TECHNICAL REPORT 2



Water Bottling Facility

Mid-Atlantic, US

Building and Plant Energy Analysis Report

The Pennsylvania State University
Architectural Engineering
Mechanical Option

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October 12, 2012

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Executive Summary

In Technical Report 2 analyses of the design load, energy consumption, and cost of operation for the Water Bottling Facility were run. All of these calculations were found using the Carrier program HAP. Information to perform these calculations was gathered form drawings and specifications provided by the Water Bottling Facility's engineer.

The first calculation of loads used a combination of building materials, area, solar loads, and interior loads. With all of this information it was found that the building uses 21,745,119 kBTU annually.

The energy consumption analysis used the total building load to find how much energy is used to power the building. After running the numbers through HAP it was found that the building uses 19,103,240 kWh annually. This estimate is low because it does not account for the power drawn for two thirds of the manufacturing equipment.

The cost analysis used the energy consumption to find that the energy bill of the Water Bottling Facility should add up to about $2.09 million annually. Because the energy consumption was missing the electricity drawn by the manufacturing equipment this number is also low. The actual electricity bill of the Water Bottling Facility comes to about $3.7 million annually.

Based on the energy consumption the amount of emissions from the fuel burned to generate electricity can be calculated. Since the building sector uses the majority of energy used in the United States it is not surprising that the facility energy use produces 6.9 million pounds per year of gaseous and particulate waste.

Mechanical System Summary

The Water Bottling Facility's mechanical systems are comprised of 6 roof top air handling units, a humidifier, 5 electrical and 4 gas unit heaters,17 VAV boxes, 35 exhaust fans, 16 supply fans, 8 indirect fired make-up air handling units, and 2 gravity hoods. In the mechanical rooms of the facility there are 3 chillers, 4 heat exchangers, 5 compressors, and 3 boilers. Outside of the mechanical rooms are 3 cooling towers. All of these systems contribute to maintaining an acceptable environment within the spaces. There are 14 spaces with load and equipment specific HVAC requirements.

System Design Load Estimation

To analyze the load on the Water Bottling Facility, Carrier Hourly Analysis Program v4.6 (HAP) was used. This allowed the loads to account for loads based on location, building materials, occupancy, and equipment. HAP was selected over other load calculating programs because of previous experience and availability. The energy analysis accounts for an entire year's worth of data, finding the peak design cooling and heating loads for the system.

Block Load Elements

Block analysis was used to minimize the amount of inputs into the load calculation program. The increased speed for entry, minimization of mis-entry, and smaller file size which block analysis makes it a good choice compared to space by space analysis especially because it provides accurate results. Blocks for this analysis were selected based on location and zone requirements resulting in 10 blocks.

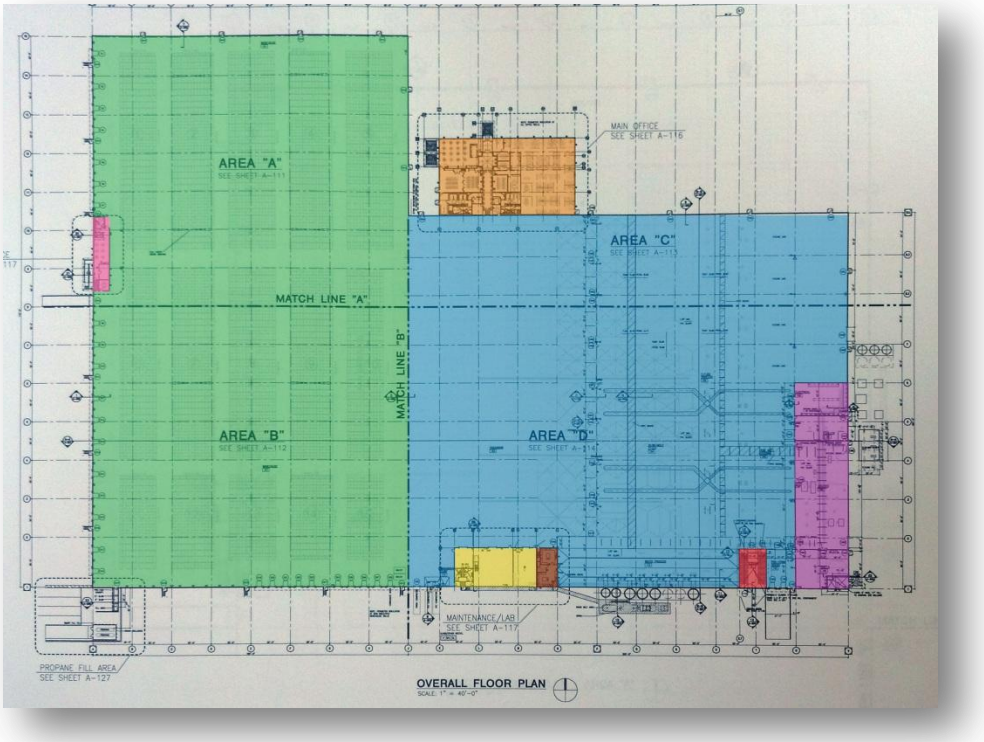


Figure 1: Block Load Calculation Boundaries

The figure above shows the breakdown of blocks. Orange represents the main office, blue the production area, green the warehouse, purple the mechanical rooms, brown the Q.C. lab, and red the H-3 essence room. The pink represents both levels of the shipping office and the yellow both levels of the maintenance area.

Load Sources and Modeling Information

Outdoor Air Ventilation

The outside air ventilation rates fulfill LEED requirements by using a 100% outside air enthalpy economizer cycle. Several of the spaces go so far as to only have supply fans that bring in outside air directly.

Design Occupancy

Design occupancy is relevant in the office spaces but used as a guide for the production and warehouse. The number of occupants is extremely exaggerated based on the large area of those spaces. The total number of people in each space can be found in the emergency egress plan. This plan used such a large number of people based on how many people could potentially be there.

The load was also influenced by this facility running on a 24 hour schedule. Although areas within the Main Office are not occupied for the whole day, they make up a small percentage. All other spaces, including the shipping office, operate on an around the clock basis.

Electrical Loads

Actual loads based on lighting were calculated. Computer loads were estimated in office spaces based on one lap top per person. An estimation of production space load was made based on information given in the specifications. Information for all production equipment was not provided.

Weather Information

Design conditions for the Mid Atlantic town were given in the mechanical drawings and confirmed using ASHRAE Handbook of Fundamentals 2009.

Heating Design Temperature 99.6%	Cooling Design Temperature Dry-bulb 1.0%	Wet Bulb 1.0%	No. Hrs. 8 AM – 4PM 55 < Tdb < 69
5°F	88°F	72°F	710

Table 1: Location Design Criteria

Space Requirements

The Water Process Area has design conditions of 80°± 2°F maximum cooling dry bulb with a cooling dew point of 48°F with a maximum of 50°F. For heating conditions, 60°F is the minimum temperature. The space is generally not in need of heat due to the equipment load in the space. The Water Process Area also requires about 0.05 CFM/SF for ventilation based on ASHRAE 62.1, and a positive pressurization of 0.01" to 0.02" W.G. to the warehousing and 0.01" W.G. to the outdoors. The space is designed to use an air enthalpy economizer cycle that utilized 100% outside air

The Injection Mold/Blow Mold/Filler Area has the temperature and humidity requirements as the Water Process Area and also has a 0.01" W.G. positive pressurization relative to the warehousing.

The Packaging Area has a cooling dry bulb design of 104°F or 10°F above ASHRAE's 1% summer design dry bulb. This is determined based on which temperature is closer to 90°F. Heating design requirements has a minimum temperature of 55°F. Ventilation required in 5,000 CFM per forklift, of which there are usually 2. The Packaging Area should have a positive pressurization of 0.01" to 0.02" W.G. to the outside.

The Warehouse has the same cooling and heating design requirements as the Packaging Area. The air changes required per forklift is also the same, but there is typically 1 forklift per 200,000 ft^2 of warehouse space. Pressurization is also the same.

The Utilities Room has minimum and maximum design temperatures of 50°F and 95°F respectively. It also requires up to 12,000 CFM of outside air make-up for the compressors.

The Chiller Room has the same design temperatures as the Packaging Area for heating and cooling. The chillers in the Chiller Room are connected to pieces of equipment with high heat load to prevent overheating as well as to the roof top units.

The Boiler/Water Treatment Room also follows the specifications of the Packaging Area but is cooled by ventilation only, not cooling or air conditioning. The boilers, like the chillers, are used by specific pieces of equipment, as well as the roof top units.

The Electrical Room follows the same guide lines as the Packaging area with a max temp of 104°F or 10°F above the 1% summer design dry bulb. This space also is only ventilated, not cooled.

The Chemical Storage Room follows the requirements of the Packaging Area for cooling, but has a minimum temperature of 50°F with temperature sensors to prevent extremes of temperature. The room is also negatively pressurized at 0.01" W.G.

The Q.C. Lab has a minimum temperature requirement of 68°F and a maximum of 75°F. The humidity should be in the range of 35% to 45% in winter and 45% to 55% in summer with positive 0.01" W.G. pressurization. All air in this space is make-up and cannot be recirculated. This space has the most critical load of the entire facility.

The Maintenance Shop has a maximum temperature of 104°F or 10°F above outside air dry bulb on the 2.5% design condition, depending on which value is closest to 95°F. The minimum temperature for the space is 60°F.

The Shipping Office is conditioned to have a heating temperature of 68°F and a cooling temperature of 74°F. The ventilation in this office space meets minimums required of local code and LEED.

The Main Office has the same design requirements as the Shipping Office.

Fire Pump Room follows the same requirements for cooling as the Packaging Area. The Minimum temperature for the space is 45°F which is maintained by electric or gas heaters.

System Load Analysis Results

The table below shows the cooling, heating, supply, and ventilation requirements for the Water Bottling Facility. The supply data was gathered from the AHU schedule within the drawings. There were no calculations provided by the engineers.

	Cooling (ft^2/cfm)	Heating (Btu/hr*ft^2)	Supply Air (cfm/ft^2)	Ventilation Air (cfm/ft^2)
Block Calculation	17.99	0.25	0.78	0.04
Data Supplied	3.33	2.80	0.57	0.14

Table 2: Block Load Calculation vs. Actual Rates

The variations seen in this table compared to those found in the mechanical schedule could be a result of missing information and a very low cooling requirement for most spaces.

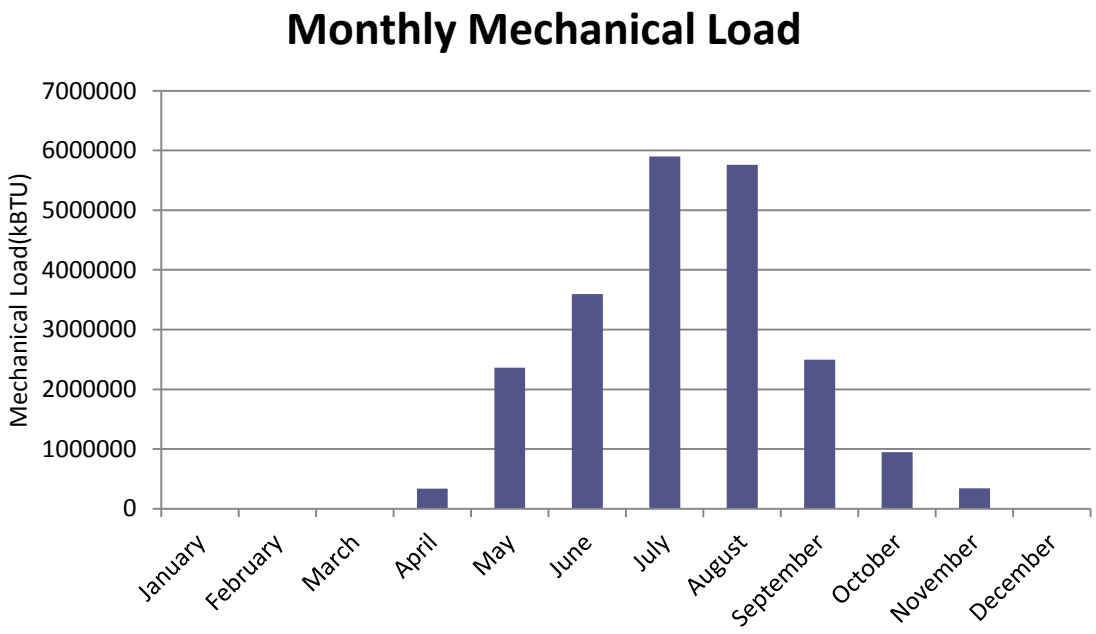


Figure 2: Monthly Mechanical Load

As seen in the graph above the summer requires a much greater mechanical output while the cooler months do not have any load requirements. This is because the processing produces such a large amount of heat that heating is unnecessary unless that facility is not running in the case of a holiday or other scheduled shutdown. These days were neglected in the load calculation because they only occur about twice a year. This results in a total demand of 21,745,119 kBTU annually.

System Energy Consumption & Operating Cost

Energy cost and consumption were taken into account in the HAP model based on the load calculation. The cooling for the roof top units was provided by chillers which run on electric. The heating via mechanical systems had very little impact on the total energy usage because of the amount of heat generated by the equipment in the production portion of the facility.

System Energy Classification

According to the Annual Energy Consumption estimate produced by HAP, the Water Bottling Facility consumes about 19,103,240 kWh annually. The majority of this energy was used to light the space and run the equipment used for processing. HVAC systems used a mere 6% of the energy consumed by the facility.

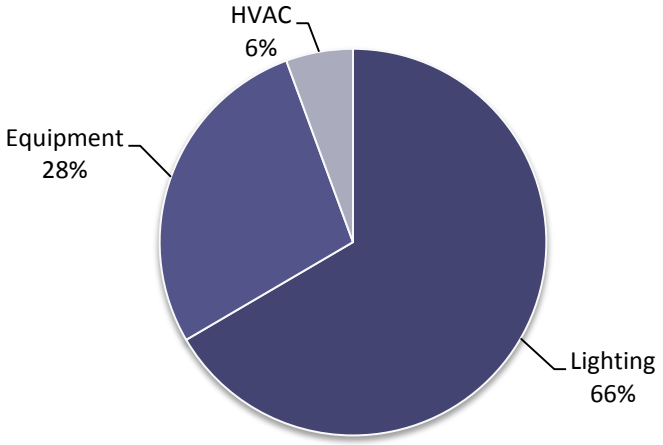


Figure 3: Percent Energy Consumption per System

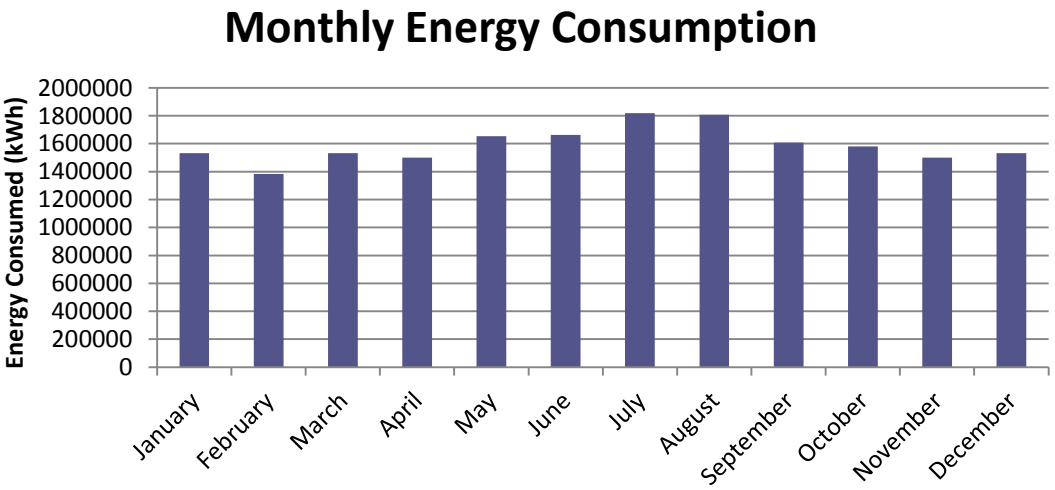


Figure 4: Monthly Electrical Energy Consumption

Although there are 4 gas unit-heaters used in the building, their usage is limited to times of facility shut down in very cold weather.

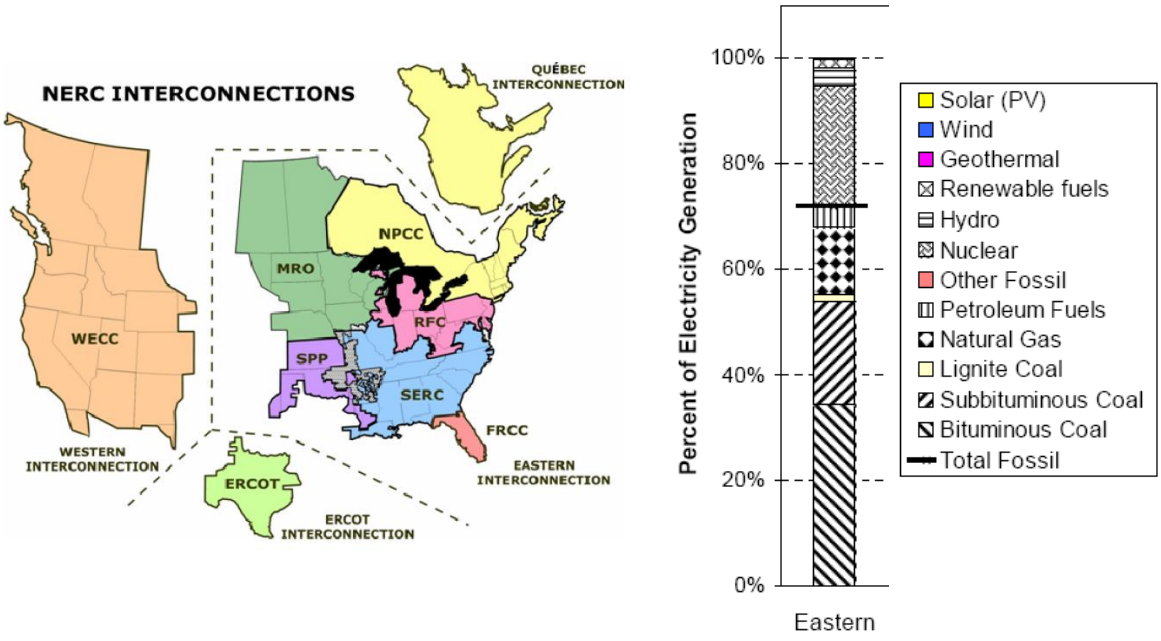
Building Energy Cost Analysis

Energy cost was found via the electricity provider. The cost per kWh varies based on the type of building it is going to. Since the Water Bottling Facility is industrial it falls in a category of businesses that pay $0.10346/kWH. While this value may seem to be low, the amount of energy consumed at the Water Bottling Facility causes it to add up quickly.

Based on the HAP calculations the annual energy cost to run the building is about $2.09 million. The actual energy cost for the Water Bottling Facility in about $3.7 million annually. This large cost difference is likely attributed to the additional production equipment whose energy information was omitted from the specifications.

Environmental Impact Analysis

The means by which the electricity is produced varies throughout the country based on available resources. The different colors in the figure below represent electrical grid boundaries of electric companies and the dotted lines indicate the area that use different ratios of fuels to produce the electricity. The graph on the right displays the percent of each type of fuel used in the Eastern Interconnection, which is where the Water Bottling Facility is located. The percentage of each contributing fuel influence the emission generated by the facility's energy use.



Figures 5 & 6: Boundaries of Electrical Grid & Percent Fuel Source to Produce Electricity

The table on the following page shows the total weight of particulate matter produced annually by the Water Bottling Facility. This total is a result of the electrical use of the building. The emissions are not necessarily being emitted into the air around the facility but emitted at the power station where the electricity is generated.

More emissions are generated by the use of the gas unit heaters but because they are used so seldom their contribution to the total emissions is minimal.

Pollutant	Regional Grid Emission Factors 2007 (lb/kWh)	Calculated Emissions (lb/year)
CO2e	1.74E+00	3.32E+06
CO2	1.64E+00	3.13E+06
CH4	3.59E-03	6.86E+03
N2O	3.87E-05	7.39E+01
NOX	3.00E-03	5.73E+03
SOX	8.57E-03	1.64E+04
CO	8.54E-04	1.63E+03
TNMOC	7.26E-05	1.39E+02
Lead	1.39E-07	2.66E-01
Mercury	3.36E-08	6.42E-02
PM10	9.26E-05	1.77E+02
Solid Waste	2.05E-01	3.92E+05

Table 3: Emissions Analysis

Building Energy and Cost Analysis Results

The results of the building energy cost analysis indicate that the impact of the equipment used in the building outweighs the mechanical systems. Based on the significant impact seen in this calculation including less than half of these components, the production equipment will trump the energy demand of the lighting. This significant increase in the energy consumption is likely to increase the energy cost by ¼. This also means that the emissions are likely to be increased by ¼. Because the facility functions partly as a factory this large cost of operation and high emissions output is expected.

References

ANSI/ASHRAE (2007), Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality. American Society of Heating Refrigeration, and air Conditioning Engineers, Inc., Atlanta, GA, 2007.

ANSI/ASHRAE (2007), Standard 90.1-2007, Energy Standard for Building Except Low Rise Residential Buildings. American Society of Heating Refrigeration, and air Conditioning Engineers, Inc., Atlanta, GA, 2007.

Deru, M. and P Torcellini, Source Energy and Emission Factors for Energy Use in Buildings. Technical Report NREL/TP-550-38617

Haskel Architects and Engineers Engineering Reports

Water Bottling Facility Specifications and Images

Acknowledgements

A special thanks to the team at the Water Bottling Facility, who have been a constant source of information.

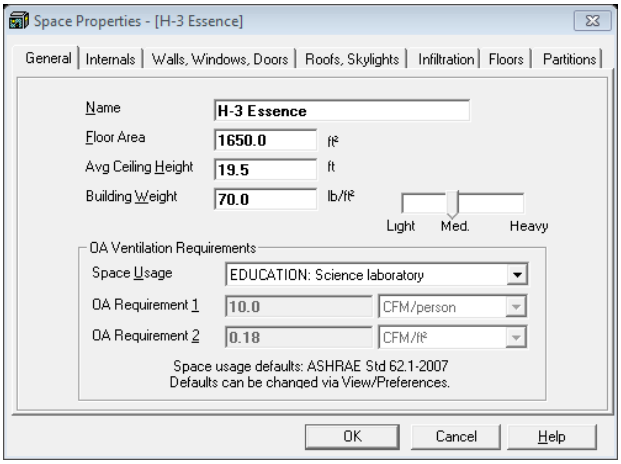
Jack Neborak, Ron Hendeson, and Chris Hoffner,
Thank you for all your help.

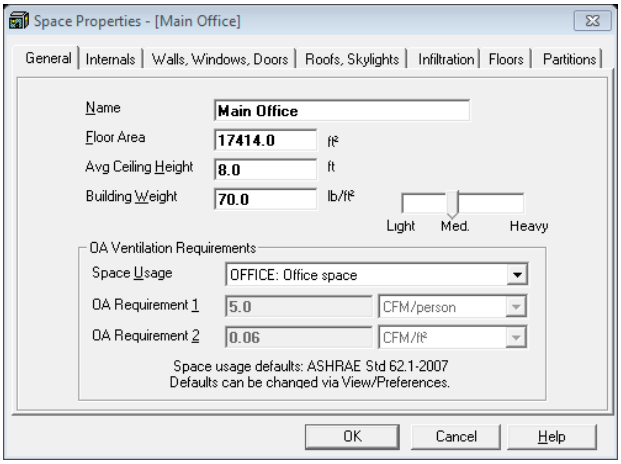
Appendix A – HAP Data Templates

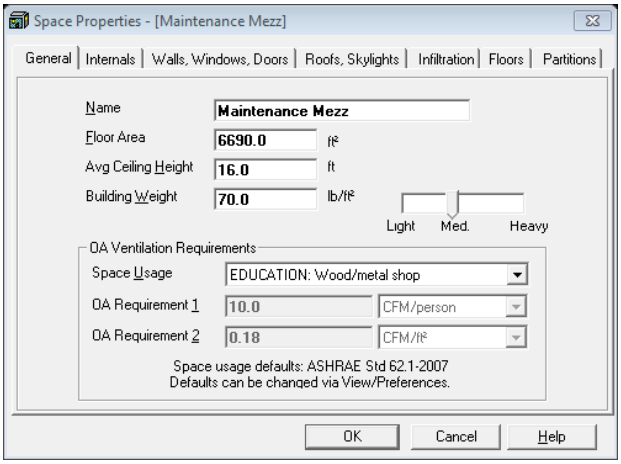
Areas of Exterior Walls, Windows & Doors

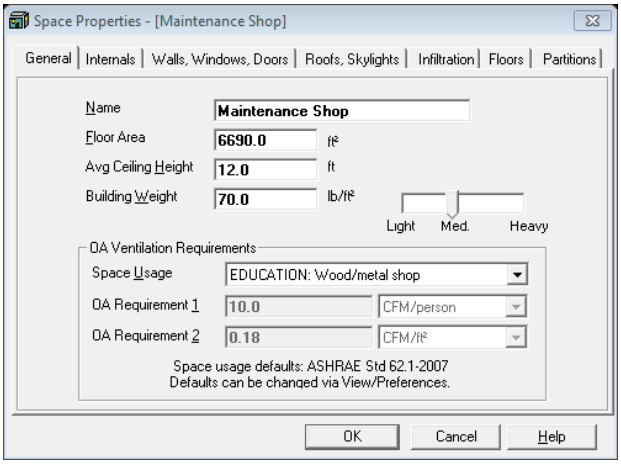
Block	Area (ft^2)	# of People	Ceiling Height (ft)	Length Facing Compass Direction (ft^2) / Doors (ft^2) / Windows (ft^2)											
				NE/W			SE/S			SW/E			NW/N		
H-3 Essence	1650	17	19.5	-	-	-	675	21	16	-	-	-	-	-	-
Main Office	17414	395	8	2176	21	438	-	-	-	2176	0	680	3103	0	939
Maintenance Mezz.	6690	22	16	-	-	-	2893	0	0	-	-	-	-	-	-
Maintenance Shop	5311	53	12	-	-	-	1050	42	0	-	-	-	-	-	-
Mechanical	17385	58	23.5	-	-	-	-	-	-	9600	100	0	-	-	-
Processing	245176	2452	23.5	-	-	-	1280	221	0	6400	121	0	12240	84	0
Q.C. Lab	1378	14	10	-	-	-	265	21	0	-	-	-	-	-	-
Shipping Mezz.	1906	6	16	1930	0	0	-	-	-	-	-	-	-	-	-
Shipping Office	1906	19	8.5	1158	21	57	-	-	-	-	-	-	-	-	-
Warehouse	285530	571	30	9280	1926	0	16000	1105	0	24800	21	0	16000	105	0

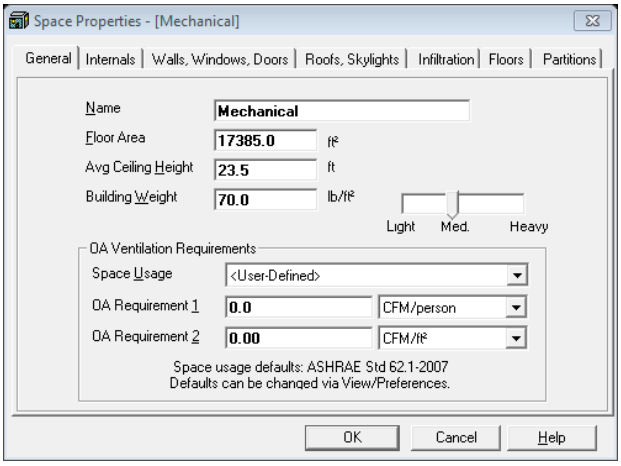
Blocks







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General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Mechanical
Floor Area
17385.0
ft²
Avg Ceiling Height
23.5
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
<User-Defined>
OA Requirement 1
0.0
CFM/person
OA Requirement 2
0.00
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2007
Defaults can be changed via View/Preferences.
OK
Cancel
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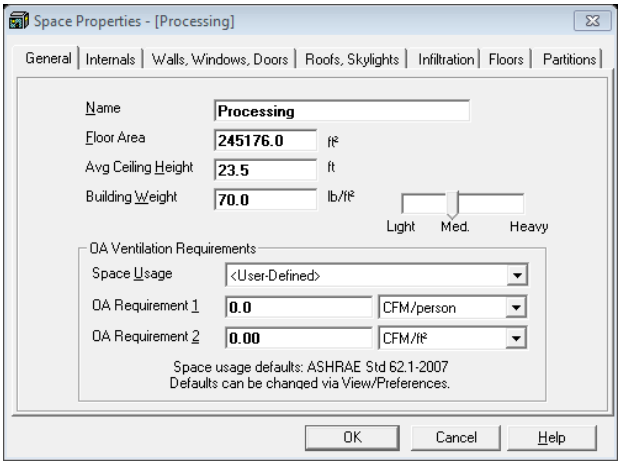
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General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Processing
Floor Area
245176.0
ft²
Avg Ceiling Height
23.5
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
<User-Defined>
OA Requirement 1
0.0
CFM/person
OA Requirement 2
0.00
CFM/ft²
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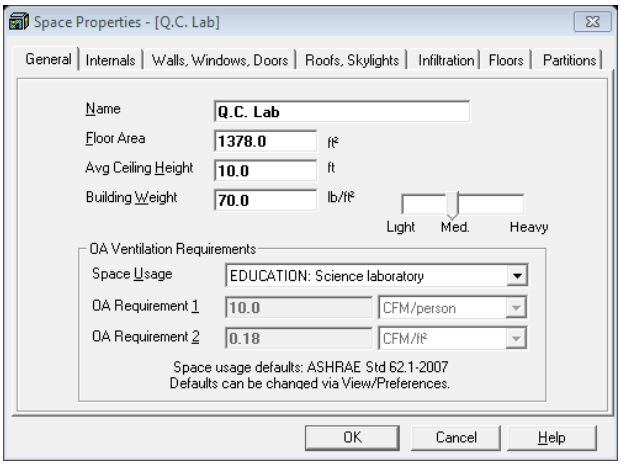
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General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
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Floor Area
1378.0
ft²
Avg Ceiling Height
10.0
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
EDUCATION: Science laboratory
OA Requirement 1
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CFM/person
OA Requirement 2
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CFM/ft²
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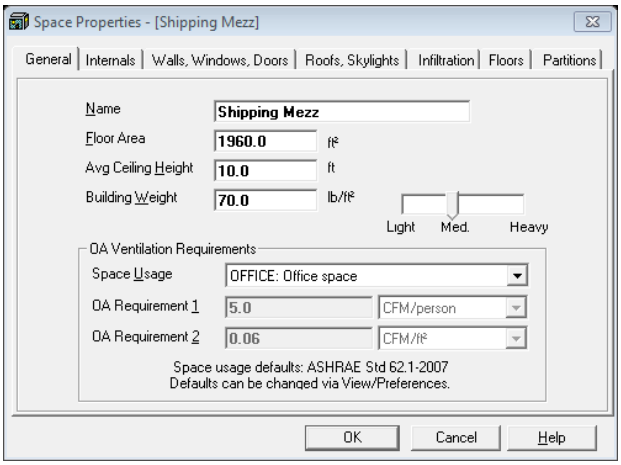
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General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Shipping Mezz
Floor Area
1960.0
ft²
Avg Ceiling Height
10.0
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
OFFICE: Office space
OA Requirement 1
5.0
CFM/person
OA Requirement 2
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CFM/ft²
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Cancel
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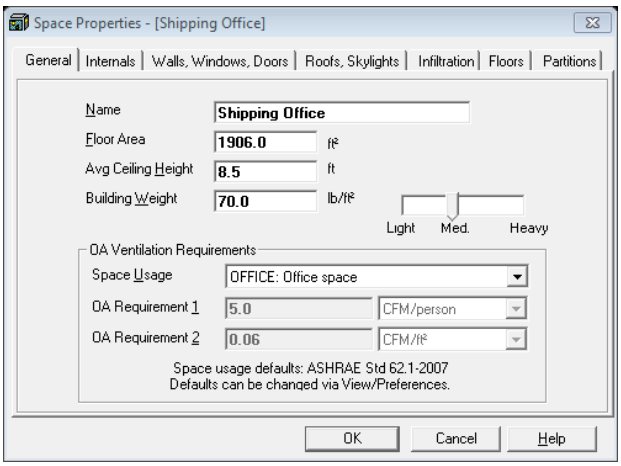
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General
Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
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Shipping Office
Floor Area
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ft²
Avg Ceiling Height
8.5
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
OFFICE: Office space
OA Requirement 1
5.0
CFM/person
OA Requirement 2
0.06
CFM/ft²
Space usage defaults: ASHRAE Std 62.1-2007
Defaults can be changed via View/Preferences.
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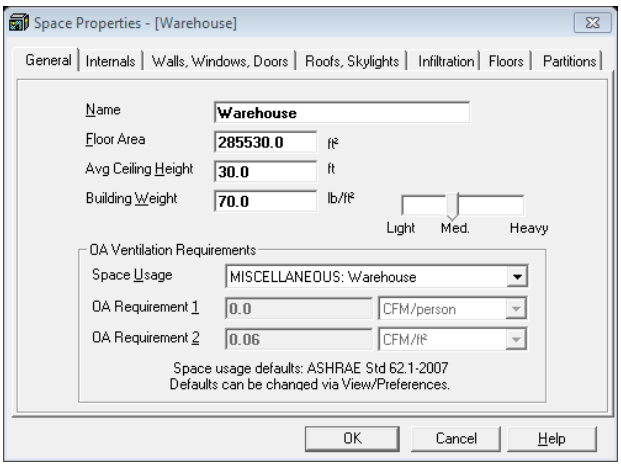
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Internals
Walls, Windows, Doors
Roofs, Skylights
Infiltration
Floors
Partitions
Name
Warehouse
Floor Area
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ft²
Avg Ceiling Height
30.0
ft
Building Weight
70.0
lb/ft²
Light
Med.
Heavy
OA Ventilation Requirements
Space Usage
MISCELLANEOUS: Warehouse
OA Requirement 1
0.0
CFM/person
OA Requirement 2
0.06
CFM/ft²
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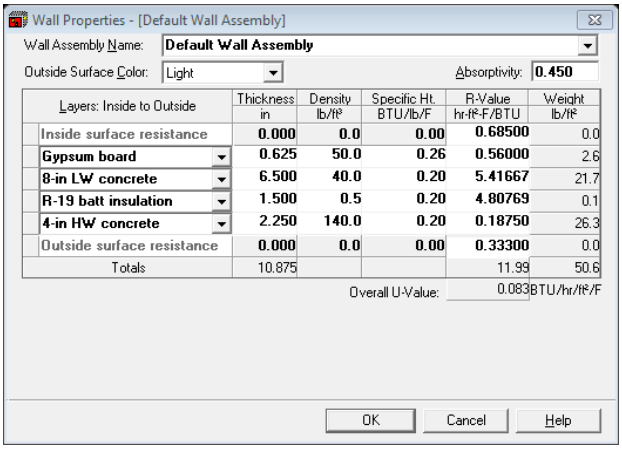
Defaults can be changed via View/Preferences.
OK
Cancel
Help

Wall & Roof Assembly



Wall Properties - [Default Wall Assembly]

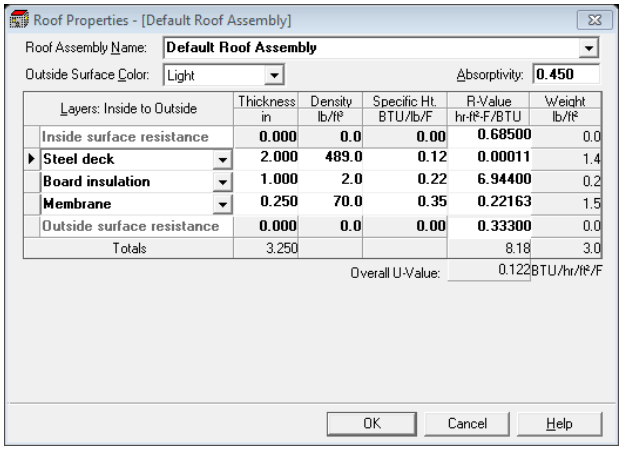
Wall Assembly Name: **Default Wall Assembly**

Outside Surface Color: Light Absorptivity: **0.450**

Layers: Inside to Outside	Thickness in	Density lb/ft³	Specific Ht. BTU/lb/F	R-Value hr-ft²-F/BTU	Weight lb/ft²
Inside surface resistance	0.000	0.0	0.00	0.68500	0.0
Gypsum board	0.625	50.0	0.26	0.56000	2.6
8-in LW concrete	6.500	40.0	0.20	5.41667	21.7
R-19 batt insulation	1.500	0.5	0.20	4.80769	0.1
4-in HW concrete	2.250	140.0	0.20	0.18750	26.3
Outside surface resistance	0.000	0.0	0.00	0.33300	0.0
Totals	10.875			11.99	50.6

Overall U-Value: 0.083 BTU/hr/ft²/F

OK Cancel Help



Roof Properties - [Default Roof Assembly]

Roof Assembly Name: **Default Roof Assembly**

Outside Surface Color: Light Absorptivity: **0.450**

Layers: Inside to Outside	Thickness in	Density lb/ft³	Specific Ht. BTU/lb/F	R-Value hr-ft²-F/BTU	Weight lb/ft²
Inside surface resistance	0.000	0.0	0.00	0.68500	0.0
Steel deck	2.000	489.0	0.12	0.00011	1.4
Board insulation	1.000	2.0	0.22	6.94400	0.2
Membrane	0.250	70.0	0.35	0.22163	1.5
Outside surface resistance	0.000	0.0	0.00	0.33300	0.0
Totals	3.250			8.18	3.0

Overall U-Value: 0.122 BTU/hr/ft²/F

OK Cancel Help

Appendix B – Weather Information

Meaning of acronyms:
DB: Dry bulb temperature, °F *WB: Wet bulb temperature, °F*
MCWB: Mean coincident wet bulb temperature, °F
Lat: Latitude, °
DP: Dew point temperature, °F
MCDB: Mean coincident dry bulb temperature, °F
Long: Longitude, °
HR: Humidity ratio, grains of moisture per lb of dry air
HDD and CDD 65: Annual heating and cooling degree-days, base 65°F, °F-day
Elev: Elevation, ft
WS: Wind speed, mph

Station	Lat	Long	Elev	Heating DB		Cooling DB/MCWB						Evaporation WB/MCDB				Dehumidification DP/HR/MCDB						Extreme Annual WS			Heat./Cool. Degree-Days	
						0.4%		1%		2%		0.4%		1%		0.4%			1%							
				99.6%	99%	DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	DP	HR	MCDB	DP	HR	MCDB	1%	2.5%	5%	HDD	CDD 65
TOPEKA MUNICIPAL AP	39.07N	95.63W	886	0.6	6.7	97.1	75.8	94.1	75.8	91.2	75.0	78.9	91.1	77.7	89.9	75.5	138.0	86.1	74.2	132.0	84.6	23.8	20.3	18.4	4983	1418
WICHITA MID-CONTINENT AP	37.65N	97.43W	1339	4.0	10.5	100.4	73.3	97.2	73.4	94.0	73.3	77.4	90.2	76.3	89.5	74.0	133.5	83.3	72.7	127.6	81.8	28.0	25.4	23.2	4564	1678
WICHITA/COL. JABARA	37.75N	97.22W	1421	6.9	11.5	99.7	73.8	97.1	74.0	92.8	73.7	77.3	90.9	76.3	89.6	73.2	130.1	83.2	72.5	126.9	82.3	27.3	24.8	22.1	4443	1578
Kentucky																										*8 sites, 5 more on CD-ROM*
BOWLING GREEN WARREN CO AP	36.98N	86.44W	538	8.5	15.1	93.2	75.5	90.8	75.4	88.8	74.7	78.4	88.6	77.4	87.2	75.5	136.1	83.6	74.5	131.5	82.4	20.1	18.3	16.6	4137	1349
CINCINNATI NORTHERN KY AP	39.04N	84.67W	883	3.1	10.3	91.4	74.5	88.9	73.7	86.5	72.5	77.3	87.1	76.0	85.0	74.4	132.9	82.3	73.2	127.4	80.8	22.3	19.2	17.4	4985	1079
FORT CAMPBELL (AAF)	36.67N	87.50W	568	9.9	16.0	94.4	76.6	92.0	76.1	90.2	75.5	79.8	89.3	78.5	87.9	77.2	144.8	84.1	75.7	137.5	83.2	19.0	16.8	14.8	3817	1600
HENDERSON CITY	37.82N	87.68W	384	7.3	14.9	92.9	76.6	90.9	76.2	89.8	75.6	79.4	90.0	78.0	88.3	76.4	139.9	86.6	74.7	132.0	85.1	21.0	18.7	16.6	4419	1342
LEXINGTON BLUEGRASS AP	38.04N	84.61W	988	6.0	12.7	91.7	73.9	89.3	73.7	87.0	72.8	77.3	87.3	76.0	85.4	74.2	132.6	82.6	73.1	127.5	81.1	20.1	17.9	16.2	4572	1175
LOUISVILLE BOWMAN FIELD	38.23N	85.66W	558	7.1	13.6	93.3	75.3	91.0	74.9	88.9	74.0	78.4	88.6	77.3	87.3	75.4	135.9	83.2	74.3	131.0	82.4	18.9	17.3	15.0	4258	1390
LOUISVILLE STANDIFORD FIELD	38.18N	85.73W	489	8.0	14.5	93.4	75.7	91.2	75.3	89.0	74.3	78.7	89.1	77.5	87.6	75.8	137.3	84.7	74.5	131.2	83.1	21.0	18.8	16.9	4168	1496
SOMERSET(AWOS)	38.00N	84.60W	928	13.6	18.6	94.7	74.9	92.1	74.5	90.3	73.9	78.1	91.0	76.8	88.9	73.4	128.7	84.7	72.8	125.9	83.7	17.9	15.3	12.5	3784	1457
Louisiana																										*12 sites, 5 more on CD-ROM*
ALEXANDRIA ESLER REGIONAL AF	31.40N	92.30W	118	26.5	28.3	97.3	76.8	94.8	77.3	92.8	77.0	80.4	89.3	79.6	89.2	78.4	148.1	83.6	77.2	142.4	83.3	16.5	13.9	12.2	2005	2412
ALEXANDRIA INTERNATIONAL	31.33N	92.55W	89	26.7	29.7	96.6	77.5	93.6	77.2	92.2	77.0	80.8	89.6	79.8	89.4	78.8	150.1	84.8	77.3	142.4	84.3	18.5	16.2	13.7	1836	2568
BARKSDALE AFB	32.50N	93.67W	177	22.5	26.8	97.3	76.3	94.9	76.3	92.8	76.3	79.8	90.2	78.8	89.3	77.2	142.5	83.7	76.1	137.4	83.0	19.0	16.9	14.7	2287	2321
BATON ROUGE RYAN ARPT	30.54N	91.15W	75	27.6	31.1	94.2	77.5	92.8	77.2	91.3	76.8	80.3	89.0	79.6	88.1	78.2	147.1	83.8	77.4	142.9	83.1	18.7	16.8	15.2	1610	2653
LAFAYETTE REGIONAL AF	30.21N	91.99W	43	28.6	32.4	94.2	77.9	92.7	77.7	91.2	77.3	80.7	89.0	80.1	88.4	78.8	149.9	83.9	77.8	144.8	83.4	20.5	18.4	16.6	1496	2763
LAKE CHARLES REGIONAL ARPT	30.13N	93.23W	10	29.6	33.1	94.1	77.8	92.5	77.8	91.0	77.7	81.4	88.6	80.4	87.6	79.4	152.7	84.4	78.6	148.6	83.8	20.7	18.6	16.8	1469	2770
MONROE REGIONAL AP	32.51N	92.04W	82	23.6	27.2	96.9	78.1	94.6	77.7	92.8	77.3	81.1	91.1	80.2	90.2	78.5	148.4	85.7	77.4	143.2	84.8	18.9	17.1	15.0	2238	2422
NEW ORLEANS ALVIN CALLENDER F	29.83N	90.03W	0	30.1	33.8	92.5	78.4	91.1	78.1	90.0	77.8	82.1	87.5	80.8	86.7	80.5	158.4	84.7	79.3	151.9	83.9	17.7	15.7	13.1	1423	2619
NEW ORLEANS INTL ARPT	29.99N	90.25W	20	31.5	35.4	93.6	78.1	91.9	77.7	90.5	77.4	80.7	88.7	80.1	87.9	78.7	148.9	84.4	78.0	145.5	83.8	20.6	18.6	16.9	1318	2846
NEW ORLEANS LAKEFRONT AP	30.04N	90.03W	10	35.6	38.8	93.4	78.7	92.0	78.3	90.7	77.9	81.4	89.5	80.5	88.3	79.3	152.0	85.5	78.6	148.7	85.0	24.0	20.4	18.5	1110	3213
SHREVEPORT DOWNTOWN	32.54N	93.74W	180	27.0	29.8	99.3	76.5	96.9	76.4	94.0	76.2	79.5	91.5	78.8	90.3	76.6	139.7	83.4	75.5	134.6	83.0	18.7	16.7	14.8	2094	2652
SHREVEPORT REGIONAL ARPT	32.45N	93.82W	259	23.8	27.7	97.8	76.3	95.4	76.4	93.4	76.2	79.4	91.1	78.7	90.0	76.4	139.1	83.3	75.8	136.1	83.0	19.6	17.7	16.1	2156	2493
Maine																										*5 sites, 13 more on CD-ROM*
AUBURN-LEWISTON	44.05N	70.28W	289	-6.8	-0.8	87.9	70.5	83.7	69.1	81.1	67.3	73.5	83.2	71.3	80.1	70.4	112.9	78.5	68.3	105.2	76.4	20.9	18.5	16.4	7672	307
BANGOR INTERNATIONAL AP	44.81N	68.82W	194	-7.4	-2.2	87.8	70.9	84.2	69.1	81.2	67.1	73.3	83.2	71.3	80.8	70.1	111.6	78.4	68.2	104.2	75.6	23.5	19.6	17.9	7673	359
BRUNSWICK NAS	43.90N	69.93W	75	-2.5	1.8	86.4	70.7	83.1	68.9	80.5	67.3	73.5	82.6	71.5	79.8	70.4	112.3	78.0	68.9	106.5	75.9	22.2	18.9	16.9	7194	375
PORTLAND INTL JETPORT	43.64N	70.30W	62	-0.3	4.2	86.8	71.0	83.5	69.7	80.4	67.9	73.9	83.0	72.0	80.0	70.8	113.9	78.6	69.2	107.7	76.3	23.2	19.6	17.7	7082	365
SANFORD MUNI (AWOS)	43.40N	70.72W	243	-6.8	-0.2	88.4	70.2	84.5	68.8	81.9	67.4	73.7	84.1	71.7	81.6	70.4	113.0	78.3	68.3	104.9	77.1	20.9	18.4	16.1	7541	334
Maryland																										*3 sites, 2 more on CD-ROM*
ANDREWS AFB	38.82N	76.87W	282	13.9	18.2	94.0	75.2	91.0	74.3	88.4	73.2	78.2	88.6	76.8	86.4	75.2	133.7	82.2	73.9	127.6	80.9	23.5	19.9	17.6	4421	1241
BALTIMORE BLT-WASHNGTN INT'L	39.17N	76.68W	154	12.9	17.3	93.9	74.9	91.2	74.2	88.5	73.1	78.1	88.6	76.8	86.5	75.3	133.3	82.1	74.1	127.9	80.8	22.4	19.2	17.3	4567	1228
THOMAS POINT	38.90N	76.43W	39	17.3	21.1	86.7	N/A	84.8	N/A	83.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38.6	32.2	26.8	4203	1216
Massachusetts																										*12 sites, 1 more on CD-ROM*
BARNSTABLE MUNI BOA	41.67N	70.27W	56	9.6	14.0	84.0	73.5	81.3	71.4	79.2	70.2	75.8	81.6	74.3	78.7	73.4	124.3	77.6	72.8	121.9	76.9	24.8	21.3	19.2	5928	487
BOSTON LOGAN INT'L ARPT	42.36N	71.01W	30	7.4	12.4	90.8	73.3	87.6	71.9	84.4	70.4	76.2	86.3	74.6	83.4	73.1	122.9	81.1	71.6	116.9	79.1	26.8	24.1	20.8	5621	750
BUZZARDS BAY	41.38N	71.03W	56	11.9	16.7	75.6	N/A	74.1	N/A	72.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	44.3	38.6	34.1	5566	281
CHATHAM MUNI ARPT	41.68N	70.00W	62	10.4	16.4	81.8	72.1	79.4	70.9	77.1	70.1	75.0	79.7	73.7	77.5	73.2	123.6	77.5	72.5	120.5	76.4	23.3	19.9	17.6	5671	428
LAWRENCE MUNI	42.72N	71.12W	151	2.8	9.3	90.2	73.6	87.8	72.5	83.8	71.2	76.0	85.2	74.7	82.9	73.0	123.3	79.7	72.3	120.1	79.2	20.2	17.9	16.0	6092	636
MARTHAS VINEYARD	41.40N	70.62W	69	8.9	12.4	82.4	71.8	81.0	70.9	78.8	69.8	75.0	80.3	73.6	77.8	73.1	123.2	77.7	72.4	120.3	76.4	26.1	23.5	20.4	5938	395
NEW BEDFORD RGNL	41.67N	70.95W	82	7.4	11.9	88.1	73.1	83.9	71.4	81.5	69.8	75.7	83.5	74.3	80.4	73.1	123.4	78.6	72.4	120.5	77.7	23.2	20.0	18.0	5837	553
NORWOOD MEMORIAL	42.18N	71.18W	49	2.6	8.8	90.4	74.3	87.9	73.4	84.0	71.7	77.1	86.5	75.4	83.2	73.5	124.8	79.6	72.9	122.2	79.0	20.5	18.2	16.3	6222	574
OTIS ANGB	41.65N	70.52W	131	8.3	13.0	84.6	72.1	81.8	71.1	79.3	69.9	75.6	81.0	74.1	78.7	73.6	125.5	77.5	72.6	121.3	76.6	27.2	24.2	20.6	5849	474
PLYMOUTH MUNICIPAL	41.92N	70.73W	148	4.6	9.7	88.4	73.1	84.2	71.7	81.8	70.0	76.0	84.2	74.5	81.0	73.3	124.3	78.7	72.5	120.9	77.8	23.3	19.8	17.8	6217	517
SOUTH WEYMOUTH NAS	42.15N	70.93W	161	5.9	10.4	91.2	73.8	87.7	72.3	84.7	70.7	76.9	86.8	74.9	83.8	74.1	127.9	81.9	72.2	119.7	79.4	18.5	16.5	14.5	5832	646
WORCESTER REGIONAL ARPT	42.27N	71.88W	1017	1.6	6.2	85.7	71.3	83.1	69.9	80.5	68.3	74.2	81.9	72.5	79.5	71.7	121.7	78.1	70.1	115.2	76.3	25.8	22.7	19.6	6707	453
Michigan																										*15 sites, 27 more on CD-ROM*
DETROIT CITY AIRPORT	42.41N	83.01W	627	4.1	8.9	90.8	73.7	88.3	72.3	85.7	70.9	76.9	86.5	74.9	84.1	73.6	127.9	82.3	72.0	121.3	80.6	20.4	18.6	17.3	5984	898
DETROIT METROPOLITAN ARPT	42.22N	83.35W	663	1.4	6.7	90.3	73.8	87.4	72.5	84.7	71.0	76.9	86.4	75.0	83.5	73.8	129.1	82.5	72.2	122.3	80.3	25.6	22.6	19.7	6183	775
DETROIT WILLOW RUN AP	42.23N	83.53W	715	0.8	6.1	90.4	74.5	87.9	72.7	84.5	70.9	77.1	87.1	75.2	83.9	73.7	129.1	81.9	72.4	123.2	80.3	24.6	21.6	19.0	6393	680
FLINT BISHOP INTL ARPT	42.97N	83.75W	768	-1.0	3.7	89.4	73.9	86.6	72.2	83.9	70.4	76.5	85.4	74.7	83.0	73.6	128.6	82.1	71.9	121.3	79.6	24.2	20.6	18.7	6759	591
GRAND RAPIDS KENT COUNTY INT'	42.88N	85.52W	804	1.4	6.1	89.3	73.5	86.4	71.8	83.7	70.2	76.5	85.4	74.5	82.6	73.6	128.8	81.6	71.9	121.3	79.4	24.8	21.0	19.0	6687	626
GROSSE ISLE ARPT	42.10N	83.15W	577	7.3	10.4	89.8	74.5	86.1	73.9	83.5	72.7	78.2	84.5	76.5	82.9	75.5	136.3	81.2	74.6	132.4	80.5	20.8	18.6	16.7	5784	861
HOLLAND/TULIP CITY	42.75N	86.10W	689	7.4	10.2	88.3	74.1	84.4	72.2	82.2	70.6	76.5	84.6	74.8	82.2	73.3	126.9	81.2	72.4	123.0	79.6	25.9	22.5	19.5	6298	582
JACKSON REYNOLDS FIELD	42.26N	84.46W	1020	-1.0	4.5	88.5	73.7	85.9	72.3	83.3	70.8	76.6	84.9	74.8	82.7	73.8	130.8	81.8	72.2	123.6	79.8	20.3	18.5	17.3	6670	576

Meaning of acronyms:
DB: Dry bulb temperature, °F *WB: Wet bulb temperature, °F*
MCWB: Mean coincident wet bulb temperature, °F
Lat: Latitude, °
DP: Dew point temperature, °F
MCDB: Mean coincident dry bulb temperature, °F
Long: Longitude, °
HR: Humidity ratio, grains of moisture per lb of dry air
HDD and CDD 65: Annual heating and cooling degree-days, base 65°F, °F-day
Elev: Elevation, ft
WS: Wind speed, mph

Station	Lat	Long	Elev	Heating DB		Cooling DB/MCWB						Evaporation WB/MCDB				Dehumidification DP/HR/MCDB						Extreme Annual WS			Heat./Cool. Degree-Days	
						0.4%		1%		2%		0.4%		1%		0.4%			1%							
				99.6%	99%	DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	DP	HR	MCDB	DP	HR	MCDB	1%	2.5%	5%	HDD	CDD 65
MANCHESTER AIRPORT	42.93N	71.44W	233	1.0	6.7	91.2	72.1	88.6	70.8	85.8	69.7	75.8	86.4	74.1	83.4	72.5	121.4	80.6	71.5	117.3	79.1	19.0	17.7	15.5	6212	739
PEASE INTL TRADEPOR	43.08N	70.82W	102	2.6	7.7	89.3	72.7	85.9	71.1	82.4	69.5	75.5	84.5	73.5	82.0	72.5	120.8	80.4	71.0	114.7	78.3	22.6	19.4	17.2	6442	534
New Jersey																										*7 sites, 1 more on CD-ROM*
ATLANTIC CITY INTL AP	39.46N	74.46W	66	9.9	14.9	92.3	75.0	89.4	74.0	86.4	72.8	77.9	87.5	76.6	85.0	75.2	132.4	81.8	74.1	127.8	80.6	24.8	21.1	18.8	4950	995
BELMAR-FARMINGDALE	40.18N	74.13W	85	10.7	15.7	90.7	73.6	88.1	72.5	84.3	71.0	76.4	86.5	74.8	83.8	73.1	123.3	80.9	72.2	119.4	80.1	25.4	22.1	19.4	5118	867
MCGUIRE AFB	40.02N	74.60W	148	10.3	15.1	92.9	75.7	90.3	74.7	87.8	73.4	78.8	87.8	77.2	86.3	76.5	139.1	83.3	74.6	130.1	81.8	23.3	19.8	17.6	4897	1074
MILLVILLE MUNICIPAL AF	39.37N	75.08W	75	10.3	15.3	91.9	74.9	89.5	74.1	86.9	73.0	78.0	87.1	76.7	85.0	75.4	133.3	81.4	74.3	128.7	80.4	19.8	18.2	16.6	4860	1052
NEWARK INTERNATIONAL ARPT	40.72N	74.17W	30	11.0	15.5	94.0	74.9	91.0	73.5	88.2	72.2	77.7	88.8	76.3	85.9	74.7	130.1	82.0	73.5	124.7	80.8	25.0	21.9	19.4	4710	1242
TETERBORO AIRPORT	40.85N	74.06W	7	9.9	14.5	92.4	75.1	89.7	74.0	86.8	72.4	78.0	88.0	76.3	85.5	75.1	131.8	82.8	73.4	124.2	80.5	20.6	18.7	17.3	5055	1002
TRENTON MERCER COUNTY AP	40.28N	74.81W	213	9.8	14.1	92.6	74.4	89.9	73.7	87.2	72.6	77.5	88.9	76.0	85.7	73.7	126.6	81.9	72.9	123.0	81.1	23.5	20.0	18.4	5144	987
New Mexico																										*8 sites, 6 more on CD-ROM*
ALAMOGORDO WHITE SA	32.83N	105.98W	4308	21.1	25.1	100.0	64.0	98.8	64.1	96.6	64.5	71.4	87.3	70.0	85.6	66.4	114.2	76.2	65.7	111.6	76.2	21.5	18.4	16.1	2833	1960
ALBUQUERQUE INTL ARPT	35.04N	106.62W	5315	17.7	21.2	95.2	60.3	92.9	60.1	90.6	60.0	65.3	82.5	64.5	81.3	61.5	99.6	67.7	60.3	95.3	68.4	28.2	24.8	20.7	4069	1348
CANNON AFB/CLOVIS	34.38N	103.32W	4295	11.8	17.4	97.4	63.6	94.9	63.8	92.2	64.2	70.4	83.2	69.2	82.6	67.7	119.5	73.0	65.8	111.7	73.0	27.9	24.6	21.1	3839	1372
CLOVIS MUNI (AWOS)	34.43N	103.08W	4213	13.8	18.0	97.1	63.9	93.4	63.5	91.2	63.6	69.4	84.1	68.3	83.6	65.5	110.4	74.0	63.9	104.3	72.5	31.7	27.2	24.3	4091	1190
FARMINGTON FOUR CORNERS REGL	36.74N	108.23W	5502	7.5	12.3	94.9	60.2	92.3	59.7	90.0	59.5	65.3	82.4	64.2	81.4	61.2	99.4	68.1	59.3	92.8	68.5	24.7	21.4	18.5	5369	892
HOLLOMAN AFB	32.85N	106.10W	4094	19.0	22.5	99.1	63.2	96.6	63.0	93.9	63.0	68.7	86.4	67.8	85.3	64.3	105.3	71.7	63.1	100.7	71.8	22.9	19.0	16.4	3257	1681
ROSWELL INDUSTRIAL AIR PARK	33.31N	104.54W	3668	16.3	20.8	99.8	65.3	97.4	65.2	95.2	64.9	70.6	87.0	69.5	86.4	66.8	113.0	74.1	65.5	107.9	73.7	25.0	20.5	18.1	3169	1869
WHITE SANDS	32.38N	106.48W	4081	18.4	22.5	99.0	63.7	96.5	63.9	94.2	63.8	69.8	87.4	68.9	86.1	65.9	111.3	72.1	64.6	106.4	72.3	18.7	16.2	13.3	2946	1811
New York																										*19 sites, 8 more on CD-ROM*
ALBANY COUNTY AP	42.75N	73.80W	292	-1.9	2.9	89.0	73.0	86.1	71.4	83.4	70.2	75.8	84.8	74.2	82.2	73.0	123.8	80.5	71.5	117.7	78.6	23.9	20.4	18.5	6608	592
AMBROSE LIGHT	40.45N	73.80W	69	13.6	17.7	83.8	N/A	80.8	N/A	78.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	42.5	36.9	33.3	4941	688
BINGHAMTON EDWIN A LINK FIELD	42.21N	75.98W	1637	-1.0	3.6	85.5	70.0	82.5	68.4	80.0	67.1	72.7	80.9	71.1	78.6	70.1	117.8	76.6	68.6	111.7	74.9	21.5	19.2	17.7	7105	400
BUFFALO NIAGARA INTL AF	42.94N	78.74W	705	2.7	6.7	86.5	71.2	84.0	70.0	81.6	68.8	74.8	82.1	73.2	80.1	72.4	123.0	79.1	70.7	115.9	77.6	28.1	24.9	21.5	6538	558
ELMIRA CORNING REGIONAL AP	42.16N	76.89W	955	-1.8	3.3	89.9	72.4	86.5	70.3	83.7	69.2	75.2	84.9	73.3	82.3	72.2	123.7	80.3	70.4	116.1	77.9	20.5	18.5	16.7	6777	476
GRIFFISS AFB	43.23N	75.40W	518	-6.0	-0.2	88.7	72.0	85.6	70.0	82.8	68.9	74.8	84.4	72.9	81.6	71.7	119.5	80.3	69.9	112.3	78.0	22.1	18.8	16.4	7081	460
ISLIP LONG ISL MACARTHUR AP	40.79N	73.10W	108	10.6	15.1	88.4	73.4	85.6	72.1	82.7	70.9	76.7	83.6	75.3	81.2	74.6	130.0	79.7	73.3	124.5	78.2	23.7	20.2	18.5	5306	795
JAMESTOWN (AWOS)	42.15N	79.27W	1722	1.0	5.1	82.4	69.7	81.0	68.7	78.6	66.9	72.4	80.0	70.5	77.6	70.1	118.1	77.7	68.0	109.8	75.2	21.5	18.9	17.3	7177	289
NEW YORK J F KENNEDY INT'L AR	40.66N	73.80W	23	12.8	17.2	89.7	73.5	86.5	72.2	83.7	71.4	77.0	84.3	75.8	81.9	74.9	130.8	80.5	73.7	125.7	79.0	27.3	24.6	21.4	4828	978
NEW YORK LAGUARDIA ARPT	40.78N	73.88W	30	12.6	17.3	92.2	74.4	89.3	73.0	86.6	71.9	77.2	87.2	75.9	84.6	74.3	128.5	81.0	73.2	123.3	80.1	27.3	24.7	21.7	4603	1210
NEWBURGH/STEWART	41.50N	74.10W	581	3.5	9.0	89.8	72.5	86.3	71.7	83.8	70.2	76.0	84.6	74.3	82.6	73.2	126.2	80.7	71.9	120.7	79.1	24.4	20.6	18.7	5935	685
NIAGARA FALLS AF	43.11N	78.95W	587	2.5	6.7	87.9	72.8	85.1	71.2	82.5	69.7	75.5	83.9	73.9	81.5	72.9	124.7	80.3	71.6	119.1	78.4	26.2	23.3	20.1	6589	589
PLATTSBURGH AFB	44.65N	73.47W	236	-9.6	-5.1	86.5	71.3	83.2	69.5	80.3	68.2	74.1	82.3	72.2	80.0	71.4	117.0	79.0	69.5	109.5	76.6	20.6	18.4	16.3	7823	360
POUGHKEEPSIE DUTCHESS CO AP	41.63N	73.88W	161	0.5	6.0	91.4	74.0	88.5	72.7	85.5	71.3	76.8	87.4	75.1	84.6	73.3	124.6	82.2	72.1	119.6	80.7	18.4	16.8	14.3	6212	678
REPUBLIC	40.72N	73.40W	85	11.9	17.6	90.2	74.1	87.5	73.3	83.7	71.4	77.0	85.0	75.6	82.4	74.8	130.8	80.2	73.2	123.8	78.3	24.9	23.0	19.5	5036	915
ROCHESTER GREATER ROCHESTER I	43.12N	77.68W	554	2.1	6.0	88.4	73.1	85.4	71.2	82.7	69.7	75.5	84.5	73.6	81.7	72.5	123.0	80.7	70.9	116.2	78.3	25.2	21.5	19.0	6579	549
SYRACUSE HANCOCK INT'L ARPT	43.11N	76.10W	417	-2.7	2.9	88.9	73.0	86.0	71.2	83.3	69.9	75.4	84.8	73.7	82.2	72.4	121.9	80.5	70.8	115.1	78.5	24.2	20.4	18.4	6635	566
UTICA ONEIDA COUNTY AP	43.15N	75.38W	745	-5.0	0.8	87.5	72.3	84.5	70.5	82.0	69.0	74.9	83.2	73.1	81.0	72.3	123.1	79.0	70.5	115.3	77.4	20.7	18.7	17.3	7051	478
WHITE PLAINS WESTCHESTER CO A	41.07N	73.71W	397	7.7	12.1	90.0	74.2	86.6	72.4	83.8	70.9	76.6	85.4	75.0	82.7	73.5	126.5	79.8	72.7	122.9	78.8	20.4	18.0	15.8	5563	755
North Carolina																										*15 sites, 8 more on CD-ROM*
ASHEVILLE REGIONAL ARPT	35.43N	82.54W	2169	13.6	18.6	88.1	71.6	85.8	70.9	83.6	70.2	74.2	83.3	73.1	81.7	71.6	126.5	77.6	70.4	121.5	76.4	23.2	19.6	17.7	4148	829
CHARLOTTE DOUGLAS INTL ARPT	35.21N	80.94W	768	20.5	24.6	94.1	74.6	91.7	74.2	89.5	73.4	77.1	88.4	76.1	86.7	74.0	130.7	80.8	73.1	126.7	79.9	18.7	16.6	14.6	3081	1669
FAYETTEVILLE RGNL G	34.98N	78.88W	194	21.4	25.6	95.5	76.6	93.1	75.6	90.9	75.1	79.3	90.0	78.3	88.3	76.8	140.5	82.7	75.5	134.3	81.6	19.8	17.5	15.3	2769	1918
FORT BRAGG/SIMMONS	35.13N	78.93W	305	21.7	26.0	96.6	76.3	94.0	75.7	91.3	75.0	79.2	90.4	78.1	88.8	76.4	139.2	83.5	75.2	133.8	82.7	17.8	14.9	12.7	2760	2007
GREENSBORO PIEDMONT TRIAD INT	36.10N	79.94W	886	17.1	21.7	92.2	74.7	89.9	73.9	87.8	73.1	76.9	87.6	75.7	85.7	73.7	129.9	81.1	72.8	125.9	80.0	19.3	17.2	15.4	3667	1367
HICKORY REGIONAL AP	35.74N	81.39W	1188	18.9	23.3	92.5	72.9	90.1	72.9	87.9	72.2	76.2	86.1	75.2	84.7	73.4	129.7	79.6	72.4	125.2	78.6	17.6	14.9	13.1	3497	1354
JACKSONVILLE (AWOS)	34.83N	77.62W	95	20.0	24.7	93.5	76.6	91.3	75.7	90.0	75.1	79.0	90.6	77.8	88.2	75.4	133.5	84.2	74.8	130.7	83.4	20.0	17.6	15.6	2994	1677
NEW RIVER MCAF	34.70N	77.43W	26	22.9	26.8	93.2	78.1	91.1	77.5	89.2	76.7	80.5	89.3	79.4	87.9	78.5	148.3	85.3	77.0	140.7	84.0	19.8	17.5	15.6	2500	1950
PITT GREENVILLE ARP	35.63N	77.40W	26	20.9	24.9	95.2	76.9	93.1	75.5	91.1	74.9	79.2	92.6	77.7	89.6	75.2	132.4	85.0	73.7	125.8	82.9	18.8	16.5	14.2	2873	1938
POPE AFB	35.17N	79.02W	217	21.2	25.2	97.0	76.4	94.3	75.7	91.6	75.1	79.5	89.4	78.3	88.2	77.2	142.6	82.8	75.5	134.5	81.9	18.4	16.0	13.5	2813	2016
RALEIGH DURHAM INTERNATIONAL	35.87N	78.79W	436	18.8	23.1	94.1	75.9	91.7	75.6	89.4	74.5	78.3	89.3	77.3	87.7	75.3	134.8	82.5	74.3	130.3	81.4	18.9	16.8	15.1	3322	1579
RICHMOND INTERNATIONAL AP	37.51N	77.32W	164	16.8	20.8	94.8	76.0	92.3	75.4	89.8	74.4	78.6	89.4	77.6	87.9	75.9	136.3	83.2	74.8	131.0	81.8	20.7	18.5	16.7	3760	1489
SEYMOUR-JOHNSON AFB	35.33N	77.97W	108	21.7	26.2	96.5	76.9	93.5	76.1	91.1	75.6	79.8	90.1	78.6	88.4	77.2	142.1	83.5	76.0	136.5	82.4	18.3	16.0	13.8	2717	1956
WILMINGTON INTERNATIONAL ARPT	34.27N	77.91W	39	24.0	27.6	93.3	78.4	91.0	77.5	89.0	76.7	80.3	89.0	79.3	87.5	78.2	146.5	84.5	77.1	141.4	83.2	20.7	18.5	16.8	2388	1987
WINSTON-SALEM REYNOLDS AP	36.13N	80.22W	971	18.2	22.8	92.4	74.5	90.3	73.9	88.1	73.1	76.9	86.8	75.7	85.3	73.9	130.9	81.1	72.8	125.9	80.2	18.7	16.9	14.4	3455	1429

Meaning of acronyms:
DB: Dry bulb temperature, °F *WB: Wet bulb temperature, °F*
MCWB: Mean coincident wet bulb temperature, °F
Lat: Latitude, °
DP: Dew point temperature, °F
MCDB: Mean coincident dry bulb temperature, °F
Long: Longitude, °
HR: Humidity ratio, grains of moisture per lb of dry air
Elev: Elevation, ft
WS: Wind speed, mph
HDD and CDD 65: Annual heating and cooling degree-days, base 65°F, °F-day

Station	Lat	Long	Elev	Heating DB		Cooling DB/MCWB						Evaporation WB/MCDB				Dehumidification DP/HR/MCDB						Extreme Annual WS			Heat./Cool. Degree-Days	
						0.4%		1%		2%		0.4%		1%		0.4%			1%							
				99.6%	99%	DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	DP	HR	MCDB	DP	HR	MCDB	1%	2.5%	5%	HDD	CDD 65
North Dakota																										*6 sites, 6 more on CD-ROM*
BISMARCK MUNICIPAL ARPT	46.77N	100.75W	1660	-20.0	-13.9	93.9	69.4	90.3	68.6	86.8	67.4	74.3	85.8	71.9	84.5	70.7	120.4	81.4	68.0	109.3	78.3	27.3	24.4	20.8	8471	539
FARGO HECTOR INTERNATIONAL AP	46.93N	96.81W	899	-20.4	-15.2	91.0	72.1	87.7	70.3	84.7	68.8	75.4	85.4	73.4	83.6	72.4	123.9	81.8	70.0	113.9	80.1	28.3	25.4	23.1	8793	553
GRAND FORKS AFB	47.97N	97.40W	906	-20.4	-15.8	90.8	71.3	87.7	70.1	84.2	68.3	76.2	84.4	73.6	82.5	73.4	128.4	80.0	71.4	119.9	78.8	28.3	25.3	22.2	9167	477
GRAND FORKS INTERNATIONAL AP	47.95N	97.18W	833	-22.2	-17.2	90.0	71.0	86.6	69.4	83.7	68.0	75.0	84.7	72.7	82.5	71.8	121.0	81.2	69.4	111.3	78.9	26.9	24.2	20.9	9310	434
MINOT AFB	48.42N	101.35W	1631	-22.2	-17.3	93.2	68.6	89.3	67.8	85.6	66.5	73.1	86.3	70.8	83.5	69.4	114.9	79.9	66.4	103.2	77.1	28.9	25.9	22.6	9097	433
MINOT FAA AP	48.26N	101.28W	1713	-19.9	-15.0	91.4	68.9	88.0	68.1	84.3	66.2	73.6	84.4	71.2	82.1	70.3	118.8	79.8	67.7	108.6	77.5	27.5	24.7	21.4	8763	450
Ohio																										*13 sites, 2 more on CD-ROM*
AKRON AKRON-CANTON REG AP	40.92N	81.44W	1237	1.8	7.1	88.7	72.9	85.9	71.7	83.3	70.2	75.4	84.6	73.9	82.3	72.7	126.9	80.3	71.3	120.8	78.3	23.4	19.8	18.1	6044	676
CINCINNATI MUNICIPAL AP LUNKI	39.10N	84.42W	499	6.3	12.4	92.8	74.9	90.2	74.4	87.9	73.2	77.9	88.0	76.7	86.2	75.1	134.1	82.5	73.8	128.2	81.1	20.2	18.3	16.6	4754	1151
CLEVELAND HOPKINS INTL AP	41.41N	81.85W	804	2.5	8.5	89.4	73.9	86.7	72.5	84.1	71.1	76.3	85.6	74.7	83.1	73.3	127.4	81.4	71.9	121.6	79.6	24.7	21.0	19.0	5904	743
COLUMBUS PORT COLUMBUS INTL A	39.99N	82.88W	817	3.2	9.1	91.1	73.8	88.7	72.8	86.3	71.6	76.7	86.8	75.2	84.5	73.6	129.0	81.2	72.3	123.4	80.2	21.9	18.9	16.9	5322	971
DAYTON INTERNATIONAL AIRPORT	39.91N	84.22W	1004	0.6	6.9	90.3	73.6	87.9	72.8	85.4	71.3	76.5	86.2	75.1	84.0	73.4	128.8	81.8	72.2	123.6	80.4	24.4	20.7	18.7	5549	924
FINDLAY AIRPORT	41.01N	83.67W	814	-0.4	5.6	90.4	73.5	87.8	72.6	84.8	70.8	76.8	86.2	75.0	83.3	73.7	129.5	82.1	72.3	123.1	80.1	24.4	20.7	18.8	5994	777
LANCASTER\FAIRFIEL	39.75N	82.65W	866	3.1	9.9	90.5	74.0	88.3	73.5	85.6	71.9	76.8	86.6	75.4	84.0	73.3	127.8	80.9	72.5	124.6	80.1	20.2	17.9	16.1	5474	776
MANSFIELD LAHM MUNICIPAL ARPT	40.82N	82.52W	1312	0.1	5.7	88.0	73.0	85.5	71.7	83.1	70.4	75.8	84.6	74.3	82.5	73.1	129.0	80.8	71.7	122.8	79.3	24.6	21.1	19.1	6150	659
OHIO STATE UNIVERSI	40.07N	83.07W	928	6.9	11.7	90.4	73.7	88.2	73.1	85.3	71.9	76.4	86.1	75.1	83.8	73.0	126.9	81.1	72.3	123.9	80.1	21.6	19.0	17.2	5343	899
RICKENBACKER ANGB	39.82N	82.93W	755	4.3	10.3	92.5	75.7	90.1	74.9	87.7	73.9	79.8	86.7	77.7	86.1	78.5	152.4	84.2	75.1	135.6	81.3	22.1	18.9	16.8	5172	1028
TOLEDO EXPRESS AIRPORT	41.59N	83.80W	692	-0.3	5.3	91.2	74.2	88.4	72.7	85.7	71.4	77.2	86.9	75.4	84.2	74.2	131.0	82.9	72.7	124.2	80.7	24.3	20.6	18.6	6156	773
WRIGHT-PATERSON AFB	39.83N	84.05W	820	1.4	8.5	91.3	74.5	89.2	73.6	86.4	72.2	77.5	87.1	75.9	85.0	74.8	134.3	82.5	73.0	126.4	80.8	21.5	18.8	16.8	5381	974
YOUNGSTOWN REGIONAL AIRPORT	41.25N	80.67W	1188	1.8	7.1	88.5	72.7	85.8	71.1	83.4	69.7	75.1	84.7	73.5	82.1	72.1	124.3	79.6	70.7	118.1	77.7	21.9	19.0	17.4	6218	577
Oklahoma																										*9 sites, 6 more on CD-ROM*
FORT SILL	34.65N	98.40W	1211	12.6	18.9	100.5	72.8	98.2	73.0	95.5	73.2	77.4	90.6	76.4	89.6	74.1	133.1	82.6	72.8	127.3	81.7	24.8	21.2	19.2	3268	2111
LAWTON MUNICIPAL	34.57N	98.42W	1109	17.9	20.8	102.4	73.4	100.2	73.7	98.9	73.8	78.1	92.9	77.2	91.6	73.4	129.4	83.9	72.9	127.2	83.3	26.0	23.1	20.1	3163	2248
OKLAHOMA CITY WILL ROGERS WOR	35.39N	97.60W	1306	11.4	17.4	99.5	74.1	96.8	74.1	94.0	73.8	77.7	90.8	76.7	89.9	74.1	133.6	83.7	73.0	128.7	82.4	27.2	24.7	22.2	3516	1926
OKLAHOMA CITY/WILEY	35.53N	97.65W	1299	12.1	17.9	99.5	73.8	97.2	73.9	94.2	73.7	77.4	91.1	76.4	89.9	73.4	130.2	83.4	72.6	126.7	82.5	26.4	24.1	21.3	3493	2045
STILLWATER RGNL	36.15N	97.08W	1010	13.6	18.2	101.8	75.0	99.2	75.3	96.6	75.2	79.0	93.4	77.9	92.2	75.1	136.8	85.7	73.4	128.8	83.8	24.6	21.5	19.5	3571	1982
TINKER AFB	35.42N	97.38W	1260	12.1	17.9	99.3	73.6	96.7	74.0	93.6	73.9	78.2	90.8	77.1	89.8	74.8	136.8	84.8	73.3	129.8	82.9	25.5	22.7	20.0	3407	1971
TULSA INTERNATIONAL AIRPORT	36.20N	95.89W	676	10.9	16.8	99.4	75.8	96.8	76.0	94.2	75.6	79.2	92.3	78.1	91.2	75.5	136.9	85.4	74.4	131.9	84.5	24.5	21.0	19.2	3494	2060
TULSA/LLOYD JONES	36.03N	95.98W	633	15.8	18.8	100.1	76.5	98.8	76.8	95.4	76.7	79.6	94.3	78.5	92.7	75.4	136.1	85.5	74.8	133.5	85.1	19.8	17.8	16.1	3481	2004
VANCE AFB	36.33N	97.92W	1339	6.5	13.1	100.6	73.5	98.6	73.5	95.5	73.7	77.4	91.8	76.4	90.9	73.4	130.7	83.2	72.4	126.2	82.6	26.7	23.9	20.7	3996	1903
Oregon																										*9 sites, 12 more on CD-ROM*
AURORA STATE	45.25N	122.77W	197	27.5	29.7	91.2	67.2	88.2	67.1	83.9	65.8	70.2	85.6	68.4	83.8	64.0	90.0	76.5	63.1	87.2	74.1	18.2	15.9	12.9	4333	385
CORVALLIS MUNI	44.48N	123.28W	253	25.0	27.7	92.9	66.7	89.8	65.7	85.7	64.1	68.4	89.5	66.8	86.9	60.6	79.9	77.8	57.4	71.0	74.6	19.7	17.7	15.9	4204	412
EUGENE MAHLON SWEET ARPT	44.13N	123.21W	374	22.4	26.3	91.4	66.6	87.6	65.5	83.9	64.4	68.7	87.2	67.0	84.5	62.0	84.3	74.5	60.2	79.0	72.1	19.6	17.5	15.9	4676	259
MC MINNVILLE MUNI	45.18N	123.13W	167	27.6	29.8	91.4	65.8	89.5	66.1	84.1	64.6	68.5	87.4	66.9	85.5	61.5	82.0	72.2	60.7	79.7	71.7	20.9	18.0	15.8	4559	300
MEDFORD ROGUE VALLEY INTL AP	42.39N	122.87W	1329	22.9	25.7	98.9	67.2	95.3	65.9	91.9	64.7	69.0	94.0	67.5	91.4	60.4	82.4	74.5	58.6	77.1	73.9	18.4	15.5	12.5	4323	790
PORTLAND INTERNATIONAL AP	45.59N	122.60W	108	23.9	28.6	91.2	67.5	87.1	66.5	83.4	65.3	69.4	87.0	67.8	84.5	62.9	86.1	75.2	61.4	81.6	73.1	23.8	19.8	17.6	4222	423
PORTLAND/HILLSBORO	45.53N	122.95W	203	21.8	26.6	91.8	68.1	88.1	67.1	83.9	65.6	70.5	87.9	68.3	85.1	63.8	89.2	77.3	61.8	83.0	74.1	18.9	17.1	14.6	4750	280
REDMOND ROBERTS FIELD	44.25N	121.15W	3084	5.4	11.9	92.8	61.9	89.9	61.0	86.5	59.7	63.8	88.4	62.2	85.9	54.8	71.7	67.4	53.0	66.9	67.0	20.6	18.5	16.7	6540	229
SALEM MCNARY FIELD	44.91N	123.00W	200	21.9	26.2	92.0	67.0	87.9	65.8	84.1	64.6	68.7	88.2	67.1	85.0	61.4	82.0	73.9	59.8	77.4	72.6	20.8	18.3	16.3	4576	292
Pennsylvania																										*14 sites, 5 more on CD-ROM*
ALLENTOWN LEHIGH VALLEY INTL	40.65N	75.45W	384	7.0	11.5	91.0	73.8	88.2	72.5	85.6	71.3	76.7	86.3	75.2	83.8	73.8	127.8	81.1	72.5	122.0	79.7	24.2	20.3	18.1	5564	828
ALTOONA BLAIR CO ARPT	40.30N	78.32W	1470	4.7	9.6	88.5	72.0	85.7	70.7	83.0	69.6	74.7	83.9	73.2	82.0	72.0	125.0	79.6	70.3	118.0	77.7	21.9	18.8	17.2	5959	617
BUTLER CO. (AWOS)	40.78N	79.95W	1247	3.1	8.9	88.0	72.4	84.4	70.6	82.1	69.1	74.6	83.5	73.0	81.7	72.1	124.6	79.8	70.4	117.1	77.3	17.8	15.3	12.9	6098	535
ERIE INTERNATIONAL AP	42.08N	80.18W	738	5.2	9.7	86.4	72.9	84.0	71.6	81.7	70.7	75.3	82.6	73.8	81.0	72.8	125.2	80.5	71.3	118.7	78.6	24.7	21.7	19.5	6092	643
HARRISBURG CAPITAL CITY ARPT	40.22N	76.85W	348	8.7	13.3	92.4	73.8	89.6	72.5	86.7	71.5	76.5	86.8	75.2	84.5	73.4	125.7	80.4	72.4	121.5	79.4	20.5	18.4	16.6	5228	990
MIDDLETOWN HARRISBURG INTL AP	40.19N	76.76W	312	10.7	14.8	92.6	74.8	89.8	73.9	87.0	72.6	78.0	87.7	76.4	85.4	75.2	133.6	82.9	73.5	126.1	81.0	25.3	22.9	19.0	5035	1114
PHILADELPHIA INTERNATIONAL AF	39.87N	75.23W	30	12.6	16.9	93.2	75.4	90.6	74.5	88.0	73.0	78.3	88.5	77.0	86.3	75.4	133.4	82.5	74.3	128.2	81.4	24.4	20.6	18.5	4579	1273
PHILADELPHIA NE PHILADELPHIA	40.08N	75.01W	118	11.0	15.6	93.1	75.7	90.4	74.6	88.1	73.4	78.7	88.8	77.0	86.8	75.6	134.6	83.3	74.0	127.4	81.4	21.1	18.7	17.3	4822	1132
PITTSBURGH ALLEGHENY CO AP	40.36N	79.92W	1273	4.3	9.8	89.9	72.5	87.4	71.1	84.6	69.8	75.2	84.9	73.7	83.1	72.3	125.4	79.9	70.9	119.5	78.4	20.3	18.5	17.0	5356	875
PITTSBURGH INTERNATIONAL AP	40.50N	80.23W	1204	3.7	9.4	89.5	72.5	86.6	71.1	84.2	69.8	75.2	84.8	73.7	82.6	72.2	124.7	79.9	70.8	118.8	78.3	23.4	19.7	17.8	5624	751
READING SPAATZ FIELD	40.37N	75.96W	354	9.4	13.4	92.4	74.1	89.6	73.0	86.5	72.0	77.2	87.5	75.5	84.6	73.7	127.0	82.3	72.7	122.7	80.8	22.6	19.2	17.9	5191	946
WASHINGTON (AWOS)	40.13N	80.28W	1184	2.7	8.8	88.4	71.1	85.4	69.8	82.8	68.7	73.5	83.0	72.1	82.1	70.4	117.0	79.1	69.6	113.5	77.8	19.5	17.1	14.8	5988	542
WILKES-BARRE SCRANTON INTL AP	41.34N	75.73W	961	3.5	8.3	88.9	72.1	86.0	70.6	83.3	69.1	75.0	84.0	73.3	81.6	72.2	123.5	79.3	70.7	117.3	77.6	20.3	18.2	16.5	6105	625
WILLOW GROVE NAS	40.20N	75.15W	361	10.2	14.4	92.7	75.0	90.0	73.8	87.4	72.6	77.7	88.6	76.3	86.1	74.5	130.7	83.2	73.1	124.6	81.7	18.3	15.9	13.5	4959	1059