Tolomatic
EXCELLENCE *IN MOTION*®

Quick Start-Up Guide

ServoChoke®

INSTALLATION, OPERATION AND MAINTENANCE

2600-4001_02
Version: _02
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LINEAR SOLUTIONS MADE EASY

Contents

TABLES & FIGURES

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Health and Safety Regulations

General

Read completely through the applicable sections of the manual before the equipment/ unit is unpacked, installed or operated. Pay careful attention to all of the dangers, warnings, cautions and notes stated in the manual.

Serious injury to persons or damage to the equipment may result if the information in the manual is not followed.

Safety Symbols

Items that are specifically marked DANGER!, WARNING!, CAUTION!, OR NOTE! Are arranged in a hierarchical system and have the following meaning:

DANGER!

Indicates a very hazardous situation which, if not avoided, could result in **death or serious injury.** This signal word is limited to the most extreme situations.

WARNING!

Indicates a potentially hazardous situation which, if not avoided, could result in **death or serious injury.**

CAUTION!

Indicates a potentially hazardous situation which, if not avoided, this situation may result in property damage or minor or moderate injury.

NOTE!

Information that requires special attention is stated here.

WARNING FOR HOT SURFACES

Indicates hot surfaces. Avoid contact.

Product Description:

ServoChoke is an electromechanical linear actuator designed for positioning linear choke valves. This actuator is designed to meet ATEX, IECEx, and North American Explosion Proof and Flame Proof requirements, and operate in an outdoor environment from -40° to +60°C (-40° to +140° F) ambient temperature. See Appendix A for details on certifications and markings.

The ServoChoke actuator is built with all steel construction and utilizes roller screw technology. The ServoChoke actuator uses an absolute multi-turn feedback encoder, and parking brake to maintain position in the event of a work stoppage or shutdown event.

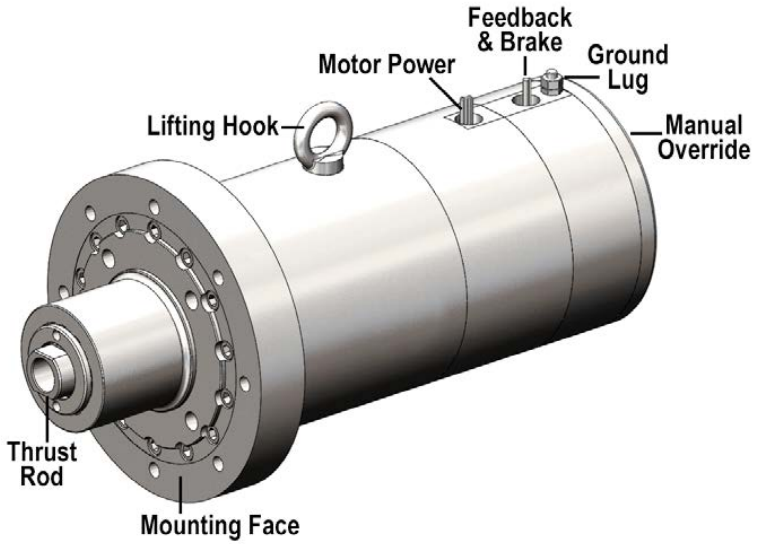


Figure 1: The ServoChoke actuator

Installation of ServoChoke 7k and 15k actuator:

MECHANICAL INSTALLATION GUIDELINES:

NOTE!

The ServoChoke actuator weighs 136 -152 kg (300 - 335 lb). Special care must be taken when lifting this device. A lift ring located at the center of gravity is provided to aid in positioning the actuator to the valve.

ServoChoke actuators are designed with 58 - 95 mm (2.3 - 3.75") of total travel. The actuator must never reach the end of stroke in service.

WARNING! - When installing, verify the total valve travel is correctly positioned inside the 58 - 95 mm (2.3 - 3.75") travel window of the ServoChoke actuator.

Mounting to the Choke: The ServoChoke actuator is to be front mounted to the choke using any of the flange mounts provided. The thru hole, ISO 5211 F25 pilot dimensions and bolt attachment sizing and specification are provided in Appendix D.

Coupling the thrust rod to the choke stem: The thrust rod extending from the actuator has an M33x2.0mm female thread with thread depth of 45 mm (1.77"). This female thread should be utilized to couple the actuator to the choke valve stem.

NOTE!

During installation, ensure that the thrust rod and valve stem are aligned concentrically within 0.025 mm (0.001") to avoid side loading the actuator. Side loading the actuator may lead to premature wear or failure of the actuator.

Flats are provided on the end of the thrust rod to hold the radial orientation of the thrust rod during the connection. A 40 mm wrench can be used on the flats to hold the radial position. Do not radially load the thrust rod when making the valve connection. If installation prohibits the use of a wrench to hold the thrust rod, contact factory for alternative installation procedure.

Input torque on the thrust rod shall not exceed 271 N-m (200 ft-lbf) or damage to the internal components of the actuator may occur.

ELECTRICAL INSTALLATION GUIDELINES:

General Connections: Two sets of flying leads exit from the ServoChoke actuator. The rearmost set of flying leads includes wiring for the brake and encoder. The foremost set of flying leads includes the servomotor power leads, a ground lead, thermal switch leads and a bare shield lead. A M10 stud with locknuts is provided on the external surface to attach an external ground. (See Appendix D: Mechanical Information, Figure A,B,C).

Conduit Connector Information:

Servomotor – ¾-14 NPT conduit connection.
Feedback – ¾-14 NPT conduit connection
(See Appendix D: Mechanical Information)

The factory sealed entries shall not be considered to serve as a seal for another adjacent explosion proof enclosure that is required to have a conduit seal.

Servomotor Information:
Maximum Speed: 3000 RPM
Current Requirements: 3.0 A Continuous

See Appendix B for motor setup information.

NOTE!

Supplying more than 365 Vdc to the motor may increase the rotational speed of the motor greater than specified maximum speed leading to premature failure of the actuator.

Leads: White, Red and Black 16AWG leads are provided for servomotor power

Wire Color	Drive Phase
Red	U
White	V
Black	W
Green	Earth/Ground
Bare Tinned Wire	Shield Wire

Table 1: ServoChoke wire colors

Earth Grounds/Shielding: The green wire or green wire with yellow stripe is the internal grounding terminal and shall be used as the equipment grounding means. The bare tinned lead is a shield wire which may be connected to conduit or other shielding at customer discretion.

Green External Ground Stud: An M10 stud with locknuts is provided to be used as a supplemental bonding connection where local authorities permit or require such a connection. The M10 stud and nuts should be used with a ring terminal connection. The top nut should be torqued to approximately 34 N-m (25 ft-lbf) to retain the ring terminal.

Thermal Switch: Two yellow 22AWG leads are attached to a normally closed thermal switch which will open if the motor winding temperature reaches or exceeds 150°C (302°F). These leads should be terminated to the motor drive and configured to stop operation of the motor on a switch position change from closed to open.

Brake Information: 24 Vdc power is required to release the brake during operation. Two white 22AWG leads exit the conduit opening as a pair and are identified as brake wires. Ensure that these two white wires are used for the brake.

NOTE!

The holding brake must be wired such that the servomotor will not turn unless 24V power is supplied to the brake. This ensures that the brake is released prior to spinning the motor.

FEEDBACK WIRING

The wiring of the feedback device is critical to the operation of the actuator with the selected drive. The installer must not pull or tug on the encoder and brake wires when cutting, stripping and terminating as it may damage the small gauge wires which will prevent the actuator from operating.

WARNING

Electrical connections and cabling should receive special attention during component selection and system design when utilizing servo motor controlled systems. It is recommended that the cable consist of individually shielded, twisted pairs of wires in addition to an outer cable shield. Contact your preferred cable supplier for their recommendations based upon the electrical specifications of the encoder and the environment in which the actuator is intended for use.

WARNING

Improperly wiring the feedback cable can cause unstable operation, incorrect operation or no operation at all.

⚠ WARNING

In some cases, improper current limits set in the drive, along with incorrect wiring of the feedback cable can lead to damage of the motor.

Absolute Feedback Encoder Device Standard Hiperface FBx1 & FBx3 Feedback Device Wiring:

Lead	Wire Color	Connection Note
Input Voltage (Vcc)	Red	7-12Vdc Encoder Power. Connect to motor drive per drive manual
Ground (Gnd)	Blue	Encoder ground. Connect to motor drive per drive manual
REFSIN	Brown	Connect to motor drive per drive manual
Data+	Gray or Yellow	Connect to motor drive per drive manual
REFCOS	Black	Connect to motor drive per drive manual
Data-	Green or Purple	Connect to motor drive per drive manual
+SIN	White	Connect to motor drive per drive manual
+COS	Pink	Connect to motor drive per drive manual

Table 2: Absolute Feedback Encoder Device Standard Hiperface FBx1 & FBx3 Feedback Device Wiring:

Absolute Feedback Encoder Wiring for FBx2 SSI + Sin/Cos:

Lead	Wire Color	Connection Note
Input Voltage	Red	5-30 Vdc
Ground	Blue	Connect to motor drive per manual
Clk+	Yellow	Connect to motor drive per manual
Data+	White	Connect to motor drive per manual
SET	Orange	Connect to motor drive per manual if required
Data-	Brown	Connect to motor drive per manual
Clk-	Violet	Connect to motor drive per manual
Sin-	Black	Connect to motor drive per manual
V/R	Orange/Black	Connect to motor drive per manual if required
Cos-	Green	Connect to motor drive per manual
Cos+	Gray	Connect to motor drive per manual
Sin+	Pink	Connect to motor drive per manual

Table 3: Absolute Feedback Encoder Wiring for FBx2 SSI + Sin/Cos:

A class 2 power supply must be used to power the selected encoder. Additionally ensure the encoder leads are isolated from the brake leads using shielded wrap as best practice to ensure a high quality feedback signal from the encoder.

The encoders have internal temperature switches which will deactivate the ServoChoke® actuator.

Encoder	Temp Range			
	°C Min	°C Max	°F Min	°F Max
FBC1 SSI	- 40	+ 85	- 40	+ 185
FBS1 & FBB3 Hiperface	- 40	+ 115	- 40	+ 239
FBS2 SSI+Sin/Cos	- 40	+ 100	- 40	+ 212
FBC2 SSI+Sin/Cos	- 40	+ 85	- 40	+ 185

Table 4: Encoder temperature range:

If the encoder reaches temperatures above maximum, the encoder will error out the drive. This encoder error signal should not be deactivated and aids in protecting the actuator from an over-temperature situation.

NOTE!

Tolomatic strongly recommends the use of wiring best practices be used when making electrical connections to the actuator. Too many junctions or improper shielding may result in poor performance or render the actuator inoperable.

ServoChoke Operation

OPERATION USING MANUAL OVERRIDE FEATURE:

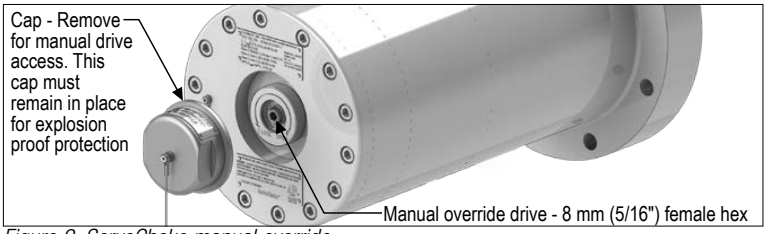


Figure 2: ServoChoke manual override:

Located under the back cap on the rear of the actuator is a manual override feature that allows the user to manually position the actuator (See Appendix D: Mechanical Information, Figure C). This feature is designed to be used during setup or in the event the actuator must be used in a non-powered situation. The cap may be unlocked by loosening the M5 set screw on the cap flange with a 2.5 mm hex tool, and then removed using the provided flats and a 63.5mm (2.5") wrench. The manual override shaft has an 8mm (5/16) female hex. It is best practice to release the brake by applying 24 volts of power before manual indexing the actuator.

When operating the manual override with the electric brake released, input torque must be limited to 5.6 N-m (50 in-lbf) for the SVC 7k and 2.8 N-m (25 in-lbf) for the SVC 15k.

If powered equipment is used to drive the manual override, care must be taken not to

drive the actuator into the end stops. Impacting these under high torque or high velocity will damage the actuator.

NOTE!

The cap must be in place during actuator use as it is integral to the protection scheme of this device. Torque cap to 217 N-m (160 ft-lb). To lock cap, torque M5 set screw to 1.7 N-m (15 in-lbf)

OPERATION USING SERVO DRIVE/CONTROLLER:

Tolomatic recommends the following start-up procedure to ensure proper safeguards are followed to avoid damaging both the ServoChoke® actuator and the choke valve.

Feedback verification

- Initial operation to verify feedback function: Wire **only** the encoder and brake to the drive.
- Apply power to the drive so the encoder and brake are powered.
- Turn the manual override clockwise to extend the thrust rod and verify that the encoder and drive are connected and the drive is updating with the moving shaft.
- Manually drive the actuator out to near middle of stroke or about 38mm (1.5") measured from the end of the nose to the wrench flat.

Applying power to the winding and homing the actuator

- With the drive power off, connect the servomotor leads to the drive. Ensuring that all motor drive parameters are correctly entered per Appendix B.
- Prior to installing the choke to the actuator, use the drives tuning features to tune the actuator with the encoder, brake, and motor leads connected to the drive. Verify the phase angle. If everything checks out with initial tuning, power down the drive and install the actuator to the choke body.
- To establish full open and close position of the actuator or choke valve, set the drive torque limits to the lowest values possible for motion (25-30% to begin with) and use a slow velocity jog command (<1mm/s) to search for the hard limits. If 25-30% of the continuous current is not sufficient to drive both the actuator and the choke, slowly increase the current limit until the unit is able to move to both the fully open and fully closed positions. Proper care must be taken when finding hard limits after installation to the choke. Applying a current load in excess of the rated continuous (3A) at the end of choke travel may cause internal damage and could render the assembly inoperable or cause damage to the check valve.
- Once the full open and closed positions are determined, these values can be stored in the drive/controller as travel limits.
- Final tuning of the actuator may be done once connection to the choke is made to optimize all the parameters of the motor with the load attached for increased system performance and responsiveness.
- To ensure peak performance and reduce the risk of drive faults during recommissioning, it is recommended that the operator re-tune the motor any time the actuator is disconnected from a drive or an actuator is replaced within a system.

NOTE!

Verify the back cap over the manual override is in place and is torqued prior to powering and jogging the servomotor as the shaft will spin with the motor.

Tolomatic recommends the setup phase current and velocity profiles be used for moves executed from the host controller during testing and development of preliminary programs. Careful attention during programming and start-up **MUST** be observed to minimize impacting end of stroke of the actuator or choke valve above the rated continuous current as this may cause damage to either the choke or the actuator itself.

WARNING!

During operation external surfaces of this device may reach 108°C (226°F). Verify surface temperature with temperature measurement device prior to handling.

Maintenance Check and Intervals:

An inspection of the device, specifically checking wire integrity at conduit entries and the front shaft scraper, wiper and u-cup seal is recommended every 5000 run hours, or whenever the device is decoupled from the choke body. If the scraper, wiper or u-cup seal show wear or are not fitting tightly to the shaft they should be replaced with an updated seal kit. Any other items needing attention should be addressed by the manufacturer, Tolomatic Inc. A 68.6mm (2.700") spanner wrench with 10mm (0.394") pins is necessary to remove the seal retainer. The seal retainer must be torqued to 380 N-m (280 ft-lb) when reinstalled.

For seal kits or repair contact Tolomatic at 1-763-478-8000 or ship to Tolomatic, 3800 County Road 116, Hamel MN 55340. Please obtain a return authorization number prior to shipping to Tolomatic.

Lubrication: ServoChoke is lubricated at the factory for service life in the millions of adjustments. No additional lubrication or lubrication replenishment is required to commission or maintain the unit.

To gain the maximum service life of the actuator, periodic cycling of the actuator across the full length of stroke is recommended. This will ensure a consistent film of grease along the length of the power screw.

NOTE REGARDING PAINT

The paint used on ServoChoke actuators shipped from Tolomatic is designed for static dissipation. If the paint becomes chipped or is in need of touch-up, contact Tolomatic.

NOTE REGARDING EXTERNAL ALTERATIONS AND CORRECT HANDLING

This is an Ex d flameproof enclosure. The external enclosure of this flameproof equipment is designed to withstand an internal explosion. End Users/Operators who paint, alter or modify the external enclosure of the Servochoke unit invalidates the certification of the complete unit. Additionally, care must be taken while handling the ServoChoke during setup and installation not to damage components that include a flamepath, such as the thrust rod and threaded back cap.

Appendix A: Product Certifications & Markings

Special Conditions of Safe Use:

1. Field repair of flame paths is prohibited. Return to manufacturer for repair and maintenance.
2. Fasteners used to retain the flameproof enclosure are A4-70 Stainless Steel Socket Cap Machine Screws (Tensile strength of 700 MPa). Please refer to the manufacturer instructions for the size, length, and quantity of the special fasteners.

	Standard Specifications Met	**Product Certification Marking**
IECEx	IEC 60079-0:2011 +C1:2012 +C2:2013 IEC 60079-1:2014 -06	Ex db IIB T4 Gb -40°C≤TAMB≤+60°C IP6X
ATEX Electrical ATEX Non-Electrical	EN 60079-0:2012 / A11:2013 EN 60079-1:2014 EN 13463-1:2009 EN 13463-5:2011	CE Ex II 2 G Ex db IIB T4 Gb -40°C≤TAMB≤+60°C IP6X
North America Ordinary Location North America Hazardous Locations	UL 1004-1:2015 2nd Edition UL 1004-6:2012 2nd Edition CSA C22.2 No. 100:2014 UL1203:2015 5th Edition CSA C22.2 No. 30:1986, R2012 UL 60079-0:2013 UL 60079-1:2015 CSA C22.2 No. 60079-0:2015 CSA C22.2 No. 60079-1:2016	 USA & Canada: Class I, Division 1, Groups C and D, T4 Class 1, Zone1, AEx db IIB T4 Gb Class 1, Zone1, Ex db IIB T4 Gb -40°C≤TAMB≤+60°C, Type 3R

Table 5: Product Certifications & Markings:

Appendix B: Motor, Brake, Feedback Specs

SERVOCHOKE SERVOMOTOR SPECIFICATIONS

	SERIES	SVC 7k	SVC 15k
		ServoChoke 7k	Servochoke 15k
PEAK SPEED	RPM	3,000	3,000
Kt (trap)	oz-in/amp DC	232.03	232.03
Kt (sine)	Nm/Arms	2.007	2.007
Ke	Vrms/krpm	121.34	121.34
DC BUS VOLTAGE	Vdc	365	365
WINDING RESISTANCE	Ohms	2.0	2.0
INDUCTANCE	mH	12.2	12.2
MOTOR THERMAL TIME CONSTANT	minutes	108.0	108.0
CONT. CURRENT @ 70°F	Amp	3.0	3.0
MAX. MOTOR TEMP	°F	302	302
	°C	150	150
NUMBER OF POLES		18	18
ROTOR INERTIA	$lb\text{-}in^2$	11.3	11.3
	$kg\text{-}cm^2$	33.0	33.0
BRAKE VOLTAGE	Vdc	24	24
BRAKE TYPE		Electric Release	Electric Release
BRAKE POWER REQUIREMENTS	Watts	16.0	16.0

All values are subject to change without notice. Based on final performance testing and design verification

Table 6: ServoChoke ServoMotor Specifications:

Appendix C: Troubleshooting Procedure

Symptom	Cause	Solution
No response from actuator	Controller / Drive not enabled	Enable Controller/Drive
	Controller / Drive faulted	Reset the Controller/Drive
	Improper / Failed wiring	Check the wiring
Actuator is enabled but is not operating or is operating erratically	Feedback cable may be damaged	Test the feedback cable
	Feedback Wiring may be incorrect	Verify feedback wiring

Appendix C: Troubleshooting Procedure

Symptom	Cause	Solution
Actuator is operating but is not up to rated speeds/ force	Motor phases are wired incorrectly or in incorrect order	Verify correct wiring of motor armature
	Drive may be improperly tuned	Check all gain settings
	Drive may be set up improperly for actuator used	Check drive settings for number of poles, voltage, current, resistance, inductance, inertia, etc.
	Feedback is improperly aligned	Contact Tolomatic
Actuator cannot move	Force is too large for the capacity of the actuator or too much friction is present	Verify force requirements
	Misalignment of output rod to application	Verify correct alignment
	Drive has too low of current capacity or is limited to too low of current capacity	Verify correct drive settings
	Actuator has crashed into hard stop	Disconnect from load and manually move away from hard stop. If problem persists, contact Tolomatic for service
Actuator moves or vibrates when shaft is in motion	Loose mounting	Check actuator mounting
	Drive is improperly tuned - wrong gain settings	Tune drive
Actuator is overheating	Duty cycle is higher than actuator ratings	Verify duty cycle is within continuous ratings
	Drive is poorly tuned, causing excessive unnecessary current to be applied to motor	Check gain settings

Table 7: Troubleshooting procedure

Appendix D: Mechanical Information

Figure 3: ServoChoke side view

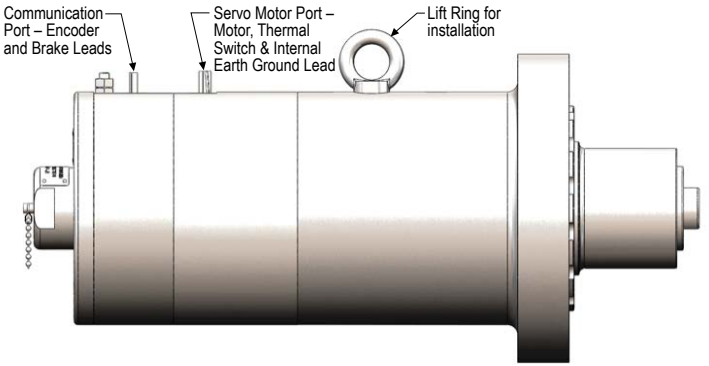


Figure 4: ServoChoke mounting (front view)

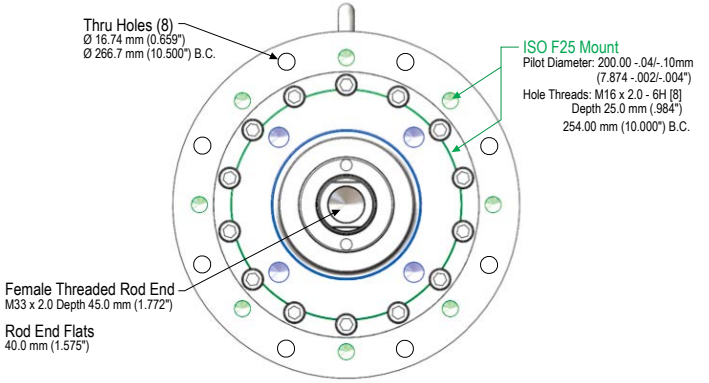
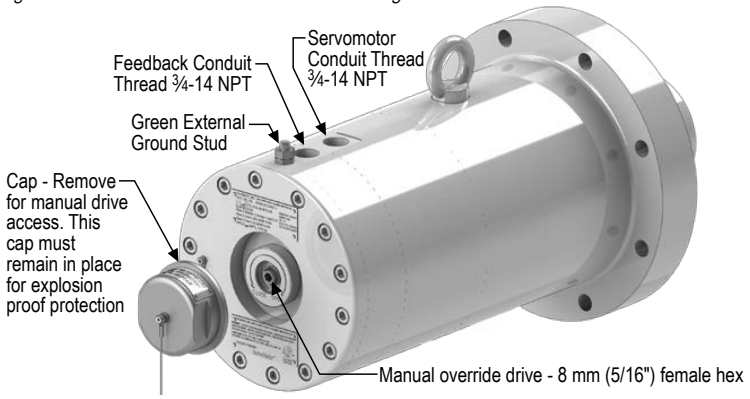


Figure 5: ServoChoke manual override & wiring



Appendix E: Performance Specifications

Mechanical Stroke: 58 - 95 mm (2.3 - 3.75")

Base Weight: 136 - 152 kg (300 - 335 lb)

Working Temperature Range -40°C to +60°C (-40°F to +140°F)

ACCELERATION LIMITS & CONSIDERATIONS

Tolomatic limits the acceleration and deceleration to 60mm/s² (2.36 in/s²) for the SVC (ServoChoke) 7k and 30mm/s² (1.18 in/s²) for the SVC 15k. It may be possible to raise these values based on specific application criteria. Contact Tolomatic for a full application review. Failure to maintain proper acceleration/deceleration values without Tolomatic review may result in premature failure of the internal powertrain components.

OPERATING INTERVAL CONSIDERATIONS

In order to maximize the service life of the SVC 7k & SVC 15k assemblies, careful attention to the ambient operational temperatures and average speed must be taken into consideration when determining pressure change intervals. Tolomatic recommends the use of a sun shade to protect the actuator from any increased elevation in temperature due to exposure to direct sunlight for temperatures over 45°C (113°F).

- Calculating the average speed value can be quickly calculated by tracking the distance moved over time and dividing this distance by the time interval (includes dwell time between moves).

Please refer to the average speed vs. force graphs (Figures 6 & 7) to determine if your motion intervals are within the recommended range given the ambient operating temperatures that the ServoChoke actuator will operate within.

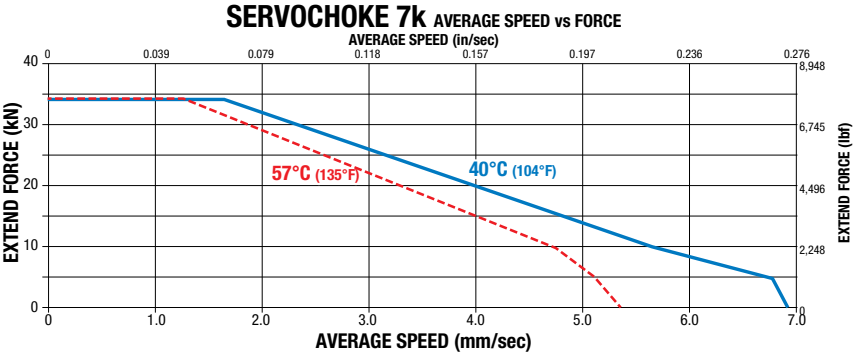


Figure 6: SVC (ServoChoke) 7k Average Speed vs Force

NOTE: Data reflects ServoChoke actuator thermally isolated from test stand and cooled only by natural convection.

Appendix E: Performance Specifications

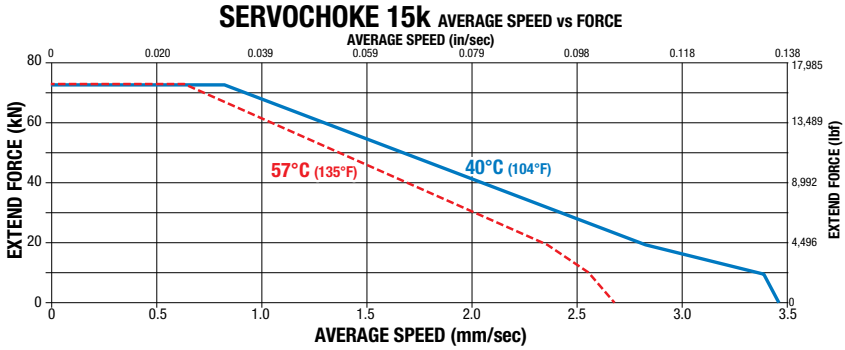


Figure 7: SVC (ServoChoke) 15k Average Speed vs Force

NOTE: Data reflects ServoChoke actuator thermally isolated from test stand and cooled only by natural convection.

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EXCELLENCE IN MOTION®

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