



Use this guide, PL821 (12 volt), or PL938 (24 volt) to repair a Hale ESP when the pumps motor runs but the pump fails to achieve a vacuum. This guide provides information to remove and determine which repair kit is required to restore functionality to a failed ESP. This guide then provides information to test and install the repaired ESP. All referenced documents and plate (PL) drawings are available from the Tech Resource Center on the Hale website (<https://www.haleproducts.com>).

Refer to 029-0810-01-0, ESP PRIMER SYSTEM (INCLUDES: SPV AND PVG VALVES) INSTALLATION, OPERATION AND SERVICE MAINTENANCE MANUAL for SPV and PVG repair instructions or SB#98, ESP PRIMER SYSTEM SOLENOID TROUBLESHOOTING for electrical problems. Also refer to 029-0020-63-0, MUSCLE (MIDSHIP) PUMPS (“Q” SERIES) INSTALLATION, OPERATION AND MAINTENANCE MANUAL, Paragraph 3.4, PRIMING SYSTEMS or SB#65 for additional ESP details.

NOTES: Recommended Grease: Lithium Base Grease with 1% to 3% Molybdenum Disulfide (or equivalent)

Recommended Solvent: Safety Kleen® or Stoddard Solvent (or equivalent)
 (Use lime scale remover & soft bristle brush for mineral deposits)

Table 1. Applicable ESP Kit

Kit Number	Description	Remarks
502-0061-50-0	ESP/SMP Pump Head Assembly	Kit contains a replacement pump assembly.
546-1410-03-0	ESP Primer Sys Kit (With PVG Spares)	Kit contains replacement pump vanes and shaft seal. Additionally, a PVG ball switch (including supporting electrical connectors) and all PVG O-rings.

ATTENTION ⚠ CAUTION

INDICATES A POTENTIALLY HAZARDOUS SITUATION, WHICH IF NOT AVOIDED MAY RESULT IN MINOR OR MODERATE INJURY.

IMPORTANT ⚠ NOTICE

ADDRESSES PRACTICES NOT RELATED TO PERSONAL INJURY (EQUIPMENT DAMAGE)



Table 2. Tools And Consumables List

Standard Tools	Special Tools	Consumables
PPE (Eye and Hand Protection)	Vacuum Gauge	Shop Rag(s) (As Required)
9/16-inch Wrench		Safety Kleen® or Stoddard Solvent (or Equivalent)
5/8-inch Wrench		Grease (See Notes on Page 1)
20 to 22 mm Bearing Driver		
Non Marring Hammer		
Timer (Watch or Stopwatch)		
Torque Wrench (23 lb.-ft.) (37 lb.-ft.) (15 lb.-in.) (35 lb.-in.)		

Perform the following to remove and replace a Hale ESP for repair. Referenced bench procedures are located at the end of this quick repair guide.

The following safety information (cautions and notices) apply throughout this entire procedure. Read and understand all safety aspects before performing any maintenance activity. Notice: ONLY trained personnel may perform the maintenance provided in this guide.

ATTENTION ⚠ CAUTION DISCONNECT THE BATTERY (OR TURN OFF THE MASTER BATTERY SWITCH) PRIOR TO SERVICING THE HALE ESP. BATTERY CURRENT MAY CAUSE ARCING, TEMPERATURES ABLE TO MELT METAL, ELECTRICAL BURNS, AND/OR ARC-FLASH HAZARDS.

IMPORTANT ⚠ NOTICE DO NOT LUBRICATE VANES OR VANE SLOTS. USING LUBRICANT ON THE VANES OR VANE SLOTS DURING DISASSEMBLY, CLEANING, OR ASSEMBLY EVENTUALLY CAUSES A GUMMY RESIDUE TO DEVELOP, RENDERING THE SYSTEM INOPERATIVE.

IMPORTANT ⚠ NOTICE IF IN 30 SECONDS (FOR A PUMP RATED AT 1250 GPM OR LESS) TO 45 SECONDS (FOR A PUMP RATED AT 1500 GPM OR MORE) ONE OF THE FOLLOWING DOES NOT OCCUR STOP PRIMING THE PUMP AND CHECK FOR AIR LEAKS OR A POSSIBLE ESP TROUBLE.

- THE DISCHARGE GAUGE READING INCREASES
- THE INTAKE GAUGE READING FALLS BELOW ZERO
- THE PRIMING PUMP DISCHARGES WATER TO THE GROUND

IMPORTANT ⚠ NOTICE IF A PUMP IS OPERATED WITHOUT WATER FOR EXTENDED PERIODS, OR WITHOUT DISCHARGING WATER, IT MAY OVERHEAT. FAILURE TO FLOW WATER MAY DAMAGE THE MECHANICAL SEAL/PACKING OR THE DRIVE MECHANISM.

IMPORTANT ⚠ NOTICE ALWAYS REPOSITION THE MOTOR COVER IF THE MOTOR VENT OPENING IS NOT ORIENTATED DOWNWARD (SEE FIGURE 3). FAILURE TO POSITION THE VENT CORRECTLY MAY ALLOW WATER TO ENTER AND DAMAGE THE MOTOR.

1. Remove ESP from apparatus. See Figure 1.
 - a. Prepare ESP priming pump for removal.
 - 1) Note/match mark ESP to gearbox.
 - 2) Tag and disconnect electrical connection.
 - 3) Tag and disconnect plumbing connections.
 - b. Remove ESP.
 (Use these instructions if ESP was mounted to the pump by Hale. Otherwise, see OEM/apparatus manufactures manual for removal instructions.)
 - 1) Using 5/8-inch wrench, loosen two [2] 7/16-14 x 1-1/4 inch long screws.
 - 2) Support ESP.
 - 3) Remove screws.



Figure 1.

IMPORTANT **NOTICE** DO NOT ALLOW WATER/CLEANER TO ENTER THE MOTOR (THRU THE VENT HOLE).

Place ESP on a clean stable work surface. Clean ESP (including motor assembly), electrical terminals (studs), and screw threads thoroughly. See Figure 2 for an exploded view of the ESP.

NOTE: Always remove old thread locking compound from used fastener threads before installation as the presence of old thread locking compound negatively affects torque.

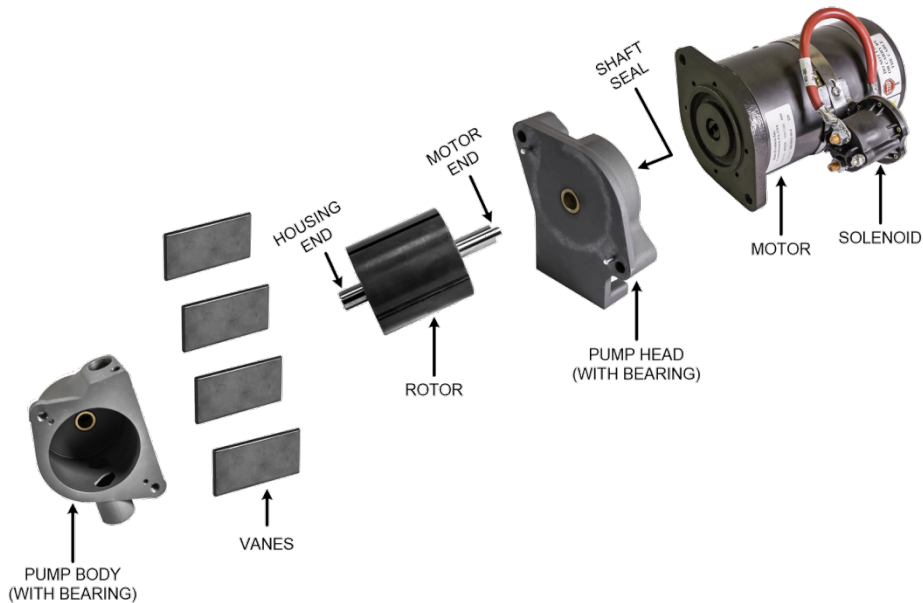


Figure 2.

2. Perform **Determine Required Repair Kit**. See page 5.
3. Verify motor vent hole location. (See Figure 3.)



**INCORRECT VENT HOLE ORIENTATION
 ROTATE MOTOR COVER 180°**



CORRECT VENT HOLE ORIENTATION

Figure 3.

4. Install ESP. See Figure 1.
 - a. Position ESP on pump. (As noted/per match mark.)
 - b. Install ESP to apparatus mounting hardware.
 - 1) Hand start two [2] 7/16-14 x 1-1/4 inch long screws.
 - 2) Using 5/8-inch wrench, tighten screws.
 - 3) Using 5/8-inch torque wrench, torque screws to 37 lb-ft.

IMPORTANT ▲ NOTICE DO NOT OVER TIGHTEN ELECTRICAL CONNECTIONS. TORQUE THE #10 NUT TO 15 LB-IN. TORQUE THE 5/16-INCH NUT(S) TO 35 LB-IN.

- c. Connect electrical connectors per tag(s).
 - d. Connect plumbing per tag(s).
5. Test ESP.
 - a. If required for test, connect vacuum gauge. (Most apparatuses already have a gauge. If bench testing, add adapter and gauge directly to priming port.)
 - b. Exercise ESP to verify repair.
 - 1) Prepare/configure apparatus (or ESP on bench) for a vacuum test.
 - 2) Activate ESP. (If applicable, via SPV or PVG.)

NOTES: If vacuum gauge does NOT begin indicating a vacuum, stop test and check for leaks. Typically, full vacuum is reached in <20 seconds (bench) or within 20 to 30 seconds (apparatus).

Vacuum attained is permitted to be less than 22 in HG by 1 in HG for each 1000 ft (305 m) of altitude above 2000 ft (610 m).

- 3) Run ESP until ESP pulls a vacuum (approximately 22 in HG or -0.75 bar).
 - c. Remove vacuum gauge if added to pump or ESP for testing.
6. Place apparatus in service in accordance with departmental procedures.

Determine Required Repair Kit

Table 1 lists two repair kits, however, only one kit will be required to restore the failed ESP to full functionality. Use this procedure to determine which kit is required to return the ESP functionality.

1. Disassemble ESP as follows.

- a. Note/match mark motor to pump head.

NOTE Record if the discharge port, ESP mounting tabs, or suction port aligns with the solenoid so the new pump head is oriented correctly, when the ESP is installed in the apparatus.



Figure 4.

- b. Separate pump from motor as follows. See Figure 4.

- 1) Using 9/16-inch wrench, remove one [1] 3/8-in -16 X 2-1/2 in long screw.

- 2) Using 9/16-inch wrench, remove nut from stud. (Typically, the stud will remove with the nut. Otherwise, use jam nut method and remove stud.)

NOTES Do NOT allow the pump body to separate from the pump head during removal.

Use of a non marring hammer may be required to separate the pump head from the motor.

- 3) Remove assembled pump head/body from motor.

2. Inspect motor drive tang for damage/wear. See Figure 5.

NOTE If the drive tang in the motor is unserviceable, discard the entire ESP and replace it with a new ESP. The drive tang is unserviceable if one side of the tang is missing, or if the shaft is cracked or split at the base of the groove, this allows the tang to widen. Burring may be repairable.



Figure 5.

3. Separate pump head from pump body as follows. See Figure 2.

- a. Place pump on work surface with pump body downward. See Figure 6.

NOTE Do NOT allow the vanes to fall out of the rotor during pump head removal.

IMPORTANT NOTICE IF SHAFT (TAB) HAS BEEN BURRED BY THE MOTOR (DRIVE TANG), REMOVE THE BURRING BEFORE REMOVING THE ROTOR/SHAFT FROM THE PUMP HEAD. DO NOT FORCE THE SHAFT THRU THE PUMP HEAD. FORCING THE SHAFT THRU THE HUMP HEAD MAY DAMAGE THE DU BEARING IN THE PUMP HEAD.



Figure 6.

- b. Hold rotor shaft in place and lift pump head off pump body and rotor shaft. See Figure 7.
- c. Hold vanes in place in rotor slots and lift rotor (with vanes in place) out of pump body.
4. Inspect end of pump body (around bearing) and pump head (also around bearing) for scarring/scoring from rotor or vane contact.



Figure 7.

NOTE: See Figure 8 for a sample of the typical acceptable ESP wear pattern.

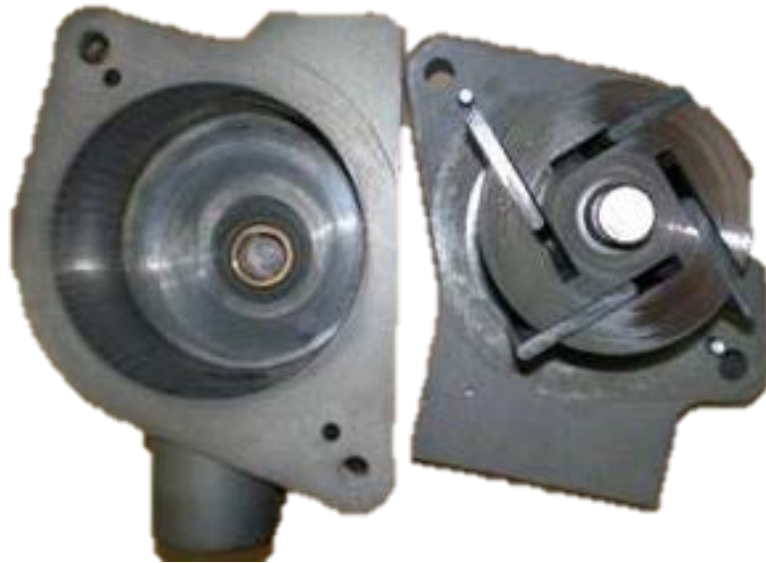


Figure 8.

If the pump body or pump head exhibit scarring/scoring (caused by rotor or vane contact) the pump is unserviceable, discard the entire pump head assembly and perform **Replace Pump Head Assembly (ESP Bench Procedure)** using the 502-0061-50-0 repair kit (Table 1).

If the pump body and pump head is serviceable, discard the vanes and shaft seal and perform **Replace Vanes And Shaft Seal (ESP Bench Procedure)** using the 546-1410-03-0 repair kit (Table 1).

Replace Pump Head Assembly (ESP Bench Procedure)

This bench procedure is NOT intended to be performed as a stand along procedure. If the ESP requires removal from the apparatus, begin with Step 1. of the main procedure (see Page 3 and perform the main and bench procedure(s) in the order instructed. If the ESP is already removed from the apparatus (or is being repaired in place), begin with **Determine Required Repair Kit** (Page 5) and perform the bench procedure and the remaining portion of the main procedure in the order instructed.

As stated at the bottom of page 5, if the pump body or pump head exhibit scarring/scoring (caused by rotor or vane contact) the pump head assembly is unserviceable. If the pump head assembly is unserviceable, discard the entire pump head assembly and perform this bench procedure using the 502-0061-50-0 repair kit (Table 1).

IMPORTANT ▲ NOTICE DO NOT LUBRICATE VANES OR VANE SLOTS. USING LUBRICANT ON THE VANES OR VANE SLOTS EVENTUALLY CAUSES A GUMMY RESIDUE TO DEVELOP, RENDERING THE SYSTEM INOPERATIVE.

1. Grease motor shaft slot and rotor shaft tang.
2. Assemble ESP as follows.

NOTE When installing a pump head assembly that has been repaired using the **Replace Vanes And Shaft Seal (ESP Bench Procedure)** consider the assembly to be a new pump head assembly for the purposes of this procedure.

- a. Place new pump head assembly (assembled pump head and pump body with rotor, vanes, bearings, and shaft seal) on to motor.
 - 1) Rotate pump head until motor and pump shafts mate (so tang and slot align with each other).
See Figure 5 (motor) and Figure 6 (pump).
 - 2) Rotate motor and/or pump head until mounting bolt holes align according to note/match marks.
 - 3) Verify pump head and motor are mated as originally noted (discharge port, ESP mounting tabs, or suction port aligns with the solenoid). Correct orientation if required.
- b. Install retaining hardware.
 - 1) Hand start one [1] 3/8-in -16 X 2-1/2 in long screw.
 - 2) Hand start one [1] 3/8-in -16 nut on stud. (If stud is separated from the nut use jam nut method to install stud first. Then install nut. ONLY torque the nut.)
 - 3) Using 9/16-inch open end wrench, tighten screw and nut.
 - 4) Using a 9/16-inch torque wrench, torque screw and nut to 23 lb-ft.

Return to main procedure, Step 4 (on Page 4) to install ESP on apparatus.

Replace Vanes And Shaft Seal (ESP Bench Procedure)

This bench procedure is NOT intended to be performed as a stand along procedure. If the ESP requires removal from the apparatus, begin with Step 1. of the main procedure (see Page 3) and perform the main and bench procedure(s) in the order instructed. If the ESP is already removed from the apparatus (or is being repaired in place), begin with **Determine Required Repair Kit** (Page 5) and perform the bench procedure and the remaining portion of the main procedure in the order instructed.

As stated at the bottom of page 5, if the pump body or pump head do NOT exhibit scarring/scoring (caused by rotor or vane contact) the pump head assembly is serviceable. If the pump head assembly is serviceable, discard the vanes and perform this bench procedure using the 546-1410-03-0 repair kit (Table 1) to replace the shaft seal, install the new vanes, and assemble the ESP.

IMPORTANT ▲ NOTICE DO NOT LUBRICATE VANES OR VANE SLOTS. USING LUBRICANT ON THE VANES OR VANE SLOTS DURING DISASSEMBLY, CLEANING, OR ASSEMBLY EVENTUALLY CAUSES A GUMMY RESIDUE TO DEVELOP, RENDERING THE ESP INOPERATIVE.

1. Remove all four vanes. See Figure 9.
2. Install four [4] new vanes as follows. See Figure 7 and Figure 9.
 - a. Place pump body on its end (pump head mating surface facing up). Place rotor in pump body (tang end facing up).
 - b. Position each new vane to align with a slot in rotor.
 - c. Slide vane into slot until bottomed in slot.
 - d. Repeat Step b. and Step c. (above) until all four new vanes are in place.

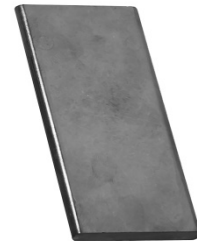


Figure 9.

NOTES The vanes must move freely in the rotor slots. Do NOT be concerned if the vanes try to fall out of the rotor slots due to gravity. Hold the vanes in place until the pump body is in place to hold them in their slot.

Keep pump body standing on its end to maintain vane positions while ESP is assembled. See Figure 7.

3. Remove and discard shaft seal. See Figure 2 and Figure 10.
4. Install new seal (Figure 11).
 - a. Lightly grease seal and bore of pump head. (Prevents seal damage and aids in assembly.)
 - b. Position new seal with metal cup facing DU bearing (down). Refer to Figure 11.
 - c. Drive seal in to pump head as follows.
 - 1) Align seal with pump head bore. (Seal must be level with and square to the bore before/during driving the seal into the bore.)



Figure 10.



Figure 11.

NOTE A bearing driver larger than 22 mm will NOT seat the seal all-the-way and a driver smaller than 20 mm will damage the seal. Use ONLY a 20 or 22 mm driver.

- 2) Using a 20 to 22 mm bearing driver and a non marring hammer, gently tap seal driver until seal seats against DU bearing.

NOTE The guide pins only align one way. Rotate pump head if required to mate guide pins with holes.

5. Install pump head on pump body.
6. Perform **Replace Pump Head Assembly (ESP Bench Procedure)** on Page 7.

Minimum Vane Height

NOTE: Inspect removed vanes for minimum vane height (see Figure 12), discard all vanes that fail to meet the minimum vane height.

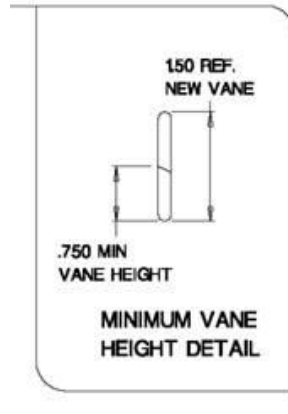


Figure 12.