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**Test procedures of gasket parameters based on leakage rate for
the pipe flange joints**

基于泄漏率的管法兰用垫片参数测试方法

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Table of Contents

1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 General test requirements	2
5 Test pieces	2
6 Test conditions	3
7 Determination of the maximum permissible gasket stress $Q_{\max}$ and of the unloading modulus of elasticity E_G	3
8 Determination of the creep relaxation factor PQR and of the change in gasket thickness due to creep	7
9 Determination of the minimum gasket stress on assembly $Q_{\min}(L)$ and of the minimum gasket stress under test conditions $Q_{\min}(L)$	7
10 Determination of the axial coefficient of thermal expansion	10
11 Determination of the static friction factor	10
12 Test report	10
Annex A (informative) General test rig	12
Annex B (informative) Compression, compression creep and creep relaxation test module	13
Annex C (informative) Room-temperature leakage test module	14
Annex D (informative) Leakage test rig permitting the use of replaceable platens	15
Annex E (normative) Determination of the sealing performance of tape gaskets	16
Annex F (informative) Test rig for the minimum gasket stress $Q_{\min}(L)$ simulating long-term high temperature	17
Annex G (informative) Recommended method for determining the static friction factor of a gasket	18
Bibliography	20

1 Scope

This document describes the test methods and test procedures for gasket parameters, including the maximum permissible gasket stress $Q_{\max}$, the unloading modulus of elasticity E_G , the creep relaxation factor PQR, the change in gasket thickness due to creep, the minimum gasket stress on assembly $Q_{\min}(L)$, the minimum gasket stress under test conditions $Q_{\min}(L)$, the axial coefficient of thermal expansion and the static friction factor.

This document applies to the parameter testing of non-metallic flat gaskets (rubber gaskets excepted), semi-metallic gaskets and metallic gaskets; gaskets of other shapes and sizes may also be tested by reference to this document.

2 Normative references

The contents of the following documents constitute indispensable provisions of this document through normative reference in the text. For dated references, only the edition corresponding to that date applies to this document; for undated references, the latest edition (including all amendments) applies to this document.

GB/T 9124.1 Steel pipe flanges - Part 1: PN series

GB/T 9124.2 Steel pipe flanges - Part 2: Class series

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 maximum gasket stress, $Q_{\max}$. The maximum stress that may be applied to the gasket at a specified temperature without the gasket being crushed, fractured, failing in compression or suffering damage to its bearing surface.

3.2 minimum gasket stress required for leakage rate class L on assembly, $Q_{\min}(L)$. The minimum stress that has to be applied to the gasket when it is installed at room temperature to ensure that tightness class L is reached between the flange faces at the test internal pressure.

3.3 minimum gasket stress required for leakage rate class L under test conditions, $Q_{\min}(L)$. The minimum gasket stress needed to maintain tightness class L under the test conditions of temperature and internal pressure.

3.4 tightness class, L. A range of leakage rates, or the maximum value of a defined leakage rate.

3.5 creep relaxation factor, PQR. A characterisation of the stress relaxation behaviour of a gasket exposed to the test temperature for a long period, expressed as the ratio of the residual gasket stress to the initial gasket stress.

3.6 unloading modulus of elasticity, EG. The ratio of stress to strain when the gasket is unloaded; its value is determined from the recovered thickness of the gasket when the initial compressive load is unloaded to one third of its value.

3.7 axial coefficient of thermal expansion. The expansion per unit length in the axial direction of the gasket produced by a unit change of temperature, at the service temperature and gasket stress.

3.8 change in gasket thickness due to creep. The change in thickness caused by creep between the completion of loading and the end of the test.

3.9 static friction factor. The ratio of the static friction force between the gasket and the flange sealing face to the normal force, under the test conditions.

4 General test requirements

4.1 Schematic diagrams of the general test rig, the compression and creep test rig, the room-temperature leakage test rig, and the leakage test rig permitting the use of replaceable platens are given in Annex A to Annex D respectively.

4.2 The test platens and the heating plates shall be stiff enough to ensure that they can carry the applied load without the deformation of the platen affecting the surface stress on the gasket. The modulus of elasticity of the platen material shall be 195 GPa to 210 GPa, the hardness of the sealing face shall be 40 HRC to 50 HRC, and the surface roughness R_a shall lie within the range 3.2 micrometres to 6.3 micrometres.

4.3 For gasket test pieces for raised-face flanges of nominal size DN 40 and nominal pressure PN 40, the dimensions of the test platens shall conform to GB/T 9124.1; for test pieces of nominal size DN 100 (NPS 4) and nominal pressure Class 300, the dimensions of the test platens shall conform to GB/T 9124.2. For gasket test pieces for tongue-and-groove flanges, the dimensions of the test platens shall conform to GB/T 9124.1 or GB/T 9124.2.

4.4 When the creep relaxation factor PQR and the maximum permissible gasket stress Q_{smax} are being measured, stainless steel foil or aluminium foil not thicker than 0.05 mm may be placed between the gasket and the platen to prevent sticking, and its use shall be recorded in the test report. The foil shall not be reused.

4.5 The compression of the gasket needs to be monitored during the test. To measure the compression of the gasket, a displacement transducer may be placed every 120 degrees around the circumference of the test platen, or a single transducer placed at the centre. Placing a displacement transducer at the centre to measure the compression of the gasket is not recommended for leakage tests.

4.6 The loading and unloading rate for polytetrafluoroethylene (PTFE) type gaskets shall be 0.1 MPa/s; the loading and unloading rate for all other gaskets shall be 0.5 MPa/s.

4.7 The heating rate for high-temperature tests is 2 degrees Celsius per minute.

4.8 For all tests, the initial thickness of the gasket is the thickness measured after a gasket stress of 1 MPa has been applied at room temperature and held for 1 min.

5 Test pieces

5.1.1 For gaskets of the PN series, a test piece of nominal size DN 40 and nominal

pressure PN 40 should be selected; for gaskets of the Class series, a test piece of nominal size DN 100 (NPS 4) and nominal pressure Class 300 should be selected.

5.1.2 For sheet material, a test piece of inside diameter 49.0 mm and outside diameter 92.0 mm should be selected for the PN series, and a test piece of inside diameter 115.0 mm and outside diameter 181.0 mm for the Class series.

5.1.3 For gaskets for tongue-and-groove flanges, the dimensions of the test piece shall be diameters of 61 mm and 75 mm (PN series) or diameters of 54 mm and 73 mm (Class series). Some of the test parameters need to be adjusted or corrected in accordance with Annex E. The tolerances of the tongue-and-groove platens shall meet the following requirements: the tongue width shall carry a minus tolerance; the groove width shall carry a plus tolerance.

5.1.4 Where a tongue-and-groove sealing face is used for the test, this shall be stated in the test report.

5.1.5 Gaskets of other shapes and sizes may be selected as test pieces where required or by agreement between the parties.

5.2 Number of test pieces. Not fewer than three test pieces shall be selected at random from the same sample for testing.

5.3 Preconditioning. Before the test, the test pieces shall be kept for not less than 48 h in surroundings at a temperature of 23 degrees Celsius plus or minus 5 degrees Celsius and a relative humidity of 50 percent plus or minus 6 percent. Not more than 30 min shall elapse between removal of the test pieces from those surroundings and the start of the test.

5.4.1 The thickness of the gasket is measured with a gauge of accuracy not lower than 0.001 mm; the arithmetic mean of measurements at three points on equal arcs is taken as the result.

5.4.2 The diameters of the gasket, the inside diameter and the outside diameter, are measured with a gauge of accuracy not lower than 0.01 mm; the arithmetic mean of measurements at three points on equal arcs is taken as the result.

5.4.3 Where the gasket has an inner ring or a centring ring related to the sealing element, the thickness of that inner ring or centring ring shall also be measured and recorded.

6 Test conditions

6.1 The ambient temperature during the test shall be kept at 23 degrees Celsius plus or minus 5 degrees Celsius.

6.2 For room-temperature tests, the test temperature shall be kept at 23 degrees Celsius plus or minus 2 degrees Celsius.