

Specification RW-2535

Document Number: 108-121034

Pre-printed PVC Cable Markers

O-Type, K-type, Z-type, V-Type

SCOPE

This quality assurance specification establishes the quality standard for pre-printed PVC cable markers for use as a general purpose identification marker. PVC markers are available as alphanumeric characters or symbols and color coded in accordance with BS3858: 1992.

PVC markers are fabricated from specially designed, profile extruded plasticized PVC. Markers are pre-marked using a thermal foil and then flame sealed to improve mark adherence and print permanence.

PVC markers are supplied as individual idents or continuous legends. Z-Type and V-Type have expanding profiles which allow markers to accommodate a wide range of wire/cable sizes, O-Type markers are thin walled which is particularly suited to high density wiring applications where space saving is paramount.

O-Type, Z-Type and V-Type markers are designed to be fitted pre termination, K-type markers are designed to be applied once cabling has been installed. K-Type markers are designed to fit onto a PVC carrier, which is then attached to a substrate using cable ties.

Operating temperature range for markers: O-Type -65°C to 95°C, Z-Type, V-type and K-Type -40°C to 70°C.

O-Type Markers also conform to BS 3858: Type 3: 1992.

Approved Signatories:

This document is electronically reviewed and approved by TE Connectivity.

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1. REVISION HISTORY

Revision Number	Description of change	Date	Incorporated By
1	New Document	September 2013	Lee Smith
2	Minor format and IEWI reference removal. Replaces '108-121034' issue 1	October 2013	Lee Smith

2. REQUIREMENTS

2.1 Composition, appearance and color

Markers are manufactured from plasticized PVC. The markers shall be smooth and free from bubbles, pinholes and creases and other defects in appearance. Color shall be uniform, and be a reasonable match to the equivalent color given in BS 6746C.

Colors and Marking

Color of Sleeve	Color code numerical association*	Color of mark O-Type	Color of mark Z-Type	Color of mark K-Type	Color of mark V-Type
Black	0	White			White
Brown	1	White			White
Red	2	Black			White
Orange	3	Black			Black
Yellow	4	Black	Black	Black	Black
Green	5	Black			Black
Blue	6	Black			White
Violet	7	Black			White
Grey	8	Black			Black
White	9	Black	Black		Black
Pink	All symbols and alphabet	Black			

*IEC 60062 Marking codes for resistors and capacitors



Not Available

2.2 Dimensions

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2.2.1. O-Type Markers

Dimensions conform to BS3858 clause 9.2 (Type 3).

Available Sizes and Formats

Size code part cut	Marker size	Wire size guide		Cable size (mm ²)	Marker length	Number of characters	Nominal character height	Weight (g/250mm)	Packed
		min	max						
1106	0.75	0.6	1.0	-	3	1	1.6	0.33	1000
1107	10	0.9	1.3	-	4	1	2.0	0.41	1000
1108	12	1.1	1.6	-	3	1	2.0	0.47	1000
1109	15	1.4	2.1	-	3	2	2.0	0.56	1000
1110	20	1.9	2.8	-	5	2	2.5	0.84	1000
1111	25	2.4	3.5	1	5	2	2.5	1.02	1000
1112	30	2.9	4.8	1.5	5	3	1.6	1.20	1000
1113	40	3.9	5.8	2.5/4.0	5	3	2.0	1.54	1000
1114	55	5.3	8.0	6.0/10.0	5	2	4.0	2.06	1000

Supplied Dimensions

Size code part cut	Marker size	Internal diameter			Wall thickness	
		Nominal	min	max	min	max
1106	0.75	0.75	0.70	0.90	0.20	0.40
1107	10	1.00	0.85	1.15	0.20	0.40
1108	12	1.20	1.05	1.35	0.20	0.40
1109	15	1.50	1.35	1.65	0.20	0.40
1110	20	2.00	1.85	2.15	0.20	0.40
1111	25	2.50	2.35	2.65	0.20	0.40
1112	30	3.00	2.85	3.15	0.20	0.40
1113	40	4.00	3.75	4.25	0.20	0.40
1114	55	5.50	4.75	5.25	0.20	0.40

Dimensions in mm

Typical Part Description

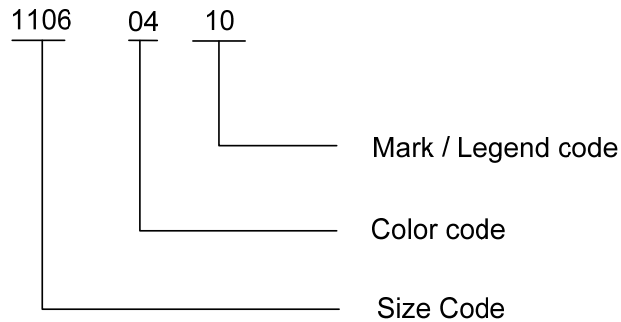
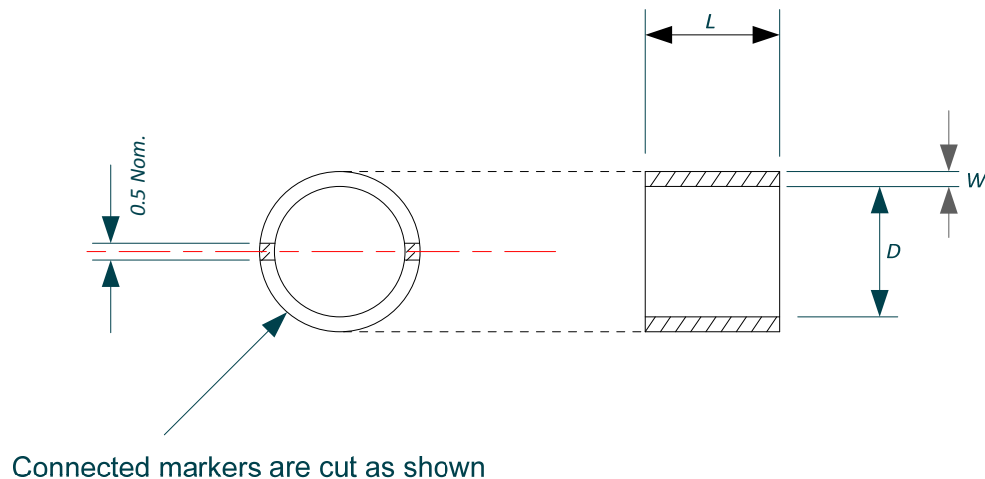
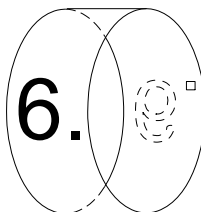


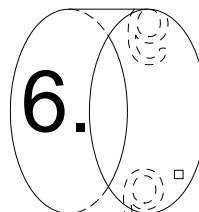
Figure 1: O-Type Marker Detail



Where two or more characters appear they shall be equally spaced. (Max error 10°) Head to tail



Character positional tolerance:
On centre ± 0.75 on horizontal Axis & $\pm 5^\circ$ rotational



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2.2.2. K-Type Markers

Supplied Dimensions

Size code part cut	Marker size	Wire size guide		Dimension 'A'		Dimension 'B'		Nominal character height	Weight (g/250mm)
		min	max	min	max	min	max		
1361	65	4.2	7.0	9.90	10.20	2.90	3.20	4.0	10.1

Available in yellow (4) only

Typical Part Description

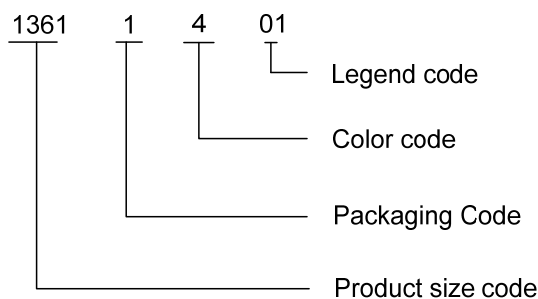
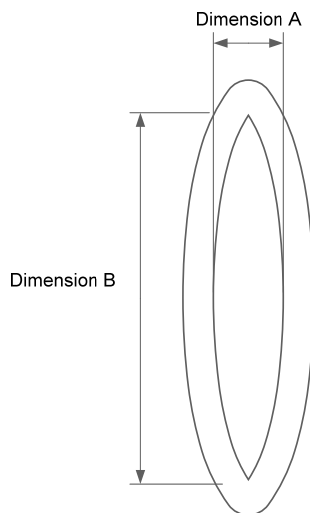


Figure 2: K-Type Marker Detail



Side elevation of K-Type marker showing height and width

2.2.3. Z-Type Markers

Supplied Dimensions

Size code (straight cut)	Size code chevron cut)	Marker size	Wire size guide		Marker length	Character height	Packed
			min	max			
0580	1151	5	1.5	2.0	4.3	1.8	1000
0581	1152	7	2.0	3.2	4.3	1.9	1000
0615	1153	9	2.5	4.0	4.3	2.6	1000
0616	1154	11	2.9	4.7	4.3	2.6	1000
0617	1155	13	3.4	5.7	4.3	2.7	1000
0618	1156	15	3.8	6.3	4.3	2.7	1000
0620	1157	18	4.3	6.9	4.3	2.7	500
0622	1158	23	5.5	8.9	6	3.5	500
0624	1159	35	7.9	12.7	6	3.5	250

Dimensions in mm

Available in Yellow (4) and White (9)

Typical Part Description

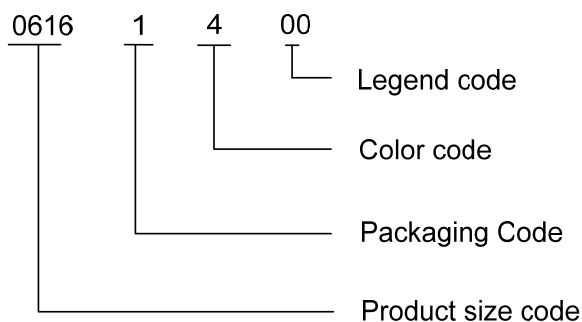
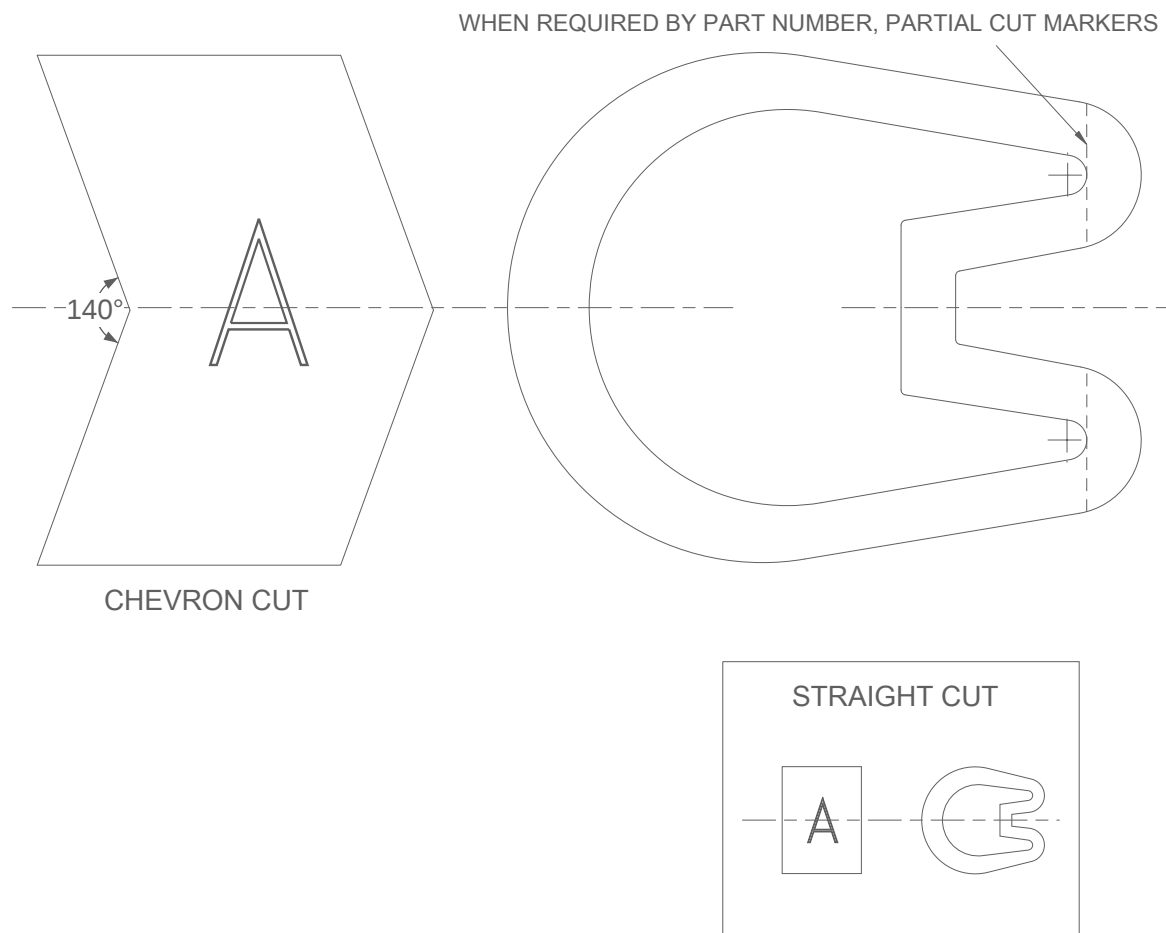


Figure 3: Z-Type Marker Detail



2.2.4. V-Type Markers

Supplied Dimensions

Size code	Marker size	Wire size guide		Marker length	Character height	Packed
		min	max			
0761	3/3	1.4	2.8	2.9	3.0	1000
0762	5/3	2.8	5.0	2.9	3.0	1000
0763	10/4	4.0	10.0	3.9	4.0	500
0764	16/6	8	16.0	5.9	4.0	250

Dimensions in mm

Typical Part Description

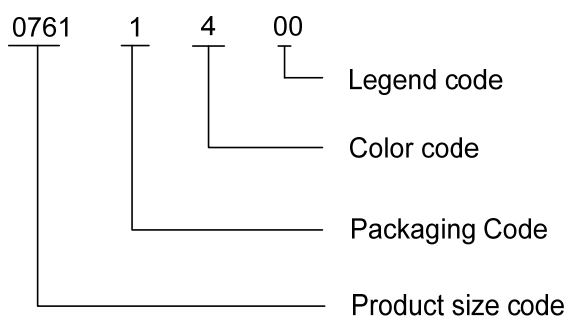
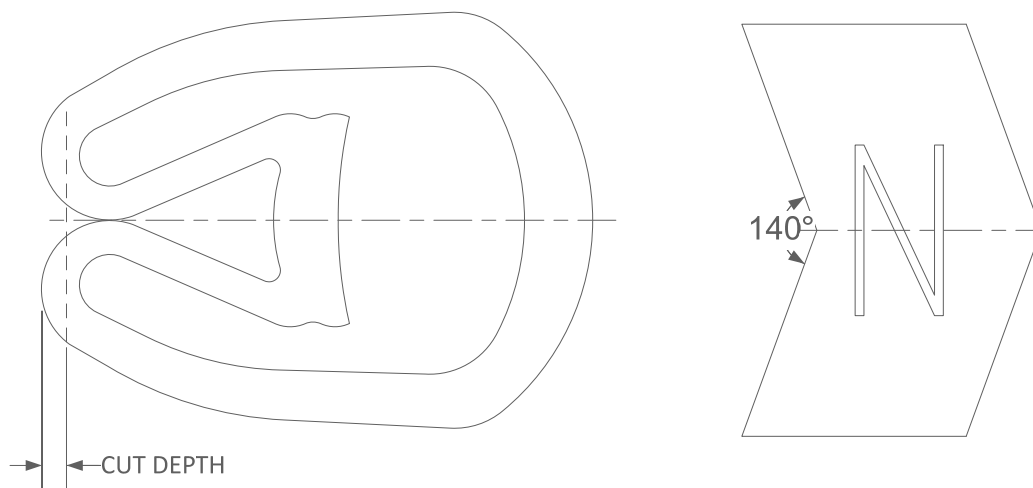


Figure 4: V-Type Marker Detail



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2.3 Printing

Markers are printed using hot foil marking with a single character or a legend. The mark is black or white as required. Where there is possibility of misinterpretation the characters shall be followed by a period in the lower right of the mark.

O-Type Markers shall conform to BS3858 Clause 7, Printing.

2.4 Properties

The markers shall meet the requirements of the general requirements table

3. QUALITY ASSURANCE PROVISIONS

3.1. Qualification Tests

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

Full qualification shall be carried out on size '55' O-Type Markers. A reduced schedule (shown in section 3.2 Sampling Instructions) is required for K-Type, Z-type and V-Type.

For O-Type Markers, the full regime shall be carried out on any color with a black mark and any color with a white mark. All colors are required for colorfastness testing.

For all other markers, only one color and size of each type is required.

3.2. Sampling Instructions

The following markers and sizes shall be submitted for test:

Marker type	Size	Scope
O-Type	Size 0.75, standard cut x 1 reel, any one color	Dimensions, finish, expansion, Print Adherence
	Size 55, standard cut, 1 reel of each color	Full Qualification
K-Type	Size 65, standard cut	Dimensions, finish, expansion, Print Adherence
Z-Type	Size 5, standard cut x 1 reel	Dimensions, finish, expansion, Print Adherence
	Size 35, standard cut x 1 reel	Dimensions, finish, expansion, Print Adherence
V-Type	Size 3/3, standard cut x 1 reel	Dimensions, finish, expansion, Print Adherence
	Size 16/6, standard cut x 1 reel	Dimensions, finish, expansion, Print Adherence

4. TEST PROCEDURES

4.1. Preparation of Test Specimens

Unless specified, markers shall be tested as supplied. All tests shall be made a temperature of $23 \pm 2^{\circ}\text{C}$.

When required by the test procedure, three markers shall be used for each test.

Except for Color Fastness to Light and Resistance to Mould Growth, markers shall be expanded onto metal mandrels before testing. Sizes are based on the maximum cable diameter as recommended by TE Connectivity:

Test Mandrel Requirements

Marker	Diameter of mandrel (marker size)	
O-Type ⁱ	1.125 (0.75 marker)	8.25 (55 marker)
K-Type	Not applicable	7.00 (Size 65)
V-type	2.8 (Size 3/3)	16.00 (Size 16)
Z-type	2.0 (Size 5)	12.70 (Size 35)

4.2 Physical Testing

4.2.1. Expansion

All marker types shall be tested. Three markers from each type shall be pushed by hand onto a tapered mandrel having an included angle of 15° .

Markers shall be applied onto a test mandrel of diameter equal to the maximum recommended diameter listed in section 4.1 'Preparation of Test Specimens'. Samples shall be held in position for 60 seconds.

Samples shall be examined for cracking, splitting or breaking from the mandrel.

4.3. Print Performance

4.3.1. Mark Adherence

All marker types shall be tested. Three samples shall be tested from each marker type. Samples shall be mounted onto metal mandrels as given in section 3.1, and then tested in accordance with TE test procedure 109-121012, using the 'Eraser Preparation for Mark Adherence testing' set up. Samples shall be rubbed 20 times using a Crockmeter fitted with an eraser and a 1kg load.

The marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

ⁱ O-Type marker size 55 is expanded to 1.5 times the original inside diameter in accordance with BS3858.

4.3.2. Solvent Resistance

O-Type Size 55 shall be tested for Solvent Resistance. Samples are prepared as described in section 4.1.

Test in accordance with TE test method 109-121014.

The marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

4.4. Environmental Testing

4.4.1. Resistance to Extremes of Temperature

All marker types shall be prepared as described in section 4.1.

O-Type Markers

Suspend vertically in an air circulating oven at 95°C for 168 hours. The samples are then transferred immediately to a cold chamber maintained at -65°C for 1 hour.

Z, K and V-Type Markers

Suspend vertically in an air circulating oven at 70°C for 168 hours. The samples are then transferred immediately to a cold chamber maintained at -40°C for 1 hour.

At the end of the conditioning period, check for signs of splitting, blistering or cracking. Samples shall be stored at 23°C for 4 hours.

Test samples in accordance with TE test procedure 109-121012, using the 'Eraser Preparation for Mark Adherence testing' set up. Samples shall be rubbed 20 times using a Crockmeter fitted with an eraser and a 1kg load.

The marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

4.4.2. Colour Fastness to Light

A continuous length of ten O-Type markers cut from a reel shall be used from each color. All colors shall be tested. Samples are tested in accordance with BS 2782: Part 5: Method 540B using a Xenon arc discharge lamp. Wool reference standards conforming to BS 1006: B01 shall be similarly exposed. The specimen temperature shall not exceed 40°C; no control over humidity shall be exercised.

The specimen shall be observed in D65 light using normal vision, for color change against the reference wool standards.

Guide to light fastness rating:

Rating 8	Excellent light fastness
Rating 7	Excellent light fastness
Rating 6	Very good light fastness
Rating 5	Fair light fastness (Impermanent)
Rating 4	Fair light fastness (Impermanent)
Rating 3	Poor light fastness (Fugitive)
Rating 2	Poor light fastness (Fugitive)
Rating 1	Very poor light fastness (Fugitive)

Samples are tested for Mark Adherence, in accordance with section 4.3.1. A mandrel shall be used to support the marker during the test. The marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

4.4.3. Resistance to Mould Growth

A continuous length of ten O-Type markers cut from a reel shall be used. Size 55 shall be submitted for testing.

Care should be taken during handling and with any containment used. Product contamination may lead to erroneous results.

The test method shall be as specified in BS EN 60068-2-10:2005. Samples shall be conditioned for 28 days, after which, Fungus growth is assessed in accordance with BS EN 60068-2-10:2005

The marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

4.4.4. Fluid Resistance

O-Type Size 55 shall be tested.

For each fluid, three samples shall be mounted onto metal mandrels as detailed in section 4.1. Completely immersed markers for the times and at the temperatures specified in the general requirements table. The volume of the fluid shall not be less than 20 times that of the specimen.

After immersion, lightly blot the markers with tissue paper to remove excess surface fluid and oven dry on absorbent tissue at 70°C for 2 hours prior to rub testing.

The marking shall be tested in accordance with TE test reference 109-121012. Samples are tested with a Crockmeter fitted with 'Super Twill' cloth and a 1kg load.

After the print permanence test, marking shall be examined for legibility using normal reading vision. Print contrast shall be measured in accordance with TE Document 411-121002.

5. Related Standards and Issueⁱⁱ

MIL-STD-202G METHOD 215: FEB 2002	PRESSURE-SENSITIVE ADHESIVE PLASTICS LABELS FOR PERMANENT USE
SAE AS5942	MARKING OF ELECTRICAL INSULATING MATERIALS
BS3858: 1992	SPECIFICATION FOR BINDING AND IDENTIFICATION SLEEVES FOR USE ON ELECTRIC CABLES AND WIRES
BS EN 60068-2- 10:2005	ENVIRONMENTAL TESTING, TESTS. TEST J AND GUIDANCE: MOULD GROWTH
BS 2782 PART 5 METHOD 540B	METHOD OF EXPOSURE TO LABORATORY LIGHT SOURCES (XENON ARC LAMP, ENCLOSED CARBON ARC LAMP, OPEN FLAME CARBON ARC AND FLUORESCENT TUBE LAMPS)

6. TE Connectivity Documents

TE REFERENCE	ISSUE	TITLE	COMPLIES WITH
411-121002	4	PRINT CONTRAST REFERENCE SCALE	NOT APPLICABLE
109-121012	5	PRINT PERMANENCE TESTING USING THE MECHANICAL CROCKMETER	SAE AS5942
109-121014	4	RESISTANCE TO SOLVENTS	MIL 202 METHOD 215

ⁱⁱ Subsequent amendments to, or revisions of, any of the above publications apply to this standard only when incorporated in it by updating, or revision.

7. List of Test Fluids

Fluid	Description
Aircraft fuel	A mixture of 70% (v/v ⁱⁱⁱ) 2,2,4 Trimethyl pentane and 30% (v/v) Toluene
MIL-PRF-23699	Synthetic lubricating oil STD class (NATO Code 0-156). Has replaced MIL-L-7808 oil at temperatures above 25°C.
MIL-H-83282	The principal hydraulic fluid used in military aircraft. It replaces MIL-H-5606.
Diesel Fuel (BS EN 590:2009 A1)	General automotive fuel
Propylene Glycol de-icing fluid (SAE-AMS-1424)	50/50% (v/v) mixture with water
Tap Water	Universal solvent
Sea Water	Artificial sea water
Sodium chloride solution	5% (mass/mass in water) standard salt solution
Teepol	1% Teepol in water (v/v) - commonly used detergent
IPA - Isopropyl alcohol	Widely used as a solvent and cleaner

8. Sampling

Testing frequency shall be Production routine or Qualification. Production routine tests shall be carried out on every manufactured batch and shall consist of visual examination for workmanship, printing quality and dimensions.

A manufactured batch is defined as that quantity of material extruded at any one time from the same compound batch.

Qualification shall be carried out to the requirements of the Design Authority.

9. Preparation for Delivery

9.1 Packaging

Markers shall be supplied on spools or in boxes. Each package shall be labeled showing the description, quantity, size, batch number and date of manufacture.

Additional information may be supplied as specified in the contract or order.

ⁱⁱⁱ v/v volume/volume

General Requirements

TEST	RW-2535 TEST METHOD	UNITS	TEST REQUIREMENTS
PHYSICAL			
Composition, appearance and color	Section 2.1.	---	Markers shall be smooth and free from bubbles, pinholes and creases and other defects in appearance. Color shall be uniform, and be a reasonable match to the equivalent color given in BS 6746C
Dimensions	Section 2.2.	mm	Figures 1 to 4
Expansion	Section 4.2	---	No splitting, cracking or breaking. Samples shall remain attached to the mandrel after 1 minute.
PRINT PERFORMANCE			
Printing	Section 2.3	---	O-Type markers BS3858:1992 Initial Print Contrast 8 minimum.
Mark Adherence	Section 4.3.1. TE Test Method 109-121012	---	Print shall remain legible, minimum Print Contrast 3
Solvent Resistance	Section 4.3.2. TE Test Method 109-121014	---	Print shall remain legible, minimum Print Contrast 3
ENVIRONMENTAL TESTING			
Resistance to Extremes of Temperature	Section 4.4.1.	---	No splitting, cracking or blistering. The original color shall be identifiable. Print shall remain legible, minimum Print Contrast 3
Color Fastness to Light	Section 4.4.2.	---	Colorfastness not less than blue wool scale 6. Print shall remain legible, minimum Print Contrast 3
Resistance to Mould Growth	Section 4.4.3.	---	Maximum growth scale 1 Print shall remain legible, minimum Print Contrast 3

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Fluid Resistance • Aircraft Fuel • MIL-PRF-23699 • MIL-H-83282 • Diesel Fuel • Propylene Glycol • Tap Water • Sea Water • Sodium Chloride (5% solution) • Teepol Detergent • Isopropyl alcohol	Section 4.4.4. 24 hours at 23°C, followed by 2 hours at 70°C air drying. 20 rubs using TE Test method 109-121012, Crockmeter, Super Twill, 1kg load.	---	No color change, no splitting swelling or cracking Print shall remain legible, minimum Print Contrast 3
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