

Cryogenic Expertise and Facilities within STFC

Overview

The nature of the science supported by the Science and Technology Facilities Council (STFC www.stfc.ac.uk) requires many facilities and instruments operating at cryogenic temperatures. As a result, STFC is home to the biggest resource of low temperature technologists in the UK. Together they provide a resource capable of delivering a comprehensive range of design and analysis skills, the manufacture, assembly and integration of complete cryogenic systems and a range of cryogenic test facilities not readily available in the commercial market. This brochure summarises what is available across the three main sites/departments and although the primary point of contact should be CryoX, provides contact details for each department.

The Rutherford Appleton Laboratory in Oxfordshire has substantial stand-alone cryogenics and materials groups working on the design and construction of major ground and space based equipment in addition to operational expertise in support of the large Diamond synchrotron and the ISIS neutron spallation source facilities. There is particular materials expertise in resins associated with superconducting magnets, reflecting the concentration of this industry in the surrounding region. High-calibre computer modelling expertise is another major domain at RAL allied to a long successful record in cryocooler technology for space applications. RAL also provide design and production of multi-layer insulation to the high standards required on equipment destined for travel in space.

At the Daresbury Laboratory in Cheshire, engineers have specialised primarily in large-scale Helium cooled cryo-systems down to 2K and associated with work undertaken by ASTeC (the Accelerator Science & Technology Centre). The lab has the ability to test complex systems such as superconducting RF cavities, and is supported by a modern, well-equipped ultra-high vacuum laboratory, and the SuperClean spinout which will undertake residual gas analysis, and (unusually) cleaning to certifiable standards.

The UK Astronomy Technology Centre in Edinburgh has particular expertise in precision mechanisms, optical systems and low noise cabling suitable for operation in cryogenic conditions. Their cryostats are usually based on mechanical cryo-cooler systems and operate down to 100mK.

Together the three sites provide a significant fleet of test cryostats with operating temperatures down to below 1K or for test pieces up to a few m³/ 100Kg. There are also facilities for materials testing at RAL and Edinburgh. All come supported by skilled technicians and appropriate control and data logging capabilities.

Given the current emphasis on economic impact from the UK Science base, STFC is keen to make this cryogenic expertise available to external organisations whether by undertaking design and build contracts for bespoke equipment, acting as consultants, renting out test facilities or working collaboratively on research and development projects.

Departments and Contact points

For most Industrial customers, or if you are unsure who to contact, your first point of call should be CryoX. Within STFC there are several departments with active cryogenics related engineering as listed below. The Departments regularly work together to meet overall requirements e.g. Cryogenics Group in Technology will deliver space qualified coolers to the Space Science and Technology Department.

CryoX

CryoX is the company formed to market the skills and commercialise the cryogenic & superconducting technologies available within the Science and Technology Facilities Council. <http://www.cryox.co.uk/>

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Technology Department

The Technology Department is divided into divisions and groups located across three STFC sites (Rutherford Appleton Labs, Daresbury Labs and the Royal Observatory in Edinburgh). More extensive information on the activities of each division and group can be found at <http://www.technology.stfc.ac.uk/technology/index.html>. The main 'cryogenics' groups are listed here:-

Applied Science Division (ASD):-

Cryogenics Group (RAL)

Tom Bradshaw
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Advanced Materials Group (RAL)

Simon Canfer
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Engineering Technology Centre (ETC):-

Phil Atkinson
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+44 (1925) 603371

UK Astronomy Technology Centre (UK ATC):-

<http://www.roe.ac.uk/ukatc/> &
<http://www.atcinnovations.com/>

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Space Science and Technology Department

The Space Science and Technology Department (SSTD) is located at the RAL site. General information about the Department can be found at <http://www.sstd.rl.ac.uk/>. The points of contact for cryogenic design and test are:

Thermal Engineering Group (RAL)

<http://www.sstd.rl.ac.uk/Thermal/>

Bryan Shaughnessy

Bryan.Shaughnessy@stfc.ac.uk

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Assembly Integration and Verification Group (RAL) Giles Case

<http://www.sstd.rl.ac.uk/envtest/Index.htm>

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Accelerator Science and Technology

The Accelerator Science and Technology Centre (ASTeC) is based in the Cockcroft Institute at the Daresbury Campus in Cheshire. (see <http://www.astec.ac.uk/>)

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ISIS

The ISIS pulsed neutron and muon source at the Rutherford Appleton Laboratory in Oxfordshire is a world-leading centre for research in the physical and life sciences. Although more of an operational facility, there are Cryogenic engineering activities that may be of external interest. (see <http://www.isis.stfc.ac.uk/index.html>)

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Central Laser Facility

The Central Laser Facility (CLF) based at RAL is one of the world's leading laser facilities providing scientists from the UK and Europe with an unparalleled range of state-of-the-art laser technology. Their experience of cryogenics mostly relates to operational issues.

Diamond Light Source

Although not strictly part of STFC, the Diamond Light Source located next to the Rutherford Appleton Labs have significant experience of operating major cryogenic cooling installations associated with their beam lines. (see <http://www.diamond.ac.uk>)

Availability of design and analysis, manufacture, assembly and integration capabilities									
Department, Division or Group	ASD - Cryogenics	ASD – Adv. Materials	UK ATC	ETC	SSTD	ISIS	ASTeC	Central Laser Facility	Diamond Light Source
Vacuum Systems	Y		Y	Y		Y	Y		Y
Complete Cryostat Systems to < 1K			Y	Y		Y			Y
Thermal Modelling – static and dynamic	Y	Y	Y	Y	Y				
Spacecraft Thermal Design/Analysis					Y				
Cooling Systems – fluid and mechanical	Y		Y	Y		Y	Y		
Special Cryo-Coolers & Compressors	Y								
Multi Layer insulation	Y		Y		Y	Y			
Fluid Heat Exchangers	Y			Y		Y	Y		Y
Cryogenic support Structures	Y	Y	Y	Y		Y	Y		
Cold Optics			Y		Y				
Cryogenic mechanisms	Y		Y	Y	Y	Y			
Thermometry, instrumentation	Y	Y	Y	Y	Y	Y	Y		
Cryostat Control systems	Y		Y	Y		Y	Y		
Superconducting Magnets	Y	Y		Y		Y			Y
Superconducting RF Cavities				Y			Y		Y
Cryogenic cabling – low noise etc			Y	Y	Y	Y			
Materials Selection	Y	Y	Y	Y					
Cryogenic Detector Systems	Y		Y	Y	Y				
Large Facility operation				Y		Y	Y		Y
Availability of Test and Measurement Facilities									
Vacuum Bake-out, Thermal Vacuum	Y	Y			Y		Y		
Cryostats for system and sub-system test	Y		Y		Y	Y	Y		
Cryogenic Mechanism – component tests	Y		Y			Y			
Cryogenic Detectors Testing			Y						
Cryogenic materials testing – Conductivity	Y		Y		Y	Y			
Cryogenic materials testing – Strength		Y				Y			
Cryogenic materials testing – CTE		Y							
Cooler Testing	Y					Y			
Vacuum material Compatability		Y							

Summary of test cryostat parameters								
Location	Name	Temp Range (K)		Cooling	Vacuum	Volume (mm ³)		Notes
		Min	Max			Area	Height	
RAL-SSTD	STC	100	423		1E-6 to 5E-8 mBar	Ø 3000	5500	The Space Test Chamber (STC) provides a complete service offering, Vacuum, Vacuum Bakeout, Thermal Vacuum and Thermal Calibration testing, including the capability, using independently thermally controlled plates, of creating different thermal environments within the same chamber. This chamber is located within a large temperature controlled clean room complex at ISO Class 6 (1,000).
RAL-SSTD	Chamber 1	100	423		1E-6 mBar	Ø 600	700	For Vacuum, Vacuum Bakeout and Thermal Vacuum testing, including the capability, using independently thermally controlled plates, of creating different thermal environments within the same chamber. The chamber is primarily used for the development and qualification testing of spacecraft instruments and sub-systems. This chamber is located within a temperature controlled clean room complex at ISO Class 6 (1,000) with localised areas at ISO Class 5 (100) levels of cleanliness.
RAL-SSTD	Chamber 2	100	423		1E-7 mBar	Ø 1000	1700	
RAL-SSTD	Chamber 3	100	423		1E-6 mBar	Ø 1000	3500	As above plus this chamber can also be used for X-Ray calibration of space instruments.
RAL -ASD	ESH-10T	4	300	Liquid		Ø 225	100	Reverse-cage loading frame with 100kN servo-hydraulic ESH/Zwick universal testing machine. Compression and bending modes available with extensometry for strain. A dry glove box facility enables quick changing of samples
RAL- ASD	ESH-5T	4	300	Liquid		Ø 150	250	Used with 100kN servo-hydraulic ESH/Zwick universal testing machine up to 50kN. Tension mode with extensometry
UK ATC	SB 1	25	300	Mech	1E-6 mBar	Ø 1000	600	Large System and sub-system testing, can be adapted to larger test pieces
UK ATC	SB 2	25	300	Mech	1E-6 mBar	400*200	175	For small component and sub-system tests

UK ATC	SB 3	4	300	Mech	1E-6 mBar	Ø 50	50	Materials - Conductivity testing
UK ATC	CB 1	25	300	Mech	1E-6 mBar	Ø 750	400	System and Sub-System Testing: Can be within Class 1000 Clean room area. Fitted to a Handling rig allowing orientation changes – e.g. Flexure
UK ATC	CB 2	4	400	Liquid	1E-6 mBar	Ø 500	800	In commissioning, can heat test pieces above room temp
Daresbury	VTF	2	300	Liquid		Ø 400	3000	Large Vertical Cryostat for qualification of high gradient accelerating structures.

See also:-

UK ATC: <http://www.roe.ac.uk/ukac/information/facilities.pdf>

RAL: http://www.sstd.rl.ac.uk/envtest/Thermal_Vacuum_chamber.htm,

Note that RAL SSTD can also provide access to vibration test facilities (LDS V8-440) as follows:-

Vibration table. Sine, Random and Shock,

Max Force = 66 kN, Max Acceleration = 140g, Max Velocity = 1.78 m/s, Max Displacement = 63mm Point to Point,

Head Expander 1 -1200mm X 1200mm

Head Expander 2 –600mm dia, Slip Table 1 -1220mm x 1220mm

Slip Table 2 –750mm x 750mm,

64 Channels as standard expandable to 128, Force Limiting 6 Triaxes