

Photo courtesy of Absolute NDE



- Compact, powerful, and versatile
- Short inspection cycle time
- Accurate detection and sizing
- User-friendly software
- Sector and linear electronic scans
- Advanced capabilities

Built upon an extensive field experience, the new PipeWIZARD® system offers a highly reliable solution for onshore and offshore inspections in harsh environments.

# Girth Weld Inspection System

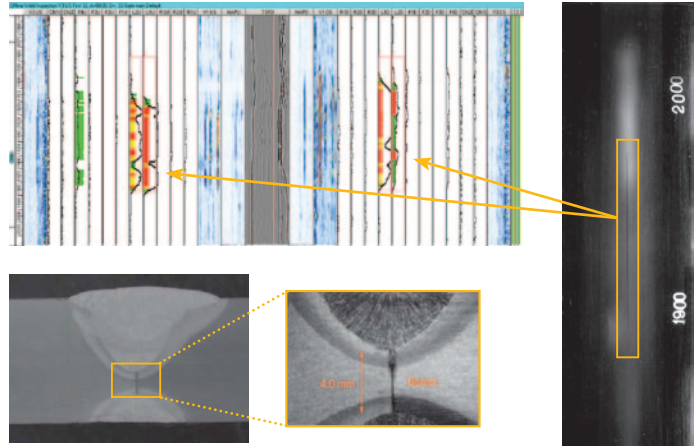
Pipelines perform a critical function in the global economy, transporting huge volumes of gas, oil, water, and other chemicals. Pipes are girth-welded on-site, typically using automated welding systems. For construction of pipelines, welds are the “weak spot” as this is where defects tend to occur. Welds are nondestructively tested, coated, and buried or laid on the sea bed. Due to the demanding construction cycle, it is important that weld defects be detected and analyzed very quickly.

## Automated Ultrasonic Testing (AUT)

In the last several years, automated ultrasonic testing (AUT) has begun overtaking traditional radiography as the pipeline weld inspection method of choice throughout the world. Radiography has significant limitations: poor detection of planar defects, no vertical sizing capability, safety issues, and environmental concerns.

### The advantages of AUT:

- No radiation hazard, no chemicals, no licensing
- Very short inspection cycle time for high production rate
- Better detection and sizing accuracy, leading to lower rejection rate
- Use of Engineering Critical Assessment (ECA) acceptance criteria with measurement of vertical height and depth of indications, reducing rejection rate
- Real-time analysis from smart output display
- Data and inspection reports on electronic support
- Better control of welding process, also giving lower rejection rate



AUT allows clear detection and identification of defects.

## Phased Array Technology

The early AUT systems used multiprobe systems with conventional ultrasonic probes. A decade ago, phased array systems became available. Phased arrays use electronic beamforming to generate and receive ultrasound. Each element in the array is individually pulsed and delayed to create a wide range of beam angles and focal distances.

Phased arrays offer major advantages over conventional multiprobe systems:

- Typically, two phased array probes replace more than 24 conventional transducers
- Phased array setups are performed by loading a file, not by adjusting each individual transducer position
- Phased array beams are optimized (angle, focus, UT path, beam width) by setting appropriate parameters in the software, leading to better sizing accuracy
- Phased array system has about 80% fewer moving parts than equivalent conventional multiprobe system, giving steady inspection reliability scan after scan
- A phased array scanner is significantly smaller and lighter than conventional multiprobe scanner. It is then easier to manipulate and requires less coating cutback on each side of the weld
- Phased array systems are used to inspect almost any type of weld configuration, while conventional multiprobe systems are limited in wall-thickness and pipe diameter
- Phased array electronic scanning allows customized weld inspections, including multiangle TOFD, advanced imaging, and detailed inspections

### Phased array: Complete coverage with two probes

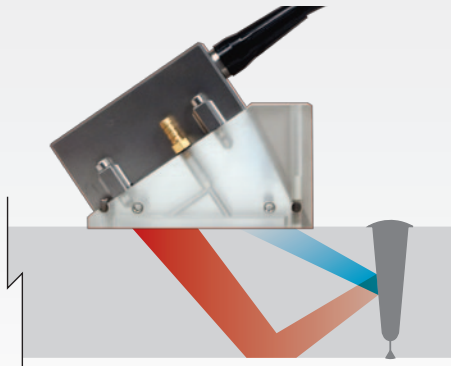


Illustration showing the inspection of one zone. Phased array technology allows the simultaneous inspection of all zones with the same probe. Phased array offers complete coverage of the weld with one probe on either side of the weld.

### Conventional UT: Complete coverage with > 24 probes

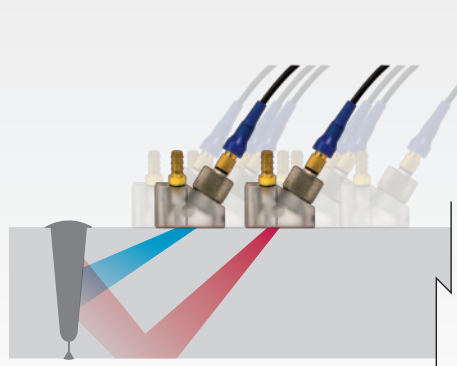


Illustration showing the inspection of one zone. With conventional UT technology several probes are needed to cover all zones.



## Codes Compliance

In 1998, the ASTM published the E-1961-98 code (reapproved in 2003), which covers key elements of AUT of girth welds – zone discrimination, rapid data interpretation, specialized calibration blocks, and configuration procedures. The E-1961 code is designed for ECA. Similarly, in 1999, the American Petroleum Institute (API) published the 19<sup>th</sup> edition of Standard 1104, which covers mechanized ultrasonic testing and radiography of girth welds.

PipeWIZARD allows inspections to comply with the ASTM E-1961 code, and by inference, with the API 1104 standard. It also allows compliance with the DNV-OS-F101 standard, the offshore AUT code.

Company specifications may exceed the codes, typically by asking for improved sizing or better resolution.

## PipeWIZARD Experience

The PipeWIZARD system is specially designed to work in extreme environments, from cold Siberian regions to hot Middle-East deserts; in humid, salty or dry conditions. Extensive tests have been also performed to ensure the PipeWIZARD capability to resist to vibrations, shocks, and electromagnetic interferences.

PipeWIZARD fits all configurations of circumferential welds:

- **Any type of weld profiles:** CRC-Evans, J-bevel, V-bevel, double V, X, etc.
- **Typical pipe wall thickness:** from 6 mm (0.25 in.) to more than 35 mm (1.4 in.)  
Options are available for thicker pipes
- **Typical pipe diameter:** from 6 in. to more than 56 in.  
Options are available for smaller diameters
- **Pipe material:** from standard carbon-steel to more complex configurations like Inconel, clad pipe, seamless pipes with wall-thickness variation, etc.

Typical detected defects are lack of fusion, incomplete penetration, porosity, burn through, undercut, hi-low, crack, cold lap, inclusion, etc.

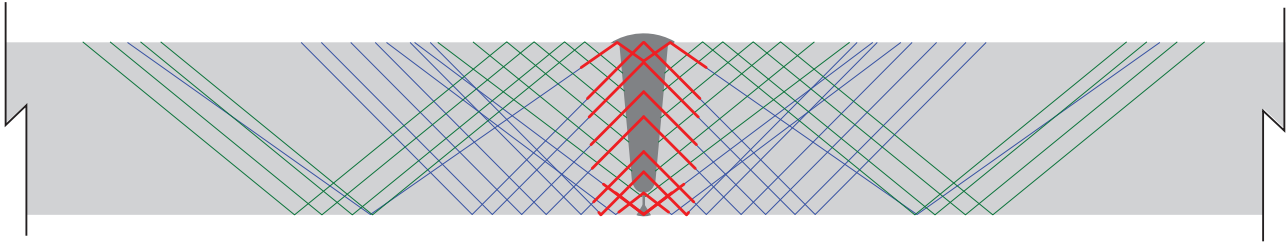
The inspection cycle time is between 2 min and 6 min depending on the type of weld, pipe diameter, location, and environment.

## Summary of PipeWIZARD Deployment

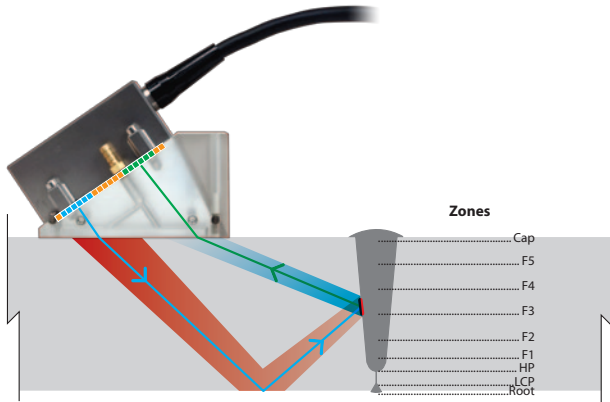
- PipeWIZARD phased array systems are used in the largest onshore and offshore pipeline construction projects throughout the world.
- More than a million welds have already been inspected with PipeWIZARD systems.
- Major oil and gas companies have already qualified the PipeWIZARD systems for pipeline construction projects:
  - Exxon Mobil
  - Shell
  - TOTAL
  - BP
  - Chevron
  - Eni
  - Petrobras
  - Gazprom
- Hundreds of operators in the world are already trained on PipeWIZARD systems.



# Zone Discrimination Inspection Technique



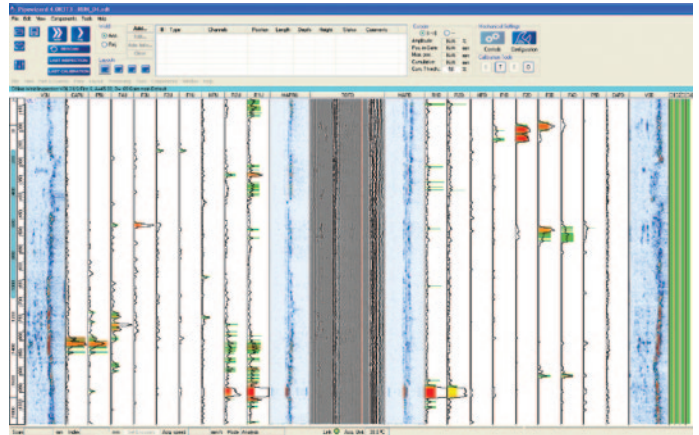
The main technique used with the PipeWIZARD system is the zone discrimination technique where each individual zone of the weld is inspected with a specific ultrasonic beam. The height of the zones is approximately equal to a welding pass.



Dedicated ultrasonic beam for F3 zone

Two phased array probes, one on each side of the weld, ensure a full coverage of the bevel area and the volume of the weld. Pulse-echo and transmit-receive (“pitch and catch”) configurations are used depending on the zone inspected. These phased array channels are displayed in a strip-chart mode.

An additional technique is used to improve detection and sizing on small or misoriented indications: time-of-flight diffraction (TOFD). It is also used to confirm indications detected in the strip-chart channels. TOFD data can be provided by the phased array probes or by dedicated conventional transducers.



An optional transverse module with 4 dedicated conventional transducers can be used to detect transverse indications in the weld.

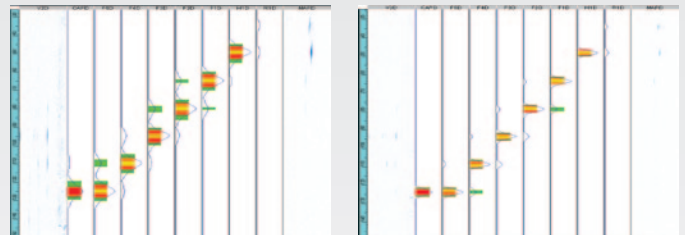
Specific channels are displayed to monitor the coupling of each phased array probe during the scans of the weld and of the calibration block.

Each weld configuration requires a dedicated calibration block with the same diameter, thickness, and material as the pipes to be used on site. Specific reflectors are machined, representing the typical defects more likely to appear during the welding process. All the beams are calibrated according to the inspection procedure.

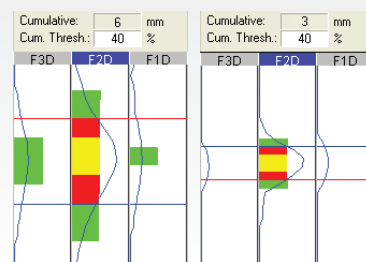
## **NEW** Improved Defect Length Sizing Using Laterally Focused Arrays

Olympus NDT has developed new phased array probes for girth weld inspection with the PipeWIZARD system. These new probes have curved elements in the passive plane, focusing the beam in the lateral direction. An integrated lens permits the use of standard wedges.

These cylindrically focused probes significantly reduces oversizing and excessive repairs. Their capacity to discriminate small indications is a major advantage when sizing the length of an intermittent defect using interaction rules.



Scans performed on the same calibration block with standard unfocused PA probe (left) and curved focused PA probe (right).



Comparison of lateral sizing between standard PA probe (left) and curved PA probe (right) for a 3 mm flat bottom hole.





# Advanced User-Friendly Software

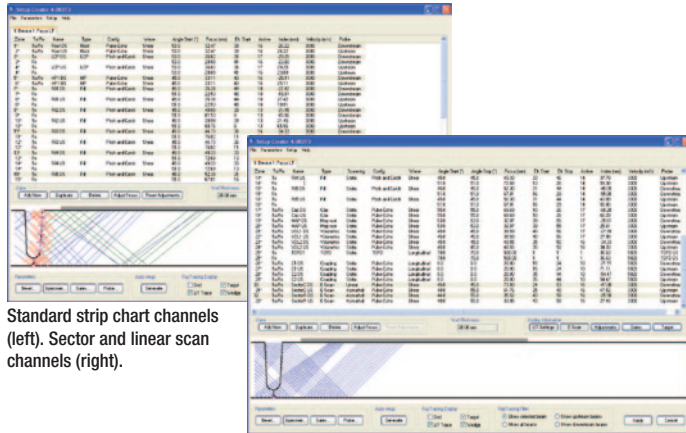
The PipeWIZARD V4 software is based on the robust and field-proven TomoView data acquisition and analysis software. It features simple automatic setup creation, numerous data analysis tools (including 2D-view), easy reporting, and advanced weld inspection capabilities. PipeWIZARD V4 software has been designed to be simple, flexible, and scalable for more complex configurations of inspection. The user interface has been optimized for fast training and efficient field operation; AUT system operators will be able to operate the PWZ V4.0 with minimal training

PipeWIZARD V4 software is based on the TomoView platform, which is constantly reviewed for improvements. It also means that upgrades can be easily implemented even in the field.

## Automatic Setup Creation

An operator can create a setup off-line, independently from the instrumentation. In a matter of minutes, the setup file can be saved and sent to any job location by email, then, the on-site operator only has to calibrate the system.

In addition to standard strip chart channels and single focal-law B-scan views (TOFD, volumetric and root mapping), setups can now feature sector and linear scan channels. This new capability has the potential to improve defect detection and sizing well beyond any zone discrimination code requirements.

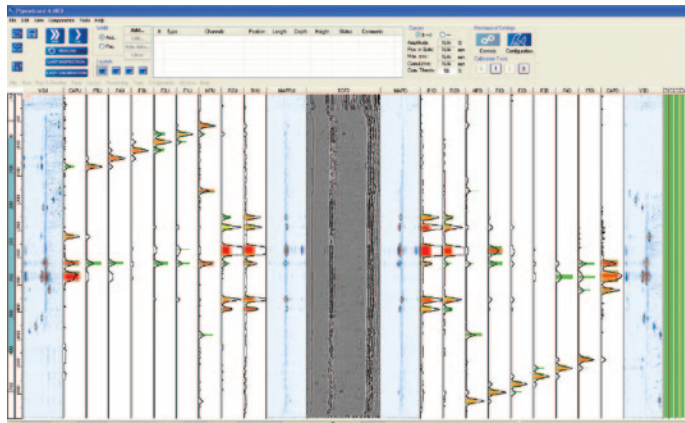


Standard strip chart channels (left). Sector and linear scan channels (right).

## Calibration and Inspection

Data acquired is displayed in real time during the inspection sequence. Data file names are automatically incremented.

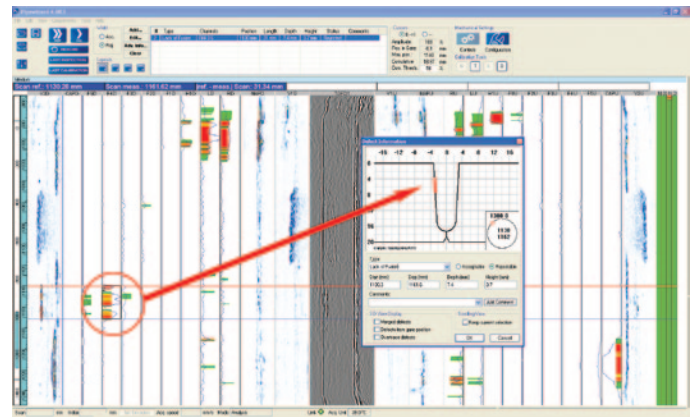
The TomoScan FOCUS LT acquisition unit used in the PipeWIZARD V4 has improved data throughput compared to the previous acquisition unit (4 MB/s vs. 0.7 MB/s). This allows full data collection of compressed A-scan; in addition, multiple setups can be run simultaneously, while scanning at up to 100 mm/s.



Example of a typical calibration scan

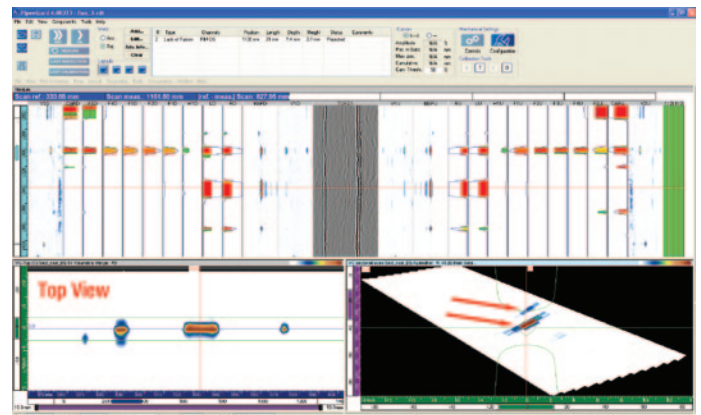
## Rapid and Detailed Analysis

The PipeWIZARD software provides virtually unlimited number of channels in 10 separated layouts. This software allows automatic interpretation of data by displaying the defect position on the bevel profile, as well as its circumferential position.



Many analysis tools are available to help the operator size and position the indications:

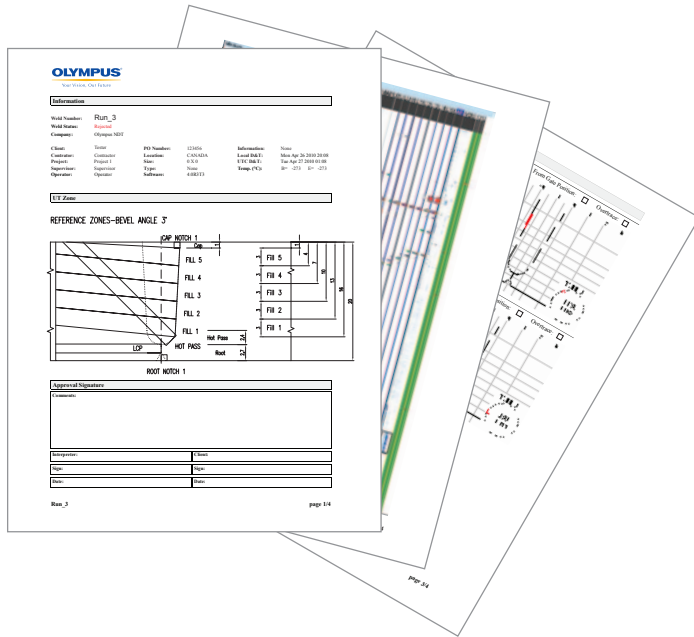
- Twin gate for the strip chart
- Weld overlay on sector scan and linear scan (see below)
- Zooming function
- View linking
- Custom views
- Automatic measuring
- Cumulative indications measurement
- C-scan merge function
- Customizable color palette



Sector scan with weld overlay showing the corner and tip of a 3-mm notch.

## Automatic Reporting

PipeWIZARD software provides automatic report generation. Reports are customizable and may include project name, scan date and time, weld ID, operator's name, full scan views, bevel drawing with information of inspected zones, defect table with identification, length, height, position in the weld, weld status, and operator's comments, etc.



## Easy Data Storage

All data files can be stored on any external hard drive or archived on CD/DVD for further consultation. Automatic backup feature allows data mirroring for increased data security. Data files can also easily be sent via Internet to other parties.

## PipeWIZARD VIEWER

PipeWIZARD VIEWER™ is a free software for phased array and ultrasonic data viewing. This software gives the capability to load data files generated by PipeWIZARD V4 software. It is very useful for third party or end customer to review scans. PipeWIZARD VIEWER software runs on Microsoft Windows XP Pro with SP2, Microsoft Windows Vista, and Microsoft Windows 7.

## Advanced Applications

The PipeWIZARD system is versatile and allows the inspection of special weld configurations and applications.

**Cladded pipe:** PipeWIZARD is already qualified for cladded pipe projects with specific inspection techniques using longitudinal waves and the advanced capabilities of the software.

**Seamless pipe:** a unique inspection technique has been developed and qualified for PipeWIZARD software to allow the inspection of welds with large variations of pipe wall thickness.

**Thick pipe:** PipeWIZARD system can be adapted to inspect welds of thick pipe using different probes, wedges, and with minor mechanical modifications.

## Service Support

Olympus is committed to meeting or exceeding our customers' expectations in the support of all Olympus products.

PipeWIZARD operates in environments and conditions, which require zero downtime. Olympus has a proactive approach to supporting the PipeWIZARD for customers all over the world. This approach will utilize the Olympus service centers to maintain a comprehensive inventory to assure customer have available spare parts in order to minimize costly downtime.

Olympus also has trained System Support Group field engineers to provide PipeWIZARD assistance.

## Other Applications

Another example of the PipeWIZARD versatility is the fact that it is built using standard components. Hence, the TomoScan FOCUS LT Rack mount can be used separately from the PipeWIZARD system to perform any kind of phased array inspection with TomoView software (included in the original software package).

Other scanners (WeldROVER, COBRA, corrosion scanners) can be used with this instrument, maximizing your investment.



### Possible applications include:

- Tie-in
- Piping
- Pressure vessel
- Structural welds
- Corrosion



# PipeWIZARD Equipment

## Computer and Software

Ruggedized laptop with Microsoft Windows and PipeWIZARD data acquisition and analysis software installed. Software package includes: TomoView and Advanced Calculator software, Microsoft Office, and all necessary software accessories.

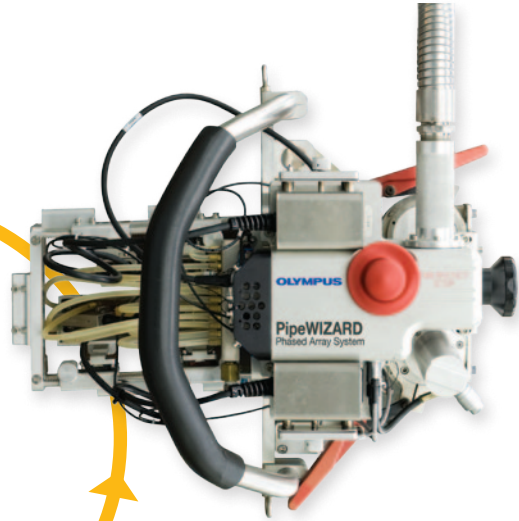


## Scanner

The PipeWIZARD scanner is a compact, robust, field-proven unit offering stable and repeatable scans.

The scanner head is designed for IP66 rating and houses a driving motor, an encoder, two phased array probes and wedges, two TOFD probes and wedges, and one temperature sensor.

An heavy-duty umbilical cable shields all necessary cables, it also includes the water line for coupling.



## Instrumentation Box

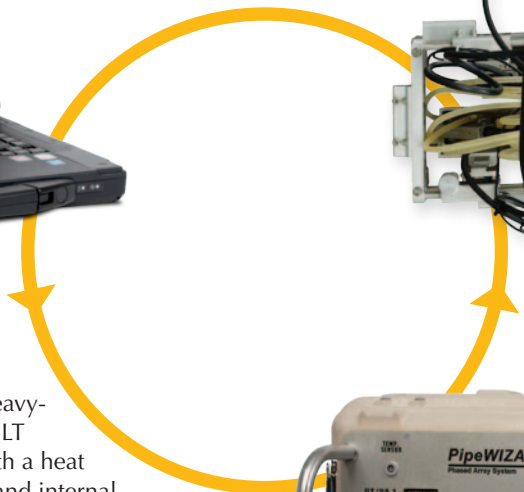
The instrumentation box is a compact, ruggedized, designed for IP64 rating, heavy-duty housing for the TomoScan FOCUS LT and the PWZ-MCDU. It is equipped with a heat exchanger mounted on the front cover and internal shock absorbers for equipment protection. An external power outlet is available on the connection panel to connect accessories.

## Acquisition Unit

The acquisition unit, a TomoScan FOCUS LT 64:128, offers up to 64 focusing channels and 128 P/R for multiple combinations of phased-array and conventional probes.

## Motor Controller and Drive Unit

The PWZ-MCDU drives one DC servo motor using an Ethernet link.



# PipeWIZARD Specifications

## TomoScan FOCUS LT Rackmount Acquisition Unit

|                                   |   |
|-----------------------------------|---|
| Conventional UT connector         | 4 (BNC)   |
| Data acquisition rate             | 4 MB/s  |
| A/D converter                     | 10 bits, 100 MHz  |
| A-scan length                     | 32 to 8192 points   |
| Real-time data compression        | 1 to 255 ratio  |
| Rectification                     | FW, HW+, HW-, and RF                                      |
| Filtering                         | Programmable digital FIR                                  |
| Video                             | Smoothing (digital)                                       |
| Dynamic depth focusing (DDF)      | Yes   |
| Encoder                           | 2-axis (quadrature, clock direction)                      |
| Network interface                 | 100BASE-T   |
| Bandwidth                         | 0.5 MHz to 23 MHz depending on the configuration          |
| Acquisition speed                 | 8000 A-scans/s (8-bit 512-point A-scans)                  |
| Number of beams                   | Up to 256   |
| Pulse repetition frequency (PRF)  | 1 Hz to 20 kHz  |
| Real-time averaging               | 1, 2, 4, 8, 16  |
| Number of gates                   | 4 for detection; 1 for synchronization                    |
| Weight                            | 11.5 kg (25 lb)   |
| Size (W x H x D)                  | 48.3 cm x 13.3 cm x 34.4 cm (19 in. x 5.2 in. x 13.5 in.) |
| External temperature sensor input | Yes   |

## PipeWIZARD System

|                                      |   |
|--------------------------------------|---|
| Power requirements                   | 100 VAC to 240 VAC, 50 Hz to 60 Hz                |
| Instrumentation Box weight           | 70 kg (154 lb)                                    |
| Instrumentation Box Size (W x H x D) | 58 cm x 38 cm x 104 cm (23 in. x 15 in. x 41 in.) |
| Operating temperature (scanner)      | -50 °C to 60 °C (-58 °F to 122 °F)                |

## PipeWIZARD System consists of:

**Acquisition Unit:** TomoScan FOCUS LT 64:128 (3U rackmount)

**Motor Controller and Drive Unit:** PWZ-MCDU (3U rackmount)

**Instrumentation Box:** Robust, sealed instrumentation box for the acquisition unit and motor controller and drive unit.

**Computer and Software:** Ruggedized laptop with Microsoft Windows and PipeWIZARD data acquisition and analysis software installed. Software package includes: TomoView and Advanced Calculator software, Microsoft Office, and all necessary software accessories. Comes with 2 software dongles (USB keys) and computer accessories (additional flat screen monitor, keyboard, and mouse)

**Scanner:** Compact phased array scanner includes motor, encoder, 2 phased array probes and wedges, 2 TOFD probes and wedges and 1 temperature sensor. Emergency-stop push button is located on scanner.

Optional transverse module including 4 transverse probes and wedges is available.

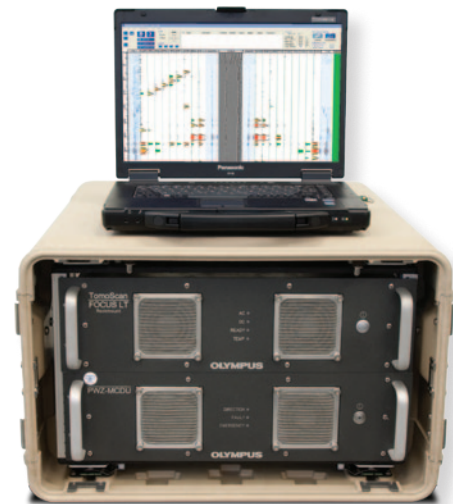
**Umbilical:** 25-m heavy-duty umbilical cable including 128 coaxial cables, cables for motors and encoders, and water line.

**Couplant Feed Unit:** Water-pump unit with remote on/off button and manual flow regulator.

## Accessories

Complete spare parts kit and all necessary tools are included.

Complete documentation and certificates are included.



Instrumentation box with front cover removed showing TomoScan FOCUS LT acquisition unit and PWZ-MCDU motor controller and drive unit.

OLYMPUS NDT INC. is ISO 9001 certified.

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[www.olympus-ims.com](http://www.olympus-ims.com)

[info@olympusNDT.com](mailto:info@olympusNDT.com)

### OLYMPUS NDT INC.

48 Woerd Avenue, Waltham, MA 02453, USA, Tel.: (1) 781-419-3900  
12569 Gulf Freeway, Houston, TX 77034, USA, Tel.: (1) 281-922-9300

### OLYMPUS NDT CANADA INC.

505, boul. du Parc-Technologique, Québec (Québec) G1P 4S9, Tel.: (1) 418-872-1155  
1109 78 Ave, Edmonton (Alberta) T6P 1L8

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