Directions for the Use of the
Kurtz Psychrometric Slide Rule

The Kurtz Psychrometric Slide Rule is employed to find all of the psychrometric values which are required in the solution of ordinary air-conditioning problems. Since it is based upon the standard barometric pressure of 29.92 inches of mercury (Hg), it serves as a convenient and accurate means for obtaining all of the values found in the usual psychrometric charts and tables.

The method of using the rule may be explained as follows:

The four fundamental factors in psychrometric problems are: dry-bulb temperature, wet-bulb temperature, relative humidity, and dewpoint temperature. Since the dry-bulb and wet-bulb temperatures are readily measured, the most common problem is to find the other factors when these two are known. However, whatever the known two factors may be, the others can be found rapidly by means of this slide rule.

Referring to the slide rule itself, it may be stated that scales 2 and 3 represent the two usually known factors—wet-bulb and dry-bulb temperatures. Both scales are in three separated sections, which will be designated as 2 and 3 **left**, 2 and 3 **center**, and 2 and 3 **right**, respectively. The section to be employed will depend entirely upon the measured dry-bulb temperature. That is, if the dry-bulb temperature does not exceed 75° F., the left sections of scales 2 and 3 must be employed; if it lies between 75° and 90° F., the center sections are to be used; and where the dry-bulb temperature exceeds 90° F., the right sections of scales 2 and 3 must be employed. This point is emphasized on the slide rule by an additional horizontal line on scales 2 and 3 over the dry-bulb temperature range for which the center and right hand sections are intended.

The general procedure is as follows:

Given: the dry-bulb and wet-bulb temperatures.

Required: the dewpoint temperature and relative humidity.

To the dry-bulb temperature on scale 2, set the dry-bulb temperature on scale 3.

At the wet-bulb temperature on scale 2, read the dewpoint temperature on scale 3.

To the dewpoint temperature on scale 6, set 100 on scale 5.

At the dry-bulb temperature on scale 6, read:

On scale 5, the percent of relative humidity.

On scale 8, the weight of dry air per cu. ft. of dry air at dry-bulb temperature.

The following values may be found directly from the dewpoint temperature:

To the dewpoint temperature on scale 6, set the hairline of the indicator.

Under the hairline of the indicator read:

On scale 7, the vapor pressure in inches of mercury (Hg).

On scale 9, the pounds of dry air per cubic foot of saturated air, at this temperature.

On scale 10, the grains of moisture per pound of dry air saturated with mois[illegible]

On scale 11, the grains of moisture per cubic foot of saturated air.

Since the sensible heat of the air is dependent only upon the dry-bulb temperature, it is found as follows:

To the dry-bulb temperature on scale 3, set the hairline of the indicator.

Under the hairline on scale 4 read the sensible heat of the air in B.T.U. per pound of dry air.

Since the total heat of the mixture is dependent only upon the wet-bulb temperature, it is found as follows:

To the wet-bulb temperature on scale 2 set the hairline of the indicator.

Under the hairline, on scale 1, read the total heat in B. T. U. per pound of dry air in a saturated mixture.

Given: the dry-bulb temperature and percent of relative humidity.

Required: the wet-bulb and dewpoint temperatures.

To the dry-bulb temperature on scale 6 set the percent of relative humidity on scale 5.

At 100 on scale 5 read the dewpoint temperature on scale 6.

To the dry-bulb temperature on scale 2 set the dry-bulb temperature on scale 3.

At the dewpoint temperature on scale 3, read the wet-bulb temperature on scale 2.

The other values are found as described under the preceding solution.

Given: the dewpoint temperature and percent of relative humidity.

Required: the wet-bulb and dry-bulb temperatures.

To the dewpoint temperature on scale 6 set 100 on scale 5.

At percent of relative humidity on scale 5, read the dry-bulb temperature on scale 6.

Find the wet-bulb temperature by the method given in the preceding solution.

Examples

Example 1.

Given: the dry-bulb temperature, 70° F., and the wet-bulb temperature, 60° F.

To 70 on scale 2 **left**, set 70 on scale 3 **left.**

At 60 on scale 2 **left**, read the dewpoint temperature, 53°.5 F., on scale 3 **left.**

To 53.5 on scale 6, set 100 on scale 5.

At 70 (dry-bulb temperature) on scale 6, read:

On scale 5, the percent of relative humidity, 56.

On scale 8, the weight of dry air per cu. ft. of dry air at 70° F., or 0.07495 lb.

To 53.5 (dewpoint temperature) on scale 6, set the hairline of the indicator.

Under the hairline of the indicator read:

On scale 7, the vapor pressure of the moisture, 0.412 in. Hg.

On scale 9, the weight of dry air per cu. ft. of saturated air at 53°.5 F., or 0.0763 lb.

On scale 10, the moisture per lb. of dry air, saturated with moisture at 53°.5 F., or 61 grains.

On scale 11, the absolute humidity of saturated air at 53°.5 F., or [illegible] grains of moisture per cu. ft. of saturated air.

To 70 (dry-[illegible]mperature) on scale 3, set the [illegible]airline of the indicator.

Under the hairline on scale 4 read the sensible heat, 16.9 B.T.U. per lb. of dry air.

To 60 (wet-bulb temperature) on scale 2, set the hairline of the indicator.

Under the hairline on scale 1, read the total heat, 26.2 B.T.U. per lb. of the mixture.

The total weight per cubic foot of partially saturated air can be found as follows:

From scale 9, the weight of dry air per cu. ft. of saturated air at the dewpoint temperature, 53°.5 F., was found to be 0.0763 lb; while from scale 11 the weight of moisture per cu. ft. of saturated air was found to be 4.65 grains.

The absolute dry-bulb temperature is 460+70 or 530° F; and the absolute dewpoint temperature is 460+53.5 or 513°.5 F.

(A pocket slide rule will greatly expedite the following calculations).

Consequently, the weight of dry air per cu. ft. of partially saturated air at 70° F. is

$$0.0763 \times \frac{513.5}{530} = 0.07392 \text{ lb.}$$

The weight of moisture per cu. ft. of partially saturated air at 70° F. is

$$4.65 \times \frac{513.5}{530.0} = 4.51 \text{ grains}$$

$$\frac{4.51}{7000} = 0.00064 \text{ lb.}$$

Hence, the total weight per cu. ft. of the partially saturated air is

$$0.07392 + 0.00064 = 0.07456 \text{ lb.}$$

Example 2.

Given: the dry-bulb temperature, 85° F., and the wet-bulb temperature, 75° F.

To 85 on scale 2 **center**, set 85 on scale 3 **center.**

At 75 on scale 2 **center**, read on scale 3 **center** the dewpoint temperature, 71° F.

To 71 on scale 6 set 100 on scale 5.

At 85 on scale 6 read on scale 5 the relative humidity, 63.1%.

Find all the other values as in example 1.

Example 3.

Given: the dry-bulb temperature, 96° F., and the wet-bulb temperature, 65° F.

To 96 on scale 2 **right**, set 96 on scale 3 **right.**

At 65 on scale 2 **right**, read on scale 3 **right** the dewpoint temperature, 44° F.

To 44 on scale 6 set 100 on scale 5.

At 96 on scale 6 read on scale 5 the relative humidity, 17%.

Example 4.

Given: the dry-bulb temperature, 83° F., and [illegible] dewpoint temperature, 50° F.

To 83 on scale 2 **center**, set 83 on scale 3 **center.**

At 50 on scale 3 **center** read on scale 2 **center** the wet-bulb temperature, 63° F.

To 50 on scale 6 set 100 on scale 5.

At 83 on scale 6 read on scale 5 the relative humidity, 32%.

Example 5.

Given: the dry-bulb temperature 80° F., and the relative humidity, 40%.

To 80 on scale 6, set 40 on scale 5.

At 100 on scale 5 read the dewpoint temperature, 53°.3 F., on scale 6.

To 80 (dry-bulb temperature) on scale 2 **center**, set 80 (dry-bulb temperature) on scale 3 **center.**

At 53.3 (dewpoint temperature) on scale 3 **center**, read the wet-bulb temperature, 63°.4 F., on scale 2 **center.**

Find the other values as in example 1.

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