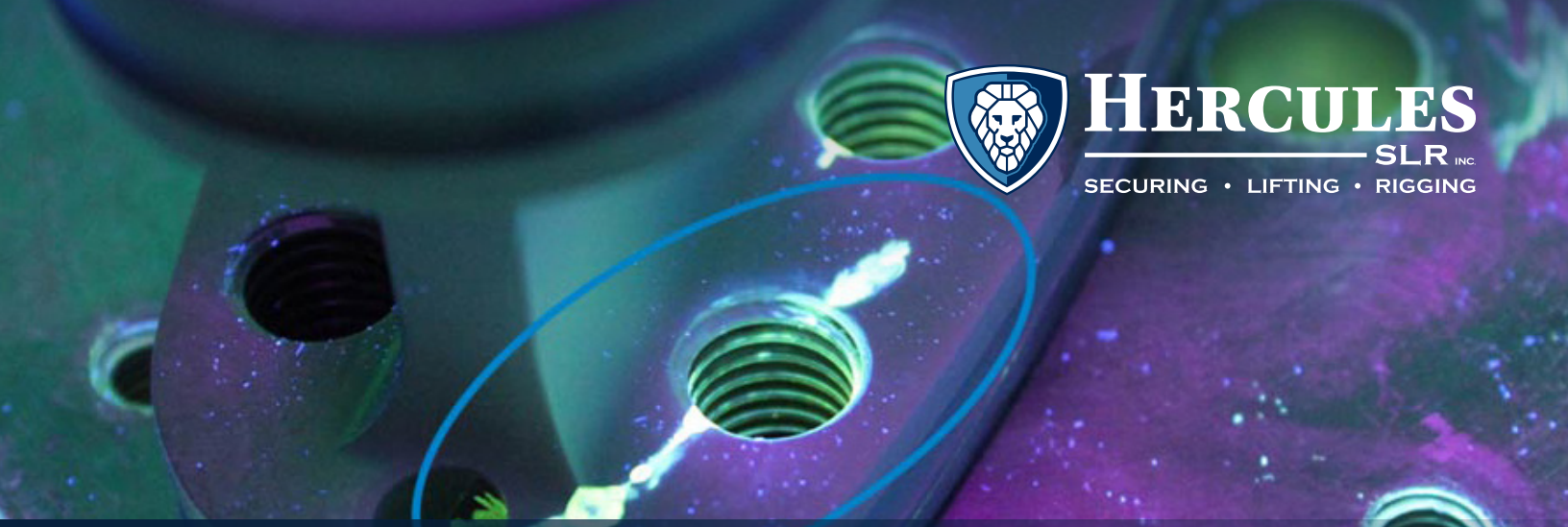

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NDT - Liquid Penetrant Inspection

Dye Penetrant Inspection (DPI), also called Liquid Penetrant Inspection (LPI) or Penetrant Testing (PT), is one of the oldest and simplists NDT methods where its earliest versions (using kerosene and oil mixture) dates back to the 19th century. Liquid penetrant inspection is used to detect any surface-connected discontinuities such as cracks from fatigue, quenching, and grinding, as well as fractures, porosity, incomplete fusion, and flaws in joints.

Principals

DPI is based upon capillary action, where low surface tension fluid penetrates into clean and dry surface-breaking discontinuities. Penetrant may be applied to the test component by dipping, spraying, or brushing. After adequate penetration time has been allowed, the excess penetrant is removed, a developer is applied. The developer helps to draw penetrant out of the flaw where an invisible indication becomes visible to the inspector. Inspection is performed under ultraviolet or white light, depending upon the type of dye used - fluorescent or nonfluorescent (visible).

Materials

Penetrants are classified into sensitivity levels. Visible penetrants are typically red in color, and represent the lowest sensitivity. Fluorescent penetrants contain two or more dyes that fluoresce when excited by ultraviolet (UV-A) radiation (also known as black light). Since Fluorescent penetrant inspection is performed in a darkened environment, and the excited dyes emit brilliant yellow-green light that contrasts strongly against the dark background, this material is more sensitive to defects.

When selecting a sensitivity level one must consider many factors, including the environment under which the test will be performed, the surface finish of the specimen, and the size of defects sought. One must also assure that the test chemicals are compatible with the sample so that the examination will not cause permanent staining, or degradiation. This technique can be quite portable, because in its simplest form the inspection requires only 3 aerosol spray cans, some lint free cloths, and adequate visible light. Stationary systems with dedicated application, wash, and development stations, are more costly and complicated, but result in better sensitivity and higher samples through-put.

Liquid Penetrant Inspection is Performed in Six Steps

1. Pre-cleaning
2. Application of Penetrant
3. Excess Penetrant Removal
4. Application of Developer
5. Inspection
6. Post Cleaning

Advantages of Liquid Penetrant Inspection

- High sensitivity (small discontinuities can be detected).
- Few material limitations (metallic and nonmetallic, magnetic and nonmagnetic, and conductive and nonconductive materials may be inspected).
- Rapid inspection of large areas and volumes.
- Suitable for parts with complex shapes.
- Indications are produced directly on the surface of the part and constitute a visual representation of the flaw.
- Portable (materials are available in aerosol spray cans)
- Low cost (materials and associated equipment are relatively inexpensive)

Disadvantage of Liquid Penetrant Inspection

- Only surface breaking defects can be detected.
- Only materials with a relatively nonporous surface can be inspected.
- Pre-cleaning is critical since contaminants can mask defects.
- Metal smearing from machining, grinding, and grit or vapor blasting must be removed.
- The inspector must have direct access to the surface being inspected.
- Surface finish and roughness can affect inspection sensitivity.
- Multiple process operations must be performed and controlled.
- Post cleaning of acceptable parts or materials is required.
- Chemical handling and proper disposal is required.

Refs/Sources: Wermac Org Original Article here: https://www.wermac.org/others/ndt_dyepenetrant.html