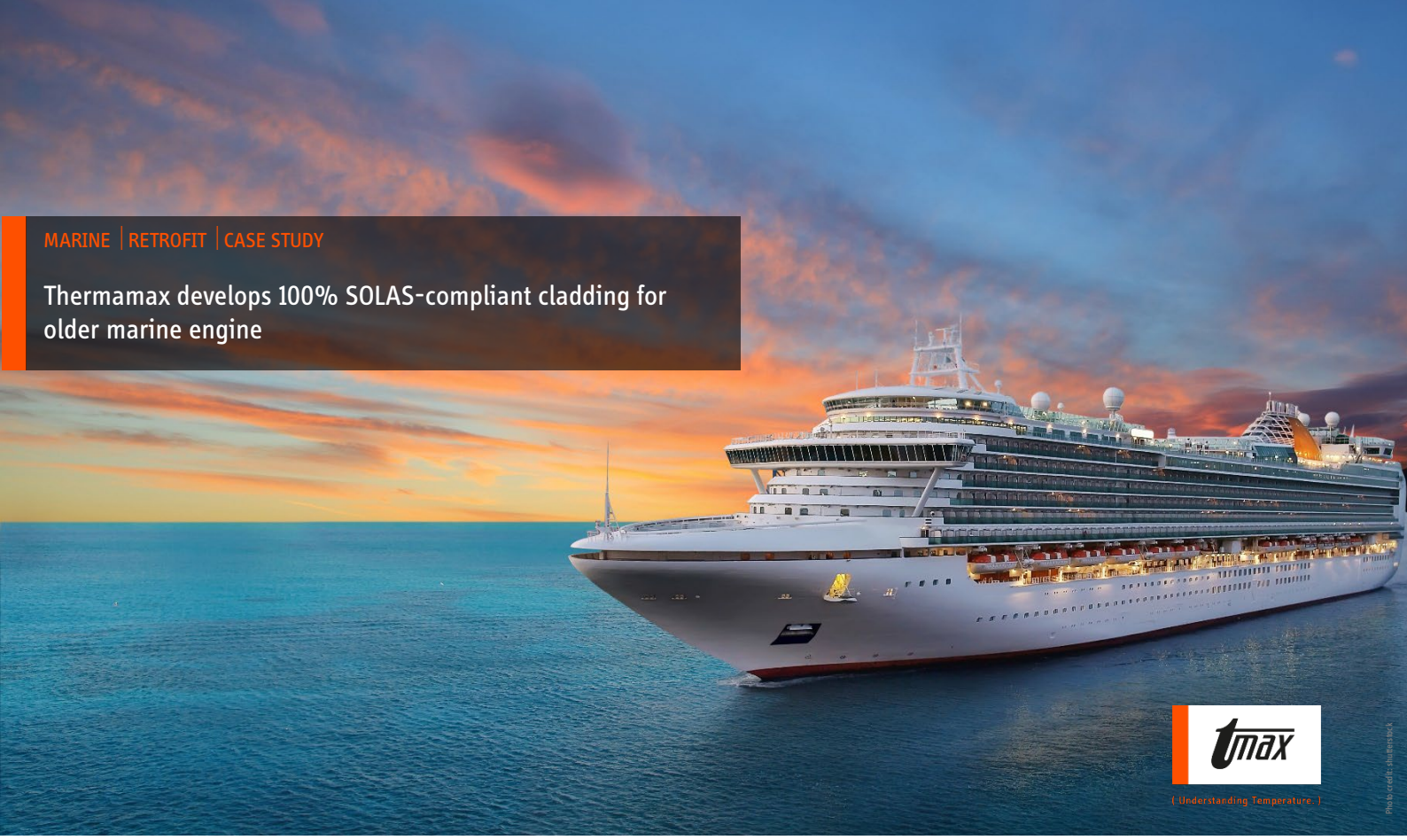

MARINE | RETROFIT | CASE STUDY

Thermamax develops 100% SOLAS-compliant cladding for older marine engine

A luxury shipping company asked Thermamax to retrofit older ship engines with SOLAS-compliant cladding. Thermamax performed a retrofit that included a 3D engine scan and after-sales service. The customized, cost-efficient solution is 100-percent compliant with the SOLAS guidelines and ensures long-term safety on board.

Who: A luxury shipping company in the US

What: 100% SOLAS-compliant cladding for an over 25-year-old engine, cost-efficiently and with no hotspots

Why: Even older engines must meet the SOLAS guidelines

About the shipping company

Founded in North America 1988, the cruise line has always represented ship travel in the luxury class. The portfolio now includes not only ocean travel but also cruises on rivers, yachts and luxury aviation. Although the two cruise ships in question are now the oldest ones in the fleet, thanks to multiple redesigns they represent the state of the art in luxury and technology. The progress has reached all the way into the engine compartment, because even ships with earlier construction dates must comply with the SOLAS guidelines. Thermamax has committed to this task on both ships. This case study will show you how.

One of the two ships in question was commissioned in 1992 and taken into service in 1995. It has six diesel engines of the type Wärtsilä-Sulzer 9ZAL40S. Each engine has a capacity of 6480 kW/8810 HP with a rotational speed of 514 rpm. The engines themselves are a little older and were built in 1990. The maximum exhaust gas temperature is 550 °C and the ambient temperature in the engine compartment ranges from 35 to 50 °C.

Challenges and needs assessment

Identifying the problem

The top priority for the ship is the safety of humans and machines. This is why the status of the 20-year-old insulation was tested. Thermography identified multiple hotspots, including some on heat shields on the exhaust manifold, the exhaust line and other areas. The SOLAS

guidelines were implemented much less consistently 20 years ago. Today, insulation in this condition must be renewed. Another problem was the small distance between an engine's pump chamber and the hottest parts of the adjacent engine. They are only two to three meters apart. In the event of a leak, flammable substances could come in contact with hot engine parts and cause a fire. The appropriate protection of the pump room or indicator valves was absolutely necessary to prevent this.

What is SOLAS?

The UN convention SOLAS (Safety of Life at Sea) is centered around safety on board. One key requirement of the specifications is that no exposed component in the engine compartment may have a surface temperature that exceeds 220 °C. This is based on the ignition temperature of some fuels, which is as low as 250 °C. Reducing the surface temperatures of all parts of the engine and exhaust system to a non-critical 220 °C absolutely requires suitable high-temperature insulation.

The cruise line finds the right partner

In September 2016, the first contact to the shipping company was established at the SMM. Soon the requirements were clear: Customized, 100% SOLAS-compliant cladding was needed for an over 25-year-old engine. The exhaust manifold/line, fuel pump, turbocharger outlet and waste gate would no longer have any hotspots. Thermamax developed a cost-efficient solution that meets all requirements. The order for the cladding was placed in March 2017.

The solution: 100% SOLAS compliance in 6 steps with Tmax-Retrofit

1. 3D scan

The first challenge was the absence of CAD data for the engine to be insulated. These data are the basis for the development and construction of appropriate insulation covering. This is why the first step offered by Thermamax is the preparation of 3D data by means of a 3D scan. Once the required conditions and effort were agreed on, a scan on board was arranged and the components to be recorded were specified: Turbocharger, exhaust system, cylinder heads and environment. In June 2017, the ship in question took its scheduled break in the port of Rostock. The team consisted of the project manager along with design engineers and measurement engineers.

Since vibrations can interfere with measurements, the operation of the ship was limited to an engine in the adjacent engine room. The customer had already removed the existing insulation coverings before the team arrived. It was also important to provide the necessary power supply (220V) for the measuring equipment. The engine rooms of the ship in question are tight. This initially made it difficult to position the sensor. It needs to be at least 1.5 meters away from the engine. After the old insulation was removed, the components to be scanned were thoroughly cleaned. Then the reference points for the scan were positioned on the surfaces – a real challenge in this confined space. On top of this, the high noise level made it difficult to communicate. Strong vibrations interfered with the measurements and the high temperatures in the engine room strained the team as well as the measuring instruments. To get a complete 3D image, the scan has to be repeated from different perspectives. Up to five million 3D measurement points were captured for each measurement. The individual measurements were transformed in the next step.

2. Reverse engineering

Based on the scanned 3D profile, Thermamax now developed a CAD model of the engine. For this purpose, a polygon network was first generated from the available data in STL format and then converted into standard geometries

and free-form surfaces. From these attributed surface models and own on-site photographs, a CAD model was created in the STEP or IGES format. Now all the data needed to develop a reliable exhaust gas or turbocharger cladding was available.

3. Design and simulation

The classic design process started in February 2018. The material and thickness of the insulation were determined on the basis of thermal 0D/1D calculations. The detailed design then took place in the Creo software. The interaction of the exhaust system, turbocharger, aftercooler, bypass valve, etc. could also be considered here.

Computer Aided Engineering (CAE) would also allow Thermamax to run simulations to make predictions about the design as early in the development as possible, long before a prototype is created.

The requirements included not only a maximum surface temperature of 220 °C; the system also had to be easy to maintain and accessible. The design of the insulation system thus also included handles and turnbuckles to simplify the removal of the cladding during frequent inspections. Accessibility is possible with a weight of up to 150 kg. The reduction of components also decreases the weight and complexity of the insulation system, which also makes the assembly and disassembly of the cladding and engine maintenance easier. With a total weight of about 750 kg, the insulation covering mainly consists of stainless steel and about 90 individual parts.

4. Production

The production of the insulation system started once the design was finished. A prototype was made and installed internally. Each individual component of the insulation covering was tested carefully. All single parts were free of scratches, easy to install and remove and fit into their intended places. Thermamax was able to deliver the cladding to the customer without further adjustments.

The final, modular cladding consists of four component groups:

1. Exhaust cladding, first layer

A direct insulation that precisely follows the contours of the exhaust line. This consists of two elements per cylinder, which are connected with sliding systems for ease of maintenance.

2. Exhaust cladding, second layer

A cassette insulation that is clamped on the flange and functions purely as a splash guard. One cassette covers two cylinders.

3. Turbocharger cladding, i.e. exhaust outlet and waste gate

4. Fuel pump room covers to flip up to simplify the frequent inspections. Specially coated insulating components were developed for the indicator valves so that they can't absorb oil.

5. Assembly on board

The installation of the insulation covering took five days and was completed by Tmax specialists in April 2018 during the trip from Valparaiso (Chile) to Callao (Peru). The prototype had a high maturity level so that only minimal adjustments were needed on site, which the team was able to make quickly and cleanly in the ship workshop. These changes were implemented in the models for the other five engines. This is how the remaining engines of the ship can be covered without requiring further work on board.

6. Thermography

The subsequent thermography showed a consistently positive picture: At an ambient temperature of about 35 °C, the measured cladding had surface temperatures of about 120 °C (with an exhaust gas temperature of about 550 °C).

Result: A reliable and SOLAS-compliant engine cladding

The new insulation covering reliably lowers the surface temperatures in the engine room to about 120 °C, which represents a considerable overachievement of the SOLAS guidelines for a 25-year-old engine. This guarantees efficient fire protection for humans and machines as well as increased reliability. The modular design saves valuable time during the assembly and disassembly.

The shipping company benefits from an overall solution from one source, thanks to the high level of vertical integration at Thermamax.

Thermamax succeeded in developing a long-term solution and bringing it to market maturity within the shortest time. Starting with worn cladding that had hotspots in multiple areas and lacking any 3D data, it took only 13 months until the finished product was installed. The retrofit on a second ship of the same cruise line was performed at the same time.

More information about Tmax-Retrofit

https://www.thermamax.com/en/products/tmax-retrofit

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About Thermamax

Thermamax is a worldwide renowned specialist for the design and manufacture of Thermal and Acoustic Insulation Systems for small, medium-sized and large engines. Thermamax Hochtemperaturdämmungen GmbH has its headquarters in Mannheim, Germany, where it was founded in 1976. With its USA subsidiary Thermamax, Inc. (Aurora, Illinois), the Serbian subsidiary Thermamax d.o.o. (Obrenovac, Serbia), the representation in China, Taicang Thermamax High Temperature Insulation Equipment Co. Ltd. (Taicang, China), as well as Sales and Marketing offices in the USA and Italy, Thermamax is active with a wide international Sales and Production network. High-temperature Insulation Systems have applications in vehicles in the Automotive, On-and Off-Highway as well as Power Sports sectors, and in Stationary Power Generation, Marine and On-and Offshore Platform markets. The Thermamax Group has ca. 500 employees worldwide.