-0201-1138	01-0204-1138	01-0301-1780	01-0304-1780
0.125 (3.18)	0.188 (4.78)	0.125 (3.18)	0.125 (3.18)	01-0201-1136	01-0204-1136	01-0301-1781	01-0304-1781
0.125 (3.18)	0.250 (6.35)	0.125 (3.18)	0.125 (3.18)	01-0201-1135	01-0204-1135	01-0301-1782	01-0304-1782
0.125 (3.18)	0.250 (6.35)	0.125 (3.18)	0.250 (6.35)	01-0201-1130	01-0204-1130	01-0301-1783	01-0304-1783
0.125 (3.18)	0.375 (9.53)	0.125 (3.18)	0.125 (3.18)	01-0201-1132	01-0204-1132	01-0301-1784	01-0304-1784
0.125 (3.18)	0.500 (12.70)	0.125 (3.18)	0.125 (3.18)	01-0201-1134	01-0204-1134	01-0301-1785	01-0304-1785
0.125 (3.18)	0.500 (12.70)	0.125 (3.18)	0.250 (6.35)	01-0201-1131	01-0204-1131	01-0301-1786	01-0304-1786
0.125 (3.18)	0.500 (12.70)	0.125 (3.18)	0.500 (12.70)	01-0201-1133	01-0204-1133	01-0301-1787	01-0304-1787
0.125 (3.18)	0.625 (15.88)	0.125 (3.18)	0.125 (3.18)	01-0201-1055	01-0204-1055	01-0301-1788	01-0304-1788
0.125 (3.18)	0.750 (19.05)	0.125 (3.18)	0.125 (3.18)	01-0201-1759	01-0204-1759	01-0301-1789	01-0304-1789
0.188 (4.78)	0.188 (4.78)	0.188 (4.78)	0.125 (3.18)	01-0201-1760	01-0204-1760	01-0301-1790	01-0304-1790
0.188 (4.78)	0.250 (6.35)	0.156 (3.96)	0.125 (3.18)	01-0201-1056	01-0204-1056	01-0301-1515	01-0304-1515
0.188 (4.78)	0.250 (6.35)	0.188 (4.78)	0.125 (3.18)	01-0201-1622	01-0204-1622	01-0301-1791	01-0304-1791
0.188 (4.78)	0.375 (9.53)	0.188 (4.78)	0.125 (3.18)	01-0201-1761	01-0204-1761	01-0301-1792	01-0304-1792
0.188 (4.78)	0.500 (12.70)	0.188 (4.78)	0.125 (3.18)	01-0201-1762	01-0204-1762	01-0301-1793	01-0304-1793
0.188 (4.78)	0.750 (19.05)	0.188 (4.78)	0.250 (6.35)	01-0201-1763	01-0204-1763	01-0301-1794	01-0304-1794
0.250 (6.35)	0.250 (6.35)	0.250 (6.35)	0.125 (3.18)	01-0201-1764	01-0204-1764	01-0301-1795	01-0304-1795
0.250 (6.35)	0.500 (12.70)	0.250 (6.35)	0.125 (3.18)	01-0201-1766	01-0204-1766	01-0301-1797	01-0304-1797
0.250 (6.35)	0.750 (19.05)	0.250 (6.35)	0.125 (3.18)	01-0201-1767	01-0204-1767	01-0301-1798	01-0304-1798
0.375 (9.53)	0.250 (6.35)	0.375 (9.53)	0.125 (3.18)	01-0201-0817	01-0204-0817	01-0301-1800	01-0304-1800
0.375 (9.53)	0.500 (12.70)	0.375 (9.53)	0.250 (6.35)	01-0201-1768	01-0204-1768	01-0301-1801	01-0304-1801
0.375 (9.53)	0.750 (19.05)	0.375 (9.53)	0.250 (6.35)	01-0201-1769	01-0204-1769	01-0301-1802	01-0304-1802

For pressure-sensitive adhesive backing: change 02 to 06.

For pressure-sensitive adhesive backing: change 03 to 07.

continued

(mm dimensions in parentheses)

COMBO-2 STRIP Gasketing *(mesh on two sides)*

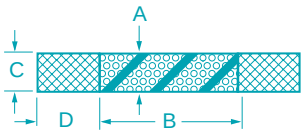


Table 3

COMBO- 2 STRIP GASKETS							
Dimensions, inch(mm)				Part Number			
				Neoprene Sponge		Silicone Sponge	
A	B	C	D	Monel	Ferrex	Monel	Ferrex
0.125 (3.18)	0.250 (6.35)	0.125 (3.18)	0.125 (3.18)	01-0201-1765	01-0204-1765	01-0301-1796	01-0304-1796
0.125 (3.18)	0.375 (9.53)	0.125 (3.18)	0.125 (3.18)	01-0201-1770	01-0204-1770	01-0301-1799	01-0304-1799
0.125 (3.18)	0.500 (12.70)	0.125 (3.18)	0.125 (3.18)	01-0201-1771	01-0204-1771	01-0301-1803	01-0304-1803
0.125 (3.18)	0.250 (6.35)	0.156 (3.96)	0.125 (3.18)	01-0201-1804	01-0204-1804	01-0301-1805	01-0304-1805
0.125 (3.18)	0.375 (9.53)	0.156 (3.96)	0.125 (3.18)	01-0201-1681	01-0204-1681	01-0301-1806	01-0304-1806
0.125 (3.18)	0.500 (12.70)	0.156 (3.96)	0.125 (3.18)	01-0201-1807	01-0204-1807	01-0301-1810	01-0304-1810
0.188 (4.78)	0.250 (6.35)	0.188 (4.78)	0.125 (3.18)	01-0201-1808	01-0204-1808	01-0301-1811	01-0304-1811
0.188 (4.78)	0.500 (12.70)	0.188 (4.78)	0.125 (3.18)	01-0201-1809	01-0204-1809	01-0301-1812	01-0304-1812

For pressure-sensitive adhesive backing: change 02 to 06.

For pressure-sensitive adhesive backing: change 03 to 07.

Table 4

COMBO AND COMBO-2 STRIP CROSS SECTION TOLERANCES		
Dimensions,* in. (mm)	Closed Cell Sponge	Solid Elastomer
A Under 0.125 (3.18)	+0.032 (0.81) – 0.016 (0.41)	±0.015 (0.38)
A 0.125 to 0.5 (3.18 to 12.7)	±0.063 (1.60)	±0.015 (0.38)
A Over 0.5 (12.7)	±0.094 (2.39)	±0.015 (0.38)
B Under 1.00 (25.4)	±0.031 (0.78)	±0.031 (0.78)
C & D 0.062 to 0.186 (1.57 to 4.72)	+0.015 −0.000 (+0.38 −0.00)	
C & D 0.187 to 0.375 (4.75 to 9.53)	+0.031 −0.000 (+0.78 −0.00)	

*See sketch on page 113.

Table 5

FABRICATED COMBO GASKET TOLERANCES		
Dimensions,* in. (mm)	Closed Cell Sponge	Solid Elastomer
A, B, C, & D for each 5 in. (127 mm) of length	±0.031 (0.78) ±0.031 (0.78)	±0.015 (0.38) ±0.015 (0.38)
G & J for each 5 in. (127 mm) of length	±0.015 (0.38) ±0.015 (0.38)	±0.015 (0.38) ±0.015 (0.38)
T Under 0.125 (3.18)	±0.016 (0.41)	±0.015 (0.38)
T 0.125 to 0.5 (3.18 to 12.7)	±0.063 (1.60)	±0.031 (0.78)
T Over 0.5 (12.7)	±0.094 (2.39)	±0.031 (0.78)
W & H 0.062 to 0.186 & (1.57 to 4.72)	+0.015 −0.000 (+0.38 −0.00)	
W & H 0.187 to 0.375 (4.75 to 9.53)	+0.031 −0.000 (+0.78 −0.00)	

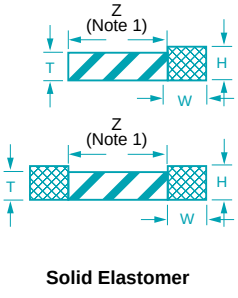
* See sketch below.

Figure 2 Typical Fabricated Combo Gasket Drawing

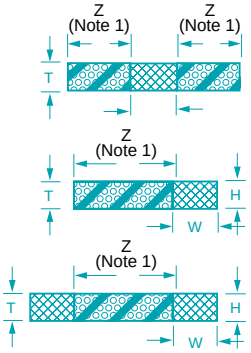
Notes:

1. Minimum width of elastomer (**Z**) is the greater of 0.125 in. (3.18 mm) or elastomer thickness (**T**).
2. Minimum wall width (between hole and edge) should equal elastomer thickness (**T**). "U" slots should be used if minimum wall requirement cannot be met.
3. Hole diameter (**E**) should be equal to or greater than elastomer thickness (**T**).

Cross Sections



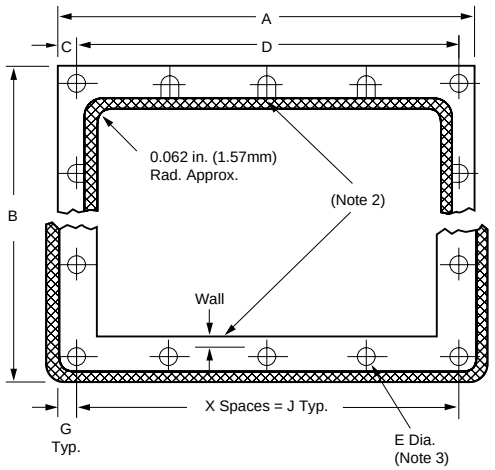
Solid Elastomer



Sponge Elastomer

= mesh portion

H = T +0.031 inch (0.79 mm)



(mm dimensions in parentheses)

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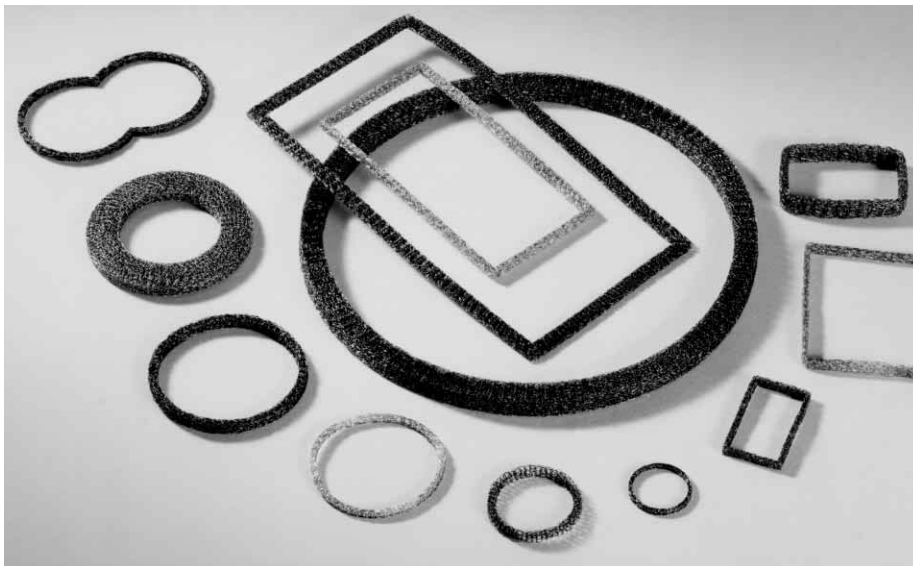
Parker Seals

SHIELDMESH™ Compressed Mesh Gaskets



Ordering Procedure

Rings: Specify wire material, I.D., O.D. and thickness on drawing supplied by customer.

Rectangular Gaskets: Specify outside and inside dimensions, wall width and thickness, as above.

Standard Washers: Some standard parts are available.

Custom Gaskets: For custom gasket design or material, consult our Applications Engineering Department.

SHIELDMESH Compressed Mesh Gaskets

SHIELDMESH compressed mesh EMI gaskets are jointless, with either round or rectangular cross sections. They are made by die-compressing knitted wire mesh into a wide range of shapes and resiliencies. Gaskets can be produced in the metals shown on page 106, or other metals for special requirements.

SHIELDMESH gaskets are designed for applications requiring small round or rectangular EMI seals such as waveguide choke flanges, or for shafts or small housings. Due to high compression set, they are not recommended where mating joints must be opened and closed. Parts are normally supplied as medium density, but this can be varied to suit applications.

The gaskets are held in place by sidewall friction in tight slots or grooves, not less than 0.062 inch (1.57 mm) wide or 0.040 inch (1.01 mm) thick. Since they are compressed, the gaskets need no allowance for material flow or lateral deflection. Width and material permitting, bolt holes can be formed in the gasket wall.

These gaskets will not provide moisture or pressure sealing. For small cross section combination EMI/environmental or pressure seals, conductive elastomer O-rings are recommended (page 64).

SHIELDMESH gaskets formed with certain alloys can be used at temperatures up to 800°F (427°C) with no change to their excellent resilience.

Table 1

TOLERANCES		
Sizes	**O.D.**	**I.D.**
Up to 1.00 (Up to 25.4)	+0.015, –0.000 (+0.38, –0.0)	+0.000, –0.015 (+0.0, –0.38)
1.01 to 2.00 (25.7 to 50.8)	+0.020, –0.000 (+0.51, –0.0)	+0.000, –0.020 (+0.0, –0.51)
2.01 to 3.00 (51.1 to 76.2)	+0.025, –0.000 (+0.63, –0.0)	+0.000, –0.025 (+0.0, –0.63)
3.01 to 4.00 (76.5 to 101.6)	+0.030, –0.000 (+0.76, –0.0)	+0.000, –0.030 (+0.0, –0.76)
Over 4.00 (Over 101.6)	+0.040, –0.000 (+1.02, –0.0)	+0.000, –0.040 (+0.0, –1.02)

Thickness: Under 1.0 in. +0.015, –0.000
(25.40) (+0.38, –0.0)

Measured under 4 oz. (113.5 gm) load, 3/4 in. (1.91 cm) anvils on a Federal Products Model 22P hand snap gauge or equivalent.

(mm dimensions in parentheses)

Frame Gaskets and Strips

EMI/EMP Frame Gaskets and Strips

Frame mounted gaskets incorporate a length of MESH STRIP monel or Ferrex gasketing (with or without elastomer core), securely crimped into the edge of extruded aluminum mounting frames. Allowing simple mechanical mounting, the aluminum frame also provides a positive compression stop to prevent over-compression of the gasket.

The aluminum frame attaches easily to a flange surface with spot welds, rivets, bolts or sheet metal screws. The frame can serve as a load-bearing element, able to meet most shock and vibration requirements.

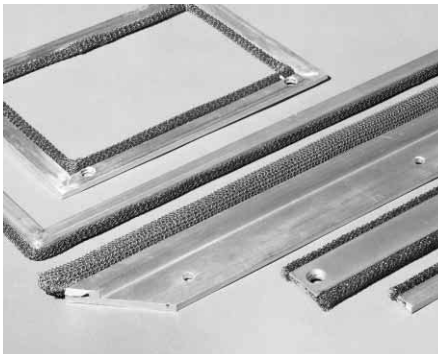
Frames can be supplied unfinished, chromate finished to MIL-C-5541, Class 3, or painted. Double-gasket versions feature a MESH STRIP gasket on both edges, or one MESH STRIP gasket and one environmental sealing gasket.

Note: These gaskets should generally not be used in salt spray or shipboard environments. Both monel and Ferrex mesh will cause galvanic corrosion of aluminum flanges. Silver-plated-aluminum filled elastomer gaskets are recommended on aluminum flanges in salt spray environments.

Standard Strips — With a maximum length of 8 feet (244 cm), Frame Gaskets are supplied in standard lengths of 7.5 feet (229 cm), and shipped straight in shipping tubes or boxes.

Fabricated Lengths — Select the style of frame required and submit a drawing indicating lengths required and location and diameter of holes.

Fabricated Frame Assemblies — Chomerics will fabricate ready-to-mount frame assemblies to customer specification. Select the frame style required. Referring to Figures 1a-c,

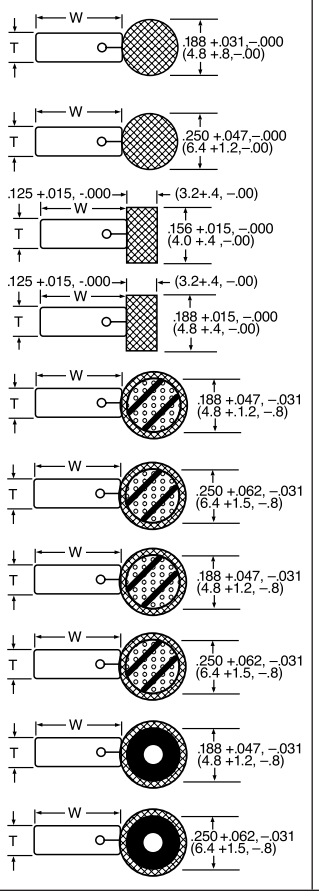
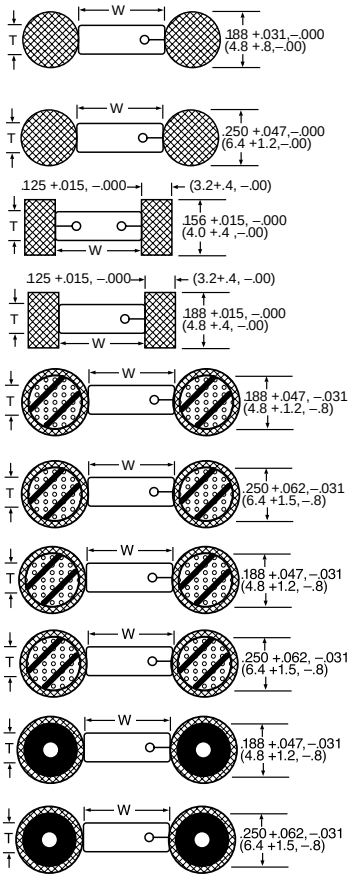


submit a drawing indicating dimensions, hole diameters, and hole locations. *Note:* Holes should not be specified in the jaw area that clamps over the gasket. .

For assistance in determining the most suitable conbination of frame and gasket for your application, consult Chomerics' Applications Engineering Department.

Table 1

EMI/EMP FRAME GASKETING

Dimensions (with Single EMI Gasket)*	Dimensions (with Double EMI Gasket)*	EMI Gasket Description (Monel or Ferrex)	Typical Sizes For Aluminum Extrusion Mounting Strip
		Round Mesh Strip 0.188 in. dia. Round Mesh Strip 0.250 in. dia. Rectangular Mesh Strip 0.156 in. high Rectangular Mesh Strip 0.188 in. high Mesh over Neoprene Sponge Core 0.188 in. dia. Mesh over Neoprene Sponge Core 0.250 in. dia. Mesh over Silicone Sponge Core 0.188 in. dia. Mesh over Silicone Sponge Core 0.250 in. dia. Mesh over Hollow Tube Silicone 0.188 in. dia. Mesh over Hollow Tube Silicone 0.250 in. dia.	**Thickness (T) / Width (W)** 0.093 (2.4) / 0.375 (9.5) 0.093 (2.4) / 0.437 (11.1) 0.125 (3.2) / 0.312 (8.2) 0.125 (3.2) / 0.375 (9.5) 0.125 (3.2) / 0.437 (11.1) 0.125 (3.2) / 0.500 (12.7) 0.125 (3.2) / 0.625 (15.9) 0.125 (3.2) / 0.750 (19.1) 0.125 (3.2) / 1.000 (25.4) 0.125 (3.2) / 1.125 (28.6) 0.125 (3.2) / 1.250 (31.8) *Part Numbers will be provided by Chomerics.* (mm dimensions in parentheses)

Note: Diameters given for mesh-over-elastomer gaskets apply only to the elastomer core. Outside diameters, including mesh covers, can be up to 0.031 in. (0.79 mm) greater.

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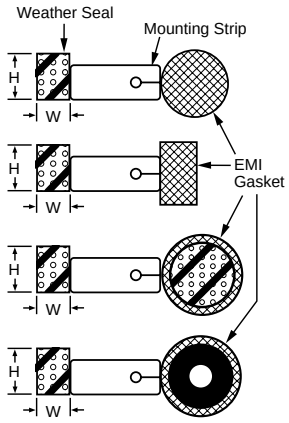
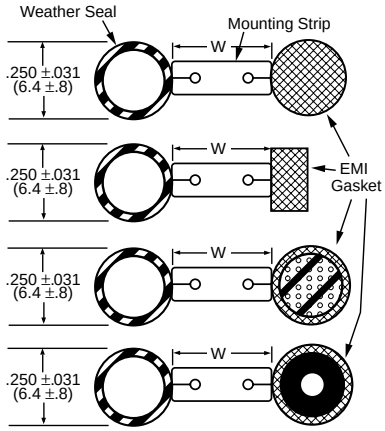
Parker Seals

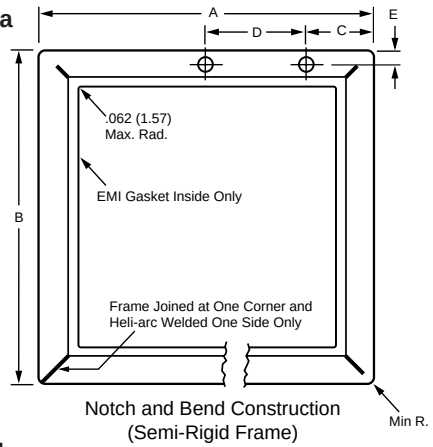
Table 2

SINGLE EMI/EMP FRAME GASKETING PLUS WEATHER SEAL	
Typical Cross Sections	**Typical Weather Seal Dimensions**
	**Neoprene or Silicone, *Sponge or Solid*** **Height (H) / Width (W)** *0.125 (3.2) / 0.125 (3.2) *0.125 (3.2) / 0.188 (4.8) 0.156 (4.0) / 0.125 (3.2) 0.188 (4.8) / 0.188 (4.8) 0.250 (6.4) / 0.188 (4.8) 0.250 (6.4) / 0.250 (6.4) **Aluminum Extrusions 0.093 (2.4 thick). All others 0.125 (3.2).* *Part Numbers will be provided by Chomerics.*
	**Solid Neoprene or Solid Silicone Tube Diameter:** 0.250 (6.4) *Used with Aluminum Extrusions 0.125 (3.2) thick, in the following widths:* 0.500 (12.7) 0.625 (15.9) 0.750 (19.1) 1.000 (25.4) 1.250 (31.8) *Part Numbers will be provided by Chomerics.*

Neoprene Weather Seal complies with MIL-R-6855, Class II, Grade 40.
Silicone Weather Seal complies with MIL-R-5847, Class II, Grade 40 and with ZZ-R-765.

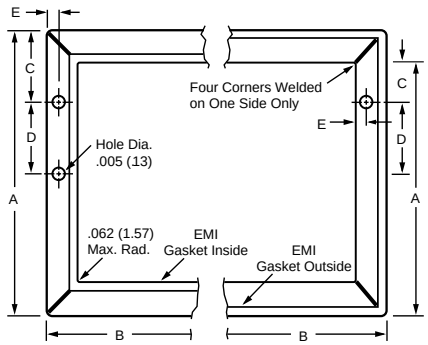
Figure 1 Fabricated Frame Assemblies

Fig.1a



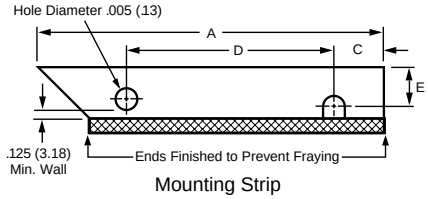
Notch and Bend Construction
(Semi-Rigid Frame)

Fig.1b



Four-Piece Construction
(Rigid Frame)

Fig.1c



Mounting Strip

Table 3

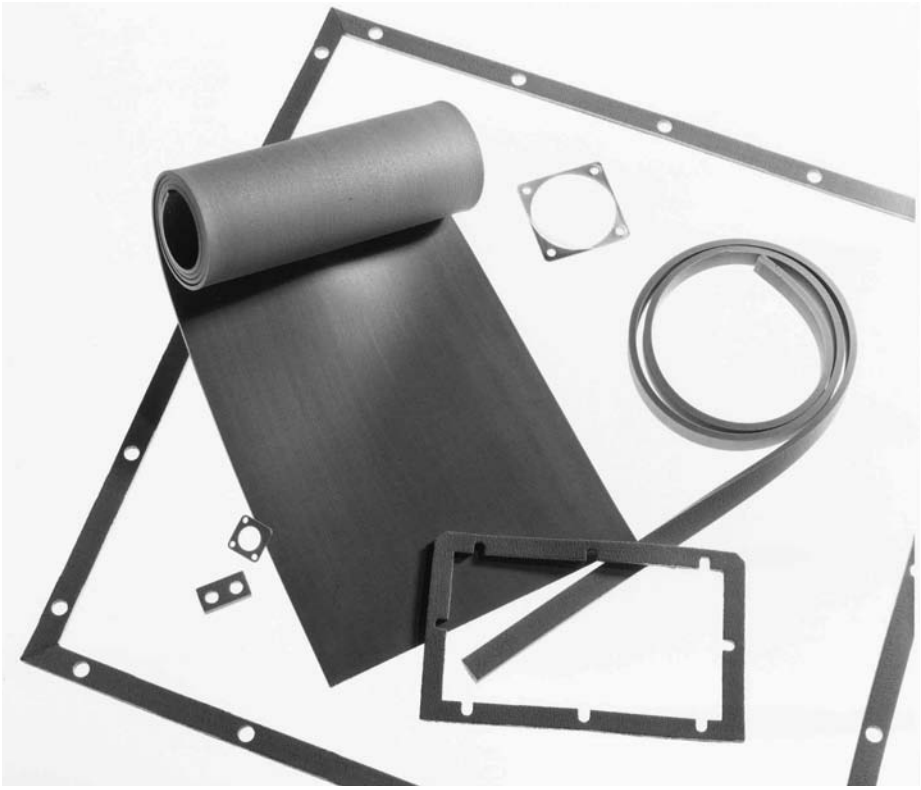
TOLERANCES FOR ALUMINUM EXTRUSION MOUNTING STRIP	
Width	**Tolerances**
<0.125 (3.18)	±0.006 (0.15)
0.125-0.249 (3.18-6.32)	±0.007 (0.18)
0.250-0.499 (6.35-12.67)	±0.008 (0.20)
0.500-0.749 (12.70-19.02)	±0.009 (0.23)
0.750-0.999 (19.05-25.37)	±0.010 (0.25)
1.0-1.499 (25.40-38.07)	±0.012 (0.30)

Table 4

TOLERANCES FOR DIMENSONS SHOWN IN FIGURES 1a-c				
Dim.	**0-12.0 (0-30.5 cm)**	**12.1-24.0 (30.8-61.0 cm)**	**24.1-36.0 (61.2-91.4 cm)**	**36.1-48.0 (91.7-121.9 cm)**
A & B	±0.020 (0.51)	±0.030 (0.76)	±0.047 (1.19)	±0.062 (1.57)
C, D, & E	±0.010 (0.25)	±0.015 (0.38)	±0.025 (0.63)	±0.030 (0.76)

(mm dimensions in parentheses)

POLASHEET®/POLASTRIP® Gasketing



POLASHEET and POLASTRIP Gasketing with Weather Seal

POLASHEET and POLASTRIP gasketing are composite EMI shielding and weather sealing materials. Either solid or sponge silicone may be specified as the weather seal.

In POLASHEET gasketing, individual monel or aluminum wires embedded in the silicone and oriented perpendicular to mating flange surfaces provide the EMI shielding. Wires are crimped for resiliency. Solid silicone POLASHEET gasketing is available with high-tack pressure-sensitive adhesive backing.

In POLASTRIP gasketing, EMI shielding is provided by monel or aluminum knitted wire mesh embedded in silicone.

POLASHEET and POLASTRIP gasketing with solid silicone weather seal are recommended for sealing under high pressure conditions. The silicone seal is rated for use at temperatures from –70°F (–56.7°C) to +500°F (+260°C). Sponge silicone is used only for pressures below 5 psi (0.03 MPa) and for rain, drip, dust and ventilating air seals.

For particularly severe pressure-sealing requirements, up to 250 psi (1.72 MPa), *COMBO*POLASTRIP® gasketing is available. In this configuration, the conductive paths are molded into only 0.250 in. (6.35 mm) of the width of the gasket.

POLASHEET materials are supplied in sheet form, from which custom gaskets can be readily cut. Even intricate gaskets can be cut with inexpensive rule dies, and custom gaskets can be factory-fabricated to customer specifications.

POLASTRIP gaskets are supplied in strip form or as finished custom gaskets fabricated from strips. For gaskets with overall dimensions less than 4.5 in. (114 mm), die-cut sheets are recommended rather than spliced strips.

Ordering Procedure

Standard Sheets and Strips: Select part number from Tables 2, 4 or 5. Standard widths for solid silicone sheets are 3.0 in. (76 mm), 4.5 in. (114 mm), 6.0 in. (152 mm) and 9 in. (229 mm) by 3 feet (91 cm) long. Widths of more than 9.0 in. are supplied as two or more widths bonded together.

Order quantities for strips should be multiples of 3 feet (91 cm) or 18 feet (5.48 m). Non-standard widths may be supplied as bonded sheets. Sponge silicone is available in standard 3.0 in. (76 mm) width by 3 feet (91 cm) length. POLA sponge is available in sheets. Contact Chomerics' Applications Engineering Department for more information.

Custom Gaskets: Provide a drawing and specify material part number from tables.

Table 1

SPECIFICATIONS

Elastomer: Solid silicone rubber per Fed. Spec. ZZ-R-765, Class 2B, Grade 40; or silicone sponge per AMS-3195. Color, gray.

Finished Product Specifications:

Tensile Strength, psi, min.	250	ASTM-D412
Elongation, % min.	200	ASTM-D412
Hardness, Shore A Durometer	35 ±5	ASTM-D2240
Tear Strength, lb/in. min.	45	ASTM-D624
Compression Set, max. %	20	ASTM-D395B
Wire Density, per sq. in.	900 ±15%	

Wire Data:

	Monel	Aluminum
Material	QQ-N-281	Alloy 5056 AMS-4182
Diameter	0.0045 in. (0.11 mm)	0.005 in. (0.13 mm)

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South America **TEL** +(55) 11 3917 1099 **FAX** +(55) 11 3917 0817
Parker Seals

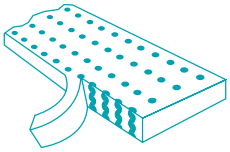

Table 2

POLASHEET COMPOSITE GASKETING			
Thickness	Width*	Solid Silicone with Monel**	Sponge Silicone with Monel**
		Part Number	
0.032 +0.010 –0.005 (0.813 +0.25 –0.13)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3003 07-0701-4503 07-0701-6003 07-0701-9003	– – – –
0.045 +0.010 –0.005 (1.143 +0.25 –0.13)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3004 07-0701-4504 07-0701-6004 07-0701-9004	– – – –
0.055 +0.010 –0.005 (1.40 +0.25 –0.13)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3005 07-0701-4505 07-0701-6005 07-0701-9005	– – – –
0.062 ±0.010 (1.57 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3006 07-0701-4506 07-0701-6006 07-0701-9006	– – – –
0.094 ±0.010 (2.38 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3009 07-0701-4509 07-0701-6009 07-0701-9009	07-0801-3009*** – – –
0.125 ±0.010 (3.18 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3012 07-0701-4512 07-0701-6012 07-0701-9012	07-0801-3012*** – – –
0.156 ±0.010 (3.96 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3015 07-0701-4515 07-0701-6015 07-0701-9015	– – – –
0.188 ±0.010 (4.75 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3018 07-0701-4518 07-0701-6018 07-0701-9018	07-0801-3018*** – – –
0.250 ±0.010 (6.35 ±0.25)	3.0 (76.20) 4.5 (114.30) 6.0 (152.40) 9.0 (228.60)	07-0701-3025 07-0701-4525 07-0701-6025 07-0701-9025	07-0801-3025*** – – –

*Solid silicone sheets available in 9.0 in. (229 mm) widths with no bonds.

**Monel is preferred. For aluminum, change 01 in 0701 or 0801 to 02.

***In these cases, 3.0 in. (76 mm) width is formed by bonding 1.0 in. (25.4 mm) wide strips. Each sheet has 2 bonds. For wider sheets without bonds, inquire–substantial minimum order requirements apply.

Note: Solid silicone POLASHEET is also available with pressure-sensitive adhesive backing. Add-77 to end of part number.

Table 3

POLASHEET DESIGN PARAMETERS	
A Dimensional Tolerances <10 (<254) 10 to 15 (254 to 381) >15 (>381)	 ±0.010 (0.25) ±0.020 (0.51) ±0.20% of Nom. Dim.
B Min. Width	0.125 (3.18)
C Min. Wall Thickness	0.080 (2.03)
D Min. Hole Diameter	0.060 (1.52)
E Slot	If min. wall thickness **C** cannot be accommodated, holes should be changed to slots.

(mm dimensions in parentheses)

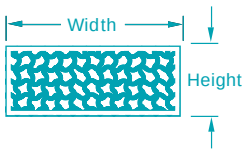

Table 4

(Tolerances shown on next page)

POLASTRIP GASKETING			
Height	Width	Solid Silicone with Monel*	Sponge Silicone with Monel*
		Part Number	
0.062 (1.57)	0.093 (2.36)	07-0101-0400	–
0.062 (1.57)	0.125 (3.18)	07-0101-0358	–
0.062 (1.57)	0.188 (4.78)	07-0101-0364	–
0.062 (1.57)	0.250 (6.35)	07-0101-0293	–
0.062 (1.57)	0.312 (7.92)	07-0101-0395	–
0.062 (1.57)	0.375 (9.53)	07-0101-0300	–
0.062 (1.57)	0.500 (12.70)	07-0101-0377	–
0.062 (1.57)	0.625 (15.88)	07-0101-0418	–
0.093 (2.36)	0.093 (2.36)	07-0101-0255	07-0201-0285
0.093 (2.36)	0.125 (3.18)	07-0101-0366	07-0201-0427
0.093 (2.36)	0.188 (4.78)	07-0101-0312	07-0201-0311
0.093 (2.36)	0.250 (6.35)	07-0101-0230	07-0201-0508
0.093 (2.36)	0.312 (7.92)	07-0101-0598	07-0201-0607
0.093 (2.36)	0.375 (9.53)	07-0101-0426	07-0201-0608
0.093 (2.36)	0.500 (12.70)	07-0101-0257	07-0201-0237
0.093 (2.36)	0.625 (15.88)	07-0101-0370	07-0201-0243
0.125 (3.18)	0.125 (3.18)	07-0101-0004	07-0201-0032
0.125 (3.18)	0.188 (4.78)	07-0101-0020	07-0201-0034
0.125 (3.18)	0.250 (6.35)	07-0101-0010	07-0201-0013
0.125 (3.18)	0.312 (7.92)	07-0101-0024	07-0201-0040
0.125 (3.18)	0.375 (9.53)	07-0101-0028	07-0201-0044
0.125 (3.18)	0.500 (12.70)	07-0101-0088	07-0201-0090
0.125 (3.18)	0.625 (15.88)	07-0101-0152	07-0201-0158
0.156 (3.96)	0.125 (3.18)	07-0101-0096	07-0201-0097
0.188 (4.78)	0.125 (3.18)	07-0101-0019	07-0201-0033
0.188 (4.78)	0.188 (4.78)	07-0101-0011	07-0201-0014
0.188 (4.78)	0.250 (6.35)	07-0101-0021	07-0201-0037
0.188 (4.78)	0.312 (7.92)	07-0101-0025	07-0201-0041
0.188 (4.78)	0.375 (9.53)	07-0101-0120	07-0201-0121
0.188 (4.78)	0.500 (12.70)	07-0101-0089	07-0201-0091
0.188 (4.78)	0.625 (15.88)	07-0101-0153	07-0201-0159
0.250 (6.35)	0.125 (3.18)	07-0101-0100	07-0201-0101
0.250 (6.35)	0.188 (4.78)	07-0101-0017	07-0201-0035
0.250 (6.35)	0.250 (6.35)	07-0101-0003	07-0201-0012
0.250 (6.35)	0.312 (7.92)	07-0101-0026	07-0201-0042
0.250 (6.35)	0.375 (9.53)	07-0101-0029	07-0201-0045
0.250 (6.35)	0.500 (12.70)	07-0101-0031	07-0201-0015
0.250 (6.35)	0.625 (15.88)	07-0101-0154	07-0201-0160
0.312 (7.92)	0.188 (4.78)	07-0101-0016	07-0201-0036
0.312 (7.92)	0.250 (6.35)	07-0101-0022	07-0201-0038
0.312 (7.92)	0.312 (7.92)	07-0101-0027	07-0201-0043
0.312 (7.92)	0.375 (9.53)	07-0101-0124	07-0201-0125
0.312 (7.92)	0.500 (12.70)	07-0101-0136	07-0201-0137

*Monel is preferred but aluminum is also available on special order. Contact Chomerics for part numbers.

(For tolerances, see table at left.)

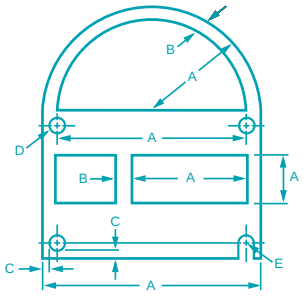

Figure 1 Dimensions for POLASHEET Die-Cut Gaskets

continued

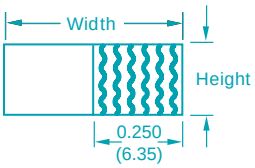

Table 5

COMBO POLASTRIP GASKETING			
Height	**Width**	**Solid Silicone with Monel**	**Sponge Silicone with Monel**
Part Number			
0.062 (1.57)	0.500 (12.70)	07-0101-0256	–
0.062 (1.57)	0.625 (15.88)	07-0101-0259	–
0.062 (1.57)	0.750 (19.05)	07-0101-0260	–
0.093 (2.36)	0.500 (12.70)	07-0101-0298	07-0201-0552
0.093 (2.36)	0.625 (15.88)	07-0101-0545	07-0201-0553
0.093 (2.36)	0.750 (19.05)	07-0101-0547	07-0201-0555
0.125 (3.18)	0.500 (12.70)	07-0101-0177	07-0201-0188
0.125 (3.18)	0.625 (15.88)	07-0101-0178	07-0201-0189
0.125 (3.18)	0.750 (19.05)	07-0101-0179	07-0201-0190
0.188 (4.78)	0.500 (12.70)	07-0101-0181	07-0201-0192
0.188 (4.78)	0.625 (15.88)	07-0101-0182	07-0201-0193
0.188 (4.78)	0.750 (19.05)	07-0101-0183	07-0201-0194
0.250 (6.35)	0.500 (12.70)	07-0101-0184	07-0201-0195
0.250 (6.35)	0.625 (15.88)	07-0101-0185	07-0201-0196
0.250 (6.35)	0.750 (19.05)	07-0101-0186	07-0201-0197

Table 6

TOLERANCES FOR FABRICATED GASKET DIMENSIONS IN FIGURE 2			
Dimensions	**0-12.0 (0-30 cm)**	**12.1-24.0 (31-61cm)**	**24.1-36.0 (61-91 cm)**
A, B	±0.03 (±0.76)	±0.06 (±1.52)	±0.12 (±3.05)
C	(Width) See Tables 4, 5 and 7.		
D	±0.02 (±0.51)	±0.02 (±0.51)	±0.02 (±0.51)
E, F, G, H, J, K	±0.02 (±0.51)	±0.04 (±1.02)	±0.06 (±1.52)
L	±0.02 (±0.51)	±0.02 (±0.51)	±0.02 (±0.51)
T	(Height) See Tables 4, 5 and 7.		

Notes:

1. Joint bonded with RTV silicone adhesive.
2. When B dim. is less than 4.5 inches (113 mm), POLASHEET, rather than POLASTRIP, gasketIng may be used.
3. Die-cut gaskets should be inspected for dimensional compliance in a restrained condition.

Table 7

POLASTRIP AND COMBO POLASTRIP GASKETING TOLERANCES				
Sizes	**Solid Silicone**		**Sponge Silicone**	
	Height	**Width**	**Height**	**Width**
0.125 to 0.250 (3.18 to 6.35)	±0.010 (±0.25)	±0.015 (±0.38)	±0.015 (±0.38)	±0.031 (±0.79)
0.251 to 0.375 (6.38 to 9.53)	±0.015 (±0.38)	±0.031 (±0.79)	±0.015 (±0.38)	±0.031 (±0.79)
0.376 to 1.00 (9.55 to 25.4)	+0.030, –0.015 (+0.79, –0.38)	±0.031 (±0.79)	±0.031 (±0.79)	±0.046 (±1.17)

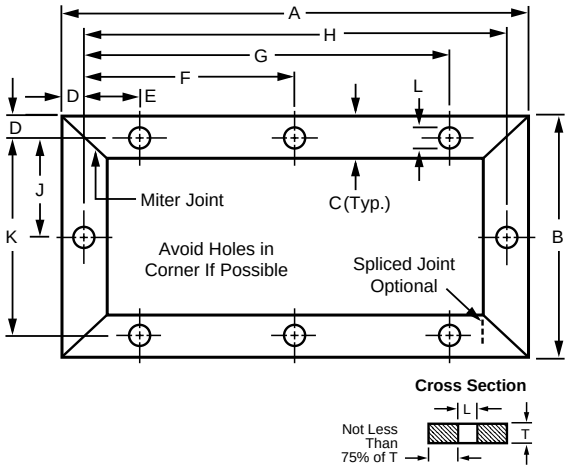

Figure 2 Dimensions and Tolerances for POLASTRIP and *COMBO*POLASTRIP Fabricated Gaskets

(mm dimensions in parentheses)

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Parker Seals

METALASTIC® & PORCUPINE METALASTIC® Gasket

METALASTIC EMI Gasketing with Pressure Seal

Chomerics' METALASTIC gasketing is a composite EMI and pressure seal in thin sheet form. Shielding is provided by woven aluminum mesh, and pressure sealing is achieved by neoprene or silicone elastomer impregnated in the mesh.

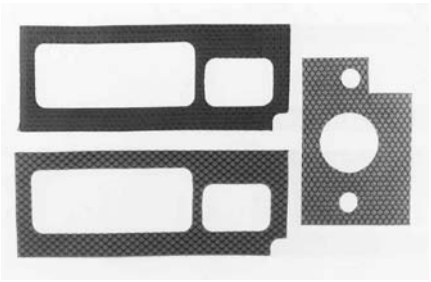
METALASTIC gasketing is intended for use only in applications in which joint unevenness is less than 0.002 in. (0.05 mm), and/or where space is severely limited. The material can be cut easily into gaskets of intricate shape, and is available with a minimum nominal thickness of 0.016 in. (0.40 mm). These gaskets are not intended to be re-used after joints are opened.

Table 1

METALASTIC GASKET TOLERANCES	
Dimensions	**Tolerances**
A 0-4.00 (0-102) over 4.00 (over 102)	±0.015 (±0.38) ±0.03 (±0.76)
B Min. Width	0.125 (3.18)
C Min. Wall Thickness	0.080 (2.03)
D Min. Diameter	0.080 (2.03)
E Slot	If min. wall thickness **C** cannot be accommodated, holes should be changed to slots.

Table 2

METALASTIC SHEETS			
Thickness	**Width**	**Elastomer**	**Part No.**
0.016 ±0.004 (0.40 ±0.10)	8.00 +0.25 −0.00 (203 +6.35 −0.00)	Silicone	04-0502
0.020 ±0.004 (0.51 ±0.10)		Neoprene	04-0202
0.020 ±0.004 (0.51 ±0.10)		Silicone	04-0102



PORCUPINE METALASTIC EMI Gasketing with Pressure Seal

PORCUPINE METALASTIC is available in two forms: EMI shielding with pressure seal and EMI shielding only. Shielding is provided by severely expanded monel foil. For composite shielding and pressure sealing, the expanded monel is filled with a silicone elastomer.

The material gains its excellent compressibility from very uniform thickness. The expanded monel provides dozens of contact points per square inch of surface area, assuring moderate shielding effectiveness.

Table 3

PORCUPINE METALASTIC GASKET TOLERANCES	
Dimensions	**Tolerances**
A 0-4.00 (0-102) over 4.00 (over 102)	±0.015 (±0.38) ±0.03 (±0.76)
B Min. Width	0.140 (3.56)
C Min. Wall Thickness	0.090 (2.28)
D Min. Hole Diameter	0.060 (1.52)
E Slot	If min. wall thickness **C** cannot be accommodated, holes should be changed to slots.

Table 4

PORCUPINE METALASTIC SHEETS				
Thickness	**Material**	**Filled**	**Width**	**Part No.**
0.020 ±0.004 (0.51 ±0.10)	Monel	No	12.0 ±0.25 (305 ±6.35)	08-0601
0.020 ±0.004 (0.51 ±0.10)	Monel	Yes	12.0 ±0.25 (305 ±6.35)	08-0201
0.030 ±0.004 (0.76 ±0.10)	Monel	No	12.0 ±0.25 (305 ±6.35)	08-0501
0.030 ±0.004 (0.76 ±0.10)	Monel	Yes	12.0 ±0.25 (305 ±6.35)	08-0101

PORCUPINE METALASTIC gasketing is intended for applications in which joint unevenness is less than 0.003 in. (0.08 mm) and where the gasket must be less than 4 x 6 in. (102 x 152 mm). These gaskets are not intended to be re-used after joints are opened.

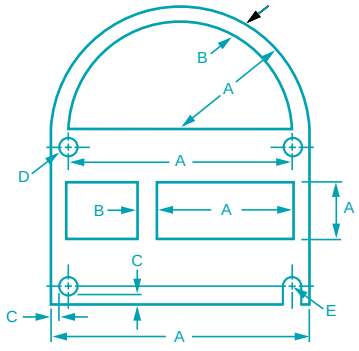
Ordering Information

Sheet gasketing: Order by part number from Table 2 or 4. All METALASTIC sheets are 8.0 in. (20.32 cm) wide, and PORCUPINE METALASTIC sheets are 12 in. (30.4 cm) wide. Both are supplied in continuous lengths.

Custom die-cut gaskets: Specify material from the table by part number and submit a drawing. For gaskets exceeding standard width, a miter or dovetail joint is recommended.

For additional assistance, contact Chomerics' Applications Engineering Department.

Figure 1 Dimensions for METALASTIC and PORCUPINE METALASTIC Die-Cut Gaskets



(For tolerances, see tables at left.)

(mm dimensions in parentheses)

Connector Gaskets

Connector Gaskets

Chomerics metal-based connector gaskets are die-cut from several sheet materials which suit various EMI shielding and pressure sealing requirements. They are available in sizes for all standard AN Series Connectors, as well as for RF types, JT, PT & PC, SO, SP and Bendix Connectors. Although these materials provide effective EMI shielding performance upon initial installation, they should be replaced if joints are opened and re-closed.

EMI shielding is provided by oriented or expanded monel, or aluminum wire. Pressure sealing is provided by silicone or neoprene elastomer. POLASHEET gaskets (page 118) are available with adhesive backing for quick mounting on one of the mating surfaces.

Materials and Construction

Gaskets are cut from the materials listed below, in sizes ranging from 0.688 in. (17.48 mm) to 3.25 in. (82.55 mm) square to fit connector shell sizes 6 to 48. Fastener holes are provided at each corner for mounting (slots in silicone-filled METALASTIC gaskets). The materials are described in detail on the previous pages.

POLASHEET® Gaskets: Perpendicular monel wire in solid silicone, 0.062 in. (1.57 mm) thick. Compensates for 0.008 in. (0.20 mm) joint unevenness. Excellent EMI shielding and pressure sealing. Available with pressure-sensitive adhesive backing.

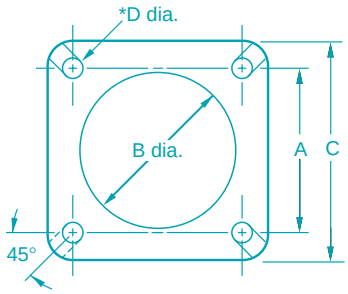
METALASTIC® Gaskets: Silicone or neoprene-filled aluminum mesh, 0.020 in. (0.51 mm) thick. Recommended where space is tight. Compensates for no more than 0.002 in. (0.05 mm) joint unevenness. *Note: Use silicone for temperatures to 500°F (260°C).*

PORCUPINE METALASTIC® Gaskets: Severely expanded monel, silicone-filled, 0.030 in. (0.76 mm) thick. Compensates for only 0.005 in. (0.127 mm) joint unevenness. Best for breaking through non-conductive surface films.

Ordering Information

Standard Connector Gaskets: Select the part number from Tables 1 or 2.

RF (BNC, BN, UHF, etc.), or Bendix Series SP Gaskets: Contact Chomerics' Sales Department.



* For silicone-filled METALASTIC, holes may become slots.

Table 1

STANDARD GASKETS FOR AN, HT & OWL, MIL-C-5015, MS-3102 CONNECTORS								
Shell Size	Dimensions in (mm)				PORCUPINE METALASTIC	POLASHEET *	METALASTIC	
	A	B	C	D			Neoprene	Silicone
8	0.594 (15.09)	0.500 (12.70)	0.875 (22.23)	0.172 (4.37)	08-0301-0062	07-0501-0008	04-0402-0008	04-0302-2495
10	0.719 (18.26)	0.625 (15.88)	1.000 (25.40)	0.172 (4.37)	08-0301-0063	07-0501-0010	04-0402-0010	04-0302-2371
12	0.813 (20.65)	0.750 (19.05)	1.094 (27.79)	0.172 (4.37)	08-0301-0064	07-0501-0012	04-0402-0012	04-0302-2470
14	0.906 (23.01)	0.875 (22.23)	1.188 (30.16)	0.172 (4.37)	08-0301-0065	07-0501-0014	04-0402-0014	04-0302-2483
16	0.969 (24.61)	1.000 (25.40)	1.281 (32.54)	0.172 (4.37)	08-0301-0066	07-0501-0016	04-0402-0016	04-0302-2488
18	1.063 (27.00)	1.125 (28.56)	1.375 (34.93)	0.203 (5.15)	08-0301-0067	07-0501-0018	04-0402-0018	04-0302-2489
20	1.156 (29.36)	1.250 (31.75)	1.500 (38.10)	0.203 (5.15)	08-0301-0068	07-0501-0020	04-0402-0020	04-0302-2484
22	1.250 (31.75)	1.375 (34.93)	1.625 (41.28)	0.203 (5.15)	08-0301-0069	07-0501-0022	04-0402-0022	04-0302-2485
24	1.375 (34.93)	1.500 (38.10)	1.750 (44.45)	0.203 (5.15)	08-0301-0070	07-0501-0024	04-0402-0024	04-0302-2490
28	1.563 (39.70)	1.750 (44.45)	2.000 (50.80)	0.203 (5.15)	08-0301-0071	07-0501-0028	04-0402-0028	04-0302-2491
32	1.750 (44.45)	2.000 (50.80)	2.250 (57.15)	0.219 (5.56)	08-0301-0072	07-0501-0032	04-0402-0032	04-0302-2492
36	1.938 (49.23)	2.188 (55.58)	2.500 (63.50)	0.219 (5.56)	08-0301-0073	07-0501-0036	04-0402-0036	04-0302-2493
40	2.188 (55.58)	2.438 (61.93)	2.750 (69.85)	0.219 (5.56)	08-0301-0074	07-0501-0040	04-0402-0040	04-0302-2494
44	2.375 (60.33)	2.781 (70.64)	3.000 (76.20)	0.219 (5.56)	08-0301-0075	07-0501-0044	04-0402-0044	04-0302-2599
48	2.625 (66.68)	3.031 (76.99)	3.250 (82.55)	0.219 (5.56)	08-0301-0076	07-0501-0048	04-0402-0048	

*For pressure-sensitive adhesive backing on POLASHEET gaskets, add -77 to Part Number

Table 2

STANDARD GASKETS FOR JT, PT & PC, MIL-C-26482, MS-3110, MS-3112, MS-3119, MS-3120 CONNECTORS								
Shell Size	Dimensions in (mm)				PORCUPINE METALASTIC	POLASHEET*	METALASTIC	
	A	B	C	D			Neoprene	Silicone
6	0.469 (11.91)	0.375 (9.53)	0.688 (17.48)	0.130 (3.30)	08-0301-0123	07-0501-0060	04-0402-0206	04-0302-0406
8	0.594 (15.09)	0.500 (12.70)	0.812 (20.62)	0.130 (3.30)	08-0301-0124	07-0501-0061	04-0402-0208	04-0302-0408
10	0.719 (18.26)	0.625 (15.88)	0.938 (23.83)	0.130 (3.30)	08-0301-0125	07-0501-0062	04-0402-0210	04-0302-0410
12	0.813 (20.65)	0.750 (19.05)	1.031 (26.19)	0.130 (3.30)	08-0301-0126	07-0501-0063	04-0402-0212	04-0302-0412
14	0.906 (23.01)	0.875 (22.23)	1.125 (28.56)	0.130 (3.30)	08-0301-0127	07-0501-0064	04-0402-0214	04-0302-0414
16	0.969 (24.61)	1.000 (25.40)	1.219 (30.96)	0.130 (3.30)	08-0301-0128	07-0501-0065	04-0402-0216	04-0302-0416
18	1.063 (27.00)	1.125 (28.56)	1.312 (33.32)	0.130 (3.30)	08-0301-0129	07-0501-0066	04-0402-0218	04-0302-0418
20	1.156 (29.36)	1.250 (31.75)	1.438 (36.53)	0.130 (3.30)	08-0301-0130	07-0501-0067	04-0402-0220	04-0302-0420
22	1.250 (31.75)	1.375 (34.93)	1.563 (39.70)	0.130 (3.30)	08-0301-0131	07-0501-0068	04-0402-0222	04-0302-0422
24	1.375 (34.93)	1.500 (38.10)	1.688 (42.88)	0.156 (3.96)	08-0301-0132	07-0501-0069	04-0402-0224	

*For pressure-sensitive adhesive backing on POLASHEET gaskets, add -77 to Part Number .

(mm dimensions in parentheses)

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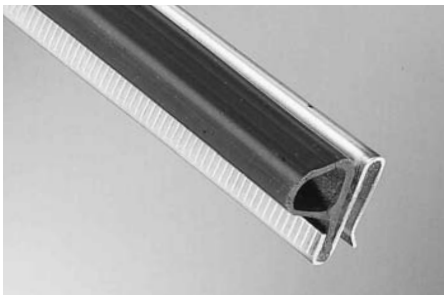
METALKLIP® Clip-On EMI Gasket



METALKLIP Clip-On EMI Gasket

Chomerics' METALKLIP gasketing is a simple, quick means of mounting an EMI gasket onto 15-20 gauge sheet metal enclosure doors or frames. EMI shielding is provided by either a carbon-filled silicone strip or by monel (nickel-copper alloy) over silicone strip. A non-standard alternative is Ferrex* wire over neoprene. The gasket is secured in a corrosion-resistant, stainless steel spring clip. No holes or fasteners are required for installation. Integral sharp teeth on the clip bite through paint or surface oxides to provide electrical continuity from gasket to chassis.

Material Selection

A variety of EMI gasket materials are available to accommodate a full range of EMI shielding performance requirements. Standard choices include a carbon-filled silicone P-strip or finned monel mesh (nickel-copper alloy) over hollow silicone tubing.

For added speed and convenience, use of Chomerics' CHO-MASK® II EMI foil tape with peel-off mask eliminates the necessity to plate the cabinet before painting (see page 144). When the mask is removed following painting, the conductive foil tape below becomes the mating surface for the METALKLIP gasket.

Ordering Procedure

Standard 8-foot (244 cm) lengths: Order by part number from Table 2.

Custom lengths or materials: Custom lengths and/or finished lengths are available. Chomerics also provides a flat strip stainless steel for mechanical attachment. Contact Chomerics' Inside Sales Department with details and a custom part number will be assigned.

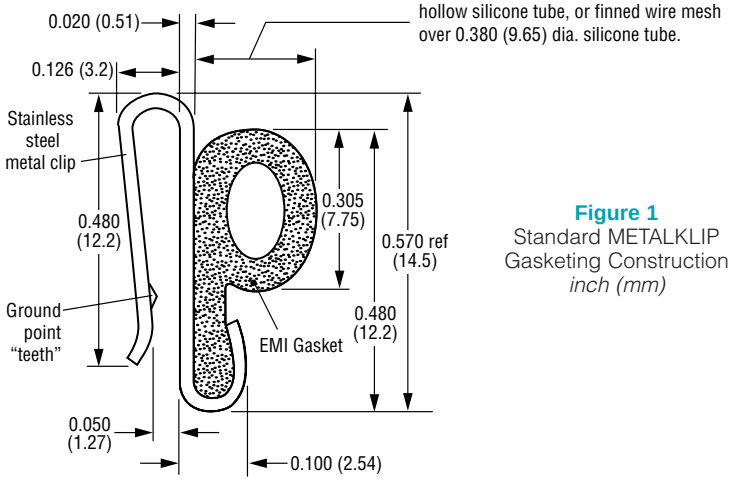


Figure 1
Standard METALKLIP Gasketing Construction
inch (mm)

Table 1

SPECIFICATIONS		
Carbon-Filled Silicone	**Value**	**Test Method**
Hardness (Shore A ±5)	65	ASTM D2240
Resistivity (ohm)	10 max.	ASTM D991
Tensile Strength psi (MPa), min.	400 (2.76)	ASTM D412
Elongation (percent)	150 min.	ASTM D412
Tear Strength lb/in (kN/m), min.	50 (8.76)	ASTM D624
Specific Gravity	1.30 ±.03	ASTM D1418
Temperature Range, °F (°C)	–67 to 400 (–55 to 200)	—
Color	Black	—
Mesh Over Core		
Monel Wire	0.0035 in. (0.09 mm) diameter per QQ-N-281, 2 layers.	
Silicone Tube	ZZ-R-765	
Clip	Stainless steel, 0.02 in. (0.51 mm) thick, series 302/304.	

Table 2

METALKLIP GASKETS		
Core Dia.	**Wire**	**Part No.**
0.340 (8.64) Carbon-silicone	—	17-0301-0008-34
0.380 (9.65) Silicone tube	Monel	17-0303-0108-37

* Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

For complete information, request Technical Bulletin Number **165**.

WARNING: ***Handle with care. METALKLIP edges when cut are sharp and can cause lacerations or puncture wounds.***

(mm dimensions in parentheses)

Performance Data

COMPRESSION-DEFLECTION

The deflection of knitted wire mesh strips under various compressive loads is a function of size, shape, and wire material.

Figures 1-7 provide typical compression-deflection data for common sizes and shapes in both monel and Ferrex materials. Figure 7 applies to monel mesh over a neoprene sponge core.

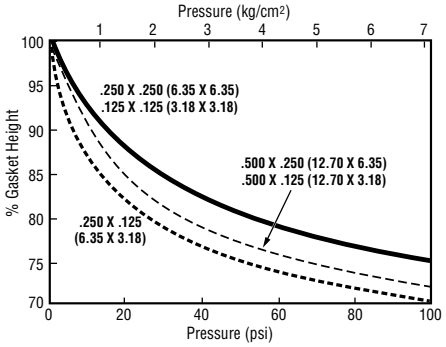


Figure 1 Compression vs. Pressure for MESH STRIP Gasketing

Dimensions are W x H in inches and (mm).

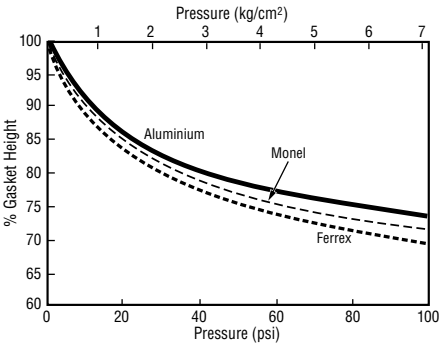


Figure 2 Compression vs. Pressure for MESH STRIP Gasketing with Cross Section of 0.250 in. (6.35 mm) x 0.125 in. (3.18 mm)

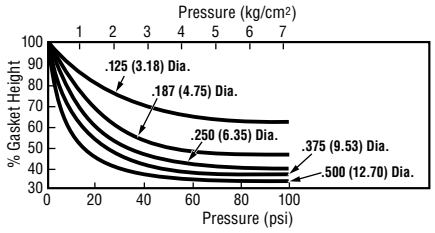


Figure 3 Compression vs. Pressure for Monel Round MESH STRIP Gasketing

Dimensions are inches and (mm).

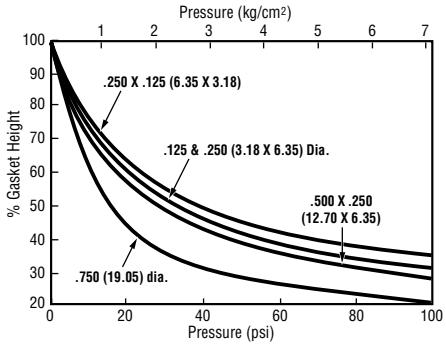


Figure 4 Compression vs. Pressure for MESH STRIP Gasketing with Neoprene Sponge Core and Two Layers of Monel Mesh

Dimensions are Dia. or W x H in inches and (mm).

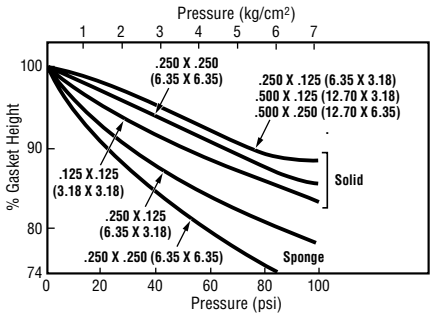


Figure 5 Compression vs. Pressure for POLASTRIP Gasketing

Dimensions are W x H in inches and (mm).

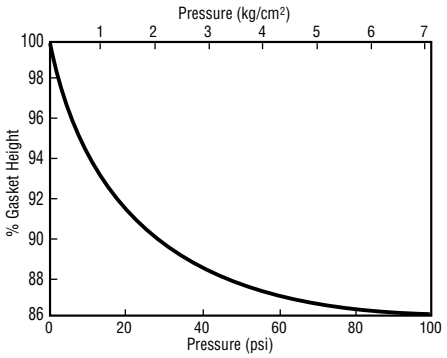


Figure 6 Compression vs. Pressure for METALASTIC Gasketing

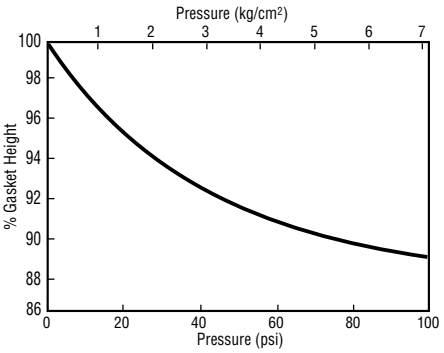


Figure 7 Compression vs. Pressure for PORCUPINE METALASTIC Gasketing

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SHIELDING EFFECTIVENESS

Figures 8-11 show the shielding effectiveness of mesh, METALASTIC and POLA gasket materials, measured per MIL-STD-285, with a 12 x12 inch (305 x 305 mm) aperture in a rigid enclosure wall. Shielding effectiveness is expressed as the difference between an open-field reference measurement and a measurement with antennas placed on each side of the covered gasketed aperture. Figure 12 shows typical shielding effectiveness of METALKLIP clip-on gaskets.

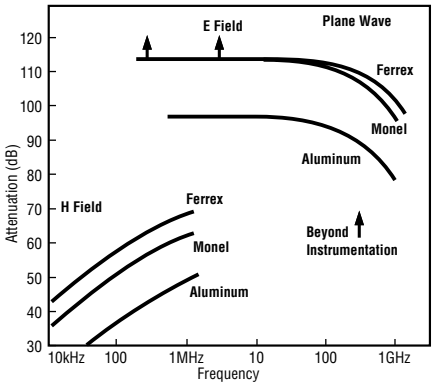

Figure 8 Shielding Effectiveness of Mesh Gaskets

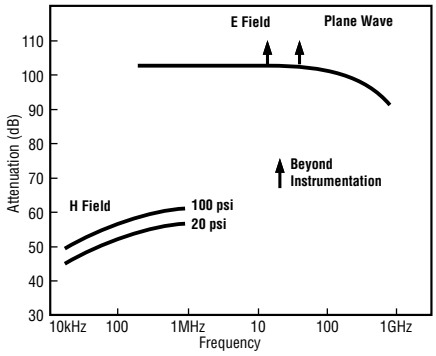

Figure 9 Shielding Effectiveness of POLA Gaskets (solid)

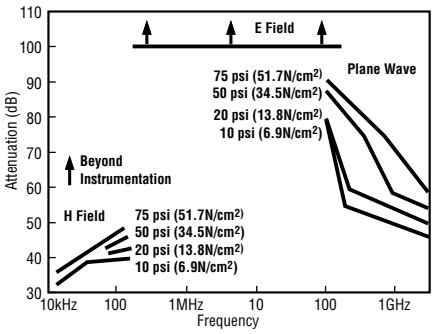

Figure 10 Shielding Effectiveness of METALASTIC Gaskets

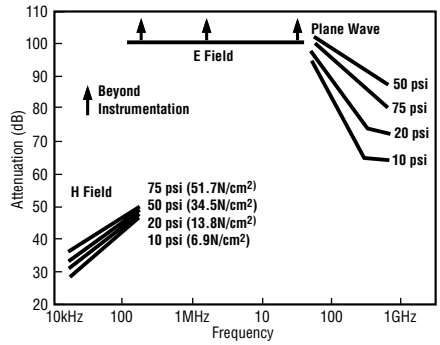

Figure 11 Shielding Effectiveness of PORCUPINE METALASTIC Gaskets

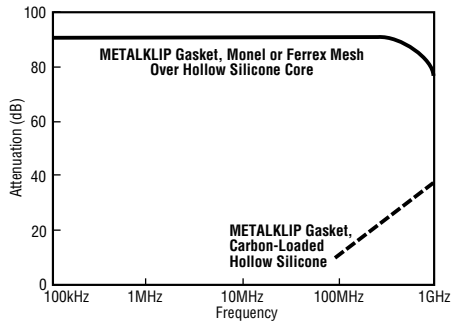

Figure 12 Shielding Effectiveness of METALKLIP Clip-On Gasketing

EMP SURVIVABILITY

In order for an enclosure to continue providing EMI isolation during and after an EMP environment, the conductive gaskets at joints and seams must be capable of carrying EMP-induced current pulses. Figure 13 shows the EMP current response of various metal mesh gasket materials.

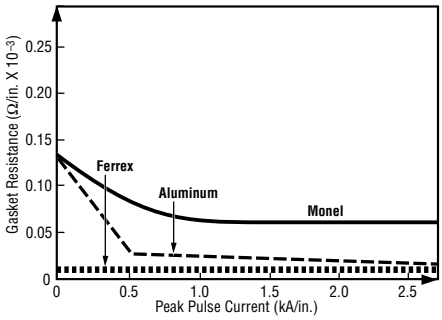

Figure 13 EMP Current Response of Mesh Gaskets

Unit Conversion Note:
Gasket Resistance, 1 mΩ/in. = 25.4 Ω/mm
Peak Pulse Current, 1 kA/in. = 25.4 kA/mm

SPRING-LINE® Beryllium-Copper Gaskets

SPRING-LINE Beryllium-Copper Gaskets

SPRING-LINE beryllium-copper gaskets combine high levels of EMI shielding effectiveness with spring-finger wiping and low closure force properties. The high performance qualities of beryllium-copper – high tensile strength, excellent anti-corrosion properties, and superb electrical conductivity – make it an ideal material for EMI shielding over a broad frequency range.

SPRING-LINE shielding gaskets are available in bright tin, bright copper, and bright nickel finishes, and others upon request. Strips can be soft soldered or resistance welded without damage to their working surface. SPRING-LINE gaskets can be applied by edge mounting using integral clips, or by high tack, pressure-sensitive adhesive (provided on some versions).

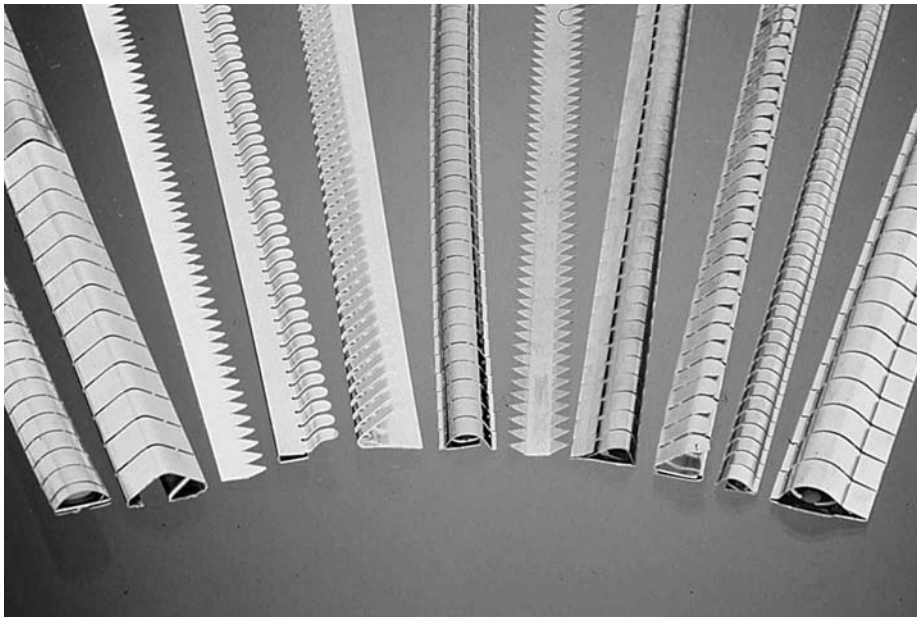

Table 1

MATERIAL SPECIFICATIONS – BERYLLIUM-COPPER ALLOY 25 AND PSA TAPE		
Chemical Composition	**Mechanical and Electrical Properties**	**Pressure-Sensitive Adhesive Tape**
Beryllium . . . . . 1.8-2.0% Cobalt plus Nickel . . . . 0.20% min. Cobalt plus Nickel plus Iron . . . . 0.60% max. Copper . . . . . Balance General plating thickness . . . . . 2 to 6 microns approx. (excluding exotic metals)	Tensile strength . . . . . 175 ksi min. Yield strength . . . . . 150 ksi min. Hardness . . . . . Rockwell C38-44	Acrylic adhesive Service temperature range –55 to 230°C (–67 to 450°F) 48 hour cure time with high peel and shear strength High resistance to solvents Minimum 12-month PSA shelf life

Table 2

PLATING FINISH	RECOMMENDED MATING AND MOUNTING SURFACES
Bright Copper	Brass, Copper, Nickel-Copper Alloys, Monel, Stainless Steel, Silver
Bright Nickel (QQ-N-290)	Brass, Cadmium, Carbon Steel, Copper, Iron, Nickel, Stainless Steel, Tin
Bright Tin (MIL-T-10727)	Aluminum, Aluminum Alloys, Beryllium, Cadmium, Carbon Steel, Chromium, Nickel, Tin, Zinc

Ordering Procedure

Standard SPRING-LINE gasket configurations are illustrated on the following six pages. Gaskets are supplied in 16 inch (40.6 cm) lengths, with the exception of configurations 11832 and 11833, which are supplied in 15 inch (38.1 cm) lengths. Strips can also be pre-cut to custom lengths. Use the following example for constructing SPRING-LINE gasket part numbers.

Example: **81-02-11816-XXXX**

81 – designates Chomerics' SPRING-LINE product line

02 – designates PSA mounting tape (01 designates no PSA tape)

11816 – designates the specific gasket configuration

XXXX – designates choice of plating finish:

- **2000** = clean and bright (unplated)
- **3000** = zinc plate per ASTM-B633, with clear chromate (color optional)
- **4000** = bright nickel
- **5000** = bright tin
- **6000** = electroless nickel per MIL-C-26074, Class 1

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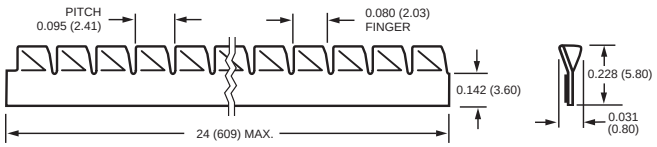
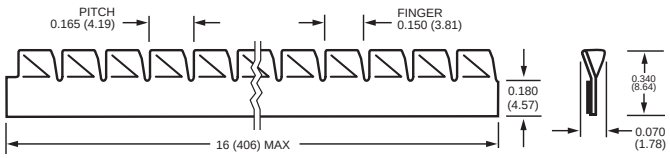
TWIST SERIES

PART NO. 81-02-11818-XXXX



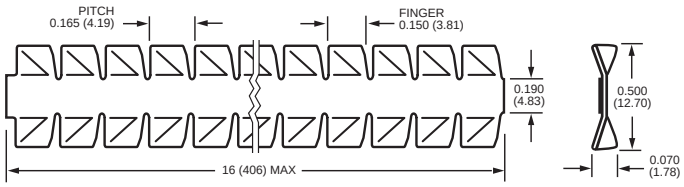
MTL THICKNESS 0.003 (0.076)

PART NO. 81-02-11817-XXXX



MTL THICKNESS 0.003 (0.076)

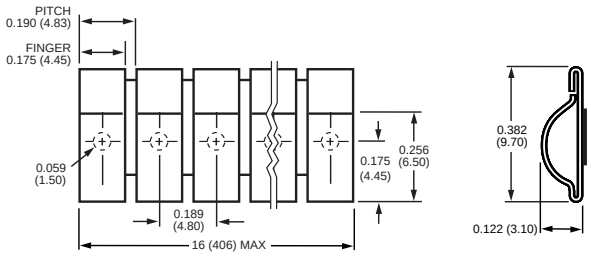
PART NO. 81-02-11816-XXXX



MTL THICKNESS 0.003 (0.076)

FOLD OVER

PART NO. 81-02-11838-XXXX



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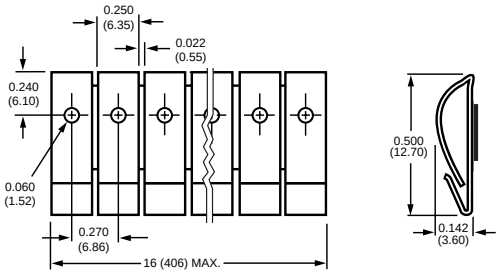
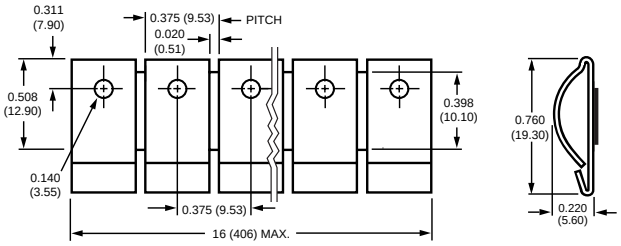
PART NO. 81-02-11837-XXXX



MTL THICKNESS 0.003 (0.076)

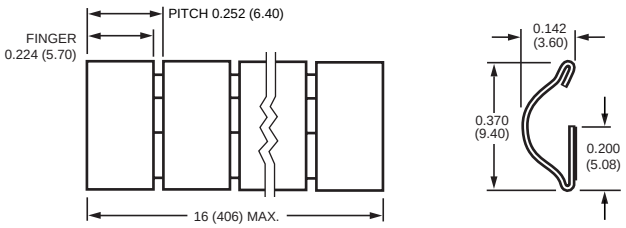
PART NO. 81-02-11836-XXXX



MTL THICKNESS 0.003 (0.076)

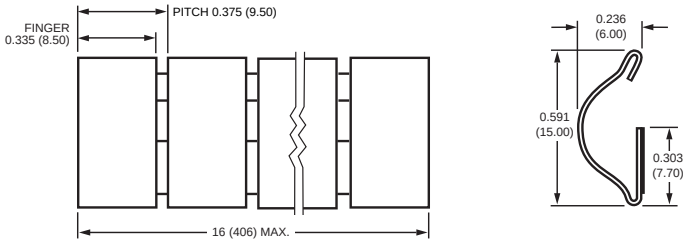
NO SNAG

PART NO. 81-02-11822-XXXX



MTL THICKNESS 0.003 (0.076)

PART NO. 81-02-11821-XXXX



MTL THICKNESS 0.004 (0.100)

Note: *Tool Diameter (0.075 in.) located under PSA*

All dimensions are nominal. For applications where tolerances are critical, contact Chomerics' Applications Engineering Dept.

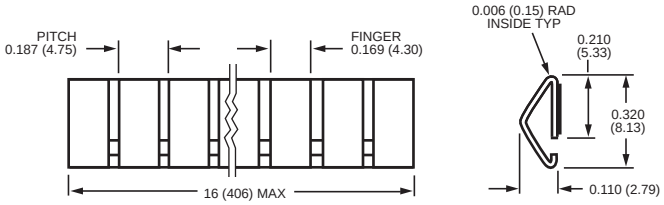
Additional configurations are available. Request information.

continued

(mm dimensions in parentheses)

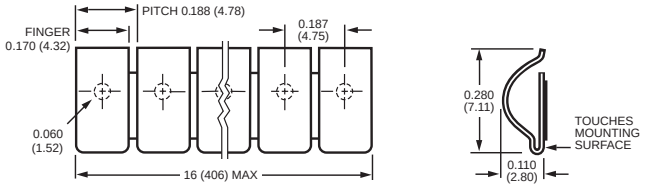
ALL PURPOSE

PART NO. 81-02-11819-XXXX



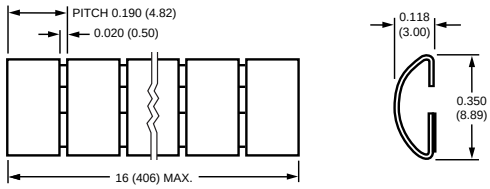
MTL THICKNESS 0.004 (0.100)

PART NO. 81-02-11826-XXXX



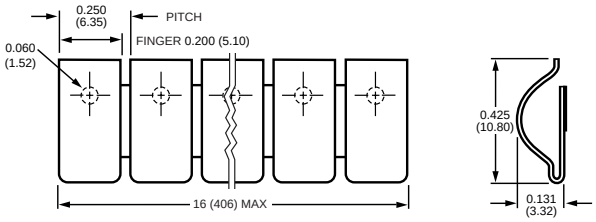
MTL THICKNESS 0.003 (0.076)

PART NO. 81-02-11834-XXXX



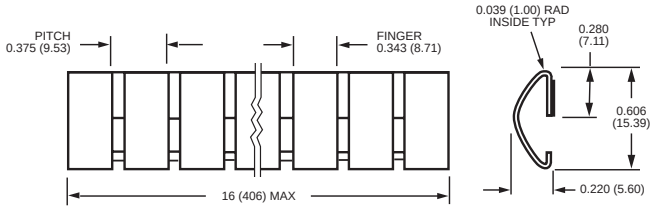
MTL THICKNESS 0.003 (0.076)
Note: *Tool Diameter (0.050 in.) located under PSA*

PART NO. 81-02-11825-XXXX



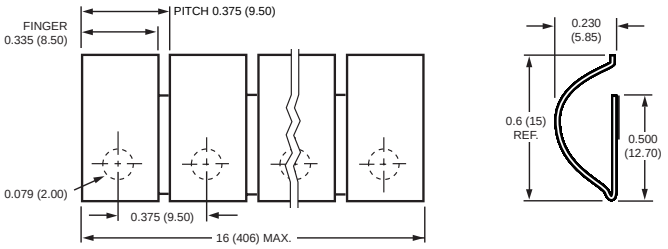
MTL THICKNESS 0.003 (0.076)

PART NO. 81-02-11820-XXXX



MTL THICKNESS 0.004 (0.100)

PART NO. 81-02-11824-XXXX



MTL THICKNESS 0.004 (0.100)

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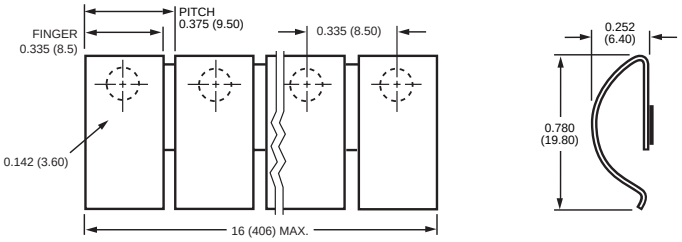
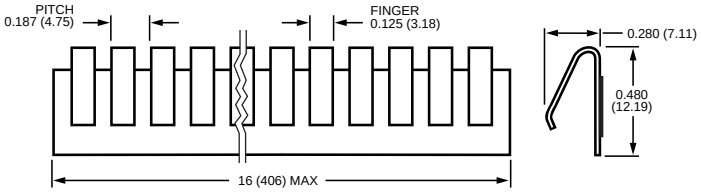


MTL THICKNESS 0.003 (0.076)

PART NO. 81-02-11840-XXXX



MTL THICKNESS 0.006 (0.152)

All dimensions are nominal. For applications where tolerances are critical, contact Chomerics' Applications Engineering Dept.

Additional configurations are available. Request information.

(mm dimensions in parentheses)

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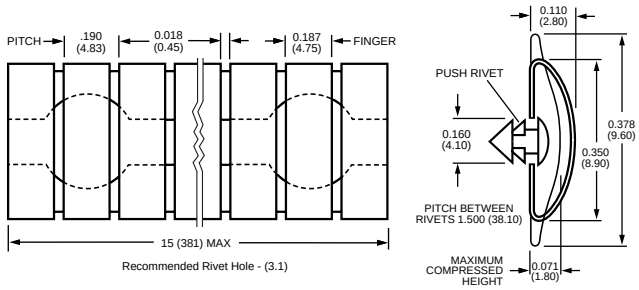
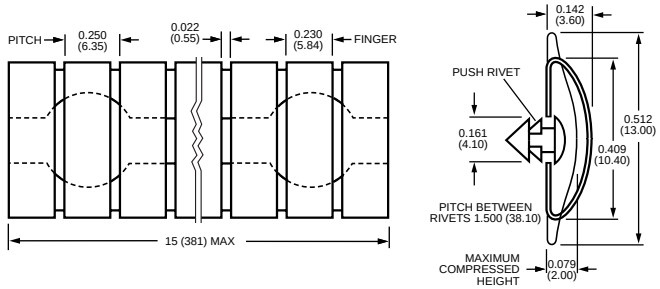
RIVET & TRACK

PART NO. 81-02-11833-XXXX



MTL THICKNESS 0.003 (0.076)

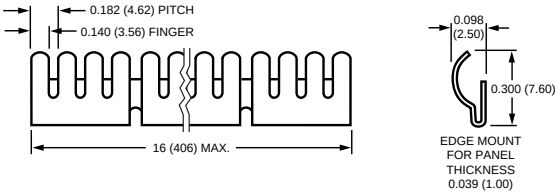
PART NO. 81-02-11832-XXXX



MTL THICKNESS 0.003 (0.076)

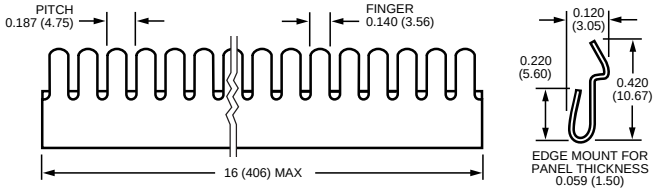
EDGE MOUNT

PART NO. 81-02-11831-XXXX



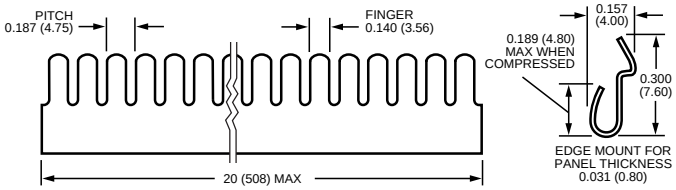
MTL THICKNESS 0.005 (0.127)
Note: *Tool Diameter (0.050 in.) located under PSA*

PART NO. 81-02-11828-XXXX



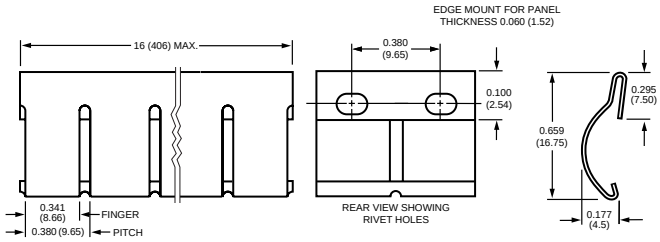
MTL THICKNESS 0.005 (0.127)

PART NO. 81-02-11841-XXXX



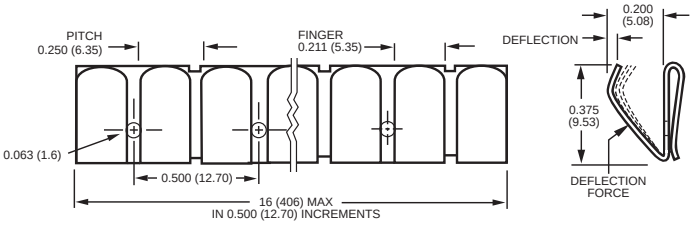
MTL THICKNESS 0.004 (0.100)

PART NO. 81-02-11830-XXXX



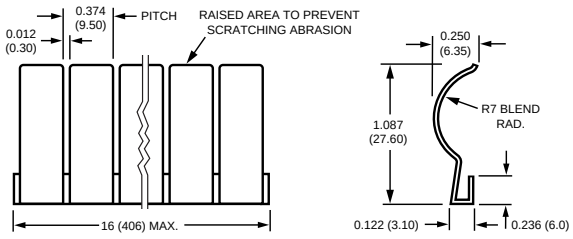
MTL THICKNESS 0.004 (0.100)

PART NO. 81-02-11827-XXXX



MTL THICKNESS 0.005 (0.127)

PART NO. 81-02-11829-XXXX



MTL THICKNESS 0.005 (0.127)

All dimensions are nominal. For applications where tolerances are critical, contact Chomerics' Applications Engineering Dept.

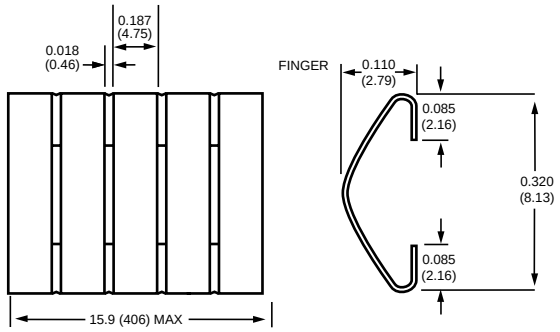
continued

Additional configurations are available. Request information.

(mm dimensions in parentheses)

SLOT MOUNT

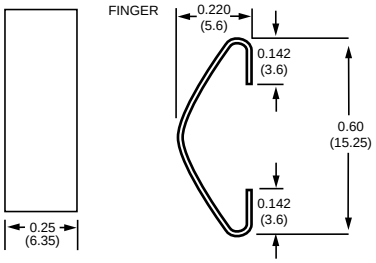
PART NO. 81-01-14186-XXXX



MTL THICKNESS 0.004 (0.100)

PART NO. 81-01-14187-XXXX

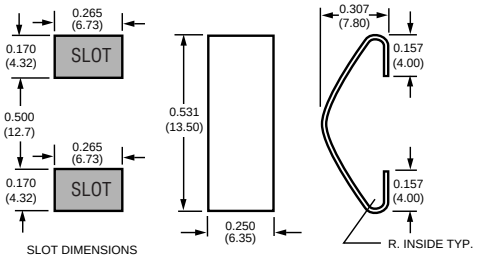
Note - available in single finger only



MTL THICKNESS 0.005 (0.127)

PART NO. 81-02-11835-XXXX

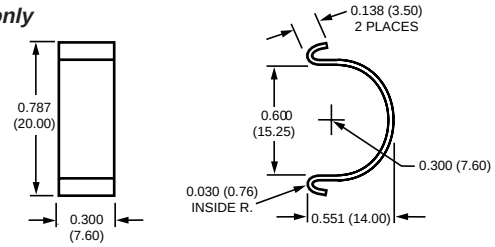
Note - available in single finger only



MTL THICKNESS 0.005 (0.127)

PART NO. 81-02-11902-XXXX

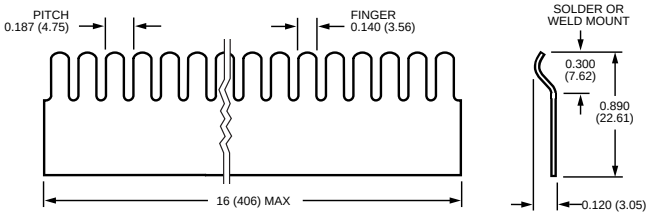
Note - available in single finger only



MTL THICKNESS 0.006 (0.152)

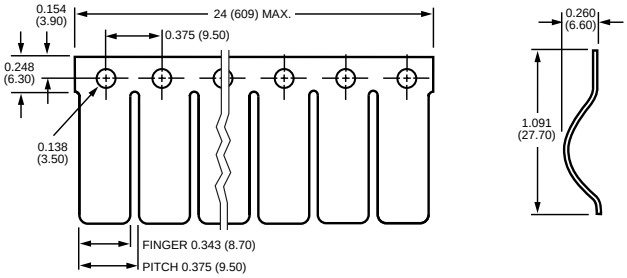
LARGE ENCLOSURE

PART NO. 81-02-11839-XXXX



MTL THICKNESS 0.004 (0.100)

PART NO. 81-02-11901-XXXX



MTL THICKNESS 0.005 (0.127)

All dimensions are nominal. For applications where tolerances are critical, contact Chomerics' Applications Engineering Dept.

Additional configurations are available. Request information.

(mm dimensions in parentheses)

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SPRING-LINE® Stainless Steel Card Cage Gaskets

SPRING-LINE
Stainless Steel Card Cage Gaskets

SPRING-LINE stainless steel card cage gaskets are designed to provide EMI shielding to the expansion slot area of PC and Server chassis. Chomerics' standard card cage series is available for PCI/EISA slot configurations from 1 to 10. The gaskets can also be modified to include additional slots and variable pitch designs.

Designed for cost effectiveness and ease of installation, Chomerics' card cage gaskets fit into most existing chassis without modifications. The contact fingers are designed to minimize any snagging during the installation of cards.

SPRING-LINE card cage gaskets are available in both standard and custom configurations, including tin-plating, to help meet demanding shielding requirements.

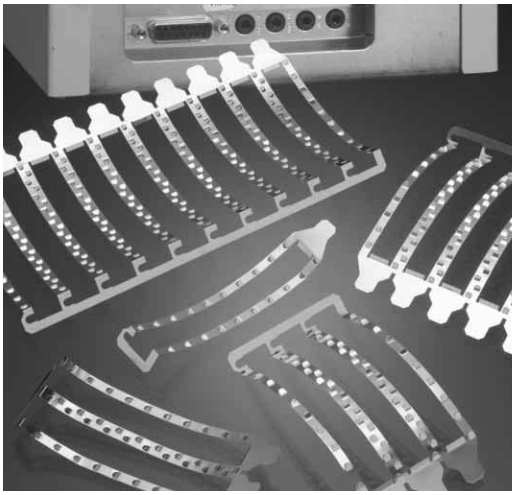


Table 1

Base Material Specifications	
Material Alloy	SS 301/302
Temper	1/2 Hard
Finish	Bright
Yield Strength	130-150 ksi
Tensile Strength (Per ASTM A666)	150 ksi
Plating Options	
Tin (pre or post)	
Plating Thickness - 5.08-10.16 microns (Per MIL-T-10727)	

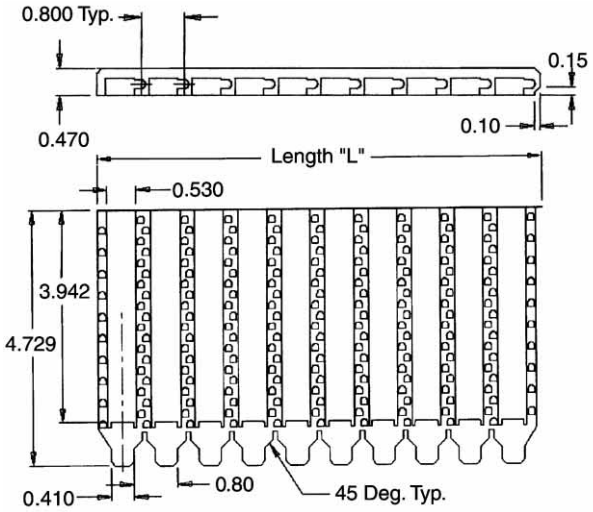


Figure 1 Standard SPRING-LINE Card Cage Gasket Configuration

Ordering Procedure

Use the following part number system to order SPRING-LINE card cage gaskets.

81 - XX - XX X XX - XXX X

- **81** — SPRING-LINE Product
- **XX** — 01= no PSA (standard), 02= with PSA
- **XX** — No. of Fingers Surrounding Slot (Standard = 20)
- **X** — Material Alloy A= SS 301/302
- **XXX** — 003 Standard Base Material Thickness, 0.003 inch (0.076 mm)
- **X** — Plating finish 2 = Clean and bright (unplated) 5 = Tin

No. of slots in cage (XX)	01	02	03	04	05	06	07	08	09	10
Length "L" inches (mm)	0.990 (25.15)	1.790 (45.47)	2.590 (65.78)	3.390 (86.11)	4.190 (106.43)	4.990 (126.75)	5.790 (147.02)	6.590 (167.39)	7.390 (187.71)	8.190 (208.03)

P/N Example: 81-01-05A20-0032 Denotes a five-slot, 0.003 inch (0.076 mm) thick, stainless steel (301/302) card cage gasket with no PSA, twenty fingers and no finish.

(mm dimensions in parentheses)

SPRING-LINE® D-Connector Gaskets

SPRING-LINE D-Connector Gaskets

Chomerics' SPRING-LINE D-connector gaskets answer most shielding and grounding needs for standard connector interfaces. The gaskets are available in both high performance beryllium-copper and economical stainless steel. D-connector gaskets offer excellent EMI protection by ensuring that maximum surface contact is achieved via independent fingers. This will lower closure force while improving conformance to surface irregularities.

Table 1 lists all standard gasket configurations available for 9-,15-, 25-, 37- and 50-pin connectors.

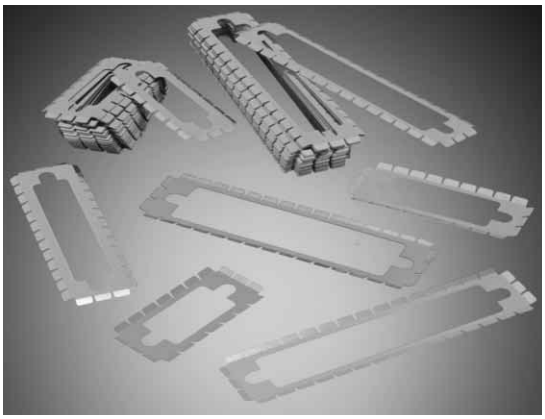


Table 1

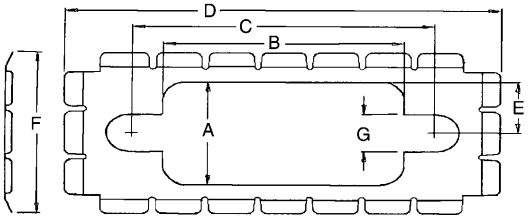
XXXX	Material	A	B	C	D	E	F	G
09A1	SS	0.44 (11.18)	0.78 (19.81)	0.98 (24.89)	1.41 (35.81)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
09A2	SS	0.35 (8.89)	0.78 (19.81)	0.98 (24.89)	1.41 (35.81)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
09B1	BeCu	0.44 (11.18)	0.78 (19.81)	0.98 (24.89)	1.41 (35.81)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
09B2	BeCu	0.35 (8.89)	0.78 (19.81)	0.98 (24.89)	1.41 (35.81)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
15A1	SS	0.44 (11.18)	1.11 (28.19)	1.31 (33.27)	1.74 (44.20)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
15A2	SS	0.35 (8.89)	1.11 (28.19)	1.31 (33.27)	1.74 (44.20)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
15B1	BeCu	0.44 (11.18)	1.11 (28.19)	1.31 (33.27)	1.74 (44.20)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
15B2	BeCu	0.35 (8.89)	1.11 (28.19)	1.31 (33.27)	1.74 (44.20)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
25A1	SS	0.44 (11.18)	1.65 (41.91)	1.85 (46.99)	2.28 (57.91)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
25A2	SS	0.35 (8.89)	1.65 (41.91)	1.85 (46.99)	2.28 (57.91)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
25B1	BeCu	0.44 (11.18)	1.65 (41.91)	1.85 (46.99)	2.28 (57.91)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
25B2	BeCu	0.35 (8.89)	1.65 (41.91)	1.85 (46.99)	2.28 (57.91)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
37A1	SS	0.44 (11.18)	2.29 (58.17)	2.50 (63.50)	2.93 (74.42)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
37A2	SS	0.35 (8.89)	2.29 (58.17)	2.50 (63.50)	2.93 (74.42)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
37B1	BeCu	0.44 (11.18)	2.29 (58.17)	2.50 (63.50)	2.93 (74.42)	0.22 (5.59)	0.69 (17.53)	0.16 (4.06)
37B2	BeCu	0.35 (8.89)	2.29 (58.17)	2.50 (63.50)	2.93 (74.42)	0.18 (4.57)	0.69 (17.53)	0.16 (4.06)
50A1	SS	0.55 (13.97)	2.20 (55.88)	2.41 (61.21)	2.84 (72.14)	0.28 (7.11)	0.80 (20.32)	0.16 (4.06)
50A2	SS	0.45 (11.43)	2.20 (55.88)	2.41 (61.21)	2.84 (72.14)	0.23 (5.84)	0.80 (20.32)	0.16 (4.06)
50B1	BeCu	0.55 (13.97)	2.20 (55.88)	2.41 (61.21)	2.84 (72.14)	0.28 (7.11)	0.80 (20.32)	0.16 (4.06)
50B2	BeCu	0.45 (11.43)	2.20 (55.88)	2.41 (61.21)	2.84 (72.14)	0.23 (5.84)	0.80 (20.32)	0.16 (4.06)

(mm dimensions in parentheses)

Table 2

MATERIAL PROPERTIES
Stainless Steel Alloy - 301/302 Hardness - 1/2H
Beryllium-Copper Alloy - 25 (172) Temper (1,000 psi) - 1/4HT

Figure 1



Ordering Procedure

Referring to Figure 1, use the following part number to order D-connector gaskets.

81 – D – XX XX – 2000

- **81** – SPRING-LINE Product
- **D** – Denotes D connector gasket
- **XX** – Number of pins in connector
  - 09 - 9-pin
  - 15 - 15-pin
  - 25 - 25-pin
  - 37 - 37-pin
  - 50 - 50-pin
- **XX** – Material type
  - A - Stainless Steel
  - B - Beryllium-Copper
- Connector Configuration (see Table 1)
- **2000** – Finish
  - 2000-Bright & clean (unplated)

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Inks

Typical Applications

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CHO-BOND® Conductive Adhesives

Single- and two-component epoxy and silicone adhesives, with room temperature, elevated temperature or moisture cure mechanisms.

Epoxies for Microelectronics

Chomerics' growing family of conductive epoxies now includes one-part, silver-filled pastes formulated for today's optoelectronic and microelectronic assembly applications.

CHO-BOND 700 Series Adhesives for Microelectronics Packaging

These pure silver-filled epoxy pastes are designed to meet the demanding requirements of semiconductor and microelectronics packaging. They are one-component systems with a unique combination of excellent die shear strength, low coefficients of thermal expansion, ionic purity, and high thermal and electrical conductivities. Each offers an extended working life with viscosity and thixotropy suitable for both time/pressure and positive displacement dispensing methods. Both are supplied frozen in bulk or standard syringe sizes.

- **CHO-BOND SV712** die attach adhesive has been optimized for high-speed, automated dispensing. It exhibits no resin bleedout on a variety of substrates and metallizations. Request Technical Bulletin.
- **CHO-BOND SV713** is especially well suited for temperature-sensitive, high performance applications. Request Technical Bulletin.

Versatile Conductive Epoxies

Our two-part silver, silver-plated-copper, and silver-plated-glass filled adhesives meet the most exacting electrical bonding requirements without the high temperatures, fluxes and expensive preparatory techniques usually needed to obtain effective lead-tin solder joints. They cure at room temperature or elevated temperatures into rigid structural bonds.

Excellent adhesion is achieved to copper, bronze, cold-rolled steel, aluminum, magnesium, Kovar, nickel, ceramic, phenolic and plastic substrates. Typical uses include bonding EMI shielded vents, windows or mesh gaskets to shield permanent seams.

CHO-BOND 500 Series Adhesive/Sealant Compounds

These pure silver-filled materials are used where tight tolerances require thin bond lines. Various cure cycles are available, and the materials are formulated for easy application by caulking gun, spatula, needle spotting, or silk screening. Their use for bonding mesh gaskets, printed circuit board repair, chip bonding, rear window defogger repair, and as low-temperature-activated flexible solders demonstrates their versatility. Request Technical Bulletin **10**.

- **CHO-BOND 584-29** adhesive combines room temperature cure with low viscosity, and can be used in place of soldering or welding. It is available in easy-to-use, two-chambered CHO-PAK dispensers in 1.0, 2.5 and 10 gram sizes (see photo above). These systems eliminate waste, mistakes, and time lost weighing components. Bulk kits are also available.
- **CHO-BOND 584-208** adhesive offers exceptional ease of application for circuit board repair. It is a two-component system with a 1:1 mix ratio, and cures in 24 hours at room temperature. With a 0.75 hour elevated cure temperature of 212°F (100°C), the material offers volume resistivity of 0.005 ohm-cm.
- **CHO-BOND 592** adhesive bonds dissimilar materials effectively. It combines long pot-life and excellent adhesion with low viscosity, a low coefficient of thermal expansion, very low thermal impedance and good thermal shock resistance. The material excels as a sealant for microwave modules and components and is useful for circuit board repair and grounding applications.

CHO-BOND 300 Series Adhesive/Sealant Compounds

These feature large (>50 micron) silver-plated-copper particles that make them well suited for bonding poorly toleranced surfaces. Bond lines should not be thinner than 10 mils. The gritty filler bites through thin, non-conductive surfaces such as oxide layers and MIL-C-5541 Class 3 irridite. Applications include bonding and shielding of cast aluminum housings, conduit bulkhead

continued

Table 1

SPECIFICATIONS AND PRODUCT CHARACTERISTICS
(Contact Chomerics for complete specifications and test procedures)

CHO-BOND Adhesive	SV712	SV713	584-29	584-208	592	360-20	360-208
Binder	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy	epoxy
Filler	Ag	Ag	Ag	Ag	Ag	Ag/Cu	Ag, Ag/Cu
Mix Ratio (by wgt.)	1-part	1-part	100:6.3	1:1	100:50	1:1	100:33
Consistency	thixotropic paste	thixotropic paste	thin paste	medium paste	nearly liquid	medium paste	thick paste
Specific Gravity	3.3 ±0.30	2.5 ±0.30	2.5 ±0.20	2.7 ±0.30	2.6 ±0.25	5.0 ±0.30	4.0 ±0.40
Minimum Lap Shear Strength, psi (MPa)	1100 (7.59)	1000 (6.90)	1200 (8.28)	700 (4.83)	1500 (10.35)	1600 (11.04)	1400 (9.66)
Minimum Die Shear* Strength, psi (MPa)	4800 (33.12)	4500 (31.05)	—	—	—	—	—
Maximum DC Volume Resistivity, ohm-cm	0.0004	0.0007	0.002	0.005	0.05	0.005	0.01
Use Temperature	–49 to 302°F (–45 to 150°C)	–49 to 302°F (–45 to 150°C)	–67 to 257°F (–55 to 125°C)	–80 to 210°F (–62 to 99°C)	–80 to 210°F (–62 to 99°C)	–80 to 212°F (–62 to 100°C)	–80 to 212°F (–62 to 100°C)
Elevated Temperature Cure Cycle	1hr. @257°F (125°C) or 30 min.@ 302°F (150°C)	1hr. @257°F (125°C) 30 min. @ 302°F (150°C)	15 min. @ 235°F (113°C)	45 min. @ 212°F (100°C)	30 min. @ 212°F (100°C)	2.0 hrs. @ 150°F (66°C)	45 min. @ 212°F (100°C)
Room Temperature Cure	NA	NA	24 hrs.	24 hrs.	1 wk.	24 hrs.	24 hrs.
Working Life	4 wks.	3 wks.	0.5 hr.	1.0 hr.	4.0 hrs.	1.0 hr.	1.0 hr.
Shelf Life, mos.	12**	12**	9	9	9	9	9
Coverage, in.^{2}/lb. (cm^2/g)	NA	NA	11,000 (156.1)	10,000 12,000 (141.9)	(170.3)	500 (7.1)	700 (9.9)
Recommended Thickness, in. (mm)	0.001 typ. (0.025)	0.001 typ. (0.025)	0.001 min. (0.025)	0.001 min. (0.025)	0.001 min. (0.025)	0.010 min. (0.25)	0.010 min. (0.25)
VOC, g/liter	0	0	0	0	47 (A & B)	0	0

* Alumina die on gold ** at -40°F (-40°C) NA Not Applicable

passthroughs, filters, and fabricated metal cabinets. Note that these compounds should be used only when the seam will not be broken. Request Technical Bulletin **47**.

• **CHO-BOND 360-20** is a low-cost, easy-to-mix adhesive/sealant with high lap shear bond strength. It fills large gaps and offers good thermal shock resistance.

• **CHO-BOND 360-208** adhesive/sealant uses a filler blend of pure silver and silver-plated-copper particles to produce superior shielding performance without requiring contact pressure, making it an ideal fillet seal. Its low flow properties make it the material of choice for vertical and overhead fillets.

Flexible Silicone Adhesives

With a choice of silver-plated-copper, silver-plated-aluminum or silver-plated-glass filler particles, these conductive silicones cure into gasket-like seals. When used to bond conductive silicone gaskets in place, they must be used in thin (8-10 mil) bond lines. Metallic surfaces may require priming with the recommended CHO-BOND primer to improve adhesion.

• **CHO-BOND 1029** is a two-component adhesive cured under pressure (6 psi/0.04 MPa, min.). Bond line thickness should not exceed 8 mils. Conductivity decreases sharply at >20 mil thickness. The material possesses superior lap shear (450 psi/3.10 MPa, min.). Ideal for quick bonding of conductive elastomers, the material's cure can be accelerated to 30 minutes at 250°F (121°C). Request Technical Bulletin **32**.

• **CHO-BOND 1030** is a one-component RTV silicone that cures by exposure to moderate humidity. It has twice the peel strength of other RTVs and a lap shear of 200 psi (1.38 MPa). For maximum conductivity, bond line thickness should not exceed 10 mils. Width should not exceed 0.5 in (1.27 cm) for proper curing. The material cures under nominal pressure of 1-2 psi (0.01 MPa) at temperatures not exceeding 150°F (66°C). Request Technical Bulletin **36**.

• **CHO-BOND 1035** is a one-component RTV silicone adhesive/sealant that can provide both environmental sealing and EMI shielding. It is well suited for bonding commercial-grade conductive elastomer gaskets and enclosure flanges, and serves as a conductive caulking material in enclosure seams. Its silver-plated-glass filler gives the material a volume resistivity of 0.05 ohm-cm. It is non-corrosive and forms a skin within minutes. Curing occurs without pressure in the presence of moisture. Packaging choices include 2.5 oz (71 g) metal tubes and 10 oz (0.3 kg) tubes for pneumatic dispensers. Request Technical Bulletin **23**.

• **CHO-BOND 1075** is used both for bonding EMI gaskets and for providing EMI shielding and environmental protection as a caulk. It is specifically recommended for bonding CHO-SEAL 1285 conductive elastomer gaskets (silver-plated-aluminum filled silicone). See "Corrosion-Resistant Sealants" on page 139. Request Technical Bulletin **35**.

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Parker Seals

Table 1 *continued*

SPECIFICATIONS AND PRODUCT CHARACTERISTICS (Contact Chomerics for complete specifications and test procedures)						
CHO-BOND Adhesive	**1029**	**1030**	**1035**	**1075******	**1085**	**1086**
Binder	silicone	silicone	silicone	silicone	primer for 1029	primer for 1030, 1035, 1075
Filler	Ag/Cu	Ag/Cu	Ag/glass	Ag/Al		
Mix Ratio (by wgt.)	1.0:2.5	1-part	1-part	1-part	1-part	1-part
Consistency	thick paste	gritty paste	thin paste	medium paste	thin fluid	thin fluid
Specific Gravity	3.0 ±0.35	3.75 ±0.25	1.9 ±0.10	2.0 ±0.25	0.87 ±0.15	0.78 ±0.10
Minimum Lap Shear Strength, psi (MPa)	450 (3.11)	200 (1.38)	100 (0.69)	100 (0.69)	NA	NA
Maximum DC Volume Resistivity, ohm-cm	0.06*	0.05	0.05	0.01	NA	NA
Use Temperature	–67 to 257°F (–55 to 125°C)	–67 to 392°F (–55 to 200°C)	–67 to 392°F (–55 to 200°C)	–67 to 392°F (–55 to 200°C)	–112 to 392°F (–80 to 200°C)	–112 to 392°F (–80 to 200°C)
Elevated Temperature Cure Cycle	0.5 hr. @ 250°F (121°C)	NA	NA	NA	NA	NA
Room Temperature Cure	1 wk.***	1 wk.***	1 wk.***	1 wk.***	0.5 hr.	0.5 hr.
Working Life	2.0 hrs.	0.5 hr.	0.5 hr.	0.25 hr.	NA	NA
Shelf Life, mos.	6	6	6	6	6	6
Coverage, $in.^2/lb.$ (cm^2/g)	1,800 1,300 (25.5)	(18.5)	1,500 (21.3)	1,200 (17.0)	NA	NA
Recommended Thickness, in. (mm)	0.008 max. (0.20)	0.010 max. (0.25)	0.007 min. (0.18)	0.010 max. (0.25)	0.005 min. (0.13)	0.0002 max. (0.005)
VOC, g/liter	0	0	151	0	719	740

*Value represents DC resistance in ohms through a 0.4 sq.in. by 0.008 in. (2.58 cm^2 by 0.02 cm) thick sample.

*** Cure is sufficient for handling in 24 hours. Full specification properties are developed after 1 week (168 hours).

**** Values reflect typical properties.

NA Not Applicable

Table 2 Ordering Information

PRODUCT	ORDERING PART NUMBER	UNIT/SIZE
CHO-BOND SV712	50-00-SV712-0000	250 gram kit kit (0.55 lb.)*
CHO-BOND SV712	50-01-SV712-0000	1 pound kit (0.5 kg)*
CHO-BOND SV712	50-04-SV712-0000	1 cc syringe*
CHO-BOND SV712	50-17-SV712-0000	5 cc syringe*
CHO-BOND SV712	50-38-SV712-0000	10 cc syringe*
CHO-BOND SV713	50-00-SV713-0000	250 gram kit kit (0.55 lb.)*
CHO-BOND SV713	50-01-SV713-0000	1 pound kit (0.5 kg)*
CHO-BOND 584-29	50-10-0584-0029	1 gram CHO-PAK (0.04 oz.)
CHO-BOND 584-29	50-02-0584-0029	2.5 gram CHO-PAK (0.1 oz.)
CHO-BOND 584-29	50-03-0584-0029	10 gram CHO-PAK (0.4 oz.)
CHO-BOND 584-29	50-01-0584-0029	1 pound kit (0.5 kg)
CHO-BOND 584-29	50-00-0584-0029	3 ounce kit (85 g)
CHO-BOND 584-208	50-01-0584-0208	1 pound kit (0.5 kg)
CHO-BOND 584-208	50-00-0584-0208	3 ounce kit (85 g)
CHO-BOND 592	50-01-0592-0000	1 pound kit (0.5 kg)
CHO-BOND 592	50-00-0592-0000	3 ounce kit (85 g)
CHO-BOND 360-20	50-01-0360-0020	1 pound kit (0.5 kg)
CHO-BOND 360-208	50-01-0360-0208	1 pound kit (0.5 kg)
CHO-BOND 360-208	50-00-0360-0208	3 ounce kit (85 g)
CHO-BOND 1029	50-01-1029-0000	1 pound kit (0.5 kg)
CHO-BOND 1029	50-00-1029-0000	3 ounce kit (85 g)
CHO-BOND 1030	50-01-1030-0000	1 pound cartridge (0.5 kg)
CHO-BOND 1030	50-02-1030-0000	4 ounce tube (113 g)
CHO-BOND 1035	51-01-1035-0000	10 ounce kit (0.3 kg)
CHO-BOND 1035	51-00-1035-0000	2.5 ounce kit (71 g)
CHO-BOND 1075	50-01-1075-0000	10 ounce kit (0.3 kg)
CHO-BOND 1075	50-02-1075-0000	2.5 ounce kit (71 g)
Primers		
CHO-BOND 1085	50-01-1085-0000	1 pint (0.47 liter)
CHO-BOND 1086	50-01-1086-0000	1 pint (0.47 liter)

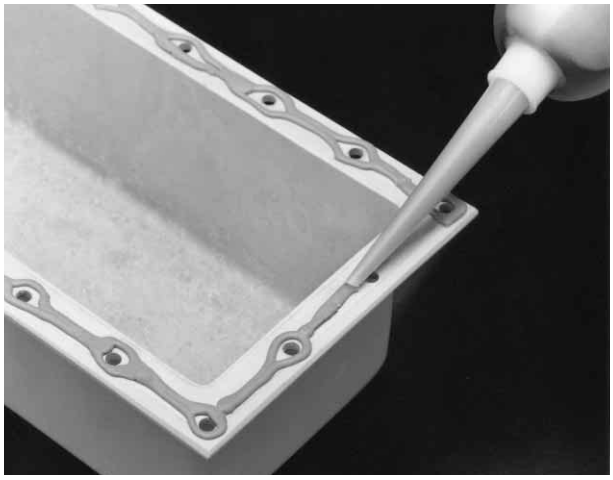
* Premixed and frozen

Note: Custom packaging can be accommodated. Please inquire.

Every shipment of Chomerics' conductive compounds is accompanied by a *Certificate of Conformance* to Chomerics specifications. Additional test reports can be obtained for a ser vice charge. Quality control procedures conform to MIL-I-45208.

CHO-BOND® Conductive Caulks and Sealants

Fill cracks and large gaps with a choice of single-component non-hardening systems, or two-component curing systems.



Rigid Epoxies

Chomerics' two-component conductive epoxy caulks provide excellent adhesion to dissimilar substrates and can be used in lap or butt joint applications. They feature large (>50 micron) silver-plated-copper particles that make them well suited for sealing poorly toleranced surfaces. Bond lines should not be thinner than 10 mils. The gritty filler bites through thin, non-conductive surfaces such as oxide layers and MIL-C-5541 Class 3 irridite. Applications include bonding and shielding of cast aluminum housings, conduit bulkhead passthroughs, filters, and fabricated metal cabinets. Note that these compounds should be used only when the seam will not be broken. Request Technical Bulletin **47**.

- **CHO-BOND 360-20** is a low-cost, easy-to-mix adhesive/sealant with high lap shear bond strength. It fills large gaps and offers good thermal shock resistance.
- **CHO-BOND 360-208** adhesive/sealant uses a filler blend of pure silver and silver-plated-copper particles to produce superior shielding performance without requiring contact pressure. This makes it an ideal fillet seal. Its low flow properties make it the material of choice for vertical and overhead fillets.

Table 3

SPECIFICATIONS AND PRODUCT CHARACTERISTICS
(Contact Chomerics for complete specifications and test procedures)

CHO-BOND Caulk or Sealant	360-20	360-208	1035	1038*	1075***	4660	4669	1086
Binder	epoxy	epoxy	silicone	silicone	silicone	polyiso-butylene	polyiso-butylene	primer for 1035, 1038, 1075
Filler	Ag/Cu	Ag/Cu, Ag	Ag/glass	Ag/Cu	Ag/Al	Ag/Cu	Ag/Cu	
Mix Ratio (by wgt.)	1:1	100:33	1-part	1-part	1-part	1-part	1-part	1-part
Consistency	medium paste	thick paste	thick paste	medium paste	medium paste	gritty paste	gritty paste	thin fluid
Specific Gravity	5.0 ±0.30	4.0 ±0.40	1.9 ±0.10	3.55 ±0.35	2.0 ±0.25	2.0 ±0.30	2.0 ±0.30	0.78 ±0.10
Minimum Lap Shear Strength, psi (MPa)	1600 (11.04)	1400 (9.66)	100 (0.69)	120 (0.83)	100 (0.69)	NA	NA	NA
Maximum DC Volume Resistivity, ohm-cm	0.005	0.01	0.05	0.01	0.01	0.08	0.08	NA
Use Temperature	–80 to 212°F (–62 to 100°C)	–80 to 212°F (–62 to 100°C)	–67 to 392°F (–55 to 200°C)	–67 to 257°F (–55 to 125°C)	–67 to 392°F (–55 to 200°C)	–67 to 212°F (–55 to 100°C)	–67 to 212°F (–55 to 100°C)	–112 to 392°F (–80 to 200°C)
Elevated Temperature Cure Cycle	2.0 hrs. @ 150°F (66°C)	0.75 hrs. @ 212°F (100°C)	NA	NA	NA	NA	NA	NA
Room Temperature Cure Time	24 hrs.	24 hrs.	1 wk.**	1 wk.**	1 wk.**	1 wk.**	1 wk.**	0.5 hr.
Working Life	1.0 hr.	1.0 hr.	0.5 hr.	0.5 hr.	0.25 hr.	0.5 hr.	2.5 hrs.	N/A
Shelf Life, mos.	9	9	6	6	6	6	6	6
Coverage, $in.^2/lb.$ (cm^2/g)	500 (7.1)	700 1500 (9.9)	(21.3)	750 (10.6)	1200 (17.0)	900 (12.8)	900 (12.8)	NA
Recommended Thickness, in. (mm)	0.010 min. (0.25)	0.010 min. (0.25)	0.007 min. (0.18)	0.007 min. (0.18)	0.010 min. (0.25)	0.015 min. (0.38)	0.015 min. (0.38)	0.0002 max. (0.005)
VOC, g/liter	0	0	151	117	0	323	361	740

* ** Cure is sufficient for handling in 24 hours. Full specification properties are developed after 1 week (168 hours).

*** Values shown for 1075 reflect typical properties. NA Not Applicable

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Parker Seals

Silicones and Flexible Polyisobutylenes

These single-component, non-hardening sealants are formulated to shield or seal joints and seams that are likely to be disassembled or subject to vibration or warping. A key feature is their capacity to remaining adherent without cracking or pulling away from the surface. Metallic surfaces may require priming with CHO-BOND primer to improve adhesion of the silicone caulks.

• **CHO-BOND 1035** is an RTV* silicone adhesive/sealant that can provide both environmental sealing and EMI shielding. It is well suited for bonding commercial-grade conductive elastomer gaskets and enclosure flanges, and serves as a conductive caulking material in enclosure seams. Its silver-plated-glass filler gives the material a volume resistivity of 0.05 ohm-cm. It is non-corrosive and forms a skin within minutes. Curing occurs without pressure in the presence of atmospheric moisture. Packaging choices include 2.5 oz (71 g) metal tubes and 10 oz (0.3 kg) tubes for pneumatic dispensers. Request Technical Bulletin **23**.

* Room Temperature Vulcanization

• **CHO-BOND 1038** is also an RTV silicone adhesive/sealant that can provide both environmental sealing and EMI shielding. Silver-plated-copper filler gives the material a volume resistivity of 0.01 ohm-cm. It is non-corrosive and forms a skin within minutes. Curing occurs without pressure in the presence of atmospheric moisture. Request Technical Bulletin **46**.

• **CHO-BOND 1075** RTV silicone sealant is used for bonding silver-plated-aluminum filled EMI gaskets and for providing EMI shielding and environmental protection as a caulk. Its silver-plated-aluminum filler provides compatibility with CHO-SEAL 1285 conductive elastomer gaskets. Curing occurs without pressure in the presence of atmospheric moisture. Request Technical Bulletin **35**.

• **CHO-BOND 4660 and 4669** polyisobutylene sealants feature a low density that permits considerably greater coverage per pound than experienced with other conductive caulks. They are most effective when applied between metal surfaces prior to assembly, and are especially useful for grounding building conduits and for shielding bulkhead and feed-through fittings, access panels and temporary structures.

Corrosion-Resistant Sealants

Chomerics pioneered silver-plated-aluminum particle technology to minimize the galvanic corrosion effects of conductive elastomer gaskets. This highly conductive filler is also used in our CHO-BOND 1075 sealant, because the Ag/Al particle will provide a more compatible system for aluminum flanges.

Extensive testing conducted at Chomerics and by the USAF has shown reduced corrosion at joints while EMI shielding is maximized. Standard specifications have been developed for these Ag/Al silicone sealants. Additional testing includes: corrosion-resistance to MIL-STD-810 salt fog: long-term effects on both physical and electrical properties; paintability; lightning survivability; and NASA outgassing. Technical information is available on request.

Table 4 Ordering Information

PRODUCT	ORDERING PART NUMBER	UNIT/SIZE
CHO-BOND 360-20	50-01-0360-0020	1 pound kit (0.5 kg)
CHO-BOND 360-208	50-01-0360-0208	1 pound kit (0.5 kg)
CHO-BOND 360-208	50-00-0360-0208	3 ounce kit (85 g)
CHO-BOND 1035	51-01-1035-0000	10 ounce kit (0.3 kg)
CHO-BOND 1035	51-00-1035-0000	2.5 ounce kit (71 g)
CHO-BOND 1038	50-01-1038-0000	1 pound kit (0.5 kg)
CHO-BOND 1038	50-02-1038-0000	4 ounce kit (113 g)
CHO-BOND 1075	50-01-1075-0000	10 ounce kit (0.3 kg)
CHO-BOND 1075	50-02-1075-0000	2.5 ounce kit (71 g)
CHO-BOND 4660	51-05-4660-0000	1.5 pound cartridge (0.7 kg)
CHO-BOND 4660	51-02-4660-0000	4 ounce tube (113 g)
CHO-BOND 4669	51-05-4669-0000	1.5 pound cartridge (0.7 kg)
CHO-BOND 4669	51-02-4669-0000	4 ounce tube (113 g)
Primer		
CHO-BOND 1086	50-01-1086-0000	1 pint (0.47 liter)

Note: Custom packaging can be accommodated. Please inquire.

Every shipment of Chomerics' conductive compounds is accompanied by a *Certificate of Conformance* to Chomerics specifications. Additional test reports can be obtained for a service charge. Quality control procedures conform to MIL-I-45208.

CHO-SHIELD® Conductive Coatings

Epoxy Coatings

CHO-SHIELD epoxy coatings provide EMI shielding, anti-static protection, corona shielding and surface grounding in a wide range of applications.

• **CHO-SHIELD 596** coatings are two-component, silver-filled systems possessing exceptionally high conductivity and generally providing EMI shielding levels of up to 60-80 dB in the 30 MHz to 1 GHz range. They can be applied with a brush or conventional spray equipment. Both offer excellent EMI and environmental protection when applied to glass, plastic or epoxy substrates. They cure at room temperature, although optimum results are achieved with elevated temperature cure. Request Technical Bulletin **51**.

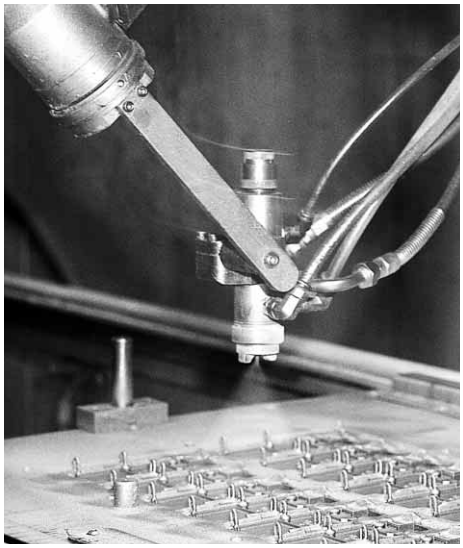
• **CHO-SHIELD 610** is a highly conductive, two-component silver-plated-copper filled epoxy coating for application to non-conductive plastic substrates, particularly those subject to hostile environmental conditions of abrasion, temperature extremes, high humidity, and salt fog corrosion. It dries to the touch in less than one hour, with best performance attained by using one of two accelerated cure cycles.

Polyurethane Coating

• **CHO-SHIELD 4076** nickel-filled polyurethane is recommended for shielding an entire room. This durable coating adheres well to plaster, wood, glass, concrete, drywall and most metals. Request Technical Bulletin **29**.

Acrylic Coatings

One-component CHO-SHIELD conductive acrylic air-dry coatings are intended for EMI shielding of non-conductive substrates. They offer a choice of filler systems that meet varying performance requirements. Silver-containing systems offer lower surface resistivity for better shielding performance. Nickel-filled systems are relatively inexpensive for providing moderate levels of EMI shielding over a wide frequency range.



• **CHO-SHIELD 2052, 2054 and 2056** silver-plated-copper filled commercial-grade coatings provide high levels of EMI shielding effectiveness, abrasion resistance and excellent adhesion on a variety of materials used for electronic enclosures. A more detailed description of these products appears below.

CHO-SHIELD 2052, 2054 and 2056 Conductive Coatings

Expressly Formulated for Commercial Enclosures

Developed especially for commercial applications, CHO-SHIELD 2052, 2054 and 2056 conductive coatings provide high levels of EMI shielding effectiveness and excellent adhesion on a variety of plastic substrates. These include ABS, PC-ABS, Noryl* and PVC. Recommended applications include plastic enclosures for notebook and desktop PCs, routers, servers, medical electronics, telephone handsets, etc.

Each coating has a silver-plated-copper filler. CHO-SHIELD 2052 uses a non-aqueous, one-component acrylic resin. In CHO-SHIELD 2054, the resin is water-based acrylic/urethane that offers the advantage of low VOCs.

Owing to its filler blend of pure silver and silver-plated copper, CHO-SHIELD 2056 offers <30 mohm maximum surface resistivity at the recommended 1-mil thickness. This translates to faster cycle times with fewer mask changes and spray passes.

Extensive testing has been performed to ensure that these coatings are stable at high humidity and moderate salt fog environments. Tough and abrasion-resistant, they meet the adhesion requirements of UL 746-C, and are UL listed for several PC/ABS substrates.

Application

With their excellent leveling and uniformity, these coatings are compatible with all commercially available application technologies, including high volume/low pressure (HVLP) spray systems, and conventional propeller-agitated pressure pots.

As low-settling compounds, they are ready for use after simple mixing in a paint shaker. They are supplied ready-to-spray, and don't require additional thinning, although MEK can be used.

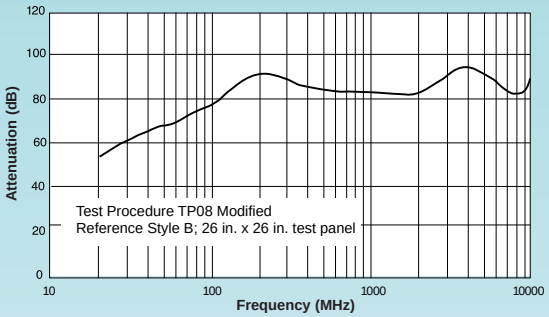


Figure 1 Shielding Effectiveness of CHO-SHIELD 2056 Coating

Performance

Typical EMI shielding performance is shown in Figure 1. Testing was performed on PC panels with a film thickness of <0.001 inch (0.025 mm). Reliability testing was performed under high and low temperature, humidity, abrasion, and salt fog conditions. For reports on these tests, contact Chomerics' Applications Engineering Department. For more information, request Technical Bulletin.

* Trademark of General Electric Co.

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Parker Seals

• **CHO-SHIELD 4900** silver-filled acrylic coating provides the highest levels of EMI shielding, as well as anti-static protection and grounding surfaces. It offers convenient fast tack and drying. Request Technical Bulletin **26**.

• **CHO-SHIELD 4914** nickel-filled coating is a low-cost choice for use on ABS, Noryl and polyester. It is *not* intended for use on polycarbonate or polystyrene substrates. It features high solvent resistance, fast tack and drying. Request Technical Bulletin **27**.

• **CHO-SHIELD 4916** nickel-filled coating dries to the touch in 30 minutes at room temperature. Effective on ABS, Noryl, polystyrene and polycarbonate, this formulation provides a surface resistivity of <1 ohm/sq. at 2 mils (0.05 mm). It is especially effective in applications requiring 40-50 dB of EMI shielding.

Corrosion-Resistant Conductive Flange Coatings

CHO-SHIELD 2000 Series Coatings provide corrosion protection for enclosure flanges that mate with EMI gaskets. They can also provide a corrosion-resistant conductive surface coating on aluminum or non-conductive composite substrates. These compounds offer excellent chemical resistance, including stability in jet fuel (JP4), hydraulic fluids and motor oil, along with high abrasion resistance even after jet fuel immersion.

With copper filler systems that are treated to remain electrically stable at elevated temperatures, 2000 Series coatings are three-part urethane formulations. Request Technical Bulletin **30**.

• **CHO-SHIELD 2001 and 2003** coatings are equivalent except for color — 2001 coating is light brown, 2003 is dark brown. Both contain soluble chromate salts that minimize the effects of galvanic corrosion of the aluminum substrate, even in the event of a coating scratch.

• **CHO-SHIELD 2002** coating is chromate-free and intended for composite substrates or for use in repairing the 2001 coating.

Corrosion resistance has been evaluated in terms of electrical stability of the coatings and their ability to protect aluminum substrates. When tested in accordance with the conditions specified in ASTM B117 (or MIL-STD-810, Method 509.2) salt fog, no corrosion occurs on the aluminum substrate after

continued

Table 5

SPECIFICATIONS AND PRODUCT CHARACTERISTICS (Contact Chomerics for complete specifications and test procedures)

CHO-SHIELD Coatings	596	610	4076	2052	2054	2056	4900	4914	4916	2001	2002	2003	1091
Binder	epoxy	epoxy	poly-urethane	acrylic	water-based acrylic/urethane	acrylic	acrylic	acrylic	acrylic	urethane	urethane	urethane	Primer for 2001, 2002, 2003
Filler	Ag	Ag/Cu	Ni	Ag/Cu	Ag/Cu	Ag, Ag/Cu	Ag	Ni	Ni	Cu	Cu	Cu	
Mix 100:37		100:28	1-part	1-part	1-part	1-part	1-part	1-part	1-part	pre-measured kit	pre-measured kit	pre-measured kit	1-part
Consistency	medium fluid	medium fluid	medium fluid	thin fluid	thin fluid	thin fluid	thin fluid	medium fluid	heavy fluid	medium fluid	medium fluid	medium fluid	thin fluid
Specific Gravity	1.8 ±0.15	1.6 ±0.15	1.1 ±0.2 (9.2 lbs./gal.)	1.1 ±0.2 (9.2 lbs./gal.)	1.4 ±0.2 (12 lbs./gal.)	1.1 ±0.2 (9.2 lbs./gal.)	1.5 ±0.15	1.7 ±0.2 (14 lbs./gal.)	1.9 ±0.1 (15 lbs./gal.)	3.1	3.1	3.1	0.78
Suggested Spraying Viscosity #2 Zahn Cup	19-26 sec.	19-27 sec.	NA	15-20 sec.	1200-1600 cPs†	14-19 sec.	19-22 sec.	19-22 sec.	19-22 sec.	19-27 sec.	19-27 sec.	19-27 sec.	NA
Maximum Surface Resistance, ohm/sq.	0.06	0.15	0.5	0.04 @ 2 mil thickness	0.03 @ 1.5 mil thickness	< 0.03 @ 1 mil thickness	0.05	2.0	0.7	0.10	0.10	0.10	NA
Use Temperature	–85 to 257°F (–65 to 125°C)	–85 to 257°F (–65 to 125°C)	–65 to 185°F (–54 to 85°C)	–40 to 212°F (–40 to 100°C)	–40 to 167°F (–40 to 75°C)	–40 to 212°F (–40 to 100°C)	–65 to 200°F (–54 to 93°C)	–65 to 185°F (–54 to 85°C)	–65 to 185°F (–54 to 85°C)	–85 to 185°F (–65 to 85°C)	–85 to 185°F (–65 to 85°C)	–85 to 185°F (–65 to 85°C)	–67 to 180°F (–55 to 82°C)
Elevated Temperature Cure Cycle	1.0 hr. @ 250°F (121°C)	2 hrs. @ RT + 1hr. @150°F (66°C) + 1 hr. @ 250°F (121°C) or 2 hrs. @ RT + 4 hrs. @ 175°F (79°C)	NA	20 min. @ RT followed by 20 min. @ 140° to 167°F (60° to 75°C)	15 min. @ RT followed by 30 min. @ 150° to 185°F (65° to 85°C)	5 min. @ RT followed by 30 min. @ 140° to 160°F (60° to 71°C)	NA	NA	NA	2 hrs. @ RT followed by 30 min. @ 250°F (121°C)	2 hrs. @ RT followed by 30 min. @ 250°F (121°C)	2 hrs. @ RT followed by 30 min. @ 250°F (121°C)	NA
Room Temperature Cure Time	1 wk.	1 wk.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	24 hrs.	1 wk.	1 wk.	1 wk.	1 hr.
Working Life	8 hrs.	8 hrs.	NA	NA	NA	NA	NA	NA	NA	2 hrs.	2 hrs.	2 hrs.	NA
Shelf Life, mos.	9	9	12	12	12	12	9 (bulk) 6 (spray)	9	12	9 9		9	15
Coverage, ft.^{2} (m^2) @ 0.001 in. (0.025) thick*	50/lb. (10.24/kg)	453/gal. (11.1/liter)	200/gal. (4.9/liter)	194/gal. (4.8/liter)	425/gal. (10.4/liter)	192/gal. (4.7/liter)	34/lb. (6.96/kg)	225/gal. (5.5/liter)	225/gal. (5.5/liter)	40/qt. (3.5/liter)	40/qt. (3.5/liter)	40/qt. (3.5/liter)	1200/lb (245.81/kg)
Recommended Thickness, in. (mm)	0.001 min. (0.025)	0.002 min. (0.05)	0.002 min. (0.05)	0.002 min. (0.05)	0.0015 min. (0.038)	0.001 min. (0.025)	0.001 min. (0.025)	0.002 min. (0.05)	0.002 min. (0.05)	0.003 min. (0.08)	0.003 min. (0.08)	0.003 min. (0.08)	0.0001 min. (0.003)
VOC, g/liter	404	888	338 (minus water)	765	75 (minus water)	759	731 (bulk)	680	575	554	554	550	680

* Theoretical coverage. Actual coverage will be 50-100% of this value, depending on part geometry, operator skill, etc.

† Brookfield viscosity measured at 100 rpm, spindle #3 @ 25°C

NA Not Applicable

500-hour exposure for CHO-SHIELD 2001 and 2003 coatings, and 100-hour exposure for CHO-SHIELD 2002.

Design Issues

Flange design and surface preparation have significant impact on the corrosion resistance offered by CHO-SHIELD 2000 Series coatings. All three coatings adhere best to MIL-C-5411, Class 3 treated aluminum (use an alkaline etching cleaner to clean the aluminum before the conversion coating step) and to most plastics and composites.

For best adhesion to aluminum, Chomerics' 1091 Primer is strongly recommended. For technical and applications information on this primer, request Technical Bulletin **31**. Consult Chomerics' Applications Engineering Department concerning application to other substrates, and assistance with design and material

Table 6 Ordering Information

PRODUCT P	ORDERING ART NUMBER	UNIT/SIZE
CHO-SHIELD 596	52-01-0596-0000	1 pound kit (0.5 kg)
CHO-SHIELD 596	52-00-0596-0000	3 ounce kit (85 g)
CHO-SHIELD 610	52-03-0610-0000	1 gallon kit (3.8 liter)
CHO-SHIELD 1091	50-00-1091-0000	1/4 pint (0.12 liter)
CHO-SHIELD 2052	52-02-2052-0000	1 quart (0.95 liter)
CHO-SHIELD 2052	52-03-2052-0000	1 gallon (3.8 liter
CHO-SHIELD 2052	52-05-2052-0000	5 gallons (19 liter)
CHO-SHIELD 2054	52-03-2054-0000	1 gallon (3.8 liter)
CHO-SHIELD 2054	52-05-2054-0000	5 gallons (19 liter)
CHO-SHIELD 2056	52-03-2056-0000	1 gallon (3.8 liter)
CHO-SHIELD 2056	52-05-2056-0000	5 gallons (19 liter)
CHO-SHIELD 2001	52-00-2001-0000	250 grams (1/2 pint)
CHO-SHIELD 2001	52-01-2001-0000	700 grams (1 pint)
CHO-SHIELD 2001	52-04-2001-0000	1378 grams (1 quart)
CHO-SHIELD 2002	52-00-2002-0000	250 grams (1/2 pint)
CHO-SHIELD 2002	52-01-2002-0000	700 grams (1 pint)
CHO-SHIELD 2002	52-04-2002-0000	1378 grams (1 quart)
CHO-SHIELD 2003	52-00-2003-0000	250 grams (1/2 pint)
CHO-SHIELD 2003	52-01-2003-0000	700 grams (1 pint)
CHO-SHIELD 2003	52-04-2003-0000	1378 grams (1 quart)
CHO-SHIELD 4076	52-03-4076-050A	1 gal. (25 gal. min.) (3.8 liter)
CHO-SHIELD 4900	52-01-4900-0000	1 pound can (0.5 kg)
CHO-SHIELD 4900	52-02-4900-0000	6 ounce spray can (0.17 kg)
CHO-SHIELD 4900	52-03-4900-0000	1 gallon (3.8 liter)
CHO-SHIELD 4914	52-03-4914-0000	1 gallon (3.8 liter)
CHO-SHIELD 4916	52-03-4916-0000	1 gallon (3.8 liter)

Note: Custom packaging can be accommodated. Please inquire.

Every shipment of Chomerics' conductive compounds is accompanied by a *Certificate of Conformance* to Chomerics specifications. Additional test reports can be obtained for a ser vice charge. Quality control procedures conform to MIL-I-45208.

CHO-FLEX® Conductive Coating and Ink

• **CHO-FLEX 601** coating is specifically designed for EMI shielding of copper/Kapton† flexible circuit laminates and for printing circuits on Kapton film. Upon cure, this coating exhibits excellent adhesion and flexibility, thermal stability, high conductivity and superior peel strength. It can be sprayed or silkscreened, and will withstand wave solder temperatures above 500°F (260°C) without losing any of its exceptional properties.

† Trademark of DuPont Company

• **CHO-FLEX 4430** polyester ink was developed for the membrane keyboard and sensor industries. It bonds to Mylar† films, and can be creased, heat-formed or scratched without affecting its performance. Pure silver-filled CHO-FLEX 4430 ink offers surface resistivity of 0.050 ohm/square at 0.0005 inch (0.013 mm) thickness.

Table 7 Ordering Information

PRODUCT	ORDERING PART UNIT/ NUMBER	SIZE
CHO-FLEX 601	52-01-0601-0000	1 pound (0.5 kg)
CHO-FLEX 4430	55-01-4430-0000	1 pound (0.5 kg)

Note: Custom packaging can be accommodated. Please inquire.

Every shipment of Chomerics' conductive compounds is accompanied by a *Certificate of Conformance* to Chomerics specifications. Additional test reports can be obtained for a service charge. Quality control procedures conform to MIL-I-45208.

Table 8 Ordering Information

SPECIFICATIONS AND PRODUCT CHARACTERISTICS (Contact Chomerics for complete specifications and test procedures)		
CHO-FLEX Coating or Ink	**601**	**4430**
Binder	poly-urethane	polyester
Filler	Ag	Ag
Consistency	Thixotropic paste	Thixotropic paste
Typical Density	1.67	3.80
Maximum Surface Resistance, ohm/sq.	0.06	0.08
Use Temperature	-65 to 225°F (-54 to 107°C)	-65 to 185°F (-54 to 85°C)
Cure Cycle	1.5 hrs. @ 360°F (182°C)*	0.5 hr. @ 250°F (121°C)
Shelf Life, mos.	6	9
Coverage, in^2/lb. (m^2/kg)**	4320 (6.13)	3000 (4.26)
VOC, g/liter	709	684

* Flexible circuit cure cycle: 4-5 min. @ 325°F (163°C) initial cure; 90 min. @ 360°F (182°C), 400 (2.76 PMPa) psi press cycle; 3-4 sec. @ 500°F (260°C) wave solder.

**Theoretical coverage. Actual coverage will be 50-100% of this value, depending on part geometry, operator skill, etc.

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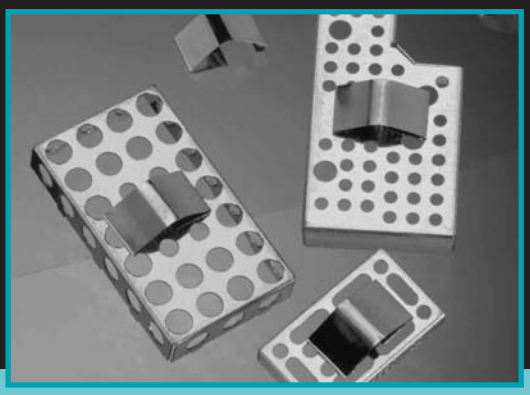
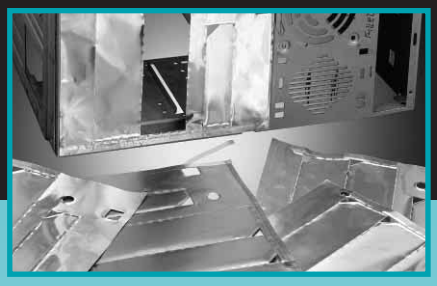
Parker Seals

Engineered Laminates & Grounding Products





CHO-MASK® II Foil Tape with Peel-Off Mask

CHO-MASK II Conductive Foil Tape with Peel-Off Mask

Easy-to-use CHO-MASK II conductive foil tape provides a cost-effective alternative to chromate conversion coating, plating and conductive paints.

CHO-MASK II tape consists of a 3 mil polyester paint mask covering a layer of 2 oz. (56.7g) tin-plated copper foil. The solvent/chemical resistant tape can withstand baking temperatures of up to 400°F (204°C) while maintaining excellent adhesion and conductivity. CHO-MASK II foil tape meets MIL-T-47012 and the tin-plating meets MIL-T-10727. The adhesive contains highly stable, conductive particles which provide long-term reliability.

CHO-MASK II tape is applied to clean metal frame, door and panel surfaces where electrical continuity is required. The mask's recessed edge allows paint to flow over foil edges and provides corrosion protection. After painting, the peel-off mask is easily removed, exposing a clean foil surface with electrical through resistance below 200 milliohms. When used with Chomerics' EMI gaskets, CHO-MASK II tape provides effective shielding performance and grounding points within the painted enclosure.

Both the ST (Standard Tack) and HT (High Tack) versions of CHO-MASK II tape can accommodate a wide range of enclosure finishing processes, including powder coating.

High Tack Version

CHO-MASK II HT (High Tack) tape offers exceptional adhesive strength at temperatures up to 400°F (204°C). It is recommended that lengths in excess of 5 feet (1.5 m), baked at over 350°F (177°C), be installed with a 0.062 inch (1.5 mm) gap between lengths. Otherwise, the thermal expansion rate differences between copper and typical cabinet substrates can cause buckling of long lengths.

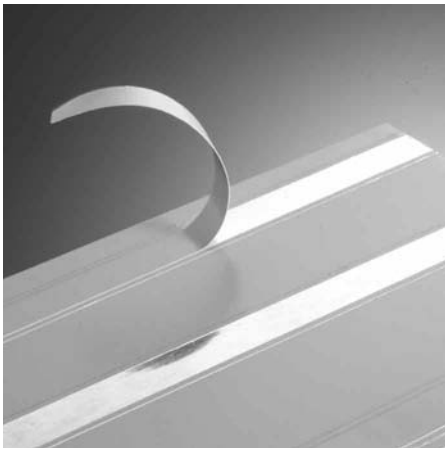


Table 1

PROPERTY	TEST METHOD	TYPICAL VALUES
Foil Type/Thickness (mils)	—	Tinned Copper/2.8
Mask Type/Thickness (mils)	—	Polyester/3.0
Adhesive/Thickness (mils)	—	Acrylic/1.8 – Standard Tack Acrylic/2.0 – High Tack
Total Thickness[1] (mils)	ASTM D1000	4.6 – Standard Tack 4.8 – High Tack
Continuous Use Temperature Range max., °F (°C)	—	–40 to 180 (–40 to 82)
Paint Cure Cycle	—	Not to exceed 1 hour at 365°F (185°C) – Standard Tack Not to exceed 1 hour at 400°F (204°C) – High Tack
Adhesion (foil to cabinet substrate)	ASTM D1000	See Table 3
Adhesion[2] oz/in (N/m) mask to foil	ASTM D1000	24 (263)
Surface Electrical Resistance[2, 6]	Chomerics TM71	<200 milliohms
Flame Resistance	UL Subject 510	Pass/File #E90722
Corrosion Resistance[3]	MIL-STD-810	Pass
Chemical Resistance[4]	ASTM D896-84	Pass
Humidity Exposure[5]	ASTM D1000	Pass
Gasket Closure Cycling (10,000 cycles, 15% deflection)[6]	Chomerics #40	See Table 4
Heat Aging Baked 48 hours @ 365°F (185°C); lb/in (N/m)	ASTM D1000	2.8 (490)

1 Includes adhesive
2 Before and after bake
3 Salt Fog Chamber at 35°C, for 144 hrs. (CHO-MASK II tape adhered to steel plate, painted)
4 Withstands 1,1,1 Trichloroethane, ethanol, acids, cleaning solvents, and alkaline solutions without degradation. Complete list available from Applications Engineering Department.
5 Tested at 60°C, 96 hours, 95% RH
6 Copies available from the Applications Engineering Department

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Ordering Procedure

CHO-MASK II tape is available on continuous rolls or custom die-cut configurations. Alternate constructions and non-standard roll sizes are available. Contact Chomerics for details. Standard rolls can be ordered using the following part number system.

For more information, request Technical Bulletin **210**.

CMT – XX – 108 – XXXX

ST = Standard Tack
HT = High Tack

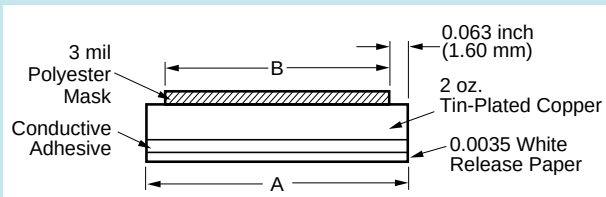
Length of Roll (108 yards/98.76 meters)

Table 2

FOIL WIDTH CODES (XXXX) *inch (mm)*			
–0430	0.430 (10.9)	–0800	0.800 (20.3)
–0500	0.500 (12.7)	–1000	1.000 (25.4)
–0625	0.625 (15.9)	–1500	1.500 (38.1)
–0750	0.750 (19.1)	–1750	1.750 (44.5)

CHO-MASK II ST and HT tapes are available in any slit width up to 21 inches (533 mm) without recessed mask edges. Contact your local Chomerics distributor for details.

Figure 1 CHO-MASK II – Construction



If "A" is …	Then "B" is …	If "A" is …	Then "B" is …
0.430 (10.9)	0.305 (7.75)	0.800 (20.3)	0.675 (17.1)
0.500 (12.7)	0.375 (9.53)	1.000 (25.4)	0.875 (22.2)
0.625 (15.9)	0.500 (12.7)	1.500 (38.1)	1.375 (34.9)
0.750 (19.1)	0.625 (15.9)	1.750 (44.5)	1.625 (41.3)

Table 3

Typical Post Bake Adhesion Values for Standard and High Tack Tapes
(Tin-plated copper tape to cabinet substrate)

TEST ENVIRONMENT	TO ALUMINUM LBS/IN (N/m)	TO STEEL LBS/IN (N/m)
Ambient Temperature	2.5 (438)	2.5 (438)
Baked 1 hour @ 350°F (177°C)	4.0 (700)	3.9 (682.5)
Baked 1 hour @ 400°F (204°C)	5.1 (892.5)	5.0 (875)
Baked 48 hours @ 350°F (177°C)	3.1 (542.5)	3.0 (525)
Baked 168 hours @ 165°F (74°C) 95% RH	4.1 (717.5)	4.0 (700)

Table 4

Abrasion Resistance
(10,000 Door closure cycles at 15% deflection on 2 oz. (56.7 g) tin-plated copper foil, using various Chomerics EMI gaskets)

EMI GASKET TYPE	TEST RESULTS	COMMENTS
Ag/Cu filled silicone elastomer	Pass	No defects/abrasions
Ag/Al filled silicone elastomer	Pass	No defects/abrasions
Ag filled silicone elastomer	Pass	No defects/abrasions
Ag/Ni filled silicone elastomer	Pass	No defects/abrasions
Ag/glass filled silicone elastomer	Pass	No defects/abrasions
Ag/Cu filled fluorosilicone elastomer	Pass	No defects/abrasions
Ag/Al filled fluorosilicone elastomer	Pass	No defects/abrasions
Ag filled fluorosilicone elastomer	Pass	No defects/abrasions
Ferrex* knitted wire mesh	Pass	No defects/abrasions
Monel** knitted wire mesh	Pass	No defects/abrasions
Monel knitted wire mesh with urethane foam core	Pass	No defects/abrasions
Aluminum knitted wire mesh	Pass	No defects/abrasions
Conductive fabric/foil	Pass	No defects/abrasions

* Tin-plated copper clad steel ** Nickel copper alloy

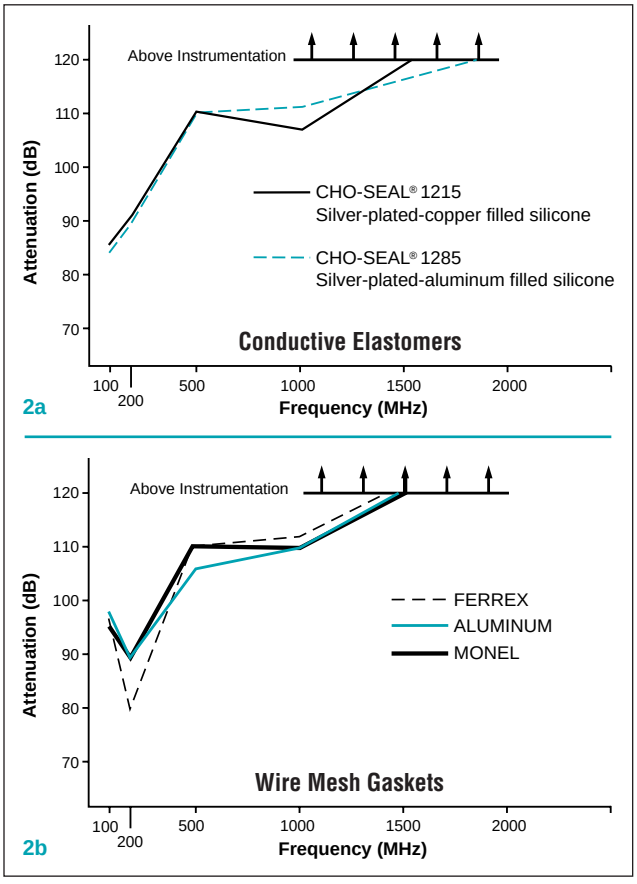


Figure 2 CHO-MASK II Shielding Effectiveness (E-Field) with Various EMI Shielding Gaskets

(mm dimensions in parentheses)

CHO-FOIL® & CHO-FAB™ Shielding Tapes

CHO-FOIL EMI Shielding Tape with Conductive Adhesive (Copper, Aluminum or Tinned Copper)

Chomerics' CHO-FOIL tapes are an economical EMI shielding solution for a variety of commercial uses. The tapes are available in copper, aluminum, or tinned copper foil backed with Chomerics' highly conductive pressure-sensitive adhesive*. Typical properties are shown in Table 1 on the next page, and reliability data appears in Table 4 on page 148. CHO-FOIL copper tape is available with a non-conductive adhesive for applications requiring surface conductivity only. An embossed version of CHO-FOIL copper tape is also available, for a more attractive appearance up to 6 inches (152 mm) wide. Standard length rolls and die-cut custom shapes can be ordered.

Typical Applications for CHO-FOIL and CHO-FAB EMI Shielding Tapes

- Provide a low impedance connection between a braided cable shield and the metal connector backshell in molded cables. An effective EMI shielded assembly can be achieved without soldering the tape to the braid or backshell
- EMI radiation measurement troubleshooting, using CHO-FOIL tape to shield ventilation slots or seam gaps
- Provide electrical continuity in seams of EMI shielded rooms and electronic enclosures
- Supply electrical contact to surfaces that can't be soldered to, such as conductive plastic or aluminum
- EMI shield for cables by wrapping the tape around the cable. An overlap is recommended
- ESD shielding
- Provide corrosion-resistant ground contact points
- Fabric tape available where weight and flexibility are important, such as for wrapping cables

CHO-FAB EMI Shielding Fabric Tape with Conductive Adhesive

CHO-FAB tape is a corrosion resistant nickel-plated cloth coated with Chomerics' highly conductive pressure-sensitive adhesive*. CHO-FAB tape is extremely strong and lightweight, and has excellent conformability/wrapability to enhance shielding performance and appearance. Use of corrosion resistant nickel-plated cloth and Chomerics' superior metal-particle-filled conductive adhesive technology produces a tape used in a wide variety of EMI shielding and grounding applications. Typical properties are shown in Table 1 on the next page, and reliability data appears in Table 4 on page 148.

Ordering Procedure

Refer to Tables 2 and 3. All CHO-FOIL and CHO-FAB tapes are available in standard 36 yard (32.9 m) rolls or die-cut custom configurations. Call Chomerics' Applications Engineering Department for assistance with a custom configuration.

* Recognized Under the Component Program of Underwriters Laboratories, Inc.

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Table 1

PROPERTIES								
Property	**Test Method**	**Typical Values**						
Part Number Prefix	—	**CCH**	**CCE**	**CCJ**	**CCK**	**CCD**	**CAD**	**CFT**
Foil/Fabric Type	—	1 oz. RA Copper	1 oz. Embossed RA Copper	Aluminum	1 oz. Tin-Plated Copper	1 oz. RA Copper	Aluminum	Nickel-Plated Fabric
Foil/Fabric Thickness, mils (mm)	—	1.4 (0.0356)	1.4 (0.0356)	2 (0.0508)	1.6 (0.0406)	1.4 (0.0356)	2 (0.0508)	5 (0.127)
Adhesive Type	—	Electrically Conductive Acrylic Pressure-Sensitive						
Adhesive Thickness, mils (mm)	—	1.5 (0.0381)				2 sides: 1.5 each (0.0381 each)		1.5 (0.0381)
Total Thickness, mils (mm)	—	2.9 (0.0737)	4* (0.1102)	3.5 (0.0889)	3.1 (0.0787)	4.4 (0.1118)	5 (0.127)	6.5 (0.165)
Temperature Range, °F (°C)	—	–40 to 400 (–40 to 205)						–40 to 180 (–40 to 82)
Electrical Resistance, ohms/in^2 (ohms/cm^2)	MIL-STD-202C	<0.003 (<0.0005)	<0.003 (<0.0005)	<0.010 (<0.0016)	<0.003 (<0.0005)	<0.010 (<0.0016)	<0.010 (<0.0016)	<0.100 (<0.016)
Flame Resistance	UL Subject 510	PASS	MEETS	PASS	PASS	MEETS	MEETS	N/A
Adhesion to Aluminum oz./inch [ppi] (N/m)	ASTM D1000	>40 [2.5] (438)						

*Embossing adds 1.1 mil

Table 2

PART NUMBER	TAPE DESCRIPTION
CCH – 36 – 101 – **ZZZZ**	Copper foil, conductive adhesive version
CCE – 36 – 101 – **ZZZZ**	Copper foil, conductive adhesive, embossed
CCJ – 36 – 201 – **ZZZZ**	Aluminum foil, conductive adhesive
CCK – 36 – 101 – **ZZZZ**	Tin-plated copper foil, conductive adhesive
CCD – 36 – 101 – **ZZZZ**	Copper foil, conductive adhesive 2 sides
CAD – 36 – 201 – **ZZZZ**	Aluminum foil, conductive adhesive 2 sides
CFT – 36 – 101 – **ZZZZ**	Nickel-plated fabric, conductive adhesive

Table 3

TAPE WIDTH CODES (ZZZZ) *inch (mm)*									
0050	0100	0150	0200	0300	0400	0600	0800	1200	2400
0.5 (12.7)	1.0 (25.4)	1.5 (38.1)	2.0 (50.8)	3.0 (76.2)	4.0 (102)	6.0 (152)	8.0 (203)	12 (305)	24 (610)

Custom widths available up to 24 inches (61 cm)

Slit rolls are available through Chomerics' authorized distributors.

Please consult Chomerics' Applications Engineering Department for assistance with a custom application involving a need for material in other than slit roll form.

continued

NOTE: The following table represents actual experimental test data taken according to Chomerics internal test procedures. This data differs from Table 1 due to differences in test methods.

Table 4

RELIABILITY DATA									
Test		**Test Method**	**CCH**	**CCE**	**CCJ**	**CCK**	**CCD**	**CAD**	**CFT**
Initial Surface Resistivity (SR) (milliohms)*		CHO-TP-57***	<2	<2	<2	<2	N/A	N/A	<100
Initial Through Resistivity (TR) (milliohms)*		CHO-TP-57***	<3	<3	<35	<2	<15****	<100****	<100
Initial Peel Strength in oz./inch [ppi] (N/m) **		ASTM D1000	44.8 [2.8] (490)	44.8 [2.8] (490)	51.2 [3.2] (560)	46.4 [2.9] (508)	48 [3] (525)	70.4 [4.4] (710)	44.8 [2.8] (490)
Initial Taber Abrasion Surface Resistivity (SR) (milliohms)		CHO-TP-57***	<6	<3	<6	<9	N/A	N/A	<100
Heat Aging 185°F (85°C)/ 168 hrs.	SR (milliohms)* TR (milliohms)* Peel, oz./in. [ppi] (N/m) **	CHO-TP-57*** CHO-TP-57*** ASTM D1000	<10 <16 57.6 [3.6] (630)	<2 <3 62.4 [3.9] (683)	<20 <22 76.8 [8] (840)	<2 <2 67.2 [4.2] (735)	N/A <7**** 73.6 [4.6] (805)	N/A <60**** 78.4 [4.8] (840)	<100 <150 59.2 [3.7] (648)
Heat Aging 250°F (121°C)/ 168 hrs.	SR (milliohms)* TR (milliohms)* Peel, oz./in. [ppi] (N/m) **	CHO-TP-57*** CHO-TP-57*** ASTM D1000	<10 <70 57.6 [3.6] (630)	<3 <3 59.2 [3.7] (648)	<20 <23 75.2 [4.7] (823)	<2 <2 51.2 [3.2] (560)	N/A <3**** 70.4 [4.4] (770)	N/A <10**** 84.8 [5.3] (928)	<100 <150 43.2 [2.7] (473)
Heat Aging with Humidity 95% RH/ 185°F (85°C)/	SR (milliohms)* TR (milliohms)* Peel, oz./in. [ppi] (N/m) **	CHO-TP-57*** CHO-TP-57*** ASTM D1000	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	<2 <2 78.4 [4.9] (858)	N/A <115**** 78.4 [4.9] (858)	N/A <150**** 84.8 [5.3] (928)	<100 <150 46.4 [2.9] (508)
Salt fog corrosion/ 168 hrs.	SR (milliohms)* TR (milliohms)* Peel, oz./in. [ppi] (N/m) **	CHO-TP-57*** CHO-TP-57*** ASTM D1000	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	<2 <2 76.8 [4.8] (840)	N/A <275**** 62.4 [3.9] (683)	N/A <600**** 80 [5] (875)	<100 <1000 33.6 [2.1] (368)
Taber abrasion 500 gramweight, CS-10 wheel, 500 cycles	SR (milliohms)*	CHO-TP-57***	<3	<5	<2	<6	N/A	N/A	<175

N/A = Not Applicable

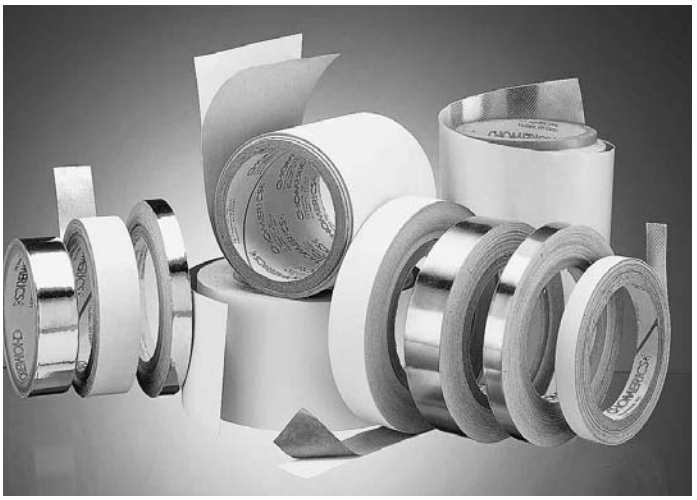
* All measurements of surface resistivity and through resistivity made at ambient temperature with tapes mounted on tinned copper substrate, except for taber abrasion where a plastic substrate was used.

** 90° peel strength tests were done on an Instron at 2 inches per minute with tapes on a 2024 aluminum substrate.

*** CHO-TP-57 available from Chomerics on request.

**** Through resistivity measurement of double sided adhesive tapes done with tapes flanged between 2024 aluminum substrates.

Contact our Applications Engineering Department to discuss your requirements.



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EMI Shielding Tapes Kit

EMI Shielding Tapes Kit

Chomerics' EMI Shielding Tapes Kit is a benchtop box containing six 1 inch x 36 yard (2.54 cm x 32.9 m) rolls of conductive foil and fabric tapes. It is designed to provide a wide range of price, performance and application options in a single, easy-to-use package.

The Kit includes copper, aluminum and tin-plated copper CHO-FOIL® shielding tapes. Their conductive pressure-sensitive adhesive provides very low electrical resistance through the tape, resulting in higher shielding performance than typical metal foil tapes. Both embossed and smooth versions are included.

CHO-FAB™ shielding tape, also included in the benchtop kit, consists of a corrosion resistant, nickel-plated fabric with a highly conductive pressure-sensitive adhesive. CHO-FAB tape is lightweight and flexible, which makes it ideal as an EMI shield to wrap over cables. The Chomerics EMI Shielding Tapes Kit provides a convenient resource for EMI measurement trouble-shooting, cable shielding and any other application where on-the-spot solutions are needed. It comes with a pair of 3 inch (7.62 cm) metal blade Fiskars* scissors.

* Fiskars, Inc., Wausau, WI.

Ordering Procedure

To place an order for the EMI Shielding Tapes Kit, contact your local Chomerics distributor and ask for:

Chomerics EMI Shielding Tapes Kit
Part Number: CHO-EMI-TAPE-BOX

For information on how to order individual rolls of the tapes contained in this kit, please refer to the preceding pages.

Table 1 Kit Contents

CHO-FOIL (CCJ-201)	CHO-FOIL (CCH-101)	CHO-FOIL (CAD-201)	CHO-FOIL (CCK-101)	CHO-FOIL (CCE-101)	CHO-FAB (CFT-101)
0.002 in. (0.051 mm) thick, electrical grade, dead-soft aluminum foil with electrically conductive acrylic adhesive	0.0014 in. (0.036 mm) thick, fully annealed copper foil with electrically conductive acrylic adhesive	0.002 in. (0.051 mm) thick, electrical grade, dead-soft aluminum foil with electrically conductive acrylic adhesive on both sides	0.0016 in. (0.041 mm) thick, tin-plated copper foil with electrically conductive acrylic adhesive	0.0014 in. (0.036 mm) thick, embossed, fully annealed copper foil with electrically conductive acrylic adhesive	0.005 in. (0.127 mm) thick, nickel-plated fabric with electrically conductive acrylic adhesive
0.0035 in. (0.089 mm) total thickness (excluding release liner)	0.0029 in. (0.074 mm) total thickness (excluding release liner)	0.005 in. (0.127 mm) total thickness (excluding release liner)	0.0031 in. (0.079 mm) total thickness (excluding release liner)	0.004 in. (0.102 mm) total thickness (excluding release liner)	0.0065 in. (0.165 mm) total thickness (excluding release liner)
<10 milliohms electrical through resistance (MIL-STD-202C)	<3 milliohms electrical through resistance (MIL-STD-202C)	<10 milliohms electrical through resistance (MIL-STD-202C)	<3 milliohms electrical through resistance (MIL-STD-202C)	<3 milliohms electrical through resistance (MIL-STD-202C)	<100 milliohms electrical through resistance (MIL-STD-202C)
>40 oz./in. (>0.44 kN/m) minimum adhesion	>40 oz./in. (>0.44 kN/m) minimum adhesion	>40 oz./in. (>0.44 kN/m) minimum adhesion	>40 oz./in. (>0.44 kN/m) minimum adhesion	>40 oz./in. (>0.44 kN/m) minimum adhesion	>40 oz./in. (>0.44 kN/m) minimum adhesion

EMI Shielding Laminates

EMI Shielding Laminates

Mechanical, electrical and processing properties, plus economy for commercial applications.

Chomerics produces a growing family of specialty laminated materials for EMI shielding. These laminates are available in bulk rolls for customizing into EMI shields, ground planes, ground straps, shadow shields, ESD shields and a host of other electronics applications. EMI shielding performance exceeds that of conductive coatings when properly designed.

Laminates provide an environmentally friendly solution that eliminates solvents, conductive paints, or plating processes. With their thin cross sections and light weight, EMI shielding laminates are also a space-saving solution.

Construction

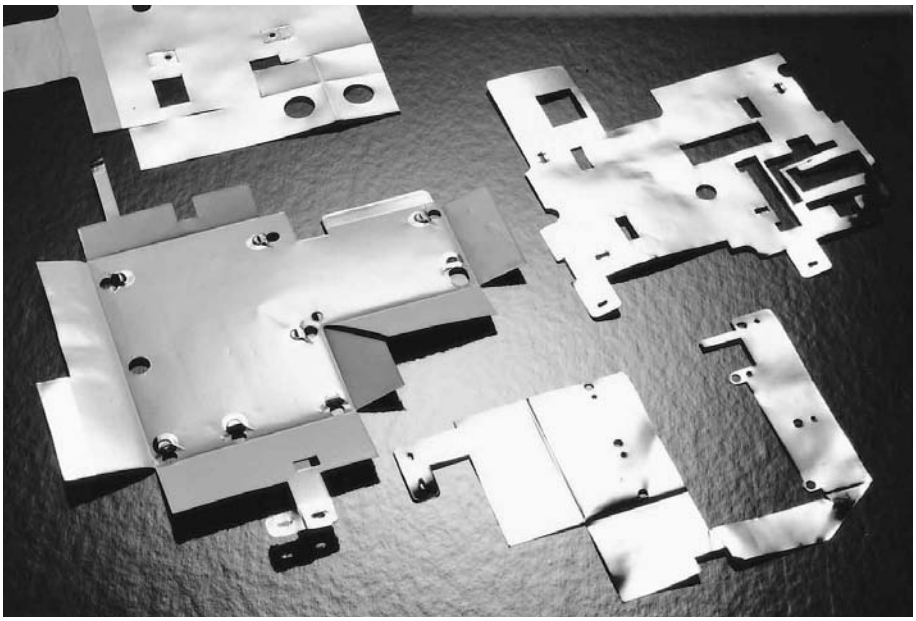
Shielding laminates are made from a variety of raw materials, including copper and aluminum foils, conductive and non-conductive acrylic pressure-sensitive adhesives (PSAs) and dielectric films such as PVC and polyester. Flame retardant materials are available, meeting the requirements of UL 94V-0 (UL File No. E140244).

The metal foil layer supplies the necessary EMI shielding (generally 20-60 dB depending on frequency, size, configuration and installation*) and grounding properties. The dielectric layer provides isolation and flexibility.

Electrically Conductive Attachment Adhesive

A conductive, metal particle-filled acrylic pressure-sensitive adhesive can be provided as a simple and cost effective method for shield termination to ground. The acrylic PSA contains a uniform dispersion of unique, oxidation-resistant conductive particles that create a very low electrical resistance through the shield. Peel strength of the conductive PSA typically exceeds 40 oz./inch (446 g/cm); non-conductives typically exceed 64 oz./inch (714 g/cm).

* To determine the shielding effectiveness of specific laminate parts, it is recommended that prototype shields be inserted and properly terminated in the product under test.



Releasable Dielectric Layer with Electrically Conductive Adhesive Simplifies Grounding and Bonding

Chomerics has developed a unique EMI shielding laminate consisting of an aluminum foil and a dielectric film layer. Sections of the dielectric layer are kiss-cut so they can be selectively removed to expose the electrically conductive PSA and foil (Figure 1). This feature provides choices for grounding/bonding sites, and eliminates the need for selective lamination, in which parts are fabricated with exposed metal foil sites.

Complete Customization Capabilities

To enhance installation of these EMI shielding laminates, scores, slits, self-adhesive mounting strips, creases and other features are easily designed into the part.

Chomerics routinely produces laminates with complex die-cuts as well as punched and stamped features.

Contact Chomerics' Applications Engineering Department to evaluate your needs and develop a cost-effective shielding solution.

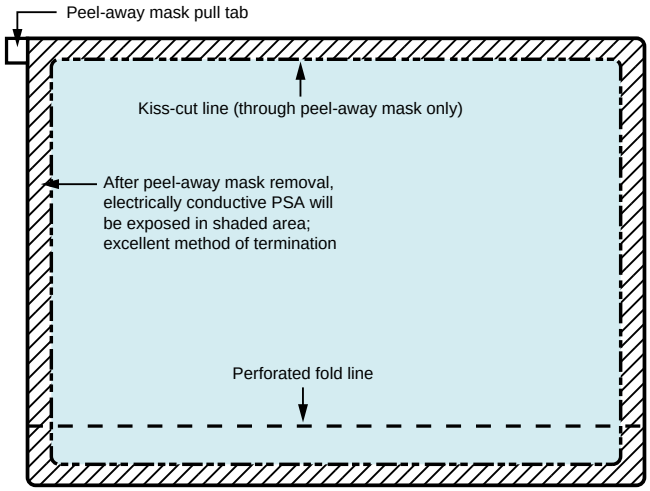


Figure 1 Releasable Dielectric Layer Exposes PSA and Foil

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Table 1

SPECIFICATIONS								
Property	**Test Method**	**Typical Values**						
Foil Type	—	Copper			Aluminum			Aluminum
Foil Thickness, inch (mm)	—	0.0014 (0.036)			0.002 (0.051)			0.005 (0.127)
Adhesive Thickness, inch (mm)	—	0.001 (0.025)			0.001 (0.025)			0.0015 (0.038)
Film Type	—	PVC			PVC			Polyester
Film Thickness, inch (mm)	—	0.003 (0.076)	0.006 (0.152)	0.010 (0.254)	0.003 (0.076)	0.006 (0.152)	0.010 (0.254)	0.002 (0.051)
Weight, oz/ft^2 (g/cm^2)	—	1.15 (0.0355)	1.3 (0.040)	1.6 (0.049)	1.15 (0.0355)	1.3 (0.040)	1.6 (0.049)	—
Dielectric Strength, kVAC	ASTM D149	5	11.5	13	5	11.5	13	3
Continuous Use Temperature, °F (°C)	—	194 (90)	194 (90)	194 (90)	194 (90)	194 (90)	194 (90)	194 (90)
Adhesive Strength (foil to PVC), lb/inch (kN/m)	ASTM D1000	4.0 (0.70)	4.0 (0.70)	4.0 (0.70)	4.0 (0.70)	4.0 (0.70)	4.0 (0.70)	N/A
Flame Resistance, UL Rating*	UL 94	V-0	V-1	V-0	V-0	V-1	V-0	NR
Punchable/Stampable		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crease Formable		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chemical Resistance**	ASTM D896-84	Pass						
Humidity Cycling ***	ASTM D1000	Pass						
Conductive Pressure-Sensitive Adhesive	—	Conductive metal particle-filled acrylic pressure-sensitive adhesive (CBL-10-2503-2400 only)						
Adhesion Value to Aluminum lbs/inch (N/m)	ASTM D1000	3.0 (525)						
Electrical Resistance ohms/in^2 (ohms/cm^2)	MIL-STD-202C	<0.010 (<0.065)						

* Underwriters Laboratories File # E140244.

** Withstands acids, cleaning solvents and alkaline solutions without degradation. Complete list is available from Chomerics' Ap plications Department.

*** Tested at 60°C, 96 hours, 95% RH.

Ordering Procedure

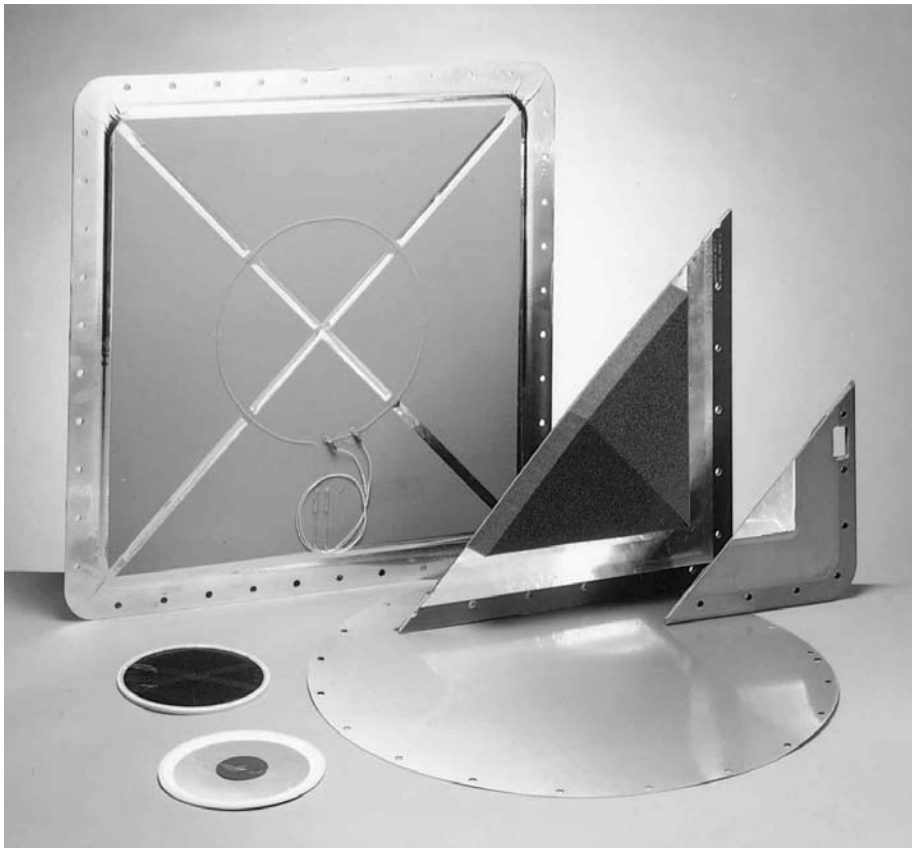
Part Number: CBL – 10 – XXXX – 2400

Roll Length	Material Part Number	Standard Width
100 ft. (30.5 m)		24 inch (61 cm)

Table 2

PART NUMBER	DESCRIPTION	COMMENTS
CBL-10-1201-2400	10 mil PVC/2 mil aluminum	UL Listed (94V-0)
CBL-10-1101-2400	10 mil PVC/1 oz. copper	UL Listed (94V-0)
CBL-10-6201-2400	6 mil PVC/2 mil aluminum	UL Listed (94V-1)
CBL-10-6101-2400	6 mil PVC/1 oz. copper	UL Listed (94V-1)
CBL-10-1111-2400	10 mil PVC/1 oz. copper/10 mil PVC	UL Listed (94V-1)
CBL-10-1211-2400	10 mil PVC/2 mil aluminum/10 mil PVC	UL Listed (94V-1)
CBL-10-6001-2400	6 mil PVC/acrylic PSA	Used for custom lamination
CBL-10-1001-2400	10 mil PVC/acrylic PSA	Used for custom lamination
CBL-10-6161-2400	6 mil PVC/1 oz. copper/6 mil PVC	Used for custom lamination
CBL-10-3202-2400	3 mil PVC/2 mil aluminum	Used for custom lamination
CBL-10-3102-2400	3 mil PVC/1 oz. copper	Used for custom lamination
CBL-10-3002-2400	3 mil PVC/acrylic PSA	Used for custom lamination
CBL-10-2503-2400	5 mil aluminum/conductive acrylic adhesive/2 mil release polyester	Releasable dielectric for easy customization
CBL-10-6261-2400	6 mil PVC/2 mil aluminum/6 mil PVC	Used for custom lamination

EMI Shielding Missile Canister Seals



EMI Shielding Missile Canister Seals

Chomerics' missile canister seals combine specialized foil/film laminates with molded conductive and non-conductive rubber seals. We offer the expert design, materials knowledge, manufacturing engineering and process control necessary to produce these sophisticated assemblies.

Our experience in building complex, multi-functional designs that meet military specifications, together with our QS-9000 certified facilities in Hudson, NH, ensures a quality product from concept to manufacture.

Lamination expertise enables us to achieve the clean fly-through and blow-out characteristics required for missile canister seals. In addition, Chomerics applies its unique strength in molding both electrically conductive elastomers for EMI shielding and non-conductive environmental seals to a variety of substrates. For these applications, we mold either silicone or fluorosilicone to metals, plastics and/or foils. In-house compounding of the elastomeric materials ensures consistency and specification compliance.

Canister seal assemblies include metal frames which provide mounting locations in addition to structural integrity. We offer in-house CNC machining capabilities as well.

Ordering Procedure

Missile canister seals are produced on a custom basis. Contact our Applications Engineering Department with your specifications.

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Parker Seals

CHO-STRAP® Insulated Ground Strap

CHO-STRAP Insulated Ground Strap*

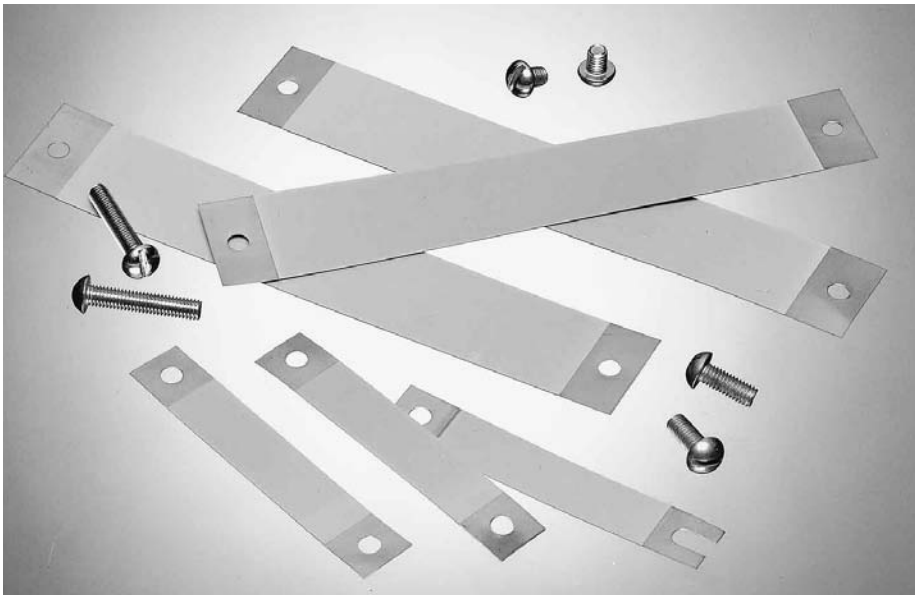
Recommended wherever board-to-chassis or chassis-to-cabinet grounding is required, CHO-STRAP ground straps provide low RF impedance and reduce radiated EMI emissions. With their flame retardant adhesive system they pass all requirements of UL specification 94V-0.

Very flexible and easily installed, CHO-STRAP ground straps are double-insulated laminates with a tinned copper interior and polyester film exterior for high dielectric strength. Punched and tinned ends facilitate termination, while tinned contacts provide corrosion resistance.

Standard construction is 5 oz. rolled annealed tinned copper, laminated on both sides to 1 mil polyester film with a flame retardant acrylic adhesive. Ends are punched with 0.187 inch (4.75 mm) dia. holes for ease of installation with #10 screws. A 0.50 inch (12.7 mm) tinned area at each end prevents oxidation of the termination contact area.

Ordering Procedure

Standard parts and dimensions are shown in Table 1. For complete information, request Technical Bulletin **203**.



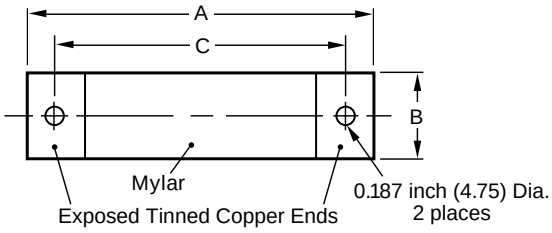


Figure 1 CHO-STRAP Insulated Ground Strap Construction

Table 1

PART NO.	NOMINAL DIMENSIONS, *inches (mm)*		
	A	B	C
L-1011-3	3.0 (76.2)	0.500 (12.7)	2.5 (63.5)
L-1011-6	6.0 (152.4)	0.500 (12.7)	5.5 (139.7)
L-1011-9	9.0 (228.6)	0.500 (12.7)	8.5 (215.9)
L-1011-12	12.0 (304.8)	0.500 (12.7)	11.5 (292.1)
L-1011-15	15.0 (381.0)	0.500 (12.7)	14.5 (368.3)
L-1011-18	18.0 (457.2)	0.500 (12.7)	17.5 (444.5)
L-1012-3	3.0 (76.2)	1.000 (25.4)	2.5 (63.5)
L-1012-6	6.0 (152.4)	1.000 (25.4)	5.5 (139.7)
L-1012-9	9.0 (228.6)	1.000 (25.4)	8.5 (215.9)
L-1012-12	12.0 (304.8)	1.000 (25.4)	11.5 (292.1)
L-1012-15	15.0 (381.0)	1.000 (25.4)	14.5 (368.3)
L-1012-18	18.0 (457.2)	1.000 (25.4)	17.5 (444.5)

Other sizes available, please inquire

* Recognized Under the Component Program of Underwriters Laboratories, Inc.

Conductive Grounding Tabs

Adequate EMI protection often can be achieved by establishing low impedance ground paths between electrically conductive elements in the chassis and components.

Conductive Grounding Tabs

Electromagnetic interference (EMI) is frequently induced by surface currents exciting metal components to create "phantom" fields. As a generality, all metal elements should be bonded to a common ground.

In some cases, conductive "tabs" provide the required grounding paths at lower costs than modifying a design or installing enclosure shielding.

For example, slot length in *enclosure seams* can be reduced effectively using conductive tabs at appropriate intervals. With wavelength the determining factor, the smaller slot size may limit leakage sufficiently to circumvent continuous gasketing. This will provide a cost savings.

Within enclosures, grounding tabs may reduce radiated EMI levels from a PCB ground plane saturated with signals. Board-mounted component shields, such as metal cans, can be grounded with conductive tabs inserted between the shield and enclosure wall.

MATERIALS AND FORMS

Virtually any suitable Chomerics EMI shielding material used in continuous lengths can be cut-to-length as grounding tabs. These include different profile conductive elastomers, conductively jacketed foam, knitted wire mesh and springfinger strips.

Pressure-sensitive adhesive (PSA) is standard on many of these, and generally available on any material and configuration other than an O-profile.

Elastomer and foam strips are supplied as continuous lengths, cut-to-length pieces, or kiss-cut parts on tape or film release sheets. Kiss-cut parts abut each other, while individual pieces can be spaced on film sheets in specified intervals for "pick and place" application.

Individual springfingers can be supplied on film sheets, or as manually snapped off individual lengths.

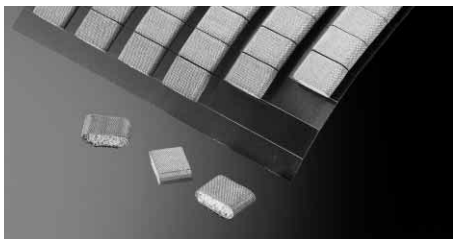
SELECTING THE SOLUTION

Choosing a material typically relates more to physical suitability than to grounding performance. Since various materials offer comparable grounding, but differ widely in composition and construction, material selection should consider:

- Compression/deflection
- Compression set
- Friction/shear forces
- Flammability
- Durability, abrasion, closure cycles
- Corrosion

More than one material may provide a cost-effective grounding solution. A typical scenario is the identification of radiated EMI during certification testing of a device, with on-the-spot resolution using available samples.

Many commercial test laboratories use samples supplied by Chomerics for expedient problem solving. Customers preparing for product testing are welcome to request grounding tab samples. *Contact our Applications Engineering Department.*



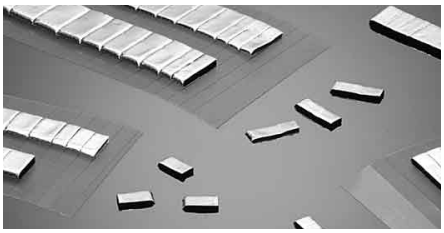
SOFT-SHIELD® 5000 Series
Conductive Fabric-Wrapped Foam

Nickel-plated silver imparts conductivity to the self-terminating, nylon rip-stop jacket of this highly compressible foam gasket. Closure force of <1 lb/inch (0.175 N/mm) makes it ideal for use in laptop computers and portable telecommunications devices.

Dozens of standard configurations include rectangular, D, C, P and V profiles. Standard sizes start as small as a 0.060 x 0.150 inch (1.5 x 3.8 mm) solid D profile, and all offer optional pressure-sensitive adhesive. Choose general-duty or UL 94V-0 rated versions.

Pre-cut lengths as small as 0.25 inch (6.35 mm) minimize waste. Parts are kiss-cut on polyester film release backers.

For detailed information on SOFT-SHIELD 5000 Series materials, refer to page 93.

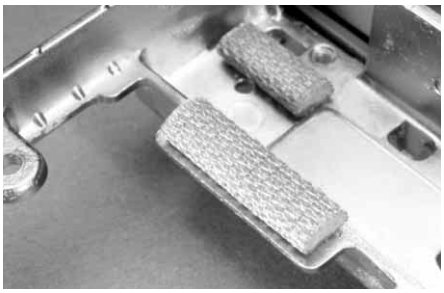


SOFT-SHIELD® 4000 Series
Foil/Fabric Wrapped Foam

Closed cell urethane foam is machine-wrapped in fabric-reinforced aluminum foil, with conductive pressure-sensitive adhesive on one side for mounting. Low compression set, excellent conductivity and durability make these materials cost-effective as grounding pads.

Choices include UL 94V-0 or 94HB-rated compositions and three grades of softness. Numerous standard thicknesses range from 0.048 to 0.279 inch (1.2 to 7.1 mm), up to 6.0 inches (152 mm) wide. For rapid peel and stick applications, kiss-cut parts are supplied on polyester film release sheets. Custom die-cutting is also available.

For detailed information on SOFT-SHIELD 4000 materials, refer to page 98.



SOFT-SHIELD® 2000 Series
Conductive Yarn over Foam

This configuration features silver-plated nylon yarn knitted over highly compressible, thermoplastic EPDM foam and securely bonded to the core. Secondary termination is not required, and closure force is <1 lb/inch (0.175 N/mm).

Ten standard D and rectangular profiles range from 0.140 x 0.100 inch (3.56 x 2.54 mm) to 0.500 x 0.375 inch (12.70 x 9.53 mm), with pressure-sensitive adhesive standard. Pre-cut pieces can be supplied for rapid application.

For detailed information on SOFT-SHIELD 2000 Series materials, refer to page 101.

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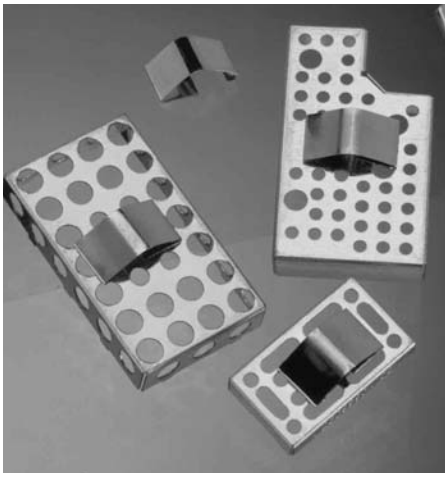


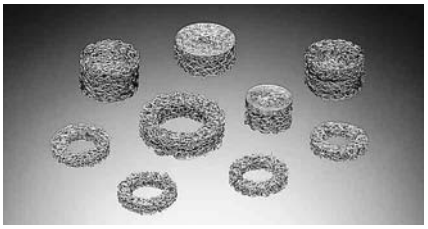
SPRING-LINE®
"Pick and Stick" Springfingers

Highly resilient, 0.002 inch (0.051 mm) thin fingers compress under low closure force. Their tin-plated beryllium copper construction provides excellent conductivity and galvanic corrosion resistance.

In a typical application, springfinger tabs affixed to metal cans soldered over board components establish contact between adjacent PCBs, simplifying grounding to the housing. Tight compression does not affect resilience or electrical performance.

Parts include high-tack pressure-sensitive adhesive on the mounting surface, and are supplied in strips for snap-off application, as individual pieces, or spaced on film reels for "pick-and-stick" application.

For more information on SPRING-LINE Springfingers, refer to page 126.



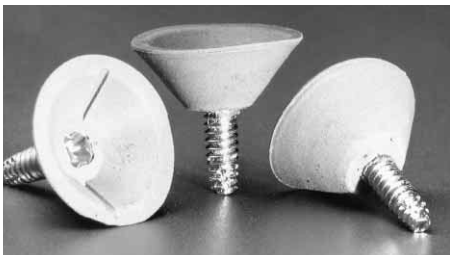
SHIELD MESH™
Compressed Mesh Buttons

Knitted wire mesh that has been die-compressed into cylindrical configurations exhibits significant resilience when compressed under load and released. Mesh buttons provide a low impedance ground contact in applications such as slide-out drawers in an enclosure rack. Integral compression stops can be included.

Since the material compresses under load, no allowance is required for lateral deflection.

Standard wires include aluminum, monel (nickel-copper alloy) or Chomerics' Ferrex tin-plated-copper clad steel.

For detailed information on SHIELD MESH Compressed Mesh, refer to page 115.



CHO-BUTTON™
EMI Grounding Contacts

Consisting of a molded CHO-SEAL conductive elastomer cap and integral thread-cutting screw, CHO-BUTTON contacts can provide an alternative to continuous conductive gasketing in flange joints. When spaced at 4 to 8 inch (102 to 203 mm) intervals, >40 dB shielding effectiveness is achieved between 20 and 200 MHz. Their design, resilience and flexibility accommodate wide joint gap tolerances, even under low closure forces.

For more information on CHO-BUTTON EMI Grounding Contacts, refer to page 156.

CHO-SEAL® and CHO-SIL®
Conductive Elastomer "Peel and Stick" Tabs

With many standard sizes and material choices, conductive elastomer extrusions afford real design flexibility for grounding applications when supplied kiss-cut on PSA mounting tape. Hollow D profiles, available as small as 0.125 (3.18 mm) wide, are typically chosen, but others may be used, including custom profiles.

Cost and performance options include a choice of conductive particle fillers in silicone or fluorosilicone binders. All offer excellent resistance to compression set over a wide temperature range.

Grounding tabs can also be produced using molding techniques that accommodate special design features or geometries.

For detailed information on conductive elastomer extrusions, refer to page 35.

PRODUCT	SOFT-SHIELD 5000 Series Foam	SOFT-SHIELD 4000 Series Foam	SOFT-SHIELD 2000 Series Foam	SPRING-LINE Springfingers	SHIELD MESH Buttons	CHO-SEAL & CHO-SIL Conductive Elastomers
Standard Profiles	Rectangular, D, V, C, P and others	Flat rectangular, die-cut shapes	Rectangular, D	Various	Cylindrical	Solid and hollow O, D, P, rectangular
Custom Profiles	Yes	Yes	Yes	Yes	Yes	Yes
Construction/ Composition	Nickel-plated silver nylon ripstop fabric over urethane	Fabric-reinforced aluminum foil over urethane	Silver-plated yarn over thermo-plastic EPDM foam	Beryllium-Copper	Knitted monel or Ferrex® wire	Conductive particle filled silicone or fluorosilicone extrusion
Attachment	Non-conductive PSA	Conductive PSA	Non-conductive PSA	Non-conductive PSA	Friction Fit	Non-conductive PSA
Continuous Lengths Kiss-cut, Tape Kiss-cut, Film Sheet Cut-to-Length Pieces	Yes Yes Yes Yes	Yes Yes Yes Yes	Yes — — Yes	Yes Yes Yes Yes	Supplied as individual parts	Yes Yes Yes Yes
Grounding Effectiveness (1 = highest)	2	2	3	1	2	2

CHO-BUTTON™ EMI Grounding Contacts

CHO-BUTTON EMI Grounding Contacts

CHO-BUTTON grounding contacts provide a reliable RF bond between metallic parts of an enclosure (side panels-to-frame, door-to-frame, etc.). When spaced at 4 to 8 inch intervals, the shielding effectiveness obtained is greater than 40 dB for emissions below 200 MHz. This level of shielding is normally adequate to meet commercial EMI specifications for digital devices operating below 50 MHz.

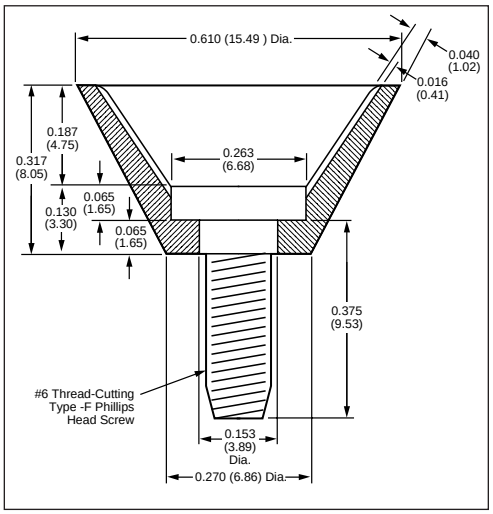
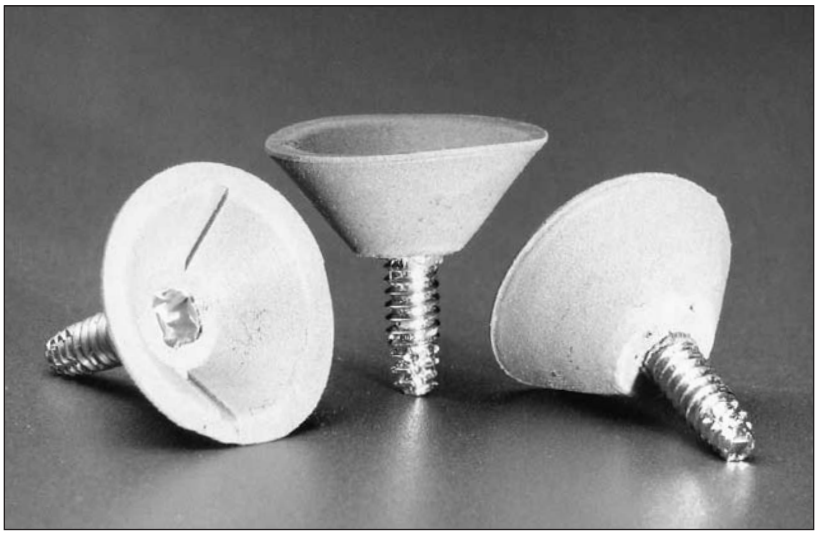


Figure 1 Standard Dimensions for CHO-BUTTON Grounding Contacts *inch (mm)*

They are molded from Chomerics' highly conductive CHO-SEAL® silicone elastomers, and provide an alternative to continuous conductive gasketing in flange joints. CHO-BUTTON contacts will deflect 30% (0.094 inch or 2.38 mm) under approximately 3 pounds (1.4 kg) of closure force.

Product Features

- Easily installed with integral thread-cutting screw
- Design of button cross section and excellent resilience/flexibility of CHO-SEAL elastomer allow conformability to wide joint gap tolerances
- Highly conductive CHO-SEAL material (5 x 10^{-3} ohm-cm) results in low contact resistance even under low closure pressure



- Provides more than 40 dB shielding effectiveness between 20 MHz and 200 MHz when spaced 8 inches (20.3 cm) apart (and even better shielding at closer spacing)
- Will not oxidize or increase significantly in resistance over time
- Cannot be over-torqued (positive stop)

Application Notes

1. The retention hole should be deburred and slightly countersunk for best long-term results. For CHO-BUTTON P/N 86-10-A617-1215, the diameter of the retention hole should be 0.118 inch (3.0 mm), and a minimum of 0.375 inch (9.53 mm) deep if not a through-hole.

2. The surface against which the button mates must remain conductive over the life of the equipment. If flanges are painted with non-conductive coatings, proper care must be taken to mask and electrically stabilize the contact points. Bare steel or aluminum will not remain sufficiently conductive over time. Flange treatments (such as MIL-C-5541 Class 3 chromate conversion) or pressure-sensitive tin-plated copper flange tapes (such as Chomerics' CHO-MASK II Foil Tape, page 144) are effective ways to provide long-term electrical stability of flange contact points.

Ordering Procedure

Dimensions for the standard CHO-BUTTON grounding contact are shown in Figure 1. The part number is 86-10-A617-1215. For custom sizes consult with our Applications Engineering Department.

Table 1

TYPICAL PROPERTIES		
Shielding Effectiveness (30-22 MHz)		>40 dB
Contract Resistance:	@ 5% deflection	25 mOhm
	@ 10% deflection	<10 mOhm
	@ 40% deflection	<10 mOhm
	@ 50% deflection	<10 mOhm
Current Capacity (5 minute test)		30 amps
Conductive Elastomer Filler		Silver -plated metallic particles

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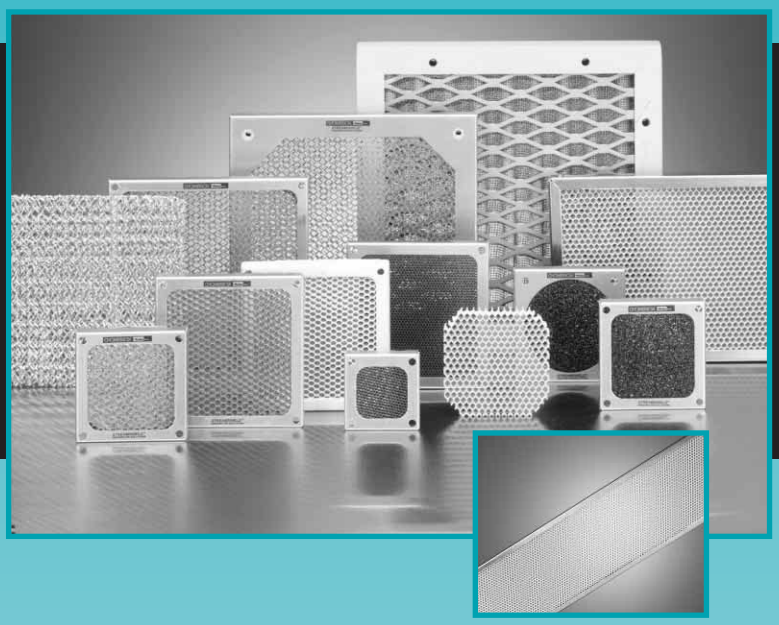
Parker Seals

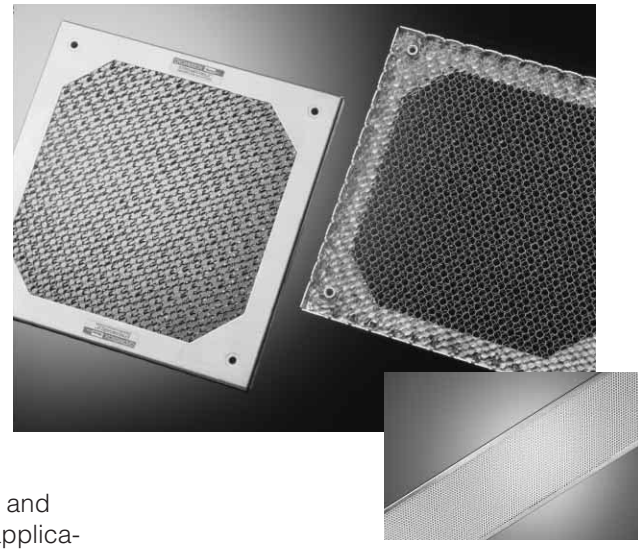
EMI Shielded Vents



SECTION CONTENTS	PAGE

STREAMSHIELD™ Technology Driven EMI/Airflow Solution

- Lightweight design
- Economical construction
- Excellent shielding performance (>50 dB @ 10 GHz)
- Excellent dimensional aspect ratios for airflow - ≥95% open area honeycomb for maximum airflow
- Customization
- Rapid prototyping



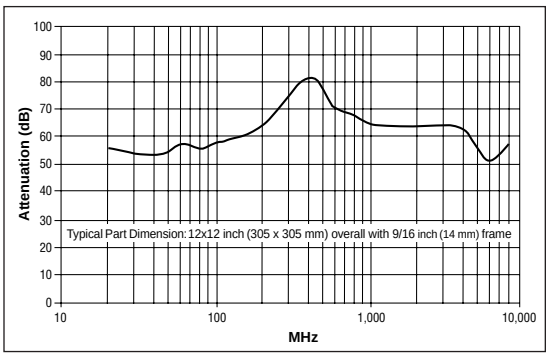
STREAMSHIELD EMI Shielded Vent/Airflow Panels

With their exclusive designs (patent pending) and manufacturing process, Chomerics' STREAMSHIELD vent panels have been developed as a high performance, economical solution to the EMI and airflow issues in information technology and telecommunications applications. Increased electromagnetic radiation and heat generation, together with intensified regulatory requirements for emissions suppression, necessitate a more sophisticated solution than simple perforations or louvers in electronic enclosures.

STREAMSHIELD vent panels deliver EMC and thermal management performance that meets the technology demands of today's electronic systems, including:

Switches	Personal computers
High speed routers	Network servers
Test equipment	Network cabinets and enclosures
Cooling fan covers	Access equipment
Indoor cellular base stations	Rack mounted power amplifiers
Wireless and wireline infrastructures	Storage cabinets

Figure 1 Shielding Effectiveness (dB) of STREAMSHIELD Vent Panel with OMNI CELL Construction



The STREAMSHIELD designs provide the same high performance as traditional honeycomb vent panels. Their honeycomb is ≥95% open area, minimizing pressure drop (Figure 4). The aperture size and cell depth provides the waveguide absorption and cut-off frequencies needed to solve even the most difficult EMI and airflow challenges.

Construction Choices

STREAMSHIELD vent panels are produced in two styles. In the first style, the honeycomb is incorporated into a stamped "tray" with integral tangs (fingers) around the periphery. The special mechanical process used to bend the tangs into the honeycomb ensures secure, consistent and reliable honeycomb-frame contact (see photo and Figure 2). This style is offered in two standard configurations that provide a square fan opening, or a round fan opening, as shown in Figure 3. In the second style, the honeycomb is incorporated into a roll-formed frame with a knitted aluminum wire mesh that maximizes contact (minimizes impedance) between the honeycomb and frame. Other construction features include:

- Aluminum alloy 3003 or 5052 framing
- Aluminum alloy 5052 honeycomb, 1/16 (1.6 mm) or 1/8 inch (3.2 mm) cells —1/8 inch (3.2 mm), 1/4 inch (6.35 mm) or 1/2 inch (12.7 mm) thickness
- 6.1 lb./ft.^{3} density, 0.0015 inch (0.38 mm) thick foil
- SOFT-SHIELD 5000 EMI Gasket (see page 93 for detailed description)
- Choice of surface finishes

Optional OMNI CELL® honeycomb construction (oriented 90° to counteract polarization effects)

OMNI CELL honeycomb construction provides higher shielding effectiveness than standard honeycomb construction. Contained in the same standard thickness frame, it utilizes two honeycomb panels, each of which is half the thickness of standard honeycomb. Foil directions of the two OMNI CELL layers are at right angles to each other to eliminate the polarized shielding characteristics of conventional honeycomb. Refer to Figure 2.

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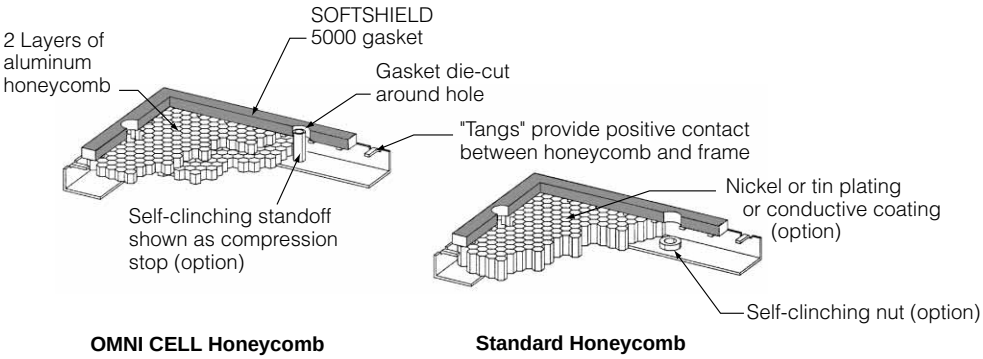
Customization Options

- Alternative honeycomb cell sizes and thicknesses
- Alternative EMI gaskets
- Custom sized frames
- Custom fastener hole patterns
- Chromate conversion coating — clear or yellow, provides corrosion resistance and paintable surface
- Electroless nickel or electrolytic tin plating — enhances EMI shielding and corrosion protection, but chromate conversion coating also required if parts are to be painted
- Conductive paint - alternative to plating
- Intumescent paint - see inset below.
- Foam filters - 30 pore per inch polyether filter foam, UL94 HF1 rated. Other pore densities are available.

Figure 2 STREAMSHIELD Panel Construction (stamped tray) Example



- Protective grilles - 0.030 inch (0.76 mm) thick, 0.250 inch (6.35 mm) hex perforated metal with 0.281 inch (7.14 mm) centers, for harsh environments
- Special hardware - for example, self-clinching standoffs or nuts (Figure 2)

Chomerics' Application Engineering Department is ready to assist you with evaluating cost-effective STREAMSHIELD EMI shielded vent/airflow panels in your design.

Fire Retardant *HE*ICF 1594 Intumescent Coating System

Optional surface treatment for STREAMSHIELD panels or other honeycomb products

Chomerics' *HE*ICF 1594 intumescent coating is a water-based system that is applied to honeycomb shielding vent panels to improve fire containment in electronic enclosures. A thin coating in the honeycomb cells reacts on exposure to flame or heat at 300°F (149°C) and expands rapidly, filling the cells with a carbonaceous foam that prevents flames from propagating through the honeycomb. This system can be invaluable in meeting the requirements for Network Equipment Building Systems (NEBS) compliance, and Bellcore GR-63-CORE Physical Protection Standards for Fire Resistance (Spread).

Fire Protection Performance

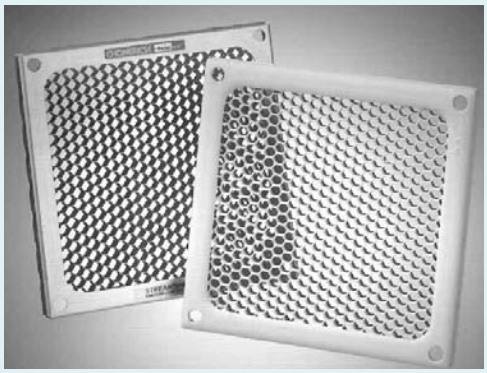
The HEICF 1594 coating system is based on the same fire retardant chemistry that meets the requirements of the ASTM E-84 Test Procedure and that is classified by UL as providing Class A (0-25) flame spread protection and low smoke density (15 on a scale of 0-450) on the standard test substrate. Currently, there are no established test criteria for intumescent coatings on honeycomb vent panels. NOTE: Suitability of use for this product in a specific application must be determined by the user.

Heat and Humidity Resistance

The *HE*ICF 1594 coating system has been tested for heat and humidity aging in Chomerics' laboratories. Heat aging at 185°F (85°C) for 168 hours caused slight darkening of the coating, but had no effect on the intumescent properties. Humidity aging at 185°F (85°C) and 85% relative humidity for 168 hours also had no effect on the intumescent properties of the coating system.

Mechanical Considerations

There is a reduction in the open area of the honeycomb when the coating system is applied. The coating system has approximately 4 mils (0.10 mm) dry film thickness. Standard 6.1 lb./ft^3, 1/8 inch cell (3.18 mm) honeycomb is 96% open before coating. After coating, it is 84% open. The addition of the coating increases the structural strength/stiffness of the honeycomb.



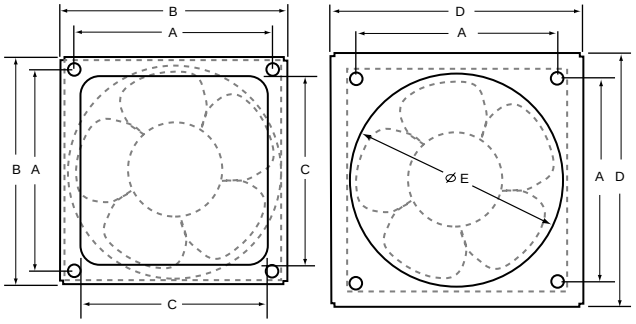
Coated (right) and non-coated (left) STREAMSHIELD vent panels. Intumescent coating of plain honeycomb pane (unframed) is also available.

Colors

The *HE*ICF 1594 coating system is off-white in color as a standard, but is compatible with universal colorants within limits. Many colors, therefore, can be offered on a custom option basis.

In addition to coating EMI shielded vents, Chomerics extends its Intumescent Coating capabilities to unframed honeycomb paneling. Contact Chomerics for more information.

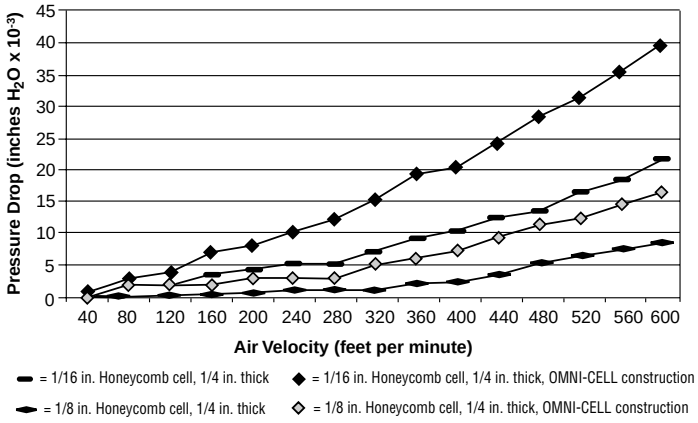
Figure 3 Standard STREAMSHIELD Configurations



Configuration 1
(square opening)

Configuration 2
(round opening)

Figure 4 Pressure Drop Across Various Honeycomb Media



Ordering Procedure

Use the following part number system to order STREAMSHIELD vent panels. For alternative frame and honeycomb cell sizes or additional customization, part numbers will be assigned by Chomerics.

FPCV - XXXXX - X X X X X X

Part Number from Table 1

Honeycomb Cell Size
A = 1/16 inch (1.59 mm)
B = 1/8 inch (3.18 mm)

Total Honeycomb Thickness
A = 1/8 inch (3.18 mm)
B = 1/4 inch (6.35 mm)
C = 1/2 inch (12.7 mm)

Honeycomb Style
A = Straight (single layer)
B = OMNI CELL (two layers, oriented)

Surface Treatment
A = Mill Finish
B = Etched
C = Clear Chromate
D = Yellow Chromate
E = Electroless Nickel
F = Electrolytic Tin

Finish
A = No Paint
B = Conductive Paint
C = Intumescent Paint
D = Intumescent/Conductive

Miscellaneous Options
F = Foam Filter
G = Protective Grille

Table 1

STREAMSHIELD VENTS FOR STANDARD FAN SIZES Dimensions, inch (mm)						Part Numbers	
Fan Size	**A**	**B**	**C**	**D**	**E (dia.)**	**Config. 1**	**Config. 2**
25 mm	0.79 (20.00)	—-	—-	1.38 (35.05)	0.90 (22.86)	——	11025
40 mm	1.26 (32.00)	1.58 (40.13)	1.07 (27.18)	1.96 (49.78)	1.50 (38.10)	10040	11040
60 mm	1.97 (50.04)	2.29 (58.17)	1.97 (50.04)	2.47 (62.74)	2.05 (52.07)	10060	11060
80 mm	2.81 (71.37)	3.13 (79.50)	2.53 (64.26)	3.51 (89.15)	3.00 (76.20)	10080	11080
92 mm	3.25 (82.55)	3.56 (90.42)	3.25 (82.55)	3.94 (100.08)	3.40 (86.36)	10092	11092
120 mm	4.13 (104.90)	4.45 (113.03)	4.13 (104.90)	4.82 (122.43)	4.20 (106.68)	10120	11120
150 mm	6.38 (162.05)	6.70 (170.18)	6.38 (162.05)	6.70 (170.18)	5.40 (137.16)	10150	11150

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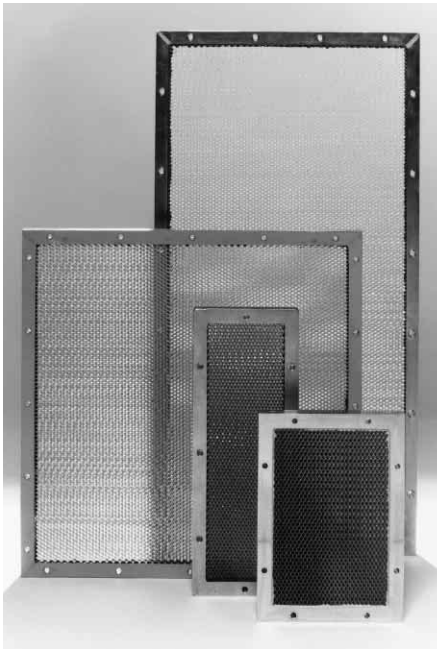
CHO-CELL™ Shielded Vent Panels



CHO-CELL Shielded Vents

CHO-CELL panels are Chomerics' very high performance shielded honeycomb air vents, especially designed for high frequency environments and to meet TEMPEST specifications. They provide greater than 90 dB attenuation between 200 MHz and 10 GHz. Shielding is typically 30 dB better than conventional panels, achieved by unique design features, which include a CHO-SEAL mounting gasket.

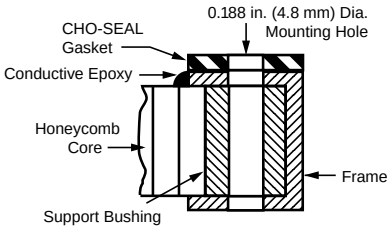
CHO-CELL vents are free of polarization effects, provide low air resistance, and are lightweight. They are offered in custom configurations, with thru-hole mounting.

Table 1

SPECIFICATIONS	
Honeycomb	0.002 in. (0.051 mm) foil, 0.125 in. (3.2 mm) cells, 0.500 in. (12.7 mm) thick aluminum per MIL-C-7438; finish: electroless nickel per MIL-C-26074C, Class 1, Grade A, 0.0015 in. (0.04 mm) thick
Frame	Aluminum per QQ-A-200/8 alloy 6061-T4; finish: electroless nickel per MIL-C-26074C, Class 1, Grade A, 0.0015 in. (0.04 mm) thick
Mounting Gasket	CHO-SEAL 1215 silver-plated-copper filled silicone
Sizes	Per customer requirements, up to 24 x 24 in. (61 x 61 cm) max.
Mounting Holes	Thru holes, 0.188 in. (4.8 mm) dia. (for #8 screws) *[2-3 in. (5.1-7.6 cm) spacing recommended]*

Ordering Procedure

CHO-CELL panels are made to customer size specifications up to 24 x 24 in. (61 x 61 cm). Part numbers will be supplied by Chomerics. Contact our Applications Engineering Department.



Cross Section of CHO-CELL Vent

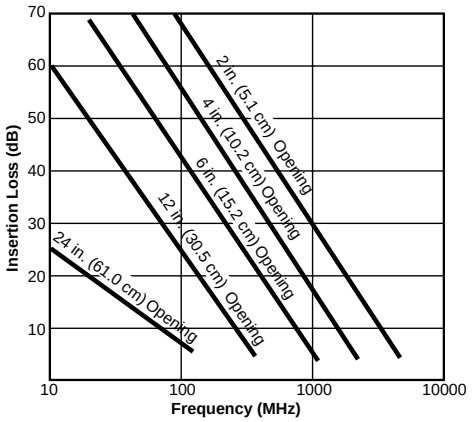


Figure 1 Insertion Loss Through Apertures
The above data illustrates insertion loss typically achieved through open apertures from 24 in. to 2 in. square (per MIL-STD-285).

See page 168 for shielding effectiveness information.

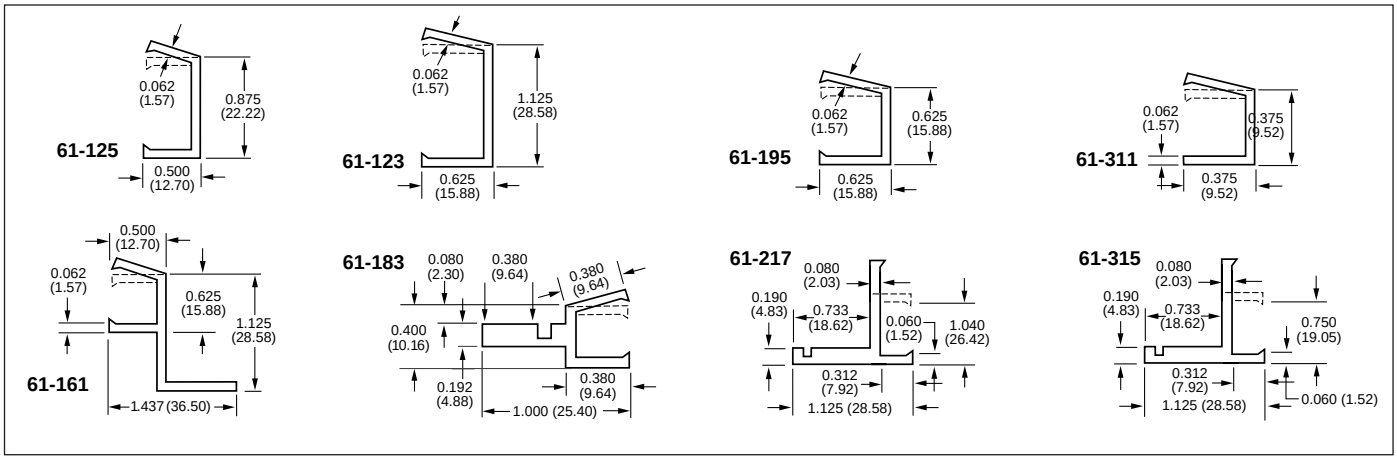


Figure 2 Alternate Extrusions for CHO-CELL Construction, in. (mm). *Others available, please inquire.*

(mm dimensions in parentheses)

SHIELD CELL® & OMNI CELL® Shielded Vent Panels

SHIELD CELL and OMNI CELL

EMI Shielded Ventilating Panels

Ready-to-install SHIELD CELL and OMNI CELL panels provide maximum EMI shielding with minimum pressure drop (air flow resistance) for ventilating air. All styles are composed of metal honeycomb shielding panels in EMI gasketed frames of like material. Panels are ready-to-mount, in such a manner that the frame gasketing is compressed firmly against the shielded housing to maximize shielding performance.

Standard framing for all panel designs includes both an EMI shielding gasket and a seal, from a combination of monel knitted wire mesh and sponge neoprene. Panels larger than 12 x 24 in. (305 x 610 mm) are equipped with cross braces.

SHIELD CELL Panels

Standard SHIELD CELL panel construction is all-aluminum, with 1/8 in. (3.2 mm) cells, 1/2 in. (12.7 mm) thick. The complete frame/honeycomb assemblies are chromate conversion coated. Additional sizes available include: 3/16 in. (4.7 mm) cells, 3/4 in. (19 mm) thick; and 1/4 in. (6.4 mm) cells, 1 in. (25.4 mm) thick. Standard aluminum honeycomb is recommended for applications where shielding requirements are not severe.*

For improved shielding effectiveness and environmental protection, these lightweight aluminum ventilation panels are available tin plated. However, in applications requiring maximum shielding levels and greater weight support, either steel or brass honeycomb shielded vents are recommended. (Refer to page 164, Steel and Brass Honeycomb Shielded Vents, for specifications.)

OMNI CELL Panels

OMNI CELL ventilating panels are high performance aluminum honeycomb units in Chomerics' unique configuration. The OMNI CELL configuration eliminates the normal polarized shielding characteristics of conventional aluminum honeycomb, as do brass and steel panels. In place of the single honeycomb, two parallel honeycomb panels, each half the thickness of standard SHIELD CELL honeycomb, are contained in a single frame of standard thickness. Foil directions of the two honeycomb layers are at right angles to each other to eliminate non-symmetrical shielding effects. Each honeycomb layer contains 1/8 in. (3.2 mm) cells, 1/4 in. (6.4 mm) thick, for a total thickness of 1/2 in. (12.7 mm). The finished panel assemblies are chromate conversion coated.

OMNI CELL construction is usually the best general purpose honeycomb vent. It provides significantly more shielding than conventional SHIELD CELL aluminum honeycomb, at only nominally higher cost.

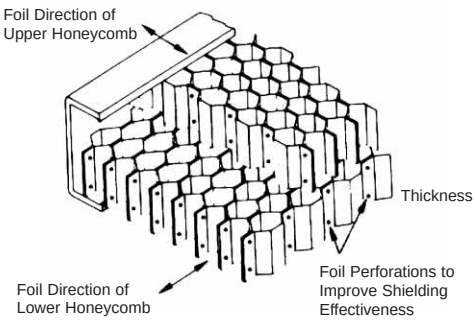


Figure 1 OMNI CELL Honeycomb Construction

Drip Proof OMNI CELL Panels

In this construction, the outer layer of aluminum honeycomb is slanted down and out at 30°, 45°, or 60° from the horizontal. This drip-proof construction results in a somewhat increased air flow resistance (Figure 4).

*See page 168 for shielding performance data.

(mm dimensions in parentheses)

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Parker Seals

Round SHIELD CELL and OMNI CELL Panels

All honeycomb panels can be supplied in circular frames, for which two common designs are recommended in Figure 5. These are of spun metal or circular tubing. Minimum flange width is 0.375 in. (9.5 mm), with 0.500 in. (12.7 mm) preferred.

Ordering Procedure

Standard aluminum honeycomb size: 0.500 in. (12.7 mm) thick. Select SHIELD CELL or OMNI CELL part number from Table 1, page 167.

Note: Please specify angle orientation relative to the outside length and width dimensions of OMNI CELL panel.

Other sizes, or round: Supply a drawing in accordance with Figure A (as shown on this page). For alternative frame designs or round panels, supply a sketch in accordance with figures 4, 5, or 6. Part numbers will be assigned by Chomerics.

Non-standard honeycomb, or brass or steel requirements: Contact Chomerics' Applications Engineering Department.

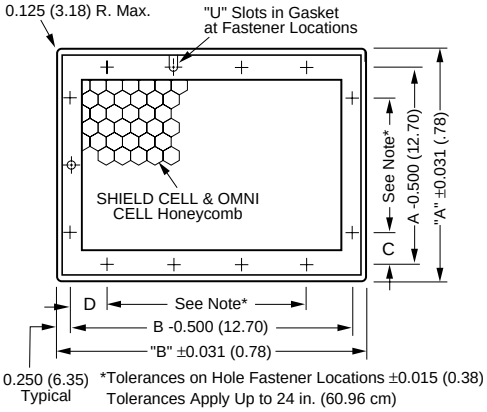

Figure 2 Dimensions for SHIELD CELL and OMNI CELL Vent Panels

(Refer to Common Parts Table, page 167)

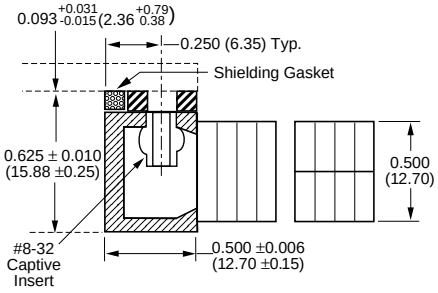

Figure 3 Standard SHIELD CELL and OMNI CELL Frame Construction Frame Design 61-118

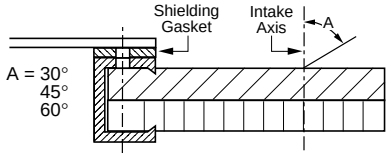

Figure 4 OMNI CELL Drip-Proof Construction

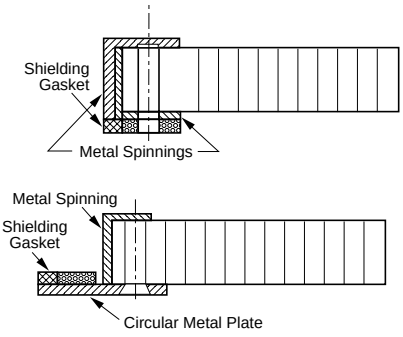

Figure 5 Circular panels

See page 168 for shielding effectiveness and airflow information.

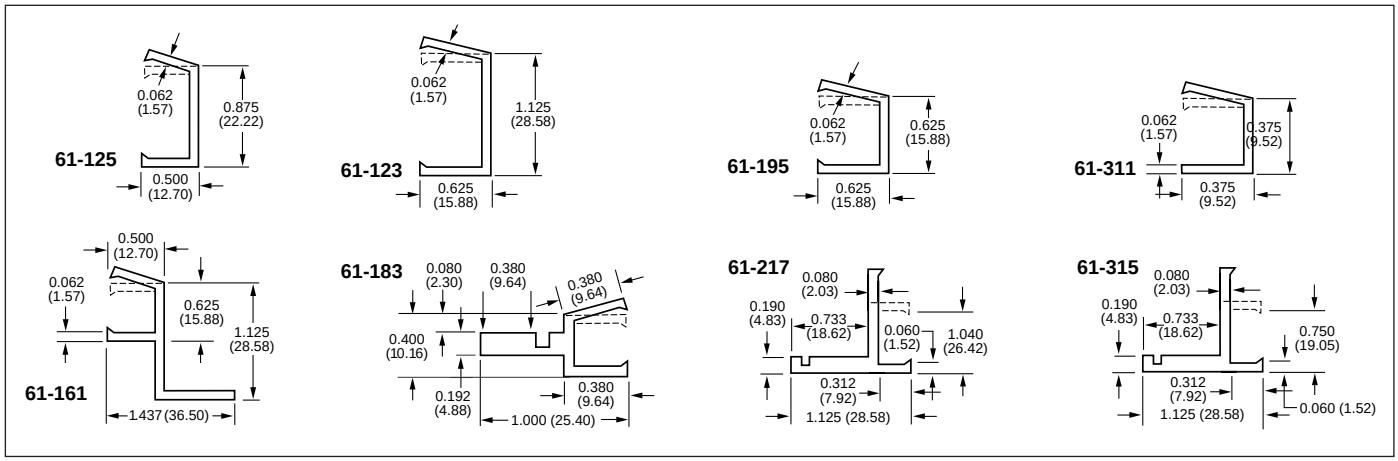

Figure 6 Alternate Extrusions for SHIELD CELL and OMNI CELL Construction *(others available, please inquire).*

(mm dimensions in parentheses)

Steel and Brass Honeycomb Shielded Vents

Steel and Brass Honeycomb Shielded Vents

Chomerics' steel honeycomb ventilation panels are designed for maximum H-field shielding effectiveness. They are especially suited for use in military enclosures, communications shelters and shielded rooms, and should be of interest to designers of EMP-hardened and TEMPEST equipment. In applications where environmental concerns are critical, brass honeycomb shielded vents are recommended. They provide optimum EMI shielding performance *plus* corrosion resistance.

Custom constructed using welded steel or brass frames with steel or brass honeycomb inserts, these panels are offered in a full range of shapes, including circular, in 0.5 in. (12.7 mm) and 1.0 in. (25.4 mm) thicknesses. The straight-through cell design minimizes pressure drop. When desirable, the honeycomb inserts may be stacked for additional thickness. In addition, shielding performance is optimized by specifying that the honeycomb be soldered to the frame. Panel surfaces are finished with cadmium, tin or nickel plating, depending on customer requirements. Stainless steel units are also available.

These panels are provided ready-to-install by welding in place (no gasket), or with mounting holes when supplied with integral EMI gasketing. Typically Ferrex* wire/neoprene COMBO® gasketing (page 112) is specified, but conductive elastomer gasketing is available on request.

Ordering Procedure

Chomerics' steel and brass honeycomb shielded vents are custom fabricated to specified dimensions. *Part numbers will be assigned by Chomerics.* A detailed drawing should be provided to Chomerics.

Table 1

SPECIFICATIONS	
Steel	
Frame	SAE 1010 steel
Honeycomb	SAE 1010 steel, welded or soldered. Foil thickness 0.005 in. (0.127 mm) and 0.006 in. (0.152 mm). Cell size 1/8 in. (3.18 mm), 3/16 in. (4.76 mm) and 1/4 in. (6.35 mm).
EMI gasketing	Typically COMBO gasketing consisting of Ferrex wire mesh in parallel with neoprene elastomer weather seal (refer to COMBO STRIP pages in the Metal EMI Gaskets section). *Also available with conductive elastomer EMI gasket.*
Finish options	Cadmium plate per QQ-P-416 Type II, Class 2 chromate; tin plate per MIL-T-10727 Type 1; nickel plate per MIL-C-2607A.
Brass	
Frame	Brass Alloy 260 1/2 hard
Honeycomb	Brass Alloy 260 1/2 hard per QQ-B-613. Foil thickness 0.005 in. (0.127 mm) ±0.0005 in. (0.013 mm). Cell size 1/8 in. (3.18 mm), 3/16 in. (4.76 mm), and 1/4 in. (6.35 mm).
EMI gasketing	Typically COMBO gasketing consisting of Ferrex wire mesh in parallel with neoprene elastomer weather seal (refer to COMBO STRIP pages in Metal-Based Gaskets section). *Also available with conductive elastomer EMI gasket.*
Finish	Copper plate per MIL-C-14550, Class 4, followed by tin plate 0.0003 in. min. per MIL-T-10727 Type

*Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

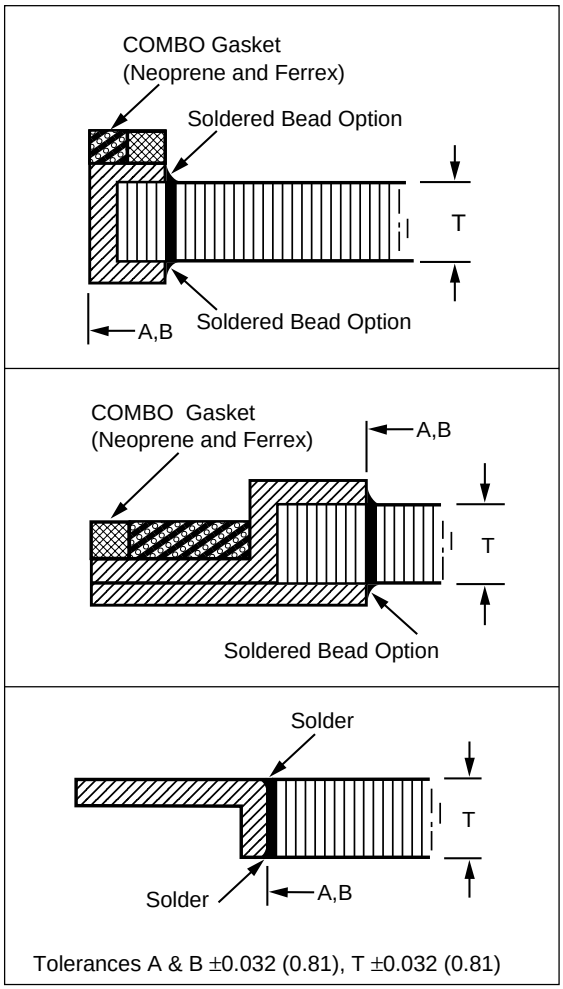

Figure 1 Typical Frame Styles *(others available)*

See page 168 for shielding effectiveness and airflow information.

(mm dimensions in parentheses)

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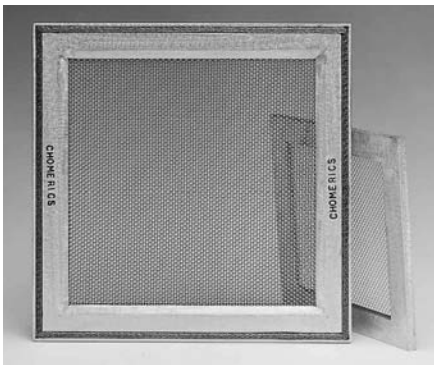
SLIMVENT™ Shielded Vent Panels VIP® & SHIELDSCREEN® Shielded Air Filters



SLIMVENT™ Thin, Lightweight Panels for Air Intake and Exhaust Ports

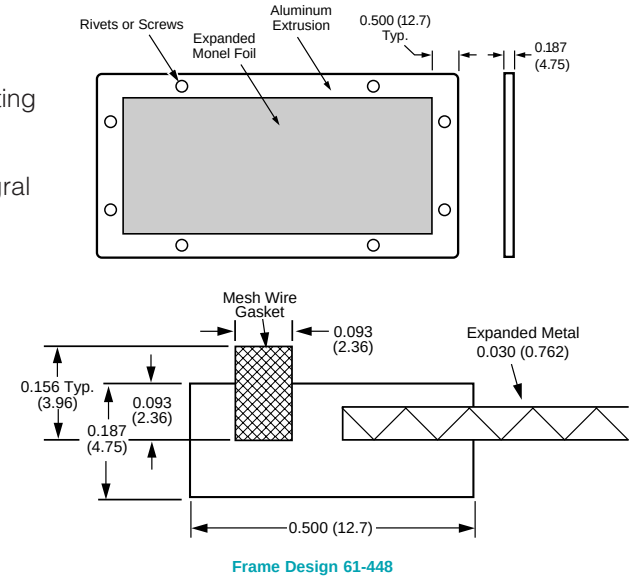
SLIMVENT air ventilation panels provide 90 dB attenuation at 1 MHz to 50 dB at 10 GHz. The panels are made from expanded aluminum or monel (a nickel-copper alloy) foil, secured in an extruded aluminum frame only 0.187 in. (4.75 mm) thick. This narrow profile is ideal for accommodating critical space limitations at air intake and exhaust ports.

The frame features an integral wire mesh gasket for EMI shielding at the mounting interface.

Ordering Procedure

Chomerics' SLIMVENT air panels are custom fabricated to specified dimensions. *Part numbers will be assigned by Chomerics.* A detailed drawing should be provided to Chomerics.

See page 168 for shielding effectiveness information.



Frame Design 61-448

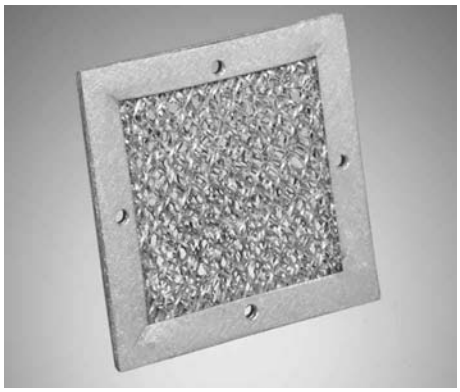
Figure 1 Typical SLIMVENT Panel Construction *(others available, please inquire).*

VIP® (Viscous Impingement) EMI Shielded Air Filters

Chomerics' VIP air filters are all metal EMI shielded panels used at the air intake on shielded enclosures which require low-velocity cooling air. Their filtering medium is multi-layer expanded aluminum, which can be coated with viscous oil for dust impingement.

VIP filters are specifically designed for applications requiring any of the following: *maximum dust arrestance; easy removal and reinstallation; repetitive cleaning of excessive dust deposits; minimum penetration of the enclosure in restricted space situations.*

To withstand severe environments, VIP panel elements are all-aluminum, chromate conversion coated. VIP filters are supplied in customer-specified sizes ranging from 2 x 4 in., to 30 x 48 in. (5.1 x 10.2 cm, to 76.2 x 122.0 cm), complete with EMI gasketed, extruded aluminum frame with mounting holes, ready for installation. Integral monel knitted wire mesh gasketing is available. However, although the panel is self gasketing, because the expanded aluminum filter is of greater thickness than the frame into which it is compressed.



VIP filters can be cleaned readily in detergent solution and re-oiled with a commercial air filter spray before being remounted.

Ordering Procedure

Chomerics readily fabricates VIP air panels to meet varying application needs. *Part numbers will be assigned by Chomerics.* A detailed drawing should be provided to Chomerics.

See page 168 for airflow information.

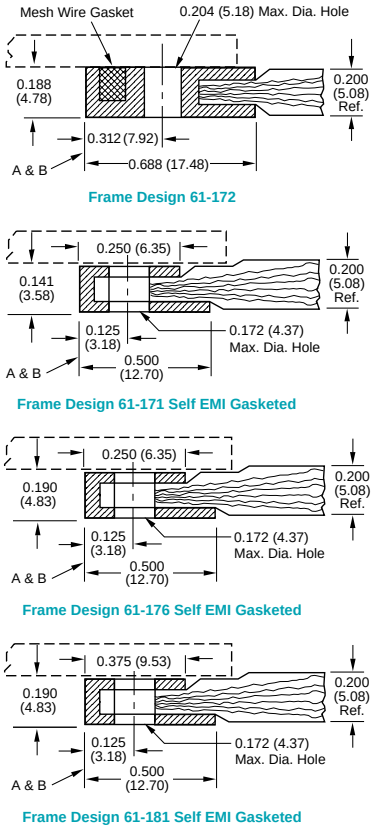


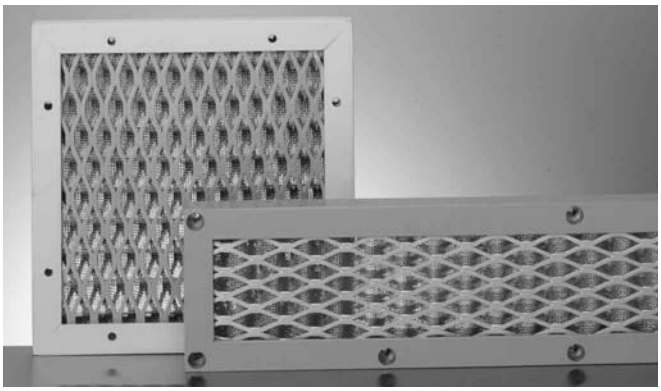
Figure 1 VIP Standard Frame designs

(mm dimensions in parentheses)

SHIELDSCREEN EMI Shielded Air Filters

Ready-to-install SHIELDSCREEN filters incorporate highly effective, integral EMI frame gasketing of monel with an optional neoprene sponge weather seal. Filtering is provided by several layers of woven wire mesh behind a retaining grille. The mesh layers are nested in "hills and valleys" of decreasing height to separate layers and increase dust holding capacity (see Figures 1 and 2). The mesh filter may be used dry, or wet with viscous oil coating, which improves adhesion of dust particles to the filtering material.

SHIELDSCREEN frames are of the same EMI gasketed, extruded aluminum construction as SHIELD CELL aluminum honeycomb panels. Because they are complete assemblies, removal for periodic cleaning is simple. Dry filters are cleaned by vacuuming from the intake side (which can be accomplished in place), or in detergent solution. Oil impregnated filters require removal and cleaning in detergent solution. Re-oiling is required after cleaning with detergent. The standard, inexpensive SHIELDSCREEN design 61-118 (Figure 1) requires the least space and includes installed fasteners. Typical alternative styles are shown in Figure 2, but more than a dozen others are available.



Ordering Procedure

Refer to Table 1 on page 167 for SHIELDSCREEN shielded air filter part numbers and dimensions. Chomerics also fabricates custom SHIELDSCREEN filters to meet specific dimensions. *Part numbers will be assigned by Chomerics.* A detailed drawing should be provided to Chomerics.

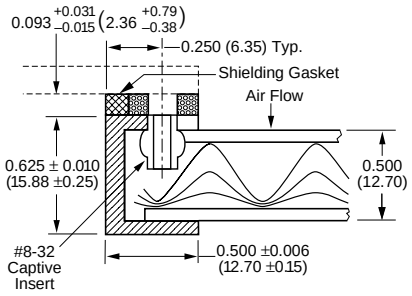


Figure 1 Standard Frame Design 61-118

See page168 for airflow information.

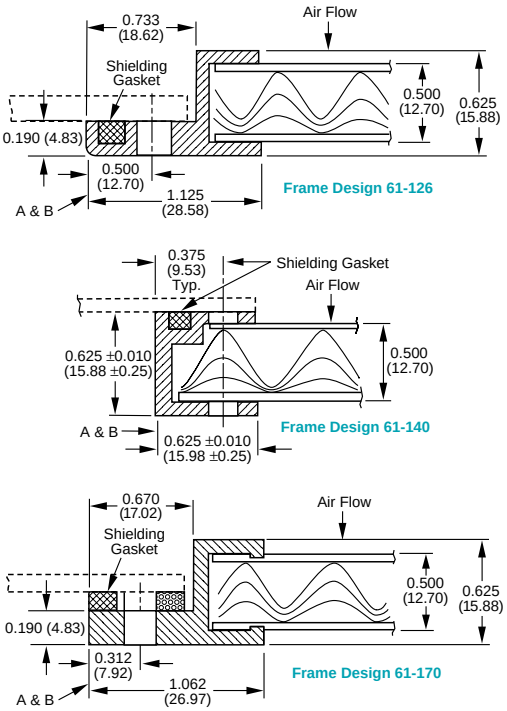


Figure 2 Alternative Frame Designs *(others available, please inquire).*

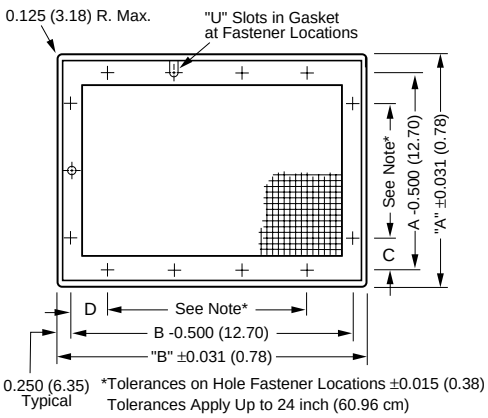


Figure 3 SHIELDSCREEN Air Filters, Standard Construction
(Refer to Common Parts Table, page 167)

(mm dimensions in parentheses)

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Table 1

STANDARD ALL-ALUMINUM FRAME DIMENSIONS: SLIMVENT, SHIELDSCREEN, VIP, OMNI CELL AND SHIELD CELL PANELS

Part Number					Overall Dimensions		Side A Dimensions			Side B Dimensions			Effective Area $in^2(cm^2)$
SLIMVENT™	SHIELDSCREEN®	VIP®	Aluminum OMNI CELL®	SHIELD CELL®	A	B	C	No. Fasteners	Spacing	D	No. Fasteners	Spacing	
Specify "SLIMVENT" Air Vents Contact Chomerics for Part Numbers	06-1302-0896	Specify "VIP" FILTER Contact Chomerics for Part Numbers	06-1102-0872	06-0302-0111	4 (101.60)	4 (101.60)	1.750 (44.45)	1	–	1.750 (44.45)	1	–	9 (58)
	06-1302-0897		06-1102-0873	06-0302-0112	4 (101.60)	6 (152.40)	1.750 (44.45)	1	–	1.000 (25.40)	2	3.500 (88.90)	15 (97)
	06-1302-0898		06-1102-0874	06-0302-0113	4 (101.60)	8 (203.20)	1.750 (44.45)	1	–	0.750 (19.05)	3	3.000 (76.20)	21 (135)
	06-1302-0899		06-1102-0875	06-0302-0114	4 (101.60)	12 (304.80)	1.750 (44.45)	1	–	1.250 (31.75)	4	3.000 (76.20)	33 (213)
	06-1302-0900		06-1102-0876	06-0302-0108	5 (127.00)	5 (127.00)	2.250 (57.15)	1	–	0.750 (19.05)	2	3.000 (76.20)	16 (103)
	06-1302-0901		06-1102-0877	06-0302-0115	5 (127.00)	7 (177.80)	2.250 (57.15)	1	–	1.500 (38.10)	2	3.500 (88.90)	24 (155)
	06-1302-0902		06-1102-0878	06-0302-0116	5 (127.00)	10 (254.00)	2.250 (57.15)	1	–	1.250 (31.75)	3	3.500 (88.90)	36 (232)
	06-1302-0903		06-1102-0879	06-0302-0117	6 (152.40)	6 (152.40)	1.000 (25.40)	2	3.500 (88.90)	1.000 (25.40)	2	3.500 (88.90)	25 (161)
	06-1302-0904		06-1102-0880	06-0302-0118	6 (152.40)	8 (203.20)	1.250 (31.75)	2	3.000 (76.20)	0.750 (19.05)	3	3.000 (76.20)	35 (226)
	06-1302-0905		06-1102-0881	06-0302-0119	6 (152.40)	12 (304.80)	1.000 (25.40)	2	3.500 (88.90)	1.250 (31.75)	4	3.000 (76.20)	55 (355)
	06-1302-0906		06-1102-0882	06-0302-0120	6 (152.40)	18 (457.20)	1.000 (25.40)	2	3.500 (88.90)	1.250 (31.75)	5	3.750 (95.25)	85 (548)
	06-1302-0907		06-1102-0883	06-0302-0121	7 (177.80)	7 (177.80)	1.500 (38.10)	2	3.500 (88.90)	1.500 (38.10)	2	3.500 (88.90)	36 (232)
	06-1302-0908		06-1102-0884	06-0302-0122	7 (177.80)	10 (254.00)	1.500 (38.10)	2	3.500 (88.90)	1.250 (31.75)	3	3.500 (88.90)	54 (348)
	06-1302-0909		06-1102-0885	06-0302-0123	7 (177.80)	14 (355.60)	1.500 (38.10)	2	3.500 (88.90)	1.500 (38.10)	4	3.500 (88.90)	78 (503)
	06-1302-0910		06-1102-0886	06-0302-0124	8 (203.20)	8 (203.20)	2.000 (50.80)	2	3.500 (88.90)	0.750 (19.05)	3	3.000 (76.20)	49 (316)
	06-1302-0911		06-1102-0887	06-0302-0125	8 (203.20)	12 (304.80)	0.750 (19.05)	3	3.000 (76.20)	1.250 (31.75)	4	3.000 (76.20)	77 (497)
	06-1302-0912		06-1102-0888	06-0302-0126	8 (203.20)	16 (406.40)	0.750 (19.05)	3	3.000 (76.20)	1.250 (31.75)	5	3.250 (82.55)	105 (677)
	06-1302-0913		06-1102-0889	06-0302-0109	10 (254.00)	10 (254.00)	1.250 (31.75)	3	3.500 (88.90)	1.250 (31.75)	3	3.500 (88.90)	81 (522)
	06-1302-0914		06-1102-0890	06-0302-0127	10 (254.00)	14 (355.60)	1.250 (31.75)	3	3.500 (88.90)	1.500 (38.10)	4	3.500 (88.90)	117 (755)
	06-1302-0915		06-1102-0891	06-0302-0128	10 (254.00)	18 (457.20)	1.250 (31.75)	3	3.500 (88.90)	1.250 (31.75)	5	3.750 (95.25)	153 (987)
	06-1302-0916		06-1102-0892	06-0302-0129	12 (304.80)	12 (304.80)	1.250 (31.75)	4	3.000 (76.20)	1.250 (31.75)	4	3.000 (76.20)	121 (780)
	06-1302-0917		06-1102-0893	06-0302-0110	12 (304.80)	16 (406.40)	1.250 (31.75)	4	3.000 (76.20)	1.250 (31.75)	5	3.250 (82.55)	165 (1064)
	06-1302-0918		06-1102-0894	06-0302-0083	12 (304.80)	20 (508.00)	1.250 (31.75)	4	3.000 (76.20)	1.000 (25.40)	6	3.500 (88.90)	209 (1348)
	06-1302-0919		06-1102-0895	06-0302-0130	12 (304.80)	24 (609.60)	1.250 (31.75)	4	3.000 (76.20)	1.250 (31.75)	7	3.500 (88.90)	253 (1632)

(mm dimensions in parentheses)

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Performance Data

SHIELDED VENTS AND FILTER PANEL PERFORMANCE

Shielding Effectiveness

The shielding effectiveness of various Chomerics honeycomb ventilation panels is shown in Figures 1-4. In Figure 1, note that single layer honeycomb (SHIELD CELL) is extremely dependent on the orientation of the honeycomb foil seams (which are bonded with a non-conductive adhesive). A difference of 40 dB can be demonstrated between seams oriented vertically and horizontally. OMNI CELL designs eliminate the effect of orientation by incorporating two separate honeycomb panels at 90° to one another.

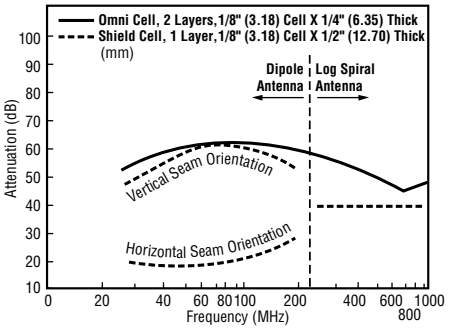

Figure 1 Shielding Effectiveness of SHIELD CELL and OMNI CELL Ventilation Panels

Figure 2 gives the shielding performance of Chomerics' highest performance CHO-CELL vent panel. Shielding data for a typical Steel Honeycomb shielded vent panel and SLIMVENT air ventilation panel is provided in Figures 3 and 4.

For shielding data on VIP and SHIELDSCREEN air filters, contact Chomerics' Applications Engineering Dept.

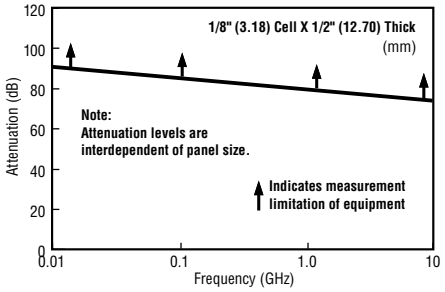

Figure 2 Shielding Effectiveness of CHO-CELL Vents

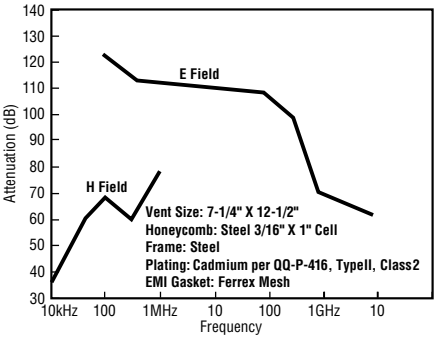

Figure 3 Shielding Effectiveness of Steel Honeycomb Shielded Vent Panel

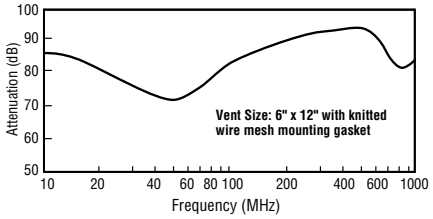

Figure 4 Shielding Effectiveness of SLIMVENT EMI Shielding Vent Panel

Air Flow

Figures 5 and 6 provide data on air flow characteristics of SHIELD CELL and OMNI CELL ventilation panels. Note that slant honeycomb (for drip-proof designs) increases the pressure drop across the panel.

Figures 7-9 show the filtering performance of wet and dry SHIELDSCREEN filter panels and VIP filters.

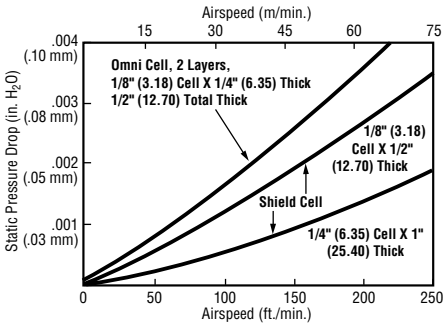

Figure 5 Static Pressure Drop vs. Airspeed *(Note: Pressure drop for steel and brass honeycomb is approximately double the value for aluminum honeycomb.)*

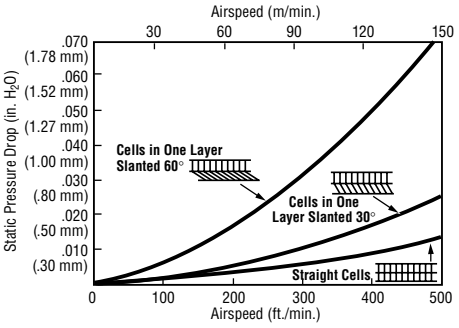

Figure 6 Static Pressure Drop vs. Airspeed OMNI CELL Honeycomb

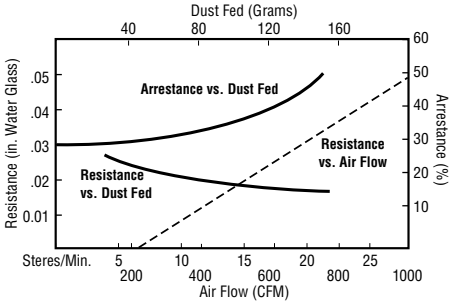

Figure 7 Dry-Type SHIELDSCREEN Filtering Performance

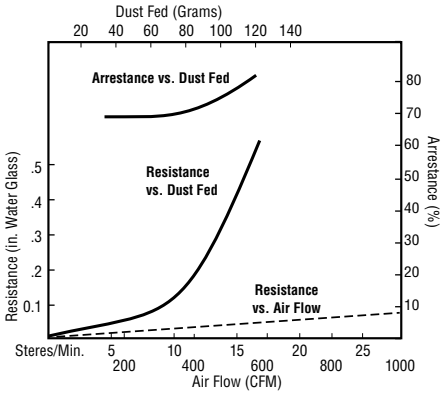

Figure 8 Wet-Type SHIELDSCREEN Filtering Performance

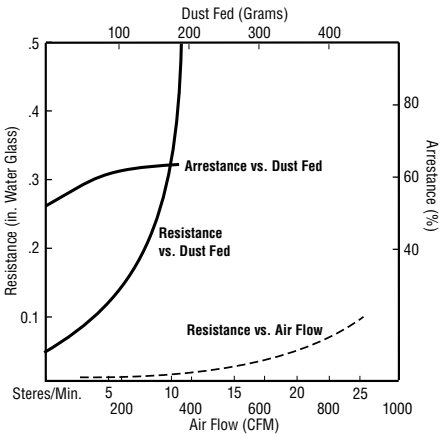

Figure 9 Arrestance and Airflow Resistance of VIP Filters

(mm dimensions in parentheses)

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EMI Shielded Windows & Contrast Enhancement Filters

SECTION CONTENTS	PAGE

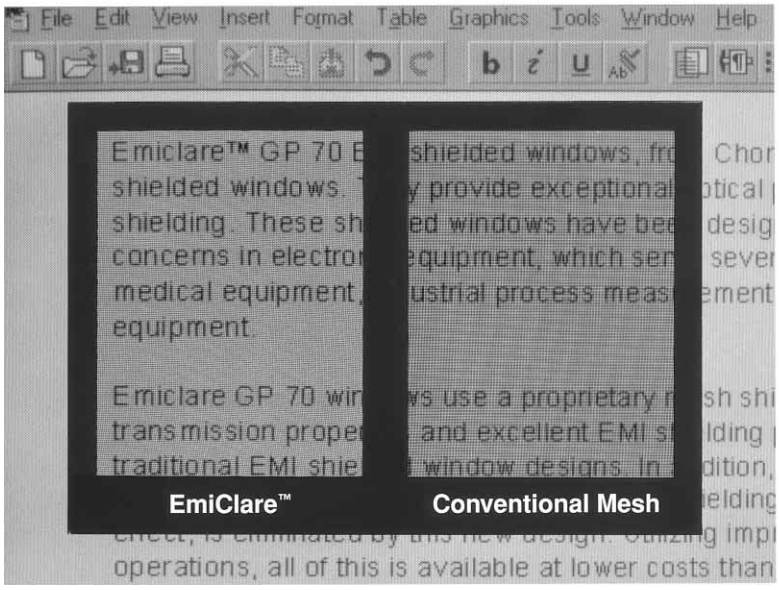
EmiClare™ GP 70 EMI Shielded Windows

EmiClare GP 70 EMI Shielded Windows

EmiClare GP 70 EMI shielded windows provide exceptional optical performance without sacrificing EMI shielding. This new generation of shielded windows is designed specifically to address shielding concerns in electronic equipment, especially medical devices, industrial process, measurement and control equipment, and test equipment.

EmiClare GP 70 windows use a proprietary mesh shielding design that provides superior light transmission and EMI shielding properties when compared to traditional shielded window designs. Total shielded window light transmittance properties (Figure 4), result from the mesh, substrates and surface finishes used. This new design also minimizes the typical problem with text distortion on display screens caused by the shielding mesh orientation, i.e., the moiré effect. Through improved, efficient manufacturing operations, these features are available at prices typically below conventional shielded windows.

EmiClare GP 70 EMI shielded windows are manufactured as a fully laminated construction with optically matched adhesives and front and rear UL 94V-0 rated, optical grade, polycarbonate substrates. Standard finish for the front surface is a non-glare hardcoat. A clear hardcoat finish is standard on the rear surface. An optional clear hardcoat is available on the front surface.The shielding media is provided by the GP 70 proprietary mesh design.



EmiClare windows are available in standard 2.0 mm (0.08 in.) thickness, and as an option in 1.66 mm (0.06 in.) and 3.0 mm (0.12 in.) thicknesses. Window termination can be either square or stepped, with a silver epoxy busbar. EmiClare windows are also available with Chomerics' SOFT-SHIELD® 5000 EMI gasket termination. SOFT-SHIELD 5000 gaskets feature a conductive cloth over urethane foam core. (See page 93.)

Figure 1 – Termination for EmiClare GP 70 Windows

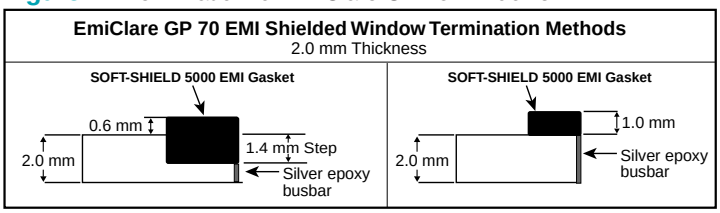


Table 1

EMICLARE GP 70 WINDOW SPECIFICATIONS	
Front Surface	Non-glare hard coating with a gloss level of 45. Clear hard coat is optional
Rear Surface	Clear hard coat is standard
Substrate	High optical grade polycarbonate, UL 94V-0 rated
EMI Shielding Effectiveness	See Figure 2
Scratch and Chemical Resistance	High scratch resistance to Pencil Test Type 2H. Chemical resistance to DIN standard 42115
Light Transmission	65-70% for the final assembly (Figure 4)
Quality	EmiClare windows are manufactured and inspected to Optical Inspection Standard OIS.3
Standard Thickness	2.0 mm (0.08 in.) with +/- 0.3 mm (0.01 in.) tolerance is standard. Other thicknesses are available on request
Maximum Window Size	Maximum window size is 533 mm x 533 mm (21 in. x 21 in.)
Termination	Square or step finishes with silver epoxy busbar and Chomerics SOFT -SHIELD® 5000 low closure force EMI gasket (Figure 1)
Part Numbering	Chomerics Part Numbers follow the format E-01-XXXXX and will be assigned by Chomerics

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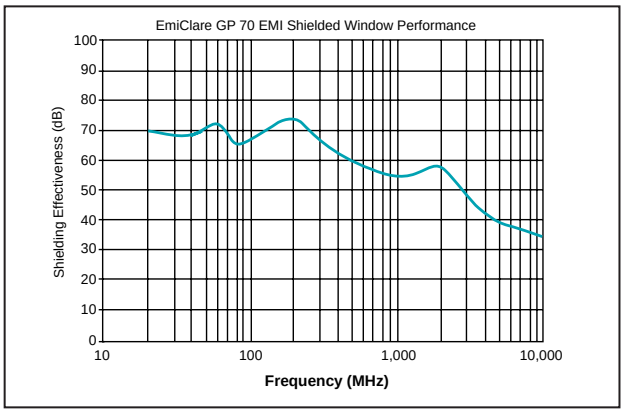
Figure 2 Shielding Effectiveness for EmiClare GP 70 Windows
(Measured via a modified MIL-STD-285 test procedure, CHO-TM-TPO8, using a 14 in. x 14 in. open aperture)



LIGHT TRANSMITTANCE

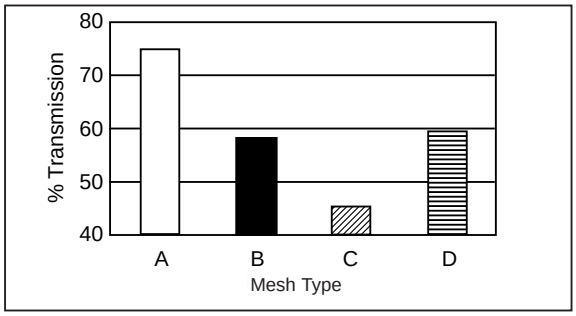
The light transmittance for a shielded window is a composite result of the effect of the shielding media, which includes the mesh, the front and rear substrates, and the surface finish on the substrates. The following figures and tables demonstrate how visual transmission is determined from the finished window assembly.

Mesh Light Transmittance

Figure 3 shows the percentage of light transmission for several different types of mesh used in typical EMI shielded windows.

A = EmiClare GP 70 mesh
B = blackened copper 100 opi/0.0022 in. (0.06 mm) wire diameter
C = plain copper 100 opi/0.0022 in. (0.06 mm) wire diameter
D = blackened/plated stainless steel 80 opi/0.0012 in. (0.03 mm) wire diameter

Figure 3 Mesh Light Transmittance



Substrate and Surface Treatment Light Transmittance

Table 2 shows the light transmittance of common shielded window substrates. Table 3 shows the light transmittance reduction for various surface finishes used on substrates for EMI shielding windows.

Table 2

SUBSTRATE LIGHT TRANSMITTANCE	
Substrate	**Light Transmittance**
Plain "float" glass	90-92%
Clear polycarbonate*	85-90%
Clear acrylic*	85-90%
Clear polyester*	83-88%

*varies with thickness due to internal dispersion

Table 3

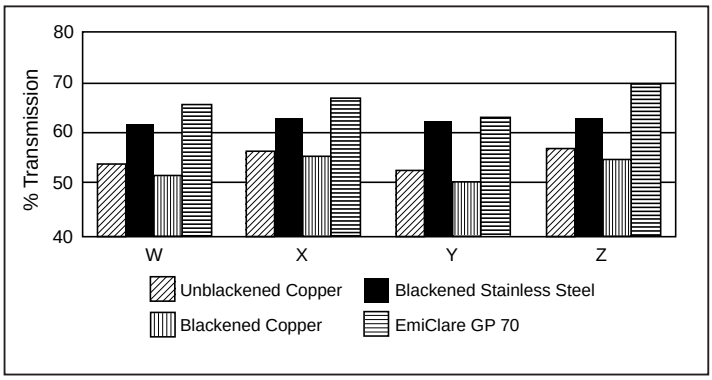
SURFACE FINISH LIGHT TRANSMITTANCE REDUCTION	
Surface Finish	**Light Transmittance Reduction**
Non-glare coatings (60-70 gloss)	2-3%
Non-glare coatings (80-90 gloss)	1%
Clear hard coat	<1%
MLAR* coating on glass	<1%

*multi-layer, anti-reflecting

Total Shielded Window Light Transmittance

Figure 4 details the actual light transmission of several types of EMI shielded windows, avoiding the common error of quoting the open mesh light transmission performance as that of the finished window.

Figure 4 Shielded Window Light Transmittance



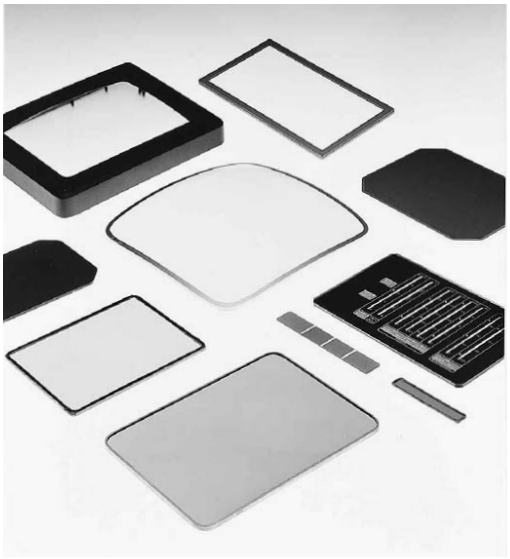
W = EMI shielded window 0.64 mm (0.025 in.) thick with polycarbonate substrates, with non-glare coating on the front surface and clear hard coat on the rear surface

X = EMI shielded window 1.2 mm (0.047 in.) thick with glass substrates, plain finish to both front and rear surfaces.

Y = EMI shielded window 1.5 mm (0.059 in.) thick with polycarbonate substrates, with non-glare coating on the front surface and plain polycarbonate on the rear surface.

Z = EMI shielded window 1.2 mm (0.047 in.) thick with glass substrates, MLAR (multi-layer anti-reflecting) coating on the front surface and plain glass on the rear surface.

WIN-SHIELD™ Optical Products



WIN-SHIELD Optical Products—Shielded Windows and Contrast Enhancement Filters

Chomerics produces a wide selection of performance-tested glass and plastic windows for visual displays requiring EMI radiation or susceptibility shielding.

These windows have been designed into commercial and military equipment to provide highly effective electromagnetic shielding while providing exceptional optical clarity and image resolution.

Chomerics' prototype-to-production capability includes an extensive line of spectrally-matched filters to meet stringent contrast enhancement performance requirements for both flat and curved configurations. By offering the best combination of EMI shielding and contrast enhancement, we've become a major supplier to manufacturers who must meet FCC and EU (European Union) requirements on digital devices.

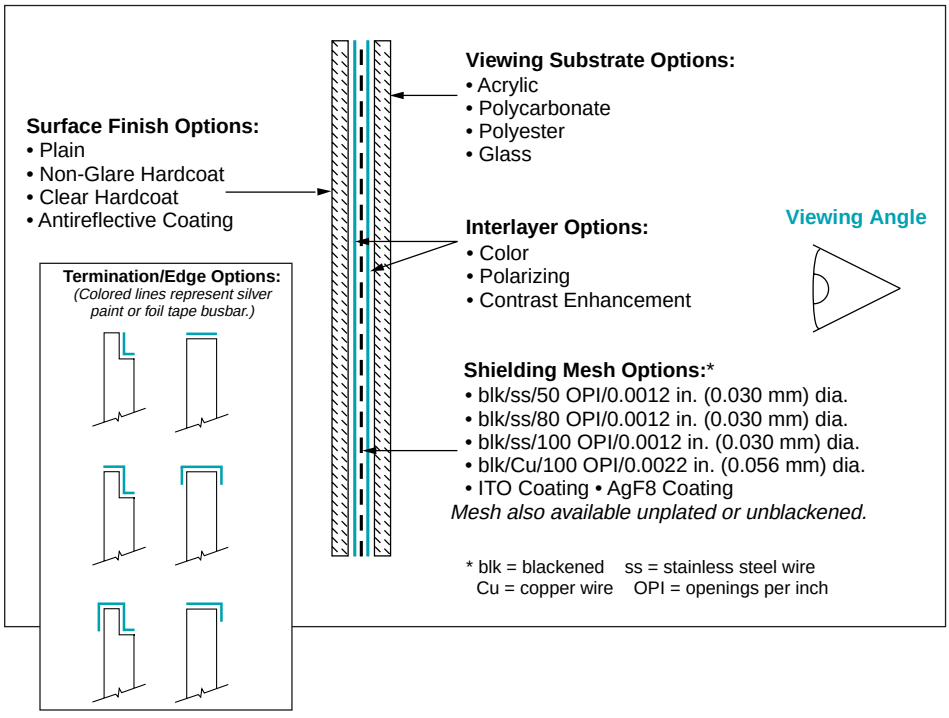
Windows can be produced in glass, plastic, or combinations of both. EMI shielding is provided by knitted or woven wire mesh, laminated between the glass or plastic substrates, or by deposited conductive coatings. Standard construction is shown in Figure 1. Shielding effectiveness is determined by the size of the wire screen openings, electrical contact between intersecting wires and the materials, and techniques employed to terminate the wire at the frame edge. Refer to Figures 2 and 3.

Our high performance EmiClare™ Shielded Windows utilize a proprietary mesh design in a fully laminated polycarbonate assembly that affords exceptional optical clarity without compromising EMI shielding performance. Refer to page 170 for more information on EmiClare Shielded Windows.

Our Applications Engineering staff and EMI Testing facilities provide the expertise necessary to design shielded window assemblies to meet specific requirements, and to verify performance. Our conductive adhesives, paints, tapes, gaskets and frames enable us to provide complete assemblies ready-to-mount.

Table 1

STANDARD COMPONENTS FOR WIN-SHIELD™ OPTICAL PRODUCTS	
Substrate materials	acrylic, polycarbonate, polyester, glass
Shielding materials	woven wire mesh, electrically conductive transparent coatings –Indium Tin Oxide, Silver Oxide
Shielding termination	conductive busbar, foil tape, extended mesh, conductive adhesive, conductive gasket
Anti-glare control	non-glare dispersive surface etch or coating on plastic and glass, multilayer anti-reflection coating on glass
Contrast enhancement	laminated broadband, high contrast narrow band, or sunlight readable spectrally matched filters, circular polarizers
Size limit and thickness range	Stainless Steel Mesh 24 x 24 in. (61 x 61 cm) 31-185 mils (0.8-4.7 mm) Copper Mesh 24 x 36 in. (61 x 91 cm) 31-185 mils (0.8-4.7 mm) AgF8 Film or Indium Tin Oxide 48 x 48 in. (122 x 122 cm) 7-8 mils (0.175-0.200 mm)



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WIN-SHIELD Windows EMI Shielding Performance

Figure 2

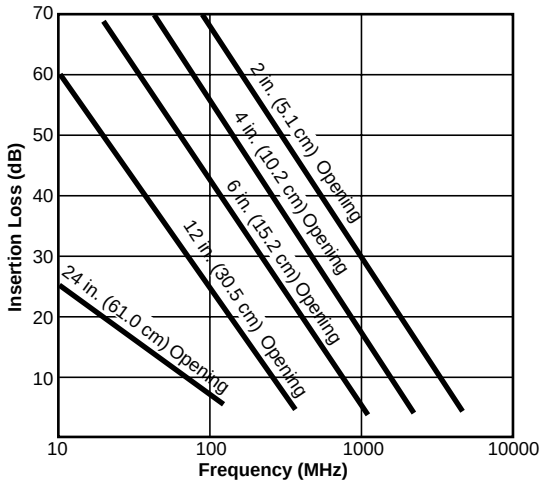


Figure 3

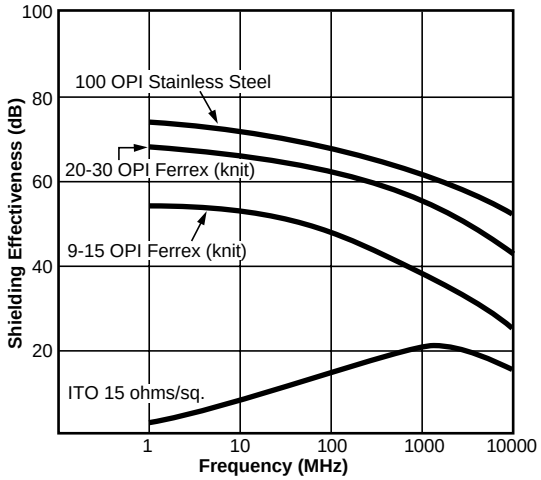


Figure 2 illustrates amount of insertion loss typically achieved through open apertures ranging from 24 in. to 2 in. (61 cm to 5.1 cm) square (per MIL-STD-285). Typical insertion losses of various window materials (properly terminated) are shown in **Figure 3.** To determine total shielding effectiveness attained for any size opening with any window material, add the appropriate curves in Figures 2 and 3 together.

Contrast Enhancement Filters

Figure 4 Antireflection Coating

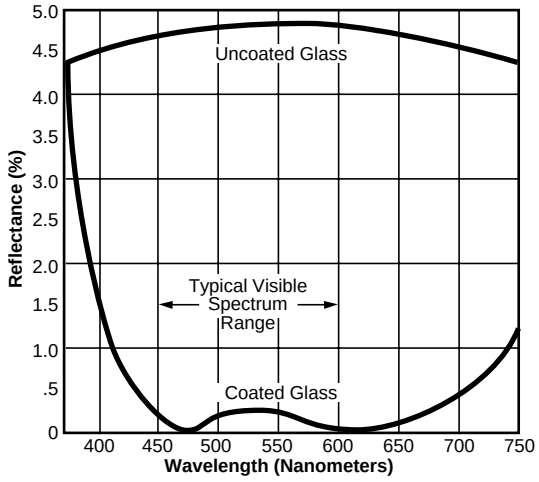


Figure 4 demonstrates the amount of glare reduction achieved with ≤0.35% MIL-C-14806A anti-reflection coating compared to uncoated glass.

Figure 5 Color Matching

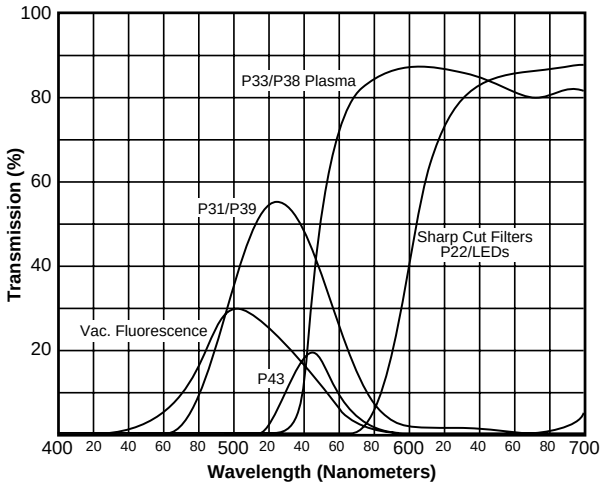


Figure 5 illustrates the light output of Chomerics' color filters. These filters are designed to match the peak wavelength of a display while selectively absorbing white light to achieve the greatest amount of display contrast.

WIN-SHIELD™ AgF8 Conductive Film

WIN-SHIELD AgF8 Conductive Film

Chomerics' AgF8 conductive film is a multi-layer, silver oxide-based thin film coating applied to a heat stabilized, optical quality polyester film. AgF8 film provides high visible light transmission and significant infrared reflectance.

The silver coating also provides high electrical conductivity, making AgF8 film a good EMI shielding material from 1 MHz to 1 GHz, suitable for use in most display applications. The attenuation profile, ignoring aperture effects, is shown in Table 2.

AgF8 conductive film is an ideal EMI shielding medium for applications where optical quality cannot be specified. Examples include high resolution CRT displays, multi-color displays, LCDs and EL displays. AgF8 conductive film will reflect heat for temperature-sensitive LCD applications.

Ordering Procedure

AgF8 coating is available as an unsupported film, in lengths up to 500 ft. (150 m). Nominal thickness is 0.008 inch (0.2 mm) and maximum width is 48 inches (122 cm). It can also be laminated to acrylic, polycarbonate or glass, and combined with circular polarizers and dichroic (color) filters.

Contact our Applications Engineering Department to review your requirements.

Table 1

WAVELENGTH (NM)	LIGHT TRANSMISSION (%)	REFLECTION (%)
400	60	10
500	82	6
550	82	5
600	80	6
650	76	10
1200	35	55
1500	20	74

Table 2

FREQUENCY	ATTENUATION (dB)
1 MHz (E-Field)	100
10 MHz (E-Field)	60
100 MHz (E-Field)	54
1 GHz (Plane Wave)	24
10 GHz (Plane Wave)	19

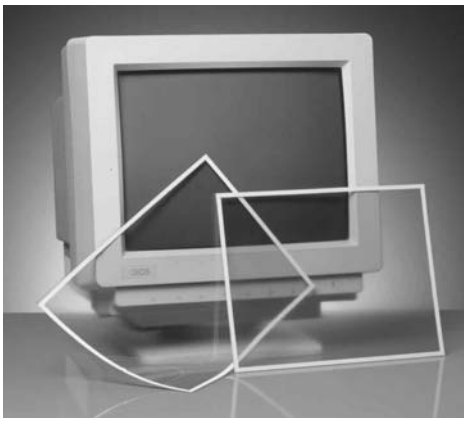
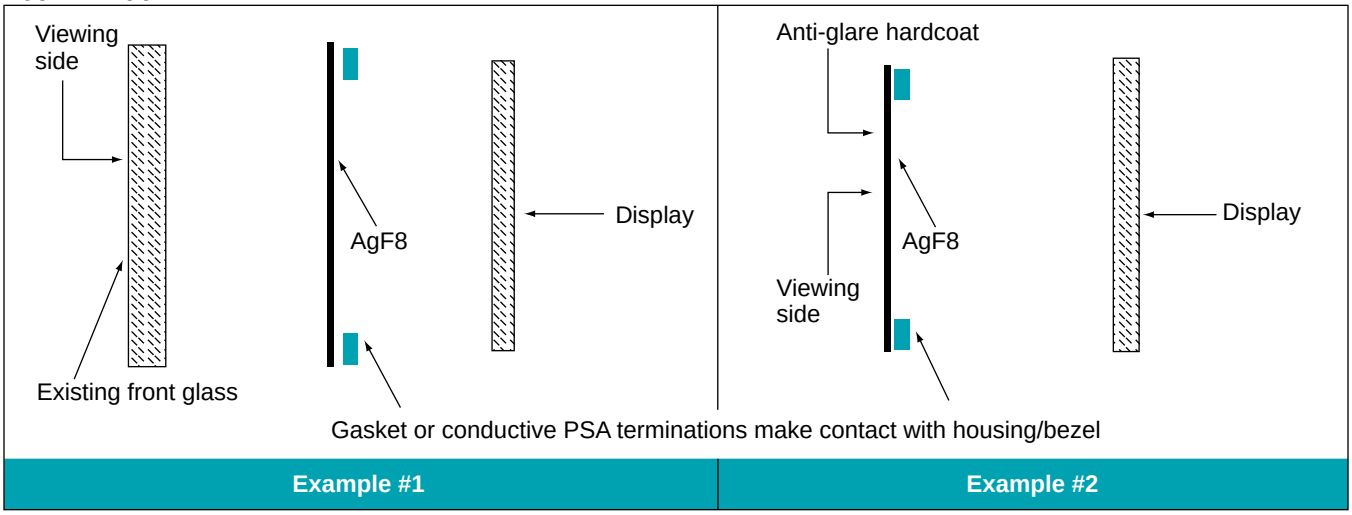


Table 3

TYPICAL PROPERTIES	
Surface Resistance, ohms/sq.	8-12
Visible Light Transmission, %	80
Thickness, inch (mm)	0.007-0.008 (0.175-0.200)
Environmental Stability Humidity: 140°F (60°C), 95% RH Dry Heat: 212°F (100°C) Saturated NaCl	120 hrs. with no change in resistance

Typical Applications



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Cable Shielding

SECTION CONTENTS	PAGE

CHO-SORB® EMI Ferrites

CHO-SORB EMI Ferrites

Cost effective CHO-SORB EMI ferrites reduce conducted emissions and ESD susceptibility on signal lines and power cables without affecting data transmission. They are widely used in computers, printers, keyboards, PBXs, CATVs, radio and television receivers, medical electronics, and data communications equipment. Unlike cable shields, CHO-SORB attenuators do not require grounding.

Easily installed CHO-SORB attenuators are made of specially formulated soft ferrite material containing various metallic oxides, primarily iron oxide. They possess two principle characteristics useful for controlling emissions: high magnetic permeability, which concentrates magnetic fields, and high electrical resistivity, which limits the flow of electrical current in the field.

CHO-SORB nickel zinc material is recommended for unwanted signals between 30 and 300 MHz and high frequency broadband transformers.

CHO-SORB ferrite attenuators are designed to absorb extraneous and unwanted energy on cable and circuit traces. Low frequency and DC see only the conductor and are unimpeded. High frequency energy couples with the CHO-SORB attenuator,

creating an impedance with inductive and resistive qualities.

When a conductor is surrounded by a ferrite attenuator, low frequency signals are transmitted without any loss. High frequency signals encounter inductive resistance due to the ferrite material's permeability. This resistance reduces the conducted current and introduces an insertion loss. At still higher frequencies, the permeability of the ferrite material decreases and the inductive resistance falls. Here, the resistive characteristics dominate and the resistive quality of the ferrite assumes control of providing the insertion loss for dissipating EMI.

Ordering Procedure

Standard CHO-SORB cable, surface mount and bead-on-lead ferrites are featured on the following pages. All configurations, including attachment clamps, are available through authorized Chomerics distributors for quick, off-the-shelf delivery.

Table 1

TYPICAL PROPERTIES – CHO-SORB EMI FERRITES		
Property	**Units**	**83-10-XXXX-1000**
Material	—	Nickel Zinc
Initial Permeability @ B <10 Gauss, μ_1	—	850
Flux Density @ (B) @ 10 Oersteds	Gauss	2750
Residual Flux Density	Gauss	1200
Loss Factor (tan/μ_1)	—	120 x 10^{-6} @ 1 MHz
Curie Temperature	°C	>130
Volume Resistivity	ohm-cm	10^5
Temperature Coefficient of μ_1 (20-70°C)	%/°C	1.0
Recommended Frequency Range	MHz	30-200

A CHO-SORB Attenuator Evaluation Kit is also available.

CHO-SORB EMI Ferrites Kit

Part Number: 83-10-KIT-1000

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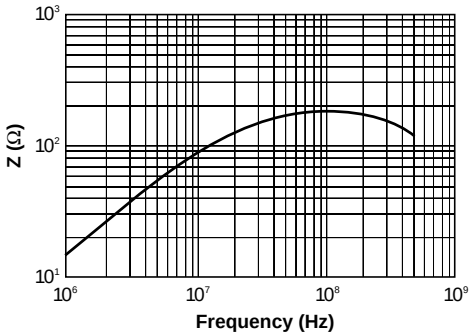
BEADS ON LEADS

Impedance-Frequency Characteristics
P/N 83-10-B550-1000



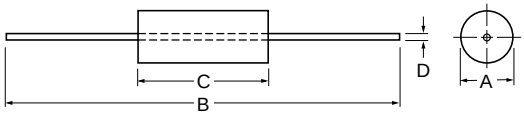


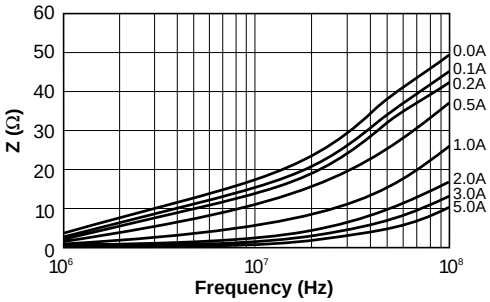
Table 2

Part Number	Dimensions – Inches (mm) A	B	C	D	Impedance (ohms) @ 25 MHz ±20%	@ 100 MHz ±20%
83-10-B519-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.175 (4.45±0.25)	22 AWG (0.65)	39	68
83-10-B544-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.236 (6.00±0.25)	22 AWG (0.65)	48	91
83-10-B545-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.263 (6.68±0.25)	22 AWG (0.65)	52	100
83-10-B547-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.350 (8.89±0.3)	22 AWG (0.65)	70	133
83-10-B550-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.545 (13.84±0.5)	22 AWG (0.65)	114	220
83-10-B840-1000	0.138 (3.51±0.25)	2.440 (61.98±1.5)	0.300 (7.62±0.3)	22 AWG (0.65)	60	110

NOTE: Beads on Leads are supplied taped and reeled. Inside tape spacing 52.4±1.5 mm.

SURFACE MOUNT BEADS

Impedance-Frequency Characteristics
P/N 83-10-S870-1000



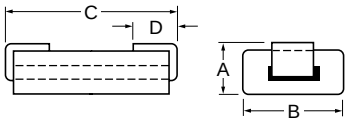


Table 3

Part Number	Dimensions – Inches (mm) A	B	C	D	Tape Width in. (mm)	Parts/ Reel	Impedance (ohms)* @ 25 MHz ±20%	@ 100 MHz ±20%	Resistance (dc/ohms) Max.
83-10-S870-1000	0.112 (2.84 ±0.2)	0.120 (3.05 ±0.1)	0.184 (5.08 –0.85)	0.059 (1.50 ±0.5)	0.47 (12)	2800	23	47	$0.6\ 10^{-3}$
83-10-S871-1000	0.112 (2.84 ±0.2)	0.120 (3.05 ±0.1)	0.359 (9.57 –0.95)	0.059 (1.50 ±0.5)	0.63 (16)	2800	45	95	$0.9\ 10^{-3}$

*Impedance measured using an HP 4191A with spring clip fixture HP 16092A.
NOTE: Surface mount beads are supplied taped and reeled in 13 inch reels.

WOUND SHIELD BEADS

Impedance-Frequency Characteristics
P/N 83-10-W891-1000

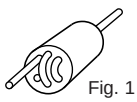


Fig. 1

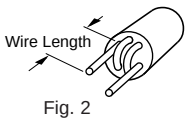


Fig. 2

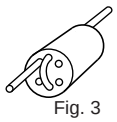


Fig. 3


Fig. 4

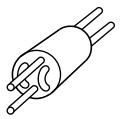
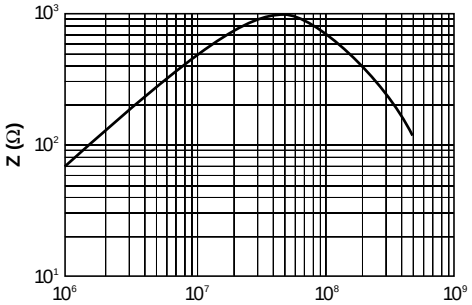
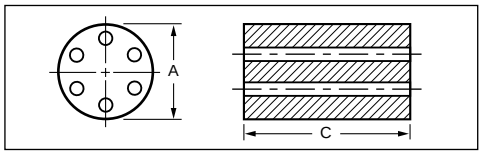


Fig. 5



Dimensions-Inches (mm)



Core O.D.: 0.236±0.01 (6.0±0.25) Core Length: 0.394±0.01 (10.0±0.25)

Table 4

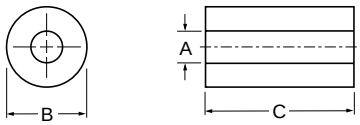
Part Number	Figure	Turns	Wire Size	Wire Length inches (mm)	Impedance (ohms)* @ 10 MHz ±20%	@ 50 MHz ±20%	@ 100 MHz ±20%
83-10-W890-1000	1	2.5	24 AWG (0.53)	1.50 (38.10±3.0)	435	824	684
83-10-W891-1000	2	3	24 AWG (0.53)	1.50 (38.10±3.0)	523	1000	758
83-10-W892-1000	3	1.5	24 AWG (0.53)	1.50 (38.10±3.0)	227	432	465
83-10-M12777-1000	4	2	24 AWG (0.53)	1.50 (38.10±3.0)	327	628	578
83-10-M12778-1000	5	2x1.5**	24 AWG (0.53)	1.50 (38.10±3.0)	228	429	450

*Impedance measured with the HP 4191A. **2 wires used - 1.5 turns on each wire.
NOTE: Wire used for winding is oxygen free, high conductivity with a tin plating.

continued

SLEEVE BEADS

Impedance-Frequency Characteristics
P/N 83-10-M460-1000



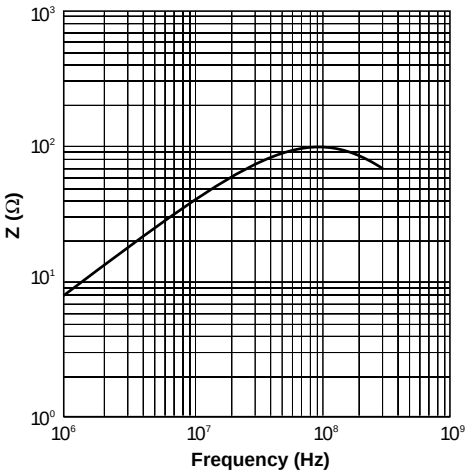


Table 5

		Dimensions - Inches (mm)		Impedance (ohms)*	
Part Number	A (I.D.) B	(O.D.)	C (Length)	@ 25 MHz ±20%	@ 100 MHz ±20%
83-10-M12886-1000	0.032±0.006 (0.80±0.15)	0.098±0.006 (2.50±0.15)	0.158±0.012 (4.00±0.30)	33	52
83-10-M12887-1000	0.032±0.006 (0.80±0.15)	0.138±0.006 (3.50±0.15)	0.552±0.016 (14.00±0.40)	144	21
83-10-M12888-1000	0.032±0.006 (0.80±0.15)	0.386±0.012 (9.80±0.30)	0.449±0.016 (11.40±0.40)	167	256
83-10-M12889-1000	0.040±0.006 (1.00±0.15)	0.119±0.006 (3.00±0.15)	0.119±0.008 (3.00±0.20)	25	47
83-10-M12890-1000	0.040±0.006 (1.00±0.15)	0.138±0.006 (3.50±0.15)	0.315±0.012 (8.00±0.30)	78	111
83-10-M12891-1000	0.048±0.006 (1.20±0.15)	0.119±0.006 (3.00±0.15)	0.119±0.008 (3.00±0.20)	23	44
83-10-M12892-1000	0.048±0.006 (1.20±0.15)	0.138±0.006 (3.50±0.15)	0.158±0.012 (4.00±0.30)	31	46
83-10-M12893-1000	0.048±0.006 (1.20±0.15)	0.138±0.006 (3.50±0.15)	0.197±0.012 (5.00±0.30)	37	55
83-10-M12894-1000	0.048±0.006 (1.20±0.15)	0.138±0.006 (3.50±0.15)	0.237±0.012 (6.00±0.30)	45	73
83-10-M12895-1000	0.048±0.006 (1.20±0.15)	0.138±0.006 (3.50±0.15)	0.276±0.012 (7.00±0.30)	54	84
83-10-M12896-1000	0.052±0.006 (1.30±0.15)	0.138±0.006 (3.50±0.15)	0.197±0.012 (5.00±0.30)	37	61
83-10-M516-1000	0.052±0.006 (1.30±0.15)	0.138±0.006 (3.50±0.15)	0.237±0.012 (6.00±0.30)	42	72
83-10-M12897-1000	0.052±0.006 (1.30±0.15)	0.138±0.006 (3.50±0.15)	0.355±0.012 (9.00±0.30)	62	80
83-10-M442-1000	0.052±0.004 (1.30±0.15)	0.139±0.008 (3.50±0.20)	0.128±0.010 (3.25±0.25)	27	44
83-10-M12898-1000	0.060±0.006 (1.50±0.15)	0.138±0.006 (3.50±0.15)	0.237±0.012 (6.00±0.30)	35	60
83-10-M12899-1000	0.060±0.006 (1.50±0.15)	0.197±0.008 (5.00±0.20)	0.434±0.016 (11.00±0.40)	93	150
83-10-M492-1000	0.062±0.006 (1.57±0.15)	0.200±0.008 (5.00±0.20)	0.438±0.016 (11.10±0.40)	93	148
83-10-M12839-1000	0.071±0.006 (1.80±0.15)	0.138±0.006 (3.50±0.15)	0.197±0.012 (5.00±0.30)	27	48
83-10-M12787-1000	0.079±0.006 (2.00±0.15)	0.158±0.008 (4.00±0.20)	0.079±0.006 (2.00±0.15)	14	37
83-10-M12901-1000	0.079±0.006 (2.00±0.15)	0.158±0.008 (4.00±0.20)	0.158±0.012 (4.00±0.30)	24	48
83-10-M12902-1000	0.079±0.006 (2.00±0.15)	0.158±0.008 (4.00±0.20)	0.197±0.012 (5.00±0.30)	28	51
83-10-M12903-1000	0.079±0.006 (2.00±0.15)	0.158±0.008 (4.00±0.20)	0.276±0.012 (7.00±0.30)	40	64
83-10-M12779-1000	0.079±0.006 (2.00±0.15)	0.158±0.008 (4.00±0.20)	0.394±0.016 (10.00±0.40)	53	80
83-10-M12904-1000	0.085±0.006 (2.15±0.15)	0.197±0.008 (5.00±0.20)	0.709±0.016 (18.00±0.40)	128	147
83-10-M12905-1000	0.091±0.006 (2.29±0.15)	0.191±0.008 (4.80±0.20)	0.250±0.012 (6.35±0.30)	43	80
83-10-M12906-1000	0.091±0.006 (2.30±0.15)	0.197±0.008 (5.00±0.20)	0.197±0.012 (5.00±0.30)	30	55
83-10-M460-1000	0.095±0.006 (2.40±0.15)	0.296±0.008 (7.50±0.20)	0.296±0.012 (7.50±0.30)	60	102
83-10-M12907-1000	0.103±0.006 (2.60±0.15)	0.178±0.008 (4.50±0.20)	0.473±0.016 (12.00±0.40)	49	72
83-10-M12908-1000	0.119±0.008 (3.00±0.20)	0.237±0.008 (6.00±0.20)	0.394±0.016 (10.00±0.40)	52	90
83-10-M12909-1000	0.119±0.008 (3.00±0.20)	0.312±0.008 (7.90±0.20)	0.394±0.016 (10.00±0.40	68	79
83-10-M12910-1000	0.119±0.008 (3.00±0.20)	0.312±0.008 (7.90±0.20)	0.749±0.016 (19.00±0.40)	130	190
83-10-M12911-1000	0.125±0.008 (3.15±0.20)	0.237±0.008 (6.00±0.20)	0.709±0.016 (18.00±0.40)	100	155
83-10-M12912-1000	0.126±0.008 (3.18±0.20)	0.315±0.008 (8.00±0.20)	0.397±0.016 (10.06±0.40)	67	115
83-10-M12913-1000	0.130±0.008 (3.30±0.20)	0.250±0.008 (6.35±0.20)	0.500±0.016 (12.70±0.40)	67	105
83-10-M12914-1000	0.130±0.008 (3.30±0.20)	0.250±0.008 (6.35±0.20)	0.623±0.016 (15.80±0.40)	76	125
83-10-M12915-1000	0.138±0.008 (3.50±0.20)	0.473±0.012 (12.00±0.30)	0.906±0.020 (23.00±0.50)	210	328
83-10-M12916-1000	0.158±0.008 (4.00±0.20)	0.312±0.008 (7.90±0.20)	0.504±0.016 (12.80±0.40)	66	107
83-10-M12788-1000	0.158±0.008 (4.00±0.20)	0.315±0.012 (8.00±0.30)	0.158±0.008 (4.00±0.20)	23	46
83-10-M12917-1000	0.170±0.008 (4.30±0.20)	0.256±0.008 (6.50±0.20)	0.394±0.016 (10.00±0.40)	34	62

*Based upon single turn impedance measurement, using an HP 4193A.

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Parker Seals

Table 5 *continued*

	Dimensions - Inches (mm)			Impedance (ohms)*	
Part Number	A (I.D.) B	(O.D.)	C (Length)	@ 25 MHz ±20%	@ 100 MHz ±20%
83-10-M12918-1000	0.170±0.008 (4.30±0.20)	0.453±0.012 (11.50±0.30)	0.788±0.020 (20.00±0.50)	148	210
83-10-M12919-1000	0.170±0.008 (4.30±0.20)	0.453±0.012 (11.50±0.30)	1.024±0.024 (26.00±0.60)	190	270
83-10-M12920-1000	0.178±0.010 (4.50±0.25)	0.367±0.012 (9.30±0.30)	0.375±0.012 (9.50±0.30)	53	98
83-10-M12921-1000	0.193±0.008 (4.88±0.20)	0.486±0.012 (12.30±0.30)	1.000±0.024 (25.40±0.60)	172	264
83-10-M12789-1000	0.197±0.008 (5.00±0.20)	0.355±0.012 (9.00±0.30)	0.119±0.010 (3.00±0.25)	21	54
83-10-M245-1000	0.197±0.010 (5.00±0.25)	0.375±0.012 (9.50±0.30)	0.410±0.016 (10.40±0.40)	53	81
83-10-M446-1000	0.197±0.010 (5.00±0.25)	0.375±0.012 (9.50±0.30)	0.571±0.016 (14.50±0.40)	75	121
83-10-M445-1000	0.197±0.010 (5.00±0.25)	0.375±0.012 (9.50±0.30)	0.626±0.016 (15.88±0.40)	74	103
83-10-M454-1000	0.197±0.010 (5.00±0.25)	0.375±0.012 (9.50±0.30)	0.749±0.016 (19.00±0.40)	9	135
83-10-M12923-1000	0.197±0.010 (5.00±0.25)	0.375±0.012 (9.50±0.30)	0.768±0.016 (19.50±0.40)	98	153
83-10-M828-1000	0.197±0.008 (5.00±0.20)	0.380±0.010 (9.65±0.25)	0.191±0.018 (4.83±0.45)	25	47
83-10-M12924-1000	0.197±0.008 (5.00±0.20)	0.394±0.012 (10.00±0.30)	0.394±0.016 (10.00±0.40)	54	85
83-10-M12925-1000	0.197±0.010 (5.00±0.25)	0.434±0.012 (11.00±0.30)	0.729±0.016 (18.50±0.40)	113	178
83-10-M12926-1000	0.197±0.010 (5.00±0.25)	0.434±0.012 (11.00±0.30)	0.985±0.024 (25.00±0.60)	145	230
83-10-M12927-1000	0.205±0.010 (5.20±0.25)	0.375±0.012 (9.50±0.30)	0.375±0.012 (9.50±0.30)	45	76
83-10-M12928-1000	0.205±0.010 (5.20±0.25)	0.375±0.012 (9.50±0.30)	0.394±0.016 (10.00±0.40)	48	74
83-10-M12853-1000	0.217±0.010 (5.50±0.25)	0.414±0.012 (10.50±0.30)	0.788±0.020 (20.00±0.50)	95	135
83-10-M12780-1000	0.221±0.010 (5.60±0.25)	0.473±0.012 (12.00±0.30)	0.788±0.020 (20.00±0.50)	119	175
83-10-M12929-1000	0.221±0.010 (5.60±0.25)	0.473±0.012 (12.00±0.30)	1.182±0.028 (30.00±0.70)	180	260
83-10-M12930-1000	0.229±0.010 (5.80±0.25)	0.375±0.012 (9.50±0.30)	0.394±0.016 (10.00±0.40)	38	68
83-10-M12931-1000	0.229±0.010 (5.80±0.25)	0.749±0.020 (19.00±0.50)	1.241±0.032 (31.50±0.80)	291	423
83-10-M12932-1000	0.237±0.012 (6.00±0.30)	0.315±0.008 (8.00±0.20)	0.386±0.012 (9.80±0.30)	35	55
83-10-M12933-1000	0.237±0.012 (6.00±0.30)	0.394±0.012 (10.00±0.30)	0.394±0.016 (10.00±0.40)	38	66
83-10-M12934-1000	0.237±0.012 (6.00±0.30)	0.394±0.012 (10.00±0.30)	0.552±0.016 (14.00±0.40)	45	73
83-10-M12790-1000	0.237±0.008 (6.00±0.20)	0.473±0.012 (12.00±0.30)	0.158±0.012 (4.00±0.30)	24	47
83-10-M12935-1000	0.250±0.012 (6.35±0.30)	0.560±0.016 (14.20±0.40)	0.591±0.016 (15.00±0.40)	92	146
83-10-M246-1000	0.250±0.012 (6.35±0.30)	0.560±0.016 (14.20±0.40)	1.123±0.024 (28.50±0.60)	164	255
83-10-M12936-1000	0.264±0.012 (6.70±0.30)	0.386±0.012 (9.80±0.30)	0.532±0.016 (13.50±0.40)	43	91
83-10-M12937-1000	0.276±0.012 (6.99±0.30)	0.591±0.016 (14.99±0.40)	0.749±0.016 (19.00±0.40)	107	171
83-10-M12823-1000	0.276±0.012 (6.99±0.30)	0.591±0.016 (14.99±0.40)	1.100±0.016 (27.94±0.40)	151	237
83-10-M636-1000	0.276±0.012 (6.99±0.30)	0.617±0.016 (15.65±0.40)	1.125±0.024 (28.57±0.60)	164	258
83-10-M12939-1000	0.276±0.012 (7.00±0.30)	0.394±0.012 (10.00±0.30)	0.394±0.016 (10.00±0.40)	31	57
83-10-M12940-1000	0.276±0.012 (7.00±0.30)	0.473±0.012 (12.00±0.30)	0.591±0.016 (15.00±0.40)	60	92
83-10-M12941-1000	0.276±0.012 (7.00±0.30)	0.560±0.016 (14.20±0.40)	0.591±0.016 (15.00±0.40)	78	116
83-10-M12942-1000	0.276±0.012 (7.00±0.30)	0.560±0.016 (14.20±0.40)	0.926±0.020 (23.50±0.50)	127	204
83-10-M12781-1000	0.276±0.012 (7.00±0.30)	0.560±0.016 (14.20±0.40)	1.123±0.024 (28.50±0.60)	143	243
83-10-M12784-1000	0.276±0.012 (7.00±0.30)	0.630±0.016 (16.00±0.40)	1.103±0.024 (28.00±0.60)	174	247
83-10-M12782-1000	0.310±0.012 (7.87±0.30)	0.626±0.016 (15.80±0.40)	1.125±0.024 (28.57±0.60)	148	241
83-10-M12943-1000	0.312±0.012 (7.90±0.30)	0.623±0.016 (15.80±0.40)	0.630±0.016 (16.00±0.40)	74	117
83-10-M827-1000	0.312±0.010 (7.92±0.25)	0.626±0.030 (15.80±0.75)	0.562±0.014 (14.27±0.35)	79	121
83-10-M12791-1000	0.315±0.012 (8.00±0.30)	0.493±0.012 (12.50±0.30)	0.250±0.012 (6.35±0.30)	27	52
83-10-12819-1000	0.315±0.012 (8.00±0.30)	0.493±0.012 (12.50±0.30)	0.493±0.016 (12.50±0.40)	42	72
83-10-M12945-1000	0.315±0.012 (8.00±0.30)	0.560±0.016 (14.20±0.40)	0.591±0.016 (15.00±0.40)	63	107
83-10-M12864-1000	0.315±0.012 (8.00±0.30)	0.560±0.016 (14.20±0.40)	1.123±0.024 (28.50±0.60)	128	195
83-10-M12947-100	0.315±0.012 (8.00±0.30)	0.601±0.016 (15.25±0.40)	1.103±0.024 (28.00±0.60)	122	180
83-10-M12793-1000	0.323±0.010 (8.20±0.25)	0.650±0.012 (16.50±0.30)	0.630±0.016 (16.00±0.40)	87	145
83-10-M12871-1000	0.327±0.012 (8.30±0.30)	0.689±0.016 (17.50±0.40)	1.123±0.024 (28.50±0.60)	148	242
83-10-M12948-1000	0.335±0.012 (8.50±0.30)	0.473±0.012 (12.00±0.30)	0.591±0.016 (15.00±0.40)	45	85
83-10-M12840-1000	0.345±0.012 (8.76±0.30)	0.673±0.016 (17.00±0.40)	1.000±0.024 (25.40±0.60)	122	180
83-10-M12783-1000	0.355±0.012 (9.00±0.30)	0.630±0.016 (16.00±0.40)	0.670±0.016 (17.00±0.40)	61	115
83-10-M12949-1000	0.355±0.012 (9.00±0.30)	0.630±0.016 (16.00±0.40)	0.788±0.020 (20.00±0.50)	98	124
83-10-M12785-1000	0.355±0.012 (9.00±0.30)	0.630±0.016 (16.00±0.40)	1.103±0.024 (28.00±0.60	104	178
83-10-M12950-1000	0.355±0.012 (9.00±0.30)	0.630±0.016 (16.00±0.40)	1.123±0.024 (28.50±0.60)	105	195
83-10-M12794-1000	0.375±0.012 (9.50±0.30)	0.689±0.016 (17.50±0.40)	0.250±0.012 (6.35±0.30)	31	53
83-10-M248-1000	0.375±0.012 (9.50±0.30)	0.689±0.016 (17.50±0.40)	1.123±0.024 (28.50±0.60)	115	170

*Based upon single turn impedance measurement, using an HP 4193A.

continued

Table 5 *continued*

Part Number	Dimensions - Inches (mm) A (I.D.) B	(O.D.)	C (Length)	Impedance (ohms)* @ 25 MHz ±20%	@ 100 MHz ±20%
83-10-M12951-100	0.375±0.012 (9.50±0.30)	0.689±0.016 (17.50±0.40)	1.378±0.032 (35.00±0.80)	152	253
83-10-M12952-1000	0.394±0.016 (10.00±0.40)	0.601±0.016 (15.25±0.40)	1.123±0.024 (28.50±0.60)	81	128
83-10-M12953-1000	0.394±0.016 (10.00±0.40)	0.630±0.016 (16.00±0.40)	1.103±0.024 (28.00±0.60)	91	156
83-10-M12954-1000	0.394±0.016 (10.00±0.40)	0.689±0.016 (17.50±0.40)	1.575±0.036 (40.00±0.90)	123	232
83-10-M12795-1000	0.394±0.012 (10.00±0.40)	0.709±0.016 (18.00±0.40)	0.394±0.012 (10.00±0.30)	47	77
83-10-M12955-1000	0.394±0.016 (10.00±0.40)	0.709±0.020 (18.00±0.50)	1.103±0.024 (28.00±0.60)	124	209
83-10-M12956-1000	0.394±0.016 (10.00±0.40)	0.709±0.020 (18.00±0.50)	1.142±0.024 (29.00±0.60)	128	210
83-10-M12957-1000	0.400±0.016 (10.16±0.40)	0.733±0.020 (18.60±0.50)	0.985±0.024 (25.00±0.60)	115	178
83-10-M249-1000	0.400±0.016 (10.16±0.40)	0.736±0.020 (18.60±0.50)	1.125±0.024 (28.57±0.60)	126	201
83-10-M12796-1000	0.402±0.016 (10.20±0.40)	0.808±0.020 (20.50±0.50)	0.394±0.012 (10.00±0.30)	53	86
83-10-M12792-1000	0.414±0.012 (10.50±0.30)	0.591±0.012 (15.00±0.30)	0.473±0.012 (12.00±0.30)	37	62
83-10-M12820-1000	0.422±0.016 (10.70±0.40)	0.689±0.016 (17.50±0.40)	1.123±0.024 (28.50±0.60)	90	150
83-10-M250-1000	0.506±0.016 (12.83±0.40)	1.021±0.019 (25.90±0.46)	1.125±0.030 (28.57±0.76)	127	195
83-10-M12958-1000	0.512±0.016 (13.00±0.40)	0.749±0.020 (19.00±0.50)	1.142±0.024 (29.00±0.60)	60	105
83-10-M12797-1000	0.532±0.012 (13.50±0.30)	0.867±0.020 (22.00±0.50)	0.315±0.012 (8.00±0.30)	37	78
83-10-M637-1000	0.543±0.016 (13.77±0.40)	1.123±0.020 (28.50±0.46)	1.125±0.030 (28.57±0.76)	158	250
83-10-M12798-1000	0.552±0.012 (14.00±0.30)	0.867±0.020 (22.00±0.50)	0.394±0.012 (10.00±0.30)	42	84
83-10-M12772-1000	0.591±0.012 (15.00±0.30)	0.985±0.016 (25.00±0.40)	0.473±0.012 (12.00±0.30)	53	97
83-10-M12773-1000	0.630±0.016 (16.00±0.40)	1.103±0.024 (28.00±0.60)	0.512±0.012 (13.00±0.30)	63	112
83-10-M825-1000	0.749±0.020 (19.00±0.50)	1.143±0.030 (29.00±0.75)	0.295±0.010 (7.49±0.25)	31	75
83-10-M12774-1000	0.749±0.016 (19.00±0.40)	1.221±0.020 (31.00±0.50)	0.315±0.012 (8.00±0.30)	36	79
83-10-M12775-1000	1.079±0.024 (27.40±0.60)	1.599±0.032 (40.60±0.80)	0.591±0.016 (15.00±0.40)	55	106
83-10-M256-1000	1.418±0.0320 (36.00±0.75)	2.418±0.052 (61.40±1.30)	0.504±0.020 (12.80±0.50)	58	124

* Based upon single turn impedance measurement, using an HP 4191A.

FLAT SOLID CABLE CORE

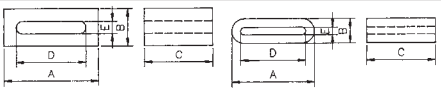

Figure 1 Figure 2

Table 6

Part Number	Dimensions – Inches (mm) A	B	C	D	E	Impedance (ohms) @ 25 MHz ±20%	@ 100 MHz ±20%
83-10-M12761-1000	0.63±0.016 (16.00±0.40)	0.197±0.138 (5.00±0.35)	0.315±0.016 (8.00±0.40)	0.453±0.016 (11.50+0.40)	0.02±.012 (0.50±0.30)	29	58
83-10-M12762-1000	1.122±0.04 (28.50±1.00)	0.256±0.012 (6.50±0.30)	0.315±0.016 (8.00±0.40)	0.925±0.02 (23.50±0.50)	0.034±.012 (0.85±0.30)	28	65
83-10-M12763-1000	1.22±0.04 (31.00±1.00)	0.197±0.012 (5.00±0.30)	0.472±0.012 (12.00±0.30)	1.063±0.028 (27.00±0.70)	0.034±.012 (0.85±0.30)	32	86
83-10-M12764-1000	1.312±0.04 (33.50±1.00)	0.256±0.012 (6.50±0.30)	0.472±0.012 (12.00±0.30)	1.063±0.028 (27.00±0.70)	0.055±0.016 (1.40±0.40)	30	66
83-10-M12765-1000	1.575±0.03 (40.00±0.70)	0.256±0.012 (6.50±0.30)	0.472±0.012 (12.00±0.30)	1.378±0.028 (35.00±0.70)	0.055±0.016 (1.40±0.40)	28	69
83-10-M12766-1000	1.78±0.04 (45.20±1.00)	0.256±0.012 (6.50±0.30)	0.472±0.012 (12.00±0.30)	1.575±0.028 (40.00±0.70)	0.055±0.016 (1.40±0.40)	28	68
83-10-M12767-1000	1.953±0.04 (49.60±1.00)	0.256±0.012 (6.50±0.30)	0.472±0.012 (12.00±0.30)	1.732±0.032 (44.00±0.80)	0.055±0.016 (1.40±0.40)	25	69
83-10-M12834-1000	2.268±0.039 (57.60±1.00)	0.756±0.012 (6.50±0.30)	0.472±0.012 (12.00±0.30)	2.047±0.032 (52.00±0.80)	0.055±0.016 (1.40±0.40)	26	75
83-10-M12768-1000*	2.362±0.04 (60.00±1.00)	0.472±0.016 (12.00±0.40)	0.5±0.016 (12.70±0.40)	1.91±0.032 (48.50±0.80)	0.087±0.012 (2.20±0.30)	40	104

*Figure 1 only

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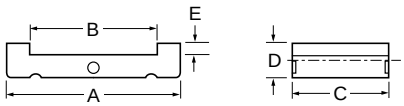
FLAT SPLIT CABLE CORE

Impedance-Frequency Characteristics
P/N 83-10-F255-1000



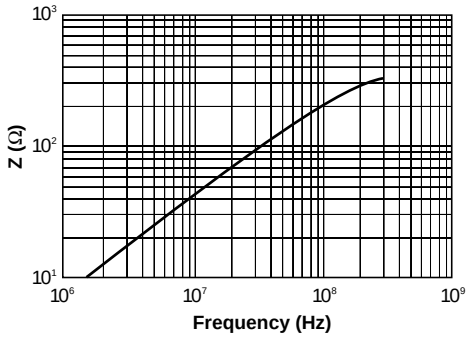
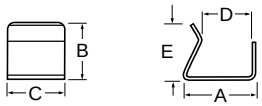


Table 7

Part Number	Dimensions – Inches (mm)					Impedance (ohms)	
	A	B	C	D	E	@ 25 MHz ±20%	@ 100 MHz ±20%
83-10-F254-1000C	2.500 (63.5±1.3)	2.050 (52.1±1.1)	1.125 (28.57±0.8)	0.250 (6.35±0.25)	0.033 (0.84±0.2)	70	235
83-10-F255-1000C	3.000 (76.2±1.5)	2.570 (65.28±1.3)	1.125 (28.57±0.8)	0.250 (6.35±0.25)	0.033 (0.84±0.2)	60	215
83-10-M12769-1000C	1.50 (38.00±1.00)	1.05 (26.60±0.70)	1.00 (25.40±0.70)	0.250 (6.35±0.25)	0.033 (0.84±0.2)	105	175
83-10-M12770-1000C	1.775 (45.00±1.00)	1.355 (34.40±0.70)	1.125 (28.50±0.70)	0.250 (6.35±0.25)	0.033 (0.84±0.2)	102	189
83-10-M12771-1000C	2.17 (55.10±1.20)	1.72 (43.70±1.00)	1.125 (28.50±0.70)	0.250 (6.35±0.25)	0.033 (0.84±0.2)	80	181

CLIPS FOR FLAT SPLIT CABLE CORE



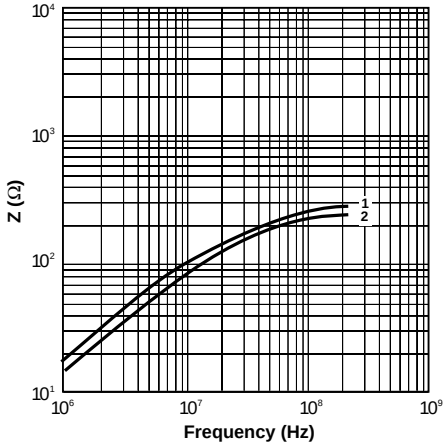
Material: 0.020 inch (0.5 mm) High Carbon Steel
Finish: Zinc Electroplate

Table 8

Part Number	Dimensions – Inches (mm)					Fits CHO-SORB Part Number
	A	B	C	D	E	
83-10-C0005-1000	0.618 (15.7)	0.280 (7.1)	0.500 (12.7)	0.457 (11.6)	0.382 (9.7)	83-10-F254-1000C 83-10-F255-1000C 83-10-M12769-1000C 83-10-M12770-1000C 83-10-M12771-1000C

ROUND SPLIT CABLE CORE

Impedance-Frequency Characteristics
1) P/N 83-10-R257-1000
2) P/N 83-10-R256-1000



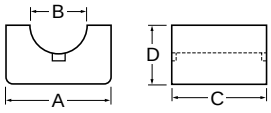
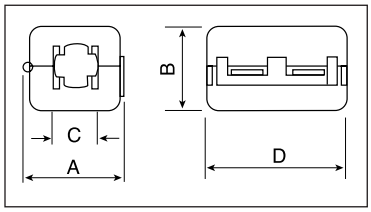


Table 9

Part Number	Dimensions – Inches (mm)					Impedance (ohms)	
	Max. Cable Diameter	A	B	C	D	@ 25 MHz ±20%	@ 100 MHz ±20%
83-10-R256-1000	0.500	1.020 (25.9 ±0.5)	0.514 (13.05 ±0.3)	1.125 (28.6 ±0.8)	0.510 (12.95 ±0.25)	125	250
83-10-R257-1000	0.250	0.590 (15.0 ±0.25)	0.260 (6.6 ±0.3)	1.125 (28.6 ±0.8)	0.295 (7.5 ±0.15)	130	275
83-10-R554-1000	0.390	.735 (18.65 ±0.4)	0.400 (10.16 ±0.3)	1.125 (28.6 ±0.8)	0.370 (9.4 ±0.15)	110	225

continued

SQUARE SPLIT BEAD ASSEMBLY



Case Material: Nylon 6/6,
Flammability Rating: UL 94V-2

Table 10

Part Number	Dimensions – Inches (mm)					Impedance (ohms)	
	A	B	C	D	Max. Cable Gauge	@25 MHz ±20%	@100 MHz ±20%
83-10-Y377-1000	1.24±0.04 (31.50±1.00)	1.22±0.04 (31.00±1.00)	0.55±0.04 (14.00±1.00)	1.28±0.04 (32.50±1.00)	0.512 (13.00)	137	268
83-10-Y379-1000	0.80±0.04 (20.50±1.00)	0.79±0.04 (20.10±1.00)	0.30±0.04 (7.60±1.00)	1.28±0.04 (32.50±1.00)	0.256 (6.50)	133	308
83-10-Y850-1000	1.00±0.04 (25.50±1.00)	0.925±0.04 (23.50±1.00)	0.453±0.04 (11.50±1.00)	1.28±0.04 (32.50±1.00)	0.394 (10.00)	124	245
83-10-M12818-1000	0.59±0.04 (15.00±1.0)	0.55±0.04 (14.00±1.0)	0.236±0.04 (6.00±1.00)	0.906±0.04 (23.00±1.0)	0.197 (5.00)	103	174

NOTE: Dimensions A, B, C and D are for the case.

ROUND SPLIT BEAD ASSEMBLY

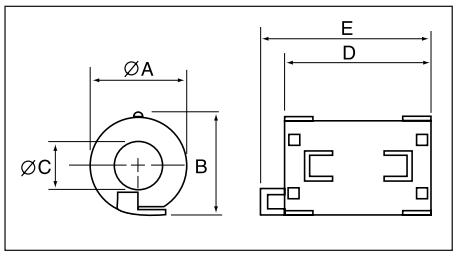


Fig. 1

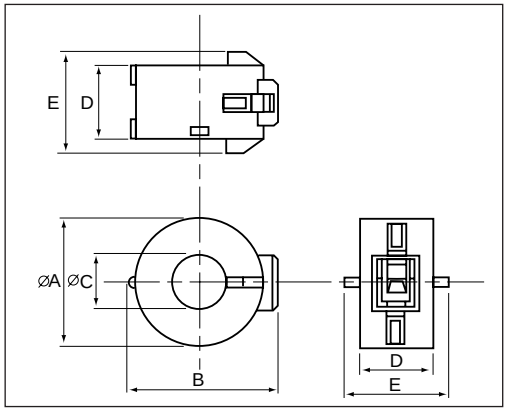


Fig. 2

Case Material: Nylon 6/6,
Flammability Rating: UL 94V-2

Table 11

Part Number	Dimensions - inches (mm)							Impedance (ohms)*	
	Figure	A (dia)	B	C (dia)	D	E	Max. Cable Gauge	@25MHz ±20%	@100 MHz ±20%
83-10-M12799-1000	1	0.77±0.04 (19.5±1.0)	0.81±0.04 (20.5±1.0)	0.39±0.04 (10.0±1.0)	1.24±0.04 (31.5±1.0)	1.40±0.04 (35.5±1.0)	0.35 (9mm)	120	190
83-10-M12813-1000	2	0.77±0.04 (19.5±1.0)	0.91±0.04 (23.0±1.0)	0.33±0.04 (8.5±1.0)	0.67±0.04 (17.0±1.0)	0.91±0.04 (23.0±1.0)	0.31 (8mm)	60	120
83-10-M12814-1000	2	0.77±0.04 (19.5±1.0)	0.91±0.04 (23.0±1.0)	0.32±0.04 (8.2±1.0)	0.79±0.04 (20.0±1.0)	1.02±0.04 (26.0±1.0)	0.31 (8mm)	75	160
83-10-M12815-1000	2	0.96±0.04 (24.5±1.0)	1.12±0.04 (28.5±1.0)	0.39±0.04 (10.0±1.0)	0.53±0.04 (13.5±1.0)	0.79±0.04 (20.0±1.0)	0.39 (10mm)	50	105
83-10-M12816-1000	2	1.10±0.04 (28.0±1.0)	1.24±0.04 (31.5±1.0)	0.45±0.04 (11.5±1.0)	0.71±0.04 (18.0±1.0)	0.94±0.04 (24.0±1.0)	0.43 (11mm)	70	140
83-10-M12817-1000	2	1.14±0.04 (29.0±1.0)	1.30±0.04 (33.0±1.0)	0.55±0.04 (14.0±1.0)	0.61±0.04 (15.5±1.0)	0.85±0.04 (21.5±1.0)	0.55 (14mm)	45	100

* Based upon single turn impedance measurement using an HP 4191A

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CHO-DROP® EMI Absorbers

CHO-DROP EMI Absorbers

CHO-DROP EMI absorbers are discrete components designed to reduce radiation from digital signal lines without significantly adding to propagation delay. They will normally suppress radiation from a given lead by 10-15 dB, and have a propagation delay of less than 10 nanoseconds.

Placed in series with a signal line, these devices will suppress EMI emissions without grounding, shielding or by-pass capacitors. They are supplied in reels for use with automatic insertion equipment.

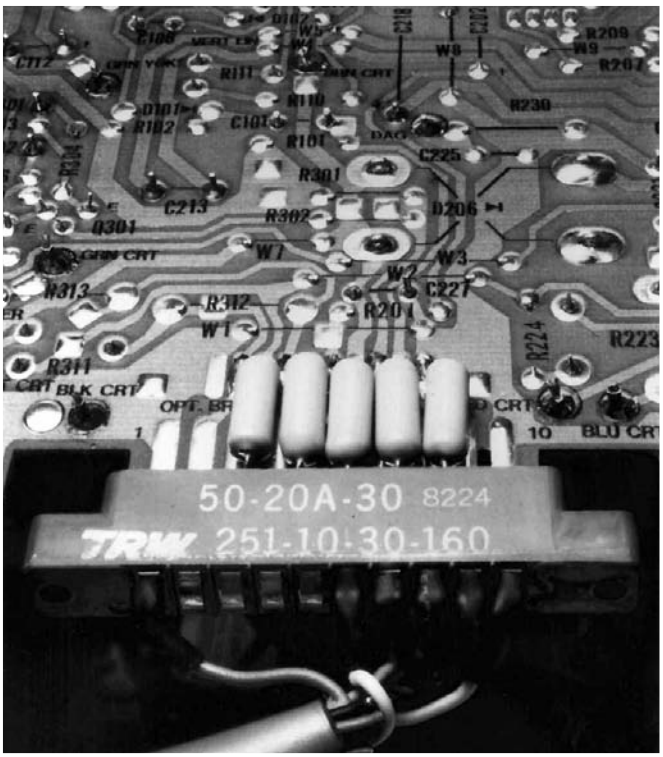
As a suppressor for unshielded cables, CHO-DROP absorbers should be put in series with each connector lead, including ground leads. To suppress radiation from a clock, place in series with a clock lead near the output of the clock driver. Undesired signals appearing at the power supply input may be reduced with a CHO-DROP absorber between the power supply output and the PCB.

Features

- Flat absorption characteristics means no ringing (unlike ferrite beads)
- No grounding or shielding required
- dB insertion loss from 50-200 MHz
- Will not affect signal transmission
- Cost effective
- Supplied on reels for automatic insertion

Specifications

Insertion Loss (in 50-ohm circuit):
50 MHz ..... 12 dB
100 MHz ..... 15 dB
150 MHz ..... 15 dB
200 MHz ..... 15 dB
Propagation Delay ..... <10 nanoseconds
Current Capacity ..... 500 mA
Color ..... Aquamarine



Five CHO-DROP absorbers are shown installed in series with each connector lead on a printed circuit board.

Table 1 Ordering Information

CHO-DROP Part No.	Size (Typ.)	Leads
80-10-9714-1000	0.185 inch (4.7 mm) dia. 0.550 inch (13.97 mm) long	#22 gauge solder-coated copper 1.10 inch (27.94 mm) long

ZIP-EX-2® Zippered Cable Shielding

ZIP-EX-2 Zippered Cable Shielding

ZIP-EX-2 cable shielding provides convenient, inexpensive EMI and EMP shielding of cable harnesses for computers, communications equipment and other interference-sensitive electronic systems. It can be zipped on and off quickly, before or after the cable is installed.

The shielding medium is Ferrex* knitted wire mesh with a protective cover of heavy-duty vinyl, a combination that provides flexibility and durability as well as positive shielding. A brass slide fastener with rugged teeth crimped to a steel cord inside the knitted wire mesh provides continuous positive closure. ZIP-EX-2 shielding is also available with a Velcro® fastening mechanism. Contact Chomerics for details.

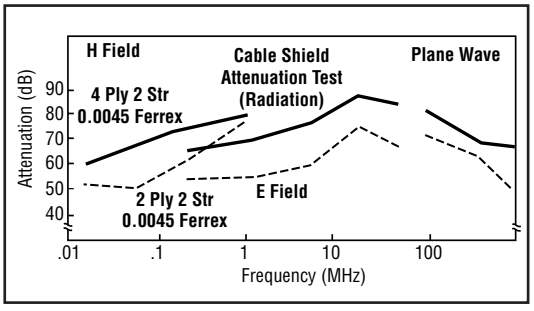
Configurations

ZIP-EX-2 shielding is supplied in nine diameters ranging from 1 to 5.75 inches (2.54 to 14.61 cm). The shielding mesh may be obtained either with or without the black vinyl jacket described above.

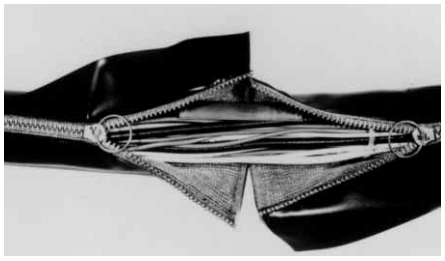
Straight lengths up to 40 feet (12.19 m) are available, as well as transition components ("Y" and reducer) and bulkhead terminations. Transition components may be specified with two diameters, A and B, (see Figure 2). Diameter A is always the larger of the two.

Straight lengths may be ordered with the ends "finished" (zipper terminations at both ends) or unfinished (see Table 1). Transition components (Figure 2) are supplied with finished ends.

Figure 1 Cable Shielding Effectiveness



*Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520 ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 coppercladding, 30-40% by weight; SAE 1010 steel wire, balance by weight.



Ordering Information

Complete descriptive part numbers should be developed in accordance with the instructions that follow. *Important Note:* To specifiy diameter in the part number, indicate in the appropriate place the total number of 0.250 in. (6.35 mm) increments in the diameter, *not* the actual diameter (see Table 1).

Part numbers for *split couplers* and *terminations* are given in Tables 3 and 5.

Part numbers for *straight lengths*, *Y transitions* and *reducers* are established as follows:

14 — X X X 4 - X X X X - X X

- **14** — Product Class Code Number (constant)
- **X** — Configuration
- **X** — Covering
- **X** — Finished or Unfinished Ends
- **4** — Ferrex shielding mesh
- **X X** — "A" diameter in number of 0.250 inch increments
- **X X** — For straight sections, length in feet (see Note 1). For transition components, "B" diameter in number of 0.250 inch increments (see Figure 2).
- **X X** — For straight lengths only, additional inches of length (see Note 1)

Note 1: Lengths must be shown as the number of complete feet and the number of additional inches. ***Wrong****: 52 inches.* ***Right****: 4 feet 4 inches with the last four digits reading* ***-04-04****. Metric dimensions must be converted to feet and inches.*

Table 1

Configuration	Covering	Ends
1 straight length	**0** none	**0** unfinished
2 reducer	**1** black vinyl	**1** finished
5 Y		

Diameters A and B

Indicate total number of 0.250 inch increments for each diameter. (Metric values must be converted.)

Examples

For 1 inch (25.4 mm) dia., use **04**
For 2.5 inch (63.5 mm) dia., use **10**
For 4 inch (101.6 mm) dia., use **16**

Sample Part Numbers

14-1114-0432-06 — a straight length with black vinyl cover and finished ends, Ferrex shielding material, 1.0 inch (25.4 mm) dia., 32 feet 6 inches (9.9 m) long.

14-2114-12-08 — a reducer with black vinyl cover and finished ends, Ferrex shielding material, reducing from 3.0 inch (7.62 cm) dia. to 2.0 inch (5.08 cm) dia.

14-1104-1438-00 — a straight length with black vinyl cover and unfinished ends, Ferrex shielding material, 3.5 inch (8.89 cm) dia., 38.0 feet (11.6 m) long.

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Figure 2

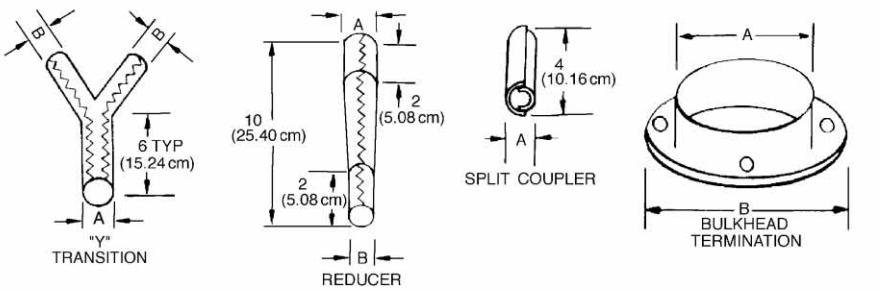

Table 2

STRAIGHT LENGTHS *inch (mm)*			
Nominal I.D.	**Contained Diameter**	**Finished Ends**	**Bulk Length**
1.0 (25.40)	0 to 0.75 (0 to 19.05)	14-1X14-04XX-XX	14-1X04-04XX-XX
1.5 (38.10)	0.50 to 1.25 (12.70 to 31.75)	14-1X14-06XX-XX	14-1X04-06XX-XX
2.0 (50.80)	1.00 to 1.75 (25.40 to 44.45)	14-1X14-08XX-XX	14-1X04-08XX-XX
2.5 (63.50)	1.50 to 2.25 (38.10 to 57.15)	14-1X14-10XX-XX	14-1X04-10XX-XX
3.0 (76.20)	2.00 to 2.75 (50.80 to 69.85)	14-1X14-12XX-XX	14-1X04-12XX-XX
3.5 (88.90)	2.50 to 3.25 (63.50 to 82.55)	14-1X14-14XX-XX	14-1X04-14XX-XX
4.0 (101.60)	3.00 to 3.75 (76.20 to 95.25)	14-1X14-16XX-XX	14-1X04-16XX-XX
5.0 (127.00)	3.50 to 4.75 (88.90 to 120.65)	14-1X14-20XX-XX	14-1X04-20XX-XX
6.0 (152.40)	4.50 to 5.75 (114.30 to 146.05)	14-1X14-24XX-XX	14-1X04-24XX-XX

Table 3

TRANSITION COMPONENTS *inch (mm)*			
Nominal I.D. (A)	**Y Transitions**	**Reducers**	**Split Coupler**
1.0 (25.40)	14-5114-04XX	———	15-6004-0005
1.5 (38.10)	14-5114-06XX	14-2114-06XX	15-6006-0005
2.0 (50.80)	14-5114-08XX	14-2114-08XX	15-6008-0005
2.5 (63.50)	14-5114-10XX	14-2114-10XX	15-6010-0005
3.0 (76.20)	14-5114-12XX	14-5114-12XX	15-6012-0005
3.5 (88.90)	14-5114-14XX	14-2114-14XX	15-6014-0005
4.0 (101.60)	14-5114-16XX	14-2114-16XX	15-6016-0005
5.0 (127.00)	14-5114-20XX	14-2114-20XX	15-6020-0005
6.0 (152.40)	14-5114-24XX	14-2114-24XX	15-6024-0005

Table 4

CODE XX IN TABLE 3	
Diameter B	**Code XX**
1.0 (25.40)	04
1.5 (38.10)	06
2.0 (50.80)	08
2.5 (63.50)	10
3.0 (76.20)	12
3.5 (88.90)	14
4.0 (101.60)	16
5.0 (127.00)	20
6.0 (152.40)	24

Table 5

BULKHEAD TERMINATIONS *inch (mm)*						
Nominal I.D. (A)	**Standard Termination**	**Split Termination**	**Total Height**	**Bolt Circle**	**No. of Holes**	**Flange O.D. (B)**
1.0 (25.40)	15-6004-0001	15-6004-0002	1.19 (30.22)	1.63 (41.30)	4	2.00 (50.80)
1.5 (38.10)	15-6006-0001	15-6006-0002	1.19 (30.22)	2.25 (57.15)	4	2.5 (64.42)
2.0 (50.80)	15-6008-0001	15-6008-0002	1.19 (30.22)	2.75 (69.85)	4	3.0 (77.12)
2.5 (63.50)	15-6010-0001	15-6010-0002	1.44 (36.58)	3.25 (82.55)	4	3.56 (89.82)
3.0 (76.20)	15-6012-0001	15-6012-0002	1.44 (36.58)	3.75 (95.25)	4	4.06 (102.52)
3.5 (88.90)	15-6014-0001	15-6014-0002	1.44 (36.58)	4.25 (107.95)	4	4.56 (115.22)
4.0 (101.60)	15-6016-0001	15-6016-0002	1.44 (36.58)	4.75 (120.65)	6	5.06 (127.92)
5.0 (127.00)	15-6020-0001	15-6020-0002	1.44 (36.58)	5.75 (133.35)	6	6.06 (153.32)
6.0 (152.40)	15-6024-0001	15-6024-0002	1.44 (36.58)	6.75 (145.05)	8	7.06 (178.72)

CHO-SHRINK® Heat Shrinkable Shielding

CHO-SHRINK Conductive Heat Shrinkable Shielding

CHO-SHRINK tubing is a heat shrinkable polyolefin tubing which provides effective EMI shielding for cables, connectors and cable/connector terminations. CHO-SHRINK offers significant weight savings over conventional metal braid shielding, and can be applied easily with standard shrink tubing heating devices.

The main feature of CHO-SHRINK tubing is Chomerics' unique conductive coating, which is applied to the surface of the tubing and which remains flexible, uniform and intact even after maximum shrinking. The coating, a silver-based system, can be applied to the inside or outside surfaces, or both. Standard CHO-SHRINK tubing is conductive on the inside only.

Standard (stocked) lengths are 4 feet (1.22 m). For longer lengths, CHO-SHRINK sections may be "spliced" together using short pieces of outside-coated tubing to maintain electrical continuity from one length to the next.

Other CHO-SHRINK products include thin-wall sleeves and molded boots, transitions and breakouts.

Ordering Procedure

Use the following part numbering system to order CHO-SHRINK tubing. Standard (stocked) length is 4 feet. Ordering quantity should specify total length required. Part number indicates length of pieces.

For complete information request Technical Bulletin **24**.

Table 1

AVAILABLE STANDARD DIAMETERS AND WALL THICKNESSES			
Expanded Inside Diameter inches (mm)		Expanded Inside Diameter Code*	Recovered Wall Thickness inches (mm)
1/8	(3.18)**	0002	0.020 (0.51)
3/16	(4.76)***	0003	0.020 (0.51)
1/4	(6.35)	0004	0.025 (0.63)
3/8	(9.53)	0006	0.025 (0.63)
1/2	(12.7)	0008	0.025 (0.63)
3/4	(19.05)	0012	0.030 (0.76)
1	(25.4)	0016	0.035 (0.89)
1-1/2	(38.1)	0024	0.040 (1.02)

* See ordering information. ** Two-foot maximum length.
*** Four-foot maximum length. For custom sizes contact Chomerics

Table 2

TYPICAL PROPERTIES	
Operating Temperature	– 66° to 275°F (– 54° to 135°C)
Shrink Temperature	250°F (121°C) (min.) 375°F (191°C) (max.)
Dielectric Strength*	
Tubing - per ASTM D876	500 V/mil
Boots - per ASTM D876	200 V/mil
Shrink Ratio	60-85%
Tensile Strength**	1500 psi (10.34 MPa)
Shielding Effectiveness	See Figure 1

* Recovered base material. ** After 100% recovery.

70 – 2 X – XXXX – XXXX

Coating Configuration
1 Coated inside
2 Coated outside
3 Coated inside & outside

Expanded Diameter Code
Inside Diameter in 1/16ths
(e.g., 0008 = 1/2 in. I.D.)

Length
Tube length in feet
(e.g., 0004 = 4 feet)

Example: 70-21-0016-0004 is
4 feet of 1 in. dia. tubing coated inside.

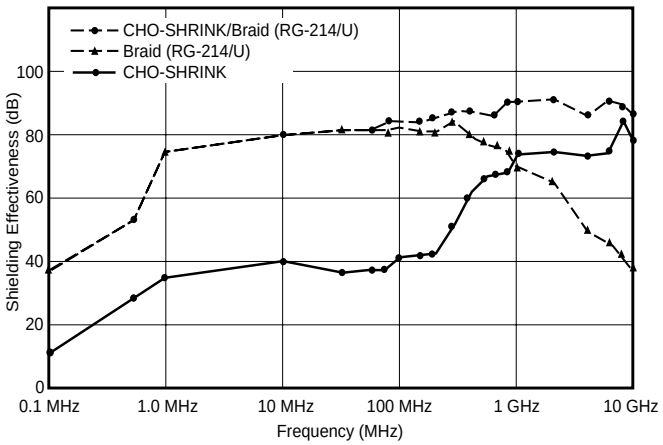

Figure 1 Shielding Effectiveness of CHO-SHRINK Compared to Wire Braid

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Parker Seals

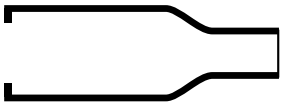
Connector Boots and Cable Transitions

CHO-SHRINK connector boots provide EMI shielding, shield grounding and strain relief at connector backshell terminations. Chomerics' unique conductive coating applied to the inside surface assures an average of 60-80 dB of attenuation at 1 GHz.

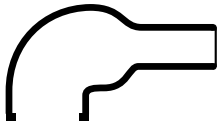
CHO-SHRINK boots shrink to a wide range of cable diameters (shrink ratio is 4:1), and offer a 40-65% weight savings compared to metal EMI adapters. They are supplied with an optional conductive hot-melt adhesive/sealant applied to each end. For optimum mechanical strength, CHO-SHRINK lipped boots should be shrunk over shrink boot adapters which provide a knurled and grooved surface.

CHO-SHRINK polyolefin cable transitions are available in a variety of shapes and sizes to provide shielding continuity for customized cable assemblies and harnesses.

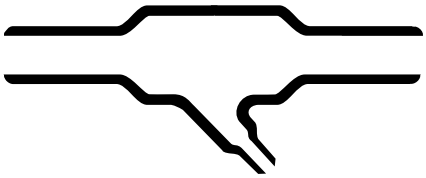
Typical CHO-SHRINK boots and transitions are shown below. Request Technical Bulletin **24** for part number and dimensional information on these standard parts. Consult Chomerics' Applications Engineering Department for assistance in specifying and ordering specialized parts.



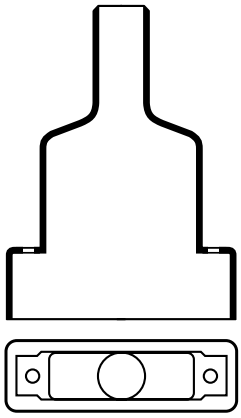
Straight Boot With Lip (To fit Shrink Boot Adapter) Also Available Without Lip



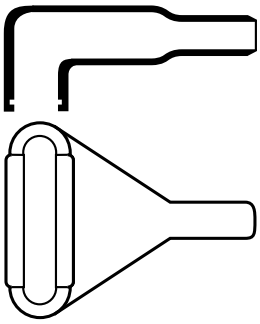
90° Boot With Lip (To fit Shrink Boot Adapter) Also Available Without Lip



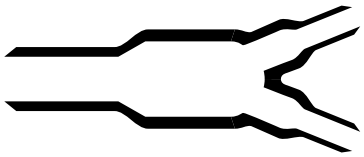
Transition, 45°



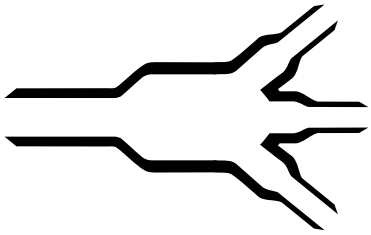
Rectangular Boot



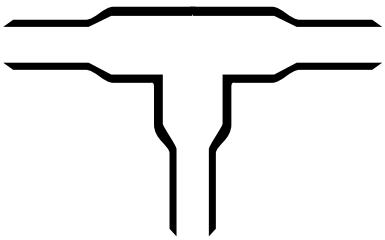
Rectangular Subminiature Boot, 90° Side Entry



Transition, Y



Transition, one to three cables



Transition, T

continued

TIPS FOR OPTIMAL SHIELDING PERFORMANCE

- Be sure to terminate the shield at both ends with full 360° contact to a low impedance ground.
- Incorporate mechanical strain relief into the cable design itself. That is, avoid stretching and bending the cable excessively.
- Transition pieces should be generous to preserve continuity at all junction points.

CHO-SHRINK ASSEMBLY PROCEDURE

Figure 1 - Lay out entire cable, with all branches in proper place.

Figure 2 - Slide CHO-SHRINK continuity splice sleeves (silver outside, black inside) into position wherever connector boots or transitions will be shrunk against the cable.

Figure 3 - Apply heat to shrink continuity splices tightly against wire bundle.

Figure 4 - Slide pre-cut lengths of CHO-SHRINK tubing (inside-coated) into position so that ends overlap approximately one-half of each continuity splice sleeve. When determining cut-lengths, allow for a maximum of 5% longitudinal shrinkage.

Figure 5 - Apply heat to shrink tubing against wire bundle. Approximately 1/2 to 1-1/2 inches of conductive (silvery) surface should be exposed at each continuity splice.

Figure 6 - Slide CHO-SHRINK transitions into position, bending branches where required to allow the expanded transition to pass breakout intersections. When properly positioned, exposed continuity splices should be entirely covered by the transition.

Figure 7 - Apply heat to shrink transitions in place. During the shrinking process, transitions can be positioned by hand to assure correct alignment and convenient breakout angles. Ends of each transition should be pressed down onto the splice sleeve so that the conductive hot melt adhesive around each opening flows around splice to provide a mechanical bond and seal. ***Note:*** *Do not handle cables after transition shrinkage until cool.*

Figure 8 - If CHO-SEAL conductive grommets are to be used to terminate individual wire shields:

a. Strip outer jacket off each wire and cut shield away leaving 1/4"-3/8" of shield exposed.

b. Comb exposed shield back over jacket.

c. Insert wires into grommet so that exposed shields are securely located in center of grommet.

Figure 9 - Terminate connector. ***Note:*** *If connector backshell does not provide a knurled and grooved surface for the CHO-SHRINK boot to grasp, a Shrink Boot Adapter should be installed on the backshell before wires are terminated (see table of Adapter sizes and part numbers).*

Figure 10 - Slide CHO-SHRINK boot over connector, and align so that boot will shrink over threads of backshell (or adapter) at one end and exposed continuity splice at other end.

Figure 11 - Apply heat and begin shrinking boot at connector end first, using hands to assure proper positioning. Press boot tightly against backshell so that conductive hot melt adhesive provides mechanical bond and seal. Continue shrinking boot, working from connector towards cable. Press "tail" end of boot down against exposed splice so that conductive hot melt bonds and seals.

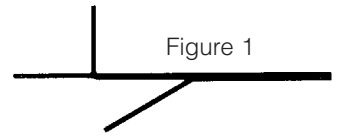


Figure 1

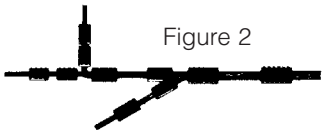


Figure 2

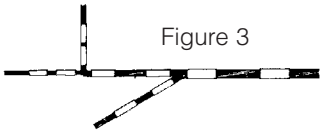


Figure 3

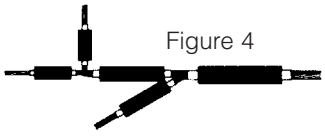


Figure 4

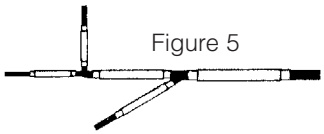


Figure 5

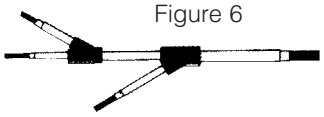


Figure 6

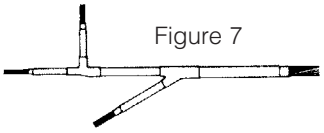


Figure 7

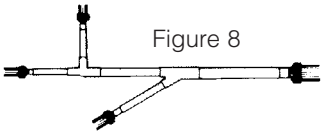


Figure 8

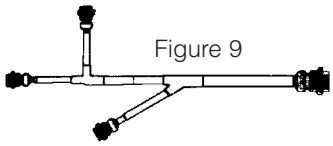


Figure 9

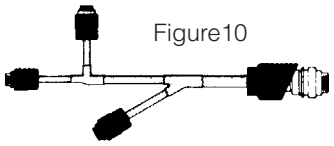


Figure10

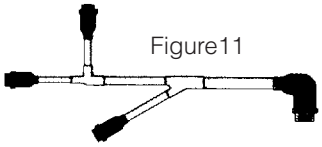


Figure11

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Parker Seals

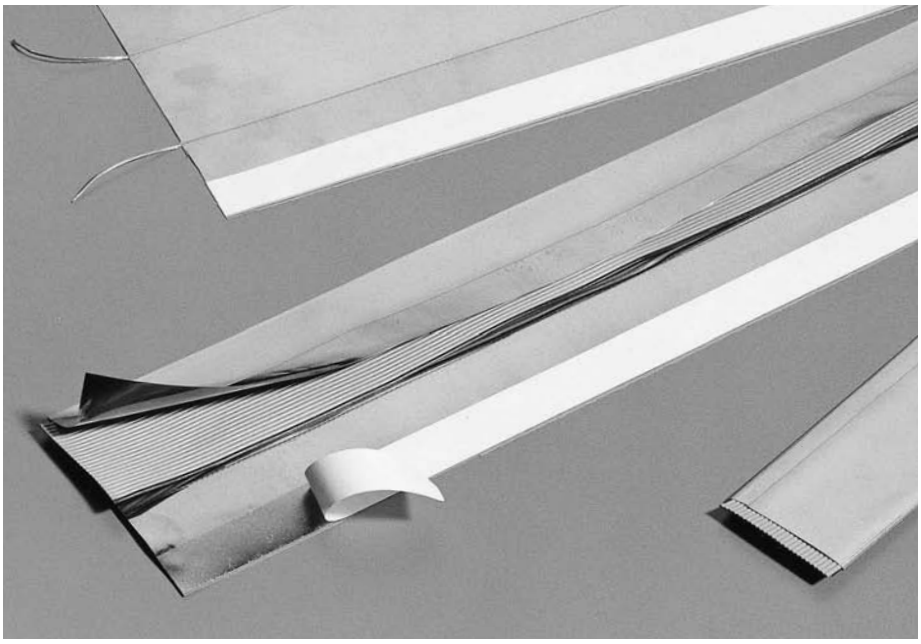
CHO-JAC® Flat Cable EMI Shield

CHO-JAC Flat Cable EMI Shield

CHO-JAC shielding is a high quality flat cable jacket designed to attenuate RF signals and bring digital electronic devices into EMC compliance at an attractive cost. It is lightweight and very flexible, easing cable routing during assembly.

The jacket is designed with a 360° aluminum or copper shield, bonded with a metal overlap to a polyester layer which resists scuff, wear and tear. Metal-to-metal contact is established as the jacket wrap is completed. This design provides the maximum EMI shielding when properly sealed and terminated. Integral wires simplify folding and termination, and provide crack resistance. Pressure-sensitive adhesive eliminates heat-sealing irons and zippers.

Two standard designs permit specification of a foil/film combination which meets your shielding requirements. For moderate performance and lower cost, CJ-021 aluminum/polyester is offered. For greater shielding effectiveness, select CJ-022, constructed of copper/polyester.



CHO-JAC CJ-021 and CJ-022 flat cable shields

CHO-JAC shielding passes the flame retardancy requirements of UL specification 94V-0.

For more information, request Chomerics' Technical Bulletin **73**.

Ordering Procedure

CHO-JAC shielding is offered in sizes to fit cables with 10, 16, 20, 26, 34, 40, 50, 60 or 64 conductors. Use the following part number system when ordering. Standard roll length is 100 feet (30.4 meters).

CJ – XXX – YY

PRODUCT DESIGNATION	
021 aluminum	022 copper

NO. OF CONDUCTORS (0.05 INCH CENTER WIRE)									
Width of cable to be shielded, inches (mm)	10	16	20	26	34	40	50	60	64
	0.50 (12.70)	0.80 (20.32)	1.00 (25.40)	1.30 (33.02)	1.70 (43.18)	2.00 (50.80)	2.50 (63.50)	3.00 (76.20)	3.20 (81.28)

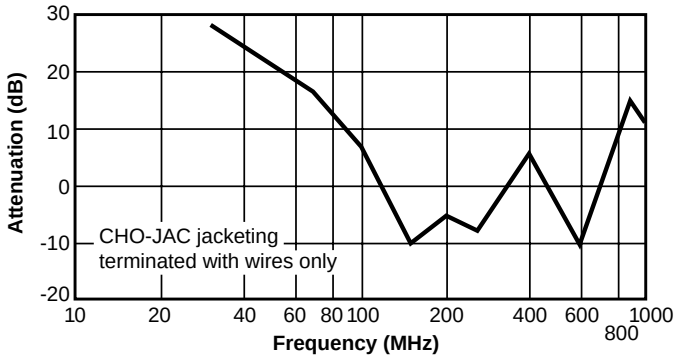


Figure 1 Shielding Effectiveness with Wire Ground Termination

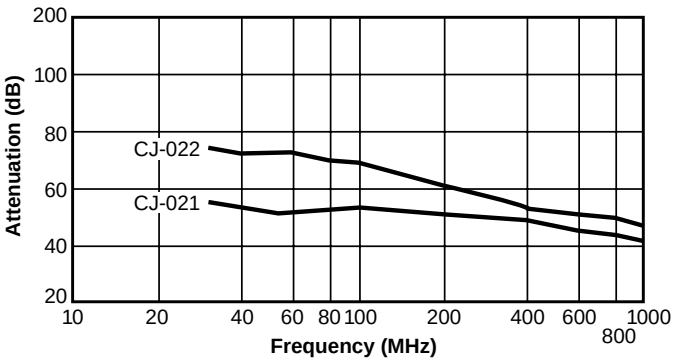


Figure 2 Shielding Effectiveness with 360° Ground Termination

SHIELD WRAP™ Knitted Wire Mesh Tape

SHIELD WRAP Knitted Wire Mesh Shielding Tape

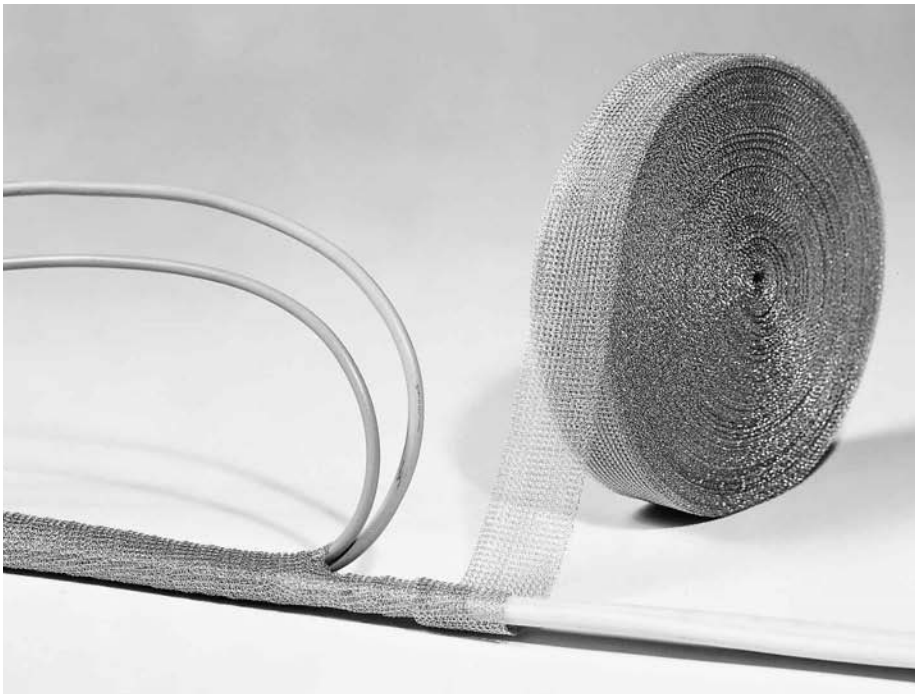
SHIELD WRAP wire mesh EMI/EMP shielding tape is produced as a two-ply flattened cylinder of varying widths, loop spacings, wire sizes and metals.

SHIELD WRAP mesh is designed to wrap easily (50% overlap recommended) around cables and harnesses, and will reduce corona discharge in addition to providing EMI shielding. It has excellent flexibility and conforms easily to irregular and complex surfaces. Under rising temperatures, the wire's knitted loops enlarge into each other instead of bulging away from wrapped surfaces, as do straight wires of woven mesh. Although not intended as a substitute for braided grounding straps, SHIELD WRAP mesh becomes especially useful for grounding when considerable flexibility is required.

Standard SHIELD WRAP mesh is available in either monel or Ferrex*, in wire diameters of 0.0035 in. (0.09 mm) and 0.0045 in. (0.11 mm), and widths from 3/4 in. (19.1 mm) to 2 in. (50.8 mm). Openings per linear in. are from 8 to 14 for these materials. Mesh can also be fabricated from a number of other metals, including aluminum, silver-plated brass, copper, tinned copper, nickel and stainless steel. Strip widths up to 24 in. (600 mm) can be provided.

For complete information, request Technical Bulletin **113**.

Chomerics can supply mesh knitted in most metals with a minimum wire diameter of .002 in. (0.051 mm). Minimum order quantities may apply. For custom applications, contact Chomerics' Applications Engineering Department for assistance.



Ordering Procedure

Standard SHIELD WRAP mesh (monel or Ferrex): Select the part number from below. Include wire diameter [0.0035 in. (0.09 mm) or 0.0045 in. (0.11 mm)] and length of strip required.

Fabricated or Non-Standard SHIELD WRAP mesh: When SHIELD WRAP mesh is to be fabricated from another metal, or in a non-standard size, consult Chomerics' Applications Engineering Department. Part numbers will be assigned by Chomerics.

Table 1

STANDARD SHIELD WRAP KNITTED WIRE MESH				
	Strip Width			
Metal	3/4 in. (19.1 mm)	1 in. (25.4 mm)	1-1/2 in. (38.1 mm)	2 in. (50.8 mm)
	Part Number			
Monel	05-0720-0272-02	05-0720-0432-02	05-0720-1012-01	05-0720-1532-01
Ferrex	05-0860-0272-02	05-0860-0432-01	05-0860-1012-03	05-0860-1532-04

Note: In addition to part number, desired wire diameter must be specified. Part numbers shown above reflect 0.0045 in. wire diameters.

* Ferrex® is Chomerics' tin-plated, copper-clad steel wire per ASTM B-520. ASTM (QQ-W-343) tin-plate, 2-3% by weight; ASTM B-227 copper-cladding 30-40% by weight; SAE 1010 steel wire, balance by weight.

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South America **TEL** +(55) 11 3917 1099 **FAX** +(55) 11 3917 0817
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EMI Shielding Theory & Gasket Design Guide

Theory of Shielding and Gasketing

Fundamental Concepts

A knowledge of the fundamental concepts of EMI shielding will aid the designer in selecting the gasket inherently best suited to a specific design.

All electromagnetic waves consist of two essential components, a magnetic field, and an electric field. These two fields are perpendicular to each other, and the direction of wave propagation is at right angles to the plane containing these two components. The relative magnitude between the magnetic (H) field and the electric (E) field depends upon how far away the wave is from its source, and on the nature of the generating source itself. The ratio of E to H is called the wave impedance, Z_w.

If the source contains a large current flow compared to its potential, such as may be generated by a loop, a transformer, or power lines, it is called a current, magnetic, or low impedance source. The latter definition is derived from the fact that the ratio of E to H has a small value. Conversely, if the source operates at high voltage, and only a small amount of current flows, the source impedance is said to be high, and the wave is commonly referred to as an electric field. At very large distances from the source, the ratio of E to H is equal for either wave regardless of its origination. When this occurs, the wave is said to be a plane wave, and the wave impedance is equal to 377 ohms, which is the intrinsic impedance of free space. Beyond this point all waves essentially lose their curvature, and the surface containing the two components becomes a plane instead of a section of a sphere in the case of a point source of radiation.

The importance of wave impedance can be illustrated by considering what happens when an electromagnetic wave encounters a discontinuity. If the magnitude of the wave impedance is greatly different from the intrinsic impedance of the discontinuity, most of the energy will be reflected, and very little will be transmitted across the boundary. Most metals have an intrinsic impedance of only milliohms. For low impedance fields (H dominant), less energy is reflected, and more is absorbed, because the metal is more closely matched to the impedance of the field. This is why it is so difficult to shield against magnetic fields. On the other hand, the wave impedance of electric fields is high, so most of the energy is reflected for this case.

Consider the theoretical case of an incident wave normal to the surface of a metallic structure as illustrated in Figure 1. If the conductivity of the metal wall is infinite, an electric field equal and opposite to that of the incident electric field components of the wave is generated in the shield. This satisfies the boundary condition that the total tangential electric field must vanish at the boundary. Under these ideal conditions, shielding should be perfect because the two fields exactly cancel one another. The fact that the magnetic fields are in phase means that the current flow in the shield is doubled.

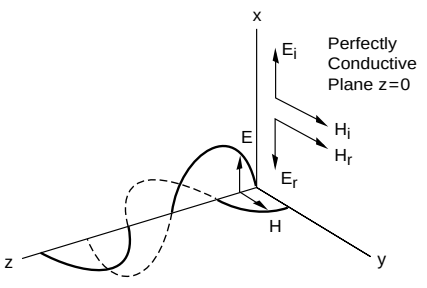

Figure 1 Standard Wave Pattern of a Perfect Conductor Illuminated by a Normally Incident, + X Polarized Plane Wave

Shielding effectiveness of metallic enclosures is not infinite, because the conductivity of all metals is finite. They can, however, approach very large values. Because metallic shields have less than infinite conductivity, part of the field is transmitted across the boundary and supports a current in the metal as illustrated in Figure 2. The amount of current flow at any depth in the shield, and the rate of decay is governed by the conductivity of the metal and its permeability. The residual current appearing on the opposite face is the one responsible for generating the field which exists on the other side.

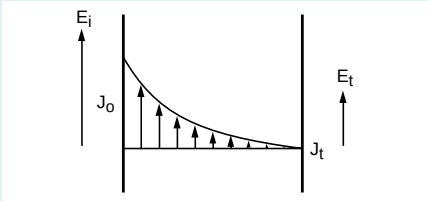

Figure 2 Variation of Current Density with Thickness for Electrically Thick Walls

Our conclusion from Figures 2 and 3 is that thickness plays an important role in shielding. When skin depth is considered, however, it turns out that thickness is only critical at low frequencies. At high frequencies, even metal foils are effective shields.

The current density for thin shields is shown in Figure 3. The current density in thick shields is the same as for thin shields. A secondary reflection occurs at the far side of the shield for all thicknesses. The only difference with thin shields is that a large part of the re-reflected wave may appear on the front surface. This wave can add to or subtract from the primary reflected wave depending upon the phase relationship between them. For this reason, a correction factor appears in the shielding calculations to account for reflections from the far surface of a thin shield.

A gap or slot in a shield will allow electromagnetic fields to radiate through the shield, unless the current continuity can be preserved across the gaps. The function of an EMI gasket is to preserve continuity of current flow in the shield. If the gasket is made of a material identical to the walls of the shielded

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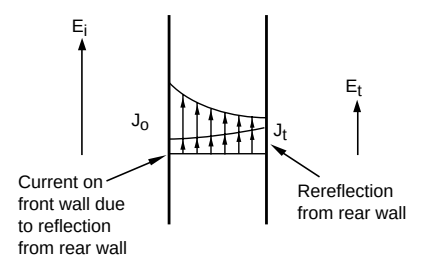


Figure 3 Variation of Current Density with Thickness for Electrically Thin Wall

enclosure, the current distribution in the gasket will also be the same assuming it could perfectly fill the slot. (This is not possible due to mechanical considerations.)

The flow of current through a shield including a gasket interface is illustrated in Figure 4. Electromagnetic leakage through the seam can occur in two ways. First, the energy can leak through the material directly. The gasket material shown in Figure 4 is assumed to have lower conductivity than the material in the shield. The rate of current decay, therefore, is also less in the gasket. It is apparent that more current will

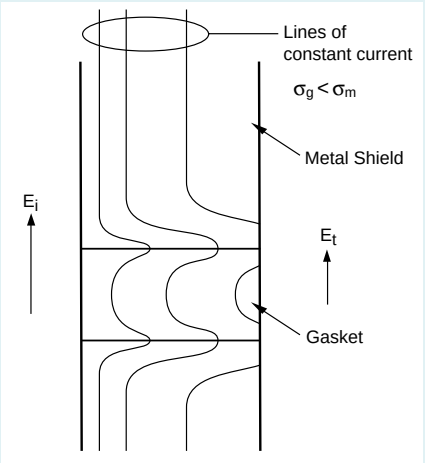


Figure 4 Lines of Constant Current Flow Through a Gasketed Seam

appear on the far side of the shield. This increased flow causes a larger leakage field to appear on the far side of the shield. Second, leakage can occur at the interface between the gasket and the shield. If an air gap exists in the seam, the flow of current will be diverted to those points or areas which are in contact. A change in the direction of the flow of current alters the current distribution in the shield as well as in the gasket. A high resistance joint does not behave much differently than open seams. It simply alters the distribution of current somewhat. A current distribution for a typical seam is shown in Figure 4. Lines of constant current flow spaced at larger intervals indicate less flow of current.

It is important in gasket design to make the electrical properties of the gasket as similar to the shield as possible, maintain a high degree of electrical conductivity at the interface, and avoid air, or high resistance gaps.

Shielding and Gasket Equations[1]

The previous section was devoted to a physical understanding of the fundamental concepts of shielding and gasketing. This section is devoted to mathematical expressions useful for general design purposes. It is helpful to understand the criteria for selecting the parameters of a shielded enclosure.

In the previous section, it was shown that electromagnetic waves incident upon a discontinuity will be partially reflected, and partly transmitted across the boundary and into the material. The effectiveness of the shield is the sum total of these two effects, plus a correction factor to account for reflections from the back surfaces of the shield. The overall expression for shielding effectiveness is written as:

$$S.E. = R + A + B \quad (1)$$

where

S.E. is the shielding effectiveness[2] expressed in dB,

R is the reflection factor expressed in dB,

A is the absorption term expressed in dB, and

B is the correction factor due to reflections from the far boundary expressed in dB.

The reflection term is largely dependent upon the relative mismatch between the incoming wave and the surface impedance of the shield. Reflection terms for all wave types have been worked out by others.[3] The equations for the three principal fields are given by the expressions:

$$R_E = 353.6 + 10 \log_{10} \frac{G}{f^3 \mu r_1^2} \quad (2)$$

$$R_H = 20 \log_{10} \left(\frac{0.462}{r_1} \sqrt{\frac{\mu}{Gf}} + 0.136 r_1 \sqrt{\frac{fG}{\mu}} + 0.354 \right) \quad (3)$$

$$R_P = 108.2 + 10 \log_{10} \frac{G \times 10^6}{\mu f} \quad (4)$$

where

R_E, R_H, and R_P are the reflection terms for the electric, magnetic, and plane wave fields expressed in dB.

G is the relative conductivity referred to copper,

f is the frequency in Hz,

μ is the relative permeability referred to free space,

r_1 is the distance from the source to the shield in inches.

The absorption term A is the same for all three waves and is given by the expression:

$$A = 3.338 \times 10^{-3} \times t \sqrt{\mu f G} \quad (5)$$

where

A is the absorption or penetration loss expressed in dB, and t is the thickness of the shield in mils.

The factor B can be mathematically positive or negative (in practice it is always negative), and becomes insignificant when A>6 dB. It is usually only important when metals are thin, and at low frequencies (i.e., below approximately 20 kHz).

$$B \text{ (in dB)} = 20 \log_{10} \left| 1 - \left(\frac{(K-1)^2}{(K+1)^2} \right) \left(10^{-A/10} \right) \left(e^{-j.227A} \right) \right| \quad (6)$$

where

A = absorption losses (dB)

$|K| = |Z_S/Z_H| = 1.3(\mu/fr^2G)^{1/2}$

Z_S = shield impedance

Z_H = impedance of the incident magnetic field

References

1. Much of the analysis discussed in this section was performed by Robert B. Cowdell, as published in *"Nomograms Simplify Calculations of Magnetic Shielding Effectiveness"* **EDN**, page 44, September 1, 1972.
2. Shielding Effectiveness is used in lieu of absorption because part of the shielding effect is caused by reflection from the shield, and as such is not an absorption type loss.
3. Vasaka, G.J., *Theory, Design and Engineering Evaluation of Radio-Frequency Shielded Rooms,* U.S. Naval Development Center, Johnsville, Pa., Report NADC-EL-54129, dated 13 August, 1956.

The preceding equation was solved in two parts. A digital computer was programmed to solve for B with a preselected value of A, while $|K|$ varied between 10^{-4} and 10^{3}. The results are plotted in Figure 9.

The nomograph shown in Figure 8 was designed to solve for $|K|$ in equation (6). Note that when Z_H becomes much smaller than Z_S (K>1), large positive values of B may result. These produce very large and unrealistic computed values of S.E., and imply a low frequency limitation on the B equation. In practical cases, absorption losses (A) must be calculated before B can be obtained.[1]

A plot of reflection and absorption loss for copper and steel is shown in Figure 5. This illustration gives a good physical representation of the behavior of the component parts of an electromagnetic wave. It also illustrates why it is so much more difficult to shield magnetic fields than electric fields or plane waves. Note: In Figure 5, copper offers more shielding effectiveness than steel in all cases except for absorption loss. This is due to the high permeability of iron. These shielding numbers are theoretical, hence they are very high (and unrealistic) practical values.

If magnetic shielding is required, particularly at frequencies below 14 kHz, it is customary to neglect all terms in equation (1) except the absorption term A. Measurements of numerous shielded enclosures bears this out. Conversely, if only electric field, or plane wave protection is required, reflection is the important factor to consider in the design.

The effects of junction geometry, contact resistance, applied force and other factors which affect gasket performance are discussed in the design section which follows.

Polarization Effects

Currents induced in a shield flow essentially in the same direction as the electric field component of the inducing wave. For example, if the electric component of a wave is vertical, it is known as a vertically polarized wave, and it will cause a current to flow in the shield in a vertical direction. A gasket placed transverse to the flow of current is less effective than one placed parallel to the flow of current.

A circularly polarized wave contains equal vertical and horizontal components, so gaskets must be equally effective in both directions. Where polarization is unknown, gasketed junctions must be designed and tested for the worse condition; that is, where the flow of current is parallel to the gasket seam.

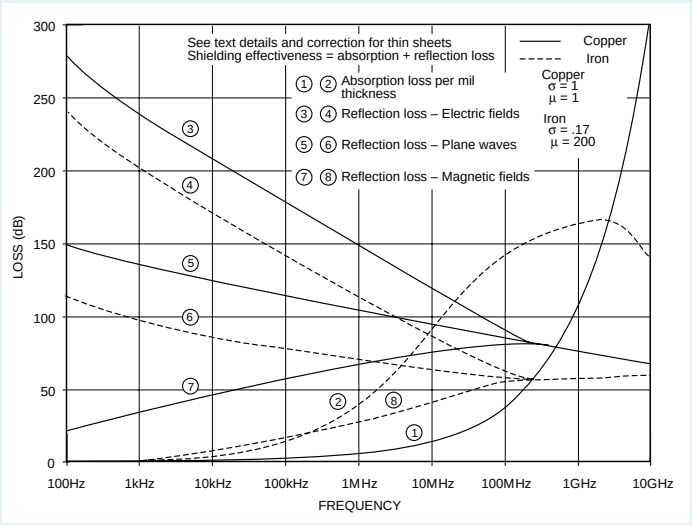


Figure 5 Shielding Effectiveness of Metal Barriers

Nomographs

The nomographs presented in Figures 6 through 9 will aid the designer in determining absorption and magnetic field reflection losses directly[1]. These nomographs are based on the equations described in the previous section.

Absorption Loss – Figure 6: Given a desired amount of absorption loss at a known frequency, determine the required thickness for a known metal:

a. Locate the frequency on the f scale and the desired absorption loss on the A scale.

   Place a straight-edge across these points and locate a point on the unmarked X scale *(Example: A = 10 dB, f =100 kHz).*

b. Pivot the straight-edge about the point on the unmarked X scale to various metals noted on the G x μ scale. A line connecting the G x μ scale and the point on the unmarked scale will give the required thickness on the t scale. *(Example: for copper t = 9.5 mils, cold rolled steel t = 2.1 mils).*

   Some care must be exercised in using these charts for ferrous materials because μ varies with magnetizing force.

Magnetic Field Reflection – Figure 7: To determine magnetic field reflection loss R_H:

a. Locate a point on the G/μ scale for one of the metals listed. If the metal is not listed, compute G/μ and locate a point on the numerical scale.

b. Locate the distance between the energy source and the shield on the r scale.

c. Place a straight-edge between r and G/μ and locate a point on the unmarked X scale *(Example: r =10 inches for hot rolled steel).*

d. Place a straight-edge between the point on the X scale and the desired frequency on the f scale.

e. Read the reflection loss from the R_H scale. (For f = 10 kHz, R_H = 13 dB).

f. By sweeping the f scale while holding the point on the X scale, R_H versus frequency can be obtained. (For f = 1 kHz, R_H = 3.5 dB).

(Note that thickness is not a factor in calculating reflection losses.)

References

1. Robert B. Cowdell, *"Nomograms Simplify Calculations of Magnetic Shielding Effectiveness"* **EDN**, page 44, September 1, 1972.

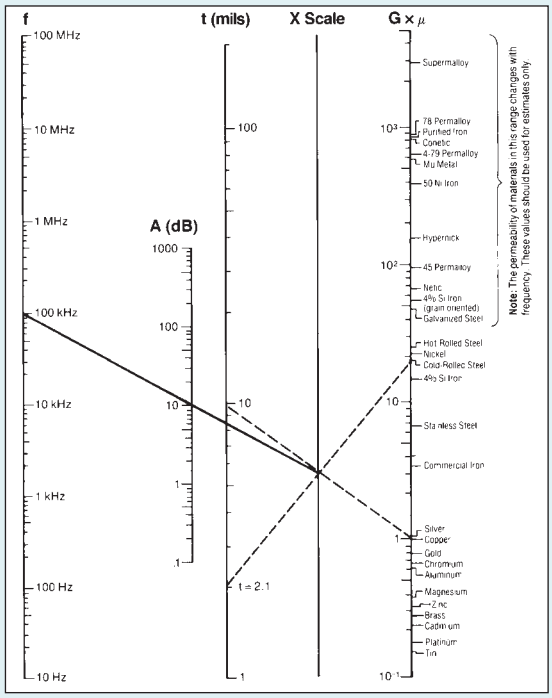


Figure 6 Absorption Loss Nomograph[1]

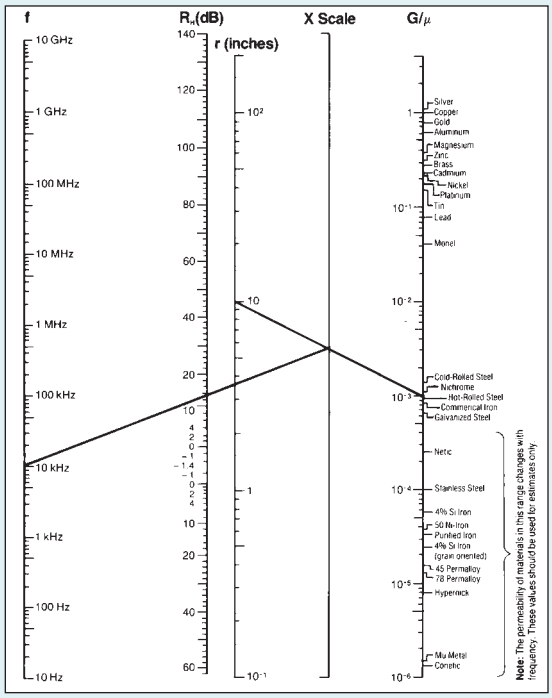


Figure 7 Magnetic Field Reflection Loss Nomograph, R_H[1]

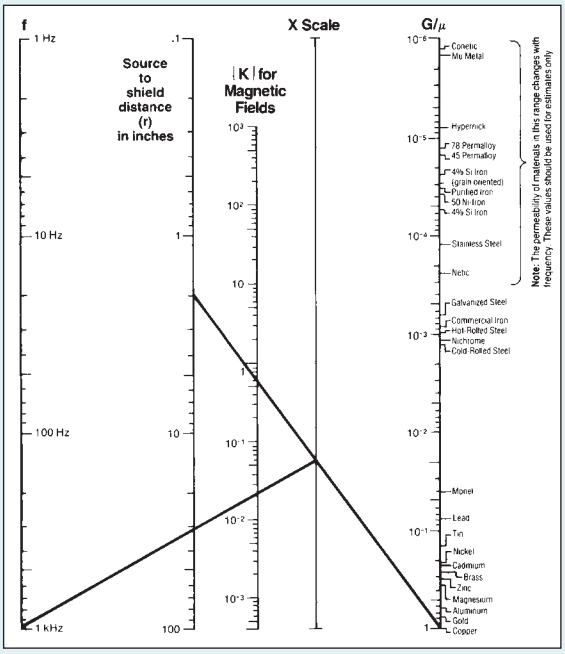


Figure 8 Magnetic Field Secondary Reflection Loss Factor Nomograph[1]

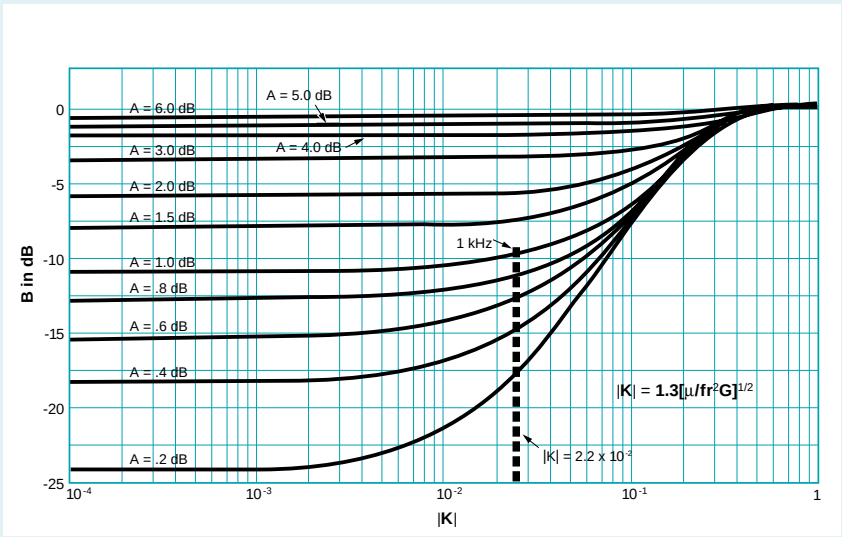


Figure 9 Solving for Secondary Reflection Loss (B)[1]

Magnetic Field Secondary Reflection Losses |K| Figures 8 and 9:
To determine the magnetic field secondary reflection loss factor |K| to solve for B:

Given: r = 2 inches for 0.0162 in. thick copper and A = 1.3 dB.

Find B at 1 kHz.

a. Draw a line between copper on the G/μ scale and r = 2 inches on the "source to shield distance scale." Locate a point on the X scale.

b. Draw a line from the point on the X scale to 1 kHz on the f scale.

c. At its intersection with the |K| scale, read $|K| = 2.2 \times 10^{-2}$.

d. Proceed to Figure 9.

e. On Figure 9, locate $|K| = 2.2 \times 10^{-2}$ on the horizontal scale.

f. Move vertically to intersect the A = 1.3 curve (interpolate), and then horizontally to find B = –8.5 dB.

Conductive Elastomer Gasket Design*

Gasket Junction Design

The ideal gasketing surface is rigid and recessed to completely house the gasket. Moreover, it should be as conductive as possible. Metal surfaces mating with the gasket ideally should be non-corrosive. Where reaction with the environment is inevitable, the reaction products should be electrically conductive or easily penetrable by mechanical abrasion. It is here that many gasket designs fail. The designer could not, or did not treat the mating surface with the same care as that given to the selection of the gasketing material.

By definition, a gasket is necessary only where an imperfect surface exists. If the junction were perfect, which includes either a solidly welded closure, or one with mating surfaces infinitely stiff, perfectly flat, or with infinite conductivity across the junction, no gasket would be necessary. The more imperfect the mating surfaces, the more critical is the function of the gasket. Perfect surfaces are expensive. The final solution is generally a compromise between economics and performance, but it should not be at the expense of neglecting the design of the flange surfaces.

The important property that makes a *conductive elastomer* gasket a good EMI/EMP seal is its ability to provide good electrical conductivity across the gasket-flange interface. Generally, the better the conformability and conductivity, the higher the shielding effectiveness of the gasket. In practice, it has been found that surface conductivity of both the gasket and the mating surfaces is the single most important property that makes the gasketed seam effective; i.e., *the resistance between the flange and gasket should be as low as possible.*

At this stage of the design every effort should be given to choosing a flange that will be as stiff as possible consistent with the construction used and within the other design constraints.

1. Flange Materials

Flanges are generally made of the same material as the basic enclosure for reasons of economy, weldability, strength and resistance to corrosion. Wherever possible, the flanges should be made of materials with the highest possible conductivity. It is advisable to add caution notes on drawings not to paint the flange mating surfaces. If paint is to be applied to outside surfaces, be sure that the contact surfaces are well masked before paint is applied, and then cleaned after the masking tape is removed. If the assembled units are subject to painting or repainting in the field, add a cautionary note in a conspicuous location adjacent to the seal that the seal areas are to be masked before painting.

Ordinarily, the higher the conductivity of a material, the more readily it oxidizes – except for noble metals such as gold and silver. Gold is impervious to oxidation, and silver, although it oxidizes, forms oxides that are soft and relatively conductive.

Most oxides, however, are hard. Some of the oxide layers remain thin while others build up to substantial thickness in relatively short time. These oxides form insulating, or semi-conducting films at the boundary between the gasket and the flanges. This effect can be overcome to a degree by using materials that do not oxidize readily, or by coating the surface with a conductive material that is less subject to oxidation. Nickel plating is generally recommended for aluminum parts, although tin has become widely accepted. Zinc is primarily used with steel. Consult the applicable specifications before selecting a finish. A good guide to finishing EMI shielded flanges for aerospace applications has been published by SAE Committee AE-4 (Electromagnetic Compatibility) under the designation ARP 1481. A discussion of corrosion control follows later in this guide.

2. Advantages of Grooved Designs

All rubber materials are subject to "Compression Set," especially if over compressed. Because flange surfaces cannot be held uniformly flat when the bolts are tightened (unless the flanges are infinitely stiff), gaskets tend to overcompress in the areas of the bolts. Proper groove design is required to avoid this problem of over compression. A groove also provides metal-to-metal contact between the flange members, thereby reducing contact resistance across the junction.

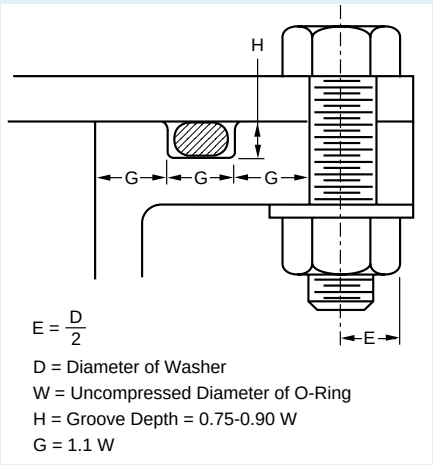
A single groove will suffice for most designs. Adding a second groove parallel to the first adds approximately 6 dB to the overall performance of a single-groove design. Adding more grooves beyond the second does not increase the gasketing effectiveness significantly.

3. Flange Design Considerations

Most designers fight a space limitation, particularly in the vicinity of the gasketed seam. Complex fasteners are often required to make the junctions more compact.

The ideal flange includes a groove for limiting the deflection of a gasket. The screw or bolt fasteners are mounted outboard of the gasket to eliminate the need for providing gaskets under the fasteners. A machined flange and its recommended groove dimensions are shown in Figure 10. The gasket may

* Complete solid-O gasket design information starts on page 209.



D = Diameter of Washer
W = Uncompressed Diameter of O-Ring
H = Groove Depth = 0.75-0.90 W
G = 1.1 W

Figure 10 Machined Flange with Gasket Groove

be an "O" or "D"-shaped gasket, either solid or hollow.

Solid conductive O-rings are normally limited to a deflection of 25 percent. Therefore, the minimum compressed height of the O-ring (also the groove depth) is related to the uncompressed height (or diameter) by the expression H = 0.75 W, where W is the uncompressed diameter. The width of the groove, G, should be equal to 1.1 W. Allow sufficient void in the groove area to provide for a maximum gasket fill of 95 percent. Conductive elastomer gaskets may be thought of as "incompressible fluids." For this reason, sufficient groove cross sectional area must be allowed for the largest cross-sectional area of the gasket when tolerances are taken into account. Never allow groove and gasket tolerance accumulations to cause an "over-filled" groove (see gasket tolerances in section which follows).

When a seal is used to isolate pressure environments in addition to EMI, the bottom of the gasket groove should have a surface finish of 32-64 µin. (RMS) to minimize leakage along the grooves. Avoid machining methods that produce longitudinal (circumferential) scratches or chatter marks. Conversely, a surface that is too smooth will cause the gasket to "roll over" or twist in its groove.

The minimum distance from the edge of the groove to the nearest terminal edge, whether this terminal be the edge of a casting, a change in cross section, or a fastening device, should be equal to the groove width, G.

Bolts should be located a minimum distance, E (equal to one-half the diameter of the washer used under the head of the bolt) from the edge of the flange.

Square or rectangular cross section gaskets can be used in the same groove provided sufficient void is allowed for displacement of the rubber. A good design practice is not to allow the height of the gasket to exceed the base width. A better, or a more optimum ratio is a height-to-width ratio of one-half. Tall gaskets tend to roll over when loaded.

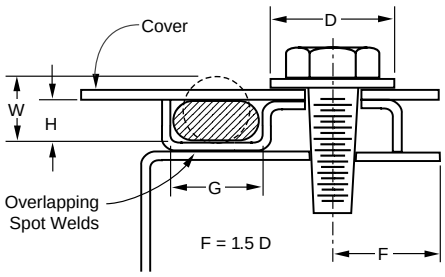


Figure 11a Shaped Sheet Metal Container

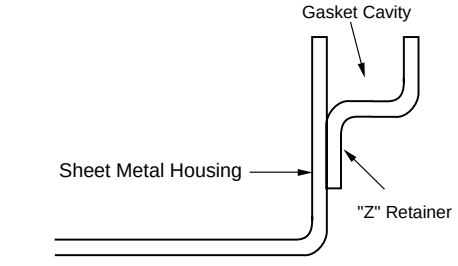


Figure 11b Z-Retainer Forms Gasket Cavity

The thickness of a flange is governed by the stiffness required to prevent excessive bowing between fastener points. Fewer, but larger bolts, require a thicker flange to prevent excessive deflections. For calculations of elastic deformation, refer to pages 206 and 207.

O-shaped and D-shaped gaskets may also be used in sheet metal flanges. The gaskets can be retained in a U-channel or Z-retainer, and are deflection-limited by adjusting the channel or retainer dimensions with respect to gasket height. Suggested retainer configurations are shown in Figures 11a and 11b.

A basic difference between flanges constructed from sheet metal and those which are machined from castings is that the bolts cannot be located as close to the edge of the part when the flange is made of sheet metal. Note, in Figure 11a, F is recommended to be 1.5 D, where D is the diameter of the washer.

Flat gaskets are ordinarily used with sheet metal or machined flanges as typically illustrated in Figure 12. Bolt holes in the flanges should be located at least 1.5 times the bolt diameter from the edge of the flange to prevent tearing when the metal is punched. If the holes are drilled, the position of the holes should be not less than the thickness of the gasket material from the edge of the flange. If holes must be placed closer to the edge than the recommended values, ears or

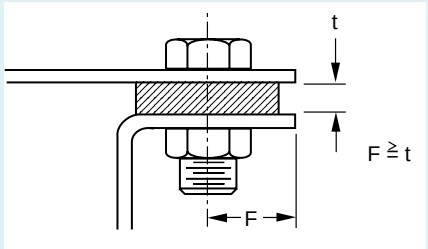


Figure 12 Flat Gasket on Sheet Metal Flange

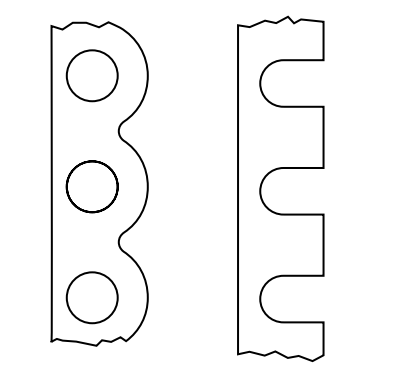


Figure 13 Ears or Slots in Sheet Metal Flanges or Flat Gaskets

slots should be considered as shown in Figure 13. Holes in flat gaskets should be treated in a similar manner.

4. Dimensional Tolerances

Grooves should be held to a machined tolerance of ±0.002 in. Holes drilled into machined parts should be held to within ±0.005 in. with respect to hole location. Location of punched holes should be within ±0.010 in. Sheet metal bends should be held to +0.030 and –0.000 in. Gasket tolerances are given in the "Selection of Seal Cross Section," later in this guide.

5. Waveguide Flanges

The three concerns for waveguide flanges are to ensure maximum transfer of electromagnetic energy across the flange interface to prevent RF leakage from the interface, and to maintain pressurization of the waveguide. Conductive elastomeric gaskets provide both an electrical and a seal function. For flat cover flanges, a die-cut sheet gasket (CHO-SEAL 1239 material), incorporating expanded metal reinforcement to control gasket creep into the waveguide opening, provides an excellent seal. Raised lips around the gasket cut-out improve the power handling and pressure sealing capability of the gasket. Choke flanges are best sealed with molded circular D-Section gaskets, and contact flanges with molded rectangular D-gaskets in a suitable groove (both in CHO-SEAL 1212 material).

The peak power handling capabilities of waveguide flanges are limited primarily by misalignment and sharp edges of flanges and/or gaskets. Average power handling is limited by the heating effects caused by contact resistance of the flange-gasket interface ("junction resistance").

Corrosion

All metals are subject to corrosion. That is, metal has an innate tendency to react either chemically or electrochemically with its environment to form a compound which is stable in the environment.

Most electronic packages must be designed for one of four general environments:

Class A. Controlled Environment Temperature and humidity are controlled. General indoor, habitable exposure.

Class B. Uncontrolled Environment Temperature and humidity are not controlled. Exposed to humidities of 100 percent with occasional wetting. Outdoor exposure or exposure in uncontrolled warehouses.

Class C. Marine Environment Shipboard exposure or land exposure within two miles of salt water where conditions of Class A are not met.

Class D. Space Environment Exposure to high vacuum and high radiation.

■ Finishes

Table I shows the minimum finish necessary to arrest chemical corrosion and provide an electrically conductive surface for the common metals of construction. Only the Class A, B, and C environments are shown in the table because the space environment is not a corrosive one (i.e., metals are not generally affected by the space environment).

Some metals require finishing because they chemically corrode. These are listed in Table I, and should be finished in accordance with the table. To select a proper finish for metals not given in Table I, refer to the material groupings of Table II. Adjacent groups in Table II are compatible. Another excellent source of information on corrosion-compatible finishes for EMI shielded

Table I

MINIMUM FINISH REQUIREMENTS FOR STRUCTURAL METALS			
	ENVIRONMENT		
Metal	**Class A**	**Class B**	**Class C**
Carbon and Alloy Steel	0.0003 in. cadmium plate 0.0005 in. zinc plate 0.0003 in. tin	0.0005 in. cadmium 0.001 in. zinc 0.0005 in. tin	0.003 in. nickel 0.001 in. tin
Corrosion-Resistant Steels	No finish required	No finish required; 0.0005 in. nickel to prevent tarnish	No finish required; 0.001 in. nickel to prevent tarnish
Aluminum 2000 & 7000 series	Chromate conversion coat (MIL-C-5541, Class 3)	Chromate conversion coat (MIL-C-5541) plus conductive epoxy or urethane	0.001 in. tin
Aluminum 3000, 5000, 6000 series and clad	No finish required, unless shielding requirements are high (see above)	Chromate conversion coat	Chromate conversion coat plus conductive epoxy or urethane
Copper and Copper Alloys	0.0003 in. tin	0.0005 in. tin	0.003 in. nickel 0.001 in. tin
Magnesium	0.0003 in. tin	0.0005 in. tin	0.001 in. tin
Zinc Base Castings	No finish required	0.0003 in. tin	0.0005 in. tin

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Table II

METALS COMPATIBILITY	
Group	**Material Groupings***
1	Gold – Platinum – Gold/Platinum Alloys – Rhodium – Graphite – Palladium – Silver – Silver Alloys – Titanium – Silver Filled Elastomers – Silver Filled Coatings
2	Rhodium – Graphite – Palladium – Silver – Silver Alloys – T itanium – Nickel – Monel – Cobalt – Nickel and Cobalt Alloys – Nickel Copper Alloys – AISI 300 Series Steels – A286 Steel – Silver Filled Elastomers – Silver Filled Coatings
3	Titanium – Nickel – Monel – Cobalt – Nickel and Cobalt Alloys – Nickel Copper Alloys – Copper – Bronze – Brass – Copper Alloys – Silver Solder – Commer cial Yellow Brass and Bronze – Leaded Brass and Bronze – Naval Brass – Steels AISI 300 Series, 451, 440, AM 355 and PH hardened – Chromium Plate – Tungsten – Molybdenum – Certain Silver Filled Elastomers
4	Leaded Brass and Bronze – Naval Brass – Steels AISI 431, 440, 410, 416, 420, AM 355 and PH hardened – Chromium Plate – Tungsten – Molybdenum – T in-Indium – Tin Lead Solder – Lead – Lead Tin Solder – Aluminum 2000 and 7000 Series – Alloy and Carbon Steel – Certain Silver Filled Elastomers – CHO-SHIELD 2000 Series Coatings
5	Chromium Plate – Tungsten – Molybdenum – Steel AISI 410, 416, 420, Alloy and Carbon – Tin – Indium – T in Lead Solder – Lead – Lead T in Solder – Aluminum – All Aluminum Alloys – Cadmium – Zinc – Galvanized Steel – Ber yllium – Zinc Base Castings
6	Magnesium – Tin

* Each of these groups overlaps, making it possible to safely use materials from adjacent groups.

flanges is ARP 1481, developed and published by SAE's Committee AE-4 (Electromagnetic Compatibility).

When a finish is required to make two mating metals compatible, finish the metal which is found in the lower numbered grouping of Table II. Metals given in Table II will, because of their inherent corrodibility, already be finished and the finish metal will be subject to the same rule. For example, to couple metals separated by two or more groups (e.g., 4 to 2), find a finish which appears in Group 3 and 4. The Group 3 metal should be plated onto the Group 2 metal to make metals 2 and 4 compatible. The reason for this is, if the finish metal breaks down, or is porous, its area will be large in comparison to the exposed area of the Group 2 metal, and the galvanic corrosion will be less.

On aluminum, chromate conversion coatings (such as Iridite) can be considered as conductive finishes. MIL-C-5541 Class 3 conversion coatings are required to have less than 200 milliohms resistance when measured at 200 psi contact pressure after 168 hours of exposure to a 5 percent salt spray. Recommended MIL-C-5541 Class 3 coatings are Alodine 600, or Alodine 1200 and 1200S dipped.

Organic Finishes

Organic finishes have been used with a great deal of success to prevent corrosion. Many organic finishes can be used, but none will be effective unless properly applied. The following procedure has been used with no traces of corrosion after 240 hours of MIL-STD-810B salt fog testing.

Aluminum panels are cleaned with a 20% solution of sodium hydroxide and then chromate conversion coated per MIL-C-5541 Class 3 (immersion process). The conversion coated panels are then coated with MIL-C-46168 Type 2 urethane coating, except in the areas where contact is required. For maximum protection of aluminum flanges, a CHO-SHIELD 2000 series conductive coating and CHO-SEAL 1298 conductive elastomer gasket material are recommended. For additional information, refer to Design Guides for Corrosion Control on page 201.

The finish coat can be any suitable urethane coating that is compatible with the MIL-C-46168 coating. It is important to note that test specimens without the MIL-C-46168 coating will show some signs of corrosion, while coated test specimens will show no traces of corrosion.

CHO-SHIELD® 2000 Series Coatings

When using CHO-SHIELD 2000 series conductive urethane coatings, not enough can be said about surface preparation to attain maximum adhesion. The easily mixed three-component system allows minimum waste with no weighing of components, thus eliminating weighing errors. Because of the filler loading of the 2000 series coatings, it is recommended that an air agitator cup be incorporated into the spray system to keep the conductive particles in suspension during the spraying sequence. It is recommended that approximately 7 mils of wet coating be applied. This thickness can be achieved by spraying multiple passes, with a ten minute wait between passes.

A 7-mil wet film coating will yield a dry film thickness of 4 mils, which is the minimum thickness required to attain the necessary corrosion and electrical values referenced in Chomerics' Technical Bulletin **30**. The coating thickness plays an important role in the electrical and corrosion properties. Thinner coatings of 1-3 mils do not exhibit the corrosion resistance of 4-5 mil coatings.

The coating will be smooth to the touch when cured. It is recommended that the coating be cured at room temperature for 2 hours followed by 250°F +/-10°F for one-half hour whenever possible. Alternate cure cycles are available, but with significant differences in corrosion and electrical properties. Two alternate cure schedules are two hours at room temperature followed by 150°F for two hours, or 7 days at room temperature.

Full electrical properties are achieved at room temperature after 7 days. It should be noted that the 250°F cure cycle reflects the ultimate in corrosion resistance properties. The 150°F/2 hour and room temperature/7 day cures will provide less corrosion resistance

than the 250°F cure, but are well within the specification noted in Technical Bulletin **30**.

1091 Primer

Because of the sensitivity of surface preparation on certain substrates and the availability of equipment to perform the etching of aluminum prior to the conversion coating, Chomerics has introduced 1091 primer, which is an adhesion promoter for CHO-SHIELD 2000 series coatings. When used in conjunction with an alkaline etch or chemical conversion coating per MIL-C-5541 Class 3, the 1091 primer will provide maximum adhesion when correctly applied. (See Technical Bulletin **31**.) This primer is recommended only for the 2000 series coatings on properly treated aluminum and is not recommended for composites.

For further assistance on the application of CHO-SHIELD 2000 series coatings on other metallic and non-metallic substrates, contact Chomerics' Applications Engineering Department.

■ Galvanic Corrosion

The most common corrosion concern related to EMI gaskets is *galvanic corrosion*. For galvanic corrosion to occur, a unique set of conditions must exist: two metals capable of generating a voltage between them (any two unlike metals will do), electrically joined by a current path, and immersed in a fluid capable of dissolving the less noble of the two (an electrolyte). In short, the conditions of a battery must exist. When these conditions do exist, current will flow and the extent of corrosion which will occur will be directly related to the total amount of current the galvanic cell produces.

When an EMI gasket is placed between two metal flanges, the first condition is generally satisfied because the flanges will probably not be made of the same metal as the gasket (most flanges are aluminum or steel, and most EMI gaskets contain Monel, silver, tin, etc.). The second condition is satisfied by the inherent conductivity of the EMI gasket. The last condition could be realized when the electronic package is placed in service, where salt spray or atmospheric humidity, if allowed to collect at the flange/gasket interface, can provide the electrolyte for the solution of ions.

Many users of EMI gaskets select Monel mesh or Monel wire-filled materials because they are often described as "corrosion-resistant." Actually, they are only corrosion-resistant in the sense that they do not readily oxidize over time, even in the presence of moisture. However, in terms of electrochemical compatibility with aluminum flanges, Monel is extremely active and its use requires extensive edge sealing and flange finish treatment to prevent galvanic corrosion. Most galvanic tables do not include Monel, because it is not a commonly used structural metal. The galvanic table given in MIL-STD-1250 does include Monel, and shows it to have a 0.6 volt potential difference with respect to aluminum – or almost the same as silver.

A common misconception is that all silver-bearing conductive elastomers behave galvanically as silver. Experiments designed to show the galvanic effects of silver-filled elastomer gaskets in aluminum flanges have shown less corrosion than predicted. Silver-plated-aluminum filled elastomers exhibit the least traces of galvanic corrosion and silver-plated-copper filled elastomers exhibit more. (See Table III).

Tables of galvanic potential do not accurately predict the corrosivity of metal-filled conductive elastomers because of the composite nature of these materials. Also, these tables do not measure directly two important aspects of conductive elastomer "corrosion resistance": 1) the corrosion of the mating metal flange and 2) the retention of conductivity by the elastomer after exposure to a corrosive environment.

Table III

CORROSION POTENTIALS OF VARIOUS METALS AND EMI GASKET MATERIALS
(in 5% NaCl at 21°C after 15 minutes of immersion)

Material	E_{corr} vs. SCE* (Millivolts)
Pure Silver	–25
Silver-filled elastomer	–50
Monel mesh	–125
Silver-plated-copper filled elastomer	–190
Silver-plated-aluminum filled elastomer	–200
Copper	–244
Nickel	–250
Tin-plated Beryllium-copper	–440
Tin-plated copper-clad steel mesh	–440
Aluminum* (1100)	–730
Silver-plated-aluminum filled elastomer (die-cut edge)	–740

*Standard Calamel Electrode. Aluminum Alloys approximately –700 to –840 mV vs. SCE in 3% NaCl. Mansfield, F. and Kenkel, J.V., *"Laboratory Studies of Galvanic Corrosion of Aluminum Alloys,"* **Galvanic and Pitting Corrosion – Field and Lab Studies**, ASTM STP 576, 1976, pp. 20-47.

Instead of using a table of galvanic potentials, the corrosion caused by different conductive elastomers was determined directly by measuring the weight loss of an aluminum coupon in contact with the conductive elastomer (after exposure to a salt fog environment). The electrical stability of the elastomer was determined by measuring its resistance before and after exposure. Figure 14a describes the test fixture that was used. Figure 14b shows the aluminum weight loss results for several different silver-filled conductive elastomers. The aluminum weight loss shows a two order of magnitude difference between the least corrosive (1298 silver-plated-aluminum) and most corrosive (1215 silver-plated-copper) filled elastomers. For silver-containing elastomers, the filler

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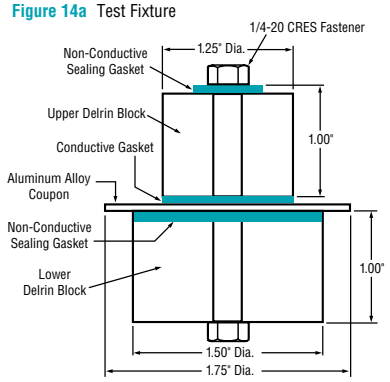
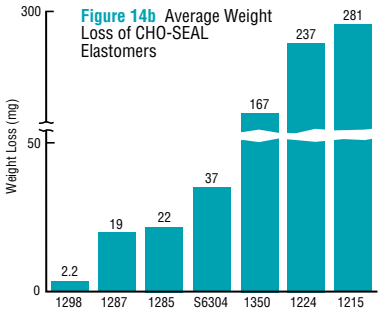
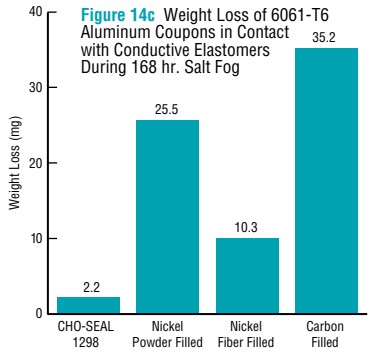
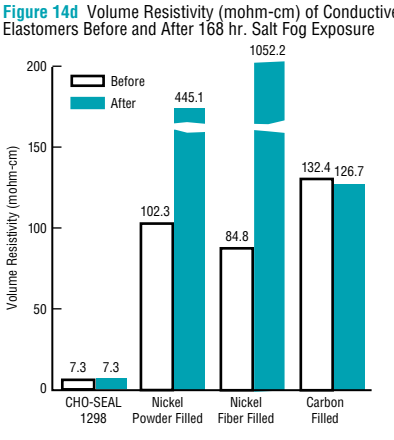
Figure 14a Test Fixture





(for composition, see Specifications Table, pgs. 32-34.)





substrate that the silver is plated on is the single most important factor in determining the corrosion caused by the conductive elastomer.

Figure 14c shows the weight loss results for nickel and carbon-filled elastomers compared to 1298. The nickel-filled materials are actually *more* corrosive than the silver-plated-aluminum filled elastomers. The carbon-filled materials are extremely corrosive.

Figure 14d compares the electrical stability of several conductive elastomers before and after salt fog exposure. In general, silver-containing elastomers are more electrically stable in a salt fog environment than nickel-containing elastomers.

Design Guides for Corrosion Control

The foregoing discussion is not intended to suggest that corrosion should be of no concern when flanges are sealed with silver-bearing conductive elastomers. Rather, corrosion control by and large presents the same problem whether the gasket is silver-filled, Monel wire-filled, or tin-plated. Furthermore, the designer must understand the factors which promote galvanic activity and strive to keep them at safe levels. By "safe", it should be recognized that some corrosion is likely to occur (and may be generally tolerable) at the outer (unsealed) edges of a flange after long-term exposure to salt-fog environments. This is especially true if proper attention has not been given to flange materials and finishes. The objective should be control of corrosion within acceptable limits.

The key to corrosion control in flanges sealed with EMI gaskets is proper design of the flange and gasket (and, of course, proper selection of the gasket material). A properly designed interface requires a moisture-sealing gasket whose thickness, shape and compression-deflection characteristics allow it to fill all gaps caused by uneven or unflat flanges, surface irregularities, bowing between fasteners and tolerance buildups. If the gasket is designed and applied correctly, it will exclude moisture and inhibit corrosion on the flange faces and inside the package.

Bare aluminum and magnesium, as well as iridited aluminum and magnesium, can be protected by properly designed conductive elastomer gaskets. It is important to note that magnesium is the least noble structural metal commonly used, and a silver-filled elastomer in contact with magnesium would theoretically produce an unacceptable couple.

Some specific design suggestions for proper corrosion control at EMI flanges are:

1. Select silver-plated-aluminum filled elastomers for best overall sealing and corrosion protection. CHO-SEAL 1298 material offers more corrosion resistance than any other silver-filled elastomer (see Figure 15, next page).

2. For aircraft applications, consider "seal-to-seal" designs, with same gasket material applied to both flange surfaces (see Figure 16).

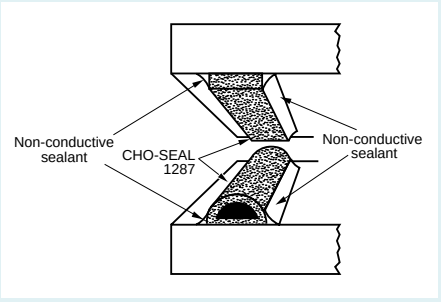


Figure 16 "Seal-to-seal" design incorporating CHO-SEAL® 1287 conductive silver-aluminum fluorosilicone gaskets on both mating flange surfaces. Gaskets are bonded and edge sealed to prevent moisture from entering the gasket/flange area.

3. To prevent corrosion on outside edges exposed to severe corrosive environments, use dual conductive/non-conductive gaskets (see page 55) or allow the non-conductive protective paint (normally applied to outside surfaces) to intrude slightly under the gasket (see Figure 17).

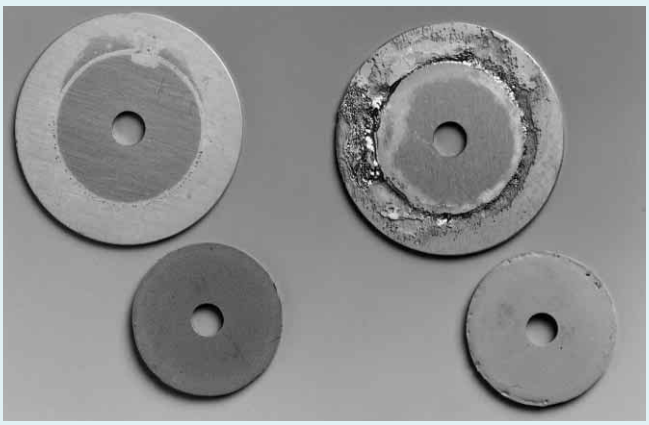


Figure 15 Comparison of corrosion results obtained from CHO-SEAL® 1298 conductive elastomer (left) and pure silver-filled elastomer (right) mated with aluminum after 168 hours of salt fog exposure.

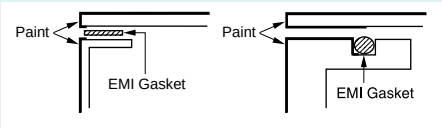


Figure 17 Non-Conductive Paint Intrudes Slightly Under Gasket to Provide Edge Protection

4. If moisture is expected to reach the flange interfaces in Class C (marine) environments, flange surfaces should be coated or plated to make them more compatible with the EMI gasket material. Chomerics' CHO-SHIELD 2000 series coatings are recommended for silver-filled elastomer or Monel wire gaskets, and tin plating for tin-plated gaskets.

5. Avoid designs which create sump areas.

6. Provide drainage and/or drain holes for all parts which would become natural sumps.

7. Provide dessicants for parts which will include sumps but cannot be provided with drain holes. Dessicant filters can also be provided for air intake.

8. Avoid sharp edges or protrusions.

9. Select proper protective finishes.

The definition of a "safe" level of galvanic activity must clearly be expanded to include the requirements of the design. If all traces of corrosion must be prevented (e.g., airframe applications) the structure must be properly finished or must be made of materials which will not corrode in the use environment. In these cases, the outside edges of EMI-gasketed flanges might also require peripheral sealing as defined in MIL-STD-1250, MIL-STD-889 or MIL-STD-454. MIL-STD-1250 deserves special mention. Although it was developed many years prior to the availability of CHO-SEAL 1298 conductive elastomer and CHO-SHIELD 2000 series conductive coatings, it offers the following useful corrosion control methods applicable to electronic enclosures:

1. Bonds made by conductive gaskets or adhesives, and involving dissimilar contact, shall be sealed with organic sealant.

2. When conductive gaskets are used, provision shall be made in design for environmental and electromagnetic seal. Where practical, a combination gasket with conductive metal encased in resin or elastomer shall be preferred.

3. Attention is drawn to possible moisture retention when sponge elastomers are used.

4. Because of the serious loss in conductivity caused by corrosion, special precautions such as environmental seals or external sealant bead shall be taken when wire mesh gaskets of Monel or silver are used in conjunction with aluminum or magnesium.

5. Cut or machined edges of laminated, molded, or filled plastics shall be sealed with impervious materials.

6. Materials that "wick" or are hygroscopic (like sponge core mesh gaskets) shall not be used.

7. In addition to suitability for the intended application, nonmetallic materials shall be selected which have the following characteristics:

a. Low moisture absorption;

b. Resistance to fungi and microbial attack;

c. Stability throughout the temperature range;

d. Freedom from outgassing;

e. Compatibility with other materials in the assembly;

f. Resistance to flame and arc;

g. For outdoor applications, ability to withstand weathering.

Selection of Seal Cross Section

Selection of the proper conductive elastomer gasket cross section is largely one of application, compromise, and experience with similar designs used in the past. Some general rules, however, can be established as initial design guidelines in selecting the class of gasket to be used.

1. Flat Gaskets

When using flat gaskets, care must be taken not to locate holes closer to the edge than the thickness of the gasket, or to cut a web narrower than the gasket thickness. This is not to be confused with the criteria for punching holes in sheet metal parts discussed earlier.

Keep in mind also that flat gaskets should not be deflected more than about 10 percent, compared with 15 to 30 percent for molded and solid extruded gaskets and 50% for hollow gaskets. Standard thicknesses for flat gaskets are 0.020, 0.032, 0.062, 0.093 and 0.125 in. (see General Tolerances on page 204.)

Where possible, the flange should be bent outward so that the screws or bolts do not penetrate the shielded compartment (see Figure 18a). If the flange must be bent inward to save space, the holes in the gasket must fit snugly around the threads of the bolts to prevent leakage along the threads and directly into the compartment. This calls for closely toleranced holes and accurate registration between the holes in the flange and the holes in the gasket, and would require machined dies (rather than rule dies) to produce the gasket. An alternate solution can be achieved by adding an EMI seal under the heads of bolts penetrating the

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enclosure, or by using an insert similar to an acorn nut that has been inserted in the flange and flared to make the joint RF-tight. “Blind nuts” can also be welded or attached with a conductive epoxy adhesive (see Figure 18b).

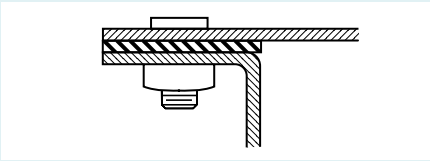


Figure 18a External Bolting Prevents EMI Leakage

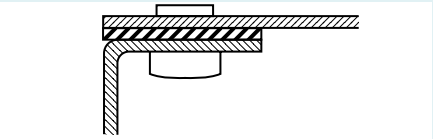


Figure 18b Insert Pressed-In and Flared Makes EMI Tight Joint (Alternate: Weld or Cement with Conductive Epoxy)

2. Shaped or Molded Gaskets

Groove designs for O- or D-shaped configurations are effective because gasket deflection can be controlled and larger deflections can be accommodated. O-ring cross sections are preferred because they can be deflected more easily under a given load. D-shapes or rectangular cross sections are excellent for retrofit applications because they can be made to accommodate almost any groove cross section. Groove designs also provide metal-to-metal flange contact, and require fewer fasteners, thereby minimizing the number of paths where direct leakage can occur.

Fasteners should be located such that pressure distribution is uniform at the corners (see Figure 19).

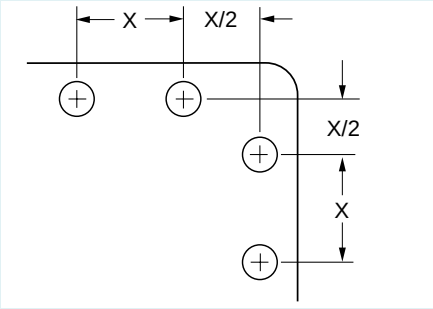
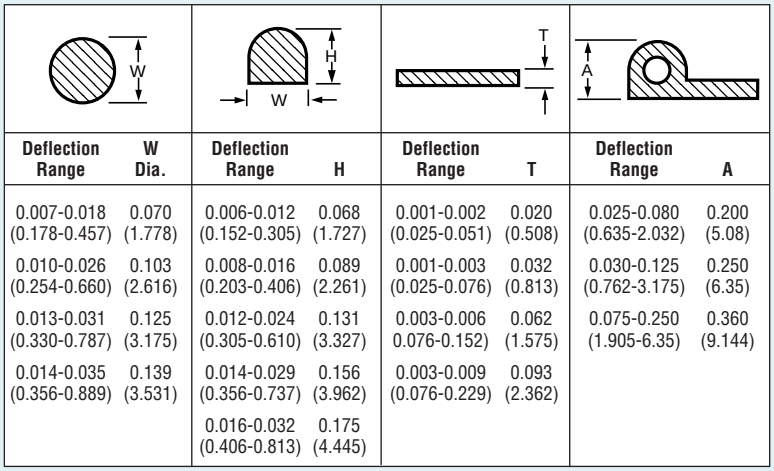


Figure 19 Fastener Location Near Corners



Deflection Range	W Dia.	Deflection Range	H	Deflection Range	T	Deflection Range	A
0.007-0.018 (0.178-0.457)	0.070 (1.778)	0.006-0.012 (0.152-0.305)	0.068 (1.727)	0.001-0.002 (0.025-0.051)	0.020 (0.508)	0.025-0.080 (0.635-2.032)	0.200 (5.08)
0.010-0.026 (0.254-0.660)	0.103 (2.616)	0.008-0.016 (0.203-0.406)	0.089 (2.261)	0.001-0.003 (0.025-0.076)	0.032 (0.813)	0.030-0.125 (0.762-3.175)	0.250 (6.35)
0.013-0.031 (0.330-0.787)	0.125 (3.175)	0.012-0.024 (0.305-0.610)	0.131 (3.327)	0.003-0.006 0.076-0.152)	0.062 (1.575)	0.075-0.250 (1.905-6.35)	0.360 (9.144)
0.014-0.035 (0.356-0.889)	0.139 (3.531)	0.014-0.029 (0.356-0.737)	0.156 (3.962)	0.003-0.009 (0.076-0.229)	0.093 (2.362)		
		0.016-0.032 (0.406-0.813)	0.175 (4.445)				

Figure 20 Gasket Deflection Ranges (mm dimensions in parentheses)

3. Hollow Gaskets

Hollow gasket configurations are very useful when large gaps are encountered, or where low closure forces are required. Hollow gaskets are often less expensive, and they can be obtained with or without attachment tabs. Hollow gaskets with tabs are referred to in the text and in the tables as “P-gaskets”. The minimum wall thickness of hollow gaskets is 0.020 in. depending on material. Contact Chomerics’ Applications Department for details. Hollow gaskets will compensate for a large lack of uniformity between mating surfaces because they can be compressed to the point of eliminating the hollow area.

4. Compression Limits

When compression cannot be controlled, compression stops should be provided to prevent gasket rupture caused by over-compression. Grooves provide built-in compression stops. Figure 20 gives nominal recommended compression ranges for CHO-SEAL and CHO-SIL materials, assuming standard tolerances.

5. Elongation

The tensile strength of conductive elastomer gaskets is not high. It is good practice to limit elongation to less than 10 percent.

6. Splicing

When grooves are provided for gasket containment, two approaches are possible. A custom gasket can be molded in one piece and placed into the desired groove, or a strip gasket can be spliced to length and fitted to the groove. To properly seat a spliced solid “O” cross section gasket, the inner radius of the groove at the corners must be equal to or greater than the gasket cross section width. Other cross sections need greater inner radius and may not be practical due to twisting when bent around corners. Splices can be simply butted (with no adhesive) or bonded with a conductive or non-conductive compound. If it has been decided that a spliced gasket will provide a satisfactory seal, the decision between splicing and molding should be based on cost. When a standard extrusion is available, splicing is generally recommended. For custom extrusions, splicing is generally more cost effective in quantities over 500 feet.

7. Gasket Limitations Imposed by Manufacturing Methods

Current manufacturing technology limits conductive elastomer gasket configurations to the following dimensions and shapes :

■ *Die-cut Parts*

Maximum Overall Size: 32 in. long x 32 in. wide x 0.125 in. thick (81 cm x 81 cm x 3.18 mm)

Minimum Cross Section: Width-to-thickness ratio 1:1 (width is not to be less than the thickness of the gasket).

■ *Molded Parts*

Currently available in any solid cross section, but not less than 0.040 in. in diameter. The outer dimensions of the gasket are limited to 34 inches in any direction. Larger parts can be made by splicing. Molded parts will include a small amount of flash (0.008 in. width and 0.005 in. thickness, maximum).

■ *Extruded Parts*

No limitation on length. Minimum solid cross-section is limited to 0.028 in. extrusions. Wall thickness of hollow extrusions varies with material but 0.020 in. can be achieved with most materials.

8. General Tolerances

The following tables provide general tolerances for conductive elastomer gaskets. It is important to note that all flat die-cut, molded, and extruded gaskets are subject to free-state variation in the unrestrained condition. The use of inspection fixtures to verify conformance of finished parts is common and recommended where appropriate.

Also note that "Over-all Dimensions" for flat die-cut gaskets and molded gaskets includes any feature-to-feature dimensions (e.g., edge-to-edge, edge-to-hole, hole-to-hole).

FLAT DIE-CUT GASKETS *inch (mm)*	TOLERANCE
Overall Dimensions	
≤10 (254)	±0.010 (0.25)
>10 to ≤15 (254 to 381)	±0.020 (0.51)
>15 (>381)	±0.20% Nom. Dim.
Thickness	
0.020 (0.51)	±0.004 (0.10)
0.032 (0.81)	±0.005 (0.13)
0.045 (1.14)	±0.006 (0.15)
0.062 (1.57)	±0.007 (0.18)
0.093 (2.36)	±0.010 (0.25)
0.125 (3.18)	±0.010 (0.25)
>0.125 (>3.18)	Contact a Chomerics Applications or Sales Engineer
Hole Diameters	
>0.060 (1.52) dia. if sheet thickness is...	
≤0.062 (1.57)	±0.005 (0.13)
>0.062 (1.57)	±0.008 (0.20)

MOLDED GASKETS *inch (mm)*	TOLERANCE
Overall Dimensions	
0.100 to 1.500 (2.54 to 38.10)	±0.010 (0.25)
1.501 to 2.500 (38.13 to 63.50)	±0.015 (0.38)
2.501 to 4.500 (63.53 to 114.30)	±0.020 (0.51)
4.501 to 7.000 (114.33 to 177.80)	±0.025 (0.64)
>7.000 (>177.80)	±0.35% Nom. Dim.
Cross Section	
0.040 to 0.069 (1.02 to 1.75)	±0.003 (0.08)
0.070 to 0.100 (1.78 to 2.54)	±0.004 (0.11)
0.101 to 0.200 (2.57 to 5.08)	±0.005 (0.13)
0.201 to 0.350 (5.11 to 8.89)	±0.008 (0.20)
Flash Tolerance	0.005 (0.13) Max.Thickness 0.008 (0.20) Max. Extension

EXTRUDED STRIP GASKETS *inch (mm)*	TOLERANCE
Cut Length	
<1.000 (25.40)	±0.010 (0.25)
1.0 to 30.000 (25.40 to 762)	±0.062 (1.58)
> 30.000 (762)	±0.2% Nom. Dim.
Cross Section	
< 0.200 (5.08)	±0.005 (0.13)
0.200-0.349 (5.08-8.86)	±0.008 (0.20)
0.350-0.500 (8.89-12.70)	±0.010 (0.25)
> 0.500 (12.70)	±3% Nom. Dim.

9. Gasket Cross Section Based on Junction Gaps

Gasket geometry is largely determined by the largest gap allowed to exist in the junction. Sheet metal enclosures will have larger variations than machined or die castings. The ultimate choice in allowable gap tolerance is a compromise between cost, performance and the reliability required during the life of the device. When a value analysis is conducted, it should be made of the entire junction, including the machining required, special handling, treatment of the surfaces and other factors required to make the junction functional. Often, the gasket is the least expensive item, and contributes to cost-effectiveness by allowing loosely-toleranced flanges to be made EMI-tight.

The maximum gap allowed to exist in a junction is generally determined by the minimum electrical performance expected of the seal. A secondary consideration must be given to the barrier as a pressure seal if gas pressures of significant magnitude are expected. The gasket will blow out if the pressure is too high for the gap.

The minimum gap allowed in the junction is determined by the allowable squeeze that can be tolerated by the gasket material. Deflection of conductive elastomer gaskets was given in Figure 20. Flat gaskets may be deflected as much as 6-10 percent (nominal), depending on initial thickness and applied force. O-shaped and D-shaped gaskets are normally deflected 10 to 25 percent; however, greater deflections can be achieved by manipulating cross section configuration.

Determination of the exact gasket thickness is a complex problem involving electrical performance, flange characteristics, fastener spacing and the properties of the gasket material. However, an initial estimate of the necessary thickness of a noncontained gasket can be determined by multiplying the difference in the expected minimum and maximum flange gaps by a factor of 4, as illustrated in Figure 21. A more detailed discussion, and a more accurate determination of gasket performance under loaded flange conditions, can be found in the Fastener Requirements section, page 206.

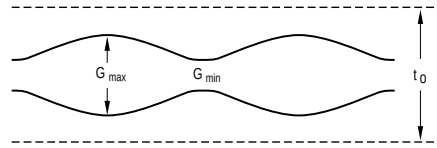


Figure 21 Gasket Deflection Along a Flange

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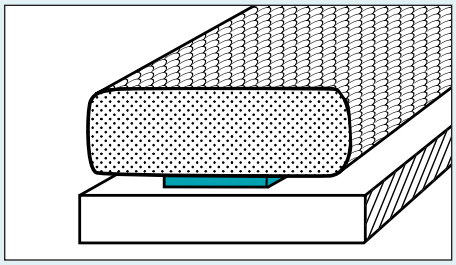
Gasket Mounting Choices

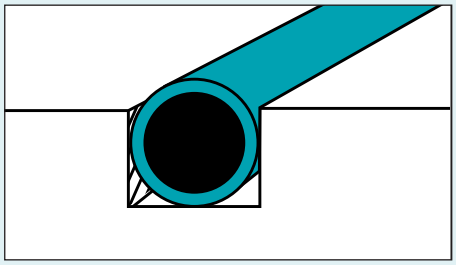
Our various EMI gasket mounting techniques offer designers cost-effective choices in both materials and assembly. These options offer aesthetic choices and accommodate packaging requirements such as tight spaces, weight limits, housing materials and assembly costs. Most Chomerics gaskets attach using easily repairable systems. Our Applications Engineering Department or your local Chomerics representative can provide full details on EMI gasket mounting. The most common systems are shown here with the available shielding products.



Pressure-Sensitive Adhesive

Quick, efficient attachment strip

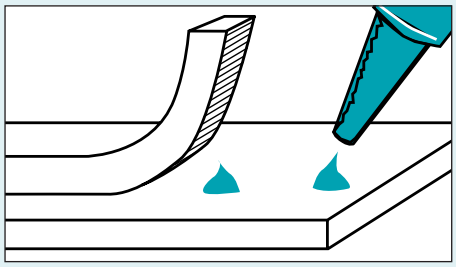
- Conductive Elastomers
- SOFT-SHIELD
- SPRING-LINE
- POLASHEET
- POLASTRIP



Friction Fit in a Groove

Prevents over-deflection of gasket
Retaining groove required

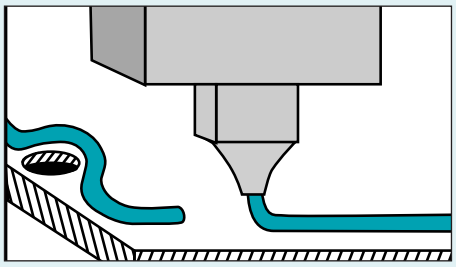
- Conductive Elastomers
- SOFT-SHIELD
- MESH STRIP
- POLASTRIP
- SPRINGMESH



Adhesive Compounds

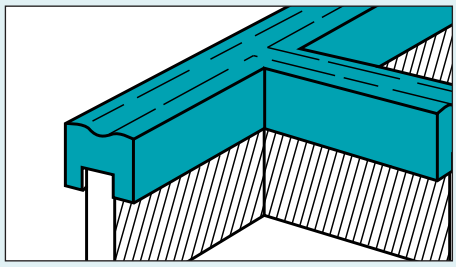
Conductive or non-conductive spot bonding

- Conductive Elastomers
- MESH STRIP



Robotically Dispensed Form-in-Place Conductive Elastomer

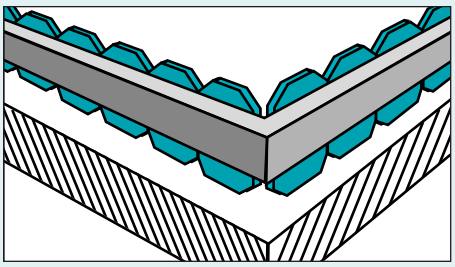
Chomerics' Cho-Form® automated technology applies high quality conductive elastomer gaskets to metal or plastic housings. Manufacturing options include Chomerics facilities, authorized Application Partners, and turnkey systems.



Friction Fit on Tangs

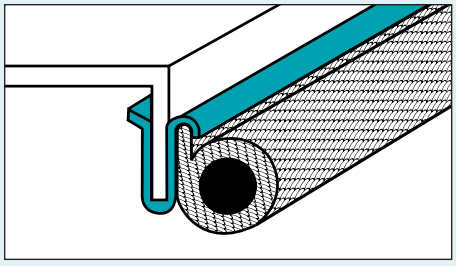
Accommodates thin walls, intricate shapes

- Conductive Elastomers



Spacer Gaskets

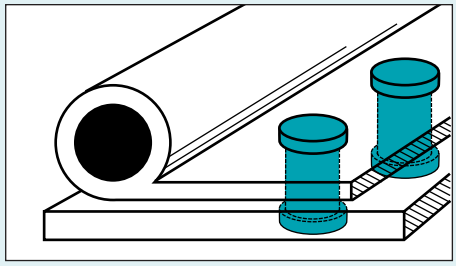
Fully customized, integral conductive elastomer and plastic spacer provide economical EMI shielding and grounding in small enclosures. Locator pins ensure accurate and easy installation, manually or robotically.



Metal Clips

Teeth bite through painted panels
Require knife edge mounting flange

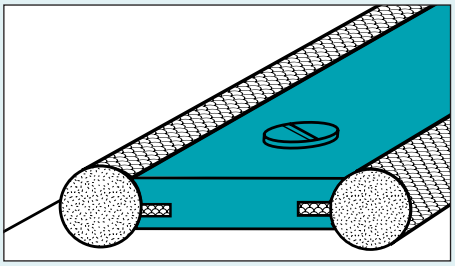
- Conductive Elastomers
- METALKLIP
- SPRING-LINE



Rivets/Screws

Require integral compression stops
Require mounting holes on flange

- Conductive Elastomers
- SPRING-LINE
- SHIELDMESH
- COMBO STRIP



Frames

Extruded aluminum frames and strips add rigidity. Built-in compression stops for rivets and screws.

- Conductive Elastomers
- MESH STRIP

Fastener Requirements

1. Applied Force

Most applications do not require more than 100 psi (0.69 MPa) to achieve an effective EMI seal. Waveguide flanges often provide ten times this amount. Hollow strips require less than 10 pounds per in. Compression deflection data for many shapes, sizes and materials is included in the Performance Data section of this handbook.

The force required at the point of least pressure, generally midway between fasteners, can be obtained by using a large number of small fasteners spaced closely together. Alternatively, fasteners can be spaced further apart by using stiffer flanges and larger diameter bolts. Sheet metal parts require more fasteners per unit length than castings because they lack stiffness.

To calculate average applied force required, refer to load-deflection curves for specific gasket materials and cross sections (see Performance Data, page 80).

2. Fastener Sizes and Spacing

Fastener spacing should be determined first. As a general rule, fasteners should not be spaced more than 2.0 inches (50 mm) apart for stiff flanges, and 0.75 inch (19 mm) apart for sheet metal if high levels of shielding are required. An exception to the rule is the spacing between fasteners found in large cabinet doors, which may vary from 3 inches (76.02 mm) between centers to single fasteners (i.e., door latches). The larger spacings are compensated for by stiffer flange sections, very large gaskets, and/or some reduction in electrical performance requirements.

The force per bolt is determined by dividing the total closure force by the number of bolts. Select a fastener with a stress value safely below the allowable stress of the fastener.

3. Flange Deflection

The flange deflection between fasteners is a complex problem involving the geometry of the flange and the asymmetrical application of forces in two directions. The one-dimensional solution, which treats the flange as a simple beam on an elastic foundation, is much easier to analyze[1] and gives a good first order approximation of the spacings required between fasteners, because most EMI gaskets are sandwiched between compliant flanges.

Variation in applied forces between fasteners can be limited to ±10 percent by adjusting the constants of the flange such that

$$\beta d = 2$$

where

$$\beta = \sqrt[4]{\frac{k}{4 E_f I_f}}$$

where

k = foundation modulus of the seal

E_f = the modulus of elasticity of the flange

I_f = the moment of inertia of the flange and seal

d = spacing between fasteners

The modulus of elasticity (E_f) for steel is typically 3 x 10^7. The modulus for aluminum is typically 1 x 10^7, and for brass it is about 1.4 x 10^7.

The foundation modulus (k) of seals is typically 10,000 to 15,000 psi.

The moment of inertia (I_f) of rectangular sections, for example, may be obtained from the following expression[2]:

$$I_f = \frac{bh^3}{12}$$

where

b is the width of the flange in contact with the gasket (inches) and

h is the thickness of the flange (inches).

where

h is the thickness of the flange.

b is the width of the flange.

d is the spacing between fasteners.

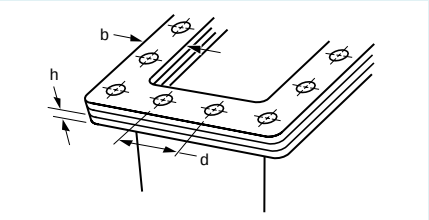


Figure 22 Bolt Spacings for Flanges

Example

Calculate the bolt spacings for flanges with a rectangular cross-section, such as shown in Figure 22,

Assume the flange is to be made of aluminum.

To maintain a pressure distribution between bolts of less than ±10 percent, ßd must be equal to 2 (see Figure 23 and discussion).

Assume an average foundation modulus (k) of 12,500 psi for the seal. If the actual modulus is known (stress divided by strain), substitute that value instead.

The bolt spacings for aluminum flanges for various thicknesses and widths have been calculated for the previous example and are shown in Figure 24.

The previous example does not take into account the additional stiffness contributed by the box to which the flange is attached, so the results are somewhat conservative.

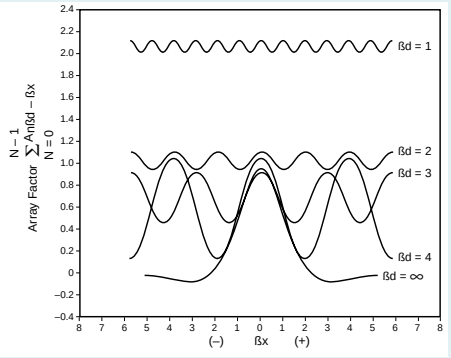


Figure 23 Array Factor vs. Spacing

References

1. Galagan, Steven, *Designing Flanges and Seals for Low EMI*, **MICROWAVES**, December 1966.
2. Roark, R.J., *Formulas for Stress and Strain,* McGraw-Hill, 4th Ed., p. 74.

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Actual deflection vs. distance between fasteners may be computed from the following expression:

$$y = \frac{\beta p}{2k} \sum_{n=0}^{N-1} A_{n\beta d - \beta x}$$

where p is the force applied by the fastener, and β and k are the constants of the flange as determined previously. N represents the number of bolts in the array.

The array factor denoted by the summation sign adds the contribution of each fastener in the array. The array factor for various bolt spacings (βd) is shown in Figure 23. Although any value can be selected for βd, a practical compromise between deflection, bolt spacing and electrical performance is to select a bolt spacing which yields a value βd equal to 2.

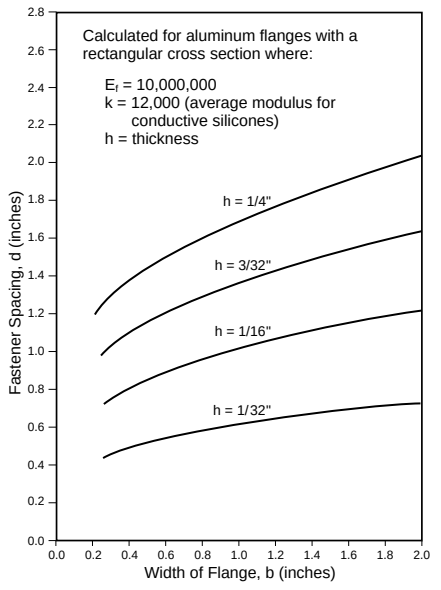

Figure 24 Fastener Spacing

For βd = 2, the flange deflection fluctuates by ±10 percent. Minimum deflection occurs midway between fasteners and is 20 percent less than the deflection directly under the fasteners. The variation in deflection is approximately sinusoidal.

Table IV lists a few recommendations for bolts and bolt spacings in various thin cross section aluminum flanges.

Bolt spacings for waveguide flanges are fixed by Military and EIA Standards. Waveguide flanges normally have bolts located in the middle of the long dimension of the flange because the flow of current is most intense at this point.

Table IV

SCREW SIZE	℄-TO-℄ (in.)	THICKNESS (in.)	MAX. TORQUE TO PREVENT STRIPPING FOR UNC-2A THREAD (in.-lbs.)
#2	3/8	0.062	4.5
#4	3/4	0.125	10.0
#6	1	0.125	21.0
#8	1 1/4	0.156	37.5
#10	1 3/8	0.156	42.5

4. Common Fasteners

Many different types of fasteners are available, but bolts are the most widely used fastening devices. The approximate torque required to apply adequate force for mild steel bolts is shown in Table V.

These values are approximate and will be affected by the type of lubricants used (if any), plating, the type of washers used, the class and finish of the threads, and numerous other factors.

The final torque applied to the fasteners during assembly should be 133 percent of the design value to overcome the effect of stress-relaxation. When torqued to this value, the gasket will relax over a period of time and then settle to the design value.

Torque may be converted to tension in the bolts by applying the formula

$$\text{Tension} = \frac{\text{Torque}}{0.2 \times \text{Bolt Dia.}}$$

Frequently the rule of thumb value of 0.2 for the coefficient of friction can result in torque and bolt estimates which may be seriously in error. Excessive bolt preload may lead to RF leakage. Therefore, if lubricants are used for any reason, refer to the literature[3] for the proper coefficient values to be applied.

In soft materials, such as aluminum, magnesium and insulating materials, inserts should be provided if the threads are "working threads." A thread is considered a "working thread" if it will be assembled and disassembled ten or more times.

Torque loss caused by elongation of stainless steel fasteners should also be considered. High tensile strength hardware is advised when this becomes a problem, but care must be taken of the finish specified to minimize galvanic corrosion.

Thermal conductivity of high tensile strength hardware is lower than most materials used in electro-mechanical packaging today, so

Table V

RECOMMENDED TORQUE VALUES FOR MILD STEEL BOLTS

Size	Threads per in.	Max. Recommended Torque (in.-lbs.)	Max. Recommended Tension* (lbs.)	Basic Pitch Dia.(inches)
#4	40	4 3/4		0.0958
	48	6		0.0985
#5	40	7		0.1088
	44	8 1/2		0.1102
#6	32	8 3/4		0.1177
	40	11		0.1218
#8	32	18		0.1437
	36	20		0.1460
#10	24	23		0.1629
	32	32		0.1697
1/4"	20	80	1840	0.2175
	28	100	2200	0.2268
5/16"	18	140	2530	0.2764
	24	150	2630	0.2854
3/8"	16	250	3740	0.3344
	24	275	3950	0.3479
7/16"	14	400	5110	0.3911
	20	425	5250	0.4050
1/2"	13	550	6110	0.4500
	20	575	6150	0.4675
9/16"	12	725	7130	0.5084
	18	800	7600	0.5264
5/8"	11	1250	11,040	0.5660
	18	1400	11,880	0.5889

* Tension = $\frac{\text{Torque}}{0.2 \times \text{Diameter of Bolt}^{\dagger}}$

† Basic Pitch Diameter

3. Roehrich, R.L., *Torquing Stresses in Lubricated Bolts*, **Machine Design**, June 8, 1967, pp. 171-175.

that the enclosure expands faster than the hardware and usually helps to tighten the seal. Should the equipment be subjected to low temperatures for long periods of time, the bolts may require tightening in the field, or can be pretightened in the factory under similar conditions.

Under shock and vibration, a stack up of a flat washer, split helical lockwasher and nut are the least reliable, partly because of elongation of the stainless steel fasteners, which causes the initial loosening. The process is continued under shock and vibration conditions. Elastic stop nuts and locking inserts installed in tapped holes have proven to be more reliable under shock and vibration conditions, but they cost more and are more expensive to assemble.

5. Electrical Performance as a Function of Fastener Spacing

The electrical performance (shielding effectiveness) provided by a gasket sandwiched between two flanges and fastened by bolts spaced d distance apart is equivalent to the shielding effectiveness obtained by applying a pressure which is the arithmetic mean of the maximum and minimum pressure applied to the gasket under the condition that the spacing between fasteners is considerably less than a half wavelength. For bolt spacings equal to or approaching one-half wavelength at the highest operating frequency being considered, the shielding effectiveness at the point of least pressure is the governing value.

For example, assume that a gasket is sandwiched between two flanges which, when fastened together with bolts, have a value of βd equal to 2. Figure 23 shows that a value of $\beta d = 2$ represents a deflection change of ±10 percent about the mean deflection point. Because applied pressure is directly proportional to deflection, the applied pressure also varies by ±10 percent.

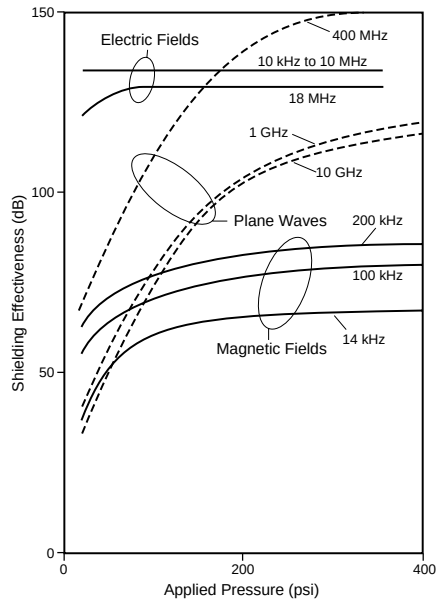

Figure 25 Shielding Effectiveness vs. Applied Pressure

Shielding effectiveness values for typical silver-plated-copper filled, die-cut gaskets as a function of applied pressure are shown in Figure 25. The curves show that the shielding effectiveness varies appreciably with applied pressure, and changes as a function of the type of field considered. Plane wave attenuation, for example, is more sensitive to applied pressure than electric or magnetic fields.

Thus, in determining the performance to be expected from a junction, find the value for an applied pressure which is 10 percent less (for $\beta d = 2$) than the value exerted by the bolts directly adjacent to the gasket. For example, examine a portion of a typical gasket performance curve as shown in Figure 26.

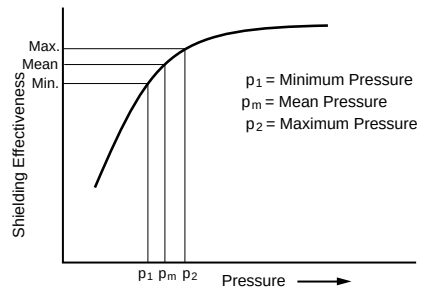

Figure 26 Typical Gasket Performance Curve

The average shielding effectiveness of the gasketed seam is a function of the mean applied pressure, p_m.

For spacings which approach or are equal to one-half wavelength, the shielding effectiveness is a function of the minimum pressure, p_1. Therefore, the applied pressure must be 20 percent higher to achieve the required performance. For this condition, the space between the fasteners can be considered to be a slot antenna loaded with a lossy dielectric. If the slot is completely filled, then the applied pressure must be 20 percent higher as cited. Conversely, if the slot is not completely filled (as shown in Figure 27), the open area will be free to radiate energy through the slot.

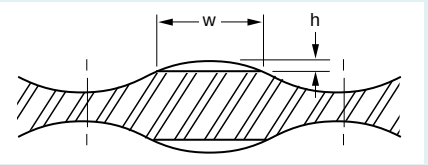

Figure 27 Unfilled Slot is Free to Radiate When Spacing is Equal to $^1/_2$ Wavelength

The cut-off frequency for polarizations parallel to the long dimension of the slot will be determined by the gap height, h. The cut-off frequency for the polarization vector perpendicular to the slot will be determined by the width of the slot, w. The attenuation through the slot is determined by the approximate formula

$$A(dB) = 54.5\ d/\lambda_c$$

where

d = the depth of the slot,

and

λ_c is equal to 2w or 2h, depending upon the polarization being considered.

This example also illustrates why leakage is apt to be more for polarizations which are perpendicular to the seam.

For large values of βd, the percentage adjustments must be even greater. For example, the

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percentage increase required to satisfy βd = 3 is 64 percent. It is desirable, therefore, that βd should be kept as small as possible. This can be achieved by using stiff flanges or spacing bolts closer together.

Designing a Solid-O Conductive Elastomer Gasket-in-a-Groove

The *solid-O profile* is the most often specified conductive elastomer EMI gasket for several key reasons. Compared to other solid cross sections, it offers the widest deflection range to compensate for poorly toleranced mating surfaces and to provide reliable EMI shielding and pressure sealing. It can be installed in a relatively small space, and is the most easily installed and manufactured. It also tends to be less prone to damage, due to the absence of angles, corners or other cross section appendages.

The *"gasket-in-a-groove"* design offers five significant advantages over surface-mounted EMI gaskets:

1. Superior shielding, due to substantial metal-to-metal contact achieved when the mating surfaces are bolted together and "bottom out". (Flat die-cut gaskets prevent metal-to-metal contact between mating flange members, which reduces EMI shielding performance – especially in low frequency magnetic fields.)

2. Positive control over sealing performance. Controlling the size of the gasket and groove can ensure that required shielding and sealing are achieved with less careful assembly than is required for flat gaskets. In other words, the gasket-in-a-groove is more foolproof.

3. Built-in compression stop provided by the groove eliminates the risk of gasket damage due to excessive compression.

4. A gasket retention mechanism can be provided by the groove, eliminating the need for adhesives or mounting frames.

5. High current-handling characteristics of the metal-to-metal flange design improves the EMP and lightning protection offered by an enclosure.

This section presents the method for calculating groove and gasket dimensions which will permit the shielding system to function under worst-case tolerance conditions. Adherence to these general guidelines will result in optimum shielding and sealing for typical electronics "boxes". It should be understood that they may not be suitable for designing shielding for sheet metal cabinets, doors, rooms or other large, unconventional enclosures.

Important Notes: The guidelines presented here are intended to consider only "solid O" gasket cross sections. The calculations for hollow O, solid and hollow D, and custom gasket cross sections differ from these guidelines in several key areas.

Chomerics generally does not recommend bonding solid O gaskets in grooves. If for some reason your design requires gasket retention, contact Chomerics' Applications Engineering Department for specific recommendations, since the use of adhesives, dove-tailed grooves or "friction-fit" techniques require special design considerations not covered here.

Extreme design requirements or unusually demanding specifications are also beyond the scope of the guidelines presented here. Examples would include critical specifications for pressure sealing, exceptionally high levels of EMI shielding, exceptional resistance to corrosion, harsh chemicals, high temperatures, heavy vibration, or unusual mounting and assembly considerations.

Mechanical Considerations

Causes of Seal Failure

In order to produce a gasket-in-a-groove system which will not fail, the designer must consider three mechanical causes of seal failure:

- *gasket over-deflection* and associated damage (see Figure 28d)
- *gasket under-deflection* and loss of seal (see Figure 28f)
- *groove over-fill*, which can destroy the gasket (see Figure 28e).

Designing to avoid these problems is made more complicated by the effects of:

- *worst-case tolerance conditions*
- *deformation of the cover* (cover bowing)
- *poor fit of mating surfaces*.

The key to success involves selection of the appropriate gasket size and material, and careful design of the corresponding groove.

Deflection Limits

In nearly every solid-O application, Chomerics recommends a *minimum deflection of 10% of gasket diameter.* This includes adjustments for all worst-case tolerances of both the gasket and groove, cover bowing, and lack of conformity between mating surfaces. We recommend a *maximum gasket deflection of 25% of gasket diameter*, considering all gasket and groove tolerances.

Although sometimes modified to accommodate application peculiarities, these limits have been established to allow for stress relaxation, aging, compression set, elastic limits, thermal expansion, etc.

Maximum Groove Fill

Solid elastomer gaskets (as opposed to foam rubber gaskets) seal by changing shape to conform to mating surfaces. They *cannot* change volume. The recommended limit is *100% groove fill under worst-case tolerances of both gasket and groove.* The *largest* gasket cross sectional area must fit into the *smallest* cross sectional groove area.

Analyzing Worst-Case Tolerances

Figures 28a-c illustrate the issues of concern, and identify the parameters which should be considered in developing an effective design.

Figures 28d and e illustrate two different cases which can result in gasket damage in the area of torqued bolts. In Figure 28d, the relationship between groove depth and gasket diameter is critical in avoiding over-deflection. In Figure 28e, sufficient groove volume must be provided for a given gasket volume to permit the gasket to deflect without over-filling the groove.

As shown in *Figure 28f*, cover deformation and groove sizing must be controlled to make sure the gasket is sufficiently deflected to seal the system.

Since a single gasket and groove are employed for the entire perimeter, the design must be optimized for each of the worst-case examples illustrated in Figures 28d-f.

Figure 28a
Exploded View of Electronic Enclosure

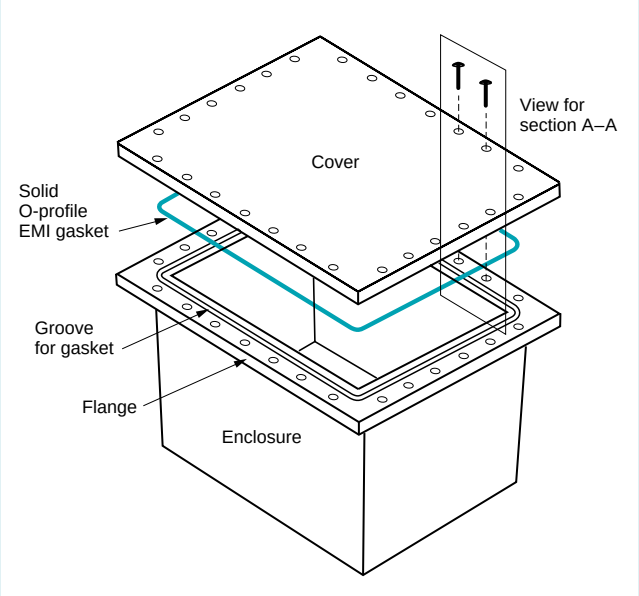

Figure 28b
Cut-away View of Assembly

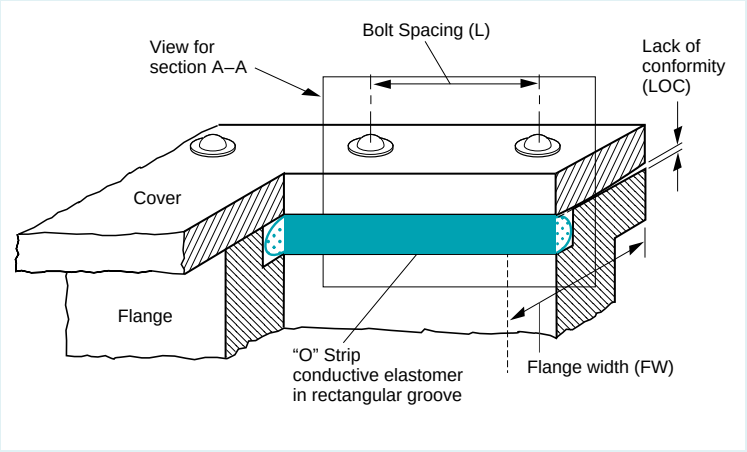

Figure 28c
Section A-A of Assembled Enclosure Flange and Gasket
(Sectioned midway through gasket and groove)

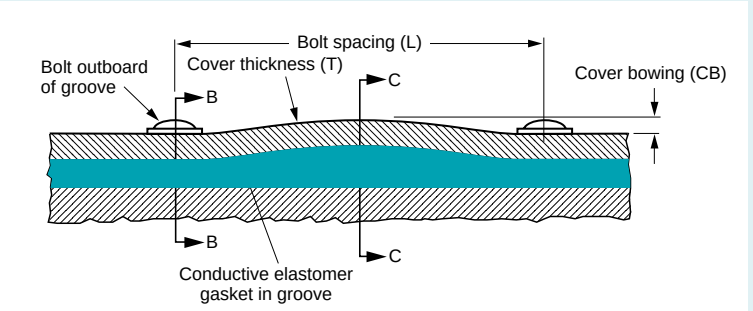

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Figure 28d Section B-B from Figure 28c – Worst Case Maximum Deflection *(Maximum gasket diameter, minimum groove depth)*

Problem: Gasket too tall for minimum groove depth (deflection beyond elastic limit). Results in gasket damage or fracture.

Solution: Over-deflection avoided with smaller maximum gasket diameter and/or deeper minimum groove depth.

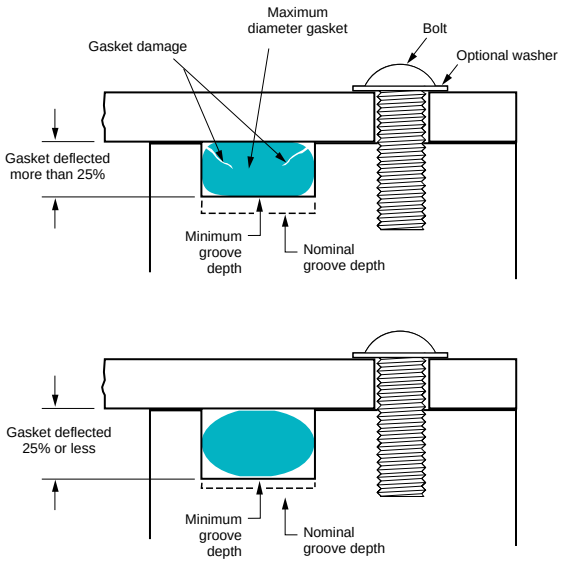


Figure 28e Section B-B from Figure 28c – Worst Case Maximum Groove Fill *(Maximum gasket diameter in minimum groove depth and width)*

Problem: Minimum groove dimension cannot accommodate maximum gasket diameter, resulting in gasket damage.

Solution: Groove over-fill avoided with smaller maximum gasket diameter and/or greater minimum groove depth and/or width.

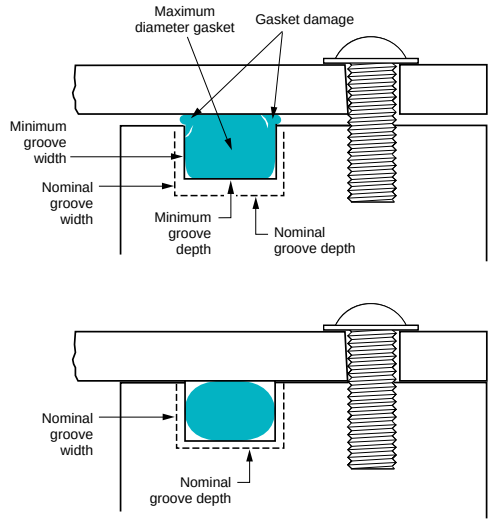
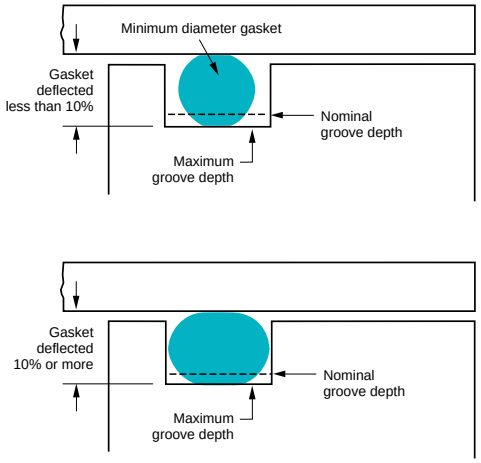


Figure 28f Section C-C from Figure 28c – Worst Case Minimum Deflection *(Minimum gasket diameter in maximum depth groove, aggravated by cover bowing and lack of conformity between mating surfaces)*

Problem: Gasket will not be deflected the recommended 10% minimum. Combined effects of tolerances, cover bowing, and lack of conformity can result in complete loss of cover-to-gasket contact over time, and consequent seal failure.

Solution: Under-deflection avoided with larger minimum gasket diameter and/or shallower maximum groove depth.



Calculating the Dimensions and Tolerances for the Groove and EMI Gasket

Figure 29 diagrams the calculation and decision sequence required to determine the dimensions for a properly designed solid-O gasket/groove system. Because the relationship between groove depth and gasket diameter is central to seal performance, *groove depth is selected as the key variable to determine first.*

Start by making an educated guess as to reasonable values for groove and gasket sizes and tolerances, based on desired nominal gasket deflection of 18%. For example, if 0.025 in. of gasket deflection is desired, start with a nominal gasket diameter of 0.139 in. This is calculated by dividing the desired total gasket deflection by 0.18 to estimate the required gasket size. (Total Gasket Deflection ÷ 0.18 = Approx. Nominal Gasket Size.) This relationship is an alternate form of Formula 1. Final groove dimensions can only be determined after completing all of the calculations called for in Figure 29, and arriving at values which remain within the recommended limits for gasket deflection and groove fill.

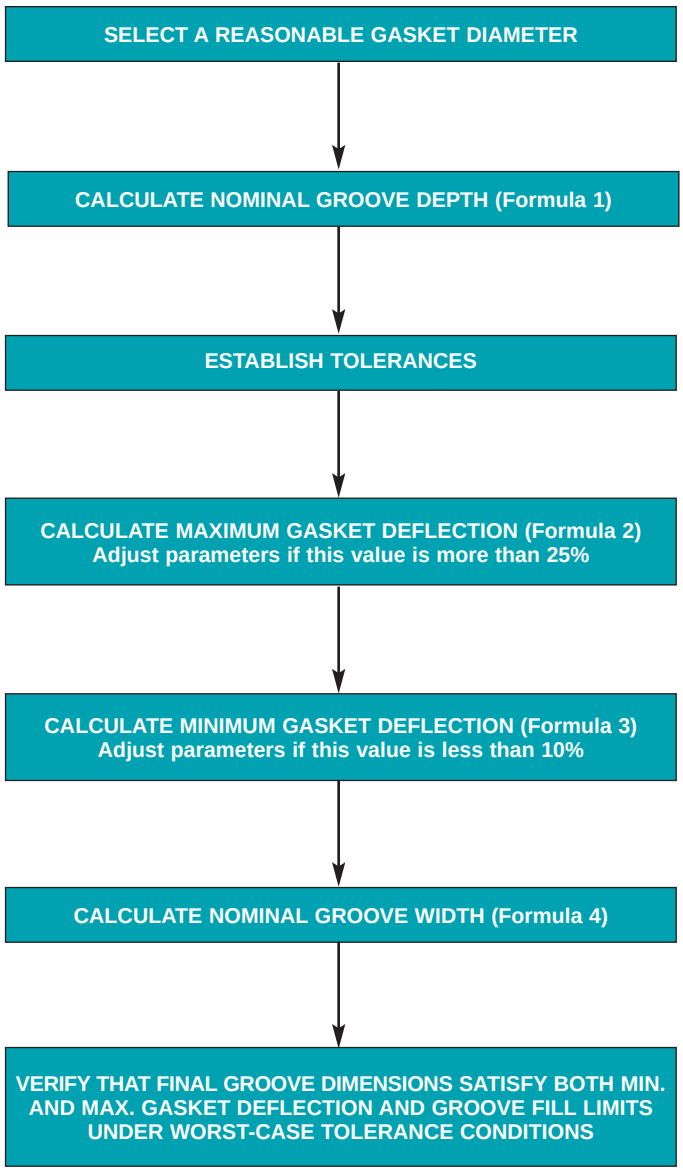


Figure 29 Procedure for Calculating Gasket and Groove Dimensions

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Formulas *(see definition of terms at right)*

1. Nominal Groove Depth

$GrD_{nom} = 0.82\ GaD_{nom}$

2. Maximum Gasket Deflection

(Worst Case, expressed as a % of gasket diameter)

$$GaDf_{max} = 100\left[\frac{(GaD_{nom} + GaT) - (GrD_{nom} - GrDT)}{(GaD_{nom} + GaT)}\right]$$

3. Minimum Gasket Deflection

(Worst Case, expressed as a % of gasket diameter)

a. $$GaDf_{min} = 100\left[\frac{(GaD_{nom} - GaT) - (GrD_{nom} + GrDT) - CB - LOC}{(GaD_{nom} - GaT)}\right]$$

where

b. $$CB = \frac{GDF \times L^4_{max}}{FW_{min} \times T^3_{min} \times E \times 32}$$

(***Note:*** Formula must be adjusted when using metric units)

and

c. LOC = 0.001 in. for machined sur faces with surface roughness of 32-64 µin. RMS.

(For discussion, see Terms.)

4. Nominal Groove Width

a. $GaA_{max} = 0.7854^{*}\ (GaD_{nom} + GaT)^2$

b. $$GrW_{min} = \frac{GaA_{max}}{GrD_{min}}$$

c. $GrW_{nom} = GrW_{min} + GrWT$

****Note:*** $0.7854 = \frac{\pi}{4}$

Terms

All values may be calculated in inches or mm unless otherwise indicated.

GaA_{max} – Maximum gasket cross section area (in^2 or mm^2)

GaD_{nom} – Nominal gasket diameter

GaT – Gasket tolerance (difference between max. and nom. or min. and nom.)

GrW_{min} – Minimum groove width

GrWT – Groove width tolerance

GrW_{nom} – Nominal groove width

GrD_{min} – Minimum groove depth

GrD_{nom} – Nominal groove depth

GrDT – Groove depth tolerance (difference between max. and nom. or min. and nom.)

$GaDf_{max}$ – Maximum gasket deflection (%)

$GaDf_{min}$ – Minimum gasket deflection (%)

L_{max} – Maximum bolt spacing

FW_{min} – Minimum flange width

T_{min} – Minimum cover thickness

GDF – Gasket deflection force (ppi or Newtons per meter).

Note: For the purpose of this guide, the GDF value should represent the worst-case minimum gasket deflection arising from cover bowing. For example, the GDF is taken at 10% deflection for the calculation in Formula 3b.

E – Young's modulus. (For aluminum, use 1×10^7 psi, or 7×10^5 kg/cm^2.)

CB – Cover bowing, generally calculated by modeling the elastic deformation of the cover as a uniformly loaded beam with two fixed supports. (The moment of inertia of the cover is modeled as a rectangular beam, the "height" of which is taken to be equal to the cover thickness, while "width" is considered equal to flange width. The moment of inertia can be adjusted for cover configurations other than flat. Refer to an engineering handbook for the necessary revisions to Formula 3b.) An assumption is made that one side of a cover/flange interface is infinitely stiff, typically the flange. If this is not essentially true, elastic deformation of each is computed as though the other were infinitely stiff, and the two values combined.

LOC – Lack of conformity, the measure of the mismatch between two mating surfaces when bolted together, expressed in inches. Experience has shown that machined surfaces with a surface roughness of 32-64 µin. RMS exhibit an LOC of 0.001 in. It is left to the engineer's judgment to determine LOC for other surfaces. LOC can be determined empirically from measurements made of actual hardware. In this guide, LOC applies only to the surfaces which form the EMI shielding interface.

EMI Shielding Plus Environmental/ Pressure Sealing

Some gasket applications require only restoration of the shielding integrity of an enclosure, and can be satisfied with Chomerics' simple MESH STRIP gasketing. In these cases, the use of MESH STRIP with Elastomer Core provides additional resiliency. Elastomer cored strips offer limited environmental sealing by positive blocking of dust and rain.

Additional environmental sealing or exclusion of ventilating air or vapor requires a gasket such as COMBO STRIP, which incorporates a smooth, easily compressed, elastomer sealing strip in parallel with the EMI shielding strip. When an appreciable pressure differential must be maintained between the interior and exterior of an enclosure, in addition to EMI protection, materials such as CHO-SEAL conductive elastomers or POLA gaskets should be used.

Gasket Attachment and Positioning

Substantial cost savings can result from the careful choice of gasket attachment or positioning method, which often determines the final choice of material.

A. Groove Capture This method is strongly recommended if a groove can be provided at relatively low cost, such as die-casting. (*Caution:* POLA-STRIP gaskets are essentially incompressible, although they seem to compress because the material flows while maintaining the same volume. Extra space must be allowed to permit the solid elastomer material to flow (see Figure 30).

B. Pressure-Sensitive Adhesive This is often the least expensive attachment method for mesh EMI gasket materials. Installation costs are dramatically reduced with only a slight increase in cost over gasketing without adhesive backing. In many cases customers purchase COMBO STRIP or COMBO Gasket materials for applications which don't require environmental sealing, but utilize the adhesive-backed rubber portion as an inexpensive, temporary attachment method ("third hand") during installation.

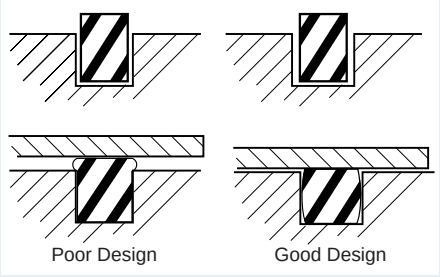

Figure 30 Allowing for Solid Elastomer Flow in Groove Capture Attachment Method

C. Bond Non-EMI Portion of Gasket Non-conductive adhesives may be employed to bond an EMI gasket in position by applying adhesive to the portion that is *not the EMI gasket* (and which can be insulated from the mating surfaces by a non-conductive material).

Note: When specifying non-conductive adhesive attachment, applicable drawings and standard procedures for production personnel should emphasize that the adhesive is to be applied only to the portion of the gasket which is not involved with the EMI shielding function. The assumption that the gasket "will hold better if all of it is bonded rather than half of it" will result in serious degradation of EMI shielding effectiveness.

1. Figure 31a illustrates this method used for *COMBO STRIP* and *COMBO Gaskets*, in which only the elastomer portion is bonded to one of the mating surfaces.
2. *"Combo" forms of POLASTRIP* may be bonded if, as in Figure 31b, the adhesive is restricted to the non-conductive portion. Spot applications to the conductive area are permissible.
3. *MESH STRIP* – The all metal and elastomer core versions of these with attachment fins can be held in position with non-conductive adhesive or epoxy if it is restricted to the mounting fins (see Figure 31c).
4. *Frame Gasketing* can be attached with a non-conductive adhesive or epoxy restricted to the aluminum extrusion (see Figure 31d). However, most Frame Gaskets are attached mechanically with fasteners.
5. *Dry Back Adhesive for Neoprene Sponge COMBO Gaskets* – Factory-applied solvent-activated adhesive is recommended for several reasons: a) controlled application guarantees restriction of the adhesive to the non-conductive portion; b) controlled adhesive thickness assures reliable bonding without reducing compressibility; and c) the adhesive provides a permanent bond.

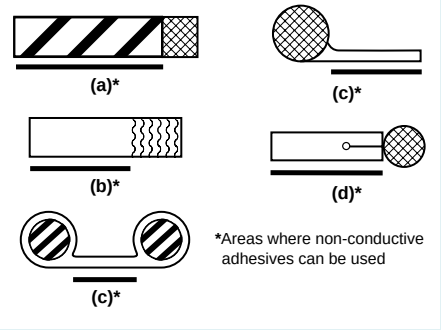

Figure 31 a-d Application of Non-Conductive Adhesive

D. Bolt-Through Holes This is a common, inexpensive means to hold gaskets in position (see Figure 32). For most Chomerics metal shielding products, providing bolt holes involves only a small tooling charge, with no additional cost for the holes

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in the unit price of the gasket. Bolt-holes can be provided in the fin portion of MESH STRIP, or in rectangular cross section MESH STRIP if these are wide enough, (minimum width 3/8 in. (9.52 mm).

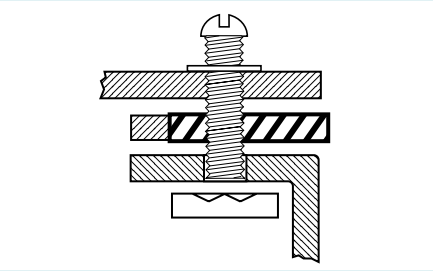

Figure 32 Bolt-Through Gasket Mounting

E. Special Attachment Means

Knitted mesh fins provided on some versions of MESH STRIP, and extruded aluminum strips on Frame Gasketing are designed for attachment (see Figure 33). Attachment fins can be clamped under a metal strip held down by riveting or spot welding, or can be bonded with a structural adhesive or epoxy. The aluminum extrusions in Frame Gaskets can also be fastened by riveting or bolting.

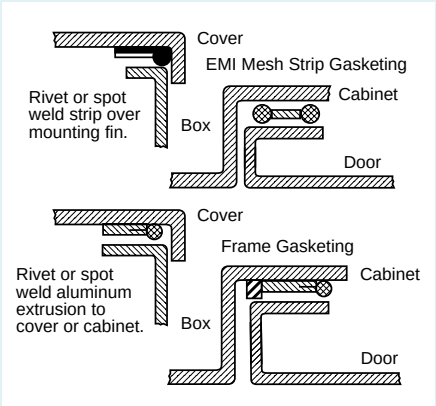

Figure 33 Rivet or Spot Welding

Friction, Abrasion and Impact Considerations

EMI gaskets should be positioned so that little or no sliding or shear occurs when compressed. In Figure 34a, the EMI gasket is subject to sliding as the door is closed, which may lead to tearing, wearing out, or detachment. Figure 34b illustrates the preferred position, in which the EMI gasket is subjected almost entirely to compression forces.

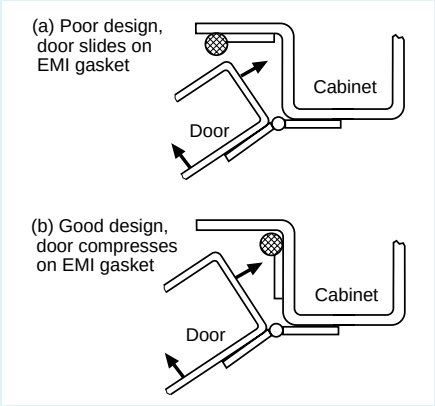

Figure 34 a-b Sliding Motion vs. Straight Compression

Mesh Gasketing Materials

A. Knitted Wire Mesh

Knitted wire mesh can be produced from any metal which can be drawn into wire form. However, the great majority of shielding requirements are readily satisfied with a choice of two materials – monel or Ferrex – both of which are standard production materials for Chomerics' mesh gaskets.

Two design considerations should influence the choice of EMI gaskets:

- required shielding performance in E-, H- and Plane Wave fields,
- required corrosion resistance of the gasket.

Additional considerations include the mechanical strength, durability, resiliency and compression set of the gasket material.

Monel

This good all-purpose nickel-copper alloy resists oxidation (thereby maintaining its conductivity), has good EMI qualities, and very good mechanical strength and resiliency. In controlled or protected atmospheres, it may be used in contact with aluminum; but where salt spray environments are encountered, galvanic corrosion is a problem.

Note: In salt spray environments, monel is corrosion-resistant, but when in contact with aluminum flanges, electrolytic currents will cause corrosion of the aluminum flange.

Ferrex®

Chomerics' Ferrex tin-plated copper-clad steel wire offers the best EMI/EMP performance of the standard mesh materials, especially for H-field shielding. Its mechanical properties are very close to monel, and it is more compatible with aluminum, but it has poorer intrinsic corrosion resistance than monel.

With this understanding of material characteristics, gasket metal is usually chosen using the following guidelines:

For low frequency magnetic field shielding: recommended gaskets are Ferrex versions of knitted mesh gasketing (provided corrosion resistance requirements are not severe).

For high frequency electric field shielding: recommended gaskets are monel or Ferrex.

For best corrosion resistance (except in contact with aluminum in salt spray environments where corrosion will occur): monel is recommended, preferably embedded

in elastomer (e.g., POLA). Aluminum mesh is sometimes selected when equipment specifications permit no other metal to be used against aluminum mating surfaces, for galvanic corrosion compatibility. However, it must be understood that aluminum mesh oxidizes readily, and shielding effectiveness therefore degrades.

Chomerics Knitted Wire Mesh Products

MESH STRIP is available as resilient, single and dual all-metal strips or compressed shapes, with optional mounting fins. Both rectangular and round profiles are offered in a large range of standard dimensions for use as EMI gaskets where no environmental sealing is required (see Figure 35). *Note:* See also *SPRINGMESH* highly resilient wire mesh gaskets made from tin-plated steel wire, page 111.

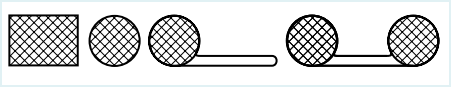

Figure 35 MESH STRIP Gasketing Profiles

Wire Mesh Frame Gaskets offer combinations of one or two round-profile mesh strips, or one mesh/one pressure-seal strip (round or rectangular) with a metal mounting frame (see Figure 36). *METALKLIP* clip-on strips consist of wire mesh over elastomer core gaskets attached to metal mounting clips.

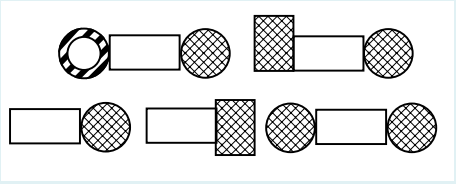

Figure 36 Frame Gasketing Profiles

COMBO and COMBO STRIP Gaskets combine a low-profile, solid or sponge elastomer strip in parallel with one or two rectangular mesh strips (see Figure 37). With solid elastomers, the mesh strip has a higher profile than the elastomer, to allow for compression of the mesh.

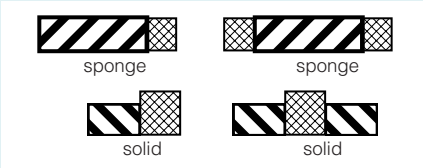

Figure 37 Normal and High Pressure COMBO STRIP Gaskets

MESH STRIP with Elastomer Core is available in round or rectangular profiles, with solid or hollow elastomer, with an optional mesh mounting fin (see Figure 38).

Figure 38 MESH STRIP with Elastomer Core Profiles

Compressed Mesh Gaskets are jointless units made by die-compressing knitted metal mesh, usually in round or rectangular forms, with a constant rectangular cross section. Standard waveguide types are available, and Chomerics maintains a large selection of existing tooling for other annular types.

B. Oriented Wire in Silicone

POLASTRIP/POLASHEET are composite mesh and elastomer materials in which wire is embedded in part or all of the silicone elastomer. The mesh is in the form of individual wires oriented perpendicular to the joint mating surfaces, for maximum EMI shielding (see Figure 39).

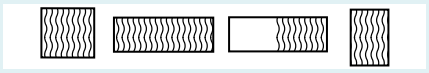

Figure 39 POLA Materials Profiles

C. Woven Metal Mesh

METALASTIC Gasketing is formed of woven aluminum mesh, filled with silicone or neoprene for pressure sealing. It is produced in 8 in. (20.3 cm) wide sheets in random lengths, in thicknesses of 0.016 in. (0.40 mm) and 0.020 in. (0.51 mm). The 0.016 in. (0.40 mm) material is the thinnest available for *EMI plus pressure seal* gasketing. It can be obtained in sheets, standard connector gaskets, or custom die-cut configurations. It should only be used where joint unevenness is less than 0.002 in. (0.05 mm).

D. Expanded Metal Mesh

PORCUPINE METALASTIC gasketing is a material composed of expanded Monel metal mesh, and is available with optional silicone filling. It is produced in sheets of continuous length, 12 in. (30.4 cm) by 0.020 in. or 0.030 in. (0.51 mm or 0.76 mm) thick. *PORCUPINE METALASTIC* gasketing is easily cut into intricate shapes with inexpensive rule dies, has high uniformity in thickness, ±0.004 in. (0.010 mm), and withstands high compression forces without damage. Available as sheets and standard connector gaskets, it can also be supplied in custom die-cut configurations. It should only be used where joint unevenness is less than 0.003 in. (0.08 mm) (see Figure 40).

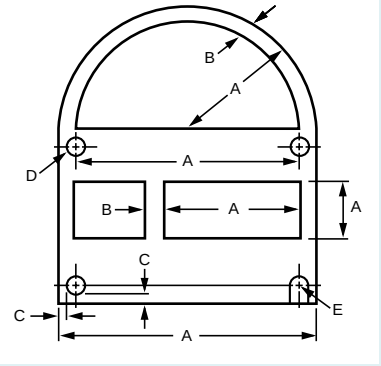

Figure 40 PORCUPINE METALASTIC Die-Cut Gaskets (fully dimensioned drawings required)

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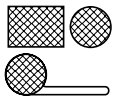
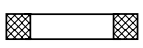
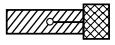
Wire Mesh EMI Gasket Selection Guide

PRODUCT TRADE NAME		MESH STRIP™ (ALL-METAL)	SHIELDMESH™ COMPRESSED MESH GASKETS	MESH STRIP™ (ELASTOMER CORE) AND METALKLIP® GASKETING	COMBO® AND COMBO® STRIP GASKETING	COMBO® GASKETS	FRAME GASKETING	PORCUPINE [5] METALASTIC® GASKETING	METALASTIC® GASKETING	POLASTRIP® GASKETING	POLASHEET®
Schematic Cross Section											
Construction		Formed or Compressed Knitted Wire Mesh		Knitted Wire Mesh Over Elastomer Strips	Formed Knitted Wire Strips in Parallel with Elastomer Strips; or Die-Cut Gaskets		Formed Knitted Wire Strips Clamped in Aluminum Extrusions	Expanded Metal in Elastomer	Woven Wire in Elastomer	Oriented Wire in Matrix of Silicone Elastomer (available with pressure sensitive adhesive)	
Available Forms		Strips, Gaskets Made by Joining Strips	Jointless Rings or Rectangular Gaskets	Strips, Gaskets Made by Joining Strips, Clip-On Strips	Strips, Gaskets Made by Joining Strips	Die-Cut Elastomer with Joined EMI Strips	Strips, Fab. Lengths, Frames with Joined EMI Strips	Sheets, Die-Cut Gaskets	Sheets, Die-Cut Gaskets	Strips, Gaskets Made by Joining Strips	Sheets, Die-Cut Gaskets
EMI Rating[6]	14 kHz (H)	>20- >30 dB	>25- >30 dB	>25- >35 dB	>20- >30 dB		>20- >30 dB	>35 dB	>35 dB	>46 dB	>35 dB
	18 MHz (E)	>102 dB	>102 dB	>102 dB	>102 dB		>102 dB	>102 dB	>102 dB	>102 dB	>102 dB
	1.0 GHz (P)	>83- >93 dB	>93 dB	>93 dB	>83- >93 dB		>93 dB	>85 dB	>40 dB	>93 dB	>93 dB
Maximum Joint Unevenness, % of Gasket Height	Class A – Permanently Closed	30-40%	30%	30-50%	30%		30%	15%	10%`	20%	20%
	Class B – Open-Close in Same Position	25-30%	25%	25-40%	30%		25%	10%	7%	17%	17%
	Class C – Completely Interchangeable	20-25%	20%	20-30%	25%		25%	10%	7%	17%	17%
Minimum/Maximum Height	Inches (mm)	0.062/0.500 (1.57/12.70)	0.040/0.375 (1.02/9.53)	0.125/0.750 (3.18/19.05)	0.062/0.375 (1.57/9.53)		0.093/0.250 (2.36/6.35)	0.020/0.030 (0.51/0.76)	0.016/0.020 (0.41/0.51)	0.062/0.312 (1.57/7.92)	0.030/0.250 (0.76/6.35)
Min. Width (Greater of Actual Dim. or Portion of Height)	Inches (mm)	0.062/1/2H (1.57/1/2H)	0.062/1/2H (1.57/1/2H)	0.62/1/2H (1.57/1/2H)	0.125/1 1/2H (3.18/1 1/2H)		0.437 (11.0)	0.140 (3.56)	0.125 (3.18)	0.093/1/2H (2.36/1/2H)	0.125 (3.18)
Recommended Compression Pressure	psi (kg/cm)	5-100 (0.35-7.03)	5-100 (0.35-7.03)	5-100 (0.35-7.03)	20-100 (1.41-7.03)		5-100 (0.35-7.03)	20-100 (1.41-7.03)	20-100 (1.41-7.03)	20-100 (1.41-7.03)	20-100 (1.41-7.03)
Attachment or Positioning	In Slot	Excellent	Excellent	Excellent	Excellent		No	No	No	Good	Possible
	Pressure Sensitive Adhesive	N/A	N/A	N/A	Excellent		N/A	N/A	N/A	Special	Excellent
	Bond Non-EMI Gasket Portion[4]	Versions with Fins Only[2]	*	Versions with Fins Only[2]	Good-Excellent		Poor[3]	Special	Special	Combo Version Only	N/A
	Conductive Adhesive	Poor to Good	Poor to Good	Poor to Good	N/A		N/A	No	No	Use Silicone Base Adhesive See Note 7.	
	Bolt thru Bolt Holes	Possible with Fin Versions[2]	N/A	Possible with Fin Versions[2]	Excellent		Excellent[3]	Excellent	Excellent	Excellent	Excellent
Elastomer Temperature Range	Neoprene Version	N/A	N/A	–30°F to 150°F –34°C to 66°C	–30°F to 150°F –34°C to 66°C		–30°F to 150°F –34°C to 66°C	N/A	–40°F to 225°F –40°C to 107°C	Special	Special
	Silicone Version	N/A	N/A	–80°F to 400°F –62°C to 204°C	–80°F to 400°F –62°C to 204°C		–80°F to 400°F –62°C to 204°C	–80°F to 400°F –62°C to 204°C	–65°F to 500°F –53°C to 260°C	–70°F to 500°F –57°C to 260°C	–80°F to 400°F –62°C to 204°C
Standard Metals Available in EMI Portion (others also available)		Monel Ferrex[1], Aluminum	Monel Ferrex[1], Aluminum	Monel Ferrex[1], Aluminum	Monel, Ferrex[1], Aluminum		Monel, Ferrex[1]	Monel, Aluminum	Aluminum Only	Monel, Aluminum	Monel, Aluminum

(1) Ferrex® is Chomerics' tradename for tin-plated, copper-clad steel EMI gasketing.

(2) Two versions,  and  have fins especially designed for easy attachment.

(3) The aluminum extrusion is intended as a convenient means of attachment.

(4) Most products for which this method is suitable are available with "dr y back" (solvent-activated) adhesives already applied.

(5) Available without elastomer in metal form only.

(6) These EMI ratings are based on MIL-STD-285 test methods and are useful for making meaningful qualitative comparisons between products in this table since all tests were conducted under similar conditions. They cannot be used to compare to other EMI gasket data unless those data were obtained by the same methods.

(7) Non-conductive RTV yields excellent results, but use sparingly. If more adhesive surface is needed, use conductive adhesive.

* Pressure sensitive adhesive is available for certain mesh over core gaskets. Contact Chomerics for details.

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Glossary of Terms

Electrical

Absorption Loss: Attenuation of an electromagnetic wave or energy encountered in penetrating a shield caused by the induction of current flow in the barrier and the resulting I^2R loss. Usually stated in dB (decibels).

Ambient Electromagnetic Environment: That electromagnetic field level existing in an area and emanating from sources other than the system under test.

Attenuation: A reduction in energy. Attenuation occurs naturally during wave travel through transmission lines, waveguides, space or a medium such as water, or may be produced intentionally by inserting an attenuator in a circuit or a shielding absorbing device in the path of radiation. The degree of attenuation is expressed in decibels or decibels per unit length.

Attenuator: An arrangement of fixed and/or variable resistive elements used to attenuate a signal by a desired amount.

Cross Coupling: Coupling of the signal from one channel to another where it becomes an undesired signal.

Conductivity: Capability of a material to conduct electrical currents.

Decibel (dB): A convenient method for expressing voltage or power ratios in logarithmic terms. The number of such units of attenuation, N is

$$N\ (dB) = 10 \log \frac{P_1}{P_2}$$

where

P_1/P_2 is a unitless power ratio. N can also be expressed in terms of a voltage ratio E_1/E_2 as follows:

$$N\ (dB) = 20 \log \frac{E_1}{E_2}$$

Degradation: An undesired change in the operational performance of a test specimen. Degradation of the operation of a test specimen does not necessarily mean malfunction.

Depth of Penetration: Distance which a plane wave must travel through a shield to be attenuated 1/e, or approximately 37 percent of its original value. (Also called "skin depth"). It is a function of the shield's conductivity and permeability and the wave's frequency.

Electrical or E-Field: A field induced by a high impedance source, such as a short dipole.

Electromagnetic Compatibility (EMC): A measure of an equipment's ability to neither radiate nor conduct electromagnetic energy, or to be susceptible to such energy from other equipment or an external electromagnetic environment.

Electromagnetic Interference (EMI): Undesired conducted or radiated electrical disturbances, including transients, which can interfere with the operation of electrical or electronic equipment. These disturbances can occur anywhere in the electromagnetic spectrum.

Emanation: Undesired electromagnetic energy radiated or conducted from a system.

Gasket-EMI: A material that is inserted between mating surfaces of an electronic enclosure to provide low resistance across the seam and thereby preserve current continuity of the enclosure.

Ground: A reference plane common to all electronic, electrical,electromechanical systems and connected to earth by means of a ground rod, ground grid, or other similar means.

Hertz: An international designation for cycles per second (cps).

Insertion Loss: Measure of improvement in a seam, joint or shield by the addition of a conductive gasket. Usually stated in dB.

Interference: Any electromagnetic phenomenon, signal or emission, man-made or natural, which causes or can cause an undesired response, malfunctioning or degradation of performance of electrical or electronic equipment.

Internal Loss: Attenuation of electromagnetic energy by the reflection and re-reflection of electromagnetic waves within a shield or a barrier. Usually stated in dB.

Magnetic or H-Field: An induction field caused predominantly by a current source. Also called a low impedance source, such as may be generated by a loop antenna.

Malfunction: A change in the equipment's normal characteristics which effectively destroys proper operation.

Permeability: The capability of a material to be magnetized at a given rate. It is a non-linear property of both the magnetic flux density and the frequency of wave propagation.

Plane Wave: An electromagnetic wave which exists at a distance greater than a wavelength from the source, where the impedance of the wave is nearly equal to the impedance of free space – 377 ohms.

Radio Frequency (RF): Any frequency at which coherent electromagnetic radiation of energy is possible. Generally considered to be any frequency above 10 kHz.

Radio Frequency Interference (RFI): Used interchangeably with EMI. EMI is a later definition which includes the entire electromagnetic spectrum, whereas RFI is more restricted to the radio frequency band, generally considered to be between the limits 10 kHz to 10 GHz.

Reflection Loss: Attenuation of the electromagnetic wave or energy caused by impedance mismatch between the wave in air and the wave in metal.

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Relative Conductivity: Conductivity of the shield material relative to the conductivity of copper.

Relative Permeability: Magnetic permeability of the shield material relative to the permeability of free space.

Shield: A metallic configuration inserted between a source and the desired area of protection which has the capability to reduce the energy level of a radiating electromagnetic field by reflecting and absorbing the energy contained in the field.

Shielding Effectiveness: A measure of the reduction or attenuation in electromagnetic field strength at a point in space caused by the insertion of a shield between the source and that point. Usually stated in dB.

Shielding Increase: The difference of an electromagnetic field amplitude emanating through a seam (measured under fixed test conditions) with and without the gasket in the seam, with the force joining the seam remaining constant. The difference is expressed in dB based on voltage measurements.

Skin Effect: Increase in shield resistance with frequency because of crowding of current near the shield surface because of rapid attenuation of current as a function of depth from the shield surface.

Surface Treatment: Coating or plating of mating surfaces of a junction.

Susceptibility: Measure of the degradation of performance of a system when exposed to an electromagnetic environment.

Total Shielding Effectiveness: The difference of an electromagnetic amplitude emanating from a source within an enclosure, and that from a source in free space. The difference is expressed in dB based on voltage measurements.

Wave Impedance: The ratio of electric field intensity to magnetic field intensity at a given frequency expressed in ohms.

Mechanical

Abrasion Resistance: The resistance of a material to wearing away by contact with a moving abrasive surface. Usefulness of standard tests very limited. Abrasion resistance is a complex of properties: resilience, stiffness, thermal stability, resistance to cutting and tearing.

Cold Flow: Continued deformation under stress.

Compression Set: The decrease in height of a specimen which has been deformed under specific conditions of load, time, and temperature. Normally expressed as a percentage of the initial deflection (rather than as a percentage of the initial height).

Durometer: An instrument for measuring the hardness of rubber. Measures the resistance to the penetration of an indentor point into the surface of the rubber.

Elasticity: The property of an article which tends to return to its original shape after deformation.

Elastic Limit: The greatest stress which a material is capable of developing without a permanent deformation remaining after complete release of the stress. Usually this term is replaced by various load limits for specific cases in which the resulting permanent deformations are not zero but are negligible.

Elastomer: A general term for elastic, rubber-like substances.

Elongation: Increase in length expressed numerically as a fraction or percentage of initial length.

Hardness: Relative resistance of rubber surface to indentation by an indentor of specific dimensions under a specified load. (See Durometer). Numerical hardness values represent either depth of penetration or convenient arbitrary units derived from depth of penetration. Devices for measuring rubber hardness are known as durometers and plastometers. Durometers are used most commonly. The higher the durometer number, the harder the rubber, and vice versa.

Hardness Shore A: Durometer reading in degrees of hardness using a Type A Shore durometer. (Shore A hardness of 35 is soft; 90 is hard).

Permeability: A measure of the ease with which a liquid or gas can pass through a material.

Permanent Set, Stress and Strain Relaxation: Permanent Set is defined as the amount of residual displacement in a rubber part after the distorting load has been removed. Stress Relaxation, or Creep, is a gradual increase in deformation of an elastomer under constant load with the passage of time, accompanied by a corresponding reduction in stress level.

Resilience: The ratio of energy given up on recovery from deformation to the energy required to produce the deformation – usually expressed in percent.

Tear Strength: The force per unit of thickness required to initiate tearing in a direction normal to the direction of the stress.

Tensile Strength and Elongation: Tensile Strength is the force per unit of the original cross sectional area which is applied at the time of the rupture of the specimen during tensile stress. Elongation is defined as the extension between benchmarks produced by a tensile force applied to a specimen, and is expressed as a percentage of the original distance between the marks. Ultimate elongation is the elongation at the moment of rupture. Tensile Stress, more commonly called “modulus,” is the stress required to produce a certain elongation.

Chomerics Part Number Cross Reference Index

Use this table to identify product groups by Part Number and locate them in this Handbook.

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01-09XX-XXXX	SOFT-SHIELD® 1000 Low Closure Force Foam Gaskets	103-104
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CHOMERICS PART NO.	DESCRIPTION	REFER TO PAGE
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19-12-XXXX-XXXX	Conductive Elastomer Molded Parts	61
19-13-XXXX-XXXX	Molded-In-Place Cover Seals	77-79
19-18-XXXX-XXXX 19-24-XXXX-XXXX	Conductive Elastomer Extrusions (see detailed index on pages 87-90)	35-58
19-41-XXXX-XXXX	Conductive Elastomers, Fabric Reinforced	76
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50-XX-XXXX-XXXX 51-XX-XXXX-XXXX 52-XX-XXXX-XXXX 53-XX-XXXX-XXXX 54-XX-XXXX-XXXX 55-XX-XXXX-XXXX	Conductive Compounds	133-142
70-2X-XXXX-XXXX	CHO-SHRINK® Heat Shrinkable Tubing	186-188
71-XX-XXXX-XXXX	CHO-SHRINK® Heat Shrinkable Molded Parts	186-188
80-10-XXXX-XXXX	CHO-DROP® EMI Absorbers	183
81-XX-XXXX-XXXX	SPRING-LINE® Beryllium-Copper Gaskets (fingerstock, card cage and D connector gaskets)	126-132
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CBL-XX-XXXX-XXXX	EMI Shielding Laminates	150-151
CHO-EMI-TAPE-BOX	EMI Shielding Tapes Kit	149
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CMT-XX-XXXX-XXXX	CHO-MASK® II EMI Foil Tape with Peel-Off Mask	144-145
CJ-XXX-XX	CHO-JAC® Cable Jacketing	149
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L-XXXX-XX	CHO-STRAP® Grounding Straps	153
P-01-XXXXX	WIN-SHIELD™ Shielded Window (Plastic or AgF8 Film Assembly)	172-174

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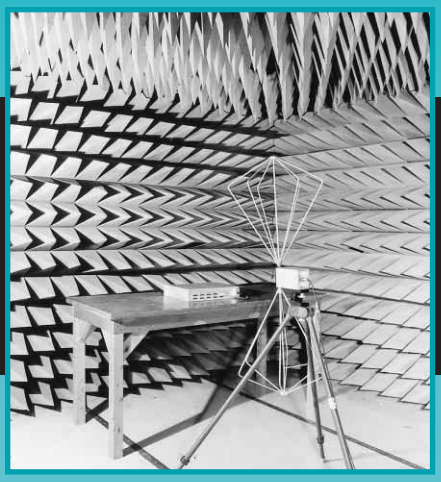

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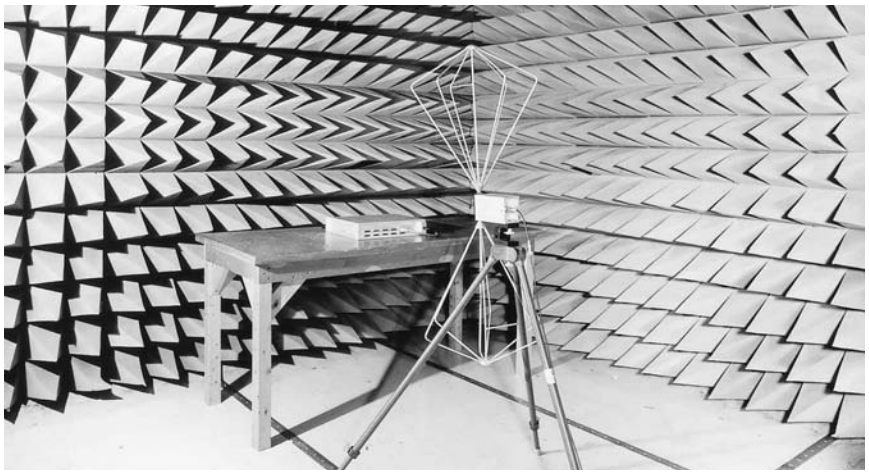
Worldwide Sales Offices, Distributors & Fabricators Page 226

Global Compliance Testing

Comprehensive EMI/EMC/Safety Compliance and Design Services

Chomerics, world leader in the manufacture of EMI shielding materials, offers full service compliance testing to meet emissions, immunity, susceptibility and safety requirements for commercial, military and government electronics.

What sets us apart from other test services are 35 years of experience in the EMI shielding industry, our EMI and safety design capabilities, and the in-house availability of our entire line of shielding materials.



Design Services

Foremost in our commitment to finding and solving EMI and safety design problems is providing expert design assistance. After evaluating your product, we will identify trouble areas and suggest practical solutions. With your design criteria in mind, our engineers will look across the full range of EMI and safety possibilities, including:

- EMI/EMC Packaging Design
- EMI/EMC Board-Level Design
- Safety Construction Review
- EMC/Safety Components Advice
- Prototype Fabrication Assistance

Full-Range Test Capabilities

Chomerics' three shielded enclosures for commercial and military equipment testing include two measuring 22x10x10 feet and one measuring 20x16x10 feet. They include three adjacent 8x8x8 foot shielded rooms for test and EUT support equipment. The 20x16x10 room is a semi-anechoic facility with absorber cones. One of the 22x10x10-foot test chambers is a fully-anechoic, ferrite-lined enclosure that meets the field uniformity requirements of EN 61000-4-3.

For commercial equipment emissions testing, Chomerics operates temperature-controlled 3- and 10-meter open field test sites, both of which exhibit characteristics accepted and on file with the FCC. One site is equipped with a flush mounted, 14-foot diameter, 5000 lb. capacity turntable. Both sites are equipped for 50 Hz/60 Hz power.

Frequency range of measurement for both emissions and susceptibility is DC to 100 GHz. Radiated susceptibility test equipment allows for field level testing to 200 volts/meter up to 40 GHz. A separate 16x12x10-foot shielded enclosure is set up specifically for shielding effectiveness testing on cables, cabinets, shielded windows, shielded air vents, EMI gaskets and composite panels. In addition, transfer impedance measurement capabilities (30 MHz to 1 GHz) are available for planar materials per ASTM D4935 and EMI gaskets per SAE 1705.

For safety testing, our state-of-the-art laboratory includes a temperature/humidity chamber, computer-controlled equipment to perform leakage testing, and a ground controlled, programmable power source. These enable us to evaluate your product to all power line voltages and frequencies.

Safety Testing — UL, CSA and European Standards

Chomerics has extensive safety testing experience in evaluating products and determining conformance with global requirements.

Products are evaluated for compliance with US Low Voltage, Medical Device and Machinery directives. Services include product evaluations to safety standards, and assembly or evaluation of technical files when making a CE Self-Declaration. We can provide verification reports outlining conformance to product specific standards, third party review, and certification programs including notified body review.

"Q" Test Program

The Q Test Program is for customers who can ship their equipment to our laboratory, but are not present for the test. Every Q Test customer receives a completion date based on availability, schedules and deadlines, with a typical turnaround of 10 days to two weeks. This allows us the flexibility to place your equipment into the queue for testing within the specified period.

Military and Avionics Equipment Qualification

Chomerics is unrivaled in testing to MIL-STD and DO-160 specifications for electromagnetic susceptibility and emissions. Because we work with these specifications on a daily basis, we know them inside and out. Our expert team of test technicians, applications engineers, scientists and EMI/EMC engineers not only test your system to military specifications, but also integrate the proper qualified materials if EMI problems are encountered.

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TEST SERVICES	
FCC, CSA, CISPR, VCCI, AUSTEL, EN Testing and Applications Engineering	• FCC Part 15/18 Class A/B • CISPR/EN Specifications • VCCI Class A/B • AUSTEL AS3548 • CSA C108.8 Class A/B
FCC Certification	• Chomerics Test with FCC Submittal • Manufacturer's Self Declaration
Power Line Harmonics and Flicker	• IEC 555-2: (<16A) IEC 1000-3-2 / EN 61000-3-2 • IEC 555-3: (<16A) IEC 1000-3-3 / EN 61000-3-3
EU Commercial Immunity Testing (IEC 801 / EN Series Generic Immunity Standards and Product Specific Standards)	• IEC 801-2 / EN 61000-4-2 Electrostatic Discharge up to 27 kV • IEC 801-3 / EN 61000-4-3 Radiated Susceptibility • IEC 801-4 / EN 61000-4-4 Electrical Fast Transient / Burst • IEC 801-5 / EN 61000-4-5 Surge Immunity • IEC 801-6 / EN 61000-4-6 Immunity to Conducted Disturbances • IEC 1000 / EN 61000-4-8, -9, -10 and -11 are also available
Q Testing (No Customer Present)	For customers who prefer to ship their equipment for testing without having to be present. Permits Chomerics Test Services to place the equipment into a queue for timely pass/fail testing at a reduced rate. (10 day to 2 week turnaround)
Cable TV Testing	• EN 50083-2 (EMC) • EN 60065 (Safety)
Medical Device Compliance Testing	• EN 60601-1-2 Medical Electrical Equipment • FDA Reviewer Guidance for Premarket Notification – 510(K)
Safety Testing **UL, CSA and TUV Witnessing for Safety Agency Approvals**	Safety evaluations to the European requirements with reports for a Manufacturer's Technical Construction File (TCF) Typical evaluations to safety standards include: • EN 60204 • EN 60950-1 • UL 1950-1 • SEMI S-2 • EN 60601-1 • EN 61010-1 • UL 2601-1 • CSA C22.2 No. 950.M89
MIL-STD 461, DO-160, HIRF, GM, Ford, Chrysler Automotive EMC Testing	• MIL-STD 461, Test Method RS03, 14 kHz-40 GHz, Up to 200 V/m • RTCA DO-160, Category Y, 30 MHz-18 GHz, Up to 200 V/m • GM9100 / Ford F2AF-1316 / Chrysler PF-9326/SAE J113, J551
Shielding Effectiveness (Enclosures / Components)	• MIL-STD 285 • SAE ARP 1173 • MIL-G-83528 • SAE ARP 1705 • Testing from 14 kHz to 40 GHz to a dynamic range of 120 dB.
Test and Design Consultation (Out of Lab)	Chomerics will provide design assistance to whatever extent you require, from consulting help to design and fabrication of prototype enclosures on both a commercial and military design level.
Test and Fix (In Lab)	Value added time utilizing the expertise of an EMC engineer to troubleshoot test failures or consult during testing.
Environmental, Lightning, EMP, Telecom Testing	• Typical Lightning Test Tasks: RTCA-DO-160 • Typical Environmental Test Tasks: MIL-STD 810
Accreditations	• **FCC** • **AUSTEL** • **VCCI** • **NARTE** • **NVLAP (12/C01 AND 12/R01)**

Call, fax or e-mail for more information about Chomerics Test Services.

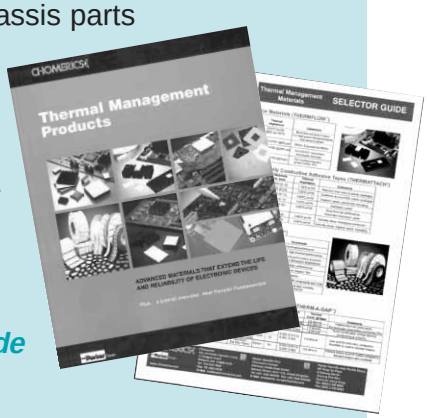
Phone: 781-939-4377 • **Fax:** 781-935-2758 • **E-mail:** mpack@parker.com

Website: www.chomericstest.com

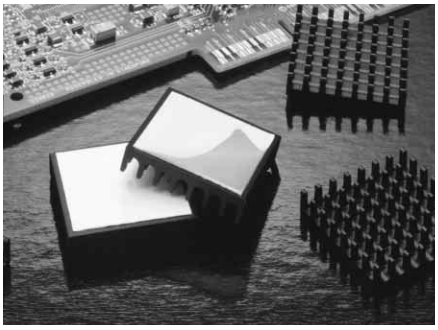
Chomerics ***is a leading manufacturer of thermally conductive interface materials that transfer heat from electronic components to heat sinks or other heat spreading devices. Careful management of these thermal interfaces is crucial to maintaining the reliability and extending the life of electronic devices.***

High Efficiency Products for Every Need

Chomerics offers an extensive family of interface materials. Phase-change materials combine the convenience of pads with performance comparable to grease. Our gap filler pads conform easily to irregular surfaces, allowing chassis parts to be used as heat spreaders. Thin profile heat spreaders add cooling to low power devices where heat sinks can't be used. Thermally conductive compounds include sealants, and form-in-place elastomers.

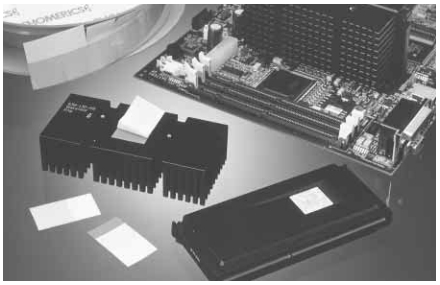


For complete information, request our Thermal Management Products Catalog and convenient Selector Guide or visit www.chomerics.com



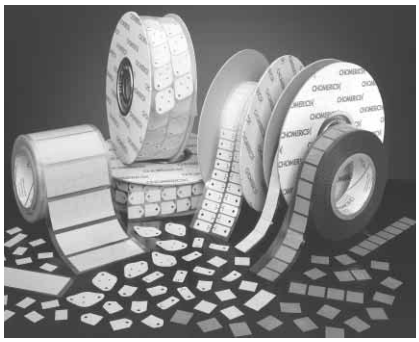
THERMATTACH® Thermally Conductive Adhesive Tapes

THERMATTACH adhesive tapes are used extensively to bond heat sinks to video graphics chips and other power-dissipating semiconductors. They are offered with a choice of aluminum oxide or titanium diboride fillers coated on Kapton film, aluminum foil, fiberglass or expanded aluminum. The THERMATTACH family includes materials with thermal impedance as low as 0.25°C-in^2/W. T410 tapes attach heat sinks to plastic packages, and T411 tapes are designed to conform to out-of-flat plastic package surfaces. Electrically isolating and non-isolating versions of THERMATTACH tapes are available.



THERMFLOW® Phase-Change Thermal Interface Materials

The THERMFLOW family of phase-change thermal interface materials combines the consistency and ease of use of elastomeric pads with the low thermal impedance of thermal grease. This winning combination makes Chomerics' THERMFLOW materials an excellent choice for today's most demanding thermal interface applications. Each pad consists of a thin, dry film that softens at microprocessor operating temperatures and completely fills interfacial air gaps and voids typically found between component packages and heat sinks. The THERMFLOW family provides materials with thermal impedance as low as 0.03°C-in^2/W. Applications include microprocessors, power semiconductors, DC/DC converters, and exposed die BGAs.



CHO-THERM® Thermally Conductive Insulators

One-component CHO-THERM insulators eliminate the need for messy, time-consuming thermal grease. Quickly applied CHO-THERM insulators can lower production costs and enhance production consistency. These advanced materials utilize silicone resins filled with boron nitride or aluminum oxide particles to achieve a range of thermal performance levels. Typical applications include power conversion equipment, power supplies and UPS systems, power semiconductors and automotive electronics. CHO-THERM pads are available in sheets, roll form, or die-cut for use with standard semiconductors. Materials are available with thermal impedance as low as 0.19°C-in^2/W.

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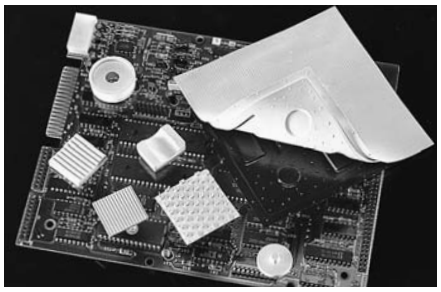
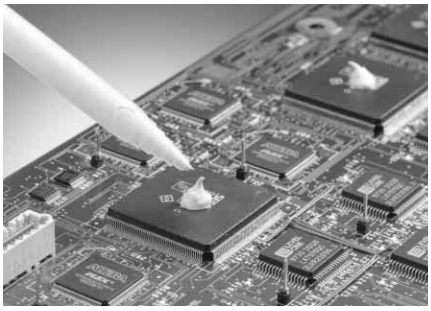
Parker Seals



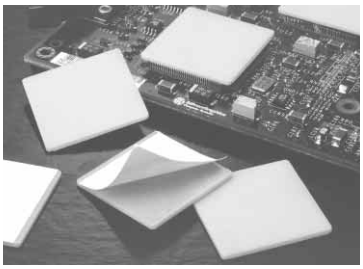
THERM-A-GAP™ Thermally Conductive Gap Fillers

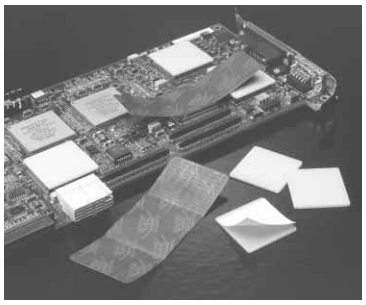
Supersoft THERM-A-GAP elastomers fill air pockets between hot components and heat sinks or metal chassis. Their flexible, elastic nature allows them to blanket highly uneven surfaces. Heat is conducted away from separate components or entire PCBs into metal covers, frames or spreader plates. THERM-A-GAP pads consist of ceramic-filled silicone and are provided in both electrically isolating form with fiberglass reinforcement, or laminated to aluminum foil for enhanced thermal conductivity to minimize hot spots. Applications include heat pipe assemblies, laptop PCs and automotive electronics. THERM-A-GAP materials can be die-cut or molded into custom shapes.



THERM-A-FORM™ Thermally Conductive Compounds

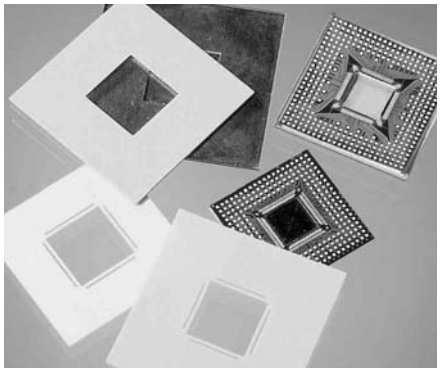
THERM-A-FORM thermally conductive silicone elastomers are supplied as kits containing liquid reactive components. Mixed and allowed to cure, they produce a flexible, low modulus rubber that is ideal for heat transfer applications in electronic component cooling. Typical applications include cooling multi-height components on a PCB, and inside laptop PCs and other high density, handheld portable electronics. This family includes thermally conductive, electrically isolating sealing/potting compound materials. It also features silicone-based, form-in-place gap fillers that conform to irregular shapes without the need for compressive force. THERM-A-FORM compounds are available in a range of kit sizes, including twin-barrel cartridges and pneumatic applicators.





T-WING® and C-WING™ Heat Spreaders

These thin heat spreaders provide a low-cost means of cooling IC devices in restricted spaces. T-Wing spreaders consist of flexible copper foil between electrically insulating films. High strength PSA (pressure-sensitive adhesive) provides a strong bond to the component. The compliant nature of the T-Wing allows nearly 100% adhesive contact to non-flat package surfaces, optimizing thermal and mechanical performance. C-Wing spreaders are a ceramic version for EMI-sensitive applications. They consist of aluminum oxide or aluminum nitride substrates with the same PSA used on T-Wing spreaders. Typical applications for T-Wing and C-Wing heat spreaders include microprocessors and cache chips, laptop PCs and other high density, portable electronics, and high speed disk drives.



Semiconductor Packaging Materials

The explosive growth of array packaging presents new challenges to users and suppliers of high performance materials for semiconductor assembly. Chomerics' THERMFLOW T443 and T725 thermally conductive phase-change materials provide superior, grease-like performance for flip chip die interface applications. THERMATTACH T421, T422, T424 and T427 tapes, used to bond heat spreaders, lids and stiffeners to EBGA and TBGA packages, offer outstanding adhesive characteristics, improved thermal performance and reduced assembly times.

For detailed information on Chomerics' products for thermal management, request our Thermal Management Products Catalog and convenient Selector Guide or visit *www.chomerics.com*