

The Test Of Time



Product and Services Guide



The MAC[®]



For 90 years, MAC has withstood “The Test of Time”, recognized the world over as a premier supplier of instruments, systems and solutions for nondestructive testing.

Today, as we move into our tenth decade of leadership, we know firsthand that industrial processes, standards and requirements are changing—and becoming more demanding—at an astonishing pace. As many of our customers have reached out for solutions to meet new challenges, MAC has responded by filling our NDT portfolio with even more innovative options. Our expanded Echomac[®] Phased Array applications (see page 11) are good examples of how we have been addressing these needs and requests.

In short, the key to “The MAC Edge” is rather simple: our company has always focused on 100% customer satisfaction. With the ability to locally supply installation help, routine maintenance and service, we are in the unique position of being able to provide quality support virtually anywhere in the world.

If you’re looking for a competitive quotation for sale or lease on an NDT system with servicing options, don’t hesitate to contact us. Our multi-talented experts and team of field service engineers are ready to meet—and exceed—your expectations.

Dudley Boden
President & CEO

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 **MAC has been a leader in nondestructive testing since 1928. Read about our company’s history at:**
<http://www.mac-ndt.com/90-years-ndt/>

Edge

Collaborative Leaps in NDT Innovation

We provide NDT solutions using the latest Ultrasonic, Eddy Current, Flux Leakage and Phased Array Ultrasonic Technology. But at MAC, the science of innovation is often driven by a specific customer challenge. Your needs often inspire our ongoing exploration of cutting-edge technologies, systems and solutions.

The Highest Level Of Customer Support

In the farthest corners of the world, MAC Field Engineers and Representatives go beyond every expectation to serve our customers.

▶ See their stories at:
<https://youtu.be/felQkySyHg8>

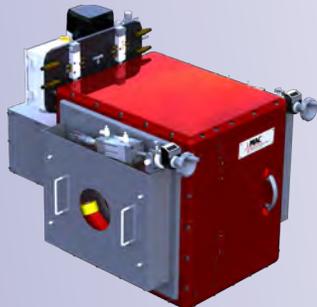
Refining and Improving Testing Technologies

We specialize in unique NDT solutions that can answer an existing demand, or push the envelope, and guide your business towards maximum potential.

Competitive Quotations

Our goal is to give you the information and guidance you need as quickly as possible. Email us at: info@mac-ndt.com or call: (914)530-2000

Recent Breakthroughs



Rotoflux® AC Flux Leakage Tester - PAGE 13

▶ See it in action at <http://www.mac-ndt.com/rotoflux-ac/>



Advanced! Echomac® FD6/6A UT Inspection - PAGE 10

🌐 Get more details at <http://www.mac-ndt.com/echomac-fd6-fd6a/>



Echomac® UT 25mm Rotary- PAGE 12

🌐 Find out more at: <http://www.mac-ndt.com/25mm-ut-rotary/>



Echomac® Phased Array Applications - PAGE 11

🌐 Find out more at: <http://www.mac-ndt.com/echomac-pa-wheel-tester-3/>

APPLICATIONS: *Industry Standards*

Through 90 years of experience, MAC has acquired a wealth of specific industry knowledge to support our extensive array of systems, solutions and services. In addition, the MAC global network places a team of industry experts, Field Engineers and seasoned Representatives right at your fingertips.

Petrochemical and Nuclear

The Challenges – Inspecting to the demands of these industries, as well as meeting ASTM, ASME and customer-specific testing requirements.

The MAC Edge – An Echomac® Ultrasonic test system can be combined with a MultiMac® Eddy Current encircling coil or Rotomac® Rotary Probe equipment to provide the advantages of several technologies in one multi-test system. The versatile Echomac® electronics can be used with a variety of transducer configurations including an immersion tank installation, where it is successfully testing titanium tube for nuclear applications. The Echomac® Model 6A also holds GE Qualification for P3TF31 and P29TF82 Class A and B, typically required for nuclear applications. Multi-channel Eddy Current units can be customized to monitor material grade, or to inspect for sigma phase in duplex materials.



UT Rotary and Eddy Current testing systems for seamless stainless steel tube and welded titanium tube.



Oil Country Tube and Pipe

The Challenges – Producers of heavy wall OCTG tube must meet the demanding specifications of API 5L & 5CT, ASTM A252, DIN, EN and other standards.

The MAC Edge – Echomac® Ultrasonic and Rotoflux® Flux Leakage Systems detect both transverse and longitudinal defects, and also meet API standards requiring two technologies.

Heat Exchanger Tube

The Challenges – Tubes made of carbon steels, stainless steels, titanium alloys, copper alloys, copper and aluminum require NDT solutions that can allow testing to meet a customer's quality standards, as well as meeting requirements of ASTM, ISO, EN and other national standards bodies.

The MAC Edge – Echomac® UT Rotary Systems can cover a large OD range of longitudinally welded or seamless precision-drawn tubes. At high throughput rates, untested ends can be limited to less than 50mm depending upon diameters and conditions.

Our systems feature Echomac® FD-6/6A electronics with up to 32 channels and full network support for remote viewing and control.

Medical

The Challenges – Materials used for the medical industry often have very small diameters or exceedingly thin walls that are difficult to test.

The MAC Edge – High-frequency Eddy Current Coils can inspect small diameter materials such as tungsten, titanium and nickel alloys that are used for applications such as guide wires and stents. In addition, the Varimac® Comparator can sort out defective medical needles, surgical blades and more.

Automotive Tube

MAC Offers a Multi-Test System for Automotive Tubing

Find out more at: <http://www.mac-ndt.com/multi-test-system-for-tubing/>

The Challenges – Eddy Current and Ultrasonic systems must be configured to meet the unique demands of the specialized tubes used by the automotive industry. Solid bar purchased by automotive parts fabricators needs to exhibit very high internal and surface quality. In addition, 100% volumetric inspection is now a requirement for many uses.

The MAC Edge – MAC offers simple Eddy Current test units as well as complex multi-method test systems. MAC can also supply full Ultrasonic volumetric capability and added AC Flux Leakage or Eddy Current systems for surface inspection. Testing speeds to 2 meters per second are standard.

APPLICATIONS: *Product Testing*

No two products follow the same path, yet one step remains constant: the critical need to evaluate product integrity. But whatever the challenge involves, MAC is ready to offer solutions that will meet your specific needs and requirements.

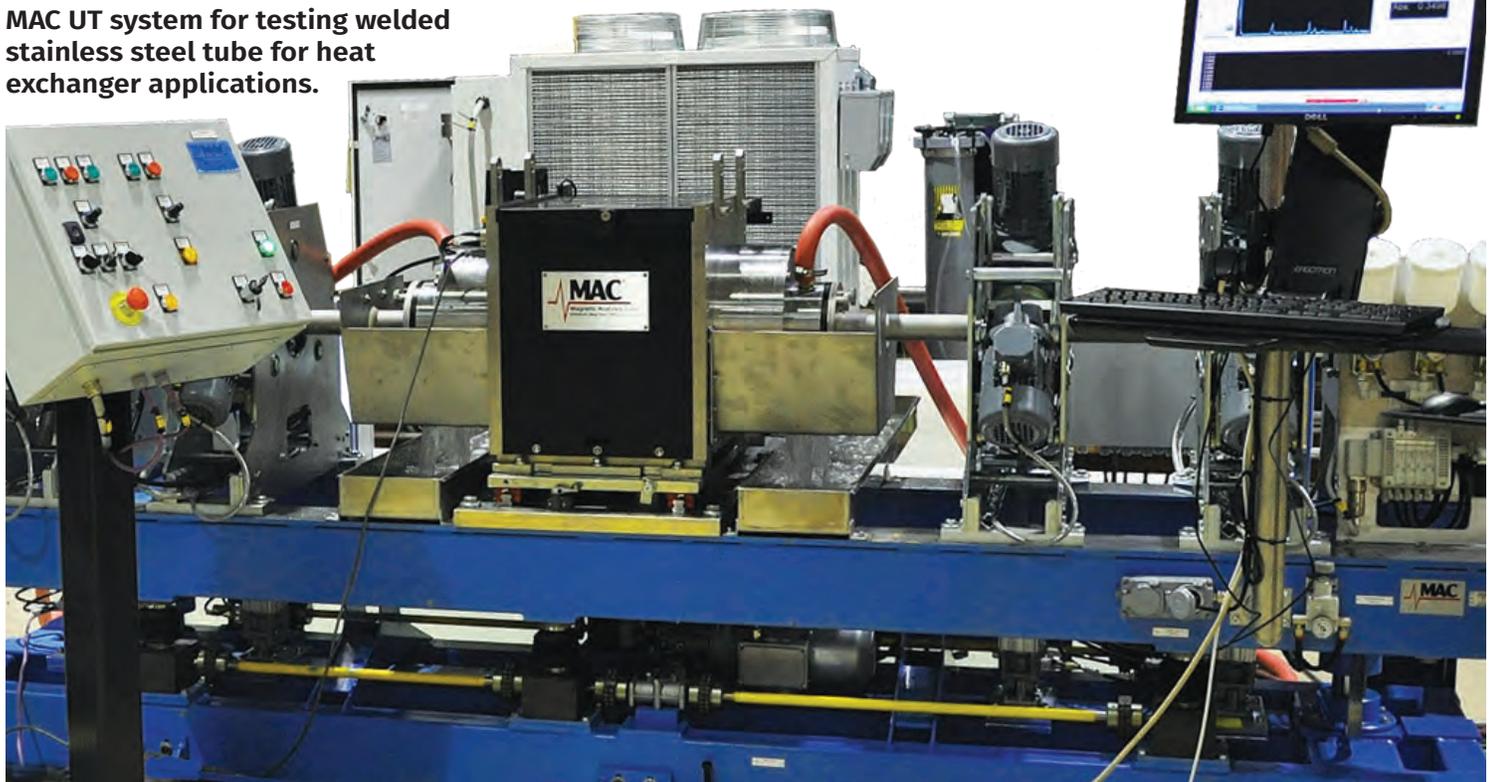
Welded and Seamless Steel Alloy Tube

In-Line Testing: A typical test for surface and subsurface defects might include the MultiMac® Eddy Current Tester with one test channel, an encircling test coil for full body defect detection, or a sector test coil for weld zone inspection. When testing welded or seamless cold-drawn tubes, the Echomac® Ultrasonic Rotary or weld zone system may be the best choice, even on small diameters.

Off-Line Testing: Using several technologies can provide more comprehensive inspection. Products from multiple lines can then be brought to one test line for final inspection.

🌐 Read more at: <http://www.mac-ndt.com/welded-tube/>

MAC UT system for testing welded stainless steel tube for heat exchanger applications.



Inclusions in Non-Ferromagnetic Tube, Bar and Wire

Metal inclusions, such as filings from finning tools, can be as small as 3mg and are difficult to find using standard Eddy Current test coils. A Flux Leakage Magnetic Inclusion Detector (MID), consisting of MultiMac® electronics with a special coil sensor to provide a DC field, can be used to detect ferrous inclusions.

In addition, MAC's Production Comparator PC-VI with null test coils detects small ferromagnetic inclusions and stringers in non-magnetic stainless steel rods and bars, and can also inspect most austenitic grade products.

🌐 Read more at: <http://www.mac-ndt.com/finned-copper-tube/>

APPLICATIONS: Product Testing

Carbon Steel Bars



Cold Drawn Carbon Steel Bars

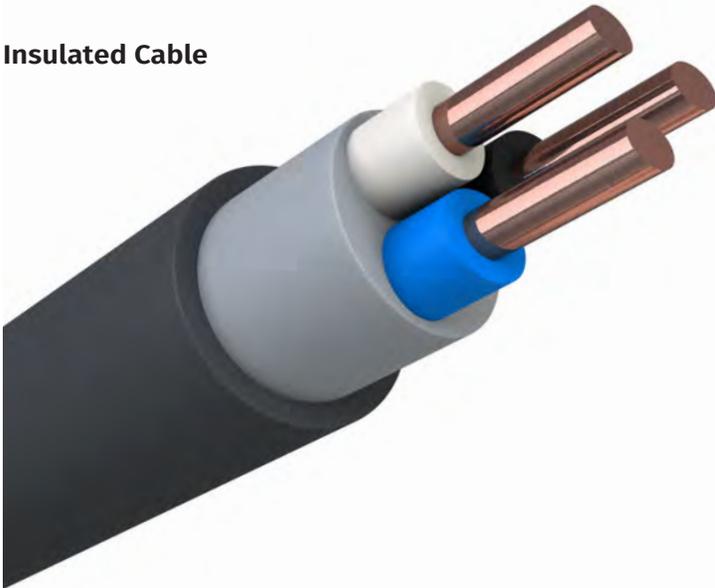
MultiMac® electronics with a Rotomac® Eddy Current Rotary System detect longitudinally oriented surface defects such as seams, laps, scabs and cracks. When used with encircling coils, MultiMac® can detect shorter defects, pits and some subsurface anomalies depending on test settings and nature of the bar. Systems can test to ASTM E2375, AMS-STD-2154 and EN 10308.

Hot Rolled Bar

The MultiMac®, with rotary probes and high sensitivity, can find defects down to .2mm deep. The new Rotoflux® AC extends this capability to even smaller defects, and can test black bar with surface conditions that often prevent detection of shallow defects.

When internal defects are a concern, an Echomac® Ultrasonic test can be added.

Insulated Cable



Wire, Rod and Insulated Cable

The Minimac® 50/55 Eddy Current Testers detect welds and discontinuity in wire, rod and insulated cable. Encircling coils detect short surface and subsurface flaws such as cracks, inclusions, butt welds and other defects in steel, stainless alloy or non-ferrous wire.

More demanding applications may require the MultiMac® SM. For small diameter material such as tungsten filament wire, a high-frequency Eddy Current test is recommended to identify welds and brazes.

Round Billet



Round and Square Billets

MAC recommends a combination of Eddy Current and Ultrasonic Systems for inspecting hot rolled square and round billets up to 9" (228.6mm) in diameter. The UT system detects internal defects, while the Eddy Current unit, using both sector coil and rotary test probes, can spot defects on the flat surface and corners. These tests meet MIL STD 2154 standards.

APPLICATIONS: Testing Parts

Rapid inspection of fasteners and metal parts for properties such as heat treatment, hardness and alloy is a key requirement in meeting tight specifications for automotive, nuclear and other industries. Improperly heat-treated parts, for example, can result in costly machining issues, reworking, lost production time and product failure. Comparators can provide a fast, reliable method of inspection.

Which Method Is Right For You?

All parts may be submitted for a free evaluation and analysis by MAC's experienced engineers to determine the best NDT solution for your application.

🌐 Log on to: <http://www.mac-ndt.com/parts/>



Typical fastener parts that can be inspected for hardness, alloy, various dimensions and other physical characteristics using Eddy Current or electromagnetic comparators.

Varimac® Comparator

Sorts for variations in alloy, dimension and cracks.

- Tests bearings, fasteners and other cold-formed parts.
- Inspects ferrous (magnetic) or nonferrous (non-magnetic) parts.



A connecting rod bolt, typical of parts that can be tested for hardness using a low-frequency electromagnetic comparator such as the Production Comparator VI.

Production Comparator

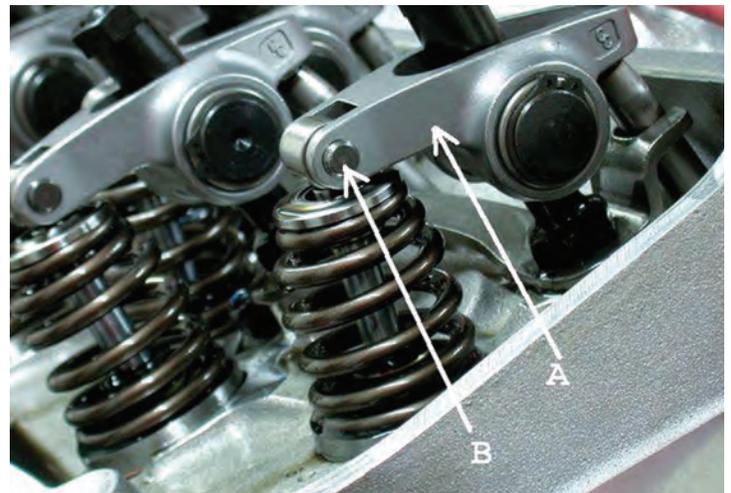
Detects variations in carbon steel parts.

- Low-frequency comparator tests for case depth, core hardness, grade and structure.
- Highly sensitive circuits can detect changes in test signal phase, amplitude or harmonic distortion.
- Optional software allows for simultaneous analysis of eight frequencies to meet complex test standards.

Custom Systems

Testing special parts and conditions.

Combinations of Eddy Current, Ultrasonic and/or Flux Leakage technologies can also be specially designed to meet your inspection needs.



Valve train assembly showing pins (B) that can be tested prior to assembly by a Varimac® for proper heat treatment. The rocker arm (A) can be inspected with the Production Comparator to detect gas pockets that result from the casting process.

APPLICATIONS: Custom Systems

Your testing process – whether it involves meeting the most exacting customer requirements or testing to your own internal standards – presents unique challenges. That’s why a MAC custom solution might be the right choice for you.

Designed to be an Integral Part of Your Production Line

Multicollector software is available to bring together results from multiple testers, even including, in some cases, existing test operations in your mill. Listed are three custom applications:

- An Eddy Current test instrument can handle a variety of applications. For example, copper water tubing is often tested for surface cracks, pinholes and other defects using a one- or two-channel MultiMac® tester. A coil platform, to hold and position the test coils, completes the system.
- A Flux Leakage test can be used to find defects in automotive tube with wall thickness variations, or for basic OCTG testing to comply with API 5L. A single longitudinal flux leakage test head will meet the requirements for detecting longitudinal defects.

- A Multi-Test System combines one or more Eddy Current, Ultrasonic or Flux Leakage testers with sophisticated electronic controls and precise mechanical components. These controls can handle and position your material and sensors so you achieve optimum performance and speed on even the most difficult test applications.

MAC Offers a Multi-Test System including the 500mm UT Rotary with 500mm Transverse and Longitudinal Rotoflux® flux leakage testers". Find out more at <http://www.mac-ndt.com/echomac-500mm-tester/>



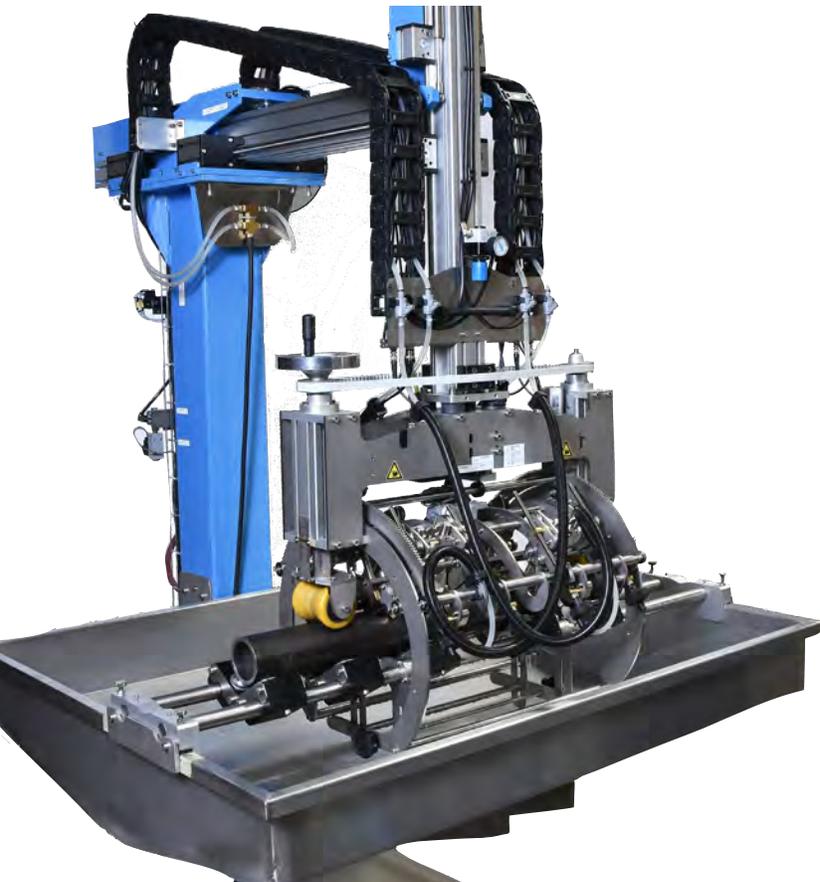
A multi-test system for inspecting OCTG heavy-wall large-diameter pipe combines Ultrasonic and Flux Leakage technologies.

MAC's Proprietary Echomac® FD-6/6A Electronics

Sophisticated UT inspection for on- or off-line flaw detection, thickness, weld inspection and dimensional measurement.

- High signal to noise ratio, precise thickness resolution (1µm), and excellent repeatability and reliability.
- A wide range of applications: from full body testing for spinning tube and weld zone inspection, to 500mm Ultrasonic/Flux Leakage multi-test systems.
- Key test parameters can be controlled on a single screen.
- Meets high level quality standards for nuclear, aerospace and other critical applications.
- Compatible with rotary, immersion, squirter, bubbler and "spin the tube" applications.

🌐 For more details about Echomac® FD6/6A technology, visit: <http://www.mac-ndt.com/echomac-fd6-multichannel-ut/>

**B T**

Echomac® WLD Ultrasonic Weld Line Test System

Designed to test for longitudinally oriented defects that are typical of the ERW welding process.

- Features operating conveniences for inspecting tube weld zones on-line during continuous production.
- System typically has four channels, using both CW and CCW sound modes. Additional channels can be added.
- Detects ID and OD longitudinal defects between 5% and 10% of wall thickness.
- Test head includes quick disconnect feature that exchanges irrigated transducer shoes in 5 seconds for tube size changes.

🌐 Find out more at:
<http://www.mac-ndt.com/weld-line-test/>

T

Echomac® Velocity Measurement

Assesses nodularity in ductile iron cast automotive components.

- Evaluates velocity, thickness or flaw detection.
- Operates with either full immersion or bubbler couplant technology.
- Enables the testing of two parts simultaneously— from separate test stations—using only one instrument.

More details at: <http://www.mac-ndt.com/echomac-vm-velocity-measurement/>



Ultrasonic Phased Array Testing Options

Echomac® 180mm Phased Array Test System

- High-speed parallel processing to handle a large amount of data.
- Designed for situations where Phased Array Ultrasonic technology is preferred to conventional Rotary Ultrasonics.
- Unique water box design.

Find out more at: <http://www.mac-ndt.com/echomac-pa-phased-array-ut/>



Echomac® Phased Array Wheel Tester

- Two solutions for rail wheel testing are offered.
- Semi-automated version uses a local immersion technique for tread inspection.
- Automated immersion tank option inspects tread and wheel face of rail wheels using two Phased Array probes.

Find out more at: <http://www.mac-ndt.com/echomac-pa-wheel-tester-3/>



Echomac® Phased Array Composite Parts Tester

- Inspects a wide range of part geometries.
- Meets or exceeds U.S., European and other international specifications for aerospace and automotive industries.

Read more at: <http://www.mac-ndt.com/echomac-pa-composite/>

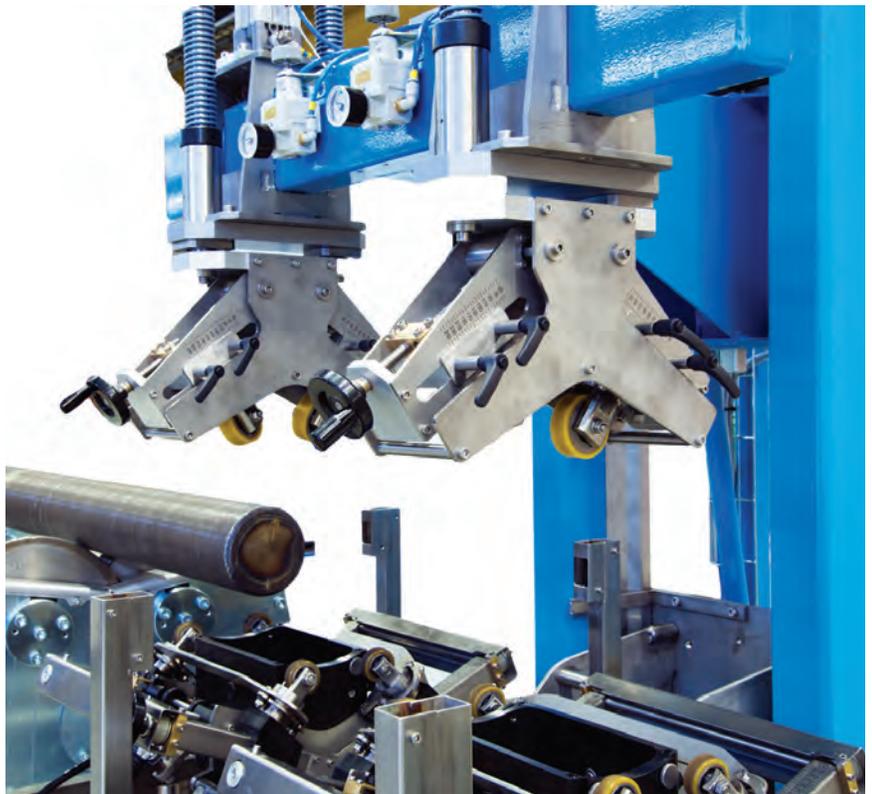


Echomac® Full Body and Tube End Tester Systems

UT test for spinning tube.

- APC (Adaptive Pitch Control) transducer carrier adjusts to the actual pitch as the tube is rotated during the test.
- Works with a simple immersion water tray to follow even unstraight tube and reliably maintain constant coupling.
- Tests a broad range of sizes from 2"-14" (50mm-355mm) in diameter.
- Premium grade conveyor accurately maintains the inspection helix and rotational speed to achieve optimum performance.
- Can also be installed to upgrade your existing test line.

🌐 For more details, visit: <http://www.mac-ndt.com/echomac-full-body-tester/>



Echomac® UT 25mm Rotary

High speed flaw and dimensional Ultrasonic inspection of tube in key precision applications.

- Part of MAC's line of Echomac® Rotaries, this model is designed to provide 100% test coverage inspecting 5 to 25mm thin wall diameter tube at high throughput rates.
- Test wall thickness as thin as 0.3mm.
- 8,000 RPM running speed.
- Use with MAC's Echomac® 6/6A instrument for optimum performance.
- 630mm length allows for ease of installation in existing inspection lines.

🌐 For more details, visit:

<http://www.mac-ndt.com/25mm-ut-rotary/>



Rotoflux® DC Flux Leakage System

The best technology to detect defects in heavy wall magnetic tubular products.

- Test for OD and ID surface defects and internal flaws in (OCTG) oil country tubular goods.
- Detect longitudinal and transverse defects as small as 5% on the OD and ID, depending on material type and conditions.
- Rotary uses wireless data transfer to avoid potential signal transfer noise.
- Complete signal transfer allows individual probe signal adjustment for accurate defect location and marking.
- Retractable probe assemblies handle upset & irregular ends.
- Models available for 30mm to 500mm diameter product.

For more information about Flux Leakage Rotaries and Rotoflux® electronics, visit: <http://www.mac-ndt.com/magnetic-flux-leakage/>



Rotoflux® AC Flux Leakage Tester

The best technology to detect surface defects in hot rolled black steel bar.

- Tests 15mm to 180mm diameter hot rolled black bar.
- Clear defect signals with minimum noise.
- Detects longitudinal flaws down to 0.1mm in depth.
- 2 surface ride probe arrays consisting of 8 elements each cover up to 160mm per rotation.
- Rotary uses wireless data transfer to avoid potential signal transfer noise.
- Operates up to 1500 rpm, depending on product diameter.
- Throughput speed of up to 4m/s (800 FPM) with larger diameters requiring slower FPM.
- Shares common graphic user interface with other MAC systems such as UT and EC testers.

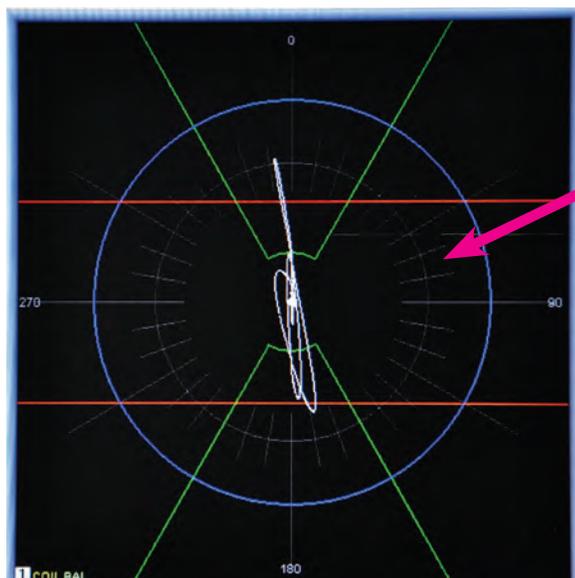
For more information, visit: http://www.mac-ndt.com/ac_flux-leakage/



Transverse Rotoflux® on-screen display of OD and ID defects.

ECT Eddy Current Testing

MAC's Eddy Current inspection systems incorporate computer-based test instruments and test coils that use two ECT coil technologies: Encircling and Sector Coils, and Spinning or Rotary Probe Coils.



MultiMac®

Simultaneous coil and/or rotary probe testing.

- Up to 8 test channels to use in any combination.
- For use with encircling/sector coils or rotary test probes to detect transverse, short and/or longitudinal, seam-type surface defects.
- Can operate on a wide variety of non-magnetic products or use direct current saturation to inspect magnetic material.
- Broad test frequency selection from 1KHz to 5MHz.

Find out more at: <http://www.mac-ndt.com/multimac/>

B **R** **P** **T** **W**

MultiMac® SM

MultiMac® testing technology in a smaller cabinet.

MultiMac® SM can test nitinol wire. Get the details at: mac-ndt.com/testing-high-performance-nitinol-wire

- Up to two independent test channels.
- Housed in a 20x12x12" cabinet (509mm x 304.8mm x 304.8mm) with a built-in 15" screen.

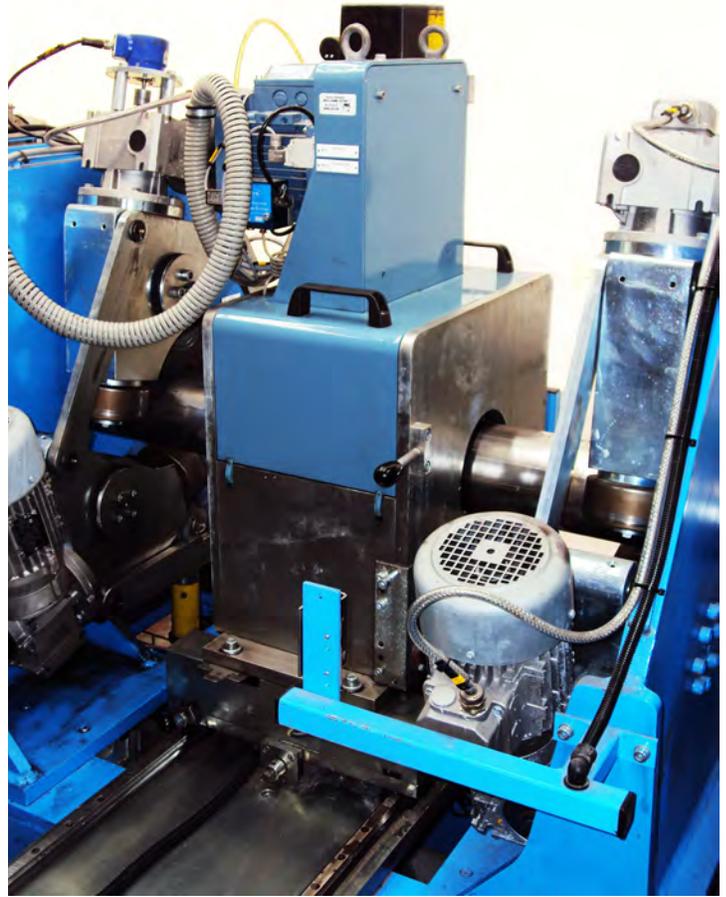
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Rotomac[®] Rotary Test Probe Technology

The method of choice for detecting seam-type defects.

- Identifies long, continuous surface flaws that might not be detected by encircling test coils.
- Features continuously variable high-speed rotaries with up to six test probes.
- Operates with MultiMac[®] Eddy Current electronics.
- Tested product moves longitudinally through rotary probes, resulting in a helical search pattern.
- Capable of testing magnetic and non-magnetic material from 1/8" to 7.0" diameter (3mm-180mm).

🌐 Get more details at:
<http://www.mac-ndt.com/ec-rotaries>



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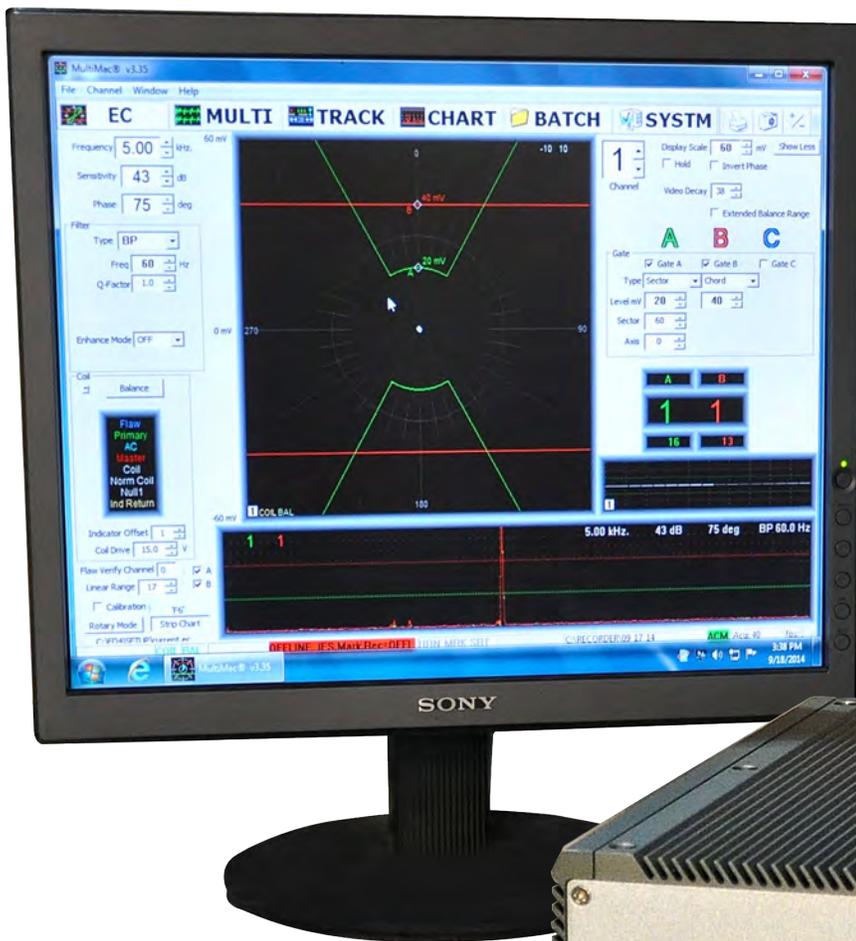
20mm Rotomac[®] HS Rotary

High-speed testing for longitudinal defects in small diameter products.

- Detects surface flaws such as seams and laps in products measuring from 2 to 20mm (0.0787-0.7874") in diameter.
- Operates at speeds up to 18,000 RPM for high production output.
- Easy-to-set-up Distance Compensation (a critical factor in the testing of ovate wire).
- Two spinning test probes can be adjusted with convenient dial-in diameter guide.
- Use for continuous wire operations such as drawing, spring-making, parts forming and shape and cut.

🌐 Visit: <http://www.mac-ndt.com/20mm-rotomac-hs-rotary/>

R T W



High-Performance Minimac® Compacts

Affordable, single-channel Eddy Current Testers.

- Detect short surface and some subsurface defects, including laps, slivers and cracks in tube, bar and wire.
- High-speed continuous operation and reliability in production environments.



Minimac® 50

For simple inspection of continuous product.

- An excellent choice for dedicated, continuous production testing of wire, cable and tube where simple setup without the need for constant operator adjustment is desired.

🌐 Find out more at: http://www.mac-ndt.com/minimac_50_and_55/

Minimac® 55

Tests continuous product or cut lengths.

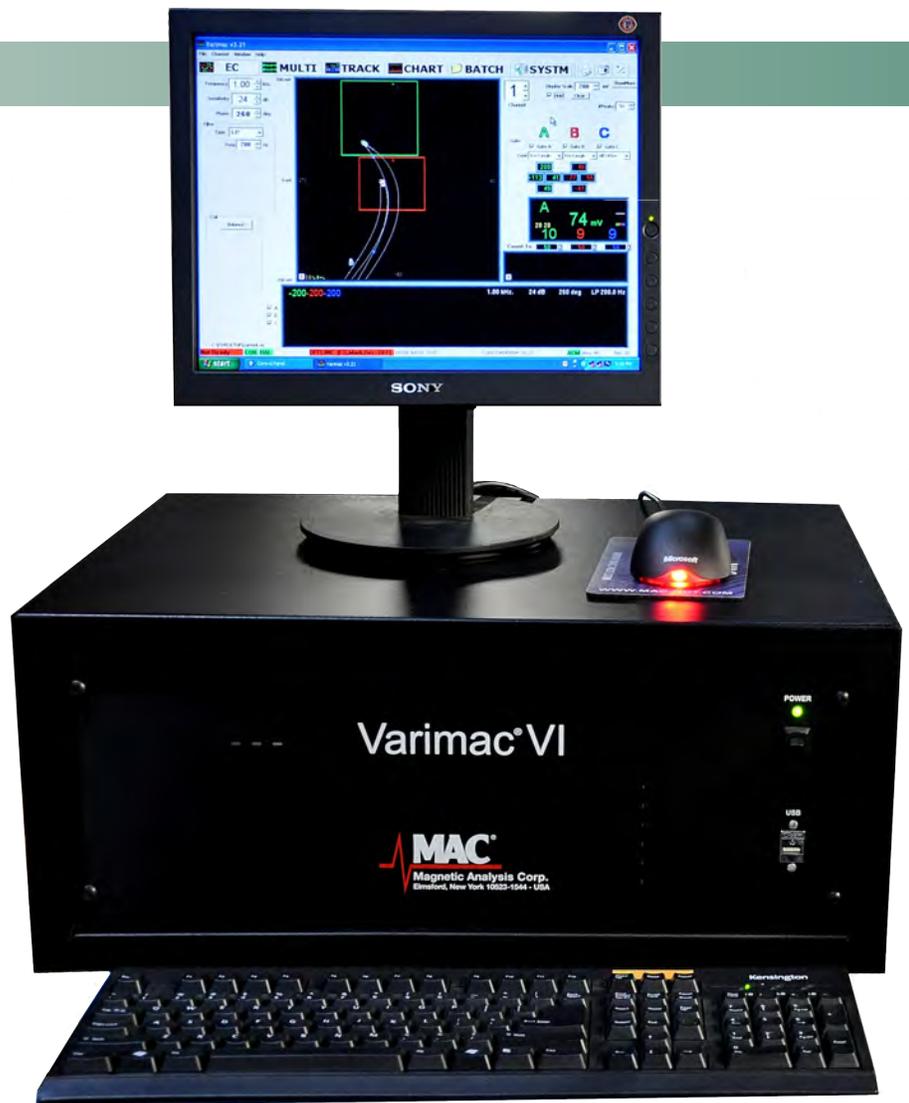
Varimac® VI

High-speed Eddy Current Comparator sorts parts and detects variations.

- Provides fast, convenient sorting of metal parts such as fasteners, bearings and other cold-formed pieces.
- Can also be used for checking alloy and hardness in bar or wire or to detect variations in alloy, hardness, some dimensions, and certain types of cracks in metal bar, tube or parts.
- High-speed continuous operation and reliability in production environments.
- When used with MAC's Parts Gates, sorts and counts at speeds up to six parts per second, into three separate groups.

Find out more at: http://www.mac-ndt.com/varimac_eddy_current_comparator/

B R P T W



Production Comparator

Low-frequency tester for ferromagnetic materials.

- Detects variations in alloy, heat treatment or case depth.
- Allows for rapid NDT sorting of ferromagnetic parts.
- Choice of Polar (Vector) or Lissajou screen displays.
- Optional 8-channel multi-frequency software.
- Can be set up and monitored on-site, or through a computer network.

Find out more at: <http://www.mac-ndt.com/production-comparator/>

B R P T W

Material Handling Equipment

MAC's full range of handling components help to ensure that NDT inspection systems reach their fullest potential.

Standard and Custom-Designed Options

- Components and systems are available to precisely hold and position test instruments, test coils, rotary and drives.
- Conductor controls allow complete command of test benches, multiple test instruments and pinches.
- Extensive input/output configurations can be handled by programmable logic controllers (PLC).

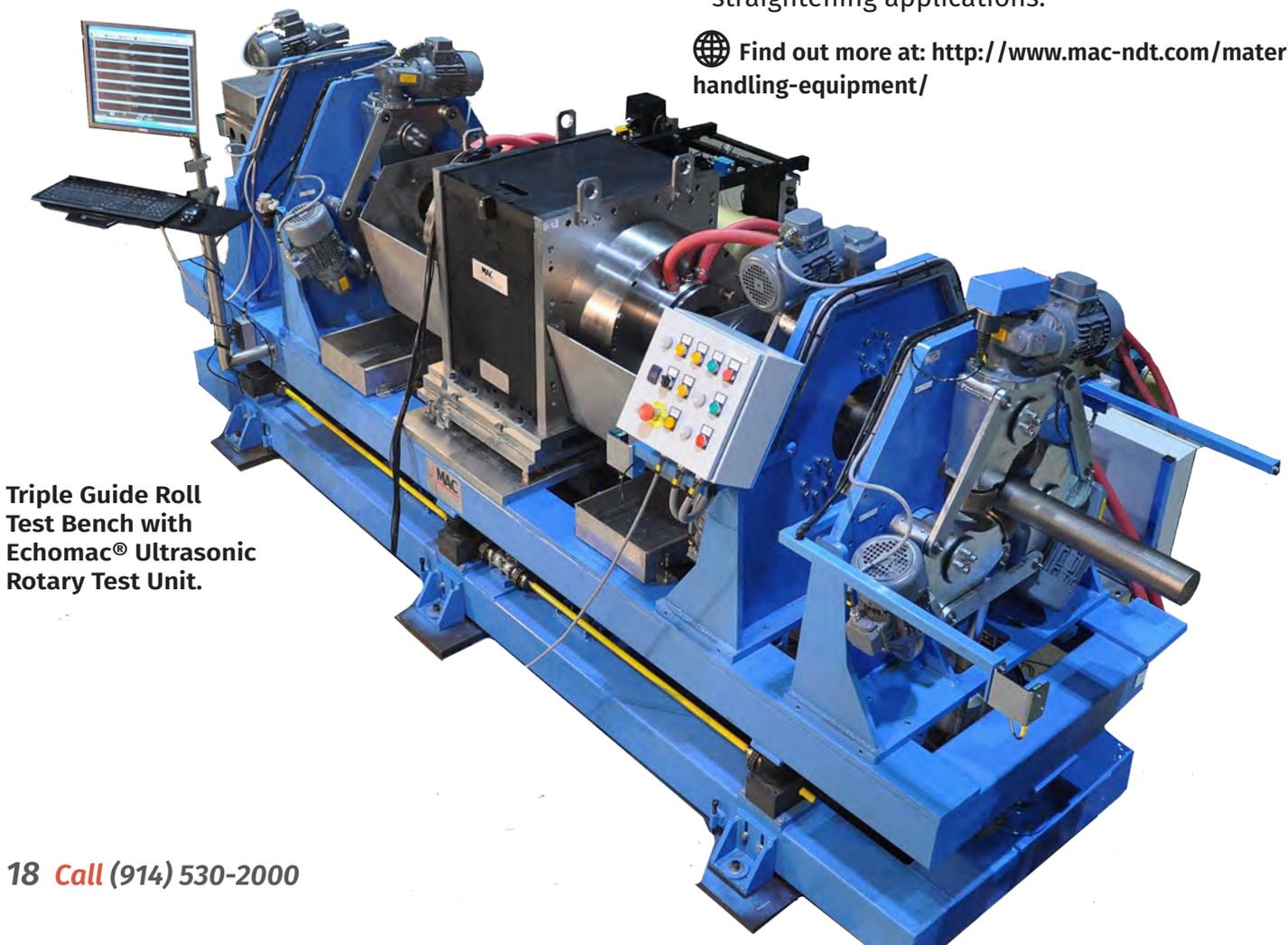
“V” Roll Test Bench

- Our standard test bench utilizes 120° “V” rolls and pinch stands to accurately support and position test material.
- “V” rolls feature three points of contact and a flat top roll to ensure firm support and eliminate vibrations.
- Automated or manual controls are offered for making easy adjustments in testing material size and diameter.

Triple Guide Roll Constant Center Test Bench

- Eliminates vibrations that can cause false reject signals.
- Convenient, automatic conductor controls adjust bench height and openings to accommodate changes in material dimensions.
- Recommended for testing upset pipe and tubes with badly formed ends, or in difficult straightening applications.

🌐 Find out more at: <http://www.mac-ndt.com/material-handling-equipment/>



Triple Guide Roll Test Bench with Echomac® Ultrasonic Rotary Test Unit.

Support & Services

MAC Lease Options

- We offer short- and long-term operating leases on most standard test systems.
- Installation assistance, training and field staff service is provided as part of the lease.
- Service contracts or pay-per-visit arrangements also available for purchased systems.

🌐 Get more details at: <http://www.mac-ndt.com/leasing/>

ISO 17025 Accredited Test Facility

- Our Boardman, Ohio facility handles small jobs that might not require investing in a system.
- Can test and return ship your product within 48 hours if necessary.
- Gives you access to encircling coil, rotary probe eddy current, high-speed rotary ultrasonic and other testing methods.
- Meets industry specifications, including ASTM E-213, ASTM E-243 and MIL STD 2154.
- Call (330) 758-1367 for information.

🌐 Find out more at: <http://www.mac-ndt.com/test-facility/>

Remote Pre-Acceptance

- View and approve full operation of your new system without leaving your office.
- Eliminates scheduling challenges and reduces travel expenses.

▶ View the video at: https://youtu.be/VVi_Nievu4g

Expert Support and Training

- MAC's global network of engineers, district managers, business development managers and representatives are always available to answer questions and address your concerns.
- These team members, trained per ASNT requirements, can provide calibrations, maintenance, upgrades, repairs, installations and staff training.

🌐 For NDT training information, visit: <http://www.mac-ndt.com/ndt-training/>



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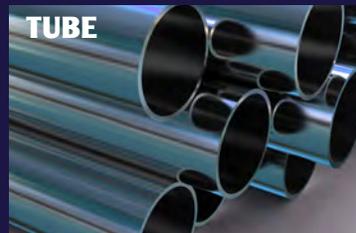
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