WHITE PAPER:

Response to Beyond UL 2196: A Comparative Study of UL Listed 2-Hour Fire-Rated Cables' Properties

EXECUTIVE SUMMARY

Prysmian Group, the world's leading energy and telecom cable systems provider, is committed to manufacturing quality products that meet stringent standards. The reliability, durability and safety of our products are critical in supplying energy and enabling communications around the globe, providing vital connections for people, businesses and communities.

That's why Prysmian Group heavily invests in research and development. We work closely with customers to develop solutions that solve important needs they have identified. Quality control in our factories leads the industry, ensuring the products we ship meet rigorous specifications. Additionally, Prysmian Group engages leading independent testing laboratories to verify that our products meet and exceed industry standards. All of these steps are important to maintaining the trust of our customers and protecting our well-earned industry reputation for global leadership.

> *"Lifeline is tested against the UL 2196 standards, which recently underwent a 5-year, industry-wide independent consultative upgrade."*

An example of this attention to quality and performance are our Lifeline® ceramifiable silicone products. The flame retardant, low smoke and low toxicity properties meet the most stringent specifications in the industry. UL is a global independent safety science company with more than a century of expertise innovating safety solutions. Recognized as the most rigorous life safety standard for fire-resistive electrical assemblies in the world, Prysmian Group invested in the latest technology to meet the revised UL 2196 standards that went into effect in August 2020.

These cables have been proven effective in actual emergencies, such as the vehicle fire that took place inside of the Baltimore area tunnel in the summer of 2019, where Lifeline cables remained operational throughout the event with no damage to the conduit system or emergency circuits.

> *"Ceramifying insulation cables like Lifeline® are safe, effective and economical alternatives to mineral insulated (MI) cables and assure emergency circuits are protected by two-hour fire rated systems."*

This paper is in response to a white paper and video published by nVent Thermal in January 2021 that makes misleading claims about ceramifying insulation cables. The nVent Thermal claims rely on company-funded tests by an anonymous vendor conducted without regulatory oversight. The process did not follow accepted industry standards and many of the methods do not accurately replicate real-life scenarios.

Prysmian Group has received several customer inquiries about the misleading claims made by nVent Thermal. We felt compelled to set the record straight and provide details on why Lifeline ceramifiable silicone cables offer independently verified performance and safety you can trust.

We are available to answer your questions about Lifeline or any of our other products. We appreciate your business, and you can count on Prysmian Group to stand behind the cable solutions we provide.

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BACKGROUND

The purpose of fire-resistive cables is to maintain power for critical life-safety equipment such as fire pumps, smoke alarms, and emergency lights for 1 or 2 hours in a fire event. To achieve this rating, the cables undergo a destructive test where they are placed into a burning chamber which reaches temperatures of 1850°F over a 1 or 2-hour period. The cables are then de-energized and sprayed with a fire hose under high pressure to cause thermal and mechanical stress. Finally, once allowed to dry, they are re-energized. All circuits must maintain integrity after the test.

The two types of life-safety cables available to the market today are mineral insulated (MI) cables and ceramifying insulation cables. MI cables use magnesium oxide to protect the copper conductor and (as a consequence) are more costly to procure and require significant additional labor time and expertise to install. Ceramifying insulation cables, which represent a more cost-effective solution with easy installation over MI cables, use a low smoke zero-halogen (LSZH) insulation, which undergoes a chemical reaction around 500°C, creating a ceramic ash over the conductor thereby protecting it. During the ceramification process, gases are released from the melting insulation into the enclosed conduit or self-contained metallic armor raceway. These gases produced are considered halogen free and pass the requirements in IEEE 1202/FT4 and UL 1685 'ST1' rating for low-smoke generation. They also meet the most stringent toxicity requirements for electrical cables in the industry.

nVent Thermal, a competitor of Prysmian Group, published a white paper[1] and video[2] in January of 2021 in an effort to undermine the reputation of ceramifying insulation cables and to challenge the UL 2196 test standard, proposing that it should be further modified so that only MI cables could pass the requirements. The result would mean fewer choices for consumers, and higher costs for over-engineered systems in commercial, industrial, and infrastructure projects.

This paper provides a detailed response to such claims, proving that Lifeline® cables are a safe, effective, and economical solution for critical life-safety circuits.

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COMPETITOR CLAIMS

nVent's video[2] attempted to demonstrate that silicone insulation cables created safety hazards due to reignition of the byproduct gases when exposed to high temperatures. Their claims can be summarized into three main categories:

1. Cable Off-Gassing
2. Cable Combustion
3. Mechanical Strength

The testing was performed by an undisclosed lab at the request of nVent. While our competitor claims that the findings of the tests performed at the unknown testing lab are conclusive, the lab itself states the following in their test report:

> *The scope of services performed during this investigation may not adequately address the needs of other users of this report, and any re-use of this report or its findings, conclusions, or recommendations presented herein are at the sole risk of the user. The opinions and comments formulated during this assessment are based on observations and information available at the time of the investigation. No guarantee or warranty as to future life or performance of any reviewed condition is expressed or implied.*[1]

According to the unnamed lab, nVent internally tested its System 1850, as well as competitor Systems 120, 50, 25B, and 25C, supposedly in accordance with UL 2196 time-temperature heating and hose stream testing requirements. However, nVent does not have the capability to perform a full-size UL 2196 test, which requires a length of ten feet, and is only capable of testing a sample of roughly three feet in length – approximately 30% of the full UL 2196 requirement (Figure 1). Therefore, the test is not representative of the full UL 2196 test.

Additionally, the laboratory, which chose to remain anonymous, claims to have an ISO 9001 accreditation. However, there is no evidence that the laboratory has an ISO 17025 accreditation, which is a relevant standard for testing laboratories granted to only those who have met the Management Requirements and Technical Requirements of ISO 17025 and deemed technically competent to consistently produce valid results. On top of the lack of proper accreditations and qualifications to perform reliable tests, there are other significant issues with the methodologies and procedures used in testing the samples. In the following sections we will provide a summary of the tests performed and discuss some of the limitations and fallacies of such tests.

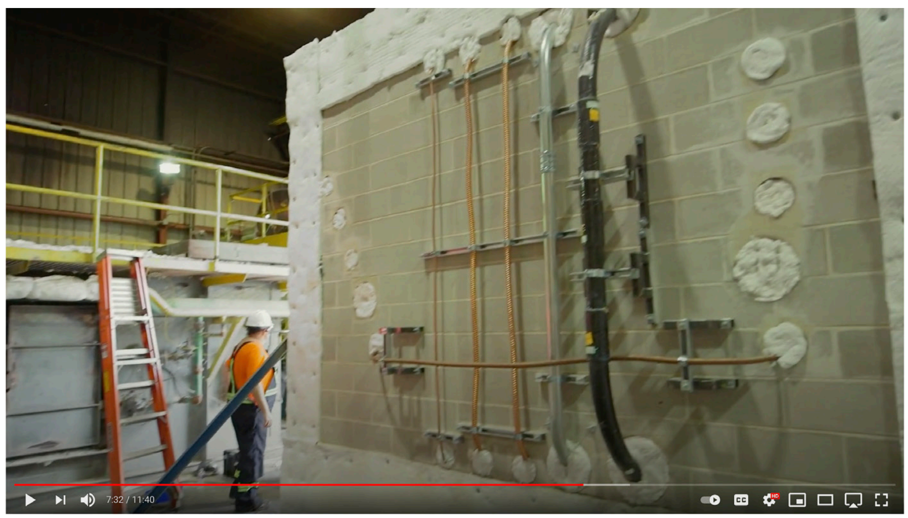

Figure 1 - Screenshot from nVent's video[2] displaying their partial UL 2196 testing

1. CABLE OFF-GASSING

This section of the lab report reviews cable constructions, describes the process used to examine material off-gassed during heating, and examines the combustion properties of these gases. First, the systems were cross-sectioned, and samples of non-metallic components were collected for analysis. These non-metallic components were examined by Fourier-Transform Infrared Spectroscopy (FTIR) to determine the type of material of each component. Next, Thermogravimetric Analysis (TGA) was used to assess the thermal stability of each material up to 900°C.

> ***Although TGA indicates the relative thermal stability of a material sample, this technique does not provide information related to the identity of the degradation products that are volatilized during heating.***[1]

The samples were then tested by pyrolysis GC-MS. GC-MS experiments can identify different substances that are present in the volatilized gases emitted from the material sample and can give a rough estimate of the quantity of each gas emitted. This type of analysis does not provide exact quantification due to experimental limitations, which we address in the Prysmian Group Response section.

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2. CABLE COMBUSTION

The off-gas combustion properties testing entailed heating the system component samples to temperatures above 400°C inside a custom-built pressure vessel (Figure 2), capturing the gases expelled during that process, and then igniting mixtures of these gases and air in another custom-built combustion chamber to determine Lower Flammability Limits (LFL), Upper Flammability Limits (UFL), maximum explosion overpressures (Pmax), and maximum rates of pressure rise (dP/dtmax).

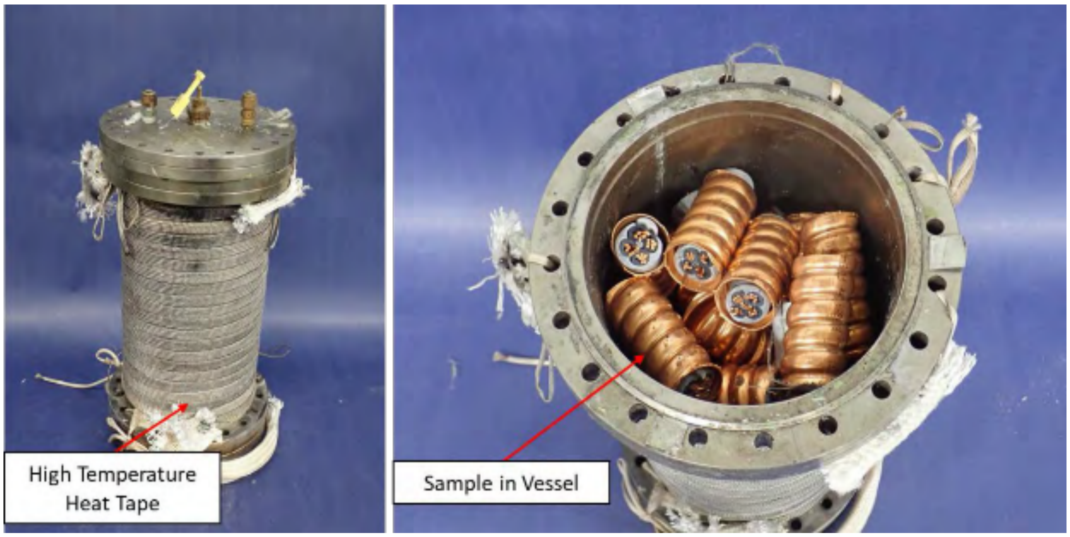

Figure 2 - Photo of the custom-built pressure vessel[1]

The combustion properties of the cable systems were compared to the combustion properties of natural gas (composed primarily of methane) and LP-gas (composed primarily of propane), two common gases used to fuel commercial and industrial gas-fired equipment. However, it is important to note that natural gas and LP-gas were not tested as controls in the custom-built combustion chamber (Figure 3), raising serious concerns on the validity and accuracy of the combustion values measured for the other systems.

System	Lower Flammability Limit (LFL)	Upper Flammability Limit (UFL)	Maximum Explosion Overpressure (P_{max})	Maximum Rate of Pressure Rise (dP/dt_{max})
1850	*Insufficient quantity of off-gas for testing*			
120	5-6%	14-15%	6.4 bar (93 psi)	148 bar/s (2150 psi/s)
50	8-9%	23-24%	6.3 bar (91 psi)	129 bar/s (1870 psi/s)
25 B/C	6-7%	*N/D*	6.3 bar (91 psi)	140 bar/s (2030 psi/s)
Natural Gas	*5%**	*15%**	6.4 bar (93 psi)	146 bar/s (2120 psi/s)
LP-Gas	*2%**	*10%**	7.1 bar (103 psi)	203 bar/s (2940 psi/s)

***LFL/UFL of Natural Gas and LP-Gas obtained from Zlochower and Green, "The limiting oxygen concentration and flammability limits of gases and gas mixtures," available on CDC.gov. Measurements of the LFL and UFL for the Natural Gas and LP-Gas were not performed.**

Figure 3 - nVent's combustion testing results[1]

As stated in nVent's white paper, two heating cycles were performed on System 50 due to concerns that the quantity of off-gas generated would be insufficient to perform the combustion testing in its entirety. Prysmian Group's MC was heated for 15 hours vs. only 6 hours for nVent's MI cable and 3 hours for Vitalink's MC. The internal cable common to both Systems 25B and 25C were heated without conduit and reported as one system, 25B/C, since the conduit in each of these systems is not expected to produce significant off-gassed material as compared to the polymer jacketing (Figure 4). This percent mass loss is based on the weight of the cable only and does not include the accompanying conduit weight that would be installed with the cable under real conditions.

System	Heating Time (hrs)	Maximum Wall Temp (°C)	Maximum Internal Temp (°C)	Elapsed Time for Wall Temp > 400 °C (hrs)	Max Pressure (psia)	Initial Mass (kg)	Final Mass (kg)	Mass Loss (%)
1850	6.0	600	523	7.0	2.3	5.028	5.024	< 0.1%
120	3.0	478	438	1.3	18.2	4.748	4.380	7.75%
50	5.6	541	503	5.1	11.1	4.276	*N/A*	NOT MEASURED
50 (2nd heating cycle)	9.7	474	445	6.4	13.4	*N/A*	3.932	8.0%
25 B/C	3.2	596	404	0.24[a]	6.0	4.282	4.102	4.2%[b]
No Sample	*4.4*	*604*	*478*	*3.9*	*1.6*	*N/A*	*N/A*	*N/A*

[a] The heat tape shorted out during this test, resulting in a shorter than anticipated heating time.
[b] This percent mass loss is based on the weight of the cable only and does not include the accompanying conduit weight that would be installed with the cable.

Figure 4 - nVent's heating testing results[1]

The method of testing by nVent's privately-contracted lab is inconsistent with the UL 2196 test and it does not, in any way, represent a real-life installation. The study claims that the combustion results of systems 120, 50 and 25C were similar to those of natural gas or LP-gas. However, considering that no measurements were made for natural gas or LP-gas, such a conclusion is impossible to draw.

3. MECHANICAL AND STRUCTURAL INTEGRITY

According to the report, Beyond UL 2196: A Comparative Study of UL Listed 2-Hour Fire-Rated Cables' Properties[1] by nVent,

> *Products were compression tested using both new, as purchased samples, and after a UL 2196 fire test (without hose stream). The cable compression testing entailed connecting cable samples in a circuit supplied by a 120/208 V three-phase power supply and compressing cable sheath or conduit sidewalls using a hydraulic press with custom-platens until the circuit failed or a total force of 50 klbf was reached. We tested both new cable samples and samples previously exposed to fire and fire-suppression conditions in accordance with UL 2196 heating and hose stream profiles.*[1]

It is important to note that according to the lab, the samples used for the compression tests were subjected by nVen, and not the lab itself, to a two-hour heating test followed by a stream test, with the heating rate profile and hose stream testing in accordance with UL 2196. These samples were then shipped and received by the lab to be mechanically tested. This process poses various significant questions, such as:

- Can the lab certify that the samples were actually tested in accordance with UL 2196 procedures? If not, how can readers know that the samples were not tampered with?
- How much time passed from when the samples were supposedly tested in accordance with UL 2196 and then tested for mechanical strength? Physical properties of material can be greatly affected over time.

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- How were the samples transported from the nVent facility to the lab? Can the lab certify that the samples were not damaged during transportation? Samples are extremely fragile after being exposed to the UL 2196 testing and could have easily been damaged or otherwise compromised during the process.
- Was the hose stream portion of the UL 2196 test performed on the samples? It is well known that the hose stream portion of the UL 2196 test is conducted to apply mechanical stress to the samples, therefore rendering the compression test redundant. Additionally, there seems to be contradictory information as to whether the hose stream portion of the test was performed on the samples. Initially, the report claims that the samples subjected to hose stream test while the Executive Summary[6] states that they were not (Figure 5).
- Why was 50 klbf used as the reference force? Is there any evidence that this force is relevant for systems to operate safely in real life applications?

> [19] Fire-testing of cable samples was performed by nVent and then shipped to us for compression testing. It is our understanding that these fire-tested cable samples were subjected to a two-hour heating test followed by a hose stream test, with the heating rate profile and hose stream testing in accordance with UL 2196.

> **MECHANICAL STRENGTH TESTING** **PAGES 35 TO 68**
>
> - Products were compression tested using both new, as purchased samples, and after a UL 2196 fire test (without hose stream).
>   - Test description and layout – pages 35 and 36.
>   - Test results in Table 5 – page 52.
>   - Discussion of results – page 67.

Figure 5 - Lab Report's footnote (p. 35)[1] and Lab Report Summary (p.3)[6]

According to the lab, the purpose of these tests was to compare the compressive strength performance across the various system samples by evaluating the systems' abilities to maintain its electrical circuit integrity under compressive forces and how these strengths are affected by fire. It is worth noting that the testing procedure showed some anomalies:

- Cable samples provided by nVent did not all contain the same number of conductors of the other systems, and so the application of the test circuit differed between tests. In order for results to be comparable the samples must all have the same number of conductors.
- System 25C was tested with phase conductors and a 6 AWG bare copper ground line, which clearly does not represent a real life installation, as bare conductors are not approved by UL 2196 in those systems.
- Testing of the fire-tested System 50 cable was performed a total of three times as initial test results produced an unexpected 7X increase in fail force compared to the new cable tests. Subsequent tests were inconclusive, with one producing a >9X increase and the other producing a >5X decrease in fail force compared to the new cable tests, respectively (Figure 6).
- Due to budget and sample availability constraints, they were not able to perform tests on multiple samples for each system except for the fire-tested System 50 cable. They also were unable to test exact like-for-like samples (i.e., samples from all systems with the exact same number of conductors and with the same current capacities).

The lab report concludes that the lab technicians are not able to explain these disparities without further investigation. Potential explanations may include non-homogeneous effects within the cable due to fire-testing or variations in sample orientation during compression testing. In addition, while the variability observed in these tests may be unique to some fire-tested systems, the results suggest that additional tests of each system should be performed to better understand failure force distributions and to ensure the results reported are good representations for each system.

These points clearly raise additional questions as to the reliability of the test results and suggest that the results are not representative or conclusive. They also cast doubts on the overall understanding of the technicians/operators of competitors' FHIT requirements.

System	New cables: Fail force (×1000 lbf)	Fire-tested cables: Fail force (×1000 lbf)
1850	>50	48.3
120	8.3	5.8
50	3.0	20.8[a] *28.1*[a] *0.53*[a]
25B	11.1	4.2
25C (1" conduit)	45.1[b]	1.8[c]
25C (1 ½" conduit)	>50	N/A
25B/25C cable only	3.9	N/A

[a] The System 50 fire-tested cable compression test was performed on three separate samples. The first test produced the 20.8 klbf fail force with subsequent tests producing fail forces of 28.1 klbf and 0.58 klbf.

[b] The System 25C (1" conduit) test recorded a peak force of 45 klbf before the entire conduit and conductors sample severed, after which the force dropped and the voltage to the load was lost.

[c] The System 25C (1" conduit) fire-tested sample consisted of a fire-tested piece of conduit and a non-fire-tested cable. It is our understanding that nVent was unable to extract an intact 25C conduit and cable sample from their fire-testing setup.

Figure 6 - nVent's compression strength results[1]

Lastly, what real life circumstances would warrant such testing? Are nVent and the lab implying that structures are liable to collapsing? If that were the case, the systems themselves would have no use or purpose in such circumstances, as a building collapse would pose threats far beyond the scope of UL 2196.

PRYMIAN GROUP RESPONSE

1. CABLE OFF-GASSING

One of the claims made in nVent's paper is that ceramifying insulation cable samples lost between 10-76% of their weight at 900°C, releasing large quantities of volatile substances that could be deemed toxic and flammable. However, the 'EVA' outer layer used in Lifeline® Cables actually contains about 50% of a flame retardant, Magnesium Di Hydroxide (MDH), the same substance used by nVent in the MI Cables. In a fire setting, MDH decomposes into water vapor and Magnesium Oxide (MgO), the same mineral used in mineral-filled cable. Interestingly enough, there was no water found when this sample was heated in the custom-built pressure vessel. The compound would be expected to generate about 15% water, and not 97.4% hydrocarbons.

We also know that the analytical testing was done using a 'flash' reaction in a Helium environment. This environment lacks external validity and can skew results away from what would happen in real-life circumstances, since cables would not be subjected to Helium in the field. In an air environment or even in depleted air, a very significant amount of hydrocarbon content will degrade to CO_2. CO_2 is not flammable and has a relatively low level of toxicity. The fact that none of the hydrocarbons were allowed to convert to CO_2 casts serious doubt on the experimental procedure used, and it appears this procedure was purposely designed to maximize the generation of toxic and/or combustible by-products. Additionally, a Helium environment can also change whether Siloxanes or cyclic Siloxanes are produced for Silicone-based layers.

Lastly, while the results of the pyrolysis GC-MS experiments found traces of hydrocarbons, the lab did not perform a toxicological risk assessment of the volatile materials identified and therefore cannot conclude that these materials are, in fact, harmful. Without a toxicological risk assessment, the conclusion from the lab is pure speculation. In fact, while certain hydrocarbons are toxic, other hydrocarbons are not considered toxic, and are often used as components of personal care products, such as petroleum jelly. These inconsistencies raise doubts on the veracity of the testing methodologies.

Smoke:

Lifeline® ceramifiable silicone insulation is classified by industry standards as Low Smoke. The industry standard for measuring low smoke materials is ASTM: E 662 "Standard Method for Specific Optical Density of Smoke Generated by Solid Materials"[3]. The test is performed in both flaming and non-flaming conditions. Lifeline® ceramifiable silicone results are compared with New York City Transit Authority requirements, considered as one of the most stringent low smoke requirements in the industry, for Low Smoke Signal Wire and Cable as follows:

	Mode	NYCTA Requirements for Low Smoke Material	Lifeline® Typical
Specific Optical Density, Ds4 =	Flaming	150	30
Maximum Optical Density, Dm =	Flaming	250	160
Specific Optical Density, Ds4 =	Non-Flaming	150	10
Maximum Optical Density, Dm =	Non-Flaming	350	100

TABLE 1 - Lifeline® ceramifiable silicone results compared with New York City Transit Authority requirements[3]

Toxicity:

The accepted practice for determining the toxicity level of combustible materials is to test for the toxicity level of each using the Toxicity Index test method in "MINISTRY OF DEFENSE STANDARD 02-713 Determination of the Toxicity Index of the Products of Combustion from Small Specimens of Material"[4]. The procedure tests for 13 toxic common toxic gases released during combustion including Hydrogen Chloride, Hydrogen Bromide, Hydrogen Fluoride, Carbon Dioxide and Carbon Monoxide. Sampled concentration levels are then weighted by lethality to calculate the Toxicity Index.

When the Toxicity Index values of Lifeline® products are compared to the Low Toxicity requirements of industry standards for applications with limited egress such as New York City Transit Authority TS-LS Specification for Low Smoke No Halogen Signal Wire Cable and Navy Mil-DTL-24643 Specification for Low Smoke Zero Halogen Cables for Shipboard Use, the Lifeline® cable materials meet or are well below accepted industry limits.

Lifeline® Material	Recognized Maximum Acceptable Toxicity Index	Lifeline® Material Toxicity Index
Inner Silicone Insulation of RHW-2	1.5*	0.0
Outer XLPO Insulation of RHW-2	1.5*	0.0
Silicone Insulation of MC Cable	1.5*	0.0
Silicone Inner Jacket of MC Cable	5.0* (2.0**)	0.9
Optional Outer Jacket of MC Cable	5.0* (2.0**)	2.0

*Requirements from Mil-DTL-24643
** Requirements from NYCTA TS-LS

TABLE 2 - Lifeline® Toxicity Index compared to Low Toxicity requirements[4]

The United States Government requires "Material Safety Data Sheets" to be available from each manufacturer. A copy of the Material Safety Data Sheets as they apply to Lifeline® Products can be obtained by request from Prysmian Group.

In conclusion, as Lifeline® cables are made of organic materials; they do produce smoke, and any smoke has some level of toxicity and combustibles content. However, the amount of smoke and level of toxicity/combustibility is relatively low and in compliance with the most stringent industry standards.

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2. CABLE COMBUSTION

In 2001, Pyrotenax, now nVent, released a video with similar misguided claims. Draka responded by creating a similar test procedure using our Lifeline® RHW-2 cable in EMT conduit and a NEMA box. The box was fitted with a transparent window on the front for viewing and 3 spark plugs placed at the top, bottom, and middle of the box to simulate an arcing source, which were activated every 5 minutes until no additional smoke buildup was observed. The cable was then burned, creating smoke which travelled down the conduit and built up in concentration inside the box. The test results proved that after a small flare, which was initiated by the spark plug ignitors, consumed the oxygen in the box, the smoke would not reignite for the remaining 30 minutes of the test. It is important to emphasize that in a sealed enclosure, the gases never combusted without a manual ignition of the spark plugs.

Although already confident that the same results would be found, Prysmian performed its due diligence by repeating the test performed in 2001—this time using the Lifeline® MC cable. This test was performed on February 2, 2020 in our Taunton, MA facility.

The cable was set up identically to the original test, with the cables leading into a NEMA enclosure with 3 spark ignitors equally spaced within the box. As expected, after 10 minutes of allowing smoke to build in the box, the ignitors were triggered, and a small flare was observed before all oxygen in the box was consumed. The flame stayed within the box causing no damage to the components within the box and presented no danger to the surrounding area. For the remainder of the 30-minute test, no additional ignition was observed. It is important to emphasize that in a sealed enclosure, the gases never combusted without a manual ignition of the spark plugs.

The results of the test allow us to draw the following conclusions:

1. For ignition to occur, an open arcing source needs to be present, which is not a normal condition in a modern electrical control box.
2. The flame will only continue burning if there is a renewing flow of oxygen into the box, which is not the case with standard gasket-sealed boxes.
3. The flame created did not have enough energy to damage the components inside the box or threaten circuit integrity. It also caused no threat of spreading fire.

In addition, the amount of smoke produced from the ceramifying process is negligible. The smoke remains encased in the conduit and termination boxes and does not travel into the breathable air supply, so people would not be exposed to inhalation.

Although nVent's video[2] shows an enclosure on fire, it is important to note that the smoke only ignited after an ignition element was triggered and that the front panel of the box is clearly open, allowing a large influx and renewing source of oxygen to enter the enclosure (Figure 7). As discussed above, these circumstances do not represent a real life application and were skillfully planned to achieve the desired outcome by our competitor.

Figure 7 - Technician igniting gases in nVent's video[2]

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To reiterate once more, a fire requires 3 important criteria to continue burning and create a hazard:

1. Enough concentration of flammable material
2. An ignition source
3. A renewing source of oxygen

These criteria were not met except through purposeful manipulation that does not reflect real-world conditions. Once the oxygen inside a box is consumed, there cannot be further ignition.

It is also important to reiterate that the analytical testing was done using a 'flash' reaction in a Helium environment. This makes the test externally invalid and does not represent how the cables will function in the real world. In an air environment or even in depleted air, a significant amount of hydrocarbon content will degrade to CO_2. CO_2 is not flammable. This environment may also change whether Siloxanes or cyclic Siloxanes are produced for Silicone based layers. Some Siloxanes (especially PDMS) have low flammability. Using pressure buildup to estimate flammability limits, as has been done by the lab, seems questionable, as most of the gas buildup would be water or CO_2, neither of which are flammable. The chamber used by the lab for flammability testing is an ad-hoc built chamber, which was not officially calibrated, therefore suggesting that the results are likely inaccurate.

To summarize, in addition to being an excellent low-smoke material, Lifeline® ceramifiable silicone does not exhibit flaming gases as demonstrated by the low value of the flaming mode optical density numbers as previously shown.

3. MECHANICAL AND STRUCTURAL INTEGRITY

Per the UL 2196 testing standard, which is arguably the most stringent fire endurance test, the cable system is subjected to a mechanical hose stream test @75gal/min of water to ensure structural integrity of the system. This test puts the cable system through mechanical, as well as thermal shock. The Lifeline® Systems passed the requirements successfully, indicating that they not only meet, but exceed all relevant required industry standards.

Additionally, there is no evidence to suggest that a force of 50 klbf is appropriate or required during a fire event and begs the question as to why that limit was chosen by nVent and the anonymous lab. Prysmian Group stands by the UL 2196 requirements and provides case studies in the following section to substantiate its stance.

Lastly, compression testing on cable systems that have been subjected to elevated conditions of fire and water are contrary to their intended use, as systems are required to be replaced after a fire incident by all local or national codes.

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CASE STUDIES

Below are two case studies of real-life situations in which Lifeline® has performed as intended and expected. The full case study documents are available upon request.

Baltimore Area Tunnel Fire

In the summer of 2019, a vehicle combusted inside a Baltimore Area Tunnel. Flames spread 50 feet in all directions and the metal components in the ceiling melted, including the light fixtures and lane signal system. All electrical systems in the direct exposure area were destroyed and rendered inoperable, except the UL 2196 listed Lifeline® and BreathSaver® XW emergency cable and conduit system (Figure 8). All emergency circuits powering the LED light fixtures remained operational and no power was lost on the Lifeline® protected emergency circuits. The Lifeline® and BreathSaver® XW fire-resistive system protected equipment and remained operational throughout the event with no tripped fuses, no smoke residue in the junction boxes, and no visible damage to the conduit system.

Figure 8 - Lifeline® RHW-2 in FRE Composites XW BreathSaver® Phenolic conduit, installed along the length of the tunnel, remained operational throughout the fire event[5]

Plumney Village Fire

In the winter of 2006, a fire occurred in a 16-story residential building called Plumney Village. The fire involved the 11th, 12th, 13th, 14th and 15th floor electrical equipment rooms. Previously, a contractor installed fire-rated RHW cable manufactured by Prysmian (at the time Draka Cableteq USA) from the emergency generator to the elevator power distribution panel. Due to the installation of the fire-rated RHW cable, first responders were able to use the elevator to aid in firefighting efforts.

The performance of the fire-rated cable that maintained power to the elevator, even after all other circuits had failed, remains a unique factor in this fire. The building maintenance superintendent stated the importance of the elevator operation during the assessment and early repair stages of building restoration, before the damaged cable was replaced. The electrical contractor also replaced the original cable with a new fire-rated cable, also supplied by Prysmian Group, to assure continued performance during a future fire.

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SPL-FPT-0022-0921

CONCLUSION

As has been described multiple times in this paper, there are many irregularities and inconsistencies in the tests performed by nVent and the anonymous laboratory. These irregularities and inconsistencies are precisely why a robust and comprehensive testing standard such as the UL 2196, the most stringent fire endurance test, is required. Lifeline® Systems consistently pass the UL 2196 testing standard. Real-life case studies further demonstrate that Lifeline® systems perform as designed and are a reliable solution for critical life safety circuits.

Circuit Integrity cable systems, like Lifeline® RHW-2 and Lifeline® MC produced by Prysmian Group are UL 2196 listed and are a safe, effective, and economical alternative to MI cables. Lifeline® ceramifiable silicone products are considered Flame Retardant, Low Smoke and Low Toxicity as measured by the most stringent specifications in the industry. In conclusion, Lifeline® products assure your circuits are protected for two-hours in case of fire per UL 2196.

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