Operation and Maintenance Manual
Helipure Chamber Gas Recovery System

Part Number:	GR10270**
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Revision:	13

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Approval Sheet

Document Information				
Advitium No	**Title**	**Classification**	**Rev**	**Date**
P1823-OM-45	Operation & Maintenance Manual Helipure Chamber Gas Recovery System	Commercial in confidence	13	15/08/2016

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Revision 13 Implemented		
Responsibility	**Name**	**Position**
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Review

This document is subject to review and revision in accordance with ISO 9001.

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1 Introduction

Note ***The pressure required to pass 60 scfm of Gas through the Helipure system depends on the Membrane type fitted.***

Pre May 2007 = 100 bar

May 2007 - December 2012 = 30 - 40 bar

January 2013 onward = 25 - 30 bar

1.1 Membrane Technology

Although fluid separation using permeable membranes is an established technique for liquid purification, similar systems for gas purification have only recently been developed. These systems have mainly been used within large industrial complexes for the separation of natural gas. Divex developed this technique to produce a compact, low cost unit for the purification of helium to compliment its existing range of gas management systems for the commercial diving industry. This has now been significantly improved by incorporating new technology acquired by Divex.

1.2 Operational Scope

During normal diving operations Helium is reclaimed from the diving complex using the Gaspure system. This routes Helium vented from equipment locks etc to a gasbag. When the gasbag is filled, gas is pumped to High Pressure Storage via a HP Compressor and filtration system.

A single storage tube within the ships gas storage system is normally dedicated to receive this reclaimed Helium and this is gradually filled over a period of days. In the past, there has been a problem in re-using this gas due to the fact that it contains significant quantities of air (typically 5 to 10%). The Helipure system allows this air to be removed and the gas to be safely reused within the dive complex.

The Helipure is used periodically, in conjunction with the gasbag, compressor and filtration package of the Gaspure system. Dirty gas (Helium and Air) is decanted from the Gaspure storage tube through the Helipure system where the air is removed. It is then passed to the gasbag from where the compressor recompresses the now clean gas and passes through the filtration package.

After this the gas can be routed into an empty, clean storage tube for subsequent re-use within the dive system. It should be noted that a gas analysis must be carried out on this cleaned gas before reuse to ensure the oxygen content is within usable limits.

2 System Operation

2.1 Overview

Gas is routed to the Helipure System from high pressure storage. From here it passes to the pressurisation control system. This limits the speed at which the membranes are pressurised and hence prevents damage. From here gas passes to an electrical heater which controls the temperature of the feed gas to 40°C, the optimum running temperature for the membranes.

On leaving the heater gas passes to the two membranes which are connected up in parallel.

Within the pressure vessels helium passes through the membrane module to the low pressure side and Nitrogen, Oxygen and Argon are connected on the high pressure side and dumped via the dump gas metering valve. The clean gas is directed to the gasbag via the outlet check valve.

An analysis panel mounted on top of the unit allows analysis to be made of the helium content or the main gas streams to allow optimum performance to be maintained during processing. It should be noted however, that this type of analyser can only provide a rough guide to helium content and tubes of cleaned gas must be accurately analysed prior to re-use.

2.2 Pressurisation Control Panel

This system consists of a dome loaded regulator, the loading pressure of which is controlled by a hand loaded regulator. A restrictor limits flow from the hand loader into a buffer volume, connected to the dome. This limits the pressurisation rate of the dome and hence the downstream pressure of the dome loaded regulator. A check valve in the circuit allows the buffer volume to vent down when the system is shut down readying it for the next pressurisation sequence.

2.3 Gas Heater

Performance of the Helipure system is dependent on the temperature of the gas passing through the membranes, the optimum temperature being 40°C.

This is achieved using an electrical gas heater with an electric temperature control and display. A resistance thermometer measures the outlet temperature from the heater housing and this is then displayed on the controller. The controller then compares the actual temperature with the desired temperature and switches on or off the heater as required.

A second temperature sensor located on the outside of the heater housing is used to check the housing temperature and will switch off the heater should a fault develop. A flow switch in the clean gas outlet, monitors for flow from the unit and also will switch off the heater when no flow is indicated. This protects both the membranes from being overheated and the heater element from burning out.

2.4 Membrane Housing

The membrane elements are housed in two stainless steel pressure vessels with bolted end caps to enable the elements to be entered and withdrawn.

The membrane element is internally secured to one end cap using a tube fitting and internally sealed to the bore of the pressure housing using a lip seal or O-ring. Due to this seal, gas entering the pressure housing is thus forced down the length of the membrane and permeate gas flows through the membrane into the central tube and out via the fitting.

To avoid the pressure housing acting as a heat sink and cooling the preheated inlet gas, trace heating tapes are spirally wrapped along the external length of each pressure vessel. These self regulating trace heating tapes are preset at and are left permanently on. When power to the Helipure is switched on a preheat time of 30 minutes should allow to bring the housing up to temperature. The pressure vessel housing is thereafter continually kept warm. Insulation applied around the outside of the tape reduces heat loss to the atmosphere and a further cladding of stainless steel prevents mechanical damage to the insulation and heating tapes.

It should also be noted that although the membranes are robust, they are easily damaged by the ingress of water. To avoid this during transportation, the housings are supplied sealed and pressurised with dry gas. If for any reason the membranes are to be removed for inspection they must be temporarily stores in a sealed bag away from high humidity.

A pressure relief valve is fitted to limit the pressure differential across the membranes thus preventing accidental over pressurisation. From the appendix it can be seen that the membrane elements are particularly sensitive to reverse pressurisation therefore a check valve is fitted which relieves pressure back from the clean gas to the dump gas should this be likely to occur.

3 Operating Procedure

3.1 Procedures

1. Ensure power to the Helipure system is on and trace heaters are functioning (housings should be warm to the touch).
2. Calibrate the helium analyser (see section 5 Helium Analyser).
3. Bring the dirty high pressure storage bank on line to the Helipure.
4. Set inlet pressure to membranes to around 25 bar using the hand loading regulator.
5. Gas will now flow out of the unit to the gasbag.
6. The performance of the unit can now be optimised as outlined below and further defined in section 4 Optimising the Performance.
7. Analyse the dump gas sample.
8. Open up the dump valve slowly until the helium content in the gas suddenly starts to rise.

Note ***There is a time lag in the system so open the valve one turn then wait for approximately one minute then repeat as required.***

9. Close off metering valve again (about half of 1 turn).
10. Helium content of the dump gas will drop back (again note the time lag).
11. The optimum setting is just before this sudden rise in helium content. Periodically check that this optimum setting is being maintained.
12. Inlet gas and clean gas samples can also be taken to check the unit performance and calculate recovery rates (see section 4 Optimising the Performance).
13. Once the dump flow rate is correctly set the temperature controller should maintain the inlet gas temperature at 40 ±2°C.
14. The analyser will require periodic recalibration as it is sensitive to changes in ambient temperature.

4 Optimising the Performance

4.1 Optimising the Dump Flow

With the Helipure set up as detailed in the operating instructions, only the dump valve needs to be adjusted to provide the optimum performance. The setting of this valve is dependent on the gas mixture being supplied to the Helipure.

As the dump gas flow increases, the purity of the clean gas improves at the expense of the helium recovery rate. As the dump gas flow decreases, the helium recovery improves at the expense of the clean gas purity.

The effect of adjusting the dump gas flow is non linear. If the dump flow is too low a significant improvement in the clean gas purity can be achieved by increasing the flow with only a minimal reduction in the gas recovery rate. Conversely if the dump flow is too high a significant improvement in the recovery rate can be achieved by reducing the dump flow with only a minimal reduction in clean gas purity.

The optimum setting is best achieved by:

1 Starting with a low dump flow.

2 Measuring the helium content of the gas.

3 Gradually open up the metering valve until the desired recovery rate/clean gas purity balance is achieved.

4 As a rough guide to performance the Helipure unit will divide the Oxygen content of the Heliox mixture by 2 and the Nitrogen content by 2.5.

Table 1 Example;

Reclaimed Gas	Cleaned Gas
4.5% Oxygen	<3% Oxygen
7.5% Nitrogen	<3% Nitrogen
88% Helium	>94% Helium

Note ***A period of at least one minute must elapse before the effect of adjusting the dump flow is registered on the helium analyser.***

4.2 Calculating Helium Recovery Rate

The following measurements need to be taken to calculate the helium recovery rate.

He^{in} = % helium in the supply gas

He^{c} = % helium in the clean gas

He^{d} = % helium in the dump gas

Substitution of these into the following equation will then give the recovery rate, where;

R = Recovery Rate.

$$R = \frac{He^{in} - He^{d}}{He^{c} - He^{d}} \times \frac{He^{c}}{He^{in}} \times 100$$

Recovery Rate example;

helium in the supply gas	=	92.1 %
helium in the clean gas	=	95.5 %
helium in the dump gas	=	42.2 %

$$R = \frac{He^{in} - He^{d}}{He^{c} - He^{d}} \times \frac{He^{c}}{He^{in}} \times 100$$

$$R = \frac{92.1 - 42.2}{95.5 - 42.2} \times \frac{95.5}{92.1} \times 100$$

$$R = \frac{49.9}{53.3} \times 1.036 \times 100$$

$$R = 0.936 \times 103.6$$

$$R = 96.9\%$$

4.3 Factors Affecting Performance

There are three factors on which the performance of a membrane is assessed.

- Clean Flow Rate
- Purity of Clean Gas
- Helium Recovery Rate

For a given membrane there are four factors which affect is performance.

- The supply Gas Mixture
- The Pressure Ratio Across the Membrane
- The Gas Temperature at the Membrane
- The Dump Gas Flow Rate

Increasing the levels of helium in the supply gas mixture.

- Increases the clean gas flow rate
- Increases the purity of the clean gas
- Increases the helium recovery rate

It also reduces the optimum dump flow rate. The increase in the level of helium in the supply gas does not produce a corresponding increase in the purity of the clean gas.

If the supply gas is about 85% helium the clean gas will be about 95% helium.

It the supply gas is about 95% helium the clean gas will be about 97.5% helium.

Increasing the pressure ratio across the membranes

- Increases the clean gas rate
- Increases the purity of the clean gas
- Increases the helium recovery rate

However, if the differential pressure across the membranes exceeds 50 bar there is a risk that they will be damaged.

If the outlet pressure is increased the inlet pressure can also be increased by the same amount. However, the pressure ratio will fail and hence the overall performance will fall as well. It is therefore important to minimise the back pressure between the Helipure and the gasbag.

Increasing the gas temperature

- Increases the clean gas flow rate
- Decreases the purity of the clean gas slightly
- Increases the helium recovery rate slightly

If the temperature of the membrane exceeds 60°C there is a high risk of them being damaged.

As discussed previously increasing the dump flow rate principally improves the purity of the clean gas and decreases the helium recovery rate. It also increases the supply gas flow rate to a lesser extent.

5 Helium Analyser

Note ***A calibration gas with a known concentration of Helium is required in order to perform the following operations.***

The gas sensor housing is a modular stainless steel assembly which accommodates a Thermal Conductivity Sensor and a Sensor Amplifier. Power is supplied to the sensor by a 24 volts dc Switching Power Supply. The sensor amplifier converts the gas reading into a 4 to 20 mA signal for connection to a loop powered LED indicator which gives an accurate, zero corrected indication of the loop current.

The unit as supplied is suitable for measuring Helium in the range 0 to 100%.

Sample flow rate is 1 to 2 litres/minute.

Time to reach final reading after introduction of gas mixture is dependant on calibration but is typically 10 seconds.

5.1 Calibration

1. Ensure that the 24 volt Switching Power Supply Unit is switched on.
2. Adjust the ‘ZERO’ potentiometer on the front facia panel of the Helipure system until the LED indicator reads 0%.
3. Introduce a known calibration gas to the detector through the flexible hose which is connected to the inlet of the sample gas flow-meter, at a flow of between 1 and 2 litres/minute. The meter reading will indicate the gas concentration.
4. Allow the gas reading to stabilise and adjust the ‘SPAN’ potentiometer on the front facia panel of the Helipure system until the LED indicator reads the appropriate reading.
5. The analyser may require periodic re-calibration as it is sensitive to changes in ambient temperature.

5.2 Operation

The analyser is permanently on when there is power to the Helipure and will give a continuous readout of the Helium percentage at the sensor.

Sample of the supply gas, the clean gas and the dump gas can be monitored alternatively by connecting the flexible hose on the sample gas flow meter to the desired sample line.

Metering valves in each sample line are used to control the flow rate of gas to the analyser sensor to between 1 and 2 litres/minute.

6 Maintenance & Trouble Shooting

The membranes in the Helipure will work efficiently for many years as long as the gas supplied to the unit is clean and free from moisture ideally -50°C dew point or below. All gas supplied to the unit which has passed through a gaspure system is -50°C dew point and filtered to 0.01 micron.

Set up a supply of 7 bar of dry air to each membrane in turn using a calibrated gauge. The clean gas flow from each membrane should be less than 30 litres/minute flow rate measured by routing the gas through a test hose and into the sample flow meter on the panel.

If either membrane has a flow rate well in excess of 40 litres/minute, replace the o-rings on the v.c.o fittings on the end of the faulty membrane. If this does not rectify the fault, the membrane may be damaged from exposure to higher than normal operating temperatures or by moisture in the gas and so should be replaced. All existing faults must be rectified before replacement of membranes as further damage is likely to occur.

New membranes must not be exposed to moisture or high humidity after removal from packing before installation in the Helipure housing.

CAUTION

MEMBRANE REPLACEMENT

If reduced membrane efficiency is experienced and membrane replacement is required, please contact JFD Ltd. for assistance as system settings may need to be updated.

7 Spares Kit

Part No.	Description	No. Off
C10280	Spares Kit, Helipure	1
Consisting of:		
FK31214	Kit, Spares, Filter	1
GP2036	Gauge,63 mm,0-1500 PSI,O2 Clean,1/4"MNPT Rear Entry	1
GP2037	Gauge,63mm,0-1500 PSI,O2 Clean,1/4"MNPT Bottom	1
GP274	Gauge,63 mm,0-4000 PSI,O2 Clean,1/4"MNPT Rear Entry	1
RN018-7	O-Ring, Membrane Outlet Seal	1
RN224-7	O-Ring, Membrane Inlet Seal	1
RN225-7	O-Ring, Membrane Housing Seal	2
RV119-7	O-Ring, Heater Element Housing Seal	1
SE29015	Sensor, Helium, 9100-4535	1
SE29016	Sensor, Oxygen, 9100-9212-94	1
VK25P	Kit, Seal, For 4R3A Relief Valve	2
VK31500	Kit, Packing, Metering Valve, To Suit VS296	3
VK33P	Kit, Seal, For Regulator A210M, 3/8"	1
VK35P	Kit, Seal, For Regulator A11, 3/8"	1
VK44P	Valve Seal Kit, For B-18KM8-A	1
VM038	Spring For 4CPZ-1	3
VM106	O-Ring For C/V B-4CP2-1, 1/4"	3

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Appendix A System Drawings

Helipure System, General Arrangement A.2

Helipure System, AA Version A.3

Process & Instrumentation Diagram, Helipure System A.4

Membrane Assembly, Helipure System A.5

Heater Housing Assembly A.6

Schematic, Helipure Wiring, Top Enclosure Layout A.7

Helipure System, General Arrangement

CONNECTIONS

I.D.	DESCRIPTION	FITTING
C1	GAS INLET	1/2" OD x 0.049" SS TUBE
C2	OVERBOARD VENT	1/4" OD TUBE CONNECTOR - 316 STNLS
C3	GAS OUTLET	12-JIC MALE - 316 STNLS

CONNECTION POINT COORDINATES

I.D.	X	Y	Z
C1	40	1300	188
C2	480	1300	188
C3	485	316	194

FIXING POINT COORDINATES

I.D.	X	Y	Z
B1	25	1637	25
B2	495	1637	25
B3	25	3	25
B4	495	3	25

UNIT RATINGS

PRESSURE RANGE 25-30 bar TO MAINTAIN
60 scfm GAS FLOW

PRV SETTING (REGULATED GAS)
(HELIPURE TOWER STAGE) = 50 bar (725 psi)
(SAMPLE BOTTLE) = 50 bar (725 psi)

SERVICES

GAS INLET

GAS FROM STORAGE OR DISTRIBUTION SYSTEM
MAX INLET PRESSURE = 206 bar (3000 psi)
MAX REGULATED PRESSURE = 45 bar (653 psi)

SAMPLE LINES

FLOWMETER VALVES REGULATE FLOW TO ANALYSER
TYPICAL SAMPLE LINE - 1/4" OD x 0.035" TUBE
(S1) SUPPLY GAS SAMPLE
(S2) CLEAN GAS SAMPLE
(S3) DUMP GAS SAMPLE

ELECTRICAL

TBD

GENERAL INFORMATION

CONNECTION DIMENSIONS

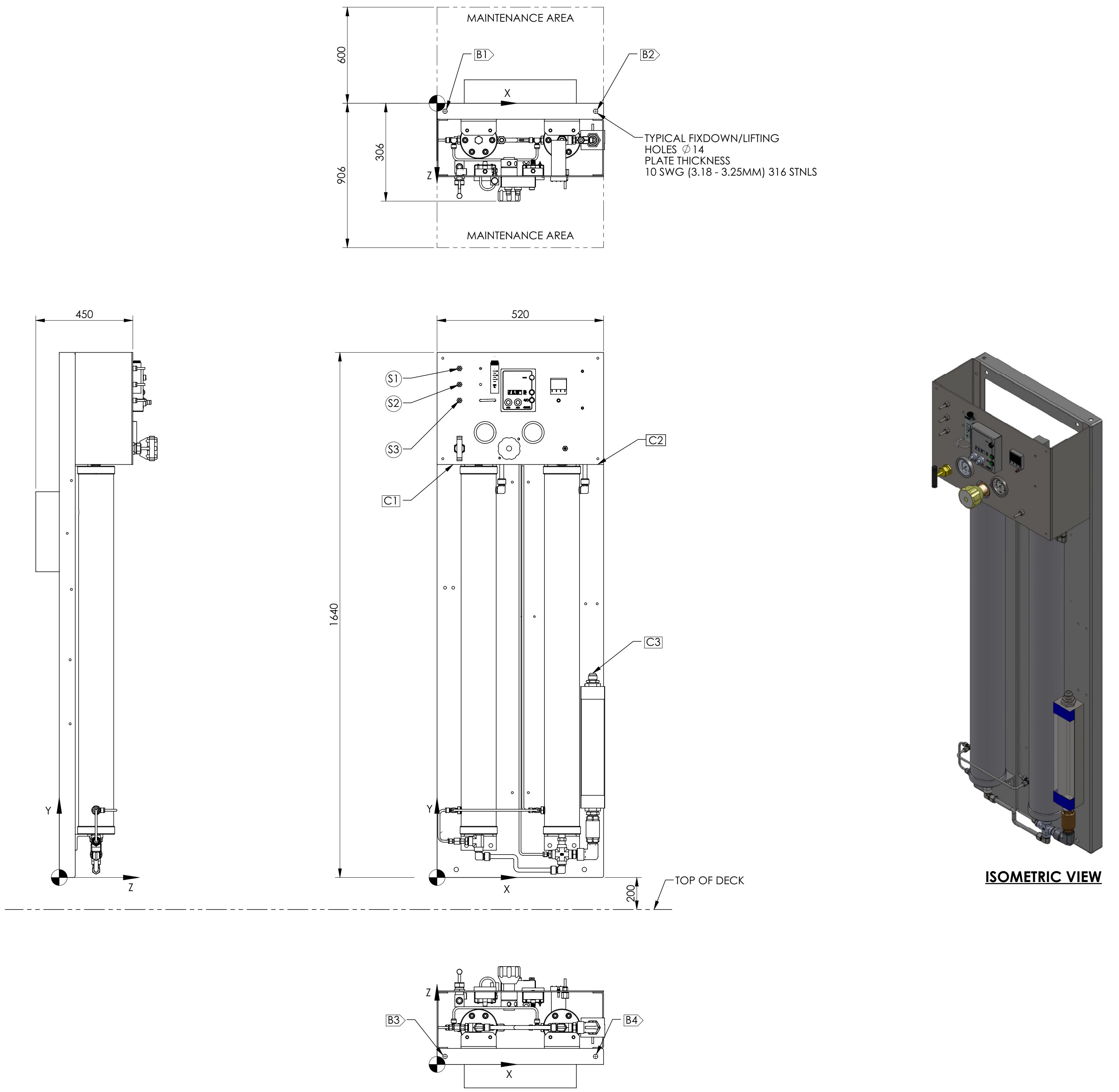
± 0.1m

LEGEND

DATUM

NOTES

ALL DIMENSIONS REFERENCE ONLY



NOTES:

MATERIAL	N/A
FINISH	N/A

ALL DIMENSIONS ARE IN mm (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

MACHINING TOLERANCE		FABRICATION TOLERANCE	
NO DECIMAL PLACE	±1.0	>0 <100	±0.5
ONE DECIMAL PLACE	±0.2	>100 <500	±1.5
TWO DECIMAL PLACE	±0.05	>500	±3.0
ANGULAR TOLERANCE	±0.5°		

DENOTES CHANGES MADE AT THIS REVISION

REV	DESCRIPTION	ECN	BY	DATE	AUTH.
R03					
R02					
R01	SHEET 2 ADDED	19672	MJ	28/06/16	AN
R00	ISSUED FOR MANUFACTURE		ZD	18/07/14	MS

THIRD ANGLE PROJECTION — DO NOT SCALE DRAWING

TITLE	HELIPURE SYSTEM
DRAWING NO.	GA1009005S1
REV	R02
PART NO.	GR10270CA
PRODUCT / PROJECT No.	GA100
SIZE	A2
SCALE (UOS)	1:10
SHEET	1 OF 2

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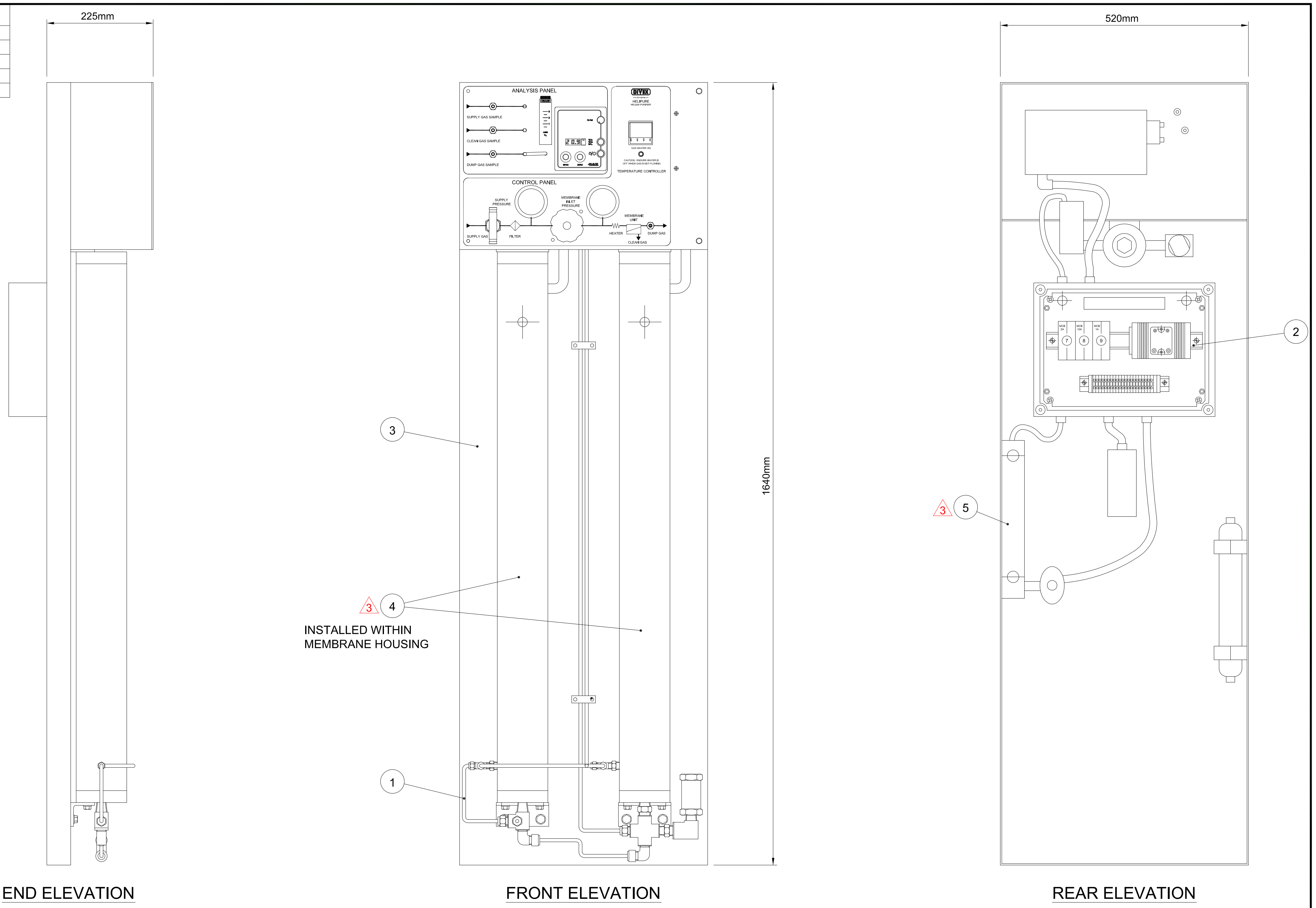
Helipure System, AA Version

ITEM No	DESCRIPTION	QTY.	PART No
1	PIPEWORK SYSTEM ASSEMBLY	1	CA3000
2	ELECTRICAL SYSTEM ASSEMBLY	1	CA3001
3	PANELS SUB-ASSEMBLY	1	CA3003
4	COLLAR, MEMBRANE, HELIPURE	2	GR10270303
5	BACKING PLATE, HEAT EXCHANGER, HELIPURE	1	GR10270304



NOTES

3 DENOTES CHANGES MADE AT THIS REVISION

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: N/A

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH. BY
R06					
R05					
R04					
R03	UPDATED PARTS LIST	19347	JJM	15/04/16	AN
R02	MOVE MTO ONTO SHEET 1 AND CHANGE PART NUMBER	13039	LJS	18/11/2009	RTW
R01	UPDATED TO REFLECT CURRENT PRACTICE	7034	GPC	17/07/2007	RTW
R00	ISSUED FOR MANUFACTURE		XXX	XX/XX/XX	XXX

DO NOT SCALE DRAWING

TITLE: HELIPURE SYSTEM, AA VERSION

PRODUCT / PROJECT No. HELIPURE

PART No. GR10270AA

DRAWING No. P182331S1

SIZE	SCALE	SHT	OF	REV
A1	NTS	1	1	R03

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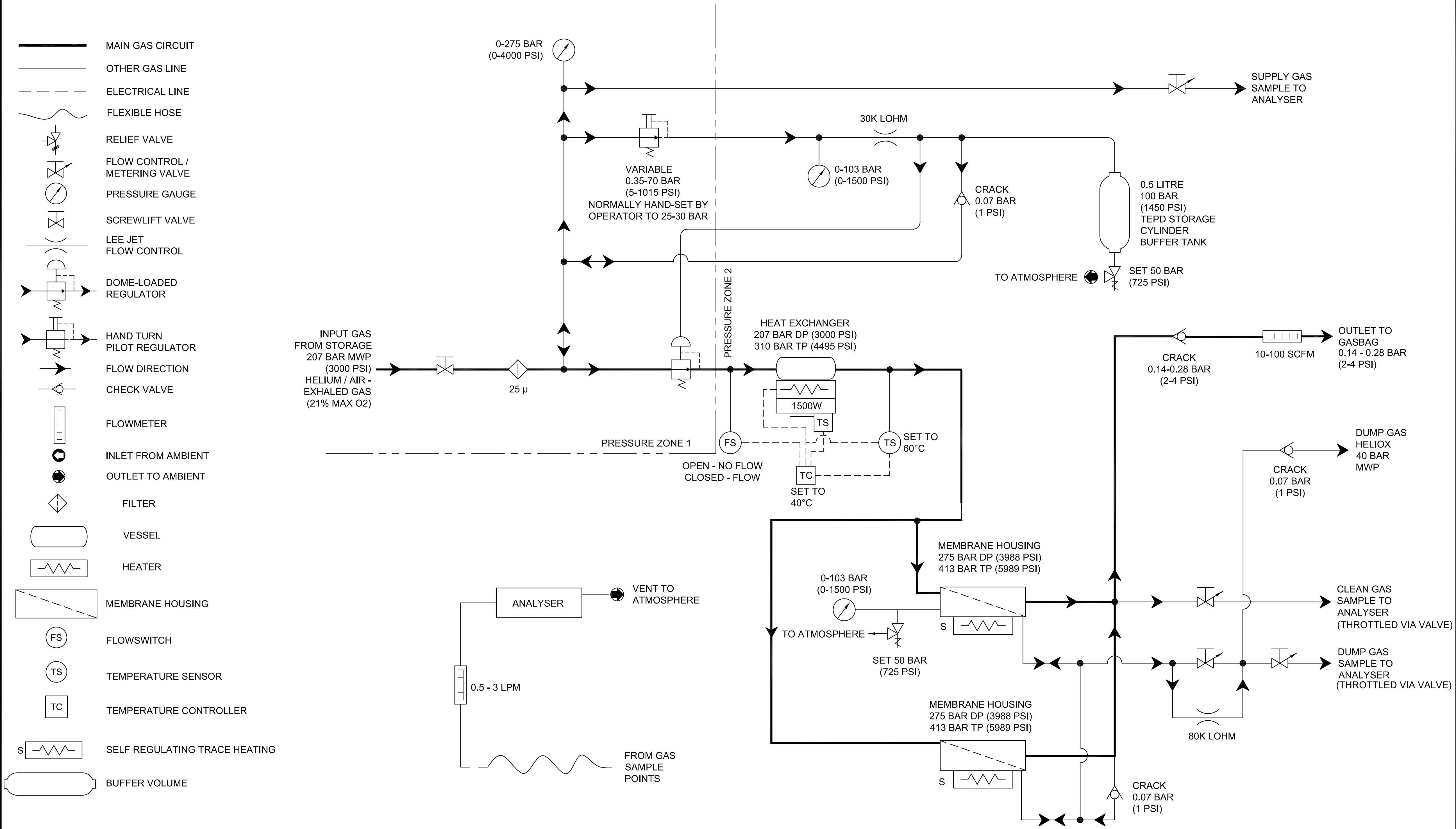
Process & Instrumentation Diagram, Helipure System



1. SYSTEM DESIGN TEMPERATURE NORMAL WORKING CONDITION 40°C, MAXIMUM TEMPERATURE HEATER CUT-OFF 60°C
2. PRESSURE ZONE 1: MAX. WORKING PRESSURE 207 BAR
   PRESSURE ZONE 2: NORMAL WORKING PRESSURE 30 BAR
   MAXIMUM WORKING PRESSURE 40 BAR (5)
   MEMBRANE HOUSING DISCHARGE TO AMBIENT ATMOSPHERIC PRESSURE

(5) DENOTES CHANGES MADE AT THIS REVISION

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DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
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ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: N/A
FINISH: N/A
THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH. BY
R05	M.W.P. UPDATED	18628	MJ	29/09/15	PB
R04	PRESSURE ZONES AND NOTES ADDED	17345	JR	12/01/15	MS
R03	DIAGRAM INFO EXPANDED FOR FUNCTIONAL PARAMETERS	17215	ZD	21/11/14	MS
R02	RELIEF VALVE SET AT 50 BAR	16790	MJ	20/06/14	MS
R01	RELIEF VALVE SET AT 60 BAR	12991	SR	18/08/10	SW
R00	ISSUED FOR INFORMATION		GR	11/12/08	RTW

DO NOT SCALE DRAWING

TITLE: PROCESS & INSTRUMENTATION DIAGRAM, HELIPURE SYSTEM
DRAWING No.: P1823900S1 REV: R05
PART No.: GR10270 VARIANTS PRODUCT / PROJECT No.: P1823
SIZE: A2 SCALE: NTS SHT 1 OF 1

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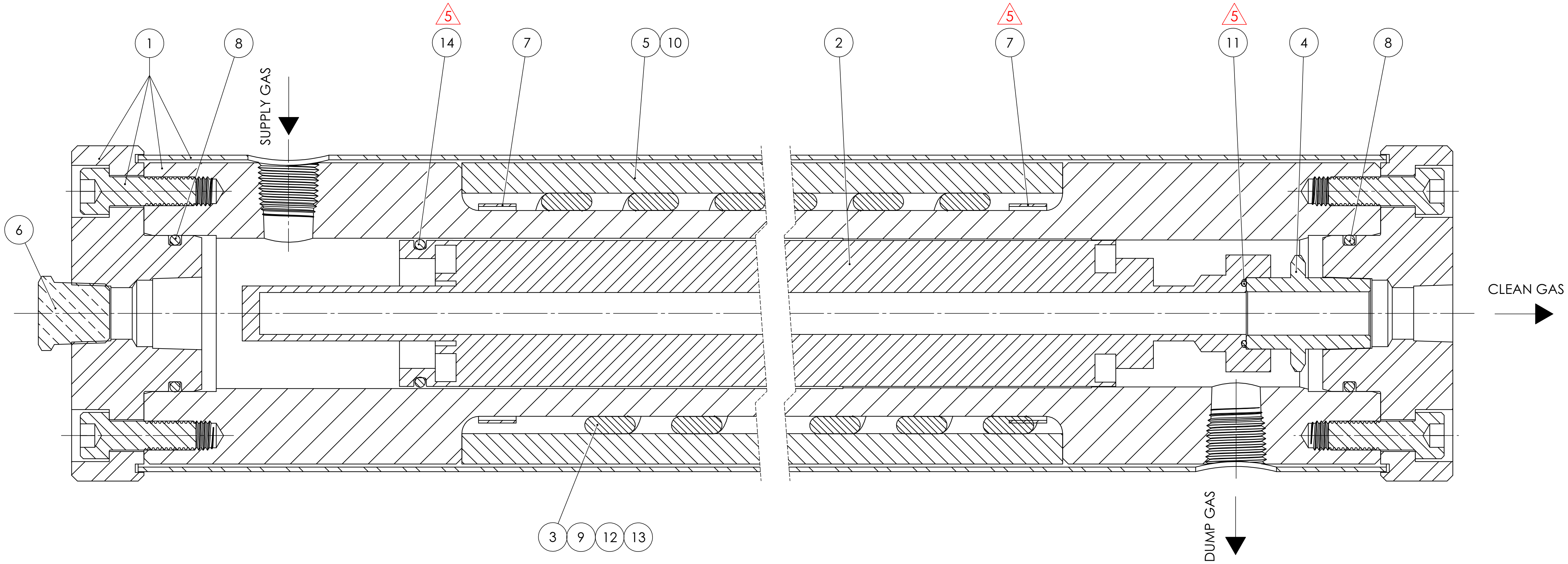
Membrane Assembly, Helipure System

ITEM	PART No.	DESCRIPTION	Qty.	
1	DM36780	MEMBRANE HOUSING, HELIPURE SYSTEM	1	
2	C44710	MEMBRANE ELEMENTS	1	
3	EM118	TAPE, SELF REGULATING	3M	
4	G0130	ADAPTOR, MEMBRANE	1	
5	MC133	INSULATION, ARMAFLEX, 2-1/2" TUBE X 1/2" TK.	1	
6	FP401	PLUG, HEX, MALE, 1/2" NPT(M), BRASS, WP269BAR	REF ONLY.	
7	FC047	CLIP,JUBILEE, 1/2" X 10" DIA., ST.ST.	2	△5
8	RN225-7	O-RING, 3.53 CS X 47.23 ID	2	
9	EM123	END TERMINATION KIT, SELF REGULATING TAPE	1	
10	MC317	TAPE, INSULATION, ARMAFLEX, 2", BLACK	1	
11	RN018-7	O-RING	1	△5
12	MC010	TAPE, SELF-ADHESIVE	2	
13	E11614	CABLE, 1.5MM (SQ), TRI-RATED, GREEN/YELLOW	AS REQ.	
14	RN224-7	O-RING (BS 224 NITRILE 70 SHORE)	1	△5



NOTES

△5 - DENOTES CHANGES MADE AT THIS REVISION.

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ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: SEE PARTS LIST

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05	ASSEMBLY, MODEL & BOM UPDATED	16883	TS	03/10/14	MS
R04	PARTS LIST UPDATED AND NEW HOUSING DESIGN SHOWN	13048	SJ	20/11/09	RTW
R03	UPDATED	2474	ML	04/03/97	HS
R02	UPDATED	1117	MB	30/08/93	GSH
R01	UPDATED	572	MB	24/07/92	JR
R00	ISSUED FOR MANUFACTURE		RD	07/02/90	GSH

DO NOT SCALE DRAWING

TITLE: **MEMBRANE ASSEMBLY, HELIPURE SYSTEM**

DRAWING No. P182310S1 REV R05

PART No. CB3000 PRODUCT / PROJECT No. HELIPURE SYSTEM

SIZE A2 SCALE 1:1 SHT 1 OF 1

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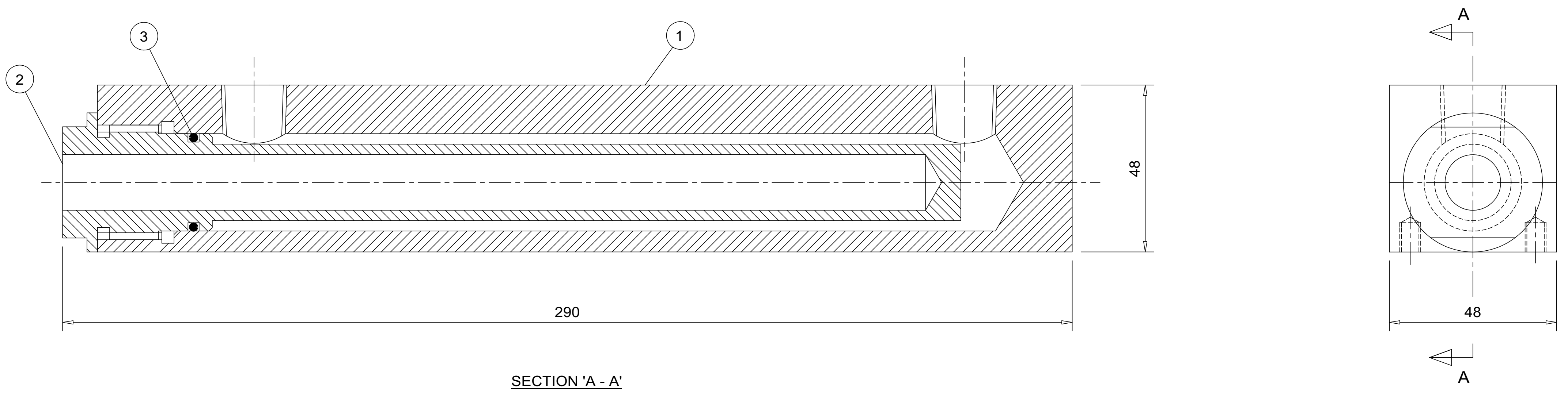
Heater Housing Assembly

Parts list *(not part of drawing)*

Item	Part No.	Description	No. Off
1	M1010	Body, Heat Exchanger, Helipure	1
2	M1000	Heat Exchanger Element HSG, Helipure	1
3	RV119-7	O-ring	1



SECTION 'A - A'

2	UPDATED	1117	MB	30.8.93	DG	GSH	GSH		
1	UPDATED	572	MB	24.7.92	RD	JR	JR		
REV	DESCRIPTION OF REVISION	ECN	BY	DATE	DRAFT CHECK	ENG CHECK	APPD		

THIRD ANGLE PROJECTION

MATERIAL: MTO : P1823-MT-003

FINISH: -

ALL DIMENSIONS IN MM (UOS)

ALL DIMENSIONS BEFORE PLATING (UOS)

REMOVE SHARP EDGES & BURRS

DIMENSIONAL TOLERANCES:
NO DECIMAL PLACES ±1.0
ONE DECIMAL PLACE ±0.2
TWO DECIMAL PLACES ±0.05
ANGULAR TOLERANCE ±0.5°

DRAWN:	RD	DATE	2.2.90	SCALE 1 : 1
DRAFT. CHECK:	PG	DATE	7.2.90	
ENG. CHECK:	PG	DATE	7.2.90	PRODUCT HELIPURE
APPROVED:	GSH	DATE	7.2.90	

CAD REF No. 15158-2

PART No. CB1103

DIVEX

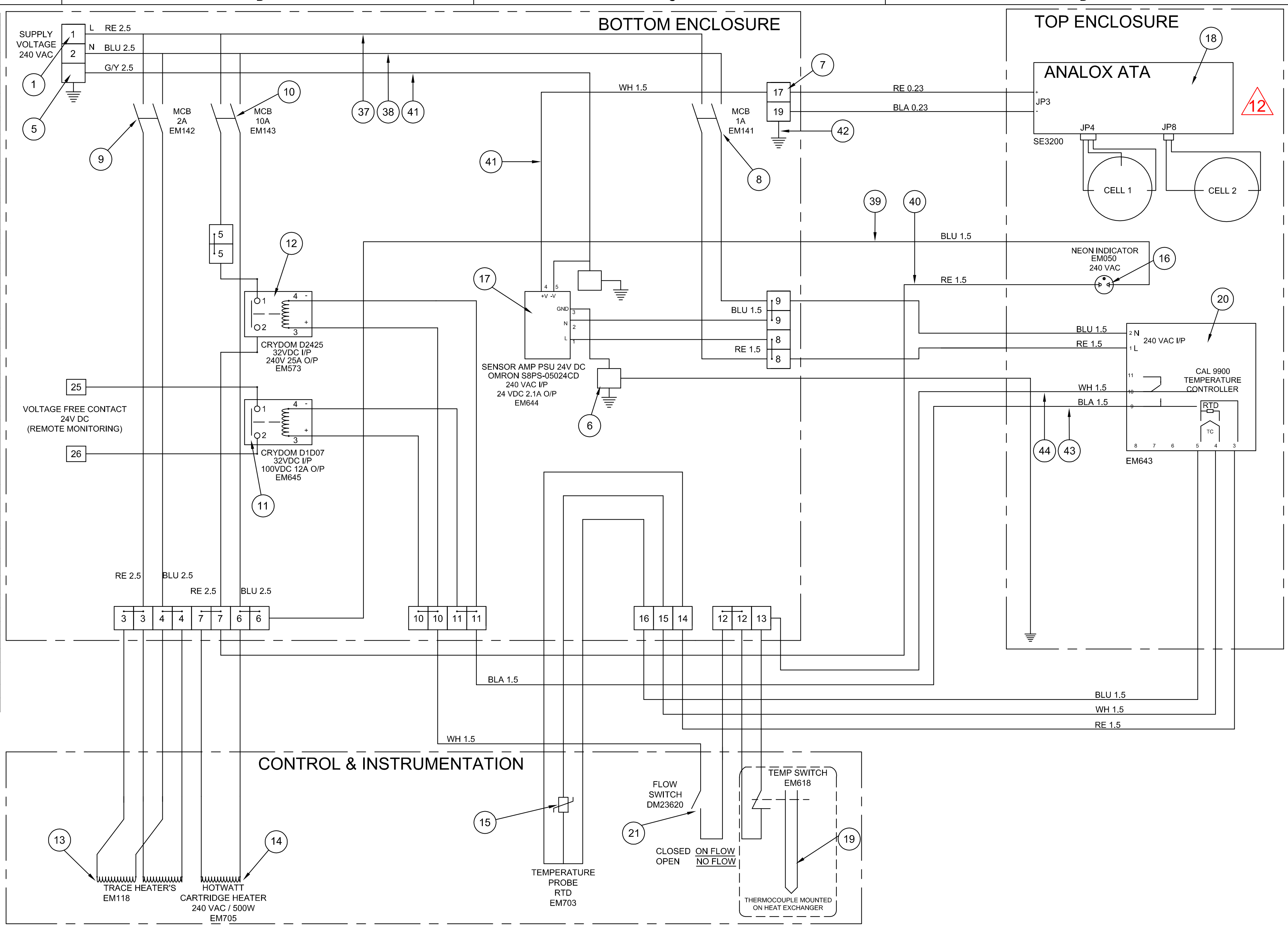
A2

TITLE: HEATER HOUSING ASSEMBLY

DRG No. P1823-DG-003 SHT 1 REV 2

Schematic, Helipure Wiring, Top Enclosure Layout

BILL OF MATERIALS			
Item No.	Description	Divex Part No	QTY.
1	ELEC,KLIPPON CONNECTOR, SAK 2.5	EM155	35
2	END STOP,TERMINAL (NOT SHOWN)	E11424	3
3	ELEC,END COVER, AP 2.5 (NOT SHOWN)	EM148	9
4	ELEC,MARKERS, 1-50 (NOT SHOWN)	EM154	4
5	EARTH TERMINAL, EK 2.5N SAK, 27A	EM224661	3
6	TERMINAL,KLIPPON	EM238	2
7	ELEC,CONNECTOR,KLIPPON	EM067	4
8	ELEC,M.C.B, 1 AMP	EM141	1
9	ELEC,M.C.B, 2 AMP	EM142	1
10	ELEC,M.C.B, 10 AMP	EM143	1
11	RELAY, SOLID STATE, DID07	EM645	1
12	RELAY,SOLID STATE, 25A	EM573	1
13	TAPE,SELF REGULATING	EM118	3
14	HOTWATT CARTRIDGE HEATER 1500W,240VAC	EM705	1
15	RESISTANCE THERMOMETER R+D TYPE, 6MM X 75MM	EM703	1
16	ELEC,NEON INDICATOR, RED	EM050	1
17	SENSOR AMP POWER SUPPLY UNIT	EM644	1
18	ANALYSER, ATA PRO, PANEL MOUNTED, HELIPURE	SE3200	1
19	SWITCH,TEMPERATURE	EM618	1
20	CONTROLLER, TEMPERATURE, CAL 9900	EM643	1
21	FLOW SWITCH ASSEMBLY, MWP 1500 PSI.	DM23620	1
22	ELEC,MALE STRAIGHT ADAPTOR, M20 (NOT SHOWN)	EM024	1
23	ELEC,90 DEG. MALE ELBOW ADAPTOR, M20 (NOT SHOWN)	EM052	1
24	FSTR,CABLE TIE, 100 X 2.5MM (NOT SHOWN)	FC029	100
25	SCREW,M/C,PAN HD, M4 X 12, 316L ST. STEEL (NOT SHOWN)	FB168	4
26	CONDUIT, 20MM (NOT SHOWN)	EM484	1.5
27	GLAND,CABLE, 8-13MM X M20,BLACK (NOT SHOWN)	EM032	1
28	TIE WRAP, BLACK, NYLON, 100 MM LG, 2.5 MM WIDE (NOT SHOWN)	EM428	20
29	GROMMET, ID6.4MM, PANEL HOLE 9.5MM, PVC, BLACK (NOT SHOWN)	MC1200	1
30	GROMMET, BLANKING, BLACK, 6.3MM (NOT SHOWN)	EM3565	2
31	GROMMET, BLANKING, BLACK, 9.5MM (NOT SHOWN)	EM3566	2
32	GROMMET, BLANKING, BLACK, 20.6MM (NOT SHOWN)	EM3567	1
33	GROMMET, ID4.8MM, PANEL HOLE 6.4MM, PVC, BLACK (NOT SHOWN)	MC1219	1
34	ELEC,END STOP (NOT SHOWN)	EM156	4
35	ENCLOSURE, ELECTRICAL (NOT SHOWN)	EM162	1
36	ENCLOSURE, ELECTRICAL, TOP, HELIPURE (NOT SHOWN)	P112	1
37	2.5 SQ MM RED TRI-RATED PVC /M	DD500316	2
38	CABLE,2.5MM(SQ),TRI-RATED,BLUE	E11610	2
39	CABLE,ELEC,RED, 1.5 SQ.MM/1 CORE	CL019	2
40	CABLE,1.5MM(SQ),TRIRATED,BLUE	E11613	2
41	CABLE,2.5MM(SQ),TRIRATED,GREEN/YELLOW	E11611	4
42	CABLE,1.5MM(SQ),TRI-RATED,GREEN/YELLOW	E11614	2
43	CABLE, TRI-RATED, BLACK, 1.5MM, 21A RATED	CL161	3
44	CABLE,1.5MM(SQ),TRIRATED,WHITE	E12914	3



8 TERMINAL

12 DENOTES CHANGES MADE AT THIS REVISION

ALL DIMENSIONS SHOWN ARE IN MM (UOS)
ALL DIMENSIONS BEFORE PLATING (UOS)
REMOVE ALL SHARP EDGES AND BURRS

DIMENSIONAL TOLERANCES

MACHINING		FABRICATION	
NO DECIMAL PLACES	±1.0	SIZE >0 <100	±0.5
ONE DECIMAL PLACE	±0.2	SIZE >100 <500	±1.5
TWO DECIMAL PLACE	±0.05	SIZE >500	±3.0
ANGULAR TOLERANCE	±0.5°	ANGULAR TOLERANCE	±0.5°

MATERIAL: N/A

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH. BY
R12	UPDATED SCHEMATIC TO ADD PART NUMBERS AND WIRE GAUGES	17193	LW	24/11/14	SC
R11	CROWCON ANALYSER REPLACED WITH ANALOX ATA	15605	MJ	27/06/14	MS
R10	BORDER CHANGED	11151	MRM	19/08/08	IB
R09	UPDATED	10677	MRM	04/07/08	IB
R00	ISSUED FOR MANUFACTURE		RD	23/01/90	

DO NOT SCALE DRAWING

TITLE: SCHEMATIC, HELIPURE WIRING, TOP ENCLOSURE LAYOUT

DRAWING No. P1823009S1 — REV R12

PART No. CA3001 — PRODUCT / PROJECT No. HELIPURE

SIZE A2 — SCALE NTS — SHT 1 OF 4

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APPENDIX B MANUFACTURER RELATED DOCUMENTS

The following details the web links where manufacturers' operating, service and maintenance information for the major components may be sourced.

CAL 9900 Autotune PID Temperature Controller

http://www.west-cs.com/assets/Manuals/CAL-9900-Manual.pdf

Hotwatt Cartridge Heater

http://www.hawco.co.uk/en/media/bluelogic/legacyproducts_uploadfiles/h/o/hotwatt_sc.pdf

Note ***Should you not be able to locate the relevant data sheets please contact you nearest JFD office for assistance.***

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