ToFD
Time of Flight Diffraction

Principal

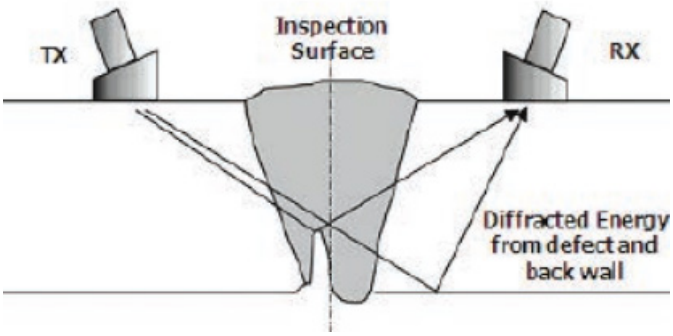
With TOFD scans, the transmitting and receiving probes are positioned equidistantly from the weld centre and scanned parallel with the weld. Normally a single pass is sufficient for the required inspection coverage.

During operation, ultrasound is transmitted at an angle into the weld by one probe. If the sound is obstructed by a defect, some of the energy is diffracted at its edges and detected by the receiving probe. The signals are recorded, processed with specialized software for interpretation and sizing of indications.

TOFD differs from other ultrasonic based methods in that it relies on the detection of diffracted signals rather than reflected signals (pulse-echo). The comprehensive coverage afforded by the wide beam used for TOFD inspections makes it much less dependent on probe position and defect orientation than pulse echo techniques. Inspections are carried out using a simple frame to hold the probes or scanner with optical encoders for position information. By varying the transducer type,
size, frequency, separation and number of scans the operator can “best fit” the system to the application.

Increasing use of risk-based inspection (RBI) on chemical and refining plant places greater emphasis on the ability to accurately size and monitor pre-existing or growing in-service discontinuities. Originally developed for the Nuclear Industry, the TOFD technique is well suited to many process industry applications.

Capabilities



Principles of TOFD

- Defect detection does not depend on orientation.
- Cracks not perpendicular to the measured surface, can be detected.
- Very accurate determination of defect height and length.
- Higher Probability of Detection (POD) improves reliability.
- Inspection results are immediately available as a permanent record of the inspection.
- TOFD fingerprinting, applied during construction, may reduce future in-service inspection costs.
- High data collection speeds possible (250mm/second).
- Can be used on high temperature surfaces (proven capability up to 450 degrees Celsius), for In-service inspection of welds (cracks and root corrosion/erosion).
- Can be used between 6mm up to 350mm thick welds and even more.
- Can be used on plastics like HDPE materials (fusion welds).

Limitations

- Small near surface defects may not be detectable due to lateral wave (dead zone).
- The system is more complex than conventional ultrasonic instruments.
- Harder to apply to complex geometries (think of Insert nozzles).
- May need to be aplied in conjunction with pulse-echo scans.
- Cannot always be used on high grain size, anisotropic material structure such as Stainless and
- Duplex steel welds (to be investigasted on a case-by case basis).

Technical Information

- Test surfaces need to be free from rust, scale, spatter and other surface contaminants that may prevent good ultrasonic coupling.
- Adequate provision for personnel and equipment access to the inspection area.
- The equipment can be operated from battery power for limited periods. Provision of 110V-240V AC power is recommended.

Applications

- In fact TOFD is an important tool for inspection of:
- New Weldments to record a repeatable base line image. Such data is invaluable for comparisons with subsequent inspections throughout the life of the equipment.
- In-service Weldments for erosion loss at the root zone, also on High Temperature surfaces.
- In-service Weldments for preferential corrosion loss at the root and heat affected zone (HAZ).
- In-service Weldments for original build quality assessment prior to change in operating conditions of the equipment
- In-service Weldments and material for fatigue orservice related cracking problems
- New construction HDPE fusion weld inspection.
- Defect sizing - height and length.
- Applus RTD ToFD technicians are specially trained and EN 473 qualified for application of ToFD.