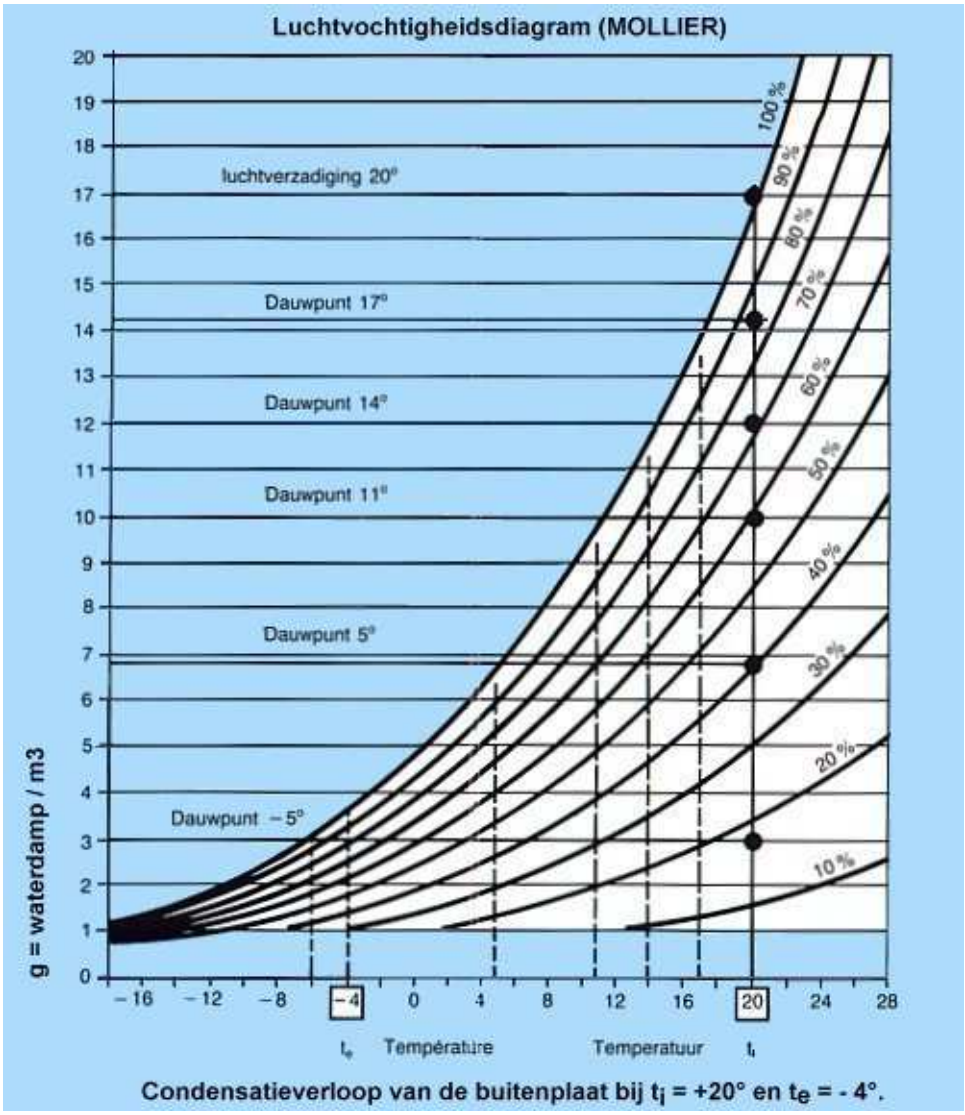
Climate control

Most churches with historical organs have some form of heating. On the whole, organ builders are not terribly enthusiastic about heating. The authorities, too, are gradually beginning to see that in quite a number of cases the heating in a building was the major cause of decline of the instruments. That is the reason why there are now set requirements as to heating, certainly after restorations.

What exactly happens when you heat a space?
Heating a space affects objects, particularly wooden objects, in two ways. In the first place there is the temperature itself. Like most materials, wood has a linear coefficient of expansion: as the temperature rises, the dimensions of the material increases. With the temperature differences commonly found in churches this effect is rather small, so it may be ignored.
More important, however, is the second aspect, the relative humidity of the air, which varies with the temperature. The absolute quantity of water that can be absorbed by air depends on the temperature. The relationship between absolute and relative humidity is shown in a Mollier diagram.



http://www.chemicalogic.com/download/mollier.html

At moderate frost, the air is 100% saturated with about 2 gram per m3. At 22 ºC the air is 100% saturated with 20 gram per m3. This means that if fully saturated air is heated from outside temperature to 22 ºC, the relative humidity decreases from 100% to 10%. In practice, of course, a relative humidity of 10% does not occur very often, because such very dry air tends to absorb humidity from the

surroundings. Churchgoers and moisture in porous objects (such as the wood in the organ) will ensure that the air is slightly less dry. However, in the recent past we have measured extremely low values of less than 20%.

What is the effect on wooden objects?
Wood is a porous material with the capacity to absorb moisture from the air and exude it again. If the air has a high relative humidity, wood absorbs moisture, and when the air has a low relative humidity, it exudes it. In the course of all this, the wood expands and contracts, particularly widthways.

In wooden constructions two pieces of word may be jointed together cross-grained. In wind chests, for instance, this is very common. Since the crossways wood warps much more than the lengthways wood, great tension is the result which may lead to cracks. And cracks in the wrong places mean leaks. They manifest themselves not only through loss of air pressure or hissing, but also because notes may sound that were not intended by the organist. The organ can then no longer be used as a musical instrument. When constructing a new wind chest we try to prevent this by restricting the size of the cross-grained wood; in older wind chest constructions we are dependent on the constructions of the original builders and the wood they used. Wind chests are, of course, not the only wooden objects that suffer damage as a result of expansion and contraction.

It is stated in the Terms & Conditions of the *Vereniging van Orgelbouwers in Nederland* that the guarantee lapses in the case of abnormal climatological conditions. The example given is a relative humidity of less than 50%. An important point is the speed at which the relative humidity changes. In previous centuries there was a slow, seasonal fluctuation of the relative humidity. Wooden constructions had ample time to adjust. Now, when a quick decrease of the relative humidity takes place, for instance when a church is heated, the wood has no time to adjust. The result will be damage such as described above.

What does this mean for climate control?
For the sake of the furniture it would be best not to heat at all. This option does not find favour with most of the churchgoers, however, and it is therefore the least frequently employed method. However, some very important churches are still unheated, such as the St Bavo in Haarlem and the Oude Kerk in Amsterdam.
If there is heating, it is best to keep the difference between the basic temperature and the heated temperature as small as possible, and to bridge the difference slowly. An example would be a basic temperature of 8 ºC and a heated temperature of 15 ºC. Generally speaking, hot air heating is more damaging to wood constructions than under-floor heating. For churchgoers the comfort of under-floor heating is greater, so that a lower temperature is sufficient.

The rule of thumb is that the temperature increases by 1 ºC with every metre in height. If the temperature is 15 ºC at floor level, the organ at 5 m will have a temperature of 20 ºC.
It is often possible to couple the central heating system to a sensor, (data logger) in the organ. When a certain relative humidity is lower than a set value, or the temperature higher, the heating system will automatically switch off. This prevents problems at the change of persons responsible (e.g. vergers), and it prevents damage by unauthorized persons. Data loggers can be rented from us at a small fee.

Within the *Rijksdienst voor Archeologie, Cultuurlandschap en Monumentenzorg* [Government Authority for Archaeology, Cultural Landscapes and Monuments], Mr Marc Stappers is specially appointed as the expert in this field. He possesses the most recent information on the subject. In specific situations the rule of thumb does not apply and other heating systems are to be preferred.

Origin of the Mollier-diagram: www.natuurwetenschappen.nl