WOODWARD

Product Manual 40133
(Revision NEW)
Original Instructions

3230 Hydraulic Pump

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 Out-of-date translations are marked with ⚠.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

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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.

Chapter 1.
General Information

The 3230 Hydraulic Pump is a positive-displacement gear pump for use with industrial gas turbines. It supplies hydraulic pressure to electrohydraulic actuators that position fuel or water metering valves and to other accessories requiring a high-pressure oil supply.

The pump is installed on the turbine's gearbox and is driven by the turbine through the pump's splined drive shaft.

The pump operates at speeds up to 4000 rpm. Discharge pressure is factory set at 750 psi (5171 kPa) nominal above supply pressure. Factory calibration is performed with MIL-L-23699 synthetic turbine oil.

The pump's oil supply is obtained from the turbine's lubrication oil system.

All components of the pump are capable of operation at temperatures from –40 to +250 °F (–40 to +121 °C).

Chapter 2.
Principles of Operation

Figure 2-1 illustrates the operating principle of the gear pump.

The positive-displacement pump provides a given amount of output flow for every revolution. Except for leakage loss, this output flow remains proportional to speed and is independent of output pressure. Pump volume is provided by a drive gear and an idler gear of identical sizes.

Positive pressure is required on the inlet side of the pump to prevent cavitation.

Accumulators may be used between the pump and actuators to assure that there is an adequate supply of pressure oil during transients.

When the pump's output flow capability exceeds output requirements, a pressure-regulating valve allows the excess oil to be bypassed back to the turbine lube oil system. This provides a continuous flow of lubricating oil through the pump and avoids an excessive buildup of heat.

The pressure-regulating valve establishes the output pressure of the pump. The spring-loaded valve is adjustable, but the adjustment is set at the factory and should not be changed.

All output from the pump gears flows through an external oil filter attached to the pump housing. It then flows back into the pump and is directed to one of the discharge ports or to the pressure regulator.

The filter will automatically bypass should it become clogged, allowing contaminated oil to pass through the filter to the components being served by the pump. Regular replacement of the filter element is required to assure that the servos are protected from dirt in the hydraulic oil supply. A gauge may be installed between the filter-inlet-pressure port and the filtered output to the Fuel Metering Valve/Actuator to check the amount of flow pressure drop across the filter, indicating the status of the filter.

A dual servo valve can be installed on top of the pump, receiving its oil supply directly through the surface port on the pump. The return from the servo valve is also directed through the top surface of the pump. The two connections are sealed from leakage with O-rings which fit into grooves in the pump face.

If the dual servo valve is not used with the pump, a cover plate must be installed to block the supply and return ports on the pump surface.

Connected fuel- and water-valve actuators receive their supply from the pump but must return oil to the lubrication system sump, not to the pump.

Pump rotation is clockwise, when facing the pump drive pad.

Figure 2-2 contains a typical flow curve for the pump. Discharge and flow are both shown in US gallons per minute. Speed is shown in pump-drive rpm. Note that the pump is capable of producing a minimum of 0.90 US gal/min (3.4 L/min) at 500 psi (3448 kPa) and a maximum of 8.6 US gal/min (32.6 L/min) at a 4000 rpm drive speed.

If the discharge pressure is doubled, pump output will run from a minimum of 0.75 to a maximum of 8.2 US gal/min (2.8 to 31.0 L/min) while being driven at 4000 rpm.

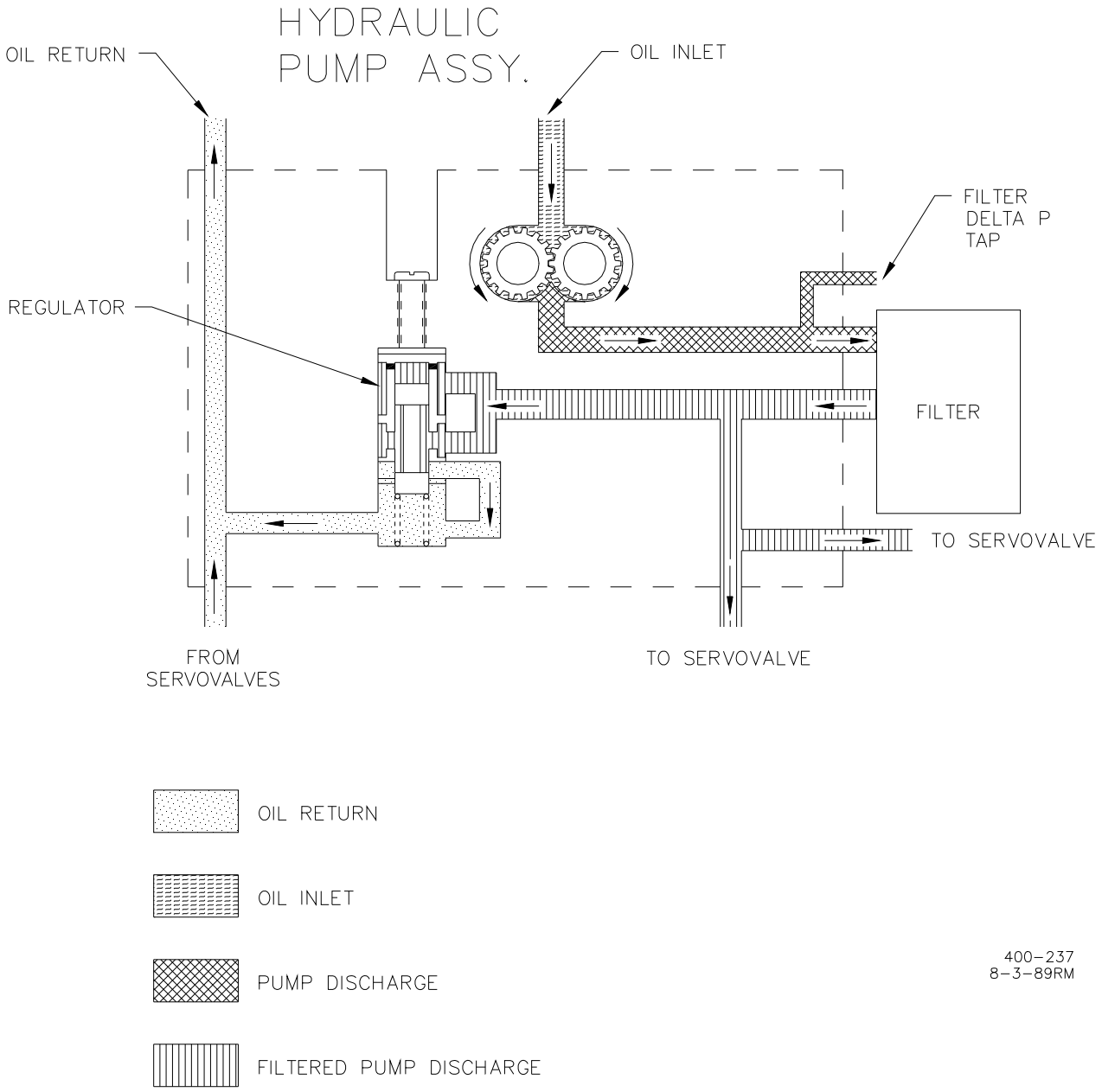

Figure 2-1. Gear Pump Schematic

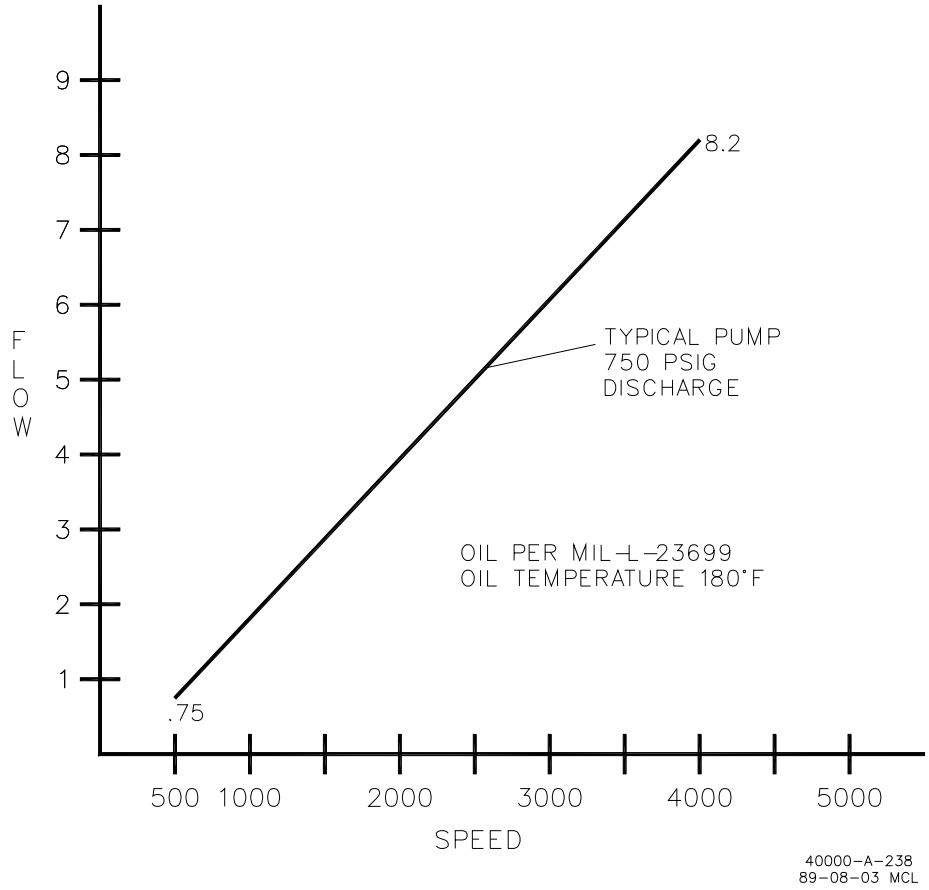

Figure 2-2. Pump Flow Chart

Chapter 3. Installation

The pump is installed on the gearbox drive pad of the turbine per AND20002, Type XII-K with a standard 5.00 inch (127.0 mm) bolt circle flange and a 4.125 (104.78 mm) pilot diameter. Installation attitude should include a minimum of 2.5 inches (64 mm) of clearance for servicing of the filter cartridge.

The drive shaft spline must insert into the drive with a minimum of pressure. Do not use force. The drive shaft will self-align to a drive pad with a 0.006 inch (0.15 mm) maximum eccentricity between pilot and drive spline.

Pump rotation can only be in the direction indicated on the pump housing.

Oil from the turbine lubricating system is provided for the pump through a 1.062-12 UNJ straight-thread port (MS16142) marked "Supply." The supply oil should be provided with a minimum of 2 psi (14 kPa) positive pressure. The turbine's lubrication-system pump will usually supply this oil. Make sure that the lubrication pump has enough volume to maintain lubricating functions when the pump is using up to 9 US gal/min (34 L/min).

A 0.562-18 straight-thread port on the pump housing marked "Filter In" may be used to install a Delta-P gauge across the filter. The other side of the gauge, if used, must be installed in the Fuel Metering Valve filtered supply line.

The 1.062-12 straight-thread pump-bypass port should be fitted with a return line to the lubricating-oil sump. The return line should provide unimpeded flow of bypass oil.

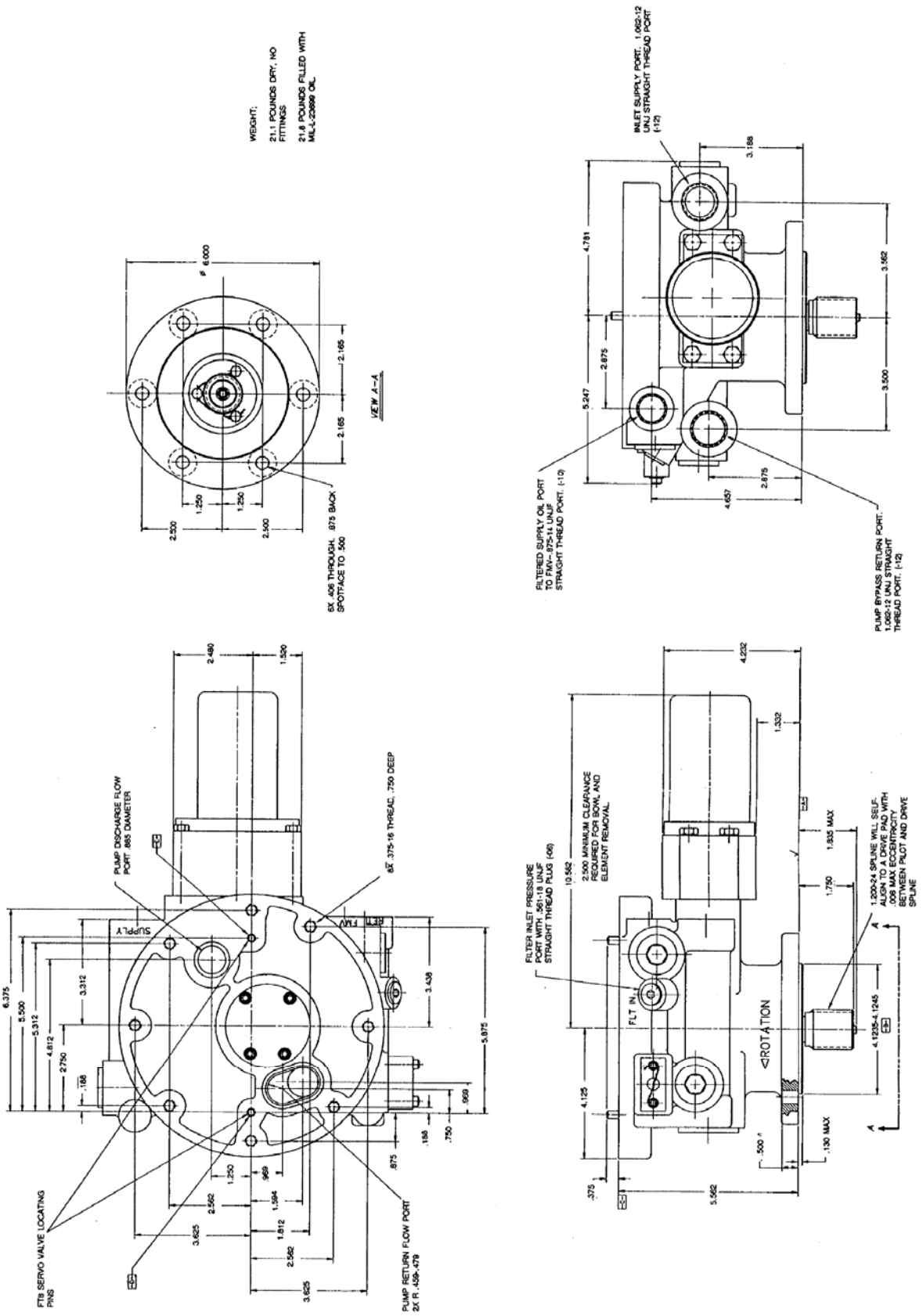

Figure 3-1. Outline Drawing of 3230 Hydraulic Pump

Chapter 4.
Maintenance and Troubleshooting

Introduction

The pump is not field adjustable. The flow rate is set by design. The regulating valve pressure is factory calibrated and should not be changed.

Filter

The filter element should be changed as necessary to provide full protection for the control equipment. If the Delta P across the filter is gauged, the filter should be changed when it reaches 50 ±5 psid (345 ±34 kPa).

Pump Wear

The pump is designed for long wear. All moving parts are lubricated with the turbine lubrication oil. The pump must not be operated without a supply of lubricating oil or damage will occur.

The factory set pressure relief valve should not change and should not be changed by the operator.

Storage

Short Term

Flush the unit with a corrosion resistant oil (MIL-C-6529, type 3, or equivalent).

Record the date the pump was prepared and identify the oil used on two identification tags. Attach one tag to the pump and one tag to the exterior of the storage container.

Place protective closures in open ports, wrap and seal the pump in barrier material (MIL-B-121, Type 1, Grade A, Class 1, or equivalent).

Cushion the unit and place in the container.

Long Term

Perform all steps outlined in short-term storage instructions. In addition, place a proper amount of desiccant (MIL-D-3464, Class 1, or equivalent) with the pump before wrapping it in the barrier material.

IMPORTANT **Once the pump has been properly prepared for storage, it does not require periodic flushing.**

Chapter 5.
Replacement Parts

Give the following information when ordering parts:

- The pump type, serial number, and part number (shown on the nameplate)
- Manual number (this is manual 40133)
- Part reference number given in the parts list and part name or description

Parts List for Gear Pump Assembly

Ref. No.	Part Name	Quantity
40133-1	Pump Housing	1
40133-2	Gear, Pump Drive	1
40133-3	Gear, Pump Idler	1
40133-4	Pressure Plate	2
40133-5	Pressure Plate	2
40133-6	Pressure Plate Seal	2
40133-7	.250 x .750 Dowel Pin	2
40133-8	O-Ring, 0.114 ID x 0.070	2
40133-9	Piston	2
40133-10	O-Ring, 0.426 x 0.070	2
40133-11	O-Ring, 0.6765 x 0.070	1
40133-11a	Piston	1
40133-12	Washer	1
40133-13	Washer, Shake proof	2
40133-14	Roll Pin, 0.125 x 0.375, stainless	3
40133-15	O-Ring, 2.489 x 0.070	1
40133-16	Cover, Pump	1
40133-17	Screw, 10-32 x 1.250	4
40133-18	Pump Drive Shaft	1
40133-19	Ball Bearing, 1.125 x 0.500 x 0.250	1
40133-20	Spacer	1
40133-21	O-Ring, 1.114 x 0.070	1
40133-22	Sleeve	1
40133-23	Drive Cover	1
40133-24	Screw, 10-32 x 0.625	3
40133-25	O-Ring, 0.864 x 0.070	1
40133-26	O-Ring, 0.364 x 0.070	1
40133-27	Seal, 0.500 ID Carbon Face	1
40133-28	Sleeve, Drive	1

Ref. No.	Part Name	Quantity
40133-29	Drive, Splined	1
40133-30	Washer, 0.266 x 0.812 x 0.120	1
40133-31	Lock Nut	1
40133-32	Plug, -12, Straight Thread	3
40133-33	O-Ring, 0.924 x 0.116	3
40133-34	Spring, Relief Valve	1
40133-35	Plunger, Relief Valve	1
40133-36	O-Ring, 0.551 x 0.070	1
40133-37	O-Ring, 0.614 x 0.070	1
40133-38	Sleeve, Relief Valve	1
40133-39	Block, Relief Valve Adjusting	1
40133-40	Washer, 0.203 x 0.438 x 0.032	2
40133-41	Screw, 10-32 x 1.250	2
40133-42	Screw, 0.250-28 x 0.625	1
40133-43	O-Ring	1
40133-44	Plug	1
40133-45	NOT USED	
40133-46	NOT USED	
40133-47	Plug, -8 Straight Thread	1
40133-48	O-Ring, 0.644 x 0.087 (-8 O-ring)	1
40133-49	Seat, Seal	1
40133-50	O-Ring, 0.612 x 0.103	1
40133-51	NOT USED	
40133-52	Filter Assembly	1
40133-53	NOT USED	
40133-54	Screw, 0.312-24 x 2.500	4
40133-55	Washer, 0.328 x .562 x 0.032	4
40133-56	Plug. -20 Straight Thread	1
40133-57	O-Ring, 1.475 x 0.118 (-20 O-ring)	1

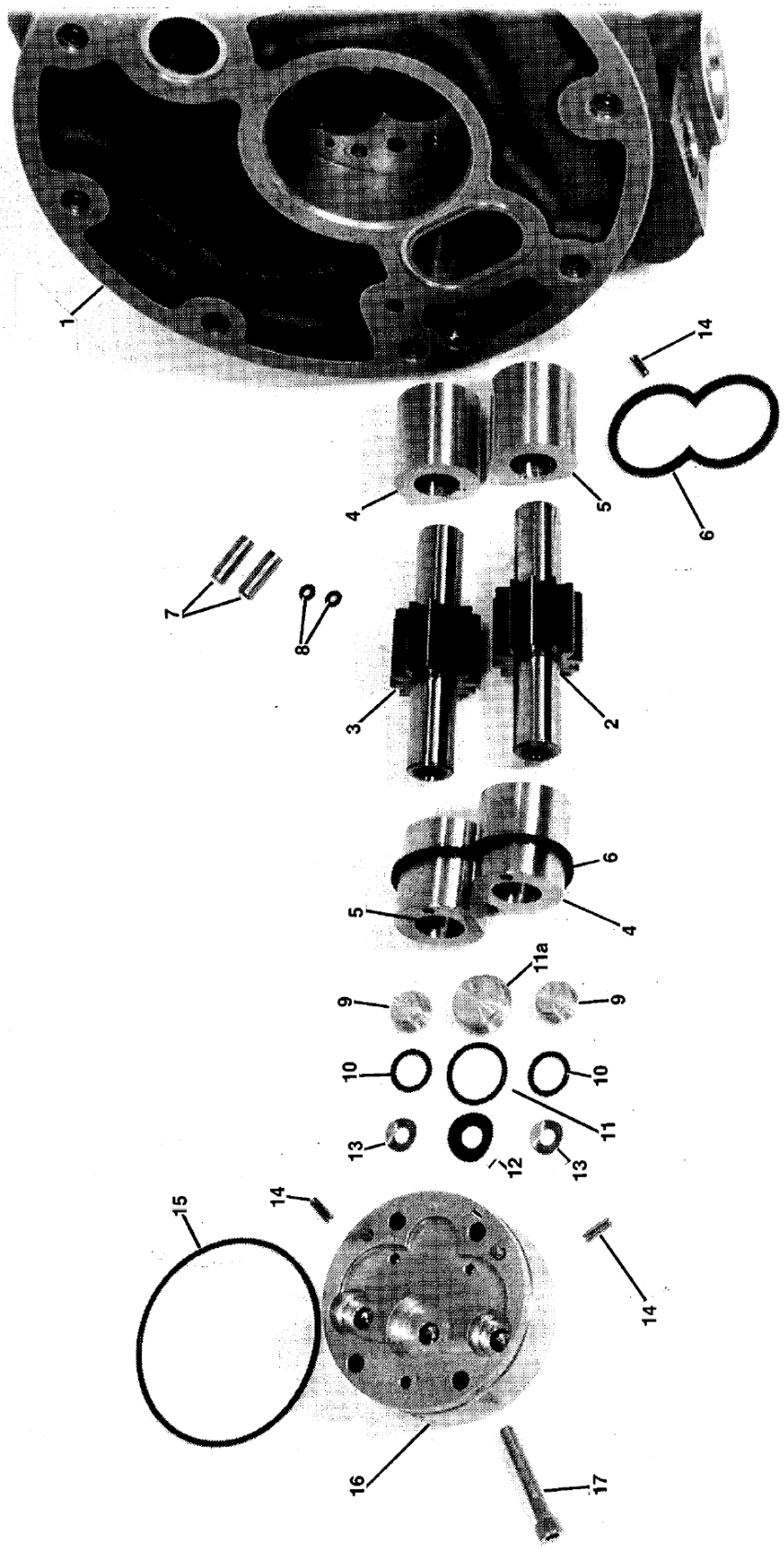

Figure 5-1. Pump Gears and Bushings

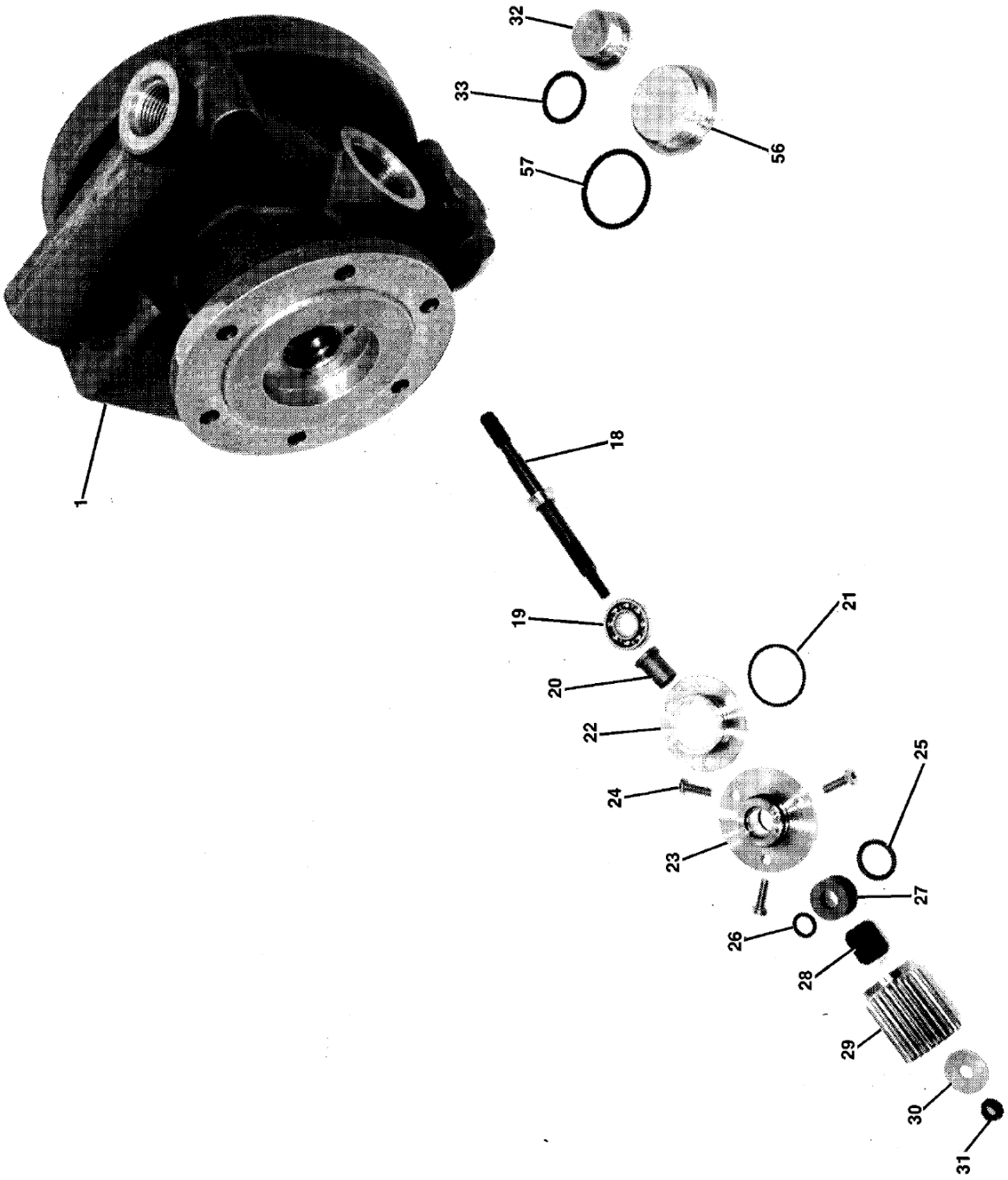

Figure 5-2. Pump Drive Parts

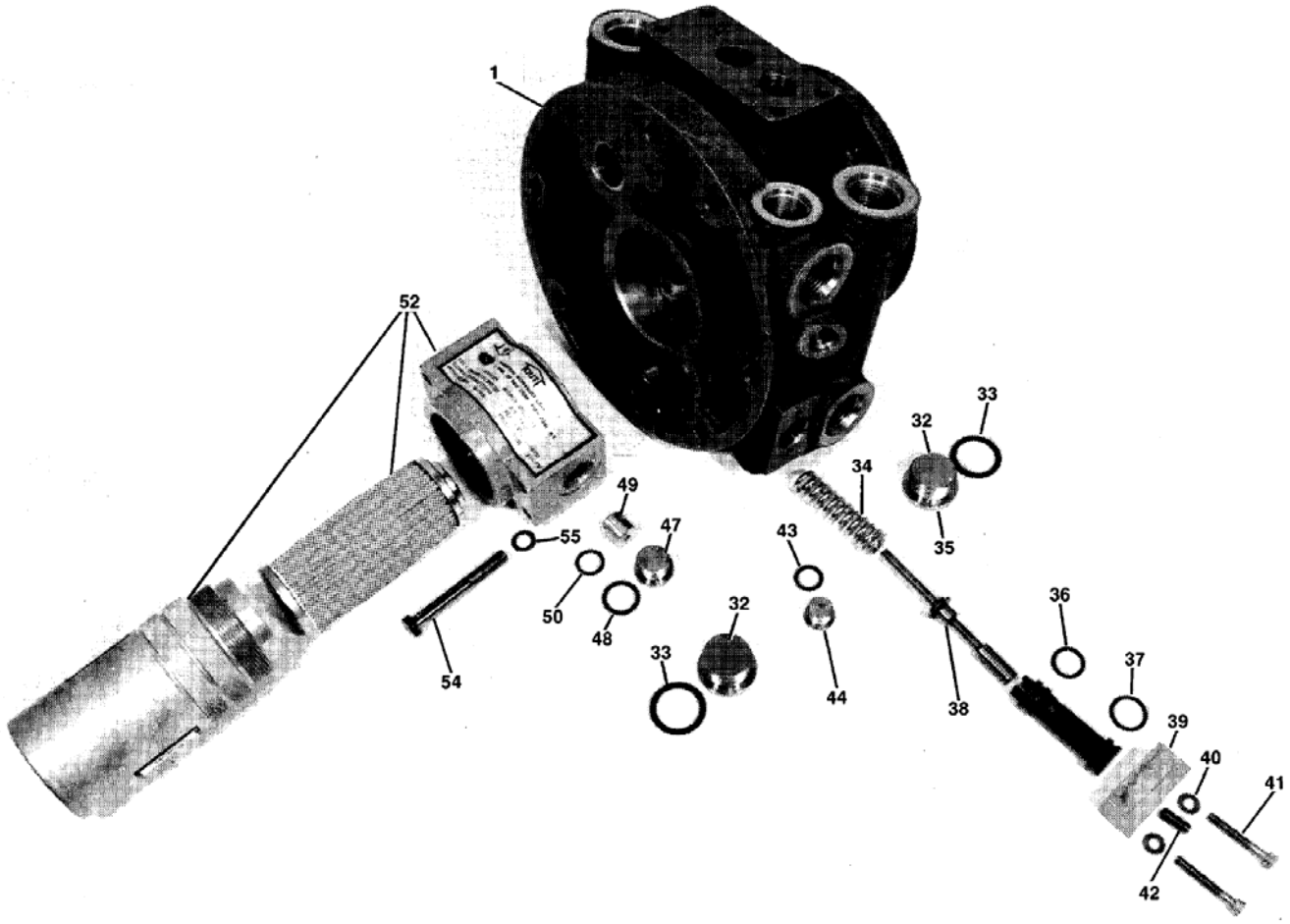

Figure 5-3. Pump Bypass Valve and Filter

Chapter 6.
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 40133.

B40133:NEW

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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