
Climatic Test Techniques

Course No. 230

FOR WHOM INTENDED: Environmental Engineering Specialists (as mandated by MIL-STD-810G), environmental test laboratory engineers and technicians, specification writers, equipment designers, and quality and reliability specialists.

COURSE DESCRIPTION: An introduction to climatic testing with an overview of field test measurement and analysis. Test methods and conditions of commercial and military test specifications and standards are discussed.

Primary emphasis is on understanding the physics of each environment, and available measurement and control techniques. The course also covers selection and use of chambers for thermal, vacuum, corrosion and dust-particle testing. It provides an overview of compressors, pumps, blowers, and heating systems. There will be a discussion of liquid nitrogen (LN₂) cooling systems and refrigeration equipment. All major MIL-STD-810G environments are covered, including humidity, solar radiation, fungus, salt fog, rain and ice, as well as synergistic, combined environments testing. A class project provides supervised practice in using the course material.

The course is presented as a series of highly-interactive lecture/discussion sessions. Problems for individual and group solution are interspersed throughout the course to act as training aids and to evaluate class progress. Special-interest discussions are encouraged outside of the regular course sessions.

DIPLOMA PROGRAMS This course is required for TTI's [Environmental Engineering Specialist \(EES\)](#), [Climatic Test Specialist \(CTS\)](#), and [Mechanical Design Specialist \(MDS\)](#) Diploma Programs. It may be used as an elective for any other [TTI diploma program](#).

PREREQUISITES There are no definite prerequisites. However, this course is aimed toward individuals involved in related technical fields.

TEXT Each student will receive 180 days access to the on-line electronic course workbook. Renewals and printed textbooks are available for an additional fee.

INTERNET COMPLETE COURSE 230 features over eleven hours of video as well as more in-depth reading material. All chapters of course 230 are also available as OnDemand Internet Short Topics. See the on-line course outline for details.

COURSE HOURS, CERTIFICATE AND CEUs Class hours/days for on-site courses can vary from 14–35 hours over 2–5 days as requested by our clients. Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

NOT AFFILIATED WITH ANY VENDOR. TTI sells no climatic testing hardware or firmware. Before buying climatic testing equipment, take this course. Equipment manufacturers' field sales people may lack time to teach fundamentals. TTI training helps you to negotiate for the equipment you really need.

INSTRUCTORS One TTI instructor normally presents the entire course, rather than using many speakers. Participants follow a controlled, systematic flow of material, and receive an effective, comprehensive program. The instructor welcomes questions and comments during lectures. Private discussions can easily be arranged between instructor and participants, after class in the afternoons or evenings. TTI policy is to make every effort to present the scheduled instructor and course content. However, on occasion, it may be necessary to modify the course content or substitute a different, equally qualified instructor, due to circumstances beyond our control.

Course Outline

Basic Principles: Laws of Motion • Mass, Weight, Volume, Energy

Temperature: Definitions and Terminology • Heat Units

Heat Transfer • Refrigeration • Pressure and Enthalpy

Introduction to Climatics: Definitions and terminology

Test Tailoring and Specifications • Life Cycle Environmental Profile

Environmental Engineering Objectives and Functions

Dynamic vs. Climatic and Natural vs. Induced Environments

General Introduction to Climatic Testing: Safety • Support Services

Accuracy of Instrumentation Calibration • Environmental Simulation

Test Conditions and Tolerances • Test Sequences

Test Procedure Selection, Conditions • General Guidance

Interrupted Tests • Failure Criteria

Environments, Test Facilities and Procedures

The Temperature Environments: Temperature Scales

Heat Transfer • Thermophysics • Convection, Conduction

Heat Energy • Thermal Characteristics of Materials

Temperature Measurement • Thermocouples and Thermistors

High, Low Temperature Environments, Effects

Temperature Cycling • Thermal Shock

Facilities for Temperature, Temperature Cycling • Heating, Cooling

Mechanical Refrigeration • LN₂ and CO₂ • Selection and Sizing

Chamber Controls • Producing & Controlling Thermal Environments

Chamber Cooling Requirements • Characteristic Response of DUT

Evaluation of Performance • Chamber Control Calibration

Temperature Distribution • Distribution Tolerance

Thermocouple Calibration • Sample Temperature Test Procedures

Pressure and Vacuum

Definitions: Absolute, Differential, Gage and Head Pressures

Conversion factors • Effects of Low Pressure • Pressure Head

Air Flow Velocity • Pressure Measurement • Test Facilities

Vacuum Systems, Pumps • Sample Pressure Test Procedures

Humidity Environment: Effects of Humidity • Dew Point, Measurement

of Humidity • Psychrometric Charts • Humidity Test Facilities

Calibration of Test Chamber, Instrumentation and Standards

Solar Radiation Environment: Effects of Solar Radiation

Solar Radiation Test Facilities • Hazards • Sample Test Procedures

Salt Fog Environment: Corrosion Mechanisms • Compatible Couples

Salt Fog Chamber • Sample Salt Fog (Corrosion) Test Procedures

Rain and Ice Environments: Rain Environment Measurement

Effects of Rain • Icing, Freezing Rain Environment • Effects of Ice

Rain and Ice Test Facilities: Rain, Drip and Watertightness

Freeze/Thaw Testing • Specifications • Sample Rain Test Procedure

Fungus Environment: Effects of Fungus • Choice of Test Fungi

Fungus Test Facilities • Sample Fungus Test Procedure

Sand and Dust Environment: How Environment is Measured

Effects of Sand and Dust • Sand and Dust Test Facilities

Blowing Dust, Blowing Sand Facilities • Sample Test Procedure

Immersion, Splash, Spray and Leak Environment Immersion and

Leak Test Facilities, Procedures • Explosive Atmosphere Testing

Combined Environments: Multiple Climatic Environments

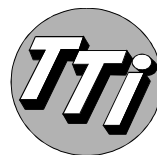
Synergistic Effects • Combining Climatic and Dynamic Environments

Test Ethics and Documentation : Ethics • Sample Test Log

Student Exercise: Prepare a test log

Summary and Conclusion; Final Review

Award of certificates for successful completion



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