ndt innovations inc.
Non Destructive Testing

Non Destructive Testing

Nondestructive testing or NDT is a wide group of analysis and techniques used in science and industry to evaluate the properties and integrity of a material, component, or piece without causing damage to the specimen or piece being tested.

The terms Nondestructive Examination (NDE), Nondestructive Inspection (NDI), and Nondestructive Evaluation (NDE) are also commonly used to describe these techniques. Because NDT does not permanently alter the physical conditions of the piece being inspected, it is a highly valuable technique that can save both money and time in product assessment, troubleshooting, and research.

Some NDT methods include ultrasonic, electromagnetic, radiographic, remote visual inspection, guided waves, magnetic particle, penetrant testing, etc. All these methods have been subject to significant improvements during the last decade, therefore making available more accurate tools in the field of materials examinations.

Advantages of Advanced Ultrasonic (AUT) and other advanced NDT technologies:

- Higher POD, Resolution & Sensitivity.
- Accurate location, characterization, and sizing of defects.
- Reduced inspection times compared to conventional methods.
- Permanent Digital Records. Potential for reduced manpower.
- Greater penetration than conventional radiography (large thickness).
- Root, cap, and mid-wall coverage simultaneously in a one-line scan.
- Flexibility- easily adjustable to varying diameters, thicknesses, and weld configurations.
- Full A-scan raw data with imaging and post processing.
- Excellent replacement for conventional radiography with almost no radiation hazard!

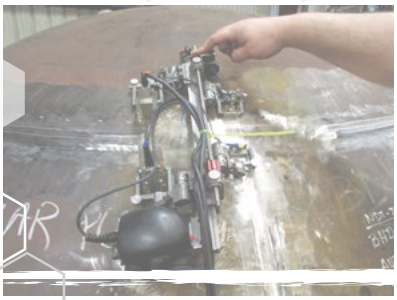
Mission:

To apply sustainable, reliable and highly innovative inspection methods, procedures and technology within responsible industries.

Vision:

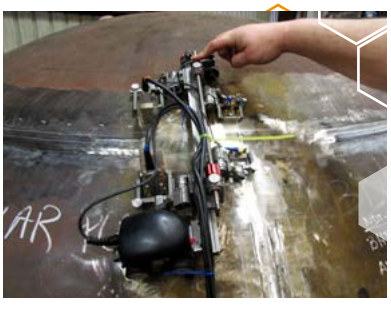
NDT Innovations is devoted to excellence in all aspects of Materials Inspection.

NDT INNOVATIONS



We provide worldwide proven inspection solutions designed to perform pressure vessel weld inspections which comply with the most demanding construction codes such as ASME Code Case 2235-9, ASME B&PV Sec VIII, Div. 1 & 2, 2013 edition, as well as other construction welding inspections. We design inspection configurations to fit each application need - TOFD, Phased Array, Digital Radiography as well as other Electromagnetic Superficial Methods and Techniques. Portable package for in-house or field inspections.

We have performed the most complex projects involving the use of Advanced Ultrasonic (05) three-inch thick - complex vessels, (02) two inch thick - stainless steel layered vessels.



PETROCHEMICAL - *PRESSURE VESSELS - IN SERVICE INSPECTION*

The versatility of our technologies and equipment allow in-service inspection of pressure vessels containing hazardous materials. Inspections are conducted using NIST-traceable portable calibration equipment and qualified inspectors certified in accordance with American standards.

The meticulous qualification process of the inspection procedure prior to performing the inspection itself permits adjusting the system to the specific needs of the project, thus yielding reliable results even without the removal of the protective paint layers on the vessels.

The periodical inspection of horizontal and spherical GLP and hydrogen vessels is very common based on maintenance management concepts - API 579 and 580 Fitness for Service.

ndt innovations inc.

We supply proven solutions designed to perform pressure pipelines weld inspections according to approved codes ASME B 31.X, Code Case 181 and ASME B&PV Section V, Article 4.

This technology also complies with the requirements of other fabrication and installation codes, such as API 1104 for the transportation of petroleum and petroleum by-products, as well as other pipeline construction welding inspections.

Designed to fit each pipeline welding configuration, whether for manual welding or for automated welding processes - Multiple Phased Array, Multiple TOFD, Zone Discrimination technologies, Digital Radiography as well as the implementation of Conventional and Advanced Superficial Methods and Techniques.

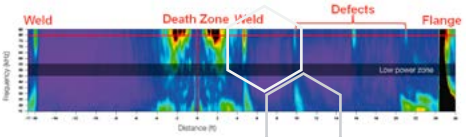
We are able to offer a variety of services in portable package for in-house or field inspections.

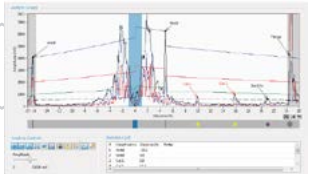
PETROCHEMICAL - *PIPELINES*

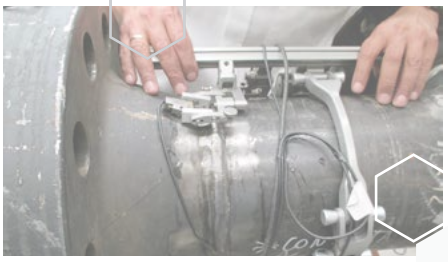
We design in-service inspections of piping in accordance with B.31.1 and ASME B31.3 as well as API and other piping codes.

We also devise custom made portable NDT solutions for these applications, also aimed to meet each customer's specific needs at the field; for Electromagnetic, Ultrasonic or Digital Radiography requirements, we offer the most efficient portable solution:

- Corrosion detection applications for in-service pipes and pipelines.
- Inspection of above ground conventional and coated pipes.
- Detection of corrosion at supports and pipe racks.
- Inspection of through-wall pipe.
- Detection of corrosion under insulation (CUI).
- Inspection of buried pipes.
- Inspection of vertical pipes.
- Application of guided waves technology to avoid unnecessary excavation, coating removal, or scaffolding unless flaws are detected.
- Inspection of high temperature insulated pipes.







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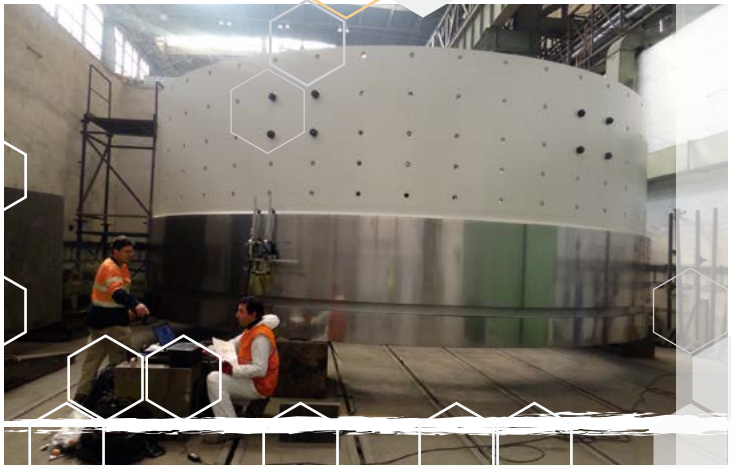


Framework and Components:

The Structural Codes of the American Welding Society allow the use of Advanced Ultrasonic to inspect welds in structural frameworks. Since early 2000, we have been focusing on the development of ultrasonic methods to be able to inspect highly attenuating materials. We have invested in developing techniques that allow us to use Phased Array and TOFD technologies conjunctively.

We developed Multiple Phased Array and Multiple TOFD Advanced Ultrasonic Inspection Technology for testing highly attenuating materials and welds of over 6 inch thickness.

We were awarded the complete inspection of the welds of the largest Marine Facilities project (2005-2007) using Advanced Ultrasonic technology. This is one of the first and largest projects in the world where advanced ultrasonic was applied for structural weld testing.

Since 2004, we have inspected several ball mill welds up to 8-in thick in the USA, Europe, China and Australia for large mine expansion projects around the world.

The need to guarantee the integrity of the base material of structural and engineered plastic piping and engineering such as HDPE and PVC, coupled with the need to detect or prevent defects during the welding process, whether by thermal-fusion or electro-fusion, led NDT Innovations to search for new procedures for inspecting these materials.

We offer highly portable equipment units, with sufficient detectability capacity to perform inspection operations at the place of fabrication of the pipes to be used in gas and liquid transportation projects in compliance with ASME B31.3 and the new ASTM E3044 / 3044M-16 Standard Practice for Ultrasonic Testing of Polyethylene Butt Fusion Joints.

A prompt delivery of the information of the inspected material permits a quick decision-making process, thus helping reduce costs of transportation of non-suitable material and the guarantee of using the materials in accordance with the designed specifications.

Large and complex projects in different parts of the world, as well as a high degree of customer retention, are the best testament that TOFD and Phased Array technologies used for the determination of the integrity of the pipes and fittings at the fabrication site or factory help to optimize the fabrication processes and the time of execution of the project.

HDPE - *BASE MATERIAL & FITTINGS*

In 2003-2004 we began working on the initial developments of ultrasonic techniques using Time of Flight Diffraction (TOFD) to inspect High Density Polyethylene (HDPE) pipes, fitting and welds.

Several failures of HDPE welds occurred during 2004 in different parts of the world. We were the company selected among various international companies to assess the causes of such incidents; this was certainly a milestone in our company's history.

Today we are the leading company in the provision of TOFD of HDPE inspection services in the world. Our intensive R&D has led us to develop proprietary technology, which in turn is now being recognized by our customers as a big contributor to improve the efficiency of their processes and product quality, in both thermal and electro fusion.

Till now, we are at the forefront of TOFD of HDPE inspection services in the world; we continue to strive to develop new and innovative solutions for our customers.

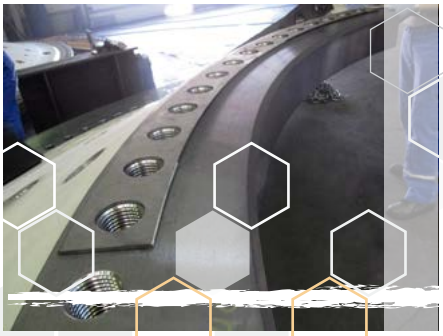
The use of new micro-alloyed structural steels (ASTM A 516, 517 SUMITEN) has permitted to reduce significantly the weight and sizes of the pressure pipelines in hydroelectric projects. There are more elaborate design criteria associated with these steels, as indicated in the Boiler & Pressure Vessel ASME Code, Division 2, as of 2010 Edition with 2011 Addenda and presently in the latest edition.

The TOFD and Phased Array technologies have demonstrated a high probability of detection for welds in these engineering applications, which is even higher than the probability of detection with industrial radiography. Similarly, the inspection application does not need access on both sides of the pipe wall, but only from inside the pipe, thus making the inspection easier in sloping areas or in vertical positions of force mains.

In 2009, NDT Innovations designed a semiautomatic inspection system for ultrasound applications in pressure pipelines for hydroelectric projects in Peru.

Prompt information on the condition of the weld is vital in the case of these high-resistance materials; they need to efficiently support the application of dehydrogenizing and post-welding treatments. The digital data obtained allows a permanent monitoring of the welds during the fabrication process of the project.

HYDRO ELECTRIC



Strategically we decided to focus our efforts on becoming the NDT Company of choice for the mining sector, which extensively uses castings. Mining equipment is usually heavier and made of highly attenuating materials such as castings and plastics. These materials are hard to test with conventional NDT equipment. We concentrated in the developing of specific techniques to enable us to perform inspections of these highly attenuating materials. It was between 1998 and 2001 that we developed new solutions which allowed us to inspect such highly attenuating materials, including manganese steels, high chrome steels, and plastics.

In 2003 - 2004 we acquired advanced ultrasonic equipment with Phased Array and TOFD capabilities. Development of know-how & technology to design and build Advanced Mockups to inspect large castings.

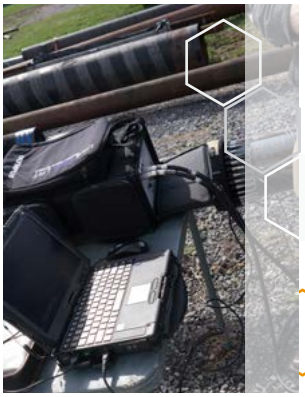
The ability to inspect heavy, highly attenuating materials and the use of advanced ultrasonic equipment represented another breakthrough in the area of testing difficult castings. Our commitment to R&D, better procedures, extensive use of mockups, the use of high-sensitivity and high-resolution transducers were strategic actions that gave us technological advantage in the global market for the inspections of castings and position our company as the supplier of choice in the world's castings testing market.

Presently we are testing steel and cast iron castings for the largest castings manufacturers and end users in the Americas, Europe, Asia and Australia.

GUIDED WAVES

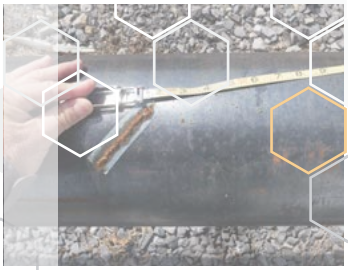
At the beginning of 2014 we acquired state of the art Guided Waves Equipment and built the first facility for testing, training and simulating all the different applications for this type of equipment:

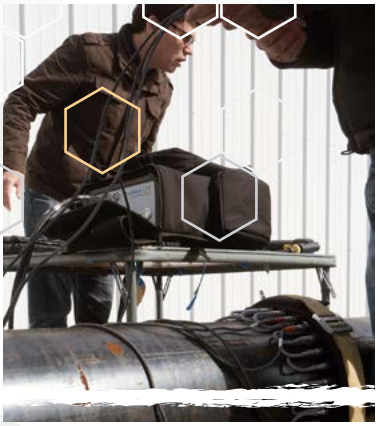
- Corrosion detection / in-service pipes and pipelines.
- Inspection of above-ground conventional and coated pipe.
- Detection of corrosion at supports and pipe racks.
- Inspection of through-wall pipe.
- Detection of corrosion under insulation (CUI).
- Inspection of buried pipes. Inspection of vertical pipes.

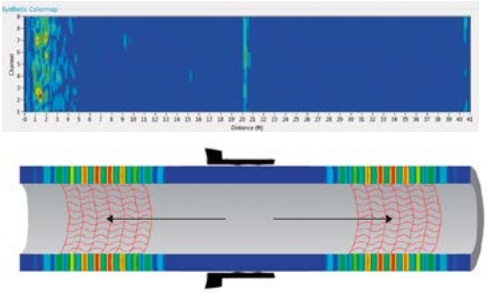


Inspecting with guided waves offers several significant cost advantages for our customers since we are able to avoid unnecessary excavation, coating removal, or scaffolding if no flaw is detected. Additionally, the use of guided waves allows us to perform inspections of pipes and pipeline over long distances, inspections of pipes with limited access from a single position, as well as targeting locations requiring further inspection; all these with substantial savings over other methods.

ASTM covers Guided Wave: E2775 - Standard Practice for Guided Wave Testing of Above Ground Steel Pipework Using Piezoelectric Effect Transduction (2011).





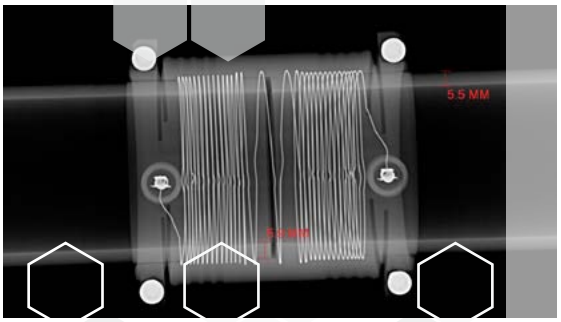


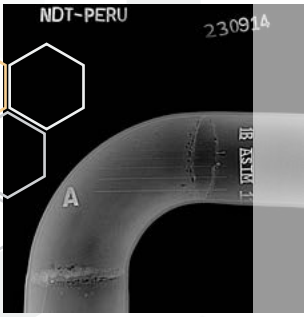
NDT Innovations uses electromagnetic inspection technologies focused on measurement. NDT Innovations is capable to provide inspection support and guarantee of integrity for mining equipment in typically short timeframes during maintenance shutdowns. The versatility of the methods we apply allows us to achieve a flaw detection capacity even over thick layers of paint, or lubrication grease of moving components (such as gears, mills, chassis, conveyors, among other components).

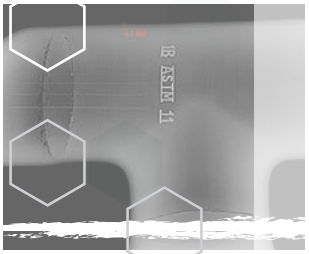
Advanced electromagnetic inspection systems of multiple technologies, including Eddy Current, MFl. NFT, and RFT for the fabrication and in-service inspection of such units as air conditioners, heat exchangers, boilers, and super heaters are commonly used. Alternating Current Field Method of measurements (ACFM) is also used to support the petrochemical sector.

The digital data obtained can be easily handled, which permits fast data processing using specific and proprietary software to maintain constant follow-up and comparison throughout the integrity status time and remaining life of the inspected units.

DIGITAL X-RAY





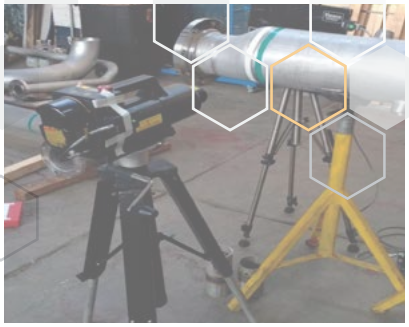


NDT Innovations offers Digital Radiography systems with the following characteristics:

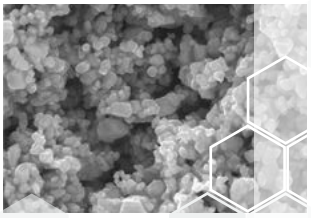
- High portability: It can be fully operated on batteries; however, it can also work on conventional sources.
- Designed for fieldwork: Light panels, mountable on a tripod.
- Shorter exposure times for obtaining the images: Image quality is immediately verifiable, thus avoiding returning to the inspection site.
- Image quality - Great, dynamic range and high resolution.
- Safer application: Reduced safety area, source can be shut-off when not in use.
- High-precision software: Easy to use with powerful filters.

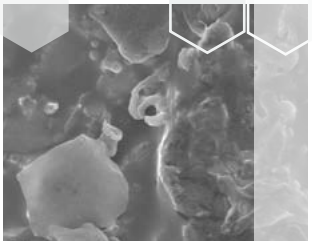
This technique allows NDT Innovations to provide the industrial fabrication sectors and in-service maintenance with the following services:

- Remote Weld inspection.
- Corrosion inspection (measurement of remaining thicknesses).
- Determination of integrity in metal and polymer joints.
- Plastic liners wear.
- Quality evaluation of multiple engineering components.



FAILURE ANALYSIS & MATERIAL CHARACTERIZATION



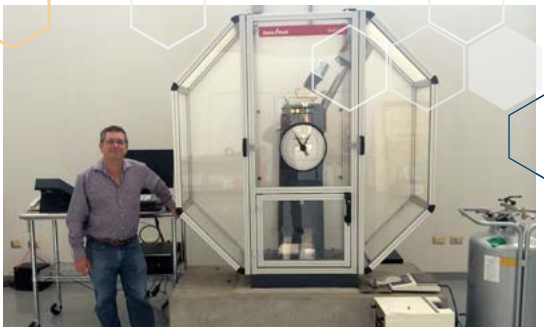


The performance of materials and components depend, to a large extent, on its own composition. We need to ensure that the materials used in any project are in accordance with the requirements for which they have been designed and meet the project specifications. NDT Innovations offers to the Mining, Industrial and Construction sectors a series of equipment with extraordinary capabilities to analyze and verify if the materials used or to be used in a project meet the physical and mechanical criteria for the application that is being used or intended to be used.

NDT Innovations, thru its sister company Materials Research & Technology, counts with a state of the art Laboratory manned by a group of scientists and engineers which are exclusively dedicated to perform research of new materials technologies and materials characterization. The result is the continued development of techniques and solutions not only for NDT applications, but also in a much broader aspect, for practical applications in the area of Materials Characterization and Analysis in the industries that we serve.

- Applications with SEM Electronic Microscopes Jeol of 20 and 30 KV with EDS, WDS and EBSD.
- Development of Analytical Models & Development of Proprietary software and hardware.
- Forensic Engineering.
- Tribology (Major types of wear, including abrasion, friction, adhesion & cohesion, erosion & corrosion).
- Mechanical Testing, Stress & Strain.
- Chemical Analysis (OEE, XRF).
- Materials Remediation (Water, soils, building materials).
- Reliability & Maintainability Engineering (Sustainability).
- Training & Experimental Simulations.

Likewise, these systems allow us to determine the causes for failure when the materials do not meet the in-service requirements and specifications, providing feedback for corrective action and processes optimization.



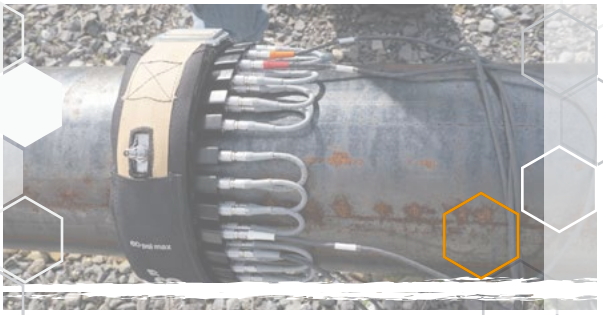
FAILURE ANALYSIS & MATERIAL CHARACTERIZATION

With years of experience in the application of nondestructive inspection in mining-related machinery, NDT Innovations can offer the following services:

- Laser Metrology in the determination of deformities and for alignment of shovels, conveyors, and crushers.
- Ultrasonic inspection with in-situ Phased array for large mounted shafts (8 - 10 m), such as shippershafts, lo comotive shafts, etc.
- Integrity inspection using magnetic methods (PMI, ACFM) for load transmission components such as mills, furnaces, crushers.
- In-situ (digital) radiography of conveyor splices.
- Evaluation of condition and integrity of pneumatic cylinders.
- Evaluation of integrity and remaining life of acid tanks and chemical products containers.
- Evaluation of integrity of exchanger tubes.

NDT Innovations has collaborated with the mining sector in the development of inspection systems and procedures for the fabrication and installation of metal and plastic piping, using modern ultrasonic, digital radiography, and electromagnetic techniques for:

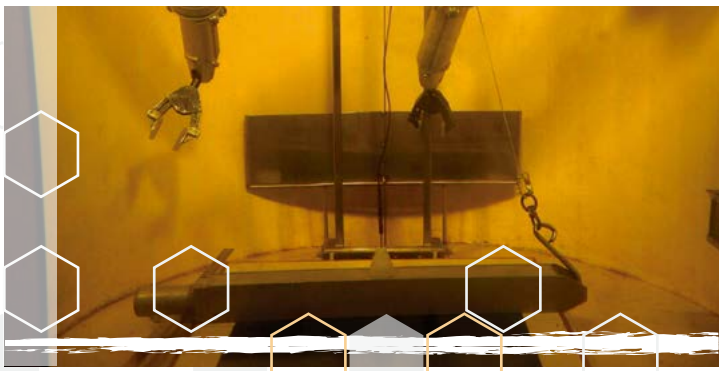
- Evaluation of integrity and time measurement for validation of aqueducts and metal or plastic tailings pipes.
- Determination of internal liner thicknesses in mining pipelines.
- Measurement of wear and estimation of remaining life of exposed and buried pipelines applying guided waves.
- NDT Innovations activities include applications at the pumping stations and at the fields along the kilometers of pipeline layout at the mines.

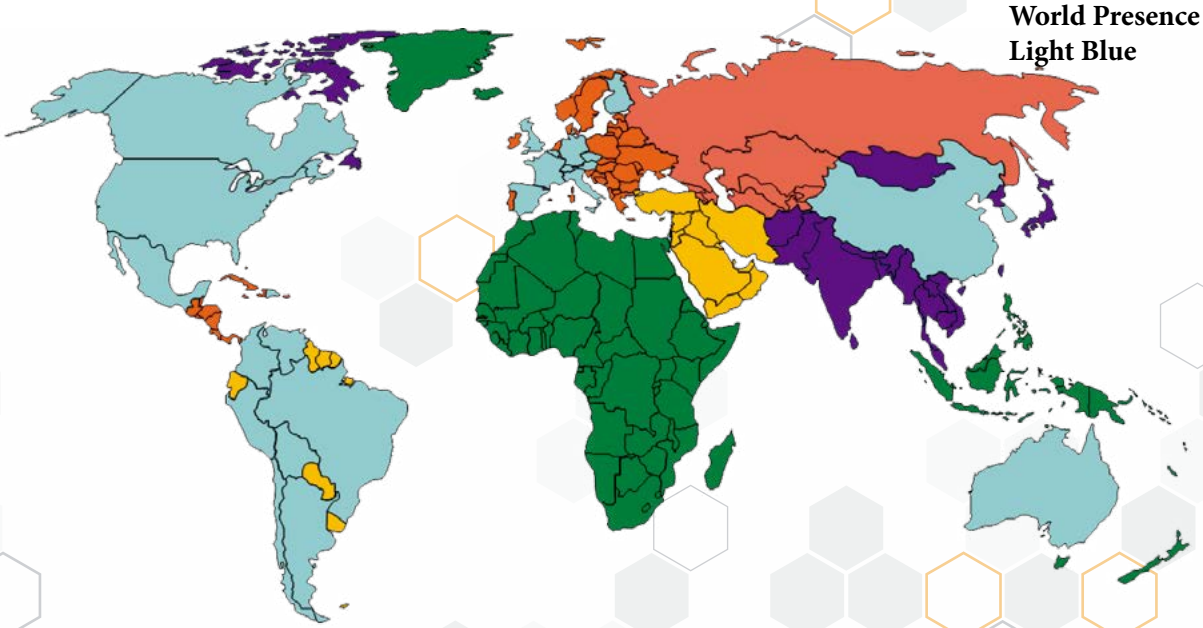


NDT Innovations has developed proprietary systems which have been approved by the authorities of Civil Aviation for their application to inspect the different components of airplanes, among them:

- Electromagnetic inspection methods for fuselage and structural beams.
- Inspection of bolts of structural characteristics using ultrasonic Phased Array.
- Inspection of propulsion systems through superficial techniques.
- Development of inspections procedures for components, endorsed by the manufacturer.

The inspections conducted by NDT Innovations can be carried out at the maintenance hangar as well as in isolated maintenance facilities.





NDT Innovations, Inc. Developments & Competitive Advantages in the Market:

- Development of ultrasonic methods to inspect highly attenuating materials.
- Early investment in Phased Array and TOFD technology.
- Development and continuous improvement of TOFD of HDPE inspection technology.
- Development of Advanced Ultrasonic Inspection Technology for testing welds and materials.
- Development of Microwave & Radar Inspection of Giant Tires.
- Development of Phased Array Testing of Helicopter bolts with limited access.
- Development of Advanced Ultrasonic solutions to inspect Castings.
- Development of Advanced Digital Radiography Testing Solutions.
- Development of Advanced Electromagnetic Testing Methods.
- Development of Ultrasonic Phased Array solutions to inspect Electro-Fusion HDPE fittings and welds.
- Development and implementation of advanced testing solutions to inspect piping and welds.
- NDT 3D.
- Advanced Guided Waves Services.
- Advanced NDT Techniques for Material Characterization.
- Failure Analysis Studies.
- Mechanical and performance Testing Services.
- Electronic Microscope WDS, EDS, EBSD, Cathode Luminescence.

TENACITY

TENACITY is a mechanical property that depends on the elemental chemical constitution as well as the microstructure and physical properties of the structural materials used in engineering.

The traditional tests for the determination of toughness require the destruction of part of the part or component for the production and manufacture of test pieces which are subjected to impact tests or fracture mechanics to obtain the data (tenacity of the piece) with respect to the sample. These destructive tests are known as Charpy and covered on ASTM E23-12c.

ASTM E23 – 12c Standard Test Methods for Notched Bar Impact Testing of Metallic Materials:
These test methods describe notched-bar impact testing of metallic materials by the Charpy (simple-beam) test and the Izod (cantilever-beam) test.
The essential features of an impact test are: a suitable specimen (specimens of several different types are recognized), a set of anvils, and specimen supports on which the test specimen is placed to receive the blow of the moving mass, a moving mass that has sufficient energy to break the specimen placed in its path, and a device for measuring the energy absorbed by the broken specimen.

These test methods of impact testing relate specifically to the behavior of metal when subjected to a single application of a force resulting in multi-axial stresses associated with a notch, coupled with high rates of loading and in some cases with high or low temperatures. For some materials and temperatures the results of impact tests on notched specimens, when correlated with service experience, have been found to predict the likelihood of brittle fracture accurately.

THE CHARPY test procedure may be summarized as follows: the test specimen is thermally conditioned and positioned on the specimen supports against the anvils; the pendulum is released without vibration, and the striker impacts the specimen. Information is obtained from the machine and from the broken specimen.
The absorbed energy shall be taken as the difference between the energy in the striking member at the instant of impact with the specimen and the energy remaining after breaking the specimen. This value is determined by the machine's scale reading.

Important number of fragile failures worldwide are happening on components which have been tested using the Charpy test.

We identified a global problem and the need to develop a non-destructive method to measure tenacity because of the unexpected occurrence of failures (breaks, fissures) in the integrity of structures such as bridges, high voltage towers, tanks, pipelines and accessories (Elbows, T, reductions, etc.) of steel to transport hydrocarbons (gas, oil), chemicals and mining pipelines, due to low tenacity in materials, generating material, personal, economic and environmental losses.

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