SLOVENSKI STANDARD
SIST-TP CEN/TR 16303-1:2012

01-marec-2012

Oprema cest - Smernice za računalniške simulacije preskusnih trčenj v sisteme za zadrževanje vozil - 1. del: Splošne informacije in dokumentacija

Road restraint systems - Guidelines for computational mechanics of crash testing against vehicle restraint system - Part 1: Common reference information and reporting

Rückhaltesysteme an Straßen - Richtlinien für Computersimulationen von Anprallprüfungen an Fahrzeug-Rückhaltesysteme - Teil 1: Allgemeine Informationen und Dokumentation

Dispositifs de retenue routiers - Recommandations pour la simulation numérique d'essai de choc sur des dispositifs de retenue des véhicules - Partie 1: Information de référence commune et documentation

Ta slovenski standard je istoveten z: CEN/TR 16303-1:2012

ICS:

13.200	Preprečevanje nesreč in katastrof	Accident and disaster control
93.080.30	Cestna oprema in pomožne naprave	Road equipment and installations

SIST-TP CEN/TR 16303-1:2012 en,fr,de

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 16303-1

January 2012

ICS 13.200; 93.080.30

English Version

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This Technical Report was approved by CEN on 7 November 2011. It has been drawn up by the Technical Committee CEN/TC 226.

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. CEN/TR 16303-1:2012: E

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Foreword

This document (CEN/TR 16303-1:2012) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

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

This document consists of this document divided in five Parts under the general title: Guidelines for Computational Mechanics of Crash Testing against Vehicle Restraint System:

— *Part 1: Common reference information and reporting*

— *Part 2: Vehicle Modelling and Verification*

— *Part 3: Test Item Modelling and Verification*

— *Part 4:Validation Procedures*

— Part 5: *Analyst Qualification*[1]

[1] In preparation

Introduction

In order to improve and maintain roads safety, the design of safer roads requires, on certain sections of road and at particular locations, the installation of road restraint systems. These road systems are designated to contain errant vehicles with a specified performance level and can provide guidance for pedestrians or other road users.

The EN 1317 standard identifies test methods and impact test acceptance criteria that need to be met to demonstrate compliance with the essential requirements for CE marking. In some cases, computational mechanics can be used in addition to physical crash testing in the CE marking process. That is why it becomes necessary to develop a methodology to verify and validate the result obtained with computational mechanics work and guarantee the reliability of the simulation itself.

Furthermore Computation mechanics can provide support in real life situations that are not described within EN 1317.

1 Scope

The focus of this Technical Report will be on establishing accuracy, credibility and confidence in the results of crash test simulations to roadside safety devices through the definition of procedures for verification and validation in roadside safety application. This part is gives a general introduction and describe the organisation of this document.

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.

EN 1317-1, *Road restraint systems — Part 1: Terminology and general criteria for test methods*

EN 1317-2, *Road restraint systems — Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets*

EN 1317-3, *Road restraint systems — Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions*

ENV 1317-4, *Road restraint systems — Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers*

EN 1317-5, *Road restraint systems — Part 5: Product requirements and evaluation of conformity for vehicle restraint systems*

prEN 1317-8, *Road restraint systems — Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers*

CEN/TR 16303-2:2011, *Road restraint systems — Guidelines for Computational mechanics of crash testing against vehicle restraint system — Part 2: Vehicle Modelling and Verification*

CEN/TR 16303-3:2011, *Road restraint systems — Guidelines for computational mechanics of crash testing against vehicle restraint system — Part 3: Test Item Modelling and Verification*

CEN/TR 16303-4:2011, *Road restraint systems — Guidelines for computational mechanics of crash testing against vehicle restraint system — Part 4: Validation Procedures*

3 Abbreviations

ASI :	Acceleration severity index
CM/E:	Computational Mechanics Europe
COG:	Center of gravity
DD:	Maximum dynamic deflection of the VRS
FE:	Finite element
HGV	Heavy goods vehicles
MB:	Multi-body
PIRT:	Phenomena importance ranking table
THIV:	Theoretical head impact velocity

VRS: Vehicle Restraint System

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

4.1
model
mathematical model of VRS and vehicles

4.2
simulation
simulation performed using computational mechanics

4.3
test
full-scale impact test performed at a test house according to specifications in relevant parts of EN 1317

4.4
test item
product to be assessed using simulation

4.5
validated model
model of the VRS fulfilling acceptance criteria

4.6
validation simulation
simulation performed to validate a model. The deviations between the results obtained in the simulation and the full-scale test should be within in CEN/TR 16303-4 defined acceptance criteria.

5 Guideline organization

This guideline presents specifications and requirements in order to use computer simulations for impact simulations of vehicle restraint systems according to EN 1317 and for other national application areas.

The guideline consists of the following parts:

Part 1: Common reference information and reporting

Part 2: Vehicle Modelling and Verification

Part 3: Test Item Modelling and Verification

Part 4: Validation and verification Procedures

Part 5: *Analyst Qualification*

This organization is made to follow the common methodology of computational mechanics for crash test analysis.

The models of the vehicle used in this field are generally limited and representative of a quite wide class of vehicle. When tested they can be used for different application with sufficient high grade of reliability; an informative roadmap, including validation tests, for the development of a vehicle for crash test analysis against

road restraint system is given in CEN/TR 16303-2, in addition a PIRT (phenomena importance ranking table) document that documents the capability of the major assemblies of vehicles is reported in CEN/TR 16303-2:2011, Annexes D and E.

The vehicle restraint system modelling guidelines are described in CEN/TR 16303-3 and its informative annex. It is important to document the capabilities of this system in order to assess what the model reasonably can be expected to predict. That is why a PIRT (phenomena importance ranking table) document, similar to the one used for vehicle, is requested and other requirements are listed in CEN/TR 16303-3:2011, Annex C.

In the end, once the model has been completely developed including the vehicle and the VRS the computer simulation performed shall be validated. This is the focus of the validation procedures in CEN/TR 16303-4.

6 General considerations on the modelling techniques

Finite Element methodologies and rigid body (or multi-body) dynamic codes can be used in the simulation of crash scenario. Due to different requirements and different technical approaches in modelling the two methods need a specific knowledge in the use of the software.

These guidelines are in any case applicable for use on software where the background knowledge and experience is well-known. The software should be able to provide the tools that the user needs to correctly replicate the full scale test and obtain consistent results.

7 Use and goals of guidelines

Due to the complexity and the dimension of the issue, CME group took many years to firstly write some guidelines for computational mechanics of crash testing against vehicle restraint system. Different approaches were evaluated and many consideration and tests conducted in order to have the knowledge suitable to write this guideline.

The purpose is to guarantee the reliability and the correct engineering use of computational mechanics for this reason every computational simulation needs to be verified and validated. It is necessary to identify the process of determining that a computational model accurately represents the underlying mathematical model and its solution and determines the degree to which a model is an accurate representation of the real word from the perspective of the intended uses of the model.

This process involves comparing the computerized discrete numerical solution to known mathematical solutions and or real word or experiments.

Validation, as used in this document, is the process of determining the degree to which a roadside safety computer model is an accurate representation of the real world crash test from the representative of accurately replicating the EN 1317 crash test evaluation parameters, the structural performance of the barrier and the response of the vehicle.

The primarily purpose of this guideline are concerning incremental improvements to VRS (modified product). In this case, the model of the original test item shall be validated against test results before it can be used in impact simulations of a modified design. This is to ensure that the model is working properly and is capable of reproducing the tests within the allowed deviations according to CEN/TR 16303-4. It is critical that validation simulations are clear, and ensure that the physics of the crash tests are captured by the simulations.

The use of computational mechanics in the approval process for CE market of a test item is defined and regulated within EN 1317. That does not preclude the use of computational mechanics to the National Authorities for subjects not included in EN 1317.