THE MALE REDGE

NDT Technologies. Performance. Test Systems. People.











Product and Services Guide

Magnetic Analysis Corp.

www.mac-ndt.com

The MAC® Edge Has



Today, more than ever,
The MAC® Edge offers a
valuable asset for metal
manufacturers the world over.
As the company continues to
grow through initiatives such
as our recent acquisition of
TacTic™ UT Test Systems, we are
also finding new ways to bring
critical NDT solutions, services

and expertise to a wider range of customers.

Many of you already know that as soon as discussions begin to purchase or lease our equipment, the MAC team of professionals becomes part of your team. Our Business Development Managers are there to help you identify the right equipment to meet your requirements... or even assist you in defining exactly what those requirements should be. Our Field Engineers, many with ASNT Level III certifications, will guide you through preparation, installation, startup and the training of your operators.

These same experts will be available to support you along the way. They're also the people who make The MAC® Edge possible...and stand behind it every day of the year.

Dudley Boden President & CEO

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INSTRUMENTS. TEST SYSTEMS

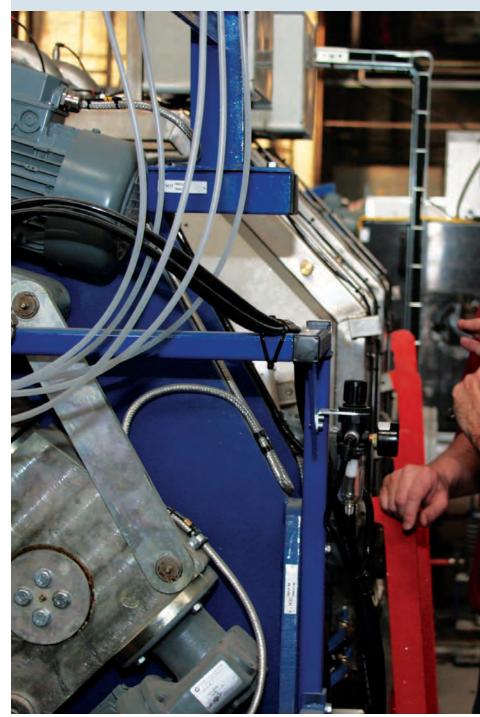
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Four Cornerstones









In The **Spotlight**

NEW ROBOTIC ECHOMAC® PA TW page 18

Operatorfriendly system detects weld zone defects in tube and pipe



ECHOMAC® PA BT FOR BAR page 18

Provides 100% inspection of round bars for core and surface defects



ECHOMAC® UT 25MM ROTARYpage 19

Inspects highprecision small diameter tube and bar



TACTIC™ **IS NOW** PART OF MAC®page 22

Broadening MAC's range of NDT systems

BAR TESTING

MAC offers complete systems with a range of technologies to evaluate defects and integrity in round, square and hex bar. Eddy Current, Ultrasonic and Magnetic Flux Leakage testing methods, used alone or in combination, can be applied to carbon steels and stainless alloys, as well as aluminum, titanium, copper and other non-ferrous metals.

Inspecting for Internal Discontinuities and Inclusions

Normal incidence and shear wave Ultrasound is the preferred method for applications where a full volumetric inspection of bar is required, such as detecting small internal flaws, voids and other anomalies, as well as shallow seams and subsurface defects.

- The new Echomac® BT Phased Array UT Bar Tester (p. 18) inspects a wide range of round and square bar diameters at speeds up to 2m/ sec with minimal operator adjustments.
- Echomac® UT Rotaries (p. 19) are often used for high-speed testing of round bar from 5-500mm diameter.

MAC's TacTic™ cost-effective "spin the bar" immersion-style UT systems

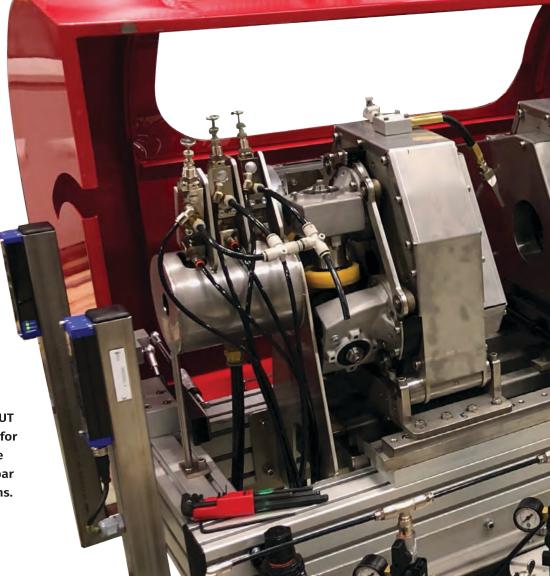
 (p. 19) are a good option for testing small batches of material or for situations that require frequent diameter changes.

Detecting Longitudinal Surface Seams

MAC's Eddy Current MultiMac® instrument (p. 20) with a Rotomac® Rotary (p. 21) spins test probes around the bar to detect seams as small as 0.10mm deep in asdrawn material. If the bar is surface finished, it is possible to detect shallower seams.

Finding Short Length Surface & Subsurface Flaws

Eddy Current MultiMac® (p. 20) will provide the best results. The encircling test coil detects changes in the flow of eddy currents around the short defects and is often used in conjunction with the Rotomac® Rotary (p. 21).



Top-of-the-line Echomac® UT 25mm Rotary System tests for longitudinal and transverse defects in small diameter bar used in medical applications.

Eddy Current Rotary and Encircling Coil Testers detect longitudinal "We can provide complete and transverse defects in SBQ bar. turnkey systems with worldclass instrumentation and a full range of material handling equipment. In addition, your project will be guided by a single collaborative team. This all makes MAC the best choice for any bar manufacturer." Ben Longman International Systems Engineer

Visit www.mac-ndt.com 5



Small Quantities of Round Tube, Pipe and Bar

MAC's recently acquired TacTic™ UT immersion tank systems (p. 19), operating with Echomac® UT test electronics (p. 18), provide a cost-effective method for testing small batches and frequent size changes. Models are available in configurations that inspect round materials with diameters ranging from 6.35-200mm and solid bars from 6.35-150mm.

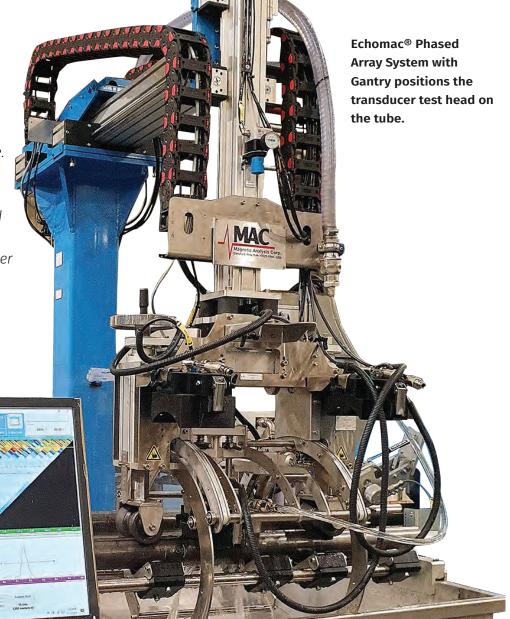


Echomac® UT 25mm Rotary for testing high precision small diameter tube and bar.

TUBE TESTING

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MAC has a full range of technologies, instruments and mechanics for automated inspection of welded, seamless, stainless, alloy, heavy wall, ferrous and nonferrous tube and pipe. Our experience—which has included countless manufacturing processes, configurations and sizes—is anchored by a large base of test equipment that meets ASTM, API, EN, ISO and other industry quality standards.



Detecting Long Continuous Seams, Inclusions, Voids or Cavities in Moderate to Heavy Wall Welded Tube & Pipe

Ultrasonic technology is recommended for the detection of incomplete seam welds and inclusions, voids or cavities in thicker wall tube and pipe. MAC's Echomac® line of ultrasonic test systems (p. 18-19) can inspect the weld zone or the full body.

- Conventional Echomac® Ultrasonic **Systems** use fixed or rotating test transducers mounted in a mechanical system to position the transducers for the test. Rotaries can test a wide range of circumferences from 5-500mm diameters.
- Phased Array Echomac® Systems (p. 18) utilize a gantry or robot to position the test transducer head on the tube for testing the weld. A large range of diameters can be tested and these systems can provide better coverage of the weld zone with less operator intervention and maintenance than conventional UT.
- Flux Leakage Systems, such as MAC's Rotoflux® DC (p. 21), are also available to detect longitudinal and transverse surface defects on the OD and ID of heavy-wall tubes. These are often used in combination with an Ultrasonic test to comply with API standards requiring dual test methodologies.

Detecting Short Surface ID/ OD Defects in Thin Wall Tube

Eddy Current technology is the most versatile and cost-effective method for testing thin wall metallic tubes. It is applicable to a broad range of diameters and throughput speeds and can detect short, incomplete welds as well as subsurface and inside diameter conditions in carbon steel, stainless or nonferrous tube. MAC's MultiMac® (p. 20) or Minimac® (p. 20) testers, used with encircling test coils and coil platforms, both provide effective solutions.

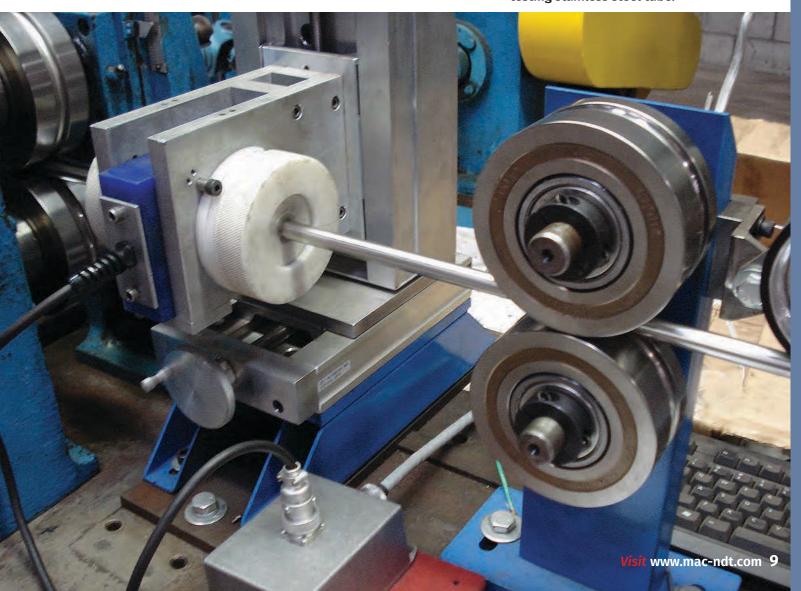
Detecting Long Continuous Surface Seams in Seamless Tube

A MultiMac® (p. 20) used with a Rotomac® Rotary (p. 21), which spins the test probes around the tube, is recommended for detecting long surface seams, especially in thin wall tube. Diameters from 5-180mm can be supported. A MultiMac® instrument with encircling coil and rotary probes can be used in combination for testing short flaws as well as surface seams.

Measuring Eccentricity

An Echomac® Ultrasonic test (p. 18) can be installed during the extrusion process while the tube is being drawn or in the final cut length. The test allows highly accurate measurements of the tube dimensions, wall thickness, and outer and inner diameter shape to monitor eccentricity. This process monitoring can be critical for nuclear or seamless applications.

Eddy Current Encircling Coil with Bushing testing stainless steel tube.



TUBE TESTING

Detecting Surface & Subsurface Defects Using Immersion "Spin the Tube" Systems

MAC's recently acquired TacTic™ "spin the tube" Ultrasonic Immersion Tank Systems (p. 19) provide cost-effective solutions for testing small batches of material or for frequent diameter size changes. The systems operate with MAC's Echomac® UT test electronics (p. 18). Systems for inspecting round materials with diameters ranging from 6.35–200mm and solid bars ranging from 6.35–150mm are available.



MAC's Echomac® FD 6/6A ultrasonic instrument with TacTic's™ Model 76 EX-24 "Spin The Tube" Immersion-Style System to test titanium tube.

Monitoring Weld Profile & Detecting Longitudinal Weld Zone Defects

MAC's Echomac® PA TW Phased Array Ultrasonic system (p. 18) - installed in the hot zone, close to the welder, at temperatures up to 252° F (122°C) – is an excellent choice to monitor the seam trim tool. The upstream location allows quick operator feedback on scarfing tool errors and gross welding defects. The system can also operate in the cool zone, after the forming rolls, for higher precision defect detection as the pipe has a more predictable shape and temperature. The Phased Array system can handle pipe 51-700mm diameter.

Finding Inclusions in Finned Tube

A two-channel MultiMac® (p. 20) with an MID (Magnetic Inclusion Detector) will detect small ferromagnetic inclusions in nonferrous tube. The system would include a Coil Platform, specialized ZZ coils and a Pinch Stand. Flaws in all areas of the tube, including the land/transition, finned, and smooth non-finned sections, can be detected.



Echomac® PA TW Phased Array UT

WIRE AND ROD TESTING

Eddy Current technology is the go-to method for checking continuity, alloy, flaws and other conditions. It's also used for locating welds and splices in a range of metal wire including cut lengths, continuous production, stranded, multi-conductor and insulated cable. Carbon steels, stainless alloys, copper, titanium, nitinol and other nonferrous metals can also be inspected.

"MAC is continuously improving its product lines to meet increasingly demanding testing requirements."



Garrett Vidak Field Engineer

Detecting Short & Longitudinal Defects in Cold Drawn Wire

A MultiMac® Eddy Current Tester (p. 20) can be installed on processing machine lines to inspect for surface defects. By using encircling test coils with DC saturation, magnetic steel wire can be tested to detect short defects. Combining encircling test coils with a Rotomac® Rotary ET System (p. 21) allows detection of both short and longitudinal defects.



MultiMac® Eddy Current Tester inspects hex and round bars on a Schumag line. A CP 65mm "floating" Coil Platform with pneumatically loaded triple guide rolls is in the foreground.

WIRE AND ROD TESTING



Detecting Longitudinal Defects in Slow Throughput Operations

The Rotomac®25 RM Rotary (p. 21) provides cost-effective, reliable online inspection for longitudinal surface defects in 3-25mm diameter wire, rod and heavy wall tube when combined with MAC's Minimac® 60/65. The Rotary is designed for cold heading, spring making, strut rod and other slow throughput operations.

Testing for Splices, Welds & Breaks

MultiMac® (p. 20) is a good choice to handle high throughput speed testing of multi-conductor wire to detect splices, welds and breaks. Split coils (p. 21) are available to accommodate oversize splices.

Checking for Continuity in Wire

Minimac® 50/55 Compacts (p. 20) require minimal operator time to check for continuity in single- or multi-conductor insulated wire and cable. They can be installed directly on the production line. Split or segment coils (p. 21) can be used to allow for dimensional changes in the outside diameter of the insulation.



Detecting Variations in Alloy, Heat Treatment, Case Depth & Hardness

The Varimac® Eddy Current
Comparator Tester (p. 20)
can test a range of product
shapes and materials including
nonmagnetic stainless steel.
Variations in carbon steel wire
are best detected by the lowfrequency electromagnetic
Production Comparator (p. 20).



Varimac® Eddy Current Comparator

"When MAC's Metal Inclusion
Detection Coils (MID) and
Grading Software are used
together, they give our
customers the advantage
of evaluating wire and rod
quality at very high speeds.
The MID Coil will detect ferritic
inclusions in copper that would
ultimately be injurious to the
end user's product."



Dave O'Connor District Manager

Detecting Defects in Small Diameter Wire

Test frequencies up to 5 MHz are most effective on diameters as small as 0.004mm using encircling coils. The 20mm Rotomac® High Speed Rotary (p. 21) is designed to detect longitudinal defects such as seams and laps in wire ranging from 2-20mm diameter. It operates at speeds up to 18,000 RPM for high production output.



PARTS TESTING

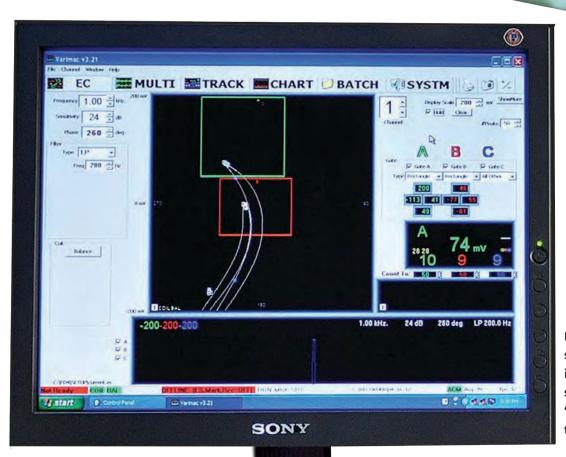
"MAC excels at fast and economical solutions for inspecting and sorting parts. Our leadership stems from a selection of highly adaptive comparator equipment and the support of a professionally trained field staff. It's a combination that has proven to be an important asset for our customers."



Mike Rakos District Manager MAC's installed testers can inspect a broad range of parts during fabrication. These include fasteners, ball bearings, pistons, strut rods, expanders, pins and medical needles, as well as components such as tubes, bars, plates and wire.

Detecting Physical Characteristics

MAC's comparators are the best choice to check 100% of your parts for dimensions, alloy, grade and heat treatment. Varimac® (p. 20) can handle ferrous or nonferrous materials. The Production Comparator (p. 20) is a low-frequency tester for ferromagnetic materials. Both can be used with MAC's Parts Gate for high-speed 3-way sorting of up to six parts per second.



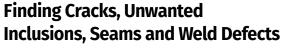
Three-way parts gate for sorting.

Rectangular target boxes show "acceptable" parts in the green box, "above spec" in the red box, and "below spec" outside the boxes.

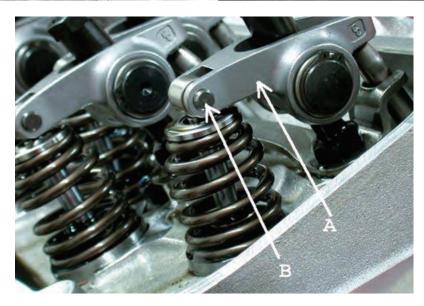
Assessing Nodularity in Ductile Iron Cast Automotive Components

Echomac® VM (p. 19) evaluates velocity, thickness or flaw detection to meet the industry-accepted means of testing automotive part integrity. Two parts can be tested simultaneously from separate test stations using only one instrument. Associated test immersion tank systems are also available.





MAC's Eddy Current, Ultrasonic and Flux Leakage technologies can be applied to inspect many ferrous and nonferrous parts, similar to the applications used for testing wire, bar and tube.



Valve train assembly with pins (B) that have been tested by a Varimac® for proper heat treatment, and a rocker arm (A) that is inspected by the Production Comparator to detect gas pockets resulting from the casting process.

COMPLETE SYSTEMS

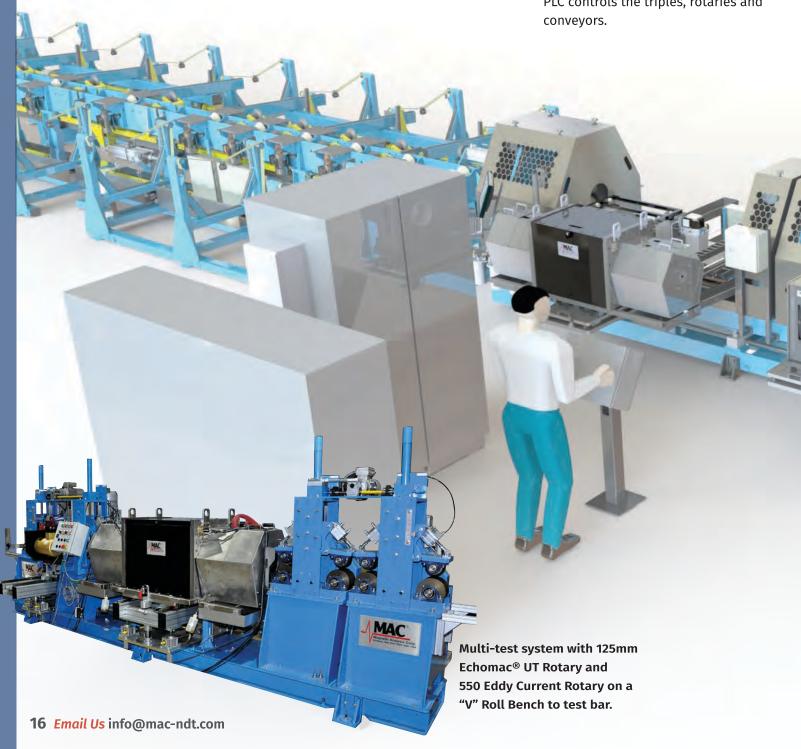
Whether you need to inspect bar, tube, wire or parts, MAC's full range of test benches, coil platforms and handling components can fully integrate with your production process. When combined with MAC instrumentation, your NDT inspection systems can reach their fullest potential.

Standard and Custom-Designed Options

Components and systems are available to precisely hold and position test instruments, coils, rotaries and drives. Conductor control options enable complete command of test benches, multiple test instruments and pinches. In addition, extensive input/output configurations can be handled.

Triple Guide Roll Constant Center Test Bench

This bench is a constant centerline guiding and driving unit that propels the tube or bar through the test units. The dual leading and trailing triple guides guarantee a controlled entrance and exit from the test stations which eliminates vibrations from tubes that can cause false reject signals. Almost no manual settings are needed when dimensions change, and the PLC controls the triples, rotaries and conveyors.



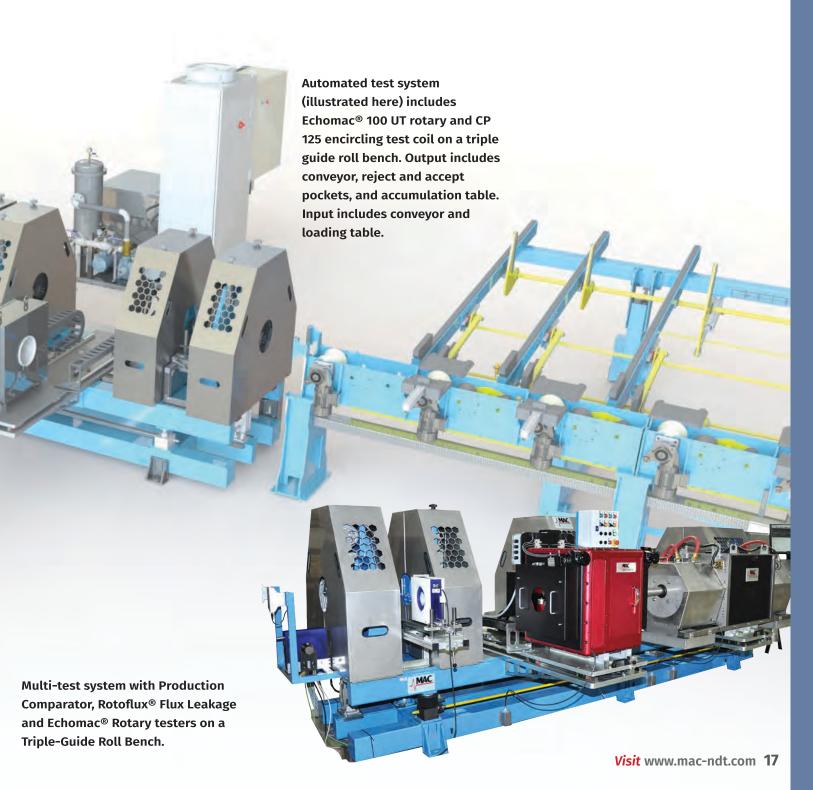
"V" Roll Test Bench

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

"Magnetic Analysis is the only manufacturer that can supply a complete testing solution with multiple NDT technologies. Thanks to the company's wealth of experience, our customers are guaranteed to get a true turnkey solution that is seamlessly integrated."



Casey Powers
Director, Asia/Pacific Operations



For Conventional and Phased Array Ultrasonic Testing



Echomac® FD-6/6A

- On- or off-line flaw detection, thickness, weld inspection and dimensional measurement of bar and tube
- · Operates with rotary, immersion, squirter, bubbler and spin the tube systems
- High S/N ratio, precise thickness resolution (<1µm), and excellent repeatability









Echomac® SM

- · Detects flaws, thickness and eccentricity and also measures dimensions of tube, bar and wire
- Features up to 8 channels, a compact cabinet and built-in screen
- · Operates with rotary, immersion, squirter, bubbler and spin the tube systems







Robotic Echomac® PA TW

- Finds defects in tube and pipe caused by scarf or the welding process
- · Cost-effective phased array test system for welded tube
- Weld profile quickly alerts operator to scarfing process issues
- Detects longitudinal OD/ID defects
- Minimal operator intervention
- · Can operate in hot zone close to weld operation



TEST SYSTEMS



Echomac® UT or PAUT With Gantry

- Ultrasound detects OD/ID and longitudinal defects
- Using multi-element transducers, PAUT inspects a range of locations in the weld line before and after the forming rolls
- PAUT detects defects and monitors scarfing process



TEST SYSTEMS

В



Echomac® PA BT

- Handles a wide range of bar diameters in a single installation
- 100% inspection of round bars for core and surface defects
- 3 Models cover a range of 10-254mm diameter
- Change cassettes for different sizes in under five minutes





For Conventional and Phased Array Ultrasonic Testing



Echomac® Velocity Measurement

- · Assesses nodularity in ductile iron cast automotive parts
- Evaluates velocity, thickness or flaw detection
- · Can test two parts simultaneously, from separate test stations









Echomac® PA Wheel Tester

- For in-service rail wheel tread inspection
- · Automated and semi-automated options
- Handles wheel diameters 650-1350mm





Echomac® PA Composite Parts Tester

- Inspects a wide array of part geometries
- Scalable system for adding channels as needed
- · Meets or exceeds U.S. and international specifications for aerospace and automotive industries





TacTic™ "Spin the Tube" UT

- For round tube or bar 6.35–200mm diameter
- Immersion type "Spin the Tube" system
- Detect surface and subsurface defects
- Cost effective for small batches or frequent diameter changes





Echomac® Rotaries can test materials ranging from 5-500mm diameter. We show two of our models.



Echomac® 25mm UT Rotary

- Tests 5-25mm diameter material with wall thickness down
- 630mm length allows easy installation in existing lines
- Precise thickness resolution (<1µm) for excellent repeatability

BIT



ROTARIES



Echomac® 150mm UT Rotary

- · High speed testing of round bar & tubular products
- Tests 30-150mm diameter material
- Maximum RPM is 1800





For Eddy Current Testing



MultiMac®

- · Simultaneous coil and/or rotary probe testing
- Up to 8 test channels to use in any combination
- · Detects transverse, short and/or longitudinal, seam-type surface defects
- · Tests magnetic or non-magnetic material





INSTRUMENTS



MultiMac® SM

- Two independent test channels
- Housed in a smaller 20"x12"x12" cabinet with a built-in 15" screen
- · Can test nitinol wire



RPTW



Minimac® Compacts

- Two affordable, single-channel high-speed options
- Both detect short surface and some subsurface defects
- Minimac® 50 is designed to inspect continuous product
- Minimac® 55 tests continuous product or cut lengths







Varimac® Comparator

- · Fast sorting of metal parts for physical variations
- · Check alloy, heat treatment or hardness in bar or wire
- · Select and adjust threshold levels within on-screen target regions
- Use with MAC Parts Gate to sort up to 6 parts per second





INSTRUMENTS



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

BP



INSTRUMENTS



Eddy Current Rotaries with rotary test probe technology are the method of choice for detecting seam-type defects. MAC's range of Rotomac® models can test from 3-180mm diameter.





25RM Rotomac® Cost-Effective Rotary

- Reliable on-line inspection for longitudinal surface defects in products ranging from 3-25mm diameter
- Operates at speeds up to 1,000 RPM for slow throughput applications



ROTARIES



20mm Rotomac® High-Speed Rotary

- Fast EC testing for longitudinal defects in smaller diameter
- Detect surface flaws such as seams and laps in products ranging from 2-20mm
- Operates at speeds up to 18,000 RPM



EDDY CURRENT



150mm Rotomac® Rotary

- Inspects products 12.7-150mm diameter
- Up to 1800 RPM, continuously variable

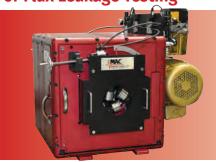
WRB



EDDY CURRENT ROTARIES



For Flux Leakage Testing



Rotoflux® AC Flux Leakage System

- The best technology to detect surface defects in hot rolled black steel bar
- Tests 15-180mm diameter
- Detects longitudinal flaws down to 0.1mm in depth







Rotoflux® DC Flux Leakage System

- · Finds defects in heavy wall OCTG
- Detects OD and ID surface defects and internal flaws.
- Models available for 30-500mm diameter



For Test Sensors



Coil Platforms and More

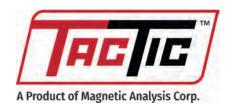
- Coil platforms for encircling, segment or tangent-type testing of materials 2.54-304.8mm
- Encircling coils, ceramic bobbins, rotating headplates with probes and UT transducers are available

SUPPORT & SERVICES

"An exciting addition to our support and services is the company's asset acquisition of TacTic™ Ultrasonic Systems. This extends our solutions into the aerospace industry and places MAC's NDT service options within the reach of customers who couldn't access them before."



Jerry Zhu Business Development Manager, China



TacTic™ Ultrasonic NDT Systems

MAC's recent asset acquisition of TacTic™ broadens our range of NDT systems. The MAC portfolio now includes automated and specialized immersion, "spin the tube" ultrasonic test systems to detect surface and subsurface defects in round tube, pipe and bar.

These systems are ideal for laboratories and manufacturers that are looking for a cost-effective system to test small batches or need to make frequent diameter size changes.

TacTic™ customers also gain the advantages of local support, service and calibration capabilities provided by MAC's global network of sales and technical staff. In addition, MAC will be able to offer leasing options to many of these customers for the first time.

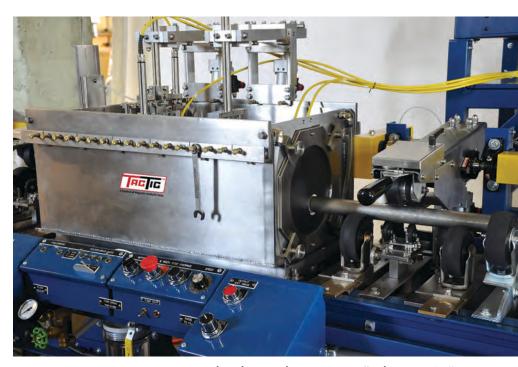
For nearly 95 years, metal producers the world over have relied on MAC's innovative NDT solutions. Our global support team spans 25 countries and includes the collective expertise of over forty Field Engineers and Representatives.



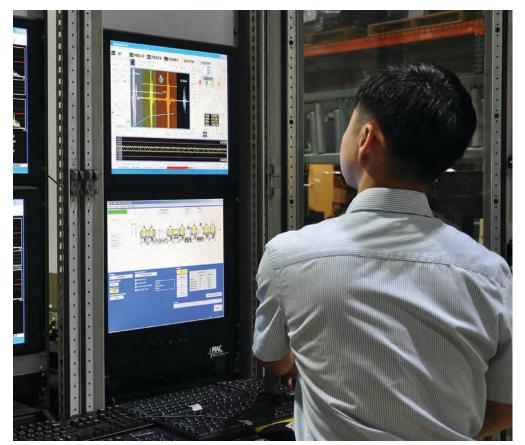
Flexible Lease Options

We offer short- and long-term operating leases on most standard test systems.

- Installation assistance, training and field staff service are provided as part of the lease
- Service contracts or pay-per-visit arrangements are also available for purchased systems



TacTic™ immersion tank and "spin the tube" conveyor. Transducer holder is shown above the tank.



Handle Small Jobs with our ISO 17025 Accredited **Test Facility**

MAC's Boardman, Ohio U.S.A. manufacturing and testing facility handles small jobs that might not require a customer's investing in a system.

- Test and return-ship your product within 48 hours if necessary
- · Gain access to encircling coil, rotary probe Eddy Current, high-speed Rotary Ultrasonic and other testing methods
- The facility can test your product to industry specifications, including ASTM E-213, ASTM E-243 and MIL STD 2154
- Call (330) 758-1367 for more information



Upgrade Existing ROWA or BIS UT Phased Array Installations with ZMS from MAC

As the single-point supplier for the program, MAC can assist you with sales, system integration and aftersales service.



Your Assurance of Worldwide Support

MAC's global network ensures your highest productivity and satisfaction:

- · Staff members trained and tested to ASNT requirements, many with Level III ASNT certification
- Immediate remote diagnostic support backed with a strong field team for quick resolution of issues
- · Ultrasound, Eddy Current, Flux Leakage and Electromagnetic testing techniques
- Detailed knowledge of mill production processes
- · Latest technology to meet all industry standards
- Rigorous factory and site acceptance testing to meet customer requirements
- · Complete service of products: installation, training, maintenance and extended warranty
- The support of MAC's Research and Development operations in the US, Sweden, Italy



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Instruments, systems and solutions for nondestructive testing.











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