

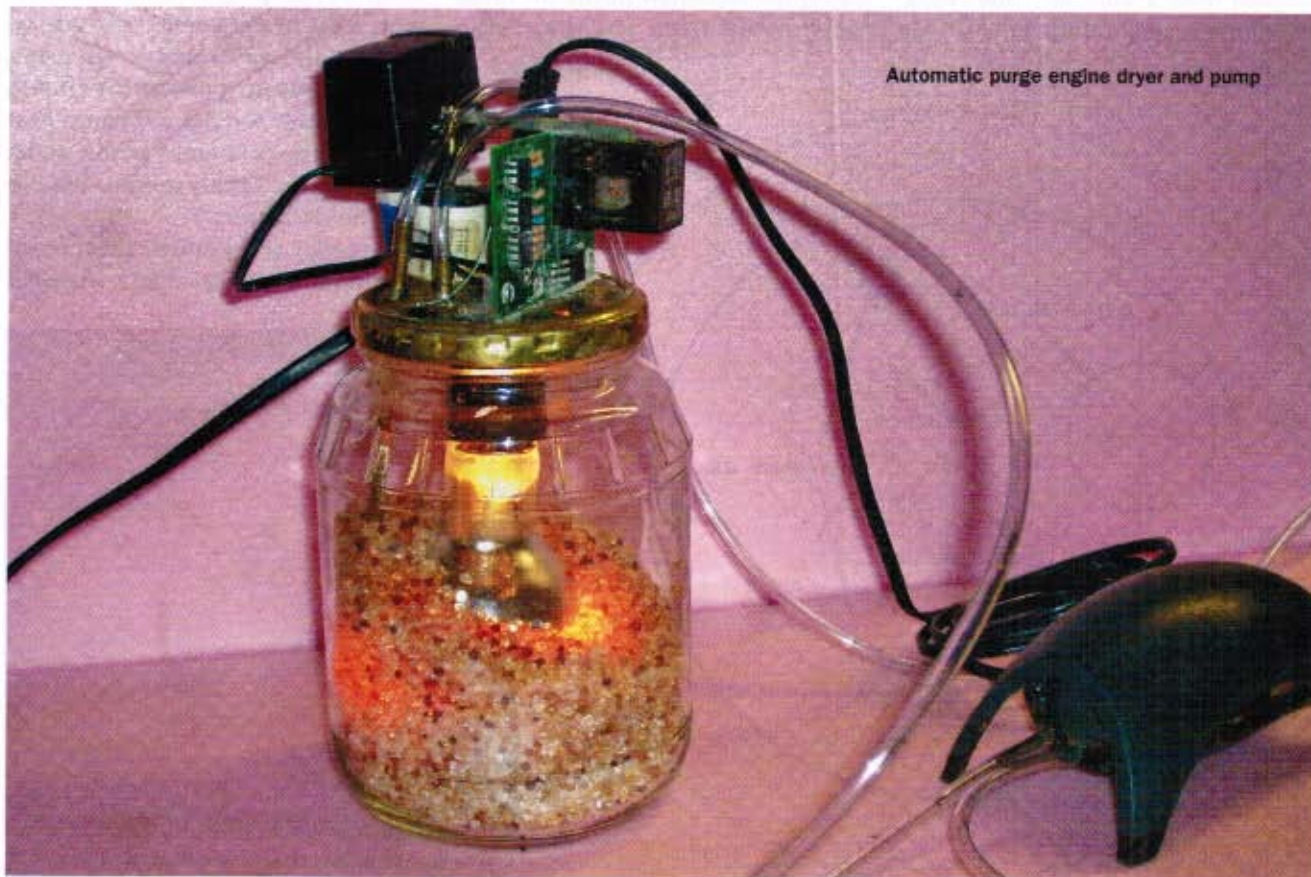
# Automatic Engine Dryer Project

New and improved since 2007

DAVID BARKER, EAA 587700

**S**ince the first do-it-yourself engine dryer kit story appeared in the April 2007 issue of *EAA Sport Aviation*, several hundred EAA members have built one for themselves. This simple unit is an inexpensive way to help get your engine to its rated time between overhauls. However, several limitations of the original design have become apparent, particularly in humid parts of the world. Some users have experienced short service intervals because of the need to re-dry the silica gel. These round trips to the kitchen oven can be a nuisance.

The following design automates the entire process, featuring "plug in and forget" operation. The original design has been updated to include electronic humidity sensing of the moisture content in the silica gel. When the moisture content reaches a preset threshold, the engine air circulation pump is shut off. At this point, a purge valve for the silica gel desiccant reservoir opens to the ambient environment, and an internal heat lamp turns on to warm the silica gel to about 200°F. This drives the moisture out of the silica gel. Upon detecting



Automatic purge engine dryer and pump

dry silica gel, the humidity sensor turns off the heat lamp, closes the purge valve, and turns the dry air circulation pump back on.

### Fabrication

The improved engine dryer is constructed on top of an approximate 2 quart, wide-mouth glass jar. All electronics mount over or under the jar lid. The lamp (heater) is suspended below the lid in the desiccant as is a custom-designed humidity sensing capacitor. After a number of failures by commercially available humidity sensors (and many dollars spent on several types), I was forced to resort to my own sensor design. By using a calcium sulfate ( $\text{CaSO}_4$ ) desiccant material as a capacitor dielectric, the failure modes of the commercial devices have been circumvented.

Next you need a relay that switches off the air pump, turns on the heat lamp, and opens the purge valve. The purge valve itself is adapted from a silicone scuba check valve diaphragm. Lamp heat drives



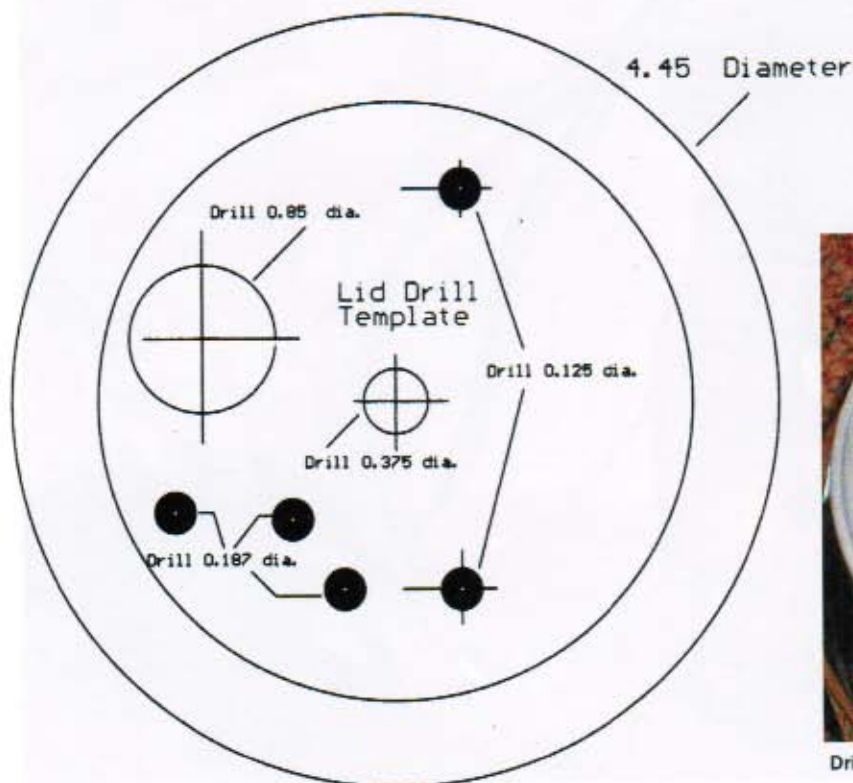
Lid with air tube/humidity sensor and lamp

out the absorbed moisture. When the desiccant moisture content drops, the humidity sensor will switch it back into the engine dryer mode. The pump injects dry air into the engine crankcase via a standpipe mounted in the oil filler. Air venting from the crankcase

vent is recovered and returned to the silica gel for re-drying.

The relay mounted on the circuit board has termination lugs for the 120V AC power cord, the connection to the pump power plug, and the lamp. A wall plug socket is modified with a cut in the connecting tang to separate the upper and lower plugs. This is done to provide a switched power outlet for the air pump/heat lamp and a continuous power outlet for the power supply module used to run the electronics.

The relay and printed circuit board mount on top of the 3-inch diameter



Drilled lid with paint removed at solder locations

twist-lock metal jar lid. A drill template pattern is used to locate all holes for the purge valve, lamp mount, and screws. The bottom of the lid carries the heat-lamp socket. The humidity sensor capacitor is cylindrical and mounted on the dry air delivery pipe. It is buried in the silica gel. All electrical feeds, lid plumbing, and mounting screws must be airtight. This is accomplished by soldering the brass air pipes to the top of the lid. Use RTV silicone or Loctite on the purge valve, wiring feeds for the lamp, and humidity sensor. A Dremel-type grinding tool is recommended to remove the paint from the lid top around the brass air tube holes. This will allow soldering of the brass air tubes to the metal lid.

Install the long, dry-air pickup tube/humidity sensor and its associated airstone (dust filter). Solder the air tubes to the lid. (A slight outboard tilt orientation in the mounting of the long, dry-air tube away from the lamp is recommended.)

### Plumbing Schematic

- Mount the lamp socket to the lid and secure with the hollow mounting bolt.
- Route the lamp wires up through the bolt and solder to the appropriate neutral plug and switched relay terminals as shown in the wiring diagram.
- Seal the leads with RTV silicone glue.



## How the Engine Dryer Works

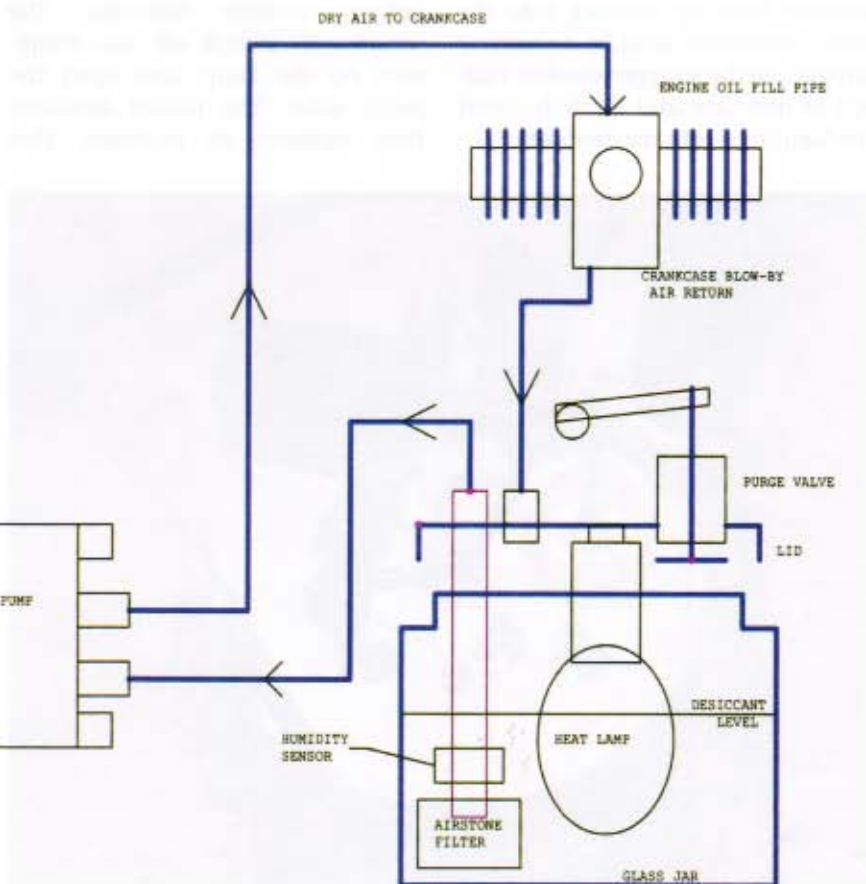
The dehumidifier is connected to the engine as soon after engine shut-down as possible—before the engine cools. It is then run on a 24/7 basis. A small aquarium-type air pump forces ambient humid air drawn from the crankcase vent through a plenum bottle containing silica gel (this is the stuff used in shipping and storing aircraft engines and electronics). The silica gel has a great affinity for moisture and literally sucks it out of the air. The dried air is filtered

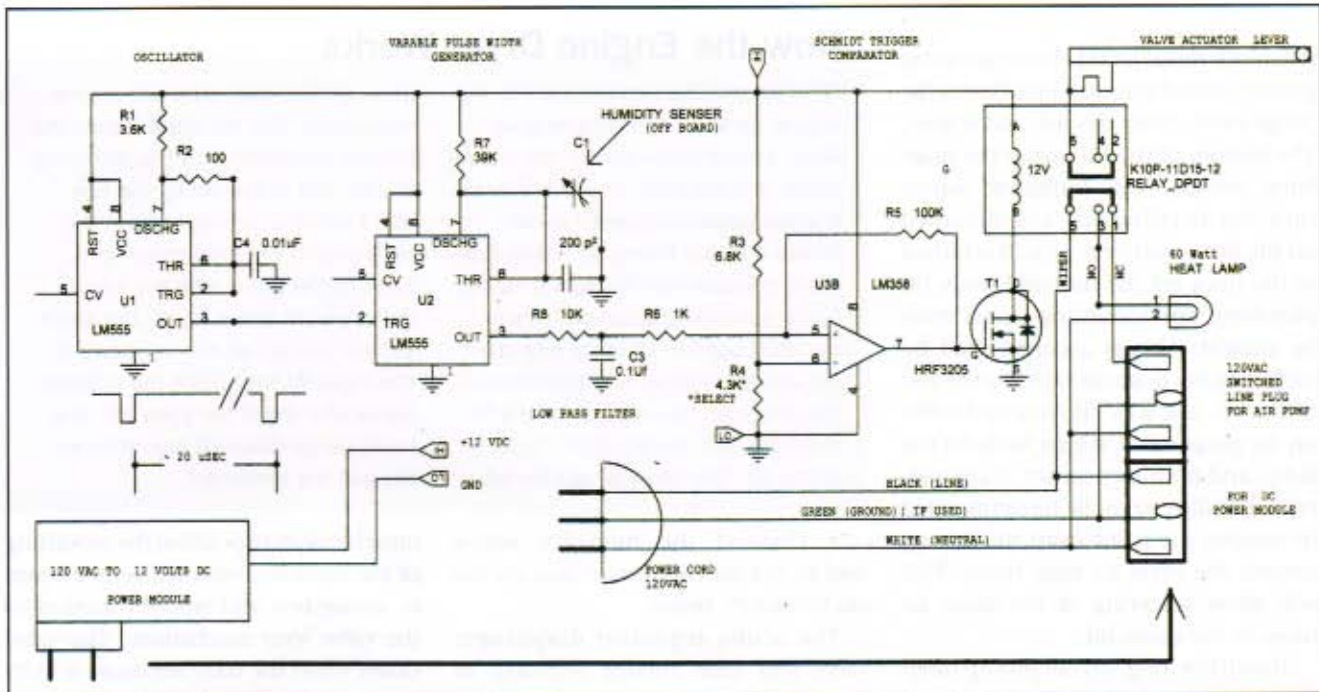
and injected back into the engine crankcase. Any moisture inside the engine vaporizes with the incoming dry air and is moved by the constant positive pressure from the air pump to the crankcase vent, back to the pump and the silica gel dryer. At some point, the silica gel will absorb all the moisture it can hold. At that point the process stops and the dryer goes into the heat/purge mode of operation to dry out the desiccant.

- Connect the humidity sensor lead to the lid connection and on the electronics PC board.

The scuba regulator diaphragm valve and stem mount vertically in the valve body and are connected by a pin linkage to the lever fixed to the modified relay armature. Some care

must be taken to position the mounting of the vertically oriented sensor board to assure free and smooth motion of the valve lever mechanism. The valve closes when the relay armature is in its normally closed (up) position. Internal air pressure buildup will help push the valve closed during dryer operation.






Dryer controller diagram

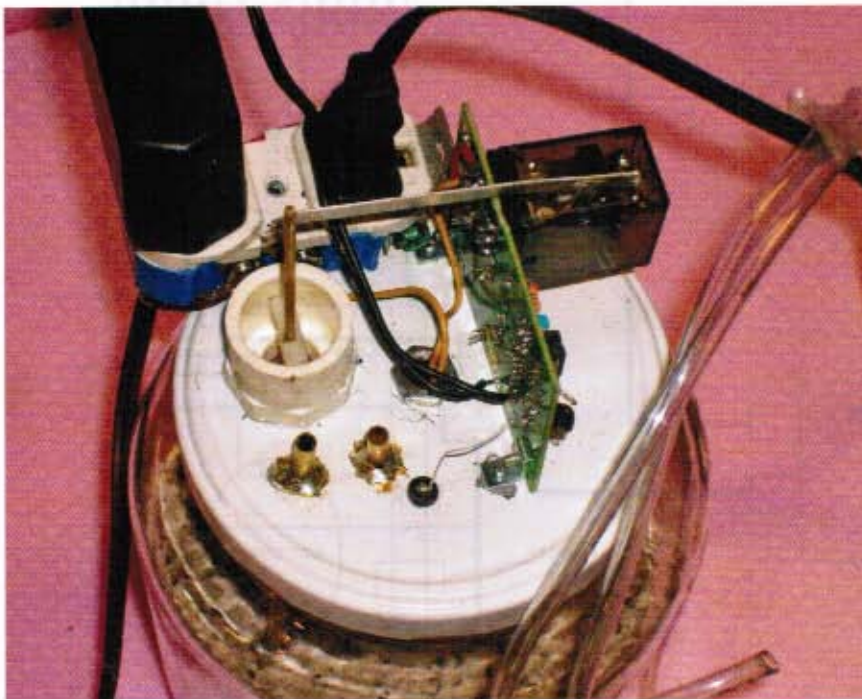
Test fit the lid assembly on the jar. Connect all the Tygon tubing and plug all but one hose to test for system pressure leaks by blowing into the hose. The system must be completely airtight. Fill the jar approximately half-full of desiccant and carefully insert the lamp/tube into the desiccant.

Upon power up the unit will circulate dry air through the engine crankcase. At approximately 30 percent relative humidity, the sensor will switch off the pump, turn on the lamp, and open the purge valve. The heated desiccant then outgases its moisture. This

can occasionally be observed as a temporary condensation near the top of the jar. With additional heating, the humidity in the jar will continue to rise and then start to fall as the moisture is driven out of the desiccant into the atmosphere. When the humidity falls below 20 percent the lamp will shut off, the purge valve closes, and the air pump turns back on for the next engine drying cycle. Typical purge time will run one to two hours. This may occur every couple of days in wet environments.

Note: A thermal insulating blanket surrounding the jar (not shown) will greatly speed up the purge process. In fact, it may be mandatory in cold climates to get the temperature high enough to drive out the moisture.

A full kit of parts with detailed instructions is available for \$95. A partial kit, for those who built the original one, is available; it doesn't include the air pump, Tygon tubing, silica gel, Delrin cap, and the brass air fitting for the oil cap. The partial kit price is \$80. For a complete listing of materials needed to build this engine dryer, visit [www.BarkerAircraft.com](http://www.BarkerAircraft.com). 



Purge valve control PC board and power supply mount on lid