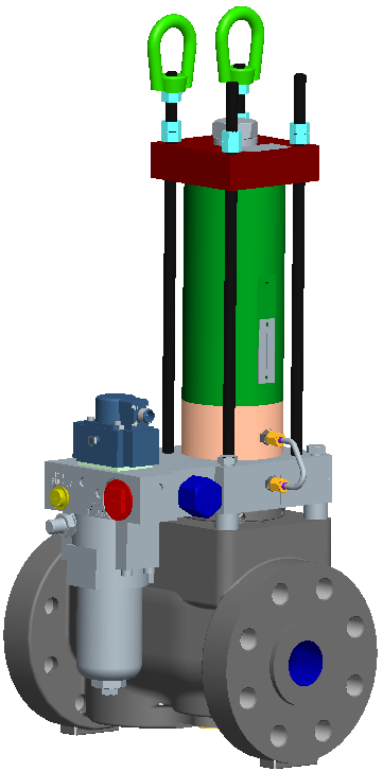
WOODWARD

Product Manual 26416
(Revision NEW)
Original Instructions



HLBV
Hydraulic Liquid Bypass Valve

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, on the *publications page* of the Woodward website:

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The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26311* , *Revision Status & Distribution Restrictions of Woodward Technical Publications*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

Revisions—Changes in this publication since the last revision are indicated by a black line alongside the text.

Contents

Illustrations and Tables

Warnings and Notices

Important Definitions

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

Regulatory Compliance

European compliance for CE Marking
These listings are limited only to those units bearing the CE Marking:

ATEX Potentially Explosive Atmospheres Directive:	Declared to 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. Zone 2, Category 3, Group II G EEx nA IIB T3X, IP54 **Special Conditions for Safe Use:** Maximum ambient temperature is 93C.
Pressure Equipment Directive:	Certified to Pressure Equipment Directive 97/23/EC of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment. Category II Moody Certificate 90 174

Other European Compliance
Compliance with the following European Directives or standards does not qualify this product for the application of the CE Marking:

Machinery Directive:	Compliant as a component with 98/37/EC COUNCIL DIRECTIVE of 23 July 1998 on the approximation of the laws of the Member States relating to machinery.
EMC Directive:	Not applicable to this product. Electromagnetically passive devices are excluded from the scope of the 89/336/EEC Directive.

North American Compliance
Suitability for use in North American Hazardous Locations is the result of compliance of the individual components:

Servo Valve:	FM Certified for Class I, Division 2, Groups A, B, C, & D per 4B9A6.AX for use in the United States. CSA Certified for use in Canadian Class I, Division 2, Groups A, B, C, D as a component for use in other equipment subject to acceptance by CSA or Inspection Authority having jurisdiction, per CSA 1072373."

Wiring must be in accordance with North American Class I, Division 2 or European Zone 2, Category 3 wiring methods as applicable and in accordance with the authority having jurisdiction.

Field wiring must be suitable for at least 100 °C.

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.

⚠AVERTISSEMENT

RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.

La substitution de composants peut rendre ce matériel inacceptable pour des applications de Classe I, Division 2 ou Zone 2.

Chapter 1.
General Information

Introduction

The Hydraulic Liquid Bypass Valve (HLBV) controls the liquid fuel system pressure of an industrial gas turbine combustion system. The unique design integrates the valve and actuator into a cost-effective, compact assembly. The valve is designed to bypass fuel from the discharge side of the positive displacement pump in order to control system pressure. The valve utilizes the common integrated actuator design as other liquid and gas valves but with a normally open valve configuration.

The integral actuator is a single-acting spring-loaded design for failsafe operation. The actuator includes an onboard hydraulic filter for last chance filtration of the fluid to ensure reliability of the servo valve and actuator. The servo valve is electrically redundant with triple coil design.

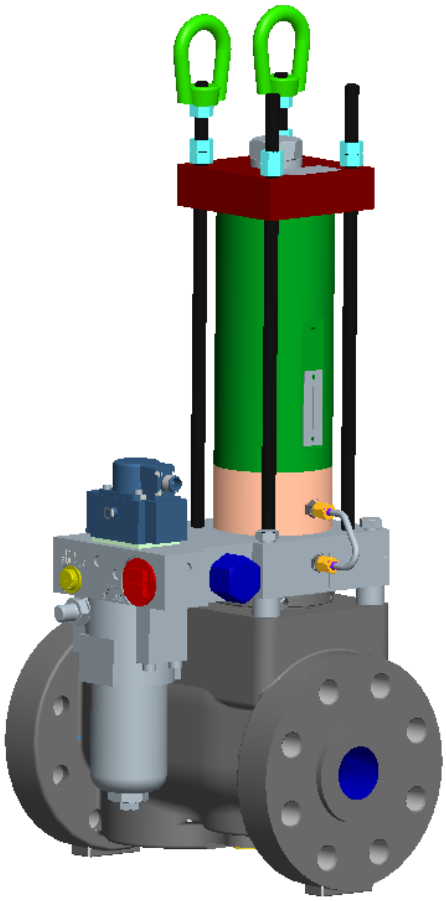


Figure 1-1. Hydraulic Liquid Bypass Valve (HLBV)

HLBV Specifications

Description	2” hydraulically actuated liquid bypass valve
Design Availability Objective	Better than 99.5% over an 8760 hour period
ACTUATOR	
Failure Mode	Spring type to drive valve to safe position (open) with loss of signal
Visual Position Indication	Yes
Actuator Ambient Temperature	–29 to +93 °C (–20 to +200 °F)
Hydraulic Fluid Temperature	10 to 66 °C (50 to 150 °F)
Hydraulic Fluid Type	Petroleum based hydraulic fluids
Hydraulic Supply Pressure	1300 to 1800 psig/8964 to 12 411 kPa
Hydraulic Proof Test Fluid Pressure Level	Per SAE J214
Minimum Hydraulic Burst Fluid Pressure	Per SAE J214
Fluid Filtration Required	10–15 µm absolute
Trip Time	Less than 0.200 s
Slew Time	1±0.150 seconds (opening & closing)
Hydraulic Fluid Connections	Trip relay pressure—1.062-12 UNF straight thread port (–12) Supply pressure—0.750-14 UNF straight thread port (–8) Drain pressure—1.312-20 UNF straight thread port (–16)
Sound Level	<100 dB at max flow
Vibration Test Level	0.5 gp 5–100 Hz sine wave Random 0.01500 gr²/Hz from 10 to 40 Hz ramping down to 0.00015 gr²/Hz at 500 Hz
Shock	Limited to 30 g by servo valve
Servo Input Current Rating	–7.2 to +8.8 mA (null bias 0.8 ± 0.32 mA)
Hydraulic Fluid Contamination Level	Per ISO 4406 code 18/16/13 max Code 16/14/11 preferred
VALVE	
Operating Fluid	Diesel fuel, kerosene, or naphtha (lubricity = 0.825 mm wear scar diameter max per ASTM D5001) - filtered to 25 µm absolute at 75 beta
Connections	ANSI Class 900 # RF flanges
Nominal Piping Size	2”– DN 50 mm
Valve Ambient Temperature	–29 to +93 °C (–20 to +200 °F)
Min Fluid Temperature	The greater of: –29 °C (–20 °F) and 11 °C (20 °F) above the wax point temperature at the supply pressure, or the temperature required to achieve fuel viscosity of 12 centistokes maximum
Max Fluid Temperature	93 °C (200 °F)
Max Pressure	15 515 kPa (2250 psig)
Min Pressure	0 kPa (0 psig)
Proof Test Pressure	23 270 kPa (3375 psig) per ANSI B16.34, ANSI B16.37/ISA S75.19 (Prod Test)
Minimum Valve Burst Pressure	54 300 kPa (7875 psig) based on 3.5 times max working pressure (Proto. Test)
Valve Cv Value	28 to 0.17
Flow Characteristics	±5% Cv deviation of full scale (at 1724 kPa / 250 psid)
Shutoff Classification	10 gal(US)/min at 1000 psig (38 L/min at 6895 kPa) measured with US MIL-C-7024 Type II Calibrating Fluid (Prod Test)
External Leakage	None
Overboard Leakage	1 cm³/min Max
Approximate Weight	110 kg (240 lb)

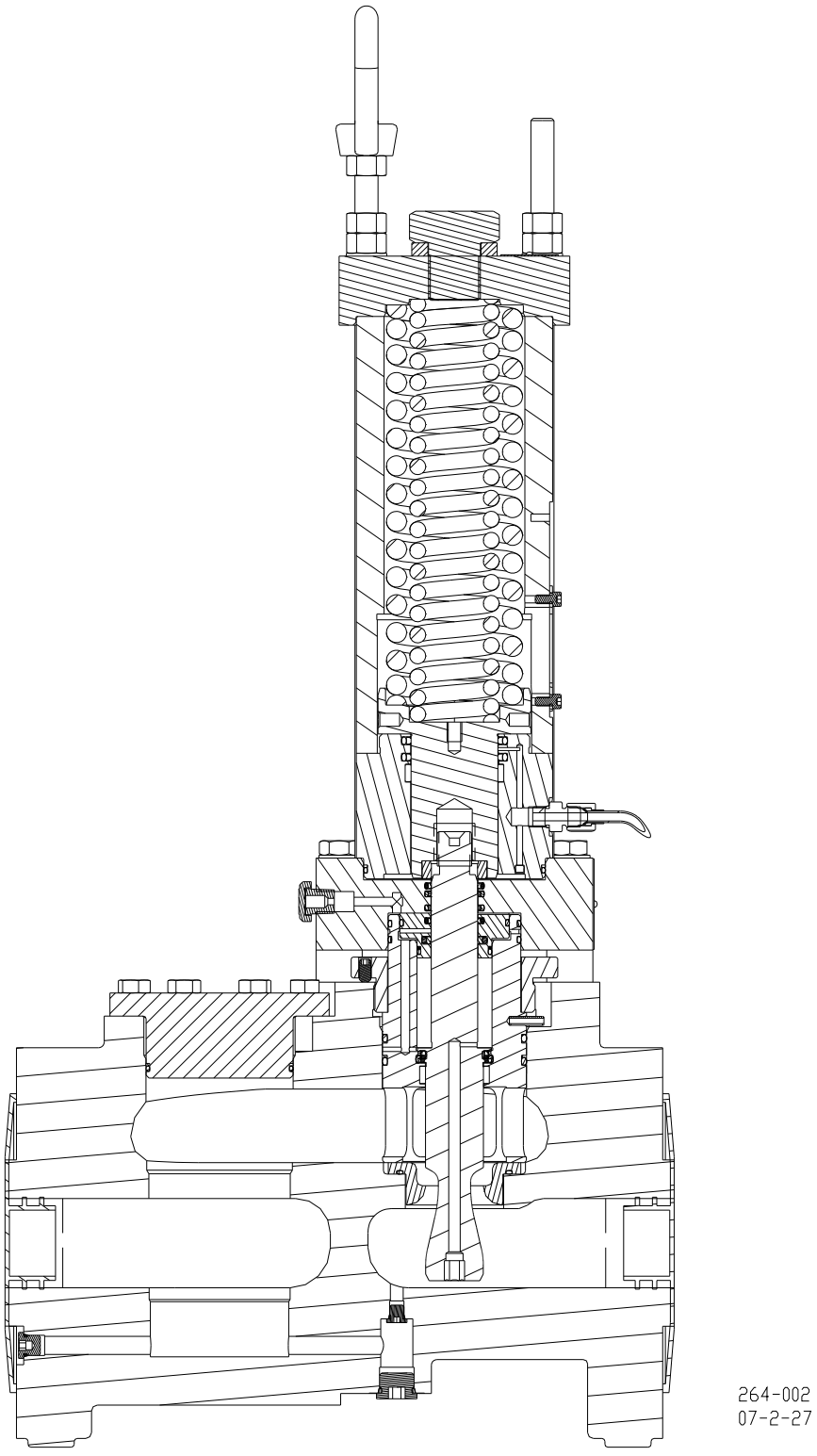


Figure 1-2. HLBV Cutaway

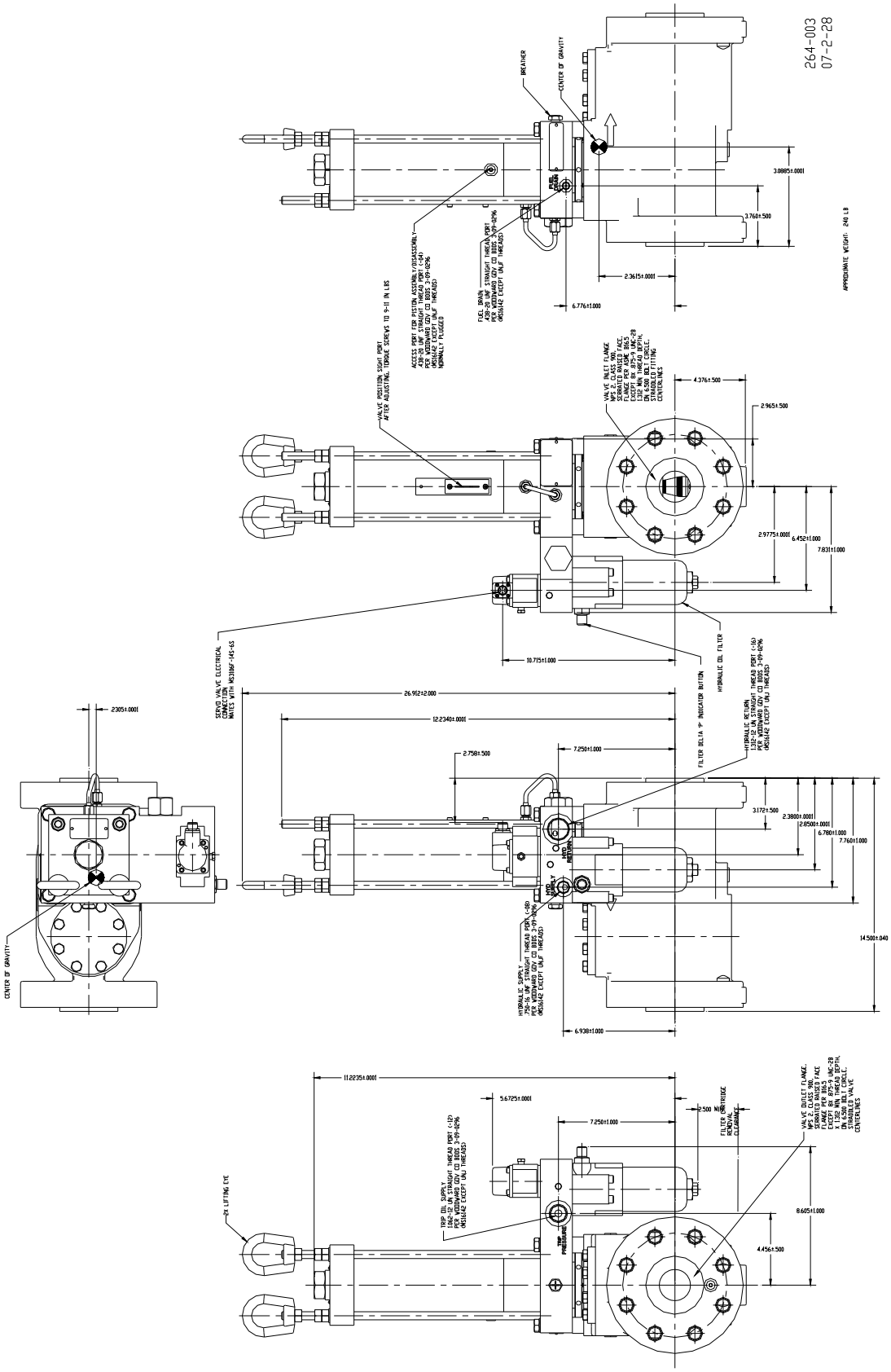


Figure 1-3. HLBV Outline Drawing
(9904-1282 shown)

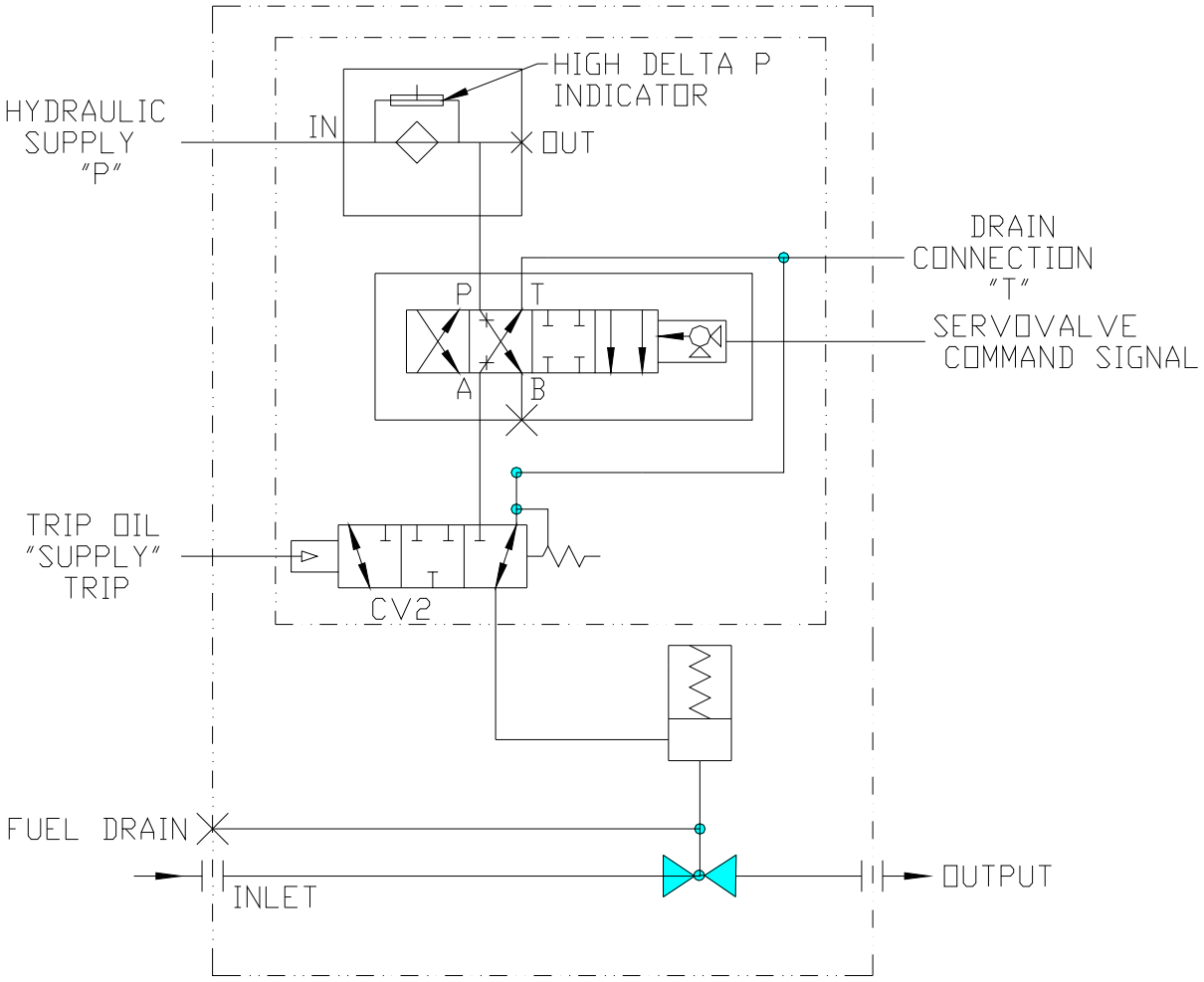


Figure 1-4. Hydraulic Schematic Circuit

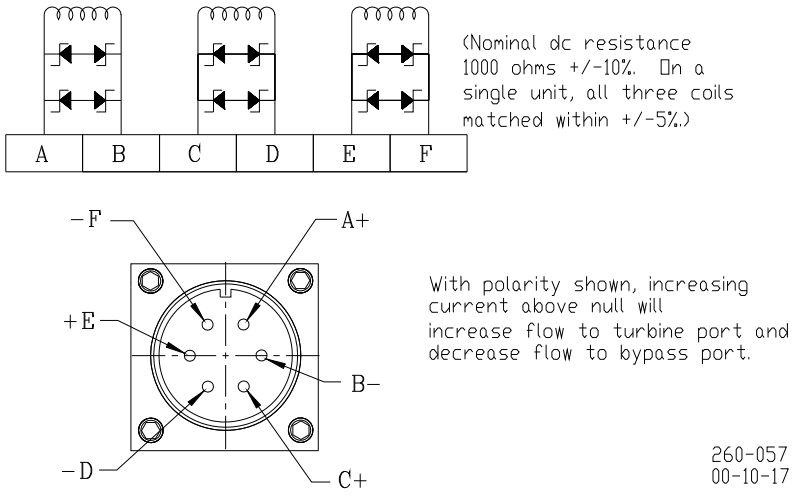


Figure 1-5. Wiring Diagram

Chapter 2.
Description

Triple Coil Electrohydraulic Servo Valve Assembly

The hydraulic actuator assembly uses a two-stage hydraulic servo valve to modulate the position of the actuator output shaft and thereby control the fuel valve. The first stage torque motor utilizes a triple-wound coil, which controls the position of the first and second stage valves in proportion to the total electric current applied to the three coils.

If the control system requires a rapid movement of the valve to bypass less fuel, total current is increased well above the null current. In such a condition, control port PC1 is connected to supply pressure. The flow rate delivered to the piston cavity of the actuator is proportional to the total current applied to the three coils. Thus, the closing velocity is also proportional to the current (above null) supplied to the torque motor.

If the control system requires a rapid movement to bypass more fuel, the total current is reduced well below the null current. In such a condition, port PC1 is connected to the hydraulic drain circuit. The flow rate from the piston cavity to drain is proportional to the magnitude of the total current below the null value. Thus, the opening velocity is also proportional to the current (below null) supplied to the torque motor.

Near the null current, the four-landed valve isolates the control port from the hydraulic supply and drain, balancing the piston pressure against the spring to maintain a constant position. The control system, which regulates the amount of current delivered to the coils, modulates the current supplied to the coil to obtain proper closed loop position of the valve.

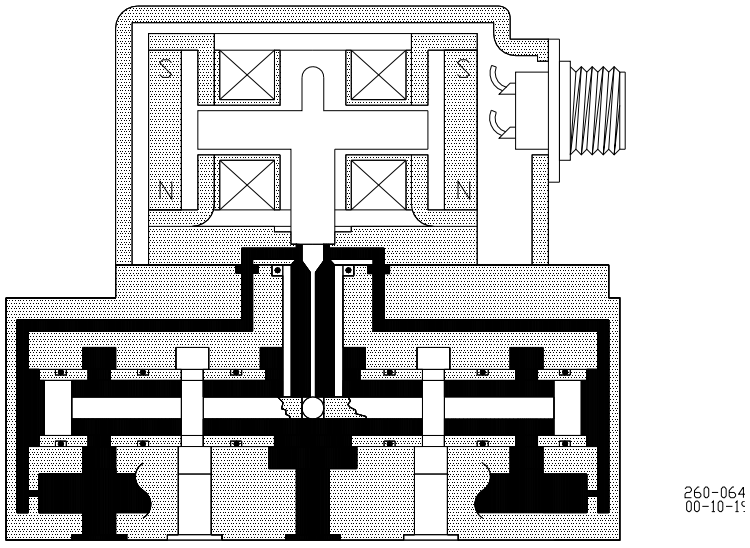


Figure 2-1. Servo Valve Cutaway

Trip Relay Valve Assembly

The HLBV uses a three-way, two-position, hydraulically-operated valve to provide a trip function for the valve. When the trip circuit pressure increases above 18–30 psig (124–207 kPa), the three-way relay valve shifts position so that the common port is connected to supply pressure and isolated from the hydraulic drain circuit. Actuation pressure is routed from the control pressure circuit of the relay valve to the lower piston cavity of the actuator. This moves the piston upward and allows the control valve to function. As the trip circuit supply pressure reduces below 16–28 psig (110–193 kPa), the three-way relay valve shifts position so that the common port is connected to the hydraulic drain circuit, and isolated from the hydraulic supply. As the pressure falls within the lower piston cavity, the return spring will rapidly return the valve plug to the downward position, opening the bypass valve, reducing supply pressure to the system and reducing fuel to the engine.

Hydraulic Filter Assembly

The valve is supplied with an integrated, high-capacity filter. The broad range filter protects the internal hydraulic control components from large oil-borne contaminants that might cause the hydraulic components to stick or operate erratically. The filter is supplied with a visual indicator which shows when the recommended pressure differential has been exceeded and thus replacement of the element is necessary.

Chapter 3.
Installation

General

See the outline drawing (Figures 1-3) for:

- Overall dimensions
- Process piping flange locations
- Hydraulic fitting sizes
- Electrical connections
- Lift points and center of gravity
- Weight of the valve

Installation attitude does not affect actuator or fuel valve performance, but a vertical position is generally preferred to conserve floor space as well as ease of making electrical, fuel, and hydraulic connections and changing the hydraulic filter element. The HLBV is designed for support by the piping flanges alone; additional supports are neither needed nor recommended. Do not use this valve to provide support to any component other than the piping to which it is directly connected.

The orientation of the visual position indicator may be changed to accommodate surrounding obstructions, if any. See Chapter 4 for instructions to change the orientation.

⚠WARNING **External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.**

⚠CAUTION **Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the HLBV.**

⚠CAUTION **Do not lift or handle the valve by any conduit. Lift or handle the valve only by using the eyebolts.**

⚠CAUTION **The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.**

Unpacking

The valve is shipped in an airtight bag with desiccant to ensure a non-corrosive environment. We recommend that the valve be kept in its shipping container until installation. If the valve is to be stored for extended periods of time, encase the valve in an airtight container with desiccant.

Piping Installation

Refer to ANSI B16.5 for details of flange, gasket, and bolt types and dimensions.

This is a globe-style valve. Verify that the process piping face-to-face dimensions meet the requirements of the outline drawings (Figure 1-3) within standard piping tolerances. Use the lifting eye to safely move the valve. The valve should mount between the piping interfaces such that the flange bolts can be installed with only manual pressure applied to align the flanges. Mechanical devices such as hydraulic or mechanical jacks, pulleys, chain-falls, or similar should never be used to force the piping system to align with the valve flanges.

ASTM/ASME grade bolts or studs should be used to install the valve into the process piping. The length and diameter for Class 900 flanges must conform to the following table according to the valve flange size.

Nominal Pipe Size	Number of Bolts	Diameter of Bolts	Stud Length	Machine Bolt Length
2 inch/ 51 mm	8	7/8 inch/ 22 mm	4.5 inch/ 114.3 mm	3.25 inch/ 82.55 mm

Flange gasket materials should conform to ANSI B16.20. The user should select a gasket material which will withstand the expected bolt loading without injurious crushing, and which is suitable for the service conditions.

When installing the valve into the process piping, it is important to properly torque the stud/bolts in the appropriate sequence in order to keep the flanges of the mating hardware parallel to each other. A two-step torque method is recommended. Once the studs/bolts are hand tightened, torque the studs/bolts in a crossing pattern to half the torque value listed in the following table. Once all studs/bolts have been torqued to half the appropriate value, repeat the pattern until the rated torque value is obtained.

Bolt Size	Torque
7/8 inch/ 22 mm	375–390 lb-ft/ 508–529 N·m

Hydraulic Connections

There are three hydraulic connections that must be made to each valve: supply, return, and trip oil. The connections to the valve are straight-thread O-ring style ports per SAE J514. The tubing up to the valve must be constructed to eliminate any transfer of vibration or other forces into the valve.

Make provisions for proper filtration of the hydraulic fluid that will supply the actuator. The system filtration should be designed to assure a supply of hydraulic oil with a maximum ISO 4406 contamination level of 18/16/13 and a preferred level of 16/14/11. The filter element included with the actuator is not intended to provide adequate filtration over the entire life of the actuator.

The hydraulic supply to the actuator is to be 0.500 inch (12.70 mm) tubing capable of supplying 10 US gallons/min (18 L/min) at 1200–1800 psig (8274–12 411 kPa).

The hydraulic drain should be 1.00 inch (25.4 mm) tubing and must not restrict the flow of fluid from the valve. The drain pressure must not exceed 30 psig (207 kPa) under any condition.

The trip relay valve supply should be 0.750 inch (19.05 mm) tubing. The Trip Relay Pressure should be above 40 psig (276 kPa) to enable the valve to function.

Electrical Connections

⚠WARNING **EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.**

⚠AVERTISSEMENT **RISQUE D'EXPLOSION—Ne pas raccorder ni débrancher tant que l'installation est sous tension, sauf en cas l'ambiance est décidément non dangereuse.**

⚠WARNING **Due to the hazardous location listings associated with this valve, proper wire type and wiring practices are critical to operation.**

NOTICE **Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system.**

The use of cable with individually-shielded twisted pairs is recommended. All signal lines should be shielded to prevent picking up stray signals from nearby equipment. Installations with severe electromagnetic interference (EMI) may require shielded cable run in conduit, double-shielded wire, or other precautions. Connect the shields at the control system side or as indicated by the control system wiring practices, but never at both ends of the shield such that a ground loop is created. Wires exposed beyond the shield must be less than 2 inches (51 mm). The wiring should provide signal attenuation to greater than 68 dB.

Servo valve cable should consist of three individually shielded twisted pairs. Each pair should be connected to one coil of the servo valve as indicated in Figure 1-5 (Wiring Diagram).

Fuel Vent Port

There is a fuel vent port that must be vented to a safe location. In normal operation, this vent should have zero leakage. However, if excessive leakage is detected from this vent port, contact a Woodward representative for assistance.

Electronic Settings

Null Current Adjustment

Every valve shipped contains documentation that gives the actual Null Current as measured by Woodward. It is imperative that the control system null current match the as-measured current for each valve in the system. Incorrect null current setting, with proportional control only, will result in position error.

Chapter 4.
Maintenance and Hardware Replacement

Maintenance

The HLBV requires no maintenance or adjustment for operation.

Woodward recommends routine checks of the DP gauge on the filter assembly to verify that the filter is not partially clogged. If the DP indicator shows red, the filter element needs to be replaced.

In the event that any of the standard components of the valve become inoperative, field replacement is possible. Contact a Woodward representative for assistance.

Hardware Replacement

⚠WARNING

EXPLOSION HAZARD—Do not connect or disconnect while circuit is live unless area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2 or Zone 2 applications.

⚠WARNING

To prevent possible serious personal injury, or damage to equipment, be sure all electric power, hydraulic pressure, and fuel pressure have been removed from the valve and actuator before beginning any maintenance or repairs.

⚠CAUTION

Do not lift or handle the valve by any conduit. Lift or handle the valve only by using the eyebolts.

⚠CAUTION

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the HLBV valve.

⚠CAUTION

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

To facilitate field replacement of items, spare parts should be kept on-site. See the outline drawing (Figure 1-3) for the locations of items. Contact Woodward for a complete list of field-replaceable parts and additional instructions for their replacement.

Hydraulic Filter Assembly/Cartridge

The hydraulic filter is located on the hydraulic manifold. It is hanging directly under the servo valve.

Replacement of Filter Assembly:

1. Remove the four 0.312-18 socket head cap screws.
2. Remove the filter assembly from the manifold block. The filter will contain a large amount of hydraulic fluid. ***Be cautious when handling***.
3. Verify that two O-rings are present in the interface between the filter and the manifold.
4. Obtain a new filter assembly from Woodward.
5. Verify that two new O-rings are present in the new filter assembly.
6. Install the filter assembly onto the manifold assembly. Be sure to place the filter in the correct orientation. See the outline drawing (Figure 1-3).
7. Install the four 0.312-18 cap screws through the filter and torque to 244–256 lb-in (27.6–28.9 N·m).
8. Check for external leakage upon pressurizing the hydraulic system.

Replacement of Filter Cartridge:

1. Using a 1-5/16 wrench, loosen the bowl from the filter assembly.
2. The filter bowl will contain a large amount of hydraulic fluid. ***Be cautious when handling***.
3. Remove the filter element by pulling straight down from the rest of the assembly.
4. Obtain a new filter element from Woodward.
5. Lubricate the O-ring on the inside diameter of the cartridge with hydraulic fluid.
6. Install the cartridge into the assembly by sliding the open end of the cartridge onto the nipple.
7. Install the filter bowl onto the assembly. Tighten only by hand. Do not torque the bowl.
8. Check for external leakage upon pressurizing the hydraulic system.

Trip Relay Valve Cartridge

The trip relay valve cartridge is located in the hydraulic manifold, below the servo valve. See the outline drawing (Figure 1-3).

1. Using a 1-1/2 inch wrench (~38+ mm), loosen the trip relay valve from the manifold.
2. Slowly remove the cartridge from the manifold. There could be a substantial amount of hydraulic fluid upon removal. ***Be cautious when handling***.
3. Obtain a new trip relay valve cartridge from Woodward.
4. Verify that all O-rings are present on the new cartridge.
5. Lubricate the O-rings with hydraulic fluid or petroleum jelly.
6. Install the cartridge into the trip relay block.
7. Torque to 40–58 lb-ft (54–79 N·m).
8. Check for external leakage upon pressurizing the hydraulic system.

Servo Valve

The servo valve of the liquid bypass valve is located on the hydraulic manifold directly above the filter assembly (Figure 1-3).

IMPORTANT **The valve contains an intermediate orifice plate under the servo.**

1. Disconnect the servo valve connector.
2. Remove the four #10-32 UNF socket head cap screws holding the servo valve to the manifold.
3. Verify that all four o-rings are removed from the interface between the manifold and the servo valve.
4. Obtain a replacement servo valve and verify the part number and revision with the existing unit.
5. Remove the protective plate from the replacement servo valve and verify that there are o-rings on all four counter bores of the servo valve.
6. Place the replacement servo valve onto the hydraulic manifold. Be sure to orient the servo valve to match the original orientation. Be sure that all four O-rings remain in their proper location during assembly. Verify that the three O-rings on the underside of the orifice plate are in their grooves. Verify that the plate is in the proper location by aligning the “P” and “T” on the side of the servo valve with the “P” and “T” etched into the plate. Be sure to orient the servo valve/orifice plate to match the original orientation. Be sure that all seven O-rings remain in their proper location during assembly.
7. Install four #10-32 UNF socket head cap screws and torque to 32–35 lb-in (3.6–4.0 N·m).
8. Connect the servo valve connector.

Clocking (Rotation) of Actuator to Valve

⚠WARNING **Be sure all electric power, hydraulic pressure, and fuel pressure have been removed from the valve and actuator before maintenance or repairs begin.**

See the outline drawing (Figure 1-3) for the location of items.

Rotation of Actuator Cylinder to Modify the Position of the Visual Indicator

1. Remove the protective covers from the four threaded tie rods that hold the actuator together.
2. Remove the two “eye nuts” from the two tie rods.
3. Remove the two fitting nuts holding the hydraulic overboard vent tube; remove the vent tube.
4. Remove the top 0.500-13 jam nuts from each of the four tie rods.

⚠WARNING **To prevent possible personal injury, do NOT completely remove the nuts in step 5 from the tie rods until you have verified that the preload has been removed from the springs.**

5. Slowly remove the four remaining 0.500-13 nuts from the tie rods, rotating each nut one turn at a time. This will keep the cover square with the housing. Failure to remove the nuts in this manner can cause the cover to become jammed.

   This action will release the preload on the integral springs of the actuator. The tie rod studs should be long enough to completely release the preload prior to coming off of the tie rods. Do NOT completely remove the nuts from the tie rods until you have verified that the preload has been removed from the springs; failure to comply could result in bodily injury.
6. Using a strap wrench or by hand, rotate the actuator cylinder to the required position.
7. Install four 0.500-13 nuts, one onto each stud. Slowly compress the springs into their cavity by rotating each nut one turn at a time. This will keep the cover square with the housing. Failure to install the nuts in this manner can cause the cover to become misaligned and jam.
8. Torque the 0.500 nuts to 35–42 lb-ft (47–57 N·m).
9. Install four additional 0.500-13 nuts onto the studs and torque to 18–21 lb-ft (24–28 N·m).
10. Because the cylinder has been rotated, a new hydraulic overboard vent tube will have to be fabricated to reconnect the overboard vent to the hydraulic manifold. Torque the fittings on the overboard vent line to 134–150 lb-in (15–17 N·m).
11. Replace the two “eye nuts” on the two tie rods.
12. Replace the protective covers onto the tie rods.

Troubleshooting Charts

Faults in the fuel control or governing system are often associated with speed variations of the prime mover, but such speed variations do not always indicate fuel control or governing system faults. Therefore, when improper speed variations occur, check all components including the engine or turbine for proper operation. Refer to applicable electronic control manuals for assistance in isolating the trouble. The following steps describe troubleshooting for the HLBV.

Disassembly of the HLBV in the field is not recommended due to the dangerous forces contained in the springs. Under unusual circumstances where disassembly becomes necessary, all work and adjustments should be made by personnel thoroughly trained in the proper procedures.

When requesting information or service help from Woodward, it is important to include the part number and serial number of the valve assembly in your communication.

Symptom	Possible Causes	Remedies
External hydraulic leakage	Static O-ring seal(s) missing or deteriorated	Replace O-rings fitted to user-serviceable components (filter, servo valve, trip relay valve) as needed. Otherwise, return actuator to Woodward for service.
	Dynamic O-ring seal missing or deteriorated	Return actuator to Woodward for service.
Internal hydraulic leakage	Servo valve internal O-ring seal(s) missing or deteriorated	Replace servo valve.
	Servo valve metering edges worn	Replace servo valve.
	Piston seal missing or deteriorated	Return actuator to Woodward for service.

Symptom	Possible Causes	Remedies
External fuel leakage	Piping flange gaskets missing or deteriorated	Replace gaskets.
	Piping flanges improperly aligned	Rework piping as needed to achieve alignment requirements detailed in Chapter 3.
	Piping flange bolts improperly torqued	Rework bolts as needed to achieve torque requirements detailed in Chapter 3.
	Packing missing or deteriorated	Return actuator to Woodward for service.
Valve will not close	Servo valve command current incorrect. (The sum of the current through the three coils of the servo valve must be greater than the null bias of the servo valve for the gas valve to open.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figure 1-5) and the GE system wiring schematic(s). Pay special attention to the polarity of the wiring to the servo valve.
	Servo valve failure	Replace servo valve.
	Hydraulic supply pressure inadequate	Supply pressure must be greater than 1200 psig/8274 kPa (1600 psig/11 032 kPa preferred).
	Trip relay pressure inadequate	Trip pressure must be greater than 40 psig (276 kPa).
	Filter element plugged	Check filter DP indicator. Replace element if the DP indicator shows red.
Valve will not open	Servo valve command current incorrect. (The sum of the current through the three coils of the servo valve must be less than the null bias of the servo valve for the gas valve to close.)	Trace and verify that all wiring is in accordance with the electrical schematic (Figure 1-5) and the GE system wiring schematic(s). Pay special attention to the polarity of the wiring to the servo valve.
	Servo valve failure	Replace servo valve.
	Springs broken	Return actuator to Woodward for service.
	Linkage broken	Return actuator to Woodward for service.
Valve will not respond smoothly	Hydraulic filter clogged	Check the differential pressure indicator on the filter housing.
	Servo valve spool sticking	Verify hydraulic contamination levels are within recommendations of Chapter 1. The use of dither may improve performance in contaminated systems.
	Servo valve internal pilot filter clogged	Replace servo valve.
	Piston seal worn out	Return actuator to Woodward for service.
	Control system instability	Contact control system supplier.
Actuator seals wear out prematurely	Hydraulic contamination level is excessive	Verify hydraulic contamination levels are within recommendations of Chapter 1. The use of excessive dither may reduce life in contaminated systems.
	System is oscillating (seal life is proportional to distance traveled). Even small oscillations (on the order of ±1%) at slow frequencies (on the order of 0.1 Hz) cause wear to accumulate rapidly.	Determine and eliminate the root cause of oscillation. Possible causes include inlet pressure regulation, control system setup, and improper wiring practices. See Chapter 3 Installation section for wiring recommendations.

Chapter 5.
Service Options

Product Service Options

If you are experiencing problems with the installation, or unsatisfactory performance of a Woodward product, the following options are available:

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full Service Distributor serving your area.
- Contact Woodward technical assistance (see "How to Contact Woodward" later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM and Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Engine Retrofitter (RER)** is an independent company that does retrofits and upgrades on reciprocating gas engines and dual-fuel conversions, and can provide the full line of Woodward systems and components for the retrofits and overhauls, emission compliance upgrades, long term service contracts, emergency repairs, etc.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

You can locate your nearest Woodward distributor, AISF, RER, or RTR on our website at:

www.woodward.com/directory

Woodward Factory Servicing Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for the majority of standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:

- return authorization number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

Use the following materials when returning a complete control:

- protective caps on any connectors;
- antistatic protective bags on all electronic modules;
- packing materials that will not damage the surface of the unit;
- at least 100 mm (4 inches) of tightly packed, industry-approved packing material;
- a packing carton with double walls;
- a strong tape around the outside of the carton for increased strength.

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

How to Contact Woodward

For assistance, call one of the following Woodward facilities to obtain the address and phone number of the facility nearest your location where you will be able to get information and service.

Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

You can also locate your nearest Woodward distributor or service facility on our website at:

www.woodward.com/directory

Technical Assistance

If you need to telephone for technical assistance, you will need to provide the following information. Please write it down here before phoning:

Your Name	
Site Location	
Phone Number	
Fax Number	
Engine/Turbine Model Number	
Manufacturer	
Number of Cylinders (if applicable)	
Type of Fuel (gas, gaseous, steam, etc)	
Rating	
Application	
Control/Governor #1	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #2	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	
Control/Governor #3	
Woodward Part Number & Rev. Letter	
Control Description or Governor Type	
Serial Number	

If you have an electronic or programmable control, please have the adjustment setting positions or the menu settings written down and with you at the time of the call.

Declaration of Incorporation

Woodward Governor Company
1000 E. Drake Road
Fort Collins, Colorado 80525
United States of America

Product: Hydraulic Liquid Bypass Valves
Part Number: Part number 9904-1282 and similar

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado, that the above-referenced product is in conformity with the following EU Directives as they apply to a component:

98/37/EC (Machinery)

This product is intended to be put into service only upon incorporation into an apparatus/system that itself will meet the requirements of the above Directives and bears the CE mark.

MANUFACTURER

Signature

Dan Gear
Full Name

Engineering Manager
Position

WGC, Fort Collins, CO, USA
Place

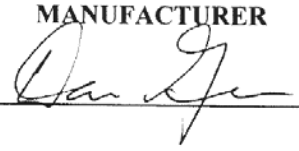
2/27/07
Date

DECLARATION OF CONFORMITY

Manufacturer's Name:	WOODWARD GOVERNOR COMPANY (WGC) Industrial Controls Group
Manufacturer's Address:	1000 E. Drake Rd. Fort Collins, CO, USA, 80525
Model Name(s)/Number(s):	Hydraulic Liquid Bypass Valve (HLBV) Product Family with CE Marking, 9904-1282 and similar.
Conformance to Directive(s):	97/23/EC COUNCIL DIRECTIVE of 29 May 1997 on the approximation of the laws of the Member States concerning Pressure Equipment 94/9/EC COUNCIL DIRECTIVE of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
Marking:	II 3 G, EEx nA IIB T3X, IP54
Applicable Standards:	ASME B31.3 Process Piping, 2004 ASME Boiler and Pressure Vessel Code VIII, Div. 1, 2004 ASME Boiler and Pressure Vessel Code II, Part D, 2004 BS EN 1503-2 : 2000 EN60079-15, 2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection 'n'
Conformity Assessment:	PED Module H – Full Quality Assurance, Certificate 90174
Notified Body For Pressure Equipment:	Moody International Certification Limited (1277) Salisbury House Stephenson's Way The Wyvern Business Park Derby DE21 6LY United Kingdom

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER



Signature

Dan Gear

Full Name

Engineering Manager

Position

WGC, Fort Collins, CO, USA

Place

2/27/07

Date

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 26416.

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Email and Website—www.woodward.com

**Woodward has company-owned plants, subsidiaries, and branches,
as well as authorized distributors and other authorized service and sales facilities throughout the world.**

Complete address / phone / fax / email information for all locations is available on our website.

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