

- Conductive elastomers • Knitted wire mesh
- Conductive coatings, sealants, adhesives
- Cable shielding products • EMI/ESD shielding laminates
- Shielded vents and windows
- Commercial and military EMI testing

# CHO-SHRINK® Conductive Heat Shrinkable EMI Shielding

## Tubing • Connector Boots • Cable Transitions • Boot Adapters

### CHO-SHRINK TUBING

CHO-SHRINK tubing is a heat shrinkable polyolefin manufactured to MIL-R-46846 Type 5, modified to provide effective 360° EMI shielding for cables. CHO-SHRINK tubing 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.

All CHO-SHRINK products may be recovered (shrunk) with the same heating equipment used on ordinary nonconductive shrinkable plastics.

Standard (stocked) lengths are 4 feet. For longer lengths, tubing sections may be "spliced" together using short pieces of outside-coating tubing to maintain electrical continuity from one length to the next.

### CHO-SHRINK CONNECTOR BOOTS AND CABLE TRANSITIONS

CHO-SHRINK connector boots provide EMI shielding, cable shield grounding, and strain relief at connector backshell terminations. A highly conductive silver-based coating applied to the inside

surface of these molded polyolefin boots provides 60-80 dB attenuation above 500 MHz and in combination with braid will provide levels of attenuation exceeding 80 dB above 10 GHz (see Figure 1).

CHO-SHRINK boots shrink to a wide range of cable diameters (shrink ratio is 4:1 at the cable end), and offer a 40-65% weight savings compared to metal EMI adapters. They can be supplied with a conductive hot melt adhesive/sealant applied to each end. Normal shrink temperatures assure good joining and sealing at boot/connector interfaces. To specify hot-melt option, see table footnotes. For optimum mechanical strength, CHO-SHRINK lipped boots should be shrunk over shrink boot adapters which provide a knurled and grooved surface (see ordering information for boot dimensions and adapters). In addition, plastic tie-wraps should be installed over both ends of boot after shrinking (while part is still warm, but not hot).

CHO-SHRINK cable transitions, including T, Y, and other custom shapes, are also available.

### APPLICATION INSTRUCTIONS

A major advantage of CHO-SHRINK EMI cable shielding over conventional metal shielding is its ease of assembly. The following has been prepared as a guide to the proper application and assembly of CHO-SHRINK tubing, connector boots, and transitions.



All CHO-SHRINK products may be recovered (shrunk) with the same heating equipment used on ordinary nonconductive shrinkable plastics. Hot air blowers and infrared heating devices provide the simplest method of shrinking. Ovens may be used to recover tubing, but boots, transitions, and other molded parts often require some hand positioning during the shrinking process to assure correct alignment. Shrink temperatures should not exceed 375°F. Care should be taken to shrink the product slowly and uniformly. Exceeding 375°F (191°C) may cause a loss of shielding integrity.

*Continued*

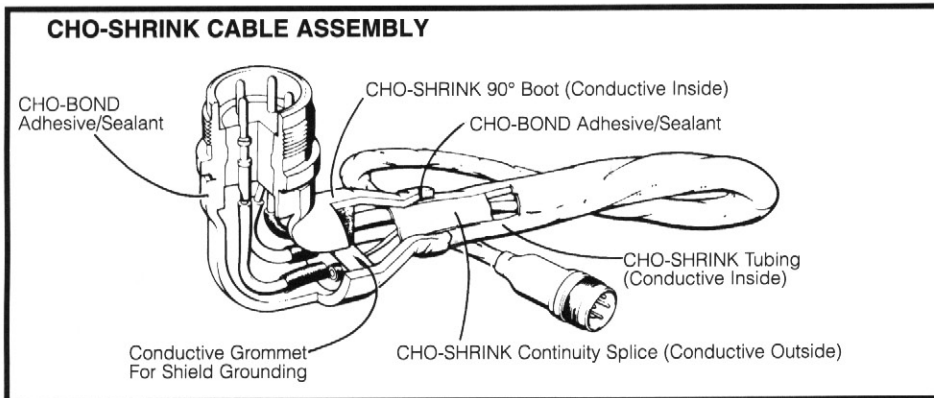
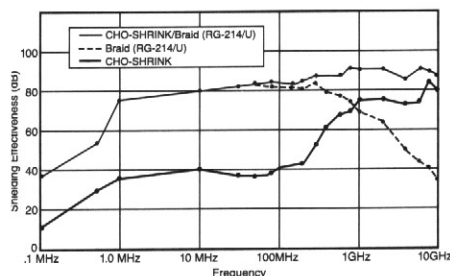


FIGURE 1

### Shielding Effectiveness of CHO-SHRINK Compared to Wire Braid



To achieve a good mechanical grip between CHO-SHRINK boots and connector backshells, Chomerics strongly recommends the use of Shrink Boot Adapters, which provide a knurled and grooved surface to enhance resistance to torque, snap-off and pull-off stresses. Tie-wraps should also be applied.

CHO-SHRINK molded parts are available with a highly conductive hot-melt adhesive/sealant at each opening. This hot melt will flow during shrinking to provide an effective environmental seal without degrading EMI shielding characteristics. If excess sealant flows outside the molded part during recovery, it can easily be wiped away while still warm.

The only assembly procedure peculiar to CHO-SHRINK is the necessity to maintain electrical continuity through conductive inside surfaces from connector to connector. Where two CHO-SHRINK parts meet (boot/tubing, tubing/transition, etc.), a continuity splice must be achieved. This is accomplished by using CHO-SHRINK splice sleeves, which are short lengths of CHO-SHRINK tubing with a conductive *outside* surface.

### 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.

### OUTGASSING CHARACTERISTICS

CHO-SHRINK heat shrinkable EMI cable shielding meets NASA outgassing requirements for space use. It is listed in NASA Reference Publication No. 1124, revised 1987. Samples of CHO-SHRINK materials were tested per NASA Goddard Specification X-735-69-471 at 125°C, for 24 hours, at a vacuum of 10-6 Torr. The results were:

	Boot	Tubing
Total Weight Loss (%)	.70	.98
Volatile Condensibles (%)	.10	.22*

\* Although condensible volatiles are generally specified by NASA at 10% max., CHO-SHRINK boots were approved because the volatiles come mainly from the inside surface and are, therefore, confined within the cable.

### Typical Properties (CHO-SHRINK Boots)

Shore D hardness (ASTM D-676)	50 ±10
Temperature limits	-55°C to 150°C (-67°F to 300°F)
Dielectric strength of base material (ASTM D-876)	200 V/mil
Shrink temperature	121°C (250°F) min. 191°C (375°F) max.
Flammability (ASTM D-635)	Self-extinguishing
Shrink Ratio	up to 4:1

### Typical Properties (CHO-SHRINK Tubing)

Operating Temperature	-54° to 135°C (-66° to 275°F)
Shrink Temperature	121°C (250°F) min. 191°C (375°F) max.
Dielectric Strength* (ASTM D-876)	500 V/mil
Shrink Ratio	2:1
Tensile Strength**	1500 psi
Flammability	UL VW-1 and CSA OFT
Shielding Effectiveness	See Figure 1
DC Resistance **	1 ohm/foot

\* Recovered base material \*\* After 100% recovery

### 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.

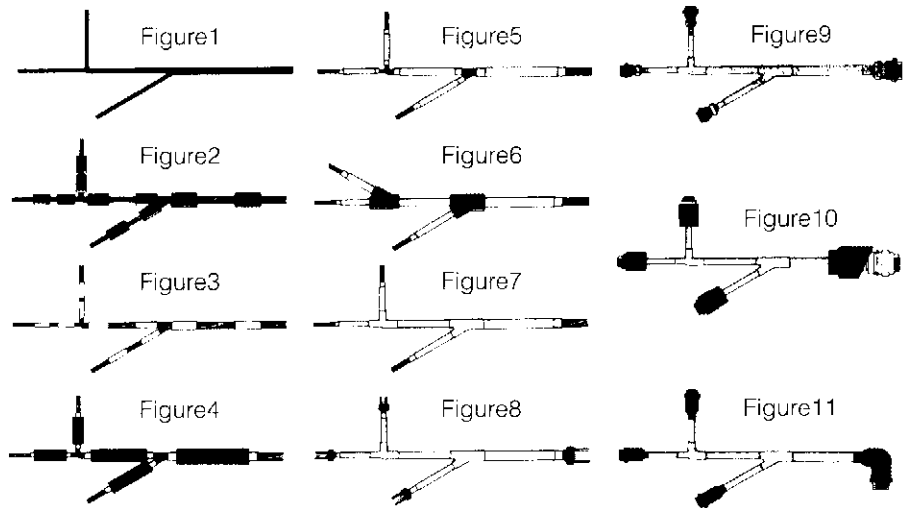
**Figure 3** - Apply heat to shrink continuity splices tightly against wire bundle.

**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:

- Strip outer jacket off each wire and cut shield away leaving 1/4"-3/8" of shield exposed.
- Comb exposed shield back over jacket.
- 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).

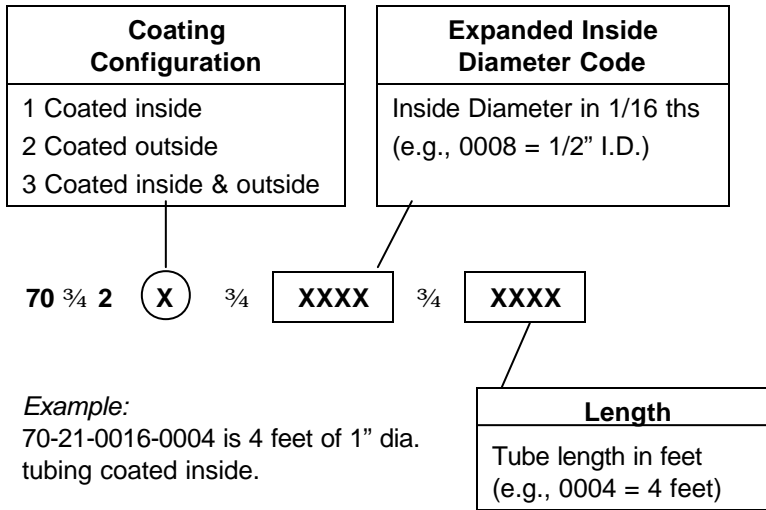
**Figure 10** - Slide CHO-SHRINK boot over connector, and align so that boot will shrink over threads of backshell (or adapter) at one end and exposed continuity splice at other end.

**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.

## ORDERING INFORMATION

### CHO-SHRINK® Tubing

Use the following part numbering system to order CHO-SHRINK tubing. Standard (stocked) lengths are 4 feet. Maximum length is 8 feet. Ordering quantity should specify total length required. Part number indicates length of pieces.



#### Available Standard Diameters and Wall Thicknesses

Expanded Inside Dia. Inches (mm)	Expanded Inside Dia. Code*	Recovered Wall Thickness Inches (mm)
1/8 (3.18) **	0002	.020 (0.51)
3/16 (4.76) ***	0003	.020 (0.51)
1/4 (6.35)	0004	.025 (0.63)
3/8 (9.53)	0006	.025 (0.63)
1/2 (12.7)	0008	.025 (0.63)
3/4 (19.05)	0012	.030 (0.76)
1 (25.4)	0016	.035 (0.89)
1-1/2 (38.1)	0024	.040 (1.02)

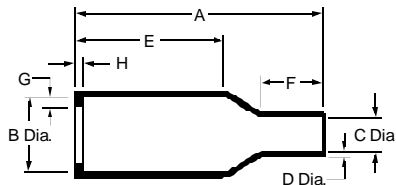
\* See ordering information.

\*\* Two-foot maximum length.

\*\*\* Four-foot maximum length.

**For non-standard sizes, contact Chomerics.**

## Selected CHO-SHRINK® Boots



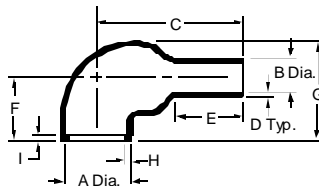
CHO-SHRINK Straight Polyolefin Boots With Lip. (To Fit Shrink Boot Adapters)

Chomerics Part Number*	Nominal Dimensions, inches (mm in parentheses)					
	A	B Dia.		C Dia.		D
	Recovered (±20%)	Supplied (min)	Recovered (max)	Supplied (min)	Recovered (max)	Recovered (±20%)
71-02-7053-XXXX	1.50 (38.10)	.92 (23.37)	.41 (10.41)	.92 (23.37)	.22 (5.59)	.07 (1.78)
71-02-7054-XXXX	2.16 (54.86)	1.12 (28.45)	.56 (14.22)	1.12 (28.45)	.26 (6.60)	.07 (1.78)
71-02-7055-XXXX	2.63 (66.80)	1.22 (30.99)	.70 (17.78)	1.22 (30.99)	.28 (7.11)	.08 (2.03)
71-02-7056-XXXX	3.15 (80.01)	1.42 (36.07)	.88 (22.35)	1.42 (36.07)	.33 (8.38)	.08 (2.03)
71-02-7057-XXXX	4.08 (103.63)	1.68 (42.67)	1.11 (28.19)	1.68 (42.67)	.39 (9.91)	.09 (2.29)
71-02-7058-XXXX	5.13 (130.30)	2.04 (51.82)	1.38 (35.05)	2.04 (51.82)	.62 (15.75)	.13 (3.30)
71-02-7059-XXXX	6.50 (165.10)	2.60 (66.04)	1.75 (44.45)	2.60 (66.04)	.80 (20.32)	.16 (4.06)

E	F	G	H	For Use With ...		
Recovered (±20%)	Recovered (±20%)	Recovered	Recovered	Mil-C-5015 Adapters	MIL-C-26482 Adapters	
					Solid	Rotating
.92 (23.37)	.40 (10.16)	.04 (1.02)	.12 (3.05)	—	—	8
1.27 (32.26)	.65 (16.51)	.04 (1.02)	.12 (3.05)	10SL, 12S	8	10
1.59 (40.39)	.70 (17.78)	.04 (1.02)	.12 (3.05)	14S	10	12, 14
1.73 (43.94)	.82 (20.83)	.04 (1.02)	.12 (3.05)	16S, 16, 18	12, 14	16, 18
2.47 (62.74)	.97 (24.64)	.065 (1.65)	.12 (3.05)	20, 22	16, 18	20
3.02 (76.71)	1.56 (39.62)	.065 (1.65)	.12 (3.05)	24, 28	20, 22, 24	22, 24
3.55 (90.17)	1.90 (48.26)	.08 (2.03)	.12 (3.05)	32, 36	—	—

NOTE: For non-lipped boots and alternate configurations, contact Chomerics.

\*XXXX will indicate adhesive/sealant option: if desired, last four digits shall be 1000; if not desired specify 0000. Allow 0.020" (0.51 mm) nominal adhesive thickness on the "Supplied" and "Recovered" diameters.



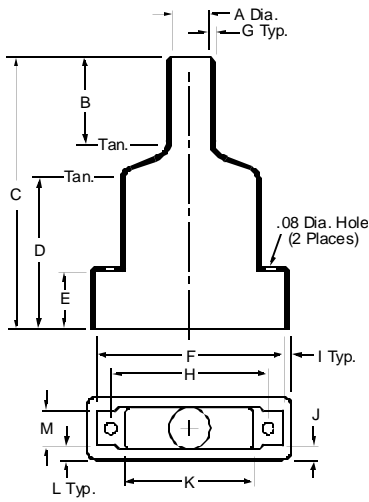
CHO-SHRINK 90° Polyolefin Boots With Lip (To Fit Shrink Boot Adapters)

Chomerics Part Number*	Nominal Dimensions, inches (mm in parentheses)					
	A Dia.		B Dia.		C	D
	Supplied (min)	Recovered (max)	Supplied (min)	Recovered (max)	Recovered (±10%)	Recovered (±20%)
71-02-7126-XXXX	.92 (23.37)	.41 (10.41)	.92 (23.37)	.22 (5.59)	.84 (21.34)	.05 (1.27)
71-02-7127-XXXX	1.12 (28.45)	.56 (14.22)	1.12 (28.45)	.26 (6.60)	1.33 (33.78)	.06 (1.52)
71-02-7128-XXXX	1.22 (30.99)	.70 (17.78)	1.22 (30.99)	.28 (7.11)	1.44 (36.58)	.07 (1.78)
71-02-7129-XXXX	1.42 (36.07)	.88 (22.35)	1.42 (36.07)	.33 (8.38)	1.72 (43.69)	.07 (1.78)
71-02-7130-XXXX	1.68 (42.67)	1.11 (28.19)	1.68 (42.67)	.39 (9.91)	2.11 (53.59)	.08 (2.03)
71-02-7131-XXXX	2.04 (51.82)	1.38 (35.05)	2.04 (51.82)	.62 (15.75)	3.07 (77.98)	.13 (3.30)
71-02-7132-XXXX	2.60 (66.04)	1.75 (44.45)	2.60 (66.04)	.80 (20.32)	3.84 (97.54)	.15 (3.81)

					For Use With ...		
E	F	G	H	I	MIL-C-5015 Adapters	MIL-C-26482 Adapters	
Recovered (±10%)	Recovered (±10%)	Recovered (±10%)	Recovered (±20%)	Recovered (±10%)		Solid	Rotating
.23 (5.84)	.65 (16.51)	.89 (22.61)	.04 (1.02)	.12 (3.05)	—	—	8
.65 (16.51)	.76 (19.30)	1.07 (27.18)	.04 (1.02)	.12 (3.05)	10SL, 12S	8	10
.50 (12.70)	.83 (21.08)	1.22 (30.99)	.04 (1.02)	.12 (3.05)	14S	10	12, 14
.57 (14.48)	.90 (22.86)	1.38 (35.05)	.04 (1.02)	.12 (3.05)	16S, 16, 18	12, 14	16, 18
.69 (17.53)	1.14 (28.96)	1.73 (43.94)	.065 (1.65)	.12 (3.05)	20, 22	16, 18	20
1.32 (33.53)	1.32 (33.53)	2.08 (52.83)	.065 (1.65)	.12 (3.05)	24, 28	20, 22, 24	22, 24
1.58 (40.13)	1.64 (41.66)	2.60 (66.04)	.08 (2.03)	.12 (3.05)	32, 36	—	—

NOTE: For non-lipped boots and alternate configurations, contact Chomerics.

\*XXXX will indicate adhesive/sealant option: if desired, last four digits shall be 1000; if not desired specify 0000. Allow 0.020" (0.51 mm) nominal adhesive thickness on the "Supplied" and "Recovered" diameters.



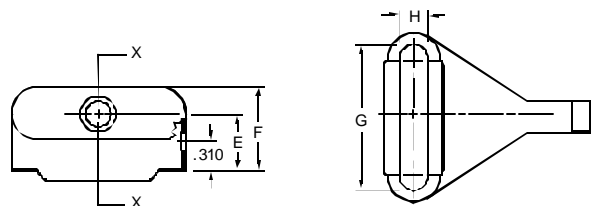
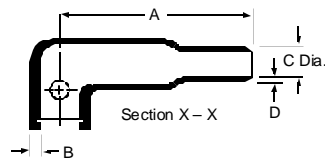
CHO-SHRINK Top Entry Rectangular Polyolefin Boot

Nominal Dimensions, inches (mm in parentheses)								
Chomerics	A Dia.		B	C	D	E	F	
Part Number *	Supplied	Recovere d	Recovere d	Recovere d	Recovere d	Recovere d	Supplied	Recovere d
	(min)	(max)	(±10%)	(±10%)	(±10%)	(±10%)	(min)	(max)
71-02-7518-XXXX	1.35 (34.29)	.27 (6.86)	.55 (13.97)	1.70 (43.18)	.95 (24.13)	.35 (8.89)	1.35 (34.29)	1.18 (29.97)

G	H	I	J	K	L	M		Fits Cinch Tykon Connectors
Recovered (±20%)	Recovere d (±10%)	Recovere d (±20%)	Recovere d (±10%)	Recovere d (±10%)	Recovere d (±20%)	Supplied (min)	Recovere d (max)	
.04 (1.02)	1.00 (25.40)	.05 (1.27)	.07 (1.78)	.80 (20.32)	.05 (1.27)	.35 (8.89)	.28 (7.11)	255-15-30-210

NOTE: Contact Chomerics for alternate configurations.

\*XXXX will indicate adhesive/ sealant option: if desired, last four digits shall be 1000; if not desired specify 0000. Allow 0.020" (0.51 mm) nominal adhesive thickness on the "Supplied" and "Recovered" diameters.









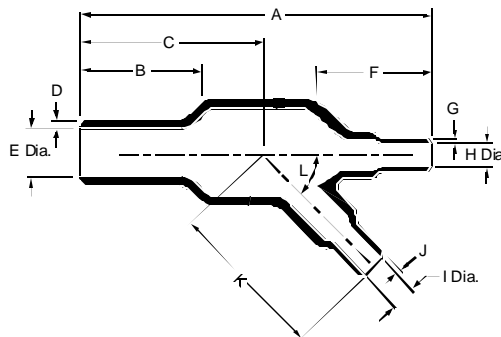


71-02-7202-XXXX	(92.46) 5.70 (144.78)	(41.15) 2.75 (69.85)	(31.75) 2.00 (50.80)	(26.92) 1.06 (26.92)	(12.70) .54 (13.72)	(2.54) .10 (2.54)
71-02-7232-XXXX	7.28 (184.91)	3.28 (83.31)	2.50 (63.50)	2.19 (55.63)	1.06 (26.92)	.18 (4.57)
71-02-7233-XXXX	8.01 (203.45)	3.76 (95.50)	2.60 (66.04)	2.19 (55.63)	1.06 (26.92)	.18 (4.57)

F	G	H	I Dia.		L
Recovered (±5°)	Recovered (±10%)	Recovered (±10%)	Supplied (min)	Recovered (max)	Recovered (±10%)
45	.92 (23.37)	.04 (1.02)	.26 (6.60)	.14 (3.56)	.77 (19.56)
45	1.41 (35.81)	.04 (1.02)	.26 (6.60)	.14 (3.56)	1.56 (39.62)
45	2.11 (53.59)	.06 (1.52)	.52 (13.21)	.29 (7.37)	2.00 (50.80)
45	2.83 (71.88)	.06 (1.52)	.52 (13.21)	.27 (6.86)	2.50 (63.50)
45	3.66 (92.96)	.10 (2.54)	1.06 (26.92)	.54 (13.72)	2.60 (66.04)

NOTE: Contact Chomerics for alternate configurations.

\*XXXX will indicate adhesive/ sealant option: if desired, last four digits shall be 1000; if not desired specify 0000. Allow 0.020" (0.51 mm) nominal adhesive thickness on the "Supplied" and "Recovered" diameters.



CHO-SHRINK 45° Polyolefin Transition

Chomerics Part Number*	Nominal Dimensions, inches (mm in parentheses)					
	A	B	C	D	E Dia.	
	Recovered (±10%)	Recovered (±10%)	Recovered (±10%)	Recovered (±20%)	Supplied (min)	Recovered (max)
71-02-7234-XXXX	1.76 (44.70)	.70 (17.78)	.90 (22.86)	.06 (1.52)	.52 (13.21)	.24 (6.10)
71-02-7226-XXXX	3.54 (89.92)	1.25 (31.75)	1.66 (42.16)	.10 (2.54)	1.06 (26.92)	.49 (12.45)
71-02-7235-XXXX	7.21 (183.13)	2.80 (71.12)	3.76 (95.50)	.18 (4.57)	2.19 (55.63)	1.00 (25.40)

F	G&J	H&I Dia.		K	L	
Recovered (±10%)	Recovered (±20%)	Supplied (min)	Recovered (max)	Recovered (±10%)	Supplied (±10°)	Recovered (±5°)
.60 (15.24)	.04 (1.02)	.26 (6.60)	.12 (3.05)	.84 (21.34)	15	45
1.22 (30.99)	.06 (1.52)	.52 (13.21)	.24 (6.10)	1.68 (42.67)	15	45
2.60 (66.04)	.10 (2.54)	1.06 (26.92)	.49 (12.45)	3.40 (86.36)	15	45



