



## Application note

# Boroblending compressor blades



## Summary

Boroblending is a technique adopted to maintain the serviceability of gas turbines in the event of detection of damage to aerofoils or blades due to domestic or foreign object damage (DOD or FOD). Assuming such damage exceeds acceptance limits (outlined in the maintenance manuals), it creates areas of elevated stress concentration and if left unchecked they can result in blade or material release which then causes significant secondary damage to the asset or engine resulting in inflight shutdowns.

Boroblending is the highly skilled technique to mechanically remove these areas of damage by careful grinding and sometimes polishing using specialist rigid or flexible equipment. This is all done without needing to remove or disassemble the gas turbine from its installed location. It is therefore considered an essential activity to ensure continued safe operation of the asset until its next scheduled shop visit whereupon such blades or aerofoils are either replaced with new or for blisks, more complex additive processes are undertaken to restore the component back to its original design intent.

## Challenge

Incremental detailed assessment using borescopes equipped with precise and accurate digital measurement technology is needed to ensure the blending operation is done in accordance with the appropriate repair procedure. It is important that the depth and width of the final boroblended site is achieved in accordance with these strict protocols. Afterall, removal of too much parent material from the aerofoil needlessly compromises the overall component; and too little material removal exposes the risk that not all the damaged site has been blended away e.g. crack tip.

An emerging requirement to also evaluate the shape of the final blend site has been identified by some engine manuals. Reliable and accurate measurement technology that provides detailed imaging and assessment capability provides the skilled technicians the tool to do this job with confidence.

## Solution

For initial assessment of the damaged blade, often a point-to-line measurement type is employed. Real3D measurement provides a fully surfaced point cloud on which a user can adjust measurement cursors and view the scene to ensure accuracy. Assessment of the point cloud is recommended to ensure the entire scene is assessed to ensure accuracy of cursor placement to generate the appropriate measurement.

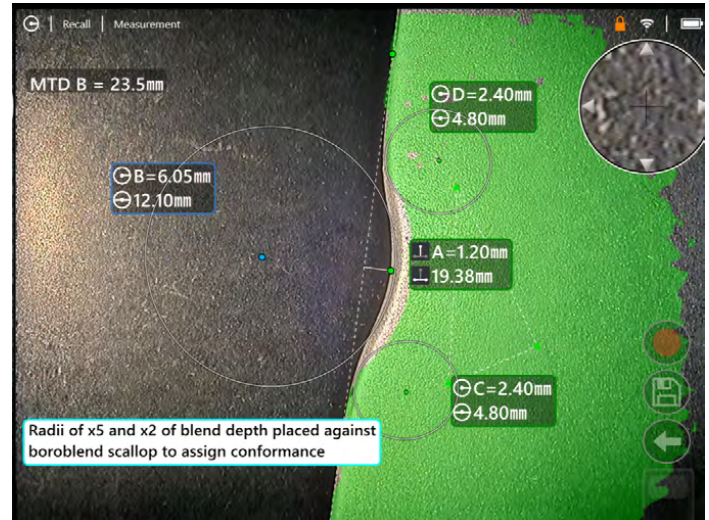
This image has captured damage to a compressor blade. It shows both the 2D (left) and 3D (right) split view on the MVIQ. Cursor placement of the full depth of deflected material significantly surpasses the initial visual assessment obtained from the 2D image alone.



Much more information about each of the measurement types and more is available within the 3D Measurement Handbook.

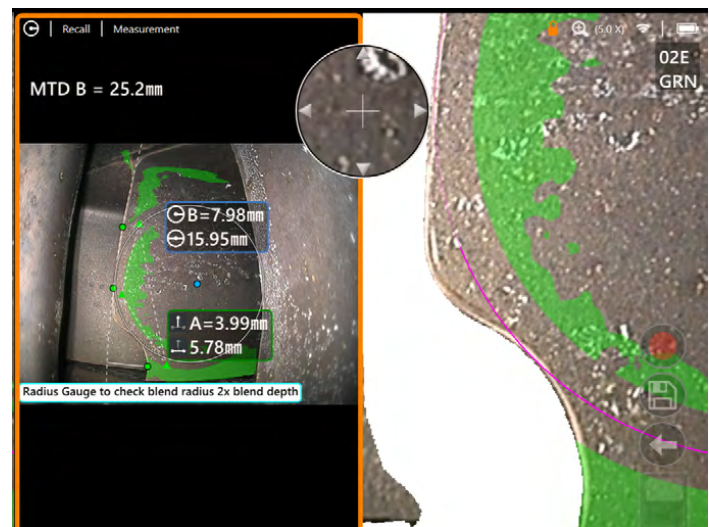
To ensure the shape of the resultant boroblend meets requirements, Waygate Technologies has leveraged Real3D technology to create a new Radius Gauge measurement type. It enables Technicians to place a 'go/no-go' of known radii on to critical points of the blended site. Comparison between the blended material and the radii generated by the Radius Gauge tool provides the Technician and subsequent reviewers of the reported data with that detailed knowledge and conformity.

Here we have a Real 3D captured image of an aerofoil containing a boroblended site (derived from a different edge-breaking defect). This example requires the user to assign a measurement plane (using three cursors) to then enable the placement of the Radius Gauge into the free space off the surface of the actual component. The circles do not bisect the blended material; therefore, this blend is acceptable.



The next example shows a tip blend. A radius gauge circle is positioned over the "blend-out" position. It is sized to conform to a known acceptance radii for the well-known aero engine type. This bisects the blended material and therefore indicates that further material needs to be removed.

This can be better viewed using the point cloud function.



Highlighting material not conforming to radius line (magenta) therefore showing material that requires further removal in order to comply with acceptance criteria.