Introduction

It is sometimes necessary to drill holes with very large depth-to-diameter ratios. A common approach is gun drilling, whereby a cutter is used at the end of a long rotating tool. Ensuring the alignment and consistent diameter of long holes represents an inspection challenge. The TFMi™
feature of the veo3 provides a useful option when the hole is parallel to nearby surfaces.

Using the TFMi™
NDT technique in the veo3, with the Intermodal set to "Keep Max." shows the reflected signal from the top surface (LL mode) and the bottom surface (LLLL mode) correctly positioned on screen. A simple gate can be used to measure the gap between them.

With the instrument set to a single propagation mode TFM scan only one of the surfaces can be imaged at one time.

Setting the instrument to TFMi™
mode allows us to use up to 4 propagation modes at once. Using the "Keep Max" viewing mode we can see the un-altered results from each mode overlayed on top of each other.

In this inspection we utilised LL and LLLL modes to show the top and bottom reflections from the blind holes. This requires the thickness of the part to be known. For the block used in this study we used a thickness of 50.mm. (See figure 1)

Figure 1 showing the test block and side drilled holes used in the study, the holes can be seen to decrease in size from left to right.

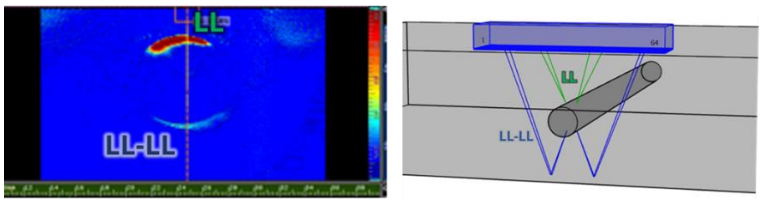


Figure 2 shows an example TFMi™ scan set to LL/LLLL keep max mode showing the upper reflections detected by the LL scan and the bottom reflections detected by the LLLL scan, the second image shows the beam paths taken by each mode to produce the image.

Industries

- Aerospace Aeronautical Inspection
- Aerospace Astronautical Inspection
- Transport Network Infrastructure
- Rail Sector
- Military Sector
- Maritime Shipping Industries
- Mining Sector
- Construction and Infrastructure

Application

- Corrosion / Thickness measurement
- Casting / Forging Inspection
- Composite Material Inspection
- Plastics Inspection
- Asset Integrity
- Rail and Axle inspection

Typical Parts

- Cast parts with hole / cavities
- Machined parts where hole position is critical
- Any parts that have an internal geometry and require an NDT technique to evaluate their size
- Flush cap welds
- Rail bolt hols

Inspection Techniques

- Phased Array L-Scan
- TFMi
- TFM

Features and Benefits

- The TFMi™ displays up to 2 compression modes at the same time so you can see the top and the bottom of the hole at the same time.
- Live and fast assessments; the height is measured by a vertical extractor and simple gates.
- Any useful propagation modes can be added in the image to enhance the profile fidelity
- Defects present more reflecting facets
- Location of the defects are more accurate

NOTE when inspecting the larger holes the bottom signal is weaker, this is because the hole is nearly 75% of the size of the probe aperture, this blocks some of the signal to and from the back wall. With the correct gate positioning, avoiding the diffraction signals we can still get an accurate measurement of hole size.

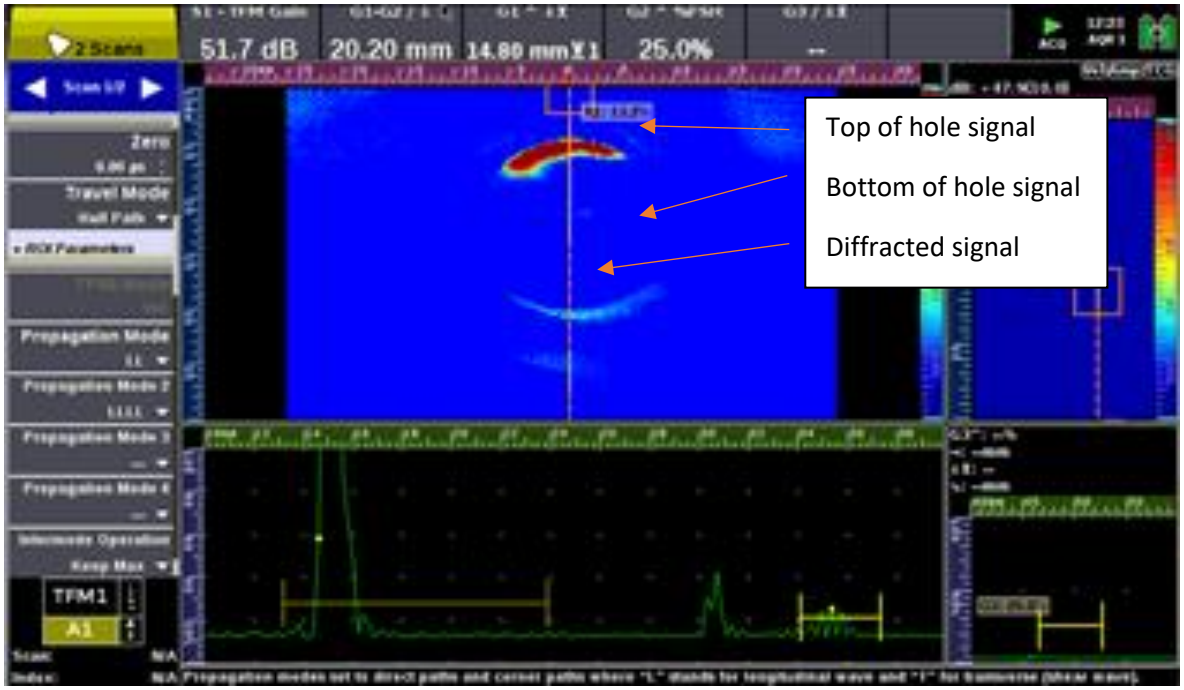
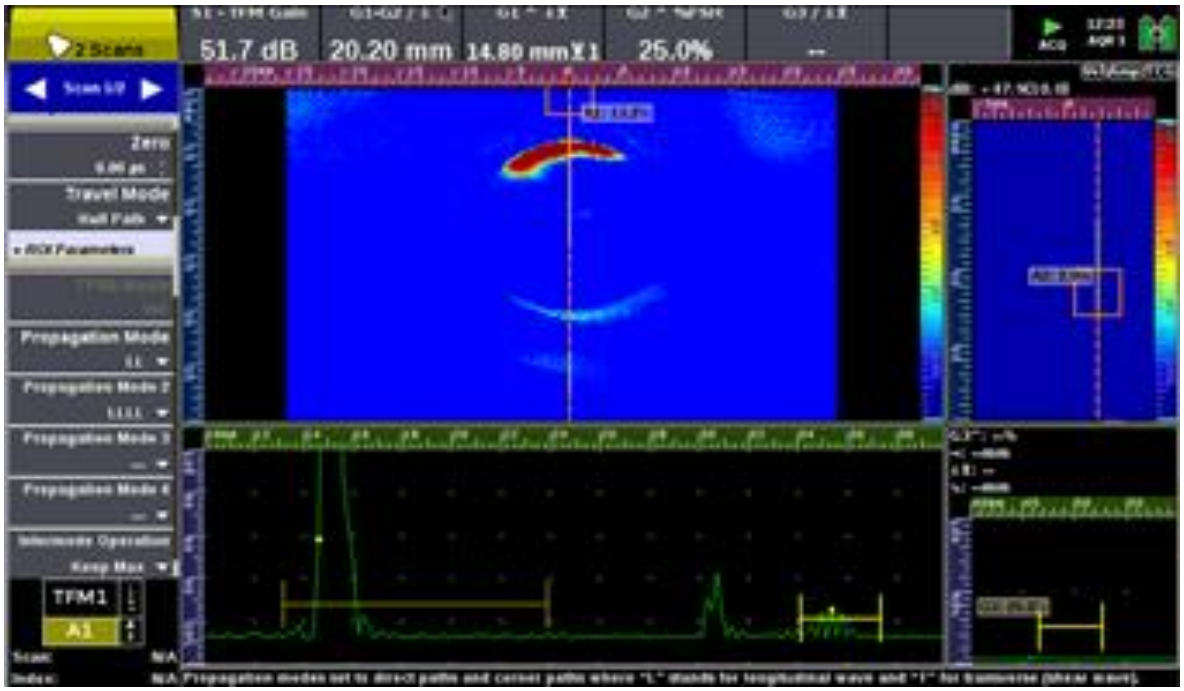
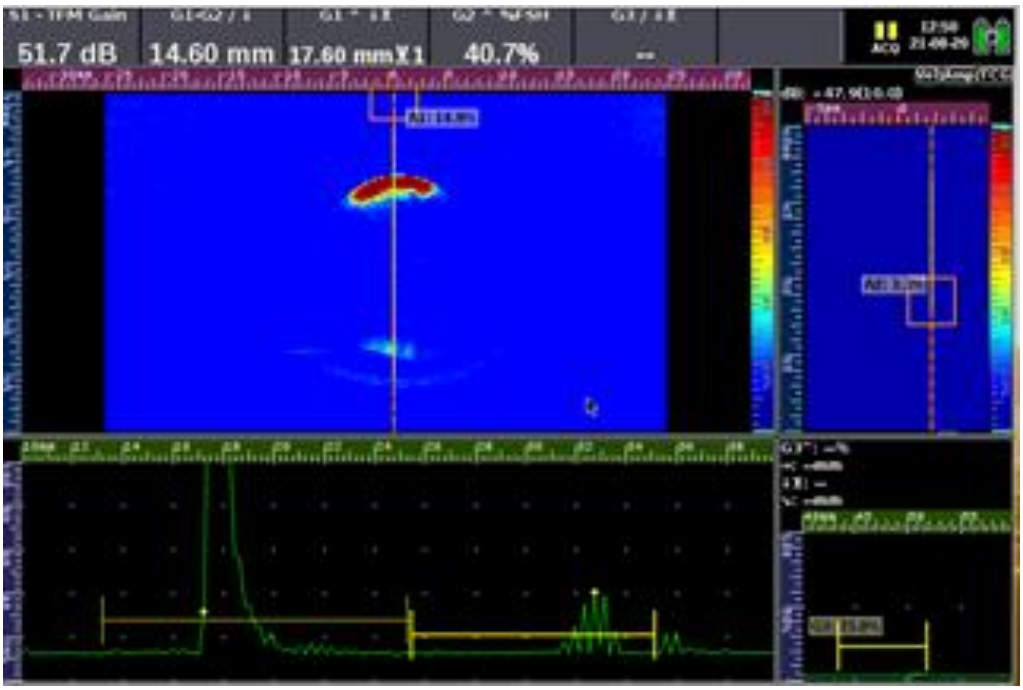


Figure 3 Showing a weak signal from the bottom of the largest hole.

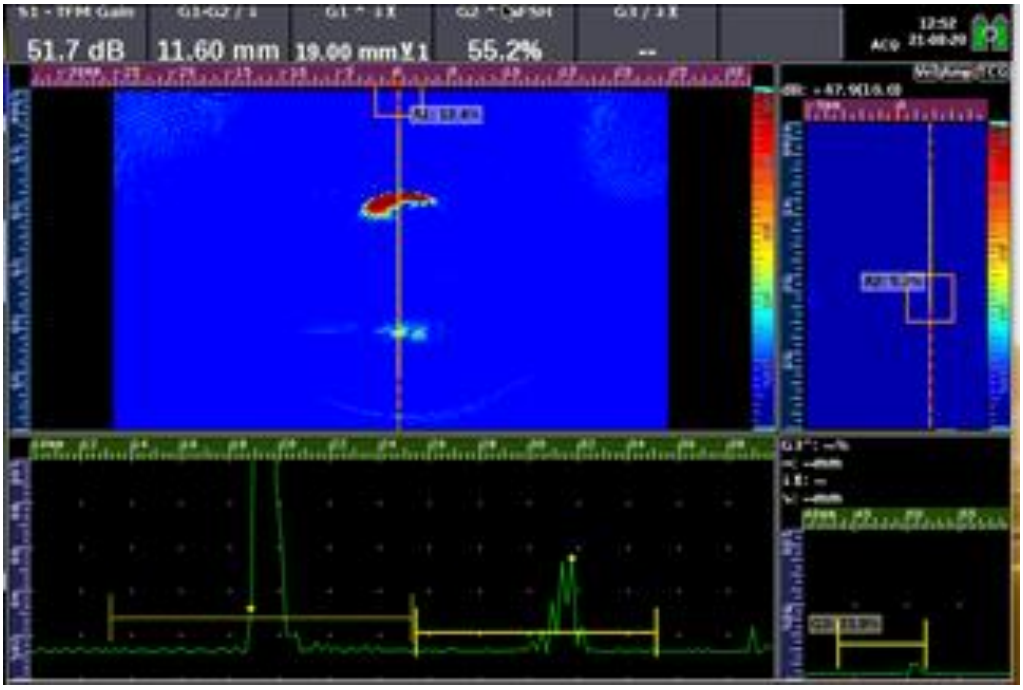
Results



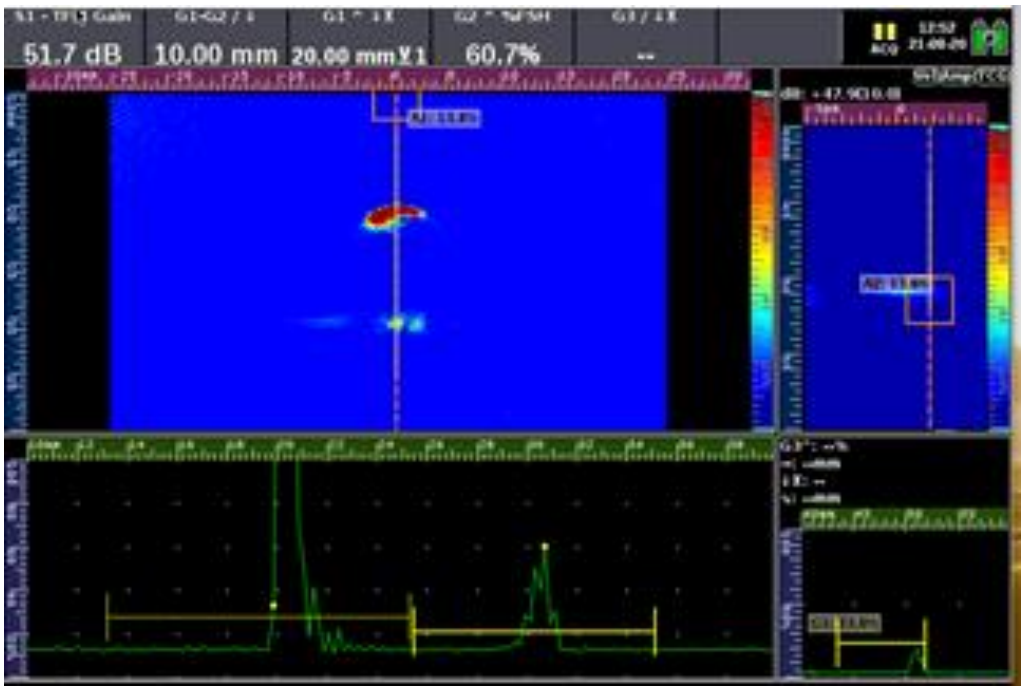
Hole 1 Diameter measurements			
Digital Calliper Results	20.03mm	TFMi™ Results	20.20mm



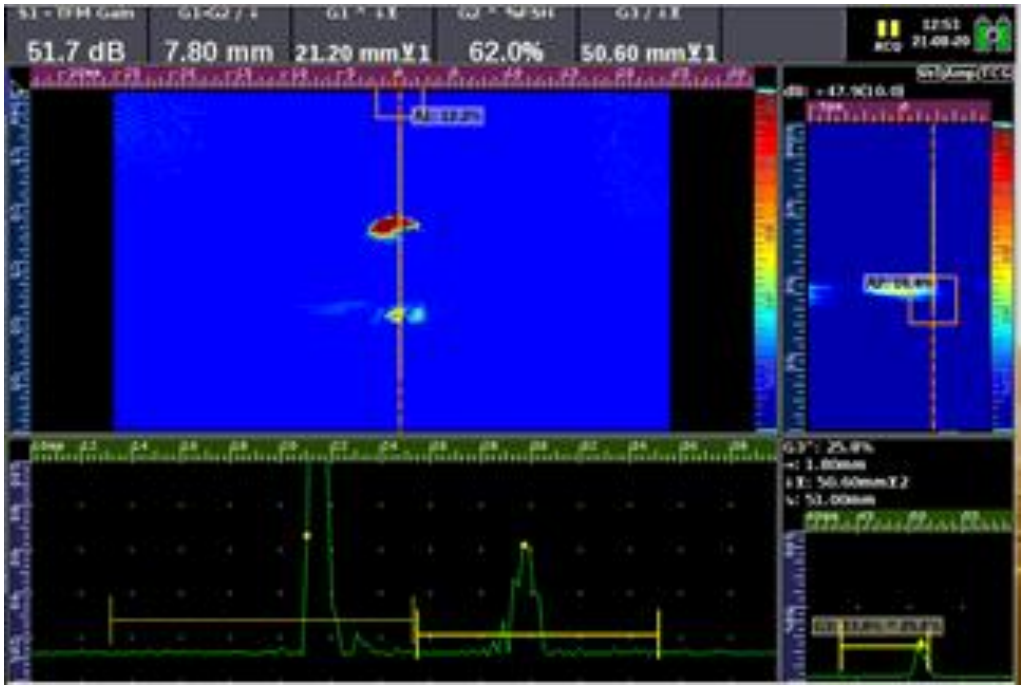
Hole 2 Diameter measurements			
Digital Calliper Results	15.05mm	TFMi™ Results	14.60mm



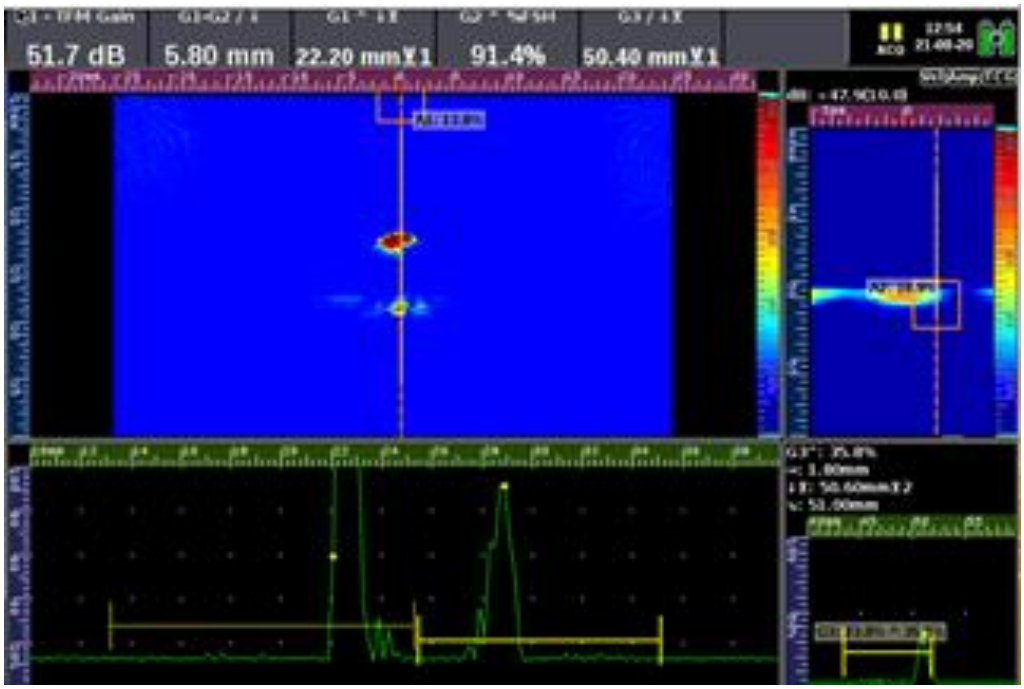
Hole 3 Diameter measurements			
Digital Calliper Results	11.97mm	TFMi™ Results	11.60mm



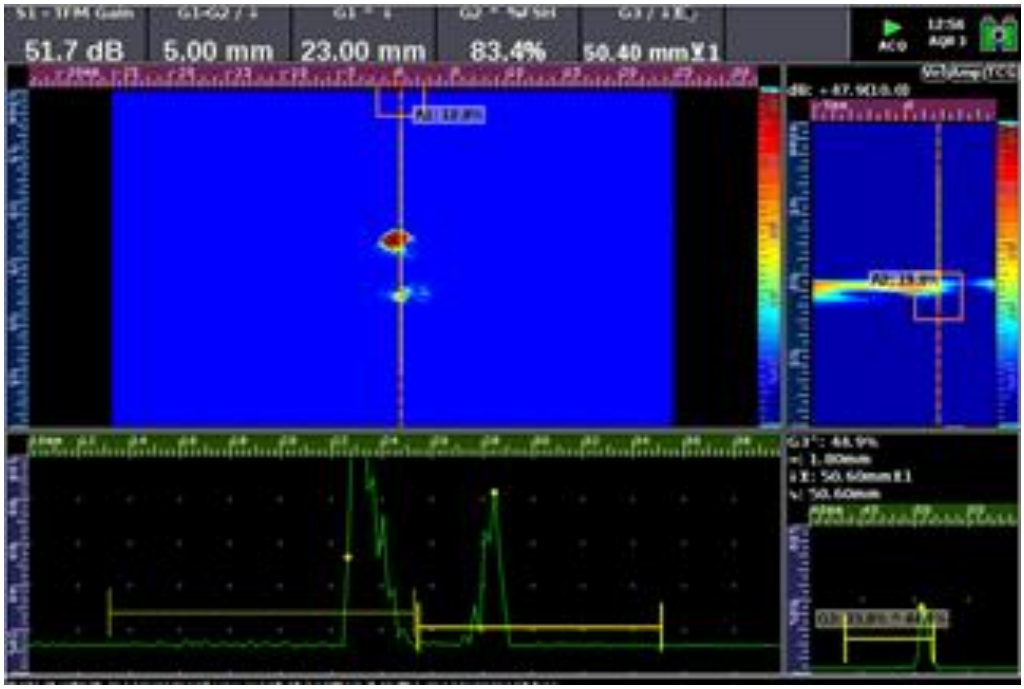
Hole 4 Diameter measurements			
Digital Calliper Results	10.02mm	TFMi™ Results	10.00mm



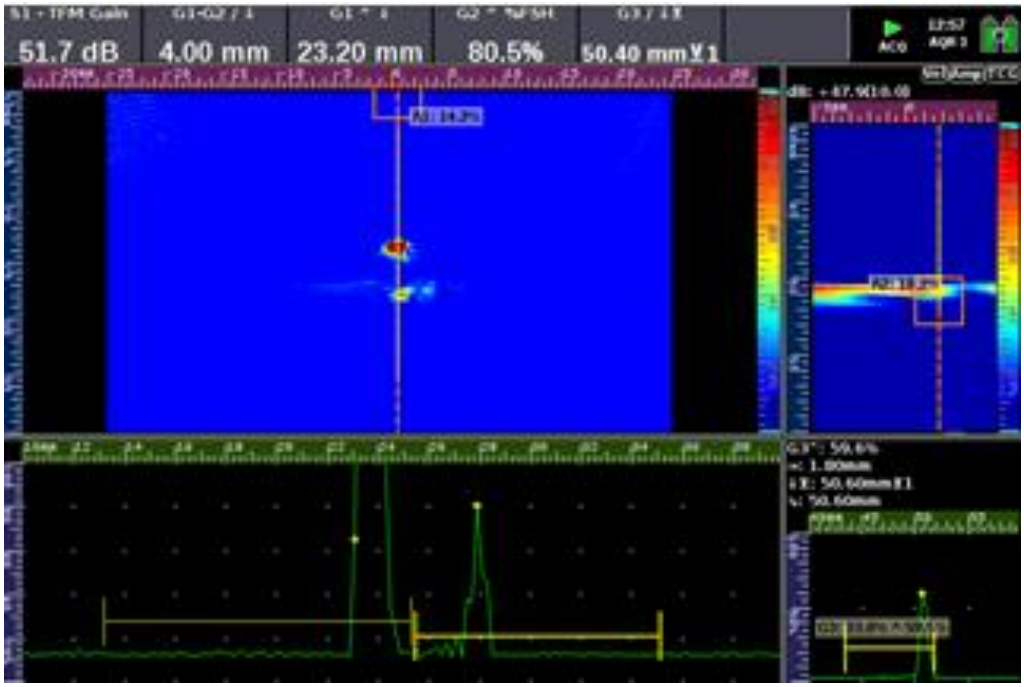
Hole 5 Diameter measurements			
Digital Calliper Results	8.03mm	TFMi™ Results	7.80mm



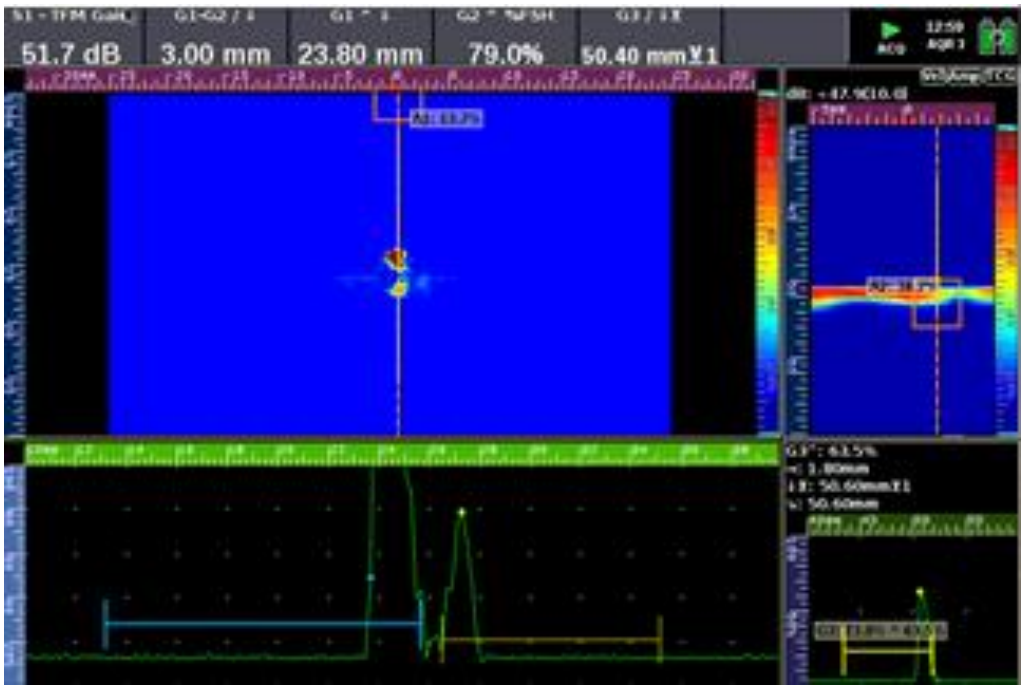
Hole 6 Diameter measurements			
Digital Calliper Results	6.11mm	TFMi™ Results	5.80mm



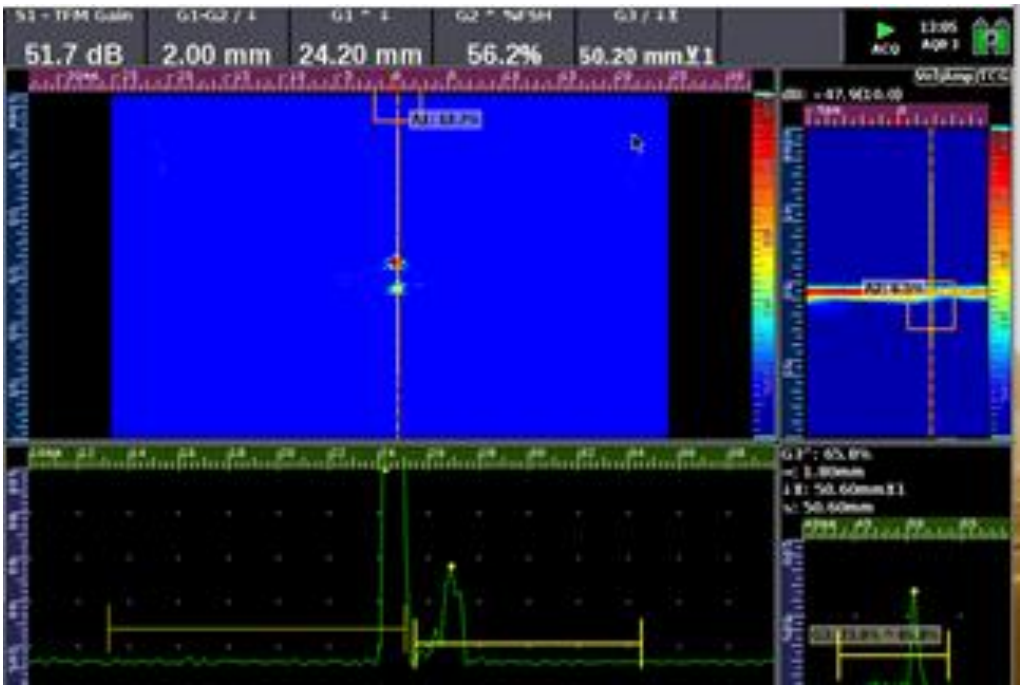
Hole 7 Diameter measurements			
Digital Calliper Results	5.08mm	TFMi™ Results	5.00mm



Hole 8 Diameter measurements			
Digital Calliper Results	4.07mm	TFMi™ Results	4.00mm



Hole 9 Diameter measurements			
Digital Calliper Results	2.93mm	TFMi™ Results	3.00mm



Hole 10 Diameter measurements			
Digital Calliper Results	1.60mm	TFMi™ Results	2.00mm

Conclusion

Blind hole inspection is an excellent fit for TFMiTM. It really enables a full comprehensive profile view of the internal geometry of a part. The benefit of displaying many propagation modes at the same time has improved complex geometry assessment just as it has been demonstrated in this app note.

There are other similar potential geometry challenges like this where keep max TFMiTM imaging could improve on current inspection methods. Indeed, other propagation modes e.g. LLL or any other shear modes could be utilised with TFMiTM keep-max processing, so additional planar or volumetric features could be added in TFMiTM view.

For further information or support, please contact the Sonatest Applications Team: applications@sonatest.com

Recommended Tool Package

Category	Part #
Acquisition Unit	VEO3 UT BNC KIT or VEO3 UT LEMO KIT
Probe	X3A-003 or D5A-001

Get in touch with your local Sonatest expert, available in more than 50 countries over 5 continents!

Sonatest (Head Office)
Dickens Road, Old
Wolverton Milton Keynes,
MK12 5QQ
t: +44 (0)1908 316345
e: sales@sonatest.com
Sonatest

(North America)
12775 Cogburn, San Antonio Texas,
78249
t: +1 (210) 697-0335
e: sales@sonatestinc.com

