

100 % Volumetric Ultrasonic Inspection on 5182 Slabs Post Casting

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Abstract

Aluminium Dunkerque produces and delivers aluminium slabs with raw surface after casting and sawing operations. At further stage, those slabs will be scalped and rolled by customers in secondary field. A certain type of slabs, particularly 5182 alloys, can be source of thin cracks. Those cracks are revealed during scalping and can lead to customer claims. However, those defects are hardly detectable in the upstream process because of their thickness and position (Some of them can be internal cracks).

Aluminium Dunkerque had the objective to protect customers by implementing a reliable quality wall before dispatching of their products. In this purpose, Aluminium Dunkerque has collaborated and still collaborates with Dynamic Concept Europe for finding an industrial and full automated machine able to detect those defects on raw surface without machining by respecting a limited cycle time.

Dynamic Concept Europe has started by listed the latest non-destructive testing technologies on the market and after having short listed the solutions, the ultrasonic inspection would be the best technology for this purpose. However, it was necessary to combine the most advanced features and software currently available on the market with an important part of development, choice was made to cooperate with TPAC who is matching all these criteria. Dynamic Concept Europe went through lab scale validations on some slab slices with positive results. Then, thanks to those positive achievements, Aluminium Dunkerque and Dynamic Concept Europe decided to develop and manufacture a prototype able to be used as industrial scale. This prototype has been a real success and it is now used into the slab storage by Aluminium Dunkerque. This prototype remains manual. The next step is to manufacture a standalone solution fully integrated in the sawing machine in order to detect those defects at early stage and avoid to bring adding value in potential scraped products. Thanks to IA, this equipment will allow to generate a catalogue of defects and achieve predictions and process adjustment in the casting process if required.

Hereby are some key parameters of this enhanced solution:

- Performed with a probe made up of 128 transmit and receive elements to achieve good coverage and insonification of the slab,
- Real-time Total Focusing Method (TFM) imaging allows ultra-fast and high-resolution inspection,
- Control speed up to 1 m/s with high resolution up to 1 mm,
- Applicable on a raw foundry surface,

- Enables upstream process predictions and adjustments,
- Control of 100 % of the product volume (saleable portion).

Keywords: Aluminium 5182 alloy slabs, Ultra-sonic crack detection.

1. Objective of the Project

The project has the following objectives:

- To detect cracks in almost 100 % of the volume of slabs (excluded shell zone),
- To meet a cycle time not exceeding 10 minutes per slab,
- To be able to fit with different shapes of slab edges,
- To work on surface with high roughness – Raw surface after VDC casting process without machining,
- To work with the following alloys series: 3xxx, 5xxx (low and high Mg (5 %)) and 6xxx,
- To work on a surface with an ambient temperature (up to 50 °C).

Different shapes of slab edges are shown in Figure 1.

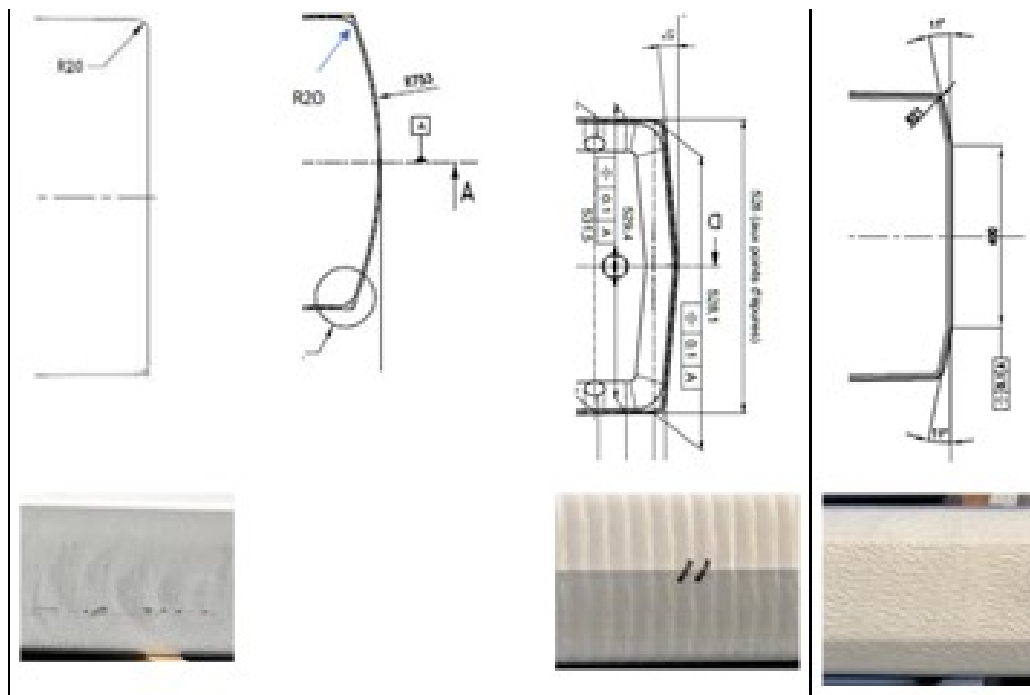


Figure 1. Different shapes of slab edges.

2. Defects/cracks Description and Signature

The equipment detects defects inside a rolling slab:

- Type of defect: cracks or fissures,
- Size of defect: thickness > 250 μm ,
- Origin of defect: Appears in casting phase at the solidification (Vertical Direct Chill technology),
- Location of defect (Figure 2):
 - These defects can be visible at the surface or can be internal only,
 - The cracks propagation is along the length of the slab (direction of casting),
 - The propagation could run all slab or only a part of the slab length.