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Mechanical vibration and shock — Resilient mounting systems —

Part 2:
Technical information to be exchanged for the application of vibration isolation associated with railway systems

Vibrations et chocs mécaniques — Systèmes de montage résilients —

Partie 2: Informations techniques à échanger pour l'application d'isolation vibratoire associée aux chemins de fer

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 2017-2 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*.

The first edition, together with ISO 2017-1:2005 cancels and replaces ISO 2017:1982 which has been technically revised.

ISO 2017 consists of the following parts, under the general title *Mechanical vibration and shock — Resilient mounting systems*:

— *Part 1: Technical information to be exchanged for the application of isolation systems*

— *Part 2: Technical information to be exchanged for the application of vibration isolation associated with railway systems*

Introduction

This part of ISO 2017 is limited to consideration of resilient devices.

Some suppliers of shock and vibration isolators (resilient mounts) have experience covering a wide variety of applications. In most instances, they are willing to use their background information for solving the user's isolation problems. However, it is frequently difficult for the supplier to provide this service, because the customer, the user or the producer of vibration source or receiver has not furnished sufficient information regarding the application.

On the other hand, the user is sometimes handicapped in applying isolators properly because sufficient technical information is not furnished by the supplier. Consequently, the user will often conduct his own experimental evaluation of the isolator and may unknowingly duplicate work already carried out by the supplier.

In some cases of vibration source or receiver, the producer provides the isolating system. To do that he needs detailed information from the customer relating to his future application, site and environment.

This part of ISO 2017 is intended to serve as guide for the exchange of technical information regarding the application of isolation elements for vibrations and shocks generated by railway systems, between the customer, supplier of resilient devices and producer of vibration source or receiver as required for their proper application.

For the purposes of this part of ISO 2017, a resilient device is defined as a flexible element or system used between an equipment item and its supporting structure to attenuate the transmission of shock or vibration from the railway systems to the structure.

Mechanical vibration and shock — Resilient mounting systems —

Part 2: Technical information to be exchanged for the application of vibration isolation associated with railway systems

1 Scope

This part of ISO 2017 establishes requirements to ensure appropriate exchange of information regarding the application of isolation for vibrations and shocks generated by railway systems.

This part of ISO 2017 is applicable to the construction of new railway systems. It may also be applied to previously installed systems when the user wishes to solve a new vibration problem arising from railroad degradation, when new environmental land use planning requirements are put in place, or when new vibration-sensitive land development occurs in proximity to existing railway systems.

It applies to vibration problems encountered in a railway environment but does not address vibration problems within railway cars (carriages) themselves.

This part of ISO 2017 intends to give appropriate responses to questions highlighted by the producer and users (why, what, when and how to isolate mechanical systems).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2041, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 2631-2, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 2: Vibration in buildings (1 Hz to 80 Hz)*

ISO 4866, *Mechanical vibration and shock — Vibration of buildings — Guidelines for the measurement of vibrations and evaluation of their effects on buildings*

ISO 7626-1, *Vibration and shock — Experimental determination of mechanical mobility — Part 1: Basic definitions and transducers*

ISO 8569, *Mechanical vibration and shock — Measurement and evaluation of shock and vibration effects on sensitive equipment in buildings*

ISO 9688, *Mechanical vibration and shock — Analytical methods of assessing shock resistance of mechanical systems — Information exchange between suppliers and users of analyses*

ISO 10815, *Mechanical vibration — Measurement of vibration generated internally in railway tunnels by the passage of trains*

ISO 10846 (all parts), *Acoustics and vibration — Laboratory measurement of vibro-acoustic transfer properties of resilient elements*

ISO 14837-1, *Mechanical vibration — Ground-borne noise and vibration arising from rail systems — Part 1: General guidance*

ISO 14964, *Mechanical vibration and shock — Vibration of stationary structures — Specific requirements for quality management in measurement and evaluation of vibration*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2041, ISO 7626-1, ISO 9688, ISO 10846 and ISO 14837-1 and the following apply.

3.1
railway system
all train, track and other elements of railway which generate or transmit vibrations, either in open space or in tunnels

3.2
vibration receiver
all structures or elements of structures responding to vibration energy emitted by an internal or external source

3.3
customer
user or purchaser of a product (building, machine, etc.)

3.4
producer
party constructing or manufacturing the product that needs to be isolated from internal or external vibration and which the customer agrees to purchase

3.5
isolation supplier
party who is responsible for providing and installing an isolation system that will meet the requirements to reduce vibration agreed upon with the customer who agrees to purchase

NOTE 1 In certain cases the producer and the supplier may be the same party.

NOTE 2 Every one of the three main actors can mandate subcontractors to execute the work or to purchase elements. From a legal point of view the three stay responsible in case of failure of the project.

3.6
base isolation
item or support arrangements that secure a structure to its supporting ground or equipment to its supporting structure and provide protection from shock and/or vibration

4 Vibration of railway systems

There are distinct mechanisms that give rise to ground vibration from the passage of trains. They are generally associated with train-track interaction.

The train is represented as a moving load. If the support stiffness did not vary along the track, a static load would then come on during the train passage. At train speeds below wave propagation speeds in the track and soil, this would present essentially a standing load problem to be solved.

However, in practice the rail is supported at intervals via rail track fasteners traditionally fixed to sleepers laid within ballast. The rail therefore provides varying support stiffness to the moving load.

The static load therefore appears and disappears at these discrete supports, the periodicity of which is a function of train speed, spacing between axles, and the spacing between the discrete supports.

This loading is therefore often referred to as quasi-static, or parametric, as it is due to a change in parameter, such as stiffness.

Measurements of wayside vibration indicate peaks in the frequency spectrum that tie in with the sleeper passage and axle passage frequencies.

The ground vibration that results from these discrete supports tends to cause peaks in the frequency spectrum below 80 Hz (train speed dependant), and is partly responsible for vibration that is felt at the wayside.

Another mechanism relates to wheel and rail roughness, arising either from manufacturing tolerances or from in-service wear. On the wheel there are wheel flats that develop due to braking. The rail surface may exhibit corrugation. As the wheel traverses this irregular profile, the unsprung mass (wheel set) is accelerated, which produces forces.

This roughness produces random vibration. There are devices for measuring the irregular rail profiles in the wavelength of 5 mm to 2,5 m. The data on rail roughness is reported as a random function.

Another mechanism involves impacts due to the rail's rail breaks or discontinuities in the rail due to joints, switches (points) and crossings.

These latter mechanisms are dynamic effects and are largely responsible for the higher frequency ground vibration that is responsible for re-radiated structure-borne noise, which is usually the dominant issue with underground train sources.

Other forces arise during acceleration and deceleration, or negotiation of curves in the track due to hunting as the bogie mechanism works. Impacts also excite vehicle dynamics such as bounce frequency, and bending modes of the coach.

5 Purpose of vibration isolation (why isolate mechanical systems)

The purpose of vibration isolation is to reduce the vibrations and shocks felt by people, structures and other mechanical systems by taking action between the source and the receiver. In the case of railway systems the purpose may include the assurance of:

a) the structural integrity of the buildings surrounding the railway systems;

b) the comfort of people in temporary or permanent structures that may be subject to the vibration excitation;

c) the functionality of sensitive equipment in these structures;

d) the correct operation of any existing isolated equipment;

e) the conformity with legal requirements, if any.