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Replacing GB/T 24173-2009

Steel Sheets – Secondary Work Embrittlement Test Method

钢板　二次加工脆化试验方法

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Foreword

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

This Standard replaces GB/T 24173-2009, *Steel Sheets – Secondary Work Embrittlement Test Method*. Compared with GB/T 24173-2009, the major technical changes of this Standard are as follows:

-- it replaces “punch pin” with “punch” in the main text;

-- it adds the normative references in Article 2;

-- it adds the definition of “clearance” in 3.5 and the requirements for clearance in the preparation of cup sample in 5.5;

-- in Table 1, it modifies the inner diameter of cup sample and the diameter of punch, and adds the explanations of primary and secondary strains;

-- it modifies the test principle in Article 4;

-- it adds Table 2, i.e. the selection of dimensions of punch and die;

-- it modifies 5.4 and indicates that other materials may also be used as lubricating agents;

-- it adds the explanations of impact centring mechanism in 6.4 and specifies that the deviation of impact centre is not greater than 0.5 mm;

-- it modifies the original Figures 1 and 2 and adds Figure 3;

-- it modifies the requirements for temperature measuring apparatus in 6.5 and indicates that the accuracy shall be ± 1°C;

-- it modifies 7.7 and indicates the criterion for the fracturing rate not smaller than 25%;

-- it adds the contents of “the designation of test material” and “the clearance of mould and sheet” in test report in Article 8.

This Standard was proposed by China Iron and Steel Association.

This Standard shall be under the jurisdiction of the National Standardization Technical Committee on Steels (SAC/TC 183).

The drafting organizations of this Part: Baoshan Iron and Steel Co. Ltd., China Metallurgical Information and Standardization Institute, Shenzhen Wance Testing Machine Co., Ltd..

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Steel Sheets –

Secondary Work Embrittlement Test Method

1 Application Scope

This Standard specifies the terms and definitions, test principle, cup sample, test apparatus, test procedure, accuracy of test results and test report of secondary work embrittlement test method for steel sheets.

This Standard applies to the secondary work embrittlement test of the sheets made of interstitial free steel and phosphorus bearing steel for punch-forming auto parts and other steel sheets having secondary work embrittlement characteristics for punch forming, with a thickness of 0.45 mm ~ 2.5 mm.

2 Normative References

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

GB/T 10623, *Metallic Material – Mechanical Testing – Vocabulary*

GB/T 15825.3, *Sheet Metal Formability and Test Methods – Part 3: Drawing and Drawing Load Test*

3 Terms and Definitions

Those defined in GB/T 10623 and GB/T 15825.3 and the following terms and definitions apply to this document.

3.1

secondary work embrittlement; SWE

The phenomenon that interstitial free steel (IF steel) and phosphorus bearing steel have certain interstitial internal stress after punch forming (primary processing), so they are liable to fracture on the grain boundary subjected to an external force (especially an impact force under low temperature conditions, secondary work).

3.2

free from defects including scratches and roll marks. The widths of cup sample no.1 and no. 2 shall not be less than 74 mm and 108 mm.

5.3 Steel sheet billets are usually punched into round billets using punching round billet mould on a press or they may also be made into round billets with other methods. The dimensions of round billets are two times of the dimeter of punch used for cup. The burr on the edge of round billets shall be removed.

NOTE The quantity of round billets required for each test is normally 32 ~ 50; if the estimated SWET is close to the measured SWET, 32 round billets can be taken, or else, the quantity of round billets needs to be added.

5.4 The punching of round billets into cylindrical cup sample is performed on a forming property testing machine, using the draw ratio DR 2:1, the corner radius of punch 6.0 mm ± 0.5 mm, the blank holder force 9.8 kN ~ 14.7 kN and the rising speed of punch normally not greater than 40 mm/min, and using polypropylene film of thickness 0.040 mm ± 0.005 mm as the lubricating agent to reduce the wrinkling of cup sample and reduce the abrasion of mould. Record the blank holder force used for deep drawing cup. For coating materials, clean mould after each time of punching.

NOTE Other materials may also be used as lubricating agents.

5.5 In accordance with the thickness of sheets, select the dimensions of punch and die required for deep drawing cup mould from Table 2. The selection deep drawing cup mould is subjected to the clearance of mould and sheet required for the test. Unless specified otherwise, the clearance is normally 40% ~ 100% and calculated in accordance with Formula (1):

NOTE The lower limit is recommended during the preparation of cup sample.

$$c = \left(\frac{D_d - d_p}{2} - t \right) / t \times 100\% \qquad \cdots\cdots (1)$$

where,

c – clearance, expressed in %;

D_d – inner diameter of die, in mm;

d_p – diameter of punch, in mm;

t – basic thickness of sheet, in mm.

EXAMPLE:

The inner diameter of die D_d is 37 mm and the thickness of sheet is 1.2 mm, so the punch of d_p 33 mm is used to punch cup sample no. 1 and the corresponding clearance is 67% through calculation. Therefore, for the sheets of thickness 1.2 mm, it is

examination results.

7.4 If none of the 4 cup samples fracture, then lower the temperature and repeat test on 4 cup samples. The temperature interval is subjected to the experiences and convenience degree of test personnel (e.g. 10°C or 20°C).

NOTE Cup sample will show plastic expansion without fracturing if the temperature is above secondary work embrittlement temperature.

7.5 If only one of the 4 cup samples fractures, carry out test on 8 cup samples at this temperature (adding 4 cup samples):

a) If only one of the 8 cup samples still fractures, then lower test temperature by 5°C (with the minimum interval of test temperature 5°C) and repeat test on 8 cup samples until at least two the 8 cup samples fracture;

b) If at least two of the 8 cup samples fracture, then improve test temperature by 5°C and repeat test on 8 cup samples until at least two of the 8 cup samples fracture.

7.6 If at least two of 4 cup samples fracture, then improve test temperature by 5°C and repeat test on 4 cup samples, until at least two of the 4 cup samples fracture. Carry out test on 8 cup samples at this temperature (adding 4 cup samples for the test). If at least two of the 8 cup samples fracture, then improve test temperature once again by 5°C and repeat test on 8 cup samples until at least two of the 8 cup samples fracture.

7.7 If at least two of 8 cup samples fracture, i.e. the maximum temperature, at which the fracturing rate is not smaller than 25%, is the secondary work embrittlement temperature SWET (SWET is the integer multiples of 5°C, e.g. – 35°C, - 40°C, -45°C and so on). If none of cup samples fracture at - 60°C, the temperature at a lower temperature may be omitted and the SWET of this steel sheet is recorded as < - 60°C.

8 Test Report

Test report shall include the following content:

a) a reference to this Standard;

b) the designation of test material;

c) the thickness of material;

d) the dimension of cup sample (diameter × height);

e) the blank holder force of deep drawing cup;

f) the clearance of mould and sheet;

g) the type of lubricating agent;

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