



DANISH
TECHNOLOGICAL
INSTITUTE

it's all about innovation

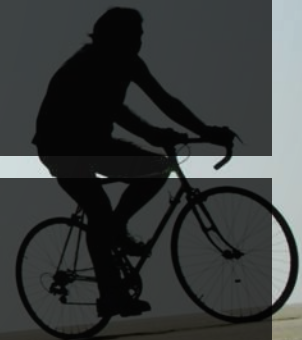




DANISH
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Danish Technological Institute

Refrigeration and Heat Pump Laboratory



Founded 1906 by Gunnar Gregersen

- "To support Danish industry, mainly small enterprises, by providing technical assistance in the form of teaching, advice, testing and technological research"
- Self-owned company
- Not-for-profit



HM the Queen of Denmark – patron of DTI



Copenhagen



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Aarhus



**DANISH
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Organization

Board of Representatives

Board of Trustees



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Danish Technological Institute

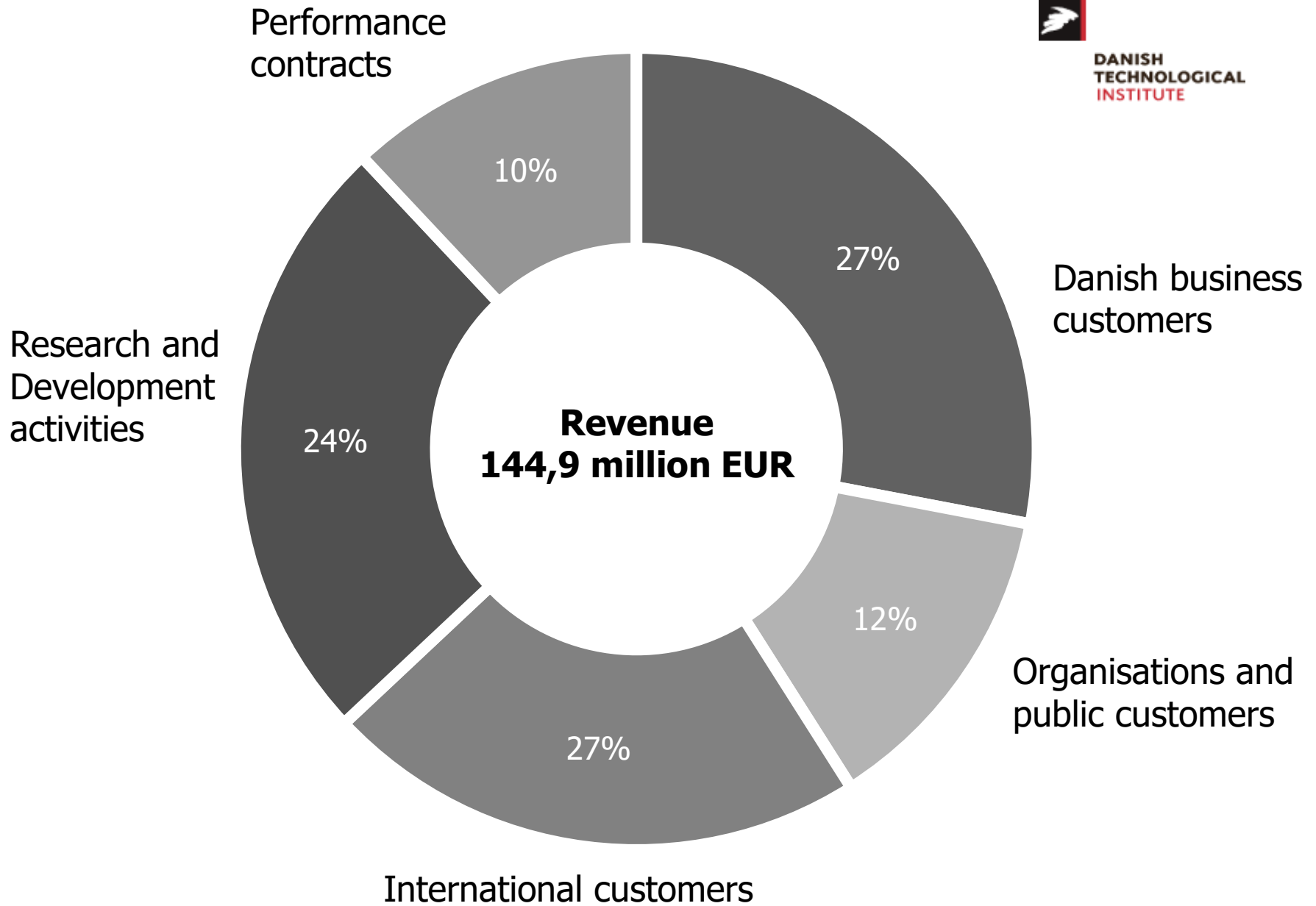
Building and Construction	DMRI	Energy and Climate	Business and Society	Life Science	Materials	Production	Finance and Accounts						
Vice President Mette Glavind	Vice President Lars Hinrichsen	Vice President David Tveit	Vice President Jane Wickmann	Vice President Bo Frølund	Vice President Mikkel Agerbæk	Vice President Anne-Lise H. Lejre	CFO Jørgen K. Pedersen						
Concrete Sustainable Building Indoor Climate and Building Inspection Masonry Swimming Pool Textile Wood Technology	Hygiene and Processing Measurement Systems and IT Dirac Meat Quality Slaughter Technologies	Automobile Technology Energy Efficiency and Ventilation Installation and Calibration Refrigeration and Heat Pump Technology Pipe Centre Secretariat Services and Quality Assurance Biomass and Biorefinery Transport & Electric Systems Energy and Climate Management	Policy and Business Analysis Human Resources Development Ideas and Innovation Training Centre	DTI Oil & Gas Food Technology Chemistry and Biotechnology Laboratory for Chemistry and Microbiology Acting	Packaging and Logistics Materials Testing Plastics Technology Acting Product Development Tribology	Metrology and Quality Assurance DTI Nano and Microtechnology Robot Technology Acting							
							Subsidiaries						
							<table border="0"> <tr> <td>DTI Robotics US, Inc.</td> <td>FIRMA 2000 Sp. z o. o.</td> <td>Danfysik A/S</td> </tr> <tr> <td>Technological Institute AB Sweden</td> <td>Dancert A/S</td> <td>Teknologisk Innovation A/S</td> </tr> </table>	DTI Robotics US, Inc.	FIRMA 2000 Sp. z o. o.	Danfysik A/S	Technological Institute AB Sweden	Dancert A/S	Teknologisk Innovation A/S
DTI Robotics US, Inc.	FIRMA 2000 Sp. z o. o.	Danfysik A/S											
Technological Institute AB Sweden	Dancert A/S	Teknologisk Innovation A/S											

1100 Employees

Energy & Climate



190 Employees

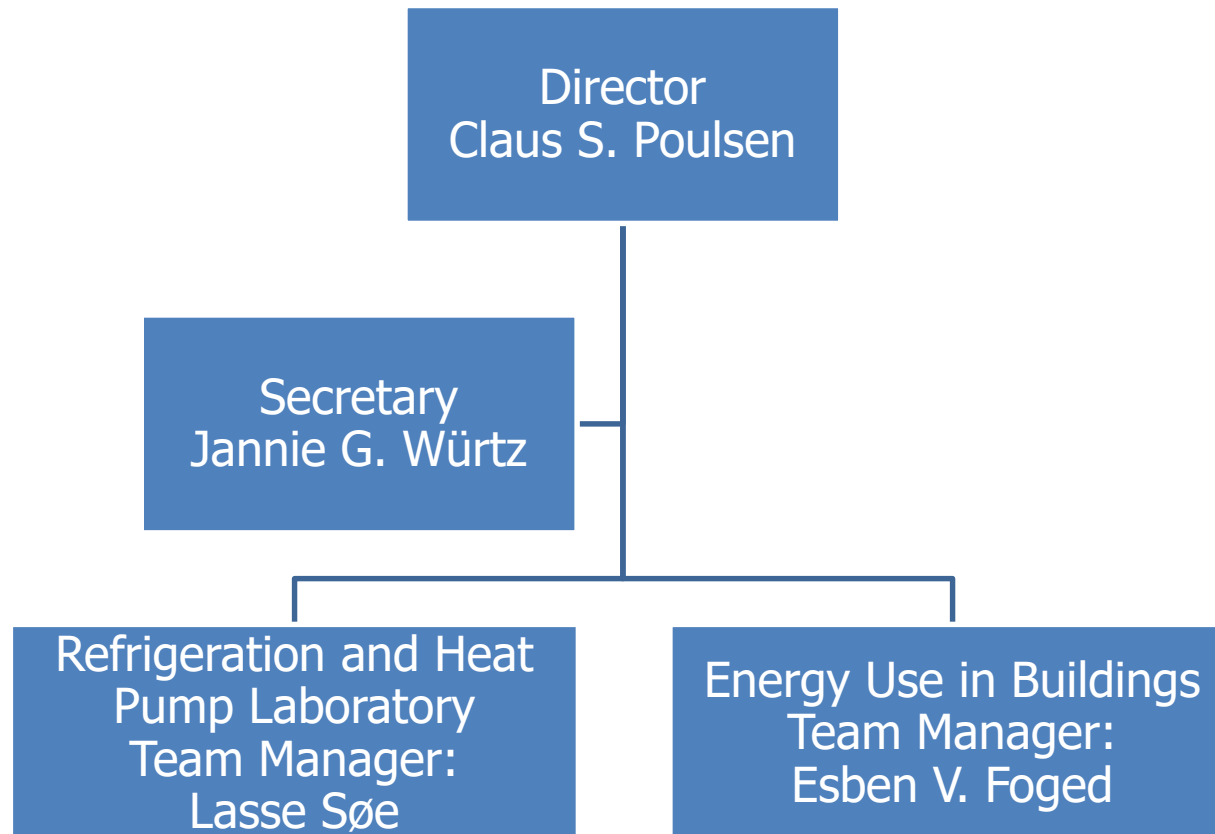


Refrigeration and Heat Pump Technology



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Organisation (30 employees):



Refrigeration and Heat Pump Technology



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- Services:
 - Testing in state-of-the-art test facilities
 - Expert consultation
 - R&D project cooperation, funded and commercial projects

- Business area – among others:
 - Refrigeration and heat pump technology
 - Solar energy
 - Drying and separation technology
 - CFD and FEM analysis
 - Modelling and simulation
 - SmartGrid
 - Intelligent building management
 - Natural refrigerants
 - Standardization



Refrigeration and Heat Pump Technology

– World class laboratory facilities



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One of the most advanced laboratories on refrigeration and heat pump technology in the world with specially designed test facilities.

The section comprises five laboratories:

- Refrigeration lab. (component test i.e. compressors, valves etc., refrigeration system test, R&D project cooperations, NH₃ & CO₂)
- Water vapour lab. (development water vapour compressor and refrigeration system)
- Energy efficiency lab. (plug-in commercial and domestic freezers, refrigerators, electronics)
- Heat pump lab. (A2A, A2W & W2W)
- Condensing unit lab.



Refrigeration and Heat Pump Technology

– Refrigeration Laboratory



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- Quality management system in accordance with EN ISO 17025 and 17020
 - <http://enerkvalitet.teknologisk.dk/23173>
 - Equipment database to track all measurement equipment
- EN ISO 9001 certified
 - Required by Danish law when employing refrigeration technicians and performing work on refrigeration systems

Refrigeration and Heat Pump Technology

– Refrigeration Laboratory



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We carry out various commercial assignments for national and international clients, e.g.:

- Testing of pressure loss in vertical riser (NH_3)
- Design validation of riser inlet (NH_3)
- Testing of oil separators (CO_2)
- Development of sensors and valves
- Testing of control valves (CO_2 , NH_3 etc.)
- Testing of units and control systems (CO_2 , NH_3)
- Freezing of food stuff (CO_2 , NH_3)
- Testing of compressors (CO_2 , NH_3)
- Component and system test (HFO & hydrocarbon)



Refrigeration and Heat Pump Technology

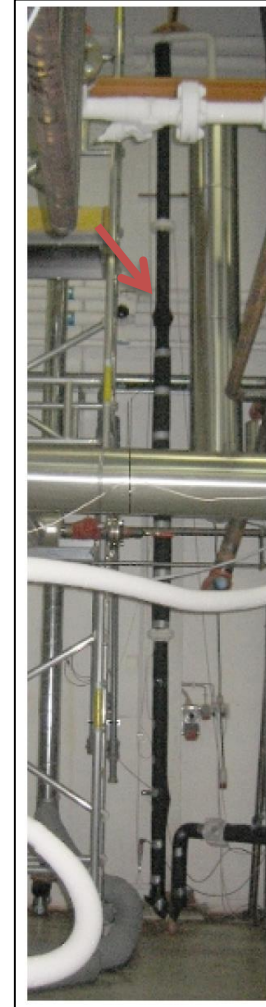
– Refrigeration Laboratory, case



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Study on pressure drop in R717 vertical risers

- One project focused on the vertical riser itself
- One project focused on the riser inlet configuration
- Saturation temperatures from -40°C to $+10^{\circ}\text{C}$
- Circulation rates from 2 - 10



Refrigeration and Heat Pump Technology

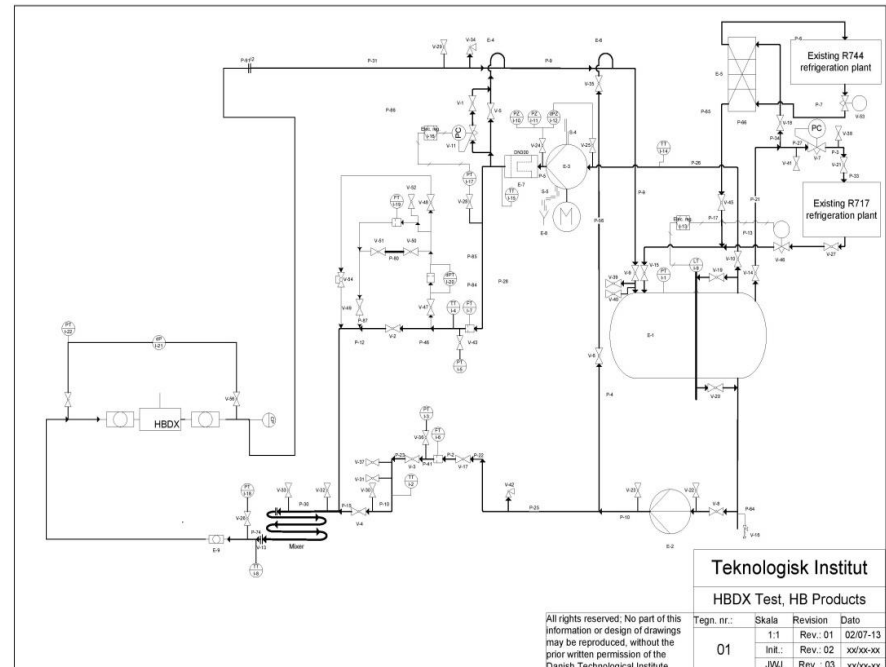
– Refrigeration Laboratory, case



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HB Products - test of sensor for measurement of vapour quality in two phase NH_3

1. Commercial test assignment (short time schedule to evaluate technology for investors' decision)
2. R&D project (further development of sensor & test at different applications)



Teknologisk Institut

HBDX Test, HB Products

Tegn. nr.:	Skala	Revision	Dato
01	1:1	Rev.: 01	02/07-13
	InL:	Rev.: 02	xxxx-xx
	JWJ	Rev.: 03	xxxx-xx

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Refrigeration and Heat Pump Technology

– Refrigeration Laboratory, case



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Test of R744 condensers/gas coolers

- 6 units tested in 2014 as gas coolers and condensers
- More than 25 capacity measurements per unit
- Results used to calibrate the manufacturers calculation models
- Capacity measured directly in the refrigeration cycle
- Capacity validated on air side, all with an energy balance within 2-3%
- Capacity range from 3 to 35 kW

Refrigeration and Heat Pump Technology

– Water Vapour Laboratory

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- **Axial compressor development process – state-of-the-art R&D project**
- 1998 – 2001 Feasibility study, scaled tests
 - York, DTI (DEA)
- 2003 – 2011 Full scale development of two sizes of prototypes
 - Tokyo, Chubu and Kansai Electrical Power Companies, Kobe Steel, DTI, JCD (DEA)
- 2012 – 2016 Commercial chiller development
 - JCD, LEGO, Rambøll, DTI (DEA)
- 2014 – 2016 Evaporator with ice generation
 - DTI, JCD, Augustenborg District Heating, Arla (DEA)

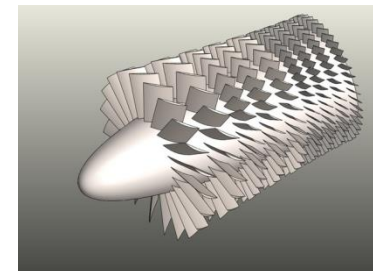
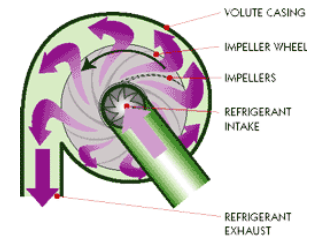
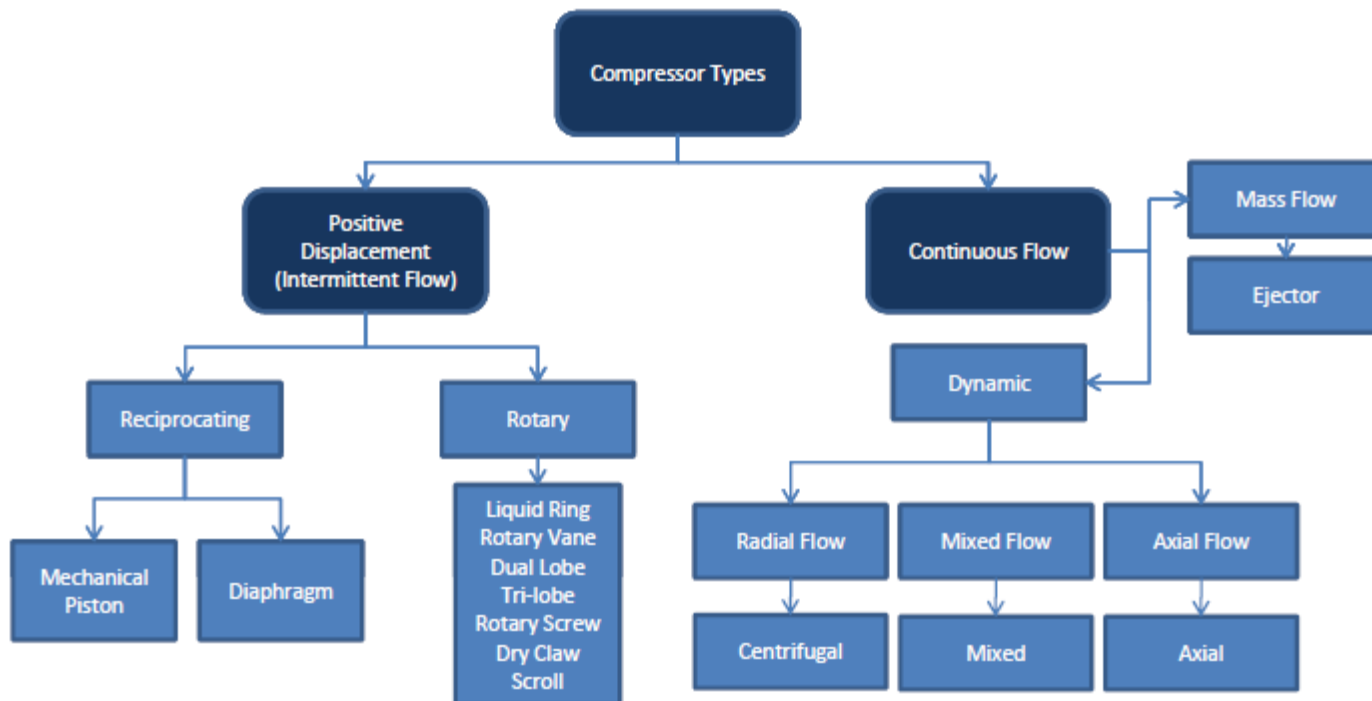
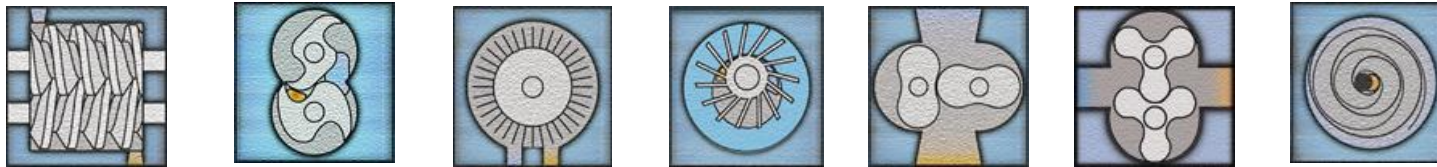
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– Water Vapour Laboratory



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- Feasibility study – identifying optimal compressor type



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– Water Vapour Laboratory



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- Two types of prototype turbo compressors developed

Axial



Centrifugal



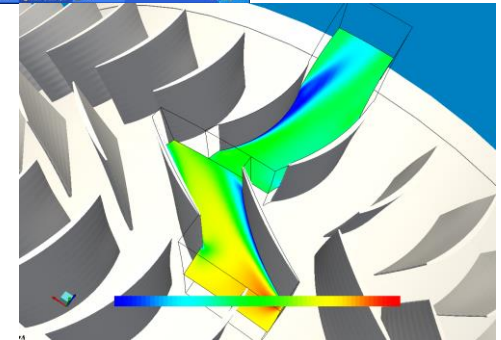
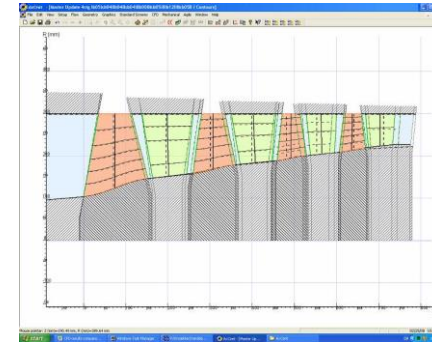
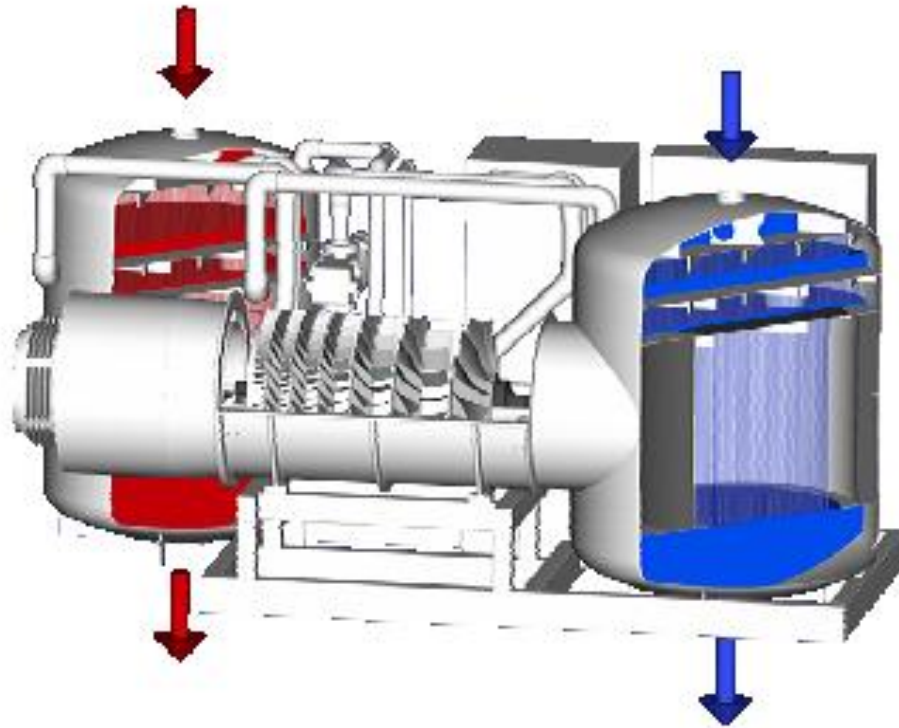
Refrigeration and Heat Pump Technology

– Water Vapour Laboratory



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- Axial compressor development process



Refrigeration and Heat Pump Technology – Energy Efficiency Laboratory



Accredited testing of

- Commercial refrigerated cabinets
- Electronic household and office equipment
- Household refrigerating appliances
- Vaccine storage units and transportation boxes



Your Contact

Hans Walloe

Senior Specialist

Refrigeration and Heat Pump Technology

+45 72 20 24 72

Refrigeration and Heat Pump Technology – Energy Efficiency Laboratory



Accredited testing according to EN/ISO 23953 and PrEN 16825 of commercial refrigerated cabinets

- Display Cabinets
- Beverage Coolers
- Storage Cabinets
- Vending Machines
- Ice-cream Freezers



Refrigeration and Heat Pump Technology – Energy Efficiency Laboratory



Accredited ecodesign compliance testing of electronic household and office equipment

Services within the field of:

- Ovens
- Coffee machines
- Computers
- External power supplies
- Printers
- Scanners
- Televisions
- Etc.



Refrigeration and Heat Pump Technology – Energy Efficiency Laboratory



Household refrigerating appliances and vaccine storage units

- EN/ISO 62552
- Ecodesign regulation 643/2009
- Energy labelling 1060/2010



Vaccine storage units and transportation boxes

- Accredited by WHO



Refrigeration and Heat Pump Technology

– Heat Pump Laboratory



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Our state-of-the-art Heat Pump Laboratory is specially designed to test the efficiency, performance and sound power level of a heat pump at the same time and at different climate conditions.



Covering all relevant international standards..



Refrigeration and Heat Pump Laboratory

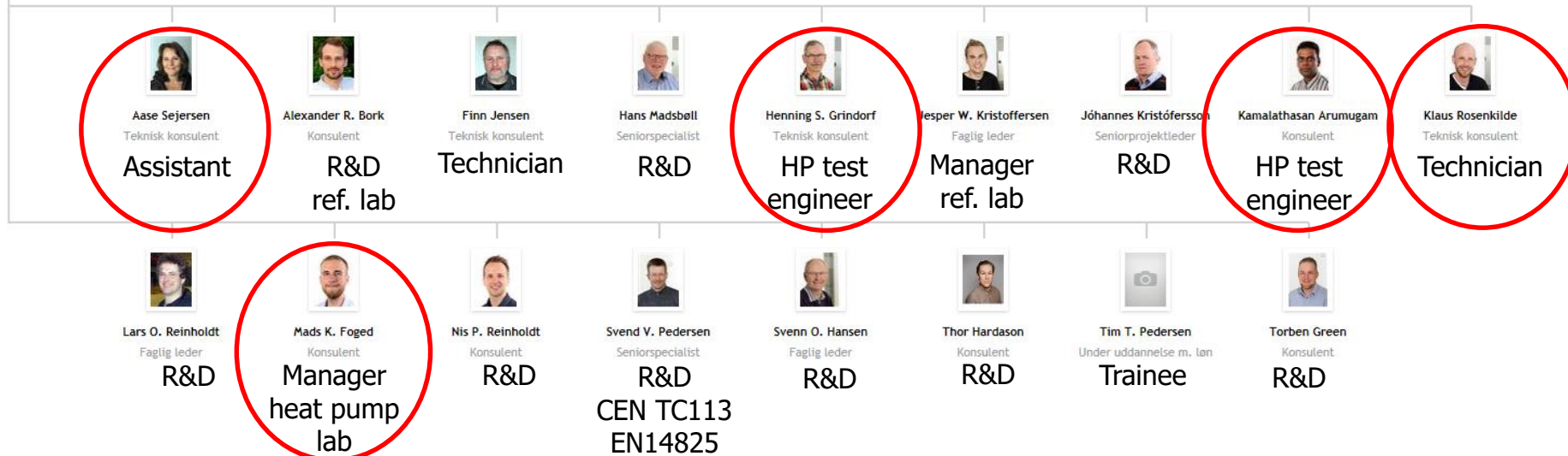


Organisation (17 employees + 1 engineer trainee):



Lasse Sae
Teamleder /
sektionsleder

Details Top Search



Refrigeration and Heat Pump Technology

– Heat Pump Laboratory



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- Testing heat pumps for more than 30 years
- Test laboratory complies with EN ISO/IEC 17025
- List of methods – accredited heat pump testing
http://english.danak.dk/English/database_eng/
 - EN14511
 - EN14825
 - EN16147
 - EN12102 (EN/ISO 3743-1)
 - EN13215 & EN13771-2 (CDU)
- Certification schemes
 - EHPA approved test institute
 - CEN Keymark test and inspection (application in process)
- Market surveillance tests
 - National Measurement Office UK
 - Danish Energy Agency
 - Norwegian Energy Agency
 - Prosafe (EU market surveillance)



Registered Test Centres

Tests according to requirements can be performed by one of the test centres mentioned below. All test centres must be accredited according to EN 17025 for heat pumps and must be able to test according to one or all of the following standards:

- EN 14511 parts 1 - 4, and/or
- EN 15879 part 1, and/or
- EN 16147, and/or
- EN 12102.

All test centres must follow the EHPA regulation for heat pump tests in their most recent version (01.5/2014).

Austria

Austrian Institute of Technology
website: www.ait.ac.at
contact: Christian Köfeler



Czech Republic

SZU Brno
website: www.szustat.cz
contact: Milan Holomek



Denmark

Danish Technological Institute
website: www.dti.dk
contact: ies@teknologisk.dk



France

CETIAT
website: www.cetiat.fr
contact: Michèle Mondot



Quality label



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– Heat Pump Laboratory



- Test capability (accredited)
 - Facility 1: A2W & A2A up to 15 kW - reference climate: colder, average and warmer - low temperature -45C (A2A calorimeter room method)
 - Facility 2: A2W up to 30 kW & CDU up to 65kW (sound power) - reference climate colder, average and warmer – low temperature -25C (restrictions: circulators and size of flow meter)
 - Facility 3: A2W up to 20 kW (sound power) - reference climate colder, average and warmer – low temperature -25C (restrictions: circulators and size of flow meter)
 - Facility 4: A2W up to 20 kW – low temperature -25C (including gas hybrid)
 - Facility 5: W2W up to 15 kW - all types of brine
 - Facility 6 W2W up to 30 kW - all types of brine (restrictions: circulators and size of flow meter)
- Note: DTI lab includes a 2 MW W2W NH₃ chiller which can be applied for testing of heat pumps & chillers



Refrigeration and Heat Pump Technology

– Heat Pump Laboratory

- Number of possible tests per year (SCOP)
 - Facility 1: A2W & A2A up to 15 kW – 15 to 20 units
 - Facility 2: A2W up to 40 kW (sound power) – 15 to 20 units
 - Facility 3: W2W up to 15 kW – 20 to 25 units
 - Facility 4: W2W up to 40 kW – 20 to 25 units
 - Facility 5: A2W up to 30 kW – 15 to 20 units
 - Facility 6: A2W up to 20 kW – 15 to 20 units
- Number of heat pumps tests during 2015
(SCOP & SEER, EHPA, HARP, NL, MCS)
 - A2A – 21 (single split)
 - A2A – 7 (mono bloc)
 - A2W – 37 (including 19 sound power measurements & DHW test)
 - W2W – 3
 - Total - 68



Refrigeration and Heat Pump Technology



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Accredited by DANAK



http://published.danak.dk/register.asp?nohead=y&lang=e

DANAK

300 Accreditation for testing

Company

Teknologisk Institut	Contact : TI Energi's sekretariat
Energi og Klima	Phone : 72 20 10 00
Kongsvang Allé 29	Fax :
Teknologiparken	Email : info@teknologisk.dk
DK-8000 Aarhus C	Homepage : www.teknologisk.dk
Danmark	
Granted 09 Jul 1993	Expires 30 Jun 2017
	Status Accredited

Scope of Accreditation

Testing

Product

- Construction products
- Engineering materials and products
- Machinery and industrial plants
- Toys, sport & leisure equipment

Test Type

- Acoustics
- Electrical and electronical testing
- Mechanical testing
- Physical testing
- Sampling

Flexible accreditation regarding systems and components (test objects) and equivalent methods for VA area

Extended Information

Standard of Accreditation : DS/EN ISO/IEC 17025:2005

List of methods : [Click here](#)

Notification : The company further complies with the relevant requirements in REGULATION (EU) No 305/211 for construction products.

Comprised Addresses/Departments

Teknologisk Institut	Contact : TI Energi's sekretariat
Termisk laboratorium	Phone : 72 20 10 00
Gregersensvej 1	Fax :
DK-2630 Taastrup	Email : info@teknologisk.dk
Danmark	Homepage : www.teknologisk.dk
Teknologisk Institut	Contact : TI Energi's sekretariat
Energilaboratoriet	Phone : 72 20 10 00
Kongsvang Allé 29	Fax :
Teknologiparken	Email : info@teknologisk.dk
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Gregersensvej 1	Fax :
DK-2630 Taastrup	Email : info@teknologisk.dk
Danmark	Homepage : www.teknologisk.dk

From DANAK's registry of accredited and approved companies

Why DTI as test and R&D partner?



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- High quality testing & engineering
 - State-of-the-art testing facilities
 - High accuracy measurements
 - Experienced and dedicated test and refrigeration engineers
- Acknowledge test institute
 - Market surveillance tests
 - National Measurement Office UK
 - Danish & Norwegian Energy Agency
 - Prosafe (Energy Agency from: BE, UK, SE, NL, BG & DK)
 - Represent the Norwegian Energy Agency and the Danish Energy Agency as technical experts in terms of Energy labelling and Ecodesign
 - Several nominated and award winning R&D projects (link: <https://youtu.be/nxnRqMDiw8c>)
- Large range of accredited test
 - Accredited testing of HVAC 10,000 m³/h, electrical motors, fans, circulators/pumps and hoods
 - Accredited testing of heat pumps including sound power measurements
 - Accredited testing of condensing units
 - Acc. test of commercial & domestic refrigerated cabinets & appliance, electronics and vaccine storage
 - WHO approved test institute
 - EHPA approved test institute (Q-label)
 - CEN Keymark (application in process)
- High flexibility in terms of
 - Customer requirements
 - Ongoing feed back
 - Speed-is-key (authorized personal only - not production site risk assessment)
- Competitive prices



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