

**MANUAL**  
**INSTALLATION, OPERATION AND MAINTENANCE**

**IMA-S**  
**INTEGRATED MOTOR ROD-STYLE ACTUATOR**  
**STAINLESS STEEL**



2700-4016\_03

Original Instructions - English

Translations will be supplied in other community languages as required by customers

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## 1.1 Safety Symbols

### 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, PROHIBITIVE, MANDATORY ACTION, 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.

#### **PROHIBITED ACTION**

Indicates Prohibited Action

#### **MANDATORY ACTION**

Indicates Mandatory Action

#### **NOTE!**

Information that requires special attention is stated here.

## 1.2 Safety Considerations

### ■ Proper and Safe Use of Product

#### Fail Safe e-Stop Recommendations

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/force ratings. In addition, proper mechanical assembly and proper wiring should be verified and safety measures checked before applying power to the complete equipment package.

#### Personal Safety

During normal operation the actuator can become hot, especially the motor housing. In addition, the case ground should be tied to an earth ground to prevent the presence of case voltage.

During normal operation, the actuator rod travels in and out creating a possible pinch point.

Proper guarding and signage must be used prevent entry into possible pinch zones and contact with hot surfaces. It is highly recommended to display proper safety notices and implement proper safety measures to prevent contact with hot surfaces.

#### 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 cause misalignment of the actuator feedback device. Damage the internal mechanical components may cause poor performance or render the actuator non-functional. 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. as this can damage the internal mechanical components rendering the actuator damaged or non-functional.

#### Packing and Transport



#### NOTE!

Package actuator to prevent damage during transport. It is recommended that the actuator be returned in its original packaging. If the original packaging is not available, the follow these recommendations.

1. Foam in place if possible.
2. Reinforce ends of box with multiple layers of cardboard or wood to prevent the actuator from breaking through the packaging during shipment.
3. Support the connectors or cables so that enough packaging or foam is in place to prevent shipping damage.
4. It is best to ship one unit per container because individual items that are not isolated with stable packaging (foam in place) from each other often get damaged during shipment.

5. When shipping more than one unit in a single container, it is recommended to foam in place to prevent damage during shipping to both the units and the packaging.
6. Add the RMA on the outside of the packaging. Failure to do so will delay processing.

## Modifications to the Equipment

### **WARNING** **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** **WARNING!**

All power and supply media must be shut OFF before any work is performed on any equipment that is associated with the actuator. The only field maintenance that may be performed on the IMA-S include lubrication and replacement of the rod seal cartridge. All other repair or maintenance for the IMA-S 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 damaging forces. The risk area surrounding the actuator must either be guarded 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.

## 2.0 General Description



The IMA-S series actuators are hygienically designed linear actuators with integrated servo motors designed for precise linear positioning. These actuators are designed for the food and beverage processing industry and feature 316 stainless steel construction, IP69K ingress protection, blue seals/O-rings, and hygienic fasteners/cord grips allowing for open machine designs and clean-in-place compatibility. The product line also includes the IMA-SA model which incorporates an internal anti-rotate feature eliminating the need for an external guidance mechanism making it a perfect actuator for applications such as volumetric filling and pumping.

The IMA-S series integrates either a roller screw or ball screw technology with a servo motor and variety of feedback options including absolute multi-turn, incremental, and resolvers to allow for easy integration with most servo drives. The servo motor drives the ball or rollerscrew and converts rotary motion into linear movement. The linear motion extends/retracts the thrust rod within the linear actuator housing.



**NOTE** IMA-S actuators are non-braking. When there is no current/torque input the thrust rod can be moved freely. An internal integrated brake option is available if the motion system requires the actuator to hold position in when no current/torque is input to the actuator

## 2.1 Product Features

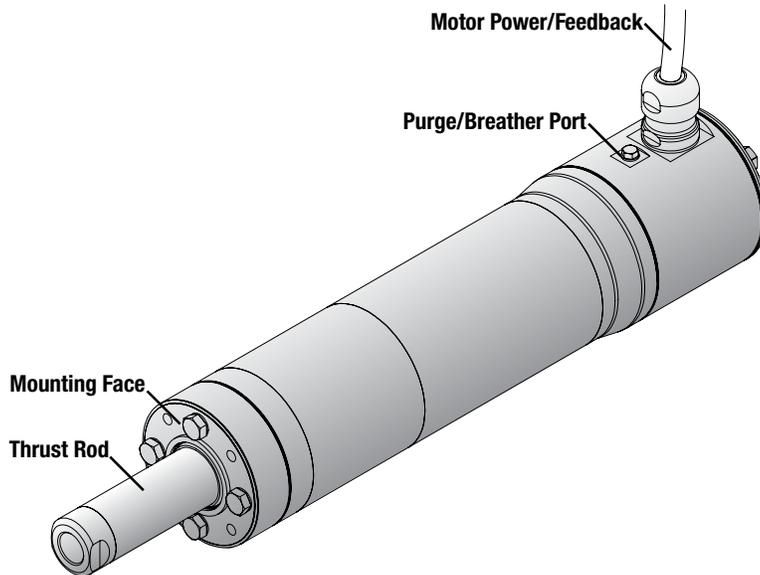


Figure 2-2 IMA-S major components

## 2.2 Installation



### NOTE!

Be sure to completely follow all recommendations in 1.2 Safety Considerations.

### Cable Routing

Over time, liquid contaminants such as oil and cleaning solutions may accumulate on the cables and onto the cable glands. To minimize the introduction of contaminants to the cable glands, mounting the actuator with the cable gland down is best. Mounting with the cable gland to the side requires a bend or drip loop. It is not recommended to mount the actuator in an orientation that faces the cable gland upwards. If mounting the actuator with the cable gland facing upwards is unavoidable, the cable should be routed with a drip loop prior to entering the cable gland.

Examples are shown depending on the orientation of the cable glands. Units mounted with the cable glands on the bottom surface of the actuator require no looping.

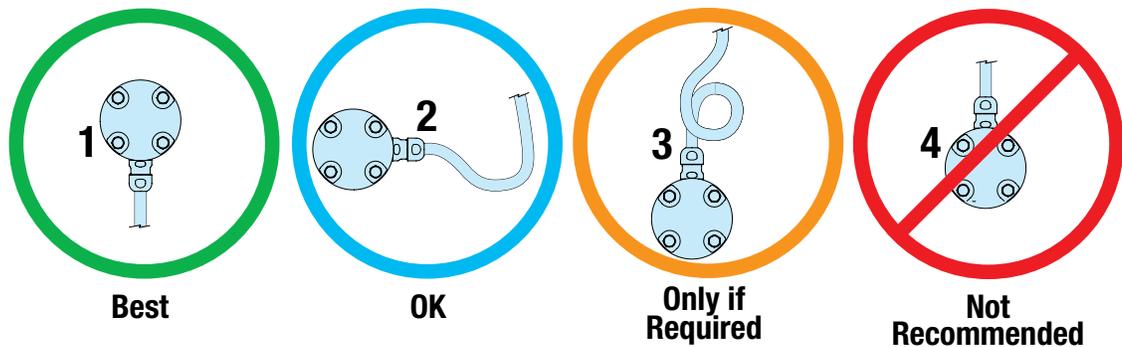
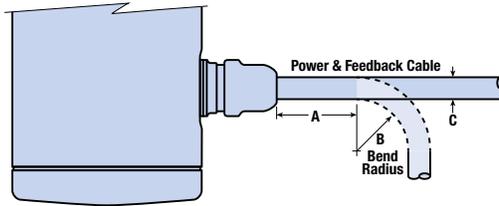


Figure 2-3: **1.** Preferred cable gland orientation is below the actuator and does not require loops or bends. **2.** Cable glands at the side requires bends or loops in the cable. **3.** If the cable glands must be at the top of the actuator a loop in the cable must be added. **4.** Cable glands at the top without a loop are not recommended.

## 2: PRODUCT OVERVIEW

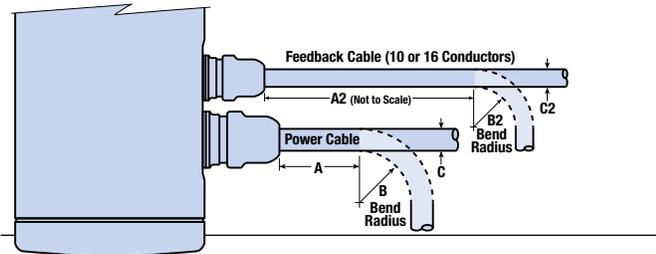


**NOTE** When routing cables it is also important to follow bending recommendations to prevent damage to the cable or cable glands.



Feedback Code	A	B (min bend radius)	C
FA2A2	105	150	15
FT2A2	105	150	15
CA2A2	105	150	15
CT2A2	105	150	15

Dimensions in mm



Feedback Code	A	A2	B (min bend radius)	B2 (min bend radius)	C	C2
FA1A1	46	34	46	51	11.5	8.5
FT1A1	46	34	46	51	11.5	8.5
FT1R1	46	34	46	51	11.5	8.5

FT1H1	46	31	46	47	11.5	7.8
FT1D1	46	31	46	471	11.5	7.8

Dimensions in mm

### ■ Actuator Orientation

#### 1. Rod End Down (Best)

#### 2. Rod End Horizontal (Good)

#### 3. Rod End Up (Never)

It is not recommended to mount the IMA-S with the thrust rod pointing upwards. Mounting the thrust rod vertically increases risk of contamination and ingress..

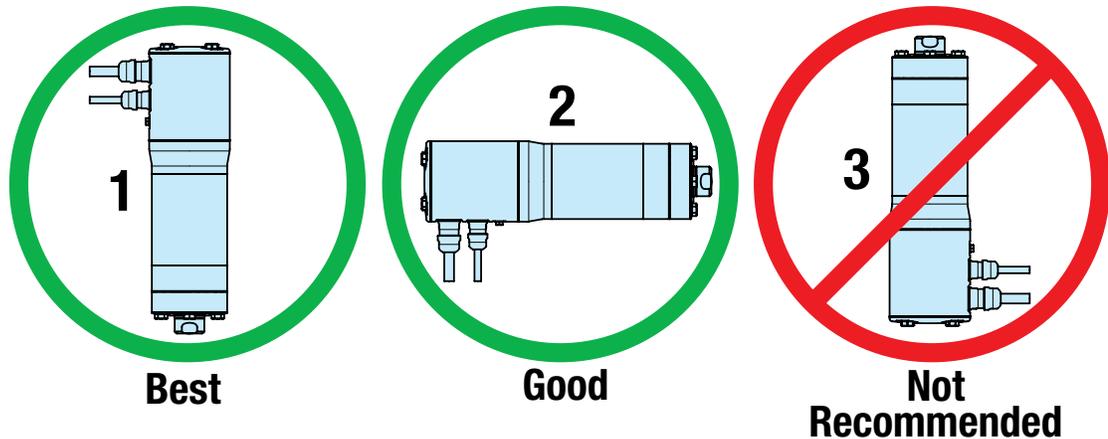


Figure 2-4: 1. & 2. Recommended IMA-S thrust rod orientation is down or horizontal. 3. Due to increased risk of contamination and ingress never orient the IMA-S actuator with the thrust rod up.

### ■ EMC Wiring Guidelines

#### Shielding and grounding

Tolomatic supplied cables have proper shielding and are recommended for proper installation. If additional or alternate cables are required, shielded cables are recommended. The standard cables provided by Tolomatic have an overall shield. To minimize EMI and ensure system reliability, all shield drain wires from all cables should be tied to a common earth ground.

#### **WARNING!**

Thrust rod is not electrically connected to ground. The thrust rod should be earth grounded during installation for safety when possible

### ■ Motion Control System Selection Recommendations

It is recommended that all servo drives be selected based on the following important parameters:

- a) CE and UL approved system
- b) Thermal switch input
- c) Servo drive sizing key parameters for IMA-S
  - i) Peak current
  - ii) Voltage
  - iii) Peak RPM
  - iv) Max current switching frequency

## 3.1 IMA-S Series Configuration

- Two sizes: 22 and 33
- Internal Anti-Rotation Option IMA-SA 33 (33 size only)
- Motor windings: 230 Vac & 460 Vac
- IP69K
- Feedback Choices:
  - Multi-Turn Absolute Encoders (SICK HIPERFACE DSL, SICK HIPERFACE, Heidenhain EnDat2.2)
  - Multi-turn Absolute Incremental
  - Incremental Resolver



**NOTE** For performance data and specifications please refer to the IMA-S catalog #2700-4014.

## 3.2 Standard Configurations and Options



**NOTE** Please see Tolomatic IMA-S Catalog 2700-4014 for complete information on ordering codes. Use 3D CAD files (available at [www.tolomatic.com](http://www.tolomatic.com)) for critical dimensions.

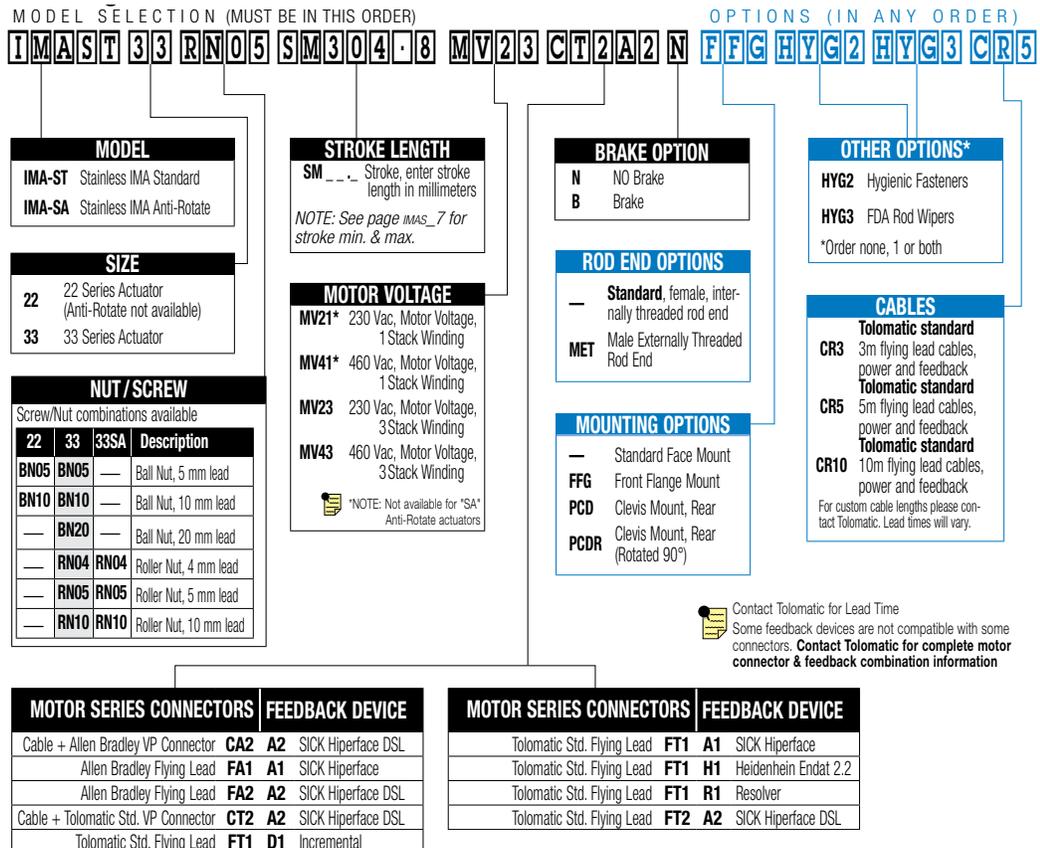


Figure 3-1 IMA-S ordering codes and descriptions

### 3.2.1 Internal Anti-Rotation Option

IMA-SA33: In order to achieve linear motion with the IMA-S a form of external anti rotation must be attached to the rod end. If the machine/application design does not allow for this, an internal anti-rotation option is available on the 33 product size and is designated as with the code “SA”, IMA-SA33.

### 3.2.2 Screw Selection

BN05, BN10, BN20, RN04, RN05, RN10: Both roller screw and ball screw technologies are offered. Contact Tolomatic for application review and assistance in selecting a screw technology.

### 3.2.3 Motor Voltage

MV21, MV41, MV23, MV43: Available with 230 Vac or 460 Vac and with 1 stack or 3 stack windings. Contact Tolomatic for application review and assistance in selecting voltage and windings.

### 3.2.4 Internal Holding Brake Option

B=Brake; N=No Brake: A 24V spring held electronically released holding brake (parking brake) is available. The holding force of the brake is capable of holding the continuous force of the actuator. The brake is spring set and releases when voltage is applied to the brake. A separate power source is required.

### 3.2.5 Standard Internally Threaded Rod End

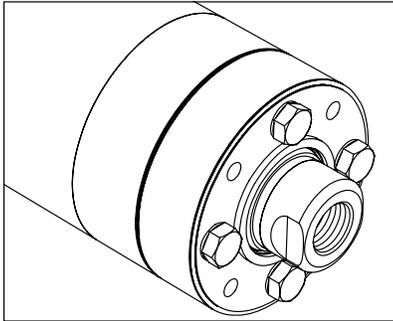


Figure 3-2 Standard Internally threaded rod end

The standard rod end for the IMA-ST is an internally threaded rod end.

### 3.2.6 Optional Externally Threaded Rod End

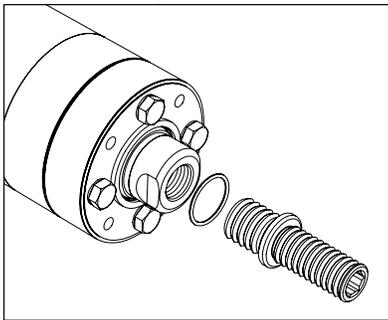
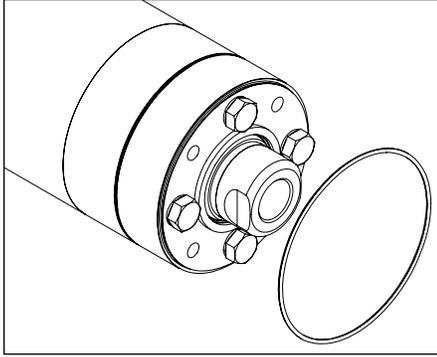


Figure 3-3 MET: externally threaded rod end

An externally threaded rod end option is available and threads into the standard internal rod end threads on the IMASx33. Rod end torque 40 ft-lbs (480 in-lbs) {54 N-m}.

Use 3D CAD files (available at [www.tolomatic.com](http://www.tolomatic.com)) for critical dimensions.

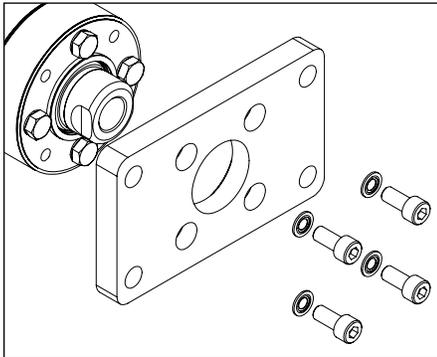
#### ■ 3.2.7 Standard Mounting Feature



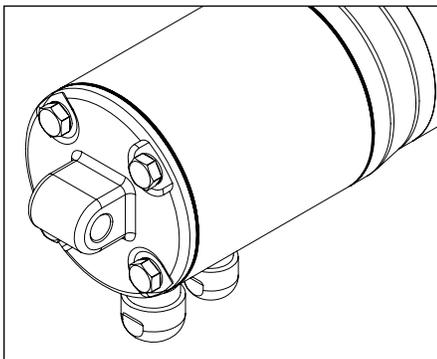
*Figure 3-4 Standard IMA-S mount*

Standard mounting for the IMA-S is through four (4) tapped holes on the front face (rod end) of the actuator, an o-ring is provided to achieve sealing between the front face and mounting surface. Use 3D CAD files (available at [www.tolomatic.com](http://www.tolomatic.com)) for critical dimensions.

#### ■ 3.2.8 Optional Mounting Options



*Figure 3-5 FFG: Front flange mount*



*Figure 3-6 PCD: rear clevis mount optional PCDR available: rear clevis mount rotated 90°*

Additional mounting options include a rear clevis and front flange option. Use 3D CAD files (available at [www.tolomatic.com](http://www.tolomatic.com)) for critical dimensions.

#### ■ 3.2.9 Hygienic Fastener and Seal Option

HYG2: The IMA-ST is available with standard hex bolt fasteners. The Hygienic fastener option can be

## 3: PRODUCT CONFIGURATION OVERVIEW

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added to replace the hex bolt fasteners with EHEDG approved fasteners. HYG3: Uses FDA approved rod seal cartridge in the design.

### ■ 3.2.10 Feedback Device

The IMA-S is offered with an absolute multi turn DSL feedback device as the standard feedback. Hiperface, EnDat absolute feedback devices as well as Incremental Encoder and Resolver options are available.

### ■ 3.2.11 Cable and Connector

CR3, CR5, CR10: Cable is resistant to cleaning and disinfecting agents. Cables are matched for each feedback/motor combination in 3, 5, 10 meter lengths. Connectors are available on cables for select feedback device options.



*Figure 3-7 IMA-S cable is resistant to cleaning and disinfecting agents*

### ■ 3.2.12 Servo Drive

The IMA-S Series actuator functions in the same way as a brushless servo motor. A servo drive is used to power and control the actuator. Please consult the servo drive manufacturer when sizing and selecting a servo drive for use with the IMA-S.



**NOTE:** The IMA-S must be ordered with all desired options. Field installation of options generally cannot be done. Call Tolomatic for complete details.



## 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.

## 4.1 General Operation

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

When ordered, the IMA-S actuator can be configured with any one of the following feedback devices: Absolute multi-turn HIPERFACE DSL, absolute multi-turn HIPERFACE, absolute multi-turn EnDat2.2, incremental and resolver. Please confirm that the servo drive supports the selected feedback protocol.

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

$$\text{Linear distance traveled} = (\text{motor revolutions}) * (\text{screw lead})$$

$$\text{Linear Speed} = ([\text{motor RPM}]/60) * (\text{screw lead})$$

$$\text{Linear Thrust (kN)} = \text{Motor torque (Nm)} * 2 * \pi * \text{pitch (rev/mm)} * \text{screw efficiency}$$

or

$$\text{Linear Thrust (lbf)} = \text{Motor torque (in}\bullet\text{lb)} * 2 * \pi * \text{pitch (rev/in)} * \text{screw efficiency}$$



## CAUTION!

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

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

### 4.2 Mounting Considerations

#### 4.2.1 Alignment and Side Loading:

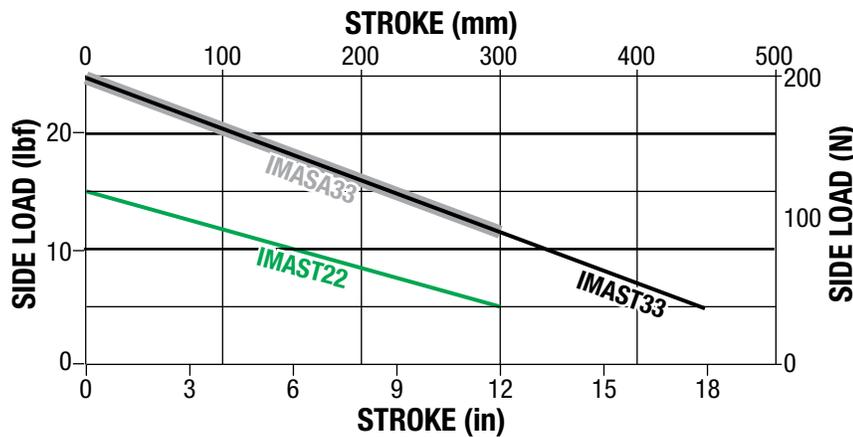
Alignment of the actuator with respect to the application load and axis of motion is essential to minimize side loading. The IMA-S is not meant to be used in applications where side loading occurs as side loading will reduce the life of the actuator and rod seals.

#### 4.2.2 Side Load Considerations



The IMA-S 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.

### IMA-S SIDE LOAD SPECIFICATIONS



### 4.3 Mechanical Installation Instructions

1. Remove packaging
2. Carefully remove linear actuator from package. \*Consider the weight of the actuator. Depending on the configuration, the actuator can weight up to approximately 22.7 kg (50 lb)
3. Visually inspect the actuator for damage
4. Notify the carrier of any shipping damage immediately
5. If the actuator is mounted in a vertical or inclined (sloping) position, include safety measures that control the work load in case of a screw failure.
6. Consider anti-rotation of the rod end. The actuator's thrust rod must be kept from rotating in order to achieve linear motion. If the application's tooling and load is free to rotate, order the IMA-SA model with internal anti-rotation to prevent the rod from rotating.
7. It is recommended to install the actuator with rod-end down or at a downward inclination to achieve best seal ingress protection.

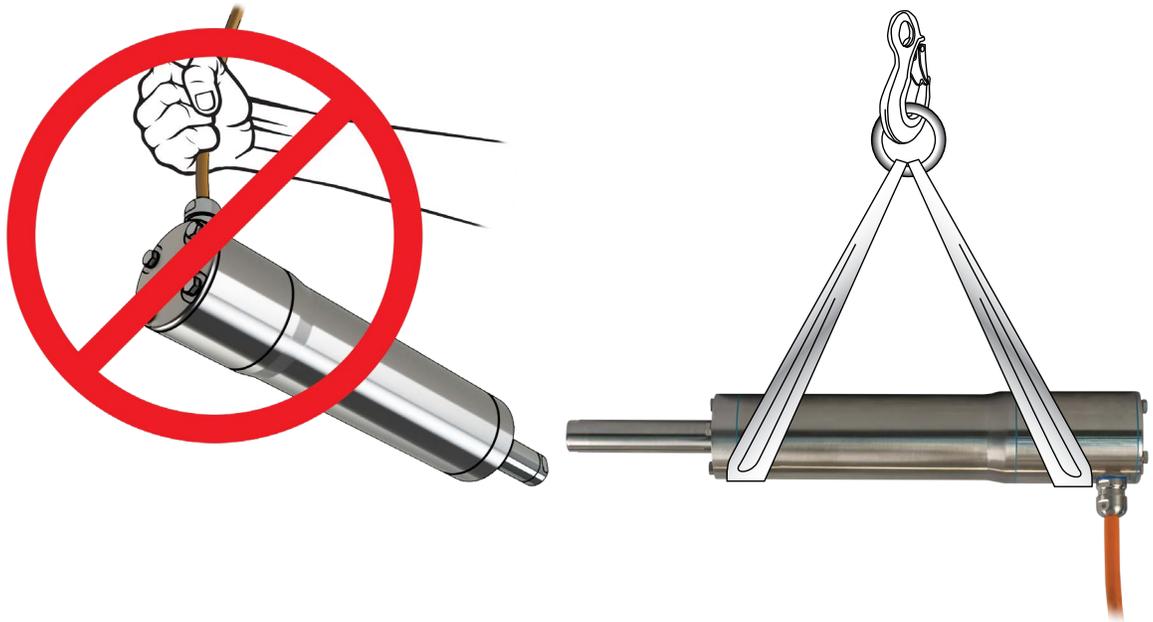
## 4: MECHANICAL INSTALLATION OF IMA-S ACTUATORS

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8. Follow recommendations for actuator orientation and cable routing.
9. Ensure sufficient clearance around the actuator to allow for airflow and cooling.
10. Follow installation mounting considerations and specifications for each mounting configuration during installation.

**⚠ CAUTION CAUTION!**

The IMA-S Series actuator weight range is approximately 4.8 to 22.7 kg (10.5 to 50 lb). Special care must be taken when lifting this device. The total stroke of actuator configurations can vary, therefore the actuator total stroke should be reviewed and taken into careful consideration during commissioning and operation to ensure actuator movement never reaches the end of stroke in service causing damage to the actuator.



IMA-S actuators can be configured for the following feedback devices: absolute multi-turn HIPERFACE DSL, absolute multi-turn HIPERFACE, absolute multi-turn EnDat2.2, incremental and resolver. The selection of the feedback device is dictated by the servo drive used to operate the actuator. Each servo drive has specific requirements for the feedback on the motor. Not all resolver-based servo drives can use the same resolver, resolver alignment, or relative direction of resolver rotation. Not all encoder-based servo drives can use the same encoder, encoder alignment or relative direction of encoder rotation. Many servo drives 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 servo drives may require assistance from the drive manufacturer.

## 5.1 Feedback Commutation

When Tolomatic manufactures an IMA-S actuator, the proper feedback is selected, mounted, commutate and tested on a drive that is known to be equivalent to the drive that the customer plans to use for confirming proper feedback alignment and operation.

**⚠ CAUTION** CAUTION! In any case where it is determined that the feedback has become misaligned, or a servo drive change is made requiring the feedback to be commutated differently, it is recommended that Tolomatic be contacted and arrangements made to have that procedure performed.

Feedback Type	Offset Alignment	Electrical Degree Tolerance
Hiperface	0 Degrees	+/- 5 Degrees
Hiperface DSL	0 Degrees	+/- 5 Degrees
Endat 2.2	0 Degrees	+/- 5 Degrees
Incremental Encoder	30 Degrees	+/- 5 Degrees
Resolver	90 Degrees	+/- 5 Degrees

## 5.2 Feedback Commutation 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-S motors are wired such that as the torque generating current vector progresses from phase U -> V -> W 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.

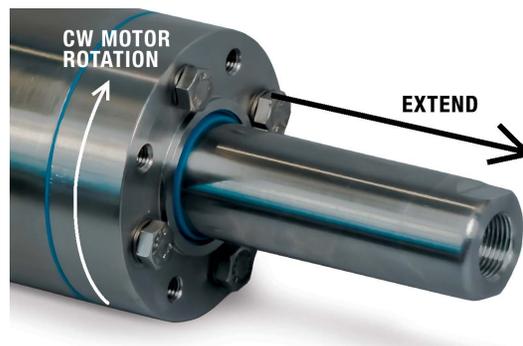


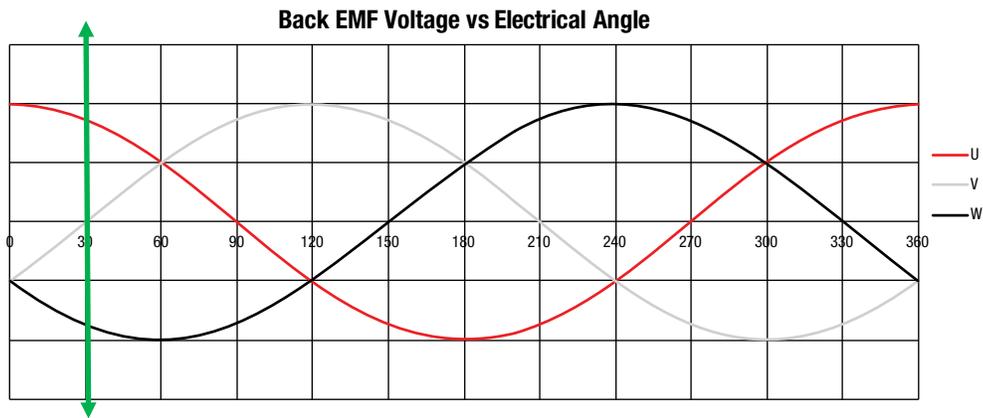
Figure 5-1: Thrust rod movement relative to motor rotation

### Absolute Encoder Feedback

The standard commutation offset for the absolute encoders offered in the IMA-S is set at 0 electrical degrees. This is accomplished by first locking the motor rotor with a current vector from phase U (+) to phase V and W (-), and then sending a set-zero position command to the encoder using appropriate programming tool.

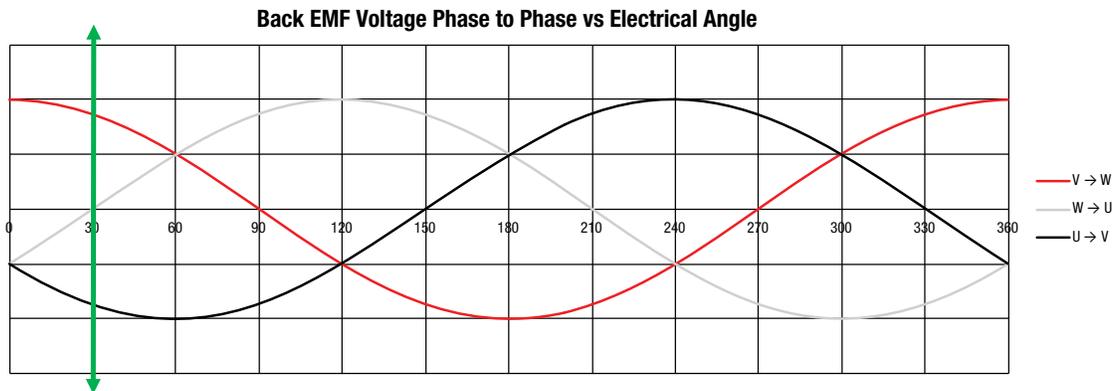
### Digital Incremental Encoder Feedback

The incremental quadrature encoder utilizes differential A and B signals for tracking position and differential index pulse and halls for commutation. The standard commutation offset of the index pulse for the incremental encoder offered in the IMA-S is set at 30 electrical degrees. This is accomplished by first locking the motor rotor with a current vector from phase U (+) to phase W (-), and then using an index alignment tool to establish commutation. This provides manufacturing the simplest means for aligning a feedback device, however, some manufactures will reference a motors back emf when discussing commutation angles. The following graph shows the index pulse location in reference to the motors back emf.



*Figure 5-2: Back EMF Voltage vs Electrical Angle*

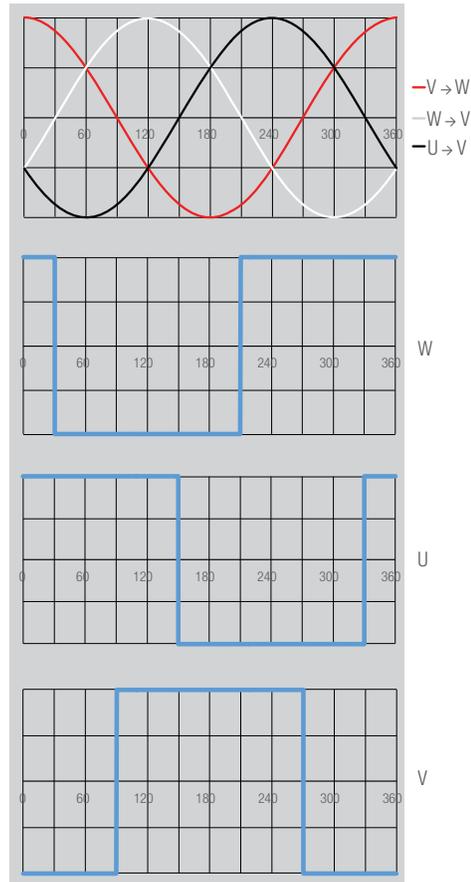
This provides manufacturing the simplest means for aligning a feedback device, however, some manufactures will reference a motors back emf when discussing commutation angles. The following graph shows the index pulse location in reference to the motors back emf.



*Figure 5-3: Back EMF Voltage Phase to Phase vs Electrical Angle*

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. The halls have an offset of 30 electrical degrees.

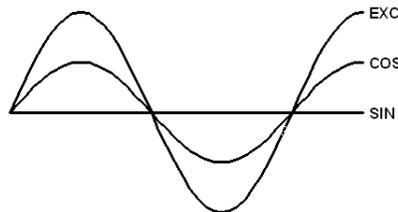


*Figure 5-4: Hall Alignment*

### Resolver Feedback

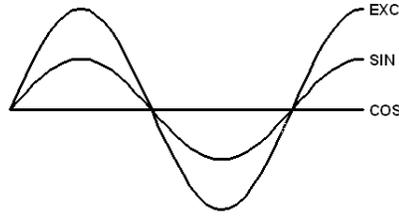
The IMA-S family is also offered with resolver feedback. A resolver must be excited with a sinusoidal input and outputs two signals, commonly referred to as cos and sin. These signals' magnitude and the phase angle relative to the excitation voltage are used by the drive to determine the absolute position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

These actuators are aligned with a current vector from phase V (+) to phase W (-). At this location, the resolver body is rotated until the cos signal is null, and the sin signal is in phase with the excitation frequency.



*Figure 5-5: Motor rotational position at 0*

Direction can be confirmed by rotating the shaft clockwise as viewed from the back, where, after 90 degrees of rotation the cos will now be in phase with the excitation frequency and the sin signal will be null.



*Figure 5-6: Motor rotational position at 90*

### Servomotor Information:



**NOTE:** See servomotor specifications in IMA-S catalog 2700-4014



**NOTE:** Do NOT exceed 650Vdc or 365 Vdc depending on motor selected, as it may cause damage to the actuator.

Supplying the motor more than 10% of the rated motor voltage may increase the rotational speed of the motor greater than its specified maximum speed, leading to premature failure of the actuator

## 5.3 Cable and Connector Leads Information

### 5.3.1 Pinout Tables

Wire Color	Wire AWG	Drive Phase
Black (U/L1/C/L+)	16	U
Black (V/L2)	16	V
Black (W/L3/D/L-)	16	W
Green/Yellow	16	Earth/Ground
*White	20	BRK +
*Brown	20	BRK -

*Table 5-1: IMA-S Power Cable wire colors*

Don't exceed rated motor voltage.

**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.

**\*Brake Information:** 24 Vdc power is required to release the brake during operation. A brown and white 20AWG lead exit the conduit opening as a pair and are used for brake wires. Ensure that these two 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.

### 5.3.2 Feedback Wiring

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



**NOTE:** Refer to Servo Drive User Manual for wiring instructions.

## 5: ELECTRICAL INSTALLATION GUIDELINES

**⚠ WARNING** **WARNING!** Electrical connections and cabling should receive special attention during component selection and system design when utilizing servo motor controlled systems. The feedback cable consist twisted pairs of wires in addition to an outer cable shield.

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

**⚠ WARNING** **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 Multi-Turn Feedback Device Standard HIPERFACE FA1A1 and FT1A1 Feedback Device Wiring:

Function	Wire Color	Wire Gauge	Pair	Connection Note
Input Voltage (Vcc)	Violet	24 Awg	P4	7-12Vdc Encoder Power. Connect to motor drive per drive manual
Ground (Gnd)	Blue	24 Awg	P4	Encoder ground. Connect to motor drive per drive manual
REFSIN	Pink	24 Awg	P3	Connect to motor drive per drive manual
Data+	Green	24 Awg	P1	Connect to motor drive per drive manual
REFCOS	Red	24 Awg	P2	Connect to motor drive per drive manual
Data-	Brown	24 Awg	P1	Connect to motor drive per drive manual
+SIN	Grey	24 Awg	P3	Connect to motor drive per drive manual
+COS	Black	24 Awg	P2	Connect to motor drive per drive manual
Thermal Device	White	20 Awg	P5	Connect to motor drive per drive manual or Isolate
Thermal Device	Brown	20 Awg	P5	Connect to motor drive per drive manual or Isolate

*Table 5-2: Absolute Multi-Turn Feedback Device Standard HIPERFACE FA1A1 & FT1A1 Feedback Device Wiring:*

### Absolute Multi-Turn Feedback Device HIPERFACE DSL FA2A2 and FT2A2 Feedback Device and Power Wiring:

Function	Wire Color	Wire Gauge	Pair	Connection Note
U	Brown	18 Awg	NA	Motor Power. Connect to motor drive per drive manual
V	Black	18 Awg	NA	Motor Power. Connect to motor drive per drive manual
W	Blue	18 Awg	NA	Motor Power. Connect to motor drive per drive manual
Ground	Green/Yellow	18 Awg	NA	Earth Groud. Connect to motor driver per drive manual
Data +	Blue	22 Awg	P2	Connect to motor drive per drive manual
BRK+	Black	22 Awg	P1	24 Vdc Brake Leads. Connect to motor drive per drive manual
BRK -	White	22 Awg	P1	24 Vdc Brake Leads. Connect to motor drive per drive manual
Data -	White/Blue	22 Awg	P2	Connect to motor drive per drive manual

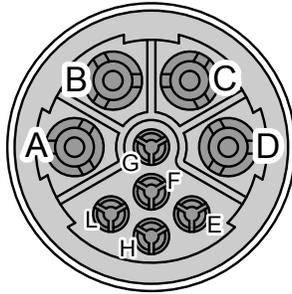
*Table 5-3: Absolute Multi-Turn Feedback Device Standard HIPERFACE DSL FA2A2 & FT2A2 Feedback Device and Power Wiring and Power Wiring:*

## 5: ELECTRICAL INSTALLATION GUIDELINES

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

**Thermal Device:** Motor is equipped with VISHAY Thermistor, which is directly wired into feedback encoder device. Consult Tolomatic for thermistor's manufactures part number

### Absolute Multi-Turn Feedback Encoder Device HIPERFACE DSL CA2A2 and CT2A2 Feedback Device and Connector Layout:



Motor Power Connector DA2 xxx	
Manufacturer: Intercontec	
Intercontec Part No.: BKUA 145 MR30 59 0200 000	
Pin	Name
A	U
B	V
C	W
D	Ground**
E	Data +
F	BR+*
G	BR-*
H	Data -
L	No Contact

\*\*Required

\* Connect brake only when present

**Brake Information:** 24 Vdc power is required to release the brake during operation. Ensure that pins "F" and "G" are used for the brake.

**Thermal Device:** Motor is equipped with VISHAY Thermistor, which is directly wired into feedback encoder device. Consult Tolomatic for thermistor's manufactures part number

### Absolute Multi-Turn Feedback Device Standard EnDat2.2 FT1H1 Feedback Device Wiring:

Function	Wire Color	Wire Gauge	Pair	Connection Note
A+	White/Yellow	24 Awg	P1	Connect to motor drive per drive manual
A-	White/Green	24 Awg	P1	Connect to motor drive per drive manual
Data +	White/Red	24 Awg	P2	Connect to motor drive per drive manual
Data -	White/Orange	24 Awg	P2	Connect to motor drive per drive manual
Clock +	White/Black	24 Awg	P3	Connect to motor drive per drive manual
Clock -	White/Brown	24 Awg	P3	Connect to motor drive per drive manual
B +	Grey	24 Awg	P4	Connect to motor drive per drive manual
B -	White	24 Awg	P4	Connect to motor drive per drive manual
Up	Violet	24 Awg	P5	Connect to motor drive per drive manual
0 V	Blue	24 Awg	P5	Connect to motor drive per drive manual
Sensor Up	Green	24 Awg	P6	Connect to motor drive per drive manual
Sensor 0 V	Yellow	24 Awg	P6	Connect to motor drive per drive manual
Not Connected	Red	24 Awg	P7	Connect to motor drive per drive manual, ground or isolation

## 5: ELECTRICAL INSTALLATION GUIDELINES

Function	Wire Color	Wire Gauge	Pair	Connection Note
Not Connected	Orange	24 Awg	P7	Connect to motor drive per drive manual, ground or isolation
Thermal Device	Black	24 Awg	P8	Connect to motor drive per drive manual
Thermal Device	Brown	24 Awg	P8	Connect to motor drive per drive manual

Table 5-4: Absolute Multi-Turn Feedback Device Standard EnDat2.2 FT1H1 Feedback Device Wiring:

**Thermal Device:** Motor is equipped with a PT1000 temperature sensor. Contact Tolomatic for the Temperature Sensor's manufactures part number.

### Incremental Feedback Device Quantum FT1D1 Feedback Device Wiring:

Function	Wire Color	Wire Gauge	Pair	Connection Note
A+	White/Yellow	24 Awg	P1	Connect to motor drive per drive manual
A-	White/Green	24 Awg	P1	Connect to motor drive per drive manual
Hall U +	White/Red	24 Awg	P2	Connect to motor drive per drive manual
Hall U -	White/Orange	24 Awg	P2	Connect to motor drive per drive manual
Hall V +	White/Black	24 Awg	P3	Connect to motor drive per drive manual
Hall V -	White/Brown	24 Awg	P3	Connect to motor drive per drive manual
Hall W +	Grey	24 Awg	P4	Connect to motor drive per drive manual
Hall W -	White	24 Awg	P4	Connect to motor drive per drive manual
I +	Violet	24 Awg	P5	Connect to motor drive per drive manual
I -	Blue	24 Awg	P5	Connect to motor drive per drive manual
B +	Green	24 Awg	P6	Connect to motor drive per drive manual
B -	Yellow	24 Awg	P6	Connect to motor drive per drive manual
+ 5 VDC	Red	24 Awg	P7	Connect to motor drive per drive manual
COM	Orange	24 Awg	P7	Connect to motor drive per drive manual
Thermal Device	Black	24 Awg	P8	Connect to motor drive per drive manual
Thermal Device	Brown	24 Awg	P8	Connect to motor drive per drive manual

Table 5-5: Incremental Feedback Device Quantum FT1D1 Feedback Device Wiring:

**Thermal Device:** Motor equipped with thermal switch designed to switch at 100°C. Tolomatic recommends the use of the thermal switch in order to protect the actuator in higher ambient temperatures.

### Resolver Feedback Device FT1R1 Feedback Device Wiring:

Function	Wire Color	Wire Gauge	Pair	Connection Note
EXC	Green	24 Awg	P1	Connect to motor drive per drive manual
EXC LO	Brown	24 Awg	P1	Connect to motor drive per drive manual
COS	Black	24 Awg	P2	Connect to motor drive per drive manual
COS LO	Red	24 Awg	P2	Connect to motor drive per drive manual
SIN	Grey	24 Awg	P3	Connect to motor drive per drive manual
SIN LO	Pink	24 Awg	P3	Connect to motor drive per drive manual
Not Connected	Blue	24 Awg	P4	Connect to motor drive per drive manual, ground or isolation

## 5: ELECTRICAL INSTALLATION GUIDELINES

Function	Wire Color	Wire Gauge	Pair	Connection Note
Not Connected	Violet	24 Awg	P4	Connect to motor drive per drive manual, ground or isolation
Thermal Device	White	20 Awg	P5	Connect to motor drive per drive manual
Thermal Device	Brown	20 Awg	P5	Connect to motor drive per drive manual

Table 5-6: Resolver Feedback Device FT1R1 Feedback Device Wiring:

**Thermal Device:** Motor equipped with thermal switch designed to switch at 100°C. Tolomatic recommends the use of the thermal switch in order to protect the actuator in higher ambient temperatures.

The encoders have internal temperature switches which will deactivate the IMA-S actuator, if thermal switch is utilized by servo drive.

**⚠ WARNING** **WARNING!** Encoder temp is not a way to monitor motor temperature. Performance is based on actuator performance.

**⚠ WARNING** **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.

### 5.3.3 Thermal Sensor Specifications

Most of the motor windings have an integral normally closed thermal switch. The switch opens at a temperature of 100°C (212° F), which is the windings maximum operating temperature. The FT1H1 option will include a PT1000 thermistor for measuring the temperature. The thermal switch/ sensor is meant to protect the windings, the actuators continuous operating region must still be obeyed. Cycles that cause the windings temperature to approach 100°C (212° F) will reduce the expected life of the actuator.

ORDERING CODE	FA1A1, FT1A1, FT1R1, FT1D1	ORDERING CODE	FT1H1	ORDERING CODE	FA2A2, CA2A2, FT2A2, CT2A2
<b>Thermal Switch</b>		<b>PT1000 Thermal Transister</b>		<b>VISHAY</b>	
Opens at:	100°C (212°F)	Make / Model	TE PTFD102B1G0	Make / Model	NTCLE213- E3103FLyy
Recommended Current	1.0 ADC	Nominal Resistance @ 0° C	1000 Ohms	Nominal Resistance @ 0° C	1000 Ohms
Max Voltage	14 VDC	Temp Coefficient of Resistance	3850 ppm	Temp Coefficient of Resistance	3850 ppm
		Measuring Current	0.5 mA	Measuring Current	0.5 mA

Table 5-7: Thermal sensor specifications

## 6.1 Homing

When homing the IMA-S avoid excessive force (120% Continuous Stall Force Maximum). During homing do not exceed speeds of 0.39 in/sec (10 mm/sec). The IMA-S is designed with internal bumpers, however, exceeding these recommendations can cause permanent damage to the actuator. Careful attention should always be taken to prevent exceeding the physical limits of the actuator.

## 6.2 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 continuous stall force of the actuator.

### **CAUTION**

**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.

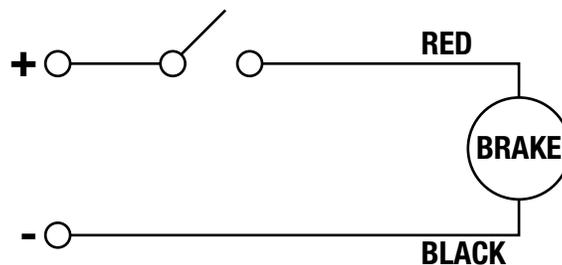


Figure 6-1: Fastest Engage/Disengage time, least protection

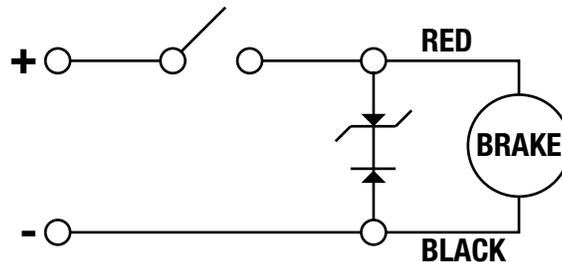


Figure 6-2: Increased Engage/Disengage time, best protection

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.

### 6.3 Breather Port

Tolomatic recommends the use of the breather port located in the back of the actuator adjacent to the cable(s). Correctly utilizing the breather port will enhance protection against ingress of moisture by equalizing pressure in the actuator.

- An IP69k face seal fitting is required.
- It is recommended that the air supplied or exchanged is dry and clean.
- The airline should be periodically inspected for moisture.



*Figure 6-3: Breather port on IMA-S actuator*



## NOTE:

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

## 7.1 Wash-down recommendations

- Cleaning should only be done by qualified personnel.
- Tolomatic requires the actuator to be stationary and de-energized during cleaning.
- It is recommended that the actuator be fully retracted during cleaning.
- Follow IP69K wash-down standards for pressure, proximity and temperature. Violating the IP69K standards could be detrimental to the life of the actuator.
- Tolomatic prohibits the use of friction style cleaning such as a wire brush. Wash-down and wipe down cleaning are the only approved cleaning methods.
- Minimum acceptable concentrations of cleaning chemicals should be used to successfully sanitize equipment. Consult Tolomatic for chemical compatibility.
- A rinse down of the actuator is required after the cleaning process to minimize seal exposure to sanitizing chemicals.

## 7.2 Seal replacement recommendations

### 7.2.1 General Application Scenario

- One wash-down per day following wash-down guidelines above.
- Actuator is not experiencing side load during operation.
- Thrust rod is not being contaminated by food product or other materials during operation.
- Hardware is not damaged and is still in operating condition.
- Maximum velocity and acceleration limits are not exceeded.
- Actuator is operating within specified temperature range.

### 7.2.2 Recommendation

- Seals should be replaced every 25 million inches of travel. Customer testing or experience can prolong seal replacement interval.

### 7.2.3 Early Replacement Recommendations

- 50% reduction in seal replacement interval if food product is expected to be present on thrust rod during operation.
- 50% reduction in seal replacement interval if wash-down frequency is 3+ time per day.

## 7: REPAIR AND MAINTENANCE

- 50% reduction in seal replacement interval if high sanitizing chemical concentrations are used
- Seal exposure time is important to consider, a rinse after sanitizing is recommended to remove residual sanitizing chemicals.

### 7.2.4 General Notes

- Periodic re-lubrication of rod seals with Mobil SHC Polyrex 462 will increase the life of the seals.
- Periodic visual inspection of thrust rod and front seal is recommended.

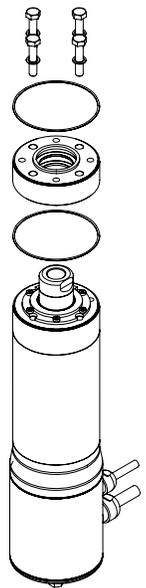
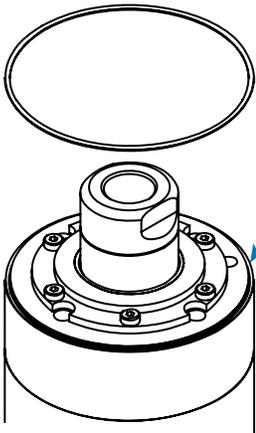
### 7.2.5 Seal Cartridge Replacement Procedure

1. Secure actuator in vertical rod up orientation.
2. Loosen Hex Bolts and remove Front Head and O-Ring between Seal Cartridge and actuator body.
3. Inspect new O-Ring and install into groove of actuator body.
  - A. Do Not over stretch the O-Ring, the O-Ring is designed to 'snap' into groove.
  - B. O-Ring doesn't require lubrication due to the nature of the material.
4. Remove new Seal Cartridge from packaging. Verify that grease is present between the rod seals. If no grease is present, the seals should be lubricated with SHC Polyrex 462 before the cartridge is installed.
5. Place the new Seal Cartridge onto the Thrust Rod and push flush with the body of the actuator.
6. Verify O-Ring is still in its groove before tightening Fasteners.
7. Install all 4 Sealing Washers and Fasteners
8. Torque Fasteners in cross pattern to the specifications listed in the table below.

- A. Check Fastener torque to ensure full compression of O-Ring.

Size	Torque	
	(in-lbs)	(N-m)
IMA-ST22	60	6.8
IMA-ST33, IMA-SA-33	160	18.8

9. Verify O-Ring is 'flush' to the surface and that Sealing Washers are seated below each of the Fasteners.



## 7.3 Lubrication



### NOTE

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



### CAUTION: DO NOT FILL WITH GREASE!

IMA-S actuators have been lubricated at the factory and are ready for installation. Please use the appropriate lubrication interval calculations listed below for schedule estimates.

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

All curves represent properly lubricated and maintained actuators.

### BALL SCREW

**Step 1:** Calculate actuator Power Output

$$P_{IMA} = V_{RMS} \times T_{RMS} \times 0.113 \text{ (watts)}$$

**Step 2:** Select the appropriate actuator power level  $P_C$

**Step 3:** Calculate the Power Factor

$$K_p = \frac{P_C}{P_{IMA}}$$

**Step 4:** The lubrication interval ( $t_l$ ) for a given cycle is then calculated as:

$$t_l = 1000 \text{ (hours)} = K_p < 1$$

$$t_l = 9000 \text{ (hours)} = K_p > 1$$

- Re-lubricate with Mobilith SHC220 #2744-1016 (QUANTITY: IMA-S 33: 3.0 g; IMA-S 44: 5.0 g) into the grease zerk located on the rod end.
- IMA-S 22 ballscrew does not require relubrication.

Where:

$P_{IMA}$  = IMA Power Output

$V_{RMS}$  = RMS Velocity (in/sec)

$T_{RMS}$  = RMS Thrust (lbf)

$K_p$  = Power Factor

$P_C$  = Power Level

$t_l$  = Lubrication Interval (hours)

**BALL SCREW LUBRICATION (Example Calculation)**

**Cycle Details:**

Product: IMA-S 33 BN

$V_{RMS}$ : 1.66 in/sec

$T_{RMS}$ : 400 lbf

$T_{MAX}$ : 400 lbf

**Step 1:** Calculate your actuator's power output.

$$P_{IMA} = 1.66 \text{ in/sec} \cdot 400 \text{ lbf} \cdot 0.113 = 75 \text{ (watts)}$$

**Step 2:** Select the appropriate actuator power level.  $P_C$

$$P_C = 105 = \text{IMA-S 33 BN}$$

**Step 3:** Calculate the Power Factor.

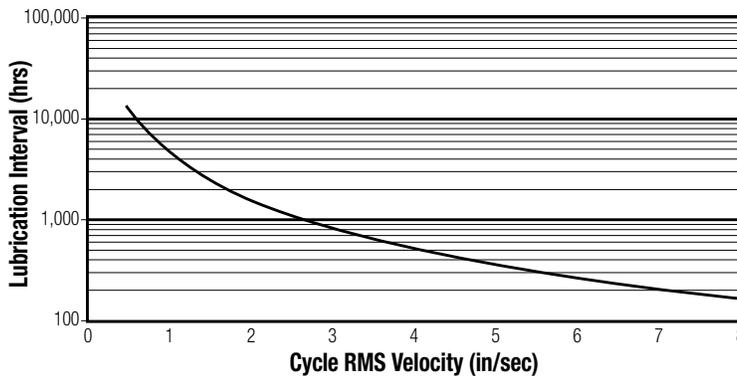
$$K_P = \frac{105}{75} = 1.4$$

**Step 4:** The lubrication interval ( $t_l$ ) for a given cycle is then calculated as:

$$t_l = 9000 \text{ (hours)} = K_P > 1$$

**ROLLER SCREW**

- For optimal performance and rated life, periodic re-lubrication is required.



**Figure 6-3: Roller Screw Lubrication Interval Graph**

**Step 1:** Select the Basic Lubrication Interval ( $t_{BL}$ ) based on the cycles RMS Velocity ( $V_{RMS}$ ).

$$t_{BL} = 4500 \times (V_{RMS})^{-1.57} \text{ (hours)}$$

**Step 2:** Determine the Thrust Correction Factor ( $K_T$ ) based on the ratio of the

## 7: REPAIR AND MAINTENANCE

Actuator Peak Thrust Rating ( $T_{PEAK}$ ) to the Cycle Equivalent Load ( $P_e$ ).

$$K_T = K_{Co} \left( \frac{T_{PEAK}}{P_e} \right) - 0.15$$

	ST33RN04	ST33RN05	ST33RN10	SA33RN04	SA33RN05	SA33RN10
$K_{Co}$	0.200	0.180	0.454	0.434	0.367	0.711

**IMPORTANT NOTE:**

**If calculated  $K_T$  is greater than 1, a  $K_T$  value of 1 should be used for the Lubrication Interval ( $t_L$ ) calculation**

**Step 3:** The Lubrication Interval ( $t_L$ ) for a given cycle is then calculated as:

$$t_L = t_{BL} \times K_T \text{ (hours)}$$

Where:

$t_{BL}$  = Basic Lubrication Interval (hours)

$V_{RMS}$  = RMS Velocity (in/sec)

$K_T$  = Thrust Correction Factor

$K_{Co}$  = Screw Static Load Factor

$T_{PEAK}$  = Actuator Peak Thrust Rating

$P_e$  = Cycle Equivalent Load

$t_L$  = Lubrication Interval (hours)

- Re-lubricate with Tolomatic Grease #2733-1345 into the grease zerk located in the rod end.

### ROLLER SCREW LUBRICATION (Example Calculation)

**Cycle Details:**

Product: IMA-ST 33 RN05

$V_{RMS}$ : 1.66 in/sec

$T_{PEAK}$ : 2500 lbf

$P_e$ : 500 lbf

**Step 1:** Select the Basic Lubrication Interval ( $t_{BL}$ ) based on the cycles RMS Velocity ( $V_{RMS}$ ).

## 7: REPAIR AND MAINTENANCE

$$t_{BL} = 4500 \times (1.66 \text{ in/sec})^{-1.57} = 2019 \text{ (hours)}$$

**Step 2:** Determine the Thrust Correction Factor ( $K_T$ ) based on the ratio of the Actuator Peak Thrust Rating ( $T_{PEAK}$ ) to the Cycle Equivalent Load ( $P_e$ ).

$$K_T = 0.200 \left( \frac{2500 \text{ lbf}}{500 \text{ lbf}} \right) - 0.15 = 0.85$$

	ST33RN04	ST33RN05	ST33RN10	SA33RN04	SA33RN05	SA33RN10
$K_{Co}$	0.200	0.180	0.454	0.434	0.367	0.711

**IMPORTANT NOTE:**

**If calculated  $K_T$  is greater than 1, a  $K_T$  value of 1 should be used for the Lubrication Interval ( $t_L$ ) calculation**

**Step 3:** The Lubrication Interval ( $t_L$ ) for a given cycle is then calculated as:

$$t_L = 2019 \text{ (hours)} \times 0.85 = 1716 \text{ (hours)}$$

### 7.4 Storage Recommendations

- Make sure the equipment is placed in a suitable storage position to prevent damage to the seals, thrust rod or cable.
- Ensure that storage will not damage external surface creating pits, scratches, or crevices.
- Protect the feedback device, which is located at the cable end of the 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-S to redistribute the internal lubricants.

It is also recommended to cycle the IMA-S 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.
- Storage Temperature is -25C to +60C (-13F to 140F)

## A.1 Specifications

### A.1.1 Performance and Mechanical Specifications



**NOTE** For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).

### A.1.2 Motor Specifications:

For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).

### A.1.3 Brake Specifications:

For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).



**NOTE** For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).

### A.1.4 Actuator Sizing:

It is recommended that the Tolomatic Sizing Software is used to determine the size of an actuator required for a specific application. (<http://sizeit.tolomatic.com/>). The RMS thrust and velocity calculations provided should be only used for calculating the re-lubrication interval.

### A.1.5 IMA-S Brake Considerations

An unpowered IMA-S will require a brake to maintain its position if the force on the actuator exceeds Back Drive Force listed in the table on page A\_1.

A brake can be used with the actuator to keep it from back driving, 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: IMA-S\_22 - 0.35 Amps; IMA-S\_33 - 0.43 Amps;

### A.1.6 Critical Speed



**NOTE** For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).

### A.1.7 Ball & Roller Screw Life



**NOTE** For performance data and specifications please refer to the [IMA-S brochure #2700-4014](#).

**B.1 Troubleshooting Procedure**

<b>SYMPTOM</b>	<b>CAUSE</b>	<b>SOLUTION</b>
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
	Drive may be improperly tuned	Check all gain settings
	Drive may be set up improperly for IMA-S 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
	Excessive side load	Verify correct operation
	Misalignment of output rod to application	Verify correct alignment
	Drive has too low of current capacity or is limited to tool low of current capacity	Verify correct drive and 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 housing 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
	Actuator low or out of grease	Re-lubricate

## C.1 Warranty

### Warranty and Limitation of Liability

Tolomatic's complete terms and conditions can be found here <https://www.tolomatic.com/info-center/resource-details/terms-and-conditions>

### Limited Warranty

Tolomatic warrants that at the time of delivery, Products shall be in good condition, free from defects in material and workmanship and that Products made to order shall conform to applicable drawings or specifications as referenced in the quotation or accepted purchase order ("Product Warranty"). The Product Warranty shall expire one year from date of shipment (the "Warranty Period"). Tolomatic warrants that Buyer shall acquire good title to the Products free from third party rights. These warranties are given only to Buyer and not to any third party.

The Product Warranty excludes any defects or non-conformance resulting (wholly or in part) from: (i) accidental damage, mishandling, incorrect installation, negligence or other circumstances arising after delivery; (ii) the repair or alteration of the Product by any party other than Tolomatic or its authorized representative; (iii) the failure by Buyer to provide a suitable storage, use, or operating environment for the Products; (iv) Buyer's use of the Products for a purpose or in a manner other than that for which they were designed; and (v) other abuse, misuse or neglect of the Products by Buyer or any third party.

The Product Warranty excludes any Products not manufactured by Tolomatic. Insofar as any Products are manufactured by third parties, Tolomatic shall, insofar as it can, pass to the Buyer the benefit of all warranties given by the supplier of such Products.

The Product Warranty shall be limited to defects of which Tolomatic is notified within twenty-one (21) days from the date of shipment to Buyer or, in the event of latent defects, within twenty-one (21) days of the defect being discovered and provided that such notice is received within the Warranty Period. As sole remedy for the breach of the warranty in paragraph (a) above, provided that (if required by Tolomatic) all non-conforming Products are returned to Tolomatic at Buyer's cost, and provided that Tolomatic confirms the defect or non-conformance, Tolomatic shall at its option (i) replace or repair the defective or non-conforming items, or correct any defective work or non-conformance, or (ii) refund to Buyer the original purchase price of the defective or non-conforming item and reimburse to Buyer any transportation and insurance charges incurred by Buyer.

Any claim by Buyer against Tolomatic alleging the breach of the Product Warranty must be commenced within twelve (12) months following the date of the alleged breach.

In the event the parties disagree whether or not a breach of the Product Warranty has occurred, Tolomatic may (but shall not be obliged to) undertake any repairs or replacement requested by Buyer pending final settlement of the matter. If it is determined that no such breach has occurred, Buyer shall pay Tolomatic upon demand the reasonable price of the repairs, corrections, or replacements made by Tolomatic including allowances for overheads and a reasonable profit margin.

THE WARRANTIES EXPRESSLY MADE UNDER THESE TERMS ARE EXCLUSIVE AND GIVEN IN LIEU OF ALL OTHER REPRESENTATIONS, WARRANTIES AND COVENANTS THAT MAY BE IMPLIED BY LAW, BY CUSTOM OF TRADE, BY THESE TERMS, BY THE PURCHASE ORDER OR OTHERWISE WITH

## C: WARRANTY

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RESPECT TO THE PRODUCTS. TO THE FULL EXTENT PERMITTED BY LAW, TOLONATIC DISCLAIMS AND BUYER WAIVES ALL SUCH REPRESENTATIONS, WARRANTIES AND COVENANTS INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. BUYER'S SOLE REMEDY FOR BREACH OF WARRANTY IS STATED IN PARAGRAPH (d) ABOVE.

No Products shall be returned without Tolomatic's prior written consent. Products which Tolomatic consents to have returned shall be shipped by Buyer at Buyer's risk and expense, freight prepaid, to such location as Tolomatic designates.

### **Limitation of Liability**

Tolomatic shall in no event be liable to Buyer or any third party, whether in contract, tort (including negligence), misrepresentation, strict liability or otherwise, for any incidental, punitive, consequential, indirect or special damages, including any loss of profits or savings or anticipated profits or savings, loss of data, loss of opportunity, loss of reputation, loss of goodwill or business or potential business, however caused, even if Tolomatic has been advised of the possibility of such damages in advance.

Under no circumstances shall Tolomatic's liability to Buyer in connection with any purchase order or Products supplied to Buyer exceed an amount equal to the amount paid by Buyer for such Products.

Buyer agrees and understands that it is solely Buyer's responsibility to ensure that Products are suitable for Buyer's requirements and for the environment, facilities or machinery for which they are intended by Buyer or by its end-customer to be fitted or used. Even if Tolomatic is advised of Buyer's intended use, Tolomatic makes no representation or warranty that the Product will be suitable for that purpose. Any technical advice furnished by Tolomatic relating to the intended use of the Products is given for information only and Tolomatic assumes no obligation or liability for the advice given or the results obtained. Except insofar as specifications or drawings form part of a purchase order and the Product Warranty, to the full extent permitted by law, Tolomatic disclaims and Buyer waives all representations, warranties and covenants that may be implied from the provision by Tolomatic of technical advice or information about Product. All such advice and information are accepted by Buyer at its risk.

Insofar as any liability or warranty of Tolomatic cannot be limited or excluded under applicable law, including any laws that do not permit limitations on liability relating to death or personal injury, the provisions of these terms and conditions shall be construed as being subject to such legal limitations, but only if those legal provisions have effect in relation to Tolomatic's liability notwithstanding the governing law provision in Section 18

### **Product Return Procedure**

1. Before initiating the RMA process and obtaining an RMA number, please contact the Tolomatic Technical Support team to determine if it is possible to correct the issue in the field.
2. If an RMA is needed your Tolomatic Technical support team will initiate the RMA process and set up an RMA number.

## D.1 Certification

CE	<b>Tolomatic</b> EXCELLENCE IN MOTION	CE
<b>EU Declaration of Conformity</b>		
No: 36004702_04		
We the manufacturer,		
<b>Tolomatic</b> 3800 County Road 116 Hamel, MN 55340 USA		
declare under our sole responsibility that the product(s),		
<b><i>IMAS Actuators</i></b>		
<b><i>All Models</i></b>		
Fulfills the essential requirements of the following directives:		
<b>LVD Directive (2014/35/EU)</b> EN60034-1 2010/AC:2010 Rotating electrical machines Part 1 Rating and performance		
<b>RoHS Directive (2011/65/EU, as amended by (EU) 2015/863)</b>		
<b>REACH (Regulation (EC) No 1907/2006)</b>		
Assumption of conformity is based on the application of the harmonized or applicable technical standards and, when applicable or required, a European community notified body certification.		
		
Brad Schulz Director of Engineering & Technology		28.10.2022 Date (dd.mm.yyyy)

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