LIQUID RING PUMP

MV and MVP Design

INSTALLATION, OPERATION

AND

MAINTENANCE MANUAL

Graham Coraham

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Section 1 - General Information

1.1 Introduction

This manual will provide assistance in the set-up, operation, and maintenance of your Graham Liquid Ring Pump. Please read this manual completely prior to operating your Liquid Ring Pump. If you need to contact the Pump Service department for assistance, please have available the pump serial number and model number. The Pump Service department may be reached by contacting Graham Corporation in Batavia, NY by phone (716) 343-2216, Fax (716) 343-1097, or e-mail at equipment@graham-mfg.com.

Graham has an extensive stock of spare parts and replacement pumps. Stocked parts and pumps can be shipped from our warehouse in Batavia, NY, by a carrier of your choice.

For your convenience, use our toll free number (1-800-828-8150) ***only*** when ordering spare parts and replacement pumps. Please have the model number, serial number and part number of the items required when placing an order. Normal business hours are 8:00 a.m. to 5:00 p.m. (E.S.T.), Monday through Friday.

Factory rebuilding service is available for pumps returned to Batavia. When a pump is returned to the factory for repairs, please drain and flush the pump and include a Material Safety Data Sheet (MSDS) for the process in which the pump was used. A Return Material Authorization (RMA) Number, issued by Graham, is required before returning a pump. A sample form is included at the back of this manual to show what type of information is required to obtain an RMA Number. Field Service Technicians are also available for travel to the jobsite for troubleshooting and repair or rebuilding of pumps.

A continuous supply of service liquid is necessary to limit the temperature rise in the pump caused by the heat of compression, friction, and condensation. Any excessive rise in temperature will have a detrimental effect on performance, reducing the capacity and degree of vacuum attainable. Installation schematics for the supply of the service liquid and for the separation of the gas and liquid discharged from the pump are shown in Section 2.

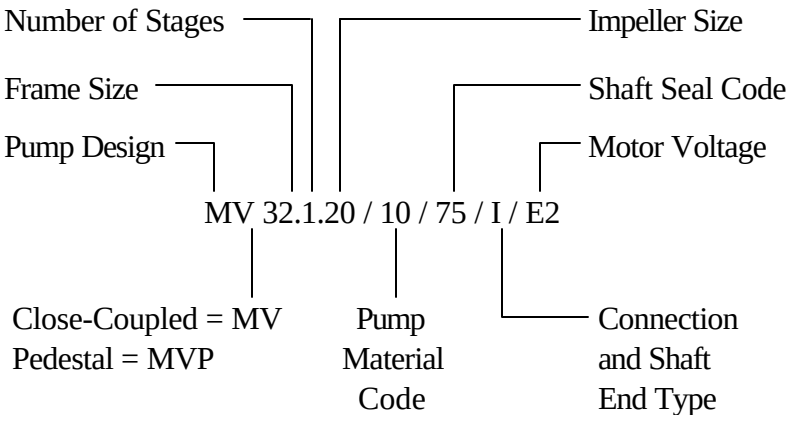
Service liquid quantities are a function of the particular model and the intended application. Check the data sheet for your specific pump model or see Table 1 of Section 3 which lists typical service liquid requirements.

The normal operating range of the MV or MVP design when using water at 59§ F (15 ºC) for the service liquid is from atmosphere down to 30 mmHgA.

The standard materials of construction are suitable for handling air and other non-corrosive gases, while using water as the service liquid. Other materials can be supplied for special applications.

1.3 Description of Pump Model Codes

Each pump is designated by a model code which describes the materials of construction, size, type of shaft seals, and any special features. An example of a typical pump is shown below. Contact Graham for a complete listing of the codes used to describe the pump.



Section 2 - Installation Instructions

2.1 Handling

Carefully unpack the pump. MV pumps may be lifted with a sling placed under the pump- motor assembly. Since the MVP pump is normally baseplate mounted, lift by the baseplate only. Do not attach slings nor hooks to the motor or the pump as this can cause misalignment. Do not attempt to run the pump until the installation work is complete.

***CAUTION* : DO NOT RUN THE PUMP WITHOUT SERVICE LIQUID AND SHAFT**

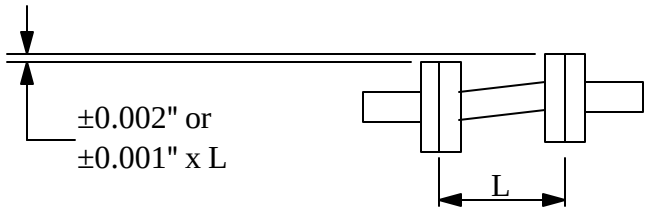
2.5 Coupling Alignment - MVP design only

***CAUTION* : TO PREVENT PERSONAL INJURY, DO NOT OPERATE THE PUMP WITHOUT PROPERLY GUARDING THE DRIVE COUPLING(S).**

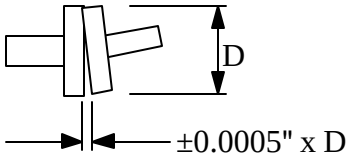
Pumps supplied from the factory packaged with a motor have had the shafts aligned prior to shipment. This ensures that alignment can be done in the field. It is *required* that the shaft alignment be rechecked after mounting on a level foundation and prior to start-up.

For smoother operation and longer life of the coupled equipment, the following maximum misalignment tolerances are recommended:

The maximum allowable parallel shaft misalignment for standard couplings is ±0.002" (0.05 mm) and for spacer couplings is ±0.001" per inch (0.025 per mm) of spacer length.



The maximum allowable angular shaft misalignment is ±0.0005" per inch (0.013 per mm) of coupling diameter.

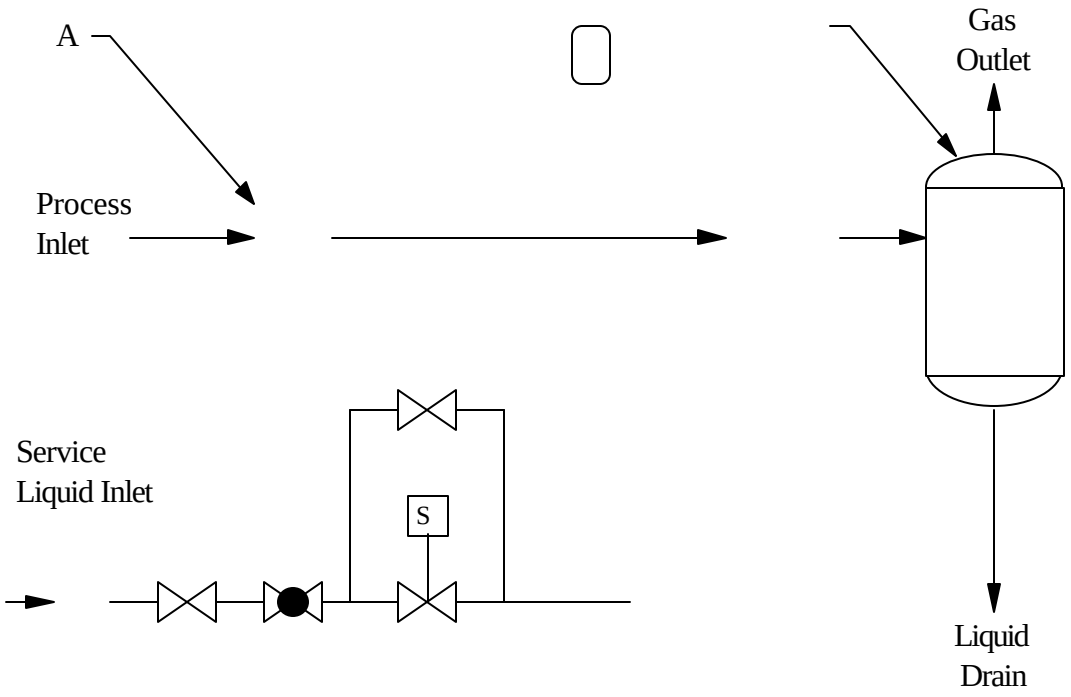


2.6 Service Liquid Piping Arrangements

The operating principle of a liquid ring pump depends on a continuous supply of clean service liquid, which is normally water. The liquid enters tThe0gous se liqui d enters ghsupplyn5 eg pump depenVamf2 iquiclea

A) Typical Installation of Once Through with No Recovery

The service liquid is piped directly from a supply source to the pump. The liquid is separated from the gas in the separator and discharged to a drain. No recirculation nor recovery takes place. This is the most basic arrangement and can be used when service liquid conservation or contamination is not a concern. A solenoid operated valve provides for flow of the liquid simultaneously with the pump/motor operation. When the motor stops, the valve closes to prevent the pump casing from filling with fluid. The by-pass valve is used to pre-fill the pump at initial start-up only. It also can be used should the solenoid fail. When a manual valve is used, it must be opened immediately *after* starting the motor and closed immediately *before* turning the motor off.



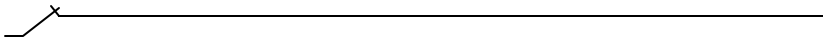
A–Inlet Check Valve
B–Vacuum Gauge
C–Vacuum Relief Valve
D–Separator
E–By-Pass Valve
F–Strainer
G–Shut-off Valve
H–Regulating Valve
J–Solenoid Valve
K–Compound Gauge
L–Liquid Ring Pump
M–Trap (required if discharge pressure is above atmospheric pressure)

Once Through with No Recovery
Diagram 1

B) Typical Installation of Closed Loop with Total Recovery

This arrangement provides for the total recirculation of the service liquid. A heat exchanger is added to the system to remove the heat of compression, friction, and condensation from the service liquid before it is re-introduced to the pump.

The service liquid level in the separator of a total recovery system should be at or slightly below the centerline of the pump shaft. A provision should be made for a high level overflow. This will prevent starting the pump while it is full of liquid, which will damage the pump or overload the motor.



A–Inlet Check Valve
B–Pressure Gauge
C–Vacuum Relief Valve
D–Level Gauge
E–Separator
F–Service Liquid Cooler
G–Shut-off or Throttling Valve
H–Compound Gauge
J–Liquid Ring Pump
K–Recirculation Pump (recommended)
L–Trap or Loop Seal (required if discharge pressure is above atmospheric pressure)
M–Drain Valve
N–Make-Up Valve

Closed Loop–Total Recovery
Diagram 2

C) Draining Before Start-Up

***CAUTION* : DO NOT START THE PUMP WITH THE CASING FULL OF LIQUID.**

A Liquid Ring Pump should not be started with the casing full of liquid. Damage to the impeller or the shaft will result. The normal liquid level should be no higher than the shaft centerline. The pump may be started with a low liquid level as long as a supply of service liquid is available immediately after start-up.

2.7 Shaft Seal Coolant

On the MV and MVP pumps, the service liquid connection is positioned on the pump casing to flush the mechanical seal along with introducing service liquid to the pump. No separate source of

2.9 Electrical Requirements

All electrical wiring and installation must comply with local safety codes.
After the electrical work is complete, the motor should be jogged to check for proper rotation.

First, turn the pump by hand to see that it rotates freely. The direction of rotation is marked on the pump. With the power off, the motor fan can be used to rotate the MV design.

Second, jog the motor momentarily to check the rotation. It is recommended to use a non-reversing motor controller to prevent the pump from turning in the wrong direction.

Section 3 - Operating Instructions

3.1 Start-up Procedures

Read all instructions before proceeding.

1) Turn the shaft manually to ensure it rotates freely. If the pump is binding or seized, refer to the troubleshooting chart in Section 5. With the power off, the motor fan can be used to rotate the MV design.
2) Fill the pump with service fluid to the shaft centerline, but do not overfill

   ***CAUTION* : DO NOT RUN THE PUMP WITHOUT SERVICE LIQUID AND SHAFT SEAL COOLANT.**

3) The normal service liquid level should be no higher than the shaft centerline. The pump may be started with a low service liquid level as long as a supply is available immediately after start-up.
4) Open any valves in the suction and discharge lines.
5) Confirm the pump rotation with the arrow on the casing by jogging the motor.
6) Start the motor, ensure service liquid supply, and set regulating valve, when used, for optimum pump performance. Open and adjust the shaft seal cooling liquid valve, when used.

3.2 Service Liquid Requirements

A) Flow Rates

The normal

Service liquid flow rates TD TD -0.D -0.2Tw (6l30W0 TDtem 36 05 Tris.123o rgh TD -0.e) Tj -e,star

B) Flow Control

If a flow device is not used to measure the service liquid quantity to the pump, a regulating valve and compound gauge in the service liquid line can be used to approximate the flowrate. For pump operating pressures between atmospheric and 400 mmHgA, the reading on the compound gauge should be in the range of 2" HgV to 5 psig (709 mmHgA to 0.35 barg). For operating pressures below 400 mmHgA, the compound gauge reading should be in the range of 15" HgV to 2 psig (379 mmHgA to 0.14 barg). This method is only an approximation of the service liquid quantity. The actual operating conditions will dictate the amount of service liquid required and also the compound gauge reading.

C) Hard Water

If hard water is used as the service liquid, scale deposits caused by the precipitation of minerals will occur. This will vary with the temperature of the water. Scale deposits on the internal surfaces of the pump will cause an increase of the operating horsepower, wear on moving parts, and may cause the pump to seize. If the hardness of the water is excessive, consider using a water softening treatment.

3.3 Cavitation

Cavitation is identified by a characteristic metallic or grinding noise inside the pump. It is caused when the pump suction pressure is too close to the vapor pressure of the service liquid. If the service liquid temperature inside the pump rises such that its vapor pressure closely approaches the suction pressure of the pump, cavitation will occur.

When cavitation takes place, vapor bubbles form and collapse within the liquid ring. This will damage the surfaces of the impeller, side plates, and casing. Cavitation causes damage by tearing away metal particles. The damage may be more severe in a corrosive situation.

Cavitation may be prevented by bleeding air into the pump to raise the suction pressure. Vacuum relief valves can be fitted in the suction piping for this purpose.

.itation is ide pvsrc 0 Tw1. (to raiouum)/ot1nt25 TD -0.t25 T4 Shut.35549

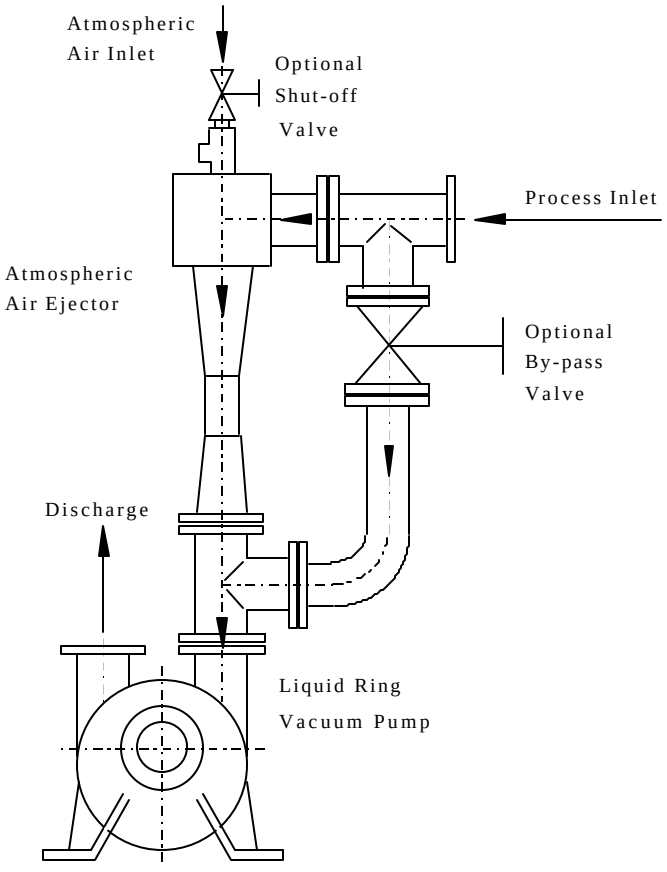
Section 4 - Accessory Items

4.1 Accessories

There are many accessory items associated with Liquid Ring Vacuum Pumps. They can be supplied by Graham and shipped from the factory or can be supplied by others and installed in the field. The particular requirements, mode of operation, and type of control scheme desired dictate the necessity of various items. The following is a list of common accessories.

Inlet Check Valve	Used to prevent a back flow of gas into the process when the pump is stopped. Check

Recirculation Pump	Used to circulate the service liquid recovered from the discharge separator in some total recovery systems.
Heat Exchanger	Used to remove heat from the recirculated service liquid.
Atmospheric Air Ejector	Used to provide a suction pressure lower than the pump is capable of when operating alone. It may be added to a pump to provide an inlet pressure as low as 10 mm HgA. The operation of the air ejector is similar to that of a steam ejector. Atmospheric air or recycled gas from the discharge separator is used as the motive force for compressing the process gas from the system design pressure up to the inlet pressure of the pump. To enhance pumping capacity at a higher suction pressure, an optional motive air shut-off valve or by-pass valve can be added. (See Figure 2)



Typical Atmospheric Air Ejector

Figure 2

Section 5 - Maintenance

5.1 Performance

Optimum performance and long service life are dependent upon good maintenance procedures and periodic inspections. When preparing to dismantle a pump, make provisions for the safe handling of heavy parts.

*5.2 MV and MVP Pump Estimated Weights (lbs.)**

MV Model	Dry
MV12.1.20	24
MV32.1.20	51
MV32.1.25	62
MV32.1.45	70
MV32.1.65	86
MV40.1.50	132
MV40.1.60	158
MV41.1.100	354

MVP Model	Dry
MVP12.1.20	18
MVP32.1.20	35
MVP32.1.25	37
MVP32.1.45	44
MVP32.1.65	53
MVP40.1.50	95
MVP40.1.60	100
MVP41.1.100	N/A

* For units in kg, multiply lbs. by 0.454

Table 2

5.3 Shaft Bearings

The MV and MVP pumps use sealed-for-life bearings that are not regreaseable.

The standard bearings are rated for an $L10_h$ life of 80,000 hours. The temperature of the bearings should not exceed 140ºF (60ºC). Overheating may be due to misalignment of the shafts or a bad bearing.

5.4 Mechanical Seals

The MV and MVP pumps are fitted with a single acting mechanical shaft seal. It should be replaced when worn, scratched, or cracked, or when the rotating segment no longer grips the shaft.

When replacing the mechanical seal, clean the shaft thoroughly. The seal faces must be protected during installation from particles which may scratch the surfaces.

***CAUTION* : DO NOT RUN THE PUMP WITHOUT SERVICE LIQUID AND SHAFT SEAL COOLANT.**

5.5 Storage

If a pump is to be out of service, it should be protected internally from rusting by using a rust inhibitor. The pump should be drained completely by removing all lower plugs. Install the plugs and fill with Oakite HPO (or equal) preservative solution. Rotate the pump manually to circulate the solution. With the power off, the motor fan can be used to rotate the MV design. Drain the pump to the shaft centerline. This procedure may be disregarded for pumps made of stainless steel or other corrosion resistant materials.

Seal any openings to prevent foreign material from entering the pump.

The pump shaft should be rotated each week to distribute the preservative and to prevent flat spots on the bearings. Document the time, date, and by whom this procedure was performed. With the power off, the motor fan can be used to rotate the MV design

The pump should be checked to see that the preservative is maintained. This will protect the pump for up to twelve months.

Pumps stored at low temperatures may need to be protected from freezing either by draining completely or by using an anti-freeze solution.

5.6 Removal from storage

The pump should be drained and flushed if necessary to remove the preservative solution. Refer to paragraph 3.1 of this manual for the recommended start-up procedure.

***CAUTION* : THE OAKITE HPO PRESERVATIVE SOLUTION IS PETROLEUM BASED AND MUST BE DISPOSED OF IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL REGULATIONS.**

An MSDS form is included in the back of this manual.

5.7 Troubleshooting Chart

Problem	Cause	Solution
Reduced Capacity	• Speed too low • Leak in suction line • Service liquid temperature too high • Insufficient or excess service liquid • Excessive back pressure	• Check power supply and transmission • Repair • Check coolant flow & heat exchanger • Provide correct flow rate • Eliminate cause of back pressure
Excessive Noise	• Excessive or insufficient service liquid • Shaft misalignment • Defective bearing • Cavitation • Back pressure	• Adjust flow rate • Realign shafts • Replace bearing • Adjust vacuum relief valve • Eliminate cause of back pressure
High Power Consumption	• Excessive service liquid • Shaft misalignment • Excessive back pressure • Defective bearing • Improperly mounted pump • High temperature process load	• Reduce flow rate • Realign shafts • Eliminate cause of back pressure • Replace bearing • Make sure surface is level and all feet touch the surface, shim if necessary. • Check conditions upstream of pump
Overheating	• Service liquid temperature too high • Insufficient service liquid • Shaft misalignment • Defective bearing	• Check coolant flow & heat exchanger • Provide correct flow rate • Realign shafts • Replace bearing
Vibration	• Shaft misaligned • Pump or baseplate not properly anchored • Defective bearing • Improperly mounted pump • Cavitation • Back pressure • Excessive service liquid	• Realign shafts • Anchor • Replace bearing • Make sure surface is level and all feet touch the surface, shim if necessary. • Adjust vacuum relief valve • Eliminate cause of back pressure • Provide correct flow rate
Abnormal Bearing Wear or Failure	• Shaft misalignment • Piping load on pump connections • Mechanical seal leakage	• Realign shafts • Support connecting pipe work • Replace seal
Shaft Will Not Turn or Partially Seizes	• Scale build-up • Foreign object in pump • Piping load on pump connections • Improperly mounted pump • Soft Foot	• Descale pump • Remove foreign object • Support connecting pipe work • Make sure surface is level and all feet touch the surface, shim if necessary. • Correct pump / motor mounting

Table 3

Section 6 - Disassembly And Reassembly Procedures

6.1 General

Complete disassembly of the pump is seldom necessary and it may only need to be disassembled to the point required to repair or service it. Specific instructions are included with the documentation sent with your liquid ring pump. The cross-section drawing and parts list should be referred to when servicing the pump and when ordering spare parts.

Before any servicing takes place, it is recommended that a set of gaskets, bearings, and mechanical seals be on hand as spare parts. The stocking of additional items beyond these basic wearing parts is dependent upon the type of application, compatibility of pump materials with the process gas and service liquid, degree of corrosion and erosion to which the pump is subjected, importance of pump reliability to the process, etc.

When ordering spare parts, be sure to identify the pump size, serial number, part name and reference number, and if available, original purchase order number, Graham job number, or a drawing number.

6.2 Impeller End Clearances

Refer to Table 4 for the impeller end clearances. These values are for each side of the impeller. These clearances are extremely important for optimum pump performance. Also refer to the dismantling and reassembly procedures that were provided with the documentation sent with your pump.

Impeller End Clearances *
(MV or MVP Design)

Pump Frame Size	Cast Iron Construction	Stain. Stl. & Titanium Construction
MV12.1.20	0.004" - 0.006"	0.006" - 0.009"
MV32.1.20	0.004" - 0.006"	0.006" - 0.009"
MV32.1.25	0.004" - 0.006"	0.006" - 0.009"
MV32.1.45	0.004" - 0.006"	0.006" - 0.009"
MV32.1.65	0.004" - 0.006"	0.006" - 0.009"
MV40.1.50	0.004" - 0.006"	0.006" - 0.009"
MV40.1.60	0.004" - 0.006"	0.006" - 0.009"
MV41.1.100	0.006" - 0.008"	0.009" - 0.012"

* For units in mm, multiply inches by 25.4

Table 4

A) Gasketed Pumps

The gaskets between the impeller casing and the sideplate determine the impeller end clearances. Check and record the thickness and quantity of these gaskets at each joint when dismantling. The gaskets may be held in place with grease during re-assembly. The gasket thicknesses used on 316SS and high alloy pumps are 0.015" to 0.018" (0.38 to 0.46 mm). Refer to Table 4 for the correct impeller end clearances.

Do not use joint sealing compound to replace a gasket as the clearances in the pump will be affected.

B) Non-Gasketed Pumps

Some of the N0Gasketed Pumps

6.4 Bearing Data

The correct bearing fit class needs to be used for proper operation. **Do not use a C3 fit as it is too loose and will cause damage to the pump.** Table 6 provides correct bearing data for the pumps. All bearing fits are Normal or Class 0.

Pump Frame Size	Close-Coupled Motor HP (60 Hz)	SKF Bearing Number DE	Bearing Journal Diameter	SKF Bearing Number NDE	Bearing Journal Diameter	Type (*All Bearings are Normal Fit - AFBMA 0)*
MV12.1.20	0.75	6304-2RS	20 mm	6203-2RS	17 mm	Ball Bearing, Single Row, Deep Groove, Double Seals, Sealed
MV32.1.20	2.0	6305-2RS	25 mm	6204-2RS	20 mm	
MV32.1.25	2.5	6305-2RS	25 mm	6205-2RS	25 mm	

0.75

Section 7 - Warranty

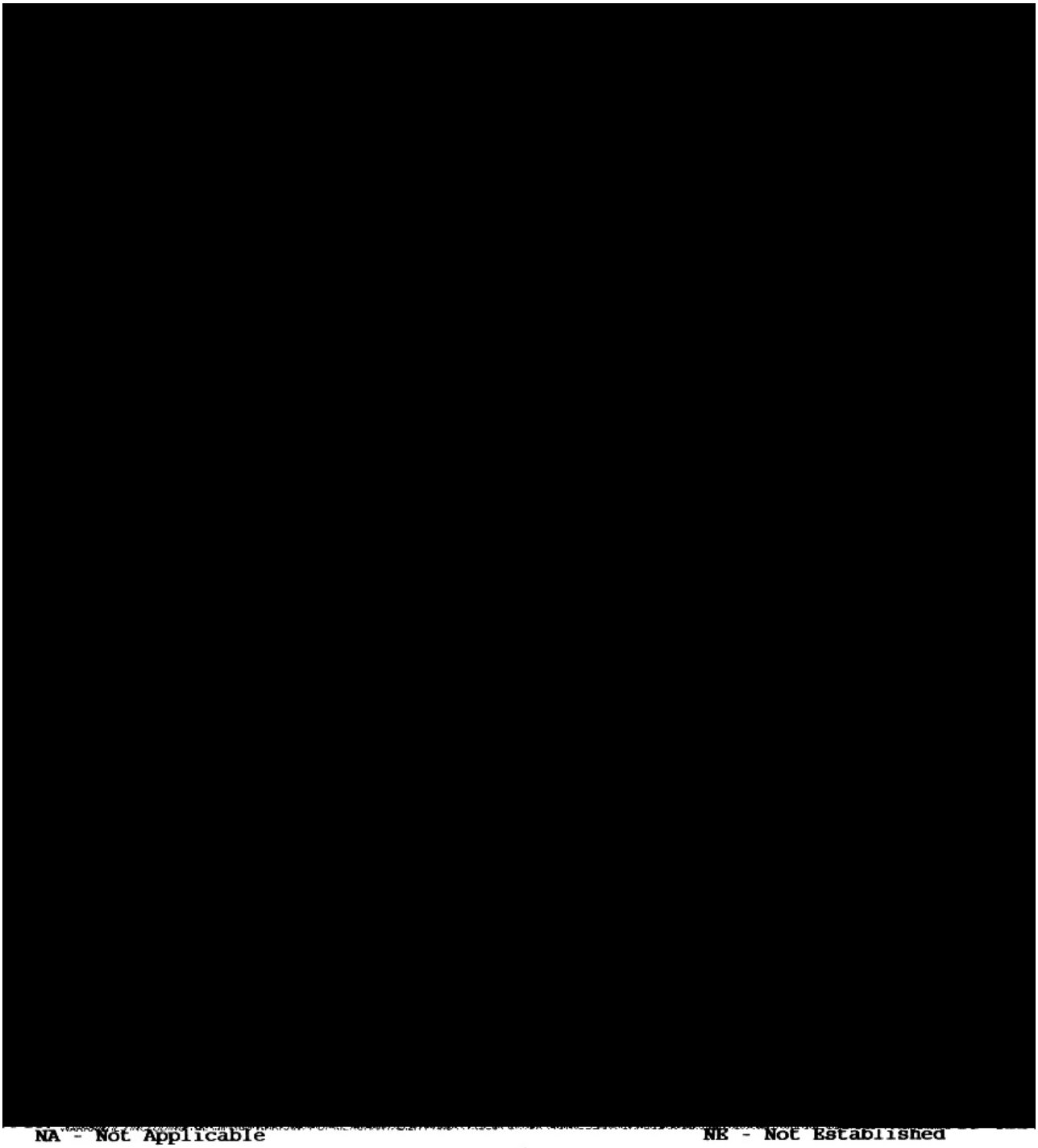
THE FOLLOWING IS IN LIEU OF ALL WARRANTIES OF GRAHAM EXPRESSED OR IMPLIED AND ALL IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND/OR ANY OTHER OBLIGATION ON THE PART OF GRAHAM ARE HEREBY EXCLUDED:

Graham, except as otherwise provided, warrants goods of its own manufacture against faulty workmanship or the use of defective materials, under normal use and service, and that such goods will conform to mutually agreed upon written specifications, drawings, and is guaranteed to meet specified performance requirements, for a period of twelve (12) months from date of shipment of the goods from the factory.

Graham assumes no responsibility for deterioration of the equipment due to corrosion, erosion, or flow induced tube vibration, or for fouling, maintenance problems or any other causes not specifically covered under the foregoing warranty. The sole remedy of Buyer with respect to any part not conforming to any warranty of Graham shall be the repair or, at Graham's option, replacement of any defective part at the point of manufacture, Buyer assuming all costs of removal, shipping, and reinstallation, provided that immediate written notice of the defect has been given to Graham, and Graham shall not be liable for any other expenses incurred because of failure of any part to meet Graham's warranty, nor for any special, indirect or consequential damages. Material returned to Graham's factory without its written consent will not be accepted. No back charges will be honored without Graham's advance approval of the work to be performed. Graham's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from this transaction, or the design, manufacture, sale, delivery, resale, installation, technical direction of installation, inspection, repair, operation, or use of any equipment covered by or furnished hereunder shall in no case exceed the price paid by Buyer for the equipment. Graham also disclaims all liability, whether in contract, tort, warranty, or otherwise, to any party other than the Buyer.

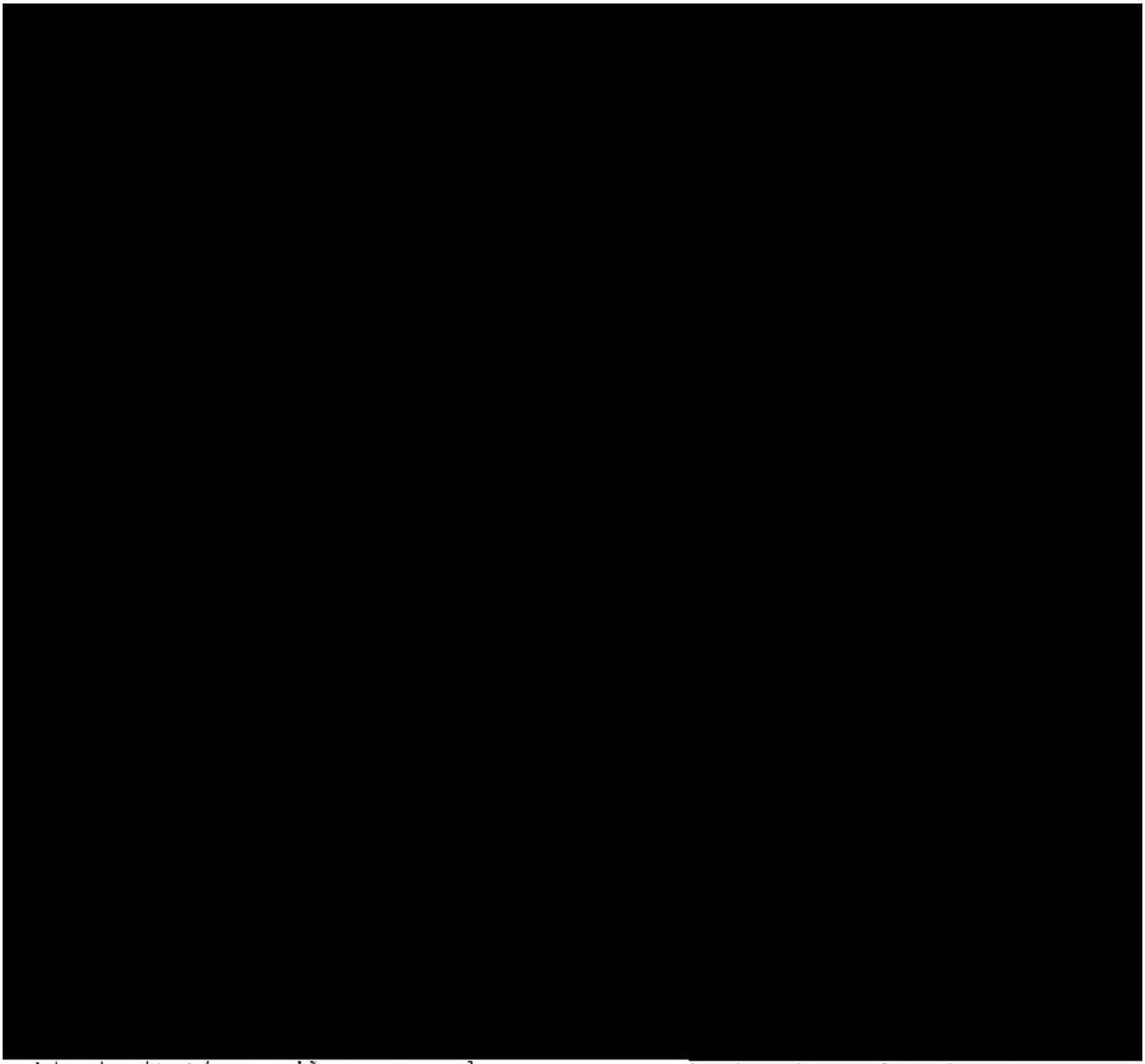
In the event the pumps are altered or repaired by any person or entity other than Graham, without written approval by Graham, all warranties are void. Bearings and shaft seals are warranted only to the extent of, and pursuant to, the original manufacturer's warranty

Appendix A



NA - Not Applicable NE - Not Established

Appendix A



skin irritation, oil acne, and irritation. Chronic exposure m
dermatitis.

FIRST AID

ush eyes with plenty of water for at least 15 minutes. EYES: Imme
eyelids open. If irritation persists get medical whil
atte

NA - Not Applicable **NE - Not Establis**

-2-

Appendix A

Appendix A

NA - Not Applicable NB - Not Established

Appendix B

RETURN MATERIAL AUTHORIZATION FORM

TO: Pump Service Department Date: _____

FROM: _____

RMA Number: _____

This form must be filled out completely before any work will be started on the equipment being returned. This is to ensure the safety of all Graham employees who may come in contact with this equipment.

MSDS (Material Safety Data Sheet) **must be included for all material handled by the equipment. Work on the equipment will be held pending receipt of the MSDS.**

The equipment must be cleaned prior to shipping back to Graham. Equipment returned in an unsatisfactory condition will be returned to the sender for cleaning.

Customer Data

Customer: _____ Contact Person: _____

Mailing Address: _____ Phone Number: _____

_____ Fax Number: _____

_____

Graham Equipment Information

Graham Serial Number: _____

Equipment Being Returned: _____

Reason for Return: _____

Material Handled by Equipment: _____

Send equipment and MSDS sheets to the address above, Attn.: Pump Service Dept.

This form is to be filled out by Graham (Batavia) personnel only. RMA forms filled out by agents and customers will not be accepted!