Certificate No: LR1900613SF
Issue Date: 12 Sep 2019
Expiry Date: 11 Sep 2024

Certificate Of Fire Approval

This is to certify that the product detailed below will be accepted for compliance with the applicable Lloyd's Register Rules and Regulations and with the International Convention for the Safety of Life at Sea, (SOLAS), 1974, as amended, for use on ships and offshore installations classed with Lloyd's Register, and for use on ships and offshore installations when authorised by contracting governments to issue the relevant certificates, licences, permits etc.

Manufacturer	**Morgan Advanced Materials, Thermal Ceramics**
Address	Tebay Road, Bromborough, Wirral, Merseyside, CH62 3PH, United Kingdom
Type	JET FIRE PROTECTION SYSTEM
Description	Fire Resisting Panel System – Type: "FireMaster Rigid Panel System" for flat steel divisions or cylindrical vessels, pipes and tubular sections of outside diameter greater than 500mm; for jet fire exposures up to 180 minutes
Trade Name	FireMaster Rigid Panel System
Specified Standard	International Standard ISO 22899-1:2007(E) "Determination of the Resistance to Jet Fires of Passive Fire Protection Materials, Part 1: General Requirements" International Standard ISO 22899-2:2013 "Determination of the Resistance of Jet Fires of Passive Fire Protection Materials, Part 2: Guidance on Classification and Implementation Methods"

Keith Taylor

Keith Taylor

Team Lead, Fire & Safety to Lloyd's Register EMEA
A member of the Lloyd's Register Group

71 Fenchurch Street, London, EC3M 4BS, UK

Certificate Of Fire Approval

This certificate is not valid for equipment, the design or manufacture of which has been varied or modified from the specimen tested. The manufacturer should notify Lloyd's Register EMEA of any modification or changes to the equipment in order to obtain a valid Certificate.

The Design Appraisal Document and its supplementary Type Approval Terms and Conditions form part of this Certificate.

This certificate remains valid unless cancelled or revoked, provided the conditions in the attached Design Appraisal Document are complied with and the equipment remains satisfactory in service.

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ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No. LR1900613SF

The undernoted documents have been appraised for compliance with the relevant requirements of International Conventions, and this Design Appraisal Document forms part of the Certificate.

This Certificate is a replacement of previous Lloyd's Register EMEA Certificate of Fire Approval No: SAS F140277.

APPROVAL DOCUMENTATION

DNV-GL, Spadeadam Test Site, Cumbria, United Kingdom, Fire Test Report No. 15548, Issue 1, dated 16 July 2014 for a Panel Test Specimen Jet Fire Test.

CONDITIONS OF CERTIFICATION

1. Applications to be based on a 180 minute maximum jet fire exposure test performed with a steel Panel Test Specimen fitted with a "FireMaster Rigid Panel System" jet fire protection system (88.6mm total thickness of insulated panel)
2. Consisting of: steel plate/substrate covered with a galvanised steel wire mesh 50mm x 50mm x 2mm dia. secured with steel support rails constructed from two 40mm x 3mm flat bars separated by upstands 78mm deep at 200mm spacing all welded together, secured in position at a maximum spacing of 800mm. The wire mesh is cut to provide raised pins through the full insulation layers at 200mm centres and the insulation is retained by friction grip washers over the pins. Two layers of "FireMaster Marine Plus" blanket 50mm + 38mm thick (128kg/m^3 density) are fitted between and under the top flat bar of the support rails with staggered insulation joints. A top layer of 0.6mm thick, Grade 304 stainless steel panels, with 75mm overlap swaged joints are secured with 4.2mm self-tapping stainless steel screws or 10mm stainless steel rivets at 100mm centres. The support rails must be retained securely to the steel substrate by a suitable design method approved by Lloyd's Register for the application at the design stage
3. Alternative use of welded steel pins 3mm dia. at the same spacing in place of the wire mesh to retain the insulation where welding to the steel substrate is allowed and additional layers of stainless steel cladding may also be considered by Lloyd's Register for the application at the design stage
4. Alternative support arrangements may be considered on a project approval basis, such as the spacing of the support rings/bars may be increased if the cladding thickness is increased accordingly. Suitable support for the outer cladding must also be provided to prevent excess movement between the cladding and the support rings/bars particularly on flat panel applications, such as, screws or rivets being fitted to secure the cladding to the support rings/bars or insulation studs may be utilised where welding to the substrate is allowed
5. Suitable approved insulation is to be applied to any other part of the protected fire exposed surfaces not covered by the panel system, in all cases. In particular, attention is to be paid to means of securing enclosure boundaries and the prevention of heat bridging; an overlap of at least 150mm should be provided between the two systems

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6. The rigid steel panel system may be considered for applications on cylindrical vessels, pipes and tubular sections of 500mm O.D or greater diameter or for flat steel fire divisions with no corners or edge features, with support rails retained securely to the steel substrate for all applications
7. Production items are to be manufactured in accordance with a quality control system which shall be maintained to ensure that items are of the same standard as the approved prototype
8. The Certificate holder is solely responsible for the products supplied under this Certificate and to ensure that their products, whether manufactured by themselves or their licensee manufacturers, if agreed by Lloyd's Register, are fully compliant with the relevant statutory regulations and Lloyd's Register Class Rules as applicable and designed and manufactured to the same quality and specifications as the prototype tested, including components that are designed and manufactured by third parties

NOTES

1. No additional hydrocarbon or jet fire tests were submitted by the manufacturer to demonstrate the relationship between hydrocarbon and jet fire test results, to enable variations in time/temperature criteria, rigid panel system thickness or substrate type to be assessed
2. The "FireMaster Rigid Panel System" may be assigned a **Jet Fire Classification** based on ISO 22899-1:2007(E), Section 15 and ISO 22899-2:2013 [Type of Fire/Type of Application/Critical Temperature Rise (˚C)/Period of Resistance (Mins)], depending on type of application, particular construction make-up of the insulation system and maximum core temperatures specified, in accordance with ISO 22899-1:2007 Section 15.4 and ISO 22899-2:2013 Section 8.4 Critical Temperature Rise as follows:

"JF/Pressure Vessels/125/30"	**OR**	**"JF/Fire Barriers/125/30"**
"JF/Pressure Vessels /180/60"	**OR**	**"JF/Fire Barriers/180/60"**
"JF/Pressure Vessels /195/180"	**OR**	**"JF/Fire Barriers/195/180"**

3. The "Classifications" listed on Note 3 above depend on the particular application and maximum allowable core temperature required, in accordance with ISO 22899-1:2007(E) "Section 15.4 Critical Temperature Rise" for load bearing steel structures this is normally 400ºC, however, Pressure Vessels and Fire Barriers may have significantly lower temperature limitations which should be taken into consideration at the design stage.
4. The Jet Fire Protection Jacket System was fitted over tubular steelwork and panel specimens and was subjected to blast / gas explosion resistance tests as described in DNV-GL, Explosion Test Report No. 1XIW3BF-1, Rev. 0, dated 29 February 2016. It is noted that the tested specimens remained intact and were considered to be suitable in withstanding the following average and peak overpressures recorded:

Blast Test No.	Average Peak Blast & Impulse Duration	Maximum Peak Blast & Impulse Duration
1	0.43 bar, 170 ms	0.52 bar, 191 ms
2	0.50 bar, 170 ms	0.68 bar, 170 ms

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It should be noted that the panels were secured (restrained) at all sides in the explosion chamber. The suitability of other configurations i.e. unrestrained at any or multiple sides, and the impact which this may have on the performance of the product under a blast scenario is excluded from this Certificate. LR recommends that the final configurations are assessed on a project by project basis to confirm suitability

JET FIRE TEST RESULTS

Test Results for Rigid Panel System (88.6mm thick) [DNV-GL Test Report No. 15548, Issue 1, dated 16 July 2014

Test Description: A jet fire test was performed on a flat panel specimen with an Hp/A section factor of 100m^{-1} in accordance with ISO 22899-1:2007.

Integrity: 180 minutes (protection remained generally in position for the duration of test, although the outer stainless steel facing had a hole in the top panel and both joints had been partially separated by the jet fire action when the test was terminated at 190 minutes).

Insulation: The following maximum temperature rises were recorded on the steel backplate of the specimen in line with ISO 22899-1:2007:

TC 03	after 30 minutes	of exposure:	128.9ºC
TC 24	after 60 minutes	of exposure:	182.9ºC
TC 24	after 90 minutes	of exposure:	194.4ºC
TC 24	after 120 minutes	of exposure:	199.2ºC

Note: *The standard thermocouples Nos. TC01 – TC18 were assessed against ISO 22899-1; in addition, 6 thermocouples No's. TC19 – TC24 were fitted adjacent to upstands for the support bars on the specimen and were considered to be heat bridges that needed to be assessed for purposes of this Certificate.*

Classification: **" JF/Pressure Vessels/125/30" OR "JF/Fire Barriers/125/30"**
"JF/Pressure Vessels /180/60" OR "JF/Fire Barriers/180/60"
"JF/Pressure Vessels /195/180" OR "JF/Fire Barriers/195/180"

Certificate No: LR1900613SF
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Description of Test Specimen:

The panel test specimen consisted of: a 10mm thick steel backplate with a "FireMaster Rigid Panel System" comprised of a layer of galvanised steel wire mesh 50mm x 50mm x 2mm dia. secured to the plate by two horizontal steel support rails, constructed from two 40mm x 3mm flat bars separated by upstands 78mm deep at 200mm spacing all welded together, the support rails were secured in position at a maximum vertical spacing of 800mm and secured at the ends by tack welding to the panel edges.

The "FireMaster Rigid Panel System" panels contained two layers of insulation, 50mm thick inner layer and 38mm thick outer layer of "FireMaster Marine Plus Blanket" (128kg/m^3 density) with staggered joints were secured by pins formed from the steel mesh and secured with friction grip steel washers. A top layer of 0.6mm thick, Grade 304 stainless steel panels, with 75mm overlap swaged joints were secured with 4.2mm self-tapping stainless steel screws or 10mm stainless steel rivets at 100mm centres. A full height vertical joint was positioned to the right hand side of the nozzle and a horizontal joint was fitted above the nozzle to form a tee-joint with the vertical joint.

SCOPE

The test described in the procedure ISO 22899: Part 1 is one in which some of the properties of passive fire protection materials can be determined and is designed to give an indication of how passive fire protection materials will perform in a jet fire. The dimensions of the test specimen may be smaller than typical items of structure and plant and the release of gas may be substantially less than that which might occur in a credible event. However, individual thermal and mechanical loads imparted to the passive fire protection material, from the jet fire defined in the procedure described in ISO 22899: Part 1, have been shown to be similar to those by large-scale jet fires resulting from high pressure releases of natural gas

Although the test method has been designed to simulate some of the conditions that occur in an actual jet fire, it cannot reproduce them all exactly and the thermal and mechanical loads do not necessarily coincide. The results of this test do not guarantee safety but may be used as elements of a fire risk assessment for structures or plant. This should also take into account all the other factors that are pertinent to an assessment of the fire hazard for a particular end use. This test is not intended to replace the hydrocarbon fire resistance test (ISO/TR 834-3/EN 1363-2 or equivalent) but is seen as a complimentary test

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PLACES OF PRODUCTION

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United States of America (USA)

Thermal Ceramics
1-31 Bookdong, Non Gong Eup
Dal Sung-Gun, Dae Gui-Shi
711 855
Korea

Thermal Ceramics
Cerrada de la Paz No. 101
Zona Industrial la Paz
CP. 4218
Mineral de la Reforma Hidalgo
México

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Murugappa Morgan Thermal
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UK&I Technical Support Office, Marine & Offshore
Lloyd's Register EMEA

Supplementary Type Approval Terms and Conditions

This certificate and Design Appraisal Document relates to type approval, it certifies that the prototype(s) of the product(s) referred to herein has/have been found to meet the applicable design criteria for the use specified herein, it does not mean or imply approval for any other use, nor approval of any products designed or manufactured otherwise than in strict conformity with the said prototype(s).