



# Major Propulsion Systems Facilities

The Defence Science and Technology Organisation (DSTO) is the Australian Government’s lead agency charged with applying science and technology to protect and defend Australia and its national interests. DSTO delivers expert, impartial advice and innovative solutions for Defence and other elements of national security.

DSTO has a number of world-class facilities that provide the organisation with the ability to test and design propulsion systems and related technologies. Among these facilities are the Combustion Test Facility, Cyclic Spin Test Facility, Helicopter Transmission Test Facility, Small Engine Test House, and the Fuel Tank Farm. The facilities are located at DSTO’s Fishermans Bend site.

## Combustion Test Facility

The Combustion Test Facility (CTF) is purpose-designed to test hot section components from many modern and older gas turbine engines at simulated engine operating conditions. These components are usually tested in a rig designed to withstand the appropriate pressures and temperatures. In the CTF, the components can be instrumented, modified and tested

without risking damage to a complete engine. This is often done in a manner that would be impossible, or at least very costly, in a full engine. Once the component has satisfactorily completed rig tests, in-service evaluation in operating engines can commence.

The CTF can simulate conditions in engines continually at:

- pressures up to 30 atmospheres;
- inlet temperatures of up to 650 degrees Celsius; and
- air mass flows of up to 9.5 kg/s.

It can also be operated with fuel/air ratios of up to 0.03 and can reduce pressures inside the test rigs to simulate pressures at altitudes of up to 10,000 metres.

During a testing program many parameters are measured and these may include:

- exhaust gas measurements of carbon monoxide and dioxide, oxides of nitrogen, unburnt hydrocarbons and smoke;
- metal temperatures;
- combustion limits such as those for light-up and flame-out conditions;

- heat transfer from the flame, and;
- quality of the temperature profile at entry to the turbine section of the engine.

All of these parameters are normally recorded on a data acquisition system that was specifically designed for the facility and, where applicable, all measurements are carried out to international standards.

The CTF is capable of running a test with two different fuel types at any one time and is also equipped with a high pressure fuel nozzle spray facility.



Combustion Test Facility Control Room



## Cyclic Spin Test Facility

DSTO's new full-scale Cyclic Spin Test Facility has been built to simulate the conditions of rotating components in gas turbine engines.

Built to test the largest rotor components from ADF military engines, the facility is suited to both research tasks and for assessing the life of service parts. By continuously cycling between various maximum and minimum speeds, the fatigue life of engine rotor parts can be tested to the full service life in days instead of years. The cyclic stress conditions at critical locations and the temperatures representative of the engine are replicated by the test. Alternatively, the test can replicate creep by holding maximum speed at high temperature, or perform sequences of speeds according to military mission profiles.

Tests are normally performed in vacuum. High temperature (turbine) parts are heated to operating temperature. The chamber is designed to withstand rupture of rotor discs during testing.

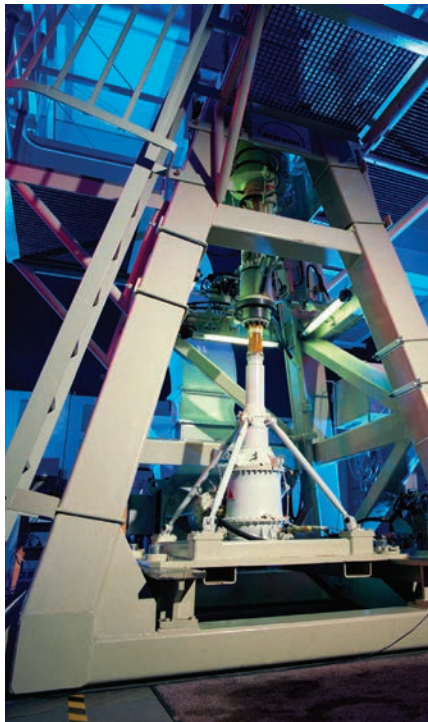
## Helicopter Transmission Test Facility

The Helicopter Transmission Test Facility (HTTF) is used to provide full-load tests for two helicopter transmission main rotor gearbox types - the Squirrel AS-350BA, and the Kiowa Bell 206B-1. Power throughputs of up to 520 kW are possible, representing a significant overload capability for the test gearbox types. The HTTF is used for generating and propagating mechanical faults for the purpose of developing and validating advanced diagnostic techniques.

The rig uses recirculating power with an electric motor-generator drive to ensure net power consumption is limited to rig losses. This results in a facility which is very cost effective and environmentally friendly to run. The electric motor-generator configuration also allows flexibility, where transmissions with different gear ratios and direction of rotation, can be accommodated in the one rig.

## Small Engines Test House

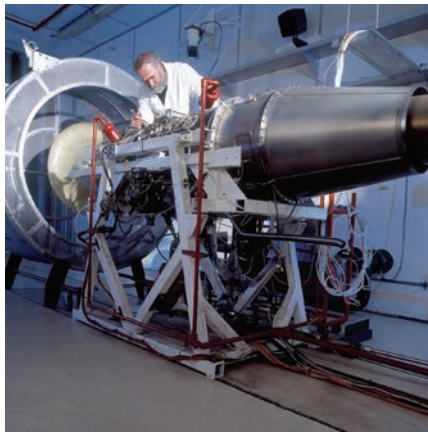
The Small Engines Test House (SETH) has the capability for testing gas turbine engines ranging in size from those used in small UAVs to engines the size of those used in



Helicopter Transmission Test Facility



Cyclic Spin Test Facility



Small Engines Test Cell



Cyclic Spin Test Facility Control Room

powering the Hawk aircraft or Iroquois helicopter. Typical test programs are aimed at developing methods of condition monitoring to improve the ADF's aircraft availability and reduce costs. Performance measurements such as shaft speeds, thrust, fuel flow, and pressures and temperatures are recorded during engine running to validate new diagnostic approaches.

## Fuel Tank Farm

The Fuel Tank Farm can hold up to 75,000 litres of fuel and up to seven different fuels utilising various stainless steel holding tanks.

## Further information

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