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NOISE FROM PARKED TRAINS - AN UIC STUDY

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ABSTRACT

Once trains have completed their operational service, they are usually "parked" for an extended period in the depot or at the terminus of a line. Some technical components remain in operation, e.g. to protect technical equipment or to heat / cool the driver's cabin and the passenger area. Line side residents may find this annoying, especially in urban areas where densification and increased traffic is a particular problem to be dealt with. UIC, in particular its Noise and Vibration Sector, conducted a study to critically analyze the current state and to foster a common understanding of the issue among stakeholders, including railway operators, infrastructure managers, rolling stock manufacturers and policy makers. The study included a technical survey, literature review, interviews, as well as analysis of regulatory frameworks and collection of measurement data.

Keywords: *railway noise, noise mitigation, standardization*

1. INTRODUCTION

Railway noise is generally associated with running trains which are in commercial service. Typical sound sources are rolling and traction noise. Nevertheless, noise from trains which are parked for a longer period in rail depots or at termini of secondary lines can present considerable noise nuisances for line side residents with possible impacts on their health, e.g. sleep disturbances. Furthermore noise related issues tend to become more relevant due to urbanization and increasing rail traffic. Also, modern rolling stock are equipped with a higher number of technical components ensuring in particular passenger's comfort and safety, meaning that the number of potential sources of noise nuisances increases as well.

After a first study on the noise from parked trains in 2014 [1], the UIC Noise and Vibration Sector launched a new study aiming to critically analyze the current state of noise from parked trains [2]. In this context a survey was carried out among railway operators, infrastructure managers and rolling stock suppliers [3]. Special attention was addressed to the collection of measurement data.

2. WHY PARKED TRAINS EMIT NOISE?

The operating scheme of a parked train can generally be divided in 3 phases, see Figure 1. Once the train is arrived at its parking location, most of the technical components, such as traction motors, compressors, etc. are still running to ensure the train's safe operation. During the preparation for resting phase these components are either switched off or their parking mode is activated, which leads to less activity of the component. Then during the resting phase, the train is mostly operated in an energy-saving mode with a low activity of the technical components and consequently low noise emission. Before entering commercial service again, the train is prepared, which comes with an increased activity of the technical components (preparation for service): motors are started, HVAC systems are operated to pre-heat or pre-cool the passenger and driver compartment.

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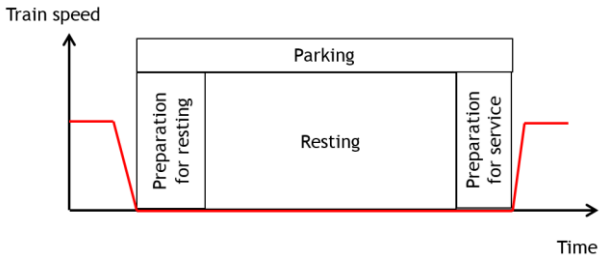

Figure 1. Operating schemes of a parked train.

The activity and noise characteristics of the operated technical components is strongly varying: some are running continuously, others intermittently for example to:

- Ensure fast readiness for commercial service,
- Allow cleaning activities (e.g. requiring light and power supply),
- Guarantee a certain temperature level aiming to avoid damage to components (frost protection of batteries),
- Keep a certain pressure level in the compressed air in system.

3. KEY CHALLENGES

Three main key challenges to reduce noise from parked trains were identified:

3.1 Regulatory frameworks

In contrast to noise from moving or stationary trains, which are covered by international standards / specifications, e.g. ISO 3095, EuroSpec, VDV 1541 [4-6], or regulations, e.g. TSI NOI [7], less commonly accepted regulatory frameworks exist for noise from parked trains. Nevertheless the current, ongoing revision of ISO 3095 includes a definition and assessment procedure for noise from parked trains. A clear need for an international framework which is accepted by all stakeholders has been identified.

3.2 Database

A second challenge is to define noise emission limits for parked trains and/or for particular technical components. The definition of such limits however requires a solid, commonly accessible database in order to define incentive, but not too restrictive limits. In [2] measurement data of different technical components was collected, but the informative value of the data is limited due to different assessed acoustic quantities/indicators, operation schemes, lack of documentation, etc. This is exemplarily illustrated in Figure 2, where the sound power levels of HVAC components of different rolling stock types and for two distinguished resting operating modes – standby and sleeping – are shown: For the EMU - Regional (electrical multiple unit) rolling stock type the levels have a dispersion of more than 20 dB(A). Hence, establishing a solid, high quality database requires a defined assessment method derived from a harmonized multi-stakeholder agreement including a measurement protocol and the definition of the train operating mode (e.g. resting phase), see the first challenge in section 3.1.

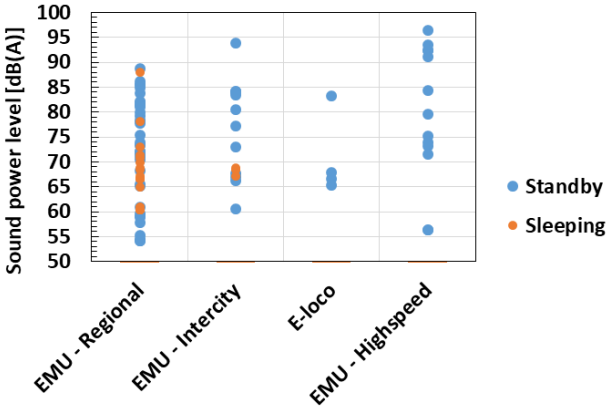

Figure 2. Sound power level of HVAC components.

3.3 Awareness

Finally, a third challenge has been identified: Some stakeholders, e.g. local authorities in charge of land use planning or those defining tenders for new rolling stock, are not aware of the potential issue regarding noise from parked trains, or there is a lack of technical competence in dealing with noise. Here, it seems that rising awareness, training and communication are required in order to prevent avoidable issues.

4. EXAMPLES OF NOISE MITIGATION

A series of noise mitigation measures were identified in the UIC study. A selection of these measures is presented in the following two sections.

4.1 Measures on the vehicle

The most efficient way to effectively reduce noise is to work on the source side, which means to implement noise mitigation measures on the vehicle. A major driver for noise reduction measures are stricter legal or purchaser's

requirements. From a technical point of view possible mitigation measures may include:

- Implementation of software solutions such as low fan speed for HVAC systems,
- Use of acoustic encapsulation of noisy components,
- Silencers for exhaust valves,
- Acoustically optimized fresh-air intakes (Figure 3) for HVAC systems

Figure 3. Fresh-air intake of a passenger HVAC – left: standard, right: acoustically optimized [8].

Such measures can be implemented in the design phase but they can also be considered for retrofit. However, technical, economical and other side aspects, e.g. homologation or certification have to be considered.

4.2 Measures taken by infrastructure managers

Two main noise mitigation measures on the railway infrastructure manager side were identified:

- Noise barriers are widely used with having however the disadvantage that their efficiency is height-dependent and thus could be insufficient for roof-mounted sources.
- Special parking orders with noise prioritization: Loud trains are parked far from line-side residents and more silent trains are used as noise barriers.

In some cases it seems that noise from parked trains is due to an incorrect setting of the train operating mode. This can be avoided by controlling the parking mode either by a trained railway worker or by using automated noise guards.

4.3 Measures taken by railway operators

Railway operators also take a series of parking noise mitigation measure such as:

- Cooperation with rolling stock manufacturers in order to implement low noise parking regimes on new or existing vehicles.
- Review of operational procedures, e.g. limited operation time of technical components, acceptance of higher temperature differences allowing to reduce noise-emitting HVAC activity.
- Consideration of parking noise in midlife overhaul, e.g. by installing low-noise components or optimization of train operation software.

5. PERSPECTIVES AND FUTURE WORK

The railway sector is aware that noise is a major issue for being a good neighbor. Therefore, the sector and in particular UIC's Noise and Vibration group continues to work on making railways more silent. With regard to noise from parked trains, the next step should be the creation of a single noise database using a common assessment procedure. This is a key element to improve suggested assessment procedures e.g. in the revision of ISO 3095, EuroSpec or VDV 1541 [4-6] and to increase efforts not to hinder progress, to guide the necessary incentives, and to encourage innovation in railways especially without strict limits for noise emission.

6. ACKNOWLEDGMENTS

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