Installation Instructions

TL-Series Electric Cylinders

Catalog Numbers TLAR-A1*xxx*B, TLAR-A1*xxx*E, TLAR-A2*xxx*C, TLAR-A2*xxx*F, TLAR-A3*xxx*E, TLAR-A3*xxx*H

Allen-Bradley • Rockwell Software

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Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://literature.rockwellautomation.com) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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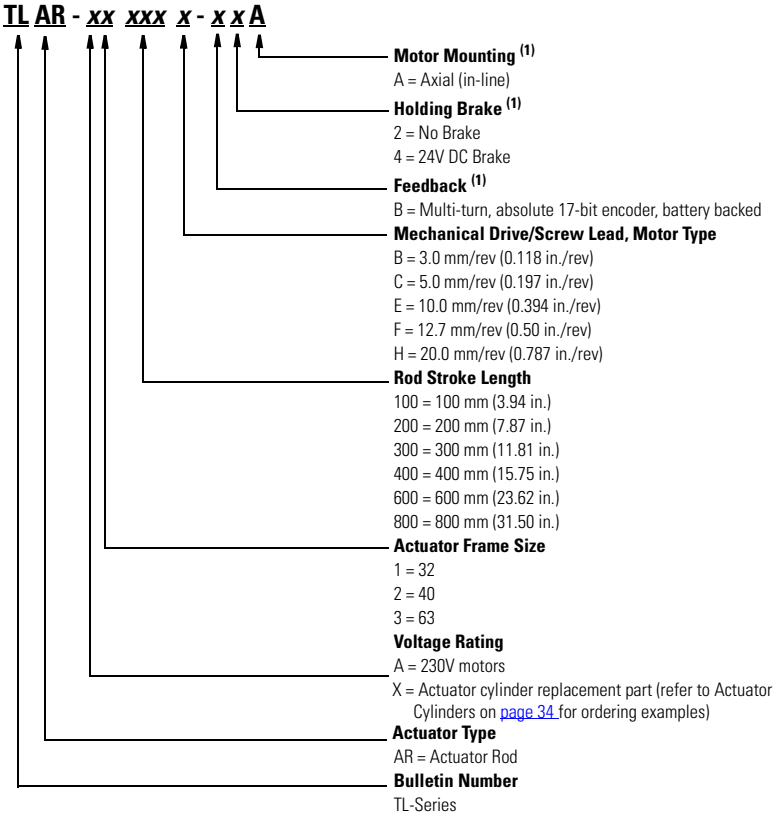
Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

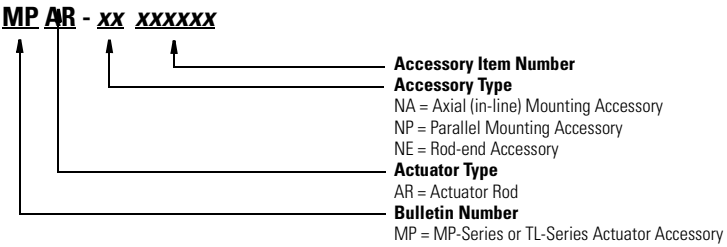
WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard and recognize the consequences.
SHOCK HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be on or inside the equipment, for example, a drive or motor to alert people that surfaces may reach dangerous temperatures.

Catalog Number Explanation

Catalog numbers consist of various characters, each of which identifies a specific version or option for that component. Use the catalog numbering chart below to understand the configuration of your actuator.



(1) This field does not apply to actuator cylinder replacement parts.

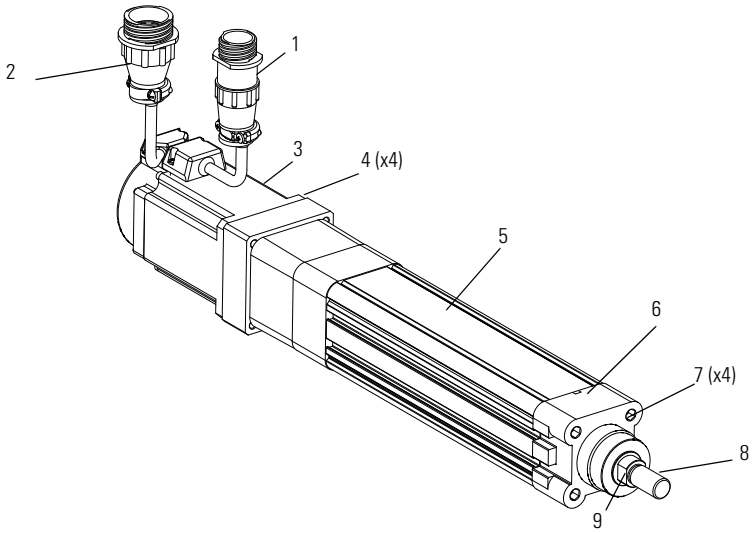


About the TL-Series Electric Cylinders

TL-Series electric cylinders feature multi-turn high resolution encoders and are available with 24V DC brakes. The TL-series motor rotates a ballscrew drive which converts rotary motion into linear movement. This linear movement results in the piston rod extending and retracting from the electric cylinder housing.

IMPORTANT The TLAR-A*xxxxx-x*2A electric cylinders are non-braking. When there is no input torque, the piston rod can be moved freely. Self-locking of your motion system can be achieved by using motors with an integrated brake or with high self-braking torque.

The TL-Series electric cylinders have been designed for exact positioning at high speeds.



Item	Description
1	Power connector
2	Feedback connector
3	TL-Series motor
4	Motor mounting bolts
5	Actuator cylinder
6	Breather port (must not be sealed or covered)
7	Hollow bolts with internal treads for fastening
8	Piston rod
9	Wrench flats for counteracting torque on piston rod

Before You Begin

Remove all packing material, wedges, and braces from within and around the item. After unpacking, verify the nameplate catalog number against the purchase order.

1. Remove packaging polyethylene foil and cardboard.

   The packing materials are recycleable, except for oiled paper which is waste.

2. Remove the electric cylinder carefully from its shipping container.

   Consider the weight of the electric cylinder. Depending on the design the electric cylinder can weigh up to 15.0 kg (33.07 lb).

3. Visually inspect the electric cylinder for damage.

4. Examine the electric cylinder frame, piston shaft, and hollow bolts for defects.

5. Notify the carrier of shipping damage immediately.

ATTENTION

Do not attempt to open and modify the electric cylinder. Only a qualified Allen-Bradley employee can service the internal working of the electric cylinder or motor.

Failure to observe these safety precautions could result in personal injury or damage to equipment.

Planning Your Installation

Refer to Kinetix Motion Control Selection Guide, publication GMC-SG001, for the specifications and additional products referenced in this section.

- This product can be operated in compliance with the relevant safety regulations, only if the maximum loading limits are observed.
- If you are mounting your electric cylinder in a vertical or sloping position, include safety measures that will control the work load, should the spindle nut fail.

ATTENTION

Uncontrolled moving masses can cause injury or damage to property.

If there is a spindle nut fracture inside the electric cylinder due to wear, the working mass will drop down.

Check whether additional external safety measures are required in order to prevent damage in the event of a spindle nut fracture.

- Corrosive environments reduce the service life of electric cylinders.
- Depending on the work load, the piston rod will bend. Refer to the piston rod deflection specifications for limitations.
- Motor feedback, auxiliary feedback, and I/O connector kits are not included, but can be purchased separately.
- Factory manufactured feedback and power cables are available in standard cable lengths. They provide environmental sealing and shield termination. Contact your Allen-Bradley sales office or refer to the selection guide for cables.

Preventing Electrical Noise

ElectroMagnetic Interference (EMI), commonly called electrical noise, can reduce motor performance. Effective techniques to counter EMI include filtering the AC power, use of shielded cables, separating signal cables from power wiring, and practicing good grounding techniques.

Follow these guidelines to avoid the effects of EMI:

- Isolate the power transformers or install line filters on all AC input power lines.
- Physically separate signal cables from motor cabling and power wiring. Do not route signal cables with motor and power wires, or over the vent openings of servo drives.
- Ground all equipment using a single-point parallel ground system that employs ground bus bars or large straps. If necessary, use additional electrical noise reduction techniques to reduce EMI in noisy environments.

Refer to System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001, for additional information on reducing the effects of EMI.

Build and Route Cables

Knowledgeable cable routing and careful cable construction improves system electromagnetic compatibility (EMC).

To build and install cables, perform the following steps.

1. Keep wire lengths as short as physically possible.
2. Route signal cables (encoder, serial, analog) away from motor and power wiring.
3. Separate cables by 0.3 m (1 ft) minimum for every 9 m (30 ft) of parallel run.
4. Ground both ends of the encoder cable shield and twist the signal wire pairs to prevent electromagnetic interference (EMI) from other equipment.

ATTENTION

High voltage can be present on the shield of a power cable, if the shield is not grounded.

Make sure there is a connection to ground for any power cable shield.

Failure to observe these safety precautions could result in personal injury or damage to equipment.

Install the Electric Cylinder

The installation must comply with all local regulations and use of equipment and installation practices that promote electromagnetic compatibility and safety.

ATTENTION

Unmounted electric cylinders, disconnected mechanical couplings, and disconnected cables are dangerous if power is applied.

Disassembled equipment should be appropriately identified (tagged-out) and access to electrical power restricted (locked-out).

Failure to observe these safety precautions could result in personal injury.

ATTENTION

Make sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors.

Excessive and uneven lateral force at the cable connectors may result in the connector's environmental seal opening and closing as the cable flexes.

Failure to observe these safety precautions could result in damage to the electric cylinder motor and its components.

ATTENTION

Damage may occur to the electric cylinder bearings and the feedback device if a sharp impact to the piston rod is applied during installation. Do not strike the piston rod with tools during installation or removal.

Do not attempt to rotate the piston rod. Rotating the piston rod will break the mechanism that allows the electric cylinder to extend and retract.

Failure to observe these safety precautions could result in damage to the electric cylinder and its components.

Follow these steps to install the electric cylinder.

1. Provide sufficient clearances in the area of the electric cylinder for it to stay within its specified operating temperature range.

   Refer to Specifications on page 32 for the operating temperature range. Do not enclose the electric cylinder unless forced air is blown across the electric cylinder for cooling. Keep other heat producing devices away from the electric cylinder.

   IMPORTANT Position the electric cylinder so that all the operating parts are accessible and the breather port is not covered.

2. Make sure the mounting surface supports the electric cylinder evenly so that it is free of mechanical stress and distortion. The evenness of support surface should be ≤ 0.2 mm (0.008 in.).

   IMPORTANT Do not modify the settings of the screws and the threaded pins.

   The electric cylinder must not be fastened by the front cover alone when used with high loads.

   Heavy tensile strain may cause the screws in the cover to pull out.

3. Attach mounting accessories to the electric cylinder, see Accessories on page 29.

   Tighten the fastening screws evenly.

Attribute	Frame 32	Frame 40	Frame 63
Internal thread of cover screws	M6	M6	M8
Tightening torque, max (1)	5 N•m (3.69 lb•ft)	5 N•m (3.69 lb•ft)	9 N•m (5.90 lb•ft)

(1) Unless otherwise noted, the torque specification have a ±20% tolerance.

4. Attach rod-end accessories and the work load.

Be sure the work load center of gravity is centric to the piston rod.

ATTENTION

Damage may occur to the electric cylinder bearings and the feedback device if sharp impact to the piston rod is applied during installation. Do not strike the piston rod with tools during installation or removal.

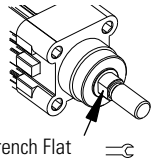
Failure to observe these safety precautions could result in damage to the electric cylinder and its components.

IMPORTANT

Do not twist or rotate the piston rod. If the piston rod is rotated, the absolute position of the electric cylinder will be lost and the absolute home position must be re-established.

When fastening a rod-end accessory or work load to the piston rod, use two wrenches. Use one wrench to tighten the mounting nut or rod-end accessory and the other, on the piston-rod wrench flats, to counter act the applied torque. Be sure that the torque is not applied to the piston rod and that the piston rod does not rotate.

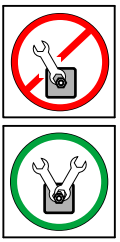
Frame Size	Piston rod thread	Wrench flats width
32	M10 x 1.25	10 mm
40	M12 x 1.25	13 mm
63	M16 x 1.5	17 mm



ATTENTION

Do not rotate the piston rod. Rotating the piston rod will break the mechanism that lets the electric cylinder extend and retract. Use two wrenches to install the work load.

Failure to observe these safety precautions could result in damage to the electric cylinder and its components.



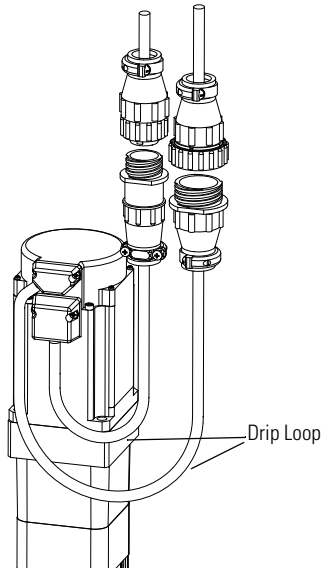
If you are using a Coupling Piece attachment, catalog number MPAR-NE3612*x* or Trunnion Mounting Kit, catalog number MPAR-NA1635*xx,* see Accessories on page 29 for torque values.

If using a Rod Guide accessory, catalog number MPAR-NE34*xxx* or MPAR-NE150*xxx,* adjust the guides of the work load and the electric cylinder so that they are exactly parallel. This avoids excessive wear on the guide.

Mount the Electric Cylinder

1. Use stainless steel fasteners to mount your electric cylinder to your application.

2. Attach power and feedback cables and use a drip loop in the cable to keep liquids away from the motor.



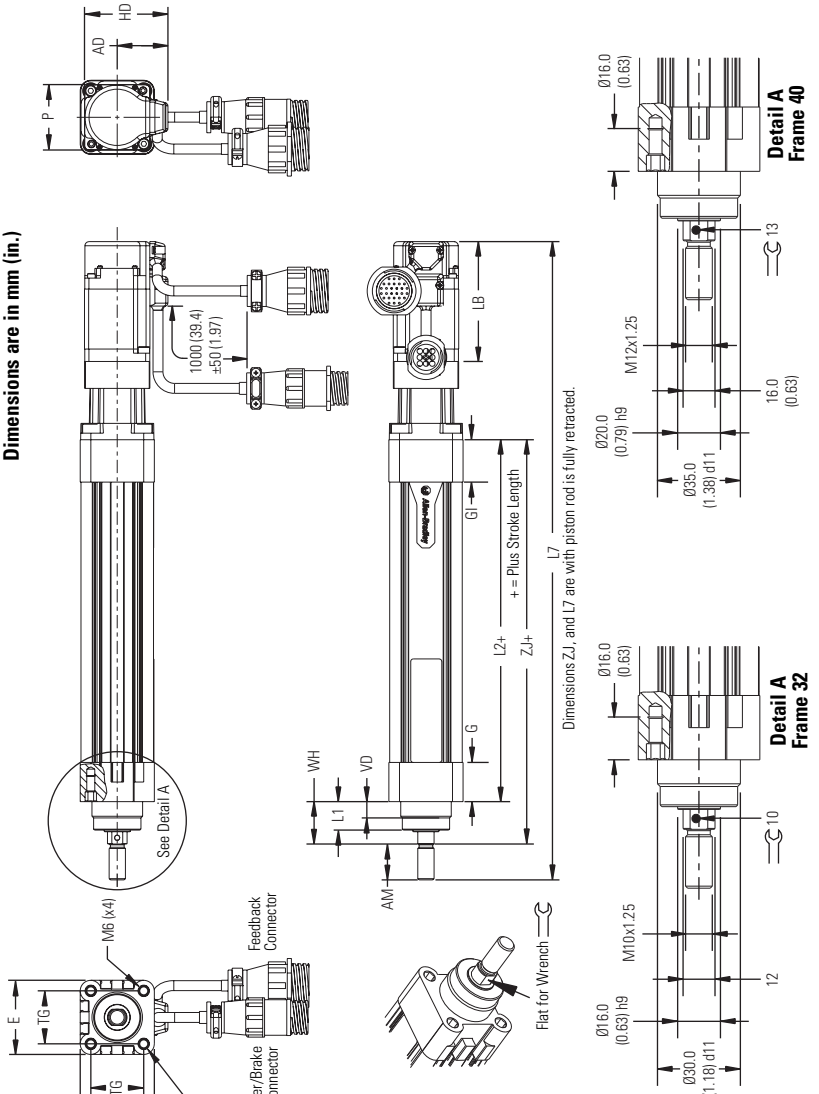
BURN HAZARD

Outer surfaces of the motor can reach high temperatures, 65 °C (149 °F) during electric cylinder operation. Take precautions to prevent accidental contact with hot surfaces. Failure to observe these safety precautions could result in personal injury.

3. Verify the continuity and functionality of the thermal switch signals, TS+ and TS-. These signals are transmitted through the feedback cable that connects the motor to its controlling drive.

Dimensions

TL-Series Electric Cylinders (frame 32 and frame 40)



TL-Series Electric Cylinder Dimensions (frame 32)

Electric Cylinder Cat. No.	L7 (1) mm (in.)	LB (1) mm (in.)	P mm (in.)	AD mm (in.)	HD mm (in.)	AM mm (in.)	G1 mm (in.)	L1 mm (in.)	ZJ (2) mm (in.)	WH mm (in.)
TLAR-A1100B-B2A	391.5 (15.41)	73.5 (2.89)	40.0 (1.57)	31.1 (1.22)	51.1 (2.01)	22.0 (0.87)	26.0 (1.02)	18.0 (0.71)	148.0 (5.83)	26.0 (1.02)
TLAR-A1200B-B2A	491.5 (19.35)									
TLAR-A1300B-B2A	591.5 (23.29)	76.1 (3.0)								
TLAR-A1400B-B2A	691.5 (27.22)									
TLAR-A1100E-B2A	405.5 (15.96)	109.1 (4.30)	60.0 (2.36)	43.0 (1.69)	73.0 (2.87)					
TLAR-A1200E-B2A	505.5 (19.90)									
TLAR-A1300E-B2A	605.5 (23.84)	110.7 (4.36)								
TLAR-A1400E-B2A	705.5 (27.78)									

(1) If ordering TLAR-A1*xxx*B-B4A actuator with brake, add 35.6 mm (1.40 in.) to dimensions L7 and LB.

If ordering TLAR-A2*xxx*E-B4A actuator with brake, add 34.6 mm (1.36 in.) to dimensions L7 and LB.

(2) The tolerance for this dimension is ±1.0 mm (0.039 in.).

TL-Series Electric Cylinder Dimensions (frame 40)

Electric Cylinder Cat. No.	L7 (1) mm (in.)	LB (1) mm (in.)	P mm (in.)	AD mm (in.)	HD mm (in.)	AM mm (in.)	G1 mm (in.)	L1 mm (in.)	ZJ (2) mm (in.)	WH mm (in.)
TLAR-A2100C-B2A	436.0 (17.17)	76.1 (3.0)	60.0 (2.36)	43.0 (1.69)	73.0 (2.87)	24.0 (0.94)	30.0 (1.18)	21.5 (0.85)	176.5 (6.95)	30.0 (1.18)
TLAR-A2200C-B2A	536.0 (21.10)									
TLAR-A2300C-B2A	636.0 (25.04)									
TLAR-A2400C-B2A	736.0 (28.98)									
TLAR-A2600C-B2A	936.0 (36.85)									
TLAR-A2100F-B2A	457.9 (18.03)	98.1 (3.86)								
TLAR-A2200F-B2A	557.9 (21.96)									
TLAR-A2300F-B2A	657.9 (25.90)									
TLAR-A2400F-B2A	757.9 (29.84)									
TLAR-A2600F-B2A	957.9 (37.71)									

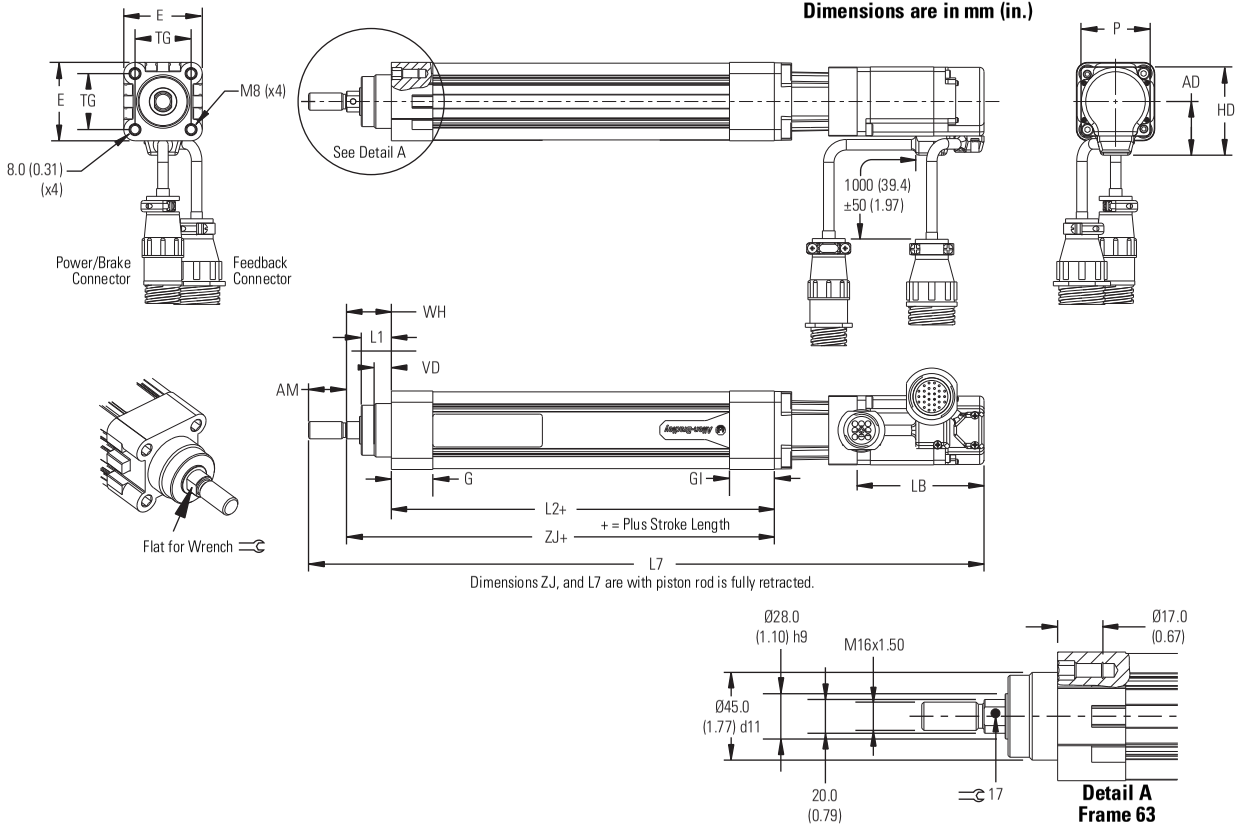
(1) If ordering TLAR-A2*xxxx*-B4A actuator with brake, add 36.1 mm (1.42 in.) to dimensions L7 and LB.

(2) The tolerance for this dimension is ±1.0 mm (0.039 in.).

Actuators are designed to metric dimensions. Inch dimensions are approximate conversions from millimeters. Dimensions without tolerances are for reference.

TL-Series Electric Cylinders (frame 63)

Dimensions are in mm (in.)



TL-Series Electric Cylinder Dimensions (frame 63)

Electric Cylinder Cat. No.	L7 (1) mm (in.)	LB (1) mm (in.)	P mm (in.)	AD mm (in.)	HD mm (in.)	AM mm (in.)	G1 mm (in.)	L1 mm (in.)	ZJ (2) mm (in.)	WH mm (in.)
TLAR-A3100E-B2A	564.6 (22.23)	144.2 (5.68)	86.0 (3.39)	56.0 (2.20)	99.0 (3.90)	32.0 (1.26)	36.0 (1.42)	28.5 (1.12)	214.0 (8.43)	37.0 (1.46)
TLAR-A3200E-B2A	664.6 (26.17)									
TLAR-A3300E-B2A	764.6 (30.10)									
TLAR-A3400E-B2A	864.6 (34.04)									
TLAR-A3600E-B2A	1064.6 (41.91)									
TLAR-A3800E-B2A	1264.6 (49.79)									
TLAR-A3100H-B2A	564.6 (22.23)									
TLAR-A3200H-B2A	664.6 (26.17)									
TLAR-A3300H-B2A	764.6 (30.10)									
TLAR-A3400H-B2A	864.6 (34.04)									
TLAR-A3600H-B2A	1064.6 (41.91)									
TLAR-A3800H-B2A	1264.6 (49.79)									

(1) If ordering TLAR-A3*xxxx*-B4A actuator with brake, add 23.0 mm (0.91 in.) to dimensions L7 and LB.

(2) The tolerance for this dimension is ±1.0 mm (0.039 in.).

Actuators are designed to metric dimensions. Inch dimensions are approximate conversions from millimeters. Dimensions without tolerances are for reference.

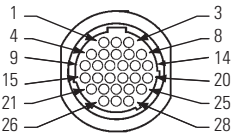
Connector Data

This table lists the signal descriptions for feedback, power, and brake connector pins on the electric cylinder.

Feedback

Pin	Signal	
1…5	Reserved	—
6	BAT+	Brown
7…12	Reserved	—
13	Data+	Blue
14	Data-	Blue/black
15…21	Reserved	—
22	EPWR 5V	Red
23	ECOM & BAT-	Black
24	Shield	Drain wire
25…28	Reserved	—

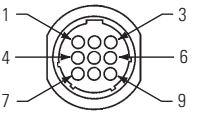
Tyco AMP 206152-1



Power and Brake

Pin	Signal	
1	U phase	Red
2	V phase	White
3	W phase	Black
4	Reserved	—
5	Ground	Yellow/grn & drain wires
6	Reserved	—
7	MBRK+	Yellow
8	Reserved	—
9	MBRK-	Blue

Tyco AMP 206705-2



ATTENTION

Be sure that cables are installed and restrained to prevent uneven tension or flexing at the cable connectors. Excessive and uneven force at the cable connector may result in damage to the housing and contacts as the cable flexes. Failure to observe these safety precautions could result in damage to the motor and its components.

Commissioning

This section provides guidelines for using RSLogix 5000 software to configure your electric cylinder servo drive system.

Required Files

Firmware revisions and software versions required to support the electric cylinders include the following:

- RSLogix 5000 software, version 16.00 or later
- Kinetix 2000 multi-axis drives
  - Firmware revision 1.96 or later
  - For RSLogix 5000 software, version 16.*xx*
    use Motion Database file, version 4_18_0 or later
  - For RSLogix 5000 software, version 17.*xx* or later
    use Motion Database file, version 5_9_0 or later
- Motion Analyzer software, version 4.7 or later

Download these files from http://support.rockwellautomation.com. Contact Rockwell Automation Technical Support at (440) 646-5800 for assistance.

Configure Your Electric Cylinder

Configure the electric cylinder by using the basic parameter settings described in this section. Please use the procedure appropriate for your drive.

ATTENTION

Moving parts can cause injuries. Before running the electric cylinder, make sure all components are secure and safe guards are in place to prevent access to the path of moving machinery.

Safeguards should prevent access to the electric cylinder until all motion has stopped.

Check that the electric cylinder is clear of foreign matter and tools. Objects hit by the moving piston rod can become projectiles that can cause personnel injury or damage to the equipment.

IMPORTANT

You are responsible to verify that the servo control system safely controls the electric cylinder with regard to maximum force, acceleration, and speed.

ATTENTION

Before powering the electric cylinder,.

Configure RSLogix 5000 Software for Electric Cylinder with Kinetix Drives

Use the following procedure to configure the drive for your electric cylinder. It is assumed the electric cylinder and a Kinetix 2000 drive are installed and wired.

ATTENTION

Incorrect parameter settings may result in uncontrolled motion, with the potential for damage to the electric cylinder.

Initiating a motion command on an electric cylinder with an incorrect Position mode setting may result in damage to the electric cylinder, and the machine in which it is installed.

1. Enter these parameters in the Axis Properties tabs of RSLogix 5000 software for electric cylinder.

Axis Properties Tab	Parameter	Entry/Selection
Drive/Motor	Motor Catalog Number	Select one from the list TLAR -A1*xxx*B-B2A TLAR -A1*xxx*B-B4A TLAR -A1*xxx*E-B2A TLAR -A1*xxx*E-B4A TLAR -A2*xxx*C-B2A TLAR -A2*xxx*C-B4A TLAR -A2*xxx*F-B2A TLAR -A2*xxx*F-B4A TLAR -A3*xxx*E-B2A TLAR -A3*xxx*E-B4A TLAR -A3*xxx*H-B2A TLAR -A3*xxx*H-B4A
	Drive Resolution	200,000
	Drive Counts per	Motor Rev

Axis Properties Tab	Parameter	Entry/Selection, with applicable distance unit settings	
		Metric	English
Conversion	Positioning Mode	Linear	
		Setting the Positioning Mode to Rotary can cause damage to the electric cylinder or the machine due to incorrect positioning.	
	Conversion Constant	66666.667 drive cnts/1.0 mm for	1693333.3 drive cnts/1.0 in. for
		TLAR-*x*1*xxx*B-B2A TLAR-*x*1*xxx*B-B4A	
	Conversion Constant	20000 drive cnts/1.0 mm for	508000 drive cnts/1.0 in. for
		TLAR-*x*1*xxx*E-B2A TLAR-*x*1*xxx*E-B4A TLAR-*x*3*xxx*E-B2A TLAR-*x*3*xxx*E-B4A	
	Conversion Constant	40000 drive cnts/1.0 mm for	1016000 drive cnts/1.0 in. for
		TLAR-*x*2*xxx*C-B2A TLAR-*x*2*xxx*C-B4A	
	Conversion Constant	15748.0315 drive cnts/1.0 mm for	400000 drive cnts/1.0 in. for
		TLAR-*x*2*xxx*F-B2A TLAR-*x*2*xxx*F-B4A	
	Conversion Constant	10000 drive cnts/1.0 mm for	254000 drive cnts/1.0 in. for
		TLAR-*x*3*xxx*H-B2A TLAR-*x*3*xxx*H-B4A	
Dynamics	Maximum Speed(1)	150 mm/s (default 157.5 mm/s)	5.91 in./s (default 6.20 in./s)
		TLAR-*x*1*xxx*B-*xx*A	
		500 mm/s (default 525 mm/s)	19.68 in./s (default 20.67 in./s)
		TLAR-*x*1*xxx*E-*xx*A TLAR-*x*3*xxx*E-*xx*A	
		250 mm/s (default 262.5 mm/s)	9.82 in./s (default 10.33 in./s)
		TLAR-*x*2*xxx*C-*xx*A	
		640 mm/s (default 672 mm/s)	24.61 in./s (default 25.84 in./s)
		TLAR-*x*2*xxx*F-*xx*A	
		1000 mm/s (default 1050 mm/s)	41.34 in./s (default 43.41 in./s)
		TLAR*x*3*xxx*H-*xx*A	
	Maximum Acceleration (2)	6000 mm/s/s	236.22 in./s/s
	Maximum Deceleration (2)	6000 mm/s/s	236.22 in/s/s
	Maximum Acceleration Jerk	Use default values, or adjusted for your application	
	Maximum Deceleration Jerk	Use default values, or adjusted for your application.	

(1) The default value is 5% more than your actuator rated maximum speed. Do not command maximum speed in your application in excess of the rated speed.

(2) Accelerations in excess of the following may lead to reduction of life of your actuator.

2. Click the Homing tab.

3. Set parameters for either absolute homing or torque level-to-marker homing as shown on the table.

Parameter	Absolute Homing	Torque Level-to-Marker Homing
	Value	Value
Mode	Absolute	Active
Position	0, typical	0, typical
Offset	N/A	0 mm
Sequence	Immediate	Torque Level-to-Marker
Direction	N/A	Reverse Bi-directional
Torque Level	N/A	30%, min Greater if the system friction, force, or weight exceeds 30% of the Continuous Force Rating at any point in the range of motion
Speed	N/A	10 mm/s (1.97 in./s)
Return Speed	N/A	10 mm/s (0.39 in./s)

ATTENTION

Avoid excessive force while homing the electric cylinder. Do not exceed 10 mm/s (0.4 in/s) during a home routine.

Speeds greater than 10 mm/s (0.4 in/s) may damage the electric cylinder when the piston rod reaches the end of travel.

4. Complete the following steps for absolute homing.

   a. Use motion direct commands to slowly jog your axis to your application's home location. Do not exceed 10 mm/s (0.4 in./s).

   b. Issue the Motion Direct Command (MAH) to set the home position on your axis.

5. Click the Limits tab.

6. Enter these parameters.

Parameter	Entry/Selection, with applicable distance unit settings
Hard Travel Limits	Check if hardware limits are in use. Use the Motion Analyzer software to determine the maximum stopping distance in your application to set negative and positive limits.
Soft Travel Limits	Check if software limits are in use. Use the Motion Analyzer software to determine the maximum stopping distance in your application to set negative and positive limits.
Maximum Positive	Enter value that is within the piston rod mechanical travel.
Maximum Negative	Enter value that is within the piston rod mechanical travel.

7. Set overtravel limits according to the maximum speed of the servo drive system and the payload of the application.

IMPORTANT Set travel limits and direction of tuning moves in reference to piston rod starting position. Leave adequate travel for the piston rod to complete its moves while tuning.

ATTENTION

Software overtravel must be set prior to initiating tuning process. Check the starting position of the piston rod and allow for adequate travel.

Insufficient travel while auto tuning will cause the software overtravel to trigger or an end-stop impact.

You can determine the deceleration distance before the piston rod contacts the end of travel based on the deceleration rate of the load, and the available peak force from the motor/ballscrew combination. Use the Motion Analyzer software to calculate the minimum deceleration distance at the maximum speed of your application.

IMPORTANT Do not exceed the maximum energy specified for end-of-travel impacts.

Cat. No.	Impact Energy, max
TLAR-*x*1*xxxx-xx*A	0.0001 J
TLAR-*x*2*xxxx-xx*A	0.0002 J
TLAR-*x*3*xxxx-xx*A	0.0004 J

This table lists maximum velocity for end-stop impact with no load.

Cat. No.	Extracted Mass g (oz)	Impact Velocity, max mm/s (in./s)
TLAR-*x*1100B-*xxx*	239 (8.4)	28.9 (1.14)
TLAR-*x*1200B-*xxx*	308 (10.8)	25.5 (1.00)
TLAR-*x*1300B-*xxx*	377 (13.9)	23.0 (0.91)
TLAR-*x*1400B-*xxx*	446 (15.7)	21.2 (0.83)
TLAR-*x*1100E-*xxx*	269 (9.5)	27.3 (1.07)
TLAR-*x*1200E-*xxx*	338 (11.9)	24.3 (0.96)
TLAR-*x*1300E-*xxx*	407 (14.36)	22.2 (0.87)
TLAR-*x*1400E-*xxx*	476 (16.8)	20.5 (0.81)
TLAR-*x*2100C-*xxx*	399 (14.1)	31.7 (1.25)

Cat. No.	Extracted Mass g (oz)	Impact Velocity, max mm/s (in./s)
TLAR-*x*2200C-*xxx*	488 (17.2)	28.6 (1.12)
TLAR-*x*2300C-*xxx*	577 (20.4)	26.3 (1.03)
TLAR-*x*2400C-*xxx*	666 (23.5)	24.5 (0.96)
TLAR-*x*2600C-*xxx*	844 (29.8)	21.8 (0.86)
TLAR-*x*2100F-*xxx*	469 (16.5)	29.2 (1.15)
TLAR-*x*2200F-*xxx*	558 (19.7)	26.8 (1.05)
TLAR-*x*2300F-*xxx*	647 (22.82)	24.9 (0.98)
TLAR-*x*2400F-*xxx*	736 (26.0).	23.3 (0.92)
TLAR-*x*2600F-*xxx*	914 (32.2)	20.9 (0.82)
TLAR-*x*3100E-*xxx*	938 (33.1)	29.2 (1.15
TLAR-*x*3200E-*xxx*	1066 (37.6)	27.4 (1.08)
TLAR-*x*3300E-*xxx*	1194 (42.1)	25.9 (1.02)
TLAR-*x*3400E-*xxx*	1322 (46.6)	24.6 (0.97)
TLAR-*x*3600E-*xxx*	1578 (55.7)	22.5 (0.86)
TLAR-*x*3800E-*xxx*	1834 (64.7)	20.9 (0.82)
TLAR-*x*3100H-*xxx*	938 (33.1)	29.2 (1.149)
TLAR-*x*3200H-*xxx*	1066 (37.6)	27.4 (1.08)
TLAR-*x*3300H-*xxx*	1194 (42.1)	25.9 (1.02)
TLAR-*x*3400H-*xxx*	1322 (46.6)	24.6 (0.97)
TLAR-*x*3600H-*xxx*	1578 (55.7)	22.5 (0.88)
TLAR-*x*3800H-*xxx*	1834 (64.7)	20.9 (0.82)

IMPORTANT Absolute position is maintained while the motor feedback cable is connected to the drive. If the cable is disconnected or if a motor fault is reported by the drive, the absolute home position must be re-established.

Tune Your Electric Cylinder with RSLogix 5000 Software

This section shows the steps to tune electric cylinders with RSLogix 5000 software, version 16.

- Tuning your electric cylinder requires you to calculate and configure the loop gain based on the actual measured inertia.
- By setting travel limits your application minimum deceleration is defined.

Follow these steps to tune your electric cylinder.

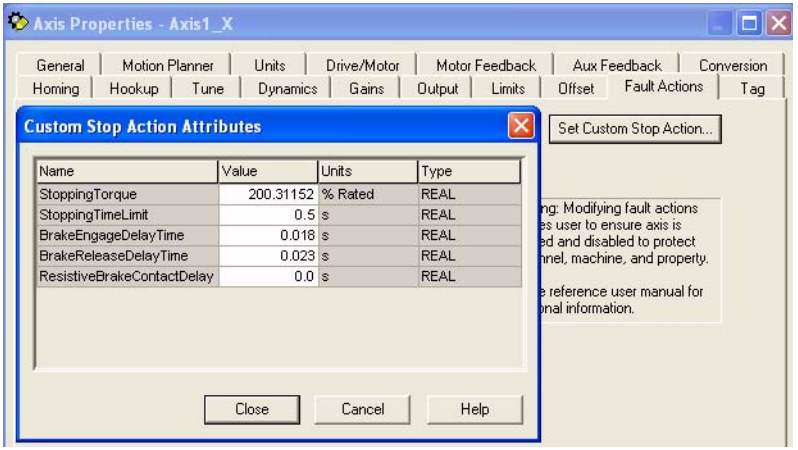
1. In the Axis Properties dialog box, click the Fault Actions tab.

2. Click Set Custom Stop Action.

TIP These parameter settings work best if the electric cylinder is installed in a horizontal (table top) or a wall mount (vertical) orientation.

3. In the Custom Stop Action Attributes dialog box, set the Brake Engage and the Brake Release delay times to the values listed in Specifications on page 32.

4. Reduce the default Stopping Time Limit from 10 seconds to 0.5 seconds.



IMPORTANT To prevent the rod from moving or falling when installed in a vertical orientation, the Stopping Time Limit must be set to 0.99 seconds or less.

5. Click the Tune tab and enter the following parameters:

   - Travel Limit - Set to within software limits.
   - Speed (velocity).
   - Torque/Force.

IMPORTANT Set travel limits and direction of tuning moves in reference to piston rod starting position. Leave adequate travel for the piston rod to complete its moves while tuning.

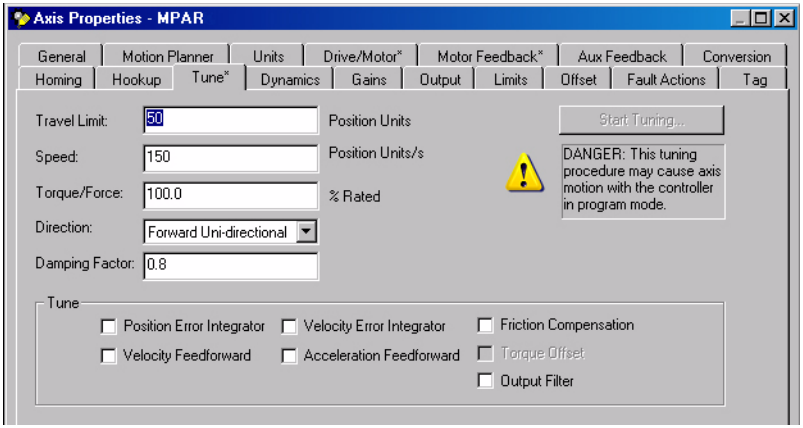
ATTENTION

Software overtravel must be set prior to initiating tuning process. Check the piston rod starting position and allow for adequate travel.

Insufficient travel while auto tuning will cause the software overtravel to trigger or an end stop impact.

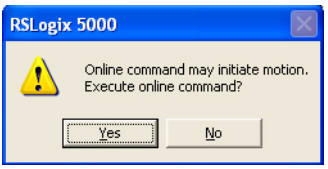
IMPORTANT

Only check Torque Offset, as shown below, if the electric cylinder is installed in a non-horizontal mount position.



6. Click Start Tuning to access the Motion Initiation dialog box.

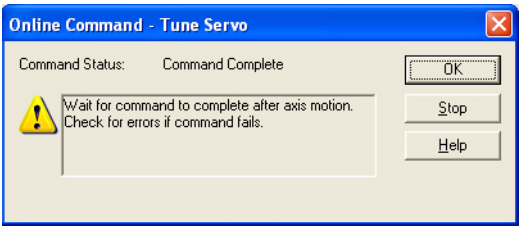
7. Click Yes to begin tuning the electric cylinder.



ATTENTION

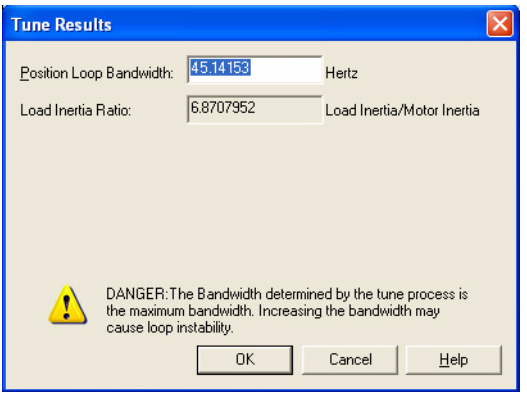
Motion occurs immediately after clicking Yes.

Tuning is complete when the Tune Servo dialog box opens.



8. Click OK to exit Tuning.

   The Tune Results dialog box opens.



9. If you are satisfied with the tuning results click OK, otherwise continue with Calculate and Configure the Loop Gain.

Calculate and Configure the Loop Gain

Calculate a position loop bandwidth based on the actual measured inertia values from the Tune Results dialog box.

In this example, the Tune Results dialog box shows a default Position Loop Bandwidth of 45.14153 Hz, and a Load Inertia Ratio of 6.8707952.

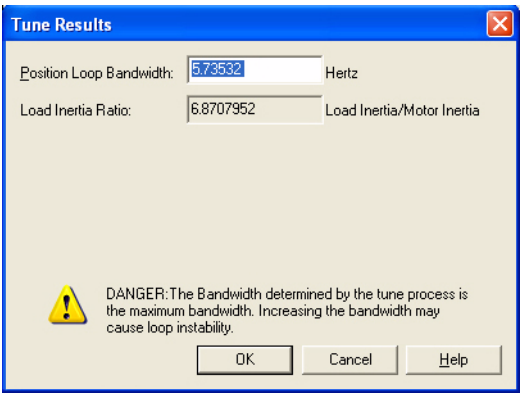
1. Calculate the Corrected Position Bandwidth.

   Corrected Position Loop Bandwidth = (Initial Position Loop Bandwidth Result/(Initial Load Inertia Ratio Result +1)

   For example, 5.73532 = 45.14153/7.8707952

2. Enter the Corrected Position Bandwidth value 5.73532 as the Position Loop Bandwidth.

3. Click OK.



4. Answer the remaining dialog boxes to apply the values.

The proper Position Bandwidth results in a stable starting point, from which you can adjust the gains to fit your application requirements.

Maintenance

Follow these steps to maintain your electric cylinder.

1. Remove power to the electric cylinder and lock-out tag-out power source.
2. Check the axial play of the piston rod for wear of the spindle nut.

   Wear on the electric cylinder leads in to increased noise.

ATTENTION

If a worn spindle nut breaks on a vertically or diagonally mounted electric cylinder, the work load will fall. Uncontrolled moving mass can cause personal injury or damage to equipment.

3. Clean the electric cylinder with a soft cloth, if necessary, using any non-abrasive cleaning solution.
4. Lightly dampen a soft cloth with isopropyl alcohol and wipe the piston rod and seal.
5. Lubricate the piston rod with a fine layer of LUB-KC1 grease from Klueber, www.klueber.com.

Storage

Store your electric cylinder for a minimal amount of time in a clean and dry location within Specifications on page 32.

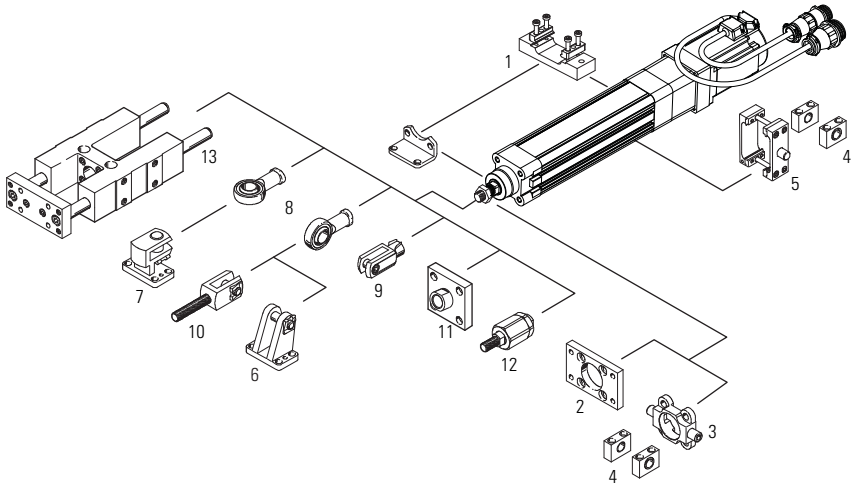
Troubleshooting

Description	Possible cause	Corrective action
Axial play too large.	Wear.	Replace actuator cylinder. Send to Rockwell Automation for repair.
Squeaking noises or vibrations.	Distortions.	Check the electric cylinder is free of stress and evenly supported ≤ 0.2 mm (0.008 in.). Lubricate piston rod. See Maintenance on page 26. Modify positioning speed.
	Needs tuning.	Modify control parameters.
	Running noises of the spindle support (with strokes 300 mm (11.81 in.) and high positioning speeds).	Normal, no impairment of function.
Piston rod does not move.	Jamming in mechanical end position, after traveling at excessive speed or into end position.	Loosen jamming manually. 1. Switch off power supply. 2. Remove motor and coupling housing. 3. Turn drive shaft. Reduce speed for reference travel. Provide software end positions, at least 0.25 mm (0.01 in.) from the mechanical end positions (stops).
	Load is too large.	Reduce load mass. Reduce positioning speed. Return for repairs.
	Ambient temperature too low (increased breakaway torque in initial run due to increasing viscosity of the lubricants in the spindle system).	Reduce load mass. Reduce positioning speed. If necessary, allow higher current with servo motors (see operating instructions for the motor). Increase ambient temperature.

Description	Possible cause	Corrective action
No response from electric cylinder.	Controller/drive not enable.	Enable controller/drive.
	Controller/drive faulted.	Reset the controller/drive.
	Improper/failed wiring.	Check the wiring.
Electric cylinder is enabled but not operating or is operating erratically.	Feedback cable may be damaged.	Test the feedback cable.
	Feedback wiring may be incorrect.	Verify correct feedback wiring.
Electric cylinder is operating but is not up to rated speeds/forces.	Motor phase are wired incorrectly or in incorrect order.	Verify correct motor power wiring.
	Amplifier may be improperly tuned.	Check gain settings.
	Amplifier may be set up improperly for electric cylinder used.	Check amplifier setting for number of poles, voltage, current, resistance, inductance, inertia, and other motor settings.
Actuator cannot move load.	Force is too large for the capacity of the electric cylinder or to much friction is present.	Verify force requirements.
	Misalignment of piston rod to load.	Verify load alignment.
	Amplifier has too low current capacity or is limited to too low of current capacity.	Verify correct amplifier and settings.
Electric cylinder moves or vibrates when piston rod is in motion.	Loose mounting.	Check electric cylinder mounting.
	Amplifier is improperly tuned-wrong gain setting.	Tune amplifier.
Actuator is overheating.	Duty cycle is higher than actuator rating.	Verify load forces and electric cylinder rating.
	Actuator is being operated outside of continuous rating.	Adjust operation to be within continuous operation rating.
	Amplifier is poorly tuned, causing excessive current to be applied to motor.	Check gain settings.

Accessories

The following diagram and tables show the available accessories and their weights. Refer to the Kinetix Motion Control Selection Guide, Publication GMC-SG001, for dimensions.



Mounting Accessories

Accessory Item		Frame	Cat. No.	Weight, approx. g (oz)
1	Foot Mounting Kit	32	MPAR-NA174991	240 (8.46)
		40	MPAR-NA174992	310 (10.93)
		63	MPAR-NA174993	510 (17.99)
2	Flange Mounting	32	MPAR-NA174376	240 (8.46)
		40	MPAR-NA174377	280 (9.88)
		63	MPAR-NA174379	690 (24.34)
3	Trunnion Flange	32	MPAR-NA174411	130 (4.58)
		40	MPAR-NA174412	240 (8.46)
		63	MPAR-NA174414	600 (21.16)
4	Trunnion Support	32	MPAR-NA32959	130 (4.58)
		40	MPAR-NA32960	400 (14.11)
		63	MPAR-NA32961	480 (16.93)
6	Clevis Foot	32	MPAR-NA761	220 (7.76)
		40	MPAR-NA762	300 (10.58)
		63	MPAR-NA764	580 (20.46)

Accessory Item		Frame	Cat. No.	Weight, approx. g (oz)
5	Trunnion Mounting Kit	32	MPAR-NA163525	210 (7.41)
		40	MPAR-NA163526	390 (13.76)
		63	MPAR-NA163528	890 (31.39)
2	Flange Mounting (corrosion resistant)	32	MPAR-NA161846	240 (8.46)
		40	MPAR-NA161847	300 (10.58)
		63	MPAR-NA161849	710 (25.04)
3	Trunnion Flange (corrosion resistant)	32	MPAR-NA161852	150 (5.29)
		40	MPAR-NA161853	260 (9.17)
		63	MPAR-NA161855	640 (22.57)
4	Trunnion Support (corrosion resistant)	32	MPAR-NA161874	200 (7.05)
		40	MPAR-NA161875	330 (11.64)
		63	MPAR-NA161876	440 (11.64)
7	Clevis Foot (right angle)	32	MPAR-NA768	290 (10.23)
		40	MPAR-NA769	360 (12.70)
		63	MPAR-NA771	880 (31.0)

TL-Series Electric Cylinders Rod-end Accessories

Accessory Item		Frame	Cat. No.	Weight, approx. g (oz)
8	Rod Eye	32	MPAR-NE9261	70 (2.47)
		40	MPAR-NE9262	110 (3.53)
		63	MPAR-NE9263	210 (7.41)
10	Rod Clevis	32	MPAR-NE32954	140 (4.94)
		40	MPAR-NE10767	210 (7.41)
		63	MPAR-NE10768	500 (17.64)
9	Rod Clevis (corrosion resistant)	32	MPAR-NE13569	110 (3.88)
		40	MPAR-NE13570	180 (6.35)
		63	MPAR-NE13571	400 (14.11)
11	Coupling Piece	32	MPAR-NE36125	110 (3.88)
		40	MPAR-NE36126	180 (6.35)
		63	MPAR-NE36127	250 (8.82)

Accessory Item		Frame	Cat. No.	Weight, approx. g (oz)
8	Rod Eye (corrosion resistant)	32	MPAR-NE195582	70 (2.47)
		40	MPAR-NE195583	110 (3.53)
		63	MPAR-NE195584	210 (7.41)
9	Rod Clevis	32	MPAR-NE6144	110 (3.88)
		40	MPAR-NE6145	170 (6.00)
		63	MPAR-NE6146	390 (13.76)
12	Self-aligning Rod Coupler	32	MPAR-NE6140	210 (7.41)
		40	MPAR-NE6141	220 (7.76)
		63	MPAR-NE6142	650 (22.93)

Accessory Item		Cat. No.	Frame	Stroke Length mm (in)	Weight, approx. kg (lb)
13	Rod Guide	MPAR-NE34494	32	100 (3.94)	1.7 (3.747)
		MPAR-NE34496		200 (7.87)	1.9 (4.19)
		MPAR-NE34497		320 (12.60)	2.1 (4.63)
		MPAR-NE150290		400 (15.75)	2.3 (5.07)
		MPAR-NE34500	40	100 (3.94)	2.7 (5.95)
		MPAR-NE34502		200 (7.87)	3.0 (6.61)
		MPAR-NE34504		320 (12.60)	3.4 (7.49)
		MPAR-NE150291		400 (15.75)	3.7 (8.16)
		MPAR-NE34505		500 (19.68)	4.0 (8.82)
		MPAR-NE34514	63	100 (3.94)	5.9 (13.01)
		MPAR-NE34516		200 (7.87)	6.4 (14.11)
		MPAR-NE34518		320 (12.60)	7.0 (15.43)
		MPAR-NE34519		400 (15.75)	7.4 (16.31)
		MPAR-NE34520		500 (19.68)	7.9 (17.42)

Trunnion Mounting Kit

Cat. No.	Frame Size	Torque N•m (lb•ft)
MPAR-NA163525	32	4…5 (2.9…3.7)
MPAR-NA163526	40	8…9 (5.9…6.6)
MPAR-NA163528	63	18…20 (13.3…14.5)

Coupling Piece Attachment

Cat. No.	Frame Size	Max Torque (1) N•m (lb•ft)	Max Torque (2) N•m (lb•ft)	Max Torque (3) N•m (lb•ft)
MPAR-NE36125	32	5.9 (4.35)	34 (25.1)	12 (8.8)
MPAR-NE36126	40	5.9 (4.35)	61 (45.0)	22 (16.2)
MPAR-NE36127	63	9.9 (7.3)	148 (109.2)	57 (42.0)

(1) Torque applies to mounting screws with standard threads and strength class 8.8. Apply torque to mounting screws evenly.

(2) Torque applies to lock nut on piston rod.

(3) Torque that coupling can transmit with coefficient of friction μ = 0.1 and 10 x safety margin at maximum permissible tightening torque.

Specifications

TL-Series Electric Cylinders General Specifications - TLAR-A*xxxxx*

Attribute	Frame 32	Frame 40	Frame 63
Construction design	Ballscrew driven non-rotating piston rod.		
Piston rod thread	M10x1.25	M12x1.25	M16x1.50
Working stroke	100…400 mm (3.9…15.7 in.)	100…600 mm (3.9…23.6 in.)	100…800 mm (3.9…31.5 in.)
Protection against torsion/guide	Plain bearing guide		
Stroke reserve	0 mm		
Angle of rotation at the piston rod, max	±0.30°	±0.25°	±0.20°
Impact energy (E) at the end positions $E = 0.5 \times m \times v^2$	0.0001 J	0.0002 J	0.0004 J
Positioning repeatability	±0.02 mm (0.0008 in.), max		
Reversing backlash (1)	0.05 mm (0.002 in.), max		
Duty cycle	100%		
Position sensing (feedback)	Multi-turn absolute encoder		
Type of mounting	Via female threads		
	Via accessories		
Mounting position	Any		

(1) In new condition.

Performance Specifications

Cat. No.(1)	Frame	Max Feed Force N (lb)	Continuous Feed Force N (lb)	Max Speed m/s (in./s)	Stroke Lengths mm (in.)	Max Acceleration m/sec^2 (in./sec^2)
TLAR-A1*xxx*B	32	300 (67)	240 (54)	0.15 (5.9)	100 (3.94) 200 (7.87) 300 (11.81) 400 (15.75)	6.0 (236)
TLAR-A1*xxx*E		350 (79)	280 (63)	0.50 (19.7)		
TLAR-A2*xxx*C	40	525 (118)	420 (94)	0.25 (9.8)	100 (3.94) 200 (7.87) 300 (11.81) 400 (15.75) 600 (23.62)	
TLAR-A2*xxx*F		800 (180)	520 (117)	0.64 (25.2)		
TLAR-A3*xxx*E	63	2500 (562)	1750 (393)	0.50 (19.7)	100 (3.94) 200 (7.87) 300 (11.81) 400 (15.75) 600 (23.62) 800 (31.50)	
TLAR-A3*xxx*H		1625 (365)	975 (219)	1.0 (39.4)		

(1) Stroke length replaces xxx in each catalog number.

Moving Load Specifications

Attribute	TLAR-A1*xxx*B	TLAR-A1*xxx*E	TLAR-A2*xxx*C	TLAR-A2*xxx*F	TLAR-A3*xxx*E	TLAR-A3*xxx*H
	Frame 32, Weight, approx. g (oz)		**Frame 40, Weight, approx.** g (oz)		**Frame 63, Weight, approx.** g (oz)	
Moving load with 0 mm stroke	170 (6.0)	200 (7.05)	310 (10.93)	380 (13.40)	810 (28.57)	810 (1.79)
Moving load per 10 mm stroke	6.9 (0.24)	6.9 (0.24)	8.9 (0.31)	8.9 (0.31)	12.8 (0.45)	12.8 (0.028)

Brake Specifications

Electric Cylinder Cat. No.	Holding Force N (lb)	Coil Current at 24V DC A	Brake Response Time		
			Release (1) ms	Engage (using external arc suppression device)	
				MOV (2) ms	Diode (3) ms
TLAR-A1*xxx*B	300 (67)	0.18…0.22	21	7	40
TLAR-A1*xxx*E	350 (79)	0.333…0.407	22	13	73
TLAR-A2*xxx*C	525 (118)				
TLAR-A2*xxx*F	552 (124)				
TLAR-A3*xxx*E	1414 (318)	0.351…0.429	42	14	86
TLAR-A3*xxx*H	707 (159)				

(1) Brake release time delay with voltage applied.

(2) Brake engage time delay with voltage removed and MOV used for arc suppression.

(3) Brake engage time delay with voltage removed and diode used for arc suppression.

Environmental Specifications

Attribute	Value
Temperature, operating ambient	0…40 °C (32…104 °F)
Temperature, storage ambient	-25…60 °C (-13…140 °F)
Humidity, relative (non-condensing)	5…95%
Liquid/dust protection	IP40 (complete unit) includes rod-end seal and breather port
Shock, max	20 g peak, 6 ms duration
Vibration, max(1)	2.5 g peak @ 30…2000 Hz

(1) Tested for one hour per Rockwell Automation specification 10000056670. Contact your distributor for a copy of this specification.

Weight Specifications

Electric Cylinders (weight of cylinder with non-brake motor)

Electric Cylinder Cat. No.	Weight, approx. kg (lb)
TLAR-A1100B-B2A	1.7 (3.75) (1)
TLAR-A1200B-B2A	2.0 (4.41) (1)
TLAR-A1300B-B2A	2.4 (5.29) (1)
TLAR-A1400B-B2A	2.7 (5.95) (1)
TLAR-A1100E-B2A	2.4 (5.29) (2)
TLAR-A1200E-B2A	2.8 (6.17) (2)
TLAR-A1300E-B2A	3.1 (6.83) (2)
TLAR-A1400E-B2A	3.4 (7.49) (2)

Electric Cylinder Cat. No.	Weight, approx. (3) kg (lb)
TLAR-A2100C-B2A	3.1 (6.83)
TLAR-A2200C-B2A	3.6 (7.94)
TLAR-A2300C-B2A	4.0 (8.82)
TLAR-A2400C-B2A	4.5 (9.92)
TLAR-A2600C-B2A	5.4 (11.90)
TLAR-A2100F-B2A	3.7 (8.16)
TLAR-A2200F-B2A	4.1 (9.04)
TLAR-A2300F-B2A	4.6 (10.14)
TLAR-A2400F-B2A	5.1 (11.24)
TLAR-A2600F-B2A	6.0 (13.23)

Electric Cylinder Cat. No.	Weight, approx. (4) kg (lb)
TLAR-A3100E-B2A	9.5 (20.94)
TLAR-A3200E-B2A	10.3 (22.71)
TLAR-A3300E-B2A	11.1 (24.47)
TLAR-A3400E-B2A	11.9 (26.23)
TLAR-A3600E-B2A	13.5 (29.76)
TLAR-A3800E-B2A	15.2 (33.51)
TLAR-A3100H-B2A	9.3 (20.50)
TLAR-A3200H-B2A	10.1 (22.27)
TLAR-A3300H-B2A	10.9 (24.03)
TLAR-A3400H-B2A	11.7 (25.79)
TLAR-A3600H-B2A	13.4 (29.54)
TLAR-A3800H-B2A	15.0 (33.07)

(1) If ordering an TLAR-A*xxxxx*-B4A electric cylinder with brake, add 0.2 kg (0.4 lb).

(2) If ordering an TLAR-A*xxxxx*-B4A electric cylinder with brake, add 0.5 kg (1.1 lb).

(3) If ordering an TLAR-A*xxxxx*-B4A electric cylinder with brake, add 0.4 kg (0.9 lb).

(4) If ordering an TLAR-A*xxxxx*-B4A electric cylinder with brake, add 0.6 kg (1.3 lb).

Actuator Cylinders (weight of replacement cylinder)

Actuator Cylinder(1) Cat. No.	Weight, approx. kg (lb)
MPAR-X1100B	1.1 (2.43)
MPAR-X1200B	1.4 (3.09)
MPAR-X1300B	1.7 (3.75)
MPAR-X1400B	2.1 (4.63)
MPAR-X1100E	1.1 (4.63)
MPAR-X1200E	1.4 (3.09)
MPAR-X1300E	1.8 (3.97)
MPAR-X1400E	2.1 (4.63)

Actuator Cylinder (1) Cat. No.	Weight, approx. kg (lb)
MPAR-X2100C	1.7 (3.75)
MPAR-X2200C	2.2 (4.85)
MPAR-X2300C	2.6 (5.73)
MPAR-X2400C	3.1 (6.83)
MPAR-X2600C	4.0 (8.82)
MPAR-X2100F	1.8 (3.97)
MPAR-X2200F	2.3 (5.07)
MPAR-X2300F	2.8 (6.17)
MPAR-X2400F	3.2 (7.05)
MPAR-X2600F	4.2 (9.26)

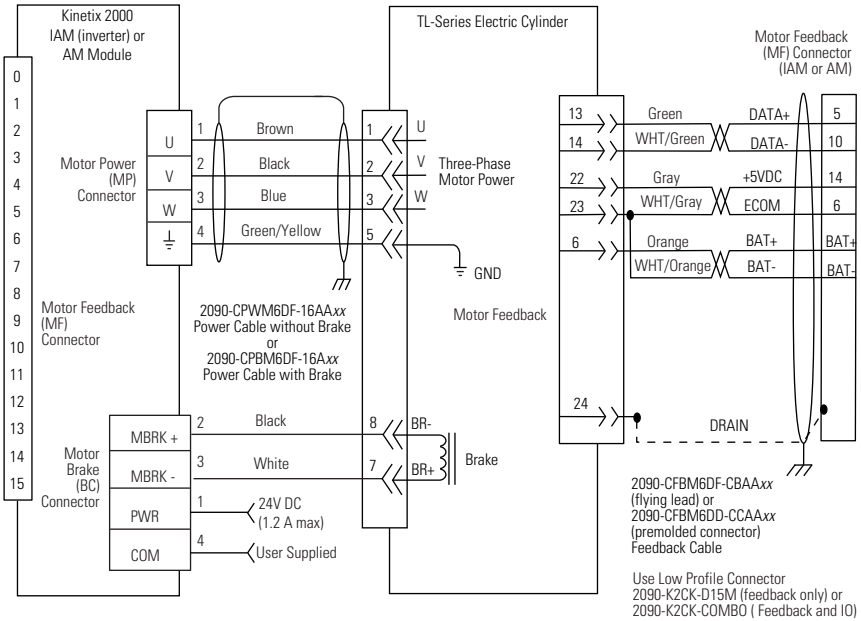
Actuator Cylinder Cat. No.	Weight, approx. kg (lb)
MPAR-X3100E	3.8 (8.38)
MPAR-X3200E	4.6 (10.14)
MPAR-X3300E	5.4 (11.90)
MPAR-X3400E	6.3 (13.89)
MPAR-X3600E	7.9 (17.46)
MPAR-X3800E	9.5 (20.94)
MPAR-X3100H	3.8 (8.38)
MPAR-X3200H	4.6 (10.14)
MPAR-X3300H	5.4 (11.90)
MPAR-X3400H	6.3 (13.89)
MPAR-X3600H	7.9 (17.42)
MPAR-X3800H	9.5 (20.94)

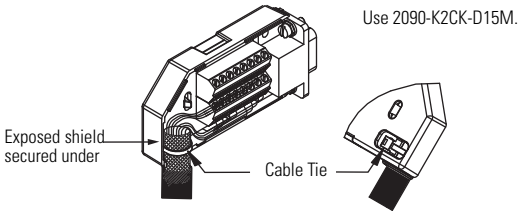
(1) Replacement actuator cylinder example, if ordering a replacement cylinder for electric cylinder catalog number TLAR-A2100C-B2A, the replacement actuator cylinder is catalog number MPAR-X2100C.

Interconnect Diagrams

This is an example diagram for wiring your TL-Series electric cylinder and Allen-Bradley servo drives.

Wiring Example of TL-Series Electric Cylinder to Kinetix 2000 Drive





Additional Resources

These documents contain additional information concerning related Rockwell Automation products.

Resource	Description
TL-Series Servo Motors Installation Instructions, publication TL-IN003	Information on installing TL-Series motors
Kinetix 2000 Multi-axis Servo Drive User Manual, publication 2093-UM001	Information on installing, configuring, startup, and troubleshooting a Kinetix 2000 servo drive system with a TL-Series electric cylinder and Kinetix 2000 servo drive.
Motion Analyzer CD, download at http://www.rockwellautomation.com/en/e-tools/configuration.html.	Drive and motor sizing with application analysis software
Motion Modules in Logix5000 Control Systems User Manual, publication LOGIX-UM002	Information on configuring and troubleshooting your ControlLogix and CompactLogix SERCOS interface modules.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
Kinetix Motion Control Selection Guide, publication GMC-SG001	Specifications, motor/servo-drive system combinations, and accessories for Kinetix motion control products.
Rockwell Automation Product Certification Website, publication available at http//:www.rockwellautomation.com/products/certification.	For declarations of conformity (DOC) currently available from Rockwell Automation
National Electrical Code. Published by the National Fire Protection Association of Boston, MA.	An article on wire sizes and types for grounding electrical equipment

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