HARVARD APPARATUS

PHD ULTRA In-Lab Calibration Method

It is recommended to use a Hamilton Glass Gastight syringe or other syringe (not plastic, which has an error of ±5%) that has little error (± 1%)

Required:
Water
Syringe (Filled with a greater volume than that which you wish to dispense)
Balance
Weigh Boat

* **Tare a weigh boat (or other liquid receptacle) on a balance**
* **Note the room temperature and determine the weight of the water based on the density of water at the temperature to which you are closest:**

Temp (°C)	Density pure water (g/cm^3)	Density pure water (kg/m^3)	Density tap water (g/cm^3)	Density pure water lb/cu.ft	Specific Gravity 4°C reference	Specific Gravity 60°F reference
0 (solid)	0.9150	915.0	-	-	0.915	-
0 (liquid)	0.9999	999.9	0.99987	62.42	0.999	1.002
4	1.0000	1000	0.99999	62.42	1.000	1.001
20	0.9982	998.2	0.99823	62.28	0.998	0.999
40	0.9922	992.2	0.99225	61.92	0.992	0.993
60	0.9832	983.2	0.98389	61.39	0.983	0.985
80	0.9718	971.8	0.97487	60.65	0.972	0.973
100 (gas)	0.0006				-	-

* **Choose a syringe volume and set the pump to output a set volume at a set rate. Easiest: 1ml over 1 minute**
* **Time the dispense with a stopwatch (if desired), but the timer in the pump is virtually never a source of error**
* **Collect the dispensed water into the tared container and weigh the water. g/cm^3 is equivalent to g/ml.**
* **If the density of water at ~20C (room temp) is .9982 g/ml, then .9982g is the goal weight of 1ml of the dispensed water that you wanted delivered in 1 minute (if you used suggested settings). The volume should be within ± 0.25% of the desired volume (0.5% if Pump11 Series). If it is off, it is probably due to syringe error: Accuracy error is corrected by altering the set diameter of the syringe up or down on the pump in the same direction as the error (e.g. dispensed too much, increase set diameter so that the pusher block travels less distance)**
* **Repeat the dispense 10 times. Reproducibility should be within ±0.05% (0.1% for Pump11 Series)**
* **If your measurement does not fall within the reproducibility specifications then the pump will need to be returned to Harvard Apparatus for repair (if necessary) and calibration.**

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