ME 301 Temperature measurement

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1. Introduction

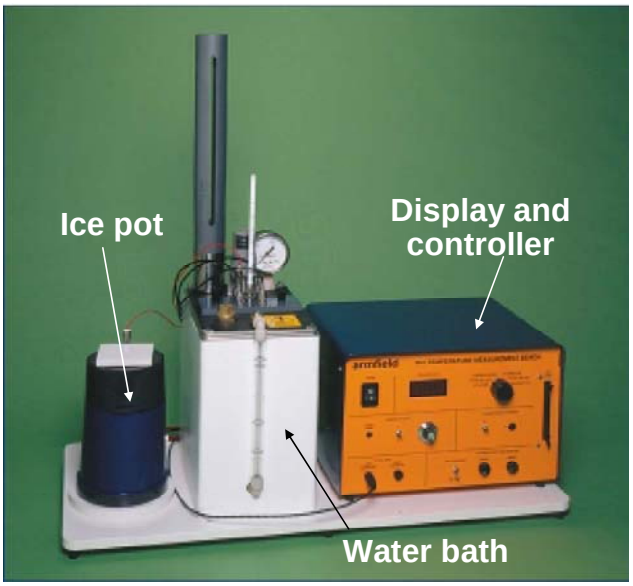
In daily life, we involve with the temperature, such as measuring the temperature for cooking, controlling the air conditioning system, and so on. Therefore, learning characteristics of the temperature measurements is important for applying suitably with work, and obtaining the reliability of the data.

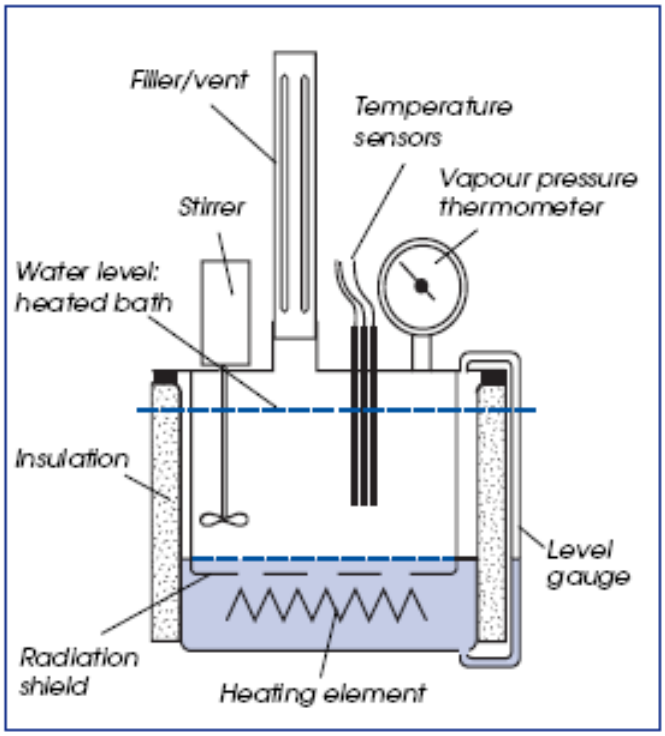
2. Objectives

- To investigate the accuracy of the temperature measurements for The measurements, which are usually used for measuring the temperature of fluids, are the PT 100, the liquid-in-glass thermometer, vapor pressure thermometer, thermistor, thermocouple of type K.

3. Equipment set-up before experimenting

- Check that the stirrer and the heater are both switch off, and the water bath is cool.
- Remove the slotted chimney on the steam vent, and fill the water bath until the water level is between the top two marks on the sight glass situated at the front. Replace the slotted chimney.
- For this experiment, the following sensors will be used: the industrial PT 100, the reference PT 100, the straight naked bead thermocouple, the thermistor, the liquid-in-glass thermometer, and the vapor pressure thermometer. Check that all the sensors are securely fastened into the carrier. The gland nuts at the top should be finger tight. Take great care not to damage the sensors or sheaths.





TH1: Schematic diagram of hypsometer/heated water bath

4. Procedure

- Take an initial reading or each of the sensors. Use the rotary selector switch on the console to change the digital display between the sensor output from the PT 100 reference thermometer, the industrial PT100 thermometer, the thermocouple, and the thermistor. Reading from the vapor pressure thermometer and the liquid-in-glass thermometer should be taken directly from the scales on the device themselves.
- Switch on the heater and the stirrer.
- As the water bath temperature rises, take readings from the test sensors at intervals of 5 ^{o}C, as indicated by the PT 100 reference thermometer.
- Due to thermal accumulation in heater wire, heat might raise very fast. In order to read the instant temperature, the heater should be switched off before the setting temperature for 2^{O}C, but leave the stirrer running.
- Record data until temperature from PT100 reference reaches 100^{O}C.

5. Results and Discussion

- Transform all data into ^{O}C (look up from Text book)
- Plot graphs of each set of sensor readings against the PT100 reference thermometer readings.
- Comment on the suitability of each device for temperature measurement.
- Discuss the advantages and limitations of each device, including comments on ease of measurement and robustness.

Result of temperature measurement

PT 100 Ref (^{O}C)	PT 100 ind (Lo) (Ω)	Thermocouple (μV)	Thermistor (Ω)	Liquid-in-glass (^{O}C)	Vapor pressure (^{O}C)	PT100 ind (Hi) (Ω)	Calibration (^{O}C)
30							
35							
40							
45							
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							

Give
For Thermistor

$$R = R_o e^{\beta\left(\frac{1}{T}-\frac{1}{T_o}\right)}$$

where

R_o is resistance at reference temperature [5137 Ohm]

β is constant, characteristic of material [4000 K]

T_o is reference temperature [298 K]

For Thermocouple type K

Celsius	mV	Celsius	mV	Celsius	mV	Celsius	mV	Celsius	mV
1	0.039	21	0.838	41	1.653	61	2.478	81	3.308
2	0.079	22	0.879	42	1.694	62	2.519	82	3.350
3	0.119	23	0.919	43	1.735	63	2.561	83	3.391
4	0.158	24	0.960	44	1.776	64	2.602	84	3.433
5	0.198	25	1.000	45	1.817	65	2.644	85	3.474
6	0.238	26	1.041	46	1.858	66	2.685	86	3.516
7	0.277	27	1.081	47	1.899	67	2.727	87	3.557
8	0.317	28	1.122	48	1.941	68	2.768	88	3.599
9	0.357	29	1.163	49	1.982	69	2.810	89	3.640
10	0.397	30	1.203	50	2.023	70	2.851	90	3.682
11	0.437	31	1.244	51	2.064	71	2.893	91	3.723
12	0.477	32	1.285	52	2.106	72	2.934	92	3.765
13	0.517	33	1.326	53	2.147	73	2.976	93	3.806
14	0.557	34	1.366	54	2.188	74	3.017	94	3.848
15	0.597	35	1.407	55	2.230	75	3.059	95	3.889
16	0.637	36	1.448	56	2.271	76	3.100	96	3.931
17	0.677	37	1.489	57	2.312	77	3.142	97	3.972
18	0.718	38	1.530	58	2.354	78	3.184	98	4.013
19	0.758	39	1.571	59	2.395	79	3.225	99	4.055
20	0.798	40	1.612	60	2.436	80	3.267	100	4.096