CHAPTER 2. DESIGN CONDITIONS

This chapter presents the data from which the outdoor design conditions are established for various localities and inside design conditions for various applications. The design conditions established determine the heat content of the air, both outdoor and inside. They directly affect the load on the air conditioning equipment by influencing the transmission of heat across the exterior structure and the difference in heat content between the outdoor and inside air. For further details, refer to *Chapters 5 and 6.*

OUTDOOR DESIGN CONDITIONS — SUMMER AND WINTER

The outdoor design conditions listed in *Table 1* are the industry accepted design conditions as published in ARI Std. 530-56 and the 1958 ASHAE Guide. The conditions, as listed, permit a choice of outdoor dry-bulb and wet-bulb temperatures for different types of applications as outlined below.

NORMAL DESIGN CONDITIONS — SUMMER

Normal design conditions are recommended for use with *comfort and industrial cooling applications* where it is occasionally permissible to exceed the design room conditions. These outdoor design conditions are the *simultaneously occurring dry-bulb and wet-bulb temperatures and moisture content,* which can be expected to be exceeded a few times a year for short periods. The dry-bulb is exceeded more frequently than the wet-bulb temperature, and usually when the wet-bulb is lower than design.

When cooling and dehumidification (dehydration) are performed separately with these types of applications, use the normal design dry-bulb temperature for selecting the sensible cooling apparatus; use a moisture content corresponding to the normal design wet-bulb temperature and 80% rh for selecting the dehumidifier (dehydrator).

Daily range is the average difference between the high and low dry-bulb temperatures for a 24-hr period on a design day. This range varies with local climate conditions.

MAXIMUM DESIGN CONDITIONS — SUMMER

Maximum summer design conditions are recommended for *laboratories and industrial applications* where exceeding the room design conditions for even short periods of time can be detrimental to a product or process.

The maximum design dry-bulb and wet-bulb temperatures are simultaneous peaks (not individual peaks). The moisture content is an individual peak, and is listed only for use in the selection of separate cooling and dehumidifying systems for closely controlled spaces. Each of these conditions can be expected to be exceeded no more than 3 hours in a normal summer.

NORMAL DESIGN CONDITIONS — WINTER

Normal winter design conditions are recommended for use with all *comfort and industrial heating applications.* The outdoor dry-bulb temperature can be expected to go below the listed temperatures a few times a year, normally during the early morning hours. The annual degree days listed are the sum of all the days in the year on which the daily mean temperature falls below 65 F db, times the number of degrees between 65 F db and the daily mean temperature.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
ALABAMA													
Anniston	95	78	117.5	19				5	2806			733	34
Birmingham	95	78	117.5	19	99			10	2611	5.0 S	8.0 N	694	34
Mobile	95	80	131	12	95	82	155.6	15	1566	9.0 SW	9.9 N	10	31
Montgomery	95	78	117.5	15				10	2071		7.5 NW	293	32
ARIZONA													
Flagstaff	90	65	81	26	90			−10	7242		7.7 SW	5,894	35
Phoenix	105	76	94	30	113	78	126.9	25	1441	5.0 W	5.4 E	1,108	33
Tucson	105	72	77	30				25		5.0 W	5.2 NW	2,376	32
Winslow	100	70	85					−10				4,853	35
Yuma	110	78	93	30				30	1036		6.7 N	146	33
ARKANSAS													
Fort Smith	95	76	104.5	16	103			10	3226	7.0 E	8.3 E	448	35
Little Rock	95	78	117.5	16	103	83	145.5	5	3009	6.0 NW	8.3 NW	324	35
CALIFORNIA													
Bakersfield	105	70	54	25				25				499	35
El Centro	110	78	94									43	33
Eureka	90	65	52					30	4758	7.0 N	7.3	132	41
Fresno	105	74	76	35	110	75	95.9	25	2403	8.0 NW	5.4 NW	287	37
Laguna Beach				9	82	70	103.0					10	34
Long Beach	90	70	78	14								47	34
Los Angeles	90	70	78	14	94			35	1391	6.0 SW	6.4 NE	261	34
Oakland	85	65	60	17	94	68	99.3	30				17	38
Montague								0				2,635	42
Pasadena	95	70	70										34
Red Bluff	100	70	62									305	40
Sacramento	100	72	73	18				30	2680		7.2 SE	116	39
San Bernadino	105	72	65										34
San Diego	85	68	75	10	88	74	78.4	35	1596	7.0 W	6.3 NW	26	33
San Francisco	85	65	60	17				35	3137	12.0 W	7.5 N	17	38
San Jose	91	70	76.5					25	2823			100	37
Williams				40	110	80	74.4					86	39
COLORADO													
Denver	95	64	60	25	99	68	89.4	−10	5839	7.0 S	7.5 S	5,221	40
Durango	95	65	70									6,558	37
Fort Collins								−30					41
Grand Junction	95	65	62	24	102	68	86.2	−15	5613	6.0 SE	4.4 NW	4,587	39
Pueblo	95	65	63	25				−20	5558		7.9 NW	4,770	38
CONNECTICUT													
Bridgeport	95	75	99	14				0				9	41
Hartford	93	75	102	16	94	82		0	6113	7.0 S	8.7 NW	58	42
New Haven	95	75	99	14	95			0	5880	7.0 S	9.4 N	23	41
Waterbury								−15					42
DELAWARE													
Wilmington	95	78	117.5	15				0		10.0 SW	NW	134	40
DIST. OF COLUMBIA													
Washington	95	78	117.5	18	99	84	155.6	0	4561	5.0 S	7.8 NW	72	39
FLORIDA													
Apalachicola	95	80	131					25	1252	5.0 SW	8.4	23	30
Jacksonville	95	78	117.5	17	99	82	150.5	25	1185	8.0 SW	9.0 NE	18	30
Key West	98	78	112.5					45	59	9.0 SE	10.6 NE	23	25
Miami	91	79	12[illegible]	12	92	81	150.5	35	185	7.0 SE	10.1 E	11	26
Pensacola	95	78	117.5	12				20	1281		10.9 N	408	31
Tampa	95	78	117.5	14	95			30	571	6.0 NE	8.6 NE	25	28
Tallahassee								25	1463		N	68	30

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (Contd)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
GEORGIA													
Atlanta	95	76	109.5	18	101	82	150.5	10	2985	7.0 NW	11.7 NW	975	34
Augusta	98	76	100	18				10	2306		6.5 NW	195	34
Brunswick	95	78	117.5										31
Columbus	98	76	100										33
Macon	95	78	117.5	18				15	2338	5.0 S	6.7 NW	408	33
Savannah	95	78	117.5	17	99			20	1635	8.0 SW	9.5 NW	42	32
IDAHO													
Boise	95	65	54.5	31	109	71	92.6	−10	5678	5.0 NW	9.1 SE	2,705	44
Lewiston	95	65	44	28				5	5109		4.1 E	763	46
Pocatello	95	65	61	28	100			−5	6741		8.9 SE	4,468	43
Twin Falls								−10			W		42
ILLINOIS													
Cairo	98	78	112.5					0	3957		9.8	319	37
Chicago	95	75	99	19	104	80	140.6	−10	6282	10.0 NE	12.0 SW	594	42
Danville								−5			NW		40
Moline	96	76	103	22	103	83	155.6	−10				594	41
Peoria	96	76	103	20	100			−10	6004	8.0 S	8.3 S	602	41
Springfield	98	77	106	20				−10	5446		11.9 NW	603	40
INDIANA													
Evansville	95	78	117.5	19	102	82	150.5	0	4410	7.0 SW	9.7 S	388	38
Fort Wayne	95	75	99	20	100			−10	6232	8.0 SW	10.4 SW	777	41
Indianapolis	95	76	104.5	18	99			−10	5458	9.0 SW	11.3 S	715	40
South Bend								−5			SW	773	42
Terre Haute	95	78	124									1,146	40
IOWA													
Cedar Rapids								−5					
Davenport	95	78	117.5	18				−15	6252		10.5 NW	648	42
Des Moines	95	78	123	18	102			−15	6375	6.0 SW	10.1 NW	800	42
Dubuque	95	78	117.5					−20	6820		7.1	740	43
Fort Dodge								−20					42
Keokuk	95	78	117.5					−10	5663		8.2 SW	637	41
Sioux City	95	78	124	19	102			−20	6905	10.0 S	11.5 NW	1,111	43
Waterloo								−15					43
KANSAS													
Concordia	95	78	125	20				−10	5425		7.7 S	1,425	39
Dodge City	95	78	132	21	106			−10	5069		10.6	2,522	38
Salina					111			−15			NW	1,226	39
Topeka	100	78	109.5	19				−10	5075	10.0 S	9.2 S	991	39
Wichita	100	75	98	21	110	79	126.9	−10	4644	11.0 S	12.4 S	1,300	38
KENTUCKY													
Lexington								0	4792		13.3 SW	989	38
Louisville	95	78	117.5	22	99			0	4417	7.0 SW	9.8 SW	459	38
LOUISIANA													
Alexandria								20			N	89	32
New Orleans	95	80	131	13	95	83	161.2	20	1203	6.0 SW	8.6 N	9	30
Shreveport	100	78	109.5	15	102	83	150.5	20	2132	5.0 S	8.8 SE	197	33
MAINE													
Augusta	90	73	95	13								362	45
Bangor	90	73	95	13									45
Bar Harbor								−15			NW		44
Belfast								−5					44
Eastport	90	70	78	13				−10	8445	7.0 S	12.6 W	100	45
Millinocket								−15					46
Presque Isle									9644		NW		47
Portland	90	73	95	13	93			−5	7377	7.0 S	10.4 NW	47	44
Rumford								−20					44

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction Summer	Winter		
MARYLAND													
Baltimore	95	78	117.5	18	99			0	4487	6.0 SW	8.2 NW	14	39
Cambridge								5			NW		39
Cumberland	95	75	99	18									39
Frederick								−5			NW		40
Frostburg								−5			W		40
Salisbury								10			NW		40
MASSACHUSETTS													
Amherst								−10			NW		42
Boston	92	75	104	13	96	78	135.9	0	5936	9.0 SW	12.4 W	14	42
Fall River								−10					42
Fitchburg	93	75	102	17				−10	6743	W	NW	402	43
Lowell								−15					43
Nantucket	95	75	99					0			14.8	45	41
New Bedford								0					42
Plymouth								−5			W		42
Springfield	93	75	102	17				−10		9.0 SW		199	42
Worcester	93	75	102	17				0				625	42
MICHIGAN													
Alpena	95	75	99					−10	8278		11.0 SW	615	45
Big Rapids								−15			NW		43
Detroit	95	75	99	19	101	79	135.9	−10	6560	10.0 SW	12.0 SW	619	42
Escanaba								−15	8777		9.5 NW		46
Flint	95	75	99	20				−10		W	W	766	43
Grand Rapids	95	75	99	20	98			−10	6702	8.0 W	12.1 NW	638	43
Kalamazoo								−5			W		42
Lansing	95	75	104	20				−10	7149		9.8 SW	861	43
Ludington								−10	7458		11.9 W		44
Marquette	93	73	90	20	96			−10	8745		10.6 NW	652	47
Saginaw	95	75	99									601	43
Sault Ste Marie								−20	9307		8.9 SE	724	47
MINNESOTA													
Alexandria								−25			NW		
Duluth	93	73	96	19				−25	9723	13.4 SW	13.4 SW	1,128	47
Minneapolis	95	75	103	17	102			−20	7966	10.0 S	11.3 NW	839	45
St. Cloud								−25					46
St. Paul	95	75	99	17	103	79	131.1	−20	7975	8.0 SE	9.5 NW	719	45
MISSISSIPPI													
Jackson				21	103	83	155.6	15		5.0 SW	7.7 SE	316	32
Meridian	95	79	124	21				10	2330	4.0 SW	6.3 N	410	32
Vicksburg	95	78	117.5	21	96			10	2069	6.0 SW	8.3	226	32
MISSOURI													
Columbia	100	78	109.5	19				−10	5070		8.9 SW	739	39
Kansas City	100	76	106.5	19	109	79	135.9	−10	4962	9.0 S	10.3 NW	741	39
Kirksville				19	108	82	150.5			SW		969	40
St. Louis	95	78	117.5	20	108	81	135.9	0	4596	9.0 S	11.8 S	465	39
St. Joseph								−10	5596		9.3 NW	817	40
Springfield				18	93	79	135.9	−10	4569	8.0 S	10.9 SE	1,301	37
MONTANA													
Billings	90	66	70	20	104			−25	7213		12.4 W	3,119	46
Butte								−20			NW	5,538	46
Great Falls								−20			SW	3,687	48
Havre	95	70	82	20				−30	8416	7.0 E	9.4 SW	2,498	49
Helena	95	67	71	20	97	70	77.4	−20	7930	7.0 SW	7.4 SW	4,090	47
Kalispell	95	65	56					−20	8032		5.2	3,004	48
Miles City								−35	7591		5.6 S	2,629	47
Missoula	95	66	49	20				−20	7604		E	3,205	47

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitud (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
NEBRASKA													
Grand Island								−20				1,856	41
Lincoln	95	78	124	20	106			−10	5980	9.0 S	10.6 S	1,180	41
Norfolk								−15		NW	NW		42
North Platte	95	78	135	26	104	76	74.4	−20	6384	6.0 S	7.9 W	2,805	41
Omaha	95	78	123	20	108	80	131.1	−10	6095	8.0 S	9.7 NW	978	41
Valentine	95	78	135	20				−25	7197		9.2	2,627	43
York								−15			NW		
NEVADA													
Las Vegas	115	75	76	40				20			S	1,882	36
Reno	95	65	62	41	102	66	66.9	−5	5621	7.0 SW	6.0 W	4,493	40
Tonopah								5	5812		9.9 SE	5,421	38
Winnemucca	95	65	62	40				−15	6357	7.0 SW	8.1 NE	4,293	42
NEW HAMPSHIRE													
Berlin								−25					45
Concord	90	73	95	14				−15	7400	5.0 NW	6.2 NW	289	43
Keene								−20			NW		43
Manchester	90	73	95	14	92							171	43
Portsmouth	90	73	95	14									43
NEW JERSEY													
Atlantic City	95	78	117.5	14				5	5015	13.0 SW	15.8 NW	8	39
Bloomfield	95	75	99	14								125	41
Camden				14	102	82	145.5	0		10.0 SW		30	40
East Orange	95	75	99	14								173	41
Jersey City	95	75	99					0			NW		41
Newark	95	75	99	14	99	81	140.6	0	5500	13.0 SW	17.1 NW	10	41
Paterson	95	75	99	14	95					13.0 SW		10	41
Sandy Hook								0	5369		16.1		41
Trenton	95	78	117.5	14	96			0	5256	9.0 SW	10.9 NW	56	40
NEW MEXICO													
Albuquerque	95	70	94.5	26	98	68	95.9	0	4517	8.0 SW	7.3 N	5,101	35
Roswell	95	70	87	25				−10	3578	6.0 S	7.1 S	3,643	32
Santa Fe	90	65	80	30	90			0	6123	6.0 SE	7.1 NE	7,000	36
NEW YORK													
Albany	93	75	102	18	97	78	131.1	−10	6648	7.0 S	10.5 S	19	43
Binghamton	95	75	103.5					−10	6818		6.8 NW	915	42
Buffalo	93	73	90	18	93	77	126.9	−5	6925	12.0 SW	17.1 W	604	43
Canton	90	73	95					−25	8305	8.0	10.5	458	43
Cortland								−10			NW		43
Glens Falls								−15			W		43
Ithaca								−15	6914		11.3 NW		42
Jamestown								−10			SW		42
Lake Placid								−20			W		44
New York City	95	75	99	14	100	81	145.5	0	5280	13.0 S	16.8 NW	10	41
Ogdensburg								−20			SW		45
Oneonta								−15			SW		43
Oswego	93	73	90					−10	7186		12.1 S	363	43
Rochester	95	75	102	18	95			−5	6772	8.0 SW	9.6 W	543	43
Schenectady	93	75	102	18								235	43
Syracuse	93	75	102	18	96			−10	6899	9.0 S	11.2 S	400	43
Watertown								−15			SW		44
NORTH CAROLINA													
Asheville	93	75	114.5	19	93			0	4236	6.0 NW	9.5 NW	2,192	36
Charlotte	95	78	117.5	16				10	3224	5.0 SW	7.3 SW	809	35
Greensboro	95	78	123.5	15				10	3849		7.9 SW	896	37
Raleigh	95	78	117.5	15	98	82	155.6	10	3275	6.0 SW	7.9 SW	345	36
Wilmington	95	78	117.5	15	95	81	150.5	15	2420	7.0 SW	9.4 SW	6	34

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction Summer	Winter		
NORTH DAKOTA													
Bismarck	95	73	95.5	19	103			−30	8937	9.0 NW	9.1 NW	1,670	47
Devils Lake	95	70	77					−30	10104		10.1 W	1,481	48
Fargo	95	75	104.5	19				−25			10.9 NW	900	47
Grand Forks								−25	9871		NW	832	48
Williston	95	73	96.5					−35	9301	8.0 SE	8.6 W	1,919	48
OHIO													
Akron	95	75	99	19				−5				104	41
Cincinnati	95	78	117.5	22	106	81	145.5	0	4990	7.0 SW	8.5 SW	553	39
Cleveland	95	75	99	19	101	79	135.9	0	6144	11.0 S	14.7 SW	651	42
Columbus	95	76	104.5	23	95			−10	5506	9.0 SW	11.6 SW	724	40
Dayton	95	78	123	23	99			0	5412	8.0 SW	11.1 SW	900	40
Lima								−5					41
Sandusky	95	75	99					0	6095		11.0	608	42
Toledo	95	75	99	19	99			−10	6269	10.0 SW	12.1 SW	589	42
Youngstown	95	75	99	19								1,186	41
OKLAHOMA													
Ardmore								10			N	762	34
Bartlesville								−10			N		37
Oklahoma City	101	77	108	21	104			0	3670	10.0 S	11.5 S	1,254	35
Tulsa	101	77	101.5		106	79	140.6	0		10.0 S	N	804	36
OREGON													
Baker	90	66	71	19				−5	7197		5.6 SE	3,501	44
Eugene	90	68	67	19				−15				366	44
Medford	95	70	76	19								1,428	42
Pendleton								−15			W	1,494	46
Portland	90	68	67	19	99	70	103.0	10	4353	6.0 NW	7.3 S	30	46
Roseburg	90	66	57	19						4.0 N		523	42
Wamic								0			W		45
PENNSYLVANIA													
Altoona	95	75	99	14				−5				1,469	40
Bethlehem								−5					41
Erie	93	75	102	18				−5	6363	9.0 S	13.6 SW	670	42
Harrisburg	95	75	99	14				0	5412		7.6 NW	339	40
New Castle								0			NW		41
Oil City	95	75	99	18									42
Philadelphia	95	78	117.5	14	97			0	4739	10.0 SW	11.0 NW	26	40
Pittsburgh	95	75	105	14	98	79	126.9	0	5430	9.0 SW	11.6 W	1,248	40
Reading	95	75	99					0	5232		9.0	311	40
Scranton	95	75	99	14	95			−5	6218	6.0 SW	7.6 SW	746	41
Warren								−15			NW		41
Williamsport								−5			NW	525	42
RHODE ISLAND													
Block Island	95	75	99						5897		20.6 NW	46	41
Pawtucket	93	75	102	14									41
Providence	93	75	102	14				0	5984	10.0 NW	12.1 NW	8	42
SOUTH CAROLINA													
Charleston	95	78	117.5	17	98	82	155.6	15	1866	10.0 SW	10.5 SW	9	33
Columbia	95	75	99	17				10	2488		8.0 SW	401	34
Greenville	95	76	104.5	17				10	3059	7.0 NE	8.4	982	35
SOUTH DAKOTA													
Huron	95	75	106	19	106	76	126.9	−20	7940	10.0 SE	10.7 NW	1,282	44
Rapid City	95	70	85	22	103	71	95.9	−20	7197	7.0 W	8.0 W	3,231	44
Sioux Falls	95	75	99	20				−20			NW	1,427	43

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
TENNESSEE													
Chattanooga	95	76	104.5	18	98			10	3238	6.0 SW	7.7 NW	689	35
Johnson City								0			W		36
Knoxville	95	75	103.5	17	100	79	135.9	0	3658	6.0 SW	7.2 SW	921	36
Memphis	95	78	117.5	18	103	83	155.6	0	3090	7.0 SW	9.3 W	271	35
Nashville	95	78	117.5	17	98			0	3613	8.0 W	9.8 NW	485	36
TEXAS													
Abilene	100	74	93					15	2573	9.0 S	10.1 S	1,748	32
Amarillo	100	72	91.6	22	101	75	110.4	−10	4196	11.0 S	12.1 SW	3,657	35
Austin	100	78	109.5	19				20	1679		8.3 N	625	31
Brownsville	95	80	131	20	96	80	150.5	30	628	9.0 SE	10.4 SE	35	26
Corpus Christi	95	80	131					20	965	13.0 SE	11.0 SE	21	28
Dallas	100	78	109.5	21	105	80	135.9	0	2367	8.0 S	10.6 NW	460	33
Del Rio	100	78	115					15	1501	10.0 SE	8.0 SE	1,020	29
El Paso	100	69	73	23	101	72	106.6	10	2532	9.0 E	9.0 NW	3,720	32
Fort Worth	100	78	109.5	21				10	2355	10.0	10.5 NW	708	33
Galveston	95	80	131	14				20	1174	9.0 S	11.2 SE	6	29
Houston	95	80	131	14	100	81	150.5	20	1315	8.0 S	10.5 SE	52	30
Palestine	100	78	109.5					15	2068		8.0	555	32
Port Arthur	95	79	124					20	1532		10.7	64	30
San Antonio	100	78	109.5	19	102	83	166.4	20	1435	7.0 SE	8.3 NE	646	29
UTAH													
Modena	95	65	66	25	97	86	80.3	−15	6598	11.0 SW	9.0	5,479	38
Logan								−15					42
Ogden								−10			S	4,446	41
Salt Lake City	95	65	61	25	102	68	89.4	−10	5650	7.0 S	7.8 SE	4,222	41
VERMONT													
Bennington								−10					43
Burlington	90	73	95	17	91			−10	8051	8.0 S	11.6 S	308	44
Rutland	90	73	95	17				−20					43
VIRGINIA													
Cape Henry	95	78	117.5					10	3538		14.0	24	37
Lynchburg	95	75	99	16	99			5	4068		8.1	386	37
Norfolk	95	78	117.5	16	95			15	3364	11.0 S	12.1 N	11	37
Richmond	95	78	117.5	16	98			15	3922	6.0 SW	8.1 SW	162	38
Roanoke	95	76	111.5	16				0	4075		8.2 W	1,194	38
WASHINGTON													
North Head	85	65	60					20	5367		16.1	199	
Seattle	85	65	60	17	86	70	99.3	15	4815	7.0 N	9.8 SE	14	48
Spokane	93	65	54.5	28	106	68	71.9	−15	6318	7.0 SW	6.2 SW	1,879	48
Tacoma	85	64	55.5	17				15	5039		8.0	279	47
Tatoosh Island								15	5857		18.9	110	48
Walla Walla	95	65	47.5	28	105			−10	4910		5.4 S	952	46
Wenatchee	90	65	52	20									48
Yakima	95	65	48	20				5	5585		4.1	1,160	47
WEST VIRGINIA													
Bluefield	95	75	99	16									37
Charleston	95	75	99	16	102			0		4.0 SW	W	603	38
Elkins								−10	5800		6.2 W	2,006	39
Huntington	95	76	104.5	16				−5			W		38
Martinsburg								−5				540	39
Parkersburg	95	75	99	16	98			−10	4928	4.0 SE	7.2 SW	615	39
Wheeling	95	75	99	14				−5					40

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

STATE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
WISCONSIN													
Ashland								−20			SW		42
Eau Claire								−20			NW	885	45
Green Bay	95	75	99	14	99	79	131.1	−20	7931	8.0 S	10.5 SW	589	45
La Crosse	95	75	99	17	100	83	161.2	−25	7421	6.0 S	9.3 S	673	44
Madison	95	75	103.5	18	96			−15	7405	8.0 SW	10.1 NW	938	43
Milwaukee	95	75	99	14	99			−15	7079	9.0 SW	12.1 W	619	43
WYOMING													
Casper								−20			SW	5,321	43
Cheyenne	95	65	68.5	28				−15	7536	9.0 S	13.3 NW	6,139	42
Lander	95	65	66	28				−18	8243	5.0 SW	3.9	5,448	44
Sheridan					102			−30	7239	5.0 NW	4.9 NW	3,773	45
CANADA													
PROVINCE AND CITY													
ALBERTA													
Calgary	90	66	71					−29	9520	9.7	10.1	3,540	51
Edmonton	90	68	77					−33	10320	8.9	7.6	2,219	54
Grand Prairie								−39			7.9	2,190	55
Lethbridge								−32	8650		15.0	3,018	50
McMurray								−42				1,216	57
Medicine Hat	90	65						−35	8650	9.1	9.0	2,365	50
BRITISH COLUMBIA													
Estevan Point								17			9.9	20	49
Fort Nelson								−38			3.7	1,230	59
Penticton								−6				1,121	50
Prince George								−32	9500		7.2	2,218	54
Prince Rupert								8	6910		8.0	170	54
Vancouver	80	67	78					11	5230		7.7	22	49
Victoria								15	5410		12.3	228	48
MANITOBA													
Brandon								−32	10930			1,200	50
Churchill								−42	16810		14.7	115	59
The Pas								−39			6.4	894	54
Winnipeg	90	71	83.5					−29	10630	11.5	12.0	786	50
NEW BRUNSWICK													
Campbellton								−11				42	48
Fredericton	90	75	107					−6	8830		9.2	164	46
Moncton								−8	8700		14.9	248	46
Saint John								−3	8380	7.9	13.8	119	45
NEWFOUNDLAND													
Corner Brook								−1	9210			40	49
Gander								−3	9440		17.2	482	49
Goose Bay								−26	12140		10.3	144	53
Saint Johns								1	8780		19.3	463	48
NORTHWEST TERRITORIES													
Aklavik								−46	17870			30	68
Fort Norman								−42	16020			300	65
Frobisher								−47				68	
Resolute								−42			9.2	56	
Yellowknife								−47				682	62

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

TABLE 1—OUTDOOR DESIGN CONDITIONS—SUMMER AND WINTER (CONT.)

CANADA PROVINCE AND CITY	NORMAL DESIGN COND.—SUMMER July at 3:00 PM			AVG. DAILY RANGE	MAXIMUM DESIGN COND.—SUMMER July at 3:00 PM			NORMAL DESIGN COND. WINTER		WIND DATA		Elevation Above Sea Level (ft)	Latitude (deg)
	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content* (gr/lb of dry air)	Dry-Bulb (F)	Dry-Bulb (F)	Wet-Bulb (F)	Moisture Content† (gr/lb of dry air)	Dry-Bulb (F)	Annual Degree Days	Avg. Velocity and Prevailing Direction			
										Summer	Winter		
NOVA SCOTIA													
Halifax	90	75	107					4	7570	6.6	9.6	83	45
Sydney								1	8220	9.9	13.1	197	46
Yarmouth								7	7520		13.5	136	44
ONTARIO													
Fort William								−24	10350	8.4	9.6	644	48
Hamilton								0	6890			303	43
Kapuskasing								−30	11790		10.0	752	49
Kingston								−11	7810		10.8	340	44
Kitchener								−3	7380			1,100	43
London								−1			11.9	912	43
North Bay								−20		9.6	11.3	1,210	46
Ottawa	90	75	107					−15	8830	8.9	11.1	339	45
Peterborough								−11				648	44
Souix Lookout								−33			8.5	1,227	50
Sudbury								−17				837	47
Timmins								−26				1,100	48
Toronto	93	75	102					0	7020	8.1	14.1	379	43
Windsor								3			12.3	637	42
Sault Ste. Marie	93	75	102									635	47
PRINCE EDWARD ISLAND													
Charlottetown								−3	8380	8.7	11.3	74	46
QUEBEC													
Arvida								−19	10440		8.2	375	
Knob Lake								−40				1,605	55
Mont Joli								−11			13.3	150	48
Montreal	90	75	107					−9	8130	9.9	12.3	187	46
Port Harrison								−39			13.4	66	58
Quebec City	90	75	107					−12	9070	9.0	12.4	296	47
Seven Islands								−20				190	50
Sherbrooke								−12	8610		8.2	620	45
Three Rivers								−13				50	46
SASKATCHEWAN													
Prince Albert								−41	11430		4.9	1,414	53
Regina	90	71	92.5					−34	10770	12.4	12.1	1,884	50
Saskatoon	90	70	81					−37	10960	10.7	9.7	1,645	52
Swift Current								−33	9660		14.6	2,677	50
YUKON TERRITORY													
Dawson								−56	15040			1,062	64
Whitehorse								−43			8.7	2,289	61

*Corresponds to dry-bulb and wet-bulb temperatures listed, and is corrected for altitude of city.

†Corresponds to peak dewpoint temperature, corrected for altitude.

CORRECTIONS TO OUTDOOR DESIGN CONDITIONS FOR TIME OF DAY AND TIME OF YEAR

The normal design conditions for summer, listed in *Table 1*, are applicable to the month of July at about 3:00 P.M. Frequently, the design conditions at other times of the day and other months of the year must be known.

Table 2 lists the approximate corrections on the dry-bulb and wet-bulb temperatures from 8 a.m. to 12 p.m. based on the average daily range. The dry-bulb corrections are based on analysis of weather data, and the wet-bulb corrections assume a relatively constant dewpoint throughout the 24-hr period.

Table 3 lists the approximate corrections of the dry-bulb and wet-bulb temperatures from March to November, based on the yearly range in dry-bulb temperature (summer normal design dry-bulb minus winter normal design dry-bulb temperature). These corrections are based on analysis of weather data and are applicable only to the cooling load estimate.

Example 1 — Corrections to Design Conditions

Given:

A comfort application in New York City.

Find:

The approximate dry-bulb and wet-bulb temperatures at 12:00 noon in October.

Solution:

Normal design conditions for New York in July at 3:00 p.m. are 95 F db, 75 F wb (*Table 1*).

Daily range in New York City is 14 F db.

Yearly range in New York City = 95 − 0 = 95 F db.

Correction for time of day (12 noon) from *Table 2*:

Dry-bulb = −5 F

Wet-bulb = −1 F

Correction for time of year (October) from *Table 3*:

Dry-bulb = −16 F

Wet-bulb = − 8 F

Design conditions at 12 noon in October (approximate):

Dry-bulb = 95 − 5 − 16 = 74 F

Wet-bulb = 75 − 1 − 8 = 66 F

INSIDE COMFORT DESIGN CONDITIONS — SUMMER

The inside design conditions listed in *Table 4* are recommended for types of applications listed. These conditions are based on experience gathered from many applications, substantiated by ASHAE tests.

The optimum or deluxe conditions are chosen where costs are not of prime importance and for comfort applications in localities having summer outdoor design dry-bulb temperatures of 90 F or less. Since all of the loads (sun, lights, people, outdoor air, etc.) do not peak simultaneously for any prolonged periods, it may be uneconomical to design for the optimum conditions.

TABLE 2—CORRECTIONS IN OUTDOOR DESIGN TEMPERATURES FOR TIME OF DAY

(For Cooling Load Estimates)

DAILY RANGE OF TEMPERATURE* (F)	DRY- OR WET-BULB	SUN TIME									
		AM			PM						
		8	10	12	2	3	4	6	8	10	12
10	Dry-Bulb	− 9	− 7	−5	−1	0	−1	−2	− 5	− 8	− 9
	Wet-Bulb	− 2	− 2	−1	0	0	0	−1	− 1	− 2	− 2
15	Dry-Bulb	−12	− 9	−5	−1	0	−1	−2	− 6	−10	−14
	Wet-Bulb	− 3	− 2	−1	0	0	0	−1	− 1	− 3	− 4
20	Dry-Bulb	−14	−10	−5	−1	0	−1	−3	− 7	−11	−16
	Wet-Bulb	− 4	− 3	−1	0	0	0	−1	− 2	− 3	− 4
25	Dry-Bulb	−16	−10	−5	−1	0	−1	−3	− 8	−13	−18
	Wet-Bulb	− 4	− 3	−1	0	0	0	−1	− 2	− 3	− 5
30	Dry-Bulb	−18	−12	−6	−1	0	−1	−4	−10	−15	−21
	Wet-Bulb	− 5	− 3	−1	0	0	0	−1	− 3	− 4	− 6
35	Dry-Bulb	−21	−14	−7	−1	0	−1	−6	−12	−18	−24
	Wet-Bulb	− 6	− 4	−2	0	0	0	−1	− 3	− 5	− 7
40	Dry-Bulb	−24	−16	−8	−1	0	−1	−7	−14	−21	−28
	Wet-Bulb	− 7	− 4	−2	0	0	0	−2	− 4	− 6	− 9
45	Dry-Bulb	−26	−17	−8	−2	0	−2	−8	−16	−24	−31
	Wet-Bulb	− 7	− 5	−2	0	0	−1	−2	− 4	− 8	−10

*The daily range of dry-bulb temperature is the difference between the highest and lowest dry-bulb temperature during a 24-hour period on a typical design day. (See *Table 1* for the value of daily range for a particular city).

Equation: Outdoor design temperature at any time = Outdoor design temperature from *Table 1* + Correction from above table.

TABLE 3—CORRECTIONS IN OUTDOOR DESIGN CONDITIONS FOR TIME OF YEAR

(For Cooling Load Estimates)

YEARLY RANGE OF TEMPERATURE(F)*	DRY- OR WET-BULB	TIME OF YEAR								
		March	April	May	June	July	August	Sept.	Oct.	Nov.
120	Dry-Bulb	−39	−22	−11	−4	0	0	−9	−24	−44
	Wet-Bulb	−23	−12	− 5	−2	0	0	−4	−13	−27
115	Dry-Bulb	−33	−22	−11	−4	0	0	−8	−20	−36
	Wet-Bulb	−18	−11	− 5	−2	0	0	−4	−10	−21
110	Dry-Bulb	−30	−20	−11	−4	0	0	−6	−17	−31
	Wet-Bulb	−15	−10	− 5	−2	0	0	−3	− 8	−16
105	Dry-Bulb	−30	−20	−11	−4	0	0	−6	−17	−29
	Wet-Bulb	−15	−10	− 5	−2	0	0	−3	− 8	−14
100	Dry-Bulb	−29	−19	−10	−3	0	0	−6	−16	−27
	Wet-Bulb	−14	−10	− 5	−2	0	0	−3	− 8	−14
95	Dry-Bulb	−29	−19	−10	−3	0	0	−6	−16	−27
	Wet-Bulb	−14	−10	− 5	−2	0	0	−3	− 8	−14
90	Dry-Bulb	−29	−19	−10	−3	0	0	−6	−16	−26
	Wet-Bulb	−14	−10	− 5	−2	0	0	−3	− 8	−14
85	Dry-Bulb	−29	−19	− 9	−3	0	0	−5	−16	−25
	Wet-Bulb	−14	−10	− 5	−2	0	0	−3	− 8	−14
80	Dry-Bulb	−24	−16	− 8	−3	0	0	−4	−12	−20
	Wet-Bulb	−13	− 9	− 4	−2	0	0	−2	− 6	−11
75	Dry-Bulb	−14	− 9	− 4	−1	0	0	−3	− 7	−15
	Wet-Bulb	− 7	− 5	− 2	0	0	0	−2	− 4	− 8
70	Dry-Bulb	−13	− 9	− 4	−1	0	0	−2	− 7	−14
	Wet-Bulb	− 6	− 4	− 2	0	0	0	−1	− 4	− 6
65	Dry-Bulb	−11	− 8	− 4	−1	0	0	−2	− 6	−12
	Wet-Bulb	− 6	− 4	− 2	0	0	0	−1	− 3	− 6
60	Dry-Bulb	− 9	− 7	− 3	−1	0	0	−2	− 5	−10
	Wet-Bulb	− 4	− 3	− 2	0	0	0	−1	− 3	− 5
55	Dry-Bulb	− 6	− 5	− 3	−1	0	0	−2	− 4	− 8
	Wet-Bulb	− 3	− 3	− 2	0	0	0	−1	− 2	− 4
50	Dry-Bulb	− 5	− 4	− 3	−1	0	0	−2	− 4	− 7
	Wet-Bulb	− 3	− 2	− 1	0	0	0	−1	− 2	− 3

*Yearly range of temperature is the difference between the summer and winter normal design dry-bulb temperatures (*Table 1*).

Equation: Outdoor design temperature = Outdoor design temperature from *Table 1* + Corrections from above table.

The commercial inside design conditions are recommended for general comfort air conditioning applications. Since a majority of people are comfortable at 75 F or 76 F db and around 45% to 50% rh, the thermostat is set to these temperatures, and these conditions are maintained under partial loads. As the peak loading occurs (outdoor peak dry-bulb and wet-bulb temperatures, 100% sun, all people and lights, etc.), the temperature in the space rises to the design point, usually 78 F db.

If the temperature in the conditioned space is forced to rise, heat will be stored in the building mass. Refer to *Chapter 3, "Heat Storage, Diversity and Stratification,"* for a more complete discussion of heat storage. With summer cooling, the temperature swing used in the calculation of storage is the difference between the design temperature and the normal thermostat setting.

The range of summer inside design conditions is provided to allow for the most economical selection of equipment. Applications of inherently high sensible heat factor (relatively small latent load) usually result in the most economical equipment selection if the higher dry-bulb temperatures and lower relative humidities are used. Applications with low sensible heat factors (high latent load) usually result in more economical equipment selection if the lower dry-bulb temperatures and higher relative humidities are used.

INSIDE COMFORT DESIGN CONDITIONS — WINTER

For winter season operation, the inside design conditions listed in *Table 4* are recommended for general heating applications. With heating, the temperature swing (variation) is below the comfort condition at the time of peak heating load (no people, lights, or solar gain, and with the minimum outdoor temperature). Heat stored in the building structure during partial load (day) operation reduces the required equipment capacity for peak load operation in the same manner as it does with cooling.

TABLE 4—RECOMMENDED INSIDE DESIGN CONDITIONS*—SUMMER AND WINTER

TYPE OF APPLICATION	SUMMER					WINTER				
	Deluxe		Commercial Practice			With Humidification			Without Humidification	
	Dry-Bulb (F)	Rel. Hum. (%)	Dry-Bulb (F)	Rel. Hum. (%)	Temp Swing† (F)	Dry-Bulb (F)	Rel. Hum. (%)	Temp. Swing‡ (F)	Dry-Bulb (F)	Temp. Swing‡ (F)
GENERAL COMFORT Apt., House, Hotel, Office Hospital, School, etc.	74-76	50-45	77-79	50-45	2 to 4	74-76	35-30	−3 to −4	75-77	−4
RETAIL SHOPS (Short term occupancy) Bank, Barber or Beauty Shop, Dept. Store, Supermarket, etc.	76-78	50-45	78-80	50-45	2 to 4	72-74	35-30**	−3 to −4	73-75	−4
LOW SENSIBLE HEAT FACTOR APPLICATIONS (High Latent Load) Auditorium, Church, Bar, Restaurant, Kitchen, etc.	76-78	55-50	78-80	60-50	1 to 2	72-74	40-35	−2 to −3	74-76	−4
FACTORY COMFORT Assembly Areas, Machining Rooms, etc.	77-80	55-45	80-85	60-50	3 to 6	68-72	35-30	−4 to −6	70-74	−6

*The room design dry-bulb temperature should be reduced when hot radiant panels are adjacent to the occupant and increased when cold panels are adjacent, to compensate for the increase or decrease in radiant heat exchange from the body. A hot or cold panel may be unshaded glass or glass block windows (hot in summer, cold in winter) and thin-partitions with hot or cold spaces adjacent. An unheated slab floor on the ground or walls below the ground level are cold panels during the winter and frequently during the summer also. Hot tanks, furnaces or machines are hot panels.

†Temperature swing is above the thermostat setting at peak summer load conditions.

‡Temperature swing is below the thermostat setting at peak winter load conditions (no lights, people or solar heat gain).

**Winter humidification in retail clothing shops is recommended to maintain the quality texture of goods.

INSIDE INDUSTRIAL DESIGN CONDITIONS

Table 5 lists typical temperatures and relative humidities used in preparing, processing, and manufacturing various products, and for storing both raw and finished goods. These conditions are only typical of what has been used, and may vary with applications. They may also vary as changes occur in processes, products, and knowledge of the effect of temperature and humidity. In all cases, the temperature and humidity conditions and the permissible limits of variations on these conditions should be established by common agreement with the customer.

Some of the conditions listed have no effect on the product or process other than to increase the efficiency of the employee by maintaining comfort conditions. This normally improves workmanship and uniformity, thus reducing rejects and production cost. In some cases, it may be advisable to compromise between the required conditions and comfort conditions to maintain high quality commensurate with low production cost.

Generally, specific inside design conditions are required in industrial applications for one or more of the following reasons:

1. A constant temperature level is required for close tolerance measuring, gaging, machining, or grinding operations, to prevent expansion and contraction of the machine parts, machined products and measuring devices. Normally, a constant temperature is more important than the temperature level. A constant relative humidity is secondary in nature but should not go over 45% to minimize formation of heavier surface moisture film.

   Non-hygroscopic materials such as metals, glass, plastics, etc., have a property of capturing water molecules within the microscopic surface crevices, forming an invisible, non-continuous surface film. The density of this film increases when relative humidity increases. Hence, this film must, in many instances, be held below a critical point at which metals may etch, or the electric resistance of insulating materials is significantly decreased.
2. Where highly polished surfaces are manufactured or stored, a constant relative humidity and temperature is maintained, to minimize increase in surface moisture film. The temperature and humidity should be at, or a little

below, the comfort conditions to minimize perspiration of the operator. Constant temperature and humidity may also be required in machine rooms to prevent etching or corrosion of the parts of the machines. With applications of this type, if the conditions are not maintained 24 hours a day, the starting of air conditioning after any prolonged shutdown should be done carefully: (1) During the summer, the moisture accumulation in the space should be reduced before the temperature is reduced; (2) During the winter, the moisture should not be introduced before the materials have a chance to warm up if they are cooled during shutdown periods.

3. Control of relative humidity is required to maintain the strength, pliability, and regain of hydroscopic materials, such as textiles and paper. The humidity must also be controlled in some applications to reduce the effect of static electricity. Development of static electric charges is minimized at relative humidities of 55% or higher.

4. The temperature and relative humidity control are required to regulate the rate of chemical or biochemical reactions, such as drying of varnishes or sugar coatings, preparation of synthetic fibers or chemical compounds, fermentation of yeast, etc. Generally, high temperatures with low humidities increase drying rates; high temperatures increase the rate of chemical reaction, and high temperatures and relative humidities increase such processes as yeast fermentations.

5. Laboratories require precise control of both temperature and relative humidity or either. Both testing and quality control laboratories are frequently designed to maintain the ASTM Standard Conditions* of 73.4 F db and 50% rh.

6. With some industrial applications where the load is excessive and the machines or materials do not benefit from controlled conditions, it may be advisable to apply spot cooling for the relief of the workers. Generally, the conditions to be maintained by this means will be above normal comfort.

*Published in ASTM pamphlet dated 9-29-48. These conditions have also been approved by the Technical Committee on Standard Temperature and Relative Humidity Conditions of the FSB (Federal Specifications Board) with one variation: FSB permits ±4%, whereas ASTM requires ±2% permissable humidity tolerance.

TABLE 5—TYPICAL INSIDE DESIGN CONDITIONS—INDUSTRIAL

(Listed conditions are only typical; final design conditions are established by customer requirements)

INDUSTRY	PROCESS	DRY-BULB (F)	RH (%)
ABRASIVE	Manufacture	75-80	45-50
BAKERY	Dough Mixer	75-80	40-50
	Fermenting	75-82	70-75
	Proof Box	92-96	80-85
	Bread Cooler	70-80	80-85
	Cold Room	40-45	—
	Make-up Rm.	78-82	65-70
	Cake Mixing	95-105	—
	Crackers & Biscuits	60-65	50
	Wrapping	60-65	60-65
	Storage—		
	Dried Ingred.	70	55-65
	Fresh Ingred.	30-45	80-85
	Flour	70-75	50-65
	Shortening	45-70	55-60
	Sugar	80	35
	Water	32-35	—
	Wax Paper	70-80	40-50
BREWERY	Storage—		
	Hops	30-32	55-60
	Grain	80	60
	Liquid Yeast	32-34	75
	Lager	32-35	75
	Ale	40-45	75
	Fermenting Cellar—		
	Lager	40-45	75
	Ale	55	75
	Racking Cellar	32-35	75
CANDY—CHOCOLATE	Candy Centers	80-85	40-50
	Hand Dipping Rm.	60-65	50-55
	Enrobing Rm.	75-80	55-60
	Enrobing—		
	Loading End	80	50
	Enrober	90	13
	Stringing	70	40-50
	Tunnel	40-45	DP — 40
	Packing	65	55
	Pan Specialty Rm.	70-75	45
	General Storage	65-70	40-50
CANDY—HARD	Mfg.	75-80	30-40
	Mixing & Cooling	75-80	40-45
	Tunnel	55	DP — 55
	Packing	65-75	40-45
	Storage	65-75	45-50
	Drying—Jellies, Gums	120-150	15
	Cold Rm.—		
	Marshmallow	75-80	45-50
CHEWING GUM	Mfg.	77	33
	Rolling	68	63
	Stripping	72	53
	Breaking	74	47
	Wrapping	74	58

INDUSTRY	PROCESS	DRY-BULB (F)	RH (%)
CERAMICS	Refractory	110-150	50-90
	Molding Rm.	80	60-70
	Clay Storage	60-80	35-65
	Decal & Decorating	75-80	45-50
CEREAL	Packaging	75-80	45-50
COSMETICS	Mfg.	65-70	—
DISTILLING	Storage—		
	Grain	60	35-40
	Liquid Yeast	32-34	
	Mfg.	60-75	45-60
	Aging	65-72	50-60
ELECTRICAL PRODUCTS	Electronic & X-ray Coils & Trans. Winding	72	15
	Tube Assem.	68	40
	Electrical Inst. Mfg. & Lab.	70	50-55
	Thermostat Assem. & Calib.	76	50-55
	Humidistat Assem. & Calib.	76	50-55
	Close Tol. Assem.	72	40-45
	Meter Assem. Test	74-76	60-63
	Switchgear—		
	Fuse & Cut-Out Assem.	73	50
	Cap. Winding	73	50
	Paper Storage	73	50
	Conductor Wrapping	75	65-70
	Lightning Arrestor	68	20-40
	Circuit Brkr. Assem. & Test	76	30-60
	Rectifiers—		
	Process Selenium & Copper Oxide Plates	74	30-40
FURS	Drying	110	—
	Shock Treatment	18-20	—
	Storage	40-50	55-65
GLASS	Cutting	Comfort	
	Vinyl Lam. Rm.	55	15
LEATHER	Drying—		
	Veg. Tanned	70	75
	Chrome Tanned	120	75
	Storage	50-60	40-60
LENSES—OPTICAL	Fusing	Comfort	
	Grinding	80	50
MATCHES	Mfg.	72-74	50
	Drying	70-75	40
	Storage	60-62	50
MUNITIONS	Metal Percussion Elements—		
	Drying Parts	190	—
	Drying Paints	110	—
	Black Powder Drying	125	—
	Condition & Load Powder Type Fuse	70	40
	Load Tracer Pellets	80	40

TABLE 5—TYPICAL INSIDE CONDITIONS—INDUSTRIAL (Contd)

(Listed conditions are only typical; final design conditions are established by customer requirements)

INDUSTRY	PROCESS	DRY-BULB (F)	RH (%)
PHARMACEUTICAL	Powder Storage		
	Before Mfg.	70-80	30-35
	After Mfg.	75-80	15-35
	Milling Rm.	80	35
	Tablet Compressing	70-80	40
	Tablet Coating	80	35
	Effervescent—		
	Tablet & Powder	90	15
	Hypodermic Tablet	75-80	30
	Colloids	70	30-50
	Cough Syrup	80	40
	Glandular Prod.	78-80	5-10
	Ampule Mfg.	80	35
	Gelatin Capsule	78	40-50
	Capsule Storage	75	35-40
	Microanalysis	Comfort	
	Biological Mfg.	80	35
	Liver Extract	70-80	20-30
	Serums	Comfort	
	Animal Rm.	Comfort	
PHOTO MATERIAL	Drying	20-125	40-80
	Cutting & Packing	65-75	40-70
	Storage—		
	Film Base, Film Paper, Coated Paper	70-75	40-65
	Safety Film	60-80	45-50
	Nitrate Film	40-50	40-50
PLASTIC	Mfg.—		
	Thermo Setting Compounds	80	25-30
	Cellophane	75-80	45-65
PLYWOOD	Hot Press—Resin	90	60
	Cold Press	90	15-25
PRECISION MACHINING	Spectrographic Anal.	Comfort	
	Gear Matching & Assem.	75-80	35-40
	Storage—		
	Gasket	100	50
	Cement & Glue	65	40
	Machinings	Comfort	
	Gaging, Assem. Adjusting Precision Parts		
	Honing	75-80	35-45
PRINTING	Multicolor Litho.		
	Pressroom	75-80	46-48
	Stockroom	73-80	49-51
	Sheet & Web Print.	Comfort	
	Storage, Folding, etc.	Comfort	
REFRIGERATION EQUIPMENT	Valve Mfg.	75	40
	Compressor Assem.	70-76	30-45
	Refrigerator Assem.	Comfort	
	Testing	65-82	47
RUBBER DIPPED GOODS	Mfg.	90	—
	Cementing	80	25-30
	Surgical Articles	75-90	25-30
	Storage Before Mfg.	60-75	40-50
	Lab. (ASTM Std.)	73.4	50
TEXTILES	Cotton		
	Opening & Picking	70-75	55-70
	Carding	83-87	50-55
	Drawing & Roving	80	55-60
TEXTILES (cont.)	Cotton, cont.		
	Ring Spinning		
	Conventional	80-85	60-70
	Long Draft	80-85	
	Frame Spinning	80-85	55-60
	Spooling, Warping	78-80	60-65
	Weaving	78-80	70-85
	Cloth Room	75	65-70
	Combing	75	55-65
	Linen		
	Carding, Spinning	75-80	60
	Weaving	80	80
	Woolens		
	Pickers	80-85	60
	Carding	80-85	65-70
	Spinning	80-85	50-60
	Dressing	75-80	60
	Weaving—		
	Light Goods	80-85	55-70
	Heavy	80-85	60-65
	Drawing	75	50-60
	Worsteds		
	Carding, Combing, & Gilling	80-85	60-70
	Storage	70-85	75-80
	Drawing	80-85	50-70
	Cap Spinning	80-85	50-55
	Spooling, Winding	75-80	55-60
	Weaving	80	50-60
	Finishing	75-80	60
	Silk		
	Prep. & Dressing	80	60-65
	Weaving & Spinning	80	65-70
	Throwing	80	60
	Rayon		
	Spinning	80-90	50-60
	Throwing	80	55-60
	Weaving		
	Regenerated	80	50-60
	Acetate	80	55-60
	Spun Rayon	80	80
	Picking	75-80	50-60
	Carding, Roving, Drawing	80-90	50-60
	Knitting		
	Viscose or Cuprammonium	80-85	65
	Synthetic Fiber Prep. & Weaving		
	Viscose	80	60
	Celanese	80	70
	Nylon	80	50-60
TOBACCO	Cigar & Cigarette Mfg.	70-75	55-65
	Softening	90	85-88
	Stemming & Stripping	75-85	75
	Storage & Prep.	78	70
	Conditioning	75	75
	Packing & Shipping	75	60