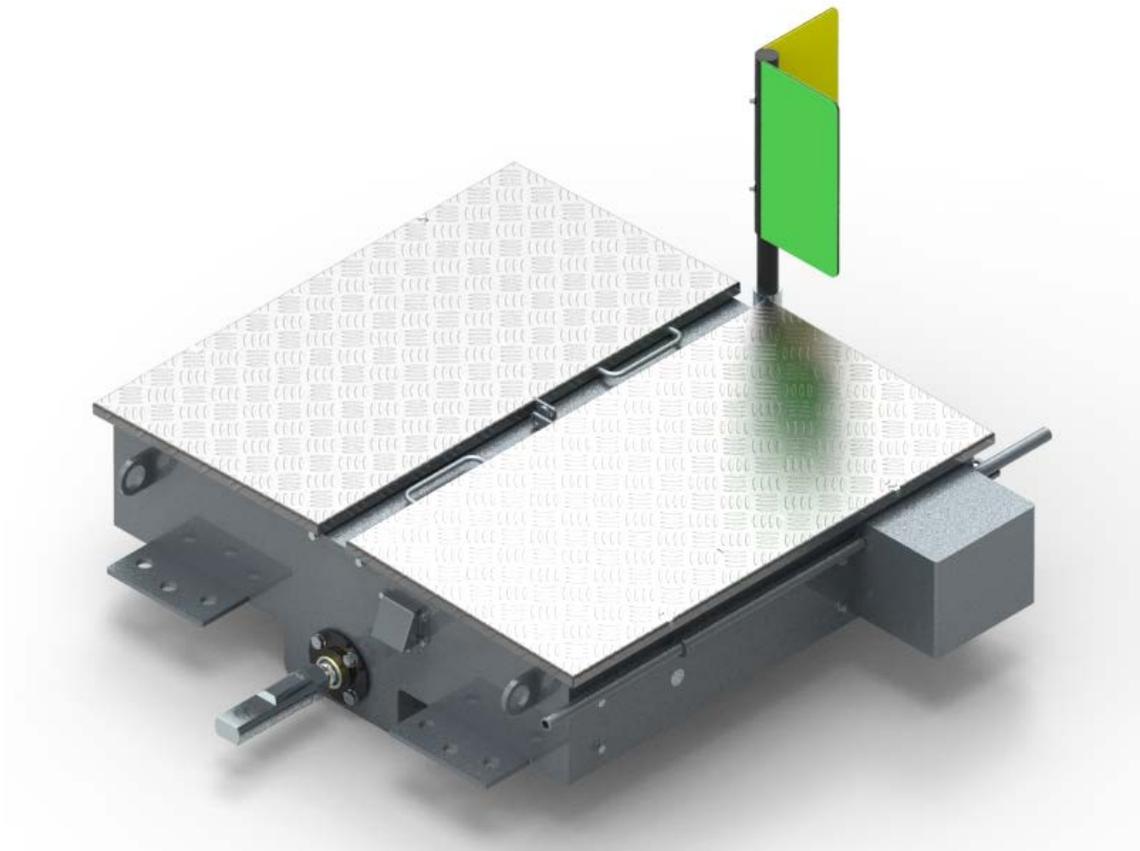


Model YM-16 Electric Hydraulic Switch Machine



Installation, Operation and Maintenance Manual

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REVISION LOG

REVISION	DATE	DESCRIPTION	BY
-	JULY 2016	ORIGINAL ISSUE	DSR
1	MAR 2017	Removed adjustment screw from sensor bracket. Updated drawings & part numbers section 1 & 7. Updated drawings and information section 3 – item 18, Proximity sensor adjustment.	DSR
2	OCTOBER 2018	Updated switch housing adding 2 lids; Add center top channel; Updated target parts; Updated center device lever locking feature; Updated hand pump bracket; Updated low-profile sensor support; Pressure limit switch become standard feature; Add special thread holes at the switch side for position lights and external push buttons installation; New Figures with LED lights and push button installed; Updated drawings and part list where needed.	DSR
3	JANUARY 2019	Orthographic correction page 1 Updated drawings and list of parts. Section 7	DSR



This manual is intended to provide the necessary information to install and ensure the proper operation and maintenance procedures for the Model YM-16 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 YM-16 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 – CORRECTIVE MAINTENANCE

This section describes the parts replacement or necessary adjustments to return the switch machine to operation.

SECTION 6 – SCHEDULE MAINTENANCE

This section describes the preventative maintenance procedures, functional tests and recommended frequency and interval of inspections.

SECTION 7 – LIST OF PARTS

This section lists all the switch machine parts and components.

SECTION 8 – AUXILIARY DRAWINGS

This section provides wiring and hydraulic schematic drawings.

SECTION 9 – OPTIONALS AND ACCESSORIES

This section provides the list of options and accessories that can be supplied with the switch machine.

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.

Table of Contents

1	SECTION 1 – GENERAL INFORMATION	1
1.1	<i>Introduction</i>	1
1.2	<i>Description</i>	1
1.3	<i>Specification</i>	3
1.3.1	Physical characteristics	3
1.3.2	Operating characteristics	3
1.3.3	Electrical characteristics	3
1.4	<i>Switch machine dimensions</i>	4
1.5	<i>Switch machine internal layout</i>	6
1.6	<i>Switch machine components</i>	6
1.6.1	Hydraulic system	6
1.6.1.1	Hydraulic power unit	7
1.6.1.2	Hydraulic manifold	8
1.6.1.3	Hydraulic cylinder	9
1.6.1.4	Hydraulic pressure and return lines	10
1.6.2	Cylinder centering device	10
1.6.3	Spring assembly	11
1.6.4	Switch point detection	12
1.6.5	Mechanical target	13
1.6.6	Electrical system	14
1.6.7	Battery charging	15
2	SECTION 2 – OPERATION	16
2.1	<i>Electric controlled operation</i>	16
2.2	<i>Electric controlled operation with pressure limit switch</i>	18
2.3	<i>Manually operated</i>	19
2.3.1	Hand throw operation	19
3	SECTION 3 – INSTALLATION	21
3.1	<i>Installation recommendations</i>	21
3.2	<i>Tools required for installation</i>	21
3.3	<i>Installation on wood or composite head block ties</i>	22
3.4	<i>Installation on steel head block ties</i>	38
4	SECTION 4 – TROUBLESHOOTING	40
4.1	<i>Switch machine, locally controlled, does not respond to local pushbutton command.</i>	40
4.2	<i>Switch machine, remote controlled, does not respond to local pushbutton command.</i>	41
4.3	<i>Switch machine, remote controlled, does not respond to remote command.</i>	42
4.4	<i>The switch hydraulic power unit HPU still runs after the switch has completed the throw.</i>	43
4.5	<i>The switch hydraulic power unit cannot complete the throw.</i>	43
4.6	<i>The hand pump is not working properly.</i>	44
5	SECTION 5 – CORRECTIVE MAINTENANCE	45
5.1	<i>Corrective and disassembly procedures</i>	46
5.1.1	Hydraulic components	46
5.1.1.1	Hydraulic power unit	47
5.1.1.1.1	Hydraulic oil	48
5.1.1.1.2	Operation pressure adjustment	48
5.1.1.2	Manifold	49
5.1.1.2.1	Solenoid directional control valve	50
5.1.1.2.2	Manual directional control valve	52
5.1.1.2.3	Hand pump piston	53
5.1.1.3	Pressure limit switch	55
5.1.1.4	Switch machine hydraulic cylinder	56
5.1.2	Mechanical components	63

5.1.2.1	Cam roller bearing	63
5.1.2.2	Spring arm bearing	63
5.1.2.3	Front rod bushing	64
5.1.3	Electrical components	65
5.1.3.1	Proximity sensors replacement & adjustment	65
5.1.3.2	Changing the switch machine position indication	66
5.1.3.3	Battery replacement	66
6	SECTION 6 – SCHEDULED MAINTENANCE	67
6.1	<i>Preventive maintenance</i>	67
6.1.1	Inspection	67
6.1.1.1	Switch layout inspection	67
6.1.1.2	Switch machine inspection	68
6.1.2	Cleaning	69
6.1.3	Switch machine performance test	69
7	SECTION 7 – LIST OF PARTS	70
7.1	<i>Switch machine housing</i>	70
7.2	<i>Switch machine lid</i>	71
7.3	<i>Cylinder centering device subassembly</i>	72
7.4	<i>Front rod bushing & flange subassembly</i>	72
7.5	<i>Hydraulic cylinder subassembly</i>	73
7.6	<i>Cylinder top bracket subassembly</i>	73
7.7	<i>Spring arm & clevis subassembly</i>	74
7.8	<i>Clevis pivot bracket subassembly</i>	74
7.9	<i>Hydraulic manifold subassembly</i>	75
7.10	<i>Hand piston subassembly</i>	75
7.11	<i>Hand piston flange subassembly</i>	76
7.12	<i>Hydraulic power unit subassembly</i>	76
7.13	<i>Pressure limit switch</i>	77
7.14	<i>Hydraulic Tubing</i>	77
7.15	<i>Battery</i>	78
7.16	<i>Battery Cables</i>	78
7.17	<i>Sensors Bracket Subassembly</i>	79
7.18	<i>Target Subassemblies</i>	80
7.19	<i>Electronic base plate</i>	81
7.20	<i>Hydraulic mounting hardware</i>	81
7.21	<i>Central Bracket and cable tray</i>	82
7.22	<i>Switch machine subassemblies list</i>	83
7.23	<i>Switch machine electrical components list</i>	83
7.24	<i>Switch machine parts list</i>	84
7.25	<i>Seals and hydraulic components list</i>	85
7.26	<i>Switch machine hardware list</i>	86
7.27	<i>Mechanical target color options</i>	88
8	SECTION 8 – AUXILIARY DRAWINGS	89
8.1	<i>YM-16 Hydraulic diagram</i>	89
8.2	<i>YM-16 Electric diagram</i>	90
9	SECTION 9 – OPTIONALS AND ACCESSORIES	91
9.1	<i>Switch machine connecting rod</i>	91
9.2	<i>Switch machine position light</i>	93
9.3	<i>Mechanical target enhancement</i>	95
9.4	<i>Switch machine with local push button</i>	96
9.5	<i>Switch machine rear stand & electronic box.</i>	97

List of tables

Table 1.1 Physical characteristics	3
Table 1.2 Operating characteristics	3
Table 1.3 Electrical characteristics	3
Table 3.1 Tools requires for installation	22
Table 5.1 Tools requires for maintenance	45
Table 5.2 Recommended hydraulic oil	48
Table 6.1 Preventive maintenance schedule	67
Table 7.1 Switch machine subassemblies	83
Table 7.2 Switch machine electrical components	83
Table 7.3 Switch machine part list	84
Table 7.4 Seals and hydraulic components list	85
Table 7.5 Switch machine hardware list	86
Table 7.6 Mechanical target color options	88
Table 9.1 Connecting rod part list	92
Table 9.2 Connecting rod length	93

List of Figures

Figure 1.1 Switch front & side view	4
Figure 1.2 Switch top view	4
Figure 1.3 Switch foot print	5
Figure 1.4 Switch internal layout without top channel	6
Figure 1.5 Hydraulic power unit (HPU)	7
Figure 1.6 Hydraulic manifold	8
Figure 1.7 Hydraulic cylinder	9
Figure 1.8 Cylinder centering device	10
Figure 1.9 Locking spring assembly	11
Figure 1.10 Proximity sensors bracket	12
Figure 1.11 Cam roller bearing	13
Figure 1.12 Mechanical target	14
Figure 1.13 Battery dimensions	15
Figure 2.1 Basic operation sequence	17
Figure 2.2 Pressure limit switch	18
Figure 2.3 Hand pump handle	19
Figure 2.4 Hand pump operation	20
Figure 3.1 Cleaning crib space	23
Figure 3.2 Removing the release pin	24
Figure 3.3 Center device lever at the active position	24
Figure 3.4 Hand pump handle in place	25
Figure 3.5 Switch rod locked at the center position	25
Figure 3.6 Measuring the throw	26
Figure 3.7 Centering the points	27
Figure 3.8 Connecting the connecting rod clevis to the point bar	27
Figure 3.9 Positioning the switch on the head block ties	27
Figure 3.10 Installing the connecting rod to the switch	28
Figure 3.11 Installation hardware for wood or composite head blocks	28
Figure 3.12 Installation hardware using lock washer	29
Figure 3.13 Drilling the mounting holes with the switch machine in place	29
Figure 3.14 Installing the mounting studs	30
Figure 3.15 Washer and 2 nuts under the ties	30

Figure 3.16 Center device lever at the release position with safety pin	31
Figure 3.17 Switch machine being operated manually	32
Figure 3.18 Point recommended gauge	33
Figure 3.19 Gauge installed at the stock rail	33
Figure 3.20 Point closed against the gauge	34
Figure 3.21 Sensor bracket layout	34
Figure 3.22 Moving the sensor near the target	35
Figure 3.23 Target out of proximity sensor's detection zone.	36
Figure 3.24 Proximity sensors adjusted	36
Figure 3.25 Switch installed	37
Figure 3.26 Switch machine installation hardware for steel head blocks	38
Figure 3.27 Drilling the holes in the steel head block ties	39
Figure 3.28 Switch machine installed on the steel head block tie	39
Figure 5.1 Hydraulic system	46
Figure 5.2 Power unit and manifold mounting bolts	47
Figure 5.3 Pressure relief valve	49
Figure 5.4 Direction valves	50
Figure 5.5 Piston movement by solenoid direction valve	51
Figure 5.6 Piston movement by manual direction valve	53
Figure 5.7 Hand pump piston control valves	54
Figure 5.8 Hand pump piston and flange seals	54
Figure 5.9 Pressure limit adjustment	55
Figure 5.10 Cylinder at center position	57
Figure 5.11 Proximity sensor bracket removed	57
Figure 5.12 Target cover panel removed	58
Figure 5.13 Target shaft with quick disconnect ball joint location	58
Figure 5.14 Cylinder at the right position	59
Figure 5.15 Springs decompressed and free	59
Figure 5.16 Cylinder at the left position	60
Figure 5.17 Pivot bar, clevis and the springs removed	61
Figure 5.18 Front rod adapter, rod washers and nuts removed	61
Figure 5.19 Center bracket removed	62
Figure 5.20 Center bracket and battery cables & tray removed	62
Figure 5.21 Spring arm bearing set	63
Figure 5.22 Front rod flange	64
Figure 5.23 Proximity sensor replacement	65
Figure 5.24 Proximity sensor adjustment	65
Figure 7.1. Switch machine housing	70
Figure 7.2. Housing breather	70
Figure 7.3. Switch machine lid	71
Figure 7.4 Cylinder centering device subassembly	72
Figure 7.5 Front rod bushing & flange subassembly	72
Figure 7.6 Hydraulic cylinder subassembly	73
Figure 7.7 Cylinder top bracket subassembly	73
Figure 7.8 Spring arm & clevis subassembly	74
Figure 7.9 Clevis pivot bracket subassembly	74
Figure 7.10 hydraulic manifold subassembly	75
Figure 7.11 Hand piston subassembly	75
Figure 7.12 Hand piston flange subassembly	76
Figure 7.13 Hydraulic power unit subassembly	76
Figure 7.14 Pressure limit switch	77
Figure 7.15 Hydraulic tubing	77

Figure 7.16 Battery	78
Figure 7.17 Battery cables	78
Figure 7.18 Sensor bracket subassembly	79
Figure 7.19 Sensors bracket subassembly	79
Figure 7.20 Target shaft subassembly	80
Figure 7.21 Target housing subassembly	80
Figure 7.22 Target subassembly	81
Figure 7.23 <i>Electronic</i> base plate	81
Figure 7.24 Hydraulic mounting hardware	82
Figure 7.25 Central bracket and cable tray	82
Figure 8.1 YM-16 Hydraulic diagram	89
Figure 8.2 YM-16 Electric diagram (Typical)	90
Figure 9.1 Connecting rod range from 1'-4" up to 3'-10"	91
Figure 9.2 Connecting rod range from 4'-2" up to 25'	92
Figure 9.3 Position indication lights installed at the switch machine	93
Figure 9.4 Slim LED lights installed at the switch	94
Figure 9.5 Position lights at the rear stand mast	95
Figure 9.6 Mechanical target enhancement	95
Figure 9.7 Mechanical target positioned	96
Figure 9.8 Switch machine side push button	96
Figure 9.9 Solar panel powered switch machine	98

1 SECTION 1 – GENERAL INFORMATION

1.1 Introduction

This service manual provides information on the YM-16 electric hydraulic switch machine. The information in this manual should not be used for any other equipment or application.

1.2 Description

The YM-16 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 spring switch, hand throw switch or switch machine for mainline or yard applications.

The YM-16 electric hydraulic machine consists of a hydraulic power unit, manifold, double rod cylinder, two springs, a battery and two proximity sensors to detect the switch connecting rod position. All components are located in a steel low profile housing.

The direct drive design allows the switch to be connected to the point rod 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.

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

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

The YM-16 is trail-able, permitting train passage up to 20 mph without damage. Additional features can be incorporated to add a mechanical or hydraulic lock when required.

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. If the operation requires a constant run through, additional pressure release valve can be supplied to eliminate any possible wear or damage.

The YM-16 can move the points from one position to another in 1.2 seconds (average) considering a 4-3/4" throw distance.

The YM-16 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 indicate out of correspondence when the points are open or the connecting rod is broken or disconnected.

A mechanical target is included.

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

The YM-16 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-line to automatically position the switch to a train passing position,
- ✓ 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	43.5" (110.5cm)
Width	39.5" (100.3cm)
Height	8.7" (22.2cm)
Target height	24.2" (61.5cm) *
Weight	588Lb (267Kg)
Throw length	3.0 – 6.0 in (76 – 152 mm)
Throw force	3,750Lbf (16.7KN) **
Spring holding force	2,000Lbf (7.1KN) ***

* Basic machine with mechanical target installed.

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

*** The spring holding force can be increased or reduced upon request.

1.3.2 Operating characteristics

Table 1.2 Operating characteristics

Parameter	Specification
Throw time	1.2 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 PNP - NO - 12VDC output – 3 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	20A @ 12VDC

1.4 Switch machine dimensions

Figure 1.1 Switch front & side view

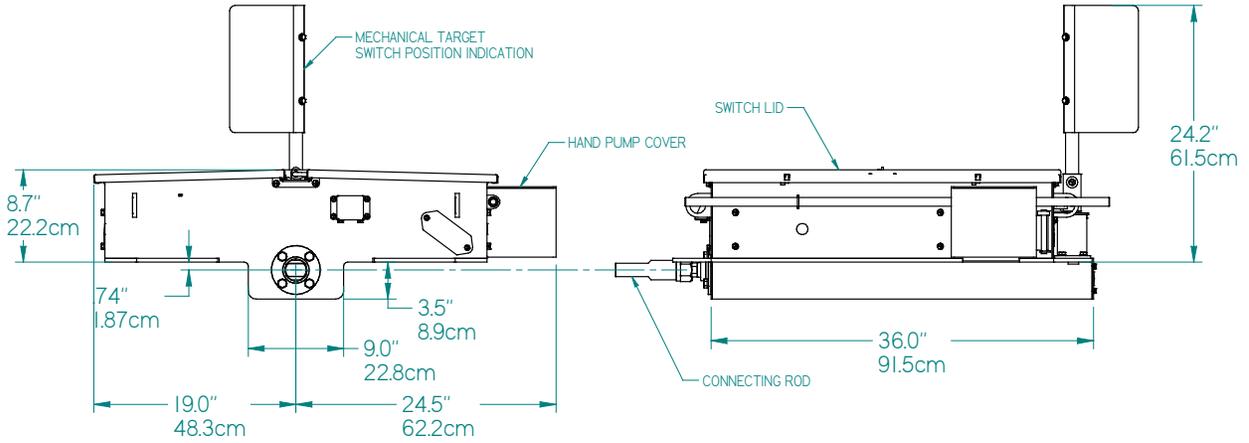


Figure 1.2 Switch top view

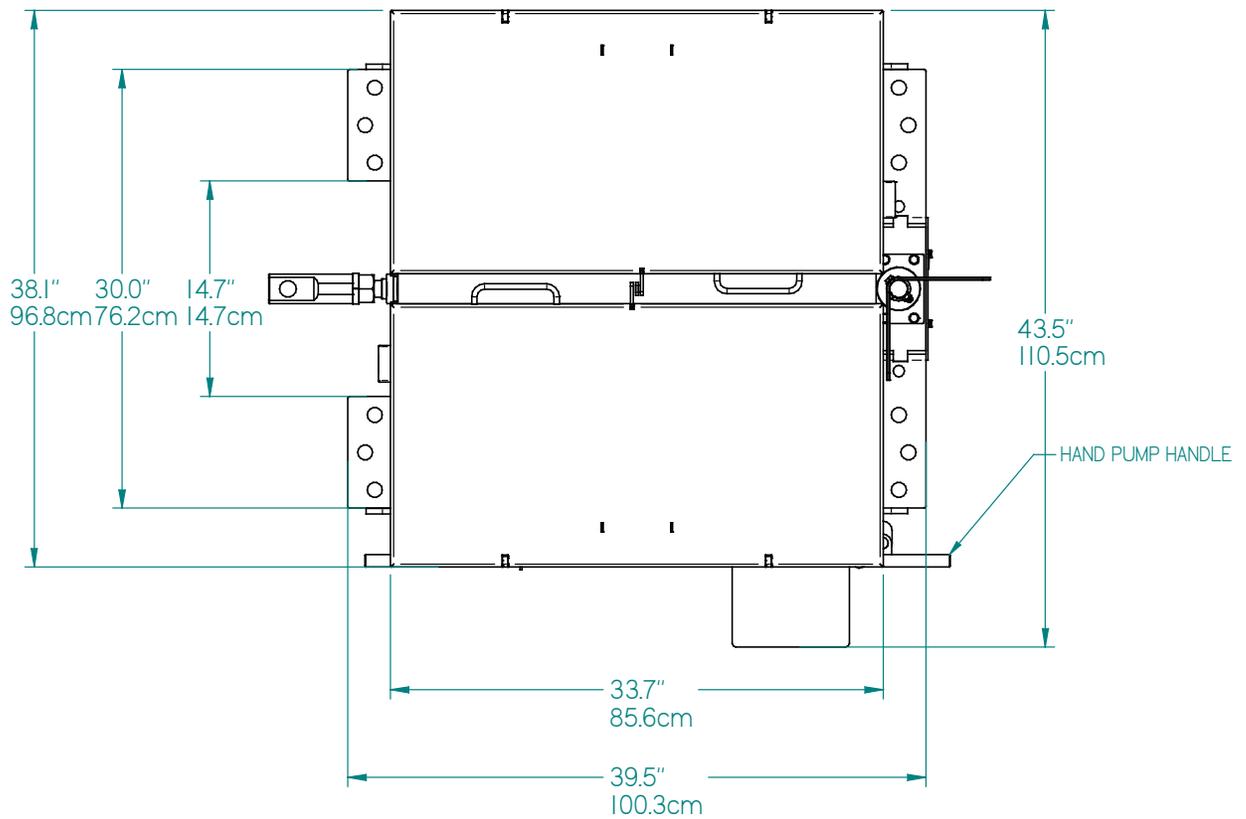
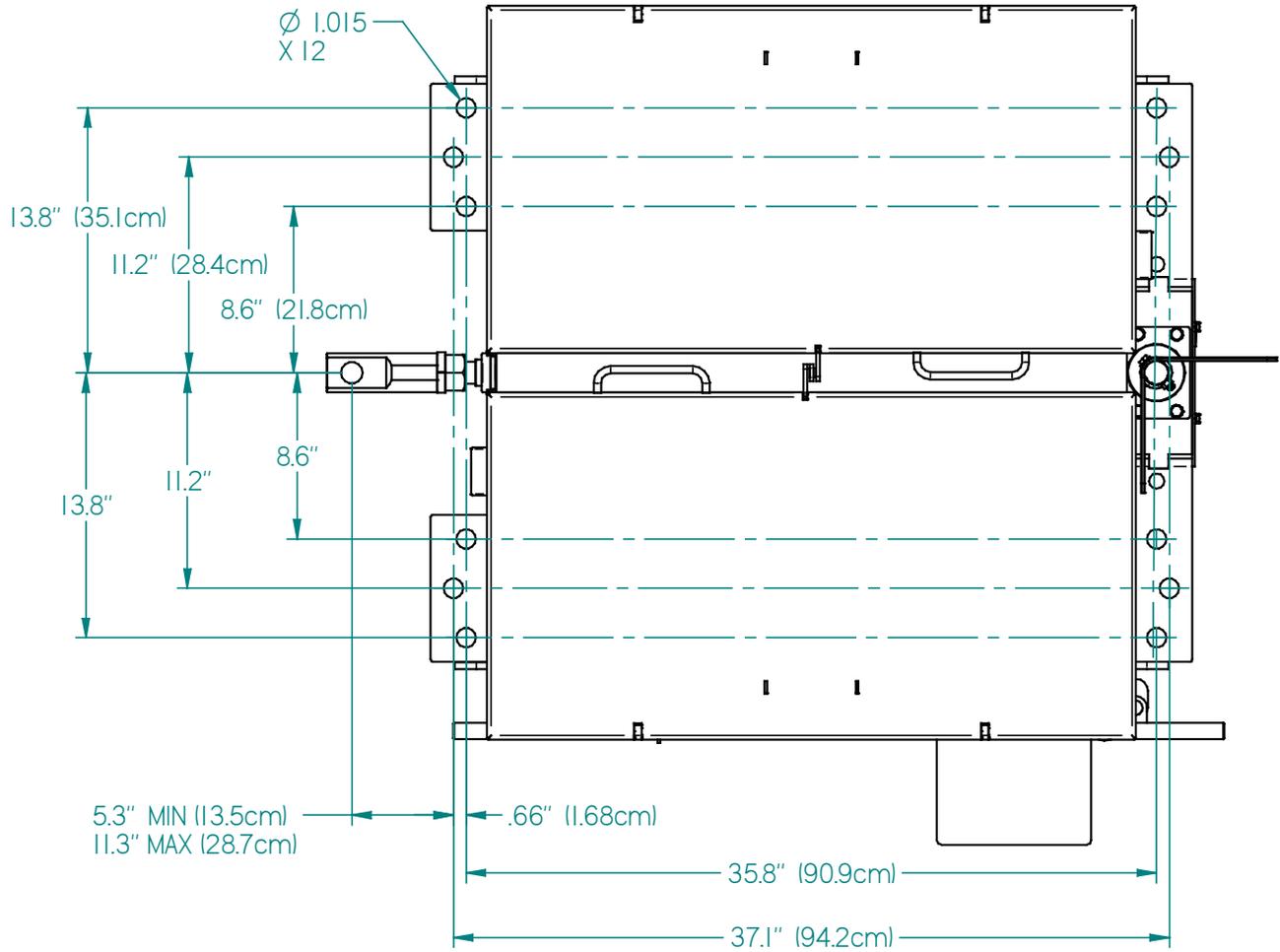
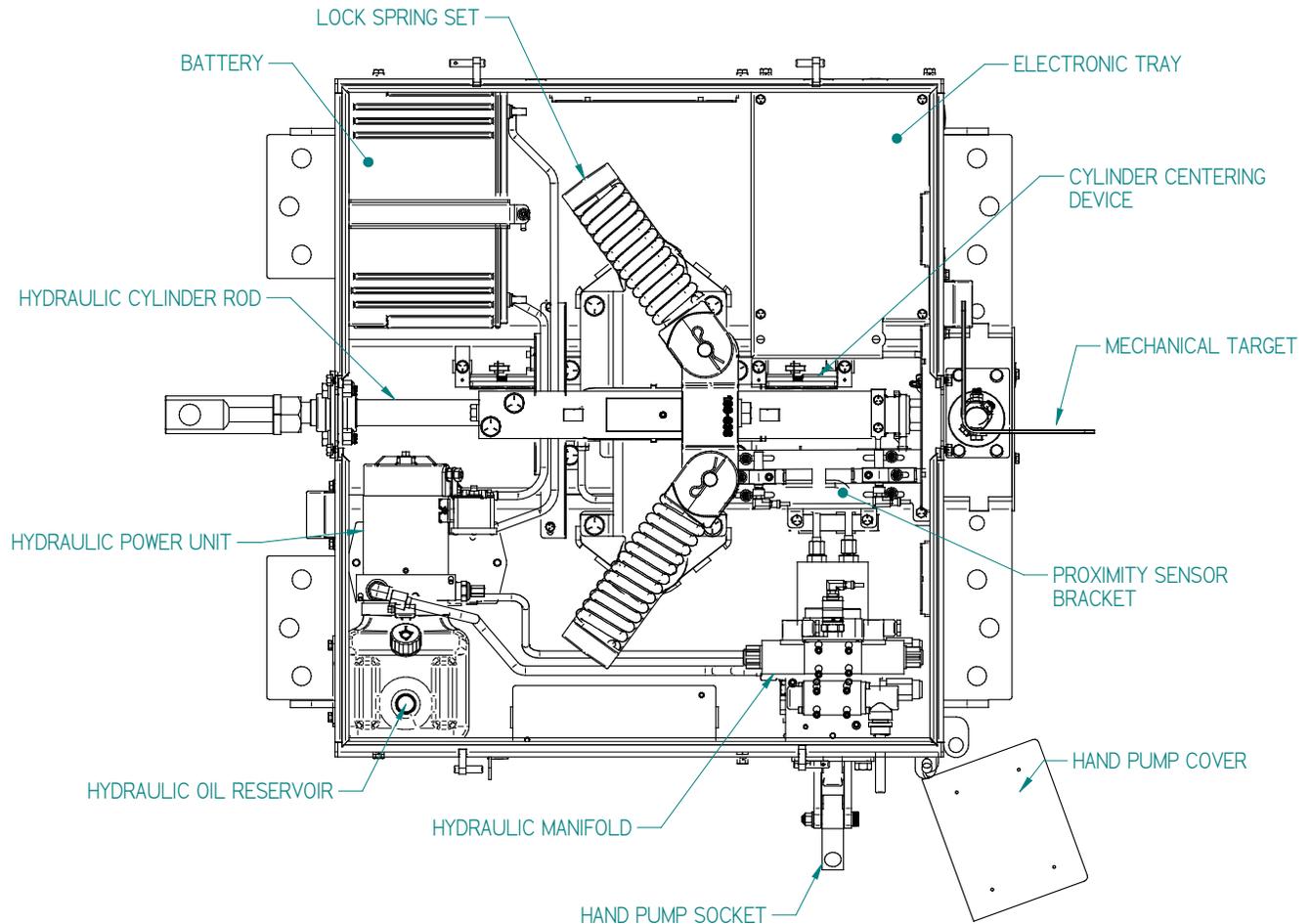


Figure 1.3 Switch foot print



1.5 Switch machine internal layout

Figure 1.4 Switch internal layout without top channel



1.6 Switch machine components

The YM 16 Switch Machines basic components can be seen in figure 1.4. above and is detailed according 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, a double rod cylinder, pressure and return lines.

The hydraulic system operates on 12VDC power or manually using the heavy-duty hand pump.

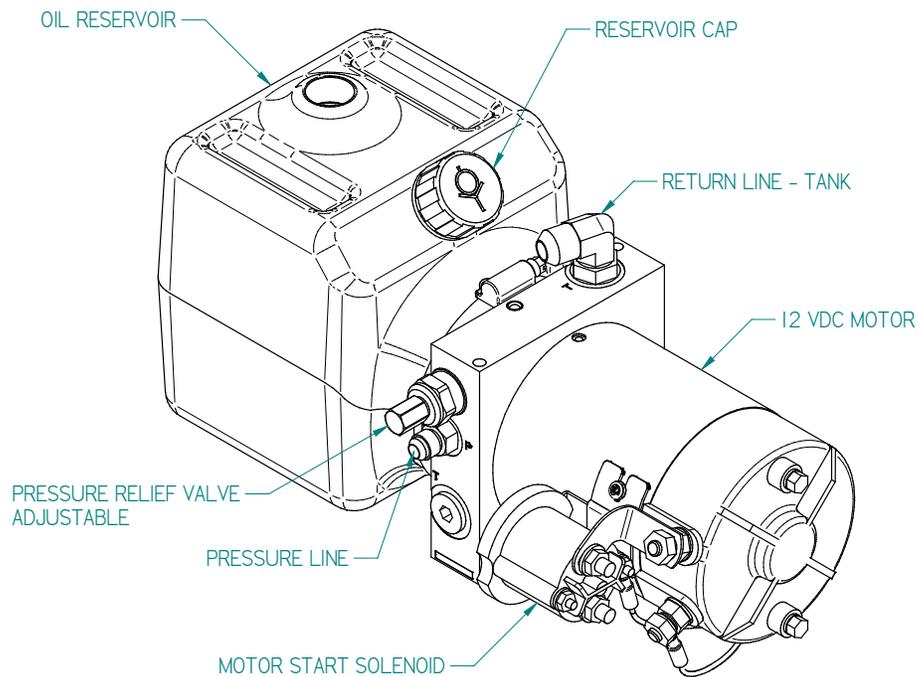
All hydraulic fittings used are SAE straight thread O-ring boss type. This system offers the best leak free connection even when high vibration and large temperature variations are present.

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 breather or plug flush mount

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).

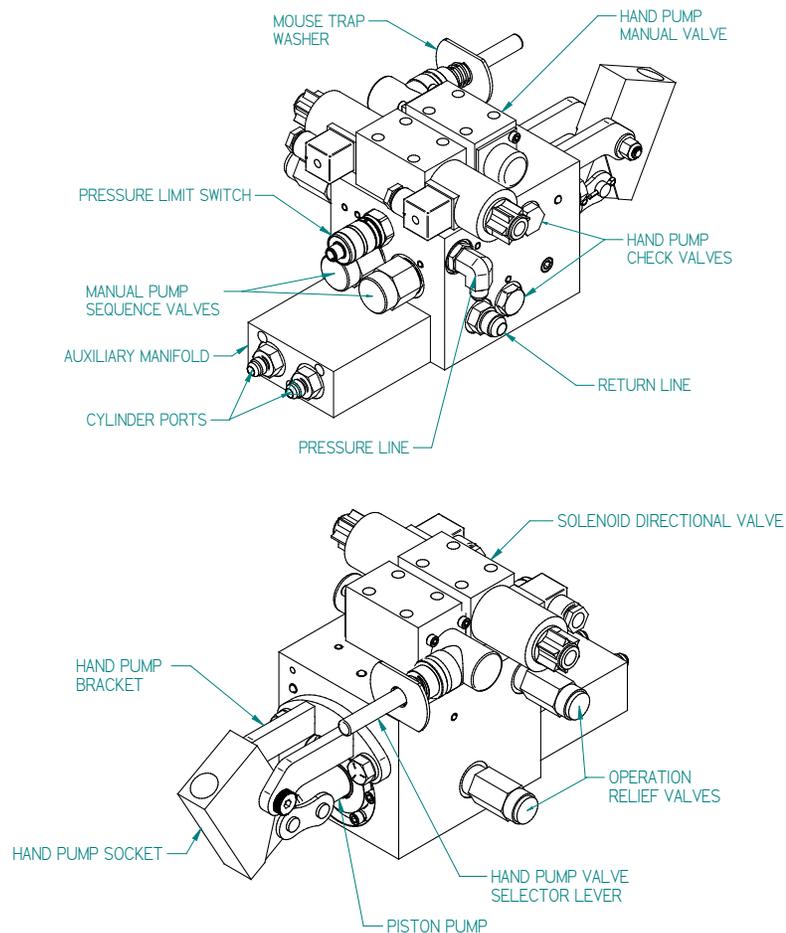
The relief valve will be preset to open at 1250 psi when a pressure limit switch is supplied, see section 2 - item 2.2 and section 5 - item 5.1.1.3.

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 cylinder movement. The valves 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 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 additional customer features to the main manifold block, such as: hydraulic lock, run through relief valves, mechanical lock operation or the cylinder connecting ports.

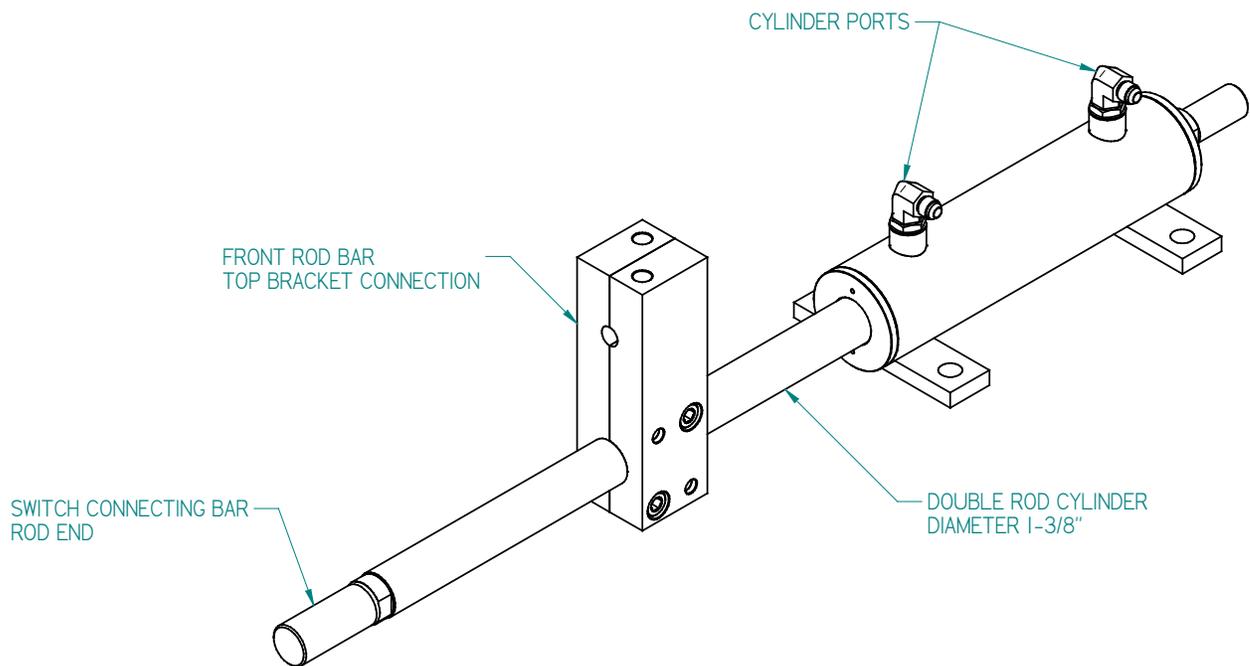
Detailed information how to operate the switch electrically and manually are supplied in Section 2 – Operation.

1.6.1.3 Hydraulic cylinder

A hydraulic double rod heavy-duty cylinder is 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 (six) 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.

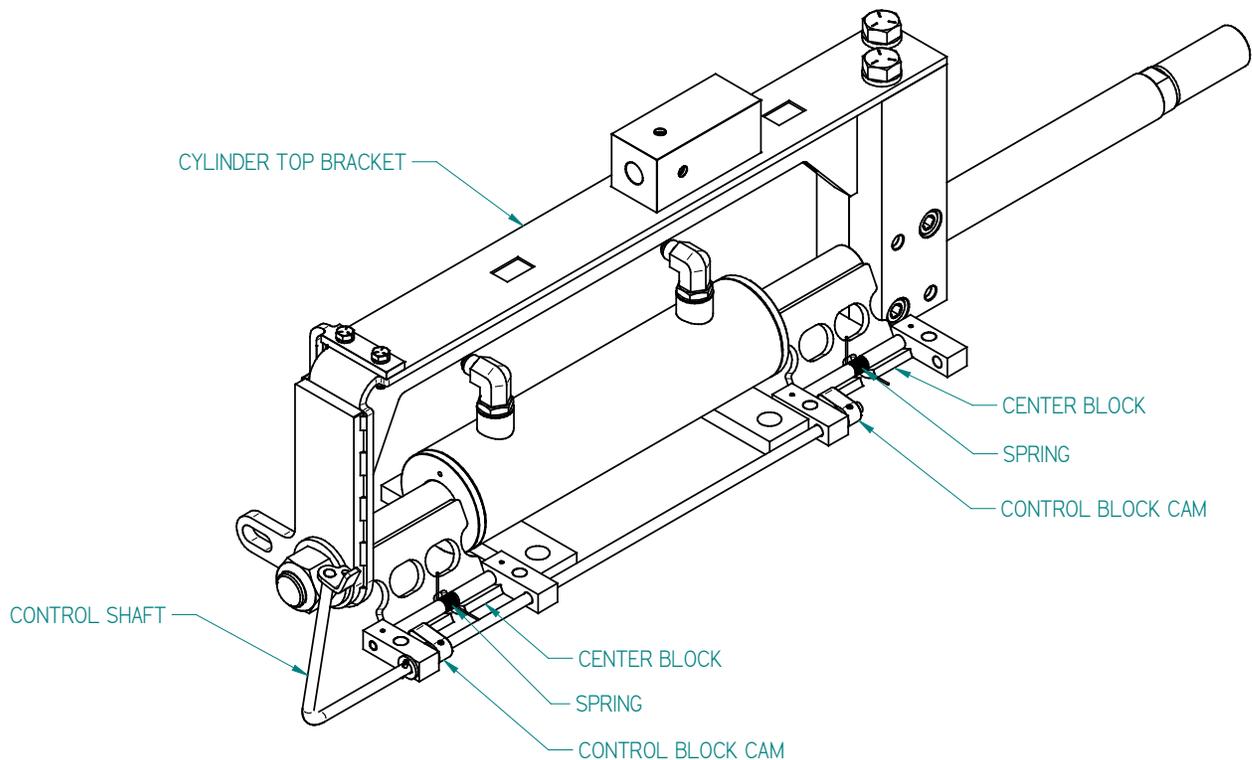
The lines are connected to the cylinder, manifold and power unit using SAE straight thread O-ring boss fittings with straight thread 37° JIC flare for high-pressure capability.

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 centralize the cylinder 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



The 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.

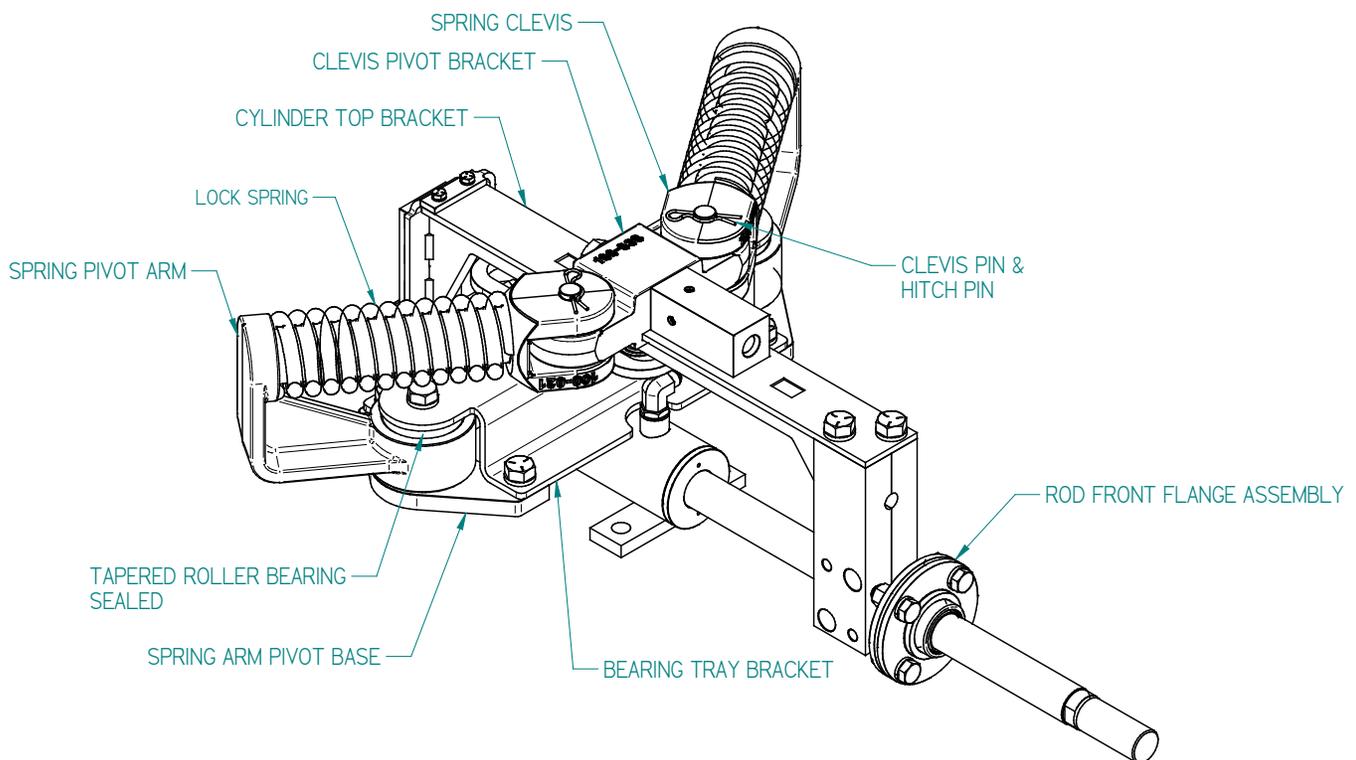
The control shaft is locked into position by a release pin (not shown at figure 1.8), see section 3 - Figure 3.2 and Figure 3.3.

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

1.6.3 Spring 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.

The spring holding force can be increased using spacing washers if additional holding force is required.

More details about the spring locking assembly can be found in Section 5 & 7.

1.6.4 Switch point detection

Two proximity sensors are used to detect the switch rod position. 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. The sensors are normally open induction sensors, PNP, three wire configuration.

Each sensor is inserted in a housing 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 0.045”.

Figure 1.10 Proximity sensors bracket

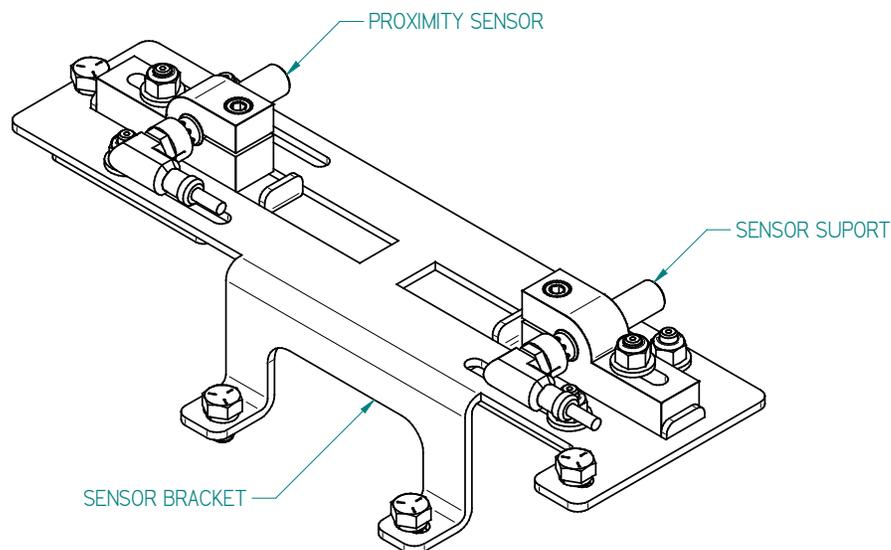
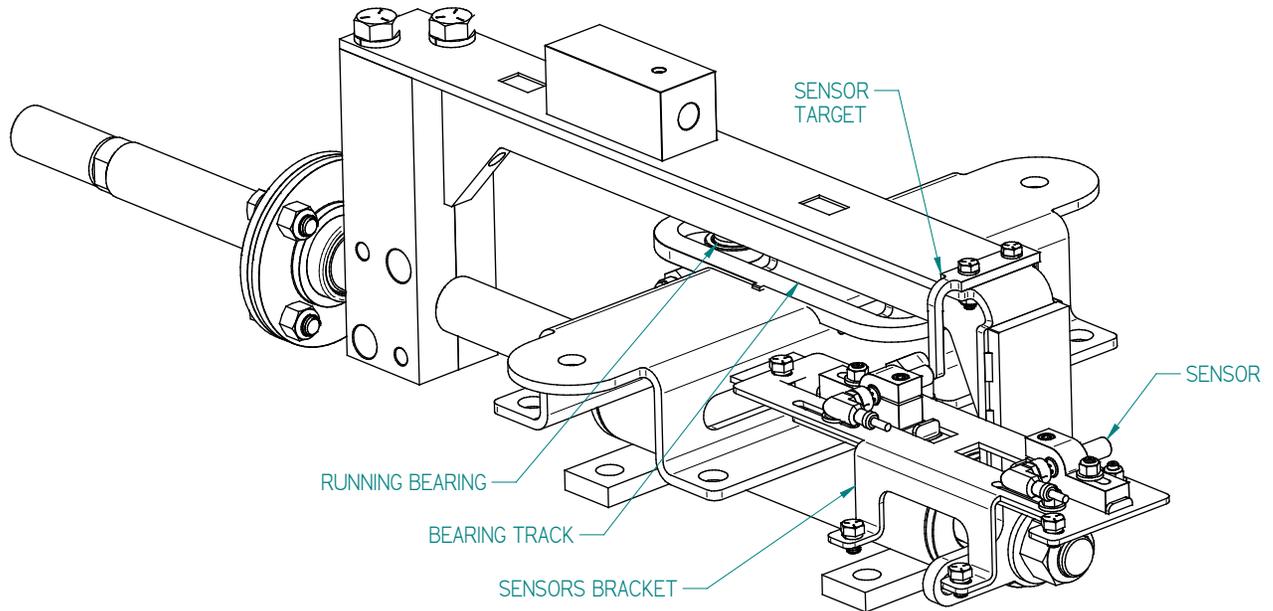


Figure 1.11 Cam roller bearing



To eliminate any possible rod rotation, the cylinder top bracket has a CAM Roller Bearing running inside a bearing track located at the center bracket.

The Cam Roller holds the target 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 & 5.

1.6.5 Mechanical target

A mechanical target can be supplied to indicate the switch rod position.

The mechanical target rotates between the normal and reverse positions.

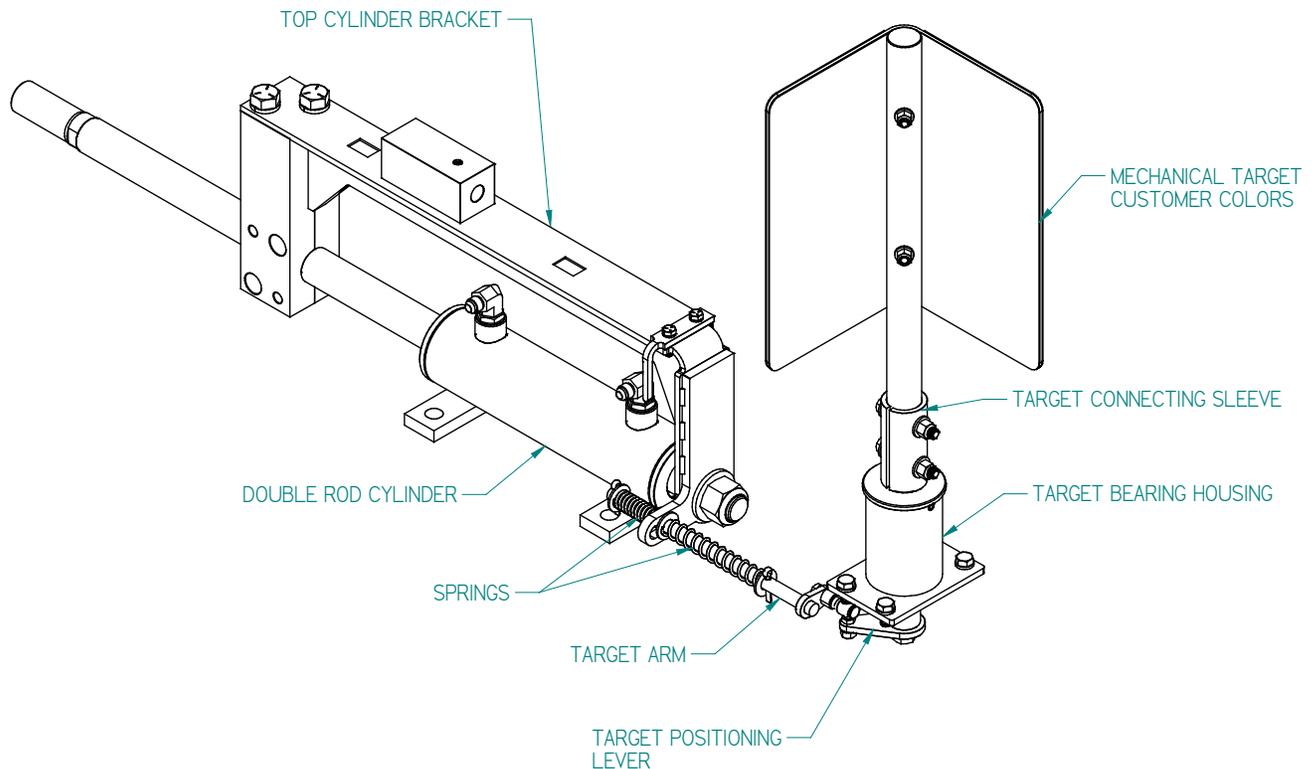
The mechanical target is connected directly to the double cylinder through the cylinder top bracket.

The target lever and target arm control the rotation.

Two compressed springs are used to compensate for different throw lengths.

Optional: Can be supplied with additional LED lights at the target. The LED light will only light on when the point is closed at each correct position.

Figure 1.12 Mechanical target



1.6.6 Electrical system

The YM-16 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 125Ah @ 20hr and when fully charged (open circuit voltage 12.8 V or higher at 68°F) and can power the YM-16 switch machine through approximately 300 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.

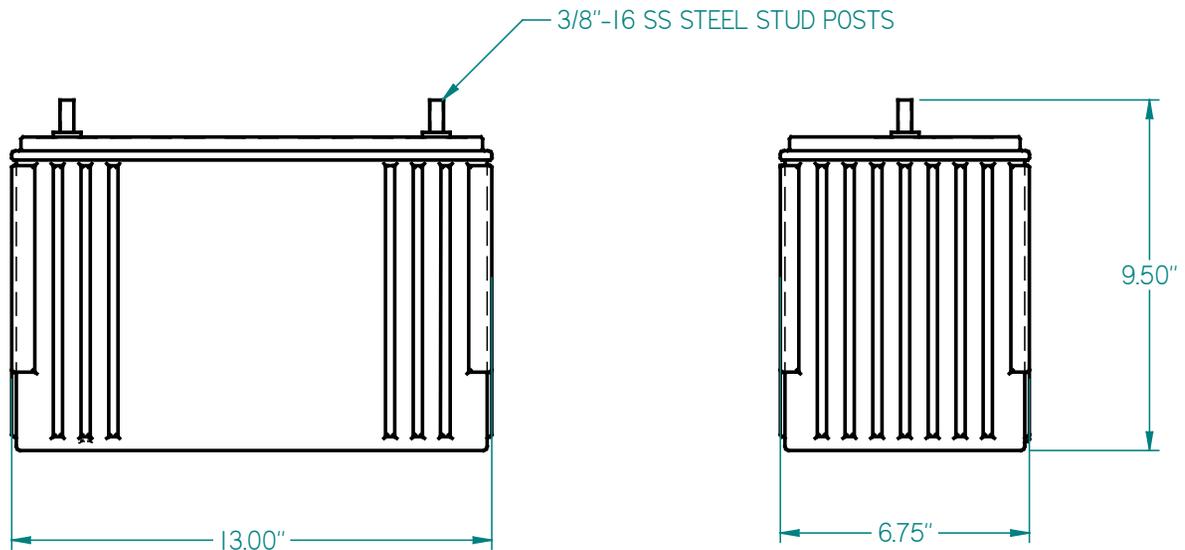
Battery specification:

BATTERY PN# 811-001 – NON SPILLABLE – ABSORBED GLASS MAT

125Ah @ 20Ah rate

Weight – 68.5 Lb – 31Kg

Figure 1.13 Battery dimensions



1.6.7 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 lightning event.

Additional charging instructions can be found in Section 5 & 6.

2 SECTION 2 – OPERATION

The operation of the YM-16 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 main spring system holds the point closed.

The proximity sensors are constantly energized so if the switch is in the normal position, the normal proximity sensor is generating a +12VDC input to the switch control unit (SCU).

When a command is received to move the switch to the reverse position, a +12VDC output from the SCU will energize the HPU Start Solenoid and the directional valve reverse solenoid.

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

The springs will be fully compressed at the middle stroke and it will start de-compressing until the points are closed at the reverse position and the reverse proximity sensor will be generating a +12VDC input to the SCU.

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 sensor to detect the new position, or the sensor 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.

When the switch machine is not in operation the hydraulic directional valve will be in the neutral position and all the hydraulic pressure is removed from the hydraulic system.

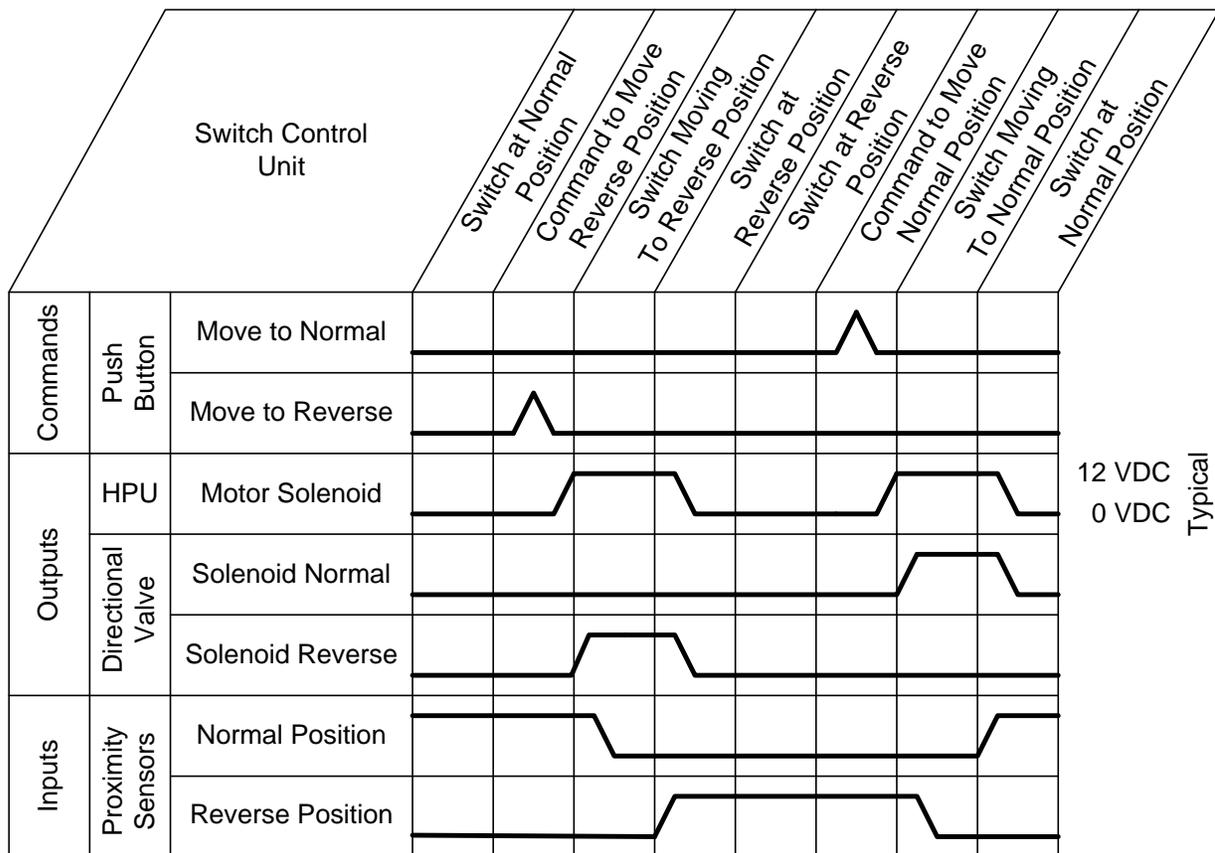
The main springs will hold the point closed at the reverse position.

The switch is then ready for another command.

NOTE: The SCU (switch control unit) 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



Additional features can be controlled by the SCU.

When the SCU is supplied by ARS, advanced diagnostics and critical operation alarms are created to:

- ✓ Monitor the switch position sensors indication;
- ✓ Monitor the switch position sensor for normal and reverse positions;
- ✓ Monitor the power unit operation time;
- ✓ Create “over the switch” protection lock features to avoid any switch movement when the switch zone or approach zone is occupied;

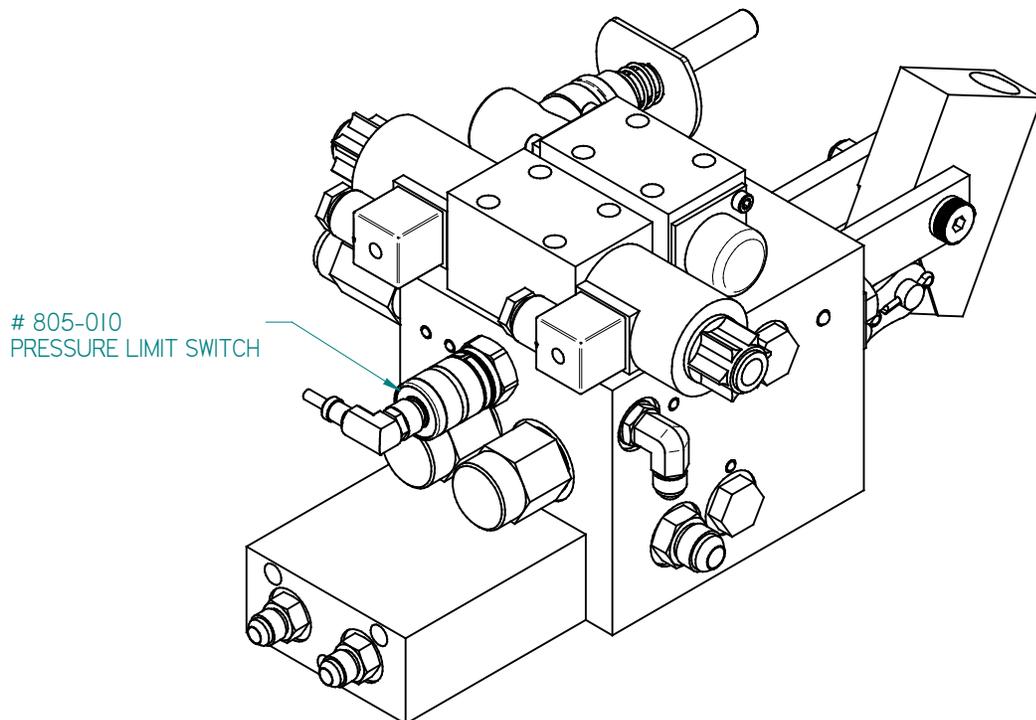
- ✓ Enable “auto return” function – to return the switch to the start position if an obstruction is detected;
- ✓ Enable “auto restore” function – to return the switch to a pre-defined rest position;
- ✓ Enable “auto align” function – to automatically position the switch to the desired position;
- ✓ Control position lights, route lights, and alarm light outputs.
- ✓ Recording of events to perform operational analysis and troubleshooting.

2.2 Electric controlled operation with pressure limit switch

When an obstruction occurs during the point movement the pressure limit switch, see Figure 2.2 below, will automatically return the switch machine to the alternate position or turn the power unit motor off.

The overrun timer will turn the power unit motor off if the proximity sensor fails to detect if the point is closed or the pressure limit switch fails to detect an obstruction.

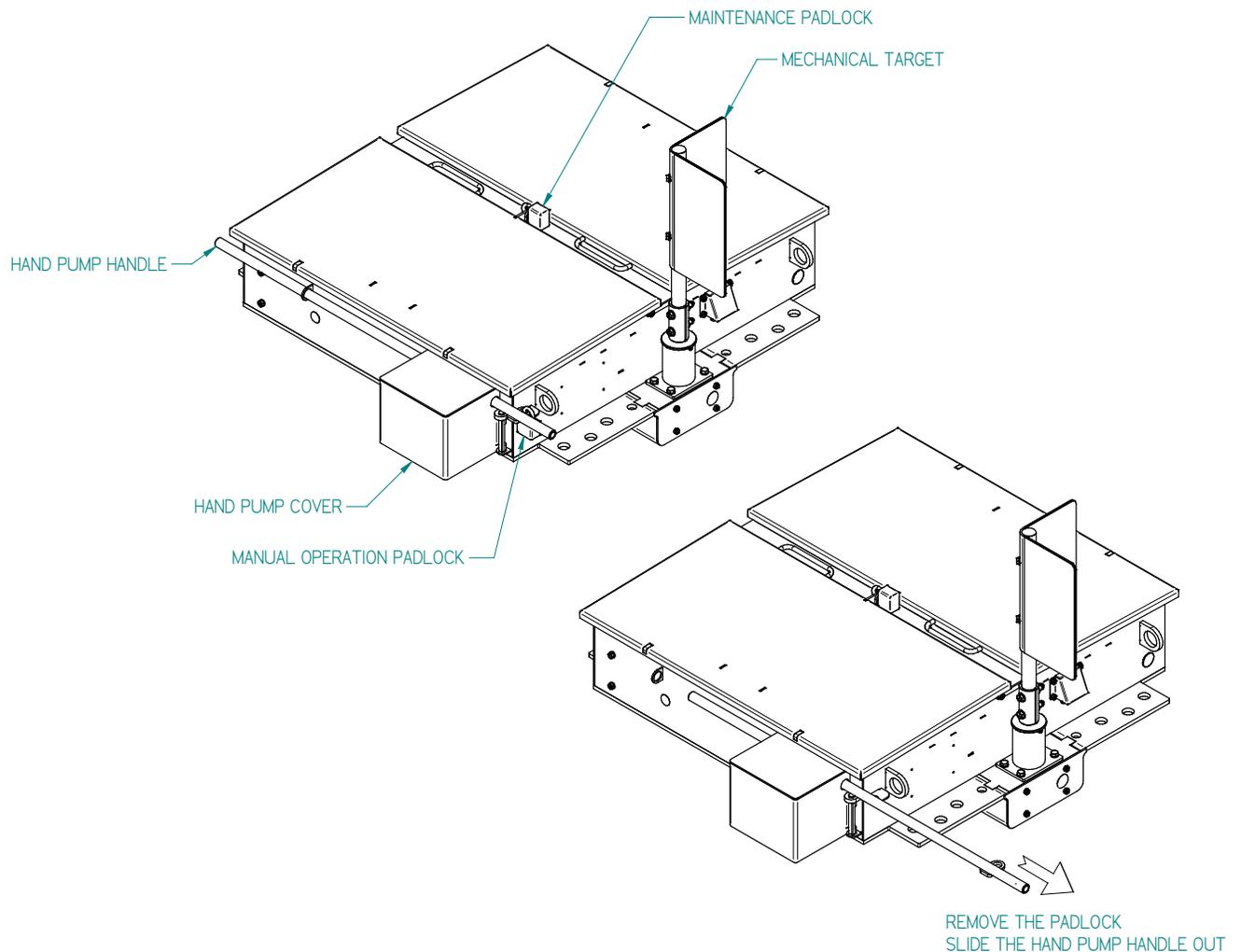
Figure 2.2 Pressure limit switch



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 2.3 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 2.3.

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;

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;

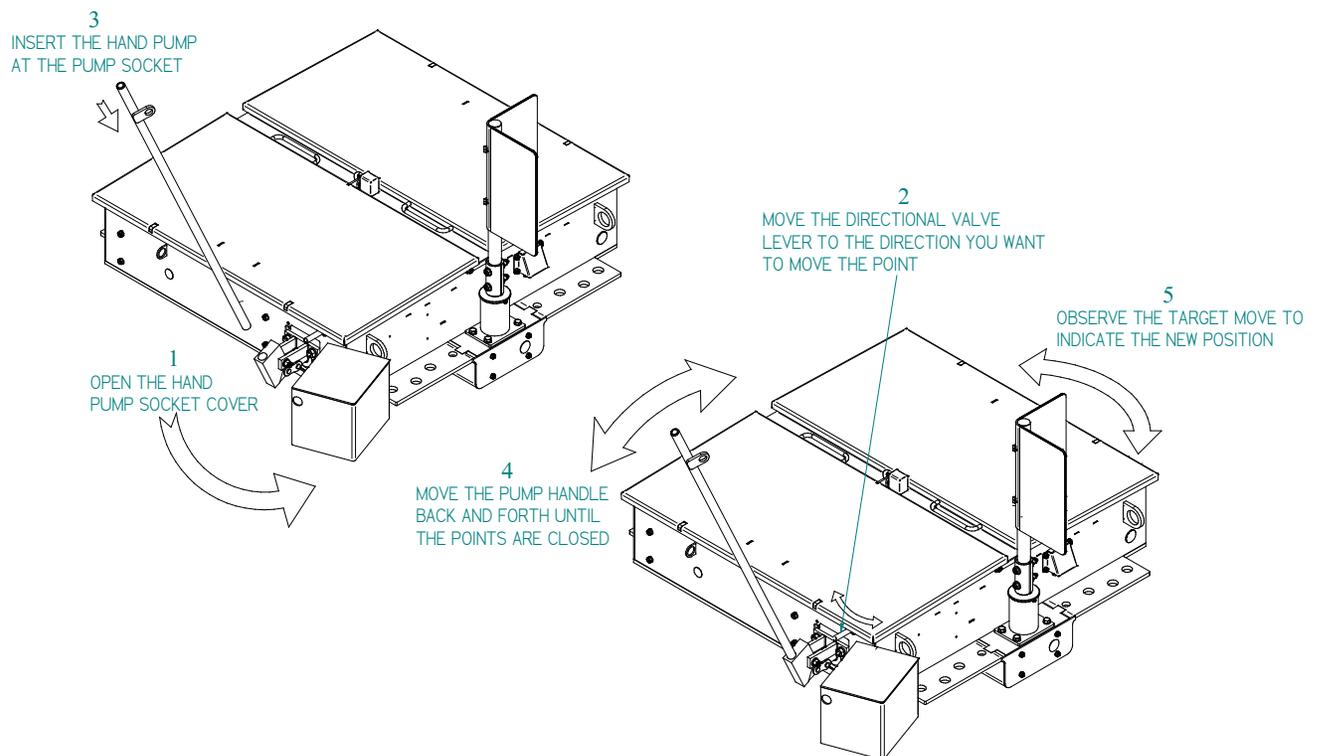
NOTE 1: It is approximately seven to nine (7 – 9) strokes to move the switch points completely to the desired position.

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 2.4 Hand pump operation



CAUTION: Stop pumping if the point is closed and becomes hard to pump. The points 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 YM-16 switch machine can be installed on wood, composite, concrete or steel head block ties 16' or longer. This will provide adequate clearance between the switch machine and the passing cars. 13" 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 railroads 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
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 – figure 3.1;

Figure 3.1 Cleaning crib space



5. Center the switch machine operational rod;

NOTE: The YM-16 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 a center device to automatically center the operation rod. See also section 1 Item 1.6.2.

- a. Open the switch lids, locate the centering device lever and remove the release pin. See Figure 3.2;
- b. Move the center device lever 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 rod is locked at center position, remove the hand pump handle and close the lids. See figure 3.5. and also section 2 item 2.3;

Figure 3.2 Removing the release pin

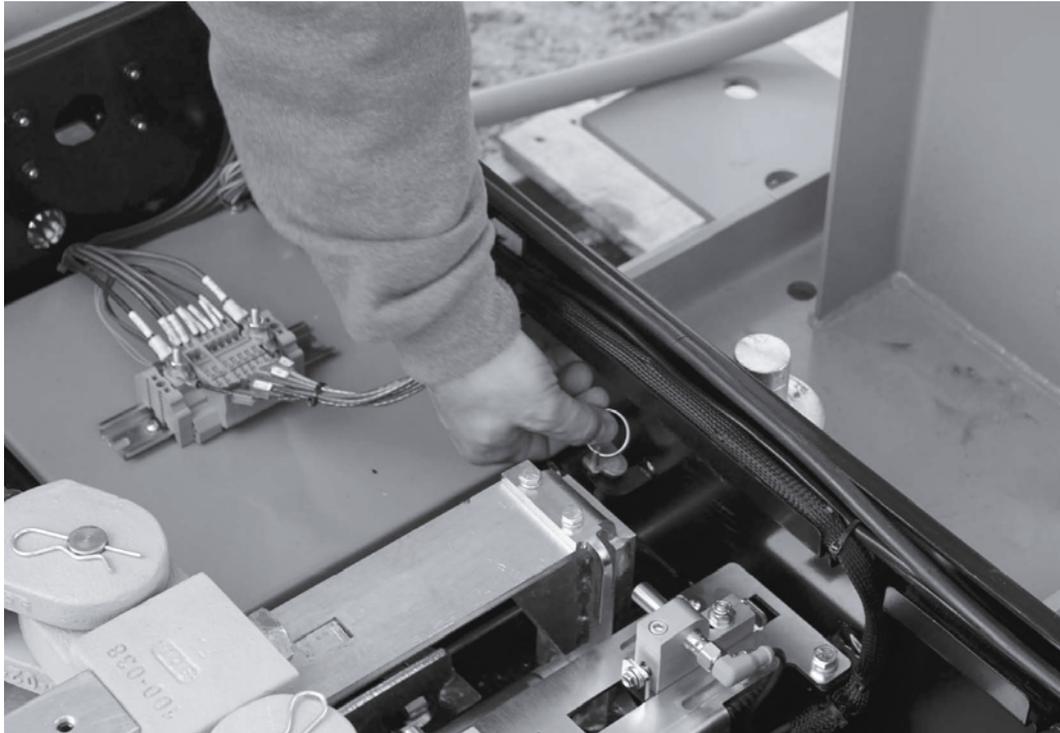


Figure 3.3 Center device lever at the active position



Figure 3.4 Hand pump handle in place



Figure 3.5 Switch rod locked at the center position



CAUTION: The switch rod must be properly centered using the internal center device. Failure to properly center the switch rod 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". See Figure 3.6;

Figure 3.6 Measuring the throw



- a. Use a lining bar to center the points to half of the throw, wedge in place using wood if possible. See Figure 3.7;
 - b. Connect the connecting rod clevis to the point bar. See Figure 3.8;
 - c. Tighten the clevis pin nut and insert the cotter pin. See Figure 3.8;
7. Position the switch machine on the head block ties. See Figure 3.9;
 8. Square the machine to the rail;
 - a. Move the switch machine to the desired distance from the rail to install the connecting rod;
 - b. The switch machine must be installed parallel to the rail. See Figure 3.9;
 - c. Use hand tools to loosen the nuts and properly connect the connecting rod to the switch rod, install the pin, nut, cotter pin and tighten all nuts. See Figure 3.10;

Figure 3.7 Centering the points



Figure 3.8 Connecting the connecting rod clevis to the point bar

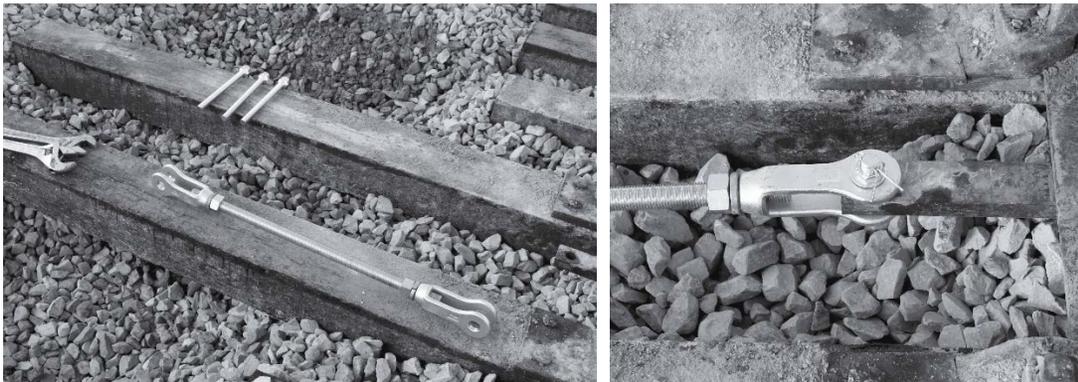
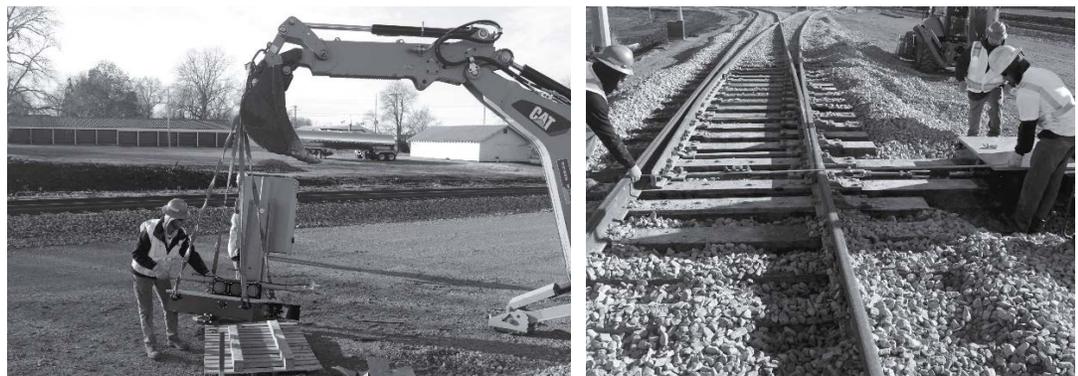
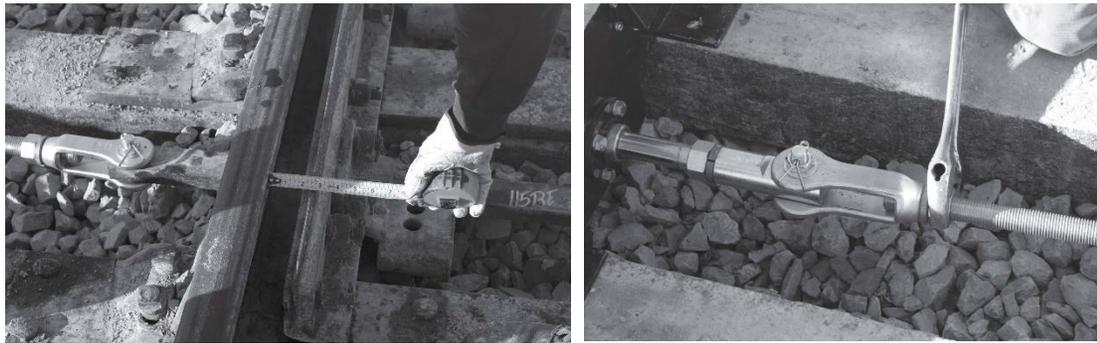


Figure 3.9 Positioning the switch on the head block ties



- d. The connecting rod must be aligned as close as possible to the point bar alignment;
 - e. Be sure the point distance did not change. See Figure 3.10;
9. Pre-assemble the mounting studs supplied with the switch machine. See Figure 3.11 & 3.12;

Figure 3.10 Installing the connecting rod to the switch



10. Install the tapered nut and jam nut to one side of the stud and tighten the nuts;
11. Drill a 7/8" holes for the mounting studs;
 - a. Only four holes and studs are needed to install the switch machine on wood or composite head block ties;
 - b. It is recommended to use the center hole of each switch machine foot to install the studs. Two additional holes are supplied per foot and can be used if the central hole cannot be used;

Figure 3.11 Installation hardware for wood or composite head blocks

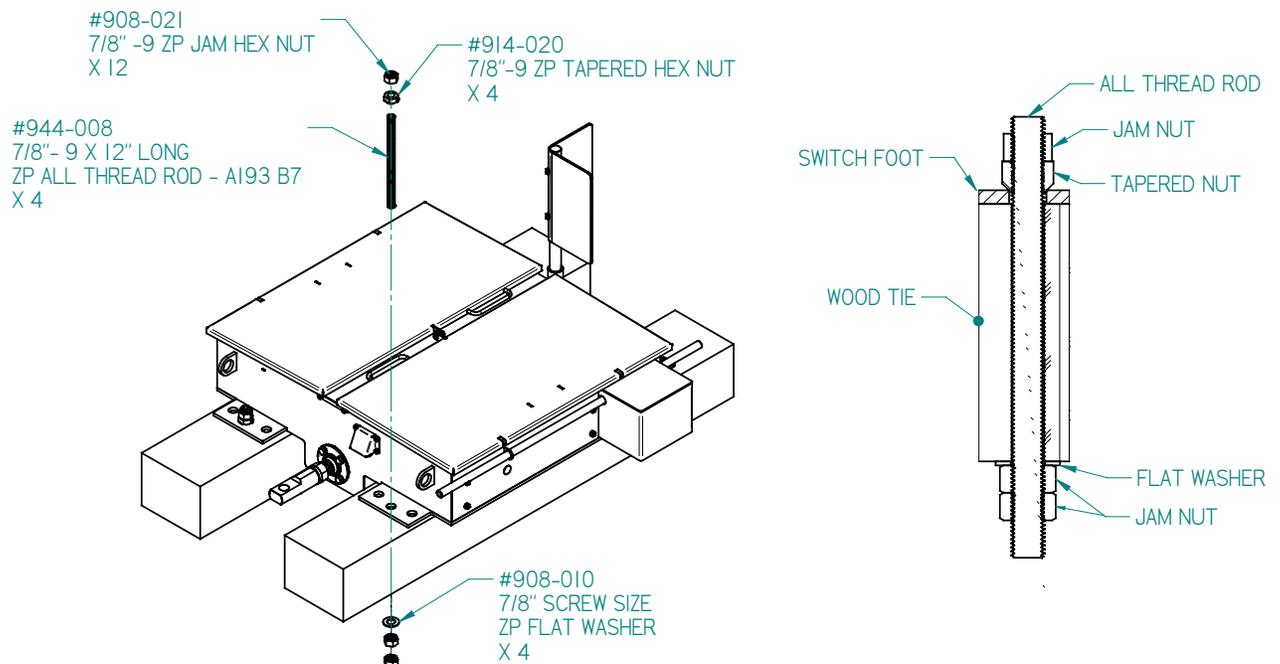
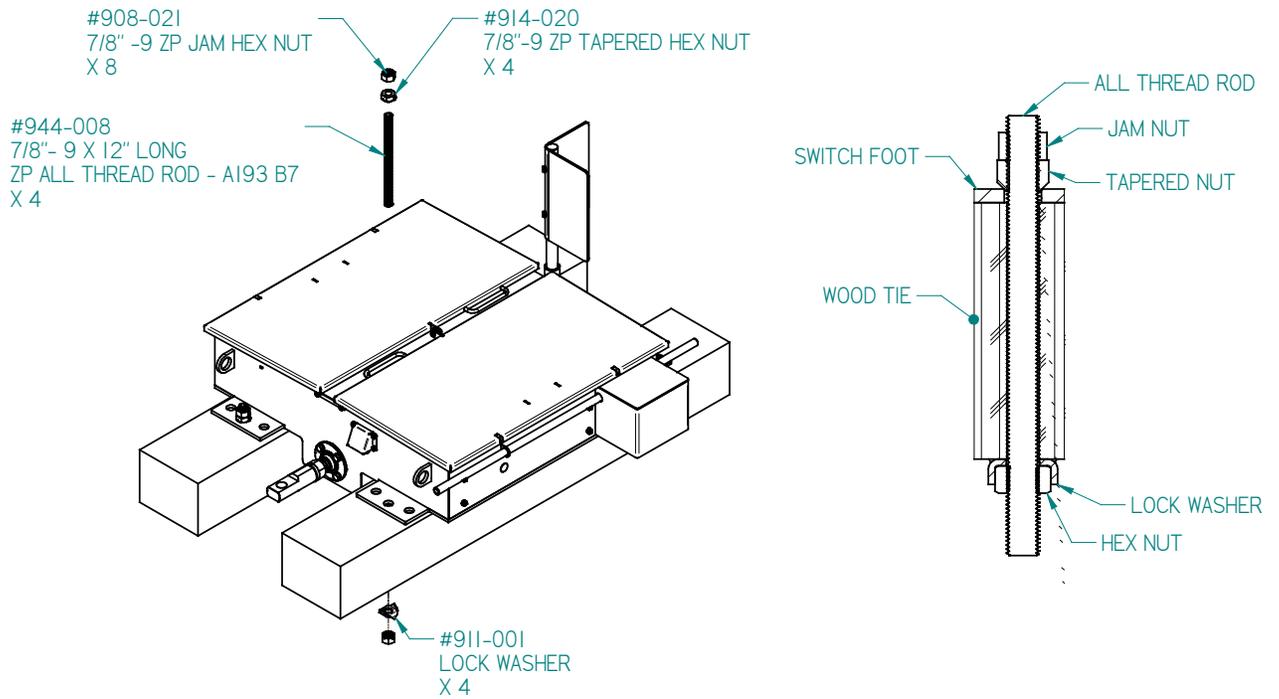


Figure 3.12 Installation hardware using lock washer



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

Figure 3.13 Drilling the mounting holes with the switch machine in place



Figure 3.14 Installing the mounting studs



12. Clean the hole and insert the stud pre-assembled with the top tapered nut and jam nut;
13. It is also recommended to have someone observing the position of the drill to be sure it is vertical when drilling;
14. Install the washer, nut and jam nut to the studs under the tie or lock washer and nut, see Figure 3.12 and tighten all nuts;

Figure 3.15 Washer and 2 nuts under the ties



15. 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 throw distance (standard 4-3/4");
16. Preparation for manual operation;
 - a. Insert the hand pump handle to the manual pump socket;
 - b. Return the center device lever to the release position and insert the safety pin;

WARNING: Prior to moving the center device lever 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.

Figure 3.16 Center device lever at the release position with safety pin



17. 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 2.2, see figure 3.17 below;
18. Proximity sensors adjustment;
- a. The switch machine is supplied with the sensors adjusted for a 6" 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 3.18;
 - d. This manual explains how to adjust the sensors using the 1/4" and 3/8" bar gauge;
 - e. First step – Open the point manually operating the YM-16 switch machine and insert the gauge with the 1/4" bar between the point and the stock rail. See Figure 3.19;

Figure 3.17 Switch machine being operated manually

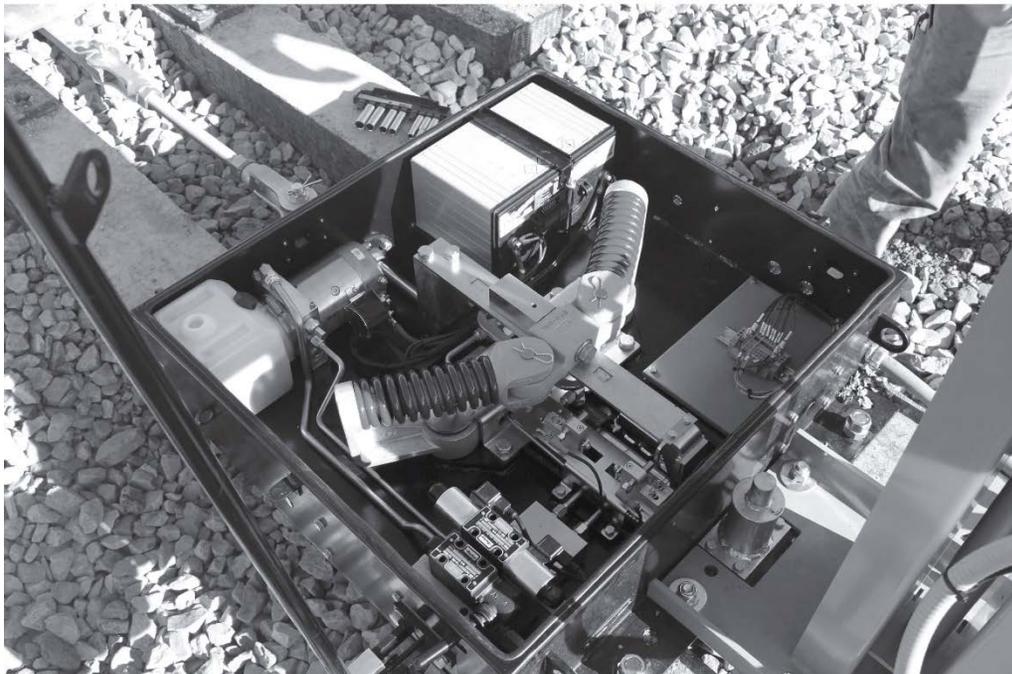


Figure 3.18 Point recommended gauge

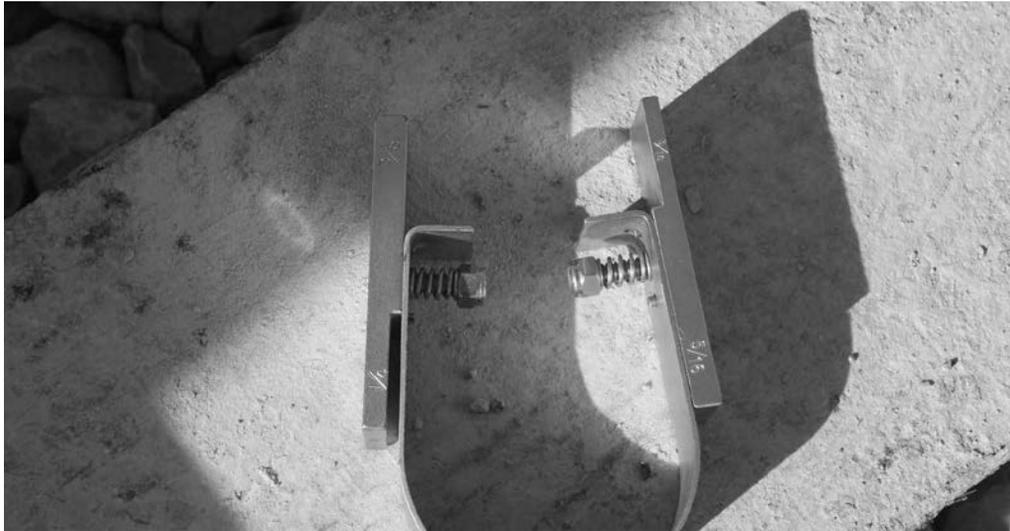


Figure 3.19 Gauge installed at the stock rail



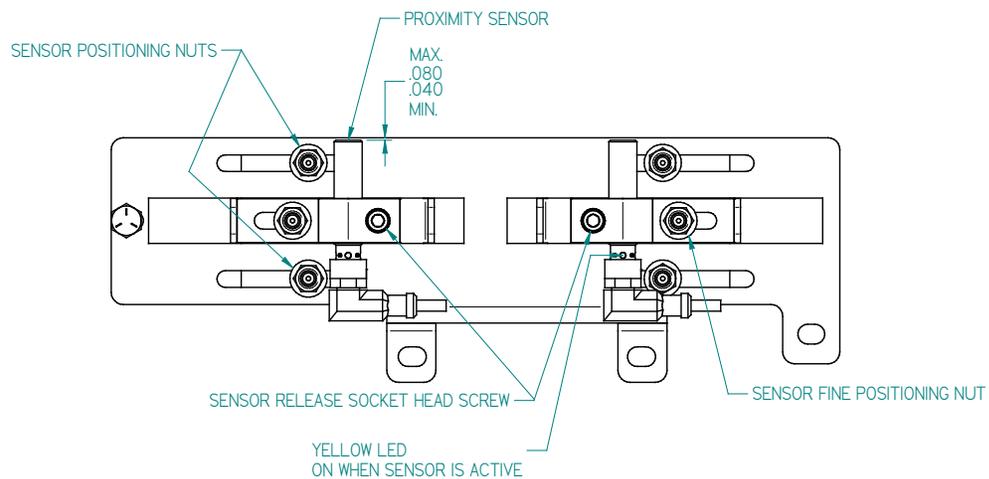
- f. Second Step – Close the point against the 1/4" bar gauge. See Figure 3.20;

Figure 3.20 Point closed against the gauge



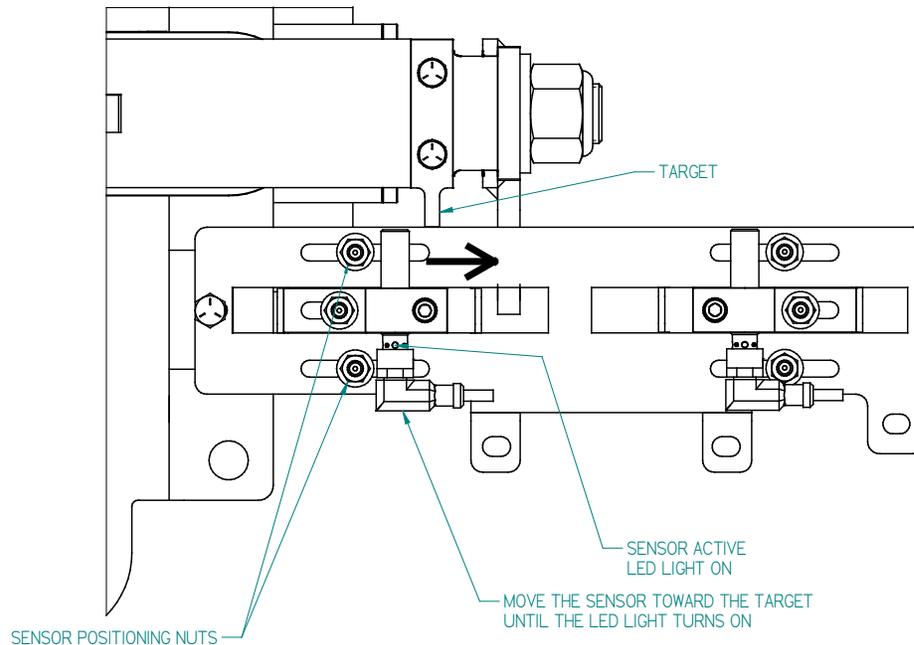
- g. Third step – Identify the sensor nearest of the target and loosen the sensor positioning nuts. See Figure 3.21;

Figure 3.21 Sensor bracket layout



- h. Fourth step - move the sensor toward the target until the sensors LED turns on, back the sensor until the LED lights turn off and tighten the sensor positioning nuts. See Figure 3.22;

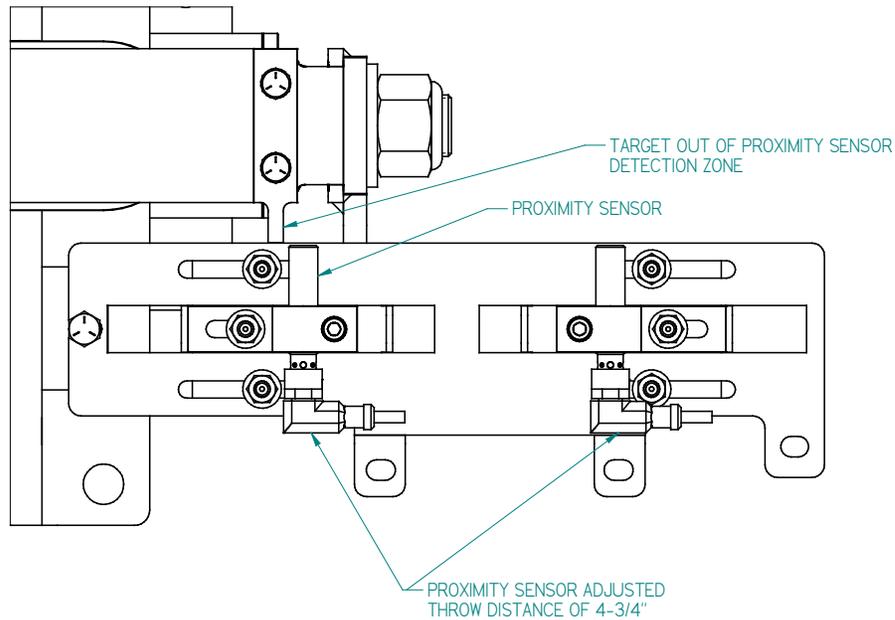
Figure 3.22 Moving the sensor near the target



- i. **Fifth step** - Loosen the sensor fine positioning nut, see the Figure 3.21, 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 to the other turn out position;
- m. Repeat the step 1 through 7 to adjust the other proximity sensor;

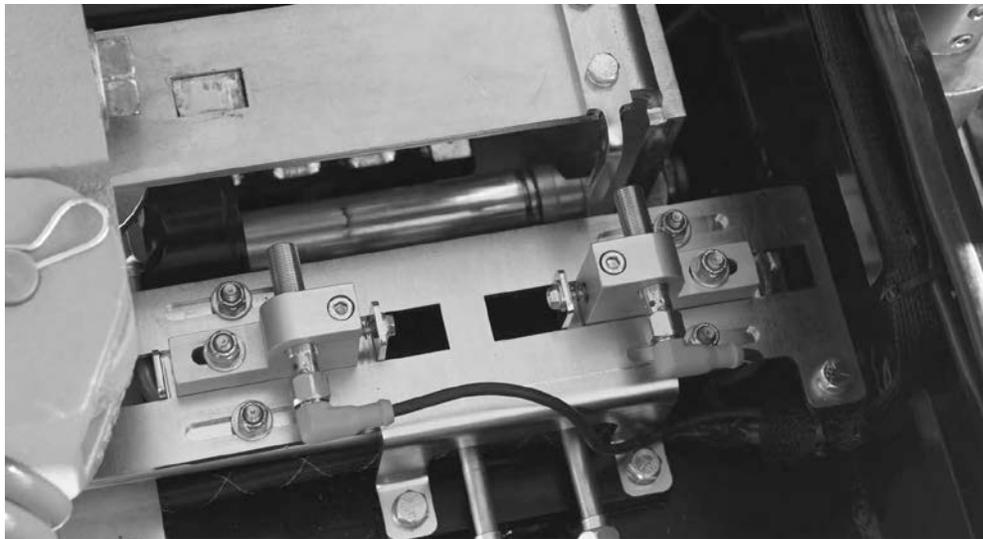
NOTE: When the proximity sensors are correctly adjusted to the recommended 4-3/4" throw distance and the connecting rod becomes free or is broken, the target will travel up to 6" (maximum switch machine throw distance) and the sensor will not be able to detect the target so an out of correspondence will be shown. See Figure 3.23;

Figure 3.23 Target out of proximity sensor's detection zone.



- n. When both sensors are correctly adjusted, the target will be travelling in the space between the two proximity sensors. See Figure 3.23;

Figure 3.24 Proximity sensors adjusted



19. Connect the battery cable;

- 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.

- 20. Remove the hand pump handle from the pump socket, close the pump cover and return the handle to the rest position;
- 21. Test the switch machine operation, using the pushbutton to move the switch to normal and reverse;
- 22. 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 18 step 1 through 7;
- 23. When complete, check all sensor nuts are tightened and verify there are no tools inside the switch machine. Close the lids and install any locks. The switch machine installation is complete. See Figure 3.25;

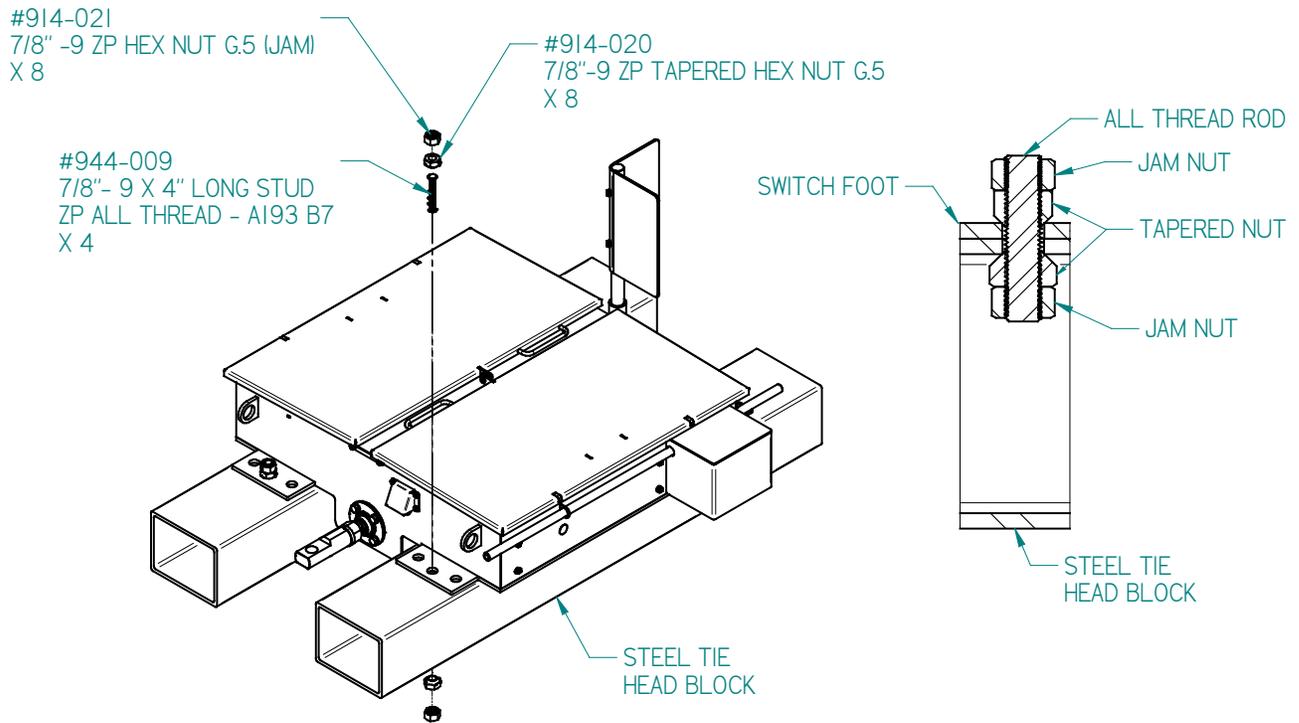
Figure 3.25 Switch installed



3.4 Installation on steel head block ties

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

Figure 3.26 Switch machine installation hardware for steel head blocks



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;

Installation steps are the same to install the switch machine on wood or composite head block ties;

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" drill bit. See Figure 3.27;

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;

Install the switch machine using the hardware as shown in Figure 3.26;

Figure 3.27 Drilling the holes in the steel head block ties



Figure 3.28 Switch machine installed on the steel head block tie



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 (SCU) supplied by Advanced Rail Switch.

When the switch machine is controlled by another SCU uses the instructions below as orientation through the process.

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 battery voltage;
 - i) If the battery voltage is 12.8 V or higher proceed as follows:
 - (1) Check battery connections;
 - (2) Check fuses and breakers;
 - (3) Check the switch control unit connectors;
 - ii) If the battery voltage is lower than 10V, the battery is discharged;
 - (1) Verify the 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 B12 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 & 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 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 B12 power is present to the motor start solenoid when the PB is applied, you can hear/feel the contact closing or use a voltage meter;
 - (1) 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 $\frac{1}{2}$ of the tank height;
 - (1) See hydraulic oil recommendation on table 5.2;
 - v) Check if the solenoid directional control valve is receiving the B12 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 item 5.1.1.2.1.;

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 SCU 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;
 - (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 rod does not move, do the following:
 - i) Check if the B12 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 $\frac{1}{2}$ of the tank height;
 - (a) Top up the oil level if necessary;
 - (b) See hydraulic oil recommendation on 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 B12 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 item 5.1.1.2.1.;

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 is programmed to run up to 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 18;
 - (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 opening during the movement, intermittent sound;
 - i) The pressure setting is too low to move the turnout, adjust the pressure valve, see instructions section 5 item 5.1.1.1.2.;
- 3) Check the battery voltage;
 - 1) The battery voltage must be at least 11 VDC;
 - i) Measure the battery voltage when the motor is turned on;
 - ii) If the battery voltage is too low, replace the battery or check the 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, check for 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 handle only works in one direction, the check valve located at the hand piston head may not working properly;
 - 1) Remove the hand piston to repair or replace the valve or piston;

5 SECTION 5 – CORRECTIVE MAINTENANCE

The YM-16 switch machine has few mechanical and electric components.

All components and assemblies can be easily removed and replaced in the field or repair shop.

The recommended maintenance tools for the YM-16 switch machine are listed in Table 5-1.

Table 5.1 Tools requires for maintenance

Dive Size	Tool type	Component	Use
5/32"	Hex Key	5/16" Set screw	Power Unit Relief Valve Adjustment
3/16"		1/4" Socket Head Cap Screw	Power Unit Assembly
		1/4" Socket Head Cap Screw	Manifold/Sensor/Target Assembly
		3/8" Set Screw	Cylinder Bracket /Target Sleeve
1/4"		1/4" NPT Socket Plug	Manifold Pressure Port
3/8"		1/2" Socket Head Cap Screw	Cylinder Front Clamp Block
9/16"		3/4" NPT Socket Plug	Housing Drain Plug
4mm		M5 Socked Head Cap Screw	Solenoid Operated Valve
			Manual Operated Valve
6mm		M10 Shoulder Screw	Cylinder Top Bracket Cam Bearing
1/2"	5/16" Hex Head Cap Screw	Sensor Bracket Assembly	
		Housing LED/Push Buttom Assembly	
5/16"	5/16" Hex Nylon Lock Nut	Lid Assembly	
		Power Unit Start Solenoid	
3/8"	#10 Hex Head Cap Screw	Lid Assembly	
3/8"	# 10 Hex Nut	Sensor Position Adjustment	
		Power Unit Start Solenoid	
7/16"	1/4" Hex Head Cap Screw	Sensor Target	
		Electronic Shelf	
		Housing Breather	
		Target Back Cover	
		Manifold & Flange Assembly	
		Hand Pump Cover Pivot Eye	
		1/4" Nylon Lock Hex Nut	Sensor Target
1/4" Thread Ball Joint	Sensor Bracket		
9/16"	3/8" Hex Head Cap Screw	Target Lever Assembly	
		Target Housing Assembly	
		Center Block Assembly	
11/16"	3/8" Hex Nut	Battery Terminals	
		Hand Pump Socket Assembly	
		Fitting Body	3/8" Hydraulic Tube Fitting
3/4"	Hex Nut	3/8" Hydraulic Pipe Assembly	
		3/8" Hydraulic Tube Fitting	
		1/2" Hex Head Cap Screw	Cylinder Front Clamp Block
7/8"	1/2" Hex Nylon Lock Nut	Target Shaft Assembly	
		Housing Rod Flange	
		Hand Pump Bracket	
15/16"	Hex Nut	Housing Rod Flange	
		1/2" Hydraulic Tube Assembly	
		Fitting Body	1/2" Hydraulic Tube Fitting
1"	CV08 Check Valve Body	Hydraulic Manifold Valves	
		Cylinder Assembly	
		5/8" Hex Head Cap Screw	Cylinder Top Bracket Assembly
1-1/8"	PS08/RV08 Valve Body	Spring Arm Assembly	
		Center Bracket	
1-1/4"	3/4" Hex Head Cap Screw	Hydraulic Manifold Valves	
1-7/16"	PD12 Pilot Valve Body	Hydraulic Manifold Valves	
1-7/16"	1" Nylon Lock Hex Nut	Cylinder Rod End - Inside Housing	
HNS-6	Nut Spanner	Tapered Bearing Spindle	Spring Arm Assembly

5.1 Corrective and disassembly procedures

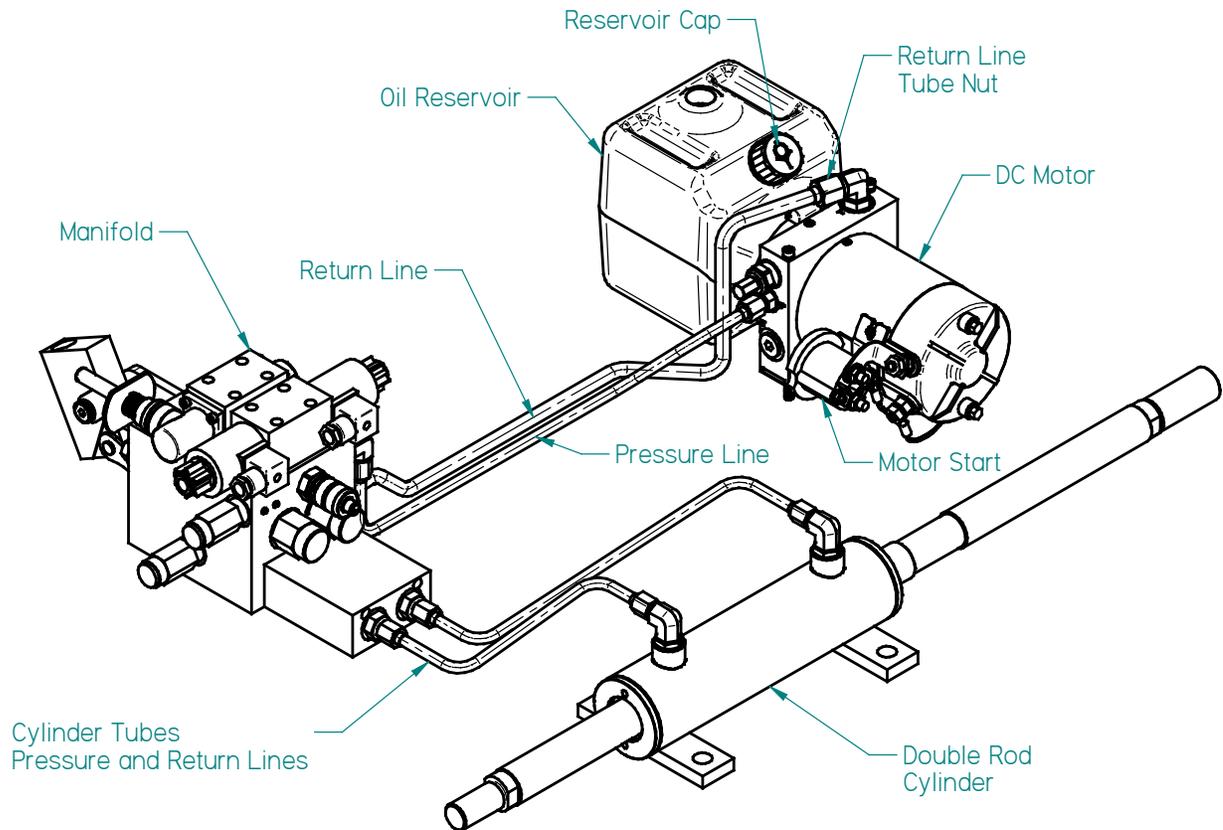
5.1.1 Hydraulic components

The hydraulic components are described in section 1 item 1.6.1. In this section, it is explained how to adjust, remove, replace or repair a component or assembly.

NOTE: Before attempting to remove or disassemble any hydraulic component, it is recommended to dis-connect the return tube line (T), by start to loosening the tube nut located at the top of the power unit flange to avoid the reservoir oil from draining inside the switch machine due to gravity

A general view of all the hydraulic components can be seen at the Figure 5.1.

Figure 5.1 Hydraulic system



5.1.1.1 Hydraulic power unit

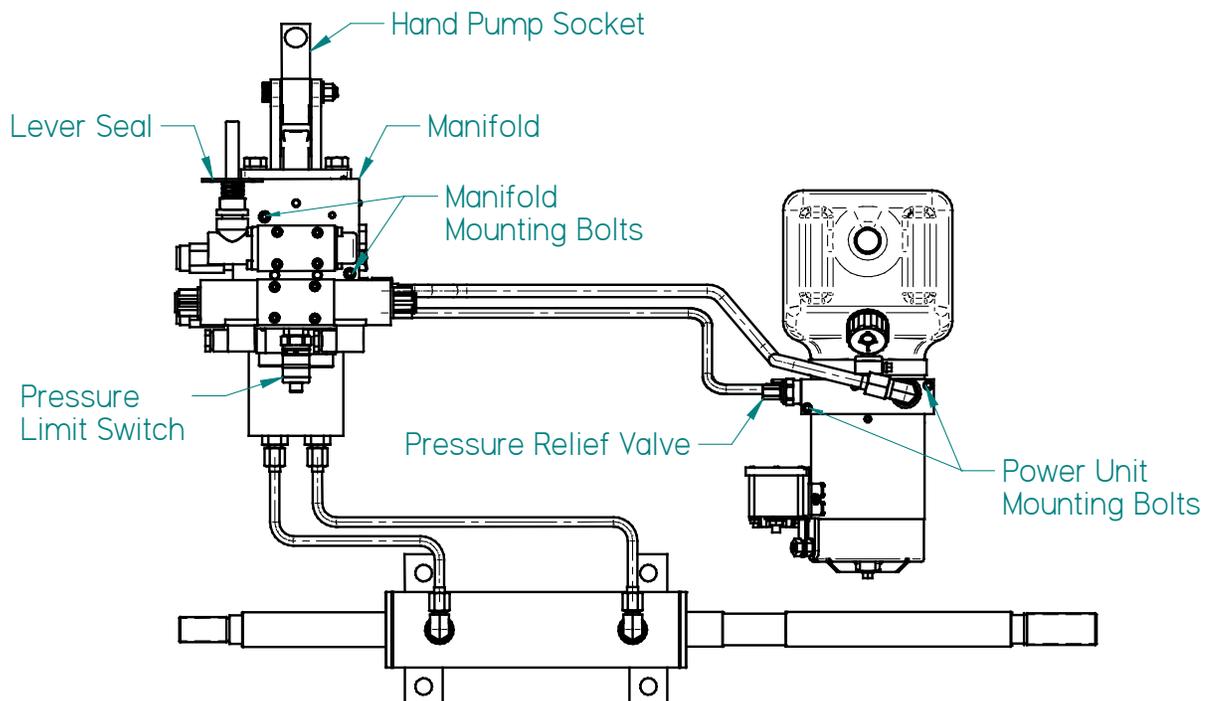
The hydraulic power unit is comprised of an electric DC motor with brushes, motor start solenoid, hydraulic gear pump, oil reservoir and a relief pressure valve, all assembled in a compact housing.

The power unit needs to be removed for maintenance when the motor or brushes need to be replaced.

To remove the power unit, proceed as follow:

1. Disconnect one of the battery cables from the battery terminal;
2. Disconnect the battery cables from the motor and motor start terminals;
3. Disconnect the command cable from the motor start terminal;
4. Loosen first the return tube nut (T) located at the top of the power unit flange;
5. Loosen the return line tube nut located at the manifold block and remove the pipe;
6. Loosen the pressure line tube nuts and remove the pipe;
7. Use paper towel or lint free cloths to absorb any oil inside the switch machine;
8. Loosen the power unit mounting bolts. See Figure 5.2;
9. Remove and replace the power unit;

Figure 5.2 Power unit and manifold mounting bolts



NOTE 1: The hydraulic double rod piston has the same oil volume displacement when moving the switch points back and forth, so the oil level inside the reservoir is kept constant. The reservoir cap has a valve to compensate the internal pressure and to avoid any contaminant or moisture to get inside.

NOTE 2: It is recommended the motor start solenoid be replaced every time the motor or brushes are replaced.

5.1.1.1.1 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 plastic reservoir allows for easy oil level checking. An oil level sticker is placed at the center (1/2) of the reservoir marking the recommended oil level.

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	

5.1.1.1.2 Operation pressure adjustment

The power unit maximum operating pressure is 2000 psi.

The power unit operating pressure is preset from the factory to operate at 1100 psi, this is the manufacturer recommended pressure for all turnout sizes.

At 1100 psi, the switch machine can move the points from normal to reverse position in 1.2 seconds for the recommended 4-3/4" throw distance.

Any change to the operation pressure will affect the switch machine operating speed or the switch machine ability to move the turnout.

In some special applications where the switch machine is installed with dual rail gauges or the switch machine needs to move additional detection equipment, it may be necessary to increase the operating pressure.

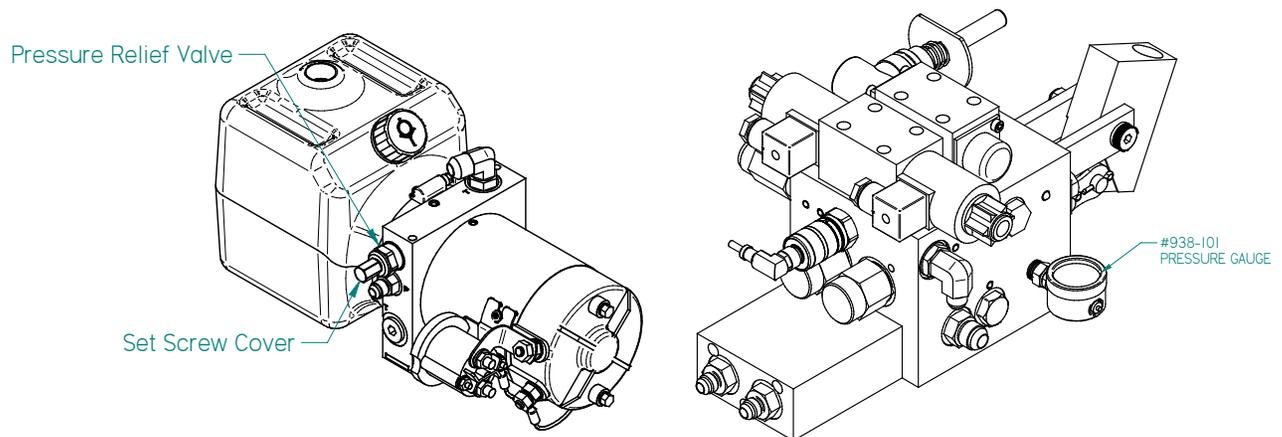
The power unit has a pressure adjustment relief valve that can be easily adjusted in the field.

To increase the pressure, localize the relief valve, remove the setscrew cover, and loosen the jam nut. Using a 5/32" hex key, turn the screw clockwise to increase pressure or counter clockwise to decrease pressure.

Turn the setscrew 1/4 of a turn at a time, until the switch machine can move the turnout in both directions without any difficulty, then turn the set screw an additional 1/4 turn, tighten the jam nut and reinstall the cover.

To read the operating pressure a pressure gauge can be installed at the port 1/4" NPT, see Figure 5.3.

Figure 5.3 Pressure relief valve



5.1.1.2 Manifold

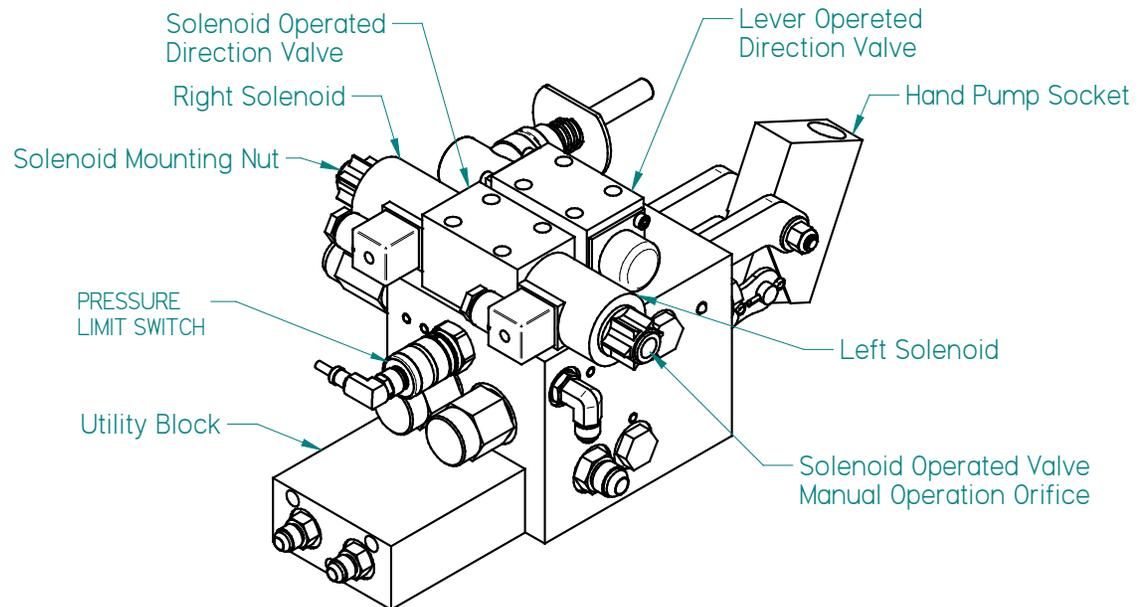
The manifold has all the hydraulic valves needed to control the switch machine movement electrically and manually. See section 1 item 1.6.1.2 - Figure 1.6.

Mounted on top of the manifold are two high performance directional control valves: one valve is solenoid operated and the other is lever operated. See Figure 5.4.

The manifold also has an integrated hand pump with a dual action piston used to move the switch points during installation or if a battery failure occurs.

All the others cartridge valves are used to control the hand pump circuit operation.

Figure 5.4 Direction valves



NOTE: If the switch machine receives an electrical command when someone is operating the switch machine manually, the hand pump circuit will be isolated automatically offering no risk to the operator.

In front of the manifold, there is an auxiliary block. The function of the auxiliary block is to allow different utility blocks to be added to implement additional hydraulic features to the switch machine such as; run through relief valves, hydraulic lock, hydraulic lock with preset relief valve, mechanical lock control, counter balance valves, etc. without changing the existing hydraulic tubes layout.

The manifold can be easily removed from the switch machine by loosening the mounting bolts. See Figure 5.2.

More information about the manifold components and the hydraulic circuit can be found in section 7 and 8.

5.1.1.2.1 Solenoid directional control valve

The solenoid directional control valve is responsible for the switch machine movement back and forth.

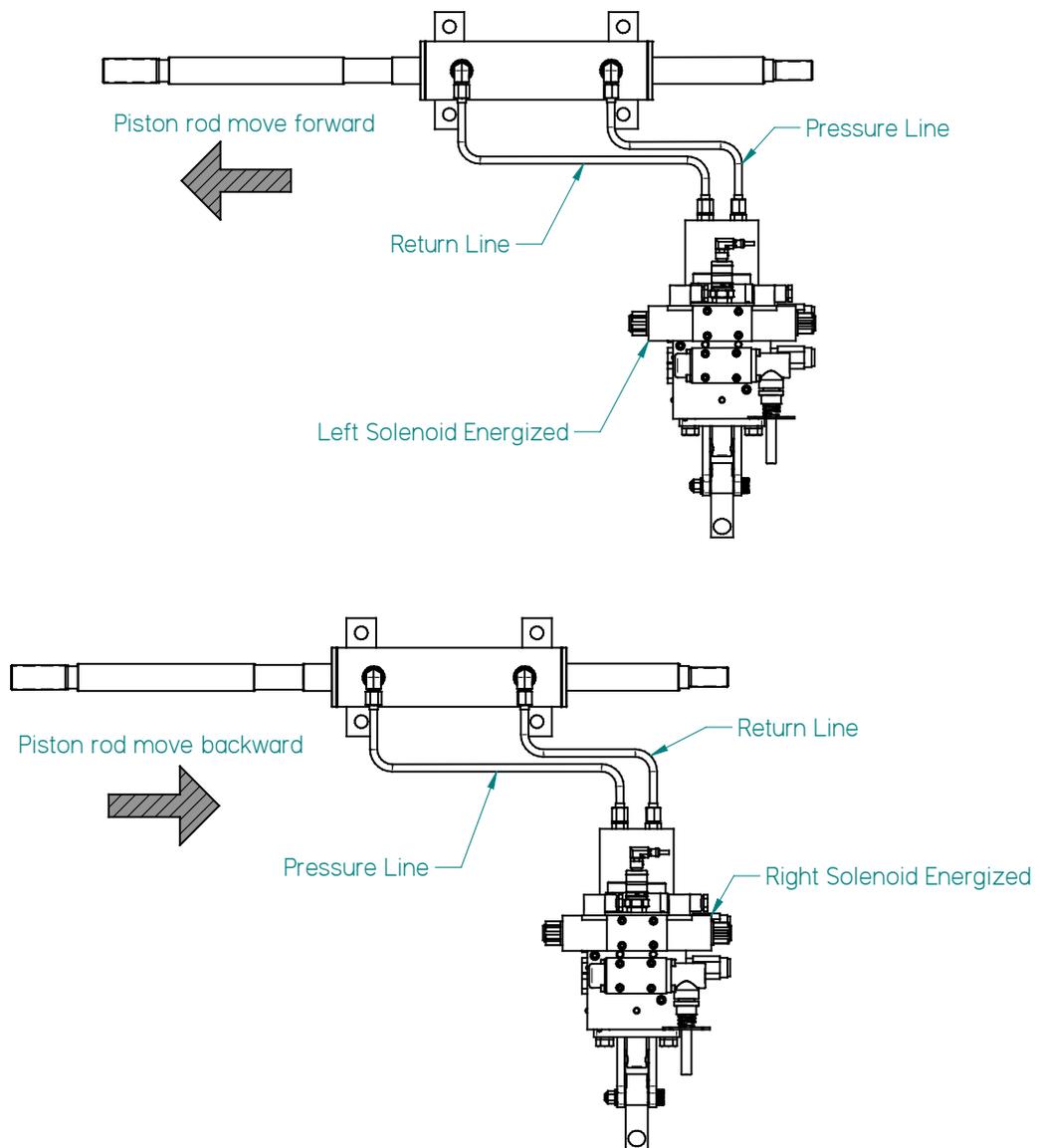
The valve has an internal cartridge centered by springs with a three position configuration: left and right position to move the piston forward or reverse and the center position to interconnect the pressure and return lines to the tank return line.

When the switch machine is in a rest position and the solenoids are de-energized, the valve cartridge returns to the center position by an internal spring action.

There is not hydraulic pressure active or any type of hydraulic holding force at the cylinder when the valve cartridge is centered.

When the power unit motor is on and one solenoid is energized the switch machine piston will move according the Figure 5.5.

Figure 5.5 Piston movement by solenoid direction valve



NOTE: One of the switch machine safety features is the need to have two different command inputs to move the switch machine from one position or another. One command to turn the power unit on and a second command to energize the right or left solenoid to move the switch machine forward or reverse.

To move the cylinder to the desire direction, both the power unit motor start solenoid and one of the direction valve solenoids must be energized with +12DC.

The internal valve cartridge can be moved manually to check if the valve is working properly using a small hex key. The internal cartridge can be jammed if any contaminant is present in the oil. You can insert a hex key at the manual operation orifice on each side of valve. See Figure 5.4.

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.

To remove a defective solenoid, loosen the solenoid-mounting nut.

5.1.1.2.2 Manual directional control valve

The manual directional control valve is responsible for the switch machine movement back and forth when using the hand pump.

The valve has an internal cartridge linked to the lever with two-positions configured: left and right position to move the piston forward or reverse.

The lever must be facing the direction you want to move the point.

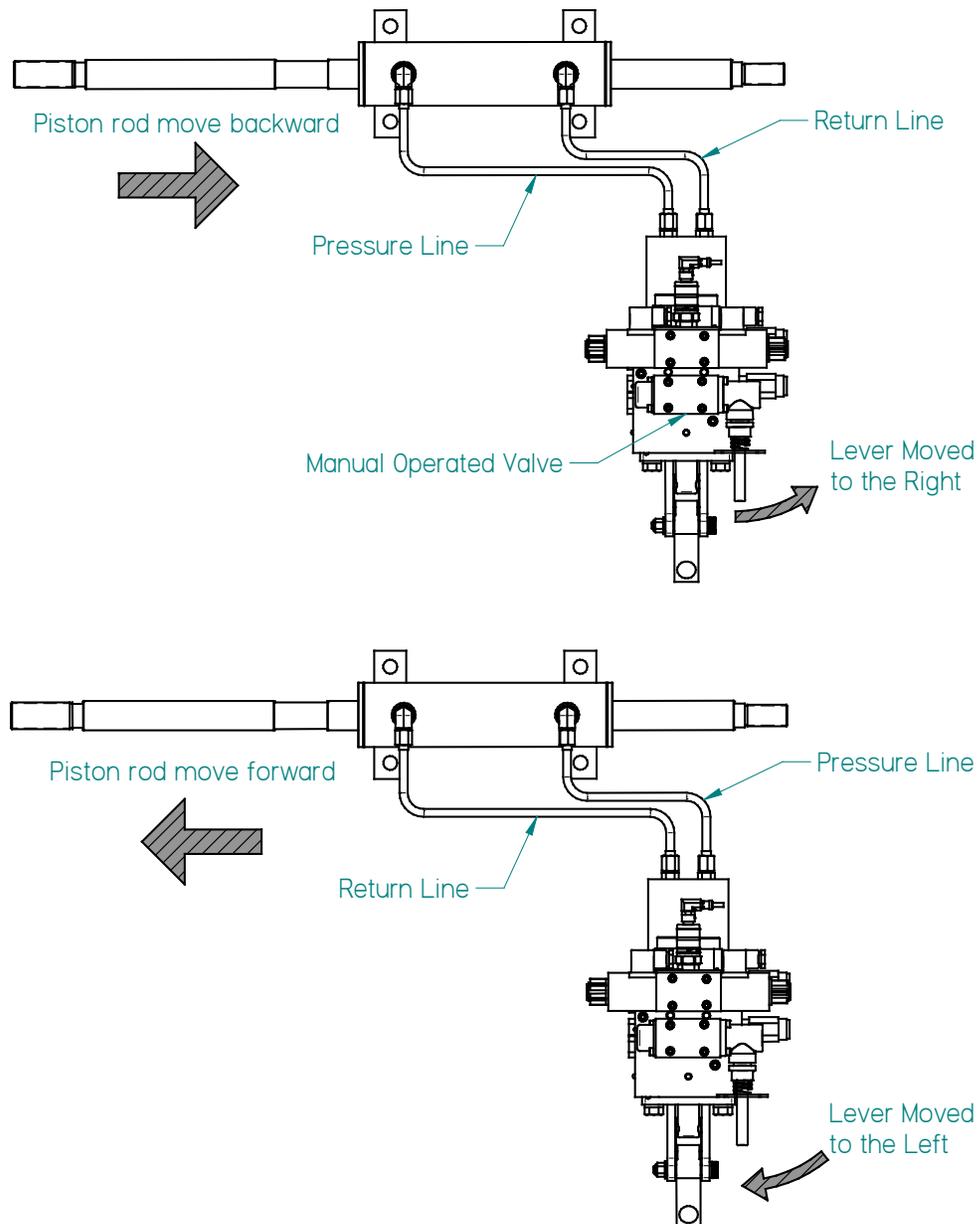
If you hand pump and the piston does not move independent of the lever position, check the hand pump system and the manual operated valve.

To check if the problem is the valve or hand pump, remove the valve 4 (four) mounting bolts and hand pump slowly and observe the pressure hole.

If the oil is coming with pressure when you pump, and a finger cannot stop it, the hand pump is working. The manual directional valve or one of sequential valve may be defective. See the hydraulic circuit in Section 8.

If the oil is not coming with pressure, the hand pump piston and check valves must be inspected.

Figure 5.6 Piston movement by manual direction valve



5.1.1.2.3 Hand pump piston

The hand pump piston is responsible for the switch machine rod movement back and forth when using the manual hand pump.

The hand pump piston was designed to work under severe operating conditions and to pump in both directions of movement in and out.

NOTE: For the first switch machine operations or until all the air is removed from the hydraulic circuit, the hand pump must be operated back and forth several times until the hand piston is pumping in both directions and the switch machine piston movement is smooth.

Three check valves are used for the hand piston to work properly; two external located at the manifold block and one installed at the piston head body.

If the check valve installed at the piston head body is defective, the piston will only be able to pump in one direction and the valve must be inspected.

If the piston head seals or external check valves are defective, the hand pump piston will not be able to pump in any direction and the seals and valves need to be inspected.

Figure 5.7 Hand pump piston control valves

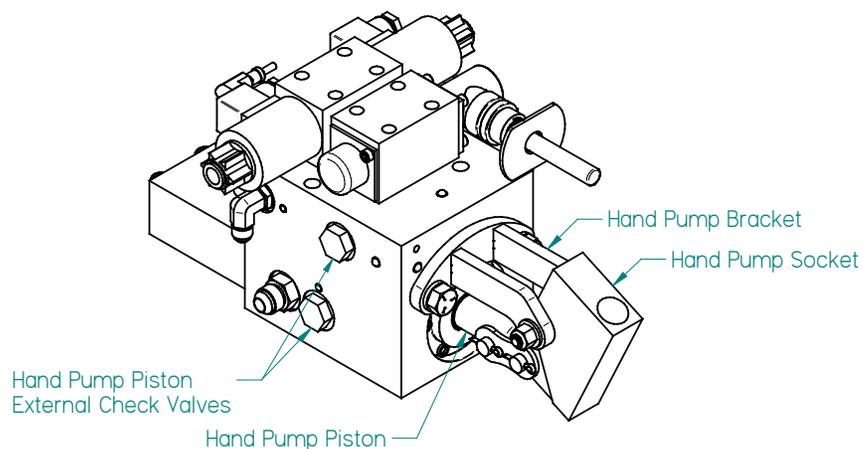
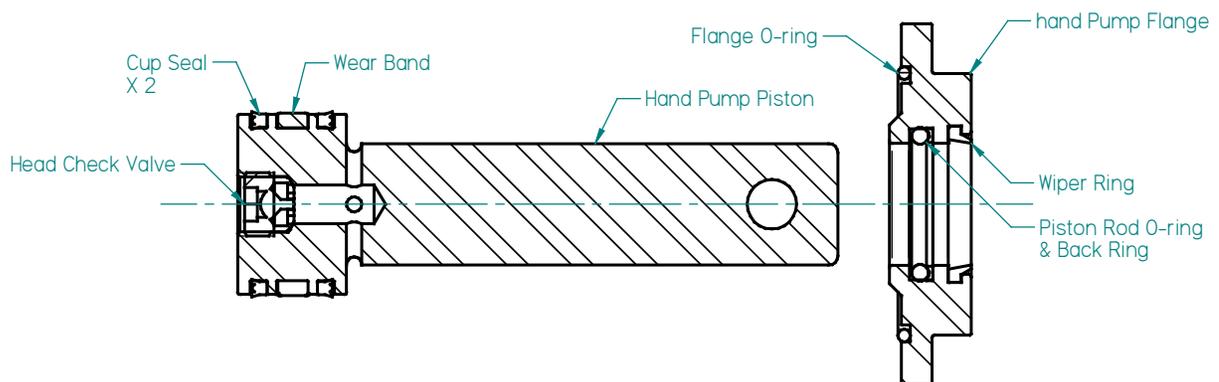


Figure 5.8 Hand pump piston and flange seals



Any leak at the flange can be repaired by replacing the hydraulic seals. See Section 7 – List of parts.

5.1.1.3 Pressure limit switch

The pressure limit switch, see also item 2.2, has an internal closed contact (pin 2) that will open when the hydraulic pressure increases during an obstruction or the proximity sensor fails to detect the point is closed.

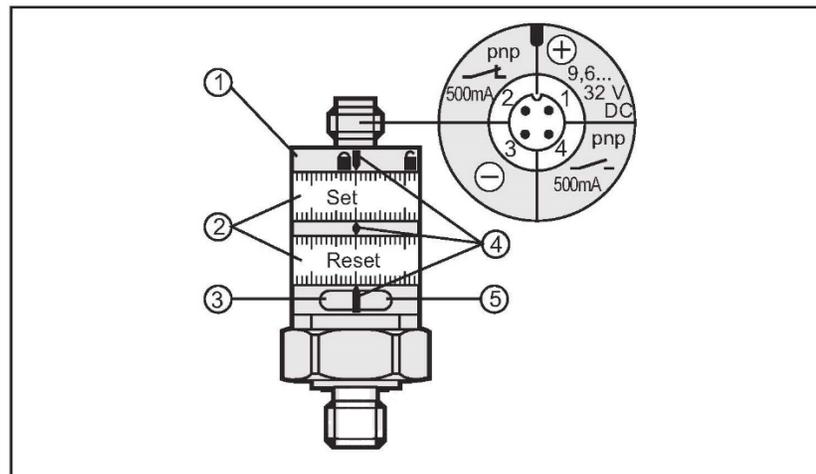
CAUTION: For the pressure limit switch to work properly, it must be set with an intermediate pressure value between the minimum pressure value to start moving the turnout and the maximum pressure value set at power unit's relief valve. If the pressure is set below the minimum, the switch machine will 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 but it can be easily adjusted in the field if necessary.

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

Decreasing pressure, the closed contact when opened (pin 2) will close when the set (Reset) value is reached.

Figure 5.9 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.

NOTE: Disconnect the power before connecting or disconnecting the unit. The minimum distance between Set and Reset = 2% of the final value of the measuring range.

5.1.1.4 Switch machine hydraulic cylinder

The switch machine cylinder was designed for high performance, long service life with zero leakage.

The cylinder was designed to work in the railroad environment under intermittent heavy-duty service and extreme temperature variation.

The cylinder has two threaded heads for easy disassembly. The high quality seals and wear band can be replaced if needed.

A high speed run through can cause unexpected high pressure and premature seal failure.

If an oil leak is detected at the rods seals or any rod damage occurs, it is recommended the switch machine be removed from service and take it to the shop for maintenance.

To remove the cylinder, it is necessary to remove the following major subassemblies:

1. Remove the switch machine lids;
2. Locate the centering device lever and remove the release pin. See section 3 - Figure 3.2;
3. Move the center device lever to the active position. See section 3 - Figure 3.3;
4. Hand pump until the switch rod is locked at center position. See Figure 5.10;
5. Disconnect the (+) positive battery cable from the battery terminal;
6. Disconnect the proximity sensors quick disconnect sockets;
7. Loosen the four center top channel mounting bolts and remove the center top channel;
8. Loosen the four position sensor bracket subassembly mounting bolts;
9. Remove the sensor bracket subassembly. See Figure 5.11;
10. Loosen the four mounting bolts and remove the target cover panel; See Figure 5.12;
11. Disconnect the target shaft from the quick disconnect ball joint. See Figure 5.13;
12. Return the center device lever to the release position and insert the release pin;
13. Hand pump the cylinder to the right or against the target. See Figure 5.14;

Figure 5.10 Cylinder at center position

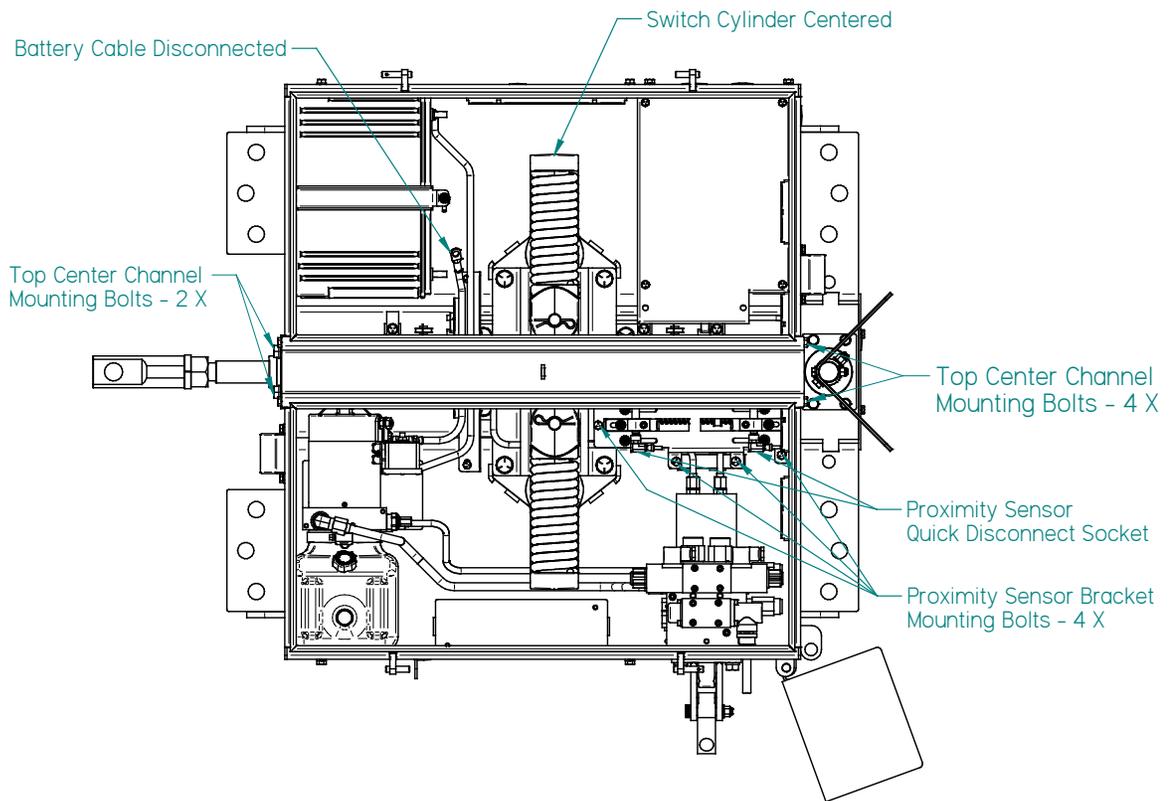


Figure 5.11 Proximity sensor bracket removed

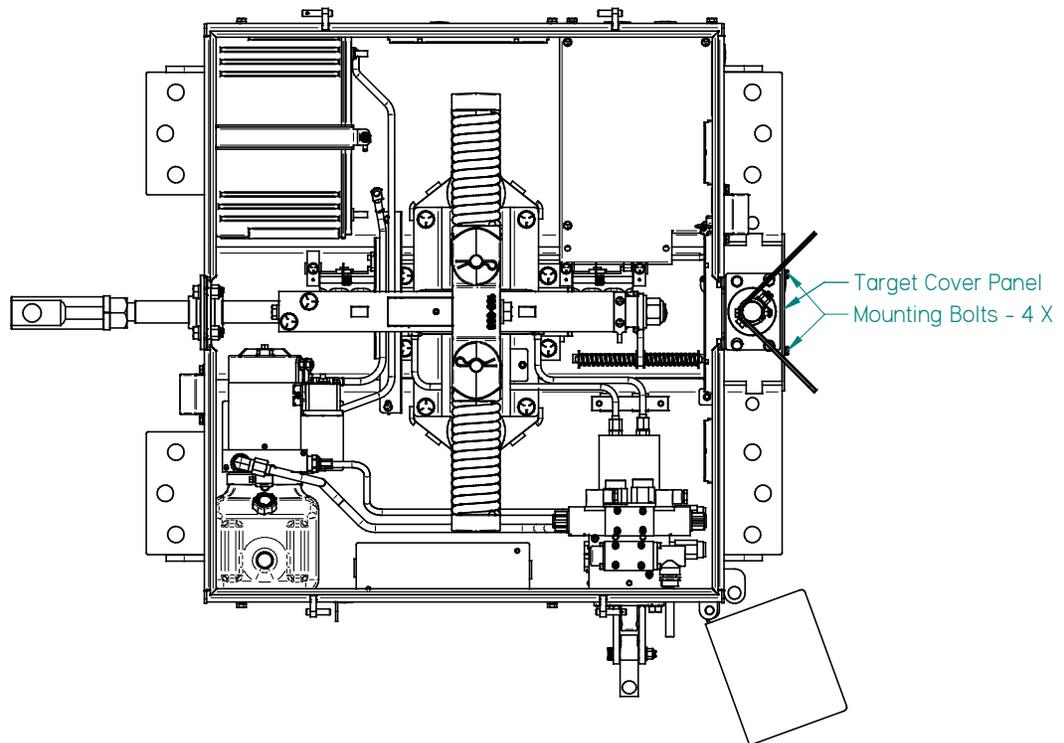


Figure 5.12 Target cover panel removed

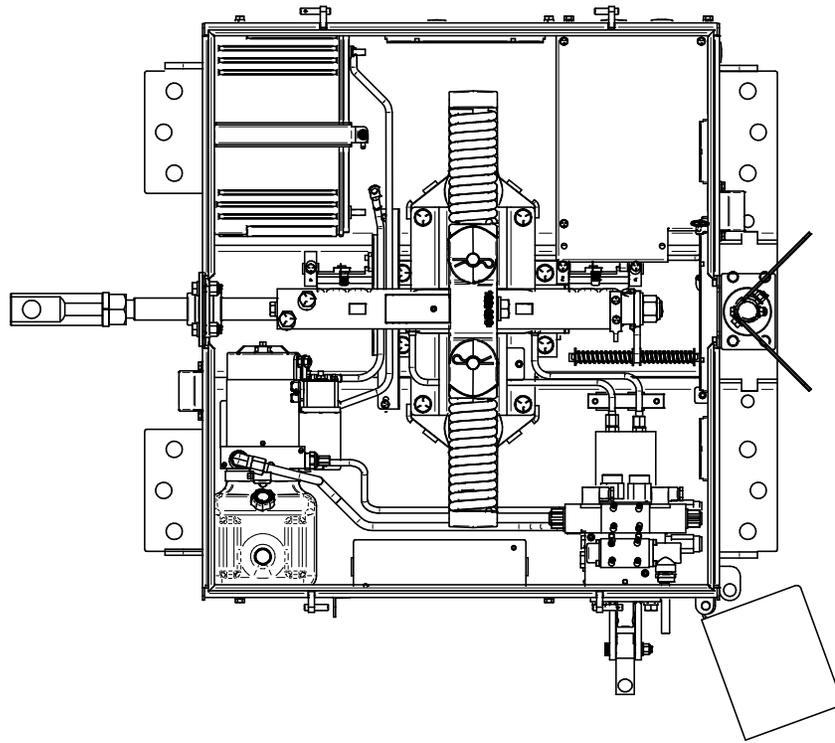
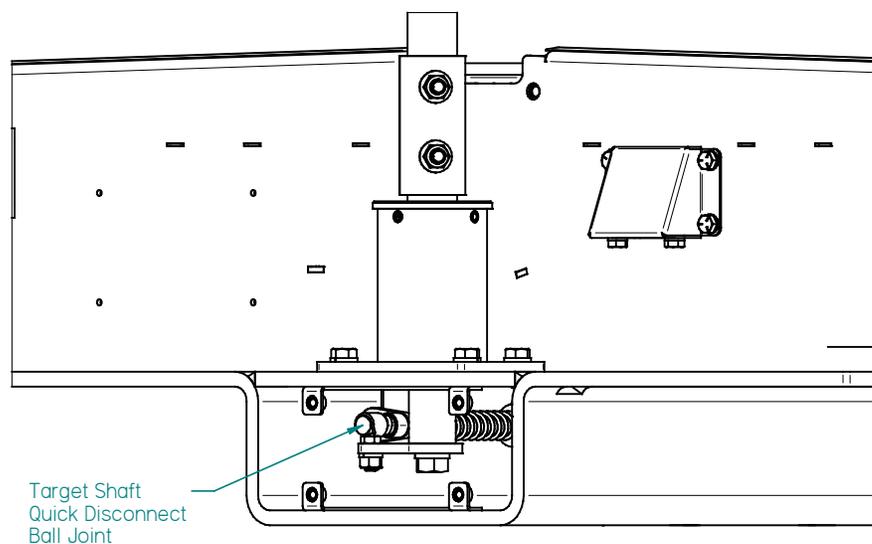


Figure 5.13 Target shaft with quick disconnect ball joint location



14. With the cylinder at the right position, loosen the spring compression bolt lock set screws (X2) and target. See Figure 5.14;
15. Loosen the spring bolt until the pivot bracket, clevis and springs are completely free;

Figure 5.14 Cylinder at the right position

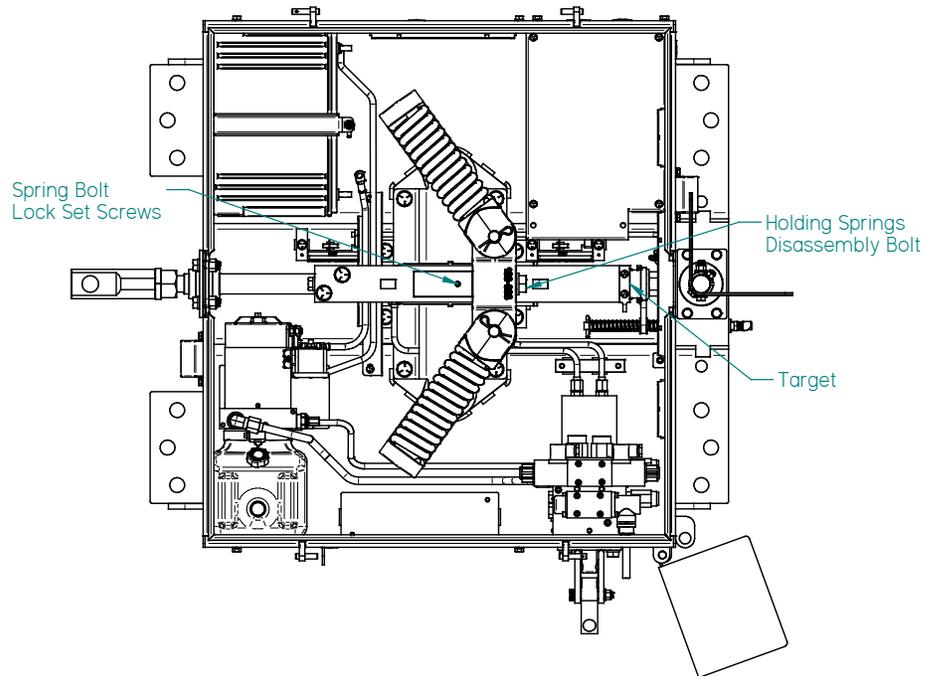
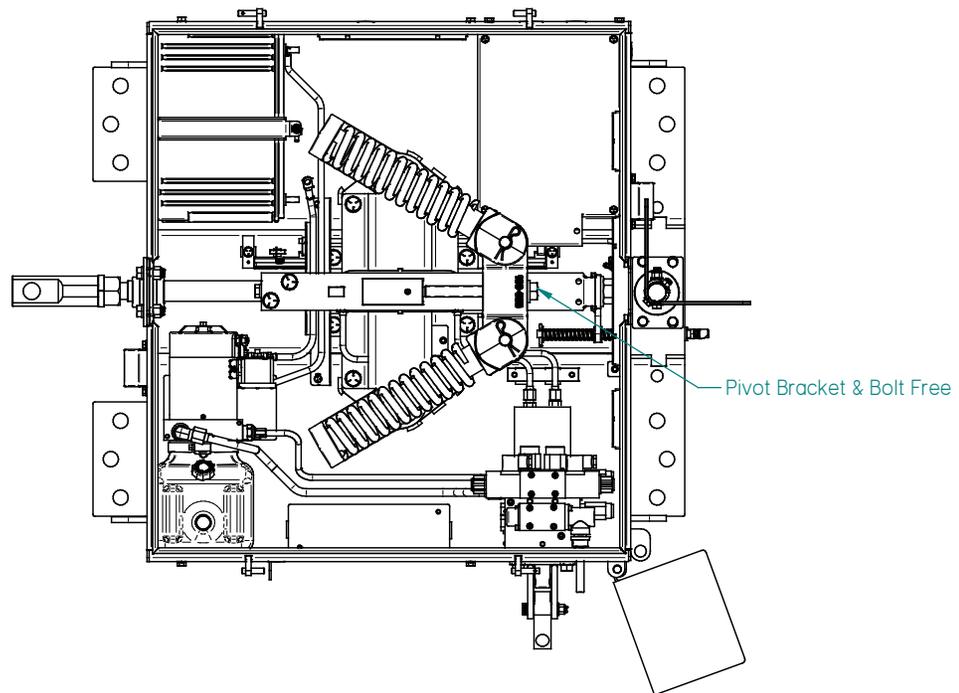
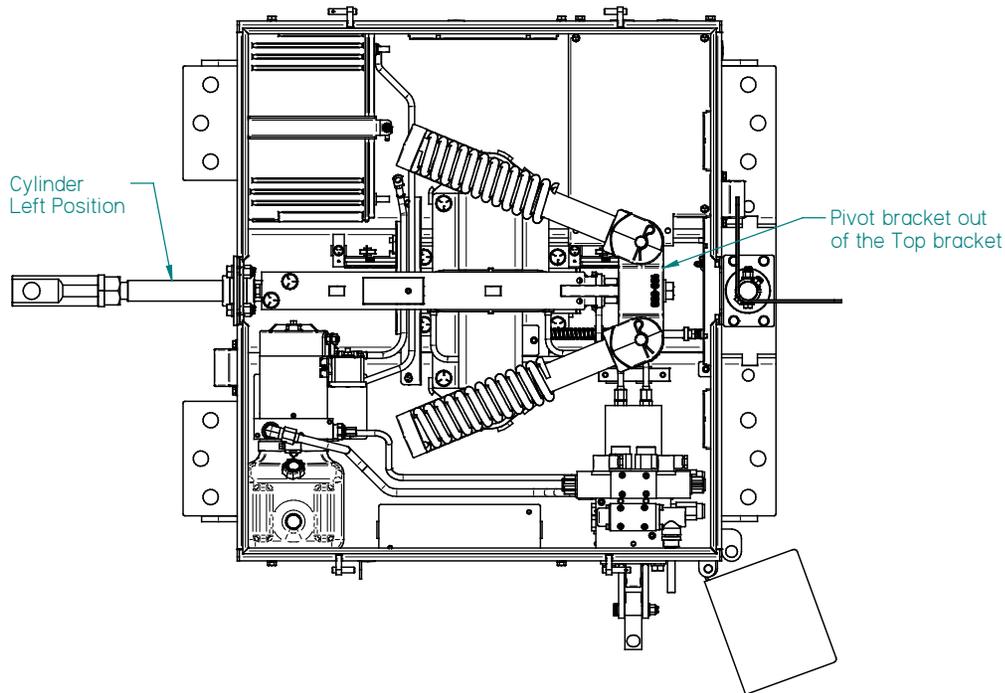


Figure 5.15 Springs decompressed and free



16. Hand pump the cylinder to the left to make it easy to remove the pivot bracket, clevis e springs. See Figure 5.16;

Figure 5.16 Cylinder at the left position



17. Remove the pivot bracket, clevis and the springs. See Figure 5.17;
18. With the cylinder at the left position, remove the front rod adapter, lock washer and nut;
19. Remove the cylinder nut and washer of the internal rod. See Figure 5.17;
20. Hand pump the cylinder to the right to remove the left bolts of the top bracket;
21. Remove the cylinder top bracket. See Figure 5.18;
22. Loosen the tube nut from the power unit. See Figure 5.18;
23. Remove the cylinder front and rear port tubes. See Figure 5.18;
24. Remove the central bracket. See Figure 5.20;
25. Remove the battery cables and cable tray. See Figure 5.19;
26. Remove the front rod bushing flange, bolts, washers, nuts and bushing support;

Figure 5.17 Pivot bar, clevis and the springs removed

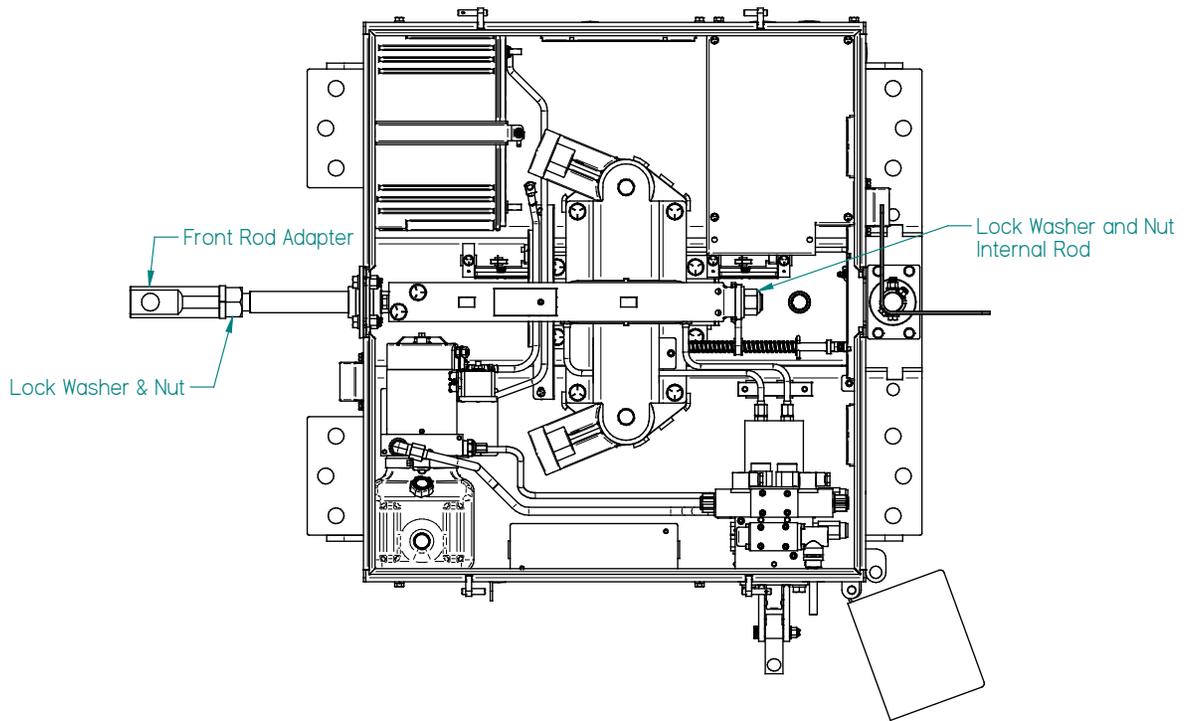


Figure 5.18 Front rod adapter, rod washers and nuts removed

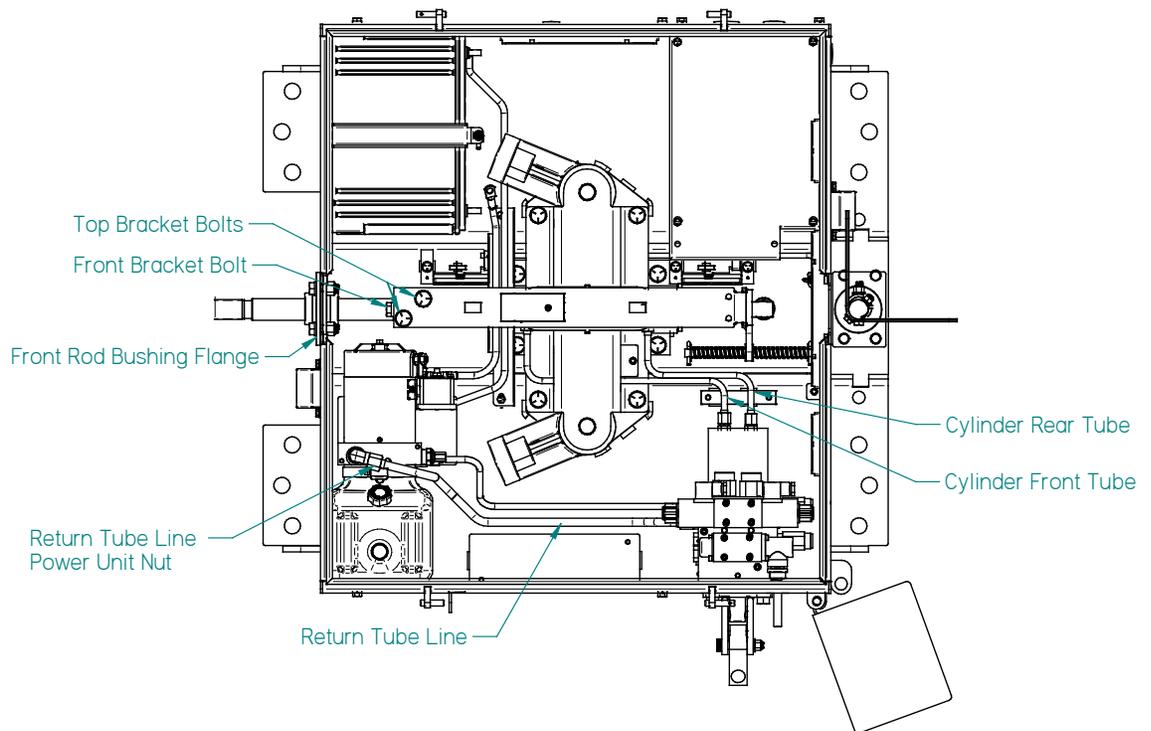


Figure 5.19 Center bracket removed

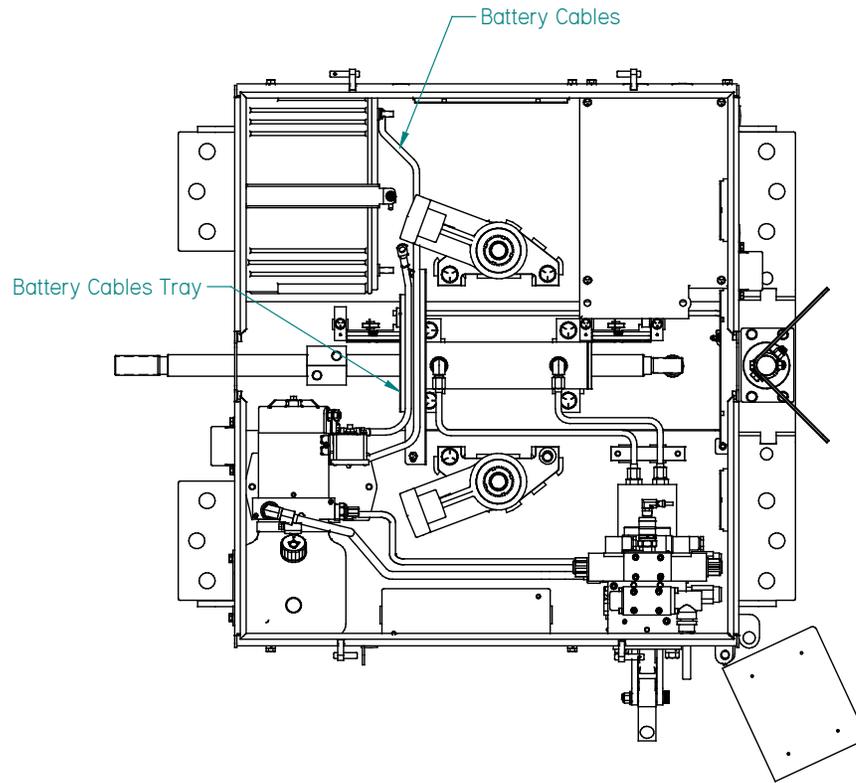
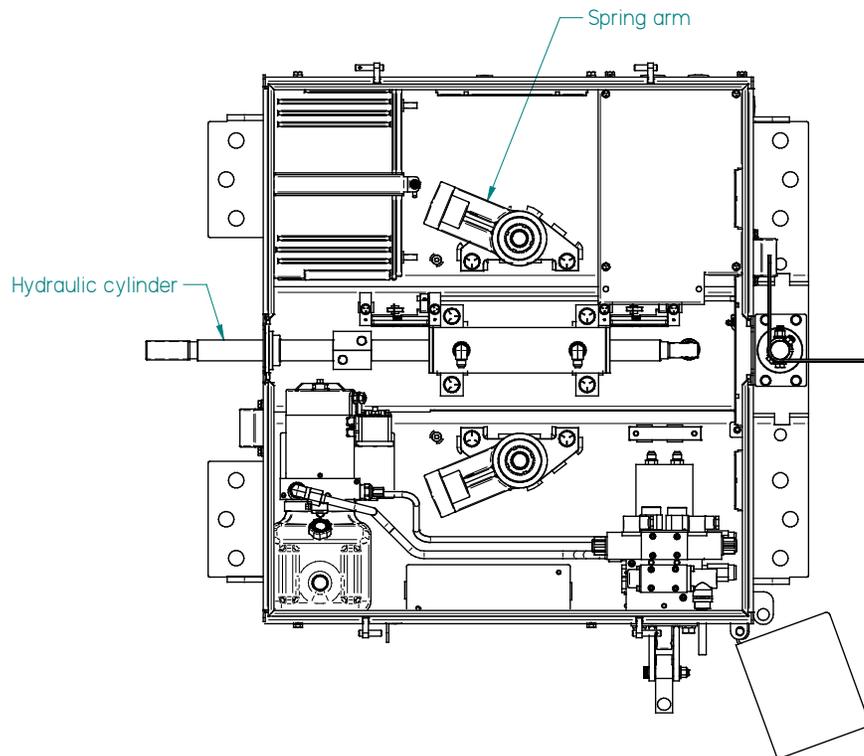


Figure 5.20 Center bracket and battery cables & tray removed



- 27. The hydraulic cylinder can be removed for service;
- 28. The spring arms can also be inspected;
- 29. To reassemble the parts, follow the steps backward;

5.1.2 Mechanical components

5.1.2.1 Cam roller bearing

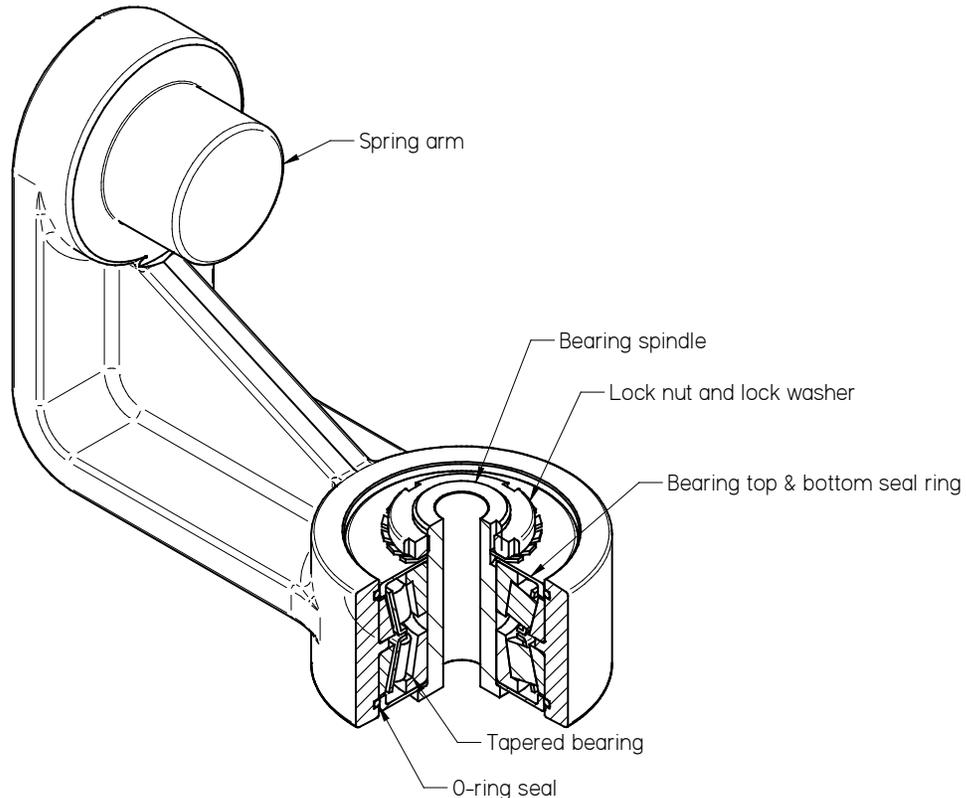
Inspect the top bracket cam roller bearing for abnormal gap or surface distress; see section 1 Figure 1.11, this bearing is used to prevent the cylinder rod from spinning under intermittent point bar loads.

This cam roller bearing also keeps the target distance stable within the proximity sensors.

5.1.2.2 Spring arm bearing

The spring arms tapered bearing set was selected to support the spring load and intermittent shocks transmitted by the point rods.

Figure 5.21 Spring arm bearing set



Inspect the spring arms tapered bearing for abnormal gap, wear and indentations as well.

The complete list of spring arm parts can be found in section 7.

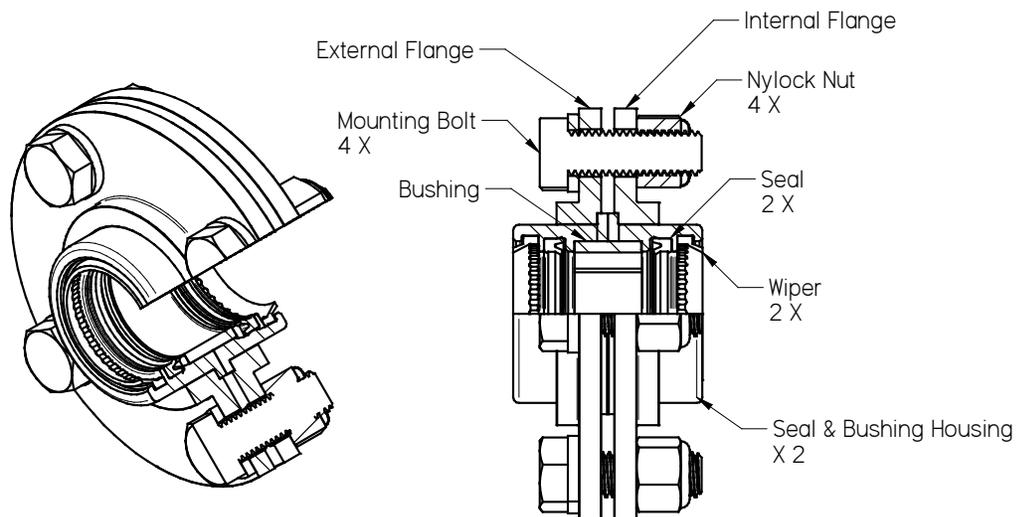
If it is necessary to open the tapered bearing set for inspection, it is recommended to reassemble using premium quality bearing grease, mineral base with lithium soap, minimum operation temperature range: -30°C to 120°C or -22°F to 280°F.

5.1.2.3 Front rod bushing

The front rod bushing was designed to protect the cylinder front rod from scratches and to support point bar side loads.

The front rod bushing can be serviced without removing the cylinder by removing the mounting bolts.

Figure 5.22 Front rod flange



Inspect the dry bushing and seals, the seals are used to capture any contaminant that could cause unexpected wear of the bushing.

If any vibration or noise is observed at the front rod bushing, a small quantity of oil drops at the rod or bushing can solve the problem.

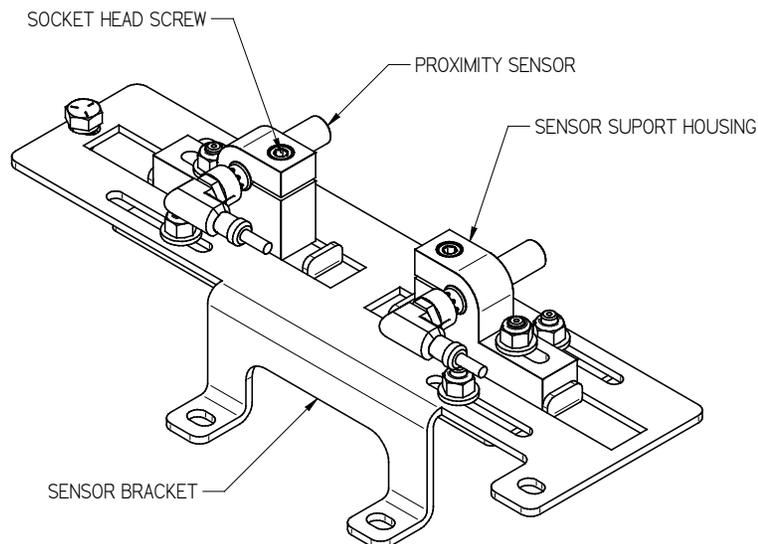
5.1.3 Electrical components

5.1.3.1 Proximity sensors replacement & adjustment

The proximity sensor description can be found at section 1, item 1.6.4. and part number at section 7.

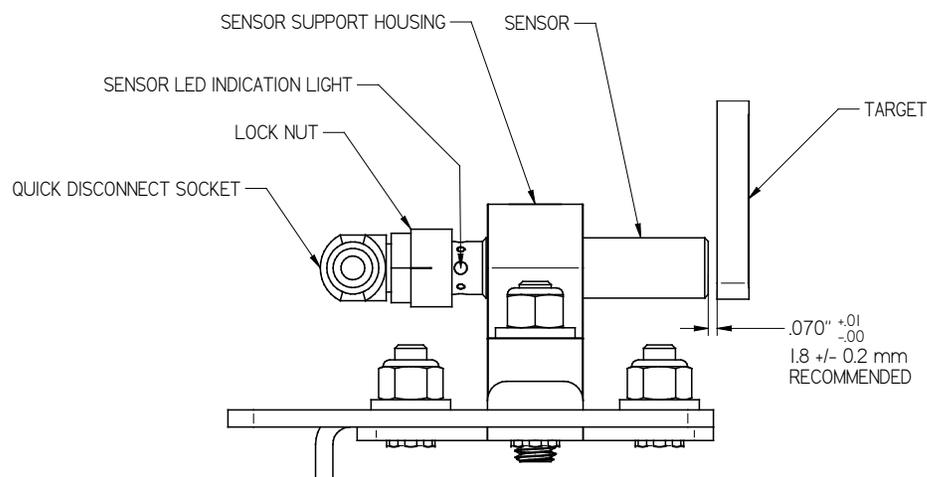
The sensor is inserted in a support housing using a single socket head screw.

Figure 5.23 Proximity sensor replacement



To adjust the distance to the target or replacement loosen the socket head screw.

Figure 5.24 Proximity sensor adjustment



A quarter (coin) can be used to measure and adjust the gap distance between the sensor head and the target. See Figure 5.24 above.

5.1.3.2 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 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 proceed will eliminate the need for changing the identification of the cables.

5.1.3.3 Battery replacement

The expected battery live, under normal operation, is approximately 3 years or longer, but deep discharge can damage or shorten the service life.

To replace the battery, disconnect the battery cables, loosen the hold down bolt and remove the battery bracket.

Do not replace the battery with standard auto liquid acid battery, only the AGM type battery is recommended by the manufacturer.

A standard battery will last less than one year, can overheat and leak, damaging the switch machine components.

General Information

List of parts and the required torque to reassembly the bolts and nuts can be found in Section 7.

6 SECTION 6 – 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 6.1.

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

Table 6.1 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.

6.1 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.

6.1.1 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, follow the section 5 – corrective maintenance recommendations.

6.1.1.1 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;

6.1.1.2 Switch machine inspection

1. Open the switch machine lids 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 power unit reservoir;
10. Observe any sign of hydraulic oil accumulation;
 - a. Look for any hydraulic leak from the manifold and fittings;
11. Check the battery voltage;
 - a. Open Circuit Voltage 12.8 VDC or higher at 68°F;
 - b. 14.4 to 14.6 volts maximum at 68°F charging;
 - c. If the battery voltage is low, verify if the battery charger system is working properly;
 - d. If the battery is showing a voltage lower than 11.8 V it is recommended to replace it;
12. Observe any sign of moisture accumulation;
13. The moister check should be made prior to winter freezing weather

6.1.2 Cleaning

If the switch machine is installed where blowing sand, dust or constant flood 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.

6.1.3 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 g 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 18 and following steps.

When any other correction or repair are needed, see section 4 & 5 for instructions.

7 SECTION 7 – LIST OF PARTS

In this section, you will find the complete list of parts and components of the YM-16 switch machine.

7.1 Switch machine housing

Figure 7.1. Switch machine housing

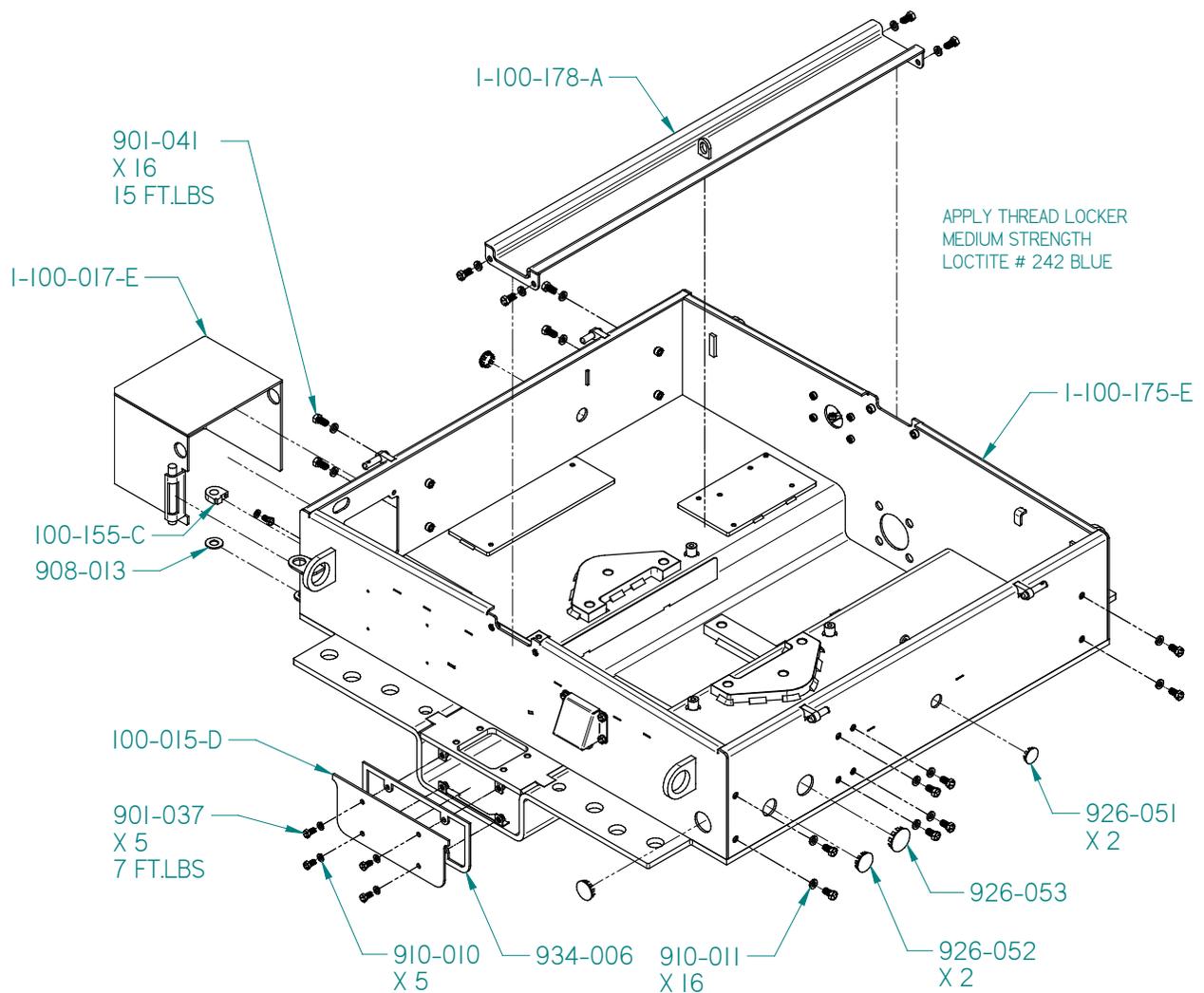
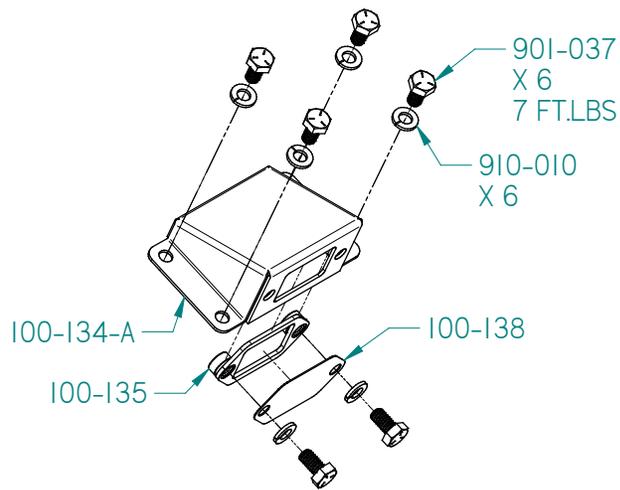
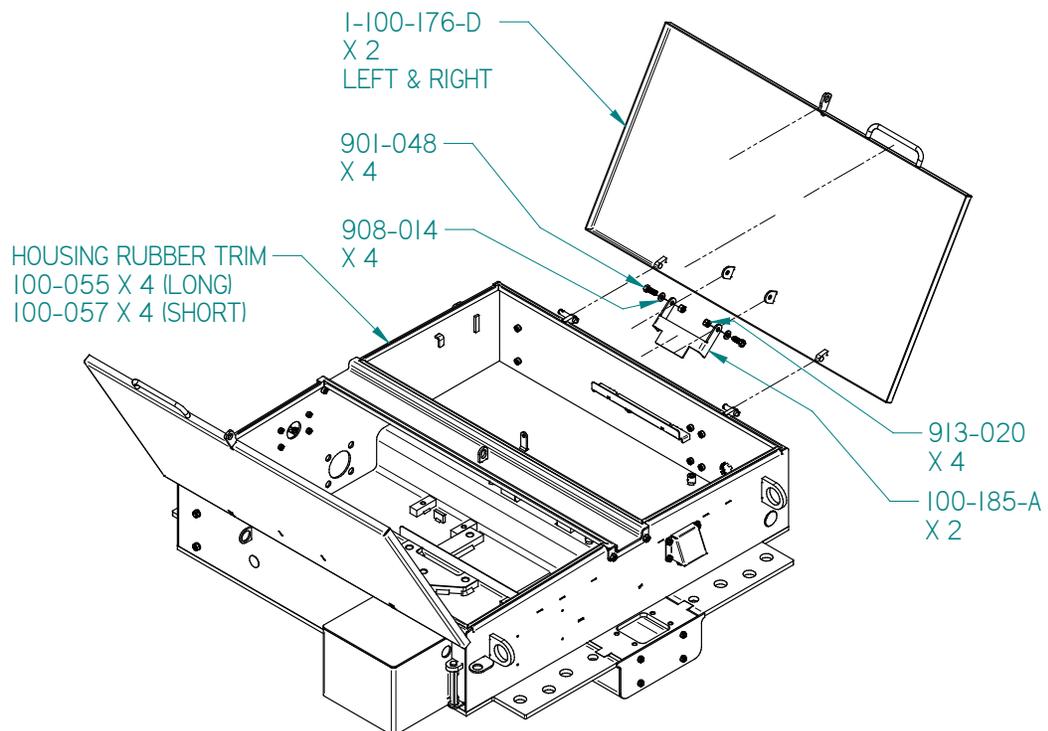


Figure 7.2. Housing breather



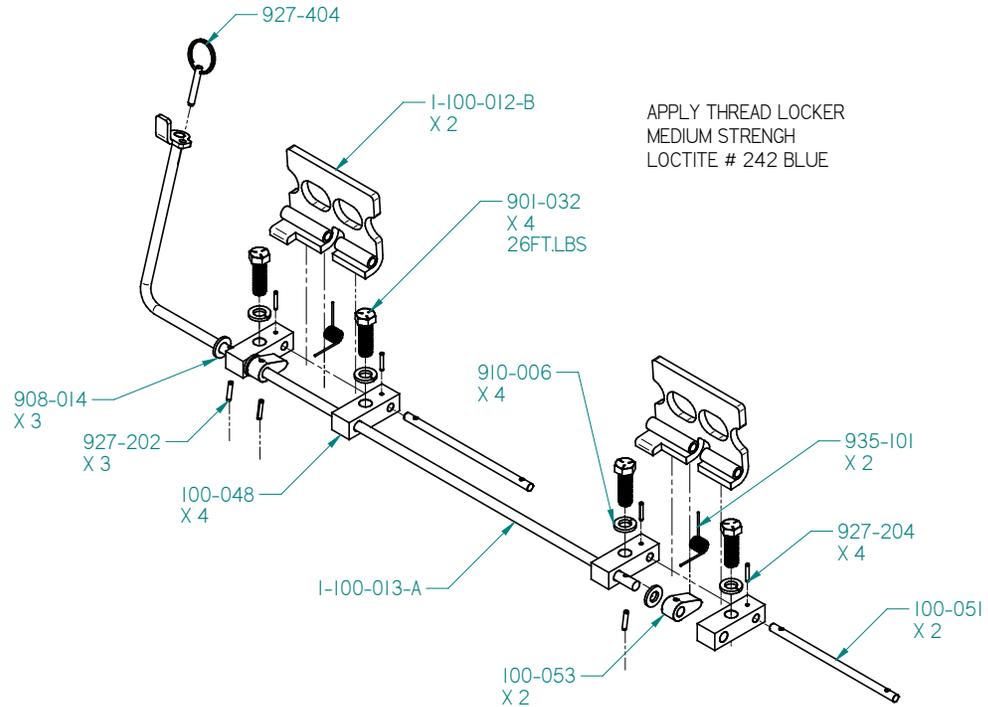
7.2 Switch machine lid

Figure 7.3. Switch machine lid



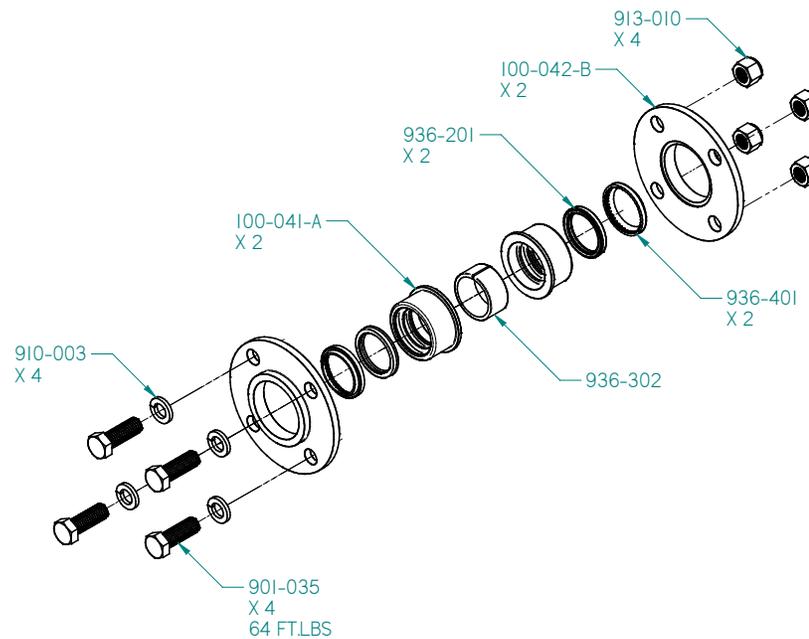
7.3 Cylinder centering device subassembly

Figure 7.4 Cylinder centering device subassembly



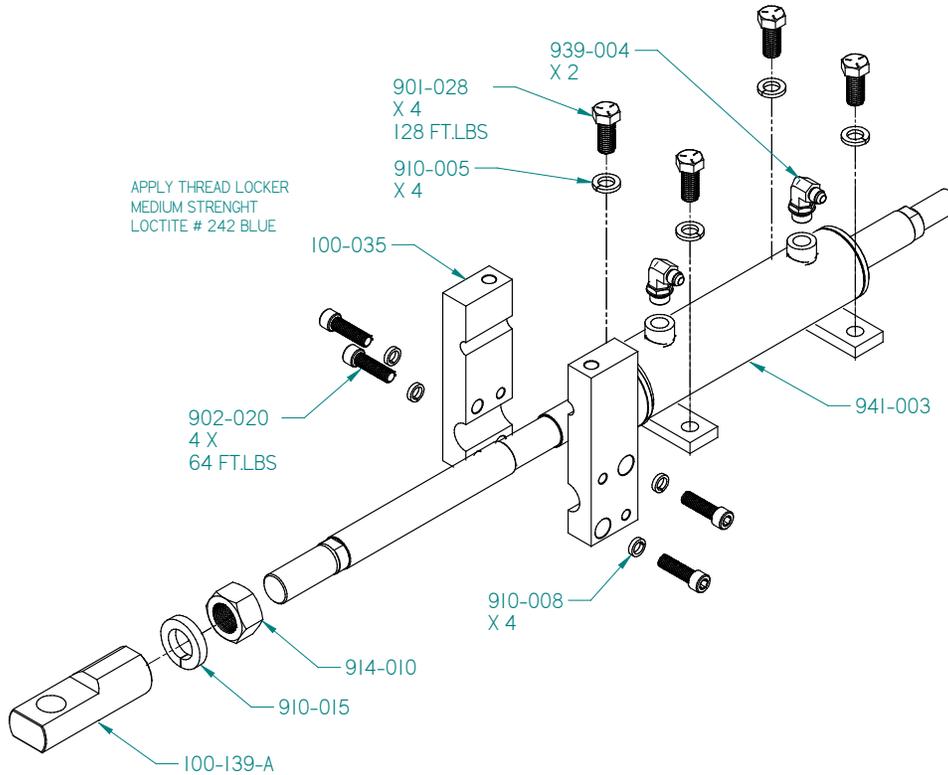
7.4 Front rod bushing & flange subassembly

Figure 7.5 Front rod bushing & flange subassembly



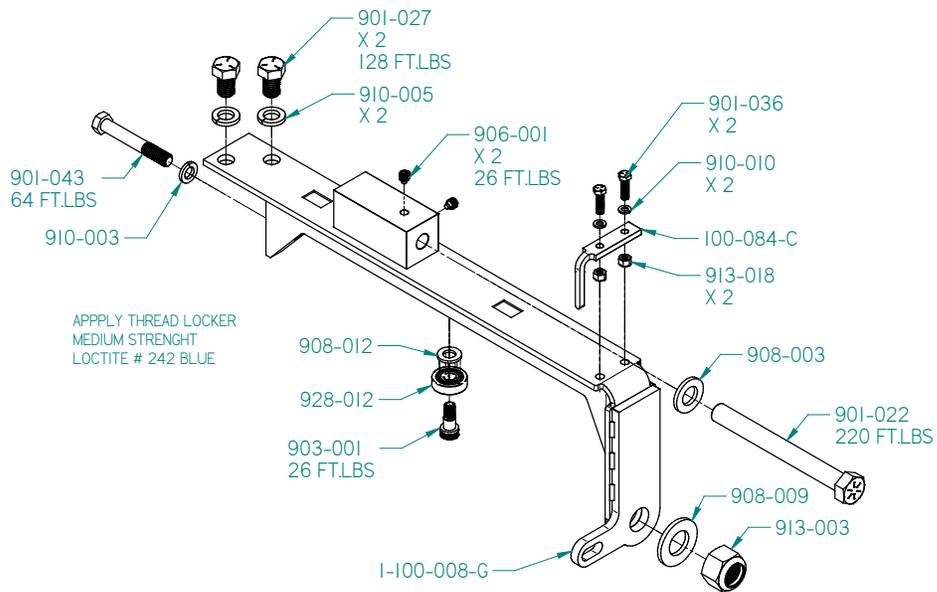
7.5 Hydraulic cylinder subassembly

Figure 7.6 Hydraulic cylinder subassembly



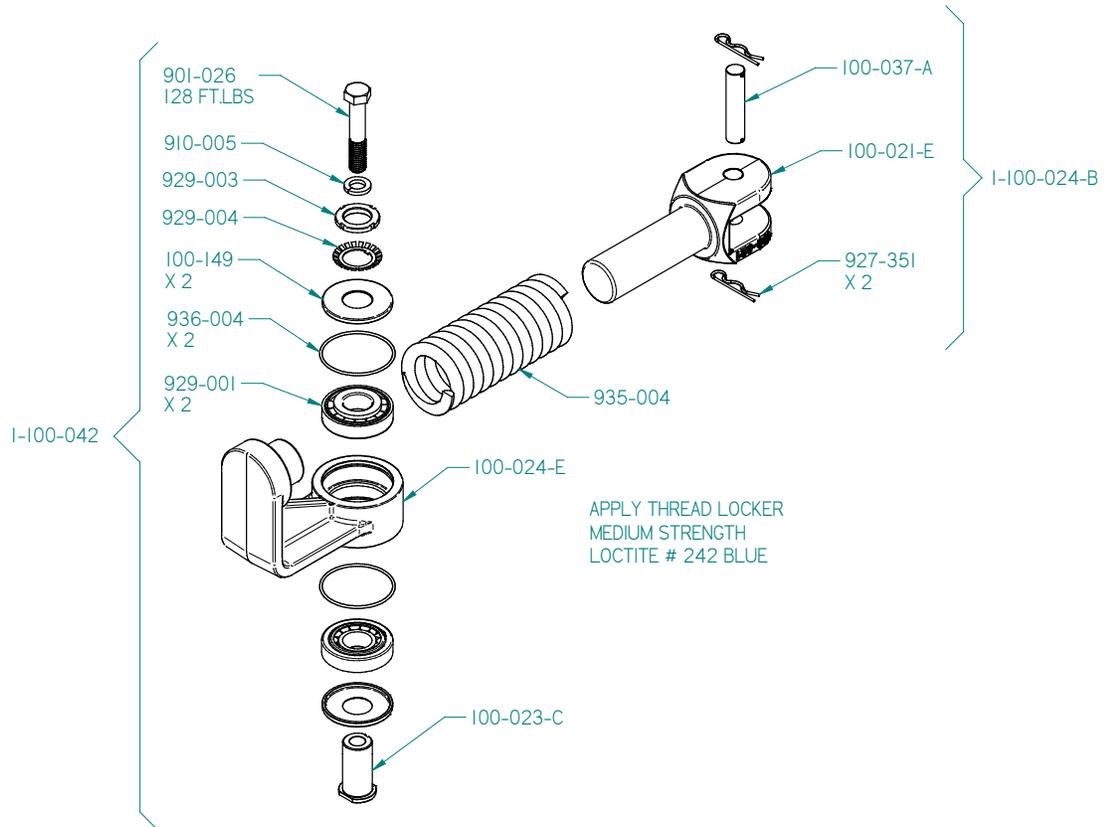
7.6 Cylinder top bracket subassembly

Figure 7.7 Cylinder top bracket subassembly



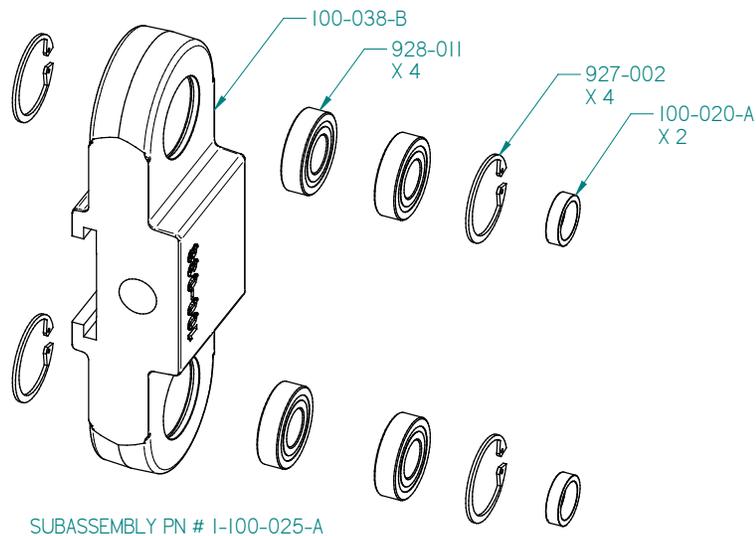
7.7 Spring arm & clevis subassembly

Figure 7.8 Spring arm & clevis subassembly



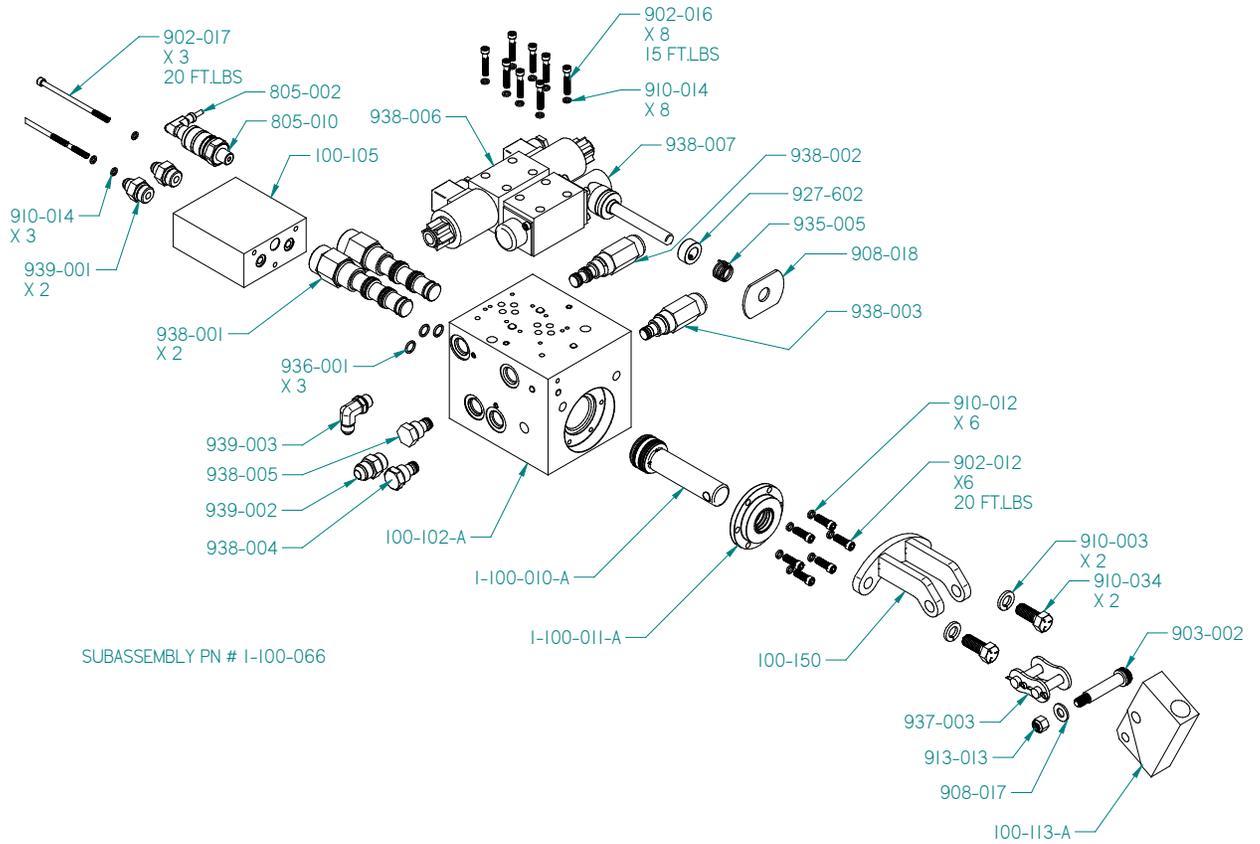
7.8 Clevis pivot bracket subassembly

Figure 7.9 Clevis pivot bracket subassembly



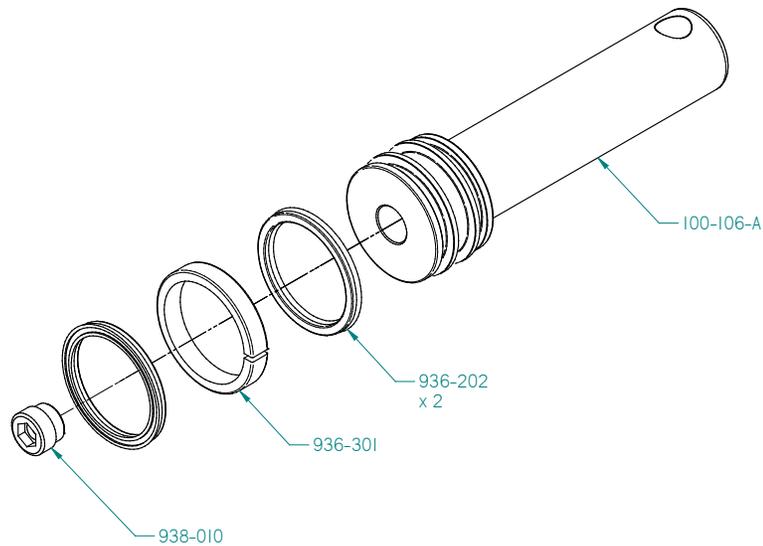
7.9 Hydraulic manifold subassembly

Figure 7.10 hydraulic manifold subassembly



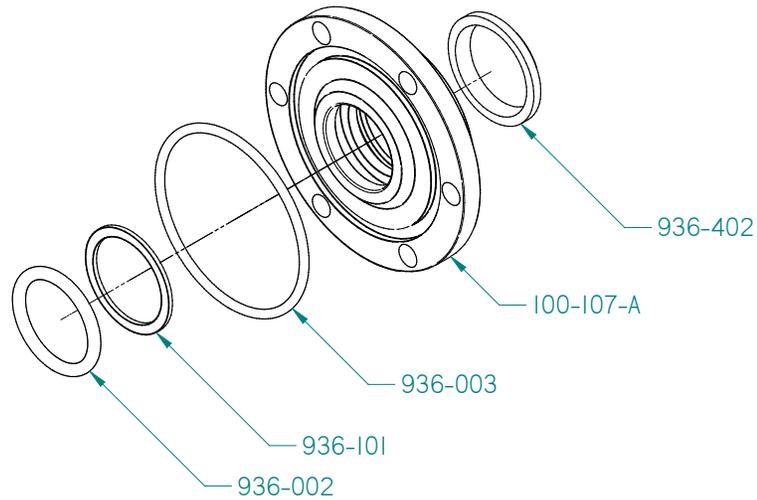
7.10 Hand piston subassembly

Figure 7.11 Hand piston subassembly



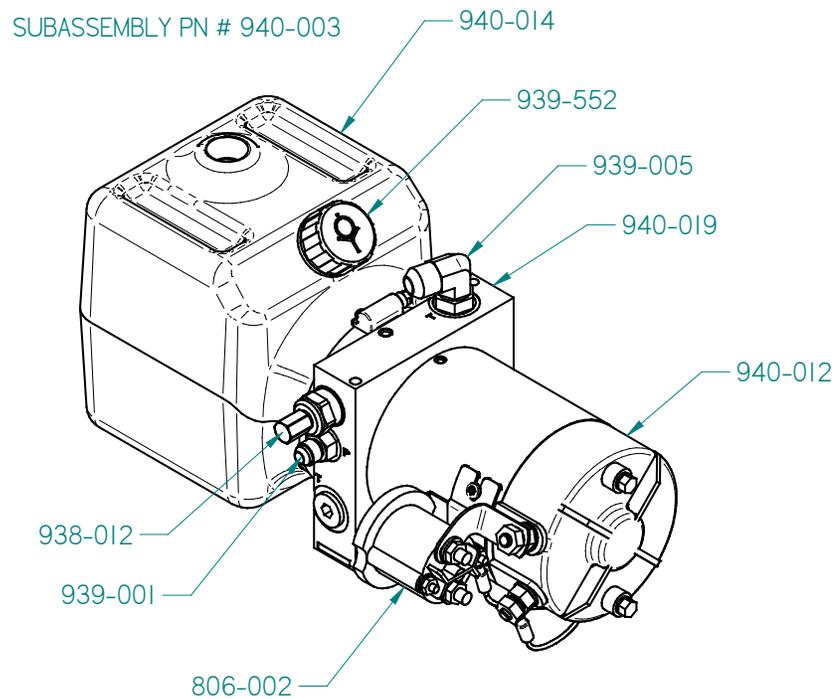
7.11 Hand piston flange subassembly

Figure 7.12 Hand piston flange subassembly



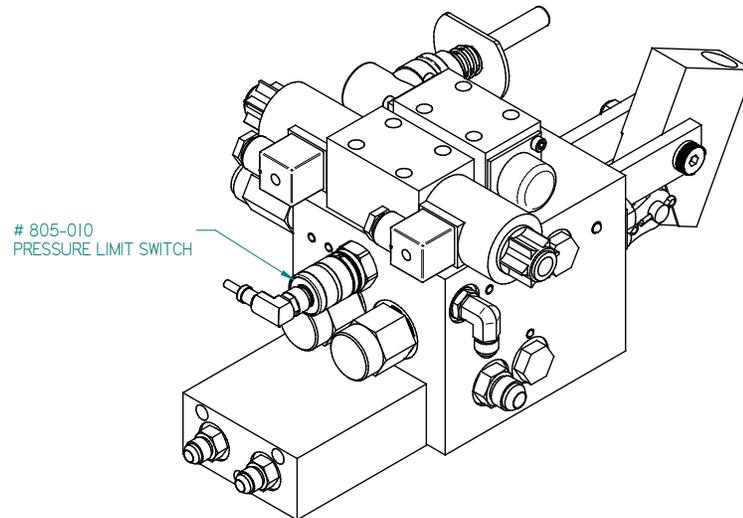
7.12 Hydraulic power unit subassembly

Figure 7.13 Hydraulic power unit subassembly



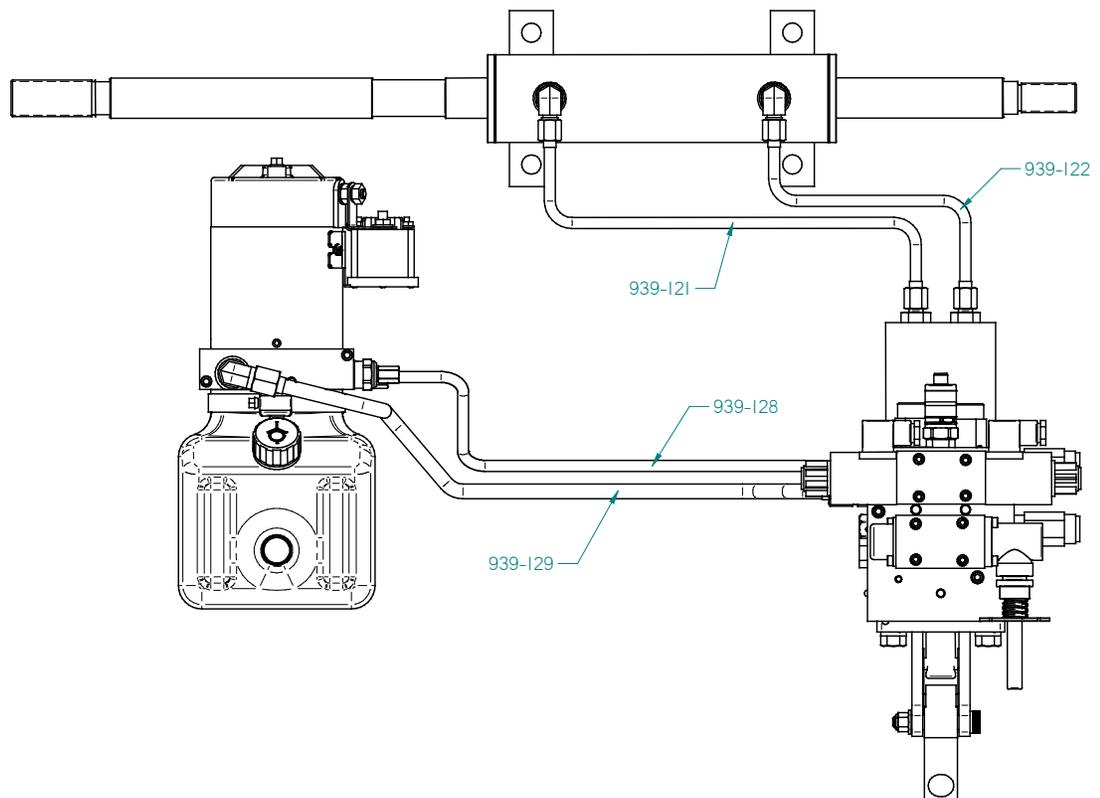
7.13 Pressure limit switch

Figure 7.14 Pressure limit switch



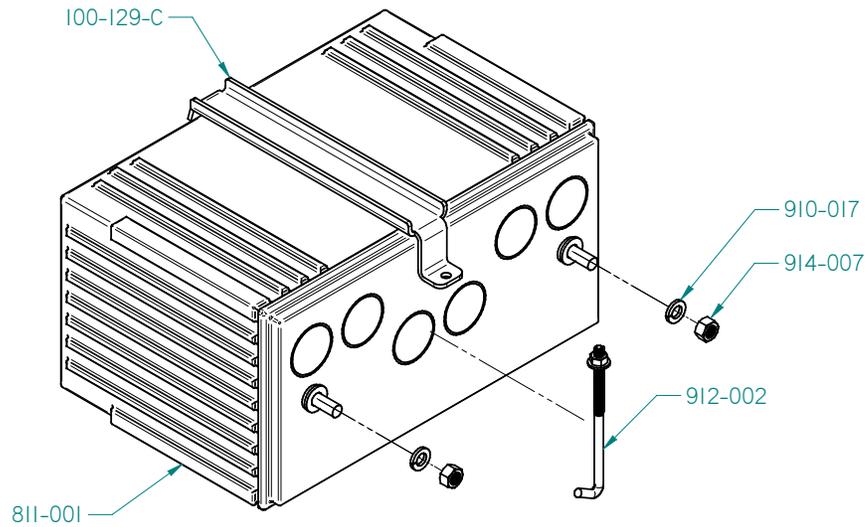
7.14 Hydraulic Tubing

Figure 7.15 Hydraulic tubing



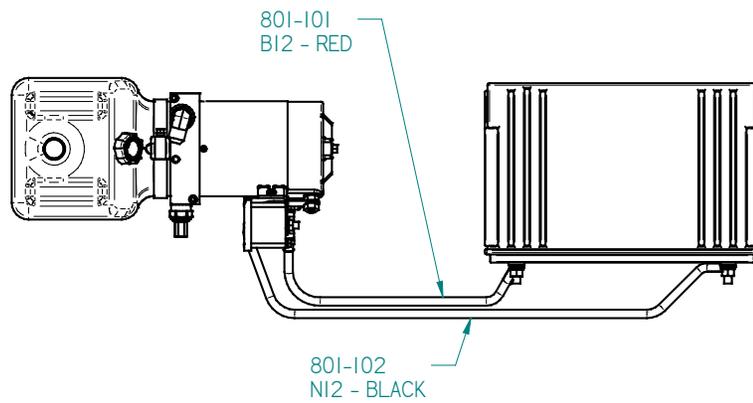
7.15 Battery

Figure 7.16 Battery



7.16 Battery Cables

Figure 7.17 Battery cables



7.17 Sensors Bracket Subassembly

Figure 7.18 Sensor bracket subassembly

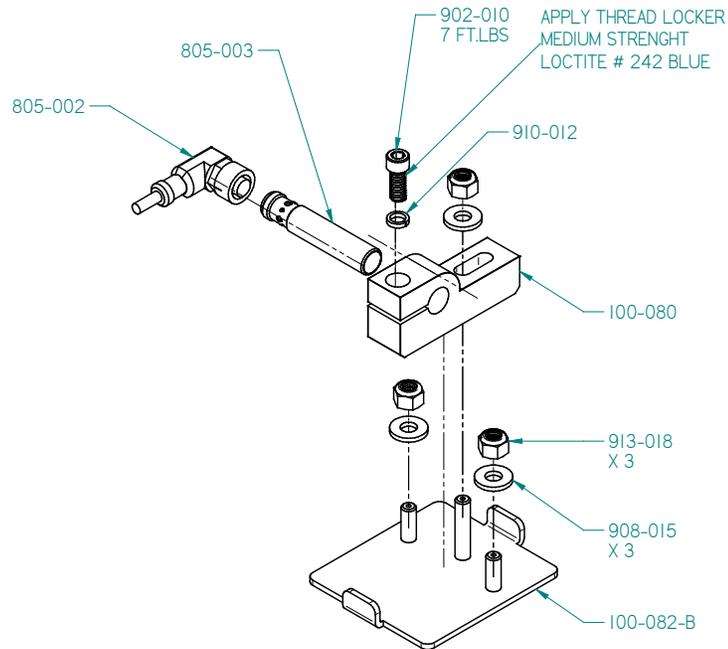
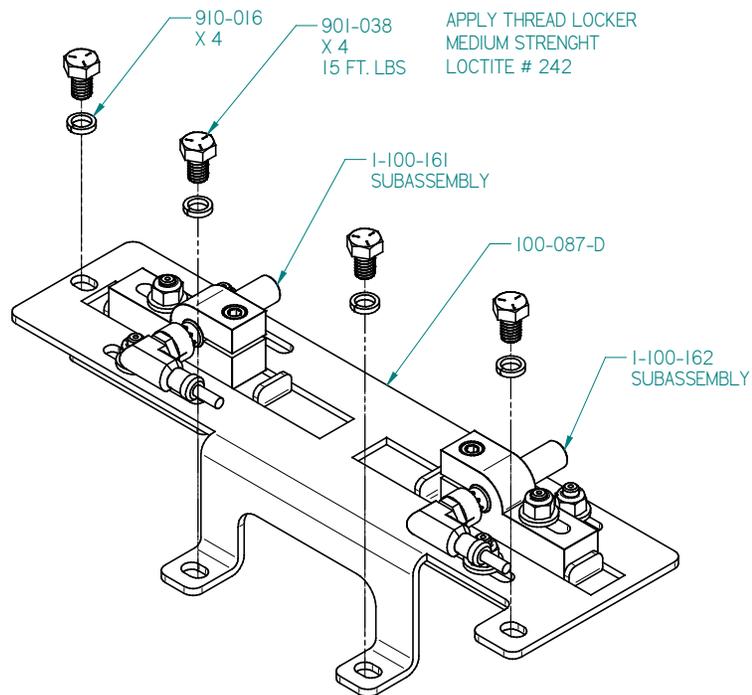


Figure 7.19 Sensors bracket subassembly



7.18 Target Subassemblies

Figure 7.20 Target shaft subassembly

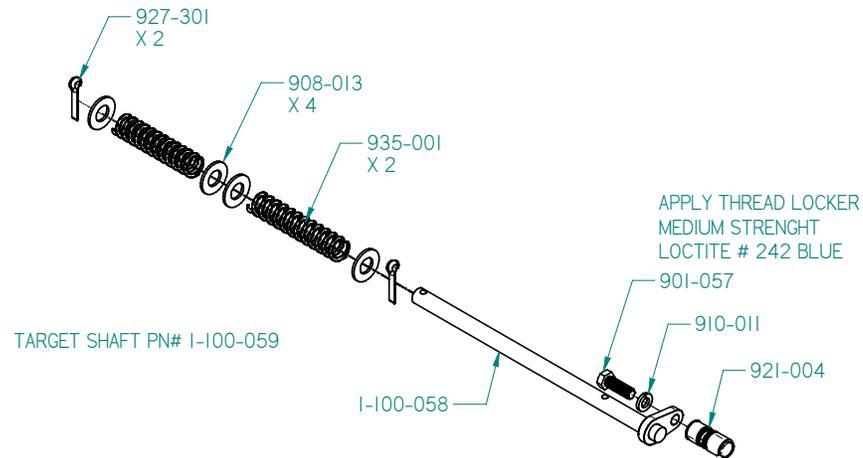


Figure 7.21 Target housing subassembly

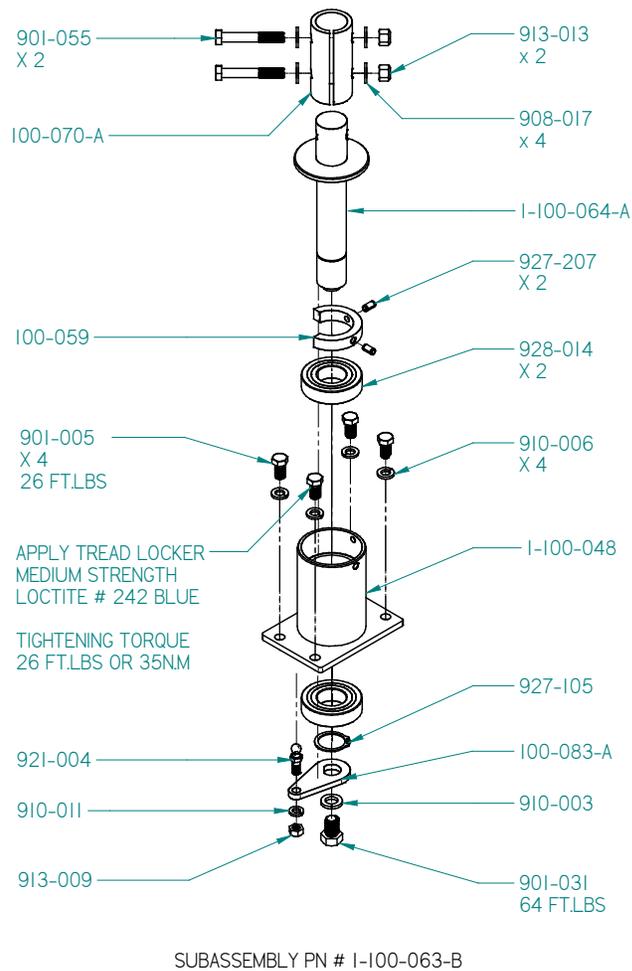
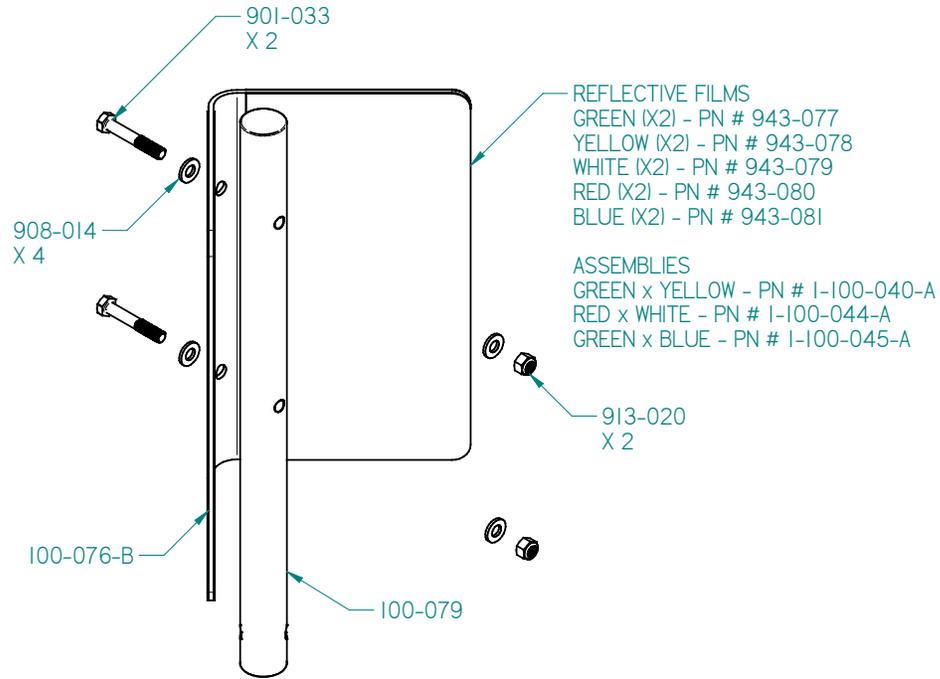
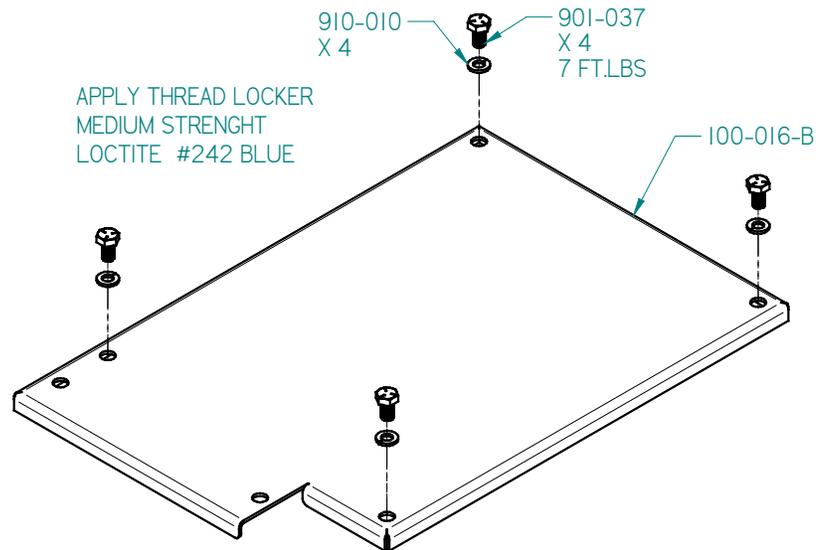


Figure 7.22 Target subassembly



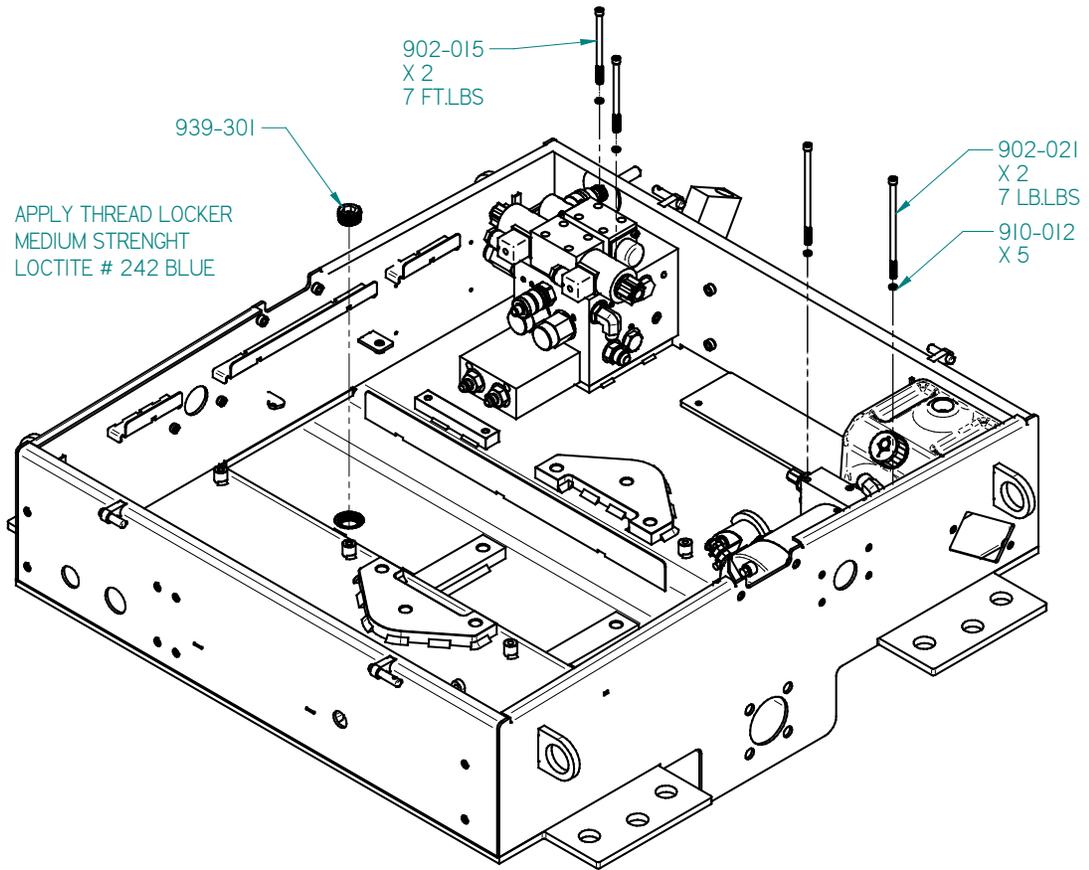
7.19 Electronic base plate

Figure 7.23 *Electronic base plate*



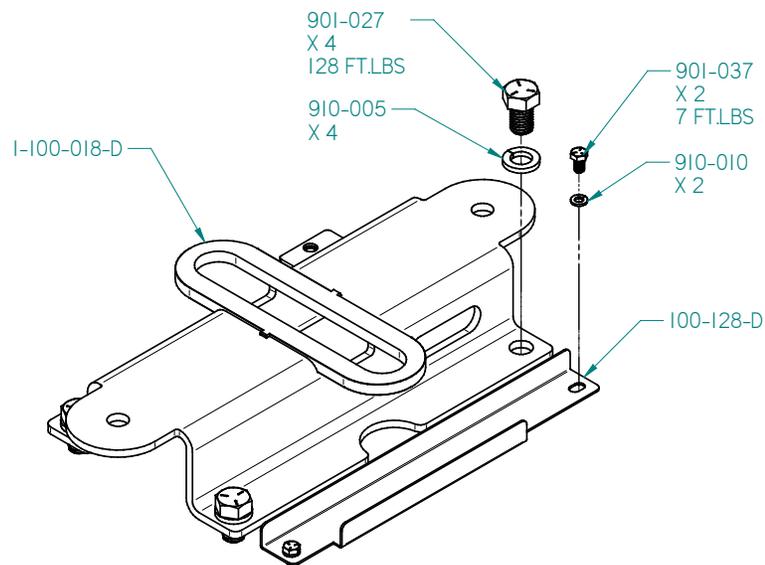
7.20 Hydraulic mounting hardware

Figure 7.24 Hydraulic mounting hardware



7.21 Central Bracket and cable tray

Figure 7.25 Central bracket and cable tray



7.22 Switch machine subassemblies list

Table 7.1 Switch machine subassemblies

PN #	DESCRIPTION
1-100-008-G	CYLINDER TOP BRACKET ASSEMBLY
1-100-010-A	HAND PUMP PISTON ASSEMBLY
1-100-011-A	HAND PUMP FLANGE ASSEMBLY
1-100-012-B	CENTER BLOCK ASSEMBLY
1-100-013-A	CONTROL SHAFT ASSEMBLY
1-100-017-E	HAND PUMP COVER ASSEMBLY
1-100-018-D	BEARING GUIDE CENTRAL BRACKET
1-100-024-B	SPRING CLEVIS ASSEMBLY
1-100-025-A	CLEVIS PIVOT BRACKET ASSEMBLY
1-100-027-A	BREATHER HOUSING ASSEMBLY
1-100-040-A	TARGET GREEN x YELLOW
1-100-042	SPRING ARM ASSEMBLY
1-100-044-A	TARGET WHITE x RED
1-100-045-A	TARGET GREEN x BLUE
1-100-048	TARGET HOUSING
1-100-058	TARGET OPERATION SHAFT
1-100-059	TARGET OPERATION SHAFT ASSEMBLY
1-100-063	TARGET SYSTEM ASSEMBLY
1-100-064-A	TARGET SHAFT ASSEMBLY
1-100-066	HYDRAULIC MANIFOLD ASSEMBLY
1-100-161	SENSOR BRACKET ASSEMBLY RIGHT
1-100-162	SENSOR BRACKET ASSEMBLY LEFT
1-100-175-E	YM-16 HOUSING ASSEMBLY
1-100-176-D	YM-16 STEEL LID ASSEMBLY
1-100-178-A	CENTER TOP CHANNEL ASSEMBLY

7.23 Switch machine electrical components list

Table 7.2 Switch machine electrical components

PN#	DESCRIPTION
801-101	BATTERY CABLE - B12 RED
801-102	BATTERY CABLE - N12 BLACK
801-105	SWITCH MACHINE WIRE SET
805-003	PROXIMITY SENSOR IFS240
805-010	PRESSURE LIMIT SWITCH PK6220
806-002	MOTOR START
811-001	BATTERY DEKA 8A31
938-011	SOLENOID PARKER D1VW VALVE
940-012	POWER UNIT 12VDC MOTOR

7.24 Switch machine parts list

Table 7.3 Switch machine part list

PN#	DESCRIPTION
100-015-B	TARGET COVER PANEL
100-016-B	ELECTRONIC BASE PLATE
100-020-A	CLEVIS SPACER
100-021-E	SPRING CLEVIS
100-023-C	SPRING PIVOT SPINDLE
100-024-E	SPRING PIVOT ARM
100-035	FRONT ROD BAR
100-037-A	CLEVIS PIN
100-038-B	CLEVIS PIVOT BRACKET
100-041-A	FROND ROD BUSHING SLEEVE
100-042-B	ROD FLANGE
100-048	SHAFT BLOCK
100-051	CENTER BLOCK PIVOT SHAFT
100-053	CENTER BLOCK CAM
100-055	HOUSING RUBBER TRIM
100-057	HOUSING RUBBER TRIM
100-059	TARGET ROTATION LIMIT
100-070-A	TARGET SLEEVE
100-076-B	TARGET PLATE
100-079	TARGET MAST
100-080	SENSOR SUPPORT
100-082-B	SENSOR BRACKET
100-083-A	SENSOR LEVER
100-084-C	SENSOR TARGET
100-087-D	SENSORS BRACKET
100-102-A	YM-16 MANIFOLD BLOCK - NO VALVES
100-105	AUXILIARY MANIFOLD BLOCK
100-106-A	HAND PUMP PISTON
100-107-A	HAND PUMP FLANGE
100-113-A	HAND PUMP SOCKET
100-128-D	BATTERY CABLE TRAY
100-129-C	BATTERY BRACKET
100-134-A	BREATHER HOUSING
100-135	WIRE MESH FRAME
100-138	BREATHER WIRE MESH
100-139-A	FRONT ROD ADAPTER
100-149	BEARING CUP SEAL
100-150	HAND PUMP SOCKET BRACKET
100-155-C	HAND PUMP COVER PIVOT EYE
100-185-A	LID OPEN LOCK TAB

7.25 Seals and hydraulic components list

Table 7.4 Seals and hydraulic components list

PN#	DESCRIPTION
936-001	O-RING SIZE #2-013 BUNA
936-002	O-RING SIZE #2-214 BUNA
936-003	O-RING SIZE #2-137 BUNA
936-004	O-RING SIZE #2-149 BUNA
936-101	BACKUP RING SIZE # 2-214
936-201	ROD SEAL
936-202	U CUP PISTON SEAL MODEL 511 - 1.25X1.50X.125IN
936-301	HAND PISTON WEARBAND # WB0150-0250-125-N1B
936-302	ROD WEAR BAND
936-401	ROD WIPER
936-402	ROD WIPER
938-001	HYDRAFORCE PD12-41-0-N-60 VALVE
938-002	HYDRAFORCE PS08-32H-0-N-3/M5 VALVE
938-003	HYDRAFORCE RV08-22H-0-N-25/1200 VALVE
938-004	HYDRAFORCE CV08-20-0-N-04 VALVE
938-005	HYDRAFORCE CV08-21-0-N-30 VALVE
938-006	PARKER D1VW2CNKWH SOLENOID OPERATED VALVE
938-007	PARKER D1VL2DN LEVER OPERATED VALVE
938-010	HAWE RB1 VALVE
938-012	POWER UNIT RELIEF VALVE
939-001	9/16"-18 X 9/16"-18 MALE ORB O-RING BOSS FITTING STRAIGHT THREAD
939-002	3/4"-16 JIC X 3/4"-16 MALE ORB O-RING BOSS FITTING STRAIGHT THREAD
939-003	9/16"-18 JIC X 9/16"-18 MALE ORB O-RING BOSS FITTING STRAIGHT THREAD ELBOW
939-004	9/16"-18 JIC X 3/4"-16 MALE ORB O-RING BOSS FITTING STRAIGHT THREAD ELBOW
939-005	3/4"-16 JIC X 3/4"-16 MALE ORB O-RING BOSS FITTING STRAIGHT THREAD ELBOW
939-121	CYLINDER FRONT PORT TUBING
939-122	CYLINDER REAR PORT TUBING
939-126	HYDRAULIC PRESSURE LINE TUBING
939-127	HYDRAULIC RETURN LINE TUBING
939-301	3/4"-14 NPT HEX SOCKET PLUG
939-552	RESERVOIR CAP
940-003	YM-16 HYDRAULIC POWER UNIT
940-012	POWER UNIT 12VDC MOTOR
940-014	OIL RESERVOIR
940-019	FLANGE & PUMP
941-003	YM-16 HYDRAULIC CYLINDER

7.26 Switch machine hardware list

Table 7.5 Switch machine hardware list

PN#	DESCRIPTION
901-005	3/8"-16 X 3/4" LONG ZP HEX HEAD CAP SCREW GR.5
901-022	3/4"-10 X 6" LONG ZP HEX HEAD CAP SCREW GR.5
901-026	5/8"-11 X 3-1/2" LONG ZP HEX HEAD CAP SCREW GR.5
901-027	5/8"-11 X 1" LONG ZP HEX HEAD CAP SCREW GR.5
901-028	5/8"-11 X 1-1/2" LONG ZP HEX HEAD CAP SCREW GR.5
901-031	1/2"-13 X 3/4" LONG ZP HEX HEAD CAP SCREW GR.5
901-032	3/8"-16 X 1-1/4" LONG ZP HEX HEAD CAP SCREW GR.5
901-033	5/16"-18 X 2" LONG ZP HEX HEAD CAP SCREW GR.5
901-034	1/2"-13 X 1-1/4" LONG ZP HEX HEAD CAP SCREW GR.5
901-035	1/2"-13 X 1-1/2" LONG ZP HEX HEAD CAP SCREW GR.5
901-036	1/4"-20 x 1" LONG ZP HEX HEAD CAP SCREW GR.5
901-037	1/4"-20 x 1/2" LONG ZP HEX HEAD CAP SCREW GR.5
901-038	5/16"-18 X 1/2" LONG ZP HEX HEAD CAP SCREW GR.5
901-041	5/16"-18 X 5/8" LONG ZP HEX HEAD CAP SCREW GR.5
901-043	1/2"-13 X 3-1/2" LONG - ZP HEX HEAD CAP SCREW GR.5
901-048	5/16"-18 X 7/8" LONG ZP HEX HEAD CAP SCREW GR.5
902-010	1/4"-20 X 5/8" LONG ZP SOCKET HEAD CAP SCREW
902-012	1/4"-20 X 3/4" LONG ZP SOCKET HEAD CAP SCREW
902-015	1/4"-20 X 4" LONG ZP SOCKET HEAD CAP SCREW
902-016	M5-.8 X 30mm LONG ZP SOCKET HEAD CAP SCREW
902-017	M5-.8 x 100mm LONG ZP SOCKET HEAD CAP SCREW
902-020	1/2"-13 X 1-3/4" LONG ZP SOCKET HEAD CAP SCREW GR.5
902-021	1/4"-20 X 5-1/2" LONG ZP SOCKET HEAD CAP SCREW
903-001	12MM X 12MM LONG X M10-1.5 SHOLDER SCREW ISO 7379
903-002	1/2" DIA. X 2" LONG X 3/8"-16 SHOLDER SCREW
906-001	3/8"-16 X 3/8" LONG SOFT TIP SET SCREW GR.5
908-003	3/4" SCREW SIZE - ZP FLAT WASHER
908-009	1" SCREW SIZE - ZP FLAT WASHER
908-012	M12 SCREW SIZE - ZP FLAT WASHER DIN 127
908-013	1/2" SCREW SIZE - ZP FLAT WASHER
908-014	5/16" SCREW SIZE - ZP FLAT WASHER
908-015	1/4" SCREW SIZE - ZP FLAT WASHER
908-017	3/8" SCREW SIZE - ZP FLAT WASHER
908-018	HAND LEVER SEAL WASHER
910-003	1/2" SCREW SIZE ZP SPLIT LOCK WASHER
910-005	5/8" SCREW SIZE ZP SPLIT LOCK WASHER
910-006	3/8" SCREW SIZE ZP SPLIT LOCK WASHER
910-008	1/2" SCREW SIZE ZP SPLIT LOCK WASHER FOR SOCKET HEAD
910-010	1/4" SCREW SIZE ZP SPLIT LOCK WASHER
910-011	5/16" SCREW SIZE ZP SPLIT LOCK WASHER

Table 7.5 Switch machine hardware list (continuation)

PN#	DESCRIPTION
910-012	1/4" SCREW SIZE ZP SPLIT LOCK WASHER FOR SOCKET HEAD
910-014	M5 SCREW SIZE ZP SPLIT LOCK WASHER FOR SOCKET HEAD
910-015	1-1/4 SCREW SIZE ZP SPLIT LOCK WASHER
910-016	5/16" SCREW SIZE ZP SPLIT LOCK WASHER FOR SOCKET HEAD
910-017	3/8" SCREW SIZE SS SPLIT LOCK WASHER
912-002	1/4"-20 HOLD DOWN BOLT
913-003	1"-14 ZP HEX NYLON LOCK NUT
913-009	5/16"-24 ZP HEX NUT
913-010	1/2"-13 ZP HEX NYLON LOCK NUT
913-013	3/8"-16 ZP HEX NYLON LOCK NUT
913-018	1/4"-20 ZP HEX NYLON LOCK NUT
913-020	5/16"-18 ZP HEX NYLON LOCK NUT
914-007	3/8"-16 SS HEX NUT
914-010	1-1/4"-12 ZP HEX NUT GR.5
921-004	5/16"-24 QUICK DISCONNECT BALL JOINT
926-051	1/2" TRADE SIZE SNAP IN ROLE PLUG
926-052	3/4" TRADE SIZE SNAP IN ROLE PLUG
926-053	1" TRADE SIZE SNAP IN ROLE PLUG
927-002	INTERNAL RETAINING RING FOR 1-5/8" BORE DIA.
927-105	30MM DIA. EXTERNAL RETAINING RING
927-202	1/8" X 5/8" LONG ZP SLOTTED SPRING PIN
927-204	1/8" X 13/16" LONG ZP SLOTTED SPRING PIN
927-207	1/4" X 1/2" LONG SLOTTED SPRING PIN
927-301	3/16" X 1" COTTER PIN
927-351	3/32" X 2-1/2" HITCH PIN FOR 3/4" SHAFT
927-404	3/16" ZP QUICK RELEASE PIN
927-602	9/16" SET SCREW SHAFT COLAR
928-011	DOUBLE SEALED BAL BEARING #R12
928-012	BALL BEARING # 361201R-2RS FOR SHAFT 12mm
928-014	SINGLE ROW BALL BEARING # 6206-2RS
929-001	TAPERED ROLLER BEARING # 30306
929-003	LOCK NUT MODEL T # KM 6
929-004	LOCK WASHER MODEL MB6
934-006	TARGET COVER PLATE GASKET
937-003	ROLLER CHAIN # 100 CONNECTING LINK
935-001	TARGET SPRING
935-004	HOLDING FORCE SPRING
935-005	LEVER SEAL SPRING CSC # S-933
935-101	CENTER BLOCK TORSION SPRING

7.27 Mechanical target color options

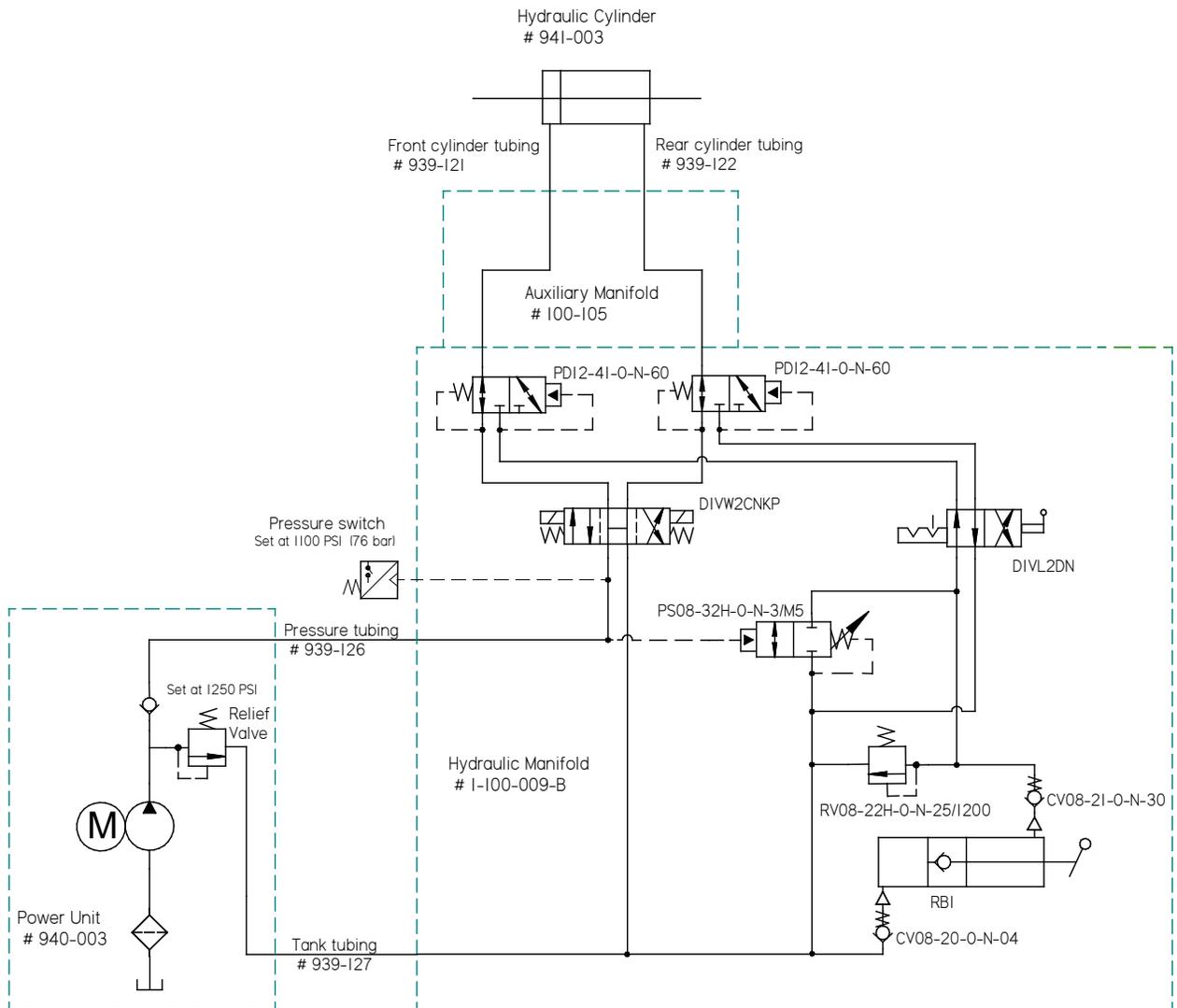
Table 7.6 Mechanical target color options

PN#	DESCRIPTION
943-077	GREEN REFLECTIVE FILM
943-078	YELLOW REFLECTIVE FILM
943-079	WHITE REFLECTIVE FILM
943-080	RED REFLECTIVE FILM
943-081	BLUE REFLECTIVE FILM
1-100-040-A	TARGET GREEN x YELLOW
1-100-044-A	TARGET WHITE x RED
1-100-045-A	TARGET GREEN x BLUE

8 SECTION 8 – AUXILIARY DRAWINGS

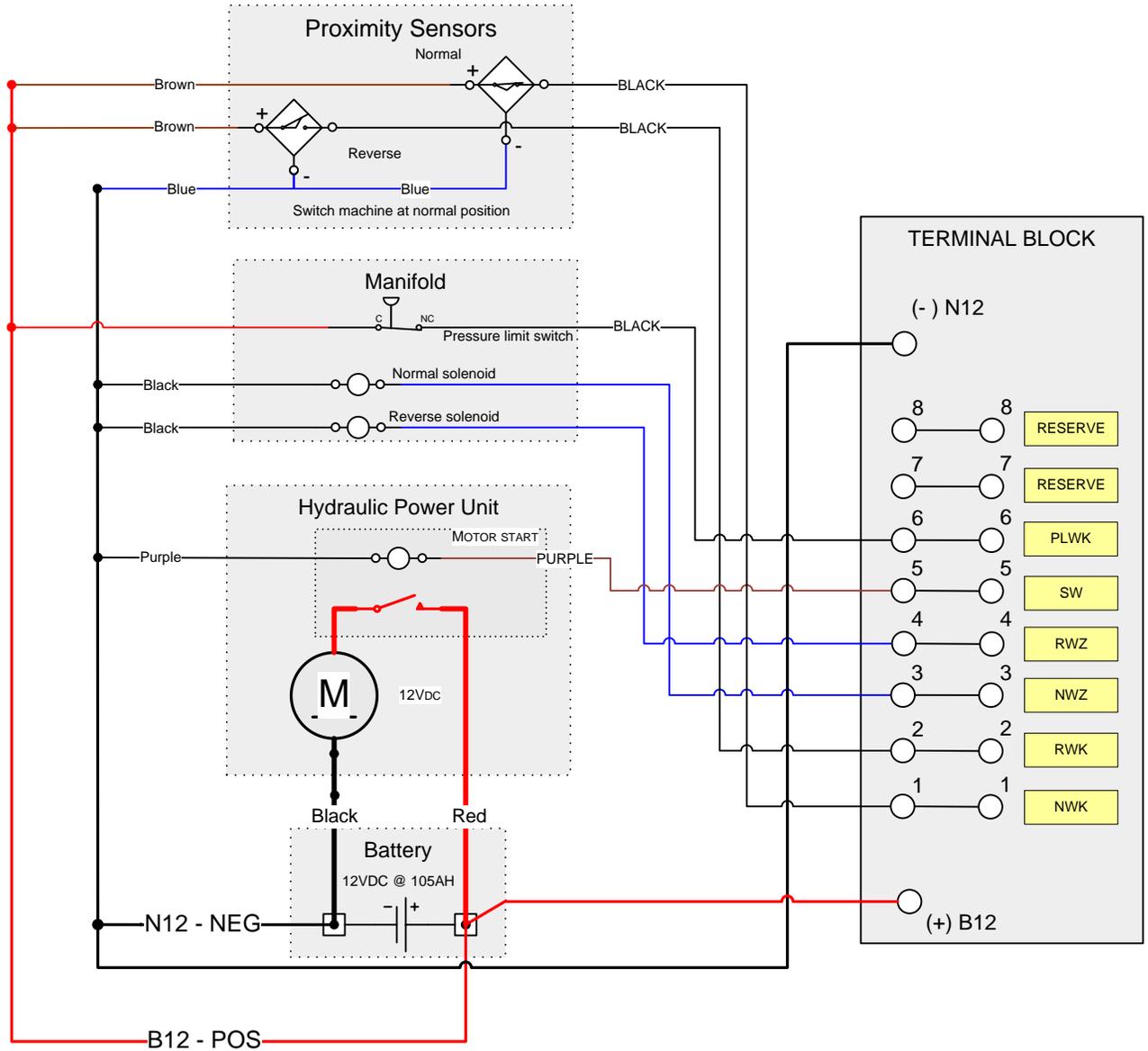
8.1 YM-16 Hydraulic diagram

Figure 8.1 YM-16 Hydraulic diagram



8.2 YM-16 Electric diagram

Figure 8.2 YM-16 Electric diagram (Typical)



9 SECTION 9 – OPTIONALS AND ACCESSORIES

9.1 Switch machine connecting rod

The YM-16 switch machine uses an adjustable connecting rod between the switch rod and the point bar. There is no need for offset adapters or bent rods.

The connecting rod length must be selected according to the clearance restrictions.

The manufacturer can supply different rods, pin diameters and length upon request.

Select the best rod for your application according to the models and tables below.

Figure 9.1 Connecting rod range from 1'-4" up to 3'-10"

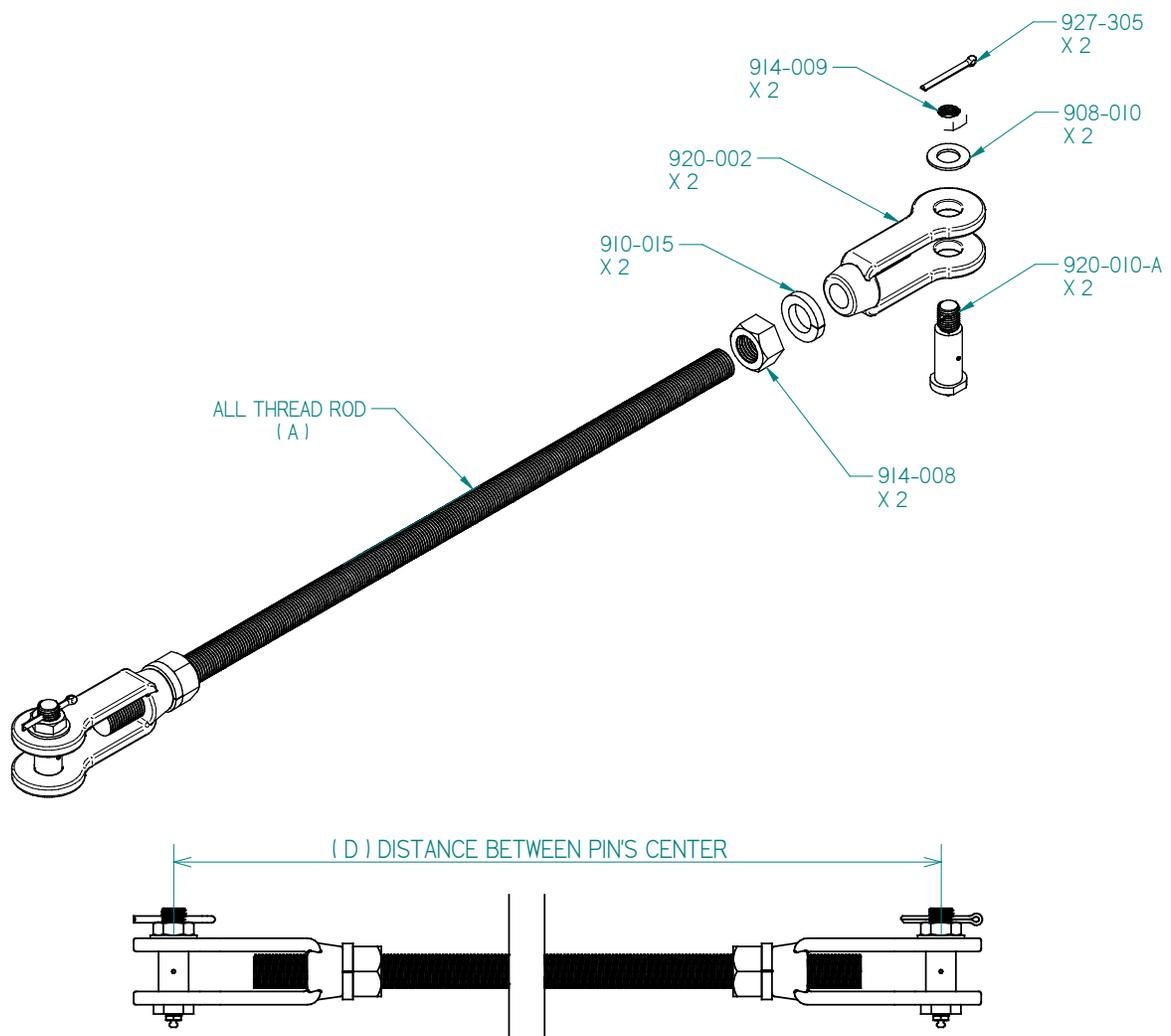


Figure 9.2 Connecting rod range from 4'-2" up to 25'

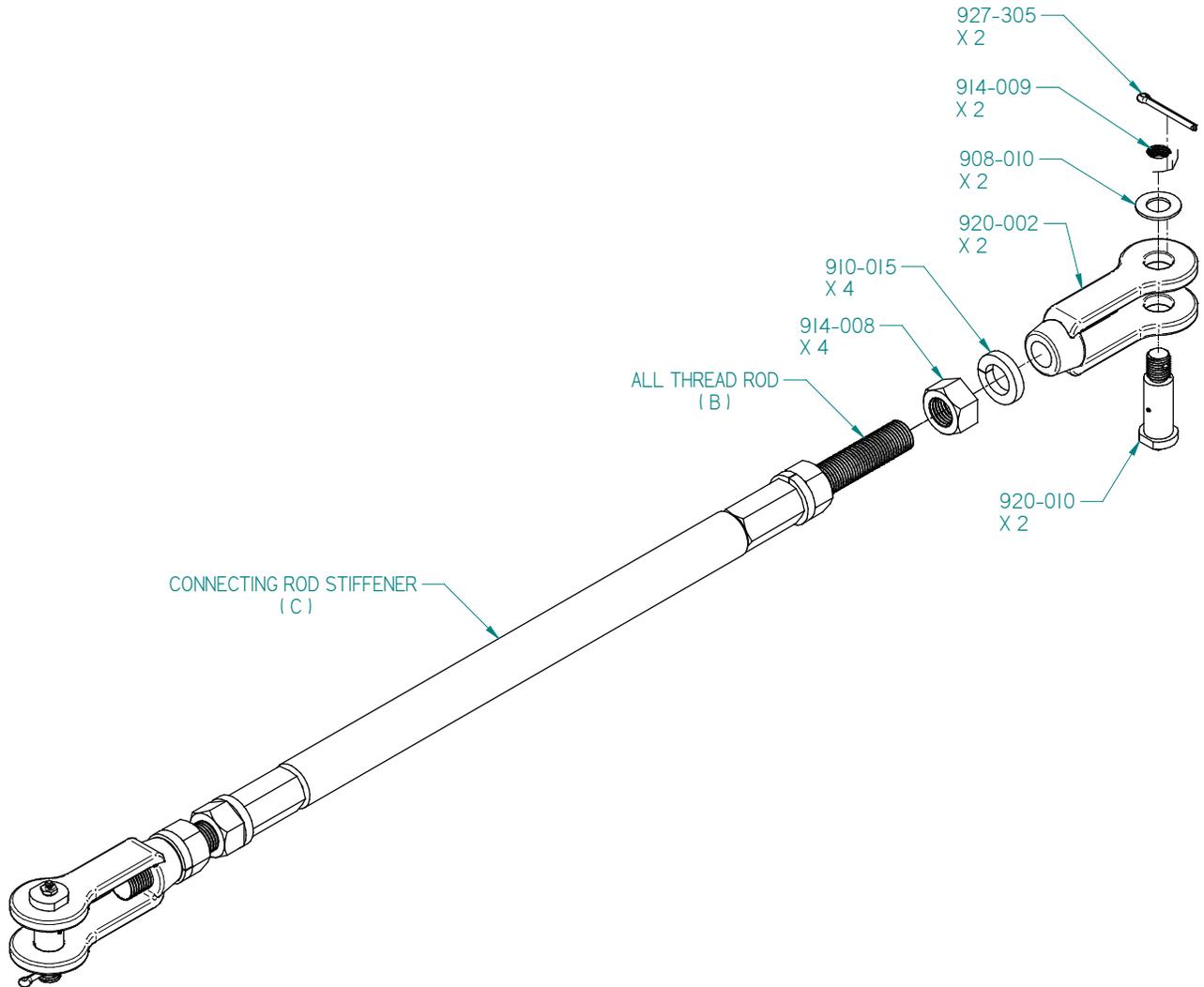


Table 9.1 Connecting rod part list

PN#	DESCRIPTION
A or B	1-1/4"-7 ZP THREAD ROD
C	CONNECTING ROD STIFFENER
908-010	7/8" SCREW SIZE ZP FLAT WASHER
910-015	1-1/4" SCREW SIZE ZP HEAVY SPRING LOCK WASHER
914-008	1-1/4"-7 ZP HEX NUT GR.5
914-009	7/8"-9 ZP THIN HEX NUT GR.5
920-002	ROD CLEVIS, SIZE 3, 1-1/4"-7 THREAD, 1-1/8" PIN HOLE DIA.
920-010-A	1-1/8" DIA. CLEVIS PIN
927-305	1/4" DIA. X 2-1/4" LENGTH ZP COTTER PIN

Table 9.2 Connecting rod length

Length (D)	Rod PN#
16" (1'-4") - 20" (1'-8")	100-252-A
20" (1'-8") - 26" (2'-2")	100-251-A
26" (2'-2") - 30" (2'-6")	100-259-A
30" (2'-2") - 34" (2'-10")	100-253-A
34" (2'-10") - 38" (3'-2")	100-254-A
40" (3'-4") - 46" (3'-10")	100-262
50" (4'-2") - 70" (5'-10")	100-264
70" (5'-10") - 110" (9'-2")	100-266
151" (12'-7") - 197" (16'-5")	100-255-A
220" (18'-4") - 266" (22'-2")	100-258
260" (21'-8") - 300" (25')	100-260

9.2 Switch machine position light

The YM-16 switch machine can be supplied with point position indication lights mounted at the switch sides.

Figure 9.3 Position indication lights installed at the switch machine

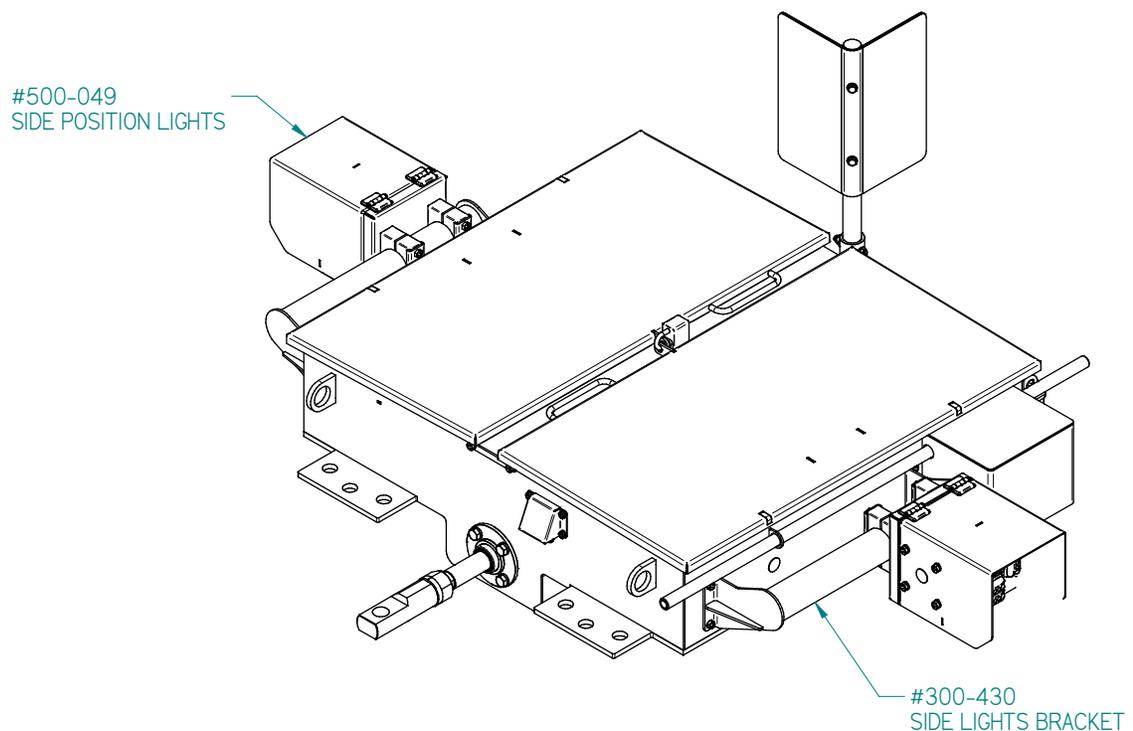
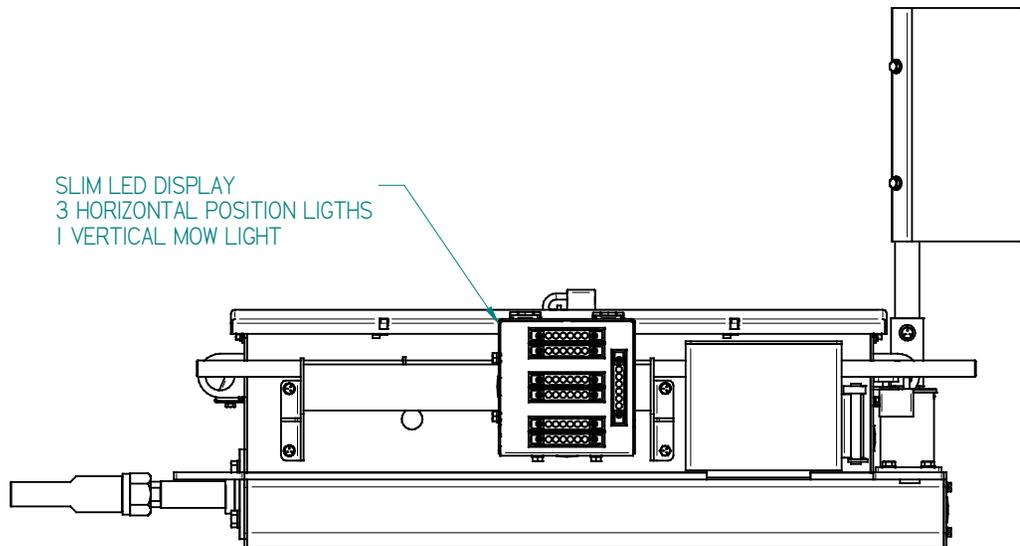


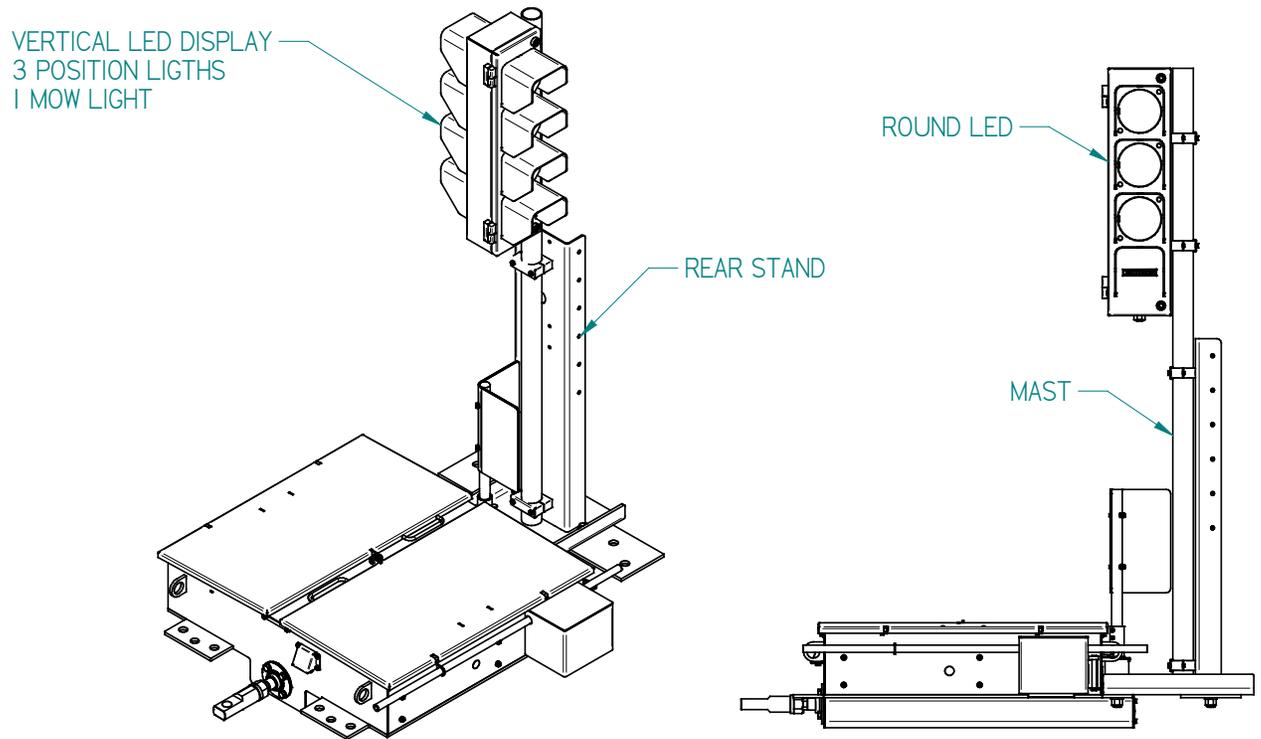
Figure 9.4 Slim LED lights installed at the switch



Can be supplied by the manufacturer the following configurations.

1. Quantity of lights:
 - a. Two lights;
 - b. Three lights;
 - c. Four lights;
2. Direction:
 - a. Unidirectional;
 - b. Back to back;
3. Colors – any combination:
 - a. Yellow;
 - b. Red;
 - c. Green;
 - d. Blue;
 - e. Other according customer requirement.
4. Position:
 - a. Vertical;
 - b. Horizontal;
5. LED type:
 - a. Slim line 4" LED
 - b. Round 5" LED

Figure 9.5 Position lights at the rear stand mast



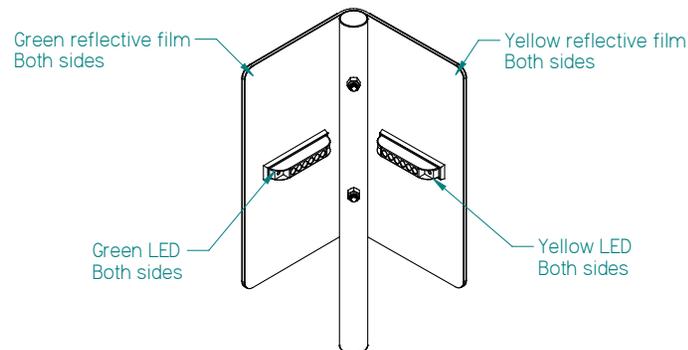
The lights can be used to indicate the switch machine rod is at normal or reverse position or it is out of correspondence.

When the mechanical target and position lights are required, the lights can be installed at the switch machine side housing or at an additional rear stand attached to the switch machine.

9.3 Mechanical target enhancement

A simple way to indicate the switch position is with the mechanical target.

Figure 9.6 Mechanical target enhancement

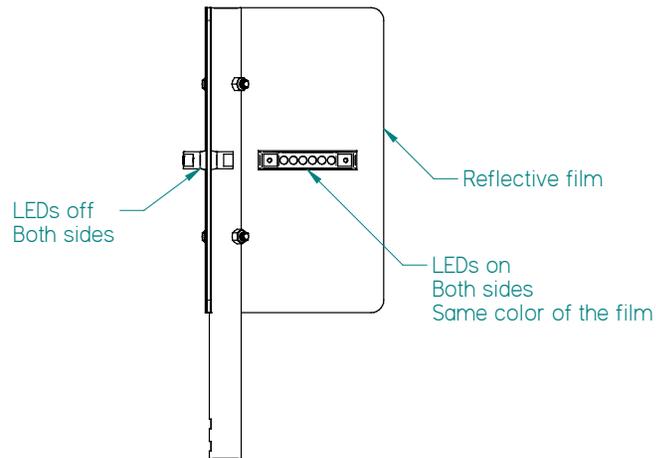


The mechanical target will indicate what position the switch machine is in, normal or reverse.

To enhance the visibility additional LED bars with the same color of the reflective film are installed on the target, see Figure 9.6 above.

When the switch machine is in the correctly positioned the corresponding LED lights will turn on, helping to identify the switch position from a distance.

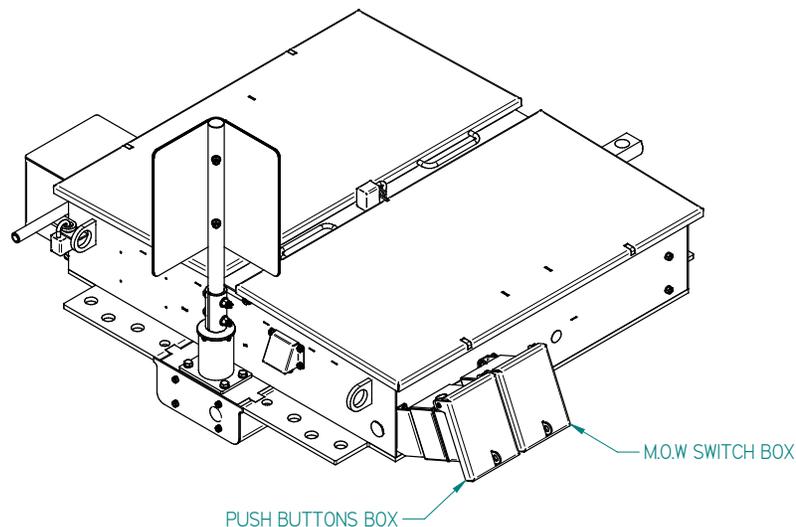
Figure 9.7 Mechanical target positioned



9.4 Switch machine with local push button

The switch machine can be controlled locally with pushbutton if the electronic equipment available to protect and control the switch machine is installed inside the machine or remotely.

Figure 9.8 Switch machine side push button



9.5 Switch machine rear stand & electronic box.

The switch machine can be controlled locally with pushbutton or remotely from a bungalow where all the electronic equipment and communication link will be available to protect and control the switch machine.

For yard application, where the switch machine can be controlled remotely by link of radio or fiber optical cable, it is more convenient to have all the electronic equipment installed inside an electronic box at the switch machine.

Two types of switch machine stands were designed to support the electronic box:

- (1) **Rigid stand** with the following features:
 - (a) Allow the installation of the electronic box at different heights;
 - (b) Installation of local pushbuttons;
 - (c) Installation of local M.O.W control switch;
 - (d) Installation of a solar panel & fixed mast;
 - (e) Installation of VHF or Data radio antenna;
 - (f) Installation of position lights at different heights;
 - (g) Allow the installation of the switch machine stand far away using a separate foundation when the equipment cannot be installed near the switch machine.
- (2) **Tilt-over mast** with the following features:
 - (a) Allow the solar panel, position lights or antenna mast to pivot for assembly or maintenance purpose without the use of ladder;
 - (b) Counter weights are used to balance the mast weight;
 - (c) All the others features are the same as the rigid stand.

A typical switch machine layout using a rigid stand can be seen at:

- (3) Figure 9.5 above - the rigid stand has a mast with vertical position lights installed. The rigid stand can be installed remotely on a separated foundation.

A typical switch machine layout using a tilt-over stand can be seen at:

- (4) Figure 3.25 – the tilt-over stand has an electronic box, position lights, VHF radio antenna installed;
- (5) Figure 3.28 – the tilt-over stand has an electronic box, position lights and data radio antenna installed;
- (6) Figure 9.9 below – the tilt-over stand has an electronic box and solar panel installed.

Figure 9.9 Solar panel powered switch machine



The manufacturer can supply any switch machine configuration according to the customer needs and clearance requirements.