

ICS 77.040.10

CCS H 22



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 29459.2-2012

**Small punch test methods of metallic materials for in-service
pressure equipment - Part 2: Method of test for tensile
properties at room temperature**

在役承压设备金属材料小冲杆试验方法 第2部分室温下拉伸性能的试验方法

(English Translation)

Issued on: December 31, 2012

Implemented on: July 1, 2013

**Issued by: General Administration of Quality Supervision, Inspection and
Quarantine**

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Foreword

GB/T 29459 Small punch test methods of metallic materials for in-service pressure equipments consists of the following two parts.

- Part 1. General requirements;
- Part 2. Method of test for tensile properties at room temperature.

This Part is the second part of GB/T 29459.

This Part was drafted in accordance with the rules given in GB/T 1.1-2009.

This Part mainly referred to relative technical content of CWA 15627 Small punch test methods of metallic materials and was formulated based on the combination of the actual situation of China and research results.

This Part was proposed by and shall be under the jurisdiction of National Technical Committee on Boiler and Pressure Vessel of Standardization Administration of China (SAC/TC 262).

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Small punch test methods of metallic materials for in-service pressure equipments - Part 2. Method of test for tensile properties at room temperature

1 Scope

This Part of GB/T 29459 specifies the explanation on symbols, test requirements, test records, test data processing and test reports of small punch test method which obtains tensile properties of material at room temperature.

This Part is applicable to metallic materials for pressure equipment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 228.1, Metallic materials - Tensile testing - Part 1 . Method of test at room temperature

GB/T 29459.1, Small punch test methods of metallic materials for in-service pressure equipments - Part 1. General requirements

3 Symbols

Symbols specified in GB/T 29459.1 and the following ones apply to this document.

A - elongation at break after conventional tensile test, %;

E - elastic modulus, in megapascals (MPa);

F(u) - load-displacement function obtained in test, in newtons (N);

F(u) - load-displacement function fitted by curve obtained in test, in newtons (N);

F_p - yield load of small punch test, in newtons (N);

h_f - minimum thickness of fracture, in millimeters (mm);

ReL - conventional tensile test yield strength, in megapascals (MPa);

RP - non-proportional elongation strength of conventional tensile test, in megapascals (MPa);

R_m - tensile strength of conventional tensile test, in megapascals (MPa);

u_{max} - punch displacement at the maximum load of small test punch, in millimeters (mm);

Z - reduction rate of cross section of conventional tensile test, %;

ZSP - reduction rate of cross section of small punch test, %.

4.1 General requirements

In addition to the requirements of this Part, it shall also comply with GB/T 29459.1.

4.2 Test environment

The test shall be carried out in the laboratory. The test is normally carried out at temperatures between 10°C and 35°C, unless otherwise specified. If the test has demanding requirements for temperature, the temperature should be (23 ± 5)°C. Special precautions should be taken when there is a harsh environment.

4.3 Test loading process

Through the punch head, a downward load is applied to the center of the specimen. The deformation of the specimen increases with increasing load until it breaks. Figure 1 shows specimen clamping and loading diagram.

a large number of materials. The returned values of R₁ and b₁ shall be applicable to the same material contained. As long as the F_P value on the loading-displacement curve of small punch test of material for test can be obtained, the ReL value of material for test can be obtained after substituting in equation (2).

6.4 Determination of tensile strength

Similar to the method of determining the yield strength in Clause 6.2, carry out a large number of pre-tests. Taking F_{max} as abscissa, R_m as ordinate, input the measured data into the coordinates respectively. Then fit a straight line according to the least squares method. Establish equation (4).

Then establish the relationship between the yield load of the small punch and the conventional tensile yield strength of the material, so as to estimate the yield strength of the material based on results of small punch test. Where, R_2 and b_2 are related to the geometry of the small punch specimen. The values of R_2 and b_2 can be determined by standard specimen tensile of a large number of materials and linear regression of small punch test.

6.5 Association with conventional elongation at break A

Equation (5) can be established by the association between the center displacement u_{max} of specimen and the elongation A of material.

R_3 and b_3 are constants related to the geometry of the small punch specimen. The values of R_3 and b_3 can be determined by standard specimen tensile of a large number of materials and linear regression of small punch test.

6.6 Association with conventional section shrinkage Z

The specimen thickness after fracture h_f can be obtained by the section shrinkage measured in small punch test, by use of section shrinkage Z_{SP} , as shown in equation (6), i.e., the percentage of the maximum reduction in thickness of the specimen after fracture ($h-h_f$) and the original thickness (h) is associated with the conventional section shrinkage Z , in equation (7).

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