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# Product Noise Control

## Course No. 198

**APPLICATIONS** This course provides an introduction to the physics, principles, language and fundamental techniques used to control noise. Emphasis will be placed on the practical applications of the physical principles behind noise control.

**FOR WHOM INTENDED** The course is intended for technicians who work in sound control testing and engineers who have recently been assigned responsibility for product noise control. Upon completion of the course, the participant will be able to choose the appropriate noise control mechanism (absorption, barriers, source modification) and avoid the costly over-application of noise control materials which is common in retrofit programs. The course will also be beneficial for engineering managers who must evaluate the noise control programs within their area of responsibility.

**BRIEF COURSE DESCRIPTION** A short introduction will be given to subjective measures of noise which serve as the background for many of the noise measurement methods in common use. The control of existing product noise through the design of enclosures and barriers will be covered. This course will also include a discussion of the design and qualifications of anechoic rooms, reverberant rooms and outdoor test sites.

While the course is developed for participants from the automotive industry—manufacturers, OEM companies and supplier companies responsible for automotive noise control treatments—the material will also be applicable to personnel from other industries. Examples and case studies from automobile applications and various heavy duty vehicle applications will be discussed if time permits.

The material presented will be practical in nature with mathematics limited as much as possible.

**BENEFITS** Participants will become familiar with noise control technology and gain an understanding of the basic physical principles needed to solve noise problems. Success in noise control, as in many other areas, rests with a good grasp of the fundamentals. The course provides practical solutions to difficult problems.

**CERTIFICATE PROGRAMS** This course is a recommended elective for TTI's [Mechanical Design Specialist \(MDS\)](#) certificate program. It may be used as an elective for any other [TTi specialist certificate program](#).

**PREREQUISITES** There are no formal prerequisites for this course. Supervisors are invited to contact the Institute on prospective attendees' backgrounds and needs.

**TEXT** Each student will receive a set of [course notes](#) including most of the viewgraphs used in the presentation.

**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.

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

### Course Outline

Introduction to Noise: The Nature of Sound  
Acoustic Measurements and Terminology: Propagation Velocity  
Pressure • Sound intensity • Impedance  
Frequency and Wavelength • Use of Decibels  
Sound Pressure Level (SPL), Sound Power Level (PWL)  
Adding, subtracting, averaging SPL or PWL  
Spreading of Sound Waves • Sound Level Variation  
Directivity Index • Doppler Effect  
Basic Noise Control Concepts  
Absorption of Sound • Absorption vs. Thickness  
Membrane Coverings • Perforated Metals  
Absorption • Reverberation • Barriers • Enclosures  
Absorption vs. Damping; Damping vs. Isolating  
Basic Concepts in Noise and Vibration  
Sound Perception • Terms • Loudness Perception  
Fletcher Munson Curves • Noise Criteria (NC) Curves  
Noise Rating (NR) Curves • Stevens Method  
Vibration Basics: Sine Wave • RMS Values • SDoF Systems  
Harmonic Waves • Radians • Natural Frequency (Resonance)  
Transmissibility • Isolation • Damping  
Critical Frequencies • Structural Propagation — Rods  
Noise Measurement: Instrumentation • Microphones  
Definitions of Terms: Free field • Free Field Response  
Pressure Response • Diffuse Field (Random Incidence)  
Free-Field and Random-Incidence Corrections  
Reverberant Rooms • Capacitor Microphones  
Electret Microphone • Dynamic Range • Frequency Range  
Moving-Coil or Dynamic Microphone • Piezoelectric Microphones, Direct  
Piezoelectric Effect • Ceramic Systems  
Microphone Calibration: Reciprocity • Closed Chamber  
Microphone Windscreens • Sound Level Meters (SLM)  
Weighting Curves • Detectors  
Vibration Instrumentation • Use of Accelerometers:  
Basic Principles, Bridge Type, Piezoelectric Type • Calibration  
Mounting • Selection and Care, Limitations  
Spectrum Analysis: Spectrum Analyzer • Parallel Filter Analyzer  
Filters • Time-Compression Analyzers • FFT Analyzers  
Fourier Transforms • Resolution • Windows • Ripple • Aliasing  
Bandwidth • Cross Spectrum • Transfer Functions • Coherence  
Data Capture and Analysis: Magnetic Tape Recording  
FM Principle • Frequency Division Multiplexing  
Digital Audio Tape (DAT) Recorders • Signal Sources  
Sampling Frequency • Filtering and Oversampling  
Analog-Digital Conversion  
Design of Facilities: Reverberant Rooms  
Anechoic and Hemi-anechoic Rooms • Outdoor Sites  
Dynamometers: Eddy Current, Hydrokinetic • Existing Standards  
Testing Acoustical Materials: Acoustic Materials Standards  
Absorption: ASTM C 423, ASTM C 384, ASTM B 1050  
Barriers: ASTM E 90, SAE J 1400,  
Damping: ASTM E 756, SAE J 1637  
Quiet Design for Automotive Applications: Noise Control Materials  
Typical Absorbers and Barriers in Vehicles  
Sources of Noise in Vehicles: Tires • Road • Wind • Accessories  
Seals and Leaks • Interior Vehicle Modes  
Summary • Final Review  
Award of Certificates for successful completion



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