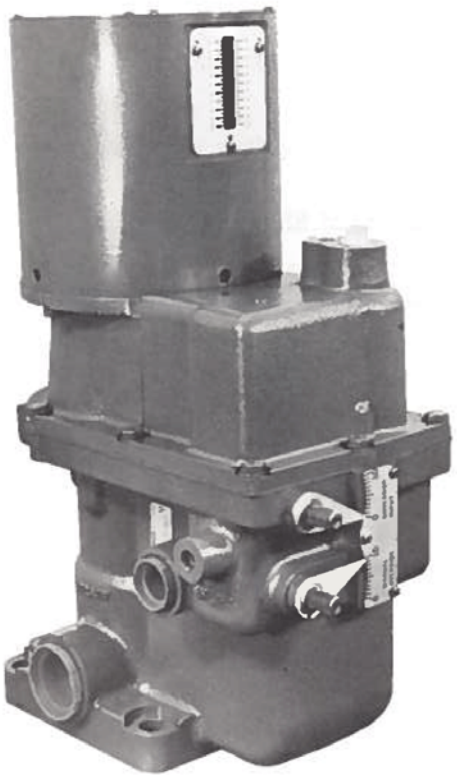
WOODWARD

Product Manual 89012
(Revision NEW, 1977)
Original Instructions



85 mm Hydraulic Amplifier (Mechanically Controlled)

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 Out-of-date translations are marked with ⚠.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

Manual 89012

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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

Description

The Woodward 85 mm Hydraulic Amplifier is a pilot operated servo actuator used where relatively large forces are required to operate power control mechanisms such as the fuel control linkages of large engines or steam control valves of turbines. Two models of the 85 mm Hydraulic Amplifier are covered in this manual. These models are basically identical except for the inclusion of either a sleeve or plug which determines single or double-acting (differential) servo operation.

The 85 mm Hydraulic Amplifier is used in conjunction with a governor having a mechanical output such as PG or UG-8 type governors.

The amplifier uses the relatively low level output from the governor (through a linkage not supplied by Woodward) to activate the amplifier control forces. Upward movement of the amplifier pilot valve directs supply pressure oil to the top (increase) side of the servo piston. The servo piston is linked to the prime mover control mechanism. In the single-acting type amplifiers, the closing force is produced solely by a return spring, either internal or external.

Closing forces in the differential amplifiers are provided by oil pressure acting on the bottom (decrease) side of the servo piston and, in some cases, combined with an optional internal return spring. In most applications, the servo return spring is designed to counteract the unbalanced forces tending to open the fuel control or steam valve. Thus, on the differential amplifier, the return spring provides a balanced system with a linear response over the full amplifier stroke. Secondarily, in the event of loss of supply pressure oil, the return spring will ensure the steam valve or fuel control closes and remains so during shutdown provided the opening forces are not greater than the return spring forces. A standard return spring will normally be installed during amplifier assembly, although various return spring preloads are available upon request.

In addition to the input from the governor, the amplifier is equipped with a manual override which can return the amplifier output to zero regardless of governor input position. A pneumatically operated starting fuel limiter is used to limit amplifier output travel during start-up.

References

Manual 25071	Oils for Hydraulic Controls
Manual 25075	Commercial Preservation Packaging for the Storage of Mechanical Hydraulic Controls

Specifications

Construction

Cover:	Cast aluminum
Case:	Cast iron
Weight:	52 kg with return springs 37 kg without return springs
Mounting:	Vertical or horizontal (servo must be placed below the pilot valve)

Hydraulic Supply

Type:	Petroleum based oils. Synthetic lubricants are not generally acceptable for use with Woodward hydraulic amplifiers. Contact the Woodward for specific oil recommendations
Source:	Prime mover lubricating system or external independent system
Normal Operating Supply Pressure:	Single-acting with standard return springs; 3450 kPa maximum, minimum supply pressure is determined by operating conditions
Differential:	345 to 3450 kPa
Flow Rate:	3.5 L/s during transient periods. Requires less than 100 mL/s during steady state
Time Constant:	10 to 40 m/s depending on operating conditions
Filter:	40 µm nominal
Viscosity:	Up to 3300 cSt, but normal viscosity range is 50 to 440 cSt
Normal Operating Temperature:	–29 to +115 °C, soak –50 to +150 °C

Input

Shaft:	Serration 10 x 12, DIN 5481 (30 teeth)
Angular Travel:	30°
Minimum Torque Required:	1.3 N·m

Output

Rod:	M22 x 1.5 CL6G thread
Maximum Stroke:	50 mm, +2, –0
Maximum Stalled Force in the Increase Direction:	Differential Servo 2.212P Single-Acting Servo with spring return 5.059 P – (F + KX)
Where:	P = supply pressure (kilopascals) F = spring preload (newtons) K = spring scale (newtons/meter) X = servo stroke (meters)

Manual Override

Shaft:	Serration 10 x 12, DIN 5481 (30 teeth)
Angular Travel:	30° travel in decrease direction gives shutdown
Minimum Torque Required:	61 N·m

Starting Fuel Limiter

Single limit point position adjustable throughout full range amplifier travel.

Minimum Pressure Required:	690 kPa
Maximum Pressure:	4800 kPa

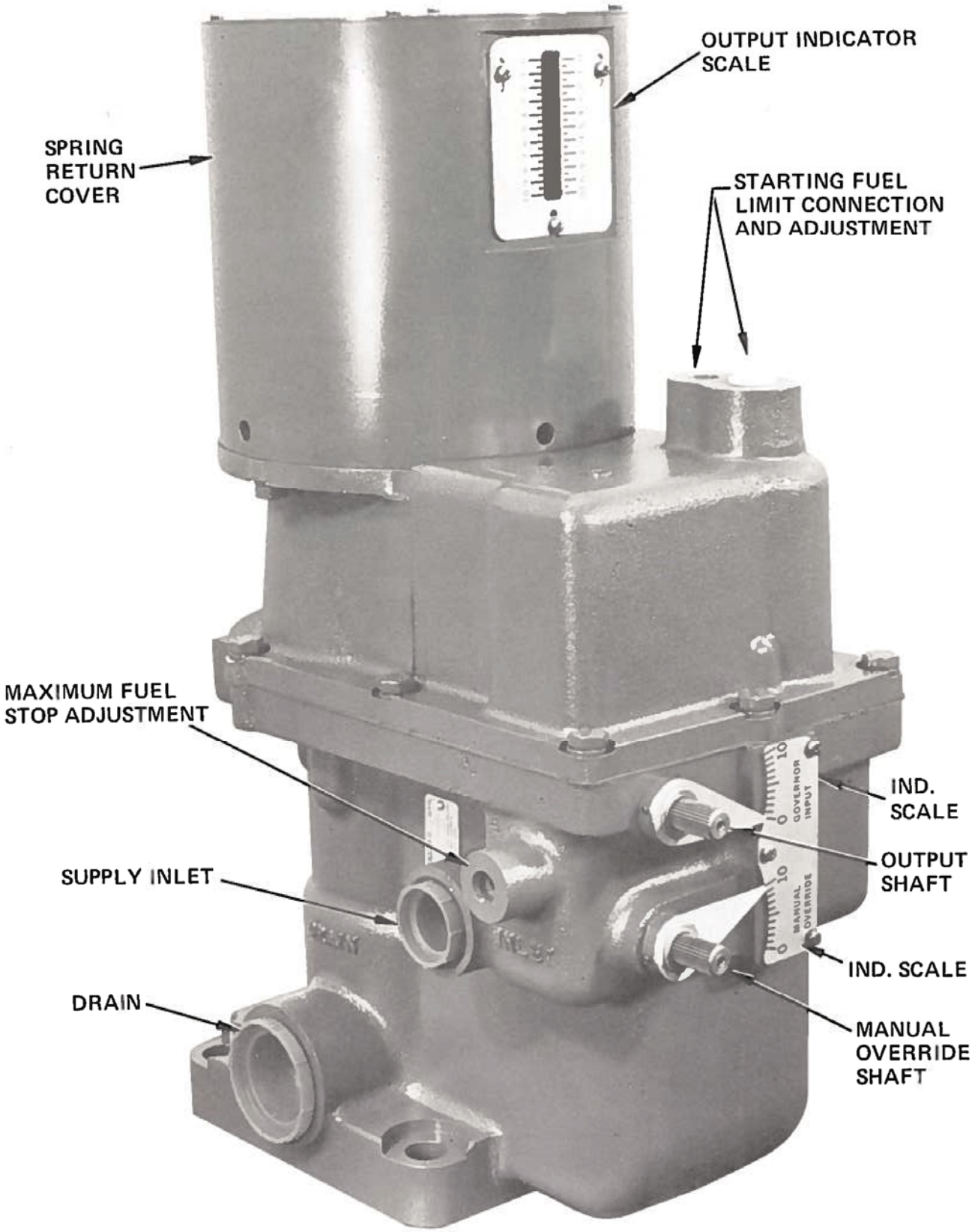

Figure 1-1. 85 mm Hydraulic Amplifier with Spring Return

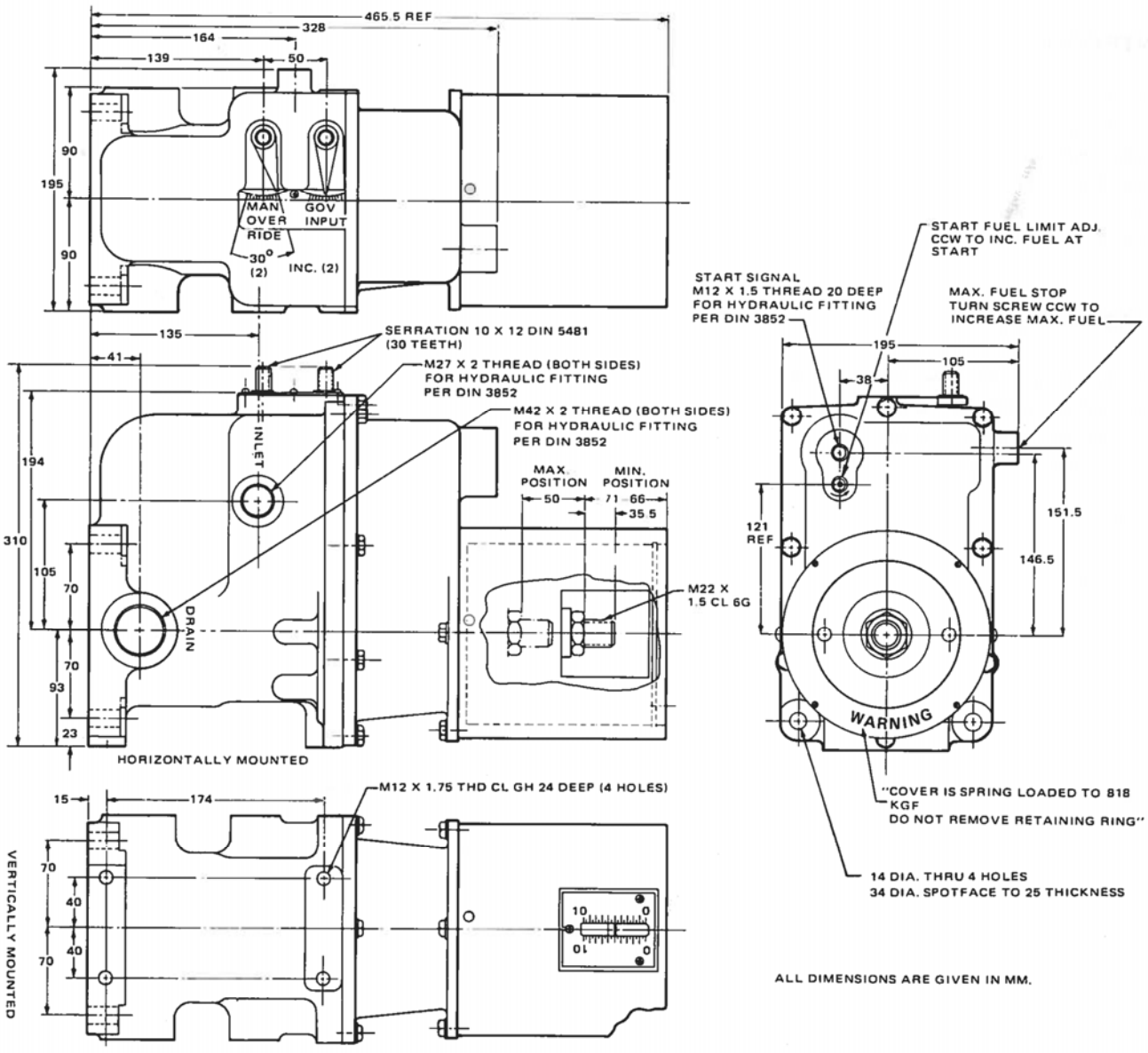

Figure 1-2. Outline Drawing of 85 mm Hydraulic Amplifier
(Do not use for construction.)

Chapter 2.
Installation

Introduction

Use care while handling and installing the amplifier. Be particularly careful to avoid striking the input and output shafts. Abuse can damage seals and internal parts.

⚠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.

Receiving

The 85 mm Hydraulic Amplifier is shipped from our factory bolted to a wooden platform in a vertical position. The amplifier has been factory tested and adjusted to specific customer requirements, then drained of oil. This leaves a light film of oil covering the internal parts, preventing rust. No internal cleaning is required before testing or installation and operation. The input and output shafts are sprayed with a light film of oil; however a soft seal preservative can be applied at the customer's request. Before installation, remove the soft seal with a cloth saturated with mineral spirits.

Storage

If the amplifier is to be stored for a period of time, please refer to Woodward's specification procedure, 25075, *Commercial Preservation Packaging for the Storage of Mechanical-Hydraulic Controls*.

Mounting Requirements

Refer to the outline drawing, Figure 1-1, for (1) overall dimensions, (2) mounting hole locations, (3) hydraulic fitting sizes, (4) input and output shaft dimensions, and (5) amplifier adjustment locations.

Mount the amplifier securely on its mounting pad. It may be mounted vertically or horizontally, on either of two mounting surfaces. If the amplifier is mounted horizontally, the servo must be placed below the pilot valve (input shafts up), to prevent air from being trapped in the servo.

Attach all mechanical linkages. Mechanical linkages must be free of binding and have minimum backlash. It is very important that the linkages between the governor and the amplifier, and between the amplifier and the fuel control valve be of correct relationship for proper system operation. Use approximately 2/3 of the available travel, either angular or linear. Allow sufficient travel at each end so the governor can cause complete shutdown and provide full fuel at full load.

Attach all hydraulic lines. The same grade and type of lubricating oil used in the prime mover will generally be suitable for use in the amplifier. We recommend an oil with a viscosity of 7.4 to 43 cSt for optimum amplifier operation at normal operating temperatures. Consult Woodward for oils not included within these ranges. Also see Woodward manual 25071, *Oils for Hydraulic Controls*.

The amplifier oil supply can be provided directly from the prime mover lubricating system or from an auxiliary supply independent of the prime mover. Supply oil pressure must be constant and within the specified range. Accumulators will normally be required to provide the necessary flow rate.

The oil supply line should be at least 22 mm diameter and as straight and short as possible. Elbows should be avoided. The drain should receive equal attention. It should be no less than 33 mm diameter. If the mounting pad has provisions for an internal drain to the sump or oil reservoir, the plug in the bottom of the amplifier can be removed to provide direct drainage through the mounting pad.

A 40 µm (nominal) oil filter in the supply line is recommended. Dirty, fatigued oil is the most common cause of governor/actuator/amplifier failure.

Attach the pneumatic line for the starting fuel limiter. Minimum operating pressure is 690 kPa.

Chapter 3.
Operation and Adjustments

Initial Operation

For initial operation of the 85 mm Hydraulic Amplifier, the operator must first make sure all mounting equipment and hardware, linkages, and hydraulic fittings are properly attached.

⚠WARNING

When first starting the prime mover equipped with an 85 mm Hydraulic Amplifier, be prepared to initiate an emergency shutdown in the event of a governor, amplifier, fuel control, or prime mover failure.

Operating instructions for the governor should also be used with these instructions. Woodward service manuals for the installed governor will describe the adjustment of the compensating needle valve. Following this procedure, the operator will cause the governor to hunt in order to purge trapped air from its internal passages. This procedure will also cause the amplifier to cycle and remove air from its system and oil supply lines.

The operator should check the indicator scales on the amplifier to see that amplifier output follows governor input position. Also check that the manual override functions properly. With the governor input at 10 (maximum), the servo must move to minimum fuel when the manual override is turned to 0 (minimum). Manual override is normally held at maximum by an internal spring.

Adjustments

Normally, all operating adjustments are made according to engine manufacturer requirements during factory testing and should not require further adjustment. Circumstances may require readjustment of the maximum fuel stop or the starting fuel limiter. These are externally accessible and may be adjusted by the operator using the following instructions.

⚠WARNING

Removal of the amplifier cover is not recommended. The servo return springs may be preloaded to 818 kgf depending upon system requirements.

Do not attempt to remove the cover and make internal adjustments unless thoroughly familiar with the proper disassembly procedures.

Whether testing and readjustment of the amplifier is made on the prime mover or test stand, the operator must provide supply oil at normal conditions. Servo output to the prime mover must be disconnected.

Maximum Fuel Stop Adjustment

The maximum fuel stop is adjustable between 32 and 50 mm servo output travel. It is adjusted by first turning the amplifier input to maximum. Turn the adjusting screw CW to decrease the maximum fuel position, CCW to increase. After the adjustment is made, check the maximum fuel stop position by returning input to zero, then back to maximum. Observe the servo output position and repeat the procedure until the desired point is reached.

Starting Fuel Limiter Adjustment

To change the starting fuel limit point, allow zero air pressure on the starting fuel limiter and turn the adjusting screw CW to decrease fuel at start, CCW to increase fuel at start.

NOTICE

Adjustment of the starting fuel limiter must not be made while there is air pressure on the limiter and the limiter is against its stop.

After the adjustment is made, admit limiter air pressure. Observe the limit point as the amplifier input is turned to maximum. Repeat the procedure until the desired limit point is reached.

Chapter 4.
Principles of Operation

Introduction

Operation of the 85 mm amplifier is very similar to other Woodward hydraulic amplifiers. Design variations and auxiliary devices provide different functions but do not alter basic operation. Along with the descriptive text, a schematic drawing, Figure 3-1, shows the working relationships of the various parts.

Schematic Operation

Supply pressure oil is provided from an external source and is admitted to the amplifier at the pilot valve plunger. The plunger has a control land that regulates oil flow through an internal port to the servo piston. Input shaft movement controls the position of the servo piston. When the governor senses an underspeed condition and signals for an increase in fuel, the amplifier input shaft is rotated to increase. Through the internal amplifier linkage, this raises the left end of the floating lever and the attached pilot valve plunger. Supply pressure oil is now directed to the top side of the servo piston causing movement to increase fuel.

Pressure oil which may leak past the servo piston to the open area below is allowed to drain through the installed sleeve. During an on-speed condition, the pilot valve plunger remains centered, covering the control port. The flow of supply oil is blocked, except to maintain servo position in relation to the governor speed setting and load on the prime mover.

When the governor senses an overspeed condition and signals for a decrease in speed, the amplifier input shaft is rotated to decrease. This lowers the left end of the floating lever and the pilot valve plunger. Supply pressure oil which had been trapped on the top side of the servo piston is opened to drain. The large return spring provides the force to move the servo piston to decrease on all single-acting type amplifiers.

Differential type amplifiers, however, do not always use the return spring. Instead, the differential types utilize oil pressure to move the servo in both increase and decrease directions. Inset B of the schematic drawing, figure 3-I, shows the sleeve to drain has been replaced by a plug. This plug closes the area below the servo piston to drain and opens that area to a continual flow of supply pressure oil.

This pressure constantly urges the servo piston in the decrease direction. Servo movement to decrease is not allowed, however, until the governor senses an overspeed condition and lowers the amplifier pilot valve plunger. Pressure oil which has been trapped on top side of the piston is allowed to drain and oil on the .opposite side can move the servo to decrease.

Note that the servo piston can move (in either direction) only when the pilot valve control land is not centered and allows oil to flow. Amplifier operation to increase fuel in the differential type is very nearly the same as the single-acting. If the pilot valve plunger is above its centered position, oil is directed to the top side of the servo piston. Now there is supply pressure oil on both sides of the servo piston. Although the oil pressure is nearly the same on both sides, the net force resulting from supply pressure oil acting over greater surface area on the top side moves the piston to increase.

Each time there is servo movement, whether to increase or decrease, there is also a corresponding movement through the floating lever to re-center the pilot valve plunger to halt further movement of the servo piston. As the servo piston moves to increase, it carries with it the right end of the floating lever and the connecting link and pilot valve plunger. Servo piston movement to increase continues until the plunger is re-centered over the oil control port. This re-centering action is the same in the decrease direction. Initially the plunger is lowered by the governor input. As the servo piston moves to decrease, it also raises the floating lever, re-centering the pilot valve plunger, and stopping servo movement to decrease.

Input from the controlling governor is through a serrated shaft having 30° angular travel, and a spring loaded linkage to the floating lever. In addition, another input shaft is provided to manually override governor control, but only in the shutdown direction. An internal spring returns the manual override to its normal maximum position.

With the governor input shaft at its maximum position, 30° travel of the manual override can return the amplifier output to zero. As the override shaft is moved to decrease, the override straps engage the pinned end of the lower governor input lever. The lower and upper governor inputs levers, previously held together by the loading spring, will separate. The lower and floating levers will be moved by the manual override. Thus engaged, the levers lower the pilot valve plunger causing servo movement toward minimum.

During start-up, the amplifier input shaft can be positioned by boosting the governor, that is, causing the governor to move to its maximum fuel position. Thus, the governor will control the amplifier immediately upon startup and will signal for maximum amplifier output. The amplifier is equipped with an internal, adjustable starting fuel limiter to limit servo output during start-up.

The limiter is activated by an external pneumatic signal, 690 kPa minimum is required. This temporary signal forces the limit piston down against its adjustable stop and limits upward travel of the floating lever and plunger. With the floating lever restricted, servo piston movement is limited at a predetermined position.

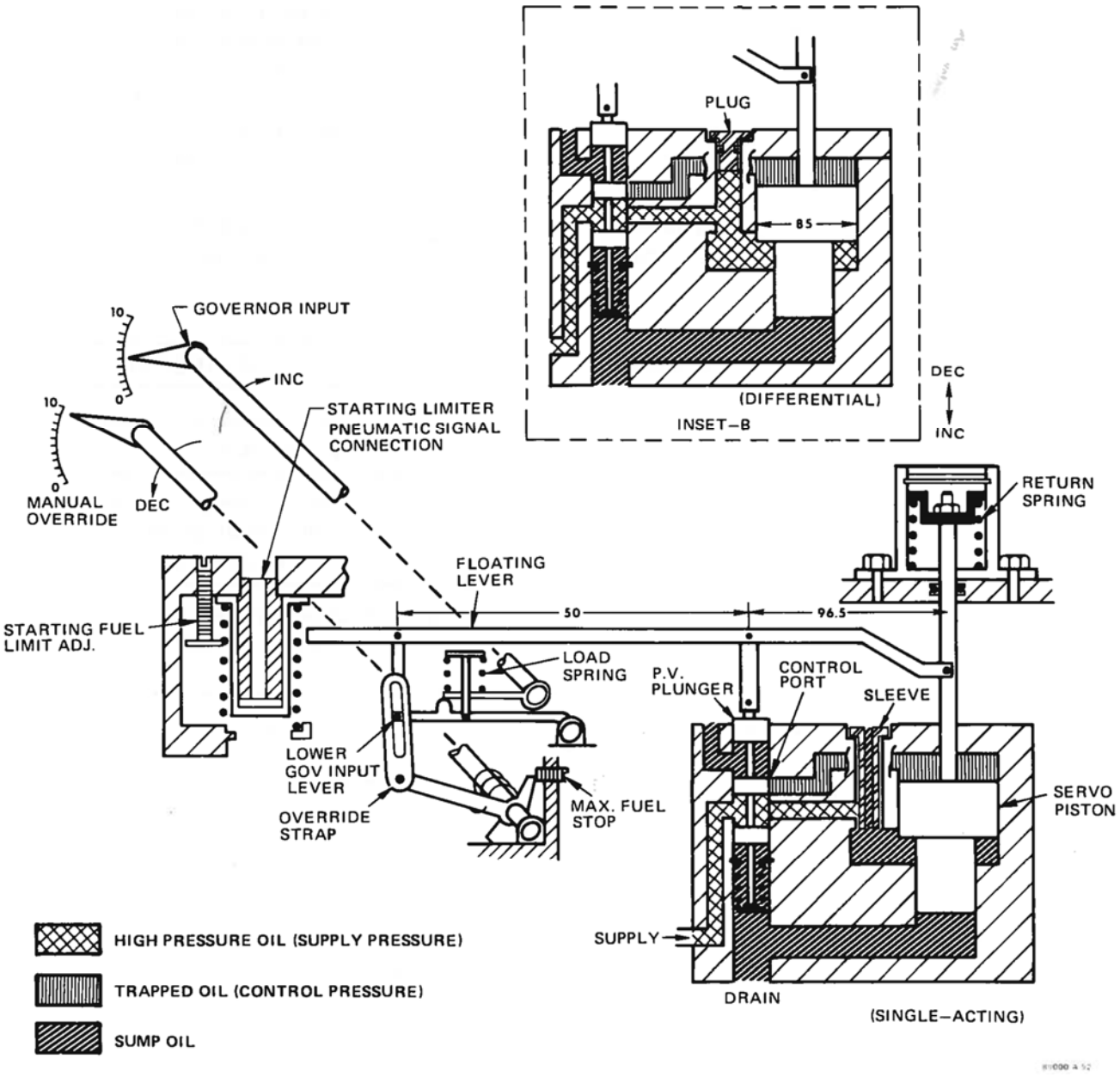

Figure 3-1. Schematic Diagram, 85 mm Hydraulic Amplifier

Chapter 5. Troubleshooting

While faults in the fuel control system are usually revealed in amplifier operation and, consequently, as speed variations of the prime mover, it cannot be assumed that such variations indicate a fault in the amplifier. Therefore, when improper operation is evident, check all components including the prime mover for proper operation.

Use the following table to aid in determining probable causes and corrective actions for common troubles which may be experienced in the field. Not all problems can be anticipated or included on the troubleshooting table.

⚠WARNING

Disassembly of the 85 mm Hydraulic Amplifier in the field is not recommended. Under unusual circumstances where disassembly becomes necessary, all work, repair, and adjustments should be made only by experienced personnel trained in the proper procedures.

⚠WARNING

The servo return spring may be preloaded to 818 kgf depending upon system requirements.

Table 4-1. Troubleshooting

Trouble	Probable Cause	Correction
No servo response to movement of input shaft.	Low or no oil pressure to amplifier.	Check external oil supply system for proper operation.
	Fuel control or steam valve sticking.	Disconnect linkage and check operation of fuel control or steam valve. Check steam valve unbalance forces.
	Internal amplifier linkage components damaged or disconnected.	Replace damaged components or make connections as required.
Erratic or lagging servo response to movement of input shaft.	Fluctuating oil supply—pressure—pump cavitation.	Check external oil supply system for proper operation.
	Fuel control or steam valve sticking.	Disconnect linkage and check operation of fuel control or steam valve. Check steam valve unbalance forces.
	Pilot valve plunger loading spring broken or missing.	Replace loading spring.
Input shaft jammed.	Pilot valve sticking—oil supply contaminated with foreign particles.	Drain, flush, and refill oil supply system. Replace filters.
	Pilot valve plunger cocked in bore—floating lever broken.	Replace damaged components as required.
	Internal amplifier linkage components damaged.	Replace damaged components as required.
Amplifier input shaft locked in full CW position or will not rotate fully CCW.	External stop adjustment incorrect, faulty linkage or governor operation.	Adjust external stop. Check linkage for binding. Check governor for adjustment and operation.

Trouble	Probable Cause	Correction
Fuel control or steam valve will not close or closes too slowly.	Fuel control or steam valve sticking.	Disconnect linkage and check operation of fuel control or steam valve.
	B. Pilot valve plunger sticking.	Check oil supply for contamination.
	Fatigued or broken servo piston return spring—excessive leakage past servo piston.	Disassembly of amplifier to the extent necessary to replace the return spring or servo piston is not recommended in the field unless absolutely necessary.
Fuel control or steam valve will not open during starting.	Fuel control or steam valve sticking.	Disconnect linkage and check operation and force requirements of fuel control or steam valve.
	Starting limit adjustment incorrect.	Reset stop adjustment.
	Oil pressure too low.	Check oil supply for correct operation.
	Pilot valve plunger or bushing sticking in depressed position—plunger spring broken or missing.	Disassemble and clean pilot valve plunger. Check oil supply for contamination. Replace plunger spring, if necessary.
Servo piston will not hold position—erratic over- or undershoot, full stroke either direction with minor change in speed setting.	External input linkage improperly arranged using less than the recommended 2/3 available travel.	Reassemble linkage.

When requesting additional information or service help from Woodward, it is important to include the amplifier designation and serial numbers in your correspondence.

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 89012.

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1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 • Fax +1 (970) 498-3058

Email and Website—www.woodward.com

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

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