

# Miniature Glycol Smoke Maker

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## DRAFT 1

There are many ways to make smoke for R/C model boats – water misters, oil burners, smoke bombs and a variety of designs of glycol “fog” makers. This unit is an efficient glycol fogger that produces a significant amount of smoke with relatively low power consumption. It’s designed to be made with simple tools and cheap, readily available materials.

### Tools needed:

- small triangular file
- wire cutter/stripper
- crimping tool (optional)
- small needle nose pliers
- small volt/amp meter (optional)
- measuring calipers (optional)
- sharp razor knife, scissors or X-acto saw
- drill and ¼” bit
- round file or Dremel with coarse sanding drum

### Materials:

- small baby food jar with metal lid (grocery store)
- small plastic kitchen funnel - dishwasher safe (grocery store)
- heat resistant test tube, approx. 15mm diameter (hobby shop)
- glass capillary tube, approx. 1mm diameter, approx. 4-6”(hobby shop)
- nichrome wire and fiber string core (from old/broken hair dryer)
- 3/32” copper or brass tubing, two ¼” pieces (hobby shop)
- high temperature silicone sealant (auto parts supply store)
- 18 gauge silicone insulated wire, approx. 1ft. (hobby shop)
- high quality glycol based smoke fluid (“fog juice”) (Wal-Mart or on-line)
- small computer fan, 1” to 1.5”, 6 or 12V (on-line)
- styrene sheet,
- styrene glue

### Construction:

#### 1. The fluid reservoir (baby food jar and lid) and stack (plastic funnel)

Get a baby food jar, or any similar glass jar with a metal screw-on lid, of a size that will fit in your model just below the stack location. The jar will be the main reservoir for

the glycol fog fluid. A typical small baby food jar, filled to just below half full, will provide at least an hour of continuous smoke. The jar needs to be glass so you can see the fluid level, for heat resistance and for reducing heat loss. Although glass gets hot, it is actually a pretty good insulating material, keeping heat inside the smoke maker and reducing battery power consumption.

The jar must have a metal screw-on lid. Draw a circle centered on the top of the lid, leaving about a ¼" margin to the edge of the lid. Drill a number ¼" of holes inside the circle and use scissors, a file and or Dremel with a grinding drum to make a large round opening in the lid using the marked circle as a guide. This is the hole that the plastic funnel will fit through, with the edge of the hole holding the funnel in place.

The plastic funnel should be "dishwasher safe" and it will take the heat of this smoke unit. The funnel size should be based on the stack diameter of the model. The throat of the funnel should be able to fit inside the model stack, acting as an internal "stack liner". The mouth of the funnel needs to be at least as wide as the top of the reservoir jar. Cut the funnel mouth (wide part) down to match the outside diameter of the jar opening. After cutting, the funnel should sit on the rim of the jar. It must not fall into the jar. When cutting, cut very evenly. Cutting to leave the funnel slightly big and then sanding flat on a sanding board to the final size helps give a level, even edge.

Test fit the assembly. Place the funnel on the jar, place the cut-out lid over the funnel and screw in place. The lid should hold and seal the funnel to the top of the jar.

Leave the throat (narrow part) of the funnel uncut until final fitting into the model and model smoke stack.

## 2. Preparing the inner reservoir (the test tube)

The inner test tube is important because it provides a preheating chamber for the glycol fluid and helps keep the outer reservoir jar – and the inside of your model – a lot cooler. The inner test tube has a small feed hole near the bottom to allow fluid to slowly flow inward from the outer reservoir jar. The hole is no more than a millimeter across. An easy way to make the feed hole in the glass test tube is to start filing (with a small triangular file) a groove in the rounded bottom, on the "shoulder" about halfway between the bottom and the start of straight side of the tube. Carefully file until the groove cuts through the wall, forming a small opening.

Place the test tube in the reservoir jar and mark its height to match the top of the jar. If the tube is close to this height, use it as-is. Otherwise, the tube will need to be cut to length. Unless you have a better method, use the edge of a triangular file to cut a continuous groove around the tube at the desired cut line. Continue filing until the tube is cut through. Sand or "heat polish" the cut edge to eliminate sharp edges.

### **3. Preparing the capillary tubes**

Cut two capillary tubes to a length that makes them even with the top of the test tube when they are centered inside the tube. The tubes are easily cut by filing a “nick” on one side of the tube and snapping the tube at that point. A good way to get a clean snap is to lay the triangular file in a flat surface, place the capillary tube on the file with the “nick” facing upwards and right on the edge of the file, cover with a cloth or paper towel and press down on the free end of the tube to snap it off on the file. The two tubes should be exactly the same length. (Note that in some higher wattage, high capacity smokers, three or four capillary tubes might be used. Two tubes are usually plenty for models up to about three feet long.)

Use nichrome wire to lash the two tubes together. Lash near the top and bottom and twist the wire ends to tighten the lashings around the capillary tubes. Secure the lashings with a touch of the high temperature silicone sealant.

### **4. Preparing the heating element**

The first step is to determine the length of the nichrome wire needed, given the diameter of the wire and the desired operating voltage of the unit. (See the example below) This can be determined with resistance and current measurements and calculations, but can be done experimentally too.

Remove, unwind and straighten a length of the fine wire from an old hair dryer. Save the “string” core from the coil of wire. Stretch about 12 inches of the straightened wire tightly between two points so that the wire is not touching anything between the suspension points. Attach a power lead from the actual battery that you will use to power the smoke unit to one end of the suspended nichrome wire. Make sure the battery is fully charged. Now touch the other lead to the opposite end of the nichrome wire for a few seconds. The wire should not start to glow red. If it does, the wire is too small in diameter or the voltage is too high for the 12-inch length. You can go to longer wire, but it becomes very hard to accurately wind even twelve inches into two coils with no shorts between winds. Consider using a lower voltage to power the smoke unit, or source wire of a slightly larger diameter.

Continue testing by moving the test lead closer to the end with the fixed power lead. Make the contact just a few seconds at a time. At some point, you will see the wire start to very slightly glow red when the power is applied. Measure the length of the wire at that point. The wire should not glow brightly, but only have a hint of dull red glow. It’s best to do this with a low light level in the room. Be sure that the battery being used has enough capacity to maintain full voltage over the course of this testing.

As a final test, wet the suspended wire with glycol smoke fluid and apply the power lead at the determined length. The fluid should vaporize and “smoke-off” the wire.

The objective of the above is to get the right length of wire for effective smoke production, at the planned supply voltage, without burning the fluid (or the system). Unless you have a small DC volt-ammeter, you can only estimate the power consumption of the heater wire. A good target is about 15-25 watts. Determine watts by multiplying the voltage applied by the amp flow measured through the heating wire.

**Example: Wire data for a 12 volt smoke unit built for a 3-foot tugboat:**

(This is the unit in the U-Tube video)

- Nichrome wire diameter: 0.011" (the small diameter wire from a 110V hair dryer)
- Length: 10.75" total on two coils in two capillary tubes
- Resistance: approx. 5 ohms.
- Applied voltage (two 6V SLA batteries in series): 12.75V
- Measured Current: 2.3Amps  
(Note: calculated amps =  $12.75V/5ohms = 2.55A$ . Heated nichrome resistance is higher than the cold and probably imprecise measurement of 5ohms)
- Watts (Volts x Amps): 29 Watts

The tug motor draws about 1.5A at average speed. With the smoker, that's a total continuous draw of 3.8A. Rounding that up to 4A, the tug should get well over two full hours of running on the 10Ah SLA batteries.

## 5. Winding the coil