



**REPAIR INSTRUCTIONS**

*MA10V0/VSO 18-100  
PISTON PUMPS 31 SERIES*



**PISTON PUMP REPAIR MANUAL**  
METARIS MA10V0/VSO 18-100 PISTON PUMPS

SEPTEMBER 2008

# Table of Contents

Overview	1
Pump Disassembly	2
Control Disassembly / Reassembly	7
Pump Reassembly	13
Adjustment Procedures DR Control	19
Adjustment Procedures DRG Control	20
Adjustment Procedures DFR / DFR1 Control	21
Adjustment Procedures DFLR Control	22
Torque Specifications	26

*The life expectancy of all hydraulic components is directly related to the cleanliness of the hydraulic system that it operates within. Typically, the cleaner the hydraulic system is maintained, the longer life expectancy the hydraulic components will have.*

*Component life is dependent upon the system cleanliness, duty cycle, operating parameters, and the environment. Noting there are many variances in maintaining a reliable hydraulic system, there must be an adequate maintenance schedule established to maximize component life.*

*Since it is generally agreed that contamination is the number one cause of hydraulic component failure, during commissioning of any repaired hydraulic unit, every effort must be made to keep the system clean and avoid all outside contamination.*

*Always consider safety when working with hydraulic systems. Wear appropriate safety apparel. Recheck all hydraulic connections for tightness before turning the system on. Always follow the manufacturer's recommendations of the equipment before beginning any work.*

*It is always recommended that the component being removed on the manufacturer's equipment be thoroughly cleaned of all surface debris and serial numbers and model numbers be recorded of the components being removed for use as future reference.*

# Pump Disassembly



1

Remove the shaft key (if applicable).



2

Remove the external shaft seal retaining ring.



3

Turn unit over with shaft assembly pointing down and remove the four 6mm control assembly retaining bolts.



4

Remove the control assembly and set aside for later disassembly and inspection.

## Pump Disassembly *continued*



5

Mark the port cover to the housing. Remove the fixing bolts, and lift off the port cover with care.



6

Remove the valve plate from the port plate, taking special care not to scratch or gouge the sealing surfaces.



7

Remove control piston, counterpiston and spring from pump body.



8

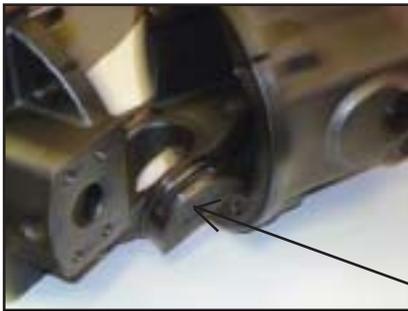
Remove the tapered rear bearing and adjustment shim.

## Pump Disassembly *continued*



9

Turn unit on its side and remove the cylinder block assembly, pistons, retaining ball, retainer plate, cradle assembly, and cradle bearings. (This may not come out as an assembly).



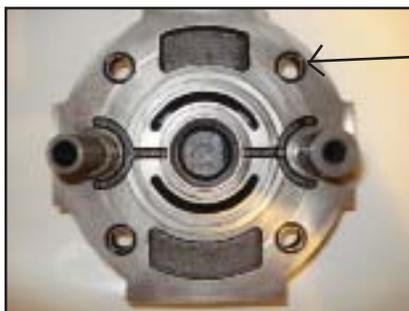
10

Mark the pressure side of the yoke for reassemble.



11

Remove shaft and front bearing assembly.



12

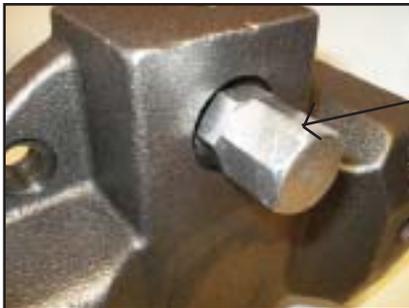
Remove the four o-rings from the port plate.

## Pump Disassembly *continued*



13

Remove the large o-ring from the main housing.



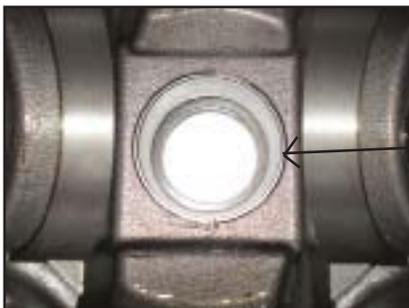
14

Disassemble locking nut from the max volume adjusting rod located at the rear of the port plate (if applicable).



15

Record the length of the exposed thread. This will be needed during reassembly of the unit.



16

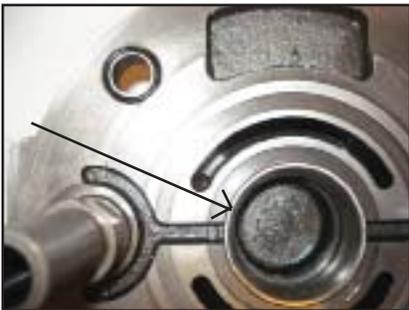
Use a suitable bearing puller and remove the front bearing race.

## *Pump Disassembly* continued



17

Check condition of control and counter pistons. If worn or sticking, remove control piston and guide and counter piston and guide for replacement. NOTE: The screw in stems are loc-tited in place and will require heat to remove.



18

Use a suitable bearing puller to remove the rear bearing race from the port plate. (Take care not to damage the lapped surface.)



1

Remove the three sealing o-rings on bottom of control.



2

To ensure control is reassembled with the same approximate control settings measure distance from face of adjusting screw plug.



3

Remove the lock nuts on the pressure adjusting screws.



4

Remove the spring chambers from the control housing.

## Control Disassembly/Reassembly

*continued*



5

Remove the pressure adjustment screw plug assembly.



6

Remove the spring, collar, and cup.



7

Remove the two sealing plugs from the control body.



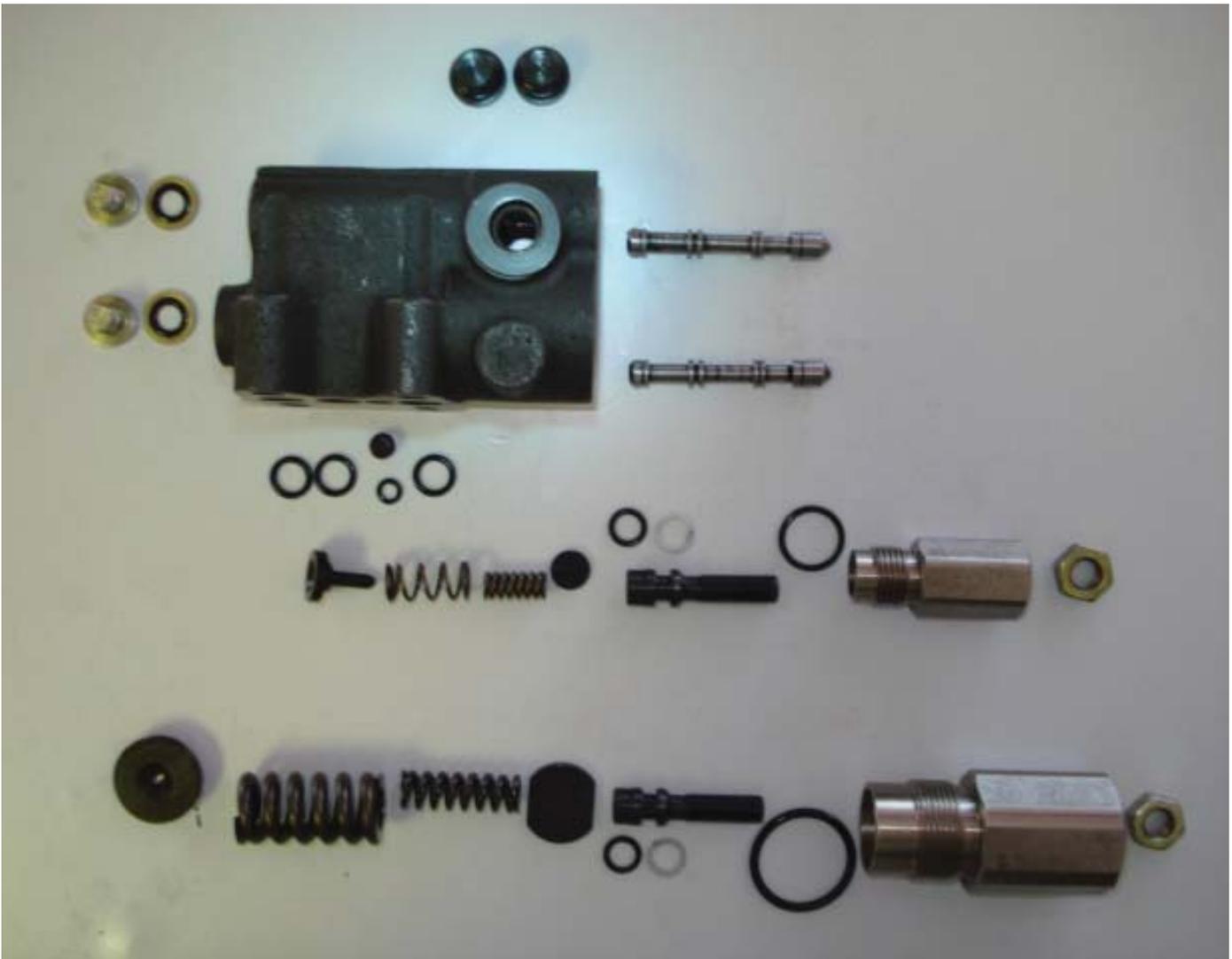
8

Remove DR and FR spool assemblies. Check for smooth movement throughout control housing. (Do not mix spools up.)

## Control Inspection

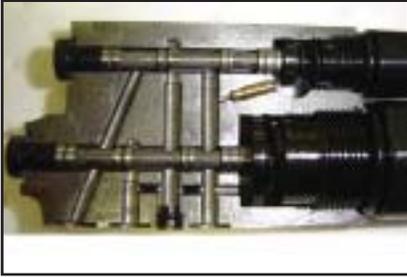
1

Inspect the pressure adjustment screws for wear and damage. Clean all components before reassembly.



DFR SHOWN

## *Control Inspection* continued



2

Inspect the springs, spring collar, and spring cup for wear and damage.



3

Carefully inspect the spools ensuring the sealing lands are free of any nicks or scratches. Also check the spool ends that contact the spring collar for wear.



4

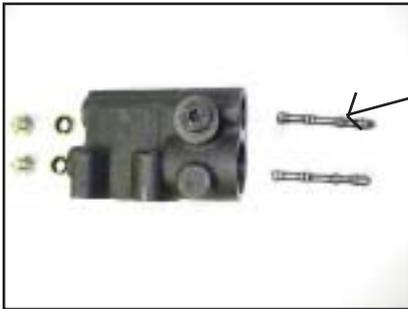
Check the spool bores within the control housing for scoring or excessive wear.

## Control Reassembly



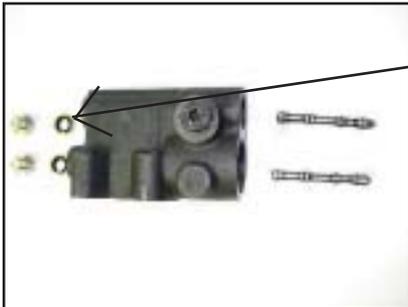
1

If after inspection it is determined that controller is to be reused, thoroughly clean then lubricate all parts with clean hydraulic fluid.



2

Install the FR and DR compensator spools into their respective bores in the control housing, checking for free movement of the spool within its bore.



3

Install new o-rings on the sealing plugs opposite the adjustment end on the control housing body and tighten.



4

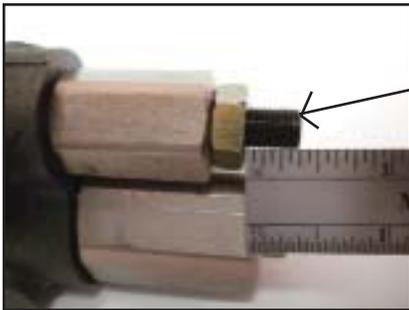
Install new o-rings onto the adjusting screw and spring cups.

## Control Reassembly *continued*



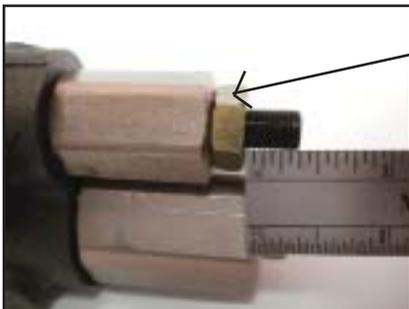
5

Tighten both spring chambers into the control housing.



6

Adjust screw adjuster in the spring cups until they reach the measurements taken in step two on Control Disassembly.



7

Install locking nuts and leave loose (to be secured upon final control adjustment). (See control setup for adjustment procedure).



8

Install new o-rings to the bottom side of the controller and place aside for later reattachment to the pump.

**Important Note:** If it is determined that any of the controller parts are damaged or worn excessively, it is recommended that the complete controller assembly be replaced.

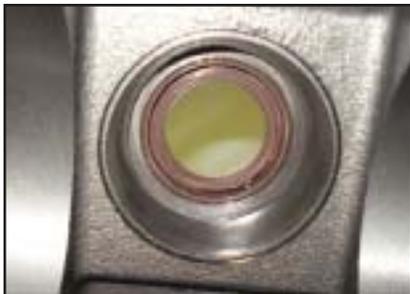
# Pump Reassembly

It is recommended that all repairs be performed in a clean lint free environment and that all seals be replaced upon reassembly. It is a good idea to check that all parts being replaced are correct for the model number and design of unit being serviced.



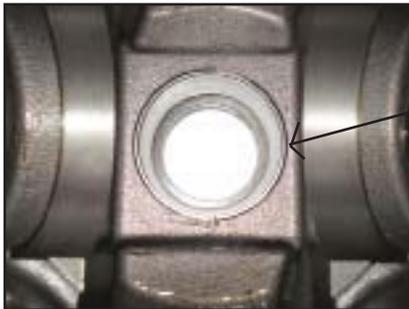
1

Turn housing over so that the pump pilot faces up and install seal retaining snap ring.



2

Lubricate the new seal and while keeping the seal perpendicular to the pump shaft, press the new seal down into the housing using the retaining ring as a stop for the seal.



3

Install new bearing race into the housing.



4

Install new bearing race into port plate.

## Pump Reassembly *continued*



5

Inspect sealing area on shaft for any defects.



6

Install preload shim and rear bearing cone onto shaft, assemble into pump housing and torque to appropriate values (see torque chart).



7

Measure distance between pump housing and port plate and adjust shim thickness to arrive at an initial preload of 0-.002 thousandths. Alternative method p. 25.



8

Remove port plate from pump housing and place aside for later attachment.

## Pump Reassembly *continued*



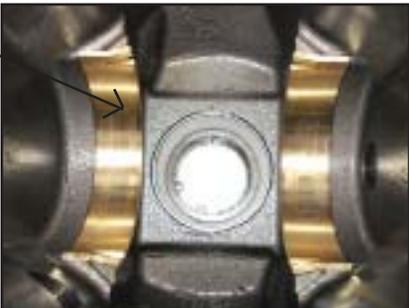
9

Remove shaft assembly from pump housing.



10

Lubricate lips of shaft seal and carefully install the shaft assembly into the pump body.



11

Grease cradle bearings and assemble into pump housing.



12

Install the yoke assembly into the cradle bearings, making sure that the long relief on the yoke bearing is located on the pressure side of the pump and the yoke moves freely.

## Pump Reassembly *continued*



13

Assemble the rotating group, making sure all components move freely and are located in place.



14

Install into the pump housing, making sure that the yoke and cradle bearings do not move out of position.



15

Install shim and rear bearing cone.



16

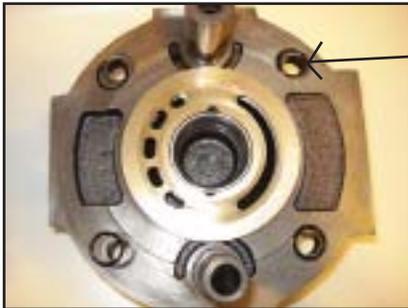
If removed reinstall the control piston and counter piston guides on to the port plate (use loctite #277) then install the control piston on the control piston guide and the counter piston spring along with the counter piston onto the counter piston guide.

## Pump Reassembly *continued*



17

Install the valve plate onto the port plate (lining up the locating pin on the port plate with the alignment slot on the valve plate).



18

Install the four sealing o-rings in the port plate.



19

Install large body o-ring seal.



20

Install completed port plate assembly onto the pump body, making sure that the scribe marks are aligned. Install four fixing bolts and torque to required values (see torque chart).



21

Install control assembly and torque four fixing bolts to appropriate values. 41 in lb (12 Nm)



22

Install max volume stop, sealing washer, locknut and protective cap into the port plate and tighten securely.



23

Replace key if applicable. Check that unit will turn freely.

YOUR UNIT IS NOW READY FOR TESTING.

## Set Up Procedure DR Controller

1. Conversion of DFR1 to DR controller:
  - a) Remove protective cap nut from FR (flow control spool). This is the spool furthest from pump body.
  - b) Loosen locking nut and turn FR adjustment screw clockwise until it bottoms out.
  - c) Tighten locking nut and replace protective cap nut.
  - d) Make sure X port is plugged with 7/16-20 UNF straight thread plug. (#4 ORB)
  
2. SET UP - DR (pressure) controller without additional system relief:
  - a) Remove protective cap nut from DR (pressure control) spool. This is the spool closest to pump body.
  - b) Loosen locking nut and turn DR controller adjustment screw counter clockwise until no spring tension can be felt.
  - c) Start pump and adjust system so as to provide a no flow-system blocked (dead head) condition.
  - d) Turn DR controller adjustment screw clockwise to required system operating pressure.
  - e) Tighten locking nut, and secure protective cap nut.

NOTE: If system is utilizing an additional relief valve - to avoid system overheating - make sure additional relief is set to a minimum of 150 psi higher than DR controller pressure setting!

# Adjustment Procedures DRG Control

## DRG Remote Pressure Controller Set Up

Although identical in appearance, the DFR and DRG controllers are not interchangeable. The DRG controller utilizes a different FR control spool which allows system oil into the FR spool spring chamber, and is accessible through the X port connection. A remote relief valve can be connected to the X port controlling oil pressure in the FR spring chamber, thus controlling pump pressure.

1. DRG (remote pressure) controller set up:
  - a) Turn remote pressure control clockwise until the adjusting screw bottoms out.
  - b) Remove protective cap nut from FR (flow control spool). This is the spool furthest from pump body.
  - c) Loosen locking nut and turn FR adjustment screw clockwise until it bottoms out.
  - d) Remove protective cap nut from DR (pressure control spool). This is the spool closest to pump body.
  - e) Loosen locking nut and turn DR controller adjustment screw counter clockwise until spring tension is removed from the spool.
  - f) Start pump and adjust system so as to provide a no flow-system blocked (dead head) condition.
  - g) Turn DR controller adjustment screw clockwise to required system operating pressure.
  - h) Tighten locking nut, then reinstall and tighten protective cap nut on DR controller adjustment screw.
  - i) Turn remote relief valve counter clockwise to its lowest setting.
  - j) Turn FR controller adjustment screw counter clockwise to approximately 200 psi then turn clockwise to a final setting of 300 psi.
  - k) Tighten locking nut, then reinstall and tighten protective cap nut on FR adjustment screw.
  - l) Turn remote relief valve to desired operating pressure.

## DFR/DFR1 (Load Sensing) Controller Set Up

The DFR controller provides an internal bleed down orifice to prevent pressure from being trapped in the load sense line and preventing the pump from going into standby during operation or at shutdown. The DFR1 controller does not provide this bleed down feature.

The DFR/DFR1 (load sensing controller) will vary the swash plate angle to maintain an operating pressure at a pressure slightly higher than what is required to move the load. This differential is controlled by the pressure value set at the FR flow control spool adjustment.

1. DFR (load sense) controller set up:
  - a) Remove protective cap nut from FR (flow control spool). This is the spool furthest from pump body.
  - b) Loosen locking nut and turn FR adjustment screw clockwise until the adjusting screw bottoms out.
  - c) Remove protective cap nut from DR (pressure control) spool. This is the spool closest to pump body.
  - d) Loosen locking nut and turn DR controller adjustment screw counter clockwise until spring tension is removed from the spool.
  - e) Start pump and adjust system so as to provide a no flow-system blocked (dead head) condition.
  - f) Turn DR controller adjustment screw clockwise to required system operating pressure.
  - g) Tighten locking nut, then reinstall and tighten protective cap nut on DR controller adjustment screw.
  - h) Turn off pump drive and disconnect sensing line from X port at FR control and cap load sense line with an appropriate plug.
  - i) Restart pump and proceed to turn FR controller adjustment screw counter clockwise (system pressure should start to decrease). Continue adjusting counter clockwise until a pressure of approximately 200 psi is observed, then turn adjustment screw clockwise to desired pressure differential setting (approx 300-400 psi).
  - j) Tighten locking nut, then reinstall and tighten protective cap nut on FR adjustment screw.
  - k) Stop pump drive, remove plug and reconnect load sense line to X port.

UNIT IS NOW READY FOR OPERATION.

# Adjustment Procedures DFLR Control

## DFLR Horsepower Limiting Controller Set Up

A DFLR control is used when the prime mover has less than the necessary horsepower to drive full pump flow at full pressure. This control will move the swash plate angle to maintain desired operating pressure while staying within the maximum power limit available from the prime mover.

A requirements for setup:

- 1 clamp on ammeter
- 2 pressure gauge
- 3 flow meter
- 4 load valve

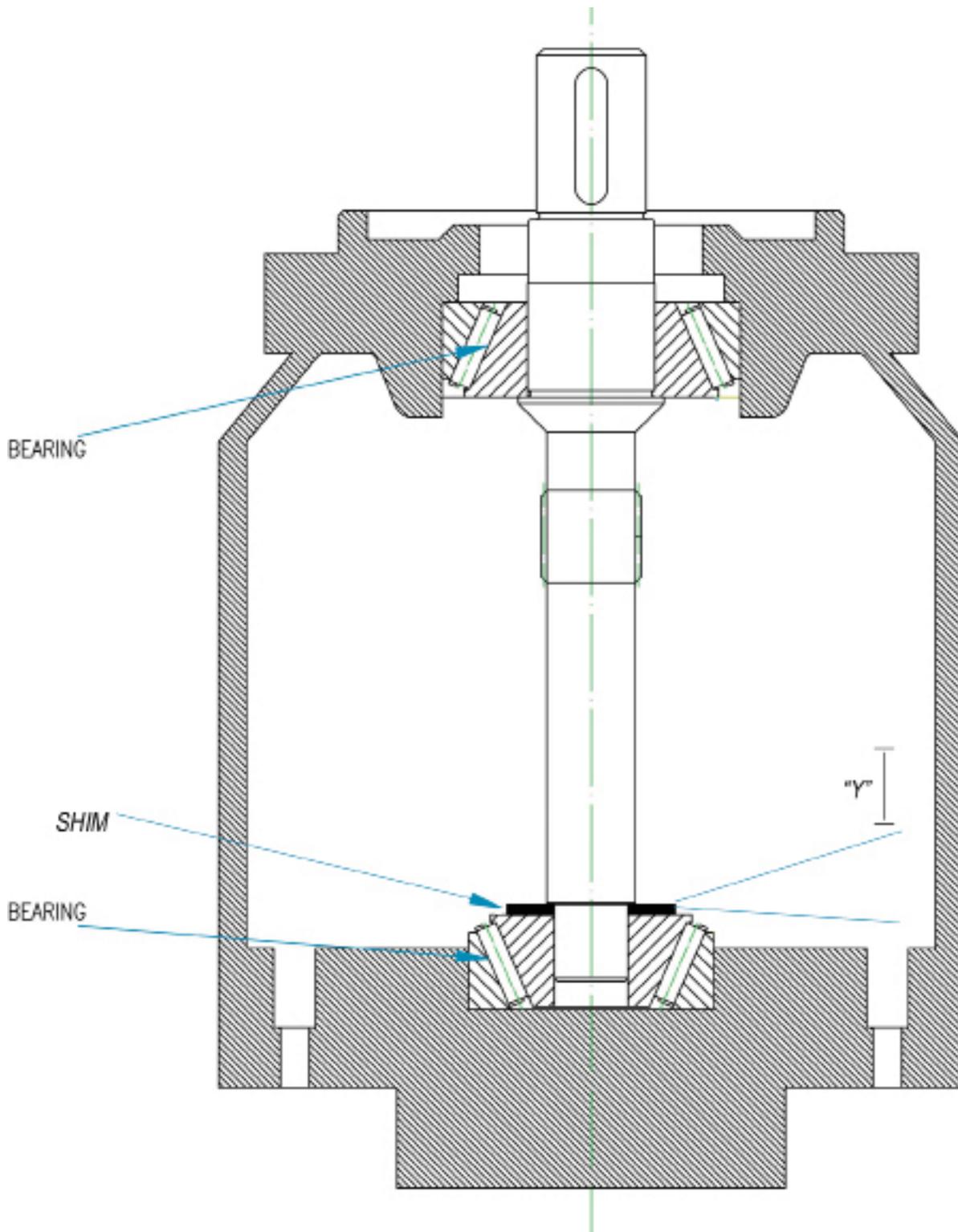
The LR (horsepower limiter) controller is located on the side of the pump body. It is connected to the FR spool spring chamber via a steel tube connection. It has two adjustments on one stem (large & small) and they are located under the protective cap.

- a) Remove protective cap nut from FR (flow control spool) this is the (spool furthest from pump body).
- b) Loosen locking nut and turn FR adjustment screw clockwise until it bottoms out.
- c) Remove protective cap nut from DR (pressure control) spool this is the spool closest to pump body.
- d) Loosen locking nut and turn DR controller adjustment screw counterclockwise until spring tension is removed from the spool.
- e) Start pump and adjust system so as to provide a no flow-system blocked (dead head) condition.
- f) Turn DR controller adjustment screw clockwise to required system operating pressure.
- g) Tighten locking nut then reinstall and tighten protective cap nut on DR controller adjustment screw.
- h) Turn off pump drive and disconnect sensing line from X port at FR control and cap load sense line with an appropriate plug.
- i) Restart pump and proceed to adjust FR controller adjustment screw to a value of 300PSI.
- j) Tighten locking nut then reinstall and tighten protective cap nut on FR adjustment screw.
- k) Stop pump drive remove plug and reconnect load sense line to x port.
- l) Calculate for later use:  
$$\text{PSI} = \text{HP} \times \text{efficiency} (0.85) \times 1740 \div \text{GPM (U.S.)}$$
$$\text{BAR} = \text{KW} \times \text{efficiency} (0.85) \times 600 \div \text{L/min}$$
- m) Review motor nameplate information and record full load amp rating for the voltage you are using.
- n) Install flow meter and load valve (adjusted to full open) into pump outlet line and install ammeter around one of the motor power leads.
- o) Start pump- flow meter should read full pump flow and ammeter should be reading below full load amps.
- p) Slowly close load valve while watching ammeter and bring motor to full load amperage as noted on motor name plate. Flow meter should stay at full pump flow; pressure gauge should read close to PSI as calculated in step L above.

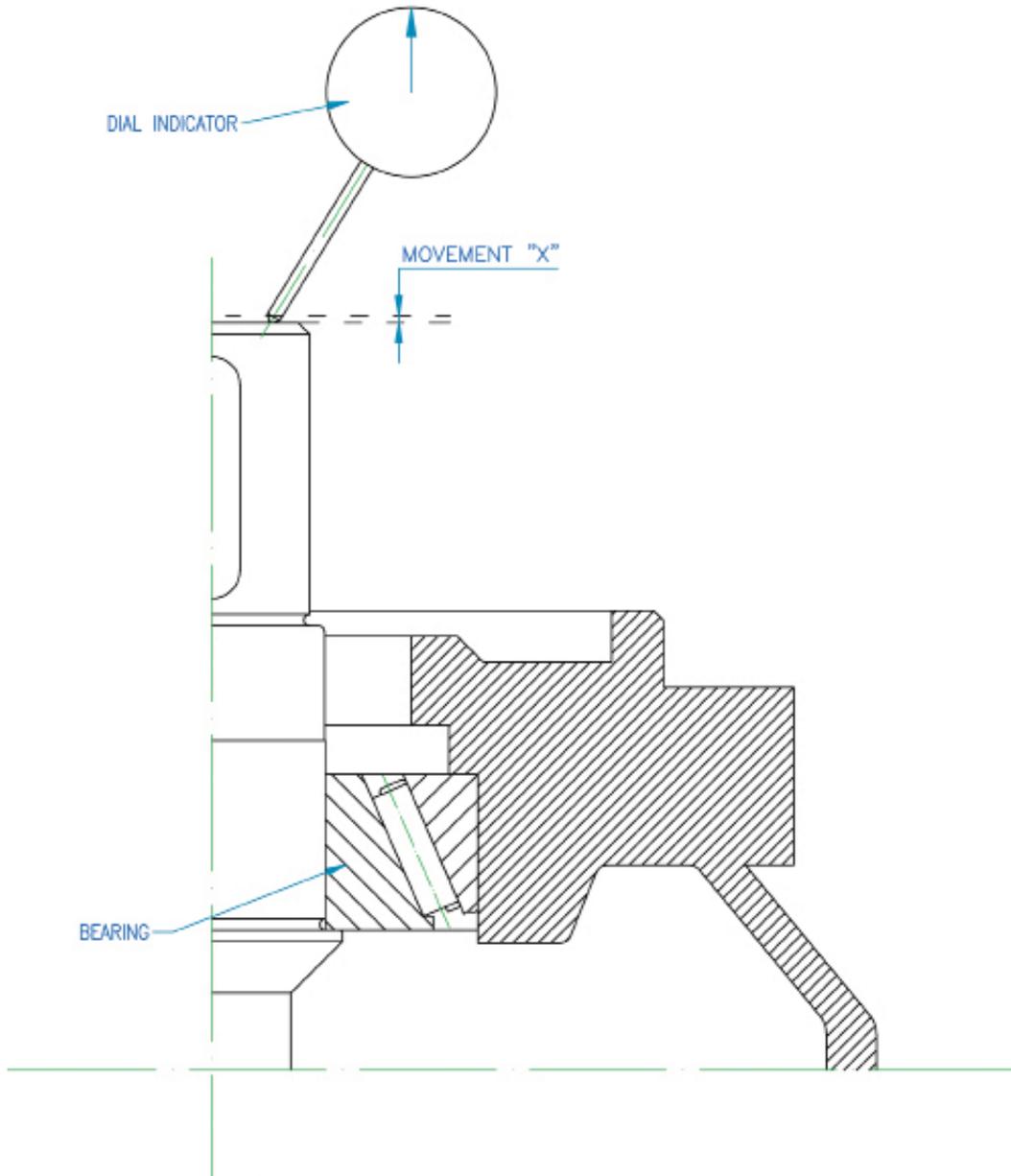
## *DFLR Horsepower Limiting Controller Set Up* continued

- q) Continue slowly closing load valve to bring motor slightly above full load amps (do not go above 10% of motor nameplate full load amp rating).
- r) Now turn power valve large adjustment counter clockwise to bring amp reading below full flow amps.
- s) Now turn power valve large adjustment clockwise and bring motor back up to full load amps.
- t) Observe flow meter and pressure gauge. Flow should be about 10% less than full flow and pressure should be the same as observed in step P.
- u) Open the load valve then slowly close it while watching ammeter and bring motor up to full load amps. All readings should be very close to those observed in step P above.
- v) Continue to close load valve while watching ammeter. Ammeter should never fluctuate more than a small amount either side of full load amps as pressure goes up and flow goes down.
- w) Continue to close load valve until pump compensator takes over. Oil flow should stop and pressure should hold at desired system operating pressure. (The load valve should be fully closed at this point.)
- x) If you find ammeter is moving more than 5% either side of full load amps
- y) Loosen small adjustment lock nut on power valve.
- z) Open and close the load valve; if the ammeter is falling 5% below full load amps turn small adjustment screw clockwise.
- aa) If ammeter is reading 5% above full load amps turn small adjustment screw counterclockwise.
- bb) Repeat procedure as necessary until ammeter stays at or just below full load amp rating.
- cc) Open load valve tighten small adjustment lock nut stop pump, replace cap, remove test equipment.

*DFLR Horsepower Limiting Controller Set Up* continued



## DFLR Horsepower Limiting Controller Set Up *continued*



Identify the required preload on the shaft:

Pre load required = .002" (0.05 mm).

Due to the build up of difference tolerances from pump to pump, it is imperative that this operation is always carried out.

1. We assemble the bearings on the shaft (top and bottom).
2. We fit the shaft into the housing.
3. We fit the valve plate to the housing, ensuring the bearing for the valve plate is correctly located.
4. **We do not fit any other internal parts.**
5. We measure the amount of movement the shaft has when fitted (**dimension X**).
6. We add the pre load required:

**X plus .002" (0.05 mm) = Dimension Y.**

**Dimension Y is the thickness of the shim required.**

**Note: This operation must be done for each pump that is repaired.**

# Torque Specifications

	<u>FT/LBS</u>	<u>Nm</u>
VS / VSO 18	20	27
VS / VSO 28	31	42
VS / VSO 45	53	72
VS / VSO 71	85	115
VS / VSO 100	100	135

*Metaris accepts no responsibility for possible errors in catalogs, brochures and other printed material. Metaris reserves the right to alter its products without prior notice.*



## **METARIS BRAND REPLACEMENT PARTS**

**Our extensive inventory assures you of prompt shipping of pump and parts anywhere in the world.**

**Our parts are 100% interchangeable with OEM products. We are committed to high quality, zero defects, and processing your orders on time.**

**Whatever your application, Metaris has a high quality replacement product backed by our 100% commitment to service.**

**We strive to meet your every hydraulic need.**



**WIDE RANGE OF  
COMPONENTS**

### **Metaris Corporation**

1519 Hwy 35 North, Forest, Mississippi 39074  
Tel: (601) 469-1987 / Toll Free 1-800-962-2703  
Fax: (601) 469-2120 / Toll Free 1-800-654-5083  
E-mail: [sales@metarisusa.com](mailto:sales@metarisusa.com)

### **Metaris Inc.**

1120 Lodestar Rd. Toronto, Ontario M3J 2Z4  
Tel: (416) 638-6000 / Toll Free 1-888-477-2737  
Fax: (416) 638-9365 / Toll Free 1-866-638-9365  
E-mail: [sales@metaris.com](mailto:sales@metaris.com)