

Control of Temperature for Close Machining Tolerances

Where tolerances must be held within 2 or 3 ten-thousands of an inch, as in the manufacture of precision instruments, tools, and high quality lenses, temperature variations may cause expansion and contraction of material to an extent that will seriously affect the quality of the work. This type of work usually requires close temperature control to assure accuracy and uniformity of the product.

Usually the temperature level with respect to the product is not as important as controlling the temperature within close limits. For this reason, conditions are usually selected within the comfort range.

Control of Dew-Point for Protection of Polished Surfaces

In the manufacture of certain metal articles, the presence of finger prints, tarnish, or *etching* can not be tolerated in the finished article. If these articles are manufactured under conditions of effective temperatures that will cause the hands to perspire, an unsatisfactory product will result. The salt and acid contained in body perspiration, when deposited on the highly polished article, can show corrosion and rust within a few hours if examined under a microscope.

It is therefore important to maintain temperatures and relative humidities (dew-point) low enough to prevent sweating of the hands. In addition, the manufacture of polished surfaces usually requires a better-than-average job of air filtering to avoid abrasion of the surfaces.

Control of Humidity for Reduction of Static Electricity

The presence of static electricity is often detrimental to the satisfactory and economical processing of many light materials, such as textile fibers, paper, etc. It is also extremely dangerous where explosive atmospheres or materials are present. Fortunately, this hazard is minimized by increasing the relative humidity to at least 55 percent, if the material being processed is not damaged thereby.

It must be borne in mind that for successful elimination, the air that actually comes in contact with the material in the machine must be at a relative humidity of 55 percent or more. As some machines consume a great deal of power, which is converted directly into heat, the temperature in the machine may be considerably higher than the temperature adjacent to the machine where the relative humidity is normally measured. In such cases, the relative humidity in the machine will be appreciably lower than that elsewhere in the room, and it may therefore be necessary to maintain a room relative humidity of 65 percent, or even more, to maintain the desired humidity.

Control of Conditions for Material Test Laboratories

Laboratories having controlled conditions of temperature and humidity, are becoming more common, not only for the purposes of scientific research, but also for routine testing and for quality production control. A control of temperature and humidity within fairly close plus or minus limits is usually required. Laboratories designed for scientific research may require control of conditions over a wide range, whereas the routine testing laboratory or quality control laboratory will usually be designed to maintain the A.S.T.M. Standard Conditions of 50 percent relative humidity and 23 C (73.4 F) temperature.

CALCULATIONS

The methods for determining the heating and cooling loads for the various industrial processes are similar to those outlined in Chapters 11 and 12. Some factors affecting heating or cooling requirements are given in Table 1. Because of the large number of motors and heat producing units usually found in an industrial application, it is particularly important that operating allowances, for the latent and sensible heat loads, be definitely ascertained and used in the calculations to determine the total design load.

GENERAL REQUIREMENTS FOR HEALTH, SAFETY AND EFFICIENCY

Control of Atmospheric Contaminants

Safeguarding the health and maintaining the safety and efficiency of workers, require control of dusts, fumes, smokes, mists, fogs, vapors, and gases, and control of the effective temperature, which includes temperature, humidity and motion of air about the worker.

General ventilation may be relied upon in some cases to control air contaminants. Chapter 10 gives information on natural ventilation. If mechanical ventilation is to be used, Chapter 32, Fans; Chapter 30, Air Distribution; Chapter 31, Air Duct Design; Chapter 33, Air Cleaning; and Chapter 34, Spray Apparatus, furnish information on a broad range of industrial design conditions.

Specialists in the field of industrial hygiene should be consulted in case of doubt concerning the presence of airborne industrial hazards to health. Chapter 8, Air Contaminants; Chapter 6, Physiological Principles; and Chapter 7, Air Conditioning in the Prevention and Treatment of Disease, will be of help in determining the atmospheric conditions which should be maintained around the worker. Local codes, ordinances, or state labor laws must likewise be observed, particularly for ventilation requirements for hazardous trades. Comfortable conditions are desirable because they are likely to increase the efficiency of workers. For purposes of analysis, both sensible and latent heat should be included as contaminants of industrial atmospheres. A recent small scale survey has indicated that more than half of the air conditioning and ventilation installations in a typical industrial plant were concerned with removal of either sensible or latent heat as a source of air contamination.

Contaminant Control Systems

In general, systems for control of atmospheric contamination in industrial plants will be of three types:

1. *Local exhaust systems* will be indicated where the contamination originates at concentrated areas and is characterized by low or imperceptible air motion, or where the contaminant is a dust, mist or fume requiring a capture velocity exceeding 25 fpm. Design of this type system is discussed in Chapter 45, and will not be further treated in this chapter.
2. A system employing the *dilution* method will usually be indicated where the contamination originates at scattered points dispersed generally throughout the area.
3. Combination of *local exhaust* and *dilution* methods is often economical, since well designed exhaust hoods or openings, removing from the space that portion of the contamination load which is susceptible to such treatment, will often reduce greatly the air volumes required for dilution purposes. The choice of the type of system should be made on the basis of economic comparisons.