

Non-Destructive and Destructive Testing Fact Sheet

Types of Non-Destructive Examination

- Visual
- Liquid Penetrant
- Magnetic Particle
- Ultrasonic
- Radiographic

Visual Examination

- Visual examination is done before, during and after the weld is made
 - Before: WPS, fit-up and preparation of base metal, cleanliness of base metal, storage of filler
 - During: interpass cleaning and temperatures, watch puddle, filler and shielding
 - After: weld size, appearance, defects, weld complete

Visual Examination Tools

- Fillet weld gauges
- Palmgren gauge (for measuring groove welds-also measures fillet welds)
- A gauge used for undercut
- Feeler gauges for overlap
- Micrometer
- Caliper
- Steel ruler
- Tape measure

Liquid Penetrant Examination

- A liquid dye uses capillary action to penetrate surface flaws
- Limited to surface flaws, can find defects that may be difficult through visual examination alone
- Can use visible or florescent dyes, visible is most common in a welding shop
- Easy to use, just need to purchase a kit of cleaner, penetrant and developer
 1. Clean a cooled off weld with the cleaner
 2. Spray the penetrant on the weld and allow it to sit for the recommended dwell time
 3. Clean off penetrant with cleaner
 4. Spray the weld with developer; the developer will show where the penetrant seeped into the weld flaws

Magnetic Particle Examination

- Only for metals that can be magnetized (steel)
- Uses magnetic powder and a high-powered magnet
- Magnetic powder is sprayed on weld area, then magnetic force is applied, attracting the magnetic powder to the surface flaw
- Limited mostly to surface flaws, some larger subsurface flaws may be detected
- A moderate level of skill is required to operate the equipment and interpret results

Ultrasonic Examination

- Uses sound waves to detect surface and subsurface flaws
- Similar concept to ships using sonar to find submarines
- A transducer sends sound waves through the metal
- A screen display will show any disturbances (flaws) in the metal detected by the sound waves
- Commonly found in a welding shop where complete joint penetration welds are required
- High skill level is required to operate the equipment and interpret the results

Radiographic Examination

- Uses radiation passed through metal to detect subsurface flaws
- Commonly used to qualify welders and procedures
- X-Rays or Gamma rays penetrate the metal and show the results on a film
- The film of the radiographic image is interpreted
 - The metal will show a consistent shade: thick metals appear lighter in color, thin metals are darker
 - The weld flaws can show up darker or lighter than the base metal, depending on the type and thickness of the metal
- High skill level is required to operate the equipment and interpret the results

DESTRUCTIVE TESTING

- Used to test the strength of welded products, welds, filler metals and base metals
- A sample of a weld, filler metal or base metal is destroyed and inspected for defects, rated for strength, or both
- Used to qualify welders and Welding Procedure Specifications (WPS)

Types of Destructive Testing

- Tension testing
- Impact testing
- Bend testing
- Nick Break testing
- Fillet Weld Break testing
- Etch testing

Tension Testing

- Tension tests measure how much a material can withstand being pulled apart
- Determines tensile strength, yield point, ductility and soundness of metal
- Extremely important test in classifying base metals and filler metals to standards
- Commonly used to qualify welding procedures

Impact Testing

- Tests toughness of base metals and filler metals at varying temperatures; Charpy V-Notch is the most common impact test
- Extremely important test for products and materials being used at very high and very low temperatures
- Impact tests are typically performed in a lab environment
- A test specimen is prepared, notched, heated or cooled to a specific temperature and placed in an impact tester

- A free-falling pendulum hits the specimen
- A readout tells how much energy was absorbed

Bend Testing

- Guided bend tests determine soundness and ductility of welds and metals
- Test specimen is prepared and bent in a “U” shape, applying bending and tensile forces
- Commonly used to qualify welders and welding procedures (WPS)
- Test plates are welded together, a strip is cut from the welded plates and sanded smooth
- Specimens are prepared to bend the face, root and side profile of the weld
- Face and root bends are typically used to qualify welders
- Test specimen is placed in guided bend tester and bent at a specific radius
- The bent specimen is examined for defects in the weld, metal and heat affected zone (HAZ)

Break Testing

- Weld testing that is inexpensive and can easily be done on the shop floor
- A welder performs a weld, the weld is broken by a hammer or in destructive equipment and then the broken weld is examined for defects
- Nick break test used to test groove welds
- Fillet weld break test used to test fillet welds
 - **Nick Break Testing**
 - Test specimen taken from a groove weld
 - Weld area is notched either on one side or all the way around
 - Specimen is broken with hammer blows or by destructive equipment
 - **Fillet Weld Break Testing**
 - Can be used to qualify tack welders
 - A fillet weld is made, and force is applied so that the root is exposed when broken

Etch Testing

- Used to inspect for soundness of welds and metals
- Metals or welds are cut and sanded, and then treated with an etchant
- Etchant reveals properties of the weld and metal
- Two types:
 - Macro
 - Test specimen etched and examined by the naked eye or with a magnifying glass
 - Typically used to inspect welds for defects and depth of penetration
 - Micro
 - Test specimen etched and examined under a microscope
 - Typically used to inspect the metallurgical properties of metals