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White Paper

Do we need new fire safety standards for methanol?

Bridging safety gaps to protect methanol-powered vessels

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The number of methanol dual-fuel ships in operation and on order is growing rapidly after a breakthrough year for new engine technology in 2023. However, market demand has overtaken research and development in correlated segments, such as fire safety, resulting in a lack of comprehensive regulations covering areas such as fire suppression systems. This regulation gap then raises questions concerning the safety of ship passengers and crew members, as Survitec realised when starting work on new methanol fire safety tests.

For now, IMO requirements are open to interpretation, but recent testing undertaken by Survitec is starting to pave the way forward.

A comprehensive fire safety study carried out by Survitec in 2024 has revealed that existing firefighting methods used to extinguish machinery space spray and pool fires on conventionally fuelled vessels are inadequate for dealing with methanol-based fires. A different approach is therefore required if these ships are to operate safely.

In this white paper, Michał Sadzyński, Product Manager, Water Mist Systems, Survitec, and Maciej Nieścioruk, Product Manager, Foam and Clean Agent Systems, Survitec, explain their findings and reveal how traditional water mist and foam fire suppression mechanisms can be modified to perform as expected on methanol pool or spray fires.

"We had to completely rethink our approach to nozzle placement, spacing and other factors to make the systems effective on methanol," says Sadzyński.

Sadzyński pinpoints where IMO guidelines are falling short and what this can mean in practice for newbuild design. He explains how Survitec's testing has paved the way for overcoming the weaknesses of diesel fire suppression system designs and technologies without overburdening ship owners. Furthermore, how new solutions from Survitec ensure minimal design changes for newbuildings and workable retrofit options.

The Rise of Methanol and the Urgent Need for Tailored Fire Safety Standards

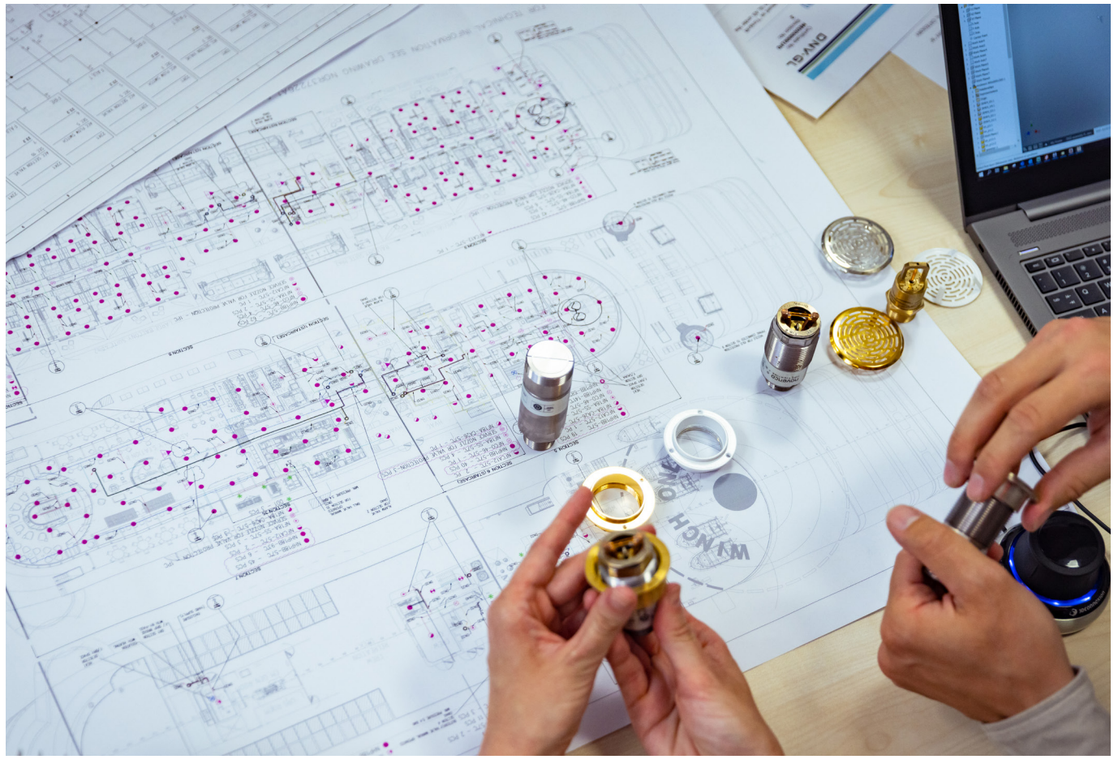
Why do we need to consider methanol fire suppression systems now?

LNG might still have a firm hold on the market overall, but methanol is rapidly becoming a popular choice for alternatively fuelled new builds. In the first four months of 2024, 70 new orders for methanol-fuelled vessels were placed.

While established fire safety regulations and testing standards already exist for LNG and diesel fuels, clear test protocols for alcohol fuels such as methanol and ethanol have yet to be developed. IMO MSC.1/Circ. 1621 provides comprehensive guidance on vessel design but there is very little guidance related to fire safety measures such as firefighting systems. This lack of specification is leading to different interpretations. Assumptions about fire suppression systems are being made based on what has been established for diesel fuels, without considering methanol's unique properties.

"At Survitec, we are "Trusted to Protect Lives", so whenever new developments come to market, we will often be the first port of call for customers seeking advice on safety requirements," explains Sadzyński. "For example, we designed the unique automatic and remotely operated fire safety system for the world's first autonomous container ship, the Yara Birkeland. We were also called upon to manage one of the world's first live CO_2 discharge tests aboard a series of large FPSOs. Likewise, customers started to consult us about fire safety for methanol, and it quickly became clear to us that the existing guidance was not rigorous enough to meet their expectations.

"The pace of change is so fast that new fuel designs are being developed ahead of the safety solutions required to protect them. We were determined to deliver verified solutions that could be trusted to protect our customers' vessels and crew."



Nieścioruk continues, "MSC.1/Circ.1621 provides a starting guideline, but it is very general and therefore open to interpretation. Methanol compliance for Local Application Firefighting (LAFF) systems is not yet covered. This leaves a vacuum, which creates a high-risk situation. As an industry, we really need to come together and develop comprehensive and robust fire test standards and safety rules tailored to methanol's unique properties, but that takes time. In the meantime, customers with upcoming newbuilding projects had an immediate need for reliable safety solutions. We decided we could not wait. We had to act and put the guidance to the test."

What is methanol?

Methanol (CH_3OH) is a clear, colourless liquid. It is water-soluble and burns with a clear blue flame that is smokeless and difficult to see in daylight. Its flashpoint is 12°C / 54°F, much lower than that of distillate and residual oil hydrocarbon fuels, with a minimum flashpoint of 60°C. Additionally, methanol can burn at oxygen levels as low as 12%.

2023 was a watershed year for orders for dual-fuel methanol vessels

In 2023, methanol emerged as the leading choice for alternative fuels, with 138 ships ordered (excluding methanol carriers). This marked a significant increase from 2022 when only 35 ships were ordered. Methanol orders also surpassed LNG orders for 2023, which totalled 130. The most common methanol-fuelled vessels ordered in 2023 were container ships (106), bulk carriers (13), and car carriers (10).

IMO MSC.1/Circ. 1621

MSC.1/Circ.1621: "Interim Guidelines for the Safety of Ships Using Methyl/Ethyl Alcohol as Fuel" was issued on December 7, 2020. It states:

11.7 Provision for fire extinguishing of engine room and fuel preparation space

11.7.1 Machinery space and fuel preparation space where methyl/ethyl alcohol-fuelled engines or fuel pumps are arranged should be protected by an approved fixed fire-extinguishing system in accordance with SOLAS regulation II-2/10 and the FSS Code. In addition, the fire-extinguishing medium used should be suitable for the extinguishing of methyl/ethyl alcohol fires.

11.7.2 An approved alcohol-resistant foam system covering the tank top and bilge area under the floor plates should be arranged for machinery space category A and fuel preparation space containing methyl/ethyl alcohol.

Taking action: Putting fire suppression technologies to the test

"Water mist systems for diesel-fuelled engines are so popular because they are simply the most effective solution for that type of fire," says Sadzyński. "As the small water droplets evaporate, they draw energy from the flame and create a barrier around it, suffocating it. However, there seemed to be a general assumption that these same mechanisms would also work for methanol-based fires. Yet diesel and methanol fuels have very different properties."

Further research proved fruitless; there were no pre-existing requirements or protocols. It was clear that the team would need to devise a test programme from scratch.

Sadzyński explains, "We knew what a Local Application Firefighting (LAFF) system should look like in theory. The question was: precisely how should we verify system performance in the lab? As of 2003, there have been universally accepted protocols in place for the testing of LAFF systems, with parameters such as the required testing pressure and flow rate all clearly defined – but all based on hydrocarbon fuels.

Alcohol fuels behave very differently. For example, methanol has very different heat release rates so the first challenge was to define parameters appropriate for alcohol fuels."

Nieścioruk continues, "It was important that all tests, and test results, should be rigorous and robust. We routinely work closely with class societies and regulatory bodies on newbuilding projects so we knew that DNV were also starting to be active in this area. We invited them to participate in the study. They followed our progress closely throughout and "checked our homework". While all tests were conducted according to international standards at RISE Fire Research Laboratory, Trondheim, a world-class, independent, and accredited fire research institution and testing facility."

Local Application Fire Fighting (LAFF): Testing general assumptions

Once in the lab, it quickly became clear that the "standard" LAFF system arrangement for diesel did not work for methanol.

All initial tests failed. The water mist had no effect on a methanol fire, even after five minutes of operation. The results were clear and led to a stark realisation: using the same arrangement as for diesel, in the absence of any more specific guidance, would be akin to having no protection at all.

"The droplets of water from a water mist system are very small, and the smaller they are, the more easily they mix with the methanol rather than smothering the fire", says Sadzyński.

The priority then was to investigate whether the system arrangement could be adapted to work successfully for methanol spray fires. The Survitec team experimented with nozzle size, spacing, and height. As Sadzyński explains, "We had to go back to the drawing board. There was a long process of trial and error, using trigonometry calculations to predict the optimal conical discharge pattern to quench the fire using different water pressures and nozzle heights. At each stage, we would then verify performance in the lab."

Protecting the bilges: Testing new requirements

MSC.1/Circ.1621 specifies for the first time that an approved alcohol-resistant foam system is to be installed to protect machinery space bilges. The system must cover the tank top and bilge area under the floor plates to protect against methanol pool fires.

"Previously, shipowners have opted for water-only systems, enhanced with foam, and they were adequate because diesel does not mix well with water. These systems could, therefore, create a suffocating barrier on top of a fuel spill. However, methanol dissolves in water while continuing to burn in concentrations of up to 90% water", says Sadzyński.

This is not the only challenge when it comes to protecting the bilge against methanol pool fires. Methanol also tends to "eat" the firefighting foam, rendering it ineffective. The foam concentrate type must therefore be carefully selected to overcome this problem. Even then, the solution may prove inadequate when used with a standard nozzle system.

"Our tests demonstrated that standard discharge devices do not adequately extinguish methanol pool fires in confined bilge spaces. Delivering properly expanded foam onto the methanol pool fire is crucial but also challenging in a narrow space with limited throw length. Finding the right foam solution formula alone is insufficient; however, when the right foam solution is combined with a new nozzle technology, they could conquer methanol pool fires, resulting in an efficient system capable of extinguishing fire quickly.

> Thanks to our investigations on the matter of foam aeration, we managed to achieve an extinguishing effect with a very low discharge density rate of only 2.36 lpm/m^2, which makes our solution extremely attractive when it comes to managing water capacity demand. The focus for many shipowners is to avoid flooding the bilge space and so they will select the smallest water pump capable of supplying the system. What is also unique is that the Survitec foam solution for bilges is equipped with a complete set of material manufacturing tests, such as vibration, clogging, and corrosion, as required for installation in a Machinery Space Category A.
>
> **Michał Sadzyński Product Manager Water Mist Systems, Survitec**

Key findings and conclusions

What should ship owners consider when choosing fire suppression systems for methanol-fuelled vessels?

When designing a water mist LAFF system to protect against methanol spray fires, the key points to consider will be the flow rate, and the arrangement of the nozzles within the protected space.

"The amount of water released from the nozzle and the discharge pattern must be considered when designing a system suitable for methanol-fuelled vessels. This, in turn, affects the height at which the nozzles are installed, their positioning and the volume of water that must be made available to the system," says Nieścioruk.

In practice, this means that an engine room that might require, say, four nozzles to protect against diesel fires, will require more than twice that number to protect against methanol fires, however Survitec has designed a more practical solution whereby a smaller number of high-flow nozzles are positioned closer to the engine and focused on where a spray fire will most likely occur. This configuration has already been specified for one newbuilding and gained class approval.

Survitec has also identified and tested appropriate foam formulations for methanol pool fires, including a more environmentally friendly fluorine-free solution. A specially designed adapter for its existing nozzle range ensures these foams are adequately aerated to reach the fire, even within confined bilge spaces.

The fluorine-free foam solution results in a slightly less compact installation as a 3% foam formulation is required rather than a 1% foam formulation. However, the benefit comes with the more environmentally friendly formulation, which fulfils a clean design notation and helps "future-proof" the vessel in anticipation of future restrictions on fluorinated products.

"Bilge spaces may contain a range of flammable materials. We have therefore tested our solutions to verify performance on varied substances including diesel and lubricating oil, with methanol being the most challenging of them all," says Nieścioruk.

Retrofit solutions are also possible. For these, the focus will be on minimising re-engineering effort while still accounting for methanol's unique properties. For instance, in cases where a gas-based solution, such as the Survitec 1230 Clean Agent System, is already installed for Engine Room protection, it may just be a matter of adding a calculated number of cylinders into the protected space. In some cases, this can be achieved without any additional modifications.

CASE STUDY : The importance of Local Application Firefighting systems

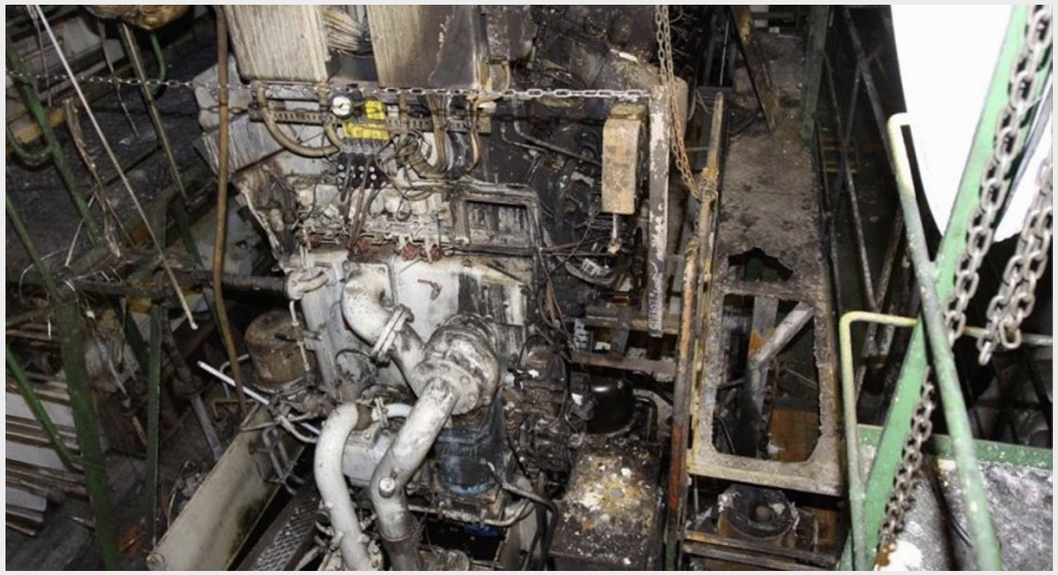
Delays in activating fire suppression systems can lead to the rapid escalation of a fire. This is why a Local Application Firefighting (LAFF) system is mandatory for all vessels with a machinery space of 500m³ or more due to its reliability as an automatic solution that activates within seconds of a fire igniting without the need for human intervention.

An incident on an offshore drilling unit highlights the risks associated with not having an effective LAFF system. On November 22nd, 2016, a fire alarm sounded in the port engine room at 17:16. However, it took approximately 14 minutes before the Survitec 1230 Clean Agent system was activated. Fortunately, nobody was harmed.

After the incident, investigators observed that the system control cabinet was opened within four to five minutes of the fire starting. However, the emergency response command was uncertain whether the engine room was airtight, and so did not activate the system until 10 minutes later. No LAFF solution was on board to extinguish or contain the fire in this case. This delay of 10 minutes contributed to extensive fire damage and compromised crew safety.

Fire testing undertaken by Survitec indicates that a similar situation could arise if a standard diesel water mist LAFF system is installed on a methanol-fuelled vessel: that is, a LAFF system based on the standard arrangement for diesel fires will have little or no impact on a methanol fire – it will be as though there is no LAFF on board.

This situation underscores the need for more detailed guidance on fire protection measures for methanol to ensure vessels and crews are adequately protected and eliminate any risk of misinterpretation.



Pushing the safety agenda: How do we move the industry forward?

What work remains to be done?

Throughout its 168-year history, Survitec has remained at the forefront of innovation, design, and application engineering. Sadzyński points to this latest safety study on methanol fires as a continuation of this history, with Survitec continuing to ensure that it provides ship owners with the highest level of safety onboard their vessels.

"We could have just proposed solutions that met the published guidelines without testing them; we didn't. We invested in developing a new generation of solutions enabling ship owners to advance their decarbonisation strategies confidently.

Regulations and standards are now emerging for firefighting systems for methanol-fuelled vessels – for example, following the results of our study, DNV updated their guidance for methanol-fuelled vessels in July 2024 - but Survitec believes that there is no time to waste in finalising their development. Fire suppression systems need to be tailored to the unique properties of methanol and based on comprehensive research and testing.

"This safety study performed by Survitec has kick-started that process. We are currently working on sharing our findings and building awareness within the industry and we're already in discussion with other class societies on how to develop comprehensive requirements that cover all vessel types.

For example, every shipyard will have their own understanding of what a bilge space looks like – it might be integrated within a larger space, such as the engine room, or it might be a separate, self-contained space. The guidance needs to be sufficiently detailed to allow for this and to avoid any risk of misinterpretation – for instance, in the case of one ship under construction we discovered that no nozzles had been placed within the bilges. More precise and detailed guidance will avoid such oversights. Most importantly, in our opinion, there is a need to make a LAFF system a statutory requirement.

We therefore encourage all stakeholders to come together to address methanol's unique fire risks and create clear standards, new testing protocols and updated safety rules for methanol to ensure we keep our vessels – and most importantly – our crews, safe", says Sadzyński.

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A Head Start to maritime safety for methanol-fuelled vessels

Maciej Nieścioruk explains how Survitec helps ship owners and operators to set their vessels on course for a lifetime of safety at sea

As an Original Equipment Manufacturer (OEM) and a leading provider of fire safety solutions to the maritime industry, we know fire safety systems inside out. We design and manufacture these systems, so we work closely with regulatory bodies and class societies to keep track of new regulations and requirements and to ensure due diligence on all new developments and innovations. We undertake rigorous testing programmes to ensure our systems are reliable and fit for purpose in line with our status in the market as a trusted fire safety expert for the maritime industry.

The Survitec advantage

Design	**Wide-ranging** portfolio of prevention, detection and suppression systems (gas, water, foam, powder) with specialist advice on the most appropriate for your vessel	Guidance on fire systems for dual and alternative fuels – gas, batteries, alcohol, ammonia and hydrogen; risks and hazards assessment and protection requirements	Digitally enabled, integrated fire systems; remote and autonomous control
Construction	**High-quality**, compliant components, global support and centres of expertise	Sales, technical support and commissioning teams close to the shipyard	Comprehensive ability to adjust and redesign where needed
Operations	**Worldwide network** with 60+ locations on six continents – providing a consistently high quality of service across the world	One point of contact in close proximity to customer's office coordinating all transactions in one currency and through one bank account	Options for remote monitoring, access and support; providing OEM support directly from Survitec's centres of expertise

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