



Cable Handling Trailer 1400 Operator's manual

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Preface

This unit is the result of Posi-Plus advanced technology and quality awareness in design, engineering and manufacturing. All information, illustrations and specifications contained within this manual are based on the latest product information available at the time of publication. It is mandatory that all operators read and understand this manual to operate the cable handling trailer in a safe and efficient manner.

This unit should never be altered or modified in any way that might affect the structural integrity or operational characteristics without the specific written approval of Posi-Plus. Any unauthorized alterations or modifications will void the warranty. Of greater concern, is the possibility that unauthorized modification could adversely affect the safe operation of this unit, resulting in property damage and/or personal injury.



ELECTROCUTION HAZARD

The Posi-Plus 1400 Series Cable handling trailer does not assure any dielectric protection for the operators.

The trailer must never be operated near energized lines. Any contact of with an energized conductor may cause in personal injury or death.

The owner and the operators are responsible for the work methods, the safety precautions and the equipment used during each work activity using this cable handling trailer.

GENERAL REQUIREMENTS FOR THE SAFE OPERATION OF THIS EQUIPMENT

This equipment must be operated and maintained in accordance with prevailing requirements of the local enforcing authorities.



Danger

Electrocution Hazard

Remain clear of the trailer and associated equipment (reels, cable) anytime they are near energized lines.

The new owner, and all authorized operators must become familiar with the equipment and all operating and maintenance procedures, and be sure each day that the equipment is in safe operating condition including all guards and safety devices in place, before allowing it to be operated on that day.



Warning

Before operating unit, read and understand all operating and safety information in manual and on all placards.

In case of any problem arising in the operation of this equipment, it is essential that the problem be identified and corrected before continuing operation.



Warning

Keep people away from this unit during the operation of the unit.

Equipment must be isolated when left unattended, to prevent unauthorized use. Misuse can result in personal injury and property damage.

Section 1- Unit specification

1.1 - Purpose of the Unit

The Posi-Plus 1400 is a multipurpose underground reel carrier that may be used to transport, install or pull out underground cables. It can be also used to pull in or tension overhead lines with the overhead pulling control option installed. Its key features include self-propelled and steered trailer, self-loading shaft less reel arms, pilot rope capstan and user-friendly radio control.

The power train of the 1400's reel drive system is an open loop hydrostatic hydraulic system, which provides the smoothest control of speed possible.



Warning

When this sign appears on these pages, it indicates where special attention should be paid to the instruction given since personal injury or damage to the equipment may occur, if the instructions are not followed.

1.2 - General Specifications and Capacities

Reel Speed	0 to 18 rpm
Maximum Reel Drive Torque	250 000 in-lb
Reel Weight Capacity	14 000 lb (6 350 kg)*
Maximum Reel Diameter	108"
Minimum Reel Diameter	48" (for self-loading)
Maximum Reel Width	68" (with conical stub drive)
Minimum Reel Width	39"
Ground Speed (self propelling).....	0 to 1.5 mph
Turning Radius (curb to curb)	11' 2"
Axle capacity	25 000 lb. (Capacity with air brakes)
Standard Engine (Deutz D2011L04i T4i)...	62 HP class, at 2600 RPM (Diesel, air cooled)
Optimal Engine (Deutz TD 2.9 L4T4F)	75 HP at 2600 RPM (Diesel, air cooled)
Fuel Capacity.....	20 gallons (US)
Pilot Rope Capstan Line pull	16 000 in-lb of torque
Pilot Rope Capstan Capacity	1000 ft of 3/8" dia. synthetic rope
Overall unit Length	219" (5,56 m)
Overall unit Width	96" (2,44 m)
Overall unit Height (without Reel)	123" (3,12 m)
Overall unit Height (with 102" dia. reel)	155" (3,94 m)
Overall unit Height (with 108" dia. reel)	158" (4,01 m)

*** This load capacity is for self-propelled mode only. When in tow mode, the load capacity will be reduced with respect to the axle capacity or to the provincial or state regulations and as per the capacities of the towing vehicle (refer to the table below).**

1.3 - Weight distribution

The weight distribution of the Posi-plus 1400 Series trailer will vary according to the weight of the reel to be carried during travel. The table below states the different weight distribution in different conditions.

<u>In self-propelled mode:</u>	<u>Standard engine</u>	<u>Optional engine</u>
Total empty weight of the trailer	5761 kg (12700 lb)	6042 kg (13320 lb)
Empty axle weight	4128 kg (9100 lb)	4291 kg (9460 lb)
Empty weight on front wheel	1633 kg (3600 lb)	1751 kg (3860 lb)
Axle capacity	10442 kg (23020 lb)	10442 kg (23020 lb)
Maximum reel weight	6350 kg (14000 lb)	6350 kg (14000 lb)
Gross vehicle weight rating (GVWR)	11795 kg (26000 lb)	11795 kg (26000 lb)
<u>In towing mode:</u>		
Trailer without reel		
Total empty weight of the trailer	5761 kg (12700 lb)	6042 kg (13320 lb)
Empty axle weight	4713 kg (10390 lb)	4910 kg (10825 lb)
Empty weight on the tow hook	1048 kg (2310 lb)	1132 kg (2495 lb)
Trailer with reel during normal period*		
Road limitation*	10000 kg (22046 lb)	10000 kg (22046 lb)
Weight on axle	10000 kg (22046 lb)	10000 kg (22046 lb)
Weight on the tow hook	1275 kg (2810 lb)	1265 kg (2790 lb)
Maximum reel & accessories weight	5511 kg (12150 lb)	5307 kg (11700 lb)
Trailer with reel during thaw period*		
Road limitation*	8000 kg (17637 lb)	8000 kg (17637 lb)
Weight on axle	8000 kg (17637 lb)	8000 kg (17637 lb)
Weight on the tow hook	1180 kg (2620 lb)	1263 kg (2785 lb)
Maximum reel & accessories weight	3425 kg (7550 lb)	3221 kg (7100 lb)

It is important to note that the above values do not take into account the towing vehicle axle capacities. Moreover, the final empty trailer weight may vary according to the accessories installed on the trailer.

- * The road limitations indicated above will vary according to the area and locations where the trailer will be used or pulled.

Section 2 – Safety

2.1 - Accident Prevention Signs

Your equipment was shipped from the factory with the decals listed at the end of this manual.

Should any of these decals be missing, they could prevent the proper operation and/or maintenance of the unit, which may result in personal injury or property damage. If any of these decals are missing, please contact us for a replacement. Order the decal (s) by stating decal description, number, and quantity.

2.2 - Safety Instructions

This "safety alert symbol" is used throughout this manual to indicate danger, warning, caution, and attention instructions. These instructions must be followed to prevent the possibility of personal injury and/or property damage.

The terms "danger, warning, and caution" represent varying degrees of personal injury and/or property damage that could possibly result if the preventive instructions are not followed. The following paragraphs from ANSIZ535.4-1991 explain each term.



Indicates an imminently hazardous situation, which, if not voided, will result in death or serious injury. This signal word is to be used in the most extreme situations.



Indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

The terms "Attention" is used to alert personnel of instructions that must be followed to prevent the possibility of property damage. Property damage could include structural damage to the unit, component failure, or damage to nearby property. Read and follow all danger, warning, caution and attention instructions.

2.3 - Safety Information and Warnings

The following text specifies important safety information all operators should observe when operating a self-loading cable trailer. Failure to observe these safety precautions could result in property damage, personal injury, and/or death.

BEFORE OPERATING THIS EQUIPMENT, FAMILIARIZE YOURSELF WITH ALL CONTROLS AND THEIR FUNCTION. EQUIPMENT MUST ONLY BE OPERATED BY FULLY TRAINED PERSONNEL.



Danger

Unauthorized alterations or modifications may cause unsafe operating conditions, resulting in death, personal injury and/or property damage.



Caution

Never attempt to pick up a reel or pull in and pay out cable without having the rear stabilizers down. Failure to do so will cause the nose of the trailer to lift. Equipment damage or personal injury could result.



Caution

Make sure reel arms are in their fully loaded position, resting on the rubber pads and the tie straps are installed before transporting a reel.

The operator of this cable handling trailer must be familiar with and understand the safety information in this manual and on all placards before using it.



Danger

It is extremely important that the outriggers are down and set firmly on stable ground before attempting to load or unload a reel. Keep the outriggers at a minimum of 4" (100 mm) from the ground when self-propelling with a reel loaded. Otherwise, the front of the cable handler trailer may lift off the ground in an uncontrolled motion.

It is impossible to foresee all possible situations and combinations for set up of the trailer. The operator bears ultimate responsibility for insuring that the trailer is properly set up for the particular conditions encountered.

Do not permit untrained persons to use this equipment.

Do not exceed the reel capacity that is stated on the serial number placard.

All operators must only operate the trailer when their view is unobstructed or a second person who has an unobstructed view instructs the operator of the position of the trailer at all times.

Keep this self-loading trailer in good operating condition.

Operate the controls smoothly avoiding rapid reversals, jump-starts when propelling and quick start of reel rotation.



Caution

In case of a defect, an emergency situation and whenever a malfunction occurs in the working area of the radio system, the radio system must be switched OFF immediately until the cause of the defect has been located and repaired.

When not in operation, the pendant is to be properly secured so as not to "bounce around" during transportation.

Section 3 – Controls

A main control compartment located on the curbside of the trailer supports the radio receiver, contains the junction panel with all the functions relays and the engine controller. The remote control, the battery charger and the harness are also stored in this compartment.



The radio control system consists of a transmitter casing with two (2) joysticks used for proportional function and several operating elements, selector switches, a key switch and an "Emergency Stop" push button, a battery charger with two rechargeable NiMh batteries and a receiver with an antenna. The transmitter and the receiver can be connected together with an electrical harness for a hard-wire operation without radio communication.



Caution

The operator will not be protected against electrocution when operating with the controls linked with the electrical harness.

The emergency controls are located on the left side of the main control panel. **The emergency controls must be used only for emergency operation since they by-pass the security systems of the radio control.**

3.1 Standard Engine Controller

The engine controller includes an hour meter and four (4) LED's indicating: voltage on / glow plug (flashing), battery charge, oil pressure and temperature. The last LED is not utilized.

The engine controller will automatically shut down the engine due to failure and informs the operator what caused the malfunction via one of the four 4 bright LED's.

Key switch

Position 0 = No operating voltage.

Position 1 = Operating voltage, pilot lights come on.

Position 2 = Start, release key as soon as engine fires, pilot lights goes out.



To start, turn the key to position 1 and wait for the glow plug LED to stop flashing before activating the starter.

The engine controller on the trailer equipped with the optional engine will vary with respect to the standard engine controller. Refer to the optional engine manual for more details.



Attention

To avoid damages to both the engine and its starter, always wait until the engine is completely stopped before starting the engine again.

If the trailer is equipped with a current inverter and this inverter was left "ON" before stopping the engine, then the inverter will have to be reset to work again. To reset the inverter, turn its switch to the "OFF" position first and then, turn the switch to the "ON" position.

3.2 Radio Receiver

The radio receiver is designed for the wireless reception of command instructions for controlling the different functions of the cable handler.

A non-interchangeable system address ensures the functional safety of the radio remote control system when operating cable handlers. This feature is particularly important when several cable handlers or machines are in use close to each other. The system address is exclusively allocated to each radio transmitter and its respective receiver.

It is not possible to activate cable handler or machine functions using a radio system allocated to another cable handler or machine.



3.3 Radio Remote Control

Operation instructions

This procedure must be carefully followed before beginning any operation.

1. Switch the engine controller to "ON".
2. For additional safety, push in the transmitter E-stop pushbutton.
3. Switch the transmitter "ON". A short buzzer signal will sound.
4. Wait for the second buzzer signal (approx. 3 seconds).
5. The green LED on the transmitter control panel will flash. This indicates that the transmitter is working and is ready to use.
6. Pull out the E-stop pushbutton.
7. Push the green pushbutton "Start/horn" on the transmitter.

8. Check that the cable handling trailer functions correspond with the transmitter functions.

IMPORTANT: The cable handling trailer functions will operate during this check. Be certain that there are no obstacles near the cable handling trailer.

9. Push the "EMERGENCY STOP" pushbutton on the transmitter. Be sure that no functions can be activated with the "EMERGENCY STOP" pushbutton depressed.

IMPORTANT: If any function of the radio remote control activates with the "EMERGENCY STOP" engaged, the radio remote control must not be used until it is repaired.

10. Pull out the "EMERGENCY STOP" pushbutton.

11. Push the green pushbutton "Start/horn" on the transmitter.

12. Both the radio remote control and the cable handling trailer are now ready for operation.

IMPORTANT: To avoid accidental start-up, always engage the E-stop pushbutton and switch the transmitter "OFF" when not in use. When the transmitter is not attached to the operator, the key switch should be removed and stored in a secure place.

A defective radio system must be repaired only by Hetronic.

It is not allowed to leave a transmitter switched "ON" without any supervision.

Most of the trailer functions can only be operated when the high throttle of the engine is selected, only the wheel forward/reverse can be operated at low throttle.

The radio remote control switches must always be set to their normal and safe position before starting the engine:

- Key switch to zero "0" or "OFF" position
- Emergency stop **not** activated (push button lifted or released)
- Axle brake to the "Automatic (ON)" position
- Tools to the "OFF" position
- Reel brake to the "Automatic" position
- Freewheel to 0%
- Joysticks in neutral position
- Switches in neutral position

Starting in 2018, the 1400 Series units systems are programmed to help the operators even more.

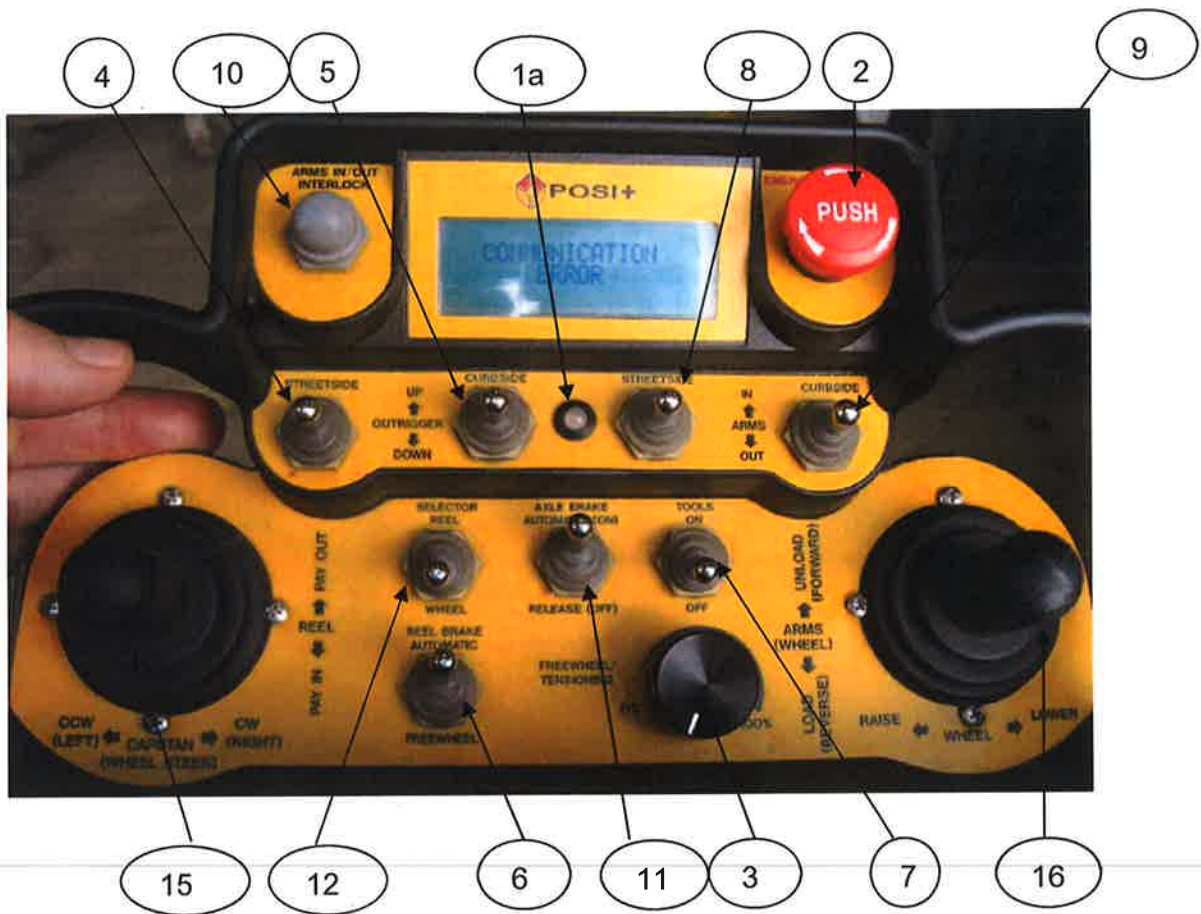
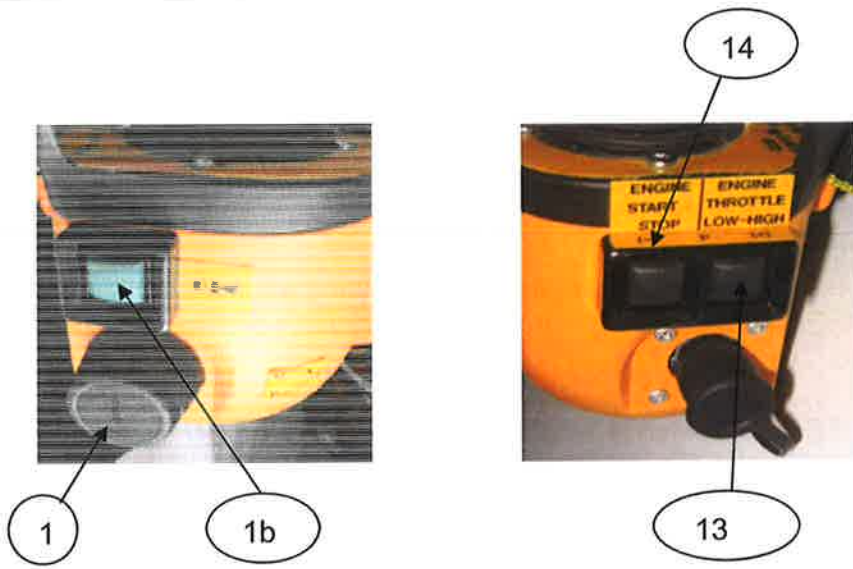
If the above conditions are not met during the start-up of the remote control, then the display will indicate the following messages:

1. If the "EMERGENCY STOP" push button is depressed, then the display will indicate "STOP".
2. If the emergency stop is released, then the following message will appear, only if the "FREE WHEEL/TENSIONING" potentiometer is not set to zero (0): "SET TENSIONING TO ZERO".
3. If the "AXLE BRAKE" switch is set to the "RELEASE (OFF)" position, then the display will indicate: "SET SWITCHES TO START POSITION".
4. If the "TOOLS" switch is set to the "ON" position, then the display will indicate: "SET SWITCHES TO START POSITION".
5. If the "REEL BRAKE" switch is set to the "FREEWHEEL" position, then the display will indicate: "SET SWITCHES TO START POSITION".

Once the start-up conditions are obtained, when the key switch is turned to the "ON" position, then the display will indicate "DEPRESS GREEN BUTTON" (push button 1b).

Once the green button has been depressed, the display will indicate "SYSTEM TURNED ON, READY TO OPERATE". The remote control will be ready to operate.

Radio Remote Control



BEFORE OPERATING THIS EQUIPMENT, FAMILIARIZE YOURSELF WITH ALL CONTROLS AND THEIR FUNCTION. THIS EQUIPMENT MUST ONLY BE OPERATED BY FULLY TRAINED PERSONNEL.

Radio Remote Control Functions

The remote control can be used in the radio mode or hard wire mode using the supplied connection cable.

The radio remote control switches **must always** be set to their normal and safe position before starting the engine, re-starting the engine and turning "ON" the remote control:

- Key switch to zero "0" or "OFF" position
- Emergency stop **not** activated (push button lifted or released)
- Axle brake to the "Automatic (ON)" position
- Tools to the "OFF" position
- Reel brake to the "Automatic" position
- Freewheel to 0% (Potentiometer or rheostat set to 0%)
- Joysticks in neutral position
- Switches in neutral position

It is important to note that when resetting the remote control, all of the above switches and joysticks positions stated above **must** be respected **or else the remote control will not work again and it will not reset.**

1. Key switch 0/1:

- Two positions switch with key.
- Activates the remote control when turned to position "1" (or "ON").
- Cuts the power supply when turned to position "0" (or "OFF"). All the functions operating will stop, the reel motor's brakes and the axle brakes are automatically applied, even if they were selected as "Freewheel" or "Off". However, the engine will not stop.

Note: When the cable handler or any of its functions are not operated, turn this switch to position "0" to improve the battery life of the remote control.

IMPORTANT: The E-Stop push button is for emergency stops only. DO NOT use it as an OFF switch. Use the key switch to turn the transmitter "ON" and "OFF".

1a. LED indicator:

- When turn the key switch is set to position "1", the LED flashes once. It changes to flashing green as soon as the radio connection to the receiver is established. It continues flashing until the transmitter is turned "off".

Note: Before you start working, a charged battery must be inserted into the battery compartment. Always have another battery being charged using the supplied charger or ready to use.

1b. Start / Horn:

- Push button.
- This push button activates the mainline contactor and sounds the horn. If the mainline contactor is already on, pushing this button will only sound the horn.
- The display will indicate "DEPRESS GREEN BUTTON" until this push button has been activated.

2. Emergency stop:

- 2 positions push button.
- Push, turn clockwise and release to activate the control, the button will lift up.
- Push the button to stop all the functions operating. The reel motor's brakes and the axle brakes are automatically applied even if they were selected as "Freewheel" or "OFF".
- The engine will not stop by depressing the emergency stop. To restart the radio control after an Emergency stop, push the Start/Horn button. Make sure that both, the axle brake and the reel brake are set to the automatic mode before any further operation. This will provide more safety to the operator.

IMPORTANT: If the reel was selected to "Freewheel" and/or Axle brake was selected to the "OFF" position, then with the Emergency stop applied, when the radio control is restarted, the functions Reel and/or Wheel brake will be activated, as selected.

3. Freewheel / Tensioning:

- Rotating rheostat (or potentiometer) knob.
- Activates the main proportional valve controlling the pressure on the loop circuit between the two (2) drive motors.
- Turning the knob to zero (0) or fully CCW will release the pressure (Freewheel).
- Turning the knob CW will increase the tension on the cable. When this knob is set fully CW (100%), then the pressure is fully applied.

NOTE: "Freewheel" from toggle switch (#6) has to be selected to allow this operation. This rheostat must be set to 0% before turning "ON" the remote control.

4. Streetside outrigger Up / Down:

- Spring return toggle switch.
- Operates the street side cylinder to retract or extend streetside outrigger.

Note: The alarm will sound when operating the outriggers.

NOTE: It is important to note that if the outrigger down interlock system is active, then both outriggers will have to be lowered to the ground (down to 4" of the ground). Otherwise, the following functions will not operate: REEL Pay In/Pay Out, side arms IN/OUT, arms Load/Unload, capstan CW/CCW and Tools.

5. Curbside outrigger Up / Down:

- Spring return toggle switch.
- Operates the curbside outrigger cylinder to retract or extend curbside outrigger.

NOTE: The alarm will sound when operating the outriggers.

NOTE: It is important to note that if the outrigger down interlock system is active, then both outriggers will have to be lowered to the ground (down to 4" of the ground). Otherwise, the following functions will not operate: REEL Pay In/Pay Out, side arms IN/OUT, arms Load/Unload, capstan CW/CCW and Tools.



Caution

Never attempt to manipulate a reel without having the outriggers down and set firmly on a stable ground. The front of the trailer may dangerously lift off the ground.

6. Reel brake Automatic/Free wheel:

- Two positions toggle switch.
- Select "Free wheel" to operate the free wheel function, thus, releasing the spring activated reel motor's brakes.
- Select "Automatic" to apply automatically the reel motor's brakes when the Reel Pay in or Pay out functions are not operated.

NOTE: The emergency stop switch will shut down the "FREEWHEEL" functions and apply the brakes automatically. To obtain the "FREEWHEEL" condition, the "Freewheel / Tensioning" knob (#3) must be turned to 0%.

7. Tools ON/OFF:

- Two positions toggle switch.
- Activates the tool circuit.

NOTE: Do not set the tools switch to the "ON" position without having a hydraulic tool properly attached. Never leave the tools switch to the "ON" position, if not in use.

NOTE: If the outrigger down interlock system is active, then the outriggers have to be extended to their minimum position to activate this function.

8. Street side arm IN /OUT:

- Spring return toggle switch.
- Operates the sliding street side arm in and out.
- Button #10 (interlock) must be pushed in and held in while operating.

NOTE: If the outrigger down interlock system is active, then the outriggers have to be extended to their minimum position to activate this function.

9. Curb side arm IN / OUT:

- Spring return toggle switch.
- Operates the sliding curbside arm in and out.
- Button #10 (interlock) must be pushed in and held in while operating.

NOTE: If the outrigger down interlock system is active, then the outriggers have to be extended to their minimum position to activate this function.

NOTE: Switches cannot be operated simultaneously. When picking up a reel, center reel on frame as close as possible. Individually, operate each arm control. When both stub shafts are engaged, the drive pin FULLY engaged, it is safe to pick up the reel.



Danger

Never operate the arm controls sideways (IN and OUT) when a reel has been loaded. The reel could be dropped. Damage will occur and personal injury is possible.

10. Arms IN / OUT interlock:

- Spring return push button.
- Push in and hold while operating the curbside or the street side arms IN and OUT functions, if the wheel steer override system is active.

NOTE: This button is also an override for the "Wheel Steer-Left / Right" function when "Wheel" function is selected to help lower the front if its center rotation position is lost.

NOTE: If the outrigger down interlock system is active (no functions can be operated if both outriggers are not deployed to their minimum mark), this button can be used to bypass the interlock when "Wheel" function is selected, allowing moving the trailer over rough ground.

11. Axle brake Automatic/Off (for off road use only):

- Two positions toggle switch.
- Select "Automatic", to apply wheel brakes when not operating "Wheel Forward or Wheel Reverse".
- Select "OFF" to operate the two hydraulic cylinders in order to release the spring activated wheel brakes used for off-road towing only.

NOTE: Selector switch #12 must be in the "Wheel" position to allow the axle brake release. No other functions can be operated when the axle brakes are in the "OFF" position and the alarm will sound.

You must be ready to set the axle brake to Automatic mode in case of an emergency and as soon as the off-road towing is completed.

12. Selector Reel / Wheel:

- Two positions toggle switch.
- Select "Reel" to operate the functions: Outriggers, Reel, Reel brake, Freewheel / Tensioning, Tools, Capstan, Arms, Start/Stop, Engine Throttle and Axle brake.
- Select "Wheel" to operate all of the functions: Outriggers, Wheel Forward/Reverse, Wheel Raise/Lower, Start/Stop, Engine Throttle, Axle brake and Wheel Steering.

13. Engine Throttle Low/High:

- Spring return push button
- Activates the engine RPM controller for high or low throttle (engine speed).
- Push in and release to switch the mode from high to low or from low to high.

NOTE: All the reel functions can only be operated when the High engine throttle speed is selected, the wheel functions can be operated in both High and Low engine throttle speed.

14. Start/Stop

- Spring return push button.
- Push in to select "Start" or "Stop" engine mode, push in again to change mode.
- Push in and hold to allow starting of the engine.

NOTE: The engine will not start if the ignition key is not turned "ON". Also, the engine may not start immediately due to the "glow plug" delay. The start button will need to be depressed twice when the remote control is turned "ON" for the first time.

Important: Once the engine has started, release the start/stop actuator immediately. If the actuator continues to be depressed once the engine is running, permanent damage to the starter could result.

NOTE: Both the reel brakes and the axle brakes will re-apply automatically when the engine is stopped.

15. Left proportional joystick:

- Lever 5 positions, spring return to neutral.
- The function speed is proportional to the lever displacement for these two functions: Reel Pay In/Pay Out and Capstan CCW/CW.

Reel Pay In / Reel Pay Out:

- Pushing the joystick away will operate the reel motors to "Pay In".
- Pushing down the joystick operates the reel motors to "Pay Out".

NOTE: "Reel/Wheel" switch (#12) must be set to the "Reel" position and **outriggers must be set on a stable ground.**

NOTE: If the outrigger down interlock system is active, then the outriggers have to be extended to their minimum position to activate this function.

Steering wheel Left / Steering Wheel Right:

- Pushing the joystick to the left will operate the front wheel to turn left.
- Pushing the joystick to the right will operate the front wheel to turn right.

NOTE: "Reel/Wheel" switch (#12) must be set to the "Wheel" position.

Capstan CCW / Capstan CW:

- Pushing the joystick to the left will operate the capstan drive to turn counterclockwise.
- Pushing the joystick to the right will operate the capstan drive to turn clockwise.

NOTE: If the outrigger down interlock system is active, then the outriggers have to be extended to their minimum position to activate this function.

16. Right proportional joystick:

- Lever 5 positions, spring return to neutral.
- The function speed is proportional to the lever displacement for these two functions: Wheel Forward/Reverse and Arms Unload/Load.

Arms Unload / Arms load:

- The function speed is proportional to the lever displacement for this function.
- Pushing the joystick away will operate the reel arms cylinder to unload a reel.
- Pulling the joystick towards the operator will move the reel arms to load a reel.

NOTE: "Reel/Wheel" switch (#12) must be set to the "Reel" position and the **outriggers must be deployed to their minimum position**, if the outrigger down interlock system is active.

Wheel Forward / Wheel Reverse:

- Pushing the joystick away will move the trailer forward.
- Pulling the joystick towards the operator will move the trailer in the reverse direction.
- This joystick operates the front wheel drive motor and releases the axle brake simultaneously. As soon as the joystick is released, the axle brake is re-applied.

NOTE: The "Reel/Wheel" switch (#12) must be set to the "Wheel" position and the **outriggers must be deployed to their minimum position**. If the outrigger down interlock system is active.

Wheel Lower/Raise:

- Pushing the joystick to the left will raise the front wheel.
- Pushing the joystick to the right will lower the front wheel.
- Activates the front wheel lift cylinder to lower or raise the wheel.

NOTE: Before raising or lowering the wheel, the safety pin must be removed during the displacement and reinstalled after the wheel displacement, before any other operation.

NOTE: A protection system (switches and indicator lamp) will allow this operation only when the wheel is correctly aligned within the frame structure and ready to be raised. On the curbside, amber light turns ON when the wheel is aligned properly to be raised. If the wheel is raised from its self propelled position, steering and displacement functions are deactivated.

Before raising the front wheel, align the arrows on the front wheel rotation mechanism. This action will help lower the front wheel when releasing the trailer from the tow hook. Even if the rotation mechanism indicator lamp is turned "ON", this does not assure that the front wheel is perfectly straight. This lamp only confirms that the front wheel can be raised or lowered without any interference.



If the front wheel has rotated due to heavy road vibrations, the rotation indicator lamp signal could be lost and the functions "Wheel / Lower" and "Wheel Steer-Left / Right" locked. Then, it is necessary to override the front wheel lock function. In order to align the front wheel for lowering, the button "Arms In/Out Interlock" must be depressed while steering the front wheel.

ATTENTION: When overriding the interlock, the wheel can be turned freely and could hit the frame and be damaged.



Caution

Never attempt to manipulate a reel without having the outriggers down and set firmly on a stable ground.

3.4 - Changing the Battery

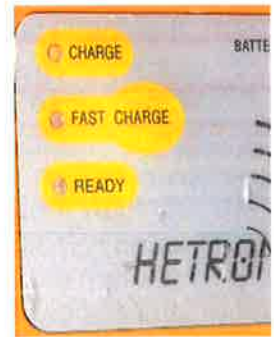
The battery voltage is monitored continuously by the transmitter. A buzzer in the transmitter sounds when the battery is nearly discharged. When the transmitter signals, the battery must be changed immediately.

1. Position the cable handler into a safe place or safe condition within 30 seconds after hearing the signal.
2. Press the E stop push button.
3. Switch the transmitter "Off".
4. Push the discharged battery slightly forward and lift it out of the battery compartment. Then, insert a fully charged battery.
5. Follow the start-up procedure to begin operation.



Charging the battery

1. Insert the discharge battery into the charger located in the controls compartment. The LED labelled "CHARGE" flashes for two seconds, and then stay lit during the charging process.
2. For a rapid charge, press the "FAST CHARGE" button. The fast charge LED lights also and stays lit during the charging process.
3. When the battery is fully charged, the "READY LED" lights up and the "CHARGE LED" goes off. Charging time is approximately 2 hours for a fast charge or 4 hours for a normal charge.
4. Leave the battery in the charger until it is needed. The charger supplies a "trickle" charge but will not over-charge the battery.



Protect the battery contacts against accidental short-circuits (i.e. do not store the batteries in a tool box or carry them loosely in your pockets). A bunch of keys is enough to shorten the battery life.

Battery specifications

- 3.6V NiMh (nickel metal hybrid)
- Typical operation time: 10-20 hrs with one charge
- Duty cycle: can be recharged at least 500 times, after 500 charges, over 80% of capacity remains and will diminish gradually.



Operation note : It must be understood that if the voltage level of the remote control battery is too low, then the red lamp will flash and the remote will shut-off eventually. Finally, the radio remote control is not equipped with an automatic shut-off if the remote control is dropped on the ground. So, if the remote control is dropped, unless it is damaged, it will continue to work normally.

3.5 - Emergency Controls

The emergency controls must be used **only** to stow the unit and take it to the repair center after a radio system failure. This control station is to be used in case of an emergency and it by-passes all of the protection systems. If the radio system fails (i.e. no charged battery) the harness can be used for direct mode operation. If the system is not working with the direct (hard-wire) mode, the emergency controls can then be used.

The reel motors cannot be activated manually. The hydraulic power comes from the main pump, the valve control is on the pump and you need tools to activate it manually.

The other functions have hydraulic power from the second pump and can be operated manually with the control valves located on the left side of the radio controls compartment.



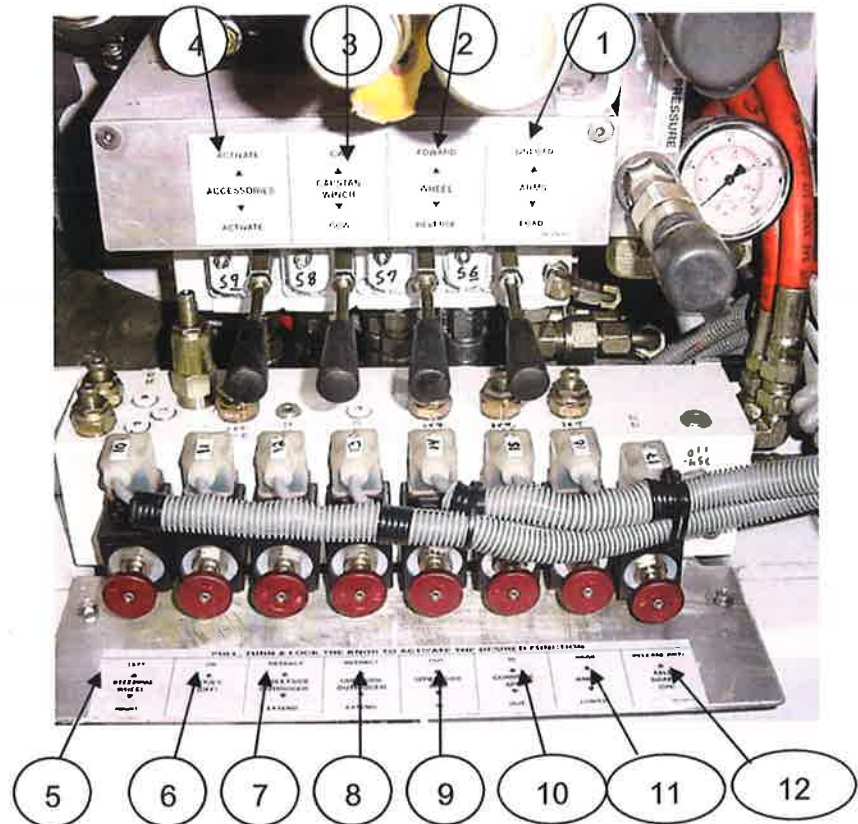
Caution

The operator will not be protected against electrocution when operating with the emergency controls.

In the event of a failure and the radio control system is still working, don't try to operate with the emergency controls as long as the problem is not determined.

When operating with the emergency controls, select only one spool at a time before activating the common lever for accessories functions. **You have to always make sure that the spools are in their normal operating position (manual override spool in the "IN" position) before operating with the radio controls.**

Emergency Controls



Control levers

- 1- "Arms" function activates the arms cylinder to load or unload.
- 2- "Wheel" activates the front wheel to move the trailer forward or in the reverse direction.
- 3- "Capstan winch" activates the capstan drive to rotate counterclockwise or clockwise.
- 4- "Accessories" function is the common lever to activate functions.

Here is the procedure to follow to operate these eight (8) functions:

Activate the function spool to be operated (items 5 to 12 above) by pulling and turning the corresponding red knob to lock it in place. Then, activate the "Accessories" (item 4 above) lever to operate the selected function. Before activating another function, the override spool must be returned to its normal operating ("IN") position.

Manual override spool knobs

- 5- "Steering wheel" to turn the front wheel left or right.
- 6- "Tools" function is used to activate the tools outlet.
- 7- "Street side outrigger" function is used to retract or extend the street side outrigger.
- 8- "Curbside outrigger" function is used to retract or extend the curbside outrigger.
- 9- "Street side arm" function is used to move the street side arms IN or OUT.
- 10- "Curbside arm" function is used to move the curbside arm IN or OUT.
- 11- "Wheel" function is used to raise or lower the front wheel.
- 12- "Axle brake" function is used to release (ON) or apply brake (OFF).

3.6 - Emergency Power Supply Connection

An auxiliary hydraulic power supply coming from a portable power unit or a vehicle equipped with a hydraulic system can be connected to the cable handler main hydraulic circuit.

The auxiliary power supply connection is to be used only in the event of an engine or pump failure.

The auxiliary circuit will not allow operating the reel motors, but all of the other functions.



AUXILIARY POWER SUPPLY CONNECTIONS

The auxiliary power supply connection should be used only to unload a reel, retract the outriggers and drive the cable handler to a towing vehicle. This auxiliary power must be supplied with at least 2000 PSI of working pressure.

The connection block is located on the curbside, to the right of the emergency controls. Two (2) hoses with matching couplings are needed to connect the auxiliary power supply.

A gate valve on the return line located behind the connection block must be closed before operating the auxiliary power supply to prevent the return of the oil to the cable handler tank.

After disconnecting the auxiliary power supply, it is important to open this valve. Failure to do so can damage the cable handler hydraulic circuit when the engine or pump will be repaired and operated.



Warning

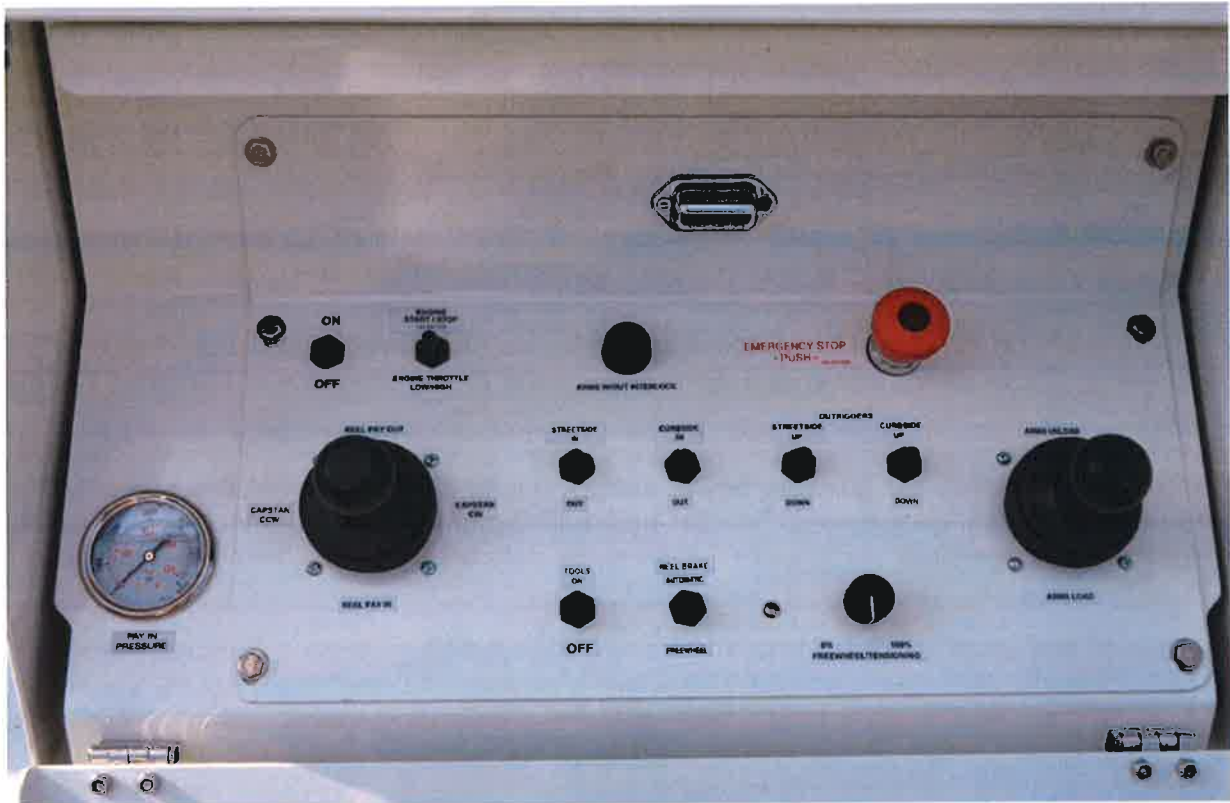
Never use these emergency supply outlets to operate a tool.

3.7 – Optional Stationary Console Station

An optional stationary console station is available for the 1400 Series trailer. This stationary console is equipped with several switches and two (2) proportional joysticks to operate all of the functions permitted. For safety reasons, all of the wheel functions are not available on this console.

The stationary console station is located underneath the main control system compartment on the right side of the trailer.

This console is available only on the 1400 Series equipped with a radio remote control.



The set-up of the stationary console provides a layout of the controls very similar to the radio remote control. All of the functions may be operated exactly the same way as the remote control. Refer to Section 3.3 of this manual for more details on all of the functions.

Operational details

Here are important operational details regarding the use of the stationary console station:

- 1- To turn "ON" the console, the "ON/OFF" switch has to be set to the "ON" position.
- 2- As soon as the console is turned "ON", the radio remote control will become inactive.
- 3- The console is ready to be used.
- 4- As for the radio remote control, the engine will need to be set to the HIGH Throttle to operate the high power demand functions. These functions are Reel Pay In/Pay Out, Reel brake, Freewheel / Tensioning and Arms Load/Unload.
- 5- If the Emergency Stop button is depressed, both, the console station and the radio remote control will become inactive. However, the engine will not stop.
- 6- As soon as the console station is turned "OFF", the radio remote control will be re-activated.

Section 4 – Before you operate

4.1 - Capacity and Stability

Maximum reel capacity for this self-loading trailer is stated on the serial number placard. Never lift a reel with unknown weight. Never exceed rated loading capacity.

Never attempt to load a reel or pay in cable without having the outriggers down and set firmly on a stable ground.

Make sure that the reel arms are in their fully loaded position and resting on the rubber pads before moving the trailer again. The load binders must be fastened and ratcheted tight to the arms before travel.

Park the unit on a level surface before operating the reel loader. Always use wheel chocks. Pads should be used on all unpaved surfaces, asphalt pavement, and other soft surfaces.

It is impossible to foresee all possible situations and combinations for set up of the unit. The operator bears ultimate responsibility for insuring that the unit is properly set up for the particular conditions encountered.

4.2 - Daily Pre-operational Checks

On a daily basis walk around the unit and look closely for any indication of the following:

- Loose threaded connectors
- Metal fatigue or excessive corrosion.
- Abraded hose surfaces.
- Hydraulic fluid leakage.
- Possible obstruction of moving parts-especially in the drive train.
- Check engine oil and air filter cleanliness.

4.3 - Preparing for Operation

The pulling rope or conductor must never put side loads on the arms and/or the trailer. This can cause sudden sideways movement on the trailer causing injury or equipment damage.

It is highly recommended to put wheel chocks around each trailer tire to prevent movement of the trailer.

PROPER GROUNDING OF EQUIPMENT IS EXTREMELY IMPORTANT: The cable handling trailer is equipped with a grounding lug. To protect against electrical hazards, the unit must be connected to a ground rod or the electrical system neutral. Follow proper grounding procedures as required by IEEE and/or other applicable standards. Ground mats and a running ground on the conductor are recommended.

Put a hazard barrier around the perimeter of the unit to keep unauthorized personnel away from equipment in operation.

Perform daily inspection and preventive maintenance if required.

The radio remote control switches must always be set to their normal and safe position before starting the engine:

- Key switch to zero "0" or "OFF" position
- Emergency stop activated
- Axle brake to the "Automatic (ON)" position
- Tools to the "OFF" position
- Reel brake to the "Automatic" position
- Freewheel to 0%
- Joysticks in neutral position
- Switches in neutral position

The hydraulic pumps are ready to work as soon as the engine is started.

There are two (2) ways of stopping a function on the trailer. The remote radio control has an emergency stop push button that will stop all functions on the trailer. However, it will not shut off (or stop) the engine.

The remote radio control also has a key switch which can be shut off. This shut off will stop the same functions, as the emergency stop button. However, if the hardwire is connected between the transmitter and the receiver, then the emergency stop button is the only switch that will stop all trailer functions.

The last switch that can be used to stop both all trailer functions and the engine is the ignition key switch inside the controls' compartment.

4.4 - Cold Weather Start-up

From the engine controller, turn the key to position 1 and wait for the glow plug LED to turn "OFF"; then start the engine, allow the system to run at a low idle for approximately ten minutes.

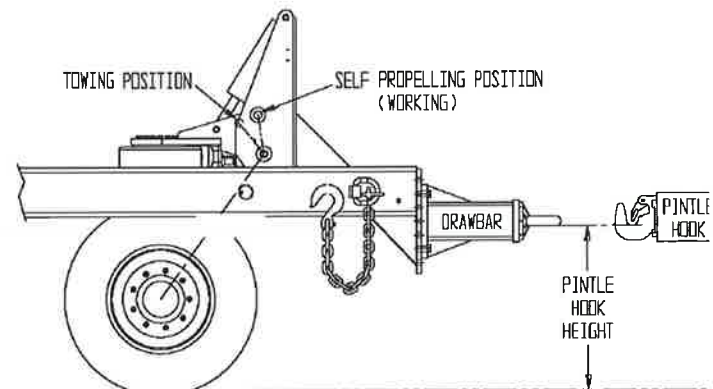
In extreme cold weather operations special low temperature hydraulic oil is recommended.

An engine oil pan heating pad can be installed and plugged into 110V AC outlet at night to keep the engine oil warm.

4.5 Coupling to a vehicle tow hook

The Posi-Plus 1400 trailer is equipped with all the components for a safe towing:

- Drawbar with adjustable height
- Safety chains
- Air brake and ABS system connections
- Road lights connections



Drawbar adjustment

Before coupling the trailer to the towing vehicle, the drawbar height must be adjusted to match the pintle hook height. Three (3) positions are available on the drawbar coupling plate giving heights of 24.25", 26.5" and 28.75". These positions should match most of the standard pintle hook heights.

Position the towing vehicle on a levelled surface and measure the height at the bottom of the pintle horn from the ground. Remove the bolts coupling the drawbar to the trailer frame and adjust the drawbar height equal or under that measure when the front wheel pivot shaft is in the self propelling hole location. When the drawbar is well adjusted, the front wheel can be lowered 5" from the self-propelling position allowing enough height on the drawbar to go over the pintle horn. The torque to apply on the $\frac{3}{4}$ " grade 8 bolts is 250 lb-ft lubricated.

Coupling the trailer

In the self operating mode, the trailer front wheel must be securely locked with the safety pin installed in the self propelling position hole.

Start the engine, select "Wheel" on the Reel / Wheel switch on the pendant control. In the wheel mode, the low speed throttle is operational to allow a precise approach to the vehicle. Approach the towing vehicle within a few feet, make sure that the trailer is in line with the vehicle axis to facilitate the coupling, remove the safety pin on the front wheel frame and lower the front wheel to lift up the drawbar. Use pads if the ground is not levelled. Move the trailer forward to have the drawbar aligned with the pintle horn, and then raise the wheel to lower the drawbar in the pintle horn. Lock the pintle hook to secure the drawbar and attach the safety chains, brake and lights connections.

NOTE: A proximity switch installed inside the front wheel frame allows turning and moving forward or reversing when the wheel is in the self propelling position. When the safety pin is removed, the front wheel can be lowered of approximately 5" or lifted up of approximately 3.25" without stopping the steering and displacement functions, if the wheel is lifted up more than 3.25", the functions are locked to protect the wheel system to be overloaded and to be rotated.

4.6 Towing the cable handler trailer

This instruction is to recall to the owners, operators and drivers different important rules to respect when towing a Posi-Plus cable handler trailer model 1400 or any other trailer type vehicle. This instruction has to be taken as basic guidelines for the operators.

Towing vehicle:

- The towing vehicle must have a sufficient GVWR to pull a 25000 lb trailer and comply with Applicable Regulations.
- The towing vehicle must have a tow hook assembly with sufficient capacity to pull a 25000 lb trailer.
- The towing vehicle must have safety chains attachment points with sufficient capacity to pull a 25000 lb trailer.
- The towing vehicle must have the required connections for the trailer brakes to work properly.
- The towing vehicle must have the required electric connections to have the brake, marker, signal and tail lights to work according to road regulations.

Limitations for trucks towing cable handler trailer:

Each country, state or province has their own limitations on speed and maximum loads permissible on their roads. The driver of the towing vehicle bears ultimate responsibility for following all regulations and safety rules of their employer and/or any state of federal law when towing a trailer type vehicle.

Here are our recommendations for normal road and weather conditions:

1. The trailer must not be towed at speeds higher than the maximum road speed limits. The maximum towing speed limit when both, towing the trailer empty (**or unloaded**) and towing the trailer with a reel installed (**or loaded**) is **55 MPH** assuming weather and road conditions are good.
2. The maximum towing speeds in any other conditions **must be at least 10 MPH** slower than the truck speed limits. Some examples of the “other conditions” are the bad road conditions (i.e. bumpy road, narrow road), roads with expansion joints (i.e. road overpass, bridges), bad weather (i.e. heavy winds, slippery or wet roads, heavy rain, icy roads, snow) conditions and heavy traffic conditions.
3. Towing in curves or bends **must be at least 5 MPH** less than posted speed limit.
4. On a 90° turn, the maximum speed limit must not be higher **than 5 MPH**.

Posi-Plus cannot establish exact limitations for each type of road, weather, etc. when towing one of their trailer, **drivers** are to follow these basic rules:

- You must always adhere to the legal speed limit for the road on which you are driving.
- You must always drive at a speed that is acceptable and safe according to the road and weather conditions that occur, and well within your capabilities.
- If the trailer starts to swerve or snake due to too fast driving, gradually ease off of the accelerator and gently reduce your speed.
- Do not take any harsh action such as sharp braking as this may cause a jack knife to occur.
- Always reduce your speed prior to a bend and select the appropriate gear for the speed at which you are traveling.

Trailer Checks before each journey

The driver of the towing vehicle holds the ultimate responsibility for the safe transport of the trailer and therefore needs to carry out the following checks before each journey:

- Is the actual gross weight that is being towed within the towing vehicle manufacturer's recommended maximum towing limit?
- Is the load within the trailer's official payload? Make sure the trailer is not overloaded.
- If a reel is to be transported, has it been secured correctly?
- Have the arms been secured with the carriage arms binding straps?
- Are all the trailer lights working correctly and undamaged?
- Is the ABS air brake system well connected and operating as it should?
- Check all tire pressure and conditions (i.e. free from cuts, bulges and with adequate threads).
- Are the wheel nuts and bolts in place and tightened adequately?
- If required, are the mudguards in satisfactory condition and securely fitted?
- Is the trailer coupled to the tow hook correctly?
- Is the coupling height correct? (i.e. not excessively nose up or nose down).
- Are the safety chains undamaged and secured to a suitable point on the tow bar or towing vehicle?

It is important to note that it is impossible to foresee all combinations of road and weather conditions and safety hazards that can occur while driving. The good judgement and experience of a qualified driver must dictate proper driving attitude.

If you have any questions regarding the above statements, please contact your Posi-Plus trailer representative.

Section 5 - Operation

5.1 - Loading a Reel

- Install appropriate reel arbor hole bushings onto the reel drive stub shaft.
- The high throttle must be selected to operate all the functions.
- If an outrigger down interlock system is installed, the outriggers must be deployed to their minimum mark to operate the other functions.
- Position the trailer using the nose wheel drive and steering control and back into the reel to be loaded.
- The reel should be positioned with the free end of the cable coming off the top of the reel toward the back of the trailer (over wound).
- Remove the tie straps and lower the reel arms around the reel.
- Fine-tune the trailer position with the reel arms down using the nose drive system.
- Align the drive arm drive pins with the reel drive pin pockets.
- When in line, use the reel arms in/out switches to engage the arms into reel. Make sure the arms are fully engaged into the reel before loading the reel!
- Extend two (2) outriggers down and set firmly on a stable ground.
- Raise the reel to the fully loaded position until it rests on the rubber stops.
- Install the arms tie straps and use the binders to secure the arms tight to the frame.

NOTE: For small reels it may be required to raise the front of the trailer and use the optional small reel adapters.



Caution

It is extremely important that the outriggers are down and set firmly on stable ground before attempting to load a reel. Keep the outriggers at a minimum of 4" (100 mm) from the ground when self propelling with a reel loaded.

5.2 - Unloading a Reel

- Extend the two (2) outriggers down and set firmly on stable ground.
- Remove the arms tie straps.
- Unload the reel to the ground and secure it.
- Retract the reel arms fully from the reel by moving the arms out and away from the reel.
- Remove reel arbour bushings from stub shafts.
- Raise the reel arms back up to their loaded position.



Caution

It is extremely important that the outriggers are down and set firmly on stable ground before attempting to unload a reel. Keep the outriggers at a minimum of 4" (100 mm) from the ground when self propelling with a reel loaded.

5.3 – Reel drive Pay In / Pay Out

- The 1400 Series trailer is designed as an over wound cable puller with rope/conductor exiting from the rear of the trailer.
- The reel must be positioned over the "man hole" to bring the cable to be feed vertically downward.
- The stabilizers must be positioned as close to manhole as possible, so that cable/conductor will be closed to be in line with the stabilizer bases as it enters the manhole.



Caution

When pulling or paying out cable/conductor, the trailer wheels must be chocked properly.

5.4 - Using Pilot Rope Capstan

- Direct the free end of the winch rope through the roller at the rear of the trailer and direct into the manhole or trench.
- Blow or pull the pilot rope into the duct and attach to the pulling line from the pulling machine at the other end.
- Inform the puller operator when the capstan drive is ready to retrieve (or pay in).
- Pull in the pilot rope using the capstan control and adjust its speed using the proportional joystick.

NOTE: The pilot rope can be freewheeled off of the rope storage reel by reversing the pinned drive dog.

5.5 - Self Propelling

- Driving and steering of the trailer can be accomplished from the remote pendant control.
- The trailer can be steered and driven at the same time for improved manoeuvrability.
- The rear axle spring brakes automatically apply and release when in self-propel.
- When parked, the axle spring brakes are automatically applied.
- Keep the outriggers at a minimum of 4" (100 mm) from the ground when self propelling with a reel loaded.

5.6 - Conductor Tensioning Instructions

The 1400 series cable-handling trailer can be used to tension overhead conductor.

Load the reel of conductor as described in Section 5.1 – Loading Reel in this manual, the wire must be pulled off of the reel from the top of the reel and away from the rear of the trailer (top wound).

Position the trailer in the most desirable position to allow the wire to run at the best angle to the first running block on the structure.

The trailer must be properly anchored either to another vehicle or ground anchors. All vehicles brakes must be set and wheel chocks under the tires.

The trailer and conductor must be properly grounded.

Once the reel is loaded, the reel carriage arms must be raised to the loaded or travel position, the load binders in the front of the reel carriage arms must be, fastened and ratcheted tight.

After the pulling line is attached to the conductor and the proper grounding devices installed, you are ready to start the conductor tensioning procedure.

Tensioning can only be done using the Radio Remote Control.

Set the Reel Brake Automatic/Freewheel Switch to the "Freewheel" position. Set the potentiometer to the zero (0) Freewheel position or fully counterclockwise. Make sure that a completely charged battery is installed into the remote radio control before attempting any tensioning. Release the Emergency Stop button on the remote control and activate the remote control.

Set the Engine Throttle to High throttle.

The conductor can now be pulled of the reel under light tension.



Caution

While tensioning, do not switch into "Automatic" operation and "Pay Out" under load, cable will pay out freely and uncontrollably.

As the conductor is pulled out and the tension needs to be increased, turn the tension control potentiometer clockwise to increase the tension on the cable while activating the function "Reel Pay-in".

If the puller on the other end of the job set up should stop pulling, the drive arms will stop and hold the conductor under tension as long as the function "Reel Pay-in" is maintained.

If you should stop the tensioning operation for any reason, then release the "Reel Pay-in" function and select the "Automatic" position on the "Reel brake" function to apply the brakes and hold the reel from turning.

Do not turn the tension control potentiometer if you have to stop tensioning. Turning the knob counter clockwise will lower the tension pressure and the reel will turn and release the tension on the conductor when you re-start the tensioning operation. There is a built-in delay of 3 seconds. During restart, the system will automatically go to maximum tension settings then ramp down to knob tension setting over 3 seconds.

When the conductor has been pulled in and secured on the pulling end or the job set up, the conductor can be pulled in or retrieved to final sag, if required.

Pulling Conductor to Final Tension or Sag

- Set the Reel Brake "Automatic/Freewheel" switch to the "Freewheel" position on the radio remote control.
- Set the engine throttle to HIGH throttle.
- Set the reel tensioning control potentiometer to the full counterclockwise (0%) position (minimum setting).
- Move the "Pay In/Pay Out" joystick **slightly** to the "Pay In" direction.
- Turn the reel tensioning control potentiometer clockwise until the reel starts to turn. Pull the conductor to final sag.
- Operate the "Pull In" function until the cable is secured on the job set up.
- The Tensioning procedure is now complete.

Do not switch out of tensioning or freewheel mode to pay out cable during this operation. If slack is needed, reduce the tension on the cable by lowering tension setting using the reel tensioning rheostat knob.



Danger

During cable tensioning, the "REEL BRAKE" selector switch must never be shifted from the "FREEWHEEL" position to the "AUTOMATIC" position while activating the "REEL" joystick to the "PAY IN" position. This selector switch must only be shifted only when the "REEL" joystick is not activated. If the "REEL BRAKE" selector switch is shifted from the "FREEWHEEL" position to the "AUTOMATIC" position while activating the "REEL" joystick to the "PAY IN" position, then the tension on the cable will increase dangerously.

5.7 – Torque Requirement Calculation

TORQUE = FORCE X DISTANCE

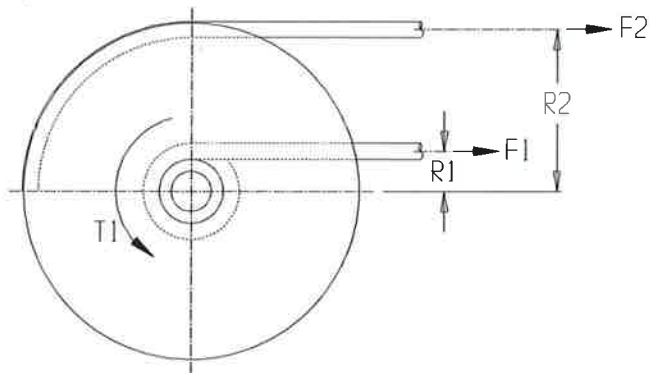
$$T_1 = F_1 \times R_1$$

$$T_2 = F_2 \times R_2$$

T = Torque to be produced by the reel arms motors (lb-in)

F = Force of pull (lb)

R = Measured distance from the perpendicular of the line of action of the Force to the center of rotation (inch)



5.8 – Cable Retrieving Speed

The linear speed of travel in feet / minute of cable being 'reeled in' is dependent upon the diameter of the reel core or the diameter of the cable layered on the reel and the RPM of the reel core.

$$\text{FEET/MINUTE} = \frac{\text{REEL DIA. (inch)} \times 3,14 \times \text{Reel RPM}}{12}$$

Speed chart

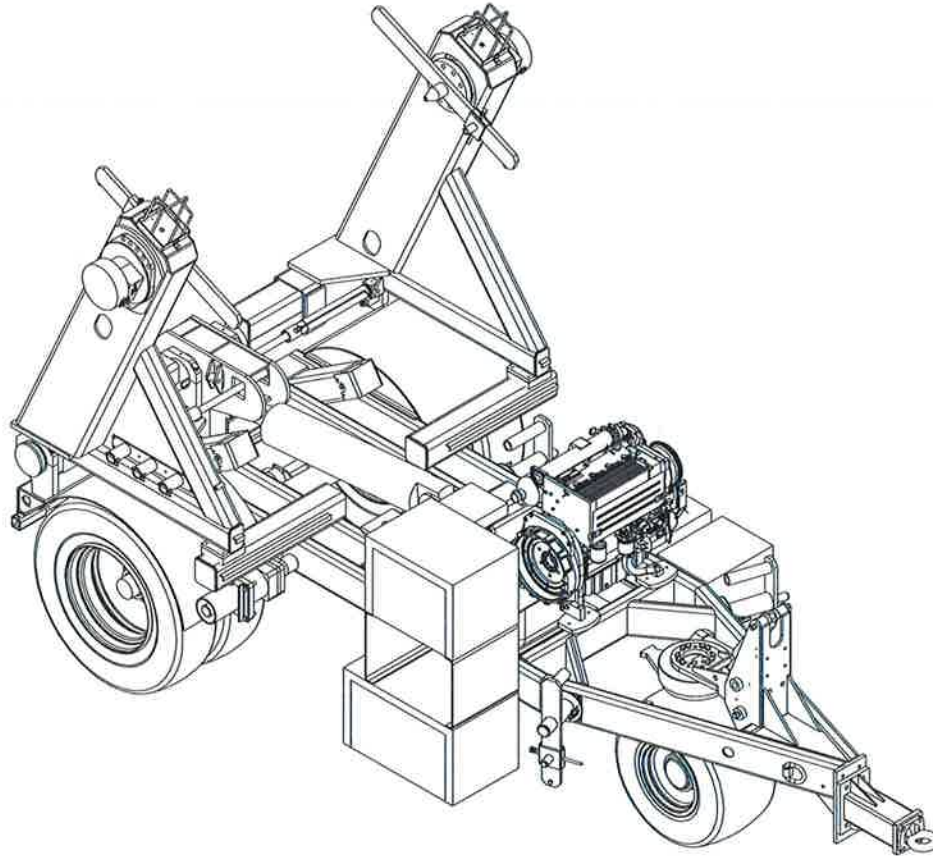
Reel Dia. (inch)	Reel RPM			
	5	10	15	20
20	26	52	79	105
40	52	105	157	209
60	79	157	236	314
72	94	188	283	377
Feet / minute				

5.9 – REEL DRIVE TENSIONING CHART

Max. reel drive torque : **250000** *In-lb*

** The maximum reel drive torque will only be attained when the maximum pressure is attained.*

Line Pull Diameter (in.)	Line Pull (lbs)													
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	11000	12000	13000	14000
	Theoretical operating pressure (PSI)													
20	208	416	624	832	1040	1248	1456	1664	1872	2080	2288	2496	2704	2912
24	250	499	749	998	1248	1498	1747	1997	2246	2496	2746	2995	3245	3494
30	312	624	936	1248	1560	1872	2184	2496	2808	3120	3432	3744	4056	4368
36	374	749	1123	1498	1872	2246	2621	2995	3370	3744	4118	4493	4867	-
42	437	874	1310	1747	2184	2621	3058	3494	3931	4368	4805	-	-	-
48	499	998	1498	1997	2496	2995	3494	3994	4493	4992	-	-	-	-
54	562	1123	1685	2246	2808	3370	3931	4493	5054	-	-	-	-	-
60	624	1248	1872	2496	3120	3744	4368	4992	-	-	-	-	-	-
66	686	1373	2059	2746	3432	4118	4805	-	-	-	-	-	-	-
72	749	1498	2246	2995	3744	4493	-	-	-	-	-	-	-	-
84	874	1747	2621	3494	4368	-	-	-	-	-	-	-	-	-
90	936	1872	2808	3744	4680	-	-	-	-	-	-	-	-	-
96	998	1997	2995	3994	4992	-	-	-	-	-	-	-	-	-
102	1061	2122	3182	4243	-	-	-	-	-	-	-	-	-	-
108	1123	2246	3370	4493	-	-	-	-	-	-	-	-	-	-



Maintenance manual

CABLE HANDLING TRAILER 1400

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Section 1 – Unit Specifications

General Specifications

The major components of the 1400 Series self-loading trailer are the frame, the rear axle, the power train (front wheel drive), the reel loading arms, the reel driver, the outriggers, the power unit, the main control panel and the remote control.

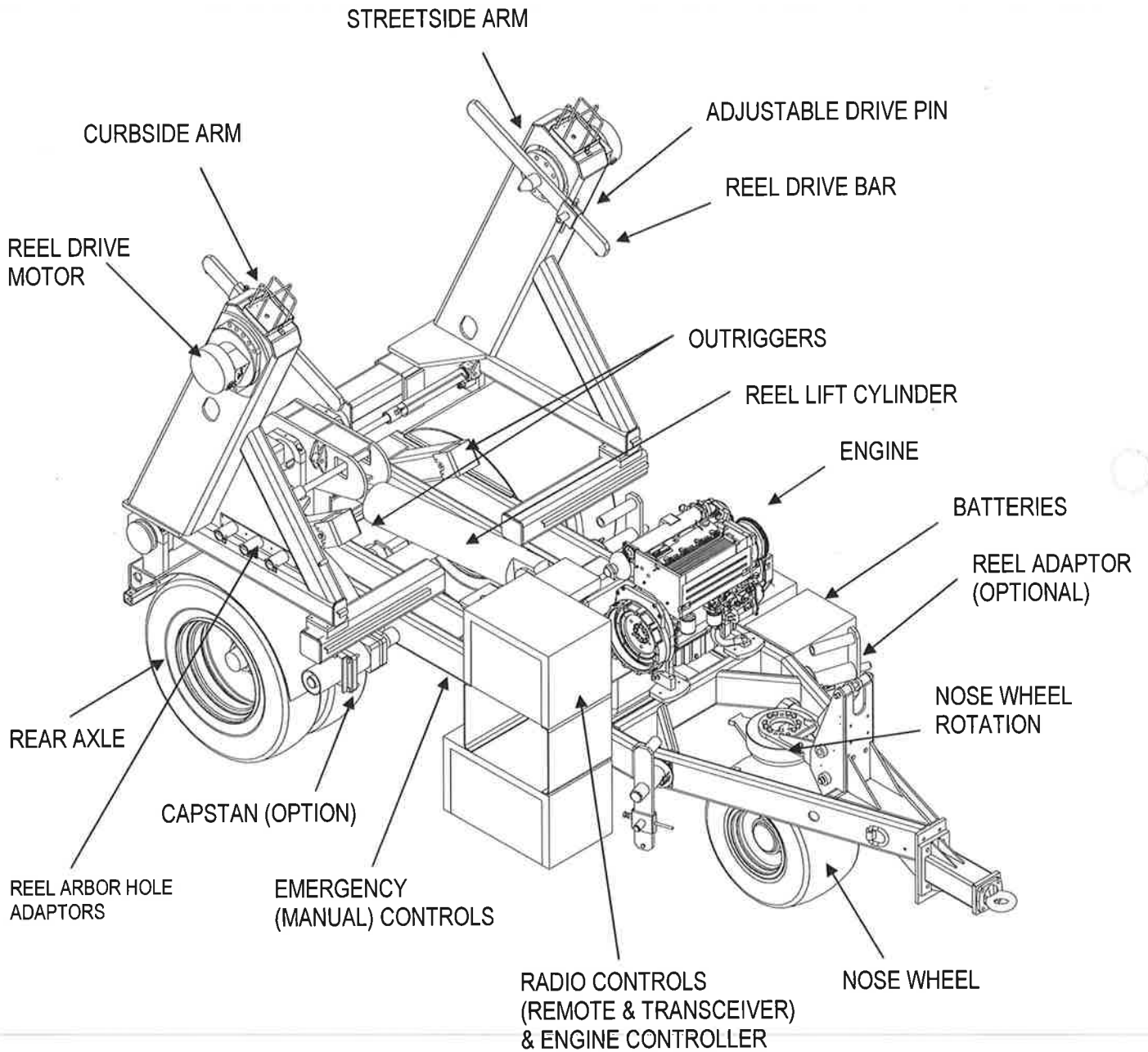
The 1400 model is a multipurpose cable-handling trailer that may be used to transport, install or pull out underground cables, as well as to install overhead lines.

Some optional equipment may be present on this self loading cable handler. Here is a list of these options:

- Capstan winch
- Tool outlet
- Dual hydraulic hose reel
- Inverter 12 Volts DC / 120 Volts AC

The capacities of this trailer must be known and understood by its users, before operating or servicing.

TERMINOLOGY DEFINITIONS



Section 2 - Safety

Safety instructions



This "safety alert symbol" is used throughout this manual to call your attention to danger, warning, caution and attention instructions. These instructions must be followed to prevent the possibility of personal injury and/or property damage.

The terms "danger, warning, caution and attention" represent varying degrees of personal and/or property damage that could possibly result if the preventative instructions are not followed. The following paragraphs from ANSI Z535.4-1991 explain these terms.



Danger

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be used in the most extreme situations.



Warning

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Caution

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

The term "Attention" is used to alert personnel of instructions that must be followed to prevent the possibility of property damage. Property damage could include structural damage to the unit, component failure or damage to nearby property. Read and follow all danger, warning, caution and attention instructions.

Safety Information and Warnings

The following section describes safety warnings and information concerning operating and maintaining the cable handler device. Following these instructions will mean safer operating and maintenance practices.

These warnings serve only as examples of good work practices to assist maintenance personnel and servicemen in doing their job more efficiently.

Most hydraulic ports and fittings on the unit are SAE or JIC straight thread, Do not attempt to connect pipe thread fitting to these types of fittings without being certain it is intended to be pipe thread connection.



Failure to remove pressure before loosening a valve cartridge hydraulic fitting or hose from its housing will cause oil to spray out under pressure as the connection is loosened. Hydraulic oil escaping under pressure can have enough force to inject oil into the flesh.

Cleanliness is extremely important in a hydraulic system. when hydraulic lines are disconnected or components are removed, the ports should be plugged or other precautions taken to prevent contaminants from entering the hydraulic system.

Even new hydraulic oil from the petroleum company may be contaminated compared to the filtered oil of the unit's hydraulic system. All oil being added to the reservoir must be filtered before using it to power the unit. This is most effectively done by filtering the oil through a 10 micron filter as it is pumped into the reservoir.

Inspect hydraulic hoses and wires frequently to be certain they are properly routed to avoid sharp cutting edges, kinking or scuffing.

Serious pump damage and trailer malfunctions are likely to occur if conditions are present which allow air into the suction side of the pump.

Do not make any modifications to this unit that might affect its structural soundness or operational characteristics without specific written permission from Posi-Plus. Unauthorized alterations or modifications may prevent the unit from operating safely and properly as designed.

Always wear the proper protective equipment for the task being performed. For example, safety shoes, eye and hearing protection, gloves, dust mask, etc.

Never place your finger, hand, foot or any part of your body in an area where it could be injured.

Never move an outrigger, reel or vehicle unless you have a clear and unobstructed view.

Never remove the fasteners of a component until you have supported the component with a hoist or other means to safely support the component.

Never use air pressure to move a hydraulic component.

Always purge air from an actuator (hydraulic cylinder or motor) before installing it on the device. Failure to purge a component may result in free and uncontrolled movement of that component.

When servicing or repairing the equipment, shut down the engine unless it is required to be running for adjustment purposes.

Do not change the pressure setting of any hydraulic valves unless authorized instruction has been obtained.

Ensure that all tire and rim parts are undamaged and correctly assembled before inflating the tires.

Use an inflation cage, safety cables or some other safety device when inflating the tires. Do not exceed the tire manufacturer's recommended maximum pressure.



It is impossible to foresee all possible situations and combinations for the use of this unit. The operator bears ultimate responsibility for following all regulations and safety rules of their employer or any state or federal law.

While servicing the self loading trailer, personnel may be exposed to hazards that cannot be protected against by any mechanical means. The use of care, common sense and safe work practices provide the best protection from accidents.

Fire prevention

Fires can create severe emergencies where both human life and property may be lost. Even when confined, a fire may cause very expensive damage to your equipment. Fire can strike at any time, not only when the equipment is used, but also when left unattended between work shifts and nobody is around to fight it.

When working in a confined environment, it is impossible to prevent combustible dust from collecting in tight corners of the trailer. This dust, in itself, may not cause a fire, however, when mixed with fuel, oil or grease in a hot and confined place, it can become a fire hazard.

To reduce the chances for a fire to break out, follow the preventative instructions listed below:

1. Inspect the trailer daily for potential fire hazards and make any necessary repairs immediately.
2. Always ensure that excess grease and oil accumulations, including spillage, are cleaned up immediately.
3. Use only inflammable cleaning agents for cleaning the trailer or trailer components.
4. Store oily rags and other combustible materials in a fire-proof location.
5. Before performing repair work such as welding, the area surrounding the repair location should be cleaned and a fire extinguisher positioned close by.
6. Maintain a charged fire extinguisher on or near the carrier at all times and KNOW HOW TO USE IT.

Inspections

Periodic inspection of the trailer according to a regular schedule will establish the normal state of the unit for personnel associated with its operation and maintenance and provide a set of consistent conditions which will tend to highlight any occurrence of a potentially hazardous malfunction.

On a daily work basis walk around the unit and look closely for any indication of the following:

1. Loose threaded connectors.
2. Metal fatigue or excessive corrosion.
3. Abraded hose surfaces.
4. Hydraulic fluid level or leakage.
5. Possible obstruction of moving parts, especially in the drive train.
6. Check engine oil and fuel level.
7. Tires condition and air pressure.
8. Taillights and warning lights.
9. Trailer brake system.
10. Tow bar and safety chains condition.

Disclaimer of Liability

Posi-Plus will not be liable for unauthorized modifications or alterations of the self loading trailer. Posi-Plus will not be liable for improper or abusive operation of the unit.

Do not alter or modify this unit in any way that might affect its structural integrity or operational characteristics without the specific written approval from Posi-Plus.

Unauthorized alterations or modifications will void the warranty. Of greater concern is the possibility that unauthorized modifications may cause unsafe operating conditions. These unsafe conditions could result in death, personal injury and/or property damage. Posi-Plus will not be responsible for unauthorized alterations or modifications that cause property damage, personal injury or death.

Posi-Plus assumes no liability for any personal injury and/or property damage related to the use of this manual when performing testing, maintenance or repair procedures on the trailer.

Section 3 - Preventive maintenance and inspection

Safety and Braking devices

A regular maintenance and check-out procedure on all safety and braking devices of your equipment is a must. The following procedure should be carried out at intervals not exceeding 250 engine hours by a knowledgeable serviceman trained to inspect and maintain this type of equipment.

- a. All safety devices which you have on your trailer such as overspeed, overload, slack cable, including all limit switches should be checked for correct operation.
- b. All operating and emergency brakes should be checked for correct operation and for holding power by the application of test weights or maximum load whichever is applicable.
- c. All drive train and structural components should be thoroughly examined for potential problems such as cracks, looseness, misalignment, etc.
- d. All support ropes, anchor ropes and attachment points at both ends should be thoroughly examined to ensure their safety and integrity.
- e. A check to see that all components have been properly lubricated in accordance with the maintenance and service instructions.
- f. Examine the tow bar and the safety chains condition and check the retaining fasteners for tightness.



Warning

Do not operate any equipment in an unsafe condition as it may result in property damage and/or serious personal injury.

Maintenance and Inspection list

The following maintenance and inspection schedule should be carried out by qualified personnel, using proper lubricant to suit environmental and operating conditions.

These are suggested recommendations only, more frequent inspections may be needed if the trailer is operated under severe conditions. Axle bearings and brakes inspections will vary depending on operating conditions, speeds, loads and mileage. Item such as Deutz engine, pumps, Meritor axle and ABS brakes etc. on this trailer should be serviced according to the Manufacturer's Service Manuals.

The following section provides the preventive maintenance items in a checklist. The items are separated into four different intervals. The items should be performed at the interval (Engine hours) that comes first. These intervals are listed below.

- 125 engine hours
- 250 engine hours
- 500 engine hours
- 1,000 engine hours

Preventive Maintenance and Inspection Checklist

The form on the following pages is the recommended checklist for the cable handler.

Besides the items on the checklist, there is an additional maintenance item that should be performed on a new unit **after the first 50 to 150 hours of operation**:

- Change the hydraulic return line filter.
- Change the engine oil.
- Change the engine filter cartridge.
- Change the fuel filter cartridge.
- Check for engine leaks.
- Check engine mounts, retighten if necessary.
- Check V-belts, retighten if necessary.

Remote radio control and main control panel

A visual inspection must be performed every 125 engine hours to verify the integrity of all switches, wires, battery tube and control board. All components must be firmly fixed at all times, in particular the control board and the switches.

Except for the rechargeable batteries, there are no field replaceable parts on the radio controls' system. The defective parts must be returned to your local Posi-Plus representative for repair. Refer to Section 6 or to the Manufacturer's manual for inspection details.

Preventive Maintenance and Inspection Checklist

Trailer No. _____ Location _____ Date _____

Model Number **Posi-Plus Cable Handler 1400** Serial Number _____

Engine Hours _____ Inspector _____

All Inspections, adjustments, repairs and lubrication must be performed in accordance with Posi-Plus specifications and manufacturers specifications.
Refer to applicable Manuals.

Intervals

- o 125 Engine hours
- o 250 Engine hours
- o 500 Engine hours
- o 1000 Engine hours
- Others _____

Symbols

- √ = Okay or completed
- R= Repair or replacement required
- X= See remarks
- C= Corrected by inspector
- U= Unsafe to operate
- N/A= Not applicable

Every 125 Hours			
Engine		Cable Handler	
	Check oil level		Pumps (Noise level, no leak, mounting bolts tight)
	Check battery and cable connectors		Hydraulic oil level and condition
	Check air cleaner		Hoses (routing, condition, no leaks)
	Clean debris from around exhaust system		Mounting (bolts tight, welds intact, no cracks)
			Remote control batteries (change if necessary)
Axle		Lubricate all pivot points (refer to Lubrication chart)	
	Lubricate camshaft bushings and automatic slack adjusters on brakes		Check brake, positioning and safety lights.
	Axle wheel ends oil level		Hydraulic cylinders (leak, rod condition, pivot bearings)
	Brakes' hydraulic cylinders operation		Remote control (rubber boots, switches, loose parts, operation)
			Main control (condition, cable)
Every 250 Hours			
Engine		Cable handler	
	Inspect and clean cooling system		Override / Emergency controls operation
Axle		Hydraulic return filter (check indicator and service if necessary)	
	Brake shoes (inspect and service if necessary)		Reel motors (brake, leak)
	Drive train (Cracks, looseness, misalignment)		Check for excessive wear on sliding arms/ torque tube
Every 500 Hours			
Engine		Cable handler	
	V-belts		Nose gear box oil level
Axle brakes		Decals missing	
	Check ABS system		Arms and trailer structure (welds intact, no deformation or cracks)
Every 1,000 Hours			
Engine		Cable handler	
	Change oil		Oil analysis (Change oil and clean reservoir if necessary)
	Change oil filter cartridge		Main system pressure
	Change fuel filter cartridge		Tool system pressure
	Valve clearance (check and adjust if necessary)		Nose gear inner ring (Lubricate)
	Clean fuel pump strainer		Change charge pump filter
	Check for fuel lines leakage		

Accident prevention signs

Your equipment was shipped from the factory with the decals showed at the end of Operator's Manual.

Should any of these decals be missing, they could prevent the proper operation and/or maintenance of the unit which may result in personal injury or property damage.

If any of these decals are missing, please contact us for a replacement.

Order the decal (s) by stating decal description, number, and quantity.

Lubrication

Use the lubricants in Figure 3.1 to grease the unit as directed in the Lubrication Chart and Diagram. The sources shown are for reference only. Any brand that meets or exceeds the specifications of the products listed is acceptable. The letter symbol next to each type of lubricant corresponds to the letter symbol used on the Lubrication Chart and Diagram.

Symbol	Lubricant
C	Multipurpose lithium base grease with good water resistance, rust inhibition, oxidation stability and extreme pressure properties. - Shell – Albida LC EP2
F	Water resistant filler type grease with good adhesion to metal under wet conditions -Esso Arcan 1
W	Automotive gear oil - Shell – Spirax HD 80W90
G	Dry lubricant Molyspray Orapi 700

Figure 3.1 - Lubricant Symbols and Specifications

Lubrication Chart and Diagram

Item #	Component Description	# of Points	Application Method	Interval	Symbol
*1	Square torque tube slides	2	Spray on	Before operation	G
2	Arms pivot shaft pillow blocks	4	Grease gun	125 hours	C
3	Outrigger cylinders	4	Grease gun	125 hours	C
4	Arms in and out cylinders	4	Grease gun	125 hours	C
5	Reel load cylinder	2	Grease gun	125 hours	C
6	Hydraulic axle brake pivot	4	Grease gun	125 hours	C
7	Front wheel up/down pivot	1	Grease gun	125 hours	C
8	Outrigger inner legs	2	Brush on	125 hours	F
**9	Nose gear gearbox oil level	1	Fill to level plug if low	500 hours	
10	Nose gear inner ring	2	Grease gun	1000 hours	C

*Remove old grease on the area where the arms slide on the square torque tubes before applying with the new grease.

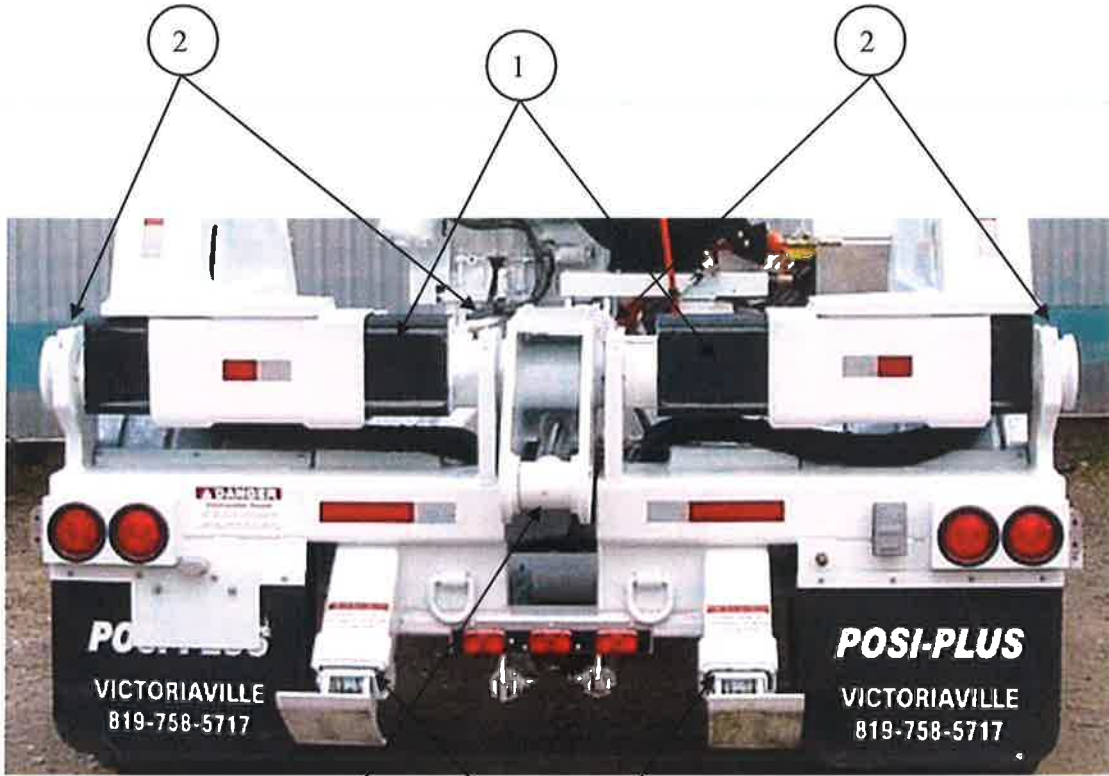
** The unit shall be half full when mounted horizontally.

Refer to Figure 3.1 for lubrication specifications. Units in heavy service or operated in extremely dusty, sandy or rainy conditions will require more frequent lubrication than noted above.

Notes

1. Wipe all grease fittings clean before greasing. This keeps contamination from entering the lubrication points. After removing the grease gun, wipe the fittings clean again. Any grease left on the fittings will collect dirt.
2. Wipe all gearboxes clean before removing the lube oil fill or check plugs. Tighten the plugs securely after checking or filling. Wipe excess lubricant off the gearbox. Any oil left on the gearbox will collect dirt.
3. For maximum life, change gearbox oil immediately if it has overheated, causing it to smell burned, or if it has become diluted with hydraulic oil from a leaking motor shaft.
4. Lubricate any spool end (pin) connection and pivot point.

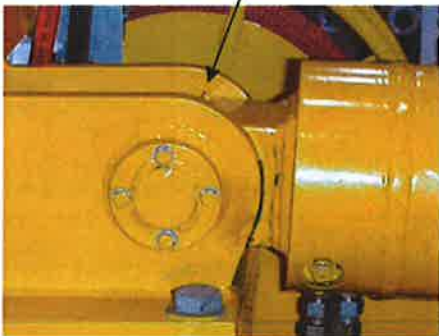
LUBRICATION



5

8

6

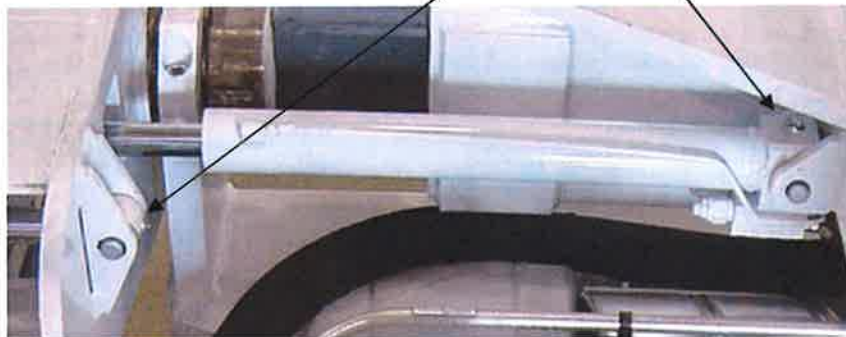


LUBRICATION



3

4



7

10



Bolts, capscrews and nuts

A variety of fasteners are used on the trailer. Depending on their use and design, different bolts have different inspection and installation requirements.

It is good maintenance practice to regularly check all fasteners for tightness; proper torque value and procedure of various size bolts are shown on drawings in the parts manual.

When checking fastener torque value during inspections, check the torque value at 90 percent of the original value. This prevents breaking the locking bond of the thread-locking adhesive. For example, if the torque value for a bolt is 100 foot-pounds, the bolt would be checked for tightness at 90 foot-pounds.

Thread locking adhesive is recommended for certain fasteners and hydraulic connections. Upon curing, thread-locking adhesive provides a powerful locking action.

When a bolt is removed or has its locking bond broken, reapply the adhesive or anti-seize compound before reinstalling the bolt. However, before applying the thread locking adhesive or anti-seize compound, clean the area that the compound will be applied to. If it is to be applied to a fastener, clean the threads of the fastener and the tapped hole with solvent. Blow-dry the threads and hole with compressed air. Grease and oil can reduce the effectiveness of both types of lubricants. In addition, make sure to follow the specific procedure indicated on the adhesive or compound.



Caution

Eye protection must be worn when operating a compressed air nozzle to prevent particles of metal, dirt or other matter from entering the eyes.

After installing the bolt, properly torque the bolt. If applying thread-locking adhesive, torque the bolt before the lubricant cures, this occurs within 15 minutes of application or according to the manufacturer's specification.

For safety, always use Posi-Plus replacement fasteners.

Section 4 – Hydraulic oil

Hydraulic system

Maintaining the hydraulic system is critical to the proper operation of the cable handler. Most of the maintenance for the hydraulic system focuses on the upkeep of the hydraulic oil. Using the proper type of oil helps to prevent many hydraulic system problems. Maintaining the oil is also important. If the oil is dirty or contaminated, components may be damaged, but will probably malfunction.

Cleanliness precautions

Contamination will ruin any hydraulic system. It is very important that no contamination enter the system. Dirt, water and air are different types of contaminants. They can enter the hydraulic system in many ways. Contaminants can enter the system when filling the reservoir or changing filters. They can also enter when changing components or performing other service procedures.

Following the precautions listed below will protect the cleanliness of the hydraulic system.

- Filter new oil with a 10 micron filter as it is added to the reservoir.
- Clean off hydraulic connections before opening them.
- Plug or cap ports and lines opened for service.
- Keep replacement hoses, tubes and other components plugged while stored.
- Make sure components are clean before installing them.
- Clean the reservoir and return line filter covers before opening them.
- Clean the filler breather cap before opening it.
- After servicing the reservoir, immediately replace the cover when finished.
- Make sure quick disconnect couplers are clean before connecting them.
- Do not spray water on the filler breather cap on the reservoir. This could force contaminants into the reservoir.

Filtration and reservoir

The cable handler is equipped with a complete filtration system. When properly maintained, this system will reduce contamination of the hydraulic system. The filtration system must be serviced regularly. If it is not, the filters will not be effective. Each part of the filtration system is explained in this section. Servicing of each filter is also covered.

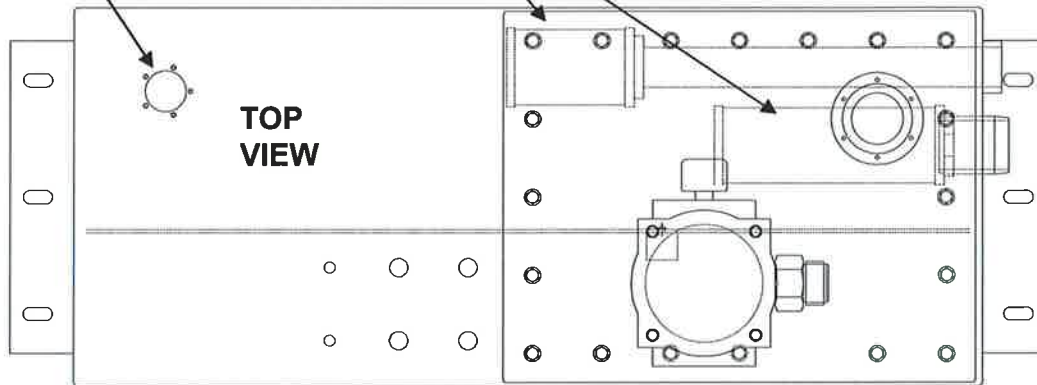
The standard hydraulic reservoir has a capacity of 33 gallons. The reservoir is equipped with an electric oil level gauge and a magnet to attract the metallic particles in the reservoir.

HYDRAULIC OIL RESERVOIR



ELECTRIC OIL
LEVEL GAUGE

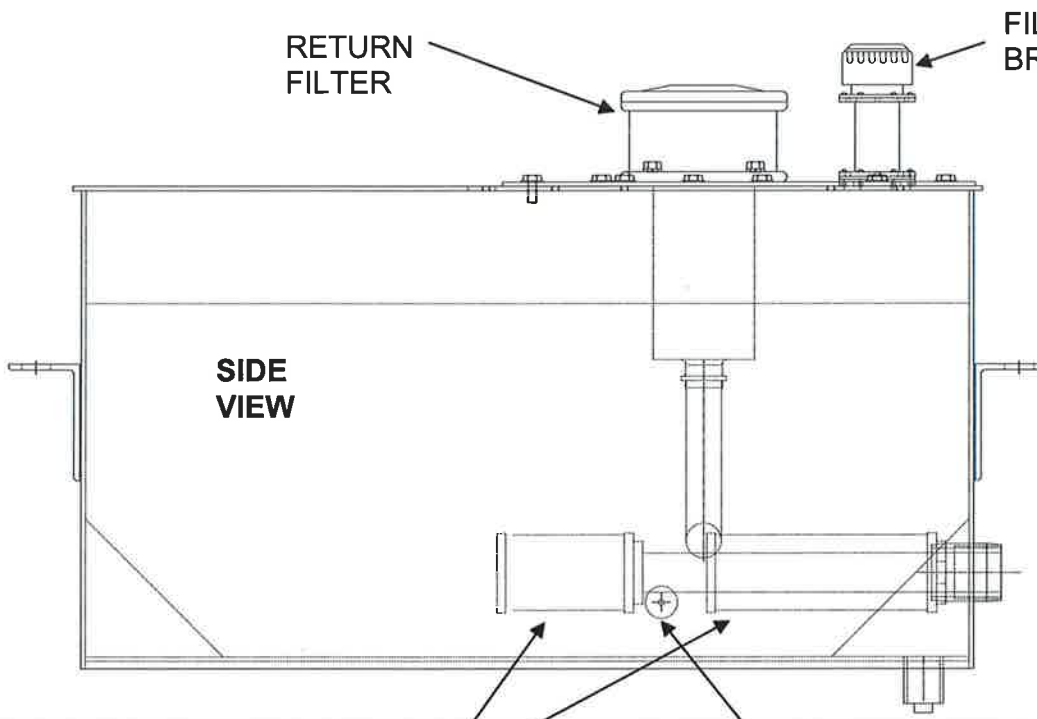
SUCTION
FILTERS



TOP
VIEW

RETURN
FILTER

FILLER
BREATHER



SIDE
VIEW

SUCTION
FILTERS

MAGNET

Filler Breather Cap and Strainer Basket

The filler breather cap is located on top of the reservoir.

The cap has three purposes. It allows air to flow in and out of the reservoir, as the oil level changes. The cap contains a filter that cleans the air, as it enters the hydraulic system. The cap also has a strainer basket that keeps large particles from entering the reservoir, when oil is poured into it. The marks on the level sight gauge are to be used to determine the oil level of the reservoir, as described in this section under Hydraulic Oil Specifications.

The filler breather cap is replaced as one component. Replace the filler breather cap once a year. If your unit is operated in an extremely dusty environment, you may need to change it more often.

Remove and flush out or replace the strainer basket when you change the hydraulic oil. Any time you notice the strainer has dirt in it, remove it and flush the strainer basket out.

Suction Filter

Two (2) **inlet strainers** (or suction filters) are located inside the reservoir. These strainers are mounted at the bottom of the reservoir near the access door and in the pumps' suction lines.

Each strainer has a stainless steel element with 125 micron (100 mesh) screen to protect hydraulic pump from solid contaminants. An integral relief valve bypasses the element when the pressure drop across the element is greater than 3 PSI. Element bypassing can be caused by excess flow rates, high fluid viscosity, dirt-loaded element or a combination of these causes. The bypass prevents system shut down or pump cavitation when these situations happen.

When the oil is monitored regularly, no service is necessary for the strainer element. If oil is contaminated and has to be changed, then the reservoir must be emptied, cleaned out and the inlet strainers must be cleaned or replaced if damaged. To clean the strainer, remove the element from the reservoir, wash thoroughly in a suitable solvent and blow dry with air from inside to outside. Check for the good operation of the bypass valve and reinstall the strainer.

Return Line Filter

The return line filter cleans the oil, as it enters the reservoir. It is located on the top of the reservoir. This filter is mounted on the return line connected to the reservoir.

The return line filter element has a media rating of ISO 16/14/12. This high rating meets the fluid cleanliness required for servo control valves.

Particles that are trapped by the return line filter are collected in the filter element. This element is disposable. Do not attempt to clean it.

The return line filter is equipped with a bypass valve. The bypass valve opens when there is a pressure drop of 25 psi (or more) across the filter element. When the valve is open, oil flows directly into the reservoir. It does not flow through the filter. This prevents the element from collapsing during cold oil start-ups or if it is clogged.

If the filter becomes clogged, oil will flow directly into the reservoir through this valve. The lack of oil filtration will eventually cause serious damage to hydraulic components.

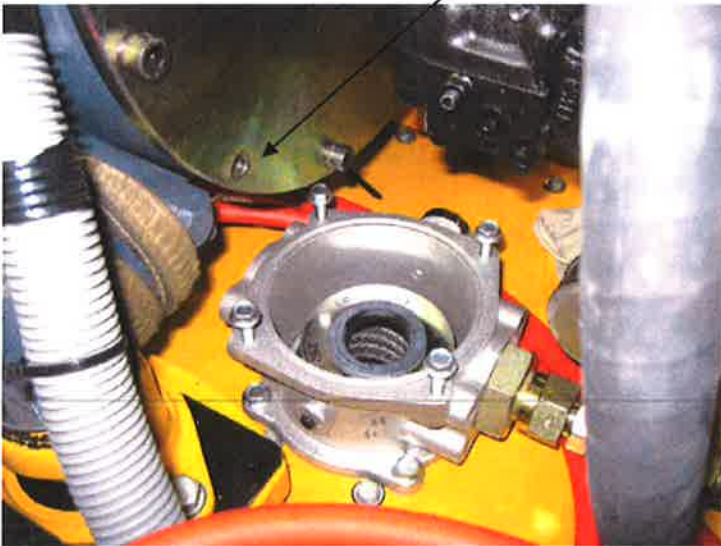
During the initial start-up period of a new machine, the hydraulic components will deposit run-in wear particles in the return line filter. **Change the return line filter element after the first 25 hours of operation.** Thereafter, check the status of the filter on the indicator every 250 engine hours of operation. When the indicator is in the yellow or red area, it is time to change the element. Also, replace the filter element after new oil has circulated through the system for the first time.

Replace the return line filter element with a genuine Posi-Plus replacement part. Other filters may fit into the filter housing, but it may not have the same filtration rating. Also, other filters may allow oil to bypass at a different rate.

Procedure to remove the return filter

Access the filter head from the space between the pumps and the manual controls, rear of the motor.

- Unscrew the four (4) bolts of the filter's cover and turn the cover to remove it.
- Unscrew and remove one bolt of the pump retaining plate (refer to picture below).
- Pull on the filter cartridge, it should come out freely. If not, you could have to push the motor a little bit on its rubber shock absorbers to have more room.



Charge pump filter

The charge pump filter is installed on the main hydrostatic pump which has an integral charge pump. The filter should be removed and replaced every 1000 engine hours, whenever the hydraulic oil is changed, and at any other time it has collected dirt or other foreign matter. If the filter is not replaced, it will become clogged. The arms drive will not work properly, if the oil does not flow properly via the charge pump filter. If the hydrostatic pump and the charge pump do not receive sufficient oil flow, they will be badly damaged.

Hydraulic Oil Specifications

Use high quality prefiltered oil in the hydraulic system. The oil should contain rust, oxidation and corrosion inhibitors. It should also contain anti-foam and anti-wear additives.

Check the oil level in the reservoir with the trailer leveled. The electric oil level gauge is located in the controls compartment. The oil level arrow indicator should be between Min. and Max. Don't overfill the reservoir. When the arms are in their full unloaded position, the oil level will increase and oil will leak from the filler breather cap of the reservoir, if the oil level is too high.



CHARGE PUMP FILTER

Typical brands that meet the recommendations for this unit are listed below. Most major companies can supply equivalent oils.

Cold Weather Oils (Below 32°F)

Imperial Oil Univis J13
Shell Tellus T15 (preferred)

All Weather Oils

Imperial Oil Univis Extra or Univis 22
Shell Tellus T 22 (preferred)

Warm Weather Oils (Above 68°F)

Mobil DTE 13
Shell Tellus T32 (preferred)



OIL LEVEL GAUGE

The hydraulic oil characteristics needed for a Posi-Plus cable handler are no different from those required for other brands of cable handlers. If long term experience with particular oil on other cable handlers has been satisfactory, consider using it for the Posi-Plus unit. If the cable handler has the same type of pump and pressures, you can expect similar results of the Posi-Plus cable handler.

Section 5 – Hydraulic system

General Operation

The hydraulic schematic applicable to this unit is included in the Parts Manual. The flow and pressure adjustments of all the functions are indicated on the hydraulic schematic.

The 1400 cable handler has two (2) separate hydraulic circuits. These circuits use separate hydraulic pumps, which are fed by the same hydraulic tank.

The **main hydraulic circuit** feeds only the reel driver motors on the arms. This circuit is a closed loop circuit. The hydraulic pump is a variable displacement hydrostatic pump that is controlled by a remote electric control. The pump displacement is controlled by the radio controlled joystick and is proportional to the joystick's displacement.

The maximum hydraulic pressure that can be applied to this hydrostatic circuit is approximately 5200 PSI. This maximum pressure can only be attained with the reel "Pay-in" function. In that case the reel drive can produce the maximum torque. With the "Pay-out" function, the maximum pressure is limited to approximately 2500 PSI.

The **auxiliary hydraulic** circuit on this unit is a more conventional circuit supplied with a variable displacement, pressure compensated, load sensing pump. This hydraulic circuit is used to operate all of the other functions on the unit. These functions are the carriage arms Load/Unload, the carriage arms lateral displacement In/Out, the outriggers, the capstan drive, the nose wheel motor, steering and lift cylinder, and the tool outlet.

The carriage arms 'Load/Unload', as well as the nose wheel motor and the capstan drive 'Pay in/Pay out' functions are fully proportional, via the remote radio control joysticks. When one of these functions is operated, the remote radio control joystick displacement provides an equivalent proportional pilot spool displacement on the proportional coil which in turn sets the spool valve position accordingly. This spool section regulates both, the flow to the function and the pressure 'sensed' on the function line. The pump compensator adjusts the flow produced by the pump at the pressure sensed in the circuit at that moment. This is the phenomenon of pressure compensation, the flow requested by the function activated is maintained whatever the pressure in the circuit.

The pressure compensator of the pump is set at approximately 3000 PSI, while the load sense standby pressure is adjusted to approximately 290 PSI.

All of the other functions on this second circuit are 'On/Off' functions. When any 'On/Off' function is activated, the hydraulic pump automatically provides the full flow set by the function activated.

External Leakage

If components and connections are installed properly, leakage can be kept to a minimum. Small external leaks are usually easy to find because dust will collect on the hydraulic oil film.

External hydraulic leakage is leakage of hydraulic oil to the environment outside the hydraulic system. Fittings that are improperly tightened are a primary cause of external leakage. Keep all hydraulic connections tight to prevent external oil leakage. Follow the torque and tightening specifications explained in this section under "Hoses, Tubes and Fittings" to properly tighten hydraulic fittings.



Caution

Hydraulic oil escaping under pressure from a faulty connection, hose, pinhole, cracked tube, etc. may not be visible, but can have enough force to penetrate the skin and inject oil into the flesh. Never use your hands, or any body parts, to check hydraulic lines and fittings for leaks under pressure that are not visually obvious.

In case of injury by escaping hydraulic oil, seek medical attention at once. Serious infection or reaction can result if medical attention is not given immediately.

Keep the unit and work areas clean. Spilled hydraulic oil creates slick surfaces and may cause personnel to slip and/or fall.

If a connection is properly tightened but continues to leak, disassemble the connection. Seal the necessary parts and/or replace the part that is the source of the leakage.

Worn or damaged parts also may cause leakage. For example, scratched cylinder rods will cause leakage. A worn or scratched output shaft on a hydraulic motor will also cause leakage. Such conditions must be repaired or replaced. The parts should also have a new seal.

Internal Leakage

Internal leakage allows pressurized hydraulic oil to escape to tank or another hydraulic circuit.

Internal leakage can cause a variety of problems in a hydraulic system. Internal leakage in a cylinder can cause drifting or malfunction of a cylinder. Leakage past a holding valve in a cylinder can also cause drifting or malfunction of the cylinder.

Internal leakage can usually be stopped by replacing the seals in the leaking component. It may also be stopped by replacing the holding valves in the component.

However, there are some types of damage, such as scoring of the inside of a cylinder barrel, that require more extensive repair.

Only qualified and trained professionals are permitted to remove scratches from the inside of the cylinder barrel.



Warning

If the internal size tolerance of the cylinder barrel is exceeded, the piston seal could be pushed out (extruded) when the cylinder is put under a load. This will cause cylinder failure. Cylinder failure may result in property damage and/or personal injury.

The component drawings in the Parts Manual give the Posi-Plus part number for the seal kits. Posi-Plus does not recommend disassembly and/or repair of cylinders in the field. Disassembly and repair of such components must be performed by skilled mechanics who are trained and qualified by Posi-Plus Technologies Inc. in these procedures. Repair and disassembly must be done in a clean, properly equipped shop.

Cylinder piston nuts and end glands must be torque to the proper values at assembly. Torque specifications for cylinder end glands and piston nuts are given on the component drawings in the Parts Manual. Many piston nuts and end glands have retention devices, such as cotter pins and setscrews. These retention devices must be installed properly.

Heat Generation

Internal leakage allows pressurized hydraulic oil to escape to tank. This creates excessive heat in the system. The amount of heat in the system has a direct relationship to the pressure and volume of leakage.

If excessive heat occurs, find and correct the cause immediately. Overheating reduces the operating efficiency of the cable handler. It may cause functions to stop working. It damages seals throughout the system. Heat also shortens the life of the hydraulic oil.

The following conditions cause heat generation:

- Excessive pump speed during high flow operations;
- Worn or faulty pump;
- Defective relief valve cartridge or faulty pump compensator;
- Contaminated spool in a control valve;
- Low hydraulic oil level;
- Improper hydraulic oil;
- Internal leakage in the functions selector valve

Hydraulic Components

The Posi-Plus 1400 cable handler may be equipped with some standard options selected and/or additional customer equipment. This section will deal with the current standard options available. **In each case, the applicable hydraulic schematic must be used as a guideline to confirm the hydraulic options selected on this unit and the necessary adjustments.**

Some hydraulic terms are used in the text below. The term "position" is used to describe the number of possible positions of a lever, a spool valve, an actuator or a switch. For example, the control lever used to operate an outrigger can be positioned in three (3) different positions, in the neutral position, there is no action. In the "up" position the outrigger will be retracted. In the "down" position, the outrigger will be extended.

Another term used is "way". The hydraulic term "way" describes the number of orifices (or ports) in a valve section or manifold. For example, a valve section with four (4) ways will have four working ports. One (1) port will be used for the inlet (pressure), another port will be used for the oil outlet (return) and the other two (2) ports will be used to supply the oil to a double acting actuator (i.e. motor or cylinder).

Hydraulic pumps

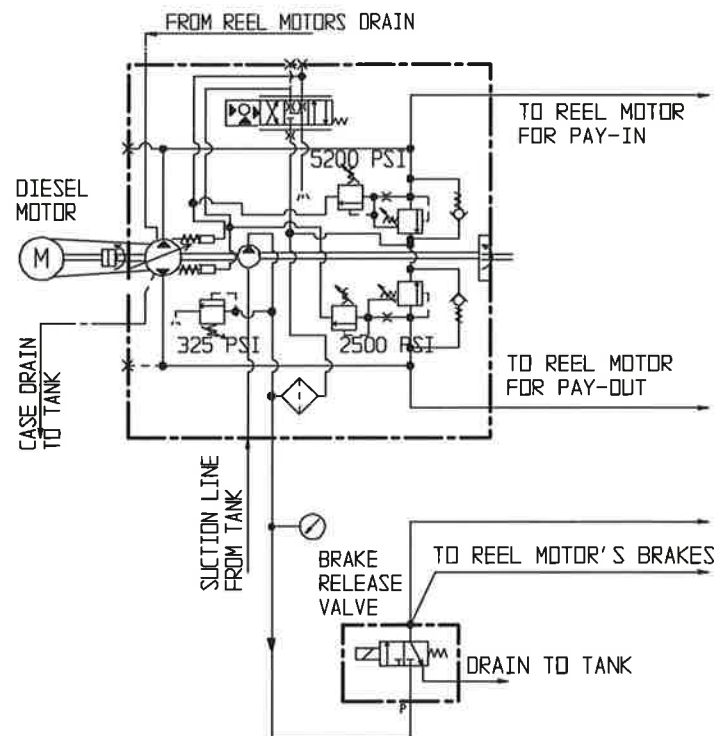
Circuit #1

The pump of the #1 hydraulic circuit is a variable displacement hydrostatic pump direct coupled to the engine. An electric displacement control integrated to the pump adjust the flow of the pump. The pump displacement is controlled by the radio control joystick and is proportional to the joystick's displacement. The pump displacement is infinitely adjustable between zero and maximum displacement. The flow direction is reversed by tilting the swash plate to the opposite side of the neutral (zero displacement) position.



The maximum hydraulic pressure that can be applied to this hydrostatic circuit is approximately 5200 PSI. This maximum pressure can only be attained with the reel "Pay-in" function. In that case the reel drive can produce the maximum torque. With the "Pay-out" function, the maximum pressure is limited to approximately 2500 PSI.

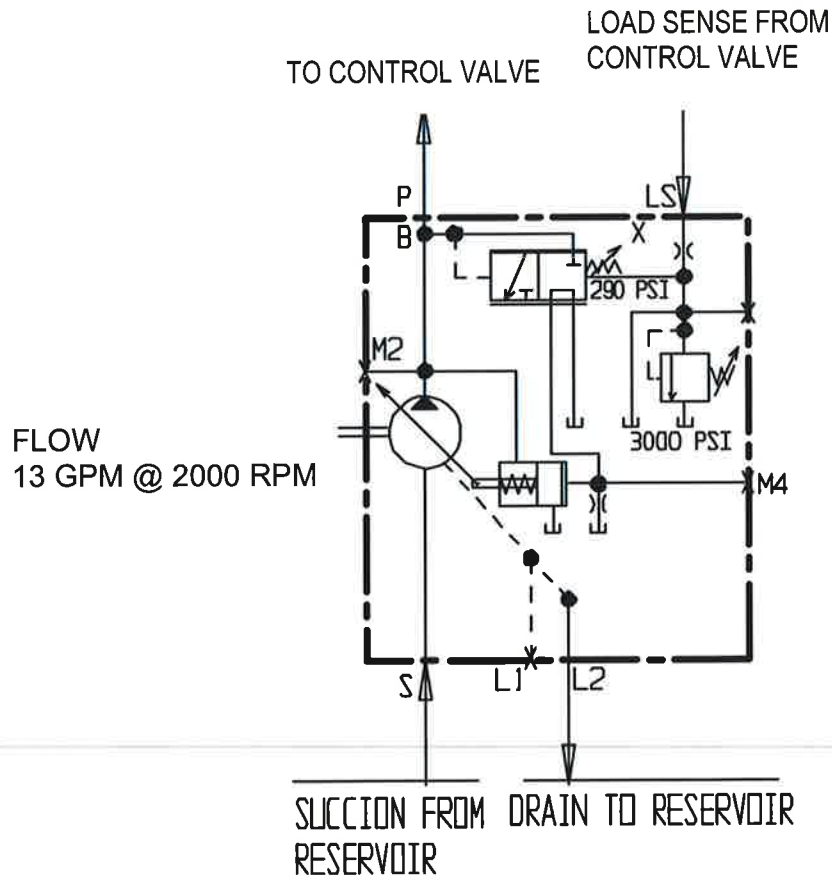
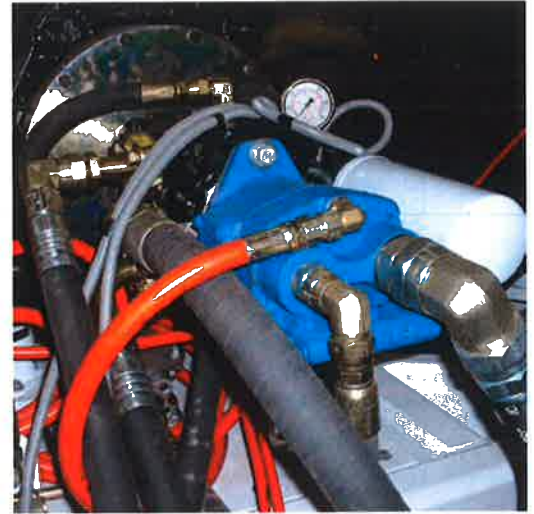
The pump of the circuit #1 includes a charge pump, which maintains a positive pressure in the main circuit and provides flow and pressure for the control system. This circuit has its own filter installed on the side of the pump. This filter assures the cleanliness rate of the oil needed for a precise pump displacement control. This charge circuit is also used to release the brakes on the reel drive motors. The charge pump is set to 325 PSI to pressurize the hydrostatic circuit at all times.



Circuit #2

The circuit #2 has a variable displacement, pressure compensated, load sensing pump. This pump is directly coupled to the circuit #1 pump for the drive.

The **pressure compensator control** is designed to limit the maximum pressure in the hydraulic circuit by varying the output flow of the pump. This type of control is typically used with closed center valves. When system pressure at the pump outlet drops below the compensator setting, the control will increase the pump displacement to maximum (maximum output flow). Once system pressure reaches the compensator setting, the control regulates pump displacement to produce an output flow which limits system pressure to the compensator setting.



Hydraulic Pumps Start-Up

If one of the pumps has to be repaired or replaced, call your Posi-Plus representative and ask for complete pumps start-up instructions. The hydrostatic main pump has a different start-up procedure than the standard auxiliary piston pump. The start-up of the main pump closed circuit requires specific steps to avoid cavitation on pump or reel drive motors. The repair and start-up must be done only by competent and qualified personnel.

Important: Before attempting to start the auxiliary pump, make sure that the main hydrostatic pump is ready to be started.

Care

Cavitation and aeration are two problems that can cause pump and reel drive motors damage. However, pump or reel drive motors damage can be prevented or minimized by promptly finding the source of the problem and repairing it.

Pump and reel drive motors cavitations occur when inlet oil does not entirely fill the cavities that open during the intake part of the pumping or drive cycle. The characteristic sound of cavitations is a high-pitched scream. This sound increases with the degree of cavitations and increased flow. The following is a list of possible causes of cavitations:

- Excessive pump or motor operating speed;
- Low oil level;
- Clogged suction filter;
- Excessive oil viscosity (thickness);
- Restrictions, sharp bends or excessive length of inlet hose;
- Pump inlet too high above reservoir level;
- Shutoff valve in suction line not fully open.



Attention

Cavitations can very quickly destroy the pump. If you notice signs of pump cavitations, determine the cause of the problem. Promptly repair the problem.

If you have pump cavitations from excessive oil viscosity because of cold temperature, allow the oil to warm up at a slow pump speed.

Aeration is another condition that can damage the pump. Aeration occurs when air bubbles are introduced into the hydraulic oil and carried along as the oil flows through the pump. Aeration can be caused by the following conditions:

- Low oil level in the reservoir. This causes a whirlpool at the suction line opening, which sucks air into the system along with oil.
- Leaking connections in the suction line between the reservoir and the pump.
- Return line outlet is located above the oil level in the reservoir. This causes turbulence as the return oil stream discharges above the surface of the oil.



Attention

Promptly repair conditions that allow air to enter the suction side of the pump. Serious pump damage is likely to occur if the pump continues to run with air circulating through it.

An air leak in the suction line can occur even if there is no oil leakage when the system is shut down. A leak in the suction line can often be located by slowly squirting clean hydraulic oil around each connection in the suction line. Do this with the pump running at normal operating speed. A suction leak will suck the oil in, and the pump may temporarily run quietly as the oil seals the air leak. The leak can then be eliminated.

When aeration is occurring, the oil in the reservoir is likely to become foamy. The pump may also become noisy.

Loose pump mounting bolts can permit misalignment of the pump shaft. This may lead to excessive shaft seal wear and bearing failure. Check the mounting bolts for tightness every 125 engine hours.

In case of catastrophic pump failure, the hydraulic system must be flushed. Flushing the hydraulic system will remove most of the metallic contamination from the system.

Pump flow output test

A slow down in functions movement may indicate a worn or faulty pump. To determine the full flow output of the pump, perform the following steps:

1. Install a tee fitting on the pressure line of the pump. Connect the other port of the tee fitting to a flow meter. The flow meter should then be connected to tank.
2. For the circuit #1 pump, operate the function "Reel Pay-in" and observe the reading on the flow meter. It should read approximately 29 GPM at 2000 engine RPM. For the circuit #2 pump, operate the function "Capstan Pay-in" and observe the reading on the flow meter. It should read approximately 13 GPM at 2000 engine RPM. If pump flow is much less than the above flows, then the pump may be faulty or worn out. **Always refer to the applicable hydraulic schematic for the pump flow applicable to this unit.** Determine the cause of the problem. Repair or replace the pump.

“Tensioning” and “Freewheel” control valves

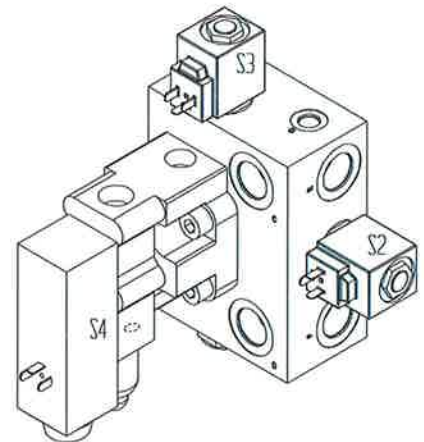
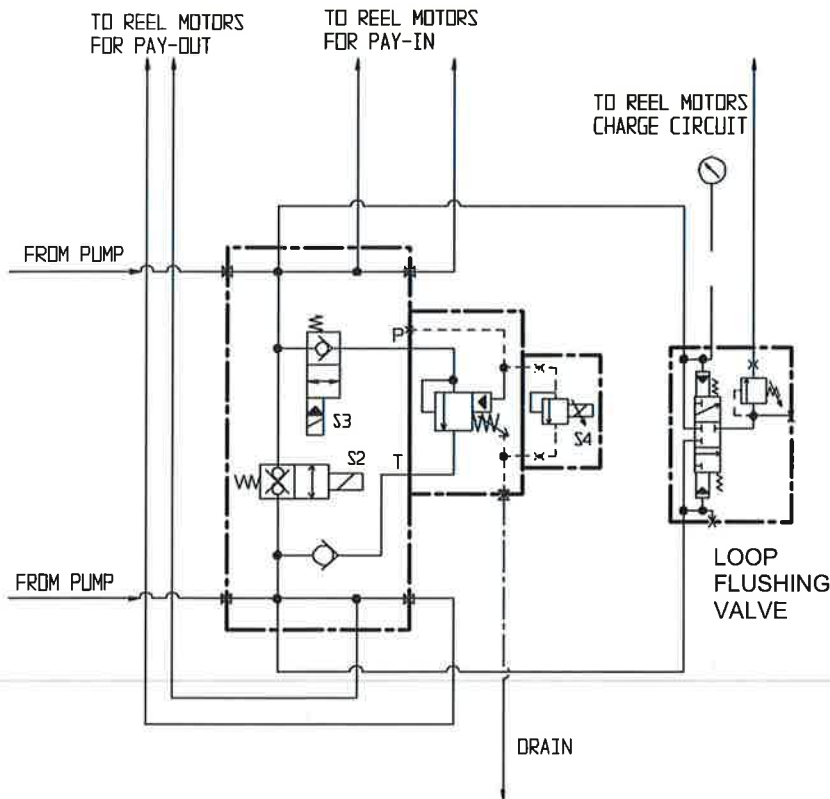
A manifold with three (3) solenoid valves is located under the Circuit #2 control valve, between the subframe rails. This assembly of valves allow to select the operation of tensioning on the reel and the freewheel function.

The manifold has three (3) solenoid valves. The first solenoid valve (S2) controls the freewheel function, which allows the oil to circulate between the motors. The second solenoid valve (S3) open the tensioning circuit. The third solenoid valve (S4) is proportional and allows to increase or decrease the pressure setting of the tensioning circuit.



When the “Freewheel” function is selected on the radio remote control, the solenoid S3 is energized and open the tensioning circuit. When the “Freewheel/Tensioning” turning knob is set to 0%, the solenoid S2 is energized and open the freewheel circuit. When the knob is turned from 1 to 100%, the solenoid S2 is de-energized and the solenoid S4 is proportionally energized to vary the pressure setting. When the Freewheel/Tensioning function is selected, the Brake release valve solenoid (S5) is also energized to release the brakes on the reel motor drives (not shown).

Located above this valve is a loop flushing valve, this control is self operating and allows the oil to freely circulate in the motors charge circuit.



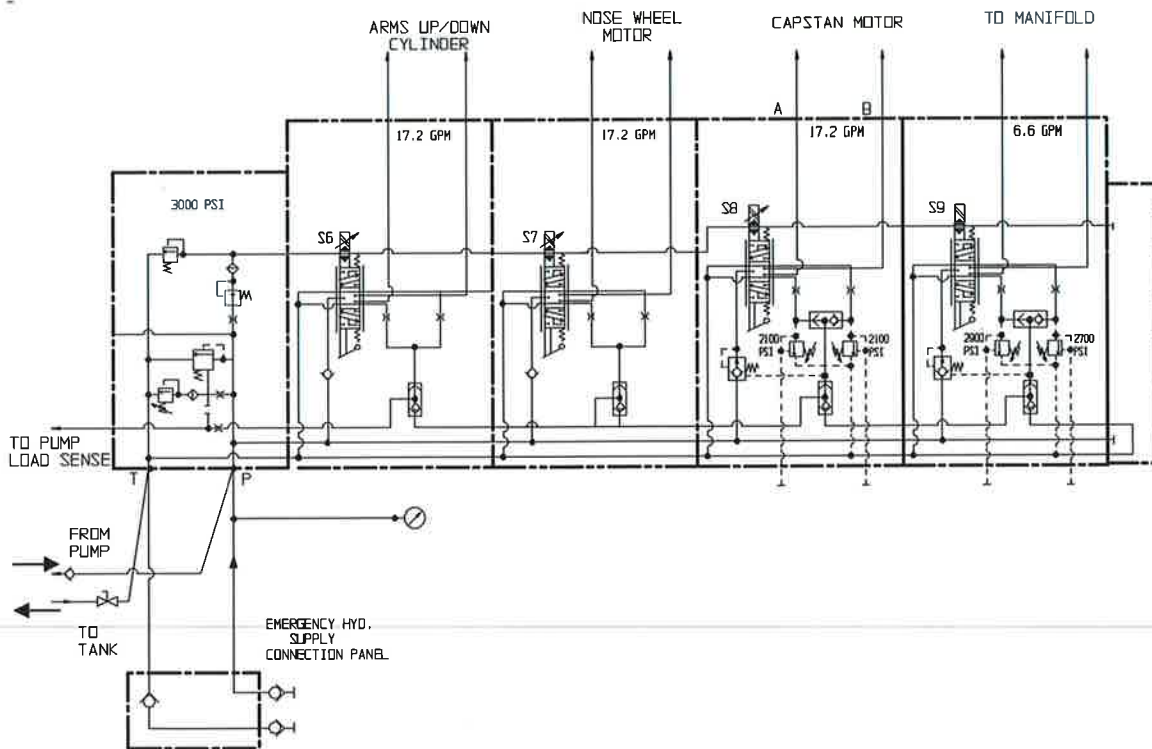
Circuit #2 control valve

The circuit #2 valve is a Danfoss four (4) spools valve with electro-hydraulic controls. The functions are activated from the remote radio control and the valve is also equipped with levers for manual operation to be used in case of emergency or maintenance only.



The Danfoss valve has five sections. The first section includes a relief valve adjusted to 3000 PSI and a load sense circuit going to the pump. The second section has a proportional solenoid and controls the arms lift cylinder. The third section has also a proportional solenoid and controls the nose wheel drive motor. The fourth section has also a proportional solenoid, controls the capstan functions and includes two (2) relief valves limiting the operating pressure of the capstan to approximately 2100 PSI. The fifth section has an "On/Off" (not proportional) solenoid and controls the other functions grouped on the 8 functions manifold described on next page, the valve include two (2) relief valves and the spool stroke is limited to set the flow at approximately 6.6 GPM.

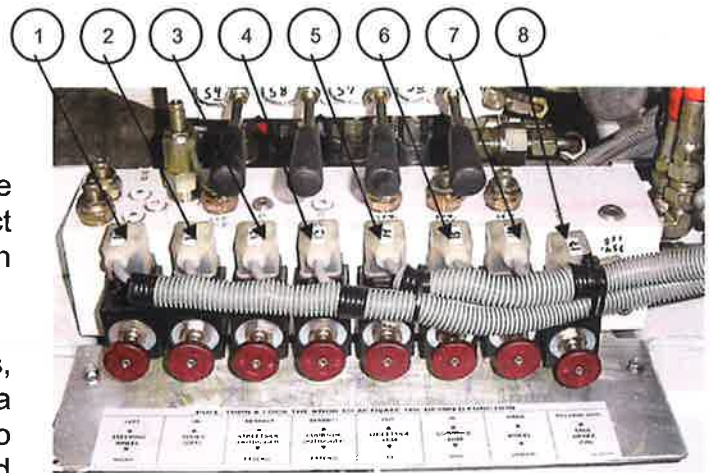
An emergency supply manifold allows to operate the functions with an auxiliary external hydraulic power unit. A shut off valve has to be closed on the return line when using this circuit. A pressure gauge indicates the operating pressure of the different functions of circuit #2. Refer to page 5-18 for flow and pressure adjustment.



8 functions manifold - circuit #2

The 8 functions manifold is located under the circuit #2 control valve and allows to select the function to be operated from the fourth spool of the Danfoss control valve.

The manifold has eight (8) solenoid valves, two (2) positions. Each solenoid valve has a push and turn lock button allowing to manually select the function to be operated for emergency or maintenance only.



The #1 solenoid valve select the steering motor and two (2) flow controls limit the steering speed for accurate driving.

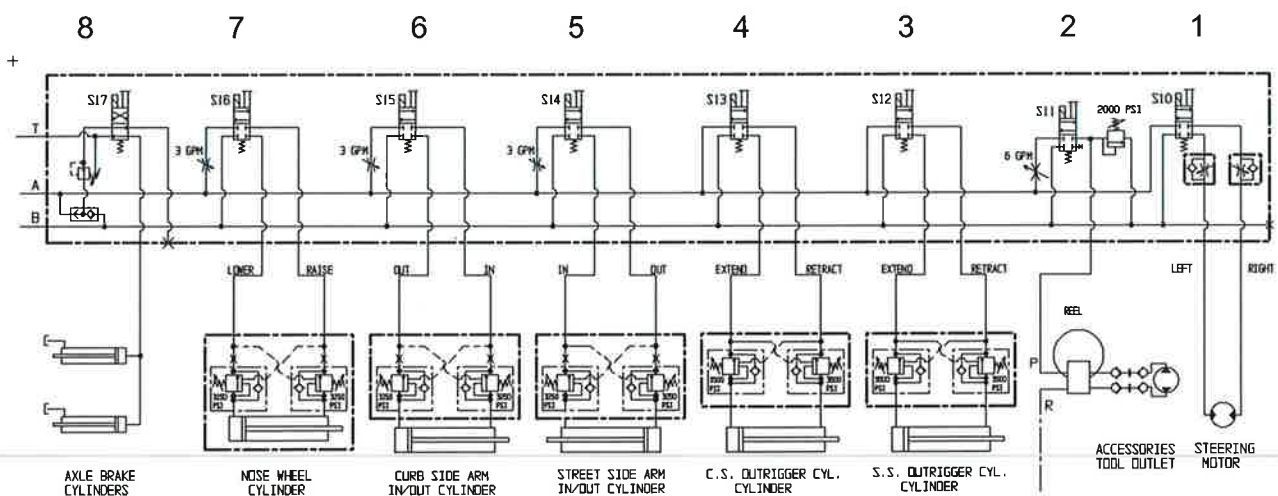
The #2 solenoid valve select the tool circuit. Adjustable relief valve and flow control limit the pressure to 2000 PSI and the flow to 6 GPM. Refer to pages 5-17 and 5-18 for adjustment details.

The #3 and the #4 solenoid valve select the outriggers on streetside and curbside at the full pump operating pressure and at the control valve flow setting.

The #5 and #6 solenoid valve select the "In" and "Out" function of the streetside or curbside arms. Two (2) flow control cartridges are limiting the operating flow to 3 GPM.

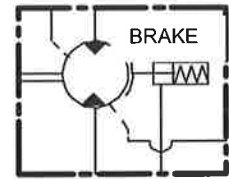
The #7 solenoid valve select the nose wheel cylinder and one (1) flow controls limits the speed of the wheel lower and raise functions.

The #8 solenoid valve select the axle brake cylinders and a pressure reducing valve limits the pressure to release the spring applied brake.



Automatic brake on motors

The reel drive motors have spring applied disk brakes. The brakes are designed to maintain the total load being applied on the motors when the function Pay-in or Pay-out is not activated in the event of a hose failure.



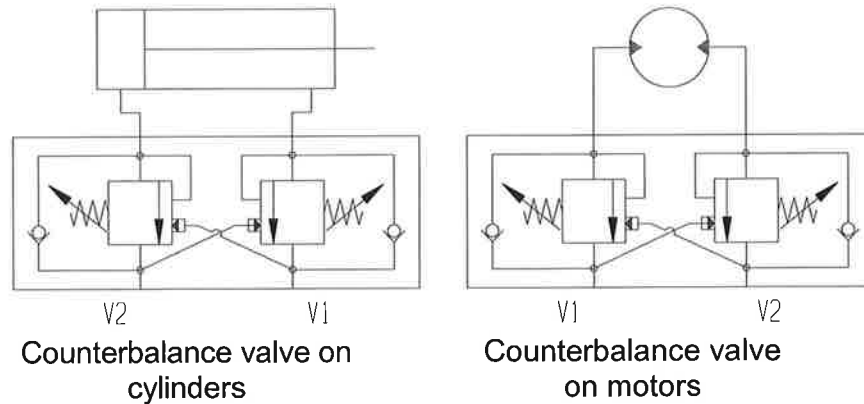
When the function Pay-in/Pay-out of either the reel driver or the traction winch is activated, a solenoid valve is energized and a pressure of approximately 325 PSI releases the disk brake of the motors selected.

Counterbalance Valves

Counterbalance valves are used to block flow out of the reel loader cylinders, the outrigger cylinders, the capstan drive motor, the nose wheel motor, the nose wheel cylinder and the arms opening cylinders.

A counterbalance valve is a combination of a check valve and a relief valve. The check valve allows free flow into the cylinder and blocks the flow from coming back out. The relief valve function can be piloted open to allow flow out of the function. It also allows the valve to relieve excess pressure and prevents damage from thermal expansion of the oil.

The counterbalance valves installed on the arms opening cylinders are installed in pairs and are cross-ported. This means that the oil sent to one side of the cylinder is used to pilot open the counterbalance valve for the other side of the cylinder.



Hydraulic System Adjustments

The following sections describe testing and adjustment procedures for the components of the hydraulic system.

When using a gauge to test the pressure or flow of a particular circuit, use a well-calibrated gauge. A calibrated gauge will provide an accurate reading, which is essential for proper hydraulic adjustments.

Valve Cartridge Installation

When installing a valve cartridge into a valve body, it must be tightened to the proper torque value. Tightening the cartridge to less than the specified torque value may lead to leakage. Tightening the cartridge over the specified torque value will cause damage to the valve or valve body. A damaged valve may not perform its intended job properly.

To properly install a valve cartridge, lubricate the threads and O'rings with clean hydraulic oil from the same system. Use the chart in Table 5.1 to determine the correct torque value for the cartridge that you are installing.

Wrench Size	Cartridge Fitting Size	Torque (ft. lbs.)
7/8"	-8	20
1"	-10	25
1-1/8"	-10	25
1-1/4"	-12	35
1-1/2"	-16	50
2"	-20	65

Table 5.1 - Valve Cartridge Torque Chart

Counterbalance Valves

A counterbalance valve provides a positive lock against hydraulic flow or leakage until it is opened by pressure from a control valve.

The counterbalance valves assures that the cylinder will maintain its position even if there is hydraulic hose failure.

Do not attempt to disassemble a cartridge in the field. Counterbalance valve cartridges should only be disassembled by the cartridge manufacturer.

Removing a Counterbalance Valve

Before removing a counterbalance valve, the cylinder must be fully unloaded. The following steps describe how to remove a counterbalance valve:

1. Position the outriggers or the arms to remove any load.
2. Stop the engine and operate the controls in both directions until the pressure is removed in the lines.
3. Slowly and carefully unscrew the cartridge from its housing. It is very important to do this slowly to allow the pressure to bleed off before the cartridge is fully removed from the cylinder.

A counterbalance cartridge on the reel loader cylinder may contain significant internal trapped pressure for some time after it is operated. This is due to having a counterbalance valve on both the extend and retract sides of the cylinder. The rush of oil past the cartridge seals as the cartridge is fully unscrewed may blow one or more of the seals off the cartridge. If this happens, obtain the proper cartridge seal kit and replace the seals before installing the cartridge.

Do not allow dirt, water or other foreign matter to enter the holding valve cavity when the cartridge is removed.



Warning

Failure to fully unload the actuator, or position it so that it cannot move, before removing a counterbalance valve can result in sudden, uncontrolled movement of the actuator and/or arms. This may result in personal and/or property damage.



Caution

Hydraulic oil escaping under high pressure from a faulty connection, hose, pinhole, cracked tube, etc. may not be visible, but can have enough force to penetrate the skin and inject oil into the flesh. Never use your hands, or any other body parts, to check hydraulic lines and fittings for leaks under pressure that are not visually obvious.

In case of injury by escaping hydraulic oil, seek medical attention at once. Serious infection or reaction can result if medical treatment is not given immediately.

Keep the unit and work areas clean. Spilled hydraulic oil creates slick surfaces and may cause personnel to slip and/or fall.

Testing and Adjustment

The preferred method of counterbalance testing is to use a test block equipped with a well-calibrated pressure gauge.

Place the counterbalance valve in the appropriate test block. Connect a port-a-power or other hydraulic pressure source to the valve. Apply pressure to test the check valve, relief valve and pilot operation of the valve. The relief function can be adjusted by loosening the jam nut and turning the adjusting screw counter clockwise to increase the setting and clockwise to reduce the setting.

The counterbalance valves for the different actuators are factory set to the values given in Table 5.2, and should not be adjusted in the field. If the setting on a counterbalance valve has been changed, the cartridge must be removed and adjusted with a test block or replaced.

Function	Adjustment
Reel loader cylinder	5000 PSI
Arms opening cylinders	3250 PSI
Outriggers cylinders	3500 PSI
Nose wheel cylinder	3250 PSI

Table 5.2 – Counterbalance valve adjustment



Caution

Do not attempt to adjust a counterbalance valve without a test block. Using a test block and pressure gauge is the only accurate way to determine that the proper setting has been obtained.

Alternate Test Methods

The counterbalance valves may be tested for proper holding by loading the function protected by the counterbalance valve. Turn the engine off and move the manual control handle on the main control valve to connect that function to tank. If the function moves, the counterbalance valve is leaking and must be replaced or reset using a test block.

Tool Circuits

Different tool circuit's options are available. The single tool outlet is adjustable in pressure and flow. The following pressure and flow adjustments are the standard preset. **Always refer to your hydraulic schematic for the options installed and for their control valves' adjustments.**

Tool Circuit – Pressure adjustment

For units with the optional tool circuit, a pressure-reducing valve controls the tool pressure. This valve is located on the 8 functions manifold of the circuit #2.

Testing the pressure

1. Shift the tool control toggle switch to the "On" position.
2. Check the reading of the gauge. The gauge should read 2000 PSI. If the pressure reading is above or below this value the pressure reducing valve cartridge needs adjusting.

Adjustment

1. Turn the engine off.
2. Loosen the jam nut on the pressure-reducing valve. Turn the adjusting screw with an Allen wrench. Turning the screw clockwise will increase the pressure. Turning the screw counterclockwise will reduce the pressure.
3. Tighten the jam nut and start the engine. Check the pressure gauge reading again. If necessary, repeat Step 2 until the pressure gauge reading is 2000 PSI.



Warning

Do not adjust the pressure of the tools circuit above the hydraulic power tools manufacturers' rating for the tool that is to be used. Hydraulic pressure above the tool pressure rating may cause the tool hoses to burst and/or the tool to rupture. This may result in hydraulic oil escaping under pressure. Hydraulic oil escaping under pressure can have enough force to inject oil into the flesh.

In case of injury by escaping hydraulic oil, seek medical attention at once. Serious infection or reaction can result if medical attention is not given immediately.

Keep the unit and work areas clean. Spilled hydraulic oil creates slick surfaces and may cause personnel to slip and/or fall.

Tool Circuit – Flow adjustment

For units with optional tool circuits, a flow regulator valve controls the tool flow. This valve is located on the 8 functions manifold of the circuit #2.

Testing

1. Connect a flow meter to the tool outlets. Start the engine.
2. Move the tools control toggle switch to the "On" position.
3. Check the reading on the flow meter. The flow meter should read 5 GPM (plus or minus 10 percent). If the reading is above or below this value, the flow can be adjusted.

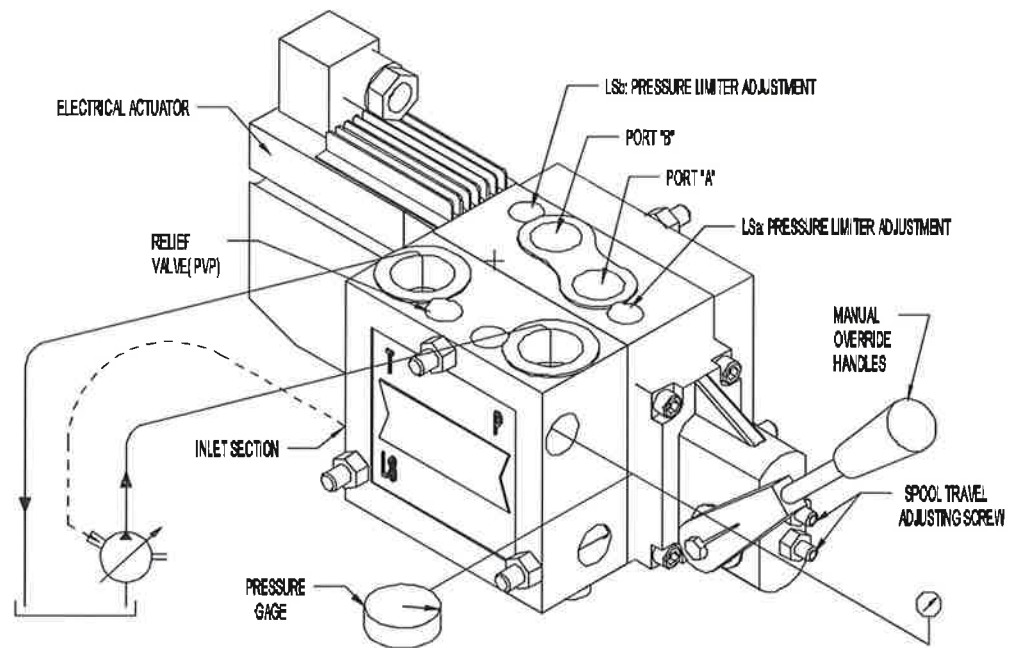
Adjustment

The tool circuit flow is adjustable by turning the cartridge screw in to decrease or out to increase the flow.

Danfoss Valve – Pressure and Flow adjustment

The accessories control valve section (the fourth section) has a limited flow. This flow can be adjusted by limiting the spool travel with the 2 screws on top of the handle control box.

The capstan and accessories control valves have relief valves which are adjustable with an Allen set screw near the A and B ports.



Hoses, Tubes and Fittings

Fittings and hose are used to connect various components of the hydraulic system.

Fittings

Most hydraulic ports and fittings are SAE straight thread O'ring or 37 degree flared JIC straight thread. These types of fittings provide a good seal. They also resist vibration.

Hoses

Inspect all hoses every 125 engine hours. Inspect the hoses for wear and physical damage. Make sure they are routed to avoid sharp edges, kinking and scuffing.

Hose identification

Most hoses have a lay line on them. The lay line contains the following information about the hose.

- Manufacturer's name
- Manufacturer's part number
- SAE rating
- Working pressure
- Burst pressure (sometimes)
- If the hose is nonconductive, the word "nonconductive" appears on the hose

Hose Replacement

It is very important that hoses be replaced only with hoses of the same type and size. Replacement fittings, lines, tubes, etc. should be the same type and size that were furnished with the unit. Before replacing a hose or tube with a different diameter part, consider the effect it will have on the hydraulic system. If hose size is doubled, four times the amount of fluid will increase. The increase in back pressure will cause heat to build up in the system. When replacing a hose, it is best to use a hose of the same size and length. If there is any doubt concerning the proper hose to be used for replacement, contact your POSI-PLUS service representative.

When disconnecting lines or removing parts, plug all ports and lines. This will prevent contaminants from entering the hydraulic system. It also prevents damage to the sealing surfaces and fitting threads.

 **Warning**

Never grasp a pressurized hose or tube. Make sure all pressure is removed from a hydraulic circuit before disconnecting a line or fitting.

Remove all pressure from a hydraulic circuit before disconnecting hydraulic lines or fittings.

 **Caution**

Failure to remove all pressure from a hydraulic circuit will cause oil to spray out under pressure as the connection is loosened. Hydraulic oil escaping under pressure can have enough force to penetrate the skin and inject oil into the flesh.

In case of injury by escaping hydraulic oil, seek medical attention at once. If medical treatment is not given immediately, serious infection or reaction can result.

Keep the unit and work areas clean. Spilled hydraulic oil creates slick surfaces and may cause personnel to slip and/or fail.

Torques and Tightening Procedures

Tube and fitting abuse is one of the major causes of leakage in a hydraulic system. Be sure to use the proper torque and tightening specifications when installing a hydraulic fitting, as this will reduce the possibility of leaks in the system. Caps and plugs should be used during the handling and storage of hydraulic components to prevent damage to sealing surfaces and fitting threads.

Overtorquing a component most often will distort the part and cause leakage. Thinking that if fitting leaks, tightening it a little more will solve the problem is not always correct. When you find a fitting that is leaking, first check to see if it is tight. If it is not tight, torque it to the correct value. If the fitting is tight, stop the unit, determine the cause of the leak and take corrective action to solve the problem. The following instructions describe proper torque and tightening specifications for various types of hydraulic fittings.

Installation of Tapered Thread (Pipe Thread) Fittings

1. Clean the male threads of the fitting with a cleaning solvent.
2. Apply pipe sealant to the male threads of the fitting. Do not apply sealant to the first two male threads. Apply enough sealant so that a ring of sealant will form on the outside of the connection when the threads are tightened into the mating body.
3. Screw the fitting into the mating part and finger tighten.
4. Turn the fitting with a wrench the appropriate turns from finger tight (T.F.F.T.), taking the final position of the tube end into consideration (refer to Table 5.3).

Size	T.F.F.T.	Size	T.F.F.T.
-2	2.0 - 2.5	-12	1.5 - 2.0
-3	2.0 - 2.5	-14	1.5 - 2.0
-4	2.0 - 2.5	-16	1.5 - 2.0
-5	1.5 - 2.0	-20	1.5 - 2.0
-6	1.5 - 2.0	-24	1.5 - 2.0
-8	2.0 - 2.5	-32	1.5 - 2.0
-10	2.0 - 2.5		

Table 5.3 - T.F.F.T. Torque Chart

5. Follow the sealant manufacturer's directions for cure time. The ring of sealant described in Step 2 will not completely harden due to its exposure to air.

Installation of SAE O'Ring Fittings With Lock nuts

1. Lubricate the O-ring with hydraulic oil or light grease such as petroleum jelly.
2. Screw the fitting into the SAE straight thread boss until the backup washer bottoms on the boss face with the O'ring squeezed into the boss cavity.
3. Unscrew the fitting (maximum of one full turn) in order to align the fitting with the mating part.
4. Tighten the locknut with a wrench and torque to the proper value for the size and material (stainless steel or steel) so the backup washer contacts the boss face.

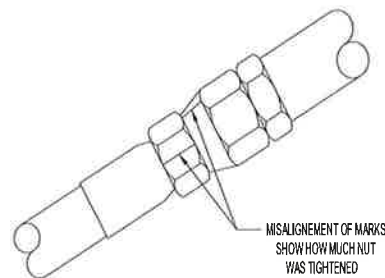
Installation of Tube Fittings and JIC Fittings

1. Clean the male threads of the fitting with a cleaning solvent.
2. Tighten the nut finger tight until it bottoms out on the flare seat.
3. Using a felt tip pen or marker, mark a line lengthwise on the nut and extend it onto the adapter body.
4. Using the Table 5.4, determine the correct number of hex flats the nut must be turned with a wrench. Using a wrench to hold the adapter body, rotate the nut with another wrench the correct number of hex flats.

Nominal Tube Size	Fitting Size	Rotate Number of Hex Flats
1/4"	-4	2-1/2
5/16"	-5	2-1/2
3/8"	-6	2
1/2"	-8	2
5/8"	-10	1-1/2 to 2
3/4"	-12	1
1"	-16	3/4 to 1
1-1/4"	-20	3/4 to 1
1-1/2"	-24	1/2 to 3/4

Table 5.4 - Hex Flat Torque Chart

5. The marks made in Step 3 are used to count the correct number of hex. flats that the nut must be turned. The marks also serve as a visual indicator that the fitting has been tightened correctly.



Marks Used to Count Hex Flats

Installation of Compression Fittings

1. The tubing should be cut to length, allowing for bend, equipment movement, etc.
2. The brass insert should be fitted into the nylon pilot tubing with the flanged end out. The insert should fit snug in the pilot tubing. The color coded 5/16" O.D. tubing requires the use of an insert.
3. With the threaded end of the compression nut facing the fitting body, slide the nut onto the nylon tubing, followed by the compression sleeve.
4. The tubing can now be inserted into the fitting body. Making sure the tubing rests firmly on the shoulder of the fitting, hand tighten the compression nut. Tighten the compression nut the correct number of turns as indicated in the Table 7.6.

Tube size	Fitting Size	Turns Required to Seal from Finger Tight
1/8" thru 1/4"	2 thru 4	1-1/4
5/16"	5	1-3/4
3/8" thru 1"	6 thru 16	2-1/4

Table 7.6 - Compression Fitting Torque Chart



Attention

Do not overtighten as damage to nut and threads will occur. To ensure a proper seal, do not reuse fitting body or compression nut if over tightening has occurred.

Section 6 –Electrical System

General operation

Electrical power is used on the cable handler to operate the radio control system and to operate different solenoid valves and controls.

The voltage levels of this system are based on a constant vehicle power source of 12 Volts DC. Voltage may vary from 10.2 Volts to 13.8 Volts and still be considered normal.



Even with 12 volts, severe arcing can occur. Use caution when working with any electrical device.

Electrical Components

The inter-wiring of the electrical components and their wiring to various valves, switches and relays installed by Posi-Plus are shown in the wiring line diagrams in the Parts manual. The major electrical components are also described in this section.



To prevent electrical shock, turn the truck ignition switch off to remove the power supply to the control box before servicing.

The electrical components are:

- Radio remote control
- Radio control receiver or transceiver
- Junction panel for cable handler functions located in curb side compartment
- Engine control
- Oil and fuel level gauges
- Engine batteries
- Inverter (option)

Radio remote control and receiver

Caution: It is not permissible to use a defective radio system. A defective radio control system may only be repaired by qualified and competent personnel.

The radio system is largely maintenance free. The following items should nevertheless be taken into account:

- Make sure the Emergency-Stop push button moves easily.
- Inspect the rubber bellows of the compact joysticks regularly for leak-tightness.
- Never clean the transmitter or the receiver with a pressure or with a steam cleaner.
- Refer to the Operator's manual for more information.

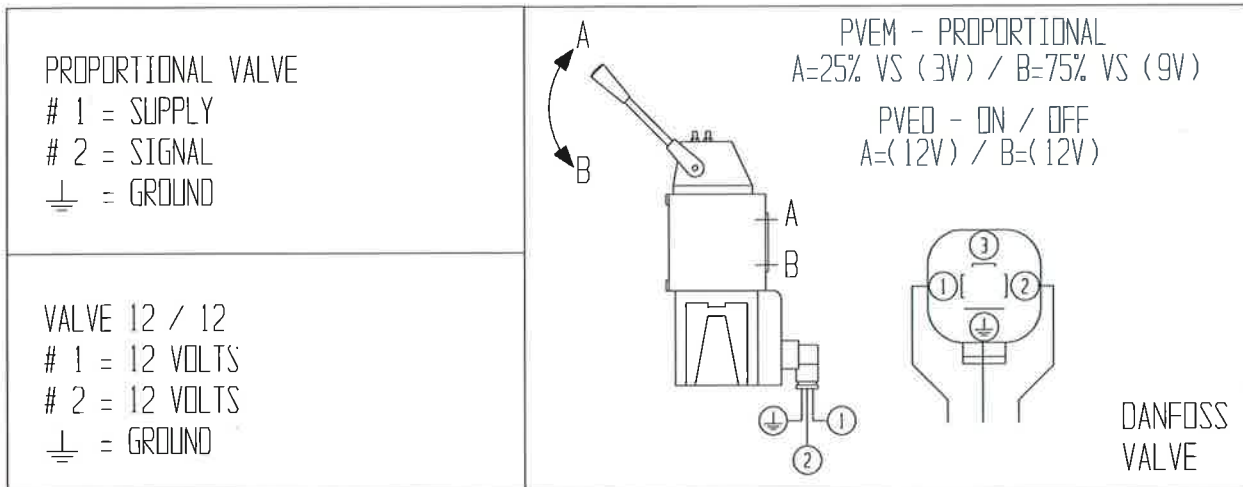


Danfoss control valve

The Danfoss valve has four (4) sections with electrical actuator controlling the spools.

Three (3) functions have a proportional solenoid, the arms up/down, the nose wheel forward/reverse and the capstan cw/ccw. On these three solenoids, the neutral supply voltage of the joystick that should be read on the solenoid DIN connector is 12 Volts. When the function is activated from the joystick, the signal reading will be 6 Volts down to 3 Volts when the lever is fully shifted to the 'A' position and 6 Volts up to 9 Volts when the lever is fully shifted to the 'B' position.

The other solenoid is an On/Off solenoid and the reading will be 12 Volts when the function is operated.



If the signals are not good at the Danfoss solenoid connector, refer to the schematic and check for the voltages found at the corresponding terminals in the electric junction panel and check for loose wires or short circuits in the harnesses.

Cable handler functions panel

The cable handler functions panel is located in the curbside compartment. This panel includes the relays and terminal boards for the connections between the radio receiver and the different cable handler control valves and the engine controls.



The harness from the radio receiver is connected to the I/O controller and to the terminal boards. From these boards, the wiring goes to the different relays and then back to the terminal boards. From there, different harnesses go to the different control valves and to the panel for the engine controls.

The engine controller shown on the picture is the engine controller for the standard engine. The engine controller for the optional engine will differ. Refer to the optional engine manual for more details.

The periodic maintenance for this panel is to check for loose wires, tight connections, loose relays on their base and rust on components.

Inverter (option)

The unit could also be equipped with a 12 Volts DC to 120 Volts AC inverter. In that case, the electricity could come from the vehicle battery or from an auxiliary battery located in one of the front compartment. The auxiliary battery will be charged from the vehicle alternator but isolated from the vehicle electrical system.

The inverter produces an alternating current of 120 Volts, 60 Hz. The capacity can vary as per the customer specifications.

A schematic of the inverter installation is included in the cable handler parts manual. Refer to the inverter service manual for information on maintenance.

