

# Temperature

VT WSMD Wastewater Program Lab Manual Section #6

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## Temperature

### Background

Temperature is perhaps the easiest of all analyses but one that may be very inaccurate without the operator knowing it. Many thermometers as they come from the factory are not accurately calibrated. It is safe to assume that the least expensive thermometers will be more often out of calibration than the more expensive. All thermometers should be checked against a NIST certified or NIST traceable thermometer at yearly intervals. It is especially important to calibrate thermometers which are used in incubators. The Vermont Agriculture and Environmental Laboratory (VAEL) has access to a certified thermometer and arrangements can be made with you to calibrate your thermometer. Other commercial laboratories also offer this service for a fee.

To better understand the requirements for thermometer calibrations:

Here is a link to the NIST Handbook 105 section 6 "Specifications and Tolerances for Thermometers."

[Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures: Specifications and Tolerances for Field Standard Weights \(nist.gov\)](#)

### Equipment

It is necessary to match the thermometer to the application. For general laboratory measurements, the standard, liquid -filled thermometer capable of reading from -20°C to 110°C, graduated in one degree increments, is sufficient. (Use of mercury -filled thermometers is no longer recommended.) For outside work, this same thermometer can be encased in a metal shield. Thermometers for the coliform water bath incubator must be graduated in 0.1°C divisions as the maximum variation in temperature is only  $\pm 0.2^\circ\text{C}$ .

### Procedure

When taking temperatures, make sure that the thermometer has ample time to stabilize at the sample temperature. Also be sure that if the thermometer is a **partial immersion** type, it is immersed to the indicated line on the thermometer; if it's a **total immersion** type, it is totally immersed. Temperature is reported to the nearest 1°C or 0.1°C, depending on the thermometer and its function. It is imperative that temperatures be taken immediately after sampling. It is best to take the temperature in the waste stream rather than to collect a sample and take it back to the lab for a temperature reading.

There is a general method for checking the accuracy of the thermometers which can be done easily right in your lab. First, fill a beaker that is deep enough to cover the submersion line on thermometer in question with a mixture of ice and water. Stir the mixture so that the temperature becomes uniform. Put the thermometer in the mixture until it reads 0 °C or 32 °F. Remove the thermometer. Next heat the beaker until the water starts to boil. Insert the thermometer, it should read 100 °C or 212 °F. If it doesn't this may be due to differences in elevation/barometric pressure. Check the current barometric pressure, using the correlating boiling point from this chart:

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### Boiling Point of Water

Pressure mmHg	Temperature °C	Pressure mmHg	Temperature °C	Pressure mmHg	Temperature °C	Pressure mmHg	Temperature °C
700	97.714	725	98.686	750	99.630	775	100.548
701	97.753	726	98.724	751	99.667	776	100.584
702	97.792	727	98.762	752	99.704	777	100.620
703	97.832	728	98.800	753	99.741	778	100.656
704	97.871	729	98.838	754	99.778	779	100.692
705	97.910	730	98.877	755	99.815	780	100.728
706	97.949	731	98.915	756	99.852	781	100.764
707	97.989	732	98.953	757	99.889	782	100.800
708	98.028	733	98.991	758	99.926	783	100.836
709	98.067	734	99.029	759	99.963	784	100.872
710	98.106	735	99.067	760	100.000	785	100.908
711	98.145	736	99.104	761	100.037	786	100.944
712	98.184	737	99.142	762	100.074	787	100.979
713	98.223	738	99.180	763	100.110	788	101.015
714	98.261	739	99.218	764	100.147	789	101.051
715	98.300	740	99.255	765	100.184	790	101.087
716	98.339	741	99.293	766	100.220	791	101.122
717	98.378	742	99.331	767	100.257	792	101.158
718	98.416	743	99.368	768	100.293	793	101.193
719	98.455	744	99.406	769	100.330	794	101.229
720	98.493	745	99.443	770	100.366	795	101.264
721	98.532	746	99.481	771	100.403	796	101.300
722	98.570	747	99.518	772	100.439	797	101.335
723	98.609	748	99.555	773	100.475	798	101.370
724	98.647	749	99.592	774	100.511	799	101.406
						800	101.441

You should also carefully inspect the liquid column. It can separate and cause inaccuracies. This space may be eliminated by holding the thermometer in one hand and carefully tapping the palm of that hand against the open palm of the other hand to force the column together.

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### **References**

There is a short section on temperature in Standard Methods for the Examination of Water and Wastewater, 23rd Edition, Section 2550 B.

[Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures: Specifications and Tolerances for Field Standard Weights \(nist.gov\)](#)