Catalogue Ultrasonic Probes
Design and manufacturing, predicted behavior by calculation

www.ApplusRTD.com

Applus RTD probe production

As one of the largest NDT service organizations in the world, Applus RTD knows how important it is to select the correct probe, and has therefore given it a lot of attention. Thus, many years ago, the founding of a group particularly involved with the design of ultrasonic probes and accessories was justified. Gradually this service has attracted the attention of clients, and sales of optimized probes, often preceded by development work, became common practice.

In this way Applus RTD ultrasonic probes are the product of more than 30 years of probe manufacturing and field experience.

Applus RTD's twin crystal compression and lens-focused probes are known worldwide. For example, these probes are used for inspection of coarse grained austenitic steel, location of under-cladding cracks or detection and sizing of IGSCC (Intergranular stress-corrosion cracking).

Design and manufacturing, predicted behavior by calculation!

Applus RTD Probes and Probe Accessories are carefully designed and manufactured to strict tolerances and specifications. The probe design team uses modern tools to develop, model and engineer tailor-made ultrasonic probes.

Probes are built to client requirements for contact or immersion scanning and can be used at depth of up to 300 meters and temperatures up to 300°C.

Probes can be supplied with couplant ducts, wear resistant shoes and fittings to comply with any type of scanning. Applus RTD probes can be documented with characteristics on bandwidth, beam spread, focus and sensitivity.

Innovation

Applus RTD is constantly looking at new materials (for example piezo composites), production methods (CNC) and probe types to improve the performance of ultrasonic transducers and to develop probes for new applications (high temperature probes, TOFD probes and phased arrays). At the same time, we take care that you get the same performance of copies from ultrasonic transducers ordered in the past.

Support and service

Applus RTD Probe Production is especially known for their client-specific probes. We have worked with clients worldwide to design or develop the ultrasonic probe best suited to their particular applications. We are always willing to discuss with you possible probe designs and solutions to any inspection tasks.

Delivery

If you need faster delivery, you are always free to call and we will do our utmost to meet your deadline.

Product information

All Applus RTD products are well known, especially in the nuclear industry, for their quality and high performance. An overview is given of ultrasonic probe types, optional features, documentation, accessories and additional products, which could be of benefit for those involved in ultrasonic inspections.

Probes for the following testing techniques make use of longitudinal wave, creeping wave, transverse wave or special techniques, which can be a combination of these wave forms.

Manual testing

Probes for manual testing are available in a variety of housings. These probes are characterized by a plastic shoe wedge, which protrudes 4mm to allow for contouring to curved surfaces.

Connectors are at the back of the stainless steel housing, which makes handling easy..

Shown are a few examples of probes for manual inspection of welds in coarse grained, anisotropic materials such as austenitic steel. These probes employ a dual element design, which produces refracted longitudinal waves in the test material.

Manual and mechanized testing probes.

Mechanised testing

These probes feature:

- Plastic shoe (wedge) flush with stainless steel housing, for better wear resistance. To improve wear resistance further, stainless steel inserts can be added. Mostly in probes 40x40mm and larger.
- On top of housing:
  - Water nozzles for internal couplant delivery
  - Connector(s) (chassis jacks)
- Fittings for use with a probe holder.

All Applus RTD probes can be specially designed for use with special manipulators in automated inspection systems. These probes are built into stainless steel housings which allow attachment to gimbal-type probe holders.

Applus RTD probe production

Immersion testing

These probes are for immersion testing and scanning of components and immersion thickness gauging. Applus RTD immersion probes can be provided unfocussed with a flat front or with a lens focus to improve sensitivity and lateral resolution.

High temperature testing

Virtually all of Applus RTD's contact-type probes, including dual element and angle beam probes can be manufactured in a high temperature version. These probes are suitable for both continuous and intermittent use up to at least 350°C.

High temperature testing

Deep water testing

Most probes can be fitted with watertight connectors for use at depths up to 50 meter. For greater depths up to 300 meter, potted cables are normally used.

Immersion bolt testing

The probe shown is specially designed to detect fatigue cracks in the threaded portion of large bolts. Inspecting from the internal bore allows an "in service" inspection. The beam angle is optimized to obtain the highest amplitude ratio between the crack and thread echoes. A four-element probe is used to increase the speed of the inspection.

Immersion bolt testing

Internal bore wall testing

These are contact probes designed for tube testing from the ID (inside diameter), which can be configured for wall thickness measurements, weld inspection, or for multifunction inspections. These probes are typically fitted with stiff or flexible insertion rods up to 6 meter (20 ft) in length and can be provided with or without couplant delivery.

Multifunction probes

Applus RTD also manufactures multifunction probes such as those used in the Applus RTD Rotoscan system for automatic inspection of circumferential pipe welds. This is an example where many probes, each having its own function, are built into a single housing. The use of multiple elements and refracted angles increases inspection efficiency as it allows several regions in the test piece to be scanned simultaneously.

Multifunction probes

Probes can be build with the following options

Lens focusing

Focused contact probes provide more accurate flaw sizing capabilities or improved signal-to-noise characteristics by controlling the focal spot size at the focus distance. As a consequence of this design, the measurement range is often reduced, depending on the degree of focusing.

Quarter wave matching layer

By using quarter wave matching layer sensitivity is improved by 6 to 10dB and bandwidth is improved from 40% to 55% (measured at –6dB, in pulse echo). Quarter wave matching layer is very useful when equipment gain should be lowered to improve signal-to-noise or when extra bandwidth is needed.

Piezo composite

Most probes can be supplied with piezo composite elements. We recommend that the effects of using piezo composite be calculated for each application. In general, piezo composites are useful for broadband applications (BW > 80%) and applications where the electrical matching between probe and equipment could be improved.

Couplant recycling

Excess couplant can be annoying. Sometimes components are in such a position or have such geometry that excess couplant is unacceptable. If seals or other means fail, or installation of these is impractical (e.g. at dose rate penalty), then couplant recycling can offer a solution.

Standard Applus RTD probes can be equipped with couplant feeds that are surrounded by a couplant recycling frame, or a recycling frame can be integrated into the probe housing. Integration of the recycling frame into the probe allows more compact probe design.

Radiation resistance

Almost without exception ultrasonic probes are partly made using "plastics" in the widest sense. They are used for the wedge, electrical isolation, backing, filler material and last but not least as bonding and acoustic matching layers. Most polymers only survive low radiation levels. For radiation exposures up to 10^8 Rad, probes using conventional polymer materials break down. This is mainly due to the swell and embrittlement of the polymer. For application at high radiation levels, Applus RTD has developed special Radiation Resistant probes (RR-probes) which do not show any deterioration effect even at maximum dose (10^8 Rad).

Accessories

Calibration blocks

High quality calibration blocks are needed for accurate time base setting of the ultrasonic equipment and probe index determination. Applus RTD's participation in international NDT committees gives us up-to-date knowledge of current requirements such as specially designed blocks for angle compression probes. Two examples, together with their stands, are shown. One block has radii of 25 and 50mm, the other 50 and 100mm. Both have a width of 40mm.

They are made of AISI 304L stainless steel, fine grained ASTM5 (E112). The sound velocity of these blocks is of 5745 ± 20 m/s, typical of commonly used stainless steels.

Calibration blocks

Characterization blocks

This block is also made of austenitic stainless steel (AISI 316L), fine grained ASTM5 (E112) with sound velocity of 5745 ± 20 m/s.

Although it is well known that acoustic behavior in stainless steel welds is different from that in parent material, it is valuable to know the basic characteristics of the probe under ideal conditions.

With the aid of the Applus RTD designed stainless steel block a number of characteristics can be established, such as:

- Distance amplitude curve or so called "focal curve"
- Check of nominal focal distance marked on the probe
- Check on nominal probe angle marked on the probe
- Beam spread
- Zone height for focused probes
- Probe angle as function of sound path
- Nominal signal to noise ratio in fine grained steel.

Characterization blocks

Time base calibration standards

Time base calibration units consist of a fixed aluminum metal path with piezoelectric elements on one or both ends. When connected to an ultrasonic instrument, the time base calibration unit will produce a series of echoes, which correspond to a 50mm shear wave path or a 91mm longitudinal wave path in steel. These multiple echoes can be used for rapid time base calibration of flaw detectors while the echo amplitude can be used to check the vertical linearity of the instruments.

Time base calibration standards

Summary of tolerances

Standard probes

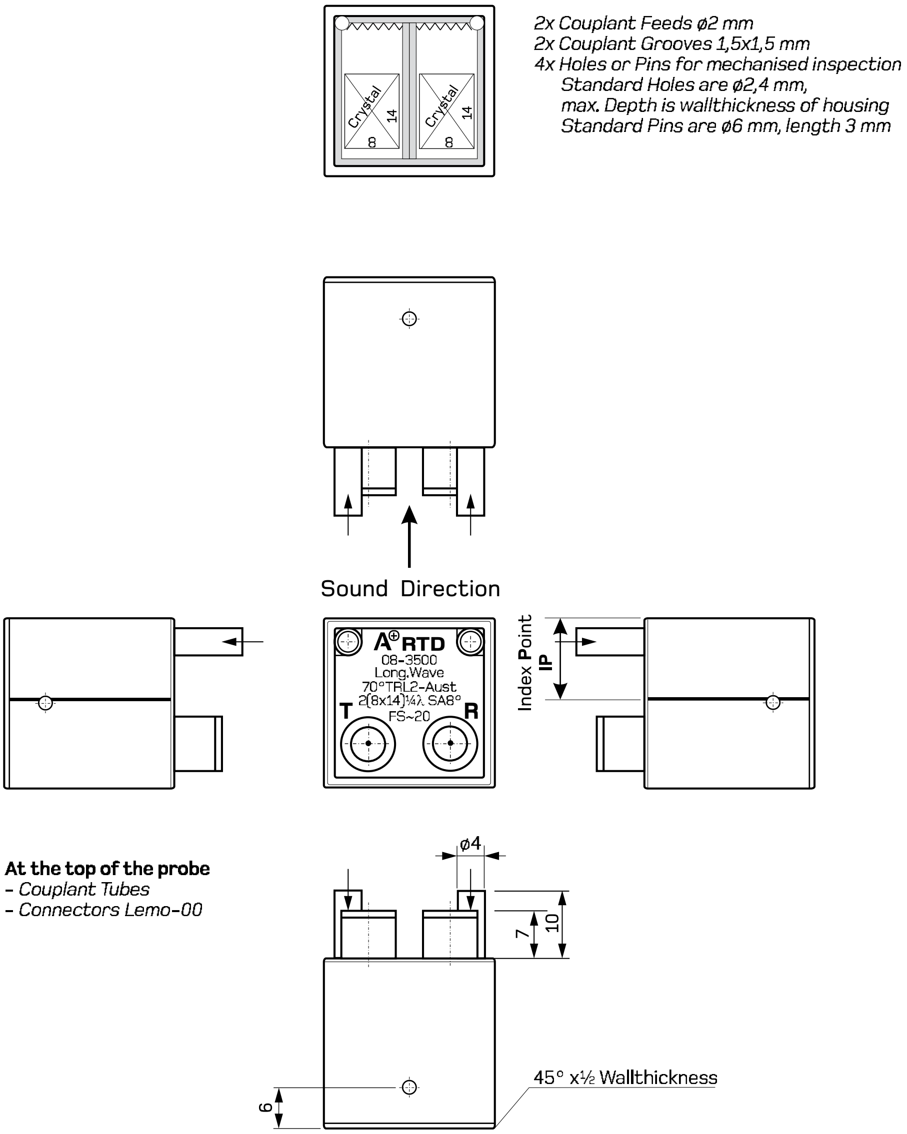
1. Refracted angle	Wave mode	
	Transverse (shear)	Longitudinal (compression)
0°	N/a	± 1°
45°	± 1°	± 1°
60°	± 1°	± 1°
70°	± 1°	+1°/ -3°
2. Center frequency (at -6dB)	± 10%	
3. Crystal size(s)	± 2%	
4. Focus sound path	± 10%	
5. Squint	± 1°	
6. Index point	± 1mm	
7. Housing size	± 0.25mm	
8. Probe shoe curvature	± 1%	
9. Temperature range	-10°C (14°F) / +50°C (122°F)	
10. Radiation resistance	~10^5 Rad accumulated	

Radiation resistant probes

1. Refracted angle	Wave mode	
	Transverse (shear)	Longitudinal (compression)
0°	N/a	± 1°
45°	± 1°	± 1°
60°	± 1°	± 1°
70°	± 1°	+1°/ -3°
2. Center frequency (at -6dB)	± 15%	
3. Crystal size(s)	± 2%	
4. Focus sound path	± 15%	
5. Squint	± 1,5°	
6. Index point	± 2mm	
7. Housing size	± 0.25mm	
8. Probe shoe curvature	± 1%	
9. Temperature range	-10°C (14°F) / +100°C (212°F)	
10. Radiation resistance	~10^8 Rad accumulated	

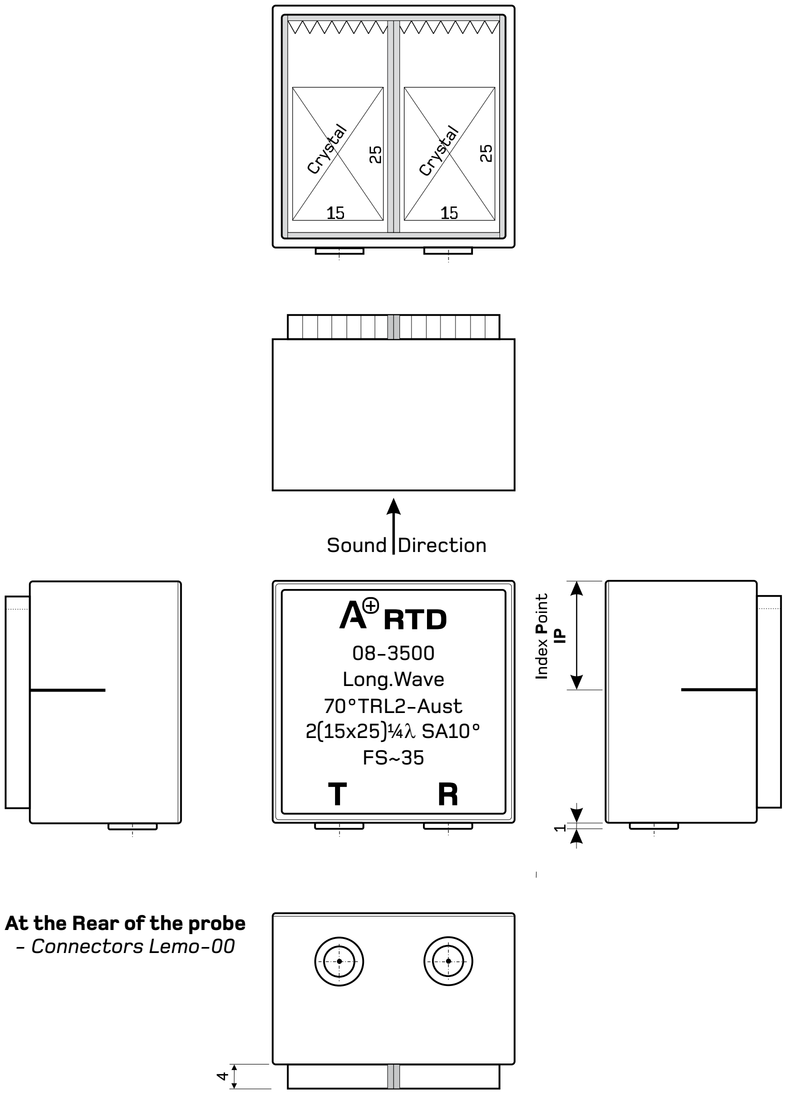
Example: Probe for mechanised testing

Dim. 25 x 25 x 25 mm



Example: Probe for manual testing

Dim. 40 x 40 x 25 mm



Frequency Sprectrum Data Sheet & Ultrasonic Beam Plot

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probes@applusRTD.com

Equipment settings Ultimo2000 V2.5

Pulser voltage	: 200 V	HP Filter	:
Squarewave width	: 112 ns	BP Filter	:
P.R.F.	: 2000 Hz	LP Filter	:
Pulser damping	: 50 Ohm	Receiver 50W Terminated	

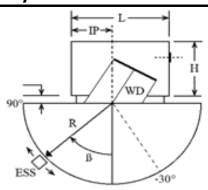
Cable: 2meter Coax RG174/U 50W **ADC: Sonic STR*8100@100MHz**

Probe RTD 09-###
Long.Wave
45°TRL4-Aust
2(7x10)¼λ
SA 14° FD~14

Schematic test setup

Frequency data

Gain	8,5dB
Block no.	95-9 Aust
Radius R	25mm
~5750 m/s Long	
~3150 m/s Trans	



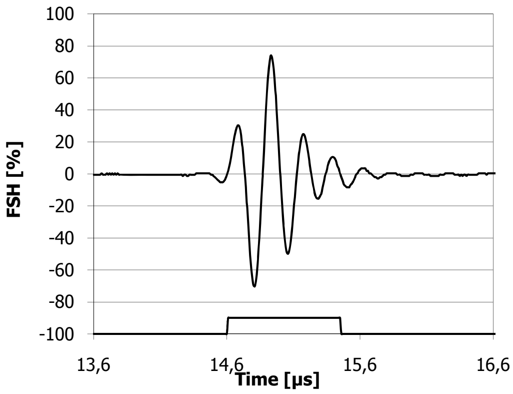
BeamPlot data

Gain T	16dB
Gain R	14dB
Block no.	51 Aust
Radius R	100mm
Eddy Sonic	Long

Housing:

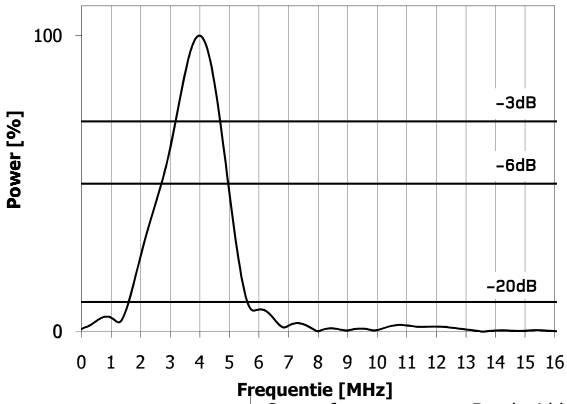
L x W x H	: 20x20x20mm
Style	: Manual
Connector	: Lemo-00
Index point IP	: 10mm
Wedge delay WD	: 17mm
On Radius	: 25mm

HF IMAGE



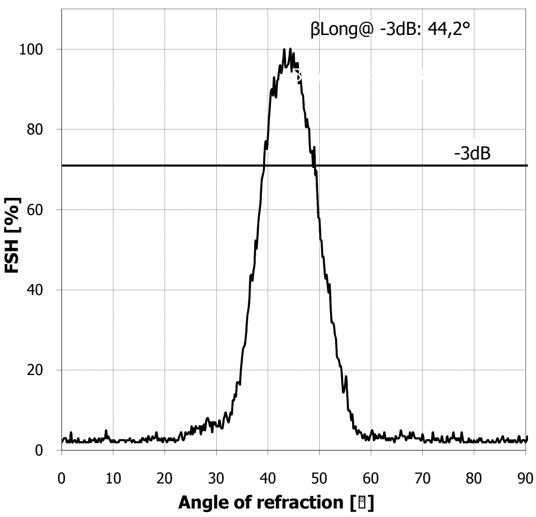
Gate width / pulse length : 0,84µs

SPECTRUM (FFT) - Flat Measurement

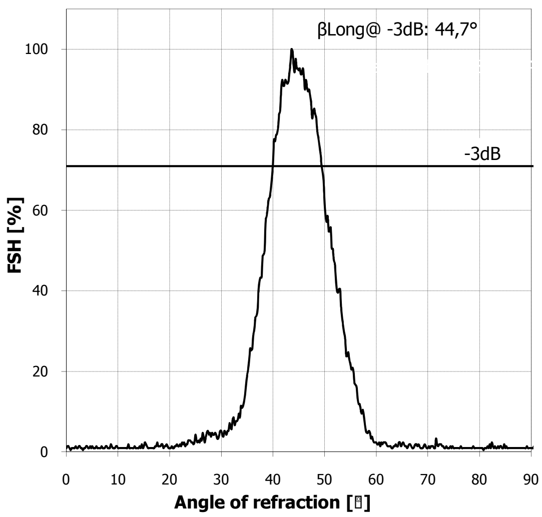


	Center frequency	Band width
At -3dB	3,94MHz	1,52MHz (39%)
At -6dB	3,84MHz	2,26MHz (59%)

BEAM PLOT I



BEAM PLOT II



Measured by
Date

Frequency Spectrum Data Sheet & Ultrasonic Beam Plot

Focus Data Sheet

Applus RTD - Probes

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probes@applusRTD.com

Equipment settings Ultimo2000 V2.5

Pulser voltage	: 200 V	HP Filter	:
Squarewave width	: 112 ns	BP Filter	:
P.R.F.	: 2000 Hz	LP Filter	:
Pulser damping	: 50 Ohm	Receiver 50W Terminated	

Cable: 2meter Coax RG174/U 50W **ADC: Sonic STR*8100@100MHz**

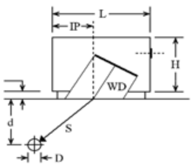
Probe RTD 09-###

Long.Wave
45°TRL4-Aust
2(7x10)¼λ
SA 14° FD~14

Schematic test setup

Focus data

Gain	21,5dB
Block no.	1981-1 Aus
Ø Cyl.holes	3mm
~5750 m/s Long	
~3150 m/s Trans	



Housing

L x W x H	: 20x20x20mm
Style	: Manual
Connector	: Lemo-00
Index point IP	: 10mm
Wedge delay WD	: 17mm
On Radius	: 25mm

SIGNAL IN FOCUS (A - IMAGE) - Flat Measurement

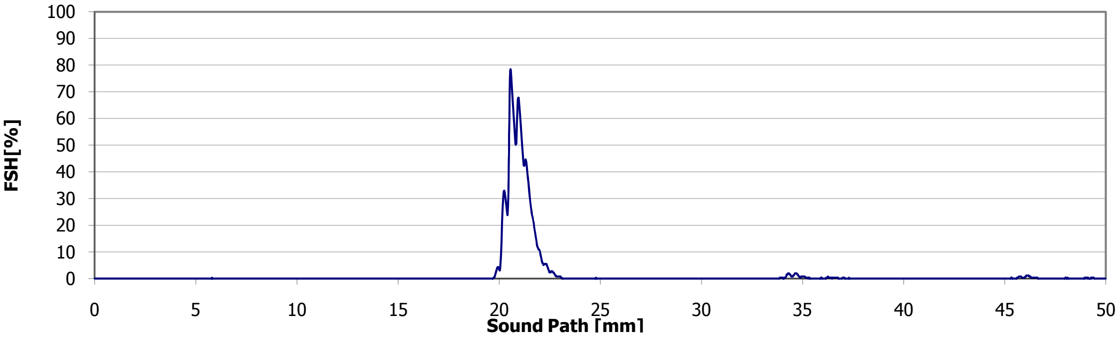


DIAGRAM I (Amplitude - Sound Path)

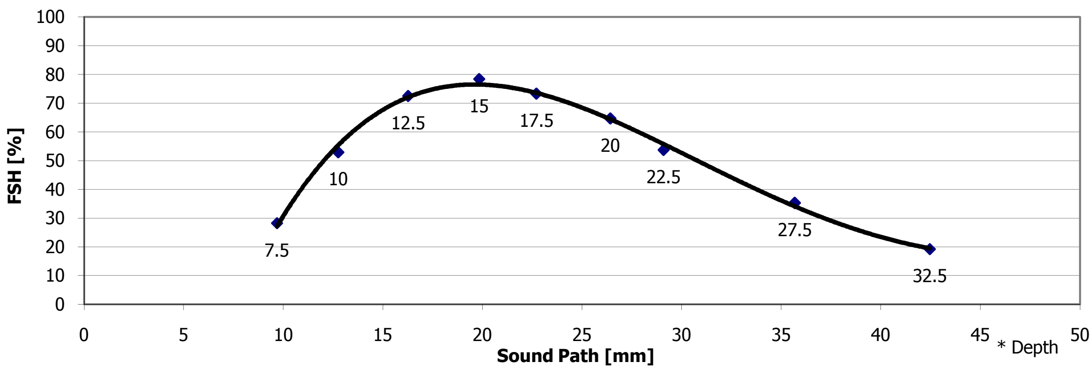
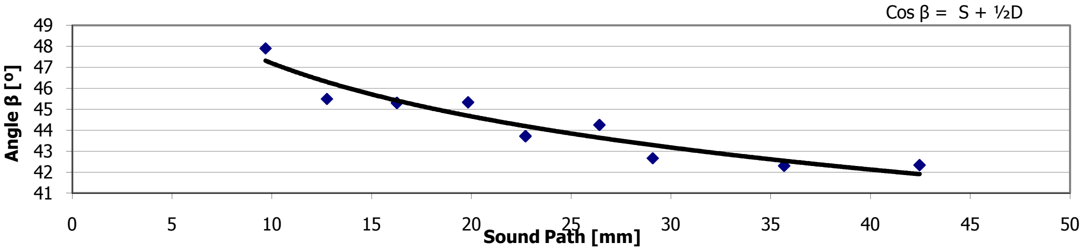


DIAGRAM II (Beam Angle - Sound Path)

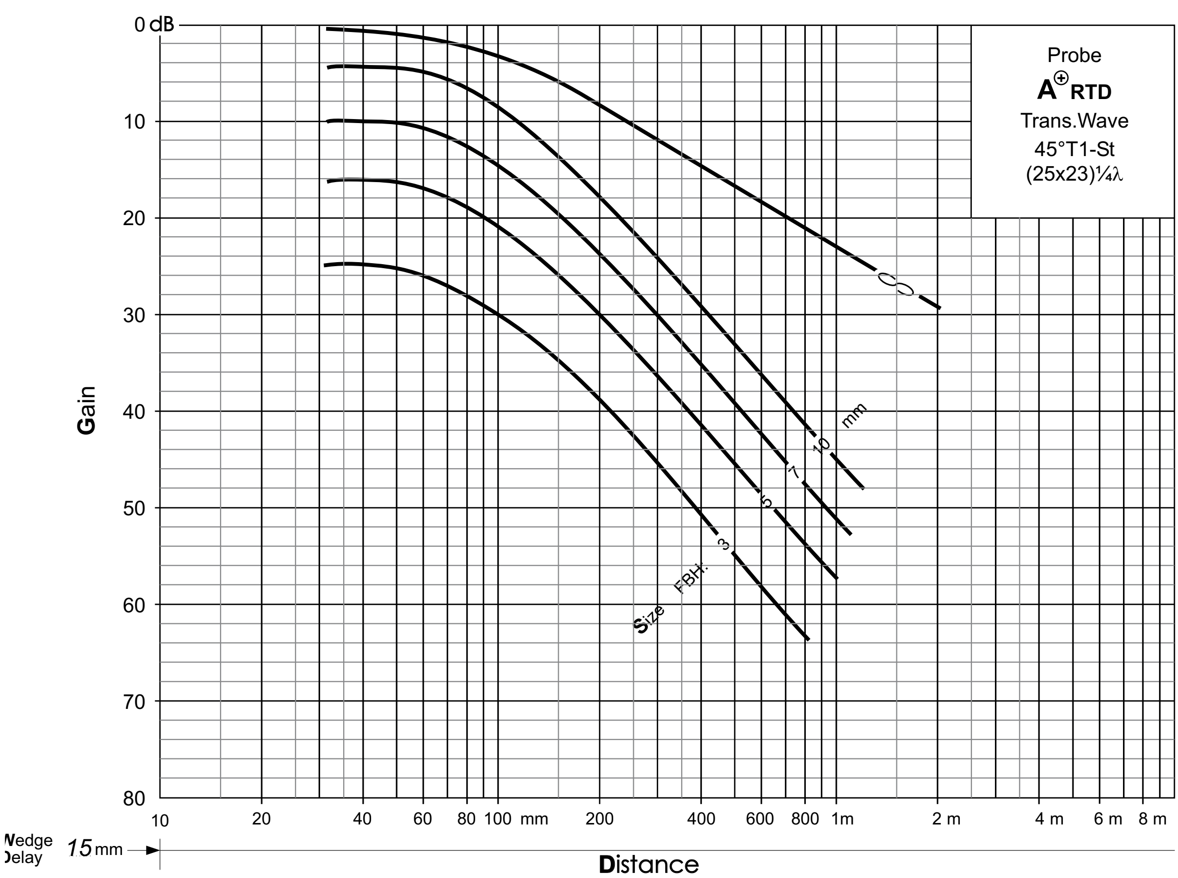
$$\cos\beta = \frac{d}{S + \frac{1}{2}D}$$



Measured by
Date

Focus Data Sheet

DGS – Diagram



0 dB
10
20
30
40
50
60
70
80
Gain
10
20
40
60
80
100 mm
200
400
600
800
1m
2 m
4 m
6 m
8 m
Wedge Delay
15 mm
Distance
Probe
A RTD
Trans.Wave
45°T1-St
(25x23)¼λ
∞
10 mm
7
5
3
Size FBH.

Technical information

Longitudinal wave probes

For inspections using longitudinal waves we often use the following probes:

- dual element probes
- longitudinal wave probes
- angle beam probes

These are known as the so-called transmitter receiver longitudinal (TRL) probes.

This design provides superior penetration and a better signal-to-noise ratio than standard shear wave probes. The dual element design restricts the range of maximum sensitivity. This is called the focal range and is usually between ½xFS and 2xFS, where the focus sound path FS is the transit distance in the material to the focal point. Angle compression wave probes can be manufactured with many different beam angles, frequencies, number of crystals, crystal sizes, and focal ranges (for more information see focus sound path information on page 18).

Multi-element probe with compression wave and shear wave functions

The nature of the inspection usually dictates the precise configuration.

Shear wave probes

Single crystal shear wave probes are the most commonly used probes for ultrasonic inspection, usually with 45°, 60° and 70° beam angles. For some inspections, however, it may be useful to optimize the angle and the crystal size to get the best sensitivity and signal-to-noise ratio. By using elliptical or rectangular elements, the spot size in the material can be precisely defined and the beam can be directed to minimize beam spread.

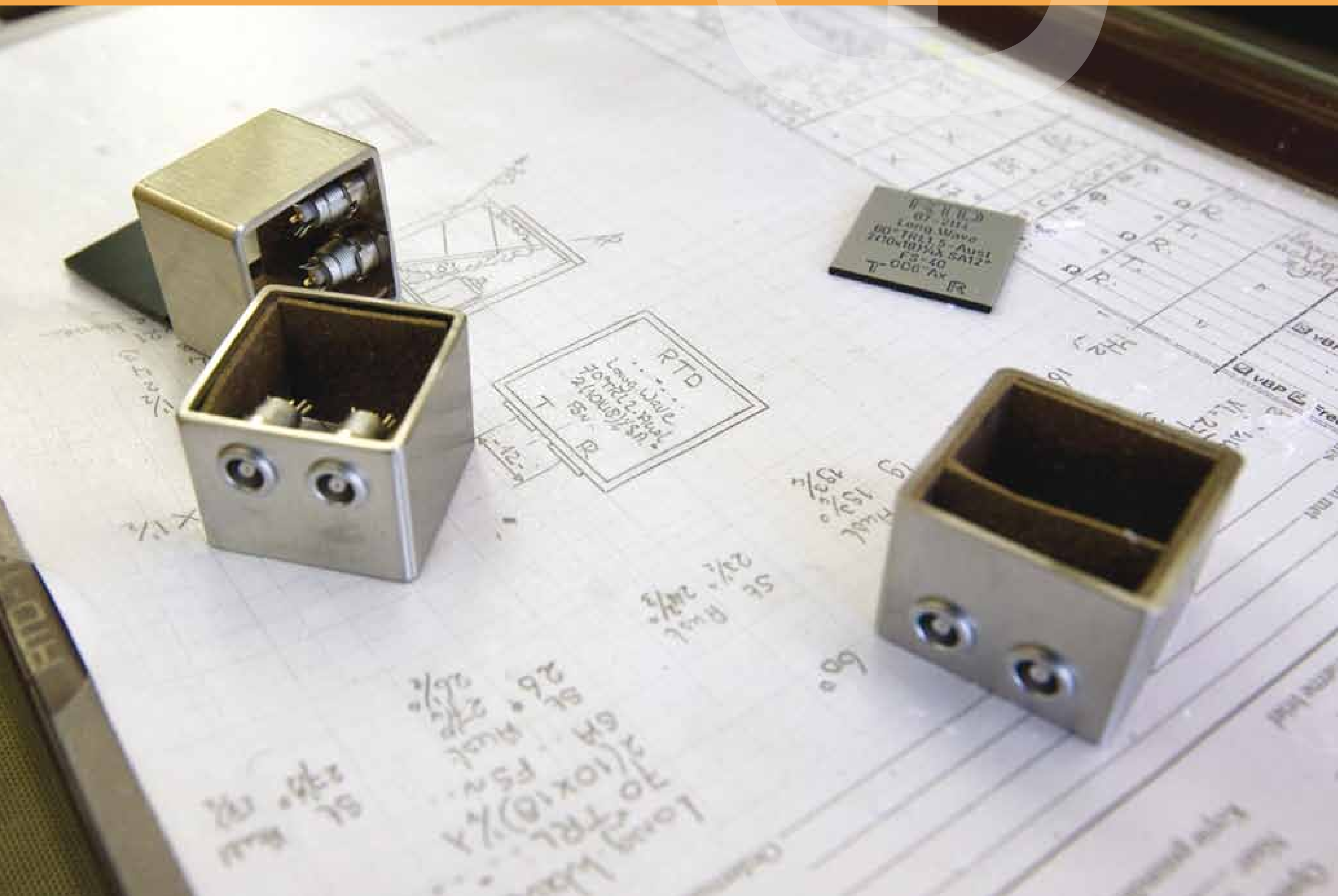
To further improve signal-to-noise, it is possible to use dual element, transverse wave probes (TRT probes) or lens focused transverse wave probes. As a consequence, there is a restricted range of maximum sensitivity, just as with TRL probes.

Creeping wave probes

Creeping wave probes are a special type of TRL-probes, which generate compression waves at angles between 70° and 90° in the test material. These waves, commonly known as creeping waves, propagate parallel to the surface of the test piece; a shear wave beam is also generated, which radiates at an angle of about 33°.

Creeping wave probes are suitable for detection and sizing of flaws close to the surface like deep IGSCC (intergranular stress-corrosion cracking). Creeping waves are unaffected by liquid drops, welding spatters or other materials on the surface. However, the working range is short because of the steep energy decay. Usually, the most sensitive point, the so-called "focus" is located just in front of the probe itself.

Nominal focus distance ranges up to 20mm and the maximum useful range is typically 45mm.



Special techniques

Detection of vertical defects

LLT/RTT

If an angle compression transducer is used on a plate with parallel surfaces, mode conversion will occur when the beam hits the opposite surface. This is also valid for the shear wave beam that is generated.

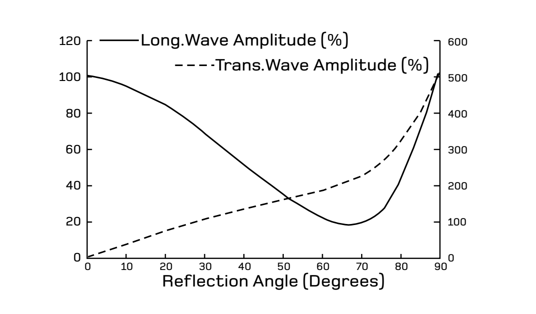


Figure 1 Amplitude of reflected waves (steel/air)

For the most commonly used probe angles (between 45° and 70°) most of the energy is in the converted beam rather than in the non-converted one. This is illustrated in figure 1 and 2. As stated before, this fact is often considered as making inspections over skip distance impossible.

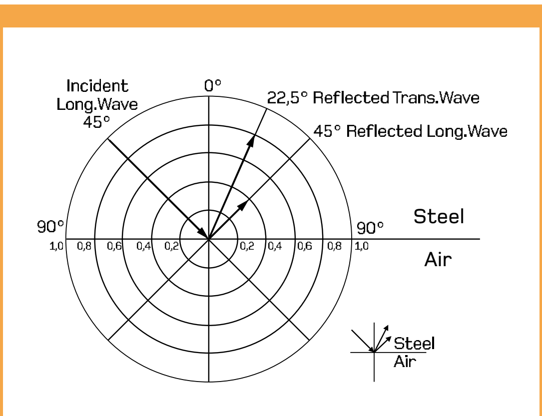


Figure 2 Compression and Shear Reflection

In weld inspection, the shear wave transmitted by the transducer travels through the base material, generally without any attenuation and scattering problems, and can thus be used without problems.
The secondary compression wave or creeping wave, generated at the opposite surface, appears to be strong enough to detect weld flaws. This can overcome the limitation of not being able to inspect over skip distance, usually associated with compression wave probes. Figure 3 illustrates this.

Of course, for defect location the different beam angles and propagation velocities in the shear and compression parts of the path must be accounted for.

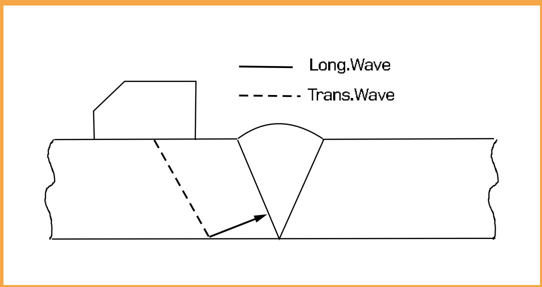


Figure 3 Indirect detection using mode conversion

Not only the "usual" mode, with identical transmit and receive paths, in which the mode converted "secondary" wave can be used. A very interesting possibility is the combined use of primary and secondary waves as shown in figure 4 and 5.

Figure 4 shows how two separated transducers with identical angles can inspect at two depths at a time, using wave mode conversion. This enables reliable detection of perpendicular flaws. The dept of the inspected zones somewhat depend on the used probe angle.

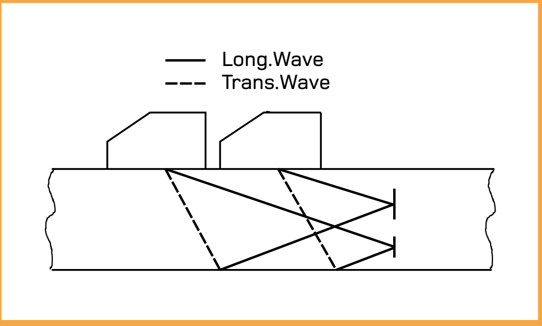


Figure 4 Tandem technique using wave mode conversion

Figure 5 shows how this technique can even be applied by using one transducer only. As in the case of figure 4, the ultrasound travels either way; the echoes from the two paths coincide and reinforce each other. The depth of the area of optimum sensitivity is here approximately 0.6 times wall thickness, depending slightly on the transducer angle.

This single transducer tandem technique is often referred to as round trip tandem (RTT). It was originally designed for the inspection of welds in high nickel alloys for liquefied natural gas containers (cryogenic application), where planar perpendicular flaws are of concern in maintenance inspections.

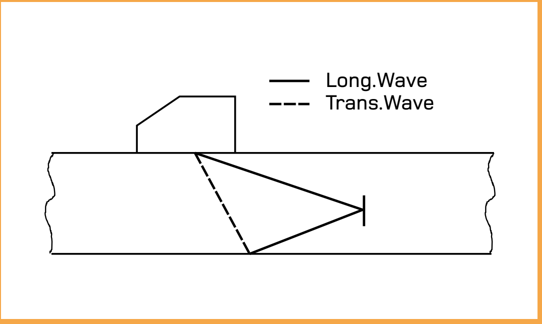


Figure 5 Principle of round trip tandem

LLT transducers

More recent development for detection of flaws perpendicular to the surface is the long/long/trans (LLT) technique. With this technique, mode conversion occurs at the defect instead of the back surface. The principle is explained in figure 6; this technique requires a special probe equiped with two crystals, since the angle of the shear wave is different from the compression wave. This technique allows a choice of inspection depth zones by selecting the appropriate probe characteristics.

This technique is less suitable for inspection inside austenitic welds, because one of the wave modes in the weld would be shear.

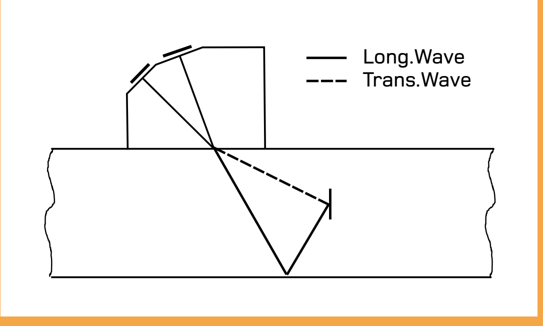


Figure 6 Principle of LLT technique

Crack detection

UCC probe

Probe for detection of notorious under cladding cracks. The "UCC-probe" was originally developed in the early seventies and is a good example of probe optimization for a single application.

Figure 7 shows the principle of this UCC-probe by selection of crystal size (near field), crystal geometry (spherical), squint angle and probe frequency. In this manner, a high signal to noise ratio is obtained.

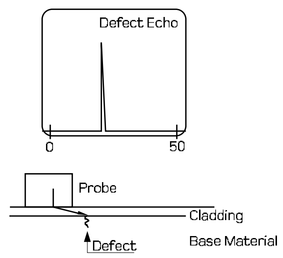


Figure 7

ADEPT tandem probe

The ADEPT tandem probe is a double angle beam probe, which shows a very good performance to size IGSCC. ADEPT stands for: advanced dual element probe technology. Figure 8 shows the principle. Intelligent use is made of the longitudinal and shear waves generated by both probe halves arranged in tandem technique, which transmit and receive at different angles.

This construction allows the probe to have small width, which is attractive for use on both small and large cracks. For very thin or large wall thicknesses, other non-standard probe angles and frequencies can be used. This requires test samples for probe optimization.

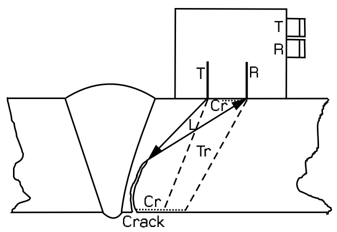


Figure 8 Principle of the ADEPT double angle probe

Delta tandem probe

Another probe for sizing of IGSCC uses the unique principle of the old Delta technique but in a new application. By individual optimization of the transmitter and receiver angles and frequency a probe can be developed whose principle is shown in figure 9. The crack tip diffraction method is applied. With small variations the required crystal combination can be selected. A more rugged single focus dual element probe is more attractive for use in difficult environments such as nuclear power plants.

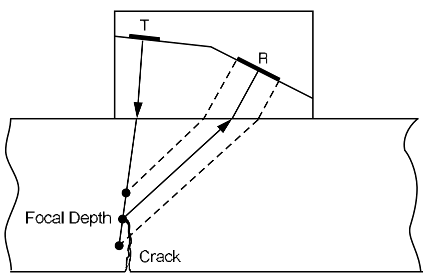


Figure 9 Principle of optimised delta tandem probe

Focus sound path information (TRL Probes)

Because TRL probes (i.e. dual element probes, longitudinal wave mode) have two overlapping beams, this type of probes has a natural focus. The focus distance can be selected within limitations according the table below. The focus distance is depending on frequency, beam angle, element size and squinting of the two elements. As a rule of thumb, the focus range at -6dB of a dual element probe is roughly between ½x focus and 2x focus. For example, a certain probe has focus FS~20, then the focus range at -6dB is about 10-40mm.

Minimum and maximum FS = Focus Sound path for TRL Transducers = Dual (Transmitter Receiver) Longitudinal Angle Beam Transducers

Max element size (mm) 2(width x height)		2(7x10)	2(8x14)	2(10x18)	2(15x25)	2(20x34)	2(24x42)
housing size (mm)		20x20	25x25	30x30	40x40	50x50	60x60
Frequency (MHz)	Angle	FS ~ min/max achievable (estimated) - (mm)					
0,5	45°	-	-	-	15/30	25/60	35/80
	60°	-	-	-	15/25	20/40	30/70
	70°	-	-	-	15/20	20/35	25/60
1	45°	-	10/25	15/30	20/55	30/80	40/120
	60°	-	10/20	15/30	20/45	25/75	35/110
	70°	-	10/20	15/30	15/45	25/75	30/100
2	45°	10/25	15/30	20/45	25/85	40/130	45/160
	60°	10/25	10/30	15/40	20/75	30/120	40/140
	70°	10/20	10/25	15/35	20/70	30/110	35/125
4	45°	10/35	20/60	25/90	30/100	-	-
	60°	10/35	15/55	20/70	25/90	-	-
	70°	10/30	10/50	15/65	20/85	-	-

Note: for flat surfaces FD = FS · cos β, where β is beam angle.

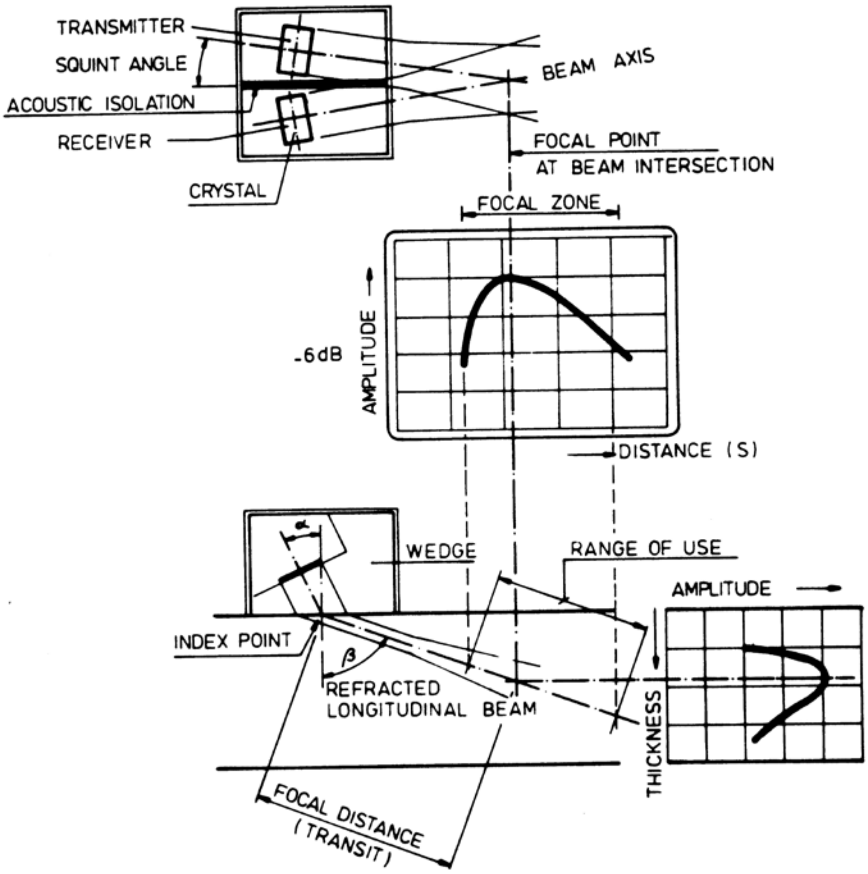
Why do you require TRL probes on coarse grained materials?

A shear wave probe on carbon steel block

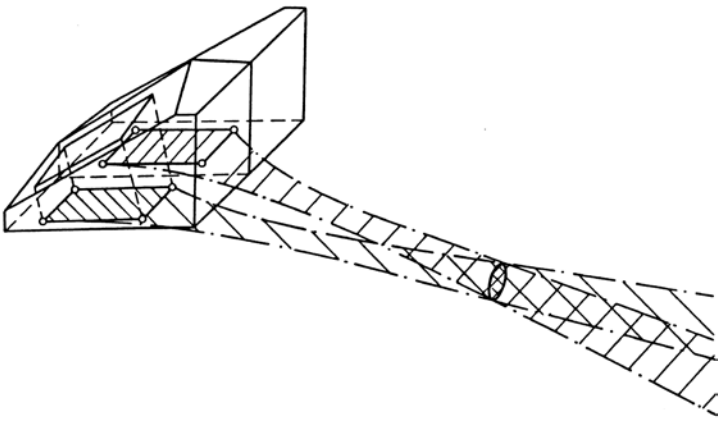
A dual element, longitudinal wave mode probe on carbon steel block

A shear wave probe on austenitic steel block

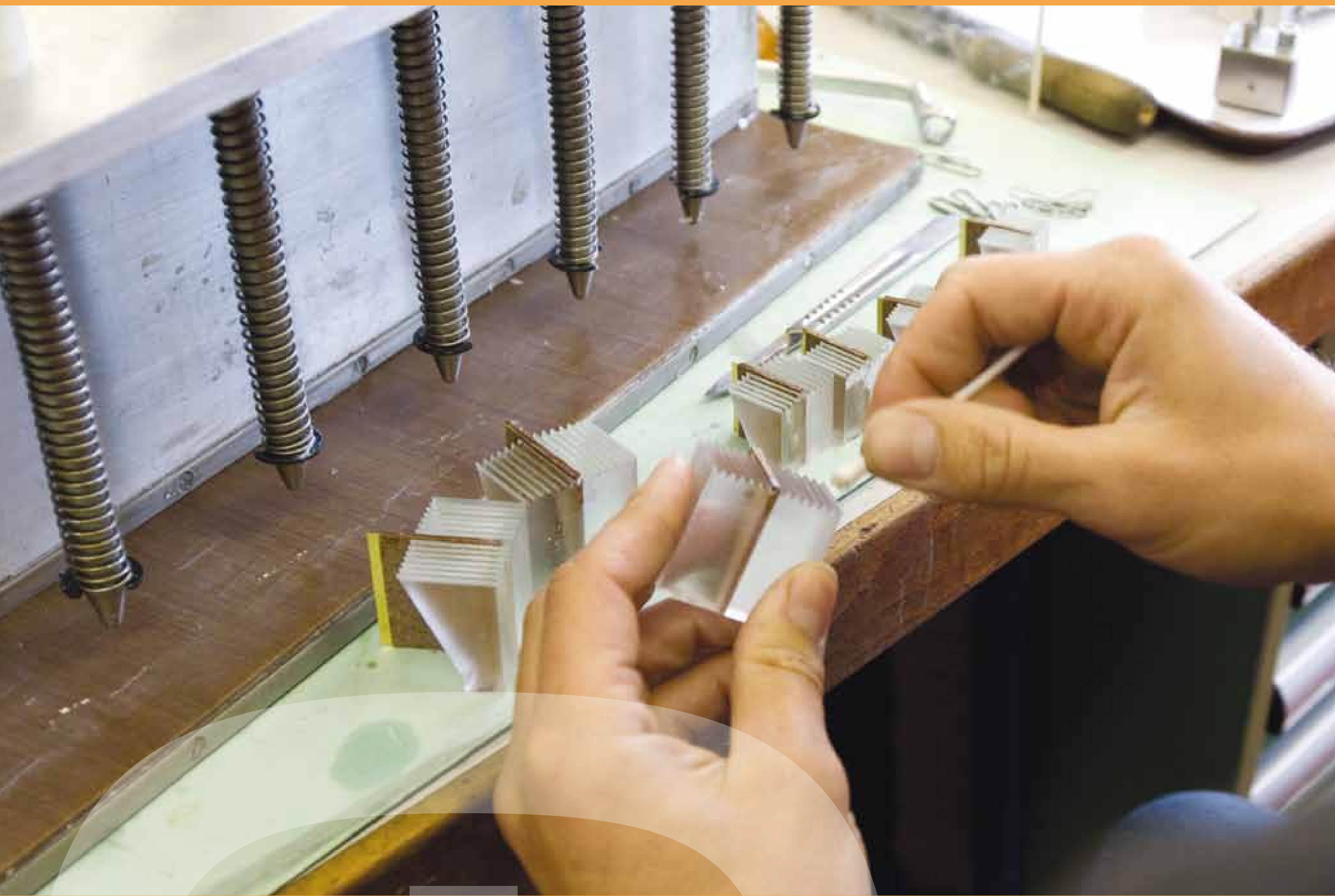
A dual element, longitudinal wave mode probe on austenitic steel



Sensitivity diagrams of TRL probes



Construction of TRL Probe with separate Transmitter and Receiver



Applus RTD Probes Product List

Ultrasonic Probes / Documentation / Test Blocks

1. Manual testing style

Longitudinal or shear wave, straight or angle beam probes.
Including quarter wave matching layer for probes up to 4MHz.
Connectors at the back of the stainless steel housing.
Plastic shoe (wedge) protrudes 4mm.

1.1 Housing 20x20x20mm / 25x25x25mm / 30x30x25mm / 40x40x25mm
1.1.1 Single crystal probe
1.1.2 Dual crystal probe
1.1.3 Triple crystal probe

1.2 Housing 50x50x30mm
Housing 60x60x35mm

1.3 UCC probe (Under-Cladding-Cracks detection probe)
70°TRL2 - St - 2(ϕ18R150) - SA25° FS~18/FD~6
Housing 40x40x25mm

2. Mechanised testing style

Longitudinal or shear wave, straight or angle beam probes.
Including quarter wave matching layer for probes up to 4MHz.
Connectors and internal couplant delivery on top of probe.
Fittings for use with a probe holder.

2.1 Housing 20x20x20mm / 25x25x25mm / 30x30x25mm / 40x40x34mm
2.1.1 Single crystal probe
2.1.2 Dual crystal probe
2.1.3 Triple crystal probe

2.2 Housing 50x50x35mm
Housing 60x60x40mm

2.3 Paintbrush probe
For example detection of corrosion over a wide area (~50mm)
Focus depth range 4÷20mm or 7.5÷30mm
Housing 50x25x25mm

2.4 TOFD probes (Time of Flight Diffraction)
Broad banded (>70% at -6dB), mechanised testing style probes, provided with composite elements.

Advisable element sizes are:

f [MHz]	ø [mm]
2	12
5	8
6	6
≥ 10	3

3. Immersion testing

3.1 Flat front
3.2 Lens focused

4. Optional features

For manual or mechanised style probes

4.1 Multi crystal / function straight and angle beam probes
4.1.1 Each extra built in single-crystal function
4.1.2 Each extra built in dual-crystal function

4.2 Increased wear resistance
4.2.1 Wear soles integrated into probe
4.2.2 Wear soles with tungsten-carbide wear-pins

4.3 Matching probes to curved surfaces
4.3.1 Cylindrical surfaces
4.3.2 Spherical surfaces

4.4 Couplant recycling
4.4.1 Integrated in probe
4.4.2 Frames for existing probes

For manual, mechanised and immersion testing

4.5 Lens focusing: for each lens focused crystal

4.6 Heat resistance up to 100°C (212°F)

4.7 Pressure resistance up to 30 bar (435 psi), test pressure 45 bar (650 psi)
4.8 Pressure resistance up to 400 bar (5800 psi), test pressure 600 bar (8700 psi)

4.9 Radiation resistance up to 108 Rad

4.10 Piezo composites
All types of probes can be manufactured with piezo composite elements.
Surcharge is calculated for each probe.

4.11 Bandwidth
Probes are manufactured with ¼λ- layer for a bandwidth of ~55% (at -6dB).
On request, we can manufacture probes with lower (~40% at -6dB) or higher bandwidth, for example for TOFD applications (Please inform).
Surcharge is calculated for each probe.

5. High temperature
250°C (480°F) continuous testing or on request 350°C (660°F) intermediate testing.

5.1 Manual style
- Single crystal probe
- Dual crystal probe

5.2 Mechanised style
5.3 Silicone oil per liter

6. Internal bore wall thickness/weld testing
Straight or angle beam, single or twin crystal probes for manual testing

6.1 Probe diameters from 12mm up to 50mm

7. Probe test sheets

7.1 Frequency Data Sheet & Ultrasonic Beam plot (if possible)
7.2 Focus diagram
Focus diagram for high temperature probes
7.3 X-Y beam profile per reflector at one depth
Additional reflector depths
7.4 DGS diagram
7.5 Certificate of Conformance (e.g. conform EN 12668-2)

8. Creeping wave probe: detection of near surface defects
Dual element, refracted longitudinal wave, angle beam probes. Available in manual and mechanised testing style.

	Type	Housing (manual style)
8.1	TRCr2 - St/Aust - 2(6x13)¼λ - SA17° FS~10/Notch	25x25x23mm
8.2	TRCr4 - St/Aust - 2(6x13)¼λ - SA20° FS~10/Notch	25x25x23mm
8.3	TRCr2 - St/Aust - 2(6x18)¼λ - SA15° FS~12/Notch	30x30x23mm
8.4	TRCr4 - St/Aust - 2(6x18)¼λ - SA18° FS~12/Notch	30x30x23mm
8.5	TRCr2 - St/Aust - 2(6x25)¼λ - SA10° FS~20/Notch	40x30x25mm
8.6	TRCr4 - St/Aust - 2(6x25)¼λ - SA15° FS~20/Notch	40x30x25mm

9. Probes for intergranular stress corrosion cracks (IGSCC)

	Type	Housing (manual style)
9.1	60°TRL2 - Aust - 2(10x18)¼λ - SA 9° FS~30	30x30x23mm
9.2	70°TRL2 - Aust - 2(10x18)¼λ - SA10° FS~25	30x30x23mm
9.3	TRCr2 - Aust - 2(10x15)¼λ - SA15° FS~12/Notch	30x30x23mm

9.4 ADEPT tandem
50°/65°LL3 - Aust - 2(8x7,5)¼λ - FD~5
Manual style, housing 30x15x30mm
Mechanised style, housing 30x30x25mm

9.5 Delta tandem
12°/40°LL2 - Aust – (10x10/12x12)¼λ - FD~18
Manual style, housing 35x20x25mm
Mechanised style, housing 30x30x25mm

10. LLT Probes for detection of vertical planar defects

Wave mode conversion: long-long-transverse.
Probes can be designed and optimised for frequency, wall thickness and angle.

10.1	T:17°L2.25-St-(24x24)¼λ R:59°T2.25-(20x10)¼λ	Upper zone
10.2	T:24°L2.25-St-(24x24)¼λ R:60°T2.25-(20x12)¼λ	Middle zone
10.3	T:43°L2.25-St-(24x24)¼λ R:65°T2.25-(20x15)¼λ	Lower zone

Manual style, housing 60x30x30mm
Mechanised style, housing 60x40x30mm

11. Austenitic probe calibration blocks

11.1 Radius 25mm and 50mm, width 40mm
11.2 Radius 50mm and 100mm, width 40mm

12. Austenitic probe characterization block

12.1 Dimension 440x100x60mm
4 edges of 45°, 60°, 65° and 70°
16 cylindrical holes ϕ3mm, depths 2.5mm up to 57.5mm
2 notches 0.5mm and 1mm depth

13. Timebase calibration (including frequency data sheet)

13.1 Single crystal unit 2.25 or 5MHz
13.2 Double crystal unit 1, 2.25 or 5MHz

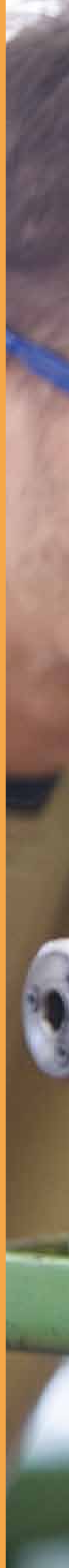
Fully dedicated to clients

Against a background of some 70 years in NDT&I operations, Applus RTD has gained an ability to develop **customized solutions** to enhance clients' process performance and assets integrity. The company's flexibility, whatever the challenge or working environment, also helps ensure tailor-made client-based solutions are provided and promises are kept.

Applus RTD's success also relies on its **people**. Highly motivated and trained specialists who treat today's toughest demands as an experience that can help with the challenges of tomorrow.

Throughout the organization, quality is a byword. Applus RTD standardizes stringent norms in the pursuit of the optimum for processes, people and the environment. The same **quality** all over the world.

Quality and innovation are also key factors in the way new **technology** is developed, specialized and successful solutions for special requirements.



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