# INTERNATIONAL STANDARD



First edition 2005-07-15

# Mechanical vibration — Ground-borne noise and vibration arising from rail systems —

Part 1: General guidance

Vibrations mécaniques — Vibrations et bruits initiés au sol dus à des lignes ferroviaires —

Partie 1: Directives générales



Reference number ISO 14837-1:2005(E)

This is a preview. Click here to purchase the full publication.

#### PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office Case postale 56 • CH-1211 Geneva 20 Tel. + 41 22 749 01 11 Fax + 41 22 749 09 47 E-mail copyright@iso.org Web www.iso.org Published in Switzerland

<sup>©</sup> ISO 2005

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

# Contents

Forewo	ord	iv	
Introduction		v	
1	Scope	. 1	
ว	Normative references	 1	
2	Tormo and definitions		
3		. 1	
4	Overview of ground-borne vibration and ground-borne noise	.3 3	
4.2	Source of ground-borne vibration and ground-borne noise	. 3 . 3	
4.3	Propagation	. 8	
4.4	Receiver	. 8	
5	Effects of ground-borne vibration and ground-borne noise	. 9	
5.2	Perception of ground-borne vibration (1 Hz to 80 Hz)	. 9 . 9	
5.3	Perception of ground-borne noise (16 Hz to 250 Hz)	. 9	
5.4	Effect on buildings (1 Hz to 500 Hz)	.9	
5.5	Effect on very sensitive equipment and sensitive tasks ( <i>circa</i> 1 Hz to 200 Hz)	10	
6	Metrics	10 10	
6.2	Perception of ground-borne vibration	10	
6.3	Perception of ground-borne noise	11	
6.4	Effects on buildings	11	
6.5	Effects on very sensitive equipment	12	
7	Ground-borne noise and vibration measurements	12	
7.1	Equipment (instrumentation chain)	12	
1.Z 7 3	Data to be acquired	13	
7.4	Data analysis	13	
7.5	Measurement report	14	
8	Concept of models	14	
8.1	Model development	14	
8.2	Stages of assessment	15	
9	Prediction models	20	
9.1	General	20	
9.2	Parametric models	21	
9.3 9.4	Empirical models	22 24	
J. <del>4</del>		~ ~	
10	Development, calibration, validation and verification	24	
Annex A (informative) Checklist of issues relevant to modelling and measurement			
Annex	B (informative) Mitigation of ground-borne vibration and ground-borne noise	32	
Annex	Annex C (informative) Process and tools for development, calibration, validation and verification 39		
Bibliography 44			

## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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 14837-1 was prepared by Technical Committee ISO/TC 108, *Mechanical vibration and shock*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

ISO 14837 consists of the following parts, under the general title *Mechanical vibration* — *Ground-borne noise and vibration arising from rail systems*:

— Part 1: General guidance

The following parts are under preparation:

- Part 2: Prediction models
- Part 3: Measurement
- Part 4: Evaluation criteria
- Part 5: Mitigation
- Part 6: Asset management

### Introduction

Many if not all ground transportation systems can give rise to ground-borne vibration and/or ground-borne noise. Railways are by far the most common and significant source as a consequence of running steel wheels over steel rail.

Rail systems of all types generate ground-borne vibration and/or ground-borne noise, which (especially in urban settings) can have an undesirable environmental impact. An assessment of the likely ground vibration and response of structures at different distances from the source may be required. This requirement may arise for planning purposes where

- a) a new or extended railway or new or altered buildings are proposed,
- b) changes in dynamic characteristics of track or dynamic characteristics of trains are proposed,
- c) a change in train operations is proposed (e.g. change of total length, speed, service pattern), or
- d) assistance is needed in the evaluation of vibration mitigation measures.

Appropriate prediction of ground-borne vibration and/or ground-borne noise is the first of the two essential blocks required to assess vibration effects of new or modified rail systems on existing buildings, or the effects on new buildings next to or over existing rail systems. Ground-borne vibration and/or ground-borne noise criteria (and/or limit values) in the receiving building are the second block of any assessment. Criteria and limit values, however, are covered by national standards and other International Standards.

Prediction of ground-borne vibration and/or ground-borne noise from rail systems is a complex and developing technical field. This part of ISO 14837 provides guidelines on the essential considerations associated with developing prediction models to ensure that they are "fit for purpose" and that they are consistent in their approach.

Guidance is given on calibrating and validating a model and verifying its implementation, which are vital steps in quantifying and improving the model's accuracy.

Table 1 shows in outline the stages to be observed for new or modified rail systems or building developments alongside rail systems. This part of ISO 14837 provides general introduction and guidance. Detailed matters will be covered in future parts, the titles of which are given in the Foreword.

#### Table 1 — Outline of stages and the appropriate parts of ISO 14837

1. Approach dependent upon:		
New build, refurbishment or adjacent development (Part 1)		
Design stage (concept, preliminary, detail) (Part 1)		
2. Evaluation criteria		
Use national standards and/or Part 4		
Define assessment location(s) and metric(s)		
3. Parameters affecting situation		
Identify relevant parameters (check list in Part 1)		
Gather parameter data		
4. Measurements		
Acquire site-specific information using metric(s) defined by criteria (Part 3 and Part 4)		
Evaluation of model parameters		
Develop and or validate prediction model		
Evaluate mitigation performance		
5. Predictions		
Use metric defined by criteria (Part 4)		
Use appropriate model in the design stage (Part 1 and Part 2)		
Ensure validation and define accuracy (Part 1)		
6. Assessment		
Compare predictions against criteria		
Identify reason(s) for exceeding criteria		
7. Mitigation		
Identify mitigation options (Part 1, Part 5 and Part 6)		
Assess whether mitigation options are reasonably practicable		
Carry out cost/benefit analysis		
8. Solution		
Develop detail design		
Implement solution		
9. Asset management		
Implement a programme of condition monitoring and maintenance to observe criteria (Part 5, Part 6)		