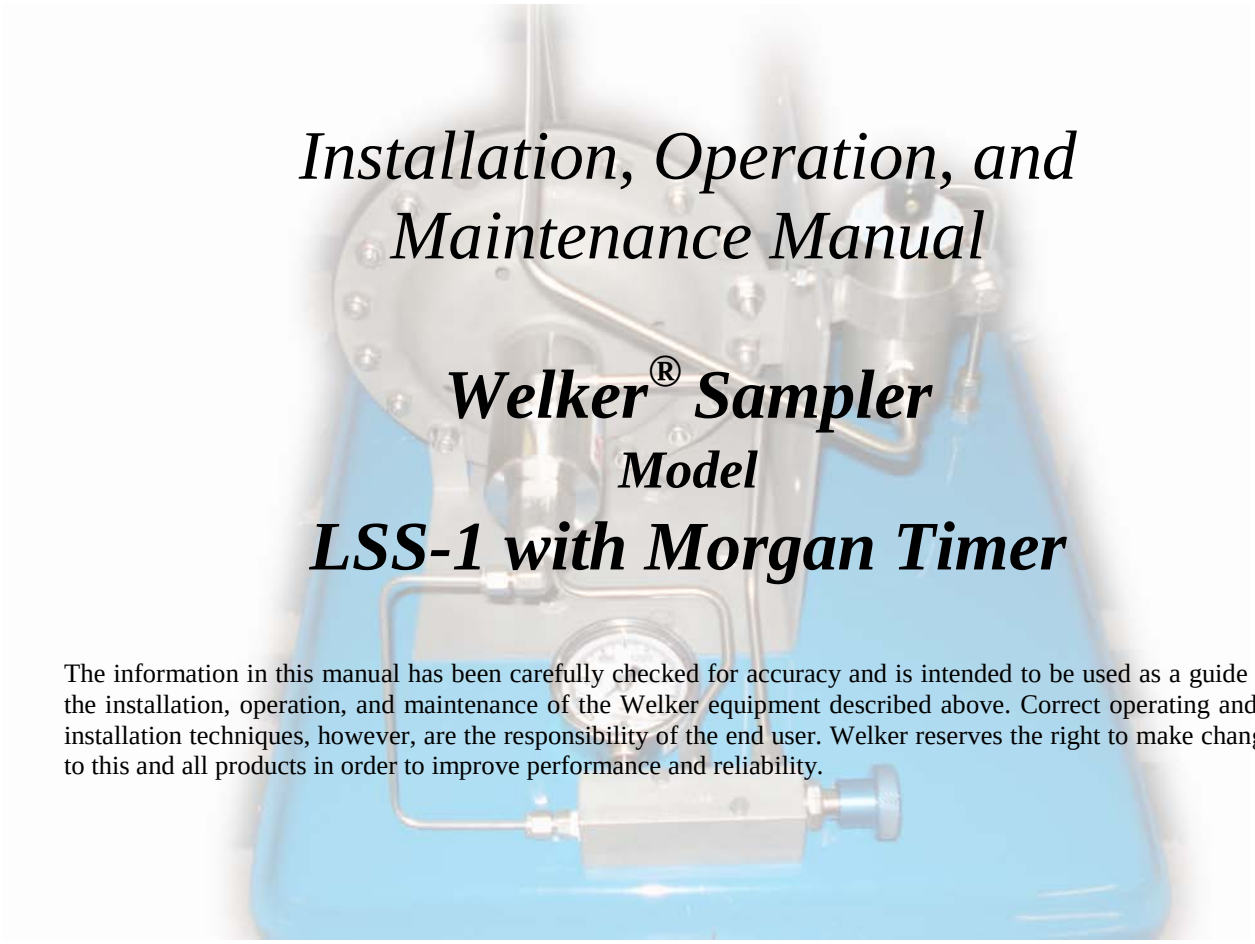

Installation, Operation, and Maintenance Manual

Welker® Sampler

Model

LSS-1 with Morgan Timer

The information in this manual has been carefully checked for accuracy and is intended to be used as a guide for the installation, operation, and maintenance of the Welker equipment described above. Correct operating and/or installation techniques, however, are the responsibility of the end user. Welker reserves the right to make changes to this and all products in order to improve performance and reliability.

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TABLE OF CONTENTS

SPECIFICATIONS

1. GENERAL

1.1 Introduction

We appreciate your business and your choice of Welker products. The installation, operation, and maintenance liability for this product becomes that of the purchaser at the time of receipt. Reading the applicable *Installation, Operation, and Maintenance (IOM) Manual* prior to installation and operation of this equipment is required for a full understanding of its application and performance prior to use. If you have any questions, please call 1-800-776-7267 in the USA or 1-281-491-2331.

The following procedures have been written for use with standard Welker parts and equipment. Assemblies that have been modified may have additional requirements and specifications that are not listed in this manual.

Notes, Warnings, and Cautions

NOTE Notes emphasize information or set it off from the surrounding text.

CAUTION Caution messages appear before procedures that, if not observed, could result in damage to equipment.

WARNING **Warnings alert users to a specific procedure or practice that, if not followed correctly, could cause personal injury.**

1.2 Description of Product

The Welker LSS-1 Wet Gas & Liquid Sampler is designed to extract a representative sample of the flowing product from the center one-third of the pipeline with the aid of a sampler probe.

The LSS-1, with its "Vanishing Chamber" collection head, is capable of extracting a representative sample from the flowing stream and pumping the sample into a sample container.

SPECIFICATIONS

1.3 Specifications

NOTE

The specifications listed in this Section are generalized for this equipment. Welker can modify the equipment according to your company's needs. However, please note that **the specifications may vary depending on the customization of your product.**

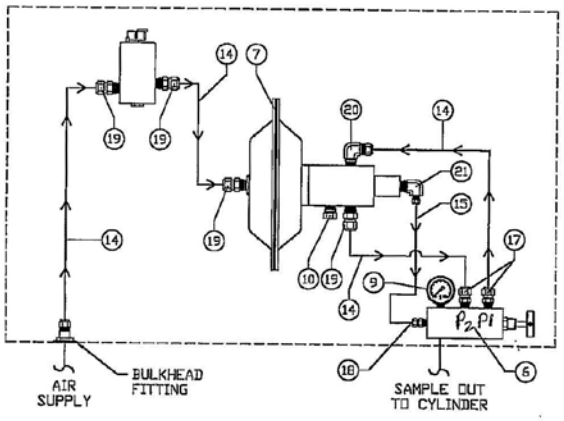
Table 1

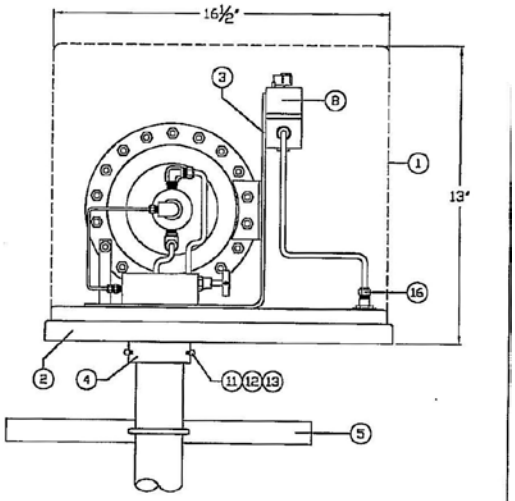
Specifications	
Products Sampled	Light liquid hydrocarbons, refined products, liquid petroleum gas, natural gas liquids, light crude and condensate
Materials of Construction	316 Stainless steel, optional aluminum, or stainless steel regulator (where applicable)
Sample Grab Sizes	0.22 cc, 0.5 cc, 1.0 cc, 1.5 cc
Grab Rate	Up to 15 grabs per minute
Line Temperature Limit	-20° F (-28° C) to 250° F (120° C) standard
Maximum Line Pressure	2,160 psi (148 bar) standard
Sample Outlet Connection	¼" FNPT standard
Area Classification	Can be used in hazardous areas as applicable
Viscosity Range	8-50° API Gravity

SPECIFICATIONS

MATERIAL	FINISH	TO PROTECT SENSITIVE PIPELINE EQUIPMENT, WELKER ENGINEERING COMPANY RECOMMENDS INSTALLING ANY PRODUCT PROTRUDING INTO THE PIPELINE UPSTREAM OF THE STRAINER.	DRAWING NUMBER	REV.
N/A	N/A		LS140.18	-

MAOP: 2160 PSIG @ -20°F TO 120°F





DATE	REV.	RECORD	AUTHORIZED	DRAFTER	CHECKED
10/26/07	-	DR# 7937	GB	EBC	

WELKER®

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SUGARLAND, TEXAS 77487-0138
PHONE (281) 491-2331
FAX (281) 491-8344

TITLE	LSS-1 OUTLINE DRAWING
COMPANY	

DRAWN BY	SCALE	APPROVED BY	DRAWING NUMBER	REV.
EBC	STF		LS140.18	-
DATE: 10/26/07			SHEET: 1 of 2	

MATERIAL	FINISH	TO PROTECT SENSITIVE PIPELINE EQUIPMENT, WELKER ENGINEERING COMPANY RECOMMENDS INSTALLING ANY PRODUCT PROTRUDING INTO THE PIPELINE UPSTREAM OF THE STRAINER.	DRAWING NUMBER	REV.
N/A	N/A		LS140.18	-

MAOP: 2160 PSIG @ -20°F TO 120°F

NO.	REQ.	DESCRIPTION	PART NUMBER
18	1	MALE CONNECTOR 1/8" T x 1/8" NPT	MF0890X
17	2	MALE CONNECTOR 1/4" T x 1/8" NPT	MF0870X
16	1	BULKHEAD FEMALE CONNECTOR, 1/4"	MF1450X
15	12'	TUBING, 316 S.S. 1/8" O.D. x .035 W.T.	0316S0012T03
14	48'	TUBING, 316 S.S. 1/4" O.D. x .035 W.T.	0316S0025T03
13	3	HEX HD. MACH. SCREW 3/8"-16 x 1" LG.	MA004AX
12	5	HEX HD. SCREW 5/16"-18 x 1" LG.	MA026FX
11	5	HEX NUT, 5/16"-18	MA027DX
10	1	HEX PLUG, 1/4"	MF001DX
9	1	GAUGE, 1/4" LM LF S.S., 0-2000#	GA00300
8	1	MORGAN TIMER, TR-2	MM12400
7	1	LSS-1 LIQUID SAMPLE PUMP	LSS11V8310
6	1	MANIFOLD BLOCK W/ PURGE	ME01800
5	1	CYLINDER HOLDER	CH1
4	1	FLOOR FLANGE	GSS1049
3	1	BRACKET	GSS1062
2	1	BASE	FRP004
1	1	DOME	FRP002

NO.	REQ.	DESCRIPTION	PART NUMBER
-	2	HEX NUT, 10-24	MA066DX
-	8	WASHER, 5/16"	MA070DX
-	2	HEX HD. MACH. SCREW 10-24 x 2" LG.	MA065KX
-	2	WASHER, #10	MA067DX
-	1	LEAK CHECK BOTTLE	MM11600
NOT SHOWN			

NO.	REQ.	DESCRIPTION	PART NUMBER
21	1	MALE ELBOW 1/8" T x 1/4" NPT	MF026DX
20	1	MALE ELBOW 1/4" T x 1/4" NPT	MF090DX
19	4	MALE CONNECTOR 1/4" T x 1/4" NPT	MF018DX

DATE	REV.	RECORD	AUTHORIZED	DRAFTER	CHECKED
10/26/07	-	DR# 7937	GB	EBC	

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TITLE	LSS-1 OUTLINE DRAWING
COMPANY	

DRAWN BY	SCALE	APPROVED BY	DRAWING NUMBER	REV.
EBC	STF		LS140.18	-
DATE: 10/26/07			SHEET: 2 of 2	

2. INSTALLATION INSTRUCTIONS

2.1 General

After unpacking the unit, check it for compliance and for any damages that may have occurred during shipment.

NOTE

Claims for damages caused during shipping must be initiated by the receiver and directed to the shipping carrier. Welker is not responsible for any damages caused from mishandling by the shipping company.

NOTE

When sealing fittings with PTFE tape, refer to the proper sealing instructions for the tape used.

NOTE

The installation instructions are written from the position that the GSS-1 is part of a complete sampler system. If it is purchased as a sample pump alone, the system should be installed in a fashion compatible to the following instructions.

INSTALLATION

2.2 Installation Instructions

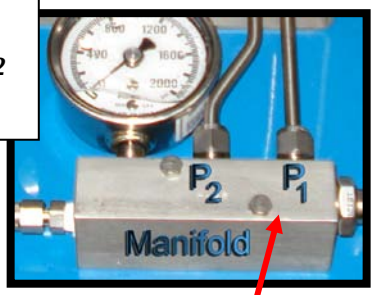
WARNING

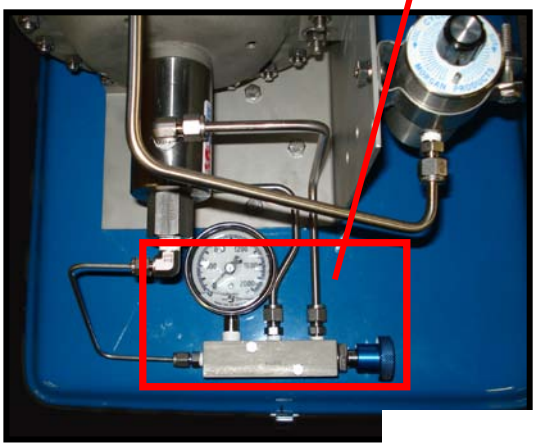
Sample probe should not be installed in a header or blow-down stack and should be away from obstructions, elbows or partially closed valves.

Off 2

Locating P1 & P2

on the Manifold





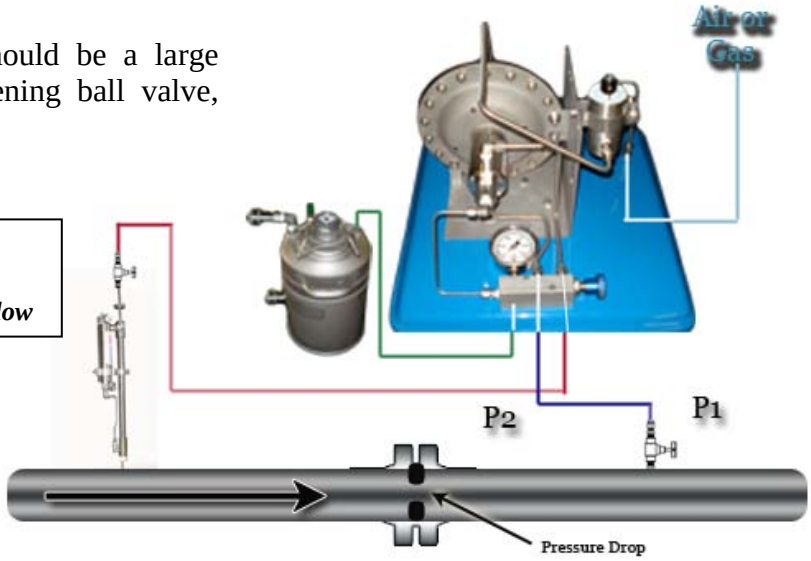
1. A sample probe should be located in a well mixed area of the flowing stream, reaching approximately into the center one-third of the pipeline.
   Typically the Welker Liquid Sampler is installed utilizing a pitot probe or with 2 single probes.
   If 2 single probes are used, one should be located upstream and the other downstream of a moderate pressure drop such as an orifice plate or control valve. This will create a hot loop for the sampler that will allow a "real-time" sample to be taken with each new actuation (See Figure 3).

2. The sampler should be located as close to the sample point as practical and level with the pipeline probe. A location up to three feet or less, from the probe is desirable.

3. The sample probe valve should be a large ported valve (i.e., fully opening ball valve, block valve, etc.)

Figure 3

Placement Relative to Pipeline Flow



INSTALLATION

2.2 Installation Instructions (Continued)

4. Next hook up the instrument air to the timer.

5. Once the sampler is mounted, and the probe and air are installed, hook-up can be completed. The sample container should be located as close to the sampler as possible.

6. The inline relief of the pump should be set at approximately 100 psi above pipeline operating pressure (See Appendix 1 – Setting the Inline Relief).

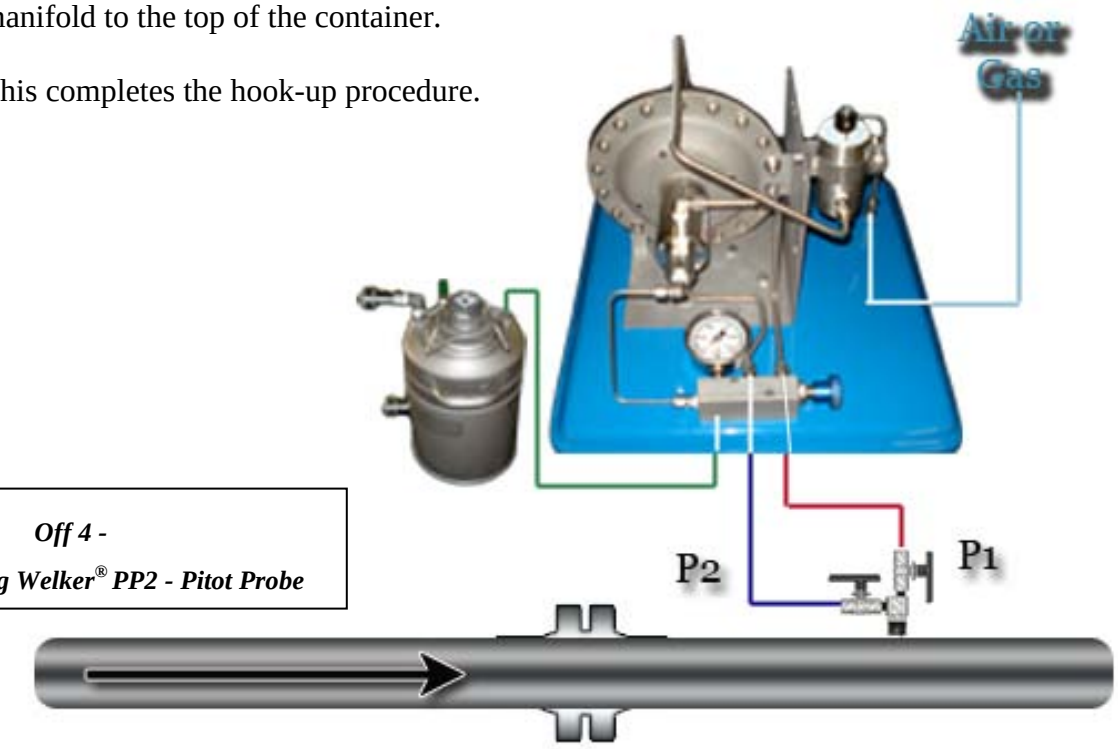
7. Using small diameter stainless steel tubing (1/4" O.D. or larger), tube from the probe to the inlet port of the manifold (P1- See Off 2). Where a hot loop or pitot probe is employed, tube from (P2) on the manifold back to the pipeline or to (P2) of the pitot probe (See Off 4).

NOTE

Nothing should be installed between the probe and the inlet of the sampler, such as filters, drips or regulators. These could have an adverse effect on the integrity of the sample. Also, make sure that all fittings are tight and NPT connections are PTFE taped or doped.

8. Using 1/4" O.D. stainless steel tubing; connect from the sample outlet port on the manifold to the top of the container.

9. This completes the hook-up procedure.



Off 4 -

Hook Up Using Welker® PP2 - Pitot Probe

INSTALLATION

2.3 Start-Up and Sequence of Operation

N NOTE

When pressuring the system, always open pipeline valves slowly. All connections must be checked carefully for leaks at full line pressure. Leaks within the sample system will compromise the sample.

1. Open the pipeline isolation valve on the probe that leads from the pipeline to the sampler.
2. Make sure there are no leaks between the probe, sampler, and the container.
   - Make sure the valve on manifold is closed.
   - Make sure there is no discharge from the sampler to the container; this would indicate the relief valve needs adjusting or repairs.
   - Turn on the air supply to the timer.
3. You are now ready to begin the sampling timing cycles with the control system you chose.
4. The instrument supply air should be set to 40-60 psi on the diaphragm motor.

W WARNING

In cases where pipeline pressures are in excess of 1,500psi, more instrument supply air may be necessary to take a sample. The instrument supply will have to be increased accordingly. The diaphragm motor can accept 100 psi in these cases. Increased supply should be used only when necessary and a relief valve for overpressure protection should always be used to prevent possible damage and accidents.

5. Please see *Appendix B - IOM of Morgan Timer* on page 16, for instructions on how to set the Morgan Timer.
6. The sampler is ready for operation.

3. MAINTENANCE

3.1 General

Prior to maintenance or disassembly of the unit, it is advisable to have a repair kit handy for the system in case of unexpected wear or faulty seals. All maintenance and cleaning of the unit should be done on a smooth, clean surface.

N NOTE

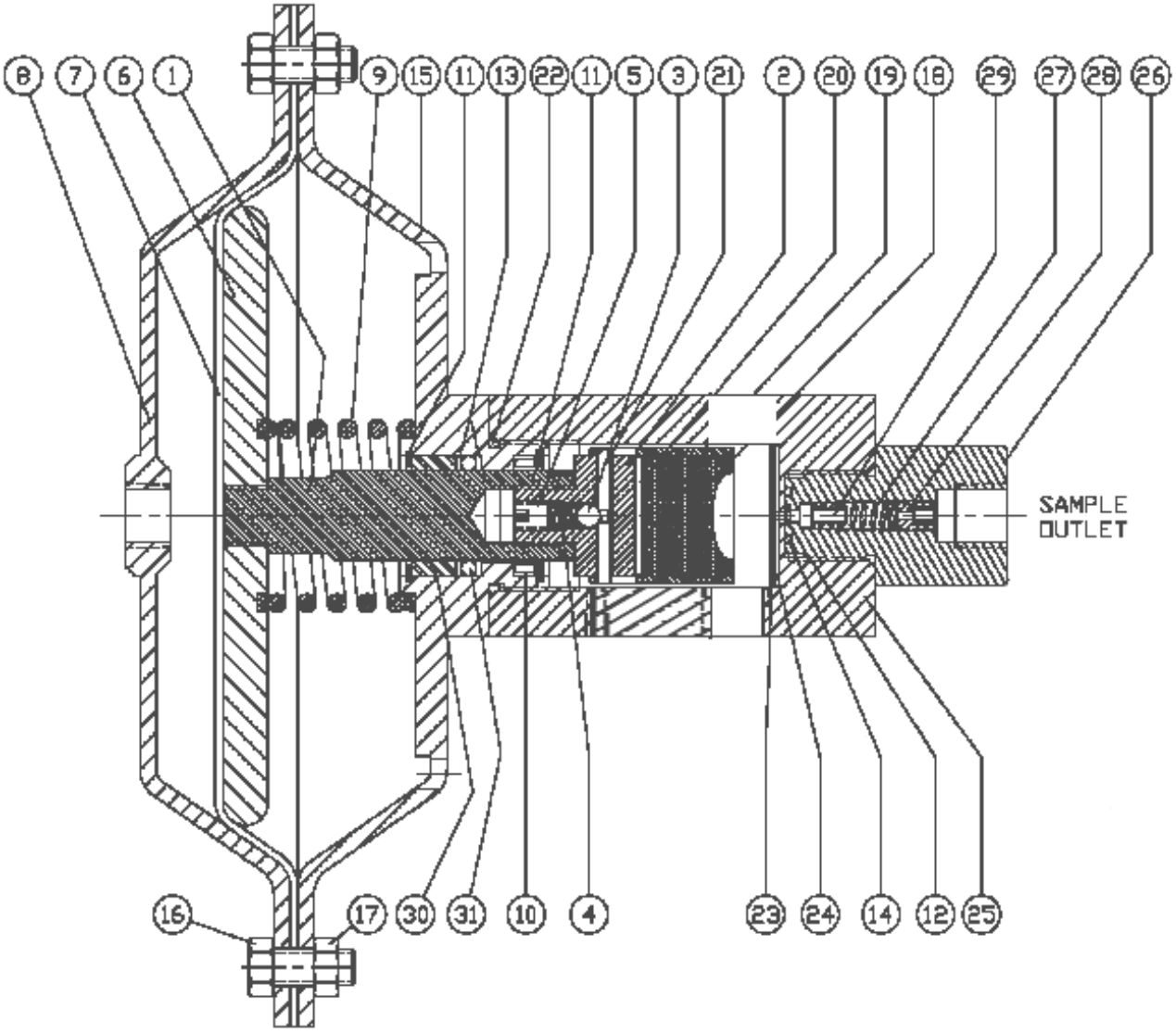
We recommend that the unit have annual maintenance under normal operating conditions. In the case of severe service, dirty conditions, excessive cycling usage, or other unique applications that may subject the equipment to unpredictable circumstances, a more frequent maintenance schedule may be appropriate.

Recommended Tools

It would be advisable to have the following tools available for maintenance of the unit; however, tools used will vary depending on probe model.

- Small hex key set
- 6" adjustable wrench
- Hex wrenches $^{1}/_{8}$" & $^{3}/_{16}$"
- Adjustable pliers
- Snap ring pliers

MAINTENANCE



LSS-1 Vanishing Chamber Sampler

1	Inner Shaft	7	Diaphragm	13	Back Up Ring	19	Head Shield	25	Body
2	Adapter	8	Upper Diaphragm Case	14	O-Ring	20	Non-Extrusion Disc	26	Relief Cap
3	Ball Bearing	9	Return Spring	15	Lower Diaphragm Case	21	Holding Pin	27	Poppet Spring
4	Spring	10	Variseal	16	Hex Head Bolt	22	O-Ring	28	Adjusting Screw
5	Set Screw	11	Snap Ring	17	Hex Nuts	23	Vacuum Breaker Disc	29	Poppet
6	Diaphragm Plate	12	O-Ring	18	Collection Head	24	Kel-F Seal, Spider	30/31	Bearing / O-Ring

3.2 LSS-1 Maintenance Instructions

N NOTE

Please see *Appendix B - IOM of Morgan Timer* on page 16, for maintenance instructions for the Morgan Timer.

1. Close the pipeline isolation valve and vent all pressure.
2. Disconnect the instrument supply tubing from the sampler body.
3. Relieve and disconnect all the tubing from the sampler to the sample cylinder.
4. Unscrew the complete diaphragm housing from the sampler body (see Figure 6).

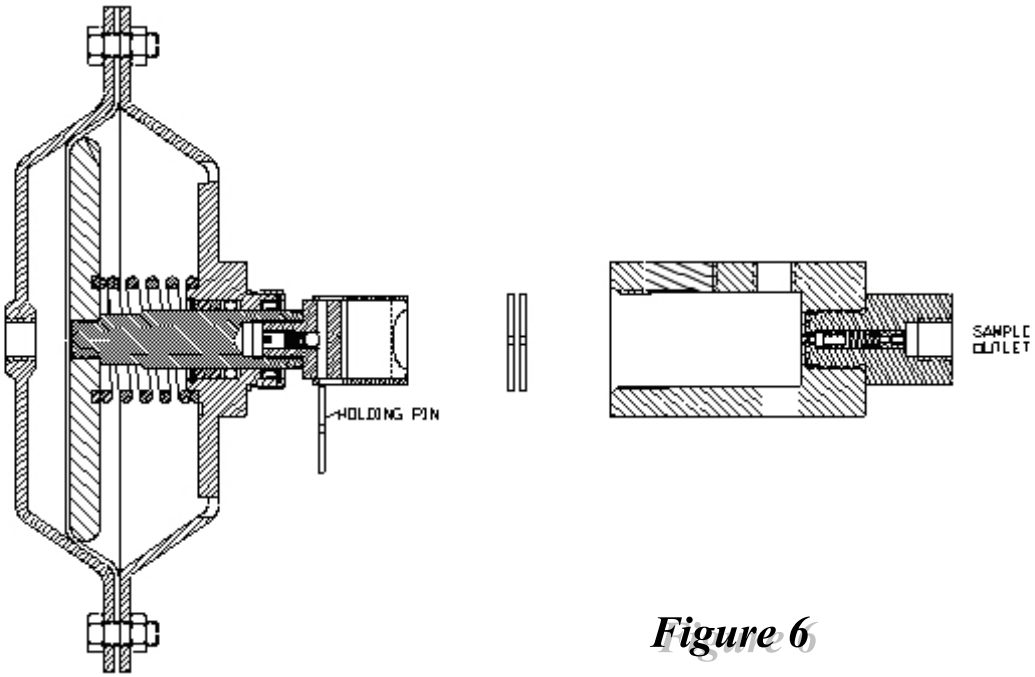


Figure 6

5. To replace the collection head (Part 18), push the holding pin out (Part 21), it is held in place by spring tension, and slip the shield (Part 19) off the shield/shaft adapter (Part 2). Push the collection head out of the shield. The non-extrusion disc (Part 20) will come out first and does not need to be replaced if it is in good condition (see Figure 6).
6. Lightly lubricate the inside surface of the shield and push in the new collection head. Replace the non-extrusion disc.
7. Slide the shield back onto the shield/shaft adapter and push the hold pin back into place.

3.2 LSS- 1 Maintenance Instructions (Continued)

8. To replace the remaining seals, remove the hex head nuts (Part 17, 18 each) and bolts (Part 16, 18 each) that hold the diaphragm case (Parts 8 & 15) together. Separate the two halves and examine the diaphragm. Replace, if necessary (see Figure 7). Replacement diaphragms are flat and over time will convolute.

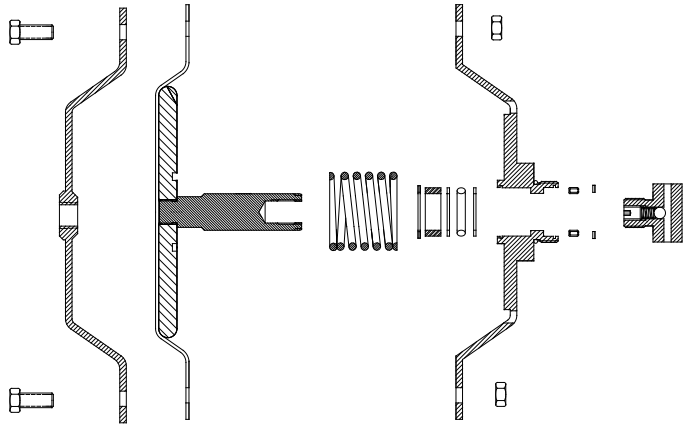


Figure 7

9. To unscrew the shield/shaft adapter (Part 2), hold on to the diaphragm plate (Part 6). With a wrench, unscrew the adapter from the shaft (see Figure 7 and 8).

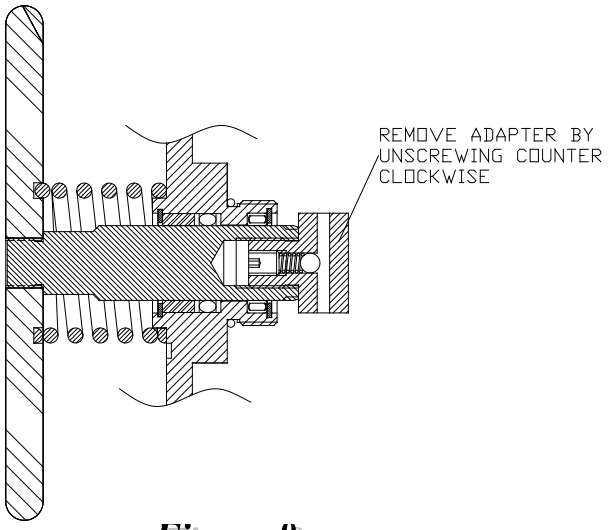


Figure 8

3.2 LSS-1 Maintenance Instructions (Continued)

10. Carefully push the shaft (Part 1) through the lower diaphragm case (Part 15) until the diaphragm plate clears the case. Then, pull the plate and shaft out from the top. (See Figure 9).

11. Examine the shaft for damage. The shaft is polished and should be free of scratches and pits. If it needs to be replaced, place the diaphragm plate in a vise and remove the shaft with an adjustable wrench on the shaft flats. Replace and tighten securely.

12. From the body side of the lower diaphragm case, remove the snap ring (Part 11) and the variseal (Part 10). When replacing the variseal, be careful not to damage it.

13. The bearing should not need replacing; however, if it is necessary, simply remove the snap ring from the opposite side of the diaphragm case and replace the bearing and/or seals.

14. Lubricate the shaft. Place the return spring (Part 9) in the center of the diaphragm case. Push the assembly back into the case, carefully guiding it through the seals. Replace the shield/shaft adapter securely.

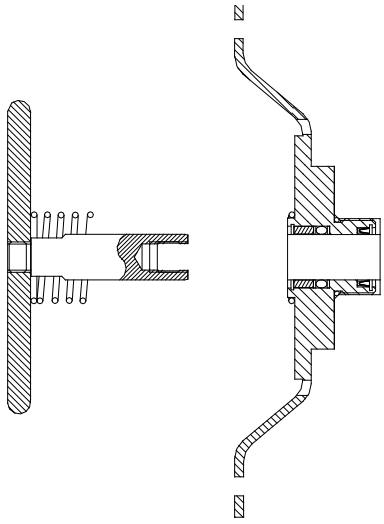


Figure 9

15. Replace the diaphragm and install the upper diaphragm case and all nuts (18 each) and bolts (18 each). Cross bolt the case and then tighten all bolts securely.

16. Replace the collection head assembly, which includes the head shield, collection cup, non-extrusion disc and holding pin.

17. Re-install the vacuum breaker disc and Kel-f® seal into the motor body and replace, if necessary. These are free floating in the body and simply need to be installed with the seal first and then the metal disc.

N NOTE

The collection head will seal against the metal disc.

18. Replace the seal around the male threads on the lower diaphragm case assembly and screw the lower diaphragm case back to the body (hand tighten only).

19. Replace instrument tubing.

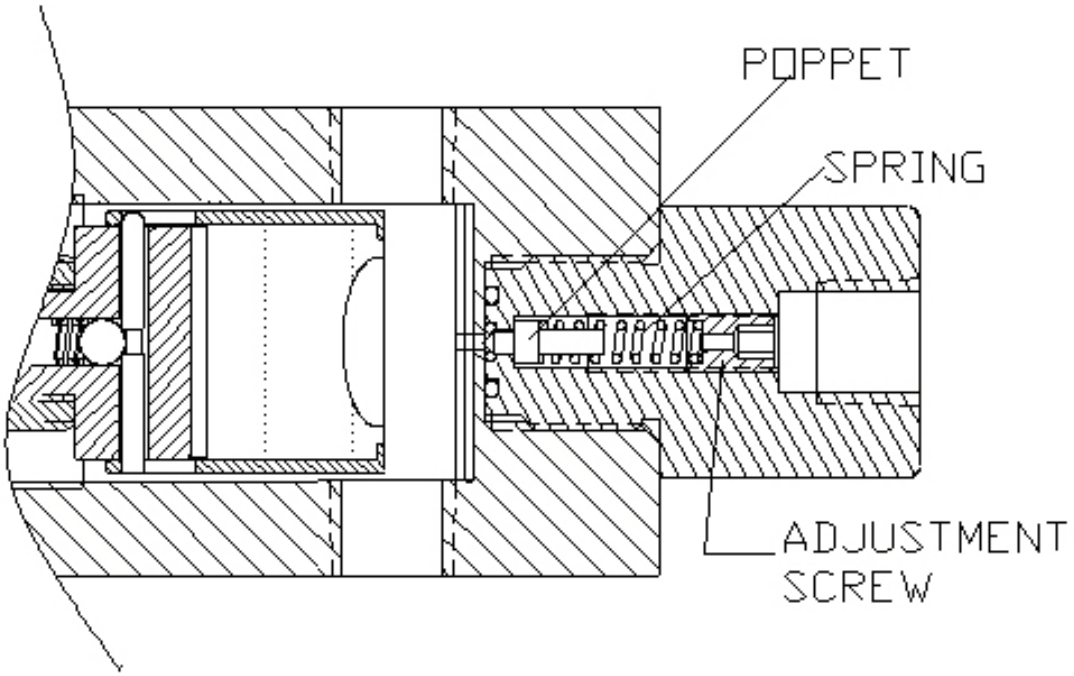
APPENDIX A

4. INLINE RELIEF INSTRUCTIONS

4.1 General Information

The function of the inline relief is to act as a check valve and to assure that the sampler pumps the product into the container and that pipeline pressure does not fill the container unless it is pumped by the sampler. This relief is used with single cavity and constant pressure type cylinders and TCC containers.

4.2 Adjusting the Inline Relief



1. Remove the fitting and tubing from the inline relief.
2. Slowly open pipeline isolation valve and allow full line pressure to the sampler.
3. With a 1/8" hex wrench, insert it inside the relief cap to the spring adjusting screw.
4. Adjust the spring tension until there is no leaking through the set screw. Then, turn adjusting screw another full turn clockwise.

N NOTE

Each full turn on spring adjustment screw increases spring tension approximately 100 psi. The relief needs to be set approximately 100 psi above maximum line pressure.

5. Replace the tubing fitting and tighten tubing.
6. If applicable, the gauge on the manifold should show 0 psi. This will assure the relief is holding and the sampler must pump product into the container.

APPENDIX B

4. MORGAN TIMER IOM

The information contained in this Installation, Operation, and Maintenance Manual is provided by the manufacture(s) and does not necessarily reflect the official policy, position, or opinions of Welker. Welker has not researched the following information, and does not guarantee its accuracy.

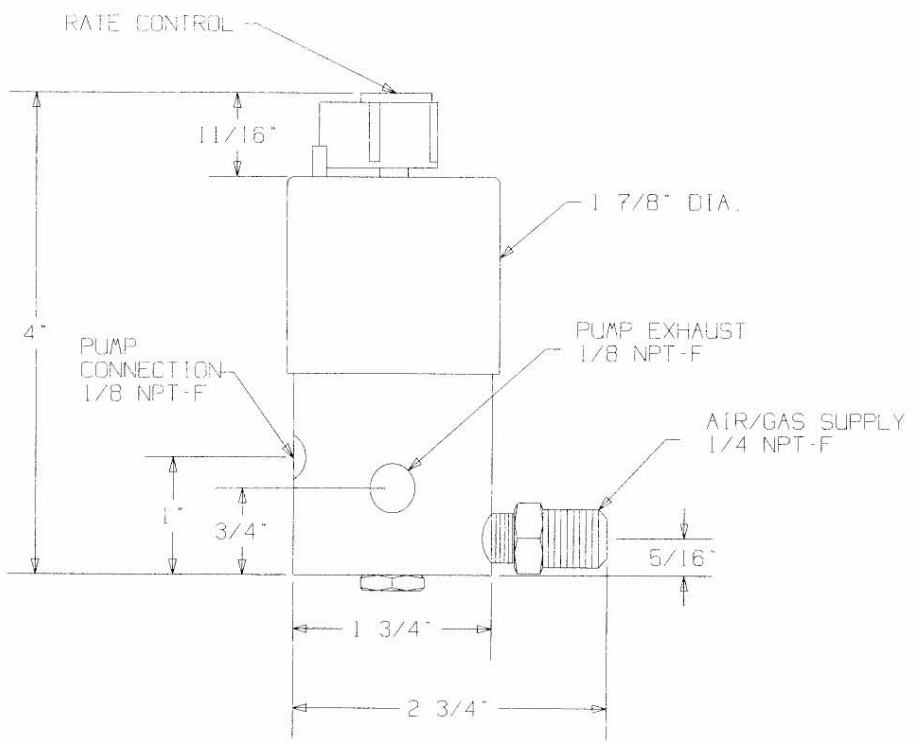
APPENDIX B

MORGAN PRODUCTS

PNEUMATIC CHEMICAL PUMPS FOR THE GAS AND OIL INDUSTRIES

MODEL TR2

AIR ACTUATED TIMER



CONNECTIONS INPUT, OUTPUT, EXHAUST	RANGE SPM	PRESSURE RATING PSI / BAR	MATERIAL
1/8 NPT-FEMALE	0 - 50	25-150 / 1.7-10.3	300 SERIES SS

MORGAN PRODUCTS INC. 28103 Ave. Stanford / Valencia, CA 91355
(661) 257-3022 - (800) 421-8910 - FAX (661) 257-3385 - www.morganproducts.com - E-Mail info@morganproducts.com

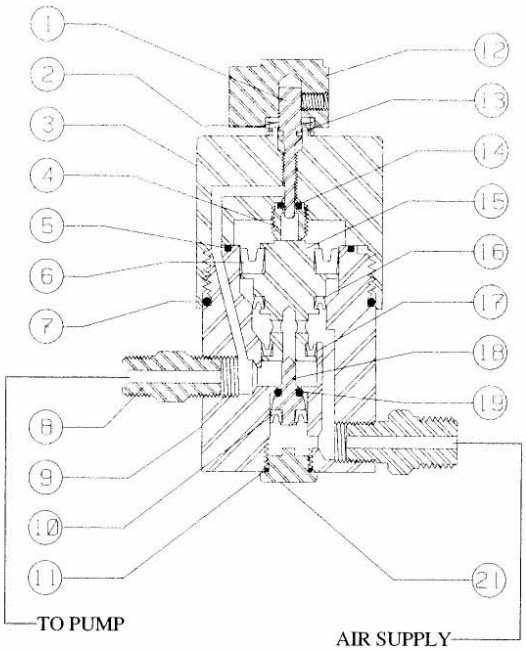
APPENDIX B

3/00

MORGAN PRODUCTS

PNEUMATIC CHEMICAL PUMPS FOR THE GAS AND OIL INDUSTRIES

Parts List Model TR2



NO	NAME	PART NO.	MATERIAL
1	Metering Valve	TR2-3	303 SS
2	Knob Spring	TR2-2	302 SS
3	Upper Body	TR2-5	303 SS
4	Metering Seat	TR2-6	18-8 SS
5	O-Ring	TR2-13 *	BUNA-N
6	Upper Seal	TR2-10 *	VITON
	Optional	TR2-10T *	TEFLON
7	O-Ring	TR2-14 *	BUNA-N
8	1/8 x 1/8 NPT Nipple	TR2-22	303 SS
9	Lower Body	TR2-8	303 SS
10	Poppet Seal	TR2-17 *	VITON
	Optional	TR2-17T *	TEFLON
11	Plug Seal	TR2-18 *	BUNA-N
12	Knob	TR2-1	PLASTIC
13	O-Ring	TR2-4 *	BUNA-N
14	Teflon Seal	TR2-7 *	TEFLON
15	Piston	TR2-9	NYLON
	Optional	TR2-29 *	ALUM
16	Middle Seal	TR2-11 *	VITON
	Optional	TR2-11T *	TEFLON
17	Lower Seal	TR2-12 *	VITON
	Optional	TR2-12T *	TEFLON
18	Poppet	TR2-15	PVC
19	Poppet O-Ring	TR2-16 *	VITON
N/I	1/8 x 1/4 NPT Nipple	TR2-21	303 SS
21	Plug	TR2-19	303 SS
	1oz. Grease	*	
	Repair Kit	TR2-50	

* = Included in Repair Kit

INSTALLATION INSTRUCTIONS

1. Choose the chemical injector best suited for your specific needs.
2. Connect the port marked "TO PUMP" on the TR2 to the air inlet port at the top of the pump.
3. Connect the air or gas supply to the port marked "AIR SUPPLY".
4. Open the control knob counter clockwise about 3/4 of a turn. The timer should start to cycle.
5. Set the air supply so that the pump full strokes. See pump start up instructions.
6. Set cycle rate in strokes per minute. (See volume graph for specific pump)
7. For continued reliable operation keep all rubber goods lubricated with Morgan Products 4024 grease. Depending on specific aplacition approximately every 30-60 days.

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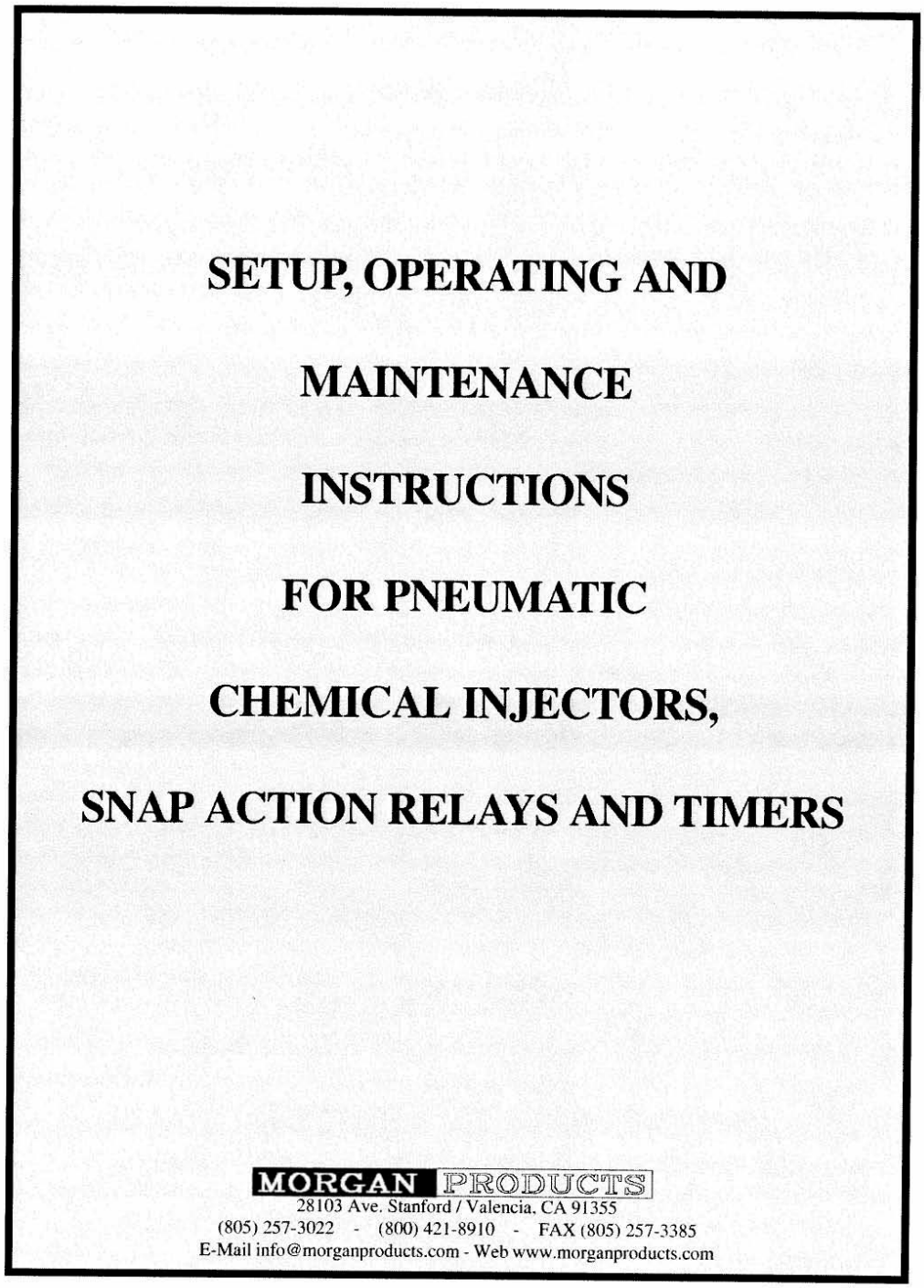
APPENDIX B



SETUP, OPERATING AND

MAINTENANCE

INSTRUCTIONS

FOR PNEUMATIC

CHEMICAL INJECTORS,

SNAP ACTION RELAYS AND TIMERS

MORGAN PRODUCTS
28103 Ave. Stanford / Valencia, CA 91355
(805) 257-3022 - (800) 421-8910 - FAX (805) 257-3385
E-Mail info@morganproducts.com - Web www.morganproducts.com

APPENDIX B

OPERATING INSTRUCTIONS
TR1 TIMING RELAY

1. Connect a regulated air/gas supply of sufficient volume and pressure to stroke the pump or relay to which it is attached with a minimal pressure drop at the regulator, to the IN port on the timer.
   NOTE: IN port is the 1/4" NPT-Female.

2. Connect the OUT port to the pump or relay being driven as close as feasible with no restrictions.
   NOTE: OUT port is the 1/8" NPT-Female and is 180 degrees from the IN port.
   The port 90 degrees from the other two is always the exhaust.

3. Be sure the pressure is sufficient to stroke the pump against process line pressure.
   NOTE: A. Air pressure should be 5 PSI to 15 PSI above the minimum required to achieve injection. Insufficient pressure or volume at the timer will result in an erratic flow rate and/or intermittent stalling of timing relay.

   B. If a filter or silencer is used in the timing relay exhaust port, take care not to restrict exhaust flow as it may cause intermittent operation.

Timing relay is preset at factory for 0-50 strokes per minute at 50 PSI. Rate will change if timer is switched between two pumps of different air chamber sizes. Rate will also change if supply pressure is above (slower) or below (faster) then 50 PSI. The knob can be repositioned to yield the desired range at any supply pressure if needed without harming the operation in any way. Do not allow maximum rate to exceed that which is specified for the pump to which it is attached.

TROUBLE- SHOOTING
TR1 TIMING RELAY

1. Constant air flow through exhaust port.
   Possible Solutions: A. Check "Air supply" and "To pump" ports for proper connection.
   B. Check exhaust poppet (TR1-24).
   C. Check lower diaphragm (TR1-17).

2. Relay cycles but will not adjust properly.
   Possible Solutions: A. Replace Teflon seal (TR2-7).

3. Constant air flow between body sections.
   Possible Solutions: A. Check upper diaphragm (TR1-11) or middle diaphragm (TR1-14).

4. Intermittent or sluggish operation.
   Possible Solutions: A. Inspect upper seat orifice (TR1-18) for any obstruction.
   B. Inspect poppet nose (TR!-24) for excessive wear.

APPENDIX B

OPERATING INSTRUCTIONS
TR2 TIMING RELAY

1. Connect a regulated air/gas supply of sufficient volume and pressure to stroke the pump or relay to which it is attached with a minimal pressure drop at the regulator, to the IN port on the timer.

   NOTE: IN port is the bottom port.

2. Connect the OUT port to the pump or relay being driven as close as feasible with no restrictions.

   NOTE: OUT port is the top port and is 180 degrees from the IN port.
   The port 90 degrees from the other two is always the exhaust.

3. Be sure the pressure is sufficient to stroke the pump against process line pressure.

   NOTE:
   A. Air pressure should be 5 PSI to 15 PSI above the minimum required to achieve injection. Insufficient pressure or volume at the timer will result in an erratic flow rate and/or intermittent stalling of timing relay.

   B. If a filter or silencer is used in the timing relay exhaust port, take care not to restrict exhaust flow as it may cause intermittent operation.

Timing relay is preset at factory for 0-50 strokes per minute at 50 PSI. Rate will change if timer is switched between two pumps of different air chamber sizes. Rate will also change if supply pressure is above (slower) or below (faster) then 50 PSI. The knob can be repositioned to yield the desired range at any supply pressure if needed without harming the operation in any way. Do not allow maximum rate to exceed that which is specified for the pump to which it is attached. TR2 timing relay requires periodic lubrication of seals on the piston. The usual time frame is 4 to 16 weeks depending on stroke rate being used, amount of moisture in supply air/gas, and possible presence of hydrocarbons in supply gas.

APPENDIX B

MAINTENANCE PROCEDURE
TR2 TIMING RELAY

1. Close air/gas supply valve.
2. Remove TR2-5 upper body.
3. Remove piston assembly.
4. Wipe residue from piston assembly and bores in TR2-8 lower body.
5. Lubricate TR2-8 and piston assembly liberally with a good quality silicone grease.
6. Reinstall piston assembly into lower body taking care not to damage seals.
7. Reinstall TR2-5 and open supply valve.

Entire operation takes only a few seconds and will insure longer, more trouble-free operation. Never use liquid type lubricators in supply line to the timer. Oil will clog the small passages in the metering valve and cause stalling of timing relay.

TROUBLE SHOOTING
TR2 TIMING RELAY

1. Problem: Constant air flow through exhaust.
   Possible Solutions:
   A. Check IN and OUT ports for proper connection.
   B. Check poppet valve TR2-15.
   C. Check lower seal TR2-12.

2. Problem: Relay cycles, but will not adjust properly.
   Possible Solutions:
   A. Replace teflon seal TR2-7.

3. Problem: Intermittent or sluggish operation.
   Possible Solutions:
   A. Inspect piston TR2-9 for any obstruction.
   B. Inspect and lubricate piston seals TR2-10, TR2-11, TR2-12 with 4024 grease.

4. Problem: Air flow through drain hole TR2.
   Possible Solutions:
   A. Inspect middle seal TR2-11 for damage.

APPENDIX B

INSTALLATION INSTRUCTIONS FOR PISTON DISPLACEMENT PUMPS

1. Discard all red plastic closures.
2. Connect the suction check valve, to a gravity fed chemical source.
3. Connect the discharge check valve, to the process line.
4. Connect a regulated air or gas supply to the timing relay.
   Note: On pumps supplied with a SR2S snap action relay you must provide a second regulated air or gas supply.
5. Fill the oil reservoir with silicone oil provided. This must be done BEFORE start up pump.
6. Open the bleeder valve until chemical starts to flow then retighten.
7. Set regulator at 10 to 15 psi ABOVE the pressure required. Refer to discharge pressure graph on pump brochure.
8. Set cycle rate in strokes per minute. Refer to volume graph on pump brochure.

PREVENTIVE MAINTENANCE PISTON DISPLACEMENT PUMPS

1. Check silicone oil periodically and refill when necessary. The chemical injector should not be operated without silicone oil, as damage may occur. (Note 1)

2. The longevity of the plunger seal depends upon the chemical being injected. The fluid should be clean and free of foreign matter to prevent damage to the seal and the injector's plunger assembly.

Note 1 -If injecting chemicals that cause the lubricant to foam, select an alternative lubricant that is compatible with the injected fluid. When a high level of purity of the injected chemical is essential, use distilled water or the injected chemical as the lubricant. Under some circumstances, the pumped fluid has good lubrication properties and no lubrication in the lubrication chamber is necessary. However, caution should be exercised.

APPENDIX B

CORRECTIVE MAINTENANCE
PISTON DISPLACEMENT PUMPS

NO PUMP DISCHARGE	
1. Suction or discharge valves not seating	*Clean or replace.
2. Pump vapor locked	*Open bleed plug and prime.
3. Suction or discharge line plugged	*Check line for closed valve.
PLUNGER NOT STROKING	
1. Plunger stuck due to tight or dry seal	*If seal swollen, check its chemical compatibility, and replace. *If dry, lubricate and fill reservoir.
2. Plunger bottomed	*Readjust stroke length.
3. Return spring broken	*Clean pump then replace pressure seal and spring.
4. Insufficient supply pressure to permit pump to over come process line pressure	*Increase supply pressure.
5. Discharge line plugged	*Clear line
6. Supply of air to timer is insufficient (timer locked up and won't cycle)	*Install larger regulator and/or supply line, vent the supply side of the timer and try starting the pump at slowest speed. In crease speed slowly if timer starts to cycle.
7. Air Chamber-piston blow by	*Check piston seal. *Check air chamber surface . Aspirated dirt or sand through faceplate equalization hole can damage air chamber. Install a filter.
SHORT SEAL LIFE	
1. Nick, burr, or scratches on plunger	*Replace plunger.
2. Seal or plunger materials not compatible with chemical being pumped	*Refer to compatibility charts, or contact your distributor.
3. Chemical crystallizing on plunger and scoring seal	*Maintain visible lubricant level.
4. Incorrect lubricant	*Use a lubricant which is compatible with chemical being pumped.
5. Excessive air supply pressure.	*Check pump ratio and adjust air supply.

APPENDIX B

INSTALLATION INSTRUCTIONS FOR AIR DIAPHRAGM PUMPS

1. Discard all red plastic closures.
2. Connect the suction check valve, (bottom) to a gravity fed chemical source.
3. Connect the discharge check valve, (top) to the process line.
4. Connect a regulated air or gas supply (150 psi MAXIMUM) to the timing relay
5. Set regulator at 10 to 15 psi ABOVE the pressure required.
6. Set cycle rate in strokes per minute. Refer to volume graph on pump brochure.

CAUTION:

Do not use this pump with chemicals that become hazardous when aerated.
Check valves will not stop the flow of a gravity fed chemical supply. Install a shut off valve between pump and chemical supply.

MAINTENCE AND TROUBLE SHOOTING FOR AIR DIAPHRAGM PUMPS

1. PROBLEM: No discharge from pump.
   POSSIBLE SOLUTIONS:
   A. Inspect suction and discharge lines for any obstructions.
   B. Inspect suction and discharge check valves.

2. PROBLEM: Pump not stroking.
   POSSIBLE SOLUTIONS:
   A. Supply pressure is insufficient 5-10 psi higher than process line pressure is required.
   B. Check return spring. Replace if broken.

3. PROBLEM: Short diaphragm life.
   POSSIBLE SOLUTIONS:
   A. Supply pressure is too high, (150 psi maximum).
   B. Chemical not compatible with diaphragm.

4. PROBLEM: Chemical in timer.
   POSSIBLE SOLUTIONS:
   A. Broken diaphragm. Replace diaphragm.

APPENDIX B

OPERATING INSTRUCTIONS
SR1S-SR2S SNAP ACTION RELAYS

1. The air or gas must be connected to the "in " port on the side of the relay.
   A. Supply should always be regulated and of sufficient pressure and volume to achieve desired injection pressure at the pump with a minimal pressure drop at the regulator.
   B. SR2S relay should NEVER be fed by a regulator which also feeds a timing relay. Failure to comply will result in intermittent stallling of timing relay.
   C. We recommend installation of relay as close as possible to regulator supplying air/gas.

2. The out port(s) should be connected to the pump(s) driven utilizing piping of sufficient size to pass the required amount of air/gas during the EXHAUST (unpressured) stroke of the pump. We recommend this instillation be as close as feasible to the pump.

3. If silencers are used, take caution not to restrict the exhausting of air/gas from the pump. Restricting the exhaust ports will result in an inability to achieve maximum stroke rate and reducing output of the pump.

4. Port at the top of the relay should be connected to the timing mechanism of choice and as close as feasible to the timer. The pressure to this point should be sufficient to actuate relay and achieve proper seal of valve seats during operation. (Usually 1/2 to 3/4 of pressure to "in" port, but always at least 35psi).

APPENDIX B

INSTALLATION INSTRUCTIONS FOR HYDRAULIC DIAPHRAGM PUMPS

1. Discard all red plastic closures.
2. Connect suction check valve, to a gravity fed chemical source.
3. Connect discharge check valve, to process line.
4. Connect a regulated air or gas supply (100 psi maximum) to the timing relay.
5. Fill oil reservoir with oil provided, until oil flows out of bleed hole.
   This must be done BEFORE start up
6. WITH METERING OPTION ONLY. Insure that the volume adjuster is screwed all the way in for maximum output at startup.
7. Open bleeder valve until chemical flows from bleed hole.
8. Set regulator at 10 to 15 psi ABOVE the pressure required. Reference discharge pressure graph on the pump brochure.
9. Set cycle rate in strokes per minute. Reverence volume graph on the pump brochure.
10. WITH METERING OPTION ONLY. Adjust output volume as needed.

CAUTION: Use only light hydraulic oil as provided with pump or repair kit.

APPENDIX B

CORRECTIVE MAINTENANCE HYDRAULIC DIAPHRAGM PUMPS

NO PUMP DISCHARGE	
1. Suction or discharge valves not seating	*Clean or replace.
2. Pump vapor locked	*Open bleed plug and prime.
3. Suction or discharge line plugged	*Check line for closed valve.
PLUNGER NOT STROKING	
1. Plunger bottomed	*Readjust stroke length.
2. Return spring broken	*Clean pump then replace pressure seal and spring.
3. Insufficient supply pressure to permit pump to over come process line pressure	*Increase supply pressure.
4. Discharge line plugged	*Clear line
5. Supply of air to timer is insufficient (timer locked up and won't cycle)	*Install larger regulator and/or supply line, vent the supply side of the timer and try starting the pump at slowest speed. In crease speed slowly if timer starts to cycle.
6. Air Chamber-piston blow by	*Check piston seal. *Check air chamber surface . Aspirated dirt or sand through faceplate equalization hole can damage air chamber. Install a filter.
SHORT SEAL LIFE	
1. Nick, burr, or scratches on plunger	*Replace plunger.
2. Hydraulic Fluid contaminated and scoring seal.	*Check and/or replace hydraulic fluid. Dirt or foreign particals will reduce seal life.
3. Excessive air supply pressure.	*Check pump ratio and adjust air supply.

APPENDIX B

REBUILDING INSTRUCTIONS FOR HYDRAULIC DIAPHRAGM PUMPS

1. Completely disassemble pump and clean parts.
2. Replace diaphragm return spring and spring cup.
3. Place diaphragm on pressure chamber with teflon side down. Place hydraulic chamber on assembly and install bolts. **CAUTION MODEL HD562 AND HD1062 ONLY** Be sure that the upper spring cup is in place. (Same as lower spring cup.)
4. Tighten bolts a little at a time in a crisscross manner to achieve a proper seal. **Torque bolts to 18 foot pounds**
5. WITH METERING OPTION ONLY. Reassemble volume adjuster and install in hydraulic chamber. Screw adjustment all the way in for maximum output at startup.
6. Install check valves with teflon tape to avoid galling and prevent leakage.
7. Fill hydraulic chamber with oil provided, to top of back-up ring. Use only light hydraulic oil.
8. Install pressure seal (spring down), back-up ring and body seal.
9. Carefully assemble spring chamber as to not disturb oil in hydraulic chamber.
10. Slip return spring onto piston-plunger assembly and slide the assembly onto pump and secure with air chamber and lock ring.
11. Install timer, pump is now ready for operation.
12. Reinstall pump and reconnect discharge line at this time.
13. To bleed pump loosen bleeder plug until chemical appears and retighten.
14. Now fill reservoir with oil provided.
15. Connect a regulated air/gas supply to the timer and set regulator 10-15 PSI above what is needed to achieve injection into your process line. This is very important for proper operation.
16. Now set stroke rate for proper flow.
16. Fine tune if needed, STANDARD PUMPS using the stroke adjuster on top of the air chamber. WITH METERING OPTION using the volume adjuster.

If you need any assistance, please contact your distributor or our plant for assistance.

APPENDIX B

AIR / GAS USAGE
SCF/DAY AT 1 STROKE PER MINUTE

SUPPLY PRESSURE

PUMP MODEL	25psi	50psi	75psi	100psi	125psi	150psi
D10-XXX	.2	.4	.5	.7	.8	1.0
D15-XXX	.7	1.1	1.6	2.0	2.4	2.8
D25-XXX	2.2	3.5	4.8	6.2	7.5	8.9
D40-XXX	9.2	14.9	20.7	26.4	32.2	37.9
HD187	1.0	2.0	2.9	3.7	4.5	5.3
HD312	3.9	6.4	8.9	11.3	13.8	16.2
HD312-3K	8.9	14.4	19.9	25.5	31.0	36.5
HD312-5K	15.7	25.6	35.4	45.3	55.1	64.9
HD562	8.9	14.4	19.9	25.5	31.0	36.5
HD562-3K	15.7	25.6	35.4	45.3	55.1	64.9
HD562-5K	28.0	45.5	63.0	80.5	98.0	115.5
HD1062	28.0	45.5	63.0	80.5	98.0	115.5
HD1062-3K	157.0	260.5	353.8	452.1	550.4	648.6
HD2000	314.5	511.0	707.6	904.1	1100.7	1297.2
50 SERIES	1.3	2.1	3.0	3.8	4.6	5.4
100 SERIES	3.9	6.4	8.9	11.3	13.8	16.2
200 SERIES	8.9	14.4	19.9	25.5	31.0	36.5
300 & 3000 SERIES	15.7	25.6	35.4	45.3	55.1	64.9
400 & 4000 SERIES	28.0	45.5	63.0	80.5	98.0	115.5
880 & 1255 SERIES	209.1	342.0	456.1	559.4	655.5	746.1
5000 SERIES	314.5	511	707.6	904.1	1100.7	1297.2
8000 SERIES	693.0	1125.4	1558.2	1991.0	2424.0	2549.8

Table constant multiplied by stroke rate = SCFD
Example: D10-XXX operated at 50 psi (.4) multiplied by 20 strokes per minute = 8 SCFD

APPENDIX B

CHEMICAL COMPATIBILITY CHART

This chart is to show the general compatibility of certain corrosive materials with specific liquids and gases at ambient temperatures. Such variables as temperature, pressure and flow rates as well as other operating conditions will affect compatibility. Because unknown variables exist, it is recommended that this chart be used as a guide only.

APPENDIX B

Chemical Compatibility Chart

Key to Rating

A - Substantial Resistance, B - Moderate Resistance, C - Severe Effect, Blanck - No Data

Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Acetaldehyde	B	A	A	A	A	C	C	B	C
Acetate Solvents	B	A	A	A	A	C	C	C	C
Acetic Acid, 20%	B	A	A	A	A	A	C	A	C
Acetic Acid Concentrated to 150°F (66°C)		B	A	A	A	C	C		C
Acetic Acid Concentrated to 212°F (100°C)	C	B	A	A	A	C	C		C
Acetic Anhydride	C	B	A	A	A	C	C	A	C
Acetone	B	A	A	A	A	C	C	B	C
Alum	C	C	B	A	A	A	A	A	A
Aluminum Chloride	C	C	C	B	A	A	A	A	A
Aluminum Nitrate	B	A	A	A	A	A	A		
Aluminum Sulfate	C	C	B	A	A	A	A	A	A
Ammonia Anhydrous	A	A	A	A	A		C	A	A
Ammonium Bicarbonate	A	A	A	A	A	A	A		C
Ammonium Bisulfite	B	A	A	A	A	A	A		
Ammonium Bifluoride	C	B	B	A	A		A		A
Ammonium Hydroxide	C	A	A	A	A	A	B	A	A
Ammonium Nitrate	B	A	A	A	A	A		B	C
Ammonium Phosphate	C	B	A	A	A	A	A	A	
Ammonium Sulfate	C	B	B	B	A	A	A	A	C
Ammonium Sulfite	C	A	A	A	A	A	A		
Amyl Acetate, Dry	A	A	A	A	A	C	C	C	C
Amyl Alcohol	A	A	A	A	A	B	A	A	B
Amyl Chloride	C	B	A	A	A	C	C	C	
Aniline Chloride	C	B	A	A	A		B		
Aniline Dyes	C	A	A	A	A	C	B	C	
Animal Fats and Oils		A	A	A	A	A	A	C	A
Aqua Regia	C	C	C	C	A		B	C	
Ascorbic Acid	C	A	A	A	A				
Barium Chloride	C	C	C	B	A	A	A	A	A
Barium Sulfite	B	A	A	A	A	A	A	A	
Benzaldehyde	B	A	A	A	A	C	C	C	
Benzene	A	A	A	A	A	C	B	C	C
Benzene Sulfonic Acid 10%	C	B	B	A	A	A	A	C	C
Benzoic Acid	C	B	B	A	A	A		C	A

APPENDIX B

Chemical Compatibility Chart

Key to Rating

A - Substantial Resistance, B - Moderate Resistance, C - Severe Effect, Blanck - No Data

Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Benzoyl Chloride	C	C	C	C	A		B		
Boric Acid	C	A	A	A	A	A	A	A	A
Bromine Anhydrous	C	C	C	B	A	C	A	C	C
Bromine Dilute	C	C	C	C	A	B	A	C	C
Bromine Trifluoride	C	C	B	B	A		C		C
Butadiene	C	A	A	A	A		A		C
Butane	B	A	A	A	A	A	A	A	A
Butyric Acid 20%	C	A	A	A	A		C	A	A
Butyric Acid, Concentrated	C	B	B	B	A		C		A
Calcium Bisulfite	B	A	A	A	A	A	A	A	A
Calcium Carbonate	A	A	A	A	A	A	A	A	A
Calcium Chlorate	C	A	A	A	A	A	A	A	A
Calcium Chloride	C	B	B	A	A	A	A	A	A
Calcium Hydroxide	A	A	A	A	A	A	A	A	A
Calcium Hypochlorite	C	C	C	C	A	A	A	C	A
Calcium Nitrate	C	A	A	A	A	A	A		
Calcium Sulfite	C	A	A	A	A	A	A		
Calcium Sulfate		A	A	A	A	A	A	C	
Camphor Alcohol Sol.	B	A	A	A	A				
Carbon Disulfide	C	A	A	A	A		A	C	
Carbon Tetrachloride, Dry	B	A	A	A	A	C		C	
Carbon Tetrachloride, Wet	C	B	B	B	A	C		C	C
Carbon Water Slurries	C	B	A	A	A	A	A	A	
Cesium, 260°F (127°C)	C	A	A	A	A	C	C		
Chlorine, Anhydrous	A	A	A	A	A		C	C	C
Chlorine Water	C	C	C	A	A	A	A	C	C
Chloroacetic Acid	C	C	C	C	A		C		C
Chlorobenzene	C	A	A	A	A	C	A		B
Chloroform	B	A	A	A	A	C	A		C
Chlorosulfonic Acid	C	B	B	B	A	C	C	C	B
Choline Chloride	A	A	A	A					
Chromic Acid to 150°F (66°C)	C	B	B	B	A			C	A
Citric Acid	C	B	B	A	A	A	A	A	A
Copper Chloride	C	C	C	C	A	A	A	A	A

APPENDIX B

Chemical Compatibility Chart

Key to Rating

A - Substantial Resistance, B - Moderate Resistance, C - Severe Effect, Blanck - No Data

Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Copper Fluoride	C	B	B	B	A	A			
Copper Nitrate	C	B	A	A	A	A	A	A	A
Copper Sulfate	B	A	A	A	A	A	A	A	A
Cottonseed Oil	A	A	A	A	A	A	A		A
Creosols	A	A	A	A	A	C	C	C	A
Cyclohexane	B	A	A	A	A	C	A	C	A
Cyclohexanone	B	A	A	A	A	C	C	C	B
Dichlorethane, Dry	A	A	A	A	A	C		C	C
Diethanolamine	A	A	A	A	A	C	C		A
Diethyl Benzene	A	A	A	A	A	C			
Diethyl Ether	A	A	A	A	A		C		C
Diethyl Sulfate	C	B	B	A	A				
Diethylene Glycol	B	A	A	A	A		A	A	A
Dimethyl Amine	A	A	A	A	A	C			
Dimethyl Phthalate	A	A	A	A	A	C	C		B
Ether	A	A	A	A	A	C	C		C
Ethyl Acetate	A	A	A	A	A	C	C	C	C
Ethyl Alcohol	A	A	A	A	A	A	C		A
Ethyl Benzene	A	A	A	A	A		A		C
Ethyl Bromide	C	C	C	C	A	C			
Ethyl Chloride	C	A	A	A	A	C	A	C	A
Ethyl Mercaptan	B	A	A	A	A	C	A		C
Ethylene (Liquefied)	A	A	A	A	A				
Ethlene Dichloride	C	A	A	A	A		B	C	A
Ethylene Glycol	B	A	A	A	A	A	A	A	A
Ethylene Oxide	C	A	A	A	A	C	C	C	C
Fatty Acids	C	A	A	A	A	A	A	A	
Ferric Chloride	C	C	C	C	A	A	A	A	A
Ferric Nitrate	C	B	B	A	A	A	A	A	
Ferric Sulfate	C	C	B	C	A	A	A	A	A
Ferrous Chloride	C	C	C	C	A	A	A	A	
Ferrous Sulfate	C	C	C	C	A	A	A	A	
Filter Aid SlurriesB	A	A	A	A	A	A	A		
Fluosilicic Acid	C	C	C	B	A	A	A	A	

APPENDIX B

Chemical Compatibility Chart

Key to Rating

A - Substantial Resistance, B - Moderate Resistance, C - Severe Effect, Blanck - No Data

Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Formaldehyde, 80°F (27°C), Rm. Temp	B	B	A	A	A	B	A	A	C
Formic Acid, 80°F (27°C)	C	B	A	A	A	B	B	C	A
Freons, 80°F (27°C)	B	A	A	A	A			C	C
Fuel Oil	A	A	A	A	A	A	A	C	A
Furfural	B	A	A	A	A	C	C	C	A
Furfural Alcohol	B	B	B	A	A	C	C	C	
Gallic Acid, 5%	C	B	B	B	A	A	A	B	
Gasoline	A	A	A	A	A		A	C	B
Glucose	A	A	A	A	A	A	A	A	A
Glycerine	B	A	A	A	A	A	A	A	A
Heptane	B	A	A	A	A	C	A	B	C
n-Hexane	B	A	A	A	A	C	A	B	
Hydrazine, 35% and above	C	A	B	B	A	C	C	B	A
Hydrobromic Acid	C	C	C	C	A	B	A	C	A
Hydrochloric Acid, 37%	C	C	C	C	A	A	A	C	A
Hydrocyanic Acid	C	A	A	A	A	A	A	C	A
Hydrofluoric Acid to 48%	C	C	C	C	A	A	A	C	A
Hydrogen Chloride, Dry	A	A	A	A	A				
Hydrogen Cyanide	B	A	A	A	A	A			
Hydrogen Fluoride-Anhydrous	C	C	C	C	A			C	A
Hydrogen Peroxide 50%	C	A	A		A		C	C	C
Hydrogen Peroxide, 90%	C	A	A		A	C	C	C	C
Hydrogen Sulfide	C	B	B	B	A	A		A	A
Hydroquinone	A	A	A	A	A	A	C		
Hypo (Sodium Thiosulfate)	C	B	A	A	A	A	A		
Iodine Solution, 5%	C	C	C	C	A	C	A	C	A
Isopropyl Alcohol	A	A	A	A	A		A	A	A
Isopropyl Chloride, Dry	B	A	A	A	A				C
Kerosene	A	A	A	A	A	A	A	C	B
Lactic Acid, 50% 80°F (27°C)	B	B	A	A	A	A	A	A	B
Lard Oil	A	A	A	A	A		A	C	A
Lead Acetate	B	A	A	A	A	A	C	A	C
Lead-Tetraethyl	B	A	A	A	A				
Magnesium Carbonate	A	A	A	A	A	A	A	A	

APPENDIX B

Chemical Compatibility Chart

Key to Rating

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Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Magnesium Chloride	C	B	B	A	A	A	C	A	A
Magnesium Nitrate	A	A	A	A	A	A	A	A	A
Magnesium Sulfate	B	A	A	A	A	A	A	A	A
Maleic Acid-Dilute	C	B	A	A	A	A	A	C	A
Melamine Resins	C	B	B	B	A			C	C
Mercaptans	A	A	A	A	A		A	C	C
Mercuric Chloride, Sol.	C	C	C	B	A	A	A		A
Mercury	B	A	A	B	A	A	A	A	A
Methyl Alcohol	A	A	A	A	A	A	C	A	A
Methyl Celiosolve	A	A	A	A	A		C	B	A
Methyl Formate	A	A	A	A	A		C		C
Methylene Chloride	B	A	A	A	A	C	C	C	C
Methyl Ethyl Ketone	A	A	A	A	A	C	C	C	C
Monochloroacetic Acid 70°F (21 °C)	C	B	B	B	A	A			
Morpholine	A	A	A	A	A		C		
Muriatic Acid	C	C	C	C	A	A	A	C	A
Mustard	C	B	A	A	A	A		A	A
Naphtha	B	A	A	A	A	A	A	C	A
Naphthalene, Molten	A	A	A	A	C	C	A	C	C
Nickel Carbonyl, Solution		B	A	A	A				
Nickel Chloride, Solution		B	B	B	A	A	A	A	A
Nickel Nitrate, Solution		A	A	A	A	A	A	A	
Nickel Sulfate, Solution		B	A	B	A	A	A	A	A
Nitric Acid to conc.-Rm.		A	A	B	A	C	A	C	B
Nitric Acid, Red Fuming, Rm.		A	A	B	A	C	C	C	B
Nitro Benzene to 212°F (100°C)		B	A	A	A	C	B	C	A
Nitrous Acid, 5%		A	A	A	A				
Nitrogen Tetroxide		A	A	A	A		C		
Nitrochlorobenzene				A	A	C	A		
Oleic Acid		A	A	A		A	B	B	A
Oleum-25%		B	A	A	A	C	B	C	C
Olive Oil	A	A	A	A	A	A	A	C	A
Oxalic Acid		B	B	A	A	A	A	B	A
Paraffin-Molten	A	A	A	A	A				A

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Corrosive Agent	Steel	304 SS	316 SS	C-20	Teflon	PVC	Viton	Buna-N	Fluoraz
Paraldehyde	A	A	A	A	A				
Pentane	A	A	A	A	A		A		A
Perfumes	A	A	A	A	A				
Phenol-Molten	B	B	B	B	A	C	A	C	A
Phosgene		A	A	A	A	C			
Phosphoric Acid, 60	C	B	B	A	A	A	A	C	A
Free of HF									
Phosphoric Acid, 75%	C	B	B	A	A	A	A	C	A
Free of HF									
Phosphorous-Molten		B	A	A	A			C	
Phosphorous Oxychloride	C				A				
Phosphorous Trichloride	C	A	A	A	A		A	C	A
Pine Oil	A	A	A	A	A		B		
Phthalic Anhydride		B	B	A	A				B
Potassium Chromate	A	A	A	A	A	A	A	A	
Potassium Bromide	C	B	B	A	A	A	A	A	A
Potassium Carbonate	B	A	A	A	A	A	A	A	A
Potassium Chlorate	B	A	A	A	A	A	A	A	A
Potassium Chloride	C	B	B	A	A	A	A	A	A
Potassium Dichromate	B	A	A	A	A	A	A		A
Potassium Ferrocyanide	B	A	B	A	A	A	A		
Potassium Hydroxide	B	B	A	A	A	A	B	B	A
Potassium Iodide	C	B	B		A	A	A		
Potassium Nitrate	A	A	A	A	A	A	A	A	A
Potassium Permanganate	C	A	A	A	A	A	A	A	A
Potassium Sulfate	B	A	A	A	A	A	A	A	A
Propane	A	A	A	A	A	A	A	B	A
Propylene Dichloride, Dry	B	A	A	A	A	C		C	
Propylene Glycol	A	A	A	A	A		A	C	A
Propylene Oxide	A	A	A	A	A		C	C	C
Pyrogallic Acid	B	A	A	A	A				
Quinoline		A	A	A	A				
Silver Nitrate		A	A	A	A	A	A	A	A
Sodium-Molten		A	A	A	C			C	

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Sodium-Potassium, NaK Alloy		A	A		C				
Sodium Acetate		B	A	A	A	A	C	B	C
Sodium Aluminate	B	A	A	A	A	A	B	A	A
Sodium Bicarbonate	B	A	A	A	A	A	A	A	A
Sodium Bichromate	B	A	A	A	A	A	A		
Sodium Bifluoride Slurry		A	A	A			C		
Sodium Bisulfate		B	A	A	A	A	A	A	A
Sodium Bisulfite	B	A	A	A	A	A	A	A	A
Sodium Borate	B	A	A	A	A	A	A	A	A
Sodium Bromide	C	B	B	A	A	A	A	A	
Sodium Carbonate	B	A	A	A	A	A	A	A	A
Sodium Chlorate	C	B	B	A	A	A	A	A	
Sodium Chloride	C	B	B	A	A	A	A	A	A
Sodium Chlorite	C	C	C	C	A	A	A	C	
Sodium Citrate	B	A	A	A	A	A			
Sodium Cyanide	B	A	A	A	A	A	A	A	C
Sodium Dichromate	A	A	A	A	A	B	A	B	
Sodium Ferricyanide, 5%	B	A	A	A	A	A	A	B	
Sodium Fluoride	C	C	B	B	A	A	A	C	
Sodium Hydroxide, 50%	A	A	A	A	A	A	B	B	A
Sodium Hydroxide, 73%	B	B	B	B	A		C	B	A
Sodium Hypochlorite, 5%	C	C	C	C	A	A	A	C	B
Sodium Hypochlorite, 20%	C	C	C	C	A	A	B	C	A
Sodium Metaphosphate	B	A	A	A	A	A	A	B	A
Sodium Nitrate	B	A	A	A	A	A	A	A	C
Sodium Nitrite		B	A	A	A	A	A	A	
Sodium Peroxide	C	A	A	A	A		A	A	A
Sodium Silicate	B	A	A	A	A	A	A	A	A
Sodium Sulfate	A	A	A	A	A	A	A	A	A
Sodium Sulfite		A	A	A	A	A	A	A	A
Sodium Thiosulfate (Hypo)	C	B	B	A	A	A	A	A	
Stannic Chloride	C	C	C	B	A	A	A	C	
Stannous Chloride		B	A	A	A	A	A	A	
Stearic Acid		A	A	A	A	A	A	B	A

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Styrene		A	A	A	A		C	C	
Sulfamic Acid				B	A			B	
Sulfur-Molten		A	A	A	A		C		B
Sulfur Chloride		C	C	A	A		C	C	C
Sulfur Dioxide, Dry	A	A	A	A	A			C	A
Sulfan	C	B	A	A	A		C		
Sulfur Trioxide	C	B	A	A	A		C		A
Sulfuric Acid below 93%	C	C	C	A	A	B	A	C	A
Sulfuric Acid-Commercial Concentrated	C	C	A	A	A	C	A	C	A
Sulfuric Acid, Fuming, 20%		B	A	A	A	C	B	C	A
Sulfurous Acid		B	B	A	A	A	A		
Tannic Acid, 10%		A	A	A	A	A	A	A	A
Tartaric Acid		B	A	A	A	A	A	A	A
Thionyl Chloride	C	C	B		A	C			
Titanium Dioxide Slurry	B	A	A	A	A	A	A	A	
Titanium Tetrachloride, Dry	A	A	A	A	A		A	B	C
Toluene	A	A	A	A	A	C	B	C	C
Tributyl Phosphate	B	A	A	A	A	C	C	C	
Trichloroethylene, Dry	A	A	A	A	A	C	A	C	
Tricresyl Phosphate	B	A	A	A	A	C	B	C	A
Triethanolamine		A	A	A	A	B	C	A	A
Trisodium Phosphate, Sol.	B	A	A	A	A	A	A	A	A
Tung Oil	A	A	A	A	A		A		
Turpentine	A	A	A	A	A	A	A	C	A
Urea Formaldehyde	A	A	A	A	A				
Vegetable Oils	A	A	A	A	A	A	A	C	A
Uranium Nitrate		A	A	A	A				
Vinyl Acetate		A	A	A	A		C	C	
Vinylidene Chloride		A	A	A	A				A
Vinylidene Fluoride	B	A	A	A	A				
Xylene		A	A	A	A	C	C	C	C
Zinc Oxide Slurry	B	A	A	A	A	A	A	A	
Zinc Sulfate	B	A	A	A	A	A	A	A	A
Zinc Chromate		A	A	A	A	A	A		

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