

METRIC

A-A-56025  
20 January 1993

## COMMERCIAL ITEM DESCRIPTION

## PASTE, CONDUCTIVE

The General Services Administration has authorized the use of this Commercial Item Description.

Abstract. This commercial item description covers three types of conductive coatings or paste used as a thick film screen printable conductor.

Salient characteristics. The material described herein shall meet the requirements shown in table I, and shall satisfy a storage stability requirement of not less than six months when stored in the original, unopened container at 20° to 25° Celsius (C). The material is a mixed bonded, high conductivity gold cermet material, in the form of a thixotropic paste, for use on alumina. It shall exhibit excellent adhesion. The material is designed to be printed with a stencil and shall not be used with a wire mesh screen. Workmanship of the material shall be such as to ensure a homogeneous compound free of foreign materials.

Contractor certification. The contractor shall certify and maintain substantiating evidence that the product offered meets the salient characteristics of this Commercial Item Description, and that the product conforms to the producer's own drawings, specifications, standards, and quality assurance practices. The government reserves the right to require proof of such conformance prior to first delivery and thereafter as may be otherwise provided for under the provisions of the contract.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data which may improve this document should be sent to: Commander, U.S. Army Missile Command, ATTN: AMSMI-RD-SE-TD-ST, Redstone Arsenal, AL 35898-5270.

AMSC N/A  
DISTRIBUTION STATEMENT A.  
distribution is unlimited.

FSC 8030  
Approved for public release;

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TABLE I. Material properties.

Property	Type I	Requirement Type II	Type III
	Viscosity @ 10 RPM Pascal second (Pa.s) Solids, % Fineness of grind, microns 1st scratch or streak 4th scratch or streak 50% point Scratch or streak joining Printability smear or shift Resistivity, milliohms/square @ 10 microns @ 12.5 microns @ 20 microns Adherence, newtons	245 to 325 87.5 to 88.5 ---- maximum 16 maximum 6 maximum ---- no voids, blur, smear or shift 5.0 maximum ---- ---- 16 minimum	250 to 300 86.0 to 89.0 23 on 4 streaks maximum ---- ---- 18 maximum no voids, blur smear or shift 30 maximum ----

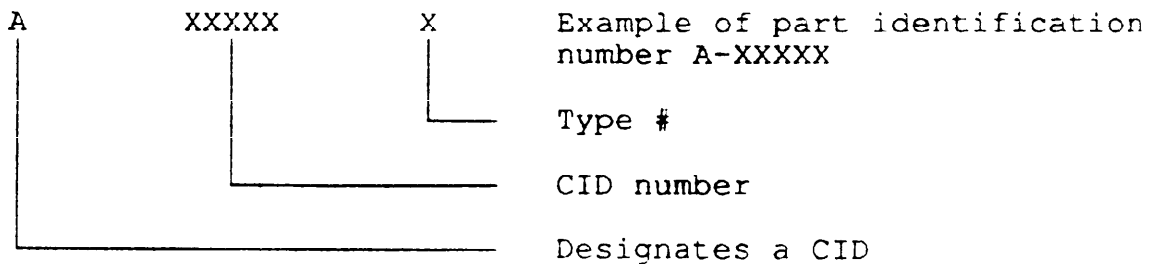
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Metric products. Products manufactured to metric dimensions will be considered on an equal basis with those manufactured using inch-pound units, provided they fall within specified tolerances using conversion tables contained in the latest revision of FED-STD-376, and all other requirements of this Commercial Item Description are met. If a product is manufactured to metric dimensions and those dimensions exceed the tolerances specified in the inch/pound units, a request should be made to the contracting officer to determine if the product is acceptable. The contracting officer has the option of accepting or rejecting the product.

Regulatory requirements. The offeror/contractor is encouraged to use recovered materials IAW Public Law 94-580 to the maximum extent practical.

Preservation, packaging, packing, labeling, and marking. The preservation, packaging, packing, labeling, and marking shall be as specified in the contractor or order.

CID-based part identification number. The following part identification number procedure is for government purposes and does not constitute a requirement for the contractor.

NOTES:

A. Types. The purchaser should specify the type material desired in the contract or purchase order. The conductive paste shall be of the following types, based on resistivity and viscosity:

- |          |   |   |
|----------|---|---|
| Type I   | - | Low electrical resistivity, low viscosity   |
| Type II  | - | High electrical resistivity, low viscosity  |
| Type III | - | Low electrical resistivity, high viscosity. |

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B. Test methods.

1. Visual examination and inspection. The item or material shall be visually examined without magnification.

2. Storage stability. A sample quantity of the material in an original, unopened package shall be stored under the conditions specified. At the end of the storage period, the material shall meet all requirements specified. The supplier's certifications of compliance to the storage stability requirements may be accepted during the storage period.

3. Viscosity.

a. Type I. This method covers the measurement of the apparent viscosity of a shear-rate dependent material in small quantities.

(1) Apparatus. A Brookfield Model HB viscometer with Small Sample Adapter SC4-14/6 (Utility Cup and Spindle), or equivalent, shall be used. A precision temperature measuring device, capable of measuring to the nearest 0.2°C, shall be used.

(2) Conditioning. The material shall not be tested until 24 hours or longer have elapsed after completion of manufacturing. Condition the Small Sample Adapter to a temperature of 24.8° to 25.2°C in a water bath. Load the sample cup with well mixed material. Slowly immerse the spindle into the material and ensure that no air is trapped under or around it. Attach the spindle to the viscometer and adjust material level to the top of the cup. Allow five to ten minutes for the material to reach a constant temperature.

(3) Procedure. Set the speed control to 10 revolutions per minute (RPM). Start the motor of the viscometer and observe the viscometer reading at the sixth revolution of the spindle. Calculate the viscosity in Pascal seconds by multiplying the scale reading by the viscometer calibration factor.

b. Type II and III. This method covers the measurement of the apparent viscosity of a shear-rate dependent material.

(1) Apparatus. A Brookfield viscometer, Model RVT with spindle ABZ, or equivalent, shall be used. A precision temperature measuring device, capable of measuring to the nearest 0.1°C, shall be used.

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(2) Conditioning. Stir material slowly for at least 2 minutes. Condition the material to a temperature between 25.0° and 26.0°C. Place the material under the viscometer and lower the viscometer until the middle of spindle indent mark is immersed.

(3) Procedure. Start the motor, set the speed control to 1 RPM, run for one minute and observe the viscometer reading. Then, start the motor, set the speed control to 10 RPM, run for 60 to 70 seconds and observe the viscometer reading. Calculate the viscosity in Pascal seconds by multiplying the scale reading at 10 RPM by the viscometer calibration factor.

4. Solids.

a. Type I. Weigh a crucible to the nearest 0.1 milligram (W1). Thoroughly mix material and add 1.5 to 2.0 grams to the crucible. Weigh to the nearest 0.1 milligram (W2). Ignite at not less than 750°C in a box furnace for at least 20 minutes. Remove crucible, cool and weigh to the nearest 0.1 milligram (W3). Calculate solids as follows:

$$\% \text{ Solids} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

b. Type II and III. Weigh an alumina substrate to the nearest 0.1 milligram (W1). Thoroughly stir material and spread 0.03 to 0.10 gram on the substrate. Weigh to the nearest 0.1 milligram (W2). Dry at 48.8° to 54.4°C for at least 15 minutes. Fire at 845° to 855°C for at least 10 minutes. Cool and weigh to the nearest 0.1 milligram (W3). Calculate solids.

5. Fineness of grind.

a. Type I. Measure fineness of grind in accordance with ASTM D 1210 and the following exceptions:

- 1) Gage path may exceed 12.5 centimeters length.
- 2) Gage path may be 2.5 centimeters wide.
- 3) Gage path may be 25 microns to zero depth.
- 4) Scraper length shall exceed groove width(s).
- 5) Draw the material down and, within 10 seconds, observe and record the point where the fourth continuous scratch is initiated in the material.
- 6) Draw the material down and, within 10 seconds, observe and record the point where 50% of the material in the path width is scratched away.

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b. Type II and III. Thin Type III material with 1% to 3% of a liquid recommended by the supplier. Measure fineness of grind in accordance with ASTM D 1210 and the following exceptions:

- 1) Gage path may be 25 microns to zero depth.
- 2) Scraper length shall exceed groove width(s).
- 3) Draw the material down, observe and record the point where the first continuous streak is initiated in the material.
- 4) Draw the material down, observe and record the point where the streaks appear to join together.

6. Test specimen preparation.

a. Type I.

(1) Screen printing. Screen print the material on a not less than 96% alumina substrate in accordance with the following parameters:

- |                          |                                  |
|--------------------------|----------------------------------|
| a.) Pattern:             | Any configuration of<br>Table II |
| b.) Screen mesh:         | 325                              |
| c.) Emulsion thickness:  | 0.7 to 1.0 mils                  |
| d.) Wet print thickness: | 32 to 44 microns                 |

(2) Drying. Dry the specimen in a vented oven at 145° to 155°C for not less than 15 minutes.

(3) Firing. Fire the specimen in a belt furnace at a peak temperature of 850° to 860°C for 8 to 12 minutes. The fired print thickness shall be 9 to 13 microns.

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TABLE II. Pattern features.

1. Trace:	Not less than 160 squares
2. Pads:	Not less than 2 millimeters square, not less than 4 pads
3. Lines:	Not less than 3, 5 mil width, 5 mil separation

b. Type II.

(1) Screen printing. Screen print the material on a not less than 96% alumina substrate in accordance with the following parameters:

- |                         |   |
|-------------------------|---|
| a.) Pattern:            | Any configuration of trace<br>and pads per Table II |
| b.) Screen mesh:        | 325   |
| c.) Emulsion thickness: | 12 to 50 microns.                                   |

(2) Drying. Dry the specimen in a vented drying oven at 120° to 130°C for 10 to 15 minutes.

(3) Firing. Fire the specimen in a belt furnace at a temperature ascent/descent rate of 60° to 100°C per minute and a peak temperature of 845° to 855°C for 10 to 12 minutes. The fired print thickness shall be 15 to 25 microns.

c. Type III.

(1) Screen printing. Thin the material with 1% to 3% of a liquid recommended by the supplier. Screen print the material on a not less than 96% alumina substrate in accordance with the following parameters:

- |                         |   |
|-------------------------|---|
| a.) Pattern:            | Any configuration of trace<br>and pads per Table II |
| b.) Screen mesh:        | 325   |
| c.) Emulsion thickness: | 12 to 50 microns.                                   |

(2) Drying. Dry the specimen in a vented oven at 120° to 130°C for 10 to 15 minutes.

(3) Firing. Fire the specimen in a belt furnace at a temperature ascent/descent rate of 60° to 100°C per minute and a

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peak temperature of 845° to 855°C for 10 to 12 minutes. The fired print thickness shall be 10 to 15 microns.

### 7. Printability.

a. Type I. Prepare test specimen in accordance with paragraph 6.a. Examine features for legibility at a distance of not less than six inches with available room lighting and either without the aid of magnification or with a viewer having a magnification no greater than 3x. Legibility consists of:

- 1.) Features not missing in whole or in part
- 2.) Features not faded, smeared, blurred or shifted (dislodged) to the extent that they cannot be readily identified
- 3.) The 5 mil width lines are not greater than 6.5 mils in width.

b. Type II and III. Prepare test specimen in accordance with paragraph 6.b. for Type II and paragraph 6.c. for Type III. Examine features for legibility at a distance of not less than six inches with available room lighting and either without the aid of magnification or with a viewer having a magnification no greater than 3x. Legibility consists of:

- 1.) Features not missing in whole or in part
- 2.) Features not faded, smeared, blurred or shifted (dislodged) to the extent that they cannot be readily identified.

8. Resistivity. Prepare test specimen in accordance with paragraphs 6.a., 6.b. or 6.c., as applicable. Measure resistance between trace ends on test specimen using a 4 wire Kelvin bridge, or equivalent. Measure fired material thickness on substrate using a calibrated microscope or equivalent. Calculate resistivity using the following formula:

$$\text{Resistivity} = \frac{1000R}{S} \times \frac{T}{\text{Normalized } T}$$

Where: R is resistance in ohms  
 S is number of squares in printed pattern  
 T is actual thickness in microns  
 Normalized T is artificial thickness used for reporting resistivity



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9. Adherence. Prepare test specimen in accordance with paragraph 6.a. for Type I and paragraph 6.c. for Type III. Solder # 20 AWG tinned copper wire to pads and allow to stabilize at 18.5° to 26.6°C for not less than 16 hours. Bend wire to a right angle with the substrate surface at a distance of 0.112 to 0.125 centimeters (cm) from the pad leading edge. Mount the specimen in a test machine and apply tension to the vertical wire at a cross head speed setting of 0.125 cm per minute until separation occurs between the pad and substrate. Test not less than ten specimens. Calculate average breaking strength.

C. Material safety data sheets. Material safety data sheets are required by Title 29 Code of Federal Regulations, Section 1910.1200, and shall be prepared in accordance with the requirements of FED-STD-313. Contracting officers will identify those activities requiring copies of completed material safety data sheets prepared in accordance with FED-STD-313. The pertinent Government mailing addresses for submission of data are listed in FED-STD-313.

D. Source for reference documents. Copies of referenced federal and military specifications and standards may be obtained by sending a request for copies to the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094:

FED-STD-313	-	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-376	-	Preferred Metric Units for General Use by the Federal Government

Copies of ASTM D 1210, "Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems," are available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.

E. Acceptable products and part numbers. The products described in this commercial item description are available from E.I. DuPont deNemours and Co., Inc. (CAGEC 82348) and Electro-Science Laboratories, Inc. (CAGEC 52539). Commercial part numbers and corresponding product types are shown below:

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<u>Supplier</u>	<u>Part Number</u>
E.I. DuPont deNemours and Co., Inc. Electronic Products Barley Mill Plaza #19 Wilmington, DE 19880-0029	4119 (Type I)
Electro-Science Laboratories, Inc. 416 E. Church Road P.O. Box 1533 King of Prussia, PA 19406	8835 Via Fill (Type II) D-8825-1G (Type III)

## MILITARY INTERESTS:

Custodian:  
Army - MI  
Air Force - 99

Review Activity:  
Air Force - 84

## CIVILIAN AGENCY:

Coordinating Activity:  
GSA-9FTE-10

PREPARING ACTIVITY:  
Army - MI

Project No. 8030 - 0660

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