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Replacing GB/T 5616-2006

Non-destructive testing - Guidelines for application

无损检测 应用导则

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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 5616-2006 “Non-destructive testing - Guidelines for application”.

As compared with GB/T 5616-2006, the main changes of this standard are as follows:

- ADD some terms and definitions (SEE Chapter 3; Chapter 3 of the 2006 version);

- DELETE acronyms (Chapter 4 of the 2006 version);

- MODIFY the general principles of application of non-destructive testing (SEE Chapter 7; Chapter 8 of the 2006 version).

This standard was proposed by AND shall be under the jurisdiction of the National Standardization Committee of Non-destructive Testing (SAC/TC 56).

The drafting organizations of this standard: Shanghai Materials Research Institute, China Special Equipment Testing and Research Institute, Shanghai Taisi Testing Technology Co., Ltd., China Aviation Industry Corporation Beijing Aeronautical Materials Research Institute, Shanghai Boiler Co., Ltd., Shanghai Jinyi Testing Technology Co., Ltd. China Commercial Aircraft Co., Ltd. Shanghai Aircraft Design and Research Institute, Mechanical Industry Non-destructive Testing Center, Mechanical Industry Non-destructive Testing Personal Training Center, Shanghai Engineering Materials Application Evaluation Key Laboratory.

The main drafters of this standard: Jin Yufei, Shen Gongtian, Shi Yiwei, Yan Jianfang, Luo Funding, Feng Jeanie, Zhang Peiping, Ding Jie, Xu Guozhen, Zhang Yiming.

This Standard replaces the standard previously issued as follows:

- GB/T 5616-1985, GB/T 5616-2006.

Non-destructive testing - Guidelines for application

1 Scope

This standard specifies the basic rules to be followed when applying the non-destructive testing (NDT).

The purpose of this standard is to guide the proper use of non-destructive testing.

2 Normative references

The following documents are essential to the application of this document. For the dated documents, only the versions with the dates indicated are applicable to this document; for the undated documents, only the latest version (including all the amendments) are applicable to this Standard.

GB/T 9445 Qualification and certification for nondestructive testing personnel

GB/T 19001 Quality management system - Requirements

GB/T 20737 Non-destructive testing - General terms and definitions

GB/T 27025 General requirements for the competence of testing and calibration laboratories

3 Terms and definitions

The terms and definitions as defined in GB/T 9445 and GB/T 20737 AND the following terms and definitions apply to this document.

3.1

Assignment

It refers to the written documents by which the employer or the responsible unit requires the unit to conduct and apply the non-destructive testing of an item.

3.2

Contract

It refers to the written documents by which the Employer (the entrusting unit) requires the Contractor (responsible unit) to conduct and apply the

[ISO 9712:2012, definition 3.16]

4 NDT summary

4.1 Non-destructive testing refers to a testing method against the material or workpiece which does not damage or affect its future performance or use.

4.2 Non-destructive testing can be used to detect imperfections in the material or inside and surface of the workpiece, which can be used to measure the geometrical characteristics and dimensions of the workpiece AND can be used to determine the internal composition, structure, physical properties and status of the material or workpiece.

4.3 Non-destructive testing can be applied to product design, material selection, manufacturing, finished product inspection, in-service inspection (maintenance) and other aspects. Reasonable application of non-destructive testing is not only conducive to quality control, but also effective in cost reduction. The non-destructive testing also helps to ensure safe operation AND/OR efficient use of the product.

5 Non-destructive testing methods

5.1 Non-destructive testing contains a number of methods that have been used effectively. In accordance with the physical principle or the difference of testing object and purpose, the non-destructive testing can be divided into the following methods:

a) Penetrant testing (penetrant testing, PT);

b) Magnetic testing (MT);

c) Visual testing (visual testing, VT);

d) Ultrasonic testing (ultrasonic testing, UT);

e) Eddy current testing (eddy current testing, ET);

f) Radiographic testing (radiographic testing, RT);

g) Leak testing (leak testing, LT);

h) Infrared thermographic testing (TT or IT);

i) Acoustic emission testing (AT or AE).

Note: Any kind of physical principles are likely to be developed and used as non-destructive testing methods, so it shall not rule out other non-destructive testing methods.

manufacturer's exit-factory (or batch) testing shall be qualified and guaranteed by the quality system, which shall comply with the requirements of GB/T 19001.

7.3.1.3 When the manufacturer delivers the non-destructive testing equipment, the accompanied documents shall comply with the requirements of the product standard, AND include at least:

a) Packing list;

b) Product certificate;

c) Product manual (when contracted);

d) Exit-factory testing report (when contracted);

e) Type testing report (when contracted);

f) Product technical data sheet (when contracted).

7.3.1.4 As for the maintained non-destructive testing equipment, it is preferable for the maintenance party to issue the testing report in accordance with the product standard exit-factory testing requirements.

7.3.2 Equipment performance and verification

7.3.2.1 Equipment performance

The working performance of non-destructive testing equipment (including instruments and materials) shall comply with the requirements of the corresponding non-destructive testing standards.

In order to ensure that the working performance of the NDT equipment reaches the requirements of the non-destructive testing application standard, it shall follow the requirements of relevant standards OR the user instruction as recommended by the manufacturer to organize the periodic performance verification (or performance testing). If necessary, it may entrust the third party as recognized by all the parts of the contract to perform the performance test, BUT the non-destructive testing personnel level of the third party shall be not less than the level of the non-destructive testing personnel of the corresponding methods of the entrusting party.

Note: When the performance verification (or performance testing) of the NDT equipment is not equivalent to that as metered and calibrated, this standard does not cover the metering issue.

7.3.2.2 System performance testing

The working performance of the NDT system shall be tested on the basis of the method recommended by the corresponding non-destructive testing application standards at least before every day or every time of testing.

7.4.3 Standards or codes

If there is no currently effective and applicable non-destructive testing standard or code, it may determine OR temporarily establish the specific technical documents as recognized by both parties of the contract through negotiation, in order to be used when there is no standard.

Note: The name and form of the specific technical document are not limited, which may be technical agreement or technical plan or part of it or other effective form.

It shall pay attention to selecting the latest version of the on-destructive testing standards. Therefore, non-destructive testing personnel and their units shall keep abreast of the establishment, revision, and update of the relevant non-destructive testing standards.

Appendix A provides a list of commonly used non-destructive testing standards for reference.

7.4.4 Non-destructive testing procedures

7.4.4.1 Non-destructive testing procedures shall be prepared by level 3 personnel. Non-destructive testing procedures shall be prepared in accordance with the NDT contract or NDT assignment contents and requirements AND the contents and requirements of the corresponding NDT standards. AND the procedures shall include at least the following:

a) The name and number of the NDT procedure;

b) The name and number of the relevant documents on which the non-destructive testing procedure is prepared;

c) The scope of the tested material or workpiece to which the non-destructive testing procedure applies;

d) Acceptance criteria, acceptance level or equivalent technical requirements;

e) Non-destructive testing personnel qualification requirements for the implementation of this procedure;

f) The name, model and manufacturer name of the non-destructive testing equipment required for the implementation of this procedure;

g) The basis and requirements for the compilation of the non-destructive testing equipment (or instrument) performance verification methods (or system performance testing methods) and requirements as required for the implementation of this procedure;

h) The position to be tested, the non-destructive testing methods and techniques adopted, the testing level and testing timing, the surface

c) (One or more of the same) tested material or workpiece name, product number, testing position, AND the surface preparation before the non-destructive testing;

d) Non-destructive testing personnel requirements and their non-destructive testing methods and levels;

e) The name, specification, model, and system performance verification methods and requirements (e.g., sensitivity) of the specified NDT equipment;

f) The detailed operation procedures and testing parameters;

g) The specifications and precautions on the observation (including the observation conditions) and recording of the non-destructive testing display;

h) The signature of the non-destructive testing instruction preparer (level 2 or 3);

i) The signature of the non-destructive testing instruction approver.

7.4.6 Data records

It shall follow the requirements of the non-destructive testing instruction to perform testing AND making the corresponding records. The testing and recording personnel shall hold the level 1 or above certificates of the corresponding non-destructive testing methods, sign each non-destructive testing records, AND be liable for the authenticity of the record. If the person conducting the test and making record holds the level 1 certificate, the level 3 or 3 supervising personnel of the corresponding non-destructive testing methods shall also sign on the NDT records, AND undertakes the corresponding technical supervision responsibilities.

7.4.7 Testing report

The level 2 or 3 personnel of the corresponding non-destructive testing methods shall be responsible for the interpretation of the NDT records in accordance with the requirements of the non-destructive testing procedure (or related documentation) AND for the preparation and review of the NDT report, AND undertake the technical responsibilities of the report contents.

The contents of the NDT report shall contain the requirements for the non-destructive testing contract and assignment.

8 Applicability and limitations of conventional non-destructive testing methods

8.1 Overview

c) It cannot detect the layered imperfection perpendicular to the ray irradiation direction;

d) It cannot determine the burial depth of the imperfections OR the size parallel to the ray direction.

8.3 Ultrasonic testing (UT)

8.3.1 Applicability:

a) It can detect such imperfections as cracks, white spots, inclusions and so on, in the forgings.

b) Direct radioactive testing technique can be used to detect the internal imperfections or imperfections in parallel to the surface. The use of oblique radioactive radiographic technique (including surface wave technique) can detect imperfections or surface imperfections that are not parallel to the surface.

c) It can detect cracks, non-penetration, non-fusing, slag inclusion, pinhole, and so on in the welds.

Note: Oblique radioactive technique is usually used.

d) It can detect the cracks, folding, delamination, sheet slag inclusion, and so on, in the profile (including sheet, pipe, bar and other profiles).

Note: The liquid immersion technique is usually used, AND the pipe or bar materials also use the focused oblique radioactive technology.

e) It can detect the cracks, loosening, slag inclusion, shrinkage, and other imperfections in the castings (such as the casting steel or ductile iron which is simple in shape, flat in surface, OR subjected to processing and finishing).

f) It can determine the burial depth and the height of imperfections.

8.3.2 Limitations:

a) It is difficult to detect imperfections in coarse crystalline materials (such as castings and welds of austenitic steels);

b) It is difficult to detect imperfections in the workpiece of complex shape or rough surface;

c) It is difficult to determine the nature of the imperfection.

8.4 Eddy current testing (ET)

8.4.1 Applicability:

Appendix A

(Informative)

Commonly used national standards on non-destructive testing

This Appendix provides a list of some of the commonly used national standards on non-destructive testing (some commonly national standards on non-destructive testing may not be included).

GB/T 3323 Radiographic examination of fusion welded joints in metallic materials

GB/T 4162 Forged and rolled steel bars - Method for ultrasonic testing

GB/T 5097 Non-destructive testing - Penetrant testing and magnetic particle testing - Viewing conductions

GB/T 5616 Non-destructive testing - Guidelines for application

GB/T 5677 Radiographic testing for steel castings

GB/T 5777 Seamless steel pipe and tubing - Methods for ultrasonic testing

GB/T 6402 Steel forgings - Method for ultrasonic testing

GB/T 7233.1 Steel castings - Ultrasonic examination - Part 1: Steel castings for general purposes

GB/T 7233.2 Steel castings - Ultrasonic examination - Part 2: Steel castings for highly stressed components

GB/T 7704 Non-destructive testing - Practice for residua stress measurement by X-ray

GB/T 7734 Method for ultrasonic testing of clad steel plates

GB/T 7735 Steel tubes - The inspection method on eddy current test

GB/T 8651 Flaw testing method by the ultrasonic plate wave for metal plates

GB/T 9443 Penetrant testing for steel castings

GB/T 9444 Magnetic particle testing for steel castings

GB/T 9445 Non-destructive testing - Qualification and certification of NDT personnel

GB/T 11259 Non-destructive testing - Practice for fabrication and control of steel reference blocks used in ultrasonic testing

GB/T 15822.2 Non-destructive testing - Magnetic particle testing - Part 2: Testing media

GB/T 15822.3 Non-destructive testing - Magnetic particle testing - Part 3: Equipment

GB/T 15823 Non-destructive testing - Test methods for helium leak testing

GB/T 15830 Non-destructive testing - Particle for ultrasonic testing of circumferential butt welds in steel pipes and tubes

GB/T 16544 Non-destructive testing - Practice for gamma-ray radiographic testing by panoramic exposure

GB/T 17455 Non-destructive testing - Metallographic replica techniques of surface examination

GB/T 18694 Non-destructive testing - Ultrasonic inspection - Characterization of search unit and sound field

GB/T 18851.1 Non-destructive testing - Penetrant testing - Part 1: General principles

GB/T 18851.2 Non-destructive testing - Penetrant testing - Part 2: Testing of penetrant materials

GB/T 18851.3 Non-destructive testing - Penetrant testing - Part 3: Reference test blocks

GB/T 18851.4 Non-destructive testing - Penetrant testing - Part 4: Equipment

GB/T 18852 Ultrasonic non-destructive testing - Reference blocks and test procedures for the characterization of contact search unit beam profiles

GB/T 19348.1 Non-destructive testing - Industrial radiographic film - Part 1: Classification of film systems for industrial radiography

GB/T 19348.2 Non-destructive testing - Industrial radiographic film - Part 2: Control of film processing by means of reference values

GB/T 19799.1 Non-destructive testing - Ultrasonic testing - Specification for calibration block No.1

GB/T 19799.2 Non-destructive testing - Ultrasonic testing - Specification for calibration block No.2

GB/T 19800 Non-destructive testing - Acoustic emission inspection - Primary calibration of transducers

GB/T 23903 Resolution indicators for ray image

GB/T 23904 Non-destructive testing - Test method for ultrasonic testing by surface wave

GB/T 23905 Non-destructive testing - Blocks for ultrasonic testing

GB/T 23906 Non-destructive testing - Ring block for magnetic particle testing

GB/T 23907 Non-destructive testing - Shims for magnetic particle testing

GB/T 23908 Non-destructive testing - Practice for ultrasonic pulse-echo straight-beam testing by the contact method

GB/T 23909.1 Non-destructive testing - Radioscopic testing - Part 1: Quantitative measurement of imaging properties

GB/T 23909.2 Non-destructive testing - Radioscopic testing - Part 2: Check of long term stability of imaging devices

GB/T 23909.3 Non-destructive testing - Radioscopic testing - Part 3: General principles of radioscopic testing of metallic materials by X-and gamma rays

GB/T 23910 Non-destructive testing - Metal intensifying screens for radiographic testing

GB/T 23911 Non-destructive testing - Blocks for penetrant testing

GB/T 23912 Non-destructive testing - Practice for immersed ultrasonic testing by the reflection method using pulsed longitudinal waves

GB/T 25757 Non-destructive testing - Test methods of performance characteristics of automatic magnetic flux leakage testing systems for steel tubes

GB/T 25758.1 Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 1: Scanning method

GB/T 25758.2 Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 2: Pinhole camera radiographic method

GB/T 25758.3 Non-destructive testing - Characteristics of focal spots in industrial X-ray systems for use in non-destructive testing - Part 3: Slit camera radiographic method

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