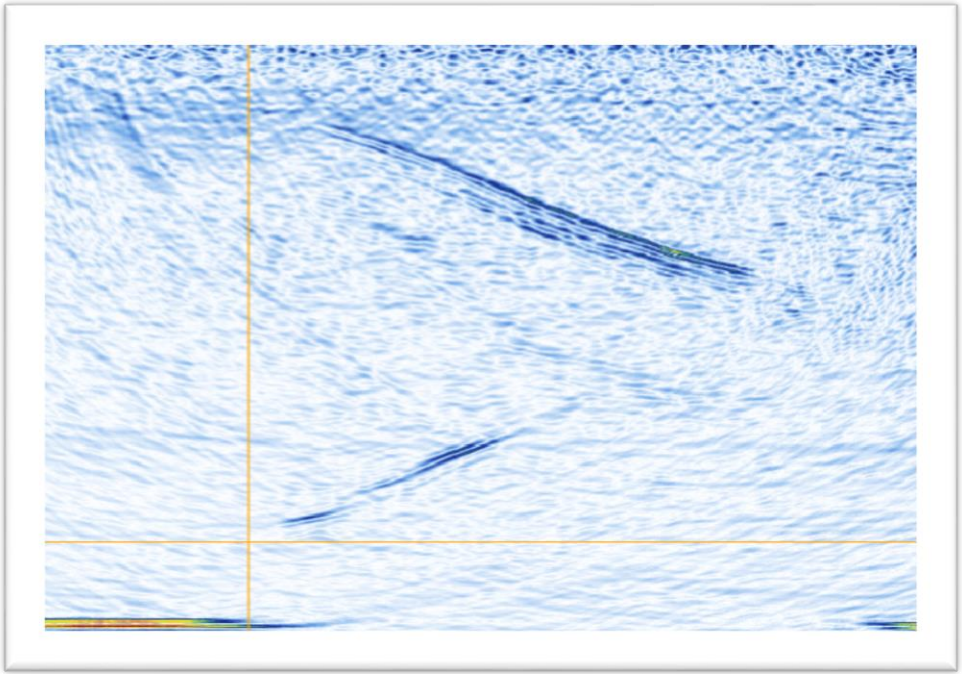

DETECTION OF CHEVRON CRACK BY TFM/FMC METHOD

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NON-CONTACT WATER COUPLED AND AIR COUPLED NDT SOLUTION

Forward extrusion is a typical way of mass-production of cold-formed bars or rods with constant cross-section. This process is used for the production of engine alternator shafts and it is based on reducing the diameter of semi-product without removing material in several reductions. However, there is a potential danger of **chevron cracking**.

Chevron cracking is a form of hydrogen-induced cold cracking taking place in the weld metal, typically on carbon-manganese low alloy medium-strength welds. It takes the name from the characteristics of the cracks, orientated approximately transverse to the welding direction and at 45° with the plane of the plates (assuming a butt joint). Chevron cracks are inside the material and therefore invisible on the surface of the semi-product.

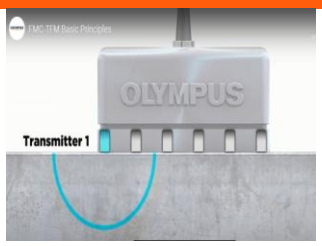
Sections showing chevron crack

Ultrasonic inspection is widely accepted as a technique for detecting chevron cracks in materials. More recently phased array ultrasonic testing is widely used and accepted as a reliable technique in the ultrasonic inspection. **Total Focusing method and Full Matrix Capture method (TFM-FMC)** are the latest technological advancements in Phased Array ultrasonic testing.

The Total Focusing Method (TFM) is an imaging algorithm that can be implemented for the post-processing of full matrix capture (FMC) data. The TFM uses the full data set, captured using FMC, to produce an image by focusing the array in transmission and

reception at every point. This can be achieved by first discretizing a region of space in front of the array into a grid and then the beam is focused at every point in the grid and thus a fully focused image is generated.

Transmission &Reception by an FMC/TFM method



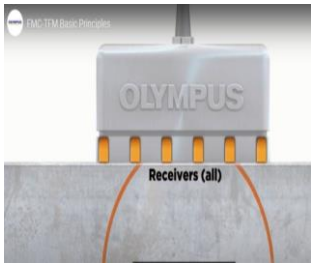


Image courtesy: Olympus

At the time of transmission, a single element will transmit the signal, but at receiving time all the elements of the probe will receive the signal at a time collecting a large amount of data, which gives a good image of the defects. The main advantage of the FMC-TFM technique is direct imaging of a large area in one probe position combined with optimal focusing and spatial resolution.

Image showing side drill hole by TFM/FMC method

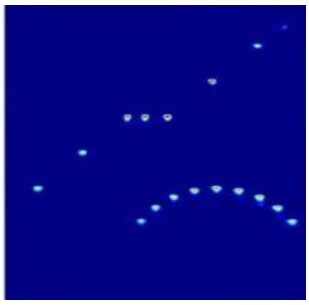


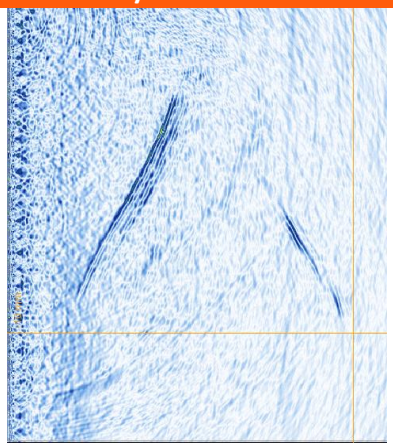
Image Courtesy: AOS

The ultrasonic testing calibration is done by using a calibration block of the same material. The TCG curves are also plotted with the calibration block. In the TFM technique, different types of probes with a different number of elements are used for different applications. As per the shape and size of the specimen different types of probes are used. For example, for the inspection of cylindrical shafts, concave probes are used

Advantages of TFM/FMC Technique

While using TFM/FMC technique, it can achieve optimal focusing and spatial resolution everywhere in the sample. Also, this technique provides direct imaging of a large area at one probe position. The phased array ultrasonic technique(PAUT) will not provide accurate flaw sizing, but TFM/FMC provides a better opportunity for **accurate flow sizing.**

Image showing Chevron crack TFM/FMC method

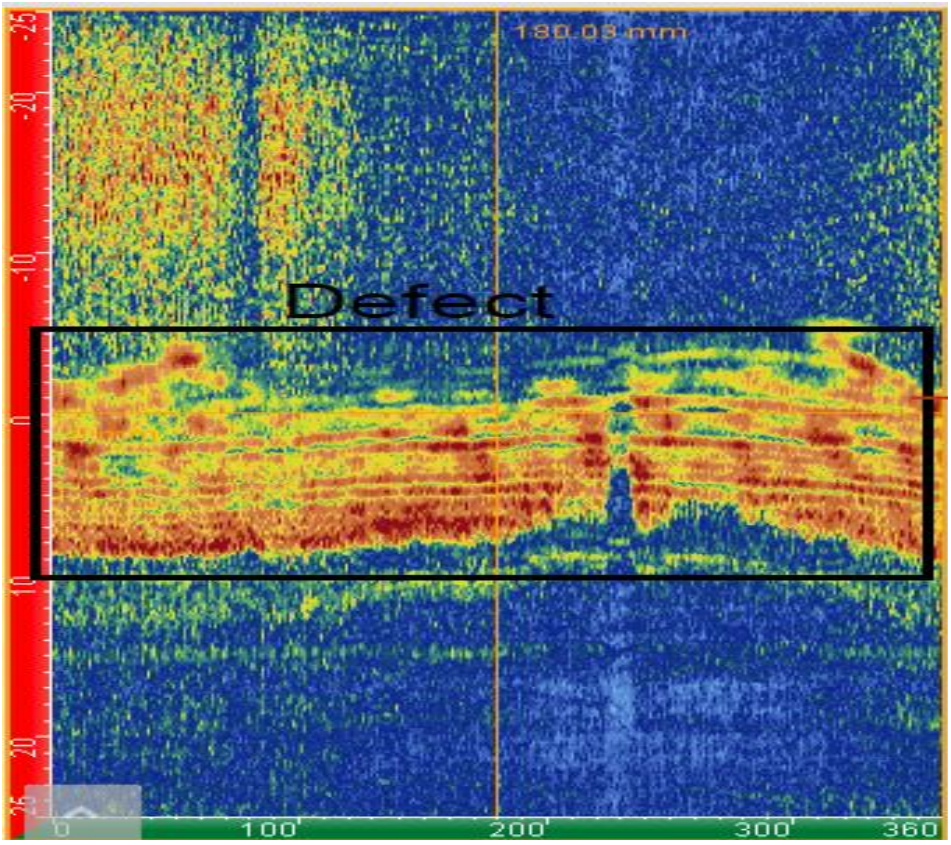


The cracks will be effectively captured in the c scan. The TFM frame shown above is a single shot direct TFM frame. As observed the top portion of the crack is perfectly visible while the lower portion is partially visible which will be visible in the 180-degree rotation. The c scan of the same by rotating the sample 360 degree imaging the chevron crack completely is shown below.

Detection of Chevron crack by TFM/FMC Method - Application Note

A Dhvani Research Application Note

Chennai, INDIA



Inspection C-scan image showing the chevron crack 360 degrees in a cylindrical shaft

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