



THE INNOVATION CENTRE: TESTING LABS





Research and development of new technologies, methods and solutions are ingrained in HiRef's DNA. At HiRef, we want to reach higher and higher goals, not only in the air conditioning and refrigeration field but in many other areas of our work as well. This is why we also strive to optimize our manufacturing methods and control and monitoring strategies.

Our close collaboration with the academic world supports these important activities and ensures continued growth based on solid scientific knowledge. The numerous thesis projects that have been undertaken at our company are proof of our commitment: 33 since 2004, on average 2.5 thesis per year.

Critical processes having to do with technological development and manufacturing of machines and semi-finished products take place entirely in-house at HiRef or with the support of subsidiary spinoffs. Our company's business model is built on this foundation, while our relationships and bonds of trust act as the centre of gravity of this model to assure its soundness over time.

327 EMPLOYEES

8 GROUP COMPANIES

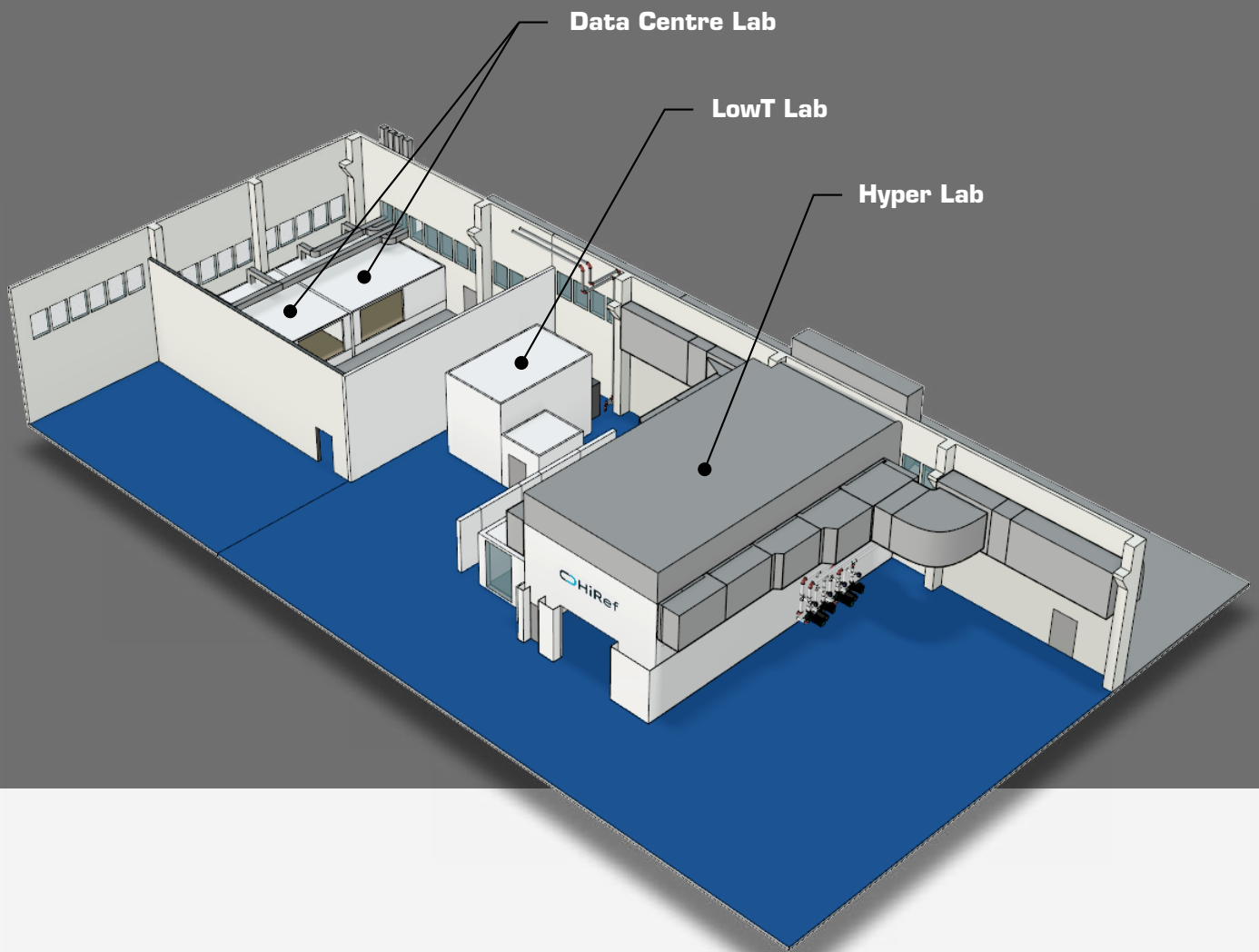
42 THESIS

62% OF GRADUATES CONTINUE THEIR CAREER IN HIREF

AVERAGE AGE **38**

HiRef

THE INNOVATION CENTRE



FATs (Factory Acceptance Tests) are part of our testing process. These let end customers or their technical consultants personally ascertain that the equipment complies with project specifications.

Temperature, pressure, flow, and vibration transducers are connected to a monitoring computer that provides readings of the product's operating parameters, for a complete performance assessment. The data gathered are used to calculate different performance indicators and assess efficiency, energy savings and any other parameter for satisfying project requirements.

Measurement of noise emissions is a very important aspect at HiRef, which provides an off-site qualified area compliant with the UNI EN ISO 3746 standard. Thanks to our collaboration with the University of Padua, we can draw on the expertise of academics for certification of acoustic tests.

HiRef also has a lab for component thermal stress testing to validate continuous operation at extremely low temperatures (as low as $-50\text{ }^{\circ}\text{C}$).

LowT Lab



The **LowT Lab** is a climatic room used to recreate extreme temperature conditions (as low as -50 °C), simulating the coldest winter climates. This makes it possible to test monobloc telecom air conditioners; components such as test units, fans, and electrical panels; and reduced-scale prototypes. To maintain critical temperature conditions, the room uses direct expansion units connected to a two-stage compressor with sub-critical CO₂ refrigeration cycle.

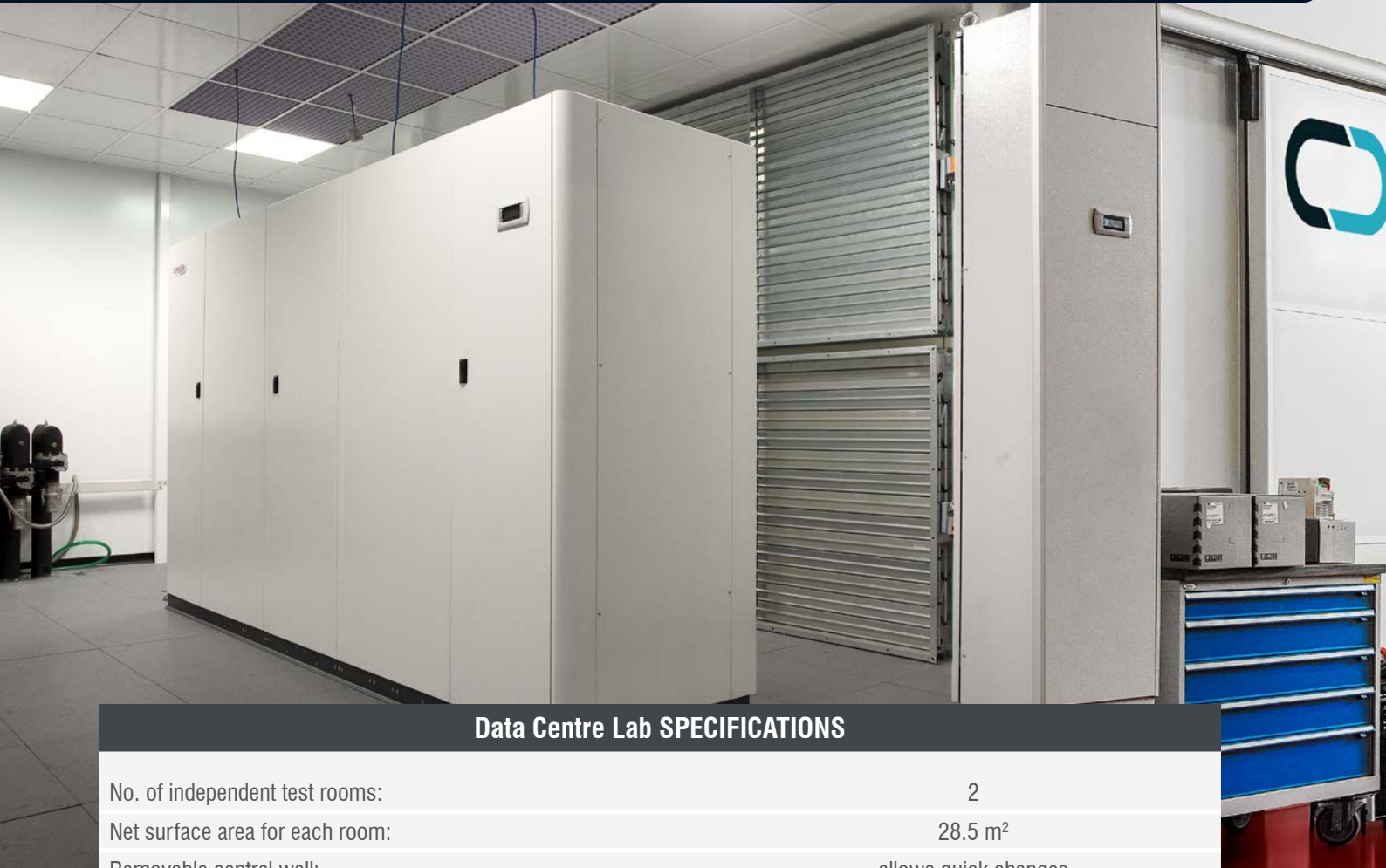
The primary purpose of the **LowT Lab** is to test components that will be installed in very cold climates for proper functioning. It is crucial, in fact, to rule out freezing of individual parts and risks for the machine when starting up or running continuously in cold temperature conditions.

The room offers the possibility to simulate extreme operating conditions. For example, in operational tests for TLC monobloc units, the room acts as an external environment from which the unit draws cold air both in the crucial start-up stage and under continuous operation.

LowT Lab SPECIFICATIONS

Test room net surface area:	6.5 m ²
Test room volume:	18 m ³
Minimum testable temperature without thermal load:	-50 °C
Maximum refrigeration capacity @ -40 °C:	9 kW
Minimum refrigeration capacity @ -20 °C:	23 kW
Available electrical power supply:	
400 / 3 / 50 Hz	250 A
230 / 3 / 50-60 Hz	63 A
230 / 1 / 50-60 Hz	125 A
380-420 / 3 / 60 Hz	250 A
48 V DC	105 A
24 V DC	40 A

Data Centre Lab



Data Centre Lab SPECIFICATIONS

No. of independent test rooms:	2
Net surface area for each room:	28.5 m ²
Removable central wall:	allows quick changes
Net volume for each room:	83 m ³
Maximum net height:	2.5 m
Maximum refrigeration power per room:	200 kW
Maximum airflow per room	40,000 m ³ /h
Maximum water flow per circuit:	40 m ³ /h
Possible airflow configurations:	Upflow, downflow, displacement
No. of independent hydraulic circuits for each room:	3 pure water + 1 with choice of mixture
Minimum testable temperature condition:	
• Temporary to simulate start-up at low temperatures	-10 °C
• DX -10 kW a -20 °C devices	-20 °C
Maximum testable temperature condition:	+60 °C
Humidification capacity per room:	45 kg/h
Available electrical power supply:	
400 / 3 / 50 Hz	250 A
230 / 3 / 50-60 Hz	63 A
230 / 1 / 50-60 Hz	125 A
380-420 / 3 / 60 Hz	250 A
48 V DC	105 A



Data Centre Lab is a climatic laboratory with raised floor and false ceiling used to replicate different server room layouts. The infrastructure enables us to test direct expansion or chilled water units and allows for reversible and multi-directional airflow inside the room to adapt to different test configurations. With the Data Centre Lab we can exactly reproduce actual operating conditions to test CRAC units with Upflow, Downflow or Displacement configuration.

The **Data Centre Lab** is made up of two rooms, separated by an insulated partition wall that can be removed, if necessary. The two rooms can operate independently, recreating two environments with different climate conditions (an internal and external environment, for example), or they can be kept at the same temperature and humidity conditions to simulate one confined space.

Thanks to the raised floor, a double set of fans and dampers, and a pair of hot and cold coils, the offset system allows recreating the specific temperature and humidity operating conditions for any Close Control unit, for TLC applications, and a large range of environmental conditions to test liquid chillers and heat pumps.

A 6-pipe water-to-water heat pump and a system for offsetting energy flows of opposite sign enable us to recreate a wide range of temperatures and humidity conditions. Lastly, the structure includes ventilated electrical heating elements that simulate the project's thermal load specification requirements.

The **Data Centre Lab** is also designed and ready for sound intensity testing of CRAC units under operating conditions and for performance tests of air-to-water and water-to-water chillers up to 400 kW chilling capacity.

Hyper Lab



Hyper Lab SPECIFICATIONS

Climatic room net surface area:	114.5 m ²
Climatic room volume:	781 m ³
Maximum testable refrigeration capacity:	1,500 kW
Maximum testable heating capacity:	2,000 kW
Maximum airflow:	450,000 m ³ /h
Maximum available water flow:	300 m ³ /h
Minimum available water flow:	30 m ³ /h
Number of independent hydraulic circuits:	5 pure water + 2 water/glycol (up to 50% glycol)
Minimum test temperature:	-15 °C
Maximum test temperature:	+55 °C
Available electrical power supply:	250 A
400 / 3 / 50 Hz	1,000 A

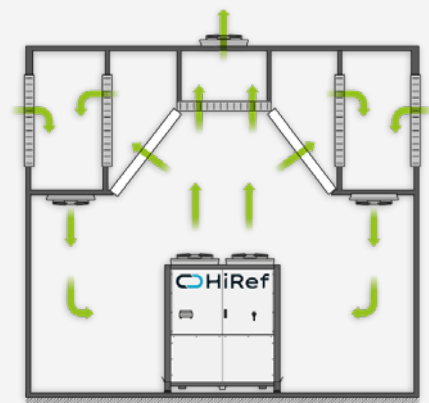


A recent addition, the **Hyper Lab** was entirely designed and built by HiRef's R&D department to test air-to-water and water-to-water chillers and heat pumps as well as large-sized (HiRef DataBatic) and high power (up to 1.5 MW nominal cooling capacity and 2.0 MW heating capacity) air-to-air units. For air-to-air units, the lab can simulate an external environment (outside air intake) with temperatures as low as $-35\text{ }^{\circ}\text{C}$.

Hyper Lab can recreate the desired operating conditions under Free-Cooling mode, in other words, drawing air directly from the outside of the building and conveying it to the climatic room through a system of ducts and motor-driven dampers.

Like our other labs, **Hyper Lab** is equipped with a sophisticated data acquisition and supervision system that offers real-time monitoring of the following parameters:

- air temperature and humidity
- water temperatures
- pressure drops at water or air side
- operating pressures and temperatures of refrigeration circuit
- flow rates of processed fluids
- electrical measurements and every derived power and efficiency measurement



OFF-SITE NOISE EMISSION TESTING



Thanks to our collaboration with the University of Padua, we can draw on the expertise of academics for the certification of acoustic tests performed in an off-site qualified area compliant with the UNI EN ISO 3746 standard. Class 1 instruments are used, providing an accuracy of 1.5 dBA under favourable environmental conditions.



HiRef ensures a minimum accuracy range for all measurements in accordance with the UNI EN 14511-3 standard. The instruments are subject to rigorous checks at regular intervals to ensure they are properly calibrated at all times. In addition, the entire measurement chain is fine-tuned during calibration of each instrument.

	Direct measurements	Accuracy
Water	Temperature	± 0.15 K
	Volumetric flow	± 1 %
	Differential static pressure	± 5 %
Air	Dry bulb temperature	± 0.2 K
	Relative humidity	± 2 %
	Differential static pressure	± 5 %
Refrigeration circuit	Pressure	± 1 %
	Pipe surface temperature	± 0.5 K
Electrical quantities	Voltage	± 0.5 %
	Current	± 0.5 %
	Cos φ	± 0.5 %



LowT Lab



Hyper Lab



Data Centre Lab



Acoustic Tests



We develop relationships

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