



HPU150 Accu-Steer Hydraulic Power Unit

Owner's Operation, Installation & Maintenance Manual



January 2020

NOTES:

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

RECORD DATA BEFORE INSTALLATION FOR FUTURE REFERENCE

Model #:	
Serial #:	
Date of Purchase:	
Date of Installation:	

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1 INTRODUCTION

1.1 CONTACT

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This document is intended to clearly present comprehensive product data and provide technical information to assist the end user in design applications. Kobelt reserves the right, without notice, to change the design, or construction, of any products and to discontinue or limit distribution of any products. Kobelt also reserves the right to change, or update, without notice, any technical information contained within this document.

Kobelt recommends that customers visit our website to check for updates to this Manual. Once a product has been selected for use, it should be tested by the user to ensure proper function in all possible applications. For further instructions, please contact our distributors or visit our website.

1.2 SAFETY

1.2.1 Safety Alerts

Throughout this manual, the following symbols, and their accompanying explanation, are used to alert the user to special instructions concerning a service or operation that may be hazardous if performed incorrectly or carelessly. The associated risk levels are stated below.

 DANGER	This symbol indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	This symbol indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 CAUTION	This symbol indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
NOTICE	This symbol informs the reader of events not related to personal injury but which there is a risk of damage to property or equipment.
SAFETY INSTRUCTIONS	This symbol informs the reader of safety-related instructions or procedures.

1.2.2 Notice to Installer

Disregarding the following safety measures can result in an accident causing severe injury to personnel and damage to material assets.

- Only use the product as directed in this manual.
- Never put the product into service if there is evidence of visible damage.
- Never put the product into service before fully completing installation and commissioning.
- Do not carry out any modifications to the product.
- Only use authentic Kobelt spare parts.
- Observe all local regulations, directives and laws during the installation of this product.
- All installation, commissioning, and maintenance work must only be conducted by qualified personnel. (For the purpose of this manual, qualified personnel are persons who are familiar with the assembly, installation, commissioning, and operation of the product and who have the qualifications necessary for their occupation.)
- Observe all specifications in this manual. If these guidelines are not followed and damage occurs, the warranty will be voided.

1.2.3 Product Hazards



WARNING

High Pressure Operation: This HPU unit generates high pressure hydraulics. Ensure all power sources are locked out prior to performing work.



WARNING

Equipment Starts Automatically: HPU units are controlled remotely and may activate suddenly causing bodily harm. Ensure all power sources are locked out prior to performing work.



WARNING

Disconnect Power: Turn off power at distribution panel before beginning installation to protect installer from electrical hazards.



CAUTION

Voltage and Current Compatibility: Confirm that the power source is compatible with the maximum voltage and current ratings of is product variant. Failure to do so could result in damage or fire.

2 PRODUCT DESCRIPTION

The Accu-Steer HPU150 pumpset is a continuous running pumpset designed to interface hydraulic steering systems with electric or autopilot control. As described the motor runs continuously when started and the output oil is directed to the port or starboard line by operating the four-way solenoid valve mounted on the pumpset. Its compact and rugged construction provides ease of installation along with long life operation. This unit is available in both 12 VDC and 24 VDC configurations.

This pumpset is suitable for vessels from 20' (6 m) to 75' (23 m) in length depending on the vessels steering characteristics. Proper pump selection and application is very important to optimize steering performance and pump longevity.

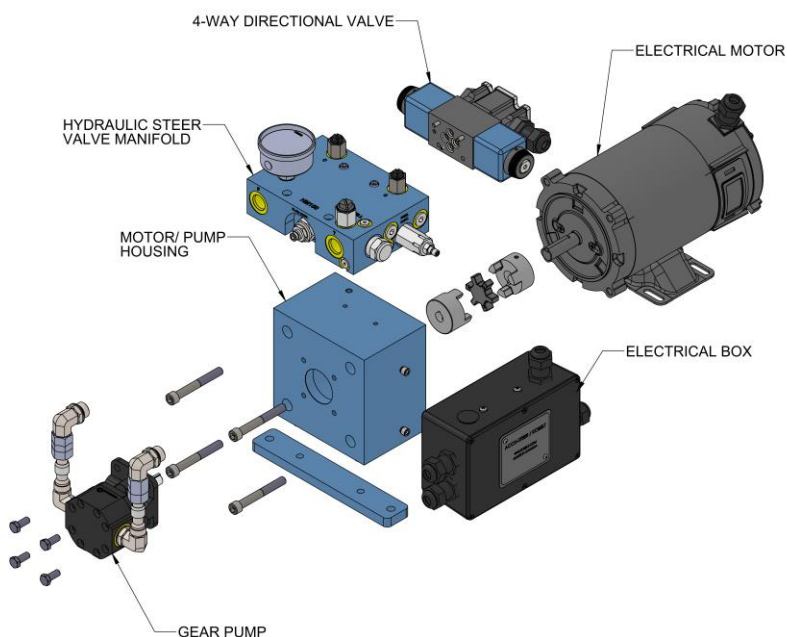


Figure 1: HPU150 Overview Diagram

2.1 COMPONENTS

The Accu-Steer HPU150 Pumpset is a complete assembly consisting of an electric motor with control box, gear pump, hydraulic control manifold and heavy-duty adapter mount. As the pump unit is self-contained, installation involves connecting the pump to the steering lines and the electrical control and adjusting the unit to the requirements of the vessel.

2.1.1 Electric Motor

The electric motor is a heavy-duty totally enclosed unit featuring high efficiency permanent magnet construction, oversized brush gear with easy access, and standard foot and face mountings. The electric motors are available in both 12 VDC and 24 VDC voltages.

The electric control box on DC motors provides for remote start and thermal protection along with large terminals for easy connection.

2.1.2 Gear Pump

The gear pump is a compact rugged unit which features a cast iron case, hardened steel gears and a high-pressure shaft seal.

2.1.3 Hydraulic Manifold

The hydraulic manifold features the following;

- Pressure Relief Cartridge
- Adjustable Flow Control
- Pressure Gauge
- Valve housing anodized aluminum with oversized porting

2.1.4 Motor/Pump Housing

This coupling interfaces all components of the pumpset as well as provides a stable foot mount. The unit is machined to ensure accurate coupling of the motor and pump. It houses the flexible drive coupling, which transfers energy from the motor to the pump. The flexible drive coupling provides quiet vibration-free alignment. It is constructed of anodized aluminum.

2.2 TECHNICAL SPECIFICATIONS

Table 1: HPU150 Technical Specifications

MODEL	HPU150-12	HPU150-24
KOBELT P/N:	600-130	600-131
NOMINAL VOLTAGE	12 VDC	24 VDC
MOTOR MAX. CURRENT	39 A	20 A
MOTOR WORKING CURRENT	20 A	12 A
SOLENOID MAX. CURRENT	2.5 A	1.3 A
INTEGRATED STARTER RELAY	Yes	
THERMAL CIRCUIT BREAKER	40 A	20 A
MAX. OUTPUT	1.5 GPM [5.68 Lit. /min.]	
MAXIMUM ALLOWABLE PRESSURE	1000 PSI [70 bar] 50 PSI [3.4 bar]	
<ul style="list-style-type: none"> A & B PORTS T PORT 		
RELIEF PRESSURE	600 PSI [41 bar]	
SERVICE DUTY	Intermittent: 20% ON / 80% OFF	
RECOMMENDED FLUID	ISO VG 32, VI 60 Hydraulic Oil	
PORT SIZE AT MANIFOLD BODY	-06 SAE ORB	
PORT ADAPTERS	-06 SAE ORB TO 1/4" NPT	
OPERATING TEMPERATURE	14°F to 122°F [-10°C to 50°C]	
PRODUCT WEIGHT	56 lbs [26 kg]	

2.2.1 Pressure Range

The normal operating pressure of the unit is 0 to 600 psi. Avoid operating the unit against the rudder stops for prolonged periods of time.

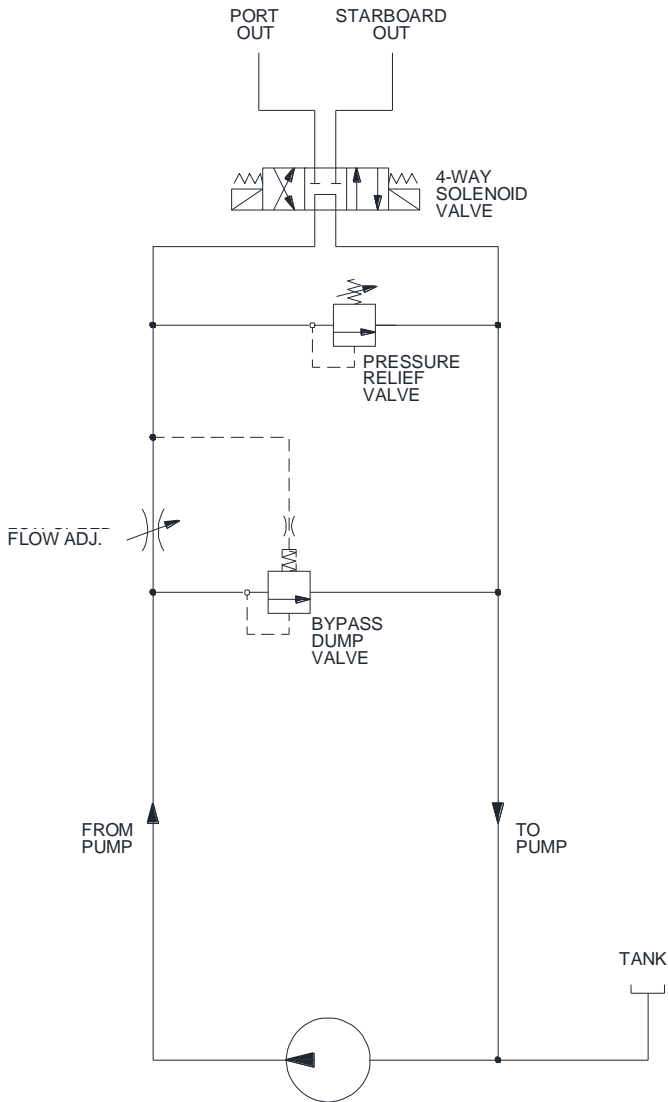


Figure 2: Hydraulic Schematic

3 INSTALLATION

3.1 MECHANICAL

The pumpset must be placed on a horizontal bracket with a solid foundation. It's better to be close to and below the steering lines for ease of connections and bleeding.

The HPU150 is equipped with (2) two clearance holes for 3/8" bolts and (4) four holes for 5/16" bolts through the mounting feet. Ensure that the unit is securely fastened to a suitable foundation.

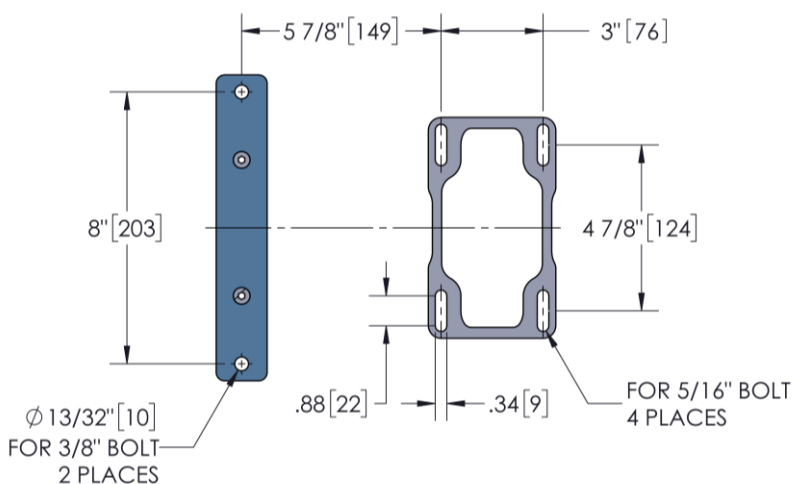


Figure 3: HPU150 Series Mounting Pattern

3.2 HYDRAULIC

Three hydraulic connections are required to the pump set. Two lines connect the main port and starboard steering lines. The third line is connected to the header tank or helm pump. This line compensates for thermal expansion of the oil and self bleeds air from the system.

The port and starboard lines should be flexible hose with a pressure rating of approx. 1500 psi working pressure.

Flexible hose (min. 250 psi pressure rating) is recommended for the fill/interconnect line. The hose should be minimum 3/8" inner diameter (1/2" is better). Shut-off valves are strongly recommended for all three lines to provide isolation in case of emergency.

NOTICE

Ensure the plugs remain in place until the unit is ready for connection.

NOTICE

All piping and hoses must be flushed prior to connection. Failure to do so can result in damaged components and seals.

The two hydraulic ports on the valve block are fitted with 3/8" NPT (National Pipe Thread) adapters. If preferred, the adapters can be removed, and connections can be made directly to the valve blocks -06 SAE ORB ports. When installing the hydraulic fitting in the 3/8" NPT port a pipe thread sealant such as Teflon paste must be used.

NOTICE

All hoses and piping must also be plugged or capped until ready for connection.

The piping to the steering cylinder should be 3/8" nominal size and no more than 1/2" with a suitable wall thickness to safely withstand the operating pressure. The Port and Starboard steering lines should have a pressure rating of 1000 psi minimum. Secure the piping against vibration with pipe clamps spaced every 3 feet [1 m].

The connections to the hydraulic manifold must be made by hoses of suitable rating to accommodate any movements, vibration or thermal strain.

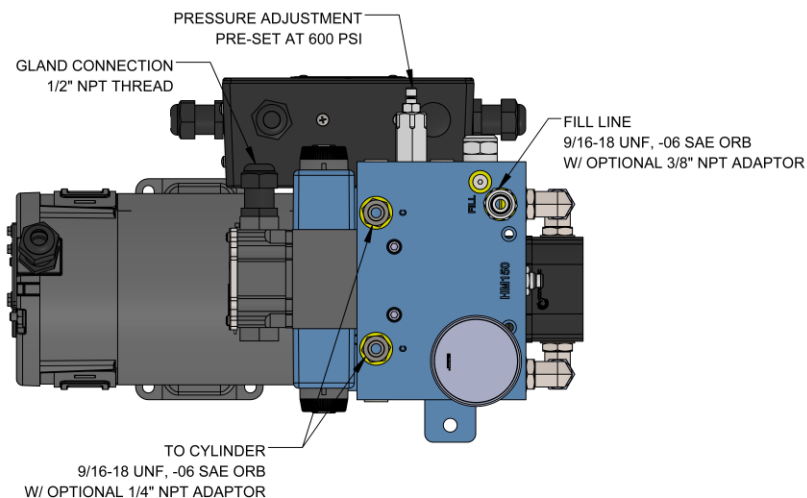


Figure 4: Connections in Top Face of Hydraulic Manifold

Three (3) hydraulic connections are required:

- Connect ports 'CYLINDER' to the (2) two steering cylinder ports. It is not critical to identify which of the steering lines is Port or Starboard as most new autopilots will determine the pump direction and program the drive outputs to suit.
- Connect the 'FILL LINE' to Helm Pump case or Header Tank.

3.3 ELECTRICAL

The pump unit is manufactured for operation from either 12 VDC or 24 VDC dependent on model number ordered. The Electrical Junction Box contains a remoter start relay (voltage dependent), a thermal overload breaker and a terminal strip for external connections. The DC start relay may be activated with a positive or negative switched signal.

Ensure that the electrical cable used to feed the main power to the motor of the HPU150 is sized properly to prevent voltage drop. Refer to ABYC or local boat electrical standards for applicable rating recommendations.

The solenoids use a common connection (Terminal 5) on the terminal strip and can be activated by a positive or a negative control signal. The Port and Starboard solenoid coils are connected to Terminals 6 and 7 respectively.

Some autopilots have a switched output or clutch/relay output that may be optionally used to operate the start relay.



DO NOT energize these solenoid coils detached from the valve.

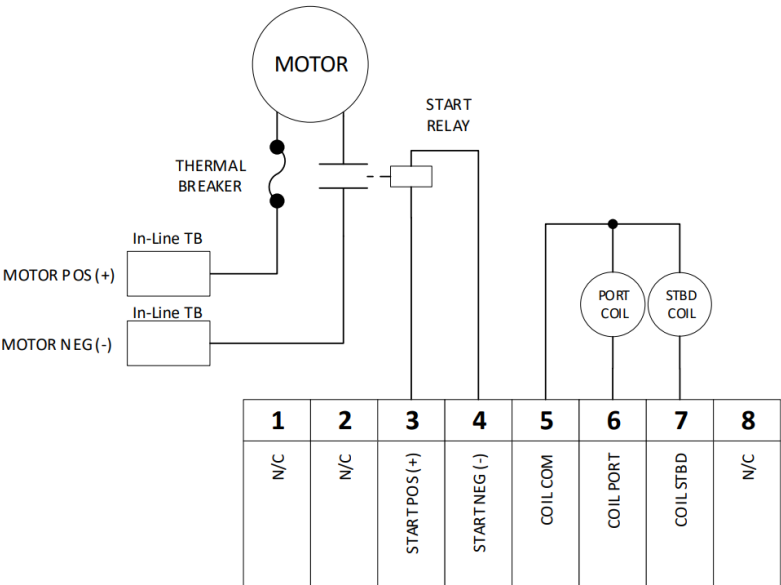


Figure 5: HPU150 Electrical Junction Box Internal Wiring

NOTICE

HPU150-12 contains a 20 A Thermal Breaker.
 HPU150-24 contains a 40 A Thermal Breaker.



Figure 6: "In-line Terminal Block" Provided for Motor Connections

Table 2: HPU150 Terminal Block Wiring Connections

HPU150 Series			
Terminal #	Wire Name	Wire Colour	Function
1	N/C	--	No Connection (N/C). Motor directly wired through in-line terminal blocks.
2	N/C	--	No Connection (N/C). Motor directly wired through in-line terminal blocks.
3	START POS (+)	Red	Positive control signal to starter relay to active motor and pump.
4	START NEG (-)	Yellow (or Black)	Control signal common (negative) to start relay to active motor and pump.
5	COIL COM	Green	Common Positive or Negative signal for solenoids coil control.
6	COIL PORT	Red	Positive or Negative signal for PORT direction solenoid coil.
7	COIL STBD	Black	Positive or Negative signal for STBD direction solenoid coil.
8	N/C	--	No Connection (N/C)

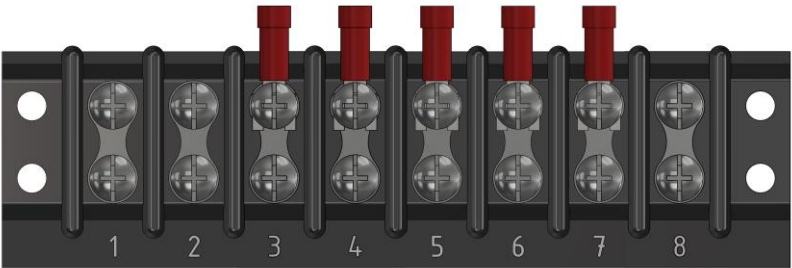


Figure 7: HPU150 Terminal Block Diagram

3.3.1 Example Connection Diagrams

The following section contains various example methods for connection of the HPU.

NOTICE

It is recommended that installation work is carried out by a Kobelt Partner, authorized service representative, or trained installation technician. Please contact the nearest Kobelt authorized distributor for assistance.

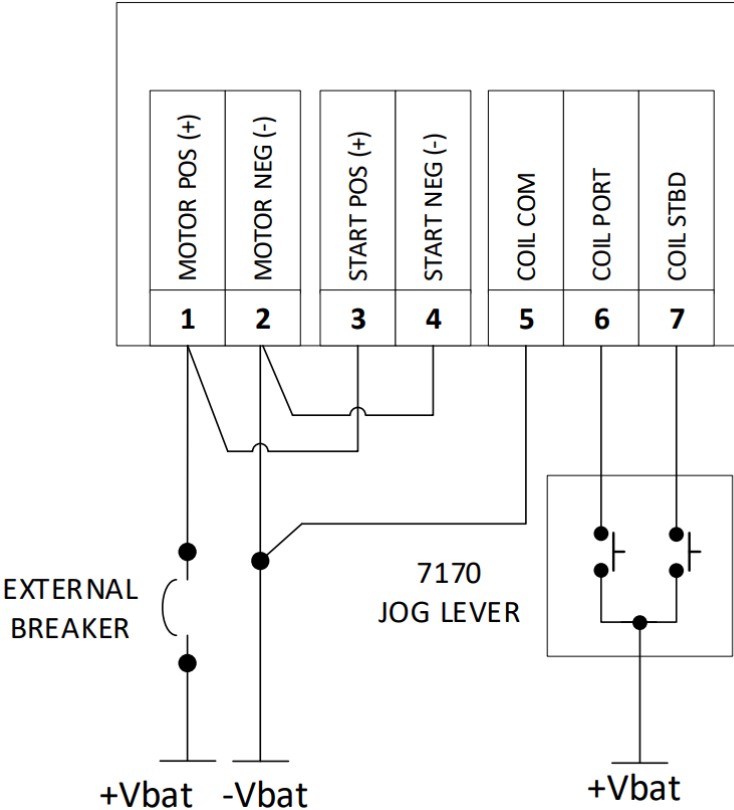


Figure 8: HPU150 Jog Control Diagram, Common Negative

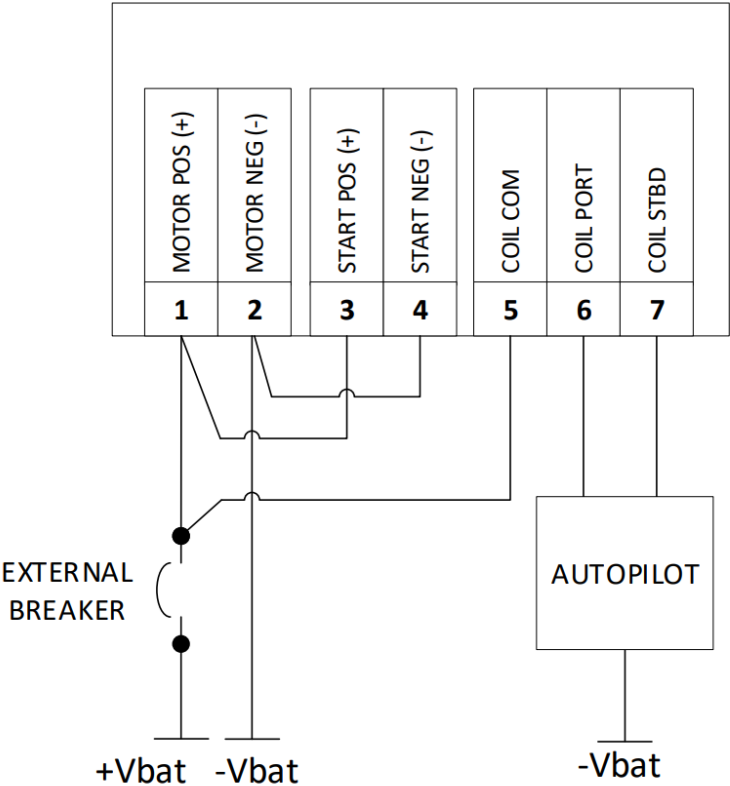


Figure 9: HPU150 Autopilot Wiring Diagram, Common Positive

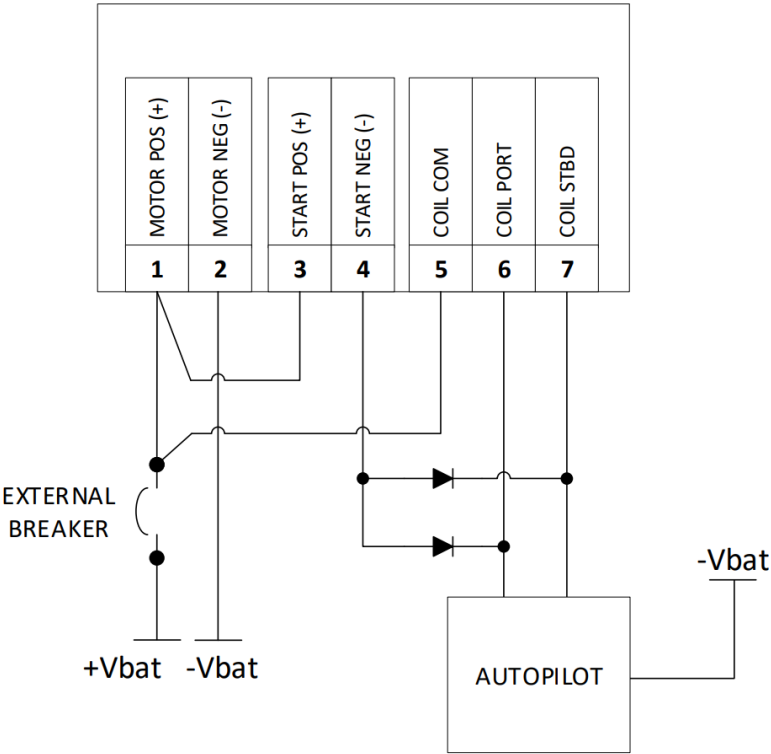


Figure 10: HPU150 Autopilot Connection Option with Starter Connections

4 COMMISSIONING

4.1 HYDRAULIC FILL & BLEED

After the hydraulic and the electrical connections have been completed, open all isolating valves and allow enough time for the pump and lines to fill with oil. Start the pump and observe the pressure gauge. There should be some pressure showing (approx. 40psi). If not, check the rotation of the pump motor (clockwise as viewed from the motor end). If the rotation is wrong check the polarity of the power connection to terminals 1 and 2. Terminal 1 is positive and terminal 2 is negative. Pump operation is tested in the factory.

Operate the 4-way solenoid valve to check that the port and starboard directions are correct. If they are wrong, reverse connections to Terminals 6 and 7. Check the hard over to hard over speed of the rudder and adjust the flow for the appropriate speed. Clockwise to decrease and counterclockwise to increase.

The pressure relief is factory set (approx. 600psi) and should not require adjustment.



CAUTION

The pressure relief is factory set at 600 psi and should not require adjustment.

4.2 ELECTRICAL CHECK



CAUTION

Ensure that the cover is installed and secured on the valve junction enclosure and all pigtail connections have been properly terminated and enclosed before powering on the HPU150.

Confirm that the electrical connections to the HPU150 have been made correctly and correspond to the requirements of your system installation.

4.3 FUNCTIONAL TEST



The Function Test should be carried out while the vessel is still at dock and before it is taken out to sea after installation has been completed.

After installation and filling perform the following function tests:

1. Power ON the autopilot (or electronic jog lever).
2. Active the autopilot (or electronic jog lever) to command motion.
3. Verify that the rudder position changed.
4. Set the autopilot to the manual mode and operate the pump-set to determine if the Port and Starboard directions are correct.
5. If the rudder goes the opposite way than expected.
 - a. Reverse the two electrical leads between the coils and the autopilot.

NOTICE

Most new autopilot systems will perform this test during their dockside set-up procedures.

6. Operate the pump-set and note the “hard-over” to “hard-over” (HO to HO) time.
7. Verify that it is in the range of 10 to 16 seconds. Times outside of this range indicate a mismatched pump-set for the steering system.
8. Confirm the unit develops rated pressure during operation.

5 OPERATION

The HPU150 operates as follows:

- Manifold receives oil from pump, and outputs to steering lines. Output flow determining the speed of the rudder.
- Output flow is controlled by flow control valves.
- Pressure relief valve is factory set to approximately 600 psi.
- Excess flow is returned to tank via differential bypass valve.
- By energizing related solenoid on directional valve, flow will be sent to port or starboard.

6 MAINTENANCE

6.1 PREVENTATIVE MAINTENANCE

The brushes on the electric DC motor can be easily checked by removing the access plate and visually inspecting the brushes. Replace the carbon brushes as required and check the internal condition of the motor.

- Monthly (12 times per year)
 - Inspect connections for leaks.
- Quarterly (4 times per year)
 - Verify adequate oil level.
 - Visually inspect wire and cable insulation for splits or damage.
- Every (2) two years
 - Sample and analyze the oil in the steering lines.
 - Drain reservoir and clean out.

6.2 RECOMMENDED SPARE PARTS

As a minimum Kobelt recommends the following spare parts are on-hand:

Table 3: Recommended Spares

RECOMMENDED SPARES		
QTY	ITEM	KOBELT PART #
1*	HPU150 REPAIR KIT (12 VDC)	600-130-RK
	• Motor Repair Kit	
	○ Motor Brushes and Caps	7070-0007-RK
	• Pump Repair Kit	
	○ Shaft Seal and Bearing	7061-0005-RK
1*	HPU150 REPAIR KIT (24 VDC)	600-131-RK
	• Motor Repair Kit	
	○ Motor Brushes and Caps	7070-0008-RK
	• Pump Repair Kit	
	○ Shaft Seal and Bearing	7061-0005-RK

*Select appropriate kit to match voltage of model purchased.

When purchasing spare parts refer to Appendix B: Parts List at the back of this manual for Kobelt component Part Numbers.

Instructions for installation of replacement of brushes in Appendix F: Motor Brush Replacement.

Replacement In-Line Terminal Blocks can be ordered as Kobelt Part Number: 6009-0100.

NOTICE

It is recommended that any required service work on an Accu-Steer unit be performed by a factory authorized service representative. Please contact the nearest Kobelt authorized distributor for assistance.

7 TROUBLESHOOTING

If you encounter problems with the operation of your product, please refer to the troubleshooting suggestions before contacting Kobelt for assistance. If the steps below do not resolve your issue, please reach out either Kobelt directly or our Dealers in your area.

Table 4: Common Solutions

Problem (Issue encountered)	Cause (What it means)	Corrective Action (What to do)
Steering gear goes hard over	Short circuit in electrical wiring to solenoid	Test wiring and solenoid valve coils.
	Solenoid valve contaminated	Isolate lines, clean and/or repair the solenoid valve as required.
Steering gear does not respond	Solenoid not being energized	Manually operate the solenoid valve.
	No pressure on gauge. Bypass open.	1. Check if bypass valve opens due to contamination. 2. Check if flow valve open 3. Check drive coupling
Pump is noisy	Air is in system	Fill and bleed the hydraulic system to remove air.
Motor is running but not making pressure	Motor direction is not correct	Reverse motor wires.

8 WARRANTY

Kobelt Manufacturing Co. Ltd. ("Kobelt") warrants the Products and Parts manufactured by Kobelt to be free from defects in workmanship or material and that said products are designed mechanically and functionally to perform to specifications.

This warranty is effective providing:

- The equipment is used within the intended operating conditions and in accordance with Kobelt recommendations
- The equipment is installed according to equipment diagrams, specifications and recommendations which Kobelt has provided

This warranty becomes invalid if the factory supplied serial number has been removed or altered on the product. This warranty does not cover cosmetic damage or damage caused by an act of God, accident, misuse, abuse, negligence or modification of any part of the product. This warranty does not cover damage due to improper operation or maintenance, connection to inappropriate equipment or attempted repair by anyone other than an authorized Kobelt representative.

Upon identification of a potential issue or defect with a Kobelt Product or Part, the Warranty Applicant ("Applicant") must immediately contact Kobelt and describe the issue in writing, by letter, fax, email or other electronic conveyance. Kobelt will then assess the cause of the defect and determine warranty applicability and appropriate remediation.

If any part is found to be defective, Kobelt will replace said part FOB the Kobelt factory provided that any such defective part is returned by the Buyer with freight and applicable forwarding charges prepaid by the Buyer. Kobelt's sole obligation to the Applicant will be to repair or replace the defective part with same or similar product, to a maximum value of the list price of the product or part. The Kobelt warranty does not cover labour charges, travel or any other associated expenses.

All Products and Parts manufactured by Kobelt, are subject to a warranty against manufacturer's defects in materials or workmanship for a period of two (2) years from the date of purchase.

Kobelt will be responsible for all Products or Parts sold by Kobelt but manufactured by 3rd party manufacturing companies. However, these products and parts are subject to applicable 3rd party warranties and may not be the same as the Kobelt warranty.

9 APPENDIX A: INSTALLATION DIMENSIONS

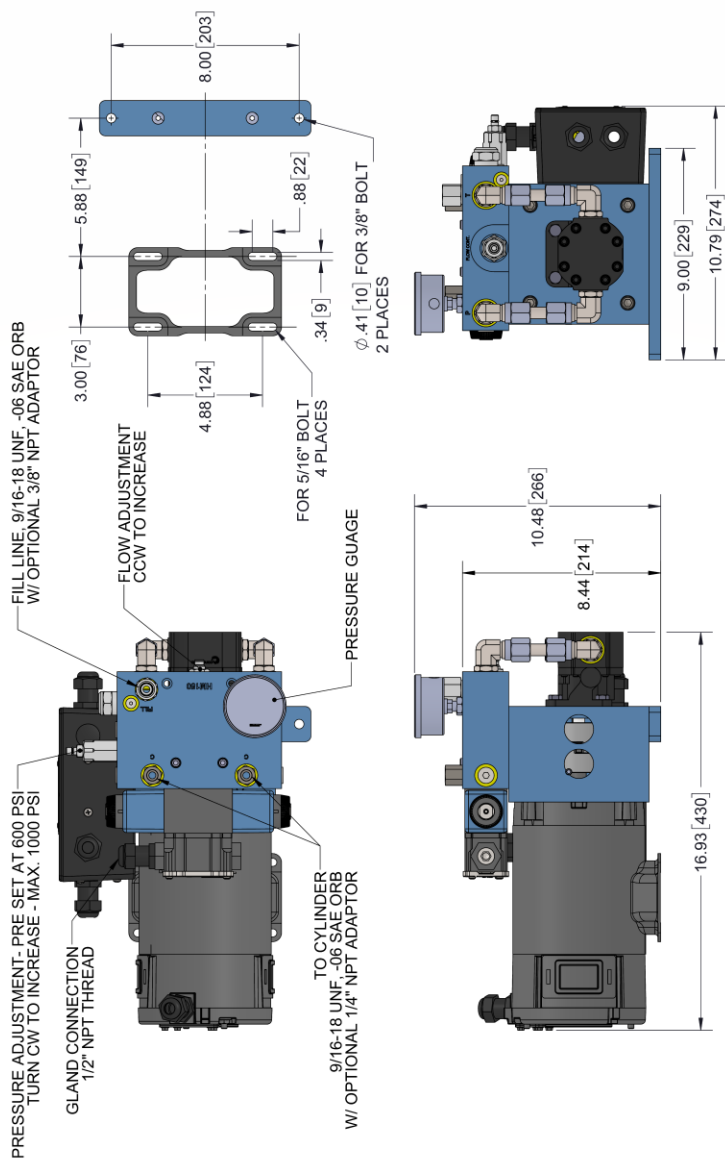


Figure 11: HPU150 Installation Dimensions

10 APPENDIX B: PARTS LIST

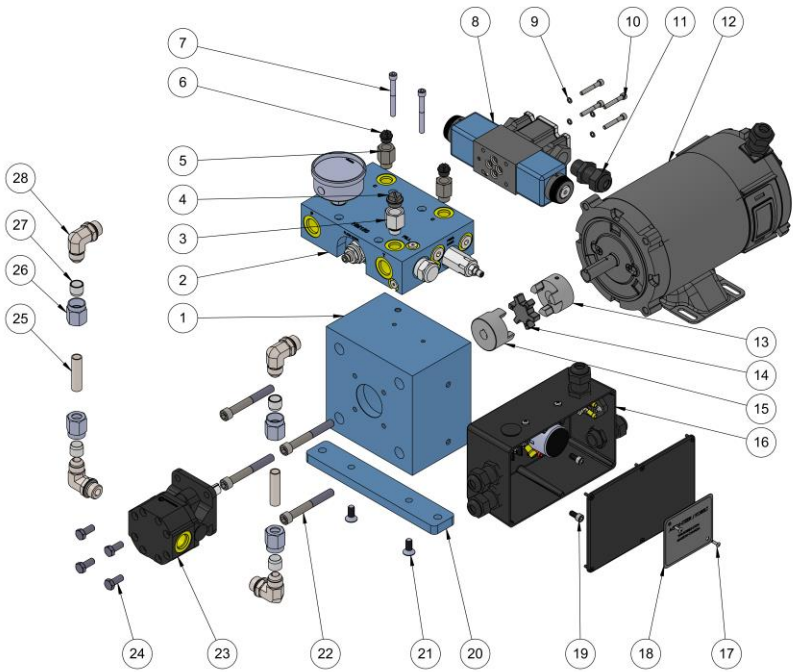


Figure 12: HPU150 Parts Diagram

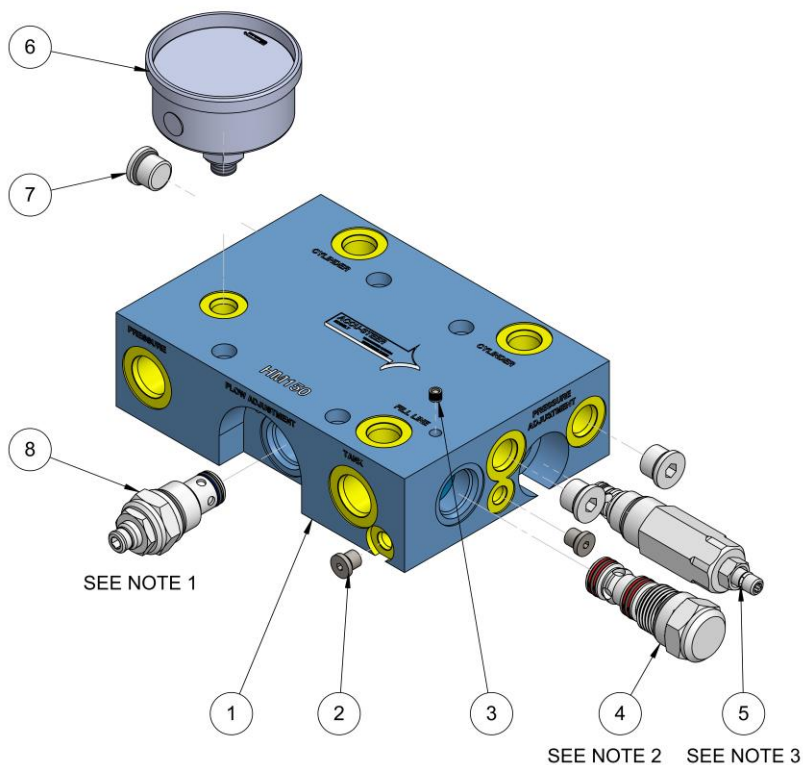
Table 5: HPU150 Parts List

Model No.:		HPU150-12	HPU150-24
Part No.:		600-130	600-131
ITEM	DESCRIPTION		
1	HPU MOTOR/ PUMP ADAPTOR	7001-0030	
2	MANIFOLD	502-400	
3	FITTING, -06 ORB M x 3/8 NPT F	7039-0139	
4	PLASTIC PLUG, 3/8 NPT	7039-3043	
5	FITTING, -06 ORB M x 1/4 NPT F	7039-0141	
6	PLASTIC PLUG, 1/4 NPT	7039-3042	
7	SCREW, CAP, SKT HD, 1/4-20 X 2 1/4, SS	1002-1036	
8	DIRECTIONAL VALVE	7036-0012	7036-0013
9	LOCK WASHER	1023-0408	
10	SOCKET HEAD CAP SCREW, 10-24x 1 1/4	1002-0820	
11	CABLE GLAND, 1/2 NPT	6009-7840	
12	ELECTRIC MOTOR, 1/2HP, DC	7070-0007	7070-0008
13	COUPLING, JAW, L075 X 5/8 X 3/16	7056-0037	
14	INSERT, COUPLING, L075, BUNA	7056-0025	
15	COUPLING, JAW, L075 X 1/2 BORE	7056-0023	
16	ELECTRICAL JUNCTION BOX	503-201	503-202
17	RIVET 1/8 IN, NAIL TYPE BLIND	1023-0420	
18	HPU NAMEPLATE	701-100	
19	CAP SCREW - SKT HD; 1/4 UNC X 1/2 LG	1002-1008	
20	HPU FOOT MOUNT PLATE	7057-0011	
21	SCREW, FLAT SKT HD, 5/16-18 UNC X 3/4	1015-1112	
22	HPU JUNCTION BOX BRACKET	7057-0012	
22	HPU FOOT MOUNT PLATE	7057-0011	
23			
24	LOCK WASHER, 3/8	1023-0412	
25	SCREW, SKT HD, 3/8-16 UNC x 3	1002-1248	
26	GEAR PUMP	7061-0005	
27	LOCK WASHER 5/16,	1023-0311	

28	SCREW HEX HEAD, 5/16-18 x 3/4	1001-1112
29	HPU150 TUBE	7056-0041
30	FLARELESS TUBE NUT, 1/2	7039-0630
31	FLARELESS TUBE FERRULE, 1/2	7039-0631
32	ELBOW, 90, 08 MJIC X 08 MORB	7039-0224

** Part included in standard repair kit. Not sold separately.*

11 APPENDIX C: MANIFOLD ASSEMBLY PARTS



NOTES:

TIGHTENING TORQUE:

1. 35-40 ft lbs (47-54 Nm)
2. 35-40 ft lbs (47-54 Nm)
3. 25-30 ft lbs (34-41 Nm)

Figure 13: 502-400 Manifold Parts Diagram

Table 6: HM150 Manifold Parts Table

			Part No.:	502-406
ITEM	QTY	DESCRIPTION		
1	1	HM150 MANIFOLD BODY		7001-0028
2	2	PLUG, HEX SKT, 02 ORB, PLATED STEEL		7039-0660
3	1	EXPANSION PLUG CV173-218S		7039-3054
4	1	DIFFERENTIAL PRESSURE SENSE VALVE, 80 PSI		7046-0001
5	1	RELIEF VALVE		7043-0008
6	1	PRESSURE GAUGE, 1450 PSI, 04 ORB		7088-0025
7	1	PLUG, HEX SKT, 06 ORB, PLATED STEEL		7039-0662
8	1	FLOW CONTROL VALVE		7044-0010

* Part included in standard repair kit. Not sold separately.

12 APPENDIX D: ELECTRICAL BOX ASSEMBLY PARTS

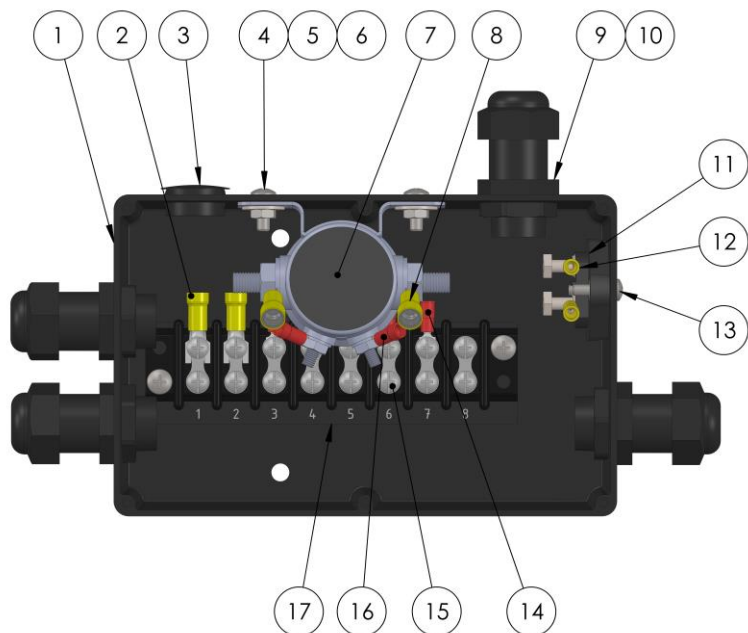


Figure 14: ELECTRICAL BOX

Table 7: Electrical Box HPU 150 DC Parts Table

Part No.:			503-201	503-202
ITEM	QTY	DESCRIPTION		
1	1	JUNCTION BOX; HPU 150	300-010-3	
2	2	SPADE TERMINAL #10 YEL, 10-12AWG	6009-6473	
3	1	DOMED FILLER PLUG 7/8 IN	200-263	
4	4	SCREW, PAN HEAD, #10 UNC X 1/2, GR 18-8	1012-0808	
5	2	NUT, HEX, #10-24, 18-8 SS	1022-0108	
6	2	WASHER FLAT 1/4IN 18-8	1023-0110	
7	1	RELAY STARTER SPST 12VDC 85ADC CONT. BRACKET MOUNT	6010-1607	6010-1608
8	2	TERM RING INS VYL 5/16IN, 10-12 AWG	6009-6425	

9	4	CABLE GLAND, 1/2 NPT, .27 - .48 CORD, NYLON	6009-7840	
10	4	NUT, CABLE GLAND, 1/2 NPT	302-064	
11	1	CIRCUIT BREAKER	6009-8111	6009-8110
12	2	TERM RING INS VYL #10 10-12AWG YEL	6009-6423	
13	2	SCREW, PAN HEAD, PHILLIPS, 8-32 X 5/8	1012-0710	
14	5	TERM FORK INS VYL #8 18-22AWG RED	6009-6452	
15	1	TERM BLOCK 8POS 30A 250V	6009-0014	
16	2	TERM RING INS VYL #10 18-22AWG RED	6009-6403	
17	1	TERM LABEL 8POS	6009-0015	
18	20*	CABLE; 2C/10AWG, RED/BLK	302-100	
19	15*	CABLE; 4C/18AWG, SOW EXT CABLE	302-105	
20	6*	WIRE, STRANDED, TYPE MW, 18 AWG, BLK	6014-0018B	
21	6*	WIRE, STRANDED, TYPE MW, 18 AWG, RED	6014-0018R	
22	6*	WIRE, STRANDED, TYPE MW, 10 AWG, BLK	6014-0010B	
23	9*	WIRE, STRANDED, TYPE MW, 10 AWG, RED	6014-0010R	

*Cables and Wires unit expressed in inches

13 APPENDIX E: TYPICAL SYSTEM ARRANGEMENT

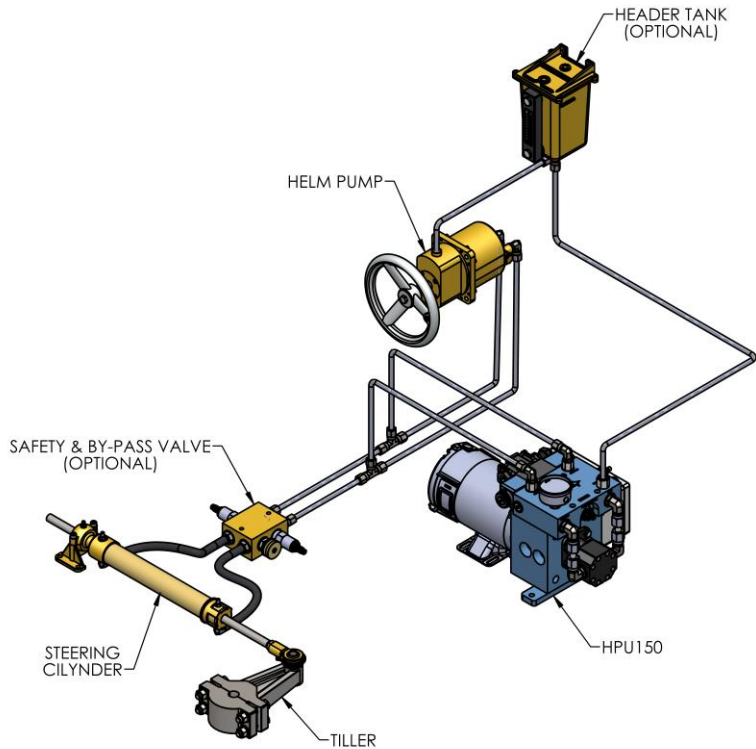


Figure 14: Typical System Arrangement

14 APPENDIX F: MOTOR BRUSH REPLACEMENT

Steps for Replacement of Motor Brushes:

1. Disconnect power from the motor using safe and approved lockout procedures.
2. Remove the brush cover plate as shown.

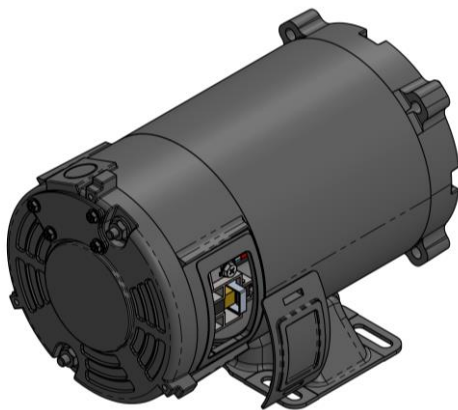


Figure 15: Changing Brush (1)

3. Remove the brushes wire connection from the electrical terminal. Philips Hex Head Screw under the brush cover plate as shown.

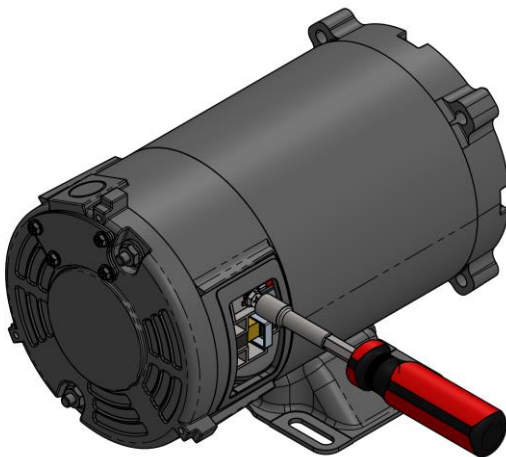


Figure 16: Changing Brush (2)

4. Release the brush. Push the brush clip to the left to release brush and spring.

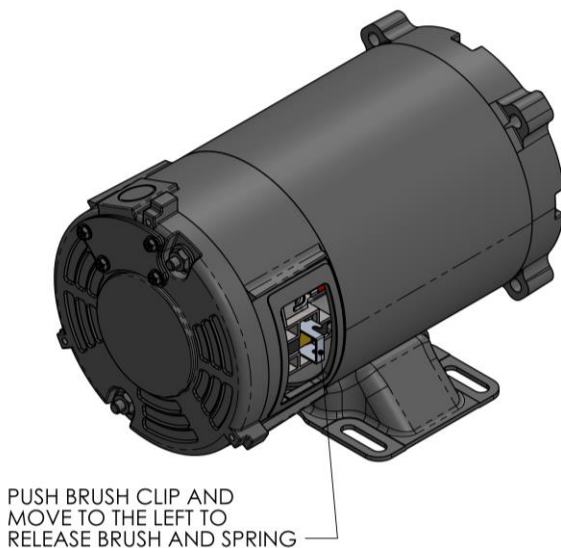


Figure 17: Changing Brush (3)

5. Remove the old brushes. Note the orientation of the brushes for re-installation.
6. Inspect the brushes for wear. Take note of unusual conditions including a burned brush face, frayed shunts, or shining rail mark on the sides of the brush.

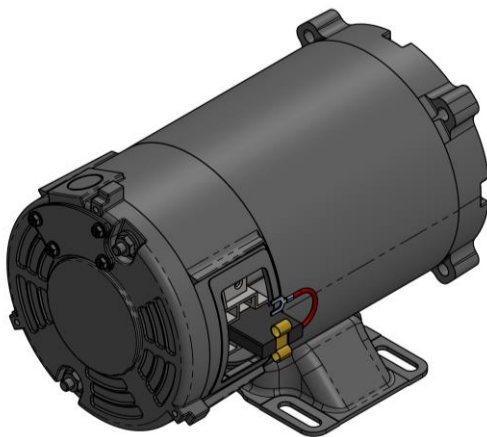


Figure 18: Changing Brush (4)

7. Inspect the contact surfaces. Take note of any unusual conditions.
 - a. Check the inside holder cavity for dust, dirt, oil depositions, carbon buildup, or burned areas. Clean the cavity if needed to remove any contamination.
 - b. Check the terminal connections area. Clean the area if needed.

NOTICE

If the motor commutator is deeply grooved it should be serviced by a motor shop before reinstallation of the brushes and continued operation.

8. Install new brushes in proper orientation.
9. Apply the pressure spring on top of the brush as shown.
10. Pull up on the brush and allow it to generally return to the contact surface. This ensures that the brush moves freely within the holder.
11. Re-connect brush wire connection to electrical terminal.
12. Check that electrical connections are tight and secure.

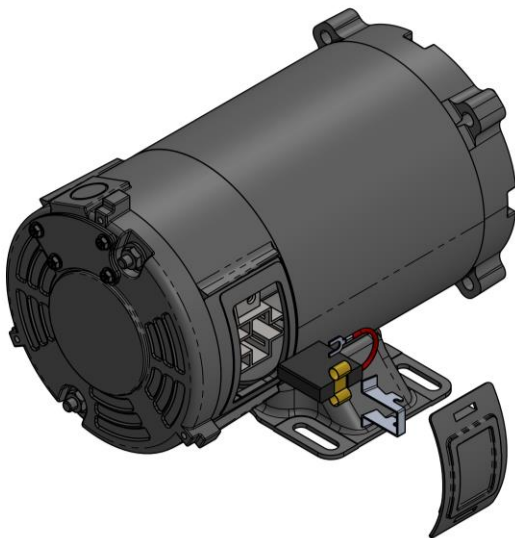


Figure 20: Changing Brush (5)

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