UFC 3-400-02
28 FEBRUARY 2003

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: ENGINEERING WEATHER DATA

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN ENGINEERING WEATHER DATA

U.S. ARMY CORPS OF ENGINEERS (Preparing Activity)

NAVAL FACILITIES ENGINEERING COMMAND

AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Record of Changes (changes are indicated by **1**\ ... /**1**/)

Change No.	Date	Location

This UFC supersedes AFH(I) 32-1163, *Engineering Weather Data,* Dated 1 July 2000.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

AUTHORIZED BY:

DONALD L. BASHAM, P.E.
Chief, Engineering and Construction
U.S. Army Corps of Engineers

DR. JAMES W WRIGHT, P.E.
Chief Engineer
Naval Facilities Engineering Command

KATHLEEN I. FERGUSON, P.E.
The Deputy Civil Engineer
DCS/Installations & Logistics
Department of the Air Force

Dr. GET W. MOY, P.E.
Director, Installations Requirements and Management
Office of the Deputy Under Secretary of Defense (Installations and Environment)

CONTENTS

FIGURES

CHAPTER 1

INTRODUCTION

1-1 **PURPOSE**. The purpose of this document is to provide an overview of and instructions for access to climatological data available for use by engineers designing government structures.

1-2 **SCOPE**. The Air Force Combat Climatology Center (AFCCC) compiled the data in this document at the request of the Air Force Civil Engineer Support Agency (HQ AFCESA). Sites were identified by AFCESA, US Army Corps of Engineers (USACE), and the Naval Facilities Engineering Command (NAVFACENGCOM). Final selection of sites was based upon availability of climatological data. Most are located at military installations supporting airfield operations, or at local airports/airfields. (See Chapter 3 for a listing of sites.) Department of Defense (DOD) agencies and DOD contractors may obtain data for additional sites by providing site coordinates and elevation in written request to AFCCC/DOO, 151 Patton Avenue, Room 120, Asheville, North Carolina, 28801-5002. Non-DOD users should contact the National Climatic Data Center, Federal Building, Asheville, North Carolina, 28801. Nongovernmental site data may be obtained from a private consulting meteorologist or the following Web site: http://lwf.ncdc.noaa.gov/oa/ncdc.html.

1-3 **ACCESSING THE DATA.** To access the data, go to the AFCCC Web site at http://www.afccc.af.mil/ and follow the instructions in paragraph 1-3.1, 1-3.2, 1-3.3, or Appendix A.

1-3.1 **Retrieving Data for DOD (.mil Domain) Users**. Follow the procedures outlined in Appendix A. Open the data from the site or save it to disk for future viewing. Each site is presented in an 18-page Adobe Acrobat file (PDF) format and will require Adobe® Acrobat® Reader to view the file. To comply with Standard 90.1-2001, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, co-sponsored by the American Society of Heating, Refrigerating, and Air Conditioning Engineers and the Illuminating Engineering Society of North America (ASHRAE/IESNA) and approved by the American National Standards Institute (ANSI), the AFCCC has added a separate file containing all cooling degree-day data based on 50 °F for all sites. Paragraph 2-10.1.3 covers the use of this file in more detail. Bin Temperature Data .csv files are suitable for importing into Microsoft® Excel.

1-3.2 **Retrieving Data by World Meteorological Organization (WMO) Number**. Follow the procedures outlined in Appendix A. The product locator WMO menu requires a six-digit input. Many of the locations in Chapter 3 have five-digit WMO numbers; therefore, when inputting a five-digit WMO, you must enter a leading zero. For example: Paris has a WMO number of 71490; input 071490 in the appropriate space.

1-3.3 **Retrieving Data for Non-DOD (.mil Domain) Users**. Non-DOD users (e.g., contractors) may access data from the AFCCC Web Site by following these instructions:

1. Open the initial AFCCC page: http://www.afccc.af.mil/ and select the OTHER DOMAIN button. Answer any Security Alert prompts appropriately.

2. When the main AFCCC page displays, select the Support Request (SAR) button from the column on the left. A Support Assistance Request form will display.

3. Fill in this form and select the Submit button. The form requires you to input the subject, the unit you are supporting, a point of contact at that unit, the contract number, an e-mail address for the person who will receive the data, a complete description of the information being requested (e.g., site location, WMO number, coordinates), a suspense date, and a statement about how the data applies to the mission.

AFCCC must be able to verify that the contractor is working on a valid DOD contract before providing the information. AFCCC will then e-mail the appropriate PDF file for the site requested. Non-DOD contractors and vendors must contact the National Climatic Data Center (NCDC) to purchase the Engineering Weather Data (EWD) CD. Visit the NCDC Web site at http://lwf.ncdc.noaa.gov/oa/ncdc.html or call (828) 271-4800, ext. 3170.

1-4 REFERENCES

1-4.1 Government Publications

1. U.S. Army Corps of Engineers Engineering Division Directorate of Military Programs Washington, DC 20314 UFC Internet site http://65.204.17.188//report/doc_ufc.html	UFC 3-310-01, Load Assumptions for Buildings
2. Department of the Air Force	AFM 88-29 [AFH(I) 32-1163], Engineering Weather Data

1-4.2 Non-government Publications

1. American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) 1791 Tullie Circle, N.E. Atlanta, GA 30329	2001 ASHRAE Handbook: Fundamentals Standard 90.1-2001, Energy Standard for Buildings Except Low-Rise Residential Buildings, ASHRAE/IESNA
2. ASHRAE Journal, November 1997, pp: 37-45	"Dehumidification and Cooling Loads from Ventilation Air," Harriman, Plager, and Kosar
3. Society of American Military Engineers Prince Street, Bldg 607 Alexandria, VA 22314	Fact Book of the Society of American Military Engineers, June 1995
4. American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191-4400	ANSI/ASCE 7-95, Minimum Design Loads for Buildings and Other Structures
5. Missouri Water Well and Pump Contractors Association, Inc. 601 Dempsey Road Westerville, OH 43081	Water Well Handbook, 5th ed., 1984, Keith E. Anderson
6. Building Officials and Code Administrators (BOCA) International, Inc. 4051 West Flossmoor Road Country Club Hills, IL 60478	International Plumbing Code, 2000
7. LINRIC Company 44 Greenmeadow Lane Bedford, NH 03110	PSYFUNC Algorithms, 1996, James Judge, P.E.
8. National Renewable Energy Laboratory 1617 Cole Blvd Golden, CO, 80401	Solar Radiation Data Manual for Buildings, 1995

CHAPTER 2

DATA DESCRIPTION AND APPLICATIONS

2-1 **INTRODUCTION.** This chapter summarizes each page in a typical site data set and provides guidance for using the data.

2-2 **DATA SET PAGE 1: CLIMATE SUMMARY**. Figure 2-1 is a sample of Data Set Page 1, which summarizes the site's climate.

2-2.1 **Location Information.** This section of Data Set Page 1 contains a summary table that includes site name, location, elevation (above mean sea level), WMO number, period of record (POR), and average (atmospheric) pressure not corrected to sea level (higher elevations result in lower pressures). The WMO number is a unique number assigned to every location in the world that takes and transmits regular weather observations. The POR is the time frame over which the data used to compute the statistics in this document were compiled.

2-2.2 **Design Values**

2-2.2.1 **Explanation of Design Values**. Design values are provided for dry bulb temperature, wet bulb temperature, and humidity ratio at specific percentile frequencies of occurrence. The old EWD summer design values of 1%, 2.5%, and 5% were based on the warmest four months of the year. In the United States this was standardized as June through September. The new design values of 0.4%, 1%, and 2% are based on the entire year. The old winter design values of 99% and 97.5% were based on the three coldest months of the year (December through February). The new winter design values of 99.6%, 99%, and 97.5% are based on the entire year. In other words, the new design values are **annual** values, not **seasonal** values. In general, for mid-latitude locations with continental climates (hot summer, cold winter), there are some *generalizations* that can be made about the differences between the old and new values. The new 0.4% annual value is comparable to the old 1% seasonal value. The new 1% annual value is usually about a degree cooler than the old 2.5% seasonal value. The new 2% annual value is similar to the old 5% seasonal value. The new 99.6% and 99% annual values are generally cooler than the old 99% and 97.5% seasonal values; however, there is more variability between stations. The new design values were instituted for several reasons. At some locations, the warmest or coldest months of the year do not fall into the months listed above. It is easier to compare locations that are in tropical or marine climates where there is less seasonal variability. It is also more straightforward to compare southern hemisphere locations.

2-2.2.2 **Dry Bulb Temperature**

2-2.2.2.1 **Median of Extreme Highs (or Lows)**. The dry bulb temperature extreme high (or low) is determined for each calendar year of the POR along with the coincident values for wet bulb temperature, humidity ratio, wind speed, and prevailing wind direction. Median values are determined from the distribution of extreme highs (or lows).

Figure 2-1. Sample Data Set Page 1

SCOTT AFB/BELLEVILLE IL	
Latitude = 38.55 N	WMO No. 724338
Longitude = 89.85 W	Elevation = 453 feet
Period of Record = 1967 to 1996	Average Pressure = 29.52 inches Hg

Design Criteria Data

Dry Bulb Temperature (T)	**Design Value (°F)**	Mean Coincident (Average) Values: Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	99	78	110	7.3	SSW
0.4% Occurrence	95	78	117	7.6	S
1.0% Occurrence	92	76	115	7.7	S
2.0% Occurrence	90	75	111	7.6	S
Mean Daily Range	19	-	-	-	-
97.5% Occurrence	16	14	8	7.6	NW
99.0% Occurrence	9	8	6	7.6	NW
99.6% Occurrence	3	2	4	7.5	NNW
Median of Extreme Lows	-3	-4	3	7.0	NW

Wet Bulb Temperature (T_{wb})	**Design Value (°F)**	Mean Coincident (Average) Values: Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	82	92	146	6.8	S
0.4% Occurrence	80	91	136	6.6	S
1.0% Occurrence	78	88	128	6.6	S
2.0% Occurrence	77	87	125	6.4	S

Humidity Ratio (HR)	**Design Value (gr/lb)**	Mean Coincident (Average) Values: Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	153	89	1.00	6.0	S
0.4% Occurrence	142	87	0.94	5.2	S
1.0% Occurrence	134	85	0.88	5.8	S
2.0% Occurrence	129	84	0.85	5.2	S

Air Conditioning/ Humid Area Criteria		$T \geq 93^oF$	$T \geq 80^oF$	$T_{wb} \geq 73^oF$	$T_{wb} \geq 67^oF$
	# of Hours	84	1033	773	1897

Other Site Data

Weather Region	Rain Rate 100 Year Recurrence (in./hr)	Basic Wind Speed 3 sec gust @ 33 ft 50 Year Recurrence (mph)	Ventilation Cooling Load Index (Ton-hr/cfm/yr) Base 75°F-RH 60% Latent + Sensible
7	3.3	90	2.7 + 1.1
Ground Water Temperature (°F) 50 Foot Depth *	Frost Depth 50 Year Recurrence (in.)	Ground Snow Load 50 Year Recurrence (lb/ft^2)	Average Annual Freeze-Thaw Cycles (#)
57.9	38	15	53

**NOTE*: Temperatures at greater depths can be estimated by adding 1.5°F per 100 feet additional depth.

2-2.2.2.2 **0.4%, 1.0%, 2.0%, 97.5%, 99.0%, and 99.6% Dry Bulb Design Values**. Listed is the dry bulb temperature corresponding to a given annual cumulative frequency of occurrence and its respective mean coincident values for wet bulb temperature, humidity ratio, wind speed, and prevailing wind direction. The dry bulb temperature listed represents the value that was exceeded for the respective percent of time over the entire POR. For example, the 1.0% occurrence design value temperature (92 °F) has been exceeded only 1 percent of the time during the entire POR. All the observations occurring within one degree of the design value are grouped, and the Mean Coincident (Average) Values for Wet Bulb Temperature, Humidity Ratio, and Wind Speed are calculated. The prevailing wind direction (the “mode” of the wind direction distribution) is also calculated.

2-2.2.2.3 **Mean Daily Range**. The mean daily range (difference between daily maximum and daily minimum temperatures) is the average of all daily dry bulb temperature ranges for the POR.

2-2.3 **Wet Bulb Temperature**

2-2.3.1 **Median of Extreme Highs**. The Median of Extreme Highs value for wet bulb temperature is the highest annual extreme wet bulb temperature averaged over the POR. The corresponding Mean Coincident (Average) Values are determined the same way as for the respective values for dry bulb temperature.

2-2.3.2 **0.4%, 1.0 %, 2.0% Wet Bulb Temperature Design Values**. The design values listed and the corresponding Mean Coincident (Average) Values are determined the same way as for dry bulb temperature, described in 2-2.2.2.2.

2-2.4 **Humidity Ratio**

2-2.4.1 **Median of Extreme Highs**. The value for humidity ratio is the highest annual extreme averaged over the POR. The corresponding Mean Coincident (Average) Values are determined the same way as described in 2-2.2.2.2.

2-2.4.2 **0.4%, 1.0%, and 2.0% Humidity Ratio Design Values**. Design values are provided for humidity ratio and the corresponding Mean Coincident (Average) Values for dry bulb temperature, vapor pressure, wind speed, and wind prevailing direction.

2-2.5 **Air Conditioning/Humid Area Criteria**. These are the number of hours, on average, that dry bulb temperatures of 34 °C (93 °F) and 27 °C (80 °F) and wet bulb temperatures of 23 °C (73 °F) and 19 °C (67 °F) are equaled or exceeded during the year.

2-2.6 **Other Site Data.** This information is provided **for general reference only, and should not be used as the basis for design**. There are some locations for which this data is not available. In these cases, that portion of the table will be left blank.

2-2.6.1 **Weather Region**. Eleven weather regions have been developed by the Department of Energy. They are defined by the range of cooling-degree days and heating-degree days based on 65 °F. ASHRAE/IESNA Standard 90.1 of 2001 uses annual HDD65 (Heating Degree Days based on 65 °F) and CDD50 (Cooling Degree Days based on 50 °F) to select the appropriate Building Envelope Requirements table for energy conservation design. Refer to paragraph 2-10 for further explanation of this data.

2-2.6.2 **Ventilation Cooling Load Index**. The Ventilation Cooling Load Index (VCLI) is a two-part index that defines the total annual cooling load for ventilation air by calculating sensible heat load separately from the latent heat load (moisture). The results are expressed in ton-hours per cubic feet per minute per year of latent and sensible load. Values for sensible heat load are calculated by comparing the outdoor temperature to indoor conditions (75 °F and 60% relative humidity [RH]), and calculating how much energy is required to bring the outdoor air to the indoor temperature. The latent load is calculated similarly. Separate calculations are made for each hour of the year and then summed to form the annual VCLI.

2-2.6.3 **Average Annual Freeze-Thaw Cycles**. This value is the average number of times per year that the air temperature first drops below freezing and then rises above freezing, regardless of the duration of either the freezing or thawing. The number of cycles is summed per year and averaged over the entire POR. Days with high temperatures or low temperatures at 0 °C (32 °F) are not counted for a freeze-thaw cycle. A cycle is counted only when the temperature drops below freezing (-0.5 °C [31 °F] or colder) or goes above freezing (0.5 °C [33 °F] or warmer).

2-2.6.4 **Other Values**. The following values are derived from sources other than the AFCCC. Engineers and architects should review the publications listed below and contact the organizations for current values, including background information and complete guidelines for use of these data elements.

2-2.6.4.1 **Groundwater**

The National Ground Water Educational Foundation
601 Dempsey Road
Westerville OH 43081-8978
(800) 551-7379

NOTE: Average groundwater temperature parallels long-term average air temperature, because soil at a depth of 15 meters (50 feet) does not undergo significant temperature change over the course of a year. Soil temperature at 15 meters stays slightly warmer than average annual air temperature by approximately 1.4 °C (2.5 °F).

2-2.6.4.2 **Rain Rate**

International Plumbing Code
BOCA International
4051 West Flossmoor Road
Country Club Hills IL 60478
(708) 799-2300

2-2.6.4.3 **Frost Depth, Basic Wind Speed, Ground Snow Loads**

ANSI/ASCE 7-95, *Minimum Design Loads for Buildings and Other Structures*
American Society of Civil Engineers
1015 15th Street NW, Suite 600
Washington DC 20005
(800) 548-2723

NOTE: Use UFC 3-310-01, *Load Assumptions for Buildings*, for reference on some frost depth and ground snow load values.

2-2.7 **Suggestions For Use.** The dry bulb, wet bulb, and humidity ratio values in Figure 2-1 are peak load conditions and are used for sizing mechanical equipment. Design guidance determines the frequency of occurrence design is to be based upon.

2-2.7.1 **Dry Bulb Temperature**. The 0.4% dry bulb temperature value is seldom used for sizing conventional comfort control systems but is sometimes appropriate for mission-critical systems where equipment failure due to high heat would be unacceptable. Using the 0.4% value for equipment sizing requires that the engineer consider its operation at less-than-peak design conditions. In the past, oversized cooling equipment has been incapable of modulating during the more common range of operating conditions, yielding comfort control problems. Also, over-sized equipment cycles on and off more frequently, increasing maintenance costs and failing to remove enough moisture to maintain humidity control.

2-2.7.1.1 Similar special considerations apply to the extreme low dry bulb temperature. Heating equipment designed for extreme conditions must be evaluated carefully to ensure that it will modulate properly to maintain comfort at less extreme outdoor temperatures that occur in 99.6% of the hours during the year.

2-2.7.1.2 The mean coincident value for humidity at the 0.4% peak dry bulb temperature is not the highest moisture value and must not be used for design of humidity control systems. The mean coincident value is the arithmetic average of all the moisture levels that occur when the dry bulb temperature is high; however, the highest moisture values typically occur when the dry bulb temperatures are lower.

2-2.7.2 **Wet Bulb Temperature**. High wet bulb temperature is used for sizing cooling towers and other evaporative equipment.

2-2.7.3 **Peak Humidity Ratio**. Peak humidity ratio is used for sizing dehumidification systems. Peak moisture condition usually represents a higher enthalpy (total heat) than peak dry bulb condition. Consequently, engineers use the peak moisture condition to cross-check operation of a system that may be primarily intended to control temperature.

2-2.7.4 **Coincident Wind Speed**. Coincident wind speed allows the engineer to accurately estimate latent loads due to infiltration of humid air in the summer and of dry air in the winter.

NOTE: The same precautions that apply to heating and cooling equipment also apply to dehumidification and humidification systems. Oversized equipment may not control properly under typical operating conditions without special attention from the engineer.

2-3 **DATA SET PAGE 2: AVERAGE ANNUAL CLIMATE**. Figure 2-2 is an example of Data Set Page 2, a graph summarizing the site's average annual climate.

2-3.1 **Explanation of Graph.** The graph on Data Set Page 2 shows the site's monthly mean temperature, dew point, and precipitation. The bar graph representing precipitation uses the scale on the right side of the chart (inches or centimeters). Lines of temperature and dew point use the scale on the left side of the chart (degrees Fahrenheit or Celsius). These charts have fixed maximum and minimum values on their axes for easy comparison between different sites. The precipitation chart is capped at a maximum of 45 centimeters (15 inches) per month. A few sites may exceed this value, but to keep the graph readable, a fixed maximum value was used. For a number of sites, no accurate precipitation data was available. In those cases, no bars appear on the chart.

2-3.2 **Suggestions For Use**

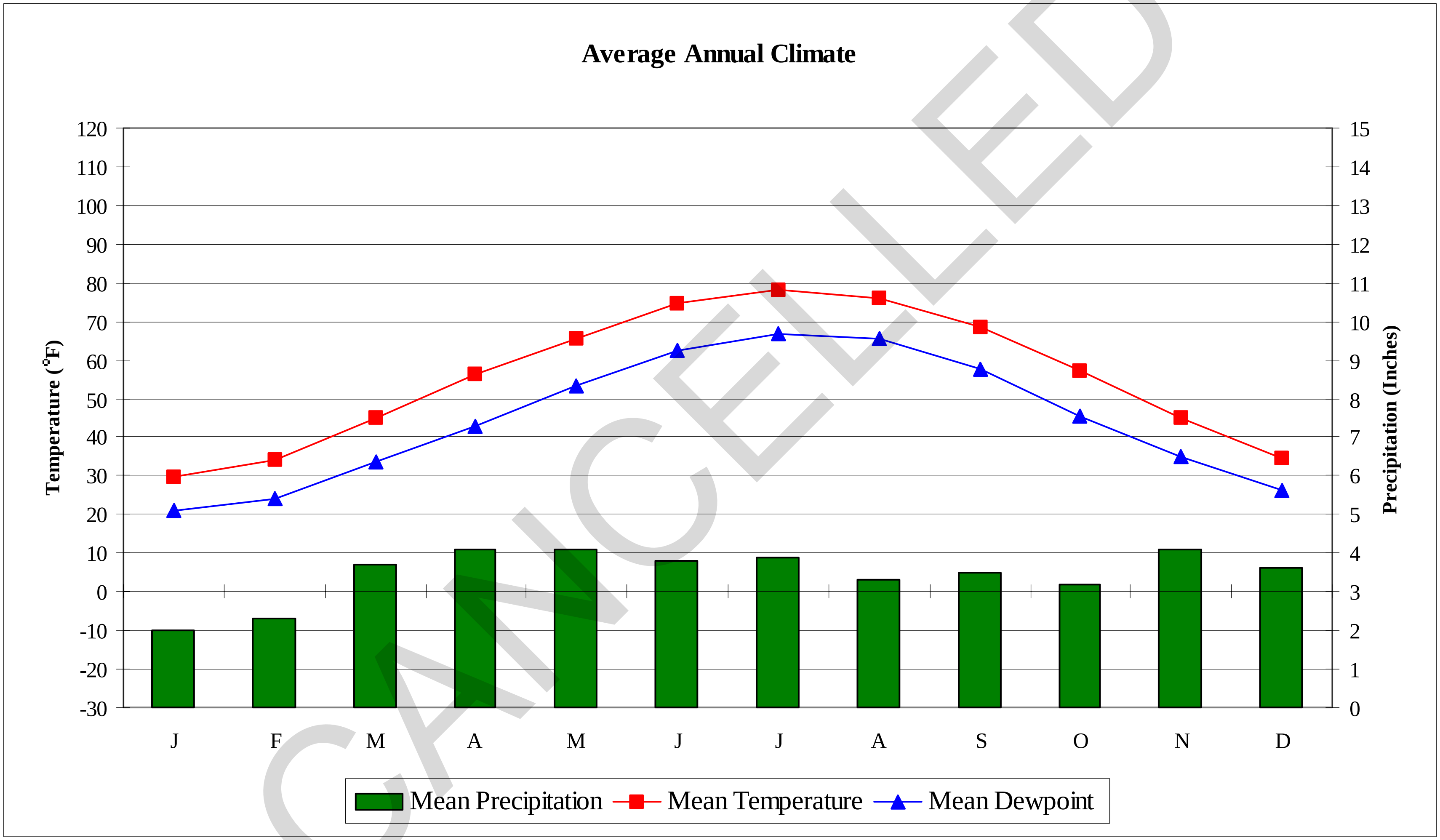
2-3.2.1 The Data Set Page 2 graph displays the average behavior of weather over a single year. An architect can compare rainfall patterns at one station with another and also the relative importance of water resistance for the exterior envelope. An engineer can compare the temperature and moisture patterns to understand the relative importance of sensible heat loads rather than latent loads at this location.

2-3.2.2 With averages displayed by month, it is relatively easy to comprehend seasonal variation of each variable, and also to understand which specific months are likely to be hot or cold, humid or dry, or have high precipitation. This can be helpful for mission planning, as well as for planning construction and building operation.

NOTE: This graph displays averages, not design or extreme values. Data shown should not be used to determine equipment capacities or thermal characteristics of building envelopes.

Figure 2-2. Sample Data Set Page 2

SCOTT AFB/BELLEVILLE IL WMO No. 724338



2-4 **DATA SET PAGE 3: 30-YEAR PSYCHROMETRIC SUMMARY**. Figure 2-3 is an example of Data Set Page 3, a graph summarizing the site's psychrometric data.

2-4.1 Explanation of Graph

2-4.1.1 The graph displays the joint cumulative percent frequency of temperature and humidity ratio. Hourly observations are grouped into bins of 5 Fahrenheit degrees and 10 grains per pound (gr/lb) (or 3 Celsius degrees and 1.5 grams per kilogram [g/kg]), centered on each value of temperature or humidity ratio. For example, the 70 °F temperature bin collects all observations between 67.5 °F and 72.5 °F. The bin is depicted as a gridline on the chart; the vertical lines represent the temperature bins and the horizontal lines represent the humidity ratio bins. The intersection of temperature and humidity ratio lines represent a further subdivision of the observations into groups meeting both temperature and humidity ratio criteria. For example, the intersection of the 70 °F bin line and the 40 gr/lb bin line represent the observations when temperature was between 67.5 °F and 72.4 °F and the humidity ratio was between 35 gr/lb and 44 gr/lb. Thus, a joint-frequency table is created for all temperature and humidity ratio bin combinations.

NOTE: The psychrometric graph is intended as a visual tool only. Its purpose is to allow a quick visual comparison between climates at different locations. Extrapolation of data directly from the graph is not advised due to the approximate plotting routine used to generate the graph from the binned data. This is evident where values of humidity appear past their saturation point. This discrepancy between the actual data and the graph is the result of the plotting routine used to generate the graph and not from errors in the original hourly data used to create the binned summary.

2-4.1.2 The contours on this chart represent the areas containing 99%, 97.5%, 95%, 80%, and 50% of all observations (cumulative percent frequency or percentiles). The contours are centered on the most frequently occurring bins (50% contour), spreading outward until almost all observations (99%) are grouped. Contours are defined by calculating a percent frequency for each bin (relative to the others), and then accumulating these percent frequencies (from most frequent to least frequent) until the 50% value is passed, and thus the first set of bins is grouped. The accumulating continues until the 80% value is passed, and the second group of bins is grouped. This process continues until the 95%, 97.5%, and 99% values are passed.

2-4.1.3 Consequently, the least frequent (most extreme) bins, which when accumulated amount to less than 1 percent of the total observations, are outside of the 99% contour. Any bins outside the 99% contour thus have either not occurred, or have occurred so infrequently that they should not be taken into consideration for sizing equipment.

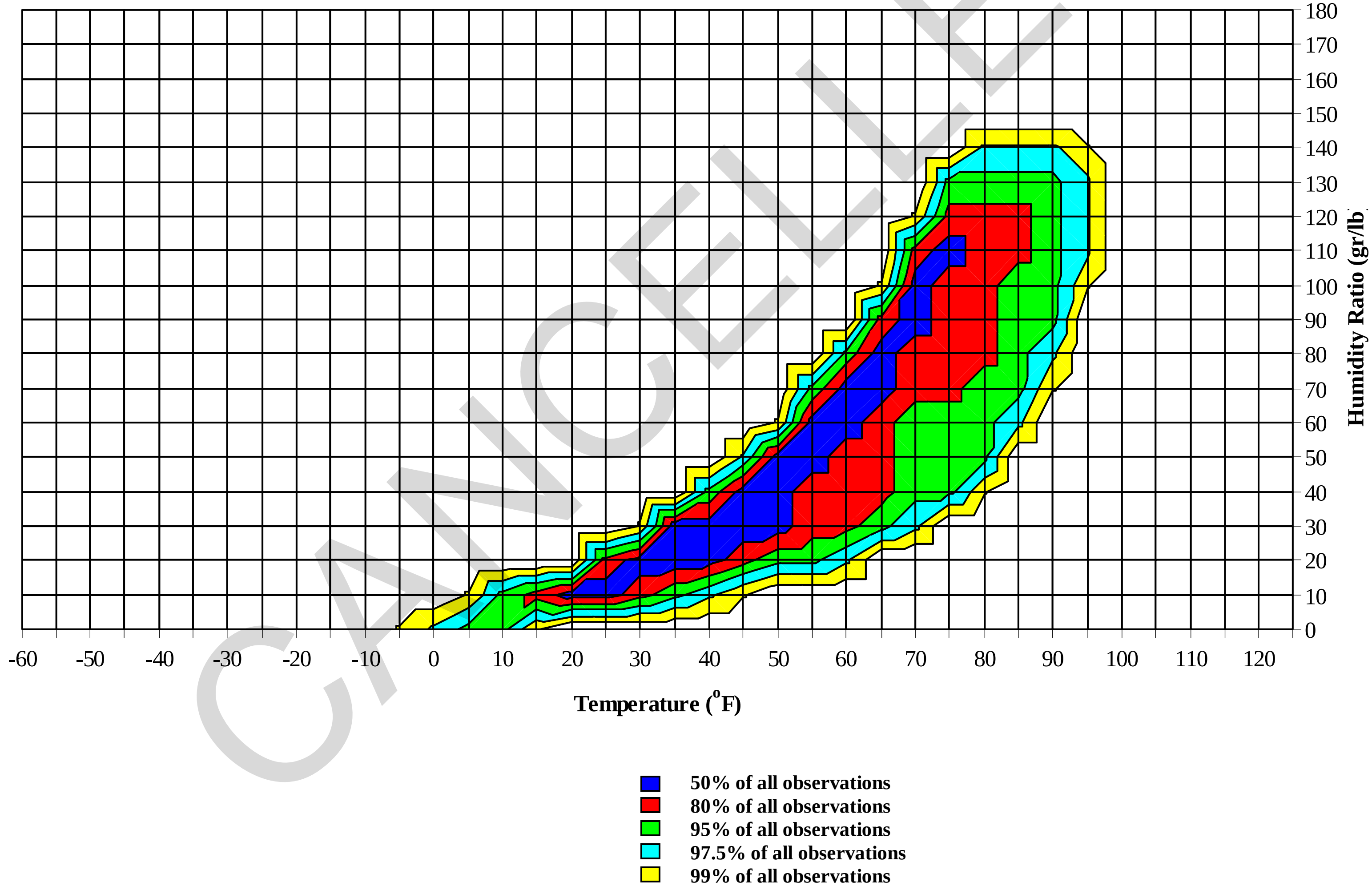
2-4.2 Suggestions For Use

2-4.2.1 The Data Set Page 3 graph displays the long-term history of temperature and moisture at each station (a total of 262,800 hourly observations if the POR is 30 years and if the data is complete over that period). The engineer can use this graph to ascertain the most common temperature and moisture conditions that will be encountered over the operating life of the mechanical equipment.

Figure 2-3. Sample Data Set Page 3

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Long Term Psychrometric Summary



2-4.2.2 It is often useful to calculate the behavior of the proposed system at “most common” conditions and assess these calculations in addition to the traditional peak design calculations. This will help ensure that the selected equipment and controls are capable of modulation and control at all points of operation rather than simply at extreme conditions.

2-5 **DATA SET PAGE 4: PSYCHROMETRIC DISPLAY OF DESIGN VALUES**. Figure 2-4 is an example of Data Set Page 4, a psychometric display of the site’s design values.

2-5.1 Similar to Data Set Page 3, this chart depicts the saturation curve (when RH = 100%) along with peak design values. The design values are calculated as in the table on Data Set Page 1 (Figure 2-1), but this chart shows their relationships graphically, depicting their position relative to each other and relative to the saturation curve.

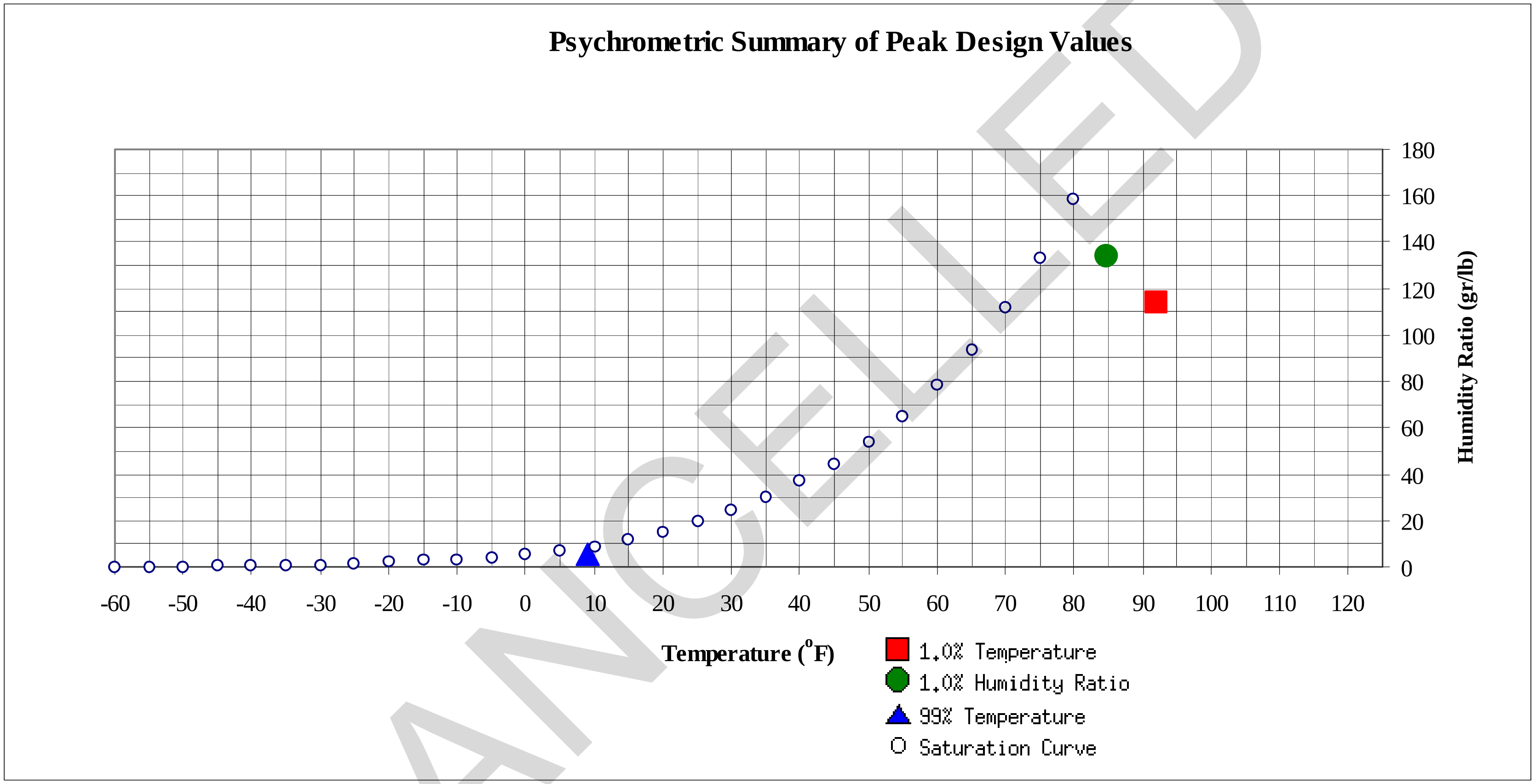
2-5.2 Above and to the left of the saturation curve, RH would be greater than 100% (not possible). The area below and to the right of the curve (including the points on the curve itself) represent the area where RH is less than or equal to 100%, and thus where all observations occur. Note that since the humidity ratio is a function of pressure, and pressure varies with elevation, different sites will have different saturation curves.

2-5.3 The dry bulb temperature is the horizontal coordinate on this scatter plot, and the humidity ratio is the vertical coordinate. Peak design values are depicted by the red square (1.0% Temperature [dry bulb]), the green circle (1.0% Humidity Ratio), and the blue diamond (99% Temperature [dry bulb]).

2-5.4 The table below the chart shows the exact values of 99% dry bulb temperature, 1.0% humidity ratio, and 1.0% dry bulb temperature, along with calculated values of enthalpy, mean coincident wet bulb temperature, and humidity ratio (as applicable). The value of enthalpy coincident to each temperature/humidity ratio is created using the psychrometric functions provided by the Linric Company, Bedford, New Hampshire. The dry bulb temperature and humidity ratio are used to calculate enthalpy using the Linric algorithms.

Figure 2-4. Sample Data Set Page 4

SCOTT AFB/BELLEVILLE IL WMO No. 724338



	(°F)	MCHR (gr/lb)	Enthalpy (btu/lb)		(gr/lb)	MCDB (°F)	MCWB (°F)	MC Dewpt (°F)	Enthalpy (btu/lb)
99% Dry Bulb	9	5.6	3.0	**1.0% Humidity Ratio**	133.7	84.8	77.6	75	41.3

	(°F)	MCHR (gr/lb)	MCWB (°F)	Enthalpy (btu/lb)
1.0% Dry Bulb	92	113.8	76.3	40.0

2-6 **DATA SET PAGES 5 THROUGH 9: TEMPERATURE BIN DATA.** Figures 2-5 through 2-9 are examples of Data Set Pages 5 through 9, respectively. These tables show the number of hours that temperatures occur in 5 Fahrenheit degree (3 Celcius degree) bins of specific 8-hour daily periods during a given month. The 8-hour periods are based upon a 24-hour clock and displayed in Local Standard Time (LST). For each month, the number of observations for each temperature bin during each of the specific 8-hour periods of the day appear in a column under the specific Hour Group (LST). The total number of observations (hours) in each temperature bin is displayed in the "Total Obs" column for the month. The mean coincident wet bulb temperature is the mean value of all those wet bulb temperatures that occur coincidentally with the dry bulb temperatures in the particular 5° temperature bin. At the upper, or warmer, end of the mean coincident wet bulb distribution, the values occasionally reverse their trend because the highest wet bulb temperatures do not necessarily occur with the highest dry bulb temperatures. There are 13 such tables, one for each month and one representing the overall annual summary (Data Set Page 9).

2-6.1 **Suggestions for Use.** Binned summaries are used by many different technical disciplines for different purposes. They are useful in making informal estimates of energy consumption by cooling and heating equipment, and for gaining a general understanding of patterns of temperature and moisture at different times of the day, month, and year.

NOTE: Do not use these binned summaries to calculate design moisture loads.

2-6.2 **Comments**. These particular binned summaries are based on the dry bulb temperature. After each observation has been placed into a dry bulb bin, the average humidity ratio is calculated for all observations in each bin. Consequently, dry bulb bins underestimate the magnitude of dehumidification and humidification loads because the averaging calculation "flattens" the peaks and valleys of humidity ratios. The amount of the underestimation varies according to the intended humidity control level.

Figure 2-5. Sample Data Set Page 5

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Dry-Bulb Temperature Hours For An Average Year (Sheet 1 of 5)

Period of Record = 1967 to 1996

	January					February					March				
	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB
Temperature Range (°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)
100 / 104															
95 / 99															
90 / 94															
85 / 89												0	0	0	65.0
80 / 84												3	0	3	64.4
75 / 79							0	0	1	60.7		6	1	7	62.2
70 / 74		1		1	59.5		2	0	2	58.2	0	12	5	17	60.3
65 / 69	0	1	0	2	58.0		4	1	5	54.8	2	16	12	30	57.2
60 / 64	1	4	1	6	54.6	1	8	4	13	53.0	9	21	17	47	54.2
55 / 59	2	7	4	13	51.7	4	12	8	24	50.2	14	27	24	65	50.3
50 / 54	4	11	7	22	46.9	5	15	11	31	45.5	21	33	33	87	46.2
45 / 49	5	18	12	35	42.1	9	22	19	50	41.8	33	35	37	105	42.3
40 / 44	17	30	26	72	38.1	22	33	29	84	37.8	38	34	38	111	37.8
35 / 39	34	38	40	112	33.7	39	38	41	119	33.7	43	31	34	108	33.4
30 / 34	51	42	51	143	29.5	42	30	39	111	29.2	43	19	28	89	29.2
25 / 29	35	34	34	102	24.5	37	25	28	90	24.5	28	9	13	50	24.5
20 / 24	32	24	28	84	19.7	21	16	17	54	19.7	11	2	3	16	20.1
15 / 19	25	18	21	64	15.1	15	9	13	37	15.1	3	1	1	5	15.4
10 / 14	18	10	13	41	10.4	14	7	8	29	10.6	1	0	1	2	11.0
5 / 9	12	6	7	26	5.7	9	2	4	15	6.0	1	0	0	1	6.3
0 / 4	7	3	4	13	0.9	4	1	1	6	1.4	0			0	0.5
-5 / -1	3	1	1	5	-3.3	1	0	0	1	-2.8					
-10 / -6	2	0	0	2	-7.4	1	0	0	1	-7.9					
-15 / -11	0	0	0	1	-12.7	0			0	-11.4					
-20 / -16	0		0	0	-16.9										

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 2-6. Sample Data Set Page 6

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Dry-Bulb Temperature Hours For An Average Year (Sheet 2 of 5)

Period of Record = 1967 to 1996

	April					May					June				
	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB
Temperature Range (°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)
100 / 104												1	0	1	75.6
95 / 99							0		0	76.0		4	1	5	75.6
90 / 94		1	0	1	70.9		4	1	4	72.7	0	28	8	35	75.1
85 / 89		3	1	4	67.7		18	4	22	70.6	1	54	21	76	73.1
80 / 84		13	3	16	65.8	0	34	13	47	68.2	9	60	40	109	70.5
75 / 79	0	20	9	29	63.9	5	43	27	75	65.7	32	47	55	134	68.6
70 / 74	4	28	19	52	60.8	19	49	42	110	63.2	68	29	56	153	66.6
65 / 69	13	34	31	78	58.1	46	43	51	140	60.5	60	11	34	105	62.8
60 / 64	31	39	36	105	54.7	55	32	46	134	56.8	41	5	18	64	58.4
55 / 59	34	35	41	109	50.5	48	18	35	100	52.6	21	1	5	28	54.3
50 / 54	41	30	37	107	46.5	37	5	21	63	48.1	6		1	7	49.7
45 / 49	46	21	30	97	42.4	27	2	7	36	43.9	1			1	46.3
40 / 44	35	12	20	66	38.1	8	0	2	10	39.2					
35 / 39	21	4	9	34	33.8	3		0	3	35.1					
30 / 34	13	1	4	18	29.8	0			0	30.8					
25 / 29	3	0	0	3	25.3										
20 / 24	0			0	21.5										
15 / 19															
10 / 14															
5 / 9															
0 / 4															
-5 / -1															
-10 / -6															
-15 / -11															
-20 / -16															

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 2-7. Sample Data Set Page 7

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Dry-Bulb Temperature Hours For An Average Year (Sheet 3 of 5)
Period of Record = 1967 to 1996

	July					August					September				
	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB
Temperature Range (°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)
100 / 104		2	0	2	77.5		1	0	1	77.8					
95 / 99		14	3	18	77.9		10	1	12	78.4		2	0	2	76.7
90 / 94	0	49	15	64	76.9		35	8	43	77.1		11	2	12	75.1
85 / 89	2	68	31	102	74.6	1	61	21	83	74.3	0	28	6	34	72.6
80 / 84	19	63	56	138	72.6	9	65	45	118	72.0	1	46	17	64	70.0
75 / 79	63	34	67	163	71.1	43	46	64	153	70.6	11	48	35	94	68.1
70 / 74	86	14	48	149	68.3	76	25	60	160	67.8	41	44	51	137	65.7
65 / 69	48	3	20	71	63.7	61	6	32	99	63.5	46	30	44	120	61.8
60 / 64	22	1	6	29	58.9	38	1	13	52	59.2	46	18	38	103	57.6
55 / 59	7		1	8	54.8	16	0	3	19	54.9	42	8	27	77	53.4
50 / 54	1		0	1	51.2	3		0	4	50.4	30	3	14	47	49.1
45 / 49						0		0	0	45.8	16	0	5	21	44.9
40 / 44											6		2	7	40.2
35 / 39											1		0	2	36.1
30 / 34											0			0	31.5
25 / 29															
20 / 24															
15 / 19															
10 / 14															
5 / 9															
0 / 4															
-5 / -1															
-10 / -6															
-15 / -11															
-20 / -16															

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 2-8. Sample Data Set Page 8

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Dry-Bulb Temperature Hours For An Average Year (Sheet 4 of 5)

Period of Record = 1967 to 1996

	October					November					December				
	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB	Hour Group (LST)				MCWB
Temperature Range (°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)	01 To 08	09 To 16	17 To 00	Total Obs	(°F)
100 / 104															
95 / 99															
90 / 94		0		0	69.4										
85 / 89		4	0	4	68.0										
80 / 84		13	1	14	66.7		0		0	61.2					
75 / 79	1	26	6	33	64.3		3	0	3	62.8					
70 / 74	3	35	19	57	62.1	0	8	2	11	61.9		1	0	1	62.9
65 / 69	17	41	33	91	59.6	2	15	8	26	59.4	1	3	1	4	59.5
60 / 64	30	43	39	112	55.6	12	23	18	53	56.5	2	8	3	13	56.2
55 / 59	37	37	47	121	51.3	15	28	22	65	51.0	6	11	8	26	52.4
50 / 54	44	29	40	113	47.1	23	32	29	84	46.7	8	17	11	36	46.7
45 / 49	46	15	34	95	43.0	31	38	36	105	42.6	12	27	18	58	42.6
40 / 44	36	4	19	59	39.0	39	39	42	119	38.0	27	40	35	102	38.1
35 / 39	23	1	8	33	34.6	44	31	41	117	33.7	42	48	50	140	33.9
30 / 34	9	0	2	11	30.5	40	14	28	82	29.5	52	41	48	140	29.5
25 / 29	2		0	2	25.9	20	5	10	35	25.0	39	23	34	96	24.7
20 / 24						9	2	4	14	20.3	25	12	17	54	20.1
15 / 19						3	1	1	5	15.4	16	7	9	33	15.4
10 / 14						1	0	0	2	10.8	9	6	6	20	10.6
5 / 9						0			0	7.5	4	2	3	10	5.9
0 / 4											3	1	2	6	1.2
-5 / -1											2	1	1	3	-3.5
-10 / -6											1	0	1	2	-7.3
-15 / -11											0	0	0	1	-12.0
-20 / -16															

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 2-9. Sample Data Set Page 9

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Dry-Bulb Temperature Hours For An Average Year (Sheet 5 of 5)

Period of Record = 1967 to 1996

Annual Totals

Temperature Range (°F)	Hour Group (LST) 01 To 08	09 To 16	17 To 00	Total Obs	MCWB (°F)
100 / 104		3	0	3	77.1
95 / 99		31	5	37	77.7
90 / 94	0	127	32	160	76.3
85 / 89	4	236	84	325	73.5
80 / 84	37	296	176	509	70.8
75 / 79	154	274	263	690	68.7
70 / 74	298	247	303	848	65.7
65 / 69	296	207	267	770	61.1
60 / 64	288	201	241	730	56.5
55 / 59	246	184	224	654	51.8
50 / 54	223	175	205	602	47.0
45 / 49	228	179	197	603	42.7
40 / 44	227	192	211	631	38.1
35 / 39	250	192	224	667	33.8
30 / 34	251	146	199	596	29.4
25 / 29	163	95	120	379	24.6
20 / 24	99	54	69	222	19.9
15 / 19	63	36	46	145	15.2
10 / 14	43	24	28	95	10.5
5 / 9	26	11	14	51	5.9
0 / 4	14	5	7	25	1.1
-5 / -1	6	2	2	10	-3.3
-10 / -6	3	1	1	6	-7.5
-15 / -11	1	0	0	2	-12.2
-20 / -16	0		0	0	-16.9

Caution: This summary reflects the typical distribution of temperature in a typical year. It does not reflect the typical moisture distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

2-7 **DATA SET PAGE 10: ANNUAL TEMPERATURE SUMMARY**. Figure 2-10 is an example of Data Set Page 10. This chart shows a week-by-week summary of dry bulb temperatures for the given site. The observations are grouped into 7-day periods (approximate calendar weeks). For example, observations from January 1 through 7 from all years are grouped, observations from January 8 through 14 from all years are grouped, and so on, overlapping the end of one month and beginning of the next month where necessary. The following statistics are shown for each of the 7-day periods:

- *1% Dry Bulb Temp* is the dry bulb temperature that is exceeded 1% of the time during that calendar week.
- *MCWB (1% Dry Bulb)* is the mean of wet bulb temperatures coincident with 1% dry bulb temperatures during the same week.
- *Mean Max Temp* is the daily maximum dry bulb temperature, averaged by week over the POR.
- *Mean Min Temp* is the daily minimum dry bulb temperature, averaged by week over the POR.
- *99% Min Dry Bulb Temp* is the daily dry bulb temperature that is at or above this value 99% of the time, or below this value 1% of the time.

NOTE: The information in this chart is calculated on a weekly basis; information on a climate summary (Data Set Page 1) is calculated on an annual basis.

2-7.1 **Suggestions for Use.** The weekly 1% and 99% temperatures are useful for understanding the probable temperature extremes that can occur during a given week of the year. The weekly dry bulb temperatures are useful for understanding the change of seasons at a given location. The display is helpful for mission planning and construction project planning.

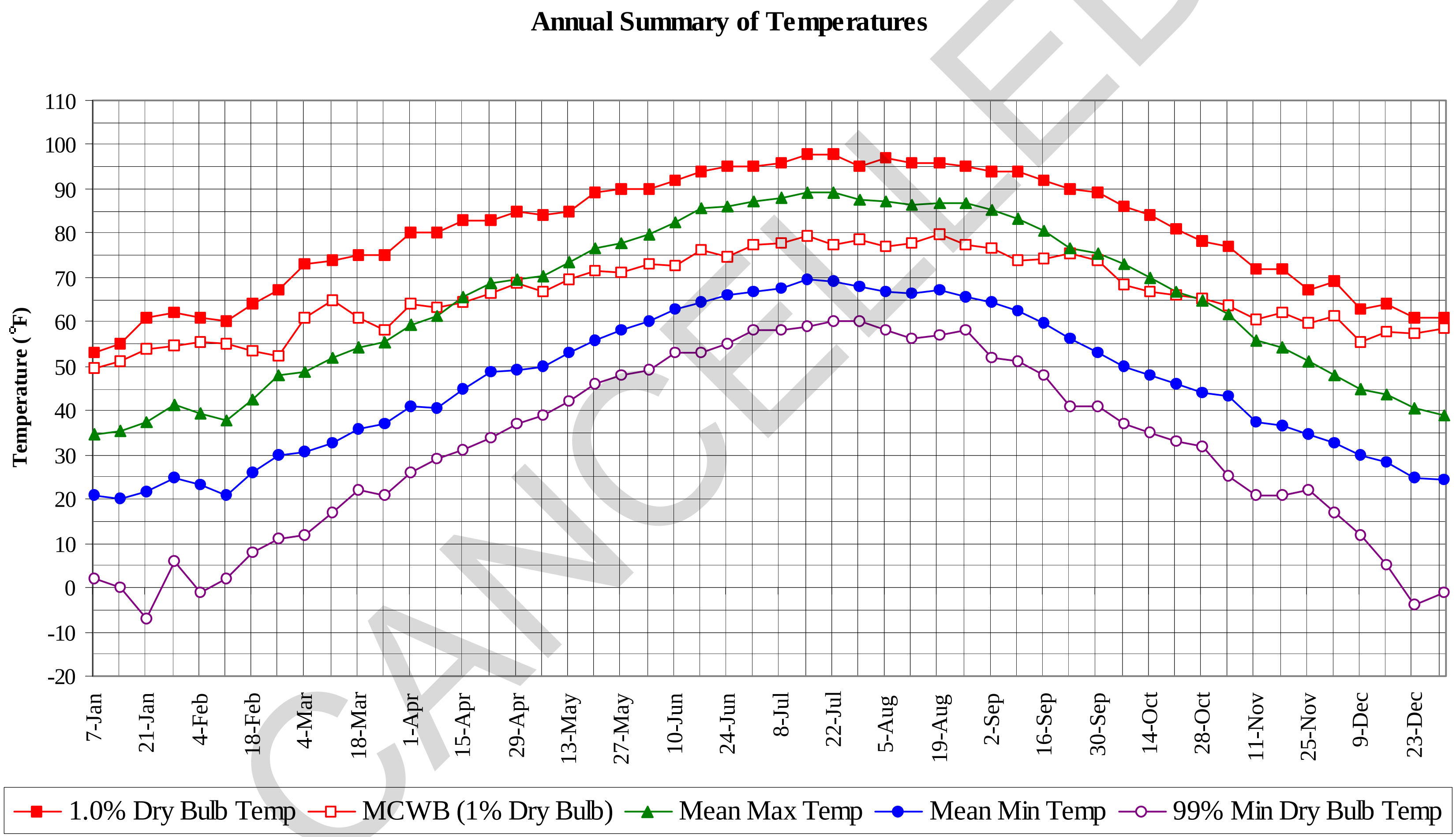
2-7.2 **Special Considerations**

2-7.2.1 **Designers**. The values displayed here are based on the 30-year record. It is important that designers **not** base equipment selection on the “highest” or “lowest” recorded temperature at the station. That error would result in selecting equipment extremely costly to install, which would operate inefficiently for all but the very hottest or coldest single hour in 30 years. See the Design Criteria Data section on Sample Data Set Page 1 (see Figure 2-1) in this document for appropriate maximum and minimum temperatures for sizing equipment.

2-7.2.2 **Construction and Operation Planners**. The mean maximum and minimum temperatures shown for each week seldom occur in the same year. Keep in mind that these are mean values that are useful for understanding the **typical** range of temperatures in a given week. The difference does **not** represent the **actual** day-night temperature swing in a given week.

Figure 2-10. Sample Data Set Page 10

SCOTT AFB/BELLEVILLE IL WMO No. 724338



2-8 **DATA SET PAGE 11: ANNUAL HUMIDITY SUMMARY**. Figure 2-11 is an example of Data Set Page 11. Similar to the annual temperature summary (see Sample Data Set Page 10, Figure 2-10), this chart depicts mean maximum and minimum values of humidity ratio, plus the 1% maximum humidity ratio, along with its mean coincident dry bulb temperature, summarized by calendar week. The chart uses two vertical axes: on the left are the humidity ratio values and on the right is a temperature scale for the mean coincident dry bulb temperature.

2-8.1 **Suggestions for Use.** Weekly humidity ratios are useful for understanding the change of seasons at a given location and the probable high and low moisture levels during a given week of the year. The display is helpful for planning humidity-controlled storage projects and for understanding factors contributing to atmospheric corrosion. Humidity also affects the deterioration rate of building materials and the weathering of military equipment and structures exposed to the elements.

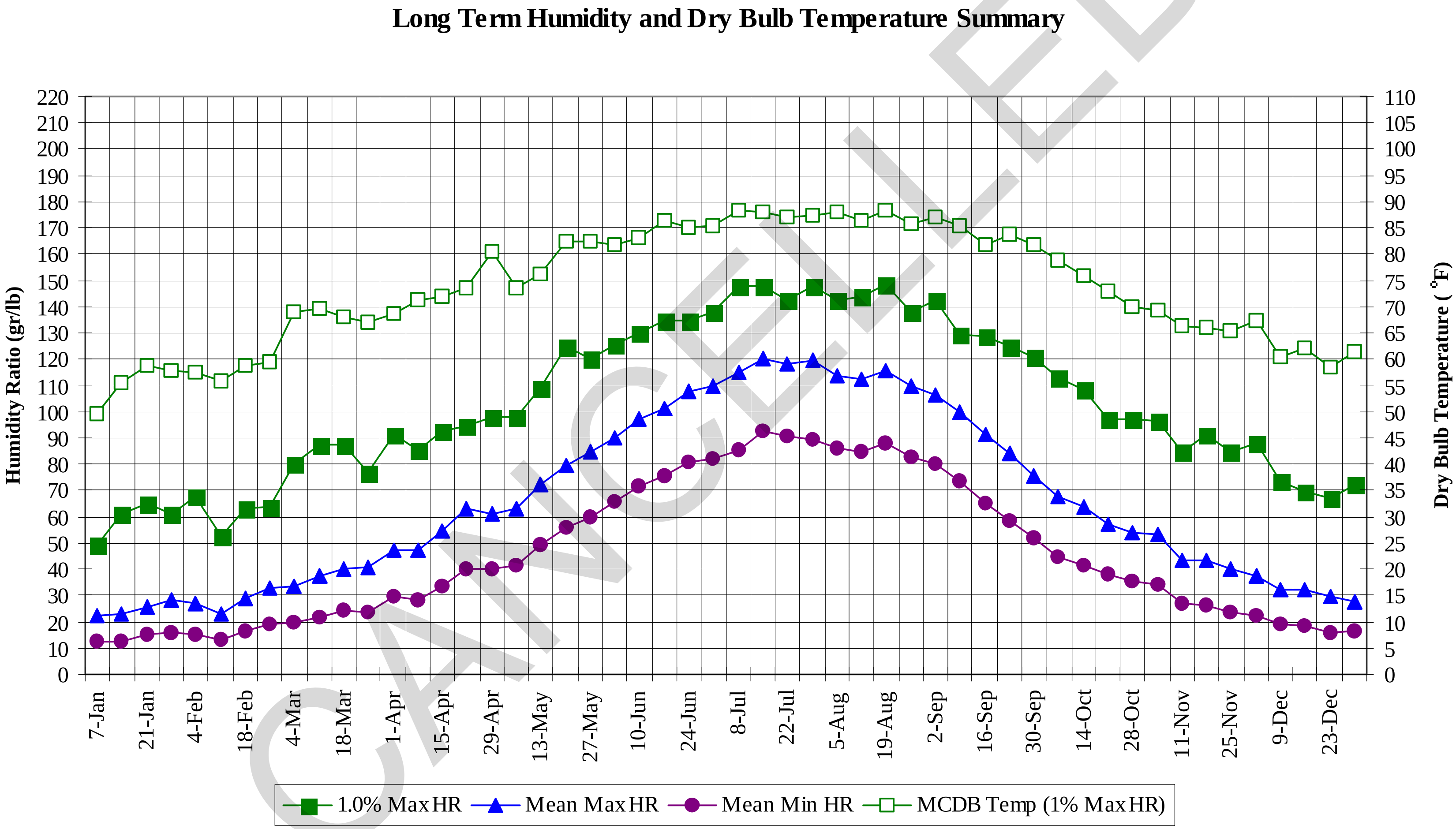
2-8.2 **Special Considerations**

2-8.2.1 **Designers**. The values displayed here are based on the 30-year record. It is important that designers **not** base equipment selection on the “highest” or “lowest” recorded humidity at the station. That error would result in selecting oversized equipment, which would increase costs and might result in control problems at other than extreme conditions. Use design values on Data Set Page 1 (Figure 2-1) for equipment sizing.

2-8.2.2 **Construction and Operation Planners**. The high and low humidity ratios shown for each week seldom occur in the same year. Keep in mind that these are mean values that are useful for understanding the **typical** range of humidity ratio in a given week. The difference does **not** represent the **actual** day-night humidity ratio swing in a given week.

Figure 2-11. Sample Data Set Page 11

SCOTT AFB/BELLEVILLE IL WMO No. 724338



2-9 **DATA SET PAGE 12: ANNUAL DRY BULB TEMPERATURE AND HUMIDITY SUMMARY TABLES**. Figure 2-12 is an example of Data Set Page 12. Data Set Page 12 consists of tables containing the values used to plot the charts on Data Set Page 10 and Data Set Page 11. The left half of the table uses Data Set Page 10 and the right half uses Data Set Page 11.

Figure 2-12. Sample Data Set Page 12

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Long Term Dry Bulb Temperature and Humidity Summary

Week Ending	1.0% Temp (°F)	MCWB @ 1% Temp (°F)	Mean Max Temp (°F)	Mean Min Temp (°F)	99% Temp (°F)	1.0% HR (gr/lb)	MCDB @ 1% HR (°F)	Mean Max HR (gr/lb)	Mean Min HR (gr/lb)
7-Jan	53.0	49.4	34.7	20.9	2.0	49.0	49.6	22.6	12.8
14-Jan	55.0	50.9	35.2	20.1	0.0	60.9	55.6	22.7	12.2
21-Jan	61.0	53.8	37.2	21.7	-7.0	65.1	58.9	25.8	14.8
28-Jan	62.0	54.6	41.4	24.9	6.0	60.9	57.9	28.2	15.8
4-Feb	61.0	55.4	39.2	23.1	-1.0	67.9	57.4	26.6	15.4
11-Feb	60.0	55.2	37.7	21.0	2.0	52.5	55.8	23.2	13.1
18-Feb	64.0	53.6	42.4	25.9	8.0	63.0	58.8	28.6	16.7
25-Feb	67.0	52.4	47.9	30.0	11.0	63.7	59.4	32.8	19.2
4-Mar	73.0	61.1	48.6	30.6	12.0	79.8	69.1	33.3	19.8
11-Mar	74.0	64.8	51.7	32.5	17.0	87.5	69.5	37.5	21.9
18-Mar	75.0	61.0	54.4	35.6	22.0	87.5	68.1	40.2	24.1
25-Mar	75.0	58.3	55.6	36.9	21.0	77.0	67.0	40.6	24.0
1-Apr	80.0	64.0	59.3	40.8	26.0	91.0	68.6	47.2	29.8
8-Apr	80.0	63.3	61.4	40.6	29.0	85.4	71.3	47.3	28.0
15-Apr	83.0	64.4	65.5	44.9	31.0	92.4	71.8	54.6	33.7
22-Apr	83.0	66.4	68.8	48.7	34.0	94.5	73.4	62.9	39.9
29-Apr	85.0	68.9	69.5	49.1	37.0	98.0	80.3	61.4	39.9
6-May	84.0	66.9	70.3	49.9	39.0	98.0	73.7	63.2	41.2
13-May	85.0	69.5	73.6	53.2	42.0	109.2	76.3	72.6	49.5
20-May	89.0	71.6	76.6	55.6	46.0	124.6	82.5	79.7	55.6
27-May	90.0	71.3	77.9	58.1	48.0	120.4	82.3	84.5	59.9
3-Jun	90.0	72.9	79.7	60.1	49.0	125.3	81.8	90.1	65.4
10-Jun	92.0	72.7	82.7	62.9	53.0	130.2	83.2	97.4	71.8
17-Jun	94.0	76.0	85.6	64.4	53.0	134.4	86.4	100.9	75.5
24-Jun	95.0	74.8	86.2	66.0	55.0	134.4	85.0	107.7	80.7
1-Jul	95.0	77.5	87.3	66.8	58.0	137.9	85.3	109.6	82.2
8-Jul	96.0	77.8	88.0	67.7	58.0	147.7	88.4	114.8	85.5
15-Jul	98.0	79.3	89.0	69.6	59.0	147.7	87.9	119.9	92.4
22-Jul	98.0	77.3	89.0	69.0	60.0	142.8	86.9	117.9	90.8
29-Jul	95.0	78.7	87.6	68.2	60.0	147.7	87.2	119.4	89.2
5-Aug	97.0	76.9	87.0	66.8	58.0	142.8	88.1	113.5	86.0
12-Aug	96.0	77.7	86.4	66.4	56.0	143.5	86.4	112.6	84.9
19-Aug	96.0	79.6	86.8	67.0	57.0	148.4	88.2	115.6	88.3
26-Aug	95.0	77.6	86.7	65.6	58.0	137.9	85.6	109.9	82.6
2-Sep	94.0	76.6	85.1	64.5	52.0	142.8	87.1	106.3	80.3
9-Sep	94.0	73.9	83.3	62.5	51.0	129.5	85.4	99.7	73.6
16-Sep	92.0	74.3	80.5	59.6	48.0	128.8	81.6	91.1	65.2
23-Sep	90.0	75.6	76.7	56.0	41.0	124.6	83.7	84.0	58.2
30-Sep	89.0	74.1	75.5	53.1	41.0	121.1	81.9	75.5	52.0
7-Oct	86.0	68.4	73.1	49.8	37.0	112.7	78.9	67.9	44.9
14-Oct	84.0	66.7	69.9	47.8	35.0	108.5	76.0	63.9	41.7
21-Oct	81.0	66.1	66.7	45.9	33.0	97.3	73.0	57.4	37.9
28-Oct	78.0	65.1	64.7	44.2	32.0	97.3	69.8	54.1	35.5
4-Nov	77.0	63.6	61.6	43.1	25.0	96.6	69.3	53.3	34.1
11-Nov	72.0	60.5	55.9	37.3	21.0	84.7	66.5	43.0	26.6
18-Nov	72.0	62.1	54.4	36.8	21.0	91.0	66.0	43.4	26.5
25-Nov	67.0	59.6	51.3	34.7	22.0	84.7	65.4	40.4	23.6
2-Dec	69.0	61.3	48.0	32.7	17.0	88.2	67.2	37.7	22.1
9-Dec	63.0	55.5	44.9	29.9	12.0	73.5	60.5	32.2	19.3
16-Dec	64.0	57.9	43.7	28.3	5.0	69.3	62.2	32.0	18.5
23-Dec	61.0	57.4	40.3	24.6	-4.0	67.2	58.4	29.3	15.9
31-Dec	61.0	58.5	38.9	24.6	-1.0	72.1	61.4	27.7	16.4

2-10 **DATA SET PAGE 13: BUILDING ENVELOPE LOADS**. Figure 2-13 is an example of Data Set Page 13. Data Set Page 13 consists of charts summarizing a site's mean heating and cooling degree days.

2-10.1 **Explanation of Charts**

2-10.1.1 **Calculation of Cooling Degree-Days**. Cooling degree-days are derived by multiplying the number of hours that the outdoor temperature is above the base temperature of 65 °F (18 °C) times the number of degrees of that temperature difference. For example, if 1 hour was observed at a temperature of 78 °F, that observation adds 13 degree-hours to the annual total. The sum of the degree-hours is divided by 24 to yield degree-days.

2-10.1.2 **Calculation of Heating Degree-Days** Heating degree-days are calculated similarly, against the base temperature of 65 °F, so a 1-hour outside temperature observation of 62 °F adds 3 degree-hours to the annual total. Heating degree-days are summed separately from the cooling degree-days. Heating and Cooling degree-hours do not cancel each other out, since both heating and cooling conditions may occur over the course of a given day.

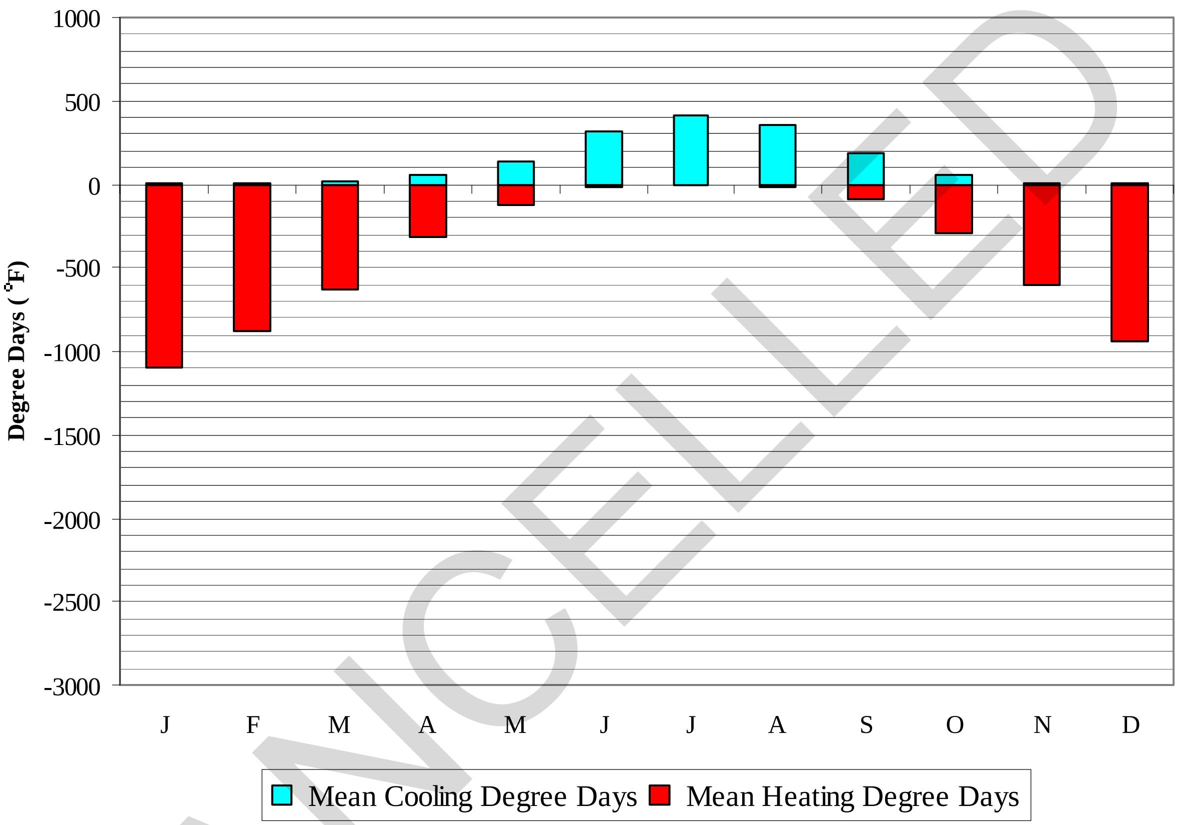
2-10.1.3 **Alternate Cooling Degree-Days Calculation**. A separate file has been added to the AFCCC Web site to include the cooling degree-days based upon a base temperature of 50 °F. This file is located on the Engineering Weather Data page under the Standard EWD Package file. This data is intended to allow selection of the proper Building Envelope Requirements table from within ASHRAE/IESNA Standard 90.1 of 2001 for energy conservation design. The cooling degree-days based on 65 °F tabulated and graphed here are historically used to estimate loads as suggested in paragraph 2-10.2 below.

2-10.2 **Suggestions for Use.** Degree-days are used to estimate the sensible heat and sensible cooling loads on the building envelope. Degree-day loads can be used to estimate the annual energy consumption of a building, provided that the loads from ventilation and infiltration air are also considered (see paragraph 2-11).

Figure 2-13. Sample Data Set Page 13

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Degree Days, Heating and Cooling
(Base 65^{o}F)



	Mean Cooling Degree Days (^{o}F)	Mean Heating Degree Days (^{o}F)
JAN	0	1094
FEB	1	879
MAR	13	634
APR	50	312
MAY	137	122
JUN	314	21
JUL	418	6
AUG	354	14
SEP	188	87
OCT	52	298
NOV	7	608
DEC	0	942
ANN	1534	5017

2-11 **DATA SET PAGE 14: VENTILATION AND INFILTRATION LOADS**. Figure 2-14 is an example of Data Set Page 14. Data Set Page 14 consists of a graph and table that display the independent loads imposed by heating, cooling, humidifying, and dehumidifying outside air as it is brought into a building. The calculation assumes that air inside the building is maintained at conditions between 68 °F (20 °C)/30% RH and 75 °F (24 °C)/60% RH. For the purposes of these calculations, when the outside air is within that range of temperature and moisture, any incoming air is assumed not to impose any load.

These values are calculated with the methodology used to calculate the annual VCLI on Data Set Page One, except that values on this page are computed by month and the result is displayed as British thermal units per cubic foot per minute (Btu/cfm) rather than as ton-hours per CFM per year. The heating and humidifying loads are shown as negative values. Cooling and dehumidifying loads are displayed as positive values.

2-11.1 **Suggestions for Use.** Bringing fresh ventilation air into a building or allowing air to infiltrate into buildings through cracks imposes heating, cooling, dehumidification, and humidification loads on the mechanical system. The information on this data set page helps the architect, engineers, and operating personnel understand the nature and magnitude of those loads on an annual basis. It also shows how the loads vary from month to month throughout the year.

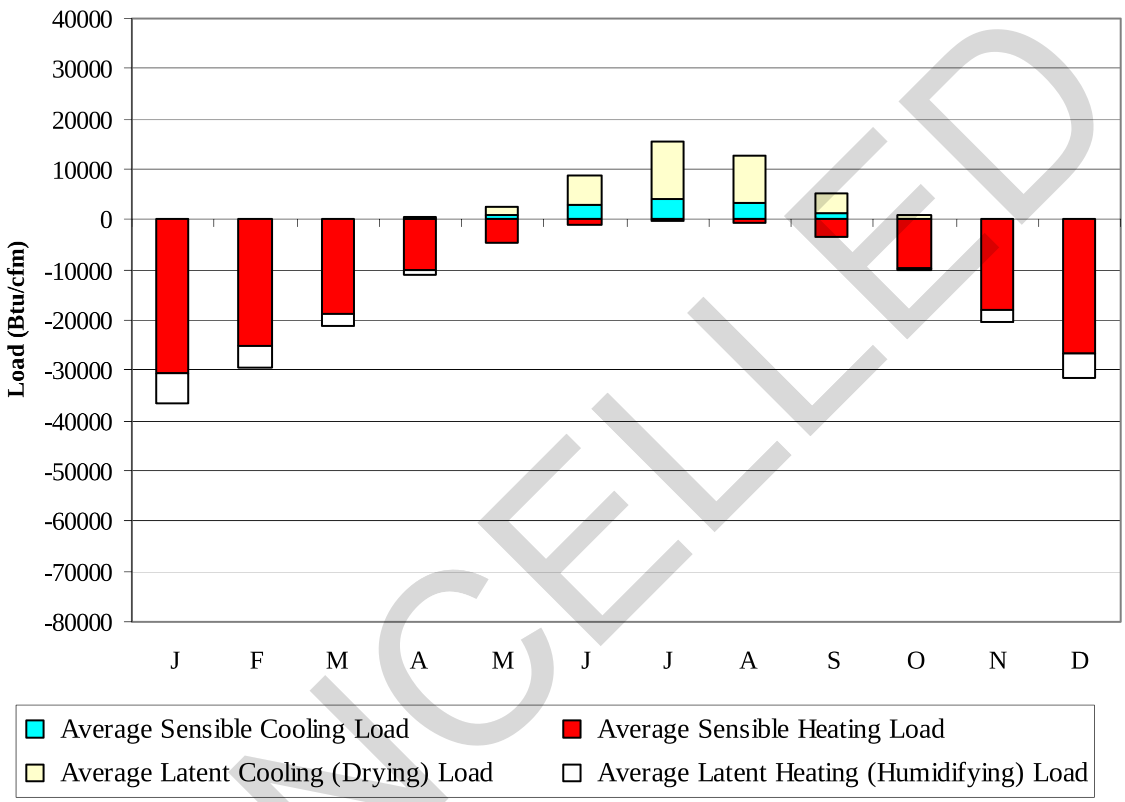
2-11.2 **Comments.** These calculations are based on the load created when 1 cubic foot of outside air is brought into the building each minute. The results of the calculation include the moisture load or deficit, and the sensible heat load or deficit created by that cubic foot of air during each month of the year. Note that most months have both a load and a deficit for temperature and moisture. The monthly deficit and load do not "cancel" from the perspective of the mechanical system, because temperature and moisture loads will often occur at different times of the day.

NOTE: The values displayed here assume that the inside air is maintained between 68 °F/30% RH and 75 °F/ 60% RH. If the inside conditions are held in a different range of temperature or moisture, the loads will be different. For example, in calculating loads for humidity-controlled but unheated storage, the loads vary according to the change in both temperature and humidity, since the inside temperature varies but the inside humidity is held constant. For estimating loads in that or similar applications, the engineer may obtain better results by using the average maximum weekly humidity data shown on Data Set Pages 11 and 12 (Figures 2-11 and 2-12).

Figure 2-14. Sample Data Set Page 14

SCOTT AFB/BELLEVILLE IL WMO No. 724338

Average Ventilation and Infiltration Loads
(Outside Air vs. 75°F, 60% RH summer; 68°F, 30% RH winter)



	Average Sensible Cooling Load (Btu/cfm)	Average Sensible Heating Load (Btu/cfm)	Average Latent Cooling Load (Btu/cfm)	Average Latent Heating Load (Btu/cfm)
JAN	0	-30775	1	-5940
FEB	0	-24966	3	-4532
MAR	34	-18713	57	-2613
APR	227	-9959	222	-826
MAY	843	-4462	1787	-87
JUN	2828	-981	6087	-1
JUL	4255	-341	11159	0
AUG	3285	-705	9343	0
SEP	1350	-3230	3729	-24
OCT	215	-9619	515	-527
NOV	8	-18010	85	-2268
DEC	0	-26811	10	-4609
ANN	13045	-148572	32998	-21427

2-12 **DATA SET PAGES 15 AND 16: SOLAR RADIATION DATA**. Figures 2-15 and 2-16 are samples of Data Set Page 15 and Data Set Page 16, respectively.

2-12.1 **Explanation of Charts**

2-12.1.1 **Data Source**. This data is reproduced courtesy of the National Renewable Energy Laboratory (NREL). The data were first published in the NREL's *Solar Radiation Data Manual for Buildings* (1995). The user should refer to that publication for a complete description of how to use this data. The manual can be accessed online at http://www.osti.gov/bridge by searching for "NREL/TP--463-7904."

2-12.1.2 **Site Location**. The site used in each station record is the nearest NREL-published site available within a 1.5° latitude radius from the requested location. Consequently, some sites may be several miles away, and in some cases, the NREL location may be in a neighboring state. Use caution when the nearest site available is not in the same city as the requested location, since significant differences in cloud climatology can exist over short distances.

2-12.1.3 **Site Availability**. When this document was prepared, the only sites available from NREL were Puerto Rico, Guam, and the 50 states. For locations where solar radiation data is not available, Data Set Pages 15 and 16 are blank. For these locations, users may wish to contact NREL directly to obtain advice concerning data not published in the NREL solar radiation data manual.

2-12.2 **Suggestions for Use.** The solar data presented here can be used for calculating solar radiation cooling loads on building envelopes, and also for estimating the value of solar illumination for daylighting calculations. Again, the user should refer to the *Solar Radiation Data Manual for Buildings* for a complete description of how to use this data.

NOTE: The data source for the NREL reports comes from the National Solar Radiation Database—not the data set used to calculate peak design values and other monthly temperature and moisture data in this document. The two data sets will differ for many reasons, including different POR, measurement locations, sampling methodology and frequency, and differences in calculation methodology. Consequently, the user should expect differences in degree-days, minimum and maximum temperatures, and humidity values between this data and that calculated by the AFCCC. For design criteria, use the temperature and moisture values presented on the Design Criteria Data section of Data Set Page 1 (see Figure 2-1) of this document. These were calculated more recently and used a longer POR. Also, they are taken from records at DOD locations rather than from civilian locations near—but not always identical to—the military data collection points.

Figure 2-15. Sample Data Set Page 15

Average Annual Solar Radiation – Nearest Available Site
(Source: National Renewable Energy Laboratory, Golden CO, 1995)

City:	ST. LOUIS
State:	MO
WBAN No:	13994
Lat(N):	38.75
Long(W):	90.38
Elev(ft):	564

Stn Type: Secondary

SHADING GEOMETRY IN DIMENSIONLESS UNITS

Window:	1
Overhang:	0.498
Vert Gap:	0.314

AVERAGE INCIDENT SOLAR RADIATION (Btu/sq.ft./day), Percentage Uncertainty = 9

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HORIZ	Global	690	930	1230	1590	1860	2030	2020	1800	1460	1100	720	580	1340
	Std Dev	56	69	98	135	138	114	120	110	112	98	69	57	42
	Minimum	550	800	1060	1370	1550	1830	1750	1570	1190	870	590	490	1280
	Maximum	780	1070	1430	1930	2180	2350	2240	1960	1690	1250	870	710	1480
	Diffuse	340	460	590	710	810	840	810	730	600	430	350	300	580
Clear Day	Global	950	1300	1760	2230	2520	2630	2550	2290	1870	1400	1000	840	1780
NORTH	Global	210	280	360	440	550	630	600	490	380	290	220	190	390
	Diffuse	210	280	360	430	500	530	520	460	380	290	220	190	370
Clear Day	Global	190	250	330	430	580	680	630	470	360	270	200	170	380
EAST	Global	460	590	750	920	1060	1140	1130	1050	880	710	470	390	800
	Diffuse	260	340	440	530	600	640	620	570	470	360	270	230	440
Clear Day	Global	710	910	1150	1340	1440	1460	1430	1340	1170	940	730	640	1110
SOUTH	Global	1080	1110	1060	970	830	780	820	950	1110	1220	1020	940	990
	Diffuse	370	440	500	540	560	570	570	560	520	440	360	330	480
Clear Day	Global	1930	1970	1770	1380	1040	890	950	1210	1580	1840	1870	1860	1520
WEST	Global	470	600	740	920	1040	1110	1120	1030	880	700	480	390	790
	Diffuse	260	340	440	530	610	650	630	580	480	360	270	230	450
Clear Day	Global	710	910	1150	1340	1440	1460	1430	1340	1170	940	730	640	1110

Figure 2-16. Sample Data Set Page 16

Average Annual Solar Heat and Illumination – Nearest Available Site

(Source: National Renewable Energy Laboratory, Golden CO, 1995)

AVERAGE TRANSMITTED SOLAR RADIATION (Btu/sq.ft./day) FOR DOUBLE GLAZING, Percentage Uncertainty = 9

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HORIZ	Unshaded	450	640	870	1150	1350	1480	1470	1300	1040	770	480	370	950
NORTH	Unshaded	150	190	250	300	370	410	390	330	260	200	150	130	260
	Shaded	130	170	220	270	330	370	350	300	240	180	140	110	230
EAST	Unshaded	320	410	530	660	750	810	810	750	620	500	320	270	560
	Shaded	290	370	470	570	650	700	700	650	550	450	290	240	490
SOUTH	Unshaded	810	810	740	630	510	470	490	600	750	870	760	700	680
	Shaded	790	750	590	420	350	360	360	390	550	770	730	680	560
WEST	Unshaded	320	420	520	650	740	790	800	740	620	490	330	270	560
	Shaded	290	370	460	570	640	680	690	640	550	440	300	240	490

AVERAGE INCIDENT ILLUMINANCE (klux-hr) FOR MOSTLY CLEAR AND MOSTLY CLOUDY CONDITIONS, Percentage Uncertainty = 9

		March					June				
		9am	11am	1pm	3pm	5pm	9am	11am	1pm	3pm	5pm
HORIZ.	M.Clear	40	73	82	64	26	48	84	101	96	67
	M.Cloudy	23	45	52	40	16	32	61	76	71	49
NORTH	M.Clear	10	14	15	13	8	19	16	17	17	15
	M.Cloudy	9	16	17	14	7	15	18	19	19	16
EAST	M.Clear	75	56	15	13	8	78	72	31	17	15
	M.Cloudy	25	30	17	14	7	40	49	27	19	16
SOUTH	M.Clear	40	73	82	64	26	12	31	45	41	19
	M.Cloudy	17	36	43	32	12	12	26	37	33	18
WEST	M.Clear	10	14	24	67	64	12	16	17	53	78
	M.Cloudy	9	16	21	33	22	12	18	19	41	50
M.Clear	(% hrs)	32	28	27	28	29	43	39	32	29	34

		Sept					Dec				
		9am	11am	1pm	3pm	5pm	9am	11am	1pm	3pm	5pm
HORIZ.	M.Clear	29	68	86	78	47	16	42	48	30	2
	M.Cloudy	17	42	58	53	31	9	25	28	17	2
NORTH	M.Clear	9	14	16	15	12	6	10	11	8	1
	M.Cloudy	7	15	18	17	12	4	10	11	7	1
EAST	M.Clear	65	70	28	15	12	42	39	11	8	1
	M.Cloudy	23	36	23	17	12	11	18	11	7	1
SOUTH	M.Clear	21	57	75	67	37	39	82	88	63	6
	M.Cloudy	11	31	45	41	21	10	29	32	20	2
WEST	M.Clear	9	14	16	54	74	6	10	22	50	9
	M.Cloudy	7	15	18	35	35	4	10	14	17	2
M.Clear	(% hrs)	47	47	41	41	43	31	30	30	30	32

2-13 **DATA SET PAGES 17 AND 18: WIND SUMMARY**. Figures 2-17 and 2-18 are samples of Data Set Page 17 and Data Set Page 18, respectively.

2-13.1 **Explanation of Charts**

2-13.1.1 These charts depict the frequency of different wind direction and wind speed combinations. The observations are binned into the 16 cardinal compass directions and 5 speed categories (1 to 5 knots, 6 to 14 knots, 15 to 24 knots, 25 to 34 knots, and greater than 34 knots). The frequency of direction and the tick marks indicate that values lie along each "spoke" of the wind chart. The wind speed bins for each direction are color coded by the legend at the bottom of the chart.

2-13.1.2 To determine the percent frequency of a particular wind direction, look for the tick mark bounding the outer edge of a colored (wind speed) area. In the case of the first wind speed bin (1 to 5 knots), the percent frequency is simply the value of the tick mark on the outer edge of the 1 to 5 knot region. For the higher speed bins (6 to 14 knots or greater), subtract the earlier spoke values from the value shown to get the frequency for the speed bin in question.

2-13.1.3 The values for percent frequency have been summed by direction, so to determine the total percent frequency for all speeds from a particular direction, look up the tick mark (or interpolated value) bounding the outermost colored area along that spoke. That tick mark represents the total percent frequency of wind from that direction.

2-13.1.4 Since the calm condition has no direction, the percent occurrence of calm conditions is displayed immediately below the chart.

2-13.2 **Wind Summary Chart Example.** The wind summary charts are prepared by 3-month seasons, over all hours (e.g., December, January, February for northern hemisphere winter or southern hemisphere summer; March, April, May for northern hemisphere spring or southern hemisphere fall). See the December through February sample wind summary chart in Figure 2-17 for an example of determining percent frequencies.

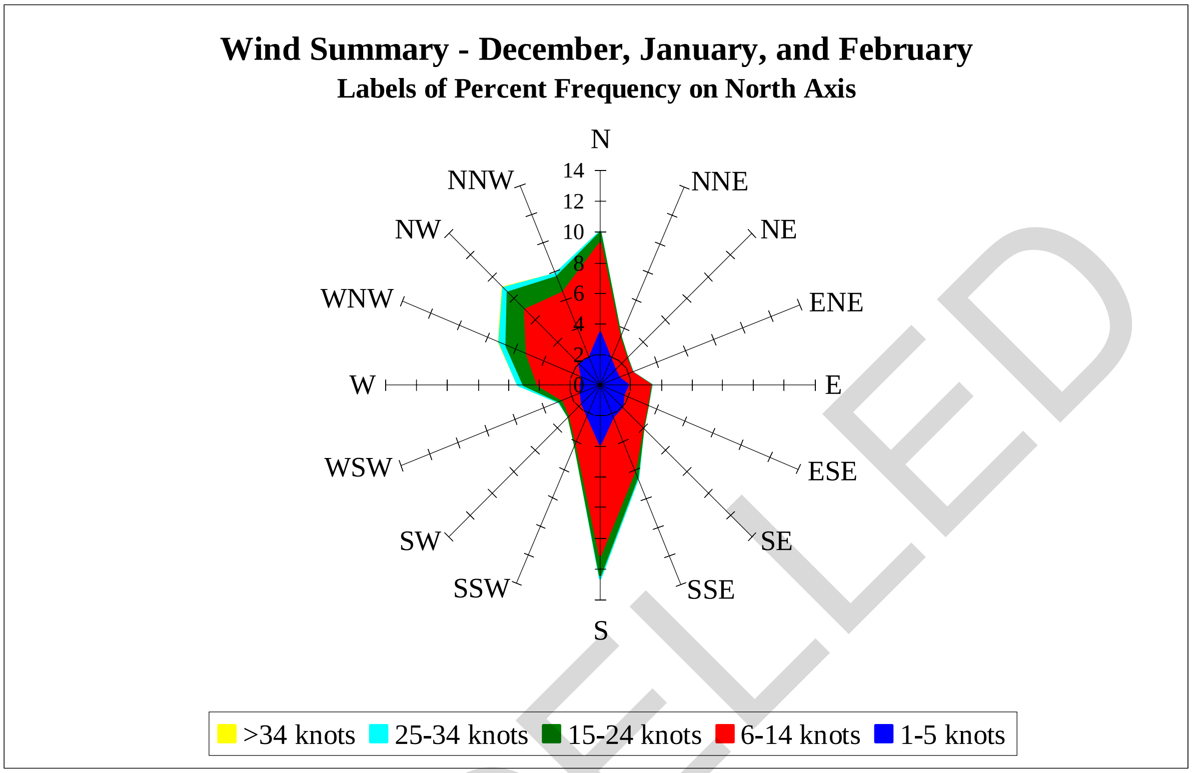
2-13.2.1 From the December through February sample wind summary chart, the percent frequency of wind between 1 to 5 knots and from the north (N) is about 3%. The percent frequency of wind between 6 to 14 knots and from the northwest (NW) is about 5% (7% minus 2%). The percent frequency of all wind speeds from the south (S) is about 12%. The percent frequency of all wind directions from the west through north (W, WNW, NW, NNW, and N) is about 38% (5% + 7% + 8% + 8% + 10%, respectively). It is easy to determine that wind speeds greater than 34 knots almost never occur (or are such a small frequency from any direction) because the colored area (yellow) is not shown or is indistinguishable because it is extremely small.

2-13.2.2 The percent of time the wind is calm is indicated in the lower left corner of the chart—in this case, 12.82%. When the outermost value from each of the 16 directions are summed and added to the percent calm, the result is 100% (allowing for rounding). Occurrences of variable wind direction are omitted from the sample before computing percent frequency by direction.

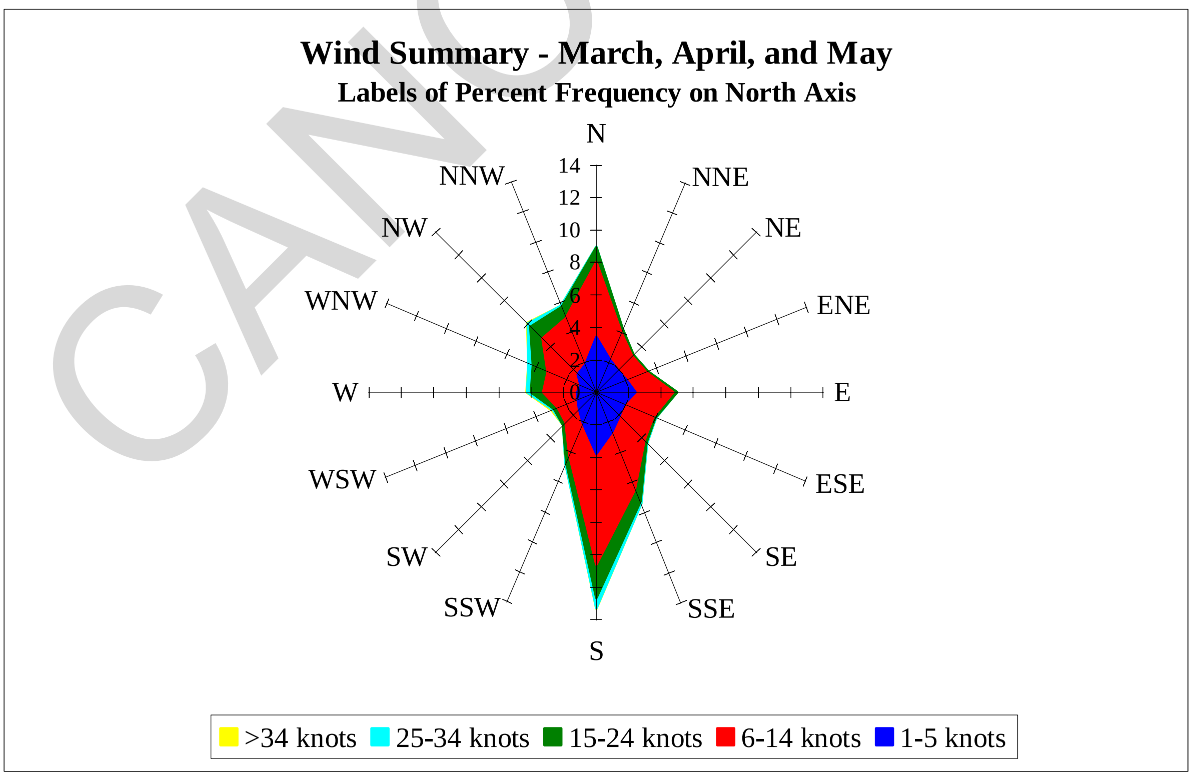
2-13.3 **Suggestions for Use.** Knowing the probable wind speed and direction in a particular month can be helpful in construction and mission planning as well as in designing structures that experience severe wind-driven rain or drifting snow. Engineers designing outside air intake and building exhaust vents for heating and air conditioning systems can use these data to minimize the potential for cross-contamination between supply and exhaust air streams. Also, when drifting snow accumulation on roofs is likely, the information on these data set pages can be helpful for locating inlet and exhaust ducts so they are less likely to be obstructed by snowdrifts.

NOTE: The wind currents around any building are strongly affected by the geometry of the building and the topography of the site as well as those of any surrounding buildings. The wind data used for these wind summaries are typical of flat and open airfields where there are no obstructions near the observation point.

Figure 2-17. Sample Data Set Page 17

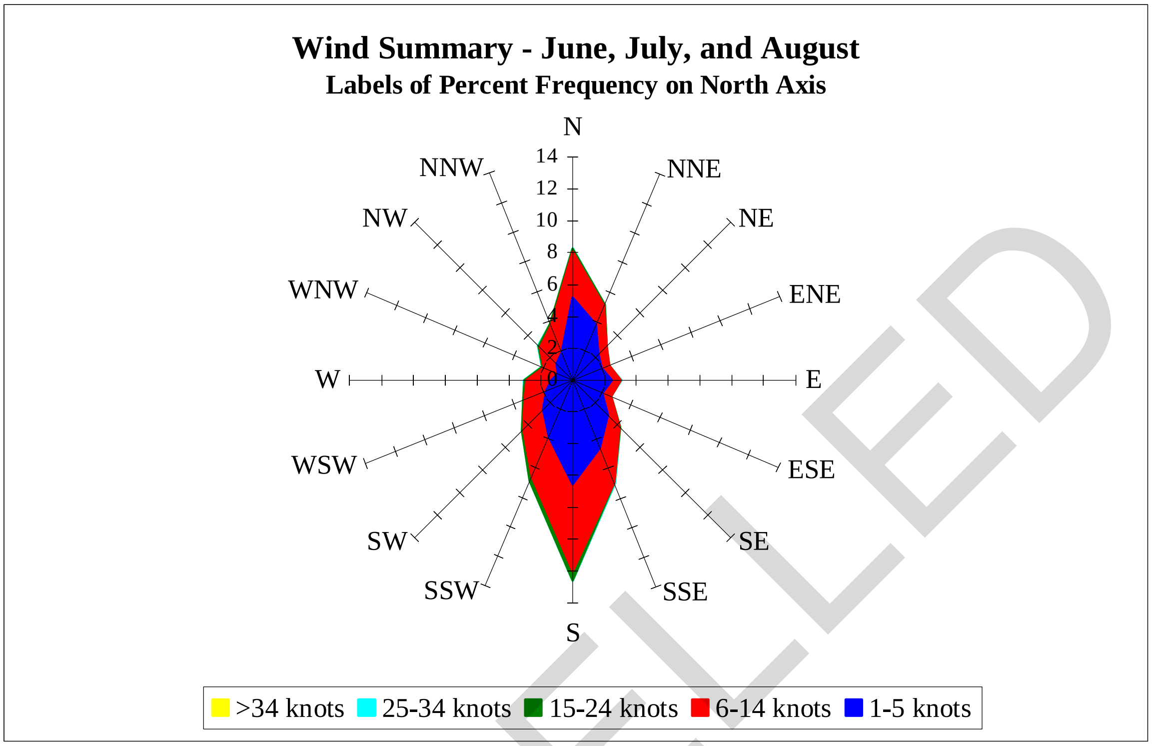


Percent Calm = 12.82

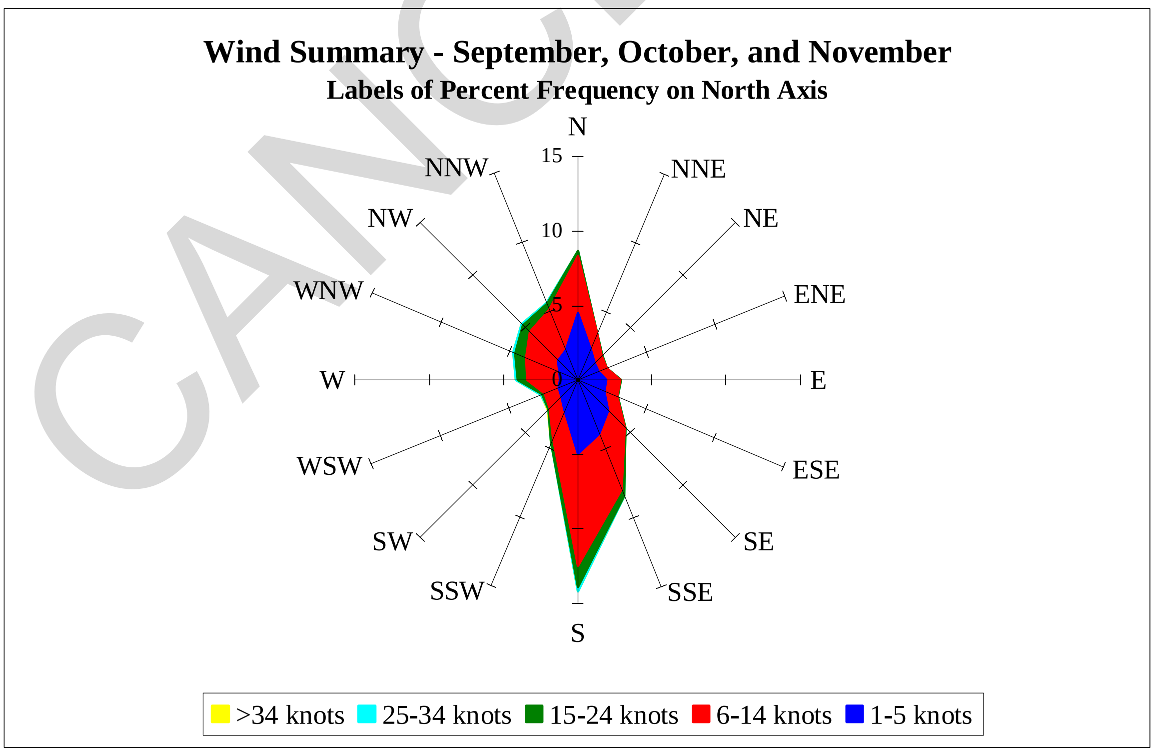


Percent Calm = 14.93

Figure 2-18. Sample Data Set Page 18



Percent Calm = 25.11



Percent Calm = 20.73

CHAPTER 3

SITE DATA

3-1 **US SITES (50 STATES, TERRITORIES)**. This list consists of the site name, the corresponding WMO number, and the site's location in latitude and longitude. NOTE: Site data sets retain the site name used in AFM 88-29 (as applied by WMO) for ease of reference.

	ALABAMA		
Anniston/Calhoun	722287	33.58N	85.85W
Birmingham	722280	33.57N	86.75W
Dothan	722268	31.32N	85.45W
Huntsville/Madison	723230	34.65N	86.77W
Maxwell AFB/Montgomery	722265	32.38N	86.37W
Mobile/Bates	722230	30.68N	88.25W
Montgomery/Dannelly	722260	32.30N	86.4W
Muscle Shoals	723235	34.75N	87.62W
Ozark (formerly Cairns AAF)	722269	31.28N	85.72W
Tuscaloosa	722286	33.22N	87.62W
	ALASKA		
Adak Island (formerly Adak NAS)/Mitchell	704540	51.88N	176.6W
Anchorage	702730	61.17N	150W
Anchorage/Merrill	702735	61.22N	149.8W
Aniak	702320	61.58N	159.5W
Annette Island	703980	55.03N	131.5W
Barrow/Post-Rogers	700260	71.30N	156.7W
Barter Island	700860	70.13N	143.6W
Bethel	702190	60.78N	161.8W
Bettles Field	701740	66.92N	151.5W
Cape Lisburne	701040	68.88N	166.1W
Cape Newenham	703050	58.65N	162W
Cape Romanzoff	702120	61.78N	166W
Cold Bay	703160	55.20N	162.70W
Cordova/Mile 13	702960	60.5N	145.5W
Dutch Harbor	704890	53.9N	166.5W
Eielson	702650	64.67N	147.1W
Elmendorf AFB	702720	61.25N	149.8W
Fairbanks	702610	64.82N	147.8W
Fort Greely (formerly Allen AAF)	702670	6.4N	145.7W
Fort Richardson/Bryn	702700	61.27N	149.6W
Fort Yukon	701940	66.57N	145.2W
Galena	702220	64.73N	156.9W
Gulkana	702710	62.15N	145.4W
Homer	703410	59.63N	151.5W
Iliamna	703400	59.75N	154.9W

Indian Mountain (formerly AFS)	701730	66N	153.7W
Juneau	703810	58.37N	134.5W
Kenai	702590	60.57N	151.2W
King Salmon	703260	58.68N	156.6W
Kodiak	703500	57.75N	152.5W
Kotzebue/Ralph Wien	701330	66.87N	162.6W
McGrath	702310	62.97N	155.6W
Middleton Island	703430	59.43N	146.3W
Nenana	702600	64.55N	149W
Nome	702000	64.5N	165.4W
Northway	702910	62.97N	141.9W
Port Heiden	703330	56.95N	158.6W
Saint Paul Island	703080	57.15N	170.2W
Shemya/Eareckson AFS	704140	52.72N	174.12E
Sitka/Japonski	703710	57.07N	135.3W
Sparrevohn	702350	61.1N	155.5W
Tatalina AFS	702315	62.9N	155.9W
Tin City (formerly AFS)	701170	65.57N	167.9W
Unalakleet	702070	63.88N	160.8W
Whittier	702757	60.77N	148.6W
Yakutat	703610	59.52N	139.6W
ARIZONA			
Davis-Monthan AFB	722745	32.17N	110.8W
Flagstaff	723755	35.13N	111.6W
Fort Huachuca/Libby	722730	31.6N	110.3W
Luke AFB/Phoenix	722785	33.53N	112.3W
Phoenix/Sky Harbor	722780	33.43N	112W
Tucson	722740	32.12N	110.9W
Winslow	723740	35.02N	110.7W
Yuma	722800	32.65N	114.6W
ARKANSAS			
Arkansas Aeroplex (formerly Eaker AFB)/ Blytheville	723408	35.97N	89.95W
El Dorado/Goodwin	723419	33.22N	92.8W
Fayetteville/Drake	723445	36N	94.17W
Fort Smith	723440	35.33N	94.37W
Harrison/Boone	723446	36.27N	93.15W
Little Rock AFB	723405	34.92N	92.15W
Pine Bluff/Grider	723417	34.18N	91.93W
Texarkana/Webb	723418	33.45N	93.98W
CALIFORNIA			
Alameda (formerly Alameda NAS)	745060	37.78N	122.3W
Arcata/Eureka	725945	40.98N	124.1W
Bakersfield/Meadows	723840	35.43N	119W
Barstow-Daggett	723815	34.85N	116.7W
Beale AFB/Marysvile	724837	39.13N	121.4W

Blue Canon	725845	39.28N	120.7W
Camp Pendleton MCB (formerly MCAS)	722926	33.3N	117.3W
Crescent City	725946	41.78N	124.2W
Edwards AFB	723810	34.9N	117.8W
Fresno	723890	36.77N	119.7W
Imperial	747185	32.83N	115.5W
Lemoore NAS/Reeves	747020	36.33N	119.9W
Long Beach	722974	33.77N	118.1W
Long Beach (airport)	722970	33.82N	118.1W
Los Angeles	722950	33.93N	118.4W
March ARB (formerly AFB)/Riverside	722860	33.88N	117.2W
Marina Municipal/Fritzsche			
(formerly Fort Ord-Fritzsche Airfield)	724916	36.68N	121.7W
McClellan AFB	724836	38.67N	121.4W
Merced (formerly Castle AFB)	724810	37.38N	120.5W
Miramar NAS	722930	32.85N	117.1W
Mountain View/Moffett Federal Airfield			
(formerly Moffett NAS)	745090	37.42N	122W
Montague/Siskiyou	725955	41.78N	122.4W
Monterey Peninsula	690070	36.58N	121.8W
North Island NAS	722906	32.7N	117.2W
Sacramento/Mather Airport			
(formerly Mather Field)	724835	38.55N	121.3W
San Bernardino (formerly Norton AFB)	722866	34.1N	117.2W
Oakland	724930	37.73N	122.2W
Ontario	722865	34.05N	117.6W
Paso Robles	723965	35.67N	120.6W
Point Mugu	723910	34.12N	119.1W
Piedras/Blancas Point	723900	35.67N	121.2W
Red Bluff	725910	40.15N	122.2W
Sacramento/Executive	724830	38.52N	121.5W
San Clemente	722925	33.02N	118.5W
San Diego/Lindbergh	722900	32.73N	117.1W
San Francisco	724940	37.62N	122.3W
San Jose	724945	37.37N	121.9W
Sandburg	723830	34.75N	118.7W
Santa Barbara	723925	34.43N	119.8W
Stockton	724920	37.9N	121.2W
Travis AFB/Fairfield	745160	38.27N	121.9W
Tustin	690160	33.7N	117.8W
Vandenberg AFB	723930	34.73N	120.5W
Victorville (formerly George AFB)	723825	34.58N	117.3W

COLORADO

Buckley ANGB/Denver	724695	39.72N	104.7W
Colorado Springs	724660	38.82N	104.7W
Denver/Stapleton	724690	39.75N	104.8W

Fort Carson/Butts	724680	38.68N	104.7W
Grand Junction	724760	39.12N	108.5W
La Junta	724635	38.05N	103.5W
Pueblo	724640	38.28N	104.5W
Trinidad/Animas County	724645	37.27N	104.3W
CONNECTICUT			
Bridgeport/Sikorski	725040	41.17N	73.13W
Hartford/Bradley	725080	41.93N	72.68W
DELAWARE			
Dover AFB	724088	39.13N	75.47W
Wilmington	724089	39.68N	75.6W
DISTRICT OF COLUMBIA			
Washington/Dulles	724030	38.95N	77.45W
Washington/National	724050	38.85N	77.03W
FLORIDA			
Apalachicola	722200	29.73N	85.03W
Cape Canaveral (formerly Cape Kennedy)	747940	28.47N	80.55W
Cecil Field NAS	722067	30.22N	81.88W
Daytona Beach	722056	29.18N	81.05W
Eglin AFB/Valparaiso	722210	30.48N	86.53W
Fort Myers/Page Field	722106	26.58N	81.87W
Fort Lauderdale/Hollywood	722025	26.07N	80.15W
Gainesville	722146	29.68N	82.27W
Homestead ARB (formerly AFB)	722026	25.48N	80.38W
Hurlburt Field	747770	30.43N	86.68W
Jacksonville	722060	30.5N	81.7W
Jacksonville/Craig	722068	30.33N	81.52W
Jacksonville NAS	722065	30.23N	81.68W
Key West	722010	24.55N	81.75W
Key West NAF (formerly NAS)	722015	24.57N	81.68W
MacDill AFB/Tampa	747880	27.85N	82.52W
Mayport Naval Air Station	722066	30.4N	81.42W
Melbourne	722040	28.1N	80.65W
Miami	722020	25.82N	80.28W
Miami/Kendall-Tamiami	722029	25.65N	80.43W
Orlando (Jetport)	722050	28.43N	81.32W
Patrick AFB/Cocoa Beach	747950	28.23N	80.6W
Pensacola	722220	30.47N	87.18W
Pensacola NAS	722225	30.35N	87.32W
St. Petersburg	722116	27.92N	82.68W
Tallahassee	722140	30.38N	84.37W
Tampa	722110	27.97N	82.53W
Tyndall AFB	747750	30.07N	85.58W
Vero Beach	722045	27.65N	80.42W
West Palm Beach	722030	26.68N	80.12W
Whiting Field NAS	722226	30.72N	87.02W

	GEORGIA		
Albany	722160	31.53N	84.18W
Atlanta	722190	33.65N	84.42W
Augusta/Bush	722180	33.37N	81.97W
Brunswick/Malcolm	722137	31.15N	81.38W
Columbus	722255	32.52N	84.93W
Dobbins ARB (formerly AFB)/Marietta	722270	33.92N	84.52W
Fort Benning	722250	32.33N	85W
Hunter AAF	747804	32.02N	81.15W
Macon/Lewis Wilson	722170	32.7N	83.65W
Moody AFB/Valdosta	747810	30.97N	83.2W
Rome/Russell	723200	34.35N	85.17W
Savannah	722070	32.13N	81.2W
Robins AFB (formerly Warner Robins AFB)	722175	32.63N	83.6W
	HAWAII		
Barbers Point NAS/Oahu	911780	21.32N	158W
Hilo	912850	19.72N	155W
Honolulu/Oahu	911820	21.35N	157.9W
Kahului/Maui	911900	20.9N	156.4W
Kaneohe/Oahu	911760	21.45N	157.7W
Lihue/Kauai	911650	21.98N	159.3W
	IDAHO		
Boise Municipal	726810	43.57N	116.2W
Coeur D'Alene	727834	47.77N	116.8W
Idaho Falls/Fanning	725785	43.52N	112W
Lewiston	727830	46.38N	117W
Mountain Home AFB	726815	43.05N	115.8W
Pocatello	725780	42.92N	112.6W
	ILLINOIS		
Champaign/Urbana	725315	40.03N	88.28W
Chicago/Midway	725340	41.78N	87.75W
Chicago/O'Hare	725300	41.98N	87.9W
Decatur	725316	39.83N	88.87W
Glenview (formerly NAS)	725306	42.08N	87.82W
Moline/Quad City	725440	41.45N	90.52W
Peoria	725320	40.67N	89.68W
Scott AFB/Belleville	724338	38.55N	89.85W
Springfield/Capital	724390	39.85N	89.67W
West Chicago/Du Page	725305	41.92N	88.25W
	INDIANA		
Evansville Regional	724320	38.05N	87.53W
Fort Wayne/Baer	725330	41N	85.2W
Grissom ARB (formerly AFB)/Peru	725335	40.65N	86.15W
Indianapolis	724380	39.73N	86.27W
South Bend	725350	41.7N	86.32W

Terre Haute/Hulman	724373	39.45N	87.32W
	IOWA		
Burlington	725455	40.78N	91.13W
Cedar Rapids	725450	41.88N	91.7W
Des Moines	725460	41.53N	93.65W
Fort Dodge	725490	42.55N	94.18W
Mason City	725485	43.15N	93.33W
Sioux City	725570	42.4N	96.38W
Waterloo	725480	42.55N	92.4W
	KANSAS		
Chanute/Martin John	724507	37.67N	95.48W
Dodge City	724510	37.77N	99.97W
Ft Riley/Marshall	724550	39.05N	96.77W
Goodland/Renner	724650	39.37N	101.7W
Hutchinson	724506	38.07N	97.87W
McConnell AFB	724505	37.62N	97.27W
Salina	724586	38.8N	97.65W
Topeka/Billard	724560	39.07N	95.62W
Topeka/Forbes	724565	38.95N	95.67W
Wichita/Mid-Continent	724500	37.65N	97.43W
	KENTUCKY		
Cincinnati/Covington	724210	39.05N	84.67W
Fort Campbell	746710	36.67N	87.5W
Fort Knox/Godman	724240	37.9N	85.97W
Lexington/Bluegrass	724220	38.03N	84.6W
Louisville/Standiford	724230	38.18N	85.73W
	LOUISIANA		
Alexandria/Esler	722487	31.4N	92.3W
Barksdale AFB	722485	32.5N	93.67W
Baton Rouge/Ryan	722317	30.53N	91.15W
England Industrial Air Park (formerly England AFB)/Alexandria	747540	31.33N	92.55W
Fort Polk	722390	31.05N	93.2W
Lafayette	722405	30.2N	91.98W
Lake Charles	722400	30.12N	93.22W
Monroe	722486	32.52N	92.03W
New Orleans NAS	722316	29.83N	90.03W
New Orleans/Lakefront	722315	30.05N	90.03W
New Orleans/International	722310	29.98N	90.25W
Shreveport	722480	32.47N	93.82W
	MAINE		
Augusta	726185	44.32N	69.8W
Bangor	726088	44.8N	68.83W
Brunswick NAS	743920	43.88N	69.93W
Loring Commerce Centre (formerly Loring AFB)/Limestone	727125	46.95N	67.88W

Portland	726060	43.65N	70.32W
	MARYLAND		
Andrews AFB	745940	38.82N	76.87W
Baltimore/Washington	724060	39.18N	76.67W
Patuxent River NAS	724040	38.28N	76.4W
	MASSACHUSETTS		
Boston/Logan	725090	42.37N	71.03W
Chicopee/Westover ARB	744910	42.2N	72.53W
Hanscom AFB/Bedford	744900	42.47N	71.28W
Otis ANGB	725060	41.65N	70.52W
Weymouth (formerly South Weymouth NAS)	725097	42.15N	70.93W
Worcester	725095	42.27N	71.88W
	MICHIGAN		
Alpena	726390	45.07N	83.57W
Battle Creek	725396	42.3N	85.25W
Detroit City	725375	42.42N	83.02W
Flint/Bishop	726370	42.97N	83.75W
Grand Rapids	726350	42.88N	85.52W
Houghton	727440	47.17N	88.5W
Jackson/Reynolds	725395	42.27N	84.47W
K. I. Sawyer AFB (closed)	727435	46.35N	87.4W
Lansing/Capital	725390	42.77N	84.6W
Marquette	727430	46.53N	87.55W
Muskegon	726360	43.17N	86.25W
Oscoda (formerly Wurtsmith AFB)	726395	44.45N	83.4W
Pellston/Emmet County	727347	45.57N	84.8W
Sault Ste. Marie	727340	46.47N	84.37W
Selfridge ANGB	725377	42.62N	82.83W
Traverse City/Cherry Capital	726387	44.73N	85.58W
	MIDWAY ISLAND		
Midway Island NAS (closed)	910660	28.22N	177.3W
	MINNESOTA		
Bemidji	727550	47.5N	94.93W
Duluth	727450	46.83N	92.18W
International Falls	727470	48.57N	93.38W
Minneapolis-St. Paul	726580	44.88N	93.22W
Rochester	726440	43.92N	92.5W
	MISSISSIPPI		
Columbus AFB	723306	33.65N	88.45W
Jackson/Thompson	722350	32.32N	90.08W
Keesler AFB/Biloxi	747686	30.42N	88.92W
McComb/Lewis	722358	31.18N	90.47W
Meridian/Key Field ANGB	722340	32.33N	88.75W
Meridian NAS/McCain	722345	32.55N	88.57W
	MISSOURI		
Chesterfield/Spirit of St. Louis	724345	38.67N	90.65W

Columbia	724450	38.82N	92.22W
Fort Leonard Wood	724457	37.73N	92.13W
Joplin	723495	37.15N	94.5W
Kansas City/Richards-Gebaur ARS (formerly Richards-Gebaur AFB)	724466	38.85N	94.55W
Springfield	724400	37.23N	93.38W
St. Louis/Lambert	724340	38.75N	90.37W
Whiteman AFB	724467	38.73N	93.55W
MONTANA			
Billings/Logan	726770	45.8N	108.5W
Butte/Mooney	726785	45.95N	112.5W
Cut Bank	727796	48.6N	112.3W
Glasgow	727680	48.22N	106.6W
Great Falls	727750	47.48N	111.3W
Havre	727770	48.55N	109.7W
Helena	727720	46.6N	112W
Kalispell/Glacier	727790	48.3N	114.2W
Lewistown	726776	47.05N	109.4W
Malmstrom AFB	727755	47.5N	111.1W
Miles City	742300	46.43N	105.8W
Missoula	727730	46.92N	114W
NEBRASKA			
Grand Island	725520	40.97N	98.32W
Lincoln	725510	40.85N	96.75W
North Platte/Lee Bird	725620	41.13N	100.6W
Offutt AFB/Bellevue	725540	41.12N	95.92W
Omaha/Eppley	725500	41.3N	95.9W
Scottsbluff/Heilig	725660	41.87N	103.6W
NEVADA			
Elko	725825	40.83N	115.7W
Ely	724860	39.28N	114.8W
Las Vegas/McCarran	723860	36.08N	115.1W
Mercury/Desert Rock	723870	36.62N	116W
Nellis AFB	723865	36.23N	115W
Reno/Cannon	724880	39.5N	119.7W
Tonopah	724855	38.05N	117W
Winnemucca	725830	40.9N	117.8W
NEW HAMPSHIRE			
Concord	726050	43.2N	71.5W
Lebanon	726116	43.63N	72.3W
Manchester	743945	42.93N	71.43W
Pease ANGB (formerly AFB)/Portsmouth	726055	43.08N	70.82W
NEW JERSEY			
Atlantic City	724070	39.45N	74.57W
Lakehurst NAS	724090	40.03N	74.35W
McGuire AFB	724096	40.02N	74.6W

Newark	725020	40.7N	74.17W
Teterboro	725025	40.85N	74.07W
Trenton/Mercer County	724095	40.28N	74.82W
	NEW MEXICO		
Albuquerque	723650	35.05N	106.6W
Cannon AFB/Clovis	722686	34.38N	103.3W
Carlsbad/Cavern City	722687	32.33N	104.2W
Farmington	723658	36.75N	108.2W
Gallup	723627	35.52N	108.7W
Holloman AFB	747320	32.85N	106.1W
Roswell/Industrial Air Center	722680	33.3N	104.5W
Tucumcari	723676	35.18N	103.6W
White Sands Missile Range	722690	32.38N	106.4W
	NEW YORK		
Albany County	725180	42.75N	73.8W
Binghamton/Broome	725150	42.22N	75.98W
Buffalo	725280	42.93N	78.73W
Fort Drum/Wheeler	743700	44.05N	75.73W
Glen Falls/Warren	725185	43.33N	73.62W
Islip/MacArthur	725035	40.8N	73.1W
Jamestown	725235	42.15N	79.27W
New York/John F. Kennedy	744860	40.65N	73.78W
New York/LaGuardia	725030	40.77N	73.9W
Newburgh/Stewart	725038	41.5N	74.1W
Niagara Falls	725287	43.1N	78.95W
Plattsburgh AFB	726225	44.65N	73.47W
Poughkeepsie	725036	41.63N	73.88W
Rome Business and Technology Park (formerly Griffiss AFB)	725196	43.23N	75.4W
Syracuse/Hancock	725190	43.12N	76.12W
Utica/Oneida	725197	43.15N	75.38W
Watertown	726227	44N	76.02W
White Plains	725037	41.07N	73.7W
	NORTH CAROLINA		
Asheville	723150	35.43N	82.55W
Cape Hatteras	723040	35.27N	75.55W
Charlotte/Douglas	723140	35.22N	80.93W
Cherry Point MCAS	723090	34.9N	76.88W
Fort Bragg/Simmons	746930	35.13N	78.93W
Greensboro/Piedmont Triad	723170	36.08N	79.95W
New River MCAS	723096	34.72N	77.45W
Pope AFB	723030	35.17N	79.02W
Raleigh-Durham	723060	35.87N	78.78W
Seymour-Johnson AFB	723066	35.33N	77.97W
	NORTH DAKOTA		
Bismarck	727640	46.77N	100.7W

Dickinson	727645	46.8N	102.8W
Fargo/Hector	727530	46.9N	96.8W
Grand Forks AFB	727575	47.97N	97.4W
Minot AFB	727675	48.42N	101.3W
OHIO			
Akron/Canton	725210	40.92N	81.43W
Cincinnati/Lunkin	724297	39.1N	84.42W
Cleveland/Hopkins	725240	41.42N	81.87W
Dayton/Cox	724290	39.9N	84.2W
Mansfield/Lahm	725246	40.82N	82.52W
Port Columbus	724280	40N	82.88W
Rickenbacker ANGB	724285	39.82N	82.93W
Toledo Express	725360	41.6N	83.8W
Wright-Patterson AFB	745700	39.83N	84.05W
Youngstown	725250	41.27N	80.67W
Zanesville	724286	39.95N	81.9W
OKLAHOMA			
Altus AFB	723520	34.67N	99.27W
Fort Sill	723550	34.65N	98.4W
McAlester	723566	34.88N	95.78W
Oklahoma City	723530	35.4N	97.6W
Tinker AFB	723540	35.42N	97.38W
Tulsa	723560	36.2N	95.9W
Vance AFB/Enid	723535	36.33N	97.92W
OREGON			
Astoria/Clatsop	727910	46.15N	123.8W
Burns	726830	43.58N	118.9W
Eugene/Mahlon Sweet	726930	44.12N	123.2W
Klamath Falls/Kingsley	725895	42.15N	121.7W
Medford/Jackson	725970	42.37N	122.8W
North Bend	726917	43.42N	124.2W
Pendleton	726880	45.68N	118.8W
Portland	726980	45.6N	122.6W
Redmond	726835	44.25N	121.1W
Salem/McNary	726940	44.92N	123W
Sexton Summit	725975	42.62N	123.3W
PENNSYLVANIA			
Allentown/Bethlehem-Easton	725170	40.65N	75.43W
Altoona/Blair	725126	40.3N	78.32W
DuBois	725125	41.18N	78.9W
Johnstown/Cambrian	725127	40.32N	78.83W
Middletown/Olmsted	725115	40.2N	76.77W
Philadelphia	724080	39.88N	75.25W
Philadelphia Northeast	724085	40.08N	75.02W
Pittsburgh	725200	40.5N	80.22W
Wilkes-Barre/Scranton	725130	41.33N	75.73W

Williamsport	725140	41.25N	76.92W
Willow Grove NAS	724086	40.2N	75.15W
	RHODE ISLAND		
Providence/Green	725070	41.73N	71.43W
	SOUTH CAROLINA		
Beaufort	722085	32.48N	80.72W
Charlestown	722080	32.9N	80.03W
Columbia	723100	33.95N	81.12W
Florence	723106	34.18N	79.72W
Greenville/Spartanburg	723120	34.9N	82.22W
McEntire ANGS	723105	33.92N	80.8W
Myrtle Beach	747910	33.68N	78.93W
Shaw AFB/Sumter	747900	33.97N	80.47W
	SOUTH DAKOTA		
Aberdeen	726590	45.45N	98.43W
Ellsworth AFB	726625	44.15N	103.1W
Huron	726540	44.38N	98.22W
Pierre	726686	44.38N	100.2W
Rapid City	726620	44.05N	103W
Sioux Falls/Foss	726510	43.58N	96.73W
	TENNESSEE		
Bristol/Tri-City	723183	36.48N	82.4W
Chattanooga/Lovell	723240	35.03N	85.2W
Jackson/McKellar	723346	35.6N	88.92W
Knoxville	723260	35.82N	83.93W
Memphis	723340	35.05N	90W
Memphis NRC (formerly NAS)	723345	35.35N	89.87W
Nashville	723270	36.13N	86.68W
	TEXAS		
Abilene	722660	32.42N	99.68W
Amarillo	723630	35.23N	101.7W
Austin/Mueller	722540	30.3N	97.7W
Beaumont-Port Arthur/Jefferson	722410	29.95N	94.02W
Bergstrom AFB/Austin	722545	30.2N	97.68W
Brownsville	722500	25.9N	97.43W
Chase NAS/Beeville	722556	28.37N	97.67W
Corpus Christi	722510	27.77N	97.5W
Corpus Christi NAS	722515	27.7N	97.28W
Dallas/Fort Worth	722590	32.9N	97.03W
Dallas/Love	722583	32.85N	96.85W
Dallas NAS/Hensley	722585	32.73N	96.97W
Del Rio	722610	29.37N	100.9W
Dyess AFB/Abilene	690190	32.43N	99.85W
El Paso	722700	31.8N	106.4W
Fort Hood/Gray AAF	722576	31.07N	97.83W
Fort Worth NAS	722595	32.77N	97.45W

Galveston/Scholes	722423	29.3N	94.8W
Houston/Ellington	722436	29.6N	95.17W
Houston/Intercontinental	722430	29.97N	95.35W
Kelly AFB	722535	29.38N	98.58W
Kingsville NAS	722516	27.5N	97.82W
Laughlin AFB	722615	29.37N	100.7W
Lubbock	722670	33.65N	101.8W
Lufkin/Angelina	722446	31.23N	94.75W
Midland	722650	31.95N	102.1W
Randolph AFB	722536	29.53N	98.28W
Reese AFB/Lubbock	722675	33.6N	102W
San Angelo/Mathis	722630	31.37N	100.5W
San Antonio	722530	29.53N	98.47W
Tyler/Pounds	722448	32.35N	95.4W
Waco-Madison Cooper	722560	31.62N	97.22W
Wichita Falls/Sheppard AFB	723510	33.98N	98.5W
UTAH			
Cedar City	724755	37.7N	113.1W
Hill AFB/Ogden	725755	41.12N	111.9W
Provo	725724	40.22N	111.7W
Salt Lake City	725720	40.78N	111.9W
Wendover	725810	40.73N	114W
VERMONT			
Burlington	726170	44.47N	73.15W
VIRGINIA			
Charlottesville	724016	38.13N	78.45W
Fort Belvoir/Davison	724037	38.72N	77.18W
Langley AFB/Hampton	745980	37.08N	76.37W
Newport News	723086	37.13N	76.5W
Norfolk	723080	36.9N	76.2W
Norfolk NAS/Chamber	723085	36.93N	76.28W
Oceana NAS/Soucek	723075	36.82N	76.03W
Quantico	724035	38.5N	77.3W
Richmond	724010	37.5N	77.33W
Roanoke	724110	37.32N	79.97W
WASHINGTON			
Bellingham	727976	48.8N	122.5W
Bremerton	727928	47.5N	122.7W
Fairchild AFB	727855	47.62N	117.6W
Fort Lewis/Gray	742070	47.08N	122.5W
Hanford	727840	46.57N	119.6W
Kelso-Longview	727924	46.12N	122.9W
McChord AFB/Tacoma	742060	47.13N	122.4W
Olympia	727920	46.97N	122.9W
Quillayute State	727970	47.95N	124.5W
Seattle/Boeing	727935	47.53N	122.3W

Seattle-Tacoma	727930	47.45N	122.3W
Spokane	727850	47.63N	117.5W
Spokane/Felts	727856	47.68N	117.3W
Walla Walla	727846	46.1N	118.2W
Wenatchee/Pangborn	727825	47.4N	120.2W
Yakima	727810	46.57N	120.5W
	WEST VIRGINIA		
Beckley	724120	37.78N	81.12W
Bluefield/Mercer	724125	37.3N	81.2W
Charleston/Kanawha	724140	38.37N	81.6W
Huntington/Tri-State	724250	38.37N	82.55W
Martinsburg	724177	39.4N	77.98W
Morgantown/Hart	724176	39.65N	79.92W
Wheeling/Ohio	724275	40.18N	80.65W
	WISCONSIN		
Eau Claire	726435	44.9N	91.5W
Green Bay/Straubel	726450	44.5N	88.1W
La Crosse	726430	43.9N	91.3W
Madison/Dane	726410	43.1N	89.3W
Milwaukee/Mitchell	726400	43N	87.9W
	WYOMING		
Casper/Natrona	725690	42.92N	106.4W
Cheyenne/Francis E. Warren AFB	725640	41.15N	104.8W
Lander	725760	42.82N	108.7W
Rock Springs	725744	41.6N	109W
Sheridan	726660	44.77N	106.9W

3-2 **NON-US SITES**. This list consists of the site name, the corresponding WMO number, and the site's location in latitude and longitude. NOTE: Site data sets retain the site name used in AFM 88-29 (as applied by WMO) for ease of reference.

	ALGERIA		
Dar-El-Beida/Houari	603900	36.72N	3.25E
	ANTIGUA, ST. KITTS, NEVIS, BARBUDA AND MONTSERRAT		
Coolidge	788620	17.12N	61.78W
	ARGENTINA		
Buenos Aires/Ezeiza	875760	34.8S	58.53W
	ASCENSION ISLAND		
Wideawake Field	619020	7.97S	14.4W
	AUSTRALIA		
Adelaide	946720	34.9S	138.52E
Alice Springs	943260	23.8S	133.9E
Brisbane	945780	27.3S	153.1E
Darwin	941200	12.4S	130.87E
Melbourne	948660	37.6S	144.83E
Perth/Belmont	946100	31.9S	115.95E

Sydney	947670	33.9S	151.18E
Townsville	942940	19.2S	146.75E
	AUSTRIA		
Salzburg	111500	47.8N	13E
	AZORES		
Lajes AB	85090	38.77N	27.1W
	BAHAMAS		
Nassau	780730	25.05N	77.47W
	BAHRAIN		
Bahrain Intl Airport	411500	26.27N	50.65W
	BERMUDA		
Bermuda (formerly Bermuda NAS)/ Kindley	780160	32.37N	64.68W
	BRAZIL		
Belem/Val de Caes	821930	1.38S	48.48W
Galeao/Rio de Janeiro	837460	22.8S	43.25W
Santos Dumont/Rio de Janeiro	837550	22.9S	43.17W
	BRITISH INDIAN OCEAN TERRITORY		
Diego Garcia	619670	7.3S	72.4E
	BURMA/MYANMAR		
Rangoon/Mingaladon	480960	16.9N	96.18E
	CANADA		
Argentia	718070	47.3N	54W
Armstrong	718410	50.3N	89.03W
Calgary	718770	51.12N	114W
Cambridge Bay	719250	69.1N	105.1W
Cape Dyer	710940	66.58N	61.62W
Cape Parry	719480	70.17N	124.6W
Churchill	719130	58.75N	94.07W
Edmonton/Namao	711210	53.67N	113.4W
Estevan	718620	49.22N	102.9W
Fort Nelson	719450	58.83N	122.5W
Fort Smith	719340	60.02N	111.9W
Frobisher/Iqaluit	719090	63.75N	68.53W
Gander	718030	48.95N	54.57W
Goose Bay	718160	53.32N	60.42W
Grande Praire	719400	55.18N	118.8W
Halifax	713950	44.9N	63.5W
Hall Beach	710810	68.78N	81.25W
Hopedale	719000	55.45N	60.23W
Inuvik	719570	68.3N	133.4W
Kamloops	718870	50.7N	120.4W
Kapuskasing	718310	49.42N	82.47W
Montreal/Dorval	716270	45.47N	73.75W
North Bay	717310	46.35N	79.43W
Ottawa	716280	45.32N	75.67W

Port Hardy	711090	50.68N	127.3W
Prince George	718960	53.88N	122.6W
Resolute	719240	74.72N	94.98W
Saint Johns	718010	47.62N	52.73W
Sandspit	711010	53.25N	131.8W
Saskatoon	718660	52.17N	106.6W
Shepherd Bay	719110	68.82N	93.43W
Sioux Lookout	718420	50.12N	91.9W
Stephenville	718150	48.53N	58.55W
The Pas	718670	53.97N	101.1W
Thunder Bay	717490	48.37N	89.32W
Timmins	717390	48.57N	81.37W
Toronto/Pearson	716240	43.67N	79.63W
Vancouver	718920	49.18N	123.1W
Whitehorse	719640	60.72N	135W
Winnipeg	718520	49.9N	97.23W
Yarmouth	716030	43.83N	66.08W
Yellowknife	719360	62.47N	114.4W
CAROLINE ISLANDS			
Koror/Palau Island	914080	7.3N	134.5E
Ponape Island	913480	6.97N	158.22E
Truk International/Moen Island	913340	7.47N	151.85E
Yap Island	914130	9.48N	138.08E
CHILE			
Pudahuel	855740	33.3S	70.78W
CHINA			
Beijing	545110	39.93N	116.28E
Shanghai/Hongqiao	583670	31.17N	121.43E
COLOMBIA			
Bogota/Eldorado	802220	4.7N	74.13W
COSTA RICA			
San Jose/Santa Maria	787620	10N	84.22W
CRETE			
Iraklion	167540	35.33N	25.18E
Souda Bay NSA (closed)	167464	35.53N	24.15E
Souda/Khania	167460	35.48N	24.12E
CUBA			
Guantanamo Bay Naval Base (formerly NAS)	783670	19.9N	75.13W
Havana/Jose Marti	782240	22.98N	82.4W
DOMINICAN REPUBLIC			
Caucedo/Las Americas	784850	18.43N	69.67W
ECUADOR			
Quito/Mariscal Sucre	840710	0.15S	78.48W
EGYPT			
Alexandria	623180	31.2N	29.95E

Cairo	623660	30.13N	31.4E
	EL SALVADOR		
Ilopango Caldera/San Salvador	786630	13.7N	89.12W
	FIJI		
Nandi/Nadi	916800	17.7S	177.45E
	FRANCE		
Lyon/Bron	74800	45.72N	4.95E
Marseille/Marignane	76500	43.45N	5.23E
Paris/Orly	71490	48.73N	2.4E
	FRENCH GUIANA		
Cayenne/Rochambeau	814050	4.83N	52.37W
	FRENCH POLYNESIA		
Tahiti Island/Faaa	919380	17.5S	149.6W
	GERMANY		
Augsburg/Mulhausen	108520	48.43N	10.93E
Berlin/Tempelhof	103840	52.47N	13.4E
Bremen	102240	53.05N	8.8E
Bremerhaven	101290	53.53N	8.58E
Coburg	106710	50.28N	10.98E
Erding	108690	48.32N	11.95E
Frankfurt am Main	106370	50.05N	8.6E
Giessen	105320	50.58N	8.7E
Grafenwohr	106870	49.7N	11.95E
Hahn (Airport)	106160	49.95N	7.27E
Hanau	106420	50.17N	8.97E
Hannover	103380	52.47N	9.7E
Heidelberg	107340	49.4N	8.65E
Idar-Oberstein	106180	49.7N	7.33E
Karlsruhe	107270	49.03N	8.37E
Kassel	104380	51.3N	9.45E
Kiel	100440	54.5N	10.28E
Kitzingen	106590	49.75N	10.2E
Mannhein/Neuostheim	107290	49.52N	8.55E
Munich/Riem	108660	48.13N	11.7E
Nurnberg	107630	49.5N	11.08E
Oldenburg	102150	53.18N	8.17E
Ramstein	106140	49.43N	7.6E
Sembach AB	107120	49.5N	7.87E
Spangdahlem AB	106070	49.98N	6.7E
Stoetten	108360	48.67N	9.87E
Stuttgart/Echterdingen	107380	48.68N	9.22E
Ulm	108380	48.38N	9.95E
Wendelstein Mountain	109800	47.7N	12.02E
Wiesbaden	106330	50.05N	8.33E
Wurzburg	106550	49.77N	9.97E
Zweibrucken	107140	49.22N	7.4E

	GREECE		
Athens/Hellenkion	167160	37.9N	23.73E
Elefsis	167180	38.07N	23.55E
Larissa	166480	39.63N	22.42E
Preveza/Aktion	166430	38.95N	20.77E
	GREENLAND		
Angmagssalik	43600	65.6N	37.63W
Sondre Stromfjord	42310	67N	50.8W
Thule AB	42020	76.53N	68.5W
	GUAM		
Agana (formerly Agana NAS)/Brewer	912120	13.48N	144.8E
Andersen AFB	912180	13.58N	144.93E
	GUATEMALA		
Guatemala/La Aurora	786410	14.58N	90.52W
	HONDURAS		
Tegucigalpa/Toncontin	787200	14.05N	87.22W
	HONG KONG		
Hong Kong	450070	22.33N	114.18E
	HUNGARY		
Budapest/Ferihegy	128390	47.43N	19.27E
	ICELAND		
Keflavik NAS	40180	63.97N	22.6W
Reykjavik	40300	64.13N	21.9W
	INDIA		
Bombay/Santa Cruz	430030	19.12N	72.85E
Calcutta/Dum-Dum	428090	22.65N	88.45E
Delhi/Safdarjung	421820	28.58N	77.2E
Hyderabad	431280	17.45N	78.47E
Madras/Menambarkkam	432790	13N	80.18E
	IRAQ		
Baghdad/Sirsenk/Bam	406500	33.23N	44.23E
	IRAN		
Tehran-Mehrabad (formerly Mehrabad AFB)	407540	35.68N	51.35E
	IRELAND		
Dublin	39690	53.43N	6.25W
Shannon	39620	52.7N	8.92W
	ISRAEL		
Tel-Aviv-Yafo	401760	32.1N	34.78E
	ISRAEL-JORDAN DMS		
Jerusalem/Atarot	402900	31.87N	35.22E
	ITALY		
Aviano AB	160360	46.03N	12.6E
Brindisi (formerly Casale AFB)	163200	40.65N	17.95E
Cagliari (formerly Elmas AFB)	165600	39.25N	9.05E
Ciampino	162390	41.8N	12.55E

Cimone Mountain	161340	44.2N	10.7E
Ghedi AB	160880	45.42N	10.28E
Milano/Linate	160800	45.43N	9.28E
Naples/Capodichino	162890	40.85N	14.3E
Pisa	161580	43.68N	10.38E
Rimini	161490	44.03N	12.62E
Sigonella	164590	37.4N	14.92E
Sigonella NAS	164594	37.4N	14.93E
Venezia/Tessera	161050	45.5N	12.33E
Villafranca	160900	45.38N	10.87E
	IVORY COAST		
Abidjan/Port Bouet	655780	5.25N	3.93W
	JAMAICA		
Kingston/Norman Manley	783970	17.93N	76.78W
	JAPAN		
Ashiya	478030	33.88N	130.65E
Atsugi NAF (formerly NAS)	476790	35.45N	139.45E
Fukuoka	478070	33.58N	130.38E
Fukuoka/Itazuke	478080	33.58N	130.45E
Futenma AS	479330	26.27N	127.75E
Iruma	476430	35.83N	139.42E
Iwakuni	477640	34.15N	132.23E
Kadena NAF	479310	26.35N	127.77E
Misawa AB	475800	40.7N	141.37E
Morioka	475840	39.7N	141.17E
Nagasaki	478550	32.92N	129.92E
Nagoya	476350	35.25N	136.93E
Naha	479300	26.18N	127.65E
Osaka/Itami	477710	34.78N	135.45E
Sapporo	474120	43.05N	141.33E
Sasebo	478120	33.15N	129.73E
Tokyo	476620	35.68N	139.77E
Tokyo (International)	476710	35.55N	139.78E
Yokota	476420	35.75N	139.35E
	JORDAN		
Amman	402700	31.98N	35.98E
	REPUBLIC OF KOREA		
Camp Red Cloud/Uijd	471060	37.75N	127.03E
Chupungnyong	471350	36.22N	128E
Inchon	471120	37.48N	126.63E
Kangnung	471070	37.75N	128.95E
Kunsan	471410	35.9N	126.62E
Kwangju	471580	35.12N	126.82E
Mangilsan	471260	36.93N	126.45E
Mosulpo	471870	33.2N	126.27E
Osan AB	471220	37.08N	127.03E

Pusan	471590	35.1N	129.03E
Pusan/Kimhae	471530	35.18N	128.93E
Pyongtaek Taeng-Ni	471270	36.97N	127.03E
Seoul	471170	37.5N	126.93E
Seoul East	471110	37.43N	127.12E
Seoul/Kimpo	471100	37.55N	126.8E
Taegu	471420	35.9N	128.65E
Taejon	471320	36.33N	127.38E
LEBANON			
Beirut	401000	33.82N	35.48E
LIBYA			
Baninah/Benghazi	620530	32.08N	20.27E
Tripoli	620100	32.67N	13.15E
MALAYSIA			
Kuala Lumpur/Subang	486470	3.12N	101.55E
Pinang/Bayan Lepas	486010	5.3N	100.27E
MARSHALL ISLANDS			
Kwajalein/Bucholz	913660	8.73N	167.73E
Majuro	913760	7.1N	171.4E
MEXICO			
Mexico City	766793	19.43N	99.1W
MOROCCO			
Rabat/Sale	601350	34.05N	6.77W
Tangier/Boukhalef Souahel	601010	35.73N	5.9W
NETHERLANDS			
Amsterdam/Schiphol	62400	52.3N	4.77E
Hoek Van Holland	63300	51.98N	4.1E
Soesterberg	62650	52.13N	5.27E
Volkel	63750	51.65N	5.7E
NEW ZEALAND			
Christchurch	937800	43.4S	172.55E
Wellington	934360	41.3S	174.8E
NICARAGUA			
Managua/Augusto Cesnicaragua	787410	12.15N	86.17W
NORTHERN MARIANA ISLANDS			
Saipan	912320	15.12N	145.73E
NORWAY			
Oslo/Fornebu	14880	59.9N	10.62E
PHILIPPINES			
Baguio/Luzon Island	983280	16.42N	120.6E
Clark International (formerly ClarkAFB)/Luzon Island	983270	15.18N	120.55E
Manila/Ninoy Aquino	984290	14.52N	121E
Olongapo	984260	14.8N	120.27E
PAKISTAN			
Karachi	417800	24.9N	67.13E

	POLAND		
Warsaw/Okecie	123750	52.17N	20.97E
	PANAMA		
Howard AFB	788060	8.92N	79.6W
Tocumen	787920	9.05N	79.37W
	NORTH PACIFIC		
Johnston Island	912750	16.73N	169.5W
	PARAGUAY		
Asuncion/Silvio Pettirossi	862180	25.2S	57.63W
	PERU		
Lima/Jorge Chavez	846280	12S	77.12W
	PORTUGAL		
Lisbon/Portela	85360	38.78N	9.13W
	PUERTO RICO		
Aguadilla/Borinquen	785140	18.5N	67.13W
Roosevelt Roads NS (formerly NAS)	785350	18.25N	65.63W
San Juan	785260	18.43N	66W
	RUSSIA		
Moscow/Sheremetevo	275155	55.98N	37.5E
	SAUDI ARABIA		
Dhahran	404160	26.27N	50.15E
Riyadh	404380	24.72N	46.72E
	SEYCHELLES		
Seychelles	639800	4.67S	55.52E
	SINGAPORE		
Singapore/Payalebar	486940	1.37N	103.92E
	SPAIN		
Alicante/El Altet	83600	38.28N	0.55W
Barcelona	81810	41.28N	2.07E
Cordoba	84100	37.85N	4.83W
Madrid/Barajas	82210	40.45N	3.55W
Mahon/Menorca Island	83140	39.87N	4.23E
Malaga	84820	36.67N	4.48W
Moron	83970	37.15N	5.62W
Rota NS	84490	36.65N	6.35W
Sevilla	83910	37.42N	5.9W
Torrejon	82270	40.48N	3.47W
Valencia	82840	39.5N	0.47W
Zaragoza	81605	41.67N	1.05W
	SURINAME		
Zanderij/Paramaribo	812250	5.45N	55.2W
	SWEDEN		
Stockholm/Bromma	24640	59.35N	17.95E
	SWITZERLAND		
Geneva/Cointrin	67000	46.25N	6.13E

	TAIWAN		
Chia-i	467460	23.47N	120.38E
Sungshan/Taipei	466960	25.07N	121.55E
Taichung	467510	24.18N	120.65E
Tainan	467430	22.95N	120.2E
Wuchia Observatory	467700	24.27N	120.62E
	THAILAND		
Bangkok/Don Muang	484560	13.92N	100.6E
Chiang Mai	483270	18.78N	98.98E
Korat/Nakhon Ratchasima	484310	14.97N	102.08E
Nakhon Phanom	483570	17.42N	104.78E
Ubon/Ratchathani (formerly AB)	484070	15.25N	104.87E
Udon Thani	483540	17.38N	102.8E
	TUNISIA		
Tunis/Carthage	607150	36.83N	10.23E
	TURKEY		
Adana/Incirlik AFB	173500	37N	35.42E
Ankara/Esenboga	171280	40.12N	32.98E
Balikesir	171500	39.62N	27.92E
Diyarbakir	172800	37.88N	40.18E
Eskisehir	171240	39.78N	30.57E
Golcuk/Dumlupinar	170670	40.72N	29.82E
Istanbul/Ataturk AB	170600	40.97N	28.82E
Izmir/Cigli	172180	38.5N	27.02E
Malatya/Erhac	172000	38.43N	38.08E
Samsun	170300	41.28N	36.33E
Sinop	170260	42.03N	35.17E
	UNITED KINGDOM		
Aberdeen/Dyce	30910	57.2N	2.22W
Benson	36580	51.62N	1.08W
Bentwaters	35963	52.13N	1.43E
Brize Norton	36490	51.75N	1.58W
Church Lawford	35440	52.37N	1.33W
Edinburgh	31600	55.95N	3.35W
Fylingdales	32810	54.37N	0.67W
Leuchars	31710	56.38N	2.87W
London/Gatwick	37760	51.15N	0.18W
London/Heathrow	37720	51.48N	0.45W
Mildenhall	35770	52.37N	0.48E
Northolt	36720	51.55N	0.42W
Prestwick	31350	55.5N	4.58W
Woodbridge	35953	52.08N	1.4E
	URUGUAY		
Carrasco	865800	34.8S	56W

	VIETNAM		
Da Nang	488550	16.03N	108.18E
Ho Chi Minh City/Tan Son Nhut	489000	10.82N	106.67E
	WAKE ISLAND		
Wake Island Airfield	912450	19.28N	166.65E
	YUGOSLAVIA		
Belgrade/Surcin	132720	44.82N	20.28E

GLOSSARY

AAF—Army Air Field

AB—Air Base

AFB—Air Force Base

AFCCC—Air Force Combat Climatology Center

AFCESA—Air Force Civil Engineer Support Agency

AFM—Air Force Manual

AFS—Air Force Station

ANGB—Air National Guard Base

ANGS—Air National Guard Station

ANSI— American National Standards Institute

ARB—Air Reserve Base

ARS—Air Reserve Station

ASHRAE/IESNA— American Society of Heating, Refrigerating, and Air Conditioning Engineers/Illuminating Engineering Society of North America

Btu—British thermal units

Btu/cfm—British thermal units per cubic foot per minute

Btu/lb—British thermal units per pound of air (enthalpy)

Btu/sq. ft./day—British thermal units per square foot per day (solar radiation)

C—Celsius

Cfm—Cubic foot per minute

DOD—Department of Defense

EWD—Engineering Weather Data

F—Fahrenheit

gr/lb—Grains per pound (humidity ratio, grains of water vapor per pound of air)

g/kg—Grams per kilogram (humidity ratio, grams of water vapor per kilogram of air)

in. Hg—Inches of mercury (atmospheric pressure)

in.—Inches (frost depth)

in./hr—Inches per hour (rain rate)

klux-hr—Thousands of lux-hours (average incident illuminance)

lb/ft^2—pounds per square foot (snow load)

LST—Local Standard Time

MCAS—Marine Corps air station

MCB—Marine Corps base

MC Dewpt—Mean Coincident Dewpoint

MCDB—Mean of dry bulb temperatures

MCHR—Mean Coincident Humidity Ratio

MCWB—Mean of wet bulb temperatures

mph—Miles per hour (wind speed)

NAS—Naval Air Station

NAF—Naval Air Facility

NAVFACENGCOM—Naval Facilities Engineering Command

NCDC—National Climatic Data Center

NRC—Naval Reserve Center

NREL—National Renewable Energy Laboratory

NS—Naval Station

NSA—Naval Support Activity

POR—Period of record

RH—Relative humidity

ton-hr/cfm/yr—Ton-hours of load per cubic foot per minute per year (Btu÷12,000)

USACE—US Army Corps of Engineers

VCLI—Ventilation Cooling Load Index

WBAN No—Weather Bureau Army Navy number, an identification number for solar radiation data stations in NREL's *Solar Radiation Data Manual for Buildings*

WMO—World Meteorological Organization

APPENDIX A

ENGINEERING WEATHER DATA ACCESS INSTRUCTIONS

A-1 RETRIEVING DATA FOR MILITARY .MIL DOMAIN USERS ONLY

1. Access **http://www.afccc.af.mil.**
2. If you are using a computer within the military, select .MIL DOMAIN.
3. Select the appropriate response at any Security Alert prompts.
4. Select the Get Products button on the left side of the page.
5. Select the Engineering Weather Data (EWD) link in the center of the page. The AFCCC PRODUCT LOCATOR page will display.
6. In the Product pull down menu, EWD will be selected by default. At this point, you can select the SUBMIT button at the bottom of the page to display a listing of all 808 sites, or;
7. From the Country pull-down menu, select the country of interest. For the United States, the individual states are listed alphabetically (e.g., United States – Florida).
8. Selecting SUBMIT will bring up only the viewable/downloadable files for the site selected. NOTE: Select the station data for a site nearest the location of interest. Consider topography as well as stations in nearby states or countries in your selection to approximate climatological conditions for the location of interest.
9. Select the Standard EWD Package for download. For Binned Data, select that .csv package for download. For the New Cooling Degree Day Summary Base 50 F in Excel Spreadsheet, write down the WMO number for the station of interest. Select the Cooling Degree Day Base 50 F Supplement hot link. When the Excel spreadsheet opens, the identifier cell A6 is selected, and the default identifier is shown in the row just above column C. Revise the default entry to be the WMO number of the appropriate station, and hit Enter. Selecting the degree-day Excel file will require answering Yes to two more security prompts.
10. Use Adobe Acrobat Reader to open the Standard EWD Package. Optionally, you may import the Binned Temperature Data .csv file into a program such as Excel.

A-2 RETRIEVING DATA BY WORLD METEOROLOGICAL ORGANIZATION (WMO) NUMBER

1. Follow steps 1-5 listed above.
2. In lieu of selecting a site from the Country pull down menu on the AFCCC PRODUCT LOCATOR page, you may type the WMO number in the WMO Station Number field in the Optional Text Input section on the right side of the page. (You can select from WMO numbers located in Chapter 3 of this

document.) Select SUBMIT. Make sure you enter the leading zero where required as described in paragraph 1-3.2.

3. Follow steps 8-10 above.

A-3 **RETRIEVING DATA FOR UNLISTED SITES.** The AFCCC will provide EWD for unlisted sites for DOD activities. Submit a Support Assistance Request (SAR) form to AFCCC. They will promptly provide engineering weather data for installations not currently listed, when source data is available. Unlisted site request data can be saved for future inclusion into the EWD database. Include this request in the SAR when you submit your request for data. You can access SAR forms from the main AFCCC screen by selecting the Support Request (SAR) button on the left side of the page.

A-4 **DATA RETRIEVAL BY CONTRACTOR, VENDOR, OR OTHER NON-DOD USERS**. Follow procedures described in paragraph 1-3.3