

# A Low-Cost, Precision Hydrometer for Classroom Use

Michael D. Murphy

University of Alabama, University, AL 35486

Hydrometers have been a basic tool in teaching labs and industrial labs for countless years, but, because of their current expense, they can cause an unacceptable drain on a budget through frequent breakage in the hands of inexperienced freshman students.

The hydrometer shown in Figure 1 can be assembled in a few minutes by students, using stock laboratory items with a total retail cost of about 17 cents. The thinness of the glass walls of the capillary melting-point tube and 5-ml ampule assures that the hydrometer is quite bottom-heavy, thus permitting the apparatus to float perfectly upright, with no tendency to fall over on its side. Before they are dispensed to the students, the tubes are sealed at both ends, laid parallel to each other in groups of 10 or so, and taped on each end to the table to prevent rolling. A mask of lines carefully cut out of a manila folder is then taped firmly over the tubes, and a light discharge of quick-dry paint from a spray can is used to apply the graduations. Likewise, the plastic NMR sample tube caps are drilled ahead of time to provide a snug opening into which the capillary tube may be inserted.

The student can adapt the hydrometer for use in any liquid by varying the amount of weight (lead shot, BB's, sand) added to the ampule. In our particular experiment, the students were to determine the specific gravity (and thus the percent alcohol) of the clear decantate from a finished fermentation of sugar water by yeast. By adjusting the hydrometer's weight so that it floated at the lowest graduation in water, alcohol solutions of 0–10% could be tested. Testing of the hydrometer against standard alcohol solutions in that range showed that all points fell very close to a straight line (Fig. 2), indicating

that the capillary tube had the uniform diameter and thickness required for accurate readings.



## List of Materials

5-ml ampule	Fisher 01-215. Avoid pre-scored ampules to prevent undue breakage.
100-mm melting-point tube	Fisher 12-141-1
5-mm NMR sample tube caps	Norell, Inc., 314 Arbor Ave., Landisville, NJ 08326. \$2.75/100

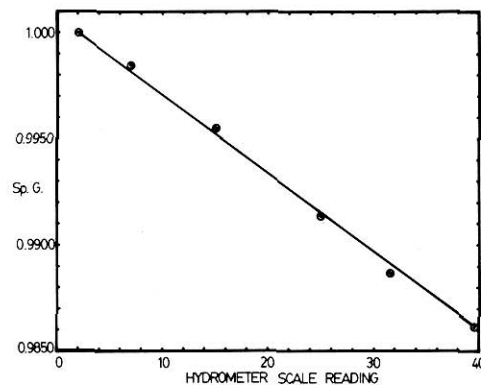


Figure 1. (left) The assembled hydrometer.

Figure 2. (right) Data obtained for 0–10% alcohol solutions.