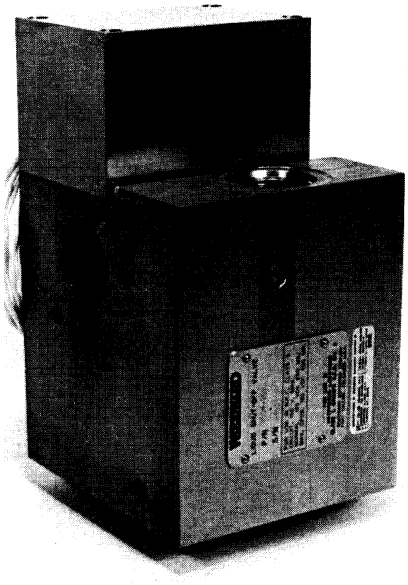
WOODWARD

Product Manual 40134
(Revision A)
Original Instructions



Liquid Fuel Shutoff Valve

9904-257 and 9907-198

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:

www.woodward.com/publications

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 Out-of-date translations are marked with ⚠.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.

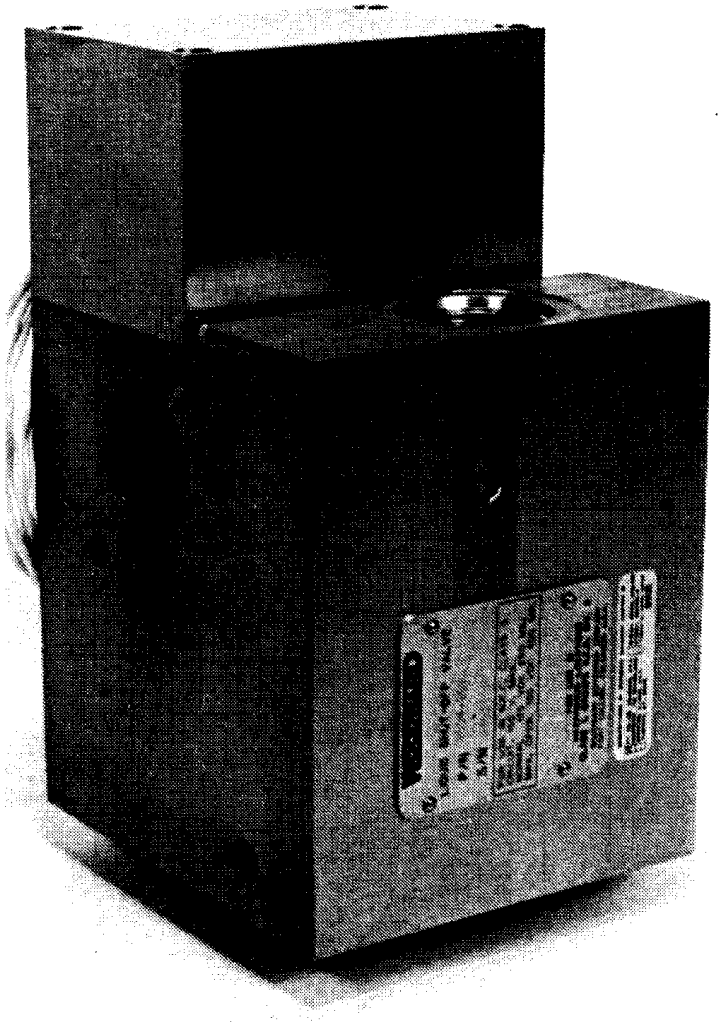


Figure 1-1. Liquid Fuel Shutoff Valve

Chapter 1.
General Information

Safety Considerations

⚠WARNING

The shutoff valve is a critical component for protection against equipment failure and turbine overspeed. Routine inspection is necessary for the protection of the turbine and/or the turbine operators.

The shutoff valve is designed to protect the turbine should the normal fuel control become inoperative for any reason. Critical overspeed may occur should the valve fail to shut off fuel to the turbine. Engine overspeed can cause serious mechanical damage as well as personal injury or death.

Always use the shutoff valve to stop the turbine. This exercise provides proof of the proper operation of the safety equipment.

Because of the critical function of the valve, it is mandatory that the operator regularly monitor the valve whenever the turbine is shut down, as well as during normal operation.

While the valve is closed, check for excessive leakage, either through the valve or through the vent. Any leakage through the valve to the turbine should be considered proof of wear and/or possible malfunction. The valve should be immediately replaced and returned for factory service.

A minimal amount of leakage can be expected through the bypass connection of the valve. Should the volume of leakage change appreciably, the valve should be replaced and returned to a service facility.

Woodward recommends the installation of two shutoff valves per API-616.

Shutoff Valve Description

The Woodward High Speed Liquid Fuel Shutoff Valve is a three-way, two-stage valve, designed to provide fuel bypass in 0.090 seconds or less after termination of the solenoid current. Loss or termination of the electrical signal will result in all fuel delivery to the valve being bypassed to the return system.

The valve is compatible with most liquid fuels, including diesel fuel, methanol, ethanol, Jet "A", kerosene, #2 home heating oil, heated light crudes, and residuals. The valve will accommodate contaminated fuels within prescribed limits.

An inlet screen in the valve prevents contaminants in excess of 40 µm (nominal) from damaging the pilot-valve section.

The shutoff valve housing is constructed of anodized aluminum. All moving internal parts are hardened stainless steel.

Electrical Requirements

Voltage	Nominal 24 Vdc, 125 Vdc, 115 Vac or 220 Vac
Power	15 W maximum
Resistance to Ground	50 MΩ minimum at 500 Vdc

General Specifications

Liquid Fuel	Diesel fuel, methanol, ethanol, Jet "A", kerosene, #2 home heating oil, heated light crudes, and residuals
Fuel Temperature	0 to +250 °F (–18 to +121 °C)
Chemical Compatibility	All typical fuels. Call Woodward for special applications.
Rated Flow	30 000 lb/h (13 608 kg) of MIL-C-7024 calibrating fluid at 70 °F (21 °C)
Cycle Life	10 000 cycles
Weight	21.5 lb (9.8 kg)
Construction	Anodized aluminum housing; hardened stainless steel internal components
Fittings	Fuel inlet, fuel outlet, and bypass threaded for 1.625 (-20) straight thread port
Electrical	0.500-14 NPTF conduit connector with 10 ft (3 m) of insulated conductor for field wiring

Operating Specifications

Opening Time	0.4 seconds maximum after admission of fuel and solenoid current
Closing Time	Within 0.09 seconds after the solenoid is de-energized with 1200 psig (8274 kPa) fuel applied to the inlet
Pressure Drop	53 psid (365 kPa) inlet to discharge at 30 000 lb/h (13 608 kg) 90 psid (621 kPa) inlet to bypass at 30 000 lb/h (13 608 kg)
Internal Leakage:	
Shutoff	From inlet to discharge: None From inlet to bypass: 370 lb/h (168 kg) maximum at 800 psid (5516 kPa)
Reverse Pressure Condition	900 psig (6206 kPa)
Contaminants	The shutoff valve will operate satisfactorily when using fuel contaminated with less than 0.01% by volume of salt-water compound or 4% by weight of NaCl and 96% water and solid contamination of 10 grams per 1000 US gallons (2.6 g/1000 L) composed of particle sizes up to 40 µm.
Fluid Supply Range	Normal: 1200 psig (8274 kPa) Proof: 1800 psig (12 411 kPa) Burst: 6000 psig (41 370 kPa)

Chapter 2. Installation

Receiving

The liquid fuel shutoff valve is tested with a non-corrosive liquid, drained and packed in a foam-filled box for shipment. The unit may be stored for an extended period in the original container.

Mounting

The valve is designed for installation in any attitude with two 3/8 inch or M10 bolts. (See the outline drawing, Figure 2-1, for location of the mounting holes and of the valve.)

1.625 inch (-20) straight thread ports are provided for inlet, bypass and outlet pipe connections. The bypass plumbing must be of equal size to the inlet and unobstructed to assure positive shutoff by the valve.

Electrical

A 0.500 inch-14 NPTF conduit adapter and 10 ft (3 m) leads of shielded wire are provided for the electrical connection. Connect the proper voltage to the two wires extending from the conduit connector (see the outline drawing). Polarity is not important.

Maintenance

Recommended: Disassembly for cleaning and inspection every 10 000 cycles or 3 years of operation, whichever occurs first. In case of contamination of the interior passages, the valve may be disassembled and cleaned in the field by a trained service technician.

Routinely check the shutdown switches or relays to be sure they are capable of interrupting the electronic signal to the shutoff valve.

Always use the valve for routine shutdown as a check for continued operation.

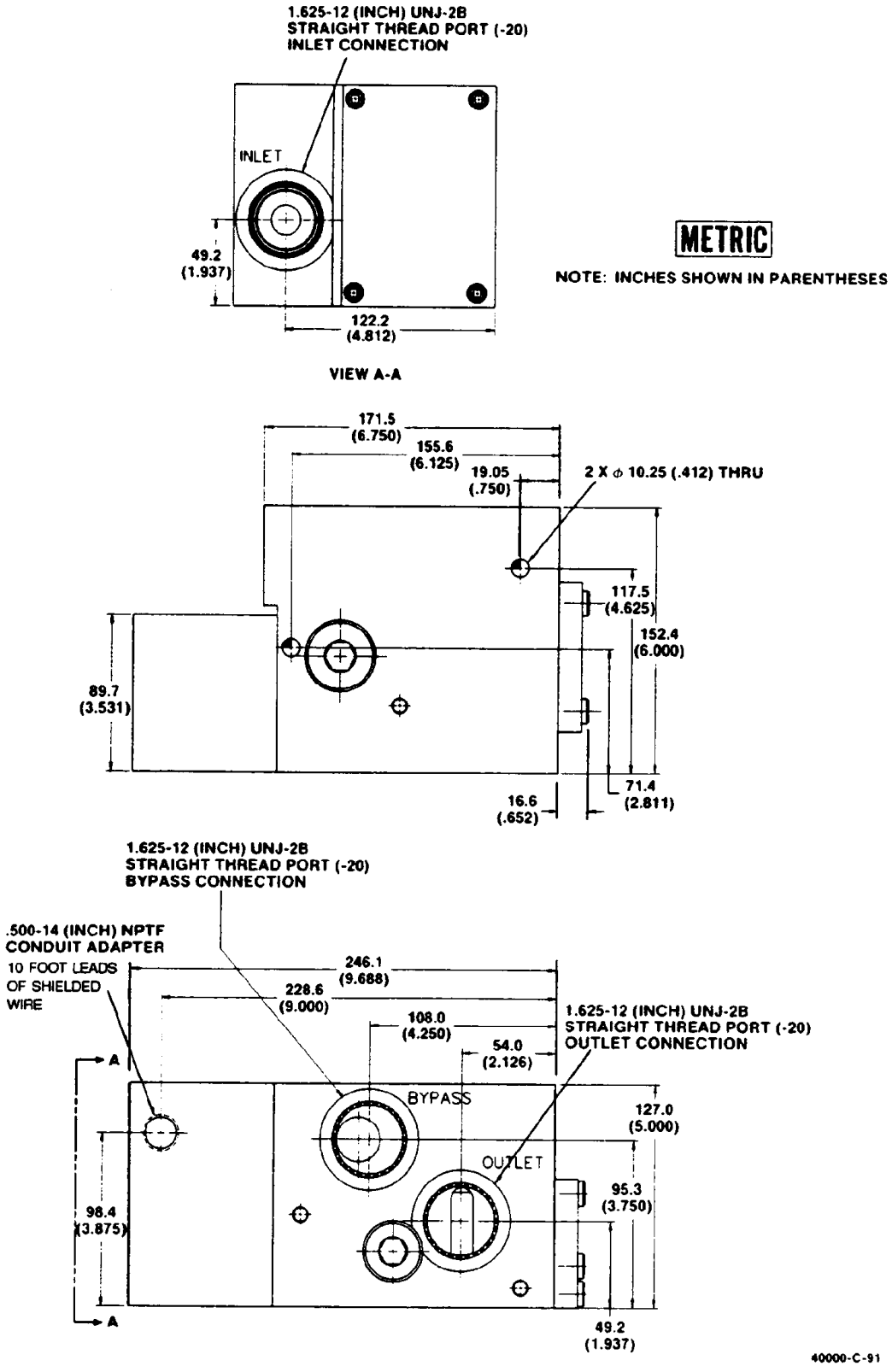


Figure 2-1. Outline Drawing of Liquid Fuel Shutoff Valve

Chapter 3.
Principles of Operation

Figure 3-2 illustrates the operating principle of the shutoff valve.

The shutoff valve is designed to be the last element in the fuel-supply line to the turbine. Its rapid closure time of less than 1/10 second, and opening time of 4/10 second, makes it an ideal valve for both routine and emergency shutoff of the fuel supply to the controlled device.

The valve is either full on or sealed tightly off. In the full on (valve energized) mode, a small amount of leakage will occur to bypass. Termination of the electrical signal will result in all fuel delivery to the valve being bypassed to the fuel return system.

Fuel pressure and flow must be present to ensure proper operation of the valve. Springs on the control plunger in the valve will cause the valve to close itself should the fuel flow drop below a nominal amount.

The regulator generates a working pressure within the valve. In the de-energized state, the working pressure supplements the return spring force on the shuttle piston to provide a positive no-leak seal at the turbine fuel manifold. This ensures rapid shutdown capability and prevents nozzle contamination when dual-fuel turbines are operated on gaseous fuel.

When energized, the first-stage solenoid valve directs fuel pressure to the top of the control piston (C_2). The pressure drives the control piston down. This closes the bypass port and drives the shuttle piston away from the seal, opening the fuel passage through the valve to the turbine.

As soon as fuel system pressures reach 50 psi (345 kPa) or more, the regulator piston opens completely. This results in a minimum pressure drop through the valve and assures that maximum fuel flow can go through the valve.

When the electrical signal is removed from the solenoid, inlet pressure is directed below the shuttle piston. Simultaneously, the pressure on the control piston is vented to bypass. The combination of spring pressure and fuel pressure then drives the shuttle piston against the seal.

A 40 µm wash-flow filter is provided between inlet pressure and the solenoid control valve to assure trouble free operation of the shutoff valve. The valve provides no filtration for the fuel flowing to the turbine or to bypass. In the shutoff position all inlet flow is directed to bypass. This prevents buildup of pressure in the positive-flow fuel system which could cause damage to the pump or plumbing. For optimum dynamic response, it is important that the bypass fuel plumbing be sized large enough to accommodate the maximum expected pump delivery with less than 50 psi (345 kPa) head measured at the valve bypass port. Also, inlet pressure should be at least 50 psi (345 kPa) higher than bypass pressure in all operating conditions.

Polarity is unimportant in the dc-operated valve.

The maximum power consumption of the valve is 15 W.

A bipolar zener diode is provided in the solenoid wiring to prevent voltage spikes during operation and to prevent the generation of electromagnetic interference (EMI).

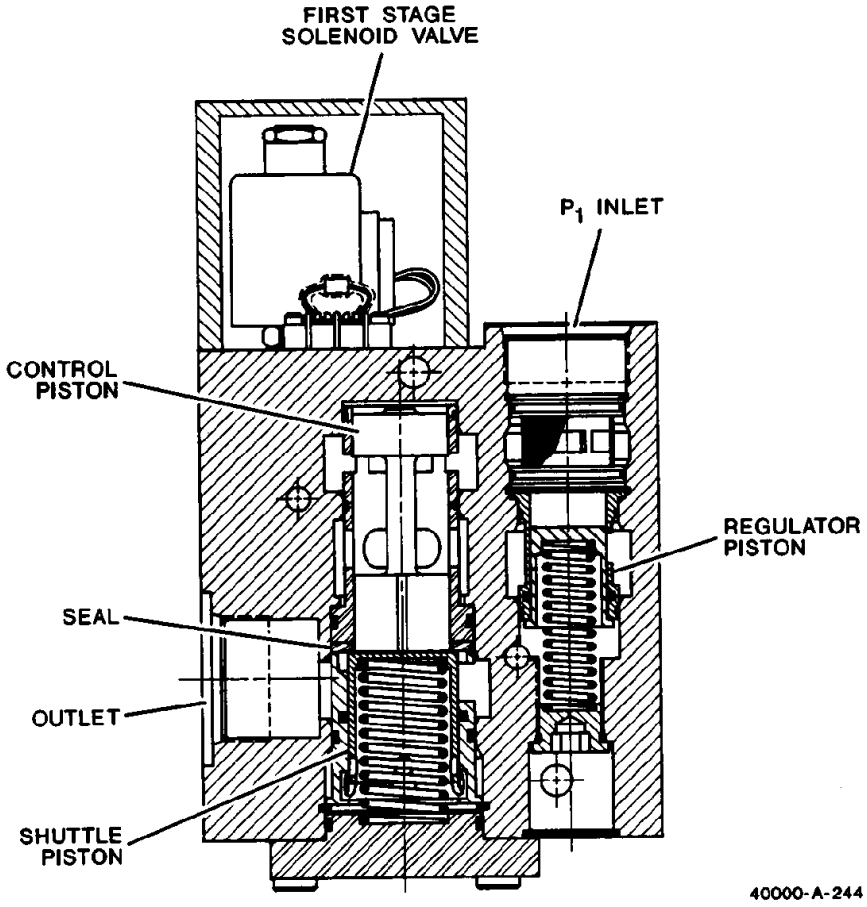


Figure 3-1. Cross Section of Liquid Fuel Shutoff Valve

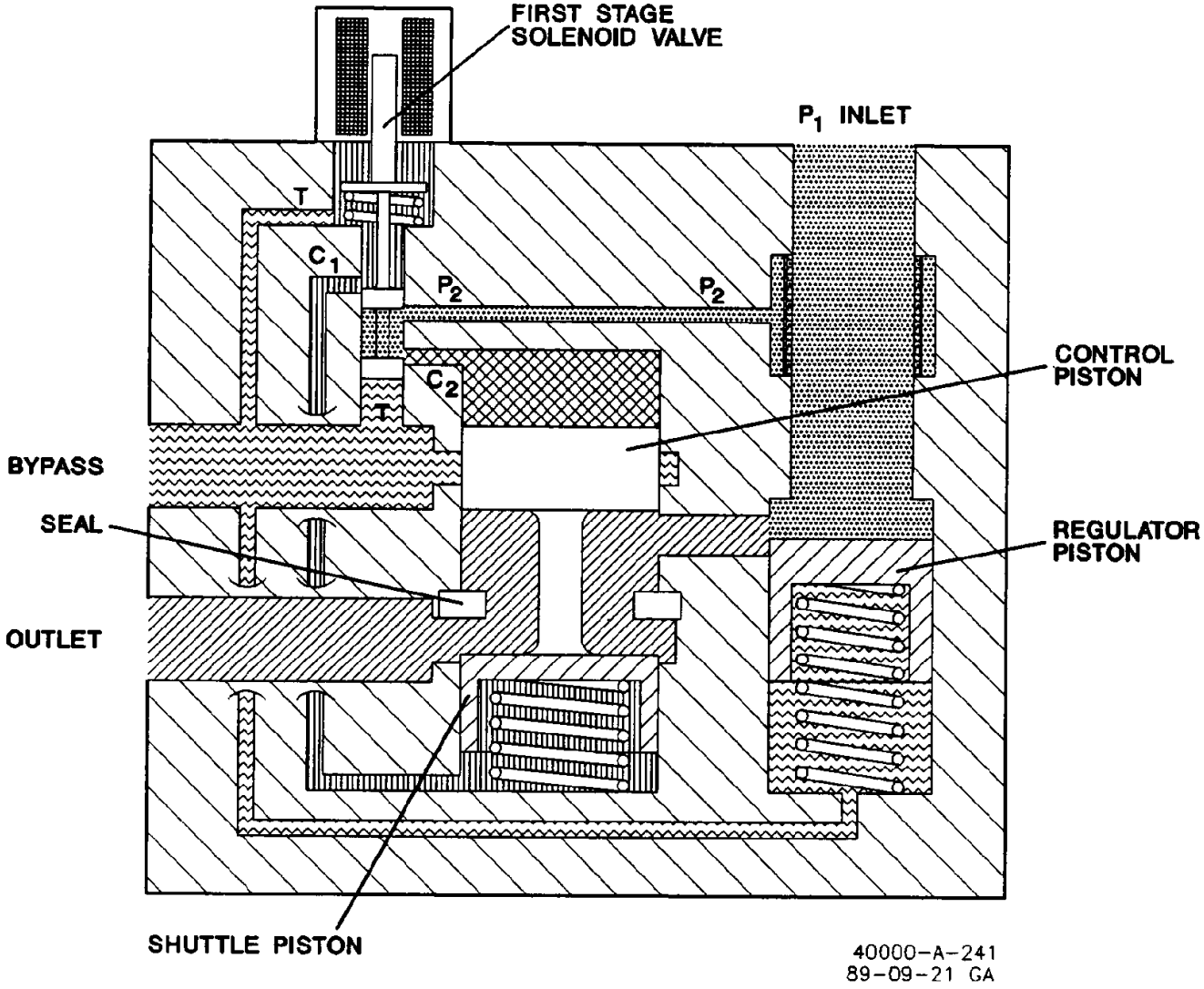


Figure 3-2. Liquid Fuel Shutoff Valve Schematic

Chapter 4.
Replacement Parts

When ordering replacement parts, include the following information:

- Valve serial number and part number shown on the nameplate
- Manual number (this is manual 40134)
- Part reference number and part name from parts list

Reference numbers on Figure 4-1 are in approximate disassembly order (remove part 1 first, etc.). Assemble in the reverse order.

Ref. No.	Part Name	Quantity
40134-1	Body Assembly	1
40134-2	Solenoid Cover	1
40134-3	Screw, .250-20 x 2.5 inches, soc. hd. cap	4
40134-4	Wire Protector Bushing	1
40134-5	Solenoid Control Valve	1
40134-6	Solenoid Service Wire	1
40134-7	Screw, 6-32 x .625 inch, soc. hd. cap	4
40134-8	Terminal Block	1
40134-8a	Bipolar Diode	1
40134-9	O-ring, .489 x .070	1
40134-10	O-ring, .551 x .070	1
40134-11	O-ring, .611 x .070	1
40134-12	O-ring, .755 x .097	1
40134-13	Wire Bundle Clamp	1
40134-14	Screw, 8-32 x .312 inch,	1
40134-15	Retaining Ring, 1.662 free diameter	1
40134-16	Filter Assembly, 40 micron	1
40134-17	O-ring, 1.364 x .070	2
40134-18	Retaining Ring, 1.500 free diameter	1
40134-19	Regulator Piston Sleeve	1
40134-20	O-ring, 1.051 x .070	1
40134-21	Glyd Ring Seal	1
40134-22	O-ring, 1.176 x .070	2
40134-23	Regulator Piston	1
40134-24	Plug, straight thread, hollow hex, (-12)	1
40134-24a	O-ring, .924 x .116	1
40134-25	Plug, straight thread, hollow hex, (-16)	1
40134-25a	O-ring, 1.171 x .116	1
40134-26	Screw, .375-16 x .875, soc. hd. cap	4
40134-27	Washer, .390 id x .625 OD x .032 thick	4
40134-28	Control Section Cover	1
40134-29	O-ring, 1.862 x .103	1
40134-30	Retaining Ring, 2.062 diameter	1
40134-31	Shuttle Return Spring	1
40134-32	Shuttle Piston	1
40134-33	Shuttle Sleeve	1
40134-34	O-ring, 1.674 x .103	1
40134-35	Glyd Ring Seal	1
40134-36	O-ring, 1.487 x .103	1
40134-37	Control Piston	1
40134-38	Shuttle to Control Piston Seal	1
40134-39	O-ring, 1.674 x .103	1
40134-40	O-ring, 1.364 x .070	2
40134-41	Control Piston Sleeve	1
40134-42	Spring Seat/Plug, straight thread, (-10)	1
40134-42a	O-ring,.755 x .097	1
40134-43	Regulator Return Spring	1

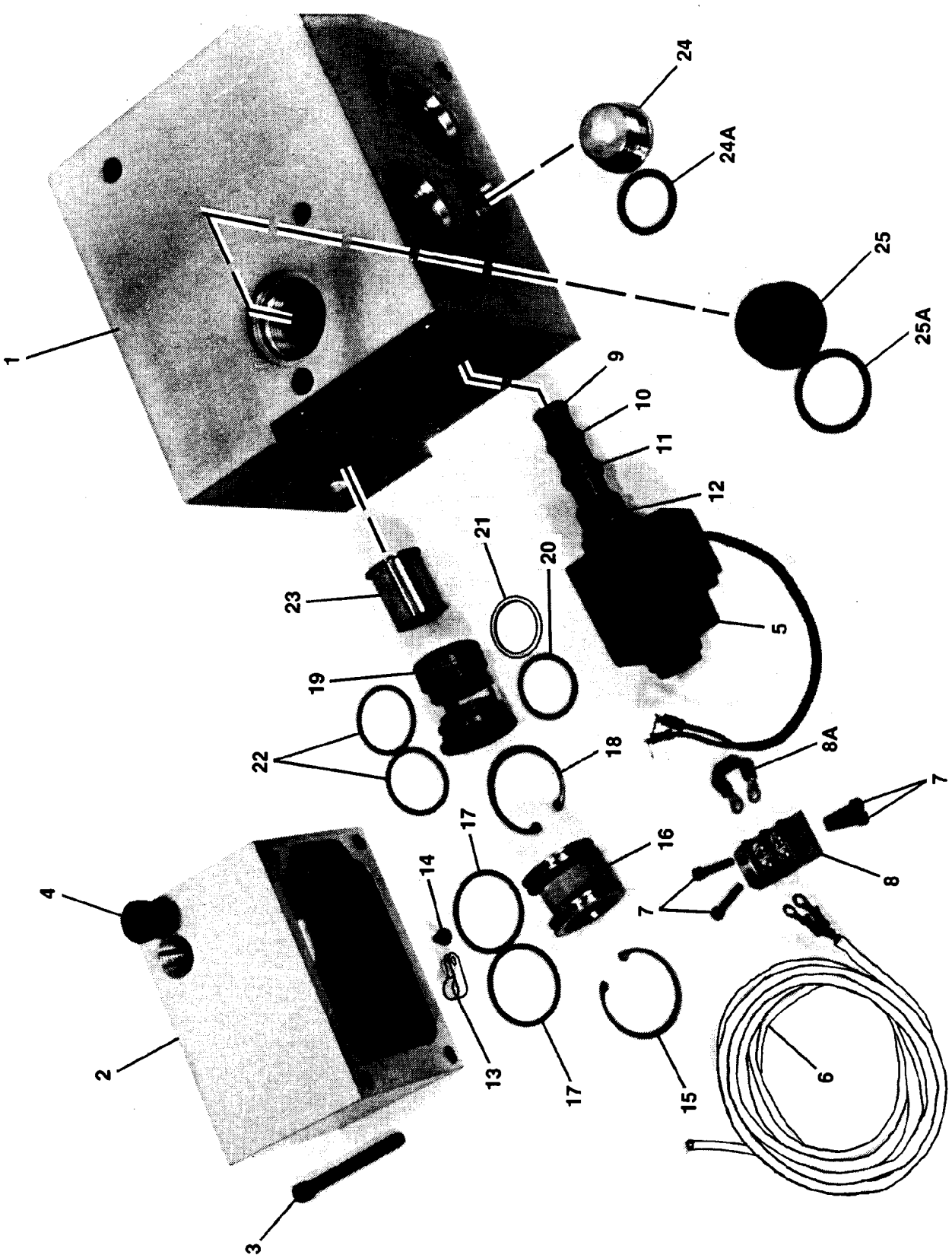


Figure 4-1. Liquid Fuel Shutoff Valve Exploded View

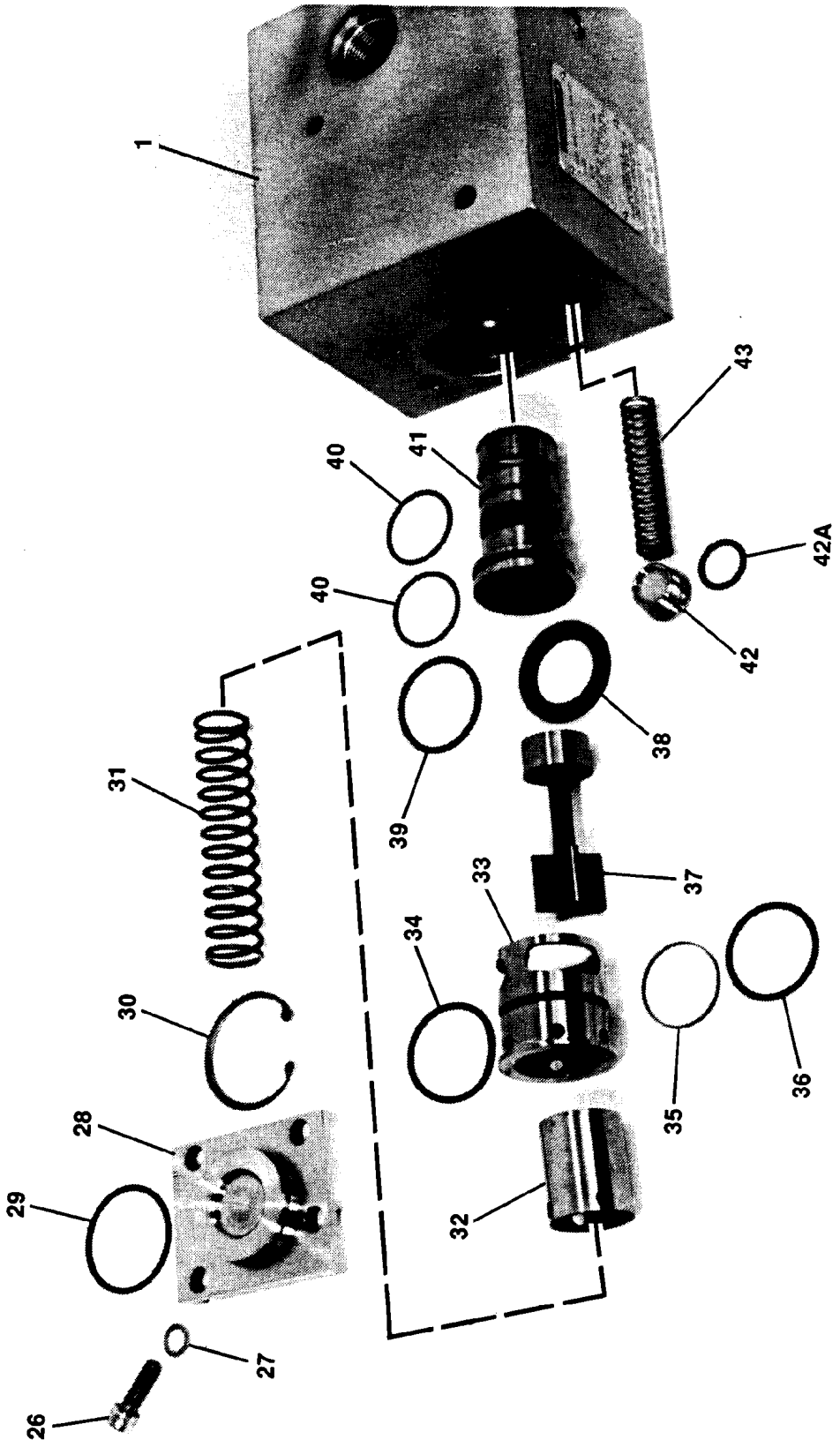


Figure 4-2. Liquid Fuel Shutoff Valve Exploded View

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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 40134A.

B40134:A

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Email and Website—www.woodward.com

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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.

2013/1/Colorado