

## **INCE Classification of Subjects in Noise Control Engineering**

Below is the classification system (version 7.0) used by the Institute of Noise Control Engineering of the USA (INCE/USA) and the International Institute of Noise Control Engineering (I-INCE). An explanation of this classification system appeared in *Noise/News International*, **2**, 12-24, March 1994.

### **GENERAL**

#### **01 International INCE**

- 01.1 INCE/USA (US)
- 01.2 Acoustical Society of Denmark (DK)
- 01.3 Acoustical Society of Norway (NO)
- 01.4 Acoustical Society of Japan (JP)
- 01.5 Schweizerische Gesellschaft fuer Akustik (CH)
- 01.6 Acoustical Society of America (US)
- 01.7 Normenausschuss Akustik, Laermminderung & Schwingungstechnik (DE)
- 01.8 South African Acoustics Institute (ZA)
- 01.9 Australian Acoustical Society (AU)

#### **02 International INCE (continued)**

- 02.1 The Institute of Noise Control Engineering of Japan (JP)
- 02.2 Nederlands Akoestisch Genootshap (NL)
- 02.3 Committee on Acoustics of the Polish Academy of Sciences (PL)
- 02.4 Canadian Acoustical Association (CA)
- 02.5 Acoustical Commission of the Hungarian Academy of Sciences (HU)
- 02.6 Association Belge des Acousticiens (BE)
- 02.7 Acoustical Commission of the Romanian Academy of Sciences (RO)
- 02.8 Acoustical Society of Sweden (SE)
- 02.9 Institute of Acoustics, United Kingdom (GB)

#### **03 International INCE (continued)**

- 03.1 Acoustical Society of China (CN)
- 03.2 Acoustical Society of Finland (FI)
- 03.3 Acoustical Society of Korea (KR)
- 03.4 Associazione Italiana di Acustica (IT)
- 03.5 Osterreichischer Arbeitsring fuer Laermbekaempfung (AT)
- 03.6 Noise Section, Environmental Engineering Society Singapore (SG)
- 03.7 Groupe Acoustique Industrielle et Environnement (FR)
- 03.8 Sociedade Brasileira de Acustica (BR)
- 03.9 New Zealand Acoustical Society (NZ)

#### **04 International INCE (continued)**

- 04.1 Hungarian Society for Optics, Acoustics and Filmtechnics (HU)
- 04.2 East European Acoustical Association
- 04.3 Deutsche Gesellschaft fuer Akustik (DE)
- 04.4 Lithuanian Acoustical Society

#### **05 Publications (other than technical articles)**

- 05.1 Books
- 05.2 Book reviews

- 05.3 Editorials
- 05.4 Announcements and calendars
- 05.5 Biographical and personal notes
- 05.6 Bibliographies
- 05.7 Patents
- 05.8 Errata and addenda

## **06 History and philosophy**

## **07 Education**

## **08 Noise programs**

- 08.1 National governments
- 08.2 State governments
- 08.3 Local governments
- 08.4 Universities
- 08.5 Industries
- 08.6 Trade associations

## **09 Definitions and descriptors**

# **EMISSION: NOISE SOURCES (Noise generation and control)**

## **10 General**

## **11 Noise-generating devices (including components and subassemblies)**

- 11.1 Mechanical devices (noise generated mechanically)
  - 11.1.1 Bearings*
  - 11.1.2 Cams*
  - 11.1.3 Gears*
  - 11.1.4 Belts and belt pulleys*
  - 11.1.5 Drive trains*
  - 11.1.6 Stepping mechanisms*
  - 11.1.7 Clutches*
  - 11.1.8 Actuators*
  - 11.1.9 Chains*
- 11.2 Electrical elements (noise generated electrically)
  - 11.2.1 Resistors, capacitors, inductors, diodes*
  - 11.2.2 Transformers*
  - 11.2.3 Ballasts*
  - 11.2.4 Solenoids*
  - 11.2.5 Switches*
  - 11.2.6 Circuit breakers*
- 11.3 Hydraulic/pneumatic elements
  - 11.3.1 Valves*
  - 11.3.2 Orifices and nozzles*
  - 11.3.3 Piping*
- 11.4 Air-moving and distribution devices
  - 11.4.1 Axial fans*
  - 11.4.2 Centrifugal blowers*

- 11.4.3 Mixed-flow devices*
  - 11.4.4 Diffusers and grilles*
  - 11.4.5 Dampers*
- 11.5 Electric power devices
  - 11.5.1 Electric motors*
  - 11.5.2 Electric generators*
  - 11.5.3 Power supplies*
- 11.6 Other power devices
  - 11.6.1 Air motors*
  - 11.6.2 Compressors (air, gas, vapor)*
  - 11.6.3 Pumps (oil, water, other liquids)*
  - 11.6.4 Engines*
  - 11.6.5 Gas and steam turbines*
  - 11.6.6 Power transmissions*
- 11.7 Rolling contact noise sources
  - 11.7.1 Tires and road-tire interactions*
  - 11.7.2 Metal wheels and wheel-rail interactions*
  - 11.7.3 Rollers*
- 11.8 Stick-slip motional noise sources
  - 11.8.1 Brake squeal*
  - 11.8.2 Clutch squeal*
  - 11.8.9 Other friction squeal sources*
- 11.9 Signaling devices
  - 11.9.1 Bells*
  - 11.9.2 Horns*
  - 11.9.3 Whistles*
  - 11.9.4 Sirens*
  - 11.9.5 Fog horns*
  - 11.9.6 Impulsive devices*
  - 11.9.9 Other warning devices*

## **12 Stationary noise sources**

- 12.1 Large equipment (indoor and outdoor; major source dimension greater than 1 meter)
  - 12.1.1 Electric power transformers*
  - 12.1.2 Cooling towers and heat exchangers*
  - 12.1.3 Chillers*
  - 12.1.4 Motors and generators*
  - 12.1.5 Primary power sources (diesel engines, gas turbines)*
  - 12.1.6 Furnaces, burners, boilers and incinerators*
  - 12.1.7 Stacks and flares*
  - 12.1.8 Large rotating electrical equipment*
- 12.2 Construction and demolition equipment (stationary)
  - 12.2.1 Pneumatic and hydraulic tools*
  - 12.2.2 Air compressors*
  - 12.2.3 Pile drivers*
  - 12.2.4 Concrete mixers*

- 12.2.5 *Space heaters*
- 12.2.6 *Wood chippers*
- 12.3 Computers and business equipment
  - 12.3.1 *Subassemblies*
  - 12.3.2 *Typewriters and word processing equipment*
  - 12.3.3 *Office and business equipment*
  - 12.3.4 *Computer equipment*
  - 12.3.5 *Commercial heating and ventilating equipment*
- 12.4 Home appliances and small equipment
  - 12.4.1 *Radio, television and high fidelity*
  - 12.4.2 *Room air conditioners, humidifiers and dehumidifiers*
  - 12.4.3 *Home heating and ventilating equipment*
  - 12.4.4 *Vacuum cleaners and powered cleaning equipment*
  - 12.4.5 *Small appliances and housewares*
  - 12.4.6 *Major appliances*
  - 12.4.7 *Personal equipment - electrically powered*
  - 12.4.8 *Plumbing equipment and fixtures*
  - 12.4.9 *Cameras and projectors*
- 12.5 Power tools
  - 12.5.1 *Portable power tools (gasoline, electric or air power)*
  - 12.5.2 *Stationary power tools*
- 12.6 Vibratory equipment
  - 12.6.1 *Feeders*
  - 12.6.2 *Shakers and shake-outs*
  - 12.6.3 *Conveyors*
  - 12.6.4 *Hopper vibrators*
  - 12.6.5 *Concrete vibrators*
- 12.7 Truck-mounted equipment
  - 12.7.1 *Solid waste compactors*
  - 12.7.2 *Refrigeration units*
  - 12.7.3 *Air compressors*
- 12.8 Equipment for transporting materials
- 12.9 Equipment for recreational areas and sports
  - 12.9.1 *Amusement park equipment*
  - 12.9.2 *Ski area equipment*
  - 12.9.3 *Equipment for sound amplification*
  - 12.9.4 *Auxiliary power units for RV's and motor homes*
  - 12.9.5 *Swimming pool filter pumps*

## **13 Moving noise sources**

- 13.1 Aircraft
  - 13.1.1 *Subsonic aircraft (fixed wing)*
  - 13.1.2 *Supersonic aircraft*
  - 13.1.3 *CTOL, VTOL, and STOL aircraft*
  - 13.1.4 *Helicopters*
  - 13.1.5 *Sources of external aircraft noise*
  - 13.1.6 *Aircraft interior noise*

- 13.2 Highway vehicles
  - 13.2.1 Automobiles*
  - 13.2.2 Motorcycles*
  - 13.2.3 Buses*
  - 13.2.4 Trucks*
  - 13.2.5 Recreational vehicles*
  - 13.2.6 Snow plows and snow removal equipment*
- 13.3 Off-road vehicles
  - 13.3.1 Snowmobiles*
  - 13.3.2 All terrain vehicles*
  - 13.3.3 Motorcycles*
  - 13.3.4 Snow cats*
  - 13.3.5 Modified automobiles*
  - 13.3.6 Racing vehicles*
- 13.4 Railbound vehicles
  - 13.4.1 Railway trains (locomotives, coaches, freight cars)*
  - 13.4.2 Underground and elevated trains*
  - 13.4.3 Street rail vehicles (streetcars, trams, etc.)*
  - 13.4.4 Monorails*
- 13.5 Ships and marine vehicles
  - 13.5.1 Craft for inland waterways, including pleasure boats*
  - 13.5.2 Transoceanic vessels*
  - 13.5.3 Recreational water craft*
  - 13.5.4 Hovercraft, hydrofoils, and surface effect vehicles*
- 13.6 Small engine-powered equipment
  - 13.6.1 Lawn mowers*
  - 13.6.2 Agricultural and garden care equipment*
  - 13.6.3 Snow blowers*
  - 13.6.4 Leaf blowers*
  - 13.6.5 Shredders/grinders*
  - 13.6.6 Log splitters*
  - 13.6.7 Electric-powered equipment*
- 13.7 Large engine-powered mobile equipment (non-highway)
  - 13.7.1 Construction and earth-moving equipment*
  - 13.7.2 Materials handling equipment*
- 13.8 Sources inside moving vehicles, including ships and aircraft
- 13.9 Spacecraft

## **14 Specialized industrial machinery and equipment**

- 14.1 Machinery used in manufacturing industries
  - 14.1.1 Tobacco processing (SIC 21)*
  - 14.1.2 Textile mills (SIC 22)*
  - 14.1.3 Apparel and related products (SIC 23)*
  - 14.1.4 Lumber and wood products (SIC 24)*
  - 14.1.5 Furniture and fixtures (SIC 25)*
  - 14.1.6 Paper and allied products (SIC 26)*
  - 14.1.7 Printing and publishing (SIC 27)*

- 14.1.8 Chemicals and allied products (SIC 28)*
  - 14.1.9 Petroleum and coal products (SIC 29)*
- 14.2 Machinery used in manufacturing industries (continued)
  - 14.2.1 Leather and leather products (SIC 31)*
  - 14.2.2 Stone, clay and glass products (SIC 32)*
  - 14.2.3 Primary metals (SIC 33)*
  - 14.2.4 Fabricated metal products (SIC 34)*
  - 14.2.5 Machinery - except electric (SIC 35)*
  - 14.2.6 Electrical machinery (SIC 36)*
  - 14.2.7 Transportation equipment (SIC 37)*
  - 14.2.8 Food products (SIC 20)*
  - 14.2.9 Rubber and plastic products (SIC 30)*
- 14.3 Mining and quarrying equipment
  - 14.3.1 Surface operations*
  - 14.3.2 Underground operations*
- 14.4 Farming machinery
  - 14.4.1 Threshing machines*
  - 14.4.2 Harvesting equipment*
  - 14.4.3 Milking equipment*
  - 14.4.4 Conveyors, pneumatic transporters*
  - 14.4.5 Dryers (hay, corn etc)*
  - 14.4.6 Heaters*
  - 14.4.7 Farm tractors*
- 14.5 Power generation and transmission (SIC 49)
  - 14.5.1 Electrical transmission lines and equipment*
  - 14.5.2 Natural gas transmission equipment*
  - 14.5.3 Power station equipment*
  - 14.5.4 Wind turbines and wind farms*
- 14.6 Automated assembly and manufacturing equipment
  - 14.6.1 Welding robots*
  - 14.6.2 Painting robots*

## **PHYSICAL PHENOMENA**

### **21 Physical mechanisms of noise generation**

- 21.1 Theoretical sound sources
  - 21.1.1 Monopoles*
  - 21.1.2 Dipoles*
  - 21.1.3 Quadrupoles*
  - 21.1.4 Other multipoles*
- 21.2 Noise produced by solid bodies
  - 21.2.1 Vibrating bodies*
  - 21.2.2 Contacting bodies - impulsive sounds*
  - 21.2.3 Sliding bodies*
- 21.3 Rapid changes in temperature and/or pressure
  - 21.3.1 Explosions*
  - 21.3.2 Combustion*

- 21.3.3 *Cavitation*
- 21.3.4 *Blast waves*
- 21.3.5 *Transient or impulsive noise*
- 21.3.6 *Noise from weapons*
- 21.4 Resonance, standing waves and normal modes (also 25.1)
  - 21.4.1 *Vibrating air columns (one-dimensional)*
- 21.5 Interaction of a moving solid with a fluid
  - 21.5.1 *Movement of solid body through fluid*
- 21.6 Flow noise, aerodynamic sound
  - 21.6.1 *Produced by jets*
  - 21.6.2 *Blade slap and blade-vortex interactions*
  - 21.6.3 *Blade vortex interactions*
  - 21.6.4 *Produced by turbulence; ingestion and boundary layers*
  - 21.6.5 *Produced by fluid-boundary interactions*
  - 21.6.6 *Flow-induced noise generation in ducts and pipes*
  - 21.6.7 *Supersonic flow, shock waves, sonic booms*
  - 21.6.8 *Nonlinear effects*
  - 21.6.9 *Cavities*
- 21.7 Vibration excitation by mechanical and electrical sources
- 21.8 Non-audible sounds
  - 21.8.1 *Infrasonic sound*
  - 21.8.2 *Ultrasonic sound*

## **22 Natural sources of noise**

- 22.1 Rain storms, including thunderstorms
- 22.2 Waterfalls and streams
- 22.3 Wind
- 22.4 Waves
- 22.5 Surf
- 22.6 Animate sources
  - 22.6.1 *Birds*
  - 22.6.2 *Insects*
  - 22.6.3 *Barking dogs*
- 22.7 Other

## **23 Propagation, transmission & scattering of sound (general wave equation)**

- 23.1 Radiating surfaces
- 23.2 Reflection and echoes
- 23.3 Refraction and focusing
- 23.4 Diffraction
- 23.5 Interference
- 23.6 Scattering
- 23.7 Reverberation
- 23.8 Directivity
- 23.9 Transmission

## **24 Sound propagation in the atmosphere**

- 24.1 Divergence decrease

- 24.2 Absorption (attenuation) of sound in air
- 24.3 Effects of fog and precipitation
- 24.4 Reflection by and diffraction around obstacles
- 24.5 Topographical factors; effects of grass, shrubs and trees
- 24.6 Meteorological factors; effects of wind, temperature and humidity
- 24.7 Scattering by small-scale temperature and wind variations
- 24.8 Reflection and absorption at small angles over a ground surface
- 24.9 Effects of ground impedance and height above ground level

## **25 Sound propagation in enclosed spaces**

- 25.1 Standing waves and normal modes
- 25.2 Steady-state response
- 25.3 Diffusivity
- 25.4 Reverberation and echoes
- 25.5 Decrease with distance from the source

## **26 Sound propagation in ducts or pipes**

- 26.1 General theory of propagation in ducts or pipes
  - 26.1.1 *Without fluid flow*
  - 26.1.2 *With fluid flow*
  - 26.1.3 *With hard, non-absorbing surfaces*
  - 26.1.4 *With absorptive surfaces*
- 26.2 Radiation from duct terminations

# **NOISE CONTROL ELEMENTS (for path noise control)**

## **30 General**

## **31 Barriers and screens, shielding**

- 31.1 Outdoors
- 31.2 Partial-height partitions indoors
  - 31.2.1 *Barriers in industrial halls*
  - 31.2.2 *Barriers in open-plan offices*

## **32 Enclosures for noise sources**

- 32.1 Sound absorptive materials in enclosures
- 32.2 Wall construction
- 32.3 Isolation of plumbing and other wall penetrations
- 32.4 Ventilation openings
- 32.5 Doors and access openings
- 32.6 Windows

## **33 Sound isolating elements (including panels, partitions and curtains)**

## **34 Filters, mufflers, silencers and resonators (conventional types)**

- 34.1 Dissipative type
- 34.2 Reactive type
- 34.3 Helmholtz resonators

## **35 Absorptive materials**

- 35.1 Mechanisms of absorption - theory
- 35.2 Physical properties

- 35.2.1 *Bulk sound absorption coefficient*
- 35.2.2 *Acoustic impedance*
- 35.2.3 *Flow resistance; effect of airflow rate*
- 35.2.4 *Density*
- 35.2.5 *Porosity*
- 35.2.6 *Elasticity of structures*
- 35.2.7 *Propagation constants*
- 35.2.8 *Structure factor*
- 35.2.9 *Non-acoustical properties*
- 35.3 Commercial acoustical materials
- 35.4 Common materials
  - 35.4.1 *General building materials*
  - 35.4.2 *Furnishings and chairs*
  - 35.4.3 *Audience and individual persons*
  - 35.4.4 *Floor coverings*
  - 35.4.5 *Sprayed mineral fibers*
- 35.5 Materials for special applications
  - 35.5.1 *Exposed to high temperatures (flame retardant)*
  - 35.5.2 *Exposed to high gas velocities*
  - 35.5.3 *Exposed to severe weather conditions*
  - 35.5.4 *Surface treatments for anechoic chambers*
  - 35.5.5 *Roadway materials*
- 35.6 Perforated facings for absorptive materials
- 35.7 Resonant absorbers
- 35.8 Wrappings and lagging materials

## **36 Hearing protective devices**

- 36.1 Earmuffs
- 36.2 Ear plugs
- 36.3 Helmets
- 36.4 Active noise reduction in protective devices

## **37 Noise attenuation and transmission in ducts**

- 37.1 Lined ducts
- 37.2 Unlined ducts
- 37.3 Plenums
- 37.4 Area changes, bends and elbows
- 37.5 Transmission through duct walls
- 37.6 Duct attenuators
- 37.7 Active noise control in ducts

## **38 Special treatments**

- 38.1 Noise control by masking
- 38.2 Active noise control (three dimensions)
- 38.3 Active vibration control for noise reduction
- 38.4 Noise control by operational changes
  - 38.4.1 *Traffic control*
  - 38.4.2 *Routing and scheduling control*
- 38.5 Change of configuration or design for noise control purposes

- 38.5.1 *Smart structures*
- 38.5.2 *Material tailoring*
- 38.6 Seals for openings
  - 38.6.1 *Absorptive seals (absorptive linings around openings)*
  - 38.6.2 *Sealing cements, plastic & rubber mastics, foams, etc.*
  - 38.6.3 *Sealing tapes and caulking materials*
  - 38.6.4 *Foam and rubber ribbons and profiles*

## **VIBRATION AND SHOCK: GENERATION, TRANSMISSION, ISOLATION AND REDUCTION**

### **40 General**

### **41 Characteristics of sources of vibration and shock**

- 41.1 Periodic vibration, sinusoidal
- 41.2 Stationary random vibration
- 41.3 Transients and shocks, impacts
- 41.4 Non-stationary random vibration
- 41.5 Nonlinear vibrations

### **42 Vibrating surfaces and structures (beams, plates, shells)**

### **43 Propagation in structures (solid-borne noise)**

- 43.1 Decrease due to spreading
- 43.2 Transmission and attenuation in solid structures
  - 43.2.1 *Mechanical constructions (internal damping)*
  - 43.2.2 *Buildings, civil engineering constructions*
  - 43.2.3 *Earth (geoacoustics)*
  - 43.2.4 *Foundations/soil interactions*
- 43.3 Reflections and interference
- 43.4 Vibration breaks
- 43.5 Structural intensity

### **44 Balancing of rotating and reciprocating machines**

### **45 Reduction of impact forces; shock isolation and absorption**

### **46 Vibration isolators and attenuators**

- 46.1 Theories of vibration isolation and isolators
- 46.2 Vibration isolators
- 46.3 Foundation analysis and design
- 46.4 Active vibration control

### **47 Vibration-damping materials and structures**

- 47.1 Mechanisms of damping - theory
- 47.2 Constrained layer damping
- 47.3 Damping of structures and panels
- 47.4 Dynamic absorbers

### **48 Vibration generators, shake tables**

### **49 Effects of vibration and mechanical shock (on man, on structures)**

- 49.1 On man

- 49.2 On structures and machines
  - 49.2.1 *Vibration induced effects*
  - 49.2.2 *Noise induced effects*
  - 49.2.3 *Designs to withstand high noise levels*
- 49.3 Criteria
  - 49.3.1 *Criteria for vibration of human body and organs*
  - 49.3.2 *Criteria for machine vibrations*
  - 49.3.3 *Criteria for shock in transportation of goods*
- 49.4 In buildings

## **IMMISSION: PHYSICAL ASPECTS OF ENVIRONMENTAL NOISE (Multiple sources and multiple paths)**

### **50 General**

### **51 Building noise control**

- 51.1 Sound fields in rooms and enclosed spaces
  - 51.1.1 *Industrial halls and plants*
  - 51.1.2 *Concert or other halls for audiences or performances*
  - 51.1.3 *Special spaces (corridors etc).*
  - 51.1.4 *Classrooms*
  - 51.1.5 *Hospitals*
  - 51.1.6 *Churches*
- 51.2 Reduction of noise levels by increased absorption
- 51.3 Sound transmission thru windows, doors, walls, ceilings, floors
- 51.4 Sound-insulating structures, transmission coefficients and transmission loss
- 51.5 Flanking and impact transmission
- 51.6 Heating, ventilating and air conditioning (HVAC) systems
- 51.7 Landscaped (open plan) offices and lobbies
- 51.8 Elevators and escalators
- 51.9 Plumbing and piping noise

### **52 Community noise control**

- 52.1 Community noise levels
- 52.2 Airport noise
  - 52.2.1 *Commercial airports*
  - 52.2.2 *Military airfields*
  - 52.2.3 *General aviation airports*
  - 52.2.4 *Heliports*
  - 52.2.5 *Police*
  - 52.2.6 *Hospitals*
  - 52.2.7 *Military*
- 52.3 Road traffic noise
- 52.4 Rail vehicle noise
- 52.5 Industrial noise (incl. noise around plants and power stations)
- 52.6 Construction noise

- 52.7 Sport and recreation areas and events
- 52.8 Residential area noise due to lawn mowers, air conditioners, etc
- 52.9 Planning for noise control, zoning, land use and urban planning

- 52.9.1 *Ambient sound levels*

### **53 In-plant noise control**

- 53.1 In-plant noise levels
- 53.2 Exposures of workers
- 53.3 Planning, design and construction for noise control
- 53.4 Booths and control rooms

### **54 Shipboard and offshore platform noise control**

- 54.1 Noise control in ship spaces
- 54.2 Noise control on offshore platforms
- 54.3 Underwater noise

### **55 Outdoor plant noise control design and construction**

### **56 Noise surveys**

- 56.1 Outdoors
- 56.2 Indoors
- 56.3 Soundscapes

## **IMMISSION: EFFECTS OF NOISE**

### **60 General**

### **61 Perception of sound**

- 61.1 Biomechanics of the ear
- 61.2 Theories of hearing
- 61.3 Hearing levels and hearing thresholds of populations
- 61.4 Presbycusis and sociocusis
- 61.5 Critical bandwidths, masking
- 61.6 Just noticeable differences
- 61.7 Head-related transfer function

### **62 Physiological effects**

- 62.1 Hearing loss (temporary and permanent threshold shifts)
- 62.2 Extra-auditory effects (fatigue, blood pressure, heart rate)
- 62.3 Hearing conservation programs
- 62.4 Workers compensation; liability for hearing loss
- 62.5 Effects of noise on health

### **63 Psychological effects**

- 63.1 Loudness
- 63.2 Perceived noisiness, annoyance
- 63.3 Speech intelligibility and interference, speech levels, speech communication
- 63.4 Sleep disturbance
- 63.5 Work interference and efficiency
- 63.6 Infrasonic noise
- 63.7 Sound quality

### **64 Effects of noise on physical structures**

- 64.1 On natural environment, parklands
- 64.2 On structures and in material, sonic fatigue
- 64.3 Sonic boom damage

## **65 Effects of noise on domesticated and wild animals**

- 65.1 Domestic animals
- 65.2 Wildlife

## **66 Sociological effects: community reaction to noise**

- 66.1 Community disturbance, interference with activities
- 66.2 Assessment of impact of community noise

## **67 Economic effects**

- 67.1 Economic aspects of noise reduction
- 67.2 Cost-benefit analyses
- 67.3 Manufacturers', operators' and users' costs
- 67.4 Social costs of noise

## **68 Environmental impact statements**

- 68.1 Background or ambient noise (baseline)
- 68.2 Environmental noise sources
- 68.3 Population exposure; impact criteria and assessment techniques
- 68.4 Highway projects
- 68.5 Airport projects
- 68.6 Public facilities under construction
- 68.7 Noise control planning; siting issues and zoning

## **69 Criteria and rating of noise**

- 69.1 For acceptable levels of noise in rooms
- 69.2 For speech interference
- 69.3 For annoyance
- 69.4 For sonic-fatigue resistance
- 69.5 For land-use planning with respect to noise

# **ANALYSIS**

## **70 General**

## **71 Instruments for noise and vibration measurements**

- 71.1 Transducers
  - 71.1.1 *Microphones, wind screens*
  - 71.1.2 *Vibration pick-ups*
  - 71.1.3 *Intensity probes*
  - 71.1.4 *Transducers for sound generation and reproduction*
  - 71.1.9 *Other sensors*
- 71.2 Amplifiers, including preamplifiers
  - 71.2.1 *Amplifiers for measurement systems*
- 71.3 Sound level meters
  - 71.3.1 Conventional
  - 71.3.2 Integrating-averaging
  - 71.3.3 Computer-based
- 71.4 Sound exposure meters

- 71.5 Waveform or frequency analyzers
- 71.6 Filters, analog and digital
- 71.7 Indicating devices
- 71.8 Data acquisition systems, recorders and data storage devices
- 71.9 Calibration; acoustical and electrical performance verification

## **72 Measurement techniques**

- 72.1 Sound pressure level
- 72.2 Vibration level
  - 72.2.1 *Surface contact methods*
  - 72.2.2 *Non-contact methods (laser interferometry, holography)*
  - 72.2.3 *Power flow*
- 72.3 Sound intensity
- 72.4 Sound power
- 72.5 Transmission loss
- 72.6 Reverberation time
- 72.7 Measurement of properties of materials
  - 72.7.1 *Sound absorption*
  - 72.7.2 *Acoustic impedance*
  - 72.7.3 *Flow resistance; effect of airflow rate*
  - 72.7.4 *Density*
  - 72.7.5 *Porosity*
  - 72.7.6 *Elasticity of structures*
  - 72.7.7 *Propagation constants*
  - 72.7.8 *Structure factor*
  - 72.7.9 *Non-acoustical properties*
- 72.8 Impulsive noise measurements
- 72.9 Measurements of other quantities

## **73 Test facilities (design and qualification)**

- 73.1 Free-field (anechoic rooms)
- 73.2 Free-field over a reflecting plane (hemi-anechoic rooms)
- 73.3 Reverberation rooms (diffuse field)
- 73.4 Outdoor test sites
- 73.5 Laboratory facilities (design and construction)
- 73.6 Other test environments (indoor and outdoors)
- 73.7 Scale models

## **74 Signal processing**

- 74.1 Correlation and coherence analysis
- 74.2 Bursts and impulsive sounds
- 74.3 Digital processing and simulation
- 74.4 Automated data processing and reduction
- 74.5 Diagnosis and failure prediction
- 74.6 Source localization and transmission paths
- 74.7 Processing by microphone arrays
- 74.8 Frequency domain and spectral analysis
- 74.9 Other signal processing techniques

## **75 Methods of mathematical modeling**

- 75.1 Statistical methods
- 75.2 Statistical energy analysis (SEA)
- 75.3 Finite element methods (FEM) and computation fluid models (CFM)
- 75.4 Computer algorithms including computer aided design
- 75.5 Boundary element methods (BEM)
- 75.6 Modal analysis
- 75.7 Imaging of acoustical and vibrational fields (holography, etc.)
- 75.8 Wave vector analysis
- 75.9 Analytical models

## **76 Modeling, prediction and simulation**

- 76.1 Propagation models, noise models
  - 76.1.1 *Road traffic noise*
  - 76.1.2 *Rail traffic noise*
  - 76.1.3 *Noise in communities around airports*
  - 76.1.4 *External industrial noise*
  - 76.1.5 *Factory halls, sound level contours indoors*
  - 76.1.6 *Concert halls*
  - 76.1.7 *Sources of noise generation and emission*
- 76.2 Small scale modeling
- 76.3 Building foundation modeling
- 76.4 Computer software programs
- 76.9 Other modeling, prediction and simulation methods

## **77 Sampling, quality control procedures and measurement uncertainty**

## **78 Audiometry, dosimetry and hearing measurements**

- 78.1 Audiometry
- 78.2 Dosimeters
- 78.3 Hearing measurements
- 78.4 Hearing aids

## **79 Psychoacoustical evaluations and testing**

- 79.1 Speech quality
- 79.2 Preference testing
- 79.2 Small scale modeling
- 79.3 Building foundation modeling
- 79.4 Computer software programs
- 79.9 Other modeling, prediction and simulation methods

# **REQUIREMENTS**

## **80 General**

## **81 Standards**

- 81.1 National standards
- 81.2 International standards
  - 81.2.1 *International Organization for Standardization (ISO)*
  - 81.2.2 *International Electrotechnical Commission (IEC)*
  - 81.2.9 *Other international standards*

81.9 Other standards documents

**82 National government legislation and regulations**

**83 State and local legislation and regulations**

**84 Other legislation and requirements**

84.1 European Community requirements

**85 Ordinances, including zoning requirements**

**86 Building codes**

**87 Specifications**

**88 Auditing, enforcement and certification**

**89 Noise policies and requirements**