# High-pressure Water Mist Active Firefighting Systems: First Testing Experiences According to Italian Standard UNI 11565

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**Summary**

The paper presents the preliminary testing experience of Fogtec in testing and assessing on-board high pressure water mists systems for firefighting in passenger areas of rolling stock according to the new Italian standard UNI 11565:2014. The testing has been conducted in EN 17025 certified laboratories in Italy and Germany. The outcomes collected in this preliminary campaign – as well as similar ones by other manufacturers – constituted the base of the UNI 11565:2014 review process started in September 2015 and finalized in May 2016 with the publication of the UNI 11565:2016.

**Keywords:** UNI 11565:2014, UNI 11565:2016, fire protection, firefighting, water mist, testing, safety, standard, rolling stock

## 1. Introduction

Fire protection in railway vehicles has been a topic of major importance in rolling stock engineering since many decades. Beside passive safety, improved dramatically in last decades and resulting in the recently released EN 45545 [13], active fire protection systems for both passenger and technical areas are always more and more daily business of train designers, manufacturers, consultants, independent safety assessors and safety authorities. The literature on the subject is very limited, although for an exhaustive overview of active fire protections systems for rolling stock applications the reader can refer for example to the volume in reference [7].

### 1.1. Water mist systems for rolling stock applications

Active firefighting systems for passenger areas mainly, if not uniquely, rely on high pressure water mist's technology.

Water mist is a very fine water fog made where pressurized water passes through special nozzles; high pressure up to 200 bar is realized by pressurized nitrogen cylinders or pump-systems. By definition, water mist is a water spray for which the 99% of the total volume of liquid is in droplets of diameter smaller than 1000 μm [16]. The high effectiveness of water mist as extinguishing agent is based on its ability to fight all hazardous elements in a rolling stock fire scenario. In detail, water mist gives great contribution in:

- Heat absorption: main feature of water is its heat absorption and therefore cooling ability (Table 1);
- Oxygen displacement: easy water vaporization due to small droplets makes the atmosphere locally inert by displacement of the oxygen;
- Radiation heat stop: water mist plays an important role as a heat barrier between the heat source and the surrounding atmosphere cooled by water mist, avoiding heat and flame diffusion (Fig. 1).

Table 1

**Heat absorption characteristics of water [7]**

| | **Specific heat capacity [J/kg*K], liquid, at 298 K $C_p$** | **Specific heat capacity [J/kg*K], steam, at 373 K $C_p$** | **Enthalpy of vaporization [kJ/kg] $\Delta H_{vap}$** |
|---|---|---|---|
| **Water** | 4181.3 | 2080 | 2257 |

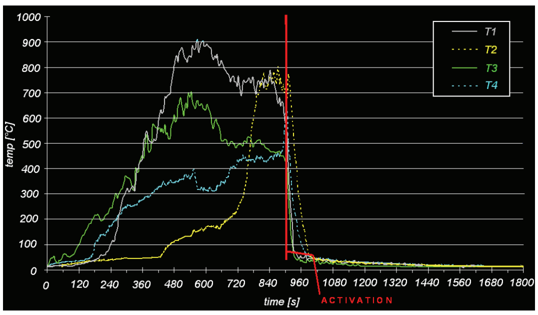


Fig. 1. Cooling effect by activation of high pressure water mist, from full-scale fire tests for passenger areas according to ARGE guidelines [7]

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The main reasons for the success of such technology in the rolling stock industry, already mature in other industrial fields, can be here resumed [7, 18]:

- Water mist is absolutely environmentally friendly and compatible with presence of the passengers;
- Water mist has limited side effects and damages to the surrounding equipment, especially in comparison with traditional sprinkler system for buildings;
- Water has the highest cooling effect of any other extinguishing agent (Fig. 1);
- Water mist has high effectiveness in absorption and dragging down of the smoke, limiting the lack of visibility;
- Water has no restrictions in use and transport, differently from e.g. chemical gases banned or subjected to gradual banning in a lot of countries;
- Particularly in comparison with sprinkler systems, water mist systems allow use of very limited quantity of water, keeping weight and volume of tanks low.

This very last feature of high pressure water mist is especially matching with the requirements of the railway industry, being a train a moving system not connected to water supply and with need of limit any non-paying weight (Fig. 2).

Fig. 2. High pressure water mist spraying in passenger train [16]

The appearance of this technology in the late industry dates back to beginning of years 2000 and started in pioneer times without relevant standardization and technical guidelines. For this, on year 2007 a working group of companies active in fire protection in rolling stock put together testing, research, development and design efforts to lay out the first draft of technical design guidelines for testing and validating the design of fire protection systems for rolling stock application.

These guidelines are the so-called „ARGE" guidelines [2–4] (from the German *ARbeitsGEmeischaft*, working group) for fire protection in rolling stock, released first in 2009 and updated in their last revision in 2012, currently structured in three parts covering respectively fire detection, firefighting and system functionality of fire detection and firefighting systems in rolling stock. Those guidelines do remain still today the most common railway industry practice for design and validation of active fire protection systems; however they also remain a non-official guideline, and are strongly related to the industrial experience of the first pioneer companies in the German-speaking area.

**The Italian Case**

The Italian railway network reflects country's irregular orthography and it is characterized by many tunnels. Safety in railway tunnels is therefore a major topic and a fire on board of a train running in a tunnel constitutes a primary danger with high risk due to potentially disastrous consequences. In 2005, while approaching the opening of the new high speed lines, with particular reference to the new 78,5 km long Florence-Bologna, 73 of which in tunnel, the need of improving the national legislation in regards to safety in railway tunnels way high. In this frame is to be read the introduction, on the 28th October of 2005, of the Minister's Decree „*Sicurezza nelle gallerie ferroviarie*" (safety in railway tunnels), introducing the mandatory requirement of on-board firefighting solutions for all trains running in tunnels longer than 1000 m [1, 11].

The need of a technical standard that could set the technical requirements for implementation of this new technology arose immediately. The already mentioned ARGE guidelines have been widely adopted as short term solution. Nevertheless, their already mentioned status of technical guidelines and their relation to the German speaking industry could not allow them to be adopted as national standard. Therefore in 2012 the Italian National Authority for Safety on Railways (ANSF) set a working group in charge of drafting the first Italian national standard for on-board active fire protections systems for rolling stock. This working group was led by the Italian Institute for Standardization in Railways (UNIFER) and drafted the document code-name U94020570 which constituted the base for the national standard UNI 11565.

The UNI 11565 was then published in its first release on the 18th December 2014 by the Italian Institute for Standardization (UNI) [9] and put into force by the ANSF on the 19th May 2015 as applicable standard for fulfilling the requirements of the mentioned Ministry Decree [1].

Notable application of the UNI standard is also to cover the „special case Italy" of the Technical Specifications for Interoperability (TSIs) of the Trans European Network of the European Union. For further reading about this topic the reader can refer to [9, 10, 15, 17].

## 1.2. The UNI 11565

The UNI standard (Table 2) is the result of the effort of many subjects of the Italian and railway industry to gather different experiences and define the specific aspects of active fire protections systems for rolling stock. The standard covers the design, the installation, the validation and the maintenance of fire detection and firefighting systems, and prescribes the testing procedures to assess functionality for validation and homologation purposes. This applies not only to firefighting systems for passenger areas, but also to firefighting system for technical areas as well as fire detection systems in general.

Table 2

**Limit values of main survivability indicators according to UNI 11565; based on [24]**

| Parameter | Test with „liquid fire" | Test with „solid fire" |
|---|---|---|
| **T max** | < 65 C | < 65 C |
| **CO max** | N/A | 1400 ppm |
| **$CO_{2\,max}$** | N/A | 6% vol |
| **HCN** | N/A | 55 mg/m³ |
| **$O_2$** | > 15% vol | > 15% vol |

Object of this paper the focus is only on the testing for assessment of firefighting systems for passenger areas based on water mist technology. The relevant parts covering the assessment procedures for firefighting systems for passenger areas are in chapter 10 and attachment B.

The design target of a water mist firefighting system in passenger area is to control and suppress the incipient fire at its smaller stage, allowing survival conditions on board of the fire-affected vehicle, for the first 20 min from fire event. In these conditions passengers can safely evacuate to the closer place of relative or final safety, which might be the coach nearby or outside the vehicle. To guarantee survival conditions on board, the firefighting system must:

- Control the fire source, avoiding fire spread;
- Create a thermal barrier so avoiding dangerous temperature increase in the wagon;
- Suppress or extinguish the fire in the way to limit or stop the combustion process, so avoiding release of toxic gases and smoke, so keeping the atmosphere breathable.

In order to give quantitative and measurable values for those targets, the standard applied some experience from ARGE guidelines as well as some newly introduced concepts. The measure focused on temperatures and values of CO, $CO_2$, HCN and $O_2$ in the passenger areas, whose limit values where already set by the ARGE based on previous studies [19, 26]. Very important for passengers' safety is of course the concentration of toxic gases: concentrations higher then set thresholds can quickly ring to intoxication and loss of consciousness. The position of the probes to measure the values is set at 1m in longitudinal distance from the fire source, at two different heights: 1,6 m and below the ceiling. 1,6 m is chosen as it is the average quote of breathing for a standing human. The already mentioned current state-of-art, the ARGE guidelines, are in this case slightly different prescribing a measuring at 2 m distance from the fire source, and only at a height of 1,6 m, being below the ceiling (approx. 2 m or higher) a quote not common for human breathing and therefore not relevant for survivability analysis.

Additional to temperature and smoke measurement, the UNI 11565 introduces a new concept of „visibility" based on a newly introduced test specification. This consists in an optical-based visibility test conducted by use of optical transmittance measurement. The measurement is carried at 5 m distance from the fire location, at a quote of 1.6 m from the floor. Target of the test is a transmittance higher the 70% during the whole test duration of 20 s.

The standard foresees then three different configurations, reproducing three different areas on a rolling stock:

- Single deck saloon,
- Double deck saloon.
- „Small" compartment like toilet cell, couchettes-compartment or vestibule those configurations are defined in dimensions, geometry and position of seats and luggage racks.

The standard foresees two types of testing: for type-assessment approval and project application specific. The firefighting system object of a project application specific assessment must be tested in the configuration which more closely reproduces the real application, and each configuration must be tested with two different fire loads and two different geometric positions between fire and water mist spraying nozzles (nozzle positioning). In a type-assessment approval, as the purpose of this test campaign, all configurations in all nozzle-positioning configurations and with all types of fire source were tested.

The two types of nozzle positioning are the so called „under one nozzle" and „between the nozzles": in the first, the fire source is located directly under one nozzle – which is mounted below the ceiling; in the latter, the fire source is located at half-spacing[2] distance from two nozzles, on both longitudinal sides.

[2] Spacing is the design longitudinal distance between two nozzles, as defined by the nozzle's manufacturer/designer.

The two different fire loads are set with the goal to recreate two standard fire scenarios [14], following the model already proposed years before by the ARGE guidelines:

- „liquid fire", caused by burning of liquid or liquefied materials (foam, plastics, fuel…) with prevalent surface gaseous combustion, and with non-railway conform non-flame retardant materials for the surroundings.
- „solid fire", caused by burning of solid material (cotton, paper, polyamide…) with low-temperature flame and high production of ashes and non-combustible residuals. In this case railway conform materials are used for the surroundings.

The first fire scenario is realized by a primary fire load (ignition source) constituted by one 40×40×10 cm IMO-pillow ignited by 50 ml of ethylic alcohol. This ignition source is located above a seat realized by using other two IMO-pillows of same dimension, positioned in vertical and horizontal positon to recreate the geometry of a seat. IMO-pillows are used to simulate also a second seat nearby, as well the seat-rows immediately around, and to simulate luggage on the luggage rack. Floor and lateral panels are realized in normal non-flame retardant materials as plywood.

In the second fire scenario the primary fire load is realized by a metal cage-box with four compartments filled by cotton, paper and polyamide fibre (Nylon), positioned under a seat realized with same features as previous scenario. The primary fire load is ignited by 100 ml of ethylic alcohol. The surroundings are realized by UNI 11170 [25] conform railway materials for wall panels and floor.

In both cases ignition is realized manually by laboratory operator and the activation of the water mist is then commanded by system technician after 60 s free-burning time.

The decision of applying the UNI 11170 for material standard instead of the newer EN 45545 was motivated by the need of applying this norm also to existing trains, which have interiors realized according to the Italian standard. Furthermore, the EN 45545 allows a three-year period from its introduction (1/2015) when manufacturers can continue apply previous national standards [23]. However, the UNI 11170 will be no longer accepted from 2018 onwards, and the UNI 11565 will need to reckon this very soon.

## 2. Testing experience

As the standard UNI 11565 was published without preliminary research and testing, the testing was targeted to:

- Testing the high pressure water mist according to the new standard;
- Find out possible weak points of the standard;
- Critically analyse these points in a problem-solving mentality;
- Studying alternative or innovative solutions to address weak points.

The test campaign was structured as following:

- Phase 1: fire tests for single deck configuration.
- Phase 2: fire tests for small compartment configuration.
- Phase 3: fire tests for double-deck configuration.

The test bench consists of a tunnel realized in fireproof material, with the dimensions set by the UNI 11565 and reproducing a railway carriage, similar to the one defined by the ARGE guidelines. The overall dimensions are 12 m in length, 2,8 m in height (1,9 m for the double deck configuration) and 2,9 m in width.

The very first weak point of the new standard was found out at the very beginning of the test campaign: the „liquid" fire scenario constituted a too big fire load creating immediate dangerous conditions for the safety and integrity of the test bench. Due to strong ignition source over non-flame retardant IMO-pillows, and immediate fire spread in nearby seats and wooden (plywood) side walls, fire became out of control long before the 60 s pre-burning time defined by the standard before water mist activation leading to quick flash-over of the whole furnishing of the test bench. This point was already been studied by the laboratory independently and still by the laboratory was brought in the review process of the UNI 11565.

### 2.1. Single deck test

The system type adopted was characterized by following specification:

- 90 l of water as extinguishing agent[3],
- 4× water mist spraying nozzles of Fogtec type DK-4.

The nozzles where located below the ceiling at a height of 2.75 m, and the positioning was defined according to Fogtec's design specification (Fig. 3). This nozzles' layout is the standard design of Fogtec

[3] The Fogtec system is designed for 100 l nominal capacity of water tanks, according to UNI 11565 fire tests must be carried with 90% of the nominal quantity.

for single deck passenger carriages and was already successfully tested according to ARGE guidelines. As mentioned before, only the scenario with „solid" fire could be tested.

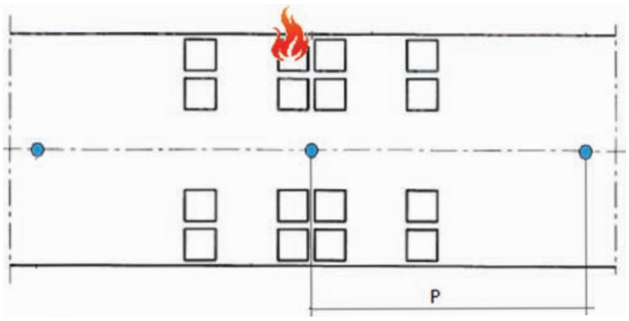


Fig. 3. Nozzles' positioning for single deck, layout „under the nozzle" [5, 16]

The first test carried out was the one „under the nozzle" (Table 3). The testing did show the general effectiveness of the high pressure water mist: temperature and gas measurement at a height of 1.6 m where abundantly below the set limits.

Table 3

**Values measured on single-deck, under the nozzle configuration, with „solid" fire; based on [20]**

| Measurement | Limit value | Max measured value |
|---|---|---|
| **T at ceiling** | <65 C | 62.2 C |
| **T at 1,6 m height** | <65 C | 43.2 C |
| **CO** | <1400 ppm | 350 ppm |
| **$CO_2$** | <6% vol | 0.7% vol |
| **HCN** | <55 mg/m$^3$ | <1 mg/m$^3$ |
| **$O_2$** | >15% vol | 20.4% vol |

Temperature curves at 1.6 m did show a regular trend: quickly increasing till the highest level in the first phase (pre-burning and first instants after water mist release) and then slowly and regularly dropping after water mist activation.

More critical where the results of the temperature measurement below the ceiling: here temperatures did rise up to above almost 65 C, with irregular trends, apparently not influenced by water mist.

While testing „between the nozzles", results were fully compliant (Table 4):

Table 4

**Values measured on single-deck, between the nozzle configuration, with „solid" fire; based on [20]**

| Measurement | Limit value | Max measured value |
|---|---|---|
| **T at ceiling** | <65 C | 61.5°C |
| **T at 1,6 m height** | <65 C | 36.5 C |
| **CO** | <1400 ppm | 300 ppm |
| **$CO_2$** | <6% vol | 0.7% vol |
| **HCN** | <55 mg/m$^3$ | <1 mg/m$^3$ |
| **$O_2$** | >15% vol | 20.4% vol |

Although compliant, results of temperature measurement below the ceiling where strongly in contradiction with previous test. The same non-regular trend was observed too.

This unexpected result did show a potential lack of reproducibility of the measurement below the ceiling, which is strongly influenced by the air movements inside the carbody more then by the effectiveness of the water mist system. This can be easily explained by referring to Figure 4: by observing the spraying cone of the water mist system it is visible how the area immediately below the ceiling is not object of protection of the water mist.

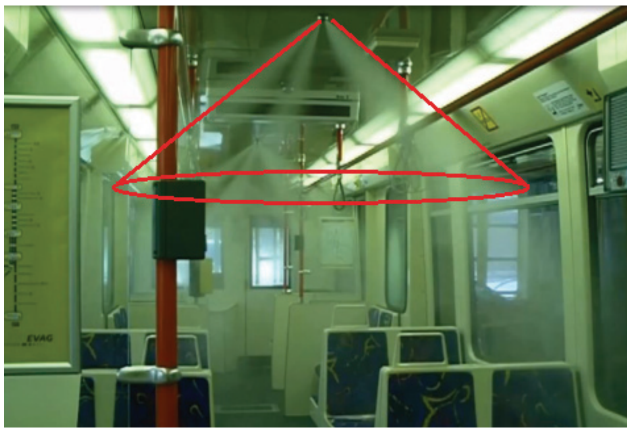

Fig. 4. Spraying cone of water mist [16]

## 2.2. Compartment test

The system type adopted was characterized by following specification:

- 40 l of water as extinguishing agent[4],
- 1× water mist spraying nozzles of Fogtec type DK-6.

[4] The Fogtec system is designed for 100 l nominal capacity of water tanks, according to UNI 11565 fire tests must be carried with 90% of the nominal quantity.

The nozzle was located below the ceiling at a height of 2.75 m, in central position. Being only one nozzle used, only the configuration „under the nozzle" was object of the test.

The testing of the compartment eventually resulted to be the less challenging: the small dimensions of the area contributed to a very rapid distribution of the water mist in the whole volume and immediate full extinguishment of the fire (Table 5). Particular interest was given to the results of the gas measurement (CO, $CO_2$, HCN, $O_2$), potentially a challenge due to small volumes, and of temperature measurement directly below the ceiling.

Table 5

**Values measured on compartment configuration, with „solid" fire; based on [21]**

| Measurement | Limit value | Max measured value |
|---|---|---|
| **T at ceiling** | <65 C | 61 C |
| **T at 1,6 m height** | <65 C | 46.5 C |
| **CO** | <1400 ppm | 450 ppm |
| **$CO_2$** | <6% vol | 0.6% vol |
| **HCN** | <55 mg/m$^3$ | 5 mg/m$^3$ |
| $O_2$ | >15% vol | 20.2% vol |

Gas measurement resulted to be very similar to previous tests, with insignificant deviations (less than 1/10 of the measurement scale) and still strongly below set limits, demonstrating the effectiveness of the water mist in stopping the combustion process. On the other side, temperature measurement at ceiling level, despite remaining lower than the limits, show again the non-regular trend, oscillating around temperatures higher than the measured T at 1.6 m, which did show again a constant curve.

## 2.3. Double deck test

The system type adopted was characterized by following specification:

- 80 l of water as extinguishing agent[5],
- 4× water mist spraying nozzles of Fogtec type RD-4.

The nozzles where located below the ceiling at a height of 1.9 m, being the ceiling of the double-deck configuration lower than the single deck, in semi-central alternated position. This scenario resulted to be the most challenging of the three: very small volumes and hidden fire source due to short seat spacing, created a configuration where fire was almost fully hidden and water mist can very hardly reach it.

In the first test, „under the nozzle" (Fig. 5), temperatures at 1.6 m where kept in terms of threshold values but the temperature curves again did show a strongly non-regular trend, same as ceiling probes who again measured irregular oscillating temperatures: during the test was clearly visible how flames could directly touch the probes.

The test between the nozzles (Table 6, 7) did show very similar results: non-regular curves for the probes at 1.6 m height, irregular trends for the curves at ceiling too.

Contrarily to temperatures, gas measurement did show again positive and coherent results, showing that the firefighting in general was effective and survivability conditions for intoxication (the main danger) where ensured.

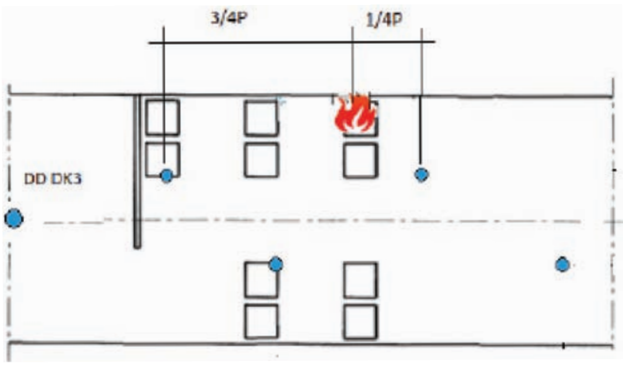


Fig. 5. Nozzles' positioning for single deck, layout „under the nozzle" [5, 16]

Table 6

**Values measured on double-deck, under the nozzle configuration, with „solid" fire; based on [22]**

| Measurement | Limit value | Max measured value |
|---|---|---|
| **T at ceiling** | <65 C | 63.1 C |
| **T at 1,6 m height** | <65 C | 61.8 C |
| **CO** | <1400 ppm | 500 ppm |
| **$CO_2$** | <6% vol | 0.9% vol |
| **HCN** | <55 mg/m$^3$ | 8 mg/m$^3$ |
| **$O_2$** | >15% vol | 20.2% vol |

[5] The Fogtec system is designed for 100 l nominal capacity of water tanks, according to UNI 11565 fire tests must be carried with 90% of the nominal quantity.

Table 7
**Values measured on double-deck, under the nozzle configuration, with „solid" fire; based on [22]**

| Measurement | Limit value | Max measured value |
|---|---|---|
| **T at ceiling** | <65 C | 64.2 C |
| **T at 1,6 m height** | <65 C | 59.6 C |
| **CO** | <1400 ppm | 370 ppm |
| **$CO_2$** | <6% vol | 0.5% vol |
| **HCN** | <55 mg/m$^3$ | 8 mg/m$^3$ |
| **$O_2$** | >15% vol | 20.2% vol |

## 2.4. Analysis of results

The results of the temperature measurement were surprising for the experts carrying the assessment, as the qualitative analysis of the test was in general positive, apart the flames touching the probe: no fire spread, fire controlled and confined to the ignition source and quantitative gas measurements where positive too. For investigating the case, it was decided to carry additional tests with two additional temperature probes, positioned again at ceiling and 1.6 m quote, but at a distance of 1.5 m instead of 1m from the fire source. This distance was chosen because it is longer then the originally set 1 m distance, so that the probe was not touched directly by the flame, but still more conservative than the 2 m set by the equivalent ARGE guidelines method.

The results showed a regular and coherent trend with quantitative analysis: quick rise during pre-burning time, continuing for few seconds after water release, and then gradual decrease during water mist activation. Maximum temperatures were still within the threshold values, and the values were not biased by the flames. Also quantitatively, it was visible that no flame attained directly the probe.

## 2.5. Visibility test

The visibility test is worth of a separate paragraph. This test was never done in previous experiences, like ARGE, being the safety concept based on the evacuation on the nearby area and not on persistence of passenger in the fire involved areas under the spray of water mist (Fig. 6).

However, the UNI working group was common agreement on the need to introduce a safety concept foreseeing the situation of passengers remaining in the fire involved coach; it was therefore necessary to introduce a visibility test during the water mist spray. The topic is critical at first glance: water mist systems are based on a concept of volume filling, and not direct action against the fire, therefore visibility is per nature of the system limited during release. On the other hand, a direct action against the fire is not realistic in an environment like a passenger area, where fire location cannot be a priori defined like e.g. an engine room.

Fig. 6. Passenger coach after approx. 3 minutes of water mist spraying. The visibility is strongly reduced [5, 16]

Additionally, the test method – optical transmittance – chosen was intrinsically wrong: visibility testing in a water filled volume is difficult for those sensors: it is enough that a water drop touches one of the sensor (emitter or receiver) that visibility drops to zero due to refraction effect.

Therefore much interest was given to this test, which was done for the first time.

Results where as expected catastrophic: few minutes after the water mist release, the first drops did hit the sensors and visibility dropped to zero.

Fogtec did investigate the possibility to develop an alternative testing method, not based on optical transmittance. This proposal was based on standard UNI EN 1838:2013 [24] and substituted the measurement of transmittance with an illumination test. By the UNI EN 1838:2013 it is foreseen that in case of emergency light operation a minimum illuminance of 1 lux above ground floor level is necessary. That applies for means of escape with a width up to 2 m and therefore it seems to be applicable for train conditions. As consequence, an illumination level of less than 1 lux during the fire tests is not acceptable. The new test was formalized into a test specification and submitted to evaluation; the pre-testing carried out internally by Fogtec and did show positive preliminary results [6]. Target was to carry independent test campaign in frame of UNI working group to verify the feasibility. However this proposal was not considered in the UNI 11565 under revision [8].

## 3. Conclusions

The activity resulted to be an extremely important „training camp" for the UNI 11565 with an extremely valuable return of experience. Thanks to it many „teething problems" of the standard could be discovered and addressed. Alternative proposal where formulated and many of them constituted discussion topics of the review group for the updated standard [26].

Following results of the test campaign have been reported to the review group:

- The measurement of temperature at 1m distance from the fire is too much biased by influence of the nearby flaming fire, especially in double deck configuration where low ceiling causes flame to not develop regularly in vertical direction, but to hit the ceiling and return back sideward. The new position at 1.5 m distance is free from this effect and can give reproducible data.
- The visibility test based on optical transmittance is not suitable due to intrinsic features of water mist systems. The alternative testing procedure proposed could be an alternative, although an independent testing campaign under UNI supervision is needed.

Eventually, the UNI 11565 constitutes a tool in need of improvement, and resources should be invested by standardization bodies and authorities to promote an independent and exhaustive test campaign.

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26. VdS 2827 Design fires for fire simulations and fire protection concepts (Germany, Austria, Switzerland May 2000).

## Aktywne systemy gaśnicze z użyciem mgły wodnej pod wysokim ciśnieniem: pierwsze doświadczenia z testów zgodnych z włoską normą UNI 11565

**Streszczenie**
W artykule opisano wstępne badania firmy FOGTEC, prowadzone według nowej włoskiej normy UNI 11565:2014 nad zastosowaniem mgły wodnej pod wysokim ciśnieniem do gaszenia pożarów w taborze pasażerskim. Badania wykonano we Włoszech i Niemczech w laboratoriach certyfikowanych do prowadzenia badań zgodnie z normą EN 17025. Wyniki badań wstępnych oraz badań przeprowadzonych przez producentów były podstawą przeglądu normy UNI 11565:2014 rozpoczętego we wrześniu 2015 roku i zakończonego w maju 2016 roku publikacją normy UNI 11565:2016.

**Słowa kluczowe:** UNI 11565:2014, UNI 11565:2016, ochrona przeciwpożarowa, gaszenie pożarów, mgła wodna, badania, bezpieczeństwo, norma, tabor

## Активные системы пожаротушения при использовании водяного тумана под высоким давлением: первые результаты испытаний в соответствии с итальянской нормой UNI 11565

**Резюме**
В статье представлен предварительный опыт компании ФОГТЕК по исследованиях и проведении испытаний проверяющих употребление бортовых систем водяного тумана под высоким давлением с целью тушения пожара в пассажирских зонах подвижного состава, согласно новой итальянской норме UNI 11565:2014. Исследования были проведены в лабораториях сертифицированных для ведения исследований в соответствии с нормой EN 17025 в Италии и Германии. Собранные результаты предварительных исследований (предварительной кампании), а также похожих исследований проведеных производителями, создали основу для процесса просмотра нормы UNI 11565:2014, который начался в сентябре 2015 года, а закончился в мае 2016 года изданием нормы UNI 11565:2016.

**Ключевые слова:** UNI 11565:2014, UNI 11565:2016, противопожарная защита, тушение пожаров, водяной туман, исследования, безопасность, норма, подвижной состав