Tolomatic
EXCELLENCE *IN MOTION*®

PRODUCT BROCHURE

SERVOWELD SYSTEM

ENDURANCE TECHNOLOGY℠

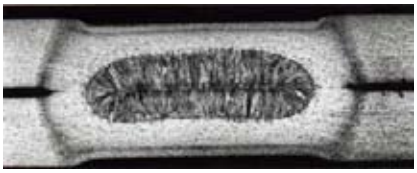
GSWA INTEGRAL MOTOR HIGH THRUST ACTUATOR

MAXIMUM DURABILITY

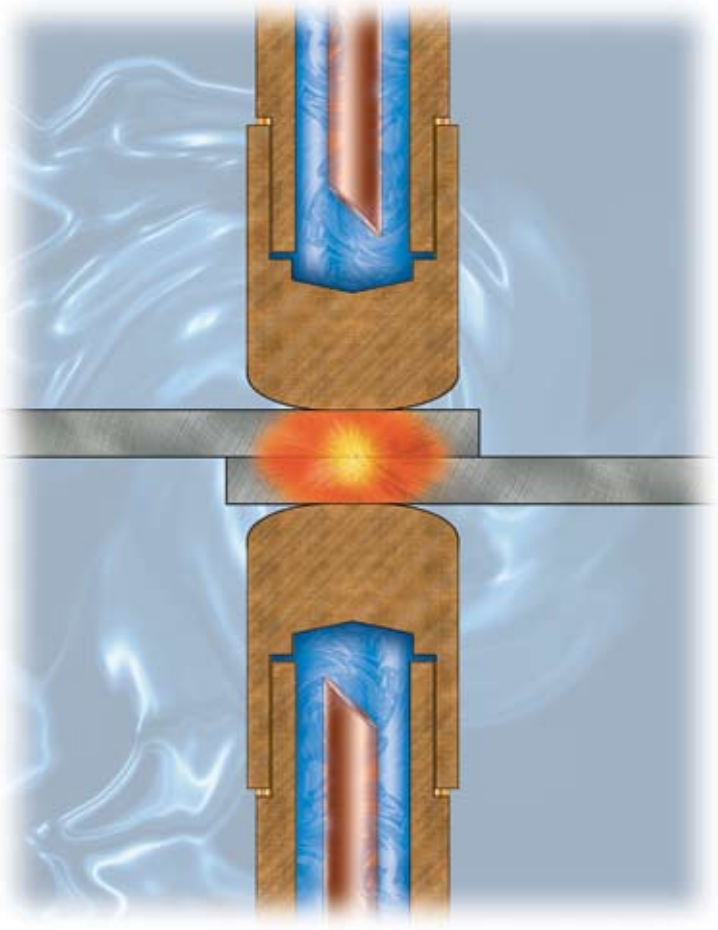
WHY CHOOSE SERVOWELD?

HIGHER QUALITY WELDS

- Force repeatability for consistent welds
- "Soft-touch" eliminates high impact wear
- Position and force can be recorded for each weld
- Cap wear and lost cap detection



Perfect welds, as seen in this cross-section, can be achieved every time



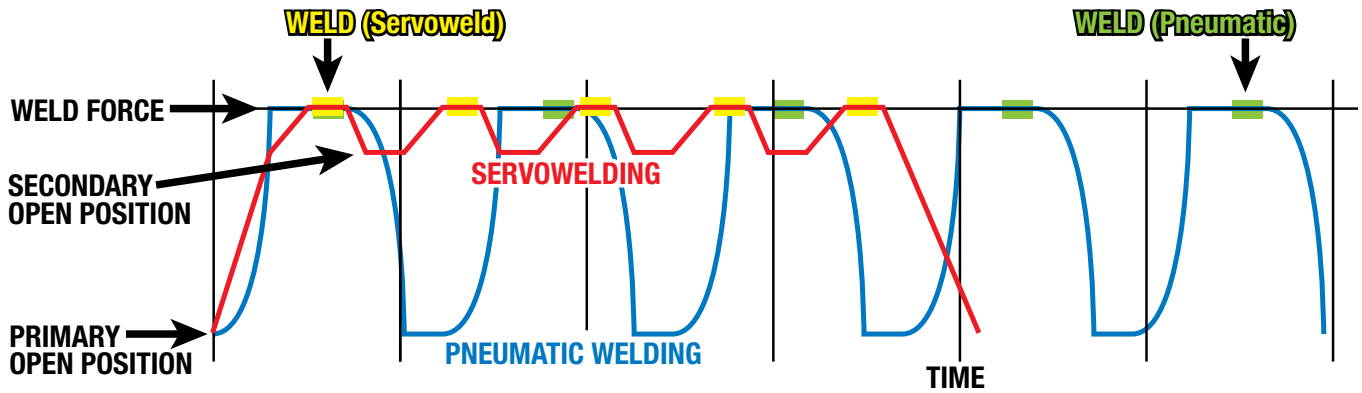
Weld nugget formation (an artist's rendition)

LOWER COST

- Lower operating cost offsets acquisition cost
- Minimizes preventative maintenance and unscheduled downtime
- Supports multiple weld schedules, easily accommodating different materials and thicknesses
- Fewer configurations required: Wide force range minimizes required configurations for varying force requirements. (An automobile manufacturer was able to replace 35 pneumatic cylinders by stocking 3 different GSWA models.)

FASTER WELDING CYCLES

- "At-force" indication allows immediate welding
- Programmable open positions shortens move time

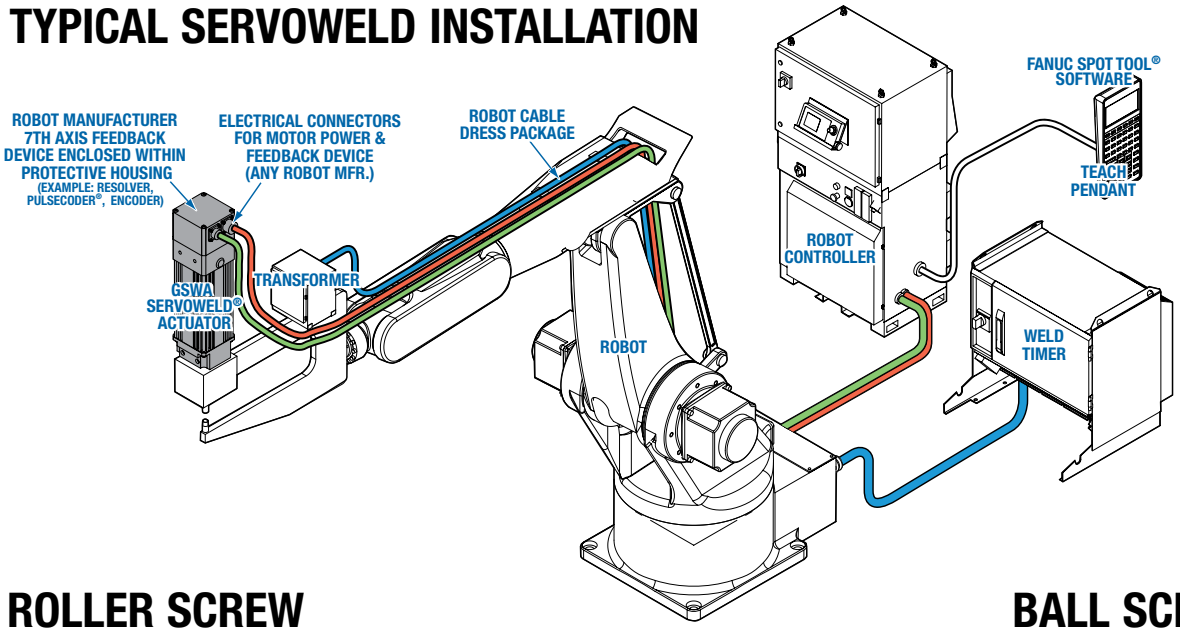


Servoweld completes this weld sequence faster because:

1. Weld begins as soon as weld force is achieved, no dwell needed

2. Gun is opened only enough to move to next weld

TYPICAL SERVOWELD INSTALLATION



ROLLER SCREW

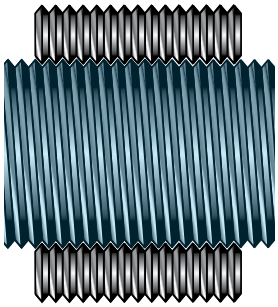
Capable of handling heavy loads. Force is transmitted via a multi-threaded helical roller assembly configured with a fine threaded roller screw. Roller screws have exceptional loading capability based on many points of contact.

- 10+ million welds at high force repeatability
- ± 3% force repeatability
- Up to 5,000 lbf. (22,000 N)
- Speeds to 16" (400 mm) per sec.

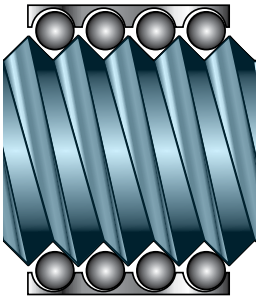
Tolomatic uses only the highest grade roller and ball screw systems. More accurate machining processes and highly stringent tolerance requirements result in greater repeatability with long-lasting Endurance Technology performance.

	ROLLER SCREW	BALL SCREW
Load ratings	Very High	High
Lifetime	Very long, many times greater than ball screw	Moderate
Speed	Very high	Moderate
Acceleration	Very high	Moderate
Stiffness	Very high	Moderate
Shock Loads	Very high	Moderate
Relative Space Requirements	Minimal	Moderate
Maintenance	None	Minimal

HELICAL ROLLER SCREW



BALL SCREW



Roller screws have a greater surface area and number of contact points than comparable ball screws

BALL SCREW

Ball nut brackets contain small ball bearings. Has a limited number of contact points resulting in lower load capability in comparison to roller screw. A robust mechanical drive system when properly applied.

- 5 million welds at high force repeatability
- ± 5% force repeatability
- Up to 5,000 lbf. (22,000 N)
- Speeds to 16" (400 mm) per second

SIDE LOADING
Some weld gun designs may subject the actuator to excessive side loading, reducing service life. Measures are required to limit side loading, especially in "C" guns with the SW actuator. For life optimization, Tolomatic recommends side loads of less than 5% of axial load (weld force) for roller screws, and less than 1% of axial load for ball screws.

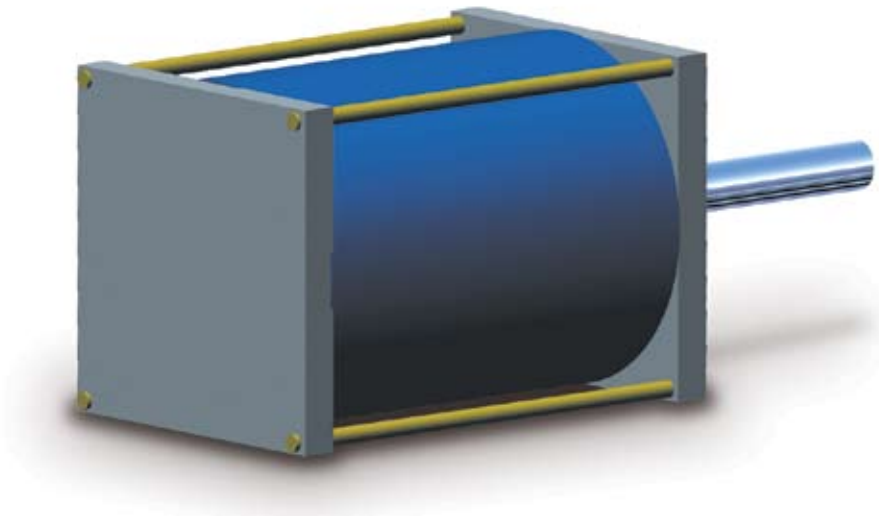
DISTANCE TRAVELED UNDER LOAD
Tests demonstrate the service life of ball screw actuators is extended when travel distance under load is limited.

When these service life factors are considered at the design phase, millions of trouble free cycles are possible. Please contact Tolomatic for more information.

COMPETITIVE ACTUATOR DESIGNS

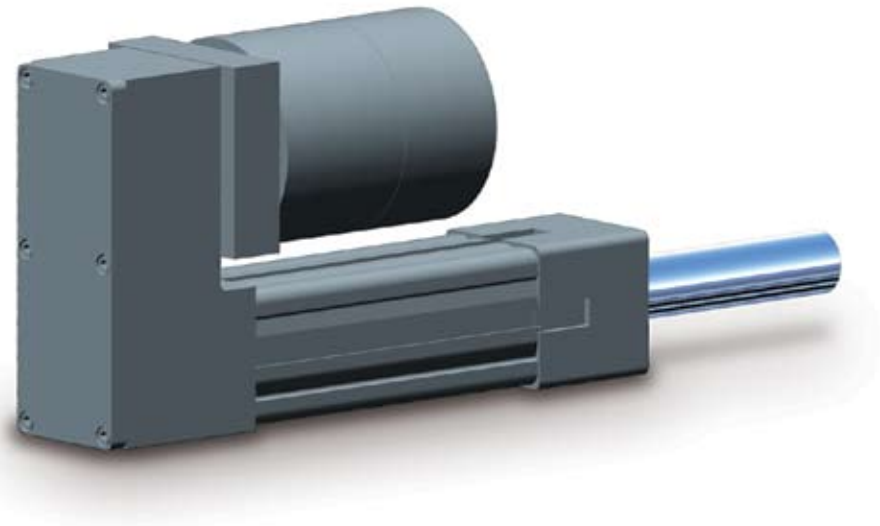
AIR CYLINDER

- High cost of use
- Frequent repair and maintenance
- Poor repeatability, reduced weld quality
- “Bang-bang” welds - greater tooling wear
- Limited adaptability
- More configurations required to address varying weld schedule requirements



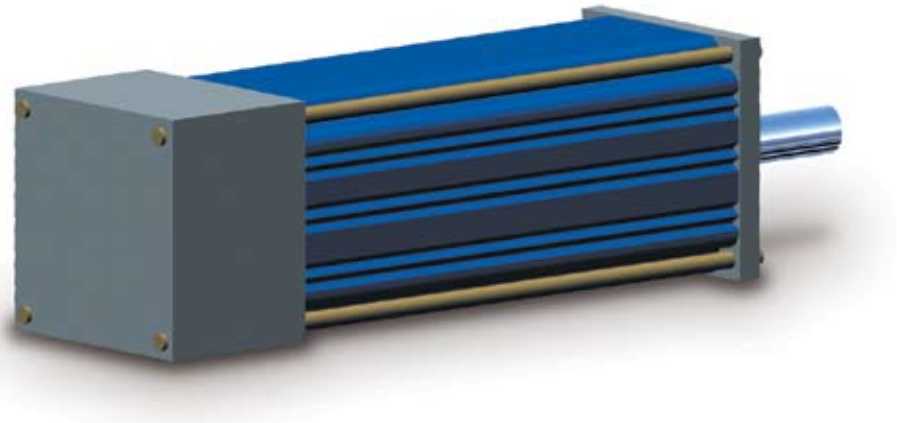
SERVO: REVERSE-PARALLEL MOTOR CONFIGURATION, BELT DRIVEN

- Size and weight create payload challenge (increase of 10% to 30% compared with integrated design).
- Mechanical linkage of belt is not as responsive as direct drive.
- Transmission belt is a maintenance item and failure point.



SERVO - INTEGRATED MOTOR SEGMENTED LAMINATIONS

- Segmented stators cannot be designed with skewed windings. Actuators employing segmented stators may compromise weld repeatability due to undesired high cogging torque.
- Higher cogging torque results in force repeatability errors with position changes, potentially compromising weld quality.



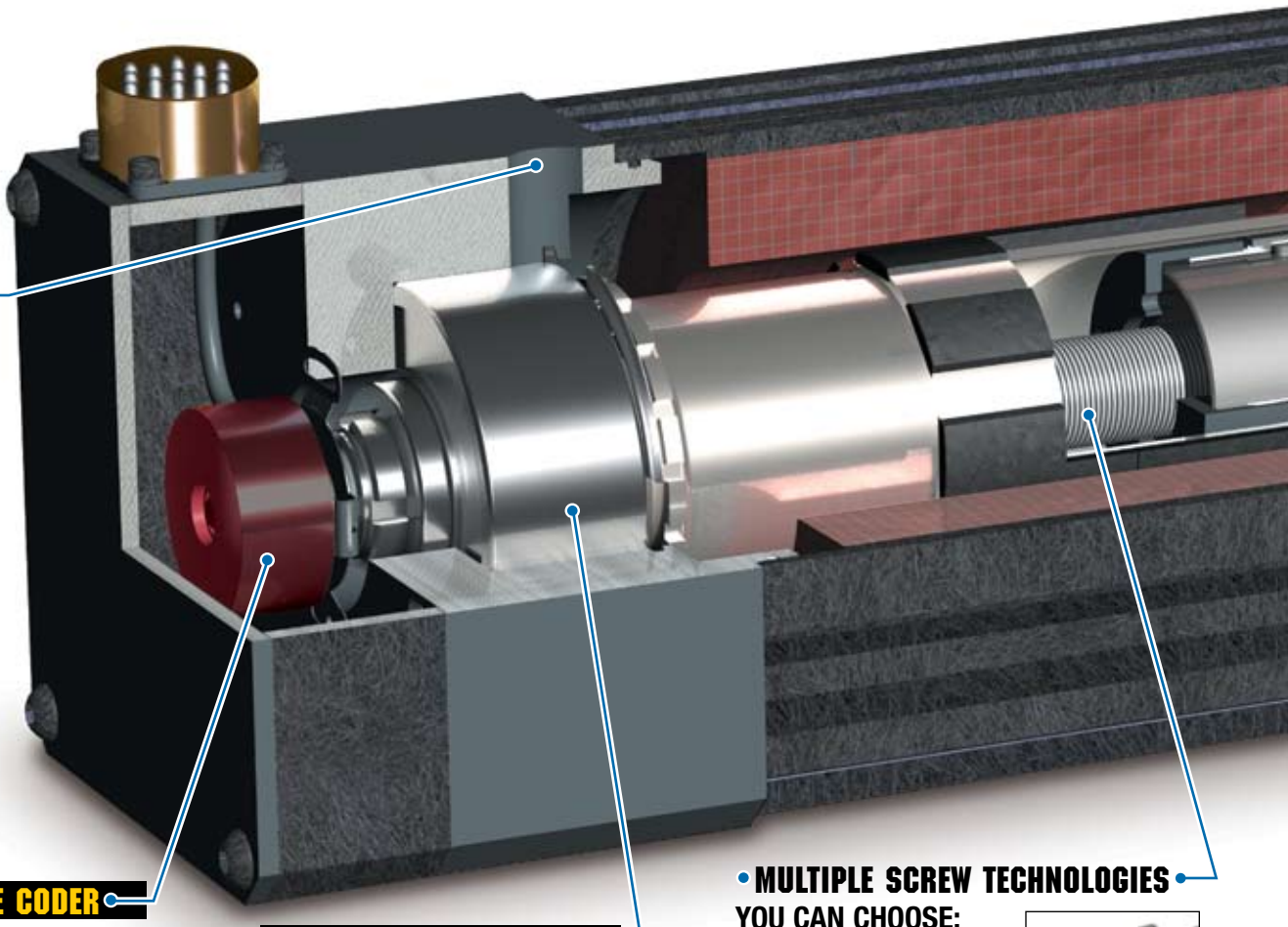
ADVANTAGES OF TOLOMATIC'S SERVOWELD vs PNEUMATIC ACTUATORS

	ELECTRIC SERVO ACTUATOR	PNEUMATIC ACTUATOR
SERVICE LIFE	Very good to excellent, depending upon actuator type and distance traveled under load. Over 5,000,000 welds achieved with ball screws, and +10,000,000 with roller screws.	Acceptable if compressed air filtration and lubrication adequate; usually less than 3,000,000 welds achieved with preventative maintenance.
MAINTENANCE REQUIREMENTS	Zero maintenance.	Frequent, either cylinder rebuilding or replacement.
SOFT-TOUCH WELDING CONTROL	Easy to achieve -- the #1 desired feature mentioned most often by end-users. Position and speed are controlled for rapid closing, slowing to a soft touch speed before tips come in contact with part. Reduces impact on part and weld gun.	Repeatable performance difficult to maintain; tips contact part at full speed, generating a high impact on both part and weld gun. Pneumatic system enhancements (proportional and cushioning controls) do not approach servo performance.
COST OF USE	Due to increased energy efficiency (+80%), cost of use vs. pneumatic operation is significantly lower. Cost of use is a decided advantage of electric servo systems over pneumatic systems.	Expensive. Compressed air is a costly utility. At $0.05/kWh, a cumulative system leak of 1/4" at 100 psig costs over $8,300/ year. The power transmission efficiency of compressed air systems ranges between 20% to 35%.
COST OF ACQUISITION	More Expensive – but reduced life cycle costs. Payback can be less than one year.	Inexpensive; but costs more over life cycle of system. Cylinder, valves, connectors, tubing, filter-regulator-lubricator all add up.
CYCLE RATE Improved production rate/ reduced cycle time	Servos move fast to point-of-work, then slow for soft-touch welding. In retract mode, servos can be programmed to travel less distance, thereby reducing overall cycle time. Also, servos eliminate the need for squeeze time -- signal sent when at force.	Pneumatic systems have ability to move fast, but full-open to full-close operation with "bang-bang" controls adds to cycle time.
WELD CAP LIFE	Weld cap life improvements range from 5% to 35%, depending upon application.	Frequent replacement; weld caps deform under full force.
ENVIRONMENTAL IMPACT	Minimal from every aspect: noise, contamination, and energy/power efficiency.	Noise and concentrated contaminants in exhaust air are undesirable conditions.
SUPPORTS MANUFACTURING FLEXIBILITY	Through weld or robot controls, servos can be easily programmed to accommodate model or tool changes. Existing 6-axis robots can be retrofitted with servos to achieve all desirable aspects of servo welding.	Pneumatic weld systems require more engineering support to accommodate model or tool changes; more spare parts.

GSWA INTEGRATED MOTOR ACTUATOR

ENDURANCE TECHNOLOGY℠

The GSWA integrated motor rod screw actuator is ideal for high thrust applications of guided loads in an ultra-compact design. The integral motor design and cylinder style operation make this product ideal for applications that were historically solved with hydraulic or pneumatic power. The high forces and longer life of a roller screw design allow you to install this actuator in a variety of demanding applications.



MANUAL OVERRIDE

- Access port to manual override in power off situations

FANUC PULSE CODER

HIGH THRUST BEARING

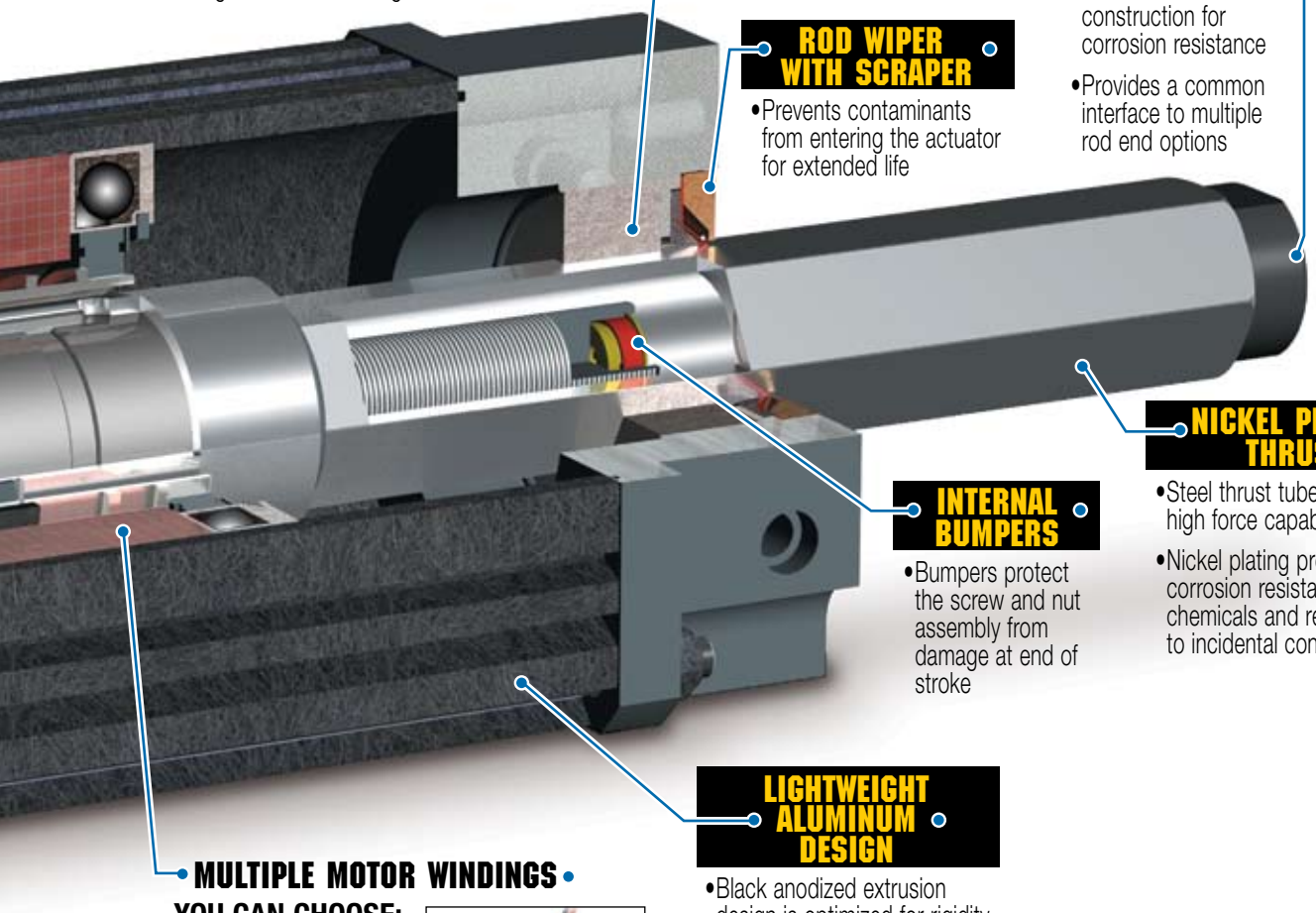
- Provides complete support of screw and protects the feedback device from linear forces

MULTIPLE SCREW TECHNOLOGIES YOU CAN CHOOSE:

- Ball nuts offer positioning accuracy and repeatability with longer life

- Roller nuts provide the highest thrust and life ratings available

TOLOMATIC…LINEAR SOLUTIONS MADE EASY



INTERNAL ANTI-ROTATION BEARING

- Unique nose bearing and thrust tube design prevent rotation of the thrust tube
- Supports the thrust tube and nut assembly through entire stroke length

ROD WIPER WITH SCRAPER

- Prevents contaminants from entering the actuator for extended life

THREADED ROD END

- Solid stainless steel construction for corrosion resistance
- Provides a common interface to multiple rod end options

NICKEL PLATED STEEL THRUST TUBE

- Steel thrust tube supports extremely high force capabilities
- Nickel plating provides excellent corrosion resistance from many chemicals and resists damages due to incidental contact

INTERNAL BUMPERS

- Bumpers protect the screw and nut assembly from damage at end of stroke

LIGHTWEIGHT ALUMINUM DESIGN

- Black anodized extrusion design is optimized for rigidity, strength and heat dissipation

MULTIPLE MOTOR WINDINGS

YOU CAN CHOOSE:

- ☐ 460V or 230V rated windings potted directly into actuator housing
- Skewed motor windings provide minimal torque ripple for smooth linear motion
- Integral thermal switch or thermistor for over temperature protection

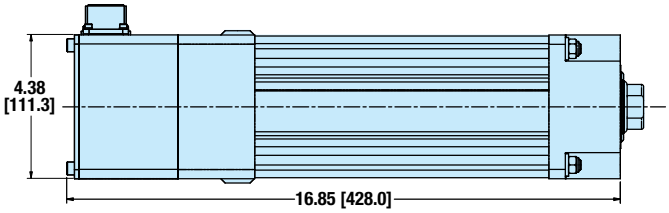
OPTIONS

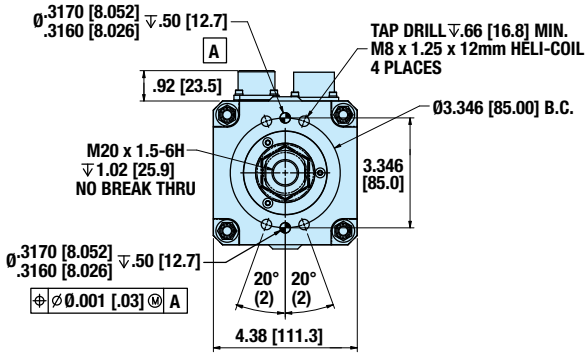
☐ **INTEGRAL FORCE FEEDBACK DEVICE**

Provides a linear signal for verification or data acquisition of actual force

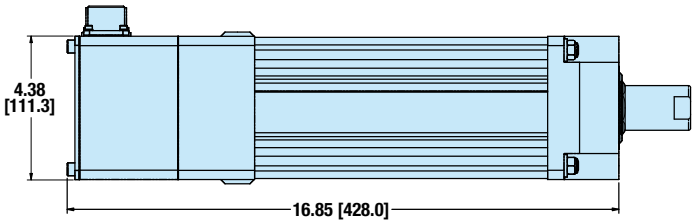
DIMENSIONS

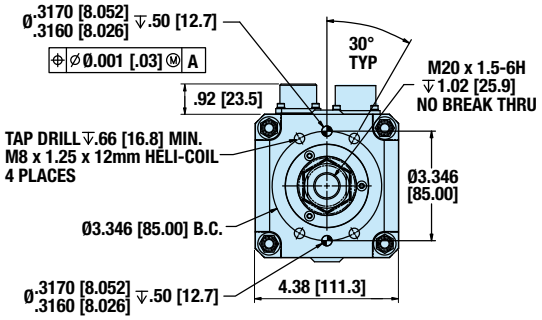
MODEL GSWA-101



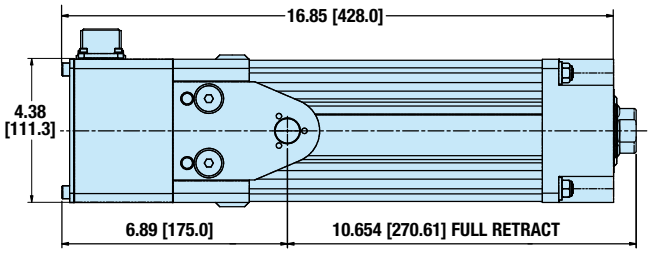


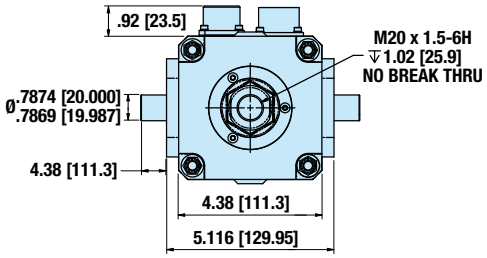
MODEL GSWA-102



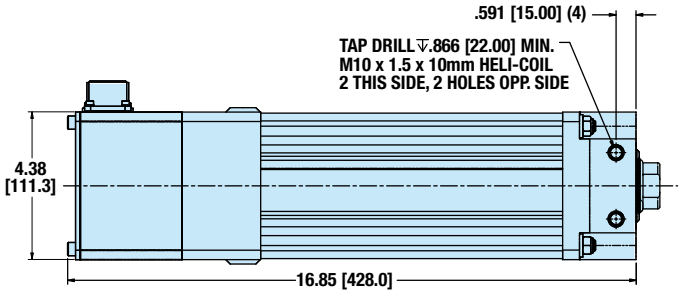


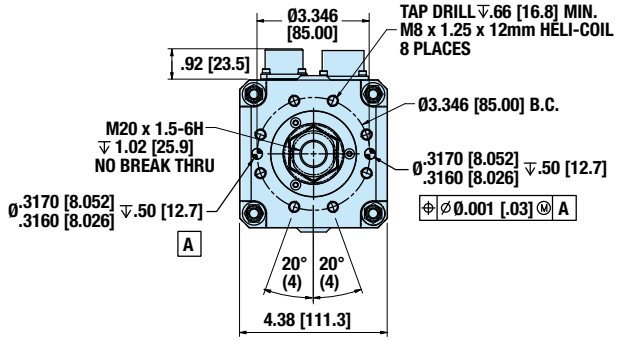
MODEL GSWA-103





MODEL GSWA-UNIVERSAL





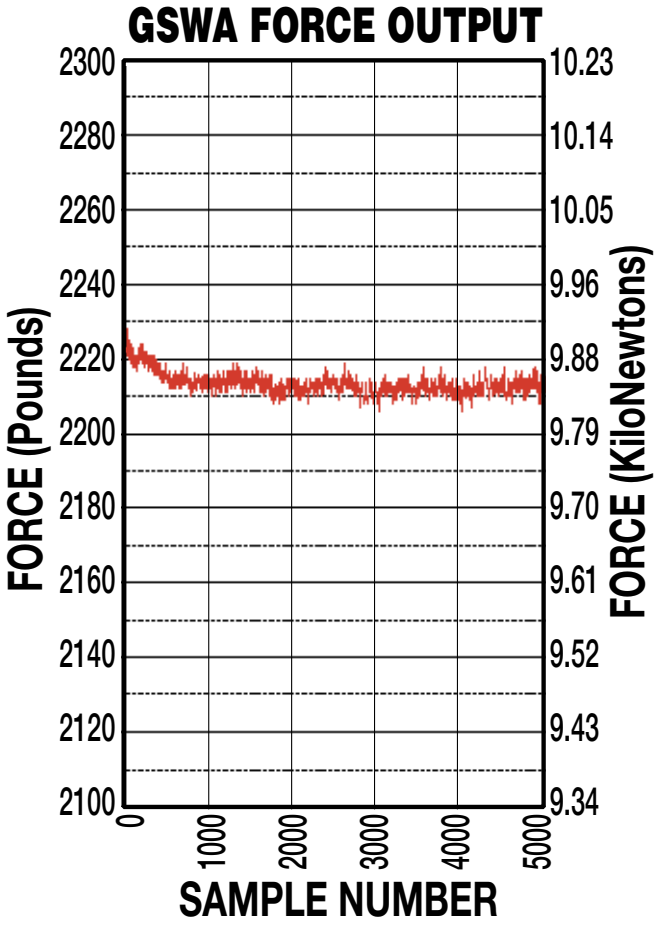
THE TOLOMATIC ADVANTAGE: PERFORMANCE BY DESIGN

Tolomatic's GSWA actuator with roller screw/nut is designed and built to maintain ±3.0% force repeatability … throughout the actuator life.

The data presented in the "GSWA Force Output" chart at right was collected from a new SW44-RN-LV3.

The actuator was run with a fixed weld current. Each sample is representative of a single "weld cycle." The test was run over the course of four and a half-hours.

The temperature of the actuator was not monitored during the test.



POINTS OF INTEREST:

1.) The overall range of 5,000 samples is 27 lbf., or less than 1.2% of nominal.

2.) The drop in force from cold start is 0.5% nominal (appr.), which means the weld-to-weld force variation is relatively constant regardless of temperature.

3.) Standard deviation remains relatively constant regardless of weld force, which means repeatability improves relative to higher weld forces. Tolomatic measures repeatability as (6)(Std. Dev.)/Nominal Force.

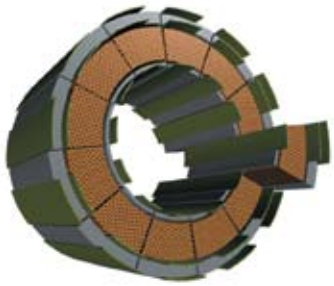
SUPERIOR LAMINATION TECHNOLOGY

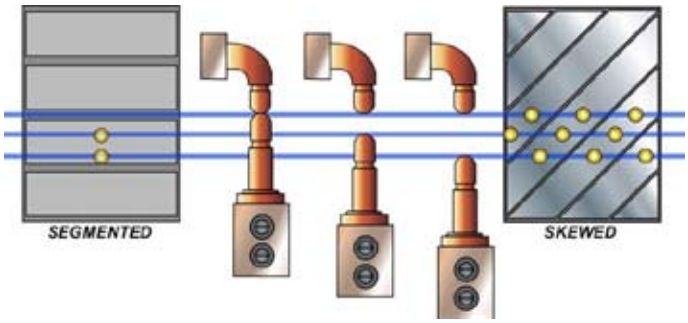
GSWA integrated motor actuator uses an 8 pole, Nd-Fe-B hollow core rotor with skewed stator laminations. This configuration maintains consistent force output at any location along actuator stroke.

- Low cogging torque for better repeatability, independent of position. Result: higher quality welds
- Patent-pending hollow core motor. Result: compact actuator/motor package

A NOTE ABOUT SEGMENTED STATORS

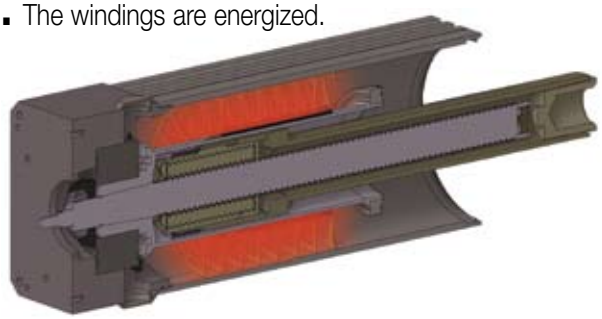
Segmented stators are rated at higher torque for comparable body sizes, however, repeatability (minimal cogging torque) may not be available at the section of stroke that welding force is required. Torque density without repeatability results in poor quality welds.



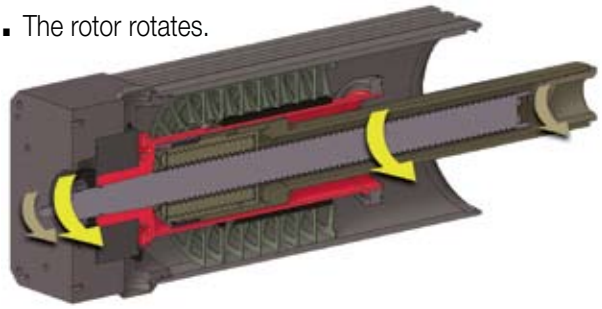


HOW THE GSWA WORKS

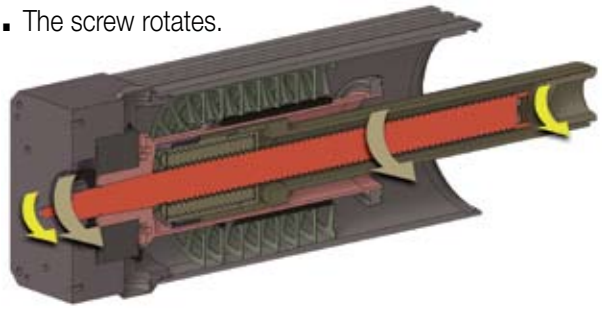
1. The windings are energized.



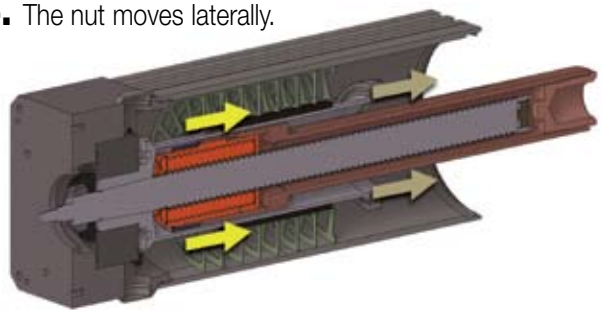
2. The rotor rotates.



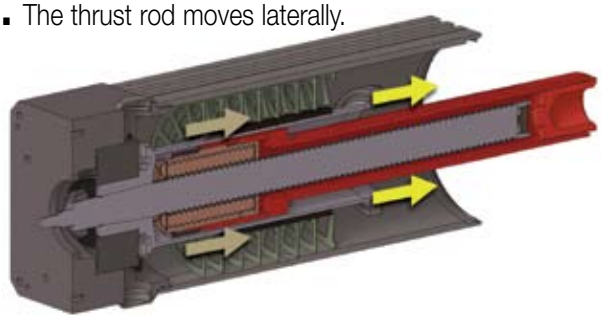
3. The screw rotates.



4. The nut moves laterally.



5. The thrust rod moves laterally.



NOTE: Essentially these movements take place simultaneously. For clarity only the extend movement is shown. The rotor is rigidly connected to the screw. The nut is mechanically captured by the thrust rod. The bearing and front plate of the GSWA prevents rotation of the nut/thrust rod.

VERIFIED PERFORMANCE

ServoWeld is designed, assembled and 100% tested to ensure a product that defines Endurance Technology. Every GSWA shipped is guaranteed for millions of cycles of maintenance free performance. We rigorously verify the performance of each individual unit before delivery.

1. High POT (High Potential/High Voltage Test)
This standard electric motor test procedure is a 3-part test that checks the insulation system of the assembly to verify proper armature and thermal wire insulation.

2. Electronic phasing of ServoWeld and feedback device (Encoder, Resolver, Pulse Coder®)
Using a fixed current and a specially designed fixture the Oldham coupler is press fitted onto the ServoWeld shaft while being physically and electronically aligned relative to the phasing of the ServoWeld motor.

3. Functional Testing
Performed with Tolomatic motion control components and dedicated data acquisition equipment. Operated for 350 cycles, this test quantifies these parameters - stroke length, torque under no load, input current vs force average, input current vs force standard deviation - using an electronic load cell in conjunction with data acquisition equipment.

4. Final Fanuc System Test

Using a Fanuc single-axis control unit this test insures that the Fanuc pulse coder windings are properly aligned with the poles of the GSWA motor.

"VOICE-OF-THE-CUSTOMER" YIELDS SUPERIOR ACTUATOR DESIGN

Off-the-shelf actuators, designed for general applications, do not perform well in the spot welding environment. Tight tolerances for force repeatability, zero maintenance, service life, side loads, cycle times …all require a servo actuator that can stand up to this demanding application. From roller screw specifications to the finish on the thrust tube, Tolomatic has engineered a product, specifically designed for resistance welding, that exceeds customer expectations.

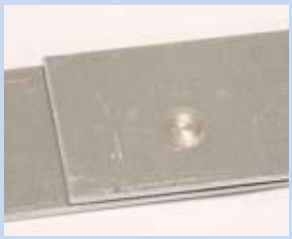
Using Voice-of-the-Customer and Design of Experiments disciplines, Tolomatic servo actuators get the job done…weld after weld…for millions of trouble free cycles.

DESIGN CONSIDERATIONS

VOICE OF THE CUSTOMER	TOLOMATIC SERVO ACTUATOR
COMPACT DESIGN	Width-- GSWA : 4.4"
LIFE	Roller screw: up to 10.0M cycles; ball screw: to 5.0M cycles (application variables affect service life.)
ZERO MAINTENANCE	Zero maintenance over the life of the actuator.
SIDE-LOAD PREVENTION	Internal bearing system sustains unidirectional side loading of up to 3 degrees without requiring external guidance.
INTEGRAL ANTI-ROTATION	Built-in. Since anti-rotation is integral to the Tolomatic actuator; the weld gun supplier is not required to design and build this as an add-on feature.
CONNECTOR PROTECTION	Connectors may be oriented in multiple locations; many styles available to match desired control specification.
ROBOT INTERFACE	Feedback devices to interface with any robot manufacturer.
MANUAL OVERRIDE	Built-in, and requires no special tools.
FORCE REPEATABILITY	In open loop, Tolomatic actuators with roller screw/nut achieve maximum ±3.0% force repeatability …over the life of the actuator, from start-up to the end of service life. This includes variations from cold startup.
INTERCHANGEABILITY/ RETROFIT EXISTING PNEUMATIC ACTUATOR	Easy retrofit due to compact design of Tolomatic actuators.
ABILITY TO "READ" AND INTERPRET	Using Tolomatic's WeldAxis™ control, existing signals to pneumatic valves can be used to signal the electric servo
HIGH VOLTAGE CAPABILITY	GSWA is available in low voltage (230 Vac / 325 Vdc) and high voltage models (460 Vac / 680 Vdc)
COMPLETE SOLUTION DESIGNED FOR OPTIMUM PERFORMANCE IN WELDING APPLICATIONS	Tolomatic offers two styles of actuators plus the WeldAxis™ panel control system …designed specifically for weld applications. (See tolomatic.com for more details about the WeldAxis.)

TECHNOLOGY PREVIEW

FRICTION STIR WELDING



Aluminum spot welding using the emerging technology of friction stir spot welding is poised to revolutionize the materials fabrication landscape. Tolomatic is at the forefront of this industry creating actuators that simultaneous supply the exact force required and the rotational motion with precision depth control; creating welds of superior strength, with verifiable results. All this with the lowest possible energy usage and cost.

EQUALIZER

The equalizer handles the challenge of positioning weld tips so that equal force is applied to each side of the weld material. Easily added to most X and P style weldguns, the equalizer uses pivot points and force feedback to properly position weld tips - optimizing weld performance.

The Equalizer works by allowing the fixed tip to contact the part and float in position until the moveable tip contacts the part. The equalization process can be completed without any increase in RSW cycle time and with the RSW gun in any orientation. No programming required! No adjustment required for changing RSW gun positions.

THE TOLOMATIC DIFFERENCE What you expect from the industry leader:

EXCELLENT TECHNICAL SUPPORT

Our people make the difference! Expect prompt, courteous replies to all of your application and product questions.

2D DRAWINGS & 3D MODELS AVAILABLE ON THE WEB

Easy to access CAD files are available in many popular formats.

SIZING & SELECTION SOFTWARE

Windows® compatible, downloadable from our website – FREE – the best tool of its kind on the market! Product selection has never been easier.

INDUSTRY LEADING DELIVERIES

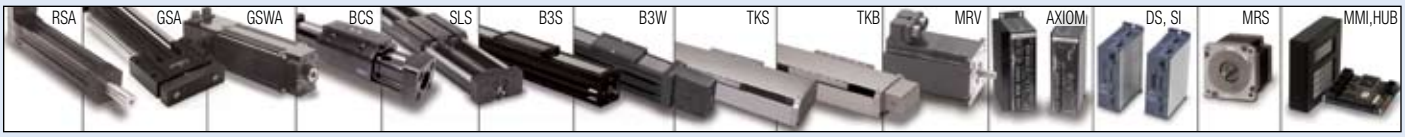
Standard catalog products are built to order and ready-to-ship in 5 days or less. Modified and custom products ship weeks ahead of the competition.

CUSTOM PRODUCTS

From standard catalog products... to modified products... to completely unique custom products, Tolomatic designs and builds the best solutions for your challenging applications.

ALSO CONSIDER THESE OTHER TOLOMATIC PRODUCTS:

ELECTRIC PRODUCTS



Rod & Guided Rod Style Actuators, Screw & Belt Drive Rodless Actuators, High Thrust Actuators, Motors, Axiom Drives/Controllers

BROCHURE #9900-9074 ENDURANCE TECHNOLOGY BROCHURE #9900-4016 CATALOG #3600-4609www.tolomatic.com/electric

PNEUMATIC PRODUCTS

RODLESS CYLINDERS: Band Cylinders, Cable Cylinders, Magnetically Coupled Cylinders/Slides; Guided Rod Cylinder Slides

BROCHURE #9900-9075 BAND CYLINDER BROCHURE #9900-4015 CATALOG #9900-4000 www.tolomatic.com/pneumatic

POWER TRANSMISSION PRODUCTS

GEARBOXES: Float-A-Shaft™, Slide-Rite™; Disc Cone Clutch; Caliper Disc Brake

BROCHURE #9900-9076 CATALOG #9900-4009 www.tolomatic.com/pt

Tolomatic
EXCELLENCE IN MOTION

3800 County Road 116 • Hamel, MN 55340 U.S.A.
Phone: (763) 478-8000 • Fax: (763) 478-8080

Toll-Free: 1-800-328-2174
Email: help@tolomatic.com • http://www.tolomatic.com

All brand and product names are trademarks or registered trademarks of their respective owners. Information in this document is believed accurate at time of printing. However, Tolomatic assumes no responsibility for its use or for any errors that may appear in this document. Tolomatic reserves the right to change the design or operation of the equipment described herein and any associated motion products without notice. Information in this document is subject to change without notice.

Visit www.tolomatic.com for the most up-to-date technical information

©2007 TOLOMATIC

BROCHURE NUMBER: 3604-4155_02