David Florida Laboratory

Communications Research Centre
Department of Communications

This unique aerospace and spacecraft test and assembly facility is ava
for use by agencies of government and by Canadian industry on a cost-recoverable basis.

These facilities, located at Shirley's Bay just west of Ottawa, are part of the Communications Research Centre of the Department of Communications. Originally built in the early 1970s to support the integration and testing of the Communications Technology Satellite (Hermes), they have since been expanded to provide all necessary equipment and assembly areas to perform integration and environmental testing of spacecraft such as Anik C, Anik D-1 and D-2 and others likely to be designed for launch with the U.S. Space Transportation System (STS or Shuttle), or by European or U.S. expendable launchers.

COMPLETE FACILITIES

The functional units of the DFL are:

Two high-bay spacecraft assembly areas, with appropriate dust and contamination control, for assembly and integration of aerospace components and systems.

An RF test facility comprising two anechoic chambers, two screened rooms, an antenna range with fixed and movable antenna tower and EMC/RFI equipment for testing to Mil. Specs.

Vibration facility including three separate vibration machines with a capability of 27 kN (6 000 lb), 53 kN (12 000 lb) and 178 kN (40 000 lb) force respectively, with associated control and measurement instrumentation for launch vibration simulation.

Five thermal vacuum chambers to simulate thermal and vacuum conditions of outer space: one large 7 m × 10 m (22′ × 35′) chamber suitable for all-up spacecraft tests; four other chambers, 3 m × 9 m (10′ × 30′), 2.5 m × 2.5 m (8′ × 8′), 1.25 m × 2.5 m (4′ × 8′), 1 m × 1 m (3′ × 3′), for testing spacecraft subsystems and components.

Data reduction facilities used to display, record and store vital thermal vacuum test data.

Spacecraft spin balance facility.

In addition, the facilities include specialized ground support handling and test hardware, together with software packages developed through many years of spacecraft testing.

The David Florida Laboratory is named after C. David Florida, who died on January 19, 1971, at age 57, in recognition of his many contributions to the Canadian space program. At the time of his death, Mr. Florida was director of the Canadian National Space Telecommunications Laboratory and program manager for the ISIS series of satellites.

INTEGRATION AND ASSEMBLY AREAS

Hermes spacecraft (CTS) shown during solar array deployment tests in spacecraft integration and assembly area.

Designed to accommodate STS payloads 4.3 m × 3 m long

Designed to accommodate STS payloads up to 4,500 kg

Cleanliness:
Class 100,000 or better
Portable class 100 shroud system
6.1 m × 6.1 m × 4.6 m high

4,500 kg travelling crane with 9.1 m maximum lift in area 1

9,000 kg travelling crane with 11 m maximum lift in area 2

Integrated 1,800 kg monorail system to thermal vacuum, vibration and RF chamber facilities

Temperature control 21°C ±2°C

Humidity control 45 per cent ±10 per cent

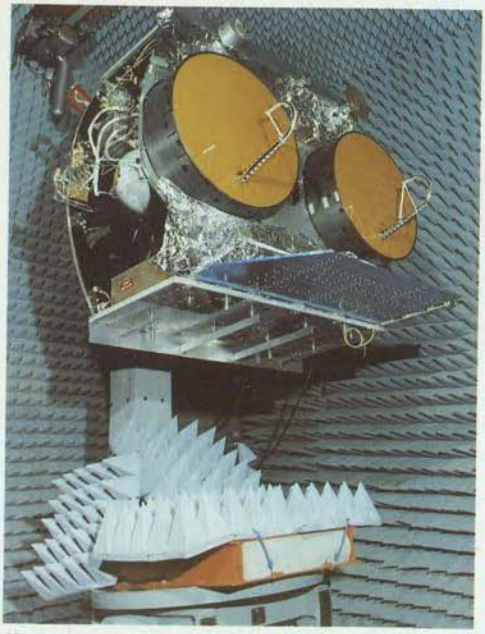
Low-bay area for subsystem assembly 12 m × 6 m

Clean storage area of 110 m² with 6,800 kg monorail access

Clean loading bay area 6 m × 18 m with 3.6 m × 5.5 m freight elevator to basement storage

Sufficient area to integrate and assemble up to five spacecraft at one time

RF TEST FACILITY



Hermes engineering model spacecraft during RF tests in small anechoic chamber.

Shielded Anechoic Chamber

6.1 m × 6.1 m × 6.7 m

Electric field shielding
100 dB @ 200 kH_z to 15 GH_z

Magnetic field shielding
90 dB @ 200 kH_z to 15 GH_z

Reflection coefficient
−30 to −58 dB, 500 MH_z to 15 GH_z

4-axis positioner

400 m inclined outdoor antenna range

EMC/RFI equipment to test to Mil. Std. 461/462

3 m indoor pyramidal horn 1.8 m × 1.8 m aperture (indoor range, radiation susceptibility)

Adjacent control room:
Intercom to tower and chamber
Closed circuit TV to chamber
Control console

Inside view of large anechoic chamber.

Anechoic Chamber

12 m × 12 m × 12 m

With 9,000 kg gantry crane access

Reflection coefficient: −30 to −55 dB, 250 MH_z to 20 GH_z, achieved with mixture of 30 cm, 60 cm, 90 cm and 120 cm absorber

3-axis positioner: load capability 3,400 kg (pointing accuracy with handcranks to 0.002°, normal operation 0.02°)

Polystyrene RF transparent window
9 m × 9 m × 47 cm

400 m inclined (7°) outdoor antenna range

Relocatable tower with azimuth over elevation turntable plus spin also available

9 m indoor range

Adjacent control room:
Scientific-Atlanta 2020 Antenna Analyser System
Fully programmable data acquisition capability
Video and audio link

EMC/RFI FACILITY

Shielded room

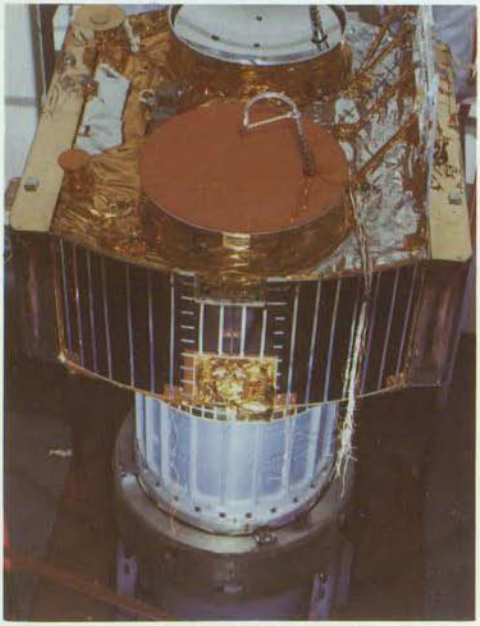
3.6 m × 4.3 m × 3.6 m with adjacent screen room 2.4 m × 2.4 m × 2.4 m

Electric field strength
100 dB @ 200 MH_z to 10 GH_z

Magnetic field strength
90 dB @ 200 kH_z to 10 GH_z

Equipped to test to Mil. Std. 461/462

VIBRATION FACILITY



Hermes communications satellite mounted on 53 kN vibration table.

C-150D System

Force rating (2 H_z to 2,000 H_z)
53 kN sinusoidal armature mass 45 kg
44 kN random
Maximum displacement 2.5 cm D.A.
Maximum acceleration 120 G (bare table)
Maximum velocity 178 cm/sec

11 control channels, including 41 accelerometers and 12 strain gauge signal conditioning amplifiers

56 recording channels, DC to 20 kH_z

Available slip tables:
152 cm × 152 cm, mass 243 kg
122 cm × 122 cm, mass 167 kg
91 cm × 91 cm, mass 110 kg
61 cm × 61 cm, mass 96 kg

Available head expanders:
89 cm diameter, mass 107 kg
102 cm diameter, mass 231 kg

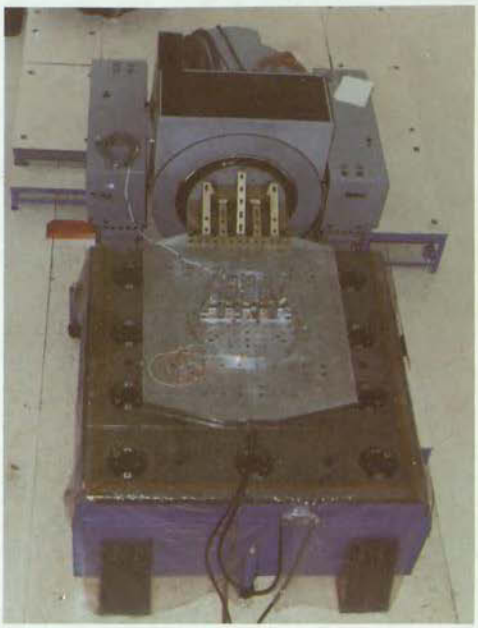
Real-time spectrum analyzer available for data reduction

A-395 System

Force rating (2 H_z to 2,000 H_z)
27 kN sinusoidal armature mass 25 kg
23 kN random
Maximum displacement 2.5 cm D.A.
Maximum acceleration 100 G (bare table)
Maximum velocity 114 cm/sec.

Available slip table 61 cm × 61 cm, mass 40 kg

Available head expander 61 cm diameter, mass 56 kg



178 kN vibration table.

UD 4000 System

Force rating (5 H_z to 2,000 H_z)
178 kN sinusoidal
165 kN random
Maximum displacement 2.5 cm D.A.
Maximum acceleration 135 G (bare table)
Maximum velocity 279 cm/sec.

With a 256 kW power amplifier

Available slip tables:
1.83 m × 1.83 m
1.22 m × 1.22 m

Available head expander 1.22 m diameter

Seismic mass of 200,000 kg
5.2 m × 6.1 m × 2.1 m

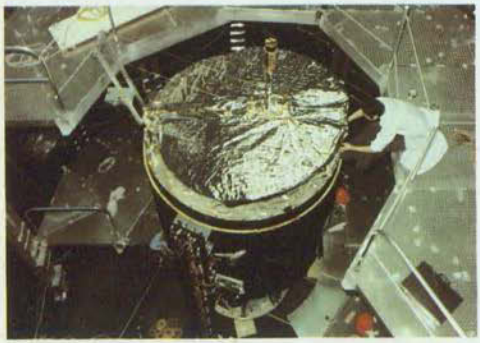
Gen Rad/Time Data TDV-25 or H.P. 5427A digital controller available

Modal analysis capabilities

139 channels of data recording available

6,800 kg gantry crane

THERMAL VACUUM FACILITY



Model of Anik D spacecraft inside 7 m × 10 m thermal vacuum chamber.

7 m × 10 m Thermal Vacuum Chamber

Ultimate vacuum
5×10^{-9} TORR (LN_2 flooded mode)
5×10^{-7} TORR within 12 hours (shroud at ambient temperature)

High vacuum pumping system comprises three 1.2 m helium cryopumps with 25 cm diffusion pump for helium leak testing.

Mechanical pumping system comprises three 33 m^3/min blowers and three 1650 kinney pumps.

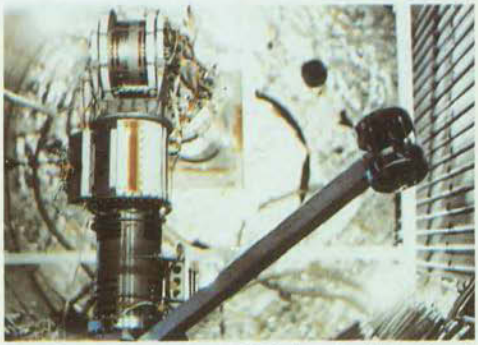
Chamber is top loading with one 2 m diameter and one 1.5 m diameter personnel doors.

Shroud is designed to absorb 1.1 solar constant over 50 per cent of shroud area for a total load capability of 260 kW with a maximum shroud temperature of −173°C.

Ancillary equipment includes spin machine, IR lamp banks as required.

Capability of performing spin balance and mass properties measurements at a pressure of 7 TORR.

23,000 kg gantry crane.



A portion of the remote manipulation arm (Canadarm) for the U.S. Space Shuttle receives its space initiation in the 3 m × 9 m thermal vacuum chamber.

3 m × 9 m Thermal Vacuum Chamber

Ultimate vacuum 5×10^{-8} TORR
(LN_2 flooded mode)
9×10^{-6} TORR (with IR lamps)

Temperature range
ambient or −195°C with LN_2 shroud; IR lamp banks available to permit temperature cycling.

Three thermal vacuum chambers used for testing spacecraft subsystems and components in a simulated space environment.

2.5 m × 2.5 m Thermal Vacuum Chamber

Ultimate vacuum
2×10^{-8} (LN_2 flooded mode)
2×10^{-6} TORR (150°C)

Temperature range −195°C to +150°C ±1°C

Load capability 2,000 watts

1.25 m × 2.5 m Thermal Vacuum Chamber

Ultimate vacuum
9×10^{-9} TORR (LN_2 shroud flooded)

Temperature ambient or −195°C

1 m × 1 m Thermal Vacuum Chamber

Ultimate vacuum
1×10^{-7} TORR (LN_2 flooded mode)
4×10^{-6} TORR (150°C)

Temperature range
−195°C to +150°C ±1°C

Load capability 500 watts

NOTES

1.
Ultimate vacuum in the 1 m × 1 m and 2.5 m × 2.5 m chambers is achieved at LN_2 temperatures (−195°C). Outgassing of test specimen can drastically affect ultimate vacuum.

2.
Temperature monitoring by up to 400 thermocouples available.

3.
The 1.25 m × 2.5 m chamber is a portion of the 3 m × 9 m pumping system. Its ultimate vacuum is achieved with the 3 m × 9 m system inoperative.

DATA REDUCTION FACILITY

PDP 11/60 data processing system with PDP 11/34 back-up computer for spacecraft, system level and component level testing.

735 sensor inputs (TCs, RTDs, voltages and currents)
60 telemetry decommutation inputs
395 calibration curves of up to 5th order polynominal applicable to any inputs
125 special calculations
alarm checking (four levels) on all outputs
hard copy display (two formats) for all outputs
video display for up to 420 outputs
graphical display for up to 45 outputs
non-real time processing capability
5 megabyte disk storage

All computers and peripherals on battery and emergency generator power systems (uninterrupted power — minimum 2 hours).

SPIN BALANCE FACILITY

Anik D spin section with solar arrays mounted on spin balance machine in spacecraft assembly high bay.

Test specimen weight 25 — 2,700 kg

Maximum overturn moment 400 N.m

Speed range 0 to 200 rpm both directions

Typical moment measurement accuracy 3.7 N.cm

Centre of gravity accuracy per axis 0.005 cm/cm of offset

Moment of inertia 34 — 1,300 kg.m²

Accuracy across full range 0.3 per cent

Product of inertia

Accuracy at		
	25 rpm	33.0 kg.cm²
	50 rpm	8.0 kg.cm²
	100 rpm	2.0 kg.cm²
	200 rpm	0.5 kg.cm²

Additional table to give 1.06 m diameter mounting surface

Remote operation capability for use in soft vacuum

Abbreviations

CTS	Communications Technology Satellite (Hermes)
D.A.	double amplitude
dB	decibel
DC	direct current
DFL	David Florida Laboratory
EMC/RFI	Electromagnetic compatibility/ Radio Frequency Interference
G	mass
GHz	gigahertz
Hz	hertz
IR	infrared
kg	kilogram
kHz	kilohertz
kW	kilowatt
LN_2	Liquid Nitrogen
m	metre
MHz	megahertz
Mil. Specs.	Military Specifications
Mil. Std.	Military Standard
N	newton
RF	radio frequency
rpm	revolution per minute
RTD	resistance temperature device
STS	Space Transportation System (Space Shuttle)
TC	thermocouple

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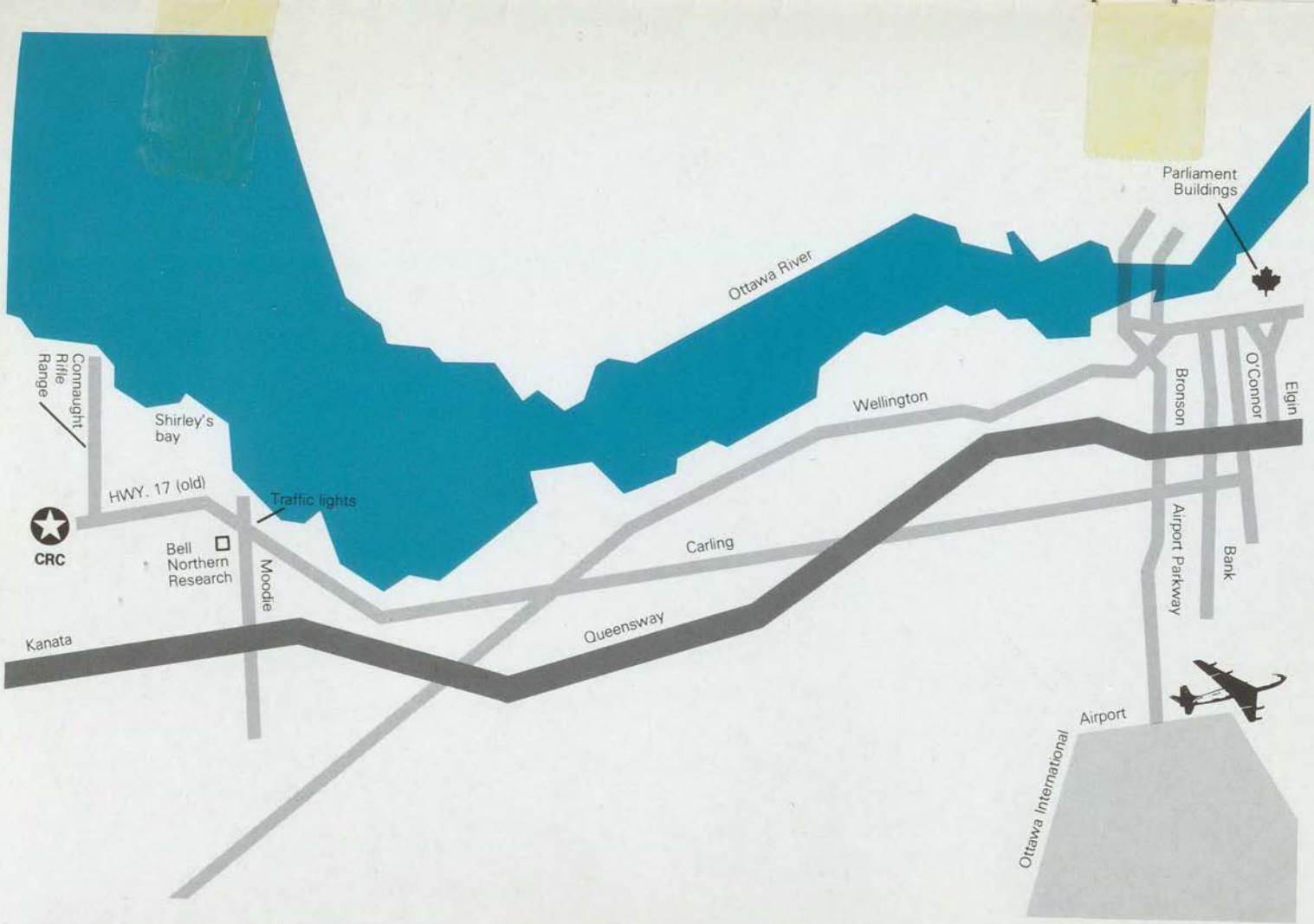
Parliament Buildings
Ottawa River
Connaught Rifle Range
Shirley's bay
HWY. 17 (old)
Traffic lights
CRC
Bell Northern Research
Moodie
Wellington
Bronson
O'Connor
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