ENBIO T2 Thermal Vacuum Test Facility

The ENBIO T2 thermal vacuum test facility is located at the ENBIO R&D lab in Glasnevin, Dublin 11, Ireland, just 15 minutes away from Dublin Airport.. This facility utilises a 60 cm internal diameter high vacuum chamber with an internal length of 66 cm (see Figure 1). The chamber contains an aluminium thermal platen, through which a cryo-fluid is circulated. The thermal platen is supported by four PEEK (polyether ether ketone) blocks to thermally isolate the platen from the chamber walls. Temperature control of the cryo-fluid is achieved using a dedicated commercial cryo-chiller with 3.0 kW of heating power and ≈ 3 kW of cooling power (3.8 kW at 100 °C, 3.7 kW at 0 °C, 2.2 kW at −60 °C, 0.7 kW at −80 °C). A PT100 resistance temperature detector (RTD) connected to the thermal platen close to the TRP position is used for feedback control by the cryo-chiller. The cryo-chiller has programmable over-temperature and under-temperature limits to prevent damage to test articles by temperature excursions. No thermal shroud is present inside the chamber.

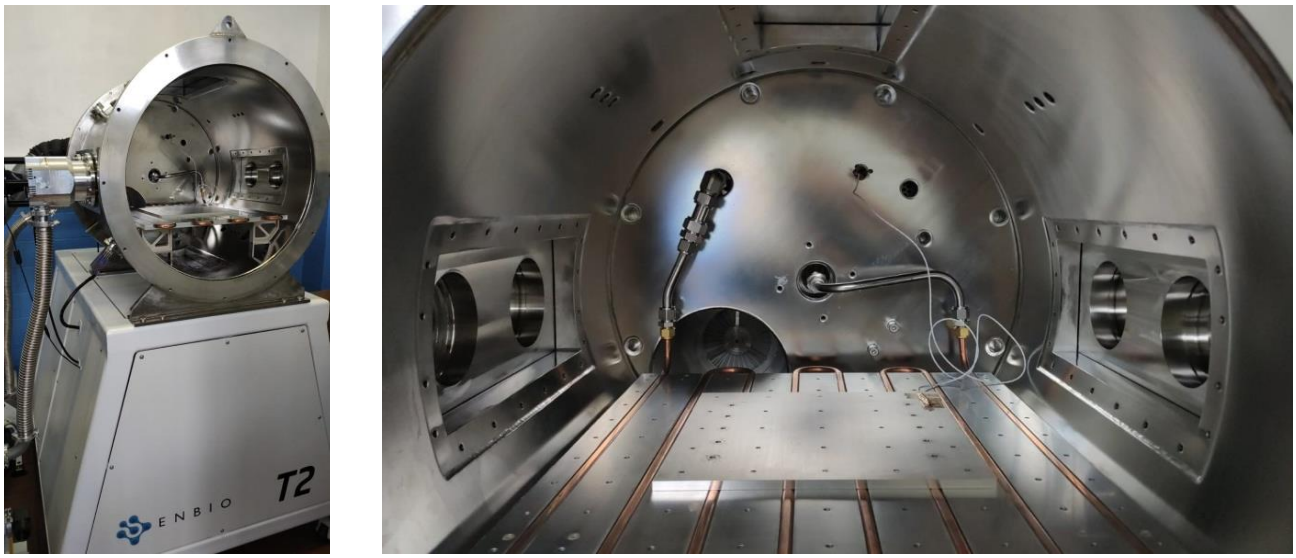

Figure 1. ENBIO T2 test facility. Left: overview photograph. Right: inside of chamber, showing a typical thermal adapter plate screwed in position on the thermal platen.

Temperature limits for the system are −70 °C to +150 °C. Ramp rates are programmatically controllable. Maximum attainable ramp rate depends on mass of test article. A ramp rate of 2 °C·min^{-1} is attainable for test article masses up to ≈ 5 kg.

The thermal platen has a width of 480 mm, length 550 mm, and thickness of 15 mm. The platen has a regular arrangement of through-holes spaced on a 60 mm × 60 mm grid (except for the outer two rows, which are spaced by 45 mm). Test articles are thermally connected to the thermal platen using custom-machined thermal adapter plates, typically made from Al 6082-T6 aluminium alloy (copper thermal adapter plate available upon request).

The pumping system is comprised of two backing pumps and two turbomolecular pumps. The ultimate pressure of the system is ≈ 1×10^{-6} mbar. Vacuum pressure is measured using a calibrated Pfeiffer full range gauge (combined Pirani and cold cathode inverted magnetron) and recorded at 10 Hz using a LabVIEW programme.

The temperature of the TRP position on the test article as well as other temperatures on the test article are measured using calibrated type E thermocouples. Thermocouple signals are typically acquired at between

0.5–4.0 Hz using a National Instruments data acquisition card, and recorded using a LabVIEW programme. Additional thermocouples are available upon request.

The system currently has the following electrical feedthroughs:

- 1 × SMA feedthrough on a KF16 flange
- 1 × 8-pin 25 A per pin power feedthrough on a KF16 flange
- 1 × d-sub 25 pin feedthrough on a DN63 ISO-K flange
- 1 × d-sub 50 pin feedthrough on a DN100 ISO-K flange

The chamber contains four large rectangular flange plates, which allows additional feedthroughs to be easily added to the system. An additional 12 D-sub 50 feedthroughs will be added to the system in the coming months. A summary of the main test facility characteristics is given in the table below:

Type	Characteristic	Values
Physical	Chamber Internal Dimensions ($\varnothing \times L$)	60 cm × 66 cm
	Thermal Platen Dimensions ($W \times L$)	48 cm × 55 cm
Performance	Ultimate Pressure	≈ 1×10^{-6} mbar
	Min. / Max. Temperature	−70 °C / +150 °C
	Maximum Ramp Rates	Dependent on DUT mass. 2 °C·min^{-1} for ≈ 5 kg DUT.
Interface	Available Thermocouples	10 type E. Additional thermocouples available upon request.
	Coaxial Feedthroughs	1 × SMA
	D-sub Feedthroughs	1 × d-sub 25 & 1 × d-sub 50. Expandable as required.

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