DSTO
Support to Accident & Incident Investigations

DSTO Melbourne
DSTO at a glance

- Budget 2011-12: $440m
- 11 research divisions
- 2600 staff
- 7 sites across Australia
DSTO Support to Accident & Incident Investigations

Impartial, independent scientific support to the ADF, and Directorate of Defence Aviation & Air Force Safety (DDAAFS).

As a national resource, support civil agencies.

Maintain a team of investigators, on-call 24/7.

Forensic Engineering group AVD underpins incident and accident investigations.

Can draw on the depth of scientific capability within DSTO
Aircraft Forensic Engineering and Accident Investigation

UNCLASSIFIED

Divisional Structure

Air Vehicles Division

- Aircraft Materials
  - Aircraft Forensic Engineering and Accident Investigation
    - Advanced Metallic Airframe Technologies
    - Advanced Composite Technologies
    - Smart Structures and Advanced Diagnostics
  - Fuels & Lubricants

- Propulsion Systems
  - Engine Life Management
  - Propulsion Prognostics & Health Management
  - Infrared Signatures and Aerothermodynamics
  - Mechanical & Combustion Experimentation

- Aircraft Structures
  - Structural Mechanics Fatigue Methods
  - Structural Integrity Combat and Trainer Aircraft
  - Structural Testing, Transport & Surveillance and Aircraft Structural Integrity

- Flight Systems
  - Helicopter Structural Integrity
  - Structural Integrity Combat and Trainer Aircraft
  - Fluid Mechanics

- Flight Systems
  - Experimental Aerodynamics, Modelling & Simulation
  - HiFire Flight Test Program

- Applied Hypersonics
  - Air Vehicles Systems
  - Scramjet Development
DSTO Scientific Capability in Support to Accident Investigation

- Trajectory analysis
- Wreckage mapping
- Wreckage damage analysis
- Forensics
- Oxygen systems
- Wiring systems
- Composites damage assessment
- Aircraft Fuel Tank Safety
- Engine parts assessment
- Wear Debris analysis
- Flight path reconstruction
- Flight simulation
- Meteorological/aerodynamic modelling of terrain
- Instrument analysis
- Filament analysis
- Human factors
- Structural analysis and testing
- POL analysis
In the 1950s a number of Comet airliners crashed without explanation. DSTO Melbourne scientist Dr David Warren and his team subsequently developed a wire recorder to record pilot conversations and instrument readings at the time of an incident.

Australia became the first country to make the device mandatory on all civil aircraft.

The Black Box was developed further by the US and UK, and has since become one of the most valuable aids in aviation accident investigation history.
On-Site Scientific Investigation
Site Mapping

DSTO has a site mapping system consisting of a GPS unit, a handheld computer, and appropriate software for mapping items of interest at a crash site.

Sea King
Accident Nias
8 April 2005
GPS maps of IL76 accident in East Timor 2003
3D laser mapping for rapid site recording
Examination and Analysis at DSTO

Component Examination

Furnace melting debris

Microscopy

Metrology

NDI

Metallography

Forensic examination of wreckage
Aircraft Forensic Engineering

Direct support to Defence into the causes of accidents, defects and failures, and deterioration of ADF systems, equipment and materials.

Largest group of scientific and technical failure specialists in Australia

Support to Civil Agencies and Industry

National Security

Underpins:
- Aircraft/Helicopter Structural Integrity
- Full-scale fatigue tests
- Aircraft Accident Investigation
Forensic Scientific and Technical Capabilities

Failure analysis of metallic, non-metallic and composite materials

Corrosion investigations of materials and components

Non-destructive testing (including evaluation and development)

Aging Wiring and Systems

Wear debris analysis

Analysis of fuels and oils

Metrology of components

Identification of component and system problems

Identification of materials and processing problems

Oxygen system hazard analysis
Failure Analysis and Testing - Quantitative Fractography

Determine the growth rates of cracks and apply this to fleet aircraft - inspection intervals.

Produce data that can be used to predict the life of aircraft structure

Produce information about the loading/material interaction that may allow redesign and/or repairs to be more efficient.
Full-Scale Fatigue Testing
Mechanical & Combustion Experimentation

Combustion Testing
Technical Support
  - Engine tests
  - Spin tests
Health Monitoring

Vibration Diagnostics
- Advanced techniques for gears and bearings
- Engine fault diagnostics

Engine Gas Path Analysis;
Performance Modelling & Monitoring
Wear Debris Analysis
Novel Techniques
Fuels & Lubricants

Condition Monitoring

- Fuels (contamination/degradation)
- Lubricants and hydraulic fluids
Wear Debris Analysis
Analysis of Aircrew Life Support Equipment
Helmet Damage Assessment

Flash Thermography
Aircraft Wiring and Systems Investigations

Air Multiplier

Fire Detector
Oxygen System Analysis

- Investigate and analyse oxygen systems
  - Failure Modes and Effect Analysis (FMEA) and Oxygen Hazards and Fire Risk Analysis (OHFRA)
- Specialist oxygen equipment advice
- Qualification testing of ADF Aircrew samples for operational units
Aircraft Performance & Modeling

aircraft flight
dynamic modeling
Aeroelasticity

- Stores separation & trajectories
- Flutter prediction
- Weapon vibration environment
Flexible Simulation capabilities

Multiple laboratories throughout DSTO
Reconfigurable components
- Fixed and rotary wing cockpits
- System models
- Display devices
- Scenario development tools
- Analysis tools
Can model accident hypotheses
HawkView and Graphical Replay Software (GRS) are general display programs used to replay:

- Release of Stores from aircraft
- Accidents & Incidents
  - Software/Hardware Failures
  - Debrief Tool
Uses either on-board data recording systems and/or external data.
Can make use of all available data eg Range Instrumentation, Camera Data, Radar Data, Voice Data, Witness data

Airshow 2003
Animations to illustrate findings
The rotating machinery on a helicopters produce sounds at various frequencies. Frequency analysis of the ambient noise can identify and isolate the noise generated by rotating machinery such as engines, gearboxes, and pumps.

- (A) Epicyclic gear mesh
- (B) Auxiliary pumps
- (C) Engine gas generator (once per rev).
- (D) Engine power turbine and Main rotor gearbox high-speed input shaft (once per rev).
Photogrammetry

Photogrammetry is the Science/Engineering discipline of measuring object position using images.

It can be used to reconstruct flights

- In this case: video footages used to determine ingress and impact conditions
Simulation from photogrammetry
Questions ?