



Test Report

Customer: Advance Products & Systems Inc.
USA – Lafayette, LA 70596

Project number (amtec): 302 527
Report number: 302 527 1/-

Test procedure: Shell Specification MESC SPE 85/300
Fugitive Emissions Test (MESC SPE 85/300 - 3.3.2)

Material: Flange insulation gasket – Trojan

Date: 23.07.2013
Pages: 5
Appendices: 4

A handwritten signature in black ink, appearing to read 'F. Herkert'.

Dipl.-Ing. F. Herkert

Test results are only relevant to the test objects submitted.

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1. Subject of Investigation

The subject of investigation was gasket material with sealing and electrical insulation characteristics manufactured by Advance Products & Systems Inc. which is named

- Trojan.

The flange insulation gasket consists of a G10 retainer with a Teflon seal. The Teflon seal is applied to both sides of the gasket.

2. Goal of Investigation

The goal of the investigation was the qualification of the gasket material Trojan in accordance to the Shell Specification MESC SPE 85/300 (dated September 2012: Procedure and Technical Specification for Type Acceptance Testing (TAT) of Gaskets).

The Shell Specification MESC SPE 85/300 describes several testing procedures for the evaluation of the gasket compressibility and the tightness characteristics of the gasket material at ambient and elevated temperature.

In this project, 2 different tests were performed in respect of the Shell approval:

- Shell leakage test at ambient temperature (MESC SPE 85/300 - 3.3.2),
- Shell leakage test at 150 °C (MESC SPE 85/300 - 3.3.2).

3. Test Specimens

The dimensions of the test specimens were:

4" Class 300: 101.8 mm x 176.6 mm

The sealing element has an outer diameter of 127 mm and an inner diameter of 118 mm. The gasket thickness was 4.3 mm and the thickness of the outer ring was 3.3 mm.

4. Testing Equipment

The gasket tests were carried out on the following testing equipment:

Test rig:	Serial number
TEMES _{fl.ai1}	010 181

Photos and the schematic view of the testing equipment are shown in **appendix 1**.

Multifunctional Testing Equipment TEMES_{fl.ai1}

The servo-hydraulic press TEMES_{fl.ai1} is capable to load up to 1 MN. Gaskets up to 180 mm diameter can be tested.

Depending on the type of test, different components (heating platens for temperatures up to 450 °C, insulation and cooling platens, different flange face designs etc.) can be used.

The load (gasket stress) is measured by a load cell on the bottom of the test rig, the gasket deformation is recorded by three displacement transducers and the temperature profile is controlled, too. LabView-Software is used for data logging and online evaluation. The entire test can be performed under software-control, thus automatic tests according to international standards or user defined procedures are possible.

Also, the simulation of different flange stiffness can be realized within the equipment. In dependence on the gasket deformation the gasket surface pressure is reduced automatically according to the nominal stiffness.

Due to the modular design, the above test rig can be modified to perform leakage tests. The heating and cooling platens are replaced by platens for leakage tests, which are connected to a separate measurement device, see appendix 1. The leak rate measurement principle is based on the pressure decay method. Using a differential pressure transducer leak rates down to about $1.0 \cdot 10^{-5}$ mg/m/s can be measured. For higher tightness classes a leak detector can be used.

5. Test Procedure

Fugitive Emission: Shell leakage test at ambient and elevated temperature (MESC SPE 85/300 - 3.3.2)

The Shell leakage test is carried out at ambient and at elevated temperature. For the tests at elevated temperature first the temperature is raised to the required test temperature under an initial gasket stress of 18.1 MPa. Afterwards the gasket is compressed with a gasket stress between 18.1 and 31.1 MPa which is equivalent to a bolt stress between 210 and 361 MPa. After reaching the first gasket stress level the test volume is pressurized with 51 bar at ambient temperature and 45 bar at 150 °C according to ASME B16.5-2003 - PT-Rating for Group 1.1 Materials. For the leakage measurement helium is used as test medium.

The leak rate can be classified in tightness classes:

- Class A: $\leq 1.78 \cdot 10^{-9} \text{ Pa}\cdot\text{m}^3/\text{s}/\text{mm}$,
- Class B: $\leq 1.78 \cdot 10^{-8} \text{ Pa}\cdot\text{m}^3/\text{s}/\text{mm}$.

6. Results

All test results of the gasket material Trojan are summarized in **appendix 2**.

Fugitive Emission: Shell leakage test at ambient and elevated temperature (MESC SPE 85/300 - 3.3.2)

In the Shell leakage test at ambient temperature the gasket was compressed in 5 steps from 18.1 MPa to 31.1 MPa. The detected leak rate at 18.1 MPa gasket stress at an internal pressure of 51 bar was $2.7 \cdot 10^{-6} \text{ mg}/\text{m}/\text{s}$, see **appendix 3**. The leak rate was slightly decreasing with increasing gasket stress. For the maximum gasket surface stress of 31.1 MPa the leak rate was $1.8 \cdot 10^{-6} \text{ mg}/\text{m}/\text{s}$.

The leak rate at a gasket stress of 31.1 MPa is equivalent to $1.1 \cdot 10^{-9} \text{ Pa}\cdot\text{m}^3/\text{s}/\text{mm}$ which is lower than the Tightness Class A.

In the Shell leakage test at 150 °C the gasket was compressed in 5 steps from 18.1 MPa to 31.1 MPa. The detected leak rate at 18.1 MPa gasket stress at an

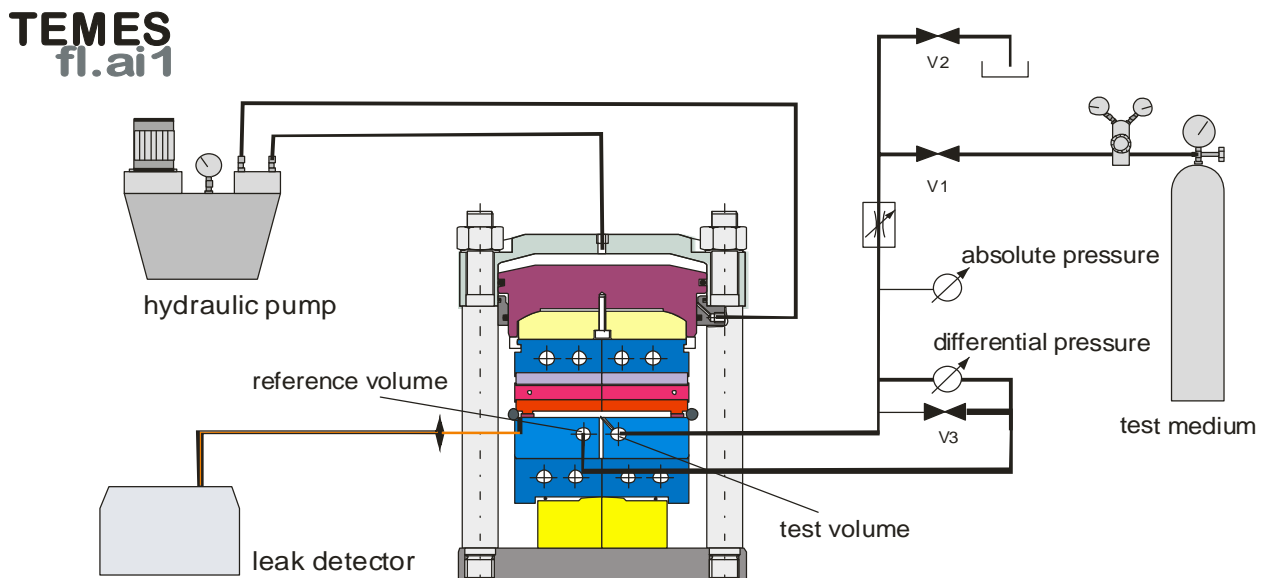
internal pressure of 45 bar was $1.5 \cdot 10^{-4}$ mg/m/s, see appendix 3. The leak rate was decreasing with increasing gasket stress. For the maximum gasket surface stress of 31.1 MPa the leak rate was $9.5 \cdot 10^{-6}$ mg/m/s.

The leak rate at a gasket stress of 31.1 MPa is equivalent to $8.3 \cdot 10^{-9}$ Pa·m³/s/mm which is lower than the Tightness Class B.

The gasket material Trojan has passed the Shell requirement of the leakage tests according to MESC SPE 85/300 - 3.3.2.

7. Photo documentation

In **appendix 4** photos of the tested gasket specimens Trojan are presented.



Testing Equipment TEMES_{fl.ai1}

Table 1: Data Sheet for Gasket Characteristics

Manufacturer: Advance Products & Systems Inc
 Product: **Trojan**

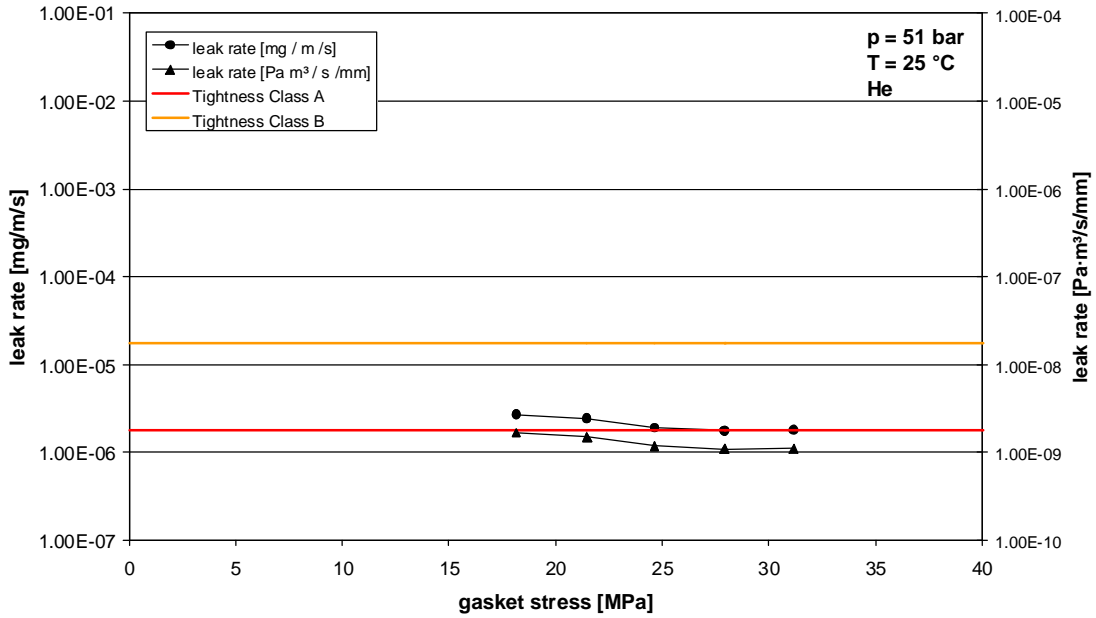
Shell leakage test at ambient temperature

Test pressure:	51 bar
Maximum gasket stress level:	31.1 MPa
Leakage rate:	1.1E-09 Pa·m ³ /s/mm
Shell tightness class:	A
Test no.	13-219

Shell leakage test at 150 °C

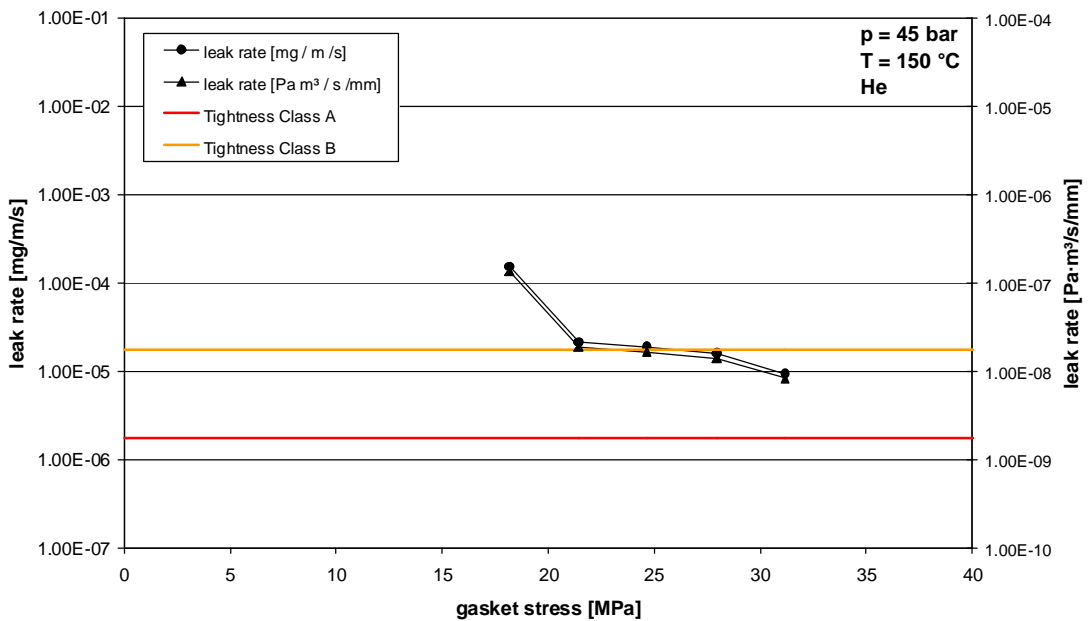
Test pressure:	45 bar
Maximum gasket stress level:	31.1 MPa
Leakage rate:	8.3E-09 Pa·m ³ /s/mm
Shell tightness class:	B
Test no.	13-230

Leakage curve
 Trojan 176.6x101.8x4.32 mm
 Test number: 13-219

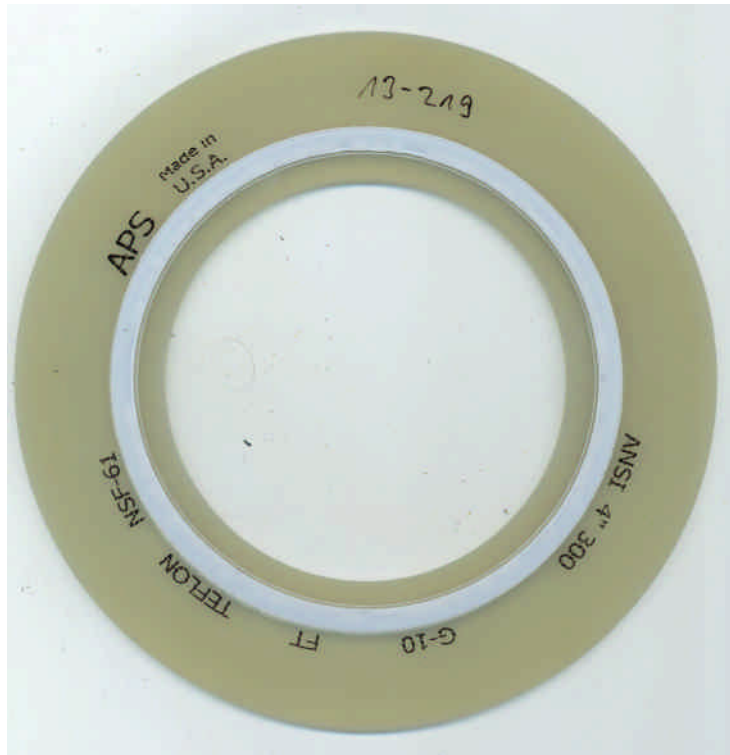


Shell leakage test (RT) according MESC SPE 85/300 - 3.3.2

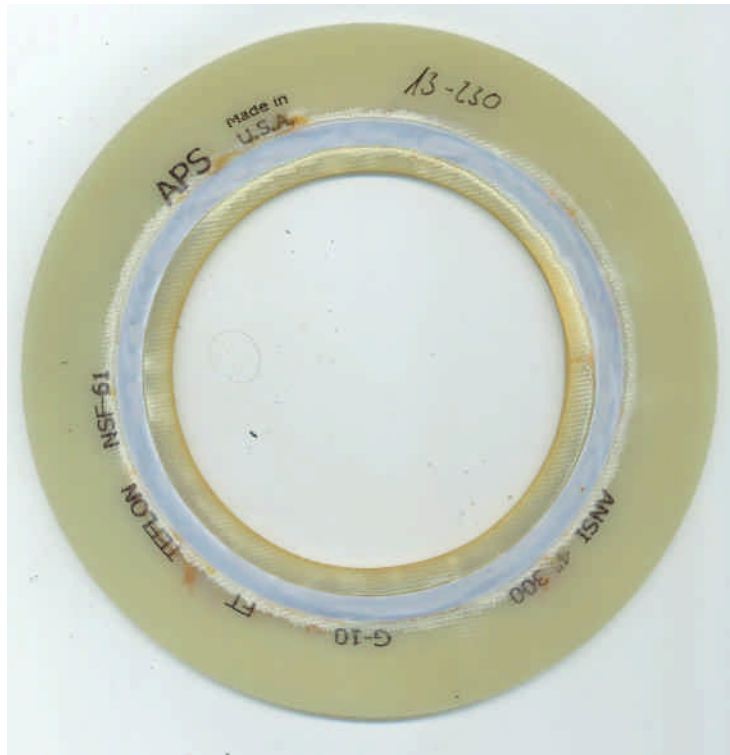
Leakage curve
 Trojan 176.63x101.78x4.3 mm
 Test number: 13-230



Shell leakage test (150 °C) according MESC SPE 85/300 - 3.3.2



Shell leakage test (RT) according MESC SPE 85/300 - 3.3.2



Shell leakage test (T) according MESC SPE 85/300 - 3.3.2