

## Description

The 838AR-P *Carbon Conductive Pen* easily draws and repair conductive traces. It dispenses a conductive paint made of durable acrylic lacquer that is pigmented with conductive carbon powders. The cured traces are durable and corrosion resistant.

This pen works best on smooth, flat, hard surfaces. The valve-tip opens when pressed against the drawing surface, and the flow is controlled by squeezing the barrel.

## Applications & Usages

Use this pen for drawing or repairing conductive traces where high conductivity is not required.

It is used for repairing damaged traces on keyboards, game controllers, or remote controls. Repaired devices may be returned to service in only 10 minutes.

Also, it is used to create conductive traces on a variety of surfaces for prototyping, hobbies, or maker projects. It is good for making small connections in or between circuits, such as jumpers, through-holes, bridges, and links. It is great for drawing resistors and it can be used to increase the surface area of contacts by painting the area around them.

For applications requiring lower resistance, use 841AR-P Nickel Conductive Pen or 842AR-P Silver Conductive Pen.

## Benefits and Features

- **Volume resistivity: 0.46  $\Omega \cdot \text{cm}$**
- **Creates durable, reliable, and conductive connections**
- **Typical trace width: 1.0 mm**
- **Dries in minutes at room temperature**
- **Adheres to plastics, epoxy, copper, aluminum, ceramics, wood, and most electronic substrates**
- **Adheres to ABS, PLA, and other 3D printed plastics**
- **Superior corrosion resistance**
- **Toluene and xylene free**
- **Cost effective**

**ENVIRONMENT**  
RoHS Compliant

**ATTENTION!** Shake rigorously before use. For best results hold pen at angle, depress pen tip against surface, and draw pen across surface while gently squeezing middle.

## Usage Parameters

<i>Properties</i>	<i>Value</i>
Handling Time	10 min
Drying Time @25 °C [77 °F]	24 h
Drying Time @65 °C [149 °F]	30 min
Shelf Life	2 y
Typical Trace Width	1.0 mm
Theoretical Pen Coverage <sup>a)</sup>	≤71 cm <sup>2</sup> ≤11 in <sup>2</sup>

a) Idealized estimate based on a coat thickness of 25 μm [1.0 mil] and 100% 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 <sup>b)</sup>	-5 to 40 °C [23 to 104 °F]

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

## Principal Components

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

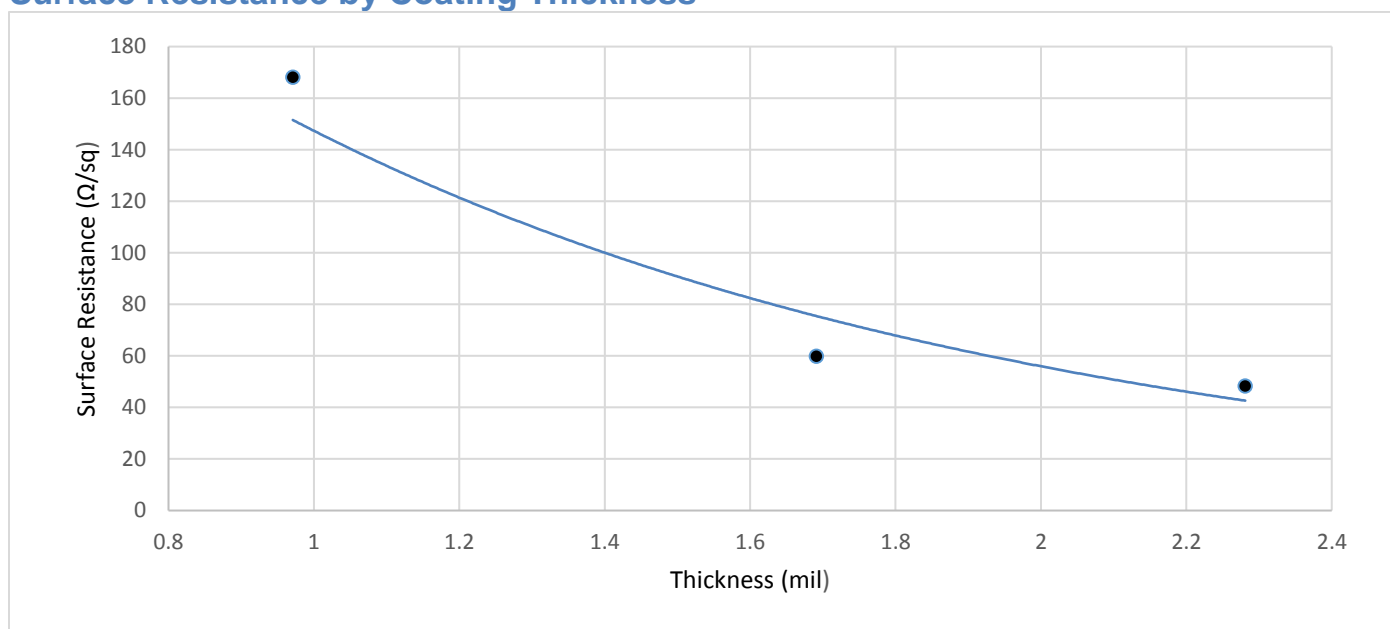
## Properties of Cured 838AR-P <sup>a)</sup>

<i>Electric &amp; Magnetic Properties</i>	<i>Method</i>	<i>Value</i>
Volume Resistivity	Method 5011.5 in MIL-STD-883H	0.46 Ω·cm      2.2 S/cm
Surface Resistance		<i>Resistance</i> <sup>b)</sup> <i>Conductance</i> <sup>b)</sup>
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
<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 <sup>c)</sup>	ASTM D3359	5B
Pencil Hardness <sup>c)</sup>	ASTM D3363	H, Hard

- a) Values based on liquid format. Pen format values may vary slightly.  
 b) The units are given in  $\Omega$ /sq and the corresponding conductance in Siemens (S or  $\Omega^{-1}$ ).  
 c) Tested on acrylonitrile butadiene styrene (ABS) material

## Surface Resistance by Coating Thickness



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

## Properties of Uncured 838AR-P

<i>Physical Property</i>	<i>Mixture</i>
Color	Black
Density @25 °C [77 °F]	0.84 g/mL
Solids Percentage (wt/wt) <sup>a)</sup>	15%
Viscosity @25 °C [77 °F] <sup>b)</sup>	319 cP [368 mm <sup>2</sup> /s]
Flash Point	-17 °C [1.4 °F]
Odor	Ketone-like

- a) Percentage for liquid only (without propellant)  
 b) Brookfield viscometer at 100 RPM with spindle LV S63



ISO 9001 Registered Quality System.  
Burlington, Ontario, Canada QMI File # 004008

# Carbon Conductive Pen 838AR-P Technical Data Sheet

838AR-Pen

## 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 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-P 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-P Adherence Compatibility

Substrate	Note
Acrylonitrile Butadiene Styrene (ABS)	Chemically etches <sup>a)</sup> and adheres well to this substrate.
Polybutylene Terephthalate (PBT)	"
Polycarbonate	"
Polyvinyl Acetate (PVA)	"
Acrylics or Acrylic Paints	Adheres well to clean surface
Copper, 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-P 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 dry area. Store pen with the tip up after use.

## Health, Safety, and Environmental Awareness

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

**Environmental Impact:** The VOC (Volatile Organic Compound) content is 43% (370 g/L) by EPA and WHMIS standards.

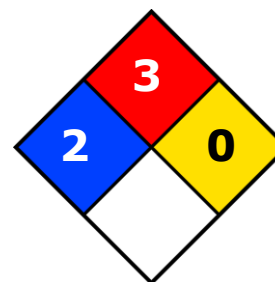
This product meets the European Directive 2011/65/EU Annex II (ROHS); recasting 2002/95/EC.

**Health and Safety:** The solvents in 838AR-P 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

<b>HEALTH:</b>	* <b>2</b>
<b>FLAMMABILITY:</b>	<b>3</b>
<b>PHYSICAL HAZARD:</b>	<b>0</b>
<b>PERSONAL PROTECTION:</b>	

## NFPA® 704 CODES



*Approximate HMIS and NFPA Risk Ratings Legend:*

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

## Pen Application Instructions

Follow the procedure below for best results.

**ATTENTION!** DO NOT apply a total coating thickness of >2.0 mil [ $>51 \mu\text{m}$ ]. This will cause coating to crack.

### To apply the liquid pen

1. Ensure that the surface to be coated is clean and oil-free.
2. Shake pen vigorously until the ball moves freely inside
3. Hold pen at angle and depress tip against surface
4. Draw pen across surface while gently squeezing barrel
5. Let dry 10 minutes before handling
6. For optimal conductivity, let stand 24 hours or heat cure at 65 °C for 30 minutes
7. Replace cap and store tip up after use

### 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.

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



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838AR-Pen

## Packaging and Supporting Products

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

Note: TBD = To Be Determined

## Thinners & Conductive Coating Removers

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

## Technical Support

Contact us regarding any questions, improvement suggestions, or problems with this product. Application notes, instructions, and FAQs are located at [www.mgchemicals.com](http://www.mgchemicals.com).

Email: [support@mgchemicals.com](mailto:support@mgchemicals.com)

Phone: +(1) 800-340-0772 (Canada, Mexico & USA)

+ (1) 905-331-1396 (International)

Fax: +(1) 905-331-2862 or +(1) 800-340-0773

Mailing address: **Manufacturing & Support**  
1210 Corporate Drive  
Burlington, Ontario, Canada  
L7L 5R6

**Head Office**  
9347-193rd Street  
Surrey, British Columbia, Canada  
V4N 4E7

## Warranty

*M.G. Chemicals Ltd.* warranties this product for 12 months from the date of purchase by the end user. *M.G. Chemicals Ltd.* makes no claims as to shelf life of this product for the warranty. The liability of *M.G. Chemicals Ltd.* whether based on its warranty, contracts, or otherwise shall in no case include incidental or consequential damage.

## Disclaimer

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