GRE Group, incorporating:

GRE

LEADERS IN THERMAL ENGINEERING

ASHBROOK

PRECISION ENGINEERING

GAS AND LIQUID

CONTROLS

Who are we?

GRE is based in Devon, between Exeter and Taunton. We have been designing and building cryogenic cooling and transfer systems since 2013 and currently have equipment at RAL Space, Central Laser Facility, CCFE, Diamond Light Source, European XFEL, European Spallation Source, CERN, along with many private organisations, such as Tokamak Energy, Rolls Royce, Astrazeneca and many more.

- 50 Employees *(GRE, Gas and Liquid Controls and Ashbrook Engineering)*

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What do we do?

Our in-house ‘one-stop shop’ can deliver a complete system including:

- Concept design and Specification
- Detailed Mechanical and Electrical Design
- Manufacture (from a single prototype to volume production)
- Custom software and controls
- Testing (factory and on site)
- Installation and commissioning
- Technical support
- Long-term aftercare

Why SIVL?

GRE have been designing and manufacturing cryogenic (helium) cooling systems since 2013 and, originally, bought-in our super-insulated vacuum (cryogenic transfer) lines, for systems such as the one pictured here for the 10J laser amplifier at European XFEL.

Being stereotypical Yorkshiremen/Devonians, we decided that rather than buying in a product the we had little or no control over, we would produce our own!

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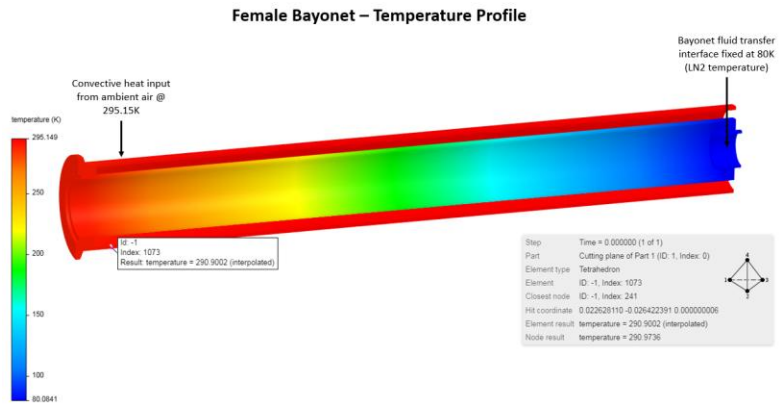
Design

SIVL Design?

Rather than simply copy what is already on the market, we've always tried to innovate our products based on client needs.

Pictured here over the next slides are just some of the components that were designed specifically for a low-pressure LN2 application at Diamond Light Source, but that have now been rolled out into our wider product range.



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SIVL Application?

In addition to the main x-ray nanoprobe beamline, i14 is home to 7 Thermo-Scientific Krios cryo-transmission electron microscopes.

Previously serviced by Dewars, the microscope labs had an LN2 infrastructure fitted circa 19/20, which performed well for a short period of time, then degraded in performance to the point of being unusable.

GRE were contracted to design an LN2 infrastructure that would bring the microscope LN2 serving back to a fully automated level, with stable pressure and minimal flash/boil-off gas levels at the microscope take-off points.

diamond

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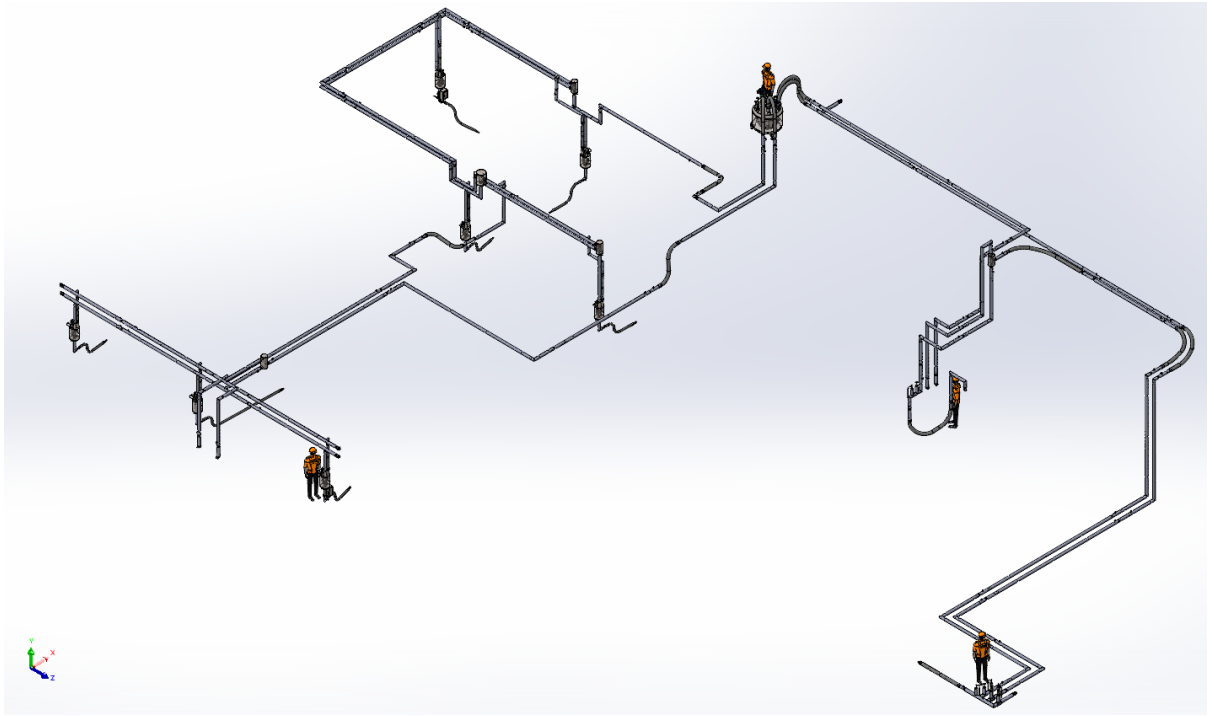
Creative design

In order to manufacture such a system, we started with a 3D ‘LIDAR’ scan of the inside and outside of the building, which was turned into a CAD model. The pipework system was then woven into the model and split into sections/components for manufacture off-site (the system comprised approximately 70 separate SIVL sections, 4 gas vents, 7 microscope modules, a large capacity phase separator and 4 heated exhaust vents).



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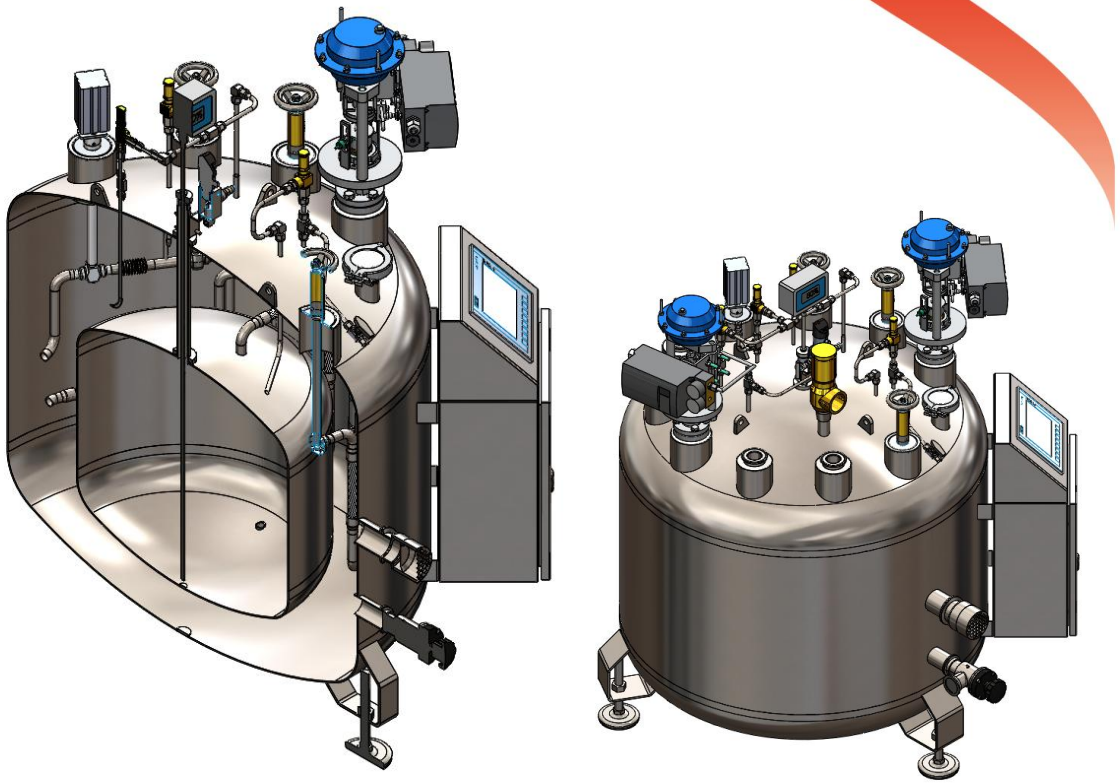
Innovative design

Variable pressure phase separator

Designed to both maintain liquid levels in the SIVL system, due to the extremely pressure-sensitive application, this high-volume phase separator uses microprocessor control to vary the line pressure by automatically heating and/or venting the LN2 reservoir.

Further to a request from the customer, we also integrated BACNET communications into the system control, so that their upper controller could monitor the system.



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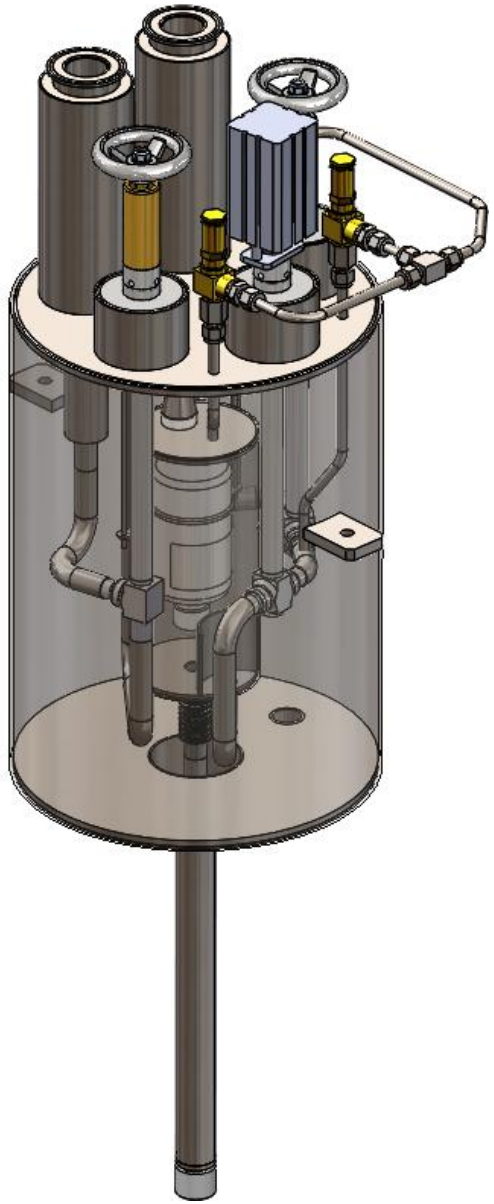
Innovative design

‘Liquid at valve’ terminal assembly

Again, due to the delicate nature of the equipment serviced by the LN2 supply, we had to ensure that high quality liquid could be provided as close to the client equipment as possible.

Rather than a cumbersome valve train, our designers came up with a single assembly that combined a small gas vent, manual isolation valves, pressure relief and an automatic slam-shut valve for connection to Diamond’s oxygen depletion safety system.



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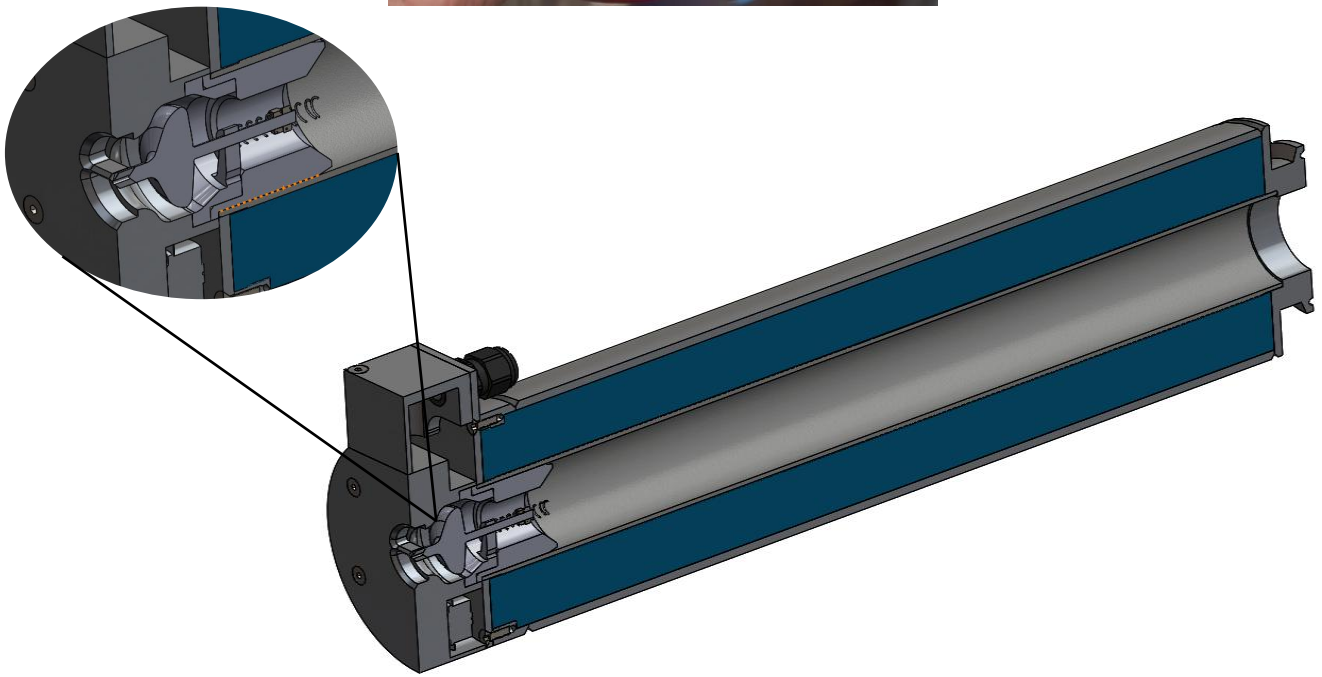
Innovative design

External, heated ‘End of line’ exhaust assembly

Designed with a heated, sprung, non-return valve, to ensure that no atmospheric moisture can track up the inside of the exhaust, to reduce the chance of icing up.

Controlled by a programmable heated tip assembly, the end of line vent is able to stay dry and frost free even when venting N2 at 20 g/s.



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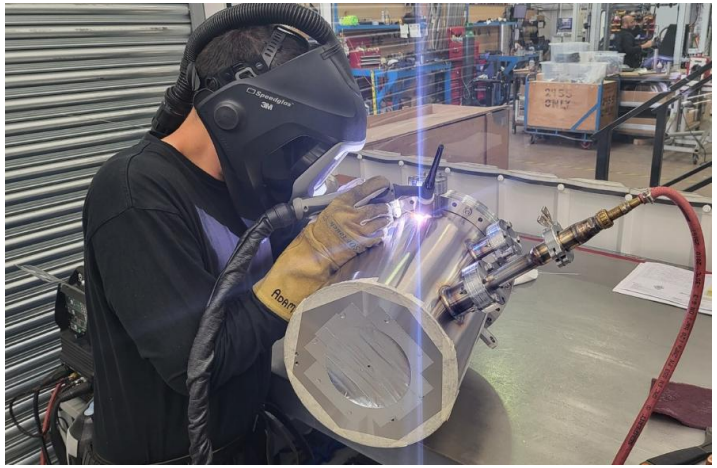
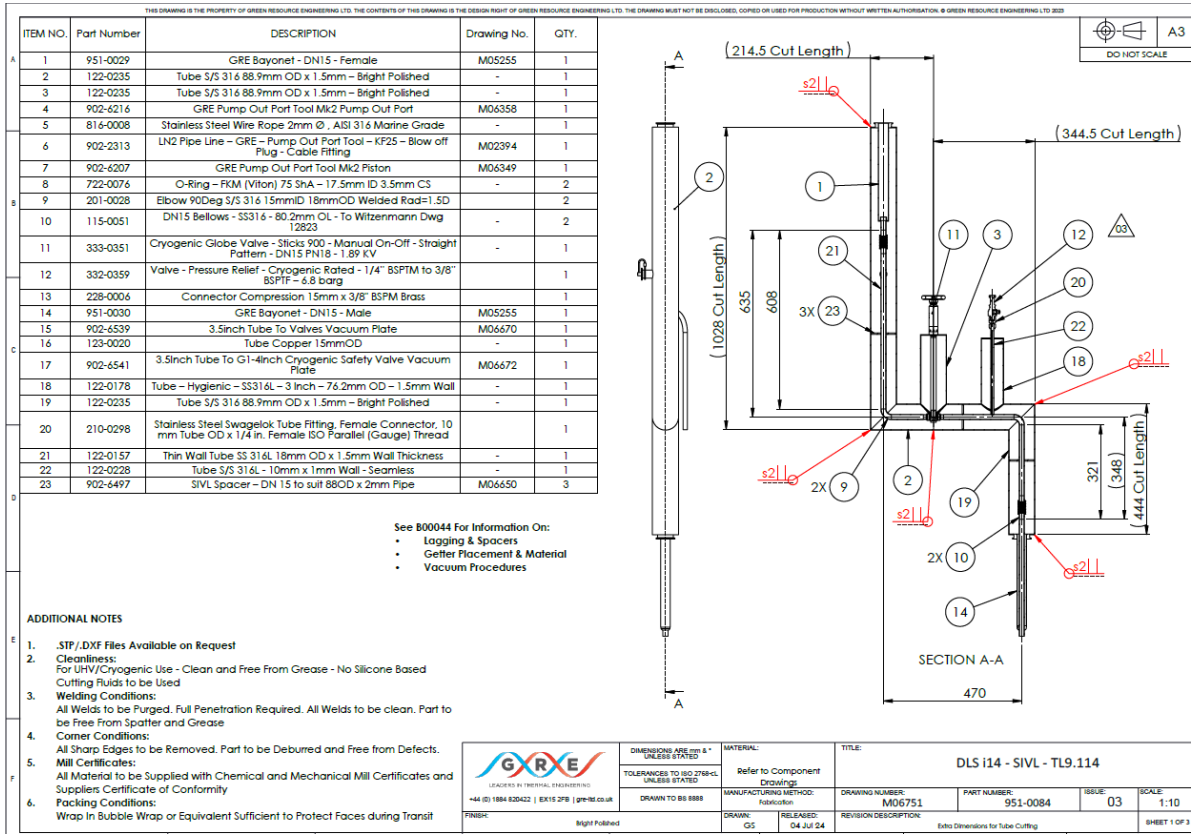
Welding & Fabrication

Quality, assured

All of GRE's SIVL's are fabricated by experienced welders, all of whom hold suitable qualifications (Coding). All lines are sent to our customers with material certificates, test certificates and full engineering drawings.





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ITEM NO.	Part Number	DESCRIPTION	Drawing No.	QTY.
1	951-0029	GRE Bayonet - DN15 - Female	M05255	1
2	122-0235	Tube S/S 316 88.9mm OD x 1.5mm – Bright Polished	-	1
3	122-0235	Tube S/S 316 88.9mm OD x 1.5mm – Bright Polished	-	1
4	902-6216	GRE Pump Out Port Tool Mk2 Pump Out Port	M06358	1
5	816-0008	Stainless Steel Wire Rope 2mm Ø , AISI 316 Marine Grade	-	1
6	902-2313	LN2 Pipe Line – GRE – Pump Out Port Tool – KF25 – Blow off Plug - Cable Fitting	M02394	1
7	902-6207	GRE Pump Out Port Tool Mk2 Piston	M06349	1
8	722-0076	O-Ring – FKM (Viton) 75 ShA – 17.5mm ID 3.5mm CS	-	2
9	201-0028	Elbow 90Deg S/S 316 15mmID 18mmOD Welded Rad=1.5D		2
10	115-0051	DN15 Bellows - SS316 - 80.2mm OL - To Witzenmann Dwg 12823	-	2
11	333-0351	Cryogenic Globe Valve - Sticks 900 - Manual On-Off - Straight Pattern - DN15 PN18 - 1.89 KV	-	1
12	332-0359	Valve - Pressure Relief - Cryogenic Rated - 1/4" BSPTM to 3/8" BSPTF – 6.8 barg		1
13	228-0006	Connector Compression 15mm x 3/8" BSPM Brass		1
14	951-0030	GRE Bayonet - DN15 - Male	M05255	1
15	902-6539	3.5inch Tube To Valves Vacuum Plate	M06670	1
16	123-0020	Tube Copper 15mmOD	-	1
17	902-6541	3.5inch Tube To G1-4inch Cryogenic Safety Valve Vacuum Plate	M06672	1
18	122-0178	Tube – Hygienic – SS316L – 3 Inch – 76.2mm OD – 1.5mm Wall	-	1
19	122-0235	Tube S/S 316 88.9mm OD x 1.5mm – Bright Polished	-	1
20	210-0298	Stainless Steel Swagelok Tube Fitting, Female Connector, 10 mm Tube OD x 1/4 in. Female ISO Parallel (Gauge) Thread		1
21	122-0157	Thin Wall Tube SS 316L 18mm OD x 1.5mm Wall Thickness	-	1
22	122-0228	Tube S/S 316L - 10mm x 1mm Wall - Seamless	-	1
23	902-6497	SIVL Spacer – DN 15 to suit 88OD x 2mm Pipe	M06650	3

See B00044 For Information On:
- Lagging & Spacers
- Getter Placement & Material
- Vacuum Procedures

ADDITIONAL NOTES

1. **.STP/.DXF Files Available on Request**
2. **Cleanliness:** For UHV/Cryogenic Use - Clean and Free From Grease - No Silicone Based Cutting Fluids to be Used
3. **Welding Conditions:** All Welds to be Purged. Full Penetration Required. All Welds to be clean. Part to be Free From Spatter and Grease
4. **Corner Conditions:** All Sharp Edges to be Removed. Part to be Deburred and Free from Defects.
5. **Mill Certificates:** All Material to be Supplied with Chemical and Mechanical Mill Certificates and Suppliers Certificate of Conformity
6. **Packing Conditions:** Wrap In Bubble Wrap or Equivalent Sufficient to Protect Faces during Transit

DIMENSIONS ARE mm & ° UNLESS STATED	MATERIAL: Refer to Component Drawings	TITLE: DLS i14 - SIVL - TL9.114	
TOLERANCES TO ISO 2768-cL UNLESS STATED	MANUFACTURING METHOD: Fabrication	DRAWING NUMBER: M06751	PART NUMBER: 951-0084
DRAWN TO BS 8888	DRAWN: GS	RELEASED: 04 Jul 24	ISSUE: 03
FINISH: Bright Polished	REVISION DESCRIPTION: Extra Dimensions for Tube Cutting		SCALE: 1:10

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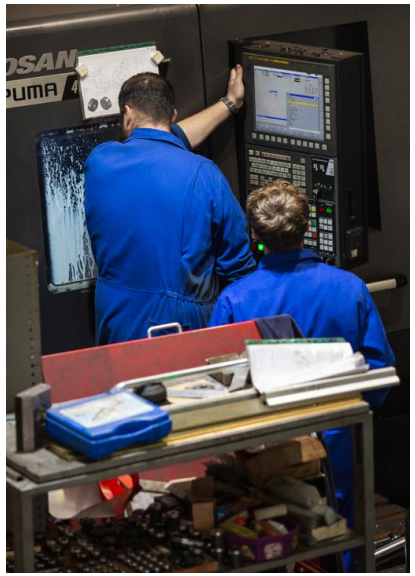
Quality, assured

Many of our components are made in-house by our own precision engineering company, Ashbrook Engineering.
All of the parts and components used in our systems are cut with silicone-free lubricants and are thoroughly cleaned using methods such as ultrasonic baths and hand-cleaning with IPA.



GXRE
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Controlled-environment fabrication

All of GRE's SIVL's are fabricated in our controlled environment, positive pressure 'clean rooms', which are both equipped with dry, filtered air, nitrogen (GN2 and LN2), along with extraction, O2 depletion, vacuum pumping and helium leak test facilities.

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Testing

All of GRE's SIVL's are pressure tested (positive pressure to 1.4 x max. operating pressure) and helium leak tested before being subject to thermal shock and being tested again.

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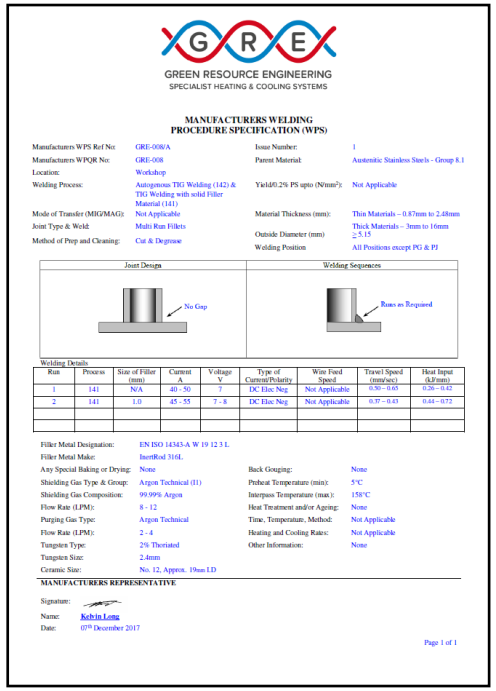
Non-destructive testing

If required, we can also provide weld maps/traceability and NDT for our welds



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SPECIALIST HEATING & COOLING SYSTEMS

MANUFACTURERS WELDING PROCEDURE SPECIFICATION (WPS)

Manufacturers WPS Ref No:	GRE-008/A	Issue Number:	1
Manufacturers WPQR No:	GRE-008	Parent Material:	Austenitic Stainless Steels - Group 8.1
Location:	Workshop		
Welding Process:	Autogenous TIG Welding (142) & TIG Welding with solid Filler Material (141)	Yield/0.2% PS upto (N/mm²):	Not Applicable
Mode of Transfer (MIG/MAG):	Not Applicable	Material Thickness (mm):	Thin Materials – 0.87mm to 2.48mm
Joint Type & Weld:	Multi Run Fillets	Outside Diameter (mm)	Thick Materials – 3mm to 16mm ≥ 5.15
Method of Prep and Cleaning:	Cut & Degrease	Welding Position	All Positions except PG & PJ

Joint Design — No Gap

Welding Sequences — Runs as Required

Welding Details

Run	Process	Size of Filler (mm)	Current A	Voltage V	Type of Current/Polarity	Wire Feed Speed	Travel Speed (mm/sec)	Heat Input (kJ/mm)
1	141	N/A	40 - 50	7	DC Elec Neg	Not Applicable	0.50 – 0.65	0.26 – 0.42
2	141	1.0	45 - 55	7 - 8	DC Elec Neg	Not Applicable	0.37 – 0.43	0.44 – 0.72

Filler Metal Designation:	EN ISO 14343-A W 19 12 3 L		
Filler Metal Make:	InertRod 316L		
Any Special Baking or Drying:	None	Back Gouging:	None
Shielding Gas Type & Group:	Argon Technical (I1)	Preheat Temperature (min):	5°C
Shielding Gas Composition:	99.99% Argon	Interpass Temperature (max):	158°C
Flow Rate (LPM):	8 - 12	Heat Treatment and/or Ageing:	None
Purging Gas Type:	Argon Technical	Time, Temperature, Method:	Not Applicable
Flow Rate (LPM):	2 - 4	Heating and Cooling Rates:	Not Applicable
Tungsten Type:	2% Thoriated	Other Information:	None
Tungsten Size:	2.4mm		
Ceramic Size:	No. 12, Approx. 19mm I.D		

MANUFACTURERS REPRESENTATIVE

Signature:

Name: Kelvin Long

Date: 07th December 2017

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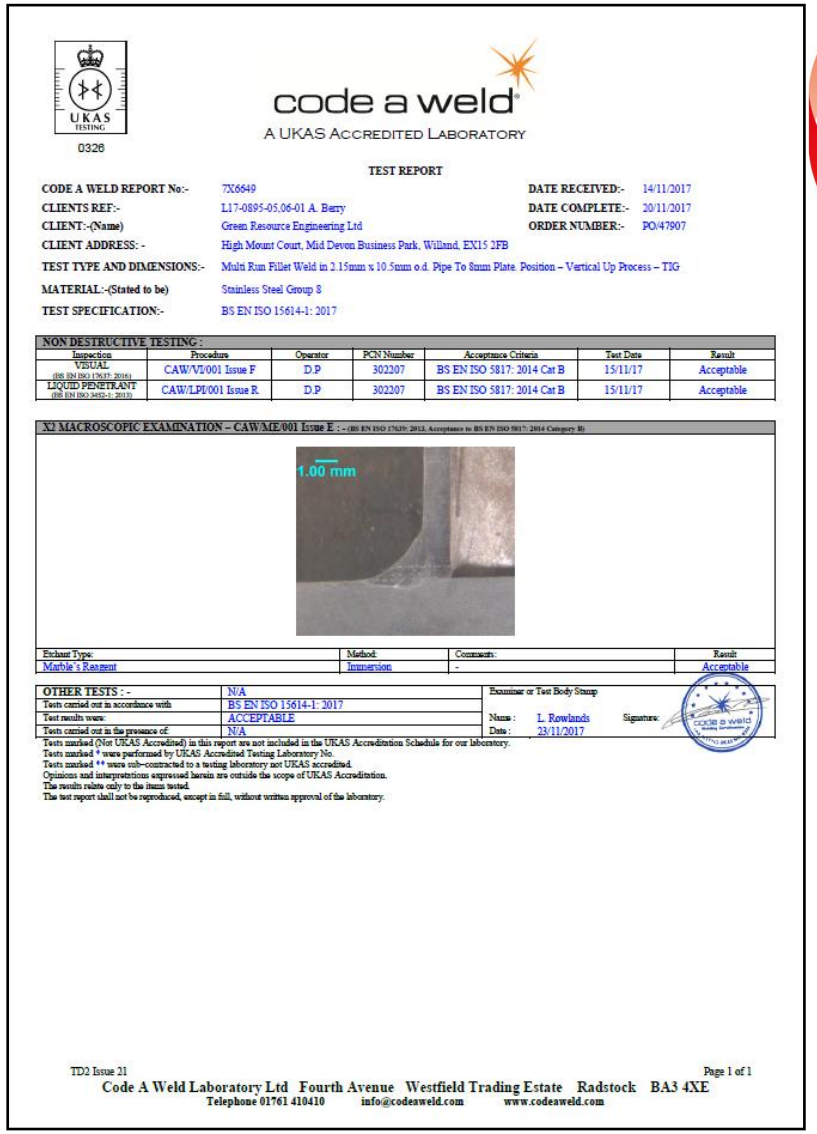

UKAS TESTING
0326

code a weld
A UKAS Accredited Laboratory

TEST REPORT

CODE A WELD REPORT No:-	7X6549	**DATE RECEIVED:-**	14/11/2017
CLIENTS REF:-	L17-0895-05,06-01 A. Berry	**DATE COMPLETE:-**	20/11/2017
CLIENT:-(Name)	Green Resource Engineering Ltd	**ORDER NUMBER:-**	PO/47907
CLIENT ADDRESS: -	High Mount Court, Mid Devon Business Park, Willand, EX15 2FB		
TEST TYPE AND DIMENSIONS:-	Multi Run Fillet Weld in 2.15mm x 10.5mm o.d. Pipe To 8mm Plate. Position – Vertical Up Process – TIG		
MATERIAL:-(Stated to be)	Stainless Steel Group 8		
TEST SPECIFICATION:-	BS EN ISO 15614-1: 2017		

NON DESTRUCTIVE TESTING :

Inspection	Procedure	Operator	PCN Number	Acceptance Criteria	Test Date	Result
VISUAL (BS EN ISO 17637: 2016)	CAW/VI/001 Issue F	D.P	302207	BS EN ISO 5817: 2014 Cat B	15/11/17	Acceptable
LIQUID PENETRANT (BS EN ISO 3452-1: 2013)	CAW/LPI/001 Issue R	D.P	302207	BS EN ISO 5817: 2014 Cat B	15/11/17	Acceptable

X2 MACROSCOPIC EXAMINATION – CAW/ME/001 Issue E : - (BS EN ISO 17639: 2013. Acceptance to BS EN ISO 5817: 2014 Category B)

Etchant Type:	Method:	Comments:	Result
Marble's Reagent	Immersion	-	Acceptable

OTHER TESTS : -	N/A	Examiner or Test Body Stamp	
Tests carried out in accordance with	BS EN ISO 15614-1: 2017	Name : L. Rowlands	Signature:
Test results were:	ACCEPTABLE	Date : 23/11/2017	
Tests carried out in the presence of:	N/A		

Tests marked (Not UKAS Accredited) in this report are not included in the UKAS Accreditation Schedule for our laboratory.
Tests marked * were performed by UKAS Accredited Testing Laboratory No.
Tests marked ** were sub-contracted to a testing laboratory not UKAS accredited.
Opinions and interpretations expressed herein are outside the scope of UKAS Accreditation.
The results relate only to the items tested.
The test report shall not be reproduced, except in full, without written approval of the laboratory.

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Code A Weld Laboratory Ltd Fourth Avenue Westfield Trading Estate Radstock BA3 4XE
Telephone 01761 410410 info@codeaweld.com www.codeaweld.com

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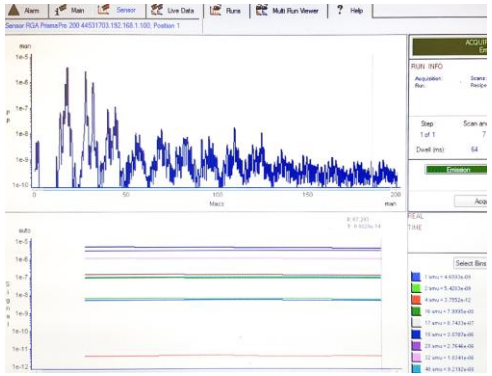
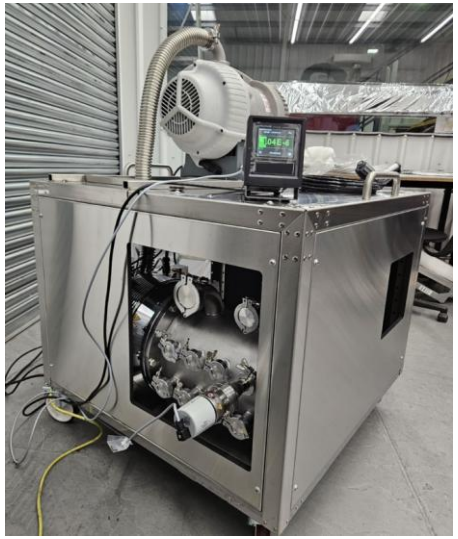
Conditioning

GRE’s bespoke SIVL conditioning system…..





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Installation

A few pictures of the system being installed at i14 by the GRE team.




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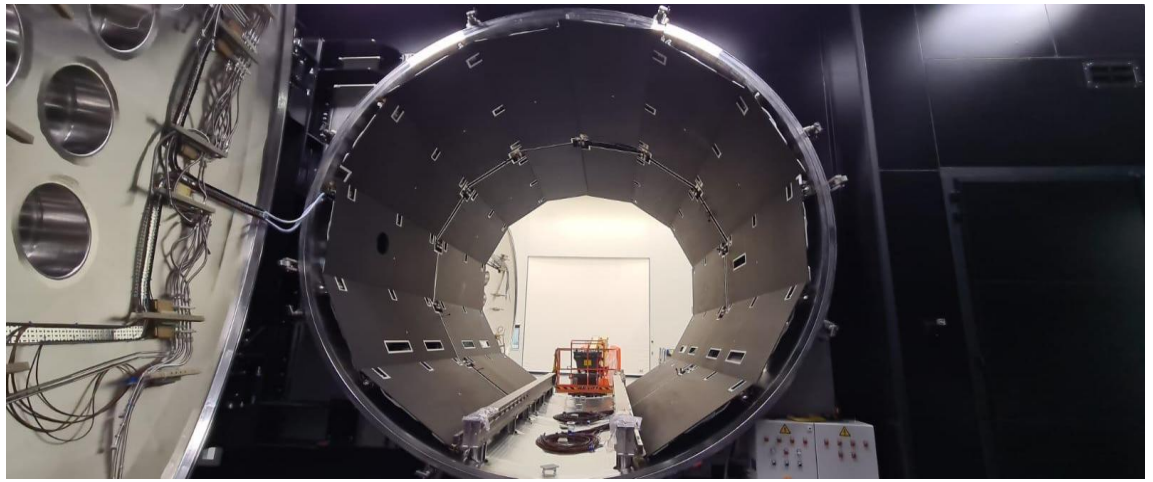
What else do we do?

Cryogenics



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Site installations

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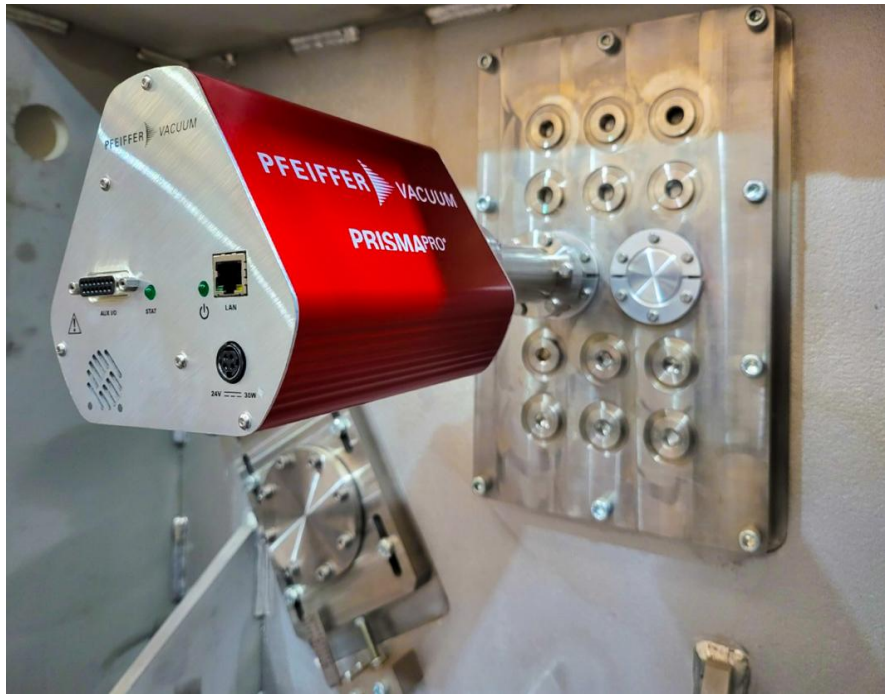
Vacuum Services



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