TOSHIBA

COMMONLY USED NDE PROCESSES

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PRECLEANING

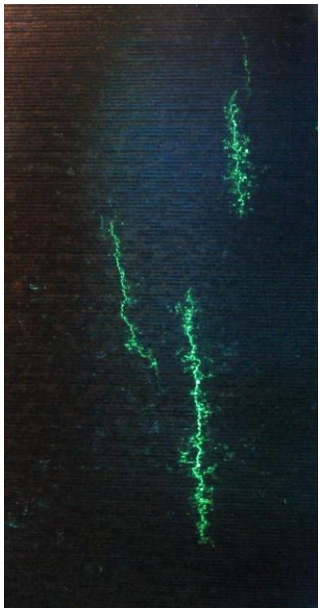
Regardless of the penetrant chosen, adequate pre-cleaning of work pieces prior to penetrant inspection is absolutely necessary for accurate results. Without adequate removal of surface contamination, relevant indications may be missed because:

- The penetrant does not enter the flaw.
- The penetrant loses its ability to identify the flaw because it reacts with something already in it.
- The surface immediately surrounding the flaw retains enough penetrant to mask the true appearance of the flaw.
- Also, nonrelevant (false) indications may be caused by residual materials holding penetrants.

LIQUID PENETRANT INSPECTION

Two methods are used at Toshiba's Milwaukee Service Center, Water-washable penetrant (method A) and Solvent-removable penetrant (method C).

- Water-washable is quicker, but sensitivity of the penetrant (Type II, visible red dye) used is low (Level 1) and the water washing operation must be carefully controlled because water-washable penetrants are susceptible to overwashing.
- Water-washable is the simplest of all penetrant techniques and does not require a darkened area nor electricity, only lighting at 320 to 540 lx (30 to 50 ftc).
- Water-washable is most useful in those applications where shallow and relatively wide flaws are not significant.
- The solvent-removable (Type I, fluorescent) penetrant used at Toshiba is Level 3, high sensitivity.
- The excess penetrant is removed with a solvent/remover, but is time consuming since penetrant must be removed under black light conditions, a laborious process. Thus, this method is especially recommended for spot inspection or where water cannot be conveniently used or is not allowed on the product, rotor coil retaining rings (RCRR) being the primary example.
- The nonaqueous solvent-suspendible developer used with the method C (solvent removable) inspections are the most sensitive form of developer, as it enters the flaw and dissolves into the penetrant. This action increases the volume and reduces the viscocity of the penetrant.
- Under black light conditions, the finest of flaws (such as fatigue cracks) are detectable as are machine marks, any dirt not removed during precleaning, etc., thus, precleaning in and of itself is critical to the inspection method.



Retaining Ring Stress Corrosion Cracks

- Flaws appear as greenish-yellow indications on purple-blue background under black light viewing. This viewing is done in a tent, with white light excluded (<20 lx [2 ftc]).

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The black light requires about 10 minutes warm up time, and is quite hot at the radiating end. Inspectors should allow themselves 1-2 minutes prior to inspections for darkness adaption.

ULTRASONIC INSPECTION

LP is another inspection method used to examine subsurface areas not accessible to surface inspection methods. Examples include:

- Volumetric examinations of generator rotor and turbine spindle materials from bore surfaces of both.
- To examine subsurface and internal surfaces of rotor coil support rings when rings are not scheduled to be removed.
- To determine maximum depths of cracks found during surface inspection methods, MT, PT or ET.
- To find unbonded areas in babbitted bearings, which may cause bearing disbond and failure in service.
- To examine bore areas of shrunk-on LP disks (blade carriers) to find stress corrosion branched cracking (SCC) in disks in wet steam service.
- To find cracks in axial blade pins in impulse rows and L-0 rows (where applicable) and in steam and gas turbine studs in the field, or in-house as required.
- To find and characterize subsurface weld flaws in heavy weldments.
- These and other specific inspections are performed routinely on components in Toshiba's facilities and in the field.

Advantages of UT

- Superior penetrating power, which allows detection of flaws deep in the part.
- Greater accuracy than other nondestructive methods in determining the position of internal flaws, estimating their size and characterizing their orientation, shape and nature.
- Only one surface needs to be accessible (in most cases).
- Operation is electronic, which provides almost instantaneous indications of flaws. This makes the method suitable for immediate interpretation, rapid scanning and process control.
- Portability
- Nonhazardous to operations or to nearby personnel and has no effect on equipment and materials in the vicinity.

Disadvantages of UT

- Manual operation requires careful attention by experienced technicians.
- Extensive technical knowledge is required for the development of inspection procedures.
- Parts that are rough, irregular in shape, very small or thin, or not homogeneous are difficult to inspect.
- Discontinuities that are present in a shallow layer (near field) immediately beneath the surface may not be detectable.
- Couplants (oil, grease, water based gels, etc.) are needed to provide effective transfer of ultrasonic wave energy between transducers and parts being inspected.

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- Reference standards are needed, both for calibrating the equipment and for characterizing flaws.

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