

The Solenoids

There are two solenoids that were/are made for the full height STG style turnstiles

The amount of force that a solenoid produces is a function of the “Ampere-Turns” of the coil. That is to say number of turns of wire of the coil times the current permitted to flow in those coils. The greater that number, the greater the magnetic field and therefore force produced. The second factor influencing force is the distance over which the magnetic field has to operate.

Solenoids generally consist of a coil and an armature. The coil is the element that produces the magnetic field and the armature is a metallic bar that will be attracted to the magnetic field when the coil is energized. As a result the armature is pulled into the core of the coil. The further the armature is from the coil’s magnetic field, the weaker is the force acting upon it. In order to move an armature that is at a greater distance, the greater the magnetic field must be. That means increasing the Ampere-Turns number.

Increasing the number of turns of a coil may not be desirable since the coil’s larger physical size might not be practical. Lowering the coil wire’s resistance to produce more Amperes is another approach used but not without negative consequences.

So why choose one method over another to increase the solenoid’s force. It all has to do with duty cycle and continuous vs. intermittent use. As we said before, increasing the Ampere-Turns number will increase the force that the coil’s magnetic field exerts on the armature. Intermittent-use solenoids can produce more force than their equivalent size continuous-use counterparts. Increasing the amount of Amperes by lowering the coil wire resistance also reduces the number of turns on the coil, for a given physical diameter, because the size of the wire (wire diameter) must also increase, therefore less wire can be wound. The net result is that the Ampere-Turns number has increased even though the number of turns has decreased. The increase in Amperes results in more electrical power in the coil and thus more heat. Enough heat, that if used continuously would cause the coil to overheat and burn out. This type coil can be utilized effectively if used intermittently, for short periods and allowed to rest (cool-off) before the next use. This is called the duty cycle.

On the other hand, continuous duty solenoids produce less force and in order to compensate need to be larger than their intermittent duty counterparts to produce the same amount of force. Clearly this can be problematic and confusing where a device, such as a turnstile may need to use both types. It would be good if a single solenoid could operate in both modes. As we said earlier, the force needed is a function of the distance the armature is from the coil. Consequently, once the armature is drawn fully into the coil, less force is needed to hold it there than was needed to get it there. Enter the “Pick and Hold” control. For some duration, a higher force must initially exist to get the armature moving and then be switched to a lower force to hold the armature in place.

Let us call the original factory solenoid type 1. This solenoid had 2 coils, One is a high power coil for the pick portion and a low power coil for the hold portion. There is also a switch mounted in the back of the solenoid that senses that the armature is fully seated. When the solenoid is energized, it is the pick coil that is active. When the armature pulls in and seats, the switch activates, and the pick coil disconnects while the hold coil activates. This works well until the switch fails or the armature fails to seat, maybe due to binding or wear. If the switch does not activate, the solenoid commits suicide and burns up.

Excerpt from the manufacturer's product sheet of the type 1 solenoid:

- 1) "This solenoid has two coils with a switch in the back that changes the wattage of the solenoid, by switching coils, once the plunger is seated in the fully energized position. If the solenoid is not allowed to travel the full distance, then the coil may overheat."
- 2) "Please check the application for obstructions to the full operation of this solenoid. This could be in the linkage causing the solenoid plunger to bind in the coil, or be other external problems."

Tomsed recognized this issue when it acquired the Philips (successors to Robot and Burle) turnstile division. A new non-self destructive design was needed. We will call this type 2. A position based pick & hold design was ineffective when the problem was time based (excessive pick time). Type 2 solenoids have a single intermittent-duty high power coil. By lowering the power to the coil electronically, a hold function could be created. Like in a variable speed drill, a technique known as "pulse width modulation" (PWM) is utilized. For a short period of time, full power is applied to the coil (pick). Then the electronic circuit changes to PWM mode (hold). The black plastic cylinder on the back of the solenoid houses this circuit. Now if there is mechanical binding, the coil will just not seat, but will also not self destruct. BUT.....

There is always a "but". Many of the older controllers relied on a full wave bridge rectifier powered by an oversized 24vac transformer. In addition the resultant DC voltage was unfiltered. In most cases filtering the DC will cause undesirable results elsewhere in the circuit. Type 1 solenoids could tolerate this dirty power. Type 2 solenoids have an electronic circuit that can be damaged if power is way out of specification. It is for this reason we have cautions posted on our website and in our literature that warn about consequences where power supply voltage to the solenoid exceeds 28VDC and has an AC component greater than 6VAC. Controllers exhibiting these off-spec conditions have become unreliable and contribute to failures. If solenoids and controllers are periodically burning out, maybe it's not the solenoid or the controller and is somewhere else.

Are type 1 replacement solenoids still available? The answer is no. Although their manufacture is still possible, we realize that there are so many drawbacks to type 1, that only type 2 will be offered for sale. As we have said, type 1 solenoids can self destruct. They would also be about twice the price of the type 2 solenoids if they were to be made now.