CHO-SHIELD® 2000 SERIES

Corrosion-Resistant Conductive Coatings

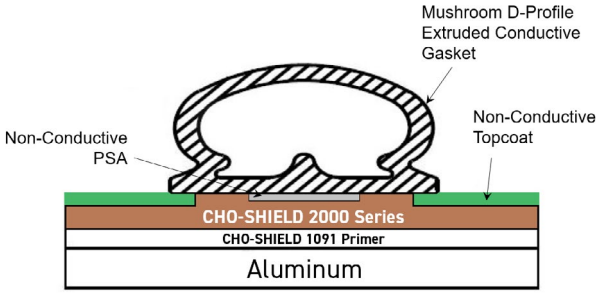
Parker Chomerics CHO-SHIELD® 2000 Series electrically conductive coatings provide a corrosion resistant conductive surface coating on aluminum or composite substrates. By reducing moisture penetration, CHO-SHIELD 2000 Series coatings offer corrosion protection for enclosure flanges which mate with particular EMI shielding gaskets.

These tough, urethane coatings offer a highly conductive interface which improves overall EMI shielding performance. When used as a coating on a composite or other non-conductive surface, they provide the conductivity necessary to achieve excellent shielding effectiveness while maintaining their electrical and mechanical stability in hostile environments.

CHO-SHIELD 2000-series coatings are three-part, copper-filled urethane coating systems which have been formulated with special additives and stabilizers to maintain their electrical stability even at elevated temperatures which prevent aluminum surfaces from corroding in high humidity and/or marine environments.

In addition, CHO-SHIELD 2001 and 2003 coatings contain soluble chromates to minimize the effects of galvanic corrosion of the aluminum substrate, even in the event of a coating scratch. The CHO-SHIELD 2002 coating, mainly intended for composite substrates or as a 2001 repair coating, is chromate-free. CHO-SHIELD 2003 coating is a dark pigmented version of CHO-SHIELD 2001 coating.

The CHO-SHIELD 2001 and 2003 coatings are designed to be used with CHO-SHIELD 1091 primer on chromate conversion coated (MIL-DTL-5541 Type I, Class 3) aluminum substrates. CHO-SHIELD 2002 is designed to be used with CHO-SHIELD 1091 primer on non-aluminum substrates such as MIL-P-18177 glass-filled epoxy composites and will typically deliver 0.1 ohm/square surface resistance when cured for 2 hours at room temperature 21°C (70°F) followed by 30 minutes at 121°C (250°F).







Product Features

- Three-component urethane system
- Exceptional mechanical properties -65°C to 85°C (-85°F to 185°F) including abrasion and scratch resistance.
- Excellent chemical resistance, including jet fuel (JP8), hydraulic fluids, and motor oil.
- Pre-measured kit allows easy mixing of components in one container.
- Corrosion-resistant copper filler
- Significantly more cost effective than silver-filled epoxies.
- Protects aluminum and graphite composite airframes from corrosion.
- No degradation of shielding effectiveness after 500 hours of salt fog.
- Good chemical/moisture barrier, hard abrasion resistant coating

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CHO-SHIELD® 2000 Series Product Information

Typical Properties	CHO-SHIELD® 2001	CHO-SHIELD® 2002	CHO-SHIELD® 2003	Test Method
Binder	Three-Part Urethane			N/A
Fillers	Stabilized Copper Soluble Chromate Salts	Stabilized Copper	Stabilized Copper Soluble Chromate Salts	N/A
Color	Light Brown	Light Brown	Dark Brown	N/A
Mix Ratio (by weight)	100 : 10.1 : 42.0	100 : 10.3 : 42.2	100 : 10.1 : 42.0	N/A
Mix Ratio (Touch-Up Version) (by weight)	100 : 10.0 : 16.1	100 : 10.3 : 16.8	100 : 10.1 : 16.5	N/A
Specific Gravity	1.6			ASTM D792
Cure Cycle	**Cure cycle option 1:** 2 hours at room temperature 21˚C (70˚F) followed by 0.5 hour at 121˚C (250˚F) **Cure cycle option 2:** 2 hours at room temperature 21˚C (70˚F) followed by 2 hours at 55˚C (130˚F) **Cure cycle option 3:** 7 days at room temperature 21˚C (70˚F)			N/A
Surface Resistance (max.) @ recommended thickness of 0.003 inches (0.0762 mm)	0.1 ohm/sq. (Cure 1) 0.1 ohm/sq. (Cure 2) 0.1 ohm/sq. (Cure 3)	Aluminum 0.1 ohm/sq. (Cure 1) 0.1 ohm/sq. (Cure 2) 0.1 ohm/sq. (Cure 3) --- G-10 Composite 0.1 ohm/sq. (Cure 1) 0.1 ohm/sq. (Cure 2) 0.35 ohm/sq. (Cure 3)	0.1 ohm/sq. (Cure 1) 0.1 ohm/sq. (Cure 2) 0.3 ohm/sq. (Cure 3)	CEPS-0002[3]
Pencil Hardness	4H (Cure 1); 6H (Cure 2); 5H (Cure 3)			ASTM D3363
Adhesion	5B			ASTM D3359
Surface Resistance after Salt Fog Exposure (max.) @ recommended thickness of .003 inches (3 mils) (.076 mm)	0.5 ohm/sq. (No substrate degradation after 500 hours)	Aluminum: 0.5 ohm/sq. (Minimal substrate degradation after 500 hours) --- G-10 Composite: 1.0 ohm/sq. (Minimal substrate degradation after 500 hours)	0.5 ohm/sq. (No substrate degradation after 500 hours)	ASTM B117, CEPS-0002[3]
Abrasion Resistance[1]	60 mg	60 mg	80 mg	ASTM D4060
Shielding Effectiveness[3] (10 MHz to 18 GHz) (Figure 2)	>80 dB[4]			CHO-TM-TP11[3]
JP8 Fluid Resistance[2] (max.) @ recommended thickness of 0.003 inches (3 mils) (.076 mm)	0.5 ohm/sq. (Cure 1); 0.5 ohm/sq. (Cure 2); 0.5 ohm/sq. (Cure 3)			CEPS-0002[3]
MIL-H-5606 Hydraulic Fluid Resistance (max.) @ recommended thickness of 0.003 inches (3 mils) (.076 mm)	0.1 ohm/sq. (Cure 1); 0.1 ohm/sq. (Cure 2); 0.1 ohm/sq. (Cure 3)			CEPS-0002[3]
Continuous Operating Temperature	-65˚C to +85˚C (-85˚F to +185˚F)			N/A
VOC	543 g/L	540 g/L	541 g/L	N/A
Working Life	2 hours			N/A
Tack Free Time	1 hour			ASTM D1650
Theoretical Coverage @ Recommended Thickness of 0.003 inch (3 mils) (.076 mm)	0.035 ft²/gram (3 mils) 0.0033 m²/gram (3 mils) 208 ft²/gallon (3 mils)	0.035 ft²/gram (3 mils) 0.0033 m²/gram (3 mils) 210 ft²/gallon (3 mils)	0.036 ft²/gram (3 mils) 0.0033 m²/gram (3 mils) 210 ft²/gallon (3 mils)	N/A
Shelf Life (from date of manufacture)	9 months			N/A
Storage Conditions	70˚F/21˚C +/- 9˚F/5˚C			N/A

Note: N/A – Not Applicable.
(6) Properties tested on 2024 T-3 aluminum with chromate conversion coating per MIL-DTL-5541, Type 1, Class 3, applied after 30 second alkaline etch, except where noted. Samples primed with CHO-SHIELD 1091.
[1] Taber Abrasion per ASTM D 4060. The weight of the sample coupons were recorded before and after 1000 cycles on the taber abrader with 500 gm CS-10 wheels
[2] Retested post immersion resistance after 6 days at room temperature followed by 80°C (176°F) for 2 hours
[3] Copies of CEPS-0002 and CHO-TM-TP11 and shielding effectiveness curves are available at parker.com

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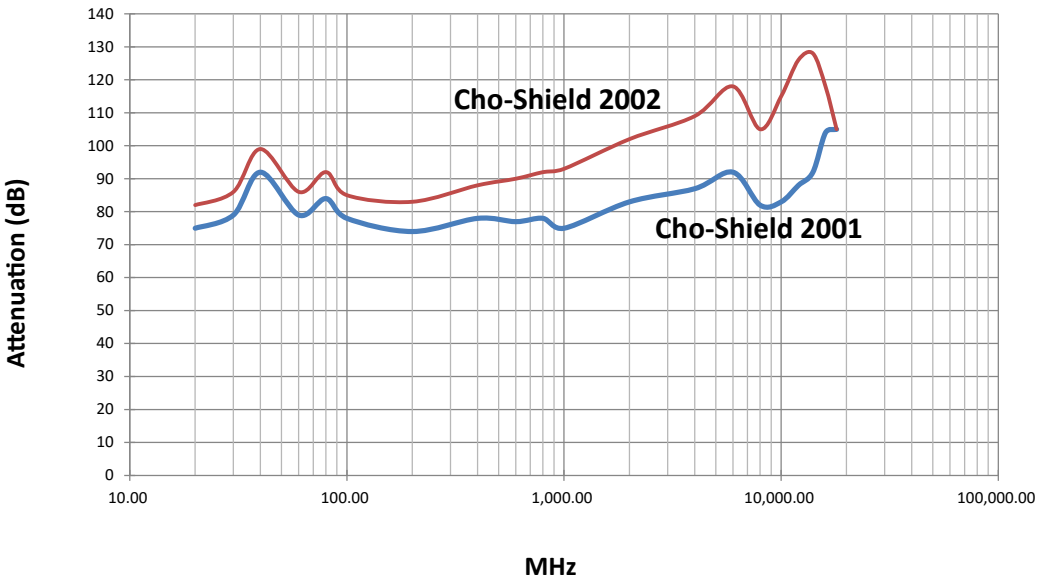
CHO-SHIELD® 2000 Series Shielding Effectiveness

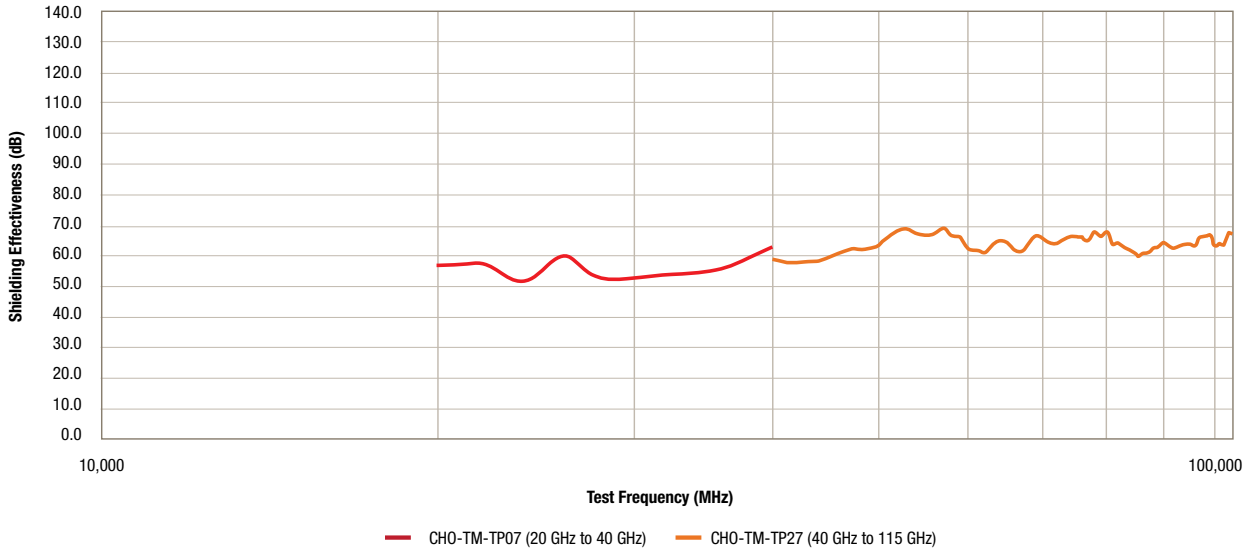
Figure 1 - Typical Shielding Effectiveness

Cho-Shield 2001 and 2002 Typical Shielding Effectiveness per CHO-TM-TP11



* CHO-SHIELD 2003 is a dark brown pigmented version of CHO-SHIELD 2001
Parker Chomerics Shielding Effectiveness Test Method CHO-TM-TP11 is available on parker.com

Figure 2 - CHO-SHIELD 2001 Typical Shielding Effectiveness per CHO-TM-TP07 and CHO-TM-TP27



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CHO-SHIELD® 2000 Series Shielding Effectiveness

Figure 3 - CHO-SHIELD 2002 Typical Shielding Effectiveness per CHO-TM-TP07 and CHO-TM-TP27

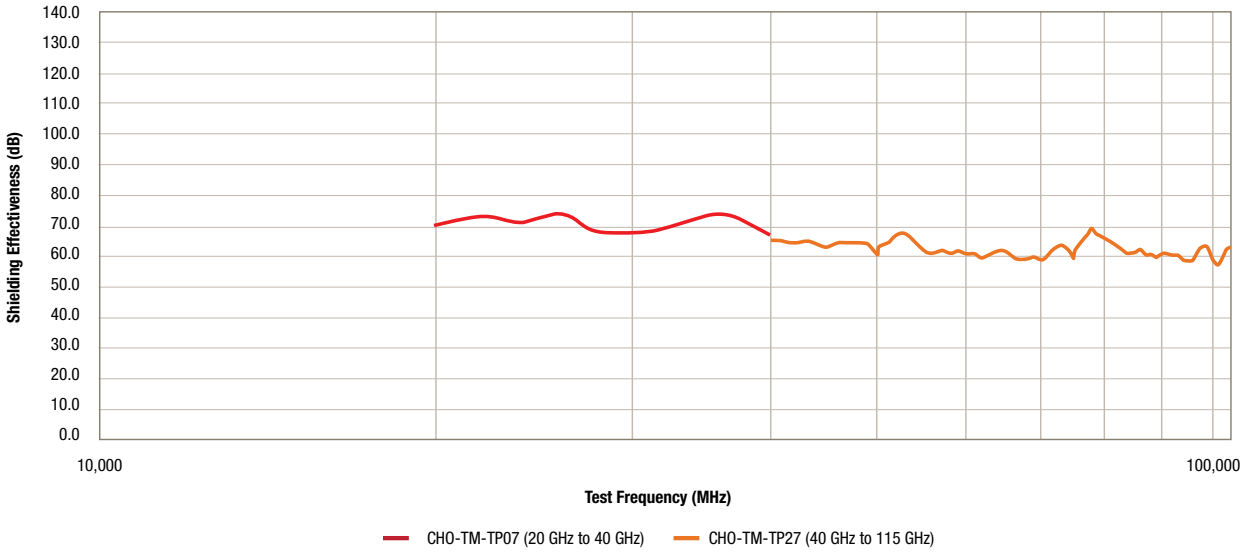
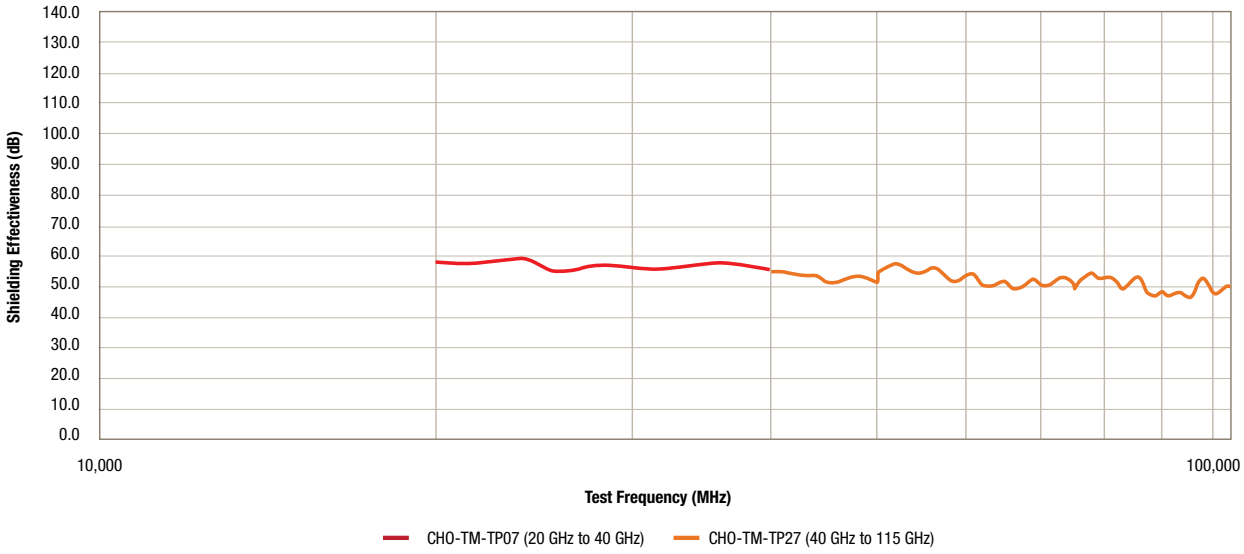


Figure 4 - CHO-SHIELD 2003 Typical Shielding Effectiveness per CHO-TM-TP07 and CHO-TM-TP27



A Note on Test Methods Used

Figure 1 illustrates traditional shielding effectiveness test data from 30 MHz to 18 GHz using the CHO-TM-TP11 test method. This method used a 26 inch (660.4 mm) square test sample size, mounted on a 24 inch square (609.6 mm) aperture on the shielded room wall.

Two new test methods are used for testing the frequency range from 20 GHz to 110 GHz. Test methods CHO-TM-TP07 (20 GHz to 40 GHz) and CHO-TM-TP27 (40 GHz to 115 GHz) were developed to be able to use the same test sample throughout the wide frequency range.

Figure 2 illustrates the new test data using a 5.25 inch diameter (133.4 mm) test sample size over the frequency range from 20 GHz to 110 GHz. This smaller test sample size is required to cover such a wide frequency range.

Further information on the testing can be found by downloading the referenced test methods, available from parker.com/chomerics, or upon request from Parker Chomerics Application Engineering.

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CHO-SHIELD® 2000 Series Application Information

Design Considerations

Flange design and surface preparation have significant impact on the corrosion resistance offered by CHO-SHIELD 2000-series coatings. All three coatings best adhere to MIL-DTL-5541, Type 1, Class 3 treated aluminum and most plastics and composites. Chomerics provides CHO-SHIELD 1091 primer for enhancing the adhesion of CHO-SHIELD 2000-series coatings on all substrates.

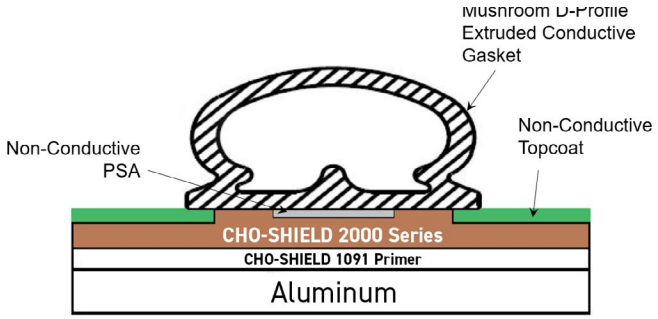
Parker Chomerics will also provide assistance with your design and material requirements.

Corrosion-Proof Flange Design with CHO-SEAL® 1298 Conductive Elastomer EMI Shielding Gaskets

The combination of the CHO-SHIELD 2000 series of conductive flange coatings and CHO-SEAL 1298 conductive elastomer gaskets can form a virtual corrosion-proof EMI sealing system for aluminum enclosures. CHO-SEAL 1298 is a fluorosilicone elastomer filled with passivated silver-plated aluminum filler. Figure 1 shows this application for an aluminum enclosure. First, the aluminum flange is typically treated with a MIL-DTL-5541, Type I, Class 3, hexavalent chromate treatment, or alternatively with Type II, Class 3, trivalent, chromate corrosion treatment. Mask the middle area of the aluminum flange (approximately half the gasket diameter width) where the CHO-SEAL 1298 conductive gasket will be attached. Apply CHO-SHIELD 1091 primer over the treated aluminum to ensure proper adhesion of the CHO-SHIELD 2000 Series coatings. After allowing the CHO-SHIELD 1091 to dry properly, apply the CHO-SHIELD 2000 series coating according to the instructions contained below in this document. The CHO-SHIELD 2000 coating is then masked while the non-conductive topcoat is applied to the aluminum enclosure. However, note that the topcoat must be overlapped onto the CHO-SHIELD coating as shown in Figure 2 to ensure that the CHO-SHIELD coating and aluminum interface is not exposed to moisture that could intrude under the coating. Note also, when choosing a topcoat, the maximum temperature for the CHO-SHIELD 2000 coatings is 85°C.

Application

Surface preparation has a significant impact on the corrosion resistance offered by the CHO-SHIELD 2000-series of coatings. CHO-SHIELD 1091 primer should be used to ensure good adhesion of CHO-SHIELD 2000-series coatings on all substrates. CHO-SHIELD 1091 primer is a one-component, air-drying system, which cures at ambient temperatures.*



Recommended Surface Preparation

1. **Clean the substrate**

   The substrate surface should be clean, dry and free of oils, release agents, dirt and lint. Clean surfaces to be painted with methyl ethyl ketone (MEK) for aluminum or isopropyl alcohol/ethanol for solvent sensitive substrates. Let the substrate air dry for 15 minutes.

2. **Apply CHO-SHIELD 1091 primer**

   Wet a lint-free cotton cloth with CHO-SHIELD 1091 primer.

   Apply primer to the surface in horizontal and vertical strokes. Keep the surface wet at all times. After the entire surface has been coated, air-dry at room temperature for 1 hour or at 88°C (190°F) for 30 minutes.

   Note: If primed surfaces are not coated within 4 hours of the primer application, repeat the cleaning and primer application procedures before coating. To eliminate the risk of an increase in surface resistance, only a light coating of the primer is recommended, typically less than one mil thick when cured.

Table 2: Primer Ordering Info

Product	Part Number	Unit Size
CHO-SHIELD 1091	50-00-1091-0000	4 fl. oz.
	50-01-1091-0000	8 fl. oz.

3. **Mix the material**

   Mix the CHO-SHIELD 2000 series coating: Combine Part A and Part C. Weigh the components if the entire kit is not to be used. Shake on a paint shaker for 3 minutes. Check the homogeneity of the mixture by feeling the sides and bottom of the container with a spatula to assure all the filler and resin are well dispersed.

   Note: If the coating mixture is not homogeneous, shake for an additional 3 minutes and check for non-dispersed material. DO NOT screen or filter the mixed coating.

   Add the Part B. Shake or mix for an additional 3 minutes.

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CHO-SHIELD® 2000 Series Application Information

* CHO-SHIELD 1091 is provided with selected kits of CHO-SHIELD 2003. It is not provided with any kits of CHO-SHIELD 2001 or 2002 and must be purchased separately. See Table 3 for details.

Wet Coating Painting System Options

Use a pressure pot (20 psi [138 kPa] typical) with large diameter, paddle-type agitator at low mixing speed to keep the metal fillers in uniform suspension.

Conventional spray equipment such as HVLP (High Volume, Low Pressure) or LVMP (Low Volume, Medium Pressure) all work well with CHO-SHIELD 2000 series coatings. Binks SD-2 with propeller agitator pressure pots may be used for spray application with approximately 20 to 50 psi (138 to 345 kPa) atomizing air. Use lowest pressure possible.

Re-circulation of the paint from the mixing pot through the spray gun and back via a pump delivery system is recommended for greater filler uniformity.

For large volume applications, a robotic spray system with an HVLP spray gun should be used to minimize material loss due to overspray and maximize paint transfer efficiency.

Siphon or gravity feed equipment can be used for small or prototype runs.

Spray Gun and Pressure Painting System Option

Use a standard HVLP spray gun with approximately 20 to 40 psi (138 to 276 kPa) atomizing air.

A fluid nozzle with a minimum orifice diameter of 0.040 inch (1.016 mm) is recommended.

To obtain maximum adhesion and conductivity, dry spraying should be avoided. Adjust the spray pressure to achieve a proper wet film when applying the conductive coating.

Nominal Dry Film Thickness

A nominal dry film thickness of between 0.003 inches (0.076 mm, 3 mils) and 0.005 inches (0.127 mm, 5 mils) is recommended to obtain typical shielding effectiveness from 80 MHz to 10 GHz and corrosion protection published by Chomerics.

Curing Conditions

The CHO-SHIELD 2000 Series coatings may be cured using one of the following cure schedules:

- **Cure cycle 1:** 2 hours at room temperature followed by 0.5 hour at 121°C (250°F)
- **Cure cycle 2:** 2 hours at room temperature followed by 2 hours at 55°C (130°F)
- **Cure cycle 3:** Room temperature for 7 days

To prevent blistering and possible adhesion issues, always allow the sprayed coating to dry a minimum of 2 hours at ambient conditions before using an elevated temperature cure.

For optimum corrosion resistance and electrical performance, Chomerics recommends curing the CHO-SHIELD 2000 Series coatings using cure cycle 1, 2 hours at room temperature and 0.5 hours at 121°C (250°F).

Clean-up

The spray system, including spray gun, mixing pot, and containers can be cleaned with MEK or Acetone (VOC exempt solvent). Masks can be powerwashed with Challenge 485S barrier coat.

Storage and Handling

CHO-SHIELD 2000 Series coatings should be stored at 70°F/21°C ± 9°F/5°C and have a 9 month shelf life from the date of manufacturing in the original sealed container. CHO-SHIELD 2000 Series coatings are flammable liquids. Please consult the material safety data sheet for proper handling procedures before use.

CHO-SHIELD® 2000 Series Ordering Information

Product	Weight (grams)	Packaging	Chomerics Part No.	Primer Included
CHO-SHIELD 2001*	250	3 component, 1/2 pint aluminum can kit	52-00-2001-0000	No
	250	3 component, 1/2 pint aluminum can "touch-up" kit**	52-00-2001-1000	No
	700	3 component, 1 pint aluminum can kit	52-01-2001-0000	No
	1378	3 component, 1 quart aluminum can kit	52-04-2001-0000	No
CHO-SHIELD 2002*	250	3 component, 1/2 pint aluminum can kit	52-00-2002-0000	No
	250	3 component, 1/2 pint aluminum can "touch-up" kit**	52-00-2002-1000	No
	700	3 component, 1 pint aluminum can kit	52-01-2002-0000	No
	1378	3 component, 1 quart aluminum can kit	52-04-2002-0000	No
CHO-SHIELD 2003*	250	3 component, 1/2 pint aluminum can kit	52-00-2003-0000	1091
	250	3 component, 1/2 pint aluminum can "touch-up" kit**	52-00-2003-1000	No
	524	3 component, 1 pint aluminum can kit	52-01-2003-0000	1091
	700	3 component, 1 quart aluminum can kit	52-04-2003-0000	1091
CHO-SHIELD 1091 Primer	95	4 fluid ounce glass bottle	50-00-1091-0000	N/A
	375	8 fluid ounce plastic bottle	50-01-1091-0000	N/A

* Requires the use of 1091 Primer.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.



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