Tubular Solenoids

- **STA® Series has enhanced design features and improved performance**
- **Push and pull models**
- **Strokes up to 2½”**
- **Life rating of 25 million actuations**

**New STA Series**

Our new tubular design, the STA Series, is available in three sizes of 1/2", 3/4" and 1" diameter. Both push and pull types are available. Additionally, each size and type is available with a choice of two plunger configurations: flat face and 60°, as well as with or without an anti-rotation flat on the mounting bushing. These options offer maximum force for a wide range of applications. The new design also improves performance and provides longer life than previous tubular designs. They offer quiet operation and improved reliability for demanding applications.

**Design Considerations**

**Performance Curves**

The performance curves in this section serve as guides to determine the solenoid size needed to produce a desired force at a given stroke, duty cycle, and power source. All curves were developed under the following standard test conditions: ambient temperature of 20°C, 65% relative humidity.

**Starting Force**

When determining an application's force requirement, apply a 1.5 safety factor. For example: a load requiring 4.5 lb of force should utilize a solenoid providing 4.5 x 1.5 or 6.75 lb of force.

**Duty Cycle**

Duty cycle is determined by:

\[
\text{ON time}/(\text{ON} + \text{OFF time})
\]

For example: a solenoid is actuated for 30 seconds, then off for 90 seconds.

**Power Requirements**

Voltage applied to the solenoid must be matched to the coil wire size for proper operation. Solenoids are cataloged in coil awgs ranging from #23 up to #37 to accommodate your input power. Refer to the individual model specification pages for coil wire awg recommendations. Many other coil awg sizes are available. Please feel free to contact our application engineering department for availability.
STA Construction
The STA is constructed with a low friction nylon bobbin which insures a 25 million actuations life rating on all models.

The problems associated with powdered metal flaking in typical tubular designs is eliminated with the metal-to-plastic bearing surface. In addition, the new design’s case is rolled over both ends of the unit for greater shock and vibration integrity, allowing the STA to withstand severe applications in which typical solenoids may come apart.

Both push and pull models offer a built-in combination air gap spacer and plunger stop. This feature eliminates the need for external E-rings and impact washers which typically fail prematurely, as well as get in the way of your attached mechanisms.

All units are provided with 10" PVC lead wires as standard, and are rated for a maximum coil temperature of 130°C. UL-approved materials are used in the construction. For higher temperature applications up to 180°C, please consult the factory for alternate materials which are available in some models. Mechanical and electrical ratings may also be affected. Other options include: special plunger configurations, springs, special mounting features, and anti-rotation flats on mounting bushings. Please consult the factory with details about your application as tooling may apply to some features.

Tubular Applications
The new STA Series is particularly ideal for applications where field service is prohibitive. Its long life and high reliability are definite advantages in applications involving:

- Computer peripherals
- Industrial sewing machines
- Automated teller machines
- Blood analyzers
- Gate mechanisms
- Packaging machinery
- Door interlocks
- Sorting machines
- Glue dispensers
- Laboratory equipment
- Business machines

STA Plunger Configurations
With two standard plunger configurations to choose from, the new STA Series offers stroke lengths up to 0.70" and up to 24 pounds of force.

A. Flat Face

For strokes typically less than 0.060", the flat face plunger is recommended with a pull or push force three to five times greater than 60° plungers.

B. 60° Angle

For longer strokes up to 0.750", the 60° plunger offers the greatest advantage over the flat face plunger.

Size 125, 150, 175 Standard Tubular Models for Large Loads
Ledex Size 125, 150, and 175 standard tubular models are offered for heavy duty applications requiring larger forces. These standard models are all pull type and offered with 60° plungers. These models feature heavy duty welded mounting brackets, and heavy duty plunger stops to limit plunger travel, provide positive stopping, and keep pole faces from slamming together at the end of stroke.

An impact cushion made of resilient non-magnetic material absorbs energy at the end of the stroke. This cushion also helps eliminate residual magnetism.

Size 125, 150, and 175 models are available with other plunger configurations, in push type models, and with other mountings. Please consult the factory as tooling may apply.

Typical Force/Stroke Comparison of Plungers
Tubular Solenoid Selection

Tubular solenoids are available in six sizes. The three STA Series sizes are available in both push and pull types.

Use the selection overview chart to determine which size offers the desired performance and mechanical specifications.

Refer to the individual size specification pages for complete performance and mechanical data.

### Tubular Selection Overview

<table>
<thead>
<tr>
<th>Size</th>
<th>Solenoid Type</th>
<th>Package Dimensions (in)</th>
<th>Maximum Stroke (in)</th>
<th>Nominal Stroke (in)</th>
<th>Force (lbs) @ Nominal Stroke and Specified Duty Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>STA 1/2&quot; x 1&quot;</td>
<td>Pull</td>
<td>0.52</td>
<td>1.05</td>
<td>0.50</td>
<td>0.13–0.19 0.25–0.51 0.44–0.56 0.81–1.00</td>
</tr>
<tr>
<td>STA 1/2&quot; x 1&quot;</td>
<td>Push</td>
<td>0.52</td>
<td>1.05</td>
<td>0.50</td>
<td>0.10 0.06–0.13 0.14–0.25 0.31–0.48 0.69–0.94</td>
</tr>
<tr>
<td>STA 3/4&quot; x 1 1/2&quot;</td>
<td>Pull</td>
<td>0.77</td>
<td>1.56</td>
<td>0.70</td>
<td>0.20 0.38–0.50 0.75–1.00 1.25–1.63 2.13–2.69</td>
</tr>
<tr>
<td>STA 3/4&quot; x 1 1/2&quot;</td>
<td>Push</td>
<td>0.77</td>
<td>1.56</td>
<td>0.70</td>
<td>0.20 0.25–0.38 0.50–0.80 1.10–1.50 2.20–2.75</td>
</tr>
<tr>
<td>STA 1&quot; x 2&quot;</td>
<td>Pull</td>
<td>1.02</td>
<td>2.05</td>
<td>0.70</td>
<td>0.30 0.75–0.90 1.50–1.75 2.60–3.00 4.80–5.20</td>
</tr>
<tr>
<td>STA 1&quot; x 2&quot;</td>
<td>Push</td>
<td>1.02</td>
<td>2.05</td>
<td>0.70</td>
<td>0.30 0.50–0.75 1.00–1.88 2.00–2.90 4.00–5.20</td>
</tr>
<tr>
<td>1 1/4&quot; x 2 3/4&quot;</td>
<td>Pull</td>
<td>1.25</td>
<td>2.25</td>
<td>0.75</td>
<td>0.40 1.00 2.00 4.00 6.50</td>
</tr>
<tr>
<td>1 1/2&quot; x 2 3/4&quot;</td>
<td>Pull</td>
<td>1.50</td>
<td>2.50</td>
<td>0.75</td>
<td>0.40 1.00 2.50 5.20 9.80</td>
</tr>
<tr>
<td>1 1/4&quot; x 4 3/4&quot;</td>
<td>Pull</td>
<td>1.75</td>
<td>4.71</td>
<td>2.50</td>
<td>1.00 1.25 2.50 3.75 6.50</td>
</tr>
</tbody>
</table>

### How to Use Tubular Performance Charts

1. Select one of the four columns which provides the appropriate duty cycle. (For example 50%)

2. Reading down this column provides a variety of performance and electrical data including maximum on time, watts, and amp turns.

3. Following down the column further into the VDC ratings, select the voltage which most closely matches your supply voltage. (For example, 11.5 for a 12 VDC power supply.)

4. Read across (to the left) to select the awg suffix. (In this example, 32 awg is required, thus to order, specify: 195203-232. Note that the digit preceding the awg refers to the plunger configuration and anti-rotation flat selected. Review the STA plunger section on page F3 and on the individual specification page to select the appropriate plunger configuration.

Note: The size 125, 150 and 175 standard models do not use this plunger configuration and anti-rotation flat suffix system.
Low Profile Solenoids

- **Linear actuation**
- **Space-saving, low-profile configuration**
- **Ideal for high force, short stroke applications**
- **Holding forces from 1.7 lbs. to 300 lbs.**
- **Stroke lengths to 0.7 inches**

The low profile shape, besides contributing to smaller size, optimizes the magnetic flux paths for maximum force versus stroke characteristics. The construction of the plunger assembly provides an auxiliary flux path which permits a significant increase in force. The low profile solenoid construction not only provides long life, but also provides a rugged design for both military and commercial applications.

### Conical Face vs. Flat Face Plunger Design

Conical-faced designs extend the useful range of a solenoid to provide higher forces for strokes typically over 0.060 inches. The pole surface area is greater and the distance between the tapered cone faces is approximately one-half that of the gap between the land faces (for 30° angles), providing the effect of a closer air gap.

While some of the force component is lost because the force vector is not parallel with the plunger motion, the shorter gap and higher flux density combine to provide more output force for longer strokes. For shorter strokes, the magnetic flux density increases and causes the iron to saturate rapidly as the poles move closer, thus reducing the efficiency of the conical-faced design. At this point, the flat-faced plunger is more efficient.

The main advantage of the flat-faced pole over the conical is that the full component of force is usable because the force vector is parallel with the pole motion.

<table>
<thead>
<tr>
<th>Flat Face: Higher efficiency for shorter strokes</th>
<th>Conical Face: Higher force for longer strokes</th>
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<tr>
<td>De-Energized</td>
<td>De-Energized</td>
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<tr>
<td>Energized</td>
<td>Energized</td>
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**Energized De-Energized**

- **Flat Face:**
  - Higher efficiency for shorter strokes

- **Conical Face:**
  - Higher force for longer strokes
Why Low Profile solenoids provide such high force and rapid response.

A key to the efficiency and compact form factor of the low profile solenoid is our special precision coil-winding process. With maximum copper packed into the allowable space, each solenoid develops tremendous force for its size and power input. The low profile form, in addition to contributing to smaller size, permits maximum pole face surface area for the magnetic flux.

Another factor that contributes to high efficiency is the additional iron surface on the external portion of the plunger; it provides an auxiliary flux path and a significant increase in force.

The force is also affected by other interrelated features, such as the length of the iron path, the magnetic saturation properties of the solenoid case and plunger, and the area and shape of the pole pieces.

The enclosed construction of the solenoid not only provides an iron path with minimum losses at the ring gap, but also provides a rugged design for critical environment applications.

Applications

The reliability and high performance of Low Profile solenoids make them an ideal choice for applications in which consistent, reliable operation is critical.

- Pumps
- Machine tools
- Packaging machines
- Cranes
- Instruments
- Flow controls
- Trucks and buses
- Computer peripherals

Design Considerations

**Performance Curves**

The performance curves in this section serve as guides to determine the solenoid size needed to produce a desired force at a given stroke, duty cycle, and power source. All curves were developed under the following standard test conditions: ambient temperature of 20°C, 65% relative humidity.

**Starting Force**

When determining an application’s force requirement, apply a 1.5 safety factor. For example: a load requiring 4.5 lb of force should utilize a solenoid providing 4.5 x 1.5 or 6.75 lb of force.

**Duty Cycle**

Duty cycle is determined by: ON time/(ON + OFF time). For example: a solenoid is actuated for 30 seconds, then off for 90 seconds.

\[
\text{Duty Cycle} = \frac{30 \text{ sec ON}}{30 \text{ sec ON} + 90 \text{ sec OFF}} = \frac{30}{120} = 1/4 \text{ or 25% duty cycle}
\]

Ledex Low Profile solenoids are rated for various duty cycles ranging from continuous to 10% duty.

Note that maximum ON time for a particular application can be a factor which overrides the duty cycle rating. For example, at 25% duty cycle, the maximum ON time for a given Ledex solenoid is 36 seconds. If, however, the solenoid is operated at a cycle rate which enables the unit to return to ambient temperature between ON cycles, then the maximum ON time is extended somewhat. In the above example, this extended ON time is 44 seconds. Maximum ON time ratings are listed on the individual model specification pages.

**Life**

When selecting a Low Profile solenoid, as with any other solenoid style, it is important to consider factors that will affect the life of the unit. Heat, side-loading, stroke and operating environment all play an important role in determining the life you can expect in your application.

A simple, yet often overlooked method to improve Low Profile solenoid life is to minimize the side load. Maximum life can be achieved by mounting Low Profile solenoids so that the shaft travels along a vertical plane. Keeping the stroke as short as possible will also improve life.

**Power Requirements**

Voltage applied to the solenoid must be matched to the coil wire size for proper operation. Solenoids are cataloged in coil awg ranging from #23 up to #38 to accommodate your input power. Refer to the individual model specification pages for coil wire awg recommendations. Many other coil awg sizes are available. Please feel free to contact our application engineering department for availability.