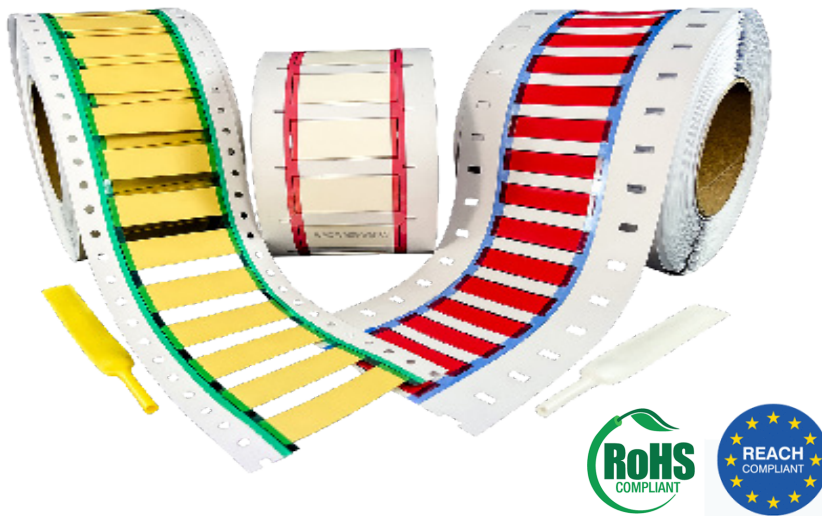


ZH -

Low Smoke 0-Halogen Flame-retardant Identification Sleeves

TECHNICAL DATA SHEET

Revision Number. 1.3
Last Edited 15. jul.2021



The ZH-2X Heat Shrinkable Wire Markers are made of halogen free, flame retardant and low smoke heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. Ideal for applications where limited fire hazard and low smoke characteristics are required.

The zero halogen material coupled with low smoke and low toxic fume emissions makes this product ideal in enclosed spaces such as mass transit, marine and industrial installations.

The compound of the tubing is excluded for halogens and offers excellent low fire hazard characteristics combined with minimal smoke emission.

ZH meets the NFPA 130 Standard and EN 60684-3. Test report available.

The ZH material is classified with EN45545-2 Class HL3 requirement set R22 (interior) - R23 (exterior) and R24 PCB " Printed Circuit boards" - electrotechnical products. Can be used without any restriction for any application.

Industry



Industry



Marine



Wind power



Commercial



Aerospace



Construction



Railway



Military



Electrical installations

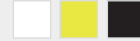


Petrochemical



Telecom

STANDARD TUBE COLOR



TUBE COLORS ON REQUEST



BACKING TAPE COLORS



MATERIAL

Extruded, cross linked polyolefin.

SHRINK RATIO

2:1

OPERATING TEMPERATURE

-55°C up to +105°C

(-67°F to 221°F)

Shrink Temperature

≥90° (194°F)

COMPLIANCES

Mark Permanence:

SAE AS-5942

LUL 3349

Print Resistance to solvents:

MIL-STD-202H

Test method 215

RECOMMENDED BLACK RIBBON

FTI-Y, FTI-X, FTI-HXX

INDUSTRY STANDARDS

EN 60684-3

EN45545-2 Class HL3 R22-23-R24

NFPA 130

NF F 16-101

London Underground

1-085 A3

BOEING BSS 7239

UNI CEI 11170-3 (LR4)

DIN 5510-2

BS6853: 1999 vehicle category 1a

STORAGE

Cool and dry in original packaging. Recommended temperature at +10°C to +25°C and 45-55% relative humidity. Use within 2 years from date of manufacture.

APPLICATIONS

Specific developed to be used in Rail, Aerospace, Marine, Industrial marking, insulation, wire bundling and mechanical protection.

General Tests for Identification Products

PHYSICAL

| PROPERTIES | TEST METHOD | TYPICAL VALUE |
|---------------------|-------------|--------------------------|
| Tensile strength | ASTM D 638 | 10.0 N/mm ² . |
| Elongation at break | ASTM D 638 | ≥200% |
| Longitudinal change | ASTM D 2671 | -10% to +5% |
| Water absorption | ASTM D 570 | ≤ 0,15% |
| Specific gravity | ASTM D 792 | 1,40 |

ELECTRICAL

| PROPERTIES | TEST METHOD | TYPICAL VALUE |
|---------------------|-------------|-------------------------|
| Dielectric strength | ASTM D 2671 | 20.0 kV/mm ² |
| Volume resistivity | ASTM D 257 | ≥ 10 ¹⁴ Ω/cm |

CHEMICAL

| PROPERTIES | TEST METHOD | TYPICAL VALUE |
|---------------------|---------------|-------------------------------|
| Chemical resistance | EN 60684-2-36 | Good - Pass |
| Copper corrosion | EN 60684-2-33 | No chemical interaction: PASS |
| Copper stability | N-A | N-A |

THERMAL

| PROPERTIES | TEST METHOD | TYPICAL VALUE |
|---|-------------------------|--|
| Heat shock 4 hours at 175°C | ASTM D 2671 | No dripping, cracking or flowing |
| Heat aging 168 hours at 150°C | ASTM D 638 | Elongation ≥ 100% |
| Flammability | ASTM D 2671 Procedure C | Pass » flame retardant |
| Low temperature flexibility / Bending | 1h at - 55°C EN 60684-2 | No cracking, no break, no detachment of coating |
| Optical density of smoke (D _s) | ASTM E 662 | Flaming mode 41 , non flaming mode 111 |
| Smoke index | NF F 16-101 | Smoke class F1 |
| Surface Flammability of Materials - Flame Spread Index - Tested on 19.1 mm sleeve ??? | ASTM E 162 | Specified Maximum = 35 |
| Heat and visible smoke release rate | ASTM E 1354 | Average Heat Release Rate & Average specific Extinguishing area M ² / kg at 3 minutes is measured |
| Generation of Toxic gases 3x3 inches sample burning in controlled setting | BSS 7239 | Toxicity for CO, HF, HCN, HCl, SO ₂ and NO _x in Combustion Gases |

FIRE PROPAGATION COMPARISON

| NORMATIVES | TOXICITY | LOW OXYGEN INDEX (LOI) | SMOKE DENSITY | FLAMMABILITY SPREAD INDEX | CAPACITY OF FORMING DROPS |
|----------------------|----------|------------------------|---------------|---------------------------|---------------------------|
| EN45545-2 | HL3 | HL3 | HL3 | - | - |
| NF F 16 101 | - | - | Class F1 | Class I4 | - |
| BS 6853 - Superseded | 1a | 1a | 1a | - | - |
| DIN 5510-2 | Pass | - | SR2 | - | ST1 |
| NFPA130 | Pass | - | Pass | Pass | - |
| UNI CEI 11170-3 | LR4 | LR4 | - | LR4 | - |

Fire behavior Standard Classification for Identification Products

| STANDARDS | CLASSIFICATION | USAGE |
|------------------------------|--------------------------------------|--|
| EN 45545-2 (R22 - R23 - R24) | HL3 | Unlimited Usage All Vehicles |
| BS6853 | 1a | Unlimited Usage All Vehicles |
| UNI CEI 11170-3 | LR4 | Unlimited Usage All Vehicles |
| DIN 5510-2 | SR2, ST1 | Usage Limited |
| NF F 16-101 | F1 & I4 | Usage Limited to External Vehicles |
| NFPA 130 | National Fire Protection Association | Usage Permitted upon agreement with end user |
| BSS 7239 | Boeing | Usage Permitted upon agreement with end user |

Compliance on fire behavior for Identification Products

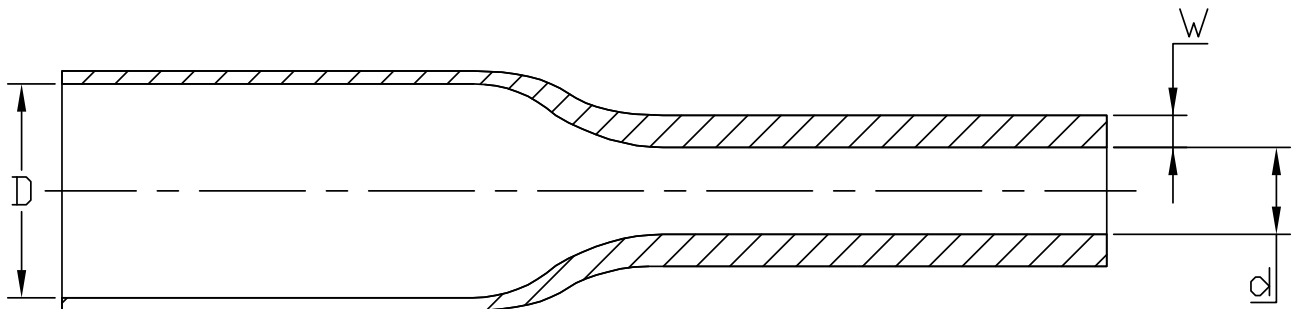
TEST METHOD

| STANDARDS | FLAME PROPAGATION FLAME SPREAD INDEX | TOXICITY | SMOKE OPTICAL DENSITY | LOW OXYGEN INDEX | HEAT AND VISIBLE SMOKE RELEASE |
|--------------------|---|---------------------------------------|--------------------------|---------------------|-----------------------------------|
| BS6853 | | BS 6853 appendix B1 or NF X-70-100 | BS 6853 D8.3 | ISO 4589-2 | |
| NF F-16 101 | NF EN 60-695-2 | NF X 70-100 | NF X 10-702-1 & 2 | ISO 4589-2 | |
| NFPA130 | ASTM E 162 | BSS 7239 | ASTM E 662 | N/A | ASTM E 1354 |
| EN 45545-2 | | NF X 70-100 600°C | EN ISO 5659-2 | ISO 4589-2 | |
| DIN 5510-2 | DIN 54837 | DIN ISO 5510-2 | DIN 54837 | | |

Product Dimensions

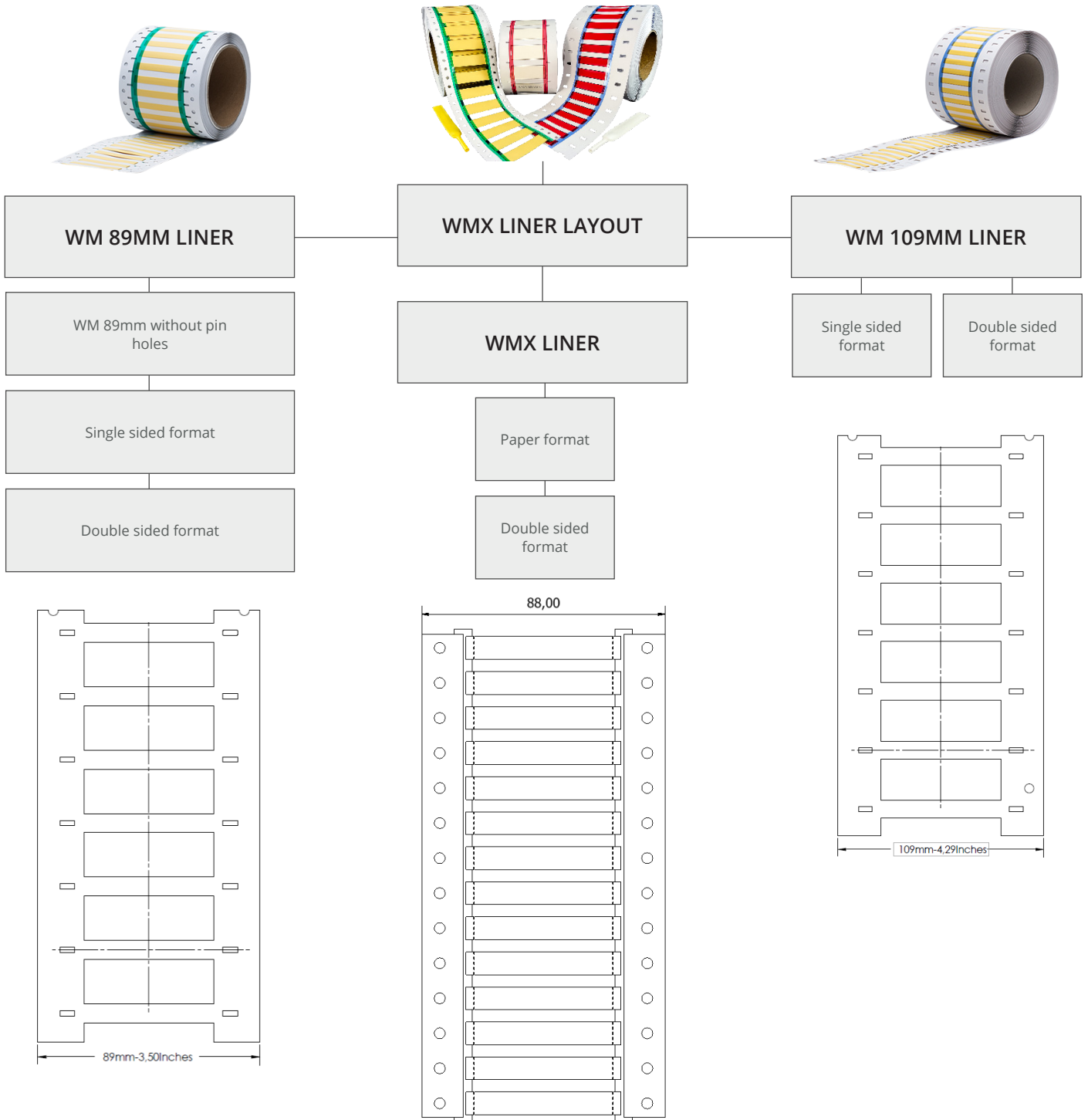
DIMENSIONS 2:1

| SIZE, INCHES | SIZE, MM | MINIMUM ID (D), AS SUPPLIED MM (INCHES) | MAXIMUM ID, RECOVERED (D) MM (INCHES) | RECOVERED WALL THICKNESS (W), MM (INCHES) |
|--------------|----------|---|---------------------------------------|---|
| 3/32 | 2.4 | 2.5 (0.098) | 1.2 (0.047) | 0.43 (0.017) |
| 1/8 | 3.2 | 3.6 (0.142) | 1.6 (0.063) | 0.55 (0.022) |
| 3/16 | 4.8 | 5.2 (0.189) | 2.4 (0.094) | 0.55 (0.022) |
| 1/4 | 6.4 | 6.7 (0.263) | 3.2 (0.126) | 0.65 (0.025) |
| 3/8 | 9.5 | 10.0 (0.393) | 4.8 (0.189) | 0.65 (0.025) |
| 1/2 | 12.7 | 13.6 (0.53) | 6.4 (0.250) | 0.65 (0.025) |
| 3/4 | 19.1 | 20.4 (0.80) | 9.5 (0.374) | 0.70 (0.027) |
| 1 | 25.4 | 27.0 (1.06) | 12.7 (0.500) | 0.85(0.033) |
| 1 ½ | 38.1 | 40.0 (1.57) | 19.1 (0.750) | 0.90(0.035) |
| 2 | 50.8 | 50.8 (2) | 25.4 (1.0) | 0.90(0.035) |

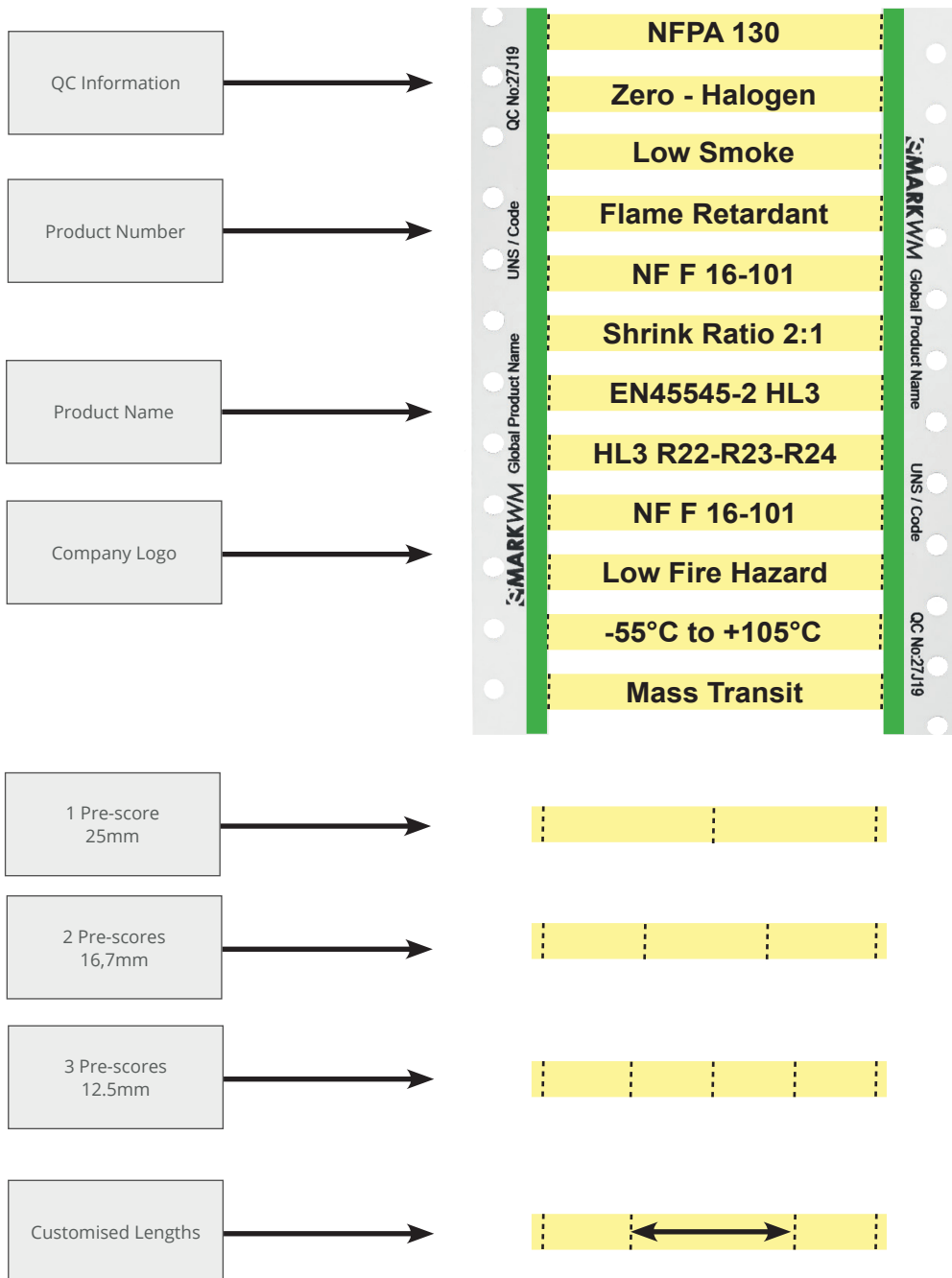


Heat Shrink Product in as supplied "D" and fully recovered state "d" with recovered wall "W"

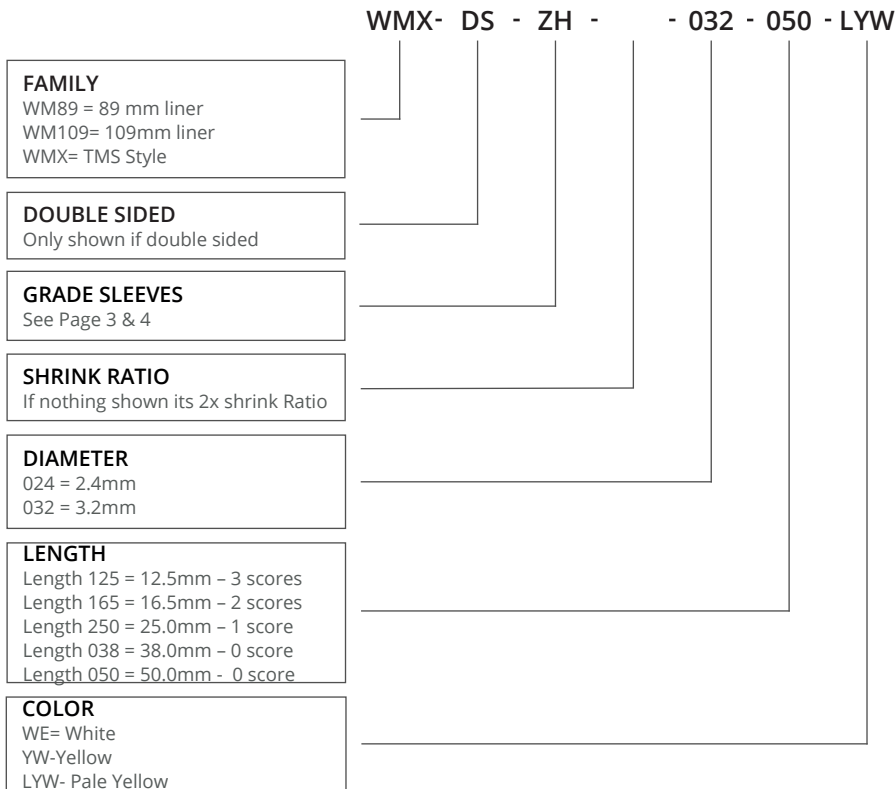
Available Formats



Customised Liner Information



Product code example



Available options -

| SIZE MM | SIZE INCHES | STANDARD | BULK | JUMBO |
|--------------|-------------|----------|-------|--------|
| 2,4 x 50 mm | 3/32 - 2.0 | 1.000 | 5.000 | 10.000 |
| 3,2 x 50 mm | 1/8 - 2.0 | 1.000 | 5.000 | 10.000 |
| 4,8 x 50 mm | 3/16 - 2.0 | 1.000 | 5.000 | 10.000 |
| 6,4 x 50 mm | 1/4 - 2.0 | 1.000 | 3.000 | 6.000 |
| 9,5 x 50 mm | 3/8 - 2.0 | 500 | 2.000 | 4.000 |
| 12,7 x 50 mm | 1/2 - 2.0 | 500 | 1.500 | 3.000 |
| 19,0 x 50 mm | 3/4 - 2.0 | 500 | 1.500 | 3.000 |
| 25,4 x 50 mm | 1 - 2.0 | 300 | 1.000 | 2.000 |
| 38,1 x 50 mm | 1 1/2 - 2.0 | 100 | 600 | 1.200 |
| 50,8 x 50 mm | 2 - 2.0 | 100 | 600 | 1.200 |

Other Spool sizes on request -

Ordering description

| ORDERING DESCRIPTION EXAMPLES | STANDARD PACK SIZE | SUPPLIED DIAMETER | | RECOVERED DIAMETER | | RECOMMENDED USE RANGE (MIN-MAX) | |
|------------------------------------|-----------------------|----------------------|-----------|-----------------------|--------|------------------------------------|-------------|
| | pcs | mm | inches | mm | inches | mm | inches |
| Family-Tube Grade-3X-024-50-Colour | 1.000 | 2,4 x 50mm | 3/32-2.0 | 0.7 | 0.031 | 0.8-1.9 | 0.032-0.075 |
| Family-Tube Grade-3X-032-50-Colour | 1.000 | 3,2 x 50mm | 1/8-2.0 | 1.0 | 0.042 | 1.1-2.6 | 0.044-0.105 |
| Family-Tube Grade-3X-048-50-Colour | 1.000 | 4,8 x 50mm | 3/16-2.0 | 1,5 | 0.062 | 1.7-4.0 | 0.069-0.160 |
| Family-Tube Grade-3X-064-50-Colour | 1.000 | 6,4 x 50mm | 1/4-2.0 | 2.3 | 0,095 | 2.3-5.4 | 0.091-0.215 |
| Family-Tube Grade-3X-095-50-Colour | 500 | 9,5 x 50mm | 3/8-2.0 | 3.1 | 0.125 | 3.4-8.1 | 0.137-0.320 |
| Family-Tube Grade-3X-127-50-Colour | 500 | 12,7 x 50mm | 1/2-2.0 | 4.75 | 0,187 | 4.6-10.7 | 0.183-0.425 |
| Family-Tube Grade-3X-190-50-Colour | 500 | 19,0 x 50mm | 3/4-2.0 | 6.35 | 0.250 | 6.9-16.2 | 0.275-0.640 |
| Family-Tube Grade-3X-254-50-Colour | 300 | 25,4 x 50mm | 1-2.0 | 8.47 | 0.33 | 9.2-21.5 | 0.366-0.850 |
| Family-Tube Grade-3X-381-50-Colour | 100 | 38,1 x 50mm | 1 1/2-2.0 | 12.9 | 0.51 | 20.9-33.0 | 0.825-1.300 |
| Family-Tube Grade-3X-508-50-Colour | 100 | 50,8 x 50mm | 2-2.0 | 17.2 | 0.68 | 27.9-44.9 | 1.100-1.750 |

Available Tube Grades

| PRODUCT GROUP | TUBE GRADE | CHARACTERISTICS | COMPLIANCES |
|----------------|------------|---|---|
| WMX-WM89-WM109 | C3 | The C3- 3:1 shrink ratio, heat shrinkable wire Markers are made of, flame retardant in inch sizes heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. C3 meets NFPA 130 requirements. The C3 material are fabricated to meet the material performance requirements of the AMS-DTL-23053/5 class 1 and meet the features in Airbus specification NSA 937201. The compound is also UL224 and CSA compliant. Ideal for Aerospace, military, industrial and energy applications. Marker sleeves meet the mark permanence requirements of AS5942 and MIL 202 Method 215K | EN 60684-3 NFPA 130 UL224 CSA 22.2 No. 198- SAE-AMS-DTL-23053/5 SAE AS 81531 / 5942 MIL-STD-202F method 215J AMS-DTL-23053/5 AIRBUS NSA937201 |
| WMX-WM89-WM109 | ZH | The ZH heatshrink tubing are made of halogen free, flame retardant, heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. The compound of the tubing is excluded for halogens and offers excellent fire safety characteristics combined with minimal smoke emission. The material meet Boeing BS 7239 for toxic gas generation M7 specification-The ZH material is classified with EN45545-2 Class HL3 requirement set R22 (interior) and R23 (exterior) and be used without any restriction for any application. R24 (electrotechnical products) "PCB Printed Circuit Boards" by test method EN ISO 4589-2, burning behavior determined by Oxygen Index only and be used without any restriction for any application. NFPA 130 & EN 60684-3 test report are available on request | EN 45545-2 HL3, R22/R23/R24 NFPA 130 EN 60684-3 LUL 1-085 A3 compliant BS 6853 (1999) cat 1a DIN5510-2 UNI CEI 11170-3 NF F 16 101 ASTM E 662, BSS 7239 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | LFH | The LFH printable heatshrink tubing are made of halogen free, flame retardant and low smoke heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. The compound of the tubing is excluded for halogens and offers excellent low fire hazard characteristics combined with minimal smoke emission. | UL224 CSA 22.2 No. 198- SAE AS 81531 / 5942 MIL-STD-202F method 215J EN50343 Annex H Section H.3 |
| WMX-WM89-WM109 | LFH-3X | The LFH printable heatshrink tubing are made of halogen free, flame retardant and low smoke heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. The compound of the tubing is excluded for halogens and offers excellent low fire hazard characteristics combined with minimal smoke emission. | UL224 CSA 22.2 No. 198- SAE AS 81531 / 5942 MIL-STD-202F method 215J EN50343 Annex H Section H.3 |
| WMX-WM89-WM109 | HT | The HT printable heatshrink tubing are made of semi flexible highly flame retardant polyvinylidene fluoride tubing. High temperature rated thin wall markers with high transparency. Excellent chemical resistance to most industrial fuels, chemicals, solvents and high degree of mechanical strength properties suitable for aerospace, defense and mass transit applications. It is inherently flame retardant, semi-rigid and highly resistant to most industrial fuels, chemicals and solvents. | UL224 SAE-AMS-DTL-23053/8 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | DR | The DR printable is printable irradiated cross linked, flame retardant, semi-rigid, diesel oil resistant heat shrinkable polyolefin tubing. Especially suitable for railways and complies with SNCF requirements NF F 00608 cat. A & H. Used where resistance to organic fluids, common fuels, lubricants and solvents properties are required for use in mass transit, aerospace, marine and industrial installations. | NF F 00-608 Class A & H UL224 SAE-AMS-DTL-23053/6 Class 1 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | AMD | The AMD printable heatshrink are made of highly flame retardant, self-extinguishing and very flexible heat shrinkable polyolefin tubing with ideal printability properties for identification purposes within aerospace, military and defence specified applications. UL VW1/CSA recognized and complies to AMS-DTL-23053/5 Class 1&3. This heatshrink are very versatile through excellent balance of chemical, electrical and mechanical properties. | NFPA 130 UL224 SAE-AMS-DTL-23053/5 Class 1 & 3 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | AMD-3X | The AMD printable heatshrink are made of highly flame retardant, self-extinguishing and very flexible heat shrinkable polyolefin tubing with ideal printability properties for identification purposes within aerospace, military and defence specified applications. UL VW1/CSA recognized and complies to AMS-DTL-23053/5 Class 1&3. This heatshrink is very versatile through excellent balance of chemical, electrical and mechanical properties. | NFPA 130 UL224 SAE-AMS-DTL-23053/5 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | 3-1 | The 3-1 a very flexible heatshrink tubing are made of flame retarded, heat shrinkable polyolefin tubing with ideal printability properties for identification purposes. Meets the requirements of a wide range of industrial standards such as SAE-AMS-DTL 23053/5 class 1 & 3. Yellow green versio also available. Material: Irradiated cross-linked flexible flame-retarded polyolefin Shrink Temperature: Min 90 dgc. | SAE-AMS-DTL-23053/5 class 1&3 UL224 600V VW-1 rating CSA 22.2 No. 198.1-98 SAE AS 81531 / 5942 MIL-STD-202F method 215J |
| WMX-WM89-WM109 | ZHR | ZHR-2X and 3X Heat Shrinkable Wire Markers are made of halogen free, flame retardant and low smoke heat shrinkable polyolefin tubing with ideal printability properties for identification purposes, which provides fluid resistance as per EN50343. This product meets rail standards EN50343 Appendix H and EN45545-2 requirement set R22/R23/24 hazard level classification 1 and 2. The compound of the tubing is excluded for halogens and offers excellent low fire hazard characteristics combined with minimal smoke emission.It can also be used for applications where limited fire hazard characteristics are necessary. | Diesel Resistance: EN50343 annex H (section 6.6) Fire Propagation: EN45545-1 HL3, R22-R23-R24 Chemical and Diesel Resistance: EN50343 annex H (section 6.6) MIL-STD-202F Method 215J Mark Permanence: EN50343 annex H (section 6.6) & SAE AS-5942 |

Related Standard Test Methods And Documents

| Document | Description |
|--|---|
| ASTM D638 | Tensile strength and ultimate elongation |
| ASTM D638 | Heat aging 168 at 150°C |
| ASTM D2671 heat shock (section 26-30), procedure b | Heat shock 4 hours at 175°C |
| ASTM D2671 | Longitudinal change |
| ASTM D2671 (Section 79-80) ASTM D570 | Water absorption. 2 Maximum |
| ASTM D149 | Dialectrical strength. 20 minimum |
| ASTM D2671B replaced by EN 60684-2-33 | Copper corrosion (Section 93 procedure A) damaged area of copper mirror, |
| EN 60684-2-36 | Chemical resistance to selected fluids |
| ASTM D257 | Volume resistivity |
| ASTM D 635-HB - | Flamiability resistance - Fire propagation |
| ASTM D E 662 | Optical density of smoke generated by solid materials, (Ds) measured in flaming mode and non flaming mode in single smoke chamber test. |
| ASTM D E 162 | Flame Spread Index . Surface Flammability of Materials Using a Radiant Heat Energy Source |
| ASTM D E 1354 | Heat and Visible Smoke Release Rates of Materials and Products using an Oxygen Consumption (Cone) Calorimeter |
| ASTM D792 Method A | Specific gravity |
| Boeing BS 7239 | Toxic gas generation M7. Gases produced for analysis are generated in a specified, calibrated smoke chamber during standard rate of smoke generation testing (ASTM E 662), in both flaming combustion and non-flaming pyrolytic decomposition test modes |
| BS EN ISO 4589-1: 1999 - Oxygen Index | Limited Oxygen Index- flammability hazard rating.Determination of burning behavior by oxygen index - part 2: ambient temperature test. 32% minimum |
| BS 6853 (1999) vehicle catagory 1a | Code of practice for fire precautions in the design and construction of passanger carrying trains |
| DIN 54837 | DIN 54837 Testing of materials, small components and component sections for rail vehicles- determination of burning behaviour using a gas burner |
| DIN 5510-2 | German railway normative related to fire protection on railway vehicles |
| ISO 5659-2: 2017 | Optical density of smoke (Dm) measured in flaming mode and non flaming mode in single smoke chamber test. |
| EN45545-2 HL3 - HL 1 - HL 2 - HL 3 | Railway applications. Rolling stock fire protection on railway vehicles. - Part 2 requirements for fire behavior of materials and components. Fire hazard class. HL1,2 & 3 R22 (Interior) & R23 (exterior) R24 - PCB - EN ISO 4589-2 , burning behavior determined by LOI - Low Oxygen Index only |
| IEC 60684-2 & 3 | Low temperature flexibility. Flexible insulating sleeving - Part 3: Specifications for individual types of sleeving - Sheet 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1 |
| London Underground Standard 1-085 | Revision A3, Fire safety performance of materials |
| NF C 20-455 | Fire hazard testing glowin/hot-wire based test methods. Glow-wire apparatus and common test procedure.c Replaced by EN ISO 60695-2-11 |
| NF F 16-101: 1988 | Railway rolling stock fire behavior choice of materials Rolling stock classification A1. |
| NF X 70-100: 1986 | Fire tests analisis of pyrolysis and cumbustion gases tube furnace method |
| NF X 10-702-1/2 | Determination of the opacity of smoke in a non-renewed atmosphere. the resulting density /time curve is used to calculate the smoke index |
| NF T 51-071: 1999 | Oxygen index test. This test have been replaced by IEC 60695-2-11/EN 60965-2-11 |
| NFPA 130 | National Fire Protection Association. Standard for fixed guideway transit and passenger rail systems This tandard specifies fire protection and life saety requirements for underground, surface and elevated fixed guideway transit and passenger rail systems |
| MIL 202 Method 215 | Resistance to-of solvents. Test methods for electronic and electrical component parts |
| SAE AS5942;2014 | Marking og insulation materials- Print permanence testing using the mechanical crockmeter |