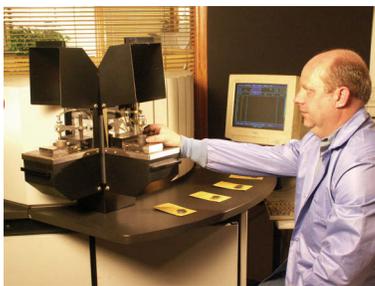


## Chemical Analysis

For over 30 years, APL, Inc. has been providing accurate and timely chemical analyses to our clients. To allow for the most efficient analysis of your material, a wide variety of spectrometers and other analytical instruments and techniques are available. APL will select the most effective and economical method that ensures accurate elemental analysis of your most sophisticated material.

### APL Inc.

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### Spectroscopy

When quick results are needed, spectrographic analysis by APL Inc. is the answer. Both speed and repeatable accuracy are gained through the use of a computer-controlled, direct reading, optically emitting, vacuum spectrometer. The spectrometer will perform its analysis on the majority of the solid samples submitted, and is programmed to cover virtually all of the standard engineering alloys. A computer-generated data file of all elements requiring ASTM standards is retained for future reference.

### SEM/EDS

Energy Dispersive Spectroscopy (EDS) is the analytical instrument on a scanning electron microscope (SEM) that can determine elemental composition on a microscopic scale. This method is useful for a range of valuable applications including:

- Fracture surface evaluation
- Defect identification
- Corrosion product analysis
- Inclusion identification
- Phase identification
- Alloy segregation
- Carbide species identification
- Particle analysis

SEM/EDS is an essential tool for the identification of the small but important constituents of castings and forgings.

### Carbon, Sulfur, Nitrogen and Oxygen Analysis

Traditional spectrographic techniques for the determination of carbon, sulfur, nitrogen, and oxygen can be inherently inaccurate. Thanks to the use of LECO® combustion analyzers, APL can determine the concentrations of these elements in a sample with an exceptionally high degree of accuracy.

In addition to the above, APL offers a wide variety of testing services to determine the quality of a metal by its mechanical properties. Customers have trusted APL since 1976 for reliable mechanical property evaluation of their casting and metal products.



## Analytical Services

Since 1976, APL Inc. has been responding to the ever-growing needs of professionals in the metallurgical materials and environmental management industries.

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Today's APL serves a diverse cross-section of industries with comprehensive testing, evaluation, engineering and consulting services.

Clients gain added confidence from APL's accreditation by the American Association for Laboratory Accreditation (A2LA). This formal recognition insures that the APL laboratory is competent to perform a wide variety of specific tests within a range of industry categories. To maintain this accreditation, highly knowledgeable independent A2LA inspectors perform regular, rigorous on-site inspections. The accreditation approval process follows international criteria ISO/IEC 17025, "General Requirements for Accreditation of Laboratories" which requires stringent adherence to written policies and test procedures.

### **What A2LA Accreditation Means to You**

- Proper accreditation is your assurance that APL testing is performed by competent personnel using recognized testing methods.
- Accreditation eliminates the need for each individual client to audit the company's facilities, equipment and personnel, saving customer time and expense.
- Under A2LA, all instrumentation and calibration standards are traceable to recognized national and international standards organizations.

For over 30 years, APL clients have reaped the benefit of this commitment to accurate and timely chemical and physical analysis. The analytic instruments used adhere strictly to the state of the art in precision and processing efficiency. Each instrument is checked and calibrated regularly, and all testing is performed in accordance with ASTM and other recognized standards. To allow for the highest efficiency of material analysis, a wide variety of analytical and other instruments and techniques are available. APL will select the most effective and economical method to ensure accurate elemental analysis of your most sophisticated material.

# Mechanical Testing

APL Inc. is well equipped to perform most standard mechanical testing as well as specialized tests designed to the customer's specifications. With the support of a comprehensive in-house machine shop, universal testing stations and knowledgeable staff, APL will prepare, test and report your specimen with accuracy and speed.

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## Common Types of Mechanical Testing

Tensile testing is performed by computer-controlled automated testers, which provide accurate, consistent, repeatable and rapid results. A range of tests are available:

**Tensile Strength:** including fasteners, wedge, axial, weld, castings, machined specimens, full-size tensile and yield...plus heat treat capabilities

**Hardness Testing:** including Rockwell, Brinell, superficial, and microhardness testing

**Torque Testing:** for locks, nuts, collars, eddy nuts, bolts-recess and wrenches

**Charpy Testing:** including subsize and standard, weld and HAZ, DIN Impact testing for elevated and cryogenic temperatures, an "U" and "V" notch to ASTM and Japan-European specifications

**Bend Testing:** for threaded fasteners, welds, and raw materials

**Proof Load Testing:** tension and compression testing of nuts, threaded fasteners, components and full products

## Machining

The mechanical analysis of a metal depends on the precision used in machining the sample. Because tensile test samples are either round or flat in geometry, proper machining preparation is an essential quality step in implementing a program of mechanical testing. To assure that dimensions and surface finish are in strict conformance to ASTM E-8 and A-370 procedures, APL machines each round sample specimen on a computer numerical control (CNC) turning center. The flat sample specimens are machined on a horizontal machining center. Charpy "V" notch impact specimens are rough machined and surfaced ground to proper dimensions. The "V" groove is machined on a precision broaching machine to create a groove of the proper depth and contour.

## Hardness Testing to ASTM E-10 and E-18

Routine hardness testing is accomplished with ease and accuracy on Brinell and Rockwell instruments. A computer controlled optical scanner is used to make Brinell hardness measurements with extreme accuracy and high repeatability. Knoop and Vickers instruments perform micro and macro hardness testing, to assure accurate and repeatable results.



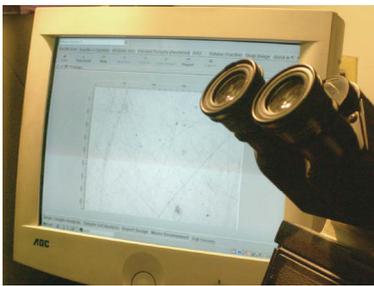
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# Metallography

Metallography is the science of dealing with the constitution and microstructure of metals and alloys that are analyzed using optical or electron microscopy. APL Inc. has skilled technicians who will identify alloys and predict material properties.

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## Failure Analysis

Failure analysis is the forensic process used to investigate the failure of a component to successfully perform to function for which it was designed. The key to diagnosing a failure is the identification of the failure mode and the design, manufacture or service factors that contributed to the failure. APL is uniquely qualified and equipped to perform failure analysis on an array of components and metallic materials. We can assist your plant personnel in both accurately identifying the correct cause of a failure and initiating corrective actions. APL is equipped with all the tools traditionally used in failure analysis:

- Scanning electron microscope (SEM)
- Optical microscopes
- Chemical analysis facilities
- Mechanical testing equipment

After determining the cause of the failure, a thorough personal explanation of the failure analysis report is given.

## Problem Solving

To recognize significant joining issues and discover effective solutions, APL offers extensive analytical capabilities that pinpoint the root of the problem. Our metallographic department has the resources to examine a wide variety of probable weld failure causes. All these capabilities assure you that the base material and filler metal specified are proper for the application.

## Image Analyzer

- Inclusion content rating
- Cast iron graphite evaluation
- Nodular count in iron
- Coating thickness
- Grain boundary detection
- Grain size
- Dendritic arm spacing

Because image analysis offers such versatility as a materials characterization tool, APL has equipped itself with state-of-the-art instrumentation for evaluating individual applications and offering reliable solutions.

## Metallography

Frequently, the key to solving metallurgical problems is examining and evaluating the microstructure of the material through the application of metallography. Metallography is the science of evaluating the structure of metals and alloys as revealed by the unaided eye or by microscopy. APL has the equipment and the expertise needed to solve specific metallographic problems. Our metallographic experts offer solutions to your problems by macroscopic and microscopic evaluations for:

- Grain Size Determination
- Size Distribution
- Phase Area Distribution
- Microhardness Determination
- Inclusions Rating
- Heat Treatment
- Crack Evaluation

# Weld Testing



APL Inc. will assist you with your performance qualifications and weld testing procedures using AWS, ASME and MIL Specifications.

## APL Inc.

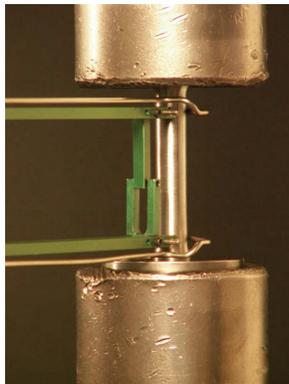
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## Weld Testing

As soon as a welded test assembly is received and we know the code to which the weldment must conform, the specimen is prepared and routed to our mechanical testing area. APL is equipped to provide all the tests commonly applied to weld joint evaluation. They include:

- Tensile Testing
- Root Bend Test
- Face Bend Test
- Side Bend Test



APL also offers a complete range of hardness testing options, including Brinell, Rockwell, Vickers, and Knoop. Certain codes or filler metal specifications require impact strength testing. A Charpy tester is used to determine the impact resistance of the base material, heat affected zone (HAZ), and the filler metal. Charpy "V" notch impact specimens are rough machined and surface ground to proper dimensions. The "V" groove is then machined on a precision broaching machine to insure the proper groove depth and contour before the specimen is subjected to the Charpy tester.

## Performance Qualifications and Procedures

APL, Inc. can assist you with your performance qualifications and welding procedures. Our laboratory and machining facilities, staffed by experienced personnel...assure thorough and prompt completion of the qualification testing and documentation. We offer all the testing methods commonly used for weld joint evaluation in accordance to AWS, ASME, and MIL Specifications.

## Special and Proprietary Testing

Some proprietary specifications require testing not covered by traditional ASTM specifications. APL will consult with you to determine and develop correct and specialized methods that will accommodate these special needs.