Ledex Solenoid Products

Tech Brief #3

Understanding Pull & Push Solenoids

SA-PLM Product Management

JOHNSON ELECTRIC

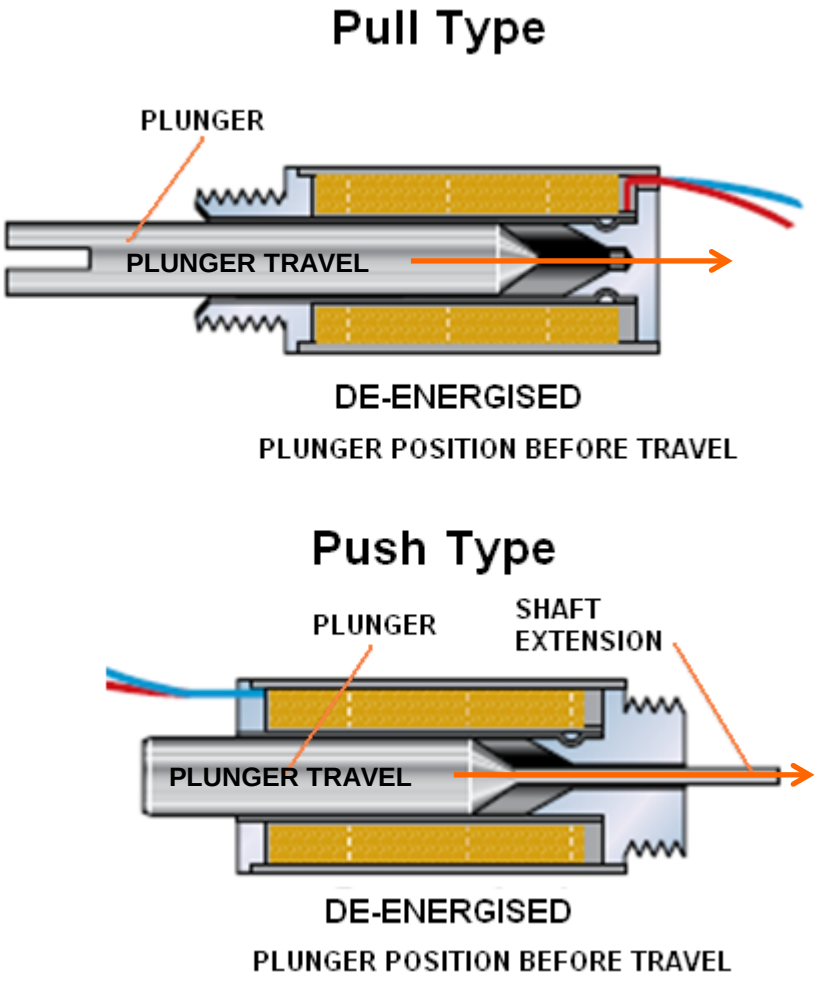
innovating motion

Pull and Push Solenoids

LEDEX

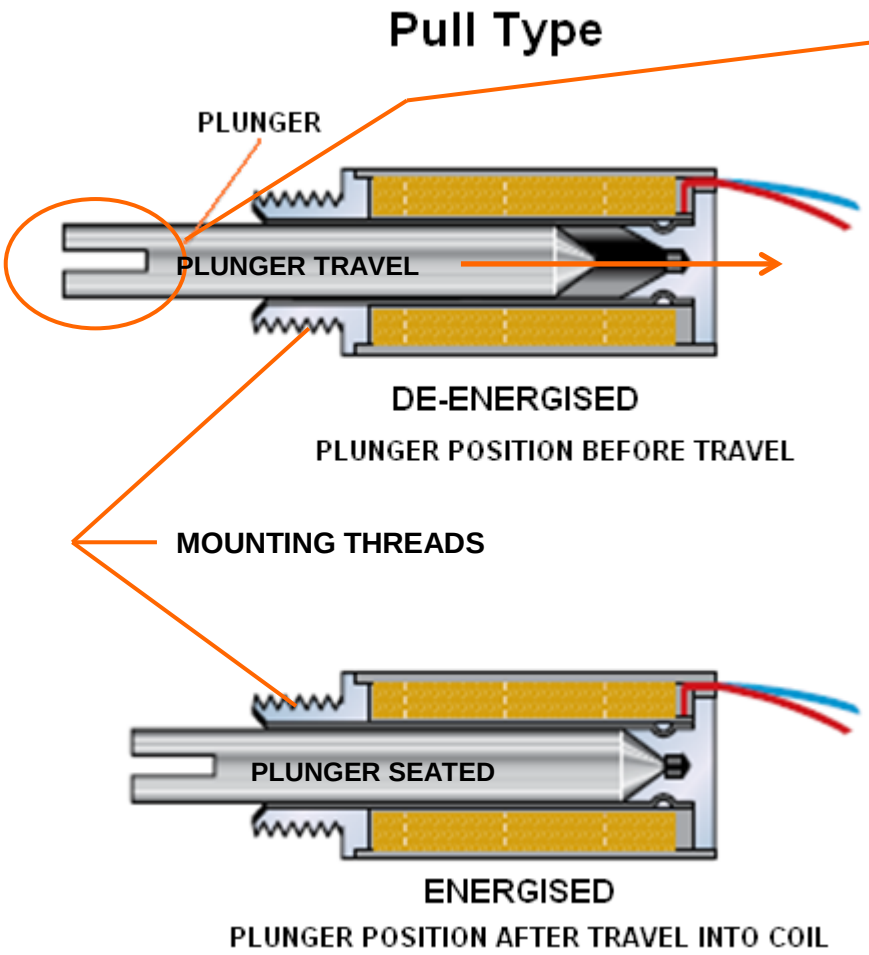
- It is important to understand the difference between pull and push solenoids and the principle of operation of both styles of units.
- There are many misconceptions of how these units work magnetically and must be understood to be skilled enough to discuss with potential customers.
- Understanding these principles and misconceptions will avoid errors with customers applying the solenoids wrong.

Pull Solenoids



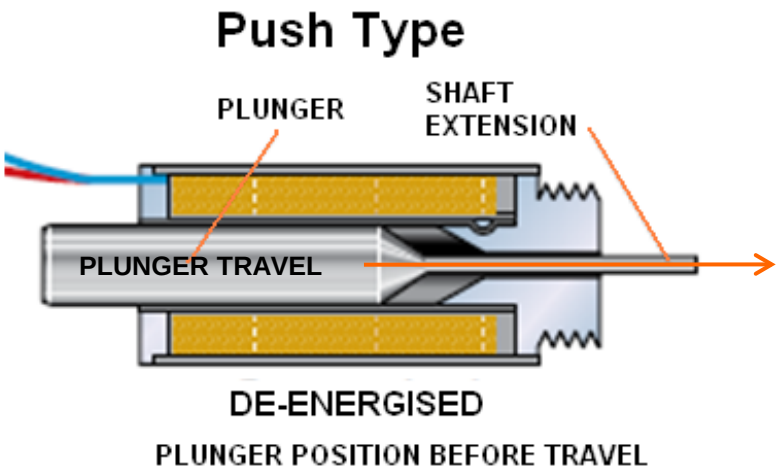
- Typically single acting Linear Solenoids are categorized into two styles, either a Pull style or a Push style.
- When power is applied to the coil, a magnetic field is created that attracts or pulls the plunger into the coil toward the base or bottom of the solenoid. The base is also called the stationary pole of the solenoid.
- Push or pull on these solenoids is determined by which end of the plunger is used to attach the load & provide the desired movement.
- On tubular style solenoids the mounting feature for the solenoid is almost always at the end of the solenoid providing the movement.

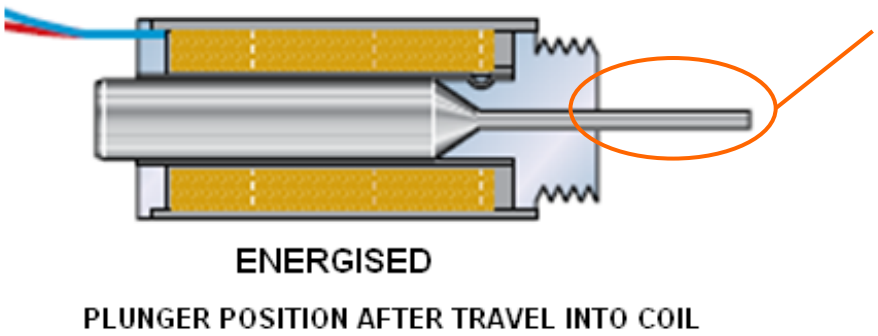
Pull Solenoids



- For a pull solenoid the attachment is made at the end of the plunger that is moving into the coil and away from the load. Attaching at this end will pull the load toward the solenoid.
- The magnetic field attracts the plunger to the stationary pole.
- Normally the solenoid mounting feature will be at the same end of the solenoid as the attachment point.
- In a pull solenoid the mounting feature is normally a threaded bushing.

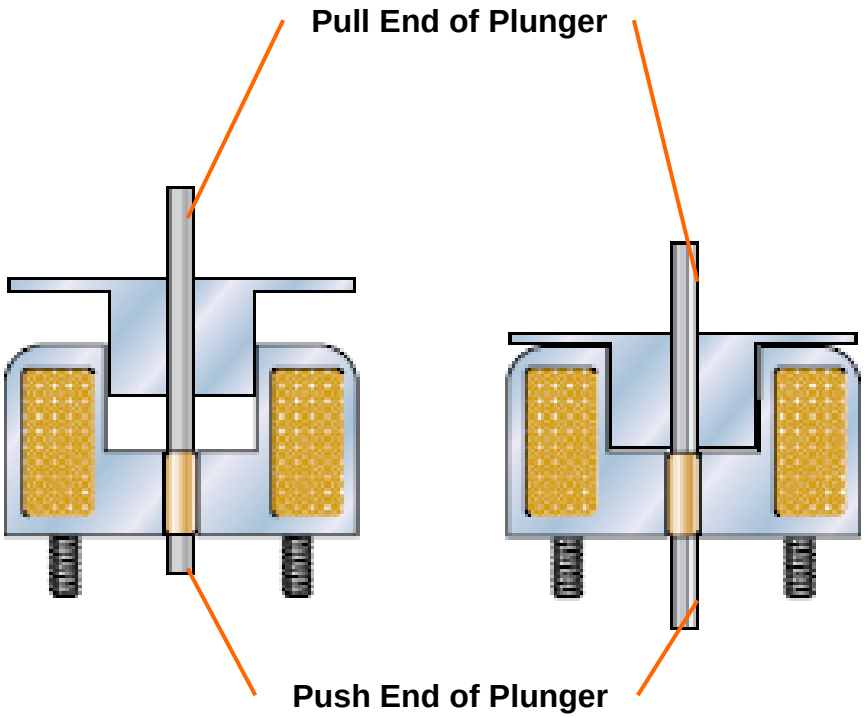
Push Solenoids





- A push solenoid is simply a pull solenoid with a small shaft added through the bottom of the solenoid to provide the push function.
- This shaft is a non-magnetic material and is generally press fit into a hole in the end of the plunger.
- The plunger is pulled into the coil and pushes the shaft out the bottom of the solenoid.
- The attachment is made at the small shaft end.
- This end is moving away from the solenoid. Attachment at this end would push the load away from the solenoid.

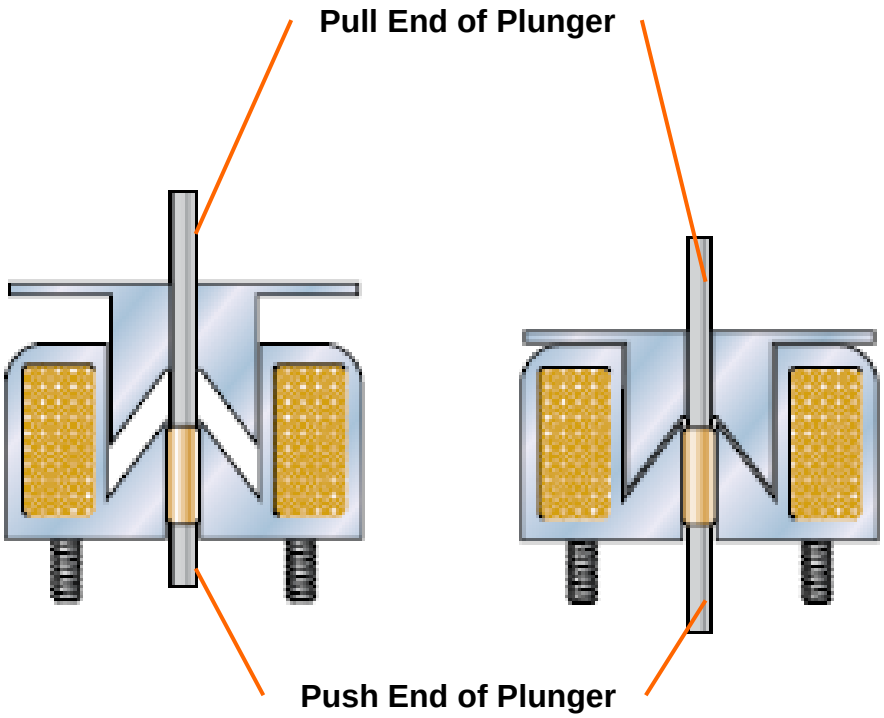
Low Profile Solenoids



Flat Face Plunger for Higher Efficiency at Shorter Strokes

- Low Profile solenoids provide both pull and push functions in one unit. This is possible due to the larger diameter of the body allowing a larger shaft to pass all the way through the solenoid.
- This shaft is a non-magnetic material and is generally press fit into the plunger.
- Attachment at the armature side of the unit provides a pull function while attachment at the base end provides a push function.
- The plunger is still magnetically pulled into the coil and pushes the shaft out the bottom of the solenoid.

Low Profile Solenoids



Conical Face Plunger for Higher Forces at Longer Strokes

- Low Profile solenoids are available in two types of pole faces:
  - Flat face
  - Conical Face
- Flat Face solenoids provide the highest holding forces but are limited to strokes from .075” to about .150” (1.9mm to 3.8mm).
- Conical Face solenoids provide longer strokes from .150” to .700” (1.9mm to 17.8mm) but have a lower force capability as a result.
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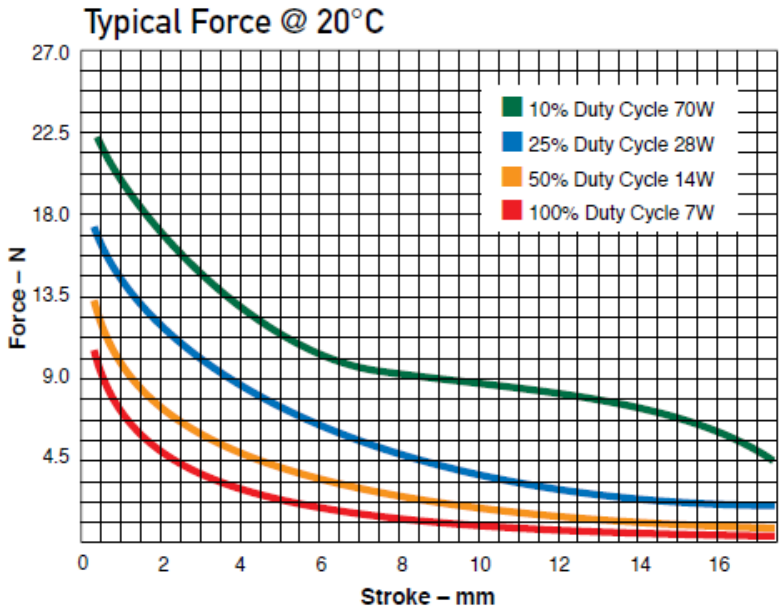
Pull and Push Solenoids

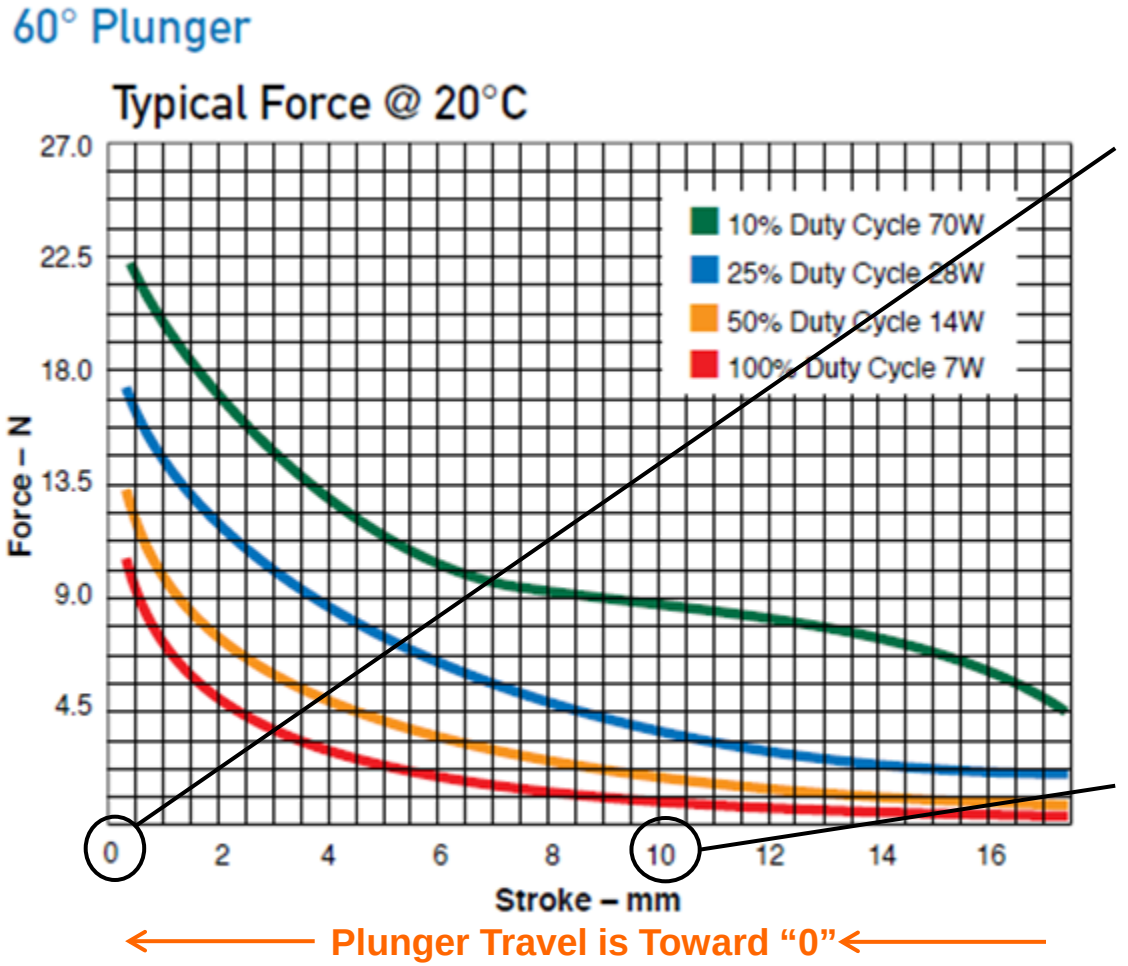
- Whether the solenoid is a pull style or a push style, the magnetic attraction and the force curves in the catalog are nearly identical.
- As shown in the graph below, zero on the X-axis is still the plunger in the fully seated position in the solenoid body.
- For more information, see Tech Brief #1 on understanding Force Curves.

60° Plunger



Force values for reference only.

Stroke



Force values for reference only.

- The "X" axis represents the stroke or travel of the plunger toward the base.
- "0" on this axis represents the plunger position when it is fully seated against the base and the air gap is closed. This is the strongest force output point of the solenoid and is at the end of the plunger travel.
- The stroke or air gap is represented by the scale on the "X" axis. The numbers represent the physical space between the plunger and the base of the solenoid.
- The de-energized or starting position of the plunger would be toward the right end of the graph.
- A stroke of 10mm represents a physical space of 10mm between the plunger and the base.
- The closer the plunger gets to zero, the stronger the attracting force.

Summary

- Plungers always move into the coil as power is applied.
- Using one end or the other of the plunger results in ability to pull or push.
- A push solenoid is a pull solenoid with an added shaft that extends out the bottom of the solenoid plunger to provide a pushing function.
- The attachment end of the moving plunger is always at the end providing the movement.
- The mounting feature on tubular style solenoids is normally at the same end as the attachment point for the plunger.
- Low Profile solenoids provide both pull and push in one unit.
- Low Profile solenoids, whether pull or push all mount from the base end of the solenoid
- Whether the solenoid is a pull style or a push style, the magnetic attraction and the force curves in the catalog are nearly identical.
- Force increases as the plunger moves into the coil toward the base.
- For more information on Force Curves see Tech Brief #1.

Quiz

- 1) What are the two styles most linear solenoids are categorized into?
- 2) True or False: When power is applied to a typical electromagnet the plunger is pulled into the coil.
- 3) If the plunger is always pulled into the coil, how is a push solenoid made?
- 4) How does a Low profile solenoid provide for both push and pull function in the same unit?
- 5) True or False: A Low Profile flat face solenoid provides lower force than a conical face unit.
- 6) On a typical solenoid force curve “0” on the X axis represents what?
- 7) True or False: Whether the solenoid is a pull style or a push style, the magnetic attraction and the force curves in the catalog are nearly identical.
- 8) True or False: Force increases as the plunger moves into the coil toward the base.

Other Topics

- Other Tech Briefs Available:
  - Tech Brief #1 – Solenoid Principles of Operation
  - Tech Brief #2 – Using Ohms Law on Solenoid Calculations
  - Tech Brief #3 – Understanding Pull & Push Solenoids
  - Tech Brief #4 – Understanding Force Curves for Linear Solenoids
  - Tech Brief #5 – Understanding Speed Curves for Solenoids
  - Tech Brief #6 – Understanding Duty Cycles
  - Tech Brief #7 – Understanding Solenoid Performance Charts
  - Tech Brief #8 – Understanding Torque Curves for Rotary Solenoids
  - Tech Brief #9 – Using the Application Data Sheet for Solenoids
  - Tech Brief #10 – How to use the Website for Solenoids
  - Tech Brief #11 – Guidelines for Modifications to Standard Solenoid Designs
  - Tech Brief #12 – Affects of Temperature on Solenoids
  - Tech Brief #13 – Mag-Latch Solenoids
  - Tech Brief #14 – AC vs DC Solenoids
  - Tech Brief #15 – Soft Shift and BTA for Medical Applications
  - Tech Brief #16 – Advantages of Using Hold In Circuits

    - If you have an idea for a topic for a Tech Brief please contact one of the solenoid Product Managers