



Technical Specifications

LIQUID-TUFF™

Low Smoke Zero Halogen – Type LSZH UL Liquidtight Flexible Metal Conduit Type LFMC

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Scope

This specification covers Kaf-Tech's LIQUID-TUFF™ LOW SMOKE ZERO HALOGEN (LSZH) UL Liquidtight Flexible Metal Conduit designed for use as a raceway for power, control and communication cables in accordance with Article 350 of the National Electric Code.

The product is intended for applications where limiting smoke and toxic materials of combustion are important considerations. The product is Underwriters Laboratories Inc. (UL) Listed for use at 80°C (176°F) in a dry location, 60°C (140°F) in a wet location and 70°C (158°F) in an oily location. It is also UL Listed through 2½ trade size for direct burial, outdoor use, sunlight resistance and for -40°C (-40°F) low temperatures applications. UL Listed Liquidtight Flexible Metal Conduit is manufactured and tested in accordance with Underwriters Laboratories Inc. Standard UL 360. The product carries the UL Listing Mark. Underwriters Laboratories Inc. does not list any manufacturers Liquidtight Flexible Metal Conduit as being low smoke zero halogen.

Construction

The LIQUID-TUFF™ LSZH Liquidtight Flexible Metal Conduit shall be formed from zinc coated galvanized low carbon steel strip having a uniform width and thickness. There shall be a continuous copper bonding strip built into the conduit core for the 3/8 through 1¼ trade sizes. The construction shall be in accordance with the UL 360 Standard. The Low Smoke Zero Halogen designation shall be based upon testing to ASTM® 162 – Flame Spread Index, ASTM® E662 – Smoke Density Generation and Bombardier SMP-800C – Toxic Gas Generation. The finished LIQUID-TUFF™ LSZH Liquidtight Flexible Metal Conduit dimensions shall be in accordance with Table 5.1 of UL 360 which is summarized in Table 3.

Jacket

A rugged low-smoke, moisture, oil, sunlight resistant and flame retardant thermoplastic polyurethane jacket shall be applied directly over the flexible metal conduit. The physical properties of the jacket material shall comply with the UL 360 Standard. The Low Smoke Zero Halogen jacket shall be tested to and comply with ASTM® 162 – Flame Spread Index, ASTM® E662 – Smoke Density Generation and Bombardier SMP-800C – Toxic Gas Generation. The test results are summarized in Table 1. Underwriters Laboratories Inc. (UL) does not List any manufacturers jacket compound as being low smoke zero halogen. The jacket wall thickness shall be in accordance with Table 4.1 of UL 360 which is summarized in Table 2.

Grounding

Permanent circuit ground protection is provided through the continuous copper bonding strip built into the conduit core in trade sizes 3/8 through 1¼. A separate grounding conductor is required by the NEC® for all trade sizes 1½ and larger.

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Reference Standards

UL 360	Standard for Liquidtight Flexible Steel Conduit
File Reference	UL E26540
NEC® Articles	250.102, 250.118(7), 250.134(B), 300.22, 350, 390.15, 501.4(B)(2), 502.4(A)(1)(e), 503.3(A)(2), 511.7(A)(1), 645.5(D)(2), 680.21, 680.42, 695.6(E) and 695.14(E)
Department of Defense	UL 360 adopted on October 1, 1987
ASTM® E 162	Flame Spread Index
ASTM® E 662	Smoke Density Generation
Bombardier SMP-800C	Toxic Gas Generation
UL 94	Tests for Flammability of Plastic Materials for Parts

Markings

The surface of the outer jacket shall be clearly marked with a legible print legend in compliance with the UL 360 Standard.

Performance Tests

In accordance with UL 360, the completed LIQUID-TUFF™ LSZH Liquidtight Flexible Metal Conduit shall meet all of the performance requirements outlined in Appendix A.



Low Smoke Zero Halogen – Type LSZH UL Liquidtight Flexible Metal Conduit Type LFMC



Table 1
LIQUID-TUFF™ LSZH Combustion and Flammability Properties

PROPERTY	TEST	RESULTS
Vertical Burn (Material)	UL 94	UL Listed: V-O Rating No Flaming Drips
Vertical Burn (Conduit)	UL 360	UL Listed: Passed
Oxygen Index % (Material)	ASTM® D 2863	25%
Flame Spread Index	ASTM® E-162	Passed No Flaming Drips
Smoke Generation (Flaming)	ASTM® E662 (NFPA-258)	Ds=13 @ 1.5 min Ds=57 @ 4.0 min No Flaming Drips
Smoke Generation (Non-flaming)	ASTM® E662 (NFPA-258)	Ds=1 @ 1.5 min Ds=8 @ 4.0 min No Flaming Drips
Toxic Gas Generation	Bombardier SMP-800C	Pass

Testing performed by independent test laboratory.
Test results available upon request.

Table 2
Jacket Thickness

Conduit Trade		Minimum Acceptable Average Thickness of Jacket, (inches)
Trade Size	Metric Designator	
3/8	12	0.030
1/2	16	0.030
3/4	21	0.035
1	27	0.035
1¼	35	0.035
1½	41	0.040
2	53	0.040
2½	63	0.050

Table 3
Conduit Diameters
Acceptable Internal and External Diameters

Conduit Size		Internal Diameter, In.		Over Conduit, In.		Over Jacket, In.	
Trade Size, In.	Metric Designator	Min.	Max.	Min.	Max.	Min.	Max.
3/8	12	0.484	0.504	0.594	0.614	0.690	0.710
1/2	16	0.622	0.642	0.732	0.765	0.820	0.840
3/4	21	0.820	0.840	0.930	0.960	1.030	1.050
1	27	1.041	1.066	1.201	1.226	1.290	1.315
1¼	35	1.380	1.410	1.540	1.570	1.630	1.660
1½	41	1.575	1.600	1.735	1.770	1.865	1.900
2	53	2.020	2.045	2.180	2.215	2.340	2.375
2½	63	2.480	2.505	2.640	2.675	2.840	2.875

Appendix A

UL 360 Performance Tests

Resistance and High Current
Fault Current
Impact
Tension
Crushing
Pipe Stiffness
Flexibility
Low Temperature Flexibility
Zinc Coating
Vertical Flame
Physical Properties
Deformation
Mechanical Water Absorption
Moisture Penetration
Sunlight Resistance
Test for Secureness of Fittings
Test for Durability of Ink Printing



Technical Specifications

LIQUID-TUFF™

Low Smoke Zero Halogen – Type LSZH-VF Non-UL Liquidtight Flexible Metal Conduit

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Scope

This specification covers KafTech's LIQUID-TUFF™ Non-UL LOW SMOKE ZERO HALOGEN (LSZH) Liquidtight Flexible Metal Conduit designed for use as a raceway for power, control and communication cables. The product is intended for applications where limiting smoke and toxic materials of combustion are important considerations. The product is intended for use at 80°C (176°F) in a dry location, 60°C (140°F) in a wet location and 70°C (158°F) in an oily location. It is also acceptable for outdoor use at -40°C (-40°F) low temperatures and is sunlight resistant. This Liquidtight Flexible Metal Conduit is manufactured and tested in accordance with generally accepted industry practices.

Construction

The LIQUID-TUFF™ LSZH Liquidtight Flexible Metal Conduit shall be formed from zinc coated galvanized low carbon steel strip having a uniform width and thickness. The Low Smoke Zero Halogen designation shall be based upon testing to ASTM® 162 – Flame Spread Index, ASTM® E662 – Smoke Density Generation and Bombardier SMP-800C – Toxic Gas Generation. The finished LIQUID-TUFF™ LSZH Liquidtight Flexible Metal Conduit dimensions shall be in accordance with Table 3.

Jacket

A rugged low-smoke, moisture, oil, sunlight resistant and flame retardant thermoplastic polyurethane jacket shall be applied directly over the flexible metal conduit. The Low Smoke Zero Halogen jacket shall be tested to and comply with ASTM® 162 – Flame Spread Index, ASTM® E662 – Smoke Density Generation and Bombardier SMP-800C – Toxic Gas Generation. The test results are summarized in Table 1. In addition the jacket shall comply with Table 2 of this specification.

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Reference Standards

ASTM® E 162	Flame Spread Index
ASTM® E 662	Smoke Density Generation
Bombardier SMP-800C	Toxic Gas Generation
UL 94	Tests for Flammability of Plastic Materials for Parts

Grounding

A separate grounding conductor is required for all trade sizes.

Markings

The surface of the outer jacket shall be clearly marked with the applicable print legend.

Performance Tests

The completed LIQUID-TUFF™ LSZH Non-UL Liquidtight Flexible Metal Conduit shall meet all of the performance requirements outlined in Appendix A.

Low Smoke Zero Halogen – Type LSZH-VF Non-UL Liquidtight Flexible Metal Conduit



Table 1
LIQUID-TUFF™ LSZH-VF Combustion and Flammability Properties

PROPERTY	TEST	RESULTS
Vertical Burn (Material)	UL 94	UL Listed: V-O Rating No Flaming Drips
Vertical Burn (Conduit)	UL 360	Passed
Oxygen Index % (Material)	ASTM® D 2863	25%
Flame Spread Index	ASTM® E-162	Passed No Flaming Drips
Smoke Generation (Flaming)	ASTM® E662 (NFPA-258)	Ds=13 @ 1.5 min Ds=57 @ 4.0 min No Flaming Drips
Smoke Generation (Non-flaming)	ASTM® E662 (NFPA-258)	Ds=1 @ 1.5 min Ds=8 @ 4.0 min No Flaming Drips
Toxic Gas Generation	Bombardier SMP-800C	Pass

Testing performed by independent test laboratory.
Test results available upon request.

Table 3
Conduit Diameters
Acceptable Internal and External Diameters

Conduit Size		Internal Diameter, In.		Over Conduit, In.		Over Jacket, In.	
Trade Size, In.	Metric Designator	Min.	Max.	Min.	Max.	Min.	Max.
3/8	12	0.484	0.504	0.594	0.614	0.690	0.710
1/2	16	0.622	0.642	0.732	0.765	0.820	0.840
3/4	21	0.820	0.840	0.930	0.960	1.030	1.050
1	27	1.041	1.066	1.201	1.226	1.290	1.315
1¼	35	1.380	1.410	1.540	1.570	1.630	1.660
1½	41	1.575	1.600	1.735	1.770	1.865	1.900
2	53	2.020	2.045	2.180	2.215	2.340	2.375
2½	63	2.480	2.505	2.640	2.675	2.840	2.875

Table 2
Jacket Thickness

Conduit Trade		Minimum Acceptable Average Thickness of Jacket, (inches)
Trade Size	Metric Designator	
3/8	12	0.030
1/2	16	0.030
3/4	21	0.035
1	27	0.035
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1½	41	0.040
2	53	0.040
2½	63	0.050

Appendix A

Performance Tests

Flexibility
Low Temperature Flexibility
Zinc Coating
Vertical Flame
Physical Properties
Deformation
Mechanical Water Absorption
Moisture Penetration
Sunlight Resistance
Test for Durability of Ink Printing