Low Smoke, Zero Halogen Cable Technology

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Goals

To Understand:

Basics of Flame Retardant Systems

&

Associated Performance Levels

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There is a growing industry trend towards cable designs that are halogen free

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Halogen free industry trend

Globalization – European influence

911 Security & Safety Emphasis

RoHS / Green Initiatives

National Standards – NFPA 502 & 130

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The Dark Side of Halogens

When halogenated materials are exposed to a fire, acid gas is created

These corrosive & toxic byproducts can damage equipment and pose a threat to human life

Most halogenated materials will generate significant smoke levels during a fire

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The Dark Side of Halogens

Example – Industrial Plant

Small contained fire in a facility that recently installed new process electronics

Less than $2K cable was replaced but over $250K of electronics was destroyed by fire byproducts

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The Dark Side of Halogens
Example – Toronto Transit

Large fire involving cable

Gases forced all fire fighting to cease

Major economic loss

Since specified LSZH cables

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What are Halogenated,
Flame Retardant Systems
&
How do they work?

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Traditional wire & cable technology utilizes halogenated systems to make compounds flame retardant

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The following three halogens are typically used in cables:

Chlorine
Bromine
Fluorine

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When exposed to fire, halogens are released and attached themselves to oxygen in the area of the fire

This deprives the fire of oxygen & acts to suffocate the fire

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Halogens are either added to a compound

or

They are part of the basic resin molecular structure

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The following have chlorine in their molecular structure:

Neoprene (Polychloroprene)

Hypalon (Chlorosulfonated Polyethylene)

CPE (Chlorinated Polyethylene)

PVC (Polyvinyl Chlorine)

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The following common insulation materials do not contain halogens in their basic molecular structure:

XLPE (Crosslinked Polyethylene)

EPR (Ethylene Propylene Rubber)

Because of this, they have no inherent flame retardancy and burn readily

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To make these materials flame retardant, we must add a halogen element

Either a chlorinated or brominated flame retardant system can be used; however, more current compounds use bromine rather than chlorine

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What are Halogen Free,
Flame Retardant Systems
&
How do they work?

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To eliminate the negative aspects of halogenated flame retardants,

metallic salts can be added to polyolefins (not inherently flame retardant) to provide flame retardancy

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These metallic salts
(aluminum tri hydrate & magnesium hydroxide)
release water molecules as one of their combustion byproducts

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The fire is suppressed three ways:

Water release is endothermic (withdraws heat & cools)

Water release (steam) displaces oxygen

Char forming element acts as a fire block

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An effective flame retardant zero halogen compound needs to contain a high loading of these metallic salts

A typical compound would contain greater than 50% of these additives in conjunction with the base polymers

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If LSZH cable technology exists, why hasn't it been utilized extensively in the United States?

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A tale of two cultures:

Europe vs. North America

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Europe puts a premium on:

Low smoke generation & Elimination of halogens

North America puts a premium on:

Fire Stopping Ability & Resistance to water

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Property	North American Halogenated Cables	European LSZH Cables
Fire Resistance	Excellent	Fair / Poor
Acid Gas Generation	High	None
Water Resistance	Excellent	Poor
Contains Lead	Typically	No

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Culturally, North American users and specifiers were not willing to compromise and sacrifice on fire and water resistance

For the last 25 years, North American users, specifiers & cable manufacturers have been awaiting a technology break through

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Fire Event – Stop Flame Spread

Let's focus our attention on
fire stopping capability
of various flame retardant systems

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Flame Spread – (UL) VW-1

(UL) Standard No. 44

Individual insulated conductors

All samples 14 AWG

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Flame Spread – (UL) VW-1

Flame Source: Tirrill Burner
Chamber: Sheet metal ventilated hood
Flame Application: 5 applications
15 sec. followed by 15 sec. rest
Failure Modes: Burn Paper Flag
Ignite Cotton
Burn longer than 60 sec.

Note: Application only when sample is not burning

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Flame Spread – (UL) VW-1

See Video

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Flame Spread – Tray Flame Test

Let's scale up this to actual finish cable vertical tray flame testing based upon IEEE -1202

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Flame Spread – Tray Flame Test

Why IEEE-1202 / FT-4?

UL / CSA Harmonization

IEEE-383 has adopted IEEE-1202

Tough Test – It differentiates

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How does IEEE-1202 differ from the (UL) 1277 tray flame test?

Burner on upward angle

Max. burn allowed (56”)

Bundled cable below ½”

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IEEE-1202 (UL)

See Video

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From

Fire To Water

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How much water does a compound absorb?

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Gravimetric Water Absorption

Slab of fixed dimension

Immersed in 70C water for 168 hrs.

Weighed before & after

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Gravimetric Water Absorption

(168 hrs. @ 70C)

European LSZH 10 mg/sq. in.

New US Style LSZH 3 mg/sq. in.

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What long term effect does water have on electrical properties?

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Long Term Insulation Resistance

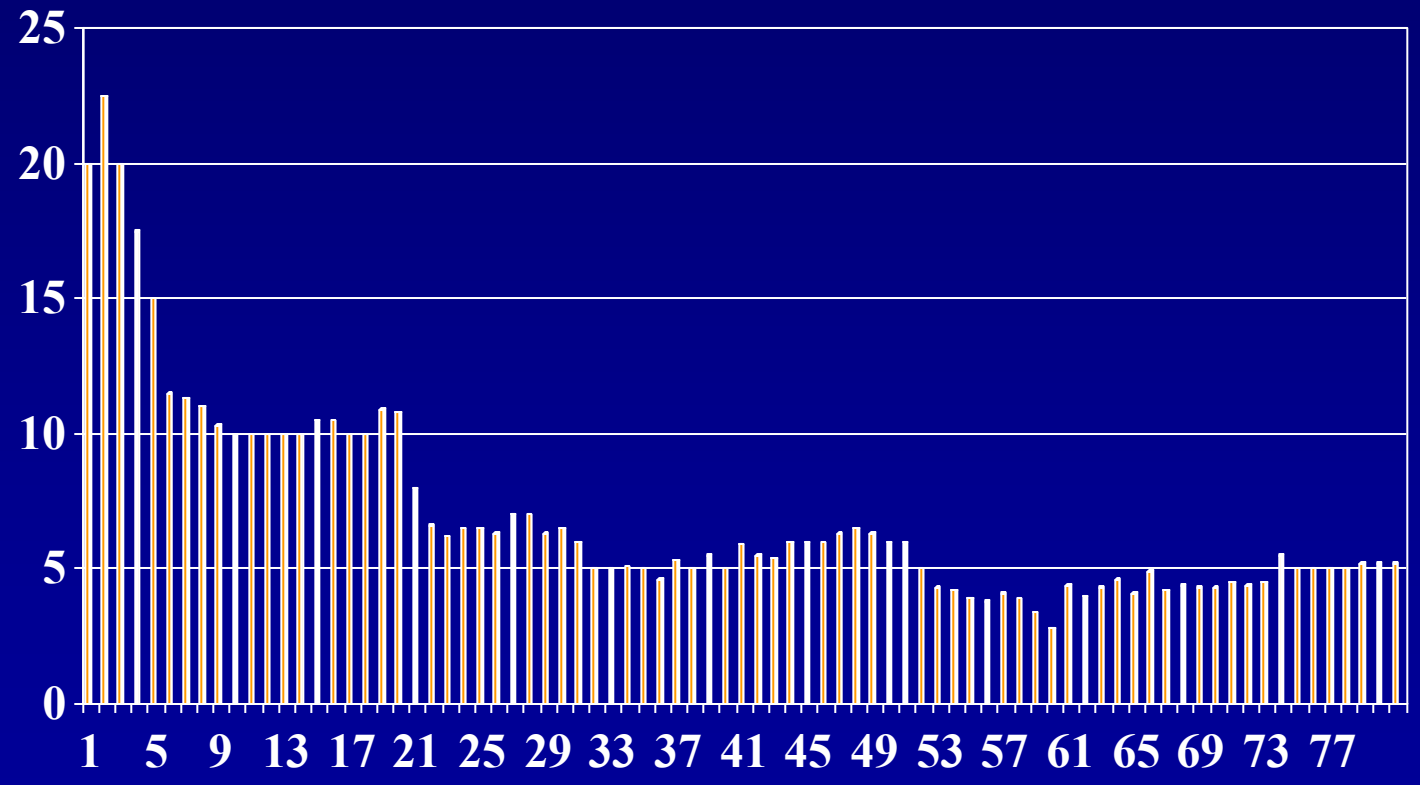
Insulated conductors immersed in 90C water

Insulation Resistance measured every week

Long Term Insulation Resistance

New US Style LSZH

(90C Water: Megohms -1,000ft. Vs. Weeks)



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Long Term Insulation Resistance

(90C Water)

European LSZH 0.3 @ 1 week*

New US Style LSZH 4.6 @ 2 years*

** megohms-1,000 ft.*

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(UL) 90C Wet Listing

European LSZH Not Attainable

New US Style LSZH XHHW-2

Halogenated vs. Non Halogenated

Property	North American Halogenated Cables	Traditional LSZH Cables	New US Style LSZH
Fire Resistance	Excellent	Fair / Poor	Very Good
Acid Gas Generation	High	None	None
Water Resistance	Excellent	Poor	Excellent
Contains Lead	Typically	No	No

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CONCLUSIONS:

Not all "LSZH" cables are alike.

The best of today's current technology has bridged the "Fire & Water" performance gap.