Calibrating Thermometers

In general we trust the thermometers we buy, but it is important to know that the cheaper they are the less likely it is that they are totally accurate. This does not usually affect the amateur meteorologist, but we should be aware of it. Look in a shop when there is more than one thermometer see if any are showing slightly different temperatures even though they are next to each other.

When you buy some expensive thermometers they come with a certificate which tells you exactly how close to the actual temperature they measure. The certificate might say that the readings are perhaps 0.1°C below the actual temperature. Then when you take readings with this thermometer you would have to add 0.1 of a degree onto your readings. Thermometers are usually calibrated at more than one temperature, as the difference can vary at different temperatures. An example of the chart on a calibration certificate might be;

Standard Thermometer	This thermometer's readings	Correction to thermometer reading
-15	-15.1	+0.1
0.0	-0.1	-0.1
20.0	20.1	+0.1
40.0	40.1	0.0
54.0	53.9	-0.1

Can you work out from the chart above at which temperature this thermometer is totally accurate?

Finding out the accuracy of a thermometer is known as calibrating it. To do this the thermometers are arranged in a location where the temperature is even, and they are left for a while to settle before being read. The thermometers on the right were a few tenths of a degree different. Click on the image to see it bigger, and you might want to see two thermometer readings close up by clicking here.

We first became aware of calibrating thermometers at a conference where a speaker was explaining about setting up a project for schoolchildren using thermometers. She had to put all of the thermometers in a room overnight, making sure that none of them were in warmer or cooler places that the others. She then read them all and noted down how they were different from the calibrated thermometer she was using. When they were used in the project the people would have to correct their readings so that their temperatures could be compared with everybody else's.

Sharing Data

If you are going to share your weather data it will be nice to be able to say that you have calibrated your thermometers. You can also ask anybody giving you weather data if they have done the same. It shows that you are taking your data collecting seriously.

Tenths of a Degree

When you calibrate your thermometers you will be observing tenths of a degree. Digital thermometers give readings to the nearest tenth of a degree. Traditional thermometers sometimes have half degrees marked. However as a rule you will have to get use to estimating how many tenths of a degree is shown on a thermometer. Helpful pointers to think about might be;

- Is it just a tiny bit past a number? It might be .1 of a degree
- Is it very nearly touching the next number marking? It might be .9 of a degree
- Is it half way between two number markings? That will be .5 of a degree

You can then get used bit by bit to spotting .2 and .8 of a degree. The next ones to get use to will be each side of .5 (.4 and .6). With practice you will become more confident in recording tenths of a degree.

Activity

NB – to complete this activity you will need to be able read tenths of a degree with your thermometers. You might want to use a magnifying glass to help you.

Gather together a set of thermometers. If you have not got many remember you can use your maximum and minimum thermometer, your wet and dry thermometers and any digital ones you have too.

Place the thermometers together. Make sure that you rule out any different conditions that might affect the readings;

- Sunlight
- Draughts from doors or windows
- Different surfaces
- Height (remember hot air rises)

Give the thermometers time to settle down to the temperature of their surroundings. Read and record the temperatures. Decide which reading you think is most accurate. You might like to work out the average temperature of the set of thermometers. Write in brackets after each reading how the readings differ from the actual temperature and what you need to do to the readings to make them standard e.g.

This photograph shows a set of different types of thermometer. The one on the left is a wet and dry thermometer. Usually one thermometer has a wick wrapped round it which sucks up water from the water container. When you are calibrating it you should remove this and make sure it is dry. The digital thermometer might have two separate sensors, one built in and one at the end of a cable. You should check and record both. On the Sixes thermometer you should record both readings on the right and the left. The thermometer on the right is a soil thermometer. Make sure that you record the temperatures using the same scales (°C or °F). The chart below could be used for this set of thermometers;

Thermometer	Reading	Difference from actual temperature	Action required
Dry thermometer	16°C	-0.3°C	Add 0.3 degree on
Wet thermometer			
Digital internal sensor			
Digital external sensor			
Sixes maximum			
Sixes minimum			
Digital maximum			
Digital minimum			
Soil thermometer			

You might want to label each thermometer clearly with what you need to do to the readings.