MECHANICAL CODE DISCUSSION

ACCA Manual J Design Conditions – For Contractors & Code Officials

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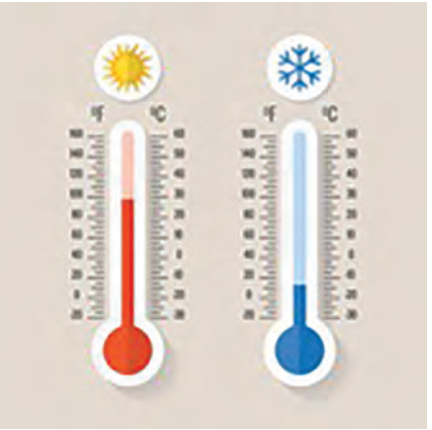
UNFORTUNATELY, ACCA DESIGN conditions, specifically the indoor and outdoor design temperatures are the most frequent issue of debate and contention of all the ACCA Residential HVAC Design Standards. *I can only dream of the day when critical system* ***airflow*** *received one-quarter the attention given to the outdoor design temperature.* Please don't misunderstand, design temperatures are important and often ridiculously exaggerated; however, a couple of degrees does not make an appreciable difference in the loads. We'll open with a review of several words and terms, as identified in Manual J. Please also refer to the design conditions for Utah provided in this article from Manual J Table 1A.

Design Conditions

A set of conditions directly affecting the transfer of heat into or out of a residential building. Includes: indoor and outside temperatures, location and orientation of structure, daily temperature range, and relative humidity (inside and outside).

Winter: 99% Dry-Bulb

The winter outdoor dry bulb temperature at which your location will stay above for 99% of all the hours in the year, based on a 30-year average. Turning it around, the outdoor air in the location you are considering, will be colder than this temperature for only 1% of the hours in an average year. That happens to be about 88 hours per year. In Salt Lake City, at the International Airport, the 99% winter design temperature is 14° F.



Summer: 1% Dry-Bulb

The location will experience temperatures higher than this number only 1% of the hours in a year, again, based on a 30-year average. In Salt Lake City, at the IAP, the number is 95° F. We see temperatures above that for only about 88 hours in an average year, *based on the past thirty years.* Obviously, if current trends continue, we'll see significant changes to this data soon.

Summer Coincident Wet-Bulb

Not used directly in the Manual J load calculation, rather used in Manual S Equipment Selection; however, wet-bulb temperatures have been used in determining the grains of moisture, identifying if the climate is humid or dry.

Obviously, this Manual J Table is lacking in the number of locations, providing only general direction. It is up to the HVAC contractor, HVAC system designer, general contractor, and the Building Official from the jurisdiction/city where the home will be built, to determine the design conditions for the specific project location. Data for all Counties in Utah and other states is found on the Energy Star website at: ***https://www.energystar.gov/sites/default/files/asset/document/Design%20Temperature%20Limit%20Reference%20Guide%20%282019%20Ed%29%20-%20ENERGY%20STAR%20SFNH%20Rev11_MFNC%20Rev02.pdf***

Common sense should apply…. Consider Salt Lake and Utah Counties; where, we just experienced a record temperature this summer. The August average high temperature in Provo was 98.5º F. This is 7+ degrees hotter than the Manual J 1% Dry-Bulb value listed.

Considering winter conditions, my home in South Jordan is typically 4 to 6 degrees F colder than the SLC airport. We experience frost 4 or 5 times before the first frost at the airport. The Airport is probably the poorest representative ►

Table 1A
Outdoor Design Conditions for the United States

Location	Elevation Feet	Latitude Degrees North	Heating 99% Outdoor Dry Bulb	Cooling					
				Outdoor Air		Design Grains			Daily Range (DR)
				1% Dry Bulb	Coincident Wet Bulb	55% RH Indoors	50% RH Indoors	45% RH Indoors	
Utah									
Cedar City Municipal AP	5,617	38	9	91	59	-48	-40	-32	H
Hill AFB, Ogden	4,787	41	12	91	61	-39	-31	-23	M
Logan-Cache AP	4,455	42	0	91	62	-36	-28	-20	H
Milford Municipal AP	5,033	38	3	93	59	-50	-42	-34	H
Moab	4,553	38	11	98	60	-54	-46	-38	H
Price, Carbon Co. AP	5,902	40	8	90	59	-47	-39	-31	H
Provo Municipal AP AWOS	4,491	40	13	91	62	-32	-24	-16	H
Richfield	5,279	38	5	91	60	-42	-34	-26	H
Saint George AWOS	2,940	37	28	104	65	-39	-32	-24	H
Salt Lake City IAP	4,226	41	14	95	63	-36	-28	-20	H
Vernal	5,276	40	5	91	61	-39	-31	-23	H
Wendover, USAF Auxiliary Field	4,236	41	12	93	60	-47	-40	-32	M

► location for the Valley, as the Great Salt Lake moderates both the summer highs and winter lows. I consider 98º F summer and 10º F winter, reasonable design temperatures for South Jordan. Other parts of the valley may experience greater or lesser extremes.

The Provo Airport, close to Utah Lake, likewise will experience milder temperatures at both ends of the spectrum, when compared with other areas in Utah County.

Please consider the following when selecting design conditions:

- The location identified on the plan should be reasonably close to the actual location; ensure correct altitude and latitude information is used within the software.
- After completing a Load, a contractor does not order a furnace or AC which is exactly sized for the load. They select the next larger size, which gives an oversize factor, often as much as 20-25%, sometime more. Example: A heat loss calculation identifies a 21,326 BTU/hour winter heat loss at design conditions. The contractor does not order a 21,326 BTU/hour furnace, rather a 40,000 95% efficient furnace, providing sufficient capacity for rare extreme cold temperatures.
- Selecting design temperatures at *record* highs and lows results in gross oversizing.
- Design temperatures are based on a 30-year average. As it appears historical temperatures are on the rise, a slight adjustment is acceptable.
- Do not be completely ridiculous; I reviewed a load where the HVAC contractor submitted a load for Midway, with a summer OD design of 107º, 8 degrees higher than the all-time high in that mountain community. The current 1% design temperature based on historical data is 84º F for Summit County.
- Also important is the selection of reasonable inside design conditions. Manual J suggests 70º F for winter and 75º F for summer. Exaggerating the summer inside temperature to 67º is the same as adding 8 degrees to the outside temperature.
- If there is a reasonable argument for higher indoor winter and lower indoor summer design temperatures, this should be justified in writing when submitting to the city. I consider a 76º F winter inside temperature is justified for senior housing, and perhaps a 70º F summer temperature for a good friend with MS, who is not comfortable unless it is quite cool. Please be aware, residential comfort cooling to below 70º F is rarely reasonable and will require advanced design procedures and controls.
- *May I suggest Code Officials and HVAC Professionals in adjoining areas get together and discuss uniformity on this subject, possibly considering a 3 or 4-degree range which is acceptable. I'm willing to work with and support you in such an effort.*

Remember, the output of a load calculation software package is only as accurate as the data inputted: garbage in = garbage out. For additional technical information, consider spending a little time studying Manual J.

Thanks for your questions on this subject and others. Your comments and questions are welcome. — ***Brent*** ■