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WINTER STEADY-STATE RELATIVE HUMIDITY AND MOISTURE LOAD PREDICTION IN DWELLINGS

K.R. Stum

ABSTRACT

With the increasing concerns about indoor air quality and energy use, of which relative humidity is a factor, it is important for building designers, heating contractors, and engineers to be able to predict what the interior relative humidity will be in houses. This allows the condensation risk and the health and energy considerations associated with moisture to be properly addressed. There is a need for a convenient model for residential relative humidity prediction.

A model for predicting the average steady-state winter interior relative humidity in dwellings has been developed. All required input variables have been defined and methods for their quantification outlined. A method for estimating the occupant moisture generation value other than the generic "family of four" value has been created as part of the model. Also, the ASHRAE equation for calculating the humidifier moisture load in dwellings has been enhanced by providing a table and a curve-fit equation for finding the monthly outside absolute humidity for more than 300 sites in the United States. In addition to the complete "equation form" models, nomographs have been created for relative humidity prediction and load calculation, which provide a very convenient, yet accurate, method of solution.

INTRODUCTION

The interior relative humidity in houses during winter affects the well-being and health of the occupants. Health complications from bacteria, viruses, and asthma increase with low and with high interior relative humidities (Sterling et al. 1985). Respiratory infections increase with low humidities, and fungi and mite growth increase with high humidities (Sterling et al. 1985; Kelly 1982). Noxious odor perceptions and formaldehyde emissions increase with higher relative humidities. With higher relative humidities, structural integrity may be damaged from mildew, peeling paint, rotting wood inside insulated cavities, and condensation on windows. During winter, maintaining a high relative humidity will increase the cost of space heating (Kelly 1982).

Depending on which of the above factors has priority, the optimum interior relative humidity during winter in dwellings may be as low as 30% or as high as 60%. It is important for designers, HVAC contractors, and engineers to be able to predict what the relative humidity will be in a dwelling. This allows the above factors to be optimized with regard to occupant health and comfort, structural integrity, and energy use. For example, by knowing that the relative humidity would be too high, the designer or engineer can recommend mechanical dehumidification, increasing point-of-source spot ventilation and using window and wall designs that are more resistant to condensation, better vapor retarders and airtightness design, higher ventilation rates, and a sensible-only heat recovery ventilator rather than an enthalpy type. Converse choices can also be intelligently made if the relative humidity is projected to be low.

Methods are available for predicting the monthly average interior relative humidity. However, from a study of available sources, none of the equations for this prediction is in a readily usable form for most designers, contractors, and engineers. Some variable values needed for input in these equations are not directly available to the typical user, requiring research of meteorological and thermodynamic tables to find them (Tenwolde 1987; Boyd et al. 1988; Kronvall 1986; ASHRAE 1988). Other equations are transient dynamic methods (Tenwolde 1987; Barringer and McGugan 1989a), not intended for monthly or seasonal averages, and require computers for generating the solution.

The only equation available in a widely read manual is that found in *ASHRAE Equipment* (ASHRAE 1988, Chapter 5, Equation 1). Its use requires knowing the outside absolute humidity, ω_o. Monthly or seasonal absolute humidity values are not directly available in tabular form. However, ASHRAE does give a typical ω_o value to use for the entire U.S. Since the equation is actually intended for load calculations and not for relative humidity predictions directly, this default value may be acceptable for rough equipment sizing. However, Figure 1 illustrates how large errors will occur if a universal outside ω_o value is assumed when predicting interior relative humidity. Figure 1 compares the interior relative humidity prediction for various sites across the upper half of the United States for a typical dwelling and occupancy scenario. The "universal" value for outside absolute humidity offered by ASHRAE equates to Salt Lake City

Karl R. Stum is a program consultant at Portland Energy Conservation, Inc., Portland, OR.

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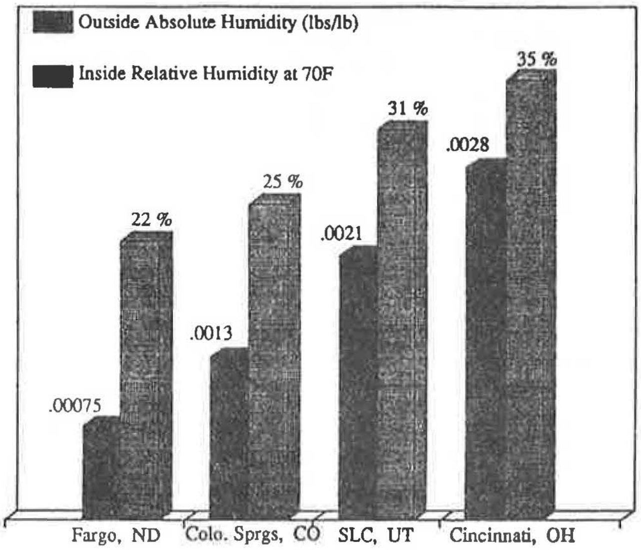


Figure 1 ***Outside moisture vs. inside relative humidity (based on a typical scenario in January).***

and results in an inside relative humidity of 31%. Using this ω_o value in a drier climate, such as Fargo, North Dakota, would again result in a prediction of 31%, overpredicting the humidity by 9 humidity points (%) from a prediction using the actual site's absolute humidity. In Cincinnati it would underpredict the relative humidity by 4 points.

The ASHRAE equation "as is" in *Equipment* is intended for humidifier load calculation. It is not in the form to give the interior relative humidity without major algebraic manipulation and thermodynamic conversion; thus it is not in a usable form for this purpose.

The other main weakness of the published methods is that they offer no way to determine an input value for the interior moisture generation from occupants unless one is dealing with a "family of four."

OBJECTIVE

It is the objective of this paper to present the development of a model to predict monthly average steady-state winter interior relative humidity in dwellings. For use with the model, a table of outside air moisture content values (dew-point temperatures) for 300 sites across the United States will be provided as well as a model of interior moisture generation for dwellings with 1 to 10 occupants. In addition, a humidifier load prediction method will also be provided. These prediction methods will be given in useful nomograph form as well as by equations with required curve fits for use with computers.

MODEL DEVELOPMENT

Interior relative humidity is a function of the following variables: the number of occupants and the amount of moisture they generate, other interior moisture sources (diffusion from soil under the house, indoor plants, gas combustion), the volume of the house, the air change leakage rate of air into and out of the house, the amount of moisture in the outside air (the absolute humidity), moisture recovery from any heat recovery ventilators, and for transient hourly predictions, vapor diffusion through the structure shell to the outside and the amount of moisture absorbed and released by building components.

Vapor diffusion through the structure shell to the outside is proportionately small enough to be neglected (Tenwolde 1987; ASHRAE 1988). The moisture storage effects into the building components (absorption and desorption) necessary for dynamic simulations can be ignored for monthly average steady-state predictions (Tenwolde 1987, 1990; Barringer and McGugan 1989).

Base Equation

The accepted ASHRAE equation for humidifier load calculations, a simple mass balance relation (ASHRAE 1988, Chapter 5, Equation 1) was chosen over other available forms since the ASHRAE equation required looking up fewer values from meteorological tables. Also, after manipulation, the ASHRAE equation will take into account elevation and specific volume differences between inside and outside air. The ASHRAE equation was solved for the interior relative humidity, with the humidifier load and diffusion and storage losses set to zero. Also, the specific volume was separately applied to the outside and inside air, rather than using an average. The derivation follows:

ASHRAE Equation 1:

$$Q_m = (VAc/\nu)(\omega_i - \omega_o) - Q_g + D. \tag{1}$$

With Q_m and $D = 0$, using ν_i and ν_o instead of an average ν, and solving for ω_i, Equation 1 becomes

$$\omega_i = (Q_g \nu_i / VAc) + (\nu_i \omega_o / \nu_o). \tag{2}$$

The standard thermodynamic relations (ASHRAE 1989),

$$\omega_i = .622\, P_w/(P - P_w) \tag{3}$$

$$P_w = \phi P_{ws} \tag{4}$$

$$\mathrm{RH} = 100\phi \tag{5}$$

when combined and solved for ω_i and substituted into Equation 2, which is then solved for RH_i, yield:

$$\mathrm{RH}_i = 100P\{(Q_g \nu_i/(VAc)) + \omega_o \nu_i/\nu_o\}/\{P_{wsi}((Q_g \nu_i/(VAc)) + (\omega_o \nu_i/\nu_o) + .622)\}. \tag{6}$$

Equation 6 is the basis for average monthly relative humidity prediction in this paper.

Determination of Base Equation Input Values

The values needed in order to use Equation 6 in predicting the monthly average interior relative humidity in winter are now given. This detailed prediction method takes into account elevation and different specific volumes between inside and outside air. These factors are not extremely significant but cause no trouble for computation by computer.

From the relation $Pv = RT$ for dry air, the specific volume v of the inside and outside air for the respective monthly average temperatures is found by

$$v = 0.3738(t + 460)/P. \tag{7}$$

It is noted that Equation 7 for dry air will give specific volumes within 1% of those from the more complex relation required to account for the actual moist air being considered.

The total pressure P is given by a curve fit as a function of altitude from Table 3, Standard Atmospheric Data (ASHRAE 1989):

$$P = 14.7077(0.999963^{(Alt)}). \tag{8}$$

(Technically P and v cannot be found independently as per Equations 7 and 8 but would require iterating to come to convergence. However, the error is negligible for this application.)

The inside saturation vapor pressure P_{wsi} is a function of inside temperature. Table 2, Thermodynamic Properties of Water at Saturation (ASHRAE 1989), has been curve fit:

$$P_{wsi} = 0.0066t^{0.4996}(1.0272^{t}). \tag{9}$$

This curve-fit equation is the dew-point temperature curve vs. the absolute humidity values on the standard psychrometric chart. The outside absolute humidity ω_o in Equation 6 is given as a function of outside mean dew-point temperature t_d, since the average monthly dew-point temperatures for many sites across the United States are compiled in meteorological tables but ω_o values are not. Equation 10 is a curve fit of ω_o vs. t_d from Table 1, Thermodynamic Properties of Moist Air (ASHRAE 1989). The curve fit was possible because the table gives the absolute humidity at saturation for the given dry-bulb temperature, which is the corresponding dew-point temperature. Dew-point temperatures are found in Table 2 in the appendix.

$$\omega_o = 0.1978\ e^{\wedge}(((t_d - 213.82)^2)/(-8286.82)). \tag{10}$$

The interior house volume V is computed by standard means: floor area times ceiling height. The air exchange rate Ac between the inside and outside varies considerably depending on the general geographical area, local conventional practice, and the particular builder. As a general rule, *new* dwellings in the upper half of the United States will have an average winter rate of about 0.4 to 0.7 air changes per hour (ach). This includes all sources of air change—natural leakage and mechanical and occupants' effects. ASHRAE (1988) assumes somewhat higher air change rates than this, but the author's own experience and considerable research on the subject (Stum 1987) give more support to the lower values. Canadian houses are built somewhat tighter. However, any houses built with a natural air exchange rate below 0.3 ach are normally fitted with ventilation systems that keep the total exchange rate between 0.3 and 0.5 ach.

If the house is going to have a heat recovery ventilator (HRV) that reclaims moisture from the outgoing airstream, the total air change Ac in Equation 6 should be substituted with Ac_{net} to account for this reduction in moisture loss from air exchange:

$$Ac_{net} = Ac - (Ac_{HRV}f) \tag{11}$$

where f is the fraction of the moisture recovered from the outgoing airstream by the HRV, typically about .5 to .7 (Tech. Note 1983; Barringer and McGugan 1989b).

Moisture Generation Model

The overall value for interior moisture generation Q_g is generally given only for a family of four, or it is listed individually by moisture generated per activity. A convenient model for other than four occupants was needed. Using moisture generation values itemized per activity from a number of sources (Boyd et al. 1988; Kronvall 1986; ASHRAE 1988; Hill 1988; Stum 1990) and from a frequency of activity survey (Aslam 1985; BPA 1989), Table 1, found in the appendix, was generated from which moisture generation values Q_g can be taken. A curve fit of the table is also provided. These curve fits (Equations 14, 15) on the bottom of the table do not account for moisture release from combustion of gas in ranges and gas dryers. Refer to the notes at the bottom of the table for values for those sources.

The equations do account for moisture transfer from an average-sized basement, well damp proofed in dry soil, with a vapor retarder on the inside of concrete walls and under concrete floors. Moisture diffusion through basement walls and slab floors and from crawl spaces is a function of soil type and water content, exterior damp proofing, interior vapor retarders, basement size, and interior relative humidity. All these factors have yet to be combined into a versatile, reliable model. Therefore, the soil diffusion value included in Table 1 and used in the nomographs is a minimum value. Variance from these "dry" soil interface conditions may require increasing the moisture generation rate by up to an additional 3 lb/h (Barringer and McGugan 1989a,b).

All the variables used in Equation 6 have now been defined and their value determination given. The site altitude, inside and outside average monthly temperatures, house volume, average air change rate, interior moisture generation rate, and the outside monthly mean dew-point temperature are the input values, along with Equations 7 through 11, needed to solve Equation 6.

Humidifier Moisture Load Calculation

Equation 1 from ASHRAE (1988, Chapter 5) is used as the basis for determining the load on a residential humidifier Q_m when a given interior relative humidity is desired. With the diffusion to the outside and the storage term equal to zero, and by using Equations 3, 4, and 5 herein, and by assuming a 70°F (21°C) inside temperature and a 2,000-ft (600-m) elevation, solving Equation 1 herein for Q_m gives

$$Q_m = VAc\{(0.0156\phi_i/(13.7 - 0.3633\phi_i)) - \omega_o/13.55\} - Q_g. \qquad (12)$$

Equation 12 is now in a convenient form. The source for the variable inputs was explained previously.

GRAPHIC SOLUTIONS

Nomographs were created for convenient solutions to relative humidity and moisture load predictions. In order to simplify Equation 6 sufficiently to make it convenient for nomographs, some of the variable terms had to be given constant values. For all the graphs (relative humidity and load prediction), an elevation of 2,000 ft (600 m), an outside temperature of 35°F (1.7°C), and an inside temperature of 70°F (21°C) were assumed. A sensitivity analysis was performed for setting these conditions. Elevation changes of 2,000 ft (600 m) either way from the base 2,000 ft (600 m) will only change the relative humidity about 1 relative humidity point (1%). An outside temperature of 0°F (−18°C) will alter the solution by about the same amount. Therefore, these assumptions will yield negligible errors for residential conditions throughout the U.S. and Canada. However, for predicting relative humidities with an inside temperature other than 70°F (21°C), a corrected RH value can be obtained by using the RH value at 70°F (21°C) with a psychrometric chart, keeping the absolute humidity constant.

Interior Relative Humidity Prediction Nomograph

The above assumptions applied to Equation 6 yield the simplified equation

$$RH_i = 3766.41\{(Q_g/(VAc)) + \omega_o/13.55\}/\{(Q_g/(VAc)) + (\omega_o/13.55) + 0.0429\}. \qquad (13)$$

Equation 13 requires the inputs of the moisture generation, volume, air change rate, and outside mean dew-point temperature.

To create the nomograph, four graphs (Figure 2) were fit to Equation 13 including a moisture generation vs. occupants graph generated from Table 1. The ω_o value in the equation was curve fit as a function of outside mean dew-point temperatures, which are found in Table 2 in the appendix. The dew-point temperature can also be found for any given condition using the standard psychrometric chart. Note the special directions and assumptions at the bottom of the figure and in Table 1. Graph 1 of the nomograph assumes that there is no humidifier operating and that the concrete and wood in the structure are past their initial drying (typically 12 to 18 months [Quirouette 1984]). If this is not the case, increase appropriately the moisture generation rate used in the nomograph. It is noted that by trying different air change rates, the nomograph can also be used to determine the air change rate required to maintain a desired interior relative humidity. This can be useful when trying to maintain a relative humidity by adjusting the mechanical ventilation rate.

Humidifier Load Calculation Nomograph

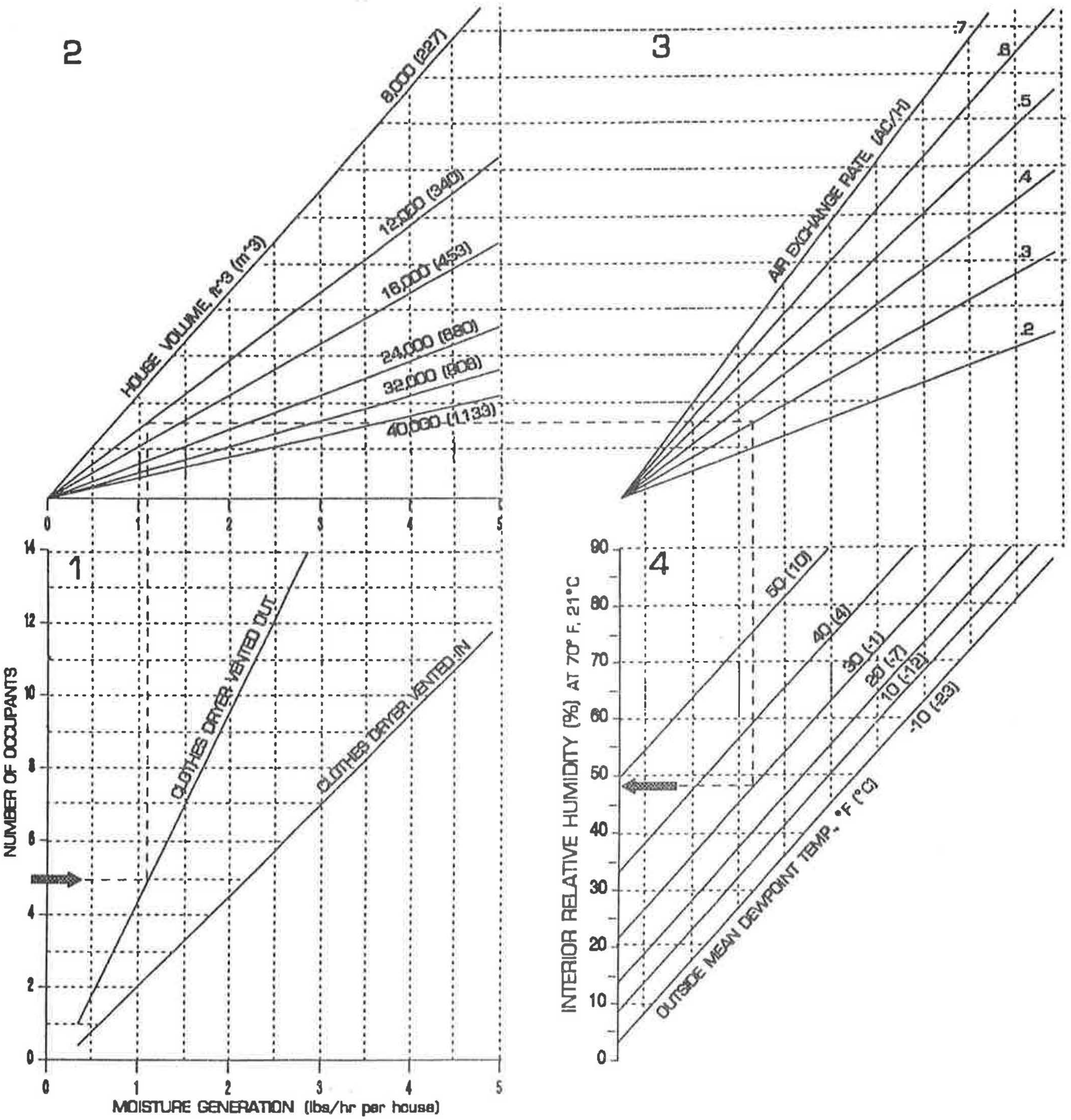
Four graphs (Figure 3) were fit to Equation 12 for calculating the moisture load required from a humidifier. From Table 2 in the appendix, the lowest monthly dew-point temperature for the site should be used. A coincidence used to simplify Graph 4 is that the moisture generation difference between the dryer vented out and vented in is very close to the moisture generation difference when the number of occupants is doubled. Graph 4, as is, is for the clothes dryer-vented-out case. To evaluate a dryer-vented-in case, simply double the number of occupants. The nomograph in Figure 3 can actually be run backward to predict the interior relative humidity, if the humidifier moisture is at zero. However, it does not give the flexibility for being able to see what the actual occupant moisture generation rate is, as do the graphs in Figure 2.

MODEL APPLICATIONS AND LIMITATIONS

As detailed in the introduction, the model will be useful to HVAC engineers and contractors for predicting what the average relative humidity or humidifier load will be in dwellings. The nomographs will be especially convenient for rapid analysis.

The model is based on simple, accepted mass balance relationships. However, the interior moisture generation rate (especially the basement soil diffusion component) and the air exchange rate are two input variables that can be difficult to predict accurately.

The model will give the total dwelling monthly average relative humidity. The actual dwelling will have hourly and daily fluctuations in relative humidity, from the monthly average, on the order of ±7% RH (e.g., 30% to 37% [Tenwolde 1987; Barringer and McGugan 1989a]), due primarily to the fluctuations in interior moisture generation. In addition, the actual realized relative humidity variation from room to room during a given day may be even greater. This is especially true for basement areas that may have significantly higher humid-

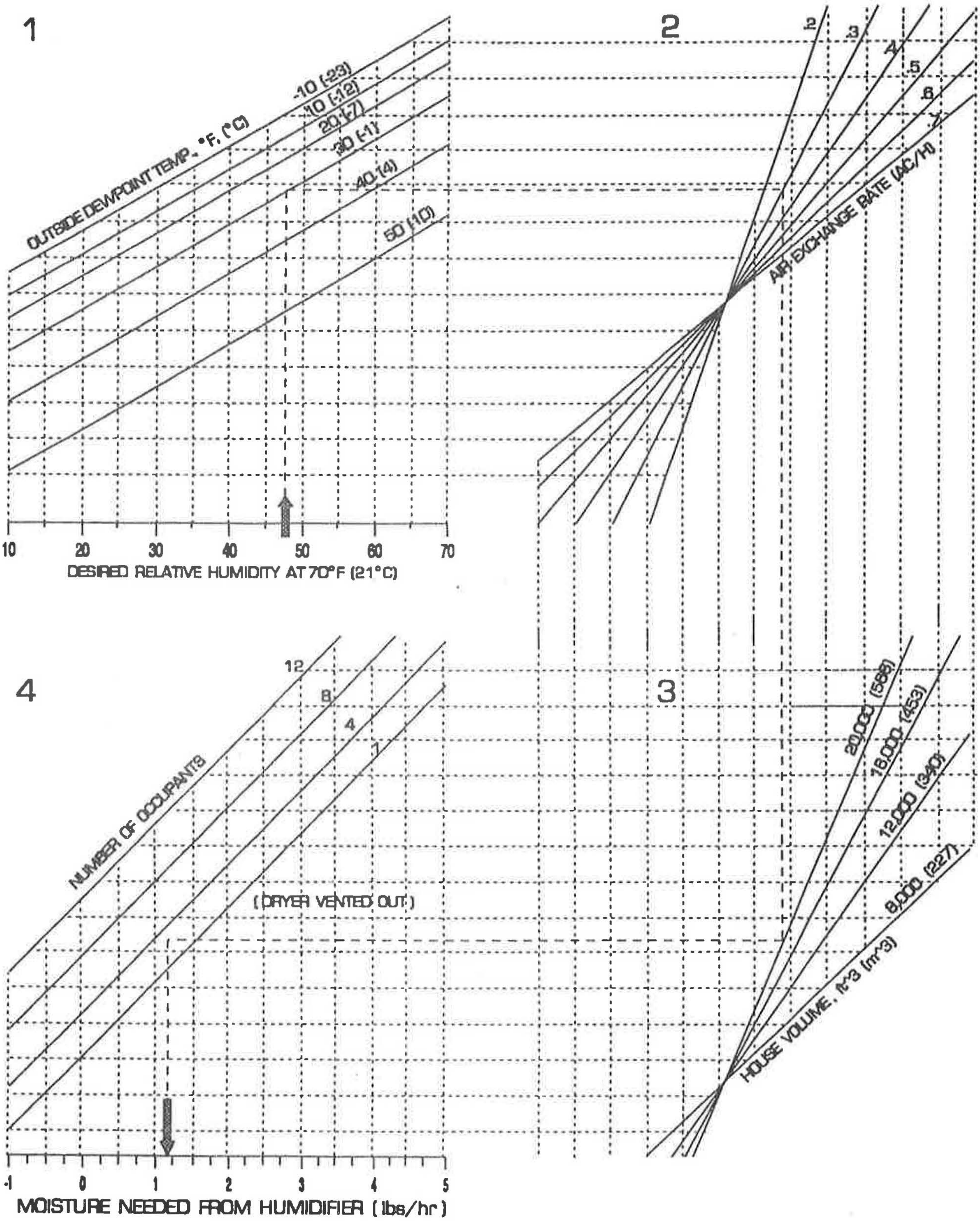


DIRECTIONS: Choose the number of occupants on vertical axis of Graph 1, with a straight edge go right to Dryer line, up to Graph 2 and the House Volume, right to Graph 3 and the Air Change Rate, down to Graph 4 to the Outside Dew-Point Temperature (from Table 2), and left to the Relative Humidity.

Notes:

1. Graph 1, Moisture Generation Rate, is based on Table 1 and assumes dry soil conditions and a vapor retarder under the basement floor and on the inside of the basement foundation walls. Refer to Table 1, and if necessary adjust the moisture generation value and use with the nomograph by disregarding the number of occupants and going up on Graph 1 from the appropriate moisture generation rate.
2. If the house has a heat recovery ventilator that recovers moisture, the total air exchange rate used on Graph 3 should be lowered by the air change rate contribution of the ventilator multiplied by the fraction of moisture recovered from the outgoing airstream (typically about 50% to 70%). See Equation 12.

Figure 2 Residential steady-state relative humidity prediction.



DIRECTIONS: Choose desired Relative Humidity on Graph 1, bottom side. With a straight edge, go up to the Outside Dew-Point Temperature, right to Graph 2 and the Air Exchange Rate, down to Volume on Graph 3, left to Number of Occupants on Graph 4, and down to Humidifier Load. If the house volume is larger than 20,000 ft^3 (566 m^3), divide the actual Volume in half, find the Humidifier Load, then multiply it by 2. For a dryer-vented-in case, just double the actual number of occupants. Refer to the notes on the Relative Humidity Prediction nomograph.

Figure 3 Residential steady-state humidifier load.

ities than the balance of the house if the soil is damp or if the exterior damp proofing is poor or if there is no vapor retarder under the concrete slab floor and inside the concrete walls. For moisture or condensation risk assessment, these factors should be considered as well as using good judgment as to where the largest moisture contributions are coming from and where the most likely condensing surfaces are located.

The model assumes a home that is at least 18 months old. For average-sized dwellings less than 18 months old, up to 9 lb of moisture per day can be released from curing concrete foundations and floors and from drying lumber (Quirouette 1984). This is not accounted for directly in this model but could be by changing the moisture generation value accordingly. Wet-spray cellulose insulation can also contribute moisture during its approximately one-year drying time.

Due to moisture storage phenomena in the building materials not being taken into account, in cold dry climates with hot summers the model will give slight underpredictions of interior humidity for the early winter months and slight overpredictions for the late winter months (Tenwolde 1990). This occurs because the structure is somewhat "dry" coming into the winter (Sherwood 1983)—summer heat usually dries the structure—and thus it absorbs airborne moisture that would otherwise contribute to the relative humidity. The situation reverses when coming out of the winter, with the structure now holding more moisture and releasing it to the air inside the dwelling, thus increasing the relative humidity above that predicted by the model. These fall and spring prediction errors are expected to be less than 5% RH. For areas that have humid, mild summers with less drying potential, the previous scenario may be reversed. The model will give summer interior relative humidity predictions if the moisture added or removed due to any air conditioning is accounted for in the Q_g term.

MODEL VALIDATION

Ten dwellings in Utah have been spot checked with a sling psychrometer for interior relative humidities during the winter. The houses had "known" air exchange rates from pressurization tests and covered a wide range of sizes and occupancy numbers. The measured values were compared with the model and found to agree quite well. However, the low frequency of spot checking along with other varying conditions needing to be more closely monitored require a more thorough and complete sampling for actual model validation.

CONCLUSION

A model for predicting the average steady-state winter interior relative humidity in dwellings has been developed. All required input variables have been defined and methods for their quantification outlined. A model for occupant moisture generation other than the "family of four" has been created as part of the model. Also, the ASHRAE equation for calculating humidifier moisture load in dwellings has been enhanced by providing a table and a curve-fit equation for finding the outside absolute humidity for more than 300 sites in the United States. In addition to these "equation form" models, nomographs have been created for relative humidity prediction and load calculation that provide a very convenient, yet accurate, method of solution. Results from the model have been compared to measured humidities from a small sample of dwellings in Utah and found to agree quite well. However, a more thorough validation with a larger data set is needed.

NOMENCLATURE

Ac = total air change rate between inside and outside (h^{-1})
Ac_{net} = air change rate between inside and outside after being reduced to account for moisture reclamation of a heat recovery ventilator (h^{-1})
Ac_{HRV} = air change rate between inside and outside of a heat recovery ventilator (h^{-1})
Alt = altitude above sea level (ft)
D = diffusion of moisture through solid building components from inside the structure to the outside (lb/h)
f = fraction of moisture recovered from the outgoing airstream in a heat recovery ventilator
P = total atmospheric pressure (psi)
P_w = partial pressure of the water vapor in the air (psi)
P_{ws} = pressure of saturated pure water (psi)
P_{wsi} = pressure of saturated pure water at inside air temperature, °F (psi)
ϕ = relative humidity ratio
Q_m = moisture load on the humidifier (lb/h)
Q_g = moisture generation from sources other than the humidifier, e.g., occupants, etc. (lb/h)
R = universal gas constant for dry air (53.35 ft·lbf/lbm·°R)
RH_i = relative humidity of inside air (%)
t = temperature (°F)
t_d = dew-point temperature (°F)
T = absolute temperature in Rankine
ν = specific volume of air (ft^3/lb dry air)
ν_i = specific volume of the inside air
ν_o = specific volume of the outside air
V = inside volume of the dwelling (ft^3)
ω = absolute humidity (lb moisture/lb dry air)
ω_i = absolute humidity inside the dwelling
ω_o = absolute humidity of the outside air
^ = power operator

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APPENDIX

TABLE 1
Interior Moisture Vapor Generation in Residences

	Moisture Generation (lbs of vapor/day per household)									
	Number of Occupants per Household									
Moisture Sources	1	2	3	4	5	6	7	8	9	10
1. Human Metabolism	3.2	6.4	9.6	12.8	16.0	19.2	22.4	25.6	28.8	32.0
2. Bathing (shower)	.5	1.0	1.2	1.6	2.0	2.4	2.8	3.1	3.5	3.9
3. Cooking (elec.)	2.0	2.5	3.0	3.2	3.5	3.7	4.0	4.3	4.5	5.0
4. Dishwashing	.6	.7	.8	.9	.9	1.0	1.2	1.4	1.6	1.8
5. Floor Mopping	.3	.3	.3	.3	.4	.4	.4	.4	.4	.5
6. Clothes Washing	.4	.8	1.1	1.4	1.8	2.1	2.5	2.9	3.2	3.6
7. Clothes Drying										
elec., vented in	6.0	10.7	16.1	21.4	26.8	32.1	37.5	42.9	48.2	53.6
vented out	.3	.5	.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7
8. Plants (8 x .15)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
9. Soil Under House	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Day Totals (lbs/day per household)									
Dryer Vented In	16.7	26.1	35.8	45.1	55.1	64.6	74.5	84.3	93.9	104.1
Dryer Vented Out	11	15.9	20.5	24.8	29.6	34.1	38.9	43.5	48.1	53.7
	Hourly Averages (lbs/hr per household)									
Dryer Vented In	.7	1.1	1.5	1.9	2.3	2.7	3.1	3.5	3.9	4.3
Dryer Vented Out	.45	.66	.85	1.0	1.2	1.4	1.6	1.8	2.0	2.2

Dryer vented in: lbs/hr = 0.293 + 0.4014 x occupant number (Eq. 14)
Dryer vented out: lbs/hr = 0.257 + 0.1932 x occupant number (Eq. 15)

Table 1 is based on surveys of occupant routines from Ref. 14 and from moisture generation data interpolated and extrapolated from Ref's. 5, 6, 7, 12; 13.

OTHER SOURCES OF INTERIOR MOISTURE:

1) BASEMENTS: Number 9 above assumes an average size house (~1500 ft^2, 140 m^2), good dampproofing dry soil and a vapor retarder on the inside of walls and under concrete floors. Changing these conditions can allow moisture diffusion from the soil of up to 3 lbs/hr (Ref. 4;17).
2) COMBUSTION OF NATURAL GAS IN COOKING STOVES will give off a 24 hr. average of .05 to .1 lb of moisture into the air depending on the number of occupants and use (Ref. 5, 7; 16).
3) COMBUSTION IN GAS DRYERS will give off a 24 hr. average of .02 to .12 lbs/hr depending on use.

TABLE 2
Mean Dew-Point Temperature (°F)

Weather Atlas of the United States. 1968. U. S. Department of Commerce, pp. 159-160. Detroit:Gale Research Co..

STATE AND STATION	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
ALA. BIRMINGHAM	20	36	37	41	49	58	66	69	68	62	52	41	36	51
MOBILE	20	44	45	48	57	64	70	72	72	68	57	48	44	57
MONTGOMERY	20	39	40	44	53	61	68	71	70	65	54	43	39	54
ALASKA ANCHORAGE	10	8	11	12	24	33	43	48	48	41	25	14	7	26
ANNETTE	10	29	29	30	35	40	47	51	52	48	41	34	31	39
BARROW	10	-23	-27	-26	-9	16	30	35	35	28	11	-8	-22	3
BARTER ISLAND	9	-23	-26	-26	-7	18	31	36	37	29	12	-8	-20	4
BETHEL	10	1	2	4	14	33	43	48	48	41	25	11	-5	22
COLD BAY	10	25	24	24	28	35	41	46	47	44	35	30	25	34
CORDOVA	9	21	24	22	31	38	45	49	49	43	34	27	23	34
FAIRBANKS	10	-15	-9	-2	19	32	44	49	48	36	18	-4	-18	17
JUNEAU	10	20	23	23	32	38	45	49	49	45	38	30	23	35
KING SALMON	10	9	11	13	24	34	42	47	48	42	27	16	5	27
KOTZEBUE	10	-8	-11	-7	7	27	39	47	47	36	16	1	-12	15
MCGRATH	10	-12	-8	-2	16	30	42	47	46	37	18	-3	-17	16
NOME	10	0	-2	2	13	29	39	45	45	37	21	9	-5	19
ST. PAUL ISLAND	10	23	19	21	25	32	38	44	45	42	34	29	24	31
SHEMYA	7	28	27	29	31	35	40	45	46	44	36	30	28	34
YAKUTAT	10	23	25	25	32	38	46	50	50	46	37	29	24	35
ARIZ. FLAGSTAFF	14	14	16	17	20	22	25	43	43	35	25	20	15	25
PHOENIX	20	33	33	33	35	36	42	58	60	53	44	36	33	41
PRESCOTT	15	19	21	21	23	25	29	48	50	41	31	24	21	29
TUCSON	20	28	26	27	26	27	35	56	59	48	39	30	28	36
WINSLOW	20	19	19	18	21	24	29	47	49	45	30	22	19	29
YUMA	20	27	28	29	33	36	42	57	61	54	43	32	29	39
ARK. FORT SMITH	20	30	33	37	48	59	67	69	67	61	51	38	32	49
LITTLE ROCK	20	32	34	39	49	60	67	70	69	62	52	40	34	51
TEXARKANA	11	35	38	43	52	63	69	70	70	64	53	43	36	53
CALIF. BAKERSFIELD	17	38	40	40	43	43	47	50	51	50	45	42	39	45
BLUE CANYON	7	23	24	25	30	34	36	36	35	35	31	30	27	31
BURBANK	17	36	38	40	45	49	53	57	57	54	49	41	36	46
EUREKA	10	41	40	40	44	48	50	52	53	53	49	48	43	47
FRESNO	20	38	41	41	44	45	48	51	52	51	46	42	40	45
LONG BEACH	7	38	42	44	48	50	55	58	60	58	53	46	42	50
LOS ANGELES	20	40	43	45	49	52	55	59	59	58	53	46	42	50
MT. SHASTA	7	25	28	26	30	35	40	41	38	38	34	34	30	33
OAKLAND	18	40	42	42	45	47	51	53	54	54	50	45	41	47
RED BLUFF	20	34	36	36	39	43	45	47	47	43	41	38	36	40
SACRAMENTO	20	39	41	41	45	47	50	53	53	50	47	42	40	46
SANDBERG	10	24	24	27	33	35	38	37	37	36	33	27	27	31
SAN DIEGO	20	42	44	46	50	52	56	60	61	60	55	46	43	51
SAN FRANCISCO	10	41	42	43	46	47	50	52	53	53	50	46	43	47
SANTA MARIA	16	40	42	42	46	48	51	54	54	53	49	43	40	47
COLO. COLORADO SPRINGS	15	10	14	15	22	35	40	47	47	37	26	17	12	27
DENVER	20	12	16	17	24	35	42	47	46	37	27	19	14	28
GRAND JUNCTION	20	17	20	21	25	29	31	39	43	35	29	24	19	28
PUEBLO	20	12	17	19	27	37	44	51	51	42	30	22	16	31
CONN. BRIDGEPORT	16	22	22	27	37	47	57	66	62	56	46	35	24	42
HARTFORD	20	18	19	25	35	46	57	62	61	54	44	37	22	40
NEW HAVEN	10	24	22	27	37	48	57	63	63	55	47	44	25	43
DEL. WILMINGTON	20	24	24	29	40	50	60	64	64	58	47	35	26	43
D.C. WASHINGTON	20	25	25	29	40	52	61	65	64	59	48	36	26	44
FLA. APALACHICOLA	10	47	48	54	60	66	72	73	74	71	62	50	50	61
DAYTONA BEACH	17	50	52	54	59	65	70	73	73	72	65	56	56	62
FT. MYERS	6	55	55	59	61	67	72	73	74	74	68	59	56	64
JACKSONVILLE	20	46	47	50	56	64	70	72	72	71	62	53	47	58
KEY WEST	16	61	63	65	66	69	73	74	75	74	71	67	64	69
MIAMI	16	57	59	61	63	68	72	73	74	74	69	63	58	66
ORLANDO	17	52	52	55	59	65	70	73	73	72	65	57	51	62
PENSACOLA	10	48	47	51	59	65	70	73	73	68	59	49	46	59
TALLAHASSEE	17	44	46	49	55	62	69	72	72	69	58	49	43	57
TAMPA	20	52	53	56	60	66	70	73	73	72	65	58	52	63
WEST PALM BEACH	17	57	58	61	63	68	72	74	74	74	68	62	57	66
GA. ATHENS	10	32	34	39	48	59	65	69	68	63	52	42	34	50
ATLANTA	20	34	34	39	48	57	65	68	67	62	51	40	34	50
AUGUSTA	20	37	37	42	50	60	66	70	70	65	54	43	36	53
MACON	20	37	38	42	51	59	66	70	69	64	53	43	37	52
SAVANNAH	20	42	43	46	54	63	69	72	72	68	58	48	41	56
HAWAII HILO	10	63	62	63	65	66	66	68	68	68	67	66	64	66
HONOLULU	10	63	61	62	63	64	65	66	66	67	66	65	63	64
KAHULUI	10	64	63	63	64	65	66	67	67	68	67	65	64	65
LIHUE	10	64	61	63	64	66	68	69	69	69	68	67	64	66
IDAHO BOISE	20	21	27	27	32	38	42	44	43	38	34	29	26	33
LEWISTON	10	21	28	28	32	40	45	44	44	42	39	33	28	35
POCATELLO	20	17	21	24	28	35	39	41	40	34	30	26	21	30
ILL. CHICAGO	20	18	20	26	36	46	56	61	61	53	43	31	21	39
MOLINE	20	15	19	26	37	48	59	64	63	54	43	30	21	40
PEORIA	20	18	21	28	38	49	59	64	63	54	44	31	22	41
ROCKFORD	7	12	17	24	35	48	56	61	61	54	43	31	24	39
SPRINGFIELD	20	20	23	30	41	49	61	65	64	55	44	32	24	42
IND. EVANSVILLE	20	26	27	34	44	53	63	67	66	58	47	35	28	46
FT. WAYNE	20	20	22	28	36	48	58	62	61	54	44	33	23	41
INDIANAPOLIS	20	22	23	30	40	50	60	64	63	55	45	32	23	42
SOUTH BEND	20	20	22	27	37	48	57	62	61	53	44	33	24	41
TERRE HAUTE	10	26	25	32	42	49	61	65	64	55	45	33	26	44
IOWA BURLINGTON	20	17	21	27	39	49	60	65	64	54	43	30	21	41
DES MOINES	20	14	18	25	37	48	60	64	63	53	42	29	19	39
DUBUQUE	10	15	18	25	35	45	59	64	62	52	42	27	19	39
SIOUX CITY	20	10	16	24	35	47	58	63	62	51	40	26	17	37
KANS. CONCORDIA	15	17	22	27	39	50	61	64	62	54	44	30	21	41
DODGE CITY	20	18	23	25	36	49	57	61	59	51	41	29	22	39
GOODLAND	20	15	21	21	30	42	52	56	55	45	34	23	18	34
TOPEKA	20	19	23	29	41	53	63	66	65	56	45	31	23	43
WICHITA	20	21	25	30	41	53	62	65	63	55	45	33	25	43
KY. LEXINGTON	20	27	27	32	42	53	61	65	64	56	46	34	28	45
LOUISVILLE	20	27	28	33	43	54	63	66	65	57	47	35	27	45
LA. ALEXANDRIA	6	37	40	46	56	62	68	72	71	67	56	49	40	55
BATON ROUGE	20	44	46	49	57	64	70	73	72	68	57	48	44	58
LAKE CHARLES	20	46	48	51	58	66	71	73	73	69	58	50	46	59
NEW ORLEANS	20	46	48	52	59	66	72	73	73	70	60	52	47	60
SHREVEPORT	20	38	40	44	54	62	69	71	70	65	55	45	39	54
MAINE CARIBOU	18	7	5	15	28	38	50	56	54	47	36	27	12	31
EASTPORT	10	18	20	25	33	40	47	55	57	52	42	33	22	37
PORTLAND	20	16	16	23	33	43	53	59	58	49	39	32	19	37
MD. BALTIMORE	20	24	24	29	40	51	61	65	64	58	47	35	25	44
MASS. BLUE HILL	10	20	20	26	35	46	56	62	61	53	45	34	23	40
BOSTON	20	19	19	25	34	44	55	60	60	53	44	34	22	39
NANTUCKET	20	26	25	29	37	46	56	63	62	57	49	39	29	43
WORCESTER	6	14	15	20	29	42	52	56	56	51	39	30	18	35
MICH. ALPENA	10	16	16	21	32	41	53	58	58	50	42	30	20	36
DETROIT	20	19	19	25	35	45	56	60	59	53	43	32	23	39
ESCANABA	10	12	14	20	32	41	52	59	58	50	41	28	17	35
FLINT	10	15	16	23	34	45	54	58	58	52	42	32	21	38
GRAND RAPIDS	20	19	19	25	34	44	55	59	59	52	43	32	23	39
LANSING	17	18	19	24	34	46	56	59	59	52	41	31	22	38
MARQUETTE	10	12	13	19	29	38	50	56	56	49	40	27	17	34
MUSKEGON	20	20	20	24	34	44	55	60	60	52	43	32	24	39
SAULT STE. MARIE	20	9	10	18	29	39	50	55	55	49	40	29	17	33
MINN. DULUTH	20	2	5	15	27	37	49	56	55	46	36	22	9	30
INTERNATL FALLS	20	-5	2	11	26	37	50	56	54	45	35	20	4	28
MINN.-ST. PAUL	20	6	10	20	32	43	55	60	59	50	40	25	13	34
ROCHESTER	20	7	12	19	32	44	56	61	59	49	39	25	14	35
ST. CLOUD	16	2	8	17	30	40	53	58	58	48	37	22	12	32
ST. PAUL	5	6	10	19	31	41	56	60	58	50	38	23	12	34
MISS. JACKSON	20	40	41	44	53	58	68	71	70	65	53	42	38	54
MERIDIAN	16	39	40	45	54	61	68	71	71	66	55	45	39	55
VICKSBURG	10	40	41	46	55	63	70	73	71	65	54	43	36	55
MO. COLUMBIA	20	21	24	29	40	52	62	66	64	55	45	32	25	43
KANSAS CITY	20	20	24	29	40	53	62	65	64	55	45	33	24	43
ST. JOSEPH	10	19	24	29	40	51	63	65	65	53	44	30	23	42
ST. LOUIS	20	22	25	30	42	52	62	66	64	56	46	33	26	44
SPRINGFIELD	20	24	27	32	43	55	64	67	64	57	47	34	27	45
MONT. BILLINGS	20	11	16	20	28	38	46	48	46	38	31	22	15	30
BUTTE	10	6	12	16	23	32	38	39	39	33	27	18	13	25
GLASGOW	13	5	10	17	25	37	45	49	44	38	29	22	10	28
GREAT FALLS	20	10	15	18	26	34	42	44	42	36	29	21	15	28
HAVRE	12	6	12	16	26	33	42	45	43	37	29	21	13	27
HELENA	20	10	16	19	26	35	42	45	43	37	30	21	15	28
KALISPELL	9	14	20	23	29	36	43	47	46	39	34	27	20	32
MILES CITY	19	10	15	20	29	39	47	51	48	39	32	23	15	31
MISSOULA	20	15	21	23	29	37	43	45	43	39	34	26	20	31
NEBR. GRAND ISLAND	16	13	19	23	34	45	57	61	60	49	38	25	18	37
LINCOLN	8	16	21	28	37	46	60	63	62	51	41	28	20	39
NORFOLK	8	11	18	23	34	44	58	62	61	49	38	24	16	37
NORTH PLATTE	20	13	18	22	32	44	55	59	58	48	36	24	17	36
OMAHA	20	14	19	26	37	48	60	64	63	54	43	29	20	40
SCOTTSBLUFF	16	13	17	19	28	40	49	54	53	43	32	21	17	32
VALENTINE	10	13	15	22	31	39	51	56	55	43	34	22	16	33

TABLE 2 (cont.)
Mean Dew-Point Temperature (°F)

STATE AND STATION	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
NEV. ELKO	17	15	20	22	26	32	35	36	34	29	25	23	18	26
ELY	20	12	18	19	24	26	29	33	34	27	24	19	16	23
LAS VEGAS	20	21	22	20	24	26	28	39	41	33	29	25	23	28
RENO	20	20	24	23	26	32	37	40	38	35	31	25	22	29
WINNEMUCCA	18	20	23	23	26	31	34	34	33	30	28	24	22	27
N. H. CONCORD	20	14	14	22	32	43	53	59	58	51	39	30	18	36
MT. WASHINGTON	10	4	5	7	20	29	41	45	45	36	28	17	7	24
N. J. ATLANTIC CITY	18	27	26	30	40	50	60	66	65	59	49	39	28	45
NEWARK	20	23	23	27	37	47	57	62	62	56	46	34	25	42
TRENTON	10	25	23	29	38	50	59	64	64	56	48	35	25	43
N. MEX. ALBUQUERQUE	20	19	19	19	23	29	35	49	50	42	33	23	20	30
CLAYTON	10	18	20	22	31	42	50	54	57	47	35	24	19	35
ROSWELL	17	20	22	22	28	37	48	56	55	48	39	26	22	35
N. Y. ALBANY	20	16	16	24	34	44	55	60	59	53	42	32	20	38
BINGHAMTON	15	17	18	23	34	44	54	58	58	51	41	30	20	37
BUFFALO	20	19	19	25	35	45	55	59	59	52	43	33	23	39
CANTON	5	16	14	21	30	43	53	57	57	50	42	30	17	36
NEW YORK	15	22	23	27	38	47	57	62	62	56	46	35	26	42
OSWEGO	7	20	18	25	33	42	54	60	60	52	44	32	21	38
ROCHESTER	20	19	19	25	35	45	55	59	59	53	43	33	23	39
SYRACUSE	20	18	18	25	35	45	55	59	59	53	42	32	22	39
N. C. ASHEVILLE	10	30	29	33	43	53	63	65	64	56	47	32	29	45
CAPE HATTERAS	20	40	40	44	52	61	68	72	72	68	59	50	41	56
CHARLOTTE	20	32	32	36	46	56	64	67	67	61	50	39	32	49
GREENSBORO	20	29	29	34	44	55	63	67	66	60	48	37	29	47
RALEIGH	20	32	31	35	45	56	64	68	67	61	50	38	30	48
WILMINGTON	16	39	39	44	52	60	68	71	70	67	56	46	37	54
WINSTON SALEM	19	29	29	32	42	54	59	66	68	59	51	36	28	46
N. DAK. BISMARCK	20	1	7	17	29	38	51	56	53	42	33	20	9	30
DEVILS LAKE	10	-4	3	14	30	40	51	57	56	45	35	19	5	29
FARGO	20	-1	6	17	31	40	54	59	57	46	36	22	8	31
WILLISTON	16	3	7	17	27	37	48	53	51	42	32	21	11	25
OHIO AKRON-CANTON	17	22	22	27	37	47	56	60	60	53	42	32	24	40
CINCINNATI	12	26	26	29	39	51	60	63	62	55	43	31	26	43
CLEVELAND	20	23	22	28	37	47	57	61	61	54	44	33	24	41
COLUMBUS	20	23	24	30	40	50	59	63	62	55	44	33	25	42
DAYTON	20	23	24	29	39	50	58	62	61	54	44	33	24	42
TOLEDO	20	21	21	27	37	47	57	61	61	54	43	32	23	40
YOUNGSTOWN	17	22	22	26	37	46	56	60	59	53	42	32	22	40
OKLA. OKLAHOMA CITY	17	26	30	33	45	58	65	67	65	58	48	35	28	47
TULSA	20	26	30	34	46	58	66	68	66	59	49	36	29	47
ORE. ASTORIA	10	37	40	39	42	46	51	54	55	52	49	42	40	46
BAKER	7	15	23	27	30	37	42	44	42	37	32	26	23	32
BURNS	15	19	23	24	27	33	37	38	37	32	30	26	19	29
EUGENE	7	33	37	35	40	44	48	50	50	48	45	42	38	43
MEDFORD	20	32	34	35	38	42	46	49	49	45	43	37	34	40
PENDLETON	17	24	30	30	34	40	42	43	43	41	39	33	29	36
PORTLAND	20	33	36	37	41	46	50	53	54	51	47	40	36	44
ROSEBURG	10	35	37	36	38	41	46	48	48	47	45	41	38	42
SALEM	17	34	38	38	41	45	50	52	52	50	46	41	38	44
PA. ALLENTOWN	18	21	22	27	38	48	58	62	62	55	44	34	23	41
ERIE	13	22	21	27	36	46	56	60	60	54	44	34	24	40
HARRISBURG	20	21	21	26	37	48	58	62	62	55	44	33	23	41
PHILADELPHIA	16	24	24	28	39	49	59	64	63	57	46	35	25	43
PITTSBURGH	20	22	22	27	37	47	57	60	60	53	42	31	24	40
READING	10	24	23	28	37	49	58	63	63	55	45	34	24	42
SCRANTON	20	19	19	25	36	46	55	60	59	52	43	32	22	39
WILLIAMSPORT	13	20	19	25	36	47	56	61	60	54	43	32	21	40
R.I. BLOCK ISLAND	10	28	26	31	39	48	57	65	64	57	50	39	30	45
PROVIDENCE	20	20	19	25	34	45	55	62	61	54	44	34	23	40
S.C. CHARLESTON	20	40	41	44	53	62	69	72	71	68	57	47	39	55
COLUMBIA	20	36	36	41	49	58	66	69	69	64	53	43	35	52
FLORENCE	13	37	37	40	49	58	67	71	70	65	56	42	34	52
GREENVILLE	17	30	30	36	44	55	63	67	66	60	50	38	32	48
SPARTANBURG	10	37	36	38	45	55	63	67	67	61	50	37	31	49

STATE AND STATION	YRS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
S. DAK. HURON	20	6	12	21	32	43	56	60	58	47	37	23	13	34
RAPID CITY	20	12	15	20	28	39	50	53	50	39	31	22	16	31
SIOUX FALLS	17	5	12	20	31	43	56	60	59	47	37	23	12	34
TENN. BRISTOL	13	30	30	34	42	54	62	65	65	58	47	35	28	46
CHATTANOOGA	20	33	33	37	47	57	65	68	68	61	50	39	32	49
KNOXVILLE	20	32	32	36	45	55	63	66	66	59	49	38	31	48
MEMPHIS	16	33	35	38	48	59	66	69	68	62	49	38	33	50
NASHVILLE	20	32	33	37	47	57	65	68	67	60	49	38	32	49
TEXAS ABILENE	20	29	32	33	45	56	62	63	61	58	50	37	31	46
AMARILLO	20	19	23	23	32	43	55	58	57	51	40	27	22	38
AUSTIN	20	38	42	45	55	64	68	69	68	65	56	46	41	55
BROWNSVILLE	20	53	55	59	65	70	73	74	74	72	66	60	54	65
CORPUS CHRISTI	20	48	52	55	63	70	73	74	74	71	64	55	50	62
DALLAS	20	34	37	41	52	62	67	68	67	63	53	42	36	52
DEL RIO	14	38	40	42	51	59	66	66	65	63	55	43	38	52
EL PASO	20	24	23	23	26	31	42	55	55	49	39	28	25	35
FORT WORTH	20	33	36	39	51	61	66	67	66	61	53	41	35	51
GALVESTON	18	47	50	54	62	69	73	75	74	71	64	54	50	62
HOUSTON	20	45	48	51	60	66	72	73	73	69	60	51	47	60
LAREDO	19	43	46	51	57	65	69	68	68	67	60	50	44	57
LUBBOCK	20	25	26	27	37	49	57	61	60	55	45	31	24	41
MIDLAND	10	25	29	29	37	49	58	60	58	56	47	36	30	43
PALESTINE	10	40	42	45	54	64	71	72	71	66	57	46	43	56
PORT ARTHUR	20	47	49	52	60	67	73	75	74	70	61	51	47	61
SAN ANGELO	20	30	34	35	45	56	62	62	61	59	50	38	32	47
SAN ANTONIO	20	39	42	45	55	64	68	68	67	65	56	46	41	55
VICTORIA	17	46	49	52	59	67	72	72	71	69	61	51	47	60
WACO	20	37	40	43	54	63	68	69	67	63	55	44	38	53
WICHITA FALLS	20	28	35	34	46	58	64	64	63	58	49	36	30	47
UTAH MILFORD	7	16	19	15	23	27	30	40	40	29	25	22	19	25
SALT LAKE CITY	20	20	23	26	31	36	40	44	45	38	34	28	24	32
VT. BURLINGTON	20	12	12	20	32	43	54	59	58	51	40	30	17	36
VA. LYNCHBURG	10	29	27	32	42	53	61	66	65	58	47	34	27	45
NORFOLK	20	32	32	36	45	56	64	68	68	63	53	42	33	49
RICHMOND	20	28	29	33	43	55	63	67	67	60	49	38	29	47
ROANOKE	17	26	26	29	39	52	60	64	63	57	45	33	25	43
CAPE HENRY	8	38	35	39	45	58	65	70	69	64	57	44	36	52
WASH. ELLENBURG	5	14	24	28	31	38	44	46	47	43	38	31	25	34
NORTH HEAD	7	34	39	40	42	47	51	54	55	53	48	43	40	46
OLYMPIA	17	33	36	35	38	43	48	51	52	49	45	40	37	42
SEATTLE AP	6	33	36	35	38	43	48	52	53	51	47	40	37	43
SEATTLE-TACOMA	16	34	35	35	39	43	48	52	53	50	46	39	36	43
SPOKANE	20	20	25	27	32	38	43	44	44	40	37	30	26	34
STAMPEDE PASS	7	18	24	24	28	34	39	42	44	41	35	29	25	32
TACOMA	7	32	36	37	40	46	50	52	53	52	46	40	37	43
TATOOSH ISLAND	20	36	38	38	41	46	50	52	54	51	47	42	39	45
WALLA WALLA	7	23	30	31	34	40	44	46	47	43	41	35	30	37
YAKIMA	19	21	26	27	31	37	43	44	46	42	37	30	26	34
W. VA. CHARLESTON	16	27	27	30	40	52	61	65	64	57	47	34	27	44
ELKINS	17	24	24	30	38	49	58	61	60	54	42	32	25	41
PARKERSBURG	10	28	26	31	40	51	60	64	63	56	46	34	27	44
WISC. GREEN BAY	20	10	12	21	33	43	55	60	59	51	41	27	15	36
LA CROSSE	20	9	13	21	33	45	56	61	61	52	41	27	15	36
MADISON	20	11	15	22	34	45	56	61	60	51	41	28	17	37
MILWAUKEE	20	14	17	24	34	44	55	61	61	52	43	29	19	38
WYO. CASPER	17	11	15	18	25	34	39	43	40	33	26	20	15	27
CHEYENNE	20	10	13	17	25	35	42	47	45	36	27	18	14	27
LANDER	20	8	13	17	24	33	39	42	40	35	28	18	12	26
SHERIDAN	20	11	16	20	28	38	46	48	45	38	30	22	16	30
ROCK SPRINGS	8	11	15	18	24	31	35	39	*39	31	27	19	15	25
PUERTO RICO. SAN JUAN	20	68	67	67	69	71	73	73	73	73	73	71	69	71

Based on years of data indicated in table during 1946-65