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Non-destructive testing — Penetrant testing —

Part 5: Penetrant testing at temperatures higher than 50 °C

Essais non destructifs — Examen par ressuage —

Partie 5: Examen par ressuage à des températures supérieures à 50 °C

Reference number
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Foreword

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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 3452-5 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 138, *Non-destructive testing*, in collaboration with ISO Technical Committee TC 135, *Non-destructive testing*, Subcommittee SC 2, *Surface methods,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

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*

Introduction

Temperatures higher than 50 °C can affect the properties of penetrant test materials. The use of penetrant materials and the testing of penetrant materials within the temperature range 10 °C to 50 °C are the subject of EN 571-1 and ISO 3452-2. This part of ISO 3452 addresses materials and their use at higher temperatures.

This part of ISO 3452 introduces the concept of process times being linked to working temperatures and accordingly users are recommended to ensure that testing products are correctly associated with process parameters in written instructions (procedures).

Testing products may be specifically developed and qualified for high temperature use but testing products qualified for use at normal temperatures, in some cases, may also be suitable for higher temperature use.

This part of ISO 3452 was prepared with the assistance of ISPESL (Italy), whose laboratory performed research activity to verify the possibility of using penetrant at temperatures higher than 50 °C, up to 200 °C.

Non-destructive testing — Penetrant testing —

Part 5:
Penetrant testing at temperatures higher than 50 °C

1 Scope

This part of ISO 3452 specifies the testing requirements particular to applications at higher temperatures (over 50 °C) and also the method for qualification of suitable testing products. It applies only to materials qualified for the relevant temperature range used in accordance with the manufacturer's instructions.

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 3452-1, *Non destructive testing — Penetrant testing — Part 1: General principles*

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 12706, *Non-destructive testing — Terminology — Terms used in penetrant testing*

ISO/TS 18173, *Non destructive testing — General terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 18173 and ISO 12706 apply.

4 High temperature penetrant testing requirements

Penetrant materials shall be qualified, type tested for the temperature range within which the test temperature is included.

The general principles as defined in ISO 3452-1 shall apply unless otherwise stated in this part of ISO 3452 or in the manufacturer's instructions.

The manufacturer's instructions shall be followed.

5 Safety precautions

Equipment and testing products shall be handled, stored and used in a safe manner and always in accordance with the manufacturer's instructions.

The viewing conditions required in this part of ISO 3452 are the same as those for the 10 °C up to 50 °C temperature range and the same safety precautions should be observed.

In addition to the safety considerations associated with 10 °C up to 50 °C temperature range, due consideration shall be given to the risks associated with use at higher temperatures. Skin-burning, flammability and volatility are examples of potential hazards which vary with temperature. The work area shall always be adequately ventilated and personnel exposure levels should be carefully assessed.

All relevant European, national and local regulations pertaining to health and safety, environmental requirements etc. shall be observed.

6 Personnel qualification

Personnel carrying out testing in accordance with this part of ISO 3452 shall be suitably certified (e.g. ISO 9712, EN 473). They shall also be knowledgeable of the special considerations for testing at higher temperatures (e.g. time limitations for inspection, special considerations of materials).

7 Classification of testing products

Testing products shall be classified by type, method and form as given in ISO 3452-2:2006, Table 1, but high temperature sensitivity shall be as described herein.

Products also classified and qualified for 10 °C up to 50 °C temperature range may be designated with a suffix to show suitability for use at temperatures above 50 °C, e.g. Type I, Method C, Form a, Level 2, Temperature M, (ICa-2/M).

8 General characteristics of the products

The reference products as stated in 14.2 are penetrant materials used in the range 10 °C to 50 °C for comparison purposes (see 14.3) and they shall conform with the requirements of ISO 3452-2.

Thermal stability shall be stated by the manufacturer and the test shall be carried out at least at 20 °C above the maximum rated working temperature for the candidate testing material.

Testing products shall be selected according to application with appropriate reference to the manufacturer's recommendations for process parameters.

9 Reference blocks

Temperature designation shall be performed with defined reference blocks (see e.g. Annex A of this part of ISO 3452 or ISO 3452-3, Type 1).

Before use, reference blocks shall be cleaned using suitable means and tested for absence of indications with a suitable non-aqueous wet developer. Absence of indications confirms that the panel is suitable for use. The developer shall be removed and the panel shall not be touched by bare hands throughout the process (to avoid contamination). Clean, white cotton, or other materials meant for temperature-rating gloves, may be used to assist with handling.

Annex A comparators shall be used only once and in matched pairs. One of them shall be tested at the temperature given in Clause 12 and the other one shall be tested at ambient temperature using penetrant materials suitable for use at 10 °C to 50 °C, (see Clause 8).

NOTE High temperature process of Type 1 panels could lead to some residues being difficult to remove from the cracks. Specific care needs to be taken to maintain the usability of the panels.

10 Equipment

Testing at higher temperatures requires additional equipment to that detailed in ISO 3452-2, specifically,

a) a thermostatic cell: capable of achieving a stable temperature at least 50 °C above the maximum testing temperature,

b) gloves suitable for that temperature,

c) a brush suitable for that temperature, and

d) a surface thermometer (contact type): ± 5 °C error of indication of a measuring instrument.

11 Viewing conditions

Viewing conditions shall comply with the requirements of ISO 3059.

12 Test temperature

Temperature ratings and test points are shown in Table 1. For materials with a working temperature range of more than 50 °C, testing shall be carried out at maximum intervals of 50 °C. Testing shall be carried out at the temperatures shown in Table 1.

Table 1 — Test temperatures

Temperature rating	Permitted range	Test point temperature	Tolerance
M: Medium temperature	50 °C to 100 °C	50 °C and 100 °C	±5 °C
H: High temperature	100 °C to 200 °C	100 °C, 150 °C and 200 °C	±5 °C
A, B: Range as specified by manufacturer	A °C to B °C	A °C; B °C and 50 °C intervals	±5 °C

13 Procedure for qualification

Qualification tests are carried out by the manufacturer and if products are used within the stated range, no further tests are needed on site.

Testing products shall be at room temperature prior to application, unless otherwise stated by the manufacturer. During the procedure detailed below the test block temperature shall not fall by more than 10 °C.

NOTE A metal block at test temperature can be used as a heat reservoir.

a) Select, according to Clause 12, the test point temperature.

b) Ensure that the thermostatic cell has achieved stability at the working temperature.

c) Manufacturers shall specify the process qualification times according to temperature, which shall reflect usage parameters.

d) For each reference block placed in the thermostatic cell, proceed as follows.

   1) Place the reference block, which has been prepared according to Clause 9, in the thermostatic cell and leave it there until it has achieved a temperature of 20 °C above the test point temperature.

   2) Take the test block out of the thermostatic cell and when its temperature reaches the test point temperature (±5 °C), apply sufficient penetrant to the surface under examination to ensure correct and complete surface coverage.

   3) Return the reference block to the thermostatic cell immediately and maintain it at the test point temperature for the qualification time.

   4) Take the reference block from the thermostatic cell and remove the excess penetrant in accordance with the manufacturer's instructions.

   5) Apply developer in accordance with the manufacturer's instructions.

   6) Inspect the reference block within the time limits of the manufacturer's instructions, and using viewing conditions as defined in Clause 11.

e) Repeat this procedure for all the required test point temperatures.

14 Evaluation of results

14.1 General

The results shall demonstrate similar, or better, performance than the reference products. Quantitative assessments, where used, shall show the candidate material giving a result of at least 90 % of the reference products.

A detailed report shall be provided including results, test parameters, equipment used, procedures, etc.

14.2 Reference blocks type 1

The use of reference block Type 1 is a quantitative assessment. Using the 30 µm and 50 µm blocks, count the number of continuous indications that cover at least 80 % of the width and compare with the results of an initial calibration (between 10 °C and 50 °C) using the same type of penetrant (Type I, sensitivity Level 1 or Type II, sensitivity Level 2).

14.3 Annex A comparator

The use of an Annex A comparator is a qualitative assessment. Using a matched pair of blocks compare the results of the block processed at high temperature with the other block which has been processed between 10 °C and 50 °C, using the same type of penetrant (Type I, sensitivity Level 1 or Type II, sensitivity Level 2).

Annex A
(informative)

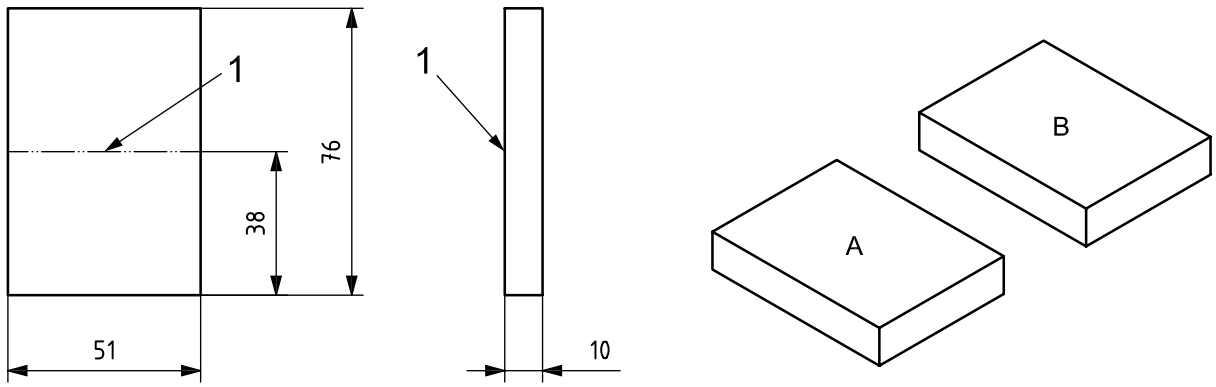
Penetrant comparator

The penetrant comparator comprises two blocks to be used as a matched pair which are cut from one piece as shown below.

The specimens can be produced as follows.

Aluminium panels, approximately 76 mm long, 51 mm wide, are cut from about 8 mm to 10 mm thick 2024 aluminium alloy in the T3 (thermic treatment) condition. The 76 mm dimension is parallel with the direction of rolling of the sheet. The panels are not uniformly heated and are water quenched to produce thermal cracks. This is accomplished by supporting the panel in a frame and impinging the flame of a gas burner or torch in the centre on the lower side of the panel without movement in any direction. A 510 °C or 527 °C temperature indicator, or equivalent, is applied to a 10 mm to 12 mm area on the top side and directly in the centre of the panel. The heat of the burner is adjusted so that the panel is heated slowly (approximately 4 min) until the temperature indicator melts after which the panel is immediately quenched in cold tap water. The panel is cut in two sections in the 51 mm direction across the centre of the heat-affected zone of both sides of the panel, to form two similar specimens. Before using, the panels are cleaned by a vigorous scrubbing with bristle-brush and liquid solvent followed by a boiling solvent.

Dimensions in millimetres



Key
1 groove

Figure A.1 —Penetrant comparator

Bibliography

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

[2] ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

[3] EN 473, *Non-destructive testing — Qualification and certification of NDT personnel — General principles*

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