

Procedure For The Dye Penetrant Testing Of Welds To ASME BPVC Section V

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1. Scope

This procedure describes the method of liquid (dye) penetrant examination of welded joints in plate and pipe sections to ASME BPVC Section V, Article 6, and must be adhered to as applicable to ensure customer requirements are met and that compliance with orders received is achieved.

This procedure covers welds in carbon and low alloy steels, austenitic and duplex stainless steels, nickel base alloys and other non-porous metals.

This procedure is only applicable to colour contrast (visible) penetrant, removed by either the solvent removable technique or the water washable technique (ASME BPVC V T-651), used with a nonaqueous wet developer. Fluorescent penetrants and post-emulsifying penetrants are outside the scope of this procedure.

This procedure covers the testing of, 1) newly fabricated products, 2) any required repairs to newly fabricated products, 3) in-service products, 4) repair work to in-service products.

When required by the referencing Code Section, the capability of this procedure to detect relevant discontinuities shall be demonstrated to the satisfaction of the Inspector by its application on a sample containing at least one known discontinuity (ASME BPVC V Article 1, T-150(a)). Where ASME BPVC VIII-1 applies, this procedure shall be certified by the Manufacturer as meeting the requirements of T-150 (VIII-1 Mandatory Appendix 8, 8-1(c)). Where procedure qualification is specified by the referencing Code Section, a change of any requirement identified as an essential variable in Table T-621.1 shall require requalification of this procedure by demonstration (T-621.2).

2. References

This procedure makes reference to the following documents:-

ASME BPVC V:2025 Nondestructive Examination. Article 1: General Requirements; Article 6: Liquid Penetrant Examination; Article 24, SE-165: Standard Practice for Liquid Penetrant Testing for General Industry

ASME BPVC VIII-1:2025 Rules for Construction of Pressure Vessels, Division 1. Mandatory Appendix 8: Methods for Liquid Penetrant Examination (PT)

BS EN ISO 9712:2022 Non-destructive Testing. Qualification and certification of NDT personnel.

3. Safety

Personnel working to this procedure shall work in such a manner as to comply with the Health and Safety at Work etc. Act 1974.

All dye penetrant consumables used shall have accompanying COSHH data sheets and shall be disposed of in a way that is non-injurious to site personnel or to the environment.

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Personnel working to this procedure shall at all times wear mandatory PPE; overalls, safety boots, hard hat, high visibility clothing, etc.

Because of the flammability of most liquid penetrant materials the use of an open flame for heating components prior to liquid penetrant examination is prohibited.

Any equipment that requires the use of mains electricity shall have successfully passed a PAT test within the last 12 months and be in good working condition.

Highly volatile solvents are to be used with caution. Their vapours are relatively toxic and the liquids are primary skin irritants. Extreme care is to be exercised in handling volatile solvents as many of them are highly flammable liquids. The appropriate safety precautions are to be carried out at all times.

4. Personnel qualification

All personnel operating to this procedure shall be qualified and certified to a minimum of Level 2 in liquid penetrant testing in accordance with their employer's written practice, as required by ASME BPVC V Article 1, T-120(e). As permitted by T-120(f), certification under a BS EN ISO 9712-based central certification scheme (e.g. PCN Level 2 penetrant testing of welds or general) may be used to fulfil the written practice requirements for training, experience and the general, basic and method examinations.

All personnel shall also hold a valid eyesight certificate (meeting the requirements of BS EN ISO 9712 section 7.4) obtained within the last 12 months. Where ASME BPVC VIII-1 applies, each examiner shall be able to read a Jaeger Type No. 2 Standard Chart at a distance of not less than 12 in. (300 mm), with correction if necessary, and shall be capable of distinguishing and differentiating contrast between the colours used; these requirements shall be checked annually (VIII-1 Mandatory Appendix 8, 8-2). A current BS EN ISO 9712 eyesight certificate meets these requirements.

Documentation relating to operators certification shall be kept on file at the administration offices for review purposes.

5. Description of method

Liquid penetrant examination is a method of detecting discontinuities which are open to the surface of non-porous metals. Typical discontinuities detectable by this method are cracks, seams, laps, cold shuts, laminations, lack of fusion and porosity.

A colour contrast (red) penetrant is applied to the surface to be examined and allowed to enter discontinuities. All excess penetrant is then removed, the surface is dried and a developer is applied. The developer acts both as a blotter, drawing out penetrant that has been trapped in discontinuities, and as a white contrasting background that makes the penetrant indications visible under white light (ASME BPVC V T-620).

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Precautions:- Liquid penetrant inspection should be carried out in a well ventilated area. The materials used are flammable and must be kept away from naked flames.

6. Testing materials

The following penetrant materials shall be used. The descriptions of the liquid penetrant classifications and material types are given in ASME BPVC V Article 24, SE-165 (T-630).

Penetrant – colour contrast (visible, red) penetrant, solvent removable or water washable.
Remover – solvent cleaner (solvent removable technique) or clean water (water washable technique).
Developer – nonaqueous wet developer. With colour contrast penetrants only a wet developer shall be used (T-675).

Intermixing of penetrant materials from different families or different manufacturers is not permitted (T-654). The penetrant, remover and developer shall all be from one manufacturer's product family.

Where procedure qualification is required by the referencing Code Section, the penetrant family (manufacturer and product designations) shall be identified in this section. Any change in type or family group of penetrant materials is an essential variable (Table T-621.1).

When examining nickel base alloys, austenitic or duplex stainless steels or titanium, certification of contaminant content shall be obtained for all penetrant materials used. The certification shall include the manufacturer's batch numbers and the test results obtained in accordance with Article 6, Mandatory Appendix II (T-641). The sulfur content shall not exceed 0.1% by weight for nickel base alloys (II-641), and the total chlorine and fluorine content shall not exceed 0.1% by weight for austenitic or duplex stainless steels and titanium (II-642). Potable water is not required to be analysed (II-643). These certifications shall be kept on file.

Penetrant consumables past their expiry (use by/best before) date shall not be used.

Certificates of conformity for consumables shall be kept on file and made available upon request.

All materials used as part of the liquid penetrant process are to be non-corrosive towards and compatible with the material to be examined. In situations where deterioration of adjacent surfaces may occur, the surfaces are to be masked to ensure that the penetrant process materials are confined to the surface under examination.

7. Method of testing

7.1 Surface preparation

Satisfactory results may be obtained when the surface is in the as-welded condition. Surface preparation by grinding, machining or other methods may be necessary where surface irregularities could mask indications (ASME BPVC V T-642(a)).

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