SciLog®
BioProcessing Systems

SciFlex™ 140 NFF Operations Manual

SciLog Inc.

05/2012, Rev. 4

(This Page Intentionally Left Blank)

PRECAUTIONS:

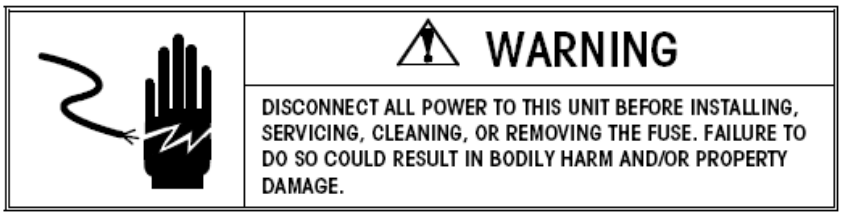
READ this manual BEFORE operating or servicing this equipment.

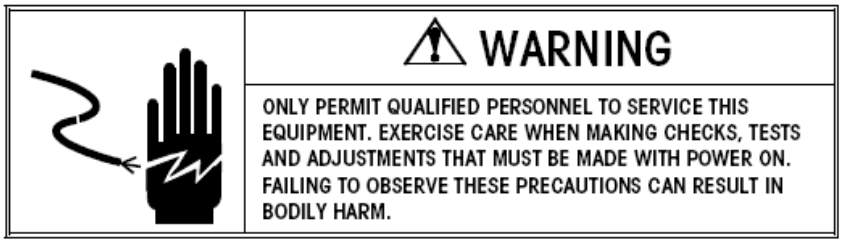
FOLLOW these instructions carefully.

SAVE this manual for future reference.

DO NOT allow untrained personnel to operate, clean, inspect, service or tamper with this equipment.

ALWAYS DISCONNECT this equipment from the power source before cleaning or performing maintenance.





CALL SCILOG for parts, information and service.

PRÉCAUTIONS:

LISEZ ce manuel AVANT de faire fonctionner ou d'entretenir cet équipement.

SUIVEZ attentivement ces instructions.

CONSERVEZ ce manuel pour future référence.

NE LAISSEZ PAS du personnel non qualifié utiliser, nettoyer, inspecter, entretenir, réparer ou manipuler cet équipement.

DÉBRANCHEZ TOUJOURS cet équipement de la source de courant avant de nettoyer ou d'exécuter l'entretien.

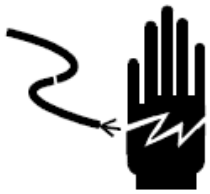
APPELEZ SCILOG pour pièces détachées, renseignements et entretien.

⚠ ATTENTION

DÉBRANCHEZ TOUT COURANT DE CETTE UNITÉ AVANT DE FAIRE L'INSTALLATION, D'EFFECTUER L'ENTRETIEN, LE NETTOYAGE OU AVANT DE RETIRER LE FUSIBLE. NE PAS OBSERVER CES PRÉCAUTIONS RISQUERAIT DE CAUSER DES BLESSURES CORPORELLES OU/ET D'ENDOMMAGER L'ÉQUIPEMENT.

⚠ PRUDENCE

SOYEZ PRUDENT LORSQUE VOUS MANIPULEZ DES APPAREILS SENSIBLES À L'ÉLECTROSTATIQUE.



⚠ ATTENTION

AUTORISEZ SEULEMENT LE PERSONNEL QUALIFIÉ À ENTRETENIR CET ÉQUIPEMENT. SOYEZ PRUDENT LORSQUE DES VÉRIFICATIONS, TESTS ET AJUSTEMENTS DOIVENT ÊTRE EFFECTUÉS SOUS TENSION. NE PAS OBSERVER CES PRÉCAUTIONS RISQUERAIT DE CAUSER DES BLESSURES CORPORELLES.

⚠ ATTENTION

POUR ASSURER UNE PROTECTION CONTINUE CONTRE UNE DÉCHARGE ÉLECTRIQUE, BRANCHEZ UNIQUEMENT SUR UNE PRISE CORRECTEMENT RELIÉE À LA TERRE. NE RETIREZ PAS LA FICHE DE TERRE.

Table of Contents

Safety Information:

Be sure to read and observe the following requirements!

Before connecting the SciFlex to mains, make sure that the mains voltage corresponds to the voltage rating shown on the nameplate.
Opening the SciFlex electronics enclosure cover exposes live parts. Therefore, the cover must not be removed. If repair should be required, return the SciFlex electronic enclosure to the factory.

If opening of the SciFlex electronics enclosure is inevitable, the system must first be disconnected from all voltage sources.

Make sure that the mains plug has been pulled out.

Repair or adjustment of an opened SciFlex electronics enclosure under voltage must be carried out only by a skilled person who is aware of the hazard involved.

Whenever it is likely that the protection has been impaired, the SciFlex must be made inoperative and secured against any unintended operation. The protection is likely to be impaired if, for example:

- The SciFlex shows visible damage
- The SciFlex fails to perform as intended
- After prolonged storage above 70°C
- After severe transport stresses

Before re-commissioning the SciFlex, a professional routine test according to the SciFlex IQ/OQ Protocols must be performed.

Installation & Start-Up:

Installation of the SciFlex™ System must be carried out only by trained personnel in accordance with the relevant regulations and this operations manual.

Make sure that the technical specifications and input ratings of the SciFlex™ are observed. See “SciFlex™ Specifications”.

The protection provided by this equipment may be impaired if the SciFlex™ is used in a manner inconsistent with this manual or for purposes not specified by the manufacturer.

Maintenance & Cleaning:

The SciFlex™ is practically maintenance free. The SciPres™ Disposable Sensors used with the system come pre-calibrated from the factory and require no maintenance.

To remove dust, dirt and stains, the outer surfaces of the SciFlex™ may be wiped using a soft, non-fluffing cloth moistened with water. If required, you may also use a mild detergent or 2-propanol.

The SciPres™ Disposable Sensors may be sanitized with 0.1 Molar NaOH, or 2-propanol. They may be autoclaved up to twice, and newer units with the grey rings around the cable connector may be gamma irradiated. Additional Sensors may be ordered from SciLog when needed, available in 5 packs. SciPres ¾ “ TC: PN 080-696PSX-5.

Description of this Manual:

The following information is covered in this Manual:

- **Safety Requirements**
- **Product Specifications**
- **Hardware Description**

NOTE:

Note calls attention to important information. *Italics* are used to further emphasize certain information. Ignoring the given instructions may lead to malfunction or damage of the instrument or other equipment and to personal injury.

Introduction:

You will find the SciFlex™ System easy to use. The state-of-the-art hardware and software design of the SciFlex™ allows you to control measure and document your Normal Flow Filtration / Dispensing processes. With proper maintenance, the SciFlex™ NFF System will provide many years of excellent service and performance.

Please read the following instructions carefully!

Inspections: Refer to the separate unpacking document, and remove the SciFlex and accessories carefully from the shipping container. Check the contents against the purchase order to verify that all parts are included and undamaged.

Please do the inspection now, even if the SciFlex is not used immediately. Many carriers must receive damage claims within seven days of delivery. Please retain all packing material so unit may be shipped safely, if necessary.

SciLog Customer Service: If assistance is required, please contact us at:

SciLog Inc.
801 Deming Way (Shipping: 8446 Excelsior Dr.)
Madison, WI 53717
Phone: 800-955-1993 or 608-824-0500
Fax: 608-824-0509

SciLog Customer Service personnel will be able to serve you more efficiently if you have the following information:

- **Serial number and model name of the equipment.**
- Installation procedure being used.
- Concise list of symptoms.
- List of operating procedures and conditions in use when problem arose.

Standards:

The SciFlex™ conforms to the following standards:

EN 61326-1:2006, Class B
EN 6100-3-2:2006
EN 6100-3-3:1995 +A1:2001 +A2:2006
EN 61010-1 Issued: 2001/03/01
UL 61010-1 Issued: 2004/07/12 Ed.2
And is certified to: **CAN/CSA-C22.2 No 61010-1 Ed.2**

Warranty Information:

SciLog LIMITED WARRANTY, LIMITATION OF LIABILITY & ACCEPTABLE USE AGREEMENT

This Agreement is hereby entered into between You, the Buyer, and SciLog, Inc.

If you do not Agree to these terms, return the item to SciLog

1. LIMITED WARRANTY: SCILOG, INC. EXPRESSLY WARRANTS THE EQUIPMENT MANUFACTURED BY IT ONLY AS SET FORTH HEREIN. SCILOG, INC. MAKES NO OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED (INCLUDING WITHOUT LIMITATION WARRANTIES AS TO MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE). IN ADDITION, THE FOLLOWING SHALL CONSTITUTE THE SOLE AND EXCLUSIVE REMEDIES OF BUYER FOR ANY BREACH BY SCILOG, INC. OF ITS WARRANTY HEREUNDER.
    a. PRODUCT WARRANTY – SciLog, Inc. warrants products it manufactures against defects in materials and workmanship for one (1) year from the date of shipment from SciLog, Inc. in normal use and service. If any products fail to conform to this warranty within the first ninety (90) days of the warranty period, SciLog, Inc. will, at its option, repair or replace such goods returned to SciLog. If any products fail to conform to this warranty for the remainder of the warranty period, SciLog, Inc. shall furnish necessary replacement parts free of charge.
    b. PARTS WARRANTY -SciLog, Inc. warrants service parts against defects in materials and workmanship for ninety (90) days from the date of shipment from SciLog, Inc. in normal use and service. If any service parts fail to conform to this warranty, SciLog, Inc. shall furnish necessary replacement parts free of charge.
    c. WARRANTY LIMITATIONS -These warranties are subject to the following conditions:
        i. Product warranty shall only apply to the item *as shipped* by SciLog. Any modifications to hardware, software, fluid line changes or any other customer alteration which may affect the functionality of the product shall *not* be covered by warranty.
        ii. Upon discovery of product non-conformity, SciLog, Inc. will be given prompt written notice with a detailed explanation of the alleged deficiencies.
        iii. The product or part must be properly installed, operated and maintained in accordance with SciLog, Inc. specifications.
        iv. The product or part must not be operated above rated load capacity or subject to accident, alteration, misuse, or abuse.
        v. The product must not have been repaired or serviced by anyone other than SciLog, Inc. or one of its authorized dealers.
        vi. SciLog, Inc. shall have a reasonable time to repair or replace the defective product or part.

vii. The buyer is responsible for shipping the product or part to SciLog, Inc. SciLog, Inc. is responsible for shipping the product back to the buyer.

2. INTELLECTUAL PROPERTY: The sale and delivery of the SciLog, Inc.'s equipment and/or software to Buyer shall in no way transfer to Buyer any right of ownership in any patents, copyrights, trademarks, technologies, designs, specifications, drawings, or other intellectual property incorporated into the equipment and/or software.

3. DISCLAIMER OF DAMAGES: IN NO EVENT SHALL SCILOG, INC. BE LIABLE FOR ANY TYPE OF SPECIAL CONSEQUENTIAL, INDIRECT, INCIDENTAL OR PENAL DAMAGES, WHETHER SUCH DAMAGES ARISE OUT OF OR ARE A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE. Such damages shall include but not be limited to loss of profits or revenues, loss of use of the equipment or associated equipment, cost of substitute equipment, damage to facilities, down time costs, increased production costs or claims of Buyer's customers or contractors for such damages. Buyer agrees that in the event of a transfer, assignment, or lease of the equipment sold hereunder Buyer shall secure for the SciLog, Inc. the protection afforded to it in this paragraph.

4. LIMITATION OF LIABILITY: The SciLog, Inc. shall not be liable for any loss, claim, expense or damage caused by, contributed to or arising out of the acts or omissions of Buyer or third parties, whether negligent or otherwise. In no event shall the SciLog, Inc.'s liability for any cause of action whatsoever exceed the replacement cost of the item giving rise to the claim, whether based in contract, warranty, indemnity, or tort (including negligence). Any suit arising hereunder must be commenced within one (1) year from the date in which the cause of action accrues. Except as otherwise provided in the terms of this Agreement SciLog, Inc. shall not indemnify any party for any reason.

5. NO RESPONSIBILITY FOR GRATUITOUS INFORMATION OR ASSISTANCE: If SciLog, Inc. provides Buyer with assistance or advice which concerns any parts, products, service supplied hereunder or any system or equipment in which any such part, product or service may be installed and which is not required pursuant hereto, the furnishing of such assistance or advice shall not subject SciLog, Inc. to any liability, whether based in contract warranty, tort (including negligence) or otherwise.

6. INTERNATIONAL SALES / RESALE / EXPORT: Buyer EXPRESSLY agrees and verifies that the purchased product(s) will not be transferred or exported to or purchased on behalf of third parties and that Buyer is the final end-user of the product. Export or transfer of any SciLog product without the express, written authorization of the SciLog, Inc. is strictly prohibited and may violate US trade laws and regulations, thereby subjecting the Buyer to civil and criminal liability.

7. REVISIONS TO THIS POLICY: From time to time SciLog, Inc. may revise the terms of this Agreement. SciLog, Inc. will make its best efforts to inform customers of these revisions. The most current revision of these terms may be accessed over the internet by accessing the webpage located at: http://www.scilog.com/warranty

SciFlex 140-NFF Specifications:

Mechanical:

- **Dimensions:** Length: 36 in. (91.4 cm); Width: 20 in. (51 cm); Height: 40 in. (102 cm).
- **Weight:** 250 lb (114 Kg);
- **Enclosure:**
  - **Framework**: Stainless Steel, Equipped with lockable 4" casters.
  - **Control cabinet**: Stainless Steel, with disconnect, on/off switch and E-Stop button.
- **Pump Head Options:**
  - Watson Marlow 620RE4. Uses 12 or 17 mm BioPrene or Sta-Pure elemental tubing, 12 L/min. max. flow, 60 psi max.
  - Watson Marlow 620R Series, Continuous I/P tubing, #26, 83, 82 or 184, 30 psi max
  - Levitronix Puralev® 200 SU Pump Head system, 21 L/min. max at 36 psi. Has Single Use replaceable pump head with 1/2" TC fittings.
  - Viking Acculobe 1:1 Rotary Lobe Pump Head, Tri-Wing design, 26 L/min. at 60 psi. 3/4" TC fittings, paired with a Micromotion F050 Coriolis Flow Meter for closed loop pump rate control.
- **Pressure Sensors:** Up to three SciPres Disposable Pressure Sensors, ¾" TC connections. Polysulfone construction, 60 psi max., CIP, SIP, Autoclavable, Gamma Stable. P1 - located in Filtrate, P2 and P3 available for filter train monitoring.

Electrical:

- **Power:** 100/120 V~, Single Phase, 20 A Breaker, NEMA 5-20P plug. (208/240 V~, Single Phase and 208 V~, Three Phase are available options)
- **Motor:** Variable speed Lenze Servomotor, IP54 wash-down, continuous duty, 1 KW, 4096 INC Encoder for rpm feedback used with Watson Marlow heads. 1.6 KW unit is used with the Viking Acculobe. Levitronix BSM 1.x motor, 24 VDC, 10,000 rpm max. is used with the Levitronix Puralev® 200 SU head.
- **Filtrate and/or Feed Scale:** SciLog WeighStation or other floor scale may be used depending upon specific configuration.
- **Operating Range:** 4 to 25° C.

Display, I/O:

- 10.4" Touch Screen Computer, On/Off switch and E-Stop button.
- One network connection for use with an OPC client.

Software:

- **Main menu with five operational modes**:
  - **Constant Rate**: Constant Rate Filtration user-definable alarms and end points.
  - **Constant Pressure**: Constant Pressure Filtration user-definable alarms and end points.
  - **R/P Stat:** Constant Rate / Constant Pressure Filtration that changes methods at a defined pressure value, also with user-definable alarms and end points.
  - **Manual**: Manual set point of individual motors, no set point control.
  - **Setup**: Selection of user preferences, interface options, alarms and interlocks.

Data Collection :

- The system contains an OPC server that may be connected to the customers OPC Data Historian, such as OSI PI. An onboard CSV File is automatically populated on a USB device attached to USB port 1 on the back of the touch panel interface. Retrieving the USB should only be done with the unit switched off and power cord disconnected.

Part A: SciFlex™ Hardware:

1.0 Overview:

The SciFlex Model 140-NFF is a pilot plant-scale normal flow filtration system that enables you to move, clarify, or sterilize solutions.

The SciFlex is designed to process volumes of material through a low shear peristaltic pump and pressure sensor(s). The SciFlex-140 can include a **SciLog Weigh Station for use with Disposable Media bags** as the Filtrate Vessel and or the Feed Vessel. An alternate Scale with appropriately sized capacity and resolution can be used for your particular process.

Up to three pressures can be monitored with **SciPres™ disposable Pressure Sensors**. P1 is used for measuring filter backpressure (plug-up) and filter trains are supported by the availability of P2 and P3. The WeighStation or other electronic scale is connected to the SciFlex for monitoring the quantitative collection of filtrate and its collection rate.

The SciFlex system provides ease of use and operational safety: Several user definable end point conditions are continuously monitored and displayed. Global alarms as well as physical interlocks are built into each system.

2.0 Front Panel: Data Entry & Display:

The Front Panel has three components: A touch screen HMI, an On/Off switch, and an Emergency Stop (E-Stop) Button.

The On/Off switch controls power to the screen and the bulk of the system. There is a master On/Off switch on the cabinet door that shuts down all power.

The E-Stop button shuts down the motors and puts the system into a safe state without shutting down the power. Useful if leaks or unexplained hi pressures occur.

The HMI is a touch screen panel and provides access to the SciFlex control software and all modes and functions.

3.0 Interface Options:

Pressure: The SciFlex is equipped with three SciPres Disposable Pressure Sensors, installed in the Feed, Retentate and Permeate lines. These are easily disconnected and replaced. They use watertight cable connectors, and have ¾" TC fittings.

Ethernet: Used for connection to the SciFlex via a LAN for data collection. The unit can be equipped with an Ethernet cable, and should be connected to the computer gathering the data via a hub or switch. Contact SciLog for information on having this option installed.

4.0 Filtrate and or Feed Scale:

This SciFlex is typically paired with The SciLog WeighStation, a media bag holder with a 50 kg capacity. This is typically used as the Filtrate scale, and can also be used as a Feed scale, or both if desired. Other bench or floor scales, based upon purchased configuration, may also be used.

5.0 Pressure Sensor Installation:

The SciPres Disposable Pressure Sensors are connected in-line with the tubing and used in a flow through manner. The SciPres Sensors have Polysulfone wetted surfaces that meet all USP Class VI requirements.

The SciPres Disposable sensors are easy to change when the need arises, and are readily available from SciLog in packs of 5. They may be sanitized using several methods, CIP with NaOH or alcohol, autoclaved up to twice, or gamma irradiated. (Only those with grey rings around the connector are gamma stable.)

6.0 System Feed Pump Head:

Currently, four options exist:

1. A Watson Marlow 620RE4 elemental tubing unit equipped with 12 mm or 17 mm BioPrene or Sta-Pure tubing. Flows of up to 15 L/m are possible, with pressures of up to 60 psi.

2. A Watson Marlow 620R Continuous tubing unit equipped with I/P sized tubing is also an option. Tubing sizes of #26, 73, 82 or 184 are possible, flows up to 12 L/m and pressures of 30 psi.

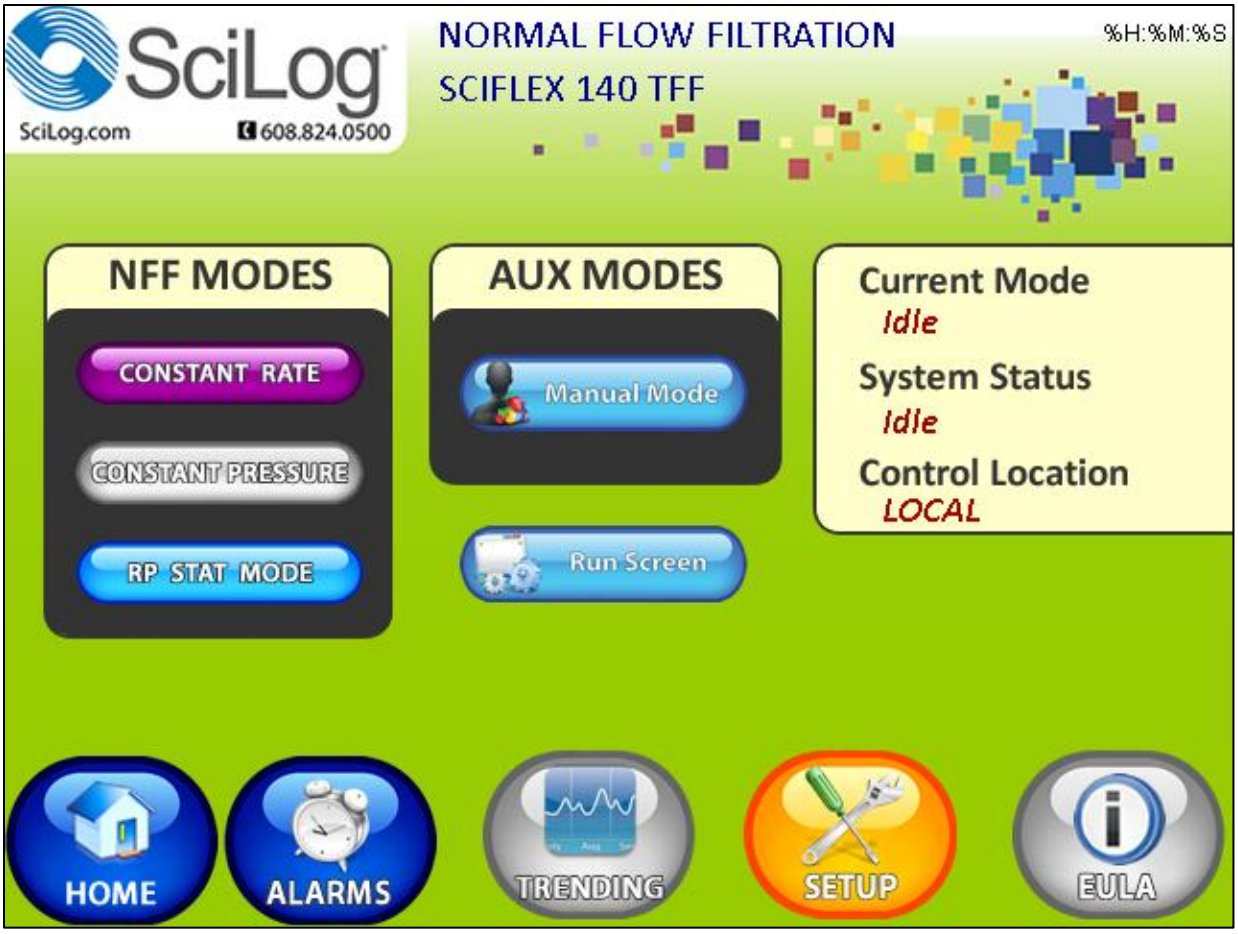
3. A Levitronix Puralev 200 SU motor/head system is an additional option. Max flow is 21 L/m with max pressure of 36 psi.

4. A Viking Acculobe 1:1 Rotary Lobe Head, Tri-wing design head is the fourth option. Max flow of 26 L/m, and max pressure of 60 psi. It is paired with a Micromotion F050 Coriolis flow meter for closed loop control of the pump rate.

The flow rate range depends upon the unit installed, and is specified on the SETUP screen in order to use the proper flow rate data.

Part B: SciFlex™ NFF Software

1.0 Home Screen:



The SciFlex has four operational modes screens, a run screen, alarms, trending and setup screens as shown above.

NFF Modes:
This provides access to the three main Normal Flow Filtration Methods and their set points. Recipes may also be created, saved, loaded, modified, and save again if desired.

- Constant Rate (Feed rate) method where the feed rate is held constant until a pressure set point is achieved,
- Constant Pressure (Inlet) method where the feed rate is controlled to maintain a constant filter backpressure until a low flow rate is achieved,
- RP Stat method, where the two are combined. The system operates under Constant Rate method and changes to Constant Pressure method at a pre-selected backpressure setting.
- **To create a recipe in these modes:**
  - **Set the parameters listed on the Mode screen, enter a name for the recipe, and click on the "save recipe" button. The name is appended with a time stamp.**
- **To load a recipe:**
  - **Click on the drop down box, tap on the recipe name, and then the "load recipe" button. The selected recipe parameters will be loaded.**

Manual Mode:
This mode allows the operator to set rate Feed Rate and run the system manually. All monitored values and alarms are available.

Run Screen:

A Run Screen is provided for all modes. Its explanation follows in a later section.

Home Screen Buttons:

Home: This brings the operator back to this Home screen, and is available on all screens.

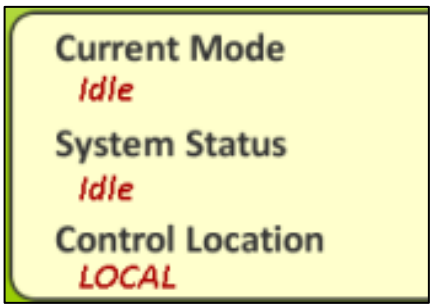
Alarms: Opens the Alarms screen, shows current Alarms and provides access to Historical Alarms.

Trending: Provides access to the Live Trending Screen, explained later in this manual.

Setup: Provides access to the Setup Screens that are explained next.

EULA: Shows the End User License Agreement which is shown near the end of the manual.

Status Box:



This box displays the Current Mode, System Status and Control Location. The system must be Idle to make most parameter changes.

2.0 Setup Screens:

The "**Setup**" button on the Home screen takes the operator to the first Setup screen that allows the setting of the Pump and Tubing in use, as well as enabling one or both scales.

The system must be "Idle" to change these settings. (Return to the "Run Screen" and tap "Abort" to put the system in Idle if needed.)

- Scale 1, Feed / Retentate, choose between Enabled and Disabled depending upon the presence of a Feed Scale.
  - The current scale value will be displayed, and if the gross weight is positive, the scale may be manually tared.
- Scale 2, Filtrate, Choose between Enabled and Disabled depending upon the presence of a Feed Scale.
  - The current scale value will be displayed, and if the gross weight is positive, the scale may be manually tared.
- Pump and Tubing, choose between the following, dependent upon that installed. The proper calibration curve will be utilized.
  - Watson Marlow 620RE4, 17 mm tubing
  - Watson Marlow 620RE4, 12 mm tubing
  - Watson Marlow 620R, #82 tubing
  - Watson Marlow 700RBE, 19 mm tubing.
- Prime Speed: Set the % of motor speed to use when the PRIME key is activated on the RUN Screen.

Press the Aux Pressure Setup button, and the next Setup Screen is displayed:

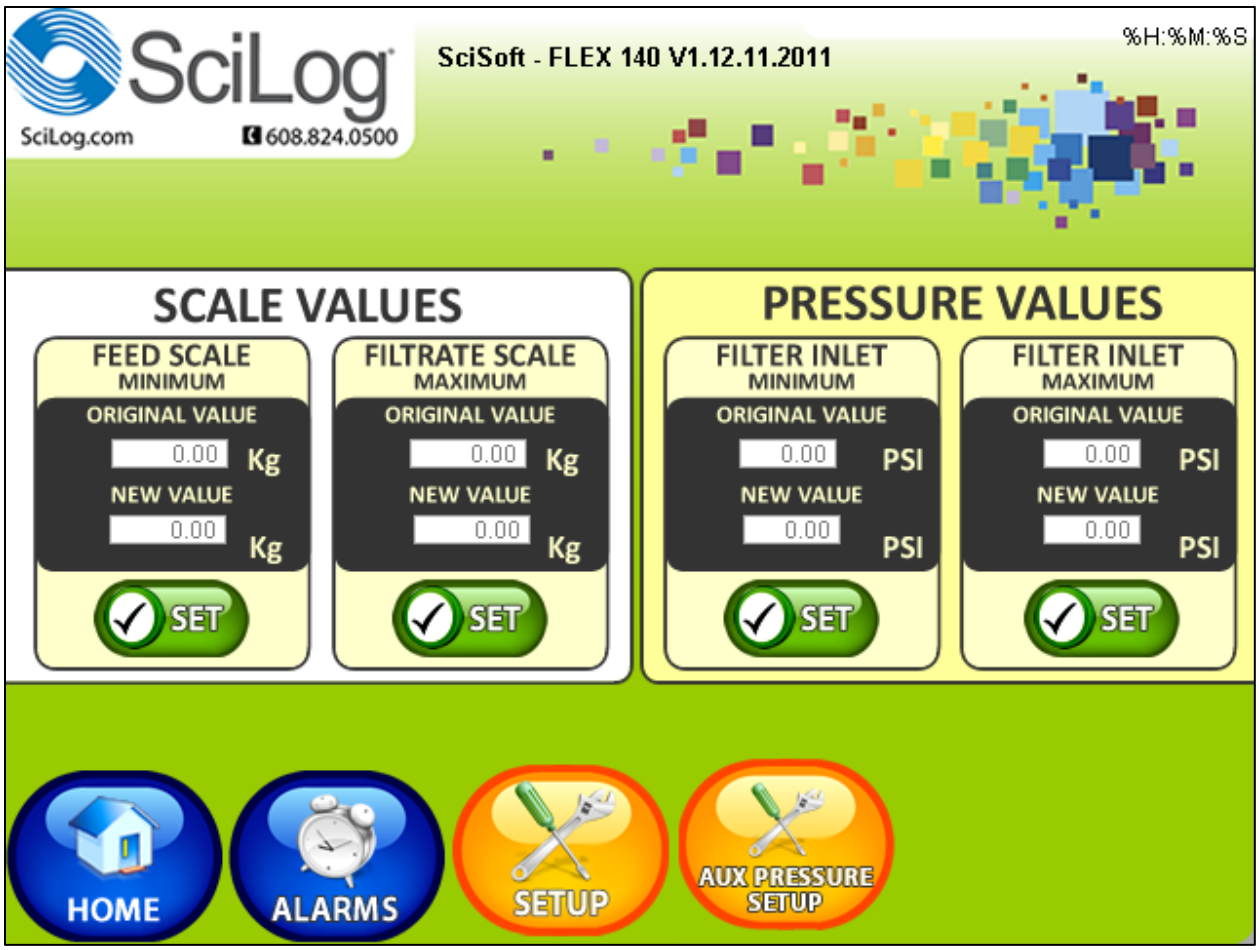
This screen allows enabling one or both auxiliary SciPres Sensors (P2 and P3), as well as the setting of the maximum pressure alarm values. The system must be idle to change these values.

Pressure Sensor 2 or 3:

- Tap and choose from Disabled or Enabled. These are available for systems using filter trains.

- Tap the New Value window and enter a new maximum pressure value, then the Set button.

The Alarms Setup button on either of the two previous screens brings the operator to the final Setup screen:

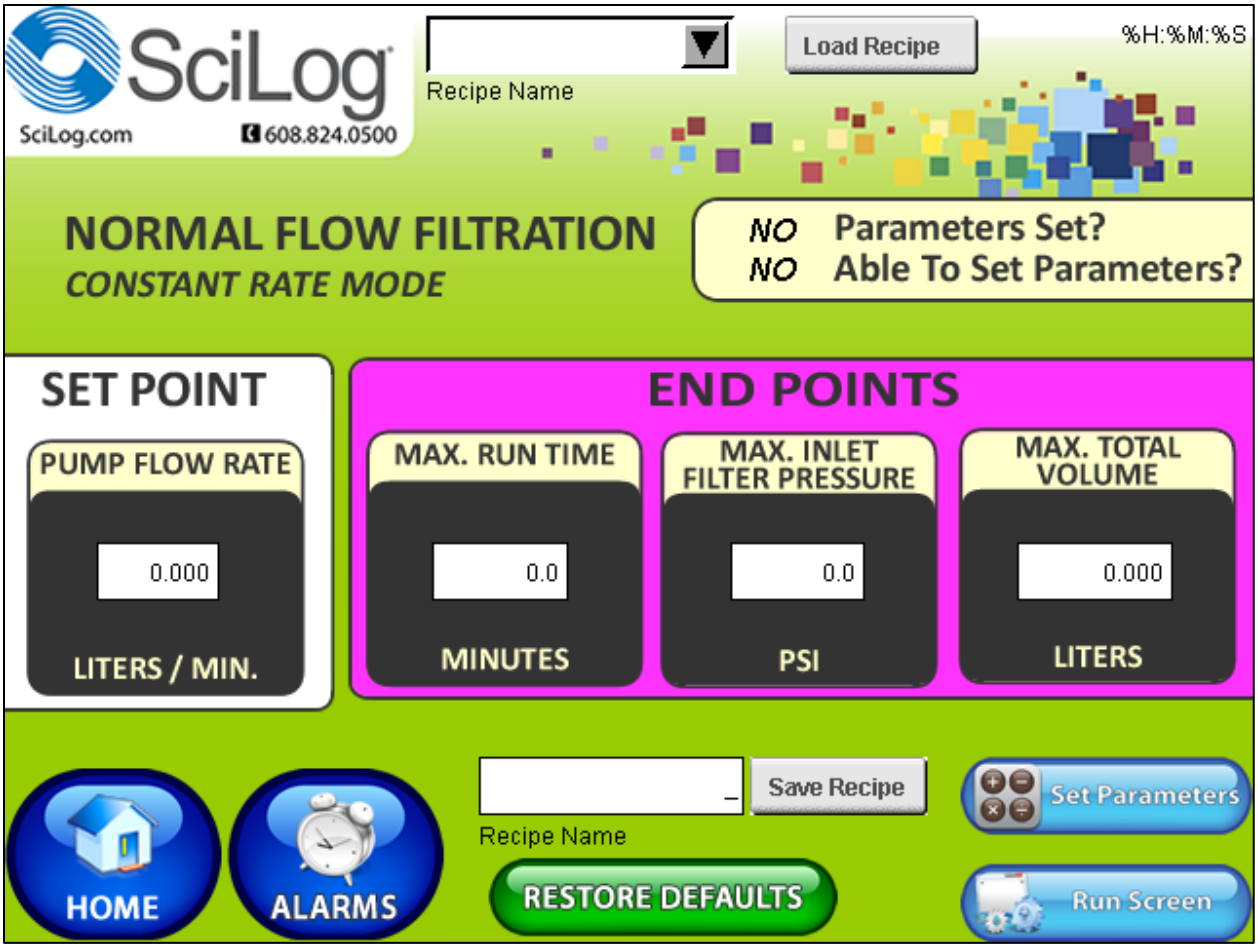


This Screen is used to set Alarm Limits for the Scales and the Filter Inlet SciPres Sensor, P1.

These Alarm Limits may be changed during any run if required. Tap on Home, Setup, and Alarms Setup to access them, change the values as shown below.

- Tap the New Value for the Feed Scale Minimum, enter a new value and tap “Set”.
    - The Feed Scale Minimum will pause the system when the Feed Vessel achieves the minimum value, allowing the changing of the vessel for a new one.
- Tap the New Value for the Filtrate Scale Maximum, enter a new value and tap “Set”.
    - The Filtrate Scale Maximum will pause the system when the Filtrate Vessel achieves the set value, allowing the changing of the vessel for a new one.
- Tap the New Value for the Filter Inlet Minimum, enter a new value and tap “Set”.
    - The Filter Inlet Minimum will pause the system when the inlet pressure (P1) reduces below the minimum value, after exceeding it. This is typically used for leak detection.
- Tap the New Value for the Filter Inlet Maximum, enter a new value and tap “Set”.
    - The Filter Inlet Maximum will pause the system when the inlet pressure (P1) achieves the set value, allowing the changing of the Filter for a new one.

3.0 Constant Rate Screen:



This mode runs at a constant inlet flow rate until a maximum pressure (P1) value is achieved, and then stops.

"Able to Set Parameters?" Must read "Yes" to change the values on this screen.

Set Points:

Tap the "Pump Flow Rate" value and a numerical entry will pop up. Enter the desired flow rate in Liters / Minute and tap the check mark button.

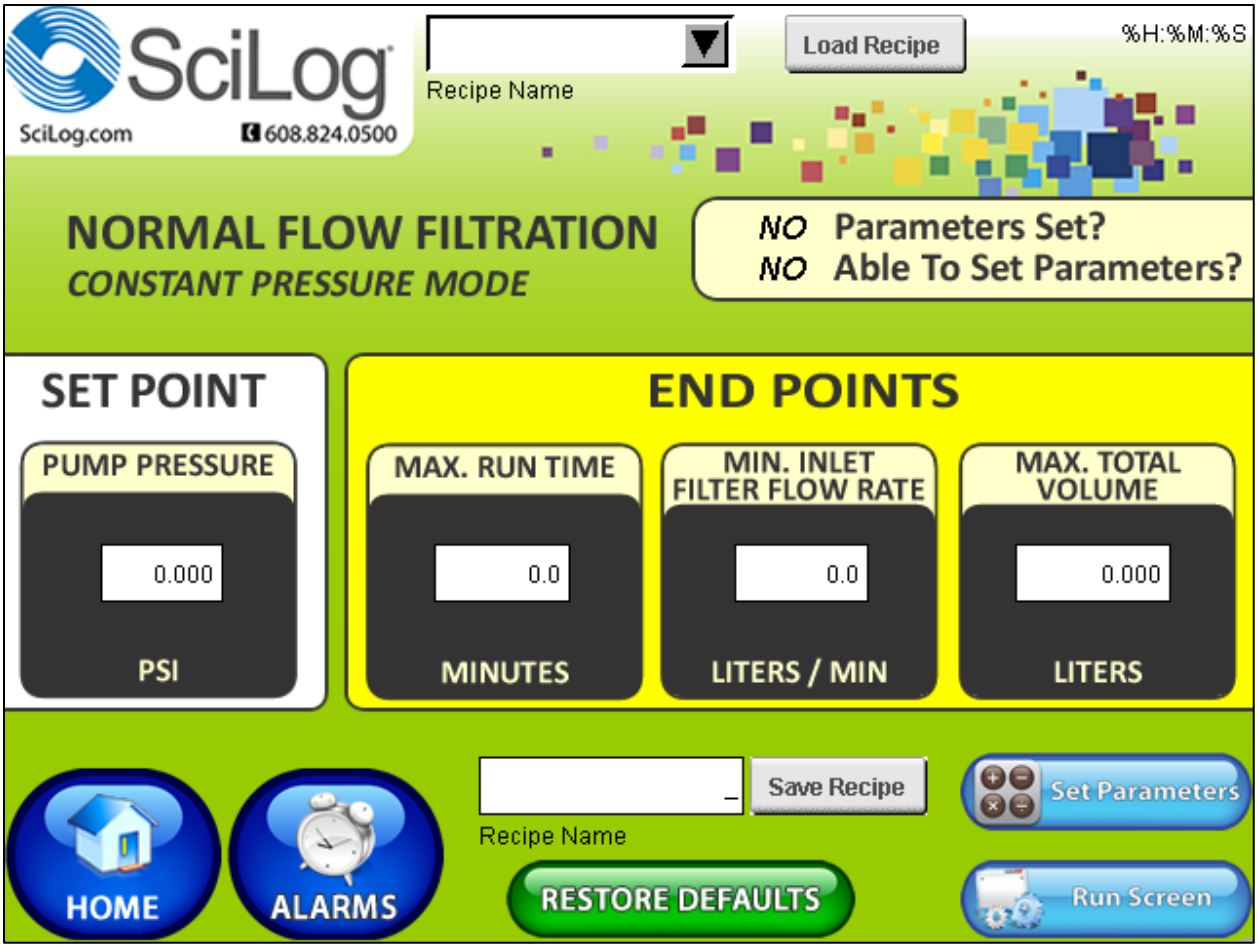
End Points:

Like the Set Point above, tap on the values for Maximum Run Time, Maximum Inlet Filter Pressure and Maximum Total Volume, enter and set the values.

- Max. Run Time is in minutes and is a mandatory value.
- Max. Inlet Filter Pressure is the value as measured by P1 in psi. This is a mandatory value.
- Max. Total Volume is in Liters as calculated by the flow rate curve. It is crucial that the correct pump and tubing is chosen in the Setup Screen.

Press the "Set Parameters" button to confirm the settings, and then the Run Screen button to change to the Run Screen and begin the process.

4.0 Constant Pressure Screen:



This mode modulates the motor speed to run at a constant inlet pressure until a minimum flow rate (low flow) value is achieved, and then stops.

"Able to Set Parameters?" Must read "Yes" to change the values on this screen.

Set Points:

Tap the "Pump Pressure" value and a numerical entry will pop up. Enter the desired pressure in psi and tap the check mark button.

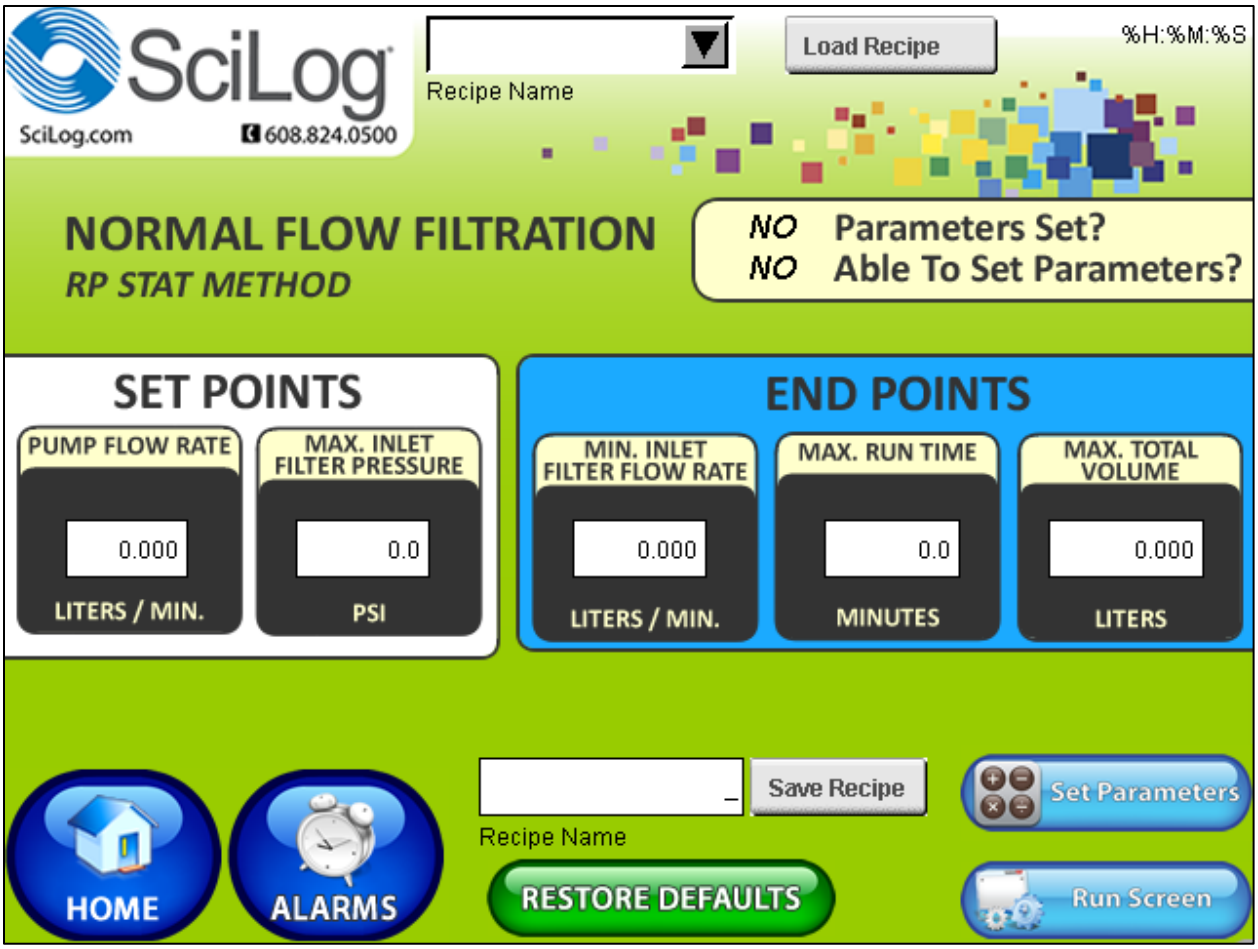
End Points:

Like the Set Point above, tap on the values for Maximum Run Time, Minimum Inlet Filter Flow Rate and Maximum Total Volume, enter and set the values.

- Max. Run Time is in minutes and is a mandatory value.
- Min. Inlet Filter Flow Rate is the pump rate in Liters / Minute and acts as a Low Flow Alarm. This is a mandatory value.
- Max. Total Volume is in Liters as calculated by the flow rate curve. It is crucial that the correct pump and tubing is chosen in the Setup Screen. This is a mandatory value.

Press the "Set Parameters" button to confirm the settings, and then the Run Screen button to change to the Run Screen and begin the process.

5.0 RP Stat Screen:



This mode combines the others into one mode. The system runs at a set flow rate until the max inlet pressure is achieved and then switches to run at a constant inlet pressure until a minimum flow rate (low flow) value is achieved, and then stops.

"Able to Set Parameters?" Must read "Yes" to change the values on this screen.

Set Points:

Tap the "Pump Flow Rate" value and a numerical entry will pop up. Enter the desired pressure in psi and tap the check mark button.

Tap the Max. Inlet Filter Pressure value, enter the desired pressure and tap the check mark.

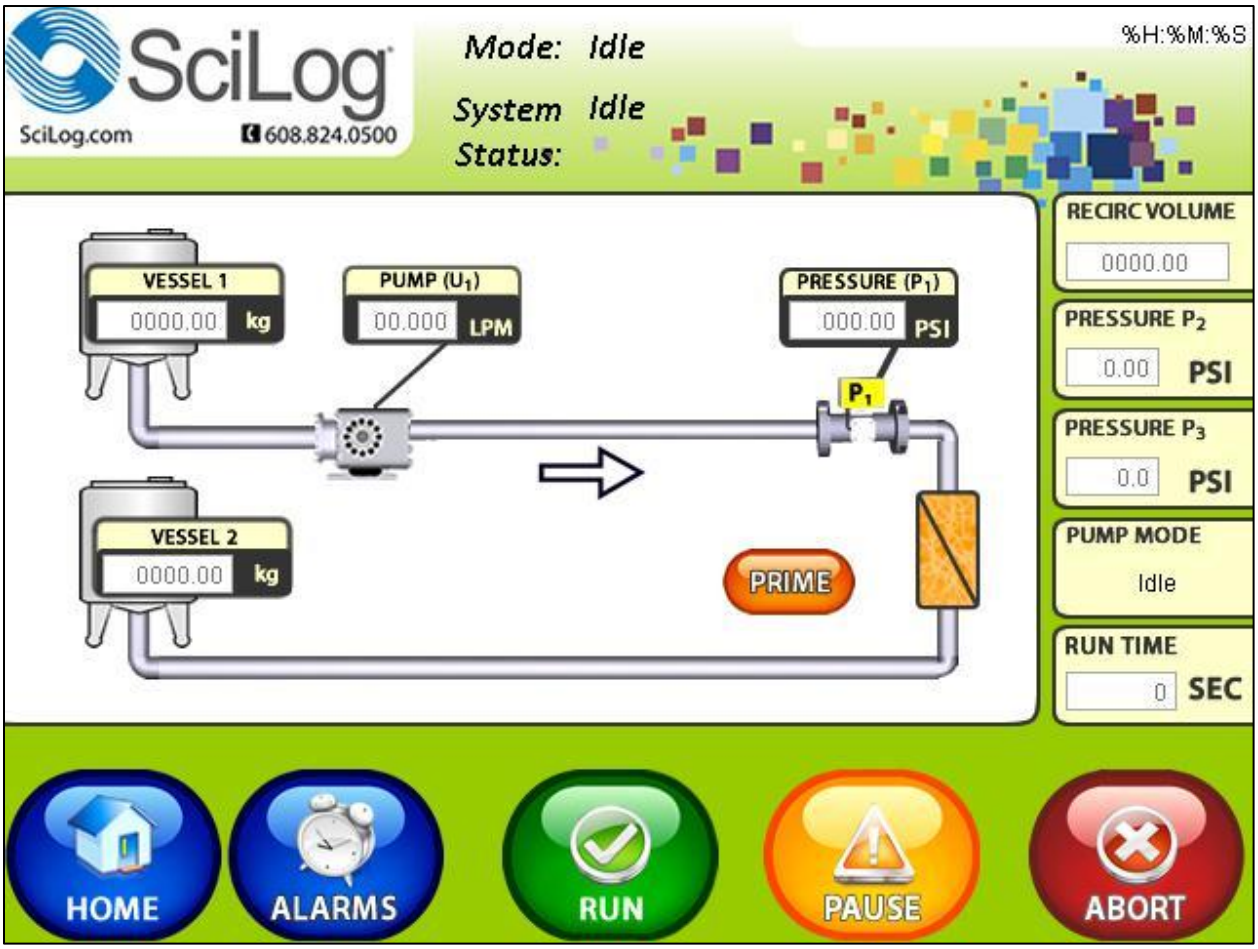
End Points:

Like the Set Point above, tap on the values for Minimum Inlet Filter Flow Rate, Maximum Run Time, and Maximum Total Volume, enter and set the values.

- Min. Inlet Filter Flow Rate is the pump rate in Liters / Minute, and acts as a Low Flow Alarm. This is a mandatory value.
- Max. Run Time is in minutes and is a mandatory value.
- Max. Total Volume is in Liters as calculated by the flow rate curve. It is crucial that the correct pump and tubing is chosen in the Setup Screen. This is a mandatory value.

Press the "Set Parameters" button to confirm the settings, and then the Run Screen button to change to the Run Screen and begin the process.

6.0 Run Screen:



<u>This screen is used for all operational modes.</u>

The operational Mode and System Status are displayed at the top of the screen. The center part of the screen displays the following:

- VESSEL 1 displays the weight as measured by the Feed Scale if enabled.
- VESSEL 2 displays the weight as measured by the Filtrate Scale if enabled.
- PUMP (U1) displays the flow rate of the peristaltic pump.
- PRESSURE (P1) displays the pressure measured by the inlet filter.

The column on the right of the screen shows additional information:

- Recirc. Volume displays the processed volume according to the calibration curve.
- Pressure P2 displays the pressure as measured by P2 if enabled.
- Pressure P2 displays the pressure as measured by P3 if enabled.
- Pump Mode repeats the system status shown at the top of the screen.
- Run Time displays the elapsed time in seconds.

The buttons on this screen are explained on the next page.

The HOME button returns the operator to the Home screen, but does not interrupt the process.

The ALARMS button will change to RED when an alarm occurs, and tapping this button will take the operator to the Alarm Screen to view and acknowledge the alarm. (If the alarm is not active, ie the pressure has dropped below the alarm limit; the Historical Alarm button on the Alarm Screen will list the Alarm. It must still be acknowledged to continue.)

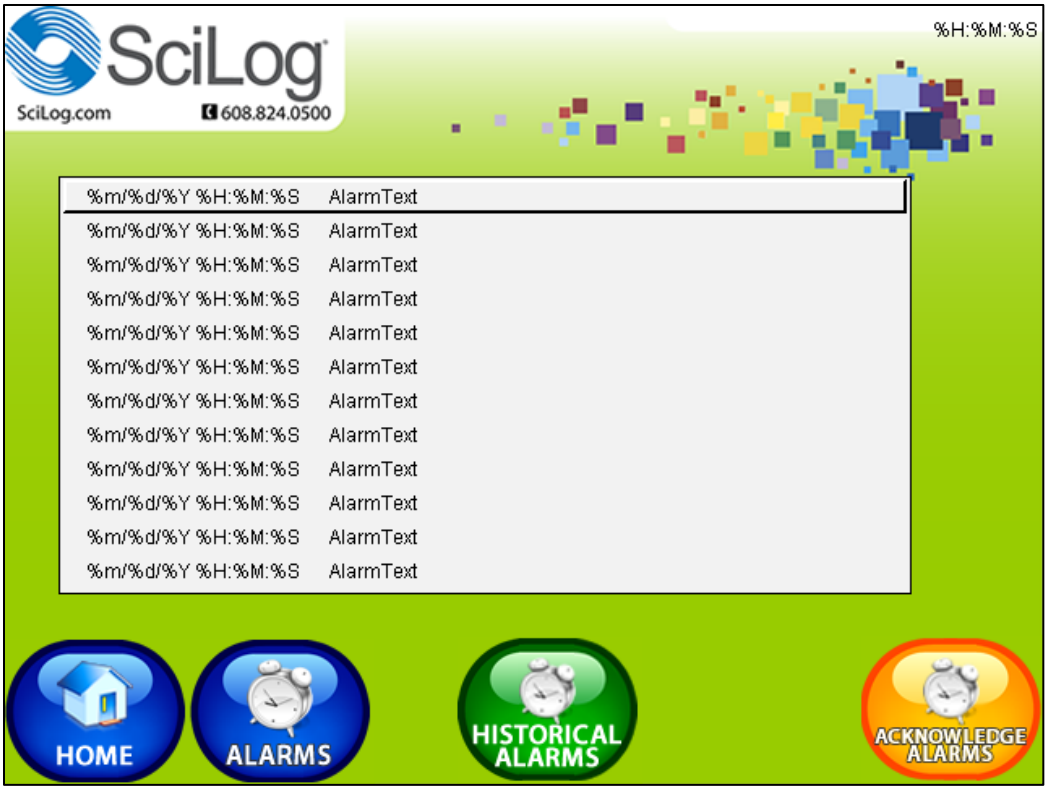
Tap the RUN button to start the process.

Tap the PAUSE button to pause (interrupt without exiting) the process. Tap the RUN button to continue.

Tap the ABORT button to end the process and exit the mode.

Press and hold the PRIME button to run the pump at a preset prime rate, 50% (Default).

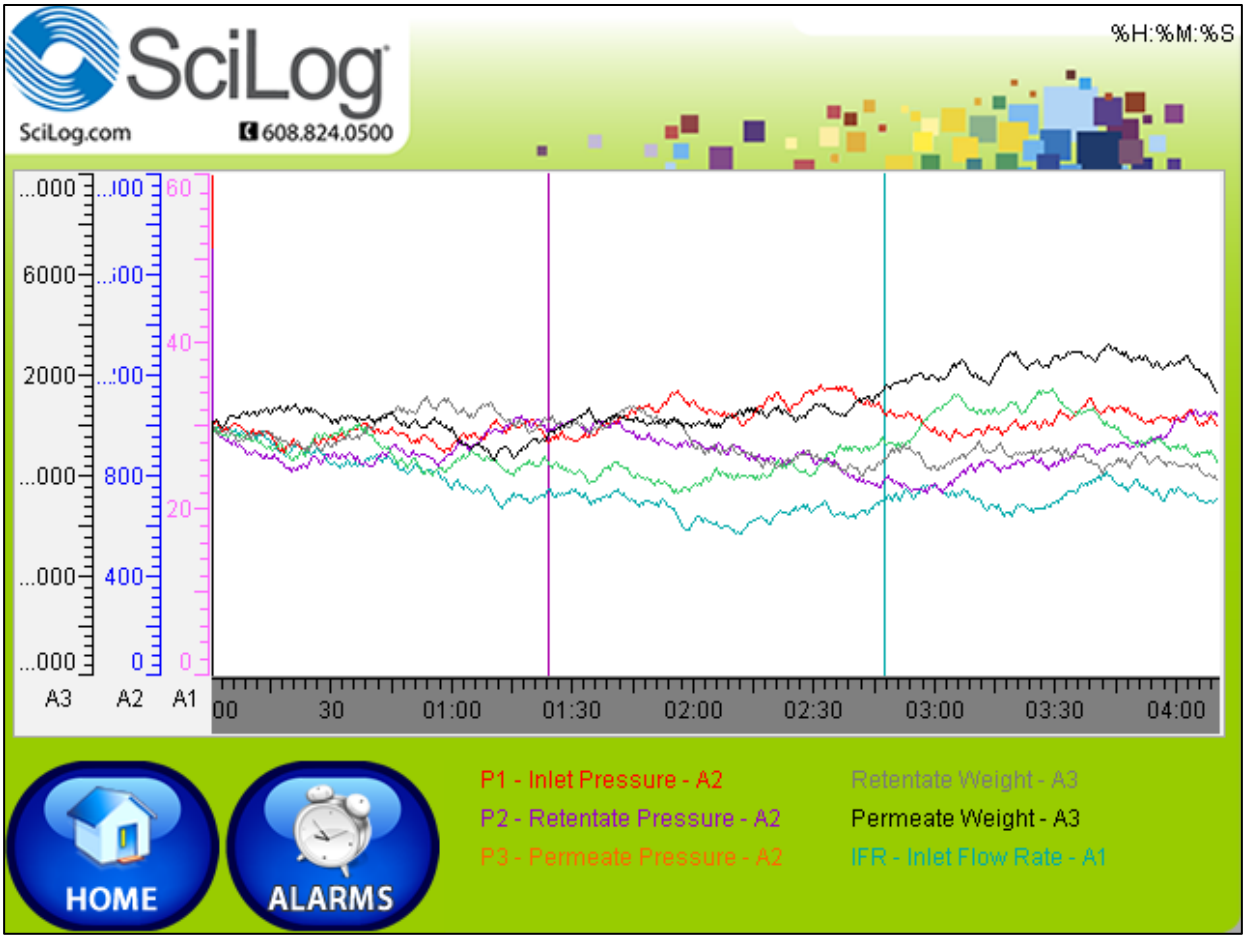
6.0 Alarm Screen:



The Alarm Screen displays all active alarms, and provides for acknowledgement of them.

Press the Historical Alarms button to review all alarms since the unit was powered up. Press the HOME button to return to the Home screen.

7.0 Trending Screen:



Real Time Trending is available on this screen.

- The Inlet Flow Rate is displayed and references scale A1.
- Pressures P1, P2, and P3 are displayed and reference scale A2.
- Feed Weight and Filtrate Weight are displayed if enabled, and reference scale A3.

8.0 Manual Mode Screen:

In the Manual Mode the SciFlex can be manually operated.

<u>"Able to Set Parameters?" Must read "Yes" to change the values on this screen.</u>

The flow rate of the main pump head can be set in L/min. Tap the value window and use the numeric keypad that pops up to enter and set the rate.

Tap "Set Parameters" and then "Run Screen" as in the other modes.

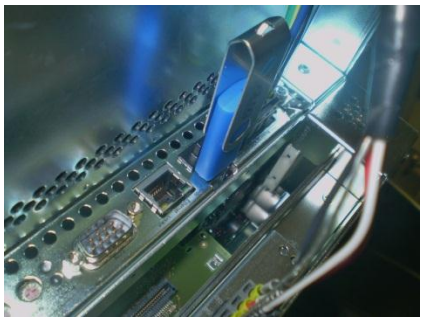
During a Manual Run, the operator may return to this screen (by tapping Home and then Manual) and change the flow rate "on the fly".

The run screen will also display the monitored values as indicated by the scales, and SciPres sensors.

7.0 Data Collection:

There are two types of Data Collection available:

1. A CSV file is automatically generated each time the “Run” button is pressed, and ends when the “Abort” button is pressed or an End Point achieved.
    - This is stored only on a USB key installed on the underside of the HMI in the bottom USB slot.
    - USE CAUTION: As high voltages can be present in the cabinet!
    - Accessing the USB requires powering down the system and opening the top of the cabinet. Do not power the unit back up until a new one is installed, and the cover is closed and locked.



    - The .CSV file is stored with the Date, Time Stamp, and Run Type information as part of the file name.
    - The files list as follows:
        - 20111218_101757_NFFCR.csv (12/18/2011, 10:17:57, NFF Constant Rate)
        - 20111218_101827_NFFCP.csv (12/18/2011, 10:18:27, NFF Constant Pressure)
        - 20111218_10199_NFFRPSTAT.csv (12/18/2011, 10:19:09, NFF RP Stat)
        - 20111221_103014_ManualRun.csv (12/21/2011, 10:30:14, Manual)
    - The data contained in these files will automatically open with MS Excel. (some formatting is needed to make all the data visible and with the proper number of decimal places)
    - Example after minor formatting for a Manual run:

RunTime	P1	P2	P3	VolFlow	CVol	Scale 1	Scale 2	Pump Mode	RPM
0	0.00	0.00	0.00	0.0	0.0	0.0	0	NA	0
9	0.44	0.02	0.00	5.0	0.5	0.0	0	Constant Rate	720
18	1.27	0.02	0.00	10.2	1.6	0.0	0	Constant Rate	1491
27	1.12	0.02	0.00	12.5	3.7	0.0	0	Constant Rate	1833
37	0.44	0.02	0.00	5.0	4.6	0.0	0	Constant Rate	721
46	0.44	0.02	0.00	5.0	5.4	0.0	0	Constant Rate	723

    - Run Time is in seconds, all other data in psi, Liters, Liters/Minute and Kg. RPM is Motor Rpm, not pump head RPM.
    - Remember to replace the USB key with a new one to maintain the ability to collect this type of data.
2. An OPC Server is built-in to the system. This allows the operator to connect to the system with a network cable and use any OPC Client, i.e. Data Historian, to collect the data from the system and graph it as need be. Many OPC Data Historians are available, and any of them may be used to browse to the server and obtain the OPC tags.
    - The system’s default IP address information:
    - IP Address: 10.0.0.74 Subnet Mask: 255.255.255.0
    - Contact SciLog if use of this option is desired and the required network cable was not installed when purchased.

8.0 End User License Agreement:

SCILOG, Inc. Binary Code License Agreement

For the SCILOG® SCIFLEX SOFTWARE VERSION 1.0

SCILOG, INC. ("SCILOG") IS WILLING TO LICENSE THE SOFTWARE IDENTIFIED BELOW TO THE USER ONLY UPON THE CONDITION THAT THE USER ACCEPT ALL OF THE TERMS CONTAINED IN THIS BINARY CODE LICENSE AGREEMENT AND ANY SUPPLEMENTAL LICENSE TERMS (COLLECTIVELY "AGREEMENT").

PLEASE READ THE AGREEMENT CAREFULLY.

BY DOWNLOADING, INSTALLING, OR USING THIS SOFTWARE, THE USER ACCEPTS THE TERMS OF THE AGREEMENT.

INDICATE ACCEPTANCE BY FIRST SELECTING THE CHECKBOX LABELED "Check This Box To Agree To The Terms Above", THEN SELECT THE "I Agree" BUTTON AT THE BOTTOM OF THIS FORM. IF THE USER IS NOT WILLING TO BE BOUND BY ALL THE TERMS, THE USER WILL NOT BE PERMITTED TO USE THIS SOFTWARE.

1. DEFINITIONS.

   "Software", “the Software”, “Software Product” means the SciLog SciFlex 300 Software identified above in binary form, any other machine readable materials (including, but not limited to, libraries, source files, header files, and data files), any updates or error corrections provided by SCILOG, and any user manuals, programming guides and other documentation provided to The User by SCILOG under this Agreement.

   “The User” or “User” means you, the end user and of the Software. This definition also includes any person who accesses the Software for any purpose.

2. GRANT OF LICENSE

   Subject to the terms and conditions of this Agreement, including, but not limited to the SCILOG SciFlex Software Technology Restrictions of Use (Section 3 below), SCILOG grants The User a non-exclusive, non-transferable, limited license without license fees to use the Software internally in its complete and unmodified form for the sole purpose of running Programs.

   Use of the Software for any other or additional purpose(s) shall constitute a violation of the terms of the Grant of License.

3. RESTRICTIONS ON USE.

   The Software is confidential and subject to US & International Copyright Laws. Title to Software and all associated intellectual property rights is retained by SCILOG and/or its licensors.

   The User acknowledge that Licensed Software is not designed or intended for use in the design, construction, operation or maintenance of any nuclear facility. SCILOG, INC. DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR SUCH USES.

   The User may not rename, edit or create any derivative works from the Software.

   The User may not modify, decompile, or reverse engineer the Software except and only to the extent that such activity is expressly permitted by applicable law notwithstanding this limitation.

4. DISCLAIMER OF WARRANTY.

UNLESS SPECIFIED IN THIS AGREEMENT, ALL EXPRESS OR IMPLIED CONDITIONS, REPRESENTATIONS AND WARRANTIES, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT ARE DISCLAIMED, EXCEPT TO THE EXTENT THAT THESE DISCLAIMERS ARE HELD TO BE LEGALLY INVALID.

5. LIMITATION OF LIABILITY.

TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL SCILOG OR ITS LICENSORS BE LIABLE FOR ANY LOST REVENUE, PROFIT OR DATA, OR FOR SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL OR PUNITIVE DAMAGES, HOWEVER CAUSED REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF OR RELATED TO THE USE OF OR INABILITY TO USE SOFTWARE, EVEN IF SCILOG HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

In no event will SCILOG's liability to The User, whether in contract, tort (including negligence), or otherwise, exceed the amount paid by The User for Software under this Agreement.

The foregoing limitations will apply even if the above stated warranty fails of its essential purpose. Some states do not allow the exclusion of incidental or consequential damages, so some of the terms above may not be applicable to The User.

6. TERMINATION.

This Agreement is effective until terminated.

The User may terminate this Agreement at any time by destroying all copies of Software.

This Agreement will terminate immediately without notice from SCILOG if The User fail to comply with any provision of this Agreement.

Either party may terminate this Agreement immediately should any Software become, or in either party's opinion be likely to become, the subject of a claim of infringement of any intellectual property right. Upon Termination, The User must destroy all copies of Software.

8. EXPORT REGULATIONS.

All Software and technical data delivered under this Agreement are subject to US export control laws and may be subject to export or import regulations in other countries.

The User agree to comply strictly with all such laws and regulations and acknowledge that The User have the responsibility to obtain such licenses to export, re-export, or import as may be required after delivery to The User.

9. TRADEMARKS AND LOGOS.

The User acknowledge and agree as between The User and SCILOG that SCILOG owns the SCILOG, SCILOG SWIRL, and SCIFLEX trademarks and any and all SCILOG, SCIFLEX, SCILOG SWIRL-related trademarks, service marks, logos and other brand designations ("SCILOG Marks"), and The User agree to comply with the SCILOG Trademark and Logo Usage Requirements currently located at: http://www.scilog.com/std_sale_terms.php And

http://www.scilog.com/legal.php

Any use The User make of the SCILOG Marks inures to SCILOG's benefit.

10. U.S. GOVERNMENT RESTRICTED RIGHTS.

    If Software is being acquired by or on behalf of the U.S. Government or by a U.S. Government prime contractor or subcontractor (at any tier), then the Government's rights in Software and accompanying documentation will be only as set forth in this Agreement; this is in accordance with 48 CFR 227.7201 through 227.7202-4 (for Department of Defense (DOD) acquisitions) and with 48 CFR 2.101 and 12.212 (for non-DOD acquisitions).

11. GOVERNING LAW.

    Any action related to this Agreement will be governed by Wisconsin law and controlling U.S. Federal law. No choice of law rules of any jurisdiction will apply.

12. SEVERABILITY.

    If any provision of this Agreement is held to be unenforceable, this Agreement will remain in effect with the provision omitted, unless omission would frustrate the intent of the parties, in which case this Agreement will immediately terminate.

13. INTEGRATION.

    This Agreement is the entire agreement between The User and SCILOG relating to its subject matter. This Agreement supersedes all prior or contemporaneous oral or written communications, proposals, representations and warranties and prevails over any conflicting or additional terms of any quote, order, acknowledgment, or other communication between the parties relating to its subject matter during the term of this Agreement. No modification of this Agreement will be binding, unless in writing and signed by an authorized representative of each party.

14. FORCE MAJEURE.

    SCILOG will not be liable for, or be considered to be in breach of or in default under this Agreement on account of, any delay or failure to perform as may be required by this Agreement as a result of any causes or conditions that are beyond SCILOG's reasonable control and that such SCILOG is unable to overcome through the exercise of reasonable diligence. If any force majeure event occurs, SCILOG will use commercially reasonable efforts to minimize the impact, if any, of the event on The User.

15. ASSIGNABILITY.

    The User may not assign this Agreement or the rights and obligations thereunder to any third party except without the prior and express written approval and explicit consent of SCILOG.

16. WAIVER.

    No waiver by SCILOG of any default by The User shall be deemed as a waiver of prior or subsequent default of the same of other provisions of this End User License Agreement.

Appendix A: Watson Marlow 620RE4/R Pump Head Manual

620R

24 hour duty

2 years warranty

CE

620RE, 620RE4 & 620R Key safety information

Before opening the pumphead guard please ensure that the following safety directions are followed.

- For close coupled drives, ensure that the pump is isolated from mains voltage.
- Ensure that there is no pressure in the pipeline.
- If a tube failure has occurred, ensure that any product in the pumphead has been allowed to drain through the controlled waste to a suitable drain.
- Ensure that protective clothing and eye protection is worn if hazardous products are being pumped.

620RE, 620RE4 & 620R Safe-guarding

- Primary safety on 620 series pumps is provided by the tool-lockable pumphead guard. On electrically-powered cased 600 series pumps, secondary (backup) protection is provided in the form of an electrical interlock which stops the pump if the pumphead guard is opened (and only for so long as the guard is opened). The electrical interlock on cased pumps should never be used as primary protection. Always disconnect the mains power supply to the pump before opening the pumphead guard.
- Only primary protection through the tool-lockable guard is provided on pneumatically powered 620 series cased pumps. Only primary protection through the tool lockable pumphead guard is provided on 620 series pumps fitted with industrial AC motors, but an interface kit to allow mains power to be switched by the pumphead guard interlock is available as an extra-cost option.

620RE, 620RE4 & 620R Pumping conditions

Pressure and viscosity

- All pressure values in this operating instruction, from which performance and life figures have been calculated relate to peak pipeline pressures.
- Although rated to 4 bar working pressure, this pump will generate in excess of 4 bar working pressure if pipeline restrictions are in place. In instances where it is critical that a working pressure of 4 bar is not exceeded, pressure relief valves should be installed in the pipeline.
- For pumping duties of 2-4 bar pressure, **only** close coupled pumps should be used, fitted with 73 Shore hardness Marprene/ Bioprene or standard STA-PURE tube elements. “M” in the tube element’s product order code denotes suitability for high pressure use.
- When pumping duties of 0-2 bar pressure, use close coupled or cased pumps fitted with 64 Shore hardness elements or the standard range of continuous peristaltic pump tubing.
- Viscosity handling is maximised by using 73 Shore hardness Marprene/Bioprene or STA-PURE tube elements in the pumphead.
- Ensure that there is always a minimum of one metre of smooth bore flexible tubing connected to the discharge port of the pumphead. This will help minimise any impulse losses and pulsation in the pipeline. This is especially important with viscous fluids and rigid pipework.

620RE, 620RE4 & 620R Pump installation

A correctly engineered installation will promote the best possible tube life, so please ensure that the following guidelines are followed:

- Avoid tight pipeline bends, pipe reducers and excessive lengths of smaller bore tubing than that in the pumphead, particularly in pipelines on the suction side.
- Ensure that connecting pipe work and fittings are suitably rated to handle the predicted pipeline pressure.
- If rigid pipe work comes in close proximity to the pumphead, a drop out section of pipe work will simplify tube replacement.
- Ensure that the controlled waste blanking plug is in position in the controlled waste port not in use. See below.

- It is advisable to use controlled waste pipe work if pumping hazardous, aggressive or abrasive fluids or products which will harden in contact with air.
- When connecting waste pipe work to the controlled waste port using the coupling adaptor supplied, ensure that there is adequate clearance underneath the pumphead. Waste pipe work should run to a suitable container or drain.
- The leak detector installation procedure is included in the leak detector kit.
- If unsure of an installation please contact your local Watson-Marlow Technical Support Office for further assistance.

620RE, 620RE4 & 620R General operation

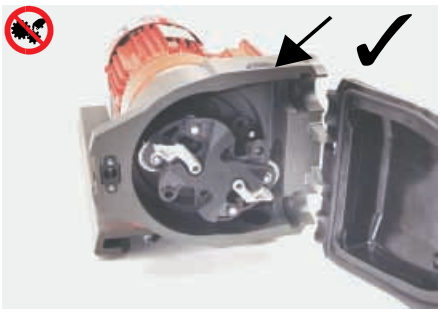
Opening the pumphead guard

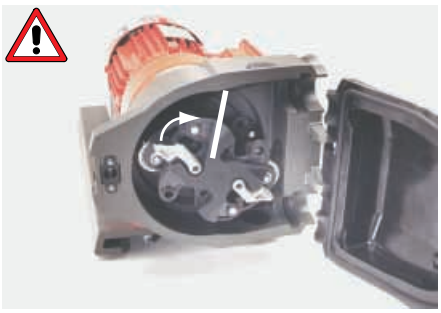
- Unlock the guard with a 5mm Allen key or a screw driver.
- Open the guard to its full extent. This creates the maximum clearance between the tube ports and guard to remove the tubing.

Engaging/disengaging the rollers

- The extent of travel of the roller release levers is indicated below. Do not try and force the levers beyond their normal extent of travel as this will damage the rotor.
- To engage the rollers snap the roller release levers counter clockwise making sure that the rollers locked out against the tubing. To disengage the rollers, snap the release levers clockwise to their disengaged position. For high pressure tubing elements or four roller pumpheads, the 5mm Allen key can be used to aid leverage when engaging/disengaging the rollers with the release levers.

	***Make sure that fingers are clear of the front face of the rotor hub when using the roller release levers.***





Pre-load checks

- Before loading tubing, ensure that all rollers rotate freely, that the tube ports and location grooves are clean and that if in use, the controlled waste pipe work is free of any obstructions.

Closing the pumphead guard and start-up

- Ensure that the guard seal is clean, replacing it if necessary.
- Ensure that the rollers are engaged and locked out against the tubing.
- Close the guard and push it against the track until the latch engages.
- Connect suitable pipe work to the pumphead using the appropriate connectors for the tube element.

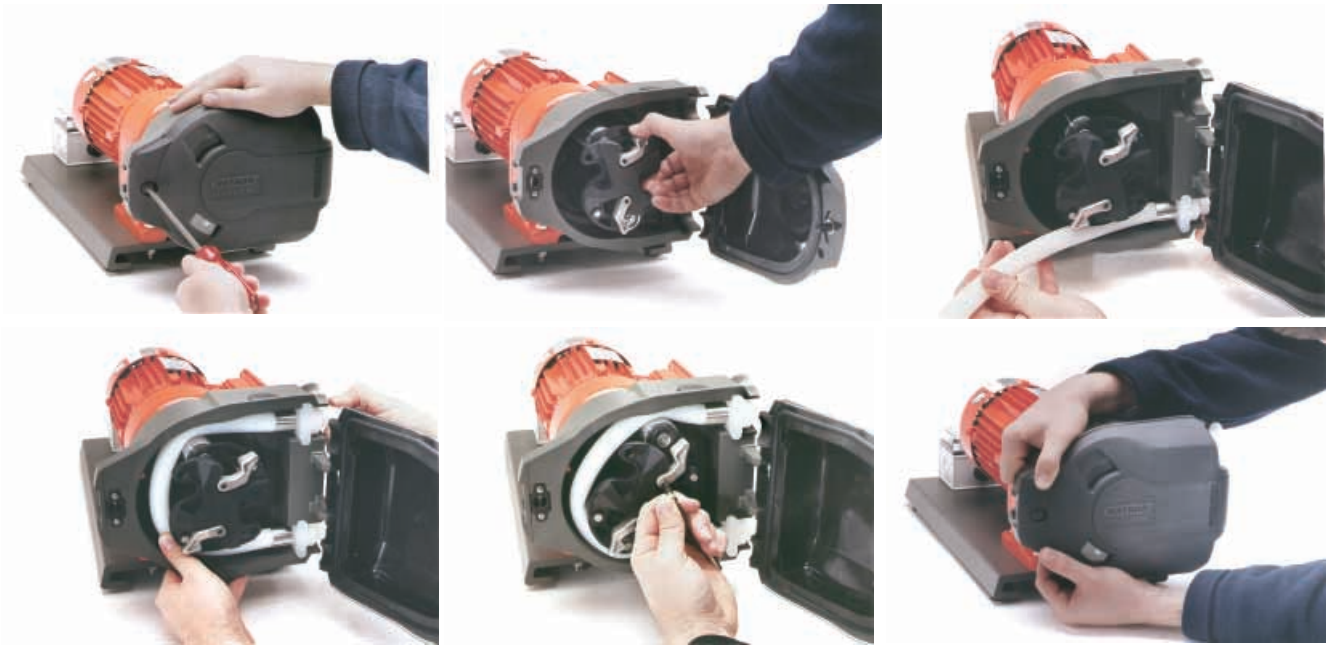
Continuous tubing clamp location in 620R pumpheads

- Select the appropriate tube clamp set for the tubing size to be used.
- Locate the two “U” shaped track clamp halves into the pumphead ports (The “U” shape ensures correct loading).
- Locate the corresponding guard clamp halves which have raised “T” locating sections, into the slots on the inner guard face above and below the guard hinge. Push and slide into their locked position.
- Closing the guard will align the two halves of the clamp around the tubing.

620RE & 620RE4 tube element loading

- 620RE element pumpheads are factory set to accept Watson-Marlow LoadSure tube elements. Pumping performance will be adversely affected if LoadSure elements are not used.
- Disengage rollers.
- Locate one of the “D” shaped flanges into the lower port. (The “D” flange ensures that the element can only be loaded correctly).
- Wrap the tube element around the disengaged rollers of the rotor.
- Locate the second “D” shaped flange into the upper port.
- Ensure the flat face of each “D” flange sits flush to the flange sealing face of the track.
- Engage rollers.
- Close the guard and push it against the track until the latch engages.

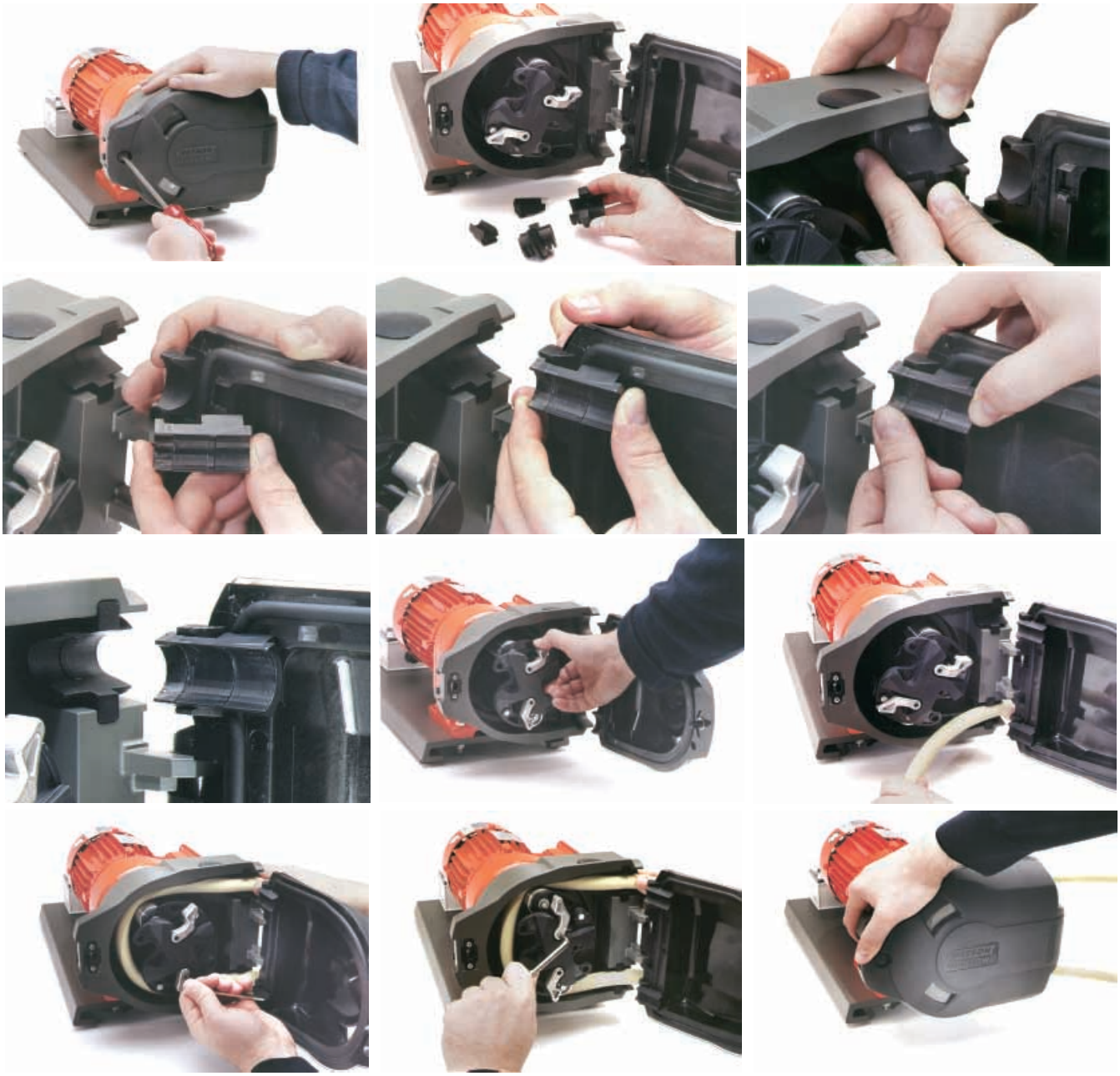
Tube element loading



620RE, 620RE4 & 620R Continuous tube loading

- 620R continuous tubing pumpheads are factory set to accept Watson-Marlow 600 series 3.2mm wall tubing. Pumping performance will be adversely affected if Watson-Marlow tubing is not used.
- Select the tube clamp set which is correct for the tubing size to be used.
- Disengage rollers.
- Locate one end of the tubing into the lower port “U” clamp and hold firmly in position.
- Wrap the tubing tightly around the retracted rollers, making sure that there is no twisting through its length.
- Locate the other end of the tubing into the upper port “U” clamp.
- Hold both ends of the tubing in one hand maintaining tension around the retracted rollers.
- Engage rollers.
- Close the guard and push it against the track until the latch engages.
- Ensure that continuous tubing is not loosely clamped at the pumphead ports.
- Ensure that when the pump is re-started all of the rollers have re-engaged. A roller which has not re-engaged will “click” continuously. No damage will occur if this happens but the roller should be re-engaged manually using the 5mm Allen key. Please refer to the Troubleshooting section.

Continuous tube loading



620RE, 620RE4 & 620R Tube element or continuous tube removal

- Unlock the guard and disengage the rollers.
- Disconnect the tubing from the external pipeline.
- Remove the tubing from the pumphead.

620RE, 620RE4 & 620R Maintenance

Scheduled maintenance

- The stainless steel pumping rollers run on sealed bearings and do not require lubrication.
- Remove the rotor and lubricate the follower rollers and roller engaging mechanisms with a molybdenum based grease. This should be carried out every six months for intermittent duties and every three months for 24 hour duties.
- If fluid is spilled inside the pumphead, flush the pumphead out with water and mild detergent as soon as possible. If specific cleaning agents are required to clean the spillage, please consult Watson-Marlow Technical Support Office before proceeding, in order to confirm chemical compatibility.
- If the rotor needs to be removed, refer to the guidelines below.

Rotor removal and re-location

- Remove the rotor cover and central locating bolt using a 5mm Allen key. Pull the rotor off the keyed shaft, remove the plastic key and clean thoroughly. Do not use tools to lever the rear face of the rotor away from the inner face of the track, it should come off by hand.
- To replace the rotor, locate the key into the keyway and apply a thin layer of molybdenum grease over the shaft and key. Align the keyway of the rotor to the shaft key and slide the rotor into position, ensuring that a positive “stop” is achieved and ensure that the full length of the drive shaft is fitted into the rotor.

	***There is only one parallel keyway in the rotor hub which is clearly marked with a hole at one end. If one of the remaining three unmarked slots is used as a keyway, it is likely that the rotor hub will sustain irrevocable damage.***

- Do not force the rotor into position. The rotor will slide into place easily if correctly aligned.
- Tighten the hexagonal locating bolt to a nominal torque of 10Nm using a 5mm Allen key. Replace the rotor cover.

When closing the guard, check it does not make contact with the rotor. If it does, then the rotor has been fitted incorrectly. Re-open the guard, remove and refit the rotor, and close the guard.







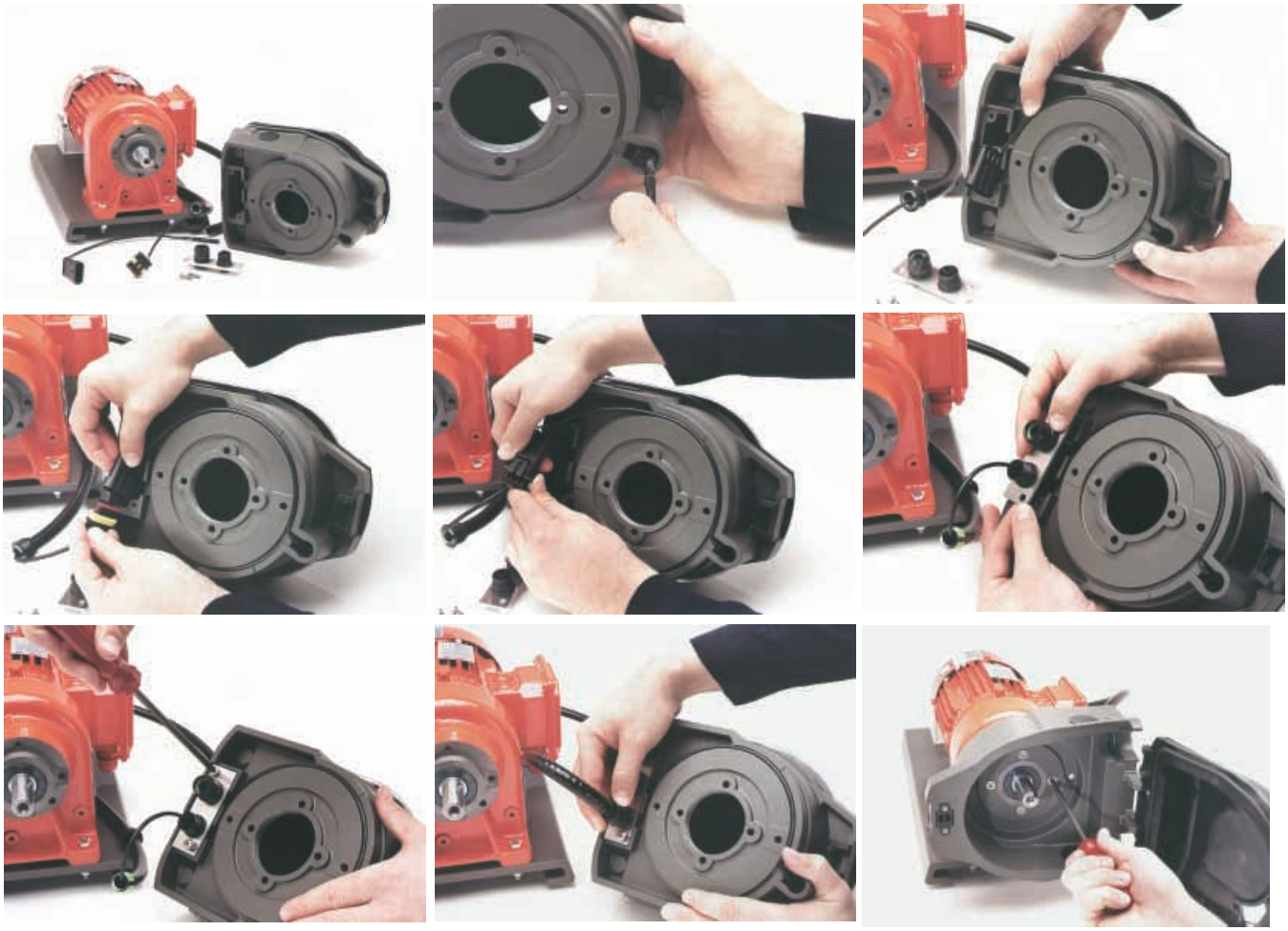


Track removal (close coupled AC motor gearboxes)

- Remove the rotor.
- Disconnect the controlled waste pipework if attached.
- Loosen the four track retaining screws using a “Number 2 Posi-Drive” screwdriver.
- Disconnect the mains interlock if connected to a mains contactor.
- Withdraw the track fully from the gearbox.

Track re-location (close coupled AC motor gearboxes)

- Ensure that the track is clean.
- Fit the track over the gearbox boss.
- Align the track horizontally so that the location holes are aligned with the threaded gearbox holes.
- Tighten the four track retaining screws using a “Number 2 Posi-Drive” screwdriver.
- Re-connect the guard interlock controlled waste pipework if required.



620RE, 620RE4 & 620R CIP & SIP

General

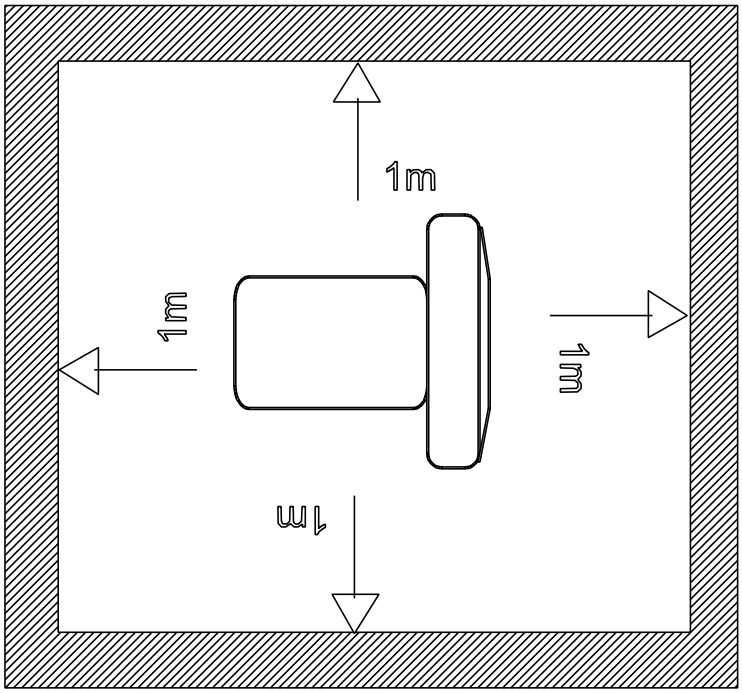
- Unlock the guard and disengage the rollers within the tube zone.
- Close the guard and squeeze against the track until the latch clicks.
- Observe a 1m safety area.

CIP

- LoadSure tube elements and continuous tubing can be cleaned using CIP processes.
- Ensure that the tubing material is chemically compatible with the cleaning agent that is to be used.
- If cleaning agents are spilled over the pumphead, wash down immediately.
- Ensure that controlled waste pipework is fitted to allow a safe release of cleaning agent in the event of a tube failure.

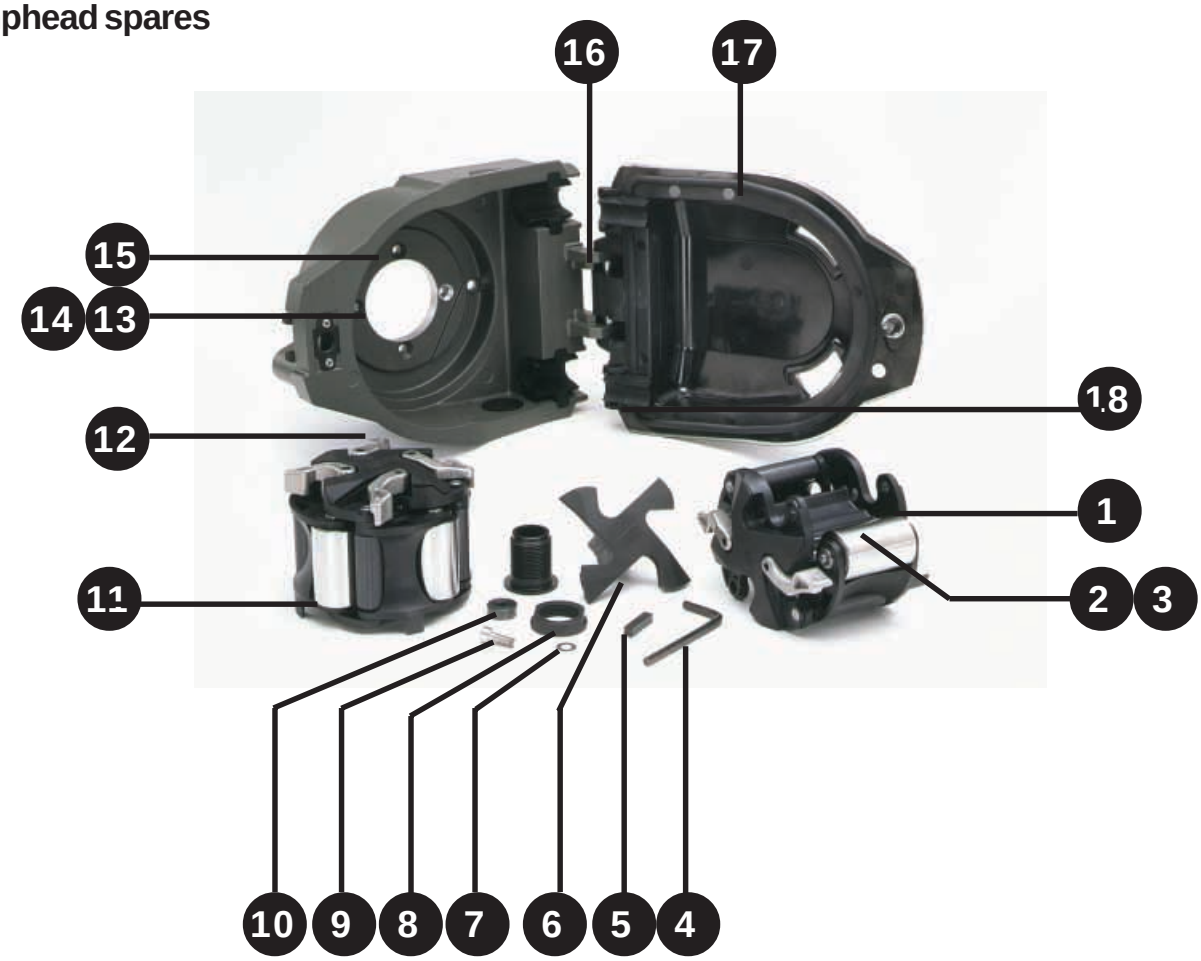
SIP

- Only STA-PURE tube elements can be used in a steam in place sterilisation processes.
- STA-PURE tubing elements can be sterilised to 3A Class two and FDA minimum recommended standard which is 121C (250F) at 1 bar (14.5 psi) saturated steam for 30 minutes.
- Monitor the process continuously.
- If a tube failure occurs, shut down the process. Do not touch the pumphead until a 20 minute cooling period has been observed.
- Ensure a 20 minute acclimatisation period is observed before running the pump following SIP.
- Ensure that controlled waste pipework is fitted to allow a safe release of steam in the event of a tube failure.
- Ensure a 1m safety zone is maintained around the pumphead during SIP cycles.



	***Ensure that the pumphead door is closed and locked before SIP cleaning commences.***

Pumphead spares



Number	Spare	Description
1	MRA0249A	Stainless steel roller for 4mm wall
	MRA0250A	Stainless steel roller for 3.2mm wall
2	MR2012T	Stainless steel roller spindle
3	CX0148	Stainless steel cir-clip
4	TT0006	5mm Allen key
5	MR2032T	Key
6	MR2055M	Rotor cover
7	FN0581	Washer M6
8	MR2027T, MR2096T	Controlled waste port pipe work connector
9	FN0503	Rotor locating bolt
10	MR 2029T	Rotor spacer (cased drives only)
11	MRA0252A	Rotor assembly 2 roller element
	MRA0253A	Rotor assembly 4 roller element
	MRA0254A	Rotor assembly 2 roller continuous
	MRA0255A	Rotor assembly 4 roller continuous
12	MR2007M	Release lever
13	MR2052C	Latch clip
14	MR2053B	Latch bolt
15	MRA0251A	Track assembly
16	MR2018T	Hinge pin
17	MR2002M	Guard
18	MR2028M	Controlled waste port blanking plug
	SW0159	Interlock
	FN0523	Close coupled track locating screws
	FN0488	Cased drive track locating screws

Product use and decontamination declaration

In compliance with the **UK Health & Safety at Work Act** and the **Control of Substances Hazardous to Health Regulations** you, the user are required to declare the substances which have been in contact with the product(s) you are returning to Watson-Marlow or any of its subsidiaries or distributors. Failure to do so will cause delays in servicing the product. Therefore, **please complete this form** to ensure that we have the information **before** receipt of the product(s) being returned. **A FURTHER COPY *MUST* BE ATTACHED TO THE OUTSIDE OF THE PACKAGING CONTAINING THE PRODUCT(S)**. **You, the user, are responsible for cleaning and decontaminating the product(s) before returning them.**

Please complete a separate Decontamination Certificate for each pump returned.
RGA No: .....

1 Company

Address ..... Postcode .....

Telephone ..... Fax Number .....

2 Product

2.1 Serial Number .....

2.2 Has the Product been used?

YES		NO	

3.4 Cleaning fluid to be used if residue of chemical is found during servicing;

(a) .....

(b) .....

(c) .....

(d) .....

If yes, please complete all the following Sections

If no, please complete Section 5 only

3 Details of substances pumped

3.1 Chemical names:

(a) .....

(b) .....

(c) .....

(d) .....

3.2 Precautions to be taken in handling these substances:

(a) .....

(b) .....

(c) .....

(d) .....

3.3 Action to be taken in the event of human contact:

(a) .....

(b) .....

(c) .....

(d) .....

4 I hereby confirm that the only substances(s) that the equipment specified has pumped or come into contact with are those named, that the information given is correct, and the carrier has been informed if the consignment is of a hazardous nature.

5 Signed ....

Name .....

Position .....

Date .....

Note: To assist us in our servicing please describe any fault condition you have witnessed.

Watson-Marlow Limited Falmouth Cornwall TR11 4RU England Tel: 01326 370370 Fax: 01326 376009

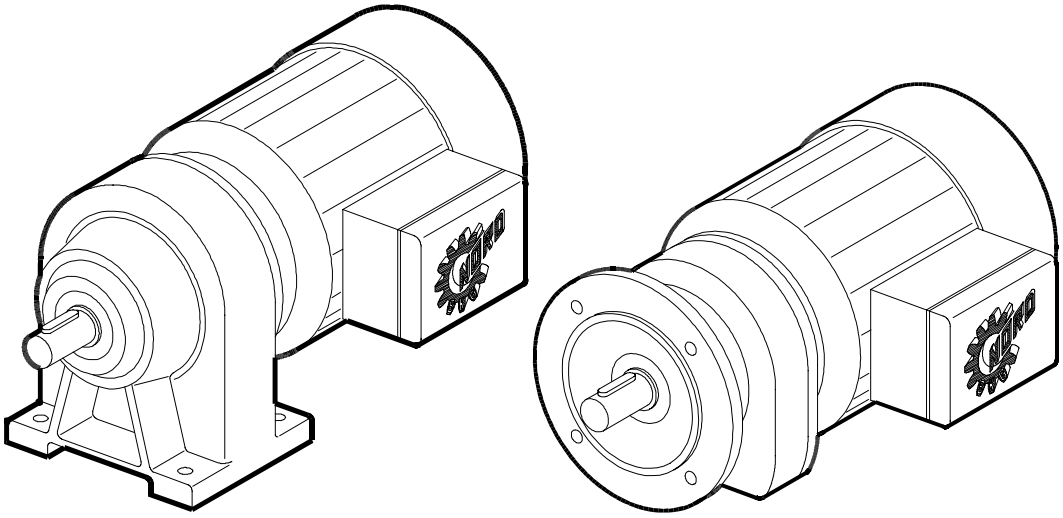
Standard Helical Inline Gearboxes
Installation and Maintenance Instructions

BIM 1012

USA

CDN

Retain These Safety Instructions For Future Use



INSPECTION OF UNIT

Thoroughly inspect the equipment for any shipping and handling damage before accepting shipment from the freight company. If any of the goods called for in the bill of lading or express receipt are damaged or the quantity is short, do not accept until the freight or express agent makes an appropriate notation on your freight bill or express receipt. If any concealed loss or damage is discovered later, notify your freight carrier or express agent at once and request him to make an inspection. We will be very happy to assist you in collecting claims for loss or damage during shipment; however, this willingness on our part does not remove the transportation company's responsibility in reimbursing you for collection of claims or replacement of material. Claims for loss or damage in shipment must not be deducted from the NORD Gear invoice, nor should payment of the NORD Gear invoice be withheld awaiting adjustment of such claims, as the carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest NORD Gear Sales Office for assistance. Please keep a written record of all communications.

RECORD NAMEPLATE DATA

Locate the gear reducer nameplate and record all nameplate data for future reference.

SK _____ S/N _____

RATIO _____ MAX TORQUE _____ RPM _____ MTG. POS _____

STORAGE

PROPER STORAGE UNTIL INSTALLED

Keep unit in a dry, temperature controlled area. If stored other than said, long term storage methods must be applied to the unit including complete fill with lubricant. Protect machined surfaces and rotate shafts periodically. Prior to putting unit into service, drain lubricant and refill to proper level as determined by the mounting position.

PROPER HANDLING OF THE UNIT

Exercise care to prevent damage to the unit when moving. Lift only at designed lifting points. Do not attach other machinery and lift by the unit lifting points. The lifting points are to be used to lift the unit only. Insure that adequate safety measures are taken to protect personnel during transportation. Protect the mounting surface from damage.

INSTALLATION OF UNIT

To ensure long service and dependable performance, an enclosed gear drive must be rigidly supported and the shafts accurately aligned. The following describes the minimum precautions required to accomplish this end.

FOUNDATION
The responsibility for the design and construction of the foundation lies with the user. The foundation must be adequate to withstand normal operating loads and possible overloads while maintaining alignment to attached system components under such loads.

MOUNTING POSITION
Unless a unit is specifically ordered for inclined mounting, the foundation must be level and flat. The lubrication system may not operate properly if the unit is not mounted in the position for which it is designed. It may be desirable to elevate the foundation to facilitate oil drainage.

CONCRETE FOUNDATION
If a concrete foundation is used, steel mounting pads and bolts of sufficient size to distribute the stress into the concrete should be grouted into the foundation.

STEEL FOUNDATION
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit.

FOOT MOUNTED UNITS
Use shims under the feet of the unit to align the output shaft to the driven equipment. Make sure that all feet are supported so that the housing will not distort when it is bolted down. Improper shimming will reduce the life of the unit and may cause failure. Dowel pins may be installed to prevent misalignment and ensure proper realignment if removed for service.

FLANGE MOUNTED UNITS
If a structural steel foundation is used (i.e. wide flange beams or channels), a base plate or sole plate of suitable thickness should be used and should extend under the entire unit. If a bulk head plate is used it should be of proper strength to minimize buckling distortions.

Flange Pilot 'AK' or 'AK1' tolerance
Metric (mm)

> ∅ 50 ≤ ∅ 80 = +0.012/-0.007
> ∅ 80 ≤ ∅ 120 = +0.013/-0.009
> ∅ 120 ≤ ∅ 180 = +0.014/-0.011
> ∅ 180 ≤ ∅ 230 = +0.016/-0.013
> ∅ 230 ≤ ∅ 315 = +0.000-0.032
> ∅ 315 ≤ ∅ 400 = +0.000/-0.036
> ∅ 400 ≤ ∅ 500 = +0.000/-0.040

Inch

> ∅ 1.969 ≤ ∅ 3.150 = +0.005/-0.0003
> ∅ 3.150 ≤ ∅ 4.724 = +0.005/-0.0004
> ∅ 4.724 ≤ ∅ 7.087 = +0.006/-0.0004
> ∅ 7.087 ≤ ∅ 9.055 = +0.006/-0.0005
> ∅ 9.055 ≤ ∅ 12.402 = +0.000/-0.0013
> ∅ 12.402 ≤ ∅ 15.748 = +0.000/-0.0014
> ∅ 15.748 ≤ ∅ 19.685 = +0.000/-0.0016

BOLT STRENGTH
Bolt size, strength and quantity should be verified to insure proper torque reaction capacity whatever the mounting arrangement.

PRIME MOVER MOUNTING
Align the prime mover to the reducer-input shaft using shims under the feet. Make sure that the feet are supported. Dowel the prime mover to its foundation.

SHAFT CONNECTIONS
When connecting shafts to either the input or output of the reducer, consider the following instructions.

FITS
Clearance or interference fits for coupling hubs should be in accordance with ANSI/AGMA 9002-A86 or as follows.

Output and Input shaft Diameter tolerance
Metric (mm)

≤ ∅ 18 = +0.012/+0.001
> ∅ 18 ≤ ∅ 30 = +0.015/+0.002
> ∅ 30 ≤ ∅ 50 = +0.018/+0.002
> ∅ 50 ≤ ∅ 80 = +0.030/+0.011
> ∅ 80 ≤ ∅ 120 = +0.035/+0.013
> ∅ 120 ≤ ∅ 180 = +0.040/+0.015

Inch

≤ ∅ 1.750 = +0.0000/-0.0005
> ∅ 1.750 = +0.0000/-0.0010

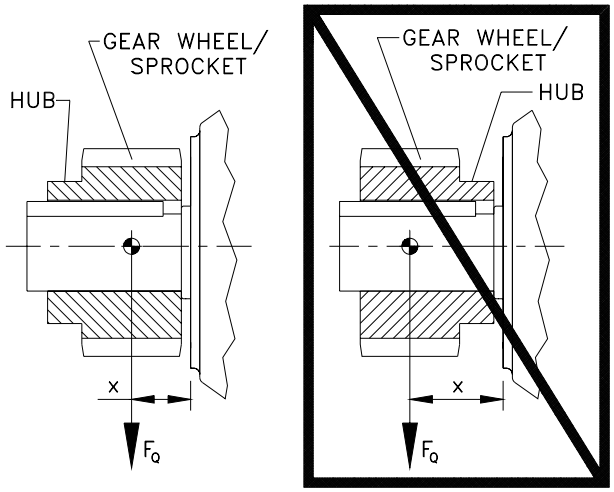
Output and Input shaft Drill and tap shaft end
Metric (mm)

≤ ∅ 16 = M5
> ∅ 16 ≤ ∅ 21 = M6
> ∅ 21 ≤ ∅ 24 = M8
> ∅ 24 ≤ ∅ 30 = M10
> ∅ 30 ≤ ∅ 38 = M12
> ∅ 38 ≤ ∅ 50 = M16
> ∅ 50 ≤ ∅ 85 = M20
> ∅ 85 ≤ ∅ 130 = M24

Inch

≤ ∅ 0.438 = #10-24 x 0.4 deep
> ∅ 0.438 ≤ ∅ 0.813 = ¼-20 x 0.6 deep
> ∅ 0.813 ≤ ∅ 0.938 = 5/16-18 x 0.7 deep
> ∅ 0.938 ≤ ∅ 1.125 = 3/8-16 x 0.9 deep
> ∅ 1.125 ≤ ∅ 1.375 = 1/2-13 x 1.1 deep
> ∅ 1.375 ≤ ∅ 1.875 = 5/8-11 x 1.4 deep
> ∅ 1.875 ≤ ∅ 3.250 = 3/4-10 x 1.7 deep
> ∅ 3.250 = 1-8 x 2.2 deep

Outboard pinion and sprocket fits should be as recommended by the pin sprockets with interference fits should be heated according to the manufacturer's recommendations, generally 250°F to 300°F, (120°C to 150° C) before assembling to the shaft.



CORRECT INCORRECT

LOCATION
Coupling hubs should be mounted flush with the shaft ends, unless specifically ordered for overhung mounting. Pinions, sprockets and sheaves should be mounted as close as possible to the unit housing to minimize bearing loads and shaft deflections.

COUPLING ALIGNMENT
Shaft couplings should be installed according to the coupling manufacturer's recommendations for gap, angular and parallel alignment. In many installations, it is necessary to allow for thermal and mechanical shaft movement when determining shaft alignment. The coupling manufacturer's recommendations should be followed.

AXIAL DISPLACEMENT
The gap between shaft ends should be the same as the specified coupling gap unless overhung mounting of the coupling hub is specified. The coupling gap and shaft gap must be sufficient to accommodate any anticipated thermal or mechanical axial movement.

ANGULAR ALIGNMENT
Insert a spacer or shim stock equal to the required coupling gap between the coupling hub faces and measure the clearance using feeler gauges. Repeat this at the same depth at 90-degree intervals to determine the amount of angular misalignment.

PARALLEL ALIGNMENT
Mount a dial indicator to one coupling hub, and rotate this hub, sweeping the outside diameter of the other hub. The parallel misalignment is equal to one-half of the total indicator reading. Another method is to rest a straight edge squarely on the outside diameter of the hubs at 90-degree intervals and measure any gaps with feeler gauges. The maximum gap measurement is the parallel misalignment.

CHECKING ALIGNMENT
After both angular and parallel alignments are within specified limits, tighten all foundation bolts securely and repeat the above procedure to check alignment. If any of the specified limits for alignment are exceeded, realign the coupling.

SPROCKET OR SHEAVE ALIGNMENT
Align the sheaves or sprockets square and parallel by placing a straight edge across their faces. Alignment of bushed sheaves and sprockets should be checked after bushings have been tightened. Check horizontal shaft alignment by placing a level vertically against the face of the sheave or sprocket. Adjust belt or chain tension per the manufacturer's specified procedure.

OUTBOARD PINION ALIGNMENT
Align the pinion by adjusting the gear tooth clearance according to the manufacturer's recommendations and checking for acceptable outboard pinion tooth contact. The foundation bolts may have to be loosened and the unit moved slightly to obtain this contact. When the unit is moved to correct tooth contact, the prime mover should be realigned.

RECHECK ALIGNMENT
After a period of operation, recheck alignment and adjust as required.

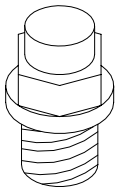
1. Properly install unit on a rigid foundation
   - adequately supported
   - securely bolted into place
   - leveled so as not to distort the gear case
2. Properly install couplings suitable for the application and connected equipment.
3. Ensure accurate alignment with other equipment.
4. Furnish and install adequate machinery guards as needed to protect operating personnel and as required by the applicable standards of the Occupational Safety and Health Administration (OSHA), and by other applicable safety regulations;
5. Ensure that driving equipment is running in the correct direction before coupling to reducers with backstops (designed to operate only in a specific direction) or machinery designed to operate only in one direction.

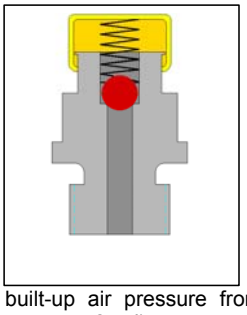
CHANGES IN PERFORMANCE SPECIFICATIONS
Owner has the responsibility to consult with NORD GEAR if such items such as applied loads, operating speeds or other operating conditions have changed.

WARNING:
LOCK OUT POWER before any maintenance is performed. Make absolutely sure that no voltage is applied while work is being done on the gearbox.

START-UP
1. Ensure that switches, alarms, heaters, coolers and other safety and protection devices are installed and operational for their intended purpose.
2. Verify that the installed mounting position is the same as the nametag mounting position. If not, adjust the oil level accordingly and relocate the vent plug, fill plug and drain plug according to the mounting position. See following.

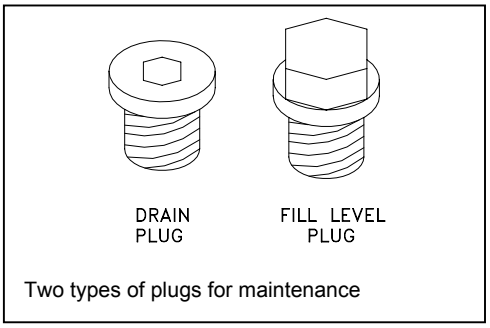
AUTOVENT PLUG
The Autovent plug is brass in color and will be located at the highest point on the gearbox. It operates like a check-valve to allow the reducer to relieve internal pressure while preventing lubricant contamination during cooling. A spring presses a ball or plunger against a machined orifice until pressure exceeds 2 psi. Above 2 psi the air is allowed to escape depressurizing the gearcase. When internal pressure drops below 2 psi, the autovent re-seals closing the unit to the outside environment. After shutdown, the reducer cools along with the air inside the reducer. The unit will temporarily maintain a slight vacuum until normalization occurs. NORD Gear supplies an Autovent as a standard feature.


AUTOVENT PLUG



The Autovent releases built-up air pressure from inside the gearbox (Max. pressure 2 psi).

FILL LEVEL & DRAIN PLUGS
The drain plugs are metric socket head cap screws. They will be located at the lowest part of the gearbox for ease of draining. The fill level plug is a hex head cap screw. It will be located between the Autovent and drain plug. Both types of plugs will have gaskets included to prevent oil from leaking.



Two types of plugs for maintenance

LUBRICANT
All NORD reducers are shipped from the factory properly filled with lubricant and all plugs are installed according to the mounting position given on the reducer nametag. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

OPERATION AND MAINTENANCE CHECKLIST
1. Operate the equipment as it was intended to be operated
2. Do not overload.
3. Run at correct speed.
4. Maintain lubricant in good condition and at proper level.
5. Dispose of used lubricant in accordance with applicable laws and regulations.
6. Apply proper maintenance to attached equipment at prescribed intervals recommended by the manufacturer.
7. Perform periodic maintenance of the gear drive as recommended by NORD.

MAINTENANCE

Mineral lubricant should be changed every 10,000 service hours or after two years. For synthetic oils, the lube should be changed every 20,000 service hours or after four years. In case of extreme operating (e.g. high humidity, aggressive environment or large temperature variations), shorter intervals between changes are recommended.

OIL SPECIFICATIONS
NORD supplies all reducers filled with oil from the factory. Consult the sticker adjacent to the fill plug to determine the type of lubricant installed at the factory. Standard lubricant is ISO VG220 mineral-based oil. However, some units have special lubricants designed to operate in certain environments or to extend the service life of the lubricant. If in doubt about which lubricant is needed, contact NORD Gear.

STANDARD OIL – ISO VG220

Ambient Temperature	Formulation
20 to 104°F (-5 to 40°C)	Mineral

TYPICAL OILS

Viscosity ISO NLGI	Formulation	Service Temperature Range	Mobil	Shell	Castrol	Klüber Lubrication	bp	Tribol
VG 460	Conventional Mineral	20°C to +50°C 68F to +122°F	Mobilgear 634	Omala 460	7EP	Klüberoil GEM 1-460	Energol GR-XP 460	Tribol 1100/460
	Synthetic PAO	-30°C to +80°C -22°F to +176°F	Mobil SHC 634	Omala 460 HD	Isolube EP 460	Klübersynth EG 4-460	N/A	Tribol 1510/460
VG 320	Conventional Mineral	0°C to +30°C 32°F to +86°F	Mobilgear 632	Omala 320	6EP	Klüberoil GEM 1-320	Energol GR-XP 320	Tribol 1100/320
	Synthetic PAO	-35°C to +80°C -31°F to +176°F	Mobil SHC 632	Omala 320 HD	Isolube EP 460	Klübersynth EG 4-320	N/A	Tribol 1510/320
VG 220	Conventional Mineral	-5°C to +40°C +20°F to +104°F	Mobilgear 630	Omala 220	5EP	Klüberoil GEM 1-220	Energol GR-XP 220	Tribol 1100/220
	Synthetic PAO	-34°C to +80°C -30°F to +176°F	Mobil SHC 630	Omala 220 HD	Isolube EP 220	Klübersynth EG 4-220	N/A	Tribol 1510/220
VG 150 & VG 100	Conventional Mineral	-15°C to +25°C 5°F to +77°F	Mobilgear 629	Omala 100	4EP	Klüberoil GEM 1-150	Energol GR-XP 100	Tribol 1100/100
	Synthetic PAO	-37°C to +10°C -35°F to +50°F	Mobil SHC 629	Omala 150 HD	Isolube EP 150	Klübersynth EG 4-150	N/A	N/A
VG 68	Conventional Mineral	-15°C to +25°C 5°F to +77F	Mobilgear 626	Omala 68	2EP	Klüberoil GEM 1-68	Energol GR-XP 68	Tribol 1100/68
	Synthetic PAO	-40°C to +10°C -40°F to +50F	Mobil SHC 626	N/A	Isolube EP 68	N/A	N/A	N/A
VG 32	Synthetic PAO	-40°C to +10°C -40°F to +50°F	Mobil SHC 624	N/A	N/A	Klüber-Summit HySyn FG-32	N/A	N/A

PAO = Poly Alpha Olefin

SPECIAL PURPOSE LUBRICANTS

Ambient Temperature	Formulation	Manufacturer	Oil Brand Name
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	Chevron	FM ISO 220
20 to 104°F (-5 to 40°C)	*Food Grade* Oil - Synthetic	OilJAX	Magnaplate 85W140-FG
5 to 125°F (-20 to 50°C)	Fluid Grease	Mobil	Mobilux EP023
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Mobil	Mobilith SHC 007
-30 to 140°F (-35 to 60°C)	Fluid Grease - Synthetic	Shell	Albida LC

STANDARD BEARING GREASE – NLGI 2EP Lithium

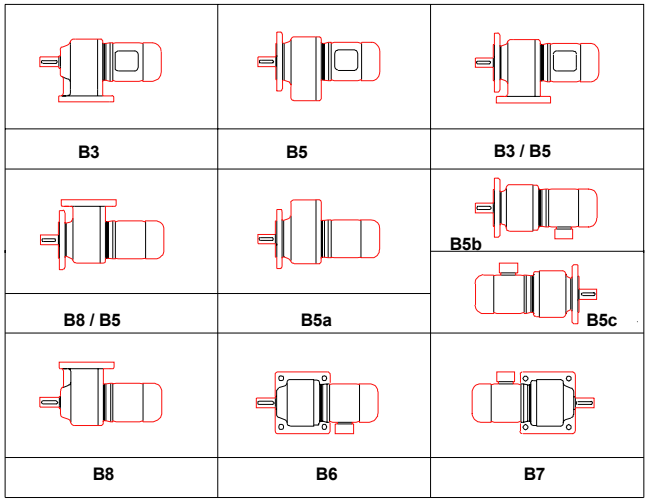
Ambient Temperature	Formulation
-20 to 140°F (-30 to 60°C)	Mineral

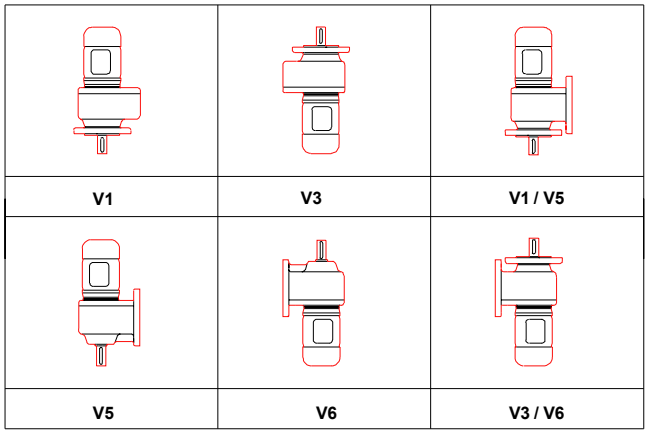
OPTIONAL BEARING GREASES

Ambient Temperature	Formulation	Manufacturer	Grease Brand Name
-40 to 230°F (-40 to 110°C)	Synthetic	Shell	Aeroshell 6
-40 to 230°F (-40 to 110°C)	*Food Grade* - Synthetic	Lubriplate	SFL1

MOUNTING POSITIONS

These charts detail the mounting positions for horizontal and vertical mounting. For mounting orientations other than shown consult NORD Gear.





LUBRICANT CAPACITY

Each reducer has the oil level and oil quantity adjusted according to the mounting position shown in the tables. When replacing the oil, consult the tables below to determine the proper amount of oil to be installed according to the reducer size and mounting position. Note that this is approximate and the final level will be adjusted when the reducer is installed. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads.

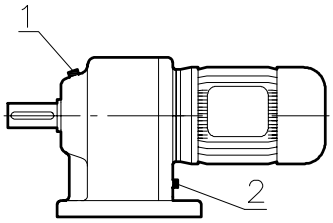
LUBRICATION CAPACITY – STANDARD LINE

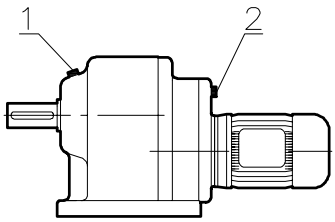
Mounting position		*Horizontal position*	*Vertical position*	*Horizontal position*			*Vertical position*
		double reduction		**triple reduction**			
		B3, B5, B5a, B8, B6, B7	**V1, V3, V5, V6**	**B3, B5, B5a, B8, B6, B7**			**V1, V3, V5, V6**
SK 0	quarts	0.11	0.16				
	liters	0.10	0.15				
SK 01	quarts	0.26	0.42	**SK 010**	quarts	0.63	0.69
	liters	0.25	0.40		liters	0.60	0.65
SK 20	quarts	0.54	0.74	**SK 200**	quarts	1.37	1.48
	liters	0.51	0.70		liters	1.30	1.40
SK 25	quarts	0.74	1.06	**SK 250**	quarts	1.48	1.58
	liters	0.70	1.00		liters	1.40	1.50
SK 30	quarts	0.85	1.48	**SK 300**	quarts	1.48	1.58
	liters	0.80	1.40		liters	1.40	1.50
SK 33	quarts	1.06	1.69	**SK 330**	quarts	1.58	1.67
	liters	1.00	1.60		liters	1.50	1.58

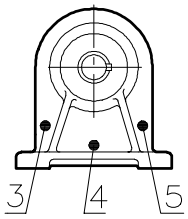
Note: Filling quantities are approximate figures. Oil level must be checked according to oil level plug after final installation. Acceptable oil fill level is within ½ inch of the bottom of the fill plug threads For mounting angles not shown, consult factory.

The mounting position of the gearbox dictates the location of the Autovent. Below is a table and illustrations to show where the Autovent should be located per the specified mounting position. The Autovent must be at the highest location of the gearbox.

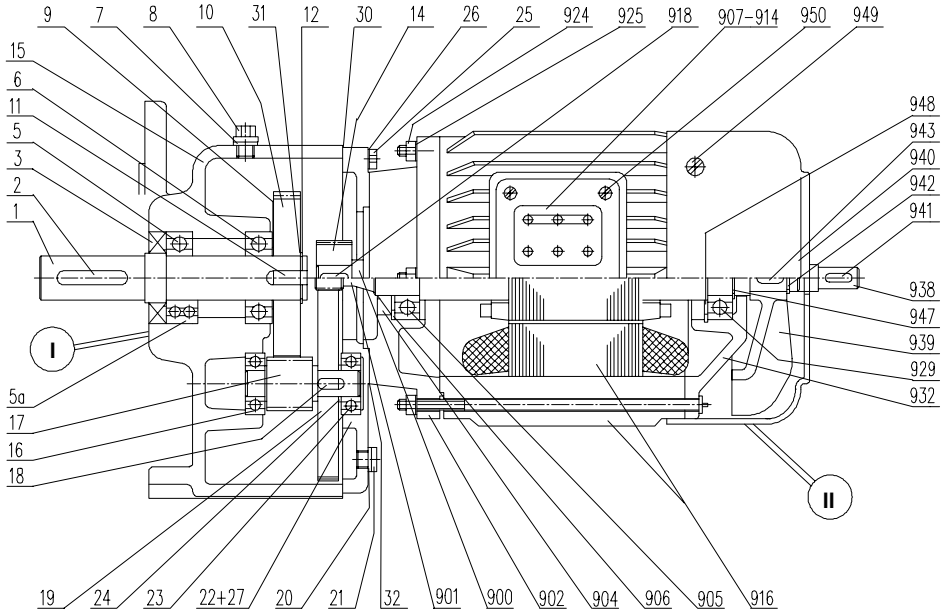
Mounting Position	Autovent Location
B3, B5, B3/B5	1
B8, B5a, B8/B5a	4
B6	3
B7	5
V3, V6, V3/V6	4
V1, V5, V1/V5	2

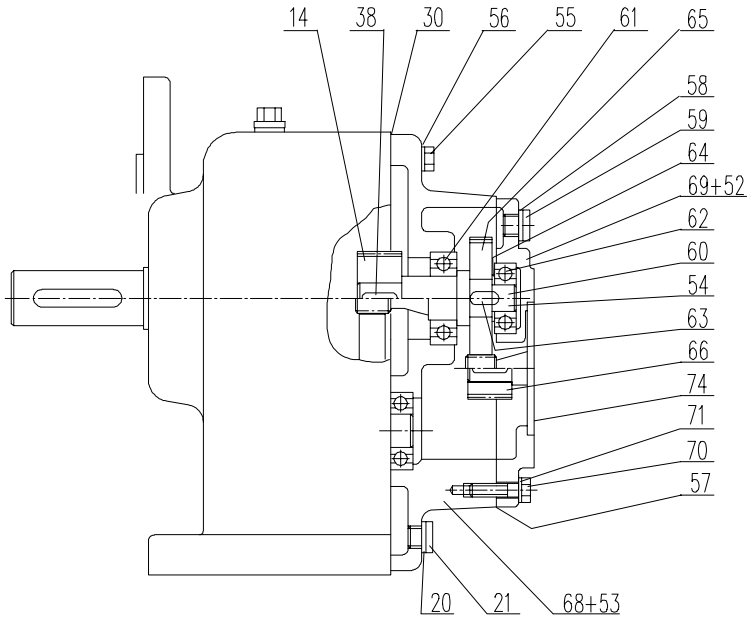






PARTS LIST





1	Output shaft
2	Key
3	Shaft seal
5	Output shaft bearing, normal
5a	Output shaft bearing, reinforced
6	Output shaft bearing
7	Seal
8	Vent screw
9	Shim
10	Driven gear
11	Key
12	Circlip
14	Driving pinion
15	Gear case
16	Pinion shaft bearing
17	Driven pinion
18	Key
19	Driving gear
20	Seal
21	Plug
22	Gear case cover
23	Pinion shaft bearing
24	Shim
25	Hexagon bolt
26	Washer
27	Spiral pin
30	Seal
31	Shim
32	Seal
52	Spiral pin
53	Spiral pin
54	Intermediate shaft, gearcut
55	Hexagon bolt
56	Washer
57	Seal
58	Seal
59	Plug
60	Intermediate shaft, plain
61	Grooved ball bearing
62	Grooved ball bearing
63	Key
64	Shim
65	Driving gear
66	Driving pinion
68	Gear case 3rd.-red.
69	Gear case cover
70	Hexagon bolt
71	Washer
74	Seal
900	Rotor with shaft, plain
901	Rotor with shaft, gearcut
902	End shield A
904	Shaft seal
905	Bearing A
906	Bearing shim
907	Terminal box frame
908	Terminal box cover
909	Terminal box frame gasket
910	Terminal box cover gasket
911	Terminal board
914	cable entry gland
916	Stator case
918	Key
924	Collar bolt
925	Hexagonal nut
929	Bearing B
932	End shield B
938	Second motor shaft end
939	Fan
940	Fan cover
941	Key
942	Circlip
943	Key
947	Circlip
948	Circlip
949	Oval flat-head bolt
950	Oval flat-head bolt

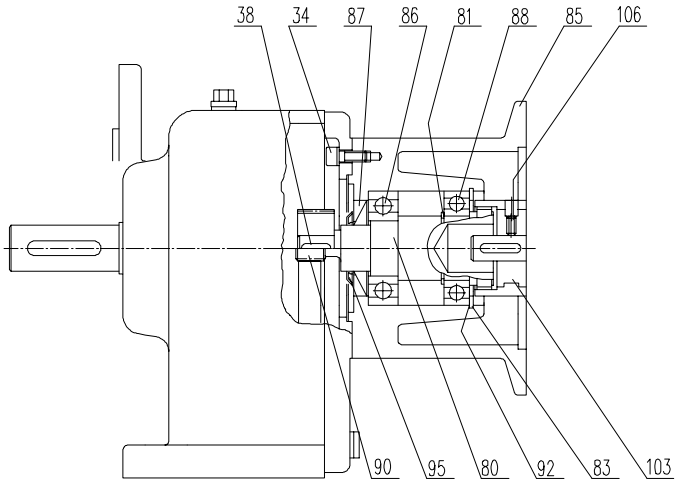
RECOMMENDED SPARE PARTS

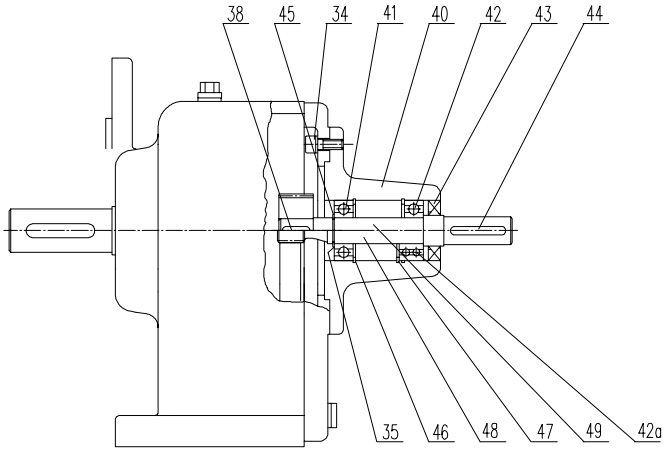
Bearings – *all* Gaskets – *all* Shims – *all*
Seals – *all* Seal Plugs – *all*

IMPORTANT!

When ordering parts, it is necessary to have the *NORD SERIAL NUMBER* from the unit the parts are for. The serial number will dictate the correct parts for that particular unit. The gearbox nameplate will have the serial number on it.

PARTS LIST





34	Socket head bolt
35	Shim
38	Key
40	Input bearing housing
41	Grooved ball bearing
42	Grooved ball bearing, normal
42a	Grooved ball bearing, reinforced
43	Shaft seal
44	Key
45	Circlip
46	Circlip
47	Circlip
48	Input shaft gearcut
49	Input shaft, plain
80	Input shaft
81	Circlip
83	Circlip
85	IEC Adaptor
86	Input shaft bearing
87	Shaft seal
88	Input shaft gearcut
90	Clutch pinion shaft
92	Shim
95	Oil flinger
103	Coupling
106	Set screw

NOTES

TROUBLE SHOOTING

PROBLEM WITH THE REDUCER		POSSIBLE CAUSES	SUGGESTED REMEDY
Runs Hot	Overloading	Load exceeds the capacity of the reducer	Check rated capacity of reducer, replace with unit of sufficient capacity or reduce load
	Improper lubrication	Insufficient lubrication	Check lubricant level and adjust up to recommended levels
		Excessive lubrication	Check lubricant level and adjust down to recommended levels
		Wrong lubrication	Flush out and refill with correct lubricant as recommended
Runs Noisy	Loose foundation bolts	Weak mounting structure	Inspect mounting of reducer. Tighten loose bolts and/ or reinforce mounting and structure
		Loose hold down bolts	Tighten bolts
	Worn RV Disc	Overloading unit may result in damage to disc	Disassemble and replace disc. Recheck rated capacity of reducer.
	Failure of Bearings	May be due to lack of lubricant	Replace bearing. Clean and flush reducer and fill with recommended lubricant.
		Overload	Check rated capacity of reducer.
	Insufficient Lubricant	Level of lubricant in the reducer not properly maintained.	Check lubricant level and adjust to factory recommended level.
Output Shaft Does Not Turn	Internal parts are broken	Overloading of reducer can cause damage.	Replace broken parts. Check rated capacity of reducer.
		Key missing or sheared off on input shaft.	Replace key.
		Coupling loose or disconnected.	Properly align reducer and coupling. Tighten coupling.
Oil Leakage	Worn Seals	Caused by dirt or grit entering seal.	Replace seals. Autovent may be clogged. Replace or clean.
		Overfilled reducer.	Check lubricant level and adjust to recommended level.
		Autovent clogged.	Clean or replace, being sure to prevent any dirt from falling into the reducer.
		Improper mounting position, such as wall or ceiling mount of horizontal reducer.	Check mounting position. Name tag & verify with mounting chart in manual.

NORD Gear Corporation
National Customer Service Toll Free 888-314-6673
www.nord.com
NORD Gear Limited
Toll Free in Canada 800-668-4378

WEST
1121 Railroad Street
Building 101
Corona, CA 92882
Phone 951-279-2600
Fax 888-408-6673

MIDWEST
PO Box 367
800 Nord Drive
Waunakee, WI 53597
Phone 608-849-7300
Fax 800-373-6673

SOUTH
100 Forsyth Hall Dr.
Building 100B
Charlotte, NC 28273
Phone 704-529-1255
Fax 888-259-6673

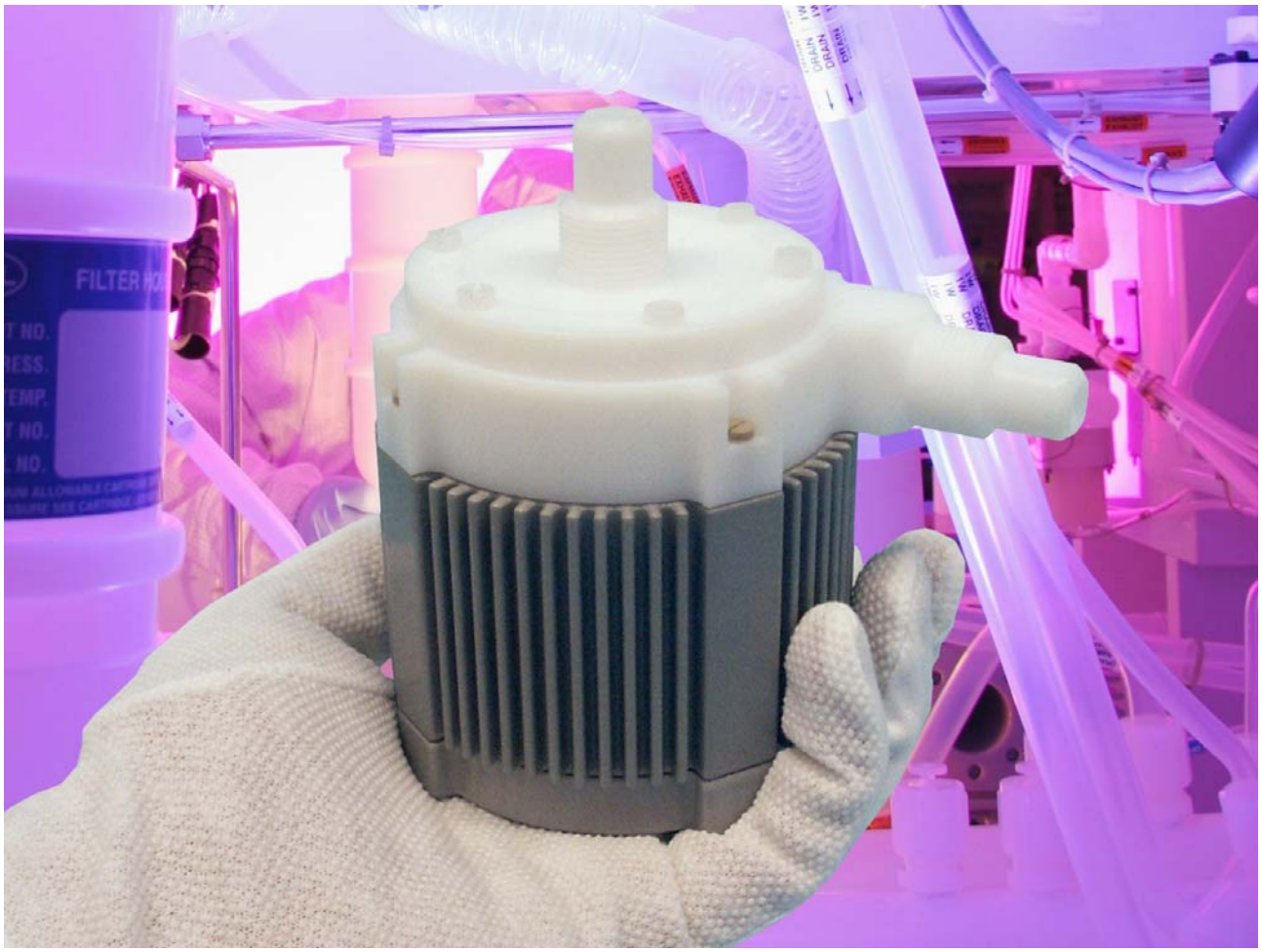
CANADA
41 West Drive
Brampton, Ontario L6T 4A1
Phone 905-796-3606
Fax 905-796-8130

Appendix B: Levitronix Puralev® 200 SU Manual

BPS-200

2.6 bar (37.7 psi)
21 liters/min (5.5 gallons/min)

USER MANUAL



This manual contains information necessary for the safe and proper use of the *BPS-200*. Included are specifications for the standard configurations of the pump system and instructions regarding its use, installation, operation, adjustment, inspection and maintenance. For special configurations of the pump system refer to accompanying information. Please familiarize yourself with the contents of the manual to ensure the safe and effective use of this product. After reading this manual, please store the manual where the personnel responsible for operating the pump system can readily refer to it at any time.

Table of Contents

1 Safety Precautions

CAUTION

Do not under any circumstances open the controller or motor. Levitronix does not assume responsibility for any damage, which occurs under such circumstances.

CAUTION

***High magnetic field strength of pump impeller**.*

The pump system contains a rotor magnet with high field strength. This may alter or damage the calibration of sensitive electronic devices and measuring instruments in the immediate surroundings.

Keep at a safe distance from computers, monitors and all magnetic data storage media (e.g. disks, credit cards, audio and video tapes etc.)

⚠ WARNING

Hazardous voltage may be present.

In case of the usage of an inadequate AC/DC power supply, mains voltages may be present (even if the system is designed for up to 24-48VDC).

The controller must be grounded and placed in a spill protected environment. Do not under any circumstances open the powered controller. The usage of galvanic separated AC/DC supply is highly recommended.

⚠ WARNING

High magnetic field strength of pump impeller.

The pump system contains a rotor magnet with high field strength. Pacemakers may be influenced and magnetic forces may lead to contusions.

Keep distance to pacemakers and handle impeller with care.

⚠ WARNING

TOXIC CHEMICALS may be present.

When using the system to pump chemicals skin contact and toxic gases may be hazardous to your health.

Wear safety gloves and other appropriate safety equipment.

2 Specifications

2.1 System Overview and General Specification

Figure 3 shows the mayor components of the *BPS-200* pump system. Two basic system configurations are available. The stand-alone configuration *(Figure 1)*, consists of a controller with an integrated user panel to set the speed manually and a reduced PLC for speed setting with an analoge signal. The extended version (*Figure 2*) consists of a controller with extended integrated PLC functions. This allows setting the speed by an external signal and enables precise flow or pressure control together with a flow or pressure sensor

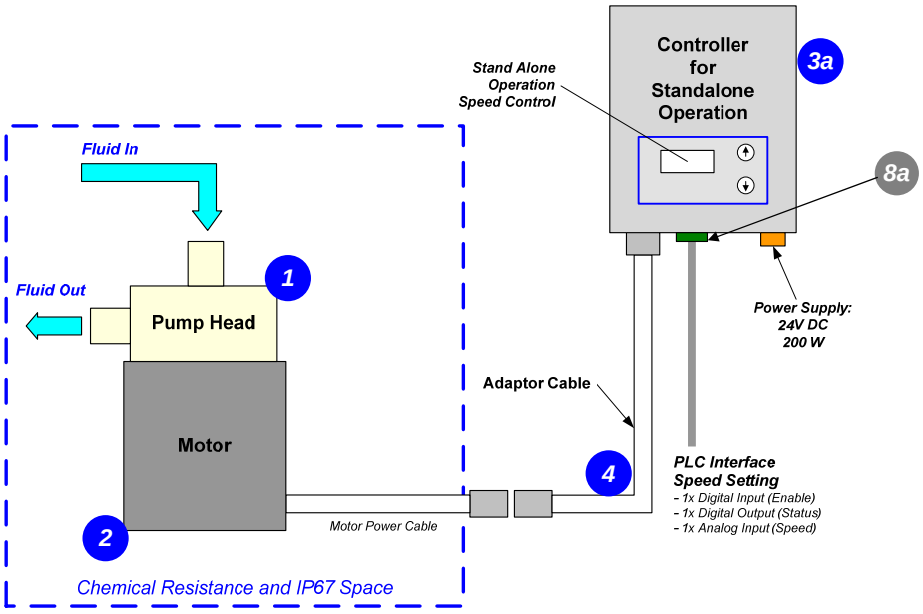


Figure 1: Standard system configuration for standalone operation
(Speed setting with integrated user panel)

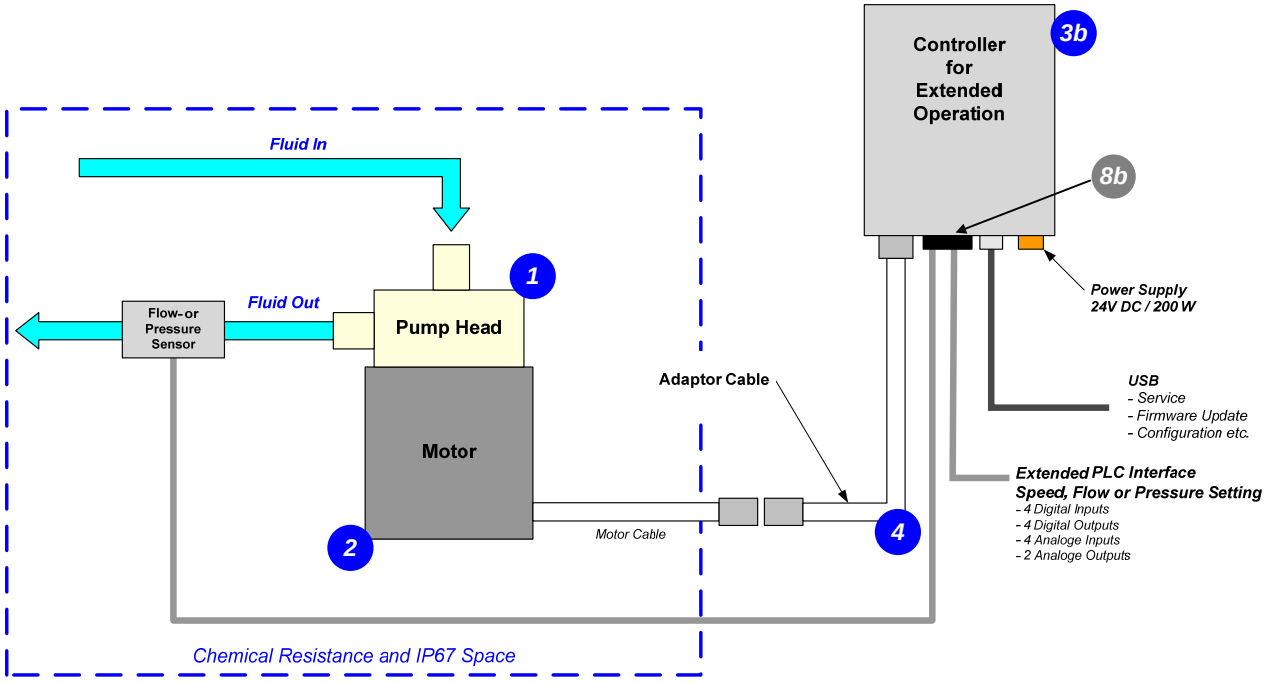


Figure 2: Standard system configuration for extended operation
(Pressure or flow control with external sensor)

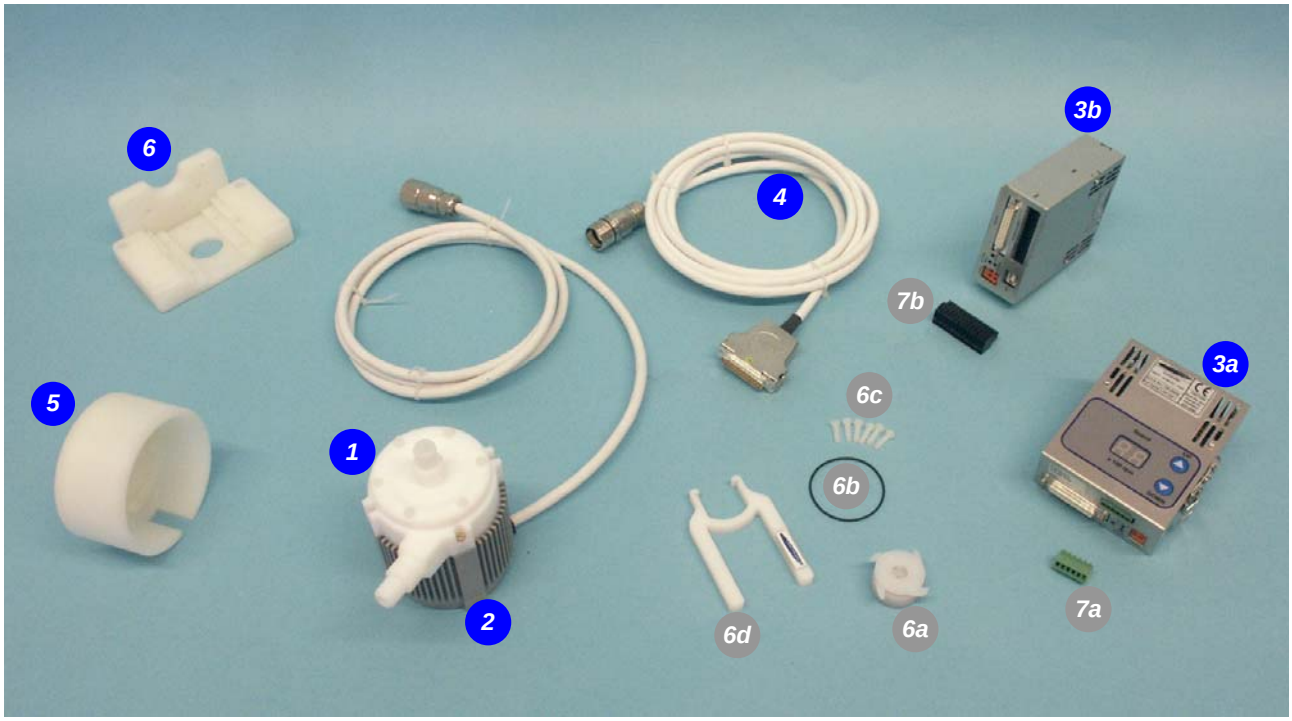


Figure 3: Pump system BPS-200 with standard components

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
1	Pump Head	LPP-200.1	100-90281	Impeller Pump Casing Sealing Ring	*PFA* *PTFE* *Kalrez® perfluoroelastomer* [1]
				Fittings	*Flaretek ½"*
				Max. Diff.-Pressure Max. Flow Max. Viscosity	*2.6 bar / 37.7 psi* *21 liters/min / 5.5 gallons/min* *50 cP*
				Max. Static Pressure (mounted on motor)	*8 bar / 116 psi @ 25 °C / 77 °F liquid temp.* *3.9 bar / 57 psi @ 90 °C / 194 °F liquid temp.*
				Max. Liquid Temp.	*90 °C / 194 °F*
2a	Motor	BSM-1.3	100-10004	Housing	*ETFE coated Aluminum* *waterproofed (IP67)*
				Max. Speed	*10000 rpm*
				Thermal Protection	*Internal temp. sensor with max temperature = 90°C (194°F)*
				Cable / Connectors	*1x 2m cables with FEP jacket / circular IP-67 (needs Pos. 4)*
2b	Motor	BSM-1.4	100-10005	Cable / Connectors	*1x 5m cables with FEP jacket / D-SUB* *(direct connection to controller, no adaptor cable needed)*
3a	Standalone Controller (User Panel)	LPC-200.1	100-30008 (Controller with Enable connector incl. in 100-90335)	Electrical Power / Voltage	*200 W / 24 - 48V DC*
				Interfaces for Standalone Controller	*Panel to set speed with automatic storage on internal EEPROM*
				PLC with	*1x analog input („Speed")* *4 - 20 mA* *1x digital input („Enable"* *0 - 24 V (optocoupler)* *1x digital output („Status")* *0 - 24 V (relais)*
				Accessories	*PLC connector (Pos. 7a) is incl. with controller in article package 100-90336*
3b	Extended Controller (PLC and USB)	LPC-200.2	100-30009 (Controller with PLC connector incl. in 100-90336)	Interfaces for Extended Controller	*PLC with* *- up to 4 digital inputs* *0 - 24V (optocoupler)* *- up to 4 digital outputs* *0 - 24 V (relais)* *- up to 2 analog inputs* *4 - 20mA* *- up to 2 analog inputs* *0 – 10 V* *- up to 2 analog outputs* *0 – 5 V*
					USB interface (for service and system monitoring)
				Accessories	*PLC connector (Pos. 7b) is incl. with controller in article package 100-90336*

Table 1: Specification of standard components

1: Kalrez® is a registered trademark of DuPont Dow Elastomers

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
4	Extension Adaptor Cable	MCA-1.2-05 (0.5m) MCA-1.2-30 (3m) MCA-1.2-50 (5m) MCA-1.2-70 (7m) MCA-1.2-100 (10m)	190-10147 190-10092 190-10128 190-10148 190-10149	Jacket and Connectors	*FEP-jacket and circular Hummel to D-SUB connector*
5	Air Cooling Module	ACM-1.1	190-10003	Material	*PVDF*
				Connection Port	*NPT ¼"*
				Cooling Medium	*Compressed air or N2*
				Air Pressure	*~ 0.5bar (7.2 psi)*
6	Mounting Base Plate	MBP-1.1	190-10004	Material	*PVDF*
7 (7a+7b+ 7c+7d)	Impeller Exchange Kit	IEK-200.1	100-90517	Impeller LPI-200.1 (6a)	*PFA*
				O-Ring (6b)	*O-Ring, Kalrez, 50.52 x 1.78*
				Pump Casing Screws (6c)	*6 pieces, PVDF, M4x15*
				Exchange Tool IET-1.1 (6d)	*POM-C*
8a	AC/DC Power Supply	SWS300-24 (Lambda)	100-40007	Voltage / Power Output	*24VDC / 300W*
				Voltage Input	*85-265 VAC (automatic detection)*
				Certification	*TUV / UL / Semi F47 (208 AC input)*
8b	AC/DC Power Supply	SWS300-48 (Lambda)	100-40008	Voltage / Power Output	*48 VDC / 300W*
				Voltage Input	*85-265 VAC (automatic detection)*
				Certification	*TUV / UL / Semi F47 (208 AC input)*

Table 2: Specification of accessories

System Name	Article #	Pumphead	Motor	Controller	Note
BPS-200.1	100-90191	LPP-200.1	BSM-1.3	LPC-200.1	*Adaptor/Extension cable (0.5 - 10m) have to be ordered as separate article according to Table 2*
BPS-200.2	100-90192	LPP-200.1	BSM-1.3	LPC-200.2	
BPS-200.3	100-90193	LPP-200.1	BSM-1.4	LPC-200.1	*Direct connection between motor and controller. No adaptor cable necessary*
BPS-200.4	100-90194	LPP-200.1	BSM-1.4	LPC-200.2	

Table 3: Standard system configurations

3 Hydraulic Specifications

3.1.1 Pressure-Flow Curves

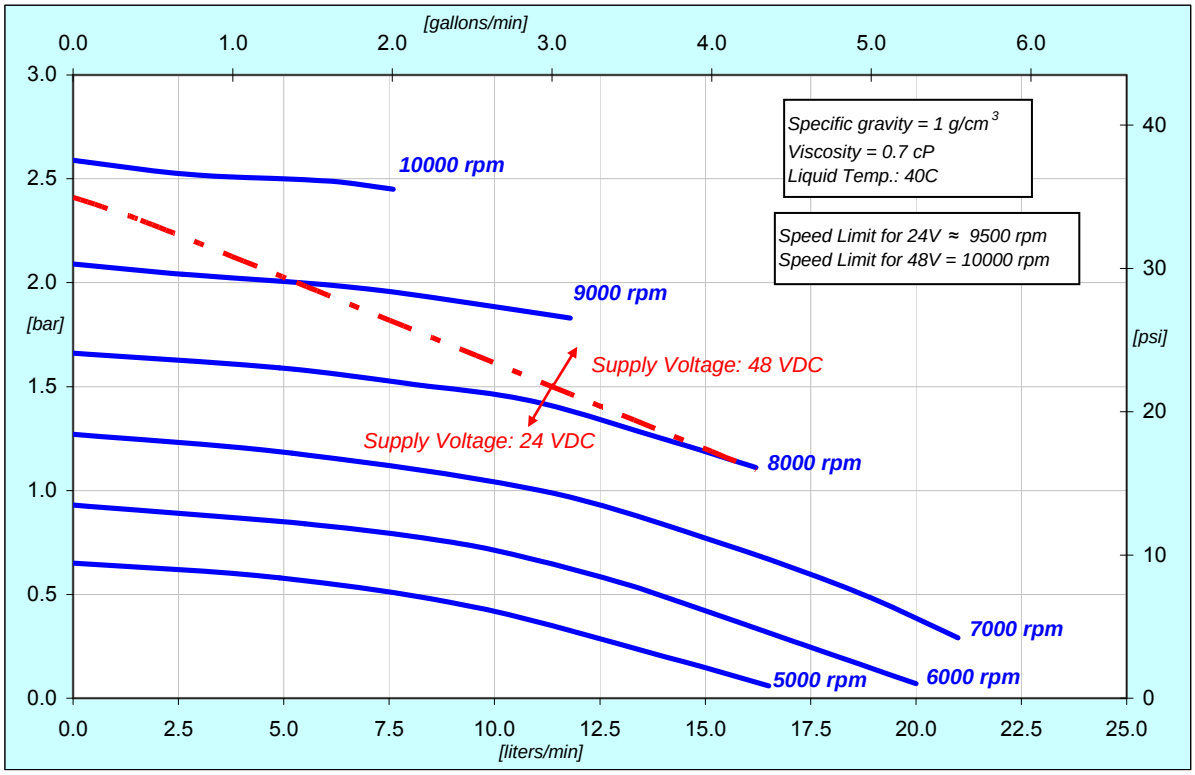


Figure 4: Pressure/flow rate curves
(Measured with pumphead LPP-200.1)

3.2 General Environmental Conditions

Usage	Indoor (motor with pump head can be placed outdoor)
Altitude	Up to 2000 *m*
Operating ambient temperature	0 to 40 ^0C
Storage ambient temperature	-20 to 80 ^0C
Operating humidity range (relative humidity)	15 – 95% (non condensing)
Storage humidity range (relative humidity)	15 – 95% (non condensing)
DC supply fluctuations	± 10% of nominal voltage
Transient over-voltages typically present on the mains supply	Surge immunity according to EN 61000-4-5 (tested with AC/DC power supply TSL 120-124 for 24VDC and TIS 600-148 for 48 VDC)
Pollution degree	2

Table 4: Environmental conditions for pump system

3.3 Basic Dimensions of Main Components

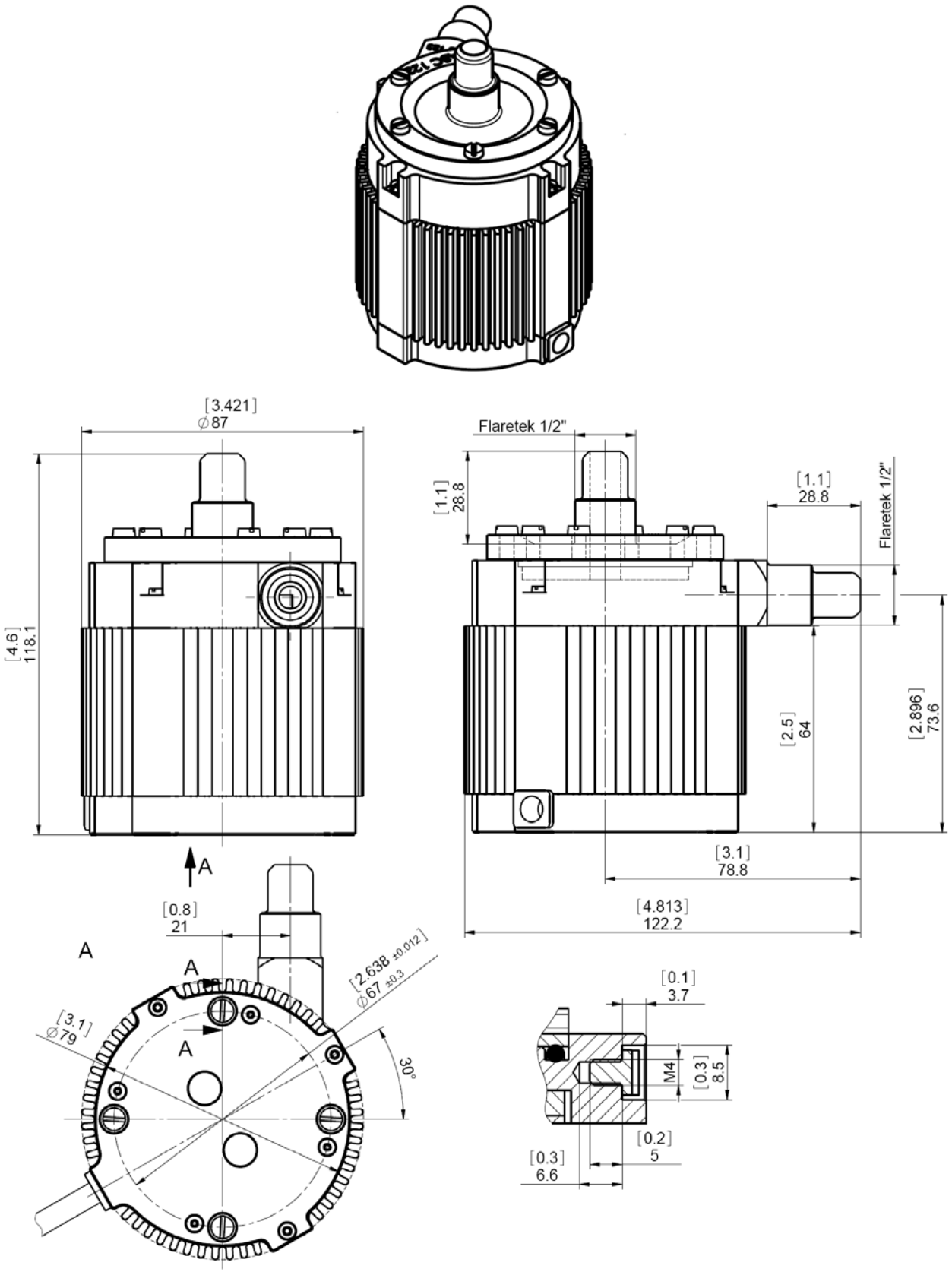


Figure 5: Basic dimensions (in mm and [inch]) of motor BSM-1.x with pump head LPP-200.1
(for other configurations refer to according drawings)

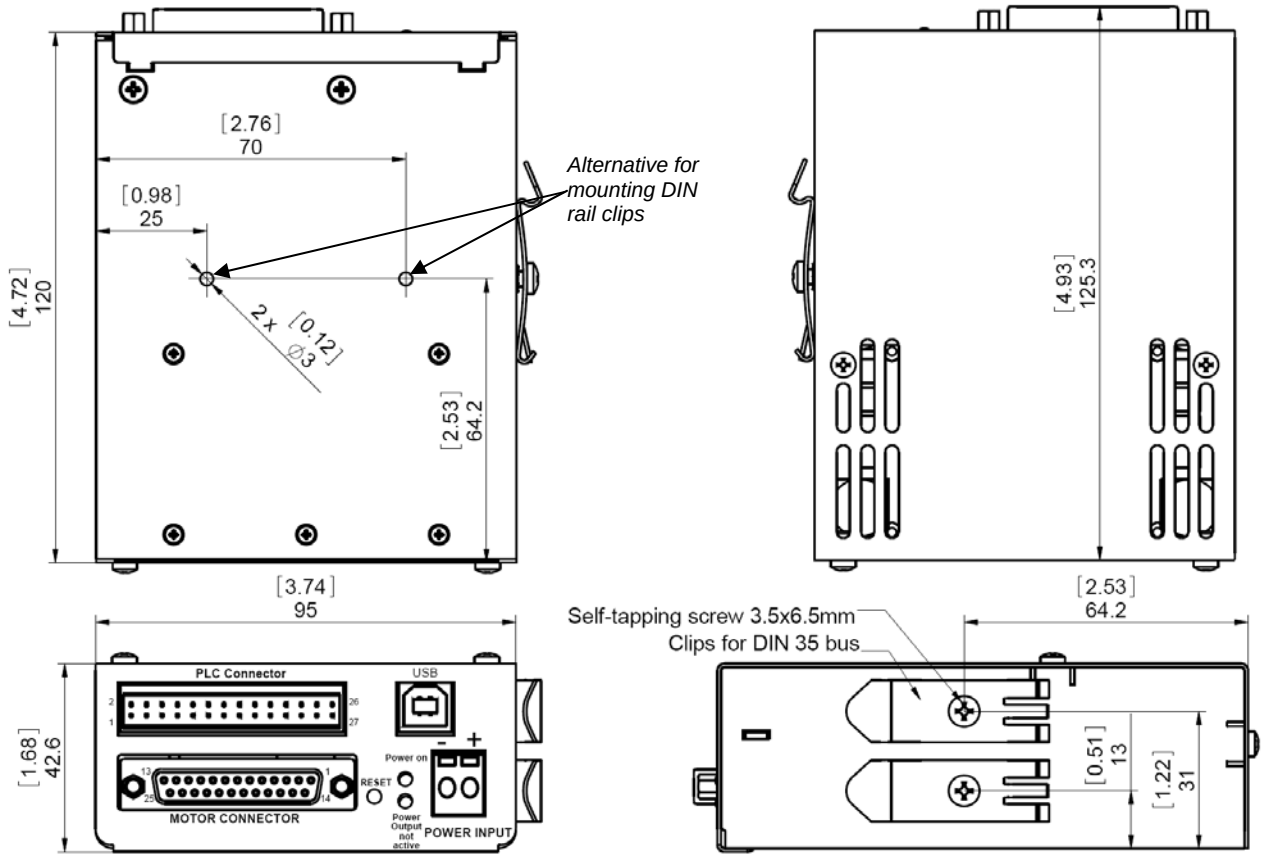


Figure 6: Basic dimensions (in mm) of controller LPC-200.2
(Same basic dimensions for LPC-200.1)

4 Engineering Information

4.1 Sealing and Material Concept

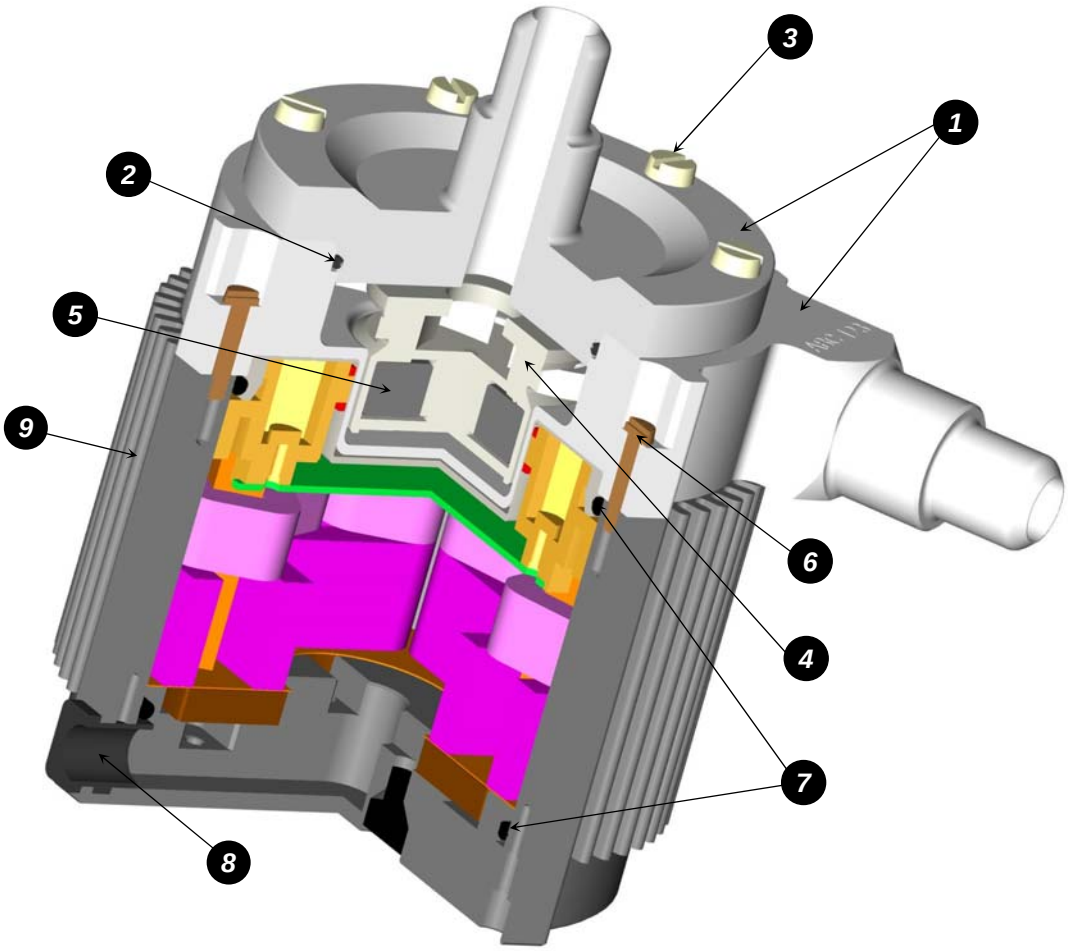


Figure 7: Sealing and material concept

System Component	Item		Materials
	No	Description	
Pump head *LPP-200.1*	1	Pump casing (lid and bottom)	PTFE
	2	Static sealing O-ring of pump casing	Kalrez®
	3	6 screws for pump casing	PVDF
	4	Impeller *LPI-200.1*	PFA
	5	Rotor magnet	NdFe (rare-earth material)
	6	4 screws for pump/motor mounting	PEEK
Motor BSM-1.3	7	Sealing O-ring for motor housing	FPM (= FKM)
	8	Cable bushing	FPM, cable jacket is FEP
	9	Motor housing	ETFE coating, waterproof (IP-67) Coils and electromagnetic circuit potted with an epoxy compound (UL94 V0).

Table 5: Materials used in the BSM-1.3 motor and LPP-200.1 pump head
(For other configurations refer to according specifications and drawings)

4.2 Power Consumption

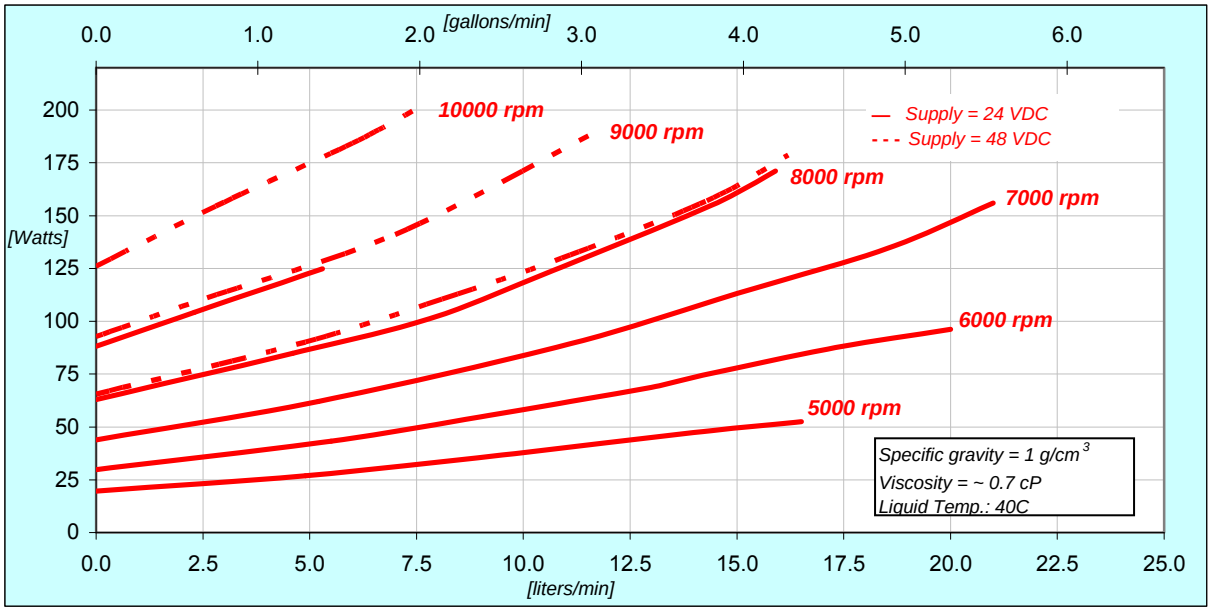


Figure 8: Electrical power consumption
(Controller LPC-200.x with pump head LPP-200.1 and motor BSM-1.x)

4.3 Temperature Monitoring

To avoid overheating of the system, the controller and motor temperatures are monitored. If the controller temperature exceeds *70°C (158°F)* or the motor temperature *90°C (194°F)* for a duration of more than 10 minutes, the system goes into an error state and the pump stops. At *80°C (176 F)* controller temperature or *100°C (212°F)* motor temperature, the system stops immediately.

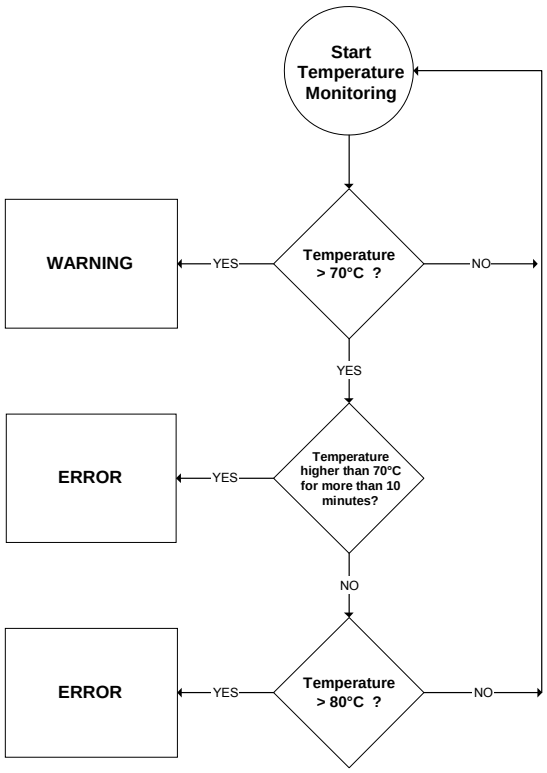


Figure 9: Controller temp. monitoring

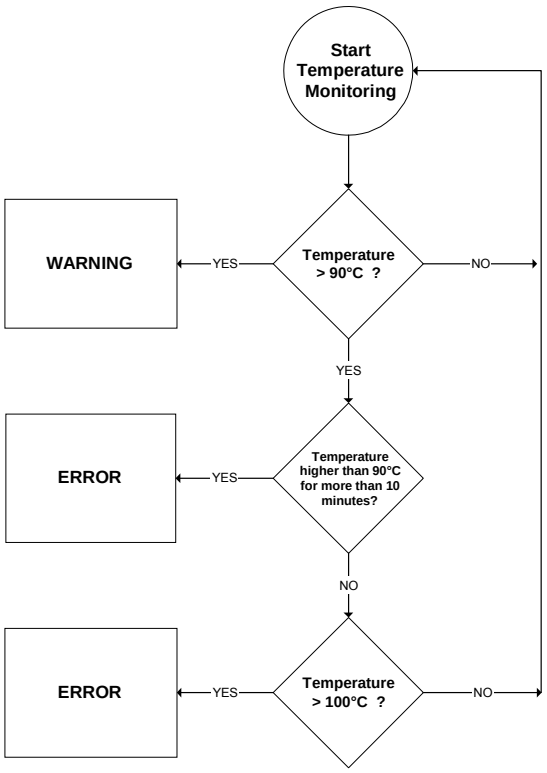


Figure 10: Motor temperature monitoring

4.4 Thermal Management

4.4.1 Motor Temperature

The motor temperature depends on the ambient and liquid temperature, as well as on the hydraulic operation point. *Figure 11*, *Figure 12* and *Figure 14* illustrate the temperature characteristics of the motor depending on these parameters. For higher liquid temperatures and hydraulic operating points active cooling is recommended for example with the air cooling module *ACM-1.1* (see *Figure 13, Table 1*).

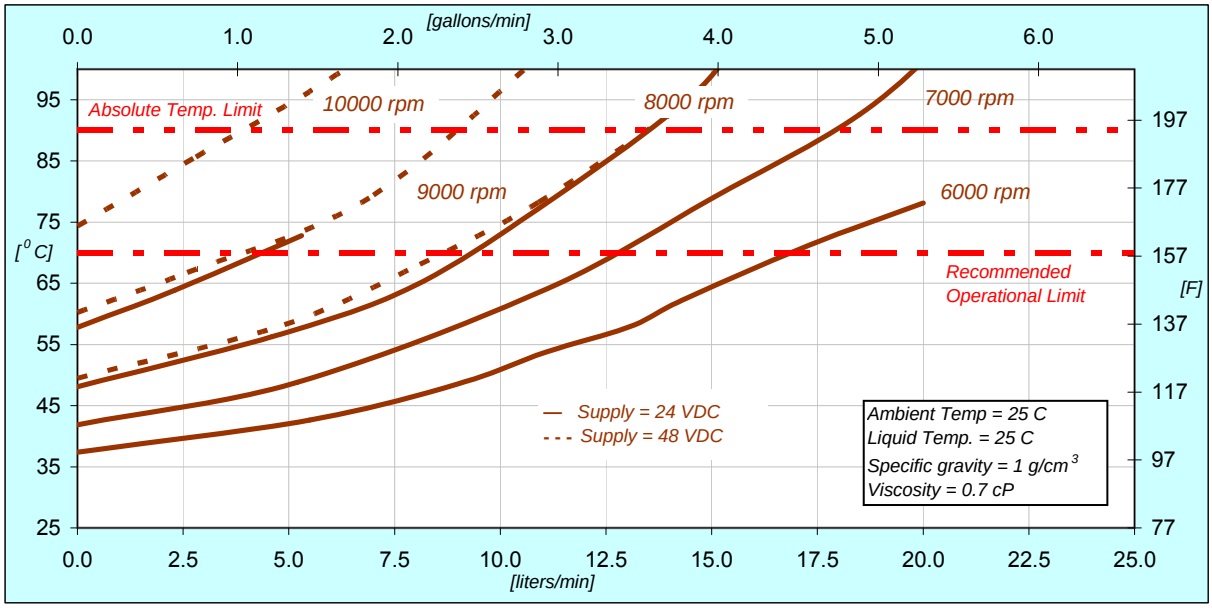


Figure 11: Temperature curves for the BSM-1.x motor @ 25 C liquid temperature
(Pumping with pump head LPP-200.1, temperature is measured inside of the motor, contact temperature of surface is below this temperature)

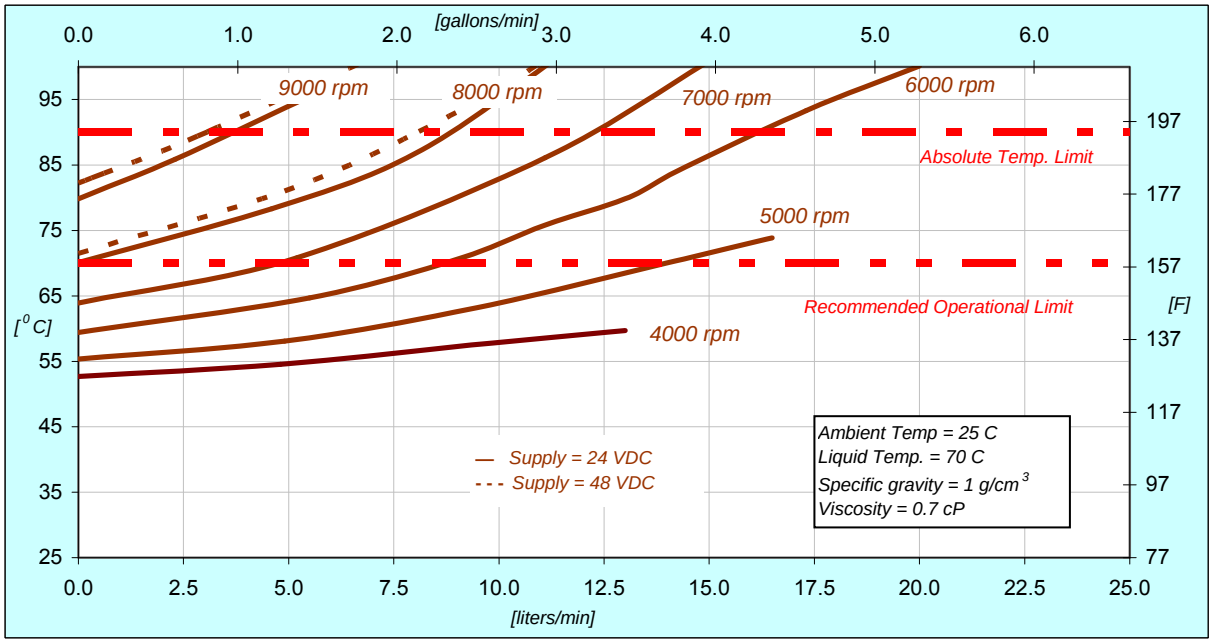


Figure 12: Temperature curves for the BSM-1.x motor @ 70 C liquid temperature
(Pumping with pump head LPP-200.1, temperature is measured inside of the motor, contact temperature is below this temperature)

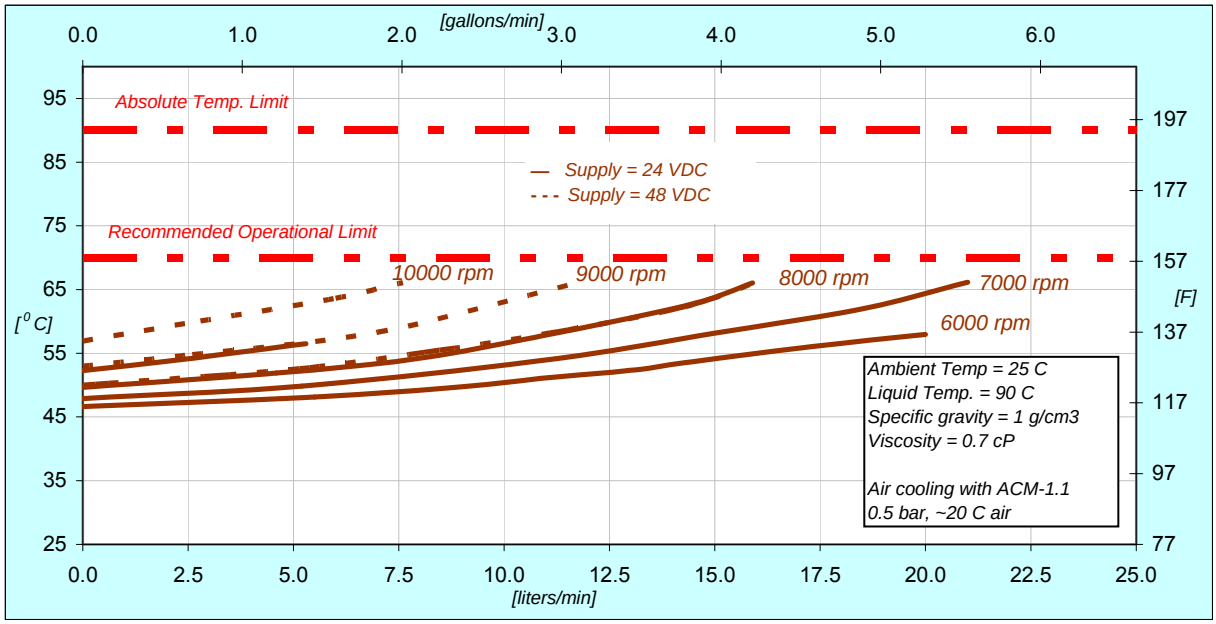


Figure 13: Temperature curves of motor BSM-1.x with air cooling module ACM-1.1
(Pump head LPP-200.1, liquid. temp = 90 ^{0}C, Air Cooling Module ACM-1.1 with 0.5 bar air at 20 ^{0}C)

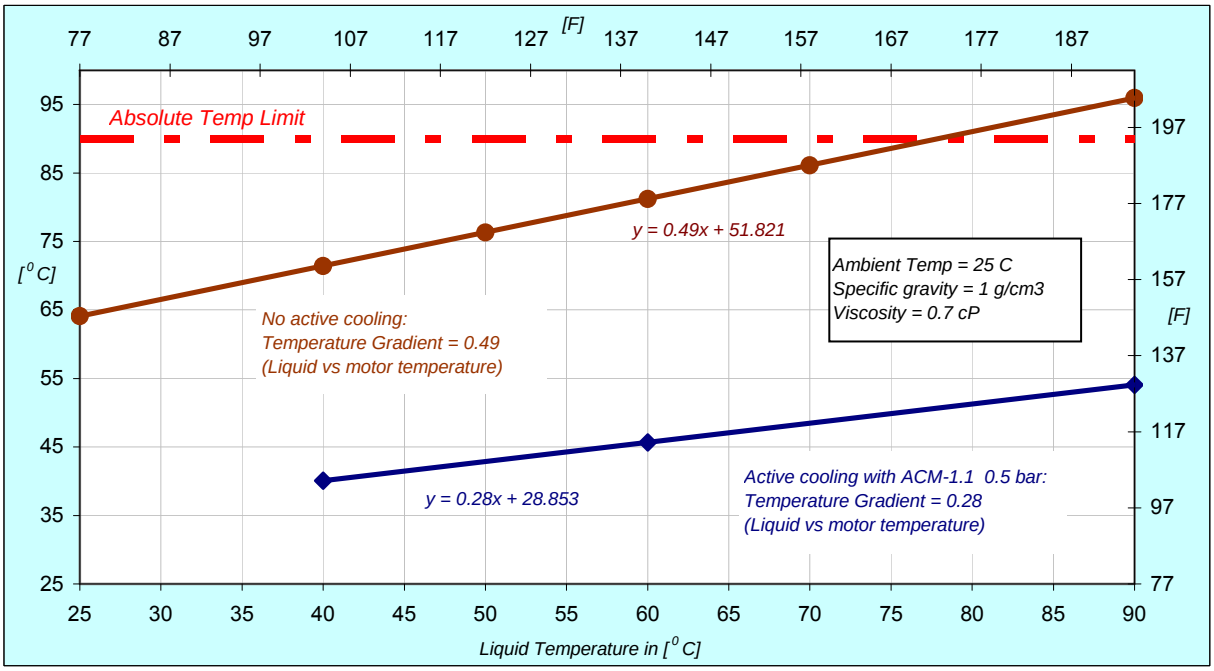


Figure 14: Influence of liquid temperature on motor temperature
(Measurement at 7000 rpm 11 lpm but gradiants are representative for other operational points)

The above curves are measurements of the motor temperature at certain liquid and ambient temperatures. Equation *(Eq. 1)* shows how to calculate the motor temperature for other liquid and ambient temperatures based on these curves.

$$T_M(T_L,T_A) \approx \underbrace{T_M(T_L = 25^0C, T_A = 25^0C)}_{see\ Figure\ 12} + (T_L - 25^0C)\cdot \underbrace{tg_{LM}}_{see\ Figure\ 15} + (T_A - 25^0C)$$

(Eq. 1)

T_M = *Motor temperature* T_L = *Liquid temperature*

T_A = *Ambient temperature* tg_{LM} = *Temperature gradient liquid/motor*

In order to account for thermal variations (like ambient temperature, closed chemical cabinets or corners without ventilations) and to not significantly reduce the MTBF of the motor it is recommended to keep about 20 ^0C safety distance to the absolute thermal limit of the motor (90 ^0C) when designing the thermal concept of the pump system.

4.4.2 Controller Temperature

Depending on the ambient temperature and the placement of the controller additional cooling may be required (see *Figure 15*). To improve cooling of the controller, place the device into a moving air stream. If the controller is mounted in a compact area or adjacent to additional heat sources (e.g. a 2nd controller) ensure that there is sufficient ventilation.

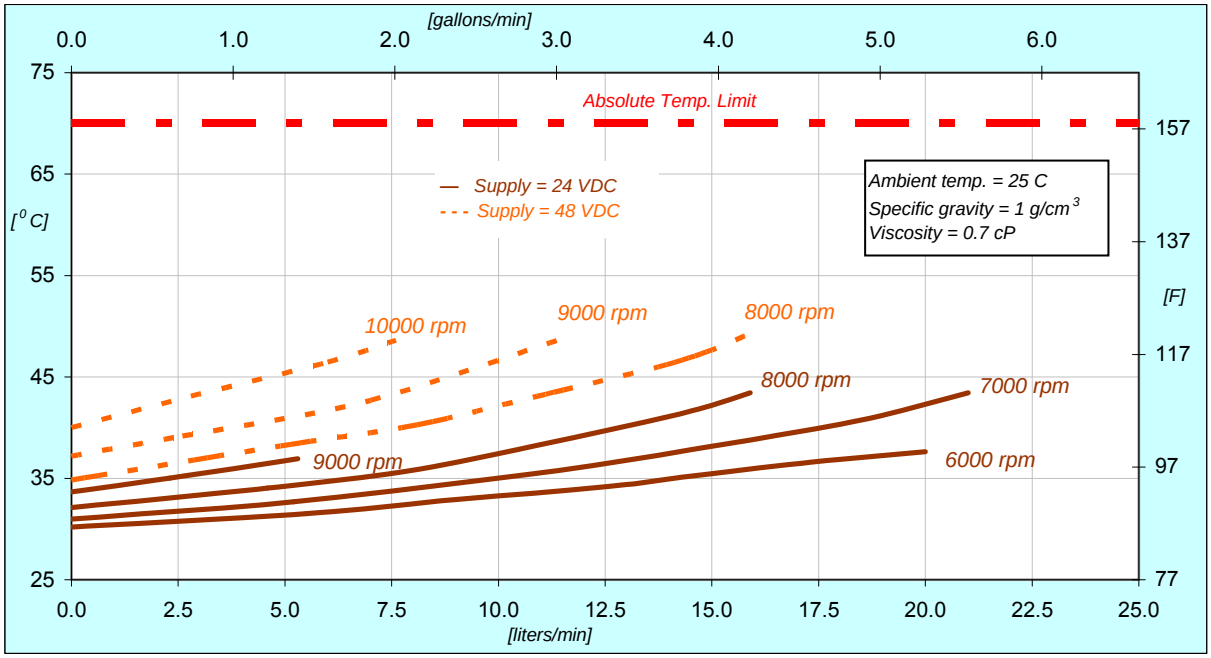


Figure 15: Temperature curves of controller LPC-200 vs. flow and speed
(for pumping with pump head LPP-200.1 and motor BSM-1.x)

The above curves are measurements of the controller temperature at 25^0C ambient. Equation *(Eq. 2)* shows how to calculate the controller temperature for at other ambient temperatures based on this curve.

$$T_C(T_A) \approx \underbrace{T_C(T_A = 25^0C)}_{see\ Figure\ 16} + (T_A - 25^0C)$$

T_C = *Controller temperature*

T_A = *Ambient temperature*

(Eq. 2)

5 Installation

5.1 Electrical Installation of Controller

5.1.1 Overview

The *LPC-200* controllers have signal processor controlled power converters with four switched inverters for the drive and the bearing coils of the motor. The signal processor allows precise control of pump speed and impeller position. *Figure 16* shows the interfaces of the *LPC-200.1* controller with stand-alone and minimal PLC functions and *Figure 17* the interfaces of the *LPC-200.2* controller with extended PLC functions and USB interface for communication.

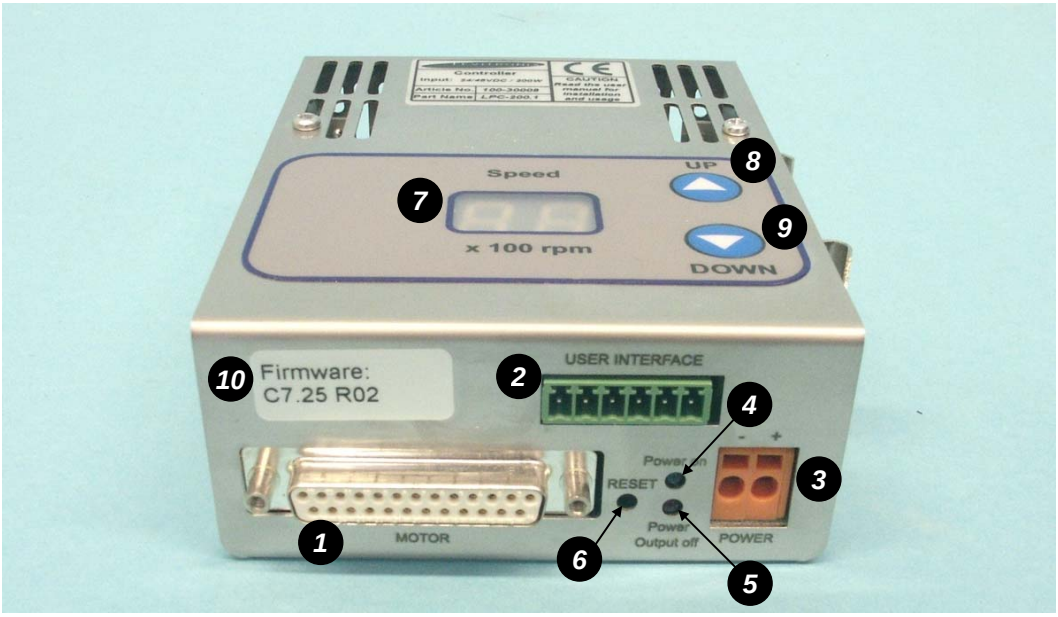


Figure 16: Overview of the controller LPC-200.1 for standalone operation

	Interface (as labeled)	Description	
1	"MOTOR"	- Position, field and temperature sensor signals from motor - Drive and bearing currents of the motor	
2	"USER INTERFACE"	1 Digital Input	- Galvanic isolation with optocoupler - Switching voltage / current: minimal 10 V / 7 mA, Typical 24 V / 16 mA, maximal 30 V / 20 mA, (Possible is 5V) - Input resistance: R_{IN} = 2.2 kΩ
		1 Digital Output	- Galvanic isolation with relay - Relay: 1A / 30VDC, 0.3A / 125 VAC
		1 Analoge Input	- Analog current input: 4 – 20 mA - 450 Ohm shunt input
3	"POWER INPUT"	DC power input -> 24V	
4	"Power on" Green LED	LED is on if supply voltage of signal electronics is present.	
5	"Power Output off" Red LED	Red LED is off if the switched output stage of the controller is enabled. If the LED is on, the bearing and drive coils of the motor carry no current.	
6	"RESET" Button	Reset button of the controller stage. The button is sunk mounted and can be activated for example with a small screw driver.	
7	2-Digit Display "Speed"	Rotational speed display in 100rpm	
8	"UP" Button	Button for speed increasing and enabling of levitation	
9	"DOWN" Button	Button for speed decreasing and disabling of levitation	
10	"Firmware" Label	Firmware version and revision number	

Table 6: Description of interfaces of LPC-200.1 controller

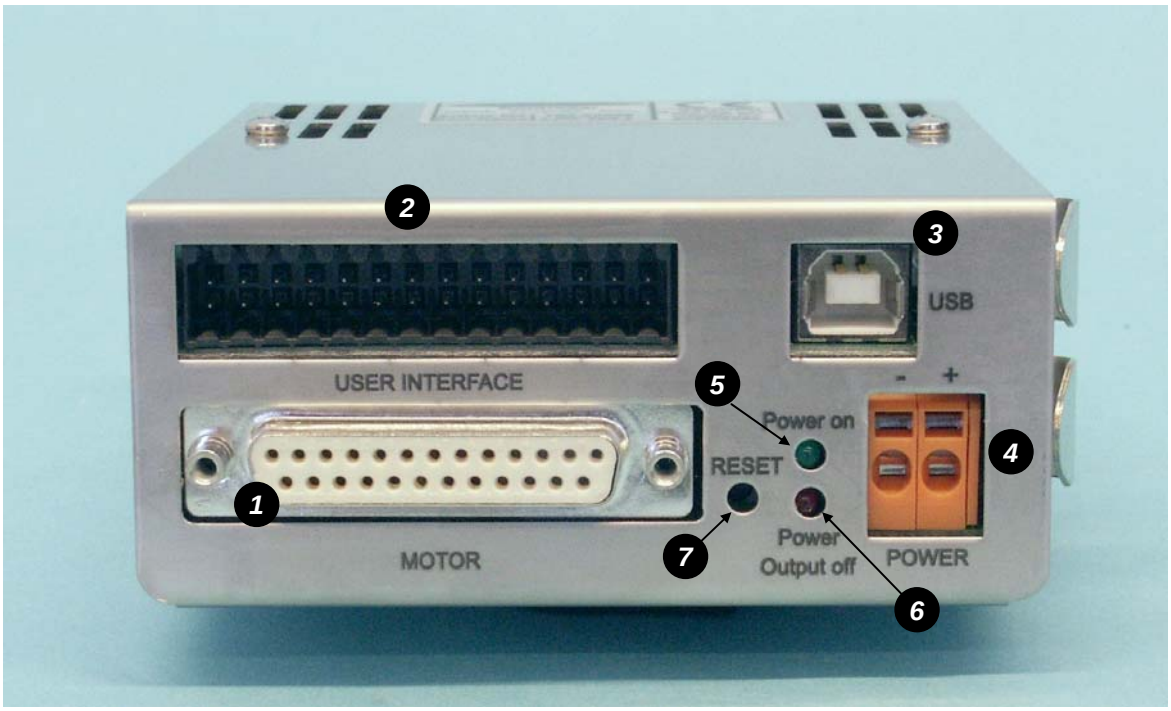


Figure 17: Overview of the controller LPC-200.2 for extended operation

	Interface (as labeled)	Description	
1	"MOTOR"	- Position, field and temperature sensor signals from motor - Drive and bearing currents of the motor	
2	"USER INTERFACE"	2 Analog Input	- Analog current input: 4 – 20 mA - 450 Ohm shunt input
		2 Analog Input	- Analog voltage input 0 – 10 V - Direct connection, no galvanic isolation - 7.8 kΩ input resistance
		2 Analog Output	- Analog voltage output: 0 – 10 V - Direct connection, no galvanic isolation - Max. output current: 2mA
		4 Digital Input	- Galvanic isolation with optocoupler - Switching voltage / current: minimal 10 V / 7 mA, Typical 24 V / 16 mA, maximal 30 V / 20 mA - Input resistance: R_{IN} = 2.2 kΩ
		4 Digital Output	- Galvanic isolation with relay - Relay: 1A / 30VDC, 0.3A / 125 VAC
3	"USB"	USB interface	
4	"POWER INPUT"	DC power input -> 24V	
5	"Power on" Green LED	LED is on if supply voltage of signal electronics is present.	
6	"Power Output off" Red LED	LED is off if the switched output stage of the controller is enabled. If the LED is on, the bearing and drive coils of the motor carry no current.	
7	"RESET" Button	Reset button of the controller stage	

Table 7: Description of interfaces of LPC-200.2 controller

5.1.2 General Installation Instructions

WARNING

Hazardous voltage may be present.

Always isolate the electrical power supply before making or changing connections to the unit.

In case of the usage of an inadequate AC/DC power supply, mains voltages may be present (even if the system is designed for 24 - 48VDC).

WARNING

Hazardous voltage may be present.

The controller housing must be properly grounded. Use one of the DIN-rail screws on the back side of the controller housing.

Do not use different and longer screws, which may result in short-circuit within the controller.

1. The controller casing must be grounded. The screws of the DIN-rail brackets can be used for grounding.
2. Connect the motor connector to the controller.
3. Connect the controller type specific connectors: see *Section 5.1.3* for standalone operation with the *LPC-200.1*, *Section 5.1.4* for extended operation with *LPC-200.1* and *Section 5.1.5* for extended operation with *LPC-200.2*
4. Depending on the required hydraulic operational point (see *Figure 4*), the pump system requires 24V or 48 DC supply voltage at a maximum power of 200 W. At a lower performance power supplies with smaller power or bigger supplies to supply several pump systems simultaneously may be used. Consult *Figure 8* to get the power consumption depending on the flow. Contact Levitronix for consulting and support on the power supply solution.
5. Connect the DC supply wires to the power input connector of the controller. Make sure that the polarity is correct (see *Figure 16* and *Figure 17*) and that AC/DC power supply is off.
6. To secure the connectors, tighten all retaining screws.

5.1.3 Electrical Installation of Controller LPC-200.1 for Standalone Operation

For standalone operation the *LPC-200.1* is disabled when power is turned on. It can be enabled manually by using the "UP" button on the display. However, if the controller shall be enabled automatically, when power is applied the "ENABLE" pin on the "USER INTERFACE" connector (see *Table 8*) has to be active (typically 24V).

5.1.4 Electrical Installation of Controller LPC-200.1 for Extended Operation

If the *LPC-200.1* shall to be controlled with external signals the "USER INTERFACE" can be used with the PIN designations described in *Table 8*.

Pin Name	Connector Pin Number	Designation	Levels	Note
Analog In, (Signal)	5	*Reference Speed*	4..20 mA = 0..10000 rpm -> Speed Limit = 6000 rpm ≅ 13.6 mA -> Cut-off (min.) speed = 300 rpm	Direct connection, no protection. Galvanic isolation on the user side is required.
Ground Analog In	6			
Digital In, (Signal)	3	*Enable*	24 *V* ⇒ active 0 *V* ⇒ not active	Is needed to enable the system with an external signal.
Ground Digital In	4			
Digital Out	1	*Status*	Relay closed ⇒ active, system on Relay open ⇒ not active, system off	This signal indicates if the system is active.
Ground Digital Out	2			

Table 8: Description of „USER INTERFACE" connector
(Description is for standard firmware C2.25, for other configurations refer to alternate firmware documentation)

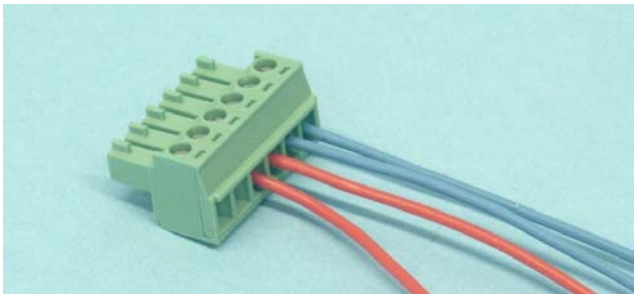


Figure 18: „ENABLE" connector
- Delivered with controllers
- Supplier: PTR Messtechnik GmbH, Germany
- Connector Type: AK1550/06-3.5

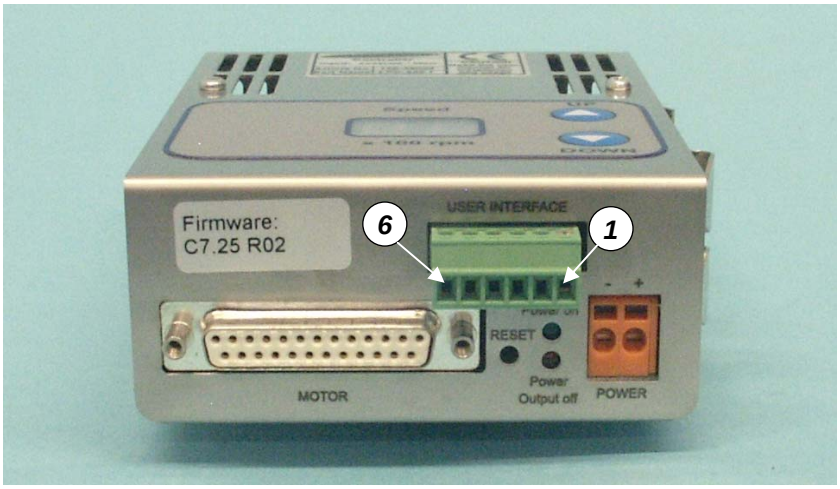


Figure 19: Mounted "USER INTERFACE" connector and Pin numbering

5.1.5 Installation of PLC Interface for Extended Controller LPC-200.2

To operate the pump system with a PLC, a minimum set of two digital inputs and one analog input is needed. The digital and analog outputs can be used to monitor the pump status and operating parameters.

CAUTION

The analog inputs and outputs are not galvanic isolated from the controller electronics. To avoid ground loops and malfunctions, use floating analog signals.

1. Detach the PLC connector from the controller
2. Connect the designated wires of a cable the pins of the detached connector according to *Table 9.* Assignment and functions of the I/Os can be changed with the controller firmware version (refer to according firmware documentation).
3. Connect the PLC connector (*Figure 20*) to the controller.

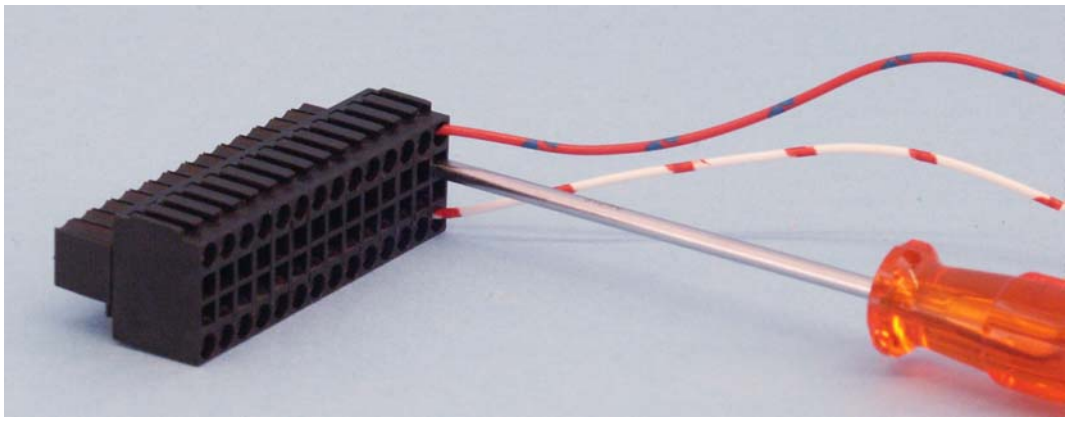


Figure 20: PLC connector
- Delivered with controller LPC-600.2
- Supplier: Weidmüller
- Connector Type: B2L 3.5/28 SN SW

Figure 21: Mounted PLC connector and Pin numbering

Pin Name	Connector Pin Number	Designation	Levels	Note
Analog In1, (Signal)	18	*Ref Value*	4..20 mA = 0..10000 rpm *(speed mode)* -> Speed Limit = 9000 rpm ≙ 18.4mA -> Cut-off (min.) speed = 300 rpm	- Grounds are internally connected - Direct connection, no protection. Galvanic isolation on the user side is required. - Default input settings: Current inputs selected. Voltage input can be selected with EEPROM–editor in Service Software (consult detailed firmware specification *D6.48* and Service Software Manual with Doc.# *PL-2034-00*)
Ground Analog In1	17	*(Current Input)*	4..20 mA = 0..100% *(process mode)*	
Analog In2, (Signal)	20	*Actual Process Control Value*	4..20 mA = 0..100%	
Ground Analog In2	19	*(Current Input)*		
Analog In3, (Signal)	22	*Ref Value*	0..10 V = 0..10000 rpm -> Speed Limit = 9000 rpm ≙ 9 V -> Cut-off (min.) speed = 300 rpm	
Ground Analog In3	21	*(Voltage Input)*	0..10 V mA = 0..100% *(process mode)*	
Analog In4, (Signal)	24	*Actual Process Control Value*	0..10 V = 0..100 %	
Ground Analog In4	23	*(Voltage Input)*		
Analog Out1, (Signal)	26	*Actual Speed*	0..5 V = 0..10000 rpm	Direct connection, no protection. Galvanic isolation on the user side is required.
Analog Out2, (Signal)	28	*Actual Process Control Value*	0..5 V = 0..100%	
Com. Ground Analog Out	25, 27	--	--	
Digital In1, (Signal)	2	*Reset*	24 *V* ⇒ active 0 *V* ⇒ not active	Resets error state
Ground Digital In1	1			
Digital In2, (Signal)	4	*Process mode*	24 *V* ⇒ active 0 *V* ⇒ not active	Switches between process mode and speed mode
Ground Digital In2	3			
Digital In3, (Signal)	6	*Enable*	24 *V* ⇒ active, system on 0 *V* ⇒ not active, system off	The Enable signal switches the pump system on and off.
Ground Digital In3	5			
Digital In4, (Signal)	8	*Not used*	--	--
Ground Digital In4	7			
Digital Out1	10	*Status*	Relay closed ⇒ active, system on Relay open ⇒ not active, system off	This signal indicates the state of the pump system.
Ground Digital Out1	9			
Digital Out2	12	*Error*	Relay closed ⇒ not active, system on Relay open ⇒ active, system off	When active, the system drives the impeller to zero rpm and shuts down. With a reset pulse the system can be re-initialized.
Ground Digital Out2	11			
Digital Out3	14	*Warning*	Relay closed ⇒ not active, system o.k. Relay open ⇒ active, system not o.k.	The warning signal indicates if a system fault has been detected. The warning signal indicates a system fault but the system does not shut down
Ground Digital Out3	13			
Digital Out4	16	*Trend Warning*	Relay closed ⇒ warning active Relay open ⇒ warning not active	Default setting: Relay closed if trend warning is active. Can be changed in EEPROM with Service Software
Ground Digital Out4	15			

Table 9: Signals of the PLC connector for standard firmware C2.48
(For other configurations of PLC Inputs and Outputs refer to alternate firmware documentation.)

5.2 Mechanical Installation of the Pump/Motor

- The motor can be fixed with four screws on the motor bottom (see *Figure 5*)
- As an alternative a the *Mounting Base Plate MBP-1.1* (see *Table 3* and *Table 2*) can be used to mount and fix the motor.
- The motor can either be mounted in horizontal or vertical position

5.3 Mechanical Installation of the Controller

WARNING

Hazardous voltage may be present.

In order to avoiding fluid spills shorting mains or other voltages within the controller, place the controller in a spill protected environment (for example protected electronic cabinets).

If explosive flammable gases are present, place the controller in an explosion-proof cabinet.

CAUTION

Make sure the controller is mounted in a position that allows free air circulation around the controller. A minimum distance of 10cm (4") to other objects above or below the controller casing is recommended.

- Use the Din-Rail bracket to mount the controller.
- If no forced air-cooling is used, mount the controller in upright position.
- The Din-Rail brackets can also be mounted on the controller back side according to *Figure 6*

CAUTION

Use only 3,5 x 6,5mm self-tapping screw for the fixation of the Din-Rail brackets. The controller may be damaged if other type or too long screws types are used!

6 Operation

6.1 System Operation with LPC-200.1 (Stand-Alone Controller)

6.1.1 State Diagram of LPC-200.1

The controller *LPC-200.1* allows stand-alone operation with manual speed setting ("Button Control Mode") as well as extended operation with analoge speed setting (Analoge Control Mode). *Figure 22* shows the state diagram which can be controlled with the manual buttons and the signals on the "USER INTERFACE" connector. The operation mode can be choosen by pressing the "UP" and "DOWN" buttons simultaneously during 5 seconds. For the standard firmware C2.25 default setting ex factory is "Button Control Mode".

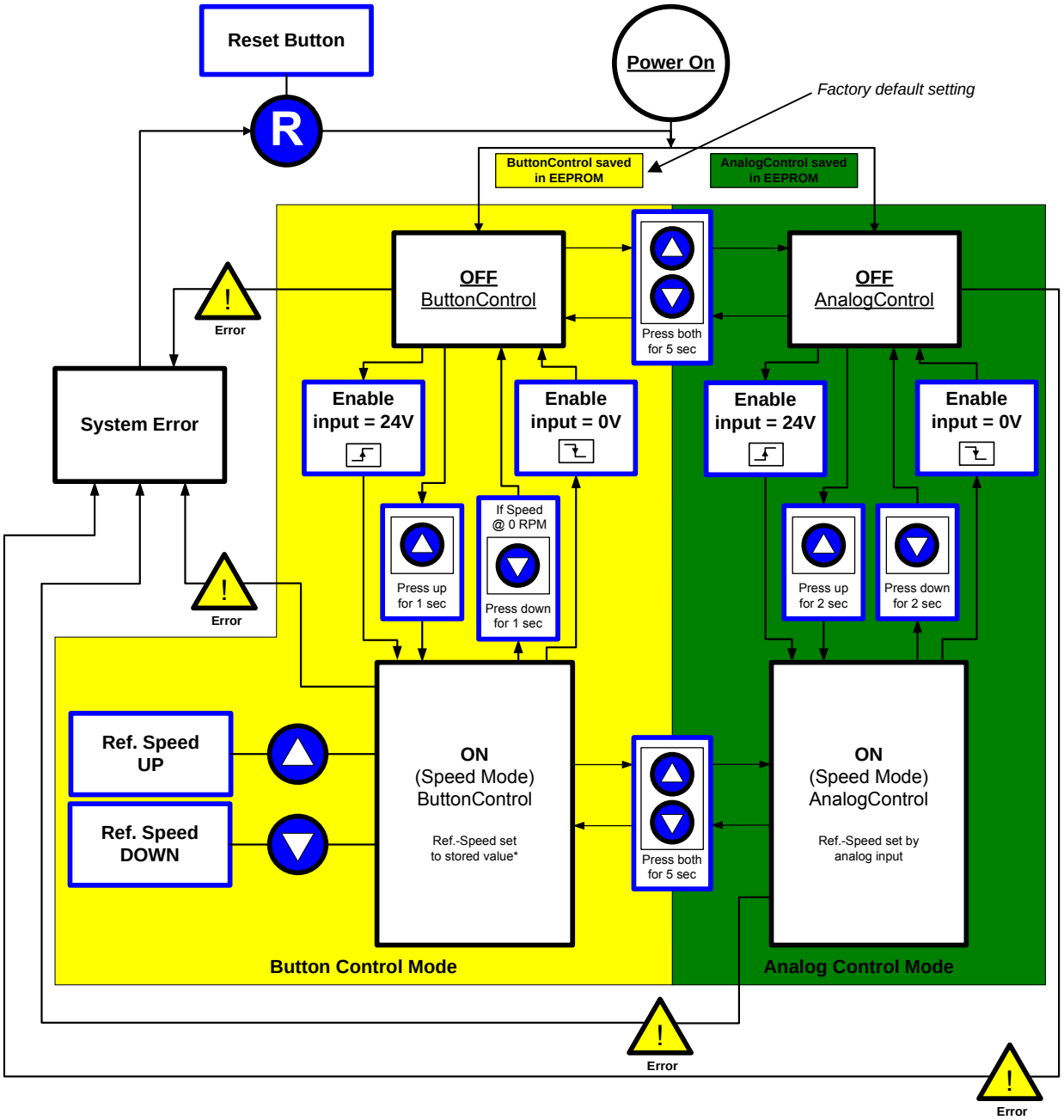


Figure 22: State diagram for operation with LPC-200.1 controller

(Description is for firmware C2.25 with revision > 00, for other configurations refer to alternate firmware documentation)

6.1.2 Standalone Operation (Button Control Mode)

- When applying power the system defaults into the “Button Control Mode” and goes into the status “OFF ButtonControl” according to *Figure 22*. Levitation is disabled and the display indicates “OF”.
- Levitation can be enable by pressing the “UP” button during 1 second (display shortly indicates “ON”) or by activating (typically 24V) the “ENABLE” pin on the “USER INTERFACE” connector (see *Table 8*). The system goes then into the status “ON Button Control” and is running at the speed which is stored in the EEPROM.
- The speed can be changed by pressing accordingly the “UP” and “DOWN” buttons.
  As long as the digits on the display are blinking the set speed is shown. As soon as blinking stops the actual speed is shown and the set-speed is stored in the EEPROM of the controller after about 2 seconds.
- The system can be disabled by pressing the “DOWN” button until 0 rpm is achieved. Pressing further 1 second the “DOWN” button the system disables levitation and shows “OF” on the display. The system can also be disabled by deactivating (0 V) the “ENABLE” pin on the “USER INTERFACE” connector (see *Table 8*). Before disabling the system the speed is automatically reduced to 0 rpm and the impeller is properly touched down without grinding the wall.
- In case of an error the “RESET” button (see *Table 6*) can be used to restart the system or the power can be switch off and on.
- In case of an error the codes described in *Table 10* are displayed (blinking between “Er” and the according code number).

6.1.3 Extended Operation (“Analog Control Mode”)

- In order to be able to control the pump with external signals (PLC) the mode “Analoge Control Mode” has to be set with the display buttons. The “UP” and “Down” buttons have to be pressed simultaneously during 5 seconds. The display should feedback the change by blinking between the stored speed value and “An”. The choosen mode is then stored in the EEPROM of the controller.
- The system and levitation can be enabled/disabled with the digital input on the “USER INTERFACE” connector (see *Table 8*). When disabling the running system the speed is automatically reduced to 0 rpm and the impeller is properly touched down without grinding the wall.
- The speed can be set with an analoge signal on the “USER INTERFACE” connector according to *Table 8.* It is strongly recommended to use galvanic separated signal values
- For monitoring purposes a digital output on the “USER INTERFACE” connector (see *Table 8*) indicates an error. In case of an error the codes described in *Table 10* are displayed (blinking between “An” and the according code number)

6.1.4 Errors Display on the Integrated Panel

Error Source	Errors	Error Code on Display
Motor	No Motor	*Er 01*
Motor	Motor cable (power wires) not connected to controller	*Er 02*
Motor	Motor cable (sensor wires) not connected to controller	*Er 03*
Motor	No Rotor	*Er 04*
Controller	Short circuit	*Er 05*
Controller	Over current in the bearing coils	*Er 06*
Controller	Over current in the drive coils	*Er 07*
Controller	DC-Link voltage out of range - Voltage range for monitoring: 18 – 54 VDC - If the voltage is out of range the system starts to reduce the speed. When reaching 0 rpm and the voltage is still out of range an Error is generated.	*Er 08*
Controller	Communication problems EEPROM Controller	*Er 09*
Motor	Communication problems EEPROM Motor	*Er 10*
Controller	Controller temp. over 80 ^{0}C or more than 10 minutes above 70 ^{0}C	*Er 11*
Motor	Motor temp. over 100 ^{0}C or more than 10 minutes above 90 ^{0}C	*Er 12*
Pump	Dry running of pump circuit: -> Pump keeps running on reduced speed (5000 rpm) -> The system accelerates to the original speed value when the pump is refilled with liquid. -> Note that the speed is only reduced during dry running if the pump speed was ≥ 6000 rpm.	*Blinking dots on display*

Table 10: Errors and warnings with indication on display of LPC-200.1
- In case of an error the system can only be restarted with a reset or a power supply restart
- Standard firmware is C2.25
- For other configurations of error codes refer to alternate controller or firmware documentation

6.2 System Operation with Controller LPC-200.2 (PLC version)

6.2.1 State Diagram of the PLC Interface

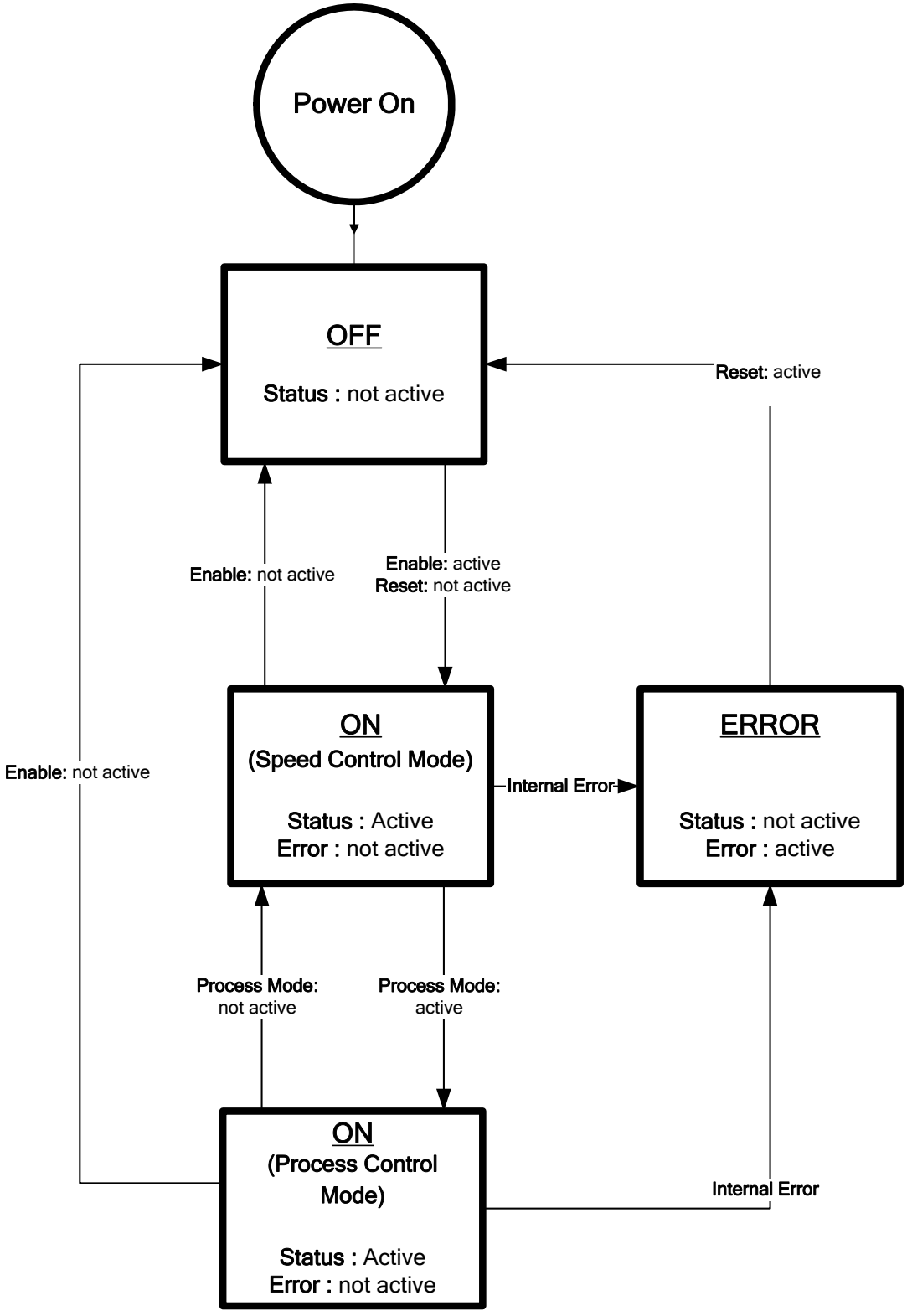


Figure 23: PLC interface state diagram for standard firmware C2.48
(For other configurations refer to alternate firmware documentation)

State "Off":

The pump system is switched off and the motor has no power. In this state, Levitronix Service Software has full control.

State "ON" (speed control mode):

The pump system is switched ON and the impeller is rotating with the referenced speed. The motor has electrical power when in this state.

State "ON" (process control mode):

The pump system is switched ON and the impeller speed is controlled in order to get the referenced flow/pressure. The motor has electrical power when in this state.

State "Error":

If an error according to *Table 11*. occurs in the pump system, the system defaults to the *Error* state. The designated digital output on the PLC Interface is activated. The pump system is switched OFF. By activating the "*Reset*" input the system gets back to the "*Off*" state.

Error Source	Errors	Effect on Designated Digital Output of the PLC
Motor	No rotor	*Error = relay open*
Motor	Temperature over 100°C	*Error = relay open*
Motor	Temp. was higher than 90°C for more than 10 minutes.	*Error = relay open*
Motor	Temperature more than 90°C	*Warning = relay open*
Motor	No motor temperature signal	*Warning = relay open*
Motor	Motor power cable not connected with controller	*Error = relay open*
Motor	Motor sensor cable not connected with controller	*Error = relay open*
Controller	Over-current	*Error = relay open*
Controller	Power channel interrupted	*Error = relay open*
Controller	Temperature over 80°C	*Error = relay open*
Controller	Temp. was higher than 70°C for more than 10 minutes.	*Error = relay open*
Controller	DC link (supply voltage) out of range (< 18 or > 54 V DC) If the voltage is out of range the system starts to reduce the speed and a warning is generated. When reaching 0 rpm and the voltage is still out of range the system is disabled and an error is generated. In case the voltage is again within the range during speed reduction the system switches to normal operation and no Error is generated.	*Error = relay open*
Controller	Temperature over 70°C	*Warning = relay open*
Controller	Dry Running Detection -> Pump keeps running on reduced speed (5000 rpm) -> The system accelerates to the set speed value when the pump is refilled with liquid -> Note that the speed is only reduced during dry running if the pump speed was ≥ 6000 rpm	*Warning = relay open*

Table 11: Errors and warnings with indication on PLC interface for standard firmware C2.48
(For other configurations refer to alternate firmware documentation)

7 Inspection and Maintenance

7.1 Replacement Interval of the Impeller

The impeller has a limited lifetime depending on the chemical type, concentration and temperature of the fluid which is pumped. Therefore a preventive periodical exchange of the impeller is recommended. Contact the *Levitronix Technical Service Department* (see *Section 7.2*) for further information on replacement times.

7.2 Impeller Replacement Procedure

7.2.1 Preparation

Before starting the impeller replacement procedure the parts and tools illustrated in *Figure 24* and *Figure 25* should be prepared. Impeller exchange kits, which contain this parts and tools are available at Levitronix (see *Table 2*). Please verify that you have the right types of impellers, O-rings and screws.

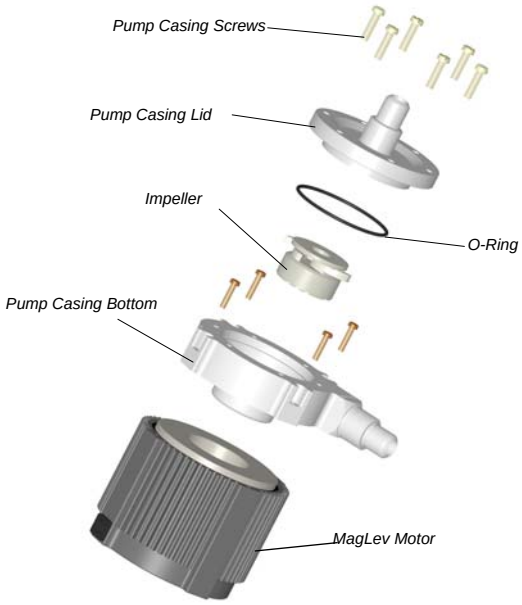


Figure 24: Explosion view of pumphead with motor

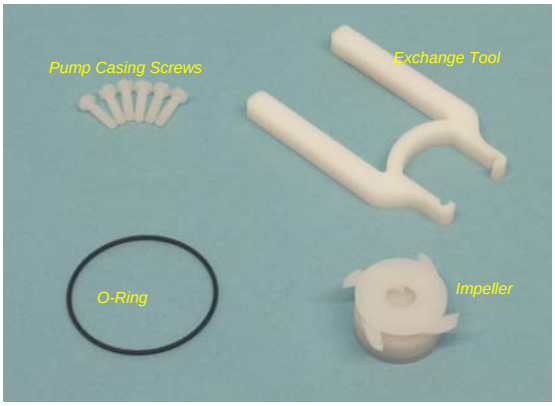


Figure 25: Components for impeller replacement

The following warnings and cautions should be read carefully before starting the replacement of the impeller.

⚠ WARNING

The impeller could splash TOXIC or CORROSIVE CHEMICALS because of the strong magnetic forces. Flush the pump housing before opening it.

⚠ WARNING

HARMFULL CHEMICALS may be present.

Skin contact and toxic gases may be hazardous to your health. Wear safety gloves and other appropriate safety equipment.

⚠ CAUTION

The rotating impeller could cause injury. Do not run the pump system when opening the pump head.

CAUTION

Pay attention to the magnetic forces when handling the impeller. The attraction of magnetic parts and particles should be avoided in order to keep the impeller and the pump head clean and free of contamination.

7.2.2 Instructions for Replacement

1. Power down the pump system and remove the AC power. If necessary, allow the housing to cool down to a workable.

2. Unscrew the top of the pump head and remove it along with the sealing ring.

3. Remove the impeller with the *Impeller Exchange Tool*. Hook the claws of the *Impeller Exchange Too*l into two opposing orifices of the impeller.

4. Inspect the wet area of the pump head carefully. In case of material damage, also replace the pump casing.

5. Place the new impeller into the pump casing using the *Impeller Exchange Tool*.

6. If necessary, remove the existing *O-Ring* and gently press the new *O-Ring* into the lid of the pump casing.

CAUTION

Use the correct O-Ring type for your process. If necessary, consult the Levitronix Technical Service Department.

Do NOT twist or roll the O-Ring as this may cause leaking to occur.

7. Press the lid with the O-ring flush into the bottom of the pump casing.

8. Carefully tighten the *6 PVDF* screws. The screws should not be used to press the lid with the O-ring into the bottom of the pump casing. Do not apply too much torque. The torque specifications are:

Maximum torque for pump screws
PVDF M4: 12 Ncm

9. Start up the system and check if the impeller is rotating properly and the pump head doesn't leak.

10. If the pump head leaks, check and make sure the lid and the O-Ring are properly pressed into the bottom of the pump casing. It may be necessary to change the O-Ring if it has been damaged.

8 Troubleshooting

8.1 Troubleshooting for Operation with Controller LPC-200.1

For troubleshooting and failure analysis with the stand-alone controller *LPC-200.1* the following procedure is recommended:

- Check the status of the LEDs. The specific LEDs are described in *Table 6*
- Use the ERROR codes on the display. The specific error codes are described in *Table 10*
- A digital output on the "USER INTERFACE" connector ("Status") indicates if the system is active. However, the source of an error cannot be identified by this signal

8.2 Troubleshooting for Operation with Controller LPC-200.2

The integrated *PLC* provides a Warning and an Error signals according to *Table 11*. However, the source of error cannot be identified by these signals.

For more detailed analysis the *Levitronix® Service Software* can be used with a PC and a USB interface to the controller.

8.3 Troubleshooting with Service Software

The *Levitronix® Service Software* allows communication with the pump system in connection with a PC and a USB interface. The software can be used for performing detailed troubleshooting. For usage of the Service Software refer to the *Service Software User Manual* (Document #: *PL-2034-00*), which is available in the download section on the Levitronix Web-page or contact the *Levitronix® Technical Service Department* (see under *Section 9*).

Note: the Service Software can not be used with the standalone controller *LPC-200.1*.

9 Technical Support

For troubleshooting, support and detailed technical information contact *Levitronix® Technical Service Department*:

Levitronix®
Technical Service Department
Technoparkstr. 1
CH-8005 Zurich
Switzerland

Phone for US: 888-569 07 18
Phone for outside US: +1 888-569 07 18
E-Mail: support@levitronix.com

10 Appendix

10.1 Regulatory Status

10.1.1 CE Marking

The Bearingless Pump System BPS-200, in his various configurations, is in conformity with the essential requirements of the *EMC Directive 2004/108/EC* and the *Machinery Directive 2006/42/EC*. The following particular harmonized standards of the *EMC Directive 2004/108/EC* are tested and confirmed at a certified laboratory (Hochschule für Technik, Switzerland, Test Laboratory, CH-8005 Zurich, Switzerland, Swiss Certification No.: STS 404):

EN55011	Limits and methods of measurement of electromagnetic disturbance characteristic of industrial, scientific and medical (ISM) radiofrequency equipment.
EN61000-4-2	ESD
EN61000-4-3	Radiated RF Immunity
EN61000-4-4	Fast transient / Burst
EN61000-4-5	Surge
EN61000-4-6	Immunity to conducted disturbances, induced by RF
ENV 50204	Radiated RF Immunity
EN61000-6-2	Generic standards, Immunity for industrial environments
EN61000-6-4	Generic standards, Emission standard for industrial environments

The following particular standards of the *Machinery Directive* are followed for the design, validation and risk assessment:

EN809	Pumps for Fluids: basic requirements are followed.
EN12162	Procedure for hydrostatic pressure testing in fluid pumps: max. pressure testing.
EN1050	Safety for machinery – principles for risk assessments.

10.2 Symbols and Signal Words

Symbol / Signal Word	Description	Type	Source
DANGER	Indication of an imminently hazardous situation that, if not avoided, will result in death or severe injury. Limited to the most extreme situation	Signal word	SEMI S1-0701
WARNING	Indication of a potentially hazardous situation which, if not avoided, could result in death or severe injury.	Signal word	SEMI S1-0701
CAUTION	Indication of potentially hazardous situations which, if not avoided, could result in moderate or minor injury. Also alert against unsafe practice. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.	Signal word	SEMI S1-0701
	Safety alert for “Warning” and “Caution”	Safety alert	SEMI S1-0701
	Safety alert for “Danger”	Safety alert	SEMI S1-0701
	Caution (refer to accompanying documents) (is used on article labels for reference to manual)	Refer to manual	ISO 3864
	Toxic material, poison	Hazard identification	IEC 61310
	Corrosive material, corrosion	Hazard identification	IEC 61310
	Cut/sever hand, sharp object	Hazard identification	ANSI Z535.3
	Strong magnetic field	Hazard identification	SEMI S1-0701
	Danger: electricity, electrical hazard	Hazard identification	IEC 61310, ISO 3864
	Wear safety gloves	Hazard avoidance Mandatory action	IEC 61310
	Wear face shield	Hazard avoidance Mandatory action	SEMI S1-0701
	Unplug power line	Hazard avoidance Mandatory action	SEMI S1-0701
	No pacemakers	Hazard avoidance Prohipition	SEMI S1-0701

Table 12: Safety symbols and signal words

Appendix C: Viking Acculobe Manual

INSTALLATION, OPERATION
AND
MAINTENANCE MANUAL
FOR THE

IDEX CORPORATION

JOHNSON PUMP (UK)

Johnson Pump (UK) Ltd. † A unit of IDEX Corporation
Highfield Industrial Estate, Edison Road
Eastbourne, East Sussex, BN23 6PT, England
Phone: Natl (01323) 509211 – Intl +44 1323 509211
Fax: Natl (01323) 507306 – Intl +44 1323 507306
E-Mail: Jinfo@Idexcorp.com

Issue B – Draft 05/09/02

INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR THE ACCULOBE PUMP

1.0 Safety Information

INCORRECT INSTALLATION, OPERATION OR MAINTENANCE OF EQUIPMENT MAY CAUSE SEVERE PERSONAL INJURY AND/OR EQUIPMENT DAMAGE AND MAY INVALIDATE THE WARRANTY.

THIS INFORMATION MUST BE READ FULLY BEFORE COMMENCING INSTALLATION, OPERATION OR MAINTENANCE AND MUST BE KEPT WITH THE PUMP. SUITABLY TRAINED OR QUALIFIED PERSONS MUST UNDERTAKE ALL INSTALLATION AND MAINTENANCE ONLY.

Safety instructions given in this manual non-compliance with which would affect safety are identified by the symbol

Safety instructions, which shall be considered for reasons of safe operation of the pump or pump unit and/or protection of the pump or pump unit itself, are marked:

WARNING

DANGER

DO NOT OPERATE PUMP IF:

- THE FRONT COVER IS NOT INSTALLED CORRECTLY.
- ANY GUARDS ARE MISSING OR INCORRECTLY INSTALLED.
- THE SUCTION OR DISCHARGE PIPEWORK IS NOT CONNECTED.

DO NOT PLACE FINGERS ETC INTO THE PUMPING CHAMBER OR ITS CONNECTION PORTS OR INTO ANY PART OF THE GEARBOX IF THERE IS ANY POSSIBILITY OF THE PUMP SHAFTS BEING ROTATED. SEVERE INJURY WILL OCCUR.

DO NOT exceed the rated pressure, speed, and temperature, or change the system/duty parameters from those for which the pump was originally supplied, without confirming its suitability for the new duty.

Installation and operation of the pump must always comply with health and safety regulations.

WARNING

A device must be incorporated into the system or drive to prevent the pump exceeding its stated duty pressure. It must be suitable for both directions of pump rotation where applicable. Do not allow pump to operate with a closed/blocked discharge unless a pressure relief device is incorporated.

The mounting of the pump or pump unit should be solid and stable. Pump orientation must be considered in relation to drainage requirements. Once mounted, shaft drive elements must be checked for correct alignment. Rotate pump shaft by at least one full revolution to ensure smoothness of operation. Incorrect alignment will produce excessive loading and will create high temperatures and increased noise emissions.

The installation must allow safe routine maintenance and inspection (check for leakage, monitor pressures, etc) and provide adequate ventilation necessary to prevent overheating.

WARNING

Before operating the pump, ensure that it and all parts of the system to which it is connected are clean and free from debris and that all valves in the suction and discharge pipelines are fully opened. Ensure that all pipework connecting to the pump is fully supported and aligned with its relevant connections. Misalignment and/or excess loads will cause severe pump damage.

WARNING

Ensure that pump rotation is correct for the desired direction of flow.

WARNING

Do not install the pump into a system where it will run dry (i.e. without a supply of pumped media) unless it is equipped with a flushed shaft seal arrangement complete with a fully operational flushing system.

WARNING

Install pressure gauges/sensors next to the pump suction and discharge connections to monitor pressures.

Caution must be taken when lifting the pump. Suitable lifting devices should be used as appropriate. If pump is baseplate mounted, the base plate must be used for all lifting purposes, not any part of the pump. If slings are used for lifting, they must be safely and securely attached. For weights of bare shaft pumps refer to pump installation dimensions section.

DO NOT attempt any maintenance or disassembly of the pump or pump unit without first ensuring that:

- The pump is fully isolated from the power source (electric, hydraulic, pneumatic).
- The pumping chamber and any shaft seal support system, front cover barrier support system, and rotorcase port barrier support system are de-pressurised and purged.
- Any temperature control devices (jackets, heat-tracing, etc) are fully isolated, that they are de-pressurised and purged, and components allowed to reach a safe handling temperature.

DO NOT loosen or undo the front cover, any connections to the pump, shaft seal housings, barrier support systems, temperature control devices, or other components, until sure that such action will not allow the unsafe escape of any pressurised media.

Avoid any contact with hot parts of pumps and/or drives, which may cause injury. Certain operating conditions, temperature control devices (jackets, heat-tracing, etc), bad installation, or poor maintenance can all promote high temperatures on pumps and/or drives.

WARNING

When cleaning, either manually or by CIP method, the operator must ensure that a suitable procedure is used in accordance with the system requirements. For CIP cleaning requirements, refer to section 3.3.2. The exterior of the pump should be cleaned periodically.

2.0 Introduction

2.1 General

Acculobe rotary lobe pump is manufactured by Johnson Pump (UK) Ltd. a subsidiary of Viking Pump Inc., Cedar Falls, USA, (a unit of the IDEX Corporation) herein after referred to as 'JPUK'.

This manual includes all the necessary information for the Acculobe pump and should be read prior to commencing installation, operation or maintenance.

When asking for assistance please quote the pump model and serial number. This information can be obtained from the pump nameplate, which is located on the top of the pump gearbox body.

If it is proposed to modify the system or change the characteristics of the product to be pumped from that for which the pump was originally selected, Johnson Pump (UK) or their authorised distributor should be consulted.

2.2 Johnson Pump (UK) Ltd Distributors

Johnson Pump (UK) distributes their products internationally via a network of authorised distributors. Throughout this manual where reference is made to Johnson Pump (UK), any authorised distributor will also provide service and assistance. Should you require any additional information regarding the Acculobe pump contact Johnson Pump (UK) or their local authorised distributor.

2.3 Receipt and Storage

On receipt of the pump, immediately examine for any signs of visible damage. If any damage is noted, contact Johnson Pump (UK) and clearly mark upon the carriers' paperwork that the goods have been received in a damaged condition, with brief description of damage.

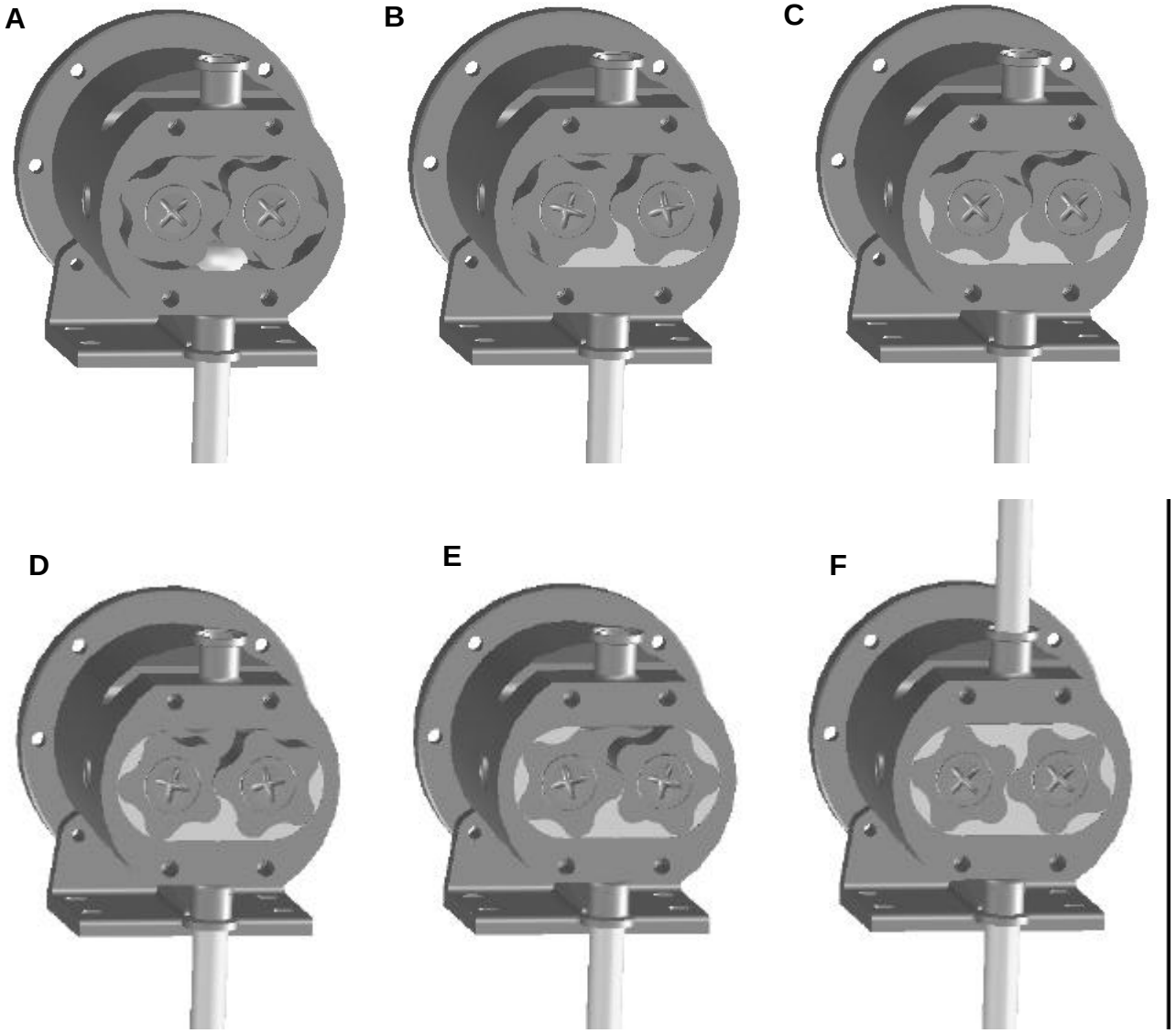
If the pump is not required for immediate installation then it should be stored within a suitable environment.

2.4 Cleaning.

The product seals are mounted directly behind the rotors and are designed and positioned to minimize product entrapment and maximize the effects of cleaning.

It is recommended that the exterior of the pump is cleaned periodically.

3.0 General



The pumping action of the rotary lobe pump principle is generated by the contra-rotation of two pumping elements (rotors) within a chamber (rotorcase). The rotors are located on shafts, which in turn are held within the pump body. The shaft assemblies comprise of the support bearings and the timing gears. The timing gears transfer the drive from the driven shaft to the lay shaft, synchronising the rotors such that they rotate without contact with each other.

As the rotors pass the suction port, (see 'A'), the cavity generated increases creating a pressure decrease, which induces the media to be pumped to flow into the rotorcase ('B').

The pumped media is carried around the rotorcase by the rotors; ('C' and 'D') to the discharge side of the pump ('E'). Here the cavity decreases and the pumped medium is discharged from the rotorcase ('F').
The maximum pressure and speed operating parameters are shown below. In practice these may be limited due to the nature of the product to be pumped and/or

design of the system in which the pump is to be installed. Consult Johnson Pump (UK) Ltd or your local distributor for assistance.

Pressure Rating		Displacement		Maximum Speed	Port Size		Maximum Temperature		Maximum Viscosity	
bar	psi	L/rev	US gal / rev	Rotor rpm	mm	inches	?C	?F	cPs	ssu
12	174	0.02	0.00528	1750	12 & 19	½" & ¾"	150	300	150,000	682,500

WARNING

If the system or product characteristics are to be changed from the original application for which the pump was selected, the factory or their authorized distributor should be consulted to ensure the pump is suitable for the new application.

The pump should not be subjected to sudden temperature changes to avoid the risk of damage from sudden expansion/contraction of components. Care should be taken when selecting pumps for handling liquids containing abrasive particles as these may cause wear of pump head components. Contact the factory or their authorized distributor for advice or assistance.

Model Designation: AL05

Standard Construction:

- 316L St. Steel Wetted Parts (0.6 ?M Surface Finish).
- Multi-Lobe (5 Lobe) Rotors
- 1/8" Male BSP Flush Connections
- ¾" Tri-Clamp Connections
- Foot Mounted
- FDA EPDM Elastomers
- Silicon Carbide Seal Faces
- Sealed For Life Grease Lubrication

Should any additional information be required, contact the factory or their authorized distributor quoting the pump model and serial number as stated on the nameplate fastened to the exterior of the pump.

Should this be damaged or missing, the serial number is also stamped on the gearbox endplate.

3.1 System Design and Installation.

When incorporating any pump into a system it is considered good practice to minimize piping runs and the number of pipe fittings (tees, unions, bends etc.) and restrictions. Particular care should be taken in designing the suction line, which should be as short and straight as possible with a minimum of pipe fittings to minimize restricting product flow to the pump. The following should be considered at the design stage of any system:

?? Be sure ample room is provided around the pump to allow for:

  ?? Access to the pump and drive for routine inspection and maintenance, i.e. to remove pump front cover and rotors.

  ?? Ventilation of the drive to prevent over heating.

?? The exterior of the pump unit may exceed 68?C (154?F), appropriate measures must be taken to warn or protect operators.

?? The pump must not be used to support piping. All piping to and from the pump unit must be independently supported. Failure to observe this may distort the pump head components or assembly and cause serious consequential damage to the pump.

WARNING

?? Valves should be provided adjacent to the pump suction and discharge connections to allow the pump to be isolated from the system for routine inspection and maintenance.

Rotary lobe pumps are of the positive displacement type and therefore an overload protection device must be provided. This can take the form of:

?? An in-line pressure relief system, i.e. external to the pump.

?? Incorporation of a torque-limiting device in the drive system.

WARNING

It is recommended that all piping and associated equipment from the tank to the discharge point is thoroughly cleaned before installation of the pump to avoid the possibility of debris entering the pump and causing damage.

WARNING

Pressure gauges should be installed adjacent to the pump suction and discharge connections such that system pressures can be monitored. These gauges will provide a clear indication of changes in operating conditions and where a relief valve is incorporated in the system, will be necessary for setting and checking the functioning of the valve.

WARNING

It is imperative that the suction condition at the pump inlet meets the Net Positive Suction Head Required (NPSHr) by the pump. Failure to observe this could cause cavitation, resulting in noisy operation, reduction in flow rate and mechanical damage to the pump and associated equipment.

WARNING

The Net Positive Suction Head Available (NPSHa) from the system must always exceed the Net Positive Suction Head Required (NPSHr) by the pump. Observing the following general guidelines should ensure the best possible suction condition is created.

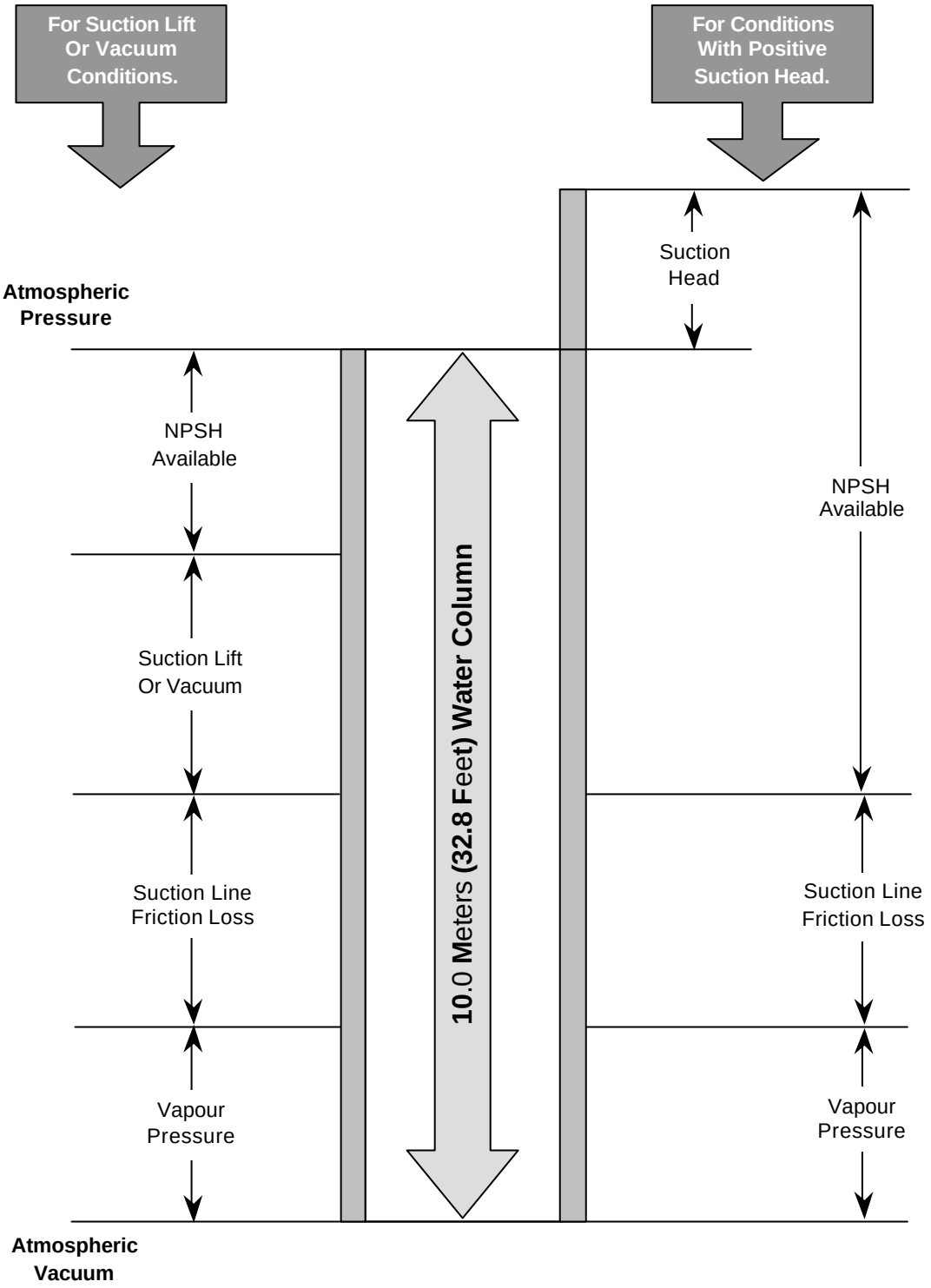
?? Suction piping is at least the same diameter as the pump connections.

?? The length of suction piping is kept to the absolute minimum.

?? The minimum number of bends, tees and pipework restrictions are used.

?? Calculations to determine system NPSHa are carried out for the worst condition see below.

Should advice on pump or system NPSH characteristics be required contact the factory or their authorized distributor.



Where motor mounted options are to be installed follow manufactures recommended guidelines. However, when installing a pump complete with base and drive the following guidelines must be observed:

- The preferred drive arrangement for any rotary lobe pump is in-line direct coupled.

- Flexible couplings must always be incorporated and correctly aligned within the limits recommended by the coupling manufacturer. To check coupling alignment rotate the shaft by at least one full revolution and ensure that the shaft rotates smoothly.

Couplings of a non-flexible design must never be used.

- Couplings must always be enclosed in a suitable guard to prevent contact with rotating parts that could result in personal injury. Guards should be of suitable material, and of sufficiently rigid design to prevent contact with rotating parts under normal operating conditions.

- When installing pump sets in flammable or explosive environments, or for handling flammable or explosive materials, special consideration must be given not only to the safety aspects of the drive unit enclosure but also to the materials used for both the coupling and the guard to eliminate the risk of explosion.

- Baseplates must be secured to a flat level surface such that distortion and misalignment are avoided. **Once baseplates are fastened in position the drive alignment must be re-checked.**

- When using electric motor drives, ensure that the electrical supply is compatible with the drive and controls and that the method of wiring is correct for the type of starting required by the motor i.e. Direct On Line, or other similar method. Ensure all components are correctly grounded.

3.2 Installations with CIP Systems

The Acculobe is has been designed to be cleaned effectively by the CIP procedures recommended for in place cleaning of process equipment. It is recommended that a differential pressure of 2 to 3 bar (30 to 45 psi) be developed across the pump head during cleaning in order to develop the necessary fluid velocities required for thorough cleaning.

3.3 Start Up Procedure.

WARNING

Check that all piping and associated equipment are clean and free from debris and that all pipe connections are secure and leak free.

WARNING

For pumps installed with flushed product seals check that all auxiliary services are in place and connected and provide sufficient flow and pressure for flushing purposes.

WARNING

If an external relief valve is incorporated in the system check that it is set correctly. For start up purposes it is considered good practice to set the relief valve lower than the system design pressure. On completion of start up the relief valve should be reset to the required setting for the application. The required setting should never exceed the lower of either the pumps maximum pressure rating or the system design pressure.

WARNING

Ensure both suction and discharge valves are fully open, and pipework is free from all obstructions. Acculobe pumps are of the positive displacement type and should therefore never be operated against a closed valve as this would result in pressure overload, resulting in damage to the pump and possibly the system.

WARNING

Ensure product is available in the tank before starting pump. This is very important for pumps installed with unflushed product seals, as these sealing arrangements must never be allowed to run dry.

Before beginning operation it is considered good practice to momentarily start/stop the pump to check the direction of rotation and ensure that the pump is free of obstructions. Once this has been carried out, begin operation keeping a visual check on suction and discharge pressure gauges and monitor pump temperature and power absorbed where possible.

3.4 Shutdown Procedure.

When shutting the pump down close both the suction and discharge valves and ensure that the necessary safety precautions are taken:

The prime mover power source has been isolated.

If Installed, flushed product seal auxiliary services have been isolated and depressurized.

Pump head and piping have been drained and purged.

4.0 Product Seal Fitting and Removal

General Procedures for Installing Seals.

Mechanical seals are precision-engineered assemblies incorporating finely lapped seal faces and seats. They must therefore be handled with care and will not give optimum performance unless installed carefully and according to instructions

Where mechanical seals are to be reused ensure that seal components are kept in their appropriate sets. **Do not mix old and new seal faces on the same seal**.

Remove any sharp corners and burs that may damage and elastomers such as o-rings or lip seals.

Ensure that all seal component fitting bores and housings are toughly cleaned before instillation.

The seal faces are undamaged and the o-rings are not cut, swollen, or cracked.

Lip seals and o-rings within the seal assemblies should be lightly lubricated with an elastomers compatible, food grade lubricant. Ensure there is not an excessive amount of lubricant especially around the seal face area.

Ensure seals seats are mounted squarely.

Ensure when installing seals with brittle faces such as silicon carbide that extra care is taken.

Do not use any excessive force to install a mechanical seal. If it is difficult to position and assemble the seal then something is wrong.

If you drop or damage a seal, Do not install it before an inspection has been carried out.

WARNING Do not run any seal options dry.

Terminology

a) "Quench"
- To provide a liquid barrier, which is not, induced to flow through the seal area by any external means.

b) "Flush"
- To provide a liquid barrier that is induced to flow through the seal area by an external means.

'Quench' or 'Flush' Media

WARNING

The media used for quenching or flushing a seal area must be fully compatible with the pumped media, and the relevant materials of construction of the pump.

Special consideration must be given to the temperature limitations of the media to ensure that no hazards are created, e.g. risk of fire or explosion.

This seal arrangement requires a supply of media to the outboard side of the mechanical seal to quench or flush the seal area. The nature of the pumped media and the specific duty conditions will determine whether a 'quench' or 'flush' is required.

A quench provides a static head. The media vessel should be mounted a minimum of 1.5 feet above the pump, preferably directly above the seal area. The interconnecting pipework should be as straight as possible, avoiding horizontal runs, and with the minimum number of bends and restrictions.

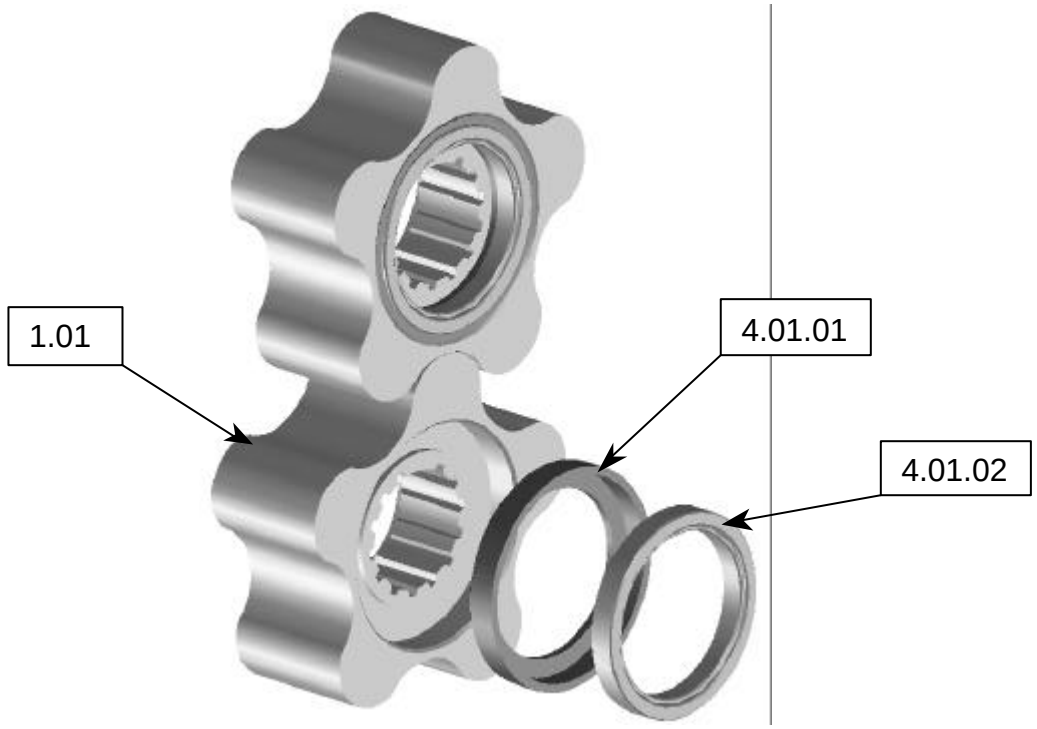
For a suitable flush, the media must be supplied at a flow rate of three liters per minute per shaft seal (0.8 US Gal per min).

WARNING

Note: The limiting 'flush' or 'quench' pressure in any application is 0.5 bar (7 psi).

5.0 Seal Assembly.

5.1 Rotary Faces

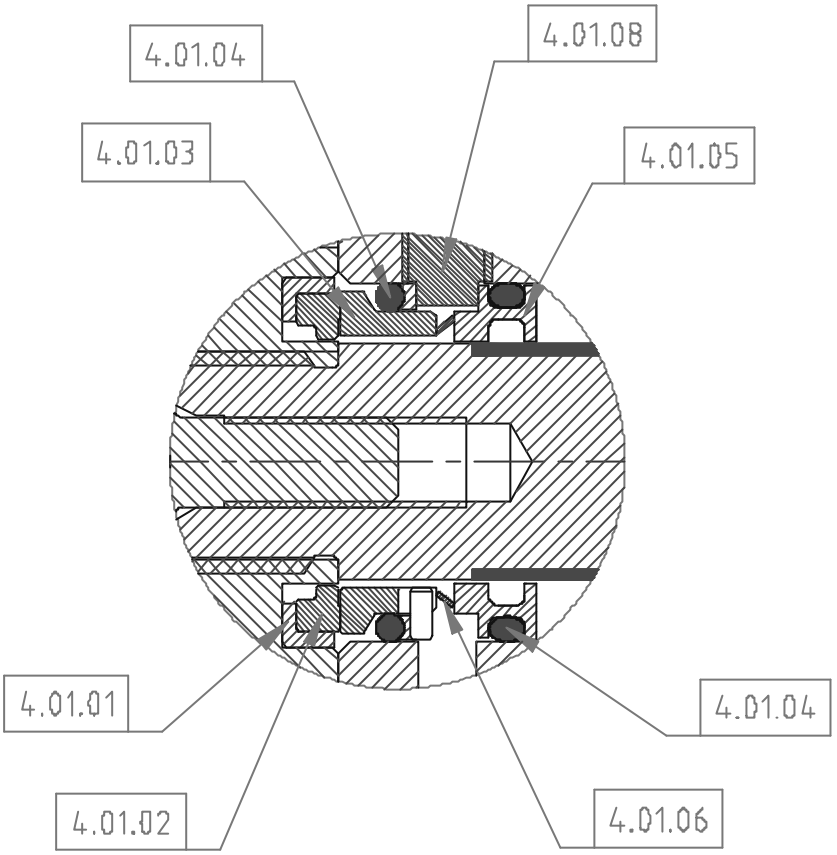


Item No	Description	Material	Quantity
4.01.01	Rotary Seal Face L-Cup	EPDM / VITON	2
4.01.02	Rotary Seal Face	SILICON CARBIDE	2
1.01	Multilobe Rotor	316S11 St Steel	2

?? Lubricate with Water and install the rotary seal face (4.01.02) into the L-Cup (4.01.01).

?? Install the L-Cup (4.01.01) and seal face (4.01.02) into the Rotor (1.01). Pressing both, the L-cup (4.01.01) and the Rotary face (4.01.02) firmly into the rotor bore, Making sure not to damage the seal face in any way.

5.2 Single Mechanical Seal.



Item Number	Description	Material	Quantity
4.01.03	Static Face	Silicon Carbide	2
4.01.04	O-ring (BS121)	EPDM / VITON	4
4.01.05	Housing	316 S11 St. Steel	2
4.01.06	Wave Spring	St. Steel	2
4.01.07 *	Slinger O-ring (BS221)	EPDM / VITON	2
4.01.08	M8 Dog Point Grub Screw	316 St. Steel	2
4.01.09 *	1/8 BSPT Hex Plug	316 St. Steel	2

*- Not Shown

?? Install Slinger O-Ring (4.01.07) onto the shaft ensuring the o-ring is all the way up the shaft and against the pump body bore face. This is also visible through the slots in the sides of the pump body.

?? Install external o-rings (4.01.04).

?? Install the seal housing into the pump assembly. Aligning the flush holes with the tappings in the pump body.

?? Install the locking grub screw (4.01.08) such that the point of the grub screw is locking the seal housing in position.

WARNING

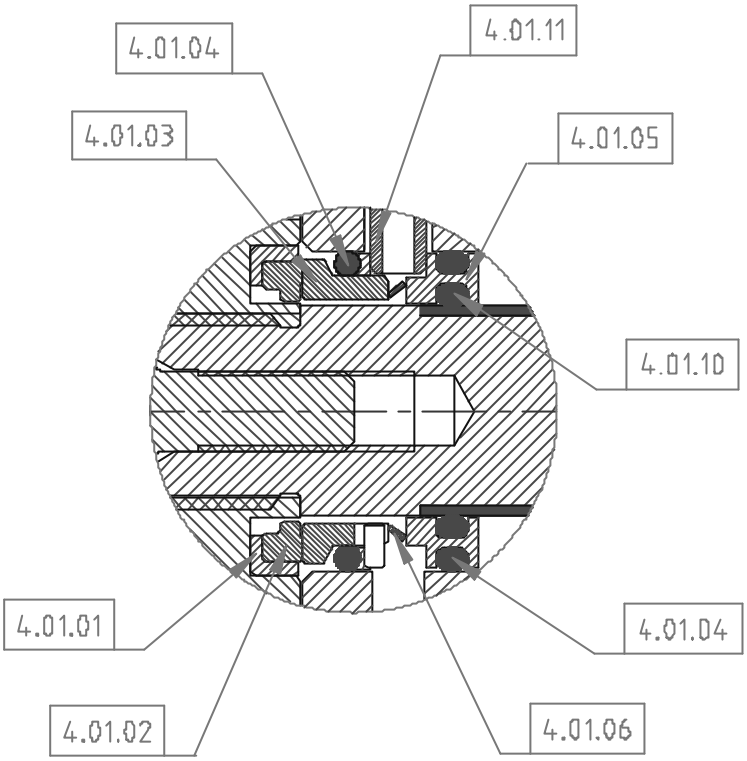
?? Undo the locking grub screw (4.01.08) by one complete turn. This is to ensure no side loading is placed on the housing or seal face resulting in seal leakage.

?? Install the primary o-ring (4.01.04) onto the Static Seal (4.01.03).

?? Install the static seal face (4.01.03) aligning the slots in the seal face with the anti-rotation pins in the seal housing.

?? Install the rotor and rotary seal face assembly.

5.3 Single Flushed Mechanical Seal.



Item Number	Description	Material	Quantity
4.01.03	Static Face	Silicon Carbide	2
4.01.04	O-ring (BS121)	EPDM VITON	4
4.01.05	Housing	316 S11 St. Steel	2
4.01.06	Wave Spring	St. Steel	2
4.01.07*	Slinger O-ring (BS221)	EPDM / VITON	2
4.01.10	O-ring (BS118)	EPDM / VITON	2
4.01.11	Flush / Locking Adapter	316 St. Steel	2
4.01.12 *	Flush / Locking Adapter O-Ring (BS012)	EPDM / VITON	2

*- Not Shown

?? Install Slinger O-Ring (4.01.07) onto the shaft ensuring the o-ring is all the way up the shaft and against the pump body bore face. This is also visible through the slots in the sides of the pump body.

?? Install external o-rings (4.01.04) and internal o-ring (4.01.10) to the Seal housing (4.01.05)

?? Install the seal housing into the pump assembly. Aligning the flush holes with the tappings in the pump body.

- Install the flush locking adapter o-ring (4.01.12) onto the adapter (4.01.11).

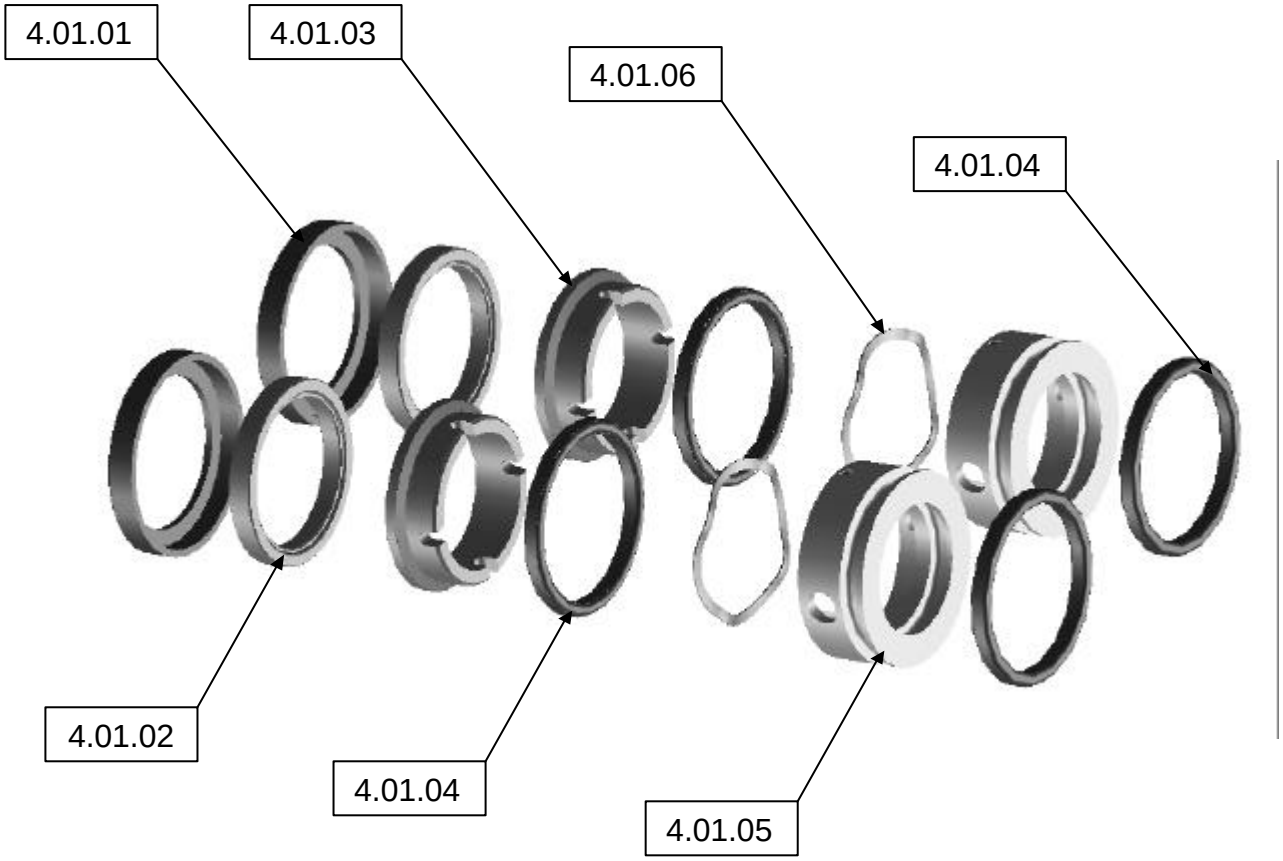
- Install the flush locking adapter (4.01.12) such that the end of the component is locking the seal housing in position.

- Install the primary o-ring (4.01.04) onto the Static Seal (4.01.03).

- Install the static seal face (4.01.03) aligning the slots in the seal face with the anti-rotation pins in the seal housing.

- Install the rotor and rotary seal face assembly.

6.13 Seal Arrangement (Exploded)



Item Number	Description	Material	Number Off
4.01.01	Cup Rubber	EPDM / VITON	2
4.01.02	Rotary Face	Silicon Carbide	2
4.01.03	Static Face	Silicon Carbide	2
4.01.04	O-ring (BS121)	EPDM / VITON	2
4.01.05	Housing	316 S11 St. Steel	2
4.01.06	Wave Spring	St. Steel	2
4.01.07 *	Slinger O-ring (BS221)	EPDM / VITON	2
4.01.08 *	M8 Dog Point Grub Screw	316 St. Steel	2
4.01.09 *	1/8 BSPT Hex Plug	316 St. Steel	2

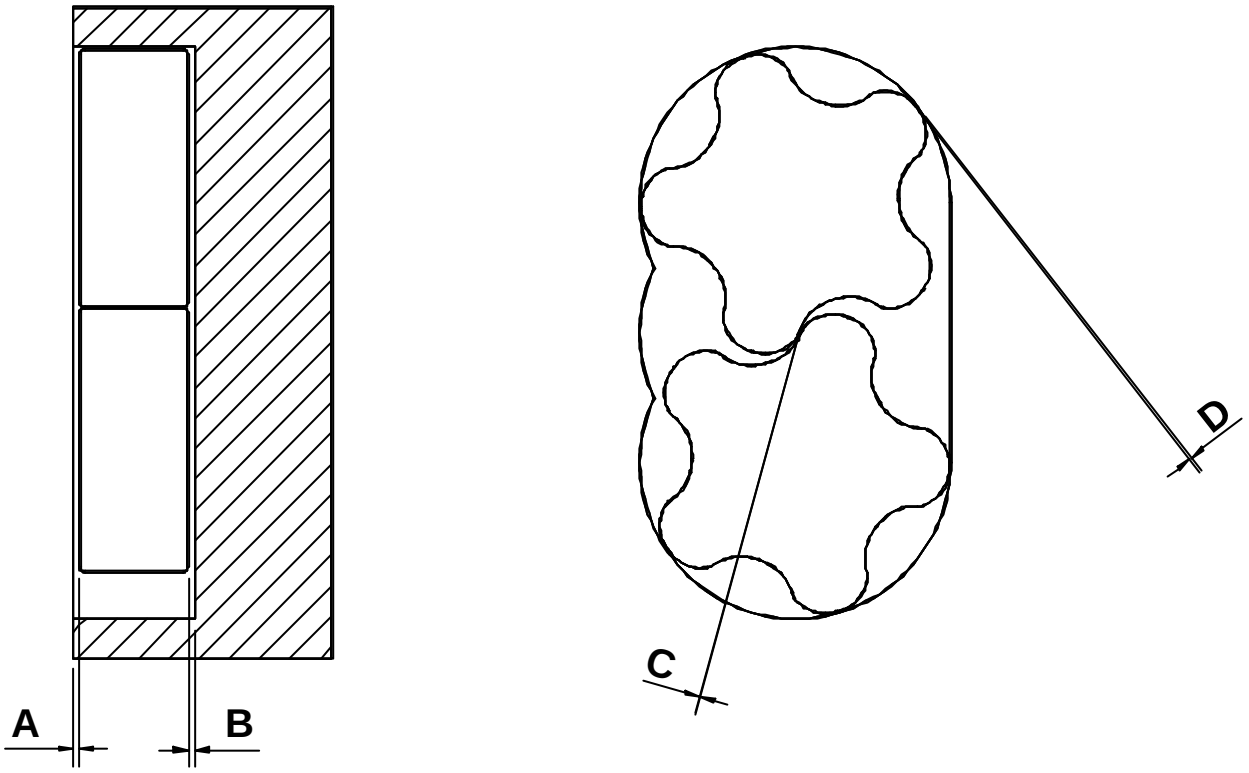
Note: - For Single flush seal add items

Item Number	Description	Material	Number Off
4.01.10 *	O-ring (BS118)	EPDM / VITON	2
4.01.11 *	Flush / Locking Adapter	316 S11 St. Steel	2
4.01.12 *	O-ring (BS012)	EPDM / VITON	2

Note: - * = Not Shown

7.0 Technical Data

7.1 Clearance Chart



Metric (Millimetres)

Front 'A'	Rear 'B'	Sides 'C'	Mesh 'D'
0.090 – 0.150	0.090 – 0.150	0.090 – 0.200	0.120 – 0.250

Imperial (Inches)

Front 'A'	Rear 'B'	Sides 'C'	Mesh 'D'
0.0035 – 0.0059	0.0035 – 0.0059	0.0035 – 0.0079	0.0047 – 0.0100

7.2 Torque Settings

Item	Description	Position		
1.02	Rotor Retainer	Rotor / Shaft	Quantity / Pump Part No. Torque – NM (ft lbs)	2 K13-2051-01M 24 (18)
2.01	Socket Head Cap Screw	Front Cover / Pump Body	Quantity / Pump Size Torque – NM (ft lbs)	8 M8 x 20 39 (29)
4.01.13	Seal Locking Adapter (Flush Only)	Pump Body / Seal Housing	Quantity / Pump Size Torque – NM (ft lbs)	2 1/8" BSP 16 (12)
7.02	Socket Head Cap Screw	Foot / Pump Body	Quantity / Pump Size Torque – NM (ft lbs)	3 M6 x 16 16 (12)

7.3 Lubricants.

The recommended lubricant for use in the Acculobe is lithium based, extreme pressure grease intended for 'sealed for life' units. Suitable for operating temperatures between –30°C and 120°C (-22°F to 266°F) and a base viscosity in the region of 200 cSt at 40°C (104°F).

The unit is shipped with 'Shell Retinax CS00' type. Refer to manufacturers recommended operating conditions concerning limitations, servicing and application. In case of doubt, please consult the factory for details.

In any mounting attitude only 55 ml (1.86 US fl oz) is required to fill the gear cavity and suitably lubricate the bearings. During the filling operation, lubricant should be directed at the front bearings to ensure good circulation and coverage in this area.

Care should be taken not to overfill the gearbox.

7.4 Tool List

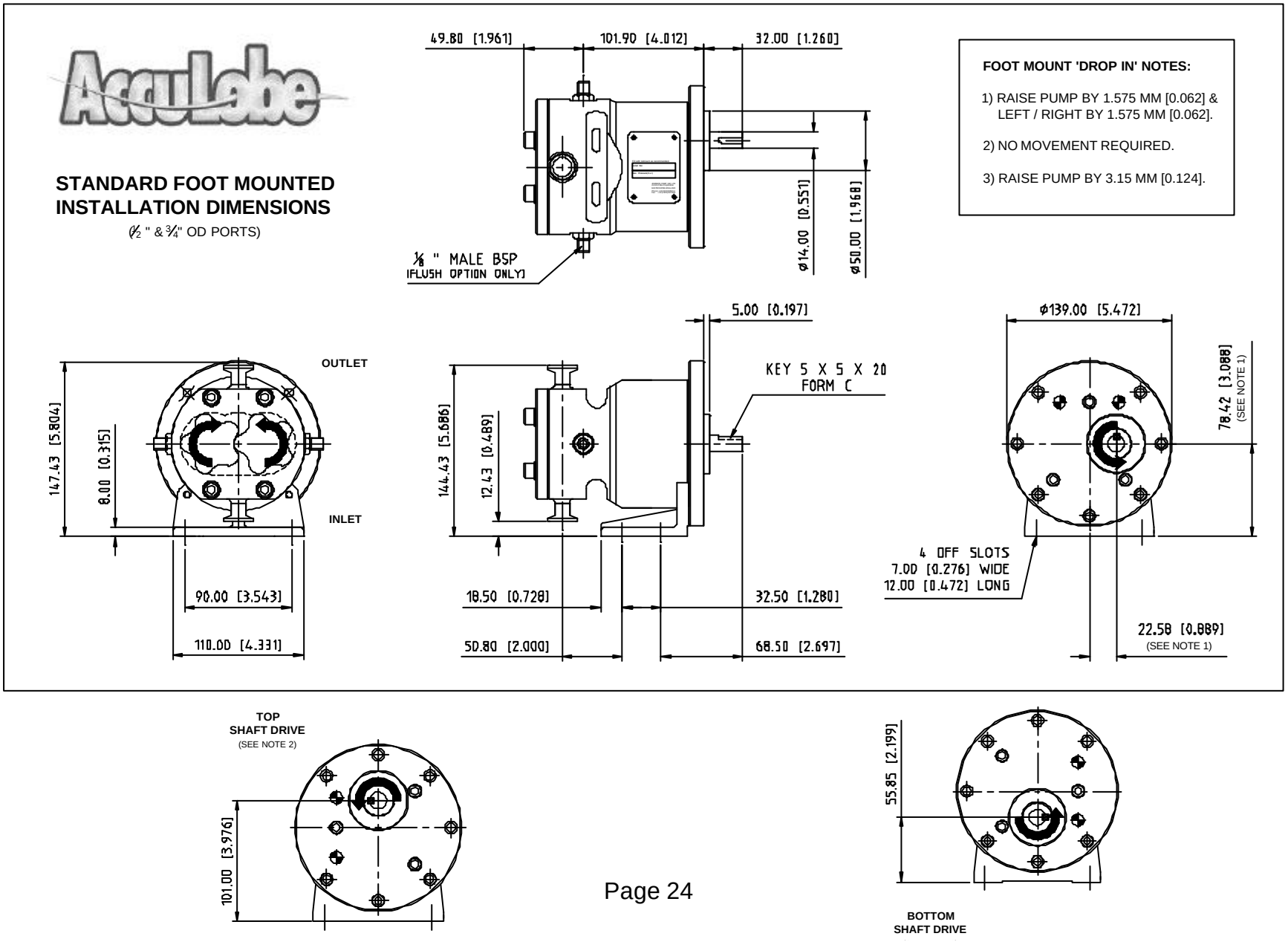
Listed below are tools required for the maintenance of the Acculobe pump.

Type	Size or Range
Rotor Retainer Tool	Supplied
Seal Removal Tool	Supplied
Hexagon (Allen) Keys	4 mm, 5 mm, 6 mm
Depth Micrometer	0 - 25 mm
Feeler Gauge Set	-
Rolling Torque Meter	0 – 25 NM (18.5 ft lbs)
Torque Wench	0 - 65 NM (48 ft lbs)

7.5 Pump Data

Pump Weight with Foot Mount: 9.75 kg (21.5 lbs)
Pump Weight for Drop in Style TBA kg (XXX lbs)
Pump Weight with IEC Motor Adaptor: TBA kg (XXX lbs)
Pump Weight with Nema Motor Adapter: TBA kg (XXX lbs)

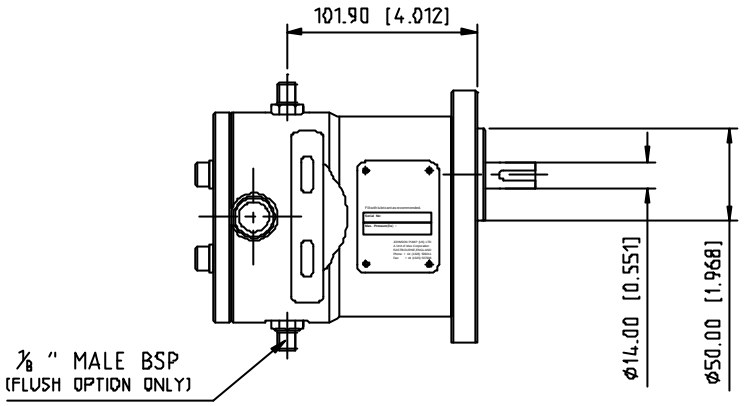
7.8 Acculobe Installation Dimensions

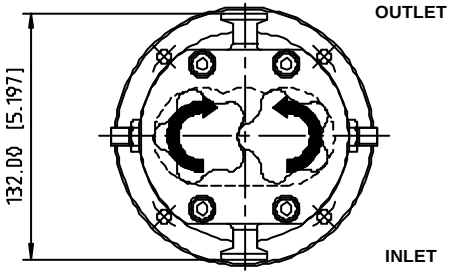


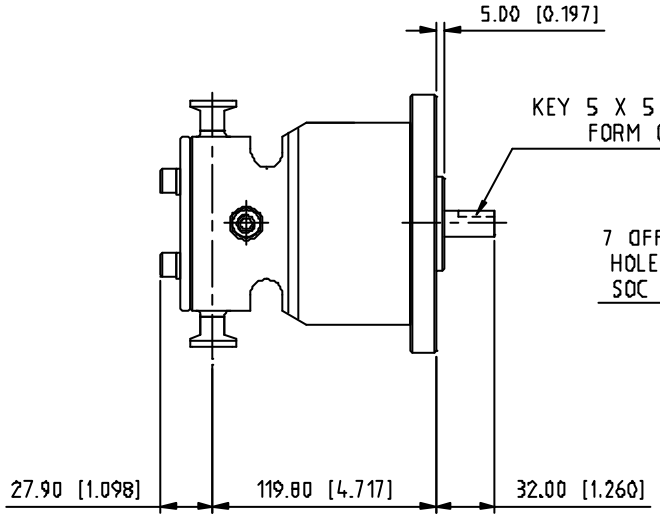
`

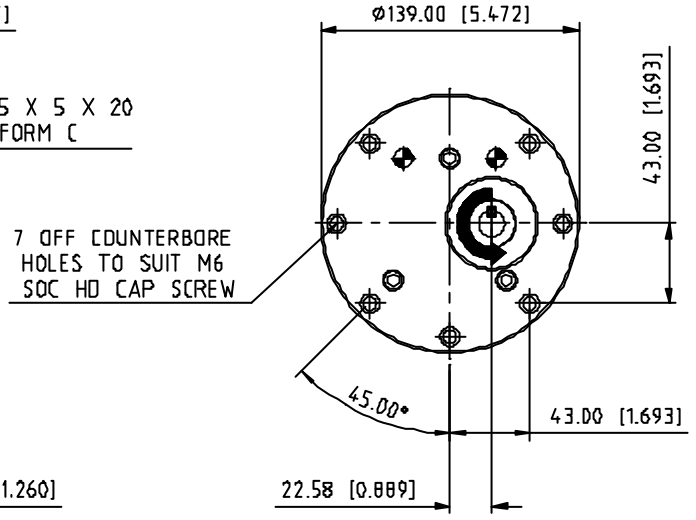
STANDARD BULK HEAD MOUNTED INSTALLATION DIMENSIONS

(½" & ¾" OD PORTS)



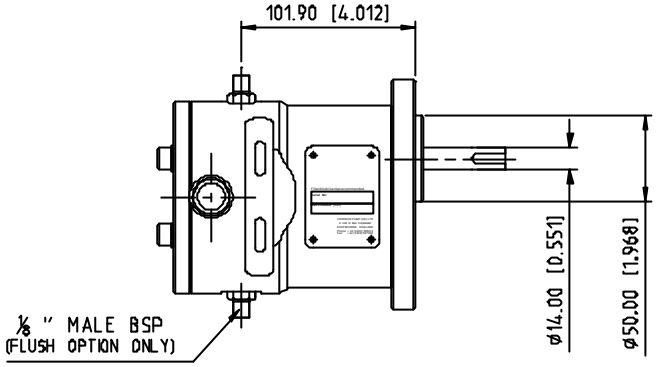




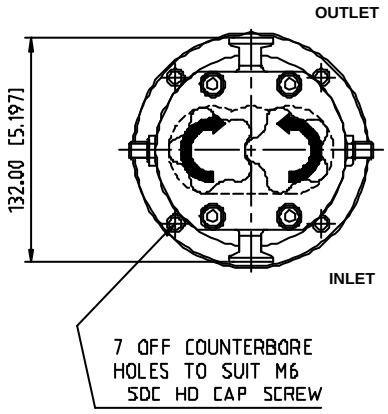


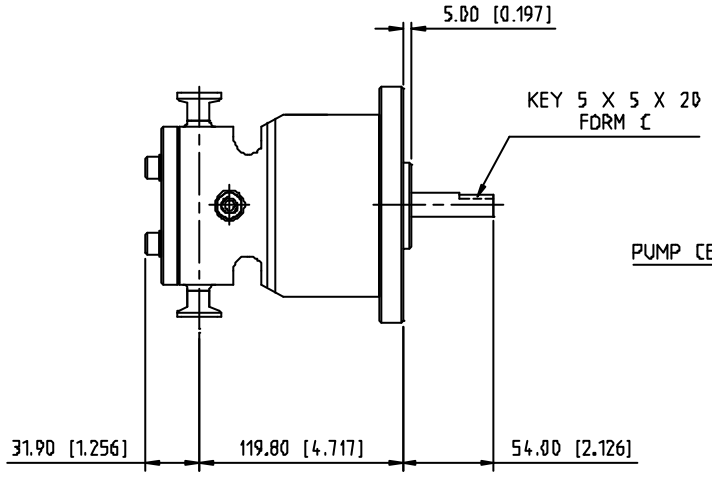
'DROP IN' BULK HEAD MOUNTED INSTALLATION DIMENSIONS

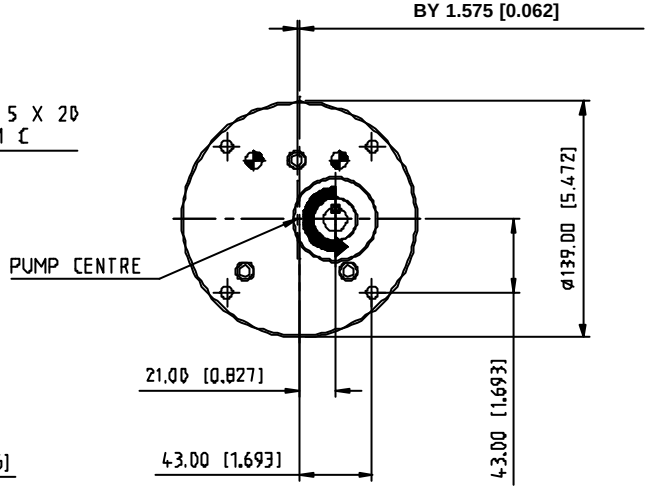
(½" & ¾" OD PORTS)



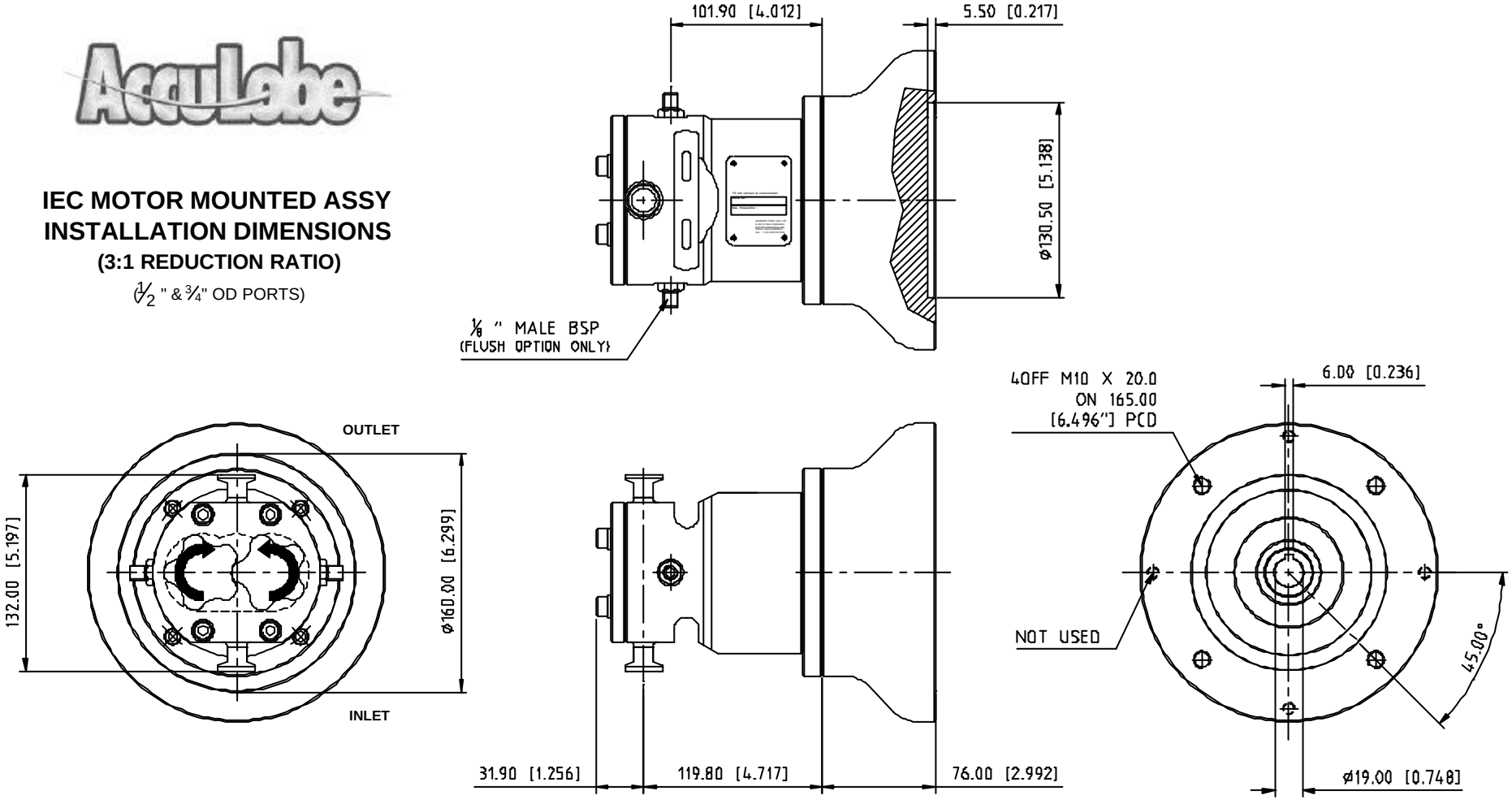
IMPORTANT
ENDPLATE FLANGE & BOLT PCD OFFSET FROM PUMP CENTRE BY 1.575 [0.062]

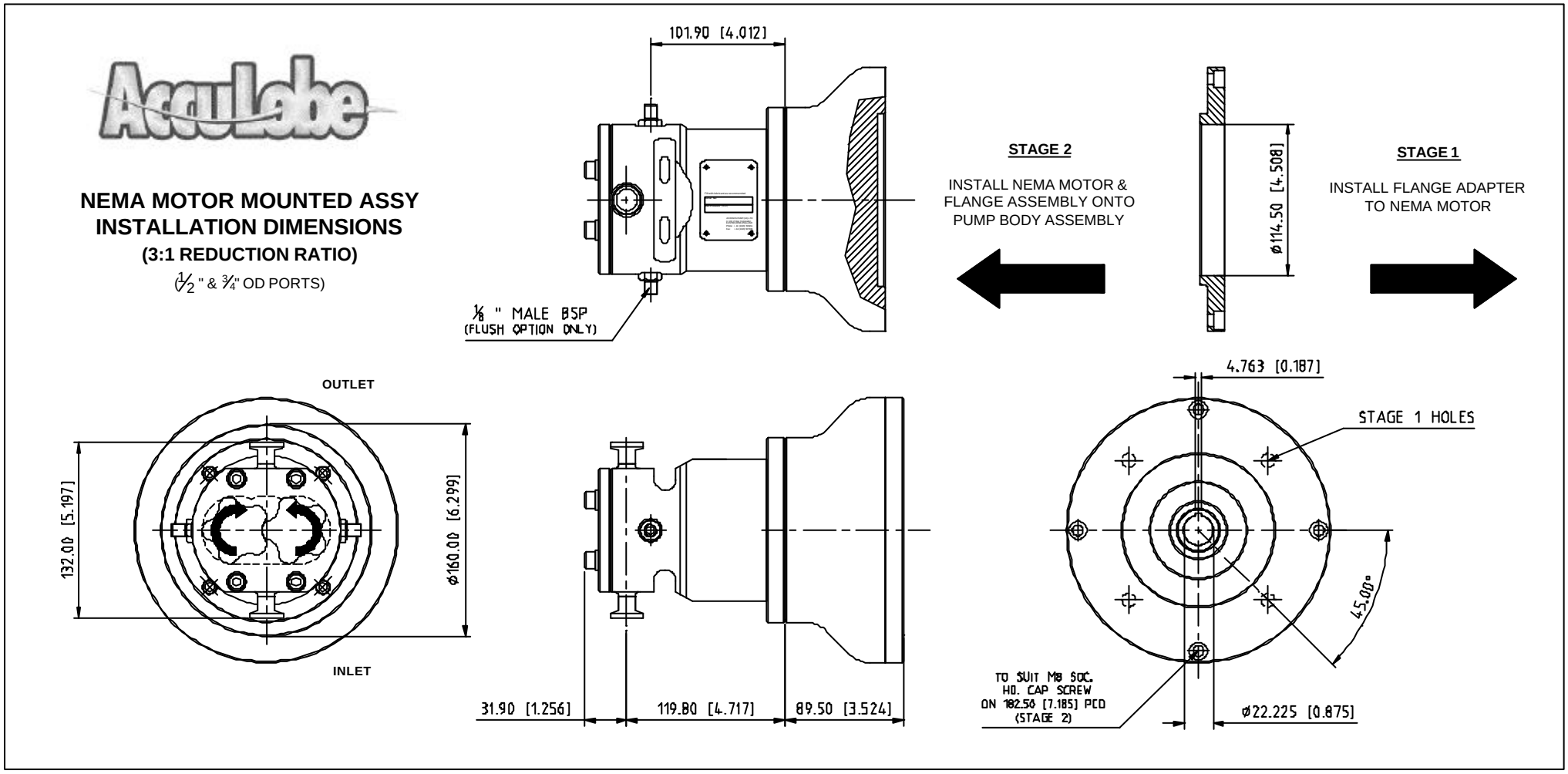






IEC MOTOR MOUNTED ASSY
INSTALLATION DIMENSIONS
(3:1 REDUCTION RATIO)
(½" & ¾" OD PORTS)




NEMA MOTOR MOUNTED ASSY
INSTALLATION DIMENSIONS
(3:1 REDUCTION RATIO)
½" & ¾" OD PORTS)
101.90 [4.012]
⅛ " MALE BSP
(FLUSH OPTION ONLY)
STAGE 2
INSTALL NEMA MOTOR & FLANGE ASSEMBLY ONTO PUMP BODY ASSEMBLY
ø114.50 [4.508]
STAGE 1
INSTALL FLANGE ADAPTER TO NEMA MOTOR
OUTLET
132.00 [5.197]
ø160.00 [6.299]
INLET
31.90 [1.256]
119.80 [4.717]
89.50 [3.524]
4.763 [0.187]
STAGE 1 HOLES
45.00°
TO SUIT M8 SOC. HD. CAP SCREW ON 182.50 [7.185] PCD (STAGE 2)
ø22.225 [0.875]

7.9 Trouble Shooting.

No Flow	Irregular Flow	Under Capacity	Pump Overheats	Motor Overheats	Excessive Rotor Wear	Excessive Seal Wear	Noise / Vibration	Seizure	Stalls On Start UP	Causes	Action
■										Incorrect Direction Of Rotation.	Reverse Motor.
■										Pump Not Primed.	Expel Gas From Suction Line / Pump Chamber & Prime.
■	■	■					■			Insufficient NPSH Available.	Increase Suction Line & Static Suction Head Diameter. Simplify Suction Line & Reduce Length. Reduce Pump Speed & Product Temperature.
	■	■					■			Product Vaporizing In Suction Line.	
	■	■					■			Air Entering Suction Line.	Remake Pipework Joints.
■	■	■					■			Gas In Suction Line.	Expel Gas From Suction Line / Pump Chamber.
	■	■					■			Insufficient Static Suction Head.	Raise Product Level To Increase Static Suction Head.
			■	■			■		■	Product Viscosity Too High.	Decrease Pump Speed / Increase Product Temperature.
		■								Product Viscosity Too Low.	Increase Pump Speed / Increase Product Temperature.
		■	■		■		■		■	Product Temperature Too High.	Cool Product / Pumping Chamber.
				■					■	Product Temperature Too Low.	Heat Product / Pumping Chamber.
					■	■	■	■		Unexpected Solids In Product	Clean System / Fit Strainer On Suction Side Of Pump.
		■	■	■	■		■	■	■	Discharge Pressure Too High	Check For Blockages / Simplify Discharge Line.
			■	■	■		■	■		Rotorcase Strained By Pipework.	Check Pipe Alignment / Support Pipework.
				■			■			Pump Speed Too High	Decrease Pump Speed.
		■								Pump Speed Too Low	Increase Pump Speed
			■	■	■	■	■	■		Seal Flush Inadequate	Increase Seal Flush To Required Pressure / Flow.
			■	■	■	■	■	■	■	Bearing / Timing Gear Wear	Replace Worn Components.

7.10 Service History.

Serial No:

DATE	COMMENTS

7.11 Notes