Sensing and Controlling Humidity

In the energy control business it is usually necessary to monitor humidity, as well as temperature. Sensing humidity cannot be done as easily or as accurately as temperature sensing. For example, a temperature sensor in outside air will provide dependable service for the life of the mechanical equipment. A humidity sensor in outside air that must withstand temperatures from -20° to 100°F, as well as all sorts of pollution, may give dependable readings for only six months before it is destroyed or requires service. Outdoor humidity sensors require protection from the elements. Although a shield provides protection, an aspirated enclosure may provide the best solution.

What are Relative Humidity, Dew Point, Wet Bulb, and Enthalpy?

Relative Humidity is the most common unit for measuring humidity. RH is the ratio of actual water vapor in the air to the water vapor in saturated air at the same temperature. This is expressed as percent RH (%RH).

Dew Point is the temperature at which water begins to condense as the air is cooled. This is the 100% RH or saturated temperature. This temperature indicates the water vapor content in the air. Below 32°F (0°C) it is called the frost point. Dew point is frequently used in high humidity areas and is used for humidity calibration standards. Dew point is measured in °C or °F.

Wet Bulb Temperature is derived from a wetted temperature sensor in an air stream. Wet bulb is a measure of the total heat present in air. Relative humidity is determined by comparing the wet bulb temperature to the ambient (dry bulb) temperature. Wet bulb is measured in °C or °F.

Enthalpy is a measurement of the heat energy in the air. Enthalpy is a combination of sensible heat (air and water vapor) and latent heat (heat required for evaporation at dew point). Enthalpy can be determined by measuring the wet bulb temperature and comparing this value to an equivalent enthalpy value on a psychrometric chart. Enthalpy is measured in Btu/lb of dry air.

Why is the Relative Humidity so low in cold weather?

Warm air has the capacity to hold more moisture than cold air. 10,000 cubic feet of 70°F air can hold 80,500 grains of moisture. The same 10,000 cubic feet at 10°F can only hold 7,700 grains of moisture. If this air is heated to 70°F with no moisture added, it will still contain 7,700 grains of moisture. This air can hold 80,500 grains when saturated, so the relative humidity is less than 10% (drier than Death Valley in the summer).

Do not be alarmed when your electronic humidity sensor reads 15% when it's 10°F outside. The only reason it's not reading 10% is because of the small amounts of moisture given off by people and hygroscopic material.

How can you check the accuracy of your electronic humidity sensor?

Unless you have an industrial quality hygrometer, your electronic humidity sensor is probably more accurate than your test instrument, especially wet and dry bulb sling psychrometers. ±6-8% is about all you can expect from a sling, if you are lucky. In the comfort range of 65-75°F, a one degree error in reading the wet bulb can result in an error of 3-5% RH. Most slings don't even have 1° divisions on the thermometers. If you have serious doubts about the readings on your electronic sensors, the only answer is to borrow or purchase an accurate test standard such as the **HMK 20** or **HM34**.

What is the best location for the humidity sensor?

Sensing the return air is generally the most accurate method. If this is not possible, then locate the sensor next to the room humidity controller and/or the room thermostat.

Because changes in humidity are actually changes in vapor pressure, these changes are transmitted through the conditioned space much faster than changes in temperature. For this reason, multiple humidifiers in a large open room should be controlled by a single humidity controller. Controllers on each humidifier are generally set up on an on-off cycling pattern since the addition of humidity by one humidifier, affects the adjacent humidity controller almost instantly.

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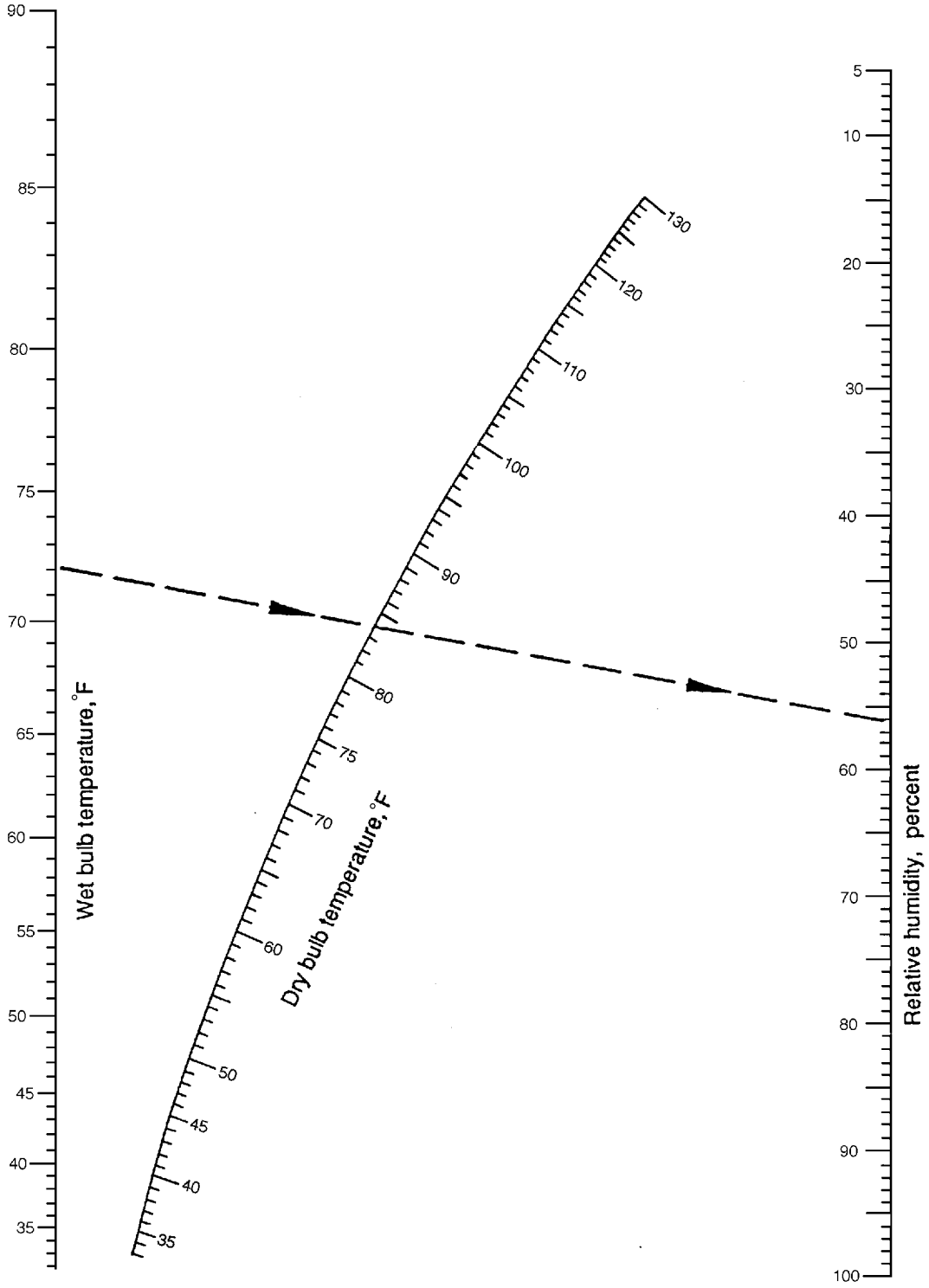
This Nomograph determines relative humidity faster than a psychrometric chart when wet and dry bulb temperatures are known. ***EXAMPLE***: With a wet bulb temperature of 72°F and a dry bulb of 84°F the broken line below indicates the Relative Humidity in this example would be 56%.



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