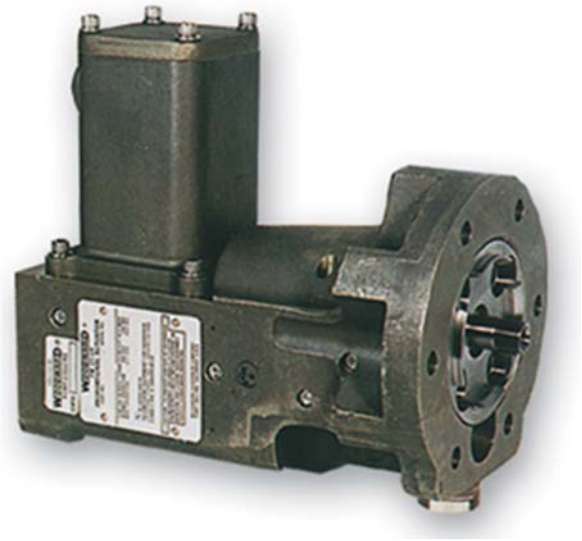
WOODWARD

Product Manual 82450
(Revision AA, 7/2017)
Original Instructions



TM-25LP, TM-200LP Actuators

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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 Out-of-date translations are marked with ⚠.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— A bold, black line alongside the text identifies changes in this publication since the last revision.

Manual 82450

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Warnings and Notices

Important Definitions

This is the safety alert symbol 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.

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

European Compliance for CE Marking:
These listings are limited only to TM-25LP units bearing the CE Marking.

ATEX – Potentially Explosive Atmospheres Directive: Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres
TM-25LP Single Coil: LCIE 12 ATEX 3022 X
Zone 1, Category 2, Group II, Ex e IIC T4 Gb IP54

TM-25LP Dual Coil:
Zone 2, Category 3, Group II, Ex nA IIC T4 Gc IP54
LCIE 12 ATEX 3064 X, Zone 1, Category 2, Group II, Ex d IIB T4 Gb c IIB T4 IP54

Other European and International Compliance:
Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking (TM-25LP only).

EMC Directive: Not applicable to this product. Electromagnetic, EMC, passive devices are excluded from the scope of the 2014/30/EU Directive

Machinery Directive: Compliant as Partly Completed Machinery with 2006/42/EC of the European Parliament and the Council of 17 May 2006 on machinery.

Pressure Equipment Directive: Compliant as “SEP” per Article 4.3 to Pressure Equipment Directive 2014/68/EU on the harmonisation of the laws of the Member States relating to the making available on the market of pressure equipment.

Note: This listing is limited to units bearing the TIIS certification labeling.

TIIS: The TM-25LP Single Coil Actuator is certified for use in Japanese hazardous locations per TIIS Certificate TC17927 as Ex e II T3 (155 °C).

KC Korea: Certified for use in explosive atmospheres per KTL Certificate 14-KB4BO-0390X as Ex e IIC T4

IECEx: TM-25LP
Single Coil: LCI 12.0010X Ex e IIC T4 Gb IP54
Dual Coil: LCI 12.0011X Ex nA IIC T4 Gc IP54; Ex d IIB T4 Gb IP54

North American Compliance:
These listings are limited only to those units bearing the CSA identification.

CSA: CSA Certified for use in the United States and Canada: Certificate 2399483.
Single and dual coil actuators certified for Class I, Division 2, Groups A, B, C, & D.
Dual coil actuators certified for Class I, Division 1, Groups C & D.

Wiring must be in accordance with North American Class I, Division 1 or 2, or European Zone 1, Category 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

The TM-25LP and TM-200LP are certified to a Zone 1-Category 2 or 3 method of protection. Wiring methods must be in accordance with their respective markings.

NPTF conduit entries are provided as shown in Figures 2-1 and 2-2.

Note: The LVDT option is only available on certain units. Contact Woodward for details.

Special Conditions for Safe Use:

- Each torque motor must be provided with a 900 mA maximum fuse to be installed before the torque motor.
- Circuit to the torque motor must be an NEC Class 2 circuit which is 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 external ground terminal to earth ground.

Additional Special Conditions for Safe Use—ATEX Flameproof Installation only:

- Electrical connection must be performed using conduit certified for the intended use.
- Maximum temperature at conductor entry and branching point: +96 °C.
- Connection of flying leads must be done in an enclosure which complies with applicable requirements.
- Minimum tensile strength of fasteners shall be 552 MPa / 80 ksi.

⚠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 1 or Division 2, and Zone 1 or Zone 2 applications.

⚠AVERTISSEMENT

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 1 ou Division 2, et Zone 1 ou Zone 2.

Chapter 1.
General Information

Description

The TM-25LP and TM-200LP actuators are electric-hydraulic, proportional actuators designed for use with Woodward 43027 and 2301 electric controls and may interface with an adapter directly to a fuel flow control valve. They have an aluminum case with through-hardened stainless steel internal parts.

In the actuator, a torque motor servovalve is energized by the electric control to generate a pressure differential applied to the ends of, and to operate, the second stage spool valve. Supply pressure is regulated by the spool valve to move a double acting servo piston and provide 25 mm (1 inch) of linear output shaft travel. Internal mechanical feedback is standard. The actuator is calibrated at the factory for bias in the minimum fuel direction in the event of a loss of input current.

Hydraulic fluid is sealed from the torque motor by a preformed packing ring between the armature and the servovalve housing, eliminating the accumulation of magnetic contaminants. A 40 µm nominal/70 µm absolute filter fitting is provided at the hydraulic supply port for protection in the event of an upstream filter failure.

References

Product Specification 82451 about the TM-25LP and TM-200LP is available on our website (**www.woodward.com/publicationsdownload.aspx?DocumentNumber=82451**).

Direction of Output

TM-25LP and TM-200LP actuators are available either to extend the terminal shaft as the actuator signal increases or retract the terminal shaft as the actuator signal increases. The reaction to signal change is a factory modification.

Single or Dual Coil

TM actuators are available with either single or dual coil torque motors. The dual coil option provides redundant electrical channels in the torque motor. In the dual coil models, the coils can be used independently or together to load share.

Terminal Shaft Options

TM actuators are available with either internal (female) 0.375-24 UNF threads as shown in Figure 2-1a or external (male) 0.375-24 threads. A clevis-type rod end can also be purchased and installed on the external threads as shown in Figure 2-1b.

Chapter 2.
Installation

Introduction

Receiving, storage, and installation for the actuator are covered in this chapter. See the outline drawing, Figure 2-1.

⚠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.

⚠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.

⚠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 1 or Division 2, and Zone 1 or Zone 2 applications.

⚠WARNING

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

⚠WARNING

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.

Be careful when installing the actuator. Do not damage the output shaft. Abuse of the actuator can damage seals, installation surfaces, and alter the calibration of the unit. Protect the hydraulic connections with plastic shipping caps when the actuator is not connected to the normal piping.

Receiving

The actuator is calibrated and drained of calibration fluid at the factory. It is then placed in a cardboard container filled with urethane foam for delivery to the customer. Additional cleaning or calibration is not necessary before installation or operation.

⚠WARNING

To avoid personal injury from improper lifting or from dropping the actuator, be sure to use appropriate equipment and safe-lifting techniques when handling the actuator. Dry weight of the actuator is approximately 9 kg (20 lb).

Storage

The actuator may be stored as received from the factory for a period of time before installation.

Installation

See the outline drawing, Figure 2-1, for:

- overall dimensions
- installation hole locations
- hydraulic fitting sizes
- output shaft dimensions

Proper filtration of the hydraulic supply is extremely important. A 10 µm (nominal) filter must be installed in the supply to the actuator within 1 meter of the supply port. If a dedicated HPU supply system is installed, the distance from the filter to the actuator is not important. It is necessary to keep the immediate area and equipment clean and free of dirt and contaminants while working on and connecting the hydraulic lines.

The attitude in which the actuator is installed does not affect the performance of the actuator.

Connect all hydraulic lines to the actuator. Supply pressure for the TM-25LP or TM-200LP actuator can be from either positive displacement or centrifugal type pumps. Woodward recommends the use of a pressure switch to be sure that correct supply pressure is established before start-up and maintained continually thereafter.

It is very important that the linkage between the actuator output and the fuel system be of correct relationship for proper operation. Use as much of the 25 mm (1 inch) output travel as possible between minimum and maximum flow points.

Use the correct Woodward control manual when making all electrical connections. A plant wiring diagram will be supplied upon request. In applications where the actuator is not used with a Woodward electric control, electrical input requirements will also be supplied upon request.

⚠WARNING

The TM-25LP and TM-200LP are certified to a Zone 1-Category 2 or Zone 2-Category 3 method of protection. Wiring methods must be in accordance with their respective markings and Zone/Category of installation.

⚠WARNING

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

NOTICE

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.

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 (Figures 2-3 & 2-4).

Supply Characteristics

TM-25LP

Fluid Types:	Mineral or synthetic based oils, diesel fuels, kerosenes, gasolines, or light distillate fuels
Specific Gravity:	0.6 to 1.0
Recommended Viscosity:	0.6 to 400 centistokes 150–200 SSU ISO 32 Grade
External Filter:	10 µm nominal
Supply Pressure:	Any nominal level between 552 and 2586 kPa (80 and 375 psig)
Ambient Temperature Range:	–40 to +93 °C (–40 to +199 °F)
Hydraulic Fluid Temperature Range:	16 to 79 °C (60 to 175 °F)
Hydraulic Cleanliness Level	ISO 4406 20/18/15 minimum

TM-200LP

Fluid Types:	Mineral or synthetic based oils, diesel fuels, kerosenes, gasolines, or light distillate fuels
Specific Gravity:	0.6 to 1.0
Recommended Viscosity:	0.6 to 400 centistokes 150–200 SSU ISO 32 Grade
External Filter:	10 µm nominal
Supply Pressure:	Any nominal level between 2758 and 8274 kPa (400 and 1200 psig)
Ambient Temperature Range:	–40 to +121 °C (–40 to +250 °F)
Hydraulic Fluid Temperature Range:	16 to 79 °C (60 to 175 °F)
Hydraulic Cleanliness Level	ISO 4406 20/18/15 minimum

Table 2-1. TM-25LP Flow Requirements

Supply Pressure	Steady State Flow	Max. Transient Flow	Rated Max. Work
Single Coil or Dual Coil			
552 kPa 80 psig	3.8 L/min 1.0 US gal/min	18.9 L/min 5.0 US gal/min	15 J 11 ft-lb
2586 kPa 375 psig	3.8 L/min 1.0 US gal/min	18.9 L/min 5.0 US gal/min	72 J 53 ft-lb

Table 2-2.TM-200LP Flow Requirements

Supply Pressure	Steady State Flow	Max. Transient Flow	Rated Max. Work
Single Coil or Dual Coil			
2758 kPa 400 psig	3.8 L/min 1.0 US gal/min	18.9 L/min 5.0 US gal/min	76 J 56 ft-lb
8274 kPa 1200 psig	3.8 L/min 1.0 US gal/min	18.9 L/min 5.0 US gal/min	231 J 170 ft-lb

Table 2-3. TM-25LP Electrical Characteristics

Input Current Range:	20 to 200 mA per coil
Coil Resistance:	26 Ω at 21 °C (70 °F) single coil, 40 Ω dual coil
Maximum Coil Current:	250 mA (single coil) 460 mA (dual coil)

Table 2-4. TM-200LP Electrical Characteristics

Input Current Range:	20 to 200 mA
Coil Resistance:	26 Ω at 21 °C (70 °F) single coil, 40 Ω dual coil
Maximum Coil Current:	250 mA

Table 2-4. TM-25LP Output Characteristics

Linear Stroke:	25 mm (1.0 inch)
Output Force:	605 N (136 lb) maximum at 552 kPa (80 psig) 2833 N (637 lb) maximum at 2586 kPa (375 psig) (both directions)

Table 2-5. TM-200LP Output Characteristics

Linear Stroke:	25 mm (1.0 inch)
Output Force:	3025 N (680 lb) maximum at 2758 kPa (400 psig) 9074 N (2040 lb) maximum at 8274 kPa (1200 psig) (both directions)

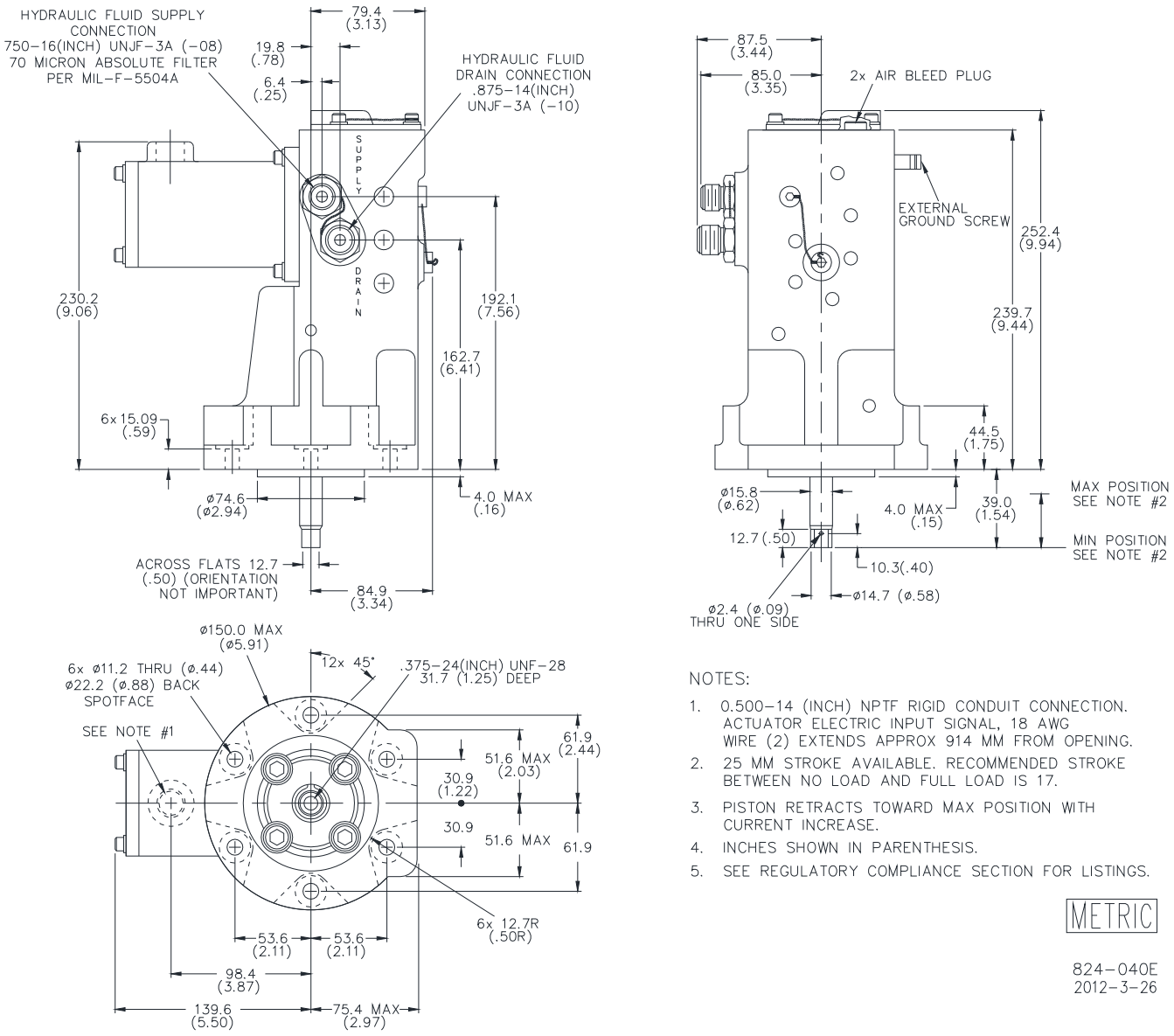
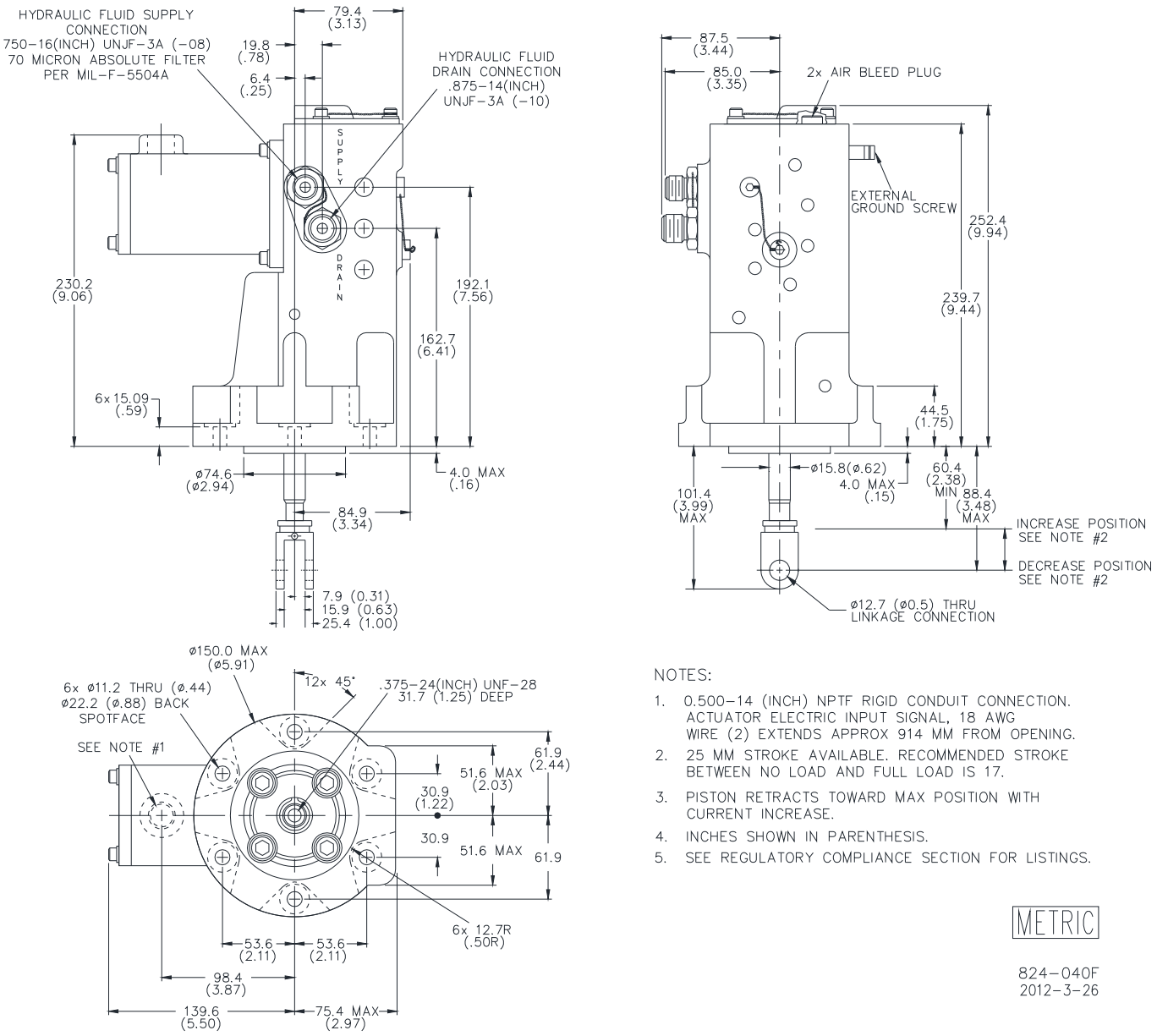


Figure 2-1a. TM-25LP/TM-200LP Actuator



NOTES:

1. 0.500-14 (INCH) NPTF RIGID CONDUIT CONNECTION. ACTUATOR ELECTRIC INPUT SIGNAL, 18 AWG WIRE (2) EXTENDS APPROX 914 MM FROM OPENING.
2. 25 MM STROKE AVAILABLE. RECOMMENDED STROKE BETWEEN NO LOAD AND FULL LOAD IS 17.
3. PISTON RETRACTS TOWARD MAX POSITION WITH CURRENT INCREASE.
4. INCHES SHOWN IN PARENTHESIS.
5. SEE REGULATORY COMPLIANCE SECTION FOR LISTINGS.

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Figure 2-1b. TM-25LP/TM-200LP Actuator with Rod End

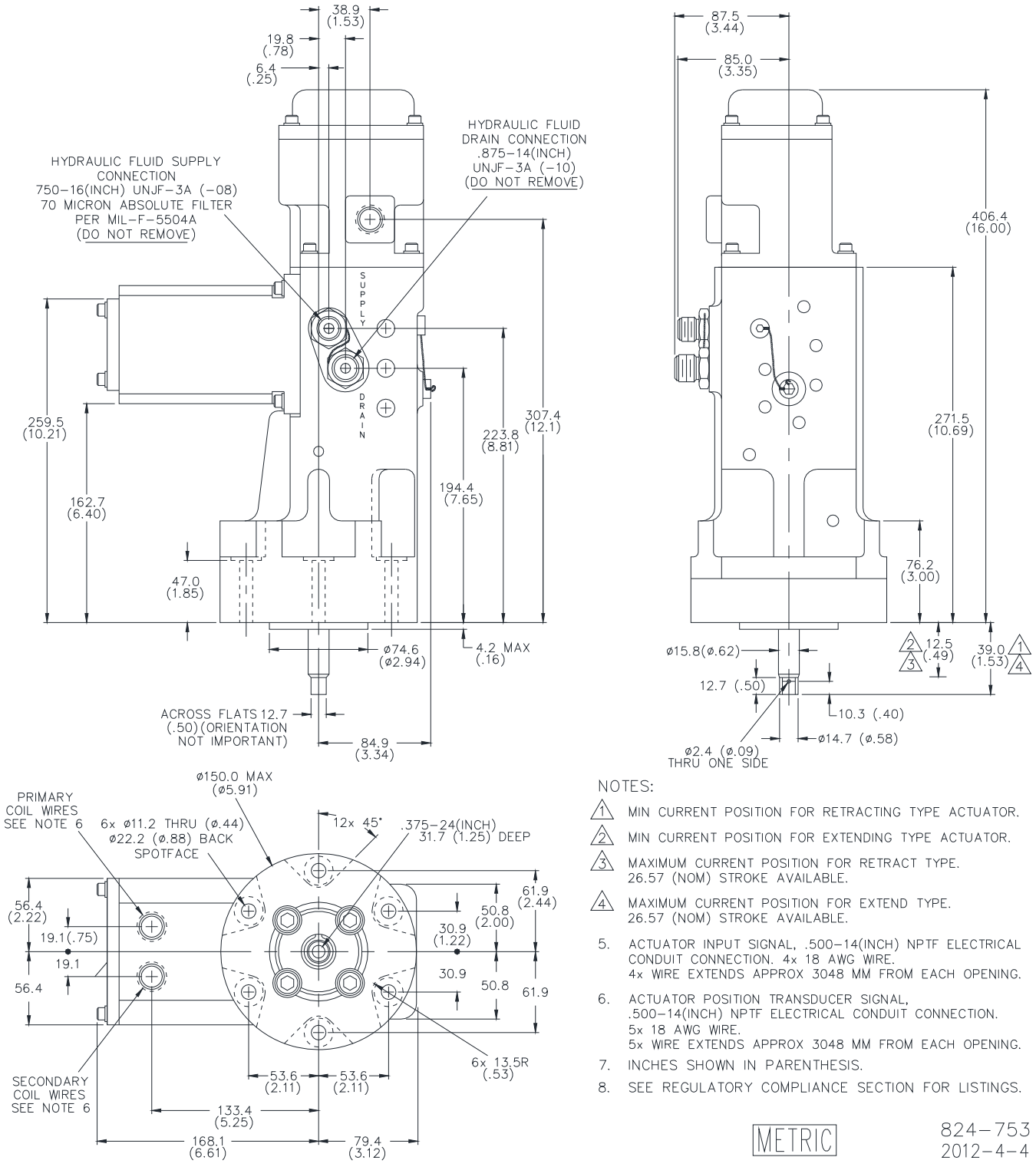


Figure 2-2a. Dual Coil TM-25LP/TM-200LP Actuator with Position Feedback

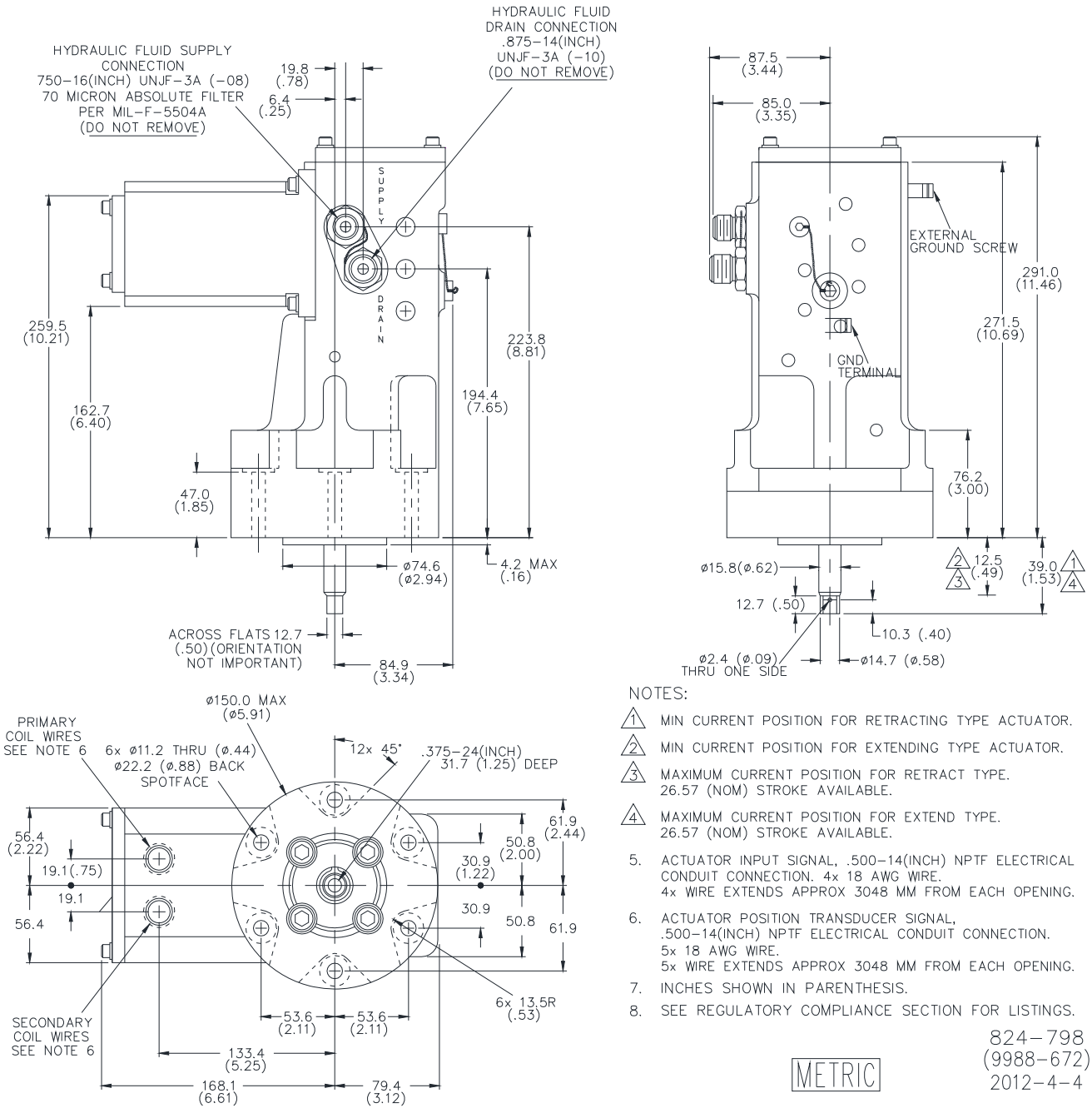


Figure 2-2b. Dual Coil TM-25LP/TM-200LP Actuator without Position Feedback

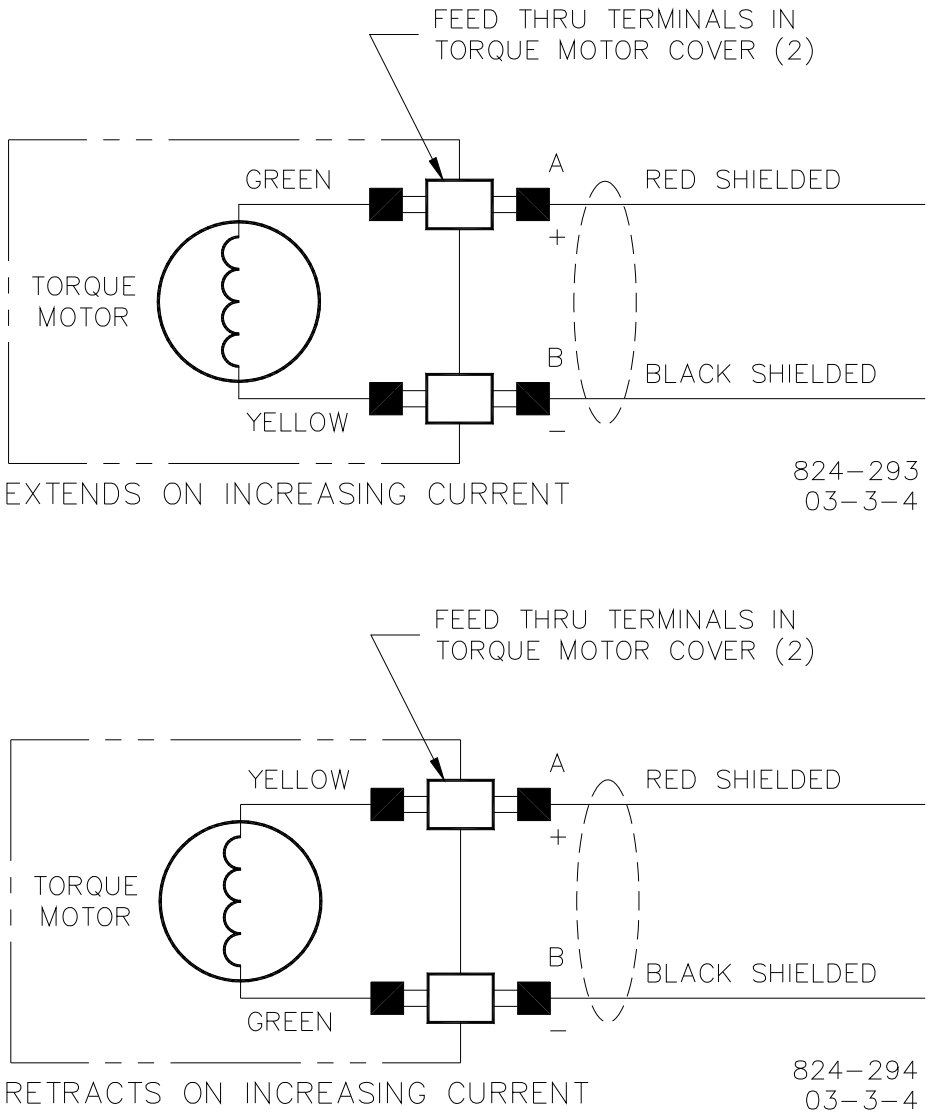
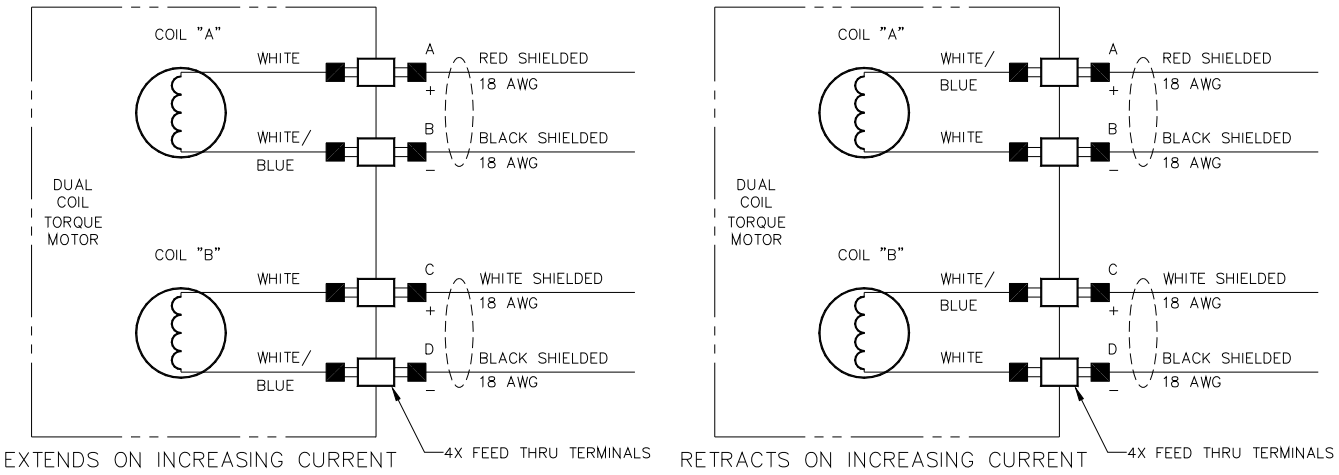


Figure 2-3. Single Coil Wiring
(Shields to be grounded at electronic control end only)



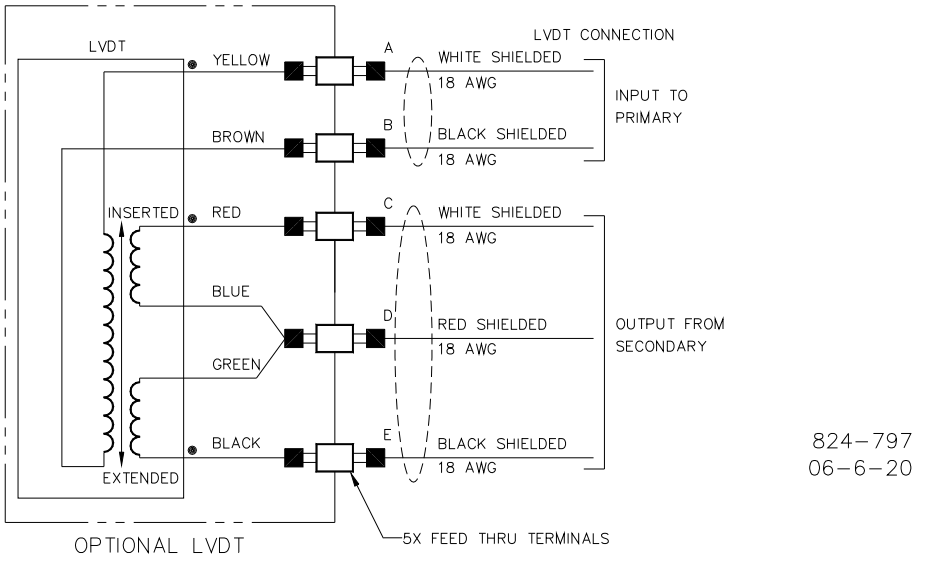


Figure 2-4. Dual Coil Wiring
(Shields to be grounded at electronic control end only)

Chapter 3.
Initial Operation of the Actuator

Initial Operation

Before the initial operation of the actuator, be sure that all previous installation and hookup procedures are accomplished and all linkages (if any), electrical connections, and hydraulic fittings are secure and properly connected.

Be sure that the correct hydraulic supply pressure to the actuator is established before start-up. Trapped air within the hydraulic system may cause momentary erratic behavior of the actuator at the initial operation. Use the correct Woodward manual for the Woodward electric control to begin prime mover operation.

Null current shifts of up to ±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.

Woodward recommends that 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.

⚠WARNING

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.

Adjustments

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

Chapter 4.
Principles of Operation

Introduction

This chapter describes the operation of TM-25LP and TM-200LP actuators. A schematic drawing, Figure 4-1, illustrates the working relationship of the various parts.

Operation

The actuator consists of three basic sections:
- a torque motor servovalve
- a spring-centered, four-land spool valve
- a double-sided, equal-area servo piston with a linear output shaft

The TM-25LP and TM-200LP actuators have torque motor servovalves. They use a double nozzle and flapper to generate a differential pressure to operate the second-stage spool valve. The torque motor received 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, Pc1 and Pc2, are equal.

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

When raised, the spool valve directs supply pressure to the bottom side of the servo piston and, at the same time, vents the top side to drain at the upper control port. the servo piston then moves up, increasing actuator output shaft 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 on the flapper to re-center it. When a force balance is obtained among the torque motor, 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 upper nozzle, while increasing flow of the lower nozzle. the pressure differential this time lowers 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 lower spring, re-centering the flapper.

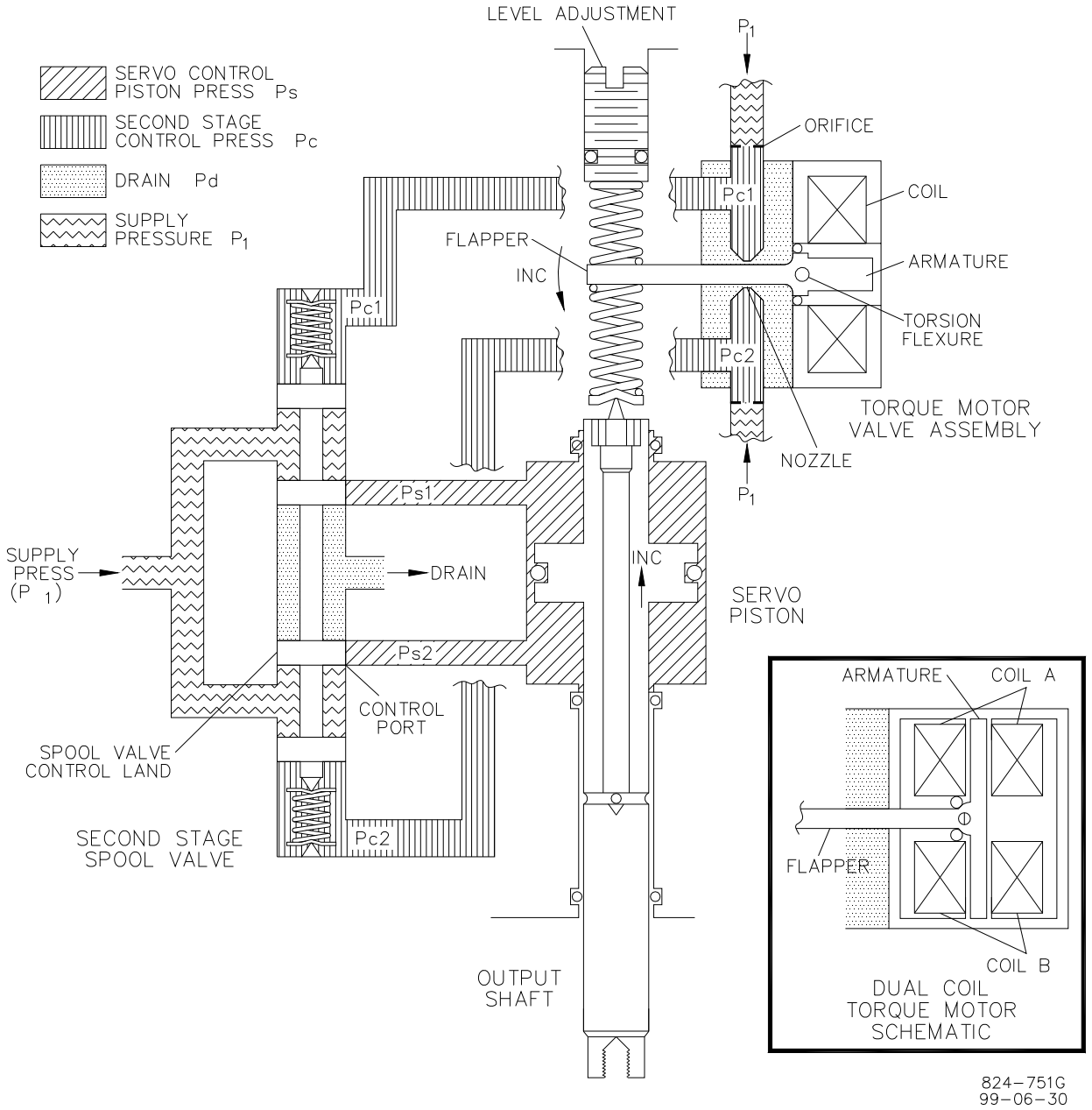


Figure 4-1. Single/Dual Coil Schematic, TM-25LP/TM-200LP Actuator

Chapter 5.
Maintenance

Introduction

⚠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 1 or Division 2, and Zone 1 or Zone 2 applications.

This chapter provides instructions for troubleshooting and preventive maintenance of the TM-25LP and TM-200LP actuators.

The service life of the actuator is increased with the use of clean supply flow. However, contaminant resistance of the actuator is excellent due to design features and high working forces.

Filter Cleaning

The actuators are equipped with a 40 µm nominal/ 70 µm absolute filter fitting at the supply connection. See the outline drawing (Figure 2-1) for the location of the fitting. If the filter becomes clogged, as evidenced by sluggish response of the actuator, it may be removed, cleaned ultrasonically, and back flushed with a light solvent. Be prepared to replace the O-ring (part 80, Figure 6-1) after cleaning the filter (part 79, Figure 6-1). Re-torque the inlet filter fitting to 17.0 ± 0.6 N•m (150 ± 5 lb-in), and re-safety.

NOTICE

Do not run the actuator with the inlet filter fitting or the in-line filter removed or bypassed, as extensive repairs can be made necessary by only momentary exposure of the interior of the torque motor to contaminants.

Troubleshooting

Malfunctions of the governing system are usually revealed as speed variations of the prime mover, but it does not necessarily mean that such speed variations indicate governing system problems. When improper speed variations appear, inspect all components, including the turbine, for proper operation. See the correct Woodward manual for assistance in isolating the trouble.

The following steps describe troubleshooting the actuator:

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

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

Disassembly of the actuator in the field is not recommended. Under unusual circumstances where field repair becomes necessary, all work and calibration should be done by personnel thoroughly trained in the proper procedures.

Refer to Chapter 7 for instructions on contacting a Woodward Service Representative or for training on this product.

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 for ordering replacement parts for the TM-25LP and TM-200LP actuators.

Disassembly of the actuator in the field is not recommended. Under unusual circumstances where field repair becomes necessary, all work and calibration should be done by personnel thoroughly trained in the proper procedures.

Refer to Chapter 7 for instructions on contacting a Woodward Service Representative or for training on this product.

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

Replacement Parts Information

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

- Serial number and part number shown on the nameplate of the actuator
- Manual number 82450
- Part reference numbers in parts list and description of part and part name

Figure 6-1 illustrates the parts for the actuator. The part numbers assigned are used as reference only and are not specific Woodward part numbers.

Table 6-1. Parts Reference Number and Name

REF. NO.	PART NAME	QTY.
82450-51	Cover	1
82450-52	Screw, 6-32 x 0.250	
	—single coil	1
	—dual coil	2
82450-53	Washer, #6 lock washer	
	—single coil	1
	—dual coil	2
82450-54	Wire clamp	
	—single coil	1
	—dual coil	2
82450-55	Housing assembly	1
82450-56	Torque motor	1
82450-57	Screw, 0.250-20 x 1.000	
	—single coil	8
	—dual coil	12
82450-58	Washer, 0.250 lock washer	
	—single coil	8
	—dual coil	12
82450-59	O-ring; furnished with torque motor	
82450-60	O-ring; furnished with torque motor	
82450-61	Actuator body assembly	1
82450-62	Preformed packing, 0.351 x 0.072 (single coil only)	3
82450-63	Plug, 0.438-20 (single coil only)	1-3
82450-64	Feedback spring assembly	1
82450-65	Trim spring	1
82450-66	Preformed packing (single coil only)	1
82450-67	Spring seat assembly, 0.299 ID x 0.103	
	(separate plug and spring seat on dual coil)	1
82450-68	Plug (single coil only)	1
82450-69	Plug assembly, 0.438-20 (single coil only)	1
82450-70	Preformed packing, 0.551 x 0.071	1
82450-71	Pilot valve bushing	1
82450-73	Pilot valve plunger	1
82450-74	Retainer assembly	1
82450-75	Spring assembly	1
82450-76	Preformed packing, /737 ID	1
82450-77	Spring support assembly	1
82450-78	Expansion plug	1
82450-79	Filter fitting, 0.750-16	1
82450-80	Preformed packing, 0.644 ID x 0.087	1
82450-81	Connector assembly, 0.875-14 UNF	1
82450-82	Preformed packing, 0.755 ID x 0.097	1
82450-83	Step seal	2
82450-84	Preformed packing, 0.636 ID x 0.070	2
82450-85	Preformed packing, 1.487 ID x 0.031	1
82450-86	Piston guide	1
82450-87	Retaining ring, 1.942	1
82450-88	Seal, 1.750 OD	1
82450-89	Preformed packing, 1.296 ID x 0.139	1
82450-90	Piston assembly	1
82450-91	Preformed packing, 1.612 ID x 0.031	1
82450-92	Cover assembly	1
82450-93	Washer, 0.375 split lock	4
82450-94	Screw, 0.375-24 x 1.250	4
82450-95	Rod and seal	1
82450-96	Preformed packing, 0.674 ID x 0.103	1
82450-97	Seal retainer	1
82450-98	Retaining ring, 1.111 dia	1
82450-99	Cover (see both views)	1
82450-100	1/4-28 Drilled socket head cap screw (single coil only)	3
82450-100a	Flat washers (single coil only)	3

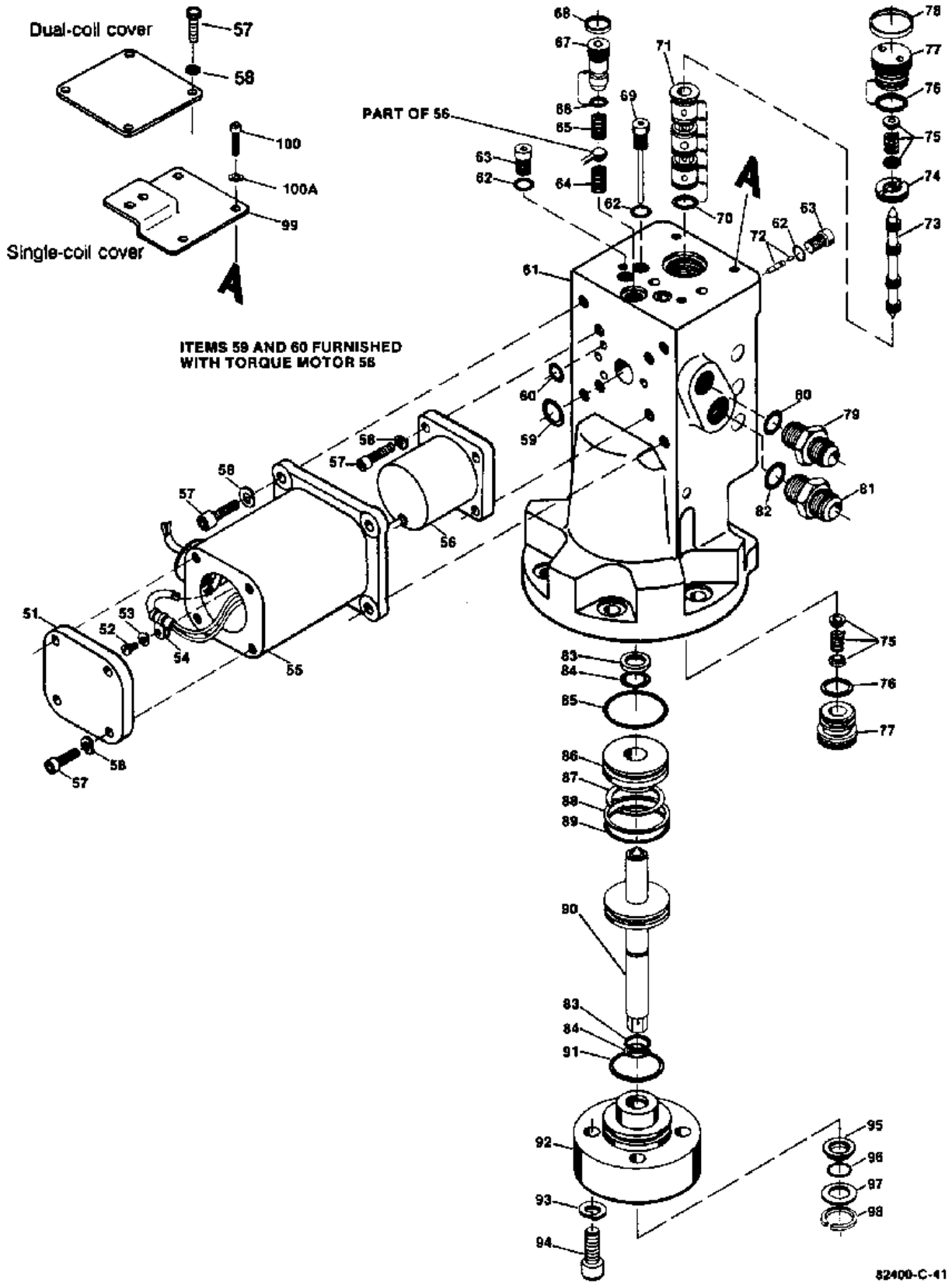


Figure 6-1. TM-200LP Exploded View

Chapter 7.
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:

- 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 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 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.

A current list of Woodward Business Partners is available at **www.woodward.com/directory**.

Product Service 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**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

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

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
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

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 _____

Turbine Model Number _____

Type of Fuel (gas, steam, 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.

Revision History

Changes in Revision AA—
- Updated Certifications
- Updated Declarations

Changes in Revision Y—
- Updated Korean Certification
- Removed GOST R Certification (expired)
- Updated Declarations of Conformity and Incorporation

Changes in Revision W—
- Added updated dual-coil Declaration

Changes in Revision V—
- Updated Compliance listing information, including ATEX, IECEx, and Special Conditions for Safe Use
- Added updated Declarations

Changes in Revision U—
- Updated Compliance listing information
- Added IECEx and GOST R listings to Regulatory Compliance

Changes in Revision T—
- Updated Regulatory Compliance information (ATEX, EMC Directive, Machinery Directive)
- Updated wiring information (pages iii & 3)
- Updated ambient temperature range (page 4)
- Updated TM-25LP max coil current (page 5)
- Updated outline drawings (Figures 2-1 & 2-2)
- Added torque information to Filter Cleaning paragraph (page 15)
- Added new DOC & DOI

Changes in Revision R—
- Removed references to UL (no longer UL Listed)

Changes in Revision P—
- Updated Compliance listing information
- Added Figure 2-2b to show dual coil version without position feedback

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00129-04-EU-02-01
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	TM25LP Dual Coil Actuator, 9908-334, -341, -342, -399, -400,
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres
Markings in addition to CE marking:	⟨Ex⟩ II 3 G, Ex nA IIC T4 Gc, IP54 ⟨Ex⟩ II 2 G, Ex d IIB T4 Gb, IP54, c IIB T4
Applicable Standards:	EN60079-0:2009 - Explosive Atmospheres - Part 0: Equipment – General requirements EN60079-1:2007- Explosive Atmospheres - Part 17: Equipment protection by flameproof enclosure "d" EN60079-15:2010- Explosive Atmospheres - Part 15: Equipment protection by type of protection "n"
Third Party Certification:	Category 2 : LCIE 12 ATEX 3064 X LCIE Siège Social : 33, Avenue du Général Leclerc F92260 Fontenay-aux-Roses, France
Conformity Assessment:	ATEX Annex IV - Production Quality Assessment, 01 220 113542 TUV Rheinland Industrie Service GmbH (0035) Am Grauen Stein, D51105 Cologne

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Christopher Perkins
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

06/JUL/2016
Date

5-09-1183 Rev 26

EU DECLARATION OF CONFORMITY

EU DoC No.:	00129-04-EU-02-03
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	TM25LP Single Coil Actuator
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres
Markings in addition to CE marking:	Ex II 2 G, Ex e IIC T4 Gb
Applicable Standards:	EN60079-0:2009 - Explosive Atmospheres - Part 0: Equipment – General requirements EN60079-7:2007 - Explosive Atmospheres - Part 7: Equipment Protection by Increased Safety "e"
Third Party Certification:	LCIE 12 ATEX 3022 X LCIE Siège Social : 33, Avenue du Général Leclerc F92260 Fontenay-aux-Roses, France
Conformity Assessment:	ATEX Annex IV - Production Quality Assessment, 01 220 113542 TUV Rheinland Industrie Service GmbH (0035) Am Grauen Stein, D51105 Cologne

This declaration of conformity is issued under the sole responsibility of the manufacturer
We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature

Joseph Driscoll
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

10/28/16
Date

5-09-1183 Rev 26

DECLARATION OF INCORPORATION
Of Partly Completed Machinery
2006/42/EC

File name: 00129-04-EU-02-02
Manufacturer's Name: WOODWARD INC.
Manufacturer's Address: 1041 Woodward Way
Fort Collins, CO 80524 USA

Model Names: TM25LP Actuator

This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.5, 1.6, 1.7

The relevant technical documentation is compiled in accordance with part B of Annex VII. Woodward shall transmit relevant information if required by a reasoned request by the national authorities. The method of transmittal shall be agreed upon by the applicable parties.

The person authorized to compile the technical documentation:

Name: Dominik Kania, Managing Director
Address: Woodward Poland Sp. z o.o., ul. Skarbowa 32, 32-005 Niepolomice, Poland

This product must not be put into service until the final machinery into which it is to be incorporated has been declared in conformity with the provisions of this Directive, where appropriate.

The undersigned hereby declares, on behalf of Woodward Governor Company of Loveland and Fort Collins, Colorado that the above referenced product is in conformity with Directive 2006/42/EC as partly completed machinery:

MANUFACTURER

Signature

Joseph Driscoll
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

10/25/16
Date

Document: 5-09-1182 (rev. 16)

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 82450.

B 8 2 4 5 0 : A A

PO Box 1519, Fort Collins CO 80522-1519, USA
1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

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.