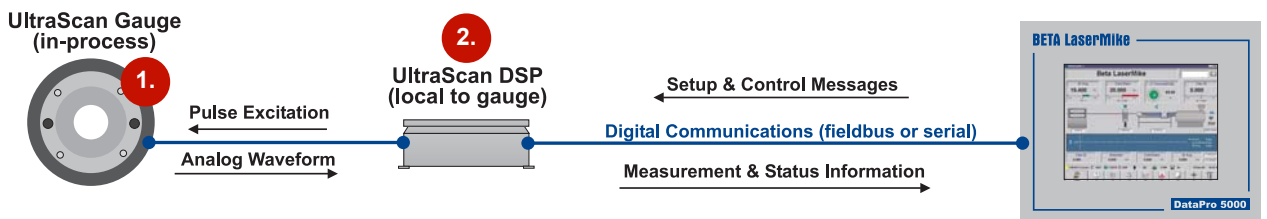


## Wall, Concentricity, Diameter, & Ovality Measurement Systems

UltraScan systems from Beta LaserMike provide on-line precision measurements of pipe wall thickness and concentricity, with an option for also measuring diameter & ovality. Using ultrasonic technology, UltraScan systems are able to make high-speed, non-contact measurements during production.

### Main Components of UltraScan Measurement Systems



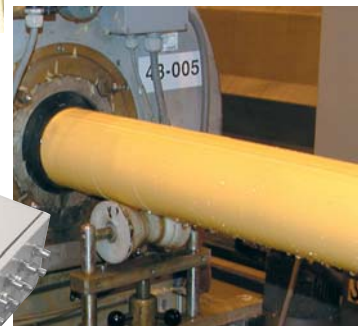
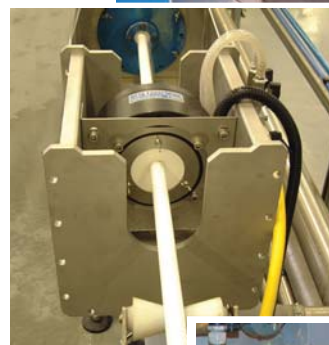
**1. The Ultrasonic Gauge** consists of a fixture holding multiple ultrasonic transducers around the pipe. Beta LaserMike offers two types of ultrasonic gauges. The **UltraScan 1000** series gauges hold the ultrasonic transducers in a static position. The **UltraScan 5000** series gauges reverse the ultrasonic transducers back-and-forth to measure 100% of the pipe.

**2. The Ultrasonic Intelligence Module** interfaces to the ultrasonic transducers and analyzes the signals in a Digital Signal Processor (DSP) to perform and communicate the measurements. The Beta LaserMike ultrasonic intelligence module, called **UltraScan DSP**, is the most powerful and advanced system of its kind in the world and is the key to providing the user with a very robust and easy-to-use ultrasonic system.

**DataPro Controller**  
(or other host system)

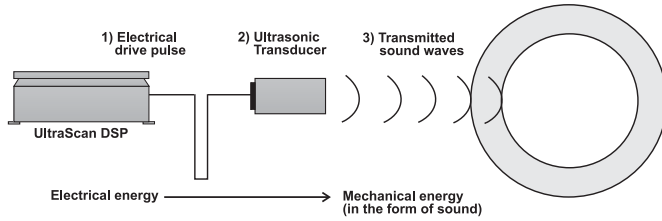
### The UltraScan™ Advantage

- Eliminates need for operator intervention with unique patented “Snap Technology” that provides automatic setup
- Achieves highest ultrasonic accuracy and repeatability with unique “Snap Technology” that optimizes each measurement in the Digital Signal Processor (DSP)
- Finds short-term wall variations with high-speed tolerance checking option
- Increases measurement repeatability with line speed and temperature compensation
- Offers flexible mounting options including inside cooling troughs and spray tanks, or in a separate installation tank provided by Beta LaserMike
- Provides flexible communication integration to UltraScan DSP with RS-232, DeviceNet, CANopen and Profibus protocol support



## Ultrasonic Wall & Concentricity Measurement Principle

UltraScan DSP sends an electrical drive pulse and the transducers convert that energy into an ultrasonic sound wave.



The UltraScan DSP calculates the wall thickness as:

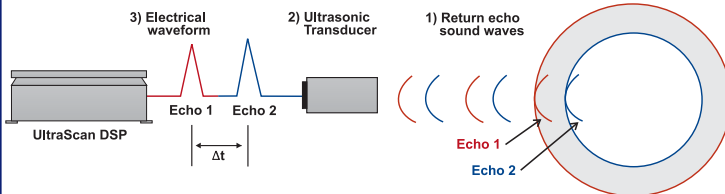
$$\text{Wall} = (\Delta t * s) / 2$$

$\Delta t$  = time between echoes

$s$  = speed of sound through the material<sup>1</sup>

<sup>1</sup>The DataPro 3000 and 5000 controllers provide a feature that allows the UltraScan DSP to determine the speed of sound through the material on line.

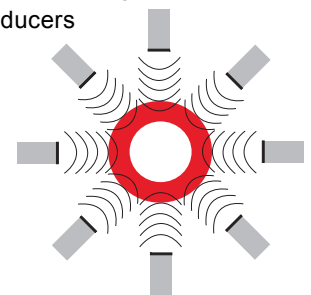
Echoes are sent back to the ultrasonic transducers from the walls of the pipe and the transducers convert that energy into an electrical waveform.\*



### Multi-Point Wall & Concentricity

Using multiple transducers (or reversing the transducers)

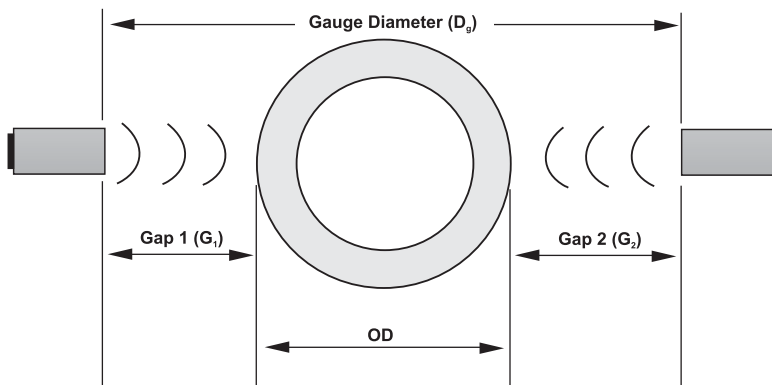
provides full measurement of the product. This allows the calculation of concentricity and the determination of the minimum and maximum wall thickness.



\*With multi-layer pipes, an echo occurs at each layer and therefore each layer can be measured individually.

## Ultrasonic Diameter & Ovality Measurement Principle

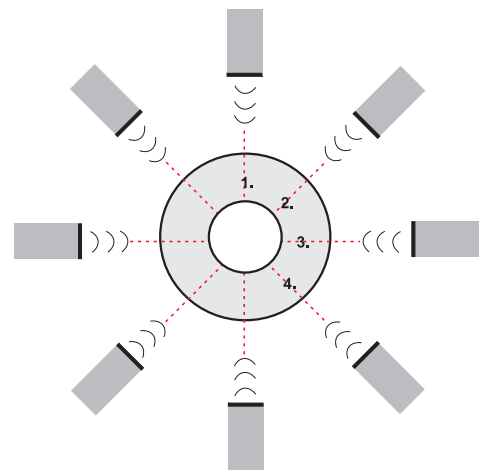
To measure pipe diameter, the distance between the two transducers is determined at calibration and the gap\*\* between each transducer and the outer wall of the pipe is measured by UltraScan DSP. The diameter of the pipe is determined with these three pieces of information.



$$OD = D_g - (G_1 + G_2)$$

where  $D_g$  is the distance between transducers and  $G_1$  and  $G_2$  are the gaps between the transducers and the outer wall of the pipe.

\*\*UltraScan gauges include a water temperature sensor to increase accuracy of gap measurements.



### Multi-Point Diameter & Ovality

Using multiple transducers (or reversing the transducers) provides full measurement of the product. This allows the calculation of ovality and the determination of the minimum and maximum diameter.

## Unique Ultrasonic Technology

### Snap Technology

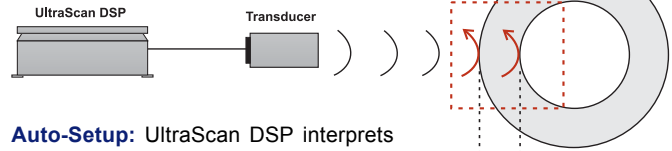
#### So Simple, it's always being used

All ultrasonic measurement systems require some form of setup of the ultrasonic waveform. The measurement system must know the proper echoes and positions in the waveform to trigger on and measure from, and the user must set this up.

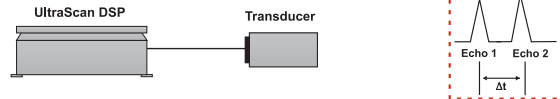
But the UltraScan DSP, with its unique and powerful patented **Snap Technology**, is the world's only ultrasonic system that is capable of completely setting up its own ultrasonic waveforms instantly and automatically. The intelligence of Snap Technology provides fully automatic ultrasonic measurement with:

- Auto-search
- Auto-setup
- Auto-tracking

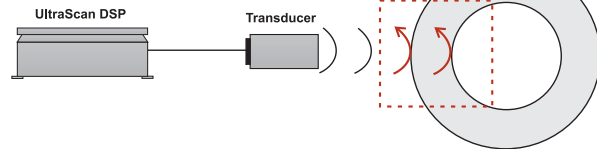
**Auto-Search:** UltraScan DSP finds the echoes and sets a "window" around them.



**Auto-Setup:** UltraScan DSP interprets the ultrasonic waveform and identifies the proper echoes.

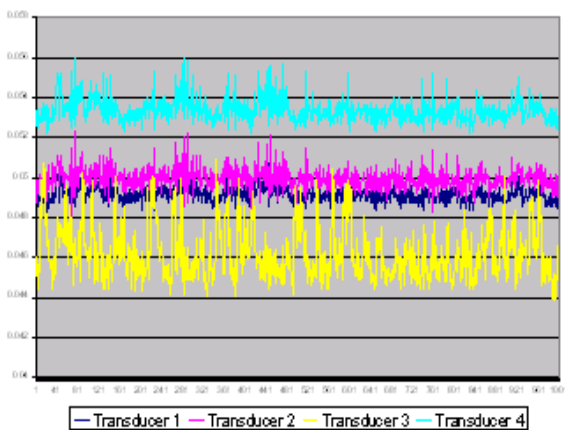


**Auto-Tracking:** UltraScan DSP locks onto the proper echoes and tracks them as the product moves.



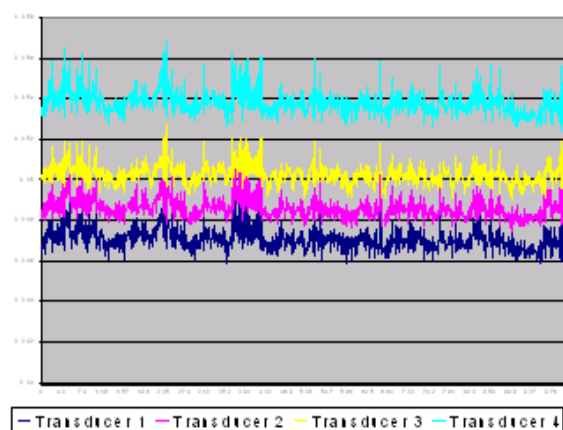
### Highest achievable ultrasonic accuracy

Since each ultrasonic transducer is set up individually, other ultrasonic systems have the potential to introduce error in the measurements due to the human error created by manual setup. And when conditions of the product or the process change, the fixed manual setup does not adapt the signal processing with the changes. But when the measurements are set up automatically with Snap Technology, it ensures that the setup is the same across all transducers. And when conditions of the product or the process change, the auto setup **instantly adapts** the signal processing with the changes. This continuous and automatic setup of all transducers ensures **maximum consistency** across each transducer, thus providing **higher accuracy** of average wall and concentricity measurements.



Gauge 1: Manual waveform setup

The 4 on-line wall measurements show some inconsistency (caused by differences in the manual waveform setup of the 4 transducers).



Gauge 2: Automatic waveform setup

The 4 on-line measurements follow the wall changes precisely the same, due to Snap Technology's automatic setup and tracking software.

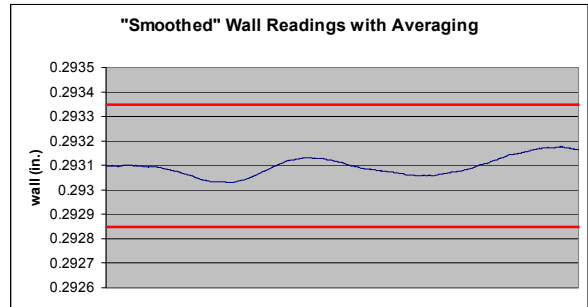
## Unique Ultrasonic Technology

### High-Speed Tolerance Checking

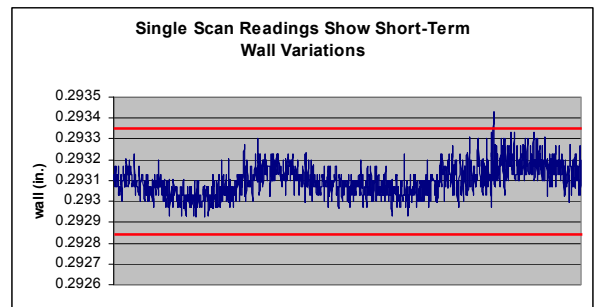
#### Detection and notification of short-term wall variations

Ultrasonic systems are often implemented in pipe extrusion lines to monitor for and correct gradual changes in the wall thickness. Short-term variations in wall thickness are often missed when the ultrasonic system is averaging data and monitoring for periodic changes. But UltraScan systems are capable of taking approximately 2,000 wall measurements per second, dependent on thickness, and have an advanced feature for **High-Speed Tolerance Checking**. The UltraScan DSP checks each scan of each transducer and compares the measurement against wall tolerances. This high-speed checking of tolerances is designed to catch short-term wall variation on each individual layer of the pipe.

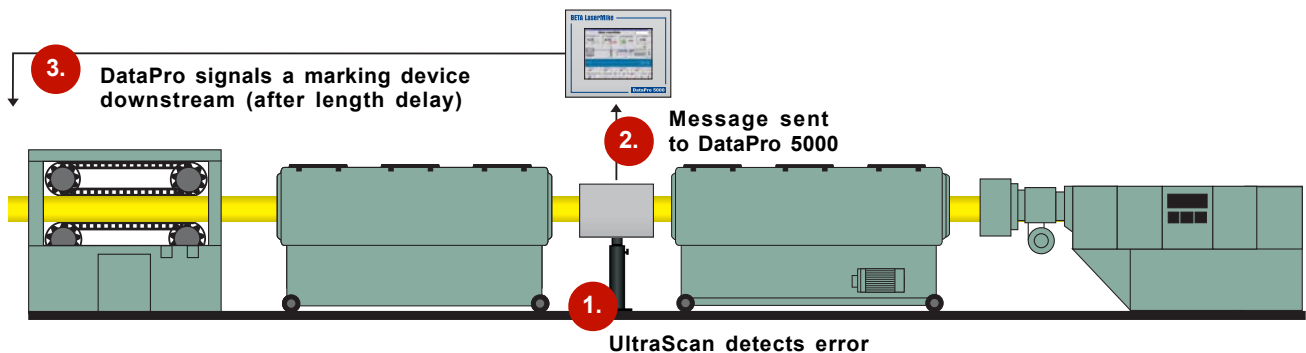
Once a high-speed tolerance error is found, the UltraScan DSP sends a signal to the DataPro 5000 controller to indicate that an error has occurred. The DataPro 5000 can then send a signal to a device downstream that will mark or cut out the area of the product that is out-of-tolerance. A length delay is implemented by the DataPro 5000 after the error message is received, so that the mark or cut matches with the position of the error.



Standard tolerance checking compares averaged wall values against tolerance limits



High speed tolerance checking compares individual scans against tolerance limits



#### Record keeping of short-term wall variations

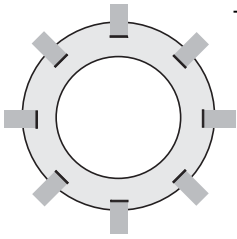
The UltraScan DSP sends details of each error\* to the DataPro 5000, including:

- which transducers detected the error
- max and min wall size during error
- length of error
- which layer or layers contain error

\*Each error message sent is logged to a report on the DataPro 5000 screen

Entry	Layer	Over_Errors	Under_Errors	Transducers	Max_Size	Min_Size	Begin
37	1	0	1	3	0	0.148	0
38	2	1	0	4	0.523	0	0
39	2	1	0	1	0.926	0	0
40	1	1	0	3	0.409	0	0
41	1	1	0	3	0.409	0	0
42	1	2	2	1,2	12.707	0.373	0
43	2	1	2	1	5.836	0.296	0
44	1	1	1	1	n 491	n 171	n

## Static Gauges: UltraScan 1000 Series



The UltraScan 1000 series of ultrasonic gauges hold the ultrasonic transducers in a static position around the pipe. UltraScan 1000 gauges are available to cover a variety of pipe diameter and wall thickness sizes in both fixed and adjustable transducer distance styles. UltraScan 1000 gauges support 4, 6, or 8 transducers (depending on model), each capable of measuring multiple layers. Each UltraScan 1000 fixed-distance gauge model has a water seal on either side of the gauge to allow installation in spray tanks or outside of cooling tanks.

### Specifications (all models)

- Wall measurement accuracy to  $\pm 0.001$  mm ( $\pm 0.000040$  in.)
- Concentricity accuracy to  $\pm 0.1\%$
- Diameter and ovality measurement accuracy to  $\pm 0.050$  mm ( $\pm 0.002$  in.)

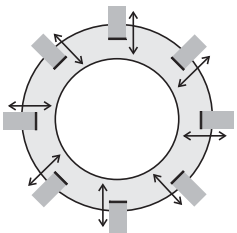
Fixed Transducer Distance Gauges		
Model	OD Range	Gauge Throat
UltraScan 1063	3.75 – 63 mm (0.148 – 2.5 in.)	83 mm (3.3 in.)
UltraScan 1125	10.5 – 125 mm (0.413 – 5.0 in.)	190 mm (7.5 in.)
UltraScan 1175	30 – 175 mm (1.181 – 7.0 in.)	236 mm (9.3 in.)
UltraScan 1305	75 – 305 mm (2.95 – 12.0 in.)	406 mm (16.0 in.)
UltraScan 1510	150 – 510 mm (5.9 – 20.0 in.)	570 mm (22.4 in.)
UltraScan 1660	225 – 660 mm (8.86 – 26.0 in.)	720 mm (28.3 in.)



### Options

- Height stand for trough
- High-speed tolerance checking software
- Small trough for mounting outside existing cooling troughs
- Base mount carriage for mounting to base of trough
- Ultrasonic diameter measurement

## Adjustable Gauges: UltraScan 1000A Series



Each UltraScan 1000 adjustable-distance gauge model comes with its own water trough or catch pan. Each gauge comes standard with a water manifold and hoses for water flow control. All UltraScan 1000 gauges can support multiple transducer types, each supporting a different wall thickness range. Beta LaserMike engineers will select the appropriate transducer type for your application.

### Specifications (all models)

- Wall measurement accuracy to  $\pm 0.001$  mm ( $\pm 0.000040$  in.)
- Concentricity accuracy to  $\pm 0.1\%$

Adjustable Transducer Distance Gauges		
Model	OD Range	# of Transducers
UltraScan 1125A	10.2 – 125 mm (0.4 – 5.0 in.)	4, 8
UltraScan 1280A	63.5 – 280 mm (2.5 – 11.0 in.)	4, 6, 8
UltraScan 1450A	160 – 450 mm (6.3 – 17.7 in.)	4, 8
UltraScan 1630A	251.5 – 630 mm (9.9 – 24.8 in.)	4, 8



### Options

- Height stand for trough
- High-speed tolerance checking software