Certificate No: LR22422781SF
Issue Date: 21/08/2022
Expiry Date: 20/08/2027

Certificate Of Fire Approval

This is to certify that the product(s) detailed below will be accepted for compliance with the applicable Lloyd's Register Rules and Regulations for use on offshore units classed with Lloyd's Register, and for use on offshore units and onshore facilities when authorised by contracting governments to issue the relevant certificates, licences, permits etc.

Manufacturer	**Morgan Advanced Materials**
Address	Thermal Ceramics, Tebay Road, Bromborough, Wirral, Merseyside, CH62 3PH, United Kingdom (UK)
Type	**Jet Fire Protection System**
Description	"FireMaster® Flexible Enclosure System (FES)", for Tubular Steel Sections, Cylindrical Vessels or Pipes; for Jet Fire Exposure durations of up to 175 minutes
Trade Name	FireMaster® Flexible Enclosure System (FES)
Specified Standard	International Standard ISO 22899-1:2007 "Determination of the Resistance to Jet Fires of Passive Fire Protection Materials, Part 1: General Requirements"

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.

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, United Kingdom

Certificate No:
Issue Date: 21 August 2022
Expiry Date: 20 August 2027

DESIGN APPRAISAL DOCUMENT

Reference: UKITSO/FIRE/TA/KT/WP47593251/PRJ11100381512

ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No. LR22422781SF

This Design Appraisal Document forms part of the Certificate.

This Certificate supersedes and is an renewal previous Lloyd's Register Certificate No: SAS F170189.

APPROVAL DOCUMENTATION

1. DNV-GL, Spadeadam Test Site, Cumbria, United Kingdom, Fire Test Report No. 113QXJH2-1, Rev. 1, dated 25 January 2017.

   Note: *A Surveyor from Lloyd's Register's Liverpool Office witnessed this jet fire test.*

2. DNV-GL, Spadeadam Test Site, Cumbria, United Kingdom, Fire Test Report No. 1ZFX1JG-2, Rev. 1, dated 16 February 2016.

   Note: *A Surveyor from Lloyd's Register's Birmingham Office witnessed this jet fire test.*

CONDITIONS OF CERTIFICATION

1. "FireMaster® Flexible Enclosure System (FES)" applications to be based to be based on two jet fire exposure tests performed on "FireMaster® Flexible Enclosure System (FES)". One mounted on a steel tubular specimen and one on a panel test specimen for jet fire protection (70mm nominal thickness of jacket in both tests). See the "Jet Fire Test Results" Section for the performance achieved from the jacketing system during each jet fire test.
2. "FireMaster® Flexible Enclosure System (FES) flexible jacket for jet fire exposure consists of: an internal skin of silicon fabric; two layers of 25mm thick "FireMaster® XLS Alkaline Earth Silicate Fibre Blanket" (128kg/m^3); two layers of 10mm thick "FireMaster® MarineFlex" insulation (270kg/m^3); and an outer skin of Hiltex fabric. The system is secured using stainless steel lacing wire and lacing hooks. All joints on tubular sections must be overlapped by 75mm and retained by 19mm wide, 0.6mm thick stainless steel banding at 200mm nominal centres and to both sides of circumferential joints. All vertical and horizontal joints on panels must be butt-jointed together and the joint covered by a 70mm wide extension of the outer textile of the FES jacket, all secured by stainless steel lacing wire and lacing hooks, fitted through the full jacket thickness at a 100mm nominal spacing.
3. May be considered for applications in pipework, pressure vessels, valves and flat panels with or without corners and edges, tubulars must not exceed an Hp/A factor of 128m^{-1} (Where 'Hp' is the outside circumference and 'A' is the cross-sectional area). ISO 22899-1, Section 6.6, also allows applications for all sizes of tubulars above the size tested for flat surfaces, with or without corners and edges.
4. Applications in each case to be approved by Lloyd's Register at the design stage and drawings for each enclosure are to be submitted to Lloyd's Register for approval.
5. Generally used in external locations, where personnel are not normally present during an emergency event. Consideration may be given to the use in internal locations for limited applications only (for example, in modules or spaces where personnel are not normally present during an emergency event).
6. Suitable approved insulation is to be applied to any other part of the protected jet fire exposed surfaces not covered by the enclosure, in all cases. In particular, attention is to be paid to means of securing boundaries and the prevention of heat bridging; an overlap of at least 100mm should be provided between the two systems where the insulation arrangements on the adjacent areas are the same or equivalent to the as-tested arrangements.

DESIGN APPRAISAL DOCUMENT

ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No. LR22422781SF

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 are fully compliant with the relevant statutory regulations and Lloyd's Register Class Rules as applicable and designed, manufactured and installed to the same quality and specifications as the prototype tested, including components that are designed and manufactured by third parties.

NOTES

1. This Certificate only approves the fire performance of the product in line with the testing standards. All other performance requirements, including durability, environmental exposure (UV, salt spray exposure, high humidity, condensation, corrosion, corrosion under PFP system) etc. are outside the scope of this Certificate.
2. No additional hydrocarbon 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, jacket thickness or Hp/A values to be assessed.
3. The "FireMaster® Flexible Enclosure System (FES)" for "Tubular Section" may be assigned a **Jet Fire Classification** based on ISO 22899-1: 2007, Section 15 (Jet Fire/Tubular Section/Critical Core Temperature/Minutes), 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, Critical Temperature Rise. These are outlined in the 'Jet Fire Test Results' Section of this Certificate.
4. The "FireMaster® Flexible Enclosure System (FES)" has also been tested on a panel test specimen and the may be classified as "Fire Barrier or Pressure vessel" and assigned a **Jet Fire Classification based** on ISO 22899-1: 2007, Section 15 (Jet Fire/Fire Barrier or Pressure Vessel/Critical Core Temperature/Minutes), 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, Critical Temperature Rise . These are outlined in the 'Jet Fire Test Results' Section of this Certificate.
5. The "Classifications" listed in Notes 3 and 4 above depend on the particular application, Hp/A Section Factor, insulation thickness and the maximum core temperature required, in accordance with ISO 22899-1:2007, Section 15.4. The Critical Temperature Rise for load bearing steel structures is typically 400°C, however some protected items may have significantly lower temperature limitations which should be taken into consideration at the design stage.

DESIGN APPRAISAL DOCUMENT

ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No. LR22422781SF

JET FIRE TEST RESULTS

Test Results for Tubular Test (DNV-GL Test Report No. 113QXJH2-1, Rev. 1, dated 25 January 2017):

Test Description: A jet fire tubular test was performed in accordance with ISO 22899-1:2007.

Description of Test Specimen: A 150 minute jet fire exposure test performed on a 3 metres long circular steel hollow section, 8" NB, Schedule 40 steel pipe (219.08mm x, 8.179mm wall thickness) and a Section Factor (Hp/A) of 128m^{-1}; fitted with a "FireMaster® Flexible Enclosure System (FES) flexible jacket system, with longitudinal and circumferential joints facing the jet fire.

The "FireMaster® Flexible Enclosure System (FES) flexible jacket test specimen comprised of: an internal skin of silicon fabric; two layers of 25mm thick "FireMaster® XLS Alkaline Earth Silicate Fibre Blanket" (128kg/m^3); two layers of 10mm thick “FireMaster® MarineFlex” insulation (270kg/m^3); and an outer skin of Hiltex fabric. The system is secured using stainless steel lacing wire and lacing hooks. All joints on tubular sections were overlapped by 75mm and retained by 19mm wide, 0.6mm thick stainless steel banding at 200mm centres and to both sides of circumferential joints.

Integrity: **150 minutes** (protection remained intact for duration of test)

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

after 15 minutes of exposure:	23.8°C	after 90 minutes of exposure:	224.9°C
after 30 minutes of exposure:	64.9°C	after 105 minutes of exposure:	260.8°C
after 45 minutes of exposure:	101.8°C	after 120 minutes of exposure:	309.6°C
after 60 minutes of exposure:	146.3°C	after 135 minutes of exposure:	360.1°C
after 75 minutes of exposure:	188.7°C	after 150 minutes of exposure:	400.0°C

Classification:

JF/Tubular Section/25/15
JF/Tubular Section/70/30
JF/Tubular Section/105/60
JF/Tubular Section/230/90
JF/Tubular Section/315/120
JF/Tubular Section/405/150

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Test Results for Panel Test (DNV-GL Test Report No. 1ZFX1JG-2, Rev. 1, dated 16 February 2016):

Test Description: A jet fire planar test incorporating a raised box to simulate edge and corner features was performed in accordance with ISO 22899-1:2007.

Description of Test Specimen: A 175 minute jet fire exposure test performed on a planar steel substrate, fitted with a "FireMaster® Flexible Enclosure System (FES) flexible jacket system. The test specimen comprised of: a 10mm thick steel backplate fitted with "FireMaster® Flexible Enclosure System (FES) flexible jacket, with a vertical and horizontal joint and a raised steel box (260mm x 260mm x 250mm x 10mm thick on outer face and 5mm thick on its sides) to the right hand side of the jet fire central impingement, in order to test edge and corner joints of the flexible jacket system. All joints were facing the jet fire.
The "FireMaster® Flexible Enclosure System (FES) flexible jacket test specimen comprised of: an internal skin of silicon fabric; two layers of 25mm thick "FireMaster® XLS Alkaline Earth Silicate Fibre Blanket" (128kg/m^3); two layers of 10mm thick “FireMaster® MarineFlex” insulation (270kg/m^3); and an outer skin of Hiltex fabric. The system is secured using stainless steel lacing wire and lacing hooks. The specimen's vertical and horizontal joints were butt-jointed together and the joint covered by a 70mm wide extension of the outer textile of the FES jacket. The raised box jacket was retained by stainless steel lacing wire and lacing hooks, fitted through the full jacket thickness at 100mm spacing.

Integrity: **175 minutes** (protection remained intact for duration of test)

Insulation: The following **maximum temperature rises** were recorded on the **planar steel substrate** in line with ISO 22899-1:2007:

after 15 minutes of exposure:	25.0°C	after 105 minutes of exposure:	199.0°C
after 30 minutes of exposure:	53.1°C	after 120 minutes of exposure:	224.3°C
after 45 minutes of exposure:	83.8°C	after 135 minutes of exposure:	244.1°C
after 60 minutes of exposure:	111.2°C	after 150 minutes of exposure:	262.3°C
after 75 minutes of exposure:	132.8°C	after 165 minutes of exposure:	272.0°C
after 90 minutes of exposure:	165.0°C	after 175 minutes of exposure:	277.1°C

Classification:

JF/Fire Barrier or Pressure Vessel/30/15
JF/Fire Barrier or Pressure Vessel/55/30
JF/Fire Barrier or Pressure Vessel/115/60
JF/Fire Barrier or Pressure Vessel/170/90
JF/Fire Barrier or Pressure Vessel/230/120
JF/Fire Barrier or Pressure Vessel/265/150
JF/Fire Barrier or Pressure Vessel/275/165
JF/Fire Barrier or Pressure Vessel/280/175

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SCOPE

The test described in the procedure ISO 22899-1:2007, 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 22899-1:2007, 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.

PLACES OF PRODUCTION

Morgan Thermal Ceramics
Ecrans Thermiques Department
Zi Du Léard
Thouarcé, 49380
France

Thermal Ceramics Korea (Daegu)
1-31 Bookdong, Non Gong Eup
Dal Sung-Gun, Dae Gui-Shi
711 855
Republic of Korea

Morgan Advanced Materials
Thermal Ceramics
Porextherm Dämmstoffe GmbH
Heisinger Str. 8/10, 87437
Kempten, Germany

Morgan Advanced Materials
Thermal Ceramics Inc.
2730 Industrial Pkwy
Elkhart, IN 46516
United States of America

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Keith Taylor
Team Lead, Fire & Safety
Statutory Discipline Team
UK&I Technical Support Office, Marine & Offshore
Lloyd's Register

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)