

## An Inexpensive Kugelrohr Still

Bulb-to-bulb, or Kugelrohr, distillation has become a popular means for the simple distillation of minute quantities ( $\leq 5$  mg) of volatile materials, either at atmospheric pressure or under vacuum. We have seen commercial units costing hundreds of dollars, and elaborate homemade models. The least expensive unit on the market costs less than \$100, but requires a Variac for operation, the costs of which doubles its effective price.

We wish to describe a simple unit which is superior to some commercial units, and may be assembled for a small fraction of the price. The key to the unit is a variable temperature air bath whose temperature can be easily controlled and monitored. We have found that commercially available "toaster-ovens" suit the purpose beautifully. Although these units are available at retail in a variety of models, almost any of which will do, it is often possible to purchase a used oven at a yard sale for \$10 or so. Most units have a thermostatted temperature control, but we have found it useful to install a thermometer through the top of the oven using a small collar and rubber o-ring as well. A 2-in. hole is cut into the side of the oven to accommodate a flask up to 50 ml. It may be necessary to remove some of the front door hinging mechanism at this point, depending on what model is used. We have used two hinged metal plates with a smaller hole drilled at the center to fit closely around the neck of the flask (see illustration).

Even though some commercial units employ a rocking motor to prevent bumping, and one may be added to this unit, we have found additional spacing bulbs, inside the oven, to be sufficient to insure a clean distillation. To cool the collecting bulb outside the oven, a slow dropwise stream of methylene chloride on a tissue wrapped around the bulb is quite efficient. A serendipitous advantage of this unit over commercially available models is that the glass front permits viewing the progress of the distillation.

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