WOODWARD

Product Manual 35183
(Revision -, 5/2022)
Original Instructions

Electric Linear Actuator (ELA)
ELA 150 Base Mount

Installation and Operation Manual

General Precautions

Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment.

Practice all plant and safety instructions and precautions.

Failure to follow instructions can cause personal injury and/or property damage.

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the publications page of the Woodward website:

www.woodward.com/publications

The latest version of most publications is available on the publications page. If your publication is not there, please contact your customer service representative to receive the latest copy.

Proper Use

Any unauthorized modifications to or use of this equipment outside of its specified mechanical, electrical, or other operating limits may cause personal injury and/or property damage, including damage to the equipment. Any such unauthorized modifications: (i) constitute "misuse" and/or "negligence" within the meaning of the product warranty, thereby excluding warranty coverage for any resulting damage, and (ii) invalidate product certifications or listings.

Translated Publications

If the cover of this publication states "Translation of the Original Instructions" please note:

The original source of this publication may have been updated since this translation was made. Be sure to check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, to verify whether this translation is up to date. Out-of-date translations are marked with ⚠. Always compare with the original for technical specifications and for proper and safe installation and operation procedures.

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

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Pentium (Intel Corporation)

Manual 35183

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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 needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

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

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

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

⚠WARNING

Start-up

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

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface, and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual *82715*, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, 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

ATEX – Potentially Explosive Atmospheres Directive: Directive 2014/34/EU on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres.
Zone 2: II 3 G, Ex ec IIC T3 Gc

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).

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

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.

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.

Other International Compliance:

IECEx Certified for use in hazardous locations
IECEx CSA 15.0032X Ex ec IIC T3 Gc

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

CSA: CSA Certified for Class I, Division 2, Groups A, B, C, & D, T3 at 121 °C Ambient. For use in Canada and the United States. Certificate 70010175

⚠WARNING

Explosion Hazard

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

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

⚠AVERTISSEMENT

Risque d'explosion

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

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

Special Conditions for Safe Use

Wiring must be in accordance with North American Class I, Division 2, or European or other international Zone 2, Category 3 wiring methods as applicable, and in accordance with the authority having jurisdiction.

Use supply wires suitable for at least 10°C above surrounding ambient.

Note: Cables supplied through Woodward meet this requirement.

To assure IP55 ingress protection, attach mating connectors to the actuator's receptacles

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.

Chapter 1.
General Information

The ELA actuation system consists of an electronically controlled linear actuator and a digital electronic positioner for position control on industrial turbine applications. The digital positioner and actuator combination are capable of precisely positioning the actuator to follow the setpoint signal from the turbine control system. The actuator position is controlled by regulating the current to a 3-phase brushless DC motor, which converts the rotary motion to linear motion via a gear reduction system and leadscrew.

Redundant resolver rotary position transducers are used to sense motor shaft position for commutation and velocity feedback to the digital positioner. Should one resolver fail, the positioner will revert to the working sensor to maintain operation.

The Woodward Electric Linear Actuator (ELA) includes the following major sub-assemblies:

- A high reliability brushless DC motor
- A high load capacity roller screw, driven by a spur gear train
- Dual motor resolvers for motor commutation and primary position feedback
- An LVDT for independent shaft positioning verification

The Woodward ELA design offers the following benefits to the purchaser in comparison to other electric actuators:

- The actuator and model-based controller provide the accuracy, bandwidth and slew times required for precise control of the guide vanes. No dynamic tuning is necessary during installation or operation.
- The highly capable electronic positioner provides comprehensive diagnostic and communication functions. These features minimize installation and replacement times and improve system maintainability.
- The Woodward actuator is designed to provide high force consistent with heavy industrial equipment. All power train and electronic components are designed with conservative design margins for high reliability. The simple and robust design is capable of consistent performance for extended periods in challenging environments.
- The actuator and digital positioner have been designed to achieve extended Mean Time Between Overhaul (MTBO) goals. These targets have been reached through the conservative rating of parts and the careful analysis of individual component and system performance.
- An integrated Identification Module (ID module) comes in each actuator. This ID module provides key information specific to the actuator assembly (i.e., identifies the stroke, gear ratio, motor characteristics, and device startup limits.) The digital positioner electronically queries the ID module every time it is powered up. This provides for quick and error free initialization of a new actuator or digital positioner.
- The electronic position controller provides for dual power inputs, and options for redundant digital interfaces for improved reliability.

Chapter 2. Specifications

Table 2-1. ELA 150 Specifications

Type	Electric Mechanical Actuator (EMA)
Duty Cycle	Continuous
Stroke Ranges Available (max):	2.000 inch stroke 3.000 inch stroke
Peak Force (0.5 seconds) *	160 kN / 36 000 lb. bidirectional
Stall Force (continuous) *	160 kN / 36 000 lb. bidirectional
Continuous Application Force *	105 kN / 24 150 lb. bidirectional
Speed under Opposing Load	2 in: 0.4 in/sec 3 in: 0.6 in/sec
Max Speed @ Zero Force	2 in: 0.4 in/sec 3 in: 0.6 in/sec
Max Motor Input Current	25 A continuous
Input Voltage (to DVP10000)	112–300 VDC absolute min/max 125 Vdc typical (see manual 26773)
Input Current (to DVP10000) – Max Steady State[1]:	2.5 Amps at 15,000 lbf 4.5 Amps at 30,000 lbf
Input Current (to DVP10000) – Max Transient[2]:	40 Amps for 5 seconds
Accuracy	≤ ±1.0% of full scale
Repeatability Range	Within ± 0.5% of full scale
Dynamic Bandwidth	> 2 Hz at –3 dB 90 degrees phase loss
Design Life	20 years with overhauls 96,000 hours overhaul period recommended Lubrication required every 3 years
MTBF	122,550 hours with 90% confidence at rated load with 2 Hz ± 2 mm noise and annual maintenance including driver
Fail-safe Actuation	Position to 0% on loss of demand signal
Normal Ambient Operating Temperature	–18 to +121 °C / 0 to +250 °F
Rated Ambient Operating Temperature	–40 to +121 °C / –40 to +250 °F
Storage Ambient Temperature	–40 to +121 °C / –40 to +250 °F
Rated Operating Elevation	3000 m (10 000 ft.) max
IP Rating (per IEC 60529)	IP55
Vibrations (validation)	Random vibration per Mil-STD 810F, M514.5 Category 22, level/duration 2.3.11 Figure 514.5C-16.
Vibrations (shock)	US MIL-STD 810F, Method 516.5, Procedure 1. 10 G Peak, 11 ms duration sawtooth pulse
Envelope and Mounting	See installation drawings and figures below
Actuator Weight	586 lbs

* Actuator output forces will be reduced below normal ambient operating temperature range due to increased grease viscosity at cold temperatures.

** Dynamic performance can be influenced by the customer filter settings. Values assume additional customer settings are turned off.

[1] Assumes slow modulation when following a base load. Does not consider additional power required as seen in grid firming applications requiring continuous and fast ramping of power. If this is expected in the application, please contact Woodward for additional information.

[2] Information provided for breaker and wire sizing. Input current required when performing a full 100% step at the continuous application force.

DVP Specifications

The ELA requires the DVP10000. Refer to DVP 5000/10000/12000 manual 26773 for specifications and additional information on the operation and configuration of the DVP 10000.

Chapter 3.
Installation Requirements

Introduction

⚠WARNING

External Fire Protection

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

⚠WARNING

Explosion Hazard

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

⚠CAUTION

Hearing Protection

Due to typical noise levels in turbine (or engine) and environments, wear hearing protection when working on or around the ELA.

This chapter provides the general information for mounting location selection, installation, and wiring of the ELA actuator. For DVP10000 installation instructions, see the DVP 5000/10000/12000 manual 26773.

Mechanical Installation Requirements

Unpacking

Use care when unpacking the ELA. Abuse can damage seals, installation surfaces, and factory adjustments. Notify the shipper and Woodward if damage is found.

Check for and remove all manuals and other items before discarding the shipping crate.

Lifting Procedures

Lifting procedures for vertical, inverted and motor lifts follow:

Vertical Lift

A vertical lift is accomplished by following the steps below:

1. Install one lifting strap or cable through rod end
2. Lift the ELA

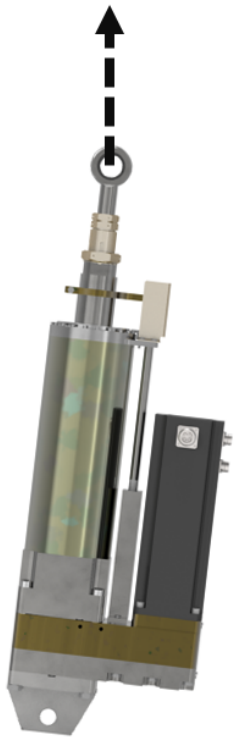


Figure 3-1. Vertical Lift Example

Inverted Lift

An inverted lift is accomplished by following the steps below:

1. Install one lifting strap or cable through clevis
2. Lift the ELA

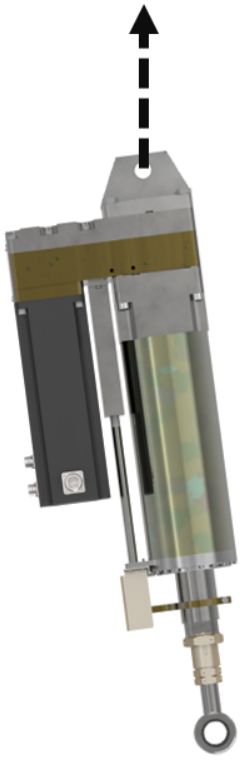


Figure 3-2. Inverted Lift Example

Motor Lift

A motor lift is accomplished by following the steps below:

1. Install one lifting strap or cable around the motor of the ELA
2. Lift the ELA

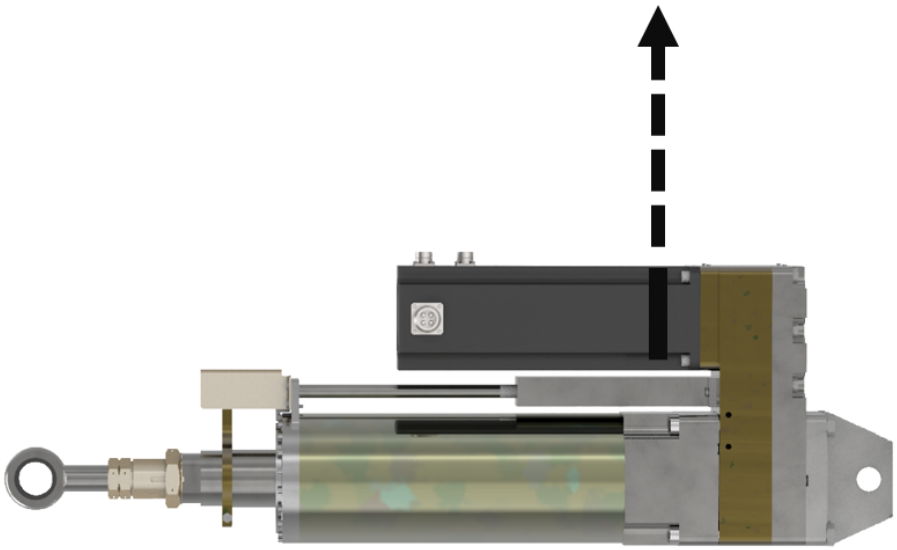


Figure 3-3. Motor Lift Example

Un-Approved Lift

⚠WARNING

Do not place any force or lift by the LVDT Housing, LVDT Rod, LVDT Cover, or LVDT Clamp Arm. Damage will occur if lifted at these locations.

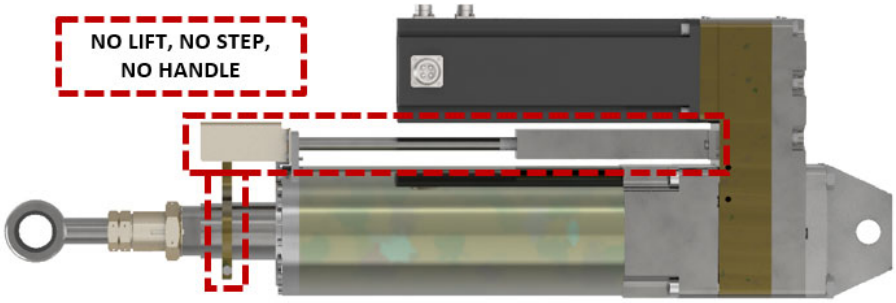
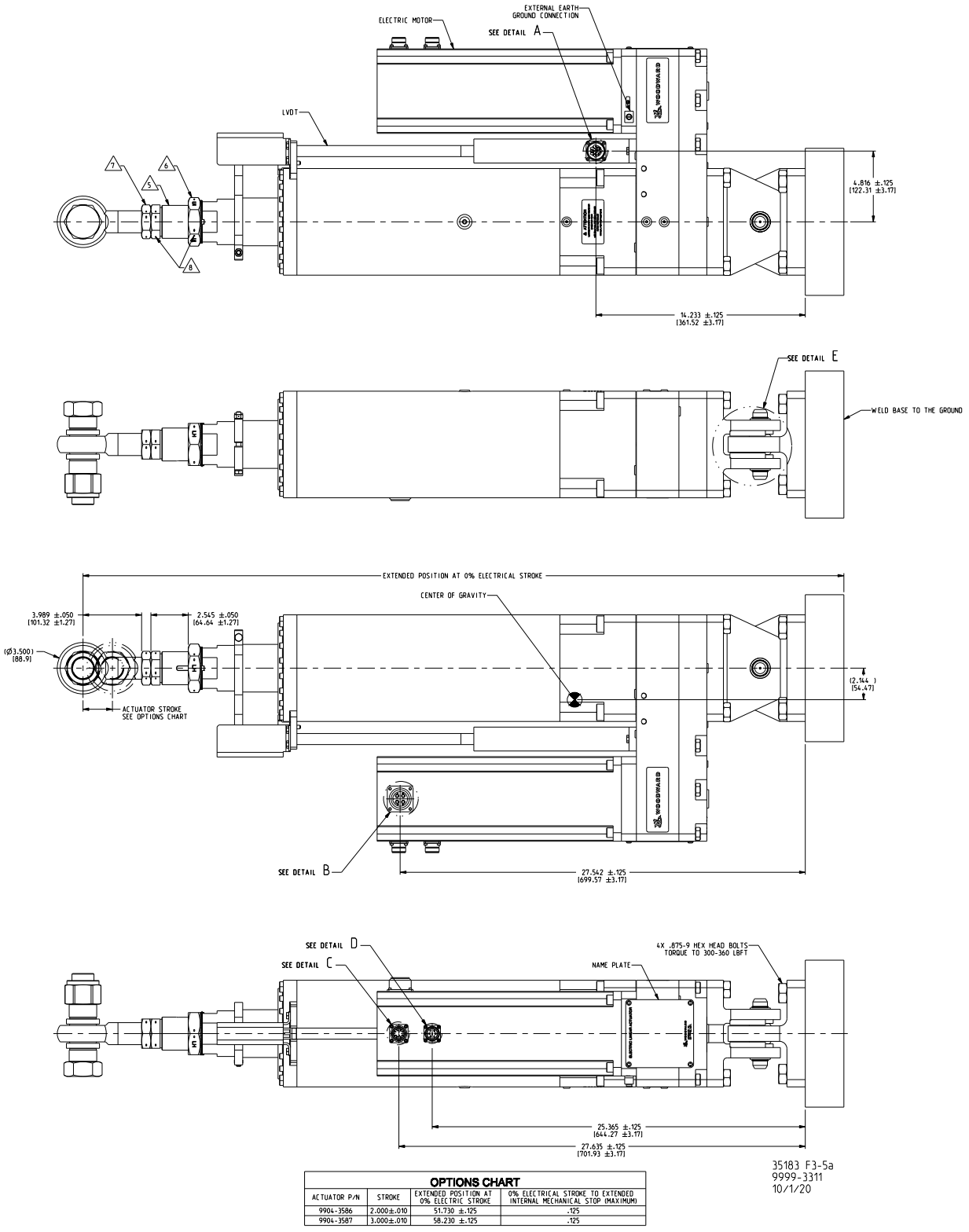


Figure 3-4. Unapproved Lifting Example

Instalation Drawing



OPTIONS CHART

ACTUATOR P/N	STROKE	EXTENDED POSITION AT 0% ELECTRIC STROKE	0% ELECTRICAL STROKE TO EXTENDED INTERNAL MECHANICAL STOP (MAXIMUM)
9904-3586	2.000±.010	51.730 ±.125	.125
9904-3587	3.000±.010	58.230 ±.125	.125

Figure 3-5a. ELA 150 Base Mount Dimensions

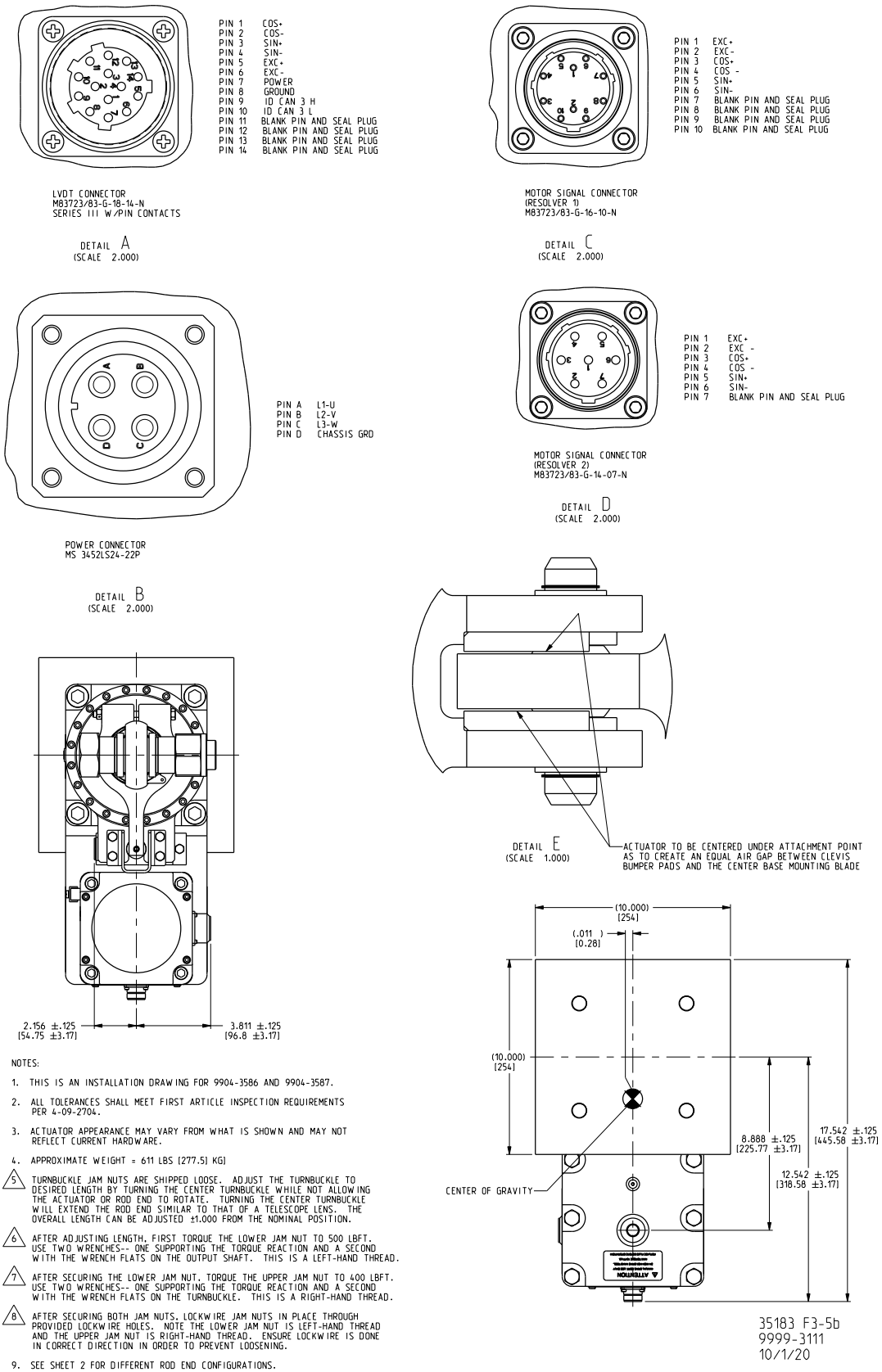


Figure 3-5b. ELA 150 Base Mount Dimensions

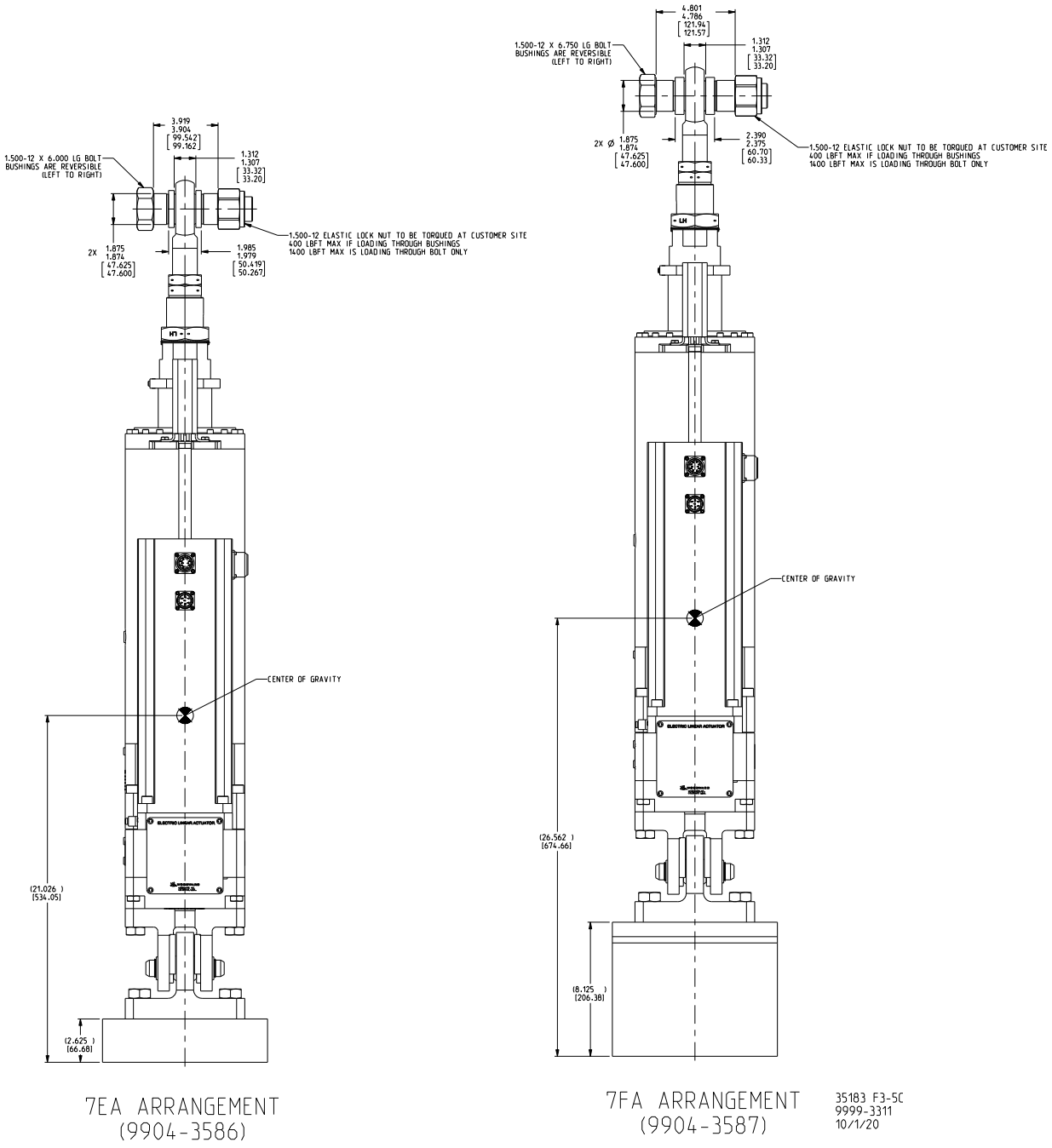


Figure 3-5c. ELA 150 Base Mount Dimensions

Turnbuckle Function

The rod end can be adjusted by loosening both jam nuts and turning the center turnbuckle. Turning the center turnbuckle will extend and retract the rod end. The overall length can be adjusted +/-1 inch from the nominal position.

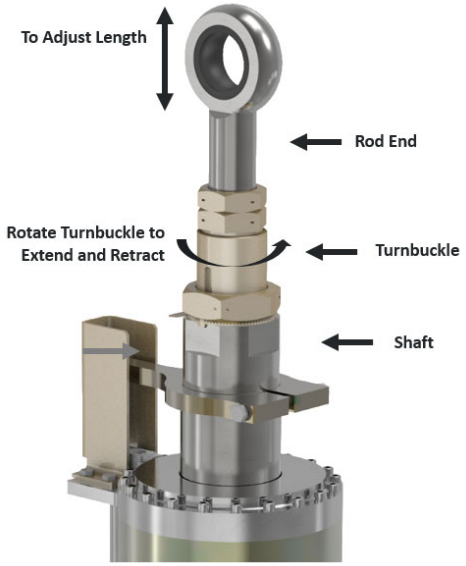


Figure 3-6. Position and Adjust Turnbuckle

Turnbuckle Tightening

1. First torque the larger jam nut to 500 FT-LBS
2. Next torque the smaller jam nut next to 400 FT-LBS

WARNING

The reaction torque from the torque wrench must be supported by a second wrench on the provided flats directly below the jam nuts. Failure to do so could damage the actuator.

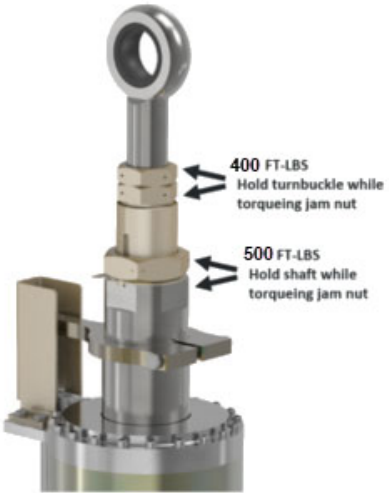


Figure 3-7. Secure Turnbuckle Jam Nuts

Turnbuckle Lockwire

1. Lockwire the nuts in place through the provided holes. See figure below.
   Note: The lower jam nut is a left-hand thread, and the upper jam nut is a right-hand thread. Ensure lockwire is done in the correct direction to prevent loosening.

Figure 3-8. Lockwire Nuts

Manual Drive Access Plug

The actuator can be mechanically stroked and aligned to a mechanical position by use of a manual drive.

1. To access the drive first remove the manual drive access plug below the motor per the image below.
2. After removing the plug, rotate the gear train by inserting a 0.75" hex drive and turning the motor and pinion gear to the desired position.

Note: The extended and retracted internal mechanical hard stops can be found by turning the drive until it stopes when 2.5 ft-lbs is applied. The actuator drive should rotate and move the shaft with less than 1.5 ft-lbs applied to the drive. Do not apply more than 10 ft-lbs to this drive or damage can occur to the actuator. The 0% electrical position is set 1 motor turn away from the hard stop position (where the hard stop position is measured at 2.5 ft-lbs).

3. Replace the manual drive access plug when you are finished.

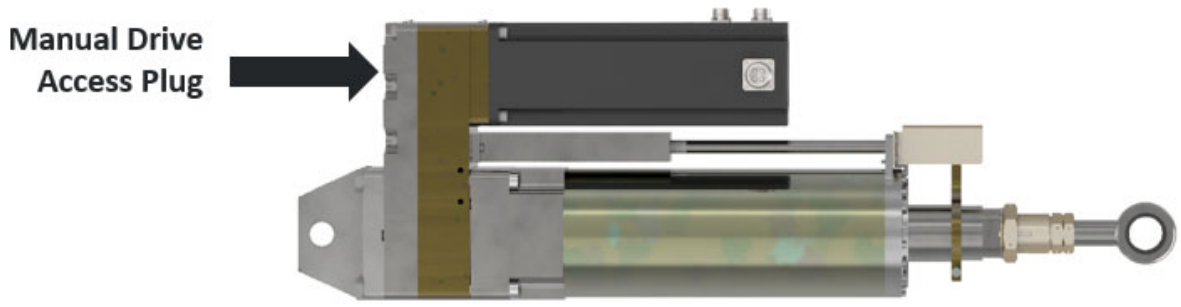


Figure 3-9. Manual Drive Access Plug Location

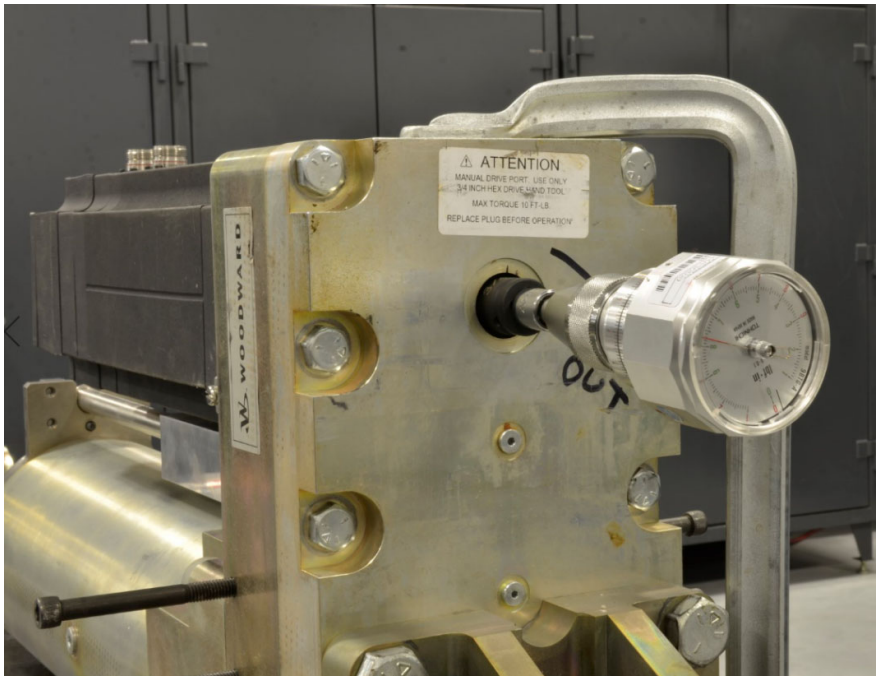


Figure 3-10. Manual Drive Rotation Example

⚠WARNING

Do not connect power to the actuator until the hand tool has been removed from the manual drive port and the plug replaced per these instructions. Serious personal injury may result from access to moving parts while actuator is powered.

Electrical Installation Requirements

⚠WARNING

DVP10000 Instructions

Refer to DVP10000 manual 26773 for critical installation instructions and warnings that may pertain to EMC or Hazardous Locations certifications. The following instructions are specific to this actuator only and are meant as a supplement to the general DVP10000 instructions. Failure to do so may result in poor performance, personal injury, or death.

Install the motor power cable, motor resolver cables, and ID Module cable in accordance with the figures in the below wiring section. Fully tighten (by hand) all mating electrical connectors on the ELA. Loose or cross-threaded connectors may lead to poor electrical connection and impair the IP rating listed in the specification section.

Shielding Requirements

See DVP 5000/10000/12000 manual 26773.

Cables

Prefabricated cables from Woodward can be used, or the customer can manufacture cables to the same standards. The figures below show the cable requirements and Woodward part numbers. Contact Woodward for other cable configuration availability (connectors on both ends, either straight or 90-degree backshell options).

Wiring

Connect all wires and protective earth grounds as shown in the wiring diagram (Figure 3-15). The DVP10000 is shipped with mating connectors for all input and output connections. Contact Woodward for availability of DVP10000 with keyed circular connectors.

⚠WARNING

Protective Earth Grounds

The ELA must be suitably grounded through both the motor power connector to the DVP10000 chassis and the external grounding terminal before power is supplied to the unit. See the installation drawing and wiring diagram (Figure 3-15) as well as manual 26773. Improper grounding may result in a shock hazard on the ELA chassis and any equipment connected, resulting in personal injury or death.

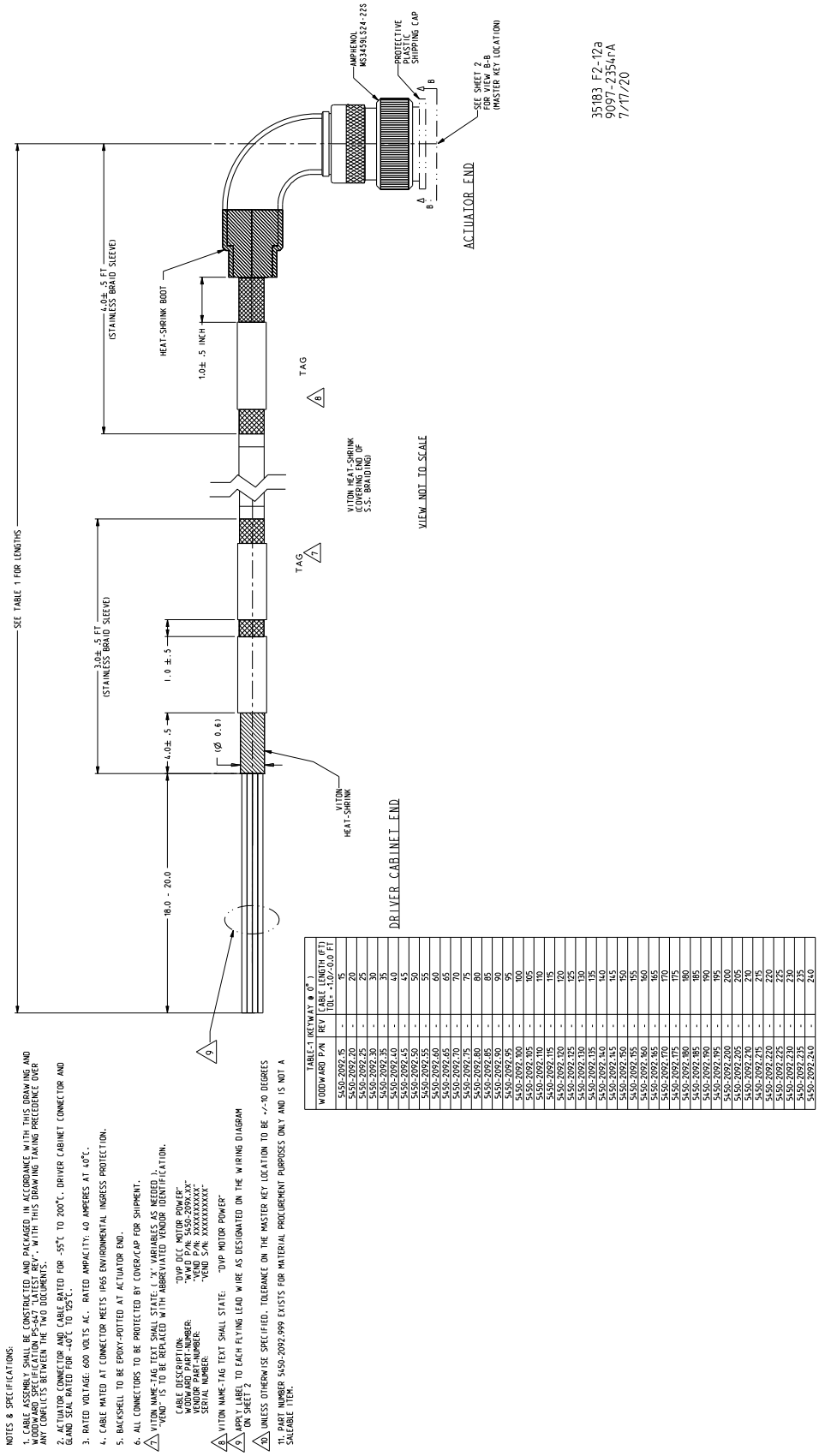


TABLE-1 (KEYWAY @ 0°)		
WOODWARD P/N	REV	CABLE LENGTH (FT) DIM: +10/-0.0 FT
5450-2092-15	-	15
5450-2092-20	-	20
5450-2092-25	-	25
5450-2092-30	-	30
5450-2092-35	-	35
5450-2092-40	-	40
5450-2092-45	-	45
5450-2092-50	-	50
5450-2092-55	-	55
5450-2092-60	-	60
5450-2092-65	-	65
5450-2092-70	-	70
5450-2092-75	-	75
5450-2092-80	-	80
5450-2092-85	-	85
5450-2092-90	-	90
5450-2092-95	-	95
5450-2092-100	-	100
5450-2092-105	-	105
5450-2092-110	-	110
5450-2092-115	-	115
5450-2092-120	-	120
5450-2092-125	-	125
5450-2092-130	-	130
5450-2092-135	-	135
5450-2092-140	-	140
5450-2092-145	-	145
5450-2092-150	-	150
5450-2092-155	-	155
5450-2092-160	-	160
5450-2092-165	-	165
5450-2092-170	-	170
5450-2092-175	-	175
5450-2092-180	-	180
5450-2092-185	-	185
5450-2092-190	-	190
5450-2092-195	-	195
5450-2092-200	-	200
5450-2092-205	-	205
5450-2092-210	-	210
5450-2092-215	-	215
5450-2092-220	-	220
5450-2092-225	-	225
5450-2092-230	-	230
5450-2092-235	-	235
5450-2092-240	-	240

Figure 3-11. Motor Power Cable

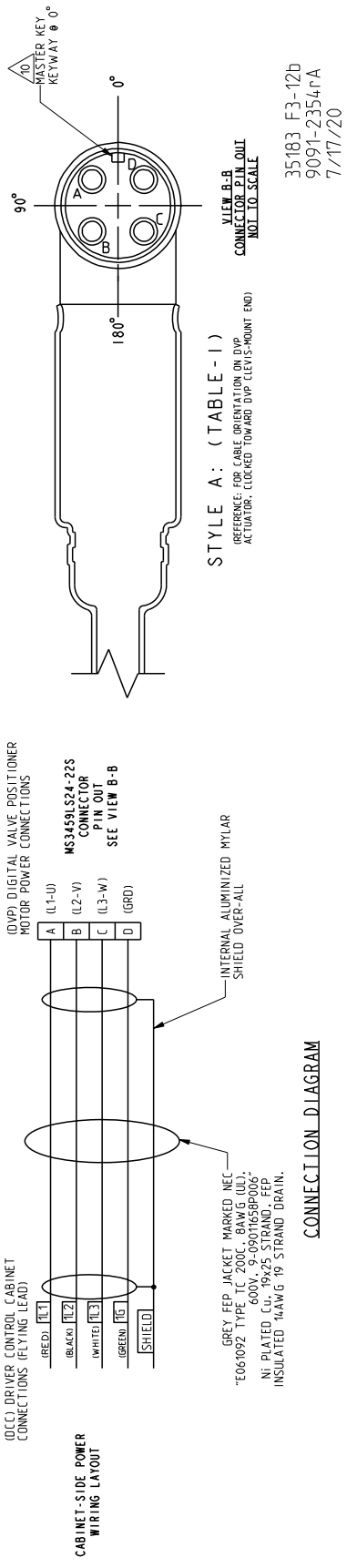


Figure 3-12. Motor Power Cable

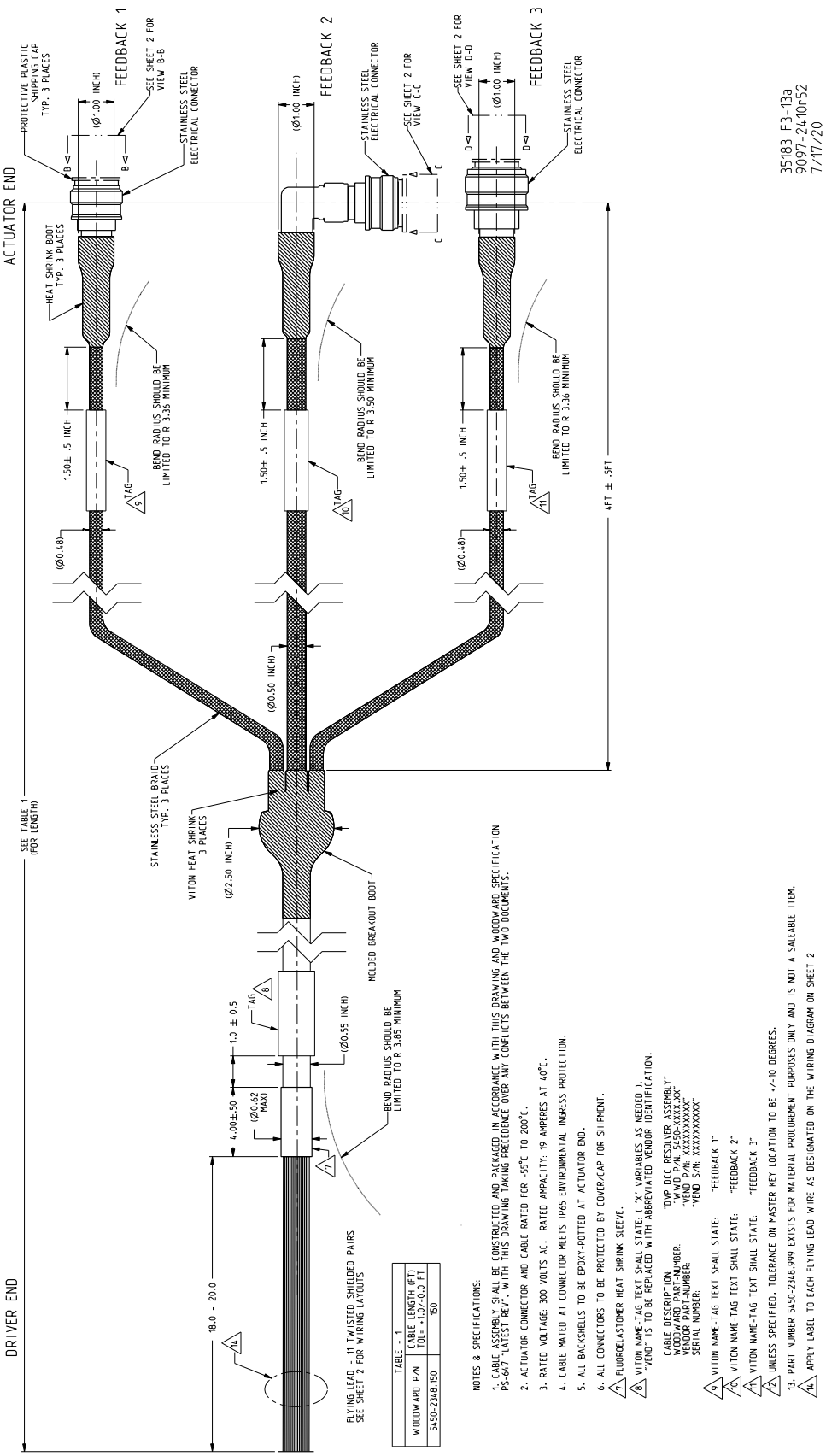


Figure 3-13. DVP Integrated Signal Cable

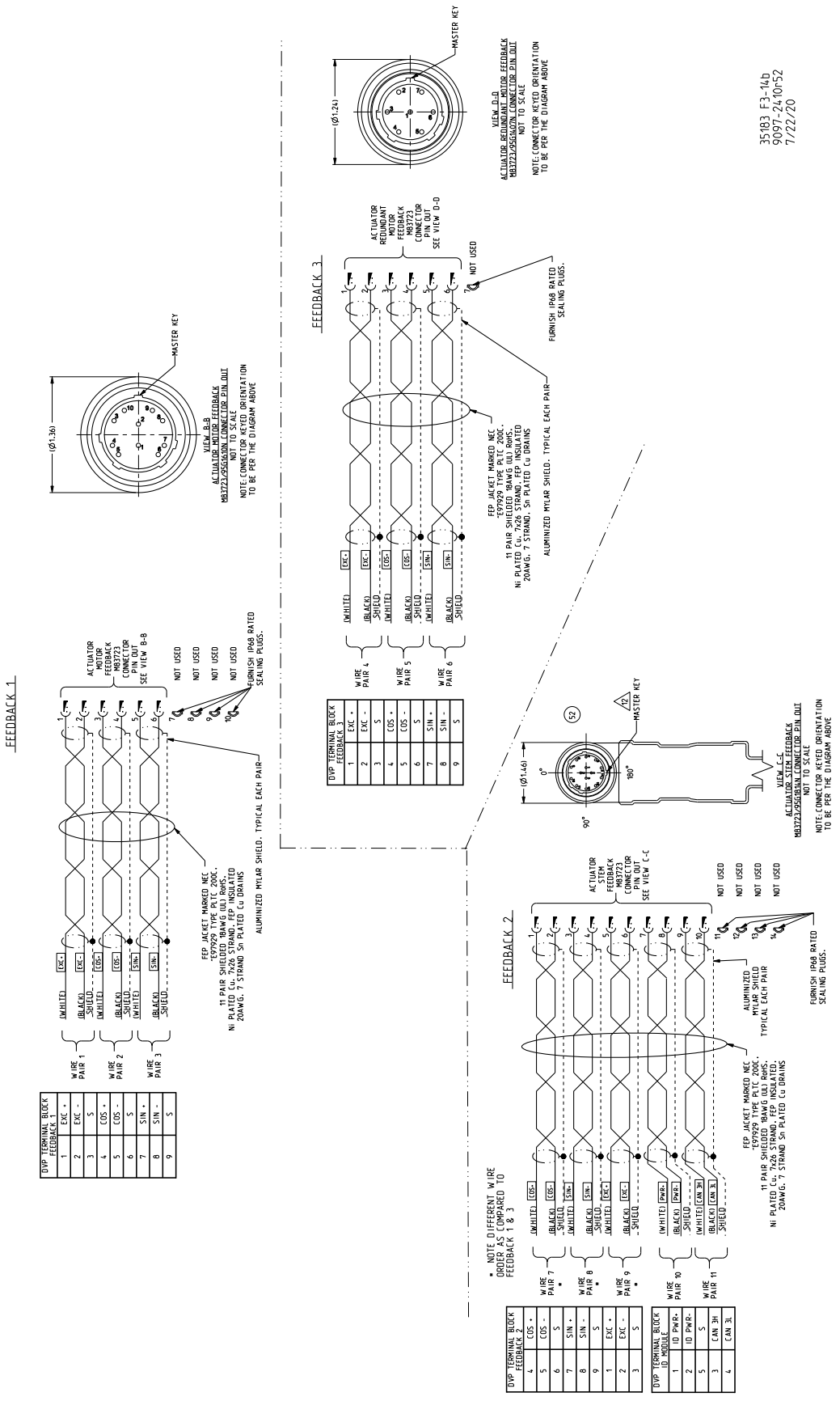


Figure 3-14. DVP Integrated Signal Cable

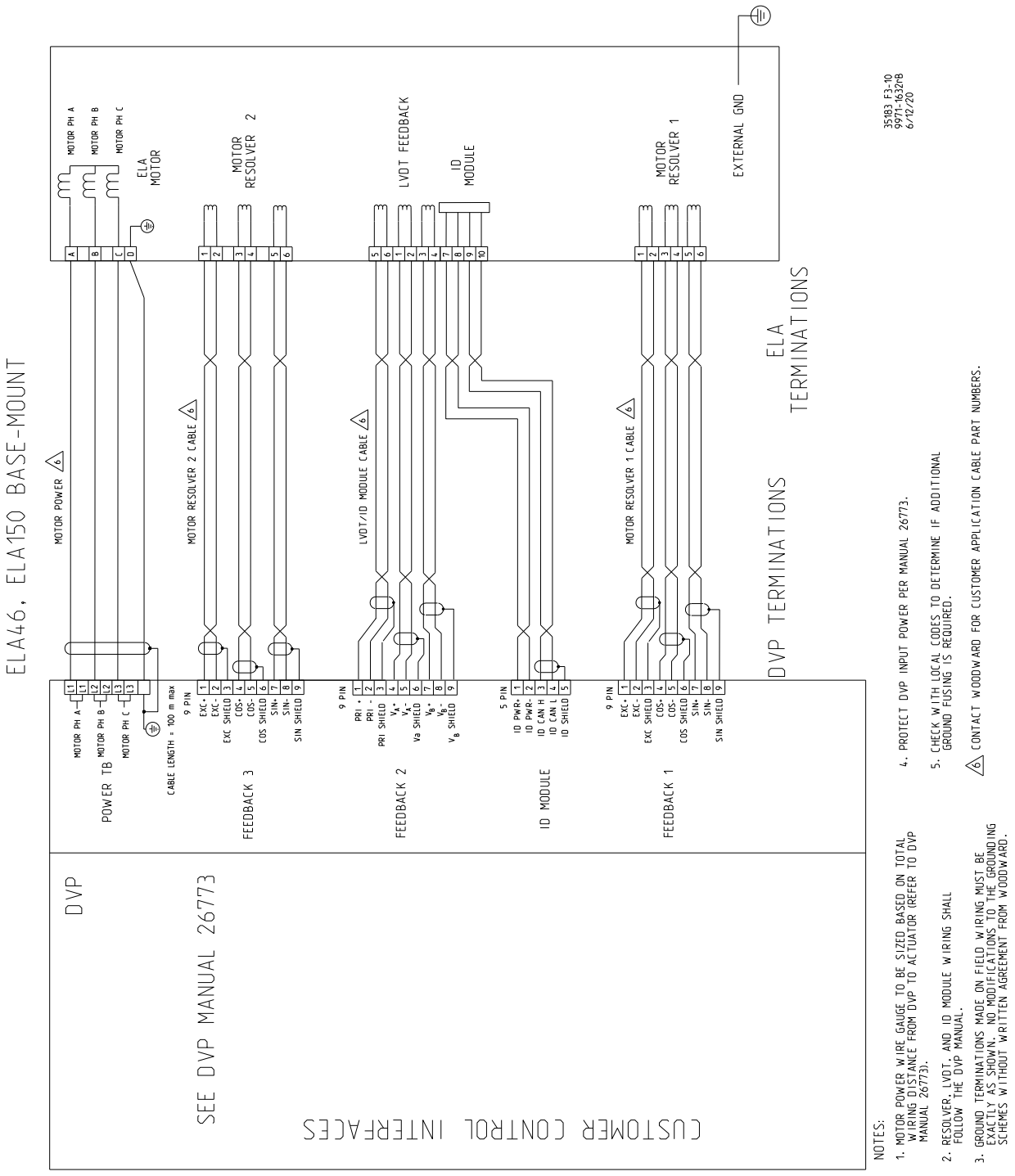


Figure 3-15. Control Wiring Diagram

Installation and Commissioning Checks

Every actuator installation should include, at a minimum, the recommended checks outlined in Table 3-1 below. All prime mover OEM recommendations and required plant safety checks must always be followed and supersede any recommended actions. It is the responsibility of the end user to ensure all procedures are carried out in a safe manner.

Table 3-1. Installation Checklist (Before Power is Applied to the System)

Wiring	Physical/Mechanical Installation	Turbine Control Integration
Protective Earth Grounds / Connectors	Actuator and DVP mounting—torque, vibration isolation	Verify independent overspeed system
Shielding and shield termination	Verify Actuator and DVP rating (environment, listings)	
Point to point verification	Remove lifting brackets	
Wire rating / gauge/ type / impedance		
Wire routing / length/ network topology		
Power source—voltage / current		
Power protection (fusing/breakers)		
Power redundancy		
Verify power wire isolation		
Hazardous Location compliance		
CAN termination applied correctly		
Communication redundancy		

Table 3-2. Pre-operational Checklist (Before Stroking the Actuator)

1. Verify actuator stroke is correctly configured.
2. Configure DVP for control system.
3. Verify communication of demand and service tool operability.
4. Verify fault and diagnostic behavior.
5. Visual check of correct actuator movement and stroke length.
6. Stroke the actuator to verify demand and feedback from 0–100%.
7. Verify internal shutdown operation and annunciation.
8. Verify independent shutdown function and annunciation.
9. Recommended demand is 0% at shutdown.
10. Verify low demand signal noise.
11. Verify voltage at DVP within limits during full actuator step.
12. Verify shutdown from safety system including overspeed.
13. Document and archive DVP configuration settings.

Chapter 4.
PC Service Tool Operation

The DVP Service Tool is used to configure, monitor, and troubleshoot the DVP and ELA system. For detailed instructions on how to set-up and use the Service Tool, refer to the Service Tool manual 26912.

WARNING

Improper Use of Software

An unsafe condition could occur with improper use of these software tools. Only qualified personnel should use these tools to modify or monitor the DVP or ELA functions.

Chapter 5.
Set-up and Operation

Setting up the DVP and ELA

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*.

⚠WARNING

During set-up and verification, it is critical that the prime mover be shut down and secured. Do not perform set-up or verification on a machine which is not properly locked out.

Abide by all local codes and plant safety procedures regarding instrument verification and check-out prior to operation on the machine.

⚠WARNING

DVP10000 Instructions

Refer to DVP10000 manual 26773 for critical installation instructions and warnings that may pertain to its EMC or Hazardous Locations certifications. The following instructions are specific to this actuator only and are meant as a supplement to the general DVP10000 instructions. Failure to do so may result in poor performance, personal injury, or death.

IMPORTANT

Before you begin, install the DVP Service Tool on a laptop or desktop computer. THE DVP SERVICE TOOL MUST BE INSTALLED TO CONFIGURE THE DVP DRIVER.

Manual 26912

For additional instructions and information regarding the DVP Service Tool, refer to manual 26912

Pre-start and Operational Checks

Every actuator installation should include, at a minimum, the recommended checks outlined in Table 5-1 below. All prime mover OEM recommendations and all required plant safety checks must always be followed and supersede any recommended actions. It is the responsibility of the end user to ensure all procedures are carried out in a safe manner.

Table 5-1. Installation, Pre-operational, Pre-start, and Operational Checks

Installation	
Before fuel or power is applied to system	
Wiring	1. Connectors 2. Shielding and shield termination 3. Point to point verification 4. Wire rating / gage / type 5. Wire routing / length 6. Power source - voltage / current 7. Verify power wire isolation 8. Power redundancy
Physical/Mechanical Installation	1. Actuator and DVP mounting- torque, vibration isolation 2. Verify product rating (force, environment, listings) 3. Verify actuator and DVP protective earth ground
Turbine Control Integration	Verify independent overspeed system
Pre-operational Checks	
Before stroking actuator	
Physical/Mechanical Installation	Verify actuator stroke is correctly configured
Turbine Control Integration	1. Configure DVP for control system 2. Verify communication of demand and service tool operability 3. Verify fault and diagnostic behavior 4. Demand and feedback loop check 0-100% 5. Visual check of correct actuator movement and stroke length 6. Stroke the actuator to verify demand and feedback from 0-100% 7. Verify internal shutdown operation and annunciation 8. Verify independent shutdown function and annunciation 9. Recommended demand is 0% at shutdown 10. Verify low demand signal noise 11. Verify voltage at DVP within limits during full actuator step 12. Verify shutdown from safety system including overspeed 13. Document and archive DVP configuration settings
Pre-start	
Before turbine lightoff	
Turbine Control Integration	1. Verify internal shutdown operation and annunciation 2. Verify independent shutdown function and annunciation 3. Verify shutdown from safety system including overspeed
Operational	
Physical/Mechanical Installation	1. Verify operating temperatures, actuator and DVP 2. Verify maintenance schedule for greasing actuators
Turbine Control Integration	1. Verify transient performance 2. Verify low demand signal noise and DVP input filter setting 3. Verify actuator schedule and emissions compliance

Chapter 6.
Diagnostics

⚠WARNING

Explosion Hazard

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

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

⚠WARNING

Electrical Shock Hazard

Follow all local plant and safety instructions/precautions before proceeding with Troubleshooting the DVP Control.

For a complete listing of DVP diagnostics, see the DVP5000/DVP10000/DVP12000 manual 26773. For additional information, refer to Service Tool manual 26912.

Chapter 7.
Maintenance and Hardware Replacement

Maintenance

The only maintenance required for the ELA is lubricating the roller screw, gears, and bearings every three years, in accordance with the descriptions below.

At 96,000 hours of run time, remove the actuator from service and send it back to the factory to have the actuator overhauled. Internal components are not serviceable in the field.

Should the actuator become inoperative, refer to Chapter 8 for return instructions. Do not attempt to service any part of the unit. Please refer to the below service programs when returning products.

⚠WARNING

Explosion Hazard

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

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

⚠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 actuator before beginning any maintenance.

⚠WARNING

Review lifting warnings and requirements per installation chapter.

⚠WARNING

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

⚠WARNING

Never put your hands near the output shaft. There are moving components with sharp edges, tight clearances, and large closing forces.

⚠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.

To facilitate field replacement of items, keep spare parts on-site. See the outline drawings for the locations of items. Contact Woodward for a complete list of field-replaceable parts and additional instructions for their replacement.

NOTICE

Only use Woodward-approved grease to lubricate the roller screw, gears, and bearing in this actuator. Use of any other grease will reduce performance and reliability. Lubrication kits are available from Woodward.

ELA Re-greasing Procedures

For detailed instructions to lubricate the ELA 80 and ELA 150 see re-greasing procedure for ELA Actuator manual 35023.

Chapter 8.
Product Support and Service Options

Product Support Options

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

- Consult the troubleshooting guide in the manual.
- Contact the manufacturer or packager of your system.
- Contact the Woodward Full-Service Distributor serving your area.
- Contact Woodward technical assistance (see “How to Contact Woodward” later in this chapter) and discuss your problem. In many cases, your problem can be resolved over the phone. If not, you can select which course of action to pursue based on the available services listed in this chapter.

OEM or Packager Support: Many Woodward controls and control devices are installed into the equipment system and programmed by an Original Equipment Manufacturer (OEM) or Equipment Packager at their factory. In some cases, the programming is password-protected by the OEM or packager, and they are the best source for product service and support. Warranty service for Woodward products shipped with an equipment system should also be handled through the OEM or Packager. Please review your equipment system documentation for details.

Woodward Business Partner Support: Woodward works with and supports a global network of independent business partners whose mission is to serve the users of Woodward controls, as described here:

- A **Full-Service Distributor** has the primary responsibility for sales, service, system integration solutions, technical desk support, and aftermarket marketing of standard Woodward products within a specific geographic area and market segment.
- An **Authorized Independent Service Facility (AISF)** provides authorized service that includes repairs, repair parts, and warranty service on Woodward's behalf. Service (not new unit sales) is an AISF's primary mission.
- A **Recognized Turbine Retrofitter (RTR)** is an independent company that does both steam and gas turbine control retrofits and upgrades globally, and can provide the full line of Woodward systems and components for the retrofits and overhauls, long term service contracts, emergency repairs, etc.

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

Product Service Options

The following factory options for servicing Woodward products are available through your local Full-Service Distributor or the OEM or Packager of the equipment system, based on the standard Woodward Product and Service Warranty (5-01-1205) that is in effect at the time the product is originally shipped from Woodward, or a service is performed:

- Replacement/Exchange (24-hour service)
- Flat Rate Repair
- Flat Rate Remanufacture

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who needs immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime. This is a flat-rate program and includes the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205).

This option allows you to call your Full-Service Distributor in the event of an unexpected outage, or in advance of a scheduled outage, to request a replacement control unit. If the unit is available at the time of the call, it can usually be shipped out within 24 hours. You replace your field control unit with the like-new replacement and return the field unit to the Full-Service Distributor.

Charges for the Replacement/Exchange service are based on a flat rate plus shipping expenses. You are invoiced the flat rate replacement/exchange charge plus a core charge at the time the replacement unit is shipped. If the core (field unit) is returned within 60 days, a credit for the core charge will be issued.

Flat Rate Repair: Flat Rate Repair is available for many standard products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be. All repair work carries the standard Woodward service warranty (Woodward Product and Service Warranty 5-01-1205) on replaced parts and labor.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option with the exception that the unit will be returned to you in “like-new” condition and carry with it the full standard Woodward product warranty (Woodward Product and Service Warranty 5-01-1205). This option is applicable to mechanical products only.

Returning Equipment for Repair

If a control (or any part of an electronic control) is to be returned for repair, please contact your Full-Service Distributor in advance to obtain Return Authorization and shipping instructions.

When shipping the item(s), attach a tag with the following information:
- Return authorization number
- Name and location where the control is installed
- Name and phone number of contact person
- Complete Woodward part number(s) and serial number(s)
- Description of the problem
- Instructions describing the desired type of repair

Packing a Control

Use the following materials when returning a complete control:
- Protective caps on any connectors
- Antistatic protective bags on all electronic modules
- Packing materials that will not damage the surface of the unit
- At least 100 mm (4 inches) of tightly packed, industry-approved packing material
- A packing carton with double walls
- A strong tape around the outside of the carton for increased strength

NOTICE

To prevent damage to electronic components caused by improper handling, read and observe the precautions in Woodward manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*.

Replacement Parts

When ordering replacement parts for controls, include the following information:

- The part number(s) (XXXX-XXXX) that is on the enclosure nameplate
- The unit serial number, which is also on the nameplate

Engineering Services

Woodward offers various Engineering Services for our products. For these services, you can contact us by telephone, by email, or through the Woodward website.

- Technical Support
- Product Training
- Field Service

Technical Support is available from your equipment system supplier, your local Full-Service Distributor, or from many of Woodward's worldwide locations, depending upon the product and application. This service can assist you with technical questions or problem solving during the normal business hours of the Woodward location you contact. Emergency assistance is also available during non-business hours by phoning Woodward and stating the urgency of your problem.

Product Training is available as standard classes at many of our worldwide locations. We also offer customized classes, which can be tailored to your needs and can be held at one of our locations or at your site. This training, conducted by experienced personnel, will assure that you will be able to maintain system reliability and availability.

Field Service engineering on-site support is available, depending on the product and location, from many of our worldwide locations or from one of our Full-Service Distributors. The field engineers are experienced both on Woodward products as well as on much of the non-Woodward equipment with which our products interface.

For information on these services, please contact us via telephone, email us, or use our website: **www.woodward.com**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com**, 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 (32) 422-5551
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 (32) 422-5551
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 (32) 422-5551
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.

Chapter 9.
Long-Term Storage Requirements

Units that will not be put into service within twelve months should be packaged for long-term storage as described in Woodward manual 25075, *Commercial Preservation Packaging for Storage of Mechanical-Hydraulic Controls.*

Woodward recommends performing the roller screw and bearing lubrication procedures (see Chapter 7) once the units are ready to be installed for optimum performance.

Revision History

New Manual—

Declarations

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

File name: 00468-04-EU-02-01
Manufacturer's Name: WOODWARD INC.

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

Model Names: ELA80, ELA150, ELA150 Base Mount

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

The person authorized to compile the technical documentation:

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

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

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

MANUFACTURER

Annette Lynch
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward Inc., Fort Collins, CO, USA
Place

May 2, 2022
Date

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

EU DECLARATION OF CONFORMITY

EU DoC No.:	00468-04-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):	ELA80, ELA150, ELA 150 Base Mount
The object of the declaration described above is in conformity with the following relevant Union harmonization legislation:	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 Council of 26 February 2014 on the harmonization of the laws of the Member States relating to electromagnetic compatibility (EMC)
Markings in addition to CE marking:	Ex II 3 G, Ex ec IIC T3 Gc
Applicable Standards:	EN IEC 60079-0: 2018: Explosive atmospheres - Part 0: Equipment - General requirements EN IEC 60079-7:2015/A1:2018: Explosive atmospheres - Part 7: Equipment protection by increased safety "e" EN 61000-6-4, 2007/A1:2011: EMC Part 6-4: Generic Standards - Emissions for Industrial Environments EN 61000-6-2, 2005: EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

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

MANUFACTURER

Annette Lynch
Signature

Annette Lynch
Full Name

Engineering Manager
Position

Woodward, Fort Collins, CO, USA
Place

May 2, 2022
Date

5-09-1183 Rev 34

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 35183.

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

Email and Website—www.woodward.com

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

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