



Aerospace Industry Support Initiative

an initiative of **the dti**

## **Advanced manufacturing boosts global competitiveness of aeronautics and defence sectors**

The Aerospace Industry Support Initiative (AISI) is fulfilling its mandate to assist in improving the global competitiveness of the local aeronautics, space and defence sectors. Advanced manufacturing, specifically, holds good potential for AISI industry partner Denel Aerostructures as a game changer to promote the aerospace industry.

The AISI is an initiative of the Department of Trade and Industry (the dti) and is hosted and managed by the Council for Scientific and Industrial Research.

Marié Botha, AISI Manager, says, “The AISI takes its strategic direction from government’s objectives with a specific emphasis on industrialisation of technology. South African industry is encouraged to advance niche capabilities and technologies through industrialisation. Our projects and contribution to the aerospace and advanced manufacturing industries cover a broad spectrum – from process design of continuous fibre-reinforced thermoplastic joining methods to process design of titanium fluid-cell forming, and the design and testing of high strength aerospace materials.”

The following project is of particular interest in the partnership with Denel Aerostructures.

### **Ultra high cycle fatigue (UHCF) design and testing of high strength aerospace materials**

Ultra-sonic fatigue research has been primarily undertaken in France, the United States of America, Slovakia, Austria and Japan.

Many newly designed systems and high strength materials are required to last for longer operational life cycles at increased frequencies. This requirement will extend the amount of fatigue cycles experienced by the new designs into the high to ultra-high cycle range.

A lack of understanding exists of the effects of UHCF on high strength materials that are subjected to UHCF loading. To this end, Denel Aerostructures is extending existing work to enhance the testing capability of the most widely used modern aerospace materials, and to create a complete and more comprehensive database of modern aerospace grade high-strength materials, which may be used in the future.

Pretesh Daya, Stress Engineer at Denel Aerostructures, explains, “We hope to develop a working fatigue and damage tolerance testing system that can be used to test a variety of high durability materials in the field of Ultra High Cycles. This will be the UHCF testing mechanism in the southern hemisphere.

“Once the system has been fully developed it is likely that it would be put to use in developing new materials that make use of new technologies such as grown/3D printed components. The system would be able to gather the data necessary for the improvement of existing materials as well. For example, one of the hurdles in adopting new materials and processes (such as grown/3D printing) in the aeronautical industry is the availability of reliable (third party) material data in different fields, such as fatigue specification data. This UHCF machine would be one of the means to be used to provide this data.”

Progress so far includes the design and development of a testing system that is capable of testing both aluminium and titanium aerospace grade materials up to and above the giga-cycle region of testing – that is billions of loading cycles.

The work has also resulted in the incorporation of a sensor system capable of monitoring and recording data up to 50 kHz (50 000 cycles) during testing. Stress-life data curves have been developed for both the materials with additional upgrades and materials to be developed and tested in the future.

The successful completion of the system will result in the development of optimised high strength materials, which would ultimately lead to cost saving as well as increased safety since much of the data for these new materials do not exist.

“As is always the case with development, some serendipitous circumstances – probably because necessity brings innovation – resulted in unexpected benefits,” Daya quips, “For example, this testing system also gave rise to the development of stress-life data for a project performed by another department of Denel. The Denel Dynamics project required the use of such a system to identify and verify the fatigue capability of a manufactured component. Our work has therefore already, unintentionally, resulted in the successful development of manufactured components.” The completion of the current project may result in future development in the near future.

The support of the AISI has made it possible for Denel Aerostructures to make gains in terms of advanced manufacturing. Botha says, “This is in line with our vision and mission, which is to make the South African aerospace industry globally competitive.”



*UHCF experimental setup*



*UHCF testing equipment*