MagnaProve®

Install, Operations and Service Manual

U.S. Patent No. 10,809,110

MP Series

MP1050
MP1300
MP2600
MP4500
MP5355
MP8500
MP12750

METER ENGINEERS

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PREFACE

This manual contains instructions for installation, commissioning, operation and maintenance. The MagnaProve Small Volume Piston Prover is a petroleum measurement instrument that accurately verifies flow metering equipment.

Warning: Use Only As Intended

Only use the MagnaProve for its intended purpose. Failure to operate within manufacture guidelines may result in personal injury, death or explosion. Any use of non-conformity resulting from an accident, abuse, misuse, misapplication or modification may result in voiding all expressed warranties.

Warning: Risk of Damage

Do not, under any circumstances, flow backwards through the prover or inject compressed air into the outlet or the downstream side of the piston within the prover. This may result in severe damage to the drive unit.

Warning: Risk of Explosion

Only trained personnel should work on mechanical and electrical installation with expertise in explosion-proof equipment in explosive environments. Any installation process should follow all regulations including national, local and private regulations.

- Do not open any of the electronics enclosures while in an explosive environment or while the MagnaProve Small Volume Piston Prover is energized.
- Must use explosion-proof compound cable glands or conduit sealed directly at all cable entries.
- Seal unused cable entries with approved plugs.
- Connections to the MagnaProve are factory-wired and no unauthorized changes are allowed to manipulate or retrofit connections.
- In order to operate properly, the bolts for the MagnaProve enclosure door must be fastened to 95lbf-ft dry and 75lbf-ft lubricated, but don't over-tighten so as not to damage the threads and/or O-ring gasket.
- To ensure safety, local grounding is required for a compliant installation. Ground connection of internal boards to enclosures is completed at the factory, but local grounding to the box is crucial for the system.

Warning: Risk of Injury

- During routine maintenance, Meter Engineers recommends shutting off the main power to ensure safety.
- Pressurize and depressurize the system in slow increments to avoid a hydraulic shock, which could result in damage to prover, personnel and/or piping systems.
- To guard against personal injury, ensure that all doors and hood on the actuator drive cabinet are properly closed and latched before operating.

Commissioning

The commissioning of the instrument shall be conducted by qualified technicians, trained by Meter Engineers.

Maintenance and Troubleshooting

It is recommended that only a qualified service technician that is familiar with the equipment or under the direction of Meter Engineers be allowed to perform repairs or maintenance.

Additional Information

If you require additional information, contact Meter Engineers or its representatives.

Installation Warning

Please read this section carefully before installing, using or maintaining your MagnaProve small volume prover. Failure to follow directions may result in personal injury and/or property damage. Meter Engineers is not responsible for injury/damages/losses as a result of deviation from installation procedure.

- Read the complete MagnaProve operation manual before performing any operations. Also read API MPMS 4.8, "Operation of Prover Systems," Current Edition, and reference any applicable standards prior to installation. If there are any discrepancies, please consult your MagnaProve representative or Meter Engineers directly.
- The MagnaProve has been designed to specific operational conditions, and operating the prover outside of the designated boundaries may cause permanent damage and will void warranty.
- All provers are designed per pressure standard ANSI B16.5 and B16.47. For process temperatures above 100°F (37.8°C), pressure may be de-rated, following the above-mentioned standards.
- The MagnaProve is tested at different flow rates, pressure tested and water draw calibrated at the factory prior to shipment. Inspect equipment once product is shipped and report damage or missing components to the carrier immediately. Contact a Meter Engineers representative with any shipping questions.
- The MagnaProve has been designed to be used as either a portable or stationary mounted flow prover. The MagnaProve small volume prover may be installed upstream or downstream of the meter under test, as the displaced volumes are equal.
- Providing enough space around the MagnaProve to accommodate maintenance on components is mandatory. See Section 1.5:1, Table 1.3 and Figure 1.2.
- The MagnaProve should be either installed on a flat surface or supported at the 12 predetermined anchor points and secured using at least 12 bolts (refer to Anchor Points Location in Installation Section). It is recommended to bolt the prover to the slab/trailer at the predetermined locations only. Meter Engineers will not be responsible for possible damages to the prover if these recommendations are not followed.

Installation Warning

It is mandatory to properly vent the MagnaProve to ensure that fluid vapor is removed from the unit. The MagnaProve can function once proving fluids are in liquid form only. Provisions must be made for upstream and downstream weep holes and sight flow indicators to drain in the event of a seal failure, See Section 1.7, Figures 1.3 and 1.4. Failure to comply with these provisions may result in a product release.

- Install a correctly sized strainer/filter upstream of the prover in order to ensure the flow entering the prover is free from debris and foreign material. Meter Engineers' recommendation would be to use strainers with minimum 40 mesh screen. Damage to prover due to foreign material will not be covered under manufacturer warranty.
- For lifting instructions, refer to Section 2.3.1.

When Connecting Prover to Pipeline, Ensure the Following

- Flow direction is correct. Flow must go through the prover in the proper direction, otherwise severe damage may occur.
- Use adequate bolts and flanges for all pressure-retaining connections.
- All connection bolts are tightened to correct torque specifications.
- Do not introduce any foreign bodies, i.e., weld slag, into the MagnaProve.
- Pressurize system slowly to avoid shock, which could result in damage to prover, personnel and/or lines.
- Ensure electrical codes before connecting and using the MagnaProve. The MagnaProve is manufactured in accordance with NFPA 70, Class 1, Division 1, Groups C and D installation requirements.
- Do not alter or modify the MagnaProve without prior written consent from Meter Engineers. Meter Engineers will not be responsible for possible damages, loss or injury as a result of unauthorized use or modification.
- Ensure that the unit is fully depressurized and drained prior to disassembly or service.

- Prover frame must be correctly grounded prior to electrical service.
- Follow all hazardous warning stickers! Pinch and crush points are present on this equipment in addition to electrical shock hazards.

Important Notice to ALL MagnaProve Small Volume Prover Users

It is advised that all MagnaProve users implement a method of preventing an over-pressurization of the flow prover. This task is most readily achieved through the use of a pressure or safety relief valve. The use of a pressure or safety relief valve will reduce, if not eliminate, possible failures due to over pressurization of the prover. Due to the fact that each installation will require a different pressure relief valve (based upon system pressure, fluid properties, flow rate, etc.), the recommendations provided by the pressure relief manufacturer should be used to size the appropriate relief valve. Failure due to improper pressurization will result in voided warranty.

Important: Watch Discharge From Relieving Devices

Additionally, take extra care when pressuring the flow prover at cold temperatures. All MagnaProve small volume prover barrels are manufactured from stainless steel, which experiences a reduction in ductility at reduced and elevated temperatures, i.e., below -20°F (-29°C) or above 100°F (37.8°C). Therefore, pressurization of flow provers in these temperature regions should be done slowly!

INTRODUCTION

1.1 Overview

Providing essential information, proper operating and troubleshooting procedures is the purpose of this MagnaProve manual. All questions not related to operation and troubleshooting in the manual can be directed to your Meter Engineers representative.

The MagnaProve small volume prover uses a proprietary electromagnet design with a linear actuator that gathers its performance by releasing the piston from the magnet, which removes drag from proving runs. The magnetic field does not transfer through the stainless steel internal parts, ensuring no extra debris is picked up that would affect the accuracy of proving readings. The MagnaProve also utilizes fixed flags to define the volume section. The flags activate the optical sensor to start and stop the run. Auto seal check option is available.

MagnaProve utilizes fixed flags to define volume displaced. A precision optical eye is used to detect the volume flags to start and stop the run. The optical sensor is reliable, fast (50-nanosecond) and precise. For maximum fluid compatibility, the only seals in contact with product within the prover in the MagnaProve small volume prover are PTFE.

The contents of this manual provide general information and operational characteristics for the MagnaProve small volume prover. Contact Meter Engineers for information on auxiliary equipment for unique applications.

1.2 Features

Downstream Rod

- Downstream rod for pressure-balanced system.
- PTFE sleeved guide for downstream rod eliminates excessive wear to the downstream seal.

Inlet and Outlet Spools

- Inlet and outlet spools separate from the barrel keep barrel replacement costs economical.
- Can be rotated for various inlet and outlet configurations, if the need for relocating the prover arises.
- Inlet and outlet sized to meet various flow rate specifications.

Flags and Optical Sensor

- Fixed flags on the flag rod mark the volume points.
- One optical sensor that, if replaced, does not affect the prover volume.

Magnet

- Durable electromagnet.
- Stainless steel casing blocks electromagnet field interference to the drive assembly.
- Magnetic field will not transfer through stainless steel internal parts, ensuring no extra debris is picked up.

Flag Rod Temperature

- Exclusive internal flag rod temperature probe gives accurate temperature within the flag rod.

Unique Drive System

- Utilizes a linear actuator and a high-strength electromagnet.
- Triple guide rod design eliminates misalignment that causes drag and optical sensor damage.
- Very low current to operate linear actuator.

Prover Piston

- Venturi designed through the poppet valve reduces flow restriction.
- Polyurethane bumpstop bushing prolongs poppet spring life.
- Variety of piston seal compounds for any application.

Prover Barrel

- Honed and polished stainless steel barrel in 304 or 316 material.
- No additional plating to eventually flake out.

MagnaProve Options

- Pressure and temperature sensors.
- Densitometer.
- Pycnometer connections.
- Stationary or portable configurations.
- Custom heavy-duty trailers and truck beds manufactured in-house.
- Prover vent box and sump tank.
- High- and low-pressure hoses.
- High-pressure load arms.
- Software package.
- Meter Engineers' auto seal check.

The unique features of the MagnaProve improve operator ease of use while ensuring accurate performance during tests of fluid flow meters on a user's application.

1.3 MagnaProve Design Specifications

Environmental configuration: MagnaProve small volume prover can be installed and used in different configurations.

AISI 316/316L (UNS31600/UNS31603) stainless steel: MagnaProve volume provers can be supplied with wetted parts from 304 (AISI 304/304L - UNS30400/UNS30403) or 316 (AISI 316/316L - UNS31600/UNS31603) stainless steel material as specified in Table 4 below. (Note: Materials choice should be based on product MSDS and application information supplied by the end user.)

Standard operating process temperature range: -15°F to +170°F (-26°C to +77°C). Consult factory for higher or lower temperature ranges.

Standard ambient temperature range: -40°F to +140°F (-40°C to +60°C).

Operating Flow range depends on many variables, Consult the applicable API MPMS standards for reference.

“Manufactured Pulses” Coriolis and Ultrasonic Flow Meters: As per meter manufacture recommendations and for estimation purposes, it is advised to deduct 33% from the max prover flow rate when sizing the prover.

Pressure drop measured between inlet and outlet of the prover is specified in the Table 1.1 (see below). The drop is obtained at maximum flow rate using water as a fluid.

Table 1.1: Maximum pressure drop across entire prover

MODEL NUMBER	FLOW RATE (BPH)	PRESSURE DROP (PSI)
MP1050	1,050	7
MP1300	1,300	5
MP2600	2,600	9
MP4500	4,476	13
MP5355	5,355	9
MP8500	8,500	12
MP12750	12,750	11.5

1.4 Prover Flow Range

Note: The maximum flow rates mentioned below must be de-rated when the fluids with viscosity above 100 cSt are used.

Table 1.2 - Design Specifications and Operating Flow Range

MODEL NUMBER	SIZE (O.D.)	DISPLACED VOLUME (GAL)	MAX FLOW RATE (BPH)	CORIOLIS & ULTRASONIC MAX FLOW RATE (BPH)	I/O SIZE
MP1050	8”	5	1,050	704	2-3”
MP1300	14”	10	1,300	871	3-4”
MP2600	14”	15	2,600	1,742	4-6”
MP4500	18”	30	4,500	3,015	6-8”
MP5355	20”	35	5,355	3,588	8-10”
MP8500	25”	65	8,500	5,695	10-12”
MP12750	29.5”	100	12,750	8,543	14-20”

Note for “Manufactured Pulses” Coriolis and Ultrasonic Flow Meters: As per meter manufacture recommendations and for estimation purposes, it is advised to deduct 33% from the max prover flow rate when sizing the prover.

1.5 Dimensions

Table 1.3 - MagnaProve Dimensions

MODEL	DRIVE	PROFILE	A	B	C	D	E	F
MP1050	TOL	Low-Profile	35 (89)	43 (109)	170 (432)	25 (64)	24 (61)	65 (165)
MP1300	TOL	Low-Profile	32 (81)	43 (109)	160 (406)	31 (79)	19 (48)	60 (152)
MP2600	SCHUNK	Low-Profile	39 (99)	49 (124)	224 (569)	31 (79)	26 (66)	82 (208)
		Standard	46 (117)	49 (124)	224 (569)	31 (79)	33 (84)	82 (208)
	TOL	Low-Profile	39 (99)	49 (124)	204 (518)	31 (79)	26 (66)	82 (208)
		Standard	46 (117)	49 (124)	204 (518)	31 (79)	33 (84)	82 (208)
MP4500	SCHUNK	Standard	44 (111)	67 (170)	258 (655)	36 (91)	29 (74)	96 (244)
MP5355	SCHUNK	Standard	50 (127)	70 (178)	271 (688)	39 (99)	33 (84)	105 (267)
MP8500	SCHUNK	Standard	60 (152)	75 (191)	309 (785)	45 (114)	41 (104)	118 (300)
MP12750	SCHUNK	Standard	67 (170)	83 (211)	331 (841)	52 (132)	43 (109)	128 (325)

NOTES:
1. All dimensions are in inches (centimeters are in parentheses).
2. Dimensions A-F are for overall dimensions (+/-1").
3. All dimensions are subject to change without notice.
4. General arrangement drawings will be issued with specific dimensions.

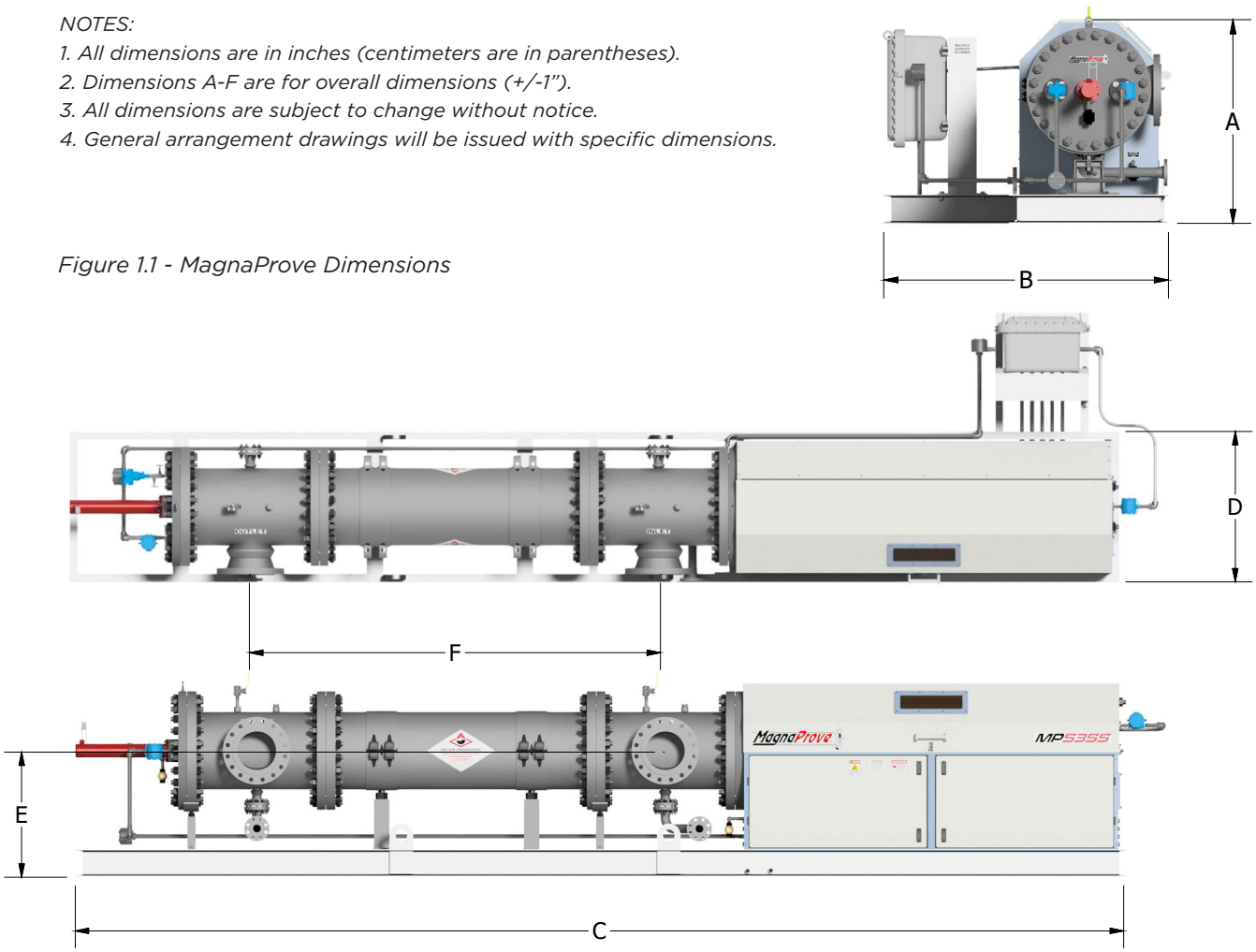


Figure 1.1 - MagnaProve Dimensions

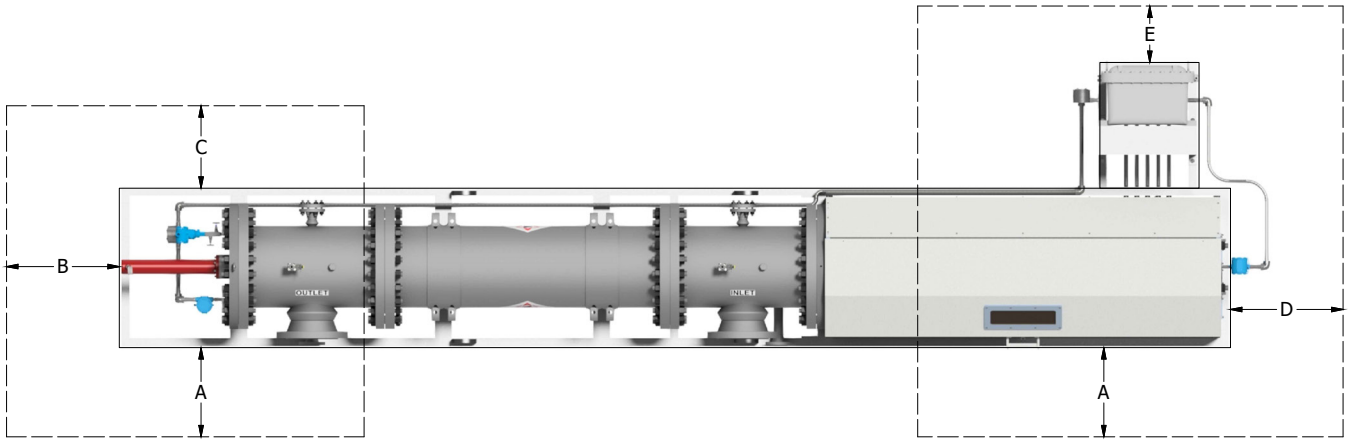
1.5.1 Service Clearance Dimensions

Table 1.4 - MagnaProve Service Clearance Dimensions

MODEL NUMBER	A	B	C	D	E
MP1050	36 (91)	144 (366)	24 (61)	96 (244)	36 (91)
MP1300	36 (91)	110 (279)	24 (61)	65 (165)	36 (91)
MP2600	36 (91)	168 (427)	24 (61)	108 (274)	36 (91)
MP4500	36 (91)	180 (457)	24 (61)	108 (274)	36 (91)
MP5355	48 (122)	204 (518)	36 (91)	108 (274)	36 (91)
MP8500	48 (122)	216 (549)	36 (91)	120 (305)	36 (91)
MP12750	48 (122)	252 (640)	36 (91)	120 (305)	36 (91)

NOTES:
1. All dimensions are in inches (centimeters are in parentheses).
2. Dimensions A-F are for overall dimensions (+/-1").
3. All dimensions are subject to change without notice.

Figure 1.2 - Service Clearance Diagram

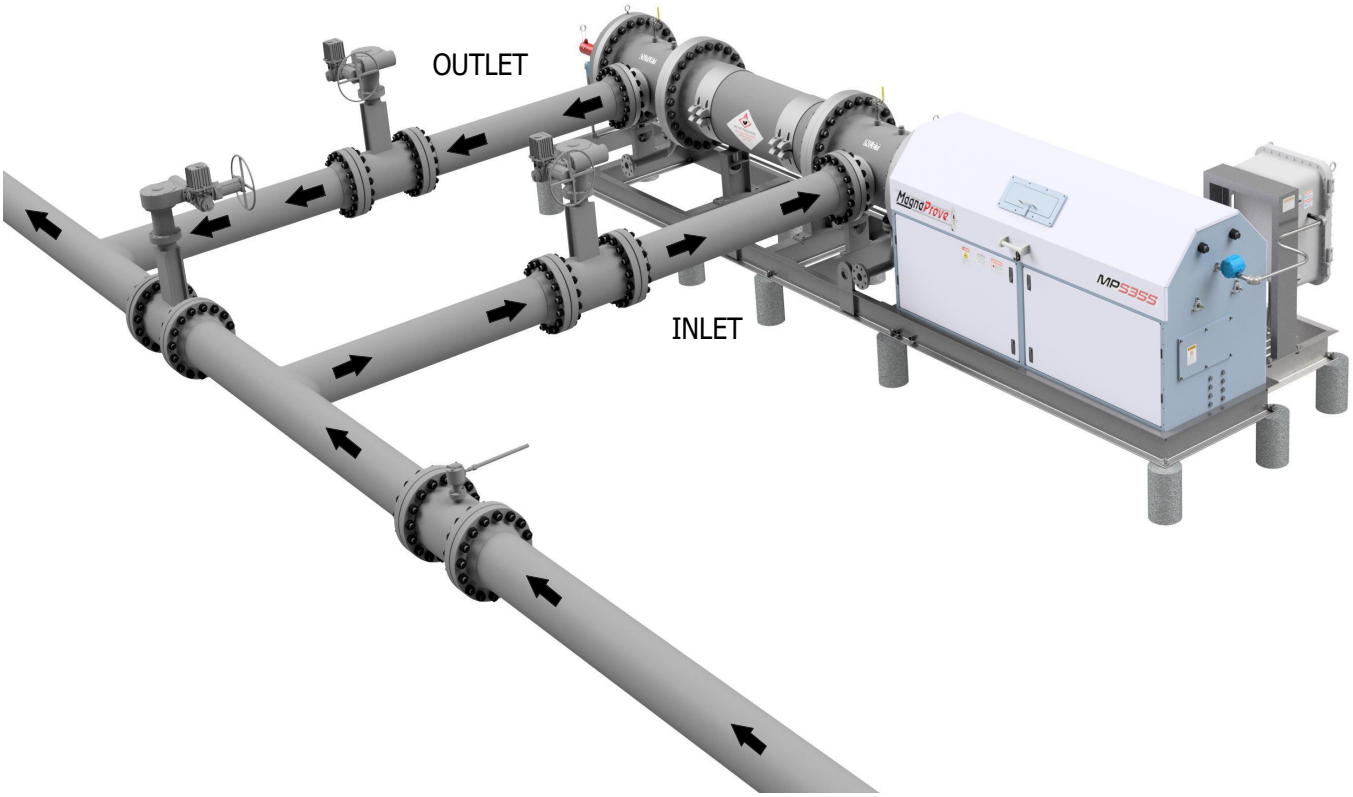


1.6 Principle of Operation

When the operator initiates a meter proving sequence, the flow computer will send a signal to the meter prover. When the prover receives the signal, it will check that the piston is in the downstream position. Once in the downstream position, the prover will send the magnet to go pick up the piston. It will then bring the piston to the upstream position and release the piston. When the piston is released, the poppet will close and the piston is free to follow the fluid flow through the measurement section. After the piston has been released and synchronized with the fluid flow, the optical plate will pass by the first measurement flag. The optical switch will then send a signal to the flow computer to start the timing sequence. The piston continues downstream with the flow. As the piston travels downstream, at around the midway point the actuator will move the magnet to the secondary ready position. Upon reaching the second volume flag, the optical switch will then send a signal to the flow computer to stop the timing sequence. After passing the second volume flag, the piston shaft is then stopped mechanically. The fluid pressure in the prover pushes the perimeter of the piston further downstream, opening the poppet and allowing the flow to continue with little to no pulsation or surge in line pressure. The actuator is started electronically to pull the piston back upstream if the flow computer requires more passes, and the above sequence is repeated.

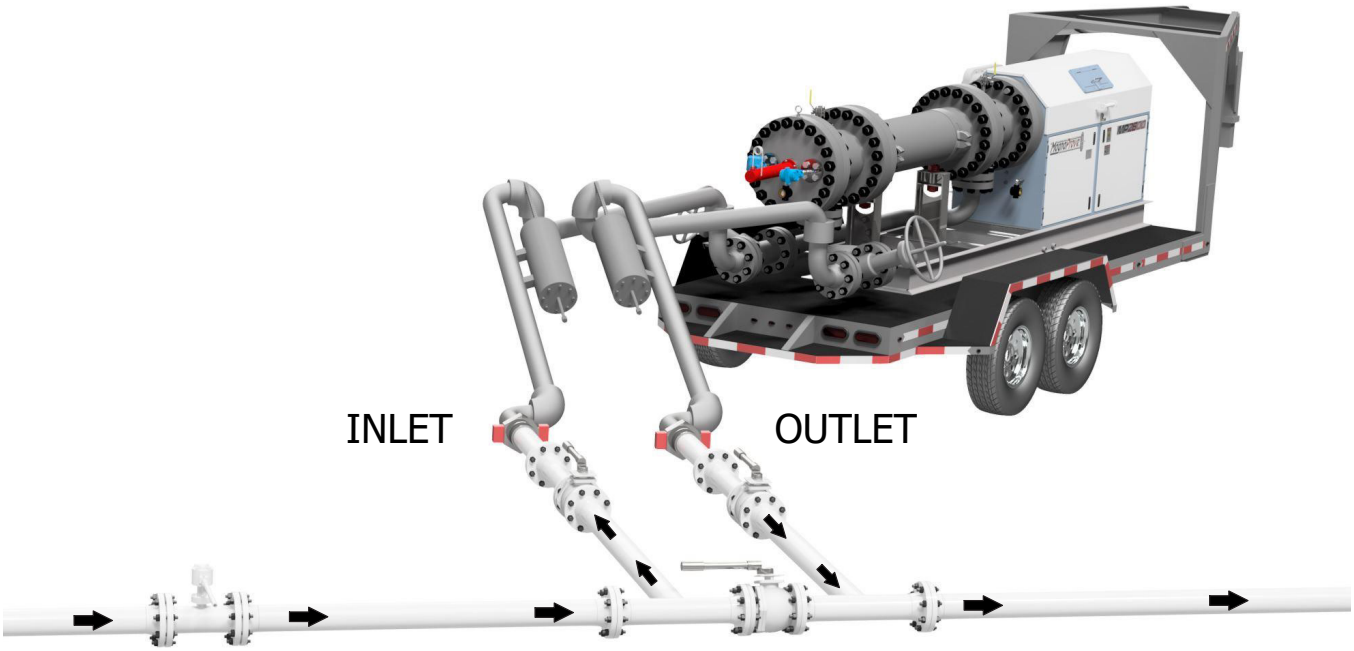
1.7 Process Connections

Figure 1.3 - Example Stationary Process Connection



1.7 Process Connections

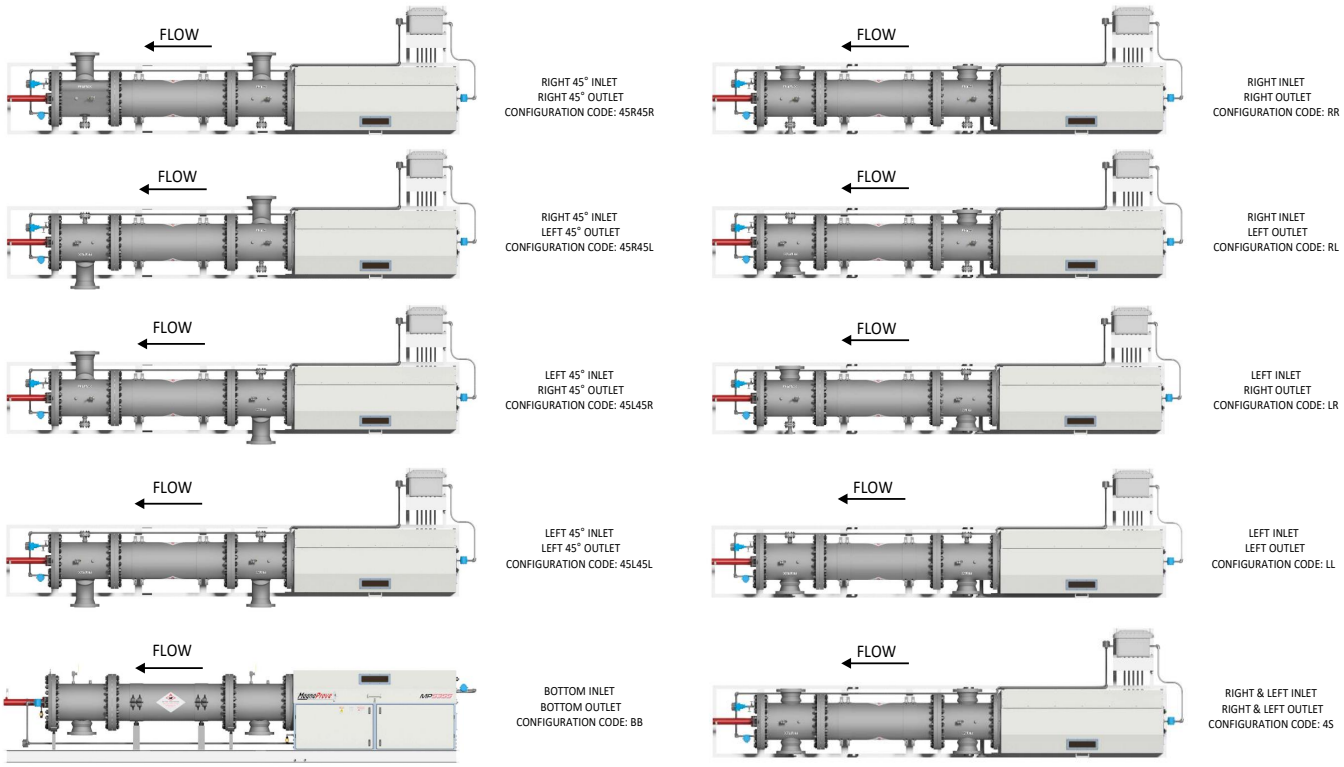
Figure 1.4 - Example Portable Process Connection



1.8 Inlet and Outlet Spool Configuration

For easy installation and connection to the end user's piping system, the MagnaProve can be configured to fit any customer application.

Figure 1.5 - Inlet and Outlet Spool Configuration



NOTE: Shown are the typical inlet and outlet spool configurations. The orientation of all MagnaProve inlet and outlet spools can be uniquely positioned to meet customer specifications.

INSTALLATION

2.1 Receipt of Equipment

The MagnaProve small volume prover is pressure and function tested and water draw calibrated at the factory prior to shipment. When the equipment is received, inspect the prover and any additional packaging for damages. If there has been any damage, the carrier should be notified immediately concerning their liability for damage to the equipment.

If anything is missing or incorrect from your shipment, please contact Meter Engineers.

2.2 Return Shipment

Before any attempt is made to return the shipment, in part or whole, contact Meter Engineers.

2.3 Mechanical Installation

The MagnaProve has been designed to be used as a portable or as a stationary mounted meter prover. The MagnaProve may be installed upstream or downstream of the meter under test as the displaced volumes are equal.

When installing the MagnaProve, follow all recommended procedures regarding placement of the prover in relation to the flow meter. To assure that all the product is diverted through the prover, use double block and bleed type diverter valves.

Refer to the system overview (Process Connections and General Arrangement) for connection points to the process line.

Before connecting the prover, be certain that all piping and connections are clean and unobstructed. Also, ensure that no debris, i.e., weld slag, will be introduced into the system. Check all drain and vent valves on the prover to make certain that they are closed.

Please note: It is an advantage to provide enough back pressure on the downstream side of the meter prover in order to achieve satisfactory repeatability results.

Warning

Do not exceed the maximum working pressure of the prover as detailed on the manufactures' data plate.

It is the customer's responsibility to install the prover in a system protected by correctly sized over-pressure protection.

Process lines should be cleaned thoroughly by flushing before installation to eliminate potentially damaging foreign material from entering the prover.

A correctly specified strainer should be installed upstream of the prover to protect it from the introduction of foreign material.

Caution: Be certain that all flanges, bolts, dry break couplers, hammerlock fittings, hoses/loading arms and pressure-containing components have sufficient pressure rating. Also be certain that the flow direction through the prover is correct!

It is essential to protect the MagnaProve from the impact of a foreign body through any route. This especially applies to provers located in high vehicular traffic areas and portable units. Permanent vehicle barricades or pylons are highly recommended around the perimeter of the unit and again at the inlet/outlet connections.

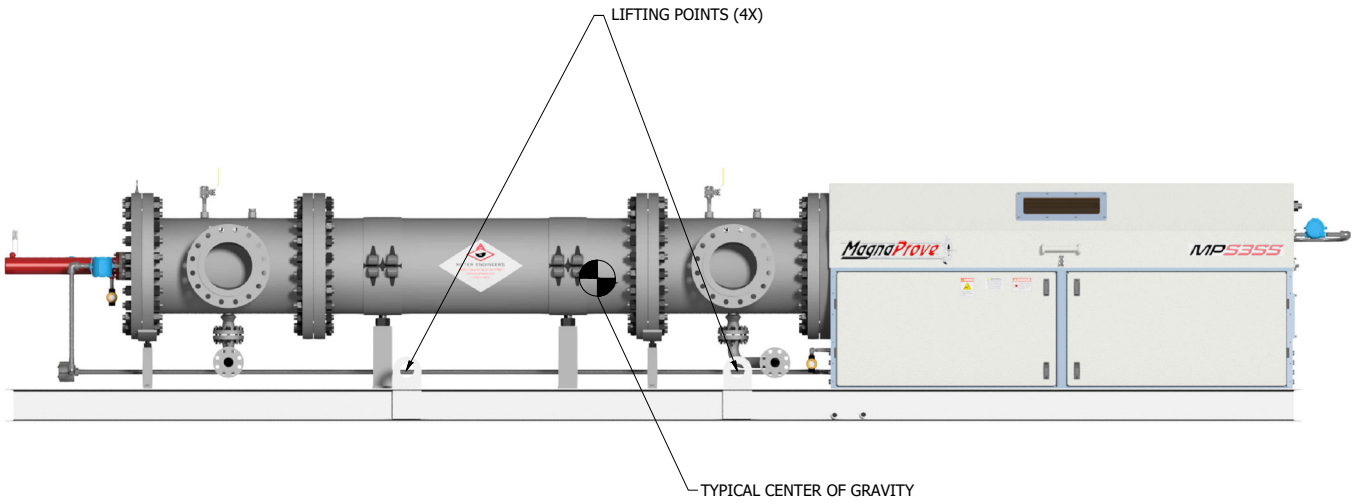
Give extra inspection to portable units after transport operations to ensure that no foreign body impacts have been encountered that would be a detriment to pressure-containing components.

2.3.1 Lifting the Prover

The stationary MagnaProve is equipped with integral lifting points. Figure 2.1 shows the location of these points along with an approximate weight distribution of the prover. Please use these lifting points for all movement of the prover to avoid damage to the unit.

The portable MagnaProve is not equipped with lifting lugs. Please contact Meter Engineers for assistance prior to moving the prover.

Figure 2.1 - MagnaProve Lifting Point Instructions



2.3.2 Anchoring the Prover

The MagnaProve should be installed on a flat surface and secured using 12 bolts through the pre-determined anchor points on the prover skid (see Figure 2.2A). It is recommended to bolt the prover to the slab/trailer at these 12 locations only. It is not recommended to use any other method or type of securing the prover against the movement during operation. Meter Engineers will not be responsible for any damages to the prover or system parts if recommendations are not followed.

Figure 2.2A - Pillar Anchor Point Location Instructions

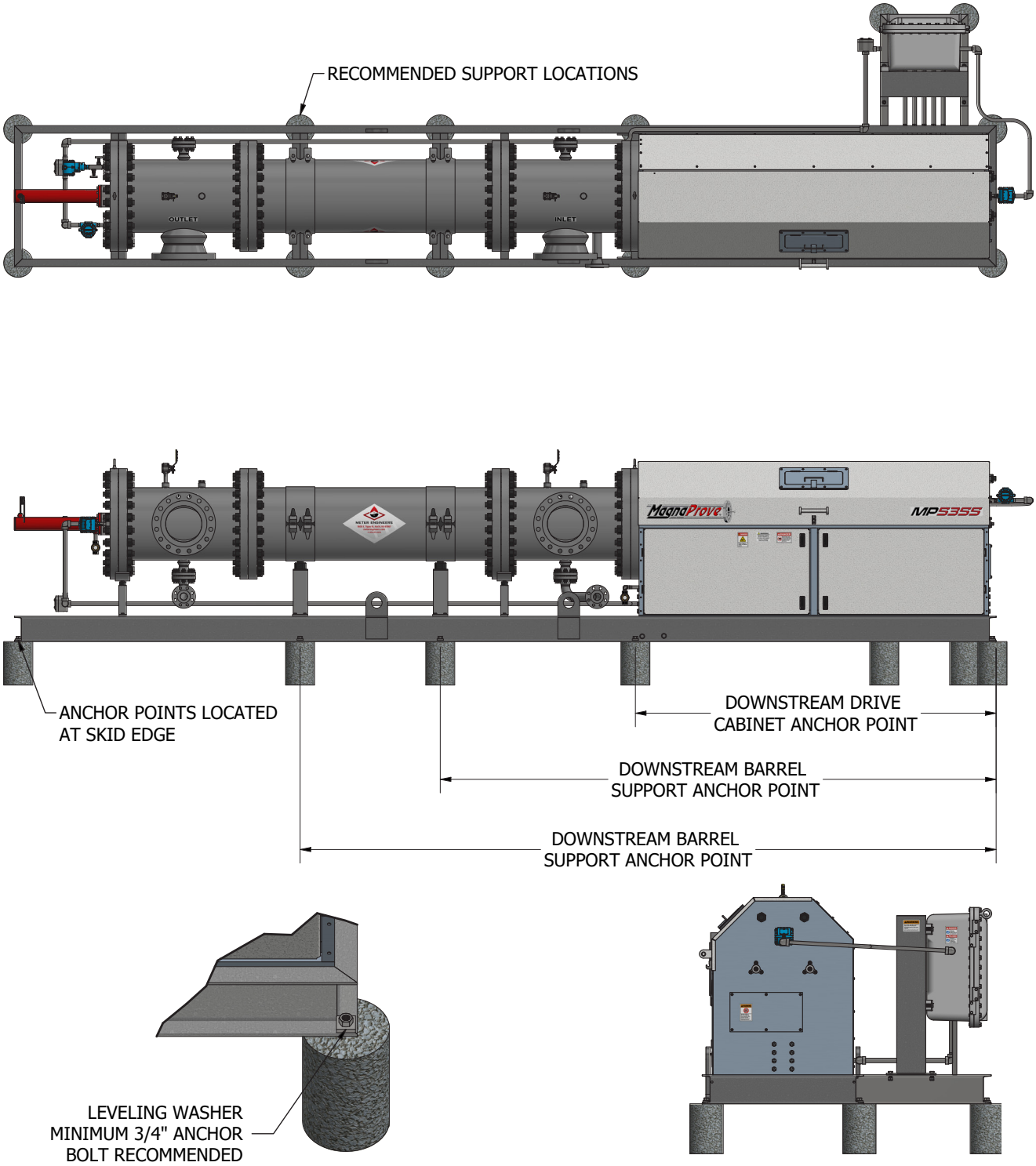
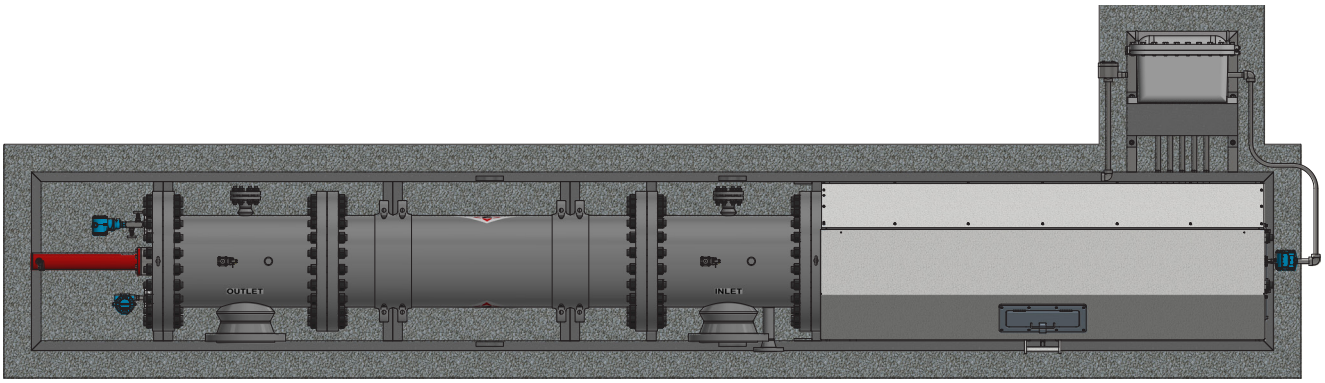
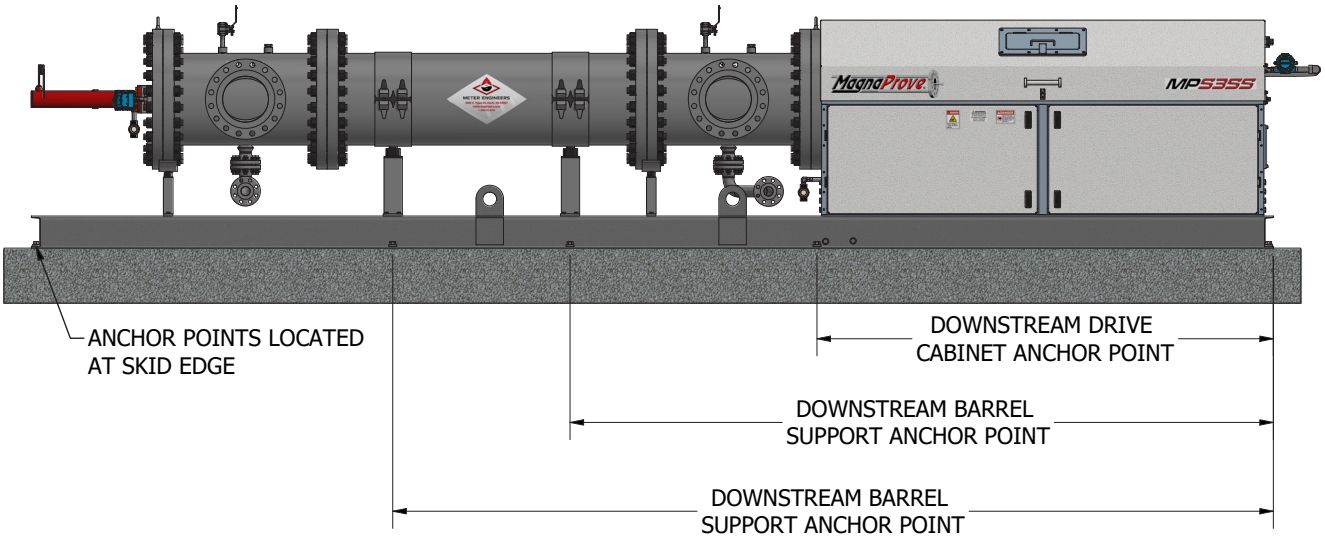
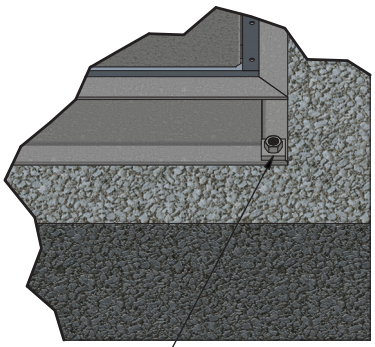


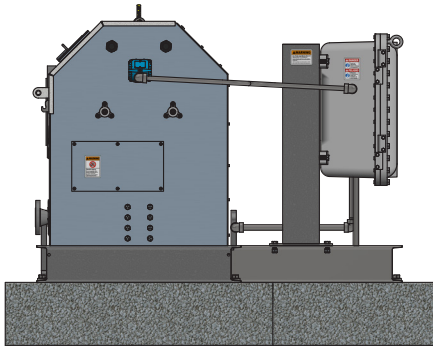
Figure 2.2B - Slab Anchor Point Location Instructions







LEVELING WASHER
MINIMUM 3/4" ANCHOR
BOLT RECOMMENDED



2.4 Electrical Connection

The MagnaProve prover is designed as compliant with the following:

U.S. certified for Class 1, Division 1, Groups C and D.

Be certain to conform to all applicable national and local electrical codes when making electrical connections to the MagnaProve to maintain electrical safety ratings.

The MagnaProve must be correctly grounded prior to electrical service connection.

2.4.1 Field Wiring

The installation of the MagnaProve must be carried out in accordance with all appropriate international, national and local standards and site regulations for explosion-proof and intrinsically safe apparatus.

2.4.2 Breaker

A readily accessible disconnecting/breaker device shall be incorporated externally to the equipment.

2.4.3 Enclosures

See Figure 2.3 which highlights the electrical components within the MagnaProve electrical enclosure.

2.4.3.1 Customer Connections

See Figures 2.4 through 2.8 for the customer connections for the various configurations of the MagnaProve.

2.5 ELECTRICAL SCHEMATICS AND DRAWINGS

Prove Input Connection

- Optically isolated, open collector input.
- To self-power the circuit and run through a relay, place jumper JP3 between points 1 and 2 and wire J4-2 and J4-3 through the normally open or normally closed contacts on the relay.
- To run the circuit using external voltage, a current limiting resistor will need to be installed in line with prove circuit. Jumper JP-3 will need to be placed between points 2 and 3.

Volume Pulse Output

- Driven by open collector transistor.

Prove Input Connection

- You will need an external resistor connected to the +5 to +24VDC supply voltage (minimum resistance at 24VDC = 100 ohms), or the output can drive an external relay. Maximum current to ground 2.5A
- See the Figure 2.4 for the customer connections to the MPIM board.
- The MagnaProve offers an optional ready-to-prove permissive output to the flow computer.
- For connections to analog circuits, and the ready-to-prove circuit, please see the power connection drawings.

Power Connections

The MagnaProve offers several power options depending on your site and prover.

- 120VAC single phase, usable for MP1050, MP1300 and MP2600 models.
- 120VAC/240VAC single phase, usable for MP1050, MP1300, MP2600, MP4500, MP5355 and MP8500 models.
- 240VAC single phase, usable for MP1050, MP1300, MP2600, MP4500, MP5355, MP8500 and MP12750 models.
- 480VAC single phase, usable for MP1050, MP1300, MP2600, MP4500, MP5355, MP8500 and MP12750 models.
- All models will need provisions for a 120Vac control circuit, whether that is providing a dedicated 120Vac circuit or adding a neutral wire to the 240Vac powered units.

Please see the following drawings for the customer power connections.

Figure 2.3 - Electrical Box Layout

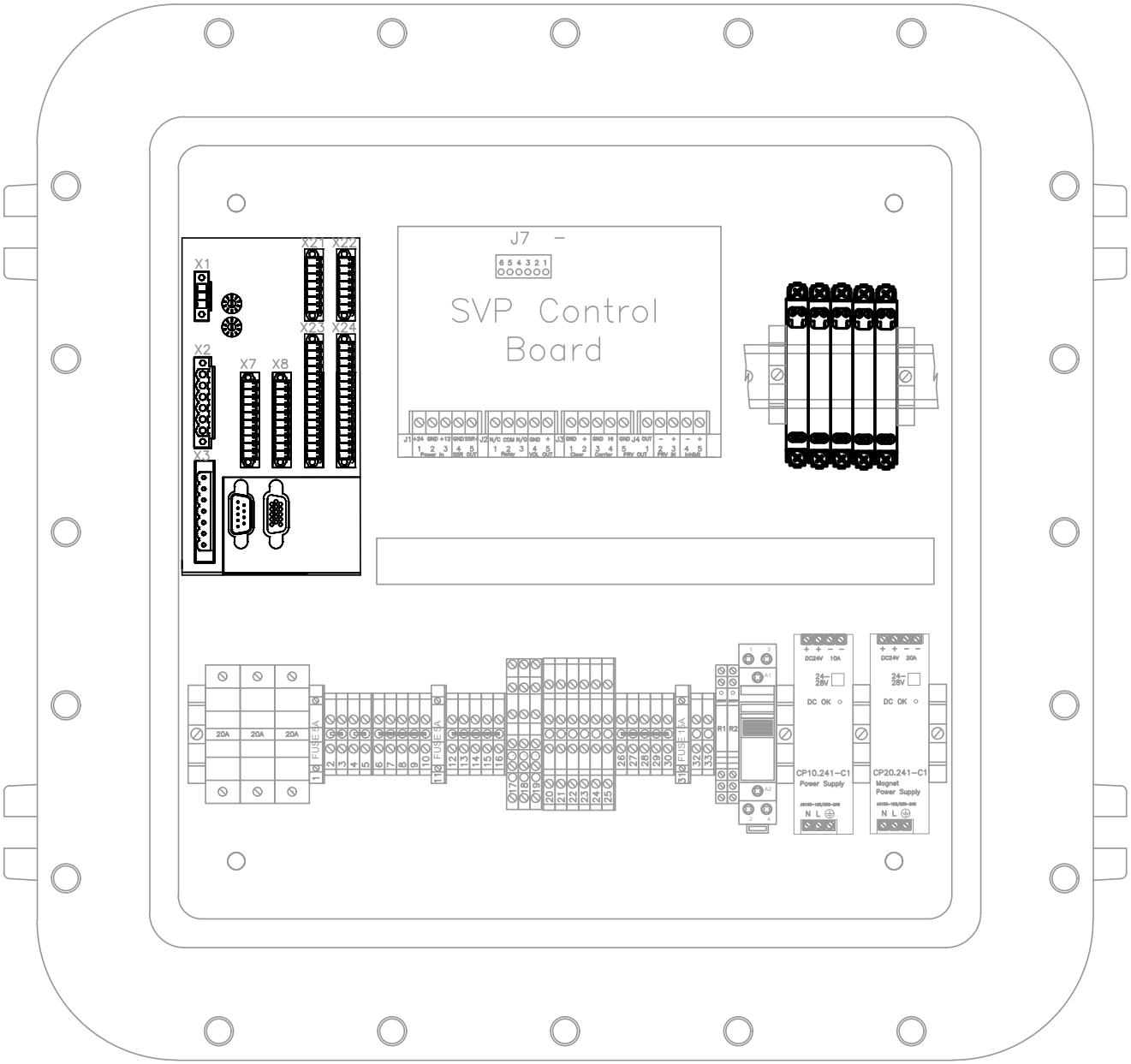
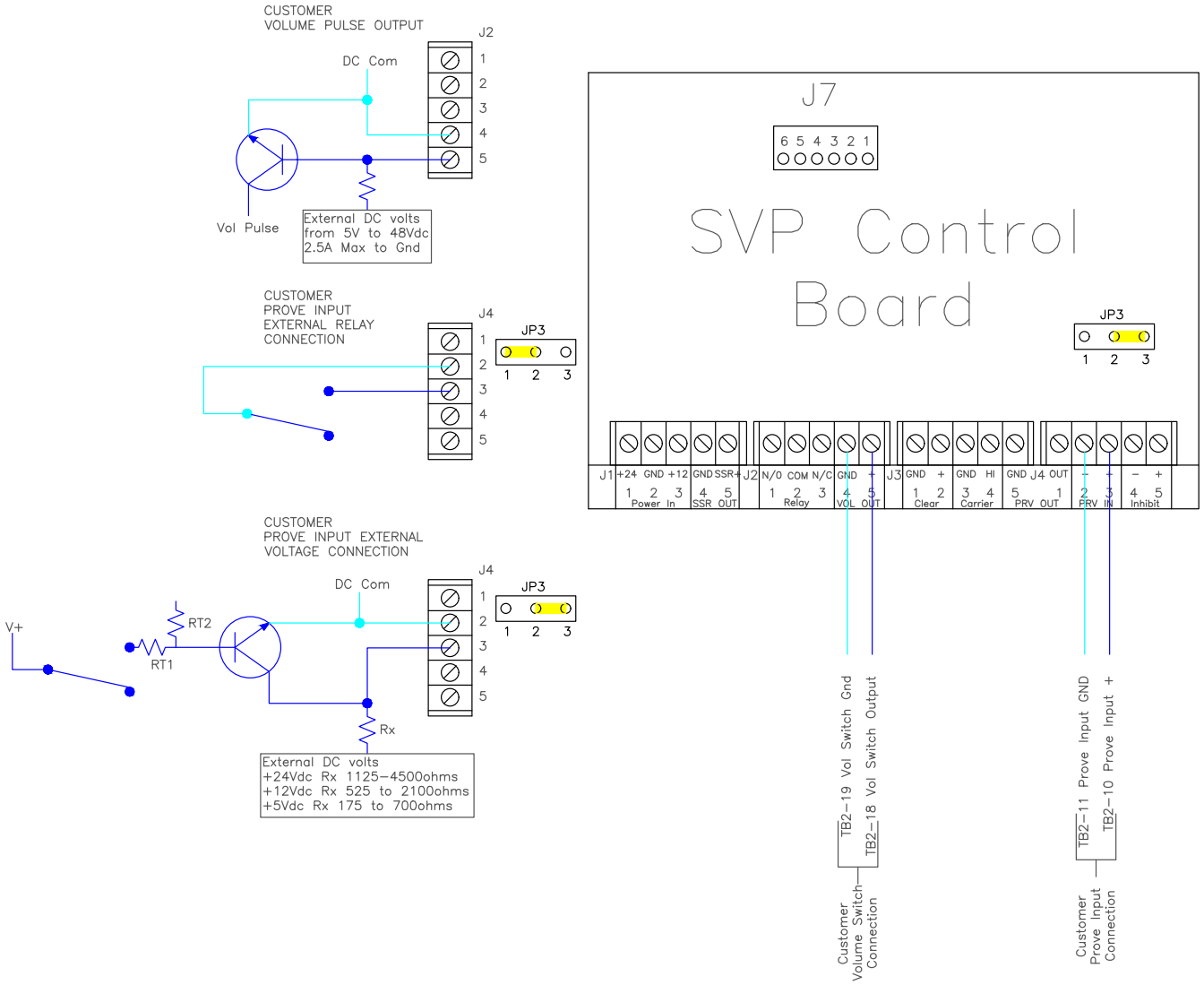


Figure 2.4 - Customers Connection at MPIM Board



Input/Output descriptions:
Volume pulse output:
Driven by open collector transistor. Will need an external resistor connected to the +5 to +24V supply voltage, (minimum resistance @24v = 100ohms) or the output can drive an external relay. Max current to Ground 2.5A.

Prove Input connection: Optically isolated, open collector input. To self power circuit and run through a relay place jumper JP3 between 1 and 2 and wire to the NO or NC contacts on the relay.
Otherwise when using external voltage, a resistor will need to be installed in line with the prove circuit, and jumper JP3 will need to be placed between 2 and 3.
+24vdc will need a resistor between 1125 to 4500 ohms
+12vdc will need a resistor between 525 to 2100 ohms
+5vdc will need a resistor between 175 to 700 ohms

Figure 2.5 - Electrical Connections - 240V 3 Phase 60hz Customer Connections at TB-1

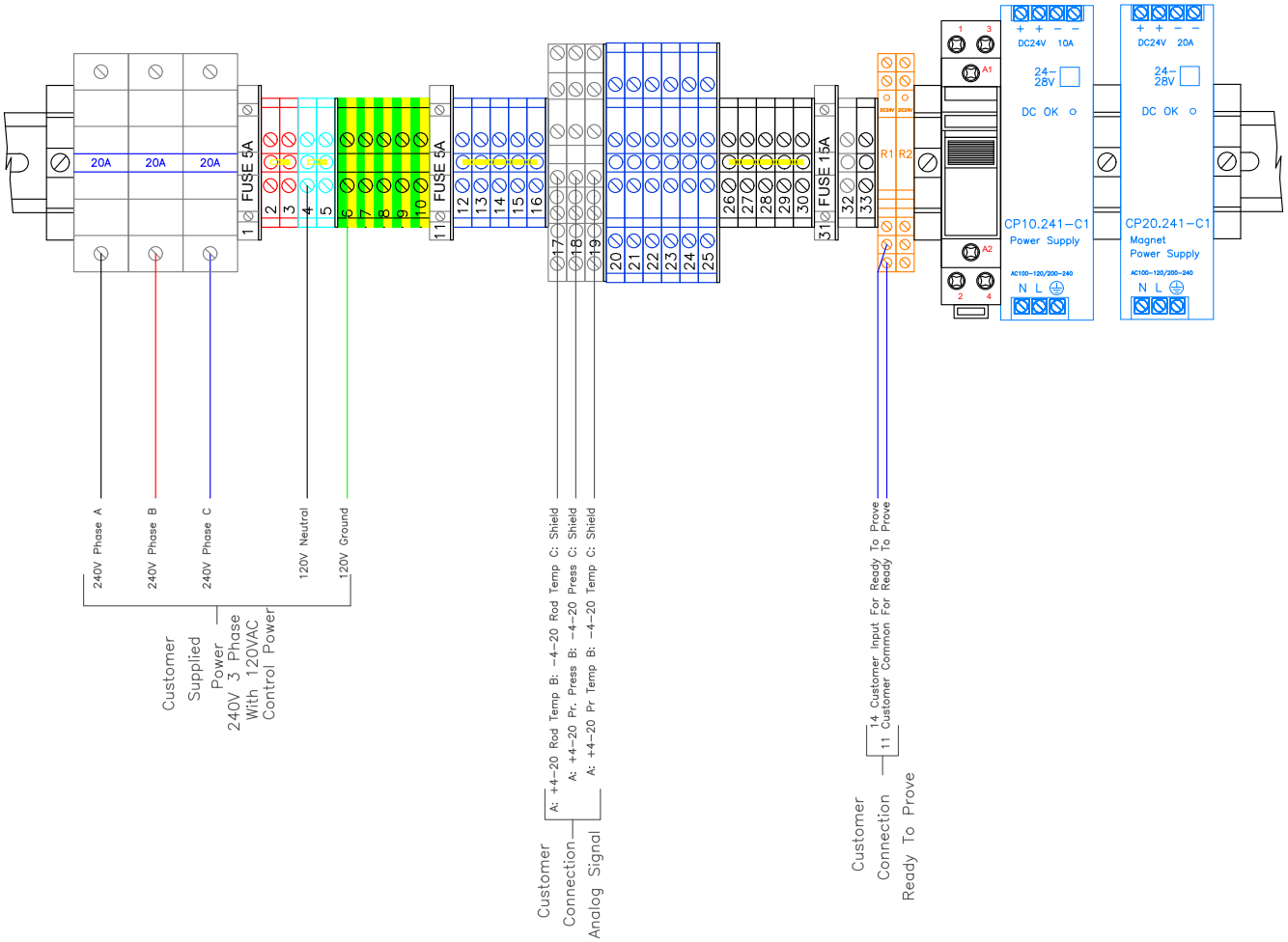


Figure 2.6 - Electrical Connections - 240V Single Phase 60hz Customer Connections at TB-1

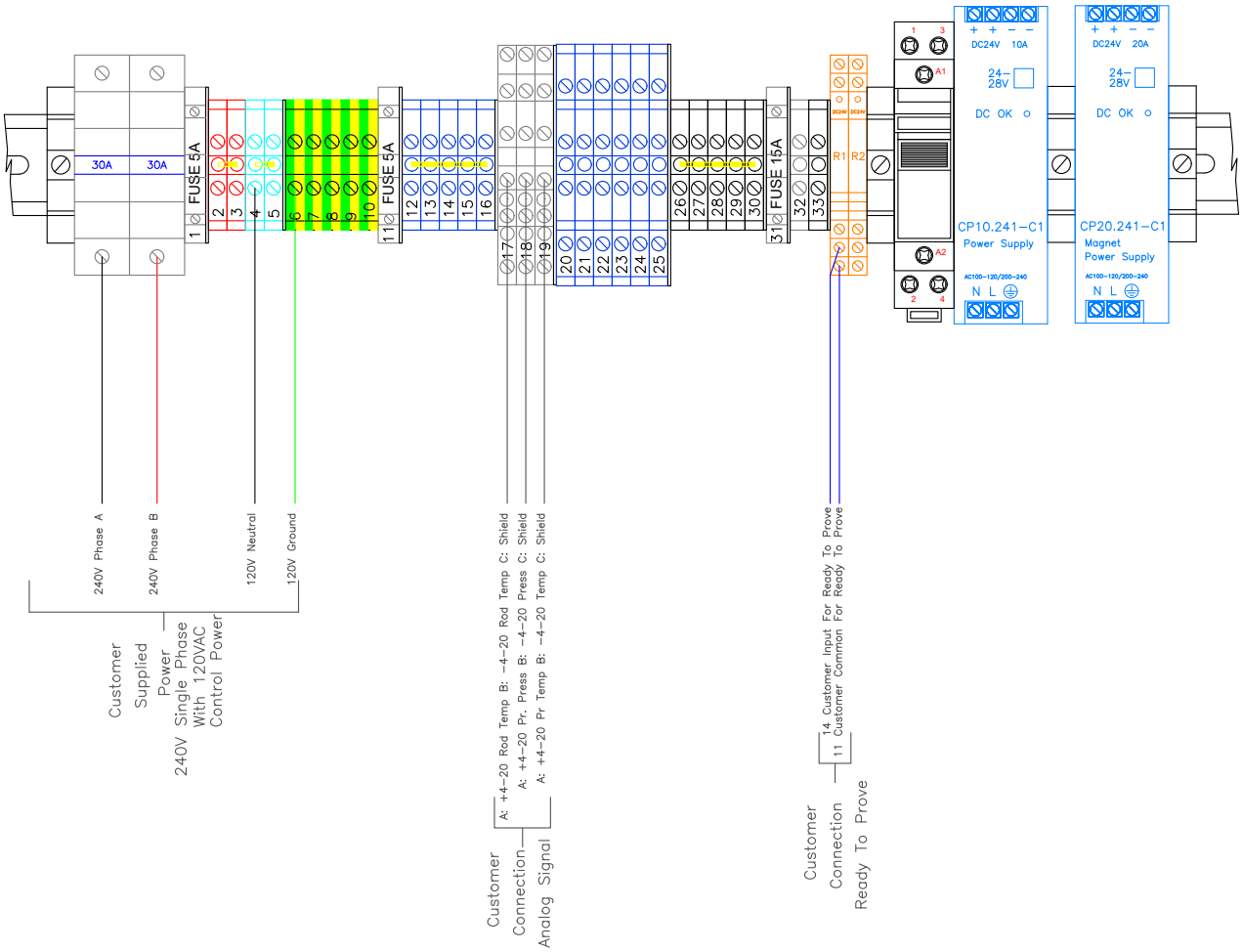


Figure 2.7 - Electrical Connections - 480V 3 Phase 60hz Customer Connections at TB-1

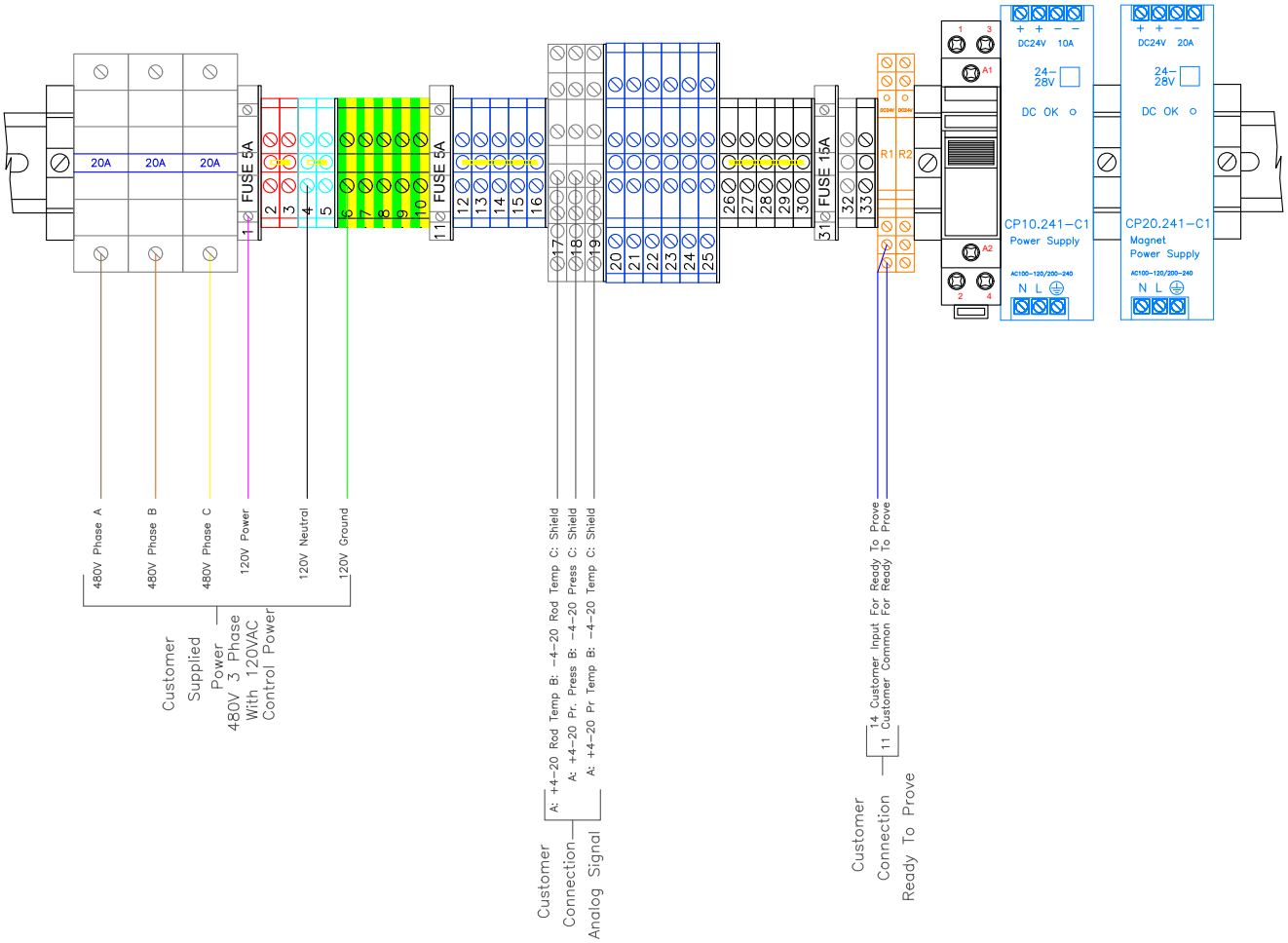
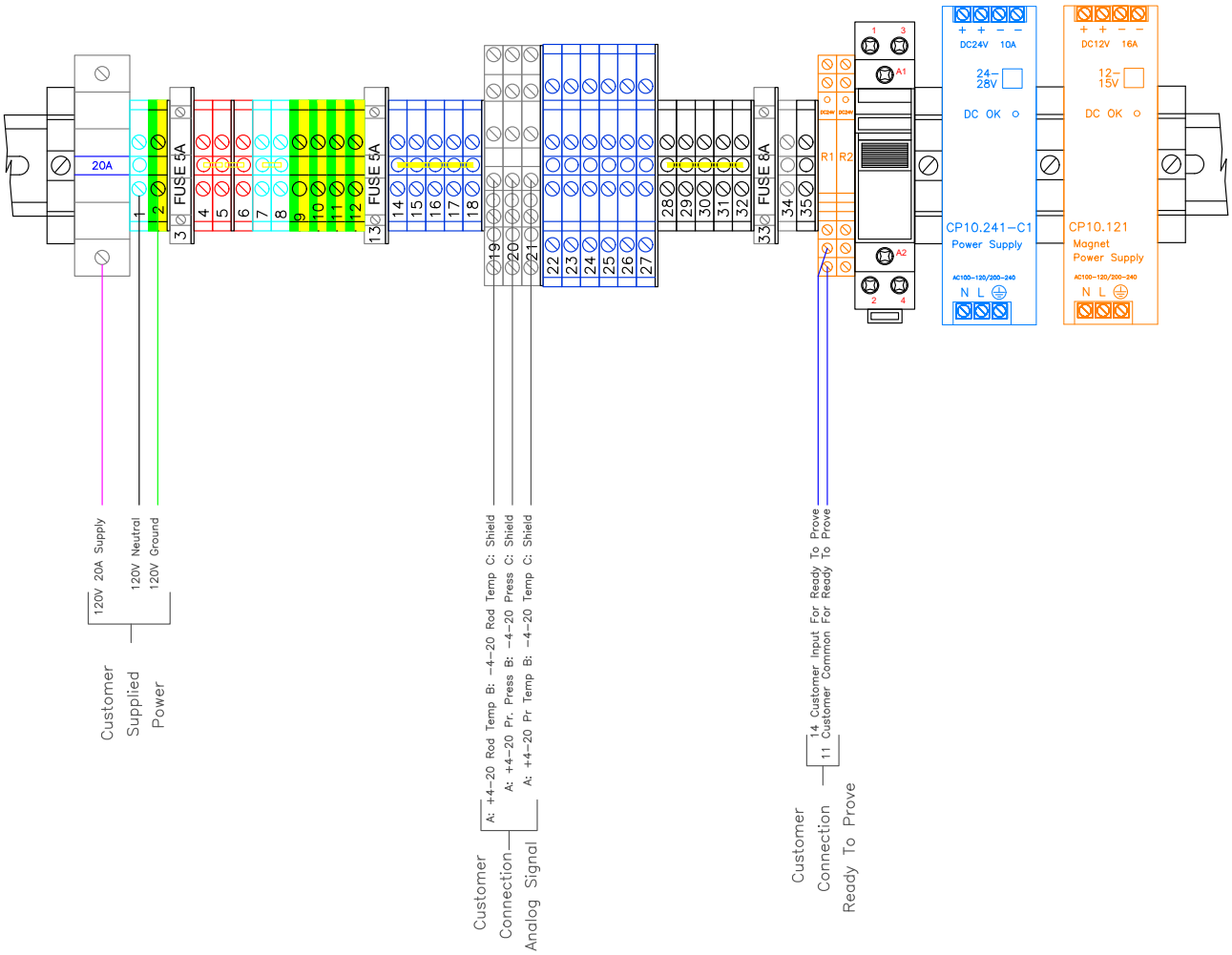


Figure 2.8 - Electrical Connections - 120V Single Phase 60hz Customer Connections at TB-1



OPERATION

3.1 Operating Instructions for Meter Proving

Warning: Ensure that flow is diverted through the prover in the correct direction. Failure to do so may cause severe damage to the prover.

1. While the process diverter valve is open, slowly open the prover inlet valve to fill the prover. Once the inlet valve is completely open, open prover outlet valve, connecting the prover to the process line.
2. Vent trapped air from the prover by opening the vent valves if necessary.
3. Slowly close process diverter valve to divert all of the flow through the prover.
4. Power up the prover, and turn the operation switch to the run position. Upon initial power up of the prover, the actuator will move to its home position, and once in the home position the ready light will light up on the electrical enclosure. Once homed, turn the operation switch to the run position and the prover will be ready for meter proving.
5. Once the green ready light is illuminated, the MagnaProve is ready for meter proving
6. Start the proving process with the flow computer. The prover will then run its normal operation until the prescribed number of passes have completed.
7. After meter proving runs have been completed, open the process diverter valve and slowly close the prover connection valves starting with the outlet valve and ending with the inlet valve.

3.2 Draining the Prover / Purge Function

Warning: Ensure that flow is diverted through the prover in the correct direction. Failure to do so may cause severe damage to the prover.

Caution: When the actuator is pushing the fluid through the drain lines, the flow out of the drain lines may vary, and care must be taken to ensure there are no accidents or spills.

When draining the prover, make sure vents are open and that the actuator is in the home position. This can be accomplished by turning the prover off then on again. After making sure the drain lines are going to the designated point, open the drain valves. Allow the prover to drain down about halfway.

Once the prover is drained down halfway or more, you can now use the purge function. With all vents open, all drains open, and the prover turned on and homed, turn the selector switch to Standby and then hit the purge button. This will cause the actuator to go pick up the piston, and then push and pull it through its travel one time.

It may take multiple passes to fully purge the prover. To make another pass, make sure the actuator has made its travel back to the home position. Leave the prover in Standby mode, and press the purge button again.

SEAL CHECK

The MagnaProve leak detection procedure should be used prior to calibrating the system. It is also necessary to have a differential pressure gauge with a sufficient pressure rating to withstand line pressure if the prover is not removed from the process line. Temperatures both ambient and fluid, should be stable during the procedure.

4.1 Equipment

- Optional Auto Seal Check
- Optional Manual Seal Check

4.2 Auto Static Leak Detection Procedure (If Equipped)

1. Make sure prover is full of fluid and all air is vented, then block all inlet and outlet ports on the prover, including the drains.
2. Determine there are no leaks from the prover ports.
3. If necessary, blind the inlet, outlet and drain lines with blind flanges.
4. Power up the prover and the laptop with the Auto Seal Check Software.
5. Turn the operation switch on the prover to Standby.
6. Connect your laptop to the prover's drive, either wirelessly or via the Ethernet port.
7. Open the Auto Seal Check Software, and make sure communications are started with the Kollmorgen Drive.
8. Once communications are established, go to the Auto Seal Check Page and press the start button.
9. The prover will then initiate the seal check procedure, stopping at three different points, marking the pressures and location of the actuator at each of these points.
10. Once the procedure is complete, the software will fill out the report giving the pass/fail data for the prover.
11. Upon completion of the Auto Seal Check, if the seal check does not pass, drain and repair the prover. Otherwise, either proceed with prepping the prover for calibration, or open the valves starting with the inlet valve to put the prover back into service.

4.3 Manual Seal Check

Manual Static Seal Check using Maintenance page.

1. Install a differential pressure gauge across the inlet and outlet spool of the prover, making sure the gauge has a sufficient pressure rating to withstand the pressure, if the prover is not removed from the process line.

2. Make sure the prover is full of fluid and air is vented, then block all inlet and outlet ports on the prover, including the drains.

3. Determine that there are no leaks from the prover ports. If necessary, blind the inlet, outlet and drain lines with blind flanges. Making sure area is safe, open the MagnaProve electrical enclosure and connect an Ethernet cable between your laptop and the Kollmorgen drive inside the enclosure. (The Ethernet connection to the drive is on the very top toward the front of the drive.)

4. Power up the prover and your laptop with the maintenance software, open the software and make sure communications are started between the devices. Turn the prover operation switch to the Standby position.

5. Enter the password into the software, and then manually move the magnet to pick up the piston plate. Once the magnet is in contact with the piston plate, turn on the magnet. Now move the actuator upstream, pulling the piston back. See chart below for how far to pull the piston back for the first, second and third positions to accomplish the seal check.

6. Now, while keeping the magnet engaged, have the actuator move forward, closing the poppet and creating a differential pressure across the inlet and outlet spools. Once you have 6 psi of differential pressure, stop the movement forward. At this time, document the position of the actuator and start a timer.

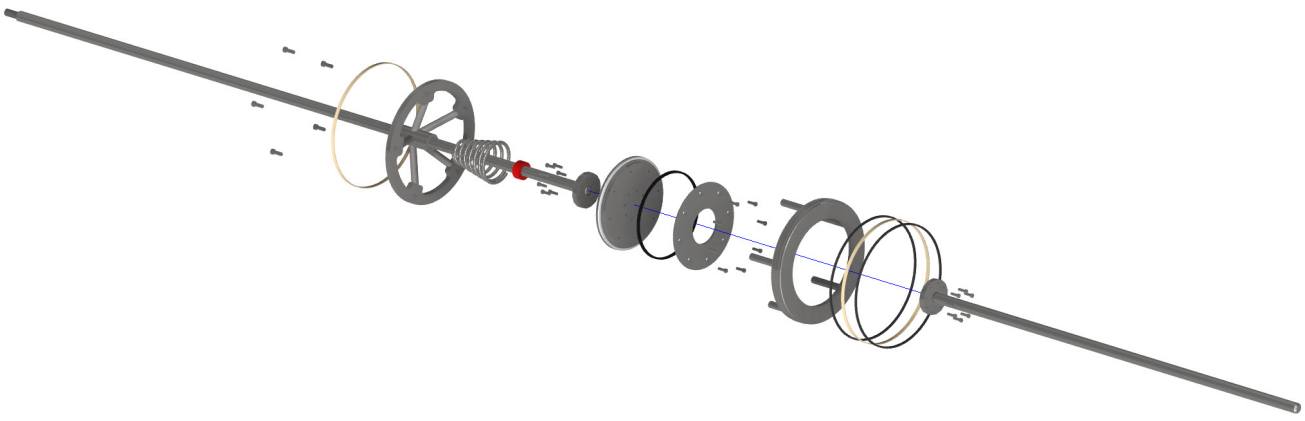
7. Let the pressure settle for 1 minute, and document the differential pressure across the piston. If the pressure is less than 5 psi, then repeat the above step until you can get a steady differential of 6 psi, plus or minus 1 psi.

8. Once the differential pressure is steady, document the position of the actuator, and now pause for 5 to 7 minutes to see if the seals will hold the differential. Once the time is up, document the pressure differential and the position of the actuator.

9. Next, move the actuator and piston to the second position. Once in the position, move the actuator forward to create the needed differential, and then repeat steps 7 and 9. Once all of the data is taken, use the chart below to determine the viability of the seals within the prover.

10. Upon completion of the manual seal check, release the magnet. If the seal check does not pass, drain and repair the prover. Otherwise, proceed with prepping the prover for calibration, or open the valves starting with the inlet valve to put the prover back into service.

Figure 5.1 - Piston Assembly



5.0 Replacing the Seals

Equipment

Have your seal kit ready before starting the seal replacement.

Contact Meter Engineers with your prover serial number to find the correct seals for your application.

The seal kit includes the following:

- Upstream seal kit
- Downstream seal kit
- Piston seal kit

Prior to starting any maintenance or repair to the MagnaProve, make sure that all power is turned off and locked out, and that all inlet and outlet valves are closed and locked out.

Seal Change Procedure

Before starting any portion of the seal change procedure, make sure that all power to the unit is removed and that the unit is drained of all product and that all vapor has been vented from the prover.

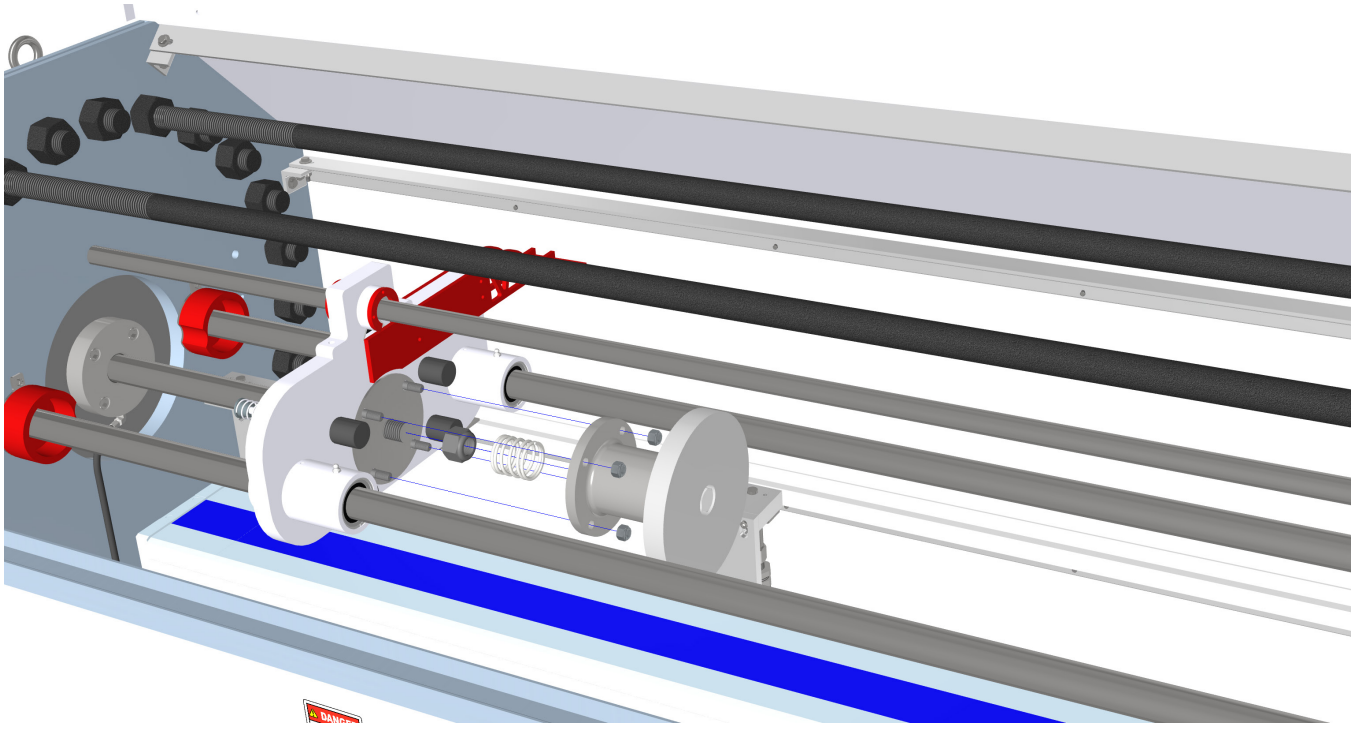
Before replacing the seals, ensure that the prover is drained down completely and that any vapor has been vented off. If also removing the piston assembly, the barrel may need to be flushed to remove any residual product.

Detaching Optical Plate Assembly

This step is most easily accomplished if the piston is in the full downstream position.

1. Detach the optical plate assembly. See Figure 5.4 for exploded view of assembly.
    A. Remove the hardware holding the target plate assembly onto the optical plate assembly. Be careful when removing this item as it is under spring tension.
    B. Once the target plate assembly is removed, remove the nut attaching the optical plate assembly from the piston rod, and move the optical plate upstream and out of the way.

Figure 5.2 - Detaching Optical Plate Assembly



Upstream Seal Gland Assembly

1. See Figure 5.3 for a detailed view of the assembly. Remove the seal gland assembly, starting with the four bolts, and the tubing connection from the assembly to the sight flow indicator if optioned. Once disconnected from the flange, pull the assembly over the piston rod and out of the way.

2. Disassemble the seal gland assembly. See Figure 5.4 for exploded view of the assembly.
   A. Starting with the upstream side. Remove the outer snap ring.
   B. Remove the rod seal.
   C. Remove the second snap ring.
   D. Remove the next two snap rings.
   E. Remove bushing.
   F. Move to the downstream side. Remove the outer snap ring.
   G. Remove the first rod seal.
   H. Remove the seal spacer.
   I. Remove the next rod seal.
   J. Remove the next seal spacer.
   K. Remove snap ring.
   L. Remove O-ring from back of flange.

Figure 5.3 - Upstream Gland Assembly

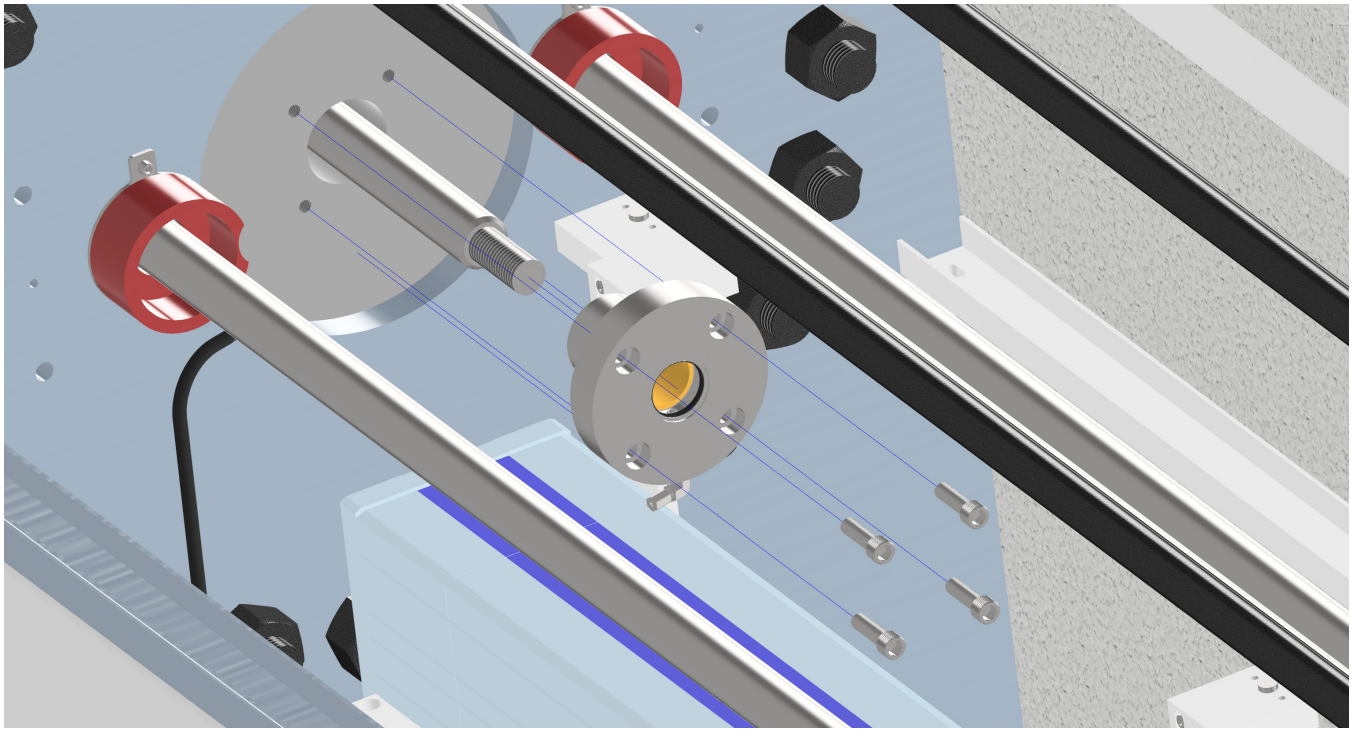
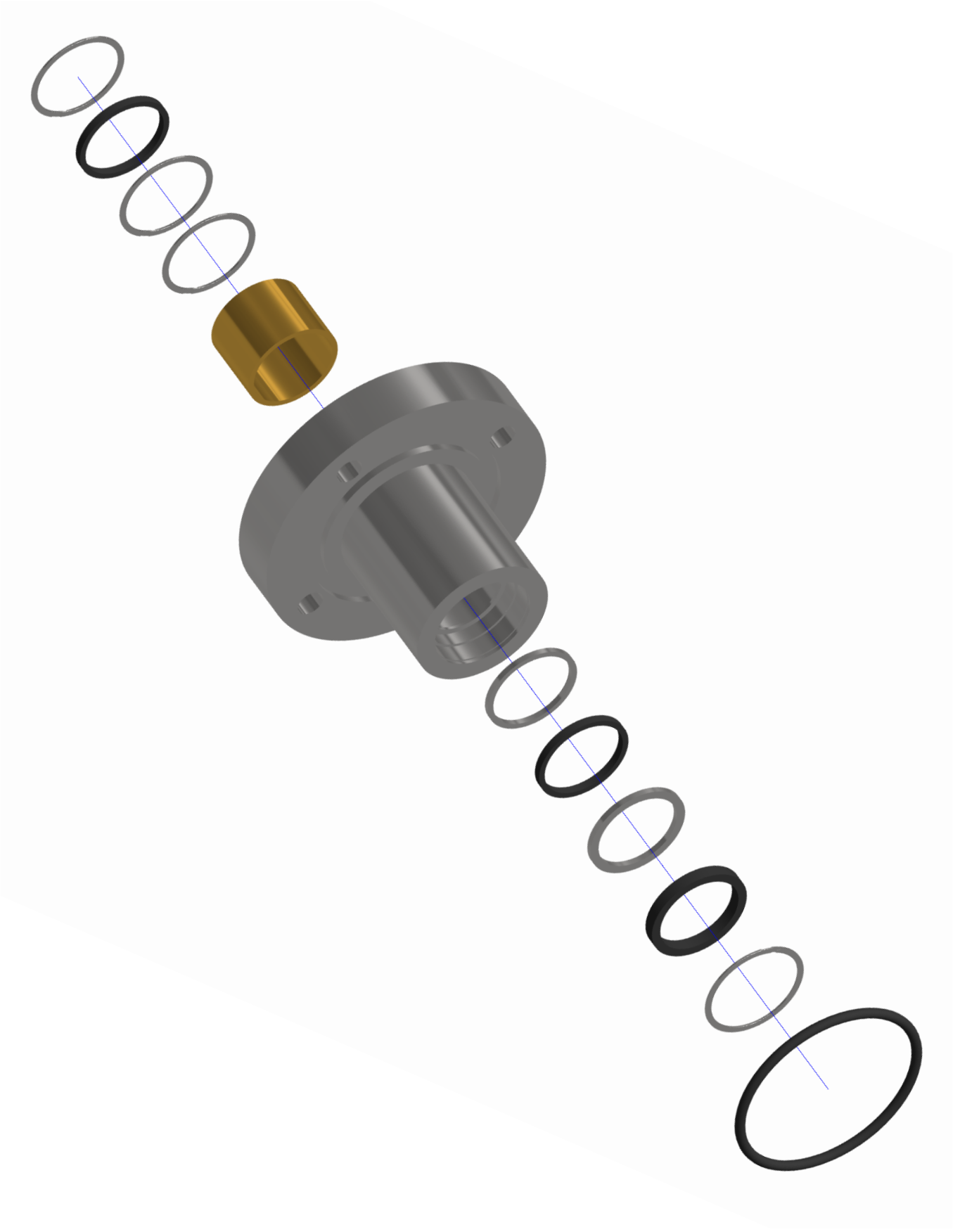


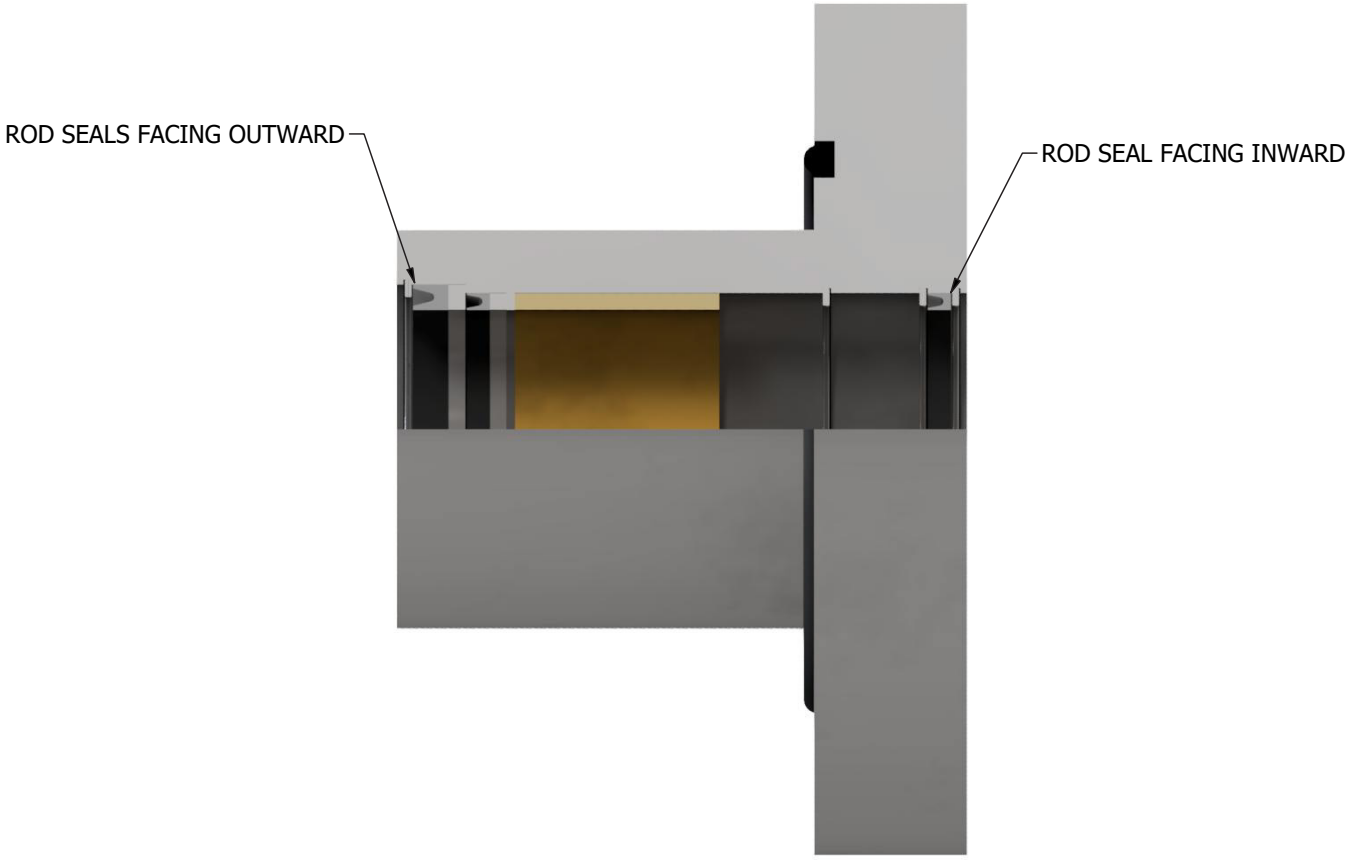
Figure 5.4 - Exploded View of Assembly



3. Rebuild the seal assembly, making sure to inspect the assembly and any pieces being reused for damage or wear. Repeat the above process in reverse order, making sure to lightly grease all surfaces as it is reassembled. Take note of the direction of the seals when reinstalling. If these seals are installed incorrectly, the assembly will leak. See details of Figure 5.5.

4. Reinstall the assembly, if piston assembly has been removed wait to reinstall the upstream seal gland assembly until after the piston has been reinstalled.

Figure 5.5 - Direction of Seals



Downstream Seal Gland Assembly

1. Remove the stop tube assembly. See Figure 5.7 for a detailed view of the downstream rod cover and seal gland assembly.
   A. Remove the bolts attaching the rod cover to the stop tube assembly and remove the rod cover from the prover. Be careful when removing the cover so as to not damage the PTFE rider inside the cover and to not damage the end of the rod.
   B. Once the rod cover is off, start removing the bolts holding the stop tube assembly in place, and then remove the assembly from the prover. Make sure to slide the assembly straight out of the prover and to not damage the piston rod as you remove the assembly.
   C. Once the stop tube assembly is removed, remove the O-ring on the flange face. Detach the seal assembly portion from the stop tube assembly and start removing the seals. See Figure 5.8 for a detailed view.
      i. Starting on the upstream side, remove the urethane stop washer.
      ii. Remove the outer snap ring.
      iii. Remove the rod seal.
      iv. Remove the seal spacer.
      v. Remove the next rod seal.
      vi. Remove the next seal spacer.
      vii. Remove the snap ring.
      viii. Remove the bushing.
      ix. Next, move to the downstream side. Remove the last snap ring.
      x. Remove the O-Ring from the outside of the seal gland assembly.

2. Rebuild the seal assembly, making sure to inspect the assembly and any pieces being reused for damage. Repeat the above process in reverse order, making sure to lightly grease all surfaces as it is reassembled. Take note of the direction of the seals when reinstalling. If the seals are installed improperly, the assembly will leak. See details of Figure 5.6

3. Reinstall the assembly. If doing anything with the piston assembly, wait to install this assembly until all work on the piston is completed and the piston is reinstalled.

Figure 5.6 - Properly Install Seals

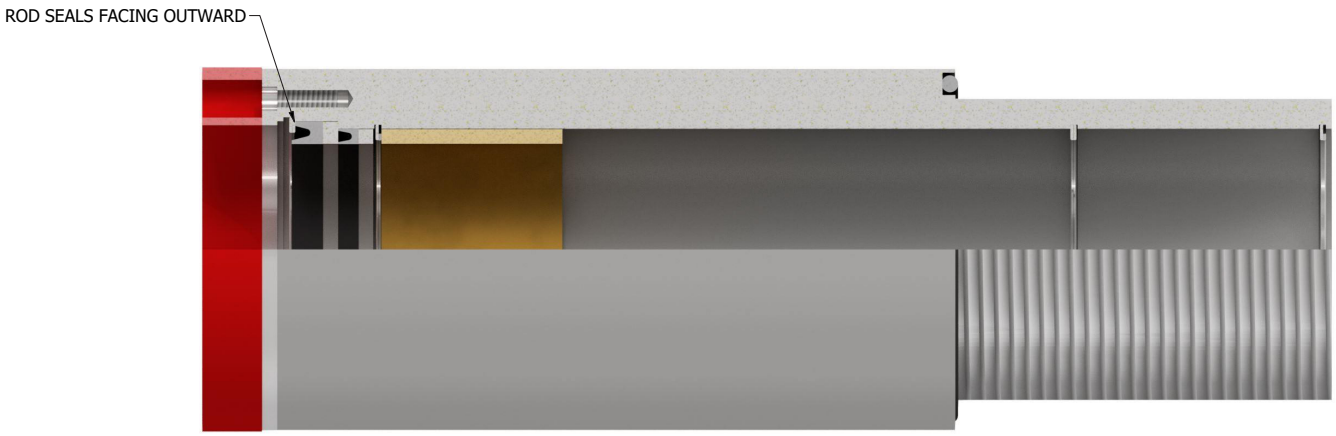


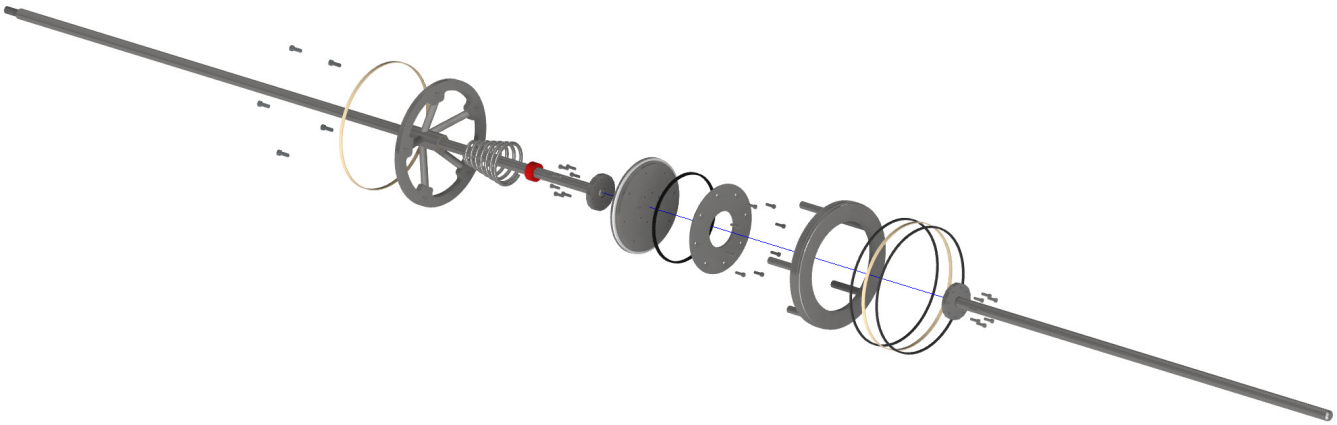
Figure 5.7 - Remove Stop Assembly Tube

Figure 5.8 - Remove Seals

Piston Assembly:

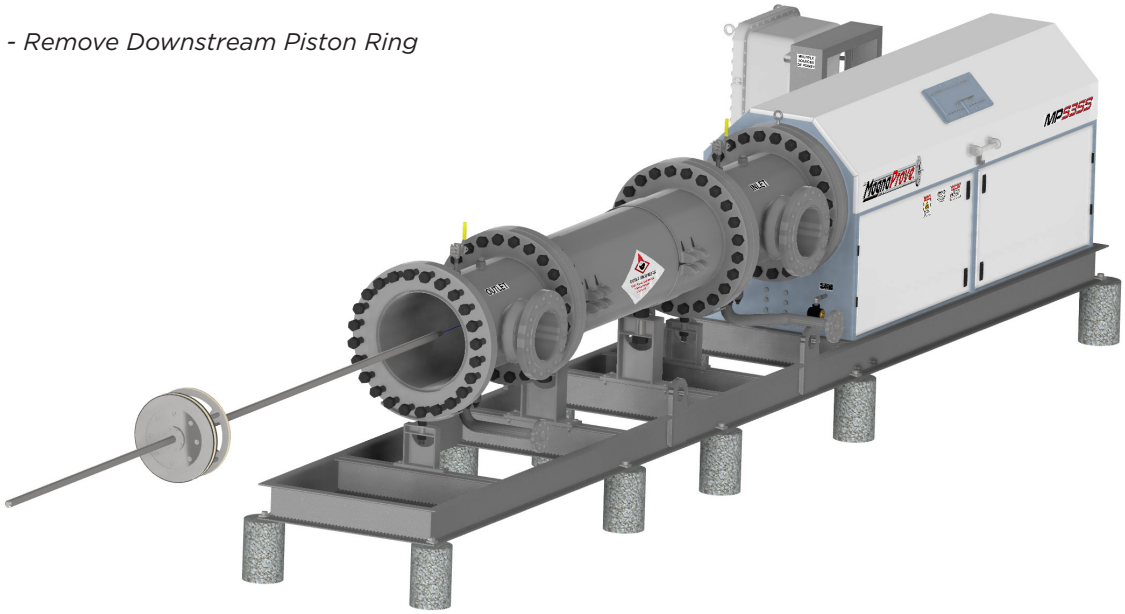
To remove the piston assembly, the upstream and downstream seal assemblies need to be removed. See enlarged view on page 40.

Figure 5.9 - Piston Assembly Exploded View



1. Before removing the piston and after removing the upstream and downstream seal gland assemblies, protect the end of the piston rod so as not to damage the rod threads or the barrel surface.
2. Disconnect the wiring and conduit from the temperature and pressure sensors on the downstream flange, if applicable.
3. Remove the downstream flange, taking care not to damage the downstream rod during this process.
4. Once the flange is out of the way, start moving the piston out of the prover, taking care to keep the piston rods perpendicular to the prover so as not to lodge the piston within the measurement section or damage the barrel. See Figure 5.10 for detail on removing the piston.
5. Once the piston is out of the prover, take care to lift the piston as close to the center of the piston assembly as possible so as to avoid bending the rods as you carry the piston.
6. For disassembly it is best to support the piston with a chain vice across the bushing housing of the piston.
7. Remove the downstream rod by removing the bolts attaching it to the piston poppet. Take care to support the piston itself as you remove this rod.

Figure 5.10 - Remove Downstream Piston Ring



8. Once the downstream rod has been removed, carefully pull apart the piston assembly, making sure to slowly and evenly release the spring tension on the poppet. Once the downstream piston ring has been removed from the piston assembly, the bushings within the piston can be inspected and replaced if necessary.

9. Once the downstream piston ring has been removed, this will enable removal of the piston poppet, poppet spring and the urethane spacer. See Figure 5.10.

10. Once the piston assembly has been disassembled, replace the seals and the rider bands. Inspect the spring, the poppet and the piston assembly for visual defects. When installing the seals, make sure of the direction that the seals are facing. See detail in Figure 5.11. If the seals are not facing the correct direction, it will cause issues during proving.

11. Rebuild the piston assembly, repeating the above steps in reverse order, taking care to lightly grease all surfaces as the unit is pieced back together.

12. Before placing the piston back into the prover, make sure to protect the piston rod so as not to damage the rod threads or the barrel surface.

13. When installing the piston assembly back into the prover, lubricate the bevel between the inlet spool and the measurement section of the barrel, and take care to keep the piston rod even so as not to "roll" a seal upon pushing the assembly into the barrel.

14. Once the piston is in place, reinstall the downstream flange, the downstream seal assembly and the upstream seal assembly. If necessary, reconnect the temperature and pressure sensors.

Figure 5.11 - Seal Installation

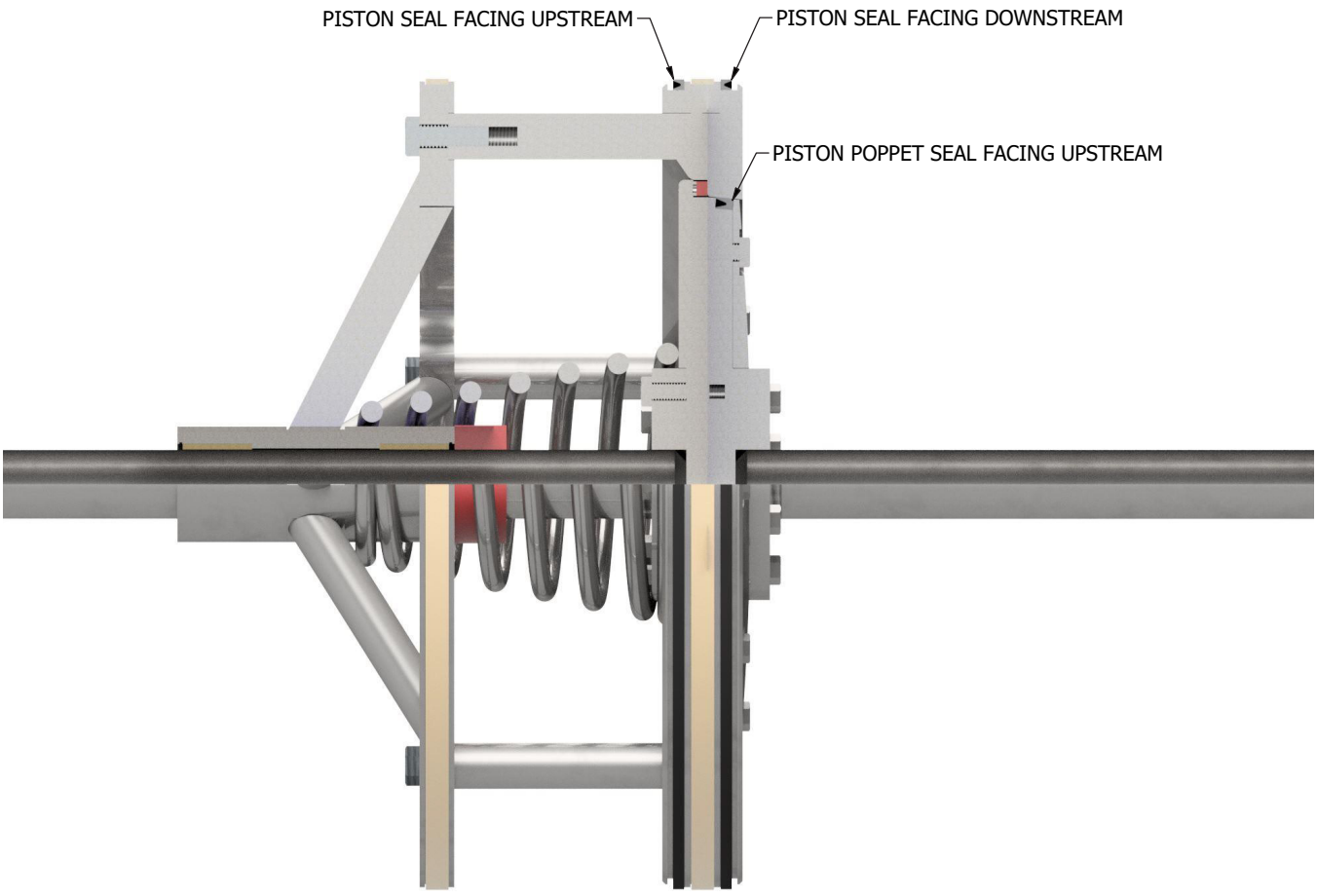
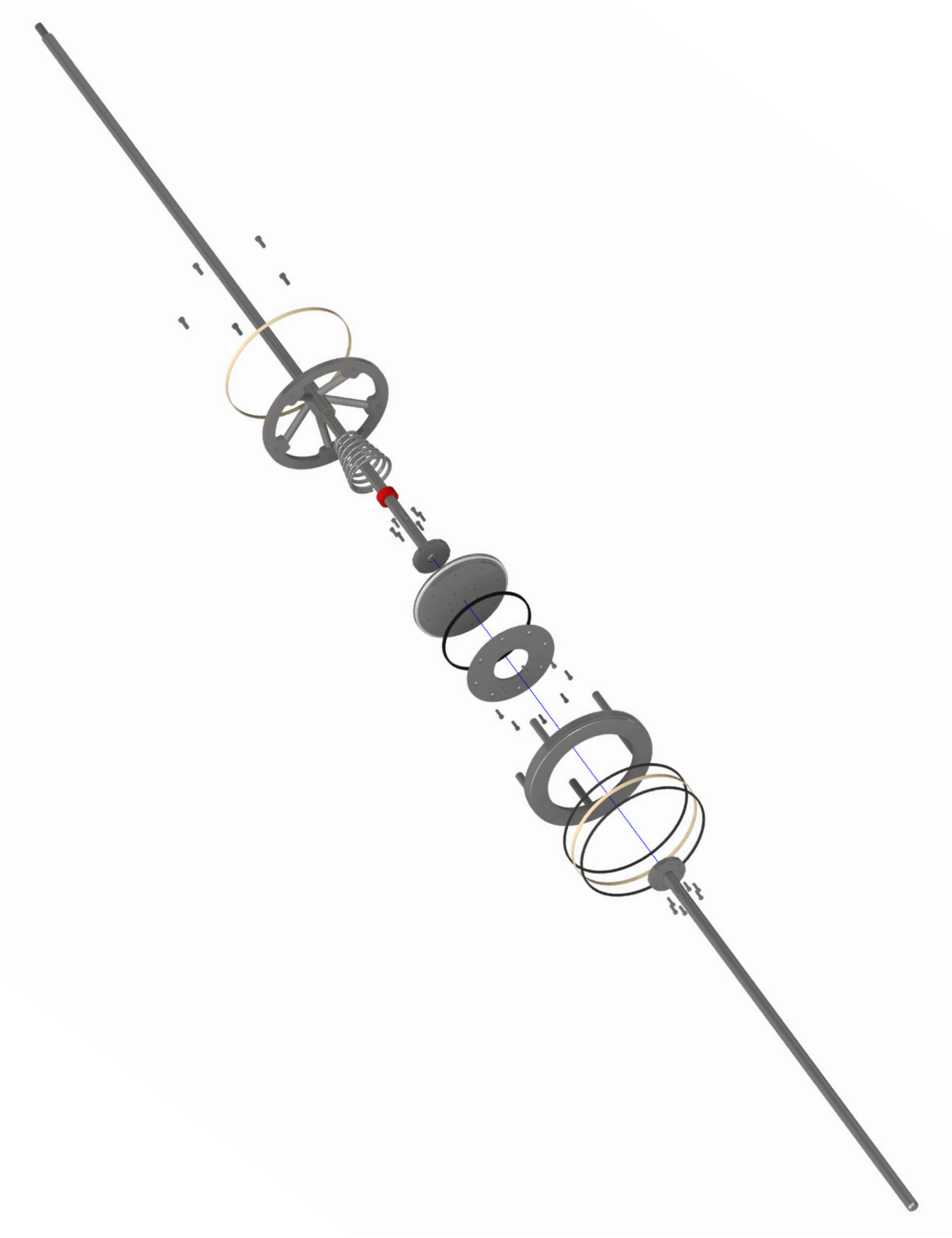


Figure 5.9 - Piston Assembly Exploded View



CALIBRATION

6.1 Prover Prep for Calibration

During the week prior to the calibration, make sure there is power to the unit and provisions if necessary for power for the water draw unit. Provisions have been made for 2" threaded connections available at the inlet and outlet of the prover, and that the prover interior is completely clean and a seal check has been performed.

Completely cleaning the prover interior will greatly reduce the amount of time required to perform the calibration. Meter Engineers recommends using Petro Gone™ to clean the prover. Contact Meter Engineers for more information about Petro Gone.

If the prover is installed in a stationary setting, it is recommended to skillet off or blind flange as close to the prover as possible.

Secure a source of clean potable water prior to calibration.

For any questions involving prover prep, please contact Meter Engineers prior to your calibration.

6.2 Basic Calibration Info

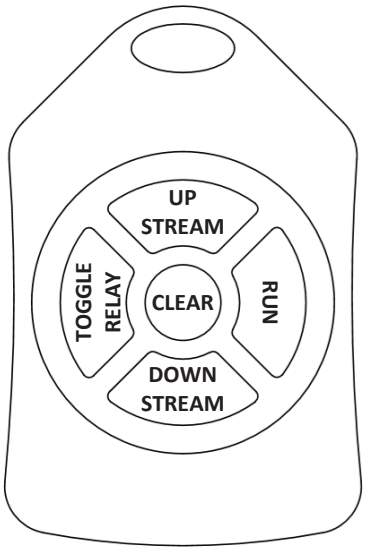
Prior to starting prover calibration, please refer to all applicable API MPMS standards referencing the prover calibration method being used.

The MagnaProve utilizes a single normally open dry contact to indicate when the optical eye passes the flag for volume reference. The connection for this contact is inside the condulet fitting marked "WATER DRAW" on the outside of the enclosure.

The MagnaProve is designed to be calibrated through the drains on the inlet/outlet spools, or at the optional water draw connections on the inlet/outlet spools.

The MagnaProve utilizes a key fob-style remote control to operate the prover during calibration. If the key fob is lost/inoperative, there are also buttons on the MPIM board that will operate the MagnaProve through the calibration procedure. Please see the below illustrations for the location and use of these buttons.

A 4-way diverter valve can be used in lieu of the MagnaProve actuator during the calibration procedure. If you use a 4-way diverter valve to move the piston, it is imperative that the prover is in the W/D mode. You will still need to use either the key fob or the MPIM board to clear the switch contacts during the calibration process.



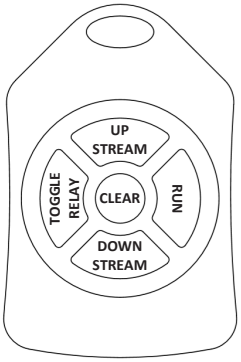
MagnaProve Key Fob

6.3 Steps for Water Draw Calibration

1. Connect the prover drain lines or the optional water draw connections to the calibration device, making sure flow will proceed from inlet to outlet on the prover.
2. Connect the solenoid leads on the calibration device to the prover calibration leads enclosed within the water draw condulet box, making sure to pay attention to the common and signal markings on the wire.
3. Turn on the prover and make sure the operation switch is in the W/D position.
4. Once everything is connected, open the valves starting with the inlet side and then the outlet side, and start flowing through the prover.
5. Start bleeding air from the prover. It is recommended to cycle the prover a few times to assist with bleeding air and to stabilize the temperature through the prover. You can cycle the prover by using the key fob or the buttons on board the MPIM module, or by cycling the 4-way valve.
6. Once air is bled and the temperature is stabilized, start the calibration procedure. Following the appropriate standards from API standards from MPMS Chapter 4.9.
7. When doing the calibration, you will need to use the CLEAR button on the remote/MPIM module to clear the relay output from the calibration portion of the MPIM module.
8. Once the calibration is complete, drain the water from the prover, disconnect the prover calibration leads and place them back into their condulet box. Turn the operational switch back to RUN and take the necessary steps to put the prover back into operation.

TROUBLESHOOTING

7.1 Run Prover Test



You can operate the prover as long as you have flow through the prover, either with the key fob or with the buttons on the MPIM board. Please see the drawing for key fob layout and button locations.

Depending on your setup to use the prove button on the MPIM board, you may have to disconnect the two wires at J4-2 and J4-3 and move the jumper at J3 to pins 1 and 2. When piecing everything back together, make sure that the jumper is in the right position. Failure to do so can damage the MPIM board.

There is a volume pulse test button on the MPIM board as well. You can use this button to simulate a volume pulse from the MPIM board. There is no button correlating to this button on the key fob. Be aware that this only tests the output of the card, and does not test the function of the eye. The best way to test the function of the eye is to place a non-reflective object between the light and receiver within the eye itself.

The CLEAR button on the key fob and the MPIM board reset the water draw relay, and is only used during that process.

7.2 Prover Troubleshooting Electrical

Please make sure that qualified, trained technicians perform any of these troubleshooting procedures. If there are any questions or there is any help needed, please call anytime: 316-721-4214.

Prover not responding, NO ready light on enclosure door.	*Is the On/Off switch turned to On? Is the Run, Standby, W/D switch in the Run or W/D?* *If yes, move on to the next steps. If not, move them to the proper position.*
Looking through the electrical enclosure window. Are the lights displaying on the power supplies and the MPIM board?	*If yes, move on to the next step.* *If not, secure the area, open the enclosure and check incoming power. Is the breaker tripped? Are there any of the control fuses blown?* *If yes, replace fuse reset breaker, etc., and check to see why these may have blown or tripped. If unsure why these may have failed, contact Meter Engineers at 316-721-4214, and we can assist with further troubleshooting.* *If none are blown or tripped, check that the 24vdc power supply is working properly. Voltage should be at a range of 23VDC to 25VDC, if not within this range, adjust to this range or replace power supply.*
If there are lights inside the electrical enclosure, is the Magnet sled at the home position?	*If not, secure the area and open the electrical enclosure.* *Check to see if the drive is showing a fault. In normal operation, the drive should show 0.2 or 0.1. If it does not show either of these, check for a fault code. A code will display as an F followed by a number flashing in a sequence of three numbers.*

If the sled is at the home position.	*Check the lamp for the ready light, and look through the window and check that the LED for the R1 relay is lit.* *If the relay is not lit, then check that the optical plate is in the downstream position, and that the flag from the plate is triggering the optical plate proximity switch, and that the proximity switch is operational.* *Caution: If an individual triggers the optical plate proximity switch manually while the prover is in Run mode or Water Draw mode, the actuator may attempt to pick up the optical plate, possibly causing injury.*
If the relay is illuminated and it is found that the Ready light lamp is bad, then check that the signal from the flow computer is delivering its pulse to the MPIM board.	*If the flow computer is properly sending a pulse, there will be a light that flashes on the MPIM board indicating that the prover is receiving a prove signal. You can bypass this signal and manually initiate a prove with either the remote or the manual prove button on the MPIM board. If the prover will still not function, check the Prove Out of the MPIM board terminal J4-1. This should be a 24VDC signal going to the drive.* *If the signal is not going to the drive, then replace the MPIM board.* *If the signal is going to the drive, then contact Meter Engineers at 316-721-4214.* *If the flow computer is not sending a proper signal, see the troubleshooting guide for your flow computer.*
Prover not responding, there IS a ready light on door.	*Check through the window that the relay R1 is lit.* *If not, check that the optical plate is in the home position. If the plate is in the home position, check that the flag is triggering the optical plate proximity switch, and that the proximity switch is operational. If the proximity switch is operational, and the flag is triggering the switch and the prover will still not operate, move on to the next step, or call Meter Engineers at 316-721-4214.* *Caution: If an individual triggers the optical plate proximity switch manually while the prover is in Run mode or Water Draw mode, the actuator may attempt to pick up the optical plate, possibly causing injury.*

If the relay is illuminated.	*Check that the signal from the flow computer is delivering its pulse to the MPIM board.* *If the flow computer is properly sending a pulse, there will be a light that flashes on the MPIM board indicating that the prover is receiving a prove signal. You can bypass this signal and manually initiate a prove with either the remote or the manual prove button on the MPIM board.* *If the prover will still not function when manually operated, check the Prove Out of the MPIM board terminal J4-1. This should be a 24VDC signal going to the drive.* *If the signal is not going to the drive, then replace the MPIM board.* *If the signal is going to the drive, then contact Meter Engineers at 316-721-4214.* *If the flow computer is not sending a proper signal, see the troubleshooting guide for your flow computer.*
If the relay is illuminated, and the motor sounds like it is running, but the actuator will not move.	*Power down the prover, remove the access plate at the end of the drive cabinet, remove the belt cover at the end of the actuator and inspect the drive belt.* *If drive belt is good and the actuator drive shaft gear moves freely, but the magnet plate does not move, contact Meter Engineers at 316-721-4214.*
Prover operates but will not pick up the optical plate.	*When the actuator proceeds to pick up the optical plate, does the LED illuminate for the R3 relay? This will occur when the magnet is within 12" of the optical plate. (Depending on the model of the prover, it may be necessary to open the electrical enclosure to see this relay. If so, please take all necessary precautions when opening the enclosure.)* *If yes, proceed to next section.* *If not, using all necessary precautions, open the enclosure and check the incoming voltage to the R3 relay. This voltage should be 24VDC.* *If there is voltage at the input side of the relay, but no voltage on the output side of the relay, then replace the relay.* *If there is no voltage at the input side of the relay, and the 24VDC control transformer is working properly, then contact Meter Engineers at 316-721-4214.*

If the relay is illuminated.	*Using all the necessary precautions, open the enclosure and check the voltage on the magnet relay at the fuse for the magnet circuit and at the output point on the R3 relay.* *This voltage should be between 12VDC and 15VDC for models with a 4" and 6" magnet, and between 24VDC and 27VDC for models with an 8" and 10" magnet.* *If there is no voltage at the output side of the relay, and the power supply is working properly, then replace the relay.* *If the voltage coming from the magnet power supply will not adjust into the proper range or is not there, replace the power supply.*
If the fuse is blown.	*Check the magnet and the cable supplying power to the magnet.* *With power off, and the area secured, disconnect the magnet from the magnet power cable inside the drive cabinet. With magnet disconnected, use an ohmmeter to check the resistance across the magnet.* *The resistance across the coil wires should be 3.8 ohms for a 4" magnet, 2.2 ohms for a 6" magnet, 4.5 ohms for an 8" magnet, and 2.8 ohms for a 10" magnet* *If the resistance across the magnet is not correct, too high or too low, then replace the magnet.* *Check the continuity across the coil wires to the ground wire. There should be no continuity across these wires. The meter should read OL. If there is any continuity across these wires, replace the magnet.*
If the resistance across the coil wires and to the ground wire on the magnet check out.	*Check the continuity across the cable supplying the magnet.* *First check the blue wire and brown wire separately to the ground wire. There should be no continuity across these wires (meter should read OL). If there is continuity across these wires, then replace the magnet power cable.* *If the wires check out properly to ground, then disconnect the wires for the magnet power cable from the R3 contactor. At this point tie the brown and blue wire together on one end and on the other end. Using your ohmmeter, check the resistance across the wires. There should be little to no resistance across these wires. If there is, replace the magnet power cable.*

If the voltage supplying the magnet is correct, and the relay is working properly.	*Is the face of the magnet unclean? Is the target plate unclean? If they are, use emery cloth and a light solvent to clean and resurface the magnet and target plate face.* *Operate the prover manually. If the magnet proceeds to the target plate and does not attract the target plate to itself, then replace the magnet.* *If the magnet attracts the target plate and begins to pull the optical plate upstream, but then releases the target plate prior to the normal release point, check the resistance of the bearings within the optical plate for any mechanical reasons why the optical plate may not be pulling back easily. (See the Prover Troubleshooting Mechanical section.)*
Prover not giving the volume signal to the flow computer.	*As the prover operates, look in the window and watch the MPIM board and see if the volume signal LED lights up as the eye passes the flags. It should light up once each time the eye passes by the two flags.* *If so, using all necessary precautions, open the enclosure and check the pulse output on the MPIM board at terminals J2-4 and J2-5. This is a high going low output, so operate the prover manually, and as the eye passes by the flags going in the downstream motion, the voltage should drop to 0 each time the eye passes a flag. This is best viewed with a scope meter, as a true RMS meter may not operate fast enough to see the voltage drop.* *If the voltage changes as the eye passes the flag, check the troubleshooting guide for your flow computer.* *If the voltage does not change as the eye passes, replace the MPIM module.*
If not, then perform the following checks.	*Inside the drive cabinet, move the flag rod bearing assembly out of the way and check that the photo-eye is undamaged.* *If the eye is damaged, replace the eye and investigate why the eye was damaged (e.g., the flags are bent or out of alignment, or the bearing has turned).*

If not, then perform the following checks. (Cont.)	*If the eye is undamaged, turn off power to the unit and remove the photo eye from the optical assembly. Then, taking necessary precautions, open the electrical enclosure.* *Once the electrical enclosure is open, check continuity across the barriers. The resistance across each barrier should be around 250 ohms, if the resistance is not between 240 ohms and 260 ohms, replace the barrier or the diode inside the barrier.* *If the barriers are good, then remove the wires going from the barriers to the eye holder, making sure to mark the wires and note what point on the barrier that they land. Once the wires are disconnected, then check the resistance of each of the wires. There should be little to no resistance within each wire, and there should be no continuity between the wires. If there is a large amount of resistance across the wires or if there is continuity between the wires, then replace the optical cable assembly.* *If all of these items check out, call Meter Engineers at 316-721-4214.*
Prover sending too many volume signals to the flow computer.	*If the prover appears to be sending out double the number of signals as is expected, make sure that the prover is in Run mode. If the prover is in W/D Draw mode, it will send a signal when the actuator is pulling the piston both upstream and downstream.* *While looking through the window, make sure that the R2 relay is illuminated when the actuator is pulling the optical plate upstream.* *If the R2 relay is not illuminated, take the necessary precautions and open the enclosure. Manually activate the actuator and check voltage incoming to the R2 relay as the actuator is pulling the piston upstream. You should be getting 24VDC at this time.* *If you are getting the voltage and the relay is not operating, replace relay.* *If you are not getting 24VDC at the coil side of the relay, call the Meter Engineers at 316-721-4214.*

Prover sending too many volume signals to the flow computer. (Cont.)	*If the R2 relay is illuminated, take the necessary precautions and open the enclosure. Check that there is continuity between R2-11 and R2-14 when the relay is on.* *If there is no continuity, replace the relay.* *If there is continuity, the problem may be with the MPIM board. Contact the Meter Engineers at 316-721-4214.*
Magnet not moving to the chase position.	*Turn off power to the unit.* *Disconnect wires at TB1- ? and TB1-?, place these two leads across an ohmmeter. Using a piece of metal, place it across the chase proximity switch. If you get continuity across the switch, then it is functional. The sensor will need to be adjusted to be within .030" of the flag on the bottom of the optical plate.*
Upon startup the prover will not home properly.	*Is the actuator is moving toward the downstream end and only stopping when the drive trips?* *Turn off the prover, disconnect the wires at TB1-13 and TB1-21A, and place these two leads leads across an ohmmeter. Using a piece of metal, place it across the home proximity switch. If you get continuity across the switch, then it is functional.* *If the switch is functional, then adjust the height of the home proximity switch to within .030" of the homing flag on the magnet carrier so that the homing flag activates the sensor.* *If the actuator does not stop in the home position, check the wiring to the home proximity switch. If the wiring is good, replace the home proximity switch.* *Is the actuator homing over the entirety of the home proximity switch? This will make the start point of the actuator program be set incorrectly, causing the magnet not to pick up the optical plate assembly.* *To resolve this problem, turn power off to the prover, then move the magnet downstream of the home switch 4–5" and rehome the actuator by turning the On/Off switch to Off and then to On again.*

7.3 Prover Troubleshooting Mechanical

Is the motor turning, but the magnet sled not moving?	*Power down the prover, remove the access plate at the end of the drive cabinet, remove the belt cover at the end of the actuator and inspect the drive belt.* *Is the drive belt broken? If yes, then replace.* *If drive belt is good and the actuator drive shaft gear moves freely, but the magnet carriage does not move, contact Meter Engineers at 316-721-4214.*
Scratches/scars on guide rods.	*Check bearings for grease and free flow. If they are dry or the grease is contaminated, it may cause damage to the rods.*
Leaks at upstream/ downstream sight flow indicators.	*If the indicator is showing a leak, replace the piston rod seals related to the side of the prover where the leak indicator is located.*
Optical plate not moving.	*If the magnet goes to pick up the optical plate and is not able to pull the plate back, and all electrical reasons have been checked, check the following:* *Optical plate bearings may be locked up, dry or contaminated to the point that they will not move freely. Check bearings and grease if necessary, or replace bearings.* *If the bearings move freely, the piston may be locked up inside the prover. This can be caused by pipeline rouge or a faulty seal on the piston. A sign of this is the magnet breaking free from the target plate. At this point you will need to remove the piston from the prover and check the seals and find where the friction lies.*
Proving problems.	*If the meter factor is too low, that is usually due to fluid leaking by the poppet or piston seals. This can have a few mechanical problems associated with it.* *Bearings may get dry or start to grab the guide rod. Check the bearings regularly to make sure they are not causing excess drag on the shaft.*

7.3 Prover Troubleshooting Mechanical

Proving problems. (Cont.)	*The upstream/downstream rod has rolled a seal. This can cause friction on the piston rods, keeping the poppet open through the proving process.* *As time progresses, the poppet spring can get weak and not close the poppet quickly enough when performing high flow proves. This could cause irregular leaks around the poppet.*

PROVER MAINTENANCE

Servicing the prover should be done in a de-energized state, but may require power to cycle the prover to assist with cleaning or positioning the actuator in a more accessible position.

8.1 General Prover Maintenance Information

Preventative Maintenance

MagnaProve provers are designed to require minimal maintenance. The following maintenance items are for key components that may require periodic inspection or maintenance to prevent undue wear, damage or possibly failure. Due to the nature of their service, portable provers will require different inspection points than stationary provers.

8.2 Portable Provers

Daily

- Visually inspect the prover, including electrical fittings, pressure-retaining fittings and shaft seals.
- Check that all covers and guards are in place and undamaged, and that all warning stickers are legible.
- Check sump tank level to be sure not to overfill.

Monthly

- Everything in the daily inspection, plus the following:
- Run a clean rag coated with a small amount of Petro Gone™ across the main two guide rods, plus the flag rod, making sure to remove all grease, dirt or other debris from the rods. On the flag rod, run a clean rag coated with a small amount of MagnaLube® G or equivalent.
- While cleaning the rods, inspect the rods and flags for any signs of wear or damage.
- Visually inspect all electrical cables for signs of wear or damage. Inspect cable track for damage or wear, keeping an eye out for any brittle pieces or cracks.

Semi-Annually

- All items from the daily and monthly inspections plus the following:
- Grease the actuator carriage (Schunk). There are two grease points on each side of the carriage. Use Mobil Grease SHC 220 or equivalent.
- Grease all guide bearings: two bearings on the optical plate and up to four bearings on the magnet carriage (if applicable). Use MagnaLube® G or equivalent grease. Make sure not to over-grease the bearings. This can cause excessive friction within the bearings on the optical plate.
- Make sure all electrical connections in the control box are tight.
- Verify the prover mounting bolts, studs and nuts, and all cover screws are tight.
- Ensure all electrical fittings are tight, and that the mounting bolts for the enclosures are secure.

8.3 Stationary Provers

Monthly

- Visually inspect the prover, including electrical fittings, pressure-retaining fittings and shaft seals.
- Check that all covers and guards are in place and undamaged, and that all warning stickers are intact and legible.
- Run a clean rag coated with a small amount of Petro Gone™ or equivalent solvent across the main two guide rods and flag rod, making sure to remove all grease, dirt or other debris from the rods. On the flag rod, run a clean rag coated with a small amount of MagnaLube® G or equivalent.
- While cleaning the rods, inspect the rods and flags for any signs of wear or damage.
- Visually inspect all electrical cables for signs of wear or damage. Inspect cable track for damage or wear, keeping an eye out for any brittle pieces or cracks.

Semi-Annually

- All items from the monthly inspection
- Grease the Actuator carriage (Schunk) there are two grease points on each side of the carriage. Use Mobil Grease SHC 220 or equivalent. Make sure not to over grease the carriage, a couple of pumps from a grease gun should be enough grease.
- Grease all guide bearings, two bearings on the eye plate and up to 4 bearings on the magnet carriage. Use MagnaLube® G or equivalent. Make sure not to over grease the bearings, this can cause excessive friction within the bearings on the eye plate.
- Make sure all electrical connections in the control box are tight.
- Verify the prover mounting bolts, studs and nuts, and all cover screws are tight.
- Ensure all electrical fittings are tight, and that the mounting bolts for the enclosures are secure.

8.4 Guide Bearing Grease Requirements

Factory Fill Level

Model: 1050, 1300, 2600, 4500, 5355

- Guide bearing housing capacity - 2.5 fl. oz.
- Filled to 1/2 capacity - 1.25 fl. oz.

Model: 8500, 12750

- Guide bearing housing capacity - 4.0 fl. oz.
- Filled to 1/2 capacity - 2.0 fl. oz.

Maintenance Fill Level (Semi-Annually)

Model: 1050, 1300, 2600, 4500, 5355

- Fill to 1/6 factory fill level - 0.21 fl. oz.

Model: 8500, 12750

- Fill to 1/6 factory fill level - 0.33 fl. oz.

NOTE: The output, or amount of lubricant dispensed from a grease gun, depends on the model and age. It is recommended to calibrate the output prior to performing a maintenance fill.

In the event of a guide bearing replacement, clean/remove all existing grease and refill to factory fill level.

FREQUENTLY ASKED QUESTIONS

Q. What type of prover is the Meter Engineers MagnaProve?

A. The MagnaProve is a small volume captive displacement prover.

Q. Why is the Meter Engineers MagnaProve prover considered a small volume prover?

A. The small volume classification is based upon the volume displaced in relationship to the number of flow meter pulses collected. A small volume prover is any prover that does not gather pulses greater than 10,000 meter pulses per meter pass to create a meter factor. A small volume prover in conjunction with pulse interpolation can generate a meter factor in less than 10,000 pulses.

Q. How can the Meter Engineers MagnaProve be used to prove Coriolis and Ultrasonic Meters?

A. The MagnaProve utilizes an extended pre-run to accommodate Coriolis and Ultrasonic meters. This extended pre-run allows for the flow to stabilize before the piston enters the measurement section of the prover.

Q. Why is the upstream and downstream volume the same on the Meter Engineers MagnaProve small volume prover?

A. The displaced volume is the same due to having a shaft on both sides of the piston assembly.

Q. Can the fluid flow through the prover all of the time?

A. Yes.

Q. How much pressure drop does the Meter Engineers MagnaProve meter prover have?

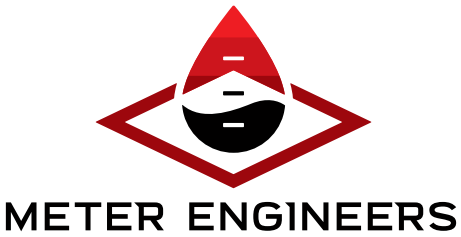
A. The pressure drop varies by prover model, and depending on the model, you can see a pressure drop of 3-10 psi across the piston.

Q. What motor size is used on the Meter Engineers MagnaProve?

A. The MagnaProve uses the same 7.5hp servo motor across all its provers.

Q. How can I receive more information and support for the Meter Engineers MagnaProve small volume prover?

A. For sales and technical support, please contact your Meter Engineers support team at 316-721-4214 during normal business hours (M-F 8AM-5PM CST) and 316-744-7600 after hours.



For sales and technical support, please contact your Meter Engineers support team:

Monday-Friday 8AM-5PM CST: 316-721-4214

After Hours: 316-744-7600

Please have your serial number and prover location available when calling for assistance.

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