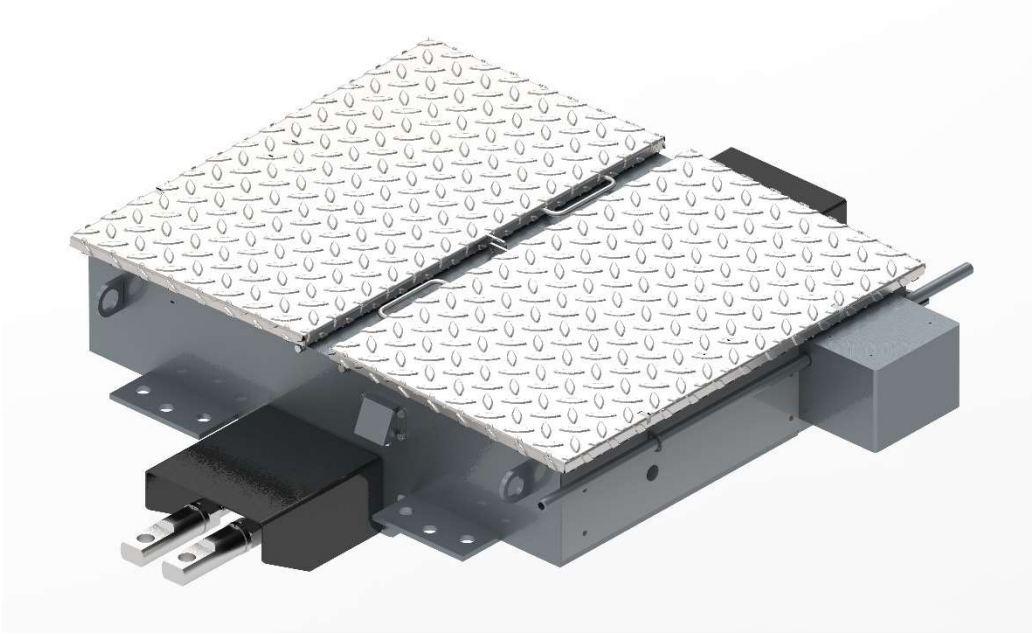
Electric Hydraulic Switch Machine Model ML-18C



Installation & Operation Manual

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FOR QUESTIONS AND INQUIRIES, CONTACT
ADVANCED RAIL SYSTEMS AT +1 254 252-3005
OR
ADVANCED RAIL SYSTEMS
418 HWY 164
RIESEL, TX 76682

WWW.ADVANCEDRAILSYSTEMS.COM

REVISION LOG

REVISION	DATE	DESCRIPTION	BY
-	SEP 2021	ORIGINAL ISSUE	DSR
A	OCT 2021	Add Fail safe inductive sensors option – rated SIL 2; pages 2,3,13 and 17.	DSR

This manual is intended to provide the necessary information to install and ensure the proper operation and maintenance procedures for the Model ML-18C Electric Hydraulic Switch Machine.

The information in this manual is arranged into sections as described below:

SECTION 1 – GENERAL INFORMATION

This section provides general information on the ML-18C switch machine components and safety considerations.

SECTION 2 – OPERATION

This section provides general information on the operation and safety precautions.

SECTION 3 – INSTALLATION

This section provides proper field installation steps and setup.

SECTION 4 – TROUBLESHOOTING

This section describes possible failures and symptoms along with corrective actions.

SECTION 5 – SCHEDULE MAINTENANCE

This section describes the periodic preventive maintenance procedures to maximize service life and ensure continued safe operation.

ATTENTION STATEMENTS

There are three methods used to highlight special attention notations to the reader.
These notations are warnings, cautions and notes.

WARNING

A warning is the most important notation to read. It is used to tell to the reader that special attention should be paid to the information following the attention statement.
If the advice or instructions are not followed, the results could be either serious harm or death.

Example: **WARNING**

DISABLE THE REMOTE SWITCH COMMAND OR DISCONNECT THE POWER SOURCE BEFORE WORKING ON THE SWITCH MACHINE. UNEXPECTED SWITCH OPERATION COULD CAUSE INJURY BY MOVING PARTS & SPRINGS, ELECTRICAL SHOCK OR MOVING SWITCH POINTS.

CAUTION

A caution statement is used when an operating, maintenance procedure or condition, which if not adhered to, **could result in damage to the equipment**.

Example: **CAUTION**

ALWAYS USE THE MANUFACTURER'S SPECIFIED HYDRAULIC OIL. USING OTHER FLUIDS MAY CAUSE FAILURE OR DAMAGE TO THE HYDRAULIC SYSTEM SEALS, PUMP AND VALVES.

NOTE

A note is normally used to provide background detail or additional information.

Example: **NOTE**

THE SOLAR PANEL ASSEMBLY ANGLE MUST BE EQUAL TO THE EARTH LATITUDE DEGREE AT THE INSTALLATION LOCATION FACING THE EQUATOR FOR OPTIMUM PERFORMANCE.

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1 SECTION 1 – GENERAL INFORMATION

1.1 Introduction

This service manual provides information on the ML-18C electric hydraulic switch machine. The information in this manual should not be used for any other equipment or application.

1.2 Description

The ML-18C is an electrically controlled switch machine, which incorporates a unique hydraulic actuation and spring holding force design for a smooth operation with any size of switch point.

It can be used as a direct replacement for any switch machine for mainline or yard applications.

The ML-18C electric hydraulic machine consists of a hydraulic power unit, manifold, double rod cylinders, two springs, a battery and four proximity sensors to monitor the spring holding force and to detect the switch connecting rods position.

All components are located in a steel low profile housing.

The cylinders double rod extends outside of the switch machine housing allowing it to be installed at any side of the rail.

The connecting rod ends not used are protected by a cover bolted to the housing.

The direct drive design allows the switch machine to be connected to the point rods directly without any special linkage to reach under the rail.

All pivot or rotation points have sealed bearings requiring no maintenance.

The dual springs, for redundant holding force, will keep the points closed if the stock rail moves under load and they will always complete the switch movement from one position to another during normal operation or a run through.

If one or both connecting rods are broken or disconnected the springs will be able to move the target away from the sensor to immediately indicate out of correspondence. See Figure 3.18.

The spring holding force is setup at the factory and is serviceable in the field.

The machine also incorporates automatic cylinder centering devices to be used during installation or maintenance. This safely locks the cylinders in center position to eliminate any unexpected movement while making adjustments.

The ML-18C is trail-able, permitting train passage up to 40 mph without damage.

CAUTION: The run through of the switch is not a standard practice. Constantly running through the switch will reduce the hydraulic seal life and cause premature wear of components.

The ML-18C can move the points from one position to another in 2.5 seconds (average) considering a 4-3/4" throw distance.

The ML-18C machine can be hand operated during installation, maintenance or emergency by inserting a removable manual pump handle and selecting the direction to move the switch point.

The machine is completely wired at the factory with the internal wiring connected to the main switch terminal board.

A typical wiring diagram is supplied showing how external connections are to be made for a particular application.

The 12VDC operation voltage allows the use of modern automated control systems and solar charger for remote locations.

The proximity sensors were designed to provide +12VDC and -12VDC to the switch control unit while monitoring the spring holding force or by indicating out of correspondence when the points are open or the connecting rods are broken or disconnected.

The ML-18C offer as an option (S2); fail-safe proximity sensors rated SIL-2 with two outputs (OSSD) enabled (logic "1") when the point is closed.

One additional proximity sensor is provided to detect when the switch in being operated manually.

Switch position indication LED's can also be incorporated to indicate the switch position.

The ML-18C can be controlled by multiple methods when a switch processor is incorporated, the below advanced operation features can be added:

- ✓ Auto-return under switch point obstruction,
- ✓ Auto-restore to move the switch back to its previous position.

1.3 Specification

1.3.1 Physical characteristics

Table 1.1 Physical characteristics

Parameter	Specification
Length	53.6” (136.1cm)
Width	47.5” (120.6cm)
Height	8.8” (22.3cm)
Weight	680Lb (308Kg)
Throw length	3.0 – 6.0 in (76 – 152 mm)
Throw force	4,500Lbf (19.8KN) *
Spring holding force combined	1,600Lbf (7.1KN)

* The throw force is pre-set at the factory and can be adjusted according the operating turnout load conditions.

1.3.2 Operating characteristics

Table 1.2 Operating characteristics

Parameter	Specification
Throw time	2.5 seconds*
Temperature range	-40°F + 185°F (-40°C + 85°C)
Hydraulic pressure	Up to 3000 psi (200 Bar)
Control voltage	10 – 13.65VDC
Switch point detection	Inductive proximity sensors 0-30VDC PNP-NO-12VDC output-3 wires NPN-NO-0VDC output-3 wires Fail-safe inductive sensors 19-30VDC - Option S2 PNP-NO-2 x OSSD (A1 & A2) output-4 wires
Switch control methods	Remote – cable or Data & VHF Radio Local – Push Buttons Manual – Hydraulic hand pump

* The throw time will vary depending upon battery voltage, throw distance and turnout operating load conditions.

1.3.3 Electrical characteristics

Table 1.3 Electrical characteristics

Parameter	Specification
AGM Battery (heavy duty cycle)	12VDC – 105 Ah
Supplied Voltage and maximum current to maintain the battery charged.	110VAC – 60Hz – 2A (Battery charger) 220VAC – 60Hz – 1A (Battery charger) 230VAC – 50Hz – 1A (Battery charger) 12VDC (Solar panel control charger)
Current to charger a discharged battery	15A @ 12VDC

1.4 Switch machine dimensions

Figure 1.1 Switch front & side view

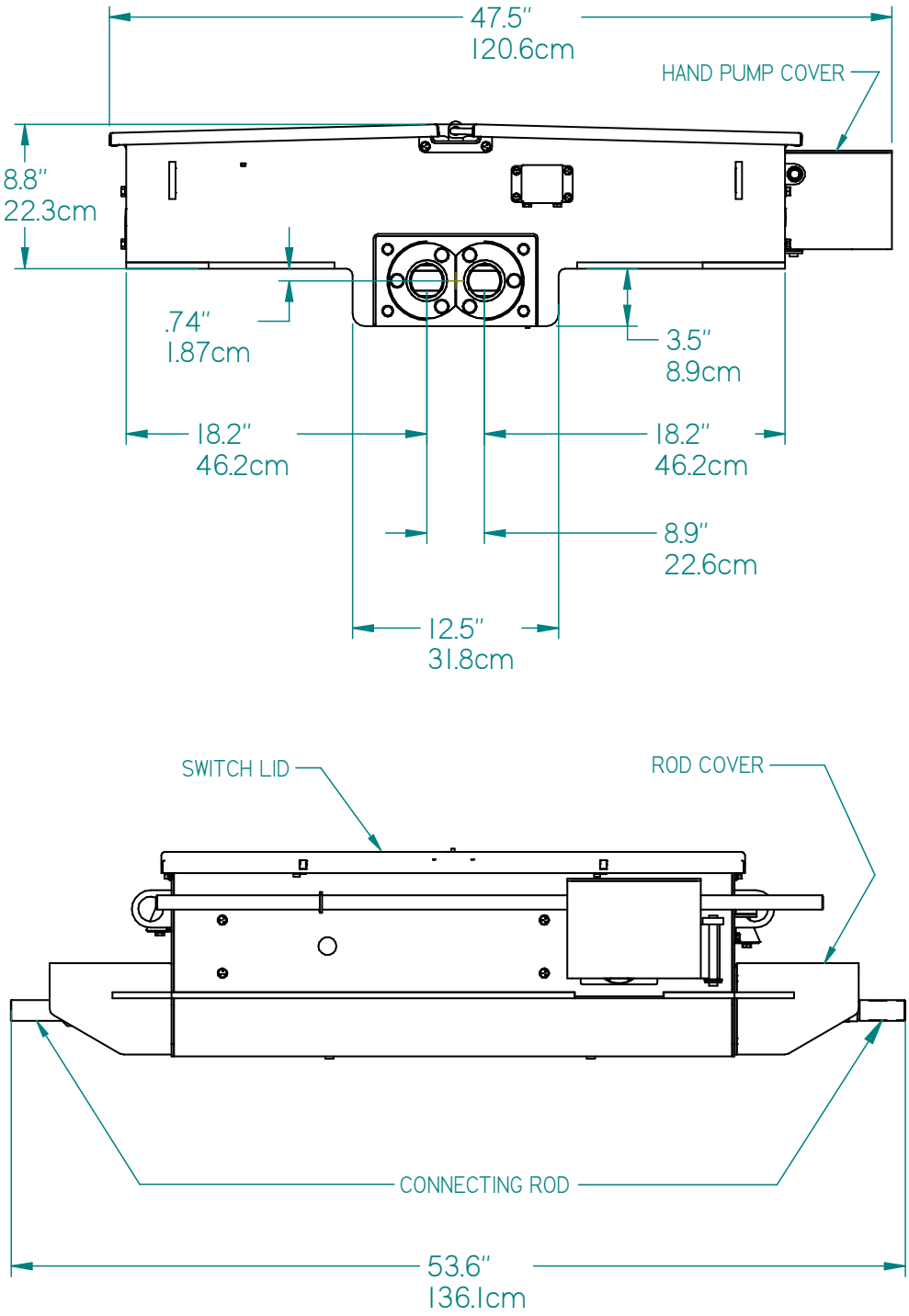


Figure 1.2 Switch top view

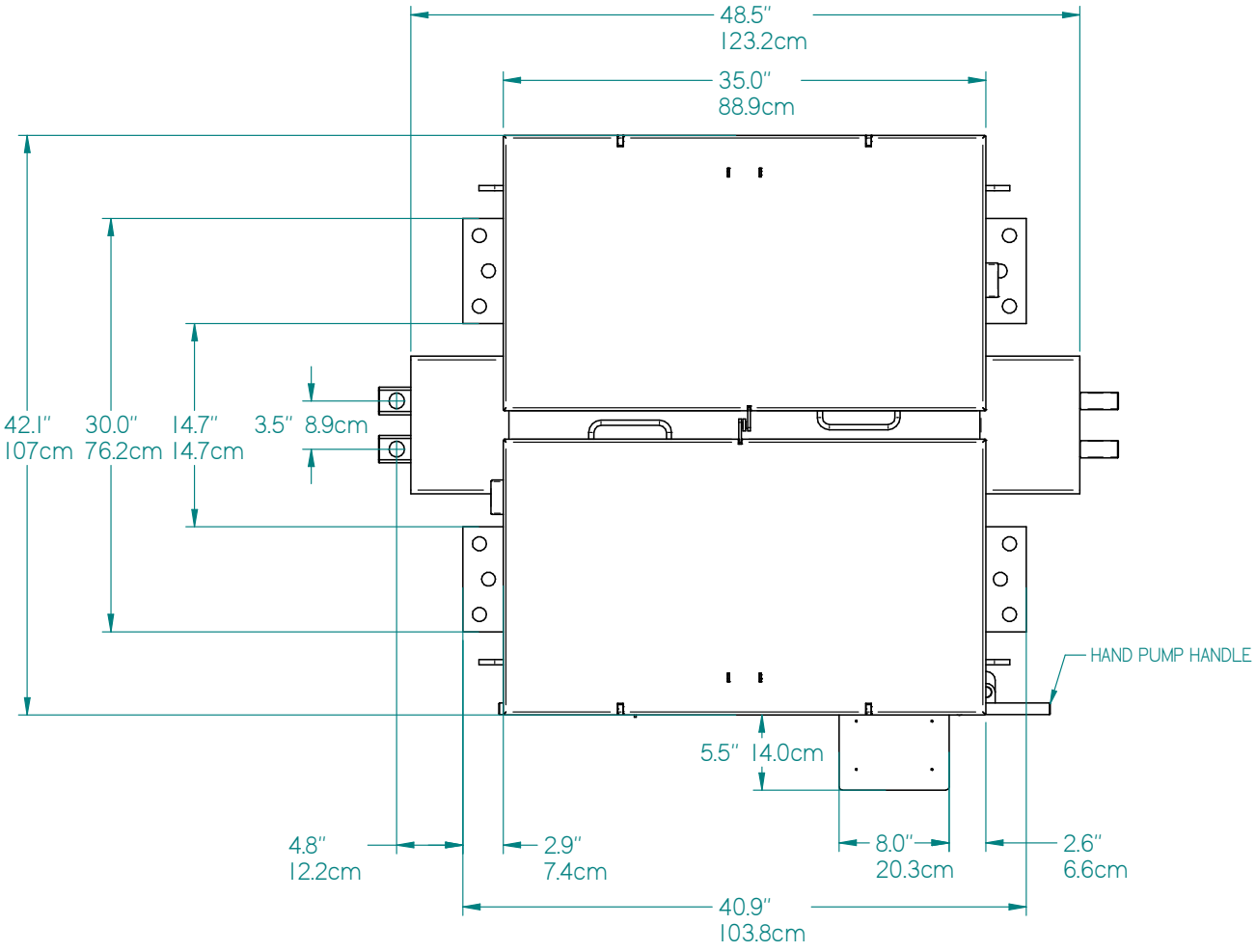
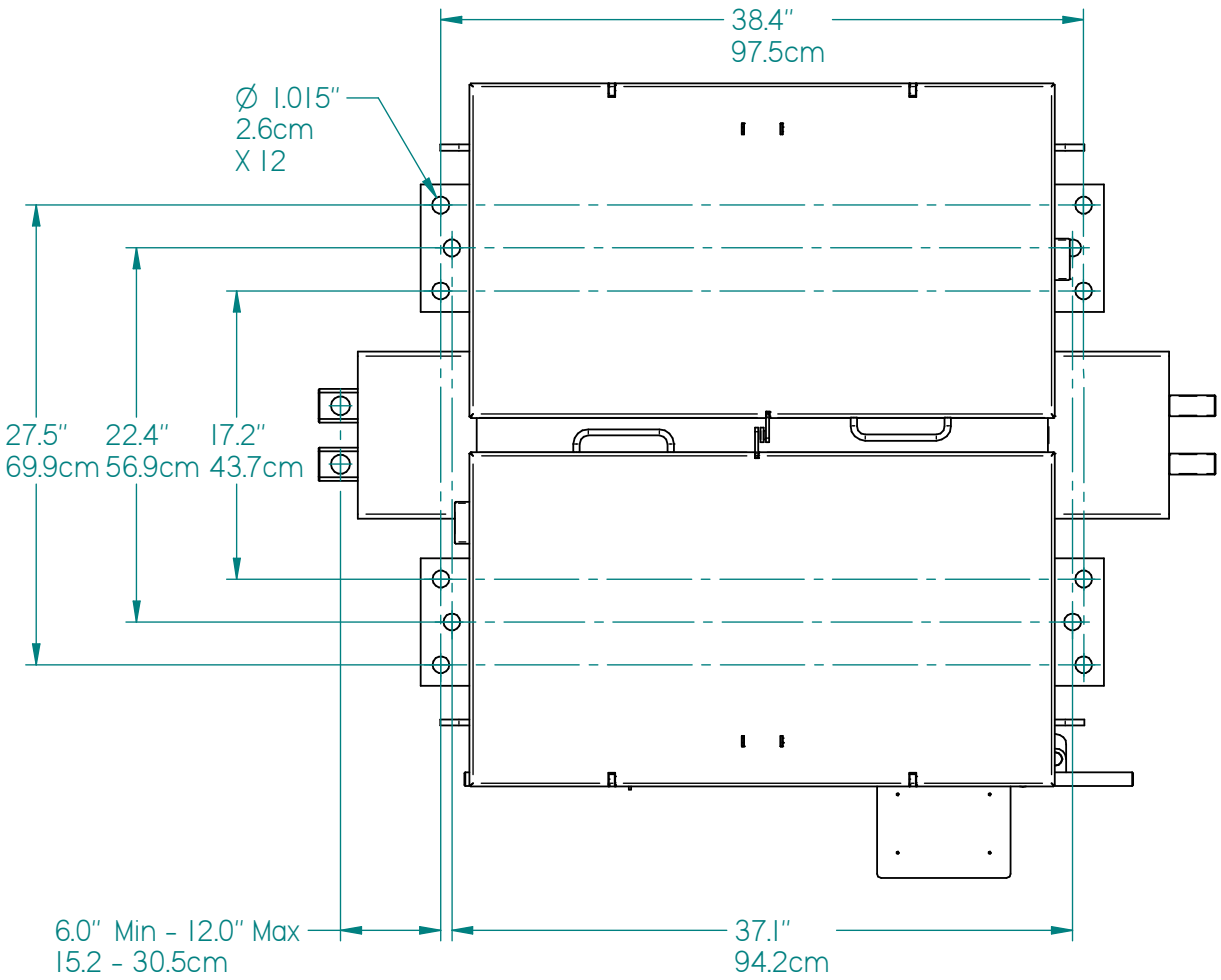
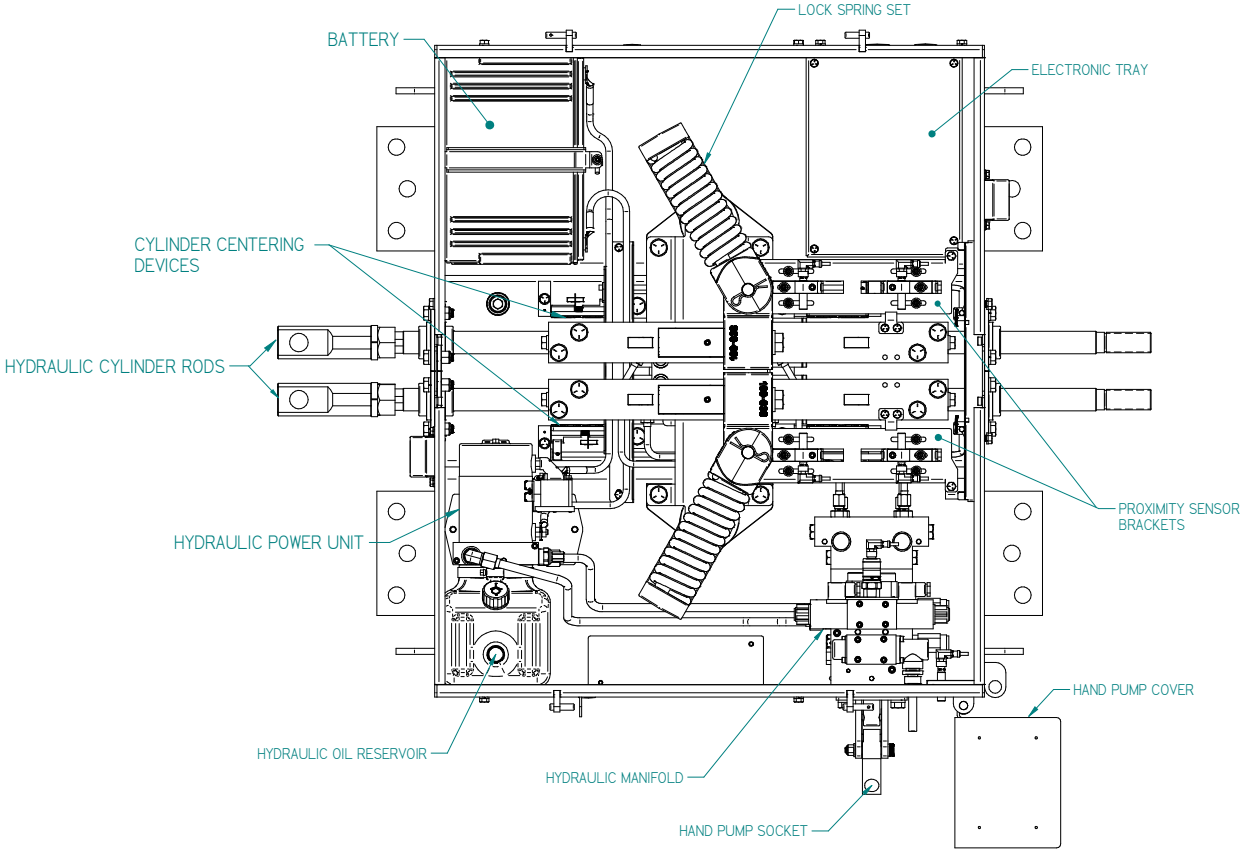


Figure 1.3 Switch foot print



1.5 Switch machine internal layout

Figure 1.4 Switch internal layout



1.6 Switch machine components

The ML-18C Switch Machines basic components can be seen in figure 1.4. above and is detailed according to the following:

1.6.1 Hydraulic system

The hydraulic system is responsible for the switch movement and all components are detailed and explained how they relate to each other to form a dual acting hydraulic system.

The hydraulic system is comprised of a power unit, a manifold block, two double rod cylinders, pressure and return lines.

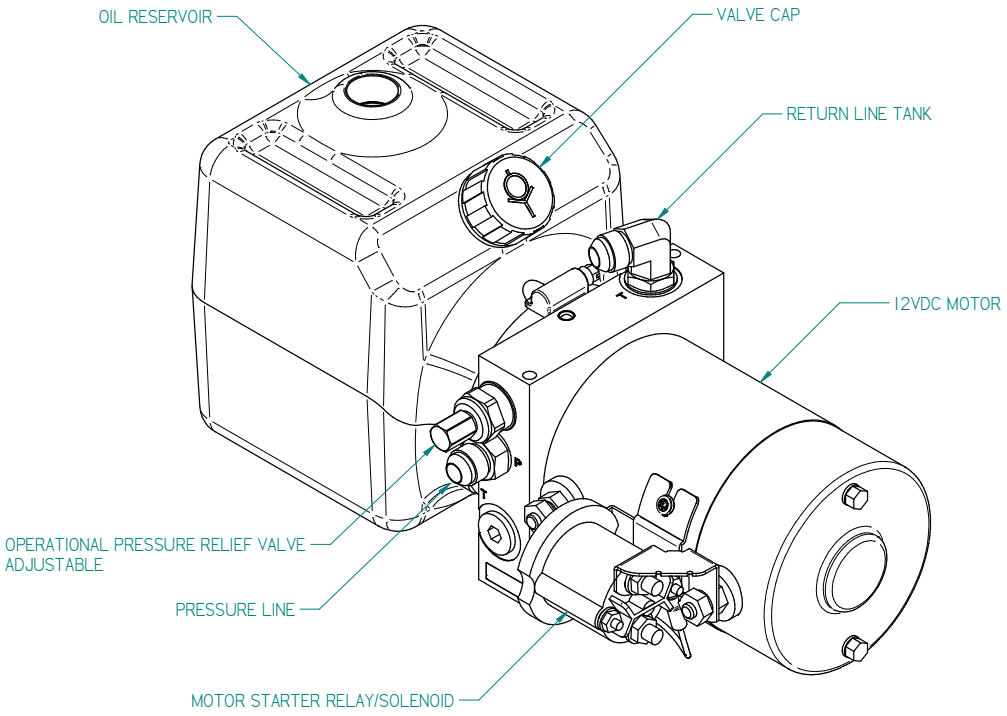
The hydraulic system operates on 12VDC power or manually using the heavy-duty hand pump. All hydraulic fittings used are SAE straight thread O-ring boss type. This system offers the best leak free connection even when high vibration and large temperature variations are present.

1.6.1.1 Hydraulic power unit

The hydraulic power unit is a compact pump motor unit with:

- ✓ DC motor for intermittent duty, two poles,
- ✓ Hydraulic pump with fixed displacement,
- ✓ Plastic oil reservoir,
- ✓ Externally adjustable relief valve,
- ✓ Check valve,
- ✓ Motor start solenoid for intermittent duty,
- ✓ Reservoir with valve cap.

Figure 1.5 Hydraulic power unit (HPU)



The HPU has the relief valve preset from the manufacturer to open at 1100 psi, limiting the system operating pressure. The power unit's operating pressure can be increased, if necessary, up to 2000 psi (maximum operation pressure).

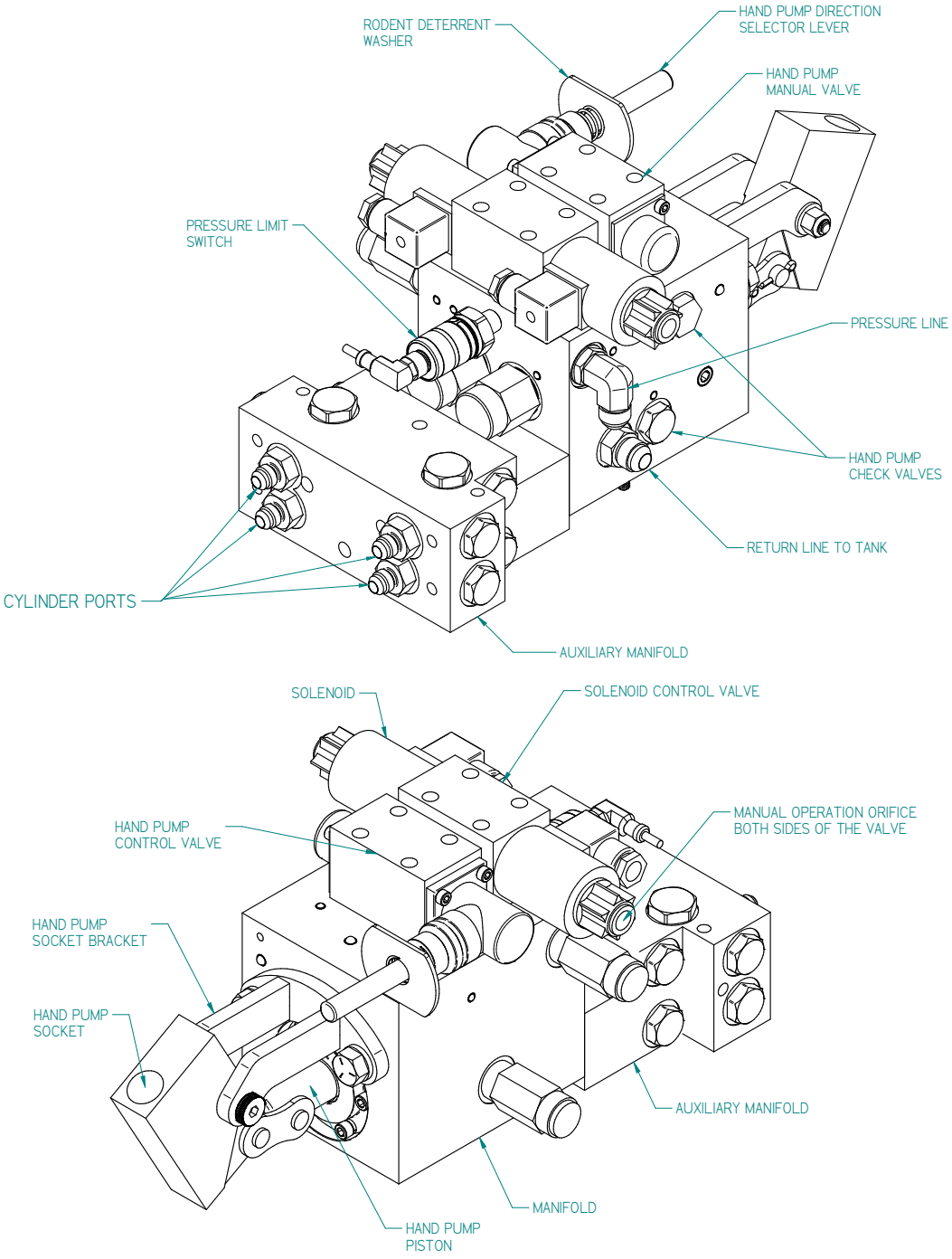
A valve cap with sealing disc is used to prevent moister and dust from getting in and fluid leakage. The sealing disc is closed in normal pressure conditions but it allows the expulsion of over pressure air from inside the reservoir.

NOTE: There is no hydraulic pressure in the system when the switch is resting in the normal or reverse position.

1.6.1.2 Hydraulic manifold

The hydraulic manifold is manufactured from Aluminum (lightweight) and has all the necessary valves to safely control the cylinders movement. The cylinders movements are operated electrically by a directional solenoid control valve or by a directional manual lever control valve.

Figure 1.6 Hydraulic manifold



The manifold also has a heavy-duty bidirectional piston pump built in.

During the normal operation, the directional solenoid control valve will be responsible for moving the cylinder forward or reverse when a constant 12VDC output is supplied to one of the solenoids.

When electrical power is not present, the switch points can be moved manually using the hand pump by selecting the direction of movement using the manual directional lever.

An auxiliary manifold is supplied to provide addition features to the main manifold block, such as: hydraulic cylinders synchronization or the cylinder connecting ports.

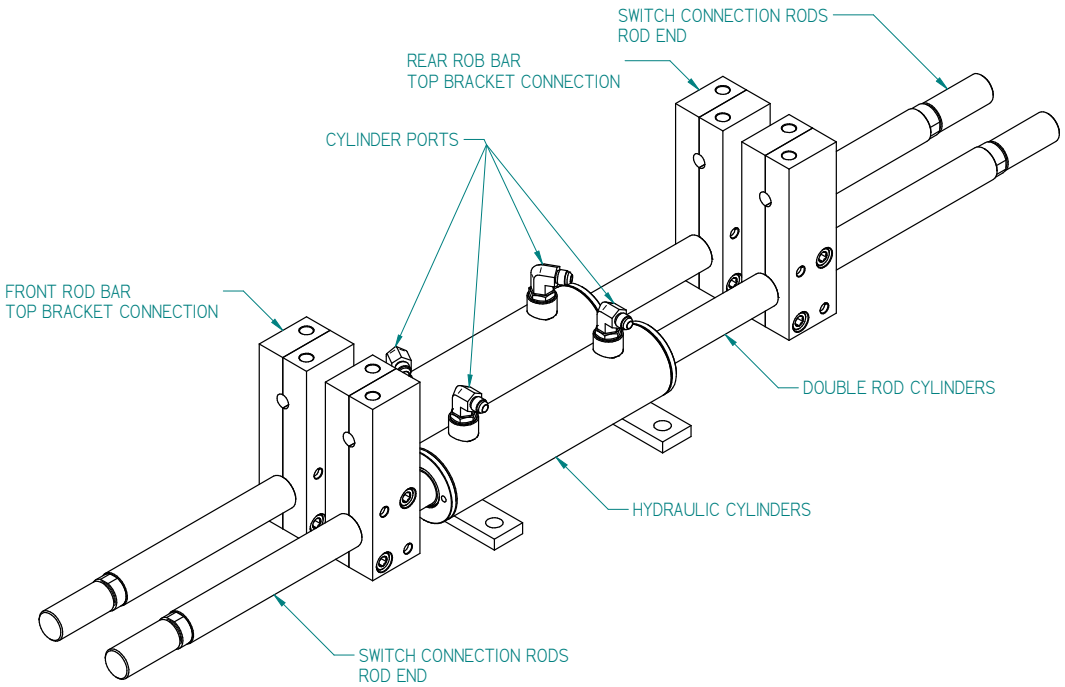
Detailed information how to operate the switch electrically and manually are supplied in Section 2 – Operation.

1.6.1.3 Hydraulic cylinder

Two hydraulic double rod heavy-duty cylinders are used to convert the hydraulic fluid pressure into throwing force to move the switch points.

The double rod cylinder operates at the same speed in either direction of movement and has 6 total inches of stroke.

Figure 1.7 Hydraulic cylinder



1.6.1.4 Hydraulic pressure and return lines

All the pressure and return lines are manufactured according to SAE J514 and ISO 8434-2 standards with steel hydraulic tubing that has external surface treatment for a long service life in the demanding railroad environment.

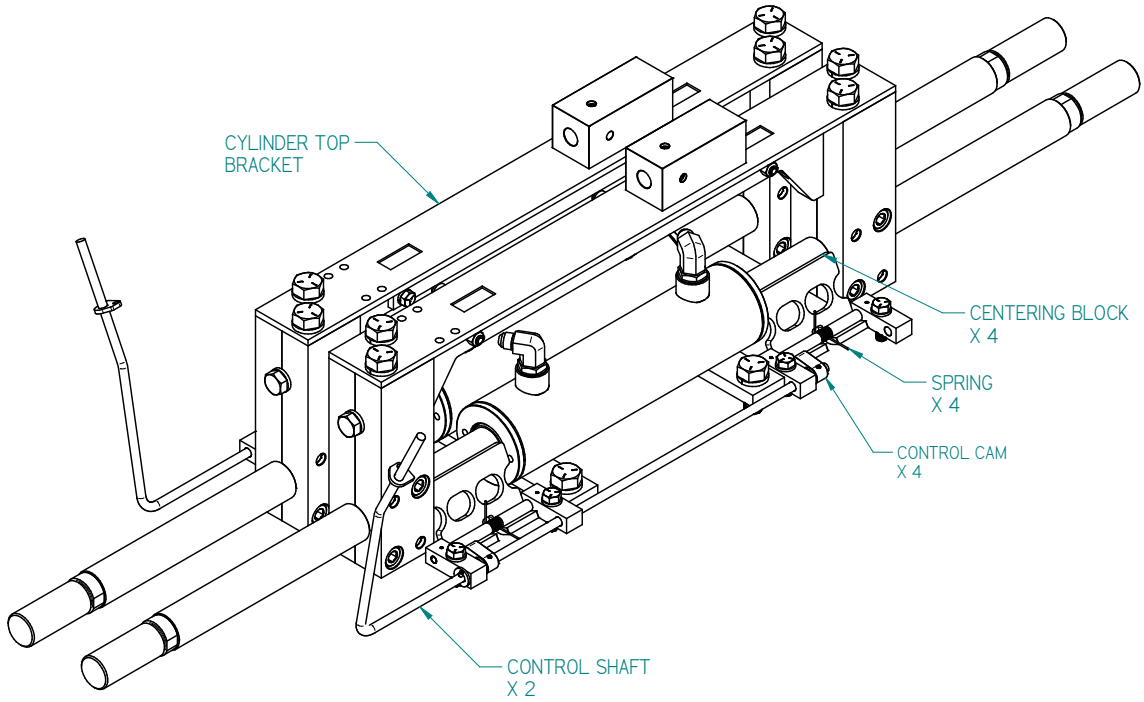
The lines are connected to the cylinders, manifold and power unit using SAE straight thread O-ring boss fittings with straight thread 37° JIC flare for high-pressure capability.

The JIC Flare seals on a metal-to-metal flange consisting of three pieces: the tube body, sleeve and nut. The tube is flared at a 37° angle and held between the fitting seat and the sleeve (support) with the nut, providing a very effective seal between the fitting nose and the tube flare.

1.6.2 Cylinder centering device

During the installation, it is necessary to center the cylinders piston to equally distribute the spring holding force between the points. For that purpose, a centering device was designed to safely lock the rod at the center of the stroke to eliminate any unexpected movements.

Figure 1.8 Cylinder centering device



Each centering device is comprised of two centering blocks controlled by a rotational control shaft.

Each center block is independent and moves into position to stop the cylinder movement via a rotational spring in each block.

The center blocks are released by two cams installed on the control shaft.

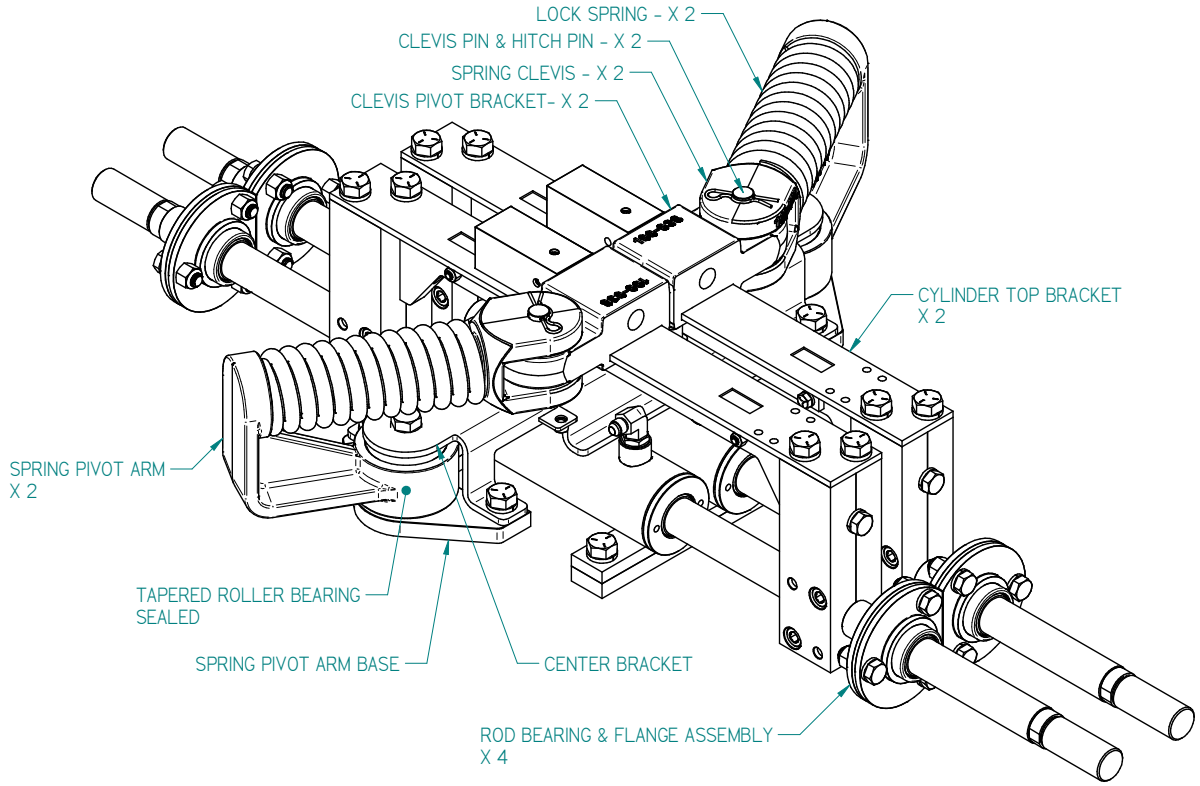
The control shaft is locked into position by a release pin (not shown at figure 1.8), see section 3 - Figure 3.2.

Detailed explanation on how to center the cylinder can be found in Section 3 – Installation.

1.6.3 Spring holding force assembly

During the cylinder movement, two springs are compressed and decompressed and the sum of the spring's forces will be transferred to the rod resulting in the point holding force.

Figure 1.9 Locking spring assembly



Because the springs, when compressed, accumulate a lot of potential energy, the springs will not allow the points to remain at the middle stroke (unstable position); the springs will always decompress moving the points to the lower potential energy (point closed).

The springs are connected to the housing through the spring pivot arm and to the clevis pivot bracket through a spring clevis.

During assembly, the springs are pre-loaded until the clevis pivot bracket is in the correct position then locked to the cylinder top bracket.

1.6.4 Spring holding force and Switch point position detection

Two proximity sensors are used to detect independently each switch rod position and holding force condition. One for the normal position and one for the reverse position.

The sensors are designed to work in the railroad environment under extreme temperature variations and high vibration.

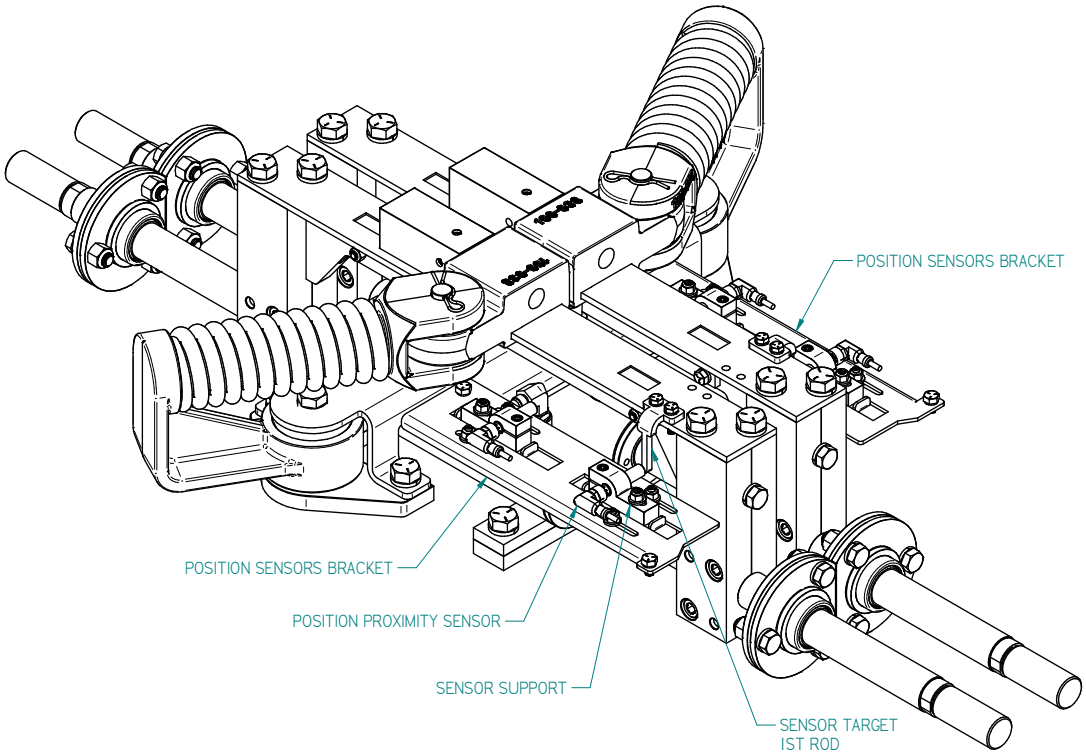
Two sensors are normally open inductive sensors, PNP configuration and the others two sensors are normally open inductive sensors, NPN configuration. If fail-safe inductive sensors are used, they are normally open, PNP, 2 x OSSD outputs (A1 & A2) rated SIL-2.

All sensors can be PNP + 12VDC outputs if the processor only accept positive inputs.

One group of sensors located in one cylinder will provide +12 VDC (battery positive) and the other group located at the other cylinder will provide -12VDC (battery negative) to the switch controller.

Each sensor is inserted in a support designed to isolate it from severe vibration using a single socket head screw. Each sensor support can easily move inside the slot to the position where it will detect the target best. The sensor can detect the target with a tolerance of 0.063" (1.6mm).

Figure 1.10 Proximity sensors bracket and target



The position target is mounted on the spring holding force assembly that follows the switch machine movement. If the switch points do not move to the correct position the sensors will not provide indication that the spring force is correctly applied.

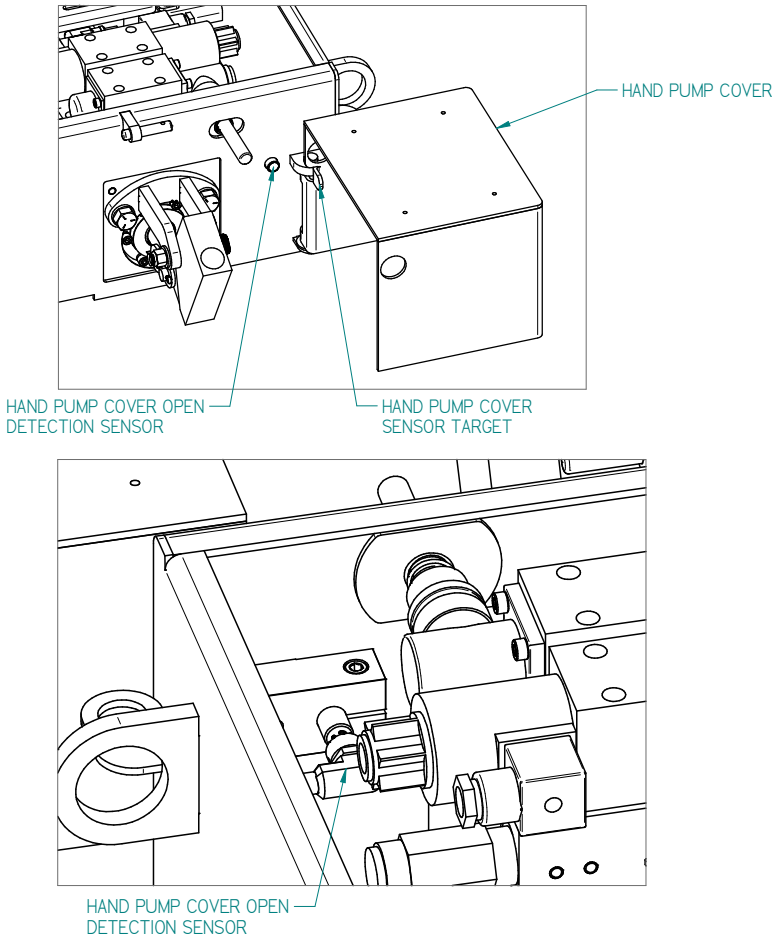
If the clevis or throw rod breaks the holding force will be lost and the spring holding force mechanism will force the target away from the sensor forcing an out of correspondence indication.

1.6.5 Hand pump operation sensor

One additional proximity sensor is provided to detect when the manual hand pump cover is open or the switch is being operated manually.

This sensor can be used to block the switch to receive any remote command to throw or to alarm of a no authorized operation.

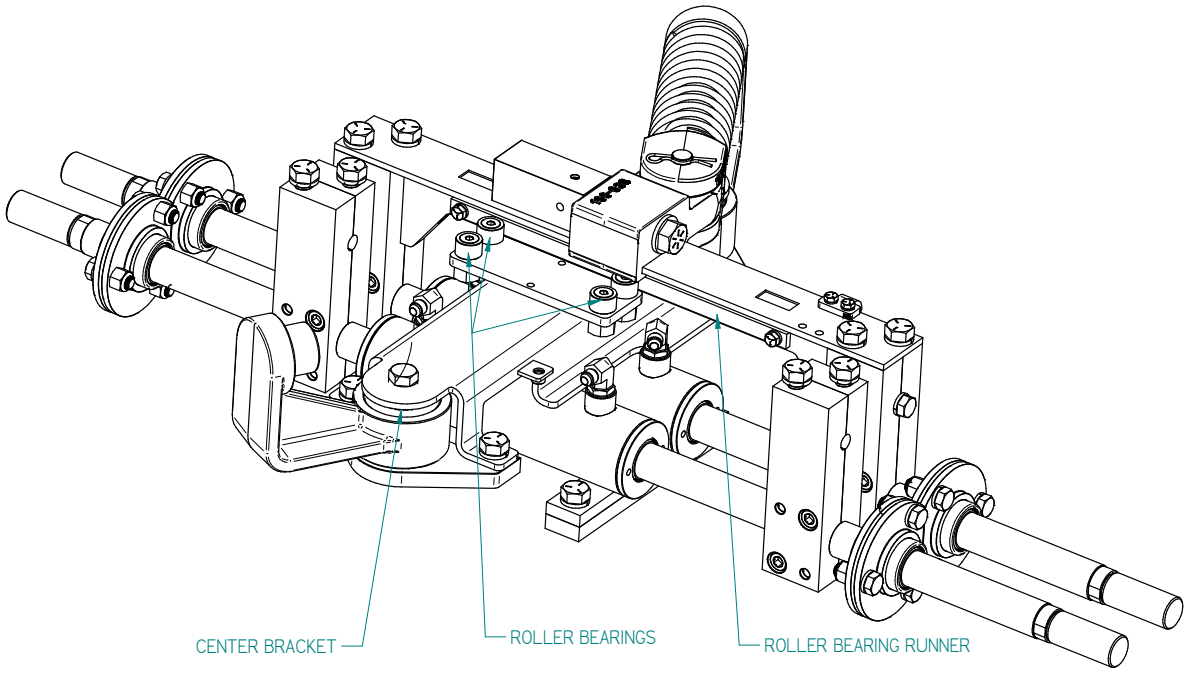
Figure 1.11 Hand pump operation detection sensor



1.6.6 Cam roller bearing

To eliminate any possible rod/bracket rotation, the center bracket has four CAM Roller Bearings. Each cylinder top bracket runs against two roller bearings by the spring decompression force.

Figure 1.12 Cam roller bearing



The Cam Roller holds the target at the correct distance to the sensors and will reduce the need of sensor adjustment.

Detailed instructions how to adjust the sensors can be found in Section 3.

1.6.7 Electrical system

The ML-18C primary power source is a sealed (spill & leak proof) valve regulated lead-acid absorbed glass mat (AGM) 12VDC battery with advanced features.

The battery encompasses both gelled electrolyte and AGM that is well suited for deep cycle applications. It is installed on its side.

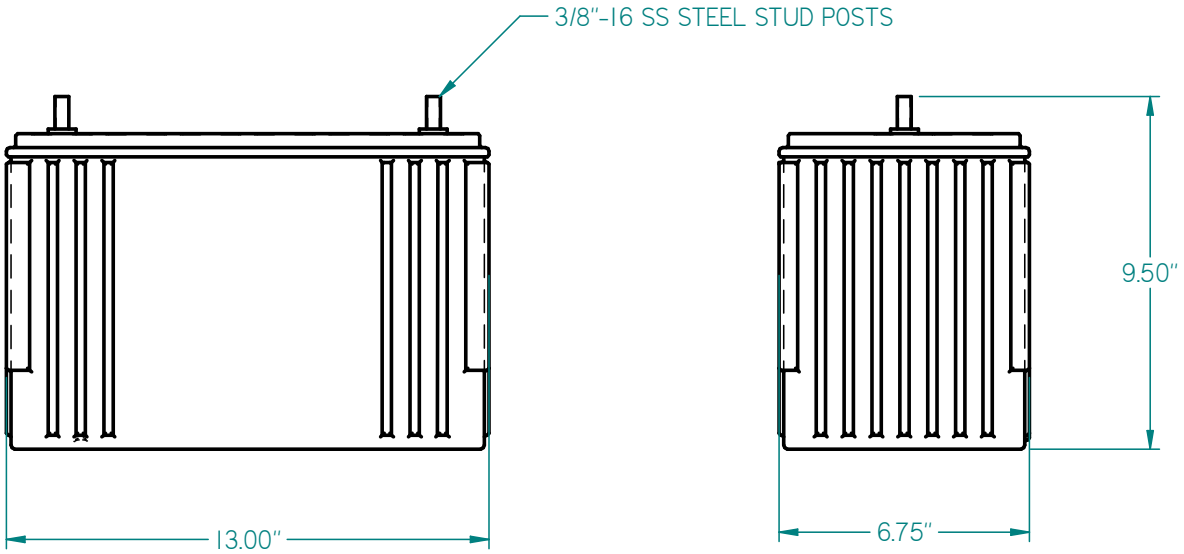
The AGM battery is rated 105Ah @ 20hr and when fully charged (open circuit voltage 12.8 V or higher at 68°F) and can power the ML-18C switch machine through approximately 120 throws before discharge (11.80 V).

The AGM Battery can be recharged from 0% to 90% in 3-1/2 hours

For best performance results, it is recommended to replace the AGM battery with the same model supplied with the switch machine.

Battery specification:
DEKA BATTERY PN# 8A31 – NON SPILLABLE – ABSORBED GLASS MAT
105Ah @ 20Ah rate
Weight – 68.5 Lb.

Figure 1.13 Battery dimensions



1.6.8 Battery charging

The AGM battery can be charged using a 110/220 VAC charger or solar array voltage regulator.

Always use a reliable "voltage regulated" or "voltage-limited" charger designed for an AGM battery.

Charge voltage must be limited to extend life (14.4 to 14.6 volts maximum at 68°F)

CAUTION: The charger or voltage regulator **must be temperature-compensated and voltage regulated and designed to charge an AGM battery** to avoid under or overcharging, otherwise the capacity is reduced and the battery lifecycle is shortened.

Constant current chargers **should never be used** on the AGM battery.

CAUTION: The (–) 12VDC generated to charge **the battery cannot be grounded** to avoid damage to the electrical equipment during a lightening event.

2 SECTION 2 – OPERATION

The operation of the ML-18C switch machine is simple and can be done by electrical command or manually.

2.1 Electric controlled operation

To move the points from one position to another requires two distinct commands (+12VDC): one to turn the hydraulic motor on and a second to the directional valve solenoids to correspond to the desired direction of movement.

NOTE: Using two distinct commands is a safety feature to eliminate any short circuit from allowing the switch machine to move on its own.

There is no hydraulic pressure in the system when the switch is in the normal or reverse position; the spring system holds the point closed.

The proximity sensors are constantly energized so if the switch is in the normal or reverse position, two proximity sensors, one in each cylinder, are generating a +12VDC (PNP) and -12VDC (NPN) outputs respectively to the switch control unit. If fail-safe sensors are used, two proximity sensors are generating 2 x OSSD outputs respectively to the switch control unit.

When a command is received to move the switch to the reverse position, two +12VDC outputs from the switch control unit will energize both the HPU Start Solenoid and the directional valve reverse solenoid.

When the hydraulic cylinder starts moving it compresses the springs and the normal proximity sensors input will be de-energized.

The springs will be fully compressed at the middle stroke and as the points move toward the reverse position the springs start de-compressing until the points are closed at the reverse position and the spring force is correctly holding the switch points. Now the reverse proximity sensors will be generating a +12VDC (PNP) on one rod and -12VDC (NPN) from the other rod providing inputs to the switch control unit.

When the move is successfully complete, the HPU start solenoid and the directional valve reverse solenoid will be de-energized.

CAUTION: An operation timer over run must be set in the SCU to turn the HPU off if an obstruction does not allow the proximity sensors to detect the new position, or the sensors fails. Normally the timer over run protection is set 50% higher than the necessary time for the switch to move from one position to another under load.

The hydraulic directional valve will be set in the neutral position automatically and all the hydraulic pressure will be removed from the hydraulic system.

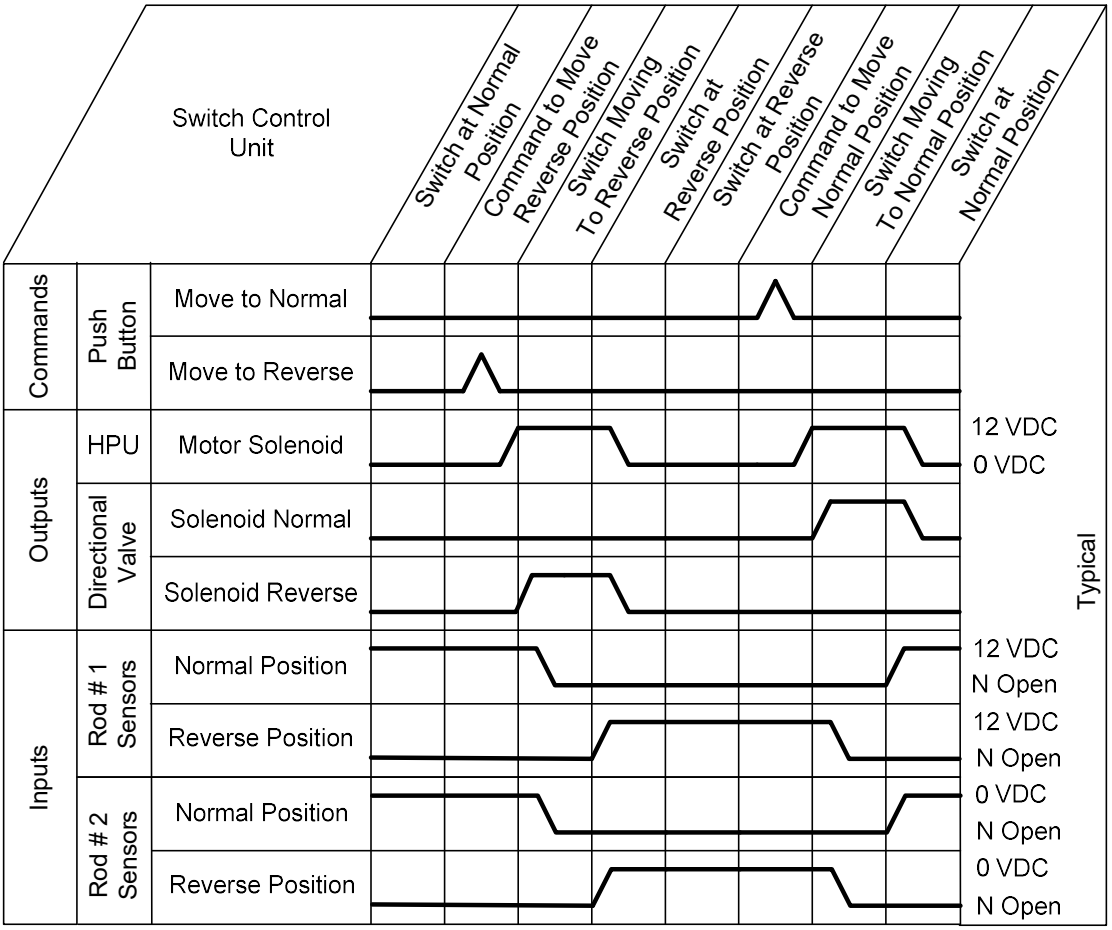
The springs will hold the point closed at the reverse position.

The switch is then ready for another command.

NOTE: The switch control unit (SCU) can receive a command to move the points generated by pushbuttons, data cable network, data radio network or DTMF radio.

The figure 2.1 is a basic representation of how the outputs and inputs are managed by the switch control unit.

Figure 2.1 Basic operation sequence



When an obstruction occurs during the point movement or a proximity sensor fails to detect if the point is closed, the power unit will continuously apply hydraulic pressure to the stock rail until the overrun timer is off.

To avoid hydraulic pressure to the stock rail, the switch control unit can automatically return the switch point when the pressure limit switch is activated during an obstruction. See item 2.2 below.

2.2 Auto return operation with pressure limit switch

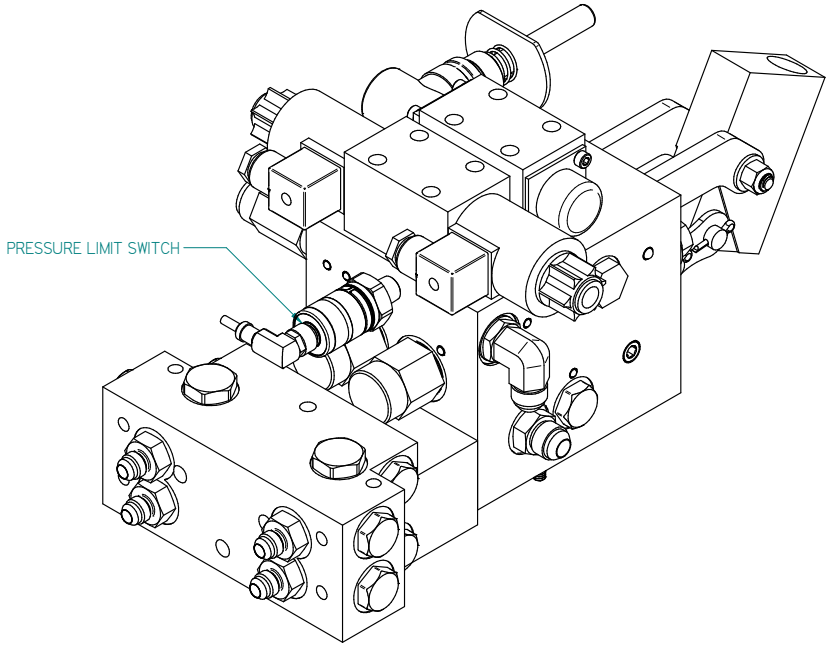
The pressure limit switch (Figure 2.2) installed at the manifold block has an internal closed contact (pin 2) providing constantly 12VDC input to the switch control unit.

NOTE: As soon as the motor starts, the point is closed or an obstruction blocks the movement of the piston, the hydraulic pressure momentarily spikes activating the pressure limit switch opening the closed contact.

If the proximity sensor is reached/activated before the pressure limit switch is activated, we turn the HPU and the directional valve solenoid valve off. The switch is at the correct position and the point is closed.

If the pressure limit switch is activated and the proximity sensor is not reached/activated, there is an obstruction and the switch must return to the alternate position;

Figure 2.2 Pressure limit switch

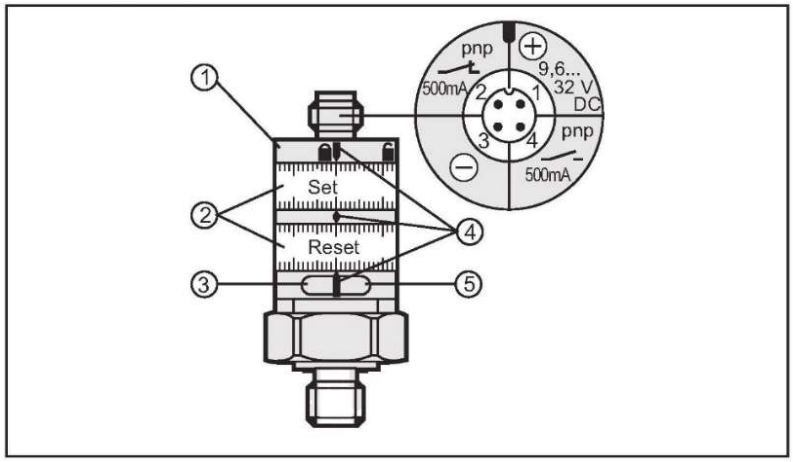


When returning the switch to an alternate position, it is not necessary to turn the HPU off; just de-energize the active solenoid and energize the alternate position solenoid to shift the hydraulic directional valve. The switch will return immediately and when the alternate position sensor is activated you turn the HPU power relay and the directional valve solenoid off.

CAUTION: For the pressure limit switch to work properly, it must be set with an intermediate pressure value between the minimum pressure value needed to start moving the switch and the maximum pressure value set at power unit's relief valve. If the pressure is set below the minimum, the switch machine will not throw; if the pressure is set above the maximum, the power unit will run over the timer if an obstruction occurs or the proximity sensors fail to detect the point is closed.

The pressure limit switch is pre- set by the manufacturer to 900 PSI but it can be easily adjusted in the field if necessary.

Figure 2.3 Pressure limit adjustment



1 – Locking ring.
2 – Setting rings (manually adjustable after unlocking).
3 – Green LED: supply voltage O.K.
4 – Setting marks.
5 – Yellow LED: Set value reached, out put on.

To obtain the setting accuracy: Set the rings to the minimum value, then set the requested value.

NOTE: Disconnect the power before connecting or disconnecting the unit. The minimum distance between Set and Reset is 100 PSI.

In case of increasing pressure, the closed contact (pin 2) will open when the set value is reached.

Decreasing pressure, the closed contact when open (pin 2) will close when the reset value is reached.

If the set ring is at 900 PSI the reset ring must be at 800 PSI, it means: the closed contact will open when the pressure reaches 900 PSI and the closed contact will close again when the pressure drops under 800 PSI.

Sometimes when the switch machine needs to move a big turnout (big operational load), the pressure limit needs to be set above 900 PSI to not cause a false obstruction input.

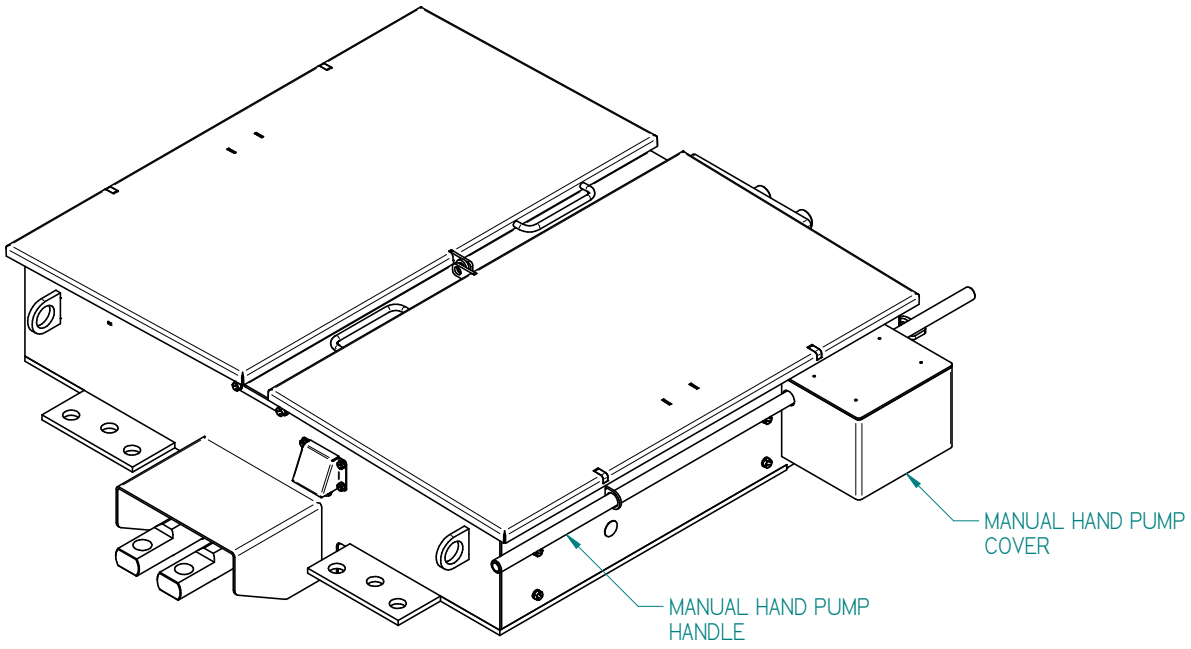
In this case, the power unit relief valve must be set above the 1100 PSI proportionally to allow the pressure limit operated correctly under obstruction. See item 2.1.

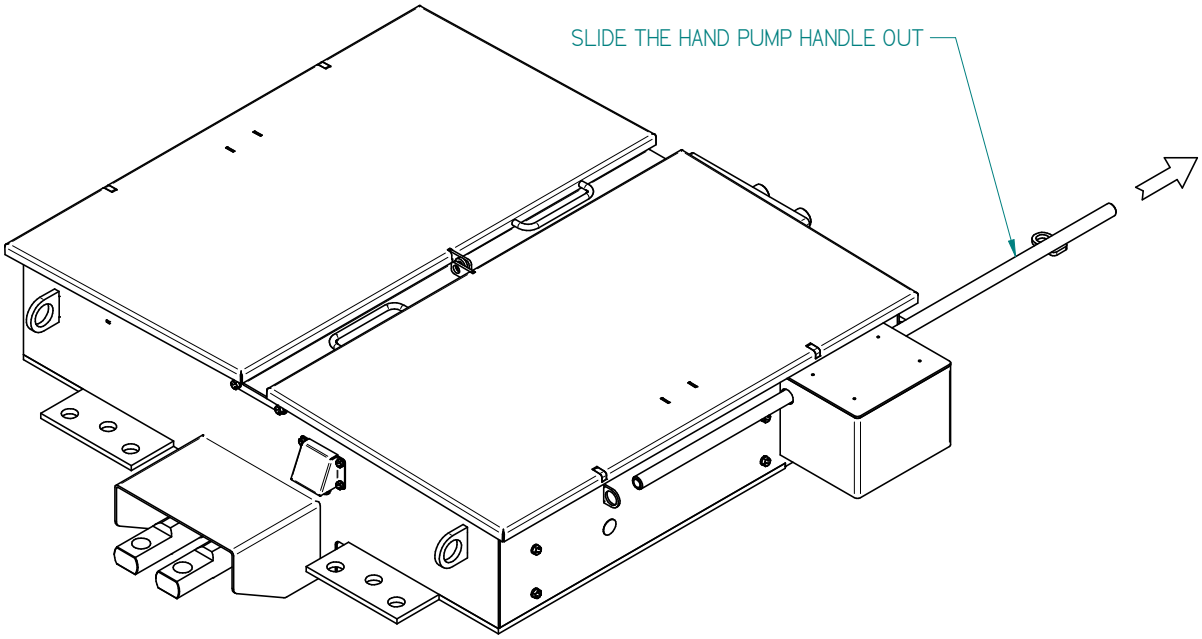
After the pressure limit switch is set, the lock ring must be turned to the lock position as shown at the Figure 2.3 above.

2.3 Manually operated

When electric power is not available or the M.O.W switch (if available) is enabled or the switch machine is unable to accept a command to throw because the detection zone is occupied, the switch can be thrown manually using the hand pump and the manual directional valve selector lever.

Figure 2.4 Hand pump handle





2.3.1 Hand throw operation

To use the hand pump, the hand pump handle needs to be removed from its cradle, see figure 2.4.

1. Open the hand pump cover;

2. Select the direction the point is to travel by moving the directional valve lever to the desired direction of movement;

3. Insert the hand pump handle in the pump socket. See Figure 2.5;

WARNING: Before pumping, confirm the points are clear and no one is working near the points.

4. Move the hand pump handle back and forth until the points are closed. See Figure 2.5;

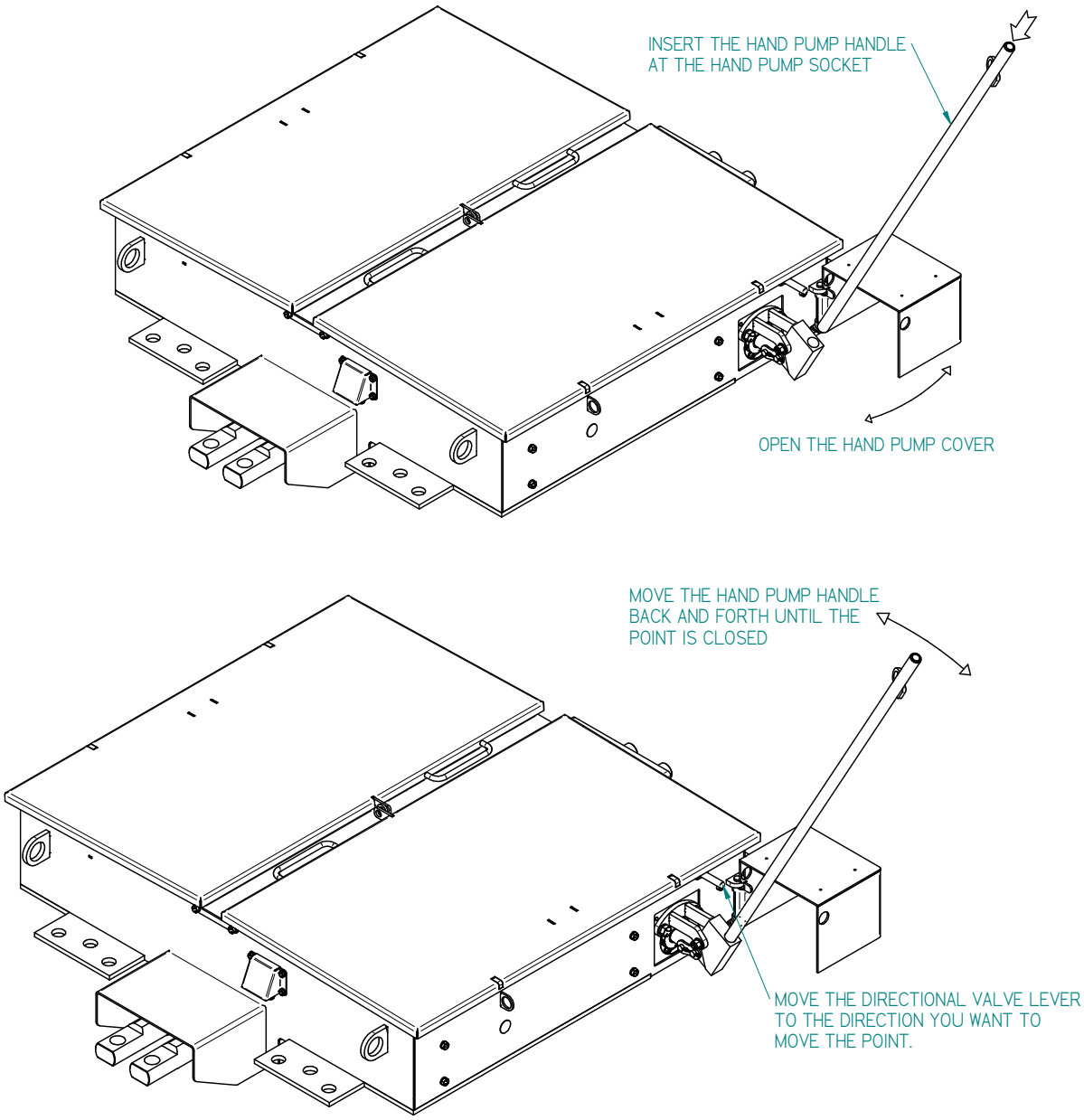
NOTE 1: It is approximately fourteen to nineteen (14 – 19) strokes to move the switch points completely to the desired position.

NOTE 2: The hand pump handle/socket will not move by itself if the switch is power operated.

5. Close the pump cover, reinstall the hand pump handle;

6. Reinstall the padlock.

Figure 2.5 Hand pump operation



CAUTION: Stop pumping if the point is closed and becomes hard to pump. The point will be kept closed by the spring holding force. Do not over pump; it can damage the hand pump seals.

3 SECTION 3 – INSTALLATION

3.1 Installation recommendations

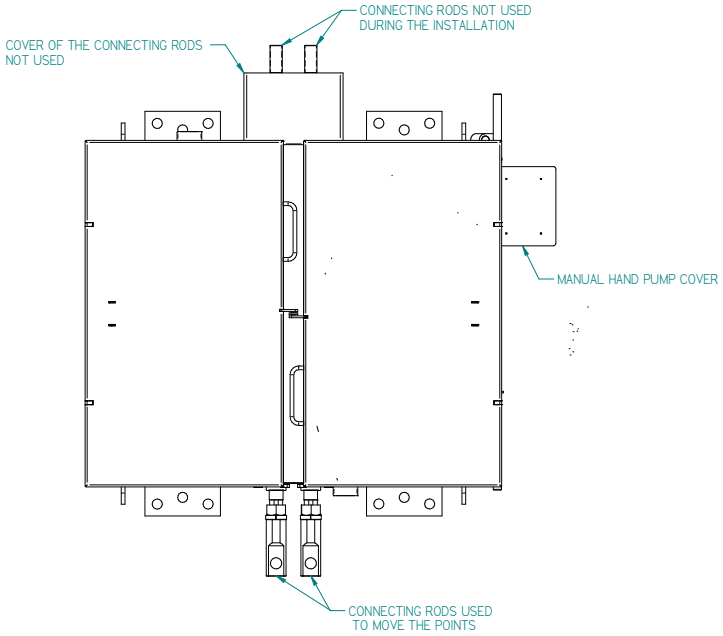
A site visit is recommended to view where the switch machine will be installed to inspect the general condition and quality of the points, ties, connecting rods and pins.

Position the switch machine on the ties according to the installation plan approved by the railroad or supplied by the manufacturer.

The switch machine can be installed at any side of the rail (left or right) so the position of the manual operation cover or cable connection will not change from one location to another.

The connection rod ends not used must be protected by the rod cover. See Figure 3.1 below.

Figure 3.1 Switch machine connecting rod both sides.



The ML-18C switch machine can be installed on wood, composite or steel head block ties 16’ (4.8m) or longer. This will provide adequate clearance between the switch machine and the passing cars. 13” (33cm) minimum tie spacing is required.

A minimum of two (2) hours of track time should be available for the installation.

WARNING 1: Before starting the installation, confirm that the track is available and the area protected from possible movements or as specified by the railroad rules and practices.

WARNING 2: Proper railroad approved personal protective equipment, PPE, such as safety shoes, goggles, hard hats, and gloves must be used while on track.

WARNING 3: When installing track circuit cables, stay clear of existing underground cables, or power lines.

NOTE 1: It is recommended a safety briefing be held with all workers prior to the start of any work as required by the property.

NOTE 2: Perform a visual inspection after installation, but prior to returning track to service, to ensure the connecting rod and switch are properly fastened and the points are free of any debris that could cause any obstruction to the normal switch operation.

3.2 Tools required for installation

Make sure all tools and hardware necessary for installing the switch machine are available before starting the installation.

It will be necessary to have adequate equipment to lift the switch machine into position. Weight and distance to move switch machine should be considered.

Table 3.1 lists all the minimum tools required to install the switch machine.

Table 3.1 Tools requires for installation

Qty.	Size	Description	Use
2	6ft x 1"	Flat eye and eye nylon web sling rate type 3 (lifting straps)	Lift the switch
4	3/4"	Screw pin anchor shackle	Lift the switch
2	1-5/16"	Open End Wrench	Clevis Pin, Installation Bolts & 7/8" Hex Nuts
1	1-7/16"	Open End Wrench	7/8" Tapered Hex Nut
1	1-11/16"	Open End Wrench	Connecting Rod Hex Nut
2	1-7/8"	Open End Wrench	Connecting Rod Hex Nut
1	12'	Tape Measure	Measure Point Throw
1	7/8"	Auger Bit & Drill Motor	Drill Wood Ties Screw Holes
1		Impact wrench and sockets	Tighten Nuts
1		Railroad Lining Bar	Center the Points
1		Railroad Claw Bar	Remove Spikes
1		Ratchet Lever Jack	To level the Ties
1	1/8"	Flat Head Screw Driver	Electrical Spring Terminals
1		Flat Head Screw Driver	Tighten Screws

Qty.	Size	Description	Use
1		Phillips Screw Driver	Tighten Screws
1		Wire Stripper	Strip Electrical Wires
1		Wire Cutter	Cut Electrical Wires
1		Crimping Tool	Crimp Electrical Connections
1		Compass (If Solar Panel is Provided)	Position Solar Panel
1	8”	Adjustment Wrench (Optional)	Connecting Rod Hex Nut
1	16”	Adjustment Wrench (Optional)	Connecting Rod Hex Nut

3.3 Installation on wood or composite head block ties

1. Transport the new switch to the installation site;

2. Remove existing switch;

3. Inspect the head block ties for condition and quality and replace the old one if necessary;

4. Clear crib space, shovel out the ballast between the head block ties and under the tie where the mounting bolts will be installed.

5. Center the switch machine operational rods;

NOTE: The ML-18C switch machine needs to be centered to distribute the spring holding force equally to the points independent of the turnout point position. To do that, the switch machine has two center devices to automatically center the operation rods. See also section 1 Item 1.6.2.

   a. Open the switch lid, locate the centering device levers. See Figure 3.2;

   b. Remove the release pins and move the center device levers to the active position. See Figure 3.3;

   c. Open the hand pump cover;

   d. Remove the hand pump handle;

   e. Insert the hand pump handle in the manual pump socket. See Figure 3.4;

   f. Hand pump until the switch rods are locked at center position, remove the hand pump handle and close the lid. See figure 3.5. and also, section 2 item 2.3;

Figure 3.2 Removing the release pin

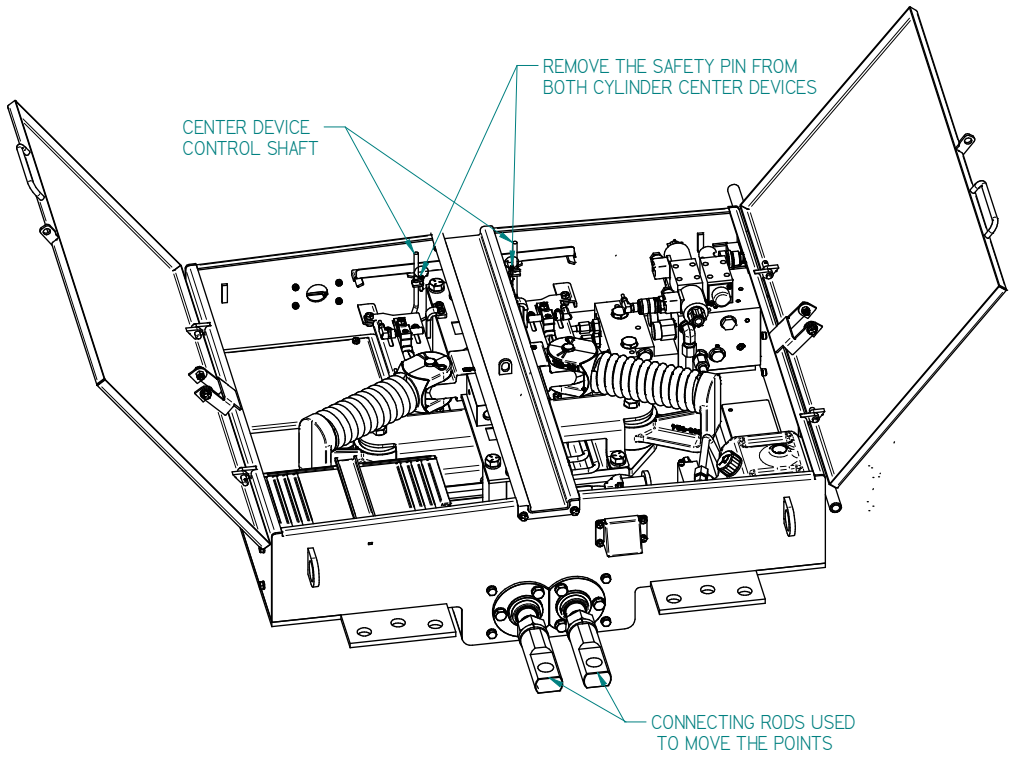


Figure 3.3 Center device lever at the active position

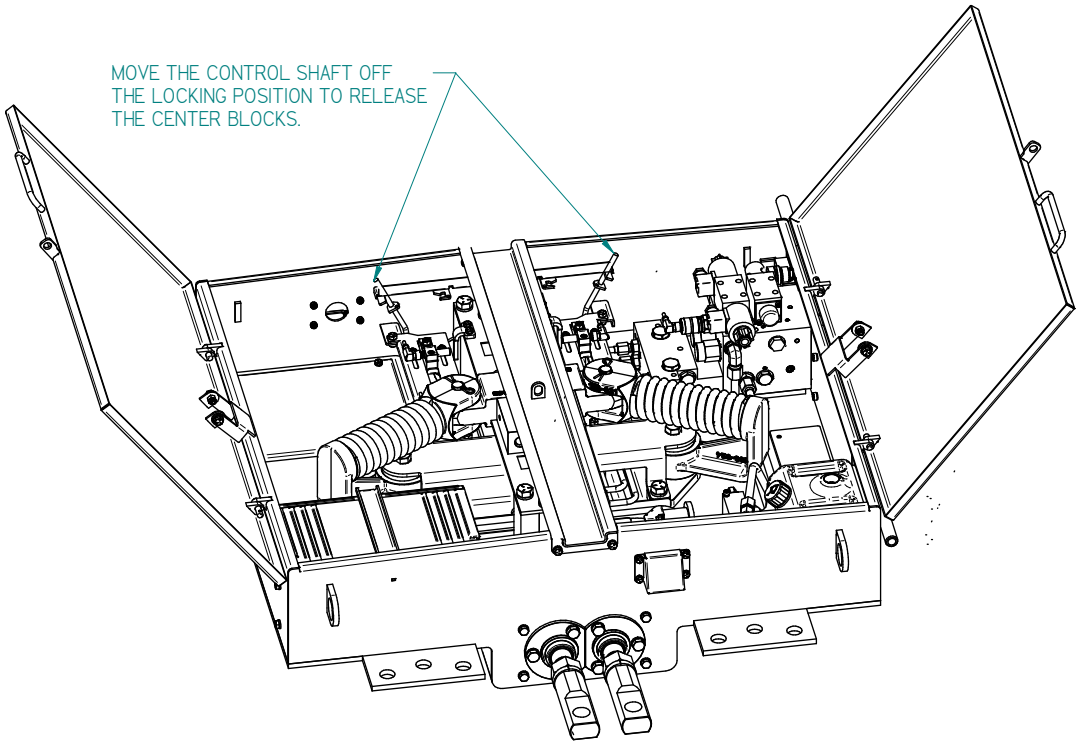


Figure 3.4 Hand pump handle in place
One lid not shown for illustration purpose only

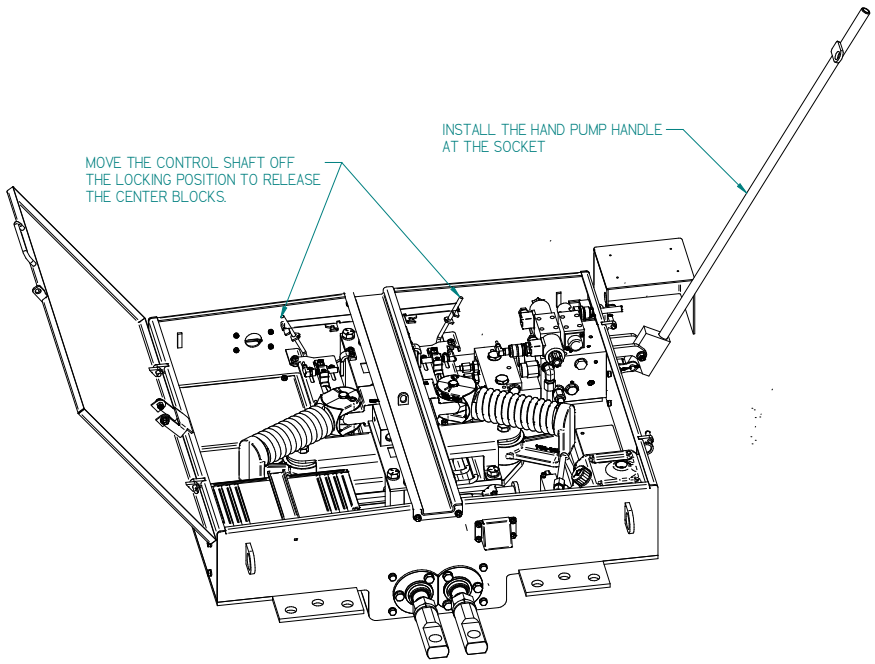
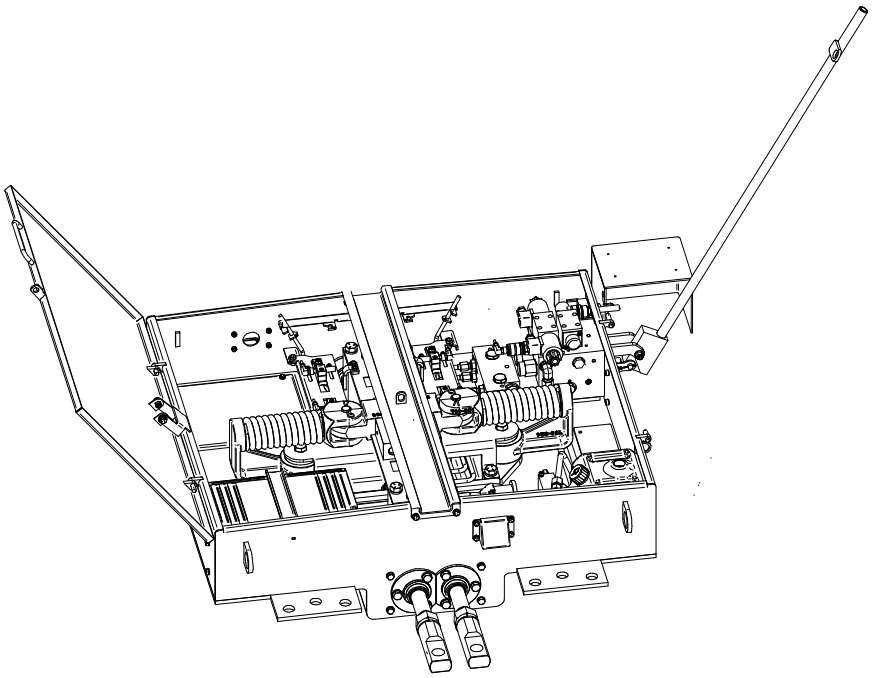


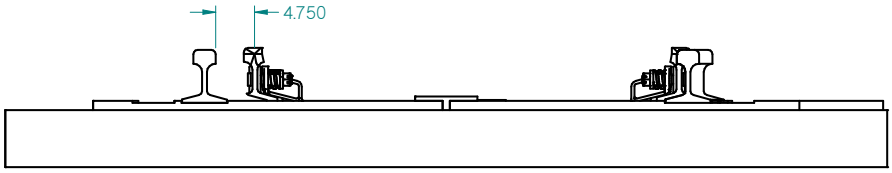
Figure 3.5 Switch rod locked at the center position
One lid not shown for illustration purpose only



CAUTION: The switch rods must be properly centered using the internal center device. Failure to properly center the switch rods will cause the throw distance and the spring force to be unevenly distributed and can damage the hydraulic cylinder or allow the point to open under traffic.

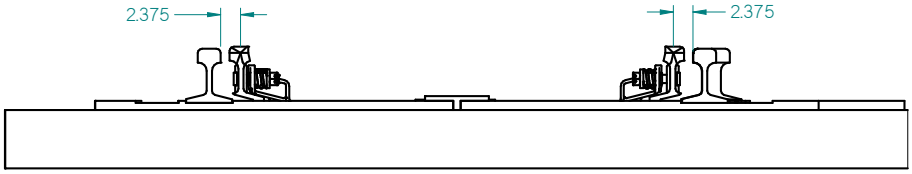
6. Measure the distance between the open point and the stock rail. It is recommended to adjust the throw to 4-3/4" (120mm). See Figure 3.6;

Figure 3.6 Measuring the throw



   a. Use a lining bar to center the points to half of the throw 2-3/8 (60mm), wedge in place using wood if possible. See Figure 3.7;

Figure 3.7 Centering the points



   b. Connect the connecting rods to the point bars. See Figure 3.8;

   c. Tighten the clevis pin nut and insert the cotter pin where needed;

7. Install the switch machine base plate if available and drill all the holes;

8. The connecting rods must be aligned as close as possible to the point bars alignment;

9. Be sure the point open distances did not change. See Figure 3.7;

10. If the switch will be installed direct to the wood tie proceed as follow:

   a. Move the switch machine to the desired distance from the rail to install the basket connecting rod first; the second connecting rod can be adjusted to fit the distance between the point bar hole and the switch machine rod hole;

   b. The switch machine must be installed parallel to the rail. See Figure 3.8;

11. Use hand tools to loosen the nuts and properly connect the connecting rods to the switch rods, install the pin, nut, cotter pin and tighten all nuts;

12. Pre-assemble the mounting studs supplied with the switch machine;
13. Install the tapered nut and jam nut to one side of the stud and tighten the nuts;

14. Drill a 7/8” (22mm) holes for the mounting studs;

15. Before drilling, be sure any mounting pads beneath the ties are cleared;

16. Clean the hole and insert the stud pre-assembled with the top tapered nut and jam nut;

17. It is also recommended to have someone observing the position of the drill to be sure it is vertical when drilling;

18. Only four holes and studs are needed to install the switch machine on wood or composite head block ties with or without steel base plate;

19. It is recommended to use the center hole of each switch machine foot to install the studs.

    a. Two additional holes are supplied per foot and can be used if the central hole cannot be used;

Figure 3.8 Switch machine installed and hardware for wood tie

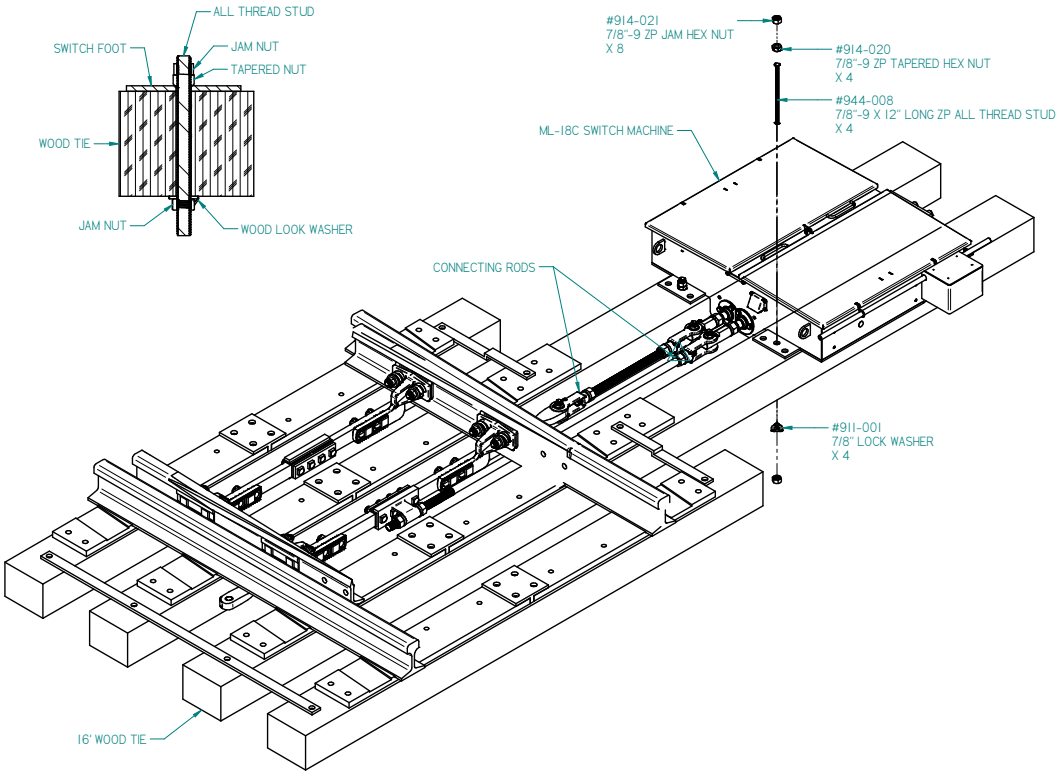
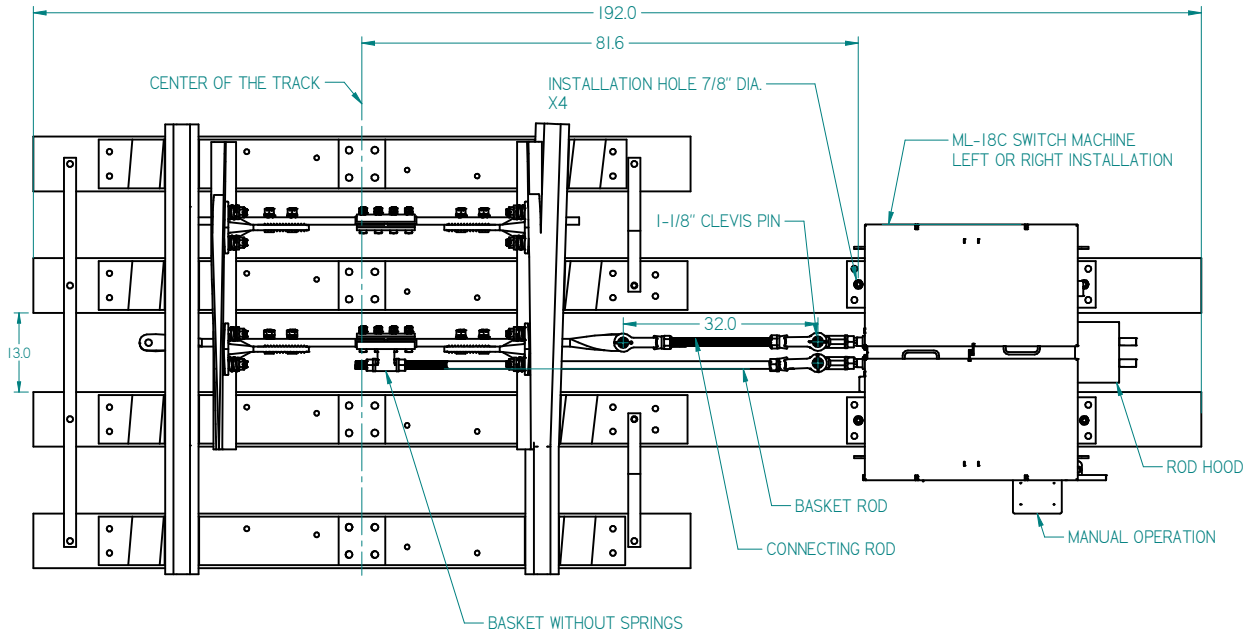


Figure 3.9 Switch machine installed at normal position with recommended distances



20. Install the washer, nut and jam nut to the studs under the tie or lock washer and nut, see Figure 3.8 and tighten all nuts;

21. With all the studs installed, check again the points distance. A small variation at the point should not affect the switch operation;

    a. Check the half throw distance, recommended 2-3/8” or 60mm;

3.4 Installation on steel head block ties

1. Only four holes and studs are used to install the switch machine on steel head block ties;

2. It is recommended to use the center hole of each switch machine foot to install the studs but two other holes per foot are supplied and can be used when the central hole cannot be used;

3. Installation steps are the same to install the switch machine on wood or composite head block ties using two tapered hex nut and jam nuts per stud;

4. If the steel head block ties do not have the holes pre-drilled to install the switch machine, the holes can be easy drilled using a small magnetic base drill using a 1” (25mm) drill bit;

5. The switch machine must be positioned on the steel head block ties at the desired distance from the rail and you can have the mounting hole locations marked using a pencil or spray;

3.5 Preparation for manual operation;

1. Insert the hand pump handle to the manual pump socket;

2. Return the center device levers to the release position and insert the safety pin;

WARNING: Prior to moving the center device levers to the release position, be sure there are no personnel working on the track near the points.

CAUTION: During the stud installation, the switch rod can move from the center position a little and can cause the center device tab to be jammed not allowing the center device lever to return to the release position. To release the center device lever manually pump to one direction or another slowly until the pressure on the lever is released. When the lever is free to move, stop pumping, move the lever to the release position and install the safety pin.

3. Manually pumping, move the switch to normal or reverse turnout position;

    a. Observe if the points are correctly closing in both directions;

    b. Instructions how to operate the switch machine manually can be found in section 2 - item 2.3.1;

3.6 Proximity sensors adjustment

a. The switch machine is supplied with the sensors adjusted for a 6-1/2” throw distance. The sensors need to be adjusted to the proper throw distance during the installation;

b. To avoid a false point indication, the sensors are adjusted to indicate the points are closed with the approved gap between the point and the stock rail the railroad uses as a standard;

c. To adjust the sensors, it is recommended to use a point gap gauge, normally supplied with four flat bar thicknesses: 3/16”, 1/4”, 5/16” and 3/8”. See Figure 3.10;

d. This manual explains how to adjust the sensors using the 1/4” and 3/8” bar gauge, but the sensors can be adjusted using others gauges dimensions;

e. First step – Open the point manually operating the ML-18C switch machine and insert the gauge with the 1/4” bar between the point and the stock rail. See Figure 3.11;

Figure 3.10 Point recommended gauge

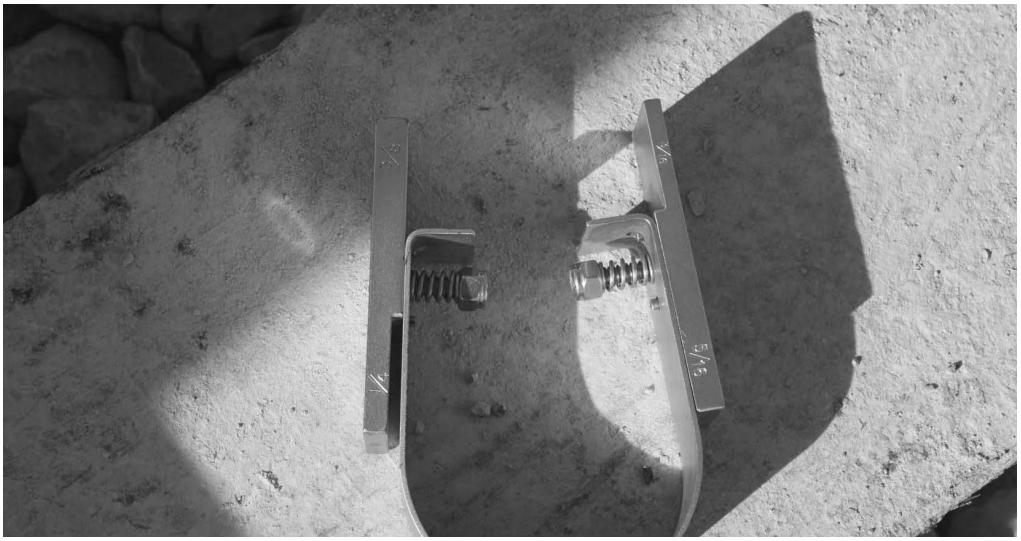


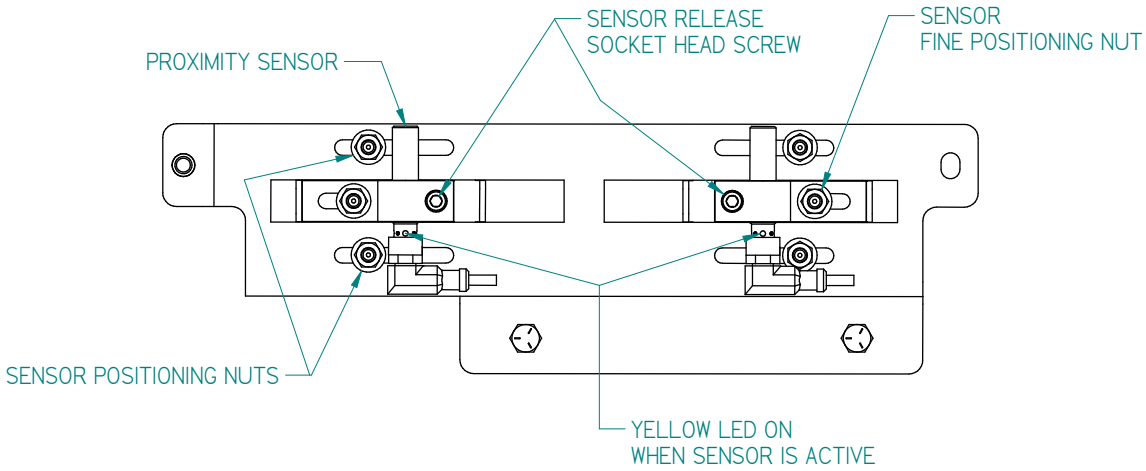
Figure 3.11 Gauge installed at the stock rail

f. Second Step – Close the point against the 1/4” bar gauge. See Figure 3.12;

Figure 3.12 Point closed against the gauge

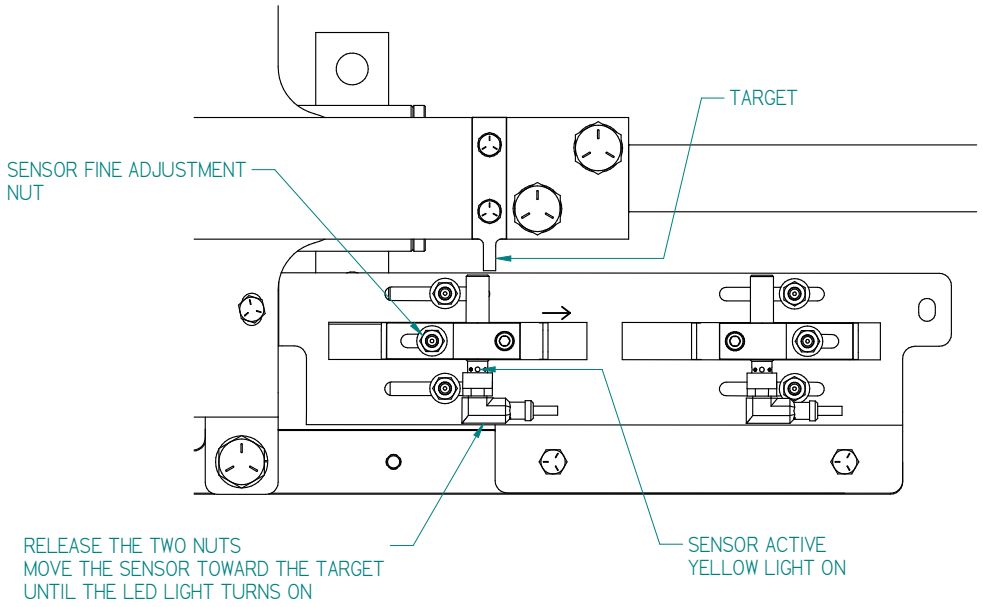
a. Third step – Identify the sensor nearest of the target and loosen the sensor positioning nuts. See Figure 3.13;

Figure 3.13 Sensor bracket layout



b. Fourth step - move the sensors toward the target until the sensors LED turns on, back the sensor until the LED lights turns off and tighten the sensor positioning nuts. See Figure 3.14;

Figure 3.14 Moving the sensor near the target



i. Fifth step - Loosen the sensor fine positioning nut, see the Figure 3.17, move the sensor toward the target until the LED light just turns on, then tighten the sensor fine positioning nut;

j. Sixth step – Open and close the point, manually operating the switch machine, to verify if the sensor LED light is on using the 1/4” gap gauge, adjust as necessary until you have a steady indication;

k. Seventh step – Open and close the point, manually operating the switch machine, to verify if the sensor LED light is off using the 3/8” gap gauge, adjusting as necessary until you have a steady indication;

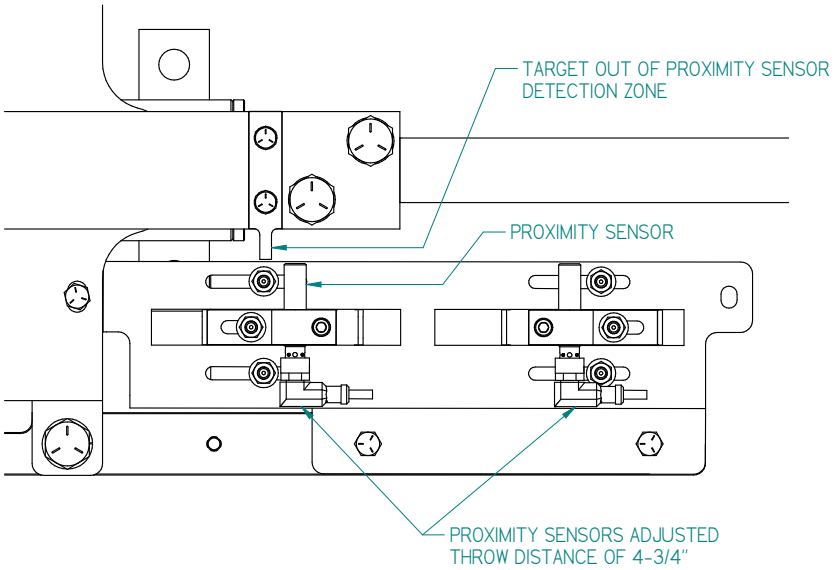
l. Manually operate the switch to move the points to the other turn out position;

m. Repeat the step 1 through 7 to adjust the other proximity sensor;

n. When both sensors are correctly adjusted, the target will be travelling in the space between the two proximity sensors;

NOTE: When the proximity sensors are correctly adjusted to the recommended 4-3/4” (120mm) throw distance and the connecting rod becomes free or is broken, the target will travel up to 6-1/2” (165mm), maximum switch machine throw distance and the sensor will not be able to detect the target so an out of correspondence will be shown. See Figure 3.15;

Figure 3.15 Target out of proximity sensor's detection zone.



4 Connect the battery cable and control cable to the terminal block;

   a. If a battery is AC charged or Solar Panel charge is in place, ensure all the cables are connected and the system is charging the battery correctly;

   b. The control cable must be wired according to the wire diagram supplied with the switch machine or for the particular application;

WARNING: Always inform the installation personnel to stay clear of the switch points or any other moving part before operating the switch machine as severe injury can occur.

5 Remove the hand pump handle from the pump socket, return the handle to the rest position and close the pump cover;

6 Test the switch machine operation, using the pushbutton or remote command to move the switch to normal and reverse;

7 Verify if the sensors are detecting the point opened with the 1/4" and 3/8" gauge bar, adjust the sensor following the procedures described in this section, item 3.5 step 1 through 7;

8 When complete, check all sensor nuts are tightened and verify there are no tools inside the switch machine. Close the lid and install any locks.

9 The switch machine installation is complete.

3.7 Changing the switch machine position indication

During the installation or relocation of the switch machine, it may be necessary to change the switch machine indication or the indication of the direction of movement from normal to reverse or vice versa.

Following the below instructions to change the direction of movement to correspond with the switch machine positioning indication:

1. Loosen the hydraulic directional valve solenoid plug connectors and replace one with the other;
    a. Tighten the screws again;

2. Loosen the proximity sensor socket nuts and replace one with the other;
    a. Tighten the nuts again;

This process will eliminate the need for changing the identification of the cables

4 SECTION 4 – TROUBLESHOOTING

This section will describe possible basic failures and symptoms along with corrective actions considering the use of the switch control unit supplied.

4.1 Switch machine, locally controlled, does not respond to local pushbutton command.

1) Switch machine and/or switch control unit is not powered.

a) Check the control voltage;
   i) If the voltage is 12VDC +/-10% proceed as follows:
      (1) Check cable connections;
      (2) Check fuses and breakers;
      (3) Check the switch control unit connectors;
   ii) If the control voltage is lower than 10VDC;
      (1) Verify the control power source;
      (2) If a battery 12VDC is available as control power source;
         (a) Check the battery AC charging system or;
         (b) Check the solar panel control charge system;
            (i) Verify if the number of throws of the switch machine exceed the ability of the battery to stay charged;
            (ii) Verify there are no areas of energy drain or any increase of electric load to the system;

2) Switch machine and switch control unit is powered.

a) Check if the pushbutton (PB) command is being received by the switch control unit, **if not** do the following:
   i) Observe the PB input LED light;
      (1) If it does not turn on when the PB is applied;
         (a) Check if the 12VDC control power is present at the PB contacts;
         (b) Check if the PB contacts are closing, if not replace the PB;
         (c) Check the cable connections;
   ii) Check if the pushbutton (PB) command is being received by the switch control unit, **if yes** do the following;
      (1) If PB LED input turns on but no HPU motor & Control Valve Solenoid outputs LEDs turn on do the following;
         (a) Check if the switch machine throw is restricted by:
            (i) Over the switch protection system;
               1. Input LED of presence detection system is on;
                  a. The switch machine will move when the track over the switch machine is not occupied.
               2. Maintenance of way (MOW) switch (if available) is on;
                  a. Input LED of MOW switch is on;
                     i. Ask for authorization to turn the switch off.
               3. Switch control unit is in fault mode;
                  a. Output LED Fault mode is on;
                     i. Manually hand pump the switch to the other point position;
                  b. Remove and reapply power to the SCU;
                     i. Inspect the switch for operation failure.

b) If PB LED input turns on and the HPU and Solenoid output LED turns on, do the following:
   i) Observe If the power unit motor turns on and off immediately after a command is sent;
      (1) Switch machine has been run through or hand pumped and is not in correspondence;
         (a) Hand pump to the other position;
         (b) Repeat the throw command again;
   ii) Check if the 12VDC control voltage power is present to the motor power relay when the PB is applied, you can hear/feel the contact closing or use a voltage meter;
      (1) Check if the 12VDC motor power voltage is present using a voltage meter;
      (2) Check the cable connections;

iii) Check if the motor brushes are worn: motor running slow or does not run;
iv) Check the oil level at the reservoir, it must be at 1/2 of the tank height;
    (1) See hydraulic oil recommendation on Section 5 table 5.2;
v) Check if the solenoid directional control valve is receiving the 12VDC control power, you can hear/feel the cartridge moving or use a voltage meter;
    (1) Check the cable connections;
    (2) Operate the directional control valve manually to check if the valve cartridge is working properly. See Figure 1.6;
        (a) The internal valve cartridge can be moved manually to check if the valve is working properly using a small hex key. You can insert a hex key at the manual operation orifice on each side of valve.
        (b) Apply a small force to move the valve cartridge from the spring centered position. You will feel the spring action trying to return the cartridge to the center position. If the cartridge is not working properly, replace the valve.

4.2 Switch machine, remote controlled, does not respond to local pushbutton command.

1) Switch machine and/or switch control unit **is not powered**, repeat the instructions above item 1) a).

2) Switch machine and switch control unit **is powered**, repeat the instructions above item 1) b).

4.3 Switch machine, remote controlled, does not respond to remote command.

1) Switch machine and/or switch control unit **is not powered**, repeat the instructions above item 1)a);

2) Switch machine and switch control unit **is powered** do the following;

    a) Check if any output command, HPU and solenoid LEDs at the Switch Control Unit turns on when the remote command is sent to the switch machine, **if not do the following**;
        i) Check if the data radio unit (if present) are powered and working properly;
            (1) Verify the data radio antenna signal and alignment are working;
            (2) Verify the data radio antenna cable and connections;
        ii) Check if the VHF radio unit (if present) is powered and working properly;
            (1) Verify the VHF radio cable and connections;
        iii) Check if the switch machine throw command is restricted by:
            (1) Verify the over the switch protection system is functioning;

(a) Input LED of presence detection system is on;
(i) The switch machine cannot be controlled when the track over the switch machine is occupied.
(2) Verify if the MOW switch is on;
(a) Input LED of MOW switch is on;
(i) Ask for authorization to turn the switch off.
(3) Verify if the switch control unit is in fault mode;
(a) Output LED Fault mode is on (ARS controller);
(i) Manually hand pump the switch to the other point position;
(b) Remove and reapply power to the SCU;
(i) Inspect the switch for operation failure.

b) Check if the power unit motor turns on and off immediately after a command is received;
i) Switch machine has been run through or hand pumped and is not in correspondence;
(1) Hand pump to the other position;
(2) Repeat the throw command again;

c) Check if the power unit motor turns on, but the switch machine rods does not move, do the following:
i) Check if the 12VDC control power is being received at the motor start solenoid when the PB is applied, you can hear/feel the contact closing and/or use a voltage meter;
(1) Check the cable connections;
(2) Check if the motor brushes are worn: motor running slow or does not run;
(3) Check the oil level at the reservoir, it must be at 1/2 of the tank height;
(a) Top up the oil level if necessary;
(b) See hydraulic oil recommendation on section 5 table 5.2;
(i) Inspect the hydraulic system looking for any oil leakage;
ii) Check if one of the solenoid direction control valve output LED turns on;
(1) Check if the solenoid directional control valve is receiving the 12VDC control power, you can hear/feel the cartridge moving and/or use a voltage meter;
(a) Check the cable connections;
(b) Operate the directional control valve manually to check if the valve cartridge is working properly, see section 4, item 4.1 - 2) b) v) (2).

4.4 The switch hydraulic power unit HPU still runs after the switch has completed the throw.

1) The HPU must be turned off when the proximity sensor is detected.

2) The HPU must be programmed to run up to 2-3 seconds if the proximity sensor is not detected at the end of the throw.

    a) The Verify if any proximity sensor LED input is on at the SCU, if not do the following;
        i) Check if the proximity sensor is detecting the target observing the LED sensor light located at the sensor body near the socket nut,
            (1) If the sensor LED is on, the sensor is detecting the target;
                (a) Check all the sensor cable connections;
            (2) If the sensor LED is off, the sensor is not detecting the target;
                (a) The proximity sensor may be out of adjustment;
                    (i) Follow the instructions on section 3 – item 3.5;
                (b) Check if the proximity sensor is damaged, replace if required;

4.5 The switch hydraulic power unit cannot complete the throw.

1) Observe any type of obstruction that could block the switch movement;

2) If the HPU starts the movement and stops during the programmed running time;

    1) Check if the pressure relief valve is installed at the HPU is open, intermittent sound;
        i) The pressure setting is too low to move the turnout, adjust the pump pressure valve;

3) Check the motor power voltage;

    1) The motor power voltage must be at least 12VDC +/- 10%;
        i) Measure the power voltage when the motor is turned on;
        ii) If the power voltage is too low, check the power/charger system;

4.6 The hand pump is not working properly.

1) Verify if the lever of the hydraulic control valve is positioned to the right or to the left;
    1) Move the lever to the direction you want to move the point;

2) If the switch is been operated for the first time or the hydraulic system was recently repaired, there is air inside the manifold block;

    1) To remove the air in the hydraulic circuit, the switch needs to be operated electrically to both directions 3 or more times;

2) Start pumping in one direction until it becomes hard to pump, move the lever to the other position and pump again until it is hard to pump again;
   i) Repeat the operation above two or three times until the piston movement is smooth and consistent in both directions;

3) If the hand pump only works in one direction, the hydraulic fluid inside the reservoir is too low or the hand pump check valves located at the manifold may not be working properly;

Contact the technical support for further instructions if needed.

5 SECTION 5 – SCHEDULED MAINTENANCE

The following periodic preventive maintenance procedures are intended to detect any possible causes of switch machine failure before it occurs.

To detect any possible failure a periodic inspection and performance test are required to maximize service life and to ensure continued safe operation.

The recommended preventive maintenance actions are presented in Table 5.1.

The actual frequency will depend upon use or the customers own operating rules.

Table 5.1 Preventive maintenance schedule

Frequency	Equipment	Type of Action		
		Inspection	Clean	Performance test
Every Three Months	Switch Layout	X		
	Switch Machine			X
Every Six Months	Switch Machine	X	X	

There is no need for lubrication, all internal bearings are greased and sealed for life.

5.1 Preventive maintenance

WARNING: All field maintenance must be executed according to the customers' safety rules. Do not start any inspection, adjustment or maintenance on the track layout or switch machine without authorization and confirm the switch operation is disabled from locally and remote activation or severe personal injury may result.

5.1.1 Inspection

The inspection consists of observing the interior of the switch machine and the integrity of the switch layout.

If the inspection indicates that any adjustment or replacement parts are required, contact the manufacturer technical support.

5.1.1.1 Switch layout inspection

1. Check the switch points to be sure they are properly adjusted and remove any debris that could obstruct switch movement;

2. Check tie plates, tie straps, rail braces, point bars, connecting rod pins and if all nuts and jam nuts are tight;

5.1.1.2 Switch machine inspection

1. Open the switch machine lid and observe the interior of the switch machine, looking for a potential or obvious faulty condition;

2. Using the hand pump, operate the switch machine back and forth as necessary and check for a smooth and proper operation without undue drag or vibrations;

3. Check if the proximity sensors nuts are tightened;

4. Check all the electrical cables looking for loose connections;

5. Inspect the liquid tight cable fitting connections;

6. Electrically operate the switch machine and check for unusual vibration and noise;

7. Observe if the hydraulic pump motor shuts off at the end of each switch throw;

8. Check if the yellow LED light of each proximity sensor is on when the switch is properly positioned normal and reverse;

9. Check the hydraulic fluid level at the reservoir;

10. Observe any sign of hydraulic oil accumulation;

    a. Look for any hydraulic leak from the hydraulic cylinders, manifold, pump and fittings;

11. Check the control voltage;

a. Open Circuit Voltage 12VDC +/- 10% at 68°F;

b. If the control voltage is low, verify if the power/battery charger system is working properly;

c. If the battery is used and it is showing a voltage lower than 10VDC it is recommended to be tested, charged or replace it;

12. Observe any sign of moisture accumulation;

13. The moister check should be made prior to winter freezing weather

5.1.2 Cleaning

If the switch machine is installed where blowing sand, dust or constant flooding can occur; the drain plug can be removed to allow whatever moisture and dirt has accumulated to drain.

A 3/4”-14 NPT pipe plug is located at the bottom of the switch machine near the proximity sensors.

A water-based degreaser, lint free cloth or paper towels can be used to clean the switch machine internal parts of any accumulated dirt.

After the switch machine has been inspected and cleaned, reinstall the drain plug, close the lid and reattach the padlock.

5.1.3 Switch machine performance test

A performance test should be done according to the customer’s operating rules.

The switch must be operated manually and electrically while inspecting for erratic or faulty operation.

The proximity sensors indication must be checked using a point gauge to simulate the point open and out of correspondence situation.

If the proximity sensor adjustment is necessary, see section 3 item 3.5 and following steps.

When any other correction or repair are needed, contact the manufacturer technical support for instructions.

5.2 Hydraulic oil

When it is necessary to replace the hydraulic oil, or add hydraulic oil to the reservoir, only use the hydraulic oil recommended by the manufacturer. See Table 5.2.

The hydraulic oil recommended is a premium mineral base hydraulic oil, red dyed, with a high viscosity index particularly suitable for the switch machine subject to wide temperature variation. The hydraulic oil has good anti wear properties and it is compatible with the synthetic rubber components used.

The reservoir oil level must be kept to ¾ of the reservoir height.

CAUTION: Using other types of fluids not recommended by the manufacture may cause the pump, and valves to fail and can damage the valves, cylinder seals and wear bands. Use of non-recommended oil will void the warranty on the hydraulic components in the switch machine.

Table 5.2 Recommended hydraulic oil

Lubrificant Brand	Specification/Grade	Operation Temperature
SHELL	AEROSHELL FLUID 4	-54° to +90°C -65°F to +194°F
EXXON	UNIVIS J13	
MOBIL	AERO HFA	
PHILLIPS	66 X/C 5606	

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