# TESTING & LAB SERVICES



EWI's dedicated laboratory testing services team manages a comprehensive inventory of testing equipment and standardized procedures for rapid characterization of the chemistry, properties, and performance of metals, plastics, and composites.

This extensive testing capability is often coupled with our material and process-specific engineering expertise, enabling us to deliver services including but not limited to:

- *Failure Analysis*
- *Production Troubleshooting*
- *Design Optimization*
- *Product Conformance*
- *Procedure/Operator Qualification*

## With precision equipment and a world-class engineering team, EWI is uniquely qualified to offer a full range of testing.

## Capabilities

EWI's laboratory testing services offerings range from commodity tests to one-off testing of unique product-specific configurations. Our knowledgeable team of engineers and technicians combines ingenuity and experience to design and execute an appropriate solution for your testing needs

EWI's materials expertise with metal alloy systems, plastics, and composites provides valuable support for all of our industrial markets including aerospace, automotive, oil and gas, light manufacturing, electronics, medical, rail transportation, and ship building. The activities of the lab services group include routine material certification and qualification tests, specialized prototype performance testing, R&D characterization, and full-scale component evaluations. These activities often support material selection, component design, product conformance, structural analysis, weld procedure development, procedure/operator qualification, and failure analysis for our clients.

# Testing Services

## MECHANICAL TESTING

- *Tensile*
- *Bend*
- *Impact (Charpy, Drop-Weight, Nil-Ductility)*
- *Fatigue Crack Growth Rate*
- *CTOD (SENB, CT, SET, SENT)*
- *KIC (SENB, CT)*
- *R-Curve (SENB, CT, SET, SENT)*
- *Fatigue (Force or Strain Control)*
- *Residual Stress*

## NONDESTRUCTIVE EVALUATION

- *Ultrasonic (Contact and Immersion)*
- *Phased Array*
- *Eddy Current*
- *Radiography*

## COMPUTED TOMOGRAPHY (CT)

- *Visual Inspection*
- *Magnetic Particle Inspection*
- *Liquid Penetrant Inspection*
- *Metrology*
- *Surface Characterization*

## SPECIALIZED SERVICES

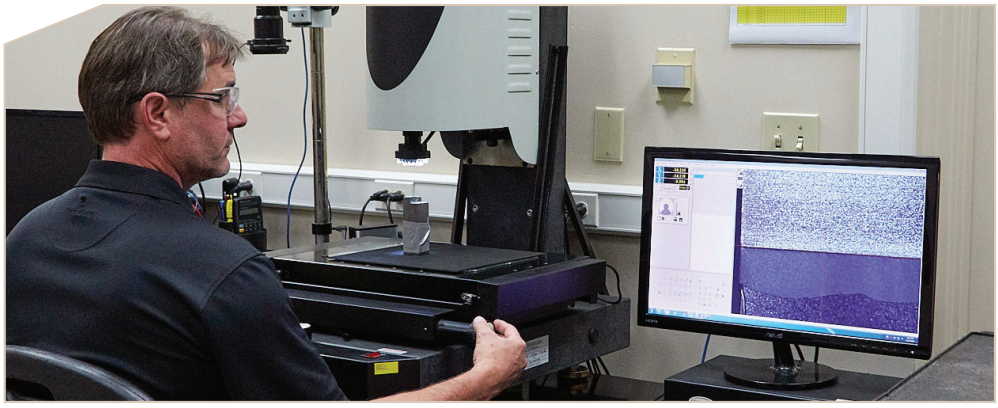
- *Resonant Fatigue*
- *Pressure/Burst Testing*
- *Varestraint Testing*
- *Gleeble*
- *Failure Analysis*
- *API RP 2Z Material Qualification*
- *Weld Toughness Compatibility*

## METALLOGRAPHY / MATERIAL CHARACTERIZATION

- *Digital Photography (Micro and Macro)*
- *Linear Image Analysis*
- *Chemical Analysis (AES)*
- *Oxygen/Nitrogen Elemental Analysis*
- *SEM/EDS/EBSD*
- *Thermogravimetric Analysis (TGA)*
- *Differential Scanning Calorimetry (DSC)*
- *Hardness (Vickers, Knoop)*
- *Hardness (Rockwell)*
- *2D Hardness Mapping (Micro-Vickers)*
- *G48 Corrosion Testing*
- *Grain Size Average*
- *Delta Ferrite Content (Magnegage)*
- *Percent Ferrite*
- *Porosity Measurement*
- *Inclusion Content*
- *Microstructure Analysis*
- *Metallographic Examination*
- *Particle Size/Morphology Characterization*

## WELD CONSUMABLE QUALIFICATION

- *Welding (GMAW, SMAW, GTAW, SAW)*
- *Diffusible Hydrogen*
- *Fillet Weld*
- *Nick Break*
- *Y-Groove*
- *Controlled Thermal Severity (CTS)*
- *Heat Treatment*



Do you need assistance with weld testing, materials characterization, product inspection, or failure analysis? Contact **EWI Lab Services** today.

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*614.484.7600*

EWI
*We Manufacture Innovation*


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For more information regarding our capabilities and services, visit EWI.org

**WWW.EWI.ORG→**

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TESTING & LAB SERVICES

# Weld Consumable Qualification



EWI's Consumable Qualification Services team uses internally certified welders and AWS Certified Welding Inspectors (CWI) to support your consumable qualification needs. Robotic, mechanized, and semiautomatic welding processes are available along with calibrated welding data acquisition equipment. Combined with EWI's Materials Engineering team, our Consumable Qualification Services is ready to assist our customers with the development and certification of welding consumables of the highest quality. Contact us for a quote.

| Consumable Qualification Welding: GMAW, FCAW, GTAW, SAW, and SMAW | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| Consumable Qualification Welding | Various | Welding to AWS and other consumable specifications in support of consumable qualification testing. |
| **Diffusible Hydrogen Welding and Testing** | | |
| Diffusible Hydrogen Test | AWS A4.3<br>ISO 3690 | Welding and testing per AWS and ISO specification. Hydrogen analysis completed via the Gas Chromatograph method. |
| **Other AWS Weld Tests** | | |
| Fillet Weld Test | AWS B4.0 | All AWS weld tests include welding, machining, testing, and reporting. |
| Nick Break Test | | |
| Y-Groove Test* | | |
| Controlled Thermal Severity (CTS) Test | | |
| **Heat Treatment – Up to 1,375*** | | |
| Heat Treat up to 1375F | Customer Specified | Various ovens with largest capacity of 270 lbs. and 18"x18"x36". |
| Aging/Bake-out up to 220F | | Calibrated oven. |
| Aging/Bake-out up to 450F | | Controlled furnace up to 450F. |

* Not included in scope of A2LA accreditation.

# Mechanical Testing 2



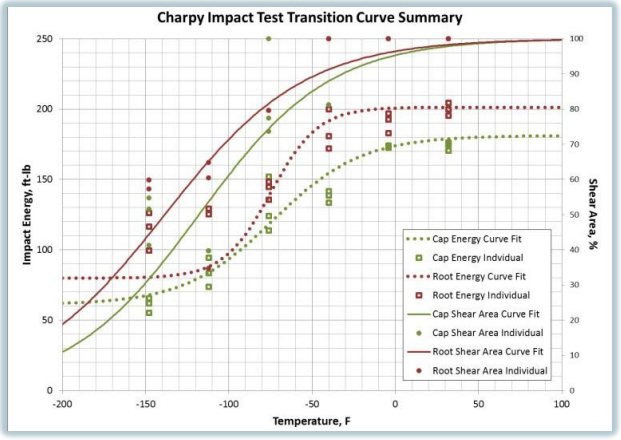

EWI Testing Services provides machining and testing services on an array of materials including metals, plastics, and composites. EWI's Mechanical Testing capabilities include force and strain-controlled fatigue, fatigue crack growth rate, crack tip opening displacement (CTOD), R-curve fracture toughness, and prototype testing. We have extensive experience with testing a variety of materials and geometries (C(T), SENB, and SENT) under a wide array of environmental conditions (sea water, drilling fluid, corrosion inhibitor, cathodic protection). EWI's precision equipment gives us the ability to test CTOD samples ranging in cross section from 0.25" x 0.5" up to 5" x 5". Our notch placement procedures allow us to place a notch in fracture toughness specimens within 0.004 inches (0.1 mm) of the target location. This unique combination of equipment and expertise allows EWI to evaluate fracture toughness properties of very specific microstructures or material locations. Contact us for a quote.

| Standard Fatigue – Up to 220,000 Pounds | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| Fatigue Test (Force-Controlled) | ASTM E466 | Constant or variable amplitude, force-controlled axial fatigue test of standard geometry samples. **Machining not included.** |
| Fatigue Test (Strain-Controlled) | ASTM E606 | Strain-controlled axial fatigue test of standard geometry samples. |
| Bend Fatigue Test (3-pt or 4-pt) | Customer Supplied | Constant or variable amplitude, force-controlled bending fatigue test of standard geometry samples. |
| **Fatigue Crack Growth – up to 45 Hz** | | |
| Fatigue Crack Growth Rate* | ASTM E647 | Determines steady-state fatigue crack growth from near-threshold to controlled instability. **Machining not included.** |
| Fatigue Crack Growth Rate – Near Threshold* | | Determines steady-state fatigue crack growth from near-threshold to controlled instability with more time spent evaluating near-threshold growth. **Machining not included.** |
| **Crack Tip Opening Displacement (CTOD)** | | |
| CTOD (max 1" x 2") | BSI 7448, ASTM E1290, E1820, E399, ISO 12135, 15653 | Determine fracture toughness properties using SEN(B) specimen geometries. Tests include pre-cracking, testing, measurement, fracture face photograph, and standard report. |
| CTOD (max 1.5" x 3") | | |
| CTOD (max 3" x 3") | | |
| CTOD (max 4" x 4") | | |
| CTOD Alt Temperature Add-on (Above 20C, Below -75C) | | Additional charge for CTOD at high or low temperatures |
| R-curve (SEN(B), C(T), SE(T)) | ASTM E1820 Customer Supplied | Multiple or single sample tearing resistance curve (R-Curve) using SEN(B), C(T), and SE(T) specimen geometries |

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# Mechanical Testing 1

EWI's Mechanical Testing capabilities include the full array of standard AWS testing (including tensile, toughness, and bend testing). Additionally, EWI can perform material tests specified by international standard organizations including ISO, ASTM, and NACE, as well as specialty tests for unique components. Our commitment to producing quality results is illustrated by our A2LA accreditation. Unlike many test facilities, EWI's Testing Services is supported by a world-renowned Structural Integrity team. This support is critical in delivering dependable test results and explaining *why* the results were obtained. Combined with EWI's Consumable Qualification and Dynamic Mechanical Testing Services, EWI is your one-stop-shop for complete weld consumable qualification or welding procedure/material qualification programs. Contact us for a quote.

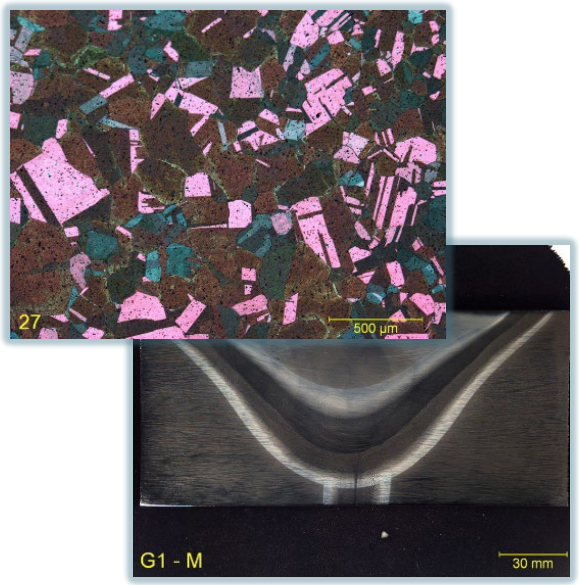



| Tensile Testing – Up to 220,000 Pound Capacity | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| Tensile Test | ASTM E8<br>AWS B4.0 | 0.2% Offset Yield, Ultimate Strength, Elongation, and Reduction of Area information is reported. |
| Computer Generated Plot of Stress/Strain | | Computer generated plot of a tensile test Stress / Strain curve. |
| Tensile Test – Ultimate Load w/Strength | | Ultimate Load and Ultimate Strength information is provided. Machining not included. |
| Elevated Temperature Tensile Test Add-on* | ASTM E21 | Additional charge for performing tensile testing at temperatures up to 475 degrees C. |
| **Bend Testing – Plunger or Wrap Around** | | |
| Bend Test | ASTM E190<br>ASTM E290<br>AWS B4.0 | Face, Root, or Side Bends using a plunger or wrap-around method. |
| **Impact Toughness Testing** | | |
| Notched Bar Impact Test (Charpy) | ASTM E23<br>AWS B4.0 | Charpy Impact Test – Impact energy. Shear Area (carbon steel only), and Lateral Expansion are reported. 300 ft-lbs capacity. |
| Drop-Weight Test | ASTM E208<br>AWS B4.0 | Drop Weight Test used to determine nil-ductility. |
| **Residual Stress** | | |
| Residual Stress | ASTM E837 | Residual stress measurement. |

* Not included in scope of A2LA accreditation.

# Metallography

EWI's Metallography Lab Technicians work tirelessly to prepare specimens of the highest quality for our external customers, as well as internal customers such as EWI's Materials Engineering team. Our skilled technicians can handle the most challenging mounting, polishing, and etching combinations: thin foils, thick sections, dissimilar welds, special metals, plastics, and composites to name a few. EWI's skilled technicians are equipped with the latest in high-resolution digital microscopes, resulting in digital images that will impress all levels of engineers. Give us a try, you will not be disappointed. Contact us for a quote.

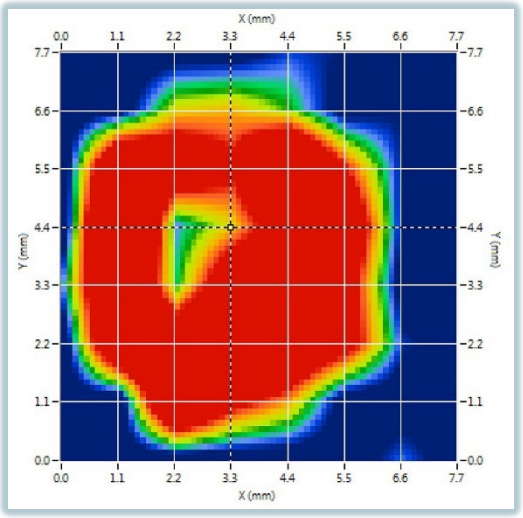



| Precision Mounting and Polishing | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| 1.5" Mount | ASTM E3 | Hot press mounted in clear or black phenolic and polished. |
| 2" Mount | | |
| Repolish, up to 2" Mount | | Re-polish of previously mounted samples. |
| Polished Section (up to 4") | | Mounted in quick curing compound (when required) and hand polished. |
| Polished Section (up to 6") | | |
| Cold Mount in 24 Hour Epoxy | | A clear epoxy, vacuum or air-cured, required for sensitive materials or visibility. |
| Additional Specimens per Mount (3 Max) | | Insertion of additional specimens into a single mount (available for 2" or 1.5" mounts). Price is per additional specimen. |
| Digital Photography and Image Analysis | | |
| Digital Photomicrograph * | PAX-it | Digital photography using PAX-it software and camera (max field of view 0.28"x 0.37"). |
| Digital Photomicrograph * | | Digital photography using PAX-it software and camera. |

* Not included in scope of A2LA accreditation.

# NDE and Other Services

EWI's Nondestructive Evaluation (NDE) group designs and performs inspections for a broad range of applications. We perform manual and automated inspections, custom equipment designs, and mathematical modelling to tackle the most challenging inspection problems. In addition to evaluating welds, we can inspect bulk materials and components. We continually update our capabilities to include state-of-the-art NDE techniques and work closely with EWI's other technology groups to assure the highest standards of quality. Contact us for a quote.

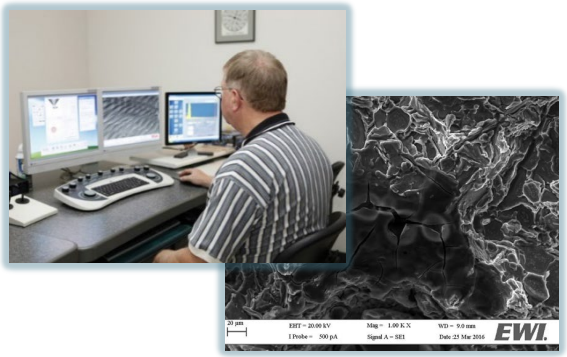



| NDE Methods | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| Radiography, PQR Plate | ASTM E 1032<br>AWS A5.01 | Film x-ray of steel for standard AWS 12" x 12" x 1" plate.<br>Includes film digitization. **Machining not included.** |
| Radiography, up to 2" Pipe | ASTM E 1032 | Up to 2" Diameter Pipe Welds. 3 - Shots (Elliptical)<br>Includes film digitization. |
| Radiography, 3-4" Pipe | | 3" - 4" Diameter Pipe Welds 6 - Shots (Double Wall)<br>Includes film digitization. |
| Radiography, 5-8" Pipe | | 5" - 8" Diameter Pipe Welds 6 - Shots (Single Wall)<br>Includes film digitization. |
| Radiography, 9-12" Pipe | | 9" - 12" Diameter Pipe Welds 6 – 7 Shots (Single Wall)<br>Includes film digitization. |
| Radiography Film Digitization* | Customer Specified | Digital scanning of previously developed films. |
| Computed Tomography (CT) | | 3D imaging of an object from a large series of 2D radiographic images. |
| Visual Inspection* | | Visual Inspection by an AWS CWI. |
| Eddy Current Inspection* | | Eddy Current Inspection. |
| Magnetic Particle Inspection* | | Magnetic Particle Inspection by an AWS CWI. |
| Liquid Penetrant Inspection* | | Liquid Penetrant Inspection by an AWS CWI. |
| Ultrasonic Inspection* | | Ultrasonic NDE using traditional or phased array inspection methods. |

* Not included in scope of A2LA accreditation.

# Material Characterization

Combining EWI's Material's Engineering team with our highly skilled Metallography Lab Technicians results in material and microstructure analyses that help to answer some of the most challenging questions regarding materials joining and performance. From SEM analysis to corrosion testing, EWI's Material Characterization Services support our mission to solve fabrication challenges, develop new materials, and optimize designs for safety, strength, and reliability. Contact us




| Chemical Analysis and SEM with EDS | | |
|---|---|---|
| **Name** | **Reference** | **Description** |
| Chemical Analysis | ASTM E415 | Optical Emission Spectroscopy |
| Chemical Analysis* | ASTM E1019 | Oxygen and Nitrogen content of carbon steel using the LECO method. |
| SEM/EDS Operation* | Customer Specified | Includes mild sample cleaning, state mounting, SEM operation, and standard SEM/EDS report. |
| **Hardness – up to 50kg Vickers, Rockwell A, B, and C** | | |
| Vickers/Knoop Hardness | ASTM E384/E92 | Micro Vickers & Knoop (10g-1kg), Macro Vickers (1-50 kg), Up to 10 indents. Additional indents $16/each. |
| Rockwell Hardness | ASTM E18 ASTM E140 | B or C Scales. Up to 3 indents. Additional indents $30/each. |
| Vickers Autohardness (up to 1000 Indents) | ASTM E384 | Vickers (10g – 1kg), 2D matrix or linear traverse, up to 1000 indents. Includes color hardness contour map. Additional indents $0.50 each. |
| **Material Evaluation** | | |
| Corrosion Testing | ASTM G48 Method A | Ferric Chloride solution for 72 hours at RT and 40 ºC. |
| Grain Size Average | ASTM E112 ASTM E1382 | Physical grain size comparison or computer generated measurement. |
| Delta Ferrite Content (Fischer Feritscope)* | AWS A4.2 | Measuring the delta ferrite content of an austenitic or duplex stainless steel weld metal. |
| Percent Ferrite | ASTM E562 | Manual point count determination only. Price includes three micro photos at 500x. |
| Automated Porosity Measurement (max 3 pores)* | Customer Specified | PAX-it image analysis software method - other methods available. |
| Inclusion Content in Steel | ASTM E45 Method A | Determination of inclusion content of wrought steel. |
| Metallographic Examination* | NAVSEA Tech Pub 248 | Metallurgical examination following customer supplied or other specifications, including detection of defects (cracks, LOF, pores, etc.) in metallurgical samples. |
| Microstructure Analysis* | ASTM A923 (Method A) | Microstructure analysis following ASTM A923 Method A or other specifications, including (but not limited to) detecting the presence and estimated volume of intermetallics, deleterious phases, and/or defects in metallurgical samples. |

* Not included in scope of A2LA accreditation.