SPECIFICATION RW-2510

Document Number 108-121013

RPS

1. SCOPE

This specification covers the requirements and performance of the RPS Marker System. This system is an automatic method of identifying wire and cable. The mark is permanent upon printing.

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.

1.1.2 System Equipment

The recommended Printer Ribbon Systems for use with RPS are shown in the latest version of document 411-121005 Identification Printer Product Ribbon Matrix. System performance is evaluated in this specification

REVISION HISTORY

Revision Number	Description of change	Date	Incorporated By
1	Replaces RT-1804 issue 8	July 2004	-
2	Format update	February 2014	M Priddle

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2. APPLICABLE DOCUMENTS

This specification takes precedence over documents referenced herein. Unless otherwise specified, the latest issue of the referenced documents applies.

2.1 PUBLICATIONS

ASTM D 2672	Heat Shrinkable Tubing for Electrical use
UL224	Standard for Extruded Insulating Tubing
ISO-846	Plastics – Evaluation of the action of microorganisms
SAE AS5942	Marking of Electrical Insulating Materials
IEWI-012	TE Connectivity: Mark Adherence & Print Permanence testing using the hand operated Crockmeter.

3. REQUIREMENTS

3.1 MATERIAL

The sleeving shall be fabricated from irradiated, thermally stabilized, modified polyolefin compound containing no cadmium in the formulation. It shall be homogeneous and essentially free from flaws, defects, pinholes, bubbles, seams, cracks or inclusions.

3.2 COLOR

The markers shall be white or yellow.

3.3 FORM

The sleeves shall be cut lengths mounted on a carrier in accordance with Figure 1.

3.4 PROPERTIES

The sleeves shall meet the requirements of Table 4.

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 performed on finished markers submitted for acceptance under the contract. Acceptance tests shall consist of the following:

Appearance
Dimensions
Longitudinal Change

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4.2 SAMPLING INSTRUCTIONS

4.2.1 Qualification Test Samples

Qualification test samples shall consist of 15 m (50 feet) of continuous marker material and the appropriate number of finished markers necessary to run all tests. Qualification of any one size shall qualify all sizes.

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 expanded tubing prior to cutting and assembly.

4.3.1 Dimensions, Dimensional Recovery and Longitudinal Change

Test three markers in accordance with ASTM D 2671 for as supplied dimensions, dimensions as recovered and longitudinal change. Mark two gauge marks 44.5 mm (1.75 ins.) apart on each sample. When required, recover specimens for 3 minutes at 200 ± 5°C (392 ± 9°F). Remove the specimens from the oven, and allow to cool to room temperature. The distance between gauge marks and inside diameter of each shall be measured. The longitudinal change shall be expressed as a percentage of the original gauge mark distance. The recovered inside diameter and recovered wall thickness shall be determined.

4.3.2 Tensile Strength and Ultimate Elongation

Test three specimens for tensile strength and ultimate elongation in accordance with ASTM D 2671, using 25 mm (1-inch) benchmarks, a 50 mm (2-inch) initial jaw separation and a jaw separation speed of 508 mm (20 inches) per minute.

4.3.3 Low Temperature Flexibility

Recover three specimens, sizes RPS 1-400 and smaller, over a stranded AWG wire (nearest gauge which is larger than the sleeving maximum I.D. nominal after unrestricted shrinkage). For tubing size RPS 400-1000, cut three 152 mm by 6.4 mm (6 inch by 1/4 inch) strips, longitudinally from recovered tubing. Condition the specimens for 4 hours at -30 ± 2°C (-22 ± 4°F). While at this temperature, bend the tubular specimens 90 degrees, in approximately 2 seconds, over a similarly conditioned mandrel, selected in accordance with Table 1. Bend the strip specimens 360 degrees over a 7.9 mm (5/16-inch) mandrel, similarly conditioned. Examine the specimens for cracks.

TABLE 1
MANDREL DIMENSIONS FOR BEND TESTING

Part Number	Diameter of Mandrel	
	Inches	millimetres
RPS 22-18 to RPS 8-4	5/16	7.9
RPS 10-2 to RPS 6-250	3/8	9.5
RPS 1-400 to RPS 400-1000	7/16	11.1

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4.3.4 Print Performance - Legibility and Durability

Mark eighteen finished markers with the recommended Printer / ribbon system as shown in document 411-121005. Print random characters across the length of each marker to within 6 mm (1/4 inch) of both ends using the font indicated in Table 2. Remove the specimens from the carrier.

TABLE 2
Character Font and Size for Print Performance Testing

Part Number	Font type and size
RPS 22-18/2.00	Arial or Courier 10 Bold
RPS 18-12/2.00	Arial or Courier 12 Bold
RPS 16-10/2.00	Arial or Courier 12 Bold
RPS 8-4/2.00	Arial or Courier 12 Bold
RPS 10-2/2.00	Arial or Courier 12 Bold
RPS 6-250/2.00	Arial or Courier 14 Bold
RPS 1-400/2.00	Arial or Courier 18 Bold
RPS 400-1000/2.00	Arial or Courier 18 Bold

4.3.4.1 Recover three marked specimens in an oven for 3 minutes at 200 ± 5ºC (392 ± 9ºF) and allow them to cool to room temperature.
The test pieces shall be tested for print permanence in accordance with SAE-AS5942 and IEWI-012. The number of rubs and weight shall be as specified in Table 4.
Examine the marking for legibility at a distance of 356 mm (14 inches).

4.3.4.2 Recover nine marked specimens in an oven for 3 minutes at 200 ± 5°C (392 ± 9°F) and allow them to cool to room temperature. Prepare three specimens for each of the following three fluids:
a) One part by volume of isopropyl alcohol, American Chemical Society (ACS) reagent grade, or isopropyl alcohol in accordance with TT-I-735, grade A or B and three parts by volume mineral spirits in accordance with TT-T-291, type II, grade A, or in accordance with P-D-680, type I or three parts by volume of a mixture of 80% by volume of kerosene and 20% by volume ethyl benzene.
b) A terpene defluxer consisting of a minimum of 90% d-Limonene and 10% surfactant[1]
c) A mixture consisting of the following:
1) Forty-two parts by volume water, I megohm-cm minimum resistivity
2) One part by volume of propylene glycol mono-methyl ether (glycol ether PM, 1-methoxy-2-propanol)
3) One part by volume of monoethanolamine [2]

4.3.4.3 Obtain a brush of the following description:
It shall be a toothbrush with a handle made of a non-reactive material. The brush is made of at least three long rows, 28.5 ± 3 mm (1-1/8 ± 1/8 inch) in length, of hard bristles. Each row shall contain eight to ten tufts, the free ends of which shall lie substantially in the same plane. Each brush shall be used with a single solvent and when there is any evidence of softening, bending, wear, or loss of bristles, it shall be discarded.

Maintain all solutions at a temperature of 23 ± 5°C (73 ± 9°F). Completely immerse the specimens and the bristle portion of the brush for one minute in the specified solution. Immediately following immersion, brush the specimen with normal hand pressure - approximately 56 - 85 g (2 - 3 ounce) pressure - for ten unidirectional strokes on the portion of the specimen where marking has been applied. Immediately after the initial brushing, repeat the

[1] A commonly used terpene defluxer is BIOACT EC-7R. “BIOACT” and is a registered Trademark of Petroferm INC.
[2] Normal safety precaution for handling this solution based on O.S.H.A. rules for monoethanolamine

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immersion and brushing procedure (one minute of immersion followed by ten brush strokes) a sufficient number of times to provide the total number of strokes specified in Table 4. After completion of the brushing, rinse the specimens in water and air-blow dry all the surfaces. Examine the specimens for legibility at a distance of 356 mm (14 inches).

4.3.5 Heat Shock

The test method shall be as specified in UL 224. The test conditions will be 1 hour at 136 ± 2°C (277 ± 4°F).

4.3.6 Heat Aging

Shrink three specimens, size RPS 1-400 or smaller, on a stranded AWG wire (nearest gauge which is larger than the sleeving maximum I.D. nominal after unrestricted shrinkage). For tubing sizes RPS 400-1000, cut three 152 mm by 6.4 mm (6 inch by 1/4 inch) strips, longitudinally from recovered tubing. Condition the specimens for 168 hours at 158 ± 2°C (316 ± 4°F) in a convection oven, with an air velocity of 30 - 60 m (100 - 200 ft) per minute past the specimens. Remove the specimens from the oven, and allow to cool to room temperature. Test the specimens for mandrel bend in accordance with Section 4.3.6.1. Test an additional three specimens for print performance in accordance with Section 4.3.6.2.

4.3.6.1 Mandrel Bend

Bend the specimens recovered on the stranded wire 90 degrees around a mandrel specified in Table 1. Bend the strips 360 degrees around a 7.9 mm (5/16-inch) diameter mandrel. Examine the specimens for cracks.

4.3.6.2 Print Performance

Mark three specimens in accordance with Section 4.3.4 and recover them in an oven for 3 minutes at 200 ± 5°C (392 ± 9°F). Condition the specimens in the oven for 168 hours at 158 ± 2°C (316 ± 4°F). Cool to room temperature and test for print performance in accordance with 4.3.4.1

4.3.7 Dielectric Strength

The test method shall be as specified in ASTM D 2671.

4.3.8 Corrosive Effect

Test two specimens in accordance with ASTM D 2671, Procedure A for 16 hours at 158 ± 2 °C (316 ± 4 °F).

4.3.9 Flammability

The test method shall be as specified in UL 224 All Tubing Flame Test.

4.3.10 Water Absorption

The test method shall be as specified in ASTM D 2671. The test conditions shall be 24 hours at 23 ± 3 °C (73 ± 5 °F).

4.3.11.1 Fungus resistance

Fungus resistance testing shall be conducted in accordance with accordance with ISO 846 B with an incubation time of 56 days.

4.3.11.2 Tensile Strength

After conditioning per section 4.3.12, test for tensile strength in accordance with section 4.3.2.

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4.3.11.3 Ultimate Elongation

After conditioning per section 4.3.12, test for ultimate elongation in accordance with section 4.3.2.

Dielectric Strength

After conditioning per section 4.3.12, test for dielectric strength in accordance with section 4.3.7.

4.3.12 Fluid Resistance

Prepare 3 markers for each fluid listed in Table 4 by marking them in accordance with section 4.3.4. and recover them in an oven for 3 minutes at 200 ± 5ºC (392 ± 9ºF). Allow samples to cool to room temperature. Immerse the samples for 24 hours at 23 ± 3 °C (73 ± 5 °F). The volume of the fluid shall not be less than 20 times that of the specimens. After immersion, lightly wipe the specimens and allow them to air dry 30-60 minutes at room temperature. Test the specimens for print performance in accordance with Section 4.3.4.1.

4.4 REJECTIONS AND RETEST

Failure of any sample to conform to any of the requirements of this specification sheet 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.

5. PREPARATION FOR DELIVERY

5.1 FORM

Markers shall be supplied on a carrier, either wound on spools, in strips or fan folded.

5.2 STORAGE CONDITIONS

Markers should be stored in a clean dry location. Maximum storage temp. 40°C (104°F).

5.3 PACKAGING

Packaging shall be in accordance with good commercial practice.

5.4 MARKING

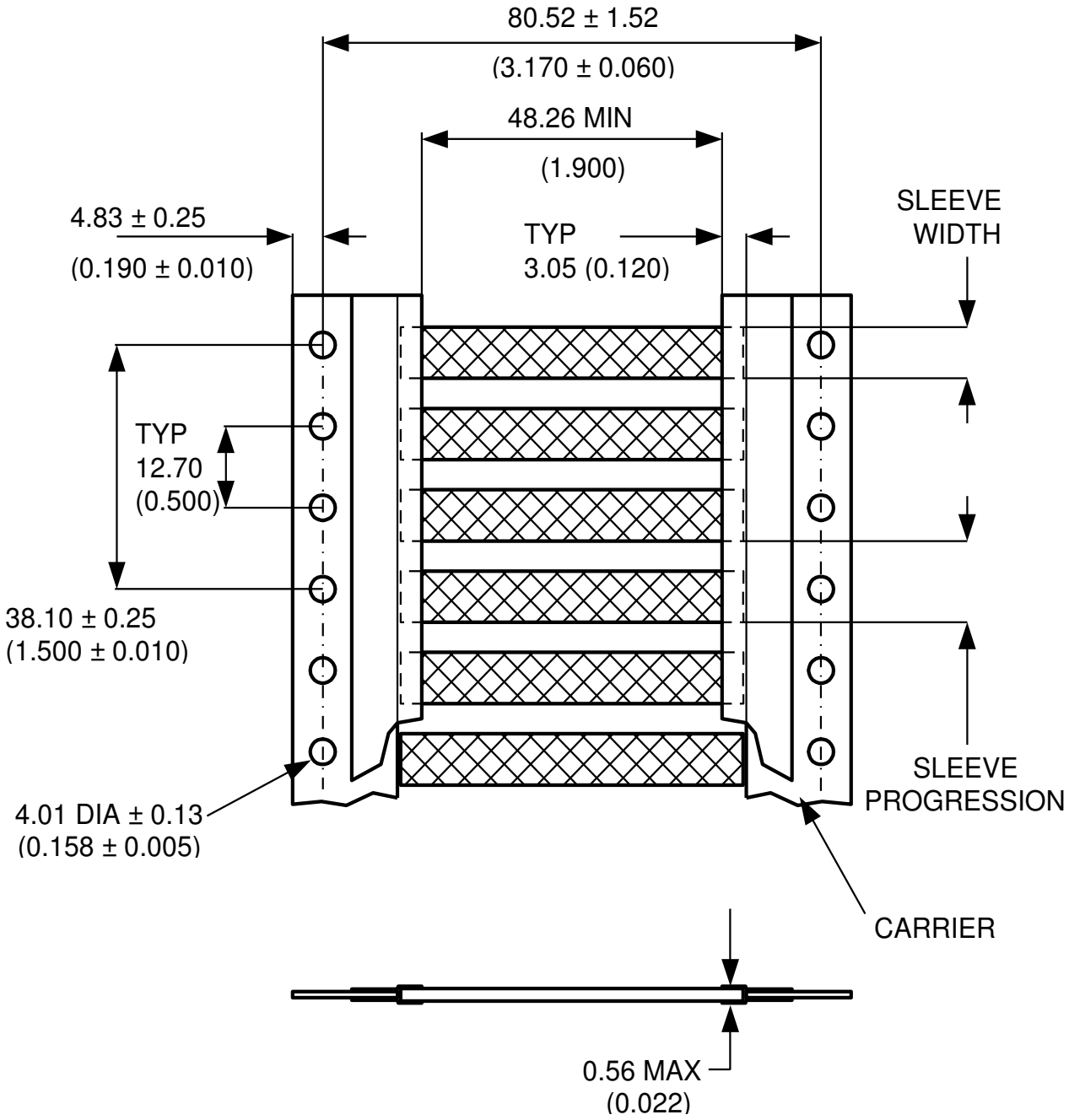
Each container of markers shall be identified with the product designation, size, quantity, manufacturer's identification and lot number and date of manufacture.

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FIGURE #1
Dimensions in mm (inches)



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TABLE 3

DIMENSIONAL REQUIREMENTS IN mm, (INCHES)					
Part Number	**Minimum Expanded Inside Dia.**	**Maximum Recovered Inside Dia.**	**Recovered wall thickness**	**Sleeve progression**	**Nominal Sleeve Weight (g)**
RPS 22-18	3.18 (0.125)	1.07 (0.042)	0.58 +/- 0.08 (0.023 +/- 0.003)	12.70 +/- 0.89 (0.500 +/- 0.035)	0.203
RPS 18-12	4.75 (0.187)	1.57 (0.062)	0.58 +/- 0.08 (0.023 +/- 0.003)	12.70 +/- 0.89 (0.500 +/- 0.035)	0.268
RPS 16-10	6.35 (0.250)	2.11 (0.083)	0.58 +/- 0.08 (0.023 +/- 0.003)	16.94 +/- 0.89 (0.667 +/- 0.035)	0.351
RPS 8-4	9.53 (0.375)	3.18 (0.125)	0.61 +/- 0.08 (0.024 +/- 0.003)	25.40 +/- 1.14 (1.000 +/- 0.045)	0.504
RPS 10-2	12.70 (0.500)	4.22 (0.166)	0.61 +/- 0.08 (0.024 +/- 0.003)	29.64 +/- 1.14 (1.167 +/- 0.045)	0.681
RPS 6-250	19.05 (0.750)	6.35 (0.250)	0.61 +/- 0.08 (0.024 +/- 0.003)	42.34 +/- 1.14 (1.667 +/- 0.045)	1.023
RPS 1-400	25.40 (1.000)	8.46 (0.333)	0.64 +/- 0.08 (0.025 +/- 0.003)	50.80 +/- 1.14 (2.000 +/- 0.045)	1.353
RPS 400-1000	38.10 (1.500)	19.05 (0.750)	0.51 +/- 0.08 (0.020 +/- 0.003)	71.96 +/- 1.14 (2.833 +/- 0.045)	2.198

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TABLE 4
Requirements

PROPERTY	UNIT	REQUIREMENT	TEST METHOD
Dimensions	mm (inches)	In accordance with Table 3 In accordance with Table 3	Section 4.3.1 ASTM D 2671
Longitudinal Change 3 min. at 200° ± 5°C (392° ± 9°F)	Percent	0 to -20	Section 4.3.1 ASTM D 2671
Tensile Strength 508 mm/min. (20 in./min)	MPa (psi)	8.27 minimum (1,200) minimum	Section 4.3.2 ASTM D 2671
Ultimate Elongation 508 mm/min. (20 in./min)	Percent	150 minimum	Section 4.3.2 ASTM D 2671
Low Temperature Flexibility 4 hours at -30° ± 2°C (-22° ± 4°F)	---	No cracking	Section 4.3.3
Print Performance Eraser Rub - 20 rubs, 2lbs Solvent / Brush - 30 strokes	 --- ---	 Legible at 356 mm (14 inches) Legible at 356 mm (14 inches)	 Section 4.3.4.1 Section 4.3.4.3
Heat Shock 1 hr. at 136° ± 2°C (277 ± 4°F)	---	No dripping, flowing, or cracking	Section 4.3.5 UL 224
Heat Aging 168 hrs. at 158° ± 2°C (316 ± 4°F) Followed by test for: Mandrel Bend Followed by: Print Performance Eraser Rub - 20 rubs	 --- --- ---	 No cracking Legible at 356 mm (14 inches)	 Section 4.3.6 Section 4.3.6.1 Section 4.3.6.2
Dielectric Strength	MV/m (Volts/mil)	19.7 minimum (500 minimum)	Section 4.3.7 ASTM D 2671
Corrosive Effect 16 hours at 158 ± 2°C (316° ± 4°F)	---	5% transparent area maximum	Section 4.3.8 ASTM D 2671 Procedure A
Flammability	---	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 4.3.9 UL 224 - All Tubing Flame Test
Water Absorption 24 hours at 23° ± 3°C (73° ± 5°F)	Percent	0.5 maximum	Section 4.3.10 ASTM D 2671
Fungus Resistance 56 day incubation Followed by test for: Tensile Strength Ultimate Elongation Dielectric Strength	 MPa (psi) Percent Kv / mm (Volts / mil)	 8.27 (1,200) minimum 150 minimum 19.7 minimum (500) minimum	Section 4.3.11 ISO 846 B Section 4.3.11.1 ISO 846 B Section 4.3.11.2 ISO 846 B Section 4.3.11.3 ISO 846 B

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TABLE 4
REQUIREMENTS cont.

Fluid Resistance 24 hours at 23° ± 3°C (73° ± 5°F) HydroFlouroCarbon Solvent Vertrel XF Isopropyl Alcohol Gasoline (unleaded) Diesel Fuel, DF2 Auto Engine Oil, SF 10W-40 (SAE J 183, SAE J 300) Motor Vehicle Brake Fluid, SAE J 1703 Ethylene Glycol Followed by: Print Performance Eraser Rub - 20 rubs	--- ---	--- Legible at 356 mm (14 inches)	Section 4.3.12 Section 4.3.4.1

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