

3161 Governor

Load Limit Control

Operation Manual

IMPORTANT



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.

DEFINITIONS

- **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

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.



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.



This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, be sure to check the *publications page* on the Woodward website: www.woodward.com/publications

The current revision and distribution restriction of all publications are shown in manual **26311**.

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.



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.

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.

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*.

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Chapter 1.

General Information

Introduction

This manual describes the operation of the Load Limit Control as used on the 3161 governor. This device is installed on the governor at the factory.

Description

The purpose of the load limit control is to mechanically and hydraulically limit the load that can be placed on the engine. This is accomplished by restricting the travel of the governor output shaft in the increase fuel direction, and consequently the amount of fuel supplied to the engine. Load limit is increased or decreased manually as needed.

The load limit control may also be used for shutting down the engine by turning the control shaft to the zero position.

References

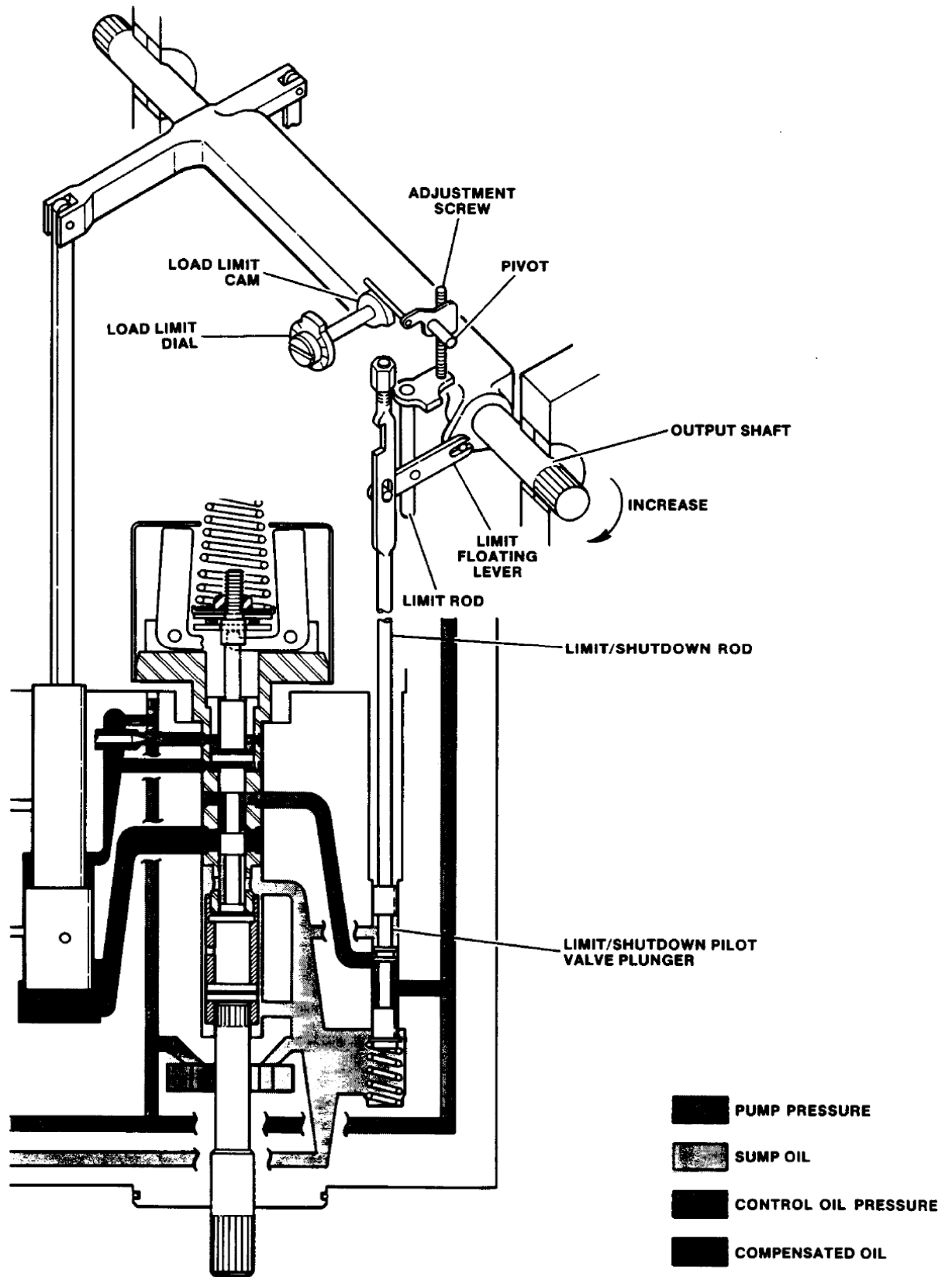
03101	3161 Governor
03102	3161 Governor, Product Specification
03103	Manual Shutdown Device for the 3161 Governor
03104	Pressure Shutdown Device for the 3161 Governor
03105	Electric Shutdown for the 3161 Governor
03106	Pneumatic Speed Setting Device (factory installed only)
03107	Speed Adjusting Motor with Manual Speed Adjustment (factory installed only)
03108	Air Pressure Fuel Limiter (factory installed only)
25075	Storage of Mechanical-Hydraulic Controls

Chapter 2.

Principles of Operation

The slotted load limit adjustment is located on the right front of the governor cover, and is set manually to a position of 0 to 10 on the load limit dial. Turning the load limit adjustment clockwise rotates an eccentric cam, limiting fuel at a higher level. Turning the adjustment counter-clockwise limits fuel at a lower level. As the cam rotates counterclockwise it raises the follower end of the load limit lever while lowering the limit screw end. As the limit screw moves down, it positions the limit rod assembly that is connected to the limit floating lever assembly.

Assume the prime mover is running on speed and the load limit adjustment is set at 5 on the dial. As load is applied to the prime mover and the governor ballhead calls for more fuel, the power piston moves up and rotates the output shaft in the increase direction. As the output shaft rotates, it lifts the right end of the limit floating lever assembly, and at the same time (because of the pivot point) lowers the left end of the limit floating lever. This action forces the limit/shutdown rod and limit/shutdown pilot valve down, draining control oil to sump, thus limiting fuel. Setting the load limit adjustment at 3 or 7, changes the pivot point thus changing the point at which fuel is limited.



03000-C-54

Figure 2-1. Schematic of the Load Limit Control

Chapter 3.

Troubleshooting, Repair, and Calibration

Troubleshooting

WARNING

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.

If the load limit control will not limit fuel at the proper levels:

1. Limit screw (6) is incorrectly set.
 - Refer to the calibration procedures at the end of this chapter and recalibrate the control.
2. **With the prime mover shut down**, carefully remove the governor cover and check for binding of limit rod (7), limit floating lever (8), limit/shutdown rod (9) or the limit/shutdown pilot valve plunger.

Repair Procedure

Shut down the prime mover.

If the load limit control is to be calibrated on a governor test stand, follow these recommended procedures:

CAUTION

Wear approved eye protection to prevent possible eye injury during disassembly, cleaning, and assembly of parts.

Disconnect all electrical leads, air and hydraulic lines (if so equipped) from the governor.

Before removing the governor from the prime mover, note the position of the linkage on the output shaft to ensure correct installation on the prime mover after calibration.

Remove the governor from the prime mover.

NOTICE

This governor is a precision device and should be treated as such. Set the governor upright on wooden blocks to protect the drive shaft. Do not drop or set the governor on the drive shaft as this may cause damage to the drive shaft, bearings, seals, and other parts inside the governor.

Before attempting the disassembly of the load limit control, remove all dirt, grease, water and other contaminants from the cover.

Remove the cover assembly from the governor and place it on a clean dry work area. Disassemble the load limit control according to the following instructions. Reference numbers in parentheses are assigned to each part in the exploded view (Figure 4-1).

Disassembly

(Figure 4-1)

1. Remove loading spring (3).
2. Hold pivot (4) with a 1/16 inch pin punch and remove 5/16 inch elastic nut (2). (Refer to Figure 3-1).

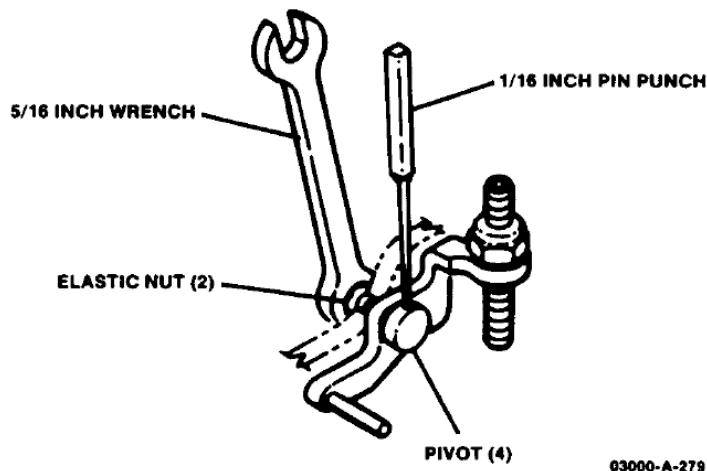


Figure 3-1. Holding Pivot (4) to Remove Elastic Nut (2)

3. Remove pivot (4) and limit lever (5). Do not remove limit screw (6) from lever (5).
4. Observe position of cam (12) on load limit shaft (13). The cam must be reinstalled in the same position.
5. Hold load limit shaft (13) with a screw driver and use a 5/16 inch wrench to remove elastic nut (2).
6. Do not remove load limit dial (14) from shaft (13) unless replacement is necessary.
7. Do not remove load limit plate (17) from the governor cover unless replacement of the plate is necessary.

Cleaning

Clean parts with solvent and a stiff brush to remove foreign particles.



Observe manufacturer's Instructions or restrictions regarding the use of solvents. If no instructions are available, handle with care. Use the cleaning solvent in a well ventilated area away from fires or sparks.

Dry parts with clean lint free wipes, or blow dry with clean dry air.

Handle parts that have been machined to a close tolerance carefully, to prevent damage caused by contact with other parts or objects.

Assembly

To prepare to assemble the load limit control, lay the parts in an orderly fashion on a clean dry work surface. Careful, precise assembly methods will save time, and help to ensure correct operation of the control.

1. Put a light coat of white petroleum jelly on O-ring (15) and install it on load limit shaft (13).
2. Install load limit shaft (13) in cover (1). Install washer (10), spring washer (11) and cam (12) on shaft (13).

IMPORTANT

Refer to Figure 3-2 for correct installation of cam (12) to ensure full load limit range.

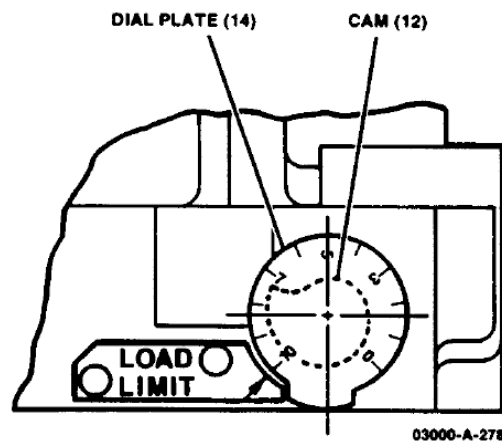


Figure 3-2. Location of cam (12) in relation to dial plate (14)

3. Install nut (2) and turn it on until it is tight against cam (12), then counterclockwise 1/8 turn. It should now require 2 to 4 lb-in torque (0.2 to 0.5 N·m) to turn load limit shaft (13).
4. Place load limit lever (5) on pivot (4) and install the pivot in cover (1). Secure the assembly with elastic nut (2). Refer to Figure 3-1 and be sure the hole in the pivot is vertical as shown.
5. Install loading spring (3). Refer to Figure 4-1 for the location of spring (3).

Calibration Procedures

(on test stand)

Before attempting to calibrate the load limit control, refer to the engine specifications and the governor test specifications for required fuel limit levels.

Install the governor on the test stand. Be sure test stand drive rotation is the same as the governor pump rotation.

Fill the governor with 2.3 qt (2.2 L) of clean oil that has a viscosity of 100 to 300 SUS at continuous operating temperature (typically 150–180 °F/66–82 °C).

Install the cover on the governor. Remove the shutdown cover plate or shutdown devices (if so equipped).

1. With the speed setting shaft rotated to the high speed position:
 - A. Run the test stand and allow the governor to reach the temperature of 130–150 °F (54–66 °C).
 - B. Be sure the governor is functioning correctly and calibrated to governor specifications.
 - C. Unhook feedback linkage and run test stand open loop.
 - D. Adjust the test stand to run the governor drive shaft at 500 rpm less than the specified high speed of the governor.
2. Rotate load limit knob (13) to read “0” on dial (14).
3. Turn limit screw (6) in load limit lever (5) counterclockwise several turns until the governor output shaft moves off “0”, then clockwise until it returns to “0”.
4. Rotate load limit knob (13) to read “10” on dial (14). Be sure the governor output shaft is free to rotate through its full range.
5. Replace the shutdown cover plate (or shutdown devices).
6. Install the governor on the prime mover, being sure of correct linkage installation.
7. Install electrical leads and air or oil lines if needed.

Calibration Procedures

(on prime mover)

Before attempting to calibrate the load limit control, refer to the engine specifications for correct limiting speeds.

1. Remove the shutdown cover plate or any shutdown devices from the governor cover (if so equipped).
2. Turn load limit dial (14) to read number 8.
3. **Start the prime mover.** Turn the governor speed setting shaft to the rated speed position and run the prime mover at full load. If the governor does not allow the prime mover to carry full load, turn limit screw (6) counterclockwise until it will carry full load.
4. With a 5/64 (2 mm) Allen wrench, slowly turn limit screw (6) clockwise until the prime mover speed just starts to decrease, or load starts to decrease if it is paralleled with another generator or the utility.

5. Remove load from the prime mover and reduce speed back to idle.
6. Turn load limit dial (14) to read zero. The engine must shut down.

IMPORTANT

If the prime mover does not shut down, refer to engine specifications for correct installation of linkage between governor and prime mover.

7. Install the shutdown cover plate or shutdown devices on the governor cover (if so equipped).

Chapter 4. Replacement Parts

When ordering replacement parts, include the following information:

- Manual number (this is manual 03109)
- Governor serial number and part number shown on the nameplate
- Part reference number and part parts list

Ref. No.	Part Name	Quantity
03109-1	Cover	1
03109-2	Elastic nut 8-32	2
03109-3	Loading spring.....	1
03109-4	Pivot	1
03109-5	Limit lever.....	1
03109-6	Limit screw 8-32 x 1.0	1
03109-7	Limit rod	1
03109-8	Limit floating lever	1
03109-9	Limit/shutdown rod.....	1
03109-10	Washer.....	1
03109-11	Spring washer	1
03109-12	Load limit cam	1
03109-13	Load limit knob/shaft	1
03109-14	Load limit dial	1
03109-15	O-ring	1
03109-16	Drive screw	2
03109-17	Load limit plate	1

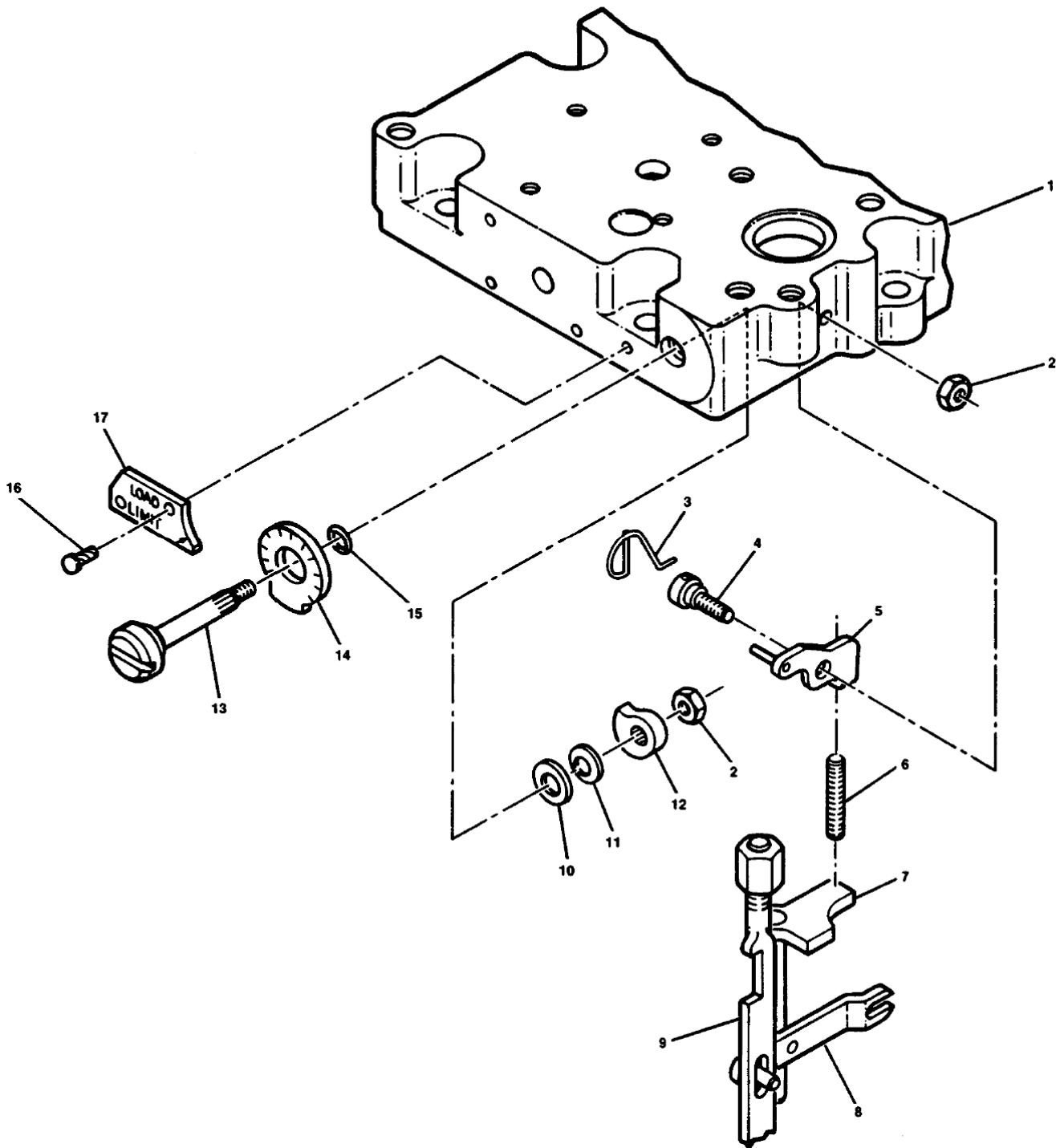
REFERENCE NUMBERS 1 THROUGH 17
USED ON THIS PAGE

Figure 4-1. Parts for Load Limit Control

Chapter 5.

Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (EngineHelpDesk@Woodward.com) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

OEM or 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 current list of Woodward Business Partners is available at www.woodward.com/directory.

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- 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 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.

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic 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.

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. 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 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's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- 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.

Product Training is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor 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 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 one of the Full-Service Distributors listed at www.woodward.com/directory.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at www.woodward.com/directory.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used In Electrical Power Systems		Products Used In Engine Systems		Products Used In Industrial Turbomachinery Systems	
<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:		Germany-----	+49 (711) 78954-510	India -----	+91 (129) 4097100
Kempen----	+49 (0) 21 52 14 51	India -----	+91 (129) 4097100	Japan-----	+81 (43) 213-2191
Stuttgart--	+49 (711) 78954-510	Japan-----	+81 (43) 213-2191	Korea -----	+82 (51) 636-7080
India -----	+91 (129) 4097100	Korea -----	+82 (51) 636-7080	The Netherlands-	+31 (23) 5661111
Japan-----	+81 (43) 213-2191	The Netherlands-	+31 (23) 5661111	Poland-----	+48 12 295 13 00
Korea -----	+82 (51) 636-7080	United States----	+1 (970) 482-5811	United States----	+1 (970) 482-5811
Poland-----	+48 12 295 13 00				
United States----	+1 (970) 482-5811				

For the most current product support and contact information, please visit our website directory at www.woodward.com/directory.

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel,
dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine,
etc.) _____

Control/Governor Information

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 _____

Symptoms

Description _____

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 03109.



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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.