Ultrasonic Thickness Gauge: Velocity Calibration and Wall Loss

Sound velocity from a reference block, wall thickness from the pulse-echo time with temperature correction, and the wall loss against nominal thickness.

Method: Pulse-echo thickness measurement

Input parameters

Unit system: SI

Parameter	Value	Unit
Calibration block thickness	20.000	mm
Round-trip time in the block	6.7800	µs
Round-trip time on the part	3.0500	µs
Velocity temperature coefficient	-1.0000e-04	
Part temperature above calibration	150.00	K
Nominal wall thickness	10.200	mm

Calculated results

Parameter	Value	Unit
Calibrated sound velocity	5,899.7	m/s
Thickness without temperature correction	8.9971	mm
Thickness corrected for temperature	8.8621	mm
Wall loss	1.3379	mm
Wall loss share	13.117	%

Notes for this case

• Pulse-echo: the sound crosses the wall twice, so t = vΔt/2. Velocity is set on a block of the same material and known thickness. Sound slows in hot steel (about 1 % per 100 K for longitudinal waves), so a gauge calibrated cold over-reads hot walls unless corrected. Coatings, curvature and pitting affect readings; use dual-element probes for corroded surfaces.

Formula and method

$$v = \frac{2t_{ref}}{\Delta t_{ref}}, \quad t = \frac{v\Delta t}{2}(1 + k_T \Delta T)$$

Variables

t_{ref}	Calibration block thickness	m
Δt_{ref}	Round-trip time in the block	s
Δt	Round-trip time on the part	s
k_T	Velocity temperature coefficient	-
$T - T_{cal}$	Part temperature above calibration	K
t_n	Nominal wall thickness	m
v	Calibrated sound velocity	m/s
t_{uncorr}	Thickness without temperature correction	m
t	Thickness corrected for temperature	m
$t_n - t$	Wall loss	m
$(t_n - t)/t_n$	Wall loss share	-

Method and standards

UT thickness.

Assumptions and limits

- Longitudinal waves; parallel surfaces; linear velocity–temperature relation.

References

Pulse-echo thickness measurement

Report details

Report reference	FCC-J6Q6-BJHT (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/instrumentation/vibration-noise/ultrasonic-thickness-gauge

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.