ULTRASONIC WALL THICKNESS GAUGE MEASUREMENT

The use of Ultrasonic non-destructive testing (NDT) to check material properties such as thickness measurement, is now extensively used in all facets of industry. The ability to gauge thickness measurement without requiring access to both sides of the test piece, offers this technology a multitude of possible applications. Metals, plastics, ceramics, glass and other materials can easily be measured by portable ultrasonic thickness gauges with a common accuracy of.001".

Ultrasonic thickness gauges measure the thickness of a part by measuring the time sound travels from the transducer through the material to the back end of a part, and then measures the time of reflection back to the transducer. The gauge then calculates the thickness based on the velocity of sound through the material being tested.

A broad variety of piezoelectric transducers, operating at given frequencies are utilized to generate sound when excited. Typically, a 5mhz frequency is standard on all Phase II Ultrasonic Thickness Gauges. Optional transducers are always available for a myriad of applications.

The direct contact method of pulse/echo type ultrasonic thickness gauges requires use of a couplant. Propylene Glycol is common, but many other substances can be used.

Easy to configure and use, many gauges today have the ability to retain memory, output to printers, PC's, and handheld portable devices. With the combination of an easy menu driven gauge and the data in memory, technician/operators have a world of technology at their fingertips to obtain highly accurate and cost effective measurements for all types of thickness applications.

Sound Velocity Chart

All velocities are approximations:

Material	**Sound Velocity**	
	Inch/µS	**M/s**
Air	0.013	330
Aluminum	0.250	6300
Alumina Oxide	0.390	9900
Beryllium	0.510	12900
Boron Carbide	0.430	11000
Brass	0.170	4300
Cadmium	0.110	2800
Copper	0.180	4700
Glass(crown)	0.210	5300
Glycerin	0.075	1900
Gold	0.130	3200
Ice	0.160	4000
Inconel	0.220	5700
Iron	0.230	5900
Iron (cast)	0.180	4600
Lead	0.085	2200
Magnesium	0.230	5800
Mercury	0.057	1400
Molybdenum	0.250	6300
Monel	0.210	5400
Neoprene	0.063	1600

Nickel	0.220	5600
Nylon, 6.6	0.100	2600
Oil (SAE 30)	0.067	1700
Platinum	0.130	3300
Plexiglass	0.110	1700
Polyethylene	0.070	1900
Polystyrene	0.0930	2400
Polyurethane	0.0700	1900
Quartz	0.230	5800
Rubber, Butyl	0.070	1800
Silver	0.140	3600
Steel, Mild	**0.230**	**5900**
Steel, Stainless	0.230	5800
Teflon	0.060	1400
Tin	0.130	3300
Titanium	0.240	6100
Tungsten	0.200	5200
Uranium	0.130	3400
Water	0.584	1480
Zinc	0.170	4200

Note: To calibrate the UTG-2000 or 2020 , you must set the velocity to 0.2330/5981M/S (Steel) as stated in Sect. 7 Calibration, on page 7.

Calibration Procedure

Phase II, Inc.

UTG-2000/2020

Ultrasonic Thickness Gauge

1 Introduction and GBC Performance Requirements

1.1 This procedure describes the calibration of the Phase II UTG-2000 and UTG-2020 Ultrasonic thickness Gages. Specifications for the gage-probe combination are shown in Table 1-1.

Table 1-1 Measurement Ranges

Gauge-Probe	***Measurement Range****	***Velocity Range***
UTG-2000 w/5MHz probe	0.040" to 5.000" 1 to 125mm	0.0492 to .3930 in/µs 1250 to 10,000 m/s

* The actual measurement range of the system depends upon the material being measured. Ranges shown are based upon carbon steel.

1.2 The unit being calibrated will be referred to as the **GBC** (gauge being calibrated)

1.3 GBC Environmental Range:

- Temperature: 23 +/- 5° C

- Relative Humidity: Up to 95%

1.4 GBC Warm Up And Stabilization Period Requirements:

- Not Required

1.5 GBC Calibration Specification And Requirements:

- See Table 1-2

Table 1-2 GBC Calibration Specification And Requirements

(GBC) Accuracy	Performance Specifications	Test Method
UTG-2000 w/5MHz Probe	+/- 0.001" +/- 0.02mm	Step Block Comparison

2 Measurement Standards And Support Equipment Performance Requirements

2.1 Minimum Use specifications are the calculated minimum performance specifications required for the measurement standards and support equipment to be utilized for comparison measurements required in the calibration process

2.2 The minimum use specifications are developed trough uncertainty analysis and are calculated through assignment of a defined and documented uncertainty ratio or margin between the specified tolerances of the GBC and the capabilities required of the measurement standards system.

2.3 The uncertainty ratio applied in this calibration procedure is 4:1 or better
Caution: The instructions in this calibration procedure relate specifically to the equipment and conditions listed in this section. If other equipment is substituted, the information must be interpreted accordingly.

2.4 Measurement Standards Equipment Environmental Requirements

- Temperature: 23 +/- 5° C
- Relative Humidity: Up to 95%

2.5 Measurement Standards Equipment Warm Up And Stabilization Requirements:

- Standards and GBC to be maintained at the same temperature and relative humidity as the GBC prior to testing

2.6 Measurement Standards Equipment Performance Requirements

- Refer to Table 2-1

Table 2-1 Measurement Standards Equipment Performance Requirements

Equipment generic name	Minimum Use Specifications	MFG & Model Applicable
5 Step Block	**Range:** 0.100 to 0.500" 2.50 to 12.50mm **Accuracy:** +/- 0.00025" +/- 0.005mm	UTG-0500 Phase II

3 Preliminary Operations

Note: Review the entire document before starting the calibration process.

3.1 Visual Inspection

Visually inspect the GBC for:

a. Damaged LCD display
b. Probe wear
c. Cracked or broken case
d. Missing parts
e. Proper identification

Damage or excessive wear should be repaired prior to calibration.

4 Calibration Process

Please refer to the operation manual for instructions on menu navigation, details and features.

4.1 Gauge reset

- With the GBC powered on, go to "Default" in the menu. Select default by pressing the save button on the gage. This will bring the tester back to factory specs for Carbon steel including the sound velocity for carbon steel.

4.2 Calibration

- Place small amount of couplant gel on face of probe. Place the probe on the metallic test block on the front cover of the gage. The reading should display .157". This is the factory calibration setting.
- Proceed to take measurements on each of the 5 steps of the test block and document and verify readings per performance requirements in table 5-2
- **Note**: Whenever the test requirement is not met, verify the results of each test and take corrective action before proceeding.

5 Performance requirements

Note: The technician should collect all data needed to complete column B of Table 5-1 and 5-2. Do not write in this procedure

Table 5-1 Expected sound velocity for UTG-2000

GBC Indication or Reading*

Nominal Sound velocity	Gauge Adjusted Sound velocity	Allowable Reading
A	B	C
.2330 in/ µs		+/-.0030 in/ µs

Table 5-2 Performance Requirements and Calibration Data For UTG-2000

*GBC Indication or Reading**

Reference Thickness	**Reference Thickness**	**Gauge Measurement**	**Allowable Reading**

A	A	B	C
2.50mm	0.100"		+/- 0.001" / 0.02mm
5.00mm	0.200"		+/- 0.001" / 0.02mm
7.50mm	0.300"		+/- 0.001" / 0.02mm
10.00mm	0.400"		+/- 0.001" / 0.02mm
12.50mm	0.500"		+/- 0.001" / 0.02mm

* For metric readings convert using 1” = 25.4mm

Sample Evaluation Report:

Report No: 0109061	**Test Date:** 1/09/06
Sample Material: Poly- mix	**Surface Finish:** Smooth
Customer Part#: n/a	**Test Method:**Ultrasonic
Company Name: Moulders Mfg.	**Inspector:** N. Gitter

Results were achieved after multiple test groupings were performed on supplied samples. Results shown in Inch. ***Sound Velocity Set: 0.082 in/ms***

Model No. UTG-2020
Ultrasonic Thickness Gauge

Section	***Test #1***	***Test #2***	***Test #3***	***Average-Thickness (in)***
1	0.265”	0.266”	0.265”	0.265”
2	0.265”	0.264”	0.265”	0.265”
3	0.265”	0.265”	0.265”	0.265”
4	0.265”	0.266”	0.265”	0.266”
5	0.265”	0.265”	0.266”	0.265”
6	X	X	X	X
7	X	X	X	X
8	X	X	X	X
9	X	X	X	X

10	X	X	X	X

This evaluation process is only intended to inform the prospective user of the capabilities and performance of above mentioned testing equipment on supplied test samples in a controlled environment. Results may vary based upon factual application, environment and product knowledge.