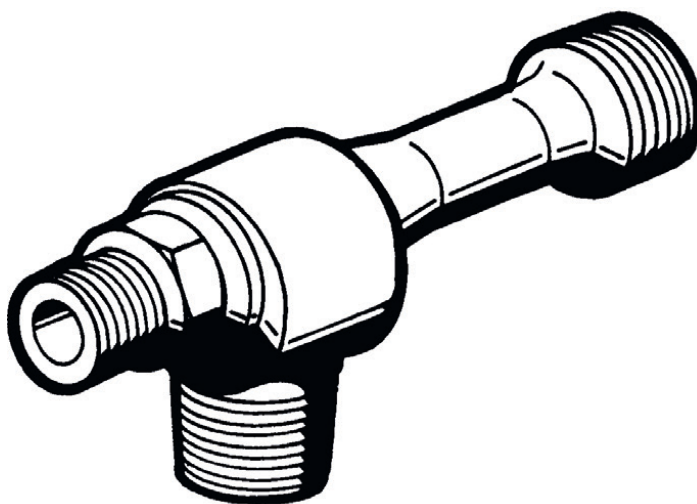


PENBERTHY SERIES LL, LM, LH, ELL, GL, GH AND HLM JET PUMPS

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

Before installation, these instructions must be read carefully and understood.



PENBERTHY®

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INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

1 ABOUT THE MANUAL

This manual has been prepared as an aid and guide for personnel involved in 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 jet pump is handled, installed or used. Penberthy cannot and will not guarantee that a jet pump is suitable for or compatible with the user's specific application.

WARNING

Failure to follow any instruction could possibly result in a malfunction of the jet pump resulting in leakage of the contained fluid, severe physical injury or property damage.

2 INTRODUCTION

2.1 Features and specifications

Penberthy models LL, LM, LH, and ELL liquid operated jet pumps are designed to pump a secondary fluid using a liquid as the operating medium. They are designed to heat the operating liquid by direct contact with steam, whereby they are also called steam jet heaters.

Penberthy models GL and GH gas operated jet pumps are designed primarily for exhausting, evacuating and priming using steam or air as the operating medium; and for pumping water using steam as the operating medium. They can also be used with other gases as the operating medium.

2.2 Design ratings at maximum and minimum operating temperatures (see Table 1)

To determine the maximum allowable working pressure for a specific temperature within the design limits stated in Table 1, the user should refer to relevant data sheets or, when provided, the specifically stated design limits on a product proposal.

2.3 Application data

Models LL, LM and LH are liquid operated jet pumps for pumping liquids against low, medium and high discharge pressures respectively.

Models LM and ELL are liquid operated jet pumps for exhausting gases. Model ELL is self priming and has greater suction capacity at vacuum.

The model GL is intended to operate between 60 psig (410 kPaG) and 150 psig (1030 kPaG) steam pressure against moderate or zero discharge head. The model GH is intended to operate between 20 psig (140 kPaG) and 150 psig (1030 kPaG) steam pressure against moderate to substantial discharge head.

Models ELL, LM and HLM are liquid operated jet pumps for heating the operating liquid by direct contact with steam at low, medium and high steam pressure respectively, whereby they are also called steam jet heaters.

Note: For specific application data within the ranges stated in Table 1, the user should consult the product proposal for the specific model and size jet pump, or should request the supply of the applicable technical data sheet.

WARNING

Under no circumstances should these design ratings or application data be exceeded. Exceeding design ratings or application data may cause severe physical injury or property damage.

3 INSPECTION AND PERFORMANCE CONFIRMATION

3.1 Receiving inspection

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

3.2 User's rating information

The user should confirm that:

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

IMPORTANT

If the size, model or performance data of the jet pump as received does not conform with any of the criteria above, do not proceed with the installation. Contact an authorized Penberthy distributor for assistance.

TABLE 1 - DESIGN RATINGS AT MAXIMUM AND MINIMUM OPERATING TEMPERATURES (6" AND UP)

Material	Body and nozzle
Carbon steel	200 psig [1.38 MPa] at -20°F [-29°C] to +250°F [121°C]
	170 psig [1.17 MPa] at +400°F [204°C]
316 SST	200 psig [1.38 MPa] at -150°F [64°C] to +250°F [121°C]
	170 psig [1.17 MPa] at +400°F [204°C]

4 INSTALLATION

Installation should only be undertaken by qualified personnel who are familiar with equipment of this type. They should have read and understood all of the instructions in this manual. The user should refer to the relevant technical data sheet or the product proposal to obtain dimensional information for the specific size and model of jet pump.

Check the cross section view (Figure 4) for the location of operating, suction and discharge connections in insure correct hook up.

4.1 Effect of related piping and precautions

1. All units

- a) Jet pumps should be installed with pipe and fittings which provide minimum resistance to fluid flow. Pipe line friction losses must always be a consideration when estimating jet pump performance.
- b) It is recommended that provisions be made for pressure gauge connections near the operating, suction and discharge connections of the jet pump. If operating difficulties are encountered at any time, it may become necessary to install pressure gauges to identify the problem.
- c) When pumping liquids, suction piping should be sized so that the velocity of the liquid does not exceed 4 feet per second. This is almost always obtained automatically when the suction line is the same pipe size as the suction connection.
- d) Install a valve in the suction line if it is desirable to:
 - 1) Prevent contamination of suction fluid by motive fluid at start up.
 - 2) Prime a centrifugal pump.
 - 3) Throttle suction flow.
- e) Discharge piping should be sized as short as possible with the least number of turns and restrictions. Discharge piping friction losses must always be considered when estimating jet pump performance. Increase discharge line pipe size if necessary to minimize loss.
- f) Do not impose system piping loads on the jet pump; the unit is not designed to be a load-bearing fitting.
- g) All piping should be free of foreign materials which could clog the jet pump.

2. Models LL, LM, LH and ELL pumping fluids or gases

- a) Models LL, LM and LH liquid operated jet pumps can be installed and operated in any position. For applications handling gases, it is more desirable to install models LM and ELL with the discharge pointing down at 45° or more. This prevents back splash of motive liquid into the suction line.
- b) Some back pressure is necessary to prime models LL, LM and LH when pumping liquids and when using the model LM as an exhauster. A simple arrangement which would provide the minimum necessary back pressure is the installation of two consecutive 90° elbows in the discharge line.
- c) When flow reversal into the suction must be prevented, a check valve should be installed in the suction line close to the jet pump. Pressure drop created by the check valve must be considered when applying the jet pump.

3. Models GL and GH pumping fluids

- a) Models GL and GH gas operated jet pumps can be installed and operated in any position.
- b) Steam must now have over 20°F (-7°C) of superheat, or performance will differ from that published in the relevant technical data sheet or product proposal referred to above.
- c) When a gas operated jet pump is used to lift liquids by suction or vacuum, the jet pump should be located as close to the level of the liquid as practical. However, any liquid entrained into the jet pump, other than water when using steam as the operating medium, will cause the jet pump to stop pumping, resulting in possible suction flow reversal.

4. Models ELL, LM and HLM heating liquids

- a) Models ELL, LM and HLM steam jet heaters can be installed and operated in any position. It is more desirable, however, to install the heater unit with the suction connection pointing up to aid in the removal of condensate in the steam line at start-up.
- b) The steam jet heater should be installed with pipe and fittings which provide minimum resistance to fluid flow. Pipe line friction losses must always be a consideration when estimating steam jet heater performance.
- c) It is recommended that provisions be made for pressure gauge connections near the operating inlet, suction and discharge connections of the steam jet heater. If operating difficulties are encountered at any time, it may become necessary to install pressure gauges to identify the problem.
- d) Steam must not have over 20°F (-7°C) of superheat, or performance will differ from that published in the relevant technical data sheet or product proposal referred to above.
- e) The steam line must be clean and provided with a strainer to prevent foreign materials from clogging the steam jet heater.
- f) The steam line should be insulated and as short as possible to prevent condensation and line friction losses.
- g) A check valve in the steam line located as close to the steam jet heater as possible will help prevent water from being driven into the steam line at shut down.
- h) Some installations require the addition of a pressure relief line to reduce discharge pressure at start up (see Figure 3). If appropriate for the application, the line can be connected to a tank, drain or the suction side of the pump supplying liquid pressure to the inlet of the heater. Back pressure limitations at start up are as follows:
 - 1) Model HLM: 1 foot of water head for every psi of operating liquid pressure.
 - 2) Model LM: ½ foot of water head for every psi of operating liquid pressure.
 - 3) Model ELL: atmospheric pressure.

WARNING

Failure to provide a pressure relief line on applications exceeding the start up back pressure limitations stated above may cause severe physical injury or property damage.

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INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

5 OPERATION

5.1 Pre-operational check

1. For pumping liquids or gases

- Ensure that all installation procedures have been completed.
- Ensure that any restrictions in the discharge line have been removed.
- Ensure that any discharge line valves are fully open.
- Ensure that the suction line valve, if installed, is fully closed.

2. For heating liquids

- Ensure that all installation instructions have been completed.
- Ensure that any restrictions in the discharge line have been removed.
- Ensure that discharge line valves are fully open (including the pressure relief line valve when applicable).

5.2 Operating

1. For pumping liquids or gases

- Open the operating valve quickly.
- Open the suction line valve, if any.
- Regulate the discharge pressure as desired to a value within the capability published in the relevant technical data sheet or product proposal referred to previously.
- For pump priming applications, when evacuation is completed, close the suction valve and start the centrifugal pump immediately. Then shut off the operating fluid valve to the jet pump.

2. For heating liquids

- Turn the operating liquid valve fully open.
- Turn the steam supply valve on slowly until the desired discharge liquid temperature is reached.
- Regulate line discharge pressure or close the relief line valve when applicable as described in Section 4.1, paragraph 4.1.4.f.

FIGURE 1

Typical installation schematic - liquid operated pumping liquids

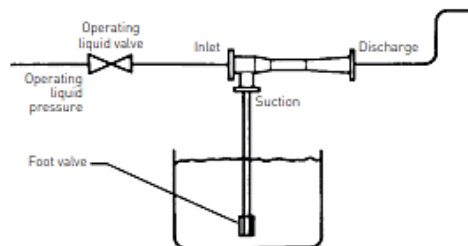


FIGURE 2

Typical installation schematic - gas operated pumping gases

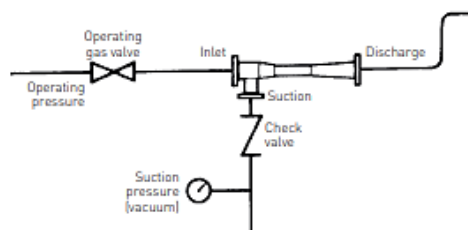
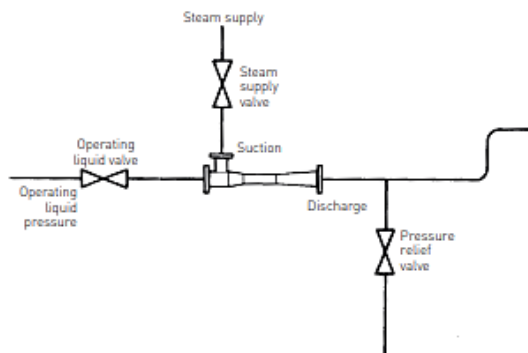


FIGURE 3

Typical installation schematic - heating operated liquid



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INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

6 MAINTENANCE

WARNING

Maintenance should only be undertaken by qualified, experienced personnel who are familiar with this equipment and have read and understood all the instructions in this manual. DO NOT proceed with any maintenance unless the jet pump 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 follow these instructions may cause a sudden release of pressure resulting in personal injury or property damage.

6.1 Preventative maintenance

The user must create maintenance schedules, safety manuals and inspection details for each specific installation of a jet pump or heater.

On all installations the following items should be evaluated regularly by the user for purposes of maintenance:

1. Jet pump units for corrosion or debris build up.
2. Piping and fittings for corrosion or debris build up.
3. All connections for tightness.
4. Units for wear.
5. Strainers for debris build up.

The user must determine an appropriate maintenance schedule necessary for his or her own specific application, upon evaluation of his or her own operating experience. Realistic maintenance schedules can only be determined with full knowledge of the services and application situation involved.

6.2 Troubleshooting (see Table 2)

7 DISASSEMBLY - REASSEMBLY

IMPORTANT

Do not proceed with removal of the jet pump from connecting piping unless the jet pump has been relieved of all pressure or vacuum, has been allowed to reach ambient temperature and has been drained or purged of all fluids.

WARNING

Penberthy fabricated metal jet pumps are of one piece construction and are not intended for disassembly or field repair (see Figure 4). Fabricated material jet pumps which have been damaged, worn out or have developed leaks should be taken out of service. The user should consult with an authorized Penberthy distributor immediately to obtain recommendation on disposition of the jet pump. Attempted repair of a defective fabricated metal jet pump may cause severe physical injury or property damage.

8 DISPOSAL AT END OF USEFUL LIFE

Penberthy jet pumps 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 jet pump 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 relevant technical data sheet for materials of construction.

TABLE 2 - TROUBLESHOOTING

Problem	Cause	Solution
For pumping		
The suction flow is less than expected	1. Suction piping is too restrictive	1. Remove restriction
	2. Discharge pressure is too high	2. Remove restriction
	3. Operating liquid pressure is lower than required	3. Increase pressure
	4. Suction or motive liquid is at much higher than ambient temperature	4. Lower temperature or size larger jet pump
	5. Suction piping leaks	5. Tighten fittings
For heating		
Discharge of live steam, objectionable noise and vibration and inlet flow reversal	1. Operating liquid pressure too low	1. Increase pressure
	2. Attempted operation beyond discharge pressure capability	2. Reduce discharge pressure
	3. Attempted start up without pressure relief line	3. Install pressure relief line
Surges in liquid outlet temperature	4. Operating liquid pressure too low	4. Increase pressure

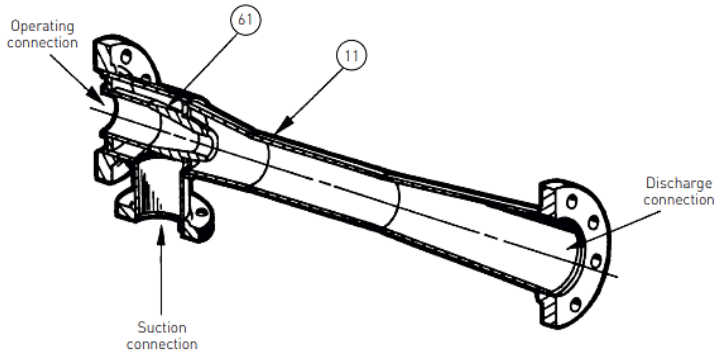
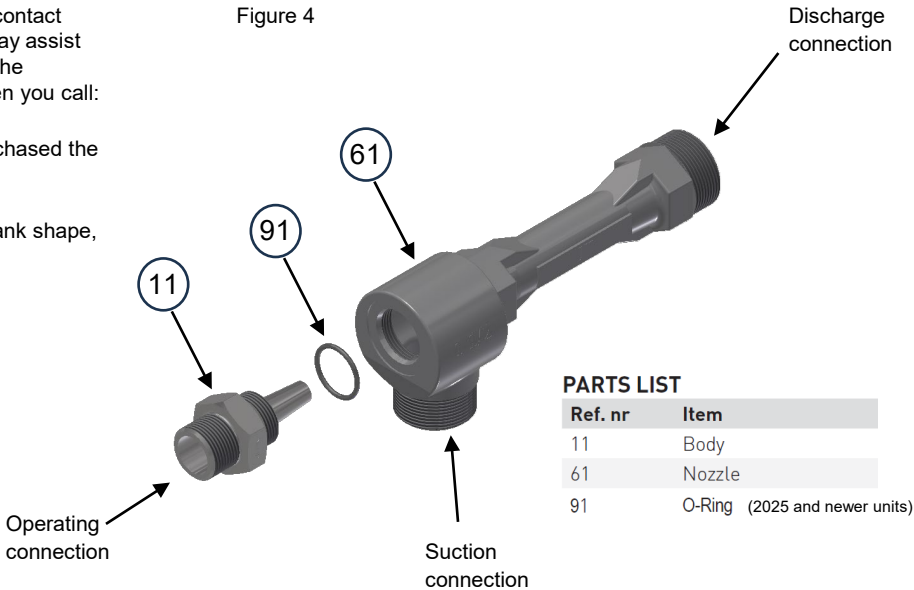
9 TELEPHONE ASSISTANCE

If you are having difficulty with your jet pump, 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 number
- Name of the company from whom you purchased the jet pump
- Invoice number and date
- Process conditions (pressure, flow rates, tank shape, etc.)
- A brief description of the problem
- Trouble shooting procedures that failed

10 EXPLODED PARTS DRAWING
CAST

Figure 4



PARTS LIST	
Ref. nr	Item
11	Body
61	Nozzle



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