Ionix Advanced Technologies
3M BIC, Firth Street,
Huddersfield, HD1 3BD UK
Registered in England. No. 07729411

+44 (0) 1484 505 859
contact@ionix.at
www.ionix.at

How does temperature affect my angled wedge inspection?

The **NEW** HotSense™ range of TOFD transducers now offer our customers the ability to perform weld inspections, including weld root corrosion and defect detection and sizing with the key advantages of

- Operating across a wide continuous operating temperature, -55 to +350 °C without duty cycling or cooling.
- Compatible with commercially available high temperature scanners from mainstream manufacturers including EddyFi Technologies, Jireh Industries and AUT Solutions.

Our TOFD transducers come with integrated wedges, offering refracted beam angles of 50°, 60° and 70° in steel, determined at a surface temperature at 200 °C.

HT0606i-70

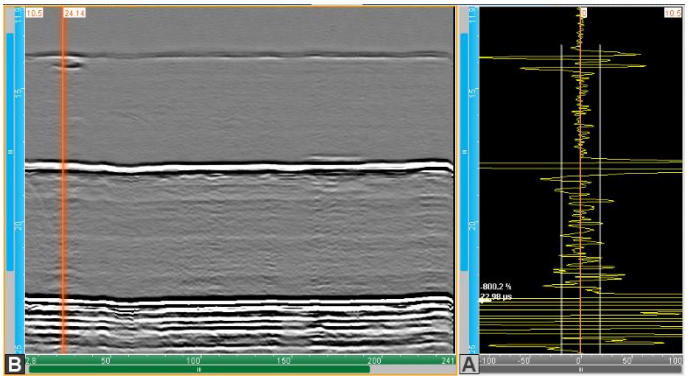
6 MHz, 6 mm crystal diameter, 70° refracted angle at 200 °C – the higher frequency improves the measurement resolution and high nominal probe angle helps to reduce the dead zone near the surface. Recommended for wall thickness up to 25 mm.

HT0506i-60

5 MHz, 6 mm crystal diameter, 60° refracted angle at 200 °C – balancing detection resolution and penetration depth across the temperature range. The nominal probe angle of 60° make it suitable for wall thickness from 15 mm to 30 mm.

HT0506i-50

5 MHz, 6 mm crystal diameter, 50° refracted angle at 200 °C – The lowest probe angle makes it suitable for thicker parts, up to 70 mm.



How does temperature effect my inspection?

Refracted Angle

These 3 wedge angles are determined at 200 °C steel surface temperature, centered within the operating temperature range, as the angles will vary depending on the temperature of the material being tested.

Ionix Advanced Technologies
3M BIC, Firth Street,
Huddersfield, HD1 3BD UK
Registered in England. No. 07729411

+44 (0) 1484 505 859
contact@ionix.at
www.ionix.at

According to Snell's law, and as the velocity of the test material *and* the wedge material change with varying temperature, then for steel, the refracted angle as a function of temperature can be plotted, as shown in Figure 1.

Although the HotSense™ TOFD transducers are suitable across the temperature range, your inspection should take in to account the variation in angle if applicable.

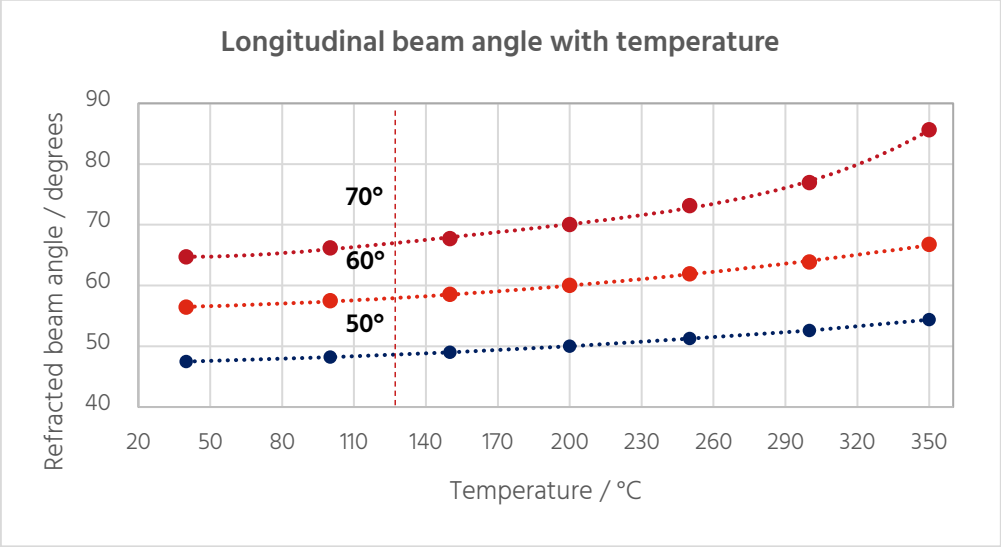
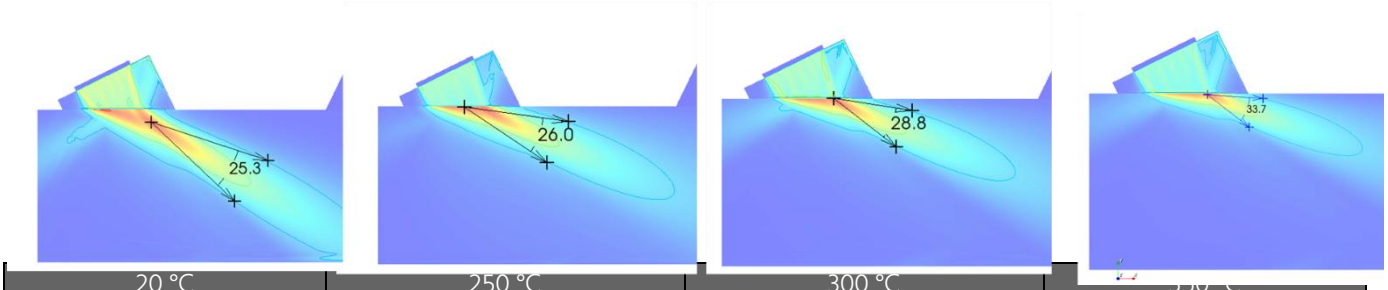


Figure 1. Longitudinal refracted angle from 3 HotSense TOFD wedges as a function of temperature.

Beam Spread

As well as refracted angle, the beam spread will also vary as the test material and wedge material velocity changes with temperature. By example, in steel, this can range from 25 to 34° across the operational range for a 5 MHz, 6 mm transducer as shown in Figure 2.



20 °C	250 °C	300 °C	350 °C
25.3°	26.0°	28.8°	33.7°
-6dB beam spread as a function of temperature for 5 MHz, 6 mm diameter element			

Figure 2. Beam spread as a function of temperature

Lateral wave

A change in temperature and associated velocity variation in the test piece and wedge will cause the lateral wave to appear to shift in time for the same PCS. Figure 3 shows a plot of velocity in steel as a function of temperature. A calibration should be performed at the inspection temperature to properly compensate for the velocity and wedge delay of the setup.

It is important to consider these factors when determining the calibration, coverage, focal point or setting your PCS for your TOFD inspection at elevated temperature.

The HotSense™ TOFD range use integrated wedges to help minimize the influence of temperature, and importantly *change in temperature* on your inspection. The high temperature resilience of HotSense™ allows the inspection setup to be brought to a stable, equilibrium temperature with the asset to avoid errors incurred from heating and cooling from duty cycling and deviation from your procedure or scan plan.

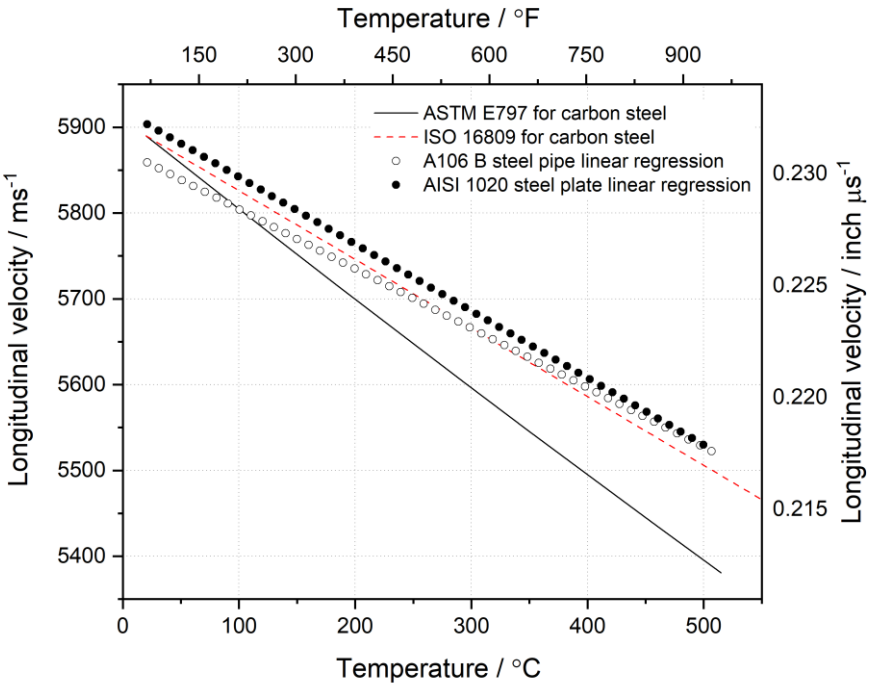


Figure 3. Velocity in steel as a function of temperature

PRODUCT CODE	DESCRIPTION	TYPICAL RANGE IN STEEL
Acoustic characteristics test report refer to ISO 22232-2 supplied with each unit		
HT0606i-70	6 MHz, 6 mm diameter active element, wedge angle 70° @ 200 °C	8 to 25 mm [0.3 to 1″]
HT0506i-60	5 MHz, 6 mm diameter active element, wedge angle 60° @ 200 °C	15 to 30 mm [0.6 to 1.2″]
HT0506i-50	5 MHz, 6 mm diameter active element, wedge angle 50° @ 200 °C	8 to 25 mm [1 to 2.75″]