

GFD®
FROM PSL

USER'S MANUAL

> OPERATION AND MAINTENANCE



PF-00001-230

PF-00001-115



www.powdersystems.com

USER'S MANUAL

OPERATION AND MAINTENANCE GUIDE

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Other languages of this documentation can be found at:

www.sigma-aldrich.com/glass-filter-dryers

1.0 PREFACE

Dear CUSTOMER

WELCOME TO THE GFD®

A simpler approach to lab scale filtration and drying!

The GFD® is an innovative laboratory solution filling a need in today's R&D labs, whether in the chemical or pharmaceutical industry. Indeed, this replacement technology combines within one piece of equipment, existing filtration and drying methods and therefore actually supersedes Buchner filtrations and Tray drying.

Established since 1989 in the pharmaceutical industry as a pioneer in containment and filtration technologies (production scale) PSL have used our world class experience to offer a better approach to Lab scale filtration and drying to the world of chemistry » **The GFD®**.

This equipment is available in 3 sizes thus suiting the needs of small labs to kilo-labs, a product line designed to give the opportunity to perform the best **scale-up studies** in the global market today.

Combining filtration and drying within one piece of equipment is the guarantee that liquid and solid separation process development benefit from:

» **Minimum Process Disruption** » **Batch Homogeneity** » **Improved Yield**

» **Reduced Product Exposure** » **Process visibility**

Contrary to other larger sizes ANFD's the GFD® has a unique feature, the **Removable Filter Basket**. This patent pending feature is an innovation in the industry and offers unique product handling experience. It guarantees:

» **Full Product Recovery** » **Easy Cleaning** » **Improved Yield**

Today, the GFD® is a laboratory process equipment meeting all the requirements of the global industry.

Most of the liquid/solid separation requirements can be applied in this new apparatus which makes the GFD® a truly global solution that fits in every lab.

We hope you will greatly benefit from your purchase and wish you to enjoy the GFD® Experience.

2.0 INTRODUCTION

BEFORE USING THE GFD®, PLEASE READ THE FULL MANUAL.



The GFD® User's Manual has been designed to provide general guideline to safely set-up, handle and operate the equipment.

As a process equipment the user's requirements will determine how to use the GFD®, however, you will find in this manual information on what cannot be done and what could be done.

"Section 3: Product Summary" displays all the technical core data of the GFD® such as specifications including all spares and options and the general arrangement drawing.

"Section 4: General Safety Instructions" lists all the principal safety aspects to consider before, while and after using the GFD®. This section is to be read before handling, setting-up and operating the GFD®.

"Section 5: Unpacking and Assembling the GFD®" explains how to unpack and assemble the GFD® in a safe manner and how to set the GFD® prior to first use.

"Section 6: Mechanical Operations Guide" deals with the set-up and handling of the GFD®. You will discover how to use main components and perform basic mechanical actions on the GFD®. We also give an example of how a GFD® can be set-up in line with a reactor.

"Section 7: Process Operations Guide" is a guide to use the GFD® with products. Each user will dry and filtrate different products with different process requirements and this section can only describe certain ways to operate the GFD® in a process that may not be applicable in certain cases.

"Section 8: Maintenance Operations" gives guideline to maintain the GFD® in order to guarantee its longevity and the quality of its performances.

"Section 9: PSL Quality Certificates" contains the Declaration of Engineering and the certificate of conformity.

"Section 10: Annex 1"

3.0 PRODUCT SUMMARY

3.1 Product Code

PRODUCT CODE	VOLTAGE	PLUG CONNECTION
PF-00001-230	230v - 50 HZ	UK: Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused). Europe: Type E/F Hybrid CEE 7/7 (16A/250V grounded).
PF-00001-115	115V - 60HZ	US: NEMA 5-15 (15A/125V grounded). Japan: JIS C 8303, Class I (15A/100V grounded)

3.2 General Design Data

Filtration area	0.002M ²		
Cake volume	0.1 Litre		
Cake depth (max)	50mm		
Volume	0.3Litres		
	Vessel	Jacket	Unit
Design temperature (Min)	- 25 (-13)	- 25 (-13)	°C (°F)
Design temperature (Max)	150 (302)	150 (302)	°C (°F)
Design Pressure (Min)	FV	FV	barg (psig)
Design temperature (Max)	0.5 (7.25)	0.5 (7.25)	barg (psig)
Area Classification Internal/External	Safe Area		
OEL	The PSL GFD® is not classified as containment equipment and therefore has to be used in conjunction with other equipment suitable to protect operator from exposure to potent compounds.		

3.3 Mechanical Data

Product contact materials	Product contact areas will be Borosilicate 3.3 Glass, PTFE coated stainless steel, polypropylene, Silicone, Viton unless otherwise stated.
Non Product contact materials	304L Stainless steel, Powder coated mild steel. Some minor proprietary procured items such as pipe clips may only be available in lower stainless steel grades. Some proprietary procured items, will be provided in the manufacturers' standard materials.
Vessel/basket clamping	304L Stainless steel quick release clamp. PTFE lined.
Filter basket	Polypropylene filtration basket. Filter cloth is welded to the base of the basket.
Filtration media	Polypropylene cloth, nominal pore size 20µm.
Basket o-rings	3mm section Silicone White - 60 shore hardness.
Filter basket support	Polypropylene plate with filtration holes.

Heating Jacket	The base jacket is constructed in Borosilicate 3.3 Glass. KF15 Flange connections for inlet and return of heating/cooling fluid.
Vessel Support	304L stainless steel, Powder coated mild steel.
Agitator	PTFE blade with 16mm diameter PTFE coated stainless steel shaft.
Agitator seal	PTFE seal rated FV and 0.5 barg (7.25 psig).
Agitator Positioning	Manual rack and pinion agitator/drive raise/lower system in anodised aluminium with glass fibre reinforced polyamide handwheel and clamping knob.
Speed of rotation	5-100RPM.
Vessel process stoppers	Rodaviss Polyurethane cap, Borosilicate 3.3 Glass stopper, Viton o-ring seal.


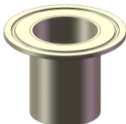

3.4 Electrical Data





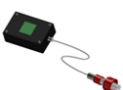
Motor	44W motor, 115 V 60 Hz / 240 V 50 Hz IP55 rated. Output torque 406Ncm.
Motor Controls	On/Off, Clockwise (Plough), Anti-clockwise (Smooth), Speed adjustment.
RPM	Digital LCD Display, 3 digits, 1 rpm accuracy.
Plug Connection	UK: Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused). Europe: Type E/F Hybrid CEE 7/7 (16A/250V grounded). USA: NEMA 5-15 (15A/125V grounded). Japan: JIS C 8303, Class I (15A/100V grounded).

3.5 General Arrangement Drawing











Please see Annex 1

3.6 Options

PICTURE	PART No	PART NAME	DESCRIPTION
N/A	ID00001	cGMP certification	Documents certifying compliance to FDA regulation 21CFR. Copy of GFD® test document. Certificates of materials of construction.
	IP00111	Heat Transfer Jacket Connector - Straight	DN 15 Chrome plated steel with FEP o-ring seal, thread M16 x 1mm Pitch.
	IP00045	Heat Transfer Jacket Connector - 90deg Elbow	
	IM00112	Polypropylene Basket, Nominal Pore size: 7 micron	Polypropylene filtration basket. Filter cloth is welded to the base of the basket.
	IM00113	Polypropylene Basket, Nominal Pore size: 12 micron	
	IM00115	Stainless Steel basket, Nominal Pore size 5 micron	316L filtration basket. Filter media is welded to the base of the basket.
	IM00116	Stainless Steel basket, Nominal Pore size: 10 micron	
	IM00117	Stainless Steel basket, Nominal Pore size: 20 micron	

	IM00119	Alloy 22 basket, Nominal Pore size 5 micron	
	IM00120	Alloy 22 basket, Nominal Pore size: 10 micron	Alloy 22 filtration basket. Filter media is welded to the base of the basket.
	IM00121	Alloy 22 basket, Nominal Pore size: 20 micron	
	IM00122	Agitator Stainless Steel	316L Stainless steel blade with 16mm DIA 316L Stainless Steel Shaft.
	IM00123	Agitator Alloy 22	Alloy 22 blade with 16mm dia Alloy 22 Shaft.
	IP00124	Basket O-ring – Viton	3mm section Viton – 70/75 Shore hardness.
	IP00125	Basket O-ring – White perfluoroelastomer	3mm section Perfluoroelastomer – 70/75 Shore hardness.
	IM00154	Vacuum Bottle	10 Litre White Polypropylene bottle and 2 way connectorTPE seal -10...+135 °C, autoclavable.
	IP00056	Temperature Infra-red probe	Digital Pyrometer, LCD 4 Digit display, 3 Hz sampling rate, resolution 0.1°C, temp range 30°C to 200°C, Aluminium housing, stainless steel sensor head. Instrument IP20, sensor head IP65. INCLUDED: Rodaviss to GL nozzle adaptor and mains power adaptor.

3.7 Spares

PICTURE	PART No	PART NAME	DESCRIPTION
	MG00008	Stopper Kit	Rodaviss Polyurethane cap, Borosilicate 3.3 Glass stopper, Viton o-ring seal. Include complete rodaviss stopper package for lid nozzles.
	IM00083	PTFE coated Agitator	PTFE blade with 16mm diameter PTFE coated stainless steel shaft.
	MG00006	Agitator Seal Kit	PTFE seal rated FV and 0.5 barg (7.25 psig). Complete with rodaviss connector.
	IM00071	Pressure Clamp	304L Stainless steel quick release clamp. PTFE lined, powder coated.
	IM00084	Polypropylene Basket Nominal Pore Size 20µm	Polypropylene filtration basket. Filter cloth is welded to the base of the basket. Media: 20µm polypropylene cloth.
	IP00085	Basket O-ring Silicone	5mm section Silicone White – 60 shore hardness.
	IM00070	Glass Ware - Vessel Lid	Mini Lab Vessel Lid. Borosilicate 3.3 Glass.
	IM00102	Glass Ware - Vessel Base	Mini Lab Vessel Base. Borosilicate 3.3 Glass.
	IP00086	High Torque Bi-directional Motor 230V	<u>Motor:</u> 44 W motor, 230 V 50 Hz. IP55 rated. Output torque 406 Ncm.
	IP00087	High Torque Bi-directional Motor 115V	<u>Motor:</u> 44 W motor, 115 V 60 Hz. IP55 rated. Output torque 406 Ncm.
	IP00108	RPM display - Control Box 230V	Motor controls: on/off clockwise (plough), anti-clockwise (smooth), speed adjustment.
	IP00109	RPM display - Control Box 115V	Speed indication (RPM): digital LCD display, 3 digits, 1 RPM accuracy.

4.0 GENERAL SAFETY INSTRUCTIONS

The **GFD®** **MUST ONLY** be operated and maintained by appropriately trained personnel who have read and fully understood the instructions and requirements detailed within this Operating and Maintenance Manual.

IMPORTANT

The maximum pressure permitted within the vessel is 0.5 BarG; **ENSURE** that a suitable relief valve is fitted in the supply line to ensure this pressure cannot be exceeded.

The vessel jacket is rated to 0.5 Barg, however, the jacket **MUST** not be pressurised because it is not designed as a closed system. The heating medium used within the jacket **MUST BE** re-circulating.

NO SAFETY INTERLOCKS ARE PROVIDED ON THIS EQUIPMENT AND IT IS NOT CURRENTLY RATED FOR HAZARDOUS AREA OPERATIONS

IF IN DOUBT – DO NOT PROCEED – PLEASE ASK

SAFETY SYMBOLS



These notes indicate where there are risks of electric shock for the operator.



These notes indicate where there are risks of injury to the operators or possible loss of containment.



These notes indicate where there are risks of damage to the equipment.



These notes indicate useful supplementary information.

4.1 SAFETY INSTRUCTIONS FOR ELECTRICAL DEVICES

Read all the safety advice and instructions! Failure to observe the safety advice and instructions may result in electric shock, fire and / or serious injury.

KEEP ALL THE SAFETY ADVICE AND INSTRUCTIONS IN A SAFE PLACE FOR FUTURE REFERENCE!

4.1.1 Workplace Safety



WARNING

Keep your working area clean and well lit. Untidy or poorly lit working areas can lead to accidents.



WARNING

Do not work with the device in potentially explosive environments in which there are inflammable liquids, gases or dusts. Electrical devices create sparks, which can ignite dusts or fumes.

4.1.2 Electrical Safety

To avoid danger to life from electric shock:



WARNING



DANGER

The mains plug on the device must match the mains socket. The plug must not be modified in any way. Do not use an adapter plug with devices fitted with a protective earth. Unmodified plugs and matching sockets reduce the risk of electric shock.



WARNING



DANGER

The **GFD**® is made for indoor use only.



WARNING



DANGER

Keep the device away from rain or moisture. Water entering an electrical device increases the risk of electric shock.



WARNING



DANGER

Do not use the mains lead for any purpose for which it was not intended, e.g. to carry the device, to hang up the device or to pull the mains plug out of the mains socket. Keep the mains lead away from heat, oil, sharp edges or moving parts of the device. Damaged or tangled mains leads increase the risk of electric shock.



WARNING



DANGER

Use a residual current device (RCD) for protection if operating the electrical device in a moist environment is unavoidable. The use of an RCD reduces the risk of electric shock.

4.1.3 Personal Safety



WARNING

Remain alert at all times, watch what you are doing and always proceed with caution. Do not use the device if you are tired or under the influence of drugs, alcohol or medication. One moment of carelessness when using the device can lead to serious injury.



WARNING

Wear personal protective equipment and always wear safety glasses. The wearing of personal protective equipment such as dust masks, non-slip safety shoes, safety helmets or ear protectors, appropriate to the type of electrical device used and work undertaken, reduces the risk of injury.



WARNING

Avoid unintentional operation of the device. Check that the mixer is switched off before you connect it to the mains, pick it up or carry it. Accidents can happen if you carry the device with your finger on the **ANTI-CLOCKWISE / OFF / CLOCKWISE** switch or with the device switched on.



WARNING

Remove any setting tools or spanners before you switch the device on. A tool or spanner left attached to a rotating part of a device can lead to injury.



WARNING

Avoid placing your body in an unnatural position. Keep proper footing and balance at all times. By doing this you will be in a better position to control the device in unforeseen circumstances.



WARNING

Wear suitable clothing. Do not wear loose clothing or jewellery. Keep your hair, clothing and gloves clear of moving parts. Loose clothing, jewellery or long hair can become trapped in moving parts.

4.1.4 Careful Handling and Use of Electrical Devices



CAUTION

Do not overload the device. Always use an electrical device that is intended for the task you are undertaking. By using the right electrical device for the job you will work more safely and achieve a better result.



CAUTION

Do not use the mixer if its switch is defective. An electrical device that can no longer be switched on and off is dangerous and must be repaired.



CAUTION

Pull the mains plug out of the socket before you make any adjustments to the device, change accessories or when the device is put away. This precaution is intended to prevent you from unintentionally starting the device.



CAUTION

Look after the device carefully. Check that moving parts are working properly and move freely. Check for any parts that are broken or damaged enough to detrimentally affect the functioning of the device. Have damaged parts repaired before you use the device. Many accidents have their origins in poorly maintained electrical devices.

4.2 OPERATION SAFETY INSTRUCTIONS



WARNING

The Operator should ensure that an appropriate RISK ASSESSMENT has been undertaken for the operation and maintenance of the **GFD®** and that where identified as required, appropriate PPE (Personal Protection Equipment) is worn.



WARNING

The Operator must ensure that where appropriate, suitable Safety Procedures are implemented to protect personnel from potential injury.



WARNING

PRIOR to commencing operations with the **GFD®** it is extremely important that a suitably sized **CLEAR VIEW PERPEX SCREEN** is positioned between the operator and the **GFD®** to protect personnel from potential injury should an unforeseen incident occur involving the glass components of the equipment.



WARNING

Please be aware that both the vessel base and vessel lid of the **GFD®** are of glass construction, it is therefore essential that care is taken when handling these components to avoid both damage to components and the potential risk of injury to personnel.



WARNING

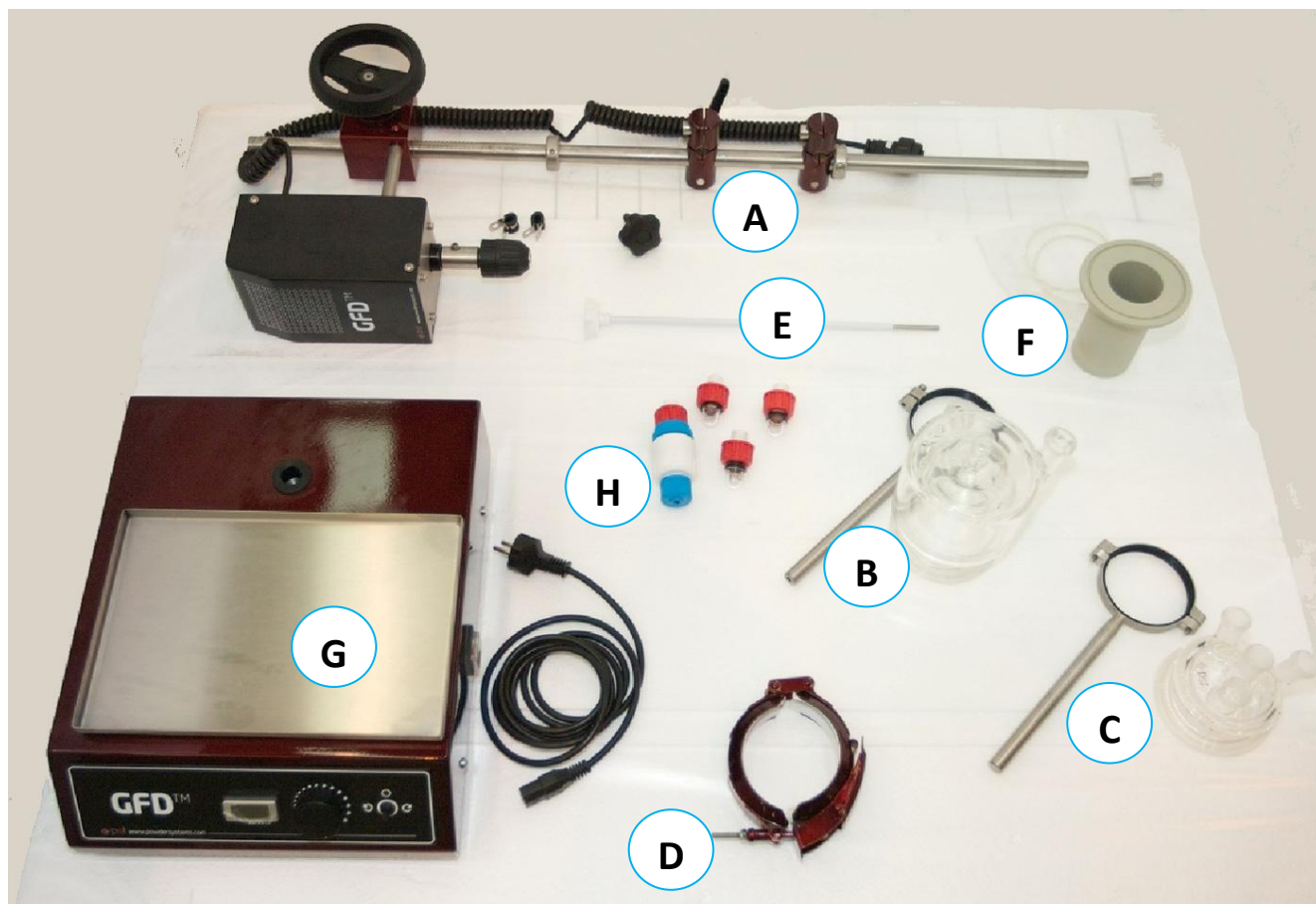
DO NOT over tighten the clamp adjoining the vessel base and vessel lid components as this could damage the glass. The torque required to seal the vessel with the clamp is minimal, once located into position, close the clamp and turn the clamp retaining screw clockwise a few turns until slight friction is felt, this will be sufficient to both retain the clamp in position and seal the vessel.

5.0 UNPACKING & ASSEMBLING THE GFD[®]

5.1 MODULES

The following section will help the user unpack to GFD[®] before the assembly.

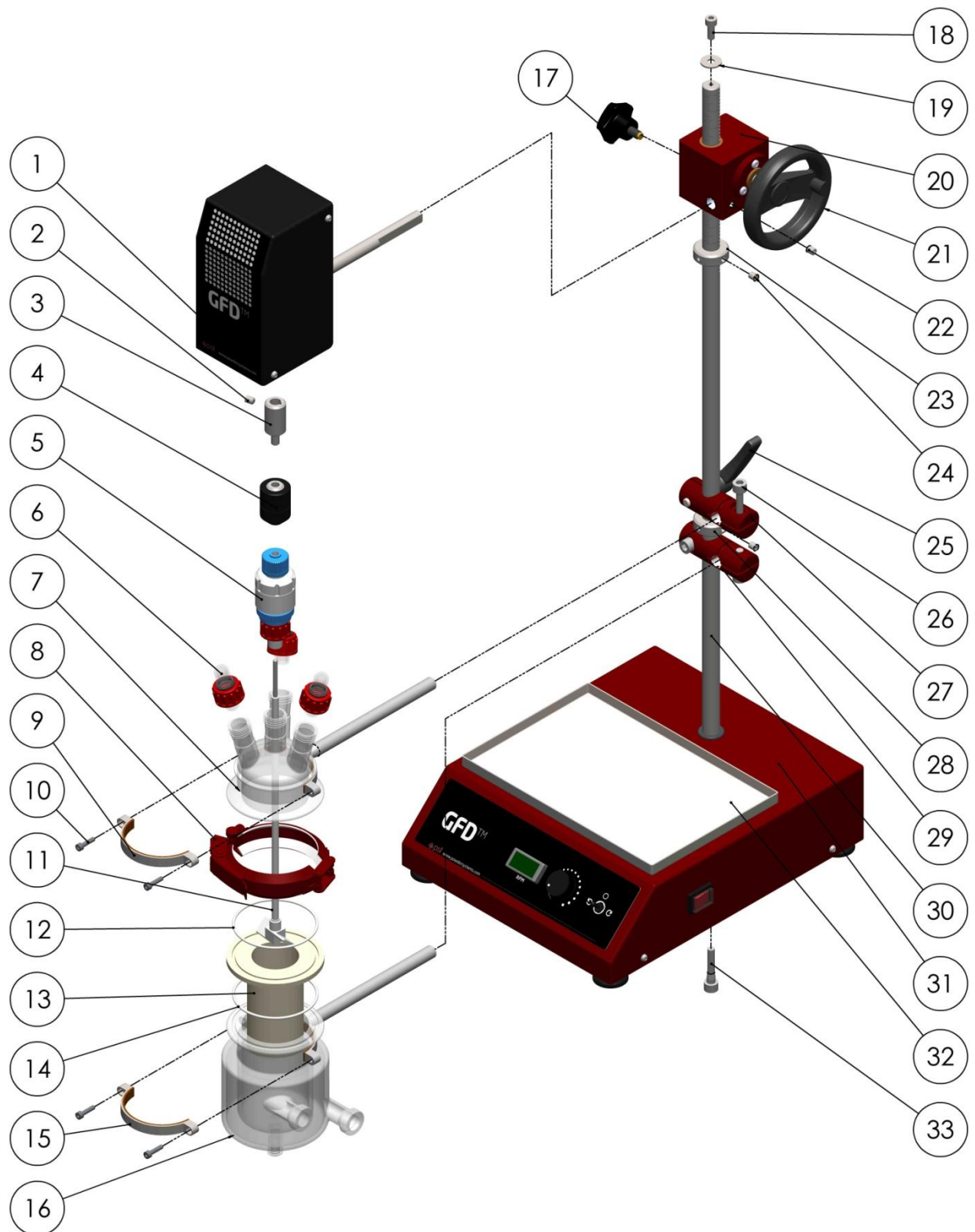
The picture below represents all the GFD[®] parts as packed by PSL. The user has to empty the 2 boxes to lay down the parts as per picture below.



MODULE	DESCRIPTION
A	Pole and Motor Assembly
B	Vessel Base and Support Clamp
C	Vessel Lid and Support Clamp
D	Vessel Pressure Clamp
E	PTFE Coated Agitator
F	Filter Basket and O-rings
G	GFD Control Unit, Mains power cable and Spill Tray
H	Stopper Kit and Agitator Seal

5.2 PARTS

Please refer to the parts list next page:



NO.	NAME	PART NO.	QTY	MODULE	COMMENTS
1	HIGH TORQUE BIDIRECTIONAL MOTOR	IP00108/ IP00109	1	A	Available As Spare
2	COUPLING LOCKING SCREW	N/A	1	A	
3	COUPLING – CHUCK ADAPTOR	IM00089	1	A	Already Fitted
4	CHUCK	IP00088	1	A	Already Fitted
5	AGITATOR SEAL KIT	MG00006	1	H	Available As Spare
6	STOPPER KIT	MG00008	1	H	Available As Spare
7	GLASS WARE - VESSEL LID	IM00070	1	C	Available As Spare
8	PRESSURE CLAMP	IM00071	1	D	Available As Spare
9	VESSEL SUPPORT CLAMP -LID	IM00074	1	C	Same As Part 15
10	VESSEL SUPPORT CLAMP SCREW	N/A	4	E	Available As Spare
11	PTFE COATED AGITATOR	IM00083	1	E	Available As Spare
12	O-RING - WHITE SILICONE - BASKET	IP00085	1	F	Available As Spare, Same As Part 14
13	FILTER BASKET – POLYPROPYLENE, NOMINAL PORE SIZE: 20 µm	IM00084	1	F	Available As Spare
14	O-RING - WHITE SILICONE - VESSEL	IP00085	1	F	Available As Spare, Same As Part 12
15	VESSEL SUPPORT CLAMP -BASE	IM00074	1	B	Same As Part 9
16	GLASS WARE - VESSEL BASE	IM00102	1	B	Available As Spare
17	CLAMPING KNOB	IP00164	1	A	
18	SUPPORT POLE CAP SCREW	N/A	1	A	
19	SUPPORT POLE CAP WASHER	N/A	1	A	
20	RAISE LOWER MECH HOUSING	IM00159	1	A	
21	HANDWHEEL	IP00163	1	A	
22	MOTOR SUPPORT LOCKING SCREW	N/A	1	A	
23	POSITIONAL STOP – MOTOR	IM00155	1	A	Same As Part 28
24	POSITIONAL STOP LOCKING SCREW	N/A	4	A	
25	CLAMPING HANDLE	IP00076	1	A	
26	MOUNTING CLAMP SCREW	N/A	3	A	
27	MOUNTING CLAMP - LID	IM00073	1	A	Same As Part 29
28	POSITIONAL STOP – LID	IM00155	1	A	Same As Part 23
29	MOUNTING CLAMP - BASE	IM00073	1	A	Same As Part 27
30	SUPPORT POLE	IM00107	1	A	
31	CONTROL UNIT	SP00039 / SP00040	1	G	Available As Spare
32	SPILL TRAY	IP00156	1	G	
33	SUPPORT POLE RETAINING SCREW	N/A	1	G	
34	MAINS POWER CABLE		1	G	Not Shown

5.3 FIRST TIME ASSEMBLY AND SET-UP

✓ Step 1 (Figure 1.a)

- Insert **Clamping Knob** (Item 17) into threaded hole on side of **Raise Lower Mech Housing** (Item 20) and screw tightly to lock the **Raise Lower Mech Housing** in position. **Motor Support Locking Screw** (Item 22) should already be fully tightened (Figure 1.b)

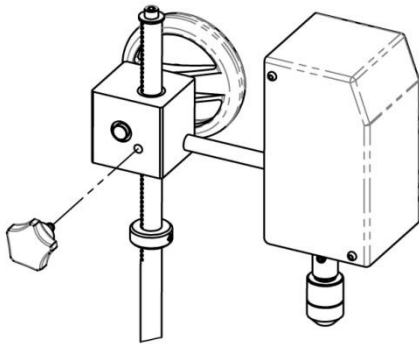


Figure 1.b

- Insert Module A (**Pole and Motor Assembly**) into hole on **Control Unit** (Item 31). The slot at the back of base of the **Support Pole** (Item 30) should be slide into pin located inside **Control unit**. This will stop rotation of the pole. (Figure 1.c)

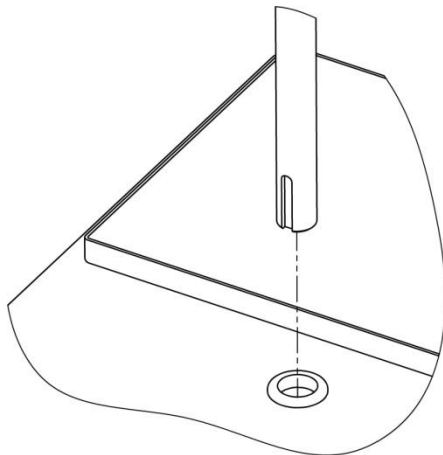


Figure 1.c

- Insert **Support Pole Retaining Screw** (Item 33) through hole in bottom of **Control Unit** and screw tightly into **Support Pole** using an 8mm allen key.

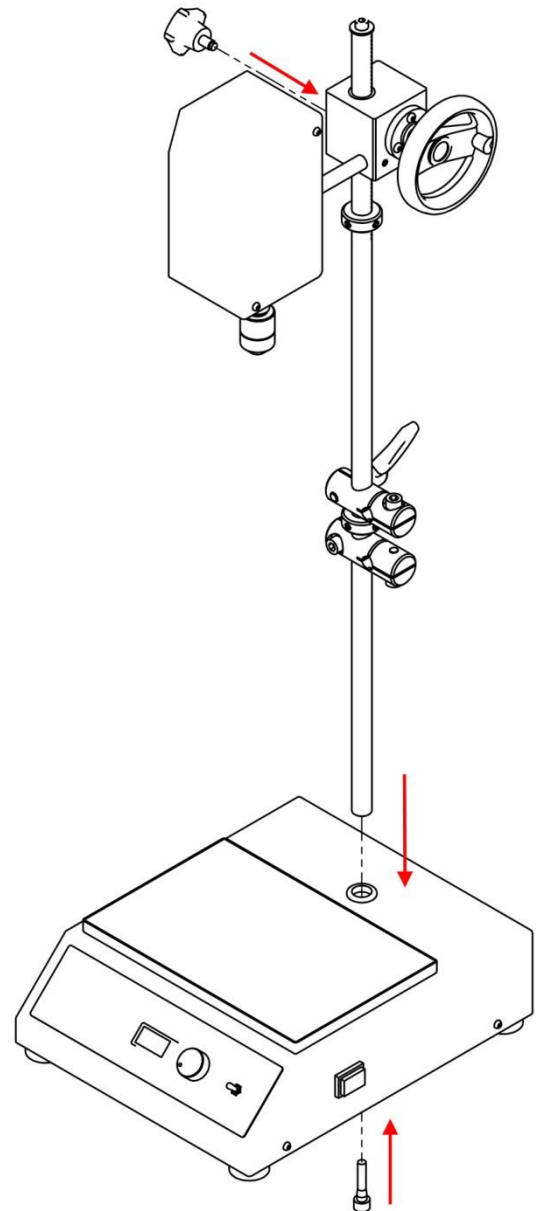


Figure 1.a

✓ Step 2 (Figure 2)

- Attach **Vessel Support Clamp-Lid** (Item 9) to **Glass Ware - Vessel Lid** (Item 7) using **2x Vessel Support Clamp Screw** (Item10) and tighten with 6mm allen key.
- Fit **Agitator Seal Kit** (Item 5) and **Stopper Kit** (Item 6) to **Vessel Lid** and hand tighten.

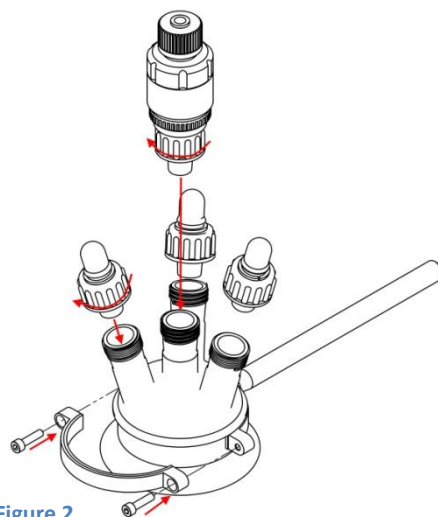


Figure 2

✓ Step 3 (Figure 3)

- Attach **Vessel Support Clamp-Base** (Item 15) to **Glass Ware - Vessel Base**(Item 16) using **2x Vessel Support Clamp Screw** (Item10) tighten with 6mm allen key.
- Insert **O-Ring - White Silicone – Vessel** (Item 14), **Filter Basket** (Item 13) and **O-Ring - White Silicone – Basket** (Item 12) into **Vessel Base**

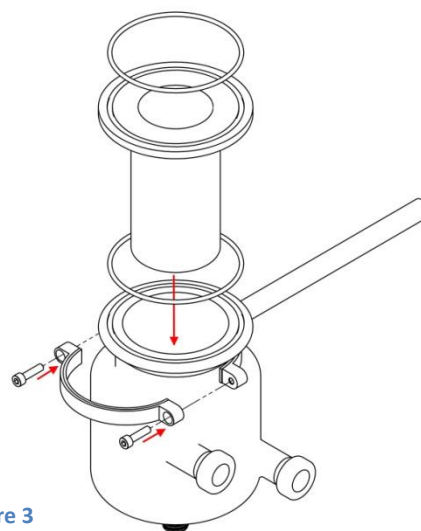


Figure 3

✓ Step 4

- Insert the metallic shaft of **PTFE Coated Agitator** (Item 11) into **Chuck** (Item 4) and hand tighten. **(Figure 4.a)**
- Insert **Vessel Base and Support Clamp assembly** into **Mounting Clamp – Base**(Item29). The vessel position can be adjusted horizontally and vertically, and locked by tightening both **Mounting Clamp Screws** (Item 26) using an 8mm allen key. **(Figure 4.b)**

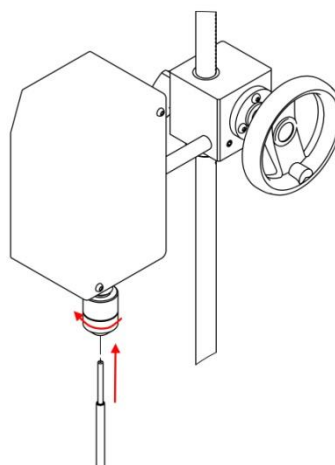


Figure 4.a

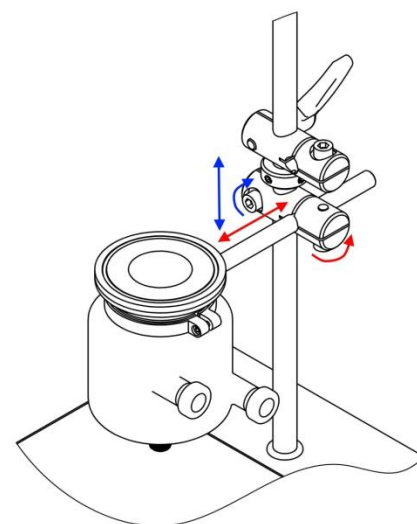
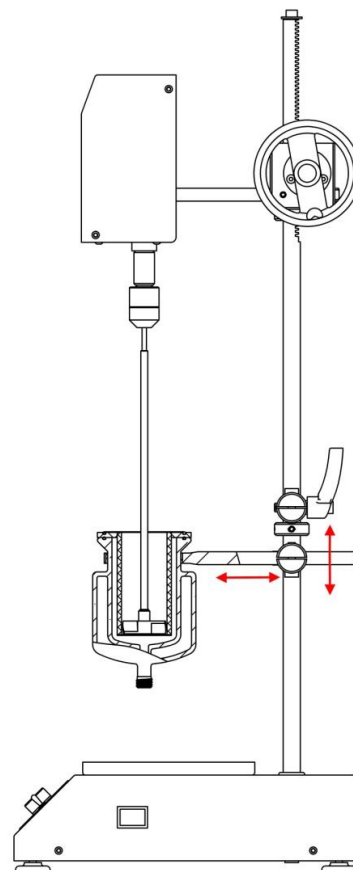


Figure 4.b

- Lower the Motor assembly to its lowest position by un-screwing **Clamping Knob** and turning **Handwheel** until **Raise Lower Mech Housing** sits on **Positional Stop – Motor** (Item 23)
- Adjust the position of the **Vessel Base and Support Clamp assembly** until it is in alignment with the **Agitator** and the bottom of the **Agitator** is touching the **Filter Basket** mesh. Lock the **Vessel Base and Support Clamp assembly** in position. (Figure 4.c)

Figure 4.c



✓ Step 5

- Raise the Motor Assembly to its highest position by un-screwing **Clamping Knob** and turning **Handwheel** until **Raise Lower Mech Housing** hits **Support Pole Cap Washer** (Item 19) and remove **PTFE Coated Agitator** from **Chuck**
- Undo **Clamping Handle** (Item 25) and swing **Mounting Clamp – Lid** (Item 27) 90 degrees anti-clockwise. (Figure 5.a)
- Insert **Vessel Lid and Support Clamp assembly** into **Mounting Clamp – Lid** and insert **PTFE Coated Agitator** through **Agitator Seal**.
- Swing **Vessel Lid and Support Clamp assembly** clock-wise until it is parallel with the **Vessel Base and Support Clamp assembly**. Adjust the Vessel lid horizontal position until it is concentric with the Vessel Base. Lock **Vessel Lid and Support Clamp assembly** in place with **Mounting Clamp Screw** using an 8mm allen key, and with **Clamping Handle**. (Figure 5.b)

Figure 5.a

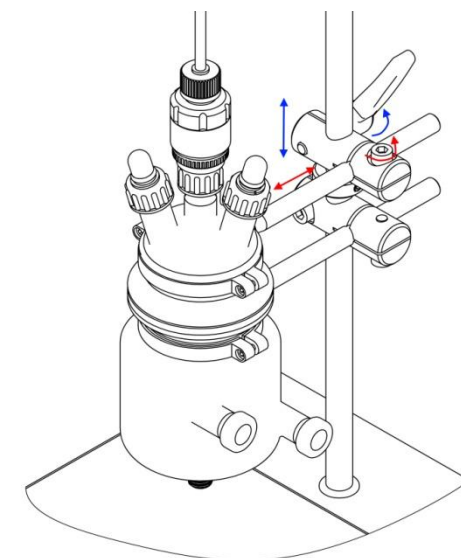
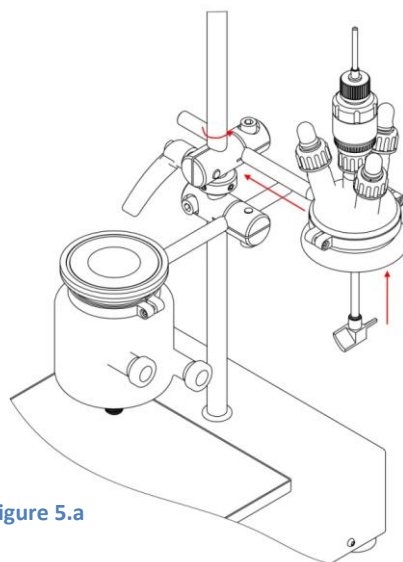


Figure 5.b

- Adjust height of **Positional Stop – Lid** (Item 28) until it touches the bottom of **Mounting Clamp – Lid**, then lock in place using **Positional Stop Locking Screw**. (Figure 5.c)
- Fix **Pressure Clamp** (Item 8) around Glass Vessel flanges.
- Lower the Motor assembly and re-insert **PTFE Coated Agitator** into **Chuck** and hand tighten.

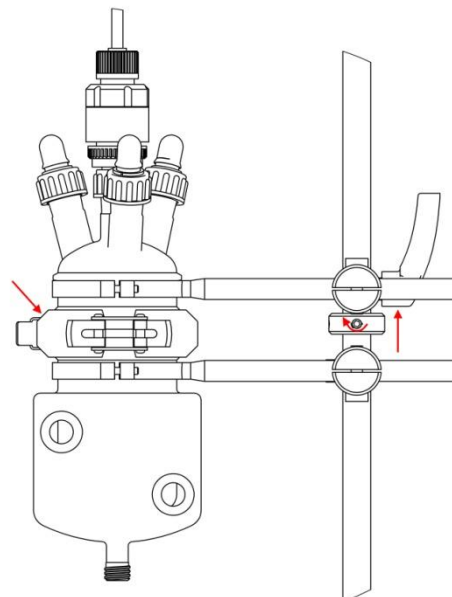


Figure 5.c

✓ Step 6

- Insert Flexible Curly Cable from **Motor Assembly** into **Cable Clip**, then screw **Cable Clip** into hole in end of **Motor Assembly** mounting shaft. Repeat process for hole in end of **Vessel Support Clamp – Lid**. (Figure 6.a)
- Screw Plug on end of motor cable into socket at back of **Control Unit** (Item 31). See section (6.8.3 - Connecting the GFD® Control unit to a power supply)
- Plug **Mains Power Cable** into socket at back of **Control Unit** and connect to mains power supply. (Figure 6.b)



Figure 6.a

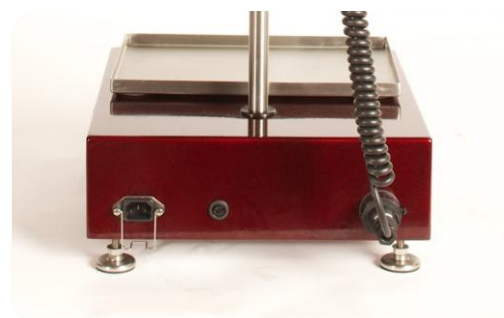


Figure 6.b

✓ Step 7

- Turn on GFD® and start agitator rotation as described in Section 6.8.4
- Check **Agitator** is running smoothly and concentrically within the **Filter Basket**. If not in alignment repeat steps 4 and 5 until correct.



Figure 7

6.0 MECHANICAL OPERATIONS GUIDE

The following section explains how to mechanically operate the various parts of the GFD® equipment.

6.1 PRE-CHECKS

The operator must ensure that;

- ✓ all safety requirements and procedures have been implemented
- ✓ the GFD® is appropriately located and stable
- ✓ any service connections (Heating media), (Pressure) to the apparatus are in place and fully operational
- ✓ all seals are in place and properly secured for the vessel to accept product
- ✓ the power supply for the GFD® is of the correct voltage, phase and frequency and is fitted with an RCD or similar safety circuit breaker.

6.2 ADJUSTING THE AGITATOR HEIGHT

6.2.1 Safety



WARNING

Before commencing to loosen the agitator shaft seal and the clamp of the torque mixer to raise the agitator out of the product, it is essential that the system has been vented to ensure that the vessel interior is at atmospheric pressure and is free of any harmful gasses or vapours.

6.2.2 Agitator Seal

The Agitator seal is composed of:

- 1: Lock Nut. This should be tightened when using the GFD vessel under vacuum or pressure. The Nut must be released to allow vertical adjustment of the agitator.
- 2: Upper body
- 3: Lower body
- 4: Retaining ring
- 5: Release nut for removing the red screw cap
- 6: Screw cap and o-ring that fits onto the central nozzle on the vessel lid

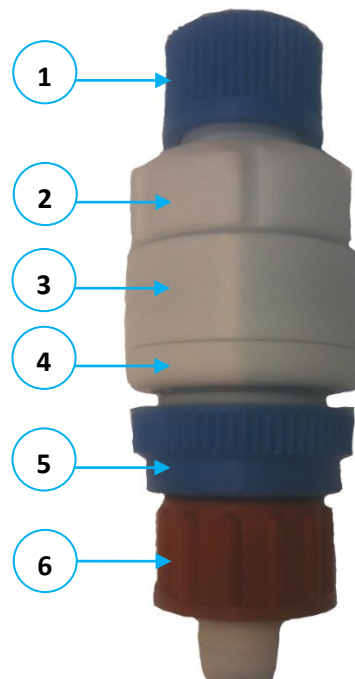


Figure 8

6.2.3 Fitting the Agitator Seal and the Agitator

- ✓ The vessel lid must be positioned 90° off centre to the vessel base.
- ✓ Ensure upper body on the agitator seal is tightly screwed to lower body
- ✓ Screw the agitator seal to the vessel lid with the red screw cap (8)
- ✓ Loosen the blue Lock nut on top of the agitator seal (1).
- ✓ Insert the agitator from the bottom of the vessel lid. Ensure the agitator blade is inside the vessel lid.
- ✓ Rotate the vessel lid back to position above the vessel base.
- ✓ Push agitator to required height, screw the blue lock nut (1) back and ensure it is tight.
- ✓ Lower motor onto the agitator (see section below 6.2.4) and manually lock the agitator metallic shaft end into the motor chuck.

6.2.4 Raising and Lowering the Agitator/Motor

WARNING: When the agitator is connected to the motor always unscrew the top lock nut of the agitator seal before raising or lowering the agitator. Tightly screw the lock nut again once the operating position is satisfactory

To raise or lower the agitator/motor:

1. If the Agitator is connected ensure the agitator seal lock nut is loose.

2. With one hand holding the handwheel to keep the motor assembly in place, unscrew the clamping knob with the other hand.

3. Turn the hand wheel anti-clockwise to raise the motor assembly.

4. Once in the required position, tighten the clamping knob again.

5. To lower the motor assembly, repeat the previous procedure but turn the hand wheel clockwise to lower the motor.

6. When the desired position is set re-tighten the agitator seal lock nut.

7. The 1mm scale markings on the support pole can be used for the accurate and repeatable setting of the agitator height.

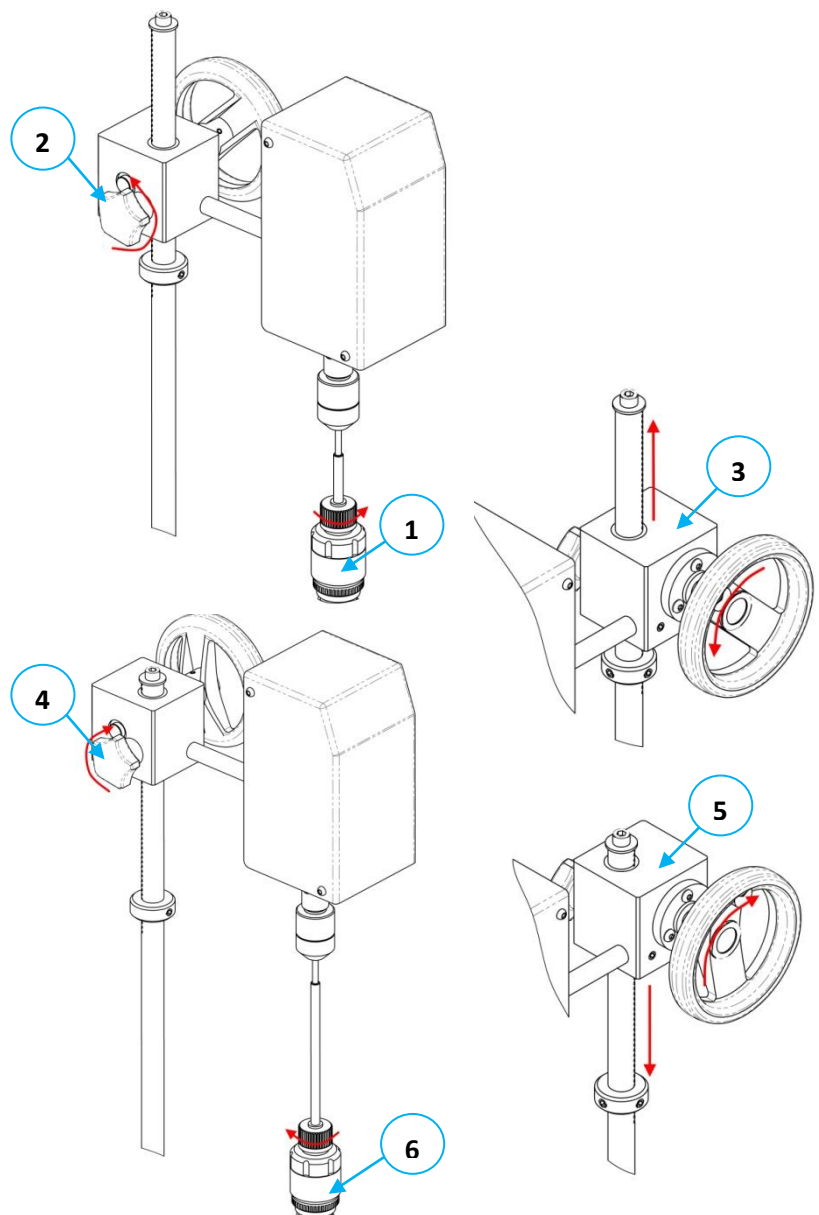


Figure 9

IMPORTANT NOTE: Once the vessel base has been fixed in position during the equipment set up procedure (Section 5), the Motor positional stop will prevent the agitator from coming into contact with the filter basket mesh. Changing the position of the positional stop after the set-up may lead to damage of the filter basket mesh.

6.3 OPENING THE VESSEL

6.3.1 Safety



WARNING

The Operator must ensure that where appropriate, suitable Safety Procedures are implemented to protect personnel from potential injury and the safety instructions in Section 3.0 above have been actioned.

6.3.2 Pressure Clamp

The filter basket and the two basket o-rings must be in place in the vessel base. Tighten the pressure clamp around the glass flanges so as to couple the vessel base and lid together. Extreme precaution should be taken to not over-tighten the clamp.



6.3.3 Vessel Base

Once the GFD® has been set-up as per the instructions in Section 5.3 the Vessel Base Support Clamp will be locked in place and should not need to be adjusted again.

6.3.4 Vessel Lid

To remove the vessel lid from the base:

1. Loosen the agitator seal.
2. Raise the agitator and motor until the agitator blade is above the level of the Filter Basket. See Section 6.2.4
3. Unscrew the Chuck to uncouple the agitator from the motor.
4. Raise the motor to its highest position. So the chuck is clear of the agitator shaft end.
5. Uncouple the vessel base and the vessel lid by removing the pressure clamp
6. Release the Clamping handle and lift and swing the lid out 90 degrees. The lid positional stop will prevent the lid from accidentally colliding with the vessel base if dropped.

6.4 ACCESSING THE PRODUCT

6.4.1 Removing the Filter Basket

1. Remove the vessel lid from the base (Section 6.3.4)
2. Once the vessel base is cleared from the vessel lid above, remove the o-ring from the basket flange and lift out the basket.

6.4.2 Inserting the Filter Basket

Ensure the vessel lid is positioned 90° off centre to the vessel base. Always ensure the integrity of the basket, its filter mesh and the o-rings before re-inserting them into the vessel.

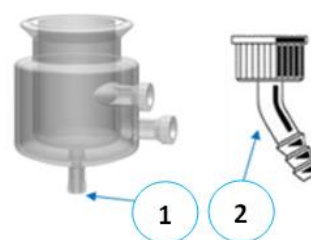
1. Insert one of the 2-off basket o-rings in the groove in the flange of the vessel base.
2. Place basket into the vessel base and ensure that the o-ring is correctly fitted with the basket in place.
3. Insert the second o-ring in the groove in the basket flange
4. Rotate vessel lid back above the vessel base and lock in place with the clamping handle.
5. Fit the pressure clamp

6.5 DRAIN CONNECTION

6.5.1 Connecting the Drain Nozzle

1: The Glass Flange profile on the bottom of the Vessel base is a GL18 thread. To connect the drain line, the operator must use an adaptor.

2: A GL18 adaptor can be purchased from any laboratory consumable supplier.



6.6 HEATING JACKET

6.6.1 Safety

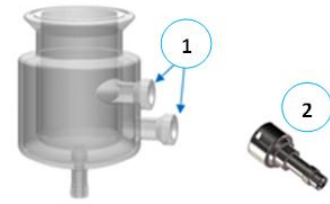


When heating media is introduced to the **GFD®**, exposed external surfaces will become hot, it is therefore essential, that personnel likely to come into contact with these surfaces have been made aware of the conditions and wear suitable hand protection / clothing to minimise the risk of injury

6.6.2 Connecting Hoses

1: The Glass Flange connection on the Vessel Jacket is a heavy wall DN15 Flange. To connect the hoses carrying the heating/cooling fluid, the operator must use a suitable adaptor.

2: PSL offer adaptors as an option.



6.7 USING THE VESSEL NOZZLES

6.7.1 Sampling Product

During operation product samples can be obtained by removing one of the stoppers positioned on the vessel lid nozzles, however, prior to loosening a stopper, the operator MUST ensure that it is safe to do so.

6.7.2 Equipment Connections

Various different auxiliary equipment can be connected to the GFD® via the vessel lid nozzles, e.g. Temperature Probe, gauges, glassware. The correct size and style of Rodaviss connection should be used to connect any auxiliary equipment, and any equipment connected should be capable of withstanding up to 0.5bar pressure if the GFD® is to be used under pressure conditions.

For more details please refer to section 7.0 Process Operations Guide.

6.8 USING THE HIGH TORQUE BIDERCTIONAL MOTOR & RPM DISPLAY CONTROL UNIT

6.8.1 Warnings



WARNING



DANGER

ALWAYS ENSURE THAT MAIN POWER SWITCH IS TURNED OFF PRIOR TO CONNECTING THE CONTROL UNIT TO THE MAINS.

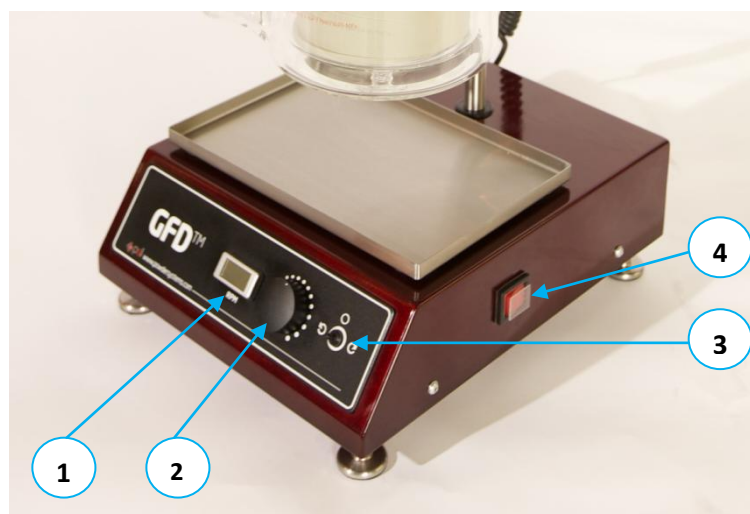
6.8.2 Layout of the GFD® Control Unit

1 : RPM DISPLAY

2 : RPM CONTROL KNOB

3 : AGITATOR DIRECTION SWITCH

4 : MAIN POWER SWITCH

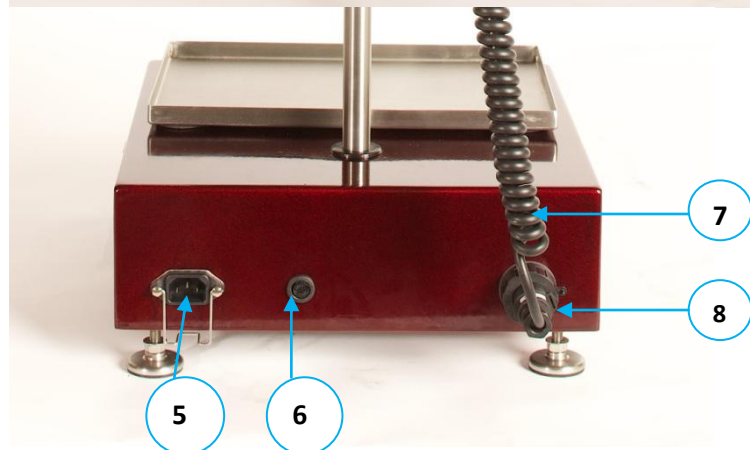


5 : POWER CABLE RETENTION CLIP

6 : OVERLOAD PROTECTION FUSE

7 : FLEXIBLE MOTOR POWER CABLE

8 : MOTOR POWER CABLE + SOCKET



6.8.3 Connecting the GFD® Control unit to a power supply

- STEP 1** Align pins on Motor Power Cable plug with corresponding holes in socket on RPM Display Control Unit (Item 8)
- STEP 2** Raise Power Cable Retention Clip (Item 5) then insert Power Cable Plug in to socket on RPM Display Control Unit.
Lower Retention Clip down so it fits over plug preventing accidental removal.
Ensure the Agitator Direction Switch (Item 3) is in the centre “stop” position.
Plug the Main Power Cable into mains supply.

- STEP 3** Flick the Main Power Cable Switch (item 4) to turn on the GFD®.
The Main Power Switch will light up in red to indicate it is on and the RPM Display screen (Item 1) will turn on.

6.8.4 Operating the High Torque Motor and RPM Display Control Unit

✓ Starting the unit

Once the above is complete flick the Main Power Cable Switch (item 4) to turn on the GFD®.
The Main Power Switch will light up in red to indicate it is on and the RPM Display screen (item 1) will turn on.

✓ Smoothing mode:

To operate the agitator in smoothing mode – clockwise rotation – flick the Agitator Direction Switch (item 3) to the right.

✓ Ploughing mode:

To operate the agitator in smoothing mode – anti-clockwise rotation – flick the Agitator Direction Switch (item 3) to the left.

✓ Speed Control

Adjusting the RPM Control Knob (item 2) will control the speed of the agitator.
The RPM Display screen (item 1) will indicate the current speed of the agitator.

IMPORTANT NOTES:

The GFD® has been designed with a soft start speed ramp to avoid damaging the motor if started at top speed in very viscous material.

However it is still recommended that users always start the agitator at its lowest speed before slowly increasing to desired RPM.

6.9 RELOCATING THE EQUIPMENT

6.9.1 Safety



WARNING



DANGER

If the apparatus needs to be re-located ensure that it is disconnected from its power supply and any service connections and all components are properly secured or removed.

6.9.2 Levelling the Equipment

The GFD® is a compact and very portable apparatus and can easily be re-located within a facility.

When the apparatus is in position, adjust the levelling feet to ensure that the GFD® is stable.

7.0 PROCESS OPERATIONS GUIDE

The objective of this Chapter of the User's Manual is to explain how basic key operations could be performed on the GFD®.

With more than 22 year of experience in filtration and drying equipments PSL can affirm there are as many ways to utilise the GFD® as there are products to process in the equipment. Therefore we can only highlight the major steps to filtration and drying, which are to be adjusted in function of your requirements:

(7.1) Charging the Product (7.2) Washing/filtering (7.3) Drying (7.4) Taking Samples (7.5) Recovering the product

Along the process development samples can be taken to ensure operations run according to the user's requirement.

7.1 CHARGING THE PRODUCT



Information

Ensure you have the appropriate connections as PSL do not provide them.

STEP 1 Connect the user's reactor to one of the GFD® vessel lid nozzle.

STEP 2: To pour/transfer the reactor's content (a.k.a. slurry) apply vacuum in the GFD®.

NOTE 1: Depending on your requirements, vacuum can be applied from either the top (vessel lid nozzle) or the bottom of the GFD® (vessel base drain).

NOTE 2: Other slurry transfer methods can be used depending on your requirements.

7.2 WASHING / FILTERING THE CAKE

Washing the cake is an important step of filtration and drying as it removes all impurities from the slurry. According to your requirements you might want to collect either the solid or the filtrate.

There are mainly two cake wash methods: (1) re-slurry wash and (2) displacement wash. The choice depends on your process requirements.

Generally 3 washing cycles would be performed in the GFD®.

Once the slurry is poured into the GFD®, with the filter basket in place, the following steps can be applied to the cake:

- Step 1** Smoothing the cake. (Purpose: enhances drying of the cake)
- ✓ Place the agitator on the top of the cake and rotate clockwise ensuring cake is smooth with no cracks, this will help reduce the residual moisture levels in the cake, saving energy in the drying process.
 - ✓ In the meantime, apply either pressure up to ½ barg, vacuum up to -1 barg or both.

Note 1: if both pressure and vacuum are applied to their maximum allowed in the GFD® the pressure differential across the cake will be 1.5 barg.

Note 2: The vessel jacket can be filled with warm liquid to keep the slurry mobile.



WARNING



DANGER

Never exceed ½ barg pressure

Step 2 Charging the solvent .

- ✓ Charge washing solvent into the GFD®.

Note: The solvent inlet can be either connected to one of the vessel lid nozzle, come from the slurry or come from the slurry inlet that is fitted upstream with a valve to let solvent in.

Step 3: Wash the cake.

(Purpose: removes impurities from the cake)

- ✓ Adjust the agitator height in the cake in function of your requirements.
- ✓ Rotate anti-clockwise to plough.

Step 4 Re-filtering.

- ✓ To proceed please start from Step 1 again.

Step 5: Final Filtration.

- ✓ Repeat step 1 to 4 as many times as required in your process until final filtration is completed.

7.3 DRYING THE CAKE

This step is the last one before product recovery.

Generally, at this stage the user will require to apply both vacuum and heating.

Step 1 Apply Vacuum.

- ✓ Vacuum from the bottom only can be required for low density cakes.
- ✓ A vacuum line connected at both the top (vessel lid) and the bottom (vessel base) can be required for higher density cakes.



CAUTION

NEVER APPLY VACUUM FROM THE TOP (VESSEL LID) ONLY.

Step 2 Nitrogen (N₂).

Connect a N₂ inlet to one of the vessel lid nozzle and apply N₂. The gas will travel through the cake thus improving the drying performances.

7.4 TAKING SAMPLES

During the operation samples can be taken to ensure your process runs according to your requirements or to study the cake before the process is terminated.



WARNING

PRIOR TO START THIS OPERATION, ENSURE THE GFD® IS AT ATMOSPHERIC PRESSURE



WARNING

PRIOR TO START THIS OPERATION; ENSURE THE GFD® IS NOT RUNNING.

Step 1 Ensure agitator is not running.

- ✓ Turn off the motor at the control box.

Step 2 Ensure vacuum is not running.

- ✓ Stop the vacuum inlet.

Step 3 Ensure vessel is at atmospheric pressure or room pressure.

- ✓ Stop pressure inlet.
- ✓ Stop Nitrogen inlet.

Step 4 Remove a stopper on the vessel lid.

Note: *If there is no available nozzle we recommend to the user to not remove possible instruments but to remove the easiest and safest inlet such as the nitrogen inlet or the solvent inlet.*

7.5 RECOVERING THE PRODUCT

Thanks to its unique removable filter basket the GFD® guarantees full product recovery.



WARNING

ISOLATE ALL SERVICES PRIOR TO THE START OF ANY WORK.



WARNING

PRIOR TO START THIS OPERATION; ENSURE THE GFD® IS NOT RUNNING.

Step 1: Ensure agitator is not running.

- ✓ Turn off the motor at the control box.

Step 2: Ensure vacuum is not running.

- ✓ Stop the vacuum inlet.

Step 3: Ensure vessel is at atmospheric pressure or room pressure.

- ✓ Stop pressure inlet.
- ✓ Stop Nitrogen inlet.

Step 4: Loosen the agitator seal.

- ✓ Unscrew the agitator seal to free the agitator.

Step 5: Ensure agitator is at a maximum height.

- ✓ The agitator blade must be fully inside the vessel lid and therefore cleared from the vessel base.

Step 6: Uncouple the vessel base and lid.

- ✓ Remove the red pressure clamp around the vessel flanges.

Step 7: Swing the vessel lid out.

- ✓ Loosen the vessel lid support clamp at the pole.
- ✓ Rotate the vessel lid so as to clear the vessel base.
- ✓ Tighten the support clamp again to maintain the vessel lid in place.

Step 8: Lift the basket.

- ✓ You can now take the basket out of the GFD[®].

8.0 Maintenance Operations

Prior to the commencement of operation it is necessary to observe the following procedures and instructions. Should any fault be detected and replacements required, then refer to the relevant section of these maintenance procedures.

8.1 ABOUT THESE PROCEDURES

There are two sections to the maintenance procedures:

- PSL Maintenance Procedures: Where the equipment is wholly supplied by Powder Systems Limited.

Whilst every care is taken to ensure that the information in this manual is correct, no liability can be accepted for damage or injury caused by any errors in, or omissions from, the information given.

8.2 GENERAL MAINTENANCE PROCEDURES



WARNING

ISOLATE ALL SERVICES PRIOR TO THE START OF ANY WORK.



WARNING

ENSURE THAT THE INTERNAL PRESSURE OF THE FILTER IS EQUAL TO ATMOSPHERIC PRESSURE (0 BARG), THE VESSEL HAS BEEN FULLY DRAINED AND CLEANED THOROUGHLY OF ANY POTENTIALLY HAZARDOUS SUBSTANCES PRIOR TO THE COMMENCEMENT OF ANY MAINTENANCE ACTIVITY.

These maintenance procedures / instructions are provided to help the user identify parts that from time to time should be inspected and where necessary replaced to ensure the continued satisfactory operation of the apparatus.

Within this section you will find that some procedures / instructions that have been covered elsewhere in this manual, however, they are repeated here because it is important that they are understood and adhered to both for safety and operational reasons.

8.2.1 Joints, Mating Faces & O-rings

Where an o-ring is used between mating faces of two components ensure that it is not suffering from deterioration, chemical attack, wear, or leakage. If an o-ring requires replacement make sure that the mating faces are clean and dry with all traces of old o-rings removed.

When cleaning a joint face, use a tool which is not likely to score or damage the face, and remove any burrs or nicks that may be present.

8.2.2 Screw Threads & Fastenings

Always ensure that a blind tapped hole is completely free from fluids and other incompressible media before installing the fixing. When checking or re-tightening a nut or bolt to a specified torque setting, slacken the nut or bolt by a quarter of a turn, and then re-tighten to the specified torque.

8.2.3 Washers

Any fastening, which, will rotate against a component or housing in the course of tightening, should always have a washer between it and the relevant component or housing.

8.2.4 Bearings

Unless otherwise stated the bearings used on this equipment have integral seals or. The standard greases within these bearings have operating temperature ranges and other properties to suit the intended application areas. The service life of the grease exceeds bearing life so that, no provision is made for re-lubrication.

Any additional maintenance requirements for specific bearings shall be described in their relevant sections.

8.2.5 Flexible Pipework Etc.

Where a flexible pipe or joint is used between two components ensure that it is not suffering from deterioration, chemical attack, damage, wear or leakage. Should replacement be required then refer to the relevant section of these procedures.

8.3 RECOMMENDED MAINTENANCE INTERVALS

TIME	DESCRIPTION
DAILY	Check for general running, excessive noise and the operation of the system.
WEEKLY	Check o-rings and seals etc. for leaks or signs of wear.
MONTHLY	Check and remove any dust build up on components.

8.4 ITEM SPECIFIC MAINTENANCE

8.4.1 O-rings

In respect of “O” ring seals, they should be routinely inspected for leakage and any obvious signs of deterioration or accidental damage.

If it is necessary to replace seals, it is important that mating surfaces, ie: - “O” ring grooves are not damaged in the process. Although unlikely to occur, if a seal is stuck in place and a tool is required to assist removal, it is important to select the right tool so as to prevent damage to the groove surface. Once the seal is removed, the mating surfaces should be examined to ensure they are free of any debris in preparation for the replacement components.

PLEASE NOTE: To ensure continuity of operations, it is highly recommended that spare seals are held in stock

8.4.2 Filter Baskets

Filter Basket should be routinely inspected for any obvious signs of deterioration or accidental damage to the sealing faces and o-ring groove or to the filter mesh. If any signs of damage are present, PSL recommend that the basket be replaced to ensure correct functionality of the GFD®.

PLEASE NOTE: To ensure continuity of operations, it is highly recommended that spare baskets are held in stock

8.4.5 Support Stand and Vessel Clamps

Before every use of the GFD® all support frame, vessel clamps and positional stop screws should be checked for tightness to prevent damage to the equipment.

8.4.6 Glass Vessel and Stoppers

All glass components should be inspected before every use for any obvious signs of deterioration or accidental damage. If any damage is found, components should **immediately** be replaced to prevent possible injury.

8.4.7 Agitator raise / lower mechanism

To ensure that the mechanism continues to run smoothly, it is recommended that it is inspected six monthly for excessive movement when locked in position, indicating wear & tear.

The mechanism internal parts and rack teeth have been coated with an FDA compliant lubricant to aid smooth movement. Should re-lubrication be necessary, use a suitable FDA compliant lubricant for moving metallic parts. For example: Ambersil MP Food Grease FG Aerosol.

9.0 PSL QUALITY CERTIFICATES



Powder Systems Limited

EC Machinery Directive 2006/42/EC
CE- Declaration of Conformity

Machine or Machine Parts Description:

PF-00001-115 - MINI LAB GFD 115V

NOTE: Modifications to the machine without written approval from the undersigned will render this declaration null and void.

Name and Address of Manufacturer:

Powder Systems Limited
Estuary Business Park
Liverpool, L24 8RG
United Kingdom

We hereby certify that the equipment stipulated above complies with the relevant provisions of the EC Machinery Directive and the National Laws and Regulations adopting this directive.

Is in conformity with the provisions of the following other EEC Directives:

Machinery Directive 2006/42/EC

Low Voltage Directive 2006/95/EC

Harmonised / National Technical Standards and Specifications were applicable:

BS EN ISO 12100-2-2003+Amendment 1:2009 Safety of Machinery. Basic Concepts, General Principles for Design Technical Principles

BS EN ISO9001: 2008 Quality Management Systems - Requirements

HSE Statutory Instrument No 2306, The Provision & Use of Work Equipment Regulations: 1998



Powder Systems Limited

Certificate of Conformance

CONTRACT / SERIAL NUMBER

PSL Part Reference

PF-00001-115 - MINI LAB GFD 115V

TO WHOM IT MAY CONCERN,

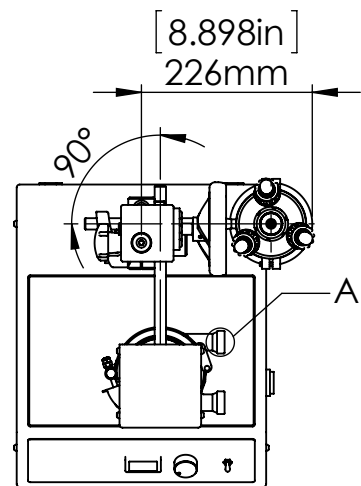
“We certify that the items referenced above and supplied against your Purchase Order have satisfied the inspection/verification requirements of our ISO9001:2008 Quality Assurance Management System and conform to your requirements”

Name (Print):	Signature:	Position

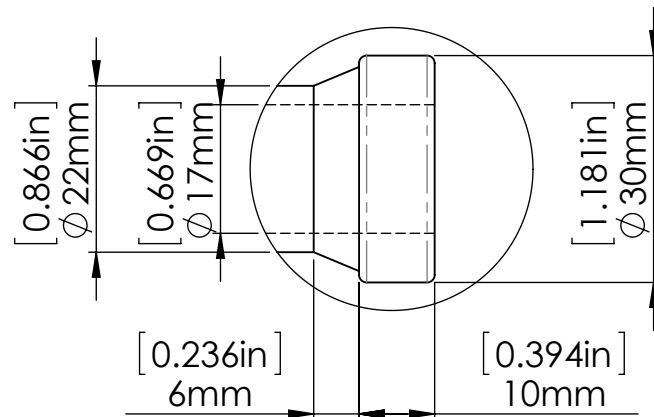
10.0 ANNEX 1

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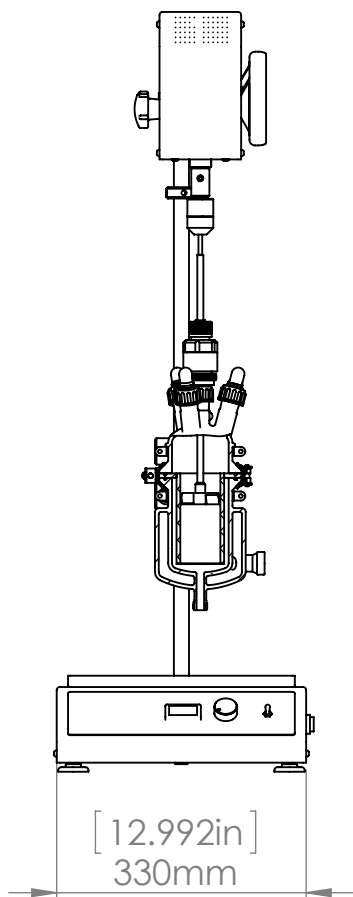
IF IN DOUBT, ASK!



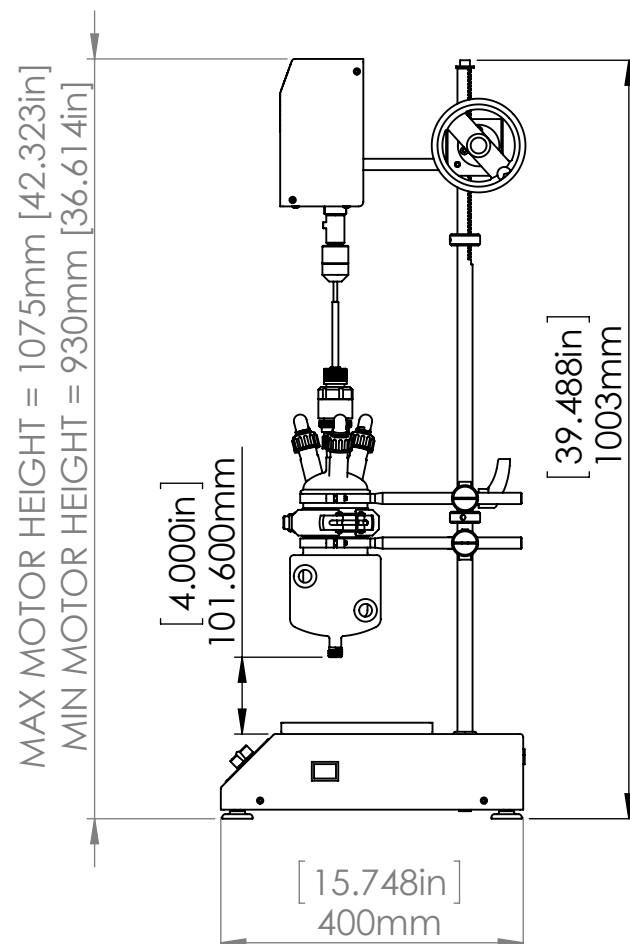
PLAN VIEW WITH
LID SWUNG OUT



DETAIL A
N5 & N6 NOZZLE SIZE



FRONT ELEVATION



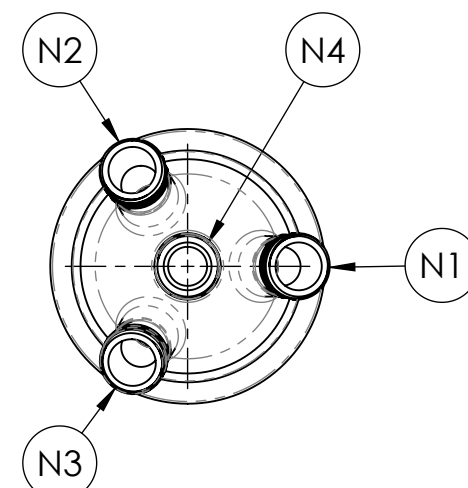
SIDE ELEVATION

ELECTRICAL DATA		
PRODUCT CODE	VOLTAGE	PLUG CONNECTION
PF-00001-230	230V - 50 Hz	UK- Type G, BS 1363 – (13A/230-240V 50Hz grounded and fused) Europe – Type E/F Hybrid CEE 7/7 (16A/250V grounded)
PF-00001-115	115V - 60 Hz	US – NEMA 5-15 (15A/125V grounded) Japan – JIS C 8303, Class I (15A/100V grounded)

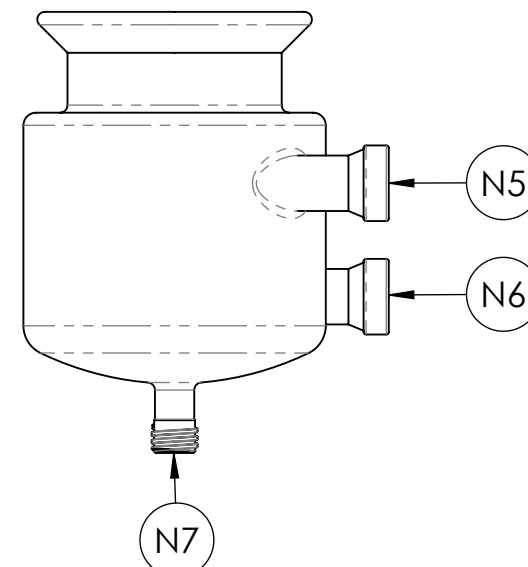
NOZZLE SCHEDULE		
NO	SIZE	ORIENTATION
N1	19/26 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	ANGLED
N2	19/26 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	ANGLED
N3	19/26 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	ANGLED
N4	19/26 GLASS FLANGE WITH RODAVISS CONN (HEAVY WALL)	VERTICAL
N5	SEE DETAIL (HEAVY WALL DN 15 GLASS FLANGE)	HORIZONTAL
N6	SEE DETAIL (HEAVY WALL DN 15 GLASS FLANGE)	HORIZONTAL
N7	GL18 SCREW THREAD	VERTICAL

DESIGN DATA			
Filtration area	0.002m ²		
Cake volume	0.1 Litre		
Cake depth (max)	50mm		
Volume	0.3 Litres		
	Vessel	Jacket	Unit
Design Temperature (Min)	-25(-13)	-25(-13)	°C(°F)
Design Temperature (Max)	150(302)	150(302)	°C(°F)
Design Pressure (Min)	FV	FV	barg (psig)
Design Pressure (Max)	0.5 (7.25)	0.5 (7.25)	barg (psig)
Area Classification Internal /External	Safe Area		

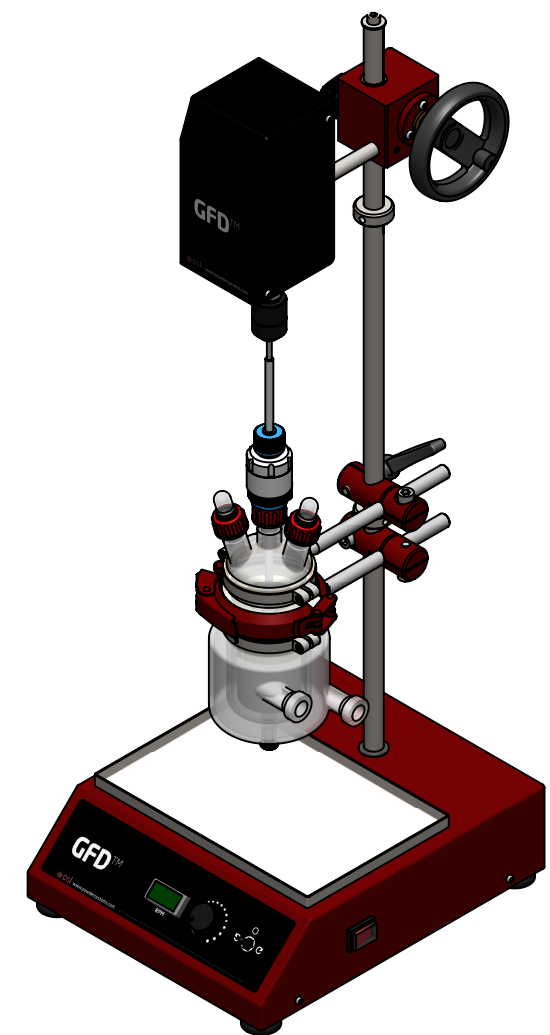
OEL	The PSL GFD is not classified as containment equipment and therefore has to be used in conjunction with other equipment suitable to protect operator from exposure to potent compounds.		
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VESSEL LID

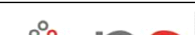



VESSEL BASE

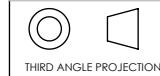


REVISION F			REVISION E			REVISION D			REVISION C –DIMENSIONS ADDED –SECTION VIEW AND SWING OUT VIEW ADDED			REVISION B –RAISE/LOWER SYSTEM ADDED			REVISION A –ORIGINAL ISSUE		
MOD BY	APPROVED	DATE	MOD BY	APPROVED	DATE	MOD BY	APPROVED	DATE	MOD BY	APPROVED	DATE	MOD BY	APPROVED	DATE	MOD BY	APPROVED	DATE
INITIS	INITIS	--/--	INITIS	INITIS	--/--	INITIS	INITIS	--/--	AGM	AGM	20/07/12	AGM	AGM	08/12/11	AGM	AGM	19/08/11
CUSTOMER APPROVAL			CUSTOMER APPROVAL			CUSTOMER APPROVAL			CUSTOMER APPROVAL			CUSTOMER APPROVAL			CUSTOMER APPROVAL		
--/--			--/--			--/--			--/--			--/--			--/--		

DIMENSIONS IN mm DO NOT SCALE	
REMOVE ALL BURRS AND SHARP EDGES.	
WELDING IS TO BE CONTINUOUS FILLET, FREE FROM CRACKS, & CREVICES AND FINALLY GROUND TO BLEND INTO SURROUND MATERIAL UNLESS OTHERWISE STATED	

	POWDER SYSTEMS LTD ESTUARY BUSINESS PARK LIVERPOOL L24 8RG UNITED KINGDOM www.powdersystems.com		DRN BY	AGM	TITLE	
			DATE	19/08/2011	MINI LAB GFD	
			SCALE	1:10	DRG NO.	PF-00001-B01
			CHK BY	CMP		
			APPR BY	CMP		
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THIRD ANGLE PROJECTION					A3	C

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