



Low Smoke Zero Halogen Cables

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Defining Low Smoke Zero Halogen

- Cable that burns cleanly and does not contain halogens

- No true official LSZH definition
 - Low Smoke is officially defined in several standards
 - LS (low smoke), ST1 (smoke test), plenum (NFPA 262)

 - Zero Halogen not clearly defined
 - Some Toxicity and Corrosivity tests
 - No UL recognized zero halogen cable designation



Common LSZH Terms

LSZH	Low Smoke Zero Halogen
LSF	Low Smoke and Fume
NHFR	Non Halogen Flame Retardant
HFFR	Halogen Free Flame Retardant
FRNC	Fire Retardant Non Corrosive
FRLS	Fire Resistant Low Smoke
LC	Low Corrosivity
LH	Low Halogen



LSZH Cables Available

- Control Cable
- Instrumentation Cable
- Fiber Optic
- Industrial Ethernet
- VFD Cable
- Shielded Control Cable
- Thermocouple Extension
- Security Cable
- Building Wire
- 600V Power Cable



Defined UL Low Smoke Types

■ ST1

- UL 83 Single Thermoplastic Wire (THHN, THWN, etc)
- UL 44 Single Thermoset Wire (RHH, RHW, etc)
- UL 719 Non-metallic sheathed cable (NM-B, NMC-B)

■ LS

- Type AC Type CMx Type DP
- Type ITC Type MC Flexible Motor Supply
- Type BLx/BMx Type OFx Type TC
- Wind Turbine Tray Cable (WTTC)



Why zero halogen?

- Halogens are prevalent in wire cable as part of common polymers and flame retardants

- Halogens used in cable:
 - Fluorine – in polymer (e.g. FEP, PTFE)
 - Chlorine – in polymer (e.g. PVC, CSPE, CPE)
 - Bromine – used as flame retardant additive (e.g. PBDE)

- Halogens function by free radical reduction
 - Acid gases (e.g. HCl) are produced which can harm people and damage equipment
 - Incomplete combustion results in thick, dark smoke
 - Part of the reason the terms are combined



Halogen Content of W&C

Polymer	Halogen Content (% by weight)
▪ XLP (cross-linked polyethylene)	<0.02
with halogen-free flame retardants	<0.02
with halogenated flame retardants	7–17
▪ EPR (ethylene propylene rubber)	<0.02
with halogenated flame retardants	9–14
▪ PU (polyurethane)	<0.02
▪ PE (polyethylene)	<0.02
with halogen-free flame retardants	<0.02
▪ CSPE (chlorosulfonated polyethylene)	13–26
▪ CPE (chlorinated polyethylene)	14–28
▪ PVC (polyvinyl chloride)	22–29
▪ FEP (fluorinated ethylene propylene)	62–78

(<0.02 generally considered zero halogen)



How do LSZH Products work?

- Most common method is used of inorganic hydrated mineral fillers
 - Aluminum Trihydrate (ATH) and Magnesium Hydroxide (MDH)
$$2\text{Al}(\text{OH})_3 \rightarrow \text{Al}_2\text{O}_3 + 3\text{H}_2\text{O} \quad (230^\circ\text{C})$$
$$\text{Mg}(\text{OH})_2 \rightarrow \text{MgO} + \text{H}_2\text{O} \quad (330^\circ\text{C})$$
- Three modes of flame retardance
 - Water vapor formed during combustion
 - Reduces available organic fuel load
 - Protective char layer formed
- Main disadvantage is high loading levels need (>60%)
 - Can lead to reduction in physical properties
 - Synergistic additives and coatings used to improve performance



Advantages of LSZH

- Less smoke generated allowing for safe evacuation and fire suppression
- Potential for less secondary equipment damage from corrosive smoke
- Potentially lower total life cycle environmental impact



Disadvantages of LSZH

- Potential Reduction in physical properties
 - Reduced Tensile Strength and Elongation
 - Increased Moisture Absorption
 - Reduced insulation resistance and dielectric strength
 - Less resistant to oil and chemicals
- Need for LSZH cable when other halogenated materials present
- Need for LSZH when environment is well ventilated
- Special Pulling Lubricant Needed
- Halogenated materials have longer track record



LSZH Applications

- Confined spaces with high cable density and human inhabitants or sensitive equipment
 - Shipboard – Navy specified LSZH in middle of 1980s
 - Public Transit – King’s cross fire in Europe
 - Europe
 - Central Offices / Data Centers
 - Latest generation of nuclear plants
- Other US applications?
 - Automotive
 - Specified for other public areas?
 - Arenas, shopping malls, houses of worship



Applications with minimum benefit?

- Installations with low concentration of cables relative to other materials (e.g. residential)
- Where exposed to chemicals or oils
- Installations with physical stress
- Non-confined areas
- Direct burial



Future of LSZH

- Environmental / Green aspects of materials increasingly important
- LSZH cables will continue to improve
- Adoption as industry becomes more comfortable with LSZH material
- What happens if a significant failure occurs in the field?
- Or if a significant non-LSZH failure occurs?



Questions?



- Thank you!