INTERNATIONAL STANDARD

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Non-destructive testing — Penetrant flaw detectors — General technical requirements

Essais non destructifs — Détecteurs de criques par ressuage — Prescriptions techniques générales

Reference number
ISO 9935:1992(E)

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.

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.

International Standard ISO 9935 was prepared by Technical Committee ISO/TC 135, *Non-destructive testing*, Sub-Committee SC 2, *Surface methods*.

Annex A forms an integral part of this International Standard.

International Organization for Standardization
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Non-destructive testing — Penetrant flaw detectors — General technical requirements

1 Scope

This International Standard lays down general requirements on penetrant flaw detectors and their functional units which are designed to reveal invisible, or poorly visible to the eye, surface discontinuities in metals and non-metals of any geometry and at any stage of manufacture.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3452:1984, *Non-destructive testing — Penetrant inspection — General principles.*

ISO 3453:1984, *Non-destructive testing — Liquid penetrant inspection — Means of verification.*

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 penetrant flaw detector: A system of functional units, measuring instruments and auxiliary means used for penetrant inspection.

3.2 functional units for preparation of the surface to be tested: Equipment used for precleaning, degreasing and drying of the surface under examination.

3.3 functional units for application of penetrant inspection materials to the prepared surface: Equipment used for application of a penetrant, excess penetrant removal, application of a developer and development of the penetrant.

3.4 functional units for surface examination: Equipment and measuring instruments used for the inspection of a test surface under ultraviolet radiation or visible light and for the recording of discontinuity indications.

3.5 functional units for quality control of penetrant inspection materials: Measuring instruments and equipment used for control of physical properties of penetrant inspection materials.

3.6 functional units for measurement of ultraviolet radiation and visible light: Instruments and equipment used for measuring ultraviolet irradiation or visible light at the test surface.

3.7 ultraviolet irradiator; UV irradiator: A source of ultraviolet radiation at a wavelength of 315 nm to 400 nm (365 nm desired).

3.8 ultraviolet radiation; UV radiation: Electromagnetic radiation at a wavelength of 315 nm to 400 nm (region A of the UV spectrum). It is used for fluorescent penetrant inspection.

3.9 ultraviolet filter; UV filter: A filter that transmits UV radiation at wavelengths of 315 nm to 400 nm (365 nm desired) and absorbs radiation at other wavelengths.

3.10 reference piece: A physical model of a test component with natural or artificial discontinuities of known geometry. It is used to check the functional units of penetrant flaw detectors, to control the quality of penetrant inspection materials and to check the sensitivity of penetrant inspection.

4 General information

4.1 Manufacturers provide penetrant flaw detectors of the three following types: stationary, movable, portable.

4.2 Depending upon the purpose, penetrant flaw detectors may consist of the following functional units:

— those for preparation of the surface to be tested;

— those for application of penetrant inspection materials to the prepared surface;

— those for surface examination;

— those for quality control of penetrant inspection materials;

— those for control of UV radiation and visible light.

A designation system for penetrant flaw detectors and their functional units is given in annex A.

4.3 Penetrant flaw detectors may operate in the following modes: long-term, short-term or intermittent.

5 General requirements

5.1 The sensitivity of inspection achieved by means of penetrant flaw detectors and particular penetrant inspection materials shall be specified in terms of the assessment of discontinuity detectability on the reference pieces (listed in ISO 3453), either visually or by means of optical measuring instruments.

5.2 Penetrant flaw detectors for fluorescent penetrant inspection shall provide UV irradiation at the test surface of not less than 8 W/m^2 (800 $\mu W/cm^2$).

5.3 When using penetrant flaw detectors for fluorescent penetrant inspection, the room where the inspection is to be made shall be darkened, although it may be illuminated with visible light such that the illuminance of the test surface does not exceed 10 lx.

5.4 Penetrant flaw detectors for colour contrast penetrant inspection require the use of combined lighting (general and local). Low-pressure fluorescent lamps or filament lamps shall be used as sources of visible light. The illuminance at a test surface depends on its nature and its colour and shall be not less than 500 lx.

The luminance of the visible light reflected by the test surface in the direction of the eyes shall not exceed 400 cd/m^2.

5.5 The surfaces of the functional units of penetrant flaw detectors exposed to UV irradiation shall neither fluoresce nor reflect UV radiation.

5.6 The functional units of penetrant flaw detectors shall be resistant to corrosion and paint, to effects produced by penetrant inspection materials and to the effects of ultraviolet, visible, thermal and other types of radiation.

5.7 Penetrant flaw detectors shall normally operate off an a.c. power supply source with voltage fluctuation within the limits from − 15 % to + 10 % of the nominal value, but they may also operate off independent supply sources.

5.8 The resistance of the insulation between the current-carrying wires of penetrant flaw detectors and the ground contact shall be not less than 20 MΩ at an ambient temperature of 20 °C ± 5 °C (293 K ± 5 K) and relative air humidity of not more than 70 %.

5.9 The design of penetrant flaw detectors shall be such that it is possible to work without unnecessary movements that could cause fatigue and waste time.

5.10 The requirements concerning the resistance of penetrant flaw detectors to climatic effects shall be specified in the technical documentation for each type of penetrant flaw detector.

6 Functional units for surface examination

6.1 Depending upon the purpose, functional units for surface examination may comprise UV irradiators and optical and measuring devices, as well as complex means for automatic processing of the results of the penetrant inspection.

6.2 UV irradiators include medium and high-pressure mercury-vapour gas-discharge lamps, UV filters, specular focussing reflectors and chokes. The UV filters and reflectors may be an integral part of the gas-discharge lamp or a separate component.

NOTE 1 Specialized ultraviolet lasers may also be used as UV irradiators.

6.3 UV irradiators shall generate UV radiation at a wavelength of 315 nm to 400 nm (peak intensity of 365 nm desired).

6.4 The technical documentation for UV irradiators shall specify the nominal distance, in millimetres, between the UV irradiator and a test surface, and the value of the UV irradiance at that distance shall be given in watts per square metre (or in microwatts per square centimetre). It shall also specify the dimensions of the irradiated area.

6.5 The time necessary to set the operating mode of UV irradiators shall not exceed 10 min.

6.6 Depending upon the output of the gas-discharge lamp, UV irradiators shall be equipped with natural or forced-convention cooling devices that ensure heat removal from the UV filters and the other components.

6.7 The design of a UV irradiator shall be such that the reflector and UV filter are protected from dust, dirt and other contaminants that could impair the optical properties of the irradiator.

6.8 It is necessary to periodically clean the UV filter and the UV irradiator with a wet pileless (lint-free) cloth in order to remove contamination that may cause attenuation of the intensity of the UV radiation. Before cleaning the UV filter and the UV irradiator, it is necessary to turn off the UV irradiator and wait until its components have cooled completely.

6.9 When penetrant flaw detectors are in continuous service, it is necessary to check the UV irradiation generated by the irradiator at the nominal distance specified in the technical documentation (see 6.4) at least once a week.

7 Functional units for control of UV radiation

7.1 UV irradiance shall be measured with radiometers reading over the range from 315 nm to 400 nm, and shall be expressed in watts per square metre (or microwatts per square centimetre).

7.2 The sensitivity of radiometers at wavelengths greater than 400 nm shall not exceed 5 % of the sensitivity at a wavelength of 365 nm.

7.3 Radiometers shall be calibrated at a wavelength of 365 nm, using standard UV radiation sources.

8 Safety requirements

8.1 The room where penetrant flaw detectors are used shall be sufficiently well ventilated to remove contaminants from the working area.

8.2 Penetrant flaw detectors used for fluorescent penetrant inspection with UV radiation sources shall be equipped with built-in or separate devices for protecting the face and eyes from UV radiation.

8.3 For individual protection of the eyes, it may be necessary to wear goggles with non-distorting light filters that absorb UV radiation but transmit the visible fluorescence light.

8.4 In penetrant flaw detectors used for fluorescent penetrant inspection, the UV radiation at a wavelength less than 315 nm shall be not more than 5 % of the intensity of radiation at a wavelength of 365 nm.

8.5 The design of penetrant flaw detectors shall be such that they meet the safety requirements applicable to work with flammable and explosive materials. Penetrant flaw detectors shall be kept away from heat sources, such as open fires and flames.

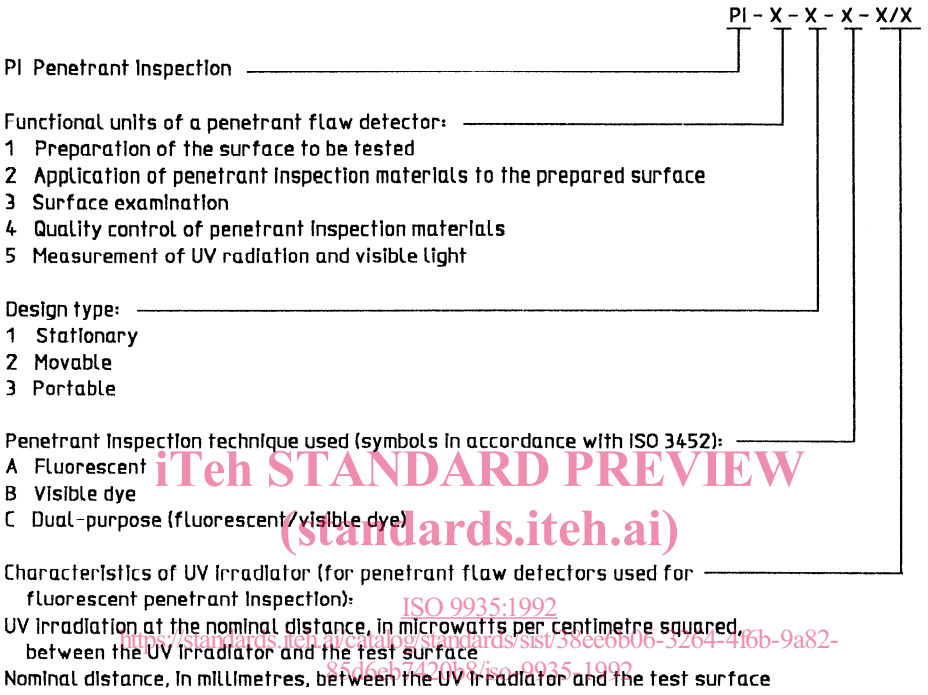
8.6 The design of penetrant flaw detectors shall be such as to ensure the security of personnel against electric shocks.

8.7 The temperature of the parts of penetrant flaw detectors that the operator touches during his work shall not exceed 40 °C (313 K).

8.8 Penetrant flaw detectors shall be used in such a way that under no circumstances are wastes allowed to reach the environment.

Annex A
(normative)

Designation system for penetrant flaw detectors



EXAMPLES

1 A portable penetrant flaw detector used for visible dye penetrant inspection with functional units for application of the penetrant inspection materials to the prepared surface and for surface examination would be designated:

PI-23-3-B

2 A stationary penetrant flaw detector used for fluorescent penetrant inspection with functional units for application of the penetrant inspection materials to the prepared surface, for surface examination and for control of the UV radiation (UV irradiance = 5 000 $\mu W/cm^2$ at a nominal distance of 400 mm) would be designated:

PI-235-1-A-5 000/400

3 A portable UV irradiator used for fluorescent penetrant inspection with a UV irradiance of 8 000 $\mu W/cm^2$ at a nominal distance of 200 mm would be designated:

PI-5-3-A-8 000/200

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Descriptors: surface defects, tests, non-destructive tests, penetration tests, fault detectors, specifications.

Price based on 4 pages