Table 1. Average Maximum Water Main Temperatures[a]

State	City	Temp. F	State	City	Temp. F	State	City	Temp. F
Ala.	Birmingham	84	Mass.	Lowell	50	Pa.	Altoona	74
	Mobile	73		Lynn	68		Erie	75
Ariz.	Phoenix	81		New Bedford	70		Johnstown	74
	Tucson	80		Salem	68		McKeesport	82
Calif.	Anaheim	60		Worcester	76		Philadelphia	83
	Berkeley	69	Mich.	Detroit	77		Pittsburgh	81
	Fresno	72		Flint	70	R. I.	Providence	68
	Fullerton	75		Grand Rapids	84	S. C.	Charleston	80
	Glendale	68		Highland Park	77		Greenville	81
	Los Angeles	75		Jackson	56		Spartanburg	78
	Oakland	69		Kalamazoo	53	S. D.	Rapid City	55
	Ontario	70		Lansing	64	Tenn.	Chattanooga	84
	Pasadena	82		Saginaw	82		Knoxville	89
	Pomona	75	Minn.	Duluth	55		Memphis	70
	Riverside	78		Minneapolis	80		Nashville	90
	Sacramento	72		St. Paul	77	Texas	Amarillo	65
	San Bernardino	65	Mo.	Jefferson City	82		Austin	90
	San Diego	82		Kansas City	84		Beaumont	86
	San Francisco	62		St. Joseph	84		Dallas	86
	Whittier	75		St. Louis	85		Fort Worth	84
Colo.	Denver	75		Springfield	70		Galveston	90
Conn.	Bridgeport	66	Nebr.	Lincoln	63		Houston	84
	Hartford	73		Omaha	87		Port Arthur	83
	New Haven	76	Nev.	Reno	61		San Antonio	76
	Waterbury	72	N. H.	Manchester	76		Wichita Falls	85
D. C.	Washington	84	N. J.	Jersey City	63	Utah	Logan	44
Del.	Wilmington	83		Newark	74		Salt Lake City	60
Fla.	Jacksonville	80		Paterson	78	Va.	Fredericksburg	75
	Miami	80		Trenton	79		Lynchburg	73
	Tampa	77	N. Y.	Albany	68		Norfolk	80
Ga.	Atlanta	87		Buffalo	75	Wash.	Olympia	58
	Macon	80		Jamaica	56		Seattle	62
Ill.	Chicago	76		Mt. Vernon	74		Spokane	51
	Cicero	76		New Rochelle	75		Tacoma	57
	Evanston	73		New York	72	W.Va.	Charleston	85
	Peoria	67		Rochester	70		Huntington	78
	Rockford	59		Schenectady	60		Wheeling	78
	Springfield	82		Syracuse	74	Wis.	LaCrosse	54
Ind.	Evansville	86		Utica	69		Madison	58
	Gary	75		Yonkers	70		Milwaukee	70
	Indianapolis	80	N. C.	Asheville	74		Racine	68
	South Bend	61		Charlotte	85			
	Terre Haute	82		Winston-Salem	82			
Iowa	Cedar Rapids	78	N. M.	Albuquerque	65			
	Des Moines	77	Ohio	Akron	76			
	Sioux City	62		Canton	50			
Kans.	Concordia	57		Cincinnati	84	Province		
	Kansas City	86		Cleveland	74			
	Topeka	88		Columbus	82			
	Wichita	72		Dayton	60			
Ky.	Louisville	85		Lakewood	82	Alta.	Calgary	64
La.	Baton Rouge	85		Springfield	72	B. C.	Vancouver	60
	New Orleans	85		Toledo	83	Ont.	London	50
Me.	Augusta	60	Okla.	Oklahoma City	82		Toronto	63
Md.	Baltimore	75		Tulsa	85	P.E.I.	Charlottetown	48
Mass.	Boston	80	Ore.	Eugene	60	Que.	Montreal	78
	Cambridge	70		Portland	64		Quebec	68
	Fall River	76						

[a]These averages taken from various city water main locations, with some actual values slightly higher and some lower than values shown.

point of the mixture should move in a direction determined by the specific enthalpy of the heated spray as explained in Chapter 3. It is possible, by elevating the water temperature, to raise the air temperature, both dry-bulb and wet-bulb, above the dry-bulb temperature of the entering air.

In each of the methods, 1, 2 or 3, the air leaving the air washer may require reheating to produce in the conditioned space the required dry-bulb temperature and relative humidity.

DEHUMIDIFICATION AND COOLING WITH AIR WASHERS

Cooling of the wet-bulb temperature of an air vapor mixture can be accomplished by an air washer if the temperature of the spray water is lower than the wet-bulb temperature of the air. Moisture removal is obtained when the spray water temperature is lower than the dew-point of the entering air. In these cases the final dry-bulb temperature and relative humidity of the leaving air are dependent upon the design factors of the air washer.

Both sensible and latent heat are removed in the process of dehumidification by cold spray water. Abstraction of sensible heat occurs during the entire time that the air is in contact with the spray medium. Latent heat removal takes place as condensation occurs. Therefore, the lower the spray temperature the greater the amount of moisture removal per pound of dry air, all other conditions remaining the same.

Washers with two or more banks of spray are usually selected for dehumidifying installations, whether for comfort or industrial installations. Generally such air washers cool the air to within one or two degrees (Fahrenheit) of the leaving spray water temperature; this differential will increase somewhat when the difference between the entering wet-bulb and leaving dew-point is relatively large.

Where a limited supply of cold water is available multiple stage washers may be used to great advantage. In such washers the cool water is pumped through the multiple spray systems in series and counterflow to the air flow. Such an arrangement brings the delivery air in contact with the coldest water, securing a maximum amount of cooling with economy of water.

When using cold well water or water from city water mains care should be used to secure accurate data on the water temperatures. Table 1 lists some approximate water main averages which may be used as a guide but they should be verified from local records. This is particularly true with city water main temperatures. In the case of well water temperatures Fig. 3 shows the approximate temperatures of water to be expected from wells at depths of 30 to 60 ft.

Air washers for dehumidifying and cooling usually have separate recirculating pumps. These pumps deliver a mixture of cold and recirculated water under the control of a three-way valve. The valve may be actuated either by a thermostat in the washer outlet or by a humidity or other controller in the space being conditioned.

Air washers for dehumidifying are very often furnished with direct expansion or water cooling coils within the washer space, in which case water for the washer sprays is entirely recirculated.

APPARATUS FOR DIRECT HUMIDIFICATION

Humidifiers may be divided into the following general types, according to the method of operation: (1) indirect, such as the air washer, which