
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.

CERTIFICATE PROGRAMS This course is required for TTI's [Environmental Engineering Specialist \(EES\)](#) and [Climatic Test Specialist \(CTS\)](#) Certificate Programs. It may be used as an elective for any other [TTI certificate program](#).

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

TEXT Each participant will receive a [course workbook](#), including most of the viewgraphs used during the course.

COURSE HOURS, CERTIFICATE AND CEUs Open courses meet seven hours per day. Upcoming presentation dates can be found on our current [open course schedule](#). 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.

For [schedules](#), [general information](#) and [registration forms](#), see TTI's web site.

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 Sequence s
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:

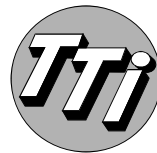
Multiple Climatic Environments
Synergistic Effects • Combining Climatic and Dynamic Environments

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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