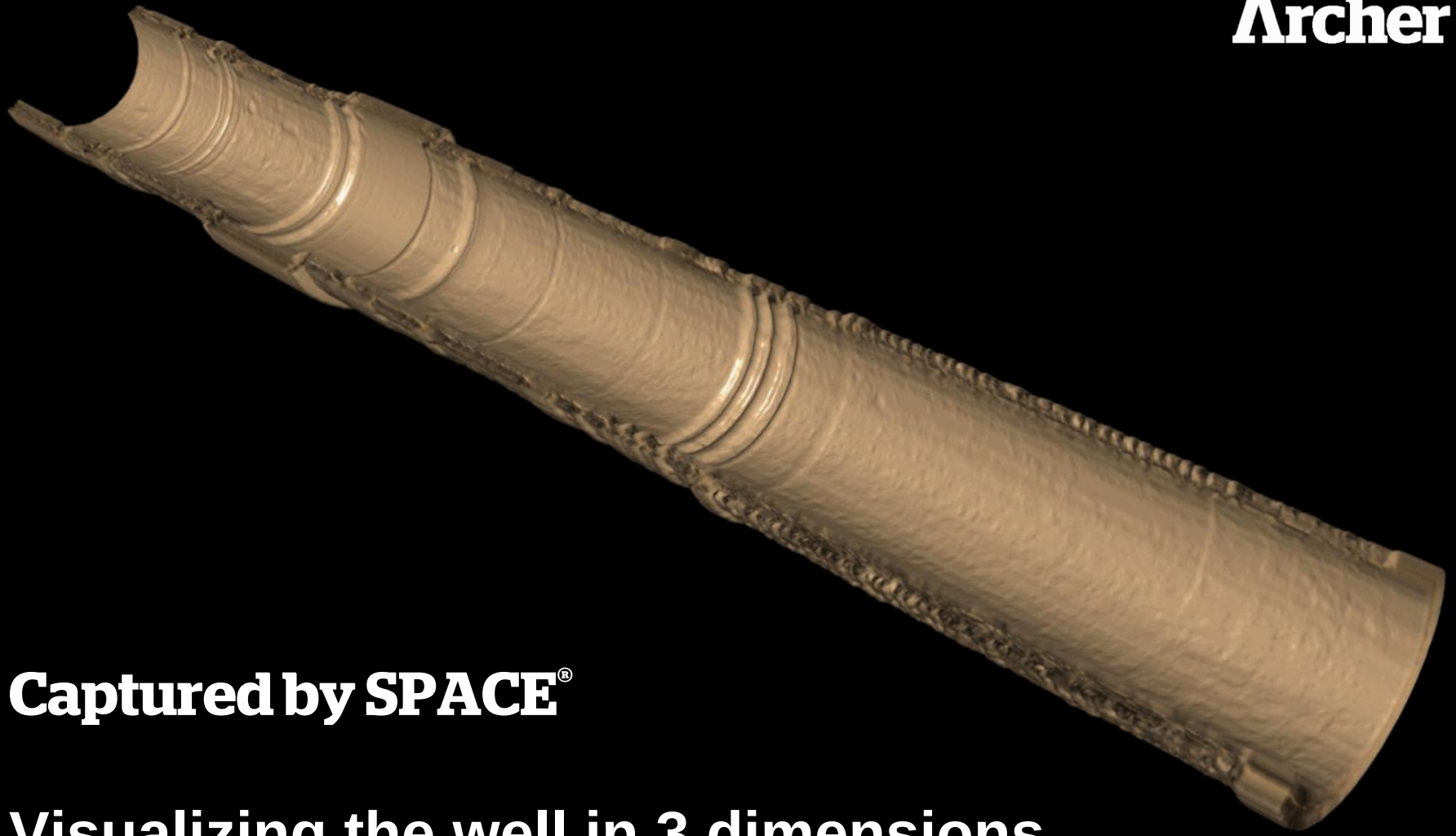
Archer



Captured by SPACE®

Visualizing the well in 3 dimensions

Visualizing the well in 3 dimensions

A well is a dark place…

To understand we need an unbroken view…

Panorama

SPACE® Panorama – What's new

Archer

Original Scanner OD 3”

New Panorama tool body 2-1/8” OD

Telemetry and electronics 2-1/8” OD

Toolstring maximum OD 2-1/8”

Temperature rating increased to 150C

Pressure rating increased to 15,000 psi

Logging while tractoring capability

If the way forward is unclear…

We need to concentrate on what is ahead

Focus

SPACE® Focus – What's new

Archer

Temperature rating increased to 135C

Pressure rating increased to 7,250 psi

New generation telemetry

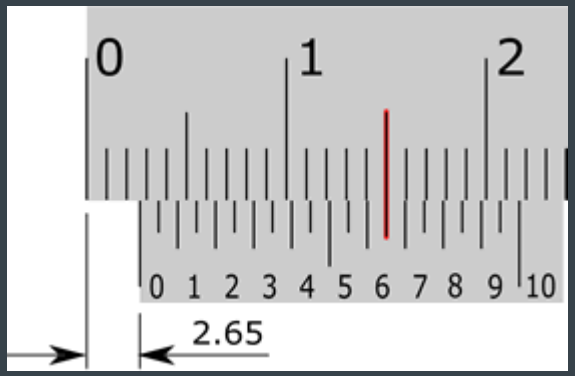
Logging while tractoring capability

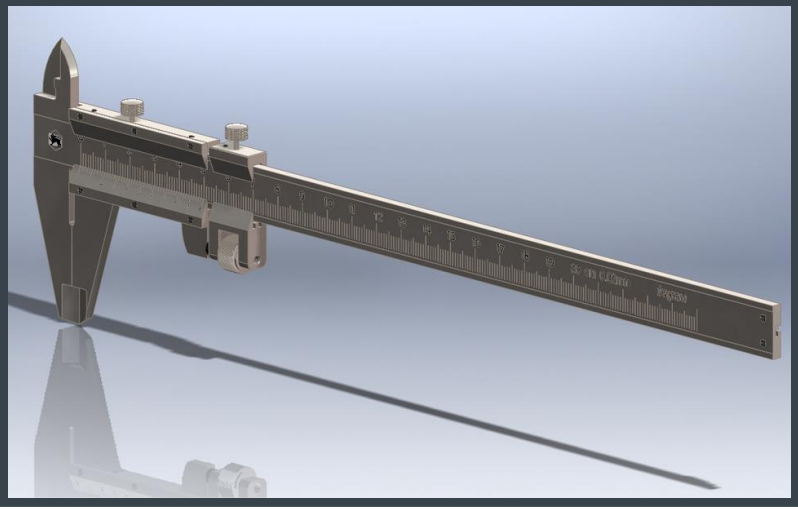
- Eliminate stick/slip

Seeing is sometimes not enough…

Adding accuracy of measurement…

Vernier





SPACE® Vernier – What's new

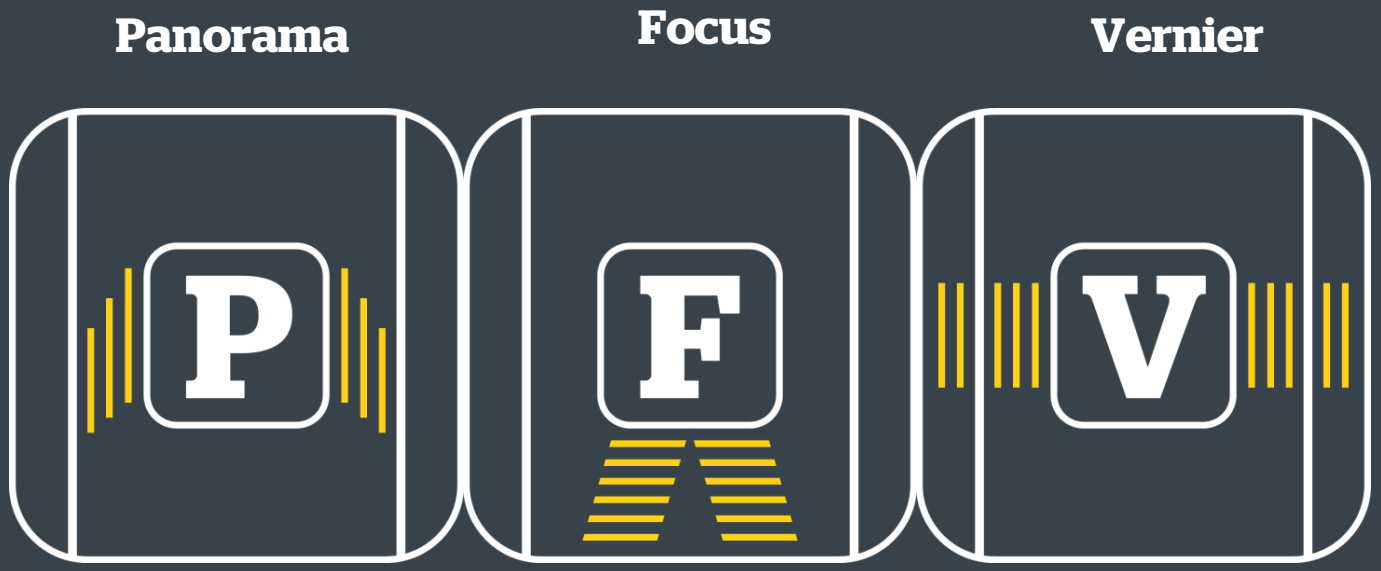
Archer

Temperature rating increased to 115C

Speed of sound sensor added

- real time calibration

New generation telemetry



Captured by SPACE®

SPACE® Panorama

SPACE® Panorama

Archer

"A complete survey or presentation of a subject"

Typical applications:

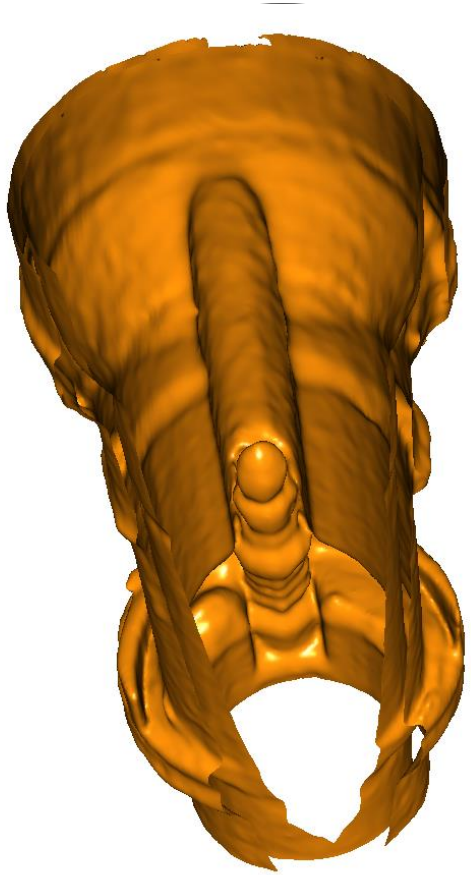
- Safety valve internal inspection
- Side pocket mandrel
- Non-obstructing fish
- Visualisation of internal surfaces
- Measurement of critical dimensions

SPACE® Panorama – Technology

Archer

- Fixed acoustic sensors used as a phased array
- Ability to control focus depth
- Enables high resolution 3D data
- Dimensional measurement

3D Ultrasound Scanning



SPACE® Panorama – Downhole Safety Valve

Archer

Job objectives

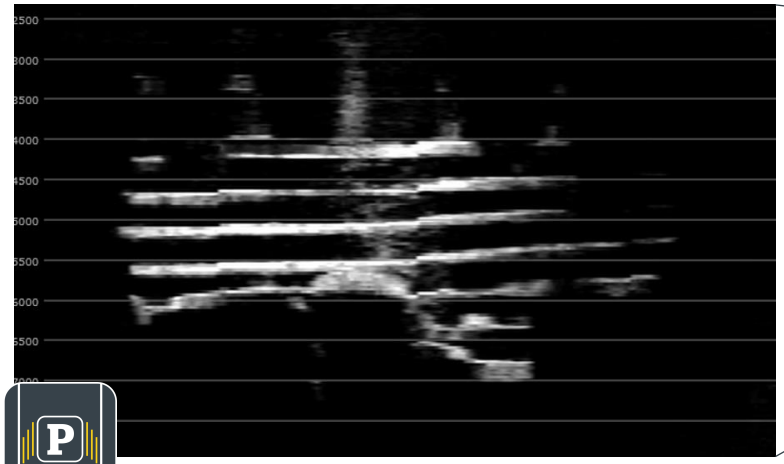
- Investigate the condition of the assembly
- Establish status of the flapper valve

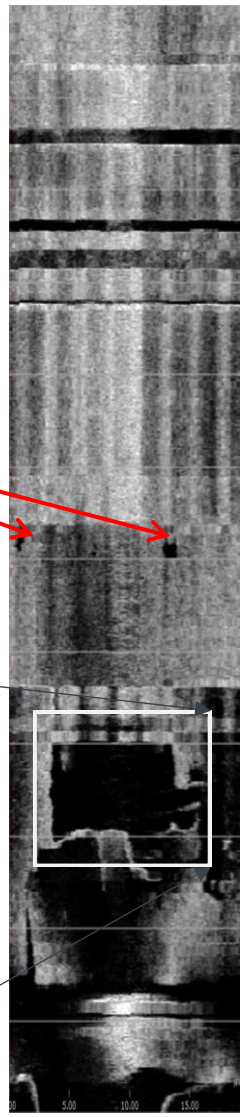
Upper section appears intact

Some holes appearing

Extensive damage revealed

Springs visible through hole in flowtube





SPACE® Panorama – Downhole Safety Valve

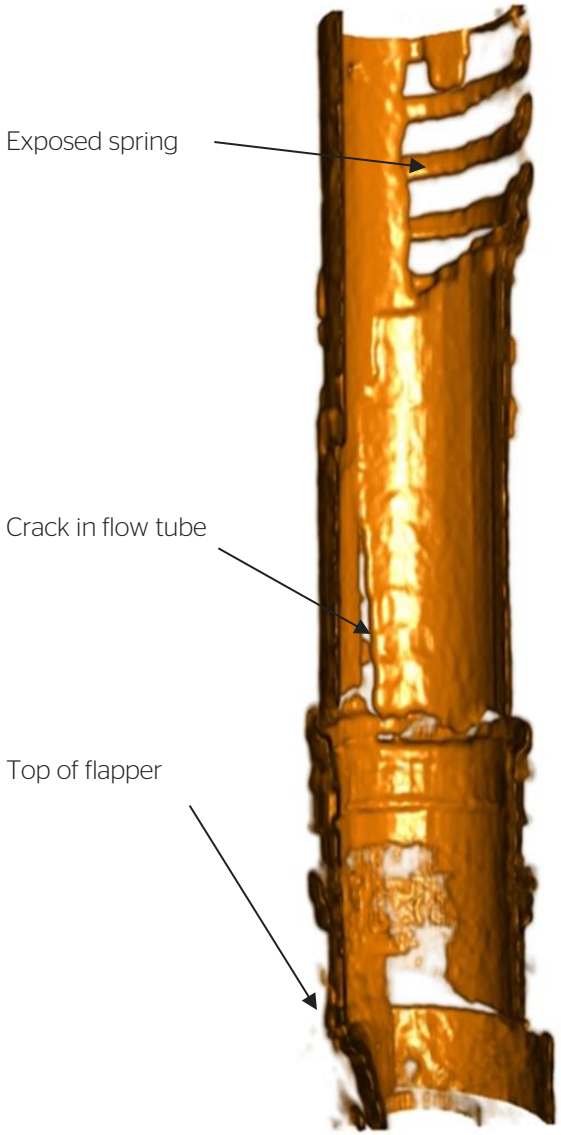
Archer

Job objectives

- Investigate the condition of the assembly
- Establish status of the flapper valve

Results

- Flowtube damage
- Flapper position confirmed



SPACE® Panorama – Dual SPM

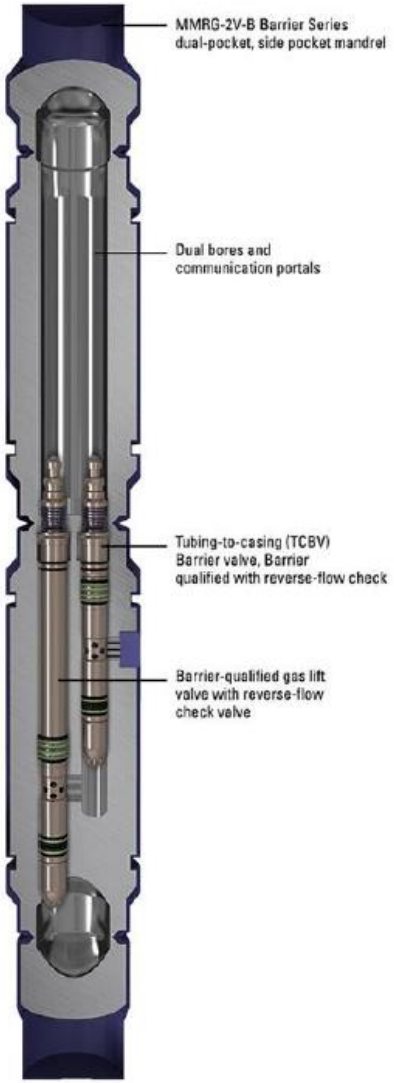
Archer

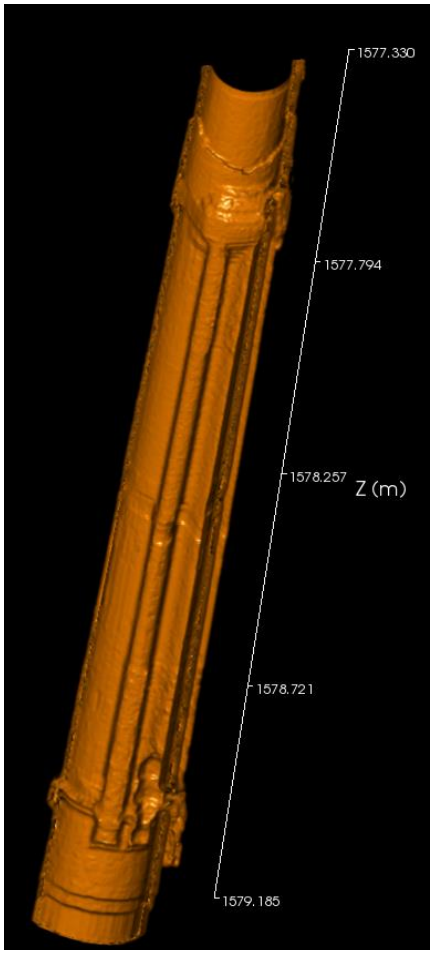
2D 360º display showing clearly:

- Helix track
- Key slot
- Dual pockets, one empty
- GLV installed in second pocket

3D render cut-away showing:

- Helix track
- Dual pockets, one empty
- GLV installed in second pocket
- No deposits, debris or damage
- Dimensional information



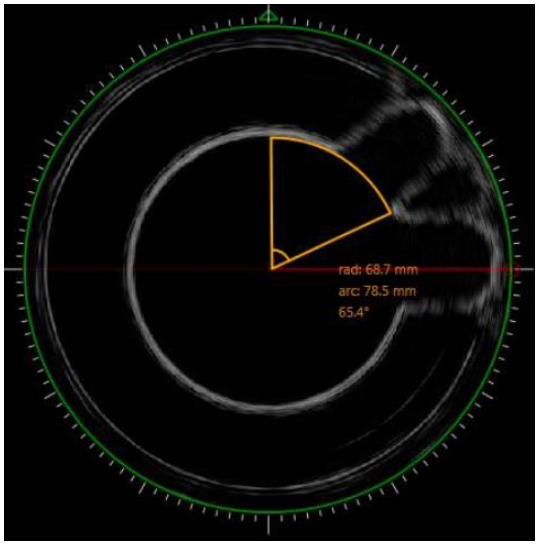


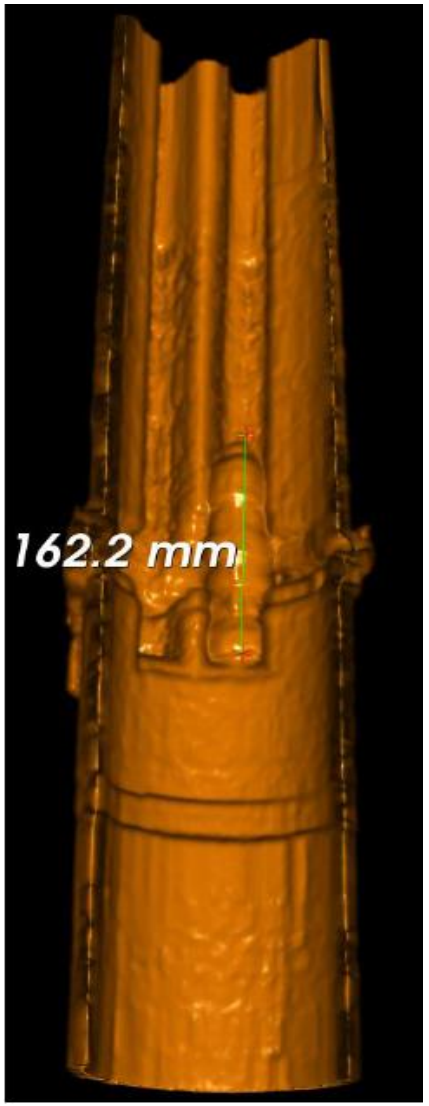
SPACE® Panorama – Dual SPM

Archer

In more detail

- TCBV is missing.
- GLV present and intact
- No deposit or damages.
- Dimensions confirmed
- Orientation of the pockets are 65° from highside



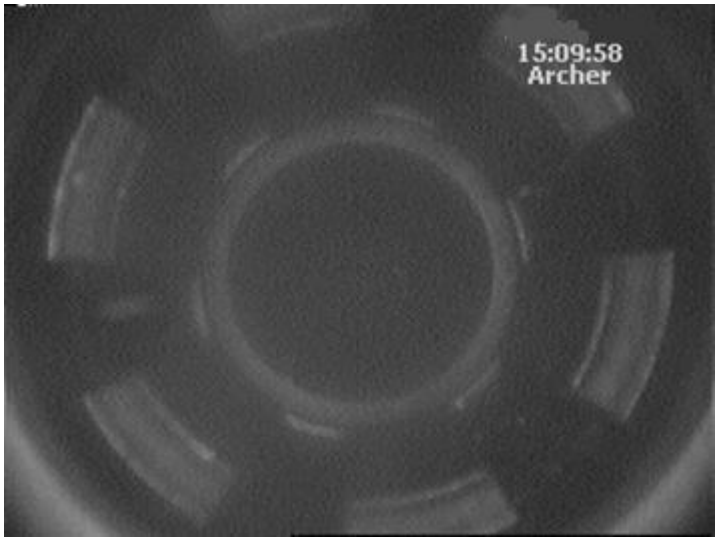


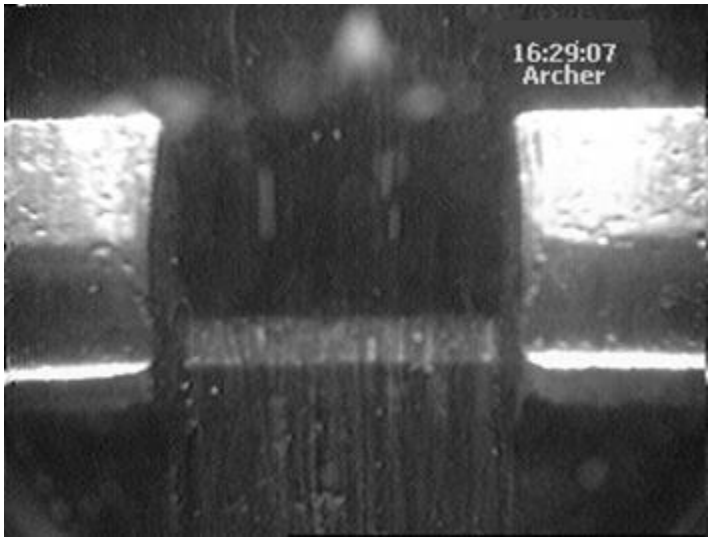
SPACE® Panorama – SSSV

Archer

Intervention to retrieve SSSV

- Unable to latch onto the SSSV with pulling tool
- An optical camera was deployed – no visible sign of damage or debris
- To evaluate fully the situation, precise measurements needed
- Minimum ID normally 3.58”

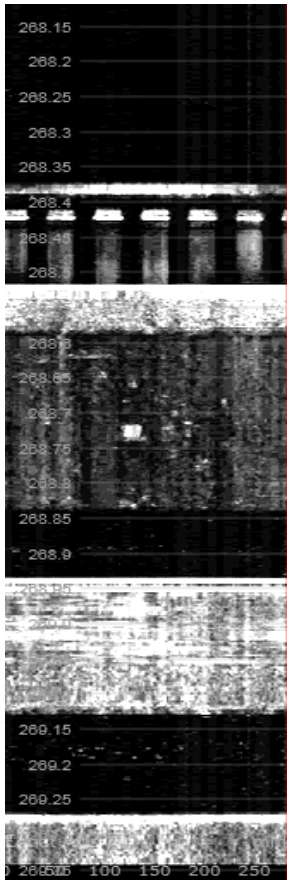


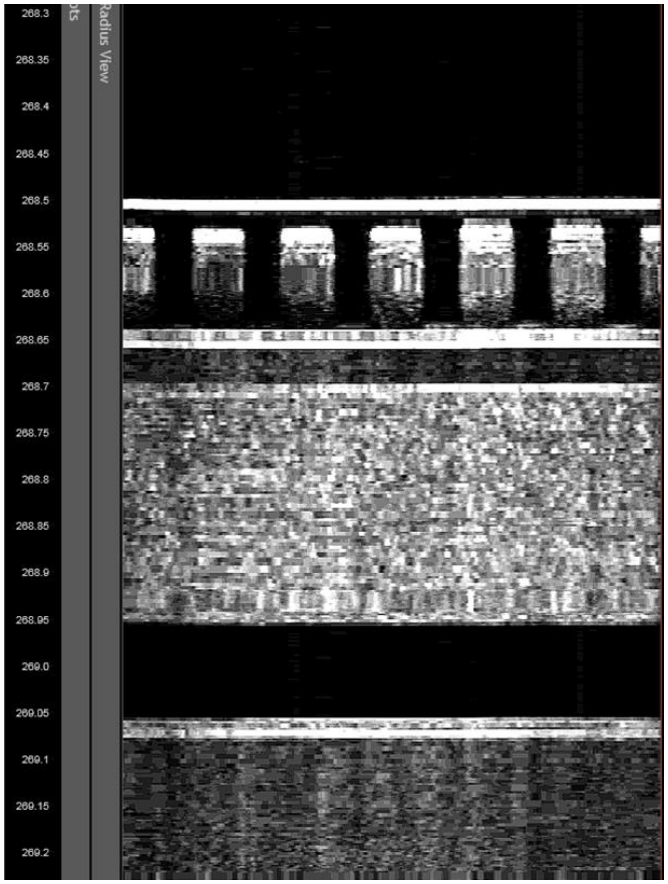


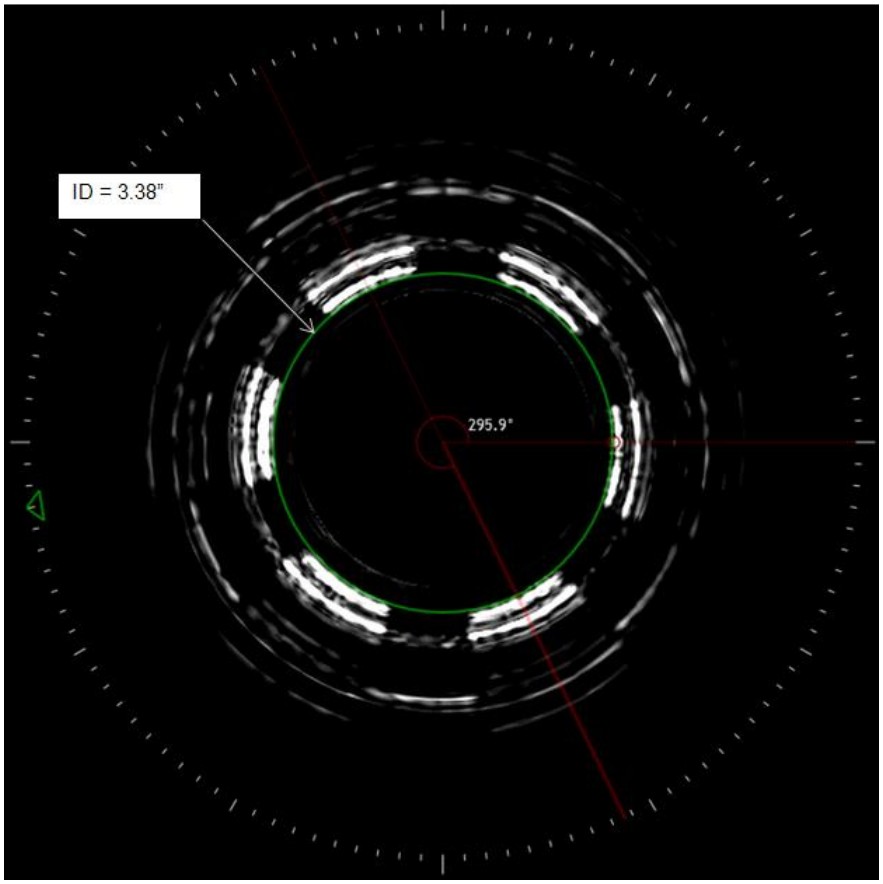
SPACE® Panorama – SSSV

Archer

- Real time data acquisition – 2D and cross-section
- Measurement shows clearly minimum ID of 3.38” – too small for pulling tool to pass.



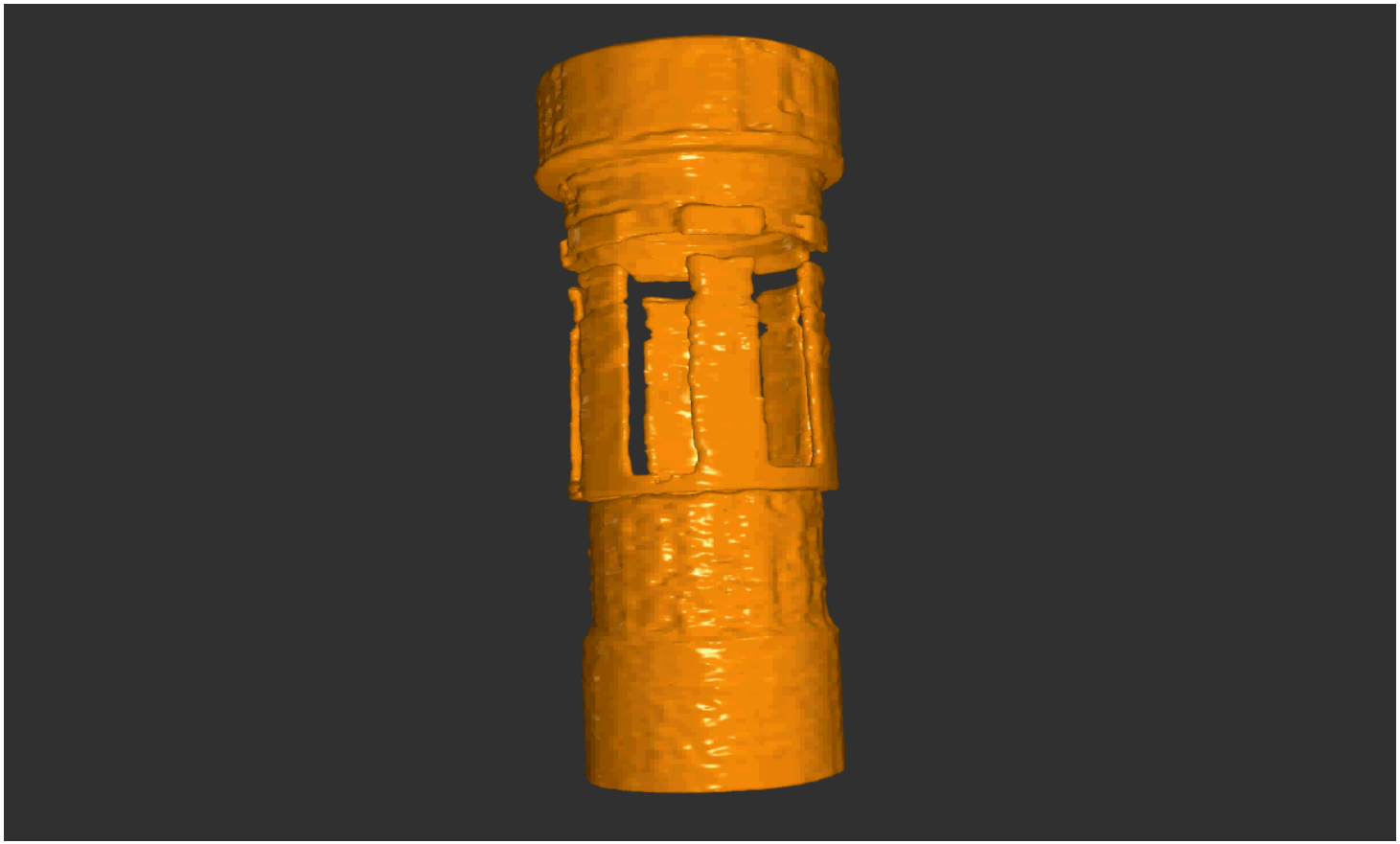




SPACE® Panorama – SSSV

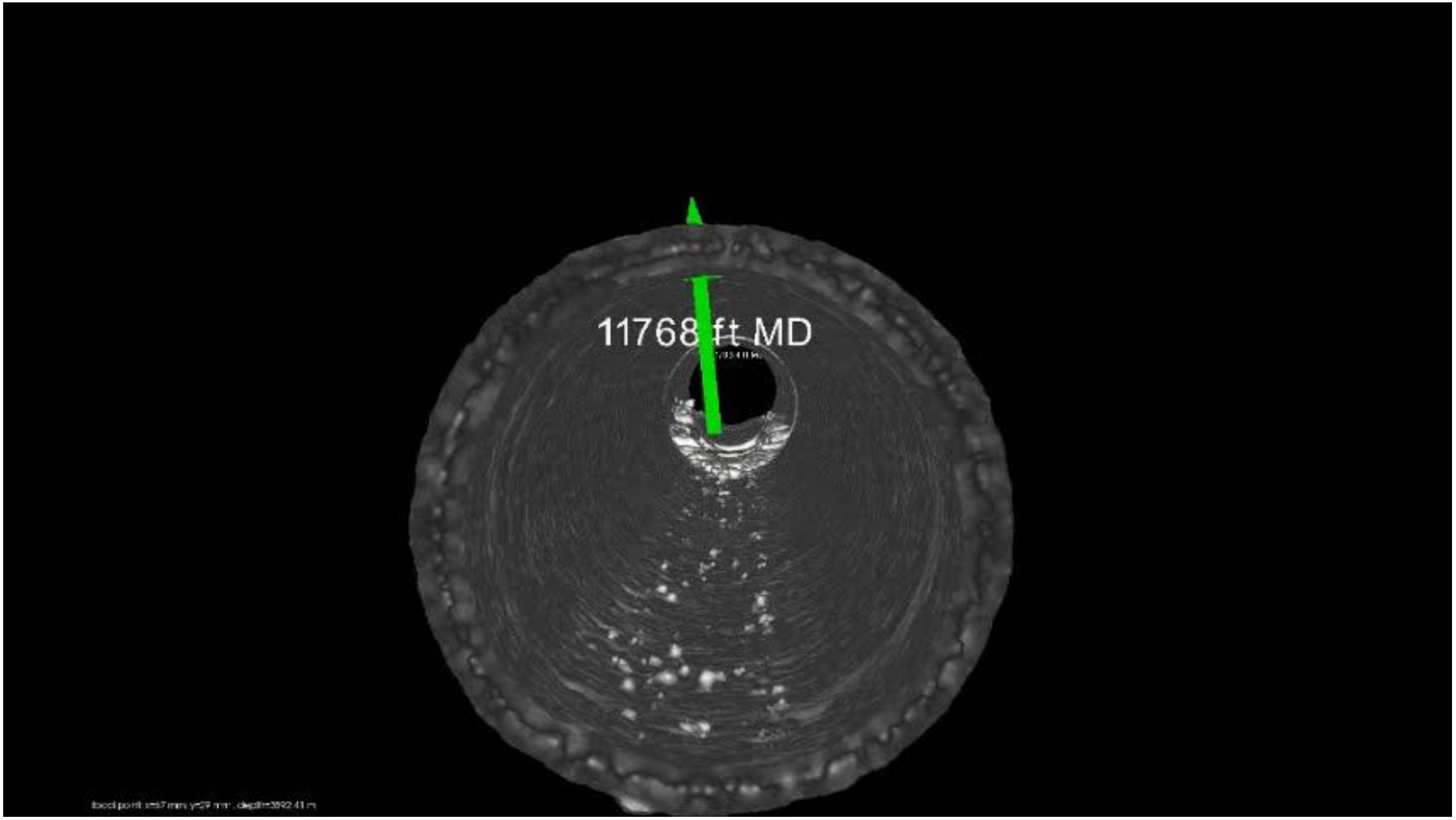
Archer

- 3D rendering allows clear visualization
- Animation allows unique understanding



SPACE® Panorama – Sand in the real world

Archer

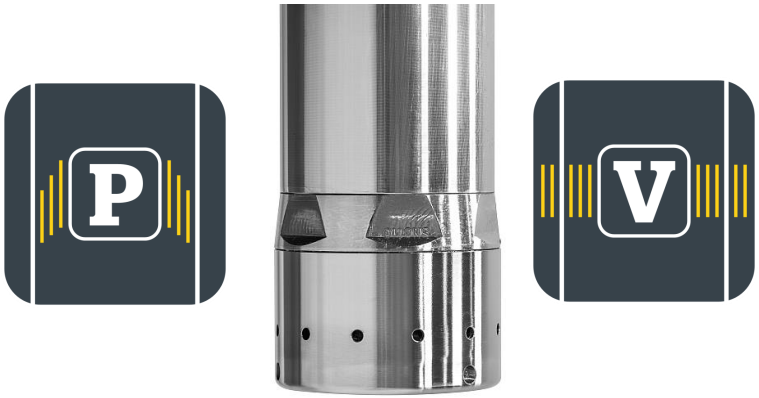


SPACE® Focus

SPACE® Focus

Archer

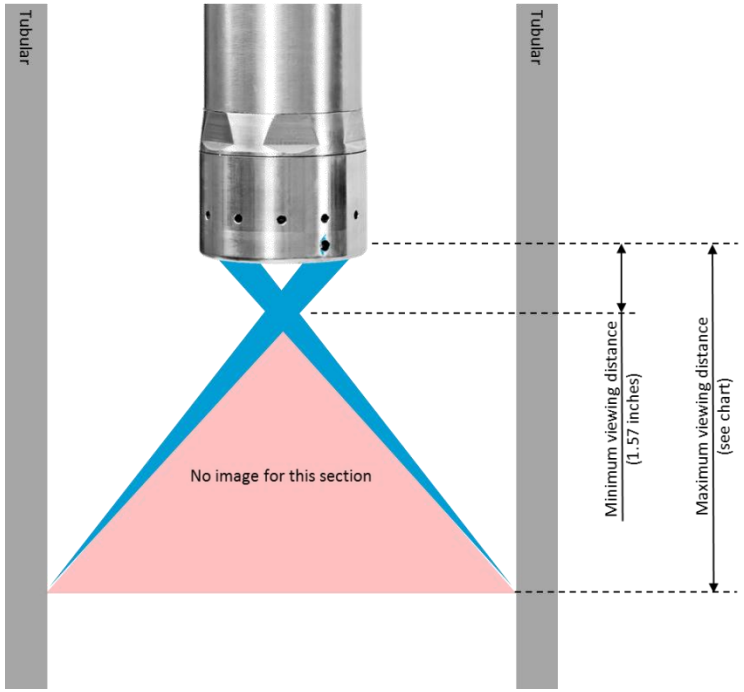
"The centre of interest or activity"



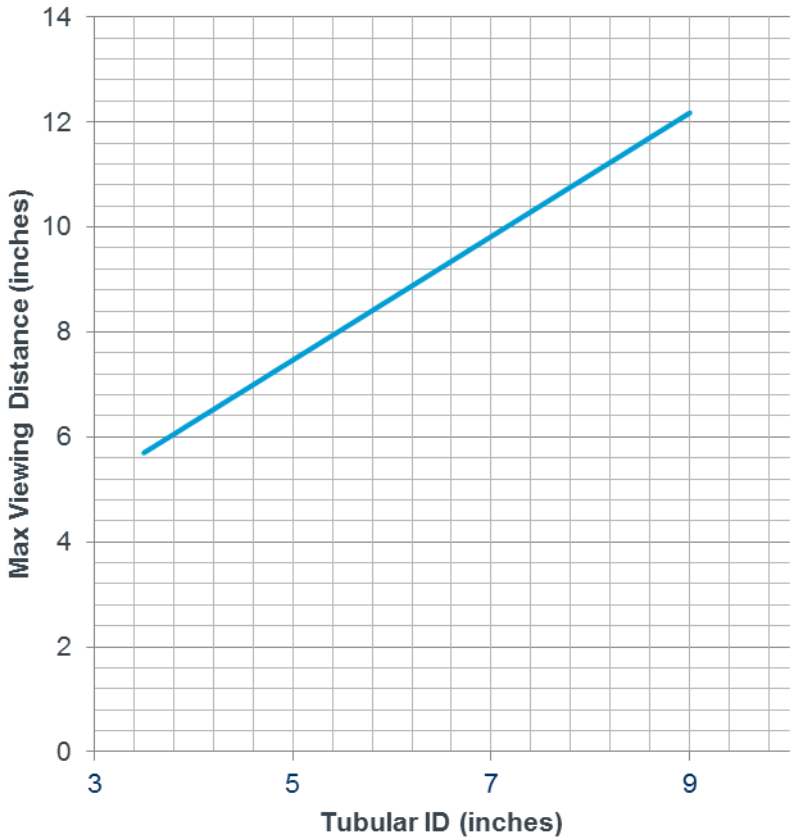
Typical applications:

- Collapsed tubing/casing
- Obstructing fish
- Parted tubing

Viewing methodology



Maximum viewing distance



Each data frame is effectively a cone

3D images are obtained by moving the tool and "stacking" the cones

SPACE® Focus – Collapsed tubing

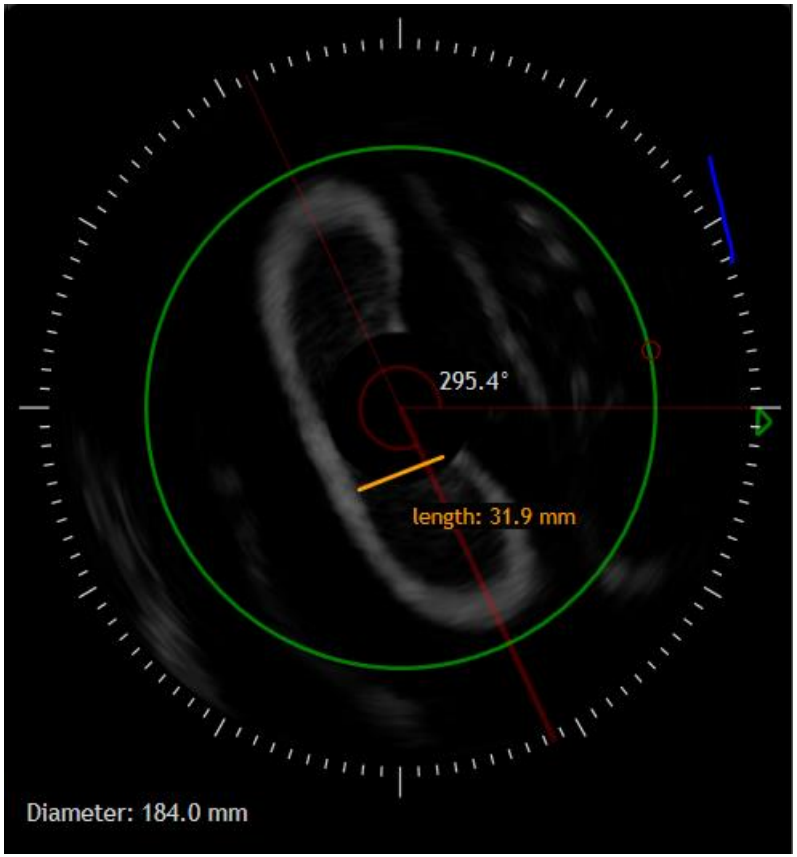
Archer

5 ½” 20# L80 tubing sample, deliberately crushed

SPACE® Focus – Collapsed tubing

Archer

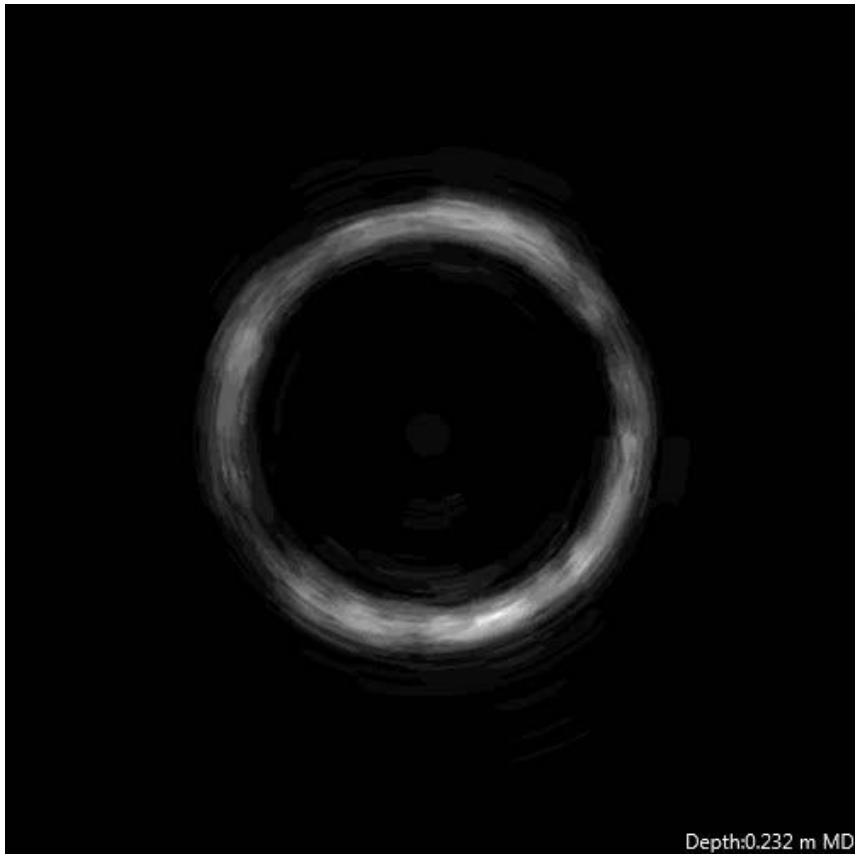
Dimensions recorded by SPACE® confirmed by physical measurements



SPACE® Focus – Collapsed tubing

Archer

Short joint with mechanical damage



SPACE® Focus – HEX plug in deviated pipe

Archer

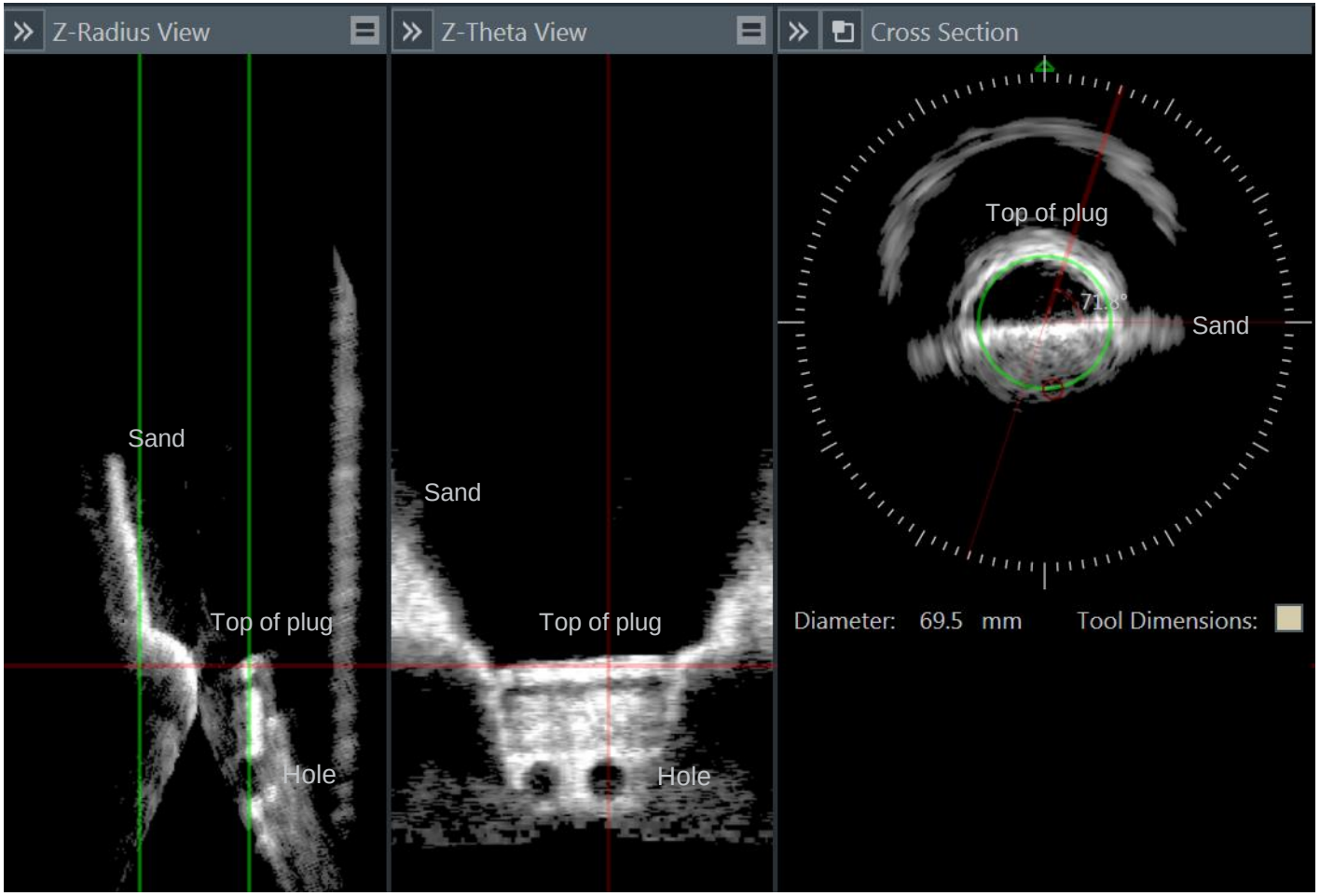
Test setup to recreate a specific fishing application

HEX plug in a deviated well with partial sand fill

SPACE® Focus – HEX plug in deviated pipe

Archer

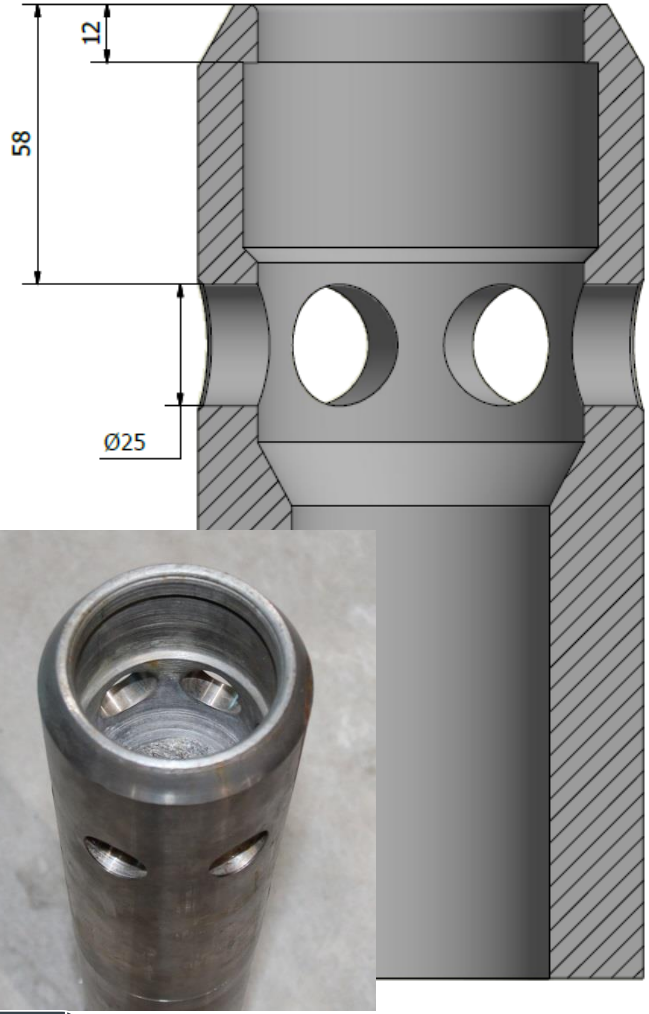
What we see when we log

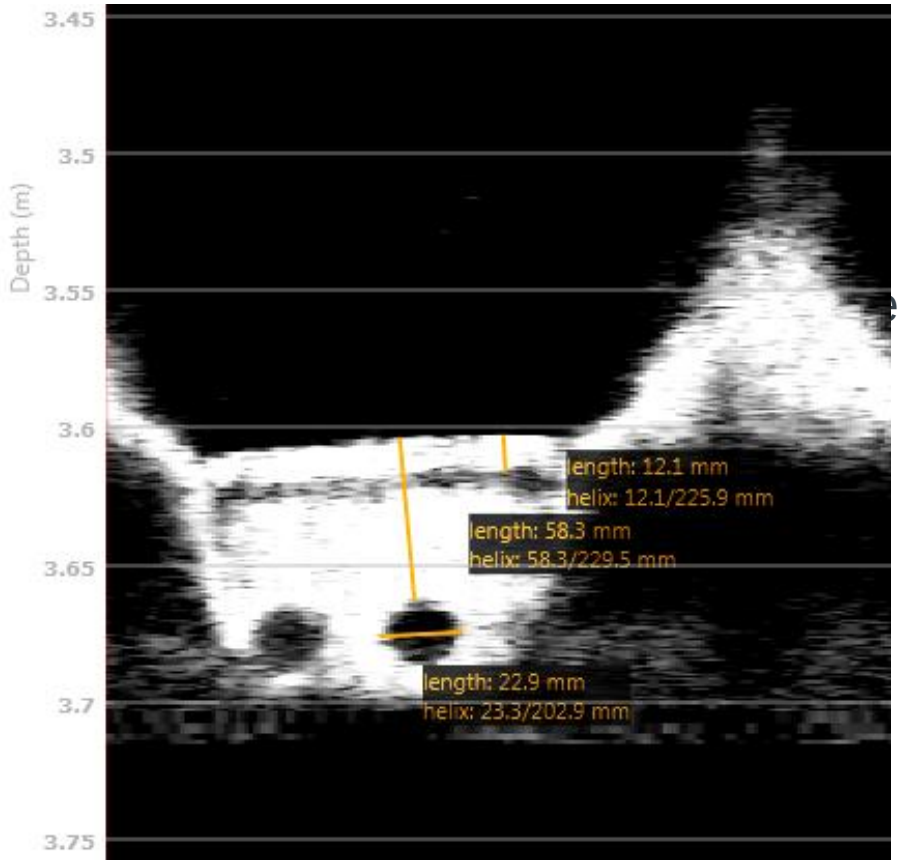


SPACE® Focus – HEX plug in deviated pipe

Archer

Let's look in a little more detail.





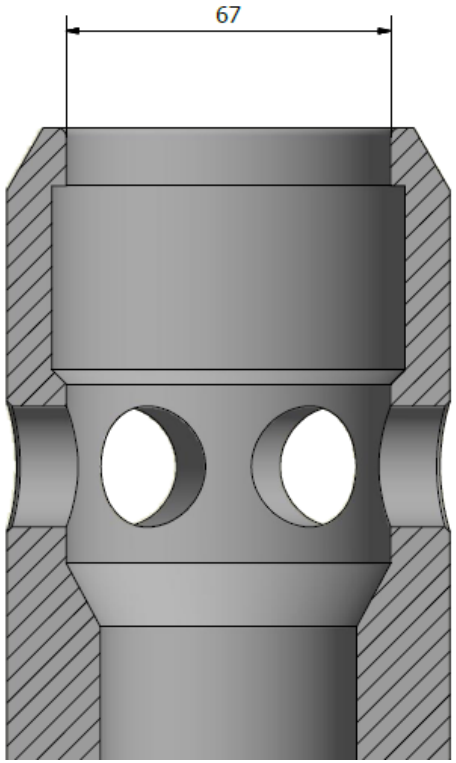
The 2D flat display allows precise measurements.

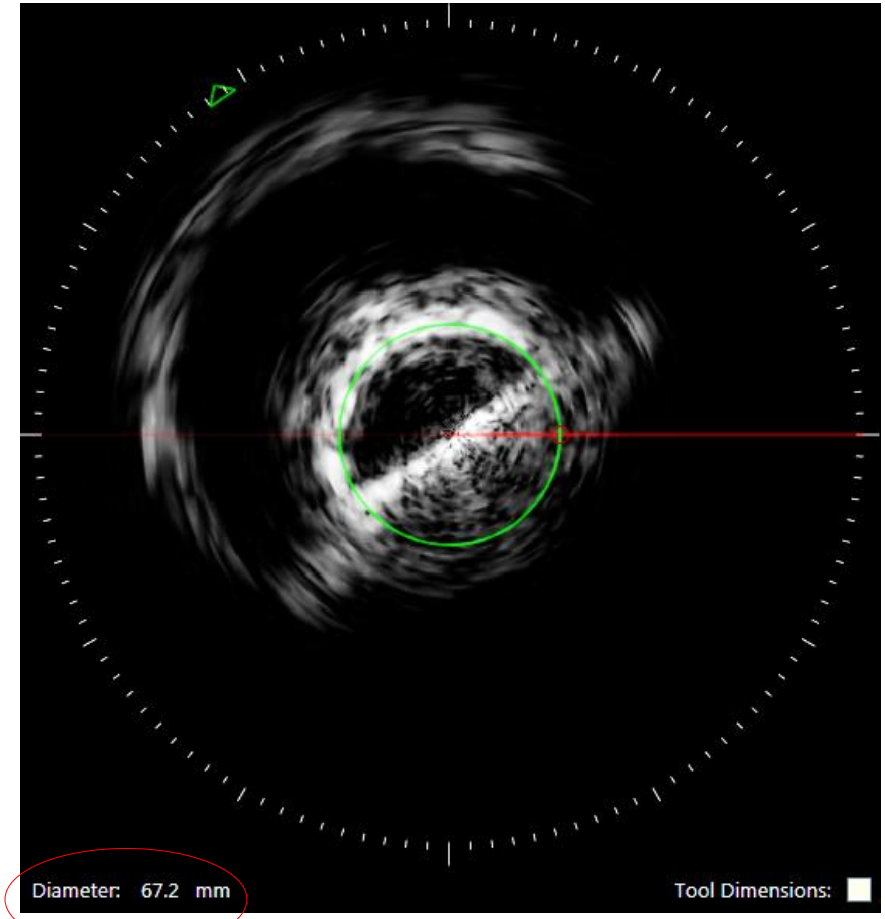
Hole diameter, distance from the top of plug to the hole and length of the internal shoulder all correspond to the actual dimensions.

SPACE® Focus – HEX plug in deviated pipe

Archer

The radial view is also useful in dimensional analysis





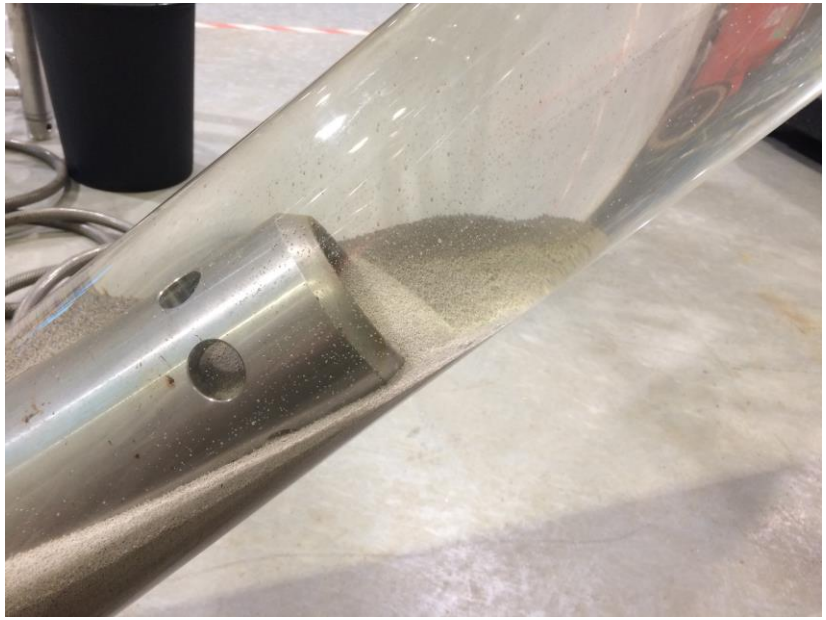
The diameter of the top of the plug can be measured accurately

Even with the plug half filled with sand.

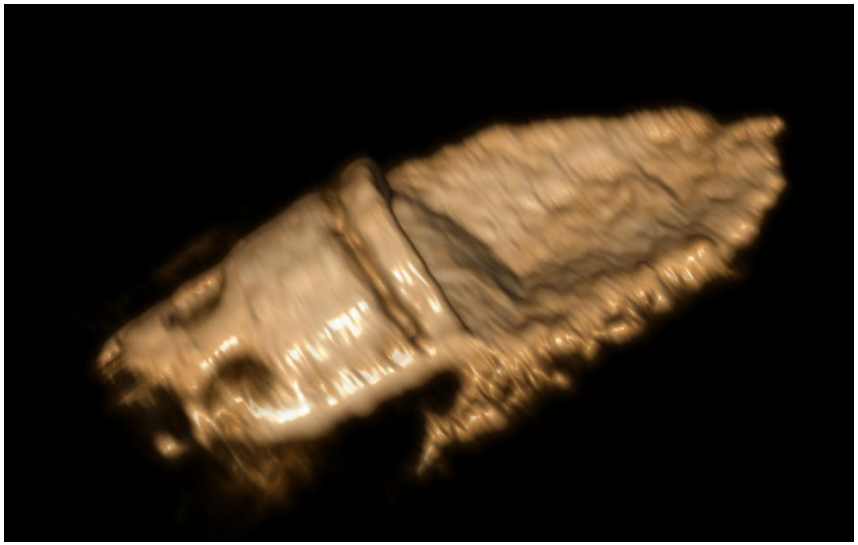
SPACE® Focus – HEX plug in deviated pipe

Archer

And finally, the acquired data can be rendered in 3D



3D representation of HEX plug with sand in front.



It is important to note that the 3D rendering is actually showing the interior of the plug, due to the geometry of the beam.

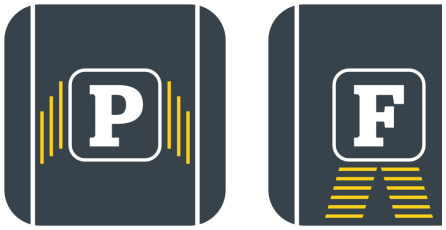
The holes are actually seen from the inside and the plug is partly filled with sand.

SPACE® Vernier

SPACE® Vernier – How much?

Archer

"A device to add accuracy to a measurement scale"



Typical applications:

- ID evaluation/Caliper
- Pipe thickness evaluation
- Corrosion logging
- Metal loss evaluation

SPACE® Vernier – Technology

Archer

- Looks sideways
- 360 degree coverage
- Pulse-echo technique

Detect the echo from the internal wall

And the external wall

To measure the metal thickness

To measure tubing ID we need accurate speed of sound in the surrounding fluid

Why do we need the local speed of sound?

Fluid sound velocity changes with temperature

And can change with depth, even in “homogenous” fluid

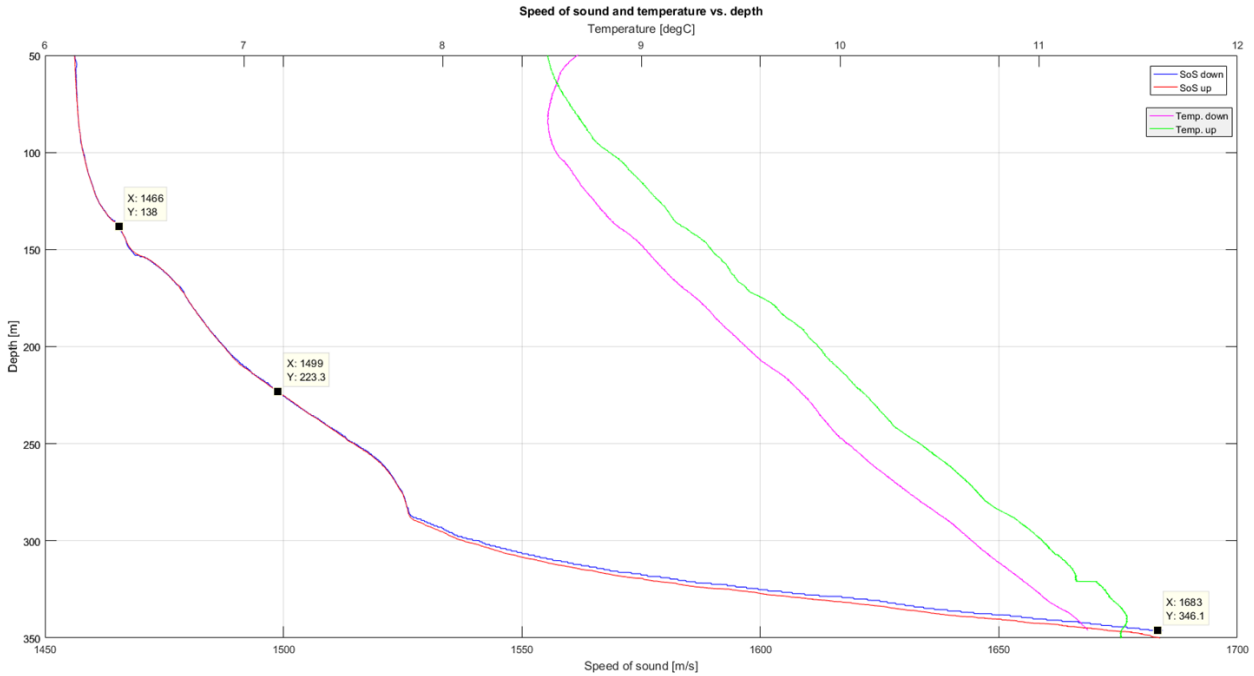


Figure 1: Speed of sound measurements. Also shown are the temperature curves for the down and up log.

The red and blue curves show the variation of speed of sound with depth.

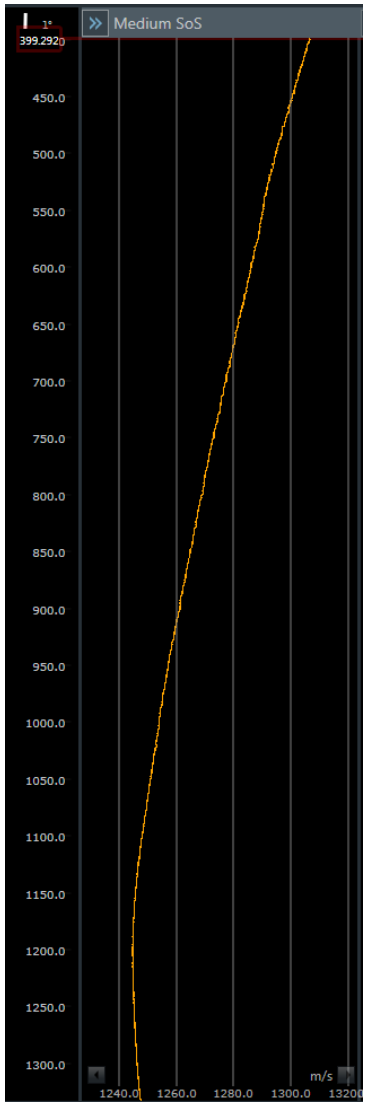
The test well fluid is “pure water”

SPACE® Vernier – Technology

Archer

A single element transducer is fitted to the tool

Continuous speed of sound calibration

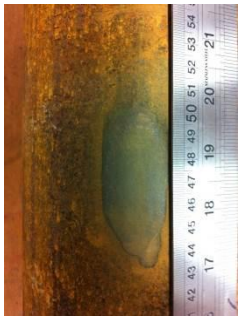


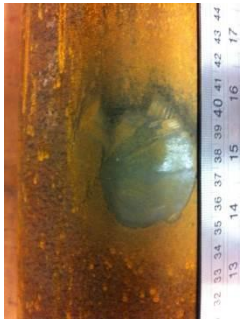
SPACE® Vernier – Pipe with crack

Archer

Crack

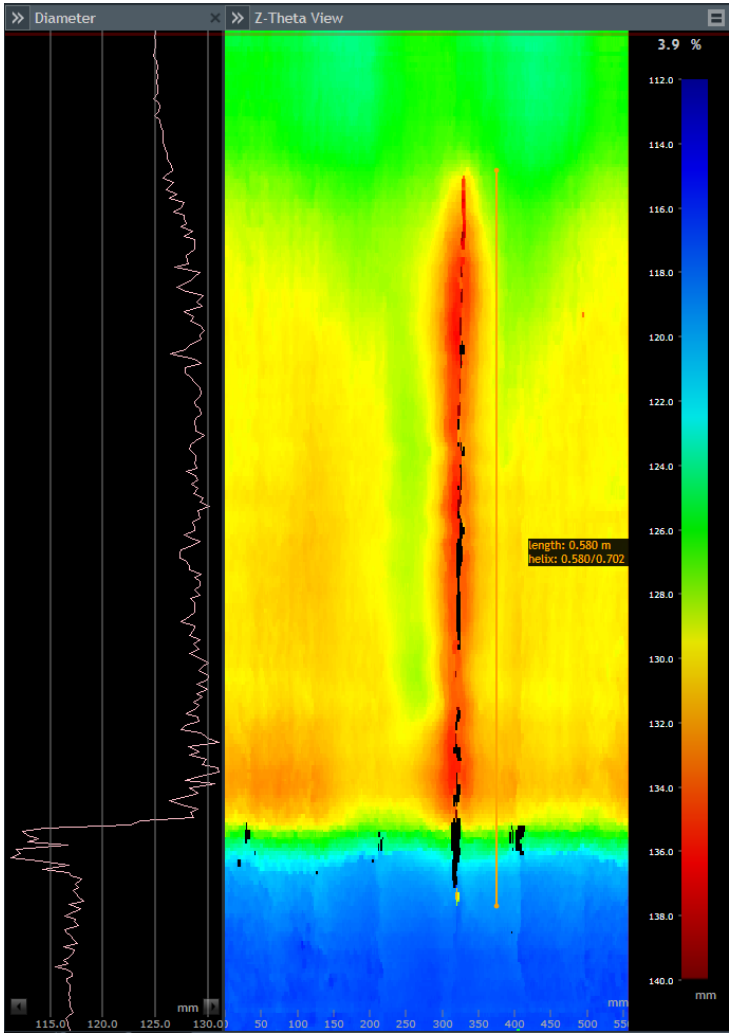
Machined areas



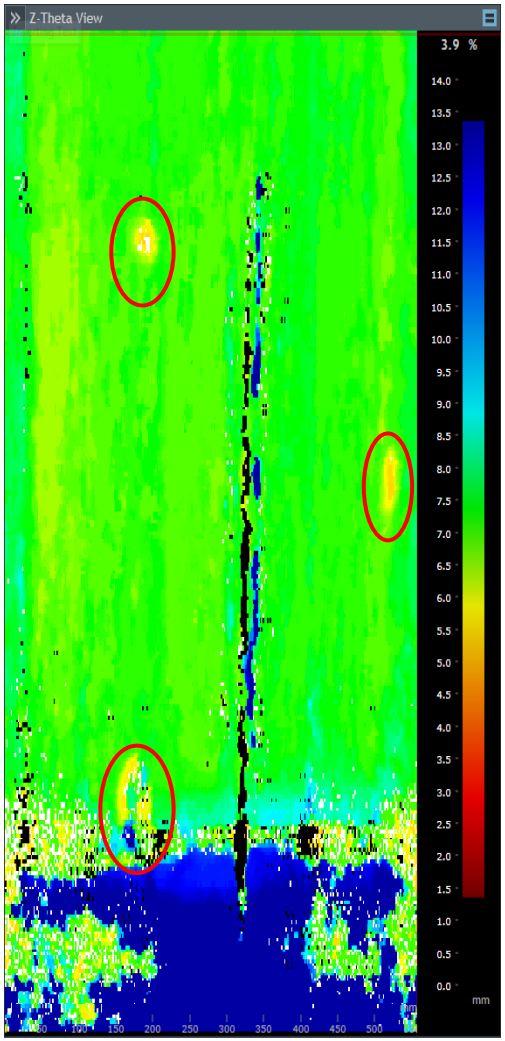


SPACE® Vernier – Pipe with crack

Archer



Internal diameter



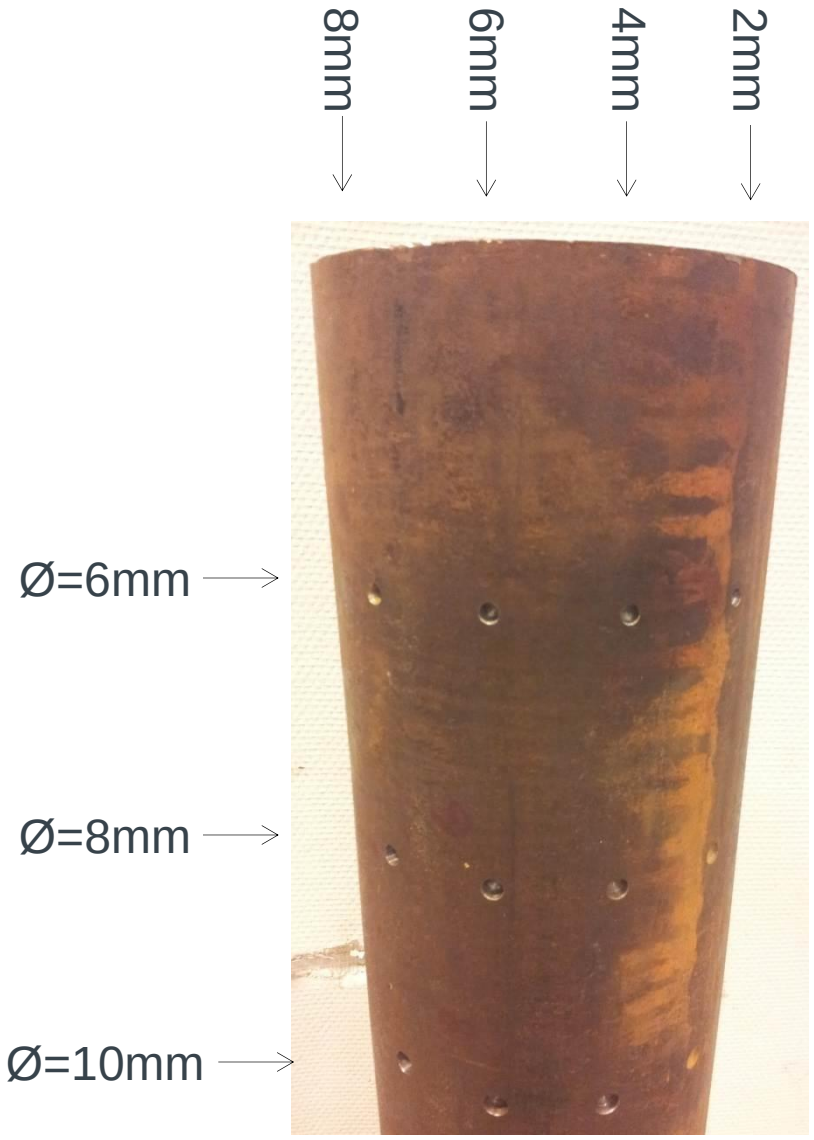
Thickness

SPACE® Vernier – Machined holes on outer surface

Archer

- Each row has one diameter
- Each column has one penetration depth

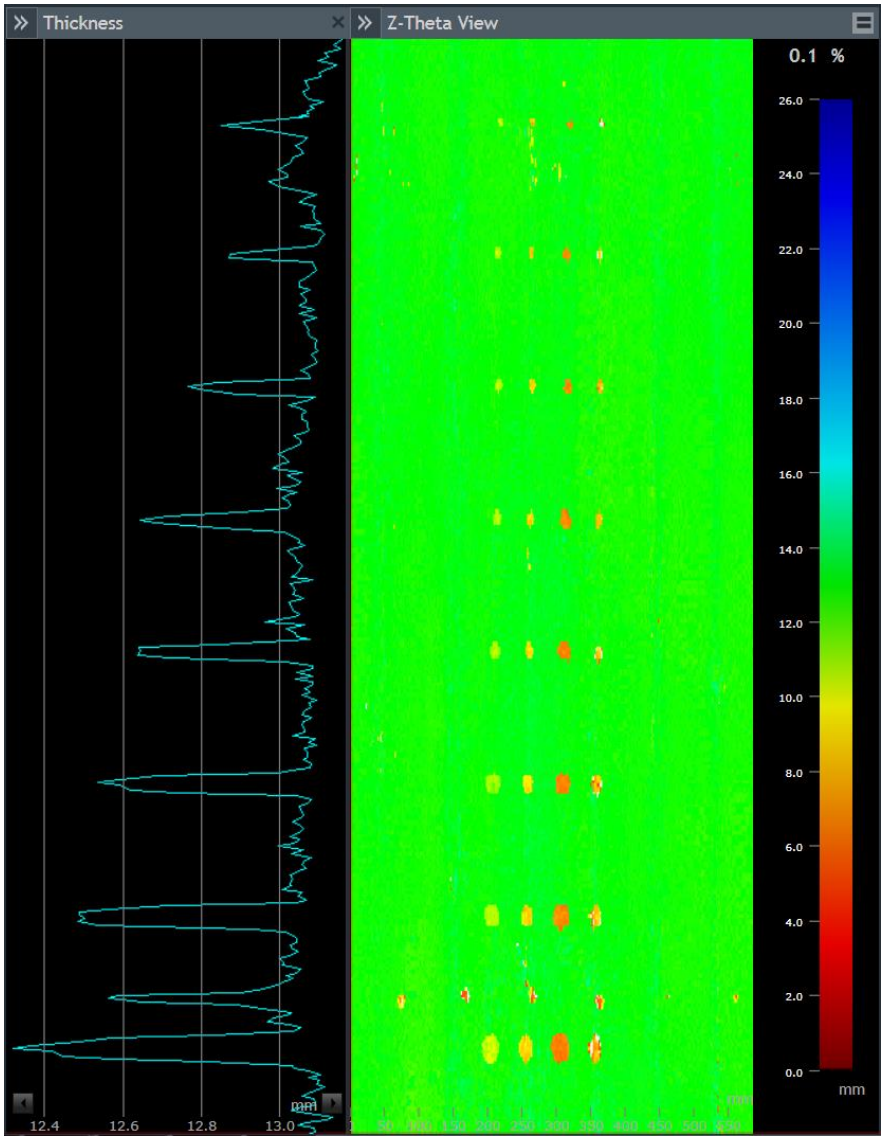
Depth 8 mm	Depth 6 mm	Depth 4 mm	Depth 2 mm
Ø=6 mm	Ø=6 mm	Ø=6 mm	Ø=6 mm
Ø=8 mm	Ø=8 mm	Ø=8 mm	Ø=8 mm
Ø=10 mm	Ø=10 mm	Ø=10 mm	Ø=10 mm
Ø=12 mm	Ø=12 mm	Ø=12 mm	Ø=12 mm
Ø=14 mm	Ø=14 mm	Ø=14 mm	Ø=14 mm
Ø=16 mm	Ø=16 mm	Ø=16 mm	Ø=16 mm
Ø=18 mm	Ø=18 mm	Ø=18 mm	Ø=18 mm
Ø=20 mm	Ø=20 mm	Ø=20 mm	Ø=20 mm



SPACE® Vernier – Machined holes on outer surface

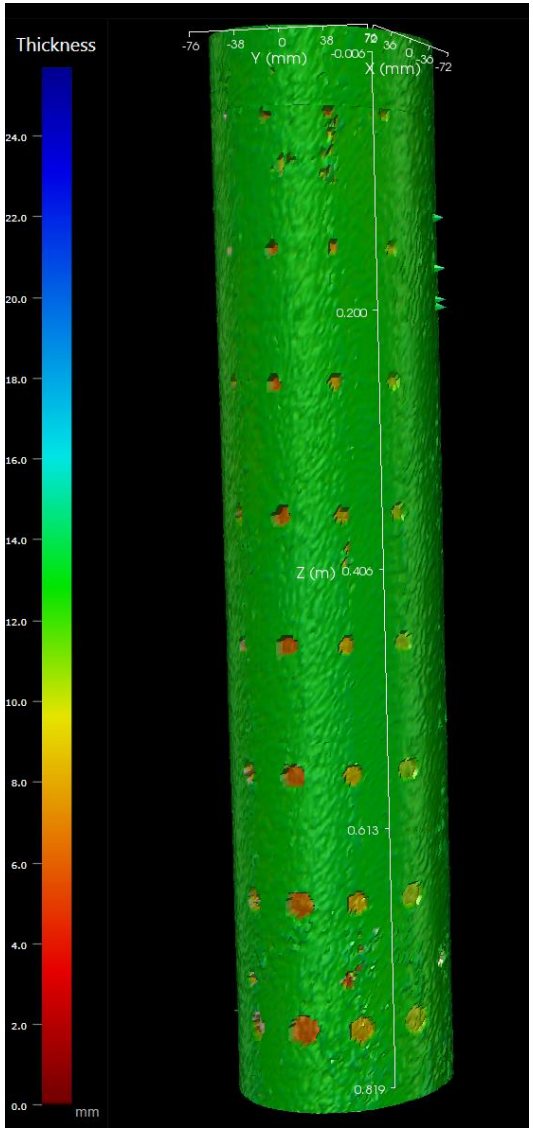
Archer

- 2D thickness map.
- All the hole sizes are seen by SPACE® Vernier.
- The plot on the left is average thickness, which indirectly indicates «metal loss» at the drilled holes.
- The Z-Theta view displays the entire circumference of the pipe using a colour map to indicate thickness.



SPACE® Vernier – Machined holes on outer surface

- 3D thickness map
- The thickness measurements can be displayed in 3D, making it easy to identify and measure pipe damage.

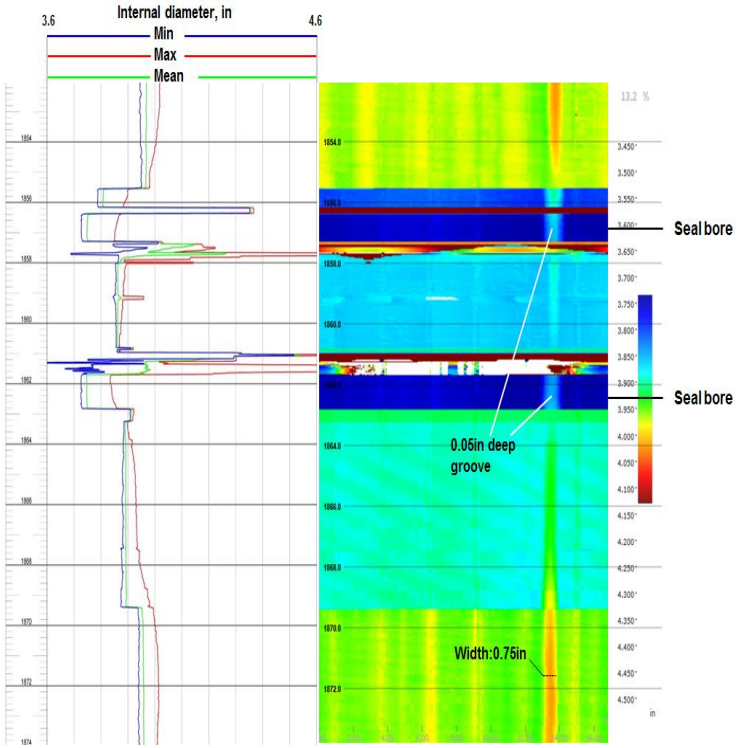


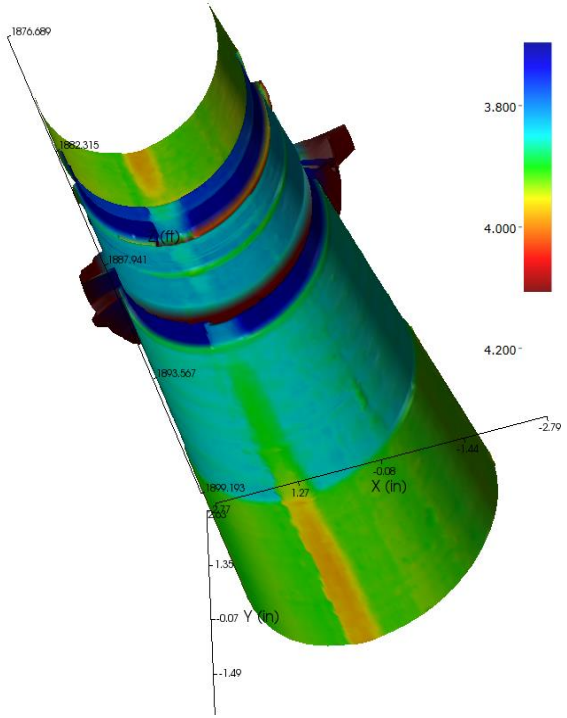
SPACE® Vernier – Safety valve

Archer

Problem: A SCSSV not sealing

Solution: Deploy SPACE® Vernier to evaluate the safety valve, and measure ID and thickness from SCSSV to surface

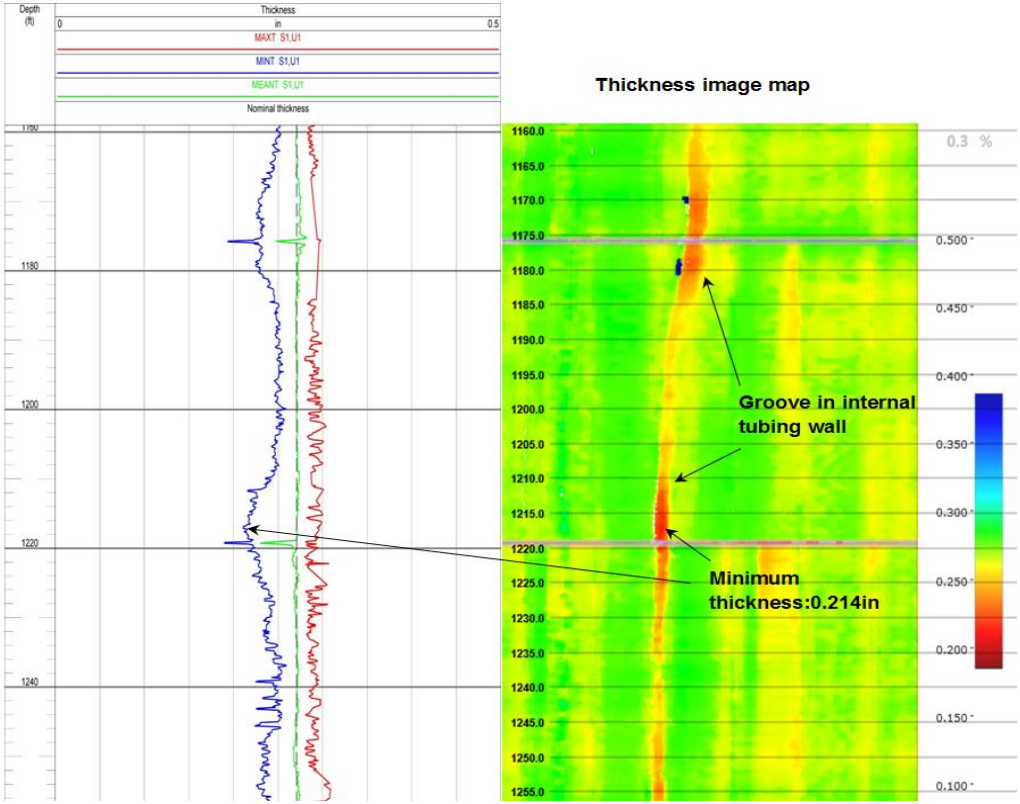




SPACE® Vernier – Safety valve

Problem: an SCSSV not sealing

Solution: Measure ID and thickness from SCSSV to surface



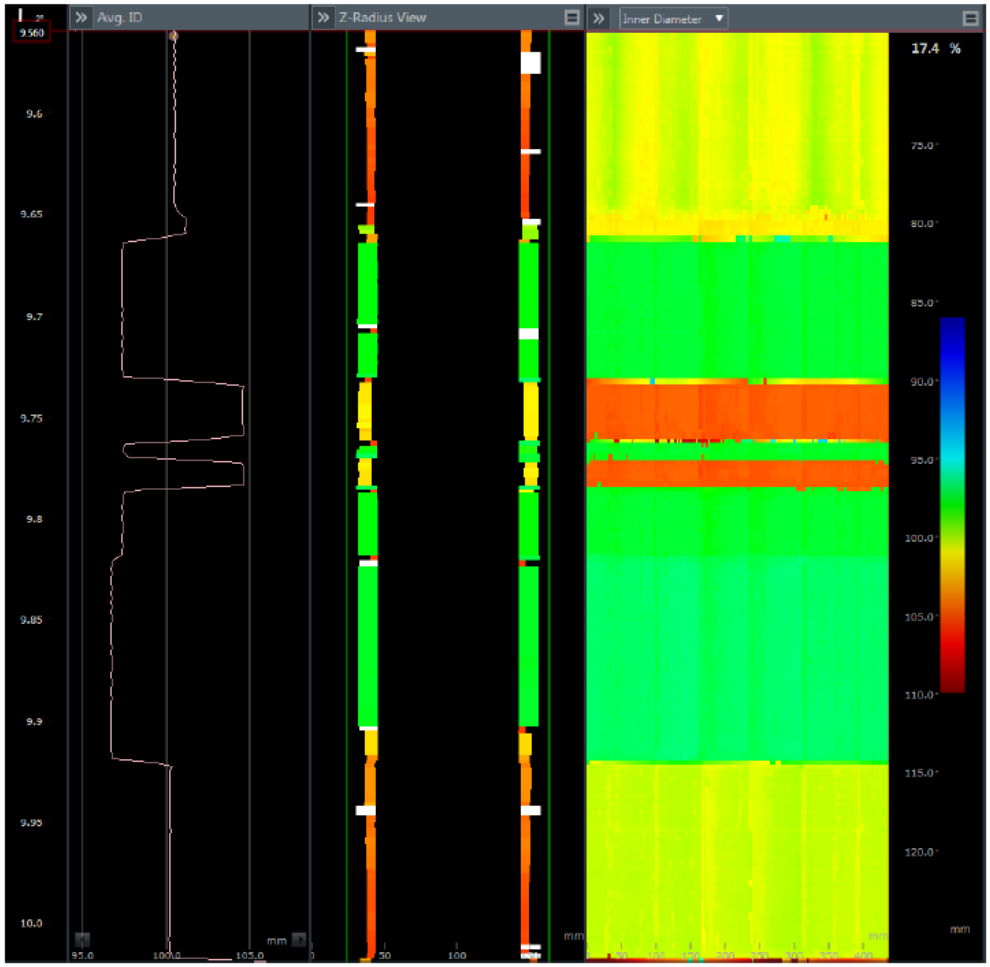
SPACE® Vernier – Nipple ID Measurement

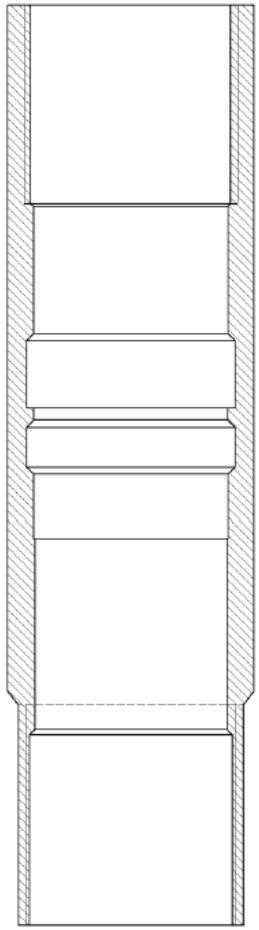
Archer

SPACE® Vernier allows detailed examination of complex geometries…

Such as nipple profiles

Compared to
the schematic



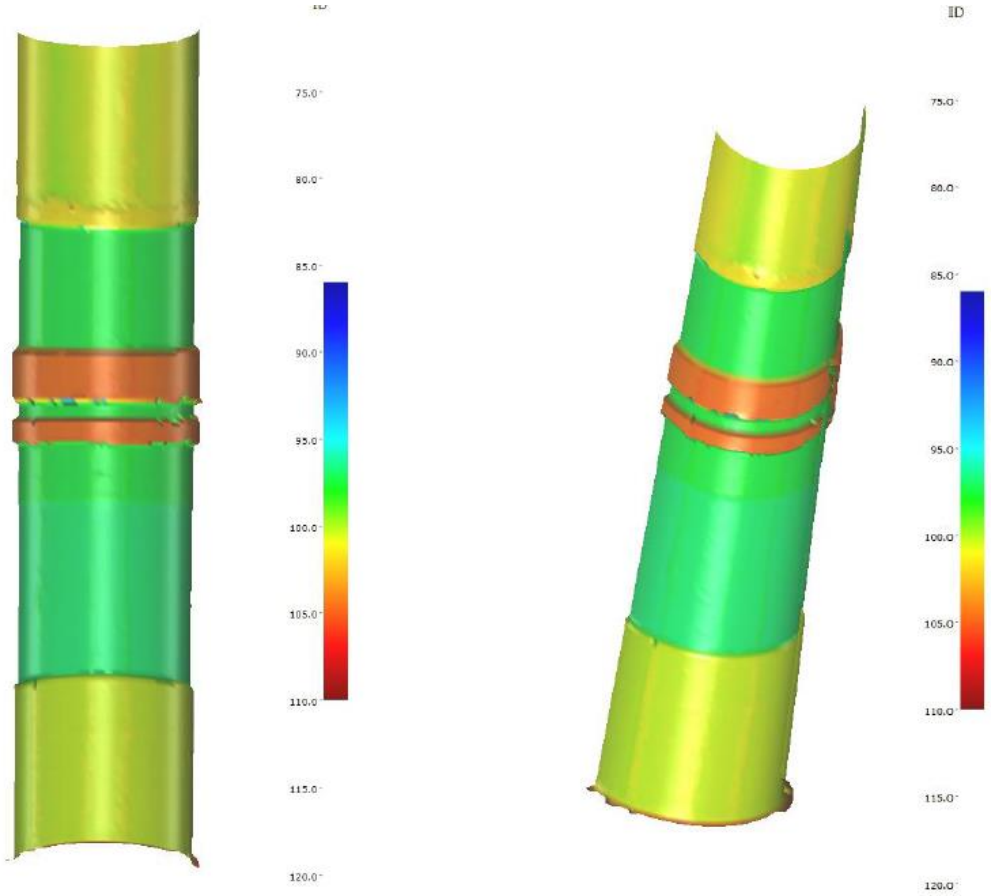


SPACE® Vernier – Nipple ID Measurement

Archer

SPACE® Vernier allows detailed examination of complex geometries…

Presented in 3D

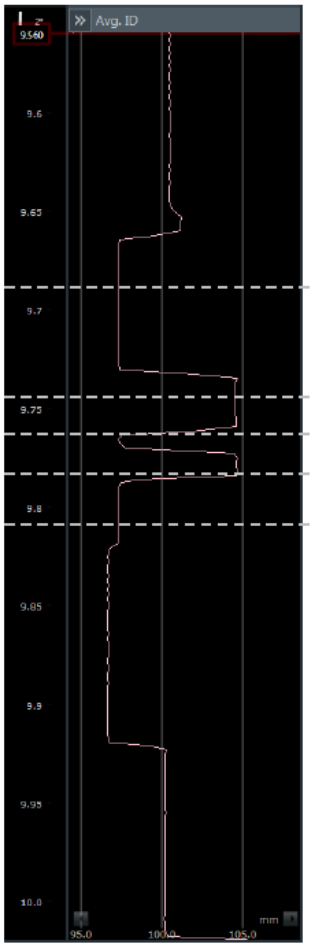


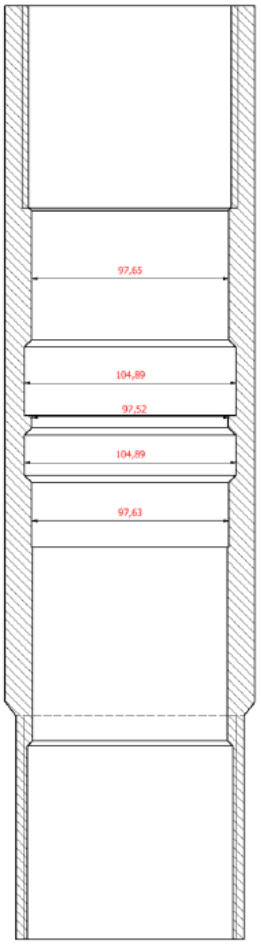
SPACE® Vernier – Nipple ID Measurement

Archer

Precise dimensional measurement

IDs measured by SPACE	Δ
97.3 mm	0.35 mm
104.6 mm	0.29 mm
97.4 mm	0.12 mm
104.6 mm	0.29 mm
97.3 mm	0.33 mm





SPACE® Vernier – Logging speed vs. resolution

Archer

- Vertical and azimuthal resolution requirements determine line speed
- Quick scan is enabled by reducing number of active elements

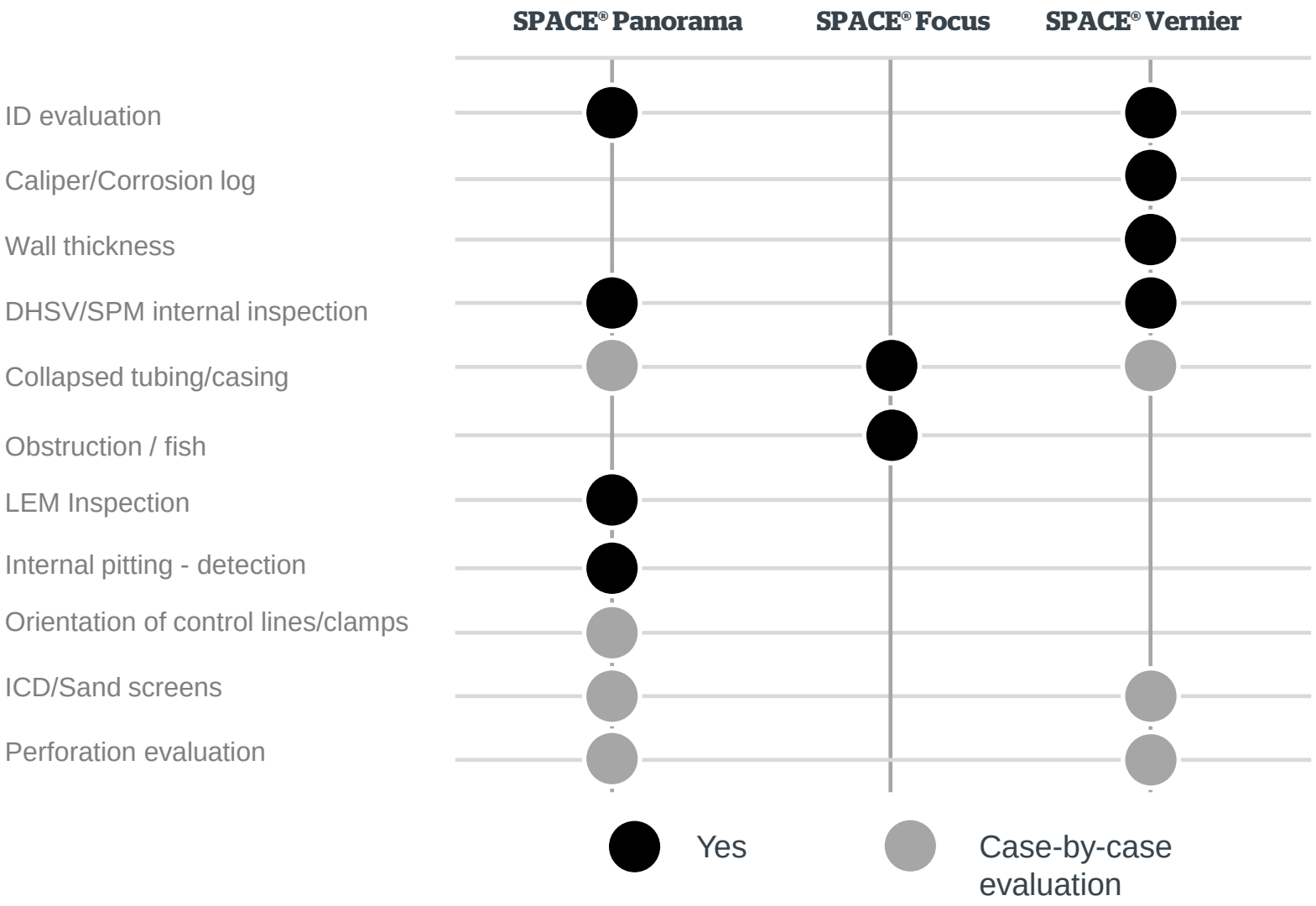
HIGH RESOLUTION (0.3in vertical resolution)			
No. elements	288	144	72
Line speed	1.3	2.5	5
	4.3	8.1	16.3

QUICK SCAN (1.5in vertical resolution)			
No. Elements	288	144	72
Line speed	6.5	12.3	24.8
	21.4	40.5	81.5

Applications

SPACE® – Applications

Archer



Tool specification

SPACE® – Tool specification

Archer

	SPACE® Panorama	SPACE® Focus	SPACE® Vernier
Pressure	15,000 psi / 1034 bar	7,250 psi / 500 bar	7,500 psi / 517 bar
Temperature	302ºF / 150ºC	275ºF / 135ºC	239ºF / 115ºC
Tool OD	2-1/8''	3.2''	3''
Well fluid compatibility	Water/ brine/ oil	Water/ brine/ oil	Water/ brine/ oil
Pipe range (OD)	3-1/2" – 13 3/8"	4"– 9 5/8"	4-1/2'' – 13 3/8''
Minimum ID	2.8"	3.5"	4"
Accuracy (ID)			+/- 0.012"
Accuracy (Thickness)			+/- 0.012"

Thank you!