,

ABPR-20

AUTOMATED

BACK PRESSURE REGULATOR

OPERATOR MANUAL

MN-04-20
Rev D

DECLARATION OF CONFORMITY

We, Thar Technologies, Inc.
575 Epsilon Drive
Suite 100
Pittsburgh, Pennsylvania 15238
USA

Declare that the product:

Automated Back Pressure Regulator, model ABPR-20

---

is in conformity with the following documents:

- EEC directives 73/23 and 93/68 (low voltage directive), applied with the following standard:

  EN 61010-1: 2001 Safety requirement for laboratory equipment

WARNING

Thar Technologies will not accept any liability for damages directly or indirectly caused by connecting this instrument to devices, which do not meet relevant safety standards.

- EEC directives 89/336, 92/31 and 93/68 (EMC directive), applied with the following standard:

  EN 61326: 2002 EMC requirements for electrical equipment for laboratory use

Use shielded cables and connectors for all remote connections.

April, 2007 Edward J.Bates, Operations Manager

TABLE OF CONTENTS

1. FOREWORD 1-1
1.1. Copyright Statement 1-1
1.2. Disclaimer 1-1
1.3. Inquiry 1-1
1.4. Warnings, Cautions and Notes Formats Used 1-2
1.5. Commonly Used Symbols 1-2
1.6. Technical Support 1-3
1.7. Warranty 1-3

2. INTRODUCTION AND OPERATION 2-1
2.1. Theory of Operation 2-1
2.2. Conditions to Avoid 2-1
2.3. ABPR-20 Plumbing Connections 2-3
2.4. Solvent Usage with the ABPR-20 2-4
2.5. Safety Overview 2-4
2.6. Venting the Outlet 2-5

3. OPERATION USING HAND CONTROL 3-1

3.1. Hand Held Terminal Control of the ABPR-20 3-1
3.2. Operate Mode 3-2
3.2.1. Keybioard Basics 3-2
3.2.2. [M] Menu Scroll 3-2
3.2.3. [Shift-ESC] Escape to Main Menu 3-2
3.2.4. [F1] Start BPR 3-2
3.2.5. [F2] Stop BPR 3-2
3.2.6. [F3] Display Data 3-2
3.2.7. [F4] Setup Run 3-3
3.2.8. [F5] Setup Profile 3-4
3.2.9 [G] Go To Position 3-6
3.2.10. [F] Factory Defaults 3-6
3.2.11. [S] System Setup 3-6
3.2.12. [H] Ext Heater ON 3-7
3.2.13. [X] Ext Heater OFF 3-7
3.3. Startup 3-7
3.4. Automatic Pressure Control 3-8
3.5. Stopping 3-9
3.6. Changing Control Pressure while Running 3-10
3.7. Shut Down 3-10
3.8. Configuration Mode 3-10
3.8.1. Display Instructions 3-11
3.8.2. [F1] Zero/Calibration 3-11
3.8.3. [F2] Com Port 3-13
3.8.4. [F3] Range Setup 3-13
3.8.5. [F4] Heater Setup 3-15

3.8.6. [F] Factory Defaults 3-16
3.8.7. [V] Version 3-16

4. OPERATION UNDER PC CONTROL 4-1

5. MAINTENANCE 5-1
5.1. Cleaning the Exterior 5-1
5.2. When Maintenance is Indicated 5-1
5.3. Alignment of the Valve 5-1
5.3.1. Using Hand Held Controller 5-3
5.3.2. Using PC Software 5-4
5.4. Seat Replacement Procedure 5-6
5.5. Needle and Packing Replacement Procedure 5-8
5.6. Replacing fuses 5-811
5.6.1. Fuse Drawer Types 5-311

6. REPLACEMENT PARTS 6-1

7. APPENDIX 7-1
7.1. General CO_2 Safety Considerations 7-1
7.1.1. Rescue 7-1
7.1.2 Inhalation First Aid 7-1
7.1.3. External Exposure First Aid 7-2

8. SPECIFICATIONS and REFERENCE DRAWINGS 8-1

TABLE OF FIGURES

Figure 1: Low and High Pressure Tubing Diameters *2-2*
Figure 2: ABPR-20 Plumbing Connections *2-3*
Figure 3: Hand Held Terminal (HHT) *3-1*
Figure 4: Hand Held Terminal Connection to a ABPR-20 ..... *3-7*
Figure 5: ABPR-20 Connection to a Computer *4-1*
Figure 6: Valve Assembly *5-7*
Figure 7: Seat Orientation in Retainer *5-8*
Figure 8: Valve Component Locations *5-9*
Figure 9: Stem Assembly *5-10*
Figure 10: Removing the Fuse Drawer *5-11*
Figure 11: 110 VAC and 220 VAC Systems Fuse Drawers *5-12*
Figure 12: Valve Replacement Part Identification *6-2*
Figure 13: Front of ABPR-20 ..... *8-2*
Figure 14: Rear of ABPR-20 ..... *8-3*

1. Foreword

1.1. Copyright Statement

The User Of This Manual Shall Hold Thar Technologies, Inc And Their Suppliers Harmless Of Any And All Costs And Expenses, Including Legal Fees, They Or Anyone Else May Allege Were Caused By The Use Of This Manual(S).

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1.2. Disclaimer

The user of this manual shall hold Thar Technologies and their suppliers harmless of any and all costs and expenses, including legal fees, they or anyone else may allege were caused by the use of this manual(s).

1.3. Inquiry

Please direct all inquiries to your representative or to the corporate office address:

Thar Technologies, Inc
575 Epsilon Drive
Suite 100
Pittsburgh, PA 15238 USA
info@thartech.com

The corporate office service HOT LINE is available during normal working hours of 8:00 AM to 4:30 PM, Eastern Standard Time:

Tel: (412) 967-5665
Fax: (412) 967-9446

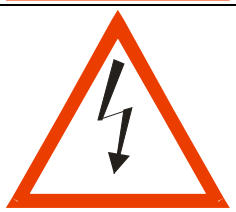
Thar Technologies users have the advantage of Applications and customer support from our knowledgeable staff.

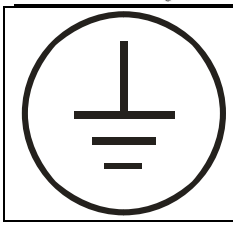
1.4. Warnings, Cautions and Notes Formats Used

☞	***NOTE:*** *Text block that provides additional and helpful information associated with the immediate surrounding text.*
!	***CAUTION:*** *Text block that identifies a procedure, practice, etc. that could result in damage to the equipment if improperly performed.*
☒	☒ ***WARNING:*** *Text block that identifies a procedure, practice, etc. that could result in personal injury if improperly performed*

1.5. Commonly Used Symbols

The chart below shows the commonly used symbols on Thar instrumentation to alert the operator to various situations regarding the operation of the instrument.

	Alerts the operator to situations that could result in serious injury. Refer to the manual for additional information.
	Caution, hot surface or high temperature.
	Caution, risk of electric shock (high voltage).

	Protective conductive terminal.

1.6. Technical Support

Technical Support

Thar Technologies, Inc. provides technical support for your instrument during the warranty period. Most problems can be diagnosed over the phone; and if necessary, a replacement part is shipped to you under the stated conditions of the warranty. Additional warranty or technical support can be purchased prior to expiration of the current warranty. Our technical support is available from 8:00 a.m. to 4:00 p.m. EST Monday through Friday at 412.967.5665. For product purchases from Thar Technologies' agent or distributor, please contact your local service representative.

1.7. Warranty

Warranty

Thar Technologies products are warranted against defect in material or workmanship for a period of one year from the date of shipment from the factory. This warranty applies only to products that are/were purchased from Thar Technologies, Inc. or appointed distributors and agents. Warranty agreement applies only to the original purchaser. If a warranty dispute occurs, customer may be required to provide Thar Technologies with proof of purchase and authorized warranty document.

This Limited Warranty covers normal use. The Thar Technologies, Inc. warranty does not cover and is not limited to:

- Expendable and consumable items that include, but are not limited to: frits & seals for vessels, pressure regulator seat and needle, UV lamps, valve seats and rotors, fittings, o-rings, filter elements, trap screens, piston seals, backup seals, sapphire pistons, polymer seals, check valves, rupture discs and relief valves etc.
- Damages during or from shipment.
- Damage caused by impact with other objects, dropping, falls, spilled liquids, or immersion in liquids.
- Damage caused by fire, flood, wind, earthquake, lightning, other natural disasters or act of war.
- Defects caused by failure to provide a suitable installation environment for the equipment.
- Damage from improper or lack of maintenance.
- Damage or contamination caused by unsuitable quality solvents or gases.

- Damage or contamination caused by improper use of solvents. Most organic chromatography solvents can be used with the system. If you have a question regarding compatibility of the solvent with the system, please call Thar Technologies, Inc.
- Damage caused by any other negligence, abuse, misuse, mishandling, or misapplication.
- Incomplete or unauthorized warranty document.

Liability

Repair or replacement shall be the sole remedies for defect and shall be made, free of charge, ex-works, provided factory inspection supports validity of customer's claim. Thar Technologies, it's appointed distributors or agents shall not be liable for consequential damages, whether or not arising out of warranty, negligence or otherwise. These remedies are the purchaser's exclusive remedies for breach of warranty.

This warranty is the only warranty applicable to this product. All other warranties, expressed or implied (including all implied warranties of merchantability or fitness for a particular purpose or quality of service) are hereby disclaimed. No oral or written information or advice given by Thar Technologies, Inc., its agents or employees shall create a warranty or in any way increase the scope of this warranty.

Indemnity and Hold Harmless

Original purchaser-user agrees to indemnify and hold Thar Technologies, it's distributors or agents harmless for any personal injuries to original purchaser-user, its employees and all third parties where said injuries arise from negligent use, misuse or use not in accordance with specifications and instructions for use supplied with Thar Technologies products.

Obtaining Service Under This Warranty

In the event that you have a problem with your Thar Technologies, Inc. product, the following guidelines apply when obtaining service from Thar Technologies, Inc.

Obtain your **product model and serial number** and then call Thar Technologies, Inc. Technical Support at 412.967.5665.

1. A technician will troubleshoot your problem over the phone. If the technician determines that a part is defective and that you should receive a replacement part, a replacement part will be sent to you.
2. The technician will give you an RMA (Return Material Authorization) number for the defective part if required. No shipments for repair are accepted without an RMA#.
3. If you need assistance installing the replacement part please call Thar Technologies, Inc. Technical Support. A technician will walk you through the installation over the phone.
4. Ship the defective part to us, freight prepaid and insured. Pack the part carefully, using the original box and packing material. Include a brief note describing the problems, list the name and telephone number of the person directly responsible for maintaining the equipment. Mark the RMA number clearly on the outside of each box. Thar Technologies, Inc. assumes no responsibility for damage incurred during shipment from customer to factory.

5. If Thar Technologies, Inc. does not receive the defective part within 21 days, you will be charged for the full value of the part.

Returning Equipment to Thar Technologies, Inc. for Repair

If we are unable to resolve your problem, we will gladly service your equipment at the factory. *Always contact Thar Technologies, Inc. to obtain an RMA (Return Material Authorization) number before your return. The RMA number should be clearly referenced on every box you ship to us.*

Please follow these instructions when returning equipment for service:

1. The technician who authorizes the return for your equipment will give you an RMA number. Write the number in large, clear characters on the outside of each box you ship to us. The receiving department may refuse boxes without an RMA number clearly visible.

2. Use proper box and packing material to protect the equipment from damage in shipment. Do not include unnecessary items (manuals, line cords). For your protection, insure the equipment for full replacement value and use a reliable shipper. Thar Technologies, Inc. can assume no responsibility for damage to equipment during shipment from the customer to the factory, whether in or out of warranty.

3. Include a brief note describing the problems you are experiencing with your equipment. List the name and telephone number of the person directly responsible for maintaining the product.

Thar Technologies, Inc. shipping address is:

Customer Service Dept.
RMA Number:
Thar Technologies, Inc.
575 Epsilon Drive
Pittsburgh, PA 15238 USA

Shipment of parts

Under warranty, Thar Technologies, Inc. will ship all in-stock parts within 2 working days. All parts will be shipped via UPS Ground (Brown) at Thar Technologies, Inc.' expense. Charges for overnight shipments are the customer's responsibility. Shipment costs are not covered for consumable or items excluded from the warranty and will be invoiced.

If Thar Technologies, Inc. chooses to replace the product or provide a loaner, Thar Technologies, Inc. will ship the product, via UPS Ground (Brown) at Thar Technologies, Inc.' expense if the equipment is within the weight limits of UPS. If the weight is greater than UPS limits, then Thar Technologies, Inc. will ship via common carrier (Ground). Charges for faster shipments at the customer's request are the customer's responsibility.

2. *Introduction and Installation*

2.1. Theory of Operation

The Thar Technologies Inc. ABPR-20 is a precision valve attached to a motor controller with a position indicator. The valve has a minimum flow rating which is presented at the maximum rated pressure, generally 680 BAR. This is normally 1/25 of the rated flow. For details check the quotation or purchase order. The ABPR-20 controls the back pressure in a system therefore proportionally controlling the system pressure.

A component of the precision valve is the needle which is driven by a motor to allow or stop the flow of the fluid. The needle position is arbitrarily given as a range of 0 to 6000 points starting with 0 as the minimum flow and 6000 as fully open. The control is most efficient when the valve does not reach the limits during steady operation.
Also, a heating system is utilized to prevent freezing of the valve as the fluid depressurizes while exiting the instrument.
In addition, a single heater control output and heater temperature input are provided for use with optional Thar vessel heaters.

2.2. Conditions to Avoid

WARNING: *Acceptable fluids include liquids, supercritical fluids, and gasses. Particulate matter should not be introduced to the valve due to the small openings and the risk of clogging the valve. If the valve becomes clogged due to solids a filter will need to be placed directly upstream of the ABPR -20.*

If a solid forms in the process of depressurization the ABPR-20 is not guaranteed to function properly.

In nearly all cases particle formation during depressurization is acceptable, but the outlet tube must be designed to freely flush the solids or gels which form.

WARNING: *The ABPR-20 valve is not designed as a shutoff valve and if it is forced to close fully the needle may break, stick, or damage the seat.*

2.2.1. General Precautions

The following sections list some of the general precautions which should be noted when operating the pump, or any high pressure equipment.

2.2.1.1. Tubing

Care must be taken to use the proper size tubing for the application. Thar pumps are built using 1/8" OD with a .035" wall thickness wherever the tubing will be exposed to high pressure. Use of tubing with inadequate wall thickness may be a safety hazard. Tubing cut with a wheel cutter can be deceiving when attempting to determine the wall thickness.

All tubing should be cleaned with an appropriate solvent, such as Acetone, after being cut and before being put into service. Failure to clean the tubing may cause sample contamination and/or premature failure of components such as check valves and valve rotors. Thar cannot be responsible for improperly cleaned tubing being installed on the unit.

Before installing the tubing, inspect the ends to assure that the tubing cutter has not deformed or closed the ends. Refer to the figure below.

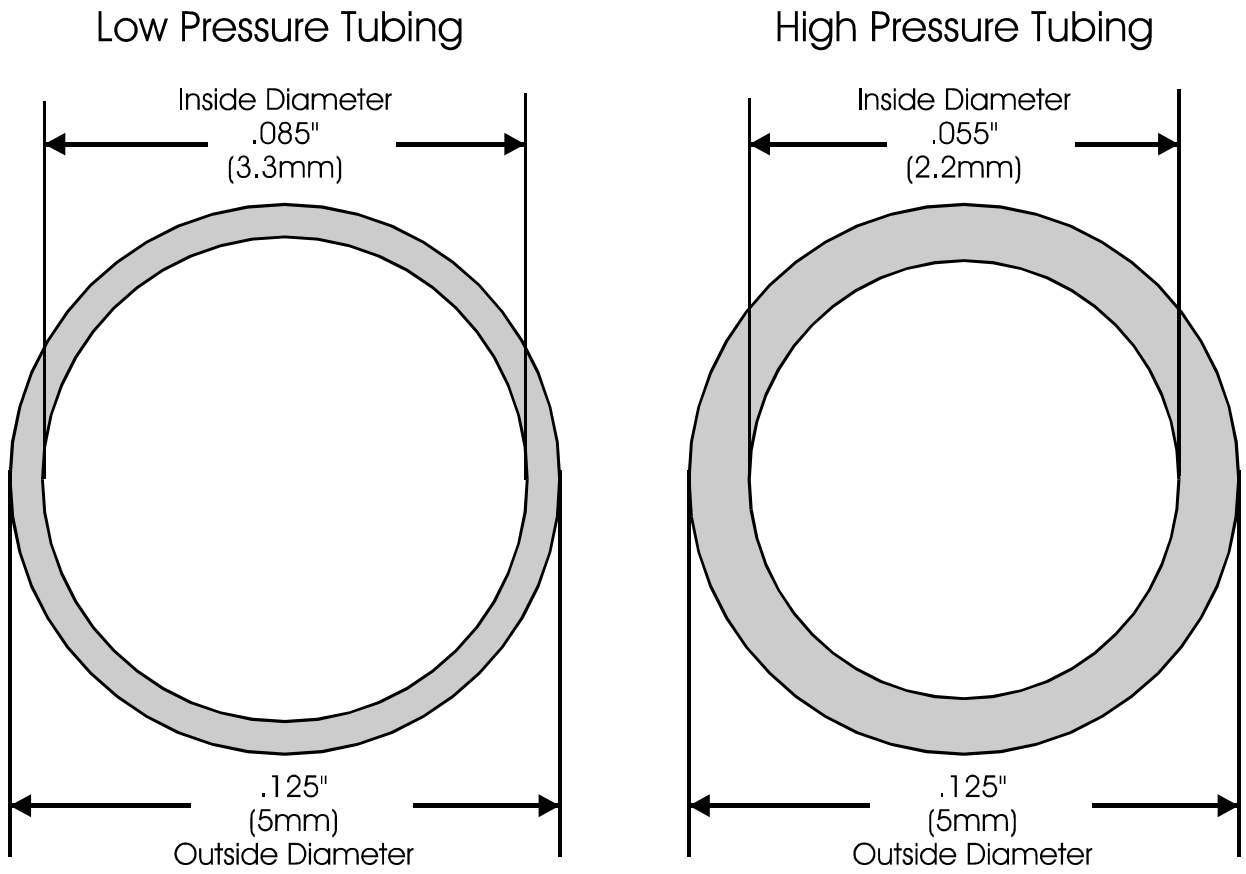


Figure 1: Low and high pressure tubing diameters

2.2.1.2. Fittings

Fittings allow interconnection of valves, pressure transducers, gauges, etc. There are many different fitting and valve manufactures with a variety of sealing techniques. Refer to the fitting manufacturers installation instruction before making new fitting connections. It is

advisable to open and inspect all new connections to assure that the ferrule is properly placed on the tube. If the ferrule is placed to close to the end of the tube it may not have sufficient strength to hold the tube in place under high pressure.

☒ ***WARNING:*** *Interchanging of ferrules and gland nuts between fitting types may be dangerous. Many fittings look the same or similar. Use only the specified ferrule and gland nut for the fitting. If you are unsure of the type of fitting contact Thar Technologies, Inc. for assistance.*

2.2.1.3. Electrical Ground Precaution

☒ ***WARNING:*** *This equipment contains hazardous voltages inside of the cabinet. Never operate this equipment with the rear cover off or with the grounding conductor of the power cord disconnected.*

2.3. ABPR-20 Plumbing Connections

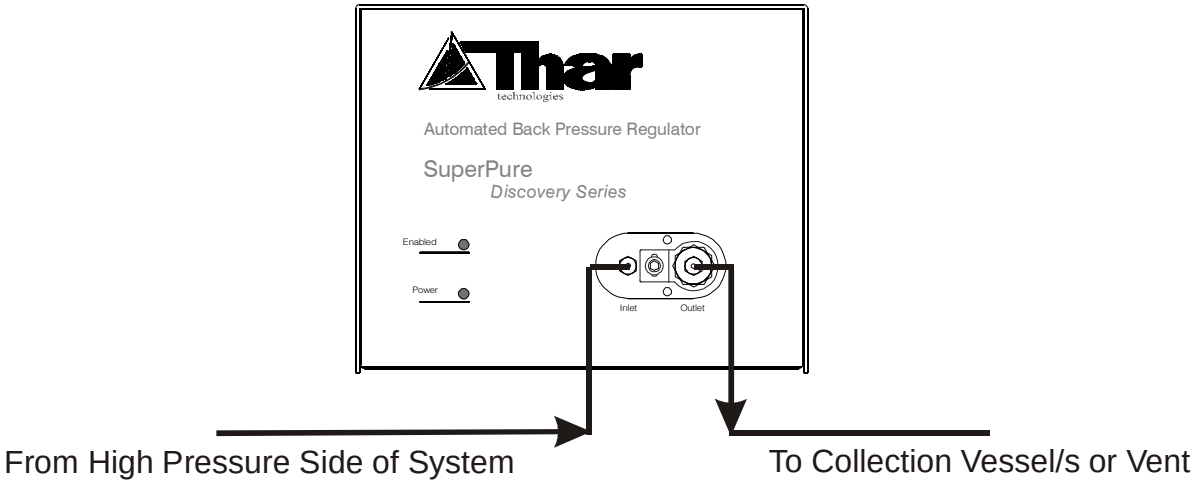


Figure 2: ABPR-20 Plumbing Connections

The ABPR-20 is used to control the system back pressure. Therefore it must always be plumbed into the system where the inlet is connected to the high pressure side of the system after any pump or other instrument that it has to be maintained at the system's set pressure point. The

outlet of the ABPR-20 is plumbed to low pressure side of a system such as a collection vessel or vessels and or an exhaust vent to allow the escape of the de-pressurized system.

2.4. Solvent Usage with the ABPR-20

2.4.1. Approved Solvents

Below is a list of solvents approved for use with Thar Technologies ABPR's. Use of solvents other than those listed below without written permission from Thar Technologies will void the unit's warranty. Thar Technologies, Inc. cannot be held liable for any damage or injury resulting from the use of unapproved solvents.

Acetonitrile
Methanol
Isopropyl Alcohol
Methylene Chloride
Ethanol
Carbon Dioxide
Chloroform

2.4.2. Solvents to Avoid

Below is a list of solvents which should NOT be used with Thar Technologies ABPR's. Use of these solvents will void the unit's warranty. Thar Technologies, Inc. cannot be held liable for any damage or injury resulting from the use of unapproved solvents.

Aquo Regia
Chlorine Anhydrous
Ferric Chloride
Freon 12
Hydrobromic Acid
Hydrofluoric Acid
Hydrogen Peroxide
Mercuric Chloride
Bromine
Copper Chloride
Ferrous Chloride
Guanidine
Hydrochloric Acid
Hydrofluorsilicic Acid
Iodine

2.5. Safety Overview

The safety features of the ABPR-20 include an alarm for over pressure conditions which, on a system, will stop other components as well as responding to alarms from other connected components of a Thar Technologies system.
The ABPR-20 responds to and delivers alarms when operating and during rest. If during operation solids build up on the needle or seat, the valve will automatically open to maintain the pressure at the set value. When the blockage passes the valve will automatically close and continue to control at the set value.

The integrated valve heater is low voltage and low wattage; thus it will not affect the bulk fluid temperature, but will maintain an internal surface temperature high enough to prevent icing within the valve.

2.6. Venting the Outlet.

Depending on your system configuration, the residual outlet CO_2 must be vented to a fume hood connected to the outside. Vent tubing should be metal and of sufficient strength and large enough diameter to withstand pressure and prevent any restriction to the flow of the escaping gas. Do not exhaust CO_2 in to the room for prolonged periods of time or in excessive amounts. See the Appendix for more information on CO_2 safety considerations.

3. *Operation Using Hand Control*

3.1. Hand Held Terminal Control of the ABPR-20

The ABPR-20 can be run from either a PC or a Hand Held terminal (HHT). The Hand Held terminal is a 4 line by 20 character backlit LCD display with a 45-key keypad. The power for the Hand Held terminal, as well as the display information is supplied by the ABPR-20. At startup, the ABPR-20 sends out a signal to determine if it is being controlled by a Hand Held terminal or a PC. If the ABPR-20 does not receive a passed response after 3 attempts it assumes that it is being controlled by a PC. If a terminal is connected after the 3 attempts have been completed the ABPR-20 will have to be turned off/on to work with the terminal.

Figure 3: Hand Held Terminal (HHT)

The Hand Held terminal is the only way to make certain changes to the ABPR-20. The terminal cable plugs into the “RS-232” connector on the back panel of the ABPR-20. The Hand Held terminal is capable of functioning in two modes. One is the operation mode where the control parameters such as pressure, temperature, and alarms are set and controlled. The other is the configuration mode, where computer communication settings can be changed, calibrations performed and general operating conditions set. This should not be done while the ABPR-20 is in it’s normal operating mode because the safety controls are not functional in the configuration mode. When the ABPR-20 is turned on it will display the operate menu. To access the configuration menu press the “CFG” (configure) button on the rear of the unit.

3.2. Operate Mode

```
Operate Menu:
[F1]Start BPR
[F2]Stop BPR
[F3]Display Data
[F4]Setup Run
[F5]Setup Profile
[G] Goto Position
[F] Factory Defaults
[S] System Setup
[H] Ext Heater On
[X] Ext Heater Off
Press “M” for More
```

Operate Mode Main Menu

3.2.1. Keyboard Basics

If an illegal button is pressed the controller will beep and the prompt will not change. Generally each of the options presents the most recent setting as the proposed setting and if [ENTER] is pressed the proposed value will be entered.

3.2.2. [M] Menu Scroll

Pressing the [M] on the main menu scrolls through all available menu options except aligning or manually moving the needle.

3.2.3. [Shift-ESC] Escape to Main Menu

If the wrong menu is entered [Shift-ESC] will jump to the main menu without saving or starting. To return to the main menu press and hold the [Shift] key, then press the [ESC] key.

3.2.4. [F1] Start BPR

The BPR will begin controlling to the set pressure and temperature.

3.2.5. [F2] Stop BPR

The pressure control will be stopped, control of valve and external heat will be per the configuration settings.

3.2.6. [F3] Display Data

This will display the current conditions, such as pressure, temperature and needle position.

```
<<MORE, PRESS 'F3'>>
Profile:A  CTRL: OFF
POS:XXXX     VTMP:XX
SET:XXX   PRESS:XXX
```

Screen 1

```
<<MORE, PRESS 'F3'>>
External Heat: OFF
SET:XXX     TEMP:XXX
```

Screen 2

Status Screens

Screen 1 gives the current pressure, valve temperature and needle position as well as the setpoint for the pressure.
Screen 2 gives the current temperature and set point for the external heater.
Pressing the [F3] alternates between the two screens.

3.2.7. [F4] Setup Run

These screens are used to setup the run parameters for the unit.

```
A- NAME1
B- NAME2
```

The unit contains two PID profiles. This screen is used to select which control profile to use.

```
<<Setup Run Params>>
Ctrl
Set Point (XXX) ?
      {1 – 680}
```

This screen is used to set the control pressure, in Bar, for the unit. Press the [ENTER] key after entering the desired pressure.

```
<<Setup Run Params>>
Ctrl
Press Alarm(XXX) ?
      {1 – 680}
```

This screen is used to set the alarm pressure, in Bar, for the unit. Press the [ENTER] key after entering the desired pressure. If the unit reaches or exceeds the alarm value an audible alarm will be sounded and the valve will be opened to relieve pressure.

```
<<Setup Run Params>>
Ctrl
Ext. Heat Set(XXX) ?
      {0 – 75}
```

If configured to control an external heater this screen will be displayed. This screen is used to set the control temperature, in °C, for the external heater. Press the [ENTER] key after entering the desired pressure.

```
<<Setup Run Params>>
Ctrl
Ext. Heat Alarm(XXX) ?
      {0 – 75}
```

This screen is used to set the alarm temperature, in °C, for the external heater. Press the [ENTER] key after entering the desired temperature. If the unit reaches or exceeds the alarm value an audible alarm will be sounded and the heat turned off.

```
<<Setup Run Params>>
Ctrl
Save setup? [Y/N]
```

Finally, you will be prompted to save the entered parameters. If you press [Y] the parameters entered will be saved even if power is removed from the unit, if you press [N] the parameters will remain until power is removed from the unit.

3.2.8. [F5] Setup Profile

The BPR uses a PID algorithm to do the pressure control. Using the settings in the screens below will change the way the BPR responds to changes in pressure and is used to optimize the control for various flow rates and vessel sizes.

```
New Name: YYYYYYY
 Max 7 Characters
```

The name can only be up to 7 characters. If an 8 letter name is entered the last letter will be ignored.

```
<<<Profile Setup>>>
Profile: YYYYYYY
Kp(XXXX) ?
       {0 – 1000}
```

Kp is the proportional gain in the PID control algorithm. A higher Kp value will cause the valve to begin opening further from the setpoint.

```
<<<Profile Setup>>>
Profile: YYYYYYY
Ki(XXXX) ?
       {0 – 1000}
```

Ki is the integral gain in the PID control algorithm. The integral is used to slowly move the pressure towards the set value once it is to close for the proportional factor to have any effect.

```
<<<Profile Setup>>>
Profile: YYYYYYY
Kd(XXXX) ?
       {0 – 1000}
```

Kd is the differential gain in the PID control algorithm. The differential gain is used to open or close the valve when a change in pressure occurs. This will aid in preventing overshoots when the pressure is changing rapidly. Larger numbers predictively open/close and may cause oscillations if too large.

```
<<<Profile Setup>>>
Profile: YYYYYYY
MaxSum(XXXX) ?
       {0 – 30000}
```

The **Maxsum** is the open clamping mechanism for the BPR and will not allow the valve to open further than this value. For full operation of the flow range, 1,000 is recommended. Smaller values can reduce memory effects due to residing closed for long periods but may limit the maximum response.

```
<<<Profile Setup>>>
Profile: YYYYYYY
Attenuation(XXXX) ?
       {0 – 255}
```

The **Attenuation** is used to reduce, attenuate, the amount of movement caused by small changes in pressure. This value should normally be set to 1. Larger numbers reduce the response dramatically.

```
<<<Profile Setup>>>
Profile: YYYYYYY
Save setup [Y/N]
```

You will be prompted to save the entered parameters. If you press [Y] the parameters entered will be saved even if power is removed from the unit, if you press [N] the parameters will remain until power is removed from the unit.

☞***NOTE:*** *The Thar Technologies ABPR-20 is delivered calibrated to operate with a ½ liter vessel at the midpoint of the flow and pressure range. The ABPR-20 has 2 sets of PID (Proportional-Integral-Derivative) values. The first one is set by Thar Technologies. The other may have been adjusted during tuning as well. Once the BPR is installed and operational both PID sets may be customized for various operating conditions.*

3.2.9. [G] Go To Position

In the stopped mode this will send the needle to any position from 0 to 6000. This is disabled during automatic pressure control.

```
<<<<Get Position>>>>

GOTO (0)?
    {0-6000}
```

Go To Position Screen

3.2.10. [F] Factory Defaults

Overwrites the current settings with the factory default values. The user will be prompted to save the default values. If [Y] is pressed the current setups will be overwritten with the factory default values and these values will be saved. If [N] is pressed the current values will not be changed or saved.

3.2.11. [S] System Setup

Pressing this button causes the following screen to be displayed:

```
For System Settings,
press red 'config'
button on back of
ABPR
```

3.2.12. [H] Ext Heater ON

Turns on the control of the external heating and the unit is switched to the data display page. This will only be visible and have an effect if the unit has been configured to control an external heater which is not under control at all times.

3.2.13. [X] Ext Heater OFF

Turns off the control of the external heating and the unit is switched to the data display page. This will only be visible and have an effect if the unit has been configured to control an external heater which is not under control at all times.

3.3. Startup

With power off, connect the hand held terminal to the female DB-9 connector, marked "RS-232", on the ABPR-20 back panel.

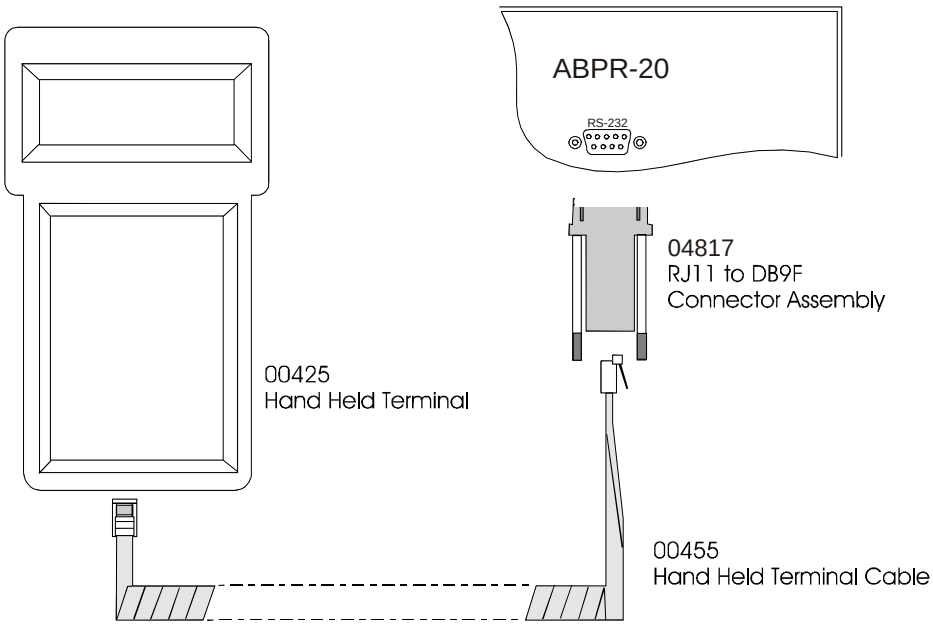


Figure 4: Hand Held Terminal Connection to a ABPR-20

Turn the ABPR-20 on and wait for the controller to beep then display the operate menu.

```
Operate Menu:
[F1]Start BPR
[F2]Stop BPR
[F3]Display Data
Press “M” for More
```

Operate Menu

3.4. Automatic Pressure Control

Initial operation of the ABPR-20 consists of 3 basic steps;
1 -Setting of the PID values (preset at the factory)
2 -Setting the operating parameters
3 -Starting the ABPR-20

After the initial setting and saving of the PID and operating parameters, pressing the [F1] key will initiate control. The PID and operating parameters will only need to be changed if a change is desired in the control point or control characteristics.

Press [F4] to set the run parameters. These parameters consists of selecting the PID algorithm setups, A or B, setting the control pressure, pressure alarm and if enabled set the external temperature and external temperature alarm.

```
A-NAME1
B-NAME2
```

This screen allows the operator to select between the two PID setups, A and B. Press the [A] key.

```
<<Setup Run Params>>
Ctrl
Set Point (XXX) ?
      {1 – 680}
```

This screen is prompting for the pressure control value. Enter [200] and press the [ENTER] button.

```
<<Setup Run Params>>
Ctrl
Press Alarm(XXX) ?
      {1 – 680}
```

Next you will be prompted to enter the pressure alarm value. If the pressure exceeds this value the unit will emit an audible beep. Enter [250] and press the [ENTER] button.

```
<<Setup Run Params>>
Ctrl
Ext. Heat Set(XXX) ?
      {0 – 75}
```

If the unit has been configured to control an external heater you will be prompted to enter the control temperature. Enter [50] and press the [ENTER] button.

```
<<Setup Run Params>>
Ctrl
Ext. Heat Alarm(XXX) ?
      {0 – 75}
```

If the unit has been configured to control an external heater you will be prompted to enter the alarm temperature. Enter [100] and press the [ENTER] button.

```
<<Setup Run Params>>
Ctrl
Save setup? [Y/N]
```

Finally, you will be prompted to save the entered parameters. If you press [Y] the parameters entered will be saved even if power is removed from the unit, if you press [N] the parameters will remain until power is removed from the unit. Press [Y].

The unit is now ready to run. Press the [F1] key to begin control. The display will automatically change to display the current unit data.

```
<<MORE, PRESS 'F3'>>
Profile:A  CTRL:  ON
POS:0123     VTMP:040
SET:150   PRESS:150
```

Status Screen - Running

3.5. Stopping

Pressing [F2] will end the control mode, the needle position will remain where it was when the key was pressed and the heaters will be controlled as per the setups.

```
<<MORE, PRESS 'F3'>>
Profile:A  CTRL: OFF
POS:0123     VTMP:040
SET:150   PRESS:150
```

Status Screen - Stopped

3.6. Changing Control Pressure while Running

Pressing the [I] key while the unit is in the operate mode will cause the control pressure to be increased by 5 Bar until the maximum allowable pressure is reached. Pressing the [D] key while the unit is in the operate mode will cause the control pressure to be decremented by 5 Bar.

3.7. Shut Down

☞***NOTE:*** *Press [G] [0] before turning off power to be sure the ABPR-20 closes the valve to position zero before power down. The ABPR-20 has battery backup position memory but this is a good practice.*

3.8. Configuration Mode

The Configuration mode of the ABPR-20 is used to adjust the control parameters and to setup how the ABPR-20 will communicate to the Hand Held Terminal and an optional PC. The ABPR-20 is normally delivered to the customer pre-configured for operation and the configuration should not have to be changed. Contact Thar Technologies, Inc. prior to making changes to the configuration or improper operation may result. When the system is turned on it will present the operate menu, to access the configure menu press the "CFG" button on the rear of the unit.

```
<Press “M” for More>
[F1] Calibration
[F2] Com Port
[F3] Range Setup
[F4] Zero Sensor
[H] External Heater
[F] Factory Default
[V] Version
Press “M” for More
```

Configuration Mode Main Menu

3.8.1. Display Instructions

Line 1 of the display provides the title of the menu. Lines 2, 3 and 4 have various purposes: presenting variables, possible ranges, proposing values and accepting user input.

3.8.2. [F1] Zero/Calibration

Pressure transducers zero point may drift over time due to the cycling of the temperatures and pressures on them. The screens outlined below will allow the user to rezero, and recalibrate, the pressure transducer to compensate for any drift. The calibration procedure is password protected to prevent unauthorized personnel from performing the function.

```
Enter Password

(-1)?
      {1 – 9999}
```

Enter the password then press the [ENTER] key.

```
Do you want to
Calculate motor
Overshoot (N)?
        {Y/N}
```

Once you have successfully entered the password you will be asked if you want the unit to automatically calculate the amount of overshoot the motor has when moving quickly to a position. If the [Y] key is press the valve will be opened 300 counts, the unit will then look to see how many counts the valve was opened past the setpoint and this value will be saved and used for positioning when the unit is in the control mode. This value is automatically saved. If the [N] key is pressed, the motor calibration routine will be bypassed and you will go to the sensor calibrations.

```
Do you want to
Zero or calibrate
a channel (N):
        {Y/N}
```

You will be prompted if you want to zero or calibrate a sensor. If you press the [N] key you will exit the calibration routine. If the [Y] key is pressed you will be prompted for the sensor you want to calibrate.

```
<Zero Sensor?
P=Zero Pres
V=Zero Valve Temp
E=Zero Ext. Temp
```

Choose the appropriate letter for the channel you wish to calibrate. When the letter is pressed the current sensor value will be the new zero. Prior to pressing a key the appropriate sensor must be at a 0 condition, pressure or temperature. If the sensor is not at zero the calibration will be incorrect.

```
Calibrate
channel (N)?
        {Y/N}
```

Next you will be prompted to if you want to calibrate the channel. If the [N] key is pressed the unit will exit the calibration routine. If you wish to continue with the calibration procedure press the [Y] key.

☞***NOTE:*** *The new zero value for the sensor will be saved regardless of whether the channel is calibrated or not.*

```
Are you sure you
want to overwrite
calibration(N)?
        {Y/N}
```

If you pressed [Y] above you will be prompted again to make sure that you want to re-calibrate the unit. If you wish to continue press [Y], if you wish to exit without re-calibrating the unit press [N]. Pressing [N] will not cause the zero calibration to be lost.

```
Set and
enter calibration
value (0)?
        {0 - 689}
```

Apply a known value to the input of the unit. When the input has stabilized enter the value, in BAR/°C, then press the [ENTER] key.

3.8.3. [F2] Com Port

The unit is connected to a PC through one of the PC's com ports. This information is used to identify the device.

```
Com Port Setup

PC COM Port(2) ?
     {0 – 255}
```

Enter the number for the PC's com port which the unit will be connected, press the [ENTER] key. Normally the unit will be connected to com port 2 on the PC.

```
Com Port Setup
PC Update Rate
millisconds(1000) ?
    {250 – 30000}
```

The next screen will set how often the unit sends update information to the PC. This is normally set to 1000, and should always be set to 1000 when connected to Thar software.

```
Save Setup [Y/N]
```

If you wish to save the changes made to the com ports settings press the [Y] key, if you want to discard the changes press the [N] key.

3.8.4. [F3] Range Setup

This section allows the factory to configure the unit. This section is password protected and should not normally be accessed by the end-user. The information is covered here for completeness only.

```
Enter Password

(-1)?
      {1 – 9999}
```

Enter the password then press the [ENTER] key.

```
Range Setup

Max Press(XXX) ?
      {1 – 689}
```

Enter the maximum allowable CONTROL pressure, press the [ENTER] key. This pressure will be determined by the components in the system, such as the control valve, pressure transducer, etc.

```
Range Setup

Max Press Alarm(XXX) ?
      {1 – 689}
```

Enter the maximum allowable alarm pressure, press the [ENTER] key. This pressure will be determined by the components in the system, such as the control valve, pressure transducer, etc. The alarm value should never exceed the recommended safe operating pressure for the components.

```
Range Setup

Max Ext Heat (XXX) ?
      {1 – 150}
```

Enter the maximum allowable CONTROL temperature, press the [ENTER] key.

```
Range Setup

Max Ext. Heat Alarm (XXX) ?
      {1 – 160}
```

Enter the maximum allowable alarm temperature, press the [ENTER] key.

```
Range Setup

Max Valve Heat (XX) ?
      {1 – 75}
```

Enter the maximum allowable valve temperature, press the [ENTER] key.

```
Range Setup

Save setup? [Y/N]
```

If you wish to save the changes made to the range settings press the [Y] key, if you want to discard the changes press the [N] key.

3.8.5. [F4 Heater Setup

These menus allow the operator to determine how the heaters will be controlled when the unit is not in the pressure control mode.

```
Valve Heater Mode
(0=Always ON,1=Start
Stop w/BPR)(0) ?
        {0 – 1}
```

This setting determines when the valve will be heated. If 0 is selected the valve temperature will be controlled at the set value whenever the unit is turned on. If 1 is selected the valve temperature will be controlled at the set value only while the unit is in the pressure control mode.

```
Heater Setup

Valve Heat Set(40) ?
        {1 – 75}
```

The sets the temperature which the valve will be controlled at.

```
Ext. Heater Mode
(0=Always ON,1=Start
Stop w/BPR)(0) ?
        {0 – 1}
```

This setting determines when the external heater will be controlled. If 0 is selected the external heater temperature will be controlled at the set value whenever the unit is turned on. If 1 is selected the external heater temperature will be controlled at the set value only while the unit is in the pressure control mode.

```
Heater Setup

Ext. Heat Set(50) ?
        {1 – 150}
```

The sets the temperature which the external heater will be controlled at.

```
Heater Setup

Ext. Heat Alarm(60)
        {1 – 160}
```

The sets the temperature which the external heater will alarm at.

```
Save Setup? [Y/N]
```

If you wish to save the changes made to the range settings press the [Y] key, if you want to discard the changes press the [N] key.

3.8.6. [F] Factory Defaults

Pressing this key will cause all of the configuration values to be set to their default values. The user will be prompted to confirm that the current values should be overwritten.

3.8.7. [V] Version

Provides version data for upgrade and compatibility decisions.

```
ABPR X.X
```

Displays the current version of the ABPR software for 5 seconds.

4. Operation Under PC Control

When used in a Thar Technologies chromatography system the ABPR-20 is controlled via Process Suite software that is custom configured for the system. Consult the Software Operating Manual for more information on operating the ABPR-20 via Process Suite software.

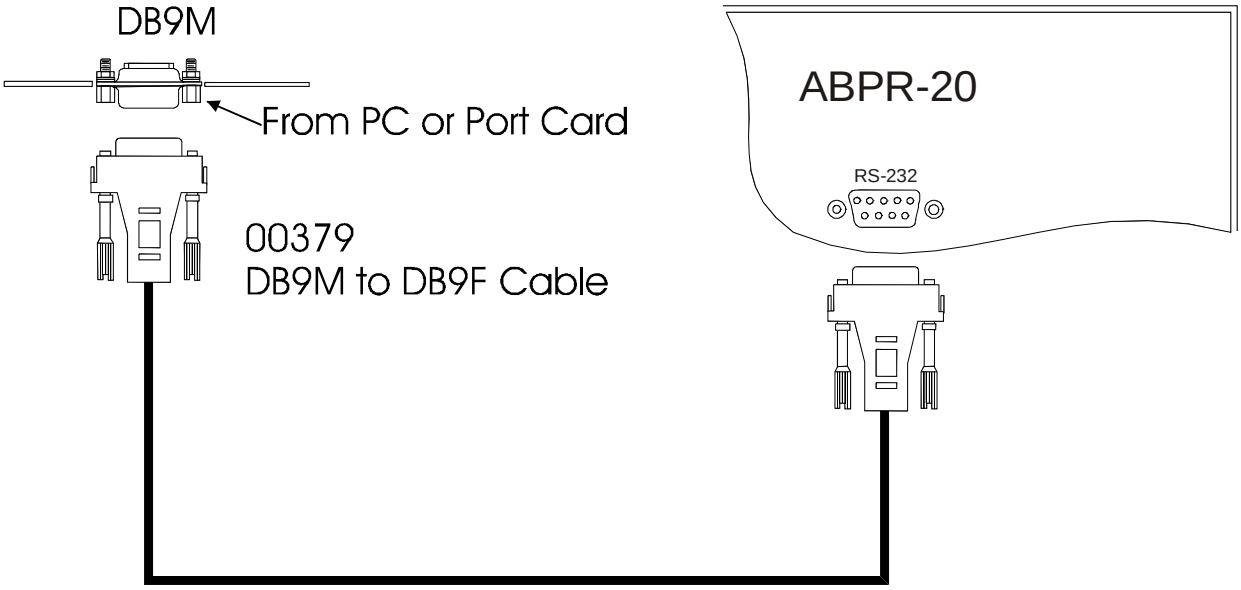


Figure 5: ABPR-20 Connection to a Computer

5. *Maintenance*

WARNING: There are no user serviceable parts inside the unit. Servicing of internal components should be done by Thar authorized service personnel or at the factory. Please direct service questions to Thar's Customer Service department or Thar authorized service agents.

☞ ***NOTE: Many parts on the system are made special to Thar Technologies specifications. Use of parts from vendors other than Thar Technologies may void warranty.***

☒ ***WARNING: This equipment contains hazardous voltages inside of the cabinet. Never operate this equipment with the grounding conductor of the power cord disconnected.***

5.1. Cleaning the Exterior

Cleaning the exterior of the ABPR-20 should be done with a mild cleaner. Use of harsh abrasives or solvents should be avoided.

5.2. When Maintenance is Indicated

The ABPR-20 is a finely controlled needle valve. The flow through the valve is controlled by adjusting the gap between the valve needle and the seat which corresponds to a needle count of between 0 and 6000. If a change occurs to the valve from wear or maintenance the gap will need to be reset, or aligned. The need for alignment occurs when the system is no longer able to achieve, or maintain, pressure at a set flowrate. Prior to aligning the valve, the system should be checked to ensuree there are no system leaks or pumping issues causing the problem.

5.3. Alignment of the Valve

.

Preliminary

Columns may add restriction to the flow of CO_2 and make alignment of the valve difficult. The column may also be exposed to higher than normal pressures and flow rates during the alignment procedure. For these reasons we recommend that you remove your column and replace it with a straight piece of tubing.

5.3.1. Using Hand Held Controller

1. With power off, connect the Hand Held Controller to the RS-232 connection on the rear of the unit. Apply power to the unit and allow the unit to complete it initialization.
2. Press the [G], [0], [ENTER] to close the valve to position 0.
3. Place the pump in pressure control mode and apply the desired maximum operating pressure to the valve but do <u>not</u> put the ABPR in control mode.
4. Hold the [SHIFT] key while pressing the [F1] key. You will be prompted to enter a new needle position, enter a position, typically 50 [ENTER].
5. Press the [G], [0], [ENTER] keys to close the valve to the new position 0. Allow the system to stabilize and observe the pump's flowrate. If the flowrate is sufficiently reduced then the alignment is complete, if not, or if the system cannot achieve the set pressure, repeat steps 3 - 4.

☞ ***NOTE:*** *Depending upon how far the valve is out of alignment it will be necessary to repeat the procedure a number of times. If components have been replaced it is normal to repeat these steps 8 – 10 times.*

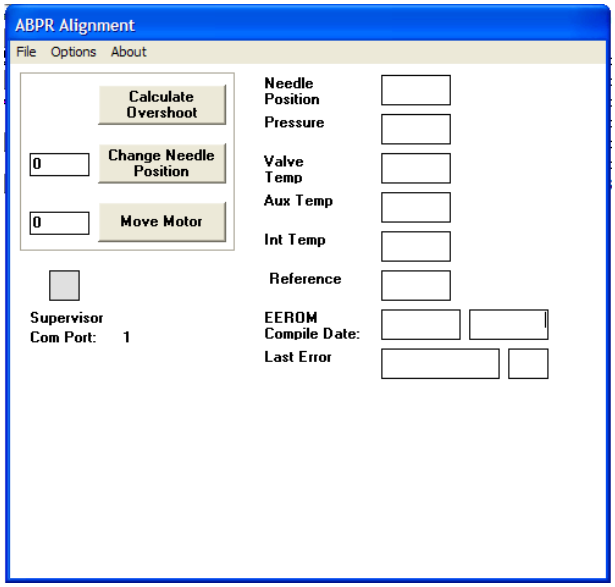
! ***CAUTION:*** *The valve is NOT designed to be a shutoff valve at high pressures. Attempting to close the valve to eliminate all flow at high pressures may damage the seat.*

☞ ***NOTE:*** *It is possible to be out of alignment in the too far closed direction. In this case use the [F4] command to set the desired position and then press [SHIFT F1] and set the position to zero.*

5.3.2. Using PC Software

INITIAL SETUPS

1. Exit Process Suite Software. Click on the "ABPR Alignment" icon on your desktop or Start Menu. You will be prompted to enter the PC Com port connected to the ABPR, the default port is 2.
2. When the main menu appears enter the value "0' in the field to the left of [Move Motor], then click on the [Move Motor] button.



3. Start Process Suite software and enter your user name and password. During the software initialization process you will receive an error that the software is unable to open the com port used for the ABPR. Say OK.
4. Place the exit line from the ABPR in a beaker of water. Apply tank pressure to the system, if you are NOT seeing any bubbling from the tubing continue to step **Error! Reference source not found.**
5. Enter a new needle position, typically 50, in the field to the left of [Change Needle Position], click on [Change Needle Position]. The new needle position will appear in the box to the right of "Needle Position".
6. Click on the [Move Motor] button to move the valve to position 0. Wait 15 seconds and check for bubbling from the exit line, if there is still flow from the line repeat steps 5 and 6.

Systems without a flow meter

7. In Process Suite, place the pump in pressure control mode and apply the desired maximum operating pressure to the valve.
8. Allow the system to stabilize and observe the pump's RPM and compare it with the RPM vs Flow chart below. If the flowrate is sufficiently reduced then the alignment is complete. If the flow rate is to high, or if the system cannot achieve the set pressure, enter a new needle position, typically 50, in the field to the left of [Change Needle Position], click on [Change Needle Position]. The new needle position will appear in the box to the right of "Needle Position".

Unit	RPM vs Flow
P-50	Flow = 4 X RPM
P-200	Flow = RPM
P-350	Flow = RPM / 2

9. Click on the [Move Motor] button to move the valve to position 0. Repeat steps **Error! Reference source not found.** and **Error! Reference source not found.** as necessary.
10. Exit the software by clicking on the [File/Exit] menu. The program will force the ABPR to reset. Restart Process Suite to allow it to communicate with the ABPR.

FDM Systems

7. In Process Suite, set the CO_2 pump flow rate to 6 mL/min. Set the pump alarm pressure to the desired pressure plus 40 Bar. Start the pump. Allow the pump to reach the desired pressure and set the flow to 1 mL/min.
8. If the pressure begins to drop, or if the system cannot achieve the set pressure, enter a new needle position, typically 50, in the field to the left of [Change Needle Position], click on [Change Needle Position]. The new needle position will appear in the box to the right of "Needle Position".
9. Click on the [Move Motor] button to move the valve to position 0. Repeat steps **Error! Reference source not found.** and **Error! Reference source not found.** as necessary.
10. Exit the software by clicking on the [File/Exit] menu. The program will force the ABPR to reset. Restart Process Suite to allow it to communicate with the ABPR.

☞ ***NOTE:*** *Depending upon how far the valve is out of alignment it will be necessary to repeat the procedure a number of times. If components have been replaced it is normal to repeat these steps 8 – 10 times.*

! ***CAUTION:*** *The valve is NOT designed to be a shutoff valve at high pressures. Attempting to close the valve so eliminate all flow at high pressures may damage the seat.*

☞ ***NOTE:*** *It is possible to be out of alignment in the too far closed direction. In this case enter the amount to open the valve in the field to the left of [Move Motor] and click on [Move Motor]. Enter "0" in the field to the left of [Change Needle Position] and click on [Change Needle Position].*

5.4. Seat Replacement Procedure

The procedure below describes the steps necessary to replace the seat in a Thar Technologies, Inc. ABPR valve. **When working with fitting connections always use a backup wrench on the seat retainer.**

Tools Required:

Phillips Screwdriver
1/2" Wrench
5/8" Wrench

Procedure:

1. Bleed off any pressure to the unit. Connect the Hand Held Terminal to the unit and apply power to the unit, or initialize "ABPR Alignment" program on the PC.

   ☞ ***NOTE:*** *If the ABPR was connected to a computer it will be necessary to turn the unit off/on in order for it to operate with the Hand Held Terminal.*

2. Open the needle to 6000 counts by:
   HHT) Press the [G] [6000] [Enter]
   PC) Entering "6000" in the field to the left of [Move Motor] and clicking on [Move Motor].
3. HHT) Press the [F3] key and wait until the needle reaches position.
   PC) On the PC software wait until the value to the right of "Needle Position" reaches 6000.
4. Turn off power to the unit.

   ☒ ***WARNING***: *The valve may be hot. If the ABPR was run at high temperature allow the valve to cool before proceeding.*

5. Disconnect the Outlet line from the front of the seat retainer using the 1/2" & 5/8" wrenches. See Figure 6 below.
6. Using a straight blade screwdriver remove the seat locking nut.
7. Remove the seat retainer using the 5/8" wrench. See Figure 6 below.
8. Normally the original seat (see Figure 6 below) will come out with the seat retainer, or fall out. Remove the original seat.
9. Place the replacement seat in the seat retainer. The seat should be placed in the retainer so that the larger hole is visible and, when installed in the valve, will be toward the needle, see Figure .

10. Screw the seat retainer & seat into the front of the valve block. Finger tighten the seat retainer into the front of valve then tighten ¼ turn with the 5/8" wrench. Do not overtighten or the seat will be damaged.
11. Apply power to the unit.
12. HHT) Press the [G], [1000], [ENTER] to close the valve to position 1000.
    PC) Enter "1000" to the left of [Move Motor], then click on [Move Motor].
13. HHT) Press the [F3] and wait until the needle reaches position.
    PC) Wait until the value to the left of "Needle Position" reaches 1000.
14. HHT) Press and hold the [SHIFT] key while pressing the [F1] key. Enter the value [0] for the new needle position.
    PC) Enter the value "0" to the left of [Change Needle Position] and click on [Change Needle Position].
15. Apply tank pressure to the ABPR. If a large volume of CO_2 is coming out of the exit port on the valve align the valve position per section 5.3 or 4.2
16. Reconnect the outlet line to the front of the unit using the ½" and 5/8" wrenches.
17. Re-install the top access cover.

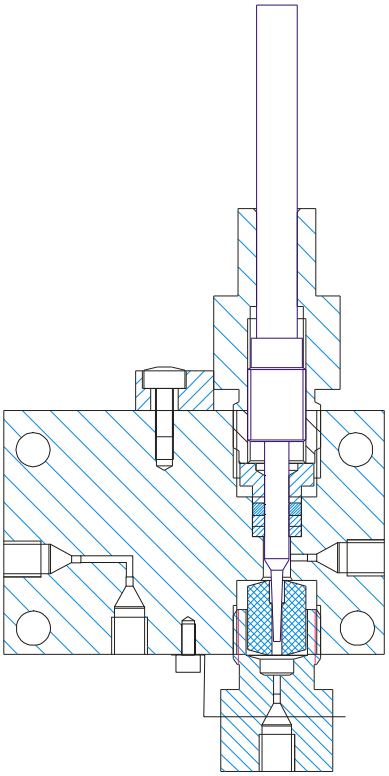


Figure 6: Valve Assembly

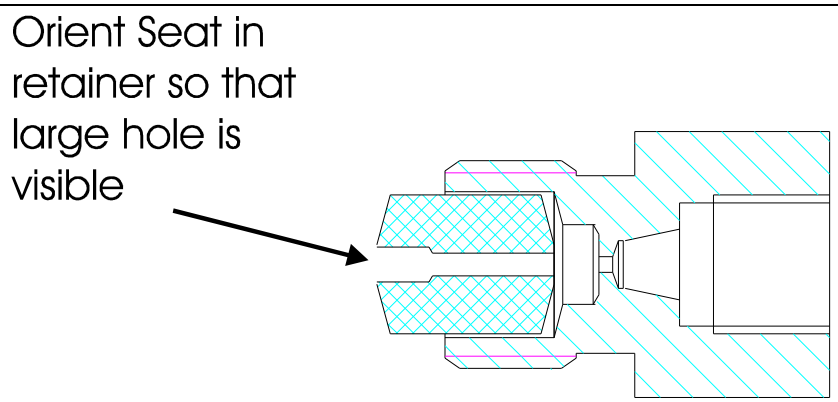


Figure 7: Seat Orientation in Retainer

5.5. Needle and Packing Replacement Procedure

The procedure below describes the steps necessary to replace the needle and packing in a Thar Technologies, Inc. ABPR valve. **When working with fitting connections always use a backup wrench on the seat retainer.**

Tools Required:

#2 Phillips Screwdriver
1/2" Wrench
13/16" Wrench
1/8" Allen Wrench
Packing Puller
3/16" Blade Straight Screwdriver
5/8" Wrench

Procedure:

1. Bleed off any pressure to the unit. Connect the Hand Held Terminal to the unit and apply power to the unit, or initialize "ABPR Alignment" program on the PC.

   ☞ ***NOTE:*** *If the ABPR was connected to a computer it will be necessary to turn the unit off/on in order for it to operate with the Hand Held Terminal.*

2. Open the needle to 6000 counts by:
   HHT) Press the [G] [6000] [Enter].
   PC) Enter "6000" in the field to the left of [Move Motor] and clicking on [Move Motor].
3. HHT) Press the [F3] key and wait until the needle reaches position.
   PC) Wait until the value to the right of "Needle Position" reaches 6000.
4. Turn off power to the unit.
5. On both the left and right sides of the chassis, remove the three screws closest to the front of the unit. This will allow the front access cover to lift off and give access to the valve.

   ☒ ***WARNING***: *The valve may be hot. If the ABPR was run at high temperature allow the valve to cool before proceeding.*

6. Disconnect the heater control, temperature sensor and pressure transducer cables from the rear bulkhead wall of the ABPR.
7. Disconnect the Inlet & Outlet fittings from the front of the valve. Refer to Figure for the valve component locations.
8. Using the wrench supplied, loosen the 2 setscrews securing the shaft coupler between to the valve. Slide the motor assembly back into the chassis.
9. Using the Philips screwdriver, remove the four (4) screws securing the valve to the bracket. Gently lift the valve up and out of the bracket.

   ! ***CAUTION:*** *The heater, temperature sensor and pressure transducer cables will remain attached to the valve. Do NOT pull on the cables or damage will result.*

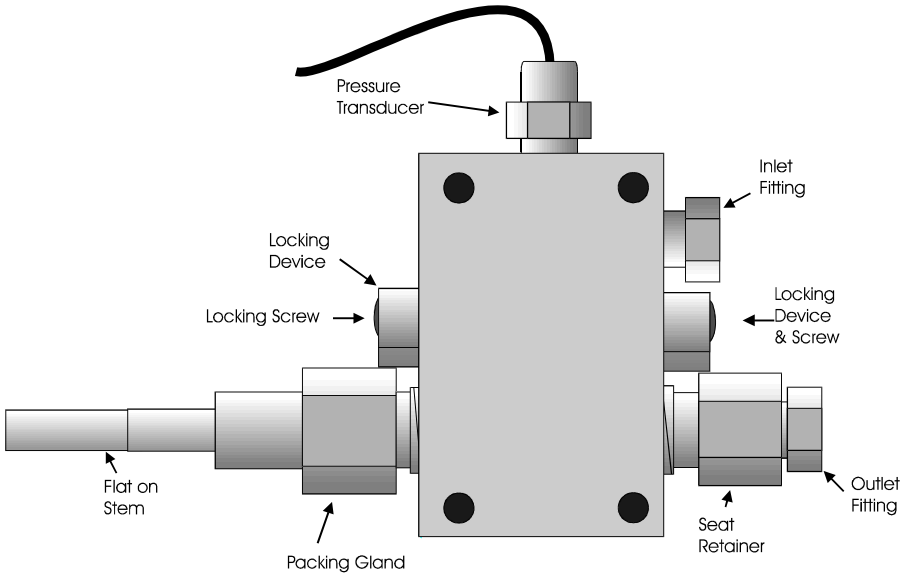


Figure 8: Valve Component Locations

10. Using the straight screwdriver, remove the locking screw and locking device from the end of the valve.
11. Using the 13/16” wrench loosen and remove the packing gland and stem from the end of the valve.

    ! ***CAUTION:*** *Use care not to damage the heater wires extending from the valve block.*

12. Remove the stem from the packing gland by turning the stem clockwise until the threads are disengaged.

13. Using a packing puller, remove the packing washer, packing and bottom washer from the valve body.
14. Apply an anti-seize compound to the components of the stem and packing as follows:
    The outside edge of the bottom washer
    The external threads of the stem
    The first three external threads of the packing gland.
15. Grasp the lubricated stem with your fingers and insert it into the packing gland. Rotate the stem counterclockwise in the packing gland until the internal threads of the packing gland are completely engaged, the stem threads bottom out in the packing gland.
16. Install the Packing Washer, Packing and Bottom Washer on the needle as shown in Figure .

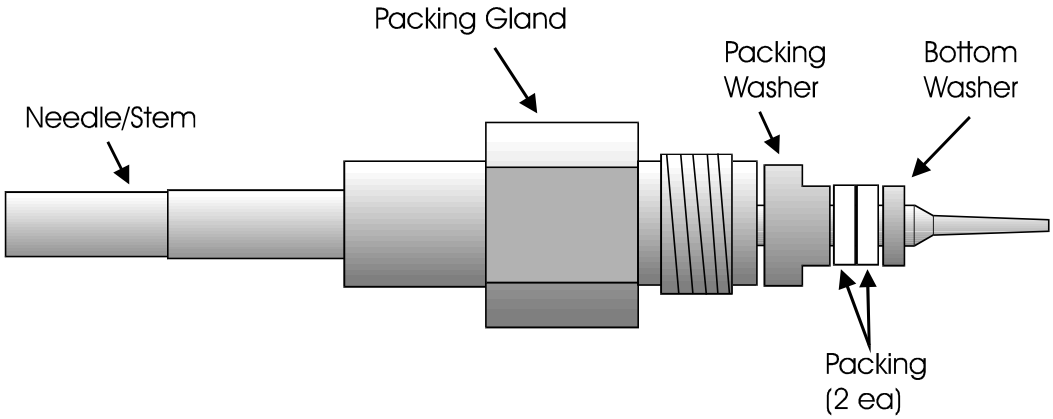


Figure 9: Stem Assembly

17. Install the packing gland and stem/packing components into the body. Tighten the packing gland to approximately 45 lb-ft.
18. Align the valve stem and drive shaft and slide the valve into place. Install the four Philips head screws through the valve and into the bracket.
19. Slide the coupler so it is centered between the motor shaft and valve stem. Tighten the setscrews on the coupler.
20. Tighten the four screws that secure the valve in place.
21. Reconnect the inlet fitting to the front of the valve using a 1/2" wrench.
22. Reconnect the heat cable, pressure transducer and thermocouple cables to their receptacles on the rear bulkhead.
23. Apply power to the unit.
24. HHT) Press the [G], [1000], [ENTER] to close the valve to position 1000.
    PC) Enter “1000” to the left of [Move Motor], then click on [Move Motor].
25. HHT) Press the [F3] and wait until the needle reaches position.
    PC) On the PC software wait until the value to the right of “Needle Position” reaches 1000.
26. HHT) Press and hold the [SHIFT] key while pressing the [F1] key. Enter the value [0] for the new needle position.
    PC) Enter the value “0” to the left of [Change Needle Position] and click on [Change Needle Position].
27. Apply tank pressure to the ABPR. If a large volume of CO_2 is coming out of the exit port on the valve align the valve position per section 5.3 or 4.2
28. Reconnect the outlet line to the front of the unit using the ½” and 5/8” wrenches.

5.6. Replacing fuses

☞ ***NOTE: 110 volt AC and 220 volt AC systems use different fuse drawers and fuses. Be sure to use the fuse or fuses, depending on your unit's voltage rating, listed in the Specifications section. Use a suitable continuity tester to determine if a fuse needs to be replaced.***

First try to determine what condition may have caused the fuse or fuses to fail and correct it before replacing them. If you need assistance in determining potential fault conditions, please contact Thar Customer Service.

To replace fuses, do the following. With the unit switched off and the power cord disconnected from the power entry module, remove the fuse drawer as shown. Use a small flat blade screwdriver to pry upward on the release tab. The fuse drawer will pop out slightly. Remove the fuse drawer and carefully remove the failed fuses. Insert the replacement fuses into the fuse drawer. Re-install the fuse drawer into the power entry module and push forward until the release tab locks. There should be an audible click when the fuse drawer is properly seated in the power entry module.

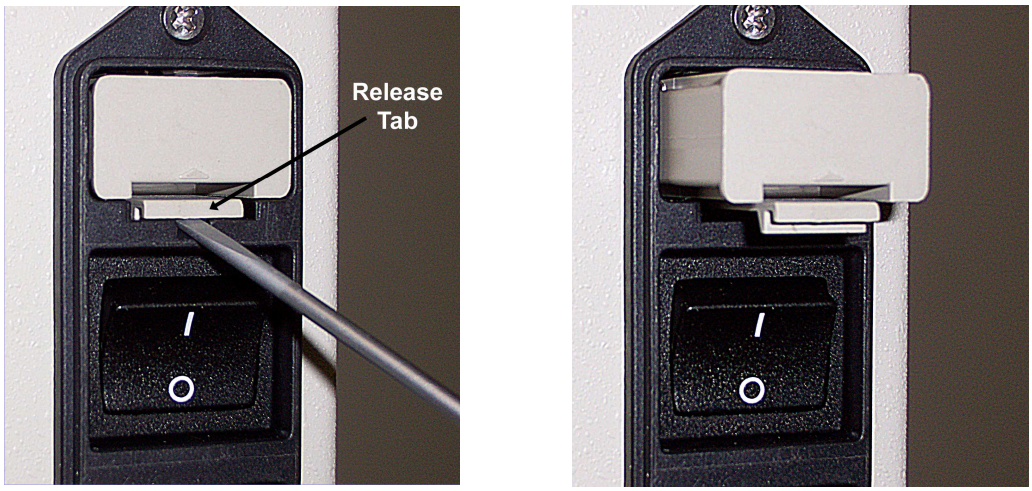
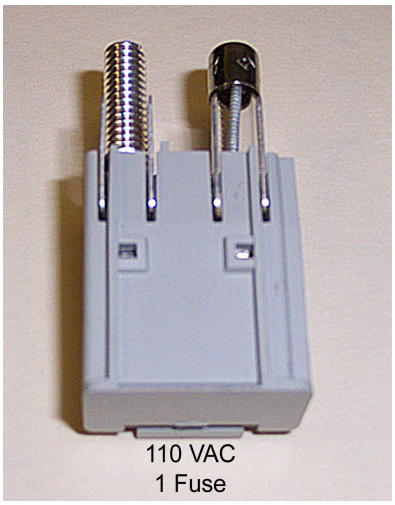


Figure 10: Removing the Fuse Drawer

5.6.1. Fuse Drawer Types

There are two types of fuse drawers used in most Thar instruments as shown in the photos below. For 110 volt nominal AC systems, a light tan colored fuse drawer with a single fuse and a built-in jumper is used. For 220 volt nominal AC systems, a black colored fuse drawer with two fuses is used. Check the Specifications section for specific part numbers. If you have any questions regarding fuse drawers, fuses and voltage ratings , please contact Thar Customer Service.



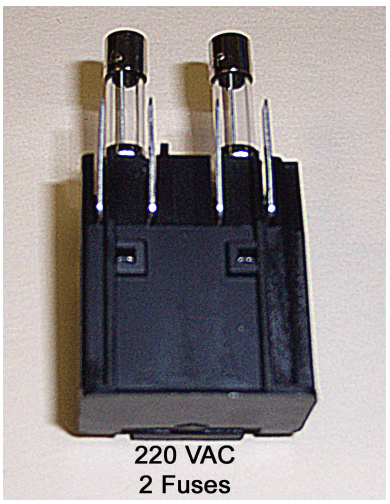


Figure 11: 110 VAC and 220 VAC Systems Fuse Drawers

! ***CAUTION: When purchased, your system will be configured to operate on the standard voltage for your location. If the system is moved to an area utilizing a different line voltage, the system must be reconfigured for the correct voltage. See the Specification section for fuse drawer and fuse information.***

6. Replacement Parts

The following parts are typical replacement parts for use on the ABPR-20. Thar Technologies does not recommend use of any substitute parts and cannot be held liable for any damage or injury caused by use of any substitute parts.

Part #	Description	Qty Used per Unit	Reference on Figure
06088	Valve Assembly for ABPR-20	1	1-X
06195	Valve Rebuild Kit		
	Needle, Micrometering Valve [1]	1	1
	Top Packing Washer [2]	1	2
	Teflon Packing, Micrometering Valve [1]	2	3
	Bottom Washer, Micrometering Valve [1]	1	4
04497	Seat, PEEK Micrometering Valve – Standard [1]	1	5
04905	Seat Retainer	1	6
00425	Hand Held Terminal	1	-
00455	Cable, HHT	1	-
04817	Connector/adapter RJ-11 to DB-9	1	-
00382	Fuse, 3A SlowBlo (110V Units)	1	-
00378	Power Cord (110V Units)	1	-
04334	Fuse,1.6A SlowBlo (220V Units)	2	-
00291	Power Cord (220V Units – European Style)	1	-
04265	1/8” Ferrule, Inlet/Outlet Fitting	1	
01684	1/8” Gland Nut, Inlet/Outlet Fitting	1	

1 Included in 06195 Rebuild Kit

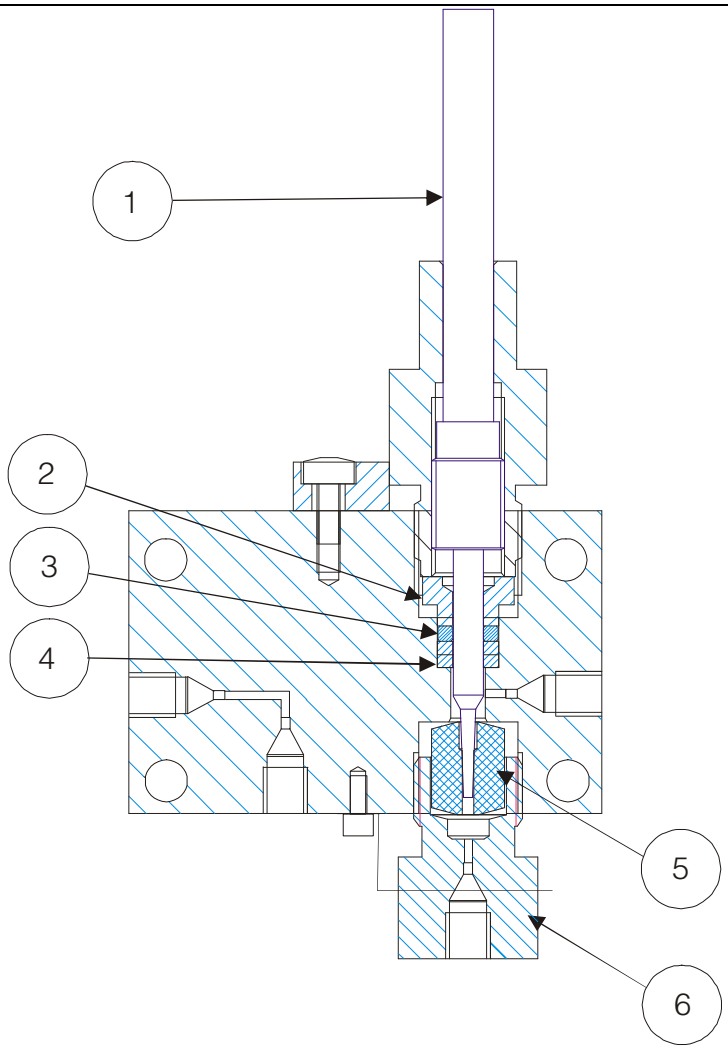


Figure 12: Valve Replacement Part Identification

7. Appendix

7.1. General CO_2 Safety Considerations

The text in this section has been adapted from the CGA (Compressed Gas Association) publication CGA G-6 – 1984: Carbon Dioxide.

Gaseous carbon dioxide is an asphyxiant. Concentrations of 10% or more can produce unconsciousness or death. Lower concentrations may cause headache, sweating, rapid breathing, increased heart rate, shortness of breath, dizziness, mental depression, visual disturbances, and shaking. The seriousness of the latter manifestations is dependant on the concentration of carbon dioxide and the length of time the individual is exposed.

Carbon dioxide is an odorless gas and should be treated as a material with poor warning properties. It is denser than air, and high concentrations can persist in open pits, tanks, or low depressions on the terrain. Before entering such an area, carbon dioxide monitoring should be carried out and the area cleared by forced ventilation, or a self-contained, supplied air respirator should be worn.

Appropriate warning signs should be affixed outside of those areas where high concentrations of carbon dioxide gas can accumulate. One such sign is shown below:

WARNING: *– Carbon Dioxide Gas - Ventilate the area before entering. A high CO_2 gas concentration may occur in this area and may cause suffocation.*

7.1.1. Rescue

Do not attempt to remove the individual without utilizing proper rescue equipment or you may also become a casualty. If the exposed person is unconscious, obtain assistance and put into effect the established emergency procedures.

7.1.2. Inhalation First Aid

Inhalation of gaseous carbon dioxide can adversely affect body function. Skin, eye, or mouth contact with dry ice (solid carbon dioxide) or compressed carbon dioxide can cause adverse effects.

If a person has inhaled large amounts of carbon dioxide and is exhibiting adverse effects, move the exposed individual to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get professional medical attention immediately.

7.1.3. External Exposure First Aid

Skin or mouth contact with dry ice or with vapor or liquid carbon dioxide discharged from a container may result in frostbite, causing skin lesions or more serious injury from deep freezing of the tissues.

If dry ice or compressed CO_2 vapor comes in contact with the skin or mouth, stop the exposure immediately. If frostbite occurred, obtain professional medical attention immediately. Do not rub the area. Do not apply heat warmer than 41.7 °C.

Eye contact with dry ice or compressed CO_2 should be considered as a corneal burn. Frostbite of the eye structure may also occur.

If dry ice or CO_2 vapor or liquid comes in contact with the eyes, stop the exposure and obtain professional medical attention immediately.

8. Specifications

General	
Sound pressure level	< 70 dB
Working temperature	5 - 40°C
Storage temperature	-25 / +60°C
Humidity	20 - 80% RH
IP Rating	IP22
Duty Rating	Continuous
Pollution Degree	2
Wetted parts	SS316, PTFE, PEEK, TiN Coated Valve Needle
Operational	
Maximum Pressure	689 Bar
Max Operating Pressure	600 Bar
Pressure Accuracy	+/- 1 % Full Scale Pressure
Max Flow Rate	20 ml/min CO_2
Programming	
Stored Profiles	2 internally stored, customer customizable
Mode	Pressure control
Physical	
Dimensions (W x D x H)	17.5 cm x 42 cm x 15.3 cm (6.875” x 16.5” x 6”)
Weight	7 kg (15.5 lbs)
Electrical	
Power requirements	110VAC; 50 Hz/60 Hz; 220 VA* 220VAC; 50 Hz/60 Hz; 220 VA*
Fuses	For 110VAC; one 3 AT-fuses (MDA-10-R) (¼” x 1¼”, UL/CSA) For 220VAC; two 1.6 AT-fuses (0218010) (5 x 20 mm, IEC 127) All fuses UL-listed and CSA-certified
Fuse Drawer	For 110VAC use Thar part number 00556 For 220VAC use Thar part number 00553
Grounding	Requires properly grounded receptacle *Normal operating current, high inrush currents are possible at power on.

Communication

OUTPUTS	Single External Heater Control for Thar Vessel Heaters
INPUTS	
Thermocouple port	J-type - for external heater control.
Serial Communication port	RS232C
PC-control	Microsoft Windows XP
TNET Protocol	Yes

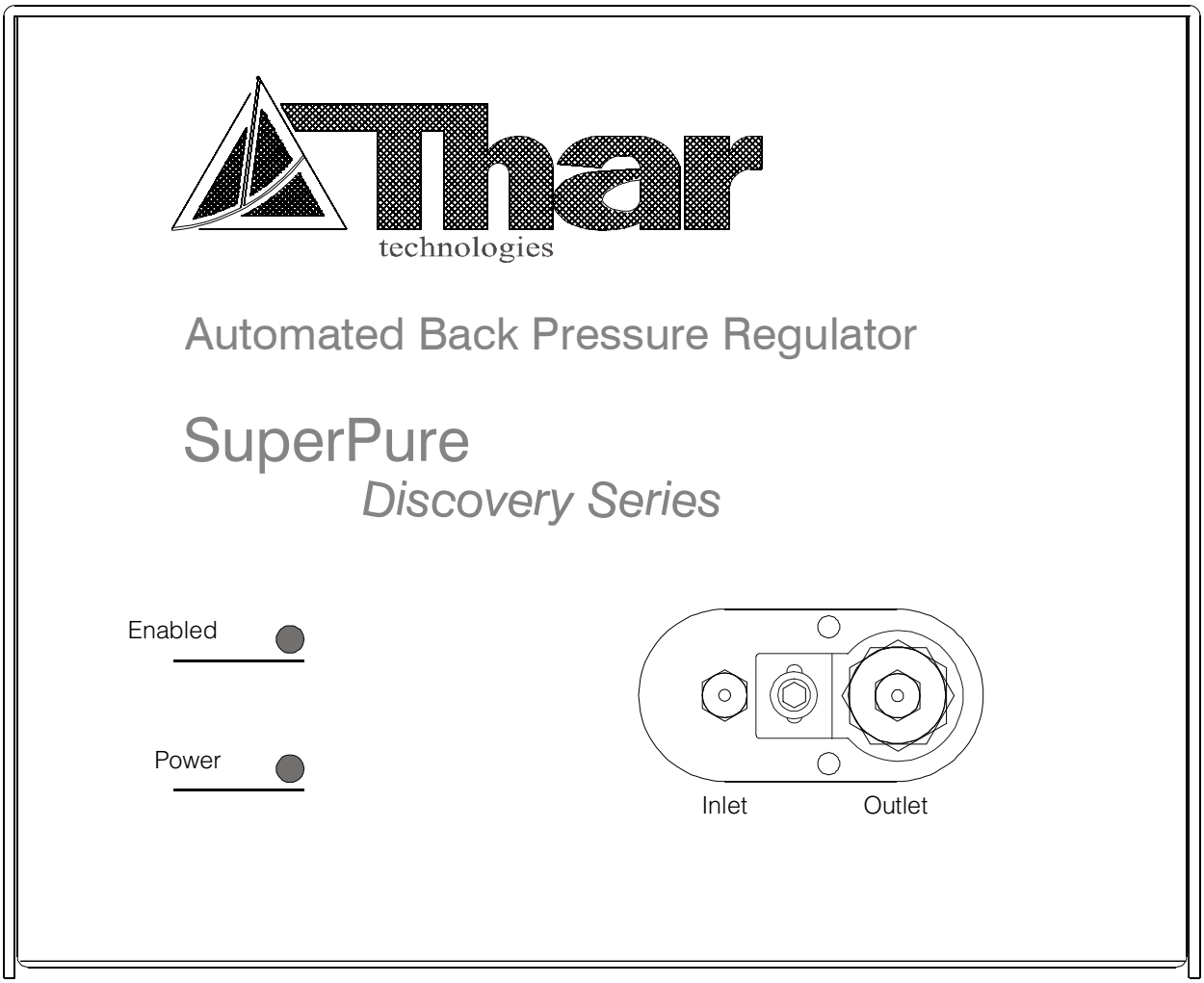


Figure 13: Front of ABPR-20

Enabled	Indicator is lit when the ABPR-20 is in the control mode.
Power	Indicator is lit when power is applied to the ABPR-20 and the power switch is in the ON position.
Inlet	Inlet port; 1/16 stainless steel fitting
Outlet	Outlet port; 1/16” stainless steel fitting

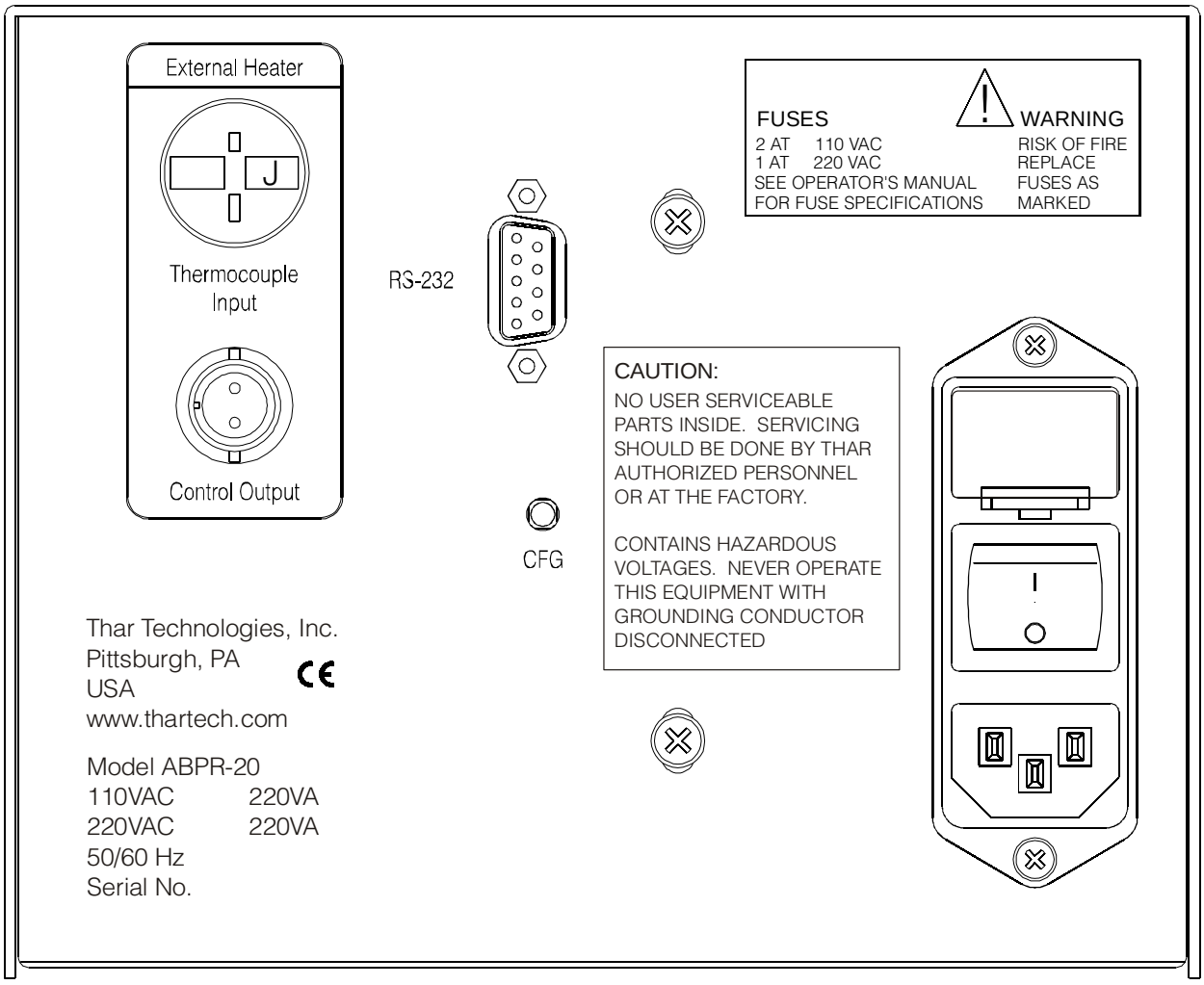


Figure 14: Rear of ABPR-20

CFG	Used to place the unit in the configuration mode. See section 3.8
RS-232	Used to communicate with PC or Hand Held Terminal
Thermocouple Input	J-type thermocouple input for an optional Thar vessel heater.
Control Output	5 VDC control signal for an optional Thar vessel heater
AC Input	Power input connection and fuse holder. AC power in must be within the specifications listed and must be properly grounded. Replace fuses with type those specified.
Power	Power On/Off switch. **I** is On, **O** is Off.