Table 1.... Temperatures and Humidities Applicable to Industrial Air Conditioning—(*Continued*)

BAKERY (*Continued*)

vection 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 and 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.

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 counterflow 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 by 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)		

Hot rooms used in the drying of jellies and gums are maintained at 120 to 150 F. A purge system using 100 percent outside air, bypassing the heating coil, is incorporated to produce rapid cooling of both the product and the room.

Cold rooms for cooling marshmallows and cast creams are maintained at 75 to 80 F with a relative humidity of 45 to 50 percent. Uniform air distribution is essential.

Standard starch drying equipment is employed.

Filtration of air is required.

Process	Temp. F	R.H.%
CERAMICS		
Refractory	110 to 150	50 to 90
Molding room	80	60 to 70
Clay storage	60 to 80	35 to 65
Decalcomania production	75 to 80	48
Decorating room	75 to 80	48

Relative humidity has no effect on the manufacture of the products.

Temperature and humidity must be controlled in the decorating shop in the whiteware plants, and the decalcomania production room.

Dust control is essential, and the dust count must be held down to four million particles per cubic foot due to the danger of silicosis.

Table 1.... Temperatures and Humidities Applicable to Industrial Air Conditioning—(*Continued*)

Process	Temp. F	R.H.%
CEREAL		
Packaging	75–80	45–50
CITRUS FRUIT		
Lemons (storage)*	58	84 to 88
Grapefruit (storage)*	60	86 to 88
* Prior to transcontinental shipment		

Careful consideration must be given to air volumes, air temperatures, humidity, ventilation, and distribution.

In regions where end rot is prevalent, it may be necessary to store grapefruit at temperatures of 32 to 34 F for a period not exceeding six weeks.

Lemon and grapefruit storage requires an air-conditioning system to (1) maintain a constant temperature, (2) maintain a high relative humidity, (3) ventilate to maintain 0.1% CO_2 content, (4) obtain uniform air distribution, and (5) provide air washing or air filtration.

Load calculations include (1) transmission losses, (2) internal load-fruit cooling and respiration, cooling fruit boxes, electric load, and people, and (3) outside air load—72 cfm per carlot.

Specific heat—Btu per (lb) (F deg):

Lemons 0.94, Grapefruit 0.87, Boxes 0.40

Heat of Evolution in Btu Per (ton) (24 hr)

Temp.	Lemons	Grapefruit
32	580	460
40	810	1070
60	2070	2770
80	6200	4180

Approximately 10 percent of the cooling load is considered as latent heat load.

In a conventional system the air required is one cfm per storage box or 650 cfm per carload, resulting in a small temperature rise in the supply air making possible the required high humidities.

In a combination system the air required is one cfm per sq ft of floor area or 300 cfm per carlot with the addition of auxiliary humidifying nozzles to maintain the required high humidities.

Installation of metal ducts is required. Ductwork made of insulation board is sometimes preferred.

Process	Temp. F	R.H.%
DISTILLING		
Storage:		
Grain	60	35 to 40
Liquid Yeast	32 to 34	
General Manufacturing	60 to 75	45 to 60
Aging	65 to 72	50 to 60

Mashing done at 150 to 155 F, then cooled to 64 to 68 F.

Yeast culture fermented at 170 F, then cooled to 70 to 72 F.

Yeast propagated at 150 to 154 F.

Mash heated to 165 F and then cooled to 80 F, then pitched with yeast and fermented at maximum temperature of 85 F.

Cooling for various distilling processes normally accomplished by use of river or well water depending on temperatures and availability.

Low humidity and dust control important where grains are ground.

Viscous filters preferred as mold spores and bacteria are trapped in the viscous film, preventing propagation.

Process	Temp. F	R.H.%
ELECTRICAL PRODUCTS		
Electronics and X-Ray:		
Coil and transformer winding	72	15
Tube assembly	68	40
Electrical Instruments:		
Manufacture and laboratory	70	50 to 55
Thermostat assembly and calibration	76	50 to 55
Humidistat assembly and calibration	76	50 to 55
Small Mechanisms:		
Close tolerance assembly	72	40 to 45
Meter assembly and test	74 to 76	60 to 63
Switchgear:		
Fuse and cutout assembly	73	50
Capacitor winding	73	50
Paper storage	73	50
Conductor wrapping with yarn	75	65 to 70
Lightning arrestor assembly	68	20 to 40
Thermal circuit breakers assembly and test	76	30 to 60
Water wheel generators:		
Thrust runner lapping	70	30 to 50
Rectifiers:		
Processing selenium and copper oxide plates	74	30 to 40
Dust control is essential in these processes		
FLOOR COVERING		
Linoleum:		
Mechanical oxidising of linseed oil	90 to 100	20 to 28
Printing	80	30 to 50
Stoving process	160 to 250	60 gr*
* grains per pound abs. hum.		

Some operations are stabilized to prevent mold growth.

Precise control of temperature and humidity is required for mechanical oxidising of linseed oil. The rate of flow and the temperature of cooling water in the jacket surrounding the tank must be controlled.

Air filtration is recommended for the stoving process.

FOUNDRIES		
Core making	60 to 70	
Mold making:		
Bench work	60 to 70	
Floor work	55 to 65	
Pouring	40	
Shakeout	40 to 50	
Cleaning Room	55 to 65	
* Winter design temp.		

The charging room is usually unheated.

In core making fume-exhaust hoods are required for oven and for cooling areas adjacent to ovens.

In mold making provide hoods at transfer points with wet collector dust removal system. Use 600 to 800 cfm per hood.

Pouring rooms require two-speed powered roof ventilators. Design for minimum of two cfm per sq ft floor area at low speed. Shielding is required to control radiation from hot surfaces. Proper introduction of air will minimize preheat requirements.

In shakeout room provide hoods with wet-collector dust-removal system. Exhaust 400 to 500 cfm per sq ft grate area. Roof ventilators are generally not effective.

In cleaning room provide hoods for grinders and cleaning equipment with dry cyclones or bag-type collectors.

Winter ventilation (preheated) is required to the extent of replacing exhausted air. Summer ventilation is usually supplemented by use of pedestal fans.

Spot coolers are sometimes used in larger installations.