



- Angle Beam Probes
- Immersion Probes
- Spot Weld Transducers
- Roller Transducers
- Pencil Transducers
- Replaceable Delay Dual Element Transducers

OLYMPUS NDT

Olympus NDT is a leading global manufacturer of innovative nondestructive testing instruments that are used in industrial and research applications ranging from aerospace, energy, automotive, and electronics to manufacturing. Olympus NDT instruments contribute to the quality of products and add to the safety of infrastructure and facilities. They include flaw detectors, thickness gages, bond testers, pulser-receivers, transducers, and advanced systems for inline applications. Our leading edge technologies include ultrasound, ultrasound phased array, eddy current, and eddy current array.

Olympus NDT offers products and services from several high quality brands: R/D Tech®, Panametrics-NDT™, NDT Engineering, Sonic®, and Nortec®. For many decades these brands have earned an excellent reputation for providing cost-effective solutions and excellent support and customer service.

Based in Waltham, Massachusetts, USA, the company has sales and service centers in all principal industrial locations worldwide. Visit www.olympusNDT.com for applications and sales assistance near you.

Harisonic Transducers

Harisonic ultrasonic transducers are available in thousands of different frequencies, element diameters, and connector sizes. In addition, we continue to manufacture transducers previously part of the Qualcorp/Automation Industries line as well as the Nortec transducer line. With more than 40 years experience, Olympus NDT has developed a wide spectrum of transducers for both standard and specialized NDT applications.

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Part Numbering System Legend

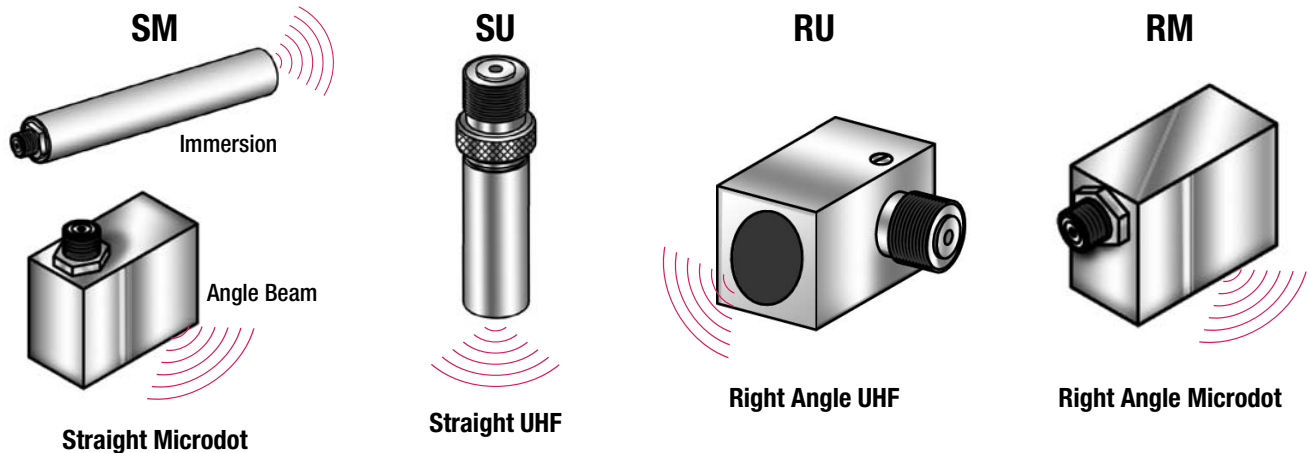
Example Part Number:

I3-0508-S-SU

Transducer Type & Case	Frequency	Size in 16ths of an Inch	Series	Connector Type & Location
	00 = 0.5 MHz	02 = 0.125" / 3 mm	Type S	-SM = Straight Microdot®
	01 = 1.0 MHz	03 = 0.187" / 5 mm	Type P	-RM = Right Angle Microdot
	02 = 2.25 MHz	04 = 0.25" / 6 mm	Type R	-SU = Straight UHF
	03 = 3.5 MHz	06 = 0.375" / 10 mm	(see page 2)	-RU = Right Angle UHF
	05 = 5.0 MHz	08 = 0.50" / 13 mm		
	07 = 7.5 MHz	10 = 0.625" / 16 mm		
	10 = 10 MHz	12 = 0.75" / 19 mm		
	15 = 15 MHz	16 = 1.00" / 25 mm		
	20 = 20 MHz	18 = 1.125" / 29 mm		
	25 = 25 MHz			

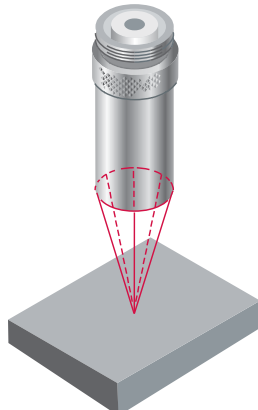
Part Number Configuration

Connector Style

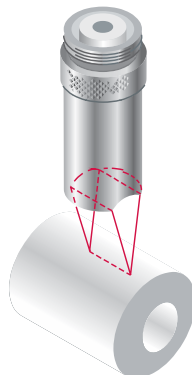


Focus Type (Immersion Transducers)

F Spherical Focus



CF Cylindrical Focus



Part Number Example I3-0308-R-SU-F2.50IN

Transducer Selection Criteria

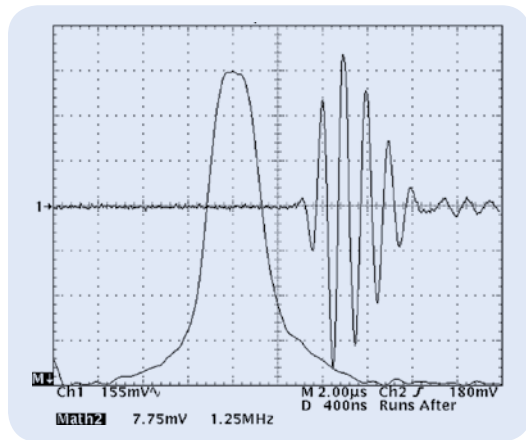
The transducer is one of the most critical components of any ultrasonic system. A great deal of attention should be paid to selecting the proper transducer for the application.

The performance of the system as a whole is of great importance. Variations in instrument characteristics and settings as well as material properties and coupling conditions play a major role in system performance.

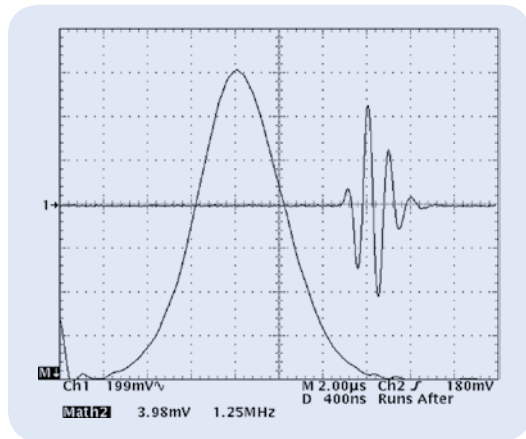
We have developed three different series of transducers to respond to the need for variety. Each series has its own unique characteristics.

Transducer configuration also has an impact on system performance. Consideration should be given to the use of focused transducers, transducers with wear surfaces that are appropriate for the test material, and the choice of the appropriate frequency and element diameter.

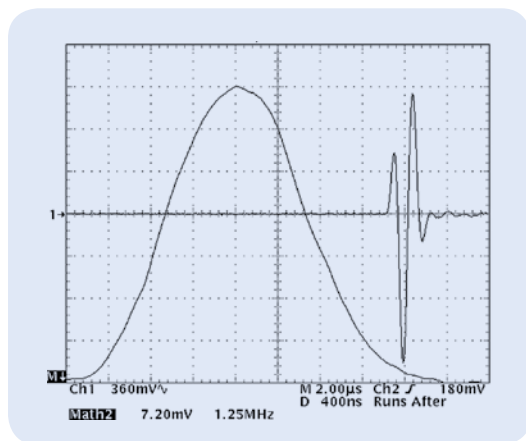
The summaries below provide a general description of the performance characteristics of each transducer series. While these guidelines are quite useful, each application is unique and performance will be dependent on electronics, cabling, and transducer configuration, frequency, and element diameter.



HARISONIC "P" type transducers are narrowband, lightly damped, tuned transducers. They have high-energy output and penetrating power, but have limited resolving power.



HARISONIC "S" type transducers are mediumband, medium damped, tuned transducers. They are used for general purpose flaw detection, and represent a compromise between high sensitivity and high resolution.

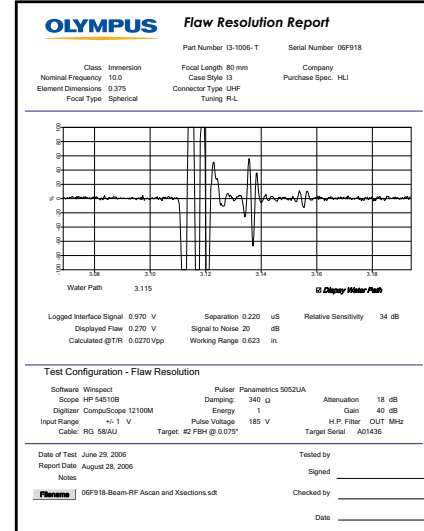
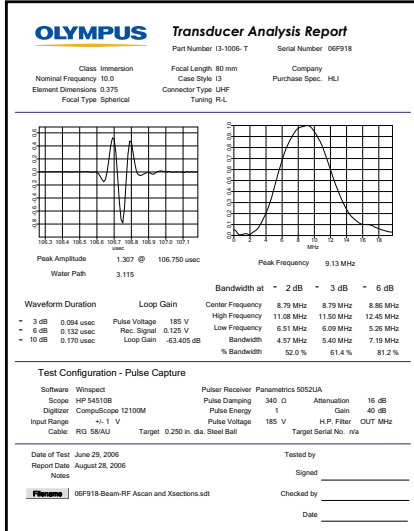


HARISONIC "R" type transducers are broadband, highly damped, tuned transducers. They are used for high resolution, near and far surface flaw detection, and thickness gaging applications.

Test and Documentation

All Olympus NDT transducers undergo a strict testing regime before they are deemed acceptable for use in the field. All tests are done in accordance with the ASTM E1065 Standard Guide for Evaluating Characteristics of Ultrasonic Search Units. As part of the test and documentation process, all transducers will automatically be shipped with a Real Time Waveform Spectrum

(RTWFS) or Pulse Characterization and are given the option of further documentation at the time of order. In addition, optional flaw/resolution tests, axial beam profile and transverse beam profiles can also be done on certain types of transducers. Please consult us with any special testing requirements.

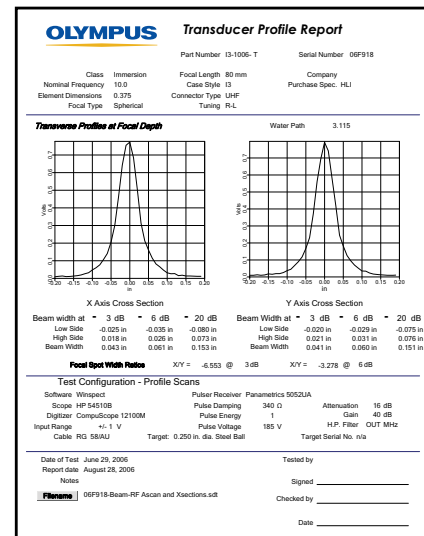
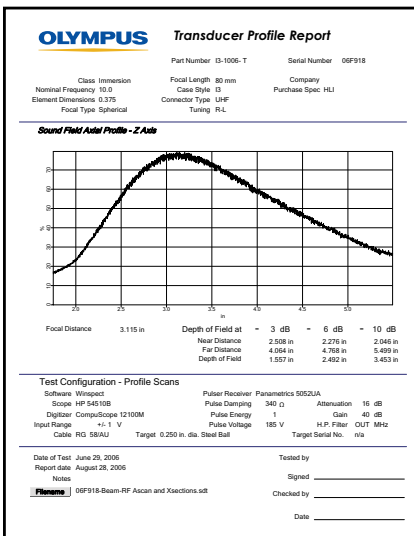


Transducer Analysis Report (Pulse Characterization)

The Transducer Pulse Characterization data sheet is our standard documentation, and is provided with every Harisonic® transducer, free of charge. The RF Waveform and Frequency Spectrum information is recorded and stored in our database, for future reference. Important parameters such as Peak and Center Frequency, Bandwidth, Pulse Voltage and Loop Gain are measured per ASTM E1065 guidelines.

Flaw Resolution Test

The optional Flaw Resolution Test certifies the resolving power of Harisonic® transducers. This test is typically performed on immersion type transducers, with the target being specified by the customer. Near or far surface resolution can be measured.



Axial (On-Axis) Beam Profile

The optional Axial or On-Axis Beam Profile is typically done on immersion type transducers, and provides critical information about the transducer's sound field. This test is performed with the transducer face starting close to the target and then moving away along the Z-axis. Pulse echo amplitude vs. distance, focal length, and depth of field are measured.

Transverse Beam Profiles

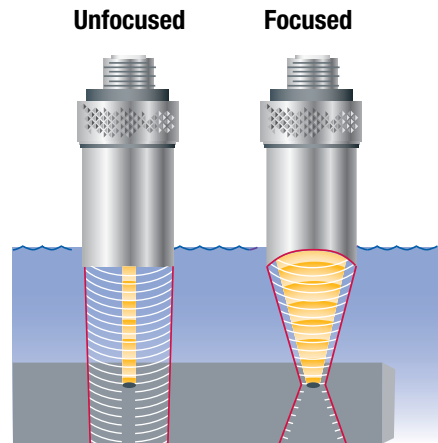
The optional Transverse Beam Profiles are typically done on immersion transducers, and provide critical information on the transducer's sound field. This test is performed at the measured focal length, along the X and Y axes. Beam width and symmetry are measured.

Immersion Transducers

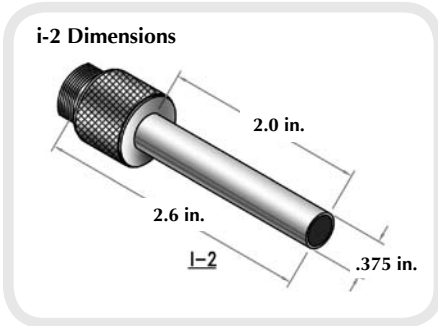
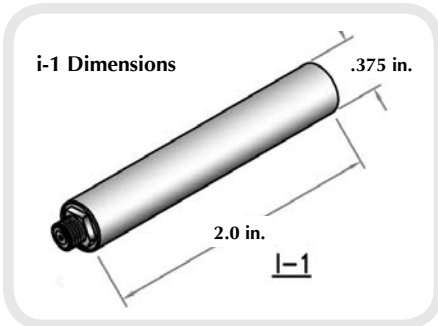
Immersion transducers are specifically designed to test parts partially or wholly immersed in water, which allows a uniform and fast coupling technique for rapid scanning of parts. Focusing lens can be added to increase transducer sensitivity and performance in a particular area of a part. Immersion transducers can be focused either spherically or cylindrically upon request within the allowable focal range for a given frequency and element size.

i-1 and i-2 Style Housings

0.25 inches (6 mm) diameter elements with 0.375 inches (10 mm) housings for difficult to reach fillet or bore areas are available with straight Microdot (I-1) or straight UHF (I-2) connectors and 303 stainless steel housings.



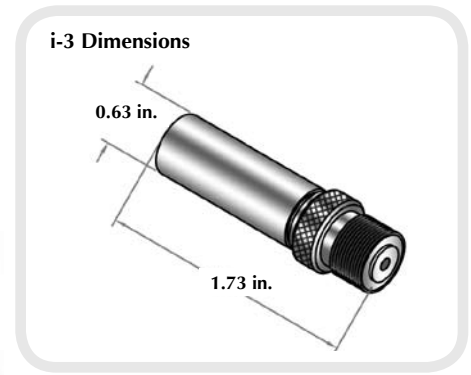
Frequency (MHz)	Element Dia. (in)	Element Dia. (mm)	Type S-Standard General Purpose	Type R-High Resolution	Focus (inches)	
			Part Number	Part Number	Min.	Max.
Type I-1						
2.25	0.25	6	i1-0204-S-SM	i1-0204-R-SM	0.35	0.45
3.50	0.25	6	i1-0304-S-SM	i1-0304-R-SM	0.39	0.70
5.0	0.25	6	i1-0504-S-SM	i1-0504-R-SM	0.43	1.00
10	0.25	6	i1-1004-S-SM	i1-1004-R-SM	0.46	2.10
15	0.25	6	i1-1504-S-SM	i1-1504-R-SM	0.50	3.15
20	0.25	6	i1-2004-S-SM	i1-2004-R-SM	0.50	4.20
25	0.25	6	i1-2504-S-SM	i1-2504-R-SM	0.50	5.25
Type I-2						
2.25	0.25	6	i2-0204-S-SU	i2-0204-R-SU	0.35	0.45
3.5	0.25	6	i2-0304-S-SU	i2-0304-R-SU	0.39	0.70
5.0	0.25	6	i2-0504-S-SU	i2-0504-R-SU	0.43	1.00
10	0.25	6	i2-1004-S-SU	i2-1004-R-SU	0.46	2.10
15	0.25	6	i2-1504-S-SU	i2-1504-R-SU	0.50	3.15
20	0.25	6	i2-2004-S-SU	i2-2004-R-SU	0.50	4.20
25	0.25	6	i2-2504-S-SU	i2-2504-R-SU	0.50	5.25



Immersion Transducers

i-3 Style Housing

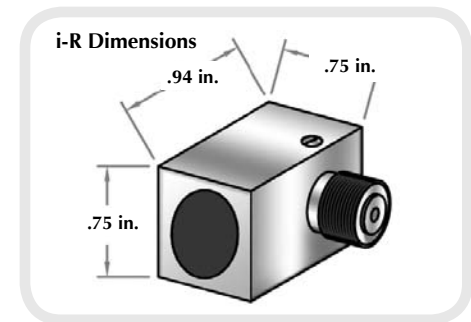
0.25 inches (6mm), 0.375 inches (10 mm) and 0.50 inches (13 mm) element diameters in 0.63 inches (16 mm) housings with straight UHF connectors and 303 stainless steel case housings. If a focus is required, select a focal length between min. and max.



Frequency (MHz)	Element Dia.		Type P Penetration Power	Type S-Standard General Purpose	Type R High Resolution	Point Target Focus (inches)	
	(in)	(mm)	Part Number	Part Number	Part Number	Min.	Max.
1.0	0.50	13	i3-0108-P-SU	i3-0108-S-SU	—	0.60	0.80
	0.25	6	i3-0204-P-SU	i3-0204-S-SU	i3-0240-R-SU	0.35	0.45
2.25	0.375	10	i3-0206-P-SU	i3-0206-S-SU	i3-0206-R-SU	0.50	1.06
	0.50	13	i3-0208-P-SU	i3-0208-S-SU	i3-0208-R-SU	0.80	1.90
3.5	0.25	6	i3-0304-P-SU	i3-0304-S-SU	i3-0304-R-SU	0.39	0.70
	0.375	10	i3-0306-P-SU	i3-0306-S-SU	i3-0306-R-SU	0.60	1.65
	0.50	13	i3-0308-P-SU	i3-0308-S-SU	i3-0308-R-SU	0.83	2.95
5.0	0.25	6	i3-0504-P-SU	i3-0504-S-SU	i3-0504-R-SU	0.43	1.00
	0.375	10	i3-0506-P-SU	i3-0506-S-SU	i3-0506-R-SU	0.60	2.35
	0.50	13	i3-0508-P-SU	i3-0508-S-SU	i3-0508-R-SU	0.75	4.20
7.5	0.50	13	—	—	i3-0708-R-SU	0.75	6.30
10	0.25	6	i3-1004-P-SU	i3-1004-S-SU	i3-1004-R-SU	0.46	2.10
	0.375	10	i3-1006-P-SU	i3-1006-S-SU	i3-1006-R-SU	0.60	4.75
	0.50	13	i3-1008-P-SU	i3-1008-S-SU	i3-1008-R-SU	0.75	8.40
15	0.25	6	—	i3-1504-S-SU	i3-1504-R-SU	0.50	3.15
	0.375	10	—	i3-1506-S-SU	i3-1506-R-SU	0.60	4.75
20	0.25	6	—	i3-2004-S-SU	i3-2004-R-SU	0.50	4.20
25	0.25	6	—	i3-2504-S-SU	i3-2504-R-SU	0.50	5.25
	0.375	10	—	—	i3-2506-R-SU	0.60	12.10

i-R Style Housings

0.50 inches (10 mm) element diameters in 0.75 inches (19 mm) x 0.75 inches (19 mm) rectangular housings with side mount (right angle), UHF connectors, and 303 stainless steel case housings are available.

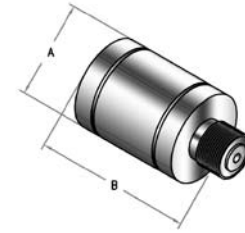


Frequency (MHz)	Element Dia.		Type P Penetration Power	Type S-Standard, General Purpose	Type R High Resolution	Point Target Focus (inches)	
	(in)	(mm)	Part Number	Part Number	Part Number	Min.	Max.
0.5	0.50	13	iR-0008-P-RU	—	—	0.40	0.43
1.0	0.50	13	iR-0108-P-RU	iR-0108-S-RU	—	0.60	0.80
2.25	0.50	13	iR-0208-P-RU	iR-0208-S-RU	iR-0208-R-RU	0.80	1.90
3.5	0.50	13	iR-0308-P-RU	iR-0308-S-RU	iR-0308-R-RU	0.83	2.95
5.0	0.50	13	iR-0508-P-RU	iR-0508-S-RU	iR-0508-R-RU	0.75	4.20
10	0.50	13	—	iR-1008-S-RU	iR-1008-R-RU	0.75	8.40

Immersion Transducers

i-4, i-7 and i-8 Style Housings

Various element and case sizes with straight UHF connectors and 303 stainless steel case housings are available.



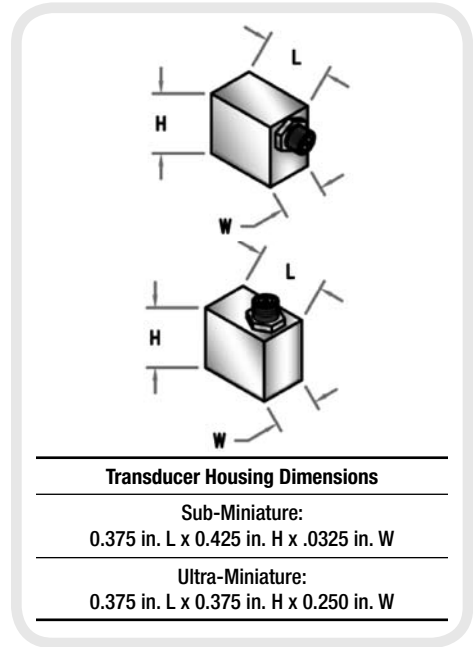
Styles i-4, i-7, and i-8

Element Dia. (in)	A	B
0.75	1.00	1.375
0.50, 0.625	0.748	1.375
1.00, 1.125	1.25	1.375

Frequency (MHz)	Element Dia		Type P Penetration Power	Type S-Standard, General Purpose	Type R High Resolution	Focus (inches)	
	(in)	(mm)	Part Number	Part Number	Part Number	Min.	Max.
0.50	0.75	19	i7-0012-P-SU	—	—	1.50	2.10
	1.00	25	i8-0016-P-SU	i8-0016-S-SU	—	1.25	1.65
	1.125	29	i8-0018-P-SU	i8-0018-S-SU	—	0.78	0.93
1.0	0.50	13	i4-0108-P-SU	i4-0108-S-SU	i4-0108-R-SU	0.60	0.80
	0.625	16	i4-0110-P-SU	i4-0110-S-SU	i4-0110-R-SU	0.70	1.34
	0.75	19	i7-0112-P-SU	i7-0112-S-SU	i7-0112-R-SU	1.00	1.90
	1.00	25	i8-0116-P-SU	i8-0116-S-SU	i8-0116-R-SU	1.63	3.38
	1.125	29	i8-0118-P-SU	i8-0118-S-SU	i8-0118-R-SU	1.90	4.30
2.25	0.375	10	i4-0206-P-SU	i4-0206-S-SU	i4-0206-R-SU	0.55	1.00
	0.50	13	i4-0208-P-SU	i4-0208-S-SU	i4-0208-R-SU	0.80	1.90
	0.625	16	i4-0210-P-SU	i4-0210-S-SU	i4-0210-R-SU	0.90	3.00
	0.75	19	i7-0212-P-SU	i7-0212-S-SU	i7-0212-R-SU	1.00	4.30
	1.00	25	i8-0216-P-SU	i8-0216-S-SU	i8-0216-R-SU	1.88	7.60
	1.125	29	i8-0218-P-SU	i8-0218-S-SU	i8-0218-R-SU	2.15	9.50
3.5	0.375	10	i4-0306-P-SU	i4-0306-S-SU	i4-0306-R-SU	0.60	1.60
	0.50	13	i4-0308-P-SU	i4-0308-S-SU	i4-0308-R-SU	0.83	3.00
	0.625	16	i4-0310-P-SU	i4-0310-S-SU	i4-0310-R-SU	0.90	4.70
	0.75	19	i7-0312-P-SU	i7-0312-S-SU	i7-0312-R-SU	1.00	6.65
	1.00	25	—	i8-0316-S-SU	—	1.95	11.25
	1.125	29	—	i8-0318-S-SU	—	2.20	15.30
5.0	0.375	10	i4-0506-P-SU	i4-0506-S-SU	i4-0506-R-SU	0.55	2.40
	0.50	13	i4-0508-P-SU	i4-0508-S-SU	i4-0508-R-SU	0.60	4.30
	0.625	16	i4-0510-P-SU	i4-0510-S-SU	i4-0510-R-SU	0.68	6.73
	0.75	19	i7-0512-P-SU	i7-0512-S-SU	i7-0512-R-SU	1.00	2.0
	1.00	25	i8-0516-P-SU	i8-0516-S-SU	i8-0516-R-SU	1.95	14.40
	1.125	29	i8-0518-P-SU	i8-0518-S-SU	i8-0518-R-SU	2.40	21.80
7.5	0.375	10	—	i4-0306-S-SU	—	0.60	1.60
	0.50	13	—	i4-0308-S-SU	—	0.83	3.00
	0.625	16	—	i4-0310-S-SU	—	0.90	4.70
10	0.375	10	—	i4-1006-S-SU	i4-1006-R-SU	0.60	4.75
	0.50	13	—	i4-1008-S-SU	i4-1008-R-SU	0.75	8.40
	0.625	16	—	i4-1010-S-SU	i4-1010-R-SU	0.85	13.40
	0.75	19	i4-1012-P-SU	i4-1012-S-SU	i4-1012-R-SU	1.00	15.37
15	0.375	10	—	i4-1506-S-SU	i4-1506-R-SU	0.60	7.10
	0.50	13	—	i4-1508-S-SU	i4-1508-R-SU	0.75	11.75
20	0.375	10	—	i4-2006-S-SU	i4-2006-R-SU	0.55	9.60

Sub-Miniature and Ultra-Miniature Angle Beam Transducers

The sub-miniature (HS-225) and ultra-miniature (HS-877) angle beam transducers are supplied in frequencies from 2.25 to 10.0 MHz with angles from 45° through 90°. Epoxy housings prevent the transducer from causing scratches to the test surface. These transducers are ideal for inspection of small diameter welded tubes and applications where the requirement is for a shear-wave transducer with a very small footprint. Depending on the type selected, either top or side mounted, Microdot connectors are available. When ordering, please specify part number, frequency, angle, material to be inspected, and connector location.



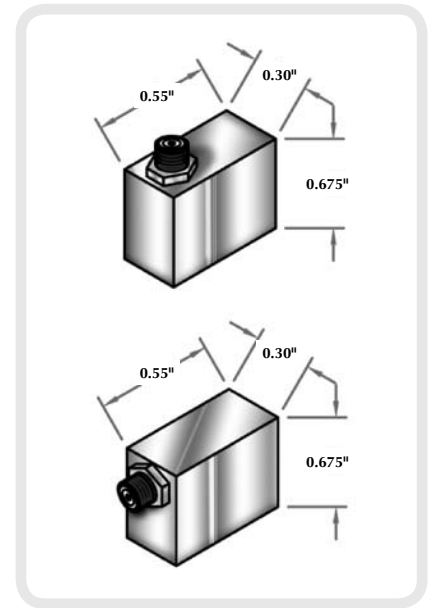
Size	Frequency (MHz)	Material	Connector	Angle XX = Specify Angle
0.120" x 0.250" 3 mm x 6 mm	2.25	Aluminum	Straight	HS-225-2-XX-AL-SM
	2.25	Aluminum	Right Angle	HS-225-2-XX-AL-RM
	2.25	Steel	Straight	HS-225-2-XX-ST-SM
	2.25	Steel	Right Angle	HS-225-2-XX-ST-RM
	5.0	Aluminum	Straight	HS-225-5-XX-AL-SM
	5.0	Aluminum	Right Angle	HS-225-5-XX-AL-RM
	5.0	Steel	Straight	HS-225-5-XX-ST-SM
	5.0	Steel	Right Angle	HS-225-5-XX-ST-RM
	10	Aluminum	Straight	HS-225-10-XX-AL-SM
	10	Aluminum	Right Angle	HS-225-10-XX-AL-RM
	10	Steel	Straight	HS-225-10-XX-ST-SM
	10	Steel	Right Angle	HS-225-10-XX-ST-RM
0.187" x 0.187" 5 mm x 5 mm	2.25	Aluminum	Straight	HS-877-2-XX-AL-SM
	2.25	Aluminum	Right Angle	HS-877-2-XX-AL-RM
	2.25	Steel	Straight	HS-877-2-XX-ST-SM
	2.25	Steel	Right Angle	HS-877-2-XX-ST-RM
	5.0	Aluminum	Straight	HS-877-5-XX-AL-SM
	5.0	Aluminum	Right Angle	HS-877-5-XX-AL-RM
	5.0	Steel	Straight	HS-877-5-XX-ST-SM
	5.0	Steel	Right Angle	HS-877-5-XX-ST-RM
	10	Aluminum	Straight	HS-877-10-XX-AL-SM
	10	Aluminum	Right Angle	HS-877-10-XX-AL-RM
	10	Steel	Straight	HS-877-10-XX-ST-SM
	10	Steel	Right Angle	HS-877-10-XX-ST-RM

Specify material to be inspected.

Integral Angle Beam Transducers

Miniature potted angle beam transducers provide an excellent balance between size and performance by utilizing integral angle beam shear wave wedges. Overall size and footprint are reduced compared to a screw-in style transducer and wedge with little or no sacrifice in performance. Epoxy housings prevent test surface scratching caused by the transducer.

Connectors are available in either top (straight) or side (right angle) mount depending on application requirements. Four standard shear wave angles of 45°, 60°, 70°, and 90° or custom angles are available upon request.

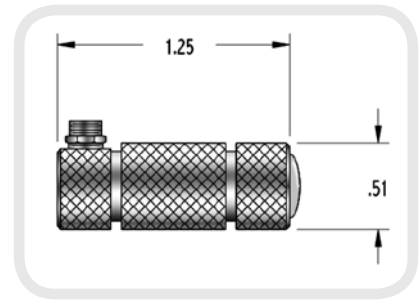


Size	Frequency (MHz)	Material	Connector	Angle XX = Angle 45, 60, 70 or 90
0.187" x 0.187" 5 mm x 5 mm	2.25	Aluminum	Straight	PAB-0203-XX-AL-SM
	2.25	Aluminum	Right Angle	PAB-0203-XX-AL-RM
	2.25	Steel	Straight	PAB-0203-XX-ST-SM
	2.25	Steel	Right Angle	PAB-0203-XX-ST-RM
	5.0	Aluminum	Straight	PAB-0503-XX-AL-SM
	5.0	Aluminum	Right Angle	PAB-0503-XX-AL-RM
	5.0	Steel	Straight	PAB-0503-XX-ST-SM
	5.0	Steel	Right Angle	PAB-0503-XX-ST-RM
	10	Aluminum	Straight	PAB-1003-XX-AL-SM
	10	Aluminum	Right Angle	PAB-1003-XX-AL-RM
	10	Steel	Straight	PAB-1003-XX-ST-SM
	10	Steel	Right Angle	PAB-1003-XX-ST-RM
0.250" x 0.250" 6 mm x 6 mm	2.25	Aluminum	Straight	PAB-0204-XX-AL-SM
	2.25	Aluminum	Right Angle	PAB-0204-XX-AL-RM
	2.25	Steel	Straight	PAB-0204-XX-ST-SM
	2.25	Steel	Right Angle	PAB-0204-XX-ST-RM
	5.0	Aluminum	Straight	PAB-0504-XX-AL-SM
	5.0	Aluminum	Right Angle	PAB-0504-XX-AL-RM
	5.0	Steel	Straight	PAB-0504-XX-ST-SM
	5.0	Steel	Right Angle	PAB-0504-XX-ST-RM
	10	Aluminum	Straight	PAB-1004-XX-AL-SM
	10	Aluminum	Right Angle	PAB-1004-XX-AL-RM
	10	Steel	Straight	PAB-1004-XX-ST-SM
	10	Steel	Right Angle	PAB-1004-XX-ST-RM

Spot Weld Transducers

These transducer designs are popular for spot weld inspection. Each has distinctive advantages. Common features among these styles are small diameter (3 mm to 6 mm) and high frequency (10 MHz to 20 MHz).

- **SOFT-TIP CAPTIVE WATER COLUMN** – Optimum for spot welds with flash free, recessed/ concave nuggets. The soft tip conforms to the irregular surface of the spot weld nugget. A lightweight liquid is required to transmit (couple) the ultrasonic energy into the nugget.
- **SOFT-TIP CAPTIVE WATER COLUMN - POLYMER TRANSDUCERS** – Polymer transducers generally are higher resolution transducers due to their greater bandwidth.



Soft Tip Captive Water Column – Polymer Transducers

Frequency (MHz)	Element Dia.		Part Number
	in.	mm	
20	.125	3.15	HPF-0315
	.141	3.6	HPF-0360
	.157	4.0	HPF-0400
	.177	4.5	HPF-0450
	.197	5.0	HPF-0500
	.220	5.6	HPF-0560
	.248	6.3	HPD-0630

Soft Tip Captive Water Column

Frequency (MHz)	Element Dia.		Part Number
	in.	mm	
15	0.125	3	SWM-1502
	0.187	5	SWM-1503
	0.250	6	SWM-1504
20	0.125	3	SWM-2002
	0.187	5	SWM-2003
	0.250	6	SWM-2004

For hard-tip delay line transducers visit our website at: <http://www.olympusndt.com/panametrics-ndt-ultrasonic/delay-line/>

Roller Transducers

Roller transducers are used in testing metallic or non-metallic materials for bonding/segregation in CFRP/GRP including Kevlar®, rubber friction materials, and high density products such as glass, wood, concrete, and metallic and plastic weldments. This series includes roller and contact type transducers at 0.5 MHz and 1.25 MHz. Contact units are available in 5, 10, and 15 mm diameters, while the roller transducers incorporate a 5 mm crystal giving a 10 mm footprint through the replaceable tire. Both styles are fitted with axial mounted Microdot connectors (other connectors available on request). The roller transducer can be ordered with either a single or dual yoke design.

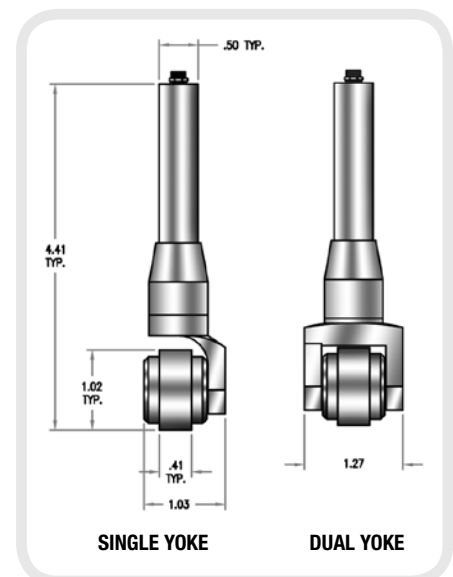
Roller Transducers

Frequency (MHz)	Size		Yoke	Wheel Diameter		Part Number
	in.	mm		in.	mm	
1.25	.187	5	Single	1.0	25	RT-0105-16SY
1.25	.187	5	Dual	1.0	25	RT-0105-16DY
0.50	.187	5	Single	1.0	25	RT-0005-SY
0.50	.187	5	Dual	1.0	25	RT-0005-DY

Spare Tires

Part Number	Wheel Diameter	
RT-16-10T	1.0 in.	25 mm

Roller transducers are used in through transmission mode for fast linear scans of parts without the need for an immersion setup. Roller transducers are typically used in applications looking for de-laminations in multilayer materials and are available in either single or dual yoke design removable and replaceable tire.



Pencil Transducers

These high frequency, focused delay line transducers are compatible with any ultrasonic instrument capable of displaying a return echo at depths as low as .010 inches in steel. The typical range is approximately from .010 inches to 0.250 inches in steel. The 0.060 inches circular contact face enables readings to be taken on curved surfaces. Typical applications for these transducers include the inspection of turbine blades, small diameter tubing and concave areas in small parts. Both transducers utilize replaceable delay tips. For best performance, a short cable (such as MB type, 6') should be used. These models, indicated by a part number ending with an "L", incorporate PowerLink™ Technology to assure optimal performance when used with a Sonic ultrasonic instrument.

The HC-876 ultrasonic transducer operates at high frequency (20 MHz) with a broad bandwidth and small contact surface. Its chief application is thickness measuring of critical components such as jet engine blades. It is fitted with a Microdot connector.



HC-876-RA-L Right Angle Type



HC-398-RDL Straight Pencil Type

Replaceable Delay Line

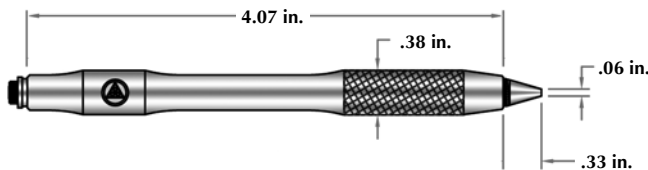
Frequency (MHz)	Nominal Element Size		Part Number	
	in.	mm	Straight Handle	Right Angle Handle
10	0.125	3	HC-398-RDL	HC-398-RA-RDL
Replacement Tips (10 μs)			HAX-398	HAX-398

Permanent Delay Line

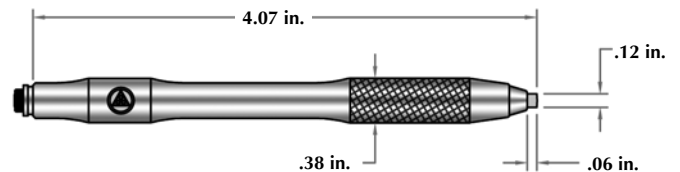
Frequency (MHz)	Nominal Element Size		Part Number	
	in.	mm	Straight Handle	Right Angle Handle
20	0.125	3	HC-876-L	HC-876*, HC-876-RA-L

Permanent Tip Delay (10 μs) *Not PowerLink compatible.

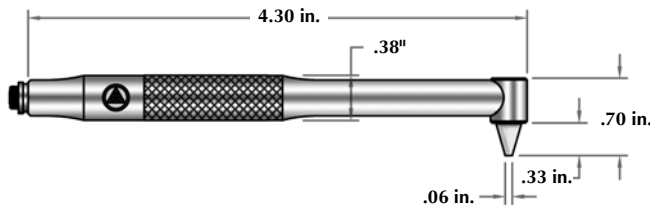
HC-398-RDL Straight Pencil Type



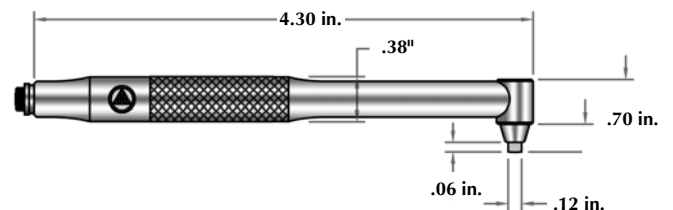
HC-876-L Straight Pencil Type



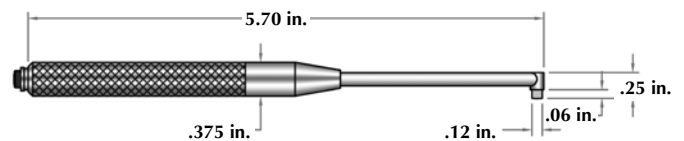
HC-398-RA-RDL Right Angle Type



HC-876-RA-L Right Angle Type



HC-876 Right Angle Type



Technical Notes

Table 1
Acoustic Properties of Materials

Material	Longitudinal Velocity		Shear Velocity		Acoustic Impedance (Kg/m ² s x 10 ⁶)
	(in/μs)*	(m/s)	(in/μs)*	(m/s)	
Acrylic resin (Perspex®)	0.107	2,730	0.056	1,430	3.22
Aluminum	0.249	6,320	0.123	3,130	17.06
Beryllium	00.5008	12,900	0.350	8,880	23.5
Brass, naval	0.174	4,430	0.083	2,120	37.30
Cadmium	0.109	2,780	0.059	1,500	24.02
Columbium	0.194	4,920	0.083	2,100	42.16
Copper	0.183	4,660	0.089	2,260	41.61
Glycerine	0.076	1,920	—	—	2.42
Gold	0.128	3,240	0.047	1,200	62.60
Inconel®	0.29	5,820	0.119	3,020	49.47
Iron	0.232	5,900	0.127	3,230	45.43
Iron, cast					
(slow)	0.138	3,500	0.087	2,200	25.00
(fast)	0.220	5,600	0.126	3,220	40.00
Lead	0.085	2,160	0.028	700	24.49
Manganese	0.183	4,660	0.093	2,350	34.44
Mercury	0.057	1,450	—	—	19.66
Molybdenum	0.246	6,250	0.132	3,350	63.75
Motor Oil (SAE 20 or 30)	0.069	1,740	—	—	1.51
Nickel, pure	0.222	5,630	0.117	2,960	49.99
Platinum	0.156	3,960	0.066	1,670	84.74
Polyamide, (nylon, Perlon®)					
(slow)	0.087	2,200	0.043	1,100	.40
(fast)	0.102	2,600	0.047	1,200	3.10
Polystyrene	0.092	2,340	—	—	2.47
Polyvinylchloride, PVC, hard	0.094	2,395	0.042	1,060	3.35
Silver	0.142	3,600	0.063	1,590	37.76
Steel, 1020	0.232	5,890	0.128	3,240	45.63
Steel, 4340	0.230	5,850	0.128	3,240	45.63
Steel, 302	0.223	5,660	0.123	3,120	45.45
Austenitic stainless steel, 347	0.226	5,740	0.122	3,090	45.40
Austenitic stainless tin	0.131	3,320	0.066	1,670	24.20
Titanium, Ti 150A	0.240	6,100	0.123	3,120	27.69
Tungsten	0.204	5,180	0.113	2,870	99.72
Uranium	0.133	3,370	0.078	1,980	63.02
Water (20°C)	0.058	1,480	—	—	1.48
Zinc	0.164	4,170	0.095	2,410	29.61
Zirconium	0.183	4,650	0.089	2,250	30.13

* Conversion Factor: 1 m/s = 3.937 x 10⁻⁵ in/μ S
Source: Nondestructive Testing Handbook, 2nd Edition, Volume 7
Ultrasonic Testing ASNT, 1991, ed. Paul McIntire

Near Field Distances of Flat Transducers in Water

The near field values in this table have been determined using the following equation:

$$N = \frac{D^2}{4\lambda} \left[1 - \left(\frac{\lambda}{D} \right)^2 \right]$$

The minimum and maximum practical focal lengths have been calculated by considering the acoustic and mechanical limitations of each configuration. These limitations are a function of transducer frequency, element diameter, and case dimensions. There may be exceptions to the limits listed in the table.

Table 2
Near Field Distance of Flat Transducers in Water

Frequency (MHz)	Element Diameter (inches)	N (inches)	Focal Length (PTF)** (inches)	
			Min	Max
0.5	10.500	4.757	2.15	3.80
	1.125	2.661	10.500	2.10
	1.00	2.095	1.25	1.65
	0.75	1.164	0.78	0.93
1.0	10.500	9.559	20.500	7.65
	1.125	5.366	1.90	4.30
	1.00	4.235	10.625	3.38
	0.75	2.372	1.00	1.90
2.25	00.500	1.043	0.60	0.80
	10.500	21.534	2.70	140.500
	1.125	12.099	2.15	90.500
	1.00	9.554	1.875	7.60
3.5	0.75	5.364	1.00	4.30
	00.500	2.374	0.80	1.90
	00.375	1.329	00.500	1.06
	0.25	0.584	0.35	0.45
5.0	1.00	14.868	1.95	11.5
	0.75	8.350	1.00	6.65
	00.500	3.699	0.83	2.95
	00.375	2.073	0.60	1.65
7.5	0.25	0.914	0.385	0.70
	1.00	21.243	1.95	14.40‡
	0.75	11.932	1.00	90.500
	00.500	5.287	0.75	4.20
10	00.375	2.965	0.60	2.35
	0.25	1.309	0.43	1.00
	0.75	17.900	1.00	12.75‡
	00.500	7.933	0.75	6.30‡
15	1.00	42.490	2.00	20.00‡
	0.75	23.868	1.00	150.375‡
	00.500	10.579	0.75	8.40‡
	00.375	5.934	0.60	4.75‡
20	0.25	2.622	0.46	2.10
	00.500	15.870	0.75	11.75‡
	00.375	8.902	0.60	7.10‡
	0.25	3.935	00.500	3.15‡
25	0.25	5.247	00.500	4.20‡
	0.125	1.290	0.25	1.00‡
25	0.25	6.559	00.500	5.25‡

** Panametrics' Standard Case style, Large Diameter Case style, Slim Line Case style, and Pencil Case style immersion transducers with straight connectors can be focused between the minimum and maximum point target focal (PTF) distance limits listed above. Please consult Panametrics before ordering a transducer focused outside these limits.

‡ Consideration should be given to attenuation effects, which increase linearity with the square of frequency and the square of bandwidth. In applications where long water paths are required the effects of frequency dependent attenuation should be checked per ASTM E 1065, Annex A7. It is advisable to consider the effects of frequency dependent attenuation if the focal distance equals or exceeds the following values:

Frequency	Focal Length
MHz	inches
5.0	13
7.5	6
10	3.5
15	1.5
20	0.8
25	0.5
30	0.4

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