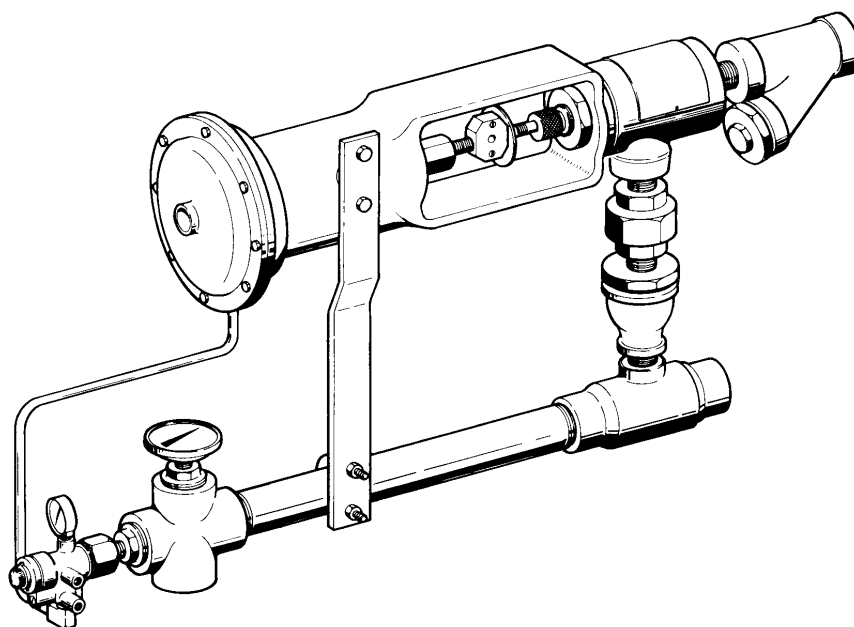




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Automatic Liquid Heating System

Model FHS



Installation, Operation and Maintenance Instructions

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PENBERTHY PRODUCT WARRANTY

Pentair Valves & Controls Black Mountain warrants its Penberthy products as designed and manufactured by PV&C Black Mountain to be free of defects in the material and workmanship for a period of one year after the date of installation or eighteen months after the date of manufacture, whichever is earliest. PV&C Black Mountain will, at its option, replace or repair any products which fail during the warranty period due to defective material or workmanship.

Prior to submitting any claim for warranty service, the owner must submit proof of purchase to PV&C Black Mountain and obtain written authorization to return the product. Thereafter, the product shall be returned to PV&C in Black Mountain, North Carolina, with freight paid.

This warranty shall not apply if the product has been disassembled, tampered with, repaired or otherwise altered outside of PV&C Black Mountain factory, or if it has been subject to misuse, neglect or accident.

The responsibility of PV&C Black Mountain hereunder is limited to repairing or replacing the product at its expense. PV&C Black Mountain shall not be liable for loss, damage or expenses related directly or indirectly to the installation or use of its products, or from any other cause or for consequential damages. It is expressly understood that PV&C Black Mountain is not responsible for damage or injury caused to other products, buildings, personnel or property, by reason of the installation or use of its products.

THIS IS PV&C BLACK MOUNTAIN'S SOLE WARRANTY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED WHICH ARE HEREBY EXCLUDED, INCLUDING IN PARTICULAR ALL WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This document and the warranty contained herein may not be modified and no other warranty, expressed or implied, shall be made by or on behalf of PV&C Black Mountain unless made in writing and signed by the General Manager or Director of Engineering of PV&C Black Mountain.

INSTALLATION, OPERATION and MAINTENANCE MANUAL FOR PENBERTHY MODEL FHS AUTOMATIC HEATING SYSTEM

1.0 About the Manual

This manual has been prepared as an aid and guide for personnel involved installation or maintenance. All instructions must be read and understood thoroughly before attempting any installation, operation, or maintenance.

Important: Penberthy does not have any control over the manner in which its FHS is handled, installed, or used, and Penberthy cannot and does not warrant or guarantee that a FHS is suitable or compatible with the user's specific application.



Always wear safety glasses when installing, servicing or operating an FHS automatic liquid heating system. Failure to follow any instruction could possibly result in a malfunction of the FHS automatic liquid heating system resulting in severe physical injury or property damage.

2.0 Introduction

2.1 Features and Specifications

Penberthy model FHS automatic liquid heating system is a complete, pre-engineered package including: a Steam Ring Heater, steam inline check valve, temperature controller, steam flow control valve, dial thermometer, steam strainer and associated piping.

The model FHS is designed to maintain a preset outlet temperature by controlling the amount of steam condensed into the inlet liquid as it passes through the Steam Ring Heater.

2.2 Design Ratings at Maximum and Minimum Operating Temperatures

1. Steam valve 150 psig (1.03 MPa) at -20°F (-29°C) to +370°F (188°C)
2. Heater and wetted parts per chart below:

Material	Rating
Bronze	200 psig [1.38 MPa] at -20°F [-29°C] to +150°F [66°C] 125 psig [0.86 MPa] at +400°F [204°C]
316 SS	200 psig [1.38 MPa] at -150°F [-101°C] to +150°F [66°C] 125 psig [0.86 MPa] at +400°F [204°C]

Table 1

To determine maximum allowable working pressure for a specific temperature within the design limits stated above, the user must refer to Penberthy dimension sheets, or when provided, the specifically stated design limits on a Penberthy product proposal.

2.3 Application Data

The Penberthy FHS is designed to operate at liquid line pressures from 10 to 100 psig (70 to 690 kPaG), steam pressures from 30 to 150 psig (205 to 1035 kPaG), and at an air supply pressure of 18 psig +/- 1 psig (125 +/- 5 kPaG).

Note: For specific application data within the above ranges, the user should consult the Penberthy product proposal for the specific model and size FHS, or request Penberthy to supply the applicable Technical Data Bulletin.



Never exceed these design ratings or application data. Exceeding design ratings or application data limits can result in serious personal injury or property damage.

3.0 Inspection and Performance Confirmation

3.1 Receiving Inspection

Upon receipt of FHS, check all components carefully for damage incurred in shipping. If damage is evident or suspected, do not attempt installation. Notify carrier immediately and request a damage inspection.

3.2 Users' Rating Inspection

The user should confirm that:

1. The FHS model and size, stamped on nameplate (163) conforms to the description on the user's purchase order.
2. The operating conditions described in the purchase order agree with the actual conditions at the installation site.
3. The actual operating conditions at the installation site are within the application data shown on the Penberthy Technical Data Bulletin or product proposal referred to above.
4. The materials of construction of the FHS are compatible with both the contained fluid and surrounding atmosphere in the specific application.

Important: If the size, model or performance data of the FHS as received does not conform with any of the criteria above, do not proceed with installation. Contact an authorized Penberthy distributor for direction on what to do.

4.0 Installation

Use qualified experienced personnel who are familiar with this equipment and thoroughly understand all the instructions in this manual, for the installation of this equipment.

Refer to Penberthy dimension sheets or Penberthy product proposal to obtain dimensional information for the specific size and model FHS.

Check Figure 1 for the location of the liquid inlet and outlet, steam inlet, and air inlet connections to insure correct hook up.

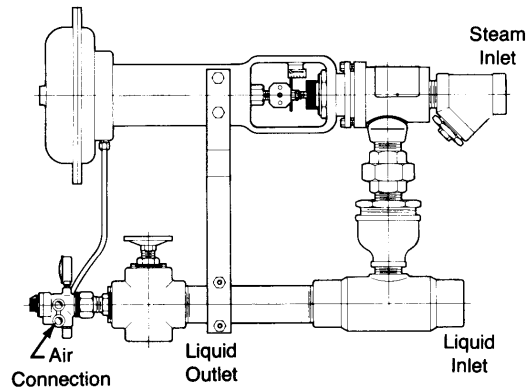


Figure 1

4.1 Mounting

Although the FHS can be oriented in any position, it is recommended to position the steam valve actuator horizontally. In this manner, the thermometer dial will be upright, the steam piping and Steam Ring Heater will be in a position to favor removal of condensate at start up, the steam line strainer will point downward, and the temperature controller will be located as recommended by the controller manufacturer.

4.2 Effect of Related Piping and Precautions

1. The FHS should be installed with piping and fittings which provide minimum resistance to flow. Pipe line friction losses must always be a consideration when estimating FHS performance.
2. It is recommended that provisions be made for pressure gage connections near the liquid inlet and outlet, and the steam inlet connections of the FHS. If performance problems occur during operation, it may be necessary to install pressure gages to identify the problem.
3. Steam must not have over 20°F (-7°C) of superheat, or performance will differ from that published in the Penberthy Technical Data Bulletin or product proposal referred to above.
4. Steam line must be clean, insulated, and as short as possible to prevent condensation and line friction losses.
5. Do not impose system piping loads on FHS. Unit is designed to be supported by the liquid inlet and outlet, and steam inlet piping.
6. Provide the steam line with a hand-operated valve for maintenance and emergency shut-off. The steam line should be provided with a steam trap.
7. Provide an air line with an air pressure regulator capable of maintaining 18 psig (125 kPaG) air pressure, and also, it is recommended that an air pressure gage be installed in this line.

5.0 Operation

5.1 Pre-Operational Check

1. Check that all installation instructions have been completed.
2. Check that any restrictions in the discharge line have been removed.
3. Check that discharge line valves are fully open.
4. Check that the manually operated steam line valve is fully closed.
5. Check that the temperature controller knob is set to the lowest possible reading by turning it counterclockwise as far as it will go.
6. Check that the air pressure regulator valve is shut off.

Note: When the control valve is completely installed and connected and ready to be put into operation, it is necessary for the user to check for correct travel, freedom of friction, and correct action (air-to-open) to match the temperature controller. If adjustments are necessary, follow all instructions printed in the installation instruction manual prepared for the specific actuator by its manufacturer.

5.2 Operating

1. Turn operating liquid valve fully on and establish full flow. Keep it on throughout the entire operation process.



Failure to maintain the liquid flow while operating the FHS with steam can cause live steam to be driven into the liquid piping, resulting in serious personal injury or property damage.

2. Turn on air pressure regulator and adjust air pressure knob to 18 psig (125 kPaG).
3. Set knob of temperature controller at 120°F (49°C) and check for proper operation of steam valve. The steam valve should be fully open in about 20 seconds time. If the steam valve does not open in about 20 seconds, adjustment of the temperature controller is necessary. Follow all steps and precautions printed in the installation instruction manual prepared for the specific controller by its manufacturer.
4. Bleed out trapped air inside pipe cross where thermometer is installed by slightly loosening the thermometer connection until liquid begins to drip out, then retighten thermometer in place.
5. Slowly and partially open the manually operated steam line valve to first check for leaks. If leaks are evident, close valve, allow line to cool off, tighten connections, and repeat procedure until all leaks are stopped.
6. Turn temperature controlled knob to 100°F (38°C) to allow steam to flow while checking for leaks. If leaks are evident, shut off steam supply, allow line to cool off, tighten connections, and repeat procedure until all leaks are stopped.
7. Fully open manually operated steam valve.
8. Turn temperature controller knob gradually to desired outlet liquid temperature and allow FHS to stabilize. Compare knob setting with thermometer reading and adjust if necessary.

There are two distinct operating noise levels typical of the FHS, within specific operating conditions. For detailed information on these operating conditions, request Penberthy to supply the Technical Data Bulletin.

5.3 Shutdown

1. Turn the manually operated steam line valve off in order to first lower the steam line pressure as much as possible before shut down.
2. Set the temperature controller knob to the lowest possible reading by turning it counterclockwise as far as it will go. This will cause the stream flow control valve to fully close.
3. Turn the air pressure regulator valve fully off.
4. Gradually turn the operating liquid flow fully off.



Failure to maintain the liquid flow throughout the shutdown procedure may cause live steam to drive into the liquid piping, resulting in serious personal injury or property damage.

6.0 Maintenance

Use only qualified, experienced personnel who are familiar with this equipment and thoroughly understand all the instructions in this manual for all maintenance.



Do not proceed with any maintenance unless the FHS has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so could result in serious personal injury or property damage.

6.1 Preventative Maintenance

Create maintenance schedules, safety manuals, and inspection details for each specific installation of an Automatic Liquid Heating System.

On all installations, regularly check the following items for purposes of maintenance:

1. FHS components for corrosion and to remove debris build up.
2. Piping and fittings for corrosion and to remove debris build up.
3. All connections to maintain tightness and eliminate leaks.
4. Air pressure regulator to maintain 18 psig (125 kPaG).
5. Outlet liquid temperature to maintain desired setting.
6. Steam line strainer to remove debris build up.
7. Temperature controller response and sensitivity.

Determine upon evaluation of your operating experience the appropriate maintenance schedule necessary for the specific application. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

6.2 Maintenance Procedures

1. For servicing the actuator, the user must follow all steps and precautions printed in the installation instruction manual prepared for the specific actuator by its manufacturer.
2. For servicing the steam flow control valve, the user must follow all steps and precautions in Section 7.0.
3. For servicing the Steam Ring Heater, the user must follow all steps and precautions printed in the installation manual prepared for the specific Steam Ring Heater.
4. For servicing the temperature controller, the user must follow all steps and precautions printed in the installation manual prepared for the specific controller by its manufacturer.

6.3 Troubleshooting

Problem: Surges in liquid flow.
Cause: Pumping action.
Cure: Increase pressure discharge.

Problem: Surges in outlet temperature.
Cause: Temperature controller overshoot.
Cure: Desensitize controller. Refer to temperature controller installation manual.

7.0 Disassembly-Reassembly



Do not proceed with removal of FHS from connecting piping unless the FHS has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids. Failure to do so could result in serious personal injury.

1. Preparation
Secure a workbench sufficiently sized to lay out parts as they are removed.
2. Removal of valve sub-assembly from the FHS may be accomplished as follows:
 - a. Loosen and remove air line connection (60) to the valve actuator.
 - b. Connect air hose to air connection of actuator (239) and pressurize (0-12 psig, 0 - 85 kPaG) to open the valve 20-80%.
 - c. Loosen stem connector nut (4) and stem packing nut (26).
 - d. Unscrew the valve stem (17) from the diaphragm actuator stem connector, turning clockwise to remove.
 - e. Remove the valve position indicating disc (43) from stem.
 - f. Loosen the yoke nut (4B) and remove from the valve bonnet (20).
 - g. Remove diaphragm actuator from valve (75).
 - h. Reduce the air pressure in the actuator to 0 psig and remove air line.
 - i. Remove valve from connecting piping.
 - j. Place valve on work bench inlet side down with stem pointing up.
 - k. While holding valve body firmly, loosen and remove the four (4) cap screws (100), and free the bonnet from the body (11) of the valve.
 - l. Grasp the valve piston (217) at the lower end and slide the stem carefully downward out of the bonnet.

Important: When sliding the stem out of the bonnet, care must be taken to avoid damaging the packing assembly with the threads of the valve stem.

- m. Using a stiff wire with a short hook on its end, remove all gaskets (7, 7A, 7B, 7C) cage (29) and seat (16) from inside body.

Note: It may be required to lightly tap the side of the body with a hammer to loosen and remove the seat.

- n. Discard all removed gaskets. Do not reuse gaskets under any circumstances.



Gaskets are permanently deformed by compression and if re-used, can cause leaks resulting in release of live steam causing serious personal injury or property damage.

- o. Inspect valve seat and piston for wear or damage and replace if necessary.

3. Packing box maintenance must be performed as follows:

Important: Valve stem must be out of the bonnet before attempting to remove packing so that the stem is not accidentally damaged. If the packing is not to be replaced be careful when moving the valve stem through the packing, so that the stem threads do not damage the packing.

- a. Remove the packing nut (26) and packing gland (19) from the bonnet (20).
- b. Using a stiff wire with a short hook on its end, draw the packing rings (211) out of the bonnet.

4. Reassembly procedures for replacing stem packing.

- a. Slide valve stem through packing box of bonnet.
- b. Carefully slide a full set of new packing rings over valve stem, per Figure 2 below, making sure that the packing is not damaged by the threads of the stem.

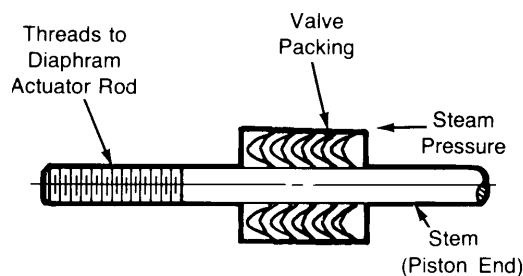


Figure 2

- c. Replace packing gland and packing nut and tighten finger tight.

Important: The stem packing nut should only be screwed down finger tight. When necessary to compress the packing more, tighten the packing nut by hand again.

5. Reassembly of valve sub-assembly.

- a. Assemble components as shown in Figure 5 and per instructions below.
- b. With valve body resting on work bench, inlet side down, insert seat gasket and seat inside body making certain that the seat is properly seated.
- c. Insert cage over top ring of seat.
- d. Place the two (2) gaskets over top ring of cage in proper order.
- e. Insert bonnet/body gasket into body.
- f. Make certain that the stem is properly installed in bonnet, refer to Paragraph 4 above, and replace bonnet into body.
- g. Hold valve firmly and replace cap screws through bonnet and wrench tighten.
- h. Replace valve body into piping system using Teflon[®] tape or equivalent on all male tapered pipe threads as shown in Figure 3 below.

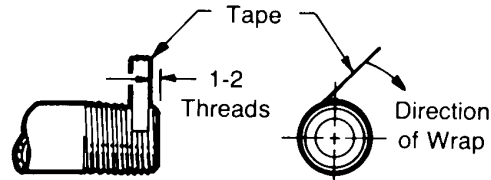


Figure 3

- i. Connect air hose and regulator to diaphragm actuator and pressurize to fully open valve (100%).
- j. Place yoke of actuator over threads of valve bonnet, making sure to place yoke nut and valve position indicating disc over the stem while doing this.
- k. Thread the valve stem into actuator connector rod approximately 6 full turns.
- l. Tighten yoke nut down finger tight and check to see if the yoke is seated against the valve bonnet.
- m. If the yoke is not seated against the valve bonnet, thread the valve stem further into the actuator connector rod until the yoke is seated against the valve bonnet, then tighten yoke nut in place.
- n. Tighten the stem connector nut against the valve position disc and actuator connector rod.
- o. Slowly reduce the air pressure to the actuator to close the valve. At 0 psig (0 kPaG), the valve position indication disc should indicate that the valve is closed. If the disc goes below the 0% open mark on the actuator scale, this indicates improper adjustment.
- p. To adjust the disc position, increase the air pressure to the actuator to raise the valve 20-40% open. Then loosen the stem connector nut a few turns and turn the stem out (clockwise) one turn, tighten the stem connector nut and release the air pressure. This procedure should be repeated until the indicating disc is exactly indicating 0% open for the valve.
- q. Remove air hose from actuator
- r. Reconnect air line connection to actuator.
- s. Refer to Section 5.0 Operation when returning FHS to service.

8.0 Disposal at End of Useful Life

Penberthy FHS's are used in a variety of fluid applications. By following the appropriate federal and industry regulations, the user must determine the extent of preparation and treatment the FHS must incur before its disposal. A Material Safety Data Sheet (MSDS) may be required before disposal services accept certain components.

Metal, glass and polymers should be recycled whenever possible. Refer to order and PV&C - Black Mountain Material Specification sheets for materials of construction.

9.0 Telephone Assistance

If you are having difficulty with your FHS, contact your local Penberthy distributor. So that we may assist you more effectively, please have as much of the following information available as possible when you call:

- Model #
- Name of the company from whom you purchased the FHS
- Invoice # and date
- Process conditions (pressure, flow rates, tank shape, etc)
- A brief description of the problem
- Trouble shooting procedures that failed

If attempts to solve your problem fail, you may request to return your FHS to the factory for intensive testing. You must obtain a Return Authorization (R.A.) number from PV&C Black Mountain before returning anything. Failure to do so will result in the unit being returned to you without being tested, freight collect. To obtain an R.A. number, the following information (in addition to that above) is needed:

- Reason for return
- Person to contact at your company
- "Ship To" address

There is a minimum charge of \$75.00 for evaluation of non-warranty units. You will be contacted before any repairs are initiated should the cost exceed the minimum charge. If you return a unit under warranty, but is not defective, the minimum charge will apply.

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10.0 Exploded Parts Drawing

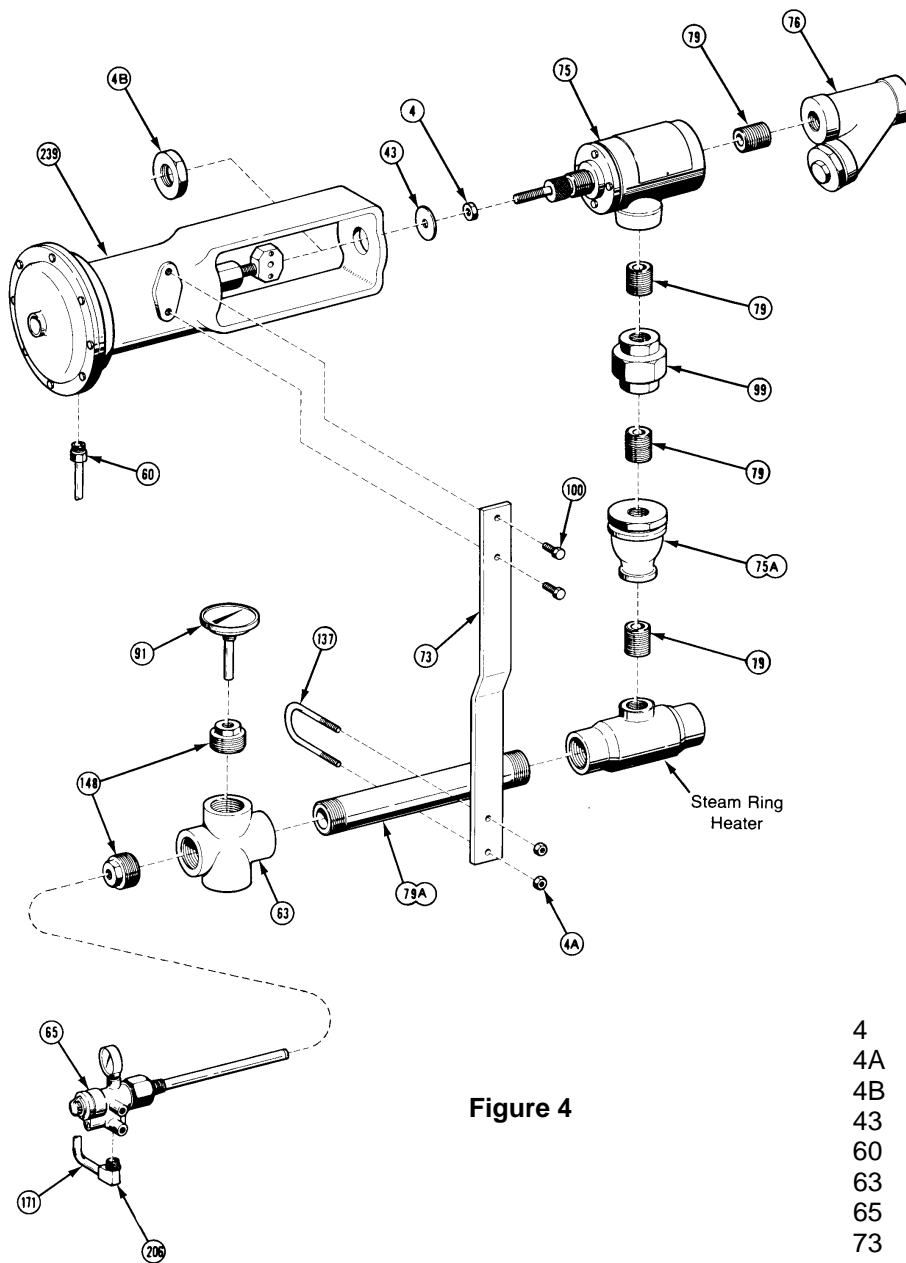
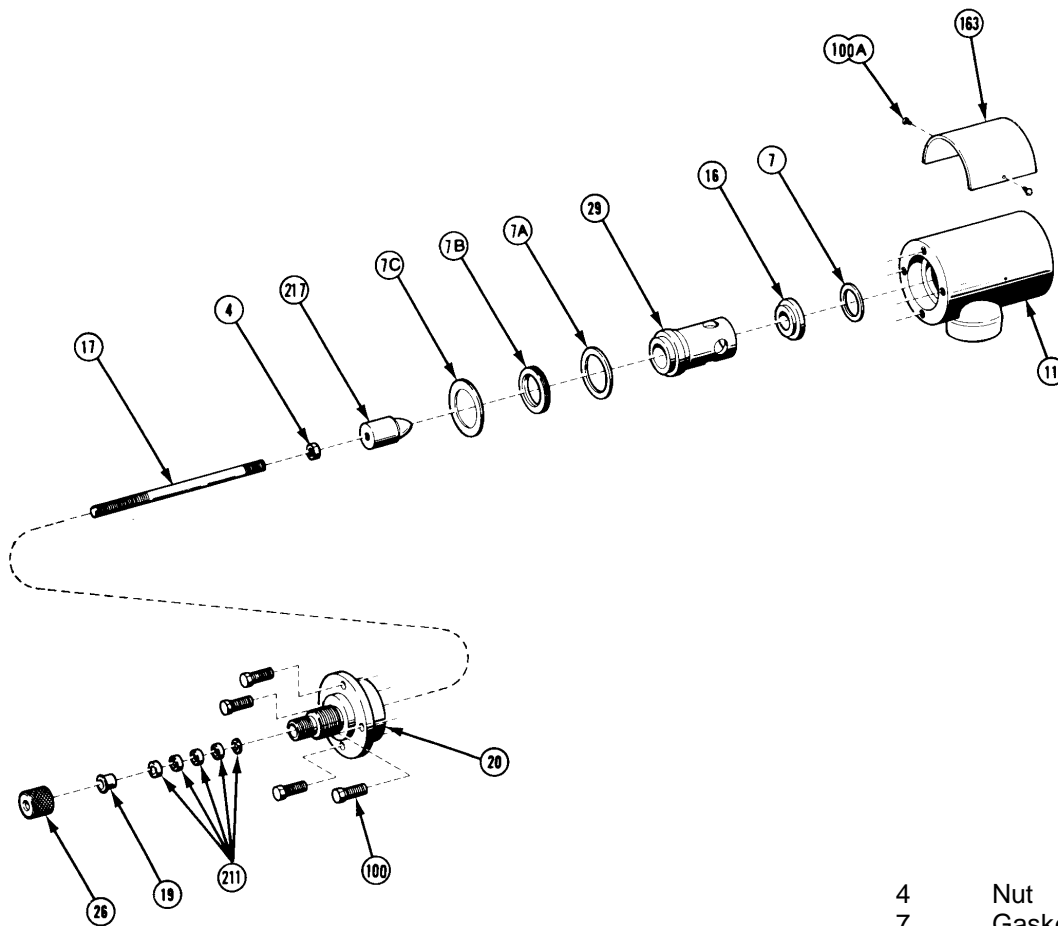


Figure 4

- 4 Nut
- 4A Nut
- 4B Nut
- 43 Disc
- 60 Fitting
- 63 Cross
- 65 Controller
- 73 Bracket
- 75 Valve
- 75A Valve
- 76 Strainer
- 79 Nipple
- 79A Nipple
- 91 Thermometer
- 99 Union
- 100 Screw
- 137 Bolt
- 148 Bushing
- 171 Tubing
- 206 Elbow
- 239 Actuator

RECOMMENDED SPARE PARTS

REF. NO.	ITEM	MIN. QTY.
7	Gasket	1
7A	Gasket	1
7B	Gasket	1
7C	Gasket	1
16	Seat	1
211	Packing	1
217	Piston	1



**Figure 5
Valve (75)**

- 4 Nut
- 7 Gasket
- 7A Gasket
- 7B Gasket
- 7C Gasket
- 11 Body
- 16 Seat
- 17 Stem
- 19 Gland
- 20 Bonnet
- 26 Nut, Stem Packing
- 29 Cage
- 100 Screw
- 100A Screw
- 163 Nameplate
- 211 Packing
- 217 Piston

NOTES



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