Certificate No: SAS F180149-03
Issue Date: 05 August 2022
Expiry Date: 30 April 2023

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 Enclosure System
Description	"FireMaster® Rigid Enclosure System for valves, actuators and flanges; for jet fire exposure durations of up to 120 minutes
Trade Name	FireMaster® Rigid Enclosure System
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

ATTACHMENT TO CERTIFICATE OF FIRE APPROVAL No. SAS F180149-03

This Design Appraisal Document forms part of the Certificate.

This Certificate is an amendment and replacement of previous Lloyd's Register Certificate No: SAS F180149-02.

APPROVAL DOCUMENTATION

1. GL Noble Denton, Spadeadam Test Site, Cumbria, United Kingdom, Fire Test Report No's: 13317, dated 24 November 2012; and 14418, Issue 1, dated 13 December 2013. (Tubular Jet Fire Test Specimens).
2. DNV-GL, Spadeadam Test Site, Cumbria, United Kingdom, Fire Test Report No. 605565, Rev. 1, dated 04 March 2018. (Tubular Jet Fire Test Specimen).
3. BRE Global, Watford, Herts, United Kingdom, Fire Test Report No. P119601, Issue: 01, dated 23 June 2022 (Alternative Seals).
4. Manufacturer's Drawing No's: 11-008 500, Rev. B, dated 24 December 2012 (Test 1); No. 11-008 800 00, Rev. B, dated 07 November 2013 (Test 2); and 19-016 500, Rev. A (Test 3) showing enclosure materials and jet fire test specimen construction details.

CONDITIONS OF CERTIFICATION

1. Applications in each case to be approved at the design stage by Lloyd's Register.
2. The "FireMaster Rigid Enclosure System" system may be considered for applications on valves, actuators and flanges, not exceeding the Hp/A section factors (where 'Hp' is the outside circumference and 'A' is the cross-sectional area) outlined in the "Jet Fire Test Results" section of this Certificate.
3. Consisting of: stainless steel panels fitted to both sides of an insulation core, forming a split rectangular box enclosure around a "pipe system component", such as an actuator, valve or flange. An internal air gap around the component of at least 36mm is to be maintained and all panel joints to be secured by stainless steel latches fitted at a maximum spacing of 200mm or they may be used in conjunction with a continuous (piano) hinge; all joints to be fitted with 'ODICE' or 'INTUMEX' intumescent seals. The enclosure is to be sealed to the adjoining pipe by overlapping stainless steel split collars, fitted with intumescent strips, insulation pads (Tests 1 and 3 only) and secured with stainless steel banding. Details of all components and insulation materials are to be in accordance with the Manufacturers Drawings outlined in Approval Document No. 3 above and as described in the "Fire Test Results" Section of this Certificate.
4. 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).
5. Suitable approved insulation shall 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 150mm 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.
6. 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.

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7. 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 Rigid Enclosure Systems" Jet Fire Protection Systems for Pipe System Components with maximum Hp/A Section Factors as outlined below, may be assigned a **Jet Fire Classification** based on ISO 22899-1:2007, Section 15 and ISO 22899-2:2013, Section 8 [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 as follows:

   Test No. 1 - "FireMaster Rigid Enclosure System" (83.5mm thick) with a Specimen Hp/A of 76m^{-1}:

   Jet Fire/Pipe System Components/35/30
   Jet Fire/Pipe System Components/125/60
   Jet Fire/Pipe System Components/75/45

   Test No. 2 - "FireMaster Rigid Enclosure System" (125mm thick) with a Specimen Hp/A of 80m^{-1}:

   Jet Fire/Pipe System Components/50/30
   Jet Fire/Pipe System Components/220/60
   Jet Fire/Pipe System Components/130/45

   Test No. 3 - "FireMaster Rigid Enclosure System" (83.5mm thick) with a Specimen Hp/A of 76m^{-1}:

   Jet Fire/Pipe System Components/35/30
   Jet Fire/Pipe System Components/255/90
   Jet Fire/Pipe System Components/85/45
   Jet Fire/Pipe System Components/315/105
   Jet Fire/Pipe System Components/140/60
   Jet Fire/Pipe System Components/380/120
4. The "Classifications" listed in Note 3 above depend on the particular application, maximum core temperature required, in accordance with ISO 22899-1:2007 Section 15.4, the Critical Temperature Rise for load bearing steel structures are normally 400°C, however some protected items may have significantly lower temperature limitations which should be taken into consideration at the design stage.

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JET FIRE TEST RESULTS

Test Results for Test No. 1 "FireMaster Rigid Enclosure System" (83.5mm thick) with a Specimen Hp/A of 76m^{-1} [Fire Test Report No. 13317, dated 24 November 2012]:

Test Description: A jet fire test was performed on a tubular section with a centre component ("Pipe System Component") with an Hp/A section factor of 76m^{-1} in accordance with ISO 22899-1:2007.

Integrity: 60 minutes (protection remained intact for the duration of the test).

Insulation: The following maximum temperature rises were recorded on the ("Pipe System Component") section (Hp/A of 76m^{-1}) in line with ISO 22899-1:2007:

after 15 minutes of exposure:	8.3°C	after 45 minutes of exposure:	75.4°C
after 30 minutes of exposure:	37.8°C	after 60 minutes of exposure:	128.5°C

Notes:
- Ambient temperature: 7°C (The thermocouples starting temperatures have deducted from actual temperature readings to calculate the maximum temperature rises)
- Only thermocouples No's. 9 – 12 and 21 – 28 were placed in the centre "component" section within the enclosure. The remainder of the thermocouples on the pipe were not assessed for the purposes of this Certificate.

Classification: The following Classifications of the centre ("Pipe System Component") section (Hp/A of 76m^{-1}) protection system in line with ISO 22899-1:2007 may be assigned:
Jet Fire/Pipe System Components/35/30 **Jet Fire/Pipe System Components/125/60**
Jet Fire/Pipe System Components/75/45

Description of Test Specimen: The test specimen consisted of a central 6" SCH 120 seamless pipe "component" section (190mm long, 168.3mm O.D. x 14.9mm thick) with an Hp/A Section Factor of 76m^{-1}; welded at each end to 4" SCH 120 seamless pipes (1405mm long x 114.3 O.D. x 10.9mm thick) .
A "FireMaster Rigid Enclosure System" was fitted around the centre section "Pipe System Component" and clamped to the outer sections. The split rectangular box enclosure of insulation panels, 400mm x 400mm x 407mm long x 83.5mm thick, forming a rectangular void around the pipe with an air gap of at least 36mm. The system had longitudinal joints which were secured by stainless steel latches, spaced at 154mm centres and fitted with "ODICE" intumescent seals. An additional holding band was fitted to a stainless steel extension collar 119mm long, at each end of the enclosure, overlapping the "pipe" insulation system.
The "FireMaster Rigid Enclosure System" panels comprised of 0.7mm thick stainless steel outer skin and a 0.15mm thick stainless steel inner skin containing two layers of two types of insulation, (83.5mm total compressed thickness) incorporating "FireMaster Marine Plus Blanket"(128kg/m^3 density) and "BTU Block-Flexible" (288kg/m^3 density) microporous insulation. At the extension collars, additional insulation pads of (25mm thick, 128kg/m^3 density) "FireMaster Marine Plus Blanket" and "BST-HET'' intumescent strips were fitted between the two adjacent "pipes" and the collars of the enclosure.
The "pipe" insulation fitted outside of the enclosure consisted of 3 layers (38mm thick, 128kg/m^3 density) "FireMaster Marine Plus Blanket", faced with 0.6mm stainless steel cladding secured by stainless steel banding 20mm wide at 200mm centres and the longitudinal joint secured by No. 8 stainless steel self-tapping screws at 100mm centres.

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Test Results for Test No. 2 "FireMaster Rigid Enclosure System" (125mm thick) with a Specimen Hp/A of 80m^{-1} [Fire Test Report No. 14418, Issue 1, dated 13 December 2013]:

Test Description: A jet fire test was performed on a tubular section with a centre component ("Pipe System Component") with an Hp/A section factor of 80m^{-1} in accordance with ISO 22899-1:2007.

Integrity: 60 minutes (protection remained intact for the duration of the test).

Insulation: The following maximum temperature rises were recorded on the ("Pipe System Component") section (Hp/A of 80m^{-1}) in line with ISO 22899-1:2007:

after 15 minutes of exposure:	19.5°C	after 45 minutes of exposure:	131.8°C
after 30 minutes of exposure:	53.8°C	after 60 minutes of exposure:	223.1°C

Notes:

- Ambient temperature: 10°C (The thermocouples starting temperatures have deducted from actual temperature readings to calculate the maximum temperature rises)
- Only thermocouples No's. 5 – 16 and 21 – 28 were placed in the centre "component" section within the enclosure. The remainder of the thermocouples on the pipe were not assessed for the purposes of this Certificate.

Classification: The following Classifications of the centre ("Pipe System Component") section (Hp/A of 80m^{-1}) protection system in line with ISO 22899-1:2007 may be assigned:
Jet Fire/Pipe System Components/50/30 **Jet Fire/Pipe System Components/220/60**
Jet Fire/Pipe System Components/130/45

Description of Test Specimen: The test specimen consisted of a continuous pipe (3000mm long, 89.2mm O.D x 15mm thick) with an Hp/ A Section Factor of 80m^{-1}.
A "FireMaster Rigid Enclosure System" was fitted around the centre section "Pipe System Component" and clamped to the outer sections. The split rectangular box enclosure of insulation panels, 700mm x 403mm x 403mm long x 125mm thick, forming a rectangular void around the pipe with an air gap of at least 36mm. The system had longitudinal joints which were secured by either three stainless steel latches, spaced at 200mm centres or by a stainless steel continuous (piano) hinge 60mm wide x 2mm thick, to be secured by M8 bolts at 200mm centres or suitable intermittent welding; both joints were fitted with "ODICE" intumescent seals. An additional holding band was fitted to a stainless steel extension collar 80mm long, at each end of the enclosure, overlapping the "pipe" insulation system. The collars also contained intumescent seals. The enclosure was also fitted with a 14rnm nominal diameter drain plug arrangement.
The "FireMaster Rigid Enclosure System" panels comprised of 0.7mm thick stainless steel outer skin and a 0.15mm thick stainless steel inner skin containing compressed layers of the following insulation: 2 x 50mm thick layers and 1 x 25mm thick layer of "FireMaster Marine Plus Blanket" (128kg/m^3 density).
The "pipe" insulation fitted outside of the enclosure consisted of 3 layers (38mm thick, 128kg/m^3 density) "FireMaster Marine Plus Blanket", faced with 0.6mm stainless steel cladding secured by stainless steel banding 20mm wide at 200mm centres and the longitudinal joint secured by No. 8 stainless steel self-tapping screws at 100mm centres.

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Test Results for Test No. 3 "FireMaster Rigid Enclosure System" (83.5mm thick) with a Specimen Hp/A of 76m^{-1} [Fire Test Report No. 605565, Rev. 1, dated 04 March 2018]:

Test Description: A jet fire test was performed on a tubular section with a centre component ("Pipe System Component") with an Hp/A section factor of 76m^{-1} in accordance with ISO 22899-1:2007.

Integrity: 120 minutes (protection remained intact for the duration of the test).

Insulation: The following maximum temperature rises were recorded on the ("Pipe System Component") section (Hp/A of 76m^{-1}) in line with ISO 22899-1:2007:

after 15 minutes of exposure:	6.4°C	after 75 minutes of exposure:	202.8°C
after 30 minutes of exposure:	36.3°C	after 90 minutes of exposure:	260.9°C
after 45 minutes of exposure:	88.5°C	after 105 minutes of exposure:	317.9°C
after 60 minutes of exposure:	145.5°C	after 120 minutes of exposure:	384.5°C

Notes:
- Ambient temperature: 12°C (The thermocouples starting temperatures have deducted from actual temperature readings to calculate the maximum temperature rises)
- Only thermocouples No's. 9 – 12 and 21 – 28 were placed in the centre "component" section within the enclosure. The remainder of the thermocouples on the pipe were not assessed for the purposes of this Certificate.

Classification: The following Classifications of the centre ("Pipe System Component") section (Hp/A of 76m^{-1}) protection system in line with ISO 22899-1:2007 may be assigned:

Jet Fire/Pipe System Components/35/30	**Jet Fire/Pipe System Components/255/90**
Jet Fire/Pipe System Components/85/45	**Jet Fire/Pipe System Components/315/105**
Jet Fire/Pipe System Components/140/60	**Jet Fire/Pipe System Components/380/120**

Description of Test Specimen: The test specimen consisted of a central 6" SCH 120 seamless pipe "component" section (190mm long, 168.3mm O.D. x 14.28mm thick) with an Hp/A Section Factor of 76m^{-1} ; welded at each end to 4" SCH 120 seamless pipes (1405mm long x 114.3 O.D. x 11.13mm thick) .

A "FireMaster Rigid Enclosure System" was fitted around the centre section "Pipe System Component" and clamped to the outer sections. The split rectangular box enclosure of insulation panels, 400mm x 400mm x 400mm long x 83.5mm thick, forming a rectangular void around the pipe with an air gap of at least 36mm. The system had longitudinal joints which were secured by stainless steel latches, spaced at 154mm centres and fitted with "ODICE" intumescent seals. An additional holding band was fitted to a stainless steel extension collar 119mm long, at each end of the enclosure, overlapping the "pipe" insulation system.

The "FireMaster Rigid Enclosure System" panels comprised of 0.7mm thick stainless steel outer skin and a 0.15mm thick stainless steel inner skin containing compressed layers of the following insulation: 2 x 10mm thick layers of "FireMaster MarineFlex 3D50" (270kg/m^3 density), 1 x 25mm thick and 1 x 38mm thick layer of "FireMaster Marine Plus Blanket"(128kg/m^3 density) microporous insulation. At the extension collars, additional insulation pads of (25mm thick, 128kg/m^3 density) "FireMaster Marine Plus Blanket" and "BST-HET" intumescent strips were fitted between the two adjacent "pipes" and the collars of the enclosure.

The "pipe" insulation fitted outside of the enclosure consisted of 3 layers (38mm thick, 128kg/m^3 density) "FireMaster Marine Plus Blanket", faced with 0.6mm stainless steel cladding secured by stainless steel banding 20mm wide at 200mm centres and the longitudinal joint secured by No. 8 stainless steel self-tapping screws at 100mm centres.

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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.

PLACE OF PRODUCTION

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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).