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

GB/T 21838.1-2019

Replacing GB/T 21838.1-2008

**Metallic materials -- Instrumented indentation test for hardness
and materials parameters -- Part 1: Test method**

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Foreword

GB/T 21838 "Instrumental Compression Test of Metallic Material Hardness and Material Parameters" is divided into four parts.

--- Part 1. Test methods;

--- Part 2. Testing and calibration of testing machines;

--- Part 3. Calibration of standard blocks;

--- Part 4. Test methods for metallic and non-metallic coatings.

This part is the first part of GB/T 21838.

This part is drafted in accordance with the rules given in GB/T 1.1-2009.

This part replaces GB/T 21838.1-2008 "Mechanical indentation test for hardness and material parameters of metallic materials - Part 1. Test

Test method, compared with GB/T 21838.1-2008, the main technical changes are as follows.

---The standard name is changed from "Metal indentation test of metal material hardness and material parameters Part 1. Test method" to "Metal

Instrumented indentation test for material hardness and material parameters - Part 1. Test methods;

--- Added symbols and descriptions (see Chapter 3);

--- Added test surface cleaning method (see Chapter 6);

--- Increased the determination of Martens hardness HMdiff (see A.3.3);

--- Refine the determination of the indentation modulus EIT (see A.5.1,.2008 edition of A.5.1);

- Increased measurement of plane strain modulus E^* (see A.5.2);
- Added normative appendix G "Drift rate and creep rate determination" (see Appendix G);
- Added the informative Appendix H "Uncertainty Evaluation of Hardness and Material Parameter Values" (see Appendix F);
- Added normative appendix I "Correction calculation of radial displacement" (see Appendix I).

This part uses the translation method equivalent to the international standard ISO 14577-1.2015 "Metal material hardness and material parameters of the instrumentation pressure

Into the test Part 1. Test methods.

The documents of our country that have a consistent correspondence with the international documents referenced in this part are as follows.

GB/T 21838.2-2008 Instrumentation indentation test for hardness and material parameters of metallic materials - Part 2

Inspection and calibration (ISO 14577-2.2002, MOD);

---GB/T 27418-2017 Measurement uncertainty assessment and representation (ISO /IEC Guide 98-3.2008, MOD).

This part was proposed by the China Iron and Steel Association.

This part is under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC183).

This section drafted by. Shanghai Materials Research Institute, Wuhan Huatuo Measurement Technology Co., Ltd., Wuhan Iron and Steel Co., Ltd., Steel Research Technology Co., Ltd.

Introduction

The classic definition of hardness is the ability of one material to resist the indentation of another harder material to create a permanent indentation. Carrying Rockwell, Vickers and Cloth

The test results obtained during the hardness test were measured after the test force was removed. Therefore, the elastic deformation of the material under the action of the indenter is neglected.

Impact.

The development of GB/T 21838 (all parts) enables the user to study the force and

deformation during the plastic and elastic deformation of the material.

The relationship of the person to assess the indentation characteristics of the material. By monitoring the entire cycle of test force application and removal, the method can be determined and traditional

Hardness value equivalent hardness value. Significantly, the method is also capable of determining the hardness values under compression modulus and elastic-plastic conditions,

All of the above values can be calculated by measuring the indentation size optically. In addition, with various techniques, instrumented indentation tests can be recorded

Record the distribution of hardness and modulus along the depth in a potentially complex press-in test cycle.

The development of GB/T 21838 (all parts) enables in-depth analysis of the various post-test data.

Metal material hardness and material parameters

Instrumented indentation test - Part 1. Test methods

1 Scope

This part of GB/T 21838 specifies the following three ranges of metal materials instrumented indentation test method for the determination of hardness and other materials

Number method.

--- Macro range. $2\text{N} \leq F \leq 30\text{kN}$;

---Microscopic range. $F < 2\text{N}$, $h > 0.2\text{ }\mu\text{m}$;

---Nano range. $h \leq 0.2\text{ }\mu\text{m}$.

For the nanometer range, the mechanical deformation is heavily dependent on the actual shape of the tip of the indenter, and the function of the contact area of the indenter used in the testing machine will be severely affected.

The calculation of the material parameters. Therefore, in order to make the reproducibility of the material parameters measured by different instruments within an acceptable range, a careful calibrator is required.

And indenter shape.

The macroscopic and microscopic ranges are distinguished by the magnitude of the test force relative to the depth of penetration.

Note that the upper limit of the microscopic range is expressed by the test force (2N), and

the lower limit is expressed by the penetration depth (0.2 μm).

See Appendix A for the determination of hardness and other material parameters.

Carbide indenters are usually used in the macro range because the head is easily damaged when the contact pressure is high. For detecting hardness values and elastic modulus

For higher samples, the standard block can be used to detect the permanent deformation that can be generated by the indenter, and the permanent deformation of the indenter should be considered.

Impact.

This section can also be applied to thin metallic and non-metallic coverings as well as non-metallic materials. In this case, it is advisable to refer to the relevant standards.

(See 6.3 and ISO 14577-4).

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only dated versions apply to this article.

Pieces. For undated references, the latest edition (including all amendments) applies to this document.

ISO 14577-2:2015. Indentation test for hardness and material parameters of metallic materials - Part 2. Examination and testing of test machines

Calibration

(Metallic materials - Instrumented indentation test for hardness and material parameters - Part

2 Verification and calibration of testing machines)

ISO /IEC Guide 98-3:2008 (GUM:1995) Measurement uncertainty - Part 3. Guide to measurement uncertainty

[Uncertainty of measurement - Part 3. Guide to the expression of uncertainty in measurement (GUM:1995)]

3 symbols and instructions

The symbols used in this section and the corresponding descriptions are shown in Table 1, Figure 1 and Figure 2.