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Non-destructive testing — Penetrant testing —

Part 2: Testing of penetrant materials

Essais non destructifs — Examen par ressuage —

Partie 2: Essai des produits de ressuage

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 3452-2:2013), which has been technically revised.

The main changes compared to the previous edition are as follows:

— normative references updated;

— Tables 1, 4, 8, 9 corrected;

— 4.2 modified;

— 5.1 modified;

— 6.6 revised;

— former Annex B deleted;

— editorial changes made.

A list of all parts in the ISO 3452 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Non-destructive testing — Penetrant testing —

Part 2:
Testing of penetrant materials

SAFETY PRECAUTIONS — The materials required by this document include chemicals which may be harmful, flammable and/or volatile. All necessary precautions shall be observed, taking into account all relevant international, national and local regulations pertaining to health and safety, environmental requirements, etc.

1 Scope

This document specifies the technical requirements and test procedures for penetrant materials for their type testing and batch testing. This document covers the temperature range from 10 °C to 50 °C. Additional tests in ISO 3452-5 or ISO 3452-6 can be required outside this range.

On-site control tests and methods are detailed in ISO 3452-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3452-3, *Non-destructive testing — Penetrant testing — Part 3: Reference test blocks*

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

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
batch
quantity of material manufactured in one production having uniform properties throughout and with a unique identifying number or mark

3.2
candidate
sample of the testing product submitted for evaluation in accordance with this document

4 Classification

4.1 Testing products

Penetrant testing products shall be classified by type, method and form in accordance with Table 1.

Table 1 — Testing products/procedures

Penetrant		Excess penetrant remover		Developer	
Type	**Denomination**	**Method**	**Denomination**	**Form**	**Denomination**
I	Fluorescent	A	Water	a	Dry
II	Colour contrast	B	Lipophilic emulsifier	b	Water-soluble
III	Dual purpose (fluorescent and colour contrast)	C	Solvent	c	Water-suspendable
		D	Hydrophilic emulsifier	d	Solvent-based (non-aqueous for type I)
		E[a]	Water and solvent	e	Solvent-based (non-aqueous for Types II and III)
				f	Special application
				g	No developer (type I only)

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.

[a] Method E relates to the use of two products, both water and solvent. Penetrant materials qualified for method A are also considered qualified for method E.

4.2 Sensitivity levels

4.2.1 General

Penetrant baseline sensitivity and product family sensitivity are determined independently; and one or both of them shall be carried out.

4.2.2 Penetrant baseline sensitivity

For penetrant baseline sensitivity, the penetrant is submitted with its designated remover and is tested using a standard reference developer. The allocated penetrant sensitivity level is only valid when the penetrant is used with the designated remover.

4.2.3 Product family sensitivity

The product family sensitivity is determined by submitting a complete set of products for assessment. The allocated product family sensitivity level is only valid when this complete set of products is used.

4.2.4 Fluorescent systems

Sensitivity levels shall be defined by reference products:

— sensitivity level 1/2 (very low);

— sensitivity level 1 (low);

— sensitivity level 2 (medium);

— sensitivity level 3 (high);

— sensitivity level 4 (ultra-high).

Sensitivity level 1/2 applies to type I method A only.

4.2.5 Colour contrast systems

Sensitivity levels shall be defined using the type 1 reference block in accordance with ISO 3452-3:

— sensitivity level 1 (normal);

— sensitivity level 2 (high).

4.2.6 Dual-purpose product family

There are no sensitivity levels for dual-purpose penetrants when used as a fluorescent system. However, these products may be classified as colour contrast products (see 4.2.3).

5 Testing of penetrant materials

5.1 Personnel

Testing shall be carried out by proficient, suitably trained and qualified personnel. For non-destructive testing (NDT) operations (e.g. sensitivity and washability), unless otherwise agreed to demonstrate appropriate proficiency, it is recommended that personnel be trained according to ISO 9712 or an equivalent formalized system. Operating authorization for personnel shall be issued by the employer in accordance with a written procedure.

5.2 Testing facilities

5.2.1 Type testing

Type testing shall be carried out on penetrant materials according to ISO 3452-1 with exceptions as defined in this document to ensure their conformance to the requirements.

Type testing shall be carried out only by an independent test laboratory that meet the applicable requirements with respect of a formalised quality system and the relevant technical competencies. Test laboratories shall meet the applicable requirements of ISO/IEC 17025. Where test activities are carried out by laboratories which are not accredited according to ISO/IEC 17025 it shall be ensured that the test activities are managed in a manner which meets the requirements of ISO/IEC 17025, provides confidence in the results, and that records are available to justify the confidence.

5.2.2 Batch testing

Batch testing to the requirements of this document shall be carried out on each production batch according to ISO 3452-1 to ensure the batch has the same properties as the corresponding type approval sample. In the case of penetrant material packed in spray cans, the content of sulfur and halogens shall be additionally determined according to 6.12.

Batch testing shall be carried out under a defined and maintained quality system. A system meeting the requirements of ISO 9001 is considered suitable.

5.2.3 Process and control testing

Process and control tests to monitor the implementation of the method are described in ISO 3452-1.

5.3 Reporting

5.3.1 Type testing

The testing laboratory (see 5.2.1) shall provide a certificate of compliance with this document and a report that details the results obtained.

If any changes are made to the penetrant material composition, then a new type test and product identity shall be required.

5.3.2 Batch testing

Manufacturers of penetrant materials shall provide certificates of compliance with this document (for example, see EN 10204 or ISO 10474).

5.4 Tests

5.4.1 Sensitivity test

A sensitivity test shall be carried out for each individual penetrant material and/or product family.

Type testing shall be carried out according to 6.2.

For batch testing, the test shall be carried out by comparison with the previously approved retained sample.

In addition, for each penetrant material, the specified tests in 5.4.2 to 5.4.5 are required.

5.4.2 Penetrants

Type and batch testing of penetrant properties shall be carried out in accordance with Table 2.

Table 2 — Properties of penetrants and required tests

Property	Test type	Reference
Appearance	Type and batch	6.1
Sensitivity	Type and batch	6.2
Density	Type and batch	6.3
Viscosity	Type and batch	6.4
Flashpoint	Type and batch	6.5
Washability (method A penetrants only)	Batch	6.6
Fluorescent brightness (type I penetrants)	Type and batch	6.7
UV stability (type I penetrants)	Type	6.8
Thermal stability (type I penetrants)	Type	6.9
Water tolerance (method A penetrants only)	Type	6.10
Corrosive properties	Type and batch	6.11
Content of sulfur and halogens[a]	Type and batch	6.12
Water content (methods A and E)	Batch	6.20
[a] Only required for products designated “low in sulfur and halogens”.		

5.4.3 Excess penetrant removers (excluding method A)

Type and batch testing of penetrant remover properties shall be carried out in accordance with Table 3.

Table 3 — Properties of excess penetrant removers and required tests

Property	Test type	Reference
Appearance	Batch	6.1
Sensitivity	type and batch	6.2
[a] Only required for products designated “low in sulfur and halogens”.		

Table 3 *(continued)*

Property	Test type	Reference
Density	Type and batch	6.3
Viscosity (for methods B and D only)	Type and batch	6.4
Flashpoint	Type and batch	6.5
Water tolerance (method B only)	Type and batch	6.10
Corrosive properties	Type and batch	6.11
Content of sulfur and halogens[a]	Type and batch	6.12
Residue on evaporation/solid content (method C only)	Type and batch	6.13
Penetrant tolerance (methods B and D only)	Type	6.14
Water content (method B only)	Batch	6.20
Other contaminants on request (as required)	Batch	
[a] Only required for products designated "low in sulfur and halogens".		

5.4.4 Developers

Type and batch testing of developer properties shall be carried out in accordance with Table 4.

Table 4 — Properties of developers and required tests

Property	Form						Test type	Reference
	a	b	c	d	e	f		
Appearance	x	x	x	x	x	x	Batch	6.1
Sensitivity	x	x	x	x	x	x	Type and batch	6.2
Flashpoint				x	x	x[b]	Type and batch	6.5
Corrosive properties		x	x	x	x	x	Type and batch	6.11
Content of sulfur and halogens[a]	x	x	x	x	x	x	Type and batch	6.12
Solid content				x	x	x[b]	Type and batch	6.13
Developer performance	x	x	x	x	x	x	Type and batch	6.15
Re-dispersability			x	x	x	x[b]	Type and batch	6.16
Density (of carrier liquid)				x	x	x[b]	Type and batch	6.17
Particle size distribution	x		x	x	x	x[b]	Type	6.19
Other contaminants on request (as required)	x	x	x	x	x	x	Batch	
[a] Only required for products designated "low in sulphur and halogens".								
[b] If applicable.								

5.4.5 Batch tests for spray cans

Batch testing shall be carried out in accordance with the product performance test given in 6.18.

The first and last containers and a container from the middle of the batch shall be tested. Where testing for content of sulfur and halogens in accordance with 6.12, only the first container needs to be tested.

6 Test methods and requirements

6.1 Appearance

The appearance of the sample shall be the same as that of the type test sample.

6.2 Penetrant system sensitivity

6.2.1 Fluorescent penetrants (type I)

6.2.1.1 Qualification provisions

6.2.1.1.1 Penetrants (type I)

Method A (water-washable) penetrants and methods B and D (post-emulsifiable) penetrants/emulsifiers shall be qualified with the appropriate reference dry developer D-1. Method C penetrants shall be qualified either on the basis of their performance as method A, B, or D materials, or, alternatively, with the appropriate reference remover R-1 and reference dry developer D-1 (see Table 5).

Table 5 — Reference material designation

Reference material	Designation	
	Method A	Methods B, C and D
Penetrant, type I, level 1/2	FP-1/2	
Penetrant, type I, level 1	FP-1W	FP-1PE
Penetrant, type I, level 2	FP-2W	FP-2PE
Penetrant, type I, level 3	FP-3W	FP-3PE
Penetrant, type I, level 4	FP-4W	FP-4PE
Penetrant, type II, level 1	VP-1W	VP-1PE
Penetrant, type II, level 2	VP-2W	VP-2PE
Emulsifier, type I, method B		FE-B
Emulsifier, type I, method D		FE-D
Emulsifier, type II, method B		VE-B
Removers, method C	R-2	R-2
Developer, form a	D-1	D-1
Developer, form e	D-2	D-2
Key		
FP fluorescent penetrant	FE emulsifier for fluorescent penetrant	
W water-washable	VP visible penetrant	
PE post emulsifiable	VE emulsifier for visible penetrant	

The list of reference products is given in Annex C.

6.2.1.1.2 Developers

For all developing methods, except when using form f (specific application), intended for use with type I (fluorescent) penetrant materials, qualification shall be with the reference level 4, method B penetrant/emulsifier system FP-4PE/FE-B (see Table 6).

A reference sample of each product shall be retained for comparison purposes and designated in accordance with Tables 5 and 6. The manufacturer, manufacturer's reference and the batch number shall be recorded.

Form g penetrant testing systems may have a limited qualification which excludes sensitivity.