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Test Report

Customer: Flexitallic L.P.
6915 Highway 225,
Deer Park, TX 77536

Project number (amtec): A300 117
Report number: A300 117 3/-

Test procedure: Fire test API 6FB

Material: Kammprofile gasket Flexpro

Date: 25.07.2014
Pages: 4
Appendices: 6

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Test results are only relevant to the test objects submitted.

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1. Subject of Investigation

The subject of investigation was a kammprofile gasket gasket manufactured by Flexitallic L.P. which is named

- Flexpro.

The kammprofile gasket Flexpro, Style ZG, has an integral outer ring according to ASME B16.5. The material of the metal core is 316L for all geometries. The facing material on both sides of the gasket is Flexible graphite (FG-SEL).

2. Goal of Investigation

The goal of the investigation was the qualification of the gasket material Flexpro in accordance to the API Specification 6FB (dated December 2008): API Specification for Fire Test for End Connections.

The API Specification 6FB describes the testing procedure and evaluation of the performance of API end connections when exposed to fire.

Fire Test according API 6FB is not part of the accreditation.

3. Test Specimen

The dimensions of the test specimen was: 6" Class 300

Geometry of the gasket:

6" Class 300: 212.5 mm x 178.1 mm x 4.1 mm

4. Testing Equipment

The gasket test was carried out on the following testing equipment:

Fire test: Fire Safe Testing device

A photo and the schematic view of the testing equipment are shown in **appendices 1 and 2**.

The fire safe testing device is used to cease a fire for a period of 30 minutes.

Depending on the type of test, different flanges and valves can be tested.

The water pressure is measured by a pressure transducer; the water volume is measured with a scale. The temperature of the fire is measured with 6 different thermocouples and with 5 calorimeters which are shared around the flange or valve. The control of the fire is done manually. Software is used for data logging and online evaluation.

5. Test Procedure

The Fire Test according to API 6FB (dated December 2008) requires that any sealing end connection hold for 30 minutes in a flame condition and then hold for a cool down period. After the assembly is cooled down to room temperature the line is depressurized and then re-pressurized. During all facets of the test the gasket must not exceed an API proscribed leak rate.

In the fire test a 6" Class 300 flange is pressurized with a test pressure of 75% of the API rated working pressure. The test pressure is maintained during the burn and cool-down period. After 5 minutes a fire is established and the flame temperature is monitored. The average of the thermocouples must reach 760 °C within 2 minutes and the average of the calorimeter shall reach 650 °C within 15 minutes. The burn period shall last for 30 minutes. After the burn period the connection is air-cooled down to 100 °C or less. After cooling down the flange is depressurized and the pressure is increased again to the test pressure and held for 5 minutes.

The maximum leak rate is 1 ml/inch/min of mean gasket circumference.

6. Results

In the fire test API 6FB the kammprofile gasket Flexpro was mounted in a 6" Class 300 flange with hydraulic spanners to a bolt load of 99 kN which means a total load of 1188 kN and a gasket surface stress of 112.5 MPa. The deformation of the gasket after the mounting procedure was 1.3 mm

After that the flange was pressurized with an internal pressure of 41 bar. The test medium was water. After 5 minutes flame impingement starts for a period of 30 minutes, see **appendices 3 to 5**. During burning period the flame temperature was nearly constant. After 30 minutes of burning the flange was cooled down to a temperature less than 100 °C. The system was pressurized with 41 bar during burning and cool-down period.

After 25 minutes of pressurization a leakage was hearable and during cool-down period two leakages could be recognized at bolts No. 9 and 11.

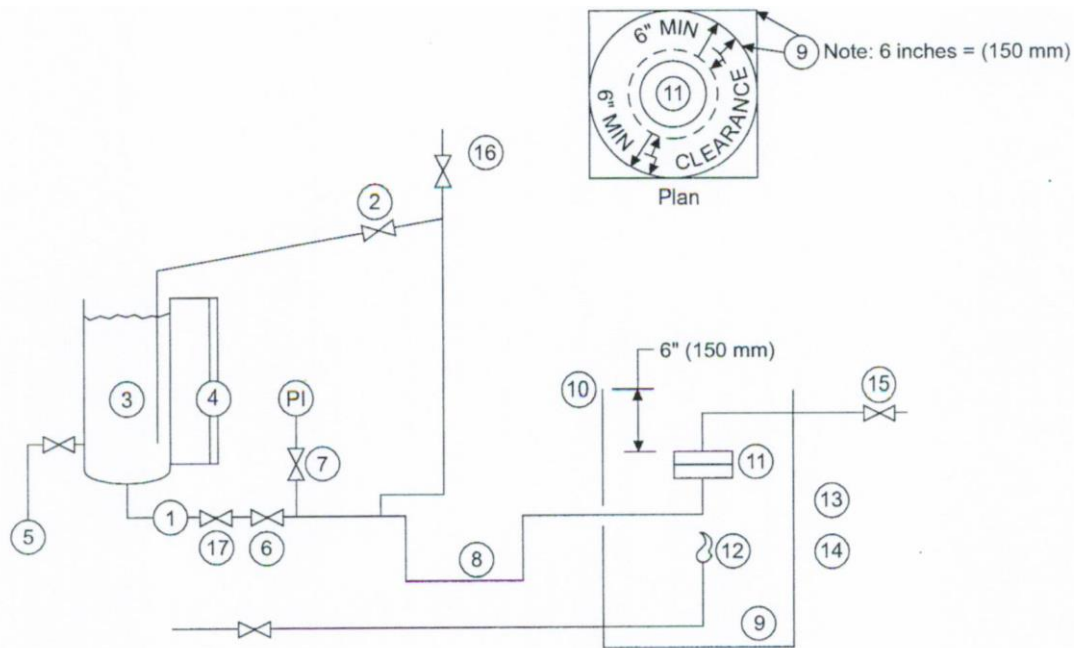
During burning period a leakage of 0.36 ml/inch/min could be measured. The leak rate of the complete test was measured to 0.88 ml/inch/min and is below the allowable leak rate of 1 ml/inch/min. Therefore the kammprofile gasket Flexpro passed the fire test according to API 6FB.

7. Photo documentation

In **appendix 6** a photo of the tested gasket specimen Flexpro for the fire test is presented.



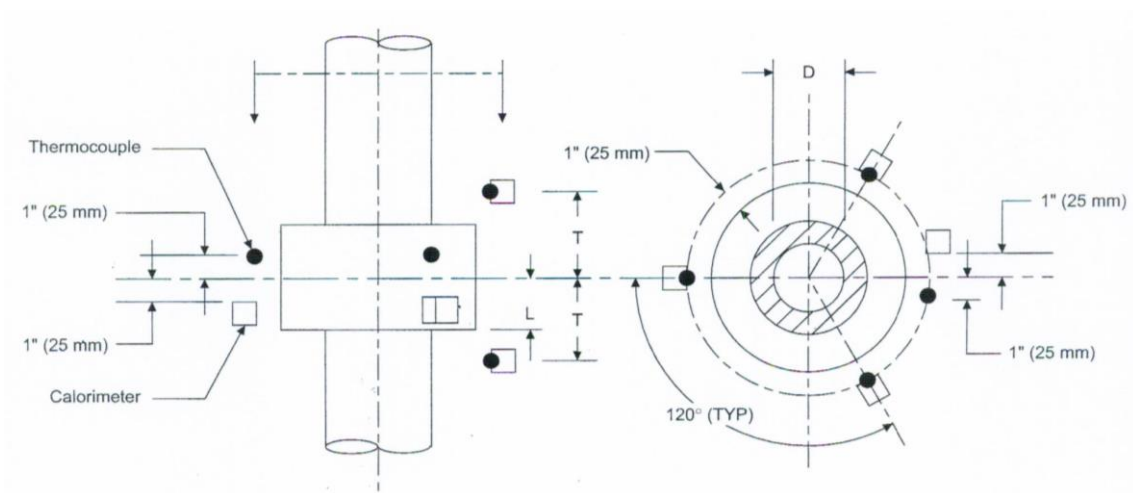
Fire Safe Testing Device



Legend

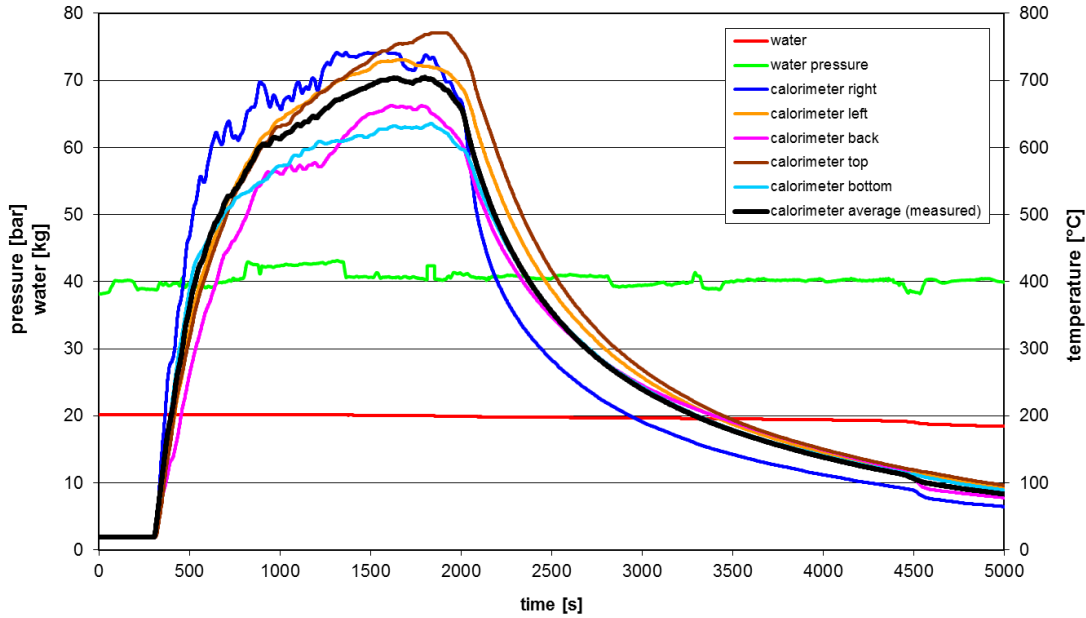
- | | |
|---|---|
| 1. Pressure source | 10. Minimum height of enclosure shall be 6 inches above the top |
| 2. Pressure regulator and relief | 11. Test connection mounted horizontally |
| 3. Vessel for water | 12. Fuel gas supply |
| 4. Calibrated sight gauge | 13. Calorimeter cubes |
| 5. Water supply | 14. Flame temperature thermocouple |
| 6. Shutoff valve | 15. Shutoff valve |
| 7. Pressure gauge | 16. Vent valve |
| 8. Piping arranged to provide vapour trap | 17. Check valve |

Schematic System for Fire Testing of End Connections

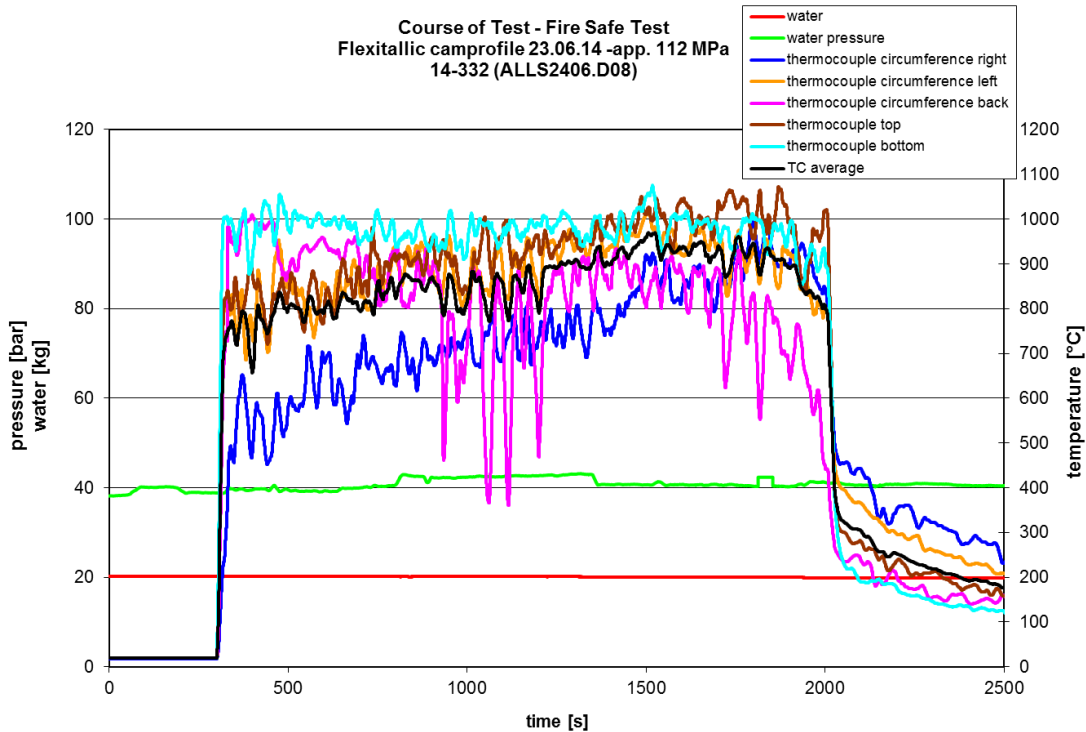


Location of Thermocouples and Calorimeters – Onshore Condition

Course of Test - Fire Safe Test
Flexitallic camprofile 23.06.14 -app. 112 MPa
14-332 (ALLS2406.D08)

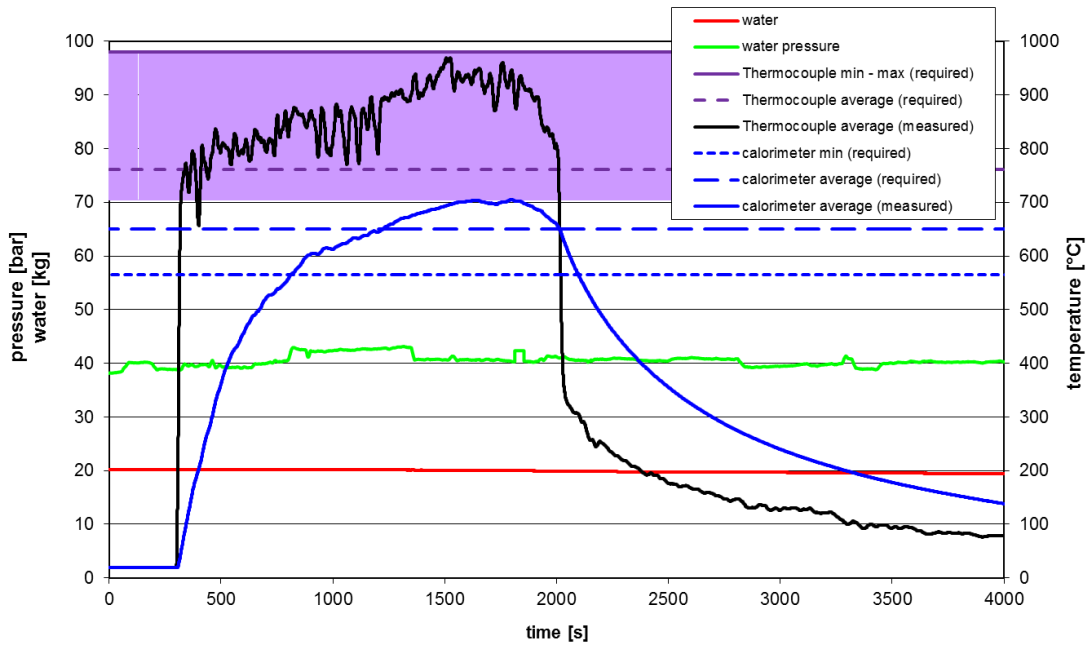


3.3.3 Fire test API 6FB - calorimeters



3.3.3 Fire test API 6FB – thermocouples

Course of Test - Fire Safe Test
Flexitallic camprofile 23.06.14 -app. 112 MPa
14-332 (ALLS2406.D08)



3.3.3 Fire test API 6FB

Flexitallic Flexpro

A300117

geometries

bolts	12	-
OD gasket	212.5	mm
ID gasket	178.1	mm
mean gasket circumference	613.6	mm
mean gasket circumference (contact area)	613.6	mm
mean gasket circumference (contact area)	24.16	inch
gasket area	10553.1	mm ²
gasket contact area	10553.1	mm ²
OD raised faces flange (6" Class 300)	215	mm

leak rate criteria	1	ml / inch / min
burning period	30	min
maximum allowable leakage during burning period	724.67	ml

Results

calculation of gasket stress

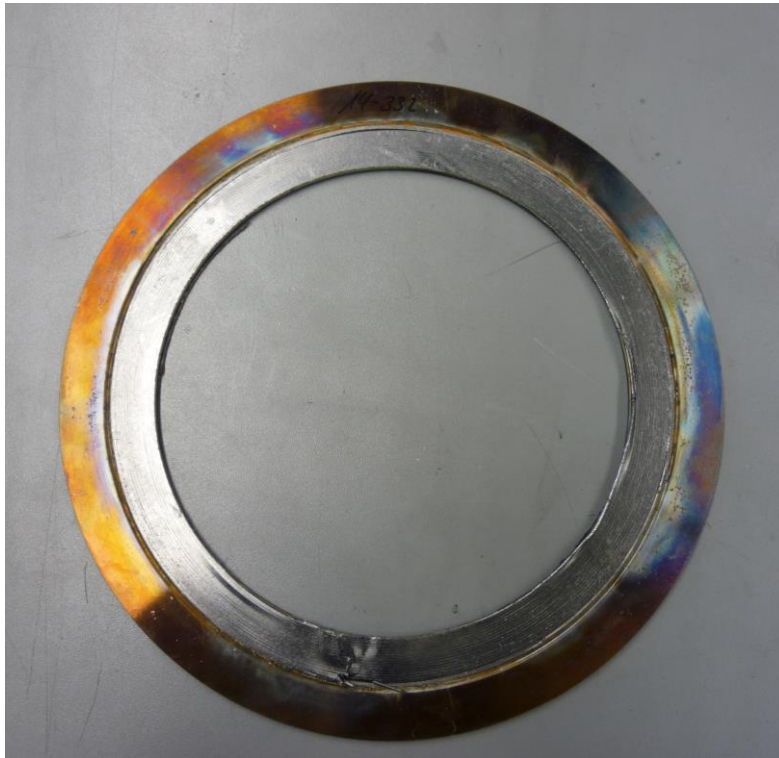
Hydraulic spanners - No.	GS 3/1	-
calibration factor	0.185	kN/bar
pressure	535	bar
force per bolt	98.975	kN
force total	1187.7	kN
gasket stress (contact area)	112.54	MPa

calculation of leak rate of complete test

start value scale	20.15	kg
end value scale	17.77	kg
leakage (absolute)	2381.9	ml
Start test	09:35:45	
End test	11:27:15	
test duration (deci)	0.077430556	
test duration (min)	111.5	min
leak rate	0.88	ml / inch / min

calculation of leak rate of burning period

start value scale	20.15	kg
end value scale	19.90	kg
leakage (absolute)	250.2	ml
Start test	09:35:45	
End test	10:04:11	
test duration (deci)	0.01974537	
test duration (min)	28.4	min
leak rate	0.36	ml / inch / min



Fire test according to API 6FB (MESC SPE 85/300 - 3.3.3) – 14-332