3-WAY SERVO VALVES

Model Sizes HS3WSL-800 thru HS3WSL-2000

FAST FORGE (PLANISH) VALVES

PURPOSE AND SCOPE

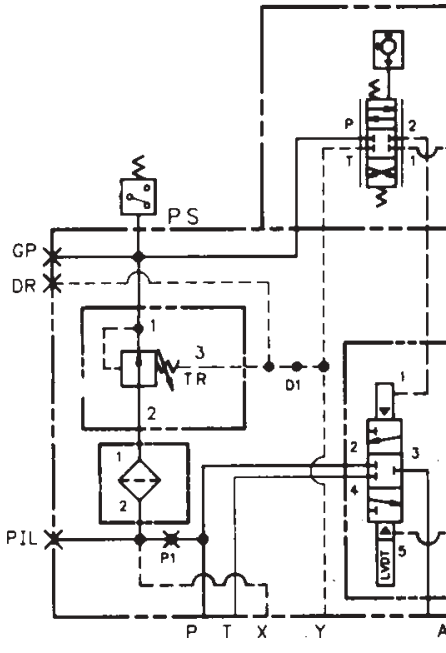
This document provides testing and calibration procedures for 3-WAY SERVO VALVES model size HS3WSL-800 through HS3WSL-2000 and FAST FORGE (PLANISH) VALVE manufactured by The Oilgear Company, 2300 So. 51st. Street, Milwaukee, Wisconsin 53219. This valve has been tested and calibrated prior to shipment. Selected portions of this document may be used for in field recalibration or testing. It is divided into four sections.

A. Section I contains tools and test equipment needed to test and calibrate 3-WAY SERVO VALVE and FAST FORGE (PLANISH) VALVES.

B. Section II contains inner-loop test and calibration procedures for 3-WAY SERVO VALVES.

C. Section III contains outer-loop test and calibration procedures for FAST FORGE (PLANISH) VALVES.

D. Section IV contains schematic diagrams for the 3-WAY SERVO VALVES and FAST FORGE (PLANISH) VALVES.



99000

Figure 1-1. HS3WSL 3-Way Servo Valve In SCVS Valve Body

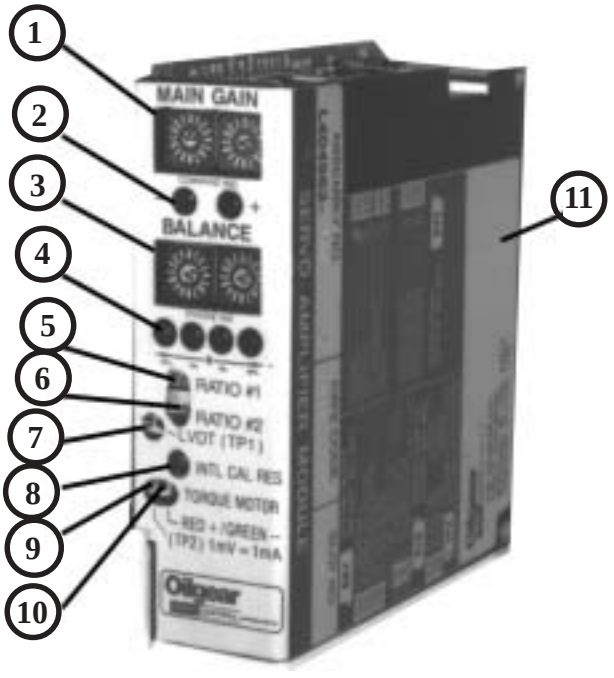
GENERAL

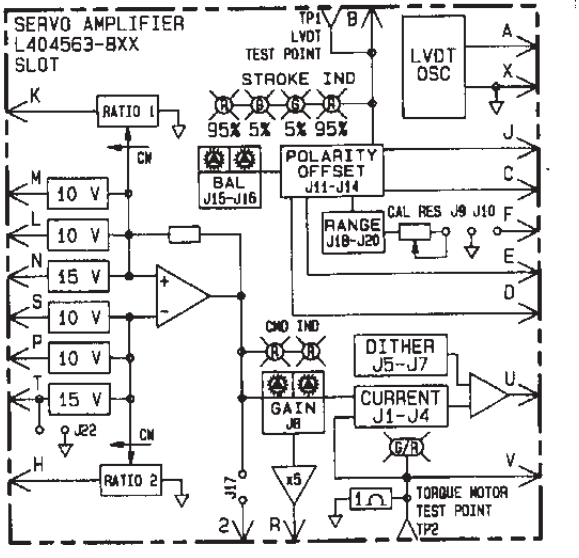
In order to better understand the 3-WAY SERVO VALVE (figure 1-1), for the purpose of this document, separate test and calibration procedures are performed for inner-loop SERVO VALVE and outer-loop FAST FORGE (PLANISH) VALVE circuitry. The inner-loop consists of PILOT SERVO VALVE, SERVO AMPLIFIER (figure 1-2), LVDT and POWER VALVE. The outer-loop consists of FAST FORGE (PLANISH) VALVE, summing SERVO AMPLIFIER (figure 1-2) and LVDT. Command signal to both the inner-loop and outer-loop circuitry is amplified and summed by means of a SERVO AMPLIFIER MODULE (figure 1-2). The SERVO AMPLIFIER MODULE also provides LVDT and TORQUE MOTOR output test points (figure 1-2) as well as diagnostic indicator lights (figure 1-2). All inner loop components (SERVO AMPLIFIER MODULE, POWER VALVE and PILOT SERVO VALVE) are tested and calibrated as matched sets and should be installed as sets.

I. TOOLS AND TEST EQUIPMENT.

Tools and test equipment required to test and calibrate 3-WAY SERVO VALVES are as follows.

1. Digital Voltmeter
2. Oscilloscope (dual trace if available)
3. Drill Rod (see table 2-1 for sizing information)
4. Vise Grips (6 inch)
5. LVDT Cable (BELDEN #8723, Oilgear #246165 or L722400-XXX/connector).
6. 8 x 32 x 1.5 machine screw.
7. Extender Card 313419 or similar.





1. Main Gain Hex Switches (SW1 and SW2)
2. Command Error Indicator LED's (+/- .5VDC)
3. Balance Hex Switches (SW3 and SW4)
4. Stroke Indicator LED's (+/-5% and +/-95%)
5. Ratio Potentiometer #1
6. Ratio Potentiometer #2
7. LVDT Test Point (TP1)
8. Internal Calibration Resistor
9. Torque Motor Test Point (TP2)
10. Torque Motor LED (Red + or Green -)
11. Side Panel Label

Figure 1-2 Servo Amplifier Module

OILGEAR
2300 So. 51st. Street
Milwaukee, WI USA 53219

Telephone: (414) 327-1700
Fax: (414) 327-0532
E110

II. INNER-LOOP TEST PROCEDURES FOR HS3WSL 3-WAY SERVO VALVES

The following tests should be run in sequence as indicated.

A. PRELIMINARY TEST SETUP

Complete test setup in accordance with the following:

1. Remove power to rack.

2. Label LVDT, SERVO AMPLIFIER MODULES and POWER VALVE to be tested with same code number. SERVO AMPLIFIER MODULES, POWER VALVE and PILOT SERVO VALVE should be ordered in sets. (Repeat all calibration procedures if any substitutions are made within sets). Later, a PILOT SERVO VALVE shall be added to each set.

3. Attach extender card to inner loop SERVO AMPLIFIER MODULE. Insert SERVO AMPLIFIER MODULE into appropriate slot in rack.

4. Remove outlet loop SERVO AMPLIFIER MODULE. (if provided for fast forge valve).

5. Connect LVDT cable to LVDT on 3-WAY SERVO VALVE.

6. Apply power to rack and inner loop SERVO AMPLIFIER MODULE.

B. 3-WAY SERVO VALVE (INNER-LOOP) CALIBRATION PROCEDURES.

Electrically center LVDT as follows.

1. Insert 8-32 x 1.5 machine screw into end of valve spool, opposite LVDT housing. Fig. 2-1, 2-2.

2. Attach digital voltmeter leads to pins D and C (or rack terminals equal to) of inner loop SERVO AMPLIFIER MODULE (ac, 2 volt range).

3. Move valve spool by pushing and pulling on machine screw. Observe LVDT output on digital voltmeter.

NOTE

AC voltage shall increase as valve spool with LVDT core attached moves in both directions away from electrical center (null) position of LVDT body.

4. Locate valve spool at position producing lowest ac voltage reading. This position is electrical center of LVDT. At this position, LVDT output voltage shall be less than 0.10vac.

5. If minimum LVDT voltage is greater than 0.10 vac, replace defective LVDT and repeat all calibration procedures.

6. If minimum LVDT voltage is not attained because valve spool has reached end of stroke, adjust LVDT stem as follows in C. PROCEDURE.

7. Proceed to Procedure Set "D" when proper LVDT center null voltage is obtained.

C. *LVDT STEM AC BALANCE ADJUSTMENT.

***When LVDT stem balance adjustment is made prior to initial shipment, refer to "Dimensions" on assembly drawings for initial sittings.**

Perform LVDT stem ac balance adjustment as follows.

1. If not previously done, remove LVDT housing on size –800 and –1200 valves or LVDT housing and bonnet on size –1600 and larger valves. Remove valve spool from valve body. Loosened jam nut on LVDT stem. Make LVDT stem adjustment as follows.

2. If lowest ac voltage is attained stroking valve spool away from LVDT connector, rotate LVDT stem clockwise.

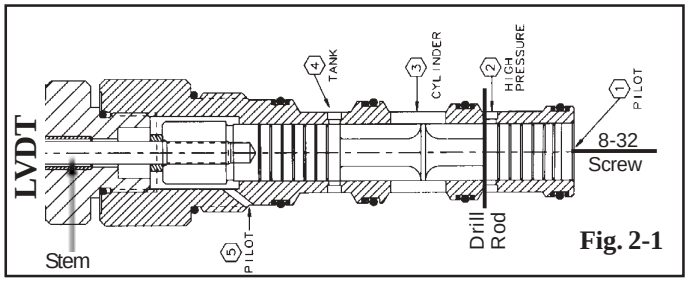


Fig. 2-1

3. If lowest ac voltage is attained stroking valve spool toward LVDT connector, rotate LVDT stem counterclockwise.

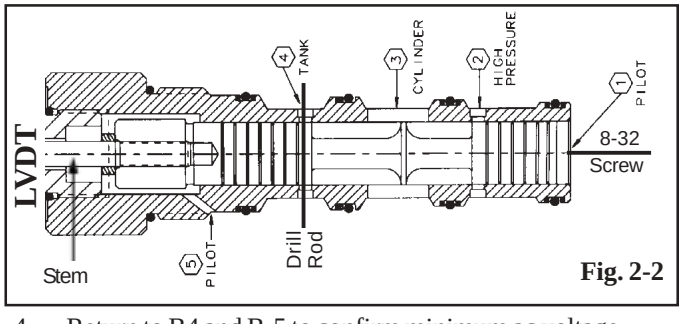


Fig. 2-2

4. Return to B4 and B-5 to confirm minimum ac voltage.

5. With valve spool at position giving lowest ac voltage (±0.005vac), measure dc voltage at LVDT test point on inner loop SERVO AMPLIFIER MODULE with respect to common (pin X). Adjust BALANCE (figure 1-2) on inner-loop SERVO AMPLIFIER MODULE. DC voltmeter shall read 0.00vdc (±0.010vdc).

NOTE:

Check spool position is maintained at minimum LVDT ac voltage position when adjustment is made.

D. LVDT OUTPUT POLARITY ADJUSTMENT.

Check proper polarity at dc output as follows.

1. Measure dc voltage at LVDT test point on inner loop SERVO AMPLIFIER MODULE with respect to common (pin X).

2. When valve spool is moved to maximum stroke away from LVDT, DC output shall be maximum negative voltage.

3. When valve spool is moved to maximum stroke towards LVDT, dc output voltage shall be maximum positive value.

4. If polarities are backwards, reverse LVDT secondary wires at rack/minirack (equal to amplifier pins C & D).

E. LVDT MECHANICAL TO ELECTRICAL CALIBRATION

Perform LVDT Mechanical Centering as follows:

1. Insert drill rod of correct size (drill rod sizing information is listed in table 2-1) through slots at port 2.

2. Push valve spool against drill rod and hold in place. Record LVDT DC output voltage at amplifier test point. Ref. Fig. 2-1.

3. Insert appropriate drill rod through slots in port 4 and pull spool against it. Record LVDT DC output voltage, at amplifier text point. Ref. Fig. 2-2.

4. Subtract two (2) voltages recorded in steps 2 and 3 above as follows.

(+ Voltage with drill rod in port 4)
- (-Voltage with drill rod I port 2)

Total voltage change

EXAMPLE

Voltage with drill rod in port 4 = 4.18vdc
Voltage with drill rod in port 2 = -9.63vdc
4.18vdc – (-9.63vdc) = 13.81 vdc

NOTE:

Subtracting a negative voltage is the same as adding it's opposite positive value.

5. Compare total voltage from step 4 to calibration voltage listed for appropriate valve size from table 2-1. Adjust voltage range by rotating LVDT oscillator potentiometer located on underside of inner-loop SERVO AMPLIFIER MODULE. For L-404563-6XX & 7XX SERIES AMPLIFIERS. ADJUST AT INTERNAL CALIBRATE RESISTOR POT ON -8XX SERIES AMPLIFIERS.

a. If total voltage change in step 5 was less than calibration voltage from table 2-1, rotate LVDT oscillator/internal calibration resistor potentiometer clockwise (cw).

b. If total voltage change in step 5 was more than calibration voltage from table 2-1, rotate LVDT oscillator/internal calibration resistor potentiometer counterclockwise (ccw).

c. Repeat steps a and b until voltage equals calibration voltage ±0.050vdc (table 2-1). Record data and proceed to centering, LVDT stem F.

F. CENTERING LVDT STEM.

Center LVDT stem as follows. Amount of LVDT stem adjustment is determined by following formula.

(A + B) /2 X LVDT calibration factor = C
A = Voltage with drill rod in port 2
B = Voltage with drill rod in port 4
C= Amount of adjustment in inches needed to center LVDT
Turns Rotation = C x Thread/Inch Factor
See Table 2-1 for calibration factor

1. Use the two (2) final drill rod voltage measurements (A & B) to center LVDT stem. From Section E-5c.

Valve Size	Drill Rod Diameter for Calibration	L.V.D.T. Calibration Factor In./Volt	Calibration Voltage Volts Volts
HS3WSL-800	0.030 in.	0.010 in./Volt	6.00
HS3WSL1200	0.095 in.	0.015 in./volt	12.66
HS3WSL-1600	0.125 in.	0.020 in./volt	12.50
HS3WSL-2000	0.188 in.	0.022 in./volt	17.10

Table 2-1

* Consult your Oilgear technical representative

2. If voltage measured at port 2 is at larger negative number than positive voltage at port 4, rotate LVDT stem counterclockwise by number of turns determined in formula.

3. If voltage measured at port 4 is a larger positive number than negative voltage at port 2, rotate LVDT stem clockwise by number of turns determined in formula.

4. To determine adjustment (turns and/or degrees of rotation) of LVDT stem, multiply C by appropriate threads/inch factor listed in table 2-2.

OILGEAR
2300 So. 51st. Street
Milwaukee, WI USA 53219

Telephone: (414) 327-1700
Fax: (414) 327-0532
E110

Valve Size	Threads/In. Factor LVDT	STEM	Thread Factor Per In.
HS3WSL-800	#8-32 UNC	.031 in./turn	32
HS3WSL-1200	.250-28UNF	.036 in./turn	28
HS3WSL-1600	.250-28UNF	.036 in./turn	28
HS3WSL-2000	.250-28UNF	.036 in./turn	28

Table 2-2

EXAMPLE

HS3WSL-1200
A = Voltage at Port 2 = -9.60vdc
B = Voltage at Port 4 = +3.06vdc
LVDT calibration factor = 0.015 in/v
C = (-9.60 + 3.06)/2 x 0.015 = -0.049 in

Counterclockwise rotation will accomplish adjustment. Ref. F-2

C = -0.049 inches x 28 =
1.372
counterclockwise turns
or 1 turn + (0.372 x 360)
Degrees
Equals 1 turn, plus additional 133 Degrees

5. Use small pair of vice grips (6 inch) for adjustment, so amount of adjustment can be easily referenced.

CAUTION

DO NOT clamp vise grips on LVDT core! Jaw marks on core will cause erroneous readings.

6. Repeat steps E and F until voltages with drill rod in ports 2 and 4 are equal, but opposite in polarity within ± 0.050vdc and sum to voltage listed in table 2-1 within ±0.050vdc.

EXAMPLE

-6.33 to +6.33 = 12.66

NOTE

Tighten jam nut securely each time adjustment is made.

G. PILOT HYDRAULICS ACTIVE PROCEDURES

Perform electrohydraulic procedures as follows.

1. Remove power.

2. Install cartridge valve/LVDT assembly and 3-WAY SERVO VALVE on manifold.

3. Make the appropriate cable connections from the electrical control to PILOT VALVE and LVDT.

4. Apply electric power and pilot pressure only.

5. If valves does not control position check for polarity reversals.

6. With zero command voltage at input pin of inner-loop SERVO AMPLIFIER MODULE, and amplifier gain at 7 turns clockwise or switch settling of 3-0, dc voltage output from LVDT should be 0 volts, ±0.4vdc.

7. If 0 ±.4vdc cannot be obtained from LVDT, null H1 & 2 procedures in section H1& 2.

H. PILOT SERVO VALVE NULL ADJUSTMENT.

Perform pilot servo valve null adjustment as follows.

1. Connect dc voltmeter to inner-loop SERVO AMPLIFIER MODULE TORQUE METER test point (current).

2. Rotate mechanical null adjustment screw on PILOT SERVO VALVE until voltage reads 0.000 ±0.005vdc.

NOTE

Fluid temperature shall be minimum 110°F or at system operating temperature when adjustment is made.

I. FINAL CHECKS

Perform final checks as follows.

1. Set oscilloscope for .5 sec. per division and approximately 1v/division.

2. Connect scope leads to inner loop amplifier LVDT DC volts (current) test point and common.

3. Connect scope leads to input command and common (channel 2 of dual trace slope if available).

4. Apply positive +3.5vdc command signal. Verify +3.5vdc LVDT feedback signal with oscilloscope.

5. Apply negative -3.5vdc command signal. Verify -3.5vdc LVDT feedback signal with oscilloscope.

6. Adjust MAIN GAIN on inner loop SERVO AMPLIFIER MODULE to achieve trace as illustrated in figure 2-3 (optimum).

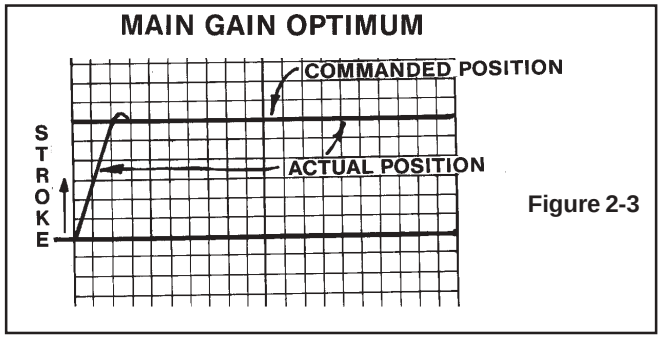


Figure 2-3

Figure 2-2 indicates oscillation at command set point. Inner loop SERVO AMPLIFIER MODULE gain is too high. Adjust inner loop SERVO AMPLIFIER MODULE gain according to standard practices (in appropriate amplifier bulletin).

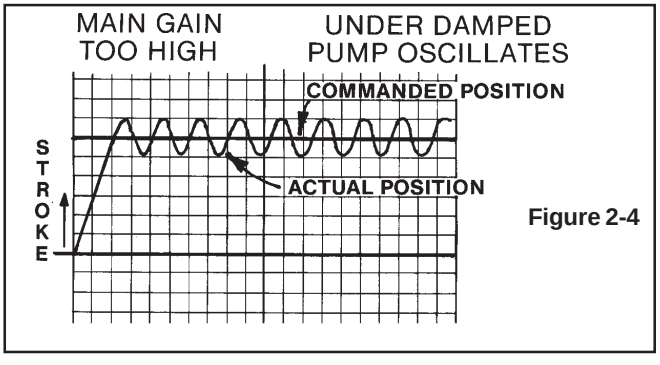


Figure 2-4

Figure 2-3 indicates slow valve shifting. Inner loop SERVO AMPLIFIER MODULE gain is too low. Adjust inner loop SERVO AMPLIFIER MODULE gain according to standard practices (in appropriate amplifier bulletin).

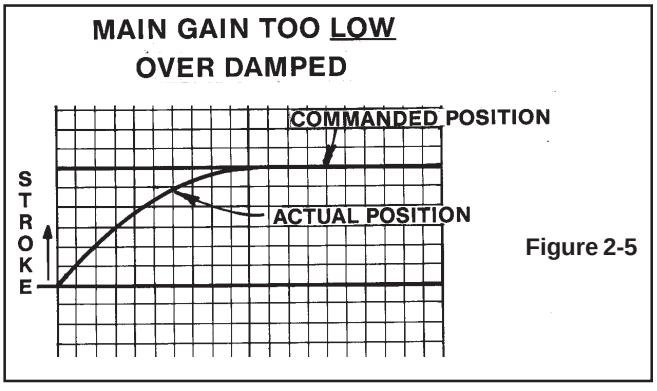


Figure 2-5

III. OUTER -LOOP TEST PROCEDURES

This section provides test procedures for the outer loop section of FAST FORGE (PLANISH) VALVE.

The following tests should be run in sequence indicated. Inner loop tests and calibrations must be performed prior to outer loop tests and calibrations. Inner loop calibration will not need to be reset in outer loop setup.

A. PRELIMINARY TEST SETUP

Complete test setup in accordance with the following.

1. Remove power to rack.

2. Remove extender card from inner-loop SERVO AMPLIFIER MODULE and reinstall amplifier in rack.

3. With extender card attached, insert outer-loop SERVO AMPLIFIER MODULE into rack.

4. Apply power to rack and pilot pressure only.

B. FAST FORGE (PLANISH) VALVE OUTER-LOOP CALIBRATION PROCEDURES

1. With FAST FORGE (PLANISH) VALVE closed tight and zero command voltage to outer-loop SERVO AMPLIFIER MODULE, adjust BALANCE potentiometer until LVDT test point voltage on outer loop SERVO AMPLIFIER MODULE reads +2vdc. This adjustment sets the main valve closing preload at 20% of calibrated stroke.

2. Apply +10vdc command signal to outer -loop SERVO AMPLIFIER MODULE. The main valve should open and LVDT test point voltage shall read approximately +10vdc. Adjust LVDT oscillator/internal calibrate potentiometer until +9.5vdc reading is obtained at LVDT test point. A command of +10vdc and feedback of +9.5vdc should indicate the pilot plunger has come in contact with “full open” stroke limit. This can be confirmed by observing an error to the 3-way servo and a rise in pilot servo torque motor current at the inner loop servo amplifier. Refer to Section II-H-2 Connect oscilloscope to outer-loop main valve AMPLIFIER MODULE LVDT test point. Apply step command from 0vdc to +5vdc and observe wave form on oscilloscope. Adjust GAIN on outer loop SERVO AMPLIFIER MODULE for 1-1/2 over shoots of waveform. Reference Similar Fig. 2-3.

4. Additional on site adjustments may need to be made to individual systems. Specifications, ie: III-B-1 with +1vdc preload, lower gain on outer-loop for stability, etc. May be required for specific applications.

OILGEAR
2300 So. 51st. Street
Milwaukee, WI USA 53219

Telephone: (414) 327-1700
Fax: (414) 327-0532
E110

IV. DIAGRAMS

Section IV contains schematic diagrams for the 3-WAY SERVO VALVE and FAST FORGE (PLANISH) VALVE.

Telephone: (414) 327-1700
Fax: (414) 327-0532
E110

OILGEAR
2300 So. 51st. Street
Milwaukee, WI USA 53219

Issued April, 1999
Bulletin 836110