

Wavemaker

G3 Pipe Screening System



NDT Global Services Limited
2 Opus Park
Lockheed Close
Preston Farm Industrial Estate
Stockton on Tees
TS18 3BP

Telephone: +44 (0)1642 704 040
Fax: +44 (0)1642 604 684

www.ndtgsl.co.uk
inspection@ndtgsl.co.uk

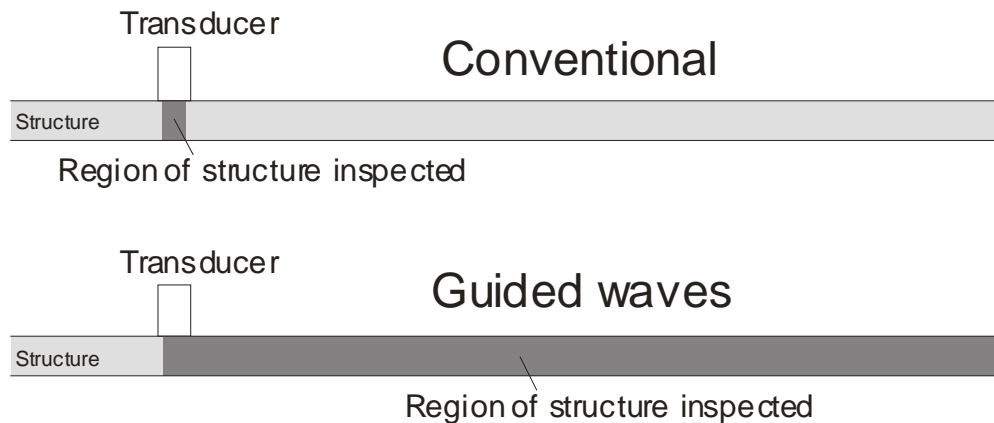


Guided Wave Testing Method

Wavemaker

G3 Pipe Screening System

Propagation along, not through, a structure

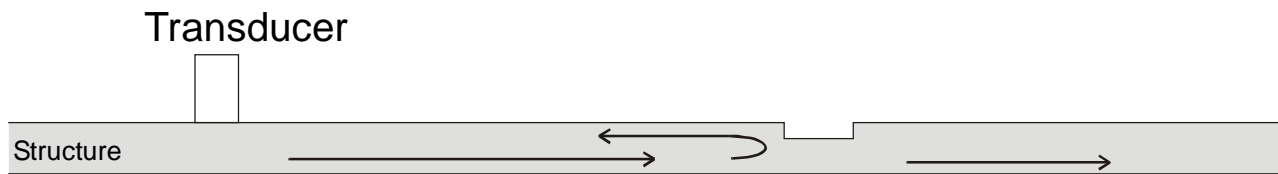


The pipe walls form a guide for ultrasonic waves, which directs them down the length of the pipe

Wavemaker

G3 Pipe Screening System

Reflection from a feature (such as corrosion)



When the guided wave hits a change in cross section (or impedance), it reflects back toward the transducer

Wavemaker

G3 Pipe Screening System

Typical applications

- Pipe racks
- Insulated pipe
- Pipe with restricted access
- Road crossings
- Submerged pipe
- Buried pipe

Wavemaker

G3 Pipe Screening System

Wide variety of applications



Wavemaker

G3 Pipe Screening System

Guided Waves The Basics

Wavemaker

G3 Pipe Screening System

Standard UT v Guided Waves

- **Standard UT**
- high frequency
- short wavelength
- sensitive to small defects at high frequencies
- point measurement
- **Guided Waves**
- low frequency
- long wavelength
- sensitive to “small” defects even at low frequencies
- rapid screening

Wavemaker

G3 Pipe Screening System

Key Advantages

- In service inspection
- Rapid 100% coverage
- Limited access required

Wavemaker

G3 Pipe Screening System

Change in cross-sectional area

- Method is equally sensitive to defects at any through wall position
- Method is sensitive to changes in cross section (increase or decrease)
- Reflection from welds and flanges are used as a reference
- Amplitude of reflection is scaled with distance

Wavemaker

G3 Pipe Screening System

Weld example

Incoming wave (100% of energy)



Reflected wave
(20% of energy)

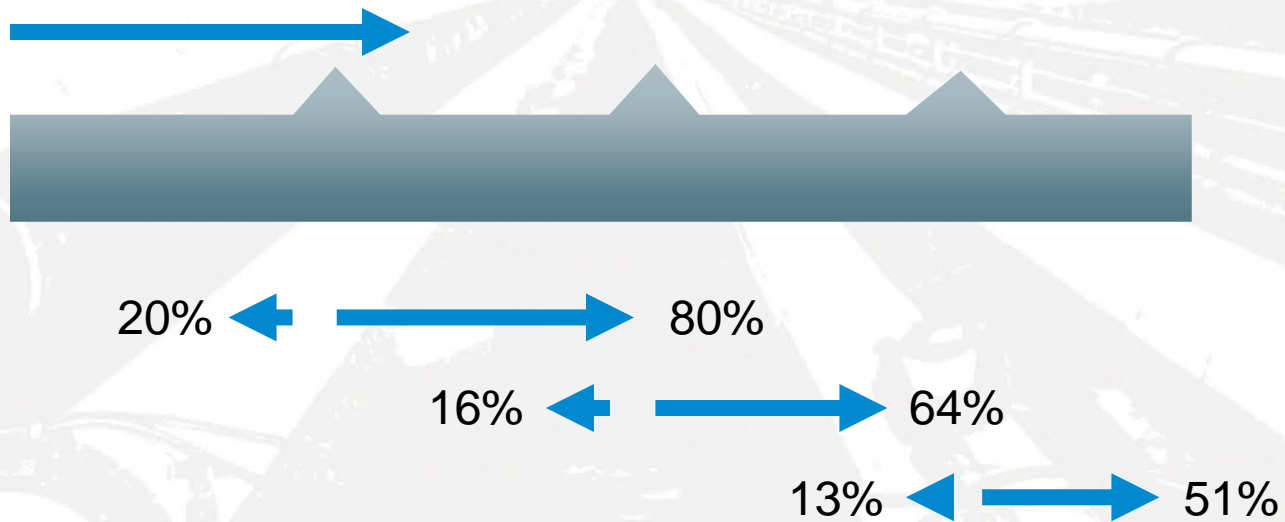
Transmitted wave
(80% of energy)

Wavemaker

G3 Pipe Screening System

At each reflection the transmitted energy becomes less

Incoming wave (100% of energy)

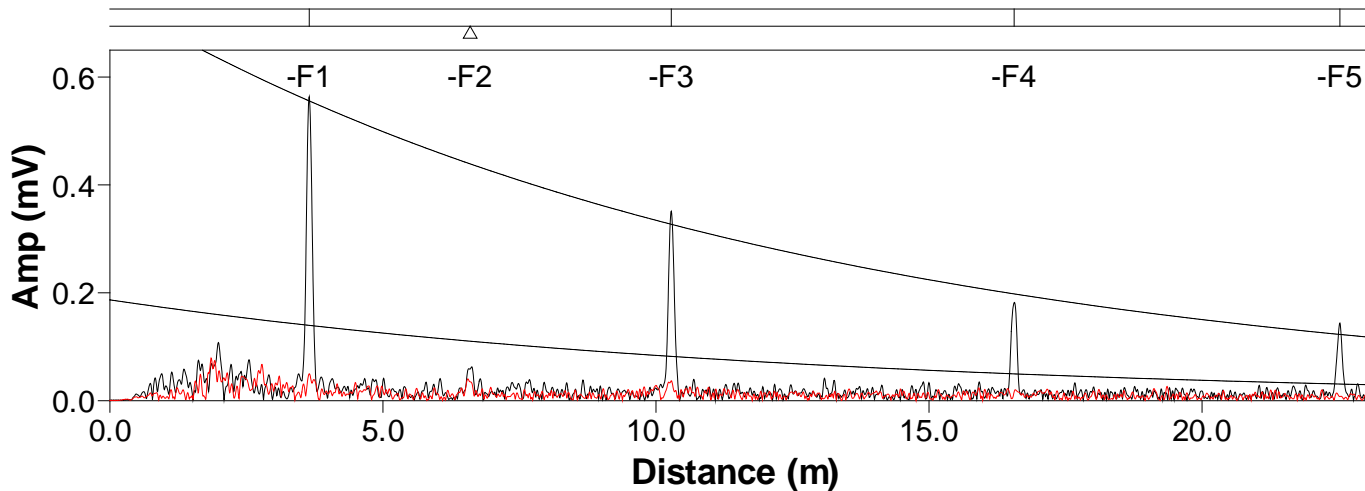


Wavemaker

G3 Pipe Screening System

These effects appear as an amplitude decay

- The reflected amplitude from distant features will be smaller than for close features
- DAC curves are used to compensate for this

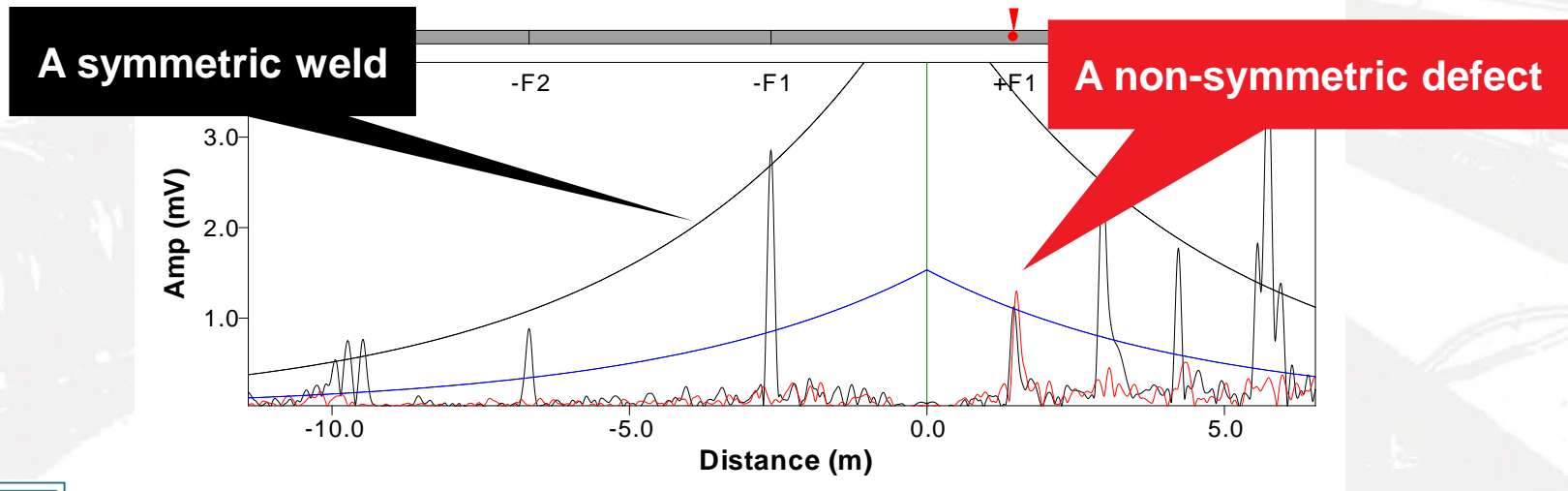


Wavemaker

G3 Pipe Screening System

Symmetry example

- BLACK lines represent symmetric features
 - Uniform around the circumference
- RED lines represent non-symmetric features
 - Varies around the circumference



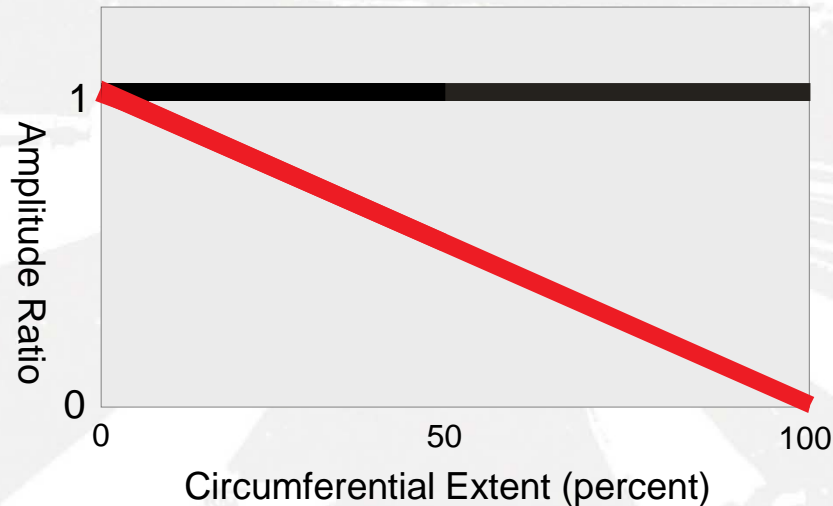
Wavemaker

G3 Pipe Screening System

The ratio of red to black depends on the circumferential extent of the feature

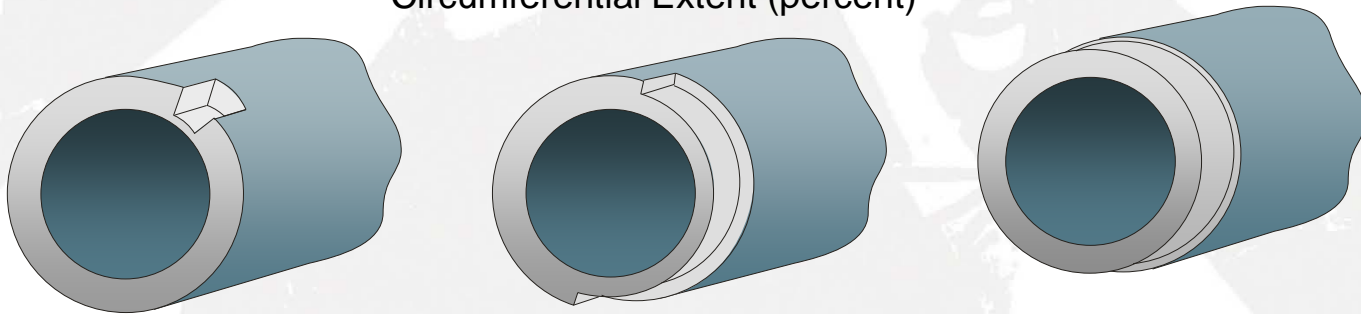
When the feature does not extend very far around the circumference

RED = BLACK



When the feature extends significantly around the circumference

RED << BLACK



Wavemaker

G3 Pipe Screening System

Determining wall thickness reduction

- The remaining wall thickness can never be measured directly by using this technique, which should always be considered a **screening** tool
- It is necessary to prove up any defective areas using a complementary method such as UT thickness measurement or visual inspection

Wavemaker

G3 Pipe Screening System

Wavemaker G3 System Components



Wavemaker

G3 Pipe Screening System

The fixed rings

- Available for pipe sizes 2"-8"
- All rings carry unique serial number which is identified in software
- Can be used on pipes up to 180°C (with special precautions)
- Pipe transducers sprung loaded onto pipe
- 3 inches clearance needed around pipe



Wavemaker

G3 Pipe Screening System

The inflatable rings

- Available for pipe sizes 6"-36"
- Rings can be joined to inspect larger pipes
- All rings carry unique serial number which is identified in software
- Can be used on pipes up to 180°C (with special precautions)
- Air pressure forces transducers onto pipe using car style foot pump.
- Transducer modules rapidly switched between rings (less than 30 mins)
- 2 inches clearance need around most of pipe



Wavemaker

G3 Pipe Screening System

Pipe diameters

- Pipes up to 75 inches (2 metres) in diameter have been inspected
- Pipes down to $\frac{3}{4}$ inch (19mm) can be inspected using special rings



Wavemaker

G3 Pipe Screening System

Wavemaker

Typical performance

Wavemaker

G3 Pipe Screening System

Detection threshold

- Typically minimum detectable defect is 5% cross sectional loss
- If pipe is in good general condition defects down to 1% have been detected
- A 1% defect in a 3" pipe equates to a half wall defect of 5mm (0.2") diameter

Wavemaker

G3 Pipe Screening System

Diagnostic range

- In ideal conditions 200m of pipe can be screened in each direction from a single test location
- Typically range on above ground pipe is 50m in each direction
- For buried pipes 20m in each direction is more typical unless the pipe is sleeved

Wavemaker

G3 Pipe Screening System

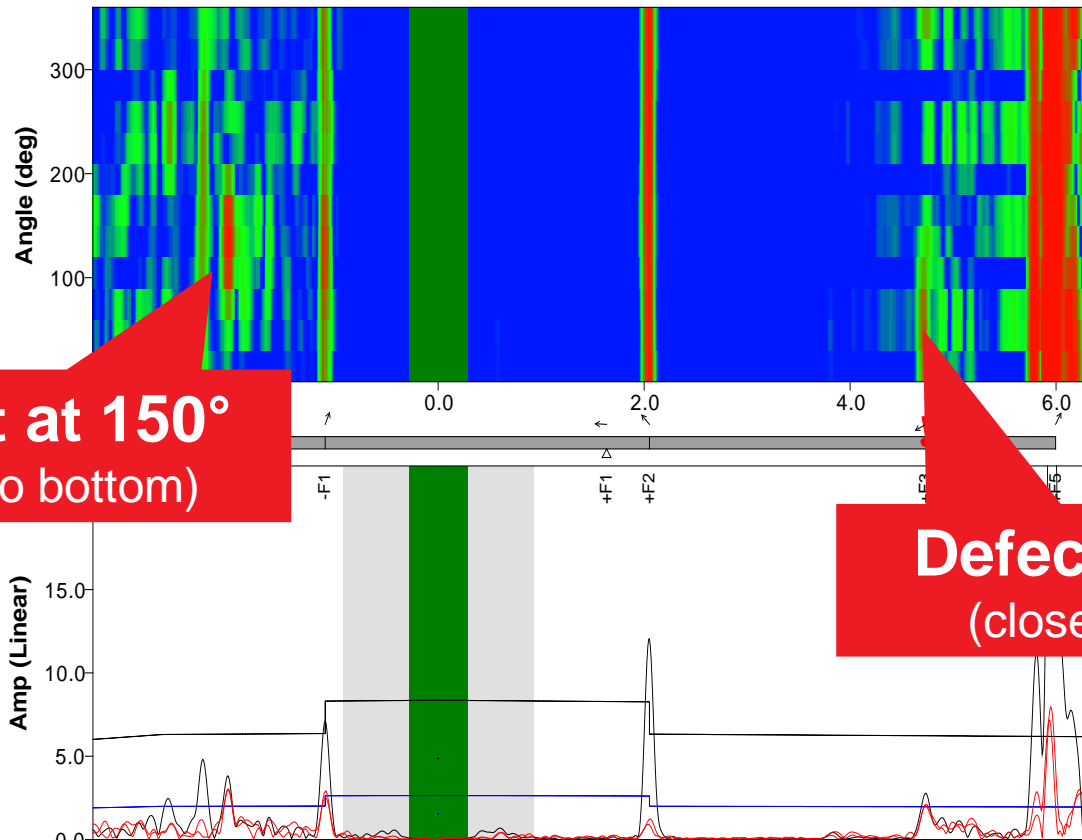
Unrolled pipe 'C-Scan'

- Circumferential orientation can now be determined accurately
- Works best with newly developed 16 channel rings
- Gives equivalent information as in-line inspection tools

Wavemaker

G3 Pipe Screening System

Unrolled pipe example



Defect at 150°
(close to bottom)

Defect at 50°
(close to top)

Wavemaker

G3 Pipe Screening System

Wavemaker

Typical application examples

Wavemaker

G3 Pipe Screening System

Pipe racks

Pipe racks are generally easy to test. Over 100m can be screened from a single test location.



Wavemaker

G3 Pipe Screening System

Insulated pipes

- Small section of insulation removed at each test point
- Over 100m of pipe can be screened from each test point



Wavemaker

G3 Pipe Screening System

Overhead pipes

- Only limited access needed
- Over 100m can be screened from a single test point



Wavemaker

G3 Pipe Screening System

Sleeved road crossings

- Only external access is required.
- Up to 35m can be screened from a single location depending on coatings



Wavemaker

G3 Pipe Screening System

Wall penetrations

- Only external access is required.
- Concrete walls up to 1m thick and earth walls up to 20m thick can be screened



Wavemaker

G3 Pipe Screening System

Buried pipes

- Holes dug at pre-defined intervals
- Around 20m of pipe can be tested in each direction from a single location (depending on pipe, coating and soil conditions)

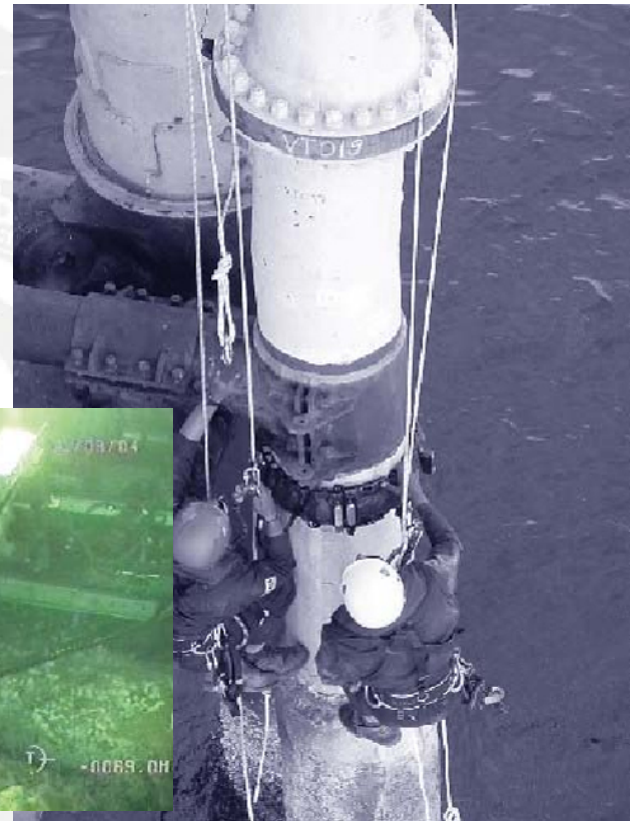


Wavemaker

G3 Pipe Screening System

Offshore pipe

- Riser splash-zone inspection (top side)
- Sub-sea pipe inspected using special transducer rings and instrumentation



Wavemaker

G3 Pipe Screening System

Limiting factors

- General condition of pipe determines detection threshold and range
- Some coatings and coverings (for example earth) reduce range
- High external noise, such as compressors, reduce performance

Wavemaker

G3 Pipe Screening System

Effect of pipe contents

- Gases - no effect
- Liquids
 - No effect when low viscosity
- Sludge
 - Heavy viscous deposits in the pipe attenuate the signal and reduce the test range

Wavemaker

G3 Pipe Screening System

Reporting

- Automatic reporting feature to increase productivity
- All raw data stored for later review and auditing
- Reports can be printed directly or imported into other applications
- Photographs can be embedded in the report file

Wavemaker

G3 Pipe Screening System

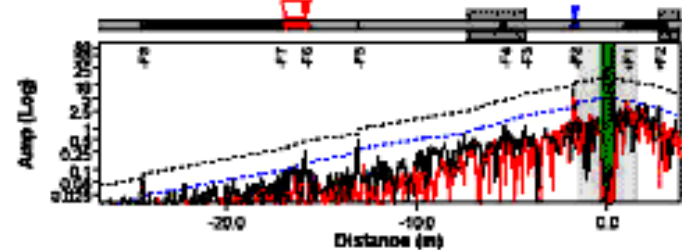
Reporting

- Inspection company header
- Site details including GPS location, operator and equipment used
- List of pipe features with distance, type and operator notes
- A-Scan trace showing the post processed data for review

Result:	Ring
File:	Config
Site:	Location
Tester:	Version
Tested by:	Client
	Procedure

General Notes: Pipe was inspected visually on the ground. Occasionally buried by sandy soil and snow.
 Minor general external corrosion was observed along the entire length.
 The result indicates that the pipe exhibits the general corrosion along its entire length.
 Name is 30m.

Feature	Location	DCI	Robot	Class	Notes
-R2	287	-	TD	Rust	
-P1	1	10	8	Minor	This area shows increased general corrosion up to the soil level.
-F1	-174	19	05	Medium	Weld shows no visual sign of defect but microscopically indicates internal defect.
-R3	-179	-	36	Weld	
-P2	-420	-	60	Minor	
-F4	-844	8	05	Minor	This area shows increased general corrosion up to the soil level.
-F5	-81.50	-	60	Weld	
-F6	-81.50	17	00	Severe	Visually verified. Two areas of external corrosion approx 12% and 45% circumference.
-F7	-10.22	8	TD	Minor	This area shows increased general corrosion up to the soil level.
-F8	-24.40	-	60	Weld	



Wavemaker

G3 Pipe Screening System

Training

- Class and site training
- 3 operator levels defined
- Level 1 can perform basic interpretation,
- Level 2 can perform more challenging inspections
- Intermediate trainings also available

Wavemaker

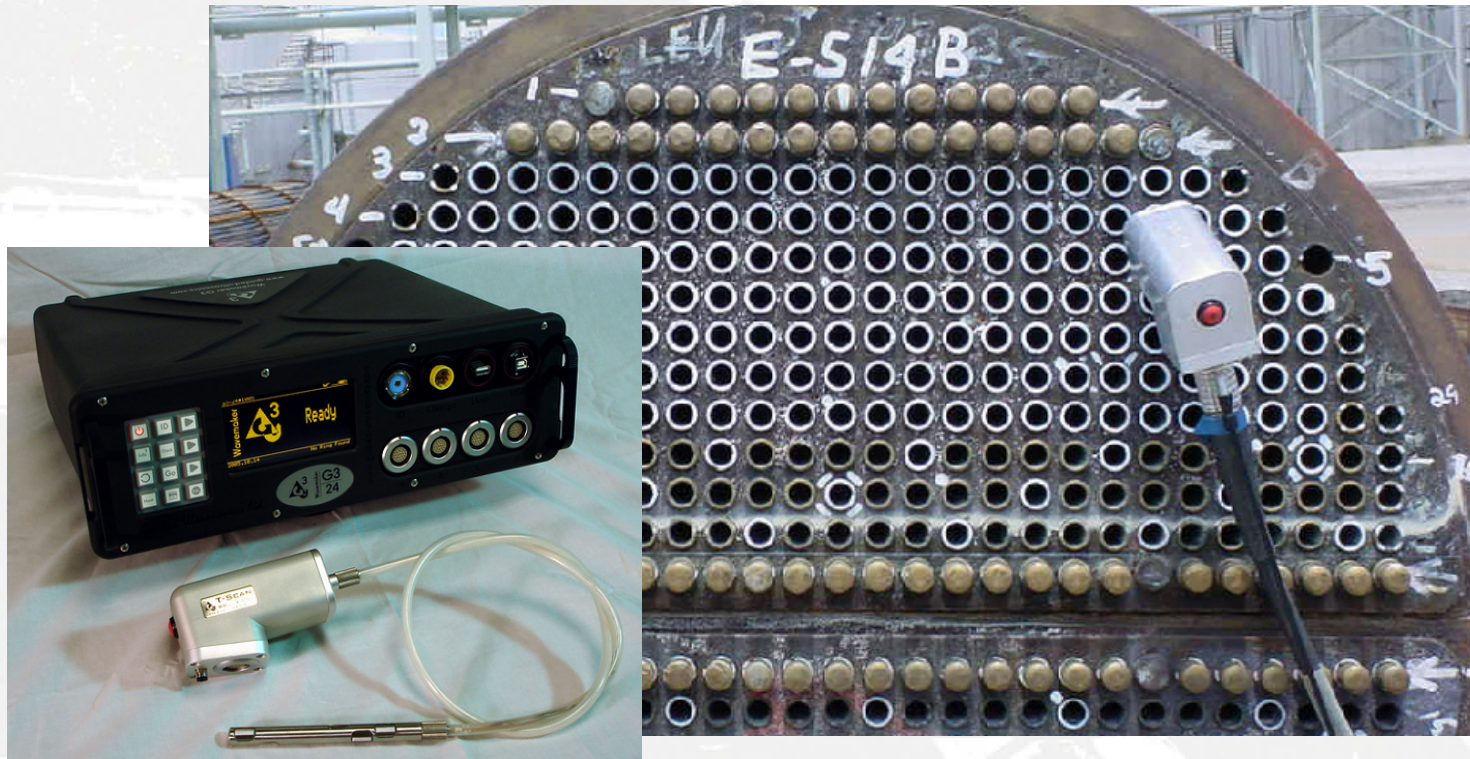
G3 Pipe Screening System

New developments

Wavemaker

G3 Pipe Screening System

Tube Inspection System (T-Scan)



Wavemaker

G3 Pipe Screening System

Boiler Tube Inspection (Claw)



Probes for access restriction



Wavemaker

G3 Pipe Screening System

Permanently Installed Rings (PIMS)

Special rings can be bonded onto the pipe permanently for use on any pipe including buried and sub-sea.

