

## **1907 Large Liquid Fuel Valve**

**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

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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.



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## 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**

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.

**Battery Charging  
Device**

## Electrostatic Discharge Awareness

**NOTICE**

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

**Electrostatic  
Precautions**

- 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.



# Chapter 1.

## General Information

### Introduction

The 1907 large liquid fuel valve is normally used with a servo and acceleration limiter assembly. The valve is the basic device for metering fuel to the gas turbine. A differential pressure regulator incorporated in the fuel valve maintains a constant pressure drop across the valve so that the fuel flow at a given position of the fuel valve will always be constant. The fuel valve is available in various ranges for different applications. The exact range of each fuel valve is selected to meet the requirements of the installation. The port in the metering valve sleeve is capable of metering fuel over a range of 30 to 1, with a maximum flow of 11 340 kg/h (25 000 lb/h). Under all operating conditions, there is a minimum fuel flow of 68 kg/h (150 lb/h) through the bleed-valve check ball seat.

### Specifications

The description, requirements, and capabilities of the fuel valve are:

Fuel Type	The valve is compatible with most types of diesels, kerosenes, gasolines, heavy and light distillates including naphtha, gas turbine fuels and fuel oils, and other liquid fuels such as biodiesel that are compatible with fluorocarbon (FKM) type elastomers and conform to international standards for utility, marine, and aviation gas turbine service. Ultra low sulfur diesels are also acceptable with proper lubricity additives. Other fuels such as ethanol or methanol may be acceptable with internal seal compound substitutions. Contact Woodward for these and other special fuel applications.
Fuel Viscosity	Fuel viscosity must be between 0.5 and 12.0 centistokes.
Fuel Cleanliness	Liquid fuel must be filtered to limit particulate size to 20 $\mu$ m or smaller. Water content must be limited to 0.1% by volume. Solids, sediment, and particulates must be limited to 1.0 mg per liter of fuel.
Specific Gravity	0.77 to 0.91
Fuel Schedule (Nominal)	
Maximum metered fuel flow	11 340 kg/h (25 000 lb/h)
Maximum bypass fuel flow	13 608 kg/h (30 000 lb/h)
Fuel Pressure:	
Inlet (Maximum)	9377 kPa (1360 psig) w/ aluminum body 17 238 kPa (2500 psig) w/ stainless steel body and class 10.9 (grade 8) bolts
Outlet (Maximum)	9032 kPa (1310 psig) w/ aluminum body 16 893 kPa (2450 psig) w/ stainless steel body and class 10.9 (grade 8) bolts
Differential Pressure	345 to 827 kPa (50 to 120 psig)
Porting:	
FUEL IN	M533786-20
FUEL OUT	MS33786-20
BYPASS	M533786-20
Overboard Drain (O. B. DR.)	MS33649-4
Flow Range	30 to 1

## Chapter 2. Principles of Operation

The liquid fuel valve meters fuel as a function of the angular position of its ported metering sleeve. The metering sleeve is positioned by a servo and acceleration limiter assembly or governor. See Figure 2-1 for a schematic diagram of the liquid fuel valve.

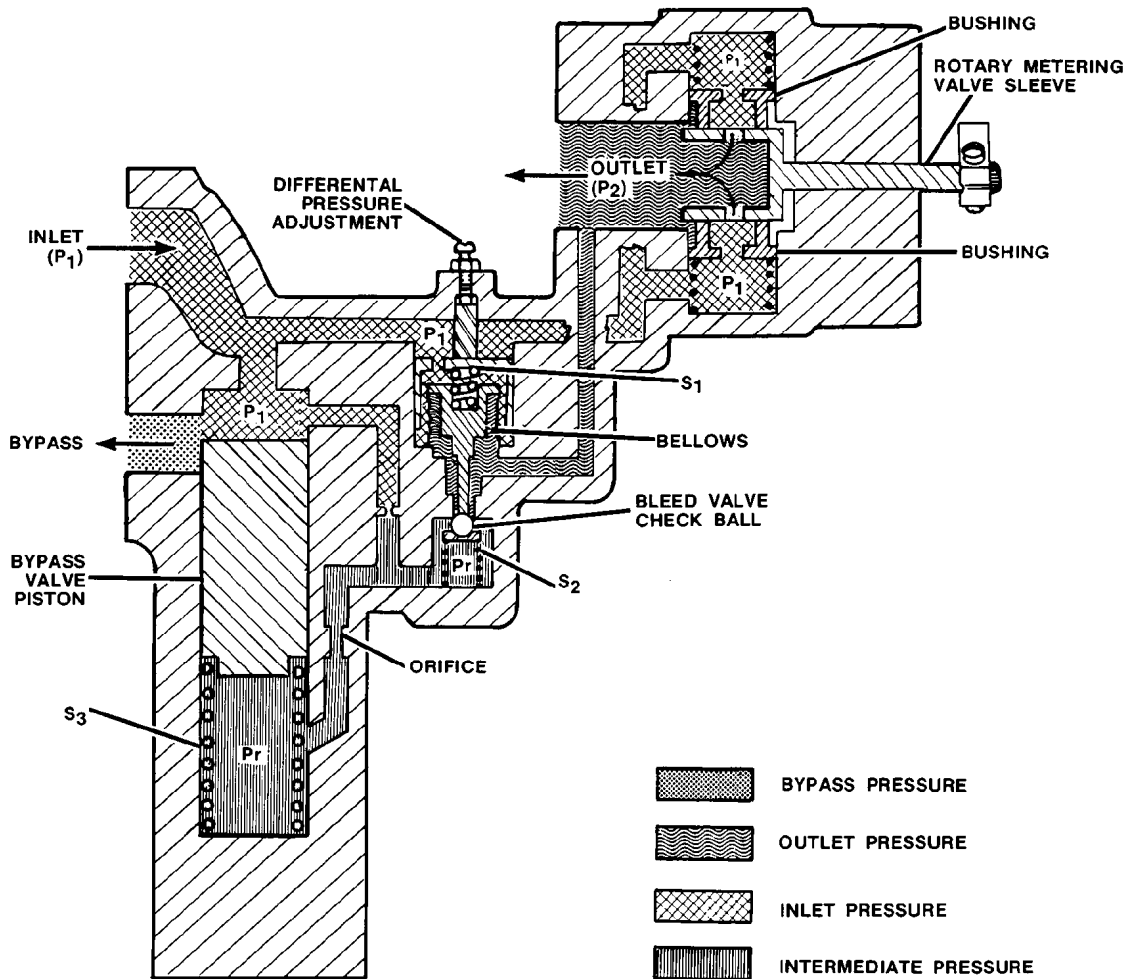


Figure 2-1. Schematic Flow Diagram of Liquid Fuel Valve

The liquid fuel valve maintains a constant pressure drop across the fuel metering ports in the metering sleeve. The fuel flow through the metering ports is proportional to the area of the port opening, without regard to changes in metered fuel discharge pressure. Fuel flow through the metering port is described by the equation,

$$W_f = K_1 a (\Delta P)^{-1/2} \text{ where:}$$

- $K_1$  = constant dependent upon fuel and port characteristics,
- $a$  = area of port opening,
- $\Delta P$  = pressure drop across fuel valve ( $P_1 - P_2$ )



With  $\Delta P$  held constant, accurate fuel metering is accomplished by controlling the metering port opening.

Under operating conditions, fuel at inlet pressure ( $P_1$ ) flows to the metering sleeve, one side of a bellows, to the bypass valve, and to an orifice. Metered fuel at pressure ( $P_2$ ) is directed to the turbine and the opposite side of the bellows. The bellows takes a position at which the sum of pressure  $P_1$ , and the force of spring  $S_1$  acting on one side of the bellows, is equal to the sum of pressure  $P_2$  and the force of spring  $S_2$  acting on the opposite side. When the balance of forces has been established, the difference between the spring forces ( $S_2 - S_1$ ) is equal to the difference between the pressures ( $P_1 - P_2$  or  $\Delta P$ ). By varying the force of spring  $S_1$ , the  $\Delta P$  can be adjusted to suit the requirements of a particular application. The position of the bellows determines the position of the bleed-valve check-ball, which then regulates the rate of fuel flow through the orifice. Pressure  $P_r$  varies with the rate of fuel flow through the bleed valve, high flows resulting in relatively lower pressures and low flows resulting in relatively higher pressures. Pressure  $P_r$  plus the force of spring  $S_3$  close the bypass valve piston. These are opposed by pressure  $P_1$ , which opens the bypass valve piston. The bypass valve piston then takes a position at which pressure  $P_1$  is equal to the sum of pressure  $P_r$  and the force of spring  $S_3$ . By varying the amount of fuel bypassed, pressure  $P_1$  is maintained at a constant differential above pressure  $P_2$ , regardless of variations in pressure  $P_2$  or flow.

Opening the metering port to increase fuel flow to the turbine results in an increase in pressure  $P_2$ . This unbalances the forces across the bellows, increases the force on spring  $S_1$  and allows the bleed-valve check-ball to partially close, reducing the rate of fuel flow through the bleed valve. With reduced fuel flow, pressure  $P_r$  increases and results in an unbalance of the forces across the bypass-valve piston. The piston moves to decrease the bypass flow and direct a greater amount of fuel to the metering port. With more fuel being directed to the metering port, pressure  $P_1$  increases until the balance of forces across the bypass valve piston and the bellows is established and further movement of the piston or bellows is stopped.

Closing the metering port to decrease fuel flow to the turbine results in a decrease in pressure  $P_2$ . The resulting unbalance of forces across the bellows forces the check ball further off its seat, and increases the rate of fuel flow through the orifice. With the resulting decrease in pressure  $P_r$ , the unbalance in forces across the bypass-valve piston causes the piston to move further open and bypass a greater amount of fuel with less fuel directed to the metering port. Pressure  $P_1$  then decreases until the balance of forces across the piston and bellows is established and further movement of the piston and bellows is stopped.

The purpose of the orifice and relief valve (Figure 2-2) is to eliminate bypass valve damping when a sudden increase in bypass flow is needed. The damping is needed for  $\Delta P$  stability in normal operation, and when change in inlet or metered outlet flows are relatively small. Damping is provided by a restriction between the bleed valve and bypass valve piston. When large decreases in metered outlet flow or large increases in inlet flow occur rapidly, it is essential that the bypass valve open immediately to prevent a transient rise in valve inlet pressure. This transient rise would raise the pressure differential above the rating of the  $\Delta P$  sensing bellows. The damping restriction is provided by the orifice in the relief valve plunger. If the pressure drop across this restriction exceeds 345 kPa (50 psi) when the bypass valve is moving in the open direction, the relief valve opens to bypass flow around the damping restrictor. This allows the bypass valve to open rapidly.

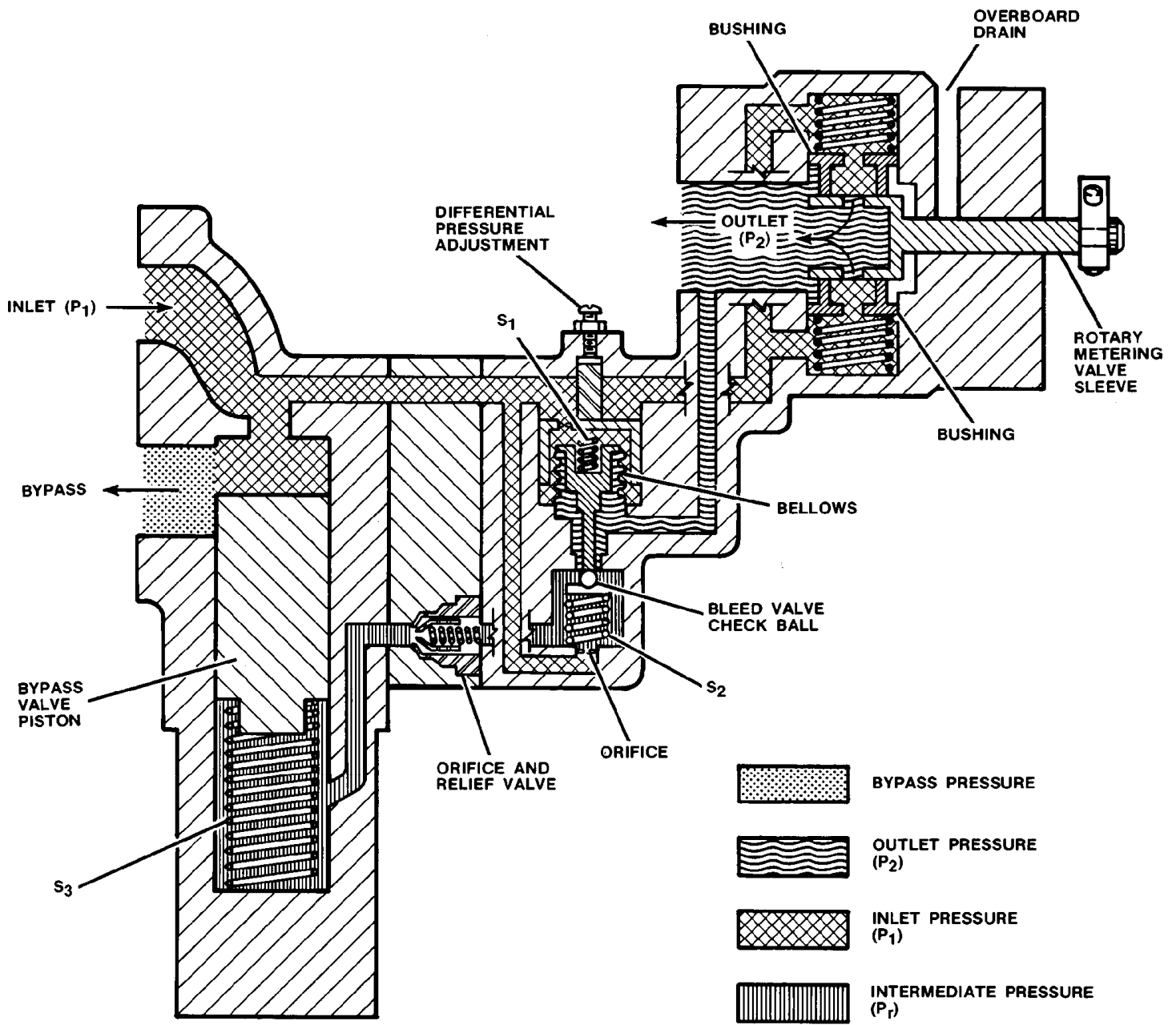


Figure 2-2. Schematic Flow Diagram of Liquid Fuel Valve with Orifice and Relief Valve

## Chapter 3. Maintenance

### Introduction

Wear approved eye protection for safety. References to part numbers are shown in brackets. Two-digit numbers refer to parts shown in Figure 4-1. Three-digit numbers are shown in Figure 4-2. If common parts are used in both figures, both sets of numbers will be used. Reference will be made to either Figure 4-1 or 4-2 if parts or procedures differ, and one set of reference numbers will be used.

Woodward recommends a yearly visual inspection of the bypass housing (3 or 122) and bypass sleeve (3 or 119) in the area where cavitation is expected due to high differential fuel pressure. Cavitation will be more pronounced on valves that are operated in high pressure applications or are in continuous service. Remove the customer fuel piping from the "Bypass" flange on the valve and visually inspect the bypass sleeve and internal surfaces of the bypass housing for cavitation and erosion wear. If significant wear is observed, replacement parts can be procured from Woodward.

### Disassembly

Refer to Figures 4-1 or 4-2 to disassemble the fuel valve.

1. Before removing the lever (15-158), make a mark on the shaft and lever for use as an index during assembly (see Figure 3-1).
2. Follow the sequence of reference numbers for disassembly of the valve. Discard all O-rings, seals, and cotter pins.
3. Do not scratch, drop, or abuse parts during disassembly.

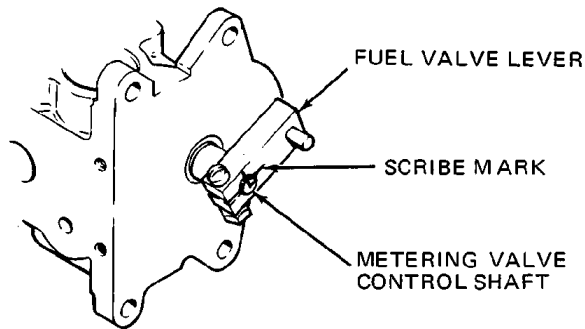


Figure 3-1. Location of Scribe Mark for Alignment During Assembly

### Cleaning

1. Soak and wash parts using a non-metallic brush to clean slots, holes, and passages. Do not allow metering valve shoes (26-127) and metering valve sleeve (29-166) to contact other parts and become damaged.
2. After parts are cleaned, coat them with a light film of lubricating oil.

## Inspection

Visually inspect parts for damage or wear.

1. Inspect ball and needle bearings. Replace bearings if there is roughness, scoring, or brinelling in balls, needles, or races.
2. Mating surfaces must not have nicks, scratches, burrs, or other damage.
3. Screws, plugs, and thread inserts must not be damaged.
4. Inspect thread surfaces and passages for dirt and corrosion.
5. Use Table 3-1 to measure springs for free length, squareness, and compressed height when specified load is applied.
6. Use Table 3-2 to inspect parts for excessive wear. Replace worn part as needed.

## Repair or Replacement

### NOTICE

Be careful when handling parts with precision edges and surfaces. Sharp edges must be maintained.

Table 3-1. Spring Inspection Data

Ref. No.	Part Name	Free Length	Load	Compressed Height
10 115	Bypass valve spring	64.01 (±0.76) mm 2.520 (±0.030) inches	66.7 N 15.0 lb	34.04 (±1.02) mm 1.340 (±0.040) inches
25 128	Valve loading spring	33.32 (±0.76) mm 1.312 (±0.030) inches	8.9–17.8 N * 2.0–4.0 lb *	20.62 (±0.25) mm 0.812 (±0.010) inches
45 142	Regulating valve spring	1.96 (±0.76) mm 0.077 (±0.030) inches	53.4 N 12.0 lb	14.73 (±0.13) mm 0.580 (±0.005) inches
147	Regulating valve spring	27.43 (±0.76) mm 1.080 (±0.030) inches	97.9 N 22.0 lb	17.63 (±0.13) mm 0.694 (±0.005) inches

\*—Do not exceed. Replace spring if value is exceeded for any reason.

Table 3-2. Wear Limits

Ref. No.	Part Name	Where Measured	Mfg. Tolerance	Wear Limits
11 116	Bypass valve piston	Land OD	22.207–22.215 mm 0.8743–0.8746 inch	0.069 mm max. 0.0027 inch max. (clearance)
13 119	Bypass valve sleeve	Land ID	22.238–22.250 mm 0.8755–0.8760 inch	
48 144	Bellows	Overall length	38.10–39.52 mm 1.500–1.556 inches	37.85–39.78 mm 1.490–1.566 inches

1. Use care when removing burrs from parts. Use a hard stone to remove nicks and scratches.
2. Replace damaged thread inserts.

3. If metering valve shoes (26-127) or metering valve sleeve (29-166) are replaced, the shoes must be lapped to the exact contour of the sleeve using an extra fine lapping compound. If there is not full contact between the shoe and sleeve, there will be too much leakage.

## Lubrication

1. Moving parts of this assembly are lubricated during operation by engine fuel. At time of assembly, lubricate parts liberally with lubricating oil.

## Assembly

See Figures 4-1 and 4-2 to assemble the fuel valve. The work area must be clean, and parts free of nicks and scratches. Be sure:

- Identification numbers on bearings face out.
- Retaining rings are installed with the sharp edge in the direction of the applied force.
- O-rings are lubricated with white petroleum jelly. When installing O-rings over threaded surfaces, tape the thread area or use the correct size sleeve to prevent damage to the O-rings. Obtain new O-rings, seals, retaining rings, and cotter pins to replace those discarded during disassembly.

### NOTICE

**Count the number of small parts such as screws, washers, and retaining rings before proceeding with the assembly. During assembly, the correct number of parts must be accounted for before proceeding to the next assembly step. If the parts cannot be located, disassemble the unit far enough to be sure the missing part has not fallen into the internal cavity. Any parts in the assembly that are not properly secured, may cause jamming and render the unit inoperative.**

1. Install ball bearing (30-153) on metering valve sleeve (29-166). Install one O-ring spacer (31-152), one O-ring (32-162), and a second O-ring spacer (31-152). Install metering valve sleeve (29-166) in valve housing (57-164). Install retaining ring (28-167) in the ring groove.
2. See Figure 4-1. Install ball bearing (33) and lever spacer (19) on metering valve sleeve (29). Place fuel valve lever (15) on the shaft. The lever will be installed in the same position as received (refer to scribe marks put on at disassembly). See Figure 4-2. Install spacers (152), O-ring (162), and ball bearing (153) into valve housing (164) below the retaining ring groove. Install retaining ring (154). Install pointer and spring retainer assembly (154-155), spacers (152), spring (157) and lever (158).
3. Install O-rings (27-126) on metering valve shoes (26-127). Install valve shoes (26-127) and loading springs (25-128). Place O-rings (24-129) on metering cap (23-130) and install in valve housing (57-164), holding with straps (22-131) and screws (20-111).

4. Install O-rings (55, 56-143, 149) on valve sleeve (54-148) and install in the housing. Place white petroleum jelly on spring seat (52-146) to secure the spring (53-147) and ball (51-145) to the spring seat. Install this assembly in the valve. Place O-rings (49, 50-107, 143) on bellows assembly (48-144). Place O-ring (47-118) on spacer (46-132). Install spring (45-142) in the bellows. Install spring seat (44-141) and spacer (46-132). Install O-ring (41-138) on valve cap assembly (40-137). Install O-ring (43-139) and pin (42-140). Install valve clamp (37-1 36) with screws (35-135). Install adjusting screw (38-134) in valve cap assembly (40-137).
5. See Figure 4-1. Install O-ring (14) on bypass valve sleeve (13). Install bypass valve sleeve (13) into bypass valve housing (3) with the bypass port of the sleeve matching the port on the bypass valve housing. Install sleeve spacer (12) over the bypass valve sleeve (13). Install bypass piston (11) into bypass valve sleeve (13) in the direction shown. Also install spring (10) on top of bypass piston (11). Place O-ring (9) on the bypass valve cover (8) and install in bypass housing (3), using the four screws (6) and washers (7).

See Figure 4-2. Install O-rings (118-120) on bypass valve sleeve (119). Place O-ring (118) on the front of the bypass sleeve and install the sleeve and bypass piston (116) in the bypass valve housing. Be sure the bypass port on sleeve (119) matches the port on bypass housing (122). Install bypass sleeve spacer (117) over the bypass sleeve.

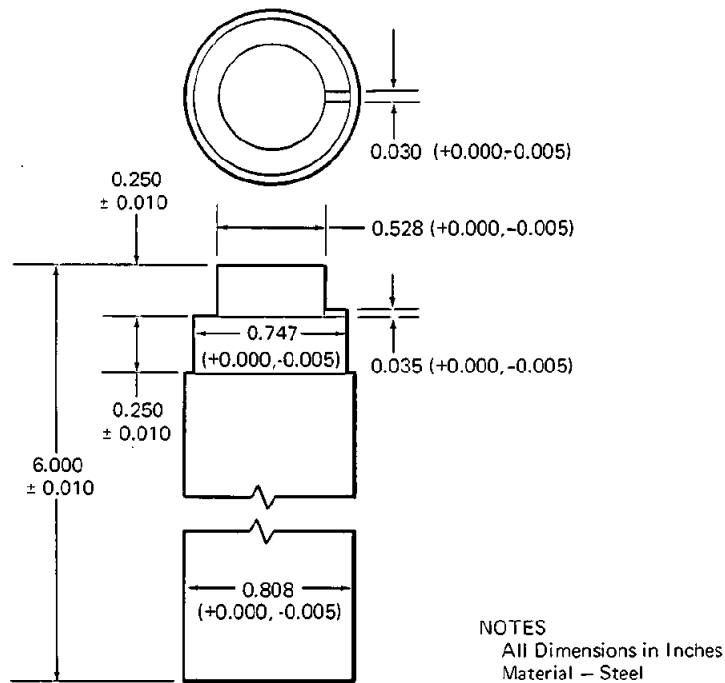


Figure 3-2. Metering Valve Bushing Insertion Tool

Install O-ring (114) on bypass valve cover (112). The arrow on the bypass cover points to the direction of bypass flow. Install the bypass cover and bypass spring (115) using four screws (111). Some models use a copper wave washer in place of the bypass sleeve spacer. If the valve uses an orifice and relief valve plate assembly (101 through 109), the orifice cup (113) is not used.

6. The orifice and relief valve assembly (101 through 109) can be used on either valve shown (Figure 4-1 or 4-2). If it is used on the valve in Figure 4-1, screws (1) must be replaced with screws (121). Assemble the orifice and relief valve assembly as shown in the detail in Figure 4-2. Place the orifice plate on valve housing (164) as shown. Install O-rings (102-123) on bypass valve housing (122) and place the housing in position on the plate assembly. Secure the assembly with four screws (121).
7. Be sure all parts are used or accounted for.

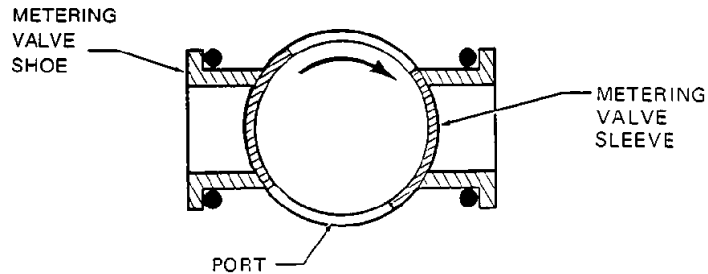
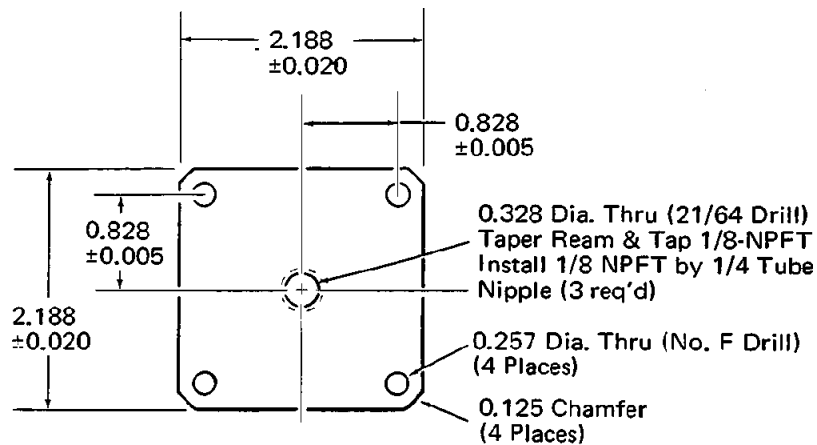


Figure 3-3. Relationship of Metering Valve Port to Shoes for Installation of Lever

## Leakage Check

1. Locally manufacture three leak test adapters as shown in Figure 3-4.



**NOTES:**  
 Material — 3/8 Thick Steel Plate  
 All Dimensions in Inches  
 Three Closure Plates Required

Figure 3-4. Fuel Valve Leak Test Adapter

2. Install the adapters on the FUEL IN, BYPASS, and FUEL OUT pads using three gaskets, six 1/4-28 by 7/8 inch-long screws, and six flat washers.
3. The test medium should be calibrating fluid (MIL-F-7024, Type 11).
4. Connect a suitable hand pump and 0–10 300 kPa (0–1500 psi) pressure gauge to the adapter on the FUEL IN pad. Operate the hand pump and fill the valve with fluid, allowing air to bleed from the valve through the open fittings in the BYPASS and FUEL OUT adapters. When a clear stream of fluid with no air bubbles flows from each of the fittings, cap off the fittings.

5. Increase pressure to 9653 kPa (1400 psig) and inspect the valve for leaks. No leakage is permissible. If leakage occurs, disassemble the unit as necessary and inspect for damage to sealing surfaces, presence of foreign material, or damaged O-rings. Replace any damaged parts, assemble the unit, and repeat the leak test.

## Orifice And Relief Valve Assembly

For liquid fuel valves that do not have the orifice and relief valve assembly, see Figure 4-1 or 4-2 and proceed as follows:

1. Press small orifice cup (113) out of bypass cover (112).
2. Assemble orifice (106) relief valve assembly (103, 104, 105, 107, 108) in plate (101).
3. Position the relief valve assembly between the valve body assembly and the bypass valve assembly. Be sure the O-rings are positioned correctly.
4. Use four screws (111) to fasten the three assemblies together.



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## Chapter 4. Replacement Parts

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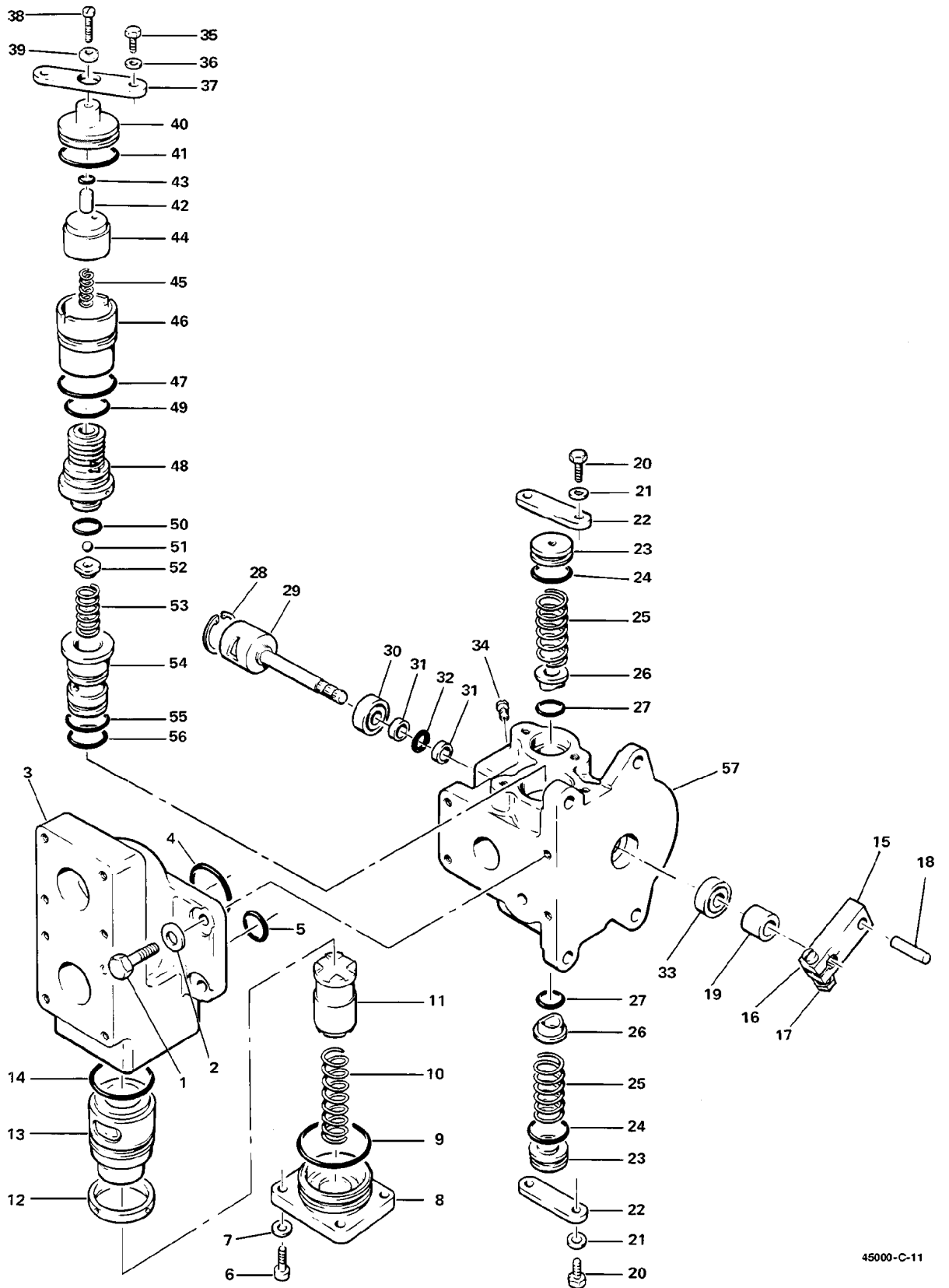
When ordering parts, give the following information:

- The fuel valve type, serial number, and part number (shown on nameplate)
- Manual number (this manual is 45002)
- Part reference number given in parts list and part name or description

Figures 4-1 and 4-2 illustrate parts for the liquid fuel valve assembly. Reference numbers are assigned in disassembly sequence.

## Parts List for Figure 4-1

Ref. No.	Part Name.....Quantity	Ref. No.	Part Name .....	Quantity
45002-1	Screw, 1/4-28 x 1.....4	45002-29	Metering valve sleeve .....	1
45002-2	Washer, split lock .....	45002-30	Ball bearing .....	1
45002-3	Bypass valve housing.....1	45002-31	Spacer.....	2
45002-4	O-ring, 1.318 OD .....	45002-32	O-ring, 0.504 OD.....	1
45002-5	O-ring, 0.816 OD .....	45002-33	Ball bearing .....	1
45002-6	Screw, 10-24 X 5/8 (AN500-1 0-10) ...4	45002-34	Minimum flow plug .....	1
45002-7	Washer, split lock, No.10.....4	45002-35	Screw, 1/4-28 X 5/8.....	2
45002-8	Bypass valve cover.....1	45002-36	Washer, split lock, 0.263 ID.....	2
45002-9	O-ring, 1.693 OD .....	45002-37	Regulating valve clamp .....	1
45002-10	Bypass valve spring.....1	45002-38	Screw, 10-32 X 0.88.....	1
45002-11	Bypass valve sleeve .....	45002-39	Hex nut, 10-32.....	1
45002-12	Sleeve spacer .....	45002-40	Cap .....	1
45002-13	Bypass valve sleeve .....	45002-41	O-ring, 1.250 OD .....	1
45002-14	O-ring, 1.505 OD .....	45002-42	Straight pin .....	1
45002-15	Fuel valve lever .....	45002-43	O-ring, 0.379 OD.....	1
45002-16	Screw, 10-32 X 0.88 .....	45002-44	Spring seat.....	1
45002-17	Locknut, hex, 10-32 .....	45002-45	Regulating valve spring.....	1
45002-18	Straight pin .....	45002-46	Spacer.....	1
45002-19	Lever spacer.....	45002-47	O-ring, 1.187 OD.....	1
45002-20	Screw, 1/4-28 X 5/8 .....	45002-48	Bellows.....	1
45002-21	Washer, split lock, 0.263 ID.....	45002-49	O-ring, 0.941 OD.....	1
45002-22	Metering valve strap .....	45002-50	O-ring, 0.629 OD.....	1
45002-23	Metering valve cap .....	45002-51	Ball .....	1
45002-24	O-ring, 1.005 OD .....	45002-52	Spring seat.....	1
45002-25	Valve loading spring .....	45002-53	Regulating valve spring.....	1
45002-26	Metering valve shoe .....	45002-54	Regulating valve sleeve .....	1
45002-27	O-ring, 0.754 OD .....	45002-55	O-ring, 1.004 OD .....	1
45002-28	Internal retaining ring.....1	45002-56	O-ring, 0.941 OD.....	1
		45002-57	Valve housing.....	1



45000-C-11

Figure 4-1. Fuel Valve Assembly

## Parts List for Figure 4-2

Ref. No.	Part Name.....Quantity	Ref. No.	Part Name .....Quantity
45002-101	Check valve plate ..... 1	45002-134	Screw 10-32 x 0.625 ..... 1
45002-102	O-ring - 1.112 lb x 0.103 ..... 2	45002-135	Screw 0.250-28 x 0.875 ..... 2
45002-103	Retaining ring 0.346 dia..... 1	45002-136	Valve clamp..... 1
45002-104	Spring seat ..... 1	45002-137	Valve cap ..... 1
45002-105	Check valve spring ..... 1	45002-138	O-ring - 1.049 ID x 0.103..... 1
45002-106	Check valve orifice ..... 1	45002-139	O-ring - 0.239 ID x 0.070..... 1
45002-107	O-ring - 0.489 ID x 0.070 ..... 2	45002-140	Straight pin 0.247 x 0.500 ..... 1
45002-108	Check valve bushing ..... 1	45002-141	Spring seat ..... 1
45002-109	O-ring - 0.739 x 0.070..... 1	45002-142	Spring..... 1
45002-110	Washer 0.250 ..... 8	45002-143	O-ring 0.801 ID x 0.070 ..... 2
45002-111	Screw 0.250-28 x 0.750 ..... 4	45002-144	Bellows..... 1
45002-112	Bypass valve cover..... 1	45002-145	Ball 0.156 ..... 1
45002-113	Orifice cup .029 dia..... 1	45002-146	Spring seat ..... 1
45002-114	O-ring - 1.362 ID x 0.103 ..... 1	45002-147	Spring..... 1
45002-115	Bypass spring ..... 1	45002-148	Sleeve ..... 1
45002-116	Bypass valve piston..... 1	45002-149	O-ring 0.864 ID 0.070..... 1
45002-117	Bypass valve sleeve spacer ..... 1	45002-150	Valve angle dial..... 1
45002-118	O-ring - 1.051 ID x 0.70 ..... 2	45002-151	Drive screw ..... 2
45002-119	Bypass valve sleeve ..... 1	45002-152	O-ring spacer ..... 2
45002-120	O-ring - 1.299 ID x 0.103 ..... 1	45002-153	Bearing..... 2
45002-121	Screw 0.250-28 x 2.000..... 4	45002-154	Retaining ring 0.338 ..... 1
45002-122	Bypass valve housing ..... 1	45002-155	Valve angle pointer ..... 1
45002-123	O-ring - 0.676 ID x 0.070 ..... 2	45002-156	Spring retainer..... 1
45002-124	Nameplate ..... 1	45002-157	Motor spring ..... 1
45002-125	Drive screw #2 x 0.125 ..... 5	45002-158	Lever assembly ..... 1
45002-126	O-ring - 0.614 ID x 0.070 ..... 2	45002-159	Screw 8-32 x 1.000 ..... 1
45002-127	Metering valve shoe ..... 2	45002-160	Screw 8-32 x 0.750 ..... 2
45002-128	Valve sleeve loading spring ..... 2	45002-161	Pin .2515 x 1.250 ..... 1
45002-129	O-ring - 0.799 ID x 0.103 ..... 2	45002-162	O-ring - 0.364 ID x 0.070..... 2
45002-130	Metering cap..... 2	45002-163	Dowel pin 0.188 x 0.688..... 1
45002-131	Metering valve strap ..... 2	45002-164	Valve housing..... 1
45002-132	Spacer ..... 1	45002-165	Flow plug..... 1
45002-133	Hex nut 10-32 ..... 1	45002-166	Valve sleeve..... 1
		45002-167	Retaining ring..... 1

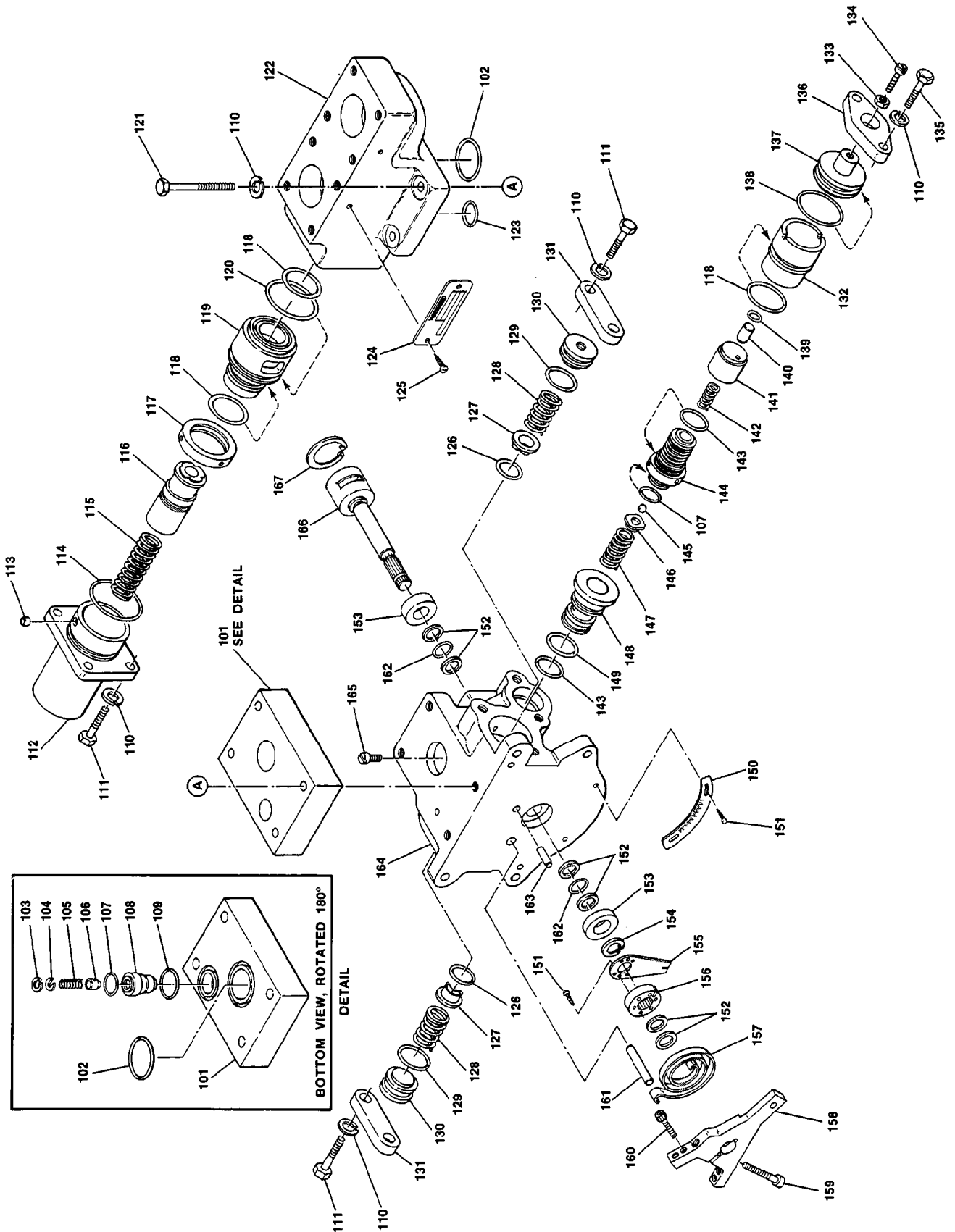
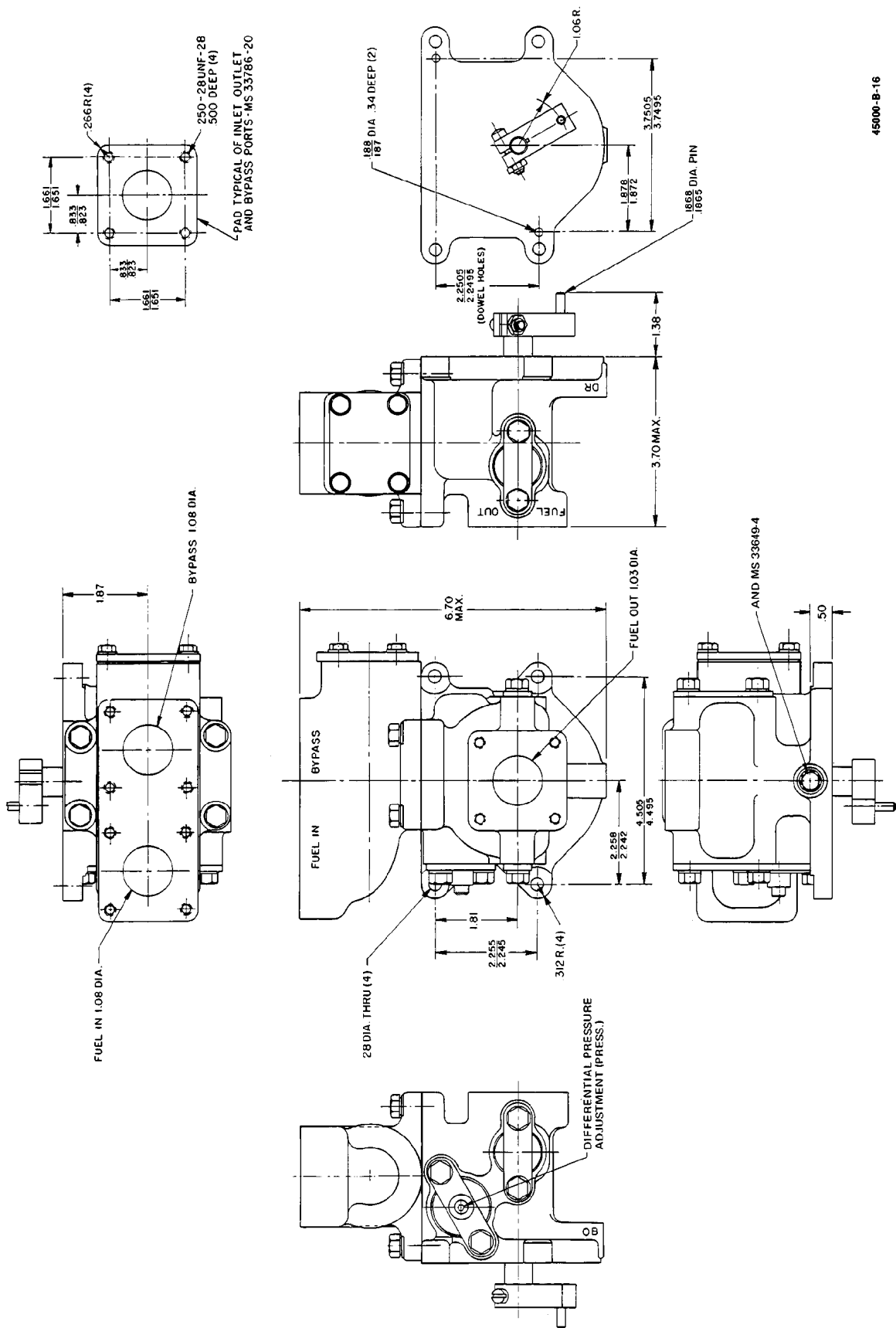
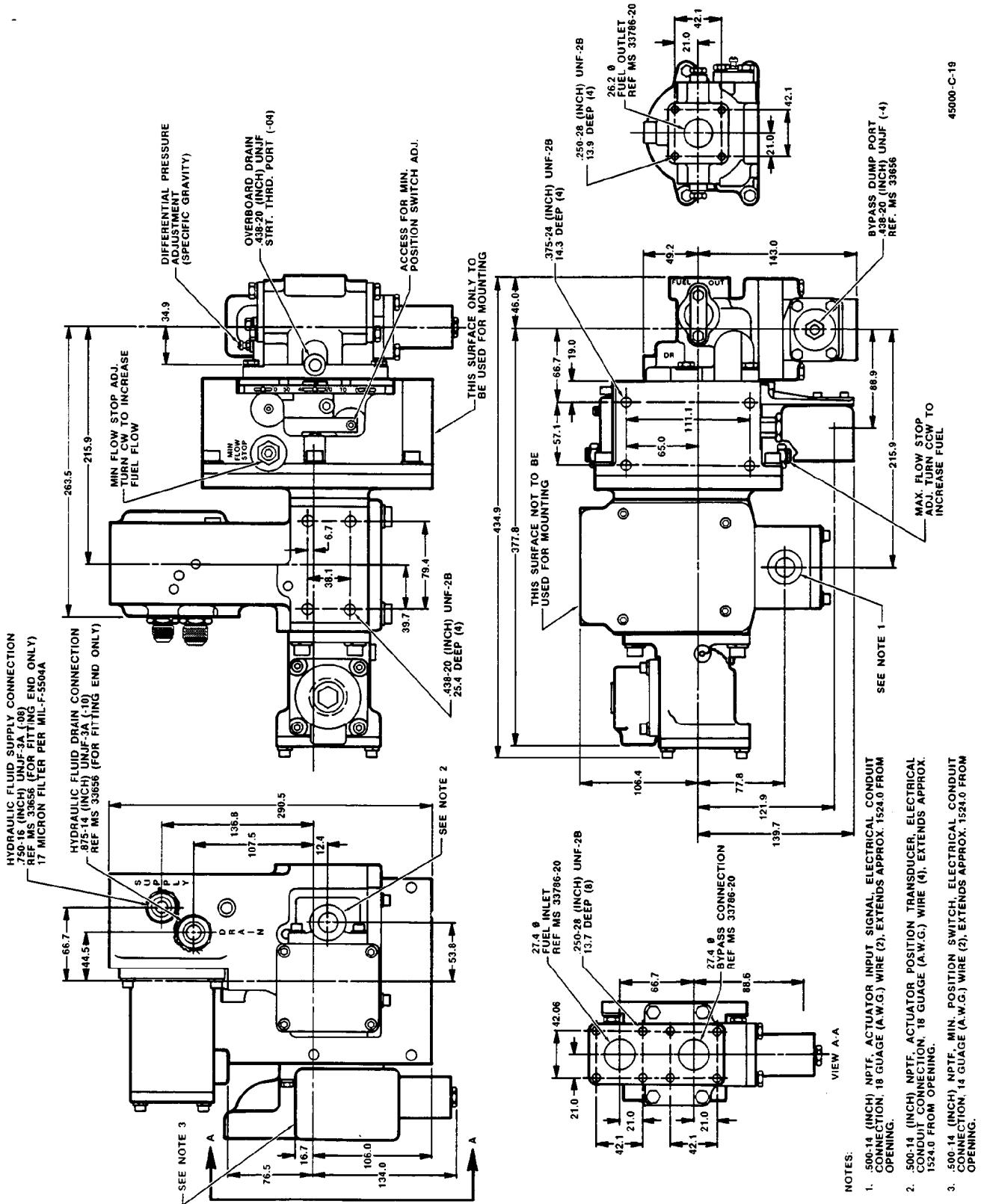


Figure 4-2. Fuel Valve Assembly with Orifice and Relief Valve



45000-B-16

Figure 4-3. Outline Drawing of Liquid Fuel Valve



45000-C-19

Figure 4-4. Outline Drawing of Liquid Fuel Valve with Orifice, Relief Valve Assembly, and TM-55 Actuator

## 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](http://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](http://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.

<b>Electrical Power Systems</b>		<b>Engine Systems</b>		<b>Turbine Systems</b>	
<u>Facility</u>	<u>Phone Number</u>	<u>Facility</u>	<u>Phone Number</u>	<u>Facility</u>	<u>Phone Number</u>
Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800	Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727	China	+86 (512) 6762 6727	China	+86 (512) 6762 6727
Germany	+49 (0) 21 52 14 51	Germany	+49 (711) 78954-510	India	+91 (129) 4097100
India	+91 (129) 4097100	India	+91 (129) 4097100	Japan	+81 (43) 213-2191
Japan	+81 (43) 213-2191	Japan	+81 (43) 213-2191	Korea	+82 (51) 636-7080
Korea	+82 (51) 636-7080	Korea	+82 (51) 636-7080	The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00	The Netherlands	+31 (23) 5661111	Poland	+48 12 295 13 00
United States	+1 (970) 482-5811	United States	+1 (970) 482-5811	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](http://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	_____
<hr/>	
Engine/Turbine Model Number	_____
Manufacturer	_____
Number of Cylinders (if applicable)	_____
Type of Fuel (gas, gaseous, steam, etc)	_____
Rating	_____
Application	_____
<hr/>	
<b>Control/Governor #1</b>	
Woodward Part Number & Rev. Letter	_____
Control Description or Governor Type	_____
Serial Number	_____
<hr/>	
<b>Control/Governor #2</b>	
Woodward Part Number & Rev. Letter	_____
Control Description or Governor Type	_____
Serial Number	_____
<hr/>	
<b>Control/Governor #3</b>	
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.*

We appreciate your comments about the content of our publications.

Send comments to: [icinfo@woodward.com](mailto:icinfo@woodward.com)

Please reference publication **45002G**.



B45002:G



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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.