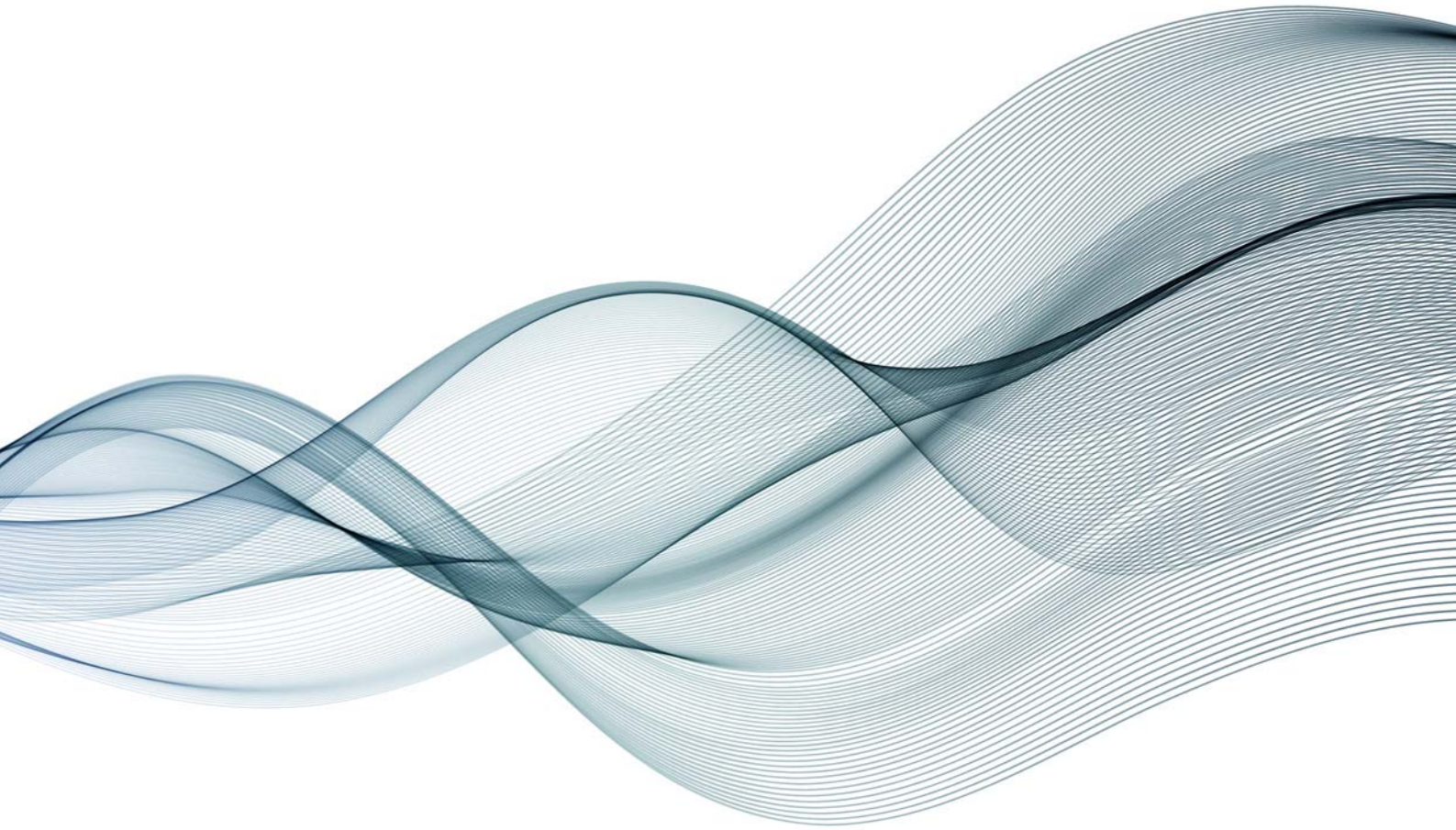

Operation and Maintenance Manual for the Kinergetics HCU 3/4 - HCU 3/6 System (Habitat Conditioning Units)

Part Numbers: KI40037 and KI40034

Document Number: P2171-OM-390
Revision: 5

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APPROVAL SHEET

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OM245	P2171-OM-390	Operation and Maintenance Manual for the Kinergetics HCU 3/4 - HCU 3/6 System (Habitat Conditioning Units)	Commercial in confidence	5	14/04/2016

Revision History					
Rev	**Date**	**BY**	**CHK**	**APP**	**Comments**
0	16/10/2001	P. Buchan	J. Rendall	F. Pope	Original for Issue
1	19/12/2001	P. Buchan	F. Pope	F. Pope	ECN: 3670
2	02/11/2005	C. Bain	J. Massie	J. Massie	ECN: 6038
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4	29/01/2014	D. Allan	V. Garzon	S. Coull	ECN: 16364
5	14/04/2016	J. Lastakauskiene	V. Garzon	P. Black	ECN: 19371

Original Approvals			
Responsibility	**Name**	**Position**	**Date**
Author	P. Buchan	Engineer	October 2001
Checked	John Rendall	Senior Engineer	October 2001
Approval	Fred Pope	Manager	October 2001

Copyright Details

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DISCLAIMER

Whilst every effort has been made to ensure the accuracy of the information provided in this document, JFD makes no guarantees therefore.

Misuse of the equipment described in this manual could result in injury. It is the responsibility of the user to ensure that the equipment is used and maintained correctly and in accordance with the instructions provided in this manual in order to ensure safety of life and to prevent injury.

WARRANTY

JFD Ltd warrants that its **Habitat Conditioning Unit (Model Number HCU 3/4 - HCU 3/60)**, conforms to the current product specification at the date of delivery and that the product will be free of patent defects in materials or workmanship for a period of twelve months from the date of delivery or for the first 3,000 operating hours, whichever occurs first.

Any component or sub-system which is established by JFD to be patently defective will, at JFD's option, be repaired or replaced on condition that such defective equipment is returned to JFD's manufacturing facility in Aberdeen, Scotland, freight pre-paid. On completion of any repair or replacement, the equipment will be returned to the customer FOB Aberdeen, Scotland. By agreement and upon prepayment by the customer of any transportation, on-site accommodation and subsistence expenses, JFD may dispatch personnel to perform on-site repairs.

The product specification and warranty terms are subject to alteration without prior notice and do not form part of any contract made between JFD and its customer.

This equipment should only be operated by suitably qualified persons conversant with the operation and maintenance of environmental conditioning equipment used in saturation dive systems. Before operating the equipment, the user must be fully acquainted with the instructions contained in this manual, as well as the individual component manufacturer's operating and maintenance information provided in the Appendixes.

Only genuine manufacturer's spare parts may be used in this JFD product. Use of other manufacturer's parts may cause degradation of performance or failure and will invalidate the warranty.

The following information is required by JFD when ordering spare parts:

- Customer's / owner's name
- Equipment serial number
- Spare part type / description
- Part number

TABLE OF CONTENTS

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CHAPTER 1 - GENERAL DESCRIPTION

CONTENTS

1.1 GENERAL SPECIFICATIONS

The HCU 3/4 and 3/6 have been designed for the use in a hyperbaric environment (Both Air or Heliox) to depths of 300 MSW.

The HCU 3/4 has been designed for four persons in saturation and the HCU 3/6 for four persons. The HCU 3/6 has a greater scrubbing and dehumidification capacity. The specification may be varied for special applications.

1.1.1 Habitat Conditioning Unit

	Model HCU 3/4	**Model HCU 3/6**
Water removal	>250 ml/hr	500 ml/hr
Humidity control	from 50% RH to 70% RH ± 3%	from 50% RH to 70% RH ± 3%
Temperature control	24^{o} C to 35^{o}C ± 1^{o}C	24^{o} C to 35^{o}C ± 1 ^{o}C
Flow rates:		
Heating / cooling	390m^3/hr (230 ACFM*)	390m^3/hr(230 ACFM*)
CO2 absorption	51m^3/hr (>30 ACFM)	102m^3/hr (>60ACFM)
Dehumidification	51m^3/hr (>30 ACFM)	102m^3/hr (>60 ACFM)
Heating / cooling capacity:		
Heating	20,000 BTU/hr	20,000 BTU/hr
Cooling	20,000 BTU/hr	20,000 BTU/hr
Weight	68kg	80kg
Size (mm)	747w x 335h x 267d (29.4w x 13.2h x 10.5d)	1016w x 335h x 267d (40.0w x 13.2h x10.5d)
Max. volume of Chamber that 1 HCU can support	11.3m^3 (400 cubic feet)	17m^3 (600 cubic feet)
Blower drive	24V.a.c or d.c Electric Motor	24V.a.c or d.c Electric Motor
**** Actual cubic feet per minute***		

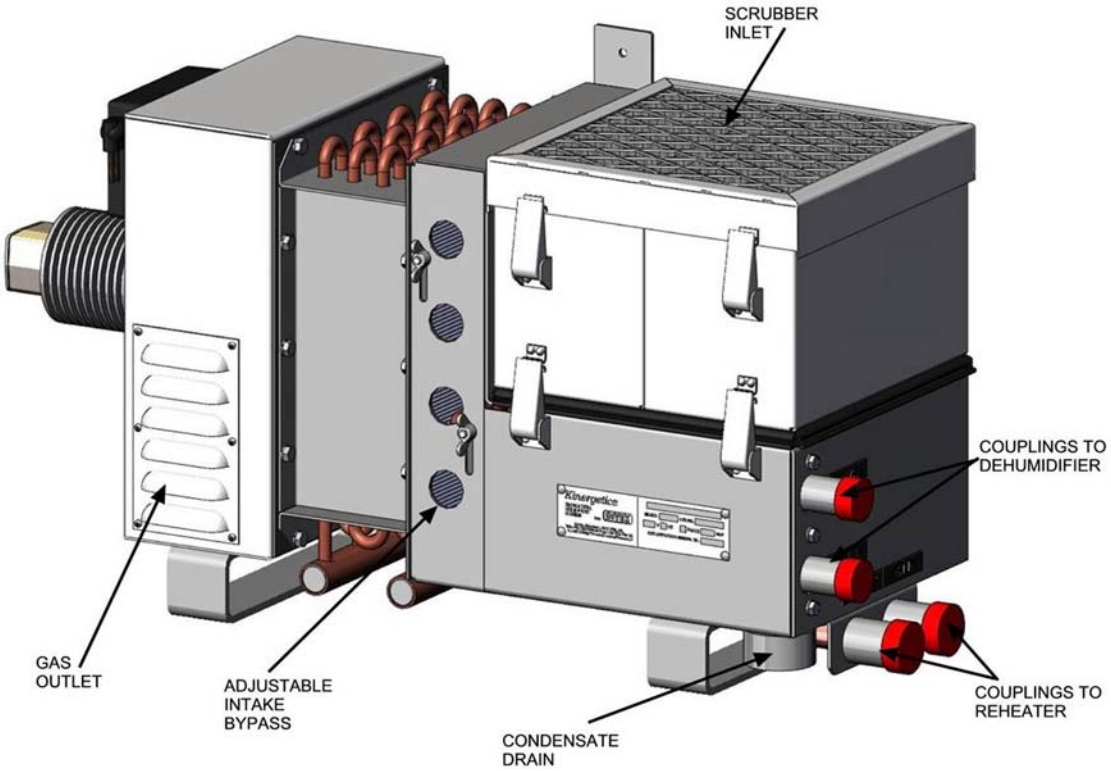

Fig 1.1 Outline HCU 3/4

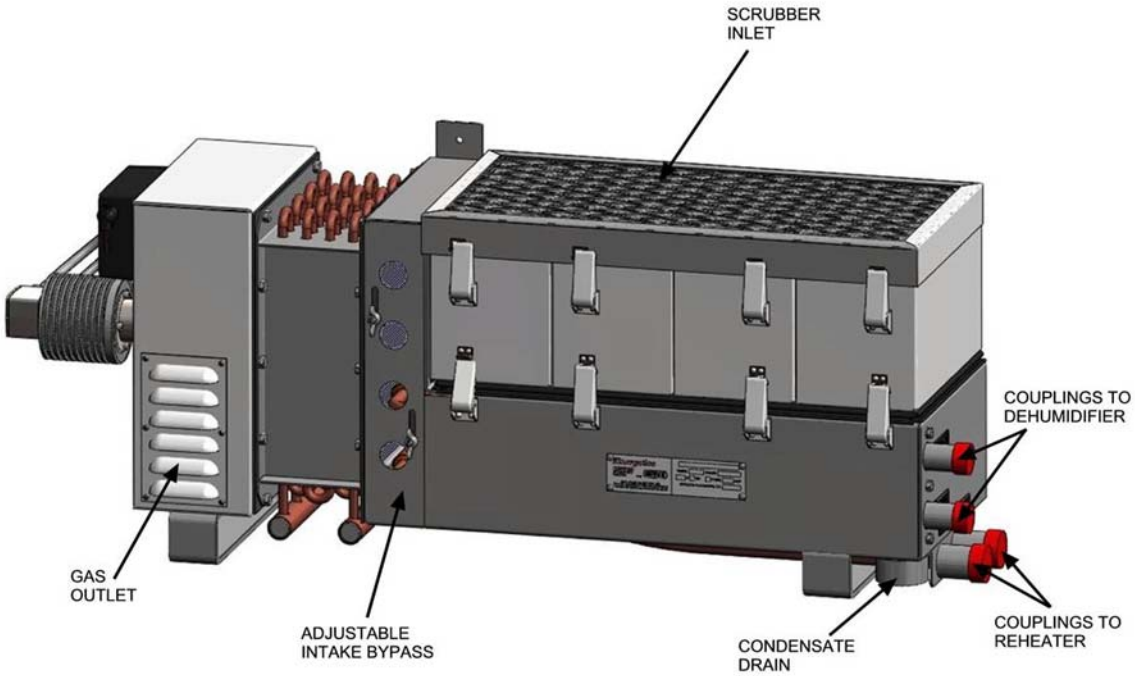

Fig 1.2 Outline HCU 3/6

1.2 THEORY OF OPERATION

See Fig 1.3.

1.2.1 Environmental Control

Inputs to habitat are heated fluid, cooled fluid and electrical power for the Blower Motor. Components contained in Habitat Conditioning Unit (HCU) are as follows: (see Fig 1.3)

1. CO_2 Scrubber (1) - Contains Sodasorb for CO_2 removal.
2. Dehumidification Coil (2) - Condenses moisture from breathing gas.
3. Reheat Coil (3) - Controls temperature of breathing gas.
4. Water Tap (4) - Collection point for condensation from Dehumidification Coil.
5. Electric Motor (5) - Provides power to drive Blower.
6. Blower (6) - Generates the flow of breathing gas.
7. Bypass (7) - Allows breathing gas to bypass Scrubber and Dehumidification Coil.

1.2.2 Heating

When heating is required, temperature of Primary Fluid entering HCU increases. Primary fluid is pumped into HCU by Primary Fluid Pump in the CMU. Heated fluid then enters Reheat Coil (3). Heat from fluid is transferred to breathing gas as it flows through Heat Exchanger. The Blower circulates heated gas in habitat.

1.2.3 Cooling

When cooling is required, the temperatures of Primary Fluid entering HCU decreases. Cooled fluid enters Reheat Coil (3). Heat is transferred to the cooled fluid from the breathing gas as it flows through Heat Exchanger. The Blower circulates cooled gas in habitat.

1.2.4 Dehumidification

When dehumidification is required, the secondary fluid is chilled and pumped into HCU by the secondary fluid Pump in the CMU. Chilled fluid enters Dehumidification Coil (2) which causes moisture in the breathing gas to condense on Coil. Water drips into Water Trap (4) then drains into a user supplied container under HCU where it can be passed manually out of habitat. When no dehumidification is required, temperature of fluid rises to a point where condensation on Coil will no longer occur.

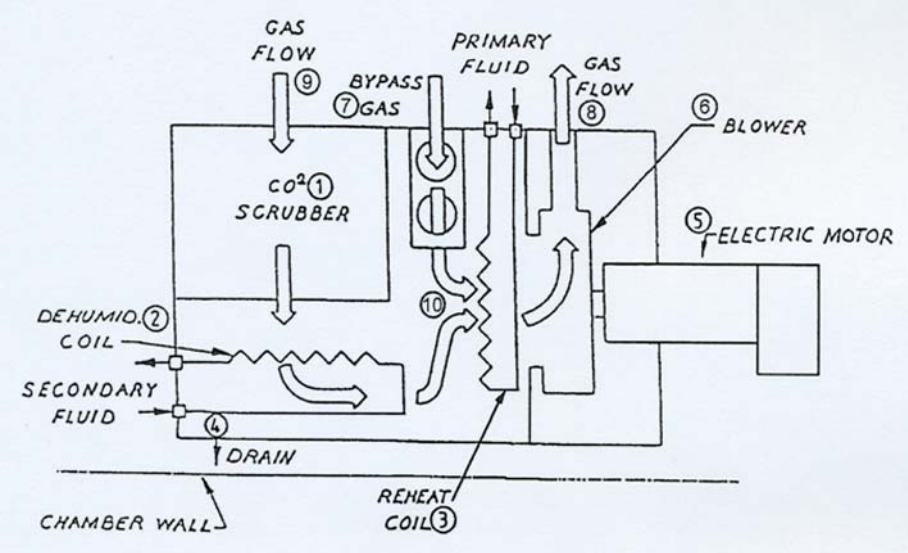

Fig 1.3 Theory of operation

1.2.5 CO2 Scrubbing

A small flow (9) of breathing gas is circulated through CO_2 Scrubber (1). Scrubber contains CO_2 remover such as Sodasorb. As breathing gas flows through absorbing material. CO_2 is removed.

1.2.6 Breathing Gas Flow

Flow of breathing gas through HCU is as follows: Total flow (8) of breathing gas exits through Blower (6). Blower pulls flow through HCU, part through CO_2 Scrubber (1) and Dehumidification Coil (2) and part through Bypass (7). The mixed flow (10) passes through Reheat Coil (3) and into Blower (6) where its pressure is raised and flow is passed back into Habitat.

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CHAPTER 2 - INITIAL SET UP

CONTENTS

2.1 INSTALLATION (FLUIDS)

Habitat Conditioning Unit, HCU 3/4 and HCU 3/6.

See Fig 2.1 and Fig 2.2.

2.1.1 Parts Required for Installation

NOTE
All pipework, valves and fittings must be brass, copper or stainless steel and be rated at a minimum pressure of 52 BAR (750 psi).

	CAUTION
	**Hoses must not be used inside the habitat as they will collapse under habitat pressure.**

2.1.2 Install Habitat Conditioning Unit (HCU)

2.1.2.1 General Information

	CAUTION
	**Do not block or restrict air flow into bypass (8), into CO2 scrubber (7) or from outlet grill (6).**

a. Mount HCU to allow breathing gas to freely circulate within Habitat. Allow at least 356mm (14 inches) between left end of HCU and any bulkhead or other obstruction. This allows blower/ motor assembly to be removed for service.

b. A container should be installed below the HCU Condensate Drain (5) whenever it is mounted over an area that moisture will damage.

c. Flared or Swagelok-type fittings should be used on all joints to allow easy disconnection of tubes for HCU service.

d. Use teflon thread tape on all pipe threads. Tighten all fittings carefully.

e. Loose fittings on return side of Primary or Secondary Fluid System will draw gas into system causing difficulty in priming.

2.1.2.2 Procedure for Typical HCU Installation

a. Bolt HCU to bulkhead. Plumb HCU per block diagram (see Fig 2.3).

b. Install flared fittings to primary and secondary input and output couplings.

c. Install shut-off valves on both sides of habitat wall and plumb tubing to HCU. The primary fluid circuit should be plumbed in ¾" tube. The secondary fluid circuit should be plumbed in ½" tube.

d. Install the external pipework to the CMU

.

	**CAUTION**
	Do not block blower outlet (6) with tubing or piping.

NOTE
Pipework may be bent or installed with swept elbows.

	**CAUTION**
	Shut-off ball valves must be rated for habitat pressure in both directions, internal and external.

2.1.2.3 Completion of Installation

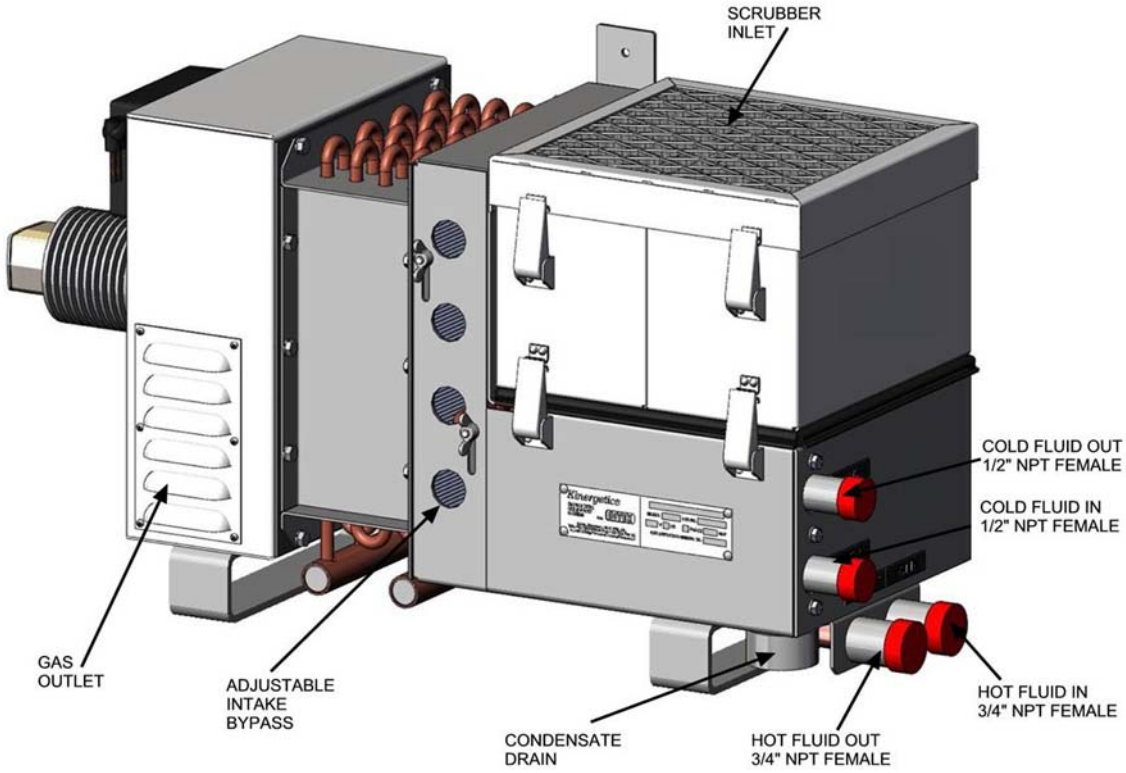

Fig 2.1 Installation diagram (HCU 3/4)

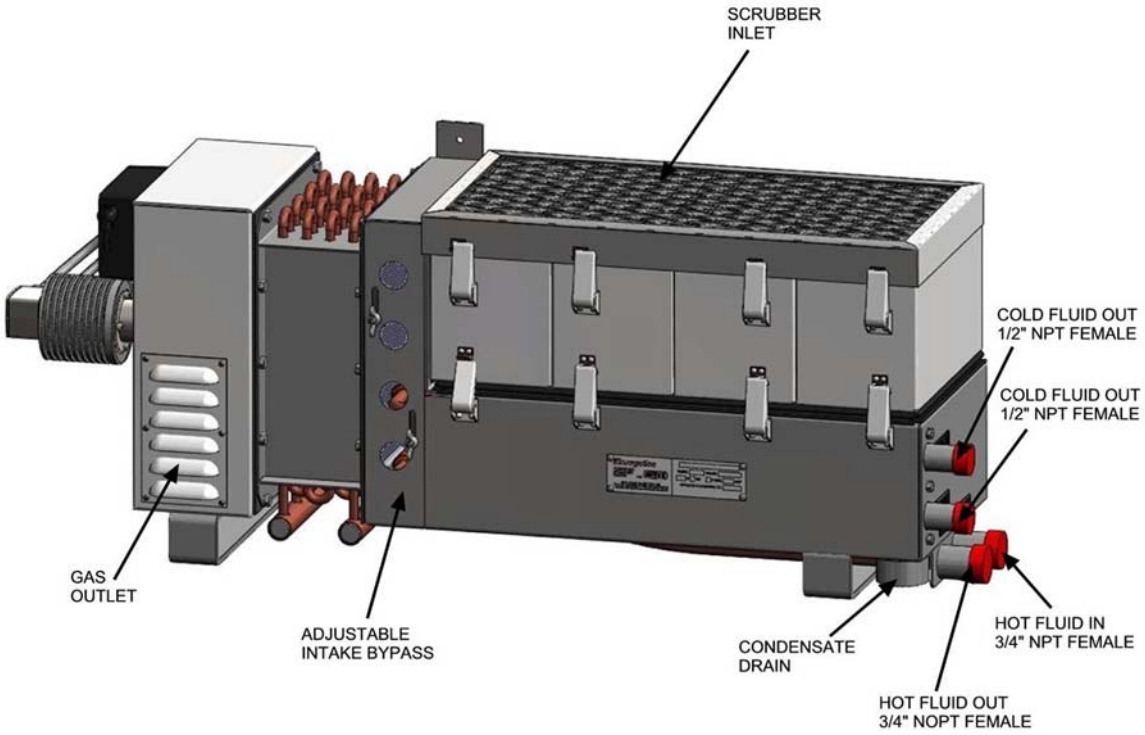

Fig 2.2 Installation diagram (HCU 3.6)

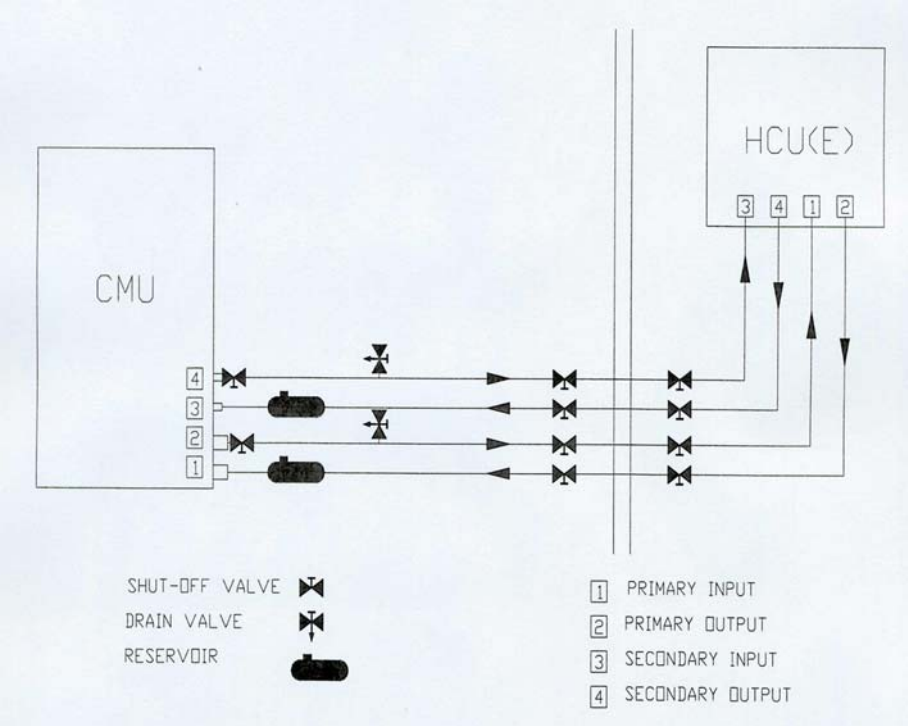

Fig 2.3 Block diagram

2.2 HCU ELECTRICS

2.2.1 Power Supply

The motor controller is configured to operate from 24 V.a.c. or d.c., via a female connector, not included, available in two styles:

Offset:	JFD Part No:	DD442054
Inline:	JFD Part No:	DD442055

2.2.2 HCU Motor Control

The motor controller is supplied factory set ready for use. The controller enclosure is fitted with a bulkhead male connector for ease of installation.

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CHAPTER 3 - OPERATION INSTRUCTIONS

CONTENTS

3.1 INTRODUCTION

3.1.1 General

Blower in Habitat Conditioning Unit (HCU) begins to circulate breathing gas in habitat as soon as the Motor is switched on.

Environmental Control System (ECS) operation is fully automatic from the moment the desired temperature and humidity settings are selected when used in conjunction with a CMU. Only noticeable change during normal system operation will be Refrigeration System cycling on and off. Moisture will begin to drip from HCU if relative humidity rises above setting of Humidity Control Potentiometer.

3.1.2 Carbon Dioxide Removal

The amount of carbon dioxide (CO_2) removed will vary with conditions, but, in general, the CO2 Scrubber Canister will be effective for approximately 90 man-hours before it will need to be refilled.

NOTE
The ECS will not function properly without Sodasorb in CO_2 scrubber canister.

3.2 MAINTENANCE

3.2.1 Maintenance During Operation

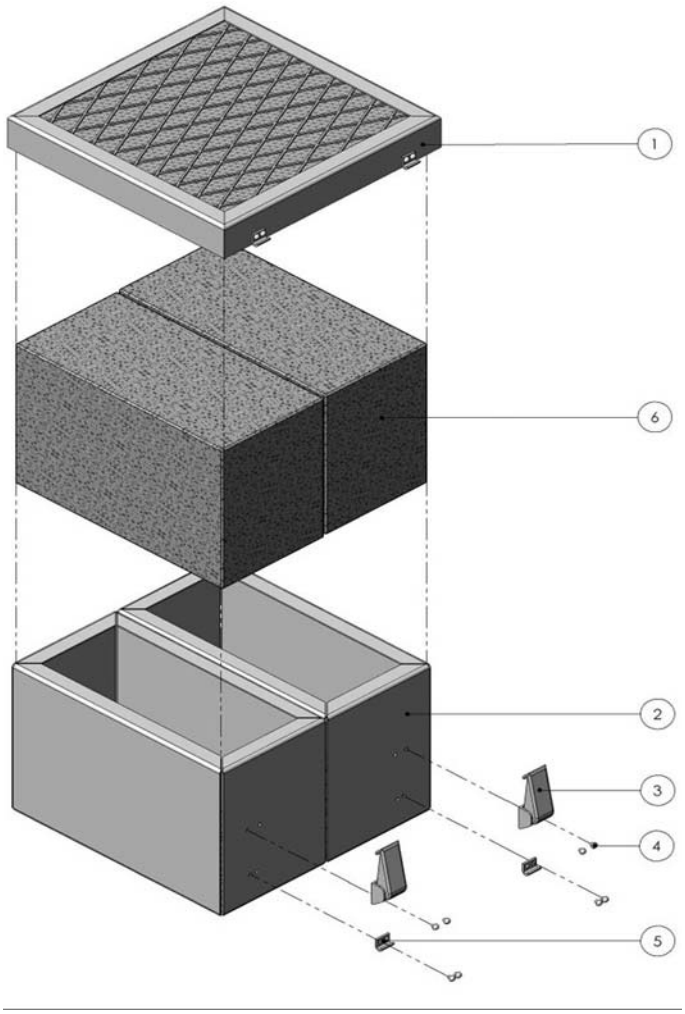
During operation, Sodasorb in CO_2 Scrubber Canister will have to be changed approximately every 90 to 125 man-hours if relative humidity is kept around 70%. If relative humidity is set lower than that, life of Sodasorb will be greatly reduced. If, however, in a diving mode, fresh Sodasorb were to become scarce while running in a low relative humidity condition, a cup of water could be poured on used Sodasorb. This will rejuvenate Sodasorb and prolong its life.

During the course of the dive, water vapour that was condensed drips from HCU drain and will have to be disposed out of the habitat. This must be done on a periodic basis. Recommended procedure is a small container placed under HCU with an overboard dump valve so that water can be easily dumped without having a large water surface exposed.

3.2.2 Refilling CO_2 Scrubber Canister (HCU 3/4)

See Fig 3.1.

1. The CO_2 Scrubber Canister is supplied as a two piece canister.
2. Canisters are easily removed from HCU by means of 4 Latches.
3. To empty CO_2 Scrubber Canister (2), remove Lid, by unlatching 4 Latches (3) and pouring out used Sodasorb (6).
4. Fill CO_2 Scrubber Canister with approximately 13kg (28 pounds) of Sodasorb (6). Pack Sodasorb down tightly for maximum performance.
5. Install Lid (1) and secure with 4 Latches (3). Then install CO_2 Scrubber Canister on HCU and secure with 4 Latches.



Item No	Description	Qty	Part No
1	Lid, assembly, scrubber box	1	KI11993
2	Box, scrubber, single, HCU	2	KI14631
3	Latch	4	KI10633
4	Rivet, pop, 3.2 dia x 2.5-4.5 grip	24	E15602
5	Latch strike	8	KI10648
6	Sodasorb	as req.	CM007

Fig 3.1 Scrubber Canister HCU 3/4

3.2.3 Refilling CO2 Scrubber Canister (HCU 3/6)

See Fig 3.2.

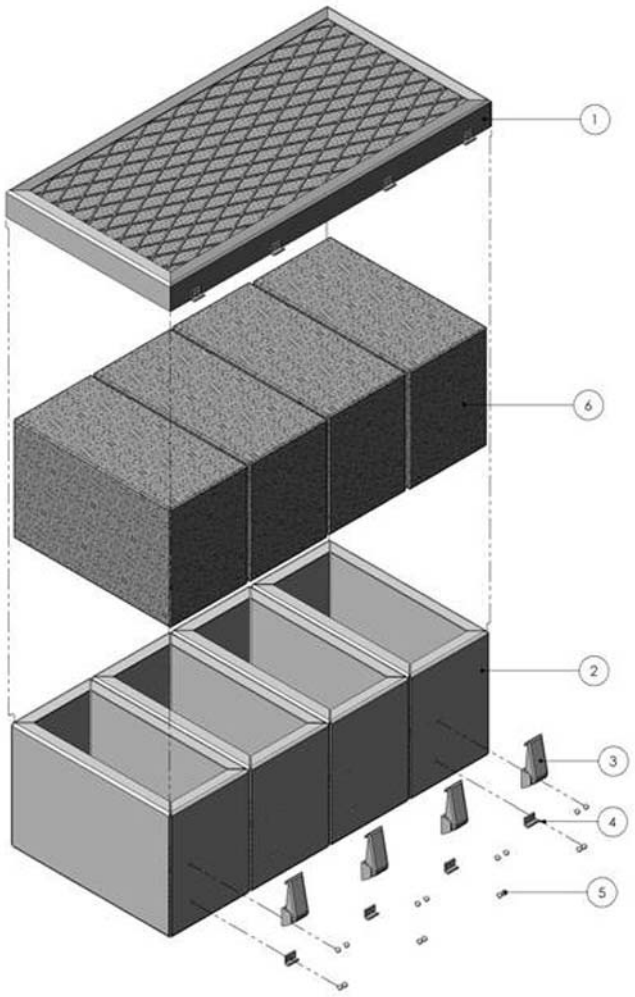
1. The CO_2 Scrubber Canister is supplied as a four piece canister.

2. Canisters are easily removed from HCU by means of 8 Latches.

3. To empty CO_2 Scrubber Canister (2), remove Lid, by unlatching 8 Latches (3) and pouring out used Sodasorb (6).

4. Fill CO_2 Scrubber Canister with approximately 26kg (56 pounds) of Sodasorb (6). Pack Sodasorb down tightly for maximum performance.

5. Install Lid (1) and secure with 4 Latches (3). Then install CO_2 Scrubber Canister on HCU and secure with 8 Latches.



Item No	Description	Qty	Part No
1	Lid, assembly, scrubber box	1	KI11993
2	Box, scrubber, single, HCU	4	KI14631
3	Latch	8	KI10633
4	Latch strike	16	KI10648
5	Rivet, pop, 3.2 dia. x 2.5-4.5 grip	48	E15602
6	Sodasorb	as req.	CM007

Fig 3.2 Scrubber Canister HCU 3/6

CHAPTER 4 - MAINTENANCE AND REPAIR

4.1 ROUTINE MAINTENANCE SCHEDULES, HCU 3/4 & HCU 3/6

4.1.1 Clean and Inspect HCU After 2,000 Hours

NOTE
HCU must be disassembled. See Fig 3.2.

1. Remove Sodasorb Canister and discard Sodasorb. Using clean, dry air source (30 psi), blow debris out of Case, Reheat Coil Fins, Dehumidification Coil Fins, Plenum, CO_2 Scrubber Canister and bottom of Case.

2. Using hot soap solution, clean inside and outside of entire HCU. Clean Reheat Coil Fins, Dehumidification Coil Fins, and inside of CO_2 Scrubber Canister. Rinse entire unit with hot water and dry with air and clean, lint-free cloth.

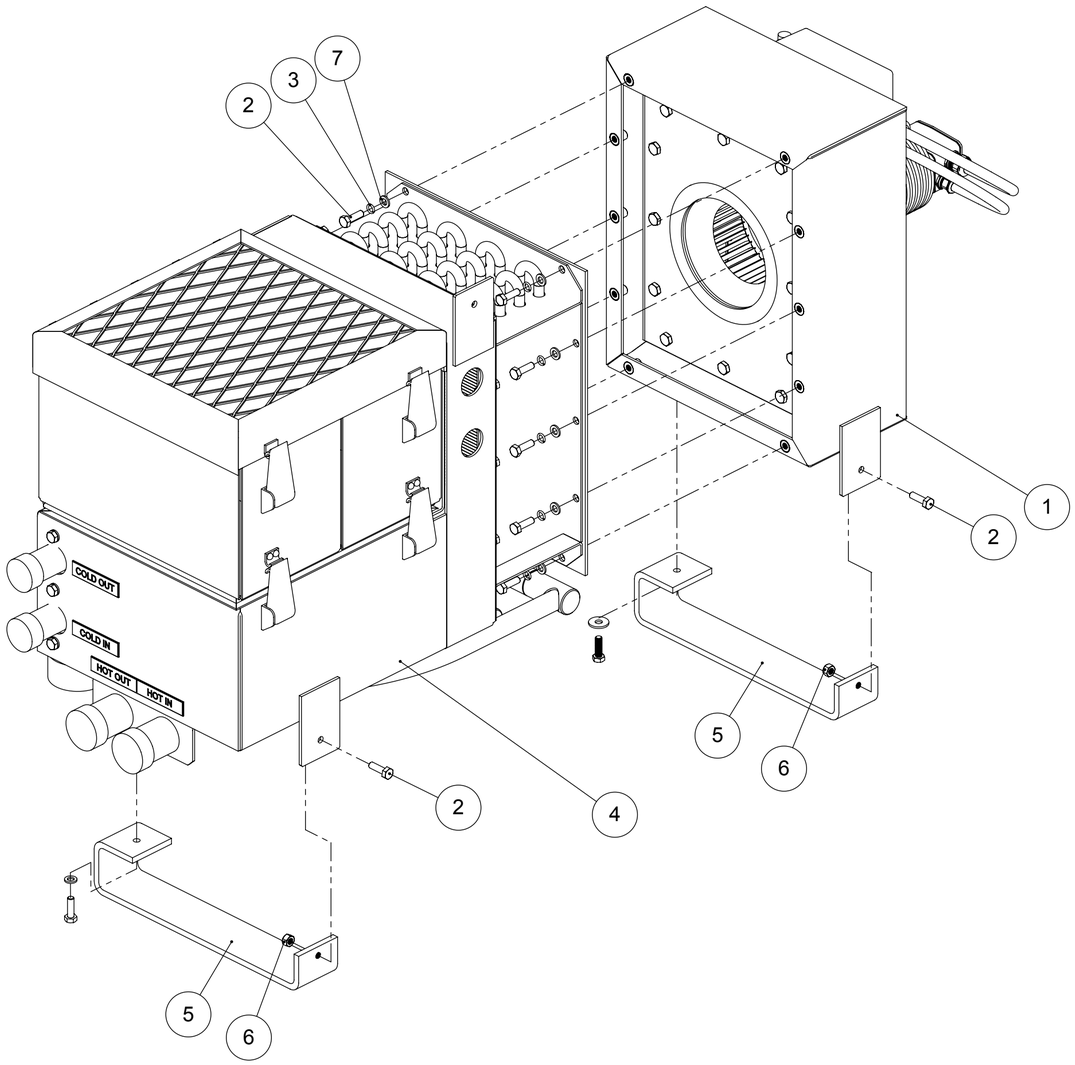
	**CAUTION**
	Be sure CO2 scrubber canister and filter screen are completely dry before adding Sodasorb. Inspect HCU for signs of damage.

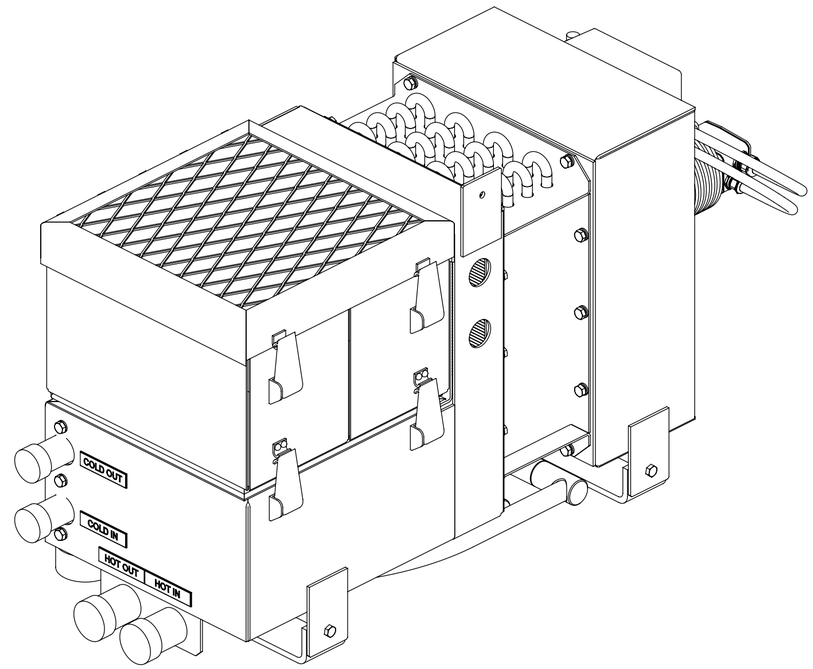
4.2 HABITAT CONDITIONING UNIT SERVICE - ELECTRIC MOTOR

This motor is not user servicable, please contact JFD service department.

Fig 4.1 HCU 3/4 Electric Drive
(Drawing P217711S1)

ITEM	PART No.	DESCRIPTION	QTY.
1	KI40037101	BLOWER SUB ASSY, HCU 3/*	1
2	FB113	SETSCREW, HEX, M6 x 1 x 20, 316L ST. STEEL	12
3	FW127	WASHER, SPRING, M6, TYPE A, SS 316	10
4	KI40034100	HCU 3/4 WITHOUT BLOWER	1
5	KI40036304	FOOT, TRANSIT, HCU 3/*	2
6	FN036	NUT, NYLOC, M6, 316L ST. STEEL	2
7	FW123	WASHER,M6, FORM A, 316L ST. STEEL	10





ISOMETRIC VIEW

NOTES

COIL : MAXIMUM WORKING PRESSURE = 30 BAR
DESIGN PRESSURE = 33 BAR
TEST PRESSURE = 50 BAR
DESIGN TEMPERATURE = 75°C (4)

ENVIRONMENT : DESIGN TEMP. = 36°C

4 - 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: SEE PARTS LIST

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05					
R04	NOTES ADDED	17480	JR	16/02/15	SC
R03	10 OFF FW123 ADDED	13711	SR	17/12/10	SW
R02	UPDATED TO SHOW LABELS	12115	GC	02/03/09	RTW
R01	UPDATED TO SHOW NEW MOTOR ARRANGEMENT	10887	GC	03/07/08	RTW
R00	ISSUED FOR MANUFACTURE		GR	28/06/08	RTW

DO NOT SCALE DRAWING

TITLE: **HCU 3/4, ELECTRIC DRIVE, 24Vdc**

DRAWING No.: **P21711S1** REV: **R04**

PART No.: KI40034 PRODUCT / PROJECT No.: KINERGETICS

SIZE: A2 SCALE: 1:4 SHT: 1 OF: 1

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ENTERPRISE DRIVE
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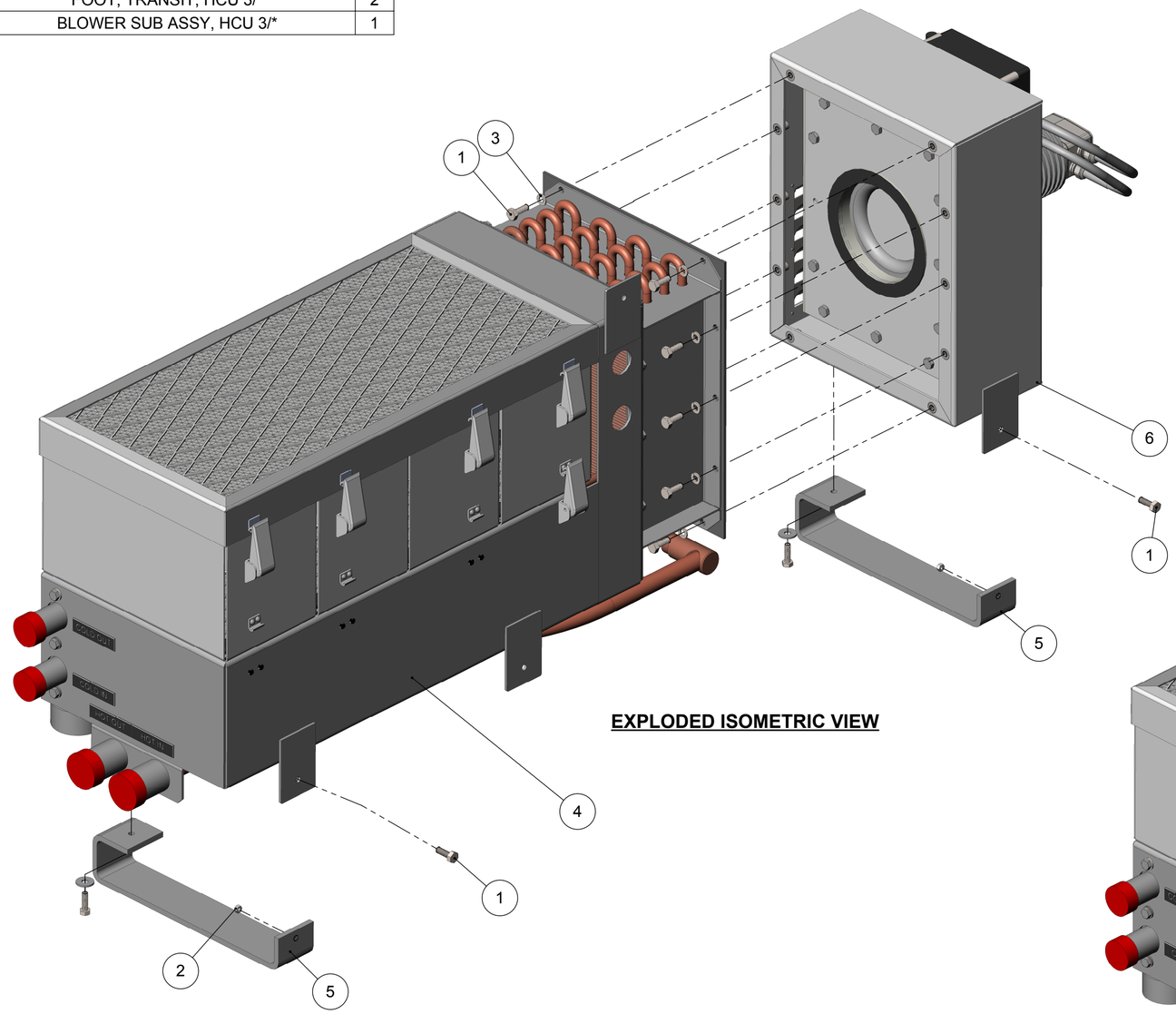
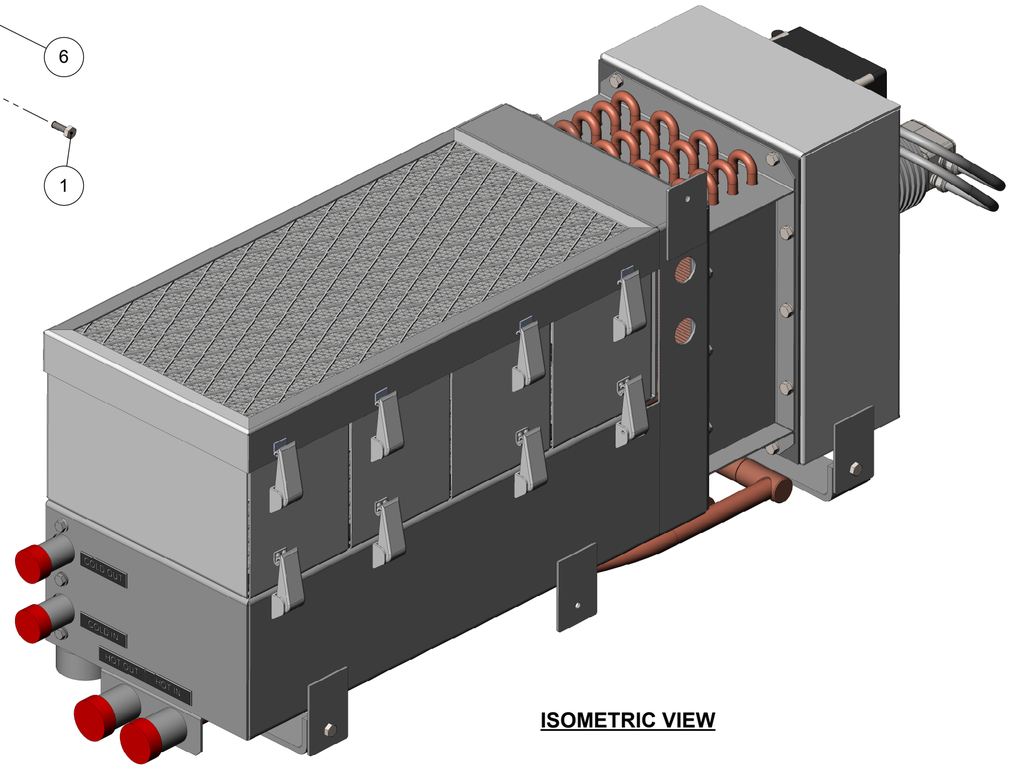
email : info@divexglobal.com
www.divexglobal.com

Fig 4.2 HCU 3/6 Electric Drive
(Drawing P21713S1)

ITEM NO.	PART NO.	DESCRIPTION	Qty.
1	FB113	SETSCREW,HEX, M6 X 1 X 20, 316L ST. STEEL	12
2	E16426	NUT,HEX, M4 X 0.7	2
3	FW127	WASHER,SPRING, M6, TYPE A, SS 316	10
4	KI40036	HCU 3/6 WITHOUT BLOWER SUB ASSEMBLY	1
5	KI40036304	FOOT, TRANSIT, HCU 3/*	2
6	KI40037101	BLOWER SUB ASSY, HCU 3/*	1



EXPLODED ISOMETRIC VIEW



ISOMETRIC VIEW

NOTES

COIL : MAXIMUM WORKING PRESSURE = 30 BAR
DESIGN PRESSURE = 33 BAR
TEST PRESSURE = 45 BAR
DESIGN TEMPERATURE = 75°C 4

ENVIRONMENT : DESIGN TEMP. = 36°C

4 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: SEE PARTS LIST

FINISH: N/A

THIRD ANGLE PROJECTION

REV	DESCRIPTION	ECN No	BY	DATE	AUTH.BY
R06					
R05					
R04	NOTES UPDATED	19452	MJ	29/04/16	AN
R03	NOTES ADDED	17482	JR	16/02/15	SC
R02	UPDATED TO SHOW LABELS	12115	GC	03/03/09	RTW
R01	UPDATED TO SHOW NEW MOTOR ARRANGEMENT	10887	GC	02/07/08	GMcC
R00	ISSUED FOR MANUFACTURE		GC	02/07/08	RTW

DO NOT SCALE DRAWING

TITLE: **HCU 3/6, ELECTRIC DRIVE, 24VDC**

DRAWING No.: **P21713S1** REV: **R04**

PART No.: KI40037 PRODUCT / PROJECT No.: KINERGETICS

SIZE: A2 SCALE: 1:4 SHT: 1 OF: 1

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