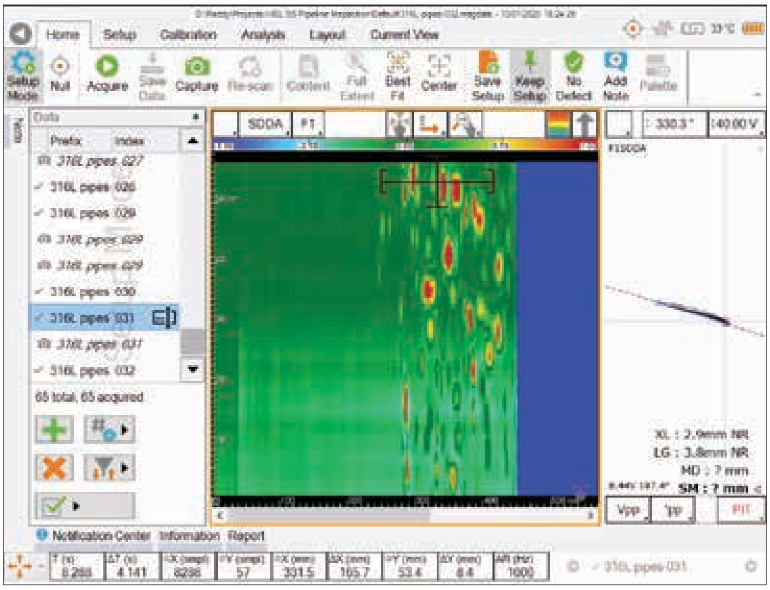
Testing pitting and corrosion with eddy current arrays

With the advances of technology in the field of eddy current array, corrosion pitting can easily be detected and sized. Grant Meredith, technical manager for inspection company, Applus, in Australia, explains the process for inspection of 316L stainless-steel to detect and size corrosion.

Multiple coil eddy current array testing of a pipe.

The eddy current array inspection technique gives instant and rapid results when scanning large areas of non-ferromagnetic piping. The advantages of using eddy current array testing over conventional surface probe coils is that, in one scan sweep, large areas are scanned and defects in all orientations as well as rounded types can be easily detected with high sensitivity.

To validate the process prior to use, reference samples were manufactured from a section of a 316L stainless steel spool piece. Based on depth sizing for the technique, with due regard to the limitations based on the selected frequency for the inspection of 150 kHz, this enabled accurate measurements of pits of up to 3.5 mm below the surface, which is the depth of penetration limitation and makes deeper measurements inaccurate.



An eddy current array corrosion scan showing a 3.0 mm deep XL pit.

In order to establish a scanning sensitivity, and as a means of sizing corrosion pits, a reference sample was manufactured as per the details in Table 1. The sample was used to establish calibration curves for measurement purposes. Creation of a depth curve is necessary to allow for the sizing of different diameter pits at varying depths. This is based on the volume of material lost at each pit site. Using a range of created calibration depth curves, more accurate sizing using eddy current array technology becomes possible.

The sample and calibration point discontinuities created for this process were manufactured with round bottom holes (RBH). The reference sample has varying diameters as well as depths. A depth curve for each diameter was created to simulate small, medium and large pits. A calibration scan was then done to establish the calibration curves between the measured and real pit sizes. A theoretical curve was created for 3.0 mm pits to allow for the sizing of larger (XL) pits.

With the system calibrated using multiple diameter and depth points, scans were carried out on a corroded pipe sample. As can be seen in the example scan, accurate measurements of pitting corrosion could be recorded.

When analysing a selected pit, the dimensions are taken to measure against calibration curves for SM (small), MD (medium), LG (large) or XL (extra-large) pits. The cursors can be used to measure the dimensions of the pit and the relevant sizing curve can be selected to get the depth measurement from the depth curve.

Eddy current array technology is a quick and easy method for detection and sizing of both isolated and cluster pits, giving good sensitivity to quantifying both size and depth.

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Examples of surface corrosion on stainless steel piping.

The specifications of the sample manufactured. Note: Round-bottom holes (RBH) are selected as they better represent the cross-sectional shape of isolated pits.

Hole Diameter Ø	Round bottom hole depths					
	10%	20%	40%	60%	80%	100%
1.0 mm @ 90°	0.305 mm	0.61 mm	1.22 mm	1.83 mm	2.44 mm	Through
1.5 mm @ 180°	0.305 mm	0.61 mm	1.22 mm	1.83 mm	2.44 mm	Through
2.0 mm @ 270°	0.305 mm	0.61 mm	1.22 mm	1.83 mm	2.44 mm	Through