



# Operation & Maintenance Manual

# DynaPump, Inc.

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**REVISION RECORD**

<b>REV</b>	<b>DATE</b>	<b>SECTION</b>	<b>DESCRIPTION</b>
A	05-01-09	-	Initial Release
B	06-10-09	App A	Update Figure A-1 schematic for timer relay circuit
C	06-24-09	Pg. 10	Delete "Limited Warranty" information
D	04-01-10	Section 7, App A,B	Separate MAN-DS-001 into two manuals. New manual MAN-DS-002 will contain parts breakdown of major repairable assemblies previously in MAN-DS-001.

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# Section 1. Introduction

*This section provides an introduction to the operation of the DynaSave pumping unit.*



The **DynaSave** pumping system is designed as a low cost option for rod pumping low flow or low load applications. The unit has a long stroke, hydraulically-actuated cylinder that connects to the polished rod by means of a carrier bar and a cable system.

The unit is comprised of two basic components: the Pumping Unit, and the Power Unit.

The Pumping Unit allows for independent control of speed in the up direction through a variable frequency drive (VFD). Stroke length is controlled by a set of adjustment switches to a maximum of 72 inches.

The Power Unit is the control center that provides the ability to convert electrical energy to hydraulic power and to control pump stroke as needed to provide optimum pumping efficiency.

## Technical Description

The DynaSave stands over the wellhead and attaches to the polished rod by and is designed for a maximum lifting load of 7,000 pounds. It is comprised of a hydraulic cylinder, a heavy duty structural base, a pulley/cable lift mechanism which doubles sucker rod stroke relative to cylinder travel, and a control box that houses the motor and pump. Maximum stroke length is 72 inches and the system can maintain up to 4 strokes per minute.

The Pumping Unit employs a very simple design. In Run mode, the cylinder is instructed to extend until it reaches the top switch, at which time it decelerates to a stop and then retracts at a controlled speed until the bottom switch is reached. The motor and pump do not operate on the down stroke. Once the bottom switch is reached, the cycle repeats.

The unit has been designed to safely retract the cylinder whenever a fault occurs (such as a VFD overcurrent when a stuck bottom hole pump is encountered), when power is lost, or whenever the **<Run/Jog>** button is pushed in to the “**Jog**” position. When the **<Run/Jog>** button is pushed in to the “Jog” position, the cylinder extends at a slower jog speed as long as the spring-loaded “**Press to Jog**” switch is held in. The cylinder will automatically retract when the switch is released

The speed up is adjustable by a setting in the motor variable frequency drive (VFD), and the speed in the down direction is controlled by setting an adjustable flow control valve. The top and bottom of stroke positions are adjustable by setting the location of proximity switches at the rear of the cylinder. The switches can be adjusted independently.

The Pumping Unit utilizes a pressure switch to automatically select a slower extend speed when the pressure setting is exceeded. The switch assists in the pump-off control logic by measuring the pressure in the hydraulic ram, which is the result of the load from the rod string. As a result, the pressure switch helps maintain a desired fluid level over the down hole pump.

**DYNASAVE OPERATION, INSTALLATION AND MAINTENANCE**

Figure 1 shows the DynaSave pumping unit.

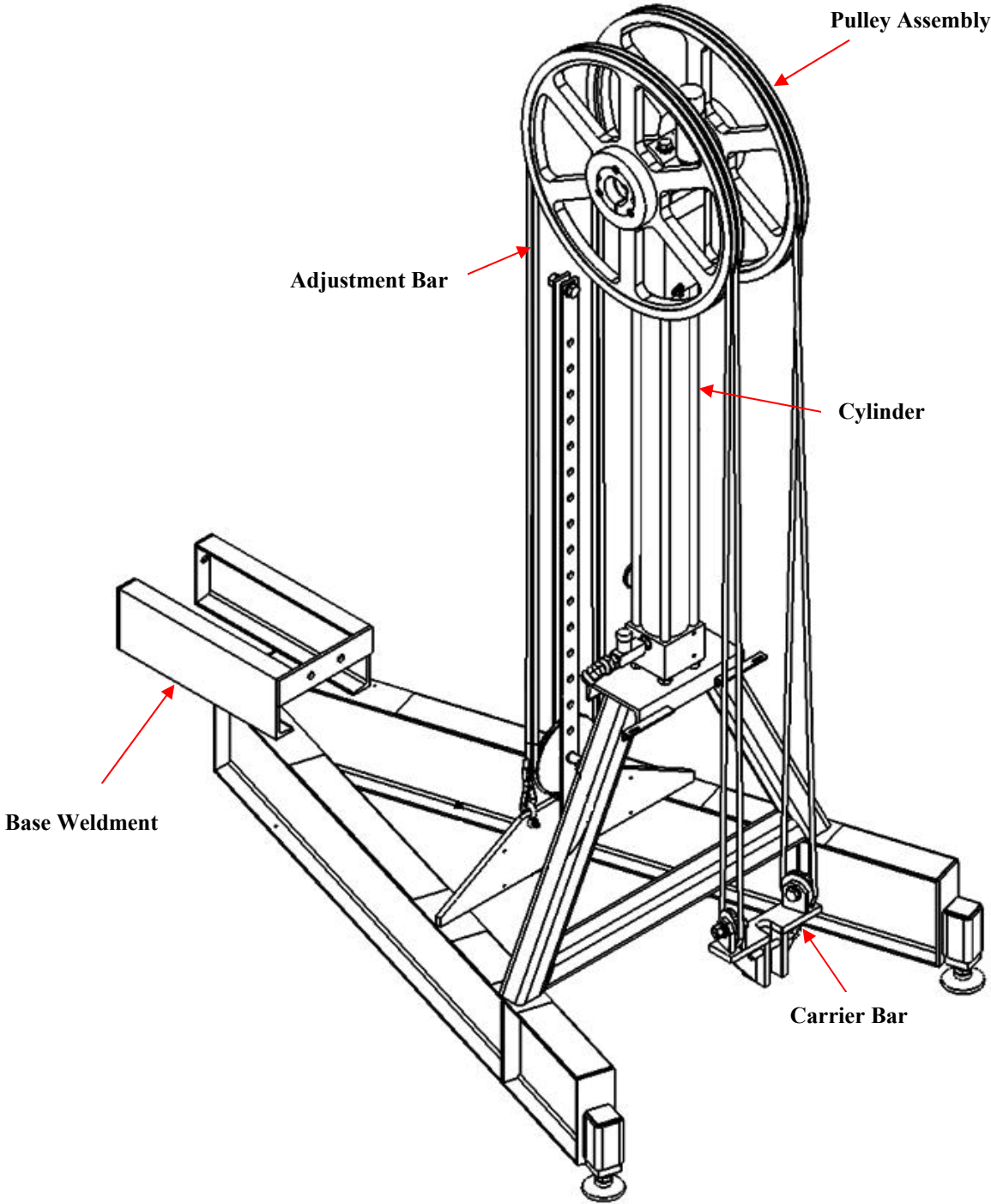


Figure 1. DynaSave Pumping Unit

**DYNASAVE OPERATION, INSTALLATION AND MAINTENANCE**

**Pumping Unit Components**

The pumping unit major components are:

- *Cylinder*– Hydraulic assembly to provide mechanical lifting action.
- *Pulley Assembly*– Enables wire rope to perform load action from cylinder to polished rod.
- *Carrier Bar*– Structural interface between the action of the pulley to the polished rod.
- *Adjustment Bar*– Allows the user to manually select desired stroke length.

**Power Unit Components**

The power unit major components are:

- *Hydraulic Cabinet*– Contains mechanical components for Dynasave operation
- *Electronic Cabinet*– Contains electronic components for Dynasave operation

**DynaSave Characteristics**

The DynaSave System has been designed to increase the overall efficiency of a well by incorporating several beneficial features:

- *Size and Load Capability* – The DynaSave pumping unit weighs only 1400 pounds, but has a polished load capacity of 7000 pounds.
- *Stroke Capability*– DynaSave has an adjustable stroke length of up to 72 inches.
- *Noise Level* – The DynaSave has a rated noise level of 68 dba measured at 20 feet.
- *Variable Speed and Pump off Control* – The DynaSave UP speed is variable and may be adjusted. The built-in pump-off control feature runs the unit automatically at lower speed in a low yield periods. and eliminates the need to shut the pump off, which can result in lost production and inefficiencies when the pump is restarted.

**Common Consumables**

This list contains some of the items most commonly ordered (see Table 1).

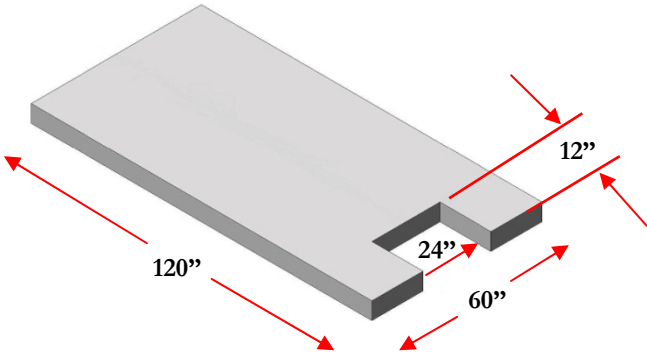
**Table 1. Consumables**

Description	Part Number
Wire rope	100-17
Hydraulic Oil Filter	30 4Z618
Auto Lubricator	155-11
Air Filter	18-2150K16

## Section 2. Site Preparation

In order to take full advantage of the long stroke capability of the pump, ensure that a 16-foot polished rod is installed and that the rod extends no more than 4 feet from the wellhead when the down hole pump is at its bottom position.

Grade the site for adequate drainage, and create an aggregate thickness of at least four inches. Once the aggregate is in place, three techniques may be used to support the DynaSave unit. These are: 1) Three 12" x 12" metal plates, positioned under each of the legs and base weldment; 2) Three concrete piers poured into position for each of the legs and base weldment; or 3) A single concrete pad poured in place, 6 inches thick and 120 x 60 inches in dimension. The selected method (1, 2 or 3) depends on the load level bearing condition of the soil. For soft, muddy soils that have a tendency to sink non-uniformly, a single concrete pad (method 3) is recommended (see Figure 2). For firmer soil conditions, metal plates (method 1) or concrete piers (method 2) may be used.



**Figure 2. Concrete Pad (Method 3)**

In general, the height of the stuffing box must be below the bottom of the cylinder to ensure that full stroke length is available for pumping. If this is not the case, then special foundation pads will be needed to elevate the three mounting plates prior to pump installation.

The electrical connections should be stubbed to a lockable switchbox located approximately 8 to 10 feet from the well head. The electrical run from this box to the DynaSave power switch shall be done using flexible conduit. This will allow the DynaSave unit to be moved from its installed position when necessary to facilitate work over rig crews.

## Section 3. Installation

### General Precautions

Due to the size and extremely large forces involved, the following safety precautions must be observed:

- Do not start the pump unless the load is attached.
- When working on the well or pumping system, shut power off and lockout/tagout equipment at the disconnect switch or power pole.
- When servicing the pump, ensure that the power button is switched to Off.
- Ensure that chains and cable slings used in installing the pump have a load test certification tag suitable for the load being lifted. The lifting load for the DynaSave is 1,500 pounds.

### Pumping Unit Preassembly

The DynaSave is delivered fully assembled to the well site on a flat bed truck. A crane or backhoe with a minimum hook height of 20 feet and a minimum load capability of 2 ton can be used to offload the Pumping Unit to place it near the well head.

Automatic lubricators are used to maintain a constant flow of grease to the pulley support bearings. This process keeps any contamination from migrating into the bearings during normal operation.

Perform the following steps to install an automatic lubricator:

1. Install an auto lubricator in the grease port on the top of the pulley support mounted on the very top of the cylinder (between the two pulleys).
2. Activate by turning the switch to the “On” position. Confirm operation by verifying the indicator light is functioning.

**DYNASAVE OPERATION, INSTALLATION AND MAINTENANCE**

**Pumping Unit Placement on Well Head**

Perform the following steps:

1. Secure the crane hook to the lifting lug located between the cabinet and cylinder.
2. Prior to placing the pump in position, be sure that the area is free and clear of any obstacles.
3. Verify that the adjustable feet are screwed all the way into the front base legs.
4. Follow all standard oil field safety practices while completing the installation.
5. Verify that the well is not pressurized to preclude a serious accident in case the wellhead is accidentally bumped.
6. Carefully place the pump on the mounting plates such that the feet are in the center of each plate and the pump is centered on the pump wellhead.
7. Position the unit to establish a setback distance (cylinder bottom cap to the center of the well head) of  $10.75 \pm 0.5$  inches.
8. The height from the cylinder bottom head to the well head should be  $41 \pm 0.5$  inches (see Figure 3). This distance should be preserved so that the stroke length is maintained.
9. In order to achieve the full stroke capacity of 72 inches, the cement pier method may be needed to meet the required system height to the well head.

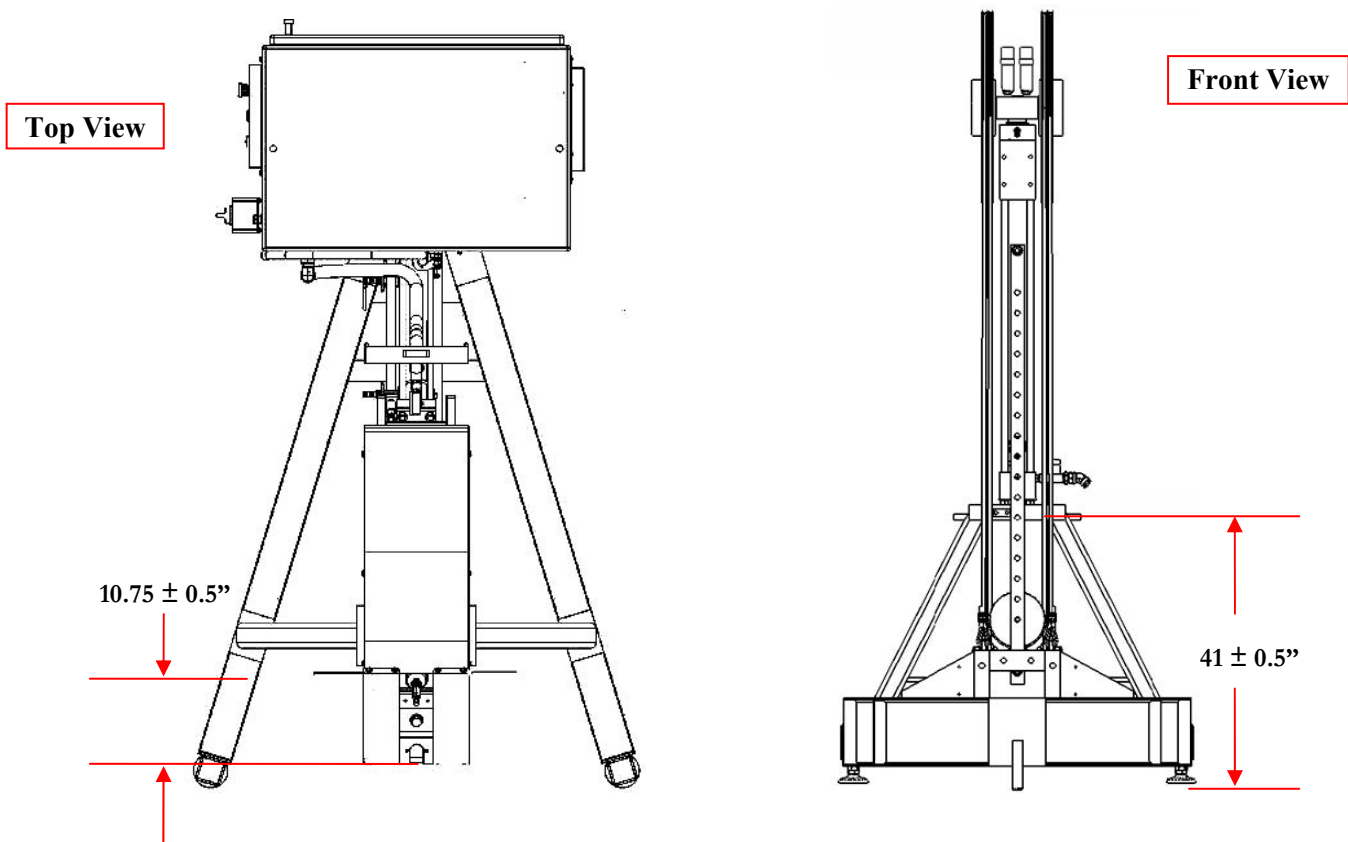


Figure 3. Site Installation

**DYNASAVE OPERATION, INSTALLATION AND MAINTENANCE**

**Cylinder Alignment**

Cylinder alignment is one of the most important issues involving performance and longevity of the cylinder and related components. Misalignments increase friction and wear on pulley and cylinder assembly components, including the wire cable, and will contribute to reduced life of the well packing.

Three measurements are involved when checking alignment: verticality, cylinder to polished rod alignment, and the distance between the centerline of the cylinder and polished rod.

1. Using a magnetic bubble level, check the verticality of the pump cylinder in two axes (fore & aft, and left & right). If the cylinder is not vertical, rotate the adjustable feet on each base leg as required to bring the cylinder to the vertical position.
2. Verify that the polished rod is centered on the cylinder centerline. If it is not centered, move the pump left or right as required to establish the proper centering.
3. Verify that the distance from centerline of the polished rod to the centerline of the cylinder is 13 3/8 inches (see Figure 4). An optional point of measure is from the face of the cylinder block, which should measure 10-3/4 inches, to the centerline of the polished rod. This distance ensures that the cables will be in the same plane as the polished rod. If the distance is not correct, move the pump fore or aft as required to establish this distance.

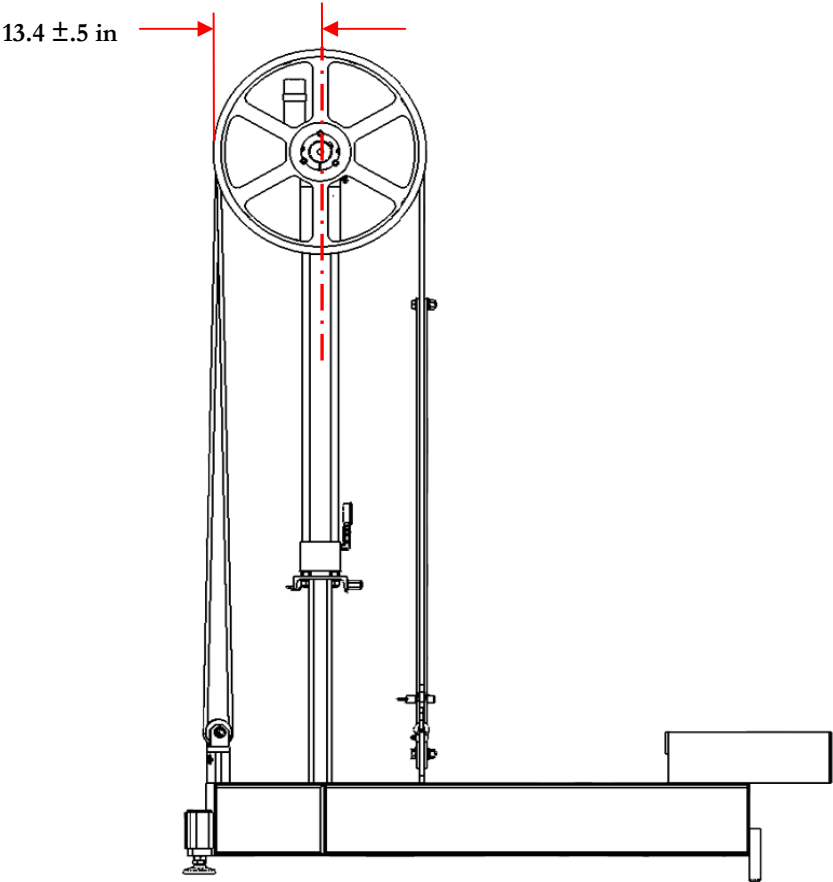


Figure 4. Cylinder Alignment

## **Connection to the Polished Rod**

Perform the following steps:

1. Remove the carrier bar that is zip-tied or strapped to the structure. Also remove any packing straps attached to the cables to keep them in place during transit.
2. Position the carrier bar so that it is just above the polished rod clamp on top of the stuffing box.
3. Slide the polished rod into the carrier bar slot and replace the pin to secure the rod per standard oil field operating procedures.
4. Install the polished rod clamp on top of the carrier bar and tighten the bolts according to the clamp manufacturer's torque recommendations. It is desirable to have the polished rod extending from the stuffing box as short as possible (maximum of 36") in order to take full advantage of the long stroke capability.
5. The cable clamp nuts must be torqued to 20 ft-lbs.
6. Acquire the load by jogging the cylinder up with the flow control valve (see Figure 7) fully closed to prevent it from retracting once the button is released.

## **Final Check of Tightness on all Bolts and Connections**

During transport and installation of the equipment it is possible that screws and bolts may have loosened and therefore may result in improper operation of the unit.

- Check that all bolts and screws are properly tightened prior to proceeding to Startup phase.
- Verify that all screw connections in the cabinet and in the electrical switch are tight.
- Verify that all fittings and hose connections are tight, including those in the cabinet.

## Section 4. Starting the System

### Pre-startup Power-On Checks

There are many factors to consider before powering up and starting the system for the first time. In some cases, the pumping unit has been tracked back after installation for well maintenance. In addition, the installation could have been handled by other technicians prior to the startup date. It is the responsibility of the startup technician to evaluate the state of the installation and verify that all work has been completed.

A DynaSave technician will normally complete these checks:

1. Do a visual check for anything that appears inconsistent with proper installation.
2. Verify the pumping unit is properly aligned to the well head.
3. Check that the rod string is properly attached to the carrier bar, and the polished rod clamp has been securely tightened.
4. Apply power to the system by closing the main circuit breaker or disconnect.
5. Measure the incoming phase-to-phase voltage from the grid (on 480V systems - at least 414 volts, and not greater than 506 volts). Make sure the voltage is consistent with power unit requirements on all three legs. It is important to check the input voltage while the pump is running to make sure the voltage stays within the acceptable range under load.
6. Verify that the hydraulic oil tank is filled to the top of the sight glass. If not, add hydraulic fluid as required.
7. Set <Run/Reset> switch in the “Run” position, and push the <Jog/Run> button in.
8. Open the bleeder cap at the top of the cylinder.
9. Momentarily push and hold the “Jog” button in. Verify that the motor rotation is correct. If incorrect, swap two of the three motor output leads.
10. Jog “up” to bleed air from the cylinder, then tighten bleeder cap.
11. Check position of the high and low proximity switches, making sure they are not at the extreme ends of the sensor rod.
12. Verify that the cylinder retracts to the full down position. If not, adjust the flow control valve (see Figure 7) to allow the cylinder to retract.
13. When ready to run the <Jog/Run> button should be out and the <Run/Reset> switch should be in the “Run” position.
14. When running for the first time, make sure the cylinder doesn’t extend too far. The proximity switches should be set so there is no less than six inches between the carrier bar and pulley.

**DYNASAVE OPERATION, INSTALLATION AND MAINTENANCE**

**Starting the Pump in Normal Operation**

When starting the pump in normal operation, verify that the <Reset/Run> switch is in the “Run” position and pull the <Jog/Run> is placed in the “Run” position. The pump will automatically start and will continue to pump unless VFD alarm conditions are detected or low oil level occurs, in which case it will automatically stop and return to the full retract position.

An alarm condition may be cleared by placing the <Reset/Run> switch in the “Reset” position for several seconds and then returning it to the “Run” position or by simply turning power off for several seconds and then turning power back on.

See Figure 5 for an illustration of the Control Panel.

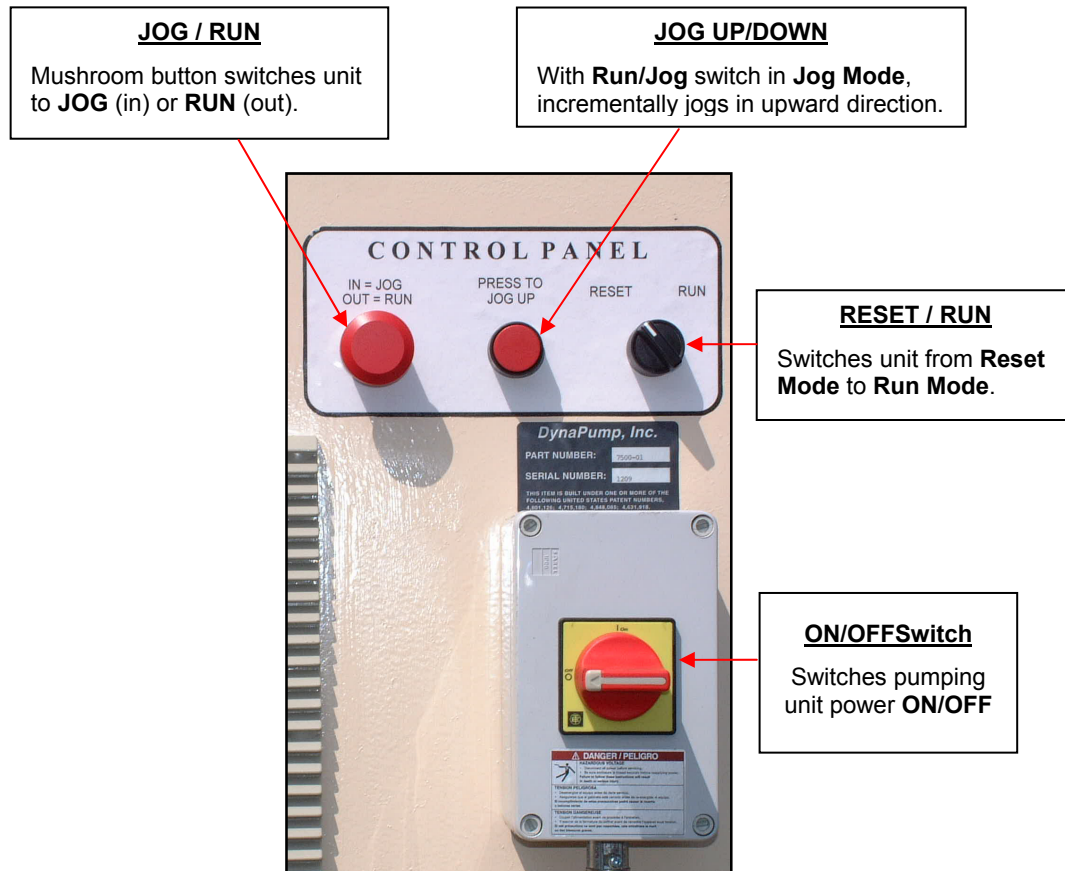


Figure 5. Control Panel

## Stopping the Pump

As a matter of safety and for normal operation as needed, the pump may be stopped at any time by using one of four means:

1. Turn off power at the main power pole or the safety disconnect switch.
2. Turn off power at the Power <On/Off> switch.
3. Push in the red mushroom button to the “Jog” position.
4. Turn the <Run/Reset> button to the “Reset” position. For normal operation, always attempt to stop the pump at the bottom of the stroke.

 **NOTE:**

*Any time the pump is stopped the cylinder will retract, returning the carrier bar and polished rod to the full down position. Stay clear of the carrier bar until it has stopped moving during the retract cycle.*

## Starting the Pump for the First Time

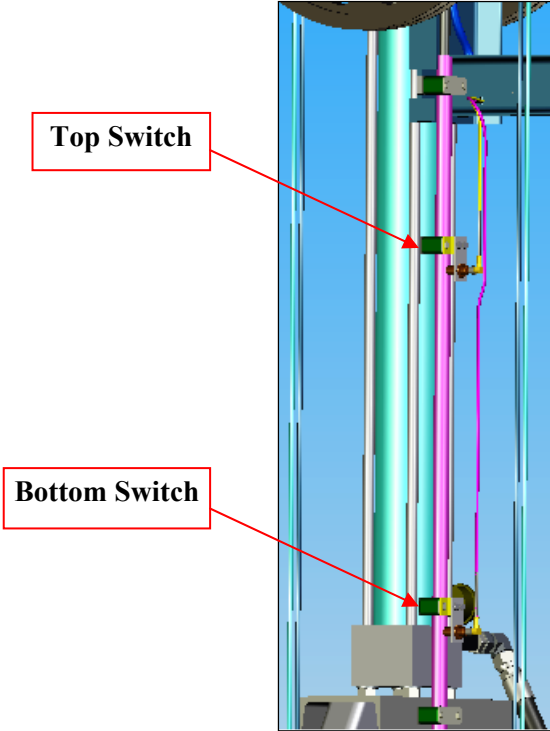
The DynaSave Pumping Unit is ready to run whenever power is applied and the <Reset/Run> switch is in the “Run” position. The pump will operate in one of two possible modes: **Run** and **Jog**, depending on whether the red mushroom button is IN or OUT.

In the **Run mode**, the cylinder is commanded to extend until it reaches the top switch, at which time it decelerates to a stop, and then retracts at a controlled speed until the bottom switch is reached. The motor is not powered during the retract cycle. Once the bottom switch is reached, the cycle repeats.

In the **Jog mode**, the cylinder is commanded to extend only when the “Press to Jog Up” button is depressed and will retract when the button is released. Push the red mushroom button IN to the “Jog” position and apply power the unit. Jog the cylinder up and allow it to retract several times to confirm the pump is operating properly.

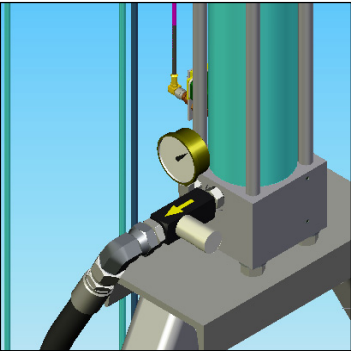
The pump is now ready to run. Perform the following steps:

1. Verify that the carrier bar is clear and there are no service personnel near the pumping area.
2. Place the <Jog/Run> switch in the “Run” position. The pump will immediately begin the pumping cycle.
3. Adjust the top of cycle and bottom of cycle switches (see Figure 6) located on the back of the cabinet to establish the desired stroke length. The switches are proximity devices that respond to the metal tube moving up and down inside the PVC pipe.



**Figure 6. Top and Bottom Position Switches**

- 4. To change one or both position switches, loosen the switch clamp bolts and slide the switch assembly up or down the PVC pipe and then reclamp in the desired position. See Figure 6. Maximum stroke for the DynaSave is 120 inches at the polished rod. Cylinder travel is actually 1/2 of this due to the 2:1 cable arrangement.
- 5. Adjust the down speed to achieve the desired pumping unit strokes per minute (SPM). The UP speed has been preset at the factory, but can be adjusted in the field by a DynaPump technician. The down speed is adjusted by adjusting the hydraulic flow control valve (see Figure 7) that controls how fast the oil in the cylinder is allowed to return to the tank following the extend cycle.



**Figure 7. Hydraulic Flow Control Valve**

# Section 5. Adjustments

## Adjustments to Customize the Well

The DynaSave has features that allow adjustments to be quickly made to customize it to the particular well being pumped. These features include: stroke top and bottom position, stroke up speed, stroke down speed, and maximum load. Consult with your DynaPump service technician to perform changes to settings or to assist you.

- **Adjusting the Top and Bottom Position Limits** – The top switch and the bottom switch can easily be adjusted as required to control the top of stroke position and the bottom of stroke position. This feature may be particularly useful if the BHP must tap down at times to avoid a gas lock condition prevalent on coal bed methane wells.
- **Adjusting the Down Speed** – The DOWN speed may be adjusted by the setting of the flow control valve (see Figure 7) .
- **Adjusting the Up Speed** – The UP speed may be adjusted by the adjusting parameters in the following memory locations in Variable Frequency Drive (VFD):

**Table 2. Up Speed Parameter Locations**

Parameter	Dynasave Model		
	230V 3-Phase (V7 model VFD)	460V 3-phase (V7 model VFD)	480V 1-phase (F7 model VFD)
Normal speed	N027 (72 Hz - default)	N027 (72 Hz - default)	d1-17 (72 Hz - default)
Slow speed (jog speed)	N032 (20 Hz - default)	N032 (20 Hz - default)	d1-32 (20 Hz - default)
Pump-off speed	N025 (40 Hz - default)	N025 (40 Hz - default)	d1-02 (40 Hz - default)

Note that the UP speed can only be adjusted when the pump is not operating, and the <Reset/Run> switch is in the “Reset” position.

- **Adjusting to Control the Maximum Load** – The peak polished rod load is a function of several factors, including the height of the fluid over the bottom hole pump (FOP). The DynaSave incorporates an adjustable pressure switch which can be used to establish the average load at a particular FOP. When this pressure limit is exceeded, the VFD commands a slower speed, thereby reducing the SPM and total flow to maintain that FOP. The slower UP speed may be adjusted by adjusting parameter P304 in the VFD in the control cabinet. Note that the UP speed can only be adjusted when the pump is not operating and the <Reset/Run> switch is in the “Reset” position.

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Refer to Table 3. DynaSave Pressure vs. Load Table” for the relationship between gauge pressure and load.

**Table 3. DynaSave Pressure vs. Load Table**

<b>Gauge Pressure (psi)</b>	<b>Rod Load (lbs)</b>
50	0
250	709
500	1592
750	2476
1000	3359
1250	4243
1500	5126
1750	6010
2000	6894

## Section 6. Software

The DynaSave unit does not require any software installation for operation.

## Section 7. Maintenance

*This section briefly describes the routine maintenance tasks that must be performed on the Pumping System to maintain running at peak performance.*

### Periodic Maintenance

Dynapump recommends that preventative maintenance be performed on the pump at various intervals to keep the pump running at peak performance. A Dynapump technician or other personnel that have undergone Dynapump training can complete these tasks. Table 4 shows the recommended maintenance activities and the service interval for each task.

**Table 4. Monthly Preventative Maintenance Tasks**

ITEM	TASK	INTERVAL	
		90	180
1	CHECK/ADJUST ALIGNMENT	x	x
2	INSPECT AUTO LUBRICATORS	x	x
3	REPLACE AUTO LUBRICATORS		x
4	CHECK MOTOR COUPLER		x
5	CHECK FOR HYDRAULIC LEAKS	x	x
6	CHECK HARDWARE INTEGRITY	x	x
7	BLEED NITROGEN FROM CYLINDER		x
8	LUBRICATE MAIN MOTOR		x
9	INSPECT PULLEY ASSEMBLY	x	x
10	INSPECT CABLE SYSTEM	x	x
11	CHECK OIL LEVEL AND FILTER	x	x
12	REPLACE FILTER		x
13	CLEAN/REPLACE FAN FILTER		x
14	PRESSURE CLEAN UNIT		x

## **Scheduled Well Maintenance**

In the event that the well has to be pulled for maintenance, the Pumping Unit must be moved to a location behind the mounting pads to provide sufficient clearance for a rig to be temporarily installed. The DynaSave can easily be picked up with a backhoe or small crane and moved a few feet with the electrical still attached.

In order to move the pumping unit, perform the following tasks:

1. Stop the pump by pushing in the red <Jog/Run> button to the “Jog” position.
2. Close the flow control valve and jog the cylinder up approximately two feet and release the switch. The carrier bar should remain at the stop position because the cylinder cannot retract.
3. Install a polished rod clamp between the carrier bar and the stuffing box to allow the load to be transferred to the well head.
4. Allow the cylinder to retract by opening the flow control valve. This will remove the load by allowing the clamp just installed to rest on top of the stuffing box..
5. Shut off power to the pumping unit at the safety switch and/or the power pole. Lockout power in accordance with acceptable industry practice.
6. Remove the carrier bar from the polished rod. Tie off the carrier bar to the pumping unit structure to keep it from swinging during the move operation.
7. Using a backhoe or small crane, pick up the DynaSave unit using the pick up hook provided between the cabinet and the cylinder. Carefully move the unit away from the well a sufficient distance to avoid interference with the work over rig. Take care to not pinch or stretch the electrical connections.
8. Reverse this procedure when the pump is ready to resume normal pumping operation.

## Section 8. Troubleshooting

### Overview

The DynaSave utilizes a Variable Frequency Drive (VFD) drive controller and simple relay logic to control the motor which drives the hydraulic pump. The VFD is self-monitored for most failure conditions including external power faults and overload conditions.

### VFD Error Codes

Errors and address locations associated with the error condition may be recorded on the Yaskawa (VFD) drive. If the pump is not running and the red button is in the “**Run**” position and the <Reset/Run> switch is in the “**Run**” position, open the cabinet door and read the VFD trip message. This message may prove useful if your DynaPump technician needs to troubleshoot for a malfunction. The trip may be reset by turning power off and then on again or by placing the <Reset/Run> switch to the “**Reset**” position and then back to the “**Run**” position. If there is no trip message, check the level of the hydraulic oil in the tank.

### Error Conditions

#### Oil Level Too Low

The pump will not run if the oil level falls below the sensor switch in the hydraulic tank, and the DynaSave will require reset. To return the unit to operation, add hydraulic oil as required to bring the level to the top of the sight glass and then press the <Start/Reset> button on the control panel. Verify there are no oil leaks that may have caused the low oil level to occur.

#### Pressure Too High

If the pressure switch on the control manifold detects a pressure that is too high, and pressure does not fall within the specified one minute period, the system will stop and must be reset. Press the <Start/Reset> button on the control panel.

## Section 9. DynaSave Service

### Introduction

DynaPump has capable sales and service technicians placed strategically throughout oil producing areas of the world. These personnel are well-trained in installation, troubleshooting, and maintaining all DynaSave model pumps.

Commonly used spare parts for repair and replacement are available and in stock at local service centers inside the United States, and internationally through a distributorship network. A complete line of parts is also available from the manufacturing plant in Northridge, California. Outside the United States, DynaPump uses qualified, trained distributors to sell, repair, refurbish and provide warranty service to DynaSave equipment.

Contact the DynaPump sales office nearest you to inquire about the availability of DynaSave replacement parts and service. When ordering replacement parts, please specify the part number, the part description, and the DynaSave serial number that the part will be used on.

### Limited Warranty

DynaPump Inc, and its employees are proud of the products and are committed to provide our customers the best designed and manufactured oil pumping systems with the best service and longevity.

### Contact Information

We welcome comments and questions regarding your DynaSave unit.

Please contact us at:

DynaPump Inc.,  
2441 High Timbers - Suite 200  
The Woodlands, TX 77380  
Phone: +1-281-973-0050

Website: [www.dynapumpinc.com](http://www.dynapumpinc.com)