TABLE 1. TEMPERATURES AND HUMIDITIES APPLICABLE TO INDUSTRIAL AIR CONDITIONING*

PROCESS	TEMP. F	R.H. %
BAKERY		
Mixer (bread dough)	75–80	40–50
Fermenting	75–80	70–75
Proof box	92–96	80–85
Bread oven	375–450	
Cake oven	300–430	
Bread cooler (room or tunnel) Vacuum 28.6 in.	70–75	80–85
Cold room	40–45	
Make up room	75–80	65–70
Cake mixing	70–75	65
Cake mixing (sponge)	95–110	
Crackers and biscuits	60–65	50
Wrapping	60–65	60–65
Dried ingredients, storage	70	55–65
Fresh ingredients, storage	30–45	80–85
Flour storage	65–80	50–65
Shortening (depending on type), storage	45–70	55–65
Sugar, storage	80	35
Water, storage	32–35	
Wax paper, storage	70–80	40–50

METHODS OF MIXER COOLING

1. 35–40 F water circulated through mixer jacket.
2. 15–25 F brine.
3. Direct expansion, refrigerant circulated through mixer jacket.
4. Cracked ice added to dough in mixer.
5. Cold air introduced into mixer during mixing process.
6. Cooled agitators are used in mixers.

MIXER LOAD CALCULATIONS

Refrigeration is required to remove: excess ingredient, if any; heat generated by the beating and mixing of dough; excess heat in mixer body; heat of hydration of flour and water; and heat absorbed by mixer from atmosphere during mixing process.

Additional factors are the design and speed of mixer, consistency, kind and mass of dough.

Data Used in Calculations:

1 bbl. flour = 200 lb
Heat of hydration = 6.5 Btu per lb of flour
Specific heat of flour = 0.42 Btu per lb
Water is 65% of weight of flour
Flour is 65% of batch
Sponge is 60% of batch

Total motor output is converted to heat in the mixer.

In fermenting rooms recent practice is to use direct radiation for heating, atomizing sprays for humidifying, and gravity convection cooling surfaces for temperature reduction and dehumidifying thereby eliminating objectionable air currents.

Proof box and bread cooler conditions vary slightly for dark bread.

Cakes are sterilized by ultra-violet rays before wrapping.

PROCESS	TEMP. F	R.H. %
BANANAS		
Ripening	68	90 to 95
Storage	60	85 to 90
Shipping	54 to 56	85 to 90

Forced ripening is accomplished in 4 to 5 days while slow ripening is extended to 7 to 9 days with lower temperatures.

The green fruit with a pulp temperature of 56 F is placed in a ripening room at 68 F and 90 to 95 percent relative humidity until it begins to change color. The temperature is then lowered sharply to 60 F (or slightly less) dependent upon how quickly the fruit is to be moved.

Typical refrigeration load for ripening room per carlot, with an 85 F ambient temperature:

Insulation & electric load = 0.4 ton
Live load = 0.9 ton
Pull down load (from 68 F to 60 F) = 1.6 ton

Minimum carlot—20,000 lb which represents about 300 stems.

Since bananas give off minute quantities of ethylene and possibly other gases necessary for ripening, ventilation during the early stages of ripening is undesirable.

Cooling unit to be sized to provide a complete air change every 1½ to 2 min.

* Information in Table 1 is drawn from many sources. See bibliography at end of chapter.

TABLE 1. TEMPERATURES AND HUMIDITIES APPLICABLE TO INDUSTRIAL AIR CONDITIONING—(Continued)

BANANAS (Continued)

Provide a heating system with a rated capacity to warm the fruit at a rate of not less than 2 deg per hr

Specific heat—0.9 Btu per (lb)(F deg).

Approximate rate of evolution of heat by bananas when stored at temperatures indicated:

Bananas at 54 F = 3,300 Btu (per ton) (24 hr).
green at 68 F = 8,360 Btu (per ton) (24 hr).
turning at 68 F = 9,240 Btu (per ton) (24 hr).
ripening at 68 F = 8,360 Btu (per ton) (24 hr).

ROOM	TEMP. F	R.H. %
BREWING		
Storage: Hops	30 to 32	55 to 62
Grain	80 max.	60 max.
Liquid yeast	32 to 34	
Lager	32 to 34	75 min.*
Ale	40 to 46	75 min.*
Fermenting Cellar: Lager	40 to 45	75 min.*
Ale	55	75 min.*
Racking Cellar	32 to 35	75
* If wooden tankage is used, otherwise humidity controlled to prevent condensation on walls and ceiling.		

Wort cooled to 47 F for lager, 54 to 59 F for ale, by evaporative cooling or use of double pipe or plate type coolers with counter flow of cooling medium.

Fermentation produces 250 Btu per lb of sugar fermented. Lager fermented five days at 55 to 60 F, ale at 68 to 75 F, then cooled to storage temperature.

Bottled beer pasteurized by heating to 140 F in twenty minutes, maintaining temperature for eighteen minutes, then cooling to 80 F in twenty minutes. Canned beer requires one-third less time.

Cold water, brine, direct expansion ammonia or propylene-glycol and water solutions may be used as the cooling medium.

PROCESS	TEMP. F	R.H. %
CANDY (CHOCOLATE)		
Candy centers for coating	80 to 85	40 to 50
Hand dipping room	60 to 65	50 to 55
Enrober room	75 to 80	55 to 60
Enrobing		
Loading End	80	50
Enrober	90	13
Stringing	70	40 to 50
Tunnel	40 to 45	
Packing	65	55
Panned specialty room	70 to 75	45
General candy storage	65 to 70	40 to 50
Tempering room = Ventilation only		

Tunnel discharge room requires a dew point lower than the temperature of the product leaving the tunnel.

During the summer months the product is usually held in the tempering room for 24 hours prior to shipping.

Recovery of sugar fly in coating kettle rooms is accomplished with the use of cyclone type dust collecting devices. Supply air to coating kettles is maintained at 85 F dry-bulb and 61 F wet-bulb temperature.

Bacteriological control is employed.

Load calculations for hand dipping rooms are based on 100 lb of 90 F chocolate per (worker) (hr).

Specific heat of chocolate = 0.30 to 0.56 Btu per (lb)(F deg).
Latent heat of fusion = 34 to 40 Btu per (lb)(F deg).
Freezing point =
Sweet milk chocolate = 86 F.
Dark chocolate = 90 to 92 F.

PROCESS	TEMP. F	R.H. %
CANDY (HARD)		
Manufacturing	75 to 80	30 to 40
Mixing and cooling	75 to 80	40 to 45
Tunnel	55	
Packing	65 to 75	40 to 45
Storage	65 to 75	45 to 50
Tempering = (Ventilation only)		