

Technical Data Sheet**Heat Shrink Labels**

This specification is intended to outline the physical and chemical properties of *PANDUIT*'s GMUHS31 tubing material for wire identification and insulation purposes and include the following part numbers and printable material identifiers:

| Part Number Prefixes | |
|----------------------|--|
| | |
| | |
| | |
| | |

| Printable Material Suffixes | |
|-----------------------------|--|
| H*C | |
| H1T-B | |
| H*T | |
| H*T-2 | |

PRODUCT SPECIFICATIONS:

Description:

Material is RoHS compliant (European Union directive 2002/95/EC). GMUHS31 is a crosslinked, flexible, heat shrinkable thermal transfer and dot matrix printable polyolefin. This product meets the material requirements and physical properties of AMS-DTL-23053/5C (Class 1 and Class 3) and UL standard 224 with a VW-1 rating. When printed using RMH4BL, RMEH4BL, RHH4BL-S, RMR4BL, RMER4BL, RMR4WH, RHR4BL-S, or RMR2BL thermal transfer ribbons it will also meet SAE-AS5942, MIL-STD-883F Method 2015.13, Solutions A, B and D, and MIL-STD-202G Method 215K, Solutions A,C and D. This product has been tested for use as an identification marker for use in (Class 1E) harsh environments in various nuclear power plants.

Recommended Ribbons:

RMH4BL, RMEH4BL, RHH4BL-S, RMR4BL, RMER4BL, RMR4WH, RHR4BL-S, or RMR2BL

Standard Colors:

White, Yellow, Red, Black (per MIL-STD-104C)

Shrink Ratio:

3 to 1

Service Temperature Range:

Minus 67F to 275F (Minus 55C to 135C)

Storage Conditions:

Store at 70F (21C) and 50% Relative Humidity
For cassette products do not exceed 95°F.

PROPERTIES:

Tensile Strength:

1500 psi (10.3 MPa) minimum (ASTM D638)

Elongation Ultimate:

200% minimum (ASTM D 638)

Dielectric Strength:

500 volts/mil minimum (ASTM D2671, Sections 20-25)

Total Longitudinal Change:

Minus 15% to +5% (ASTM D2671, Sections 8-13)

Water Absorption:

0.5% maximum (ASTM D2671, Sections 79-80)

Low Temperature Flexibility:

No cracking (ASTM D2671, Section 36-43)

Printability:

Product meets print performance of 100 rubs (Taber abraser, CS-10 wheels, 100 cycles/250 gm wt)

Flammability:

Product passes UL 224 standard, VW-1 for flammability

PERFORMANCE:

Technical Data Sheet

Specific gravity: 1.35 max (ASTM D882, Sections 73-74)
 Shrink Temperature: 194F to 248F(90C to 120C)
 Corrosion: Non-corrosive (ASTM D2671, Sections 93-95, Procedure A)
 UV Resistance: The samples were tested in a QUV weather tester as per test procedure ASTM G-154. Observations made at *3000 hours exposure showed no loss in legend or change in material.

*3000 hours equates to 5 years of assimilated outdoor UV exposure.

Fluid Resistance:

Tubings tested in the following fluids per ASTM D2671 Sections 63-67

| |
|-----------------------------|
| Hydraulic Fluid MIL-H-5606 |
| JP8 - MIL-T-5624 |
| OIL - MIL-L-7808 |
| OIL - MIL-L-23699 |
| 5% NaCl - A-A-694 |
| Deicing Fluids - MIL-A-8243 |

After immersion test:

Tensile Strength - 6.89 MPa (1000 psi) minimum per ASTM D2671 Sections 44-48
 Ultimate Elongation - 100% minimum per ASTM D2671 Sections 44-4

PROPERTIES FOR SOLAR APPLICATION:**PERFORMANCE:**

Short term temperature exposure: 30 days at -51C, no visible change observed
 Short Term high temperature exposure: 30 days at 93C, no visible change observed
 Relative Lightfastness and weatherability: 1000 hours, slight fade in color observed (ASTM D3424, Method 4)
 Tensile Strength: MD: 1158 PSI (ASTM D3759)
 Elongation: MD: 510% (ASTM D3759)

Marking Performance:

SAE-AS5942: Samples were tested heat shrunk. Print still legible after 20 eraser rubs with hard hand pressure.
 MIL-STD-202G: Method 215K, Solution A, C, and D: 3 cycles of 3 minute immersions in specified fluids followed by toothbrush rub after each immersion. Print still legible in all test fluids.
 MIL-STD-883F: Method 2015.13, Solution A, B and D: 3 cycles of 1 minute immersion in specified fluids followed by toothbrush rub after each immersion. Print still legible in all test fluids.

Nuclear Plant (Class 1E) Harsh Environment Test Result Summary

GMUHS31 heat shrink tubing has been tested for use as an identification marker for use in harsh environments in various nuclear power plants. Printed markers were subjected to radiation exposure, thermal aging and LOCA/MSLB environmental testing as shown in the three tables below. Test margins related to IEEE 323-2003 were used.

Technical Data Sheet

General Environmental Test Result Summary Table

| Item | Normal | Accident |
|--|--|--|
| Service Life: | 40 years | 1 year |
| Temperature | 140F (60C) | 360F (182.2C) (peak) |
| Pressure | Atmospheric | 57 psig (peak) |
| Relative Humidity | 90% | 100% (max) |
| Radiation | 2.0E7 rads | 2.0E8 rads (TID) |
| *Halogen Content Marker with (Print) (Thermal Print) (Thermal Print) (Thermal Print) (Thermal Print) (Dot Matrix Print) (Dot Matrix Print) (Dot Matrix Print) (Dot Matrix Print) | Fluorine < 0.1 ppm Bromine < 0.1 ppm Chlorine < 0.1 ppm Iodine < 0.1 ppm Fluorine < 0.1 ppm Bromine < 0.1 ppm Chlorine < 0.7 ppm Iodine < 0.1 ppm | Not Applicable |
| Print Permanence | Print remained legible with no change in print density | Thermal Print -No significant change Dot Matrix – Some density loss |
| Physical Integrity | No significant change | Some warping and splitting but remained attached on wire. |

*The chemical analysis method DM4110B (De-ionized Water Soluble Method) was performed to identify concentration of halogen ions in this material that could potentially leach onto materials such as stainless steel and promote corrosion. This chemical analysis does not identify the concentrations of toxic gaseous effluents released by burning this material.

Containment Spray Test Information Table

| Item | Short Term (Injection Phase) | Long Term (Recirculation Phase) |
|--|------------------------------------|------------------------------------|
| Duration | 4 hours | 30 days |
| Temperature | 60-360F (16-182C) | 60-360F (16-182C) |
| Spray Density (gpm/ft ² .) | >0.62 (25.3 L/min/m ²) | >0.62 (25.3 L/min/m ²) |
| Chemical Composition | | |
| Hydrazine (N ₂ H ₄) | 0-50 ppm | 0-50 ppm |
| Boric Acid (H ₃ BO ₃) | 4,400 ppm | 4,400 ppm |
| pH | 4.0 - 10.0 | 7.0 - 8.5 |

LOCA /MSLB Combined Temperature/Pressure Test Information Table

| TIME Seconds | Temperature Deg F (Deg C) | Pressure PSIG (kPa) |
|------------------------------------|-------------------------------|------------------------|
| 0 | 120 (49) | 0 (0) |
| 10 | 300 (149) | 57 (393) |
| 50 | 360 (182) | 57 (393) |
| 250 | 360 (182) | 57 (393) |
| 270 | 275.3 (135.2) | 57 (393) |
| 1 X 10 ³ | 275.3 (135.2) | 57 (393) |
| 1 X 10 ⁴ | 230 (110) | 46 (317) |
| 1 X 10 ⁵ | 190 (88) | 20 (138) |
| 1 X 10 ⁶ | 150 (66) | 10 (69) |
| 2.592 X 10 ⁶ (30 days) | 150 (66) | 10 (69) |
| 1.572 X 10 ⁷ (182 days) | 142 (61) | 10 (69) |

Technical Data Sheet

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|-----------------------------------|----------|---------|
| 3.15 X 10 ⁷ (365 days) | 142 (61) | 10 (69) |
|-----------------------------------|----------|---------|

CHEMICAL/SOLVENT RESISTANCE:

Samples were thermal transfer printed with RMR*BL/RMER*BL/RHR*BL-S/RMR*WH/RMER*WH and RMH*BL/RMEH*BL/RHH*BL-S ribbons. Test was conducted at room temperature. The samples were immersed in the specified chemical reagents for 5 immersions using the following cycle: a 10 minute immersion time followed by a 30 minute recovery time.

| Chemical Reagent | Visual Observation |
|-------------------------------|---------------------------|
| Distilled water | No effect |
| Mineral Spirits | No effect |
| ASTM #3 Oil | No effect |
| Isopropyl Alcohol | No effect |
| Methanol | No effect |
| 3% Alconox Detergent | No effect |
| 10% Sodium Hydroxide Solution | No effect |
| 10% Sulfuric Acid Solution | No effect |
| 5% Sodium Chloride Solution | No effect |
| Freon TF | No effect |
| Super Agitene | No effect |
| Jet A Fuel | No effect |
| Arco Truslide 68 | No effect |
| SAE 30 Motor Oil | No effect |

APPROVALS:

UL Recognized: UL224
CSA Certified: C22.2 No. 198.1-06

File Number: E205133
File Number: 256205

LIMITED WARRANTY

All *PANDUIT* Identification Solution Products (except for Software programs) are warranted to be free from defects in material and workmanship at the time of sale but our obligation under this warranty is limited to replacement of the product proved to be defective within 6 months from the date of sale, or in the case of printers, within 90 days from the date of sale. This warranty is void if the products or printers are modified, altered or misused in any way. Use of *PANDUIT* printers with any product other than the specified *PANDUIT* products for which the printer was designed constitutes misuse. Before using, the user shall determine the suitability of the product for its intended use and user assumes all risk and liability whatsoever in connection therewith. The foregoing may not be altered except by an agreement signed by officers or seller and manufacturer.

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