

# INTRODUCTION TO ELECTRICALLY CONDUCTIVE ELASTOMERS



## OVERVIEW

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

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

Laird offers conductive elastomers in the following forms:

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

## ELECTROSEAL™ GASKET INTRODUCTION

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

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

When any two flat, but rigid surfaces are brought together, slight surface irregularities on each surface prevent them from meeting completely at all points. These irregularities may be extremely minute, yet may provide a leakage path for gas or liquid under pressure, and for high frequency electromagnetic energy. This problem remains in flange sealing even when very high closure force is applied.

However, when a gasket fabricated of resilient material is installed between the mating surfaces, and even minimal closure pressure is applied, the resilient gasket conforms to the irregularities in both mating surfaces. As a result, all surface imperfections and potential leak paths across the joint area are sealed completely against pneumatic and fluid pressure or penetration by environmental gases. If the gasket is conductive as well as resilient, with conductive matrix distributed throughout its total volume in mesh or particle form, the joint can be additionally sealed against penetration by, or exit of, electromagnetic energy.

# ELECTROSEAL CONDUCTIVE ELASTOMER

## PRODUCT SELECTION GUIDE

### ECE POLYMER MATERIAL MATRIX

	<b>Benefit</b>	<b>Ag (Silver)</b>	<b>AgCu</b>	<b>AgNi</b>	<b>AgAl</b>	<b>AgGlass</b>	<b>Ni</b>	<b>NiAl</b>	<b>NiGraphite</b>	<b>Carbon</b>	<b>Non-Conductive</b>
Silicone	good all purpose material	ECE082/083	ECE080/094	ECE084	ECE081	ECE085	ECE100	ECE032	ECE072/093	ECE087	NCE220
Fluorosilicone	fuel and oil resistant	-NA-	ECE088	ECE090	ECE050/089	ECE011	-NA-	-NA-	ECE092	-NA-	-NA-
EPDM	biohazard resistant	-NA-	-NA-	-NA-	ECE096	-NA-	-NA-	-NA-	ECE095	ECE013	-NA-

### FIP RESIN MATRIX

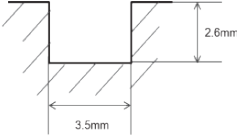
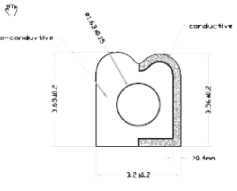

	<b>Benefit</b>	<b>AgCu</b>	<b>AgNi</b>	<b>AgAl</b>	<b>NiGraphite</b>	<b>Non-Conductive</b>
RXP - room temperature cure	simple dispense process	SNK55	SNN60	SNL60	SNC70	SIL25
HXP - heat cure	longer shelf life	SNK60	SNN65	SNL70	SNC70	SIL35

# ELECTROSEAL CONDUCTIVE ELASTOMER

## CASE STUDY

### EXAMPLE

A Telecommunication customer A is looking for a gasket for RRU chassis. The chassis will be made of Aluminum by casting. There is an existing design including groove. Groove dimension is as follows. The customer is looking for an electromagnetic shielding larger than 50 dB for the chassis. And high reliability is required considering RRU unit will be exposed in open air and sustain various weather condition such as snow, rain, fog, etc.

	Selection Process	Conclusion
<b>Select elastomer base</b>	Take reference of Table 1	Silicone
	All the three bases can meet resistance requirement against weather, but silicone is the most cost effective one. And also best on availability and processibility.	
<b>Select filler system</b>	"Take reference of Table 3 for galvanic performance and Material Selection Table 6 1. Ag/Al filler would be most compatible with casting aluminum. 2. Ni/Graphite is a cost effective solution but still acceptable. Can be a candidate for future cost/performance comparison. 3. Better use a hybrid design considering high reliability requirement. 4. Both filler system can provide high shielding. But final performance would rely also on final design."	"Hybrid (NCE+ECE), ECE81(Ag/Al) or ECE93(Ni/Graphite) "
<b>Design Shape &amp; Dimension</b>		
Closure force	Medium closure force required because the RRU unit need to sustain water flush without high pressure	Hollow cross section
Is there an existing design? (part/groove/flange/interface)	There is an existing groove design. But can not find corresponding groove recommendation in brochure. Would need a design on gasket. Contact Laird FAE for it.	
What's the shape?	Existing groove design is rectangle shaped. A standard double D co-extrusion might work	Double D co-extrusion or custom design
Decide dimension	"Filling percentage >90% to bear water flush Compression >=25% considering large coplanarity of chassis and cover Final FEA possible to confirm the design Co-extrusion required because the total length is 1600 mm"	
How to mount the gasket?	Would need a PSA to hold the strip in groove	
	But a friction fit design can also be done for easy assembly and cost saving. Example	

# ELECTROSEAL CONDUCTIVE ELASTOMER CASE STUDY

TABLE 1

Elastomer Type	Low Temperature	Upper Temperature
EPDM	-58°F (-50°C)	257°F (125°C)
Silicone	-49°F (-45°C)	392°F (200°C)
Fluorosilicone	-67°F (-55°C)	347°F (175°C)

TABLE 2

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

TABLE 3

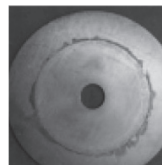
Metal Substrate	80 Sil AG/CU	81 Sil AG/AL	84 Sil AG/NI	85 Sil AG/Glass	89 FSil AG/AL	92 FSil NI/Graphite	93 Sil NI/Graphite	96 EPDM AG/AL
Chromated Al	•	•	•	•	•	•	•	•
Galvalume®	•	•	•	•	•	•	•	•
Tin Plated Steel	•	•	•	•	•	•	•	•
Zinc Plated Steel	•	•	•	•	•	•	•	•
Stainless Steel	•	•	•	•	•	•	•	•

TABLE 4

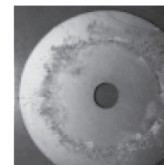
Material Thickness	Compression Force PSI (MPa) at Deflection of:			
	5%	* 10%	15%	20%
0.045 (1,1)	40 (0,3)	100 (0,7)	155 (1,1)	280 (1,9)
0.062 (1,6)	85 (0,6)	165 (1,1)	240 (1,7)	345 (2,4)
0.125 (3,2)	115 (0,8)	180 (1,2)	245 (1,7)	290 (2,0)

TABLE 5

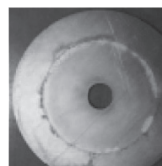
Cross Section Shape	Deflection
Flat Strip	5-10 Percent
Solid O	20-25 Percent
Solid D	15-20 Percent
Hollow O	20-50 Percent
Hollow D	25-50 Percent
Hollow P	25-50 Percent
Interference Fit	15-25 Percent



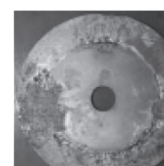
Little to no weight loss on metal coupon; less than 0.25%. Acceptable in all environments.



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



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



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

# ELECTROSEAL CONDUCTIVE ELASTOMER

## CASE STUDY

### MATERIAL SELECTION GUIDE

Laird offers a series of products to meet a wide range of customer requirements for military and commercial applications. The classifications of the most common materials are based on cost and specific applications and are outlined in Table 5.

**TABLE 6**

PARAMETER	TEST METHOD	Ni/graphite	silver/ copper	silver/Al	silver	silver	silver/ nickel	silver/glass	carbon
Filler		Ni/graphite	silver/ copper	silver/Al	silver	silver	silver/ nickel	silver/glass	carbon
Elastomer		silicone	silicone	silicone	silicone	silicone	silicone	silicone	silicone
EcE Name		EcE72	EcE80	EcE81	EcE82	EcE83	EcE84	EcE85	EcE87
<b>Electrical Properties</b>									
Volume Resistivity, $\Omega$ cm, max	MIL-DTL-83528C para 4.5.10	0.100	0.004	0.008	0.002	0.010	0.005	0.006	5.0
Shielding Eff, 10 GHz, dB, min	MIL-DTL-83528C para 4.5.12	100	120	100	120	80	100	100	30
<b>Physical Properties</b>									
Density, g/cm <sup>3</sup> ( $\pm 0.25$ )	ASTM D792	2.30	3.40	2.00	3.50	1.80	4.00	1.90	1.30
Hardness, Shore A ( $\pm 7$ )	ASTM D2240	75	65	65	65	45	75	65	75
Tensile Strength, psi, min	ASTM D412	280	200	200	300	150	200	200	700
Elongation	ASTM D412	150%	100-300%	100-300%	100-300%	50-250%	100-300%	100-300%	100-300%
Tear Strength, ppi, min	ASTM D624, die C	55	25	30	50	20	30	30	50
Compression Set, max	ASTM D395	30%	32%	32%	45%	35%	32%	30%	45%
Max Oper. Temp., °C	MIL-DTL-83528C para 4.5.15	160	125	160	160	160	125	160	160
Min. Oper. Temp., °C	ASTM D1329	-55	-55	-55	-55	-55	-55	-55	-55
Flame Retardance	UL 94	V-0			UL 94 HB (File No. E203 070)				
<b>Electrical Stability</b>									
After Heat Aging, $\Omega$ cm, max	MIL-DTL-83528C para 4.5.15	-	0.010	0.010	0.010	0.015	0.010	0.015	7.0
After Break, $\Omega$ cm, max	MIL-DTL-83528C para 4.5.9	-	0.008	0.015	0.010	0.020	0.010	0.009	7.0
During Vibration, $\Omega$ cm, max	MIL-DTL-83528C para 4.5.13	-	0.006	0.012	0.010	0.015	0.010	0.009	N/A
After Exposure to EMP, $\Omega$ cm, max	MIL-DTL-83528C para 4.5.16	-	0.010	0.010	0.010	0.015	0.010	0.015	N/A
Compression / Deflection, %, min	ASTM D575	8	3.5	3.5	2.5	8.0	3.5	3.5	3.5
Fluid Immersion <sup>1</sup>	MIL-DTL-83528C para 4.5.17	-	NS	NS	NS	NS	NS	NS	NS
<b>Manufacturing Processes</b>									
molded sheet / diecut parts		X	X	X	X	X	X	X	X
molded shapes / O-rings		X	X	X	X	X	X	X	X
extruded profiles		X	X	X	X	X	X	X	
Color		gray	tan	tan	beige	beige	tan	tan	black
Mil-DTL-83528 Type		-	A	B	E	J	L	M	-

1 SUR indicates meets the immersion test requirements for 10 specified military/aerospace fluids  
2 UL94 V-1

3 used only for low density low hardness  
4 UL94 HB  
5 corrosion resistant silver/Al filler

# ELECTROSEAL CONDUCTIVE ELASTOMER

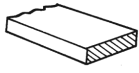
## CASE STUDY

TABLE 6 (cont.)

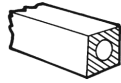
PARAMETER													
Filler	Ni/ graphite	silver/ copper	nickel	N/A	carbon	Ni/ graphite	silver/Al	silver/ glass	silver/Al	silver/ copper	silver/Al	silver/ nickel	Ni/ graphite
Elastomer	silicone	silicone	silicone	silicone	EPDM	EPDM	EPDM	fluorosilicone	fluorosilicone	fluorosilicone	fluorosilicone	fluorosilicone	fluorosilicone
EcE Name	EcE93	EcE94	EcE100	NCE220	EcE13	EcE95	EcE96	EcE11	EcE50	EcE88	EcE89	EcE90	EcE92
<b>Electrical Properties</b>													
Volume Resistivity, $\Omega$ cm, max	0.100	0.005	0.200	Non	30	0.100	0.010	0.010	0.012	0.010	0.012	0.005	0.100
Shielding Eff, 10 GHz, dB, min	100	120	–	Conductive	30	70	90	90	95	110	100	100	100
<b>Physical Properties</b>													
Density, g/cm <sup>3</sup> ( $\pm 0.25$ )	1.90	3.60	4.00	1.20	1.20	2.20	2.20	2.00	2.10	4.10	2.20	4.10	2.20
Hardness, Shore A ( $\pm 7$ )	55	85	75	70	80	80	80	75	75	75	70	75	75
Tensile Strength, psi, min	150	400	450	405	2000	200	200	200	200	180	180	300	150
Elongation	100-300%	100-300%	–	100-400%	100-400%	70-260%	70-260%	60-200%	60-260%	100-300%	60-260%	100-300%	60-250%
Tear Strength, ppi, min	30	40	50	–	100	60	60	30	35	30	30	50	40
Compression Set, max	30%	35%	–	–	30%	40%	50%	30%	30%	35%	30%	25%	30%
Max Oper. Temp., °C	160	125	160	150	125	125	160	160	160	125	160	160	160
Min. Oper. Temp., °C	-55	-45	-55	-50	-40	-40	-40	-50	-55	-55	-55	-50	-55
Flame Retardance	UL 94 HB (File No. E203 070)			UL 94 HB (File No. E203 070)			UL 94 HB (File No. E203 070)						
<b>Electrical Stability</b>													
After Heat Aging, $\Omega$ cm, max	0.200	0.010	0.400	n/a	40	–	–	0.015	0.015	0.015	0.015	0.010	0.200
After Break, $\Omega$ cm, max	0.200	0.010	–	n/a	–	–	–	0.015	0.015	0.015	0.015	0.010	0.200
During Vibration, $\Omega$ cm, max	0.200	0.010	–	n/a	–	–	–	0.015	0.015	0.015	0.015	0.010	0.200
After Exposure to EMP, $\Omega$ cm, max	0.100	0.015	–	n/a	–	–	–	–	0.015	0.015	0.015	0.010	0.100
Compression / Deflection, %, min	8.0	2.5	–	–	3.0	3.0	3.0	3.0	3.0	3.5	3.5	3.0	5.0
Fluid Immersion <sup>1</sup>	NS	NS	NS	–	NS	NS	NS	SUR	SUR	SUR	SUR	SUR	SUR
<b>Manufacturing Processes</b>													
molded sheet / diecut parts	X	X	X	X	X	X	X	X	X	X	X	X	X
molded shapes / O-rings	X	X	X	X	X	X	X	X	X	X	X	X	X
extruded profiles	X	X	X	X		X	X	X	X	X	X	X	X
Color	black	tan	dk gray	blue	black	black	tan	tan	tan	tan	blue	tan	dk gray
Mil-DTL-83528 Type	–	K	–	–	–	–	–	–	–	C	D	–	–

# VISUAL PART REFERENCE GUIDE

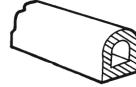
## ELECTROSEAL CONDUCTIVE ELASTOMERS



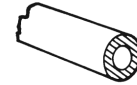
**Rectangular Strips**  
Page 87



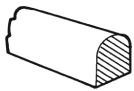
**Hollow Rectangular Strips**  
Page 87



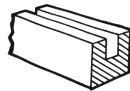
**Hollow D-Strips**  
Page 88



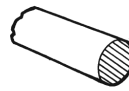
**O-Strip Tubing**  
Page 89



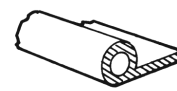
**D-Strips**  
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**Channel Strips**  
Page 90

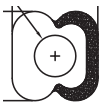


**O-Strips**  
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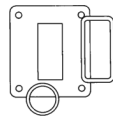
**P-Strip Tubing**  
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## CO-EXTRUSION



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## ELECTROSEAL CONDUCTIVE ELASTOMER FABRICATED COMPONENTS



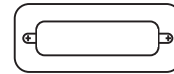
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## MIL CONNECTOR GASKETS



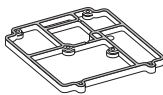
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## "D" SUBMINIATURE CONNECTOR SHIELDS



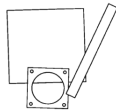
Page 101

## FORM-IN-PLACE EMI DISPENSED GASKETS



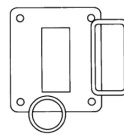
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## METAL IMPREGNATED MATERIALS



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## ELECTROCOAT



Page 102

# ELECTROSEAL CONDUCTIVE ELASTOMER MATERIAL



## ELECTROSEAL™ CONDUCTIVE ELASTOMER EMI SHIELDING

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

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

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

## SHEET MATERIAL

The Table below lists thicknesses and sizes for our molded sheet material, while Table 3, page 82, shows the compounds available for all of our conductive silicone elastomers.

## HOW TO SPECIFY ECE

Decide on molded sheet stock or extruded shapes. Select the desired configuration and dimensions from Table 1 (for sheet stock) or page 85 (for extruded shapes). Select the desired material from Table 3. Insert material number from Table 3, page 82, in place of the letters XX in the Laird part number.

### Example

1. From page 87, for a rectangular strip measuring 0.500 in. (12,7 mm) x 0.075 in. (1,9 mm), part number is 8861-0130-XX.
2. From Table 3, on page 82, for silver-nickel filler, material number is 84.
3. Ordering part number is 8861-0130-84.\*

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

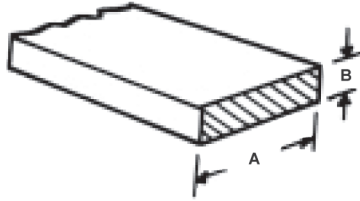
\*If pressure sensitive adhesive is required, replace the fifth digit with a 9 (i.e. 8861-9130-84).

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

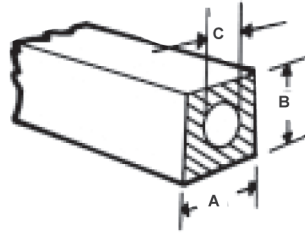


# EXTRUSIONS GUIDE

## Rectangular Strips



## Hollow Rectangular Strips



### TOLERANCES ALL PROFILES

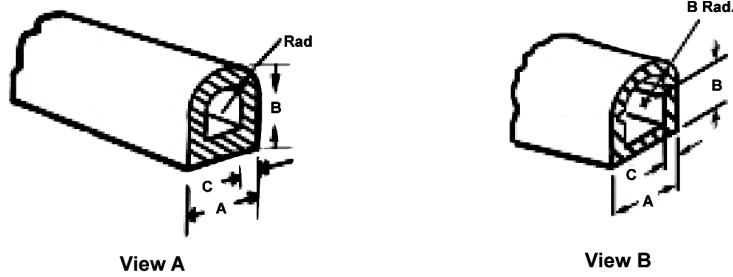
DIMENSIONS	TOLERANCE
Under 0.101 (2,6)	± 0.005 (0,15)
0.101 to 0.200 (2,6 to 5,1)	± 0.008 (0,2)
0.201 to 0.300 (5,1 to 7,6)	± 0.010 (0,3)
0.301 to 0.500 (7,6 to 12,7)	± 0.015 (0,4)
Over 0.500 (12,7)	± 0.020 (0,5)

PART NUMBER	NOMINAL DIMENSIONS		
	A	B	C
8862-0112	0.125 (3,2)	0.125 (3,2)	0.078 (2,0)
8862-0113	0.200 (5,1)	0.130 (3,3)	0.090 (2,3)
8862-0114	0.250 (6,4)	0.250 (6,4)	0.156 (4,0)
8862-0100	0.330 (8,4)	0.305 (7,7)	0.125 (3,2)
8862-0105	0.375 (9,5)	0.375 (9,5)	0.188 (4,8)

MIL-DTL-85328 PART NUMBER	PART NUMBER	NOMINAL DIMENSIONS	
		A	B
M83528/009X001	8861-0100	0.063 (1,6)	0.042 (1,1)
	8861-0179	0.079 (2,0)	0.039 (1,0)
	8861-0181	0.079 (2,0)	0.059 (1,5)
M83528/009X002	8861-0105	0.095 (2,4)	0.062 (1,6)
	8861-0110	0.120 (3,0)	0.075 (1,9)
	8861-0115	0.125 (3,2)	0.062 (1,6)
M83528/009X004	8861-0120	0.156 (4,0)	0.062 (1,6)
	8861-0121	0.187 (4,8)	0.125 (3,2)
	8861-0167	0.188 (4,8)	0.062 (1,6)
M83528/009X005	8861-0193	0.189 (4,8)	0.189 (4,8)
	8861-0125	0.250 (6,4)	0.062 (1,6)
	8861-0173	0.250 (6,4)	0.125 (3,2)
M83528/002X006	8861-0174	0.250 (6,4)	0.188 (4,8)
	8861-0136	0.250 (6,4)	0.200 (5,1)
	8861-0175	0.252 (6,4)	0.031 (0,8)
M83528/009X007	8861-0183	0.378 (9,6)	0.063 (1,6)
	8861-0172	0.500 (12,7)	0.020 (0,5)
	8861-0131	0.500 (12,7)	0.042 (1,1)
M83528/009X008	8861-0182	0.500 (12,7)	0.059 (1,5)
	8861-0130	0.500 (12,7)	0.075 (1,9)
	8861-0188	0.500 (12,7)	0.094 (2,4)
M83528/009X009	8861-0135	0.500 (12,7)	0.125 (3,2)
	8861-0140	0.500 (12,7)	0.188 (4,8)
	8861-0142	0.750 (19,1)	0.040 (1,0)
M83528/009X010	8861-0141	0.750 (19,1)	0.042 (1,1)
	8861-0145	0.750 (19,1)	0.062 (1,6)
	8861-0184	0.827 (21,0)	0.071 (1,8)
M83528/009X011	8861-0189	0.827 (21,0)	0.094 (2,4)
	8861-0150	0.880 (22,4)	0.062 (1,6)
	8861-0103	0.984 (25,0)	0.043 (1,1)
M83528/009X012	8861-0169	1.00 (25,4)	0.062 (1,6)
	8861-0192	1.00 (25,4)	0.126 (3,2)
	8861-0155	1.00 (25,4)	0.250 (6,4)
M83528/009X013	8861-0160	1.18 (30,0)	0.062 (1,6)

# EXTRUSIONS GUIDE

## Hollow D-Strips



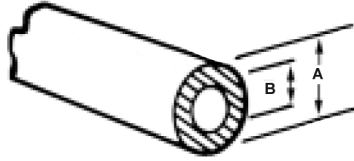
### TOLERANCES ALL PROFILES

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

MIL-DTL-83528 PART NUMBER	PART NUMBER	DIMENSIONS					VIEW
		A	B	RAD	C		
	8866-0135	0.093 (2,4)	0.093 (2,4)	0.046 (1,2)	0.027 (0,7)		A
	8866-0160	0.098 (2,5)	0.098 (2,5)	0.049 (1,2)	0.020 (0,5)		A
	8866-0130	0.100 (2,5)	0.094 (2,4)	0.050 (1,3)	0.025 (0,6)		A
	8866-0162	0.109 (2,8)	0.125 (3,2)	0.054 (1,4)	0.024 (0,6)		A
M83528/007X001	8866-0100	0.156 (4,0)	0.156 (4,0)	0.078 (2,0)	0.045 (1,1)		A
	8866-0111	0.156 (4,0)	0.156 (4,0)	0.078 (2,0)	0.027 (0,7)		A
	8866-0103	0.158 (4,0)	0.240 (6,1)	0.079 (2,0)	0.040 (1,0)		A
	8866-0136	0.160 (4,1)	0.120 (3,0)	0.080 (2,0)	0.025 (0,6)		A
M83528/007X002	8866-0105	0.187 (4,8)	0.187 (4,8)	0.093 (2,4)	0.050 (1,3)		A
	8866-0131	0.250 (6,4)	0.145 (3,7)	0.125 (3,2)	0.030 (0,8)		A
	8866-0050	0.250 (6,4)	0.250 (6,4)	0.125 (3,2)	0.050 (1,3)		B
M83528/007X007	8866-0110	0.250 (6,4)	0.250 (6,4)	0.125 (3,2)	0.065 (1,7)		A
M83528/007X005	8866-0120	0.312 (7,9)	0.312 (7,9)	0.112 (2,8)	0.062 (1,6)		A
M83528/007X004	8866-0116	0.312 (7,9)	0.312 (7,9)	0.156 (4,0)	0.062 (1,6)		B
	8866-0127	0.325 (8,3)	0.575 (14,6)	0.287 (7,3)	0.080 (2,0)		A
	8866-0168	0.358 (9,1)	0.374 (9,5)	0.179 (4,5)	0.039 (1,0)		A
	8866-0166	0.374 (9,5)	0.252 (6,4)	0.187 (4,8)	0.039 (1,0)		A
	8866-0134	0.375 (9,5)	0.250 (6,4)	0.090 (2,3)	0.050 (1,3)		B
	8866-0137	0.375 (9,5)	0.250 (6,4)	0.187 (4,8)	0.032 (0,8)		A
	8866-0169	0.421 (10,7)	0.427 (10,8)	0.210 (5,3)	0.039 (1,0)		A
	8866-0126	0.480 (12,2)	0.335 (8,5)	0.240 (6,1)	0.035 (0,9)		A
M83528/007X006	8866-0125	0.487 (12,4)	0.324 (8,2)	0.244 (6,2)	0.062 (1,6)		A
	8866-0148	0.488 (12,4)	0.312 (7,9)	0.244 (6,2)	0.055 (1,4)		A
	8866-0139	0.488 (12,4)	0.324 (8,2)	0.244 (6,2)	0.063 (1,6)		A
	8866-0129	0.500 (12,7)	0.312 (7,9)	0.250 (6,4)	0.050 (1,3)		A
	8866-0155	0.625 (15,9)	0.400 (10,2)	0.312 (7,9)	0.057 (1,4)		A

# EXTRUSIONS GUIDE

## O-Strip Tubing



### TOLERANCES ALL PROFILES

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

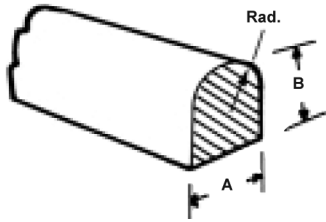
MIL-DTL-85328 PART NUMBER	PART NUMBER	NOMINAL DIMENSIONS	
		A	B
	8864-0136	0.085 (2,2)	0.035 (0,9)
	8864-0060	0.085 (2,2)	0.040 (1,0)
	8864-0173	0.085 (2,2)	0.050 (1,3)
	8864-0156	0.090 (2,3)	0.040 (1,0)
	8864-0161	0.090 (2,3)	0.045 (1,1)
	8864-0090	0.090 (2,3)	0.050 (1,3)
M83528/011X007	8864-0095	0.103 (2,6)	0.040 (1,0)
	8864-0142	0.103 (2,6)	0.050 (1,3)
	8864-0172	0.110 (2,8)	0.062 (1,6)
	8864-0153	0.115 (2,9)	0.062 (1,6)
M83528/011X001	8864-0100	0.125 (3,2)	0.045 (1,1)
M83528/011X006	8864-0101	0.125 (3,2)	0.062 (1,6)
	8864-0102	0.130 (3,3)	0.062 (1,6)
	8864-0104	0.145 (3,7)	0.070 (1,8)
	8864-0171	0.149 (3,8)	0.125 (3,2)
M83528/011X002	8864-0105	0.156 (4,0)	0.050 (1,3)
	8864-0163	0.156 (4,0)	0.062 (1,6)
	8864-0139	0.168 (4,3)	0.069 (1,8)
	8864-0162	0.177 (4,5)	0.092 (2,3)

MIL-DTL-85328 PART NUMBER	PART NUMBER	NOMINAL DIMENSIONS	
		A	B
M83528/011X008	8864-0143	0.177 (4,5)	0.079 (2,0)
	8864-0168	0.188 (4,8)	0.120 (3,0)
	8864-0147	0.216 (5,5)	0.125 (3,2)
	8864-0167	0.228 (5,8)	0.169 (4,3)
M83528/011X003	8864-0110	0.250 (6,4)	0.125 (3,2)
	8864-0160	0.312 (7,9)	0.188 (4,8)
M83528/011X004	8864-0120	0.312 (7,9)	0.192 (4,9)
	8864-0144	0.330 (8,4)	0.250 (6,4)
	8864-0050	0.375 (9,5)	0.235 (6,0)
M83528/011X005	8864-0125	0.375 (9,5)	0.250 (6,4)
	8864-0127	0.400 (10,2)	0.200 (5,1)
	8864-0170	0.422 (10,7)	0.319 (8,1)
	8864-0166	0.490 (12,4)	0.414 (10,5)
	8864-0135	0.513 (13,0)	0.438 (11,1)
	8864-0055	0.550 (14,0)	0.447 (11,4)
	8864-0159	0.623 (15,8)	0.366 (9,3)
	8864-0053	0.630 (16,0)	0.375 (9,5)

	8864-010462	0.146 (3,7)	0.091 (2,3)
	8864-3714	0.146 (3,7)	0.055 (1,4)
	8864-0103	0.138 (3,5)	0.071 (1,8)
	8864-0091	0.094 (2,4)	0.059 (1,5)
	8864-3515	0.138 (3,5)	0.059 (1,5)
	8864-2618	0.102 (2,6)	0.071 (1,8)
	8864-3824	0.150 (3,8)	0.094 (2,4)
	8864-0137	0.094 (2,4)	0.035 (0,9)
	8864-0141	0.126 (3,2)	0.087 (2,2)
	8864-0231	0.071 (1,8)	0.039 (1)
	8864-0180	0.063 (1,6)	0.039 (1)
	8864-3715	0.146 (3,7)	0.059 (1,5)

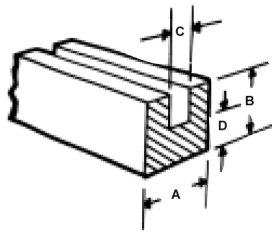
# EXTRUSIONS GUIDE

## D-Strips



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

## Channel Strips



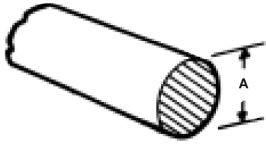
### TOLERANCES ALL PROFILES

DIMENSIONS	TOLERANCE
Under 0.101 (2,6)	$\pm 0.005$ (0,15)
0.101 to 0.200 (2,6 to 5,1)	$\pm 0.008$ (0,2)
0.201 to 0.300 (5,1 to 7,6)	$\pm 0.010$ (0,3)
0.301 to 0.500 (7,6 to 12,7)	$\pm 0.015$ (0,4)
Over 0.500 (12,7)	$\pm 0.020$ (0,5)

MIL-DTL-83528 PART NUMBER	PART NUMBER	DIMENSIONS			
		A	B	C	D
M83528/010X001	8868-0100	0.100 (2,5)	0.100 (2,5)	0.034 (0,9)	0.033 (0,8)
	8868-0055	0.114 (2,9)	0.082 (2,1)	0.030 (0,8)	0.026 (0,7)
M83528/010X002	8868-0105	0.126 (3,2)	0.110 (2,8)	0.025 (0,6)	0.050 (1,3)
M83528/010X003	8868-0056	0.156 (4,0)	0.114 (2,9)	0.030 (0,8)	0.062 (1,6)
M83528/010X004	8868-0115	0.156 (4,0)	0.156 (4,0)	0.062 (1,6)	0.047 (1,2)
	8868-0067	0.175 (4,4)	0.500 (12,7)	0.047 (1,2)	0.075 (1,9)
M83528/010X005	8868-0120	0.175 (4,4)	0.156 (4,0)	0.047 (1,2)	0.075 (1,9)
	8868-0081	0.189 (4,8)	0.189 (4,8)	0.063 (1,6)	0.063 (1,6)
	8868-0084	0.250 (6,4)	0.250 (6,4)	0.062 (1,6)	0.062 (1,6)
	8868-0085	0.252 (6,4)	0.252 (6,4)	0.126 (3,2)	0.063 (1,6)
M83528/010X006	8868-0125	0.327 (8,3)	0.235 (6,0)	0.062 (1,6)	0.115 (2,9)
	8868-0070	0.395 (1,0)	0.120 (3,0)	0.275 (7,0)	0.060 (1,5)
	8868-0075	0.530 (13,5)	0.130 (3,3)	0.390 (9,9)	0.060 (1,5)

# EXTRUSIONS GUIDE

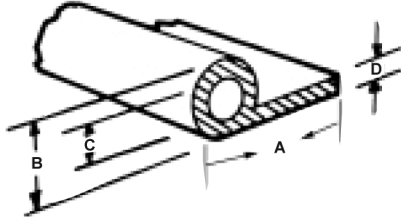
## O-Strips



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

# EXTRUSIONS GUIDE

## P-Strips



### TOLERANCES ALL PROFILES

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

MIL-DTL-83528 PART NUMBER	PART NUMBER	DIMENSIONS			
		A	B	C	D
	8867-0136	0.275 (7,0)	0.140 (3,6)	0.085 (2,2)	0.030 (0,8)
	8867-0147	0.290 (7,4)	0.095 (2,4)	0.062 (1,6)	0.025 (0,6)
	8867-0144	0.390 (9,9)	0.200 (5,1)	0.103 (2,6)	0.062 (1,6)
	8867-0128	0.415 (10,5)	0.200 (5,1)	0.060 (1,5)	0.062 (1,6)
	8867-0141	0.425 (10,8)	0.250 (6,4)	0.151 (3,8)	0.050 (1,3)
M83528/008X007	8867-0101	0.475 (12,1)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0127	0.500 (12,7)	0.200 (5,1)	0.076 (1,9)	0.062 (1,6)
M83528/008X002	8867-0105	0.500 (12,7)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
	8867-0126	0.600 (15,2)	0.250 (6,4)	0.125 (3,2)	0.062 (1,6)
M83528/008X004	8867-0102	0.640 (16,3)	0.208 (5,3)	0.080 (2,0)	0.072 (1,8)
	8867-0158	0.752 (19,1)	0.252 (6,4)	0.189 (4,8)	0.063 (1,6)
	8867-0165	0.752 (19,1)	0.437 (11,1)	0.347 (8,8)	0.060 (1,5)
M83528/008X006	8867-0130	0.780 (19,8)	0.360 (9,1)	0.255 (6,5)	0.070 (1,8)
M83528/008X001	8867-0100	0.850 (21,6)	0.200 (5,1)	0.080 (2,0)	0.062 (1,6)
	8867-0166	0.874 (22,2)	0.500 (12,7)	0.400 (10,2)	0.065 (1,7)
M83528/008X005	8867-0125	0.875 (22,2)	0.312 (7,9)	0.187 (4,8)	0.062 (1,6)