

## 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.

<b>Manufacturer</b>	<b>Carboline Company</b>
<b>Address</b>	350 Hanley Industrial Court St. Louis Missouri 63144 United States of America (USA)
<b>Type</b>	Structural Steel Jet Fire Protection System
<b>Description</b>	Structural Steel Jet Fire Protection System for I-Sections protected with "Pyrocrete 40" reinforced with Steel Wire Mesh, for Jet Fire Exposures up to 240 minutes
<b>Trade Name</b>	Pyrocrete 40
<b>Specified Standard</b>	International Standard ISO 22899-1:2007 "Determination of the resistance to jet fires of passive fire protection materials – Part 1 General Requirements"

The attached Design Appraisal Document forms 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.

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 of any modification or changes to the equipment in order to obtain a valid Certificate.

**ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No.LR2003988SF**

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 F150096.

**TEST REPORTS**

1. Intertek, Elmendorf, Texas, United States of America, Fire Test Report No. 101623327SAT-003A , dated 02 September 2014.
2. Intertek, Elmendorf, Texas, United States of America, Fire Test Report No. 101623327SAT-003B, dated 02 September 2014.

**CONDITIONS OF CERTIFICATION**

1. Application in each case to be approved by Lloyd's Register at the design stage
2. Consisting of: 29mm to 39mm thick coating of 'Pyrocrete 40' (641kg/m<sup>3</sup> or 40lb/ft<sup>3</sup> nominal density) reinforced with 3.5 galvanised diamond mesh lathe and retained to steel substrate with welded copper coated mild steel pins (3mm diameter x 25mm long) spaced at 330mm, subjected to jet fire exposure up to 240 minutes
3. Insulated face of the member to be exposed to the high risk side in all cases
4. Thickness of the 'Pyrocrete 40' for individual I- Sections applications is to be determined by considering the Hp/A or A/V value at 100m<sup>-1</sup> for the web, the maximum allowable core temperature and by comparing jet fire performance data with suitable hydrocarbon fire performance data. No hydrocarbon data has been submitted or considered for this certificate. The "Jet Fire Test Results" Section of this Certificate details the construction make-up and the performance achieved from the protection system during the jet fire testing
5. 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
6. 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. Alternative pins of stainless steel (3mm diameter x 25mm long) and plastic coated steel wire mesh (17 gauge) may be considered as an alternative to the as-tested copper coated mild steel pins (3mm diameter x 25mm long) and galvanised diamond mesh lathe (1.85kg/m<sup>2</sup>), on the basis that the galvanised diamond mesh lathe used in the test was not exposed to the jet fire and the plastic coated steel wire mesh has been fire tested with similar coatings of the same thickness by the same Manufacturer.
2. Linear interpolation between the two thickness values for the web at 400°C gives a minimum jet fire thickness for I- Sections with an Hp/A of 100m<sup>-1</sup> at 120 mins of **33.6mm**, to give 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/Structural Steel I-Section/400/120**".

**ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No.LR2003988SF**

3. The "Classification" listed on Note 2 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 400°C, however, different projects and regions of the world may have significantly lower temperature limitations which should be taken into consideration at the design stage.
4. 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, 'Pyrocrete 40' thickness or Hp/A values to be assessed.

**JET FIRE TEST RESULTS**

**Test Results for Structural Panel Specimen (28.3mm thick Coating of 'Pyrocrete 40') [Intertek Test Report No: 101623327SAT-003A, dated 02 September 2014]:**

**Test Description:** A jet fire test was performed on a structural panel specimen in accordance with ISO 22899-1:2007.

**Integrity:** 240 minutes (protection remained generally intact for the duration of the test).

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

<b>Exposure Time (Minutes)</b>	<b>Maximum Temperature Rise of Backplate (°C / °F) &amp; TC No. ( )</b>		<b>Maximum Temperature Rise of Web (°C / °F) &amp; TC No. ( )</b>	
<b>30</b>	98.9 / 210.0	(8)	117.2 / 243.0	(13)
<b>60</b>	187.3 / 370.0	(8)	303.9 / 579.0	(13)
<b>90</b>	228.9 / 444.0	(1)	428.9 / 804.0	(13)
<b>120</b>	217.0 / 422.6	(1)	521.1 / 970.0	(13)
<b>150</b>	228.4 / 443.1	(1)	574.4 / 1,065.9	(13)
<b>180</b>	N/A *	* TC Reading Error	N/A *	* TC Reading Error
<b>210</b>	N/A *	* TC Reading Error	N/A *	* TC Reading Error
<b>240</b>	N/A *	* TC Reading Error	N/A *	* TC Reading Error

<b>Classification:</b>	<b>JF/Structural Steel I-Section/200/40</b>	<b>JF/Structural Steel I-Section/450/95</b>
	<b>JF/Structural Steel I-Section/250/50</b>	<b>JF/Structural Steel I-Section/500/110</b>
	<b>JF/Structural Steel I-Section/300/55</b>	<b>JF/Structural Steel I-Section/538/130</b>
	<b>JF/Structural Steel I-Section/350/70</b>	<b>JF/Structural Steel I-Section/550/135</b>
	<b>JF/Structural Steel I-Section/400/80</b>	<b>JF/Structural Steel I-Section/600/150</b>
	<b>JF/Structural Steel I-Section/427/85</b>	

- Notes:**
- Ambient temperature: 30°C/86°F (The thermocouples starting temperatures have deducted from actual temperature readings to calculate the maximum temperature rises).
  - Thermocouple start temperature: 29.9°C/85.8°F on Backplate & 28.1°C/82.6°F on Web.

**ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No.LR2003988SF**

**Description of Test Specimen:** Structural Jet Fire Test specimen consisting of: 10mm thick mild steel open-fronted box 1.50m square x 0.50m deep, with a 20mm thick central web running its entire height and 0.25m deep. Copper coated mild steel pins (3mm diameter, 25mm long) were welded to all inner surfaces at approximately 330mm spacing and fitted with steel washers to retain a 3.5 galvanized diamond mesh lathe at the nominal centre of the coating.  
 The specimen consisted of a 28.3mm coating of 'Pyrocrete 40'. A primer coating of 'Carboguard 888' (5 mil/65 microns thick) was applied to all internal surfaces prior to coating of 'Pyrocrete 40'. The joint areas of the wire mesh reinforcement had minimal overlap.

**Test Results for Structural Panel Specimen (39.1mm thick Coating of 'Pyrocrete 40') [Intertek Test Report No: 101623327SAT-003B, dated 02 September 2014]:**

**Test Description:** A jet fire test was performed on a structural panel specimen in accordance with ISO 22899-1:2007.

**Integrity:** 240 minutes (protection remained generally intact for the duration of the test).

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

Exposure Time (Minutes)	Maximum Temperature Rise of Backplate (°C / °F) & TC No. ( )	Maximum Temperature Rise of Web (°C / °F) & TC No. ( )
30	70.0 / 158.0 (2)	73.9 / 165.0 (14)
60	90.5 / 194.9 (1)	113.4 / 236.1 (15)
90	152.8 / 307.0 (1)	226.7 / 440.1 (14)
120	183.9 / 363.0 (1)	316.1 / 601.0 (14)
150	197.2 / 387.0 (1)	384.5 / 724.1 (14)
180	206.1 / 403.0 (4)	435.6 / 816.1 (14)
210	217.2 / 423.0 (2)	471.7 / 881.1 (14)
240	219.9 / 427.8 (2)	495.6 / 924.1 (14)

**Classification:** JF/Structural Steel I-Section/200/80 JF/Structural Steel I-Section/400/155  
 JF/Structural Steel I-Section/250/95 JF/Structural Steel I-Section/427/170  
 JF/Structural Steel I-Section/300/110 JF/Structural Steel I-Section/450/190  
 JF/Structural Steel I-Section/350/130 JF/Structural Steel I-Section/500/240

**Note:**

- Ambient temperature: 26.0°C/78.8°F (The thermocouples starting temperatures have deducted from actual temperature readings to calculate the maximum temperature rises).
- Thermocouple start temperature: 29.0°C/84.2°F on Backplate & 27.2°C/81.0°F on Web.

**Description of Test Specimen:** Structural Jet Fire Test specimen consisting of: 10mm thick mild steel open-fronted box 1.50m square x 0.50m deep, with a 20mm thick central web running its entire height and 0.25m deep. Copper coated mild steel pins (3mm diameter, 25mm long) were welded to all inner surfaces at

**ATTACHMENT TO CERTIFICATE OF TYPE APPROVAL No.LR2003988SF**

approximately 330mm spacing and fitted with steel washers to retain a 3.5 galvanised diamond mesh lathe at the nominal centre of the coating.

The specimen consisted of a 39.1mm coating of 'Pyrocrete 40'. A primer coating of 'Carboguard 888' (5 mil/65 microns thick) was applied to all internal surfaces prior to coating of 'Pyrocrete 40'. The joint areas of the wire mesh reinforcement had minimal overlap.

**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.

**PLACE OF PRODUCTION**

Carboline AD  
321 Duke Street  
Louisa, VA 23093  
United States of America (USA)



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).*