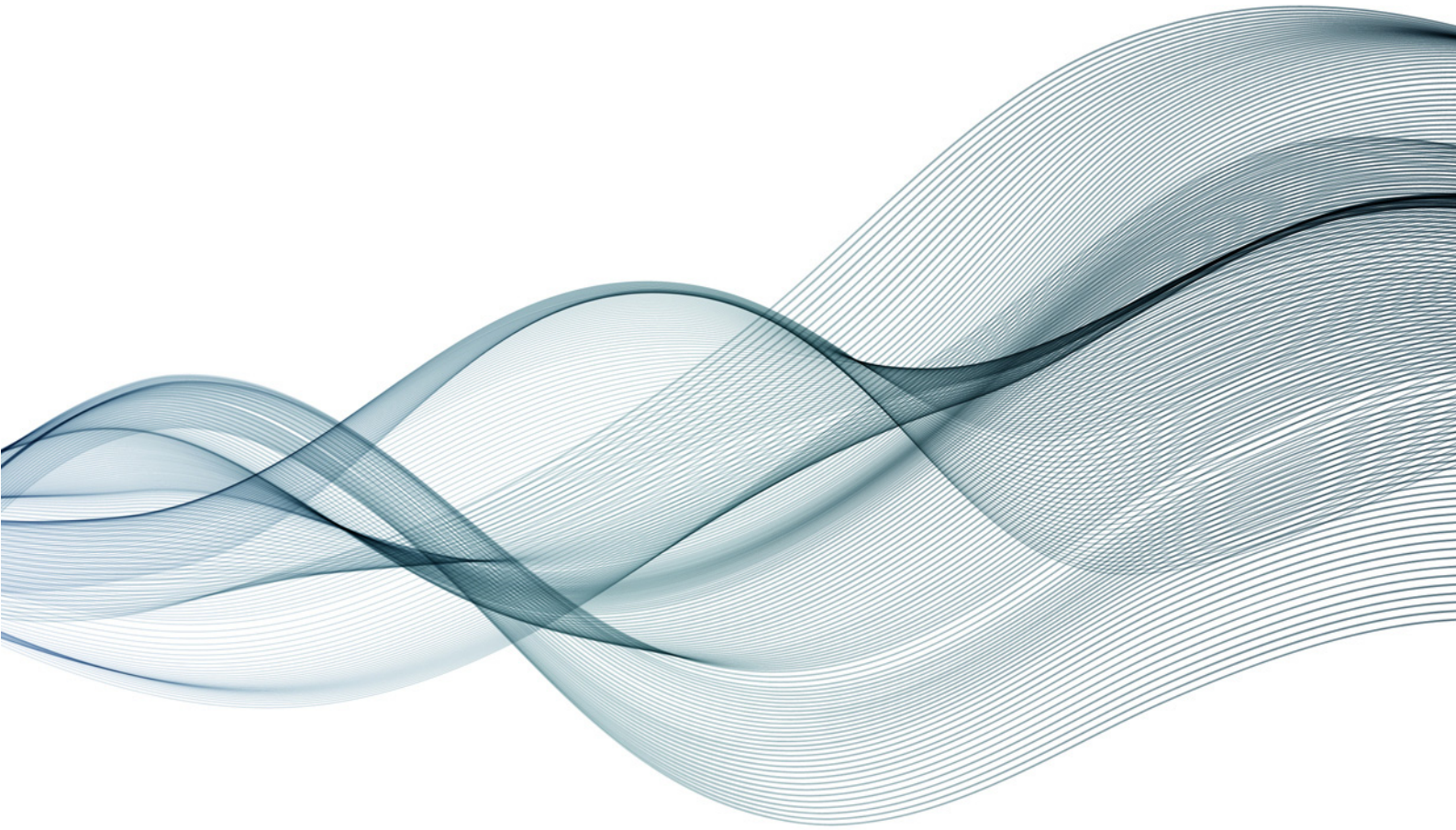


Operation and Maintenance Manual
Bell Heater & CO_2 Scrubber
DH21H & DH21S

Part No.	KI17016, KI17018 & KI17018 HS
Document No.	KI-OM-325
Document Rev.	7

TABLE OF CONTENTS

Intentionally blank

APPROVAL SHEET

Document Information		
Advitium No	**Title**	**Classification**
KI-OM-325	Operation and Maintenance Manual Bell Heater & CO_2 Scrubber DH21H & DH21S	Commercial in confidence

Revision History					
Rev	**Date**	**BY**	**CHK**	**APP**	**Comments**
0	08/06/01	AAC			Original Issue
1	02/05/13	SB	AN	MS	ECN 15848
2	22/11/16	JRC	PD	AN	ECN 19910
3	27/07/17	JRC	P. Davies	A. Naylor	ECN 21292
4	08/12/17	JRC	P. Davies	P. Black	ECN 21677
5	12/03/18	JRC	E. Thomson	P. Black	ECN 22118
6	23/04/18	J. Cusson	A. Naylor	P. Black	ECN 22342
7	11/12/19	J. Cusson	A. Naylor	A. Bennett	ECN 24541

Revision 7 Implemented		
Responsibility	**Name**	**Position**
By	J. Cusson	Technical Author
Checked	A. Naylor	Senior Mechanical Engineer
Approved	A. Bennett	Production Engineering Team Leader

Copyright Details

Disclaimer

Whilst every effort has been made to ensure the information within this document is correct at the time of publication, JFD Ltd reserves the right to make changes without notification. Users are recommended to visit www.jfdglobal.com for the most up-to-date versions of manuals.

Review

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

Intentionally blank

ABBREVIATIONS

AC	Alternating Current
bar	Metric unit of pressure, approximately equal to 1 atmosphere
CO_2	Carbon Dioxide
DC	Direct Current
kg	kilograme
kW	kilo Watt
lpm	litres per minute
mm	millimetre
MSW	Metres of Sea Water
RH	Relative Humidity
STP	Standard Temperature and Pressure
V	Volt

Intentionally blank

DANGER, WARNING & CAUTION

Danger, Warnings, Cautions and Notes where used within this manual are placed prior to the text to which they are pertinent. Their uses are as follows;

INFORMS THE READER OF AN OPERATION OR CONDITION WITCH MAY INVOLVE RISK TO LIFE.

INFORMS THE READER OF AN OPERATION OR STATE WITH POTENTIAL FOR PERSONNEL INJURY.

Informs the reader of an operation or state with potential for damage to equipment.

Note ***Informs the user of additional information for clarification or to assist with an operation.***

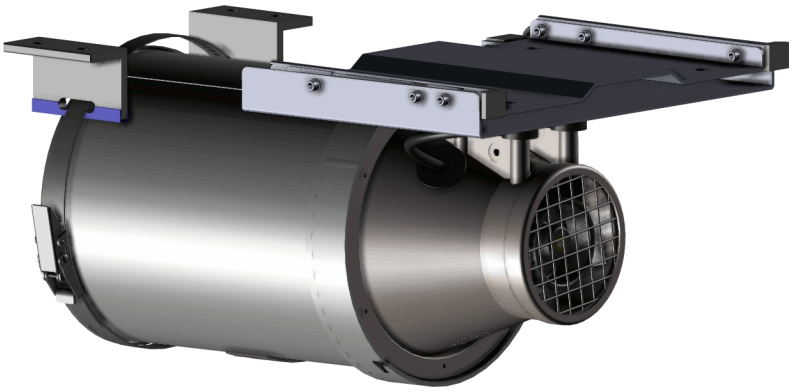
Intentionally blank

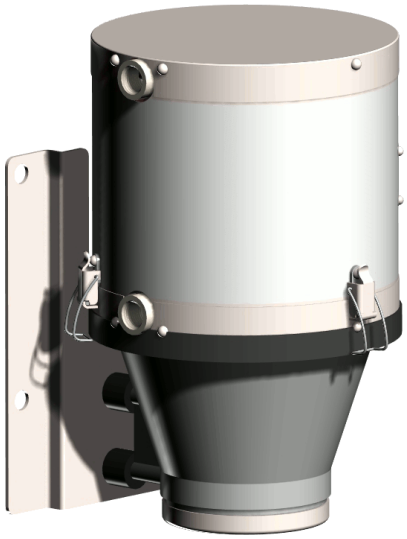
1 INTRODUCTION

1.1 The DH21 Bell Heater and CO_2 Scrubber units are specifically designed and constructed for use in professional diving systems. The units provide heating and CO_2 removal, and are easily installed and removed.

1.2 The Bell Heater and CO_2 Scrubber system consist of two independent units, the Bell Heater and the CO_2 Scrubber. The two units may be used as a set or individually. When used as a set, each unit can be mounted separately. Electric Motors within the units are sealed in containers rated at 60 bar working pressure and supply rotating power to a fan through an inductive magnetic coupling. Heater and Scrubber motors are identical and may be interchanged.

KI17018HS
Horizontal Mount
Scrubber





KI17016
Heater

KI17018
Scrubber

2 SPECIFICATIONS

Table 1 Specifications and Service Connections

Specification	Heater	Scrubber
Power Supply Voltage	24 Volt (ac or dc)	
Power Supply Current	1.2 Amp (continuous) (current limiter set to 2.1 Amp)	
Motor Rotation	Anti-Clockwise (viewed at fan end)	
Maximum Operating Depth	500 msw	
Maximum Operating Temperature & Humidity	60°C/100% RH[1]	
Gas Flow Rate (@ STP)	1,700 lpm	850 lpm
Hot Water Flow Rate	7 - 23 lpm	
Hot Water Temperature Range	60°C to 93°C	
Heat Output (theoretical)	9.5kW[2] to 70 kW[3]	
Hot Water Connections	1/2" NPT Female	
Canister Capacity		5.5 kg / 6.1 litres[4]
Scrubber Duration		9.6 hrs[5]
Installed Weight (dry)	11.5 kg	10 kg
Shipping Weight	12.5 kg	10.8 kg

1. High relative humidity and corrosive atmospheres will reduce bearing life.
2. Based on fresh water heating fluid supply @ 7 lpm, @ 60°C, with heated environment (air) @ 32°C and heat transfer efficiency of 75%.
3. Based on fresh water heating fluid supply @ 23 lpm, @ 93°C, with heated environment (air) @ 32°C and heat transfer efficiency of 75%.
4. Sodalime with bulk density of 0.9 kg/litre.
5. For one person with a carbon dioxide production @ 0.833 lpm/diver, based on a processing capacity of 88 litres of CO_2/kg for Sofnolime Grade CD. The 88 l/kg is based on a conservative 80% efficiency of the manufacturers' specification of 110 l/kg.

3 DESCRIPTION

3.1 GENERAL

3.1.1 The DH21 Heaters and Scrubbers are designed for heating and atmosphere scrubbing inside decompression chambers, diving bells and hyperbaric lifeboats, and are also suited for a variety of other living compartments. Consult JFD for more information.

3.1.2 The DH21 heaters and scrubbers are capable of operating continuously within the normal operating parameters.

3.1.3 The DH21 range utilizes a common blower platform with a hermetically sealed, magnetically coupled electric motor, rated to an external pressure of 60 bar. The electric motor is of a brushless design, equipped with Hall Effect sensors and fine tuned for optimal performance. Blower bearings are exposed to the environment.

3.1.4 The DH21 hermetically sealed design eliminates the need for potting of sensitive electronic components, thus preventing exposure of electronic component hotspots to the diving bell and chamber atmospheres where elevated concentrations of oxygen may present an increased fire risk.

3.1.5 Although functionally different, the operation of the DH21 Heater and Scrubber models is identical. Surrounding atmosphere is radially drawn in through the process canister, flows over the motor and exits from the grilled aperture at the bottom of the unit.

3.1.6 The DH21 heater and scrubber must never be submerged or exposed to water spray. The bearings are not corrosion resistant and bearing life will be reduced in corrosive, wet, or high humidity environments.

3.1.7 The process canister attaches to the blower platform with either over-centre cam latches, or optionally a bayonet type locking mechanism on some variants, allowing for quick installation and removal.

3.2 HEATER

3.2.1 The DH21 Heater canister comprises a perforated cylindrical housing fitted with a wire-wound heating coil, for increased heat transfer performance, supplied with a heated fluid from an external source to transfer heat into the bell or chamber environment.

3.2.2 Heat output is a function of heating fluid temperature, flow rate, chamber/bell temperature, and pressure. Increases in heating fluid temperature and/or flow rate will increase rate of heat transfer.

3.2.3 Increasing chamber/bell pressures will increase heat transfer efficiency. Heat output decreases as the environment temperature approaches the heating coil/heating fluid temperature.

3.3 SCRUBBER

3.3.1 The DH21 Scrubber canister comprises a perforated cylindrical housing with a removable lid containing the process chemical, most often sodalime as carbon dioxide absorbent, which facilitates the chemical removal of carbon dioxide gasses from the diving bell or chamber atmosphere. The housing is internally lined with a fine mesh to prevent dust release from the canister.

3.3.2 The CO_2 Scrubber contains a CO_2 absorbent canister and an electric motor driven fan. The fan pulls a flow of gas through the CO_2 absorbent canister where CO_2 is removed from the breathing gas.

3.3.3 Alternative chemicals may be used in conjunction with sodalime, or on their own for atmosphere sweetening. Please consult JFD for more information.

3.3.4 Scrubbing efficiency will vary with temperature and humidity conditions within the chamber/ bell. Refer to Table 1 for approximate duration per canister of Sofnolime Grade CD, at conditions specified. Grade and quality of chemicals all influence the performance of the chemical reactions. Consult with the chemical manufacturer, or JFD Ltd, to ascertain the effectiveness of chemicals for a specific application prior to use.

3.3.5 When filling the canister gently shake the canister to allow chemicals to settle, topping up as necessary. Always fill the canister to the top with chemicals to avoid free gas passage which may reduce scrubbing performance.

Note ***Metabolic oxygen make-up gas should always be injected downstream of the DH21 Scrubber outlet.***

4 INSTALLATION

4.1 GENERAL GUIDANCE

4.1.1 Installation position should ensure the motor centre line is within ±5° of horizontal or vertical depending on model, if vertical the scrubber canister must be above the motor. Special mounts are available for alternative mounting orientations, please contact JFD Ltd. for guidance.

4.1.2 To prevent fasteners from vibrating loose use locking nuts and/or thread locking adhesive.

4.2 HEATER

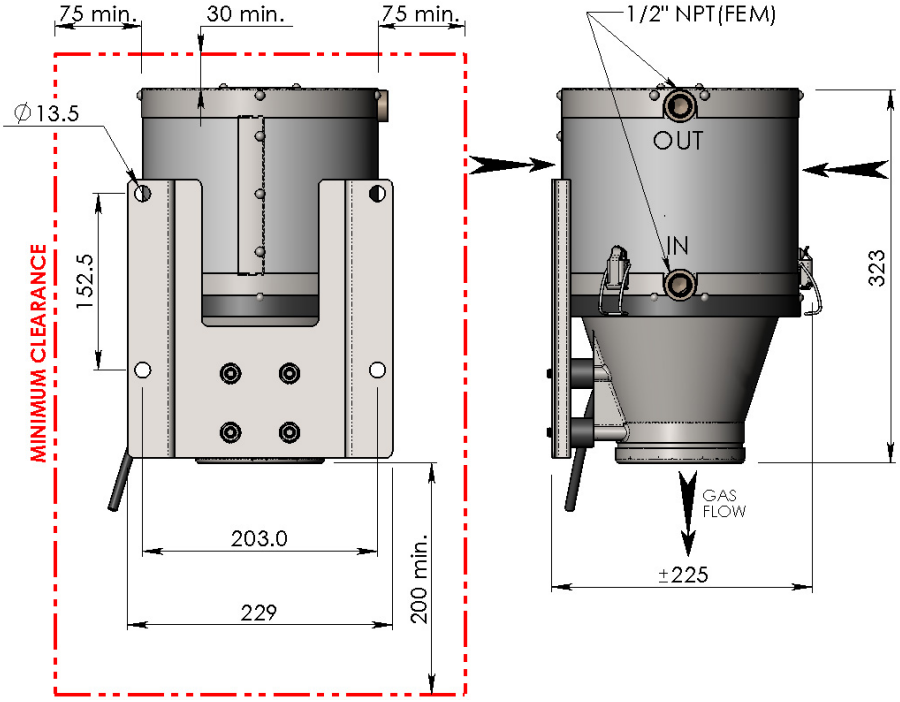
4.2.1 The heater may be mounted in any orientation. (Ref. Para 4.1)

4.2.2 Hot water interconnect piping must be rigid, and capable of withstanding external pressures in excess of 1.3 times the maximum chamber pressure.

4.2.3 Heating circuit piping must not transfer stresses into the heating coil.

4.2.4 Allow clearances as shown in Figure 1.

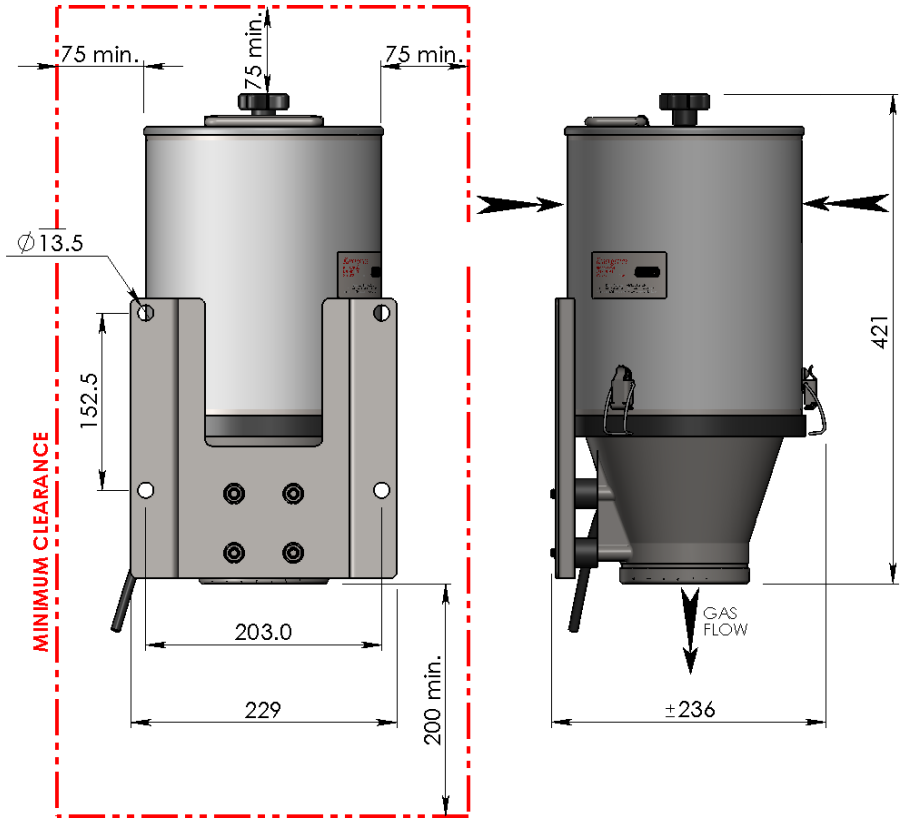
Figure 1 Heater Mounting



4.3 SCRUBBER (VERTICAL MOUNT)

4.3.1 Allow clearances as shown in Figure 1 and 2.

Figure 2 Scrubber Mounting



4.4 SCRUBBER (HORIZONTAL MOUNT)

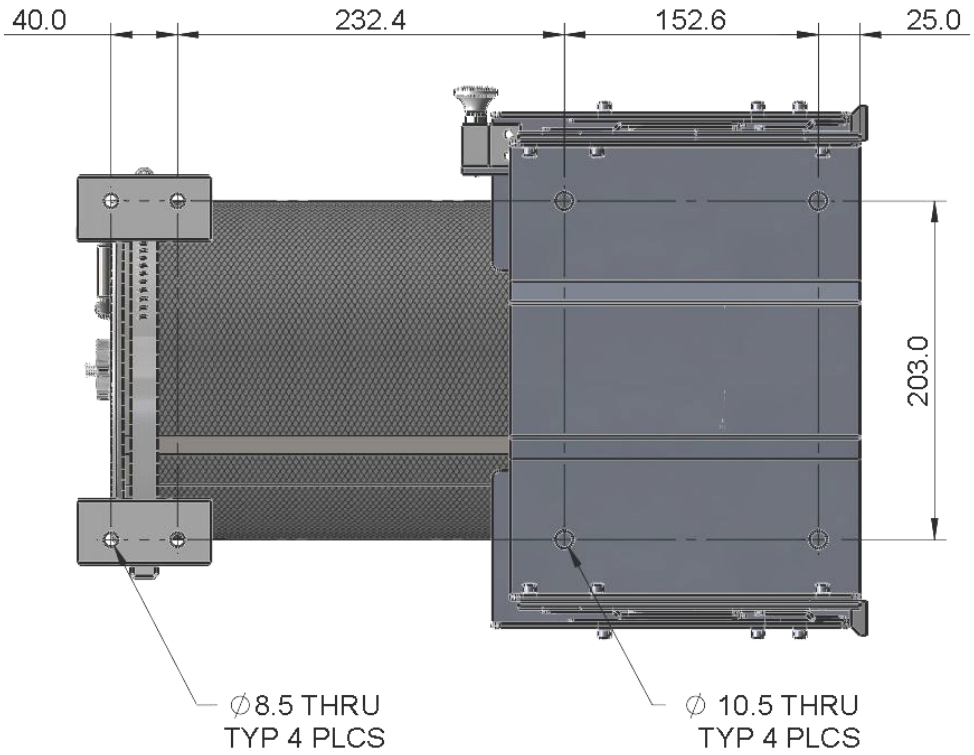
4.4.1 Refer to Figure 3 for details of hinge plate and retaining strap mounting details.

Note ***If mounting on a flat plate retaining bolts must be fitted with spacers at least 16 mm thick to allow space for the mounting plate hinges, refer to section 7.5 for details of the mounting plate.***

4.4.2 Allow clearances around the sides and ends of the scrubber as per the vertical mount.

4.4.3 Ensure a clearance of 360 mm is available below the scrubber to allow the scrubber to be hinged downward and to facilitate scrubber canister removal and re-fitting.

Figure 3 Mounting Details



4.5 ELECTRICAL

4.5.1 The power supply circuit must be 24 V (AC or DC) and rated for 1.2 Amp continuous operation.

4.5.2 The onboard current limiting circuit is set to 2.1 Amp.

4.5.3 Each DH21 unit should be protected by a 3 Amp fuse in the power supply circuit.

4.5.4 The DH21 units are supplied fitted with waterproof connectors which may be used as a contact breaker.

5 REMOVAL INSTRUCTIONS

WARNING

WEAR APPROPRIATE PPE BEFORE COMMENCING MAINTENANCE ACTIVITIES.

WARNING

TAKE NECESSARY SPILLAGE PRECAUTIONS WHEN DISCONNECTING THE HEATING FLUID CIRCUIT.

CAUTION

Cap all open electrical and fluid connections to prevent ingress of foreign material.

5.1 HEATER

5.1.1 Isolate the heating fluid circuit before commencing removal of the unit.

5.1.2 Ensure the heating fluid is cool enough, and the heating circuit is at ambient pressure before disconnecting heating circuit fittings.

5.1.3 Remove the heater canister by un-clipping the three over-centre cam latches.

5.1.4 Disconnect the waterproof connector at the rear of the motor and cap the open electrical connections to prevent ingress of foreign material.

5.1.5 Remove the grommet from the frame, and withdraw the electrical cable.

5.1.6 Restrain the unit whilst removing the four base-plate to bulkhead fasteners to prevent freefall.

5.1.7 It is recommended that the entire heater unit is removed from the chamber/bell for maintenance and repair.

5.1.8 JFD recommends that inspection, cleaning and testing of the heater coil should be conducted during maintenance and repair activities.

5.2 SCRUBBER (VERTICAL MOUNT)

5.2.1 Remove the scrubber canister by un-clipping the three over-centre cam latches.

5.2.2 Disconnect the waterproof connector at the rear of the motor and cap the open electrical connections to prevent ingress of foreign material.

5.2.3 Remove the grommet from the frame, and withdraw the electrical cable.

5.2.4 Restrain the unit whilst removing the four base-plate to bulkhead fasteners to prevent freefall.

5.2.5 It is recommended that the entire scrubber unit is removed from the chamber/bell for maintenance and repair.

5.3 SCRUBBER (HORIZONTAL MOUNT)

5.3.1 Remove the scrubber canister by un-clipping the retaining strap over-centre cam latch.

5.3.2 Push the retaining strap away from the canister and pull out the retaining pin (Figure 4).

5.3.3 Pull the canister downward, allowing it to rotate on the friction hinge (Figure 5).

5.3.4 Rotate the canister to release the three bayonet fittings (Figure 6) then remove the canister from the mounting bracket.

5.3.5 Restrain the unit whilst removing the four base-plate to bulkhead fasteners to prevent freefall.

5.3.6 If required remove the retaining strap mounting plates.

Figure 4

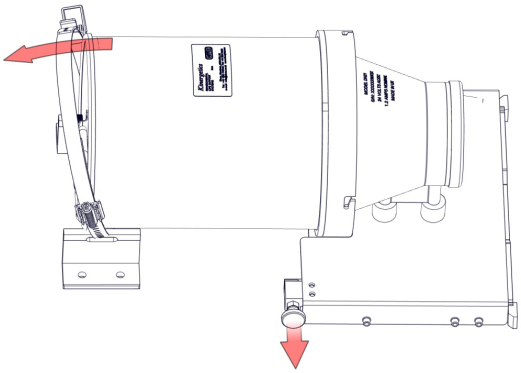


Figure 5

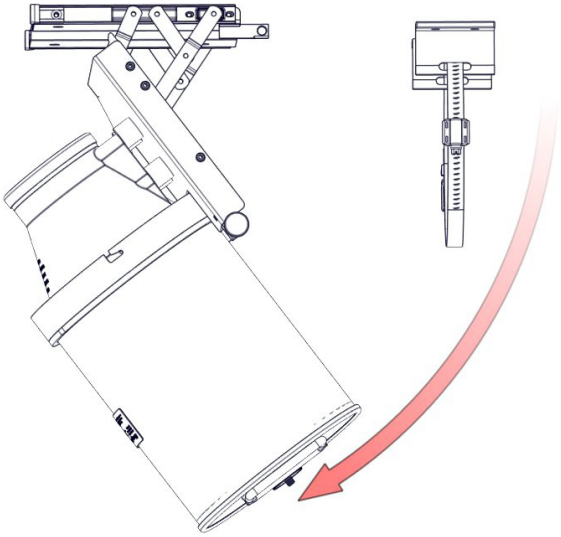
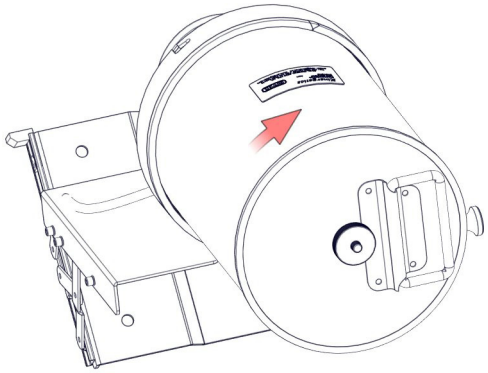
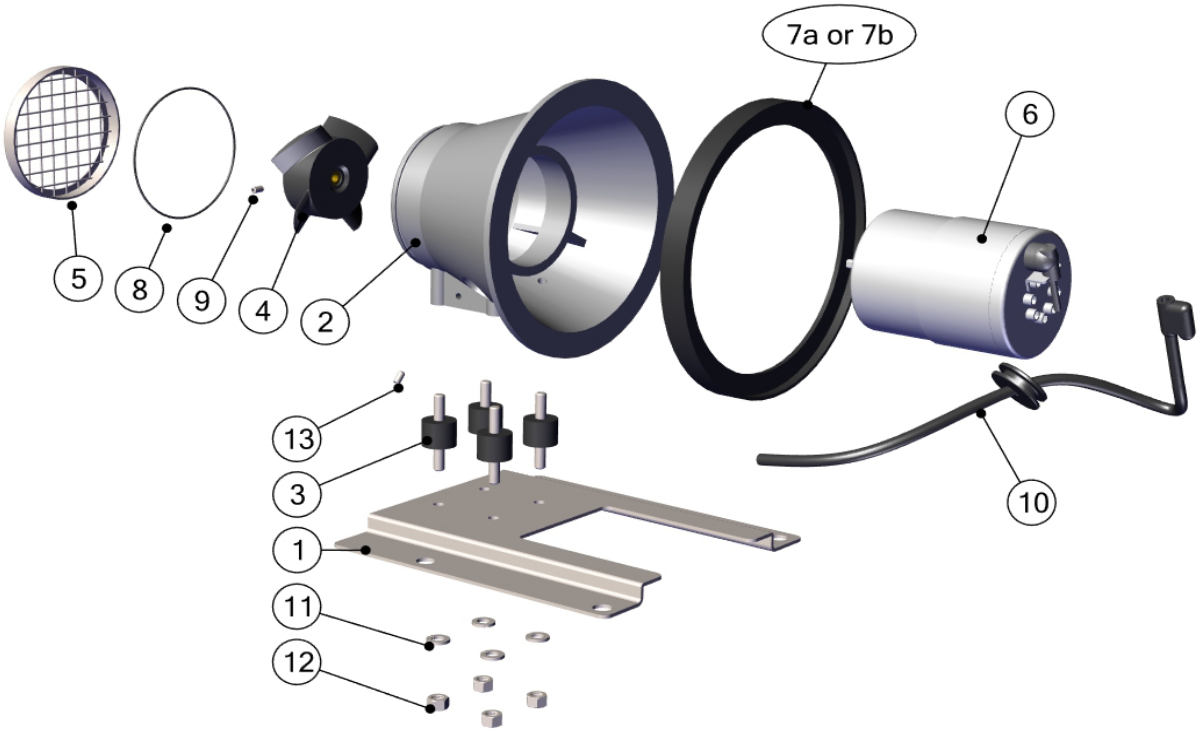


Figure 6



6 MAINTENANCE

Figure 7 Blower Assembly



6.1 MOTOR REMOVAL

6.1.1 Remove the scrubber / heater from the chamber in accordance with section 5.

6.1.2 Remove the scrubber / heater from its mounting plate.

6.1.3 Remove Fan Guard, item 5.

6.1.4 Loosen Grub Screw item 9, 3 turns.

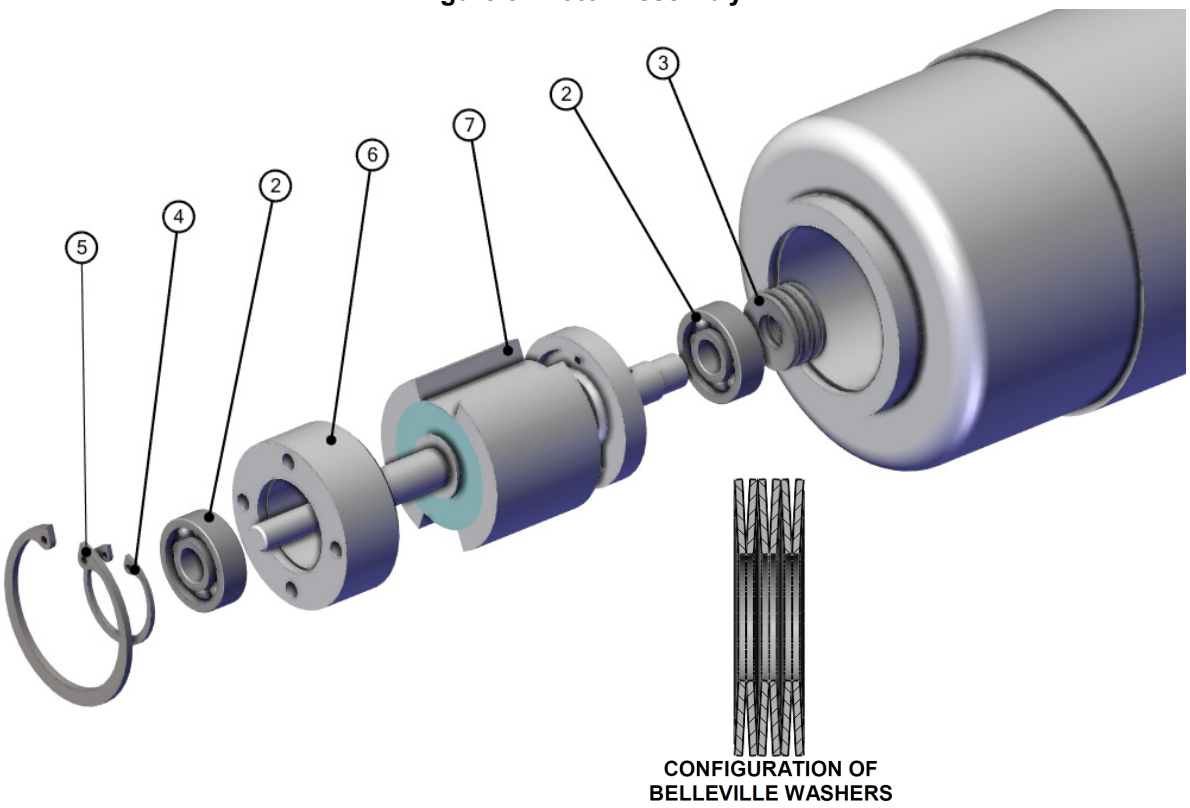
6.1.5 Remove Fan, item 4.

6.1.6 Loosen Set Screw item 13, 3 turns.

6.1.7 Withdraw the motor, item 6, from the wide end of the frame, item 2.

6.2 BEARING REPLACEMENT

Figure 8 Motor Assembly



CAUTION

Only use original bearings supplied by JFD. All bearings supplied by JFD are lubricated with oxygen compatible grease.

6.2.1 Remove the motor from the casing in accordance with para 6.1 Motor Removal.

6.2.2 Using circlip pliers remove the large internal circlip item 5.

6.2.3 Withdraw the rotor shaft assembly, along with bearing sleeve, item 6 from the rotor housing.

Note ***Ensure that all 6 belleville washers are retrieved, there may be one adhered to the bearing face.***

6.2.4 Withdraw the 6 belleville washers, item 3 from the rotor housing.

6.2.5 Remove the bearing sleeve, item 6, from the outer bearing, item 2.

6.2.6 Using a bearing puller, remove both bearings, item 2, from the rotor shaft, item 7.

6.2.7 Using a dry, lint-free cloth, clean the rotor shaft assembly, item 7, and the inside of the rotor housing, ensuring all magnetic particles have been removed.

6.2.8 Inspect the rotor shaft bearing surfaces.

6.2.9 The rotor shaft bearing surface diameters must not be less than 7.996 mm, and concentricity with shaft centreline ≤0.013 mm.

6.2.10 Press new bearings, item 2, onto the rotor shaft, item 7.

6.2.11 Bearings fit must be ‘push-fit’ onto shaft. Free play between bearing and shaft may result in premature failure and permanent damage to the rotor shaft and/or bearings.

Note ***For ease of reassembly support the motor assembly, output shaft upwards on a suitable support or hold lightly in a soft jaw vice***

Note ***To fit the belleville washers it may be helpful to assemble them correctly on a suitable rod then slide them down the rod into place to prevent them flipping over during installation.***

6.2.12 Install the 6 belleville washers, item 3, see Figure 8 for correct configuration.

6.2.13 Fit the bearing sleeve, item 6 onto the outer bearing, item 2.

6.2.14 Lower the rotor shaft, item 7 into the motor assembly.

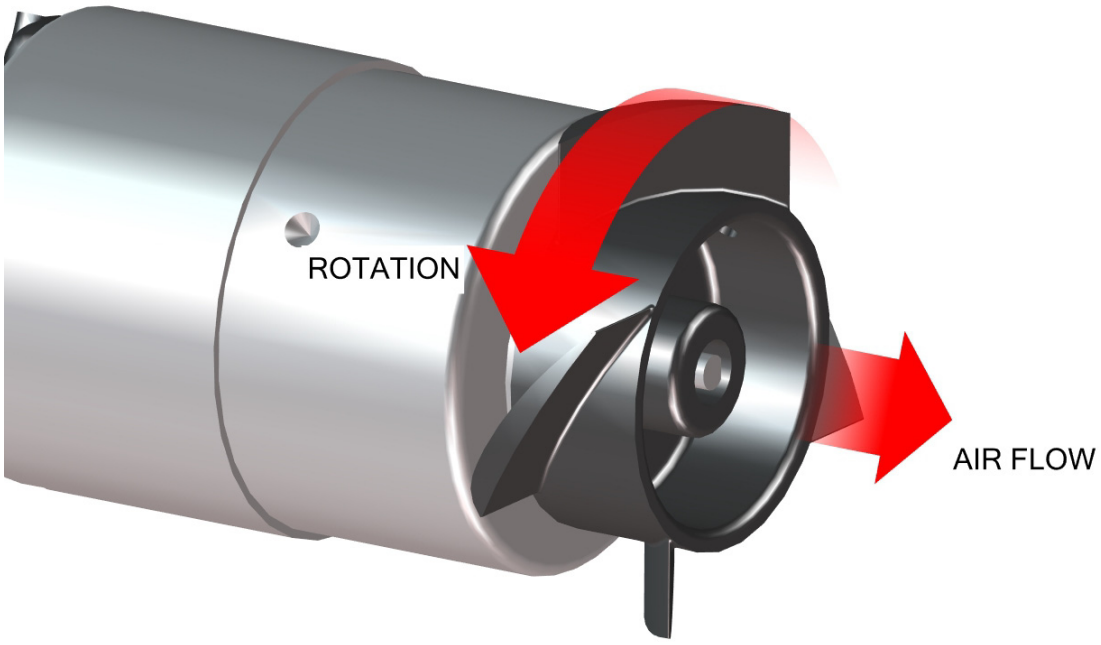
Note ***The rotor shaft must be pushed in to compress the belleville washers in order to fit the large internal circlip, item 5.***

6.2.15 Fit the large internal circlip, item 5.

6.3 REFITTING THE FAN

6.3.1 On refitting the fan to the motor shaft, ensure the hollow end of the fan is facing away from the motor, see Figure 9.

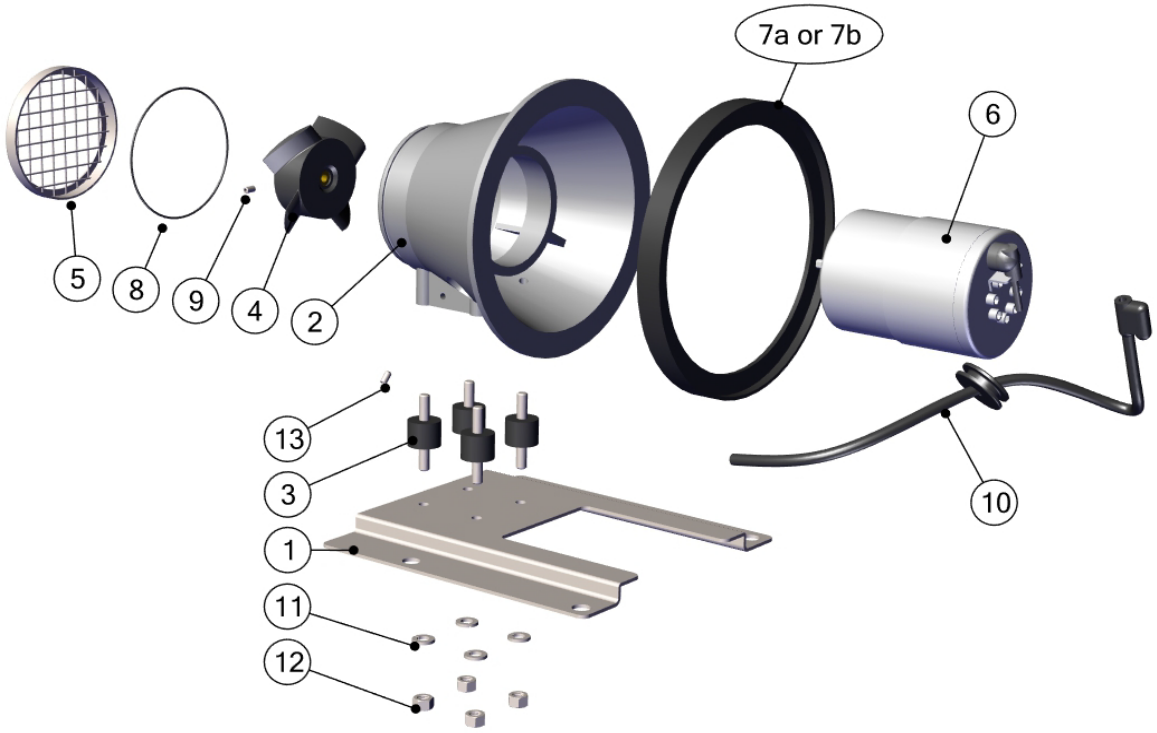
Figure 9 Fan Rotation



7 Parts List

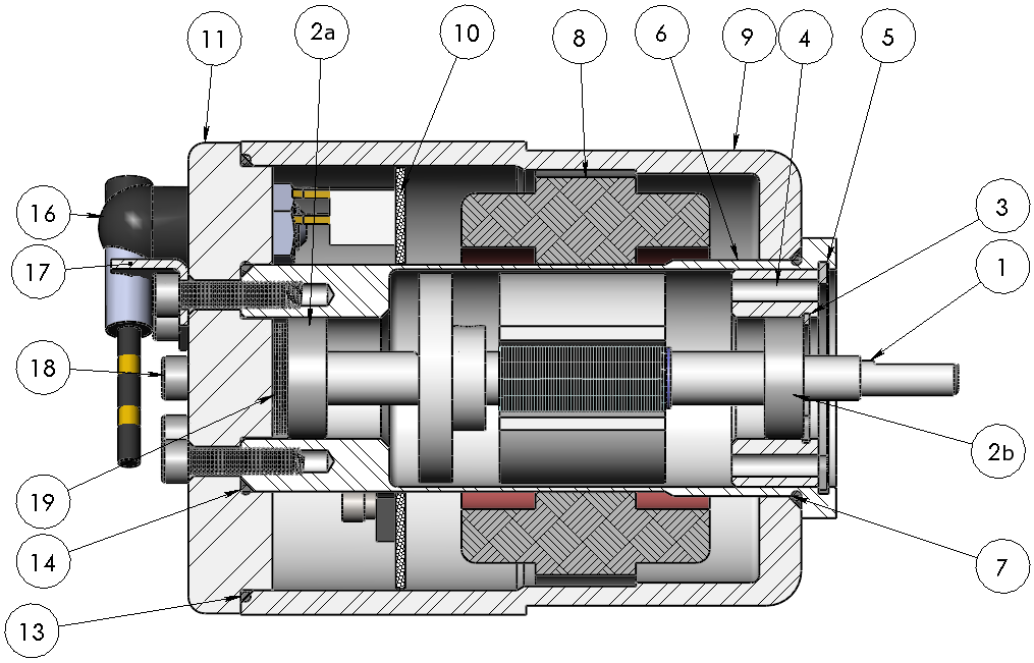
Item	Description	Part No
-	Blower Assembly	KI17022
-	Scrubber Canister Assembly	KI14905RF
-	Heater Assembly	KI14903

7.1 Blower Assembly



Item	Description	Part No
1	Mounting Plate	KI14773
2	Heater / Scrubber Frame	KI14742
3	Shock Mounting	KI13226
4	Fan	KI14749
5	Fan Guard	KI14783
6	Motor	KI14904
7a 7b	Gasket (KI17016, KI17018) Gasket (KI17018HS)	KI17215 KI17018314
8	O-ring	KI12300
9	Grub Screw, M4 x 10	FB275
10	Cable, 3 m Tail c/w Grommet Cable, 5 m Tail c/w Grommet Cable, 10 m Tail c/w Grommet	KI14754 KI14755 KI14758
11	Spring washer	KI10304
12	Nut, 5/16” 18 TPI	KI13821
13	Set Screw, 10-32 x 3/8”	KI11071

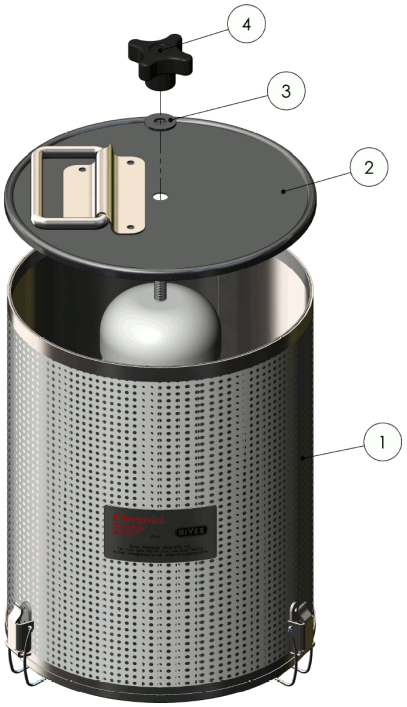
7.2 MOTOR ASSEMBLY



Note ***Parts list is limited to those items which are user replaceable.***

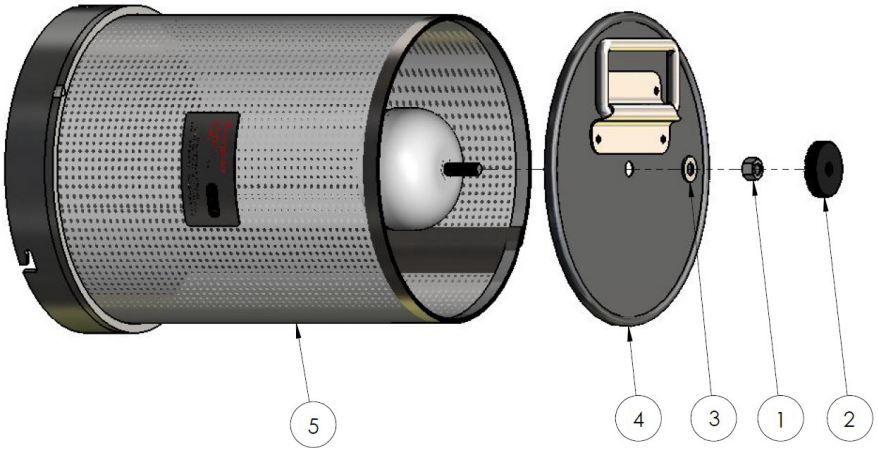
Item	Description	Part No
1	Rotor Assembly	KI14778
2 a/b	Bearing	KI14757
3	Small Circlip	KI14750
4	Bearing Sleeve	KI14776
5	Large Circlip	KI14751
19	Bellville Washers (6 required)	KI14745

7.3 SCRUBBER CANISTER (VERTICAL MOUNT)



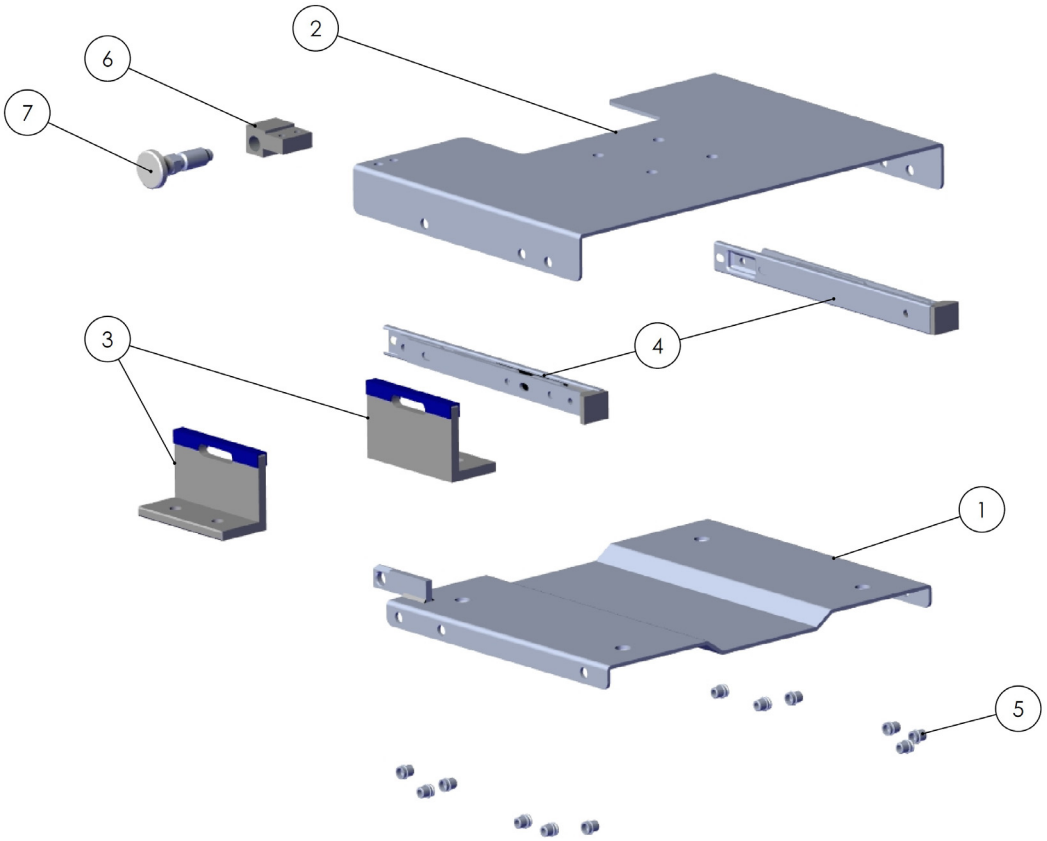
Item	Description	Part No
1	Scrubber Canister	KI14906A
2	Lid	KI14907A
3	Washer	FW044
4	Retaining Knob	FN047

7.4 SCRUBBER CANISTER (HORIZONTAL MOUNT)



Item	Description	Part No
	Scrubber Canister c/w associated parts (below)	KI17018103
1	Nut, Hex, M8, S316	FN005
2	Retaining Knob	FN229
3	Washer	FW044
4	Lid	KI14907A

7.5 SCRUBBER CANISTER HORIZONTAL MOUNTING PLATE ASSEMBLY



Item	Description	Part No
1	Plate, Hinge, HS Scrubber	KI17018301
2	Bracket, Mounting, HS Scrubber	KI17018300
	Retaining Strap (not shown)	FC16262
3	Bracket,horizontal Scrubber	DC1753082
4	Hinge, Friction 2 off	KI17018302
5	Nutsert, Open, M5X0.8, SS 12 off	FN226
6	Bracket, Plunger	KI17018315
7	Plunger, Retainer	KI17018317

Intentionally blank