

TM-55P

Proportional Actuator

Single and Dual Coil Models
with and without RVDT Position Sensor

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

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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.



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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 Out-of-date translations are marked with .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.

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Warnings and Notices

Important Definitions



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER**—Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
- **WARNING**—Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
- **CAUTION**—Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
- **NOTICE**—Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT**—Designates an operating tip or maintenance suggestion.

WARNING

**Overspeed /
Overtemperature /
Overpressure**

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

WARNING

**Personal Protective
Equipment**

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- Eye Protection
- Hearing Protection
- Hard Hat
- Gloves
- Safety Boots
- Respirator

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

WARNING

**Automotive
Applications**

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE**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.

Regulatory Compliance

North American Compliance:

These listings are limited only to those units bearing the CSA and UL agency identification.

CSA: CSA Certified for Class I, Division. 1, Groups C & D
For use in Canada
Certificate LR 79726-1

UL: UL Listed for Class I, Division 1, Groups C & D
For use in the United States
UL File E158654

The TM-55P is suitable for use in Class I, Division 1, Groups C and D per CSA for Canada or non-hazardous locations only.

The TM-55P is suitable for use in Class I, Division 1, Groups C and D per UL for US or non-hazardous locations only.

Each torque motor must be provided with a 900 mA maximum fuse to be installed before the torque motor.

Voltage to the torque motor must be limited to a nominal voltage of 30 V with a switch-off voltage of 480 V.

Field wiring must be suitable for at least 90 °C and 10 °C above the ambient operating temperature.

Connect ground terminal to earth ground.

These listings are limited only to those units bearing the CSA or UL agency identification.



EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2.



RISQUE D'EXPLOSION—Ne pas enlever les couvercles, ni raccorder / débrancher les prises électriques, sans vous en assurez auparavant que le système a bien été mis hors tension; ou que vous vous situez bien dans une zone non explosive.

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

Chapter 1.

General Information

Description

The TM-55P Actuator is an electro-hydraulic, proportional actuator for controlling diesel and gas engines or steam and industrial applications of gas turbines. It is designed for use with Woodward electric controls, and will interface with an adapter directly to Woodward liquid and gas fuel valves. The TM-55P has a standard aluminum case with through-hardened stainless steel internal parts (6.6 kg / 14.5 lb).

In the actuator, a torque motor servovalve is energized by the electric control to generate a pressure differential which is applied to both ends of, and operates, the second stage spool valve.

The torque motor is available with dual coils. In the dual coil option, the coils can either be used independently, one at a time, or together, to load share.

Supply pressure is regulated by the spool valve to move a double acting servo piston and provide terminal shaft output. Internal mechanical feedback is standard in the TM-55P Actuator for good open loop accuracy. An optional electrical position feedback transducer such as an RVDT can be installed at assembly. The actuator is factory adjusted for bias in the minimum fuel direction in the event of a loss of supply oil pressure or input current.

The supply inlet fitting contains a 40 μ m (nominal) last-chance filter to prevent gross contamination of the unit. Supply oil should be filtered to 10 μ m (nominal) to protect the torque motor from contamination. Hydraulic cleanliness must always be maintained at ISO 4406 20/18/15 or better to ensure proper operation.

Specifications

Output Shaft	0.750"-48 serrated by 0.875" long shaft
Ambient Operating Temperature	-40 to +121 °C (-40 to +250 °F)
Stalled Torque Rating	38 N·m at 2758 kPa (28 lb-ft at 400 psi) 95 N·m at 6895 kPa (70 lb-ft at 1000 psi)
Angular Travel	Max 45 degrees. Increasing current causes clockwise rotation, viewing end of shaft
Nominal Factory Calibration	20 \pm 0.5mA at 0° 200 \pm 0.5mA at 45°
Maximum Transient	350 mA
Control Qualities	
Time Constant	0.025 second
Maximum Velocity of Output Shaft	920° per second
Load Sensitivity	0.05° maximum per lb-ft at 1000 psig (per J at 6895 kPa) hydraulic supply pressure
Hysteresis	0.25°
Repeatability	0.25°
Threshold	Less than 0.25% of maximum rated current of 200 mA

Electrical Control Requirements

Standard Input Signal	0.020 to 0.200 A coil current from 0 to 45° stroke, nominal
Coil Resistance	Single coil 26 Ω at 20 °C (68 °F) Dual coil 40 Ω at 20 °C (68 °F)
Electrical Position Transducer (options)	RVDT Linearity to $\pm 0.16^\circ$ Linear synchro transmitter linearity $\pm 0.35^\circ$ Potentiometer accurate to $\pm 1.0\%$ over 60° range

Hydraulic Fluid Requirements

	Supply Pressure		Steady State Flow		Maximum Transient	
	psig	kPa	gal(US)/min	L/min	gal(US)/min	L/min
Single Coil	400	2758	0.3	1.1	2.5	9.5
	1000	6895	0.5	1.9	2.7	10.2
Dual Coil	400	2758	0.5	1.9	2.7	10.2
	1000	6895	0.8	3.0	3.0	11.4

Type	Mineral or synthetic based oils, diesel fuel, kerosene, gasoline, or light distillate fuels
Regulated Supply Pressure	2758–6895 kPa (400–1000 psig)
Return Pressure	0–690 kPa (0–100 psig)
Fluid Temperature	16 to 79 °C (60 to 175 °F), US MIL-L-23699
Recommended Viscosity	0.6 to 400 centistokes
Specific Gravity	0.6 to 1.0
Required Hydraulic Fluid Cleanliness	10 μm (nominal), ISO DIS 4406, Code 20/18/15
Standard Hydraulic Connections	Inlet—0.750-inch/16 tpi UNJF-3A (-08) (MS 33656 for fitting end only) 40 μm nominal/70 μm absolute filter per US MIL-F-5504B Drain—0.875-inch/14 tpi UNJF-3A (-10) (MS 33656 for fitting end only)
Mass/Weight	6.6 kg (14.5 lb)

References

- Product Specification 82599, *TM-55P Actuator*
- Manual 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls*

Chapter 2. Installation

Introduction

This chapter covers receiving, storage, and mounting requirements for the TM-55P Actuator. Refer to the outline drawing (Figure 2-1).

Use care while handling and installing the actuator. Be particularly careful to avoid striking the terminal shaft. Abuse can damage seals, mounting surfaces, and factory adjustments. Hydraulic connections must be protected by plastic shipping caps whenever the actuator is not connected to the normal piping.

WARNING

EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2.

WARNING

EXPLOSION HAZARD—External fire protection is not provided in the scope of this product. It is the responsibility of the user to satisfy any applicable requirements for their system.

CAUTION

Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the TM Actuator.

CAUTION

The surface of this product can become hot enough or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings are included in the specification section of this manual.

Each torque motor must be provided with a 900 mA maximum fuse to be installed before the torque motor. Voltage to the torque motor must be limited to a nominal voltage of 30 V with a switch-off voltage of 480 V.

Receiving

The TM-55P Actuator is shipped from our factory packed in foam. The actuator has been factory tested and adjusted to specific customer requirements, then drained and sealed. No internal cleaning or flushing is required before installation and operation or customer retesting.

Storage

The TM-55P Actuator may be stored as received from the factory for several years before installation. Storage temperature should not exceed -40 to $+121$ °C (-40 to $+250$ °F).

For long term storage, refer to Woodward publication 25075, *Commercial Preservation Packaging For Storage of Mechanical-Hydraulic Controls*.

Mounting

Refer to the outline drawing (Figure 2-1) for:

- overall dimensions
- mounting hole locations
- hydraulic fitting sizes
- output shaft dimensions
- electrical connections

Electrical connections for single coil servovalves are made to red (+) and black (–). The alternate coil on the dual coil servovalve connects to white (+) and black (–).

Mounting attitude does not affect actuator performance.

Make all hydraulic connections required. Supply pressure for the TM-55P Actuator can be from either positive displacement or centrifugal type pumps. For safe operating, Woodward recommends the use of a pressure switch to check that the correct supply pressure is established prior to start-up and continually thereafter.

Table 2-1. Supply Characteristics

Fluid Types:	Mineral or synthetic based oils, diesel fuels, kerosene, gasolines, or light distillate fuels.
Specific Gravity:	0.6 to 1.0
Recommended Viscosity:	0.6 to 400 centistokes
External Filter:	10 µm nominal/ISO 20/18/15
Supply Pressure:	Any nominal level between 400 and 1200 psig

Table 2-2. Flow Requirements

Supply Pressure	Steady State Flow	Maximum Transient Flow	Maximum Work
2758 kPa 400 psig	1.1 L/min 0.3 USgal/min	9.5 L/min 2.5 USgal/min	30 J 22 ft-lb
6895 kPa 1000 psig	1.9 L/min 0.5 USgal/min	10.2 L/min 2.7 USgal/min	75 J 55 ft-lb

In applications, where the actuator is supplied without an attached Woodward valve, the customer must assemble the fuel valve or valve linkage to the actuator. These attachments must be secure, free of binding and backlash. It is very important that this linkage between the electric control/actuator output and the fuel system be of correct relationship for proper operation. Use as much of the 45° actuator travel as possible between minimum and maximum flow points. In no case should less than 35° actuator travel be used.

Make all electrical connections required using applicable Woodward electric control manuals. A plant wiring diagram will be supplied upon request. In applications where the TM-55P Actuator is not used with a Woodward electric control, electrical input requirements will also be supplied upon request.

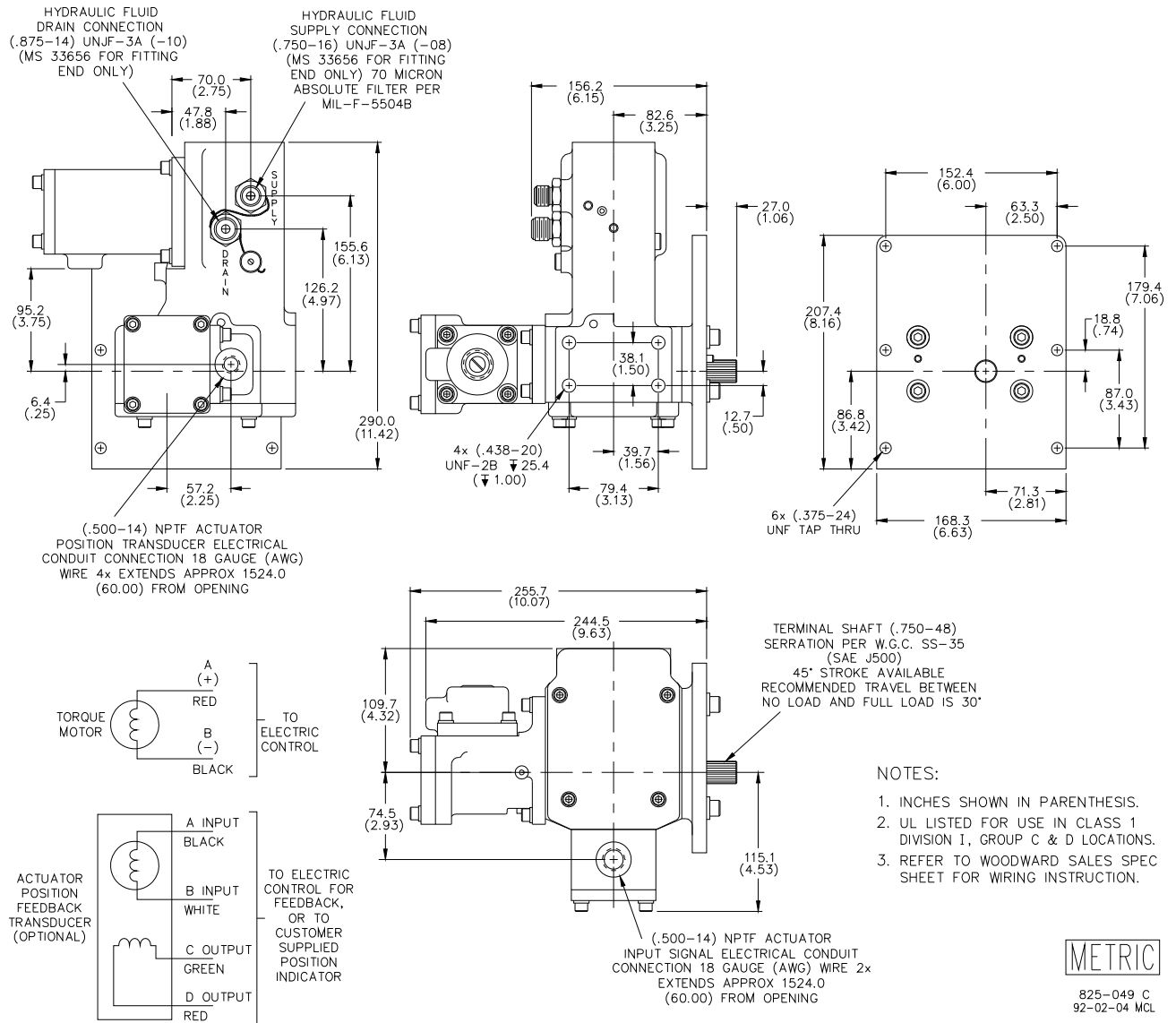
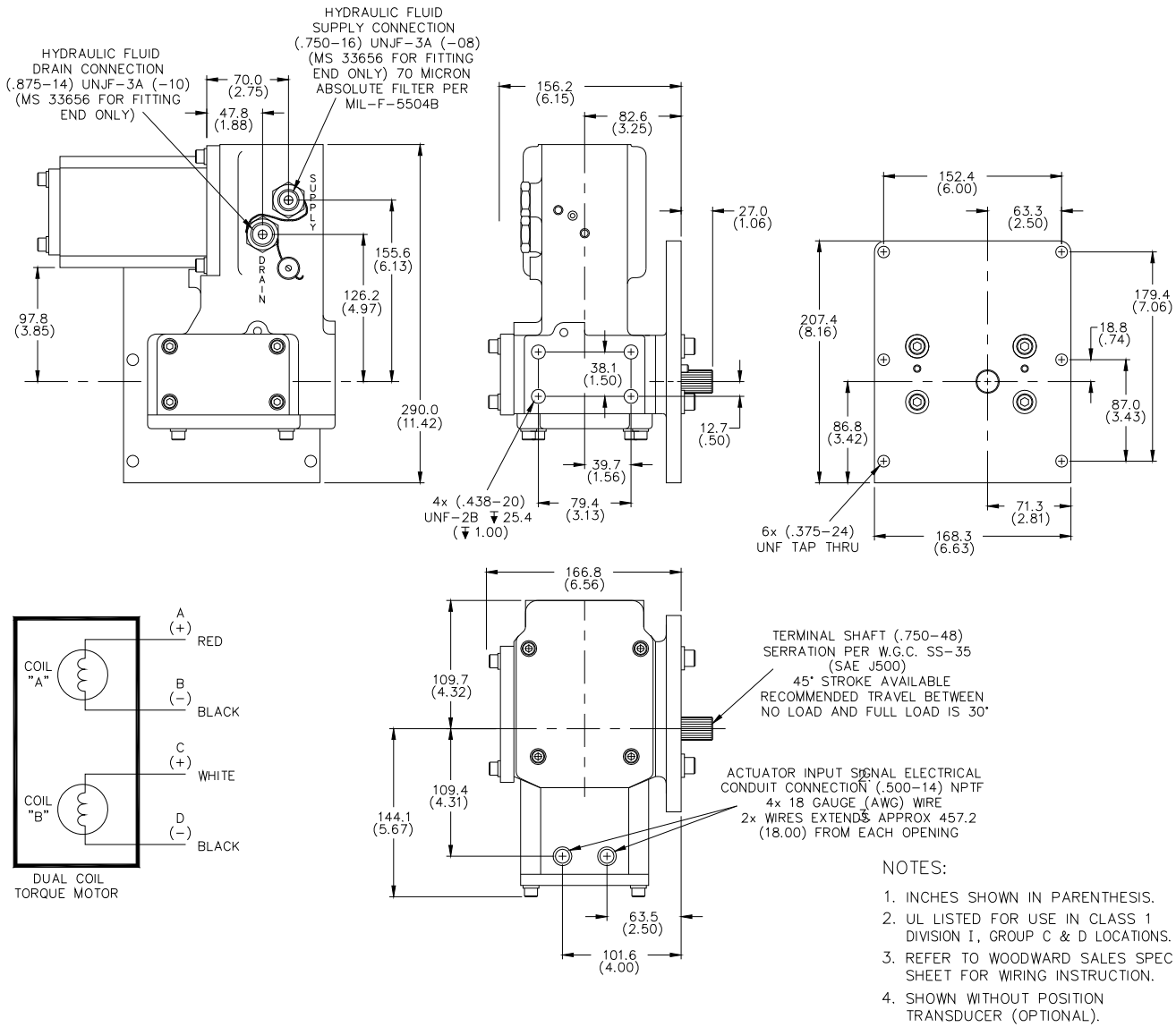


Figure 2-1. Outline Drawing, TM-55P Actuator, Single-Coil



METRIC 825-049 E
92-02-04 MCL

Figure 2-2. Outline Drawing, TM-55P Actuator, Dual-Coil

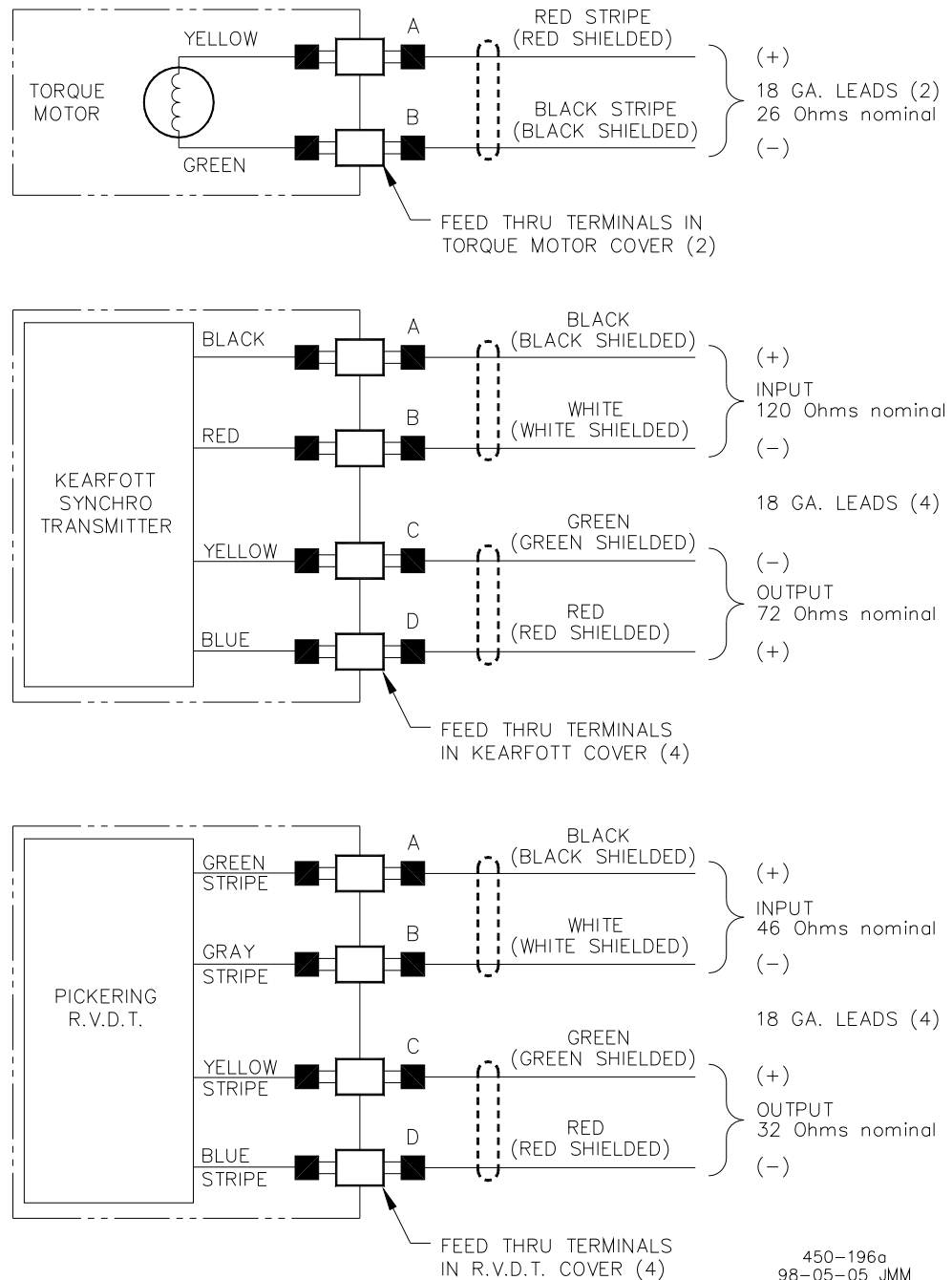


Figure 2-3. Wiring Diagram for TM55 Actuator

IMPORTANT

On feedback transducers, polarity shown indicates feedback output signal in phase with excitation signal.

WARNING

Due to the hazardous location listings associated with this product, proper wire type and wiring practices are critical to operation.

NOTICE

Do not connect any cable grounds to "instrument ground", "control ground", or any non-earth ground system. Make all required electrical connections based on the wiring diagrams (Figure 2-3).

Chapter 3.

Operation and Adjustments

Introduction

This chapter describes the initial operation and adjustments of the TM-55P Actuator.

Initial Operation

Before initial operation of the actuator, check that all previous installation and hookup steps are successfully accomplished and all linkages (if any), electrical connections, and hydraulic fittings are secure and properly attached.

Make certain that correct hydraulic supply pressure to the actuator is established before start-up. Trapped air within the hydraulic system may cause erratic behavior of the actuator during the first few minutes of initial operation. Use applicable Woodward manuals for the particular Woodward electric control to begin prime mover operation.

When first starting the prime mover equipped with the Woodward TM-55P Actuator, be prepared to initiate an emergency shutdown in the event of electric control, actuator, valve, linkage, or prime mover failure.

Adjustments

Normally, all operating adjustments are made during factory testing according to customer's specifications and should not require further adjustment. Do not attempt adjustments to the actuator unless thoroughly familiar with the proper procedures.

Woodward recommends adequate dither be used on all hydraulic actuators to minimize mA threshold and hysteresis which can result from second stage static friction or hydraulic contamination.

Dither is a low amplitude, relatively high frequency periodic signal that is superimposed on the servovalve input current signal. A typical dither signal generated by a Woodward control is:

- 25 Hz, 0–10 mA (tunable) amplitude
- 25% duty cycle, bipolar, square wave

Adequate dither is defined as that amount which produces no more than 0.013 mm (0.0005 inch) total oscillation in output shaft position.

Null current shifts of up to $\pm 4\%$ of maximum rated current (200 mA) can occur due to variations in the following parameters:

- hydraulic supply and return pressures
- hydraulic fluid temperature
- servovalve and actuator wear

Due to the inherent null shifts and position drift of all hydraulic servovalves and proportional actuators, engine control applications must be designed with these errors in mind.

Chapter 4.

Principles of Operation

This chapter describes the schematic operation of the TM-55P Actuator. A schematic drawing, Figure 4-1, illustrates the working relationships of the various parts.

The TM-55P Actuator consists of three basic sections:

- a torque motor servovalve
- a spring centered, four land spool valve,
- a double-sided, equal area servo-piston linked to the rotary output terminal shaft

The essential element of the TM-55P Actuator is the torque motor servovalve which uses a double nozzle and flapper to generate a differential pressure to operate the second stage spool valve. The torque motor receives dc current signals from the electric control and applies torque to the single piece armature and flapper which is supported on a torsion flexure. The servovalve uses the flapper as a variable flow restrictor and throttles the flow of hydraulic fluid from a nozzle on each side of the flapper. The two nozzles are supplied hydraulic fluid from the actuator supply pressure inlet via separate fixed orifices. During steady state operation, the flapper is centered between the nozzles and the two pressures, P_{ct} and P_{cb} , are equal.

TM-55P Actuators are available with dual coil torque motor servovalves. When dual coil torque motors are used, either one or both coils can be active at a given time depending on the application. The second coil is provided for redundancy, which increases the availability of the actuator.

When input current is increased to the torque motor coil, the limited pivotal movement of the flapper to increase (clockwise of the schematic) restricts hydraulic flow from the upper nozzle while flow from the lower nozzle increases. The resulting differential pressure is applied to the ends of the spool valve, lowering it from its spring centered null position.

When lowered, the spool valve directs supply pressure to the top side of the servo piston and, simultaneously, vents the underside to drain at the lower control port. The servo piston then moves down, and through a linkage to the terminal shaft, increases actuator output position. Servo piston movement also provides position feedback to the servovalve.

An extension of the flapper is held between the feedback spring and level adjusting spring. Increasing servo piston movement increases the feedback spring torque load on the flapper to re-center it. When a force balance is obtained between the torque motor and level adjusting spring and the feedback spring, the spool valve is re-centered and further servo movement is halted.

Operation of the actuator is similar in the decrease direction. Movement of the flapper restricts flow from the lower nozzle, while increasing flow of the upper nozzle. The pressure differential this time lifts the spool valve and uncovers ports to direct supply pressure to decrease actuator output position. The re-centering action is provided as servo piston movement decreases compression of the upper spring, re-centering the flapper.

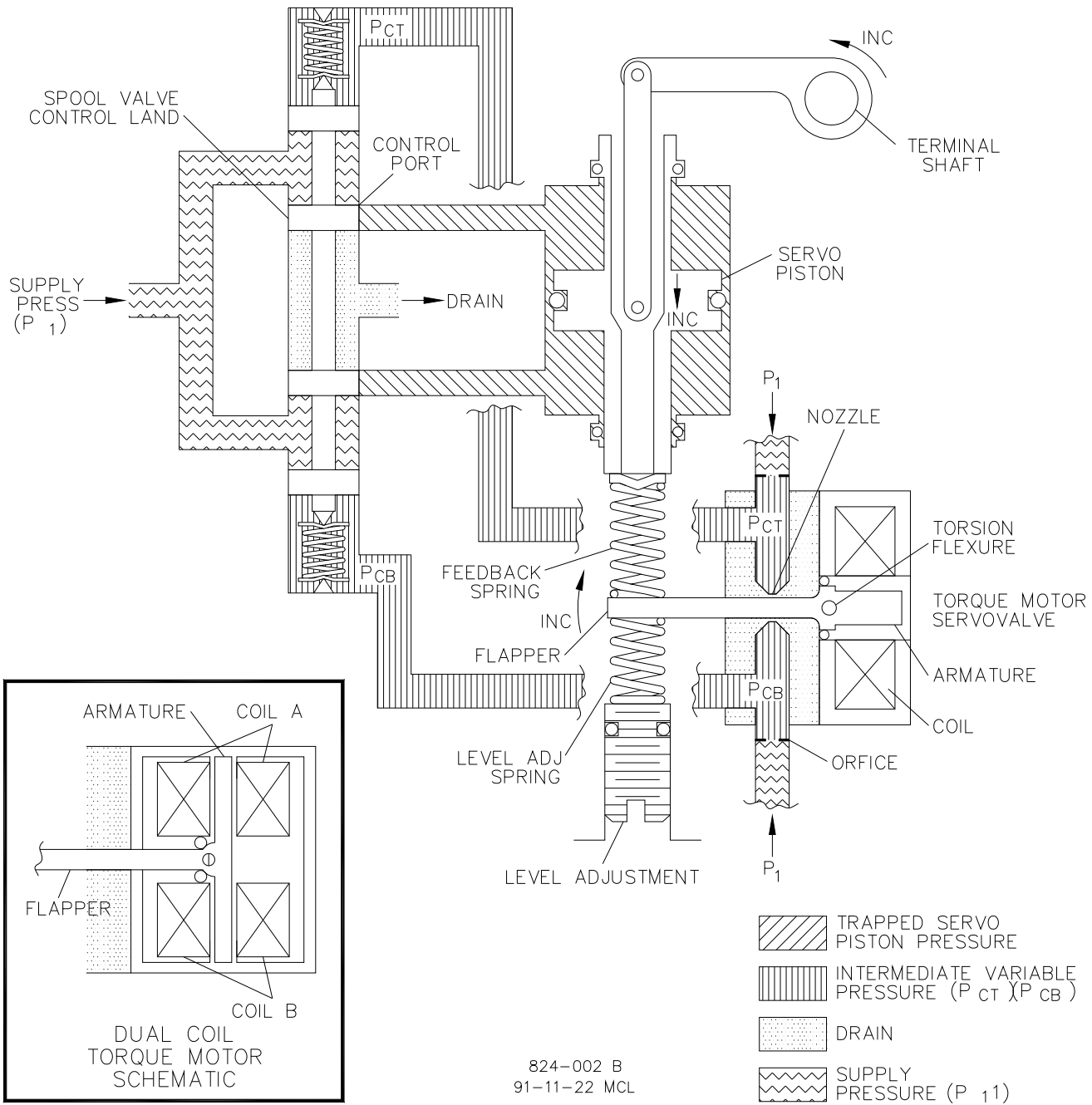


Figure 4-1. Schematic Drawing, TM-55P Actuator

Chapter 5. Maintenance

Introduction

This chapter provides instructions for troubleshooting and preventive maintenance.

Contaminant resistance of the TM-55P Actuator is excellent due to design features and high working forces. However, the service life of the actuator is increased with the use of clean supply flow. See Table 2-1 for recommended filtration level.



EXPLOSION HAZARD—Do not remove covers or connect/disconnect electrical connectors unless power has been switched off or the area is known to be non-hazardous.

Substitution of components may impair suitability for Class I, Division 2.

Filter Cleaning

The TM-55P Actuator is equipped with an in-line 40 µm filter fitting at the supply connection. See the outline drawing (Figure 2-1) for its location. This filter is a last change filter and is not meant to be used for system filtration. If the filter becomes clogged as evidenced by sluggish response, it may be removed and ultrasonically cleaned and back flushed with a light solvent.

Troubleshooting

Faults in the governing system are usually revealed as speed variations of the prime mover, but it does not necessarily follow that such speed variations indicate governing system faults. Therefore, when improper speed variations appear, check all components including the engine or turbine for proper operation. Refer to applicable Woodward electric control manuals for assistance in isolating the trouble. The following steps describe troubleshooting for the actuator.

Customer installed linkage between the actuator and liquid or gas valve should be checked. A common source of trouble is binding or lost motion in the linkage.

If, during the starting sequence, the actuator does not respond to electric control input, check the actuator pressure supply and supply filters.

If the actuator does not respond to electric input, disconnect output linkage and attach a power supply and milliammeter. Increase input current to the actuator and the output should follow smoothly with the increasing current. Do not exceed 250 mA.

Disassembly of the TM-55P Actuator in the field is not recommended. Under unusual circumstances where disassembly becomes necessary, all work and adjustments should be made by personnel thoroughly trained in the proper procedures.

When requesting information or service help from Woodward, it is important to include the part number and serial number of the actuator in your communication.

Chapter 6.

Replacement Parts

Introduction

This chapter provides information about replacement parts for the TM-55P Actuator.

Replacement Parts Information

When ordering replacement parts, it is essential to include the following information:

- Part number and serial number shown on the nameplate of the TM-55P Actuator
- Manual number (this is manual 82400)
- Part reference number shown in parts list and name and description of part

Figure 6-1 illustrates the replacement parts for the TM-55P Actuator. The numbers assigned are used as reference numbers, and are not specific Woodward part numbers.

Parts List

Reference	Description.....	Quan.
82400-1	Screw - .375-24 x 1.500 socket Head.....	4
82400-2	Washer - .375 splitlock	8
82400-3	Plate assembly - TM55 mounting	1
82400-4	Packing - preformed 1.174 ID x .103	2
82400-5	Seal - .812 ID step.....	1
82400-6	Packing - preformed .924 ID x .103	1
82400-7	Plug - TM55 shaft seal.....	1
82400-8	Shim - laminated.....	1
82400-9	Bearing assembly - terminal shaft	1
82400-10	Shaft assembly - TM55 terminal	1
82400-11	Packing - preformed .614 ID x .070 furnished with torque motor assembly) .	1
82400-12	Packing - preformed .364 ID x .070 furnished with torque motor assembly) .	3
82400-13	Plug - .438-20 socket head.....	4
82400-14	Packing - preformed .351 ID x .072	4
82400-15	Spring - feedback	1
82400-16	Spring - lever	1
82400-17	Packing - .299 ID x .103	1
82400-18	Seat assembly - trim spring	1
82400-19	Plug	1
82400-20	Bushing - pilot valve 20% port	1
82400-21	Packing - preformed .551 ID x .070	6
82400-22	Plug - expansion	1
82400-23	Support assembly - spring.....	2
82400-24	Packing - preformed .737 ID x .103	1
82400-25	Spring assembly - plunger.....	2
82400-26	Retainer assembly- plunger bushing	1
82400-27	Plunger - pilot valve	1
82400-28	Packing - preformed .644 ID x .087	1
82400-29	Fitting - .500 tube 40U nominal filter	1
82400-30	Regulator assembly (optional).....	1

82400-31	Packing - preformed .755 ID x .097	1
82400-32	Connector assembly - .625 tube x .875-14	1
82400-33	Bearing assembly - terminal shaft	1
82400-34	Shim - laminated	1
82400-35	Seal - .625 ID glyd ring	3
82400-36	Packing - preformed .676 ID x .070	3
82400-37	Plug - TM55 seal retainer	1
82400-38	Washer - .250 splitlock	29
82400-39	Screw - .250-28 x 1.000 socket head cap	27
82400-40	Seal - 1.688 OD glyd ring	1
82400-41	Packing - preformed 1.362 ID x .103	1
82400-42	Sleeve - TM55 servo	1
82400-43	Seal - 1.250 OD glyd ring	1
82400-44	Packing - preformed 1.051 ID x .070	1
82400-45	Piston - TM55 servo	1
82400-46	Pin - .375 OD x 1.062	1
82400-47	Packing - preformed .989 ID x .070	1
82400-48	Link assembly - servo	1
82400-49	Tube - piston rod guide	1
82400-50	Ring - bowed internal retaining	1
82400-51	Packing - preformed 1.614 ID x .070	1
82400-52	Cover - TM55 servo	1
82400-53	Pin - headed	1
82400-54	Race - inner	2
82400-55	Lever assembly	1
82400-56	Washer - .066 ID x .562 OD x .036 thick, stainless steel	1
82400-57	Ring - external retaining .225 free dia., stainless steel	1
82400-58	Screw - .250-28 x .750 socket head cap, stainless steel	2
82400-59	Packing - preformed 4.489 ID x .070	1
82400-60	Cover - division I TM55	1
82400-61	Nameplate	1
82400-62	Screw - #2 x .125 drive	4
82400-63	Body assembly - TM55	1
82400-64	Cover - torque motor terminal	1
82400-65	Screw - 6-32 x .250 slotted fillister head	1
82400-66	Washer - #6 splitlock	1
	(Dual Coil Model)	(2)
82400-67	Clamp - wire	1
	(Dual Coil Model)	(2)
82400-68	Housing assembly - torque motor	1
82400-69	Servo valve assembly - torque motor	1
82400-70	Cover - Kearfott housing	1
82400-71	Packing - preformed 2.114 ID x .070	1
82400-72	Transmitter - linear syn	1
82400-73	Screw - #4-40 cleat	3
82400-74	Coupling - bellows	1
82400-75	Housing assembly - Kearfott	1
82400-76	Washer - .320 x .689 x .120 thick	1
82400-77	Seal - .312 ID	1
82400-78	Packing - preformed .424 ID x .103	1
82400-79	Anchor - nylon tie	1
	(Clamp - wire, Dual Coil Model)	(2)
82400-80	Washer - #6 splitlock	2
82400-81	Screw - #6-32 x .250 locking phillips pan head, stainless steel	1
	(Dual Coil Model)	(2)
82400-82	Cover - TM55 conduit	1
82400-83	Plug - close up 1.000 - 11 1/2 NPT	1
Not Shown	Cap - shipping	1
Not Shown	Cap - shipping	1
Not Shown	Wire - lock .025 dia.	AR

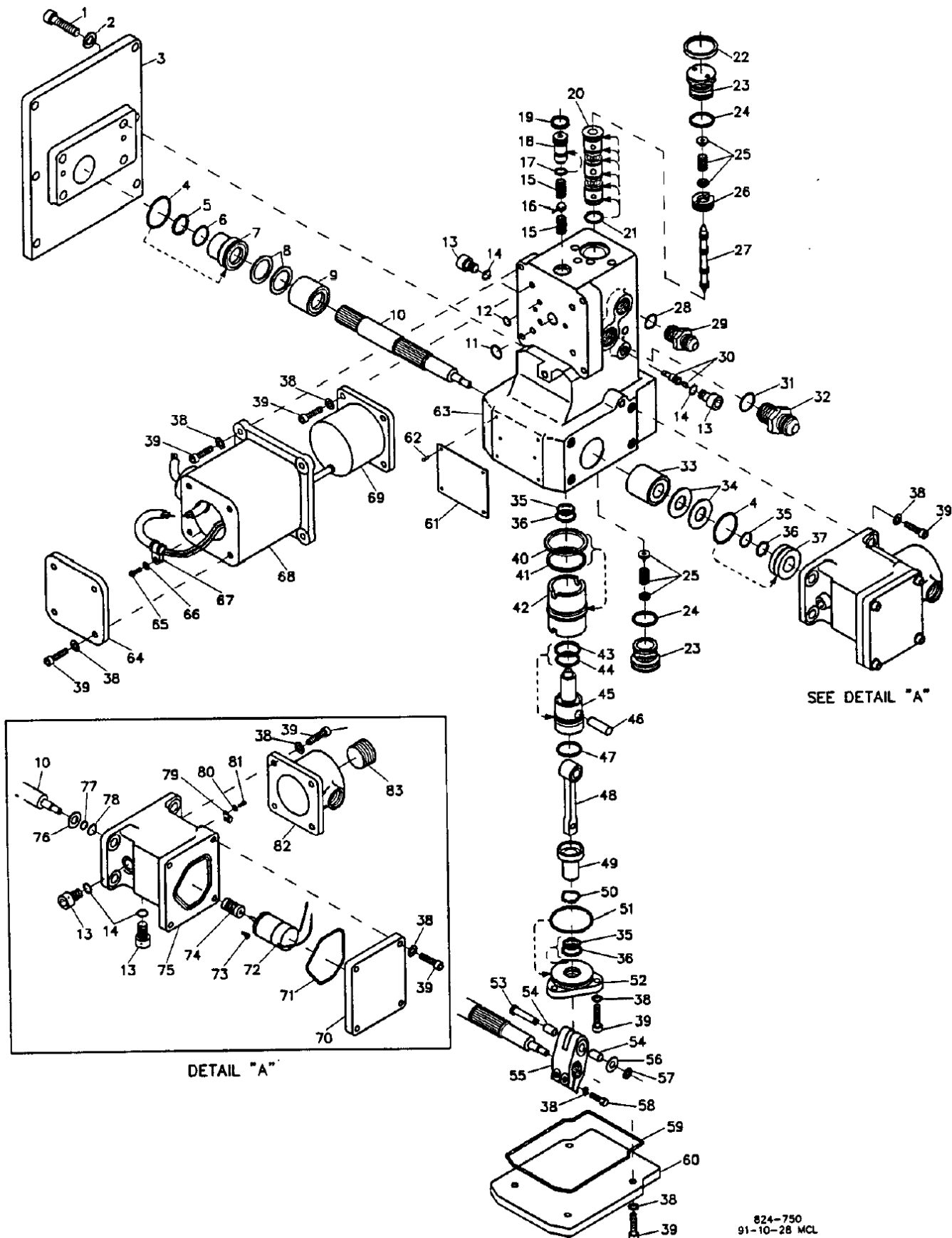


Figure 6-1. Exploded View, TM-55P Actuator

Chapter 7. 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.

Revision History

Changes in Revision G—

- Removed European compliance information as no longer applicable (pages ii, 2, 3)
- Moved all Regulatory Compliance information to page ii
- Removed Declarations from end of manual as no longer applicable

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **82400G**.



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

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