

# ***Headquarters U.S. Air Force***

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## **DESIGN CONSIDERATIONS FOR THE PREVENTION OF MOLD**



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**August 2005**

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# *Governing Criteria*

- **Air Force Engineering Technical Letter (ETL) 04-3:  
Design Criteria for Prevention of Mold in Air Force  
Facilities**
  - **Applies to the design of new or renovated Air Force  
facilities that are less than 35 percent designed**
  - **Effective April 2004**
  - **Intended Users:**
    - Installation civil engineer (CE) personnel
    - Major command (MAJCOM) engineers
    - Project managers (PM)
    - Design consultants
    - **Design agents**

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# ***ETL Requirements***

- **Provide tight building envelopes**
- **HVAC systems**
  - **Design Criteria**
  - **Design Analysis**
  - **Equipment Specifications**
- **Protect building materials during construction**
- **HVAC Commissioning**

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# ***Building Envelope***

- **Keep moisture out**
  - **Effective use of water vapor retarders and air infiltration barriers**
  - **Seal all openings, seams in barriers, intersections of walls, roofs and floors**
- **Allow for drainage and drying if/when moisture gets in**
- **Perform dew point analyses for exterior walls and roof sections**



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# *HVAC System-Design Criteria*

- **System will be designed and sized to maintain space temperature and humidity requirements at the following conditions:**
  - **Maintain dry bulb set point and 50% RH or less at 1% dry bulb temperature and corresponding mean coincident wet bulb temperature**
  - **Maintain dry bulb set point and 60% RH or less at 1% humidity ratio and corresponding mean coincident dry bulb temperature**



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# HVAC System-Design Criteria

<b>WARNER ROBINS AFB GA</b>	
Latitude = 32.63 N	WMO No. 722175
Longitude = 83.60 W	Elevation = 295 Feet
Period of Record = 1967 TO 1996	Average Pressure = 29.71 inches Hg

**Design Criteria Data**

Design Value (T)	Mean Coincident (Average) Values				
	Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)	
<b>Dry Bulb Temperature (T)</b>					
Median of Extreme High	100	77	104	6.8 WNW	
0.4% Occurrence	97	77	106	6.4 W	
1.0% Occurrence	94	76	107	6.4 W	
2.0% Occurrence	92	75	107	6.3 W	
Mean Daily Range	21	-	-	-	
97.5% Occurrence	32	29	18	4.9 NNW	
99.0% Occurrence	28	25	14	5.1 NNW	
99.6% Occurrence	24	21	11	6.3 NNW	
Median of Extreme Low	17	15	7	8.0 NW	
Design Value (T <sub>wb</sub> )	Mean Coincident (Average) Values				
	Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)	
<b>Wet Bulb Temperature (T<sub>wb</sub>)</b>					
Median of Extreme High	81	92	138	5.4 E	
0.4% Occurrence	79	90	129	5.3 W	
1.0% Occurrence	78	88	125	5.1 W	
2.0% Occurrence	77	87	122	5.1 W	
Design Value (gr/lb)	Mean Coincident (Average) Values				
	Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)	
<b>Humidity Ratio (HR)</b>					
Median of Extreme High	152	86	1.00	3.5 E	
0.4% Occurrence	137	84	0.90	4.2 S	
1.0% Occurrence	132	83	0.87	3.9 W	
2.0% Occurrence	128	82	0.84	4.3 W	
<b>Air Conditioning/ Humid Area Criteria</b>	# of Hours	T > 93°F	T ≥ 80°F	T <sub>db</sub> ≥ 73°F	T <sub>wb</sub> ≥ 67°F
		155	1519	1803	3065

**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/ft <sup>2</sup> /yr) Base 75°F-RH 60% Latent + Sensible
II	4.0	90	4.8 + 1.7
Ground Water Temperature (°F) 50 Foot Depth *	Front Depth 50 Year Recurrence (in.)	Ground Snow Load 50 Year Recurrence (lb/ft <sup>2</sup> )	Average Annual Freeze-Thaw Cycles (#)
66.7	0	5	28

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

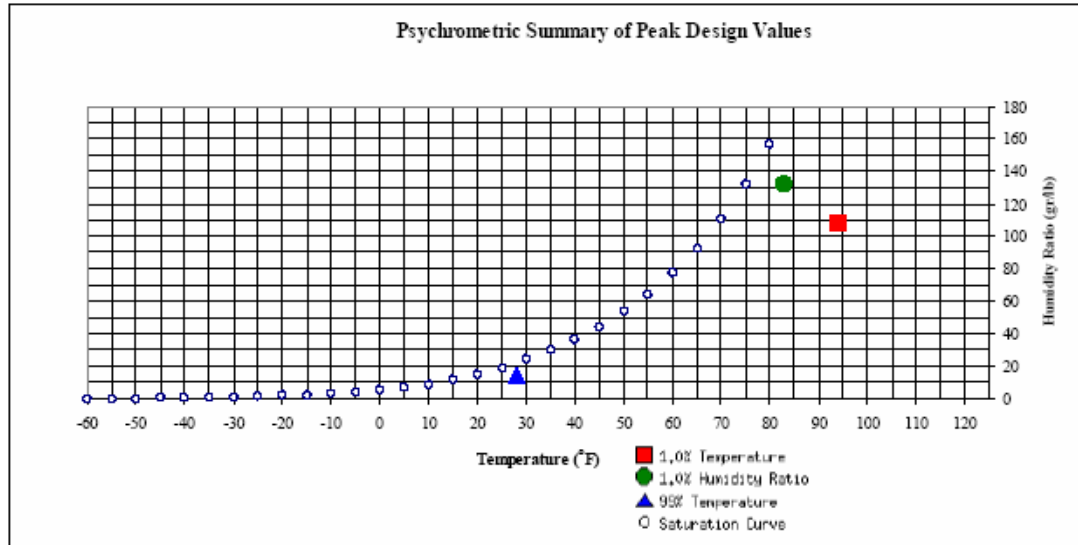


# HVAC System-Design Criteria

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WARNER ROBINS AFB GA

WMO No. 722175



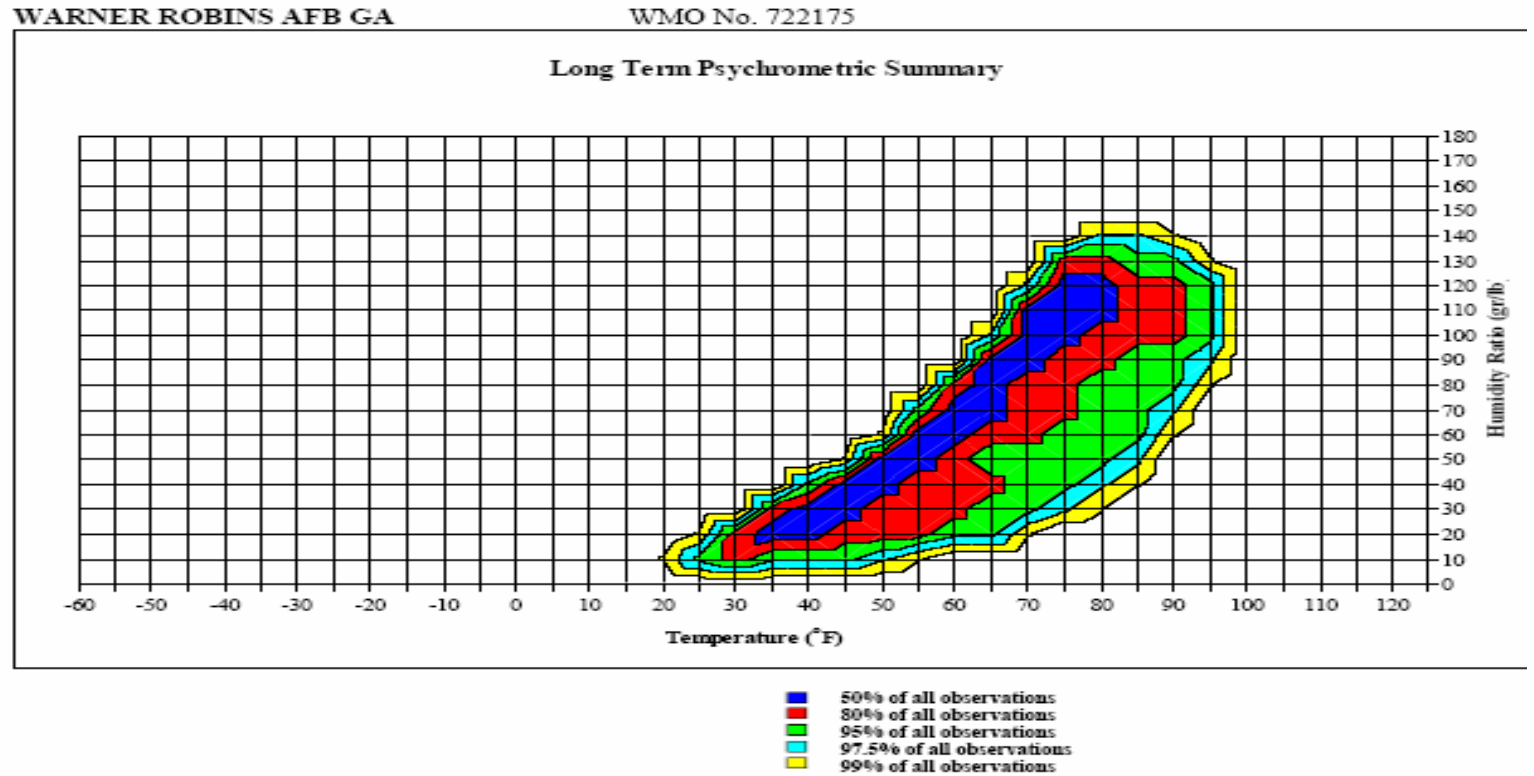
	99% Dry Bulb	MCHR (°F)	MCHR (gr/lb)	Enthalpy (btu/lb)	1.0% Humidity Ratio	MCDB (°F)	MCWB (°F)	MC Dewpt (°F)	Enthalpy (btu/lb)
	28	14	8.9		132.3	82.8	77.1	75	40.6

	1.0% Dry Bulb	MCHR (°F)	MCWB (°F)	Enthalpy (btu/lb)
	94	108.1	76.2	39.6



# HVAC System-Design Criteria

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# HVAC System-Design Criteria

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	Design Value	Mean Coincident (Average) Values			
		Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
<b>Dry Bulb Temperature (T)</b>					
Median of Extreme Highs	95	78	117	7.6	NNE
0.4% Occurrence	91	78	126	8.6	WSW
1.0% Occurrence	90	78	127	8.2	WSW
2.0% Occurrence	89	78	127	8.4	WSW
Mean Daily Range	15	-	-	-	-
97.5% Occurrence	40	36	24	6.7	N
99.0% Occurrence	36	32	20	7.6	N
99.6% Occurrence	32	28	15	8.8	N
Median of Extreme Lows	27	23	11	9.7	N
		Mean Coincident (Average) Values			
	Design Value	Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
<b>Wet Bulb Temperature (T<sub>wb</sub>)</b>					
Median of Extreme Highs	84	89	164	7.9	WSW
0.4% Occurrence	82	87	153	7.4	WSW
1.0% Occurrence	81	86	147	7.2	WSW
2.0% Occurrence	80	86	142	7.2	WSW
		Mean Coincident (Average) Values			
	Design Value	Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)
<b>Humidity Ratio (HR)</b>					
Median of Extreme Highs	162	86	1.07	6.6	W
0.4% Occurrence	157	85	1.04	6.1	WSW
1.0% Occurrence	151	85	1.00	6.4	WSW
2.0% Occurrence	146	84	0.97	5.8	W
<b>Air Conditioning/ Humid Area Criteria</b>	<b># of Hours</b>	T ≥ 93°F	T ≥ 80°F	T <sub>wb</sub> ≥ 73°F	T <sub>wb</sub> ≥ 67°F
		16	1953	2572	4157

**Other Site Data**

Weather Region	Rain Rate 100 Year Recurrence (in./yr)	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
Weather Region	4.8	130	9.1 + 1.8
Ground Water Temperature (°F) 50 Foot Depth *	Frost Depth 50 Year Recurrence (in.)	Ground Snow Load 50 Year Recurrence (lb/ft <sup>2</sup> )	Average Annual Freeze-Thaw Cycles (#)
70.9	0	0	4

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

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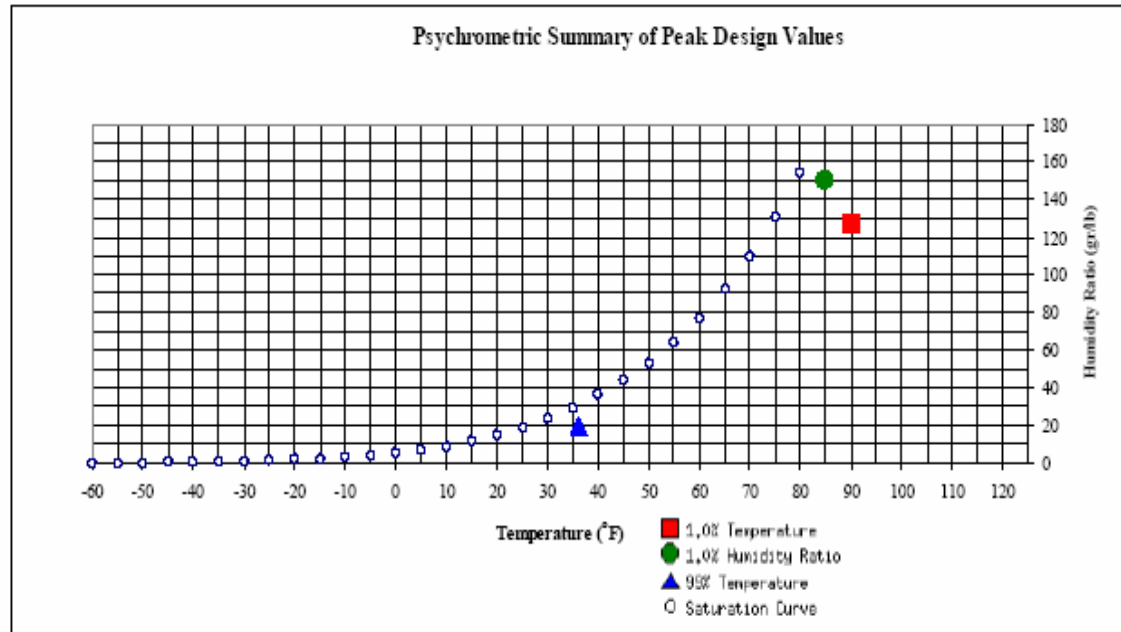


# HVAC System-Design Criteria

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TYNDALL AFB FL

WMO No. 747750



	MCHR (°F)	Enthalpy (btu/lb)	1.0% Humidity Ratio (gr/lb)	MCDB (°F)	MCWB (°F)	MC Dewpt (°F)	Enthalpy (btu/lb)
99% Dry Bulb	36	11.6	150.5	84.7	80.4	79	43.9

	MCHR (°F)	MCWB (°F)	Enthalpy (btu/lb)
1.0% Dry Bulb	90	78.4	41.6

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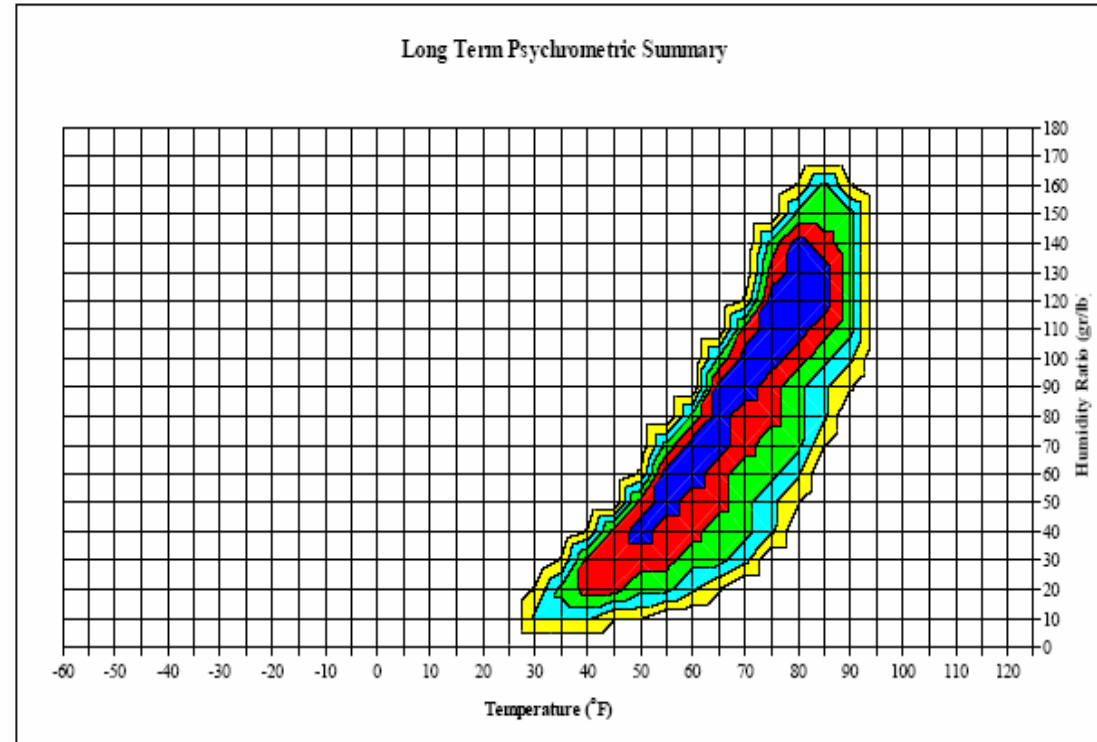


# HVAC System-Design Criteria

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TYNDALL AFB FL

WMO No. 747750



- 50% of all observations
- 80% of all observations
- 95% of all observations
- 97.5% of all observations
- 99% of all observations

TYNDALL AFB FL

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# ***HVAC System-Design Analysis***

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- **Include calculations and schematics demonstrating the system can achieve and maintain interior temperature and humidity requirements at 1% DB/MCWB and 1% HR/MCDB conditions.**
  - **Include calculations showing:**
    - **System cooling loads (latent and sensible)**
    - **Energy/mass transfer through conditioning equipment**
    - **System schematic indicating dry bulb and wet bulb temperatures (or Humidity ratios) of:**
      - **Outside air**
      - **Mixed air**
      - **Supply air**
      - **Return air**

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# ***HVAC System-Equipment Specifications***

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- **Construction Documents are to specify cooling coil characteristics and performance requirements to include:**
  - **Total cooling capacity**
  - **Sensible capacity**
  - **Coil design entering and leaving air conditions (Wet and Dry bulb temperatures)**
  - **Design airflow rate**
  - **Face velocities**
  - **Coil Sensible Heat Ratio**
  - **Entering chilled water temperature**



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## *HVAC System-Dorms, VQs, TLFs*

- **Provide separate, dedicated, central system to supply ventilation air requirements**
  - **System to supply dehumidified and tempered 100% outside air to all occupied spaces**
  - **System not intended to provide total space heating and cooling, only ventilation air**
  - **System must continuously condition and deliver ventilation air without interruption**
  - **Employ active humidity control that will maintain space humidity at less than 60% over a full range of ambient conditions up to and including the 1% HR design condition**



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## ***Protect building materials during construction***

- **Construction specifications will require all materials be protected from moisture resulting in deterioration or mold growth during storage and construction**



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# ***HVAC Commissioning***

- **Commission systems in accordance with UGFGS 15995, Commissioning of HVAC Systems**
  - **Verify and Document system performance has met design requirements**
  - **Load system or test at design conditions**

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# ***Contact Information***

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