

Description

The 838AR *Total Ground™ Carbon Conductive Coating* is a one-part durable acrylic lacquer pigmented with a highly conductive carbon powder. It utilizes a solvent based system with no heat cure necessary. The cured coating is smooth, hard, and abrasion resistant. It provides strong adhesion to plastics, good conductivity, excellent low frequency shielding, and strong corrosion resistance, even in marine environments.

Applications & Usages

Total Ground™ is an economical solution for grounding or RFI shielding applications. It may be used in applications such as these:

- Creating a grounded working surface
- Shielding control and pickup cavities on electric guitars and other electronic instruments
- Shielding metal detectors and other devices that malfunction in the presence of metal
- Other low frequency RFI shielding applications
- Acting as a conductive adhesive for electrostatic flocking
- Providing a conductive inner coating in picture tubes
- Acting as a resistor in prototype circuits
- Providing electrical conductivity to almost any surface

Benefits and Features

- **Cost effective conductive coating**
- **Provides >52 dB of RFI shielding at frequencies <1 MHz**
- **Volume resistivity of 0.33 Ω·cm**
- **Smooth, durable, and abrasion resistant**
- **Can be applied by spray or brush**
- **Available in aerosol format**
- **Available in convenient pen format**
- **Quick dry time, no heat cure required**
- **Mild solvent system**
- **Strong adhesion to acrylic, ABS, polycarbonate, and other injection molded plastics**
- **Excellent adhesion to wood, and ceramics**
- **Strong corrosion resistance, suitable for marine environments**
- **HAP Free; Does not contain toluene or xylene**

ENVIRONMENT
RoHS Compliant

Usage Parameters

<i>Properties</i>	<i>Value</i>
Recoat time (liquid) ^{a)}	3 min
Drying Time @25 °C [77 °F]	24 h
Drying Time @65 °C [149 °F]	30 min
Shelf Life	3 y
Theoretical HVLP Spray Coverage ^{b)}	$\leq 25\ 300\ \text{cm}^2/\text{L}$ $\leq 2.53\ \text{m}^2/\text{L}$ $\leq 14\ 800\ \text{in}^2/\text{gal}$ $\leq 103\ \text{ft}^2/\text{gal}$

a) Assumes let 2:1 let down with MG 4351 Thinner 1 Cleaner Solvent

b) Idealized estimate based on a coat thickness of 25 µm [1.0 mil] and 65% transfer efficiency

Temperature Ranges

<i>Properties</i>	<i>Value</i>
Constant Service Temperature	-40 to 120 °C [-40 to 248 °F]
Intermittent Temperature Limit	-50 to 125 °C [-58 to 257 °F]
Storage Temperature Limits ^{c)}	-5 to 40 °C [23 to 104 °F]

c) The product must stay within the storage temperature limits stated.

Principal Components

Name	CAS Number
Carbon Black	1333-86-4
Acrylic Resin	25608-33-7
Acetone	67-64-1

Properties of Cured 838AR

<i>Electric & Magnetic Properties</i>	<i>Method</i>	<i>Value</i>	
Volume Resistivity	Method 5011.5 in MIL-STD-883H	0.33 Ω·cm	3.1 S/cm
Surface Resistance		<i>Resistance</i> ^{a)}	<i>Conductance</i> ^{a)}
1 coat @0.97 mil	Square probe	170 Ω/sq	0.006 S
2 coats @1.7 mil	Square probe	60 Ω/sq	0.017 S
3 coats @2.3 mil	Square probe	50 Ω/sq	0.021 S
Magnetic Class		Diamagnetic (Non-magnetic)	
Relative Permeability		<1.0	
Shielding Attenuation for 51 µm [2.0 mil]	IEEE STD 299-1997		
>10 to 100 kHz	"	84 dB to 88 dB	
>100 kHz to 1 MHz	"	52 dB to 74 dB	
>1 MHz to 10 MHz	"	14 dB to 46 dB	
>10 MHz to 100 MHz	"	0 dB to 6 dB	
>100 MHz to 1 GHz	"	6 dB to 14 dB	
>1 GHz to 10 GHz	"	5 dB to 11 dB	
>10 GHz to 18 GHz	"	6 dB to 12 dB	

<i>Physical Properties</i>	<i>Method</i>	<i>Value</i>
Paint Type	—	Lacquer (Thermoplastic)
Color	Visual	Black
Abrasion Resistant	—	Yes
Blister Resistant	—	Yes
Peeling Resistant	—	Yes
Water Resistant	—	Yes
<i>Mechanical Properties</i>	<i>Method</i>	<i>Value</i>
Adhesion ^{b)}	ASTM D3359	5B
Pencil Hardness ^{b)}	ASTM D3363	H, hard
<i>Environmental & Ageing Study</i>	<i>Method</i>	<i>Value</i>
Salt Fog Test @35 °C [95 °F], 96 h ^{b)}	ASTM B117-2011	
Resistivity before	MG-ELEC-120	70 Ω/sq
Resistivity after	"	70 Ω/sq
% Conductivity after	"	100% = No detectible change
Cross-Hatch Adhesion	ASTM D3359-2009	5B
Cracking, unwashed area	ASTM D661-93	None
Visual Color, unwashed area	ASTM D1729-96	No change

- a) Surface resistance is given in Ω/sq and the corresponding conductance in Siemens (S or Ω⁻¹)
- b) Tested using HVLP spray gun application on acrylonitrile butadiene styrene (ABS) coupons

The coating surface resistance and attenuation are plotted in Figures 1 and 2.

Surface Resistance by Coating Thickness

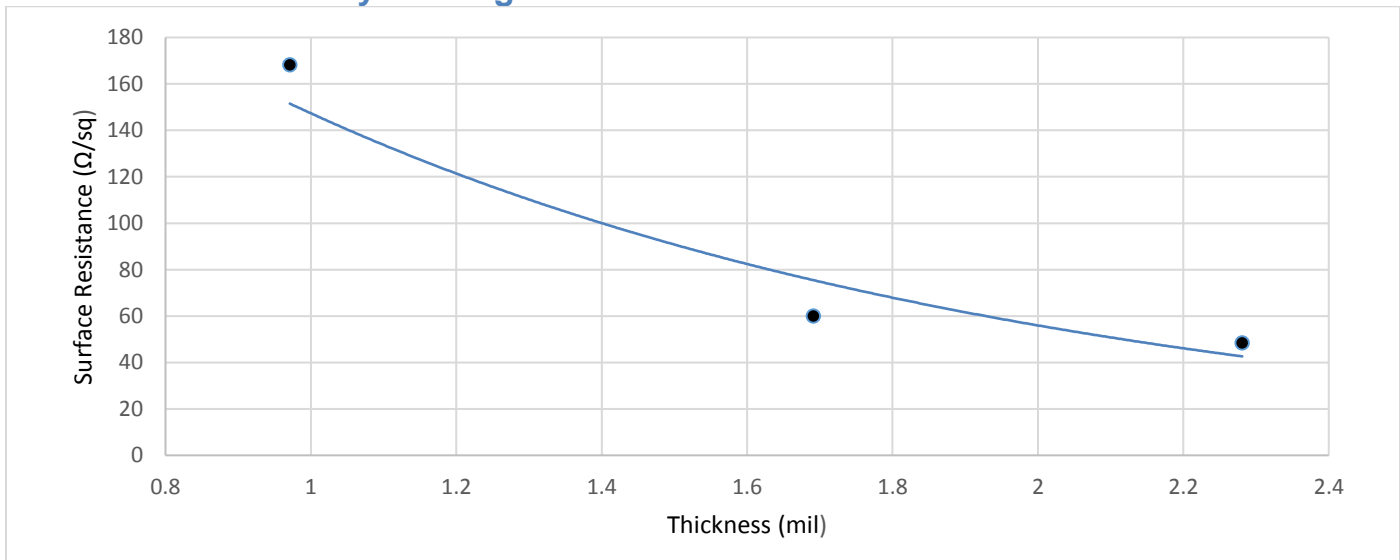


Figure 1. Carbon coating surface resistance at different thicknesses (the dots indicate typical successive coat thicknesses)

Shielding Attenuation

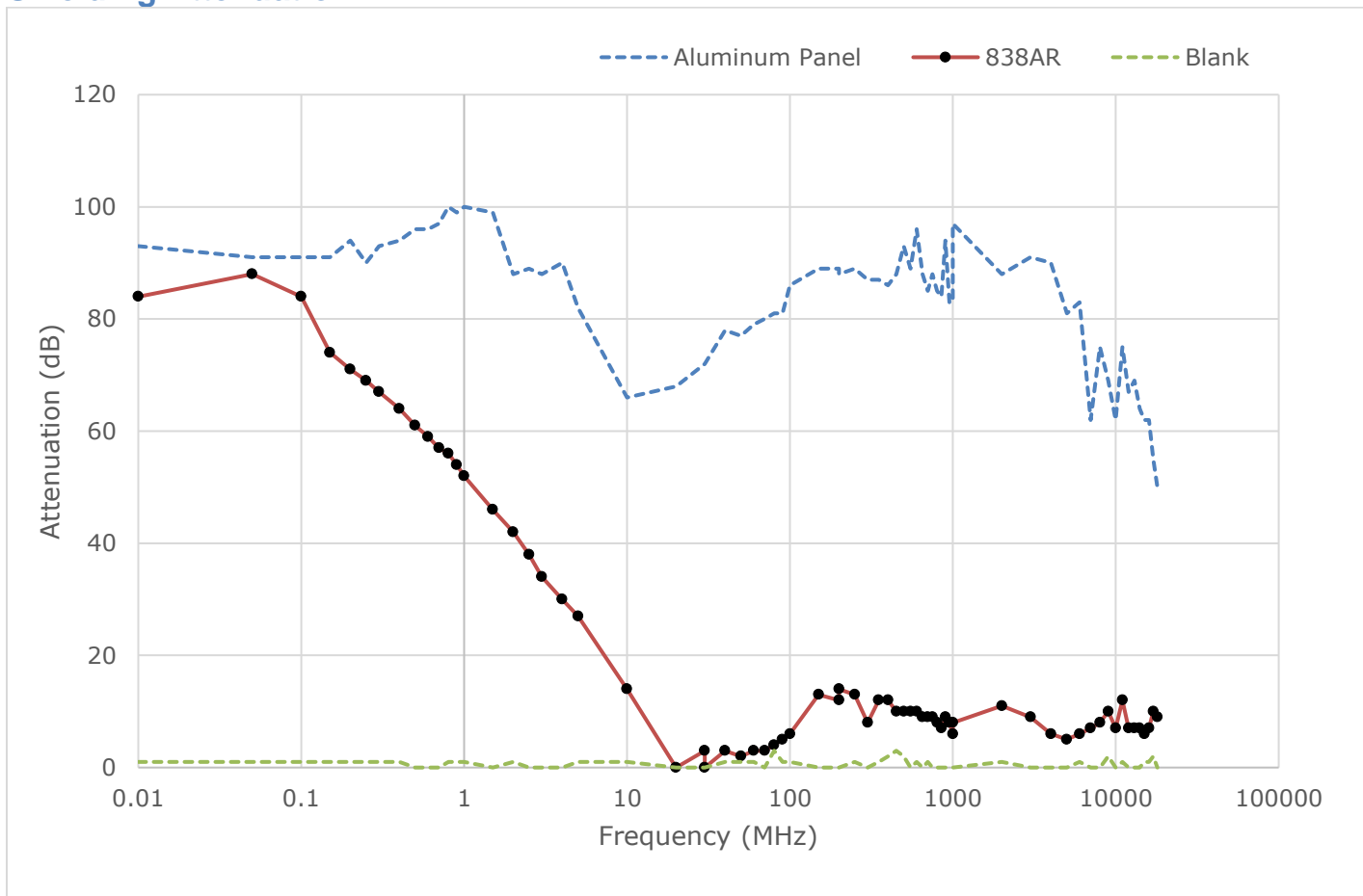


Figure 2. Attenuation of 838AR coating at different frequencies

Properties of Uncured 838AR

<i>Physical Properties</i>	<i>Mixture</i>
Color	Black
Density @25 °C [77 °F]	0.85 g/mL
Solids Percentage (wt/wt)	15%
Viscosity @25 °C [77 °F] ^{a)}	154 cP [180 mm ² /s]
Flash Point	-17 °C [1.4 °F]
Odor	Ketone-like

a) Brookfield viscometer at 100 RPM with spindle LV S61

Compatibility

Chemical—Carbon doesn't oxidize or deteriorate under a normal environment and conditions, including marine environments as seen by the salt spray test results (see page 2).

The thermoplastic acrylic resin is incompatible with common paint solvents like toluene, xylene, acetone, and MEK. Further, it will not withstand chronic exposures to engine oils, fuels and other similar hydrocarbons. While this makes the coating unsuitable for solvent rich environments, it does offer great repair and rework characteristics.

Adhesion—The 838AR coating adheres to most materials used to house printed circuit assemblies; however, it is not compatible with contaminants like water, oil, and greasy flux residues that may affect adhesion. If contamination is present, clean the surface to be coated first.

838AR Adherence Compatibility

Substrate	Note
Acrylonitrile Butadiene Styrene (ABS)	Chemically etches ^{a)} and adheres well to this substrate.
Polybutylene Terephthalate (PBT)	"
Polycarbonate	"
Polyvinyl Acetate (PVA)	"
Acrylics or Acrylic Paints	Adheres well to clean surface
Lead, Tin	"
Epoxy, FR4 substrate	"
Polyurethane	Adheres well to clean surface for most urethane types
Wood	Adheres well with surface preparation

a) Etching is similar to sanding, except that it also softens the surface helping to meld the paint to the plastic for superior adhesion.

ATTENTION! Do not use on thin plastics or on plastics where you want to keep original surface intact. The 838AR spray contains a controlled amount of solvents designed to chemically etch plastic surfaces to help adhesion by melding the acrylic coating into the plastic substrate. This prevents flaking or peeling. Using the 4351-1L thinner lessens the etching effects for chemically sensitive substrates.

Storage

Store between -5 and 40 °C [23 and 104 °F] in a dry area.

Health, Safety, and Environmental Awareness

Please see the 838AR-Liquid **Safety Data Sheet** (SDS) for greater details on transportation, storage, handling and other security guidelines.

Environmental Impact: The VOC (Volatile Organic Compound) content is 47% (404 g/L) by EPA and WHMIS standards.

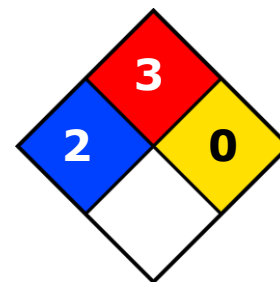
This product meets the European Directive 2011/65/EU Annex II (ROHS); recasting 2002/95/EC.

Health and Safety: The solvents in 838AR can ignite if exposed to flames or sparks and can cause respiratory track irritation. If ignited, then flame flash back is possible. Use in well-ventilated area. Wear safety glasses or goggles and disposable gloves to avoid exposures.

HMIS® RATING

HEALTH:	* 2
FLAMMABILITY:	3
PHYSICAL HAZARD:	0
PERSONAL PROTECTION:	

NFPA® 704 CODES



Approximate HMIS and NFPA Risk Ratings Legend:

0 (Low or none); 1 (Slight); 2 (Moderate); 3 (Serious); 4 (Severe)

Application Instructions

The 838AR *Total Ground™ Carbon Conductive Coating* can be easily applied by the paintbrush, spray gun, or dip method. We recommend a final dry film thickness of at least 1.0 mil [25 µm].

Material & Equipment

- Mixing spatula
- Clean paint brush **OR** HVLP spray gun **OR** dip tank systems
- Liquid agitator, agitated pot, or recirculation system
- Thinner/solvent
- Personal protection equipment (See 838AR-Liquid SDS)

Paint Dilution Ratios

For brush applications, the MG conductive paints are ready-to-use without dilution. You may however dilute it to help achieve better coat leveling and easier brush application.

For spray application, we recommend a 2:1 paint-to-thinner ratio as a starting point. To achieve the best results, adjust this dilution ratio based on the equipment and operator's preferences. The recommended thinner is the MG 4351 Thinner 1.

Surface Preparation

Clean oil, dust, water, solvents, and other contaminants and let the surface dry fully.

Spray Gun Application Instructions

Read the spray procedure fully and make necessary adjustments to get the required coat thickness for your needs. For a 2:1 dilution, one spray coat typically results in a dry film thickness of roughly 1 mil [25 µm].

Spray Equipment

Use a HVLP (high-volume, low pressure) using the initial settings described in the following table. Adjust these settings and recommendations as required.

Initial Setting Recommendations

Air Cap	#3 HVLP		
Pressure	<i>Inlet</i> 23 psi	<i>Air flow</i> 13.5 SCFM ^{a)}	<i>Air cap</i> 10 psi
Fluid Tip	1.3 mm [0.051"]	1.5 mm [0.059"] ^{b)}	

Note: These recommendations are based on a generic paint gun and may differ by brands. Please consult your spray gun manufacturer's guide.

a) SCFM = standard cubic foot per minute

b) If no or reduced let down is performed, this may be a better tip choice.

To apply the coating

1. Mix the paint thoroughly with mechanized paint shaker, paint mixer, or spatula.
2. Dilute by a **2:1** (Paint:Thinner) ratio or another ratio of your choice.
3. Make a test spray. Adjust the spray settings for best flow and spray quality, and establish an appropriate distance to avoid paint runs. A distance between 23 to 30 cm (9 to 12 in) is recommended.
4. Spray a thin and even coat onto a vertical surface to be coated. For best results, start your movement off-surface, press the trigger, and only release off-surface at the end of the stroke. Use a uniform movement of the spray gun parallel to the surface.
5. Wait 3 to 5 minutes and spray another coat. The delay avoids trapping solvent between coats.
6. Apply additional coats until desired thickness is achieved. (Go to Step 3).
7. Let dry for 5 minutes (flash off time) at room temperature.

NOTE: Ideally, your spray gun will be equipped with liquid agitation system. If not, swirling the paint gun container slightly in between spray applications slows settling.

ATTENTION! Spraying overly thick coats may cause paint runs and hamper solvent evaporation. Prefer the application of many thin mist coats rather than fewer thicker wet coats.

To cure at Room temperature

- Let air dry 24 hours

To accelerate cure by heat

- After flash off, put in oven or under heat lamp at 65 °C for 30 min.

NOTE: Coats that are very thick require more time to dry. Heat curing ensures optimal performance.

ATTENTION! If heat curing, do not exceed 65 °C as this may cause surface defects due to solvents evaporating off too quickly.

Packaging and Supporting Products

<i>Cat. No.</i>	<i>Packaging</i>	<i>Net Volume</i>		<i>Net Weight</i>		<i>Packaging Weight</i>	
838AR-15ML	Jar	12 mL	0.4 fl oz	10.2 g	0.36 oz	0.07 kg	0.15 lb
838AR-900ML	Can	850 mL	1.79 pt	725 g	1.59 lb	1.10 kg	2.43 lb
838AR-3.78L	Can	3.60 L	3.8 qt	3.07 kg	6.77 lb	3.86 kg	8.51 lb
838AR-340G	Aerosol	360 mL	12.1 fl oz	340 g	12 oz	TBD	TBD
838AR-P	Pen	5 mL	0.16 fl oz	4.21 g	0.14 oz	0.03 kg	0.06 lb

Note: TBD = To Be Determined

Thinners & Conductive Coating Removers

- *Thinner:* Cat. No. 435-1L, 435-4L
- *Thinner 1:* Cat. No. 4351-1L, 4351-4L



838AR Technical Data Sheet

Total Ground™ Carbon Conductive Coating

ISO 9001:2008 Registered Quality System. Burlington, Ontario, CANADA SAI Global File: 004008

838AR-Liquid

Technical Support

Please contact us regarding any questions, suggestions for improvements, or problems with this product. Application notes, instructions and FAQs are located at www.mgchemicals.com.

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