SPEIFICATION RW-2530

Document No. 108-121029

TMS 90 SCE Marker

TMS 90 SCE Markers are for use in permanent marking applications up to 135°C, and are especially designed for applications in which flexibility and flame retardancy are important criteria.

1. SCOPE

This specification covers the requirements and performance of the TMS 90 SCE Marker System. This system is an automatic method of identifying wire and cable by printing a mark on Tyco Electronics TMS 90 SCE Markers. The mark is permanent upon printing. The product is specifically designed for thermal transfer printing and laser marking.

1.1 CLASSIFICATION

1.1.1 Markers
The markers shall be fabricated from modified radiation cross linked polymer tubing, flattened and mounted on a carrier. All TMS 90 SCE markers covered by this specification shall meet the performance requirements of AMS-DTL-23053/5 Class 1 and Class 3.

1.1.2 System Equipment
The recommended Printer Ribbon Systems for use with TMS 90 SCE are shown in the latest version of document 411-121005 Identification Printer Product Ribbon Matrix. System performance is evaluated in this specification.
Compliance to this specification can only be guaranteed if Tyco Electronics approved printers and ribbons are used. TMS 90 SCE markers are intended for printing with thermal transfer printers.

REVISION HISTORY

Revision Number	Description of change	Date	Incorporated By
1	Created	May 2008	Lee Smith-
2	Format / update	February 2014	M Priddle

2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of the referenced documents applies. The following documents form a part of this specification to the extent specified herein.

GOVERNMENT FURNISHED DOCUMENTS

Federal

FED-STD-228	Methods of Testing Cable and Wire, Insulated

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
MIL-T-83133	Turbine Fuels, Aviation, Kerosene Types, NATO F-34 (JP-8) and NATO F-35
MIL-L-7808	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-A-8243	Anti-Icing and De-icing Defrosting Fluid

OTHER PUBLICATIONS

American Society for Testing and Materials

ASTM D 570	Test Method for Water Absorption of Plastics
ASTM D 792	Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 876	Test Method for Non Rigid Vinyl Chloride Polymer Tubing, Used for Electrical Insulation
ASTM D2671	Standard Test Methods for Heat-Shrinkable Tubing for Electrical Use

Underwriter's Laboratories Incorporated.

UL-224 Extruded Insulating Tubing

International Organization for Standardization

BS EN ISO 846:1997 Plastics. Evaluation of the action of microorganisms

SAE International

SAE-AMS-DTL-23053 Insulating Sleeving, Electrical, Heat Shrinkable, General

SAE-AS-81531 Marking of Electrical Insulating Materials

TE Connectivity

411-121002 TE Connectivity Print Contrast Reference Scale

IEWI-012 Print permanence testing using the mechanical crockmeter

3. REQUIREMENTS

3.1 MATERIAL

The sleeving shall be fabricated from irradiated, thermally-stabilized, flame retarded, modified polyolefin compound. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks or inclusions.

3.2 COLOR

The sleeves shall be supplied in white & yellow, unless otherwise specified.

3.2 PROPERTIES

The sleeves shall meet the requirements of Table 4.

3.4 FORM

The markers shall be cut lengths mounted on a carrier in accordance with Figure 1. Sleeves will not be scored and should be released from the carrier by removing the edge adhesive tape. Nominal sleeve length is shown in Figure 1.

4 QUALITY ASSURANCE PROVISIONS

4.1 CLASSIFICATION OF TESTS

4.1.1 Qualification Tests

Qualification tests are those performed on finished markers or marker material submitted for qualification as a satisfactory product and shall consist of all tests listed in this specification.

4.1.2 Acceptance Tests

Acceptance tests are those submitted for acceptance under the contract. Acceptance tests shall consist of; Dimensions, Expanded Concentricity, Longitudinal Change, Print Adherence (SAE AS 81531)

4.2 SAMPLING INSTRUCTIONS

4.2.1 Qualification Test Samples

Qualification test samples shall consist of 50 feet (15 m) of continuous marker material and the appropriate number of finished markers necessary to run all the tests listed in this specification. Qualification of any one size and 1 colour shall qualify all sizes and all standard colours in each applicable specification sheet.

4.2.2 Acceptance Test Samples

Acceptance test samples shall consist of the appropriate number of finished markers necessary to run the specified tests.

4.3 TEST PROCEDURES

Unless otherwise specified, the markers shall be removed from the carrier and recovered for testing. Where required by test method limitations, testing shall be done on marker material. Finished markers will be recovered or tubing specimens will be thermally conditioned by placing them in a forced air oven for 3 minutes at 200 ± 5°C (392 ± 9°F). Specimens should be further conditioned at 23 ± 3°C (73 ± 5°F) for at least 4 hours before testing.

4.3.1 Dimensions, Dimensional Recovery and Longitudinal Change

Test three markers in accordance with ASTM D 2671 for dimensions as supplied, dimensions as recovered and longitudinal change. Unless otherwise specified in the method, the recovery time shall be 3 minutes and recovery temperature shall be 200°C.

4.3.2 Resistance to Splitting

Test ten sleeves in accordance with EIL-3TEC-055, 'Procedure for measuring the split resistance of marker sleeves during recovery' with the following additions: Samples shall be tested from the carrier as supplied; Preheat the test mandrel for a minimum of 60 minutes at 150°C prior to testing; Insert sleeving over the mandrel and place in the oven at 150°C for 20 minutes. Remove and check for splitting using normal vision, without magnification.

4.3.3 Tensile Strength and Ultimate Elongation

Test tensile strength and ultimate elongation on 5 specimens. The specimens shall be in accordance with ASTM D 2671, using 1-inch (25mm) bench marks and a 1-inch (25mm) initial jaw separation. Cross head speed shall be set at 2-inches/min (50mm/min).

4.3.4 Specific Gravity

Measure the specific gravity in accordance with ASTM D 2671. Testing shall be made on pieces of recovered tube conditioned above.

4.3.5 Low Temperature Flexibility

For sleeving sizes less than 10.2mm maximum ID after shrinking, recover three specimens over a stranded wire as described in table 3. For larger sleeves, cut a longitudinal strip, 150mm x 6.4mm from sleeving that has been shrunk. Condition the specimens and wire for 4 hours at -55°C (-67°F). While at this temperature, bend the specimens through 90 degrees, in approximately 2 seconds, over a similarly conditioned mandrel, selected in accordance with Table 4, and visually examine for cracks, without magnification, using normal vision.

4.3.6 Heat Shock

Mark three specimens as specified in the 'Print Performance' section and remove from the carrier. Condition the specimens for 4 hours at 250°C in a forced air oven with an air velocity of from 100 to 200 feet (30 to 60 m) per minute past the specimens. Remove the specimens from the oven, cool to room temperature and bend through 90 degrees, in approximately 2 seconds, over a mandrel selected in accordance with Table 2 of the applicable specification sheet. Visually examine the specimens for evidence of dripping, flowing or cracking. Disregard any side cracking caused by flattening of the specimens on the mandrel.

4.3.7 Heat Ageing

Test 6 marker sleeves as supplied on the carrier. Print the marker sleeves in accordance with the 'Print Performance' section and remove from the carrier. Recover the markers over a stranded wire as described in Table 2. Condition the specimens at the time and temperature specified in table 4 in a forced air oven with an air velocity of from 100 to 200 feet *(30 to 60 m)* per minute past the specimens. After conditioning, remove the specimens from the oven, cool to room temperature and examine for cracks. Test the 3 markers specimens for 'Print Adherence' as detailed below using 20 rubs. Bend each of the other three specimens through 90 degrees, in approximately 2 seconds, over a mandrel selected in accordance with Table 3. Visually examine for cracks. Disregard any side cracking caused by flattening of the specimens on the mandrel.

4.3.8 Copper Contact Corrosion

Test three specimens for copper contact corrosion in accordance with ASTM D 2671, Procedure B. Samples shall be tested for 16 hours at 175°C. Slit the specimen open and examine the copper pitting and blackening.

4.3.9 Corrosive Effect

Test two specimens in accordance with ASTM D 2671, Procedure A. Samples shall be tested for 16 hours at 175°C. Evidence of corrosion shall be the removal of copper from a mirror leaving an area of transparency greater than 5 percent of its total area.

4.3.10 Dielectric Strength

Measure the Dielectric Strength under oil, in accordance with ASTM D 2671.

4.3.11 Volume Resistivity

Measure the Volume Resistivity in accordance with ASTM D 2671.

4.3.12 Flammability (FED-STD-228)

Recover tubular specimens, 18-inch (450-mm) long, over 21-inch (525-mm) long metal rods with a diameter equivalent to the maximum recovered diameter of the tubing. Subject the specimens to the vertical test in accordance with FED-STD-228, Method 5221.

4.3.13 Fungus Resistance

Test 150mm long tubes and printed sleeves for Fungus Resistance in accordance with ISO 846-1997 method B, 56 day duration. Without rubbing, record 'Print Contrast' of the markers and test 150mm long sleeves for Tensile Strength and Ultimate Elongation in accordance with ASTM D 2671 and Dielectric strength in accordance with ASTM 2671.

4.3.14 Water Absorption 24 hours at 23^{O}C *(73^{O}F)*

Test for water absorption using the method specified in ASTM D 570.

4.3.15 Print Performance

Marking

Print sleeves with a Tyco Electronics approved printer and ribbon system. Mark random characters across the length of each marker using the font indicated in the table below. Remove the markers from the carrier and test in the expanded and recovered form. Recover half of the markers for 3 minutes at 200 ± 5°C (392 ± 9°F), remove the specimens from the oven, and allow cooling for 4 hours at 23 ± 3°C (73 ± 5°F).

Table 1: Character font and size for print performance testing

Part Number	Font and Size
TMS-90-SCE-3/32	Arial 8 Bold
TMS-90-SCE-1/8	Arial 10 Bold
TMS-90-SCE-3/16	Arial 12 Bold
TMS-90-SCE-1/4	Arial 12 Bold
TMS-90-SCE-3/8	Arial 12 Bold
TMS-90-SCE-1/2	Arial 12 Bold
TMS-90-SCE-3/4	Arial 14 Bold
TMS-90-SCE-1-1/2	Arial 18 Bold

Print Adherence
Test three specimens for print adherence in accordance with Paragraph 4.6.2 of SAE AS 81531 see IEWI-012. Perform 50 rubs and examine the specimens for legibility at a distance of 356 mm (14 inches). Check the legibility as defined below.

Solvent Resistance
Test three specimens for solvent resistance at least 24 hours after marking. Test in accordance with MIL-STD-202F Method 215, with the following addition: One immersion and brushing cycle consists of a 1 minute immersion followed by ten brush strokes. This cycle shall be repeated 5 times so that the total number of strokes achieved is 50. Examine the specimens for legibility at a distance of 14 inches. Check the legibility as defined below.

Print Endurance
Test for Mark Adherence as described in IEWI-012 and in accordance with SAE AS 81531 4kg weight

Observe the print contrast until failure. Take the mean average result of the 3 sleeves. For bench marking and system comparison tests, incremental observations may be necessary.

Legibility after print performance testing shall be measured against the ‘TE Connectivity Print Contrast Scale‘, document reference 411-121002. Note print contrast 10 may be defined as very clear mark with no reduction in legibility and print contrast 2 is little or no mark remaining and illegible.

Endurance to Military Aviation Fuel
Tests shall be made on 6 marked sleeves. Recover half of the samples as described in this document and allow to condition at 23°C for at least 4 hours before fluid testing. Completely immerse sleeves in each test solvent and store at 23°C. After 1000 hours, remove from the fluid and allow drying on tissue placed in a vented fume cupboard for 30 minutes before visual examination. Observe print legibility using the ‘Tyco Electronics Print Contrast Scale‘, document reference EIL-PIP-014 revision 2, and any sleeve swelling.

4.3.16 Fluid Resistance

Test six specimens for Fluid Resistance at least 24 hours after marking. Samples shall be tested in the expanded (as received) and fully recovered form. Completely immerse markers, in each fluid, at the time and temperature listed in table 5. The volume of the fluid shall be not less than 20 times that of the specimens. After immersion, lightly blot the specimens with dry tissue paper and allow to air dry for 30-60 minutes at room temperature. Test the specimens for 'Print Adherence' as defined in this document. Printing shall be rubbed 20 times.

4.3.17 Storage Stability

Testing shall be carried out on a finished reel of product. Any standard reel length as supplied may be used for the test. Ensure product has original packaging including binding tape, polyethylene bag and cardboard box and store in an oven. Condition the reel at 40°C for 1000 hours and then allow cooling to 23°C for 4 hours before marking using a recommended Tyco printing system. If intermediate results are required during the test, further samples can be added as required. Make a visual assessment of the print quality in accordance with Tyco Electronics Print Contrast Chart EIL-PIP-014.

The design authority shall determine the system selection for test. Typically this should include the standard high volume printer and a low cost commercial option. Consideration shall also be made with regard to customer specific requirements in terms of system and font style.

During process development, dimensional checks may also be made before and after storage stability so that tube relaxation (reversion) and puffiness can be measured. This is not a mandatory requirement.

4.4 REJECTION AND RETEST

Failure of any sample to conform to any of the requirements of this specification shall be cause for rejection of the lot represented. Markers which have been rejected may be replaced or reworked to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning previous rejection and action taken to correct the defects shall be furnished to the inspector.

5. PREPARATION FOR DELIVERY

Storage Conditions
Markers should be stored in a clean dry location in the original packaging. Maximum storage temperature is 40°C (104 °F).

Storage Life
Storage Life shall be in compliance with AMS-DTL-23053/5 section 3.5.1. 5 years when stored between 18°C to 35°C (64°F to 95°F).

Packaging
Packaging shall be in accordance with good commercial practice.

Marking
Each container of markers shall be identified with the product designation, size, quantity, manufacturer's identification and lot number and date of manufacture.

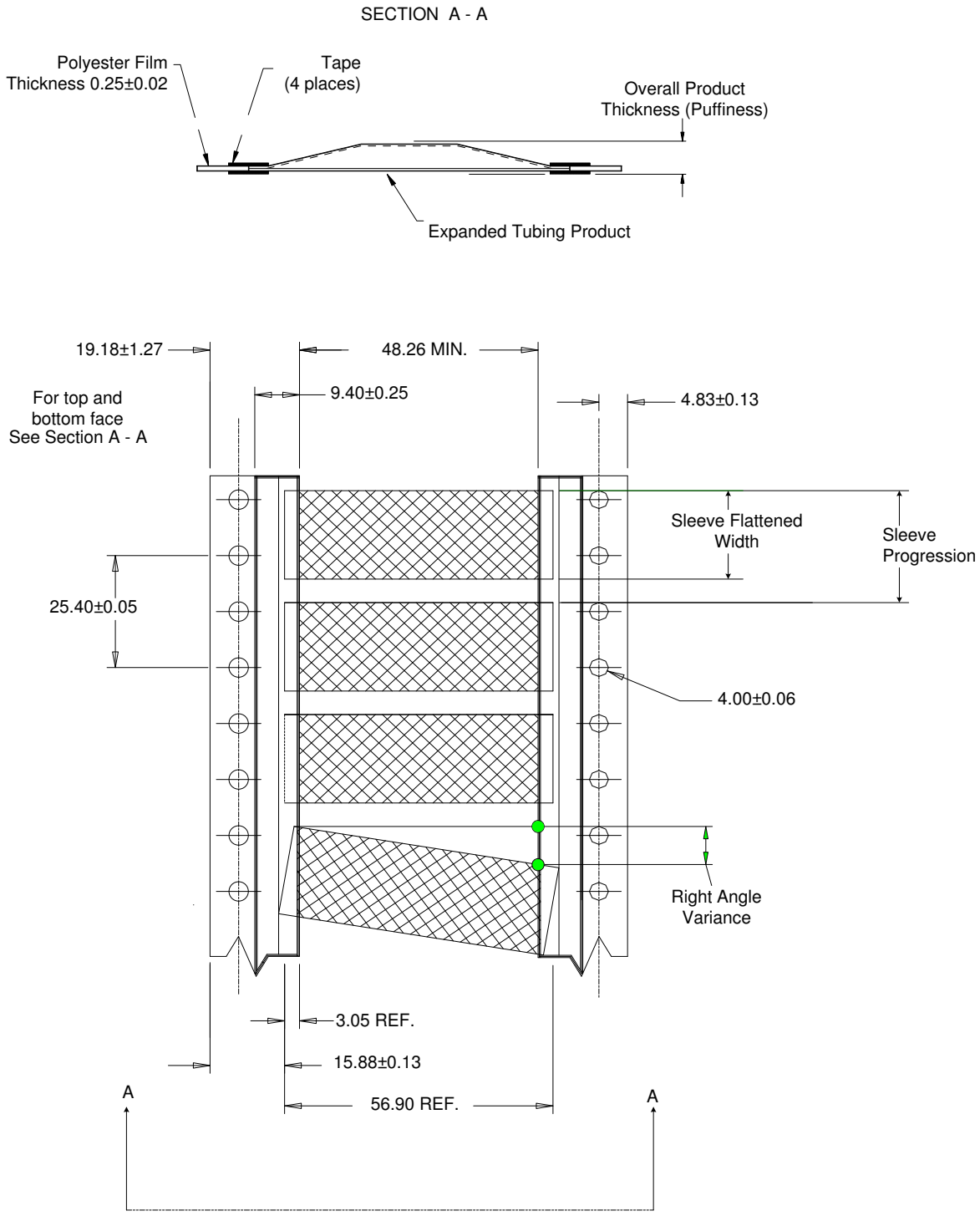

Figure 1: Assembly schematic of TMS-90-SCE

TABLE 2: Sleeve Dimensions

Part Number	Nominal weight per piece (g)	Minimum Expanded Inside Dia.	Maximum Recovered Inside Dia.	Recovered Wall Thickness	Sleeve Progression
TMS-90-SCE-3/32	0.1726	2.36 (0.093)	0.79 (0.031)	0.508 +/- 0.076 (0.020 +/- 0.003)	12.70 +/- 0.64 (0.500 +/- 0.025)
TMS-90-SCE-1/8	0.2440	3.18 (0.125)	1.07 (0.042)	0.508 +/- 0.076 (0.020 +/- 0.003)	12.70 +/- 0.64 (0.500 +/- 0.025)
TMS-90-SCE-3/16	0.3500	4.75 (0.187)	1.57 (0.062)	0.508 +/- 0.076 (0.020 +/- 0.003)	12.70 +/- 0.64 (0.500 +/- 0.025)
TMS-90-SCE-1/4	0.4727	6.35 (0.250)	2.11 (0.083)	0.635 +/- 0.076 (0.025 +/- 0.003)	16.94 +/- 0.89 (0.667 +/- 0.035)
TMS-90-SCE-3/8	0.6017	9.53 (0.375)	3.18 (0.125)	0.635 +/- 0.076 (0.025 +/- 0.003)	25.40 +/- 0.89 (1.000 +/- 0.035)
TMS-90-SCE-1/2	0.9120	12.70 (0.500)	4.22 (0.166)	0.635 +/- 0.076 (0.025 +/- 0.003)	29.64 +/- 1.02 (1.167 +/- 0.040)
TMS-90-SCE-3/4	1.704	19.05 (0.750)	6.35 (0.250)	0.762 +/- 0.076 (0.030 +/- 0.003)	42.34 +/- 1.02 (1.667 +/- 0.040)
TMS-90-SCE-1-1/2	3.5344	38.10 (1.500)	19.05 (0.750)	1.016+/- 0.152 (0.035 +/- 0.005)	71.96 +/- 1.02 (2.833 +/- 0.040)

Dimensions in mm (inches)

TABLE 3: Suggested Stranded Wire Size for Low Temperature Flexibility and Heat Ageing

Sleeve Size	Suggested Stranded Wire size	
	AWG Size Stranding	Stranding
3/32	18	19/30
1/8	14	19/27
3/16	10	37/26
¼	10	7 x 15/30
3/8	6	19 x 7/27
½	4	19 x 7/25

TABLE 4: Mandrel Dimensions for Heat Shock, Heat Aging and Low Temperature Flexibility

Size	Mandrel Diameter	
	in.	mm.
3/32 through 3/16	5/16	7.9
¼ through 1-1/2	¾	19.0

Table: 5 Mandrel Sizes for Bend Tests

Nominal sleeving ID (maximum after unrestricted shrinkage), Inches (mm)	Mandrel diameter Inches (mm)
0.023 to 0.125 (0.60 – 3.2)	5/16 ± 0.002 (7.9±0.05)
0.126 to 0.250 (3.2 – 6.4)	3/8 ± 0.003 (9.5±0.08)
0.251 to 1.000 (6.4 – 25.4)	7/16 ±0.004 (11.1 ±0.10)
1.001 to 2.000 (25.4 – 50.8)	7/8 ±0.005 (22.2 ± 0.13)
2.001 to 3.000 (50.8 – 76.2)	1 ± 0.005 (25.4 ± 0.13)
3.001 to 4.000 (76.2 – 101.6)	1 1/8 ± 0.05 (31.8 ± 0.13)

TABLE 5
Sleeve Properties

Property	Unit	Requirement	Test Method
PHYSICAL			
Dimensions	mm (Inches)	In accordance with Table 2	ASTM D 2671
Dimensional Recovery 3 minutes at 200°C (392°F)	mm (Inches)	In accordance with Table 2	ASTM D 2671
Longitudinal Change 3 minutes at 200°C (392°F)	Percent	-10 minimum and +10 maximum	ASTM D 2671
Resistance to Splitting	---	No more than 1mm splitting or tearing shall occur on any one sleeve.	Section 4.3.2
Tensile Strength	Mpa (psi)	10.3 (1500) minimum	ASTM D638 50mm/min (2 inches/min)
Ultimate Elongation	Percent	200 minimum	
Specific Gravity	---	1.35 maximum	ASTM D 2671
Low Temperature Flexibility 4 hours at -55°C (-67°F)	---	No cracking	Section 4.3.5
Heat Shock 4 hours at 250°C (482°F) Visual Inspection SAE AS 81531 Adherence: 20 rubs Bend Test Heat Ageing 336 hours at 175°C (347°F) SAE AS 81531 Adherence: 20 rubs Bend Test	---	No dripping, flowing, or cracking Legible No cracking 20 rubs legible	Section 4.3.6 Section 4.3.7
Copper Contact Corrosion 16 hours at 175°C (347°F)	---	No pitting or blackening of core	Section 4.3.8
Corrosive Effect 16 hours at 175°C (347°F)	---	No removal of copper from mirror >5% of total area	
ELECTRICAL			
Dielectric Strength	kV/mm (V/mil)	19.7 (500) minimum	ASTM D 2671
Volume Resistivity	ohm-cm	10^{14} minimum	ASTM D 2671

ENVIRONMENTAL Flammability FED-STD-228	---	Burn time shall not exceed one minute, and not more than 25% of indicator flag shall be burned or charred. No dripping or flowing.	Section 4.3.12
Fungus Resistance, followed by test for Tensile Strength Ultimate Elongation Dielectric Strength Legibility	 MPa (psi) Percent Kv / mm (Volts / mil) ---	 10.3 (1,500) minimum 200 minimum 19.7 minimum (500) minimum Shall be clearly legible, Tyco Print Contrast >#3	ISO 846 Method B (56 days) ASTM D638, 20 inches/min ASTM D638, 20 inches/min ASTM 2671 EIL-PIP-014
Water Absorption 24 hours at 23°C (73°F)	Percent	0.5 maximum	ASTM D 570
Storage Stability 1000 hours at 40°C followed by Print quality		Cleary legible, minimum Tyco print contrast C8	Section 4.3.17
PRINT PERFORMANCE Endurance to Abrasion SAE AS 81531, Adherence Dry Abrasion (Crockmeter)	 Rubs Cycles	 legible after 50 (minimum) rubs legible after 50 (minimum) rubs	 Section 4.3.15 Section 4.3.15
MIL STD 202F Method 215H Resistance to solvents (extended)	Strokes	legible after 50 (minimum) strokes	Section 4.3.15
Endurance to Military Aviation Fuel 1000 hrs JP10 Rocket Fuel SAE AS 81531 Adherence 1000 hrs JP 8 Jet Fuel SAE AS 81531 Adherence	 Rubs Rubs	 legible after 20 (minimum) rubs legible after 20 (minimum) rubs	 Section 4.3.15 Section 4.3.15
Fluid Resistance 24 hours at 23°C (73°F) JP-8 Fuel (MIL-T-83133) Skydrol 500 Hydraulic Fluid (MIL-H-5606) Aviation Gasoline (100/130) Lubricating Oil(MIL-L-7808) Salt Water (5% salt) Anti-icing Fluid (MIL-A-8243) Followed by SAE-AS-81531 Adherence	 Rubs	 legible after 20 (minimum) rubs	 Section 4.3.16

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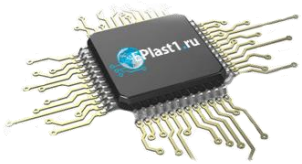

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