

Maintenance

The accessibility, good illumination, and the ease of maintenance of air-conditioning equipment is vital. The larger the building, the more complex is the total aggregate of equipment and controls, and the more there is a need for comprehensive and vigilant overseeing of the installation. The smaller the building is, the more automatic and simple should the system be.

Misoperation of a good air conditioning system, if bad enough, can turn it into a destructive agent. Hence a plan of operation should be carefully worked out and the actual performance monitored with recording instruments. Every large museum should have several temperature-humidity recorders located at strategic points. In all cases a good operating and maintenance guide should be a part of the installation. Certain members of the museum's staff should be familiar with the operation of the system.

However excellent is the air conditioning installation and its operation, it is not the final solution. The operating staff of the libraries and museums must exercise continuously watchful guardianship and practice all the other measures known to the conservation and preservation art to protect the quality and life of a book, painting, natural history museum, or other exhibit.

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HOSPITAL AIR CONDITIONING

Infection Problem; Air Quality; Air Cleaning; Zoning; Air-Conditioning Systems; Design Criteria; Administration Department, Diagnostic and Treatment Facilities, Nursery, Nursing, Surgical, Obstetrical, Emergency, and Service Departments

THE rapid advances in medical knowledge have resulted in the need for providing more complex hospital facilities to implement the application of this knowledge. Outstanding among the many innovations in hospital design over the past decade is the wide application of air conditioning. Although all of this increased use cannot be attributed solely to medical purposes, there is medical evidence that it is beneficial in the treatment of many conditions (see Chapter 9 of the 1961 GUIDE AND DATA BOOK).

The application of air conditioning to hospitals presents many problems not encountered in the usual comfort conditioning system. The basic differences result from: (1) the restriction on air movement, ventilation, and filtering to control odors and to maintain aseptic conditions, temperatures, and humidities required for certain areas and (2) the need for a design that will facilitate accurate balancing of the system.

Many of these basic differences have been accentuated by the relatively new and acute problem of staphylococcal infections common to most hospitals today. To provide the engineer with a better understanding of these differences, the infection problem will be discussed first and followed by other factors involved in the design of air-conditioning systems.

THE INFECTION PROBLEM

Particular emphasis is placed upon the staphylococcus organisms because they represent a serious recent development in hospitals and because air handling systems designed to assist in preventing their spread and in removing them from the environment will also be effective against other airborne organisms such as those causing tuberculosis and gas gangrene.

The modern hospital is unique among building types in many respects, but in no way is it more unique than in its design requirements as they affect the maintenance of an aseptic environment. Among the design features that concern the engineer, and are receiving considerable attention from investigators in the medical and hospital fields, are those relating to airborne bacterial contamination and its effects on the incidence of infection. Current research of airborne contamination stresses the importance of bacteriological quality of the air, air cleaning, air movement, and zoning of the systems by departments.

Infection has always been a primary concern to hospitals. To minimize its incidence, stringent techniques must be adhered to in all operations ranging from those involving surgical procedures to those of housekeeping. These practices were sufficient to keep the infection rate within reason-

able limits and as the sulfonamides and antibiotics became available the problem appeared to be solved. Not long after these drugs came into common use, however, an alarming increase in the number of infections was noted in many hospitals in this country and abroad. Investigations revealed that among the many organisms responsible for infections in the hospital, the previously relatively innocuous staphylococcus organisms had developed a resistance to the antimicrobial drugs. Prior to this time, these drugs had been effective both as preventatives and cures for the diseases caused by the organisms. Because of this immunity, these organisms are probably responsible for more infections contracted in the hospital and for more complications of existing infections than any other organisms with which the hospital must presently contend. Although they are relatively harmless to the person in good health, these organisms do tend to manifest themselves among the well in the form of pimples, boils, and carbuncles which are difficult to cure. An increase in incidence of such minor infections has been reported among hospital personnel.¹ The organisms are a serious hazard to debilitated persons, to those having upper respiratory infections, to the newborn and their mothers, and to patients during surgery.¹ The organisms create problems because they can be carried by a person on the hair, skin, clothing, and in the nose and may be dispersed to the environment during normal activities. The shedding of these bacteria to the air of the environment may account for the relatively high percentage of hospital personnel who become nasal carriers of these organisms. These organisms are approximately 1 micron in size and may exist as single cells or in fairly large microscopic clumps, and like other organisms, can be airborne, usually attached to dust or other particulates and thus carried by air currents from one hospital area to another as well as from one patient to another.² They have been identified bacteriologically as the cause of many infections, a number of which have been fatal.³ Owing to the ubiquitousness of the organisms, it is impossible, in most instances, to state with authority the exact or direct means by which they come in contact with the patient.⁴

The current problem of these recent infections was first identified with surgeries and nurseries but now involves most all hospital areas. Due to the acuteness of this problem, the American Hospital Association in 1958 recommended to the Surgeon General of the Public Health Service that the national professional groups interested in the control of infection look into this problem. In September 1958, a conference sponsored by the Public Health Service and the American Academy of Sciences was held and has been followed up by