

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

Process	Temp. F	R.H.%
PRECISION MACHINING		
Spectrographic analysis.....	75-80	45-50
Gear matching and special assembly room.....	75-80	35-40
Gasket storage.....	100	50
Cement and glue storage.....	65	40
Precision parts machining.....	75	45-50
Accurate gaging and inspection.....	75	45-50
Precision gage manufacture and adjustment.....	68-75	45-50
Precision gear drive assembly.....	72	42-50
Watch main spring calibration.....	76	45
Gage room.....	78	50
Precision parts—hoisting.....	75-80	35-45

For product improvement and increased personnel efficiency some manufacturing areas are being provided with summer air conditioning. Where air conditioning is not provided, an ample supply of outdoor air and air motion are relied upon to provide acceptable working conditions.

Low relative humidity is usually maintained to prevent corrosion. Temperature control within a narrow range is more important than temperature maintained. Dust control is required wherever polishing operations occur. Air distribution is important to maintain constant conditions throughout the area.

Process	Temp. F	R.H.%
PRINTING		
Pressroom:		
Multicolor offset lithography.....	75-80	46-48
Other sheet fed printing.....	75-80	45-50
Newspaper and other web printing.....	75-80	50-55
Stock room:		
Multicolor offset lithography.....	73-80	"
Other paper storage.....	70-80	"
Binding, cutting, drying, folding, and gluing.....	70-80	45-50
Roll storage.....	73-80	50
* 5 to 8% above pressroom		
* same as pressroom		

Lithography requires constant humidity control of entire pressroom with paper conditioned 5 to 8 percent higher relative humidity at start. All printing requires conditioned paper otherwise it will not lie flat, with 40 to 45 percent R.H. low limit to eliminate static electricity; and 60 percent R.H. high limit to prevent swelling of the rolls and slow ink drying. Temperature is not critical, but extremes should be avoided due to softening of the rolls at high temperature and improper ink distribution at low temperatures.

Hoods must be provided for gas dryers, with solvent recovery recommended for all except job shops. Exhaust system with dust collectors incorporated is required for type and plate cleaning areas. Check use of gasoline and other solvents. Normal air cleaning is adequate. Air distribution must prevent drafts on paper in storage or process. Gas flame dryers impose unusual loads.

Air from press and storage rooms should not be recirculated through office areas.

Process	Temp. F	R.H.%
REFRIGERATION EQUIPMENT		
Valve Manufacturing.....	75	40
Compressor Assembly.....	70 to 76	30 to 45
Refrigerator Assembly.....	75	30 to 50
Testing.....	65 to 82	47

Process	Temp. F	R.H.%
RUBBER DIPPED GOODS		
Manufacture.....	90	
Cementing.....	80	25-30
Dipping surgical articles.....	75-80	25-30
Storage prior to manufacture.....	60-75	40-50
Laboratory (ASTM Standard).....	73.4	50
Solvents used in manufacturing processes are usually explosive and toxic, requiring positive ventilation.		
Volume manufacturers usually install a solvent recovery system.		

Process	Temp. F	R.H.%
TEA		
Packaging.....	65	65

Ideal moisture content is 5 to 6% for quality and weight. Low limit moisture content for quality is 4%.

Process	Temp. F	R.H.%
TEXTILES		
Cotton: Opening.....	70-75	55-60
Picking.....	75	55-60
Carding, Winter.....	75-80	55
Carding, Summer.....	83	90
Carding, Summer.....	85	80
Carding, Summer.....	87	70
Drawing.....	80	60
Roving.....	80	60
Ring Spinning.....	80-85	70
Conventional.....	80-85	55
Long Draft.....	80-85	55-60
Frame Spinning.....	80-85	65
Spooling and Winding.....	78-80	65
Weaving.....	78-80	70-85
Cloth Room.....	75	50-65
Combing.....	75	50-65
Linen: Carding.....	75-80	60
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.....	80-85	60
Overcoating (32 oz.).....	80-85	60-65
Drawing.....	75	50-60
Worsted: Carding.....	80-85	65
Combing.....	80-85	65-70
Gilling.....	80-85	65-70
Top Storage.....	70-85	75-80
Drawing.....	80-85	65
Cap Spinning.....	80-85	50-55
Spooling and Winding.....	78	65-70
Weaving.....	80	55-70
Finishing.....	75	60
Silk: Preparatory.....	80	60-65
Weaving.....	80	60-70
Dressing.....	80	60-65
Spinning.....	80	65-70
Throwing.....	80	60
Rayon: Spinning.....	80-90	50-60
Throwing.....	80	55-60
Weaving.....	80	50-65
Regenerated.....	80	50-65
Acetate.....	80	55-60
Spun rayon.....	80	80

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

Process	Temp. F	R.H.%
TEXTILES (Continued)		
Rayon (Continued):		
Picking.....	75-80	50-60
Carding, roving, drawing.....	80-90	50-60
Knitting.....	80-85	65
Viscose or cuprammonium.....	80-85	60
Acetate.....	80-85	60
Laboratory (ASTM).....	70	65
Rayon synthetic fiber processing:		
Viscose.....	80	60
Preparatory.....	80	60
Weaving.....	80	60
Celanese.....	80	70
Preparatory.....	80	70-75
Weaving.....	80	70-75
Nylon.....	80	50-60
Preparatory.....	80	50-60
Weaving.....	80	50-60

Cotton: Relative humidity maintained in ring spinning depends on staple, twist, and whether leather aprons are used for conveying long draft stock. Aprons readily absorb moisture causing cotton to stick when relative humidity is above 55 percent.

With conventional 3 or 4 roll spinning, relative humidity may be as high as 70 percent dependent upon draft, twist, and staple.

Relative humidity carried in cotton weaving depends upon construction of the cloth. When automatic machines are to be tended and the warps are heavily sized, it may be as high as 90 percent.

Woolen: In woolen spinning, the relative humidity maintained for mules is generally 55 percent, with conditions over frame spinning at 55 to 60 percent. Both types of spinning depend on the class of stock spun, also the regain in the roving. Weave: Top storage temperature depends on whether cellar long period conditioning at low temperature or quick conditioning at high temperature is used. Weaving relative humidity depends upon staple, quality, and construction.

Filtration of air is essential.

Rayon manufacture: The steeping room, where sheets of raw material are dipped in caustic soda then broken into a fine matted crumb, is held at 70 F and 55 percent relative humidity.

(Text continued from p. 681.)

Moisture Content and Regain

In the manufacture or processing of hygroscopic materials such as textiles, paper, wood, leather, tobacco, and food-stuffs, the temperature and relative humidity of the air have a marked influence upon the rate of production and upon the weight, strength, appearance, and general quality of the product. The moisture content of materials having a vegetable or animal origin, and to a lesser extent minerals in certain forms, comes to equilibrium with the moisture of the surrounding air. This moisture content is known as *regain*. Standards of *regain* are fixed in the trade, and are the fundamental basis for the control of certain physical qualities of the material during manufacture.

Manufacturing economy requires that the moisture content be maintained at a level favorable to rapid and satisfactory manipulation, and to a minimum loss of material through breakage. A uniform condition is desirable in order that high-speed machinery may be adjusted permanently for the desired production with a minimum loss from delays, wastage of raw material, and defective product. *Moisture content* refers to free moisture (as in a sponge)

Relative humidity is held down to prevent condensation on cold pipes and jackets.

In chum room, where sodium cellulose is converted into cellulose xanthate, temperatures of 75 to 80 F are maintained while humidity control is not important. Room temperatures are held below 85 F during the summer months.

The crumb is dumped into aging tanks located in a room held at 73 F with no humidity control.

For spinning operations it is desirable to limit the temperature to 90 F with a minimum relative humidity of 70 percent for the summer, while 70 percent and 75 F are desirable for the winter months.

In the storage room, where the material is held for later processing, design conditions are 85 F and 100 percent relative humidity.

The material is washed, desulfurized, bleached, and then washed again. It is then placed in a drier where controlled conditions of 100 deg and 65 percent relative humidity are required to bring the rayon back to the proper regain.

In the coning room, where winding machines place the rayon yarn on cones, temperature is held at a maximum of 80 F. Relative humidity is held at 55 percent.

Process	Temp. F	R.H.%
TOBACCO		
Cigar and cigarette making.....	70 to 75	55 to 65
Softening.....	90	85 to 88
Steaming and stripping.....	75 to 85	70 to 75
Packing and shipping.....	74 to 76	65
Filler tobacco casing and conditioning.....	75	75
Filler tobacco storage and preparation.....	78	70
Wrapper tobacco storage and conditioning.....	75	75

In preparation for stripping, the tobacco undergoes a softening operation, whereby it is automatically heated, moistened, and then cooled.

Control of moisture regain, and of chemical and biological reactions is required in tobacco processing.

Exact temperature and humidity conditions maintained are usually trade secrets as they affect the finished product.

and to hygroscopic moisture (which varies with atmospheric conditions). It is usually expressed as a percentage of the total weight of material. *Regain* is more specific and refers only to hygroscopic moisture. It is expressed as a percentage of the *bone-dry* weight of material. For example, if a sample of cloth weighing 100.0 g is dried to a bone-dry weight of 93.0 g, the loss in weight, or 7.0 g, represents the weight of moisture originally contained. This expressed as a percentage of the total weight (100.0 g) gives the moisture content of 7 percent. The regain, which is expressed as a percentage of the bone-dry weight, is $(7.0/93.0) \times 100 = 7.5$ percent.

The use of the term *regain* does not imply that the material as a whole has been completely dried out and has re-absorbed moisture.

A basis for calculating the regain of textiles is obtained by drying, under standard conditions, a sample from the lot, and the dry weight thus obtained is used in the calculations to determine the regain.

Table 2 shows the regain or hygroscopic moisture content of several organic and inorganic materials when in equilibrium at a dry-bulb temperature of 75 F and various