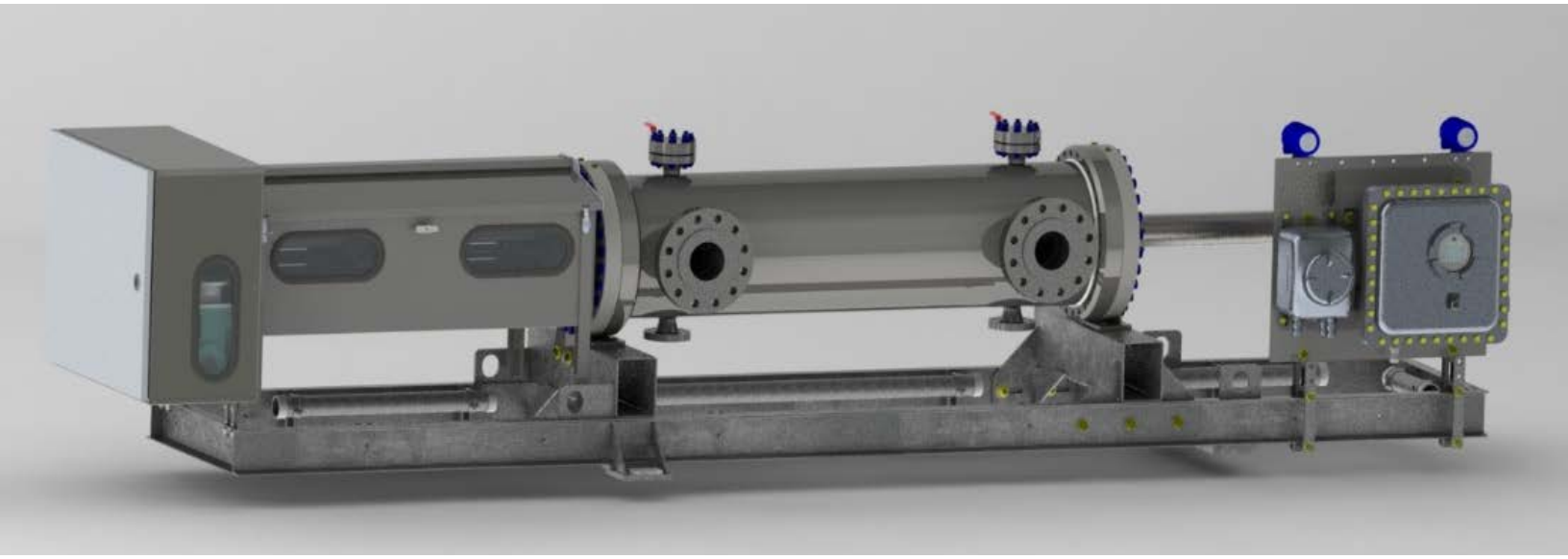


COMPACT PROVER 4TH GEN

OPERATING AND MAINTENANCE MANUAL

CONTENTS 000-112680-DOC

FIGURE LIST

INTRODUCTION

The Unidirectional Captive Displacement Prover manufactured by Flow Management Devices, LLC (Flow MD) ™ is a complex industrial piece of equipment and requires trained and qualified personnel with safety training and common sense to install and operate this equipment

Congratulations on the purchase of your prover. We believe you will be happy and completely satisfied with your purchase. Our goal is to provide our valued customers a quality prover at a reasonable price.

For your safety, please read and understand this manual thoroughly before operating your prover. If there are any questions about the information in this manual, please consult the factory. Please have the part number, purchase order number and serial number available when calling. The part number, purchase order number and serial number can be found on the name-plate attached to the electrical panel.

The FMD-XXX Unidirectional Captive Displacement Prover or Small Volume Prover is a precision instrument with a state-of-the-art control system PIM (Prover interface Module) and software. The PATENT PENDING design has many features and allows for smooth and quite operation. This manual will cover the operation and maintenance of the FMD-XXX in detail.

For future reference, please write your part number, purchase order number and serial number in the space below:

SPECIFICATION

STANDARD MATERIAL OF CONSTRUCTION

- The flow tube is precision machined from 304L stainless steel (316L SS optional) material and it contains all other components that contact the fluid (wetted parts)
- Wetted parts or any component with direct contact with liquid are manufactured with 304L stainless steel (316L SS optional) material
- The switch bar is made of 304 SS material
- The frame is galvanized per ASTM A123 Grade 100
- The drive end components are steel with Nitro carburizing or Zinc plating finish for corrosion resistance
- The belts are high strength carbon fiber
- The Electronic enclosures are explosion proof cast aluminum (stainless steel optional)
- The drive covers are 304 stainless steel (316 SS optional)

TECHNICAL SPECIFICATION

- Designed and manufactured in the United States
- Industry standard double chronometry per API 4.6
- Conforms to API 4.2 "Displacement Provers"
- Equal upstream and downstream displaced volumes
- Stainless Steel and PTFE material used on all liquid contacting surfaces
- Shock-mounted isolation pads provide independent drive end support
- Three-point installation for secure mounting on uneven surfaces
- 2" flanges allow rapid draining

- Drain orientation provides the ability to point drain valves in multiple clocked directions
- 2" vents with check thermowell and pressure verification ports
- Tool-less access to most common serviceable components
- Standard horizontally mounted units
- NACE compliant

PROVER INTERFACE MODULE (PIM) SPECIFICATION

- Low Power (3 Watts nominal from 11 to 26 Volt Power Supply)
- Fully configurable using PC via serial port or local keyboard
- Multi-level Password protection based on user level
- Direct reading for configured volume(s) with timing displayed
- Two status / diagnostic outputs to host flow computer
- Prover cycle counter with programmable limits allows for preventative maintenance planning
- A timer provides accurate elapsed time between optical switches
- Intrinsic safe design
- Compatible with most flow computers
- 1 RS232 serial port
- 1 RS485 serial port

SPECIAL CONDITIONS OF USE FOR HAZARDOUS AREA RATING

CSA/US, ATEX & IECEX PROVERS

- Flameproof joints are not intended to be repaired. For information on the dimensions of the flameproof joints, please contact the original manufacturer.
- The equipment is provided with unwired terminal blocks for field connection to user installed certified Ex d and Ex ia transmitters and sensors. The source is also to be user supplied. The terminal blocks are rated Un = 500 V, In = 32A, for conductors sized 0.2 mm^2 to 4 mm^2. For user connections to intrinsically safe apparatus, wiring and connections must be in accordance with IEC 60079-11, and the system evaluated per IEC 60079-25. All connections and cabling must also be in accordance with IEC 60079-14.
- The PIM shall be installed within an explosionproof enclosure with rating of Type 4X/IP66 and with explosion-proof cable glands and/or conduit sealing fittings with appropriate IP rating.
- The wiring connections to the PIM will be derived and powered from Certified 60950-1 or 61010-1 power supply having maximum 24Vdc output supplied by Flow Management Devices.
- For Rosemount Temperature Transmitter, the LCD cover must be guarded against impact energies of greater than 4 joules.
- User connection to the Prover power, control and analog enclosure(s) shall be made with appropriate explosion-proof cable glands and/or conduit sealing fittings with equivalent IP rating to maintain hazardous area rating shown on name plate.
- User connection at the prover control and analog enclosure must be 20-16awg and one of the following:
    - Armored Cable = ACIC 105°C dry 300V
    - Wire in conduit = AWM Style 1015/1230 105C 600V and/or MTW 90°C dry 600V and/or TEW style 105 600V
- User connection at the prover power enclosure must be 14-10awg VAC / 8-4awg VDC and one of the following:
    - Armored Cable = Teck90 105°C dry 600V
    - Wire in conduit = AWM Style 1015/1230 105C 600V and/or MTW 90°C dry 600V and/or TEW style 105 600V

ATEX & IECEX ONLY PROVERS

- Encoders shall be replaced once they have exceeded their bearing life (1.5 X 10^9 for Model H20). For bearing life of all other models please refer to conditions of certification on certificate IECEx UL 12.0035X.
- To replace the fasteners in SCANCON Encoders, use only fasteners with property class of A*-70 and a yield stress of ≥ 450MPa.
- For control voltage supplies to intrinsically safe associated apparatus, where Um is less than 250V, the source to provide Um = 30V must be from an SELV approved source.

SAFETY NOTES

BEFORE OPERATING THE FMD PROVER PLEASE READ THE USER MANUAL COMPLETELY!

FAILURE TO COMPREHEND THIS MATERIAL MAY RESULT IN PERSONAL INJURY AND DAMAGE TO THE PROVER.

WARRANTY MAY BE VOIDED IF THE INSTRUCTIONS ARE NOT FOLLOWED PROPERLY.

- The Flow MD ™ Prover must be installed with proper orientation for flow direction. Incorrect flow direction may cause damage to the Prover
- Verify that there are no foreign parts such as weld slag, nuts, bolts or any other solid material in the pipeline. Proper strainer installation can eliminate damage to the Prover
- Verify that all the connection and mounting hardware are to appropriate strength and length and are torque to the specification
- Verify that electrical wiring is complete per code. Electrical connection of the FMD Prover is the responsibility of the user
- Verify that the Prover frame is properly connected to the earth ground
- Verify that the covers on explosion-proof enclosures are tight
- Verify that all the drain and ventilation valves are closed, and the connections are tight
- Verify that the instrumentation connection, *especially the pressure connection*, is tight and the instrument valve is closed
- Verify that all drive covers are properly installed and secured
- Verify that system pressure safety valve is installed properly, and is designed for the pressure rating of the line
- Pressurize the system slowly and per code to avoid any shock to the Prover and/or harm to the operators
- Verify that the system is depressurized before opening the vent or drain valves
- Use of this equipment for any use other than its intended purpose may result in product damage or personal injury or death

If any one item from the above list is not clear, please contact Flow Management Devices LLC 602-233-9885

RELEVANT STANDARDS

API - AMERICAN PETROLEUM INSTITUTE

API 4.9.1	Manual of Petroleum Measurement Standards Chapter 4-Proving Systems Section 9- Methods of Calibration for Displacement and Volumetric Tank Provers Part 1- Introduction to the Determination of the Volume of Displacement and Tank Provers
API 11.2.3	Water Calibration of Volumetric Provers
API 12.2.1	Manual of Petroleum Measurement Standards Chapter 12- Calculation of Petroleum Quantities Section 2- Calculation - of Petroleum Quantities using Dynamic Measurement Methods and Volumetric Correction Factors Part 1
API 520 Sections (3.8), Equation (3.9)	Sizing, Selection, and Installation of Pressure-relieving Devices, Part I - Sizing and Selection

ASME - AMERICAN SOCIETY OF MECHANICAL ENGINEERS

B31.3	Process Piping
VIII	ASME Boiler & Pressure Vessel Code, Pressure Vessels
B16.5	Pipe Flanges and Flanged Fittings
B16.20	Metallic Gaskets for Pipe Flanges-Ring-Joint, Spiral-Would, and Jacketed

CSA - CANADIAN STANDARDS ASSOCIATION

CAN/CSA-C22.2 No. 0-M91	General Requirements - Canadian Electrical Code, Part II
CAN/CSA-C22.2 No. 14-05	Industrial Control Equipment
CAN/CSA-C22.2 No. 94-M91	Special Purpose Enclosures
CAN/CSA-C22.2 No. 142-M1987	Process Control Equipment (as a guide)
CAN/CSA-C22.2 No. 157-92	Intrinsically Safe and Non- incentive Equipment for Use in Hazardous Locations

UL - UNDERWRITERS LABORATORIES

UL Standard 508, 17th Ed.	Electric Industrial Control Equipment
UL Standard 698, 13th Ed	Industrial Control Equipment for Use in Hazardous (Classified) Locations
UL Standard 913, 7th Ed.	Intrinsically Safe Apparatus and Associated Apparatus for Us in Class I, II and III, Division 1, Hazardous (Classified) Locations

ATEX – ATMOSPHERES EXPLOSIBLES

EN 60079-0	Electrical apparatus for explosive gas atmospheres – General requirements
EN 60079-1	Electrical apparatus for explosive gas atmospheres – Flameproof enclosures "d"
EN 60079-11	Explosive atmospheres – Equipment protection by intrinsic safety "i"
EN 60079-18	Electrical apparatus for explosive gas atmospheres – Construction, test and marking of type of protection encapsulation “m” electrical apparatus
EN 60079-25	Electrical apparatus for explosive gas atmospheres – Intrinsically safe systems
EN 13463-1	Non-electrical equipment for use in potentially explosive atmospheres – Basic method and requirements

EN 13463-5	Non-electrical equipment for use in potentially explosive atmospheres – Protection by constructional safety “c”
EN 13463-8	Non-electrical equipment for use in potentially explosive atmospheres – Protection by liquid immersion 'k'
EN 1127-1	Explosive atmospheres – explosion prevention and protection
EN 14121-1	Safety of machinery – risk assessment

IECEX – INTERNATIONAL ELECTROMECHANICAL COMMISSION EXPLOSIVE

IEC 60079-0	Electrical apparatus for explosive gas atmospheres – General requirements
IEC 60079-1	Electrical apparatus for explosive gas atmospheres – Flameproof enclosures "d"
IEC 60079-11	Explosive atmospheres – Equipment protection by intrinsic safety "i"
IEC 60079-18	Electrical apparatus for explosive gas atmospheres – Construction, test and marking of type of protection encapsulation “m” electrical apparatus
IEC 60079-25	Electrical apparatus for explosive gas atmospheres – Intrinsically safe systems

ME – MACHINERY DIRECTIVE

EN 12100-2	Safety of Machinery - Basis Concepts, General Principles for Design, Technical Principles and Specifications
EN ISO 14121-1	Safety of Machinery - Risk Assessment
EN 953	Safety of Machinery - General Requirements for Design, and Construction of Guards (Fixed, Movable)
ISO 13852	Safety of Machinery - Safety Distances to Prevent Danger Zones Being Reached by the Upper Limbs
IEC 417	Graphical Symbols for use on Equipment
IEC 60204	Safety of Machinery

OVERVIEW – 000-113846-DOC

000-113846-DOC

PROVER CONFIGURATOR- 000-112821-DOC

000-112821-DOC

WARNINGS-YOUR SAFETY IS VERY IMPORTANT

Electrical Hazard- FMD-XXX contains high voltage and ESD (Electro Static Discharge) sensitive components

- Please follow the National Electric Safety Code during the installation and maintenance.
- Please follow proper Lock and Tag procedures
- Please make sure that the SVP frame is grounded per instruction
- Do not remove the cover from the explosion-proof enclosure without creating a SAFE ZONE
- Please protect the electronic circuits from ESD
- *Any unauthorized modification to electrical wiring will result in loss of electrical classification for hazardous area and void the Product Warranty*

Moving Parts- FMD-XXX contains many moving parts that can cause serious injury and dismemberment

- Do not operate with open enclosures and covers (water draw test will require open cover)
- *Any unauthorized modification to the mechanical parts or improper installation will void the warranty*

INSTALLATION

UNPACKING - 000-113847-DOC

000-113847-DOC

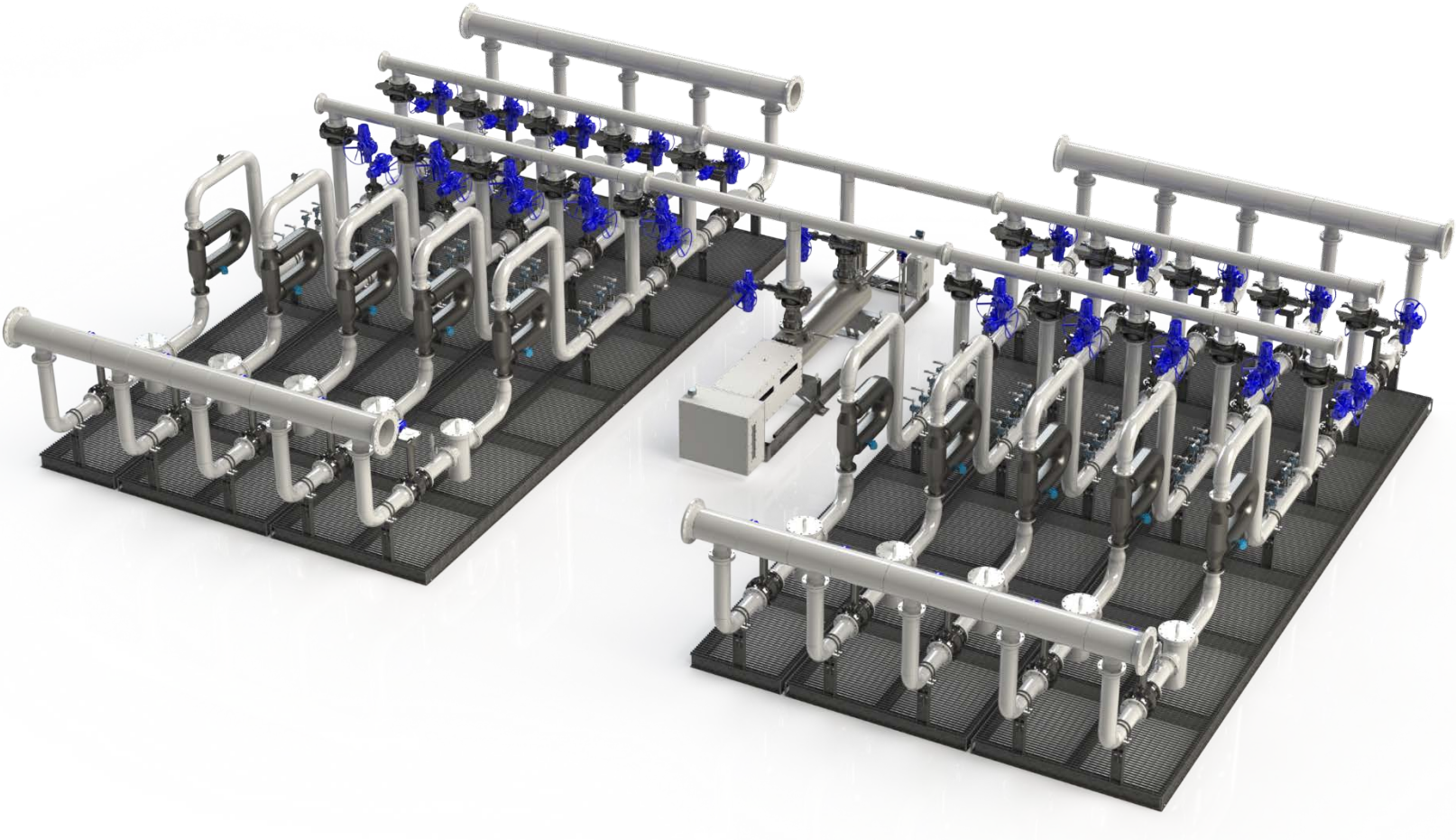
LIFTING – 000-113849-DOC

000-113849-DOC

MOUNTING & INSTALLATION – 000-113850-DOC

000-113850-DOC

Figure 1 Typical Prover Installation



ELECTRICAL

REPLACABLE FUSES:

- Clutch: 12A, 250V, Slow Blow Encapsulated **[Replacement fuse must be supplied by Flow MD]**
- PIM board: 500mA 125VAC/VDC Very Fast Acting, Nano SMF

PROPER GROUND/EARTH CONNECTION IS ESSENTIAL FOR THE FOLLOWING PURPOSES:

- Safety
- Reducing damage due to lightning strike
- Eliminating Static built up
- Protecting circuit insulation from damage due to excessive voltage

NOTE: **IMPROPER GROUNDING / EARTHING MAY CAUSE SERIOUS INJURY TO THE OPERATOR AND MAY VOID THE WARRANTY**

Figure 2 Grounding/Earthing ATEX/IECEX

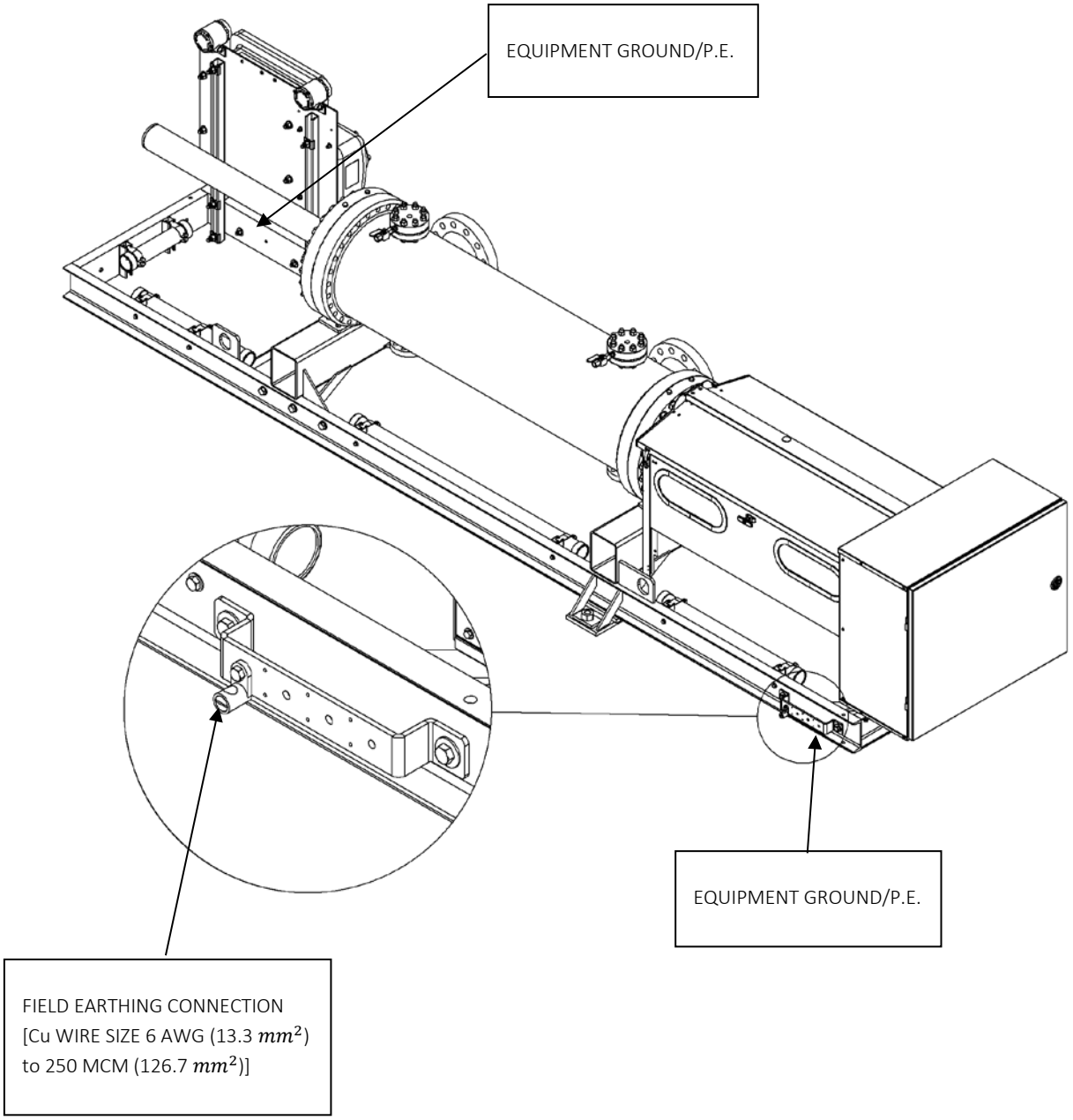
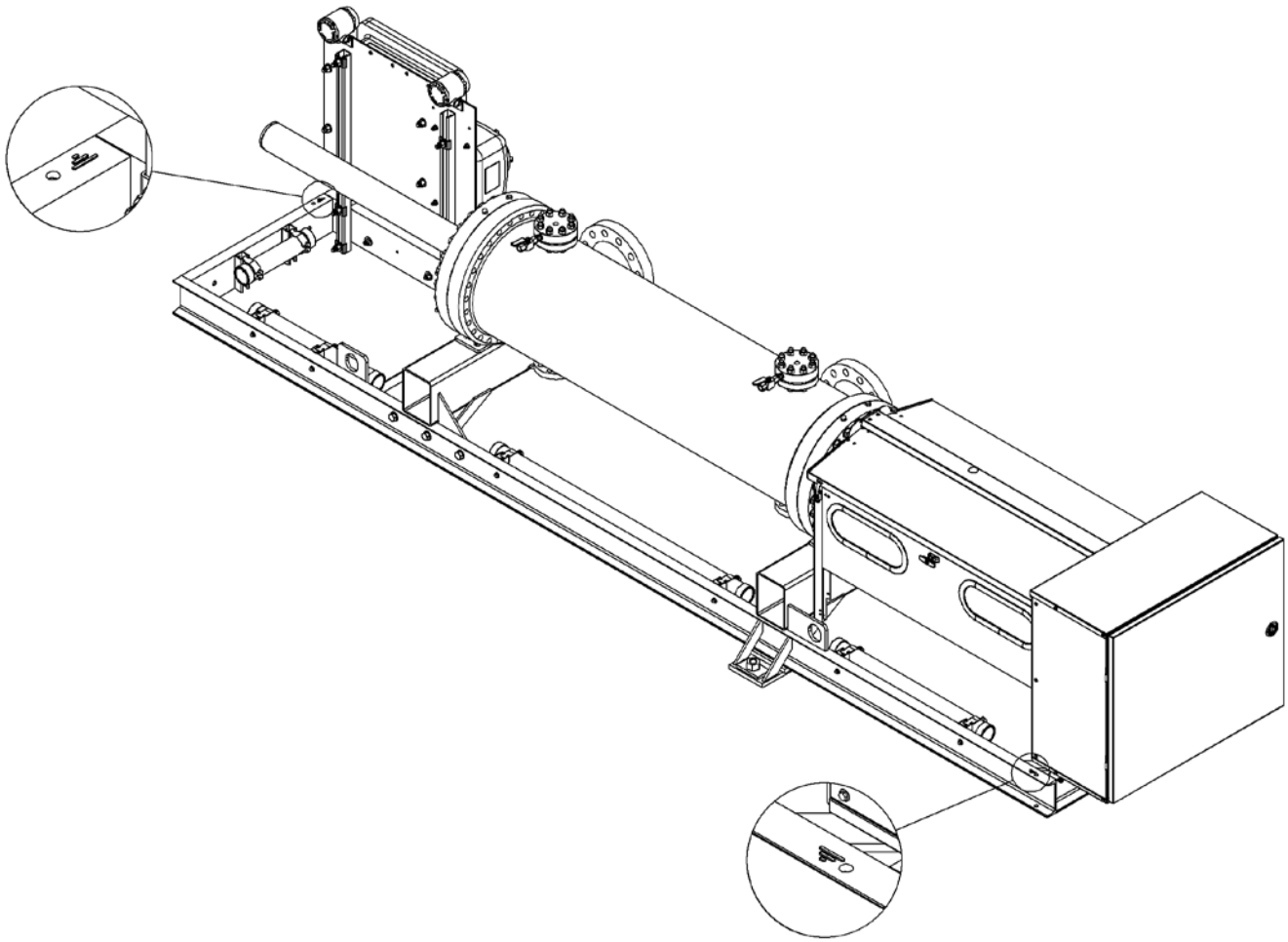


Figure 3 Grounding/Earthing CSA US/CANADA



ENCLOSURE LAYOUT

- The customer connection for electrical power is in an explosion-proof enclosure. For ease of connection the FMD Prover is equipped with three terminal blocks for connection to ground, neutral and power wires. The FMD Prover is also equipped with a circuit breaker for customer convenience.

WARNING – USE PROPER LOCK AND TAG PROCEDURE

Figure 4 Enclosure Layout

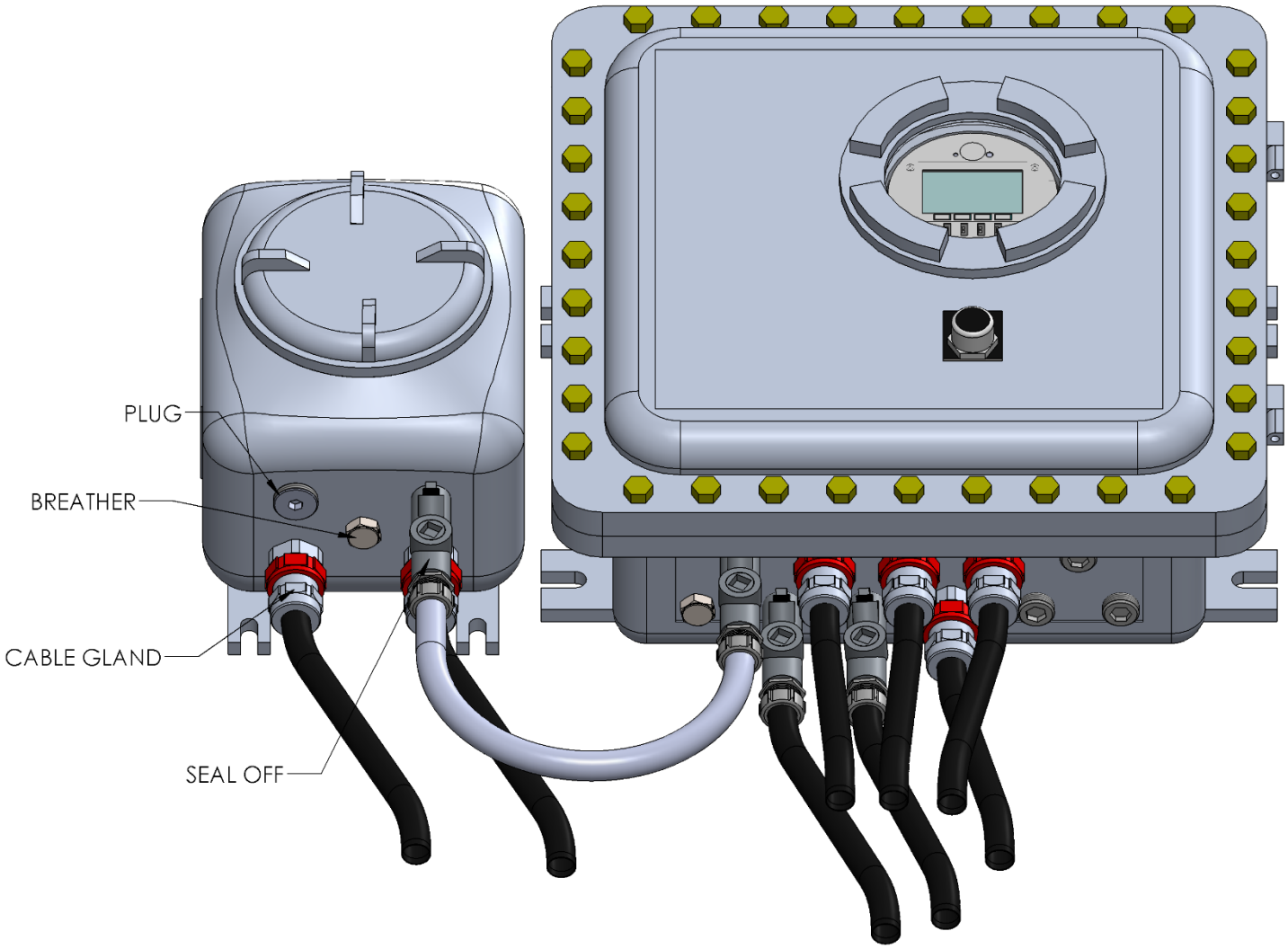
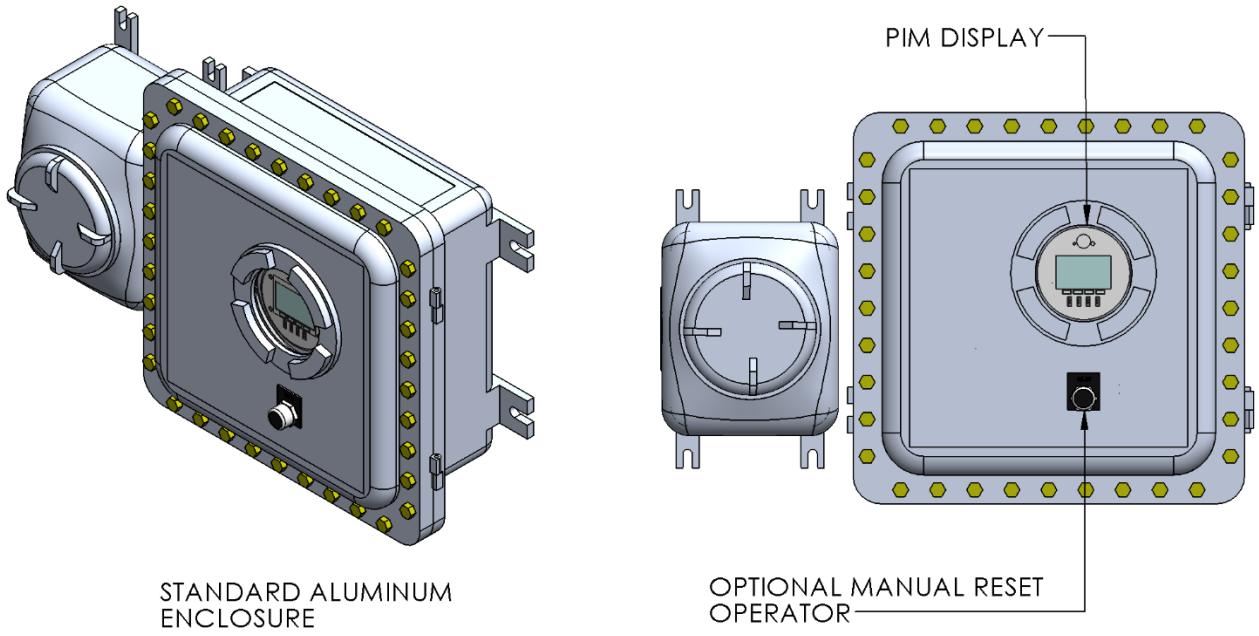


Figure 5 Enclosure Layout



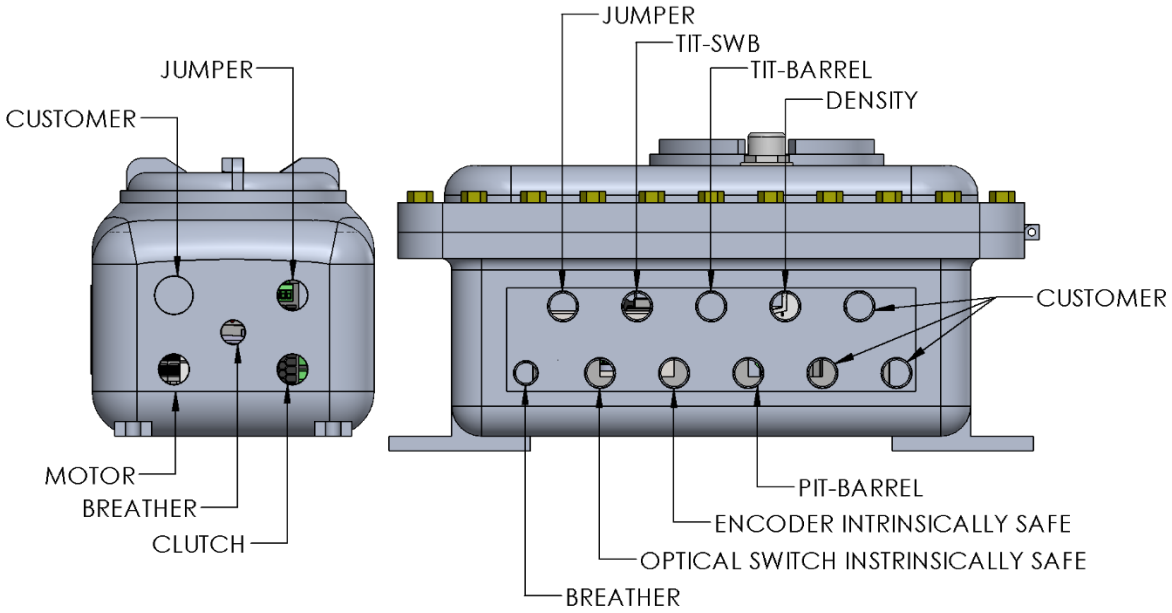
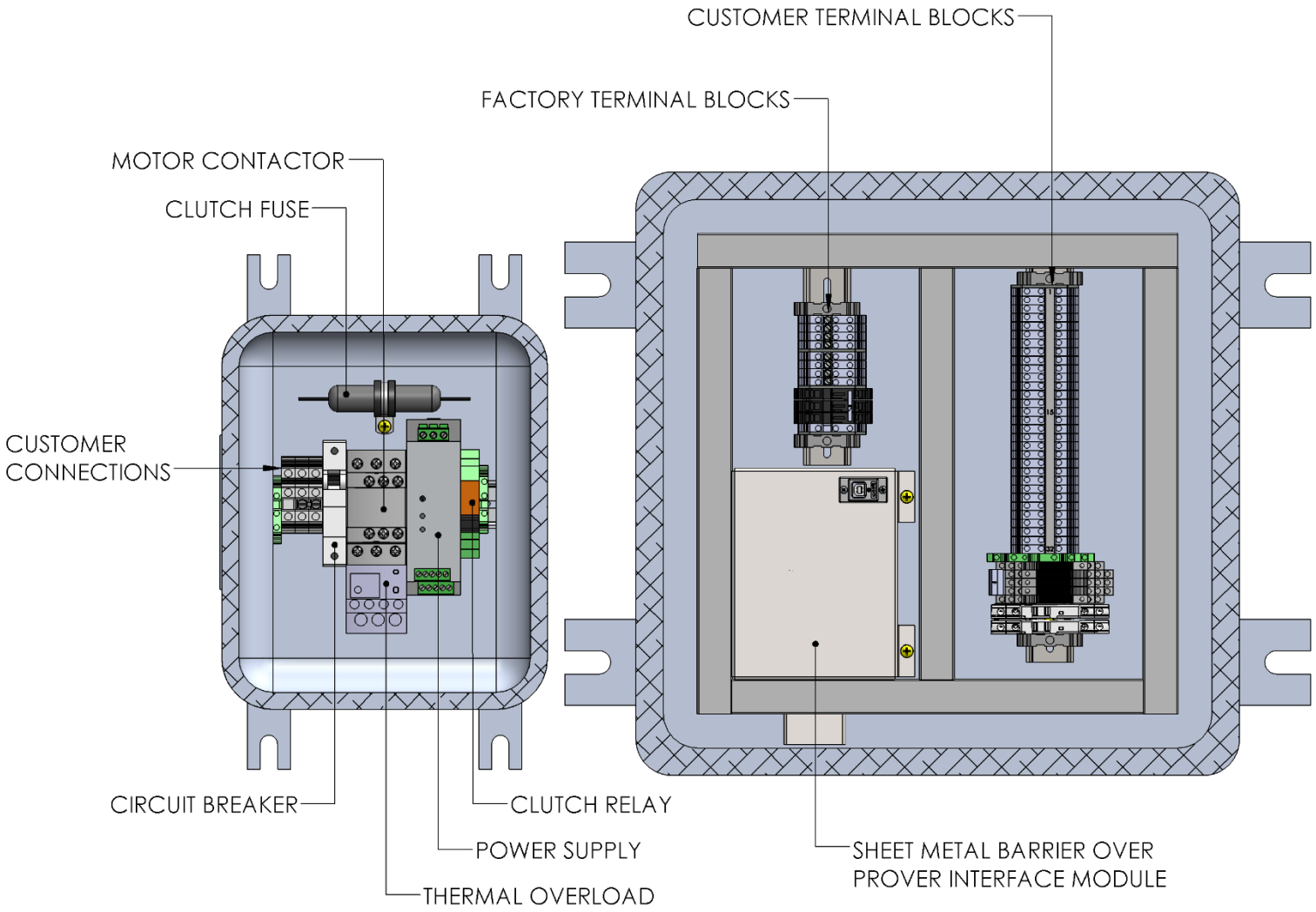


Figure 6 Enclosure Layout



CUSTOMER CONTROL AND ANALOG CONNECTIONS DIAGRAM - 000-112786-DOC

000-112786-DOC

PRESSURE AND TEMPERATURE TRANSMITTER CONNECTIONS DIAGRAM - 000-111418-DOC

000-111418-DOC

DC POWER WIRING DIAGRAM CL 1 DIV 1 – 000-111414-DOC

000-111414-DOC

AC 110-120VAC 1PHASE WIRING DIAGRAM CL 1 DIV 1 – 000-111415-DOC

000-111415-DOC

AC 208-230VAC 1PHASE WIRING DIAGRAM CL 1 DIV 1 – 000-111416-DOC

000-111416-DOC

AC 380-480VAC 3PHASE WIRING DIAGRAM CL 1 DIV 1 – 000-111417-DOC

000-111417-DOC

AC 380-480VAC 3PHASE WIRING DIAGRAM CL 1 DIV 2 – 000-113942-DOC

000-113942-DOC

HYDRAULIC & AC 110-120VAC 1PHASE WIRING DIAGRAM CL 1 DIV 1 – 000-111432-DOC

000-111432-DOC

WIRING DIAGRAM TEMPERATURE & PRESSURE TRANSMITTERS CL 1 DIV 1 – 000-111418-DOC

000-111418-DOC

WIRING DIAGRAM TEMPERATURE & PRESSURE TRANSMITTERS CL 1 DIV 2 – 000-113944-DOC

000-113944-DOC

CONTROL CONNECTION

The flow computer must be connected to the Prover Interface Module (PIM) J21 connector. Please refer to PIM manual for detailed information on PIM connection. Power must be provided from Certified 60950-1 or 61010-1 power supply(s) having maximum 24Vdc output.

INTRINSIC SAFETY INPUT AND OUTPUT PARAMETERS
FOR US/CSA CLASS 1, DIVISION 1, GROUP C & D; ATEX & IECEX EX D MB [IA] IIB T3

UM = 30VDC

VO = 5.88VDC

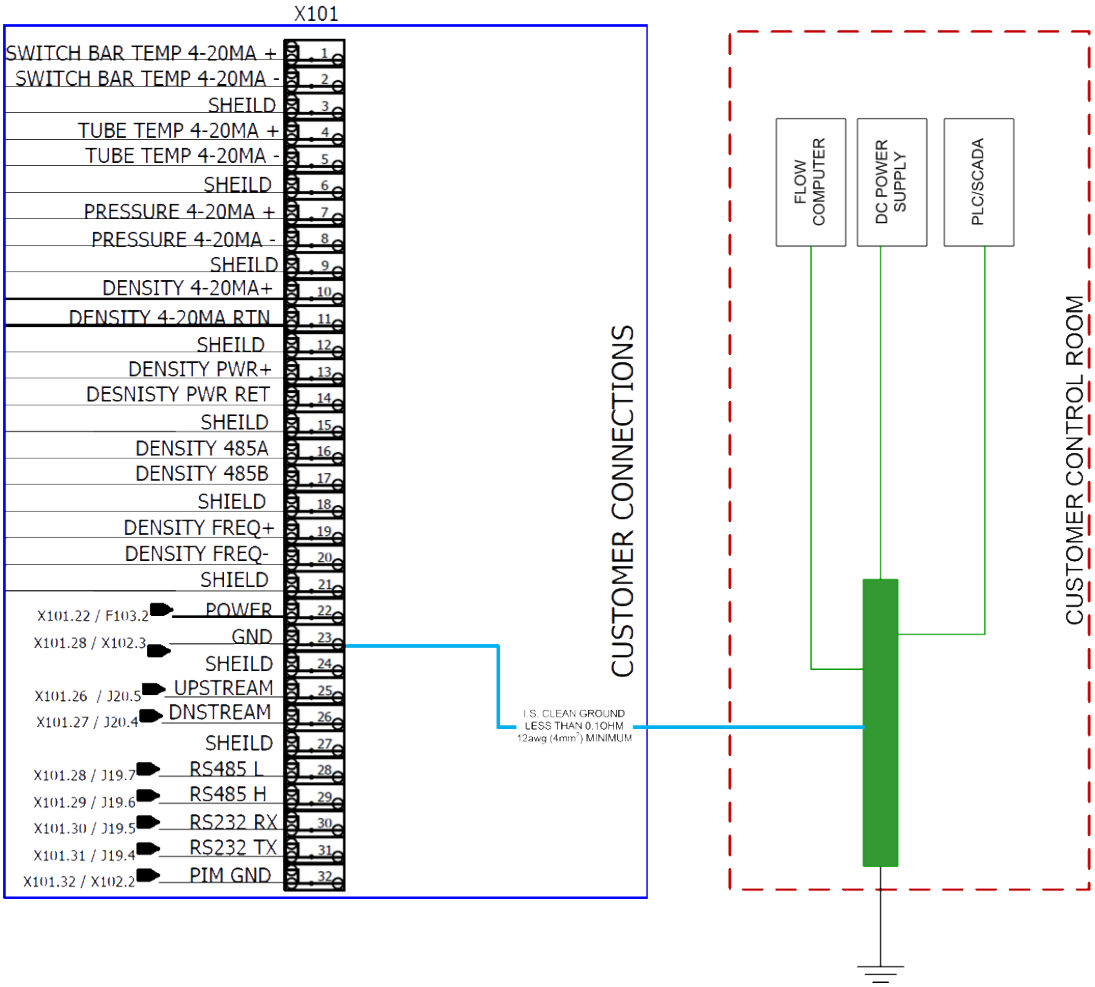
IO = 412.6MA

PO = 0.6065W

CO = 43µF

LO = 208.85µH

Figure 7 Proper Intrinsic Safety Ground
Note: IS output to switches and resistive loads only



OPERATIONS

SAFETY CHECK PRIOR TO OPERATING THE FMD-PROVER

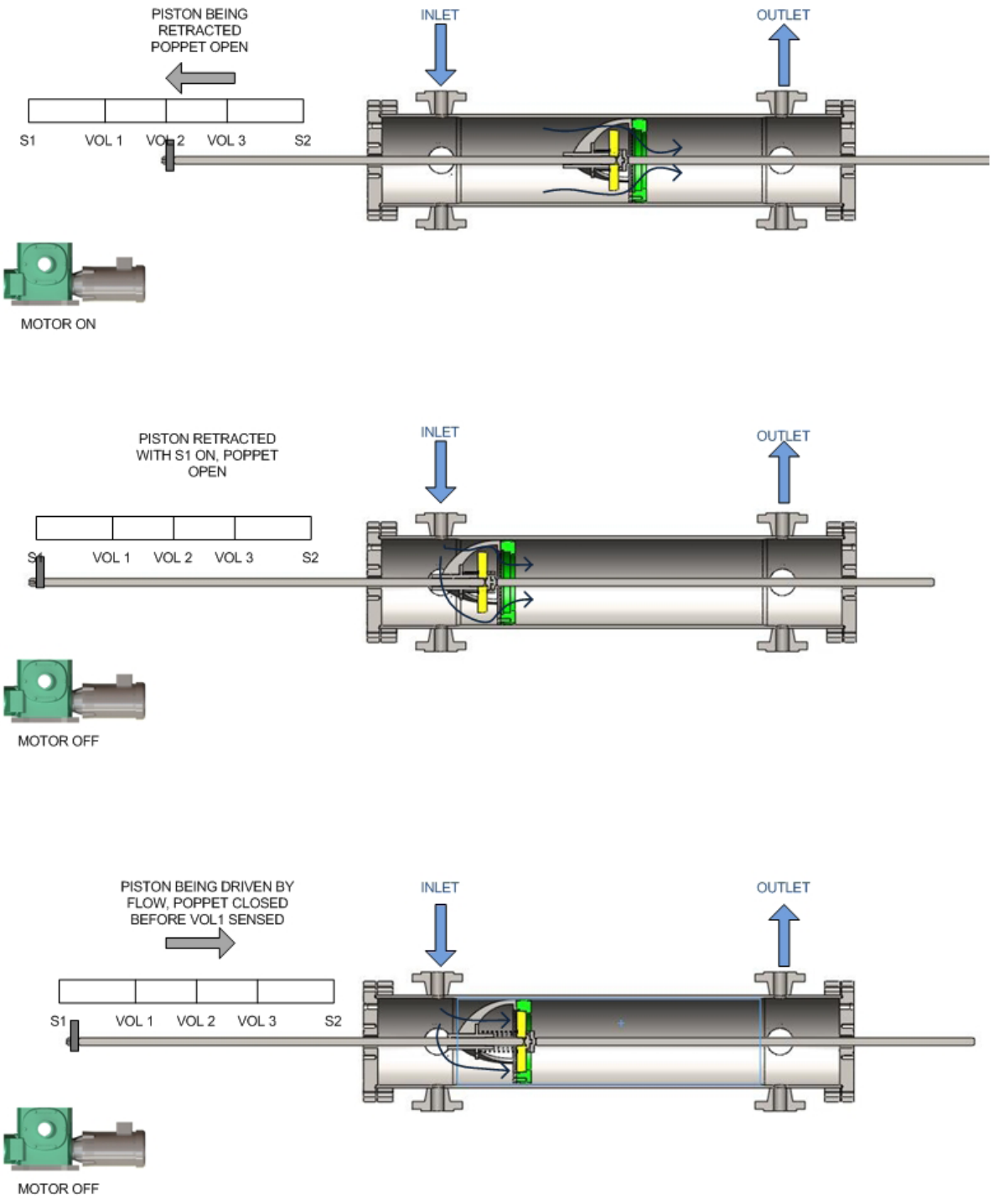
1-THE EXPLOSION PROOF ENCLOSURE ARE COVERED PROPERLY

2-THE DRIVE TRAIN COVERS IS SECURED AND THERE IS NO ACCESS TO THE MOVING COMPONENTS

The following is the step by step process and procedure for operating the FMD-XXX Small Volume Prover:

- The power is turned on, and the unit is in stand-by mode, the piston and shuttle assemblies are at downstream position and stationary.
- The Launch command is generated from Host Flow computer to the PIM (Prover Interface Module).
- PIM will send a signal to the motor relay to turn the motor on and a signal to the BC (brake/clutch) relay to turn the clutch on.
- The clutch will transfer the energy from the motor via pulleys and belt to the Shuttle assembly.
- The shuttle assembly is connected to the upstream shaft, and the upstream shaft is connected to the piston; therefore, the piston will start moving to the upstream position. The poppet is in open condition at this point, and no data is being taken or sent to the host.
- The shuttle assembly will travel to the upstream position, and the flag that is located on the top of the shuttle will trigger the furthest upstream optical switch (S1).
- The S1 optical switch will send a signal to the PIM, and the PIM will send a signal to the DC relay to turn off the clutch. At this point, the motor will continue running depending on programmed time. (please refer to PIM manual to program the motor shut down delay time).
- As soon as the clutch is turned off, the poppet valve will close, and the shuttle assembly will start traveling downstream at the rate of the liquid flow in the Prover. The Flag on top of the shuttle will trigger the Vol1, Vol2, and Vol3 switches in that order sending a signal to the PIM. (S2 switch is optional and not used at this time).
- The PIM will send the signal from the volume switch to the flow computer and will display the time between the optical switches on the display and record the information in the PIM memory.
- At this point the piston and shuttle assemblies are at the downstream position with the poppet open and are waiting for another launch command from host flow computer and repeat of the process.

Figure 8 Operation Flow Diagrams

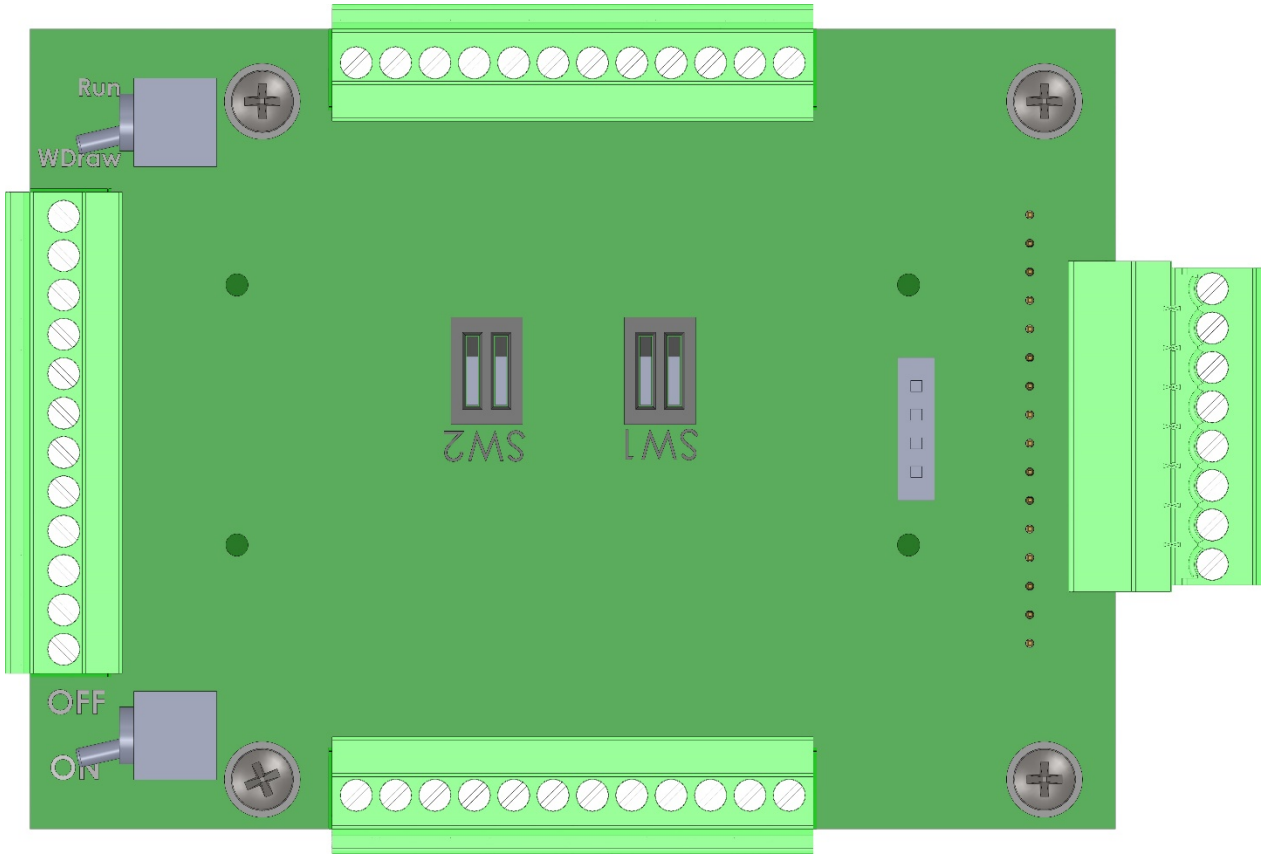


WATER DRAW CALIBRATION

The Flow MD™ Provers are calibrated at the factory using the Gravimetric method and per API MPMS chapter 4.3.7.1, 11.2.3, 12.2.1, 12.2.4, 4.9.2 and 4.9.4.

Recalibration is recommended at one-year intervals, or as determined by the authorities and parties responsible for the measurement. Recalibration is also required after any maintenance that may affect the base volume. For example, a complete switch bar replacement.

The FMD Prover Interface Module has a built-in water draw circuit, and it can be switch between Proving mode and Water Draw mode by enabling the water draw selection from the on board switch.



REFERENCE DOCUMENTS AND EQUIPMENT:

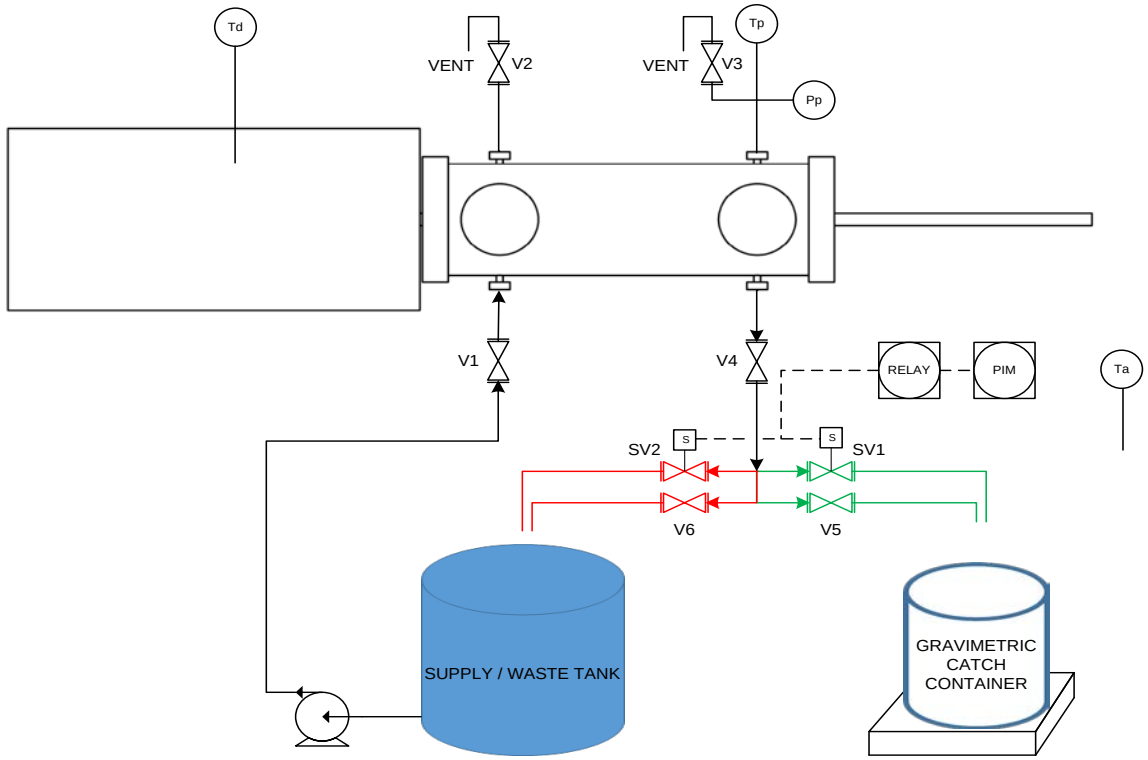
API Manual of Petroleum Measurement Standards (MPMS) Chapter 4 – Proving Systems sec 4.8, and the MPMS Chapters 4.3.7.1, 11.2.3, 12.2.1, and 12.2.4 – pertaining to the calculation for the volume of Provers using API 4.9.4 for Gravimetric water draw

- De-ionized or distilled water should be utilized for the gravimetric method. API 11.2.3.5, the water supply must have steady, non-pulsating pressure
- Precision Scale and weights-NIST traceable
- A de-ionized water source with conductivity requirement per API 4.9.4
- Water draw kit - Contact Factory www.flowmd.com
- Certified high-resolution pressure gauge: 0-100 psig
- Three traceable thermometers with 0.2 degree graduations
- Seraphin Prover can conform to API chapter 4 section 7 and NIST traceable

GRAVIMETRIC WATER DRAW

The gravimetric calibration method is done per FMD Procedure 000-100663-DOC which conforms to API 4.9.4. The water displaced by the Prover is dispensed into a container on a weight scale, see Figure 9

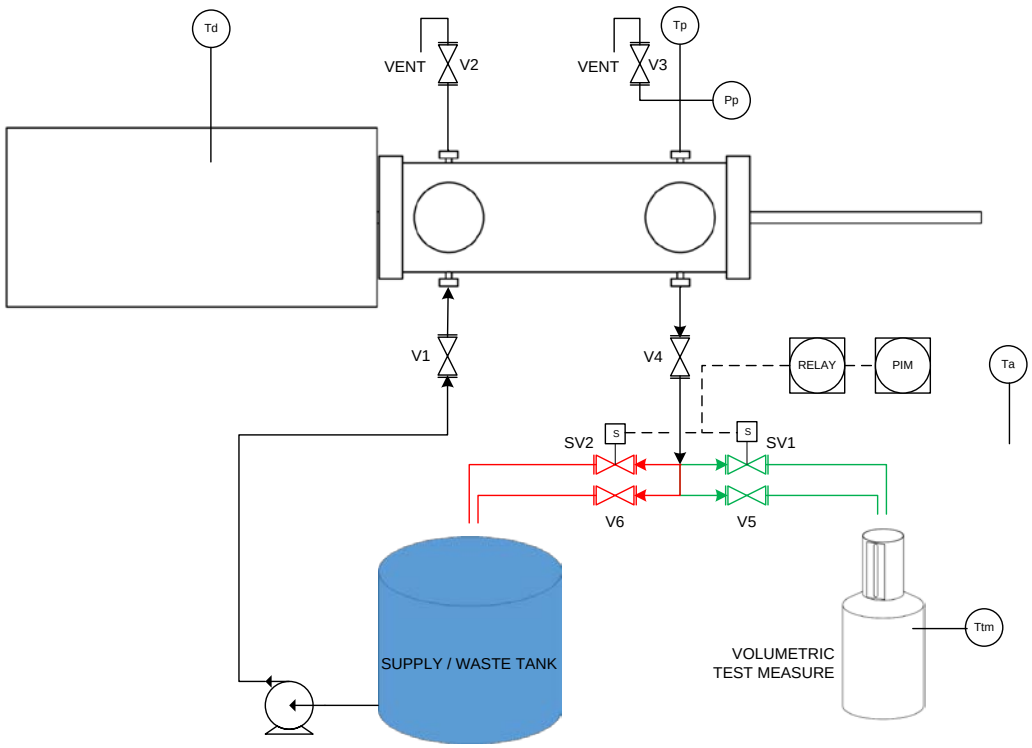
Figure 9 Typical gravimetric water draw



VOLUMETRIC WATER DRAW

The volumetric calibration method per API 4.9.2. The water displaced by the Prover is dispensed into a calibrated test measure, see Figure 10

Figure 10 Typical volumetric water draw setup



MAINTENANCE

ONLY QUALIFIED AND TRAINED PERSONNEL ARE AUTHORIZED TO PERFORM MAINTENANCE ON FMD PROVERS.

PREVENTATIVE MAINTENANCE

- Preventative maintenance is a schedule of planned maintenance actions aimed at the prevention of breakdowns and failures at an undesirable time. The primary goal of preventive maintenance on the FMD Prover is to help prolong the life of the mechanical parts and to ensure accurate and reliable operation.
- Flow Management Devices highly recommends that each user establish their own preventive maintenance schedule based on usage, products, temperatures, pressure, etc.

- Flow MD's Prover Interface Module is a powerful tool for maintenance professionals. The multi-level password protected cycle counter will keep track of the number of strokes and can be programmed for a variety of preventive maintenance functions. Please refer to PIM manual for detail information.

PISTON SEAL LEAK TEST

003-007 LEAK TEST 000-113452-DOC

000-113452-DOC

015-090 LEAK TEST 000-113161-DOC

000-113161-DOC

130-245 LEAK TEST 000-109343-DOC

000-109343-DOC

PLEASE USE DOCUMENT(S) LISTED ABOVE FOR LEAK DETECTOR MAINTENANCE INSTRUCTIONS.

SEAL REPLACEMENT

WARNING
MAKE SURE THE POWER IS TURNED OFF AND PROPER LOCK AND TAG PROCEDURE HAS BEEN FOLLOWED

- Note:
    a. ANTI-SEIZE lubricant must be applied to following bolts:
        i. Seal retainer bolts
        ii. End flange bolts
        iii. Instrument drain and vent flange studs/bolts/nuts
    b. Apply Loctite 242 to all standard hardware
    c. Apply pipe tape or liquid thread sealant to any tapered thread fittings
    d. All hardware must be torque per ASTM 307 see Figure 11
    e. Follow proper torque pattern see Figure 12

PISTON SEAL REPLACEMENT - 000-113912-DOC

000-113912-DOC

SHAFT SEAL REPLACEMENT – 000-113925-DOC

000-113925-DOC

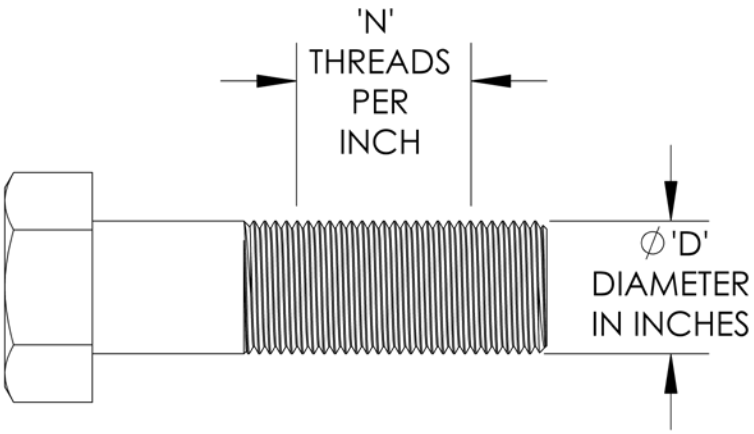
HARDWARE REQUIREMENTS

DETERMINING SCREW/BOLT TYPE

Hardware location on prover	Hardware Type	Color	Lubricant
Seal retainer	SST 18-8/304/316	Natural stainless silver 	Anti-Seize
End flange	Grade 8	Gold Cadmium or Blue PTFE coated 	Anti-Seize
	L7	Green PTFE coating 	
	B7		
ANSI B16.5 Flange Studs	B7	Silver Zinc or Blue PTFE 	None
End flange mounting plate	Grade 8	Gold Cadmium 	Loctite 242
	SST 18-8/304/316	Natural stainless silver 	
Piston support and shaft bolts	SST 18-8/304/316	Natural stainless silver 	Loctite 242

DETERMINING SCREW/BOLT SIZE

D - N
EXAMPLE: 7/8"-14



TORQUE VALUES AND SEQUENCE

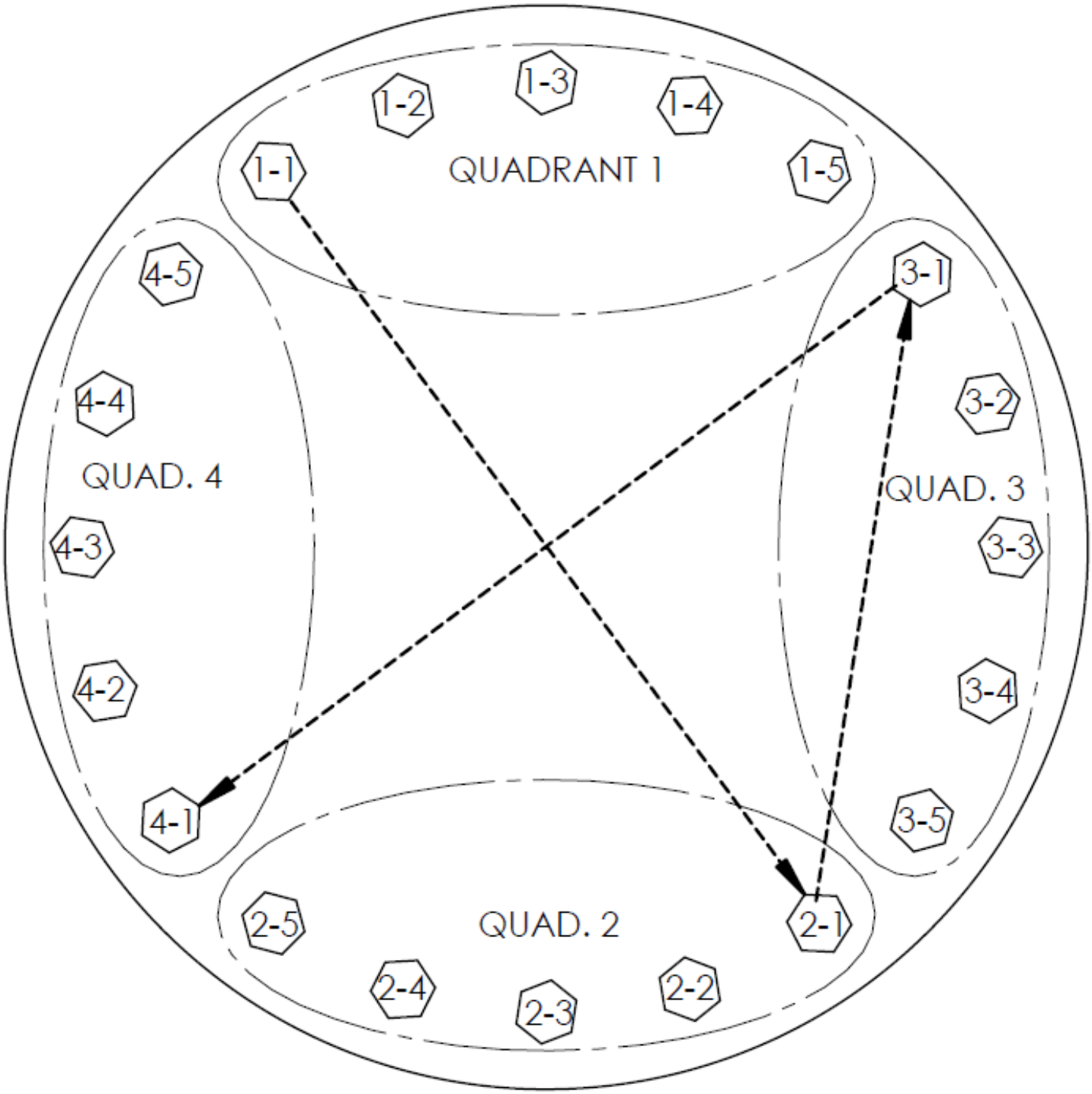
Figure 11 - Torque Table

		SST 18-8 OR 316 NO MARKING		ASTM A193 GRADE B7 ASTM A320 GRADE L7		ASTM A193 316 SST GRADE B8M CL1		ASTM A193 316 SST GRADE B8M CL2		ASTM A193 GRADE 5			ASTM A354 GRADE BD GRADE 8			
Diameter	THREAD PITCH	PLAIN	LUBED	PLAIN	LUBED	PLAIN	LUBED	PLAIN	LUBED	PLAIN	ZINC	LUBED	PLAIN	ZINC	LUBED	TOLERANCE
		FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	% +/-
1/4	20	**4**	**2**	**14**	**9**	**4**	**2**	**13**	**8**	**13**	**8**	**8**	**18**	**12**	**11**	**10**
1/4	28	**5**	**3**	**16**	**10**	**5**	**3**	**15**	**9**	**14**	**10**	**9**	**20**	**13**	**12**	**10**
5/16	18	**8**	**5**	**29**	**18**	**8**	**5**	**27**	**16**	**26**	**17**	**15**	**36**	**24**	**22**	**10**
5/16	24	**9**	**6**	**33**	**20**	**9**	**6**	**30**	**18**	**29**	**19**	**17**	**40**	**27**	**24**	**10**
3/8	16	**15**	**9**	**52**	**31**	**15**	**9**	**47**	**28**	**46**	**31**	**27**	**65**	**43**	**39**	**10**
3/8	24	**17**	**10**	**59**	**36**	**17**	**10**	**54**	**32**	**52**	**35**	**31**	**73**	**49**	**44**	**10**
7/16	14	**24**	**14**	**84**	**50**	**24**	**14**	**76**	**45**	**73**	**49**	**44**	**103**	**69**	**62**	**10**
7/16	24	**28**	**17**	**97**	**58**	**28**	**17**	**88**	**53**	**85**	**57**	**51**	**120**	**80**	**72**	**10**
1/2	13	**36**	**22**	**128**	**77**	**36**	**22**	**115**	**69**	**112**	**74**	**67**	**158**	**105**	**95**	**10**
1/2	20	**41**	**25**	**144**	**86**	**41**	**25**	**130**	**78**	**126**	**84**	**76**	**178**	**119**	**107**	**10**
9/16	12	**53**	**32**	**184**	**110**	**53**	**32**	**166**	**100**	**161**	**107**	**97**	**228**	**152**	**137**	**7**
9/16	18	**59**	**35**	**205**	**123**	**59**	**35**	**186**	**111**	**180**	**120**	**108**	**254**	**169**	**152**	**7**
5/8	11	**73**	**44**	**254**	**152**	**73**	**44**	**230**	**138**	**222**	**148**	**133**	**314**	**210**	**189**	**7**
5/8	18	**82**	**49**	**287**	**172**	**82**	**49**	**260**	**156**	**252**	**168**	**151**	**356**	**237**	**214**	**7**
3/4	10	**129**	**77**	**451**	**270**	**129**	**77**	**408**	**245**	**395**	**263**	**237**	**558**	**372**	**335**	**7**
3/4	16	**144**	**86**	**503**	**302**	**144**	**86**	**455**	**273**	**440**	**294**	**264**	**622**	**415**	**373**	**7**
7/8	9	**207**	**124**	**726**	**436**	**207**	**124**	**553**	**332**	**636**	**424**	**382**	**899**	**599**	**539**	**7**
7/8	14	**229**	**137**	**801**	**481**	**229**	**137**	**610**	**366**	**702**	**468**	**421**	**992**	**661**	**595**	**7**



		SST 18-8 OR 316 NO MARKING		ASTM A193 GRADE B7 ASTM A320 GRADE L7		ASTM A193 316 SST GRADE B8M CL1		ASTM A193 316 SST GRADE B8M CL2		ASTM A193 GRADE 5			ASTM A354 GRADE BD GRADE 8			
Diameter	THREAD PITCH	PLAIN	LUBED	PLAIN	LUBED	PLAIN	LUBED	PLAIN	LUBED	PLAIN	ZINC	LUBED	PLAIN	ZINC	LUBED	TOLERANCE
		FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	FT LBS	% +/-
1	8	**311**	**187**	**1089**	**653**	**311**	**187**	**829**	**498**	**954**	**636**	**572**	**1348**	**899**	**809**	**5**
1	12	**340**	**204**	**1192**	**715**	**340**	**204**	**908**	**545**	**1044**	**696**	**626**	**1475**	**984**	**885**	**5**
1	14	**349**	**209**	**1222**	**733**	**349**	**209**	**931**	**559**	**1071**	**714**	**642**	**1513**	**1009**	**908**	**5**
1 1/8	7	**441**	**265**	**1543**	**926**	**441**	**265**	**955**	**573**	**1352**	**901**	**811**	**1911**	**1274**	**1146**	**5**
1 1/8	12	**494**	**297**	**1730**	**1038**	**494**	**297**	**1071**	**643**	**1516**	**1011**	**910**	**2142**	**1428**	**1285**	**5**
1 1/4	7	**622**	**373**	**2177**	**1306**	**622**	**373**	**1348**	**809**	**1907**	**1272**	**1144**	**2695**	**1797**	**1617**	**5**
1 1/4	12	**689**	**413**	**2410**	**1446**	**689**	**413**	**1492**	**895**	**2112**	**1408**	**1267**	**2984**	**1989**	**1790**	**5**
1 3/8	6	**815**	**489**	**2854**	**1712**	**815**	**489**	**1359**	**815**	**2500**	**1667**	**1500**	**3533**	**2356**	**2120**	**5**
1 3/8	12	**928**	**557**	**3249**	**1949**	**928**	**557**	**1547**	**928**	**2847**	**1898**	**1708**	**4022**	**2681**	**2413**	**5**
1 1/2	6	**1082**	**649**	**3788**	**2273**	**1082**	**649**	**1804**	**1082**	**3319**	**2213**	**1991**	**4690**	**3127**	**2814**	**5**
1 1/2	12	**1218**	**731**	**4262**	**2557**	**1218**	**731**	**2030**	**1218**	**3734**	**2490**	**2241**	**5277**	**3518**	**3166**	**5**
1 5/8	8	**1481**	**888**	**5183**	**3110**	**1481**	**888**	**2468**	**1481**	**4541**	**3027**	**2725**	**6417**	**4278**	**3850**	**3**
1 3/4	8	**1871**	**1123**	**6548**	**3929**	**1871**	**1123**	**3118**	**1871**	**5738**	**3825**	**3443**	**8107**	**5405**	**4864**	**3**
2	8	**2845**	**1707**	**9958**	**5975**	**2845**	**1707**	**4742**	**2845**	**8725**	**5817**	**5235**	**12329**	**8220**	**7398**	**3**
2 1/4	4.5	**3752**	**2251**	**13132**	**7879**	**3752**	**2251**	**6253**	**3752**	**11506**	**7671**	**6904**	**16259**	**10839**	**9755**	**3**

Figure 12 Bolt torque sequence



BELT PREVENTATIVE MAINTENANCE

An effective preventative maintenance program consisting of a safe working environment, proper belt drive installation and inspection, and regular performance evaluations will continue to keep costs down and your FMD Prover operational. The following factors will reduce the life of you belts.

- Improper belt or pulley installation
- Environmental factors
- Improper drive maintenance
- Improper belt storage or handling
- Defective drive components

CLUTCH & DRIVE BELT REPLACEMENT PROCEDURE – 000-113442-DOC

000-113442-DOC

WARNING
MAKE SURE THE POWER IS TURNED OFF AND PROPER LOCK AND TAG PROCEDURE HAS BEEN FOLLOWED

CLUTCH MAINTENANCE

- The Clutch / Brake require very little maintenance.

Please contact factory if there are any problems with the clutch.

- Flushing the clutch should be done with a degreaser that leaves no residue on the clutch plates such as brake cleaner.

WARNING
DO NOT ADD OIL TO THE CLUTCH, OVERFILLING THE CLUTCH WITH OIL OR INCORRECT OIL WILL RESULT IN CLUTCH FAILURE.

TROUBLESHOOTING

GENERAL TROUBLESHOOTING CHART

Problem	Process	Action	Probability
Prover does not Launch	1. Verify that there is AC voltage on terminal blocks from customer connection	A. If not, turn on the circuit breaker or plug in the AC cord. B. Check for loose connection	Very High
	2. Verify that the circuit breaker located in the explosion proof housing is on "ON" position	A. If not turn on the circuit breaker to "ON" position	Very High
	3. Verify that the LED indicators are illuminated on the motor and BC (brake/Clutch) relays and power supply	A. Check wiring B. Replace defective relay C. Replace power supply	Very High
	4. Verify that the power switch is turned to the "ON" position on the PIM and the power indicator is illuminated on the PIM	A. Check wiring B. Replace defective relay C. Replace power supply	High
	5. Verify that the motor is running when Launch command is generated	A. Turn on the power switch B. Check the power source C. Check the wiring to J21 D. Replace PIM	High
	6. Verify that the clutch is running when the Launch command is generated	A. Check the wiring on the motor B. Replace motor	Low
	7. Verify that all drive belts are properly tensioned and turning	A. Check the wiring on S1 and mechanical switch B. Check wiring in the electrical box C. Check for the proper voltage and signal levels on DC relay D. Check the wiring in the BC junction box E. Check for proper oil level ** High oil level or wrong oil can cause the clutch to slip F. Replace clutch	Low
	8. Consult Factory	A. Check the belt B. Check the pulley and tighten the setscrews C. Check for the locking keys in the pulley	Low

Prover will launch and stop at upstream position and after 30 seconds the motor stops (PIM will Display Motor/Clutch error)	1. Verify that the stop switches are properly installed and functioning	A. A-Check the mechanical stop switch B. B-Check the Optical Stop Switch C. C-Check the wiring D. D-Check the connection from optical switch harness to cable E. E-Check the cable connection to the PIM	High
	2. Verify the power is being supplied to the switches	A. Check the PIM wiring B. Check the voltage level on PIM connector J20 Pin 8	
	3. Verify that the clutch relay is functioning properly	A. Check for loose connection	
	4. Call factory for service		
PIM is displaying "V# Sequence Error"	1. Verify that V# (optical switch for Volume 1,2 or 3) optical switches are installed properly	B. Check for loose connection C. Check the wiring on the PIM D. Replace optical switch	Low

BELT & SPROCKET TROUBLESHOOTING CHART

1. Unusual noise	A. Misaligned drive B. Belt tension too high C. Belt is riding on the sprocket flange D. Liquid or foreign objects on the belt
2. Tension loss	A. Tooth wear
3. Excessive belt edge wear	A. Misalignment
4. Tensile break	A. Belt tension too high
5. Tooth wear	A. Misaligned drive B. Tension too high C. Damaged or corroded sprocket
6. Tooth shear	A. Low belt tension B. Misalignment
7. Land area worn	A. Incorrect sprocket B. Misalignment
8. Flange failure	A. Misalignment
9. Unusual wear	A. Misalignment B. High or low tension

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Preventative Maintenance Log

Date	Cycle Count	Item Serviced	Problem Found, If any	Action Taken	Performed By