



Watermist on trains: evolution of UNI 11565 Italian Standard and case study.



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Introduction



Brief history of UNI11565 development and the decision to install watermist system on passenger areas in all Italian trains.



What is described inside UNI11565.



Latest changes in the 2021 edition.



Case study: Regional transport train protected by watermist.



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Brief history of UNI11565 development and the decision to install watermist system on passenger areas in all Italian trains.



Italy decided quite long time ago to develop an increased safety level onboard trains. D.M 28/10/2005 “Safety in Railway Tunnels (or “Decreto Gallerie” in Italian language).



Italian railway counts about 1,500Km of tunnel on a total of 16.800Km, that represents about 9% of the complete infrastructure.

UNI 11565

LUGLIO 2021

UNI 11565 is born following the decision to protect passengers on board trains, allowing them to wait until the train can be safely exit from the tunnel and passengers evacuated.



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Brief history of UNI11565 development and the decision to install watermist system on passenger areas in all Italian trains.



UNI11565 was published in 2014 and it was the first notified national rule covering fire fighting applications on railways.

UNI11565 is including design and performance criteria for validating both fire detection and watermist system.

UNI11565 application is mandatory on all newbuild trains and for all vehicles operating in Italy starting from 2024.

UNI11565 was evolving during past years with 2 revisions after publication in 2014, one in 2016 and latest in 2021.



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Latest changes in the 2021 edition.



What is new in 2021 revision?

- Introduction of a new scenario: sleeping couchette.
- Revision of the thermal test.
- Updates on fire detection part.
- New validation criteria for diesel engine fire fighting.

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NORMA ITALIANA	Veicoli ferroviari - Progettazione, installazione, validazione e manutenzione di sistemi di rilevazione ed estinzioni incendi destinati ai veicoli ferroviari - Principi generali	UNI 11565 GIUGNO 2016	NORMA ITALIANA Veicoli ferroviari - Progettazione, installazione, validazione e manutenzione di sistemi di rilevazione ed estinzioni incendi destinati ai veicoli ferroviari - Principi generali	UNI 11565 LUGLIO 2021
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Brief history of UNI11565 development and the decision to install watermist system on passenger areas in all Italian trains.



What is inside UNI 11565?

- Design criteria for fire detection and fire suppression system
- Real test scenarios descriptions and procedures.
- Performance criteria for acceptance of tests.

Watermist system is tested for 3 different coach configurations:

- Single deck
- Double deck
- Small compartment:
 - Sleeping couchette
 - Seats (Valid also for toilet protection)

Each configuration has 4 tests to pass:

- Thermal test (Below one nozzle, Between 2 nozzles).
- Baggage tests (Below one nozzle, Between 2 nozzles).



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Ultrafog was selected by a major train manufacturer for the supply of watermist system onboard regional transport trains.



The deadline for the application of UNI11565:2016 was 31/12/2022, so we needed to apply the 2021 revision for our design.



Case study: Regional transport train protected by watermist.

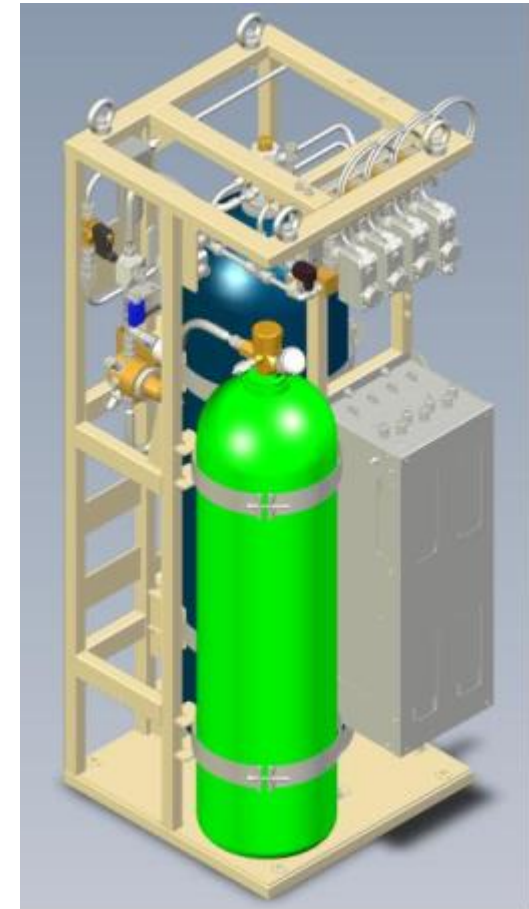
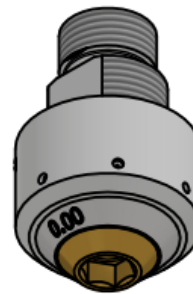
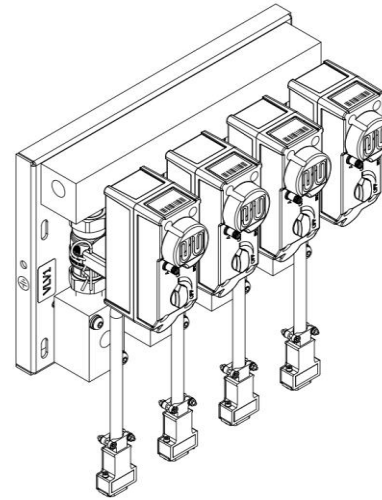


How is a typical train system designed?:

A centralized unit containing one bottle of water and one bottle with pressurized nitrogen.

A set of section valves connected to the main line to distribute the water in each of the train areas.

Nozzles, tested according UNI11565:2021.

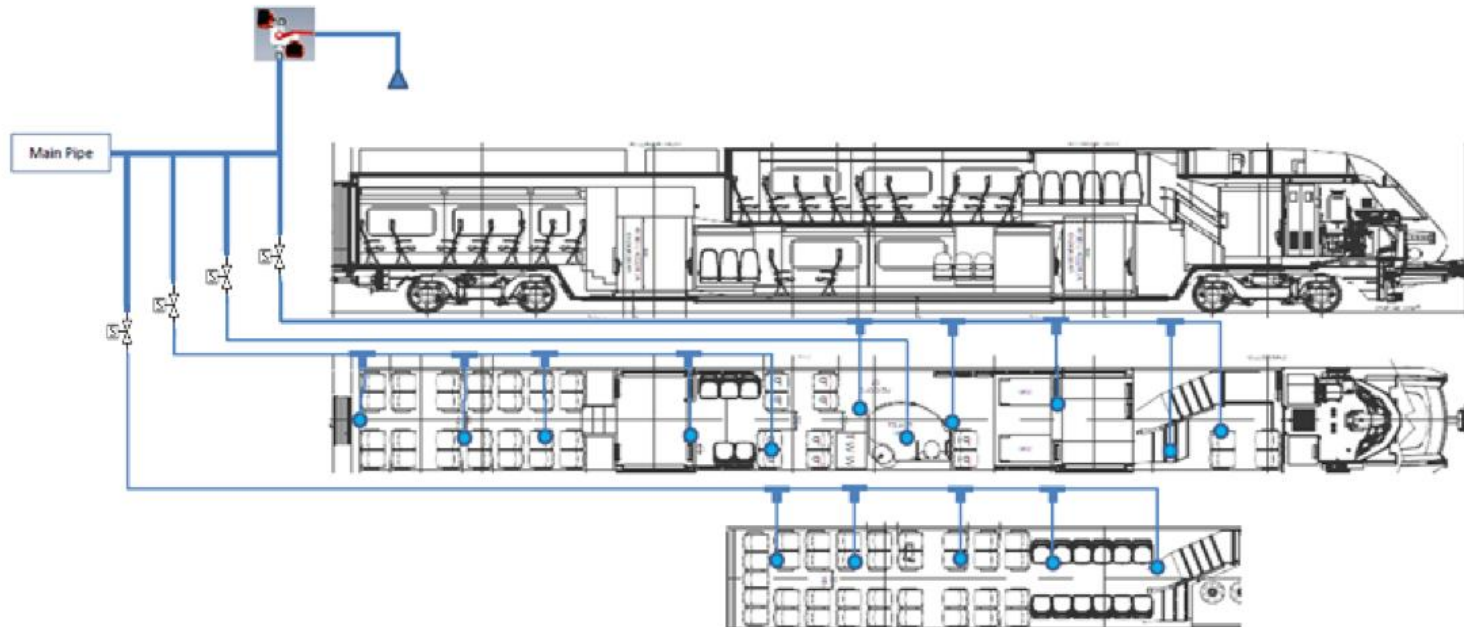




Case study: Regional transport train protected by watermist.



An example of system configuration , showing nozzle placing and area sectioning.





Case study: Regional transport train protected by watermist.



Typical limitations when designing a watermist system on trains:

- System is designed as an accumulator unit of water and nitrogen (no pumps).
- Limited quantity of space -> source of water is very limited.
- Extensive length of pipe, introducing an added delay in water discharge.



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Case study: Regional transport train protected by watermist.



Beside the request of applying the 2021 version of the UNI norm and in addition to the typical constraints found when designing a train system, we needed to manage an additional challenge:

The train was already in production with another system, and we needed to integrate our design in the current configuration without affecting or delaying the industrial production process.

Additional requests from customer:

- Use same mechanical interfaces for all parts (Water package, section valves, nozzles).
- Keep existing nozzle spacing.
- Use same amount of space (or less!).
- All mechanical interfaces shall be identical to the current configuration,



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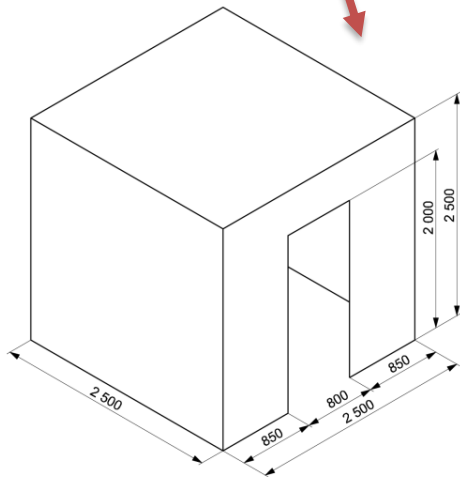
Case study: Regional transport train protected by watermist.



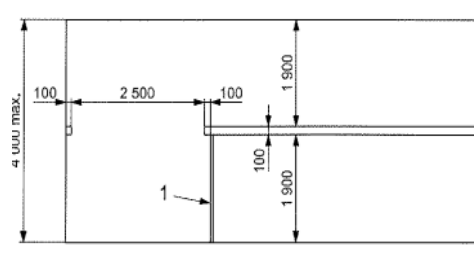
Once all specifications from the customer were received, we went to Baltic Fire Lab to perform all necessary fire tests :

- Single deck
- Double deck
- Small compartment

Ambiente tipo scompartimento
Dimensioni in millimetri



Vano a 2 piani
Legenda
1 Pannello di chiusura
Dimensioni in millimetri



Arredo base
Legenda
1 Parete di compensato di 3 mm di spessore
2 Cappelliera

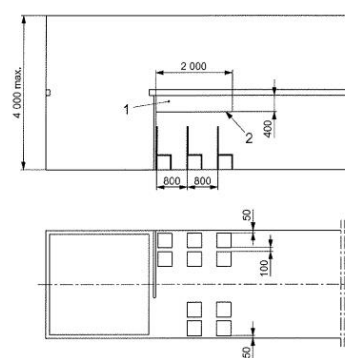
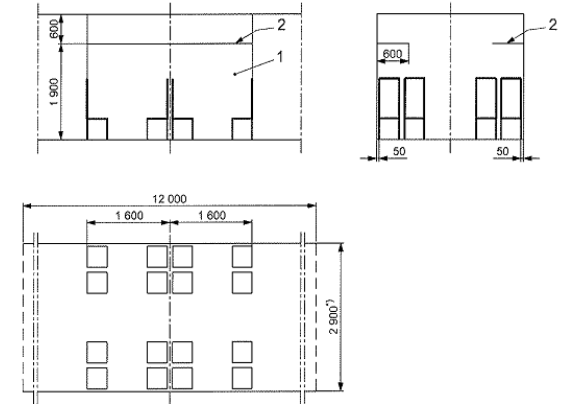


figura B2 Volume di prova

- Legenda
1 Parete in compensato
2 Bagagliera
*) Larghezza 2,9 m o come specificato dal proponente del sistema di estinzione, con un minimo di 2,6 m.

Dimensioni in millimetri





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Fire test is more demanding: the revision 2021 of the 11565 is adding for thermal tests 2 "IMO" foam cushions on the seat for a total of 3 cushions, when in previous revisions only one was there.



The increased heat release inside a small compartment has negative effect on temperature control

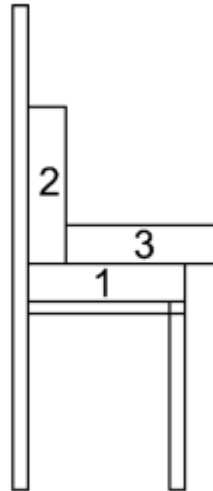


Watermist system needs adjustments to manage the evolved configuration.

2016



2021



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The water quantity to be used was imposed by the previous configuration of the system, so we needed to use a single 80 ltr cylinder of water, pressurized by Nitrogen (50 liters bottle + pressure regulator)

The quantity of water inside the cylinder shall allow the expansion of ice volume to avoid damages in case of freezing temperature. UNI11565 prescribes to run all test in laboratory with 10% less water than “in service” configuration.

Following the previous supplier configuration, we needed to feed simultaneously 6 nozzles, as some of the area onboard the train were counting this number of nozzle connected to the same valve.



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Based on the numbers above, we had only 67,5 liters of water available to be distributed simultaneously in 6 nozzles.

We had to achieve to prescribed performance using only 11,25 liters of water on each nozzle.

In addition to the above constraints, customer and Certification Authority wanted to add about 120 meters of line between the water source and nozzle, to simulate the delay introduced by filling and pressurizing time of the line, assuming the worst scenario of a fire in the most far away point of train.



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Test session was challenging, but outcome was positive.

All test scenarios were passed successfully.



Single deck test



Small compartment test



Double deck test





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While performing fire test, the engineering process was running in parallel to develop components to be fitted on the regional train.

All parts were developed in 3D models and FEM calculation executed to verify the compatibility of the components with shock and vibrations.

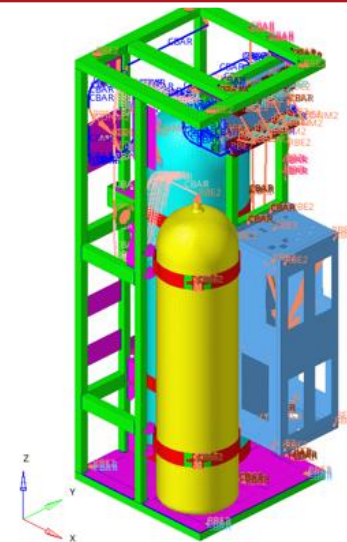
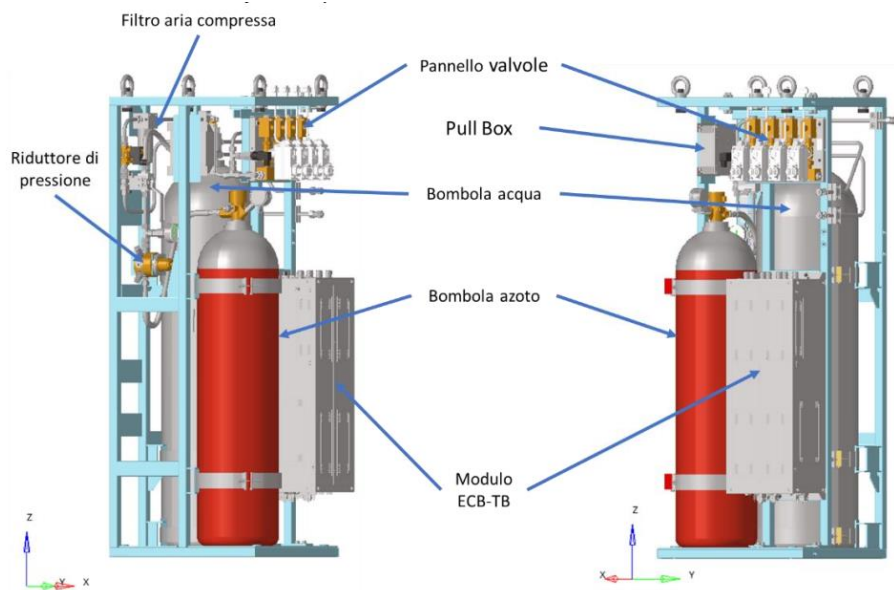


Figura 6-6: Modello FEM completo



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Once calculation were done, first prototype was built and sent to the lab for shock and vibration test (According EN61373 Class 1, B).



X Axis test



Z Axis test



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UNI11565 is taking care of fire protection performance and its validation, but it is only one of the applicable norms. There are many other standards to take in consideration when designing a train system:

Just to mention some of them:

- EN15085: Railway applications - Welding of railway vehicles and components
- EN45545: Railway applications - Fire protection on railway vehicles
- EN61373: Railway Applications - Rolling Stock Equipment - Shock And Vibration Tests
- EN61508: SIL2 Functional safety of electrical/electronic/ programmable electronic safety-related systems General requirements.
- EN50553: Railway applications - Requirements for running capability in case of fire on board of rolling stock



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Delivering Fire Protection Solutions
For Rolling Stock



Thank You!

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