

Flammability Ratings

Definitions and classification of internal cables on their behavior upon flame

FEBRUARY
2017

As the amount of indoor cables installed in buildings increases, it also increases the manufacturers, installers and end users concern about safety offered by these products in case of fire.

The cables security is a key point for choosing our products, it ensures the integrity of people, the equipment protection, and changes the current vision of cost-benefit. The advantages relating to people's safety, equipment and investment protection are important factors observed in new buildings, switchboards and electrical installations in general.

The manufactured cables with characteristics of flame retardance have as main objective to prevent the spread of fire. Thus, it avoids the use of cables using coverage with materials that propagate the fire for indoor use, replacing them with others with better performance on the flame.

Designating the type of cable used in a project is critical to the infrastructure protection or construction. Therefore, it is important to understand the flammability characteristics and the cable applications used in a network infrastructure.

This technical information defines the following cable ratings for internal installations:

- CMX - Twisted Pair Cable (Limited Use)
- OFN/CM - Optical/Twisted Pair Cable (General Use)
- OFNR/CMR - Optical/Twisted Pair Riser Cable
- OFNP/CMP - Optical/Twisted Pair Plenum Cable
- LSZH - Low Smoke Zero Halogen

In general, the indoor cables are classified, according to their behavior in the flame, into four types:

Plenum

OFNP/CMP

Riser

OFNR/CMR

General Use

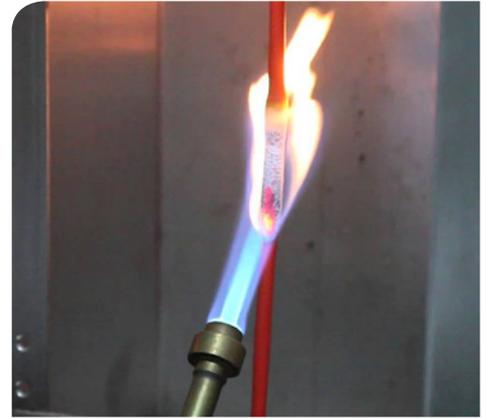
OFN/CM

Limited Use

CMX

CMX

They are suited for applications inside metal ducts where **there is no cable concentration** nor forced airflow, and that the exposed region is not more than 3 m long, and their greatest transverse dimension should be less than 6.35 mm. For cables within this classification, the vertical flame propagation test is evaluated as UL 2556 “VW-1 (Vertical Wire) Flame Test”, and the gases generated in combustion and smoke density are not evaluated. If agreed between customer and supplier, the cable can be evaluated according to IEC 60332-1.



Burning test IEC 60332-1

CM/OFN

Twisted Pair copper (CM) or optical cables (OFN) are of general use, and suitable for vertical application in ducts with high concentration in places without forced air flow in installations in the same environment or in locations with similar fire propagation conditions. For these cables, the vertical propagation of the flame is evaluated according to the test method UL 1685 “Vertical Flame Test-Tray” and gases generated in the combustion and smoke density are not evaluated. If agreed between customer and supplier, the cable can be evaluated according to IEC 60332-3.



Burning chamber UL 1666 / CMR

CMR/OFN

Twisted Pair Copper (CMR) or optical cables (OFNR) of the riser type are for vertical application in shafts, in installations where cables exceed more than one floor, in places without forced air flow, in ducts with low concentration or places with fire propagation conditions similar to these. For these cables, the vertical propagation of the flame is evaluated according to the test method UL 1666 and gases generated in the combustion and smoke density are not evaluated.

CMP/OFNP

They are suitable for horizontal application in confined spaces (between floors, ceiling, gutters, etc.), with or without forced airflow, or places with fire propagation conditions similar to these. To be qualified as CMP/OFNP, internal cables must be evaluated for their flame spread and smoke density according to the NFPA 262 or UL 910 standards.



Steiner Tunnel Test (NFPA-262)

The CMX cables have less protection against the spread of flames. For this reason, it is of **limited use** and is not recommended for installations through open gutters or structures with forced airflow.

The CM/OFN cables are of **general use**, i.e. they do not have many restrictions, being indicated for commercial indoor facilities. However, they must be installed through ducts in environments without forced airflow.

The CMR/OFNR Cables for riser applications, are installed in buildings backbones, and as they are thrown through shafts, they must have a good feature to delay the spread of fire.

The CMP/OFNP cables are insulated with fluoropolymer (FEP), i.e. halogen, and are typically installed in ventilation and air conditioning ducts. These cables have a more widespread use in the US and Canadian markets.

Flame Resistance Level	Test Method (Thermic Capacity)	Cable
Regular	UL 2556 (VW-1) (1 700 BTU/h)	CMX
Good	UL 1685 (70 000 BTU/h)	CM/OFN
Excellent	UL 1666 (527 500 BTU/h)	CMR/OFNR
Excellent	NFPA-262 (300 000 BTU/h)	CMP/OFNP

LSZH Cables

In a fire, the fire spread can be very damaging to infrastructure or construction, but the smoke containing toxic gas is the leading cause of damages to people's health. The damage to buildings are reversible, but the damage to people often are not.

Seeking to increase the safety of people during a fire, it was developed the LSZH materials - Low Smoke Zero Halogen that, during the firing process, presents low smoke and do not generate toxic gases. Thus, it minimizes the main risk factors to people, as the smoke hampers the exit of people from the environment and the toxic gases generated can lead to choking, depending on the time exposed to them.

The LSZH cables must meet flame retardance characteristics of IEC 60332-1 or IEC 60332-3 cables, and the smoke density requirements and toxicity of the gases generated in combustion. They are recommended for large concentration or movement of persons as commercial buildings, train and subway stations, hospitals, airports, etc.

LSZH-1 (60332-1)

They are suited for applications in ducts where **there are no cables pooling**, with or without forced air flow and where the exposed region is not more than 3 m long, thus its greatest transverse dimension is less than 6.4 mm, in areas where there is large influx of public. To be classified as LSZH-1, indoor cables must be evaluated for vertical flame propagation, according to IEC 60332-1, Smoke density according to IEC 61034-1 and IEC 61034-2, and toxicity of the gases generated in the combustion according to ES713.

LSZH (60332-3)

They are suited for applications in horizontal and vertical paths and spaces with or without forced airflow or in places with fire propagation conditions similar to those in areas with large influx of public. To be classified as LSZH, internal cables must be evaluated for vertical flame propagation, according to IEC 60332-3, Smoke density according to IEC 61034-1 and IEC 61034-2, and toxicity of the gases generated in the combustion according to ES713.

The use of cables retardant to the flame, as described in this report, provides greater reliability and protection to people and facilities.

IEC x UL Classification

There are many questions about the similarity between the IEC 60332-1, IEC 60332-3, CMX and CM classifications.

The cables classified as IEC 60332-1 (LSZH-1) or CMX, are recommended for applications with simple cables without the use of cable bundles. In the table below, we can see the difference between the test methods:

Characteristics	IEC 60332-1	CMX (UL 2556)
Sample	Sixty cm cable sample is fixed vertically inside a metal box.	Sixty cm cable sample is fixed vertically inside a metal box.
Burner	175 mm Flame applied for 60 seconds with a 45° angle located at 450 mm from the top. (LAN cables - diameter below 25 mm)	Flame applied five times for 15 seconds with 15 seconds intervals without burning. Flame at a 20° angle located at 238 mm from the bottom.
Approval Criteria	A cable is considered approved after the firing stops and the carbonized position (burned) does not exceed 50 mm from the top position of the top fixing.	Cable is considered approved if the paper flag positioned on the cable at 250 mm from the burner does not ignite.

The IEC 60332-3 and UL 1685 (CM), describe the test methods for determining the capacity of bundled cables to resist the spread of fire. In the IEC 60332-3 test, a 3.5 long cable sample is set in a vertical ladder where the flame is applied. Five categories (A/F, A, B, C and D) are defined as the amount of cables and test duration. The sample is considered approved if the maximum length of carbonized part does not reach a height higher than 2.5 m above the bottom edge of the burner.

IEC 60332-3			
Category	Related Standard	Sample Quantity (l/m - non-metallic part)	Flame Application Time (min)
A/F	IEC 60332-3-21	7	40
A	IEC 60332-3-22	7	40
B	IEC 60332-3-23	3.5	40
C	IEC 60332-3-24	1.5	20
D	IEC 60332-3-25	0.5	20

In the UL 1685 (CM) burning test, a cable sample is evaluated for 20 minutes and the carbonized part shall not exceed 2.44 m. This test is similar to that performed with C category IEC 60332-3, except in the number of samples tested.

Summary

Characteristics	Classification					
	LSZH (LSZH-3)	LSZH-1	CMP/OFNP	CMR/OFNR	CM/OFN	CMX
Flammability	Good	Regular	Excellent	Excellent	Good	Regular
Smoke Generation	Excellent	Excellent	Good	Bad	Bad	Bad
Toxicity	Excellent	Excellent	Bad	Bad	Bad	Bad
Gas Corrosion	Excellent	Excellent	Terrible	Bad	Bad	Bad

The CMP/OFNP, CMR/OFNR, CM/OFN and CMX Cables contain halogens in its composition and, under normal use, they are stable and represent no danger. But when they are burned or combust, give off gases and smoke whose toxicity and corrosiveness, are extremely harmful to the infrastructure and human health.

In addition to the high toxicity, cables containing halogens present combustion whose smoke is dense and dark, blocking light and preventing emergency exits view.

According to the firefighter's statistics, most of the deaths in fire situations occur due to:

- Loads of black and dense smoke, making it difficult to escape and rescue people.
- Low visibility, generating panic among people.
- Inhaling (poisoning) of toxic gases contained in smoke.

For locations with a forecast of concentration or movement of persons as office buildings, shopping malls, theaters, department stores, cinemas, supermarkets, gymnasium, restaurants, hotels, bus stations, train stations, subways, airports, hospitals, schools, colleges, exhibition centers, data centers, etc., we recommend the use of LSZH cables (LSZH-3), it does not emit toxic gases, generate little smoke, which is not dense and dark and the burning of classification is for general use.

Furukawa has its own line of products, cables that meet the requirements in the various described situations.