

Heat Units

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Introduction

Heat units are a method of quantifying a biological organism's thermal environment. Research conducted over the past several decades has proven that proper use of heat units can provide a reliable means of predicting the growth and development of important crop species as well as many crop pests. This bulletin explores the concept of heat units and provides information for individuals interested in calculating and using heat units.

What are heat units?

A proper thermal environment is essential to the survival of all biological organisms. The thermal environment is especially critical to "cold-blooded" organisms such as plants and insects because their internal temperatures are dictated by the surrounding environment. If environmental temperatures exceed some upper limit or decline below some lower limit, growth and development of "cold-blooded" organisms are impaired or halted (Figure 1). However, when these organisms are exposed to temperatures within some optimal range, growth and development typically increase with temperature (Figure 1). Heat units quantify an organism's thermal environment, providing a daily estimate of the amount of "contributory" heat — heat that will contribute to growth and development.

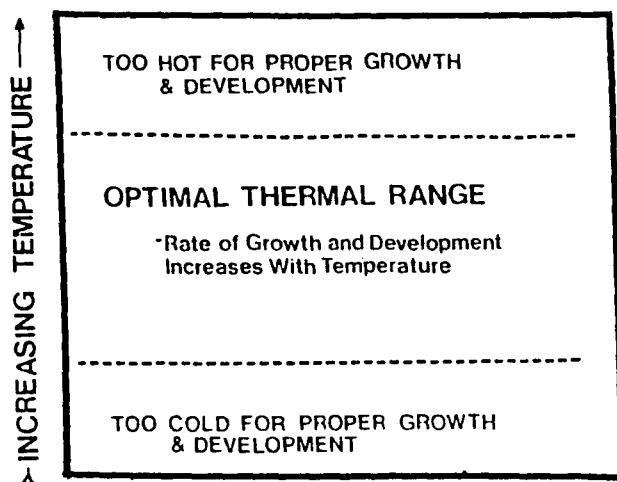


Figure 1. Hypothetical response of a "cold-blooded" biological organism to temperature.

The heat unit concept is best understood with the use of diagrams (Figure 2). Figure 2A shows a typical daily temperature cycle for Arizona. The heat unit concept utilizes this daily temperature information along with knowledge about a plant's or pest's thermal limits to quantify the "contributory" heat. Figure 2B shows the

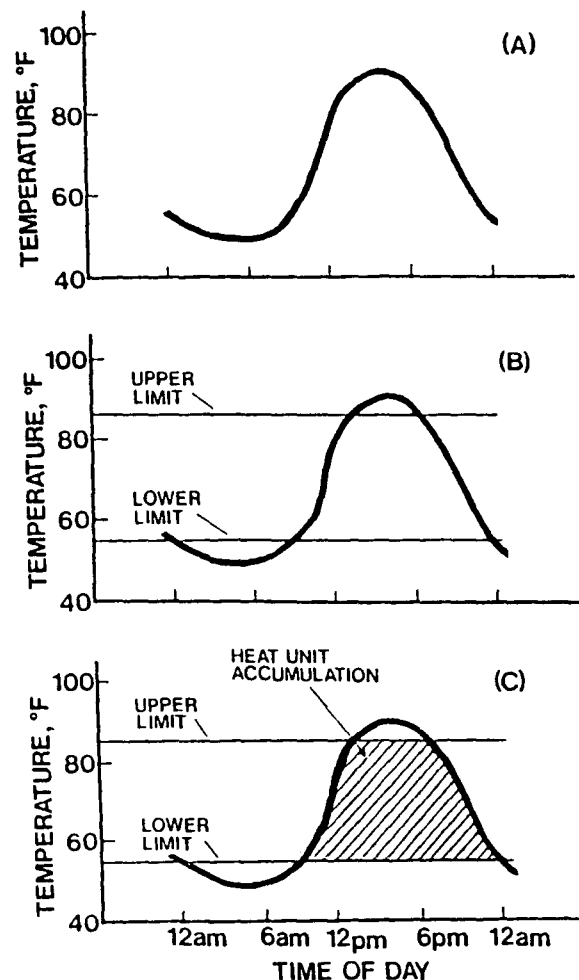


Figure 2. Graphical explanation of the heat unit concept. Figure 2A depicts a typical daily temperature cycle for Arizona. Figure 2B shows this same curve with horizontal lines representing upper and lower temperature limits for cotton and cotton insects. The daily accumulation of heat units is the hatched area in Figure 2C.

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temperature cycle in Figure 2A with two horizontal lines representing the upper and lower thermal limits of cotton (and pink bollworm) superimposed on the diagram. As previously mentioned, temperatures below the lower limit are too cold for proper growth and development, while temperatures above the upper limit do not contribute to additional growth and development. The hatched area in Figure 2C, bounded by the daily temperature curve and the lines designating the upper and lower temperature limits, represents the daily amount of "contributory" heat. This area can be calculated with the help of mathematics to give a number that is the daily accumulation of *heat units* or *growing degree days*. The accumulation of heat units is very dependent on daily temperature conditions as shown in Figure 3.

How are heat units determined?

Temperature data must be available to determine heat unit accumulations. Typically, daily maximum and minimum temperatures are used to reconstruct the daily temperature cycle since detailed temperature data (e.g., hourly) are rarely available. Reconstructing a daily temperature cycle involves forcing a sine curve (Figure 4) through the day's maximum and minimum temperatures. The sine curve closely approximates the daily temperature cycle on clear days — a common occurrence in Arizona.

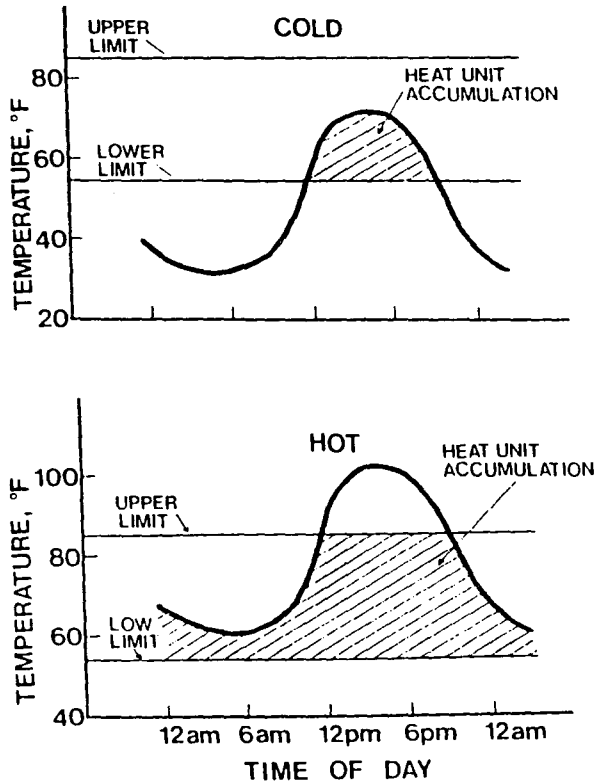


Figure 3. Heat unit accumulations (hatched areas) differ greatly between cold and hot days.

With the temperature cycle reconstructed, the next step in calculating heat units is to select the upper and lower temperature limits. These limits, or thresholds, differ between various crop and insect species, and individuals calculating their own heat units must take care to choose the thresholds appropriate for their crop or pest in question.

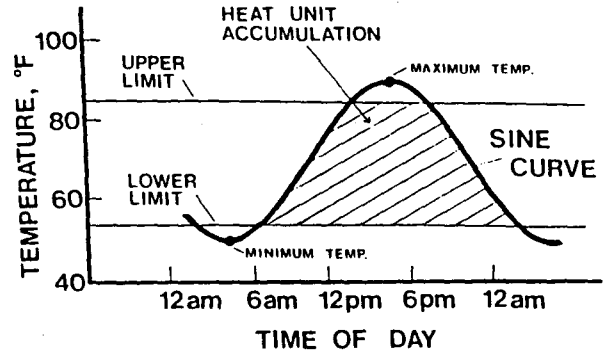


Figure 4. The Sine Curve Method of calculating heat units reconstructs a daily temperature cycle by forcing a sine curve through the daily maximum and minimum temperatures. The area under the sine curve that rests within the upper and lower temperature limits provides the daily accumulation of heat units (hatched area).

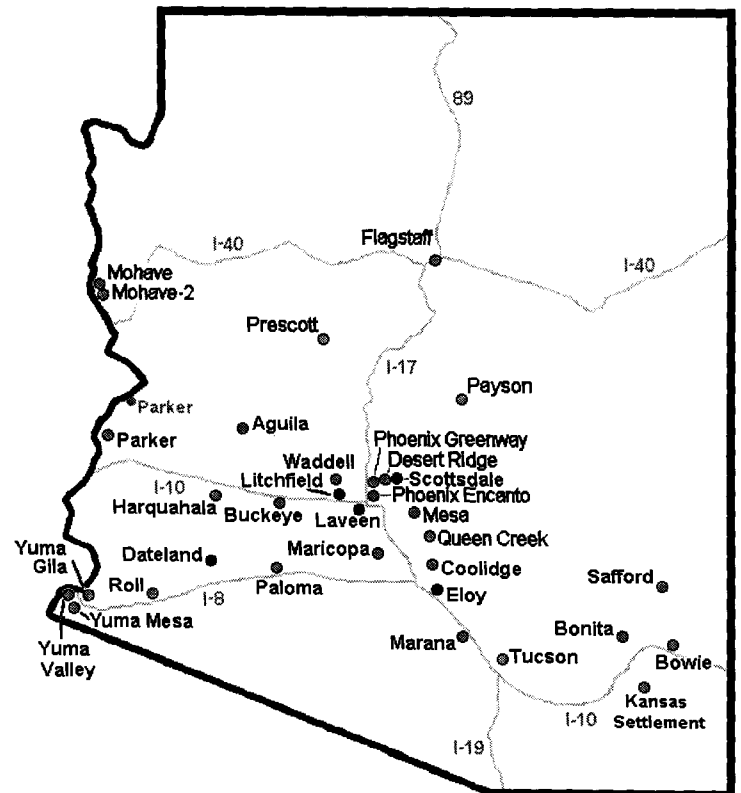


Figure 5. Locations served by the Arizona Meteorological Network (AZMET)

Finally, the daily heat unit total is obtained by determining the area under the daily temperature curve that resides within the temperature thresholds. A computer and appropriate software, or a set of heat unit tables (see Tables 3, 4, and 5 at end) are typically employed to make this area determination.

How to obtain heat unit information

Heat unit information may be obtained at the local level from a variety of public and private sources. Many areas in the southern and central part of the state are served by a weather information system operated by the Arizona Cooperative Extension known as AZMET. AZMET provides daily updates on heat unit accumulations for 28 locations (Figure 5). AZMET heat unit information is available from local extension offices, or by contacting the AZMET website: <http://ag.arizona.edu/azmet/>

In areas not served by AZMET, heat unit information is frequently available from farm consultants, pest control advisors, and agrochemical suppliers. If no local source of heat unit information exists, heat units can be calculated using Tables 3, 4, and 5 (see below), provided a local source of maximum and minimum temperatures exists. A likely source of temperature data is the local National Oceanic and Atmospheric Administration (NOAA) volunteer observer. Most areas in Arizona have NOAA volunteer observers, and it may be possible to obtain an observer's temperature data on a regular basis for use in determining heat unit accumulations.

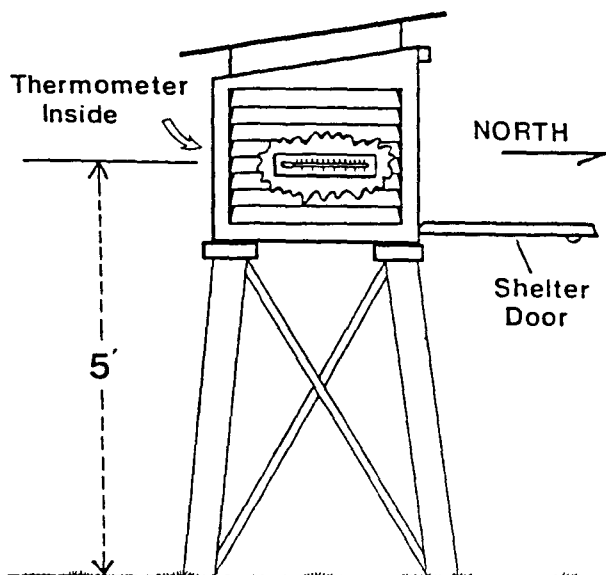


Figure 6. Diagram depicting the correct installation of an on-farm instrument shelter for obtaining maximum and minimum temperatures. The enclosed thermometer should reside at 5 feet above ground level, and the shelter should be oriented such that the door faces north.

When no local temperature data is available, it will be necessary to set up an instrument shelter containing a maximum/minimum thermometer. Thermometers and shelters appropriate for this purpose are available from a variety of sources (Table 1). Do not skimp by using a substandard shelter or thermometer; the success of local calculation of heat units is totally dependent on the accuracy of the temperature obtained. The shelter should be constructed with louvered side panels to aid in ventilation and must be painted white. Locate the shelter adjacent to the production areas of interest. Avoid locating the shelter where wind flow is impeded (e.g., near walls, trees or buildings) or near hot surfaces such as parking lots. Mount the shelter in such a manner that the enclosed thermometer resides 5 feet (1.5 m) above the ground and the shelter door faces north (Figure 6).

Table 1. Approximate costs and regional suppliers of maximum/minimum thermometers and instrument shelters.

Maximum/Minimum Thermometers		
Type	Cost	Sources ¹
Mercury-Filled U-Tube Enclosed In Plastic	\$25-30	1, 2, 3, 4, 5
NWS* Standard With Mounting Support	\$150-200	2, 3, 4, 5
Instrument Shelters		
Type	Cost ²	Sources ¹
Small, Wood	\$90-110	2, 3, 4, 5
Medium, Wood	\$180-290	2, 3, 4, 5
Large, Wood (NWS Standard)	\$300-440	2, 3, 4, 5

¹Sources (Listing does not indicate endorsement by AZ Coop. Ext.)

- 1 Local hardware and farm supply stores
- 2 NASCO, Modesto, CA. 1-800-558-9595
- 3 Weathermeasure, Sacramento, CA. 1-800-824-5873
- 4 Wind and Weather, Mendocino, CA. 1-707-937-0323
- 5 Belfort Instrument Co., Alhambra, CA. 1-818-282-4893

²Low end of cost range typically provides just the shelter. High end of price includes legs for shelter.

*NWS: National Weather Service

Daily values of maximum and minimum temperature are easily converted to daily accumulation of heat units using the attached tables. Tables are provided for three sets of temperature thresholds: 86/55 °F, 86/50 °F and 86/45 °F. The heat unit tables are similar to mileage tables commonly included on road maps. To calculate a daily heat unit accumulation, select the table corresponding to the upper and lower temperature thresholds of the desired heat unit. Next, move across the top of the table until you locate the maximum temperature for the day. Move down through the column associated with this maximum temperature until you

intersect the row of numbers associated with the daily minimum temperature. The number located at the intersection point is the daily accumulation of heat units or growing degree days.

Four sets of daily maximum and minimum temperatures and the corresponding daily heat unit accumulations are provided in Table 2. Practice in calculating heat units may be obtained by using the appropriate heat unit table (Table 3, 4, or 5) to confirm the heat unit accumulations listed for each of the four days.

Table 2. Maximum and minimum temperatures and the resulting daily heat unit accumulation for four hypothetical days. Heat unit accumulations for the three sets of temperature thresholds: 86/55 ° F, 86/50 ° F and 86/45 ° F were obtained using Tables 3, 4, and 5 respectively.

Daily Temperature Extremes				
	Day 1	Day 2	Day 3	Day 4
Maximum Temperature	87 ° F	54 ° F	110 ° F	90 ° F
Minimum Temperature	42 ° F	30 ° F	90 ° F	60 ° F

Daily Heat Unit Accumulation				
Temperature Thresholds				
86/55 ° F (Table 3)	12	0*	31**	19
86/50 ° F (Table 4)	16	1	36**	24
86/45 ° F (Table 5)	20	2	41**	29

*Heat unit accumulation is always 0 when maximum temperature does not exceed the lower threshold temperatures.

**Heat unit accumulation is equal to the difference between the upper and lower temperature thresholds when the minimum temperature exceeds the upper threshold.

Table 2 also provides insight into how to determine heat unit accumulations during periods of very cold and very warm weather. Note that during cold weather when the daily maximum temperature fails to exceed the lower temperature threshold of the desired heat unit (Day 2 in Table 2), the daily heat unit accumulation is zero. In contrast, during periods of extremely hot weather when the minimum temperature stays above the upper threshold (Day 3 in Table 2), the daily heat unit accumulation attains a maximum value equal to the difference between the upper and lower temperature thresholds of the particular heat unit.

Use of heat units: Some examples

Heat units are commonly used to predict growth and development of crops and crop pests. The development of several Arizona crops including cotton, corn, melons and small grains can be predicted using heat units. Pink bollworm, boll weevil, alfalfa weevil and codling moth are among the important Arizona insect pests whose development can be predicted using heat units. The

following paragraphs provide a few examples of how heat units can be used to assist the management of a particular crop or insect pest. Further details on these and other uses of heat units can be obtained by contacting your local extension agent or the Extension Biometeorology Program.

Heat units have proven particularly useful in pest management. For example, both the development of cotton and the annual spring emergence cycle of the pink bollworm can be predicted using heat units. By tracking late winter and early spring heat unit accumulations, growers can select cotton planting dates that minimize the potential for infestation from the emerging bollworms. Once the cotton is planted, heat units can be used in conjunction with field monitoring techniques to determine when pink bollworm populations are at levels sufficient to justify chemical treatment.

Another area where heat units have been successfully employed relates to the development of planting schedules for horticultural crops such as sweet corn, green beans and peas. Seed companies often provide information on the number of heat units required for a given variety to attain harvest maturity. Given this heat unit requirement and some information on typical seasonal patterns of heat unit accumulation, planting schedules can be developed that allow for orderly harvests over a targeted period. An example of a planting schedule for sweet corn is provided in Table 6.

Table 6. Sweet corn planting schedule developed for Coolidge, AZ using heat units.

LOCATION: Coolidge, AZ	
VARIETY: Jubilee	
HEAT UNIT REQUIREMENT: 1697	
Planting Date	Desired Harvest Date
Feb. 11	Jun. 1
Mar. 3	Jun. 8
Mar. 21	Jun. 15
Apr. 5	Jun. 22

A planting schedule such as the one presented in Table 6 is based on historical average heat unit trends. Since each season's weather differs from the long-term average, the planting schedule only approximates harvest dates. However, by monitoring actual in-season heat unit accumulations for each planting date, growers can project the actual harvest date with considerable accuracy several weeks ahead. Such late-season projections of harvest dates can assist in scheduling harvest, packing and shipping crews.

Precautions when using heat units

Several methods of calculating heat units have been developed and are presently used worldwide. The method outlined in this bulletin is referred to as the *Sine Curve Method* and works well in arid regions. Growers interested in using heat-unit-based models to predict pest development or crop maturity should identify the heat unit method used

to develop the model, as well as the proper upper and lower temperature thresholds required for heat unit calculation. Models based on heat units calculated using some method other than the *Sine Curve Method* may need some adjustment when used in Arizona. If questions arise about the model or the method of heat unit calculation, contact the Extension Biometeorology Program.

Table 3. Table used to calculate daily heat unit accumulation from maximum and minimum temperature using sine curve method. Temperature thresholds: Upper = 86°F, Lower = 55°F.

		Maximum Temperature, °F																												
		90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
86	-	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
85	-	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
84	-	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
83	-	30	30	30	30	30	30	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
82	-	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
81	-	29	29	29	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
80	-	29	29	29	29	29	29	29	29	29	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
79	-	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	30	30	30	30	30	30	30	30	30
78	-	28	28	28	28	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	30
77	-	28	28	28	28	28	28	28	28	28	28	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
76	-	27	27	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	29	29	29	29	29	29	29	29	29
75	-	27	27	27	27	27	27	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
74	-	26	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
73	-	26	26	26	26	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	28	28	28	28	28	28	28	28	28
72	-	24	25	26	26	26	26	26	26	26	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
71	-	24	25	25	25	25	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
70	-	24	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
69	-	24	24	24	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
68	-	23	23	24	24	24	24	24	24	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
67	-	23	23	23	23	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
66	-	22	23	23	23	23	23	23	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
65	-	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
64	-	21	22	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
63	-	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
62	-	20	21	21	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
61	-	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
60	-	19	20	20	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
59	-	19	19	19	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
58	-	18	19	19	19	19	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
57	-	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
56	-	17	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
55	-	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
54	-	16	17	17	17	17	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18	18
53	-	16	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
52	-	16	16	16	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
51	-	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
50	-	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
49	-	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
48	-	15	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
47	-	14	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
46	-	14	15	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
45	-	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
44	-	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
43	-	13	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
42	-	14	14	14	14	14	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
41	-	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
40	-	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
39	-	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
38	-	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
37	-	13	13	13	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
36	-	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13

Note: If minimum temperature exceeds 86°F, the daily heat unit accumulation equals 31.
If maximum temperature fails to exceed 55°F, the daily heat unit accumulation is zero.

Table 4. Heat unit table for temperature thresholds 86°F and 50°F continued.

Minimum Temperature, °F	Maximum Temperature, °F				
	50	51	52	53	54
35 -	0	0	0	1	1
34 -	0	0	0	1	1
33 -	0	0	0	1	1
32 -	0	0	0	0	1
31 -	0	0	0	0	1
30 -	0	0	0	0	1
29 -	0	0	0	0	1
28 -	0	0	0	0	1
27 -	0	0	0	0	1
26 -	0	0	0	0	1
25 -	0	0	0	0	1
24 -	0	0	0	0	1
23 -	0	0	0	0	1
22 -	0	0	0	0	1
21 -	0	0	0	0	1
20 -	0	0	0	0	1
19 -	0	0	0	0	1
18 -	0	0	0	0	1
17 -	0	0	0	0	1
16 -	0	0	0	0	1
15 -	0	0	0	0	1
14 -	0	0	0	0	1
13 -	0	0	0	0	1
12 -	0	0	0	0	1
11 -	0	0	0	0	0
10 -	0	0	0	0	0

Note: If minimum temperature exceeds 86°F, the daily heat unit accumulation equals 36.
 If maximum temperature fails to exceed 50°F, the daily heat unit accumulation is zero.

Table 5. Table used to calculate daily heat unit accumulation from maximum and minimum temperature using sine curve method. Temperature thresholds: Upper = 86°F, Lower = 45°F.

		Maximum Temperature, °F																												
		90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118
86	-	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
85	-	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
84	-	40	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
83	-	40	40	40	40	40	40	40	40	40	40	40	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
82	-	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
81	-	39	39	39	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
80	-	39	39	39	39	39	39	39	39	39	39	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
79	-	38	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	40	40	40	40	40	40	40	40	40
78	-	38	38	38	38	38	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39
77	-	38	38	38	38	38	38	38	38	38	38	38	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39	39
76	-	37	37	37	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	39	39	39	39	39	39	39	39	39	39
75	-	37	37	37	37	37	37	37	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	39	39	39
74	-	36	36	36	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	38	38	38
73	-	36	36	36	36	36	36	36	37	37	37	37	37	37	37	37	37	37	37	37	37	38	38	38	38	38	38	38	38	38
72	-	35	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
71	-	35	35	35	35	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
70	-	34	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
69	-	34	34	34	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
68	-	33	33	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
67	-	33	33	33	33	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
66	-	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
65	-	32	32	32	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33	33
64	-	31	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
63	-	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
62	-	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
61	-	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
60	-	29	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
59	-	29	29	29	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
58	-	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
57	-	28	28	28	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
56	-	27	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28	28
55	-	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
54	-	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
53	-	26	26	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
52	-	25	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
51	-	25	25	25	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
50	-	24	25	25	25	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
49	-	24	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
48	-	23	24	24	24	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
47	-	23	23	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
46	-	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
45	-	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
44	-	22	22	22	22	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
43	-	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
42	-	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
41	-	21	21	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
40	-	20	20	21	21	21	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
39	-	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
38	-	20	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
37	-	19	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
36	-	19	20	20	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21

Note: If minimum temperature exceeds 86°F, the daily heat unit accumulation equals 41.
 If maximum temperature fails to exceed 45°F, the daily heat unit accumulation is zero.

Table 5. Heat unit table for temperature thresholds 86°F and 45°F continued.

		Maximum Temperature, °F																																						
		55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89				
86	-																																							
85	-																																		41	41	41	41		
84	-																																		41	41	41	41		
83	-																																		40	40	40	40		
82	-																																		39	39	40	40	40	
81	-																																		38	38	39	39	39	
80	-																																		37	37	38	38	39	
79	-																																		36	36	37	37	38	
78	-																																		35	35	36	36	37	
77	-																																		34	34	35	35	36	
76	-																																		33	33	34	34	35	
75	-																																		32	32	33	33	34	
74	-																																		31	31	32	32	33	
73	-																																		30	30	31	31	32	
72	-																																		29	29	30	30	31	
71	-																																		28	28	29	29	30	
70	-																																		27	27	28	28	29	
69	-																																		26	26	27	27	28	
68	-																																		25	25	26	26	27	
67	-																																		24	24	25	25	26	
66	-																																		23	23	24	24	25	
65	-																																		22	22	23	23	24	
64	-																																		21	21	22	22	23	
63	-																																		20	20	21	21	22	
62	-																																		19	19	20	20	21	
61	-																																		18	18	19	19	20	
60	-																																		17	17	18	18	19	
59	-																																		16	16	17	17	18	
58	-																																		15	15	16	16	17	
57	-																																		14	14	15	15	16	
56	-																																		13	13	14	14	15	
55	-																																		12	12	13	13	14	
54	-	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	26	26	27		
53	-	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	26	26		
52	-	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	26		
51	-	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26		
50	-	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25	26		
49	-	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25	25		
48	-	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24	25		
47	-	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24	24		
46	-	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23	24		
45	-	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23	23		
44	-	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	23		
43	-	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22		
42	-	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22		
41	-	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22		
40	-	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22		
39	-	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22		
38	-	4	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	
37	-	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	
36	-	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	
35	-	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	
34	-	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22
33	-	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22
32	-	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18</								

Table 5. Heat unit table for temperature thresholds 86°F and 45°F continued.

		Maximum Temperature, °F									
		45	46	47	48	49	50	51	52	53	54
35 -	0	0	0	1	1	1	2	2	2	3	
34 -	0	0	0	1	1	1	2	2	2	3	
33 -	0	0	0	1	1	1	2	2	2	3	
32 -	0	0	0	1	1	1	2	2	2	3	
31 -	0	0	0	1	1	1	1	2	2	2	
30 -	0	0	0	1	1	1	1	2	2	2	
29 -	0	0	0	1	1	1	1	2	2	2	
28 -	0	0	0	1	1	1	1	2	2	2	
27 -	0	0	0	0	1	1	1	2	2	2	
26 -	0	0	0	0	1	1	1	2	2	2	
25 -	0	0	0	0	1	1	1	2	2	2	
24 -	0	0	0	0	1	1	1	2	2	2	
23 -	0	0	0	0	1	1	1	1	2	2	
22 -	0	0	0	0	1	1	1	1	2	2	
21 -	0	0	0	0	1	1	1	1	2	2	
20 -	0	0	0	0	1	1	1	1	2	2	
19 -	0	0	0	0	1	1	1	1	2	2	
18 -	0	0	0	0	1	1	1	1	2	2	
17 -	0	0	0	0	1	1	1	1	2	2	
16 -	0	0	0	0	1	1	1	1	2	2	
15 -	0	0	0	0	1	1	1	1	2	2	
14 -	0	0	0	0	1	1	1	1	2	2	
13 -	0	0	0	0	1	1	1	1	2	2	
12 -	0	0	0	0	1	1	1	1	2	2	
11 -	0	0	0	0	1	1	1	1	2	2	
10 -	0	0	0	0	1	1	1	1	2	2	

Note: If minimum temperature exceeds 86°F, the daily heat unit accumulation equals 41.
 If maximum temperature fails to exceed 45°F, the daily heat unit accumulation is zero.