

Section 10: Pneumatics

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When building a robot for competition, you must consider the challenge, your strategy, and your means of accomplishing the challenge. The goal of this is to get your team more familiarized with pneumatics, the use of pressurized air to operate your robot.

Pneumatics are often used as a quick and light way to extend or retract robot parts. During LOGOMOTION, many teams used pneumatics to extend their robot's arm, so they could score tubes on the upper rack, and they could retract that same arm in order to keep the robot balanced while driving.

Air Compressor



The air compressor is the component that actually compresses the air for use in the pneumatic system. The air compressor in the 2011 KOP was light enough to be mounted on the robot, ensuring the pneumatic system will never run out of air. To power the compressor, it needs to be wired to a relay with a 20A breaker on it. While powered, the compressor will vibrate (a lot), so be sure to mount it on something solid. When programming, remember that a relay has four modes: *On*, *Off*, *Forward*, and *Reverse*. Only program the relay *Forward*, so the compressor will compress air and add it to the system. If you program the relay *Reverse*, the compressor will suck air out of the system. THAT IS VERY BAD.

Pressure Relief Valve



The pressure relief valve is the component of the pneumatic system that makes sure the total PSI (Pounds per Square Inch) of the system does not exceed 120 PSI. The pressure relief valve should be connected right to the compressor, as seen in the compressor photo above.

Pressure Switch



This sensor detects the pressure of the pneumatic system. If the pressure is too low, the pressure switch sends a signal to the digital sidecar and starts the relay that is connected to the compressor. When the pressure gets to 115 PSI, the switch sends a signal to the relay and stops it, saving battery. This ensures the PSI of the system is never too high or too low.

Air Tank (Accumulator)



The air tank is what actually stores the air for the pneumatic system. With one tank, you can maintain 120 PSI, but you will run out faster than if you had two tanks. Also note that the air tank that is provided in the

KOP is not the only air tank available. The tank included in the 2011 KOP is 32 in.³.

Main Regulator



This is the main regulator, which is somewhat similar to the pressure relief valve. The pressure relief valve ensures that the total pressure of the system does not exceed 120 PSI. The main regulator, however, makes sure that the total pressure going to the cylinders is no greater than 60 PSI. The total force of a cylinder is equal to the area of a cylinder times the total pressure. Say you have a cylinder with an area 5 in.², but you don't have a regulator, so the cylinder is fired at 120 PSI. The total force the cylinder is firing at is 600 pounds. However, with a regulator, the total force is only 300 pounds. This makes the cylinder less dangerous, yet still lets the robot operate with enough force to run well. You can also modify the regulator to lower the total pressure going the cylinders even more.

Solenoids



A solenoid is a lot like a relay, only for a pneumatic system. Electrically, a solenoid has two sides, and each side can be plugged into the solenoid breakout, one of the cRIO modules. Just like a relay, a solenoid can control the flow of air in four ways: *On*, *Off*, *Forward*, and *Reverse*. Each solenoid has a small button on them that manually opens the valves. In the rookie

KOP, teams were given a 24V solenoid. To operate these, the solenoid breakout needs to be powered by the 24V power slot on the power distribution board (the same slot that also powers the cRIO).

Plug Valve



The plug valve is a safety measure for the pneumatic system. When the robot is not in use, it is a good idea to open the valve and release the pressure. That way, there is no pressure in the system to activate any cylinders unintentionally.

Pneumatic Tubing



This is the tubing used to connect each pneumatic component in a circuit. The pneumatic tubing used on your robot should be rated to 125 PSI. When cutting the tubing, make sure to cut at a level horizontal. Otherwise, the tubing will not securely fit into the plugs and the pneumatic system will leak.

Cylinders



Cylinders are the component of the pneumatic system. They can either be retracted or extended. Cylinders can be custom ordered from Bimba. They come in $\frac{3}{4}$ " diameter, $1\frac{1}{16}$ " diameter, $1\frac{1}{2}$ " diameter, and 2" diameter.

Teflon Tape



When screwing together fittings for the air system, always put a wrap of Teflon tape on the threads to insure an air-tight seal.

Pressure Gauge



Two pressure gages are required in the system. One gage should be located on the accumulator side of the regulator, the other on the solenoid side (or in the regulator pressure port). The regulator should be between them. The accumulator pressure should be less than 125 psi. The working pressure should not exceed 60 psi.

Simple Pneumatic Circuit

