ENVIRONMENTAL TEST EQUIPMENT

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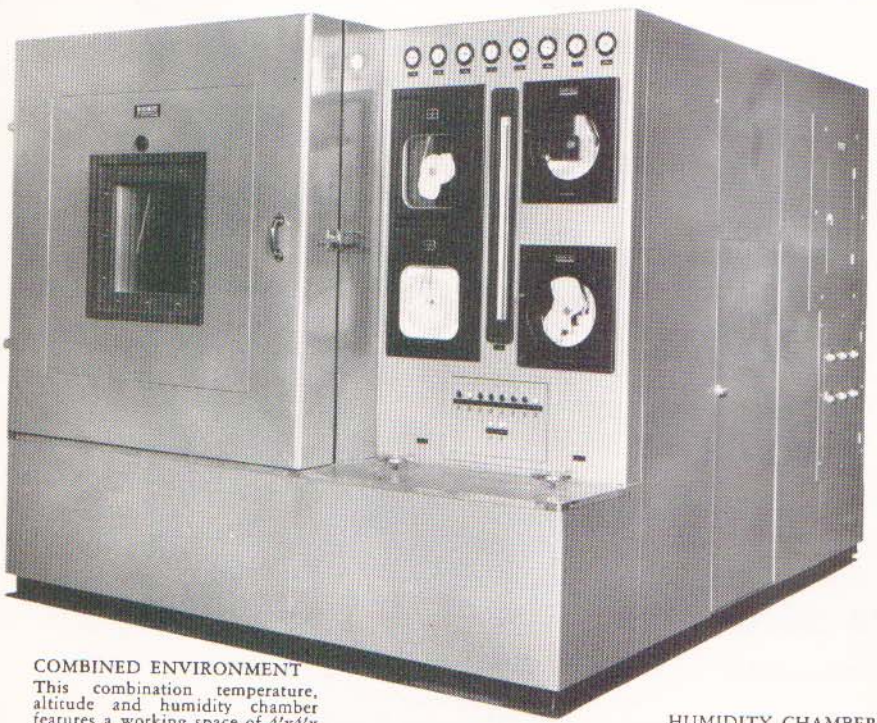
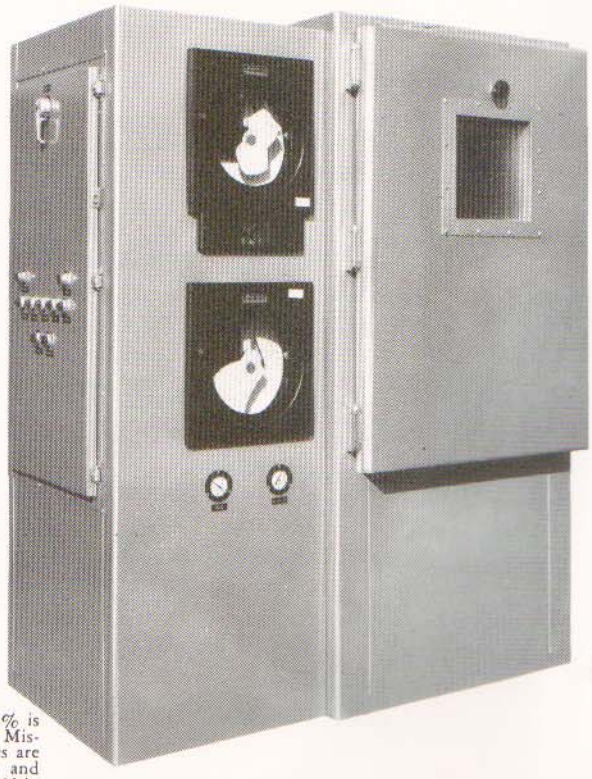
Four Missimers Chambers in use at Norair Division of Northrop Corporation. A missile checkout unit for the SM-62 Snark Weapon system is shown being wheeled into the 2300 cubic foot humidity chamber. Other similar sized Missimers chambers are rain and salt spray, and two extreme temperature units.



COMBINED ENVIRONMENT

This combination temperature, altitude and humidity chamber features a working space of 4′x4′x 4′ with temperatures from —100 to 400 F, altitudes from site level to 200,000 feet, and 20 to 95% relative humidity (Model FTAH64-100x400). Other sizes are built for almost any requirement.



HUMIDITY CHAMBER

Relative humidity of 20 to 95% is produced in this compact Missimers Chamber. Temperatures are controlled from 0 to 200 F, and inside working space is 2′x2′x3′ in this Model FH12-0x200.

41. ENVIRONMENTAL TEST EQUIPMENT

FOR the purposes of this chapter, environmental test equipment may be defined as test equipment designed to create, under controlled laboratory standards, the external conditions that may be encountered in actual service by an item of equipment or by personnel in the course of their work. The end objects of the creation of these conditions are first to assist the equipment designer in his preliminary work by exposing materials and subassemblies to their anticipated service environments in order to determine their suitability, and second to test out completed items of equipment to ensure that they will function satisfactorily in service. Environmental testing of personnel has usually had the primary objective of testing personnel protective equipment such as high-altitude suits, though the Air Force altitude indoctrination chambers are principally designed to familiarize flying personnel with the effects and hazards of high altitudes. In addition, these test chambers have been used to record these physiological effects quantitatively in order to formulate design criteria for protective equipment.

Twenty years ago environmental testing as it exists today was virtually non-existent. Those tests that were carried out were conducted in the field under natural, though extreme, conditions, but more commonly a manufacturer used his best judgment in the design of an item and modified later models to achieve greater reliability after reports from the field and complaints from his customers. Today most items of military equipment, and many civilian ones too are subjected to rigorous tests in the manufacturer's laboratory at the prototype stage so that very complex equipment today performs more reliably in service than its much simpler forebears. Environmental tests carried out today may expose the test item to simulated climatic conditions of high and low temperatures, controlled high or low humidities, altitude, salt spray, rain, sunshine, fungus resistance, or sand and dust storms. In addition, exposure to non-climatic environments such as physical shock, acceleration, vibration, physical stresses, explosive and nuclear radiation atmospheres may also be required. A current trend in environmental testing, as discussed in the last part of this chapter, is towards combination conditions in which several parameters are varied simultaneously in an attempt to reproduce actual conditions more accurately.

Since most of these simulated environments require some phase of temperature control, the design of such test equipment will directly concern the refrigerating engineer, and suggested design approaches to the production and control of the various conditions of most interest to him are given. It is impossible here to describe in detail the ranges of temperature, humidity and altitude that may be required in any test chamber, since these are largely determined by what is to be tested. In general, however, temperatures will range from −100 F to 300 F, humidity from 20–98% rh at temperatures above freezing to 200 F and altitudes to 100,000 ft, with extreme requirements of −300 F to 1,000 F and altitudes to 200,000 ft occasionally occurring. Requirements for other tests such as salt spray and sand and dust, and many of the basic requirements for temperature, altitude, and humidity tests are detailed in military specifications.

In addition, the techniques and arts used in the design of environmental test chambers are applicable to equipment for basic research and for processing. For basic research, equipment is used to determine the behavior of materials under extreme conditions, and very high and low temperatures, or extremely high vacuums may be required. Process equipment includes low temperature cabinets for shrink fitting of mating parts, stabilization and/or toughening of ferrous alloys, storage of aluminum alloys in the soft state, the storage of living animal cells such as bull semen, vacuum freeze drying and the frozen mercury precision casting process.

ENVIRONMENTAL CONDITIONS

Heat

Nearly all environmental chambers require provision for heating in some form, either to attain elevated temperatures in the performance range or to defrost and dry out the chamber rapidly after low temperature operation.

Electric heat is most commonly used, generally in the form of tubular or strip heaters located in the circulating air stream. Open nichrome strip or coiled wire heaters have also been satisfactorily used and offer the advantage in that their low thermal mass results in a more rapid response to the action of the temperature controller. Care should be taken to insure that leads to the heaters are adequately elec-