Tolomatic
EXCELLENCE *IN MOTION*®

USER GUIDE

IMA
Integrated Motor
Rod-Style Actuator

LINEAR SOLUTIONS MADE EASY

200911121553

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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.

Proper and Safe Use of Product

Fail Safe e-Stop Recommendations

A means for a fail safe e-stop is highly recommended to ensure equipment and personal safety. The e-stop should provide a means to remove main power from the actuator to cease and prevent any unwanted motion.

Device Damage Prevention

To prevent permanent damage to the device, proper care should be taken not to exceed published voltage, current, temperature, and load ratings. In addition, proper wiring should be verified and safety measures checked before applying power.

Personal Safety

During normal operation the actuator can become hot, especially the motor housing. It is highly recommended to display proper safety notices and implement proper safety measures to prevent contact with hot surfaces. In addition, the case ground should be tied to an earth ground to prevent the presence of case voltage.

Handling and Unpacking

When unpacking and handling the actuator, care should be taken not to drop the actuator as this can damage the connectors, internal electronics, or knock the actuator out of alignment. Since this is an electromechanical device, proper ESD measures should be taken to avoid static electricity from contacting the signal and power lines of the device.

Packing and Transport

NOTE!

Anchor and secure actuator in such a way as to prevent damage during transport. Also make sure the actuator is clean and dry and protected from moisture.

Modifications to the Equipment

WARNING!

The manufacturer takes no responsibility whatsoever if the equipment is modified or if the equipment is used in any way beyond performance specifications. Unauthorized modifications or changes to the equipment are strictly forbidden, and void all warranties.

Repair and Maintenance

WARNING!

All power and supply media must be shut OFF before any work is performed on any equipment that is associated with the IMA. The only field maintenance that may be performed on the IMA include lubrication and replacement of the front bearing. All other repair or maintenance for the IMA must be performed at Tolomatic.

Requirement Regarding Personnel

NOTE!

All personnel must be completely informed regarding all safety regulations and the function of the equipment.

Risk Area and Personnel

When installed, pinch points are generated capable of high damaging forces. The risk area surrounding the IMA must either be enclosed or clearly marked, including display signage in accordance with all applicable national and international legal requirements. The risk area must be protected by a safety system that stops the equipment if anyone enters the risk area. Personnel who enter the risk area must be authorized, trained and qualified for the different tasks inside the risk area.

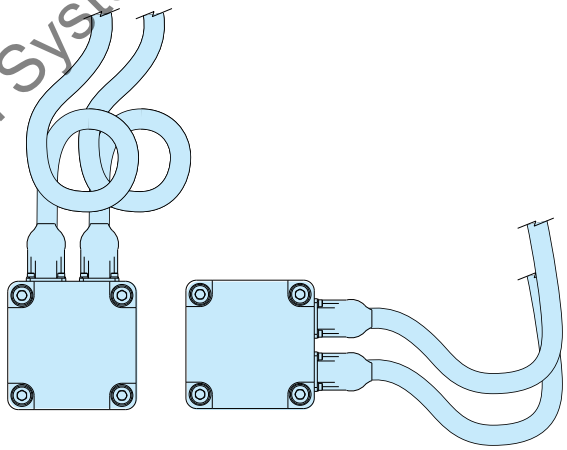
EMC Wiring Guidelines

Cable routing

It is recommended that the power and signal cables for IMA actuators be routed as far apart as possible to minimize system noise.

Over time, liquid contaminants such as oil and cleaning solutions may accumulate on the cables and into the connectors if they are an exposed type. To minimize the introduction of contaminants to the connector, route the cables so that there is a loop in the cable just prior to its attachment to the connector.

Two examples are shown below depending on the orientation of the connectors. Units mounted in such a way that the connectors are on the bottom surface of the actuator require no looping.



NOTE!

The standard cables from Tolomatic are not flex rated and have a minimum bend radius of 3.75 inches. Any repeated flexing or excessive bending can result in broken conductors and intermittent faults.

Shielding and grounding

When cabling the system, shielded cables are recommended. The standard cables provided by Tolomatic have an overall shield with drain wires and the case ground of the actuator is tied to a pin on the power connector. To minimize EMI and ensure system reliability, all shield drain wires from all cables should be tied to a common earth ground.

1.1 General Description

The IMA is a compact, durable, high force rod-style actuator. The IMA integrates a servo motor into the mechanical design to minimize the overall envelope. The patent-pending design allows for easy re-lubrication without disassembly for extremely long service life.

1.1.1 IMA Product Overview

- Two sizes: IMA33, IMA44
- Ball Screw Driven
  - 5 & 10 mm leads
- Forces up to:
  - IMA33: 1000 lbs (4448 N)
  - IMA44: 2000 lbs (8896 N)
- Speeds up to 23 in/sec (584 mm/sec)
- Motor windings: 230 Vac & 460 Vac
- IP65 standard; IP67 optional
- Feedback Choices:
  - Digital Incremental
  - Multi-turn Absolute Encoder
  - Resolver
- Connector Choices:
  - Tolomatic Standard
  - Bosch Rexroth MSK
  - Emerson FM
  - Emerson NT
  - Lenze MCS

1.1.2 Standard Configuration and Options

1.1.2.1 Standard Mounting

Standard mounting for the IMA is four (4) threaded holes on the front face (rod end) of the actuator.

1.1.2.2 Mounting Options

Other mounting options include: Side mounting holes (a total of 12 mounting holes on both sides and bottom of actuator), mounting plates, rear clevis, front flange, front trunnion and rear trunnion.

MOUNTING

- *Front Face - Standard*
- Side Mounting Holes, 2 sides & bottom *(no photo)*

- Mounting Plates

- Rear Clevis

- Front Flange

- Trunnion, Rear or Front

1.1.2.3 Standard Rod End

Standard rod end for the IMA is internal threads.

1.1.2.4 Rod End Options

Other rod end options include: External threads, clevis, spherical eye and alignment coupler.

- External Threads

- Clevis

- Spherical Eye

- Alignment Coupler

1.1.2.5 Other Options

Other IMA options available are: 24V spring held / electronically released brake; IP67 rating for protection against water and dust ingress; anti rotate option

BRAKE  • 24V Spring held / electronically released

IP67 • For protection against water and dust ingress

ARO • Anti-Rotate 

CABLES 
• Signal Cable (6m)
• Power Cable (6m)

NOTE:

The IMA must be ordered initially with all desired options. Field installation of options generally cannot be done. Call Tolomatic for complete details.

1.2 Intended Use

The IMA is a compact high force screw drive servo actuator. The IMA provides linear motion of the moveable rod developing the required thrust force and velocity in a variety of applications.

WARNING!

Before installation and commissioning of the equipment, this manual and all accompanying manufacturer documents and manuals MUST be completely read by the appropriate personnel. All warning texts must be given special attention.

1.3 General Operation

The IMA actuator functions by translating the rotary motion of the integral brushless servo motor into linear motion using a screw mechanism. The linear travel, speeds and forces are controlled in conjunction with a brushless servo drive.

When ordered the IMA actuator can be configured with any one of the following feedback devices: Digital encoder, resolver, multi-turn absolute encoder. Please confirm you are using a version of software that supports the correct feedback device and operation of IMA actuators.

The relationship between the rotary motion of the motor and the linear motion of the actuator corresponds to the following relationships:

Linear distance traveled = (motor revolutions) * (screw lead)

Linear Speed = ([motor RPM]/60) * (screw lead)

Linear Thrust (kN) = Motor torque (Nm) * 2 * π * pitch (rev/mm) * screw efficiency

or

Linear Thrust (lbf) = Motor torque (in•lb) * 2 * π * pitch (rev/in) * screw efficiency

CAUTION

Motor RMS current must be maintained at a level below the continuous current rating of the IMA actuator or damage to the motor stator will result.

The peak current setting must be maintained at a level below the peak current rating of the IMA actuator or damage to the motor stator will result.

CAUTION

Care should be taken not to exceed the physical travel limits of the IMA actuator. Doing so will cause the actuator to reach mechanical end of stroke internally. Although protected by the end of stroke bumpers, frequently reaching internal end of stroke can physically damage the screw and the internal components of the actuator.

1.4 Storage

Pay attention to the following when storing the actuator:

- Perform repairs, maintenance and inspections before storing equipment to ensure that the equipment is in good working order.
- Make sure the equipment is placed in a suitable storage position (horizontal) to prevent damage to the connectors and electronics.
- Protect the feedback device, which is located at the blind (non-rod end) of the IMA actuator.
- Store in clean and dry environment.
- After six (6) months of storage it will be necessary to cycle two complete strokes of the IMA to redistribute the internal lubricants.

It is also recommended to cycle the IMA two complete strokes before placing in service.

- If stored for a period longer than 2 years without use it will be necessary to replace the lubricants. Please return to Tolomatic for this maintenance.

1.5 Identification Label

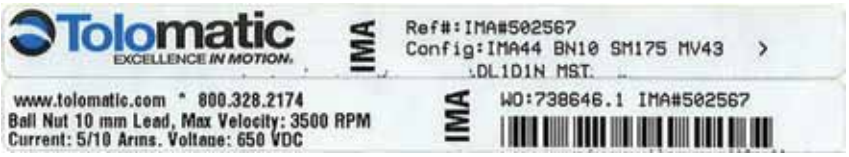


Figure 1.5.1: Actuator identification labels

Do not remove the identification label. Do not render it unreadable!

1.6 Certification

Pending certifications for the IMA include:

- UL
- CE

CE 95

1.7 Manufacturer

Tolomatic
3800 County Road 116
Hamel, MN 55340, USA
763-478-800 0
www.tolomatic.com
email: help@tolomatic.com

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2.1 IMA Actuator System Configuration

IMA series actuators incorporate an integral brushless servo motor. The design of the motor with the proper feedback device allows the IMA to be powered by nearly every brand of brushless amplifier on the market. This flexibility allows the IMA actuator to be used in the highest performing single and multi-axis motion control systems.

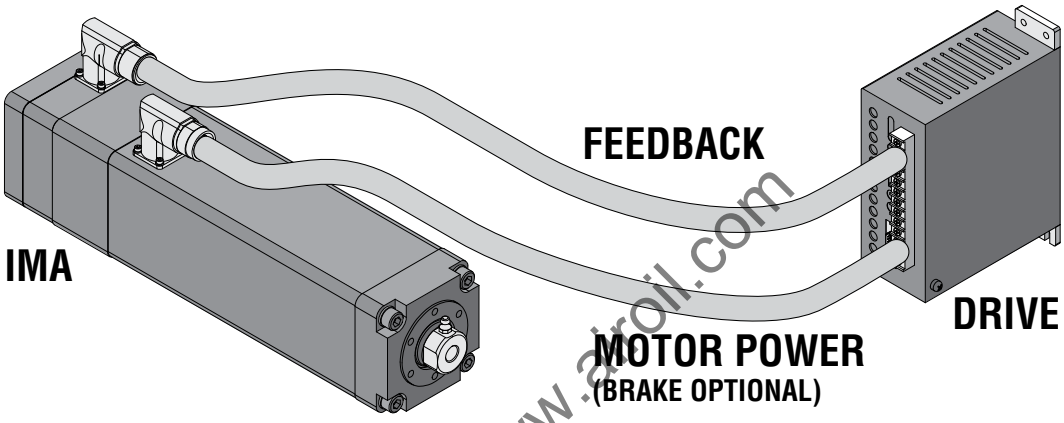


Figure 2.1.1: Typical connections for a single-axis system with an IMA actuator with optional brake to a servo amplifier

2.2 Feedback Information

IMA actuators may use a digital encoder, multi-turn absolute encoder or a single-pole resolver as the rotary feedback device. The selection of the feedback device is dictated by the amplifier used to operate the actuator. Each amplifier has specific requirements for the feedback on the motor. Not all resolver-based amplifiers can use the same resolver, resolver alignment, or relative direction of resolver rotation. Not all encoder-based amplifiers can use the same encoder, encoder alignment or relative direction of encoder rotation. Many amplifiers offer software that allows the entering of parameters or the downloading of "motor data files" that dictate how the feedback must be set up on the motor. Tolomatic can provide many of these "data files" or the proper parameters to enter. Entering motor parameter data to some amplifiers may require assistance from the amplifier manufacturer.

2.2.1 Feedback Alignment

When Tolomatic manufactures an IMA actuator, the proper feedback is selected, mounted, aligned and test run on an amplifier that is known to be equivalent to the amplifier that the customer plans to use for confirming proper feedback alignment and operation.

In any case where it is determined that the feedback has become misaligned, or an amplifier change is made requiring the feedback to be aligned differently, it is recommended that Tolomatic be contacted and arrangements made to have that procedure performed.

2.2.2 Feedback Alignment Details

Terminology in the industry varies from motor supplier to motor supplier. One example is in the labeling of phases; some suppliers will reference phase R, S and T while others refer to U, V and W. With the differences in terminology visual explanations are used for clarification purposes.

Tolomatic IMA motors are wired such that as the torque generating current vector progresses from phase R -> S -> T positive rotation is created. Positive rotation is defined as clockwise as viewed from the front face of the actuator. For reference, positive rotation will cause the thrust rod to extend.

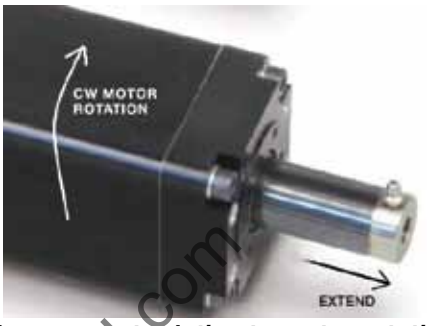


Figure 2.1.2: Thrust rod movement relative to motor rotation

Digital Quadrature Encoder Feedback

The IMA standard feedback device is a digital quadrature encoder. This encoder utilizes differential A and B signals for tracking position and differential index pulse and halls for commutation. The encoder is mounted with a current vector from phase R to phase T, at this commutation angle the index pulse of the encoder is located and the encoder is locked to the shaft of the motor.

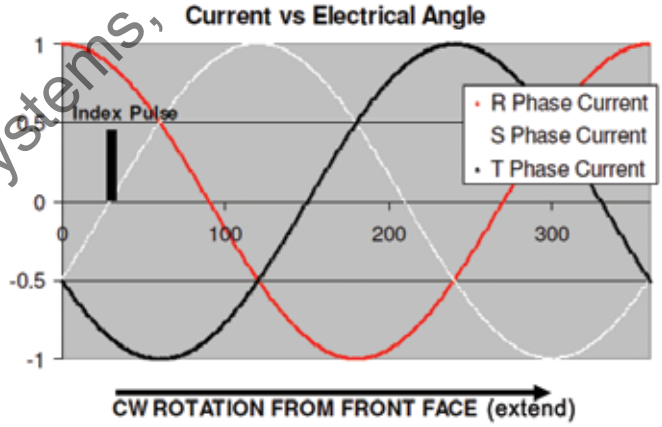


Figure 2.1.3: Current vs Electrical Angle

From a manufacturing viewpoint the utilization of a fixed current vector provides the simplest means for aligning a feedback device. Some manufacturers however will reference a motor's back emf when discussing commutation angles. This is due to the ability to quantify via measurement the alignment of a feedback device. With that in mind; when measuring the back emf phase to phase of the winding the following can be verified on an IMA.

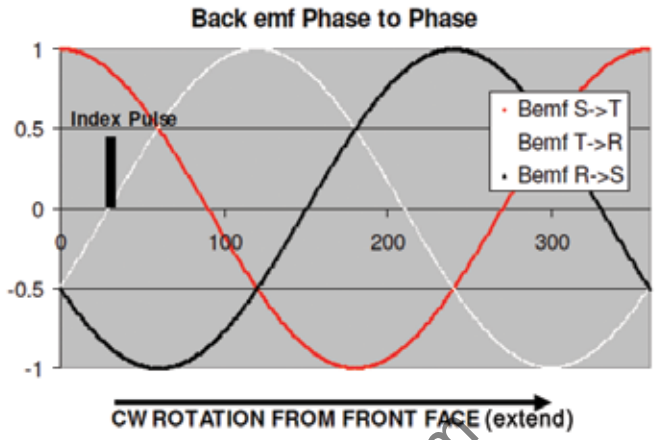


Figure 2.1.4: Back emf Phase to Phase

The quadrature output of the encoder will be such that the rising edge of the A channel leads the rising edge of the B channel with positive rotation as defined in the graph above.

The halls are configured such that the falling edge of the U channel coincides with the index pulse location. The graph at right shows the relationship of the halls to the phase to phase back emf.

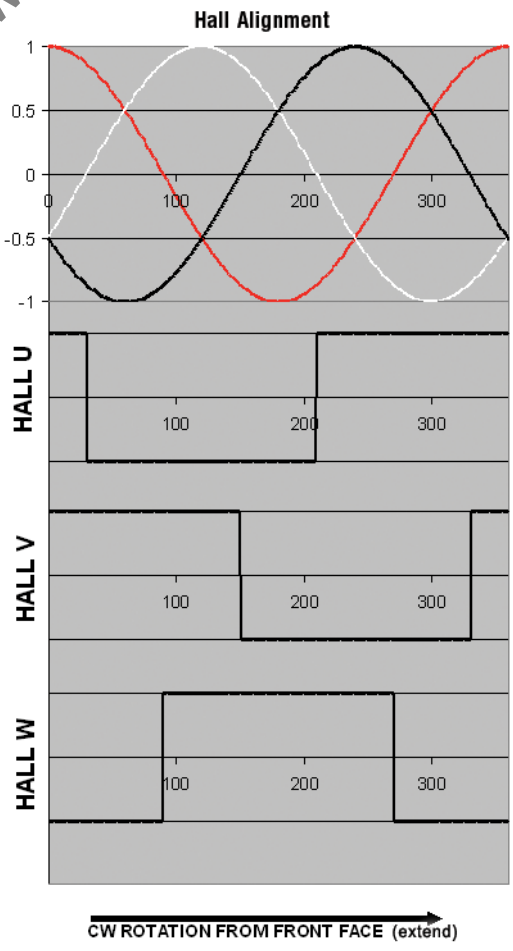


Figure 2.1.5: Hall Alignment

Resolver Feedback

The IMA family is also offered with resolver feedback. A resolver must be excited with a sinusoidal input and outputs two signals, commonly referred to as cos and sin. These signal's magnitude and the phase angle relative to the excitation voltage are used by the drive to determine the absolute position (single rotational) of the motor's armature.

With the motor's rotational position at 0 (as shown at right); the cos signal will be at its maximum level and in phase with the excitation voltage and the sin signal will be at 0.

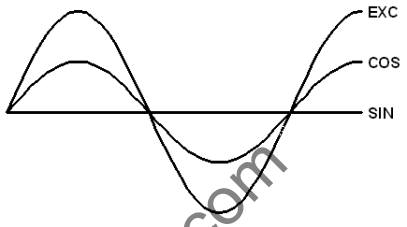


Figure 2.1.6: Motor rotational position at 0

Rotating the motor to rotational position at 90 (as shown at right); the sin signal will be at its maximum level and in phase with the excitation voltage and the cos signal will be at 0.

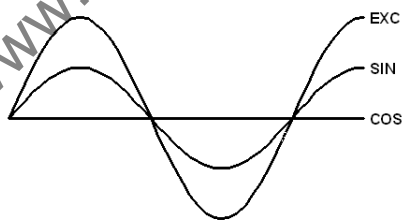


Figure 2.1.7: Motor rotational position at 90

2.2.3 Feedback Wiring

The wiring of the feedback device is critical to the operation of the actuator with the selected amplifier.

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 amplifier, along with incorrect wiring of the feedback cable can lead to damage of the motor.

2.3 Feedback Specifications

DIGITAL ENCODER	Quantum
Input Voltage	5 VDC (+/-5%)
Input Current	125 mA Typical
Output Circuits	AM26LS31 (RS22A line Driver)
Output Format	Quadrature, 2000 line

ABSOLUTE	Stegman SKM36
Output Type	Sin/Cos w/MultiTurn Absolute
Input Voltage	7-12 VDC (8 V recommended)
Max NL Operating Current	60 mA
Sin/Cos Resolution	128 periods per revolution
Absolute Resolution	4096 revs with 4096 steps per rev

RESOLVER	Dynapar BRX
Input Voltage	8 Vrms (+/- 5%)
Excitation Frequency	8 kHz
Max Input Current	50 mA
Transformation Ratio	0.5 (+/-10%)
Impedance [ZRO]	182 Ohms
Impedance [ZRS]	168 Ohms
Impedance [ZSO]	627 Ohms
Impedance [ZSS]	584 Ohms

2.4 Connector Orientation

The IMA is manufactured with both the power and feedback connectors facing forward (toward rod end). They are mounted to allow the connectors to be rotated 180 degrees to the straight back orientation and are able to be rotated to either side of the actuator.

For the Tolomatic standard connectors it is not necessary to loosen the screws retaining the connectors. Just carefully rotate to the desired orientation.

NOTE!

Do not apply excessive force while rotating connectors.

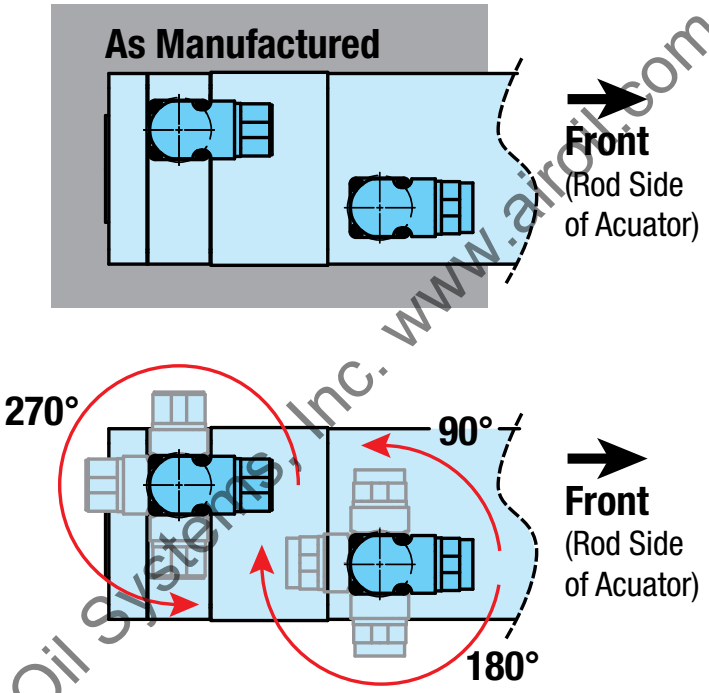
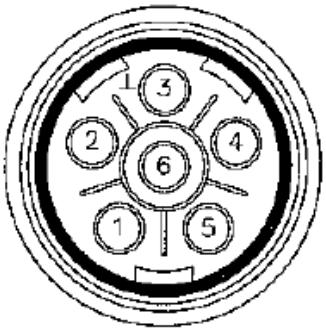


Figure 2.4.1: Connector rotation. Note that the connectors may be rotated from -90° to +180° allowing for cables to connect toward the front (rod end, as manufactured), to either side, both sides, or back of actuator.

2.5 Connector Pinouts

The IMA is manufactured with your choice of several different connectors to be compliant with popular motor and drive manufacturers. Be sure to also reference all manufacturer material to insure proper connections.

2.5.1 Tolomatic Standard



2.5.1.1 Motor Power Connector	
Manufacturer: Intercontec	
Intercontec Part No.: BEDC 088 MR10 00 0005 000	
Pin	**Name**
1	Phase R
2	Phase S
3	GND
4	Phase T
5	* BR+
6	* BR-

* Connect brake only when present

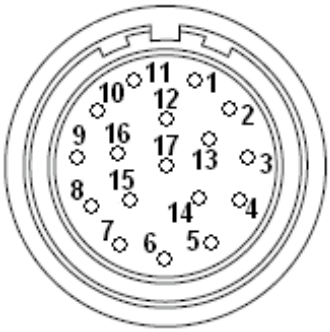
2.5.1.2 Motor Power Cable Wiring

IMA33 – NO Brake	
Cable Part No.: 2733-1221	
Wire Color	**Signal Name**
RED	Phase R
WHITE	Phase S
BLACK	Phase T
GREEN	Ground

IMA44 – NO Brake	
Cable Part No.: 2744-1221	
Wire Color	**Signal Name**
RED	Phase R
WHITE	Phase S
BLACK	Phase T
GREEN	Ground

IMA33 – WITH Brake	
Cable Part No.: 2733-1222	
Wire Color	**Signal Name**
RED	Phase R
WHITE	Phase S
BLACK	Phase T
GREEN	Ground
RED (18 AWG)	Brake +
BLK (18 AWG)	Brake -

IMA44 – WITH Brake	
Cable Part No.: 2744-1222	
Wire Color	**Signal Name**
RED	Phase R
WHITE	Phase S
BLACK	Phase T
GREEN	Ground
RED (18 AWG)	Brake +
BLK (18 AWG)	Brake -



Keyed Center

2.5.1.3 Digital Incremental Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 113 MR04 00 0012 000	
Pin	**Name**
1	Temp -
2	Temp +
3	NC
4	Hall U
5	Hall U-
6	Hall V
7	Hall V-
8	Hall W
9	Hall W-
10	A+
11	I+
12	I-
13	A-
14	B+
15	B-
16	+5 Vdc
17	Com

2.5.1.4 Digital Incremental Cable Wiring

IMA33 & IMA44	
Cable Part No.: 2733-1224	
Wire Color	**Signal Name**
Black Pair 1	COM
Red Pair 1	+5Vdc
White Pair 2	Hall U
Black Pair 2	Hall U-
Green Pair 3	Hall V
Black Pair 3	Hall V-
Blue Pair 4	Hall W
Black Pair 4	Hall W-
Yellow Pair 5	A+
Black Pair 5	A-
Brown Pair 6	Index
Black Pair 6	Index-
Orange Pair 7	B+
Black Pair 7	B-
Red Pair 8	Temp Switch
Black Pair 8	Temp Switch

Keyed Full CCW

2.5.1.5 Resolver	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Signal Name**
1	Excite
2	Excite Lo
3	Cos
4	Cos Lo
5	Sin
6	Sin Lo
7	Temp +
8	Temp -
9	NC
10	NC
11	NC
12	NC

2.5.1.6 Resolver Cable Wiring

IMA33 & IMA44	
Cable Part No.: 2733-1223	
Wire Color	**Signal Name**
Violet	Excite
Grey	Excite Lo
Black	Cos
White	Cos Lo
Orange	Sin
Yellow	Sin Lo
Blue	Temp Switch
Brown	Temp Switch
Red	NC
Green	NC

NOTE: NC = no connection

Keyed Full CCW

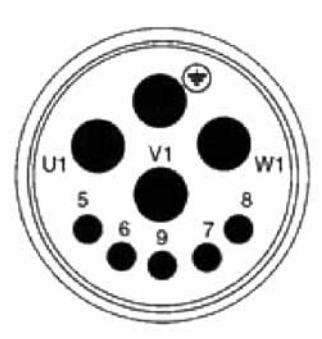
2.5.1.7 Multi-turn Absolute Encoder	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Name**
1	REFCOS
2	Data+
3	Data-
4	+COS
5	+SIN
6	REFSIN
7	Temp +
8	Temp -
9	NC
10	COM
11	NC
12	+9V dc

2.5.1.8 Multi-turn Absolute Encoder Cable Wiring

IMA33 & IMA44	
Cable Part No.: 2733-1223	
Wire Color	**Signal Name**
Violet	RefCos
Grey	Data+
Black	Data-
White	+Cos
Orange	+Sin
Yellow	RefSin
Blue	Temp Switch
Brown	Temp Switch
Red	+9Vdc
Green	COM

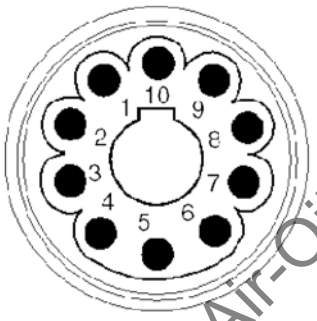
NOTE: NC = no connection

2.5.2 Bosch Rexroth MSK Motor Series



2.5.2.1 Motor Power Connector	
Manufacturer: Bosch Rexroth	
Bosch Rexroth Part No.: 911 309687 (RLS1100/C02)	
Motor Power Coninvers	
Pin	**Name**
U1	Phase R
V1	Phase S
W1	Phase T
PE	GND
5	Temp +
6	Temp -
7	* BR+
8	* BR-
9	NC

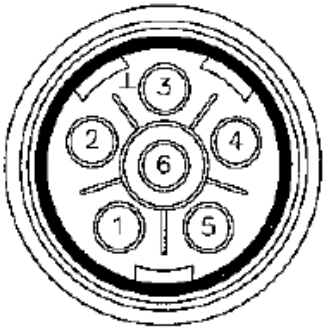
* Connect brake only when present



2.5.2.2 Multi-turn Absolute Encoder Connector	
Manufacturer: Bosch Rexroth	
Bosch Rexroth Part No.: 911 309733 (RGS1100/C02)	
Stegmann Hiperface	
Pin	**Signal Name**
1	Vcc
2	Com
3	+COS
4	REFCOS
5	+SIN
6	REF SIN
7	Data+
8	Data-
9	NC
10	NC

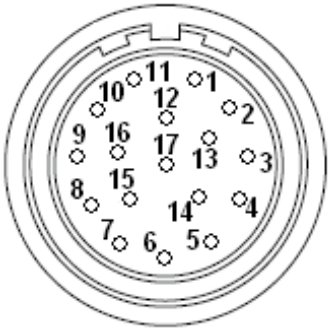
NOTE: NC = no connection

2.5.3 Emerson FM Motor Series



2.5.3.1 Motor Power Connector	
Manufacturer: Intercontec	
Intercontec Part No.: BEDC 088 MR10 00 0005 000	
Pin	**Name**
1	Phase R
2	Phase S
3	GND
4	Phase T
5	* BR+
6	* BR-

* Connect brake only when present



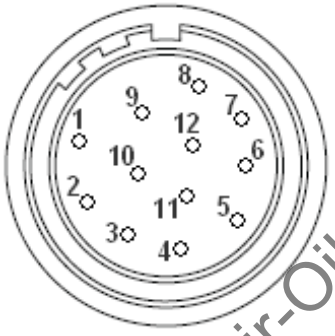
Keyed Center

2.5.3.2 Digital Incremental Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 113 MR04 00 0012 000	
Pin	**Name**
1	Temp -
2	Temp +
3	NC
4	Hall U-
5	Hall U-
6	Hall V
7	Hall V-
8	Hall W
9	Hall W-
10	A+
11	I+
12	I-
13	A-
14	B+
15	B-
16	+5 Vdc
17	Com

2.5.3 Emerson FM Motor Series (cont.)

Keyed Full CCW

2.5.3.3 Resolver Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Signal Name**
1	Exc
2	Exc Lo
3	Cos
4	Cos Lo
5	Sin
6	Sin Lo
7	Temp +
8	Temp -
9	NC
10	NC
11	NC
12	NC

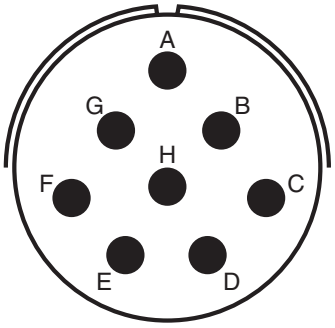


Keyed Full CCW

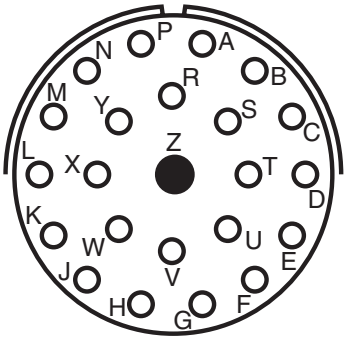
2.5.3.4 Multi-turn Absolute Encoder	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Name**
1	REFCOS
2	Data+
3	Data-
4	+COS
5	+SIN
6	REFSIN
7	Temp +
8	Temp -
9	NC
10	COM
11	NC
12	+9V dc

NOTE: NC = no connection

2.5.4 Emerson NT Motor Series



2.5.4.1 Motor Power Connector	
Manufacturer: Amphenol	
Amphenol Part No.: PT02E-16-8P(025)	
Pin	**Name**
A	R
B	S
C	T
D	GND
E	NC
F	NC
G	NC
H	NC



2.5.4.2 Digital Incremental Encoder Connector			
Manufacturer: Amphenol			
Amphenol Part No.: PT02E-16-23P(025)			
Pin	**Name**	**Pin**	**Name**
A	Temp+	N	B+
B	A+	P	B-
C	A-	R	HALL U-
D	NC	S	HALL V-
E	HALL U	T	COM/Temp-
F	HALL V	U	I-
G	HALL W	V	NC
H	HALL W-	W	NC
J	NC	X	NC
K	+5Vdc	Y	NC
L	NC	Z	NC
M	I+		

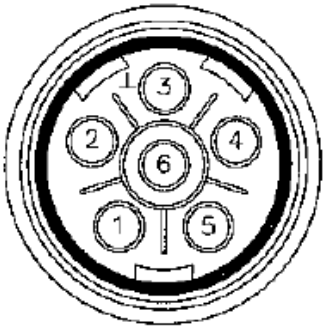
2.5.4.3 Brake Connector	
Manufacturer: Amphenol	
Amphenol Part No.: PT02E-8-3P(025)	
Pin	**Name**
A	NC
B	* BR+
C	* BR-

Separate Brake connector required

* Connect brake only when present

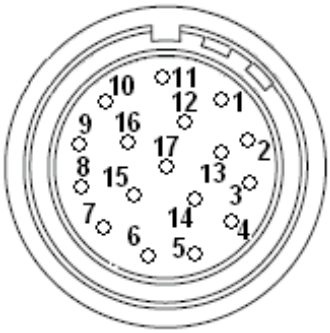
NOTE: NC = no connection

2.5.4 Lenze MCS Motor Series



2.5.4.1 Motor Power Connector	
Manufacturer: Intercontec	
Intercontec Part No.: BEDC 088 MR10 00 0005 000	
Pin	**Name**
1	* BR+
2	* BR-
3	GND
4	Phase R
5	Phase S
6	Phase T

* Connect brake only when present



Keyed Full CW

2.5.4.2 Digital Incremental Encoder Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 113 MR04 00 0012 000	
Pin	**Name**
1	Temp +
2	I-
3	I+
4	Temp -
5	Hall U+
6	Hall U-
7	+5 Vdc
8	Hall W-
9	Hall W+
10	Com
11	NC
12	B+
13	B-
14	Hall V+
15	A+
16	A-
17	Hall V-

Keyed Center

2.5.4.3 Resolver Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Name (Resolver)**
1	Exc
2	Exc Lo
3	NC
4	Cos
5	Cos Lo
6	Sin
7	Sin Lo
8	NC
9	NC
10	NC
11	Temp +
12	Temp -

Keyed Center

2.5.4.4 Multi-turn Absolute Encoder Connector	
Manufacturer: Intercontec	
Intercontec Part No.: AEDC 052 MR04 00 0012 000	
Pin	**Name (Resolver)**
1	+SIN
2	REFCOS
3	+COS
4	Vcc
5	COM
6	DATA-
7	DATA+
8	NC
9	REFSIN
10	NC
11	TEMP+
12	TEMP-

NOTE: NC = no connection

2.6 Brake

Many applications benefit from the addition of the Tolomatic integral brake. Whenever the brake is not powered the screw is prevented from turning. (Back driving under the load)

The brake is spring engaged and electrically released. The holding capacity of the brakes exceeds the rated continuous force of the actuator.

CAUTION!

DO NOT attempt to operate the actuator with the brake applied. Allowing the actuator to operate with the brake applied may cause serious damage to the actuator and/or the brake. Do not use the brake to support heavy loads while an operator is under the load. Provide another means to lock the load in position. The brake is a spring applied friction mechanism and does not provide a positive lock.

Protecting the brake from voltage transients in applications where it will be engaged and disengaged frequently is advised. The use of a rectifying diode and zener diode will provide optimal protection against these transients.

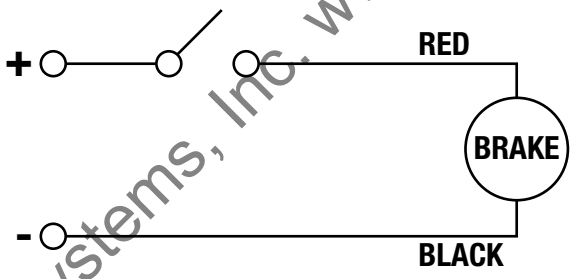


Figure 2.6.1: Fastest Engage/Disengage time, least protection

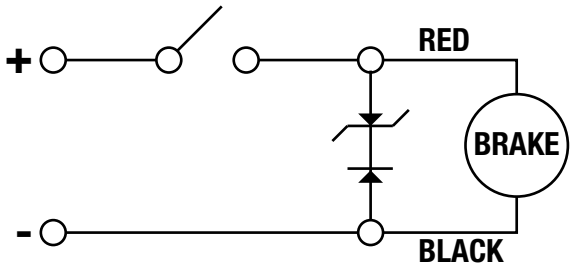


Figure 2.6.2: Increased Engage/Disengage time, best protection

2.7 Anti Rotate Option

The design of the IMA actuator allows the extending rod to rotate. This provides simple setup of the actuator by allowing the user to rotate the rod and thread it in and out of the actuator for mechanical attachment or system testing. This feature also requires that the rod be kept from rotating when used in its dedicated application to insure proper linear motion. In most applications, such as those where the load is coupled to linear bearings, or some other support device, the load cannot rotate, and thus provides anti-rotation for the extending rod of the actuator.

For applications in which the load is free to rotate, Tolomatic offers the anti-rotation systems shown below.

WARNING!

The anti rotate option (ARO) is not a guide or support mechanism. It is intended only as an anti rotate device.

ANTI ROTATE (ARO)

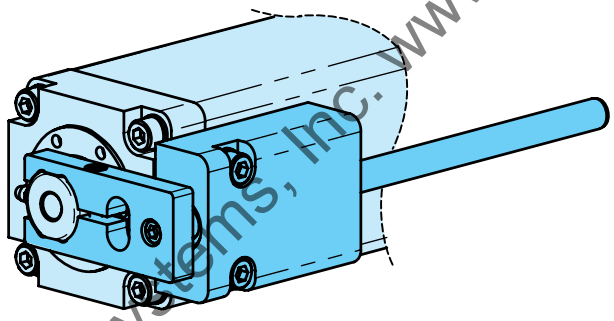


Figure 2.7.1: Anti Rotate Option

3.1 Lubrication

NOTE!

Before starting any maintenance activities, make sure that the supply power is shut OFF.

CAUTION: DO NOT FILL WITH GREASE!

IMA actuators has been lubricated at the factory and are ready for installation. For many applications the unit is greased for life.

- For light to moderate use, no additional lubrication is required.
- For severe duty use, periodic re-lubrication will be necessary to maintain optimum performance. Grease should be added every 1,000 hours of operation.
- Re-lubricate with Mobilith SHC220 (IMA33: 3.0 g; IMA44 5.0 g) in the grease zerk provided.

Overfilling will cause a reduction in performance, excessive heat build up and potential premature failure.

All curves represent properly lubricated and maintained actuators.

3.2 IMA Maintenance and Repair

The only user serviceable components of the IMA actuator is the front rod bearing and wiper.

Further disassembly of the IMA is not recommended. IMA actuators should be returned to Tolomatic for evaluation and repair.

Contact the Tolomatic for instructions on how to return the IMA actuator for evaluation.

WARNING!

Never rotate the actuator via the feedback device connection. Doing so may result in the loss of phasing between the feedback device and motor windings.

3.2.1 Wiper Maintenance

In extreme environments it may be necessary to replace the main rod wiper and front bearing assembly. The main rod wiper can be removed, after grease zerk removal, by threading it out of the front plate using a spanner wrench. A new main rod bearing and wiper assembly can then be reinstalled. To have this service performed for you, contact Tolomatic.

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A.1 Specifications

A.1.1 Performance and Mechanical Specifications

SERIES		IMA33		IMA44	
SIZE	in	3.3		4.4	
	mm	83.0		110.0	
STROKE	in	6.0 to 18.0			
	mm	152.4 to 457.2			
NUT/SCREW		BN05	BN10	BN05	BN10
SCREW LEAD	in	0.197	0.394	0.197	0.394
	mm	5.0	10.0	5.0	10.0
DYNAMIC LOAD RATING (1 mil revs)	lbf	1709	1214	3395	3372
	N	7602	5400	15100	15000
LEAD ACCURACY	in/ft	0.002			
	mm/300	0.051			
BACKLASH	in	0.004	0.004	0.005	0.005
	mm	0.10	0.10	0.13	0.13
CONT. THRUST	lbf	850	425	1650	825
	N	3781	1891	7340	3670
PEAK THRUST	lbf	1000	850	2000	1650
	N	4448	3781	8896	7340
MAX. VELOCITY	in/sec	11	22	11	22
	mm/sec	279	559	279	559
TEMP RANGE	°F	50 to 122			
	°C	10 to 50			
IP RATING		Standard IP65, Optional IP67			
**BASE WEIGHT	lb	14.1		28.6	
	kg	6.4		13.0	
WEIGHT PER UNIT OF STROKE	lb/in	0.6603		1.1035	
	kg/mm	0.0118		0.0197	
**BASE INERTIA	lb-in^2	1.649	1.653	3.311	3.321
	kg-cm^2	4.826	4.837	9.689	9.719
INERTIA PER UNIT OF STROKE	lb-in^2/in	0.003	0.003	0.018	0.019
	kg-cm^2/mm	0.0003	0.0004	0.0021	0.0022
BREAKAWAY TORQUE	in-lb	2.4	2.3	4.3	3.6
	N-m	0.271	0.260	0.486	0.407
BACK DRIVE FORCE*	lbf	60	28	100	44
	N	267	126	445	196

*In vertical applications an unpowered IMA will require a brake to maintain position if the load on the actuator exceeds this value

**Value given is for a zero stroke actuator

A.1.2 Motor Specifications:

SERIES		IMA33		IMA44	
VOLTAGE		MV23	MV43	MV23	MV43
TORQUE CONSTANT (K_t)	in-lb/A Peak	5.5	10.7	5.4	10.6
	N-m/A Peak	0.62	1.21	0.61	1.20
VOLTAGE CONSTANT (K_e)	V/Krpm Peak	79.8	154	78.1	153.1
CONTINUOUS STALL TORQUE	in-lb	35	34	67	67
	N-m	4.0	3.8	7.6	7.6
CONTINUOUS STALL CURRENT	Arms	4.5	2.25	8.8	4.5
PEAK TORQUE	in-lb	70	68	134	
	N-m	7.9	7.7	15.2	
PEAK CURRENT	Arms	9	4.5	17.6	9.0
RESISTANCE	Ohms	2.07	8.3	0.58	2.32
INDUCTANCE	mH	3.8	15	2.75	11.5
NO. OF POLES		8			
BUS VOLTAGE	Vrms	230	460	230	460
SPEED @ RATED V	RPM	3500			

A.1.3 Brake Specifications:

SERIES		IMA33	IMA44
ROTOR INERTIA	oz-in^2	0.112	0.656
	gm-cm^2	20.5	120.0
CURRENT	Amp	0.516	0.67
HOLDING TORQUE	in-lb	35	80
	N-m	4.0	9.0
ENGAGE TIME	mSec	20	50
DISENGAGE TIME	mSec	70	40
VOLTAGE	Vdc	24	24

A.1.4 Speed vs Thrust Graphs:

Refer to the charts below for the continuous and peak thrust and speed capabilities of the screw selections.

NOTE: IMA integrated motor rod-style actuators are designed to move guided and supported loads and are not designed for applications that require significant side loading. Please contact Tolomatic at 1-800-328-2174 or 763-478-8000 for details regarding side loading capabilities.

A.1.4.1 IMA33

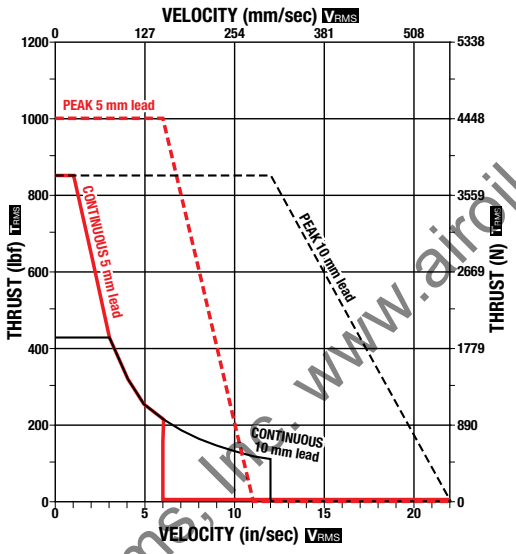
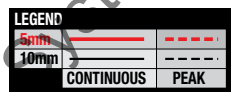


Figure A.1.4.1.1 IMA33 Speed vs Thrust Graph



A.1.4.2 IMA44

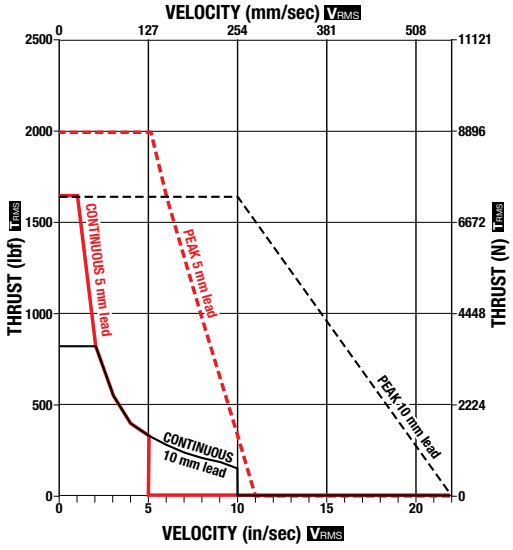


Figure A.1.4.1.2 IMA44 Speed vs Thrust Graph

A.1.5 Calculating RMS Thrust and Velocity:

Servo motor actuator systems have two speed/thrust curves: one for continuous duty operation and another for intermittent duty. A servo system can be selected according to the total thrust and maximum velocity indicated by the continuous duty curve. However, by calculating the root mean square (RMS) thrust based on the application duty cycle, you may be able to take advantage of the higher peak thrust available in the intermittent duty range. The RMS thrust must fall within the continuous duty region of the motor/drive and the application maximum thrust must fall under the peak thrust of the actuator. Use the following formula when calculating the RMS thrust and velocity. When selecting an integrated servo actuator system, it is necessary to add a margin of safety to the thrust and velocity required to move the load. The recommended margin for servo motors is 15%.

$$\mathbf{T}_{RMS} = \sqrt{\frac{\text{sum } (\mathbf{T}_i^2 \text{ x } \mathbf{t}_i)}{\text{sum } (\mathbf{t}_i)}}$$

$$\mathbf{V}_{RMS} = \sqrt{\frac{\text{sum } (\mathbf{V}_i^2 \text{ x } \mathbf{t}_i)}{\text{sum } (\mathbf{t}_i)}}$$

Where:

$\mathbf{T}_{RMS}$ = RMS Thrust

$\mathbf{V}_{RMS}$ = RMS Velocity

$\mathbf{T}_i$ = Thrust during interval i

$\mathbf{V}_i$ = Velocity during interval i

$\mathbf{t}_i$ = Time interval i

A.1.6 IMA Brake Considerations

An unpowered IMA will require a brake to maintain its position if the force on the actuator exceeds Back Drive Force listed in the table on page 6.

A brake can be used with the actuator to keep it from backdriving, typically in vertical applications. A brake may be used for safety reasons or for energy savings allowing the actuator to hold position when unpowered.

NOTE:

The optional Spring-Applied/Electronically-Released Brake requires 24V power. Input current rating: IMA33 - 0.516 Amps; IMA44 - 0.67 Amps.

A.1.7 Critical Speed

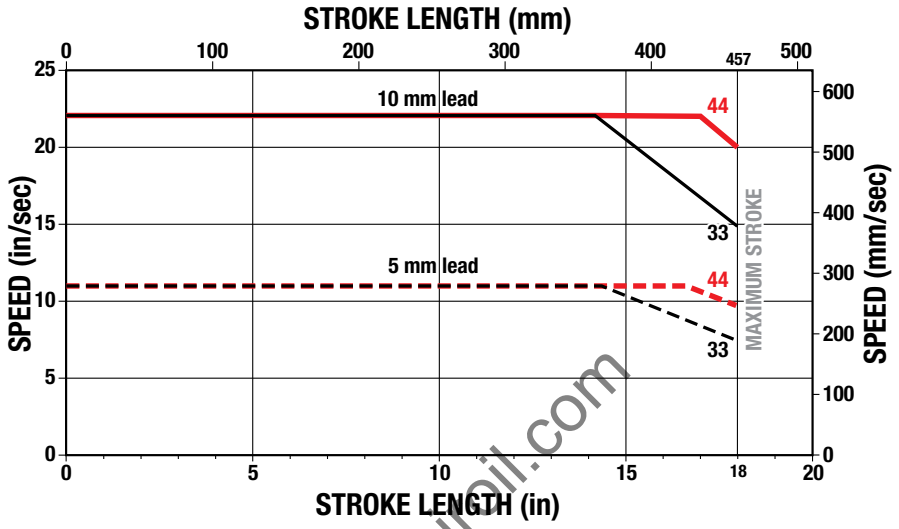


Figure A.1.7.1 IMA33 & IMA44, BN05 & BN10 Critical Speed Graph

A.1.8 Ball Screw Life

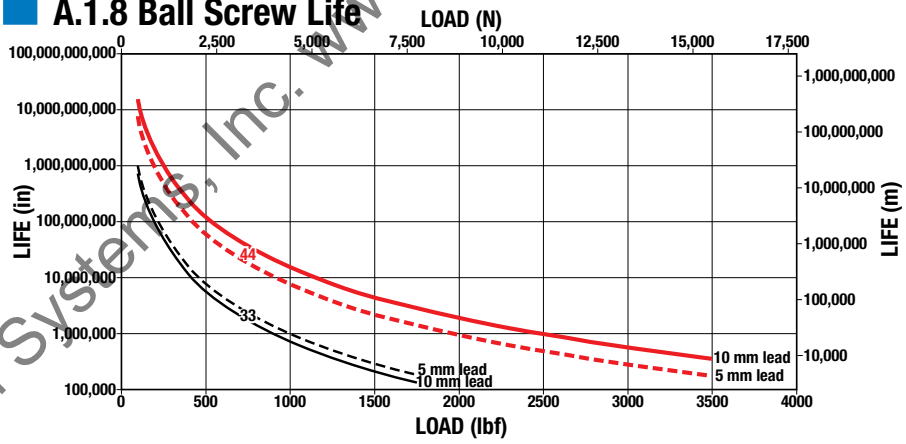


Figure A.1.8.1 IMA33 & IMA44, BN05 & BN10 Ball Screw Life Graph

NOTE:

The L_{10} expected life of a ball screw linear actuator is expressed as the linear travel distance that 90% of properly maintained ball screws manufactured are expected to meet or exceed. This is not a guarantee and this graph should be used for estimation purposes only.

The underlying formula that defines this value is:

$$L_{10} = \left(\frac{C}{F}\right)^3 \equiv$$

Travel life in millions of inches, where:

C = Dynamic load rating (lbf)
F = Cubic mean applied load (lbf)

All curves represent properly lubricated and maintained actuators.

A.1.9 Side Load Considerations

The IMA integrated motor actuator is not meant to be used in applications where side loading occurs. Loads must be guided and supported. Loads should be aligned with the line of motion of the thrust rod. Side loading will affect the life of the actuator.

CAUTION!

Excessive side load on the output thrust rod of the actuator will dramatically reduce the life of the actuator and should be avoided. Side load can be caused from misalignment or loading that is not in-line with the actuator output thrust rod.

A.1.10 Thermal sensor specifications

The motor windings have an integral normally closed thermal switch. The switch opens at a temperature of 212° F (100°C), which is the windings maximum operating temperature. The thermal switch is meant to protect the windings, the actuators continuous operating region must still be obeyed. Cycles that cause the windings temperature to approach 212° F (100° C) will reduce the expected life of the actuator.

B.1 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
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
	Amplifier may be improperly tuned	Check all gain settings
	Amplifier may be set up improperly for IMA actuator used	Check amplifier 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
	Excessive side load	Verify correct operation
	Misalignment of output rod to application	Verify correct alignment
	Amplifier has too low of current capacity or is limited to tool low of current capacity	Verify correct amplifier and settings
Actuator housing moves or vibrates when shaft is in motion	Loose mounting	Check actuator mounting
	Amplifier is improperly tuned – wrong gain settings	Tune amplifier
Actuator is overheating	Duty cycle is higher than actuator ratings	Verify duty cycle is within continuous ratings
	Amplifier is poorly tuned, causing excessive unnecessary current to be applied to motor	Check gain settings

C Appendix

C.1 Warranty

Tolomatic, warrants product manufactured by it to be free from defects in material and workmanship for a period of one year from date of shipment by Tolomatic. If within such period any such product shall be proved to Tolomatic's satisfaction to be defective, such product shall either be repaired or replaced at Tolomatic's option.

This warranty shall not apply:

a. To product not manufactured by Tolomatic with respect to product not manufactured by Tolomatic the warranty obligations of Tolomatic shall in all respects conform and be limited to the warranty actually extended to Tolomatic by its supplier.

b. To product which shall have been repaired or altered by parties other than Tolomatic, so as, in Tolomatic's judgment, to affect the same adversely, or

c. To product which shall have been subject to negligence, accident, or damage by circumstances beyond the control of Tolomatic or to improper operation maintenance or storage, or to other than normal use and service.

The foregoing warranties are exclusive and in lieu of all other expressed and implied warranties whatsoever, including but not limited to implied warranties of merchantability and fitness for a particular purpose. Tolomatic shall not be subject to any other obligations or liabilities whatsoever with respect to product manufactured or supplied by Tolomatic or service rendered by it.

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