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Non-destructive testing — Penetrant testing —

Part 1: General principles

Essais non destructifs — Examen par ressuage —

Partie 1: Principes généraux

[Revision of first edition (ISO 3452-1:2008)]

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This draft has been developed within the European Committee for Standardization (CEN), and processed under the **CEN-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

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Contents

Page

| | |
|--|---|
| Foreword | v |
| 1 Scope | 1 |
| 2 Normative references | 1 |
| 3 Terms and definitions | 2 |
| 4 Safety precautions | 2 |
| 5 General principles | 2 |
| 5.1 Personnel | 2 |
| 5.2 Description of the method | 2 |
| 5.3 Process sequence | 2 |
| 5.4 Equipment | 3 |
| 5.5 Effectiveness | 3 |
| 6 Products, sensitivity and designation | 3 |
| 6.1 Product family | 3 |
| 6.2 Testing products | 4 |
| 6.3 Sensitivity | 4 |
| 6.4 Designation | 4 |
| 7 Compatibility of testing materials with the part(s) to be tested | 4 |
| 7.1 General | 4 |
| 7.2 Compatibility of penetrant testing products | 4 |
| 7.3 Compatibility of penetrant testing materials with parts under examination | 5 |
| 8 Test procedure | 5 |
| 8.1 Written test procedure | 5 |
| 8.2 Preparation and precleaning | 5 |
| 8.2.1 Mechanical precleaning | 5 |
| 8.2.2 Chemical precleaning | 5 |
| 8.2.3 Drying | 5 |
| 8.3 Application of penetrant | 6 |
| 8.3.1 Methods of application | 6 |
| 8.3.2 Temperature | 6 |
| 8.3.3 Penetration time | 6 |
| 8.4 Excess penetrant removal | 6 |
| 8.4.1 General | 6 |
| 8.4.2 Water | 6 |
| 8.4.3 Solvents | 6 |
| 8.4.4 Emulsifier | 6 |
| 8.4.5 Water and solvent | 7 |
| 8.4.6 Excess penetrant removal check | 7 |
| 8.4.7 Drying | 7 |
| 8.5 Application of developer | 7 |
| 8.5.1 General | 7 |
| 8.5.2 Dry powder | 8 |
| 8.5.3 Water-suspendable developer | 8 |
| 8.5.4 Solvent-based developer | 8 |
| 8.5.5 Water-soluble developer | 8 |
| 8.5.6 Water or solvent based for special application (e.g. peelable developer) | 8 |
| 8.5.7 Development time | 9 |
| 8.6 Inspection | 9 |
| 8.6.1 Viewing conditions | 9 |

| | | |
|---------|--|----|
| 8.6.2 | General..... | 9 |
| 8.6.3 | Wipe-off technique..... | 9 |
| 8.6.4 | Recording | 10 |
| 8.7 | Postcleaning and protection | 10 |
| 8.7.1 | Postcleaning..... | 10 |
| 8.7.2 | Protection | 10 |
| 8.8 | Retesting..... | 10 |
| 9 | Test report | 10 |
| Annex A | (normative) Main stages of the penetrant examination..... | 12 |
| Annex B | (normative) Process and control tests..... | 13 |
| B.1 | General..... | 13 |
| B.2 | Control tests..... | 13 |
| B.3 | Control test forms..... | 1 |
| B.4 | Control test..... | 1 |
| B.4.1 | Materials levels (including refillable spray systems)..... | 1 |
| B.4.2 | System performance | 1 |
| B.4.3 | Penetrant appearance | 2 |
| B.4.4 | Rinse water appearance..... | 2 |
| B.4.5 | Rinse water temperature..... | 2 |
| B.4.6 | Oven temperature | 2 |
| B.4.7 | Working area | 2 |
| B.4.8 | Compressed air filter(s) | 2 |
| B.4.9 | Integrity of UV-A filters..... | 2 |
| B.4.10 | UV-A irradiance | 2 |
| B.4.11 | Visible light intensity in inspection booth (fluorescent systems)..... | 2 |
| B.4.12 | Visible light intensity (colour contrast systems)..... | 2 |
| B.4.13 | Fluorescent intensity..... | 3 |
| B.4.14 | Colour contrast intensity | 3 |
| B.4.15 | Supplier's overcheck..... | 3 |
| B.4.16 | Concentration of hydrophilic remover | 4 |
| B.4.17 | Developers..... | 4 |
| B.4.18 | Ultraviolet radiometer calibration | 5 |
| B.4.19 | Luxmeter calibration | 5 |
| B.4.20 | Thermometer calibration..... | 5 |
| B.4.21 | Pressure gauge calibration..... | 5 |
| B.4.22 | Test block calibration..... | 6 |
| Annex C | (informative) Example of a test report | 7 |

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3452-1 was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Subcommittee SC 2, and by Technical Committee CEN/TC 138, *Non-destructive testing* in collaboration.

This second edition cancels and replaces the first edition (ISO 3452-1:2008) which has been technically revised.

ISO 3452 consists of the following parts, under the general title *Non-destructive testing — Penetrant testing*:

- *Part 1: General principles*
- *Part 2 : Testing of penetrant materials*
- *Part 3: Reference test blocks*
- *Part 4: Equipment*
- *Part 5: Penetrant testing at temperatures higher than 50 °C*
- *Part 6: Penetrant testing at temperatures lower than 10 °C*
- *Part 5: Penetrant testing at temperatures higher than 50 °C*
- *Part 6: Penetrant testing at temperatures lower than 10 °C*

The main changes with respect to the previous edition are listed below:

- a) the normative references were updated;
- b) a table referring to the testing products was added;
- c) the document was technically and editorially revised.

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Non-destructive testing — Penetrant testing —

Part 1: General principles

1 Scope

This standard defines a method of penetrant testing used to detect discontinuities, e.g. cracks, laps, folds, porosity and lack of fusion, which are open to the surface of the material to be tested. It is mainly applied to metallic materials, but can also be performed on other materials, provided that they are inert to the test media and they are not excessively porous, examples of which are castings, forgings, welds, ceramics, etc.

This standard also includes the requirements for process and control testing.

This standard is not intended to be used for acceptance criteria and gives neither information relating to the suitability of individual test systems for specific applications nor requirements for test equipment.

The term 'discontinuity' is used here in the sense that no evaluation concerning acceptability or non-acceptability is included.

Methods for determining and monitoring the essential properties of penetrant testing products to be used are specified in ISO 3452-2 and ISO 3452-3.

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.

ISO 3059, *Non-destructive testing — Penetrant testing and magnetic particle testing — Viewing conditions*

ISO 3452-2, *Non-destructive testing — Penetrant testing — Part 2: Testing of penetrant materials*

ISO 3452-3, *Non-destructive testing — Penetrant testing — Part 3: Reference test blocks*

ISO 3452-4, *Non-destructive testing — Penetrant testing — Part 4: Equipment*

ISO 3452-5, *Non-destructive testing — Penetrant testing — Part 5: Penetrant testing at temperatures higher than 50 °C*

ISO 3452-6, *Non-destructive testing — Penetrant testing — Part 6: Penetrant testing at temperatures lower than 10 °C*

ISO 9712, *Non-destructive testing — Qualification and certification of personnel*

ISO 12706:2009, *Non-destructive testing — Penetrant testing — Vocabulary*

EN 473, *Qualification and certification of NDT personnel — General principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12706:2009 apply.

4 Safety precautions

As penetrant inspection techniques often require the use of harmful, flammable and/or volatile materials, certain precautions shall be taken.

Prolonged or repeated contact of these materials with the skin or any mucous membrane should be avoided. Working areas shall be adequately ventilated and sited away from sources of heat, sparks and naked flames in accordance with local regulations.

The penetrant testing products and equipment shall be used with care and always in compliance with the instructions supplied by the manufacturer.

When using UV-A sources, care shall be taken to ensure that unfiltered radiation from the UV-A source does not directly reach the eyes of the operators. Whether it forms an integral part of the lamp or is a separate component, the UV-A filter shall always be maintained in good condition.

There is legislation and regulations regarding health, safety, pollution and storage, etc.

5 General principles

5.1 Personnel

Personnel performing non-destructive testing and evaluation of the results for penetrant testing shall be qualified and certified in accordance with EN 473 or ISO 9712 or to a system agreed upon by the contracting parties.

5.2 Description of the method

Prior to penetrant testing the surface to be inspected shall be cleaned and dried. Then suitable penetrants are applied to the test area and enter into discontinuities open to the surface. After the appropriate penetration time has elapsed the excess penetrant is removed from the surface and the developer applied. This absorbs the penetrant that has entered and remains in the discontinuities and may give a clearly visible enhanced indication of the discontinuity.

Should complementary non-destructive testing be required, the penetrant inspection shall be performed first unless agreed upon between the contracting parties so as not to introduce contaminants into open discontinuities. If penetrant inspection is used following another non-destructive testing technique, the surface shall be cleaned carefully to remove contaminants before application.

5.3 Process sequence

The sequence of operations is illustrated for the general case in Annex A.

Testing generally proceeds through the following stages:

- a) preparation and precleaning (see 8.2);
- b) application of penetrant (see 8.3);
- c) excess penetrant removal (see 8.4);

- d) application of developer (see 8.5);
- e) inspection (see 8.6);
- f) recording (see 8.6.4);
- g) postcleaning (see 8.7.1).

5.4 Equipment

The equipment for carrying out penetrant testing depends on the number, size and shape of the parts to be tested. For the requirements of equipment, see ISO 3452-4.

5.5 Effectiveness

The effectiveness of the penetrant testing depends upon many factors such as:

- a) types of penetrant materials and testing equipment;
- b) surface preparation and condition;
- c) material under examination and expected discontinuities;
- d) temperature of the test surface;
- e) penetration and development time;
- f) viewing conditions, etc.

Control checks shall be carried out to demonstrate that the correct parameters are used. See Annex B.

6 Products, sensitivity and designation

6.1 Product family

Various test systems exist in penetrant testing.

A product family is understood as a combination of the following penetrant testing materials: penetrant, excess penetrant remover and developer. When tested in accordance with ISO 3452-2 the penetrant and excess penetrant remover shall be from one manufacturer. Only approved product families shall be used.

6.2 Testing products

The testing products are given in Table 1.

Table 1 — Testing products

| Penetrant | | Excess penetrant remover | | Developer | |
|-----------|--|--------------------------|--------------------------------|-----------|--|
| Type | Denomination | Method | Denomination | Form | Denomination |
| I | Fluorescent penetrant | A | Water-washable | a | Dry powder |
| II | Colour contrast penetrant | B | Post-emulsifiable, lipophilic | b | Water-soluble |
| III | Dual purpose (fluorescent colour contrast penetrant) | C | Solvent removable: | c | Water-suspendable |
| | | | Class 1 Halogenated | d | Solvent-based (non-aqueous for Type I) |
| | | | Class 2 Non-halogenated | e | Solvent-based (non-aqueous for Types II and III) |
| | | | Class 3 Special application | | |
| | | D | Post-emulsifiable, hydrophilic | f | Special application |
| | | E | Water and solvent removable | | |

NOTE For specific cases, it is necessary to use penetrant testing products complying with particular requirements with regards to flammability, sulfur, halogen and sodium content and other contaminants, see ISO 3452-2.

6.3 Sensitivity

The sensitivity level of a product family shall be determined using reference block 1 as described in ISO 3452-3. The assessed level always refers to the method used for type testing of the approved product family.

6.4 Designation

The approved product family to be used for penetrant testing is given a designation comprising the type, the method and the form for the testing products, and a figure which indicates the sensitivity level achieved by testing with the reference block 1 as described in ISO 3452-3.

EXAMPLE Designation of an approved product family comprising fluorescent penetrant (I), water as excess penetrant remover (A) and a dry powder developer (a), and a system sensitivity of level 2 is the following penetrant testing system when using ISO 3452-1 and ISO 3452-2 giving the example: product family ISO 3452-2 IAa Level2.

7 Compatibility of testing materials with the part(s) to be tested

7.1 General

The penetrant testing products shall be compatible with the material to be tested and the use for which the part is designed.

7.2 Compatibility of penetrant testing products

The penetrant testing materials shall be compatible with each other.

Dragout losses shall be replaced with the same materials which may be from a different batch.

The products shall be from the same manufacturer.