Railway acoustics: applications, measurements and evaluation

JESÚS OTERO YUGAT

jotero@cetestgroup.com
Agenda

1. CETEST: your test and evaluation department
2. Introduction
3. Tests: scope and validation of a railway vehicle
4. Interior noise
5. Exterior noise
6. Speech intelligibility
7. Acoustic characterization
8. Summary and conclusions
CETEST: your test and evaluation department

Jesús Otero Yugat
Ph.D. in Mechanical Engineering, Fluids and Aeronautics
Head of Acoustics, Noise and Vibration

CETEST: Anywhere, anytime
Fully accredited test laboratory: ISO 17025, ISO 9001, ISO 14001, EN 9100 and EN 9712
Five continent presence
More than 40 years in the rail sector
Introduction

- Environmental noise has become an increasingly important issue
- Railway noise is often identified as a source of dissatisfaction by residents and passengers
- International standards defines methodologies for acoustic evaluation
- Mandatory acoustic requirements have been defined by the European Union Agency of Railways, international standards and customer requirements
- High quality of measurements with less uncertainties are needed
Tests: scope and validation of a railway vehicle

- Validation in terms of interior and exterior acoustic behaviour
- Evaluation of different situations
- Class 1 instrumentation according to IEC 61672-1:2013
- Quick and easy installation
- Fast processing and accurate results
Interior noise: test procedure

- All type of vehicles:
  - Tramways or light rail vehicles
  - Electrical Multiple Units (EMU)
  - Diesel Multiple Units (DMU)
  - High-speed trains.

  - Measurements on stationary vehicles
  - Tests on vehicles with constant speed
  - Measurements on accelerating trains from standstill
  - Tests on decelerating vehicles

- Warning horn tests according to standard EN 15892:2011 and TSI 1304/2014.
Exterior noise: test procedure

  - Exterior noise in stationary
  - Exterior noise at constant speed
  - Exterior noise in acceleration from standstill
  - Exterior noise during braking

- Measurements according to standard EN 15153-2:2020 and TSI 1302/2014
  - Warning horn tests

- Exterior noise emitted by railway components (that is, power inverters) according to standard ISO 3744:2010

- Equipment and sensors operating in heavy weather conditions
Interior and exterior noise: test setup

- Omnidirectional microphones
- LAN-XI multi-channel input modules
- Sound level meter
- Sound calibrator
- PULSE Time Data Recorder, LabShop and Reflex

Don’t forget the dongle!
Speech intelligibility

Characterization of the PA system
- Evaluation of the broadcast system
- Quality of conversation between adjacent passengers

Test setup
- Echo speech sound source
- Omnidirectional microphones
- LAN-XI modules and sound calibrator
- PULSE Time Data Recorder and DIRAC
Acoustic characterization

Sound power evaluation
- Characterization of railway components (that is, gearboxes or traction equipment)
- Sound intensity level measurements using a sound intensity probe
- Test procedure according to standards ISO 9614-1 and ISO 9614-2

Reverberation time according to ISO 3382-2:2008

Acoustic insulation
- Sound intensity level measurements using a sound intensity probe
- Calculations based on standard ISO 717-1:2013
# Summary and conclusions

## Challenges

| Evaluation of acoustic behaviour in railway vehicles and components. |
| Verification of criteria defined on international standards and customer requirements. |

## Solutions

| Quick and easy installation. |
| Fast calculations and processing. |
| Reliability in heavy weather conditions. |

## Final comments

Several years of successful testing all over the world.
Thank You

Questions?
Do you have a question for the Presenter? Visit the Guest Speakers Virtual booth within the next hour for an interactive Q&A session.