

# Builder's Guide

## Pressure Live Demos

### Pressure Vessel Demo

The primary component of this demo is a pressure vessel equipped with a solenoid valve for a quick release of pressure. Electrical components are necessary for the operation of the solenoid valve and an air compressor is required to charge the pressure vessel. The materials listed below were acquired from Home Depot and Amazon.com. The manufacturers and model numbers of the parts used in the original prototype are listed as a recommendation only. Most of the components are common construction materials/hardware, so other products may be easily substituted.



## Material List

1. 2x10x8' SPF Piece of Lumber



2. 110/120VAC Electric Air Compressor  
(Campbell Hausfield RP410099AV)



3. 110/120VAC  $\frac{3}{4}$ " Brass Normally Closed Air Solenoid Valve  
(U.S. Solid USS2-00007)



4.  $\frac{1}{2}$ " Barb x  $\frac{3}{4}$ " NPT Male Brass Hose Fitting  
(Nozzle)



5. Thread Seal Tape (Plumber's Tape)



6. 4"x4"x1-1/2" Square Outlet Box



7. Duplex / Toggle Switch Outlet Box Cover  
(Steel City RS2-10L)



8. 15-Amp Single-Pole Toggle Switch (Leviton  
R52-01451-02W)



9. 15-Amp Duplex Grounding Outlet (Leviton R52-05320-00W)



10. 8ft 16/3 Grounded Power Tool Replacement Cord (Husky AW62631)



11. Non-Metallic (NM) Twin-Screw Cable Clamp Connectors (5-Pack)



12. 15ft ROMEX copper wire with ground



13. 2.1 Gallon Steel Water Expansion Tank  
(Watts DET-5-M1-HD)



14. 0.85oz Quick-Set Epoxy  
(Loctite 1395391)



15. 11in Stainless Steel Cable Ties  
(Commercial Electric MLG-300ST(10))



16. #8 x 1-1/4 in. Philips Bugle-Head Coarse  
Thread Sharp Point Drywall Screws (1 lb.-  
Pack)  
(Grip-Rite 114CDWS1)



## Tools Required

- Power Drill
- 1/4" Drill Bit
- 1/8" Drill Bit
- Screwdriver
- Drill Press (optional)
- Table saw, band saw, or handsaw
- Electric Wire Cutters and Strippers
- Utility Knife

## Assembly Instructions

1. The 2x10 wood board will serve as a mount for all of the components. Layout all components on top of 2x10 to determine the minimum length of wood required. Note that the original demo was approximately 2' long.
2. Cut the 2x10 to length. Note that the 2x10 may be cut at the end of assembly, but it is much easier to cut the board **BEFORE** all of the components are mounted to it.
3. Securely affix the air compressor to one end of the 2x10 board. The original prototype used the entire 0.85oz of quick-set epoxy for this purpose.
4. The intended use of a water expansion tank is to provide pressure to a home water system. However, this demo uses the water expansion tank as a simple pressure vessel. A water expansion tank typically includes a rubber diaphragm that divides the tank into two compartments: an air compartment and a water compartment. We simply need one air compartment.

Using the 1/4" drill bit and power drill, drill as many holes in the rubber diaphragm as possible.

**CAUTION: Use extreme caution when drilling the first hole in the diaphragm, as the air side of the tank is usually pre-charged to ~60PSI. Letting air out of the expansion tank by pressing the needle on the Schrader valve is highly recommended before drilling holes in the diaphragm.**

5. Use a 1/4" drill bit and drill press (or power drill) to drill (4) 1/4" holes in the 2x10 for mounting the pressure vessel.
6. Set the expansion tank on the 2x10 board and run stainless steel cable ties around the tank and through the holes in the board to secure the tank.
7. Wrap the 3/4" threads of the expansion tank with thread seal tape.
8. Screw the solenoid valve onto the expansion tank. Note that the solenoid valve should have an arrow on it, indicating the direction that air will flow through the valve. Ensure that the arrow is pointing AWAY from the expansion tank.
9. Wrap the 3/4" threads of the brass hose fitting with thread seal tape.
10. Screw the brass hose fitting into the other end of the solenoid valve.

11. Mount the 4" square outlet box to the 2x10 board using the 1-1/4" #8 screws (4). Note: the outlet box needs to be grounded, so when installing the mounting screws, wrap one end of a ~1' long bare copper wire around one of the screws, such that the copper wire is securely fastened and in contact with the metal outlet box.
12. Remove two of the circular knockouts in the outlet box and install a cable clamp connector in each knockout hole. In the original prototype, the right knockout on the bottom side of the box was used, and the bottom knockout on the left side of the box was used.
13. Feed the wires from the solenoid valve into the outlet box, through the cable clamp.
14. Feed the wires from the power tool replacement cord into the outlet box, through the cable clamp.
15. Using a utility knife and wire cutters/strippers, expose the ends of the power tool cord as required.
16. Using the Romex wire, duplex outlet, toggle switch, power tool replacement cord, and solenoid valve, assemble the circuit shown in Figure 1 (next page).
17. Screw the duplex outlet and toggle switch into the outlet box cover.
18. Connect the bare copper ground wire from the outlet box to the ground screw of the duplex outlet.
19. Install the outlet box cover on the outlet box.
20. Tighten the cable clamps.
21. Ensure that the toggle switch is in the OFF positon.
22. Plug the air compressor into the duplex outlet.

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## Pressure Live Demos

### Soil Pressure Chest Cuff Demo

The purpose of this live demo is to simulate the feeling of soil pressure on a person's chest after a trench collapse. The primary component is an aneroid sphygmomanometer (a blood pressure cuff).

#### Material List

- Aneroid sphygmomanometer , Ultra-Large Thigh-size (16 to 25 inch)



- VELCRO Brand - Sticky Back - 15' x 3/4" Tape - Black



#### Assembly Instructions

1. VELCRO strips may be used as extensions for the cuff. Cut VELCRO strips to ~2' lengths and attach them together such that one side is a "hook" side and the opposite side is a "loop" side.  
Alternatively, (2) cuffs may attached together without VELCRO.