

Technology/Process: **Orbital Drilling**
 Responsible: **Novator AB**
 Partners: **Saab, Exova, Linköpings Universitet**
 Work package: **4.1 – "Orbital Drilling"**



Description of Technology/Process:

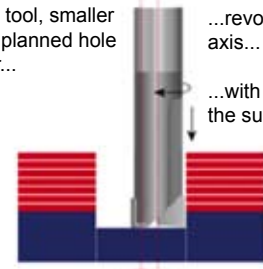
Orbital Drilling is created by combining three motions - feed, spindle rotation and orbital rotation - resulting in a helical movement of the tool through the material. The cutting tool is always smaller than the hole diameter leading to a drilling process that generates less heat and smaller axial force. The result is virtually burrless and delamination free holes of the highest quality requiring minimal rework.

Before:

Orbital drilling is an approved technique in production for high demanding applications, for example the wing to body with joint in Boeing 787 Dreamliner with Ti/CFRP material (TRL 9). The issue of fatigue life in AL is however on a low TRL and in focus for this work package in GF-Demo.

Illustration:

A cutting tool, smaller than the planned hole diameter...
 ...revolves around its own axis...



...with pressure towards the surface...



...while orbiting to create the hole diameter

Keywords:

Orbital drilling,
 semi-automatic,
 one-up assembly,
 dry drilling

Benefits:

Orbital drilling gives low burr-height in metal and less delamination in CFRP. There is no need for disassembly of structures for secondary operations which opens up for one-up assembly also for large size holes in holes in production.

The RFID technology built in to the machines gives a fool proof production with predefined process and repeated hole quality. Orbital drilling in Ti/CF applications lower costs for cutting tools and shortens lead time in production.

Findings in GF-Demo can open up for these benefits also in applications including aluminium.

Work performed:

Fatigue tests in aluminum, Al, coupons have been done for orbital drilled holes with conventional drilled and reamed holes as reference. Test conditions has been open hole, play fit as press fit fastener. Samples have also been investigated for residual stress. Different machining parameters and cutting tool geometries was tested to see impact on the fatigue properties .

In the open hole test, orbital drilled holes gives less fatigue properties in Al compared to conventionally drilled and reamed holes. Reference samples with conventional drilled and reamed holes show significantly higher residual stress and tension at greater depths which may explain the improved fatigue strength.

Variations of the cutting process parameters for orbital drilled holes gave small effect on fatigue strengths while amendments to the cutting tool resulted in increased fatigue strength, but less than for conventionally drilled holes. The test with play fit fasteners gave an equivalent fatigue life of orbital drilled holes as for conventionally drilled holes.

Test with press fit fasteners with orbital drilled hole showed reduced fatigue life. In this part of the test no reference samples for conventional drilled holes was done and faulty sample cannot be excluded.



Future developments & exploitation:

We see that longer series with reference samples both for the tests with fasteners with play fit as well as for the tests with press fit fasteners would provide more

solid results with greater value into future implementation of the technology in aluminum applications.