INSTALLATION/OPERATION

COMFORTMINDER

INSTRUCTIONS

INTRODUCTION:

Please read these instructions carefully before installing your COMFORTMINDER indicator. We have prepared them carefully, knowing that some owners will use this instrument in a variety of areas for a variety of purposes – greenhouse control, central air conditioning and heat monitoring, furniture protection, general comfort conditions etc.

INITIAL ACTIVATION (HUMIDITY):

Before installation, place your indicator with its face down on a soft surface so as not to scratch the finish. Locate a cloth, such as a dish towel or face cloth, wet it and wring it out so it is not dripping wet and lay it over the back of the indicator for at least one half hour. Do not be concerned with the relative humidity reading at the end of this time. Wipe any residual moisture off the back of the indicator when removing the cloth.

This procedure should only have to be done once, unless the COMFORTMINDER is to be used in areas of persistently low humidities – that is, long periods where humidity is less than 40-45% RH. Once this activation procedure is completed it may be several hours before COMFORTMINDER settles out to actual room conditions.

We include this initial "activation process" in our instructions because we often do not know where your instrument has been and for how long, prior to your purchase. This procedure is for the humidity portion of COMFORTMINDER only, and will not affect the temperature element or damage it.

INSTALLATION:

Your COMFORTMINDER indicator is easy to install. It is the actual location of the indicator that should take some consideration. Simply put, the humidity sensing element of COMFORTMINDER is an absorption rather than an evaporative device. Therefore actual air circulation is not vital to accuracy, but it will enhance response rate.

The temperature element is a durable high quality Bi-metallic spring which is thermally coupled to the instrument housing to attain as closely as possible, the average temperature in the area being monitored. Keeping this information in mind, try to locate the indicator on a wall that will demonstrate, as closely as possible, the average temperature and humidity in the area that is to be monitored – not on a cold outside wall or a wall with a heating pipe or vent behind it or under it.

COMFORTMINDER can be mounted outdoors if it does not come in direct contact with moisture – spray, rain, etc. Nor should it be used in direct sunlight, which could cause erroneous temperature readings. Place indicator on the wall you have chosen and using the supplied brass screws, fasten to surface but do not snug down tightly. Your indicator is designed to be spaced slightly off the wall. This space is controlled by the three spacers mounted on the back of the indicator. These spacers, not the lip of the indicator, will make contact with the wall. Once mounted, this space will hardly be noticeable.

HELPFUL COMMENTS & INFORMATION

* Lightly tap the instrument when reading.

* COMFORTMINDER should net need any maintenance (regeneration) unless as

stated earlier, it is to be used in areas of persistent low relative humidities. If COMFORTMINDER is subjected to such conditions, periodically follow initial activation instructions. This procedure does not apply to nor will it affect the temperature portion of COMFORTMINDER.

* COMFORTMINDER is measuring the relative humidity and temperature at the location of the indicator, not at the local weather forecasting station. Relative humidity and temperature, like many other elements, can be drastically different with the smallest change of location.

* Your COMFORTMINDER case is jewelry quality brass with a durable finish. Do Not clean with abrasives.

* Attempts to alter calibration will only destroy the elements and void your 5-year warranty.

Because humidity is the least understood and most difficult function of our environment to measure accurately, the following essay should be carefully read to help you use and understand your COMFORTMINDER.

UNDERSTANDING HUMIDITY MEASUREMENT

A commonly asked question is, “why does my COMFORTMINDER read a different humidity than the weather service, or another hygrometer in my home?” To adequately answer this question we must first explain a little about humidity measurement.

Humidity is defined as the amount of water vapor present in the atmosphere. The simplest way of expressing humidity is as the absolute humidity. Absolute humidity is the density of water vapor, or the mass of the vapor divided by the volume. The problem with this form of measurement is that it can vary as much as five orders of magnitude (i.e. 1 to 100,000) over the surface of the earth at any point in time. Because of this large variation, absolute humidity is not a useful form of measurement to most people.

A number of other measurements of humidity have been defined to correlate natural phenomenon with humidity. Specific humidity is the ratio of the mass of water vapor to the mass of natural air. This form of measurement is useful because it has less variation and is independent of temperature and barometric pressure (altitude). Specific humidity is often used to relate the different forms of humidity measurement.

Relative humidity is by far the most popular form of humidity measurement. By definition, relative humidity is the ratio of the measured vapor pressure to the maximum possible vapor pressure at the measured temperature. In simpler terms, if the relative humidity is 50% then the air is holding 50% of the maximum amount of water vapor possible at that temperature. Relative humidity is the measurement of humidity that most closely relates to natural phenomenon. Some examples are, the changes in organic substances (i.e., the shrinking and swelling of wood), the performance of electronic devices, and the level of comfort that we feel.

It was stated previously that specific humidity is independent of temperature and pressure. Relative humidity, however, is dependent on temperature and pressure. Therefore, the relationship between specific and relative humidities is governed by temperature and pressure. In general, barometric pressure doesn’t vary over small areas. Also, of the two variables, pressure and temperature can vary greatly in a small area. Therefore, we will only consider the effect of temperature on the specific versus relative humidity relationship.

You can convert one version of humidity measurement to another by using complex mathematical formulae, a table or a chart. A typical chart, known as a psychrometric chart, relates all of the basic humidity measurements. We have included a simplified chart to facilitate comparison of specific and relative humidities.

Generally, the specific humidity in a small area (i.e., inside a building or around a yard) is constant. This is due to the fact that most substances in the atmosphere (i.e., smoke, water vapor) tend to disperse evenly throughout the air mass by a process called diffusion. Additionally, the specific humidity tends to be fairly constant from outside to inside a building. Because relative humidity is dependent on temperature, the relative humidity will vary in a small area even though the specific humidity is not varying. A few examples will help illustrate this point.

In a building, we measure the temperature and relative humidity in one location to be 75 degrees F and 50% RH, respectively. Referring to the psychrometric charts, we locate 75 on the bottom scale. We then follow the line vertically up to the intersection with the 50% RH curve. From this point, we move horizontally to the right and read the specific humidity as approximately 64 gr./lb. (grains of moisture per pound of natural air). We then measure the temperature in another location within the building and find it to be 70 degrees. Now, assuming the specific humidity to be constant, we can find the relative humidity at the new location. On the chart, we find the intersection of the 70-degree line and the 64 gr./lb. line. This point is on the 60% RH curve. So, if we were to place a hygrometer in the new location it would read 60% RH. An indoor temperature variation of 5 degrees is not uncommon. In many buildings we have measured 20-degree variations from one area to another. This shows that within a building, 10% RH variations are common and 50% RH variations are possible.

Let us examine some indoor to outdoor variations. The local weather service reports that the temperature is 40 degrees F and the humidity is 60% RH. Using the chart, we find specific humidity to be 25 gr./lb. If the temperature inside is 68 degrees F then, from the chart, the indoor relative humidity will be about 25%. This example illustrates why it feels so dry inside during the cold winter months.

Next, let us assume that the weatherman says it is 90 degrees F and 50% RH outside. And because your home is in the shade, your indoor temperature is 80 degrees F. Referring to the chart, we find the specific humidity to be 106 gr./lb. which, at the indoor temperature of 80 degrees, will yield an indoor humidity of 70% RH.

The previous examples show that if the specific humidity remains constant, then as the air temperature increases, the relative humidity decreases. Conversely, as the air temperature decreases, the relative humidity increases. This phenomenon explains why cellars tend to be wetter and attics tend to be drier than the rest of a building.

In modern buildings there are many factors besides air temperature that can influence humidity readings. One factor is the material used in the construction of the building. Many common building materials (i.e. wood, plaster, concrete) absorb and then release water vapor as the humidity varies. This causes the specific humidity to vary, which in turn causes the relative humidity to vary. Probably the single biggest factor affecting the humidity is heating and air conditioning systems. A heating system can increase or decrease the specific humidity. Air conditioning systems cause a decrease in the specific humidity. This decrease is because the cooling element in an air conditioner is very cold. From the chart, you can see that as air passes by the very cold element, its relative humidity increases rapidly. When the relative humidity reaches 100%, the water vapor condenses to liquid water. The removal of vapor by condensation causes a drop in the specific humidity.

Another factor affecting the indoor humidity is that many newer buildings incorporate humidifiers and/or dehumidifiers into the heating and air conditioning systems. We have had a number of customers who question why their hygrometers never change more than 10% RH. When we check the instrument calibration, we find it accurate. We then contact the customer and find out that their home has climate control. So, as it turns out, their hygrometer is simply indicating that their control system is controlling the relative humidity very well. The hygrometer, then, is a good indicator that all is well with their climate control systems.

With all of the aforementioned variables affecting humidity measurement, one might wonder, “How will I ever know if my hygrometer is reading correctly?” Well, there is an acceptable method of checking hygrometer accuracy that applies to all hygrometers.

First, you should place the instrument on a non-absorbent surface (i.e. glass or plastic, not wood) in the center of a small room. You should leave the unit there at least two hours before proceeding. Next, you must obtain an accurate instrument to compare against. The only commercially available instruments accurate enough to compare against are:

Instrument Type	Accuracy	Approximate Cost
Sling Psychrometer	+2.3% RH	$40-80
Aspirated Psychrometer	+1-2% RH	$100-200
Chilled Mirror Dewpoint	+0.5% RH	$1,000-5,000

Because of the high cost of the other two types of instruments, we will consider only the sling psychrometer. If you buy an official US Weather Bureau sling psychrometer, it will contain the proper operating instructions and tables for high accuracy usage. If the unit you obtain does not contain tables for various pressures, then you should obtain the official pamphlet from the Superintendent of Documents at the US Government Printing Office.

The pamphlet's name is *"Psychrometric Tables for Obtaining the Vapor Pressure. Relative Humidity and Temperature of Dewpoint from Readings of the Wet and Dry Bulb Thermometer, No. 235, Reprint 1941"*: by C.E. Marvin.

The calibration check is made by swinging the psychrometer as close as possible to the instrument under test. You should swing the psychrometer at a rate of two revolutions per second for at least one minute. The readings of the wet and dry bulbs should then be recorded and the procedure repeated until at least two consecutive identical readings are obtained. You should then record the hygrometer's reading, making sure the unit is in the vertical position and lightly tapping the instrument. Also record the time of observation. Now following the instructions supplied with the tables, determine the % RH and record it. Because of the relatively slow response of most hygrometers compared to a psychrometer, you need to repeat the checking procedure every 15 to 30 minutes until the psychrometer and hygrometer readings are stable (usually within an hour).

Now that you have your comparative data, you must take into account the specified accuracy of **both** instruments. As an example, we will use our COMFORTMINDER compared to an official weather bureau psychrometer. The COMFORTMINDER has a rated accuracy of ±5% RH from 20 to 80% RH. The psychrometer is accurate to ±2% RH from 0 to 100% RH. So, if the psychrometer reads between 20 and 80% RH, then the two instruments should read within 7% RH of each other. If, however, the humidity is below 20% or above 80%RH, then no comparison can be made because it is outside of the COMFORTMINDER'S accurate range. The seven percent span is derived by adding the ± tolerances together, ±5% and ±2% = 7% (i.e. the COMFORTMINDER reads +5% and the psychrometer reads –2%, then the difference is 7% RH). This shows us that if you were to compare two COMFORTMINDERS they could read as much as 10% RH different and still be within calibration tolerances.

In conclusion, humidity measurement is one of the most difficult and least understood environmental measurements made. We hope that this essay has helped you to understand humidity and its measurement. However, this is far from a complete explanation, in fact, there is a branch of the sciences called Hygrometry that deals with humidity measurement. If you want more detailed information, please refer to the publications listed below:

Introduction to Meteorology
Author – Sverre Petterssen, PHD
Publisher – McGraw Hill, Inc.
New York, NY
Library of Congress #68-15476

A Field Guide to the Atmosphere
Authors – Vincent J. Schaefer and
John A. Day
Publisher – Houghton Mifflin Co.
Boston, MA
Library of Congress #80-25473
ISBN #0-395-33033-5

Climate and Weather
Author – Hermann Flohn
Publisher – McGraw Hill, Inc.
New York, NY
Library of Congress #67-22978

Instruments for Physical Environmental Measurements, Vol. I 2nd Edition
Authors – J.Y. Wang and C.M.M. Felton
Publisher – Kendall/Hunt Publishing
Dubuque, IA
Library of Congress #83-81613
ISBN #0-8403-3098-7

Humidity and Moisture, Vol. I to IV
Publisher – Reinhold Publishing Corp.
New York, NY
Library of Congress #65-13613

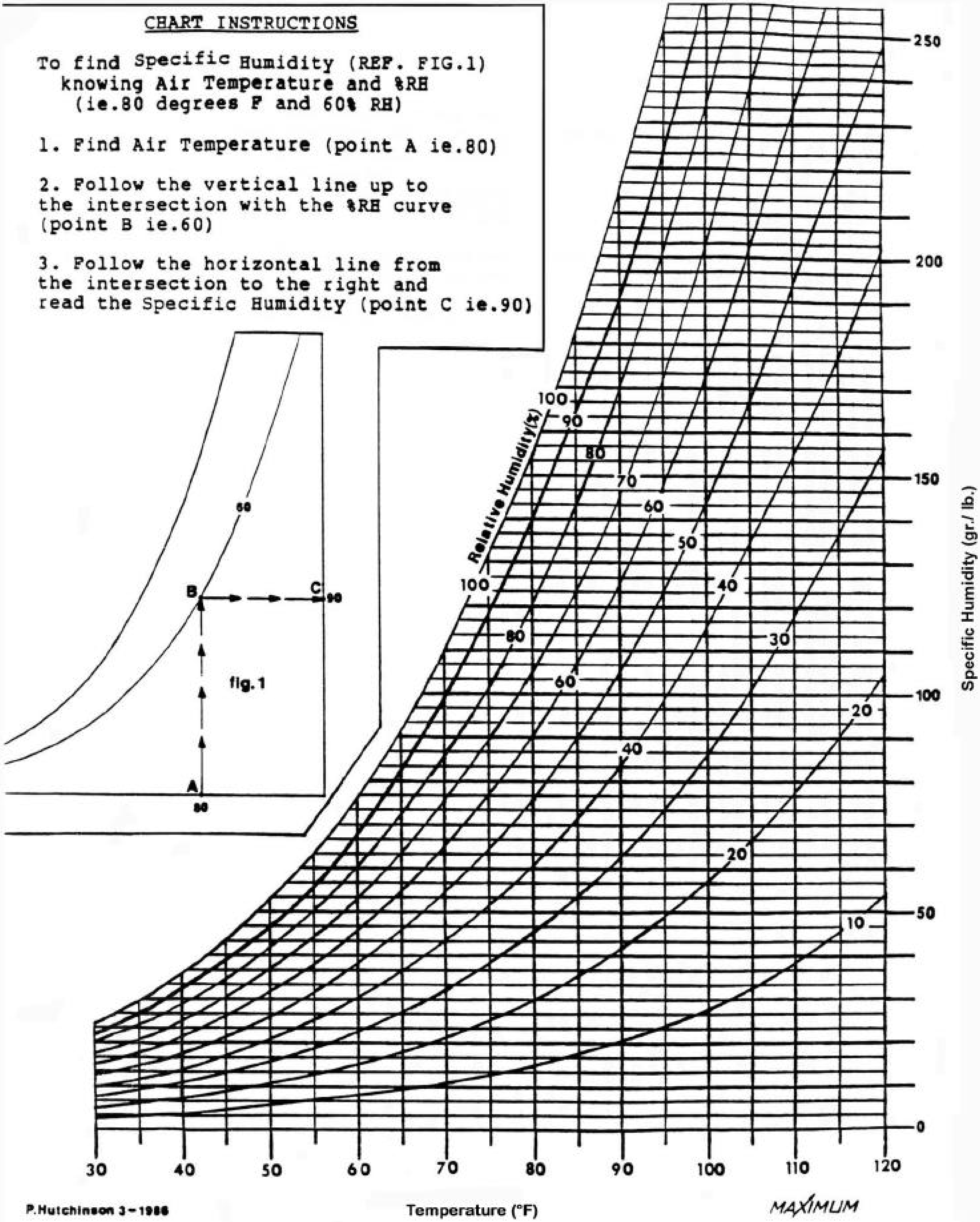
CHART INSTRUCTIONS

To find Specific Humidity (REF. FIG.1)
knowing Air Temperature and %RH
(ie.80 degrees F and 60% RH)

1. Find Air Temperature (point A ie.80)

2. Follow the vertical line up to the intersection with the %RH curve (point B ie.60)

3. Follow the horizontal line from the intersection to the right and read the Specific Humidity (point C ie.90)



P.Hutchinson 3-1986

MAXIMUM

IMPORTANT ADDITIONAL INFORMATION

Components: Along with the indicator, the following components are included with this instrument:

Brass Case: Your brass case is solid brass A70-30 Holloware quality, with a durable lacquer finish. It is in fact a piece of jewelry and should be treated as such. It should be cleaned at least once a week to keep airborne pollutants (dust, etc…) and any moisture from collecting on the case thereby attacking the lacquer. At no time should you use an abrasive cleaner or cloth on the brass case. Simply use a soft cloth or soft paper towel with a mild glass cleaner to wipe the case clean. If your instruments are in a summer home, and you are not able to clean them regularly, simply lay a small cloth or towel across the top two-thirds so that dust cannot settle on the finish.

Specifications: All instrumentation or measuring devices have accuracy tolerances and specifications. Making comparisons between different pieces of equipment is appropriate provided the specified accuracies of both are known.

	Measurement Range	**Guaranteed Accuracy**
Temperature	10 - 110°F	±2°F
Relative Humidity	10 – 100% RH	±5% RH (20-80% RH)