

LIQUID PENETRANT TESTING

This procedure applies to valves components fully machined. All accessible surfaces of each finished part shall be inspected. This procedure contains the minimum requirements to be observed during the inspection

Related norms

- API6D
- ASTM E165
- ASME V
- ASME VIII
- EN 473
- ASNT-TC-1A

Principle

The basic principle of liquid penetrant testing is that when a very low viscosity (highly fluid) liquid (the penetrant) is applied to the surface of a part, it will penetrate into fissures and voids open to the surface. Once the excess penetrant is removed, the penetrant trapped in those voids will flow back out, creating an indication. Penetrant testing can be performed on magnetic and non-magnetic materials but does not work well on porous materials. Penetrants may be "visible", meaning they can be seen in ambient light, or fluorescent, requiring the use of a "black" light. When performing a PT inspection, it is imperative that the surface being tested is clean and free of any foreign materials or liquids that might block the penetrant from entering voids or fissures open to the surface of the part.

After applying the penetrant, it is permitted to sit on the surface for a specified period of time (the "penetrant dwell time"), then the part is carefully cleaned to remove excess penetrant from the surface.

When removing the penetrant, the operator must be careful not to remove any penetrant that has flowed into voids. A light coating of developer is then be applied to the surface and given time ("developer dwell time") to allow the penetrant from any voids or fissures to seep up into the developer, creating a visible indication. Following the prescribed developer dwell time, the part is inspected visually, with the aid of a black light for fluorescent penetrants.

Surface preparation

All surface irregularities that could affect the test must be removed by grinding prior to the inspection.

All machined surfaces prior to testing will be thoroughly cleaned to remove all machining oils, grease, dust, spatter, paints, etc. using a solvent conform to ASME V Art 6 applied by brushing.

After cleaning all surfaces will be thoroughly dried with oil free forced cold air. All surfaces shall be free from any kind of liquid.

Penetrant liquid shall be from the same family grouping. Intermixing of family groupings shall not be allowed.

Application of liquid penetrant

The method used shall be as described under ASME V Section SE165 for “Visible Dye Penetrant color contrast and water washable (procedure B-1).

Penetrant shall be applied by brushing or spaying. During the penetration time the penetrant shall not be dried. The surface temperature shall range between 16°C up to 52°C. In the event that the ambient temperature is lower, local heating may be used.

The following are a guide to required penetration times:

- Semi-finished parts, machined parts from rolled or forged materials, inspection to cracks, pores, folds and overlaps: 10 to min.
- Weld seams, inspection to lack of fusion: 10 to 20 min
- Castings, inspected to pores: 3 to 5 min
- Castings inspected to cracks: 10 to 20 min

Penetrant removal

The dye penetrant shall be removed by water rinsing. The water pressure shall not exceed 2,8 bar and the temperature shall not be greater than 16°C. Distance of spray nozzles shall be less than 30 cm from the surface. Dwell time shall not exceed 5 min., unless otherwise specified by the material specification.

Rinse time shall not exceed 120 sec. unless otherwise specified by the material specification (ASME V, SE-165, 8.6.1.1.c) until the excess penetrant is removed. After penetrant removal all surfaces will be dried with low pressure oil free air.

Developing

Before application of the developer, the surface shall be wiped clean and dried with lint-free cloths or paper towel. The developer shall be applied only by spaying not later than 10 min from the removal of the excess penetrant. The surface inspection must be performed promptly to proper interpret any discontinuity indications, from 10 min. to 20 min, not longer than 30 min after application of the developer. Visible penetrant indications will be inspected in either natural light or artificial white light.

Adequate illumination is required to ensure no loss of sensitivity at the inspection site. A minimum of 1000 lux of light intensity is required

Acceptance criteria

An indication of an imperfection may be larger than the imperfection that causes it; however, the size of the indication is the basis for the acceptance evaluation.

Relevant indications are defined as indication when the length is three times greater than the width. Indications resulting from machining traces and other mechanical surface conditions may result in non-relevant indications.

In the case where such indications give doubtful results, the indication will be considered defect provided it cannot be removed after grinding on the surface.

For acceptance all surfaces to be examined shall be free of:

- Relevant linear indicator
- Relevant rounded indication greater than 5 mm
- Four or more relevant rounded indications in a line separated by less than 1,6 mm (edge to edge)
- Relevant indication in pressure contact sealing surface

As standard the following apply:

- Cast parts: EN 1371-1, according to the quality class
- Weld seams: AD-HP5/3 – no cracks permissible
- Welded joints: EN 1289
- Rolled and forged parts: EN 10228-2 Quality Class 1 to 4
- Sealing surfaces: no indications permissible.

Repair of defects

All repairs requiring welding shall be done in accordance with the manufacturer's approved welding repair procedures. In the event that the defect may be removed by simple grinding without an addition of weld metal, it's accepted provided the repaired surface are blended smoothly with the surrounding surface and the wall thickness of the area shall not be reduced below the minimum specified on the relevant drawing. All weld repaired and dressed areas shall be re-inspected in accordance with this procedure.

Documentation of inspection results

The result of all inspections will be recorded and reported in an appropriate certificate.

Post cleaning of parts

All parts shall be cleaned by simple water spray rinse and then dried with compressed oil free air, where residual penetrant or developer could interfere with subsequent processing or service requirements. If necessary the same solvent as stated before shall be used for final cleaning.