ACOUSTICS AND VIBRATIONS Method (AV)

INDUSTRIAL SECTOR

Contents	Level 1	Duration (hours)
1.1. Quality systems and certification	1.1.1 Italian quality system 1.1.2 Reference technical standards 1.1.3 Personnel certification: requirements and obligations to obtain and maintain certification	1
1.2. Measurement theory	1.2.1. International system 1.2.2. Uncertainty (brief information) 1.2.3. Measuring chain	1
1.3. Physical theory (acoustics and vibrations)	1.3.1. Frequency, period, wavelength, phase 1.3.2. Decibel, Loudness and level 1.3.3. Frequency analysis and Fast Fourier Transform 1.3.4. Sound sources and sound propagation 1.3.5. Free vibrations and damped vibrations (shift, speed, acceleration) 1.3.6. Frequency Response Function (FRF) representation methods and properties 1.3.7. Transmissibility	6
1.4. Noise and vibration measurements in the industrial environment	1.4.1. Measurement of emissions 1.4.2. Measurements of workers' exposure 1.4.3. Standards and procedures for assessing exposure to noise 1.4.4. Legal obligations	8

Contents	Level 2	Duration (hours)
2.1. Noise and vibrations in the industrial environment	2.1.1. Determination of personal exposure 2.1.2 Measurement of vibrations to the hand-arm system and to the entire body 2.1.3. Mapping 2.1.4. Drafting of an assessment report 2.1.5. Legal obligations 2.1.6. Measures for exposure reductions 2.1.7. Instrument calibration	6
2.2 Noise and vibration measurements in the industrial environment	2.2.1 Sound power measurements (microphone method) 2.2.2 Sound power measurements (intensimetry method) 2.2.3 Measurement of machine vibrations on non-rotating parts	8
2.3 Basics of mechanical component diagnostics	2.3.1. Rotating machines: defects in the low frequency range 2.3.2. Defects in gear reducers 2.3.3. Defects in turbomachinery, alternating machines and belt drives 2.3.4. Defects in bearings 2.3.5. Signal analysis for bearing diagnostics	6

	2.3.6. Order analysis 2.3.7. Order analysis – Resampling	
2.4. Basics of remediation operations	2.4.1. Insulation techniques 2.4.2. Balancing 2.4.3. Isolating elements (Springs, viscous dampers, air springs, other types of isolators, bases and foundations, gloves and other anti-vibration PPE) 2.4.4. Sound insulation	4

Contents	Level 3	Duration (hours)
3.1 Quality systems and certification	3.1.1. Italian quality system 3.1.2. Reference technical standards 3.1.3. Personnel certification 3.1.4. Requirements and obligations to obtain and maintain certification 3.1.5. Accreditation of laboratories 3.1.6. Conduction and grading of qualification examinations	4
3.2 Measurement theory	3.2.1. Precision and accuracy 3.2.2. Uncertainty and uncertainty propagation 3.2.3. Hints on statistics and probability theory	4
3.3 Mechanical component diagnostics	3.3.1. Rotating machines: defects in the low frequency range 3.3.2. Defects in gear reducers 3.3.3. Defects in turbomachinery, alternating machines and belt drives 3.3.4. Defects in bearings 3.3.5. Signal analysis for bearing diagnostics 3.3.6. Order analysis 3.3.7. Order analysis - Resampling	8
3.4. Remediation design	3.4.1. Insulation techniques 3.4.2. Balancing 3.4.3. Isolating elements (Springs, viscous dampers, air springs, other types of isolators, bases and foundations, gloves and other anti-vibration PPE) 3.4.4. Sound insulation 3.4.5. Active Noise Cancellation	8
3.5 Communications and techniques in classroom	3.5.1. Verbal and non-verbal communication 3.5.2. Basics of neurolinguistic programming 3.5.3. Effective methods of presentation 3.5.4. Lessons 3.5.5. Preparation of teaching materials 3.5.6. Structures of training programs 3.5.7. Learning verification methods	4
3.6 Management of disputes	3.6.1 Reference laws 3.6.2 Writing of a report 3.6.3 The justice consultant's activity	4

CIVIL SECTOR – THE BUILDING SUBSECTOR

Acoustics and vibrations in the building sector

Contents	Level 1	Duration (hours)
1.1. Quality systems and certification	1.1.1 Italian quality system 1.1.2 Reference technical standards 1.1.3 Personnel certification: requirements and obligations to obtain and maintain certification	1
1.2. Measurement theory	1.2.1. International system 1.2.2. Uncertainty (brief information) 1.2.3. Measuring chain	1
1.3. Physical theory (acoustics and vibrations)	1.3.1. Frequency, period, wavelength, phase 1.3.2. Decibel, Loudness and level 1.3.3. Frequency analysis and Fast Fourier Transform 1.3.4. Sound sources and sound propagation 1.3.5. Free vibrations and damped vibrations (shift, speed, acceleration) 1.3.6. Frequency Response Function (FRF) representation methods and properties 1.3.7. Transmissibility	6
1.4. Noise and vibration measurements in the industrial environment	1.4.1. Measurement of emissions 1.4.2. Measurements of workers' exposure 1.4.3. Standards and procedures for assessing exposure to noise 1.4.4. Legal obligations	8

Contents	Level 2	Duration (hours)
2.1. Noise and vibrations in buildings	2.1.1. Calculation 2.1.2. Measurement 2.1.3. Drafting of an assessment report 2.1.4. Legal obligations 2.1.5. Measures to improve acoustic performances 2.1.7. The instruments 2.1.8 Measurement of vibrations affecting buildings 2.1.9 Disturbance evaluation criteria	12
2.2. Remediation design	2.2.1. Partition walls 2.2.2. Sealing windows and doors 2.2.3. Absorption panels 2.2.4. Noise and vibration reduction in the technological systems of buildings 2.2.5. Reduction of impact noise and of structural transmission of noise inside buildings 2.2.6. Active Noise Cancellation	12

Contents	Level 3	Duration (hours)
3.1 Quality system and certification	3.3.1. Italian quality system 3.3.2. Reference technical standards 3.3.3. Personnel certification 3.3.4. Requirements and obligations to obtain and maintain certification 3.3.5. Accreditation of laboratories 3.3.6. Conduction and grading of qualification examinations	4
3.2 Measurement theory	3.2.1. Precision and accuracy 3.2.2. Uncertainty and uncertainty propagation 3.2.3. Hints on statistics and probability theory	4
3.3 Acoustic design of buildings	3.3.1 Design of passive acoustic requirements 3.3.2 Design of acoustic requirements of sources in buildings 3.3.3 Measurements in building acoustics 3.3.4 Intervention and remediation techniques 3.3.6 Acoustic design of plants in buildings 3.3.7 Methods for improving acoustic comfort	16
3.4 Communication and teaching techniques in classroom	3.4.1. Verbal and non-verbal communication 3.4.2. Basics of neurolinguistic programming 3.4.3. Effective methods of presentation 3.4.4. Lessons 3.4.5. Preparation of teaching materials 3.4.6. Structures of training programs 3.4.7. Learning verification methods	4
3.5 Management of disputes	3.5.1 Reference laws 3.5.2 Writing of a report 3.5.3 The justice consultant's activity	4

CIVIL SECTOR – THE ELECTROACOUSTICS AND ELECTRONIC ACOUSTICS SUBSECTOR

Acoustics in rooms and indoor environments

Contents	Level 1	Duration (hours)
1.1. Quality systems and certification	1.1.1 Italian quality system 1.1.2 Reference technical standards 1.1.3 Personnel certification: requirements and obligations to obtain and maintain certification	1
1.2. Measurement theory	1.2.1. International system 1.2.2. Uncertainty (brief information) 1.2.3. Measuring chain	1
1.3. Basics of electroacoustics	1.3.1 The decibel 1.3.2 Loudness and level 1.3.3 Frequency analysis and Fast Fourier Transform 1.3.4 Wavelength 1.3.5 Sound propagation	6

	1.3.6 Human perception of sound	
1.4. Measurements in indoor environments	1.4.1 Measurements of acoustics performances of rooms 1.4.2 Calculation methods 1.4.3 Measurements standards and procedures 1.4.4 Basics of acoustic design in indoor environments 1.4.5 Basics of sound system design	8

Contents	Level 2	Duration (hours)
2.1. Acoustics of indoor environments	2.1.1 Sound absorption 2.1.2 Reverberation and reverberant field 2.1.3 Reverberation and acoustics of a room 2.1.4 Reverberation time 2.1.5 Echo, near-echo, Haas effect, standing waves 2.1.6 Subjective and objective parameters	4
2.2 Analyses and measurements in indoor environments	2.2.1 Standing waves, resonance modes, reverberation 2.2.2 Impulse response 2.2.3 Calculation of the acoustics parameters of the environment according to the reference standard 2.2.4 Evaluation of the intelligibility of speech according to the reference standard 2.2.5 Qualification of environments	4
2.3 Acoustic design of indoor environments	2.3.1 Calculation methods and design 2.3.2 Drafting of an assessment report 2.3.3 Legal obligations 2.3.4 Measures to improve acoustic performances	8
2.4 Design of sound systems	2.4.1 Electroacoustic devices (loudspeakers, microphones) 2.4.2 Electronic signal processing instruments (DSP, equalizers etc) 2.4.3 Guidelines concerning design and reference standards 2.4.4 Types of systems and relevant performances 2.4.5 Hints on active techniques for the enhancement of the listening environment (Equalization, Sound Reinforcement, Active Noise Cancellation, etc)	8

Contents	Level 3	Duration (hours)
3.1 Quality systems and certification	3.1.1. Italian quality system 3.1.2. Reference technical standards 3.1.3. Personnel certification	4

	3.1.4. Requirements and obligations to obtain and maintain certification 3.1.5. Accreditation of laboratories 3.1.6. Conduction and grading of qualification examinations	
3.2 Measurement theory	3.2.1. Precision and accuracy 3.2.2. Uncertainty and uncertainty propagation 3.2.3. Hints on statistics and probability theory	4
3.3 Acoustic design of buildings	3.3.1 Design of passive acoustic requirements 3.3.2 Design of acoustic requirements of sources in buildings 3.3.3 Measurements in building acoustics 3.3.4 Intervention and remediation techniques 3.3.6 Acoustic design of plants in buildings 3.3.7 Methods for improving acoustic comfort	16
3.4 Communication and teaching techniques in classroom	3.4.1. Verbal and non-verbal communication 3.4.2. Basics of neurolinguistic programming 3.4.3. Effective methods of presentation 3.4.4. Lessons 3.4.5. Preparation of teaching materials 3.4.6. Structures of training programs 3.4.7. Learning verification methods	4
3.5 Management of disputes	3.5.1 Reference laws 3.5.2 Writing of a report 3.5.3 The justice consultant's activity	4

CIVIL SECTOR – THE ENVIRONMENTAL SUBSECTOR

Acoustics and vibrations in the environmental sector

Contents	Level 1	Duration (hours)
1.1. Quality systems and certification	1.1.1 Italian quality system 1.1.2 Reference technical standards 1.1.3 Personnel certification: requirements and obligations to obtain and maintain certification	1
1.2. Measurement theory	1.2.1. International system 1.2.2. Uncertainty (brief information) 1.2.3. Measuring chain	1
1.3. Physical theory (acoustics and vibrations)	1.3.1. Frequency, period, wavelength, phase 1.3.2. Decibel, Loudness and level 1.3.3. Frequency analysis and Fast Fourier Transform 1.3.4. Sound sources and sound propagation 1.3.5. Free vibrations and damped vibrations (shift, speed, acceleration) 1.3.6. Frequency Response Function (FRF) representation methods and properties 1.3.7. Transmissibility	6
1.4. Noise and vibration	1.4.1. Measurement of emissions	16

measurements in the environment	1.4.2. Measurements of immissions 1.4.3 Evaluation of tolerance 1.4.4 Zoning and remediation 1.4.5. Standards and procedures for noise impact assessment 1.4.6 Revision software 1.4.7. Legal obligations	

Contents	Level 2	Duration (hours)
2.1. Noise and vibrations in the external environment	2.1.1. Calculation techniques 2.1.2. Land mapping 2.1.3. Noise impact assessment 2.1.4. Legal obligations 2.1.5. Measures for noise/environmental vibration reduction 2.1.6. Noise and vibrations of transport infrastructures	12
2.2. Design of noise reduction structures	2.2.1. Noise reduction in road infrastructures (barriers, noise-reducing asphalts,…) 2.2.2. Noise reduction in railway infrastructures 2.2.3. Aircraft noise 2.2.4. Techniques for reducing the industrial environmental noise (barriers, silencers, …)	12

Contents	Level 3	Duration (hours)
3.1 Quality systems and certification	3.1.1. Italian quality system 3.1.2. Reference technical standards 3.1.3. Personnel certification 3.1.4. Requirements and obligations to obtain and maintain certification 3.1.5. Accreditation of laboratories 3.1.6. Conduction and grading of qualification examinations	4
3.2 Measurement theory	3.2.1. Precision and accuracy 3.2.2. Uncertainty and uncertainty propagation 3.2.3. Hints on statistics and probability theory	4
3.3 Acoustic design of buildings	3.3.1 Design of passive acoustic requirements 3.3.2 Design of acoustic requirements of sources in buildings 3.3.3 Measurements in building acoustics 3.3.4 Intervention and remediation techniques 3.3.6 Acoustic design of plants in buildings 3.3.7 Methods for improving acoustic comfort	16
3.4 Communication and teaching techniques in classroom	3.4.1. Verbal and non-verbal communication 3.4.2. Basics of neurolinguistic programming 3.4.3. Effective methods of presentation 3.4.4. Lessons 3.4.5. Preparation of teaching materials	4

	3.4.6. Structures of training programs 3.4.7. Learning verification methods	
3.5 Management of disputes	3.5.1 Reference laws 3.5.2 Writing of a report 3.5.3 The justice consultant's activity	4

EXAMINATION ADMITTANCE REQUIREMENTS

To be admitted to the examinations, a candidate must have the minimum training, experience and physical fitness requirements set out in the UNI EN ISO 9712 standard and listed here below:

1. Physical fitness
   The candidate shall provide documented evidence of satisfactory vision in conformity with the following requirements:

   - Near-vision acuity shall permit reading, with one or both eyes, either corrected or uncorrected, a minimum of number 1 of the Jaeger scale, or Times Roman N4.5 or equivalent characters (with 1.6-mm height) at not less than 30 cm.
   - Colour vision shall be sufficient that the candidate can distinguish contrast between the colours or the grey shades used in the NDT method concerned, as specified by the employer.

2. Training
   a) The candidate must possess the requisite knowledge for performing the expected tasks to the extent related to the level for which he/she is certified. This knowledge must be:

      - general basic knowledge of mathematics and physics, behaviour of materials, production technologies and types of defects
      - general and specific knowledge of test method and applicable codes and standards regulating its application

      As a guide to these requirements reference should be made to the recommendations issued by the International Committee for Non Destructive Tests ICNT WH.

   b) The personnel must be subject to a training period, which must be recognized by RINA; training must:
      - be provided under the supervision and responsibility of a person certified to level 3 and have the duration specified in Table 1
      - write a diary with information about attendance to the course, training hours and subjects dealt with

   c) Training hours include both theory and practical courses
   d) In case of direct access to level 2 a minimum number of training hours is required, equal to the sum of the training hours required for level 1 and 2, whereas no direct access is possible for level 3;

e) Each participant shall receive a copy of the above diary signed by the level 3 technician

f) The training duration specified in Table 1 may be reduced by 50% for candidates who have graduated from technical or scientific college or university.
Furthermore this reduction may also be applied to the personnel who are already qualified as Technician Competent in Acoustics, achieved in accordance with the standards issued on a national and regional level and who can provide evidences of their training paths.
In no case can these reductions be combined.

Table 1 – Minimum training requirements in hours – AV method		
Level 1	Level 2	Level 3
16	24	32

3. Experience

Table 2 provides information about the minimum required training for the three levels depending on the education title.

Table 2 – Minimum required experience in years – AV method			
Education	Level 1	Level 2	Level 3
Technical-scientific degree or degree course (3 years)	1 year	Level 1+ 1 year Direct access 2 years	Level 2 + 4 years
Secondary school diploma	1 year	Level 1+ 3 years Direct access 4 years	Level 2 + 4 years
Compulsory school	1 year	Level 1+ 5 years Direct access 6 years	Level 2 + 4 years

4. Examinations

Examinations are held at one of the Examination Centres chosen by the candidate, but approved and supervised by RINA.
Candidates must show a valid identity document.

a) Level 1 and 2 examinations

- General examination – The general examination, about the principles of the method, must only include questions chosen from the collection of questions of the Examination Centre and approved by RINA.
  Candidates must answer 30 questions
- Specific examination - The specific examination, about calculations, procedures and questions on codes, standards and specifications, must only include questions chosen from the collection of questions of the Examination Centre and approved by RINA.
  Candidates must answer 20 questions.
  For Level 2 candidates the examination also involve drafting of an NDT instruction suitable for level 1 for a test selected by the examiner
- Practical examination
  The practical examination shall involve a test on prescribed specimens or methods, recording (and, for level 2, also interpreting) the resulting

information to the degree required, and reporting the results in the required format.
For level 1 candidates, the number of tests or specimens to be examined is 1, whereas for level 2 candidates this number is 2.

To successfully complete the examination test, a candidate must obtain a minimum pass grade equal to 70% in each single part of the examination (general, specific, practical and instructions at level 1, if applicable).

b) Level 3 examination
   - Basic examination – This examination must evaluate the candidate's knowledge of basic subjects with questions randomly chosen from the collection of questions of the Examination Centre and approved by RINA. These questions will be concerned with:
     - technical knowledge of applied physics, material sciences and process technologies; (25 questions)
     - knowledge of RINA's qualification and certification system based on the UNI EN ISO 9712 standard. This may be an open book examination; (10 questions)
     - general knowledge of at least four methods as required for level 2 and chosen by the candidate from the methods specified in paragraph 1 of the UNI EN ISO 9712 standard. These four methods shall include at least one volumetric method (UT or RT) (15 questions for each test method)
   - Main-method examination – This examination must evaluate the candidate's knowledge of the main-method subjects with questions randomly chosen from the collection of questions of the Examination Centre and approved by RINA. These questions will be concerned with:
     - level 3 knowledge relating to the applied test method (30 questions)
     - application of the NDT method in the selected sector, including applicable codes, standards and specific procedures. The candidate may refer to any codes, standards, specifications and procedures (20 questions)
     - drafting of an NDT procedure in the selected sector, with the possibility to refer to any codes, standards and specifications.

   To successfully complete the examination test, a candidate must obtain a minimum pass grade equal to 70% in each single part of the examination.

For any information not contained in this annex, reference should be made to the UNI EN ISO 9712 standard and applicable RINA rules.