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TEST REPORT

Report n° 736219/6J1/d **Date :** 12/11/2002

Subject :

Final report :

HOBT - TEADIT 1580 1/8"

HL/MT

Specimens supplied by the customer :

TEADIT 1580 1/8"

- This report concerns only the tested objects.
- Reproduction of this report is permitted only in its integral form. The report includes 18 pages

"Conditions générales de vente et d'exécution des prestations" : see over leaf.

1 - AIM OF TEST

Increasing use of PTFE gasket products for difficult service and as substitute for asbestos and nonasbestos fiber reinforced materials has fostered interest in developing standard test protocols that measure and qualify the performance of PTFE based gaskets on the basis of a direct measure of their margin of safety against blow-out. This has led to the development of a HOt Blow-out Test (HOBT) for gauging PTFE gasket tightness performance under extreme relaxation conditions.

The main goal of this test is to determine the gasket resistance to hot relaxation and the gross leakage susceptibility to blow-out conditions.

2 - HOBT TEST PROCEDURE

2.1 - HOBT without thermal cycles procedure

The HOt Blow-out Test consists in applying 5000-psi compressive stress to the gasket and holding it for 30 minutes. Then the rig is pressurized with a 750 (up to 1200) psig helium gas pressure and temperature is increased, up to 1200°F if required, at a 3°F/min rate until blow-out occurs.

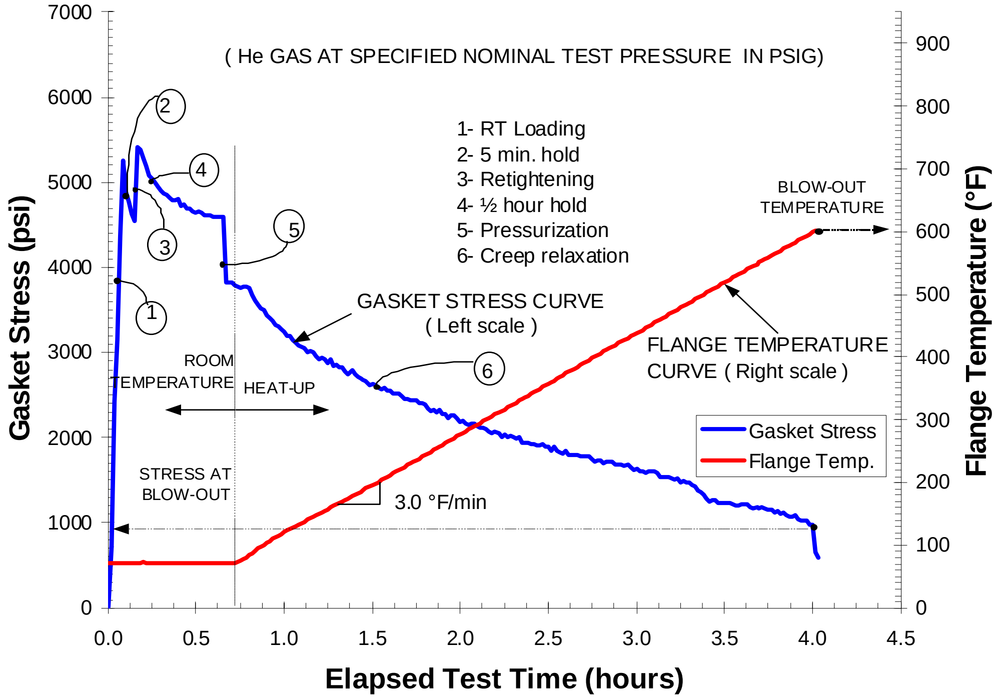


Figure 2.1.0.a - HOBT without thermal cycles test procedure sequence

The Hot Blow-out Test can be described as being a six steps procedure. The first step seats the gasket by conducting a sequential room temperature loading. The second step is short waiting period for gasket creep and relaxation. The third step reloads the gasket to the nominal gasket stress of 5000 psi. The fourth step is a second waiting period that allows the gasket to creep and relax. The fifth step is the helium pressurization of the gasket while the sixth and final step heats the gasket until a blow-out occurs or until the maximum temperature of the rig is reached.

•Step 1 - Gasket Seating

The ambient temperature should be 75 ± 5 °F. Open the system to the atmospheric pressure. Tighten the four bolts with a torque wrench using four levels: 30, 60, 75 and 80 lb-ft, to reach the nominal gasket stress of 5000 ± 250 psi. Make a one-pass crisscross pattern in about 15-30 seconds for each torque levels and wait one minute between each level. For the last one, reverse the pattern.

•Step 2 - Waiting time

Wait 5 minutes to allow for the initial gasket creep and relaxation

•Step 3 - Reloading to the target stress level

Retighten the bolts to adjust the gasket stress back to 5000 ± 250 psi.

•Step 4 - Waiting time

Wait 30 minutes to allow for the gasket creep and relaxation.

•Step 5 - Helium pressurization

Connect the pressurizing line to the pressure inlet and apply an internal helium pressure of 750 psig.

•Step 6 - Gasket heat-up

Turn on the electrical cartridge heater inside the central heating core at its maximum power until the core temperature reaches 180 °F. Then, continue to heat the gasket at a rate of 3.0 °F/min until a blow-out occurs or until the average temperature between the top and bottom flanges reaches 680 °F (maximum test temperature).

2.2 - HOBT with thermal cycles procedure

It is not safe to consider only the blow-out Temperature and gasket stress (Tbo and Sgbo) found with an HOBT without thermal cycles. It is more useful for service, to know the potential reserve that exists between typical operating service conditions and blow-out conditions.

Most gross leaks occur during or after thermal or pressure events such as: plant start-up (heat-up), plant shutdown (cool-down), thermal or pressure upset, rain or sun exposed joints because thermal cycling results in bolt load losses due to differential thermal expansion between flanges and gasket.

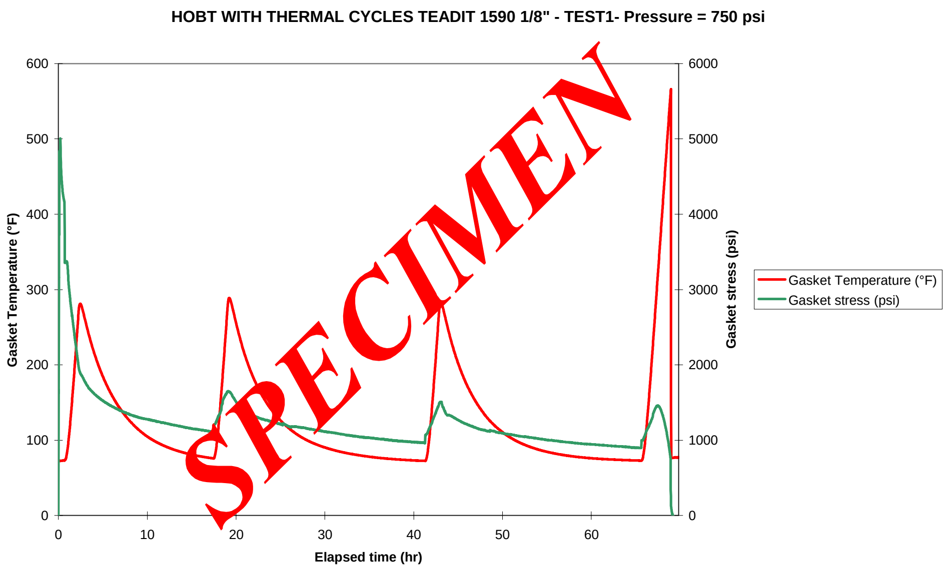


Figure 2.2.0.a - Typical HOBT with thermal cycles sequence

The full procedure involves three tests:

1) HOBT without thermal cycles to estimate cool down temperature (according to ASTM draft 5 standard "Test méthods for Hot Blow Out Performance of PTFE Sheet or Sheet Like Gaskets")

2) HOBT with 3 thermal cycles using cool down temperautre estimation from 1)

3) HOBT with 3 thermal cycles using cool down temperautre estimation from 2)

3 - TESTED SPECIMENS

The tests have been performed on the following specimen.

Gasket family	Gasket reference	Gasket Dimension
PTFE	1580	5" OD * 3.5" ID - thickness:1/8"

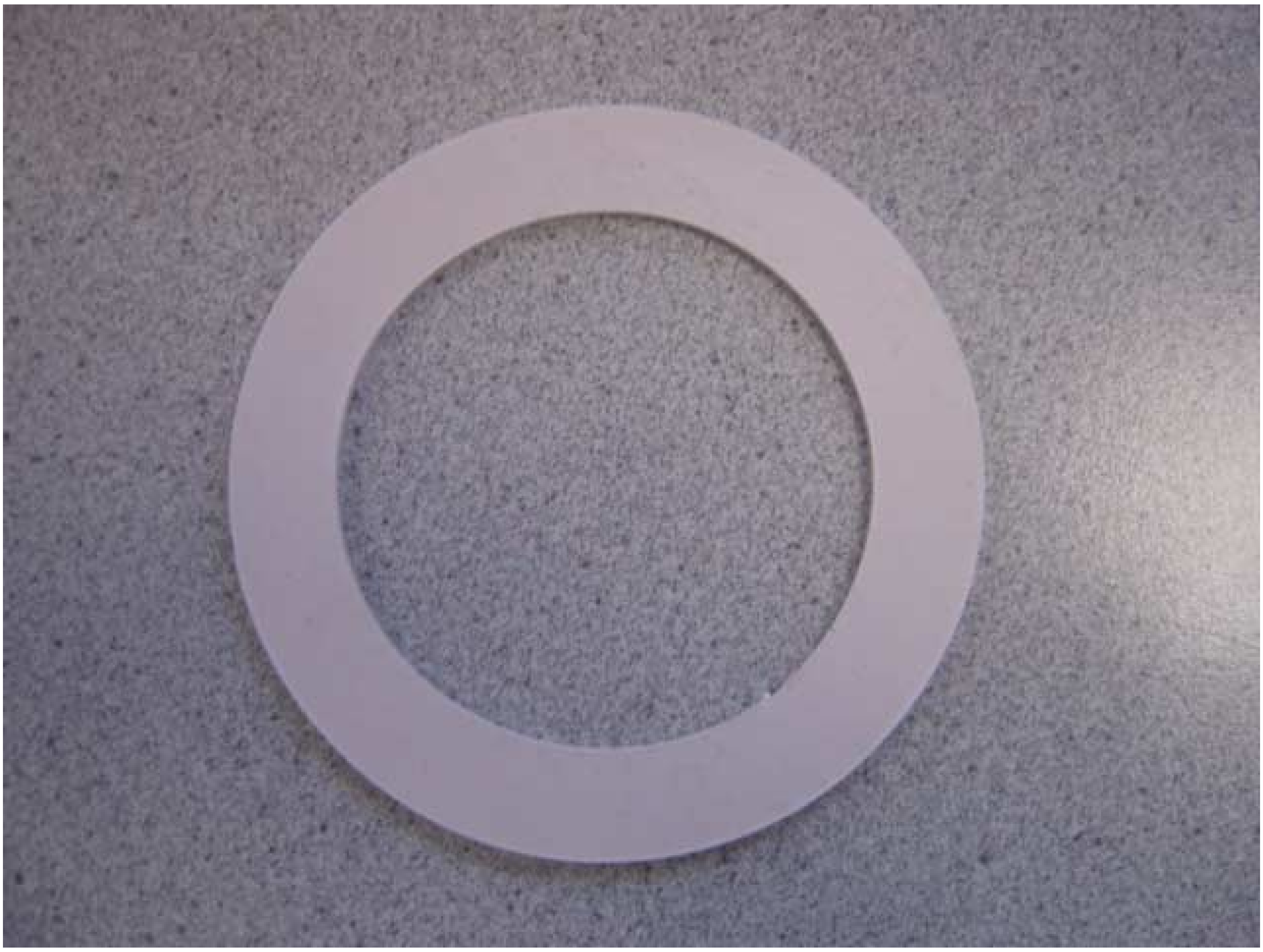


Photo 1 - Gasket before test - TEADIT - 1580 - 5" OD * 3.5" ID - thickness:1/8"

4 - TESTING EQUIPMENT AND MEASUREMENT INSTRUMENTS

The Hot Blow-out Test Rig is designed to reproduce hot blow-out conditions in a real gasketed flanged joint subjected to a maximum compressive load of 50000 lb, at a working temperature of up to 750 °F and with helium gas pressure up to 1000 psig. Tested gaskets are NPS 3", 3.5" ID x 5" OD for sheet gaskets, with a surface area of about 10 in^2.

The rig is composed of a pair of standard NPS 3" Class 150 flanges with raised faces.Both flanges are welded to schedule 80 pipes and are equipped with four 5/8" - 18 UNF high-strength steel bolts. The flange surface finish is in accordance with the ASME/ANSI B16.5 standard. The joint axial rigidity is evaluated to 4.4x106 lb/in.

Flanges are mounted on a steel cylindrical core welded to a steel base plate. Gasket loading is performed with a torque wrench, and the usual criss-cross sequence is used to torque the four bolts. These calibrated bolts are equipped with special extensometers to measure the bolt stretch that is converter to bolt load. Each extensometer consists of a pair of long ceramic rods that are spring loaded. The extensometers are compensated for thermal effects. To measure bolt strech, a displacement transducer is placed at the end of each extensometer. These transducers are placed at the bottom of the rig, well below the heated zone, and measure the relative displacement between the pair of ceramic rods.

The helium gas is supplied by a high-pressure gas cylinder.The pressure is adjusted with a precise manual pressure regulator and it is measured with an electronic pressure transducer.

The central heating core is embedded with a 2000 W electrical cartridge heater. An electronic temperature controller is used to achieve a constant temperature increase of 3.0 °F/min. Temperature is measured at three locations: in the solid core and inside the top and the bottom flanges at mid gasket diameter, close to the raised face surface.

The top and bottom parts of the fixture are insulated to minimize thermal gradients. The top insulation casing is removable to allow for gasket change and bolt torquing.

A manual relief valve permits gas purging during heating to prevent internal pressure increase.In order to minimize the gas flow when a blow-out occurs, the gas volume inside the fixture is minimized by the use of the solid central core and the gas flow from the pressure regulator is restricted by a micrometric valve. Gasket deflection and leakage are not measured during the HOBT test.

HOBT rig technical data summary

Rig flanges: NPS 3" Class 150 Slip-on

Rig bolts: 4 bolts 5/8"-18UNF

Pressurizing gas:Helium

Nominal gas pressures:4750 psig

Nominal initial gasket stress: 5000 ± 250 psi

Initial gasket temperature:75 ± 5 °F

Heating rate: 3.0 °F/min.

HOBT rig – general view

HOBT rig – detail

HOBT rig – upper flange 3 ‘’ 150 lbs-

HOBT rig – PTFE Gasket Blow Out example

Photo 2 - HOBT test rig

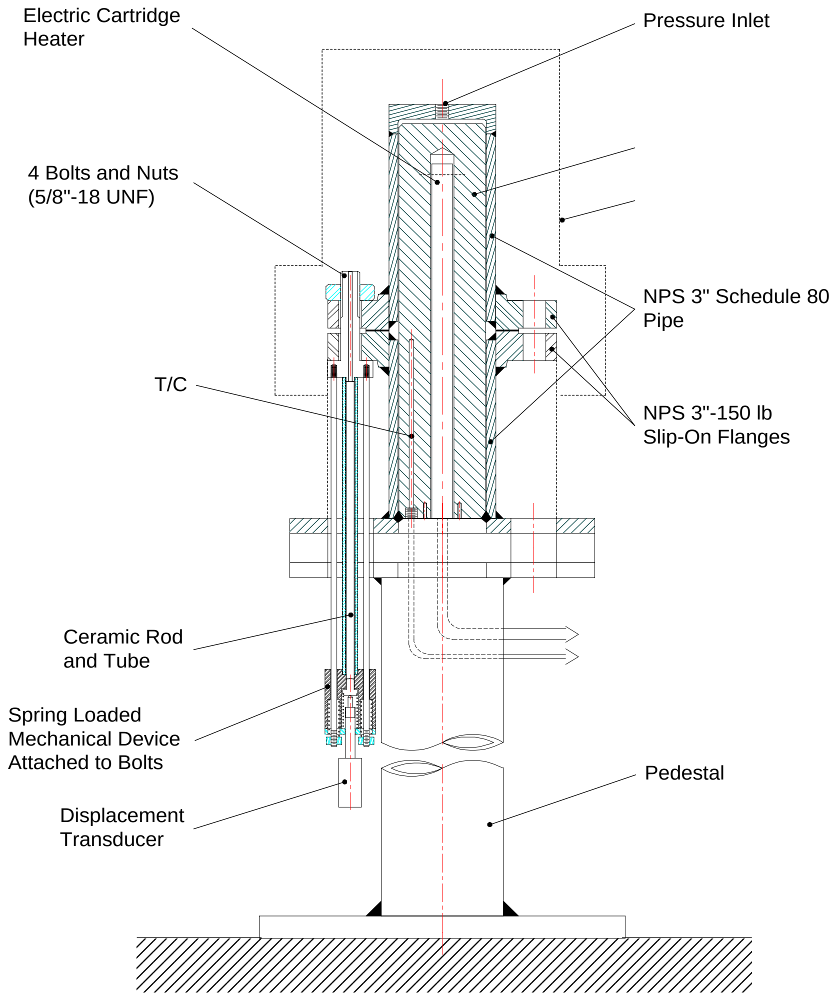


Figure 4.0.0.a - HOBT test rig principle

5 - RESULTS

5.1 - Gasket thicknesses

Gasket reference	test reference	Initial gasket thickness (in.)	Final gasket thickness (in.)
TEADIT 1580	1580_1	0.115	0.067
TEADIT 1580	1580_2	0.121	0.101
TEADIT 1580	1580_3	0.119	0.091

5.2 - HOBT results

Gasket reference	Thermal cycles	Test reference	BLOW OUT VALUES			Cool down Temp. (°F)
			Blow out Temp. (°F)	Blow out Stress (psi)	Blow out Pressure (psig)	
TEADIT 1580	NO	1580_1	541	745	764	275
TEADIT 1580	YES	1580_2	530	659	747	255
TEADIT 1580	YES	1580_3	534	648	746	258

The first HOBT test without thermal cycles leads to a first cool down temperature of **Tc1=275°F**. This cool down temperature is computed following ASTM draft for HOBT)

Conduction of the second test with this new temperature (Tc1) as cool down temperature leads to a new predicted cool down temperatrure: **Tc2=255° F**.

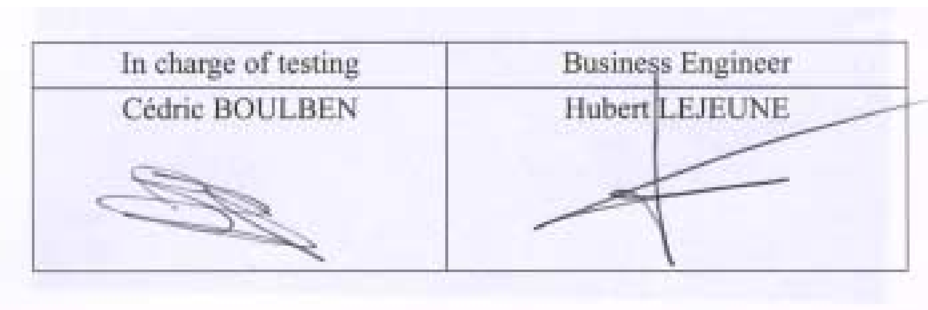
Conduction of a third test with this new temperature (Tc2) as cool down temperature leads to a new predicted cool down temperatrure: **Tc3=258° F**.

5.3 - Conclusion

According to the HOBT test results, the safe cool-down reserve temperature for TEADIT 1580 1/8" is **255°F** lowest value from safe cool-down reserve temperature from 3 tests.

6 - APPENDICES LIST

- APPENDIX 1: Gasket after test
- APPENDIX 2: HOBT without thermal cycles
- APPENDIX 3: HOBT with thermal cycles (1)
- APPENDIX 4: HOBT with thermal cycles (2)



In charge of testing	Business Engineer
Cédric BOULBEN	Hubert LEJEUNE

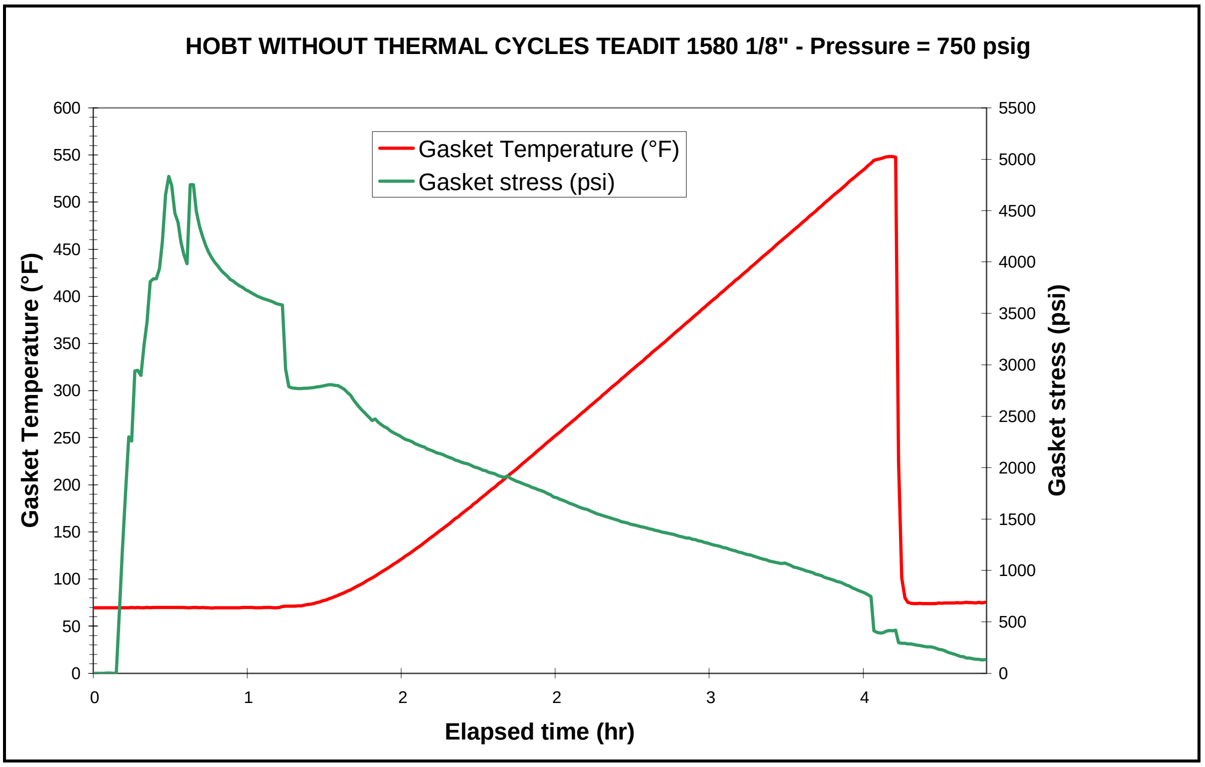
Appendix I : GASKET PICTURES AFTER TEST

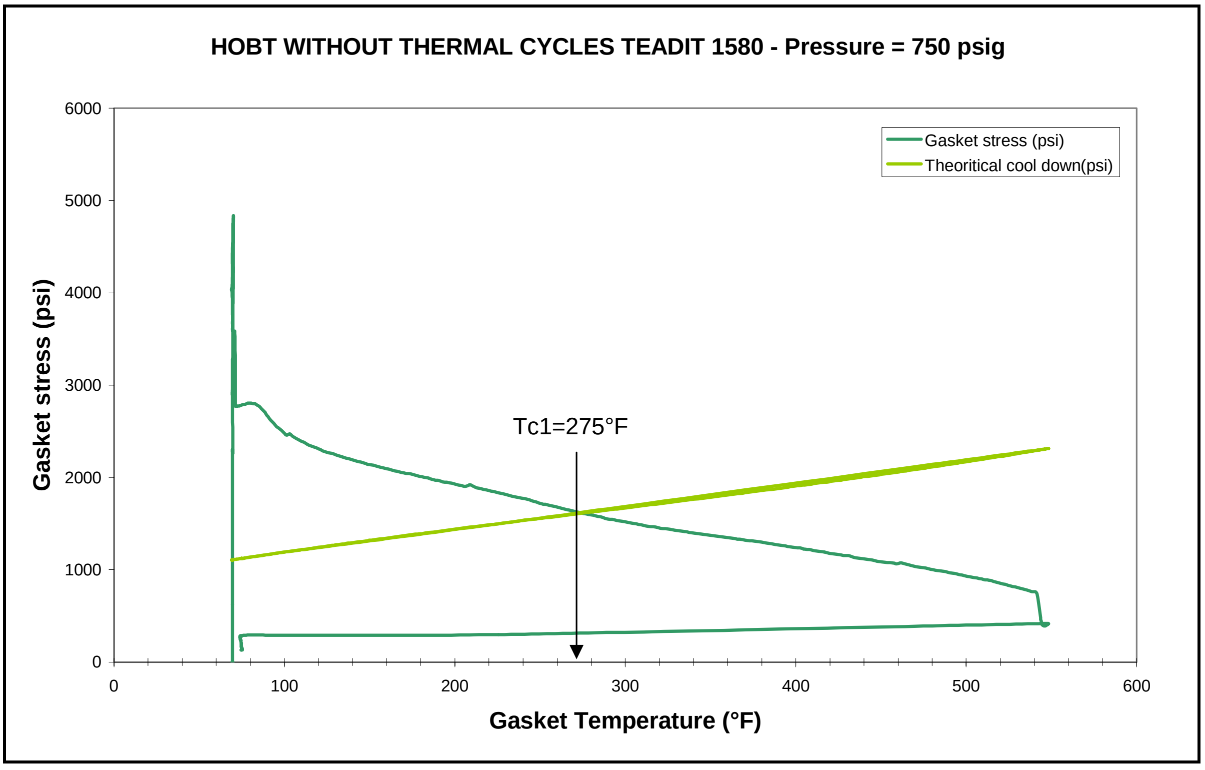
Photo 1 - Gasket after test 1 (without thermal cycle)

Photo 2 - Gasket after test 2 (with thermal cycle)

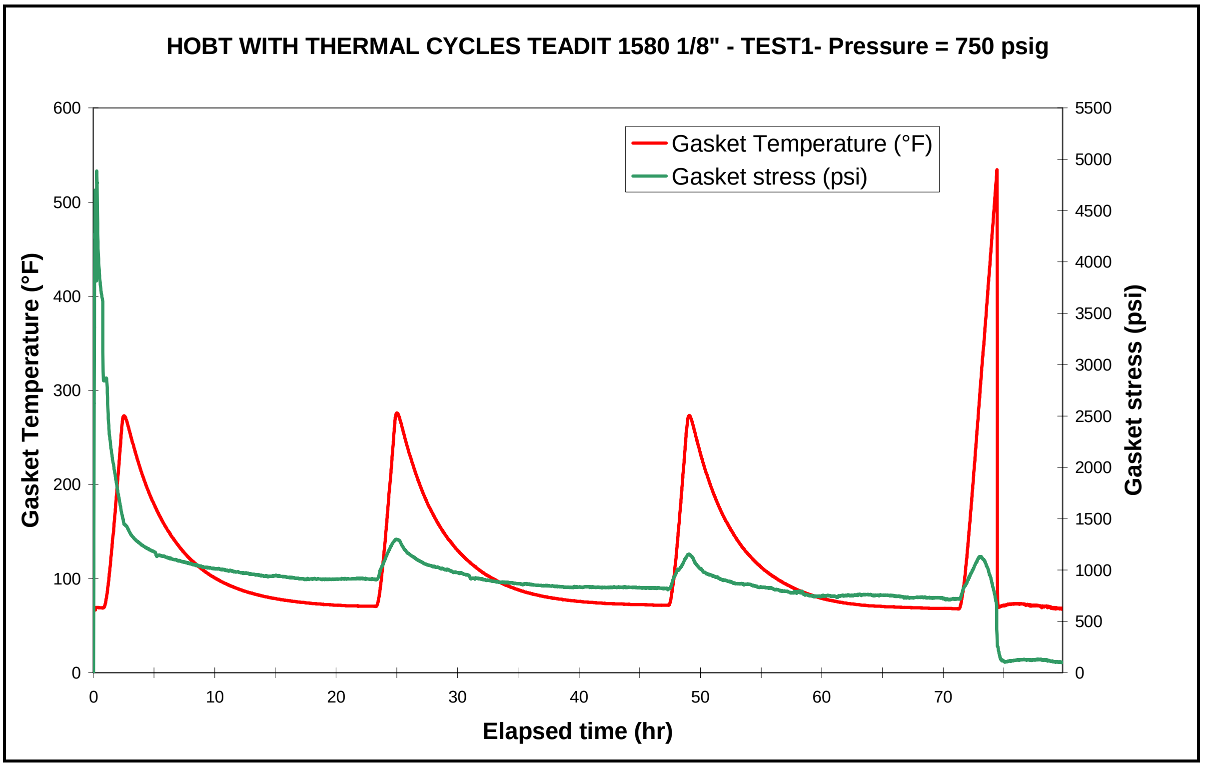
Photo 3 - Gasket after test 3 (with thermal cycle)

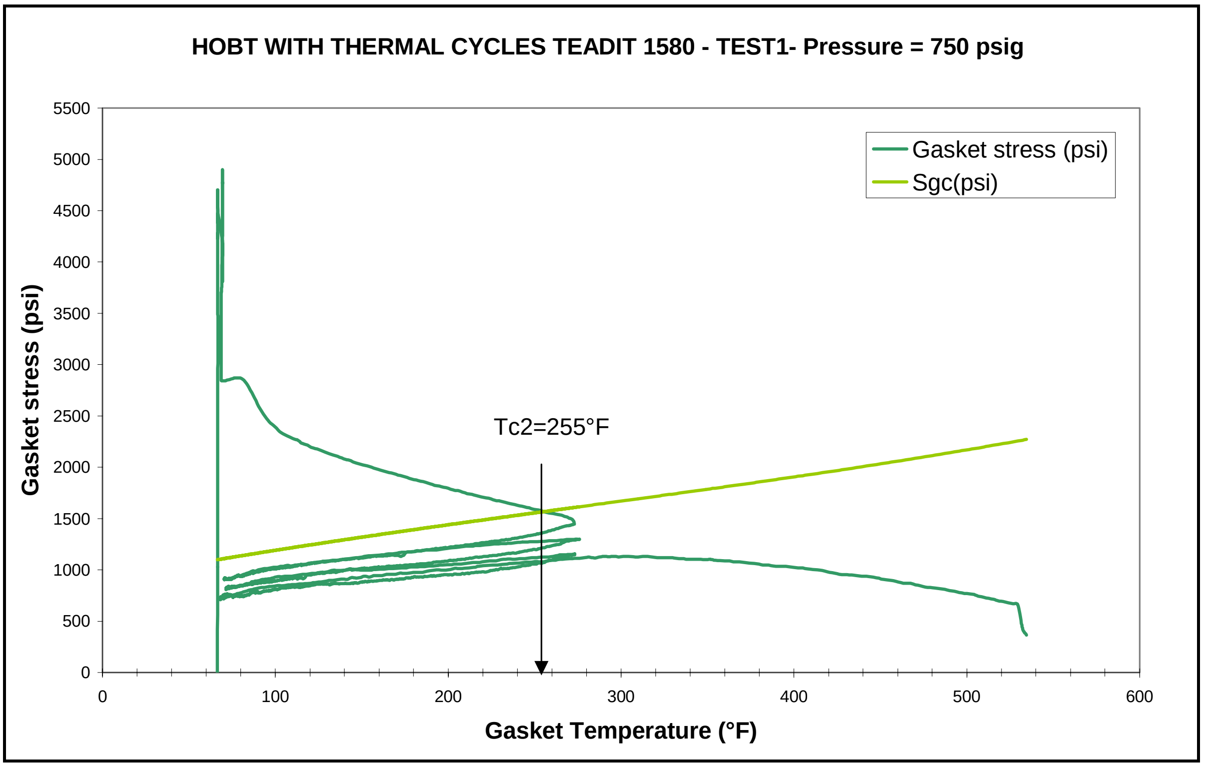
Appendix 2 : HOBT WITHOUT THERMAL CYCLES





Appendix 3 : HOBT WITH THERMAL CYCLES (1)





Appendix 4 : HOBT WITH THERMAL CYCLES (2)