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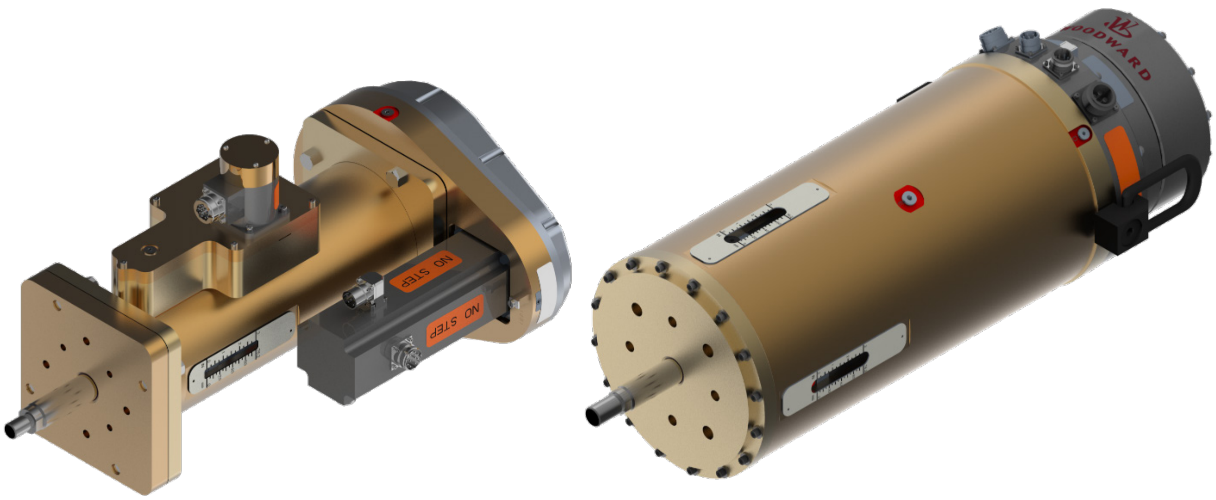
WOODWARD

Product Manual 35227
(Revision A, 11/2024)
Original Instructions



Electric Linear Actuators
ELA7, ELA13, ELA53

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. The latest version of most publications is available on the Woodward website. Woodward Industrial Support: Get Help 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. The latest version of most publications is available on the Woodward website. Woodward Industrial Support: Get Help Always compare with the original for technical specifications and for proper and safe installation and operation procedures. If your publication is not on the Woodward website, please contact your customer service representative to get the latest copy.

Revisions— A bold, black line alongside the text identifies changes in this publication since the last revision.

Contents

Illustrations and Tables

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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 completely independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be necessary 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.

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 since 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. After removing the old PCB from the control cabinet, immediately place it in the antistatic protective bag.

Regulatory Compliance

European Compliance for CE Marking:

These listings are limited only to those units bearing the CE Marking.

EMC Directive: Declared to Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC).

ATEX Directive: Directive 2014/34/EU on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
ELA7, ELA13: Zone 2, Category 3, Group II G, Ex ec IIC T3 Gc
ELA53: Zone 2, Category 3, Group II G, Ex ec IIC T3 Gc

Other European Compliance:

Compliance with the following European Directives or standards does not qualify this product for application of the CE Marking:

ATEX Directive: Exempt from the non–electrical portion of the ATEX Directive 2014/34/EU due to no potential ignition sources per EN ISO 80079–36:2016 for Zone 2 installation.

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

RoHS Directive: Restriction of Hazardous Substances 2011/65/EU:
Woodward Turbomachinery Systems products are intended exclusively for sale and use only as a part of Large-Scale Fixed Installations per the meaning of Art.2.4(e) of directive 2011/65/EU. This fulfills the requirements stated in Art.2.4(c), and as such, the product is excluded from the scope of RoHS2.

Other International Compliance:

IECEx (ELA7 & ELA13): Soon to be certified for use in explosive atmosphere for Ex ec IIC T3 Gc

IECEx (ELA53): Soon to be certified for use in explosive atmosphere for Ex ec IIC T3 Gc

North American Compliance

These listings are limited only to those units that bear the appropriate marking.

CSA (ELA7 & ELA13): Soon to be certified for use in Canada and the United states for Class I, Div. 2, Groups A, B, C & D, T3 at 93°C

ETL (ELA53): Soon to be certified for use in Canada and the United states for Class I, Div. 2, Groups A, B, C & D, T3 at 93°C

Special Conditions for Safe Use

ELA7 & ELA13 actuators are to be used with the Woodward DVP5000.
ELA53 actuator is to be use with the Woodward DVP12000, suitably certified for the intended area of use.

Mating electrical connectors must be tightly installed on the actuator to maintain the IP55 rating. Appropriate caps must be in place for any unused connectors.

ELA7 & ELA13: Use supply wires suitable for 10 °C (50 °F) above surrounding ambient.
ELA53: Use supply wires suitable for at least 125 °C (257 °F).

Maximum operating ambient temperature is 93 °C (199 °F).

ELA7 & ELA13 valve–actuator interface temperature must not exceed 141 °C (286 °F).
ELA53 valve–actuator interface temperature must not exceed 110 °C (230 °F).

No insulation is permitted on the actuators.

Compliance with the Machinery Directive 2006/42/EC noise measurement and mitigation requirements is the responsibility of the manufacturer of the machinery into which this product is incorporated.

WARNING

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

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

Chapter 1.
General Information

Introduction

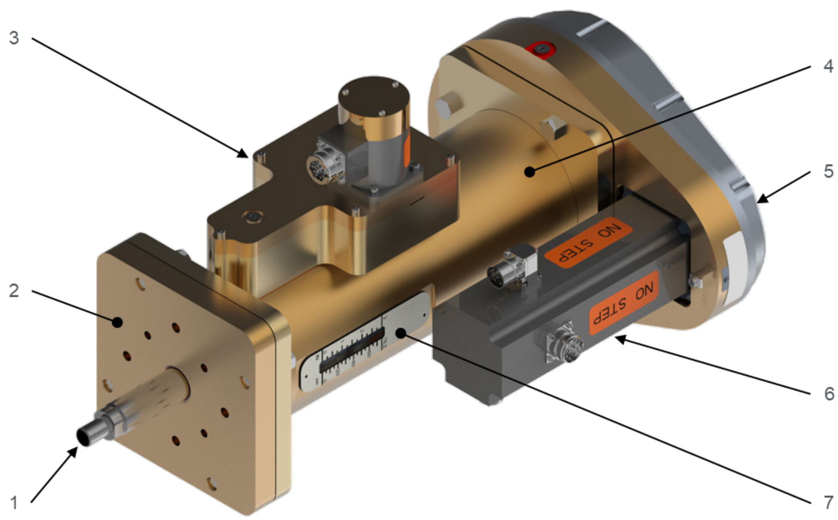
The Woodward Electric Linear Actuator (ELA) product family consists of multiple models to fit a variety of applications. Each ELA model differs by output force (shown in kilonewtons) and can easily be recognized by the numeric value shown after the ELA term. This manual is focusing on three specific versions of the overall family of Woodward products (i.e., ELA7, ELA13 and ELA53):

- ELA7 – 7 kilonewton output linear actuator
- ELA13 – 13 kilonewton output linear actuator
- ELA53 – 53 kilonewton output linear actuator

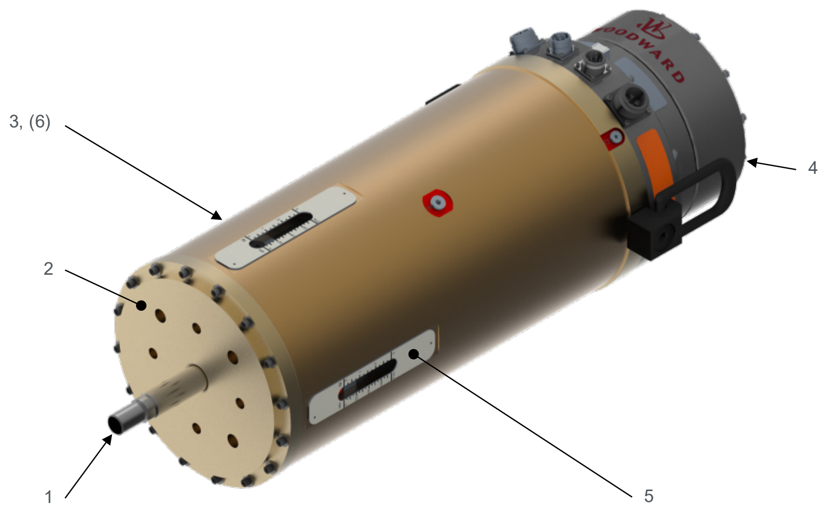
Each ELA system consists of an electronic linear actuator (ELA) and a digital valve positioner (DVP) for position control on industrial applications. The ELA actuators can be used for a variety of applications; however, these three versions are customized for integration with non-Woodward process valves used for controlling the flow of fuels to the combustion system of an industrial or utility gas turbine.

The ELA7, ELA13, and ELA53 actuators consist of:

- A brushless DC motor
- Two integral resolvers for motor commutation and position feedback to the controller
- A secondary feedback device for motor resolvers' verification
- A high-efficiency and high-precision ball screw for rotary-to-linear motion conversion
- A fail-extend spring designed to extend the actuator if power is removed from the actuator
- A soft-stop spring to dissipate motor rotor inertia during actuator fail-extend shutdown and prevent ball screw, valve and retaining hardware damage



1. Output shaft
2. Interface plate with ISO 5210 bolting pattern
3. Secondary position feedback - shaft resolver
4. Cylinder
5. Gearbox
6. Electric motor
7. Visual position indicator



1. Output shaft
2. Interface plate with ISO 5210 bolting pattern
3. Cylinder
4. Electric motor with integrated gearbox
5. Visual position indicator
6. Secondary position feedback – LVDT (internal to actuator, not visible)

Figure 1-1. ELA7 and ELA13 (top) and ELA53 (bottom) Actuators Overview

ELA Variants and DVP Requirements

ELA actuators are intended to operate only with specific models of the Woodward DVP (see Table 1-1). Refer to manual 26773 for specifications and additional information on the operation and configuration of the DVP5000 and DVP12000. Contact your Woodward sales associate for part numbers for your specific applications.

Table 1-1. ELA7, ELA13, and ELA53 Part Numbers and Description

Part No.	Model No.	Description	Required Digital Valve Positioner (DVP)
8915-2054	**ELA7.1**	Standard offering actuator	DVP5000 – Various models available, contact Woodward
8915-2052	**ELA13.1**	Standard offering actuator	DVP5000 – Various models available, contact Woodward
8915-2055	**ELA13.2**	Reduced force actuator	DVP5000 – Various models available, contact Woodward
8915-2051	**ELA53.1**	Standard offering actuator	DVP12000 – Various models available, contact Woodward
8915-2053	**ELA53.2**	Reduced force actuator	DVP12000 – Various models available, contact Woodward

Additional Product and Maintenance Documentation

NOTICE	**Documentation listed below should be read, understood, and used in conjunction with the information found in this manual.**

Table 1-2. Reference Documents

Publication No.	Description
Technical Manuals	
82715	Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards & Modules
26773	Digital Valve Positioner (DVP) DVP5000 / DVP10000 / DVP12000 Product Manual
35228	ELA Configuration Tool Manual
Maintenance Documentation[1]	
35134	Re-lubrication procedure for ELA7 & ELA13 actuators
35103	Re-lubrication procedure for ELA53 actuators

[1] Re-lubrication recommended every 24 000 operating hours.

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Product Installation & Outline Dimensions

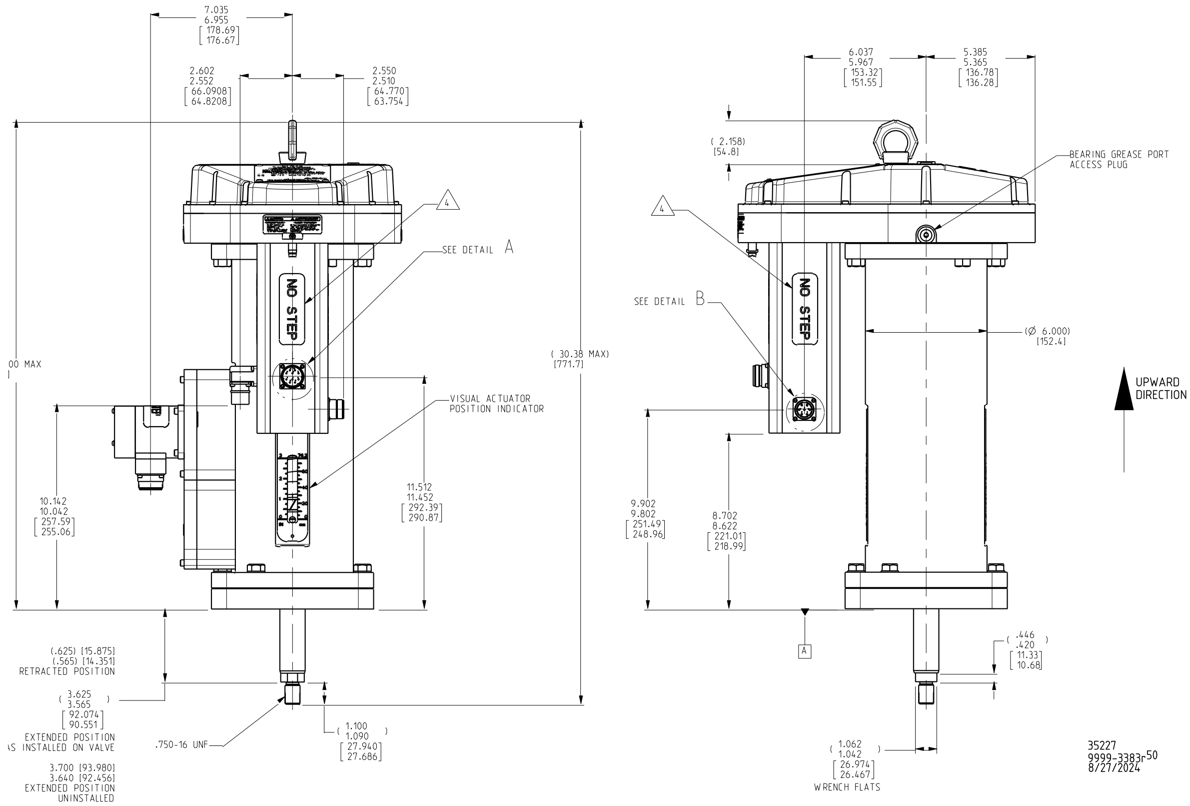


Figure 1-2a. ELA7 & ELA13 Outline Drawing

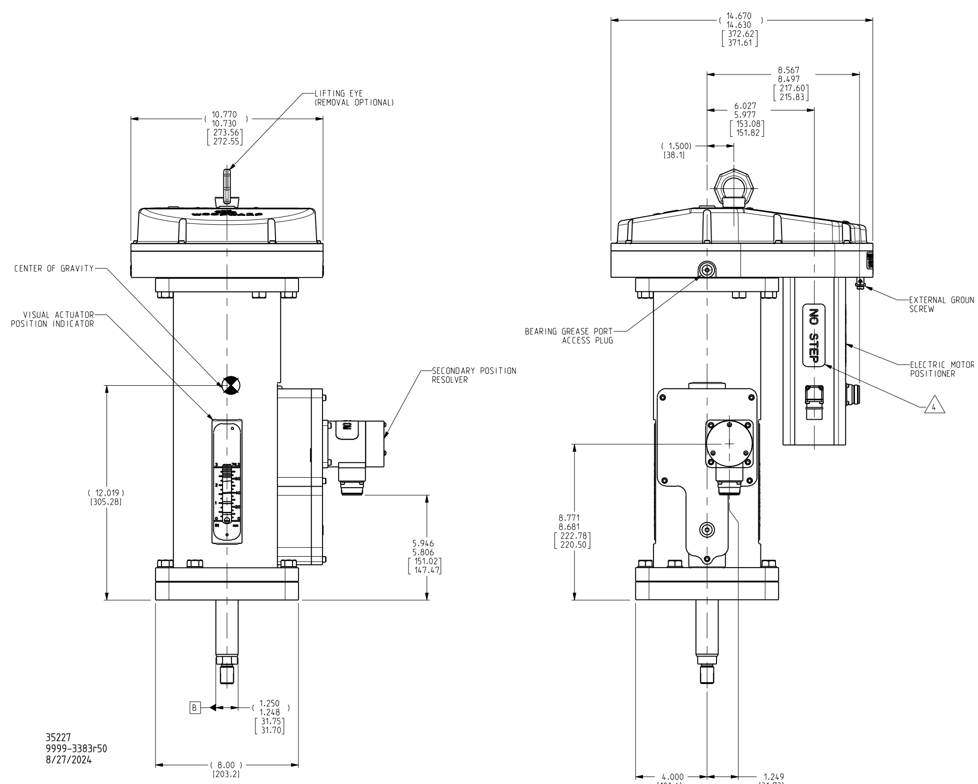


Figure 1-2b. ELA7 & ELA13 Outline Drawing

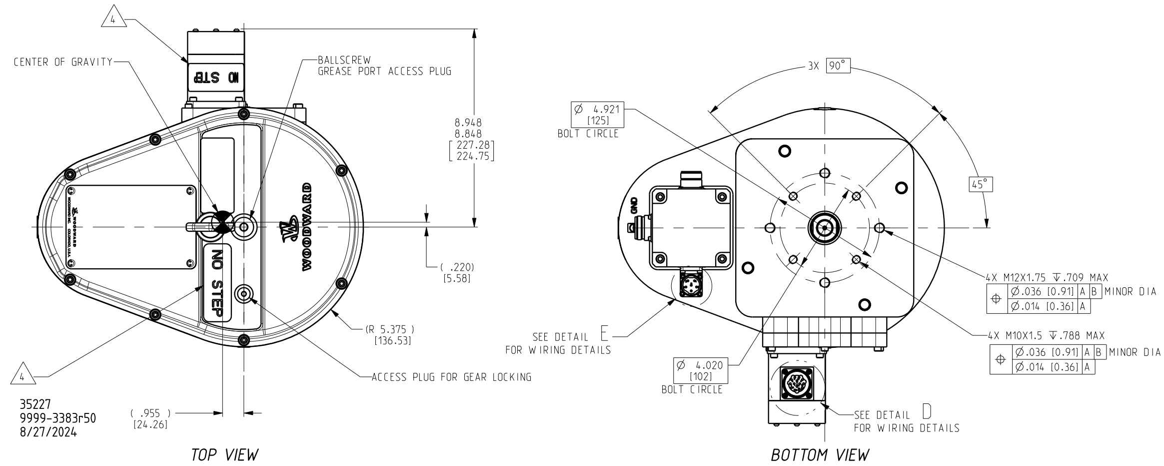


Figure 1-2c. ELA7 & ELA13 Outline Drawing (Top and Bottom View)

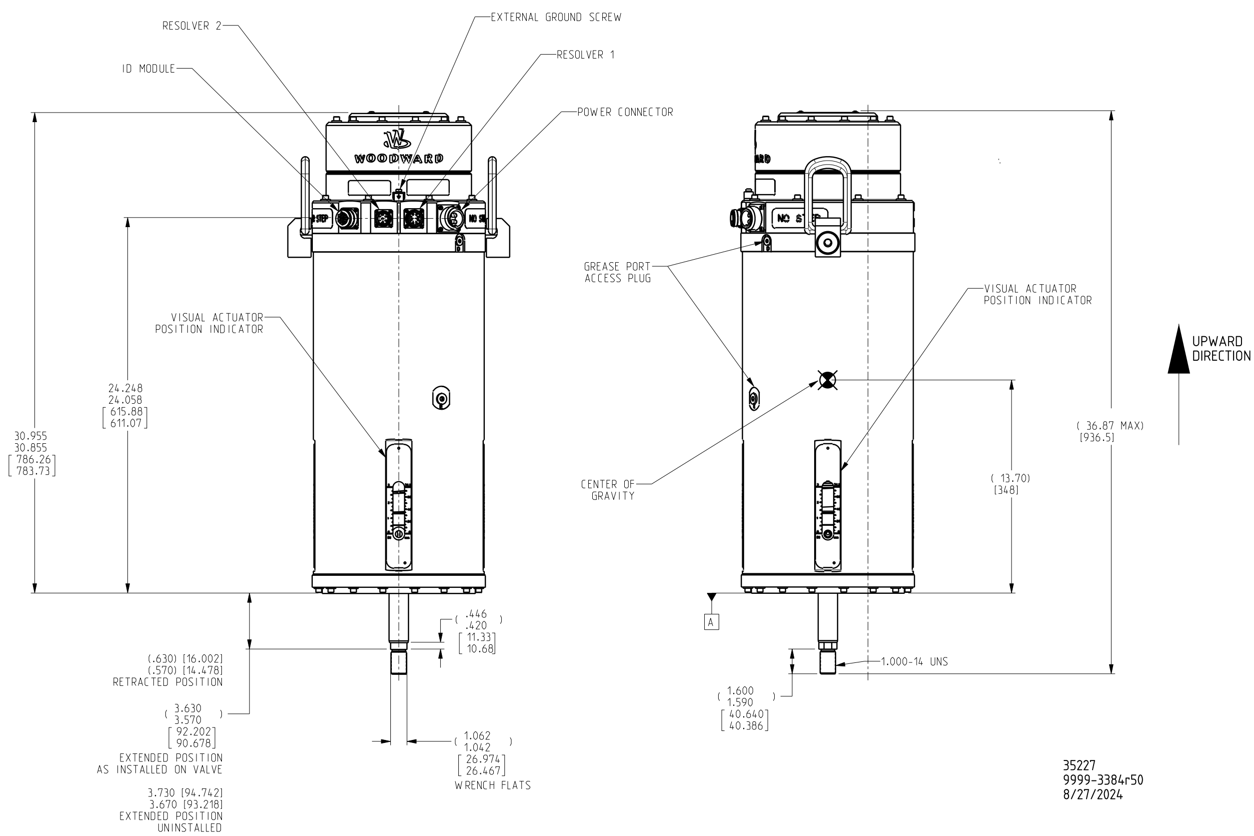


Figure 1-3a. ELA53 Outline Drawing

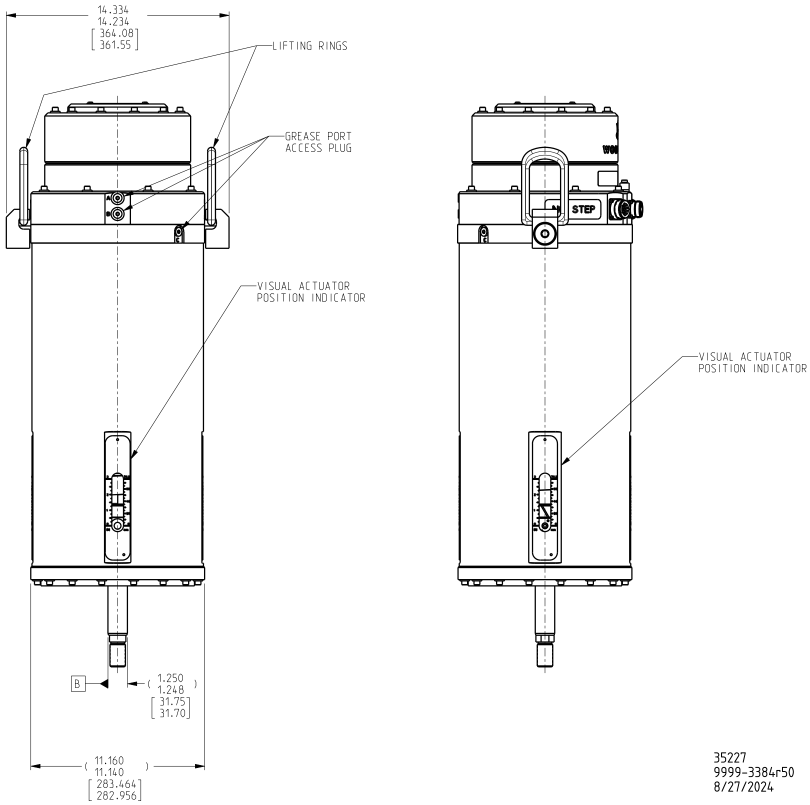


Figure 1-3b. ELA53 Outline Drawing

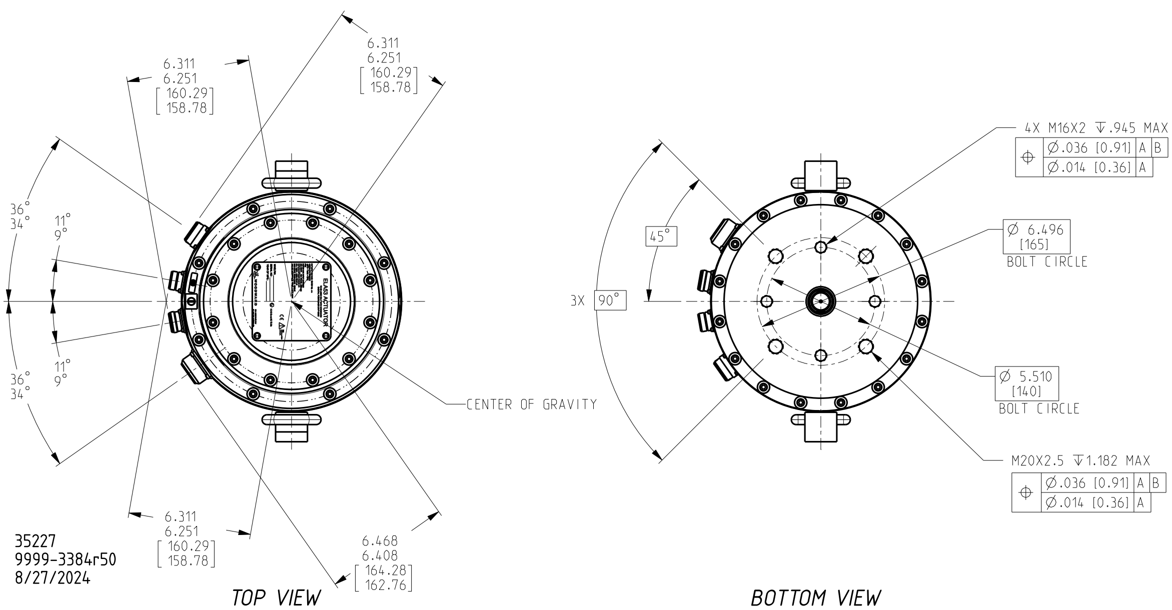


Figure 1-3c. ELA53 Outline Drawing (Top and Bottom View)

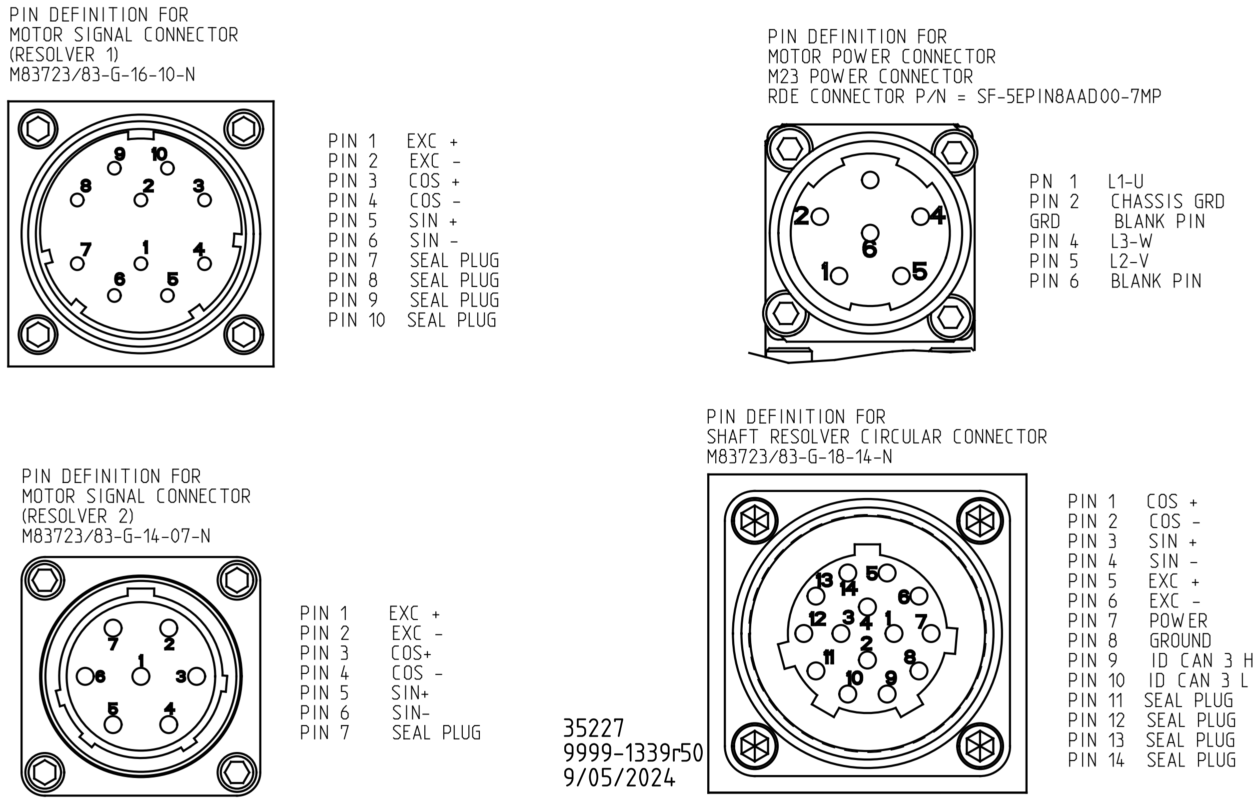


Figure 1-4. Connector Pin-outs (DVP5000 Driver with ELA7 & ELA13 Actuators)

Note: Connector key orientations shown above are for reference only. Refer to product outline drawing for product or part number specific key orientations.

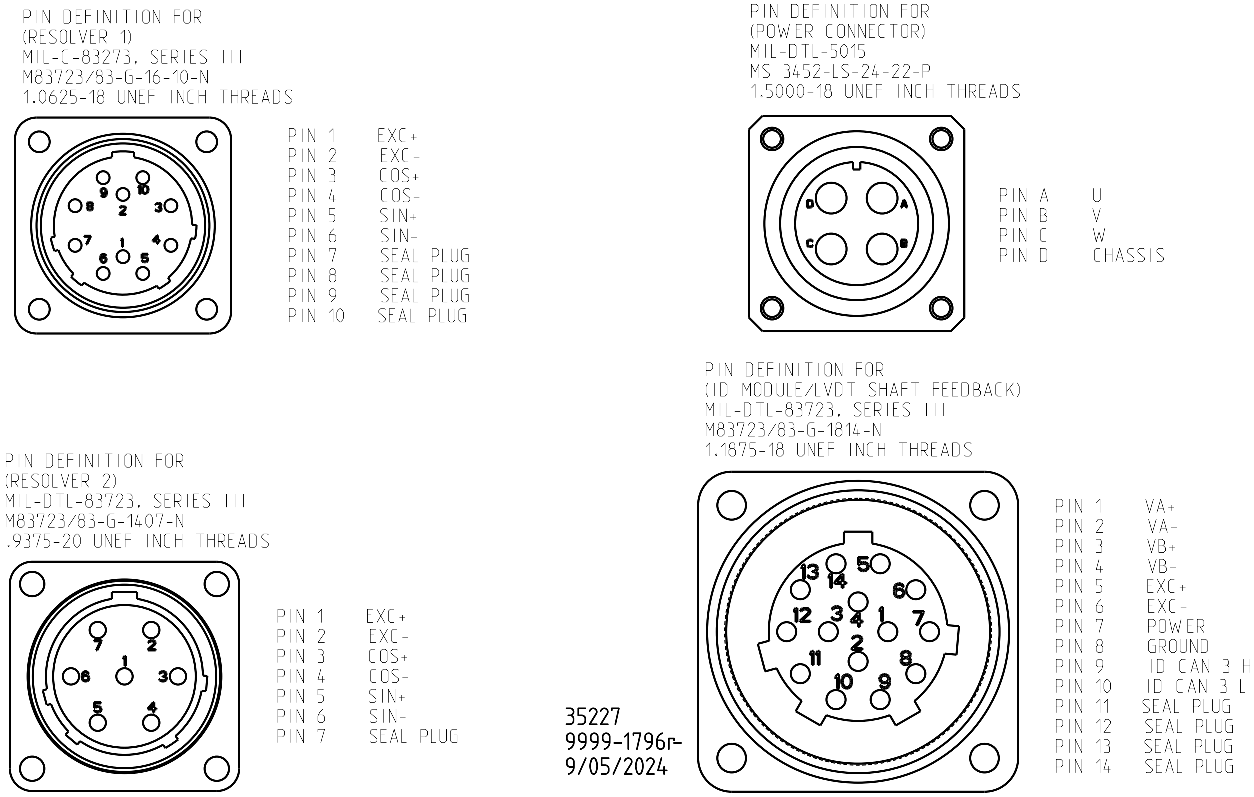


Figure 1-5. Connector Pin-outs (DVP12000 Driver with ELA53 Actuator)

Note: Connector key orientations shown above are for reference only. Refer to product outline drawing for product or part number specific key orientations.

Chapter 2.
Specifications and Detailed Description

Woodward ELA (Electrical Linear Actuator)

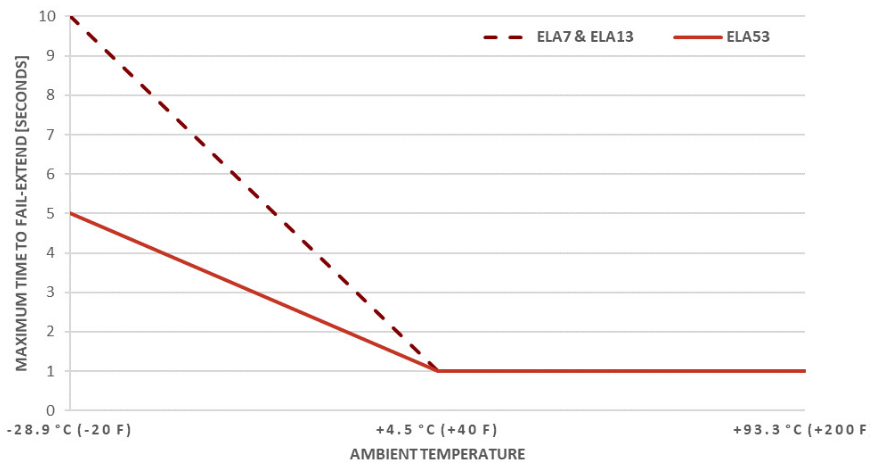
The electric linear actuator consists of a brushless DC motor and gear train which drives a precision lead screw for precise linear positioning. Dual resolvers are provided for motor commutation and position sensing. The actuators include a return spring for fail-closed operation (output shaft extended at trip). The actuators include a high temperature memory device (ID Module) which stores all the configuration and calibration information to be read by the Digital Valve Positioner (DVP) when the actuator is connected and powered up. A soft stop cushion within the actuators is provided to protect the gear train and lead screw from damage when the actuator impacts the valve seat during trip events.

Table 2-1. ELA7, ELA13, and ELA53 Actuators Specifications

	ELA7	ELA13	ELA53
Gear train steady state stall force	6.7 kN (1500 lbf)	13.3 kN (3000 lbf)	53.4 kN (12000 lbf)
Stroke	Configurable: minimum 12.70 mm (0.5 in) to maximum 76.20 mm (3.0 in)		
Mean Time Between Failure (MTBF)	100 000 hours of operation Combined actuator/DVP/cable subsystem.		
Service interval	Re-lubrication of the ball/roller screw recommended every 24 000 operating hours.		
Mean Time Between Overhaul (MTBO)	Every 64 000 hours. Unpowered trips: 500 events[6].		
Allowable duty cycle	Small signal (dither): maximum demand profile ±0.15% percent of full stroke at frequency 0.3 Hz		
Bandwidth[1]	30 rad/s with no more than 6 dB attenuation and less than 180 degrees phase loss at ±0.5% to ±2% magnitude and minimum supply voltage at driver.		
Actuator slew time (as measured from 90% to 10% [closing])	350 ms maximum	700 ms maximum	650 ms maximum
Actuator slew time (as measured from 10% to 90% [opening])	350 ms maximum[1]	700 ms maximum[1]	650 ms maximum[1]
Ambient temperature range	–29 to +93 °C (–20 to +200 °F)		
Storage temperature range	–40 to +93 °C (–40 to +200 °F)		
Ingress protection	IP55		
Motor coil insulation rating	Class H		
Visual position indication	Yes		
Failure mode[2]	Fail-extend, spring-type return mechanism that drives the actuator output shaft to the extended position in the event of a loss of signal from the driver.		
Return spring force (Specified at position from 0% to 100% of a full stroke)	2.90 – 4.45 kN (650 – 1000 lbf)	4.45 – 7.60 kN (1000 – 1711 lbf)	19.40 – 28.10 kN (4360 – 6316 lbf)

Table 2-1. ELA7, ELA13 & ELA53 Actuators Specifications (cont'd.)

	ELA7	ELA13	ELA53
Maximum time to fail-extend (motor offline, unpowered shut-down)	See chart below		



	ELA7	ELA13	ELA53
Maximum impact load in fail-extend direction (unpowered shut-down)	See Table 2-3 for details.		
Allowable operational side (lateral) load[3]	See "Actuator Installation" chapter.		
Random Vibration Profile (Validation)	Based on MIL-STD-810F, Method M514.5A, Cat. 4: .015 G²/Hz, 10–500 Hz, 1.04 Grms, 2 Hrs/axis		
Vibration (Shock)	5G peak, 11 ms, ±3 pulses/axis		
DVP model	DVP5000		DVP12000
DVP input voltage			
Typical	220 VDC		220 VDC
Maximum	300 VDC		300 VDC
Minimum (for full dynamic actuator performance)	112.5 VDC		190 VDC
Minimum	90 VDC		90 VDC
DVP in-rush current	< 50 Amps		
DVP input current			
Maximum in steady state[4]	1.5 Amps		1.5 Amps
Maximum in transient state[4]	20 Amps for 1 second		30 Amps for 1 second
DVP output current			
Maximum in steady state[5]	12 Amps		25 Amps
Maximum in transient state[5]	40 Amps		40 Amps
Approximate weight	81 kg (178 lb)		169 kg (372 lb)

1 Specified for the actuators at full force settings. Enabling the "Force limiter" functionality may reduce the actuator performance.

2 In application where the return spring is required to return the actuator to fully extended position, Woodward recommends that the sum of all valve loads should not exceed 2/3 of the minimum spring force specified.

3 The ELA7, ELA13, and ELA53 actuators are not designed nor intended to support significant side (lateral) loads. It is important that valve stem is aligned concentrically with the actuator output shaft. To mitigate the possibility of any side loads, the actuator shall be mounted on a flat surface that is perpendicular to the output shaft and valve stem, with external load concentric to the actuator output shaft as specified in the "Actuator Installation" chapter.

[4] Assumes slow modulation as when following a base load. Does not consider additional power required as seen in grid firming applications requiring continuous and fast ramping of the valve. Stated current values are based on minimum DVP input voltage for full dynamic performance. Recommended input protection DVP5000: 15A time delay fuse or 15A breaker / DVP12000: 40A time delay fuse or 45A breaker.
[5] Information provided for breaker and wire sizing. Current seen when performing a full 100% step against load. Note: this value varies by actuator type. The values above are applicable only for the products referenced in this manual. Stated current values are based on minimum DVP input voltage for full dynamic performance.
[6] Total number of events before actuator endurance limit is exceeded. The number of these events is not monitored via software. After exceeding the limit, an overhaul is recommended as actuator performance may be degraded. "Shutdown Position" or "Shutdown System" should not be used routinely due to stress on the actuator and/or valve.

Resolver Position Feedback Sensors

The primary position feedback transducers are the dual redundant resolvers that are integral to the DC brushless motor assembly. Each actuator also has a secondary actuator stem position feedback. Secondary feedback device is used as a watchdog function of the primary motor control, to prevent runaway conditions and to ensure that the primary motor resolver is reading correctly:

Typical actuator response to a large step demand is presented below. Area of software cushioning can be observed where the actuator is close to reaching the demanded position. The actuator will decelerate before reaching the demand to minimize overshoot and to minimize stress against valve metering plug/seat.

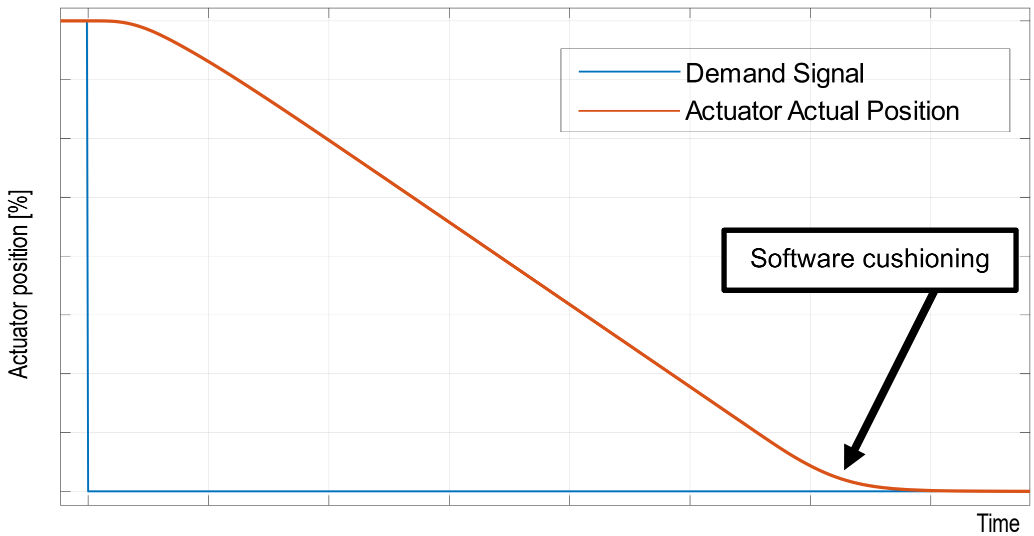


Figure 2-1. Actuator Response to a Step Demand

Startup Checks for Resolvers

Whenever the DVP is reset from a power up or any critical diagnostics shutdown, a series of automatic startup checks are performed and must be successfully completed before the DVP enters the running state. The purpose of the start-up checks are to ensure that correct feedback readings are verified, that the valve or actuator is at the required start-up or "home" position (confirmed by more than one sensor), and that the actuator moves in the correct direction when commanded before resuming operation. These actuators use multi-turn reduction gear trains with multi-turn feedback systems, so it is important that the starting point or "zero turn" of the system be confirmed during the startup process. This is particularly important for normally closed control valves, to ensure that the valve is not open at the indicated 0% position, and to prevent a potentially dangerous high flow starting condition. For actuators controlling externally connected equipment or linkage, verifying the correct zero point during startup can prevent potential collision against the actuator's internal end-stops, or against a hard stop within the driven linkage. This is important to prevent damage of the actuator, driven equipment, or both.

The startup checks are a critical function designed to help ensure system reliable actuation. The DVP Valve/Actuator Startup Check sequence includes a Minimum Direction Startup Check, Maximum Direction

Startup Check, and Motor Direction Check. Each of these are explained in further detail in the DVP Service Tool Manual 26912. This manual lists how the startup check indications are displayed. The various fault conditions are also referenced in the troubleshooting chapter for explanation and recommended actions

IMPORTANT **Refer to the DVP Service Tool Manual 26912 for more information on details of startup checks for resolvers.**

Zero Cut-Off Current Control

Zero Cut-Off Current Control mode is specifically dedicated to applications where higher than usual actuator closing thrust-down is required. In this mode, when position demand meets the programmed conditions, the actuator motor will actively generate additional torque to push the valve stem in the closing direction with additional force. This mode can be used to achieve higher valve seat loading. This mode operates only in output shaft extended (e.g., normally closing the valve) direction.

Table 2-2. ELA7, ELA13, and ELA53 Zero Cut-Off Current Controlled Capabilities

	ELA7.1	ELA13.1	ELA13.2	ELA53.1	ELA53.2
Maximum continuous thrust down (force in extended direction)[1]	6.2 kN (1400 lbf)	11.1 kN (2500 lbf)	11.1 kN (2500 lbf)	35.8 kN (8060 lbf)	26.9 kN (6060 lbf)

[1] This maximum thrust-down is achievable only with “Zero Cut-Off Current Controlled” mode activated during the calibration process. This mode requires that actuator is online & powered.

IMPORTANT **In case of loss of power, the actuator total thrust-down will drop to return spring force only as specified in Table 2-2.**

NOTICE **Leakage test of the valve is not performed as part of the Configuration Tool steps. It is recommended that the user develop and perform a separate test if leakage is important to the application.**

Soft Stop Spring

Integral to the actuators is a soft stop spring. This provides a bumper-like action if the actuator is driven hard into the fully extended position. This will occur only on loss of power, certain wiring faults, and in rare cases of internal fault conditions within the positioner. The soft stop mechanism is not used when the positioner is controlling the actuator. Although the positioner will rapidly drive the actuator towards the minimum position, it also decelerates the actuator as the actuator approaches the mechanical minimum stop. Under the control of the positioner, the actuator will not reach the mechanical minimum stop at a high velocity.

Failure Mode (Including Bounce)

Explanation of typical actuator/valve assembly response to a loss of power/control is provided, including bounce effect.

Bounce is an effect of a bumper-like action of the soft stop spring (described above). Bounce will occur only on loss of electrical power to the DVP, certain wiring faults, and in rare cases of internal fault conditions within the positioner. When the actuator remains under the control of the positioner, there will be no bounce on closing the valve as the positioner will decelerate the actuator close to demand position. An example of bounce action can be seen in Figure 2-2.

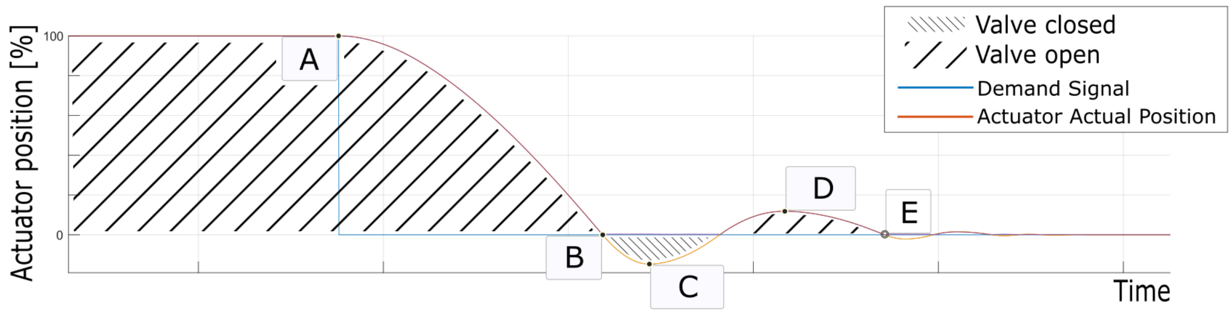


Figure 2-2. Failure Mode
(Example of actuator output shaft position on "Shutdown Position" and "Shutdown System" scenarios)

In Figure 2-2, before the time (A) position demand is 100% and the actuator holds its position, with the valve open. At the time (A), the position control is lost, and the actuator is back driven by the return spring only. Note that from the point (A) the actuator is no longer under the control of the positioner. The return spring drives the actuator and valve to the 0% position (B) – the valve is shut, but the actuator motor rotor continues to rotate and drive into the soft stop mechanism, dissipating the rotary motion energy. At the time (C), the energy stored in the bumper soft stop mechanism begins to drive the actuator back into the open direction. At this time, the maximum impact load is exerted on the valve stem. Energy stored in the soft stop mechanism is high enough to compress the return spring and thus open the valve when moving toward point (D). The maximum bounce is observed at time (D). Each subsequent bounce is significantly smaller, up to the point of complete equilibrium (E) (less than a few bounces).

NOTICE

It is the responsibility of the user to satisfy compliance to all applicable requirements for the system design and system safety, including but not limited to, taking into consideration the bounce action of the ELA7, ELA13, and ELA53 actuators.

Bounce varies from unit to unit and is affected by variables such as operating temperature, actuator and/or valve wear, valve stem seal packing friction etc.:

- The higher the operating temperature the higher the bounce
- The longer the stroke the higher the bounce
- The higher the valve friction, the lower the expected bounce

Data provided is specified for a bare actuator only (actuator performance before connecting it to the valve).

Table 2-3. ELA7, ELA13, and ELA53 Actuators Detailed Unpowered Specifications

	ELA7.1	**ELA13.1**	**ELA13.2**	**ELA53.1**	**ELA53.2**
Maximum time to fail-extend	See Table 2-1.				
Expected maximum first bounce[1]	30.5 mm (1.20 in)		25.4 mm (1.00 in)	7.6 mm (0.30 in)	5.0 mm (0.20 in)
Maximum impact load in fail-extend direction (unpowered shut-down)[2,3]	21 kN (4700 lbf)	22 kN (5050 lbf)	18 kN (4050 lbf)	61 kN (13660 lbf)	38 kN (8410 lbf)

[1] Position measured at maximum bounce-back, characteristic point (D), according to Figure 2-2. Specified at maximum operating temperature, when tripped from full 3 in stroke.
[2] This is a maximum impact load (thrust in extended direction) that actuator will exert during “Shutdown Position” or a “Shutdown System” unpowered trip, corresponds to point (C), according to Figure 2-2.

	ELA7.1	ELA13.1	ELA13.2	ELA53.1	ELA53.2

[3] "Shutdown Position" or "Shutdown System" should not be used routinely due to stress on the actuator and/or valve. Make sure that all hardware (including but not limited to valve, valve stem, hardware connecting the actuator to the valve) is rated to withstand the all the loads specified in this Manual.

NOTICE **"Shutdown Position" or "Shutdown System" should not be used routinely due to stress on the actuator and/or valve.**

Force Limiter

Woodward ELA actuation systems offer a force limiter feature that can be enabled during the configuration process. When this option is enabled, the DVP will limit the current provided to the actuator. This functionality allows ELA actuators to be used on less robust metering valves where there is risk of damaging the valve. Force limitation will reduce both maximum transient and maximum steady state current in actuator retracted direction (e.g., normally opening the valve).

NOTICE **Force Limiter feature will not adversely impact the actuator performance in the extending direction (e.g., normally closing the valve). Refer to the figures provided below for details.**

NOTICE **Although Force Limiter functionality may help to protect the metering valve from premature wear or damage (e.g., an unlikely valve stuck scenario), it will also reduce the actuator performance in the retracted direction (normally opening the valve). Setting this limit too low may result in stalling the actuator in the retracted direction or create alarm conditions (such as Position Error) during operation. It is necessary to evaluate the effect of force limiter functionality from the system perspective. This should evaluate force requirements including, but not limited to, load conditions, friction characteristics, and thermal considerations.**

Use Figures 2-3, 2-4, and 2-5 below to help evaluate the effect of Force Limiter functionality on each of the ELA actuator performances against large step demand signal.

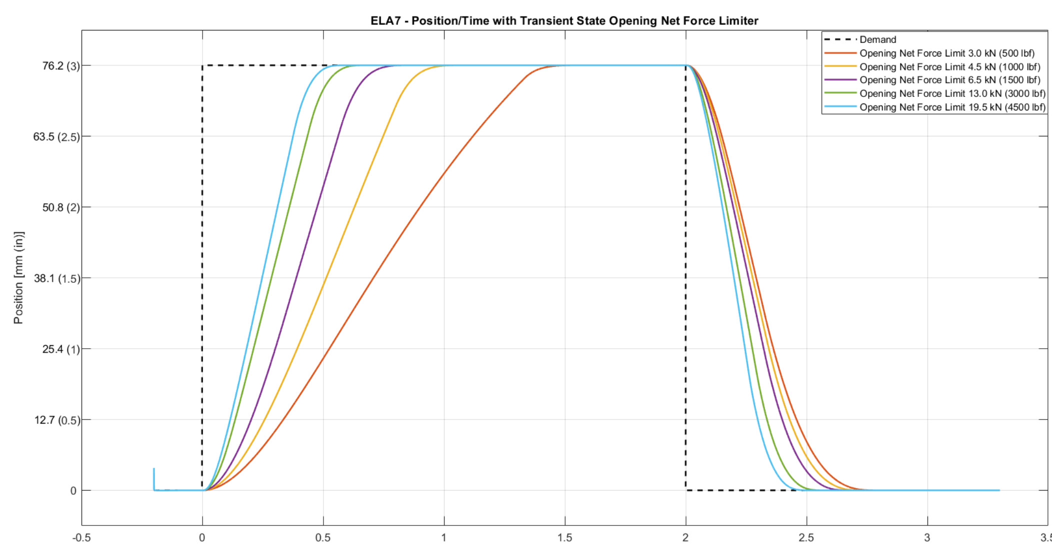


Figure 2-3. ELA7 Force Limiter

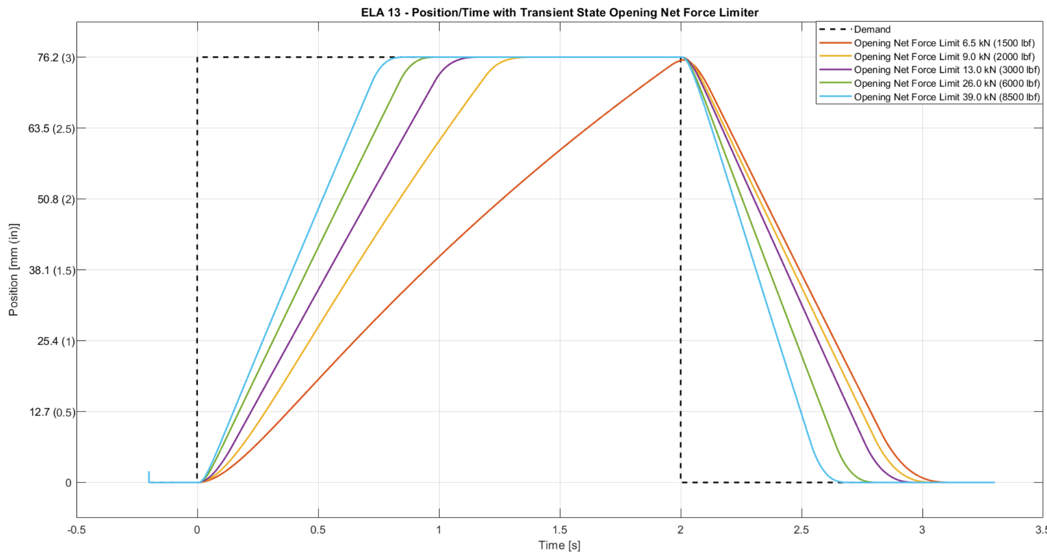


Figure 2-4. ELA13 Force Limiter

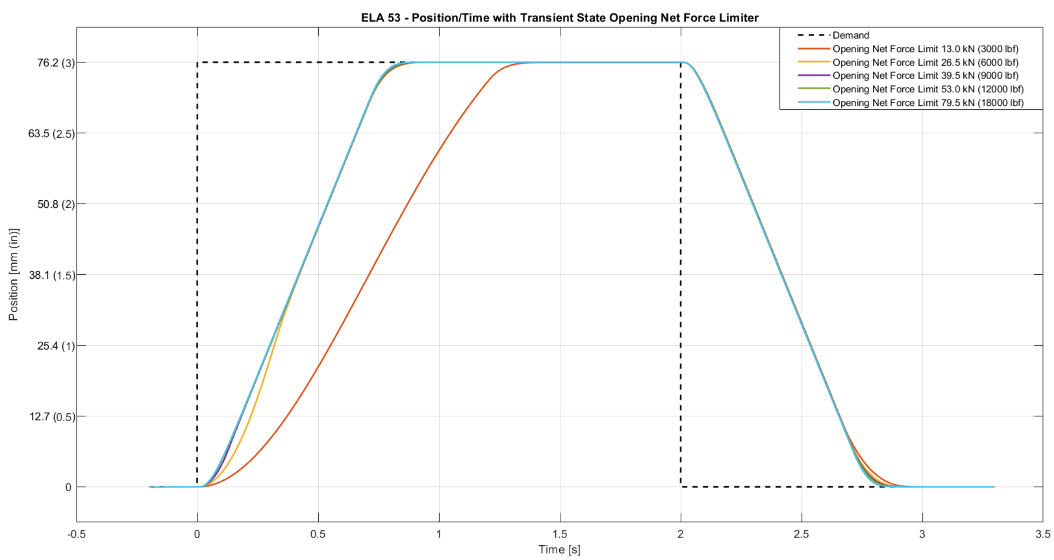


Figure 2-5. ELA53 Force Limiter

Driven Equipment (Valve) Opposing Loads

The ELA actuators described herein are intended for integration with non-Woodward process valves used for controlling the flow of fuels to the combustion system of an industrial or utility gas turbine. Different valves may have varying actuator opposing loads, therefore it is important for the user to conduct a careful analysis of actuator opposing load to ensure it falls within the force capability of the ELA actuators. Exceeding the specified force capability may lead to alarm conditions and/or actuator stall condition.

NOTICE

All opposing loads shall act along the axis of the actuator output shaft. Torsional load and/or torque shall not be transferred through the actuator output shaft into the actuator (there is no external load anti-rotation feature in the design of ELA actuators).

Analysis of actuator opposing force should also include friction force consideration. Friction force of linear valve sealing should not exceed limits specified in Table 2-4.

Table 2-4. ELA7, ELA13 & ELA53 Actuators, Driven Valve Friction Limits

	ELA7	**ELA13**	**ELA53**
Maximum friction force opposing the actuator	667 N (150 lbf)	1334 N (300 lbf)	4003 N (900 lbf)

NOTICE

The friction caused by valve sealing must not exhibit a "slip & stick" action characteristic. If the valve sealing exhibits “slip & stick” characteristic, it may lead to the actuator hunting issue, where the actuator rapidly and repeatedly switches between positions and is unable to maintain a stable position due to sudden friction release.

Chapter 3.
Installation

General

See the outline drawings (Figures 1-2 through 1-5) for:
- Overall dimensions
- Mechanical connections
- Electrical connections
- Lift points and center of gravity

Installation orientation does not affect actuator performance, but a vertical position is generally preferred to conserve floor space as well as ease of making electrical and fuel connections. Actuators can also be installed and operated in the horizontal orientation. Do not install actuators with the gearbox facing downward. The actuators are intended to be installed on an appropriate valve-to-actuator fixture (yoke), using the mounting interface presented in outline drawings only; additional supports are neither needed nor recommended. Do not use this actuator to provide support to any other component in the system. The valve should be aligned and adequately supported such that excessive loads are not transmitted to the actuator. Proper alignment between the actuator and valve is critical to reduce side loads transmitted to the actuator. It is recommended to use a shaft-to-shaft coupling that can absorb any unintended misalignment.

IMPORTANT — **Make sure to satisfy required maintenance clearances, such as required clearance for lubrication syringes, guns, and/or needles.**

⚠CAUTION — **Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the actuators. Noise levels greater than 90 dB are possible.**

⚠WARNING

Hot Surface

The surface of the ELA7, ELA13, and ELA53 actuators (or the valves that are controlled by these actuators) can become hot or cold enough to be a hazard. Use protective gear for product handling in these circumstances. Temperature ratings for the actuators are included in the specification section of this manual and shall be strictly followed.

Under no circumstances should the actuator thermal limitations be exceeded.

NOTICE — **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.**

NOTICE — **Install ELA actuators only in vertical orientation (with gearbox facing in the upward direction as shown in Figures 1-2a and 1-3a) or in the horizontal orientation. Any negative installation angle (gearbox facing downard) is not permitted.**

Required Clearance for Lubrication Kit Syringes and Gun/Needle

For ELA7 & ELA13 grease ports, refer to Figure 3-1. For both ports indicated, leave a minimum of 30.5 cm (12 in) clearance for maintenance access. See manual 35134 for additional lubrication details.

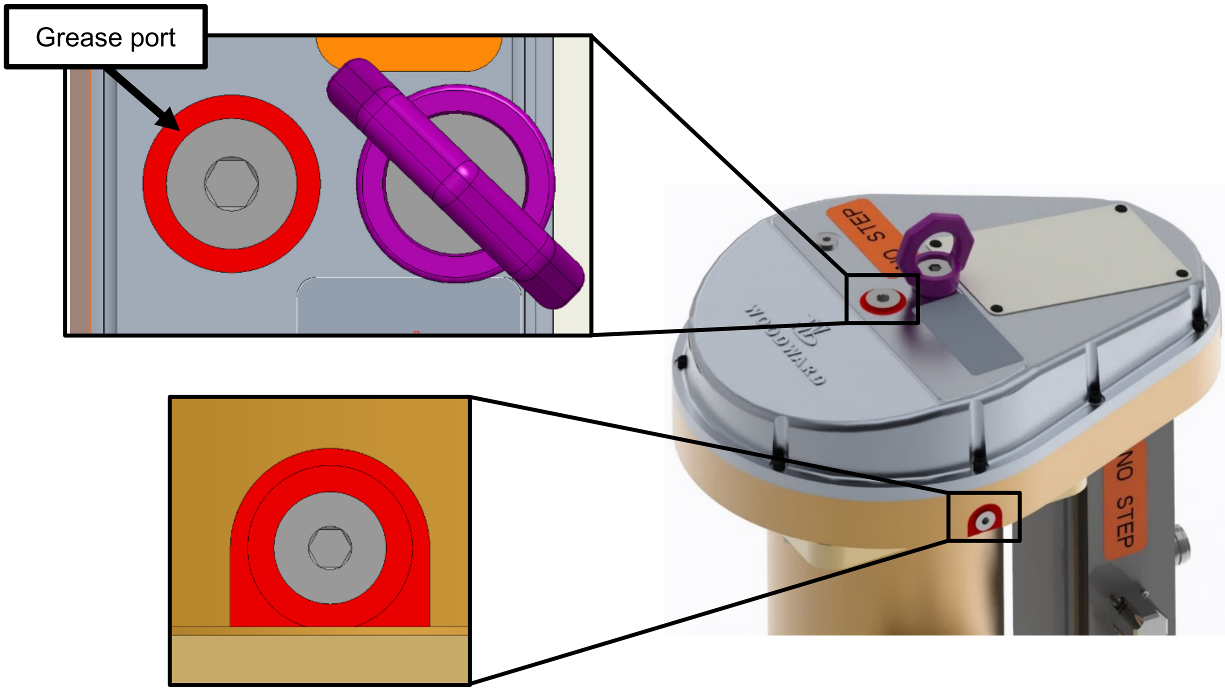


Figure 3-1. Grease Port Locations for ELA7 & ELA13 Actuators

For ELA53 grease ports, refer to Figure 3-2. For grease ports A, B, C, D, E leave a minimum of 30.5 cm (12 in) clearance for maintenance access. See manual 35103 for additional lubrication details.

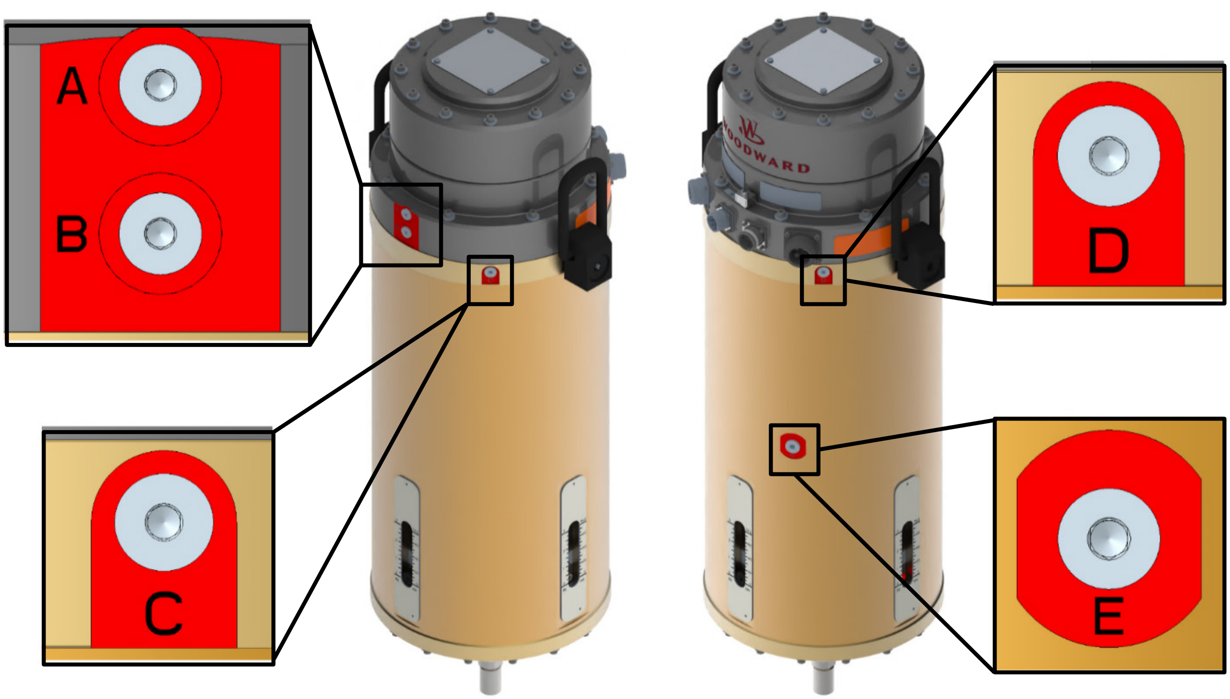


Figure 3-2. Grease Port Locations for ELA53 Actuator

Lifting Procedures

⚠WARNING Crushing Hazard	Carefully review Figures 1-2 and 1-3 and Table 2-1, for lifting locations, weight, and center of gravity before moving the actuators. Do not lift or handle the actuator by electrical connections. The significant weight of the actuators poses a crushing hazard that can result in personal injury or death. - Center of Gravity symbol. Refer to outline drawing for CoG.

⚠CAUTION	The actuators are not designed to be a step or to support the weight of a person.

⚠CAUTION Self-lift Only	Provided lifting eyes are only for self-lifting of the actuators. Under no circumstances should the lifting points of the actuator be used to handle or lift any object or load that is attached to the actuator.

NOTICE	PROTECT ELECTRICAL CONNECTORS. If not properly protected, electrical connector damage can occur during lifting and installation of the actuators.

For lifting ELA7 & ELA13 actuators, use the provided lifting eye that is mounted on the top cover or the gearbox. For lifting ELA53 actuators, use the provided two lifting eyes that are mounted on the sides of the motor. While a single lifting eye can support the weight of the ELA53, Woodward recommends lifting the ELA53 by the two lifting eyes, as shown in Figure 3-3. The maximum lifting strap angle of 15° (shown in Figure 3-3) is to prevent the lifting eyes and straps from rubbing against the motor housing.

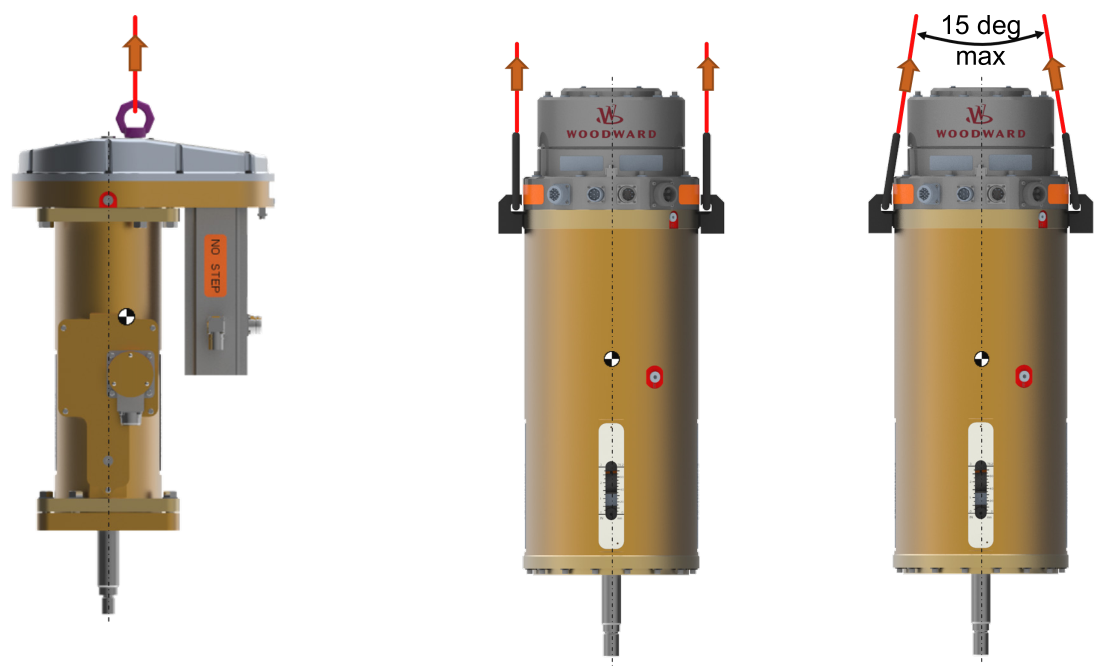


Figure 3-3. Vertical Lifting (ELA7 & ELA13 left, ELA53 right)

When lifting the actuator from a horizontal position and transitioning to a vertical position, use caution to ensure the lifting straps do not contact, and potentially damage, the electrical connectors, position resolver, or motor housing. Also, use caution not to damage the actuator output shaft. When lifting the actuator from the horizontal position, Woodward recommends lifting the actuators as shown in Figure 3-4.

NOTICE	**Lift or handle the actuator in vertical only position by using the eyebolts provided, unless horizontal lift is absolutely required.**

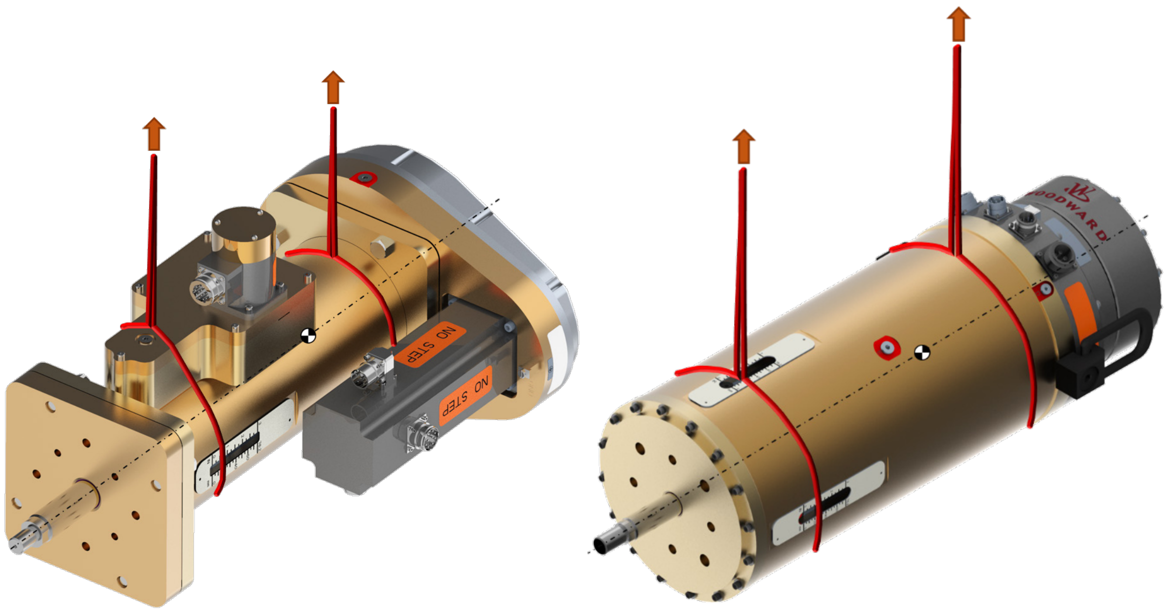


Figure 3-4. Horizontal Lifting (ELA53 right, ELA7 & ELA13 left)

Output Shaft – Mechanical Considerations

The output shaft is used to connect the actuator output shaft to the valve metering stem via appropriate coupling hardware. To prevent loosening due to system vibration, it is also recommended to use a serviceable thread locker compound or other applicable secondary retention method, based on coupling assembly design.

Table 3-1. Output Shaft and Interface Details

Actuator Model	Thread Type	Thread Designation	Maximum Allowable Torque[1, 2] Nm (lb-ft)
ELA7 & ELA13	Male (external thread)	.750-16 UNF-2A	122 (90)
ELA53		1.000-14 UNS-2A	312 (230)

[1] Never exceed the specified maximum torque as it may damage the actuator.

[2] During actuator installation, output shaft must be backed-up by wrench flats to prevent its rotation and potential over torque.

NOTICE	**Ensure that all the linkages and couplings connecting the actuator output shaft to the valve are appropriately sized for expected operational loads.**

NOTICE	**It is recommended not to use a stainless steel coupler at ELA actuator output shaft due to possibility of galling corrosion under high operational loads.**

Interface Plate – Mechanical Considerations

The interface plate is used to connect the actuator to the valve yoke/mounting fixture. Appropriate bolt grade (or studs) shall be used to install the actuator onto the valve interface. The length of the bolts (or studs) shall be sufficient to ensure at least 1.5-times diameter thread engagement into the actuator interface plate when mounted onto the valve yoke. Each actuator interface plate has two different bolting patterns as described on the outline drawings. It is sufficient to use either one of the available patterns. For details on bolting patterns, please refer to the outline drawings.

- Values of torque presented in Table 3.1 are based on fastener material grade equal to international standard ISO Class 8.8. Use only equivalent or higher–grade fasteners.
- Due to excessive force, Woodward recommends using washers under bolt head (or nut).
- To prevent loosening due to system vibration, it is also recommended to use a serviceable thread locker compound or other applicable secondary retention method.

Table 3-2. Interface Plate Fasteners Specifications

ISO 5210 Flange Type	Actuator Model	Thread Type	Number of Bolts/Studs	Internal Thread Designation	Minimum Required Thread Engagement[2] mm (in)	Bolting Torque N·m (lb-in)	Maximum Allowable Torque[1] N·m (lb-in)
"F10"	ELA7 & ELA13	Female (internal thread)	4	M10×1.5-6H	15 (.59)	37 - 41 (28 - 31)	220 (162)
"F12"			4	M12×1.75-6H	18 (.71)	65 - 71 (47 - 52)	385 (284)
"F14"	ELA53		4	M16×2-6H	24 (.94)	162 - 179 (119 - 131)	925 (682)
"F16"			4	M20×2.5-6H	30 (1.18)	316 - 350 (234 - 258)	1865 (1375)

[1] Never exceed the specified maximum torque as it may damage the actuator.

[2] Use fasteners of appropriate length, in accordance with the information provided and the thickness of the utilized valve yoke.

Actuator Integration with Valve

IMPORTANT

Woodward ELA stand-alone actuators are intended to be integrated with valves only by specialized Woodward channel partner personnel, at the channel partner facility.

IMPORTANT

Actuators will remain in an inoperable status before they are fully configured via the ELA Configuration Tool. Unless authorized, ELA actuators are not intended to be calibrated with the valve on-site. The configuration & calibration process will be completed by Woodward Channel Partner technical personnel.

Before installing the actuator, verify that the valve mounting interface dimensions meet the requirements of the outline drawings (Figures 1-2 through 1-3). The actuator should mount onto the interface such that the two can be aligned with only minimal manual pressure. Actuator output shaft shall be carefully aligned with the valve stem. Do not exceed the misalignment specified below as it may result in pre-mature wear of the ELA actuators.

NOTICE

Mechanical devices such as hydraulic or mechanical jacks, pulleys, or similar equipment shall never be used to force the actuator into the alignment with the valve interface and/or valve stem.

- Parallel misalignment between actuator shaft and valve stem not to exceed 1.27 mm (0.05 in)
- Angular misalignment between actuator shaft and valve stem not to exceed 0.35 degree

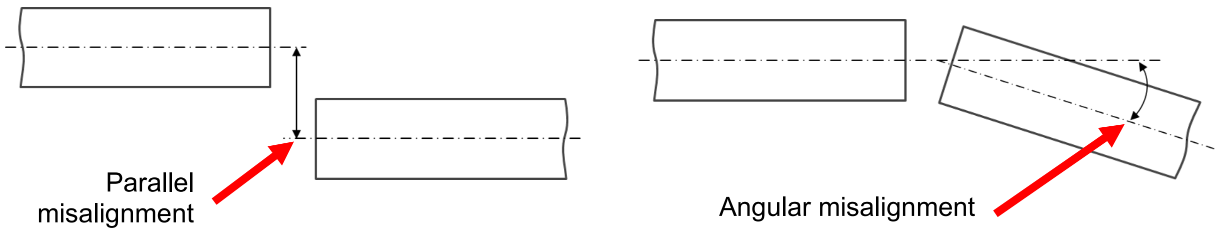


Figure 3-5. Maximum Allowable Misalignment Between Actuator Shaft and Valve Stem
(Figure is exaggerated and not to scale)

In “as shipped” condition, the actuator return spring will be preloaded against the internal-to-actuator mechanical hard-stop. This may be observed on visual indication, as it will indicate position slightly below the “0%” position mark. During actuator-to-valve rigging, it is necessary to preload the actuator return spring against the valve plug/seat according to the procedure below. Two rigging methods are specified and acceptable for use. It is at the discretion of the technical personnel to decide which procedure to use.

IMPORTANT **There is a small amount of adjustment available for the 0% Position location in the ELA Configuration Tool. However, this adjustment is not intended to compensate for incorrect rigging of the valve.**

Rigging Method #1 – Using the shim to preload the return spring

It is recommended to use Woodward rigging tools listed; however custom-made shims are also acceptable, provided the same thickness material is used and the shim is large enough to provide stable and secure support for the actuator during the rigging process.

Table 3-3. Actuator to Valve Rigging Tools Details

Actuator Model	Reference Woodward Tool Item Number	Shim Thickness mm (in)
ELA7 & ELA13	1010-9186	1.85 – 1.96 (0.073 – 0.077)
ELA53	1010-9187	2.44 – 2.64 (0.096 – 0.104)

1. Using an appropriate lifting procedure, lift the ELA actuator carefully into the desired position.
    - Do not remove the lifting aids (slings) until the installation process is completed.
2. Place the appropriate shim on the valve yoke.
3. Land the actuator on the valve yoke, with the shim in between the actuator and the yoke, making sure to align the actuator shaft with the valve stem.
4. Install the interface plate fasteners, but do not tighten yet.
5. Connect the actuator shaft with the valve stem using appropriate hardware.
    - Make sure to follow valve manufacturer recommendations.
    - Back-up the actuator output shaft by the wrench flats to prevent rotation when connecting it to the valve.
    - Make sure to follow all OEM hardware instruction, especially the recommended torque and secondary torque retention. Do not exceed the torque limit specified for the actuator.
6. Lift the actuator slightly off the valve yoke to remove the shim used in step #2.
7. Lower the actuator back onto the yoke and confirm correct alignment.

⚠CAUTION
High Energy Spring

In the next steps, the actuator return spring will be compressed. Proceed with caution through the following steps.

8. Evenly tighten the interface plate fasteners installed in step #4.
9. Torque the interface plate fasteners in the appropriate sequence as per Figure 3-5 to keep the mating interfaces parallel to each other. Please follow the outlined torque method.
   9.1 Torque the interface plate fasteners in a 4-point crossing pattern to half of the required torque per Table 3.1.
   9.2 Repeat the pattern and torque interface plate fasteners to full rated torque per Table 3.1.

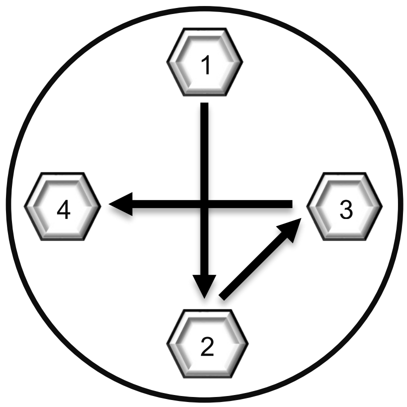


Figure 3-5. Interface Plate Fasteners 4-point Tightening Sequence

10. Verify that actuator was correctly seated onto the valve yoke.
11. Install all remaining retaining hardware needed for completion of your system, such as external stroke indicators/auxiliary sensors etc.
12. Lifting aids (slings) can be removed now.
    - For ease of maintenance later, it is recommended not to remove the lifting eyes.

Rigging Method #2 – Using the threaded coupling to preload the return spring

In this method, the return spring will be preloaded against the valve using the translation of rotary-to-linear movement of threaded coupling. The number of turns required to achieve linear movement must be calculated (e.g., based on the pitch of the valve stem being assembled). Linear movement should be controlled through process and later verified. Mechanical offset must fall within limits per Table 3-4. Note that this method typically requires the coupler assembly to be equipped with a free-to-rotate part.

NOTICE

Do not exceed the mechanical offset specified in Table 3-4. Failure to adhere to limits specified may result in actuator damage.

Table 3-4. Actuator to Valve Rigging, Mechanical Preload Offset (for return spring preload process)

Actuator Model	Offset for Return Spring Preload mm (in)
ELA7 & ELA13	1.85 – 1.96 (0.073 – 0.077)
ELA53	2.44 – 2.64 (0.096 – 0.104)

1. Using an appropriate lifting procedure, lift the ELA actuator carefully into the desired position.
    - Do not remove the lifting aids (slings) until the installation process is completed.
2. Land the actuator on the valve yoke making sure to align the actuator shaft with the valve stem.
3. Install the intended threaded coupler assembly onto the actuator output shaft and valve stem.
    - Make sure that the coupler is fully threaded and torqued onto the output shaft. Do not exceed torque limit specified for the actuator
    - Verify that the actuator was correctly seated onto the valve yoke.
    - Verify that the valve stem/plug is at the desired position.
4. Install the interface plate fasteners. Tighten the interface plate fasteners evenly.
5. Torque the interface plate fasteners in the appropriate sequence as per Figure 3-5 to keep the mating interfaces parallel to each other. Please follow an outlined torque method.
    5.1 Torque the interface plate fasteners in a 4-point crossing pattern to half of the required torque per Table 3.1.
    5.2 Repeat the pattern and torque interface plate fasteners to full rated torque per Table 3.1.

⚠CAUTION High Energy Spring	**In the next steps, the actuator return spring will be compressed. Proceed with caution through the next steps.**

6. Back-up the actuator output shaft by the wrench flats to prevent its rotation when preloading the actuator against the valve.
    - Be sure to follow all OEM hardware instruction, especially the recommended torque and secondary torque retention.
7. Rotate the free-to-rotate part of the coupler assembly to move the actuator output shaft upward. This will preload the return spring.
    - Do not exceed limit specified in Table 3-4.
8. Secure the coupler assembly (e.g., use of counter-nut if suitable).
9. Install all remaining retaining hardware needed for completion of your system, such as external stroke indicators/auxiliary sensors etc.
10. Lifting aids (slings) can be removed now.
    - For ease of maintenance later, it is recommended not to remove the lifting eyes.

NOTICE	**All ELA7, ELA13, and ELA53 actuator units must undergo a calibration & configuration process after being assembled with the valve and before the completed actuator/valve system is operational. Refer to Chapter 3 and the section regarding the ELA Configuration Tool.**

Other Installation Precautions

The valve and the valve inlet/outlet piping may be insulated. If the valve is insulated, the insulation cannot extend beyond the valve body as it would cover part of the actuator. The actuators are not to be insulated, otherwise the actuator components may exceed their rated temperatures.

It is also permissible to leave the valve body un-insulated, provided temperatures stated in the actuator specifications are not exceeded (i.e., the ambient temperature and valve to actuator interface temperature). Please be advised that it is critical to adhere to the provided thermal limits.

⚠CAUTION	**When welding near the ELA, disconnect all cables, and verify the actuator chassis is grounded prior to beginning welding operations.**

NOTICE

If pressure testing is being performed on the valve, the actuator must be connected to the DVP, powered up, and under position control. If the actuator is unpowered during a pressure test, the actuator return spring force alone may be insufficient to prevent the valve from moving open, and potential damage to the actuator could result.

Electrical Connections

⚠WARNING

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

⚠CAUTION

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 1-4 and 1-5).

This product is designed to be used with four dedicated cables that connect the Digital Valve Positioner (DVP) to the ELA actuators. These cables must be used for the system to meet all regulatory requirements for hazardous and ordinary locations, as well as EMC requirements. Please contact Woodward for the appropriate cable configuration.

Refer to the outline drawings (Figures 1-2 through 1-3) for location of grounding lug to properly earth ground the actuators.

Figures 3-9 through 3-14 show drawings of the six typical dedicated cables used to connect the actuator to the DVP driver. The drawings in these figures include wiring diagrams and connector descriptions. Application specific requirements such as termination at the DVP, length, environmental conditions, key orientation, etc., may result in a custom implementation of these cables by the customer.

⚠WARNING

Electrical circular connectors must be properly seated and tightened to provide correct performance, to eliminate potential shock hazard, and to maintain the product IP rating.

NOTICE

For best noise immunity, and to prevent damage to on-board actuator instruments, the motor power cables should be run in separate cable trays or conduits from the motor resolver cables and any other low-level signal cables.

Motor Power Connector

The mating power cable connector shall be installed hand-tight followed by a final torque of 2.5 Nm (22 lb–in) to meet the IP rating.

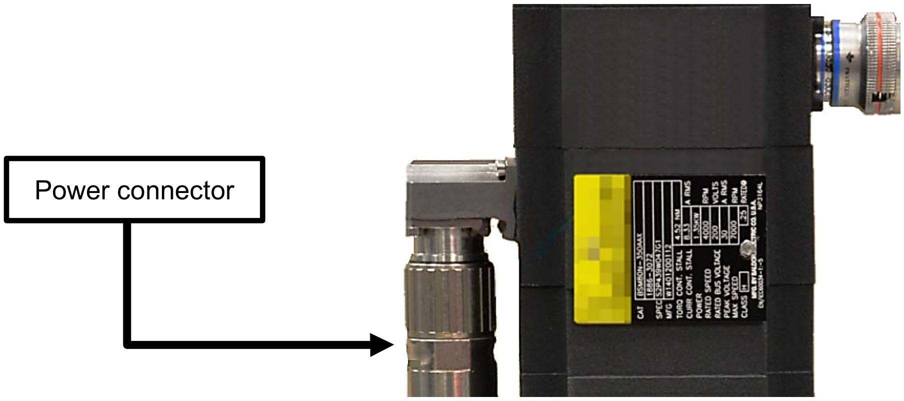


Figure 3-6. Power Connector
Note: Actual connector orientation on motor may appear different than shown.

Connectors for Motor Resolver #1 and Motor Resolver #2 (Redundant)

Install these two mating cable connectors by hand, so that the red line is no longer visible, and the connector cannot be turned any further.

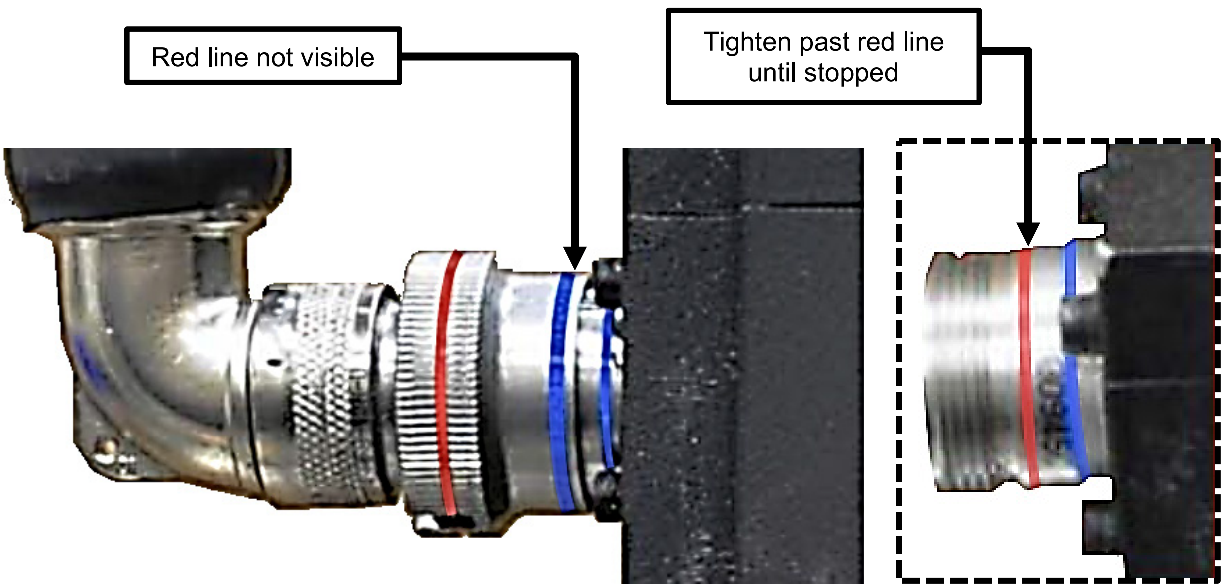


Figure 3-7. Motor Resolver Connectors
Note: Actual connector orientation on motor may appear different than shown.

ID Module/Shaft Feedback Connector

Install the mating cable connector by hand, so that the red line is no longer visible, and the connector cannot be turned any further.

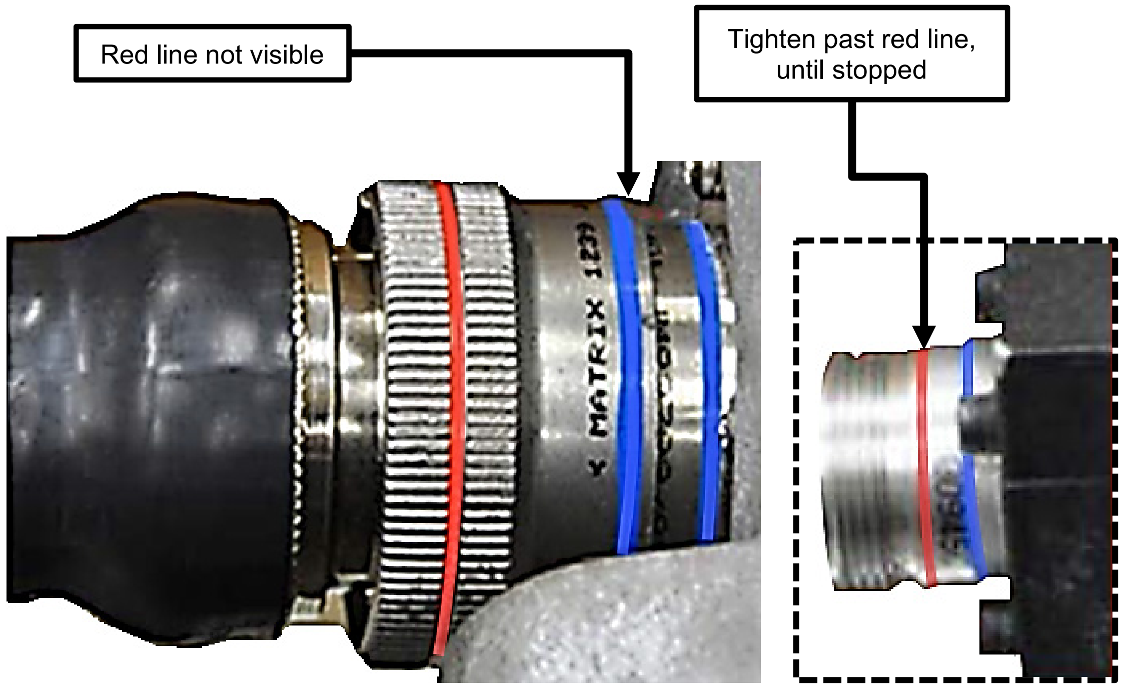


Figure 3-8. ID Module/Shaft Resolver Actuator Connector
Note: Actual connector location on actuator may appear different than that shown.

Typical Electrical Cables

IMPORTANT **Different cable lengths and connectors are available. Contact Woodward for the optimal electrical cable solution for your application.**

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

Contact Woodward for assistance in selection of Electrical Cables to ensure compliance to associated listing requirements.

Table 3-5a. Typical Electrical Cable Length

Length m (ft)	Motor Power ELA7 & ELA13 (5450-1701)	Motor Power ELA53 (5450-1632)	Resolver #1 (5450-1703, 5450-1808)	Resolver #2 (5450-1699, 5450-1813)	ID Module / Shaft Feedback (5450-1810)	Integrated Signal Cable (5450-2093)
3.05 (10)						Y
4.57 (15)	Y	Y	Y	Y	Y	Y
6.1 (20)	Y	Y	Y	Y	Y	Y
7.62 (25)	Y	Y	Y	Y	Y	Y
9.14 (30)	Y	Y	Y	Y	Y	Y
10.67 (35)	Y	Y	Y	Y	Y	Y
12.19 (40)	Y	Y	Y	Y	Y	Y
13.72 (45)	Y	Y	Y	Y	Y	Y
15.24 (50)	Y	Y	Y	Y	Y	Y
16.76 (55)	Y	Y	Y	Y	Y	Y
18.29 (60)	Y	Y	Y	Y	Y	Y
19.81 (65)	Y	Y	Y	Y	Y	Y
21.34 (70)	Y	Y	Y	Y	Y	Y
22.86 (75)	Y	Y	Y	Y	Y	Y
24.38 (80)	Y	Y	Y	Y	Y	Y
25.91 (85)	Y	Y	Y	Y	Y	Y
27.43 (90)	Y	Y	Y	Y	Y	Y
28.96 (95)	Y	Y	Y	Y	Y	Y
30.48 (100)	Y	Y	Y	Y	Y	Y
32 (105)	Y	Y	Y	Y	Y	Y
33.53 (110)	Y	Y	Y	Y	Y	Y
35.05 (115)	Y	Y	Y	Y	Y	Y
36.58 (120)	Y	Y	Y	Y	Y	Y
38.1 (125)	Y	Y	Y	Y	Y	Y
39.62 (130)	Y	Y	Y	Y	Y	Y
41.15 (135)	Y	Y	Y	Y	Y	Y
42.67 (140)	Y	Y	Y	Y	Y	Y
44.2 (145)	Y	Y	Y	Y	Y	Y
45.72 (150)	Y	Y	Y	Y	Y	Y
47.24 (155)	Y	Y	Y	Y	Y	Y
48.77 (160)	Y	Y	Y	Y	Y	Y
50.29 (165)	Y	Y	Y	Y	Y	Y
51.82 (170)	Y	Y	Y	Y	Y	Y
53.34 (175)	Y	Y	Y	Y	Y	Y
54.86 (180)	Y	Y	Y	Y	Y	Y
56.39 (185)	Y	Y	Y	Y	Y	Y
57.91 (190)	Y	Y	Y	Y	Y	Y
59.44 (195)	Y	Y	Y	Y	Y	Y
60.96 (200)	Y	Y	Y	Y	Y	Y
62.48 (205)	Y	Y	Y	Y	Y	Y
64.01 (210)	Y	Y	Y	Y	Y	Y

Table 3-5b. Typical Electrical Cable Length (continued)

Length m (ft)		Motor Power ELA7 & ELA13 (5450-1701)	Motor Power ELA53 (5450-1632)	Resolver #1 (5450-1703, 5450-1808)	Resolver #2 (5450-1699, 5450-1813)	ID Module / Shaft Feedback (5450-1810)	Integrated Signal Cable (5450-2093)
65.53	(215)	Y	Y	Y	Y	Y	Y
67.06	(220)	Y	Y	Y	Y	Y	Y
68.58	(225)	Y	Y	Y	Y	Y	Y
70.1	(230)	Y	Y	Y	Y	Y	Y
71.63	(235)	Y	Y	Y	Y	Y	Y
73.15	(240)	Y	Y	Y	Y	Y	Y
74.68	(245)	Y	Y	Y	Y	Y	
76.2	(250)	Y	Y	Y	Y	Y	
77.72	(255)	Y	Y	Y	Y	Y	
79.25	(260)	Y	Y	Y	Y	Y	
80.77	(265)	Y	Y	Y	Y	Y	
82.3	(270)	Y	Y	Y	Y	Y	
83.82	(275)	Y	Y	Y	Y	Y	
85.34	(280)	Y	Y	Y	Y	Y	
86.87	(285)	Y	Y	Y	Y	Y	
88.39	(290)	Y	Y	Y	Y	Y	
89.92	(295)	Y	Y	Y	Y	Y	
91.44	(300)	Y	Y	Y	Y	Y	
92.96	(305)	Y	Y	Y	Y	Y	
94.49	(310)	Y	Y	Y	Y	Y	
96.01	(315)	Y	Y	Y	Y	Y	
97.54	(320)	Y	Y	Y	Y	Y	
99.06	(325)	Y	Y	Y	Y	Y	

“Y” symbol indicates that the specific cable length should be available. Please, contact Woodward for availability details before placing the order.

For ordering purposes please use the Electrical Cable part number with the required cable length, for example 5450-1701.xx, where .xx is the length in feet.

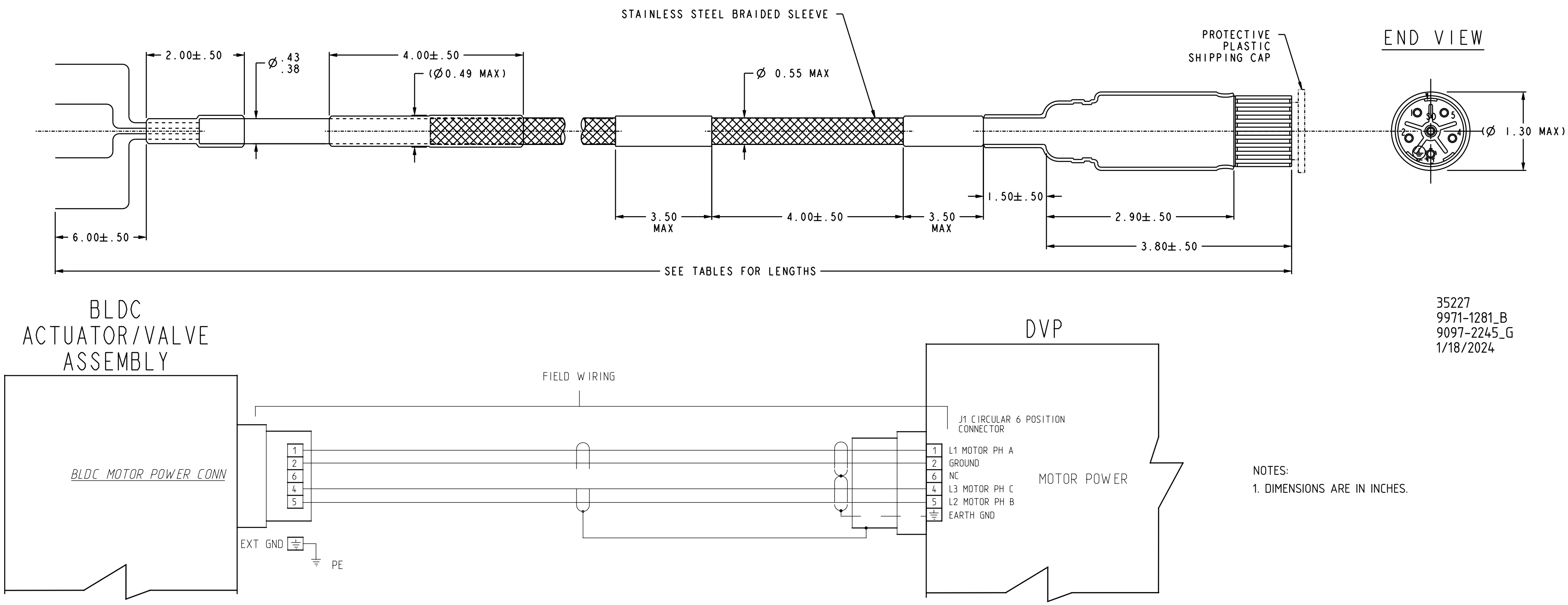


Figure 3-9. Cable, 6-Pin Motor Power
Straight Connector at Actuator to Flying Leads at DVP J1 Connector, for ELA7, ELA13 with DVP5000

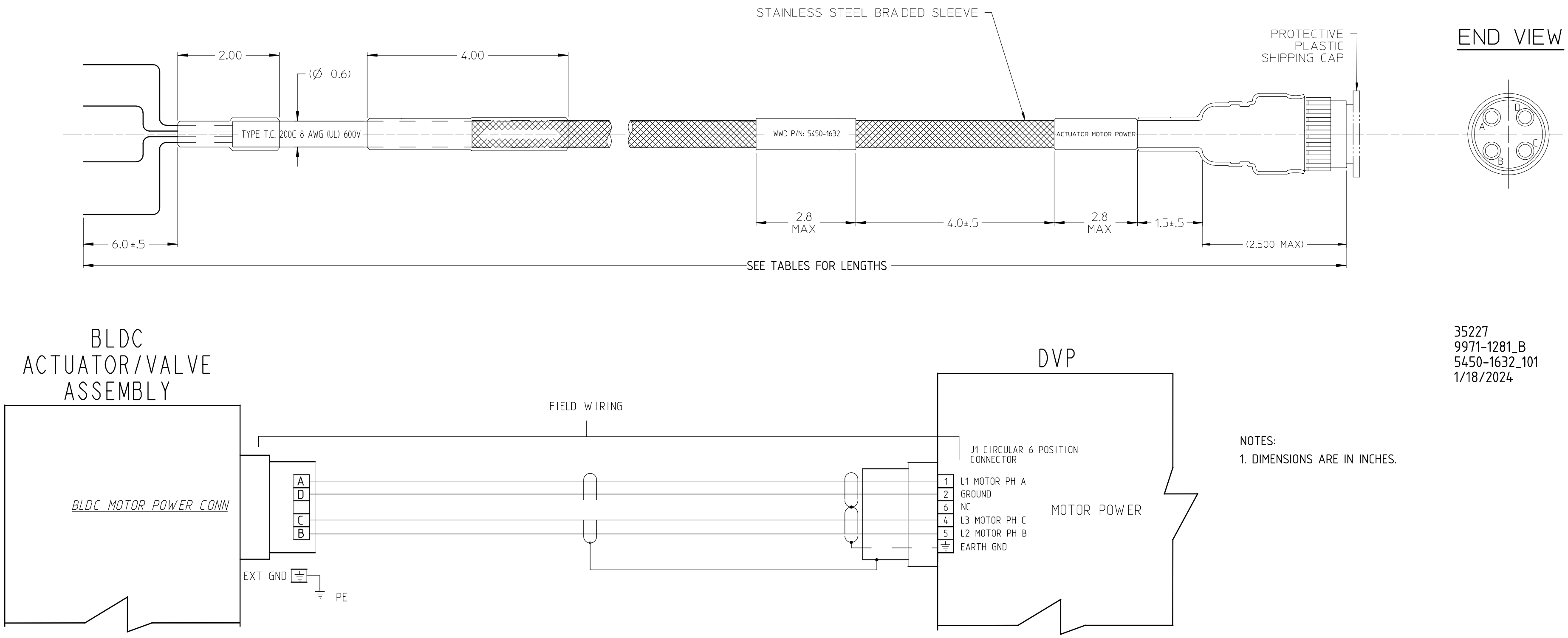


Figure 3-10. Cable, 4-Pin Motor Power
Straight Connector at Actuator and Flying Leads at DVP J1 Connector, for ELA53 with DVP12000

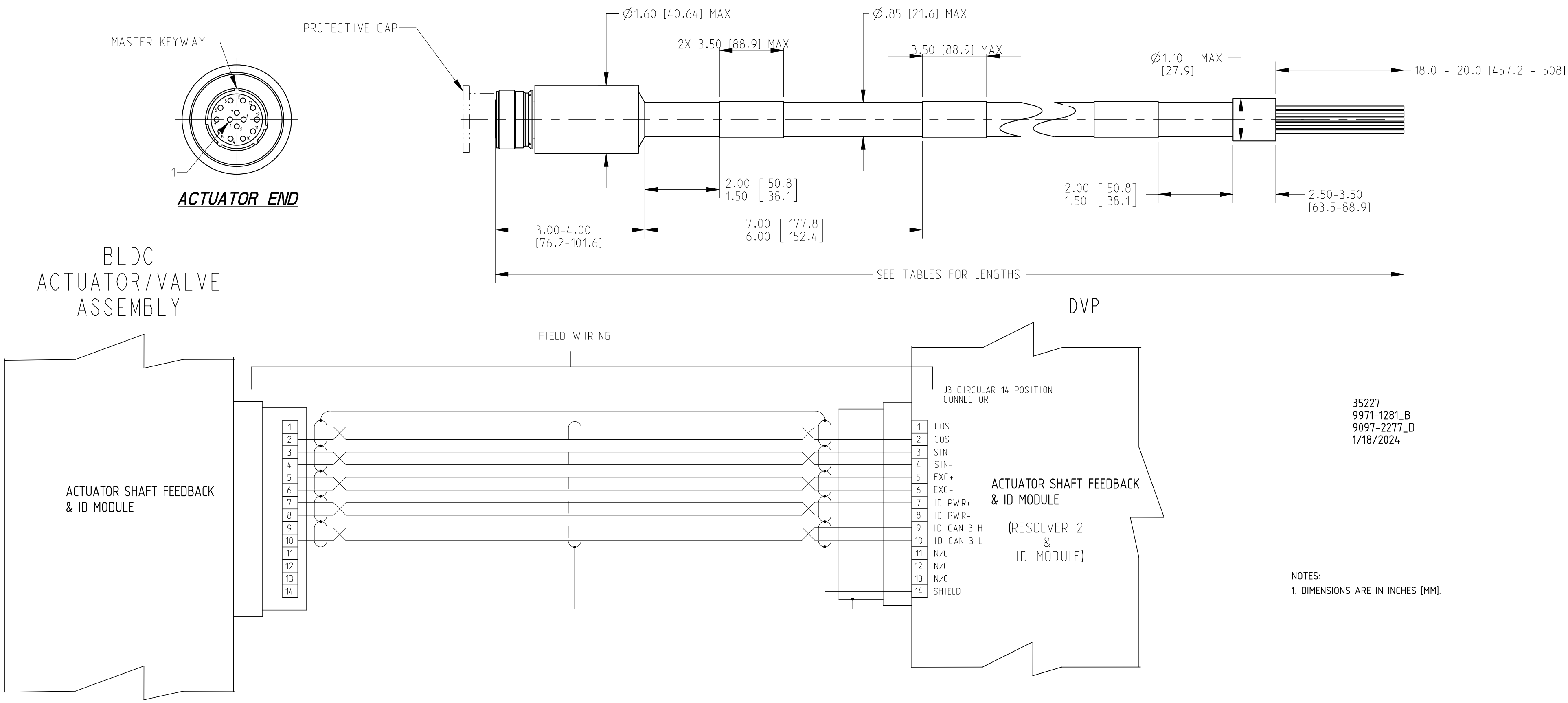


Figure 3-11. Cable, 14-Pin Actuator Shaft Feedback & ID Module
Straight Connector at Actuator and Flying Leads at DVP J3 Connector, for DVP5000 & DVP12000

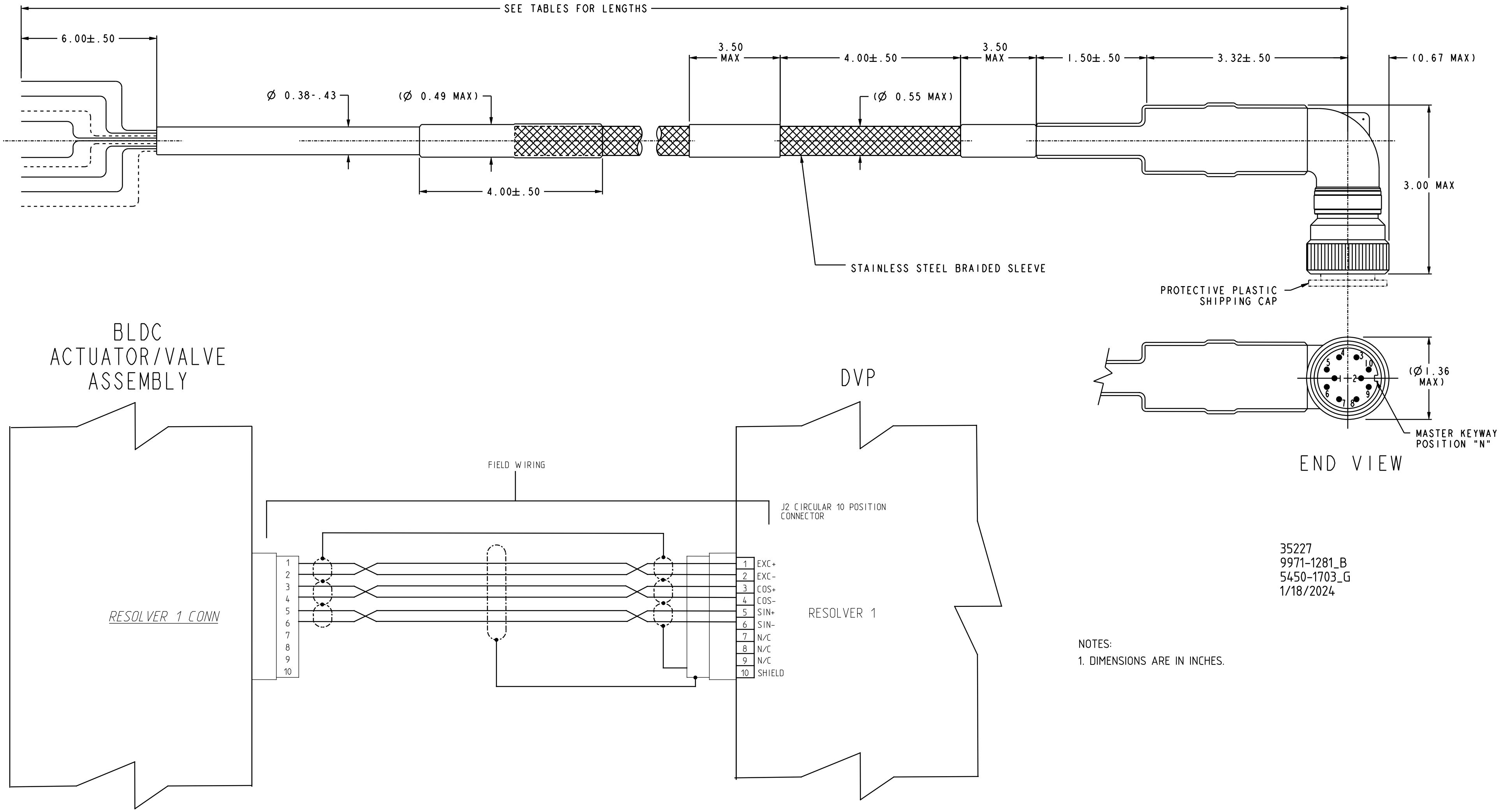


Figure 3-12. Cable, 10-Pin Actuator Motor Resolver #1
Right Angle Connector at Actuator and Flying Leads at DVP J2 Connector, for DVP5000

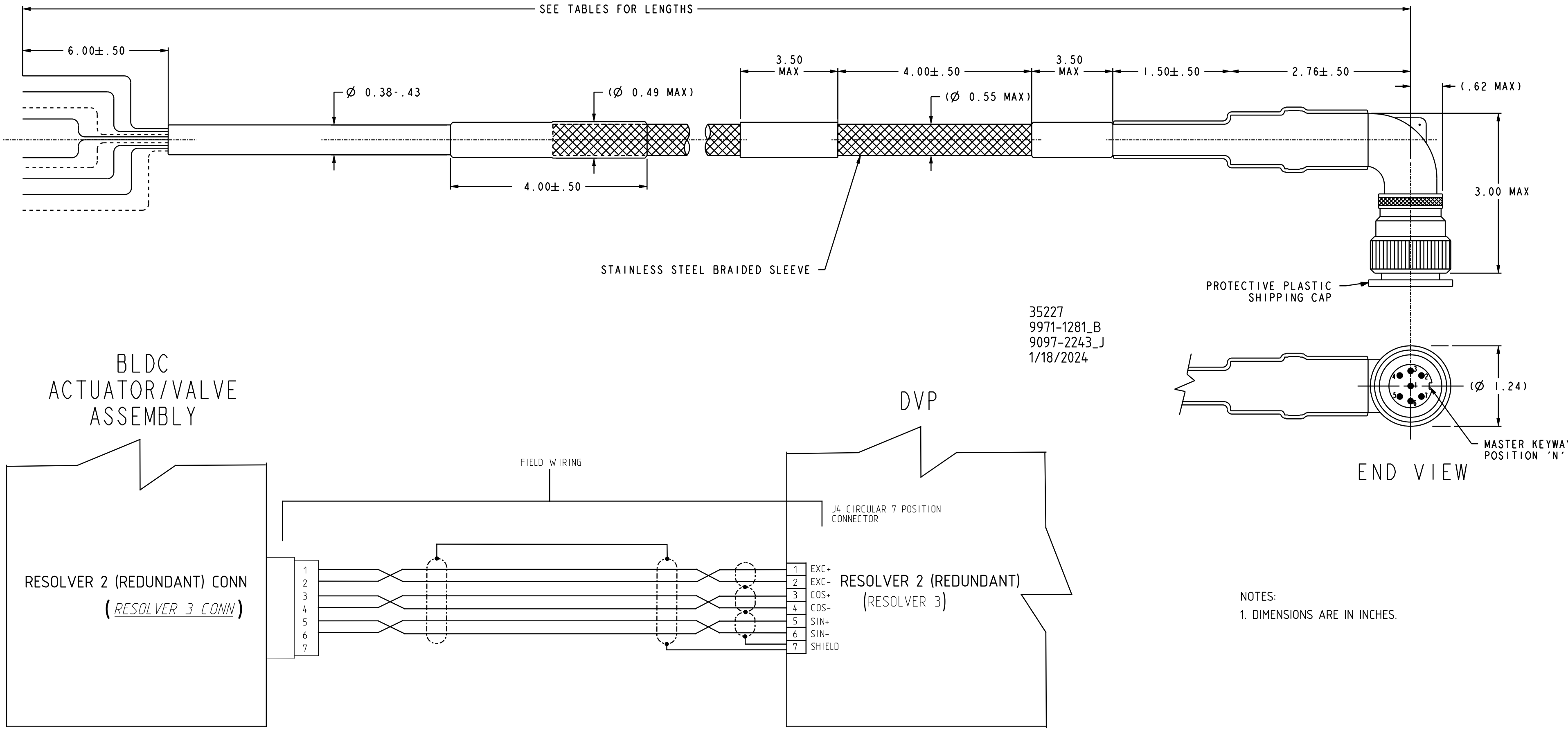


Figure 3-13. Cable, 7-Pin Actuator Motor Resolver #2 (Redundant)
Right Angle Connector at Actuator and Flying Leads at DVP J4 Connector, for DVP5000

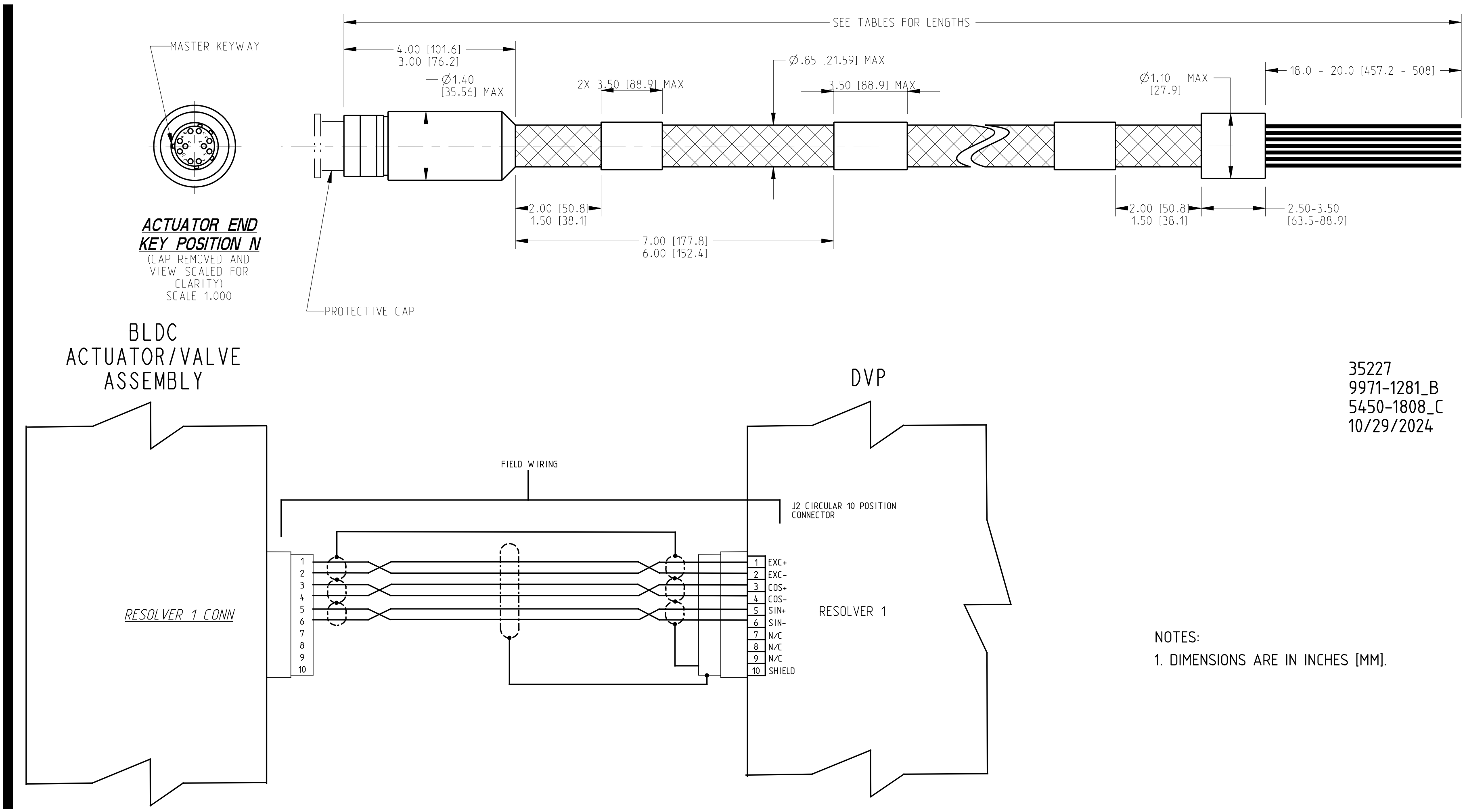
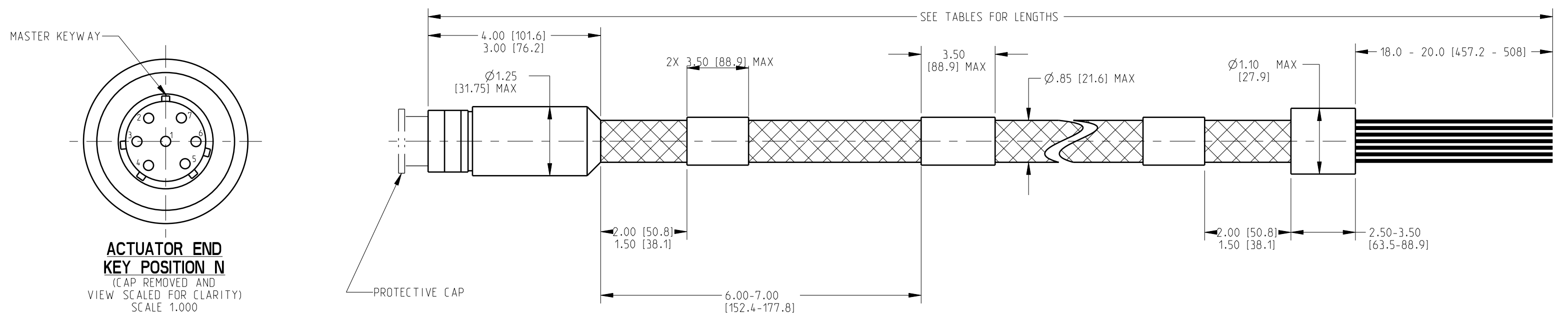
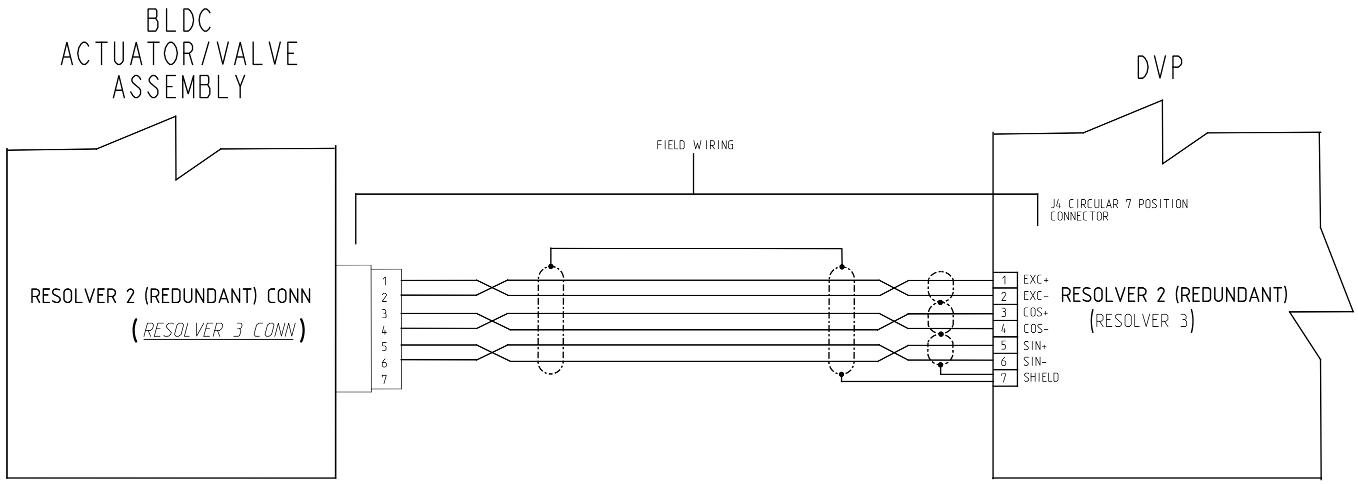


Figure 3-14. Cable, 10-Pin Actuator Motor Resolver #1
Straight Connector at Actuator and Flying Leads at DVP J2 connector, for DVP12000





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10/29/2024

NOTES:
1. DIMENSIONS ARE IN INCHES [MM].

Figure 3-15. Cable, 7-Pin Actuator Motor Resolver #2 (Redundant)
Straight Connector at Actuator and Flying Leads at DVP J4 connector, for DVP12000

Integrated Signal Cable

Woodward also offers a series of cables that combine all necessary Motor Resolver #1 + Motor Resolver #2 (Redundant) + ID Module/Shaft Feedback signal cables into a single, integrated signal cable assembly.

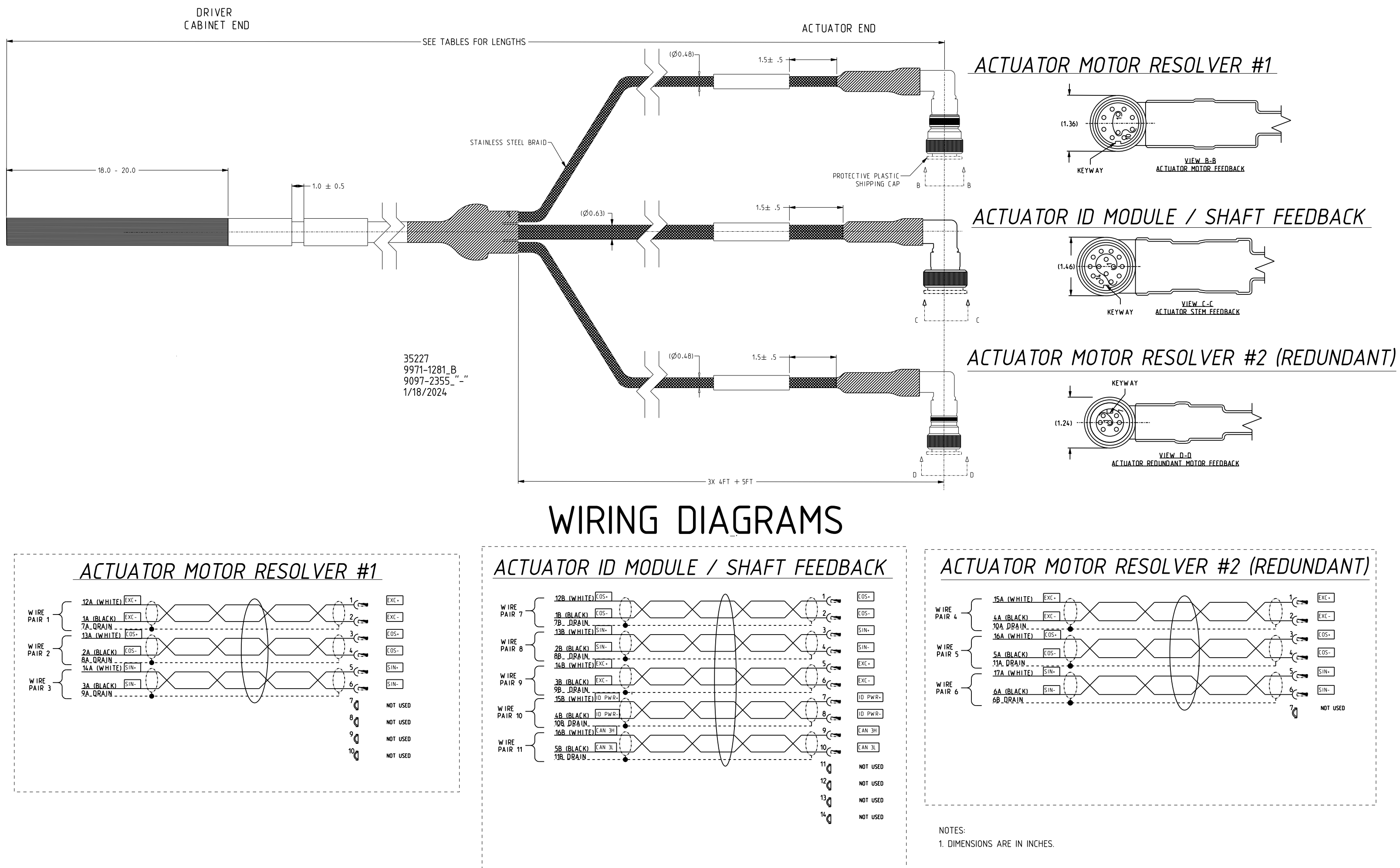

Figure 3-16. Integrated Signal Cable
Motor Resolver #1 + Motor Resolver #2 (Redundant) + ID Module/Shaft Feedback, ×3 Right Angle Connectors at Actuator and Flying leads at DVP, for DVP5000 & DVP12000

Valve/Actuator Configuration Settings

ELA actuators are shipped from Woodward's factory in an "un-configured status". This setting will be stored in the actuator ID Module. This setting will cause the DVP software to not allow normal operation (driver will force Shutdown Position/Alarm based on DVP settings) until the "un-configured status" is cleared by completing all configuration steps via the ELA Configuration Tool.

NOTICE	**Actuators will remain in an inoperable status before they are completely calibrated & configured using the ELA Configuration Tool.**

IMPORTANT	**Failures during configuration will require restarting the ELA Configuration Tool and repeating some/all configuration steps.**

NOTICE	**It is recommended that the DVP driver be configured with the Configuration Process error setting enabled and set as a Shutdown. This allows the DVP driver to avoid operating an actuator which has not yet been configured.**

The ELA utilizes a device (ID Module) which contains all the configuration and factory-set calibration information that is read by the Digital Valve Positioner (DVP) when the actuator is connected and powered up. Initial configuration settings for the actuator do not need to be entered into the DVP due to the ID Module communicating directly with the positioner. However, in the unlikely event that the configuration settings must be entered manually, the following tables outline the necessary configuration settings for the ELA. These configuration settings are distributed into three groups: Customer/User Configuration Parameters, Valve Part Number Specific Parameters, and Valve Serial Number Specific Parameters. Some of the configuration settings include factory calibration information. Please contact Woodward and/or the Channel Partner with the actuator part number and serial number for the data containing the specific calibration and configuration settings if the need arises. Many of these parameters are accessible via the Woodward Service Tool.

Customer/User Configuration Parameters

The User Configuration Parameters are used in the DVP to define the interface between the DVP and the turbine control system. Examples of these include the demand type selection, analog input scaling, discrete input, and output configurations, etc. For a complete description of all the options for the Customer/User Configuration Parameters, please see the DVP product manual.

Serial Number Specific Parameters

Each actuator, regardless of valve type or part number, will have a set of unique settings corresponding to the calibration process done on each unit at the factory or Channel Partner. Some of these values are to be overwritten via the ELA Configuration Tool in the next step.

ELA Configuration Tool

All the ELA7, ELA13 and ELA53 actuator units must undergo a calibration & configuration process after being assembled with the valve. This "ELA Configuration" software will guide the operator through entire process of calibration after the ELA actuator is mechanically assembled with the valve. Refer to ELA Configuration Tool Manual 35228.

⚠WARNING	**The actuator will move during the calibration process. Ensure the actuator and/or the valve are clear during the calibration process.**

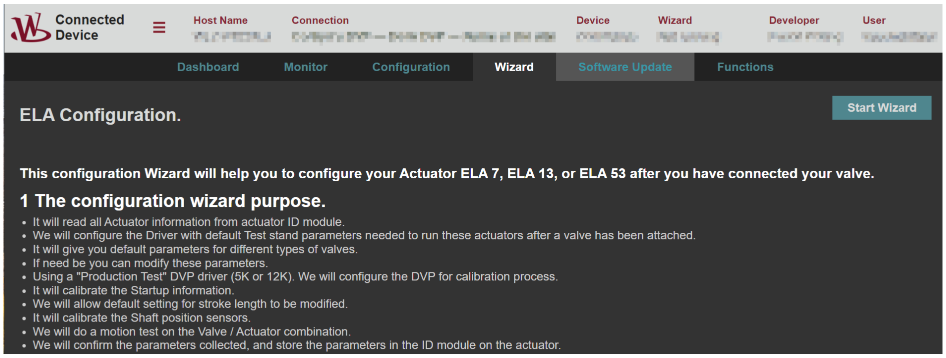

Figure 3-17. ELA Configuration Tool Screen

The ELA Configuration Tool will go through a total of 12 semi-automated steps to correctly calibrate the actuators. A brief description of each step is provided below. Note that the user of the Configuration Tool is referred to as “operator”.

⚠CAUTION	**Before commencing the configuration process, ensure that the valve is operational and that all the hardware coupling the ELA actuator to the valve have been correctly installed.**

IMPORTANT	**Refer to the ELA Configuration Tool Manual 35228 or the Configuration Tool online help for more information on details of each configuration step.**

⚠WARNING **Moving Parts** **High Energy Spring**	**During the calibration process, the actuator will actively move through the full stroke range.** **The return spring operation will be tested.** **Stay clear from the operating actuator and valve assembly as it may cause severe bodily harm.**

Step #1: Introduction
Introduction screen. Operator will be prompted to set DVP driver voltage.

Step #2: Retrieve Settings
The ELA Configuration Tool will load default parameters set to the DVP and retrieve settings from ELA actuator ID Module. Default parameters set will be loaded into the DVP. This step will also perform a basic check on the BLDC motor wiring connection, including but not limited to, ensuring that motor resolvers #1 and #2 are not swapped, and motor resolver gains are within expected threshold.

Step #3: General Settings
The operator will be able to set a series of general settings such as position error settings, delay for relubrication intervals, noise filtering, bandwidth settings, and more.

Step #4: Specific Settings

The operator will be able to set a series of specific settings including:

- Force Limiter setting – used to limit the maximum transient current the actuator will drive with. This is recommended for less robust valves, to protect the valve and/or linkage from mechanical overstress.
- Zero Cut-off setting – mode can be enabled or disabled. Additionally, the operator may activate "Current Controlled Zero Cut-off" mode, which can be used to increase actuator thrust in down (extended) direction. "Current Controlled Zero Cut-off" is normally used for valves that require greater than usual thrust-down to achieve required seat leakage.

IMPORTANT	For details on the settings, please refer to DVP Manual 26773.

Step #5: Parameters to DVP

ELA Configuration Tool will commit initial parameters to the DVP.

Step #6: Startup Checks

The actuator will perform a series of autonomous startup checks. Current draw will be analyzed and verified in actuator retracted and extended (normally valve open and closed) directions. The Configuration Tool will establish the reference point for the Minimum Direction Startup Check and Maximum Direction Startup Check by measuring each during the Startup Checks screen. The operator can override the default settings for the individual thresholds below and above these reference points (subject to the limitation of a maximum range of ½ revolution of the motor for the motor checks). Determining the proper settings may require analysis or empirical testing of how much variation is expected for system startup conditions relative to conditions when the actuator is configured.

NOTICE	**Startup check ranges are limited to a maximum of ½ revolution of the motor. The settings used must be evaluated to ensure they cover the required operating conditions during the startup checks.**

Table 3-6. Adjustable Range of the Startup Check Windows

Actuator Model	Maximum Linear Distance of Motor Startup Check Window[1] mm (in)
ELA7	2.000 (0.07874)
ELA13	1.000 (0.03937)
ELA53	1.634 (0.06436)

[1] Maximum limit specified is defined by the mechanical design and is not adjustable.

NOTICE	**It is the user's responsibility to evaluate their system to ensure specified maximum linear distance for motor startup check window is not exceeded for the required startup conditions. This should include variation according to thermal characteristics of the system, any applicable environmental conditions during the startup checks, and potential mechanical wear over time.**

Step #7: Stroke Length

The operator will be able to set the desired stroke length, based on the operational needs of the valve. Stroke length set in this step will be considered a 100% position for the actuator, e.g., actuator is fully retracted (normally valve fully open).

IMPORTANT **Minimum stroke length setting allowed = 12.70 mm (0.5 in)**
Maximum stroke length setting allowed = 76.20 mm (3.0 in)

Step #8: Shaft Calibration

Actuator feedback will be calibrated to the newly set 100% position, based on the setting of stroke length made in Step #7. Actuator will perform a series of movements to calibrate a secondary shaft position feedback.

Step #9: Motion Testing

The DVP will command the actuator to move according to a series of step and ramp demand profiles. During this step, the actuator will perform an unpowered shutdown (trip) to verify the return spring is working correctly. During the tests, the DVP will collect data which may be later analyzed by the operator to ensure that actuator operates in the required performance threshold.

Step #10: Confirming Settings

A summary of all the acquired parameters will be displayed. The operator will be prompted to review them and verify the settings. Ensure that the set parameters are correct for your application. Settings will be committed to the actuator ID Module upon the operator's confirmation.

Step #11: Report Out

A report will be generated containing a summary of all the configuration and calibration values. Report can be also downloaded in a .pdf format file.

IMPORTANT **It is highly recommended to store and archive all calibration reports for later retrieval.**

Step #12: Power Down

The actuator will be powered down to finish the calibration process. The ELA Configuration Tool will disconnect from the DVP and exit the configuration software.

Installation and Application Pre–Start Checks

Every ELA installation should include, as a minimum, the recommended checks outlined in the table below.

⚠WARNING **All prime mover OEM recommendations and all required plant safety checks must always be followed and supersede any recommended actions outlined in this manual. It is the responsibility of the end user to ensure all procedures are carried out in a safe manner.**

⚠WARNING **Never put your hands into the actuator, between the actuator and the valve or inside the valve housing. There are components moving with high velocity, tight clearances, and large closing forces which can cause serious bodily harm.**

Valve position should only be verified by using the visual position indicator on the side of the actuator. Never put your hands inside the valve to measure/verify its position.

Table 3-7a. Commissioning Procedure

Recommended Commissioning Procedures, ELA	
Commissioning Phase: Installation (Before fuel or power is applied to the system)	
Wiring	Connectors Shielding Point to point verification Wire rating / gage / type Wire routing / length Power source – voltage / current Power redundancy Hazardous Location compliance CAN termination applied correctly
Physical / Mechanical Installation	Flush system prior to installation of control valve Actuator and DVP mounting – torque Valve and pipe sizes Pump flow rate / pressure If applicable, complete correct connection of OBVD Piping connections / loads Flange bolt torques and seals Verify product rating (Pressure, Environment, Listings) Verify if there is no piping obstruction
Turbine Control Integration	Verify independent overspeed system
Commissioning Phase: Pre–operational Checks (Before applying fuel to system)	
Wiring	Connectors Shielding Point to point verification Wire rating / gauge / type Wire routing / length Power source – voltage / current Power redundancy Hazardous Location compliance CAN termination applied correctly
Physical / Mechanical Installation	Verify fuel compatibility / quality
Turbine Control Integration	Configure DVP for control system Verify communications Verify fault and diagnostic behavior (trip setting) Demand and feedback loop check 0–100% Visual check of correct valve movement Verify internal shutdown operation and annunciation Verify independent shutdown function and annunciation Recommended demand is 0% at shutdown Verify low demand signal noise Verify voltage at DVP within limits during full valve step Verify shutdown from safety system including overspeed Document and archive DVP configuration settings

Table 3-7b. Commissioning Procedure (continued)

Commissioning Phase: Pre–start (Before turbine light-off)	
Wiring	Connectors Shielding Point to point verification Wire rating / gauge / type Wire routing / length Power source – voltage / current Power redundancy Hazardous Location compliance CAN termination applied correctly
Physical / Mechanical Installation	Verify no leaks
Turbine Control Integration	Wet motor test recommended Verify purge sequence operation Flow rate verification (manifold pressure) Verify internal shutdown operation and annunciation Verify independent shutdown function and annunciation Verify shutdown from safety system including overspeed
Commissioning Phase: Operational	
Wiring	
Physical / Mechanical Installation	Verify operating temperatures, at actuator and at DVP
Turbine Control Integration	Verify fuel flow stability (manifold pressure) Flow rate verification (manifold pressure and/or flow meter) Verify transient performance Verify low demand signal noise Verify fuel schedule and emissions compliance

Chapter 4.
Maintenance and Hardware Replacement

Maintenance

ELA actuators are not designed with field-replaceable components. Contact the Woodward Channel Partner (primary contact) or Woodward (secondary contact) for assistance in the event there is a problem requiring service or replacement.

The only maintenance required for ELA actuators is lubricating the ball/roller screw every 12 months. For ELA7 and ELA13, refer to manual 35134. For ELA53, refer to manual 35103.

Hardware Replacement

⚠WARNING	**EXPLOSION HAZARD—Substitution of components may impair suitability for Class I, Division 2, or Zone 2.**

⚠WARNING	**To prevent possible serious personal injury, or damage to equipment, be sure all electric power, hydraulic pressure, and gas pressure have been removed from the valve and actuator before beginning any maintenance or repairs.**

⚠WARNING	**Lift or handle the actuator only by using the eyebolts unless horizontal lift is absolutely required.**

⚠WARNING	**Due to typical noise levels in turbine environments, hearing protection should be worn when working on or around the ELA. Noise levels greater than 90 dB are possible.**

⚠WARNING	**The surface of this product can become hot 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.**

⚠WARNING	**All ELA actuators contain a mechanical spring under load. Do not disassemble, as this spring can cause severe bodily harm.**

Preservation and Storage

Woodward products are packaged and shipped to the most stringent industry standards for international shipments. In most cases, Woodward products are constructed with stainless steel and other corrosion resistance materials. Products not manufactured from these materials are provided with a corrosion inhibiting coating to best protect the item under normal conditions.

To maintain the Woodward warranty, items must be stored in a clean, dry environment free of ingress from any foreign debris (including animals, insects, and other organic materials). The preferred method of storage is to keep the product in the “as shipped” containers until the product is installed per the O&M manual. If this is not possible, each product is shipped with covers to prevent ingress of normal materials to the internals of the product. These shipping covers must not be removed until the product is installed per the O&M manual.

Products for the intended use of containing pressurized fluid of any kind will contain various styles of seals. After extended periods of storage (greater than 12 months), these seals can experience compression setting and may allow leakage during the initial use of the product.

Prior to use, Woodward recommends that the product be pressurized and manually stroked over its full stroke for at least five minutes or 100 cycles, whichever occurs first. This cycling will enable the seals to regain their preferred shape and provide optimal sealing for the remainder of the product life.

Products that include electronic components (internal driver or other circuit boards) should be powered at least once every six months. This process will ensure the integrity of the electrical components for the remainder of the product life.

Following these general recommendations will allow Woodward products to be stored for long periods of time without degradation to the product performance. Please contact a Woodward representative for more detailed information or for questions based upon specific field conditions. When storing beyond three years, it is recommended to return the product to the factory for recertification as seals can experience compression setting.

Long-Term Storage Requirements

Units that will not be put into service within 12 months should be packaged for long-term storage as described in Woodward manual 25075, Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls. Note that ELAs are fully electric devices and therfore do not require the oil flushing procedure as described in manual 25075.

IMPORTANT	**For optimum performance of the units that were stored long-term, Woodward recommends performing the ball/roller screw lubrication procedures once the units are ready to be installed (see Chapter 4).**

Chapter 5.
Troubleshooting

Faults in the fuel control or governing system are often associated with speed variations of the prime mover, but such speed variations do not always indicate fuel control or governing system faults. Therefore, when improper speed variations occur, check all components, including the engine or turbine, for proper operation. Refer to the applicable electronic control manuals for assistance in isolating the trouble. The following steps describe troubleshooting for the gas fuel control valve.

Disassembly of the ELA actuators in the field is not recommended due to the dangerous forces contained in the internal-to-actuator springs. Under unusual circumstances, where disassembly becomes necessary, contact Woodward's Channel Partner for assistance. When inspecting the valve for suspected blockages, remove the valve from the fuel system and only inspect with the actuator powered off.

⚠WARNING **All ELA actuators contain a mechanical spring under load. Do not disassemble, as this spring can cause severe bodily harm.**

⚠WARNING **When inspecting the valve internally through the flanges for potential blockages, remove the valve from the fuel system and ensure that all power and electrical cables are disconnected. Never place hands inside the valve or between the actuator and the valve without ensuring that power is disconnected, and the position indicator shows the actuator/valve is at the closed position.**

Note: 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.

Table 5-1. Troubleshooting Guide

Symptom	Possible Causes	Recommended Action
Actuator will not open because the DVP will not reset	Motor wires not properly connected between DVP and actuator.	Conduct continuity check.
	Resolver wires not properly connected between DVP and actuator.	Conduct continuity check.
DVP will reset but actuator will not retract (normally open the valve)	Resolver sine wires high and low are flipped.	Conduct continuity check.
	Resolver cosine wires high and low are flipped.	Conduct continuity check.
	Resolver sine and cosine wires are swapped.	Conduct continuity check.

Table 5-1. Troubleshooting Guide (cont'd.)

Symptom	Possible Causes	Recommended Action
Upon enabling, actuator will retract (normally open the valve) and then fail-extend (normally close the valve)	Resolver sine and cosine wires are swapped, and sine wires high and low are flipped.	Conduct continuity check.
	Resolver sine and cosine wires are swapped, and cosine wires high and low are flipped.	Conduct continuity check.
Poor flow accuracy	Characterization data in engine control does not match the valve.	Verify characterization data matches the valve requirements.
	Build–up of contamination on the fuel metering unit.	Remove valve and inspect flow elements.
Poor position stability	One motor wire disconnected.	Conduct continuity check.
Actuator shaft resolver (secondary feedback) indicates position error	Incorrect parameter file loaded.	Verify the parameter file matches the valve serial number.
	Actuator shaft secondary feedback wires not properly connected between DVP and actuator.	Contact manufacturer for instructions or return to manufacturer for repair.
	Faulty secondary feedback device.	Return to manufacturer for repair.
	Drive train failure.	Return to manufacturer for repair.
High seat leakage on fuel metering unit	Damage to valve seat or plug.	Remove valve and inspect flow elements. Return to valve manufacturer for repair.
	Contamination buildup in seat or plug of the valve.	Remove valve and inspect flow elements. Return to valve manufacturer for repair.
	Valve not fully closed.	Remove valve and verify plug is not properly seated. Return to valve manufacturer for repair.
Actuator not able to stabilize the position of output shaft	Contamination buildup and/or excessive wear in valve stem sealing package.	Remove valve and inspect valve stem sealing elements. Return to valve manufacturer for repair.
Configuration Process Error	Actuator has not been configured by the Configuration Tool.	Perform actuator/valve configuration with the Configuration Tool.

Chapter 6.
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 current list of Woodward Business Partners is available at:
https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner

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 (Woodward North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690).

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 North American Terms and Conditions of Sale 5-09-0690) 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 North American Terms and Conditions of Sale 5-09-0690). 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 one of the Full-Service Distributors listed at **https://www.woodward.com/en/support/industrial/service-and-spare-parts/find-a-local-partner**

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **https://www.woodward.com/support**, 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) 8818 5515
Germany	+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) 8818 5515
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) 8818 5515
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

Revision A —

- Added part numbers 5450-1808 and 5450-1813 to Table 3-5.
- Added electrical cable ordering details to Table 3-5.
- Revised Important box in Typical Electrical Cables section.
- Revised Figures 3-10, 3-11, 3-12, 3-13 and 3-16.
- Added Figures 3-14 and 3-15.
- Renumbered Figures in Chapter 3.
- Modified the description of Figures 3-12, 3-13, and 3-16.

New Manual —

Declarations

EU DECLARATION OF CONFORMITY

EU DoC No.:	00371-04-EU-02-22
Manufacturer's Name:	WOODWARD INC.
Manufacturer's Contact Address:	1041 Woodward Way Fort Collins, CO 80524 USA
Model Name(s)/Number(s):	Large Electric Servo Valve - LESV II - with LELA 2 Actuator Sizes 3", 4", and 6" with ASME B16.34 Class 600 flanges With or without external position sensor
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	LELA 2 Actuator portion of LESV II: Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres Directive 2014/30/EU of the European Parliament and of the [illegible] 2014 on the harmonisation of the laws of the Member States [illegible] (EMC). Valve portion of LESV II: Directive 2014/68/EU of the European Parliament [illegible] harmonization of the laws of the Member [illegible] of pressure equipment 3", 4" PED Category II 6" PED Category III
Markings in addition to CE marking:	With external position sen[illegible] II 3 G Ex dc se III [illegible] Without external po[illegible] II 3 G Ex[illegible]
Applicable Standards:	ASME BPVC [illegible] Vessels Division 2 – Alternative [illegible] EN IEC [illegible] Equipment – General Requirements EN 60[illegible] Part 7: Equipment protection by in[illegible] [illegible] Compatibility (EMC) - Part 6-4: Generic [illegible] [illegible] Compatibility (EMC) - Part 6-2: Generic Standards - [illegible]
Conformity A[illegible]	[illegible] [illegible] Bureau Veritas SAS (0062) [illegible] – La Défense FRANCE

We [illegible] under the sole responsibility of the manufacturer [illegible] equipment specified above conforms to the above Directive(s).

MANUFACTURER

Signature: [signature]

Annette Lynch
Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

April 20, 2022
Date

5-09-1183 Rev 34

PLACEHOLDER only
This will soon be updated with declarations for ELA Actuators (TBD)

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

File name: 00371-04-EU-02-01
Manufacturer's Name: WOODWARD INC.

Contact Address: 1041 Woodward Way
Fort Collins, CO 80524 USA

Model Names: Large Electric Sonic Valve (LESV), LE...
Sizes 2", 3", 4", and 6", Class 300 ...

This product complies, where applicable, with the following Essential Requirements of Annex I: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7 ...

The relevant technical documentation is comp... Woodward shall transmit relevant informatio... ...onal authorities. The method of transmittal shal...

The person authorized to compile the...

Name: Dominik Kan...
Address: Woodward ... ...polomice, Poland

This product must not ... which it is to be incorporated has been declared ... ...e, where appropriate.

The undersi... ...Inc. of Loveland and Fort Collins, Colorado ... ...ity with Directive 2006/42/EC as partly compl...

PLACEHOLDER only

This will soon be updated with declarations for ELA Actuators (TBD)

...FACTURER

Annette Lynch

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

August 20, 2021
Date

Document: 5-09-1182 (rev. 18)

PLACEHOLDER only

This will soon be updated with declarations for ELA Actuators (TBD)

EU DECLARATION OF CONFORMITY

EU DoC No.: 00371-04-EU-02-02

Manufacturer's Name: WOODWARD INC.

Manufacturer's Contact Address: 1041 Woodward Way, Fort Collins, CO 80524 USA

Model Name(s)/Number(s): Large Electric Sonic Valve with LELA Actuator
ASME B16.34 Class 300 and 600 flanges
LESV 2, 3, 4 and 6 inch diameters
LESV II 2 inch diameter

The object of the declaration described above is in conformity with the following relevant Union harmonization legislation: LELA Actuator portion of LESV:
Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonization of the laws of the Member ... to equipment and protective systems intended for use in potentially ...

Valve portion of LESV:
Directive 2014/68/EU of the European P... 2014 on the harmonization of the laws of the ... available on the market of pressure ...
2", 3", 4" PED Category II
6" PED Category III

For models with ID M...
Directive 2014/30/E... 26 February 2014 on the harm...
electromagnet...

Markings in addition to CE marking: II 3 G ...

Applicable Standards:
PED: ... 2010
ATEX: ... explosive gas atmospheres – Part 0: ... explosive gas atmospheres – Part 15: ... 6-4: Generic Standards – Emissions for ... 6-2: Generic Standards – Immunity for Industrial ...

C... ...ality Assurance: ... 002-23 USA Bureau Veritas SAS (0062) ... 92800 Puteaux – La Défense FRANCE

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

MANUFACTURER

Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

April 20, 2022
Date

5-09-1183 Rev 37

Released

We appreciate your comments about the content of our publications.

Send comments to: industrial.support@woodward.com

Please reference publication **35227**.

B35227:A

WOODWARD

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Email and Website—www.woodward.com

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