Kommission
Arbeitsschutz und
Normung

27e

Standardization relating to OH&S in the field of rail traffic

VFA
Verein zur
Förderung der
Arbeitssicherheit
in Europa

Standardization relating to occupational health and safety in the field of rail traffic

KAN Report 27e

Verein zur
Förderung der
Arbeitssicherheit
in Europa

The project “Kommission Arbeitsschutz und Normung” is financially supported by the German Federal Ministry of Economics and Labour (BMWA).

Authors

Prof. Dr.-Ing. habil. Horst Illhardt (Project management)
Dr. oec., Dipl.-Ing. Wolfgang Kölbel
Dresden Polytechnic, “Friedrich List” Faculty of Transport Science,
Institute of Transport Systems Technology

Edited by

Verein zur Förderung der Arbeitssicherheit in Europa e.V.

Published by

Kommission Arbeitsschutz und Normung (KAN)
Geschäftsstelle (Secretariat)
Alte Heerstraße 111, 53757 Sankt Augustin
Telefon +49 22 41 2 31-34 51
Telefax +49 22 41 2 31-34 64
E-Mail: info@kan.de
Internet: www.kan.de

Overall production

Druckerei Plump oHG, Rheinbreitbach

ISBN

3-88383-634-6

June 2002

Content

Content

List of figures

List of tables

List of appendices

Owing to their length, the appendices of this project have not been included in the printed version of the report. They can be viewed on the KAN web site at http://www.kan.de/pdf/bericht/gesamt/Beri27.pdf (or reached from the home page under the "Publications" button).

The Commission for Occupational Health and Safety and Standardization (KAN) was founded in 1994 to assert German interests in OH&S matters, especially with regard to European standardization. KAN is composed of representatives of the social partners, the federal state and the Laender, the Hauptverband der gewerblichen Berufsgenossenschaften (HVBG, Federation of the Statutory Accident Insurance Institutions of the Industrial Sector) and the German Standards Institute (DIN). One of KAN´s tasks is to focus the public interests in the field of occupational health and safety and to exert influence on current and future standardization projects by delivering opinions on specific subjects.

KAN procures studies and expert opinions in order to analyse occupational health and safety aspects in standardization and to reveal deficiencies or erroneous developments in standardization work.

This study was based on the following task in hand:

Background

A large number of rules and regulations apply to occupational health and safety in the field of transport. In addition to provisions for occupational health and safety contained in national safety rules and regulations, transport regulations also have to be complied with. Provisions concerning construction, equipment and testing, which have so far been contained in accident prevention regulations, are to be transferred to European standards.

The special role of standardization in the field of rail traffic is characterized by the fact that directives based on Art. 137 of the EC Treaty are applied in addition to those based on Art. 95. A shunter, for example, can be of significance in three functions:

- As a **machine** for transportation it has to satisfy worker protection needs which may be standardized in requirements concerning the nature of a product according to Machinery Directive 89/392/EEC. (Art. 95)
- As **work equipment** it is covered by the scope of Directive 89/655/EEC which places employers under the obligation to provide workers with work equipment which complies with the minimum regulations of this directive. (Art. 137)
- As a **workplace** for the engine driver it is subject not to Workplace Directive 89/654/EEC, since means of transport are excluded from the scope of this directive, but to the Directive on "Minimum regulations for safety and

health protection for transport activities and at workplaces in means of transport" (COM(92)234 final) which has not yet been adopted. (Art. 137)

Based on EC Directives under Art. 95 of the EC Treaty, standardization projects are carried out in CEN/TC 256 "Railway applications" and in CENELEC/TC 9X "Electrical and electronic applications for railways" with the aim of harmonizing the national rules and regulations which exist for this field.

According to the statutory accident insurance institution (BG BAHNEN), the above European standards bodies do not pay sufficient attention to the subject of "Occupational health and safety in railway applications". An internal ad-hoc working group, "Occupational health and safety" - similar to that in CEN/TC 242, "Safety requirements for passenger transportation by rope" - was not active in CEN/TC 256 at the outset; the TC had however initially entered into a liaison with an external working group, "Occupational health and safety in the field of railway applications", which was formed external to the standards organizations and which comprised representatives of European OH&S institutions.

In what way the needs of occupational health and safety can be introduced into CENELEC/TC 9X is yet to be examined.

Aim of the study

In support of further standardization work and the revision of existing standards and draft standards, this study sets out to analyze the level of safety reached in standardization and to reveal existing deficiencies:

- ☐ Status review of standardization relating to occupational health and safety in the field of rail traffic (including rapid transit and special goods traffic, but not including the transport of dangerous goods),
- ☐ Determination of the need for standardization in the field of rail traffic required for comprehensive occupational health and safety,
- ☐ Analysis of the effects of standardization on occupational health and safety from Germany's point of view.

Tasks

1. Definition and structuring of the area forming the subject of the study.
2. Status review of the statutory framework for European standardization, in consideration of the classification in accordance with Articles 95/137 of the EC Treaty:
   a) existing EC Directives and those in preparation containing essential

occupational safety and health protection requirements for the field of rail traffic,

b) UIC leaflets,

c) currently valid regulations containing provisions governing occupational health and safety in rail traffic:
   - laws/state ordinances
   - accident prevention regulations
   - other regulations

3. Status review of standards and standardization projects containing provisions governing safety and health protection.

4. Analysis of standards and standardization projects with regard to their compliance with the "German Consensus Statement on standardization in the field of directives pursuant to Article 118a of the EC Treaty".

5. Assessment of the existing level of protection in standards/standardization projects based upon the essential requirements for occupational safety and health protection in the underlying EC Directives.

6. Comparison of the standards and standardization projects with the regulations governing the health and safety of workers at work, in order to identify gaps in regulation.

7. Comparison of the provisions in the area of occupational safety and health protection, and assessment of the discrepancies.

8. Identification of further need for European standards.

KAN wishes to thank the authors for conducting the project and submitting the report. Thanks also go to the following experts for their critical supervision and support during the evalua-tion of the study:

Herrn Dipl.-Ing. Alfons Grösbrink, Berufsgenossenschaft der Straßen-, U-Bahnen und Eisenbahnen (BG BAHNEN)

Herrn Dipl.-Ing. Lothar Grünert, Deutsche Bahn AG / Arbeitsschutz, Gesundheitsförderung, Arbeitssicherheit

Herrn Dipl.-Ing. Jost-S. Hasler, Eisenbahn-Bundesamt

Herrn Dipl.-Ing. Helmut Hübener, Berufsgenossenschaft der Straßen-, U-Bahnen und Eisenbahnen (BG BAHNEN)

Herrn Dipl.-Ing. Werner Imiela, Deutsche Bahn AG / Arbeitsschutz, Gesundheitsförderung, Arbeitssicherheit

Herrn Jungholt, Bundesministerium für Verkehr, Bau- und Wohnungswesen

Herrn Dipl.-Ing. Günther Lacina, Bundesverband der Unfallkassen (BUK)

Herrn Dipl.-Ing. Andreas Mahr, Berufsgenossenschaft der Straßen-, U-Bahnen und Eisenbahnen (BG BAHNEN)

Herrn Dipl.-Ing. Jürgen Mallikat, Verband Deutscher Verkehrsunternehmen (VDV)

Herrn Dipl.-Ing. Wilfried Müller, Berufsgenossenschaftliche Zentrale für Sicherheit und Gesundheit (BGZ)

Herrn Dipl.-Ing. Eckhard Ogrzey, Eisenbahn-Unfallkasse (EUK)

Frau Dr. Angelika Pensky, Bundesanstalt für Arbeitsschutz und Arbeitsmedizin (BAuA)

Herrn Dr.-Ing. Günter Stier, Köln

Herrn Ulrich Bamberg, KAN-Geschäftsstelle

Herrn Dr. Georg Hilpert, KAN-Geschäftsstelle

In March 2002, KAN adopted the following summary of the study and the recommendations.

Summary

Overall assessment

The present KAN study on standardization relating to occupational health and safety in the field of rail traffic analyses the level of occupational health and safety for rail transport which has been attained in European standards. The analysis was not limited to technical standards, but also encompassed regulations and legislative provisions for the transport sector with a bearing upon occupational health and safety. These specifically included railway legislation and associated ordinances, and the codes of practice of the International Union of Railways (UIC).

Broadly speaking, analysis of the documents shows that:

- ☐ an extremely comprehensive body of regulations exists, in which standards are granted relatively low status compared to that of provisions specific to railways (particularly the UIC leaflets of the International Union of Railways);
- ☐ OH&S aspects have as yet been given little consideration in the product requirements provided for in the standards (which are few in number) and the (numerous) UIC leaflets;
- ☐ in their standardization activity for rail transport, Technical Committees CEN/TC 256 and CENELEC/TC 9X pay widely varying degrees of attention to occupational health and safety.

The study reveals a need for action in European standardization of rail transport, the following areas being those most needful of attention:

- ☐ Occupational health and safety must be considered an integral element from the outset in future development of railway technology.
- ☐ Cross-border rail transport within Europe requires solutions to be as interoperable as possible. A high standard of occupational health and safety must be assured in such solutions.
- ☐ New transport technology is often multimodal, i.e. it encompasses different modes and systems of transport. This means that the OH&S interests of all parties involved must be considered in an interdisciplinary fashion.
- ☐ In the first instance, the UIC Code of Practice addresses requirements for the functional and operational safety and reliability of equipment and installations. The content of the UIC Code of Practice is to be analysed from an OH&S perspective and, where adequate, incorporated into European standards.
- ☐ Relevant German provisions should be introduced into European stand-

ardization projects in accordance with the two-pronged German OH&S system (comprising statutory occupational safety provisions and sector-specific occupational safety provisions provided by the accident insurance institutions) and in the interest of a high standard of occupational health and safety.

Structural classification of the area studied

The study provides a detailed description of the complex system of rail transport. Fifty-nine task fields, which provided the structure for the subsequent study, were defined from the interaction between human beings (operating procedures) and technology (vehicles, installations, etc.).

The hazard level was first assessed. Procedures involving movement at workplaces within the danger zone of the tracks were accordingly deemed particularly hazardous. Accidents occur most frequently during boarding of and alighting from vehicles, and during walking at or within the vicinity of the tracks (shunters' and lineside walkways) and during the coupling of rolling stock. The condition of the walkways, in particular in combination with the other conditions associated with boarding and alighting, is seen to be a key factor.

A consequence of technical development in the rail sector is however that a range of hazardous activities within the danger zone of the tracks (e.g. coupling) are eliminated, reduced, or modified.

The status of European standardization

A feature peculiar to rail transport is that equipment (e.g. locomotives) and railway facilities employed for public transport are largely excluded from the scope of European Directives pursuant to Articles 95 or 137 of the EC Treaty, a consequence being that the objectives of protection (e.g. for machinery or workplaces) of these articles present no direct requirements for implementation.

At the same time, routine railway operation involves not only the equipment and facilities which are unique to railways, but also work equipment for general use (e.g. hoists, horizontal conveyors) which is subject to particular requirements (e.g. the Machinery Directive).

Within the complex of international, European and national regulations, a characteristic of the European directives specific to rail transport is that they have a bearing upon occupational health and safety, but without it being a primary objective as is the case in the pertinent Eu-

ropean directives governing occupational health and safety.

At the same time, the assurance of operational safety also represents a cornerstone of occupational health and safety within the rail sector. The railway companies' obligation to provide for their customers' welfare, which arises from national statutory provisions specific to rail transport, also has a direct bearing upon the occupational health and safety of personnel. An example of this is the specification of engineered solutions for safe operation, as is the case in the German Regulation on Construction and Operation of Railroad Systems. To this extent, a need exists for provisions of transport and OH&S legislation to be harmonized with each other.

The Code of Practice of the International Union of Railways (UIC) chiefly governs technical solutions, through binding, recommendatory or informatory provisions. The UIC leaflets primarily govern operationally safe use of equipment (i.e. encompassing its functional safety and reliability), and the safety of its operators and users. The UIC leaflets consequently have a certain indirect relevance to occupational health and safety, although this relevance is not generally stated explicitly.

The UIC leaflets frequently represent an important basis and source of reference for the relevant European standards. For the most part, however, they are drafted exclusively by representatives of the railway companies. Manufacturers are not involved, and OH&S institutions rarely so.

Even though EN standards and UIC leaflets differ in their background and the mechanism for their application, however, the facility for mutual citation and the transposition of UIC leaflets to EN standards provide a basis by which the area of standardization may continue to be addressed from the OH&S perspective with both forms of regulation and in accordance with the provisions of EC directives pursuant to Article 95 (formerly 100a) of the EC Treaty, i.e. without contradictions and redundancy.

Conversely, the facility for the inclusion of *recommendatory* or *informatory* information in UIC leaflets may be exploited for the testing and improvement of regulations.

Assessment of the present level of protection

The statements and recommendations below are based essentially upon an evaluation of 160 German, 156 European and 56 international standards and standards projects, and upon 106 UIC leaflets.

Requirements concerning the design and function of passenger coaches and their components are formulated for assurance of the safety and health of both passengers and personnel. OH&S concerns are already covered to some degree by the obligation to provide for customers' welfare in public passenger transport.

Conversely, particular requirements for railway rolling stock in the areas of

- ☐ fire protection (such as in the German DIN 5510 series of standards),
- ☐ noise,
- ☐ pollutant emissions (as in UIC leaflet 623-2) and
- ☐ electrical hazards

are not defined adequately, if at all, in European standards. For example, no standards exist governing exhaust emissions from diesel locomotives.

OH&S concerns were voiced by the (initially external) ad hoc OH&S working group *attached to* CEN/TC 256, which in the course of the study received recognition as the internal OH&S advisory group *within* CEN/TC 256. The systematic and timely consideration of OH&S interests was thus improved. The influence of this group can be seen from the following examples:

- ☐ Where rolling stock is pushed rather than pulled by the locomotive, the engine driver/shunter must be protected against being thrown off the shunter's step by sudden emergency braking. For this purpose, either the braking effect must be reduced, or the engine driver/shunter riding on the shunter's step must be warned. This provision was implemented in the past in German VDV regulation 201; the requirements formulated in this regulation have been incorporated (in the form of a compromise) in the draft text of EN 50239, „Radio remote control system of traction vehicles for freight traffic".
- ☐ Design requirements such as
  - arrangements for steps and driver's platforms (nonslip surface, clearance dimensions, dimensions of driver's platforms);
  - provision of handles and handrails;
  - facility for the fitting of a safety harness

  which are governed in the UVV accident prevention regulations for ladders and steps (VBG 74) have been implemented accordingly in the draft of EN 12561-7, „Tank wagons - platforms and ladders".
- ☐ Marking of hot pipes for heating connections on tank wagons has been

incorporated into the draft of standard EN 12561-8, „Heating connections".

„Cross-border workplaces" in the form of the vehicles represent an example of a particular need for harmonization: rolling stock (and work equipment) cross national borders and are used by the personnel of another country, or employees are required to operate the same equipment in a different country. A need for action exists here in the interest of interoperability and organizational arrangements.

On the one hand, the German Consensus Statement does not permit standards to impact upon employers' OH&S responsibilities. On the other hand, the OH&S requirements imposed by one country must be implemented in another. In the authors' view, this means that a particular need exists for harmonization of standards pursuant to Article 137 of the EC Treaty (e.g. in the design of vehicles as „workplaces" and in the design of stationary workplaces, with respect to the organization of operations).

One conclusion related to Europe-wide requirements in the area of the health and safety of workers at work is that a framework must be created (for example in the form of a directive pursuant to Article 137) within which a harmonized procedure may be followed throughout Europe.

Identification of the need for standardization

The need for European standards is demonstrated in a comprehensive summary (Table 9) of examples in accordance with the principles (technical development, technical arrangements) and the background to implementation (interoperability, German safety standard). The examples are taken from Appendix 1 and show that existing regulations may generally serve as a basis for an improvement of European standardization.

On the one hand, the longer-term objective remains of transposing UIC leaflets to EN standards. On the other, mutual citation is possible.

- ☐ Duplication and unsubstantiated derogations, such as design requirements for freight cars or comfort characteristics for coaches, should be progressively eliminated in the course of systematic implementation of normative references in accordance with the „Memorandum of Understanding" between CEN and UIC.
- ☐ Parallel regulation at different levels, for example regulation in DIN standards, accident prevention regulations and UIC leaflets governing clearances to be provided at vehicle extremities, or governing steps and handles,

should be eliminated, and the provisions concerned transposed to EN standards.

- ☐ It is conceivable that, with the aid of recommendatory or even informatory statements in UIC leaflets, moves may be made, for the purpose of testing and consolidation, towards more binding provisions (ultimately in EN standards). *Recommendatory* agreements have for example been reached regarding interaction between fixed installations and passenger rolling stock (UIC leaflet 508-1), and *informatory* agreements for installations for servicing and stabling passenger rolling stock ready for operation (UIC leaflet 508-2). As interoperability requirements become increasingly more stringent, a process of clarification should lead to corresponding European standardization.

The fact that UIC leaflets contain both binding provisions and recommendatory and informatory statements may be exploited in a transitional phase for the purposes of consolidation and testing. Co-operation between UIC and CEN committees should however be intensified, with the objective of defining technical requirements increasingly in EN standards.

Recommendations

The results of the study identify starting-points for OH&S-related European standards projects in the rail sector which may at the same time contribute towards improvement, reduction and harmonization of the existing body of regulations.

A particular focus in this respect is the transposition over the long term of UIC leaflets into EN standards, with systematic inclusion of the safety requirements of relevant EU directives.

Need for action by the Federal Ministry of Labour and Social Affairs

☐ Occupational health and safety objectives are addressed only indirectly in the EU directives governing the development of railways in Europe (91/440/EEC, 95/18/EC, 95/19/EC, 96/48/EC). In future initiatives for directives (governing interoperability, for example in high-speed traffic, or combined transport), greater attention must be paid to occupational health and safety.

☐ To enable occupational health and safety to be given adequate consideration in standards, the Federal Ministry for Labour and Social Affairs (BMA) is requested, in conjunction with the Federal Ministry of Transport, Building and Housing (BMVBW), to bring its influence to bear during the revision or reformulation of EU directives for the transport sector on two counts:

- Preparation of EU directives: new directives for example in order to safeguard the interoperability of Europe-wide rail transport are needed, in which OH&S requirements could be included from the outset.
- Review of the derogations by which public rail transport (and other transport sectors) are excluded from the scope of EU directives of relevance to occupational health and safety.

☐ Where personnel are deployed in cross-border duty, „workplaces" peculiar to rail transport must be defined, and minimum requirements applicable throughout Europe laid down for their design.

☐ The proposal for a directive governing minimum health and safety requirements for transport activities and workplaces on means of transport (OJ EC C 025 of 28.01.1993, p. 17) has not been developed further since 1993.

Need for action by the Federal Ministry of Labour and Social Affairs and the statutory accident insurance institutions

☐ Product requirements for walkways and loading ramps are defined in the

German Ordinance on Working Premises, the General Accident Prevention Regulations (VBG 1) and the Railway Accident Prevention Regulations (VBG 11), and also in the Regulation on Construction and Operation of Railroad Systems (EBO). From an OH&S perspective, the surfaces of walkways must be given particular consideration, in order to ensure ideal conditions for boarding of and embarking from steps and access doorways on rail vehicles, and for negotiating walkways. Surfacings for walkways for example are defined as construction measures (DIN 18315, DIN 18317). The authors propose that these requirements be developed as a field of standardization and contradictions eliminated in the process, that special safety requirements, for example for high-speed transport, be included, and that safety clearances and surface characteristics which vary according to the mode of use be addressed and incorporated into appropriate European standards projects.

Need for action by DIN

DIN is requested to promote, through the DIN rolling stock standards committee (FSF), the launching of European standards projects in the areas identified by the study. In the process, as the study shows:

- ☐ relevant DIN standards embodying a high level of safety may serve as foundation documents;
- ☐ legacy product requirements from the accident prevention regulations of the BGs and
- ☐ OH&S-related product requirements in UIC leaflets may be integrated.

Product requirements for rolling stock

- ☐ The following German standards may serve as foundation documents for European standards projects for the design of rolling stock:
  - DIN 27150, 27151 for regional/ national freight wagons;
  - DIN 5557 for handwheels for rail vehicles;
  - DIN 25252, 25254, 25255, 25256 for hopper/self-discharging wagons;
  - standards series DIN 26012 to 26034 for tank wagons.

  The standards EN 12561-1 to 12561-8 governing the safe operation of tank wagons and their equipment, which are currently at the draft stage, represent a benchmark for the design of freight cars in consideration of occupational health and safety aspects. In this context, selected UIC

leaflets could be harmonized in order to promote safe operation and use, as provided for by the leaflets themselves, and given consideration in the standardization projects:

- steps, handrails and control devices (UIC leaflets 535-1/-2, 536, 576);
- characteristics of standard wagons (UIC leaflets 571-1 to 571-4);
- technical conditions for the construction of tank wagons (UIC leaflet 573);
- equipping of wagons with electrical connections and loads (UIC leaflets 533, 538, 554-1, -2).

☐ The authors propose that the draft of DIN 27505 governing the clearances to be provided at vehicle extremities be taken as a basis for a corresponding EN standard in conjunction with further transposition of the Directive on the interoperability of the trans-European high-speed rail system (96/48/EC), and that in the process the content of UIC leaflets 505-1, 505-4 and 506 be incorporated.

☐ For issues relating to cross-border traffic, a standardization project is recommended for passenger rolling stock which gives consideration to the UIC leaflets governing coaches accepted on international service (565-1 and -2, 567-1 to -7). Particular attention should be paid here to hazards arising from unforeseeable changes in acceleration.

☐ In order to permit uniform conditions of use in different countries, the requirements for coupling handles should be harmonized. The German provisions could be transposed within an EN standard for this purpose.

☐ An essential starting-point for the establishment of safe working conditions is harmonized equipping of coaches with appliances, and harmonized use and monitoring of the serviceability of these appliances. A relevance to occupational health and safety exists in that hazards ensuing from incorrect, neglected, or untimely actions must be avoided.

UIC leaflet 584, „Directives for the drawing up of service instructions to assist staff in the use of equipment in coaches authorised to run on international services", should be incorporated at the same time.

☐ Requirements in the area of fire protection, noise, pollutant emissions or electrical hazards specific to rolling stock are not specified adequately, if at all, in international or European standards. Relevant recommendations by the European Rail Research Insti-

tute ERRI (Project 226) and the activity of the UIC (Action Plan) should be used as a basis for standardization activity.

Requirements for the transport chain

☐ The authors propose that the DIN 30800 series of standards, which govern arrangements for the transportation chain (including the components freight wagons and loading units, equipment and installations), be incorporated into adequate European standardization projects together with their OH&S aspects.

☐ For combined transport, the international and European standards governing containers and swap bodies must be harmonized with the relevant UIC leaflets, in order to create the conditions for uniform and safe operation throughout Europe.

Requirements for on-board workplaces

☐ The German DIN 5566 series of standards could serve as the basis for a European standardization project for the design of driver's cabs; such a project could also incorporate UIC leaflets 617, 625 and 651. The objective should be a modular concept for a uniform driver's cab for local and long-distance traffic.

☐ Safe design of radio remote-control for the engine driver/shunter entails converting the shunter's riding platform to a control platform which is able to assure safe boarding and embarking and safe footing and grip during one-handed operation of the radio remote control.

Product requirements, which are formulated in § 15(4) VBG 11, and the safe design of the step/handrail unit specified in UIC leaflet 535-2, are suitable for transposition to an EN standard. A project should be launched for this purpose.

Requirements for the operator/ equipment interface

☐ In the interests of interoperability and expansion of the high-speed rail network, a new project should address the design of the vehicle/passenger traffic facility interface (in this case, the platforms). From an OH&S perspective, the objective should be for the transition between carriage and platform to be as uniform and as convenient as possible.

☐ DIN 30800-1 to -3 and DIN 30801/ 30802 governing interface design, and DIN 26572 governing pneumatic pressure discharge, meet the OH&S requirements for bulk freight transport only indirectly. The level of protection

stipulated in the German standards could serve as a starting-point for European standardization projects.

- ☐ The tasks associated with the transshipment of fluid products require the operator to be present directly at the vehicle. The following standards apply in this context:
  - international standards for containers (ISO 9669, 9670);
  - European draft standards for tank wagons (EN 12561-1 to -8);
  - the German standards DIN 26012 to 26034;
  - UIC leaflet 573 (Technical conditions for the construction of tank wagons).

  The product requirements and the documents themselves must be harmonized, in order to assure the conditions for safe operation in the interests of occupational health and safety.

Need for action by KAN

In order to promote occupational health and safety, KAN should exert influence upon the mandating of the standards projects indicated above.

KAN should use its influence to have the level of fulfillment of safety requirements defined more precisely, in order to permit assessment of whether adequate protection is assured. (Experience in standardization activity shows that compromises must generally be reached.)

The KAN Secretariat should promote the model of the „OH&S internal advisory group" in CEN/TC 256, in order for systematic and timely consideration of OH&S requirements to be supported in the processes of standards drafting and revision. This applies first and foremost to European standardization, but is also indispensable for national standardization, as the results of such activity frequently form the basis of European standards.

Need for action by the Railways Committee of Experts

In order for OH&S requirements to become a more integral element in UIC leaflets, influence should be brought to bear for the (existing) UIC „Occupational Health and Safety" working group to be involved as a matter of course in the drafting and revision of the leaflets.

1 Introduction

Attainment of optimum occupational health and safety standards is a general objective for work processes in all areas of society. Occupational health and safety is influenced in different ways by a wide range of regulations. Such regulations include European Union directives, statutory regulations, and national and international regulations and standards.

In the present study, interest is focussed upon occupational health and safety in rail transport. One reason for launching this project was the view of the BG BAHNEN that "occupational safety in the rail industry" is not (yet) dealt with adequately by European standards.

This position:

- ☐ is based upon the need for an improvement in occupational health and safety in rail transport;
- ☐ initially states only that regulation in this area is inadequate, owing to the absence of European standards in rail transport;
- ☐ does not constitute a statement upon the state of regulation in relation to occupational safety in rail transport.

The study deals with the rail transport system together with its elements and procedures, and their safe design.

These systems and, for example, the particular activities performed by personnel which require them to stand in and on rail vehicles subject to (some cases considerable) changes in acceleration, or the requirement for employees to approach moving rail vehicles on railway tracks in the course of their activities, give rise to special conditions.

The study is not geared towards the behaviour of employees, for example with the objective of influencing the level of occupational health and safety by addressing such behaviour. (In this context, the objective can only be, for example, to remove from the danger zone such activities which entail hazards and which place particular requirements upon the behaviour of personnel, or to eliminate them altogether by means of technical solutions.)

The study is focussed upon technical standards – within the scope specified by the European Union – in order to examine whether characteristics providing adequate protection for employees are specified for work equipment and tools, and if so, in what way. In the process, the study considers the entire body of regulations relevant to safety, which has acquired a particular form in the railway industry, both in Germany and internationally.

The standards studied comprise:

- ☐ International standards drawn up by the
  - – International Organization for Standardization (ISO)
  - – International Electrotechnical Commission (IEC)
- ☐ European standards, drawn up by the
  - – CEN (Comité Européen de Normalisation)
  - – CENELEC (Comité Européen de Normalisation Electrotechnique)
- ☐ National standards, drawn up in Germany by the
  - – DIN Deutsches Institut für Normung e.V.,
  - – Deutsche Elektrotechnische Kommission im DIN und VDE (DKE).

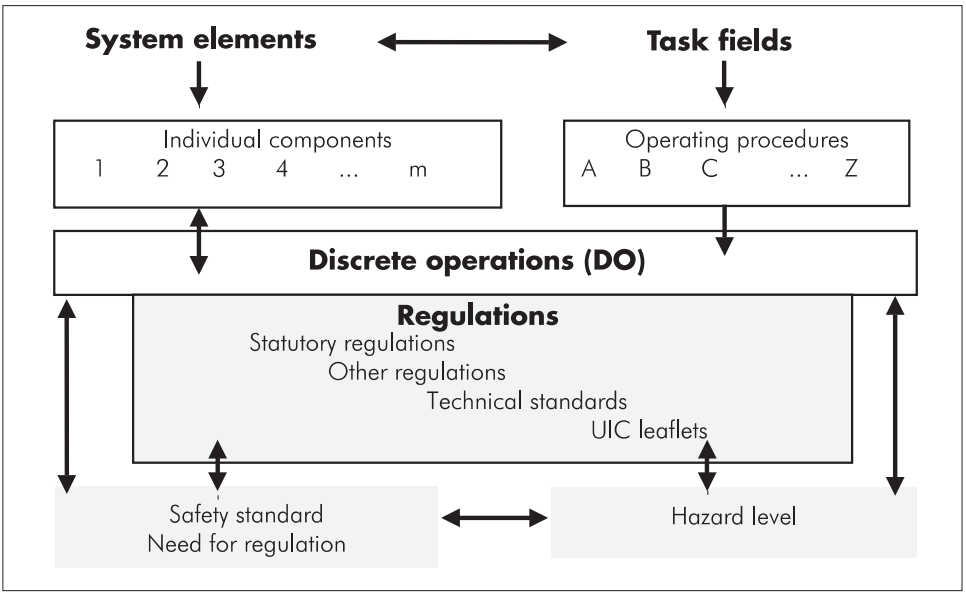
From the perspective of occupational safety in Germany, the function of the various standards in the railway industry and their mutual interrelationship is as follows:

- ☐ International standards are:
  - – of limited application at present;
  - – conversely of great importance when they are adopted as European standards.
- ☐ European standards always enjoy the greatest importance owing to the fact that they must be transposed as national standards.
- ☐ Exclusively national standards are always of great importance; they represent a decreasing proportion of standards, however, commensurate with the increase in importance of European standards.

Articles 95 and 137 (formerly 100a and 118a) of the EC Treaty [1], and the European Union Directives concerning occupational safety and issued on the basis of these articles, represent the statutory framework governing standards. In Germany, this area is governed by legal provisions, and by supporting technical rules and/or accident prevention regulations (cf. [16], Appendix 3). This area is characterized in Germany by the dual system of occupational health protection, which distinguishes between statutory occupational safety provisions and independent occupational safety provisions recognized by the accident insurance institutions.

In order to permit evaluation of the specific function of technical standards within the body of regulations governing occupational safety, the relevant functions and conditions are addressed systematically. Fig. 1 shows the general framework of the study in schematic form.

Fig. 1: Framework of the study



The subject of the regulations is represented by system elements and their components, which are employed in the form of tools and equipment in defined task fields and in the context of adequate operating procedures and discrete operations. They present a certain hazard level according to the level and efficacy of regulations with a bearing upon occupational safety.

Rail transport involves the transportation of persons and freight by rail vehicles over a permanent way from a source (access point) to a destination, possibly involving transfer/transshipment.

The following underlying features of the rail transport system were crucial to performance of the study:

☐ The rail transport sector encompasses public and non-public transport running on standard-gauge railways. This corresponds to the scope of the Regulation on Construction and Operation of Railroad Systems (EBO) [2] and the Regulation on Construction and Op-

eration of Private Industrial Railroad Systems (EBOA/BOA) [3].

- ☐ The study encompasses standard operation of conventional transport and conveyance processes together with the supplementary and sub-processes which characterize them directly or are associated with them indirectly. Care and maintenance processes are therefore included as auxiliary processes, but not construction, fault mode, emergency or similar processes.
- ☐ The terms of reference do not extend to the transport of hazardous substances, but do include high-speed and combined transport.
- ☐ Known developments in technology must be included in the study where they can be expected to have a bearing upon occupational health and safety.

The objective of the study is to assess the scope for and basis of standards required for comprehensive occupational safety in the area of rail transport, and is to be achieved by the standards bodies named. A requirement is specified according to the following principles:

- ☐ reduction to a minimum of all relevant hazards in accordance with the state of the art;
- ☐ compatibility with European Directives;
- ☐ consensus of interested parties;
- ☐ consistency, and ease of application.

The working committees currently responsible for drawing up railway standards and in which the interests of occupational safety are represented are listed in Table 1.

The leaflets issued by the International Union of Railways (UIC) are particularly relevant in this context. They often represent an important basis and source of reference for the applicable European standardization process. They are drawn up exclusively by representatives of the railway companies. At present, occupational safety is taken into account only indirectly.

During preparation of the present study, the authors were able to refer to the results of a feasibility study entitled "Arbeitsschutzbezogene Normung im Bereich Schienenverkehr" (occupational safety standardization in the rail transport sector), Part 1: "Güterwagen" (freight wagons) [4], which proved useful for the formulation and testing of the procedure. Co-operation with an in-project working group during performance of the study was so successful that it was considered beneficial and essential for future activities.

Table 1: Standardization activities

Level	Standards organization	Committees addressing railway issues	Consideration of occupational safety
International	ISO	No TC	
	IEC	TC 9	No facility for involvement
European	CEN	TC 256	Involvement of an internal advisory committee
	CENELEC	TC 9X	Limited involvement in individual working groups
German	DIN	FSF	Involvement by representatives of the BGs
	DKE	K 351	
International	UIC	All committees	No involvement

2.1 Description of the system

In order to complete the study, the framework of which is shown in Fig. 1, for rail transport, the (technical and organizational) elements of the rail transport system are cross-referenced to the tasks entailing their use and operation. The relevance to occupational health and safety lies in the fact that personnel employed in tasks typical of the railway industry interface directly with the system/process elements through discrete operations.

The procedure thus entails three steps:

1) Selection of system elements/ components relevant to the action

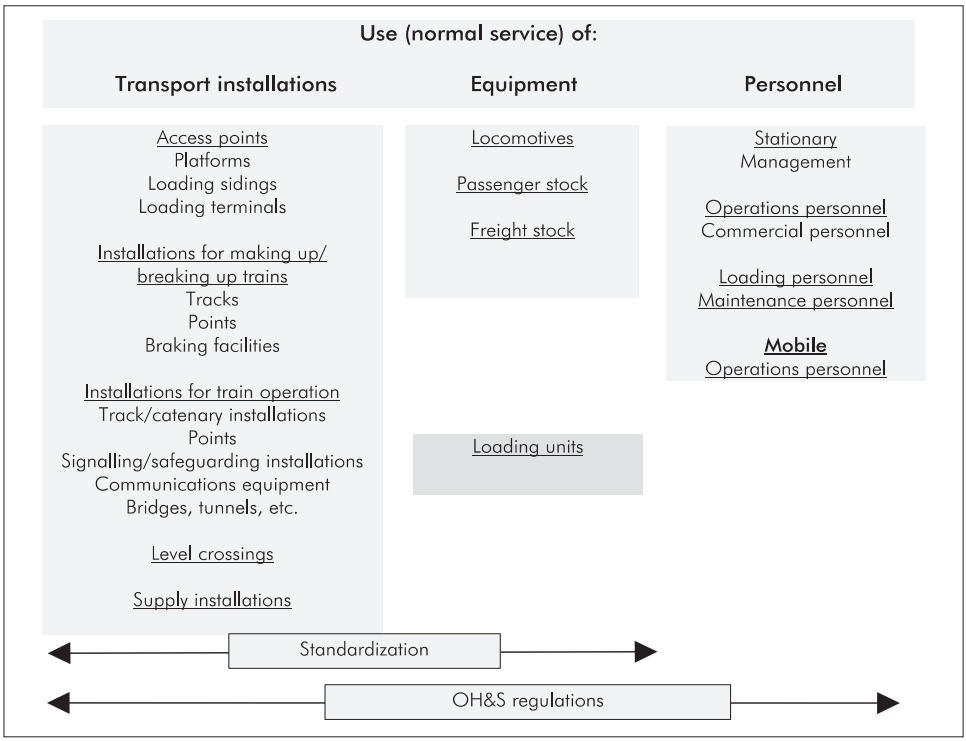
System elements employed in rail transport and of interest in the present context as subjects of regulation are shown in the overview contained in Fig. 2. They may represent the origin of hazards. The personnel are therefore classified as users or operators requiring protection against hazards.

The broad summary shown is refined further by systematic definition and denotation of the elements and components in Appendix 1 (columns 1 to 4). In the process, the authors based their work upon existing classifications for the system to be studied, whilst observing the terminology of the relevant standards (cf. [5], [6]).

The following principles were applied for the purpose of classification:

- ☐ Selection of the transport installations and resources relevant to the transportation process and to auxiliary processes subject to classification.
- ☐ Definition of components of these transport installations and resources which interface directly with discrete operations.
- ☐ Inclusion of additional work equipment.
- ☐ Supplementing of the selection by work equipment and tools which are not specific to rail transport, but which come into play in multimodal processes at external interfaces to rail transport.
- ☐ Definition of selected elements of the working environment (workplaces) and working conditions (atmospheric conditions).
- ☐ Consideration of innovative elements which represent the progress of the state of the art, and which are effective in particular in that their use renders hazardous actions obsolete or enables new activities to be performed with a higher safety level.

Fig. 2: Rail transport system elements with regulatory fields



2) Systematic structuring of the process tasks

The production and auxiliary processes in rail transport are represented by task fields. A summary is provided in Fig. 3. The task fields are classified further in a systematic fashion appropriate for the process in terms of operating procedures, as shown in Appendix 2.

The following aspects were considered in order to ensure that the operating procedures are related in a representative manner to occupational health and safety.

- ☐ Selection of tasks and workplaces which are characterized by direct contact with moving and stationary rail vehicles close to the tracks.

Fig. 3: Task fields of rail transport

A Train operation	B Shunting operation	C Loading/unloading operation
A1 Preparation for running	B1 Running around	C1 Loading tasks
A2 Performance of running	B2 Fly shunting	C2 Combined transport
A3 Service on the train	B3 Gravity shunting	C3 Formation of road-railers
A4 Service at the train		C4 Auxiliary services
	D Auxiliary processes	
	D1 Servicing of vehicles	
	D2 Dispatch	
	D3 Supplies	
	D4 Cleaning	
	D5 Repairs	
	D6 Inspection/checks	

- ☐ Consideration of the process of operation on vehicles and installations which exhibit particular scope for hazards.
- ☐ Definition, as terms of reference, of tasks which are currently and will in the future be required regularly and/or frequently (repetition to be avoided where possible).
- ☐ Consideration of the changes to be expected as a result of technical development.
- ☐ Consideration of operating procedures at the external interfaces to the processes in rail transport.
- ☐ Consideration of the working environment associated with certain activities.

3) Selection of typical and representative types of employee

The decisive criterion for selection of the subject of study with regard to the relevance to occupational safety is the direct involvement of personnel in processes at workplaces in the rail transport sector, irrespective of the personnel's assignment to a specific organizational unit or the responsibility of a particular BG. This applies to the employees of rail transport companies, customers (loading work), and service personnel who are involved in transportation processes prior to, during and following such processes.

Table 2 provides an overview of workplaces of particular interest, the designa-

tions of which were selected in accordance with the applicable codes of practice of the DB AG (cf. [7]) and BG BAHNEN (cf. [8], [9], [10]). The summaries shown in Appendices 1 and 2 represent principles by which on the one hand, regulations can be related to subjects of regulation, and on the other, conclusions can be drawn systematically with regard to the hazard situation.

2.2 Hazard levels

In the context of scheduled service conditions, the characteristic of a system, sub-system or component is described as controlled with respect to scheduled service conditions when operation and maintenance are assured with the use of normal auxiliary materials. The system must be such that it can be operated properly by the personnel deployed for the purpose and under acceptable conditions, i.e. in particular without hazard (cf. [EM1]).

The hazards associated with activities were assessed in order to identify key areas in which a requirement for safety regulations exists. Definition of the hazards, i.e. of the probability and scale of potential damage, would have entailed

- ☐ evaluation of relevant accident statistics;
- ☐ consultation of experts and affected parties, and/or
- ☐ performance of hazard analyses (interaction between person – tool – work equipment)

on the basis of uniform criteria.

Neither time nor resources were available for this purpose within the scope of the present study. Efforts were therefore made to assess other feasible instruments and information in order to draw conclusions with regard to activities.

- ☐ A hazard index [11] and the safety checks specified by the BG BAHNEN [8] and the DB AG [7] were employed for identification and description of hazards in conjunction with operating procedures and their respective environments.
- ☐ Workplaces and activities – as shown in Table 3 – are characterized by location for the classification of environments in the railway industry.
- ☐ Hazard analysis was based upon assessment of the consequences of an event as a function of the energy brought into play (e.g. velocity, mass), the nature of the surfaces and bodies concerned, and the parts of the body at risk.

Table 2: Workplaces in the rail transport industry

Task fields		Workplaces
A	**Train operation**	
A1	Preparation for running	Foreman shunters, drivers, examiners, checkers, guards
A2	Performance of running	Movements inspectors, pointsmen, station inspectors, crossing keepers, drivers
A3	Service on-board	Guards/local service inspectors, railway engineers, service personnel, catering personnel
A4	Service in stations	Customer service personnel, porters, railway security personnel, service personnel
B	**Shunting operation**	
B1	Running around	Shunting engine driver, shunting gang (foreman shunter)
B2	Fly shunting	Driver, shunting gang (shunters), pointsman
B3	Gravity shunting	Driver, shunting gang, brakeman
C	**Freight handling operation**	
C1	Freight loading operation	Loading personnel (loading labourers, operators, slingers)
C2	Combined transport	Crane operators, mobile equipment operators, spotters, road vehicle drivers
C3	Formation of road-railers	Operators, road vehicle drivers
C4	Auxiliary services	Loading personnel
D	**Auxiliary processes**	
D1	Servicing of vehicles	Examiners
D2	Dispatch	Checkers, customs officers
D3	Utilities supply	Drivers, service personnel
D4	Cleaning	Service personnel (cleaning personnel)
D5	Breakdown repairs	Authorized personnel (e.g. drivers, movements inspectors), technicians
D6	Inspection/checking	Drivers of service vehicles, technicians

Table 3: Location of workplaces specific to the railway industry

Location	Workplaces/tasks specific to the railway industry
In the loading gauge*)	Shunting gang including shunting engine drivers, drivers of tractive stock
At the tracks (specified clearance gauge)	Shunting gangs including shunting engine driver, engine driver, examiner, checker, external rolling stock inspection
Close to the tracks (adjacent to/between tracks)	Station inspector, train monitoring personnel, crossing keeper, technicians
On the vehicle – Moving – Stationary	 Drivers, drivers of service vehicles, guards/local service inspectors, railway engineers, on-board catering staff Loading personnel, cleaning personnel
At the vehicle – Moving – Stationary	 Shunting gang including shunting engine drivers Checkers, technicians, cleaning personnel
In traffic areas	Labourers (stations), crane operators, mobile equipment operators, loading supervisors, loading labourers, service personnel, railway security personnel
In enclosed areas	Points and signals operators (movements inspectors, pointsmen), customer care personnel, left-luggage personnel, service personnel (buildings cleaning, catering personnel)

*) Clearances to be observed at the ends of vehicles.

- ☐ The duration for which individuals are present within the range of action of the hazard must be taken into account for assessment of the urgency for measures. The urgency for measures must be interpreted as a process variable of rail transport in the sense that it is to reflect the frequency of occurrence of individual operating procedures.
- ☐ The hazard variables are defined as shown in Table 4.
- ☐ The classification of the hazard of an activity selected here does not correspond to the definition of hazardous activities contained in § 36 Para. 1 of VBG 1 [12].
- ☐ The assignment of discrete operations (DOs) to locations typical of the railway industry represents a basis by which conclusions can be drawn regarding hazards arising within the scope of the operating procedures.

Table 4: Grading of hazard variables

Injuries	Frequency of injuries	
	Major	Minor
Fatal	Serious hazard (seh)	Serious hazard (seh)
Major	Serious hazard (seh)	Hazard (h)
Minor	Hazard (h)	Slight hazard (slh)

Hazards specific to rail traffic can thus be described and classified by their nature and frequency according to Table 5. Occupational accident statistics were employed to assist classification. To this end, a survey of examples (reported accidents) performed by the BG BAHNEN for shunting and loading operation [13], a survey performed by the railway accident fund (EUK) on shunting operation within an area of DB AG [14] and the 1997 annual occupational safety report for the local and main-line areas of business of the DB AG [15] were also

Table 5: Classification of hazards specific to the railway industry

Location		**DO1** Operation, use	**DO2** Changing position	**DO3** Climbing onto, off or over work equipment/obstacles	**DO4** Standing, sitting	**DO5** Checking, observing
In the loading gauge *)	1	seh	–	seh	seh	–
At the tracks (within the specified clearance gauge)	2	seh	seh	(seh)	seh	seh
Close to the tracks (adjacent to / between the tracks)	3	h **)	h	h	h	h
In the vehicle – Moving – Stationary	 4a 4b	 slh slh	 h slh	 – –	 slh slh	 slh slh
At the vehicle – Moving – Stationary	 5a 5b	 h slh **)	 (seh) h	 seh h	 seh h **)	 h slh
In traffic areas	6	slh **)	slh **)	slh **)	slh	slh
In enclosed areas	7	slh **)	slh **)	slh	slh	slh

*) Clearances to be observed at the ends of vehicles.

**) Other components, for example lifts and horizontal conveyors, loading tackle, freight, damaged surfaces, present (additional) potential hazards.

evaluated for this purpose. The data concerned are shown in Table 6.

The data are not universally comparable. The condition of the roads and paths, particularly in conjunction with the other conditions relating to boarding and alighting, is evidently a key aspect, however.

Table 6: Selective aspects from the accident incidence statistics

Task field	Activity	Workplace	Proportion of accidents
Shunting and loading operation (BG BAHNEN, Sample: 741 accidents)	Alighting from locomotive or carriage	Drivers Shunting gang	24 %
	Coupling	Shunting gang	12 %
	Walking - shunter's lineside walkway, railway track	Shunting gang Loading personnel etc.	12 %
	Travelling in locomotive or carriage	Shunting gang Shunting engine driver	8 %
	Leaving/entering the loading gauge	Shunting gang	5 %
	Boarding engine or carriage	Drivers Shunting gang	5 %
Task field	**Cause**	**Workplace**	**Proportion of causes**
Shunting and loading operation (BG BAHNEN, DB AG Hamburg)	Twisting of the foot	Shunting gang etc.	30 %
	Slipping on a surface	Shunting gang etc.	10 %
	Slipping off a surface	Shunting gang Shunting engine driver	7 %
	Change in acceleration	Shunting gang Shunting engine driver	8 %
	Technical defects	Shunting gang Loading personnel etc.	14 %
Train operation	**Activity**	**Workplace**	**Proportion of accidents (ML/LT)**
Mainline/ passenger traffic Local services DB AG	Walking/travelling on lineside walkways	All	25 %/14 %
	Boarding, alighting, entering, exiting	Train crew	22 %/22 %
	Coupling	Shunting gang Drivers	10 %/8 %
	Running around	Shunting gang	7 %/10 %
	Ticket validation	Guard	7 %/14 %
	Opening/closing of windows and doors	Guard etc.	5 %/8 %

2.3 Existing regulations and requirement for regulation

The objectives of health and safety regulation of system elements and components include the following:

- ☐ Individual components of installations and vehicles in the railway industry must be designed and rated such that they can be operated, used and maintained properly under acceptable conditions. This means that hazards to persons must be excluded (to the extent possible) under normal service and operating conditions. Controls which are operated at infrequent intervals and which present no risk of injury are deemed to be not relevant to safety.

- ☐ Mutual compatibility must be considered in the case of rolling stock. This includes, for example, assurance of operation of the drawing and buffing gear, brakes, and other interconnections between vehicles.

- ☐ The interaction between the vehicle and the permanent way includes the safeguarding or prevention of activities and the presence of persons within the clearance to be provided at the vehicle extremities, the clearance gauge, and the vicinity of the wheels and rails.

- ☐ The particular conditions of rail transport require specific regulations governing the use of machinery and equipment, for example loading and conveyor gear employed during the loading and unloading of freight cars.

- ☐ Either the emissions (noise, dust) arising in operation must be kept so low that no hazards can arise, or suitable protective measures must be put in place.

These objectives are addressed by a hierarchical body of regulations containing a number of individual regulations of different types which are largely independent of each other. Fig. 4 shows the regulations governing occupational health and safety which are of direct or indirect relevance to the railway industry within the context of regulatory practice as a whole. It can be seen that:

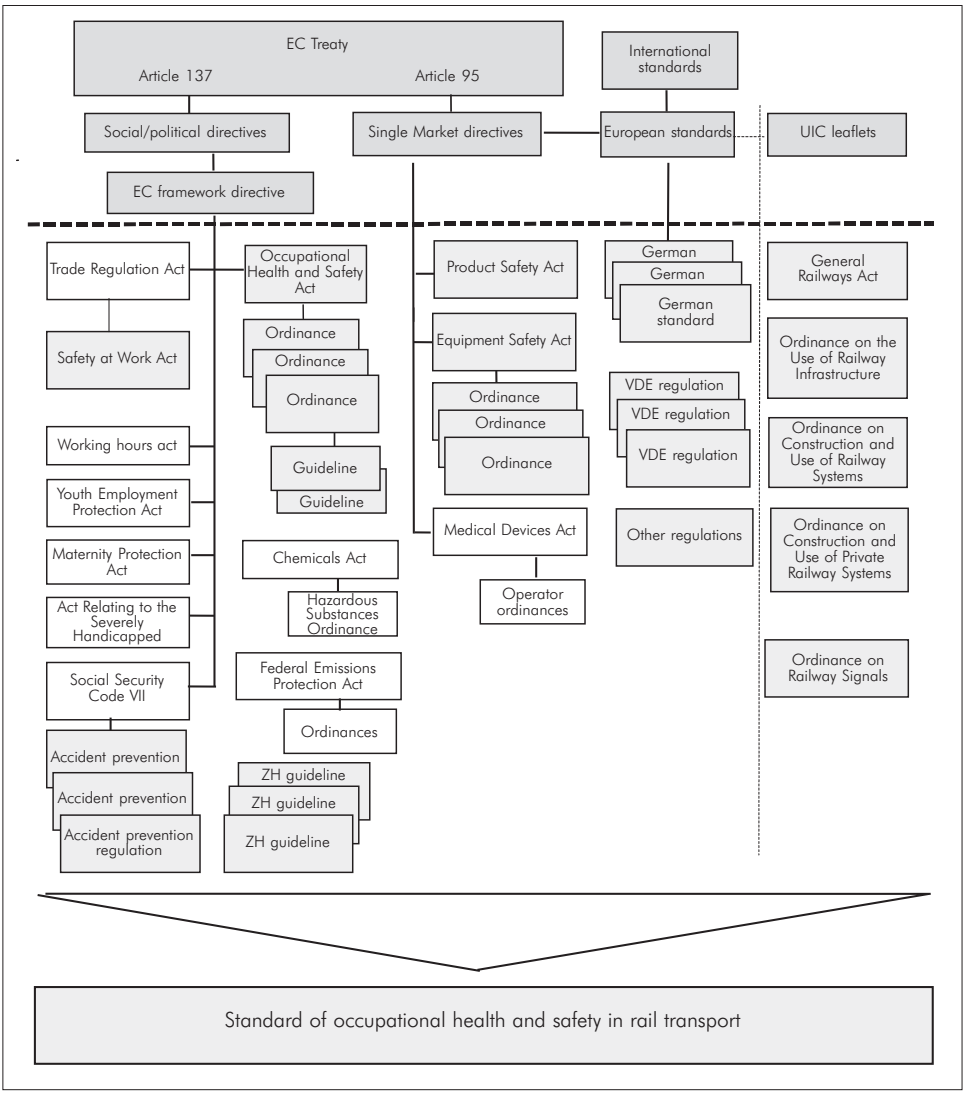
1. regulations governing the railway industry (transport law and company regulations) with a bearing upon occupational health and safety must be taken into consideration in addition to occupational safety regulations;
2. the effect of standards applicable to other areas and sectors must be considered in equal measure with those relating to occupational health and safety in the railway industry.

For the sake of clarity, generic interdependencies have not been reproduced in full. Where relevant, attention is drawn in specific cases to such interdependencies in the context of conclusions concerning the efficacy of the regulations during the search for redundant and contradictory provisions.

The following interrelationships are of particular importance:

- Article 95 of the EC Treaty forms the basis for Single Market directives which also define occupational health and safety objectives, which in turn are to be specified in technical terms within harmonized standards.
- Article 137 of the EC Treaty forms the basis of European Directives governing occupational health and safety, the objectives of protection of which are to be reflected in standards only in a certain respect. This is also a consequence of the German Consensus statement on Standardization in the area of the directive is pursuant to Article 118a of the EC Treaty (cf. [16], Appendix 3) and the European Commission's memorandum concerning the "Role of standardization in relation to Article 118a of the EC Treaty" (cf. [16], Appendix 4).
- Statutory provisions (legislation, ordinances), accident prevention regulations and other regulations present a (high) standard of occupational health and safety in Germany, which must be at least preserved when European Directives are transposed. Proposals for European standards should therefore be based upon existing German regulations where possible.
- The system of accident prevention regulations and statutory accident insurance companies, which since 1994 has included a legislative aspect in the form of the railway accident fund(EUK), is regarded as a yardstick for occupational health and safety objectives(German safety standard). Critical examination is required with regard to the fact that where contradictions arise between individual provisions, they must be eliminated, and any remaining requirements governing product characteristics must be transferred to the harmonized European body of standards.
- The UIC leaflets provide railway companies and infrastructure operators with a body of regulations by means of which the conditions can be put in place for assurance of operation beyond network limits. These rules are also implemented widely in the railway industry.
- The UIC leaflets are of great significance for European standardization of the mechanical area of the railway

Fig. 4: Body of regulations of relevance to occupational health and safety in rail transport



industry, as the technical principles which they contain have by and large been incorporated into the standards. Co-operation between CEN and UIC in this field is governed by a CEN/UIC memorandum [17]. A similar agreement exists between CENELEC and UIC. This enables reference to be made in European standards to UIC leaflets and vice-versa, within certain constraints. UIC leaflets can also be incorporated virtually completely into the EN body of standards.

In order to permit assessment of the requirement for regulation in European standards relevant to occupational safety, the state of regulation must first be surveyed. A wide range of primary and secondary data sources were consulted for this purpose. A systematic procedure required the introduction of suitable search terms. These are based upon criteria of relevancy which adequately represent occupational health and safety. Relevant databases and summaries were therefore used, in order to reduce the scale of the survey, and because access to the regulations is often difficult, for both technical and financial reasons. The following sources were consulted:

☐ For **European Union Directives**:

- The wording of EC directives in the Official Journal of the European Communities, Part L (cf. [EM2])
- Compilation of relevant directive titles in the Appendices of [19] and [16]

☐ For **standards**:

- DIN catalogue of technical rules 1998
  Volume 1 (German standards and technical rules) [6]
  Volume 2 (International standards and technical rules) [22]
- Beuth catalogue for DIN, ISO, VDI [EM3]
- Catalogue of standardization projects of CEN/TC 256 [23]
- VDE regulations [EM4]

  The standards texts were viewed in the standards library of Dresden Technical University.

☐ An index of the **UIC leaflets**, divided into sections, can be found on the RailLexic CD-ROM [EM1]. Updates are available from UIC's website [EM5].

The leaflets were viewed at the collection held by the DB AG's research and technology centre in Minden. This collection is continually updated.

The **railway laws and ordinances** applicable to railway transport in Germany

for which relevance to occupational health and safety can be demonstrated were also considered in the survey of statutory provisions.

The following regulations with primary or secondary occupational safety objectives were analysed. Primary occupational safety objectives for example may be implemented by BG regulations, or contained in user instructions and instruction handbooks. Such regulations are based upon:

- ☐ EC Framework Directive 89/391 "on the introduction of measures to encourage improvements in the safety and health of workers at work",
- ☐ the German Occupational Health and Safety Act (§ 12 ArbSchG),
- ☐ the "general regulations" of the German accident prevention regulations (UVV) (§ 2 VBG 1), and
- ☐ the special accident prevention regulations (VBG).

Regulations embodying secondary occupational health objectives include for example service instructions in accordance with § 24 EBOA or the company codes of practice of the DB AG.

The relationships between laws, ordinances, accident prevention regulations and other regulations in the area of occupational safety and of rail transport on the one hand and standards (DIN, DIN EN) on the other, which in many cases exist but in others may be lacking, were surveyed and evaluated in terms of the specific objective of the study.

The individual regulations and draft regulations were selected by way of:

- ☐ the relevance of the system elements and components in the overview provided in Appendix 1 to tasks and to safety;
- ☐ the areas of activity and standards projects of specific relevant standards bodies (DIN FSF, CEN/TC 256; DKE K351, CENELEC/TC 9X);
- ☐ definition of indirect relevance (for example work equipment or protective clothing which is also employed in the railway industry).

[18], p. 32 and [19], p. 76 contain a selection of terminology for occupational health and safety, both general and specific to certain directives, which was employed for the present study. The technical component of the search selection is derived from terms for elements and components of rail transport which define the area forming the subject of the study.

The relevance of the individual regulations to occupational health and safety in the railway industry is established by means of the algorithm shown in Fig. 5.

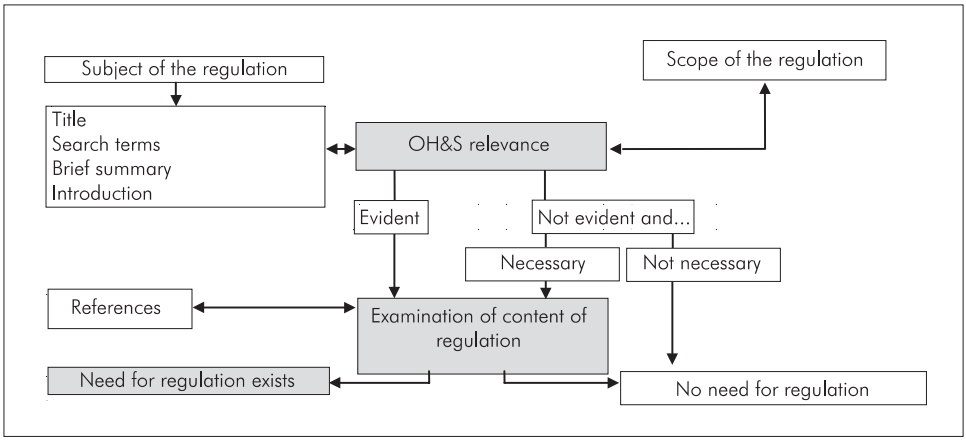
Regulations and regulation projects were classified and evaluated as follows:

- ☐ The regulations are adequate/comprehensive: no requirement for regulation exists.
- ☐ The regulations are deficient: the requirement for regulation must be stated.
- ☐ No pertinent regulations or regulation projects have been identified: the requirement for regulation must be stated.

Such conclusions require that the occupational health and safety objectives be clearly identifiable or predictable in regulations. **Relevance to occupational health and safety** was defined as follows for this purpose:

- ☐ **Identifiable from the title:** use of terminology related to occupational safety
- ☐ **Predictable from the subject of regulation:** subjects of regulation relevant to tasks and activities
- ☐ **Content:**
  - Safe operations and the avoidance of hazards are stated explicitly (direct occupational safety regulation)

Fig. 5: Algorithm for review of existing regulations



- Technical solutions enable the absence of hazards to be recognized without express reference to the fact (indirect occupational safety regulation). Dimensions and operating principles (clearly) satisfy the requirements

☐ Governed by references: comparison of the content of the referenced standard with regard to relevant safety provisions

☐ Assessment of the regulation:

- The standard complies with the state of the art; hazards are excluded.
- Terms of reference are special safety and/or protective measures.
- Terms of reference are organizational regulations.

A further criterion for assessment of the quality of the regulation in this context is the **relationship to EC directives**: the occupational health and safety objectives must be related to Articles 95 and 137 of the EC Treaty and the derived directives.

☐ **Directives pursuant to Article 95** contain requirements for the characteristics of products. These are based upon a high level of protection in the areas of health, safety, environmental protection and consumer protection, where relevant to the free movement of goods. The requirements are to be transposed directly into European standards.

☐ **Directives pursuant to Article 137** contain minimum requirements for occupational health and safety. They must be implemented and where appropriate surpassed by each country concerned. This excludes by definition implementation in the form of European standards. Principally affected are the requirements concerning the safety and health of workers at work, which are not to be implemented in the form of EN standards. EN standards are compatible with general user requirements.

On the basis of the German Consensus Statement, a distinction is to be drawn according to whether the content of regulations can be governed in standards. The decision taken in this respect is supported by the (example) content shown in Fig. 6.

One premise for the terms of reference for the study is that a system element (for example the shunting engine) is at one and the same time a machine, an item of work equipment, and a workplace. Combinations of this kind result in multiple references to EC directives which

were issued and must be transposed in accordance with Article 95 or Article 137 of the EC Treaty. If the relationship to a directive forms an essential characteristic of a European standard, this may also be applied to the subjects and content of other types of regulation, for example UIC leaflets, with regard to the objectives of protection to be implemented.

The result of the survey of standards and standards projects and of UIC leaflets with regard to their relevance to occupational health and safety thus contains a denotation of their relationship to directives as follows:

☐ PR and a code denoting the EU directive in question for regulations which define product characteristics;

Fig. 6: European standards relating to occupational health and safety (cf. [16] and [20])

Type of standard	Content of standard
Standards governing the health and safety of workers at work Basis: generally without reference to directives; exceptions: directives pursuant to Article 137	● Terminological standard (concepts, definitions) ● Procedures for assurance of comparability of a given safety level (test, measurement and sampling procedures) ● Characteristics of safety markings, hand signals, emergency signals ● Requirements for operating instructions/instruction handbooks ● Modules summarizing characteristics for the selection of equipment, procedures, technical apparatus ● Design procedures ● Emission values ● Manufacturer's information
● Not operating instructions (certain procedures, organization) ● Not safety-related provisions (affixing of safety markings, equipping with secondary safety technology) ● Not classification in the interests of risk identification, inspection cycles, emission impact limit values → Regulations within the area of the health and safety of workers at work	

☐ BA for regulations containing user requirements and

☐ BE for regulations containing requirements governing the safety and health of workers at work.

With respect to their degree of generalization, the regulations are organized in the hierarchical structure of the standards from the general to the particular. Standards governing machinery represent an example of such a classification (cf. EN 292-1). In accordance with the particular purpose of the present study, a classification of this kind can be implemented from two different aspects:

1. with regard to the level of detail of the safety objectives;
2. with regard to the subjects of regulation: general (technical) components or components specific to rail transport.

Table 7 shows clearly that this classification must be applied on two levels (cf. [21], p. 85 f).

It can be assumed that the provisions governing the characteristics of other products can also be classified[1]. This fact is to be exploited for classification during the study.

Table 7: Classification of standards

Type	Standards and subjects of regulation	Technology general	Rail transport
A	**Fundamental safety standards** Basic concepts, principles for design, general aspects	X	X
B	**Group safety standards** For one safety aspect, one type of safety-related device	X	X
B1	**Special safety aspects** (e.g. safety distances, surface type)		X
B2	**Safety related device** (Two-hand control, interlock, pressure-sensitive mat, guard)		X
C	**(Machine) safety standard** (Detailed safety requirements upon a certain machine or group of machines)		X

[1] This is rejected, and the reasons for the rejection stated in [25], p. 92, for PPE standards.

2.4 Use of special resources

The following resources were created and prepared for the analysis:

1) Overview of system elements and regulations

The regulations selected in the result of the survey in Appendices 4 to 7 are cross-referenced to the system elements and components listed in Appendix 1. The general overview is intended to indicate:

- ☐ what subjects of regulation are covered by international/European standards, German standards, UIC leaflets and other national regulations;
- ☐ accordingly, where there are deficiencies in regulation, repetitions and a need for harmonization. Specific conclusions are drawn in consideration of the class and type of the regulations.

2) Formulation of the job profiles

The structure of the job profiles serving as a practical tool for classification is presented by way of an example in Fig. 7.

The job profiles are selected in direct relation to the task fields and operating procedures contained in Appendix 2. The procedure for compilation of the job profiles is subject to the following:

- ☐ Each job profile applies to one operating procedure in a specific system environment (system element, components). Differentiating factors are derived from differences in process arrangement (e.g. the use of auxiliary materials) and conditions (e.g. work equipment, tools). In consequence, selection of the job profiles is also dependent upon specific designs of controls, working equipment, and tools (e.g. the load).
- ☐ Without completeness being an objective, the aim is to
  - group comparable operating procedures in typical job profiles;
  - exclude technical obsolescence where possible;
  - include technical innovations where practical, and
  - consider quantifiable and/or potentially recognizable hazard levels retrospectively.
- ☐ The system elements/components (i.e. those relevant to the task) in Appendix 1 (resources, equipment and auxiliary materials) are covered by 59 job profiles in the context of the discrete op-

Fig. 7: Structure of the job profiles

Job profile A2d:	Train operation - Performance of running - Driving train			**Workplace:** Engine driver	
Description:	Task of the engine driver during running of the train, from reception of the departure signal to braking at the next stop				
	Discrete operations (DO)				
	DO1 Operation, use	DO2 Changing position	DO3 Climbing onto, off or over work equipment	DO4 Standing/sitting	DO5 Checking/ observing
Elements	Control panel			Driver's cab Driver's seat	Signals, route, train
Conditions	Ease of reach Ease of control			Design quality, climatic conditions Layout and design	Visibility conditions
Hazard level	Slight hazard			Slight hazard	
Objective of regulation	Ergonomic design			Ergonomic design	
Standard of regulations:					
Standard-ization EN					
DIN	33411-1 to -4			5510-1 E 5566-1, -2, -3	
UIC leaflets				553 , 617-5 to -7 642 , 651	
Acts/ ordinances				ArbStättV EBO, EBOA, BOA	
Other regulations					
Assessment:	The DIN draft standards are based upon national regulations governing ergonomics and rail transport, and upon UIC leaflets. EN projects for the design of drivers' cabs should be supported or launched on this basis and in the interests of interoperability.				
Remarks:	Drivers' cabs are the workplaces of engine drivers. They must meet general requirements and be suitable for particular fields of application.				

erations which give rise to the hazards.

☐ These system components were selected in accordance with Chapter 2.1 with respect to their relevance to occupational health and safety.

☐ The hazard level of the discrete operation was determined in accordance with Chapter 2.2. Objectives of regulations for the promotion of occupational health and safety were extrapolated.

☐ A description of the selected operating procedures and the hazards related to them is provided in Appendix 8.

☐ The measures which will best enable the identified hazards to be overcome are to be stated as the objectives of regulation.

☐ In order to ascertain the state of regulation, the regulations selected according to Chapter 2.3 were cross-referenced to the system components employed in the discrete operations. The state of existing and planned regulations was therefore demonstrated initially for the purpose of analysis in order to ascertain whether occupational health and safety are assured within the scope of the task fields and operating procedures, and if so, by what means. Reciprocal relationships between regulations had to be observed. The relationship of European and international standards to the UIC leaflets[2] was accorded particular attention here, with the stipulation that clarity and simplicity be promoted.

☐ The assessment entailed evaluation, in accordance with the principles stated in Chapter 2.3, of

- whether there is a general dearth of requisite standards;
- whether hazards are reduced by the existing or planned standards;
- whether European and German statutory and other regulatory provisions are met by the existing or planned regulations;
- whether and in what way the existing or planned regulations meet the requirements for efficiency in terms of their hierarchical status and avoidance of redundancy.

☐ Recommendations for European standardization activity were extrapolated from these evaluations. Owing

[2] It must be borne in mind that manufacturers are never and OH&S institutions seldom involved in the drafting of UIC leaflets.

to the limited scope of the analyses possible within this study, there is no question of it representing comprehensive demonstration of all aspects and requirements relevant to occupational health and safety.

3 Status review of regulations relevant to occupational health and safety

The systematic selection and compilation of regulations relevant to rail transport and with a bearing upon occupational safety represents one result of the study. This compilation, contained in Appendices 5 to 7, provides a quantitative summary of the state of regulation. It forms a basis for assessments and conclusions.

3.1 EC directives

Appendix 3 lists a total of 32 European Community directives for which an objective of protection in the area of occupational health and safety can be demonstrated, in the form of Single Market directives (in accordance with Article 95 of the EC Treaty) or of occupational safety directives (in accordance with Article 137 of the EC Treaty). Furthermore, directives regulating rail transport have been included in order for consideration to be given to their relevance to occupational safety. No projects are known to be currently in progress for new directives which could be included within the scope of the study.

The standards and standardization projects and the UIC leaflets were denoted as follows, in order to document relevance to the directives as an essential characteristic of the European standards:

- ☐ PR: regulations governing product characteristics (directives pursuant to Article 95 of the EC Treaty);
- ☐ BA: regulations governing user requirements (directives pursuant to Article 137 of the EC Treaty);
- ☐ BE: regulations containing requirements for the safety and health of workers at work, which must not be made the subject of EN standards.

In this respect, the authors point out that rail vehicles, for example, being a form of transport, do not fall under the scope of the directives governing machinery and workplaces. In terms of their function, however, they serve as work equipment, workplaces and machines. It follows that both the objectives of protection of applicable directives pursuant to Article 95 of the EC Treaty and the minimum provisions of the directives pursuant to Article 137 must be considered accordingly in the present context in the sense of the German Consensus Statement.

3.2 Standards and standardization projects

Appendix 4 contains 160 German, 156 European and 56 international standards and standardization projects which were selected in accordance with Chapter 2.3

3 Status review of regulations relevant to occupational health and safety

Tabel 8: Checklist for OH & S provisions within standards

PR	**Product characteristics (referencing to EC directives)** Product characteristics standards	Assessment of the existence and necessity of provisions governing occupational health and safety
1	Low-voltage (73/23/EEC)	
2	Machinery (98/37/EC)	Refer also to PR 11
3	Electromagnetic compatibility (89/336/EEC)	Often excludes OH&S
4	Personal protective equipment (89/686/EEC)	Characteristics of PPE
5	Construction products (89/106/EEC)	
6		
7	Wire-ropes, chains and hooks (73/361/EEC)	
8	Limitation of noise emitted by loaders and excavators (86/662/EEC)	
9	Appliances for burning gaseous fuel	
10	Simple pressure vessels (87/404/EEC); pressure equipment (97/23/EEC)	
11	Electrically operated lifts (84/529/EEC)	Refer also to PR 2
12	Railways (91/440/EEC, 95/18/EEC, 95/19/EEC) 96/48/EEC)	Refer also to BE 2
BA	**User requirements** EC directives imposing user requirements (Article 137)	User requirements based upon standards
1	Definition of terms relating to the safety and health of workers at work	Terminology
2	Test methods, measuring, analysis and sampling procedures, statistical methods, safety markings and warning labels	Testing and measurement
3	Guide to the selection of work equipment, personal protective equipment: not workplace design	Selection of PPE
4	Requirements for training, qualification criteria: not quality requirements for supervisory personnel	
5	Specification of test obligations for operators	Test obligations
BE	**Requirements governing the health and safety of workers at work** (need for action with respect to the provisions of Article 137)	Relevance to occupational safety is related to the health and safety of workers at work, and should not be reflected in the standards
1	Methods for plant organization (instructions on behaviour, selection of working methods) (89/391/EEC + individual directives) Development of the Community's railways (91/440/EC) Interoperability (96/48/EU)	Interface design Refer also to PR 12
2	Requirements for the design of workplaces (selection of equipment or PPE) (89/686/EEC; 86/663/EEC)	
3	Definition of limit values for occupational exposure (exposure limit values for persons at work) (80/1107/EEC; 91/322/EEC; 96/94/EC)	
4	Requirements for qualifications of personnel employed in a supervisory function	
5	Other requirements for the health and safety of workers at work	

and the corresponding algorithm shown in Fig. 5. Information concerning the relevance to occupational health and safety was sought by consultation for standardization projects in the area of rail transport (indicated in some cases only by the project number).

The relevance to occupational safety is documented firstly by the referencing of operating procedures and system elements, and secondly by the declaration of safety-related objectives. The safety objectives (/level) stated in the respective standard were evaluated according to whether the regulation influences safe and non-hazardous use/operation of the subject of regulation

☐ directly, adequately

☐ indirectly, adequately

☐ inadequately

in accordance with the state of the art. This evaluation is based upon the results of participation of the "Occupational Health and Safety" group[3] in standardization projects of CEN/TC 256.

The standards are denoted by category (cf. Chapter 2.3 and Table 8) and type (cf. Chapter 2.3)

3.3 UIC leaflets

Appendix 5 contains 106 UIC leaflets. The leaflets were selected in the first instance according to whether

☐ the title indicated a relationship to the scope of the study, and

☐ the subject of regulation and/or study could be assigned to the task fields (Appendix 2) and discrete operations.

The leaflets included in this (comprehensive) preliminary selection were examined individually according to the following criteria:

☐ Can the actual objective of regulation be linked to functions of occupational health and safety?

☐ Must occupational health regulations be observed?

- The leaflet governs design and/or equipment; explicit interests of safe control and handling are considered in the objective and/or in the content.
- The leaflet addresses the process; the interests of safe operation and handling are considered.

☐ Are the regulations adequate from the aspect of occupational health and safety?

[3] Now: internal OH&S advisory group in CEN/TC 256.

Operating procedures were referenced to system components. The category and type of regulation of each leaflet were defined in accordance with Chapter 2.3 and by comparison of the respective subject of regulation. The dates of issue or amendment are indicated in order to permit assessment of the immediacy, and the leaflet status code (V for obligatory, E for recommendatory and I for informatory) to permit assessment of the respective qualification for efficacy.

3.4 Legislation and ordinances

Appendix 6 contains 22 German laws and ordinances, on the one hand with a specific objective of occupational safety (relationship to EU directives) and on the other for railway transport with general relevance to occupational safety, together with 15 accident prevention regulations.

3.5 Further regulations

Appendix 7 contains a summary of 45 national regulations which are to be included within the framework of the study. This is documented by the relationship to operating procedures.

The respective safety objectives of regulations which do not have occupational safety as their terms of reference were the subject of a separate survey.

4.1 Evaluation

The state of and need for standardization can be evaluated in two respects. (Refer to the resources described in Chapter 2.4.)

1. On the one hand, the study examines the extent to which elements and components of rail transport are covered by existing and planned regulations with respect to occupational health and safety. Appendix 1 cross-references the individual categories of regulation to the elements and components.

- ☐ This method provides a relatively general overview of the scale of the body of regulations in terms of the various categories.
- ☐ The extent to which occupational health and safety requirements are covered by the regulations, if at all, is evaluated qualitatively where practical.

2. On the other hand, the study examines the extent to which, if at all, occupational health and safety is assured within the framework of the task fields and operating procedures (Appendix 2) by the regulations listed in Appendices 4 to 7, which were selected by different criteria.

A requirement for standardization is presented in the first instance by discrepancies between the safety objectives specified in the EC directives and the body of standards.

A further need for standardization is defined by the requirement for harmonization which can be derived from existing regulations and directives. This concerns both unambiguous referencing to the directives in accordance with Articles 95 and 137 of the EC Treaty, and the systematic avoidance of redundancies in the system of regulations, both nationally and internationally.

A review of the relationship of European or international standards to the UIC leaflets is of particular relevance here, a stipulation being that clarity and simplicity be promoted. A corresponding agreement between CEN and UIC forms the basis of this review (cf. [17]).

The review must also evaluate whether regulations conform with the responsibilities for legislatory and other regulatory activity in Germany, and whether and in what way they satisfy the requirement for efficiency in their hierarchical classification and the low redundancy of organization. At the same time, it will of course become apparent should relevant regulations be completely absent. Basic regulations which are applicable to a number of system elements and the

influence of which is increased by reference/citation require particular attention in this context.

A requirement for European standardization/regulation is to be identified which can be classified within the defined technical and statutory framework and which contributes to the implementation of systematic organization and clarity. This framework is characterized in particular by European legislatory drafting practice and the German Consensus Statement on standardization in the context of directives pursuant to Article 118a of the EC Treaty.

The level of regulation is documented in each case by way of job profiles. For the purpose of formulation and substantiation of a requirement for standardization, the job profiles of the individual groups are summarized, in consideration of the suitability and facility for use of different forms of regulation.

Conclusions regarding a requirement for standardization are first drawn for complex system elements and subjects requiring basic occupational safety regulations. The pertinent European, international and national regulations are then considered for system components, which are referenced individually in job profiles to a specific task framework. Deficiencies in regulation in European standards relevant to occupational safety are established in accordance with Chapter 2.3 and characterized by their hazard level (cf. Chapter 2.2 and Appendix 8). Particular importance is attached here to consideration of trends in technological development.

4.2 Complex system elements

As complex system elements, railway vehicles and installations are considered with the objective of compliance with basic occupational safety requirements independent of the requirements of specific activities.

Railway vehicles

An essential premise for safe behaviour in connection with railway vehicles is uniform standardization of the **clearances to be provided at vehicle extremities**. This aspect becomes increasingly important as European high-speed rail transport is extended.

Draft standard DIN 27505 is proposed as a basis for a corresponding EN project in conjunction with further transposition of the directive on the European network of high-speed trains (96/48/EC), and is to incorporate the content of UIC leaflets 505-1, 505-4 and 506 in the process.

Rail vehicles must be of functionally safe design for international use in terms of interoperability (not only for high-speed use) and must meet the minimum requirements applicable to workplaces and working equipment. Workplaces (e.g. on locomotives, in coaches) are occupied periodically by employees of other German companies and also of foreign companies which are not subject to the German regulations.

The authors propose that the particular requirement for harmonization of standards which exists in this regard and the specific requirement for co-ordination of the health and safety of workers at work be made the subject of further clarification.

Requirements for the design and operation of coaches and their components exist in the interests of the health and safety of both passengers and employees. It may be assumed that occupational health and safety interests will in the main already be covered adequately by obligations to assure preventive measures within public transport.

Requirements for rail vehicles in the areas of:

☐ protection against fire;

☐ noise;

☐ emissions of harmful substances;

☐ electrical hazards

are not defined by ISO, IEC and CEN, and by DIN and DKE standards adequately, if at all, specifically for rail vehicles. Emissions standards for diesel-powered stock, for example, still do not exist. The relevant recommendations of the ERRI (Project 226) and activities of UIC (action plan) should serve as a basis for standardization activities.

EN 50110 (operation of electrical installations) does not extend to vehicles and railway systems. Application of this standard to these areas is however recommended.

The authors propose that an EN standardization initiative for the implementation of interoperability requirements for electrical powered stock be based upon this recommendation, and that it incorporate pertinent VDE regulations governing electrical safety.

Freight cars must fulfil multimodal functions with regard to automated integrated transport chains and combined transport systems; these functions must ultimately also take occupational health and safety requirements into account. This requirement is reflected for example in standards the purpose of which is to support

the organization of integrated transport chains by specification of the characteristics of individual components (freight cars, load units, loading tackle, loading installations) in terms of their compatibility, fitness for function and safety in use.

The authors propose that the DIN 30800 series of standards, for example, which govern the organization of transport chains, be incorporated together with their occupational safety philosophy into adequate European standardization projects.

Railway installations

Hazards may arise on railway installations as a result of vehicle movements, in particular with regard to the observance of the specified clearance gauge, distance between centres of lines, side safety clearances, the characteristics of lineside walkways, including shunter's lineside walkways, and the loading installations.

Principles are specified at national level in Germany for design of the specified clearance gauge (§ 9 EBO) and for the distance between centres of lines (§ 10 EBO, and § 11 VBG 6).

The requirement for European standardization in conjunction with interoperability on the high-speed train network concerns the assurance of (additional) clearances for constructional and operational purposes similar to that described above with regard to clearances to be provided at vehicle extremities.

As far as occupational safety is concerned, clearances intended for operational purposes and distances between the centres of lines must be assured such that individuals working there are not exposed to hazards, and regulations governing behaviour can be reduced to a minimum. Ultimately, this has a bearing upon the design of workplaces. Occupational safety provisions, where they need to be defined in this context, are a company function.

The authors propose that, in the interest of the international deployment of personnel, workplaces specific to rail transport be defined and minimum requirements upon their design be laid down in European regulations.

Technical developments in rail transport are reducing the amount of work carried out at the tracks; the working equipment employed is also changing. This development requires corresponding review and adjustment of existing standards, also at an international level.

Requirements for the characteristics of lineside walkways and loading platforms

are contained in the Ordinance on Working Premises, in VBG 1 and VBG 11/GUV 5.6, and also in the EBO. With regard to occupational safety, the surfaces of the lineside walkways in particular must be taken into account, in order to ensure optimum conditions for the boarding of and alighting from footboards and entrance platforms on rail vehicles and for walking on lineside walkways. The top surfaces for lineside walkways are defined for example as construction measures (DIN 18315, DIN 18317).

The authors recommend that these requirements be compiled, free of anomalies, as an object of standardization and that they be included in corresponding European standardization projects.

4.3 System components for specific activities

The conclusions below, which are grouped according to task field, are based upon the job profiles defined and evaluated according to Fig. 7 for task fields and operating procedures (cf. Appendix 2).

Where system components are employed as the subject of regulation in a number of cases by activities of a similar nature, a requirement for standardization is stated only once.

A1 Train operation/preparation for running

Description of the problem:

The key issues with respect to occupational health and safety are:

- ☐ **the conditions to be met for coupling of and travelling on coaches;**
- ☐ **the safety requirements for door systems of coaches;**
- ☐ the conditions to be met for coupling between tractive stock and coaches;
- ☐ **the design of the platform/rail vehicle interface.**

It is clear from the course of technical development that the brake test in its current form, and the associated hazards, can be consigned to the past when a rake of coaches can be checked by means of automatic brake-testing devices (EBAS).

State of regulation:

European standards (and standardization projects):

- ☐ **Door systems in rail vehicles (PrNr 256112)**

UIC leaflets:

- ☐ **Interaction between passenger rolling stock and fixed installations (UIC leaflet 508-1)**

- ☐ Clearance to be provided at vehicle extremities (UIC leaflet 521)
- ☐ Signal lamp brackets (UIC leaflet 532)
- ☐ Hose connections and electric cables – dimensions, positioning (UIC leaflet 541-2)
- ☐ Couplings for electrical and pneumatic lines on powered stock (UIC leaflet 648)
- ☐ Technical characteristics of the train bus (UIC leaflet)
- ☐ Doors, entrance platforms, windows, steps, handles and handrails (UIC leaflet 560)
- ☐ Means of intercommunication for coaches (UIC leaflet 561)
- ☐ General conditions for coaches (UIC leaflet 567)
- ☐ **Passenger stations – height of platforms (UIC leaflet 741)**

Relevant German regulations:

- ☐ Step/handle units for rail vehicles (DIN 1588).
- ☐ EBO stipulates in § 28(1) that two coupling handles must be provided beneath each frame end of a **freight car**.
- ☐ § 15(6) VBG 11 stipulates that two coupling handles must be provided beneath buffers of **rail vehicles** for coupling.

Recommendations:

European standards projects can be launched on the basis described above as follows:

- ☐ In the interests of interoperability and extension of the high-speed rail network, a new standardization project should be launched for design of the vehicle/passenger transport installation interface (in this case: platforms). With regard to occupational safety, the objective is for the transition between coach and platform to be as uniform and convenient as possible.
- ☐ The occupational health and safety advisory committee in TC 256 will submit occupational safety requirements for the design of the door systems to the project 256 112; these conditions must surpass the general requirements upon safety of operation.
- ☐ The German provisions governing coupling handles must be harmonized. No implementation in EN exists. At present, recommendation of an initiative can be justified only by the requirement that designs be ensured which permit uniform handling in all countries.

A2 Train operation/performance of running

Description of the problem:

a) Sedentary service

Sedentary service is not to be classed as an area of focus at present with respect to the hazard level and incidence of accidents. Track release duty and safeguarding of level crossings in their traditional form will progressively be consigned to the past. Technical and technological development is increasingly addressing aspects which draw attention to harmful physical and ergonomic effects upon health.

Concentration of the train protection and control function in a small number of electronic signal boxes, and management and monitoring of traffic in control centres, results in an ever-increasing number of computer screen workstations.

In the light of this, a review must address the extent to which the ergonomic design of control centres and the layout of control rooms is applicable specifically to applications in rail transport.

b) Train service

The driver's workplace is of interest with regard to both occupational health and safety, and will continue to be so in the future with regard to the requirements of interoperability in Europe.

Attention must be directed towards ergonomics and control of atmospheric conditions, in the interests of reliable completion of tasks and the avoidance of adverse effects upon health.

State of regulation:

UIC leaflets:

- ☐ **Control equipment on tractive stock (UIC leaflets 617-3, 625-5)**
- ☐ **Windows in driving compartments (UIC leaflets 617-4, 625-2)**
- ☐ **Special safety regulations for drivers' cabs of tractive units (UIC leaflet 617-5)**
- ☐ **Layout of drivers' compartments in powered stock (UIC leaflet 617-6)**
- ☐ **Conditions of visibility from driving compartments of electric powered stock (UIC leaflets 617-7, 625-6)**
- ☐ **Layout on drivers' cabs (UIC leaflet 651)**

German regulations:

- ☐ **Requirements for driver's cabs (DIN 5566-1 to 5566-3)**

Recommendations:

A European standardization project addressing the design of driver's cabs should be derived from the German project, and should incorporate the UIC leaflets.

A corresponding project has been launched by the Institute for Occupational and Social Hygiene (Foundation) (IAS) in Berlin (seminar held parallel to INNOTRANS 98, on 29 October 1998). The objective of this project is a modular concept for a uniform driver's cab for main-line and local services.

A3 Train operation/service on-board

Description of the problem:

The extent to which occupational health and safety regulations considered necessary for passengers are or could also be applicable to personnel presents a problem in this respect.

It is generally to be assumed that provisions for protection against fire are always in the interest of persons, irrespective of their status. It can further be seen that provisions governing ambient conditions and lighting expressly consider the interests of personnel.

State of regulation:

European standards:

- ☐ **Ride comfort for passengers – measurement and evaluation (EN 12299)**
- ☐ Air-conditioning for main-line rolling stock – comfort parameters (EN 13129-1, -2)
- ☐ Electric lighting for rolling stock in public transport systems (EN 13272)
- ☐ Fire protection on railway vehicles (EN 45545-1, -3, 50120)

UIC leaflets:

- ☐ **Catering on international trains (UIC leaflet 149)**
- ☐ **Guidelines for evaluating passenger comfort in relation to vibration in rail vehicles (UIC leaflet 513)**
- ☐ **Heating, ventilation and air-conditioning in coaches (UIC leaflet 553)**
- ☐ Electric lighting in passenger rolling stock (UIC leaflet 555)
- ☐ **Power supply installations for passenger stock (UIC leaflets 550, 552, 553, 557)**
- ☐ **Special comfort and constructional characteristics for sleeping and restaurant cars (UIC leaflets 565-1, -2)**

- ☐ Indications for the layout of coaches suitable for conveying disabled passengers in their wheelchairs (UIC leaflet 565-3)
- ☐ **Standard coaches accepted for running on international services – Characteristics (UIC leaflets 567-5, -6, -7)**
- ☐ **Directives for the drawing up of service instructions to assist staff in the use of equipment in coaches authorised to run on international services (UIC leaflet 584)**

DIN:

- ☐ Measurement of inside noise in railbound vehicles (DIN 45638)
- ☐ Preventive fire protection in railway vehicles (DIN 5510-1 to 5510-5).

Recommendations:

- ☐ The authors recommend that the design of coaches be safeguarded in a uniform manner, in particular against hazards arising from unanticipated changes in acceleration, by means of European product standards. The UIC leaflets indicated governing this issue should be transposed to EN standards for this purpose.
- ☐ A further fundamental issue for the implementation of interoperable conditions is uniformity of the apparatus fitted to the coaches, and standardization of its operation and monitoring of its serviceability. This aspect is relevant to occupational safety insofar as hazards arising from incorrect, unauthorized or untimely actions are to be avoided.

  UIC leaflet 584, "Directives for the drawing up of service instructions to assist staff in the use of equipment in coaches authorised to run on international services", could form the basis of an EN standard.

A4 Train operation/service in stations

Description of the problem:

Service tasks take place first and foremost in an occupational safety environment that is covered adequately by preventive measures for the protection of passengers. Additional hazards can be identified for certain tasks involving the use of equipment (luggage trolleys, elevators, wheelchair lifts). These components cannot be standardized expressly for use specifically in rail transport systems; they must be designed, for example, in accordance with general principles of machine safety, and must be introduced with the use of suitable service instructions.

Interfaces between such equipment and rail transport systems exist at door sys-

tems of passenger coaches, dining cars and sleepers.

Recommendations are referenced accordingly to the proposals for A2 and A3.

B1 Shunting operation/running around

Description of the problem:

Operating procedures with a high hazard level may be assumed in this instance. The following points may be emphasized:

- ☐ safety conditions for manual coupling;
- ☐ **conditions for remote radio control of rakes of wagons;**
- ☐ **the design of shunter's lineside walkways.**

It is clear from technical developments that coupling operations will be effected automatically in the near future or that uncoupling will be less hazardous when the pull-only coupler is employed. Where the requisite dimensions (loading gauge) are observed, the authors are of the opinion that standards initiatives are neither necessary nor possible in this case.

State of regulation:

European standards project **prEN 50239**, drawn up by CENELEC/TC 9X, stipulates **radio remote control** of powered stock together with safe design of the control operations and conditions, as the external occupational safety working group in CEN/TC 256 was able to implement the essential requirements of Publication 201 of the VDV (Association of German Transport Companies). This publication refers to controlled rapid deceleration. This avoids the shunting engine driver being subjected to unanticipated, sudden changes in speed.

German standards place requirements upon:

- ☐ **steps, handrails, gangways, working platforms (DIN 1580, 1585, 1588);**
- ☐ main dimensions of specific types of hauled stock (DIN 25250);
- ☐ freight cars, general (for regional use) (DIN 27150).

VBG 11 contains requirements for characteristics of rail vehicles in § 15 and provisions governing the characteristics of lineside walkways for persons on foot in §§ 5 and 8.

Relevant UIC leaflets are:

- ☐ **standardisation of steps, handrails and controls on wagons (UIC leaflets 535-1/-2);**

- ☐ standard wagons – characteristics (UIC leaflets 571-1 to 571-4);
- ☐ technical conditions for the construction of tank wagons (UIC leaflet 573).
- ☐ UIC leaflets 779-1 and 779-11 address aerodynamic considerations, but largely exclude any occupational safety requirements.

Recommendations:

- ☐ Safe design of the remote radio control for the shunting engine driver means conversion of the shunter's riding platform to a control console which assures safe boarding and alighting, and safe standing and grip for operation of the radio remote control with one hand. Requirements upon the characteristics formulated in § 15(4) VBG 11, and the safe design of the step/grip unit specified in UIC leaflet 535-2, are suitable for inclusion in a European standard. A corresponding project should be launched.
- ☐ Requirements for lineside walkways in railway track areas which are subject to different safety clearances and surface characteristics according to their different uses should be made the subject of a European standardization project. The increase in high-speed traffic presents increasing safety requirements for such lineside walkways.

B2 Shunting operation/fly shunting

Description of the problem:

The job profiles form a sub-process in which system components are present which have proved their suitability over decades, but which will evidently be required less and less frequently in future. They present little basis for a need for regulation.

VBG 11 contains requirements for the characteristics of drag shoes (§ 14), which are now unlikely to be incorporated into future European standardization projects. In order to lay and retrieve the drag shoe, the shunter must stand directly in the path of vehicles. Requirements are presented for behaviour on the one hand and for the condition of the shunter's lineside walkways on the other.

Communication between the parties involved is the focus of fly shunting. Suitable communications facilities must be specified as a function of the incidence of the discrete operations concerned and the local conditions. In the case of verbal communication with the pointsman, the latter is often subject to variations in temperature at the open window, and is thus exposed to a health risk.

B3 Shunting operation/gravity shunting

Description of the problem:

Gravity shunting can to a large extent be automated. The remaining requirement for personnel to stand in the path of vehicles can be reduced even further. The system components involved in conjunction with discrete operations which must (still) be performed in this context will hardly present a specific field of occupational safety standardization in future in terms of their hazard levels or incidence.

C1 Freight handling/loading operations

Description of the problem:

In the light of their consequences, hazards related to the corresponding operating procedures do not warrant high classification.

Key areas in conjunction with loading operations result from the interaction between rail vehicle, freight, loading installation and loading tackle and the requirement for movement and communication in this environment. Equipment and controls on freight cars must be designed with regard to their safety and ease of reach and control.

Manual loading operations are increasingly disappearing with the mechanization and automation of loading processes. The integrated character of all elements of a transport chain includes other areas of transport, and must assure the safety of all parties involved. Occupational safety measures specific to rail transport are therefore also on the decrease.

With regard to rail transport, requirements related to health and safety which are placed upon the characteristics of hoists and industrial trucks may be entailed by certain permanent conditions of use, such as

- ☐ direct vicinity of the track (in the path of vehicles, with a risk of collision);
- ☐ in the vicinity of the track (pressure, suction);
- ☐ catenaries (presentation of an obstacle; electrical safety);
- ☐ ramps (gradient, height);
- ☐ freight cars (access, visibility conditions, car floor);
- ☐ freight (weight, dimensions).

State of regulation:

The supplementary stability tests for stackers in accordance with ISO/DIS 13562-2 and 13563-2 for container handling (L >= 6 m) serve as examples in this context.

Draft standards EN 1757-1 to 1757-3 contain adequate universal occupational safety requirements for manual and semi-automatic industrial trucks.

Recommendations:

☐ With regard to rail transportation of bulk freight, DIN 30800-1 to 30800-3 and DIN 30801/30802, governing transshipment interface design, and DIN 26572, governing pressure discharge, may be assumed to meet the indirect occupational safety requirements.
The stringent requirements of the German standards should represent the basis for European standardization projects. Occupational safety would not, however, suggest particular urgency.

☐ The operator is employed directly at the vehicle for control operations entailed by liquid freight handling. International standards governing containers (ISO 9669, 9670) are applicable here. Occupational safety requirements upon tank wagons are implemented specifically in draft standards EN 12561-1 to 12561-8.

☐ Supplementary standards exist: firstly the German DIN 26012 to 26034 series of standards and secondly UIC leaflet 573 (Technical conditions for the construction of tank wagons).
These standards specify the requirements for characteristics for the assurance of safe operation. They represent a basis for the launching of further EN standards projects in this area.
UIC leaflet 537 (Pipe connections for wagons equipped for pneumatic discharge) has the function of standardizing these couplings, but has no relevance to occupational safety and cannot therefore be exploited in this context.

C2 Freight handling operation/combined transport

Description of the problem:

Tasks involving the use of equipment are defined only marginally, if at all, by aspects of rail transport in these job profiles. In the multimodal interaction of the system elements, the crucial factor is the precision of the individual components, which permits freight securing operations and the access/departure of personnel under safe conditions.

State of regulation:

The international standards governing containers (ISO 1161, 1496-1 to 1496-5, 3874, 668) represent a basis.

Dimensions and general requirements (EN 283, 284, 452) are specified for swap bodies.

The following UIC leaflets exist in which occupational safety aspects are not addressed explicitly:

- ☐ Cooperation between railway undertakings for international combined transport (UIC leaflet 291)
- ☐ Technical conditions to be fulfilled by large containers and swap bodies (UIC leaflets 592-2/-3/-4)
- ☐ Transport of road vehicles on wagons – Technical organisation (UIC leaflet 596-5)
- ☐ Equipment for loading and unloading containers or vehicles used in combined transport on/from wagons (UIC leaflet 599)

Recommendations:

Standardization activities are required in conjunction with further multimodal arrangements of the combined transport elements by which conditions are to be assured for optimum uniform and safe operation of equipment in Europe.

C3 Freight handling operation/formation of road-railers

Description of the problem:

A number of mutually incompatible systems exist in Europe for the forward-thinking bimodal "semitrailers on bogies" system. UIC has declared service conditions for the individual systems, specialized installations, and principles of operation, without making express reference to occupational safety (UIC leaflet 597).

Recommendations:

As testing of the system progresses, a European standard is deemed necessary which clearly specifies conditions for safe working at the interfaces.

C4 Freight handling/auxiliary services

Description of the problem:

The auxiliary services selected entail manual tasks involving the use of equipment on and in connection with the rail vehicles; such tasks are in some cases more frequent and comprehensive in comparison with freight loading activity.

The interaction between vehicles, freight handling installations and freight types forms the basis of all task cases, as already substantiated for freight loading operations on bulk freight wagons in (C1). Access to a freight loading installation is therefore necessary in order to permit tasks involving the use of equipment on the vehicle prior to and following the loading operation.

State of regulation:

Criteria for the design of freight wagons in consideration of occupational safety aspects for safe operation of tank wagons and their equipment are defined by standards EN 12561-1 to 12561-8, which are currently being drafted.

Draft standard EN 12561 Part 7 "Platforms and ladders" represents an efficient transposition of the key provisions contained in accident prevention regulation VBG 74 governing ladders and steps, which represent the German standard.

Recommendations:

The high level of safety embodied by German standards governing rail vehicle design can be used as a basis for launching or influencing European standardization projects, for example:

- ☐ DIN 5557 governing the operating safety of handwheels for rail vehicles;
- ☐ DIN standards 25252, 25254, 25255, 25256 for self-discharging wagons with side-wall flaps;
- ☐ the DIN 26012 to 26034 series of standards for tank wagons (already cited under C1).

The principle of harmonization proposed in a number of UIC leaflets should in any event be reviewed for its suitability of application with regard to the aspect of safety of control and use. This concerns, for example:

- ☐ steps, handrails and control facilities on wagons (UIC leaflets 535-1/-2, 536, 576)
- ☐ standard wagons – Characteristics (UIC leaflets 571-1 to 571-4)
- ☐ technical conditions for the construction of tank wagons (UIC leaflet 573)
- ☐ equipment fitted to freight cars with electrical terminals and loads (UIC leaflets 533, 538, 554-1,-2).

D1 Auxiliary processes/servicing of vehicles

Description of the problem:

The conditions for safe movement within and outside trains have already been addressed elsewhere (cf. Chapters 4.2 and A1 to A3). Requirements related directly to activities arise in particular in relation to the technical design of the rail vehicles.

State of regulation:

The following regulations have a bearing upon the safety of operations and health protection:

- ☐ protective provisions relating to electrical safety and earthing (EN 50122-1);

- ☐ electrical and air-conditioning equipment on railway vehicles (DIN 27168 to 27170);
- ☐ low-voltage switchgear for railway applications (DIN VDE 0660-14);
- ☐ power supply installations for passenger stock (UIC leaflets 550, 553, 554, 555);
- ☐ information transfer by train bus (UIC leaflet 556);
- ☐ diagnostics on passenger rolling stock (UIC leaflet 557);
- ☐ standard technical characteristics of the train bus (UIC leaflet 552).

Recommendations:

The general objective of replacing UIC leaflets with EN standards also applies to this area. Recommendations beyond this objective for harmonization and simplification in the interests of operability cannot be made at present.

D2 Auxiliary processes/dispatch

Description of the problem:

No specific requirement for regulation is identified for the tasks under consideration, since pertinent requirements have already been stated in conjunction with vehicles and installations. Remote-control and data input devices are to be subject in the first instance to ergonomic requirements concerning their portability (weight, attachment) and safe operation.

Particular attention must be paid to ease of use when ladders intended for the inspection of loads are selected (EN 131-1 and -2).

D3 Auxiliary processes/utilities supply

Description of the problem:

A particular increase in the requirements concerning operability can be expected in this area in the future. Utilities supply to powered and passenger stock must be facilitated internationally and at the same time regulated in a harmonized manner with regard to occupational safety, ergonomics and hygiene.

State of regulation:

UIC has published UIC leaflets 508-1 and 508 -2, which have informatory and recommendatory status, concerning the handling of passenger rolling stock.

Recommendations:

The authors recommend that a standardization project be launched which would also incorporate the provisions of UIC leaflets governing special comfort and constructional characteristics for passenger rolling stock accepted in internation-

al traffic (UIC leaflets 565-1, -2, and 567-1 to -7) with regard to interface design.

D4 Auxiliary processes/cleaning

Description of the problem:

The statements made with regard to D3: utilities supply apply accordingly with regard to interface design.

Cleaning of the outside of cab windows, where performed manually, represents a safety issue, which currently requires the use of restraints for protection against falling.

The cleaning of freight cars is considered in general terms in the design regulations for car floors. The activities in question are not however of specific relevance to occupational health and safety.

State of regulation:

With regard to the cleaning of coaches, UIC leaflets are available governing the interaction between passenger rolling stock and fixed installations (UIC leaflet 508-1), and fittings provided in coaches in the interests of hygiene and cleanliness (UIC leaflet 563).

An occupational health and safety element for the cleaning of freight wagons can be found in German regulations in the sample form for the repeat inspection of the occupational safety of high-pressure cleaners (VDMA 24413).

The products and methods to be used for routine disinfection of wagons have been specified by UIC (UIC leaflet 422).

Recommendations:

The authors therefore consider it beneficial to launch European standardization initiatives for the cleaning and disinfection of freight cars only within the constraints of environmental compatibility.

Specific occupational safety requirements must be met by company regulations.

D5 Auxiliary processes/breakdown repairs

Description of the problem:

A fundamental requirement upon any object requiring repair or maintenance is that safety issues must be considered at the design stage.

The issue of whether safe access to and availability of the affected objects may be impaired by influences peculiar to railway transport is however of additional interest. Appropriate regulations form part of company procedures and must

be supplemented by regulations governing behaviour.

State of regulation:

- ☐ The basic standard is EN 50126, governing the specification and demonstration of reliability, availability, maintainability and safety (RAMS).
- ☐ UIC has issued uniform principles for the manufacture and use of portable units for earthing overhead electric-traction power lines through the rail (UIC leaflet 792).
- ☐ A national standard contains general provisions for equipment for operation, testing and safeguarding of parts under voltage over 1 kV (DIN VDE 0681-1).
- ☐ UIC leaflet 965 contains instructions governing the behaviour and safety of staff working (where applicable, alone) on the track. According to the German Consensus Statement, this area should not be regulated by standards.

Recommendations:

In this case, too, the authors issue the general recommendation that a standardization project take the form of influencing characteristic criteria harmonized in EN standards with the objective of creating the best possible conditions for reliable operation.

D6 Auxiliary processes/inspection/checking

Description of the problem:

The project 256010 concerned with licensing requirements for construction and maintenance machinery must also place licensing requirements relevant to occupational safety upon the transport of guided machines; such requirements have a bearing upon the driver's workplace.

Problems currently arise with regard to the possible arrangement of the driver's seat at right-angles to the direction of travel, which cannot be justified on ergonomic grounds, avoidance of which would however entail considerable expense.

UIC leaflet 969 contains recommendations concerning the safety of staff working in tunnels during normal service. The statements made concerning breakdown repairs also apply here: European standardization governing the regulation of behaviour is not reconcilable with the German Consensus Statement.

4.4 Personal protective equipment

With respect to personal protective equipment, requirements specific to rail transport are generally covered in the

existing body of standards. Technical committees in CEN for personal protective equipment are responsible for drafting EN standards (cf. [24], pp. 33 and 45). [25], Appendix B lists deficiencies in standards for specific types of personal protective equipment in the form of the result of a comprehensive survey and evaluation of the body of standards concerned. Reference is made to this in Appendix 4 for the selected personal protective equipment standards. This must be taken into account where appropriate where personal protective equipment is employed in rail transport.

The following requirements must be observed in conjunction with the necessity for the use of personal protective equipment during **shunting operations**:

- ☐ high-visibility garments – potential hazards presented by rail and road vehicles;
- ☐ protective shoes – grip on uneven surfaces, protection against shock, impact and crushing;
- ☐ safety helmets – protection against impact;
- ☐ gloves – protection against cuts, scratches and injuries resulting from entrapment;
- ☐ tight-fitting clothing – protection against injury caused by entanglement;
- ☐ weatherproof clothing.

European standards in this area include product standards containing requirement characteristics for:

- ☐ safety, protective and professional shoes (EN 13287, 344-1,-2, 345-1,-2, 346-1,-2, 347-1,-2);
- ☐ protective clothing (EN 340, 342, 343, 510);
- ☐ industrial safety helmets (EN 397);
- ☐ gloves (EN 420, 511);
- ☐ high-visibility warning clothing (EN 471).

The selection and use of this equipment is a function of health and safety of workers at work, according to the specific conditions at the workplace in shunting operation.

The following requirements must be observed in conjunction with the necessity for the use of personal protective equipment during **freight handling operations**:

The requirements for the equipment of employees involved in freight handling operations are broadly similar to those for shunting operations. This concerns high visibility garments, safety helmets, gloves, tight-fitting clothing and weatherproof clothing.

Where relevant, the following are also required during freight handling operations:

- ☐ respiratory protection during the handling of dusty or vaporous freight;
- ☐ personal protective equipment providing protection against falls from a height during the mounting of platforms on cars and loading installations.

In addition to the standards already cited, European standards in this area include product standards containing required characteristics for:

- ☐ respiratory protective devices (EN 132 to 149, 400 to 405, 1827);
- ☐ equipment for protection against falls from a height (EN 341, 353-1, -2, 354, 355, 358, 360 to 365, 795).

The selection and use of this equipment is also a function of health and safety of workers at work, according to the specific conditions at the workplace in freight handling operation.

The following requirements must be observed in conjunction with the necessity for the use of personal protective equipment in **auxiliary processes**:

Provisions should be made for personal protective equipment for the restraint function and for the prevention of falls, and the wearing of high-visibility warning clothing and gloves, for the selected operating procedures.

As already stated for shunting operation and freight handling operation, the relevant European product standards are sufficiently well suited to the selection of personal protective equipment for the use in question.

5 Summary and conclusions

The purpose of the present study, "Occupational health and safety standardization in the rail transport sector", was to survey existing occupational safety standards in the context of other relevant regulations. The objective was to identify the requirement for standardization in rail transport for comprehensive occupational safety, and to analyse the effects upon the German occupational safety situation.

The area of rail transport was defined and delimited as the basis for the method. The framework for the studies is therefore:

- ☐ the scope of the German Regulation on Construction and Operation of Railroad Systems (EBO) and the Regulation on Construction and Operation of Private Industrial Railroad Systems (EBOA);
- ☐ normal service conditions of rail transport;
- ☐ including main-line traffic and special freight transport;
- ☐ excluding transport of hazardous substances;
- ☐ consideration of technical development.

A method was developed which enables the interaction of system components and activities relevant to the process to be classified in terms of their influence upon occupational health and safety.

Fifty-nine job profiles were drawn up which describe in a representative manner the efficacy of existing regulations and those in preparation with respect to hazards.

The **role of occupational health and safety standards** in the relevant (international, European and national) **body of regulations** applicable to rail transport required definition.

- ☐ The state of regulation was portrayed comprehensively.
- ☐ In their standardization activities for rail transport, the Technical Committees, e.g. CEN/TC 256 and CENELEC/TC 9X, pay varying degrees of attention to occupational health and safety.

System elements and components of rail transport are influenced in a variety of ways by the different categories of regulation in the body of regulations as a whole. Closer examination of this situation prompted the recommendation that deficiencies in the area of occupational health and safety in European standards be compensated for by other, existing and proven types of regulation.

This applies for example to the national legislation governing railways, and the UIC code, with its provisions specific to rail transport defined in the interests of international technical compatibility. The consideration of occupational safety interests is not a primary objective of these regulations; they are however addressed indirectly in the objectives of

- ☐ safety of railway operations;
- ☐ safety for passengers and other customers;
- ☐ ease of control and use of the installations and equipment.

Particular standardization requirements arise in Europe from the obligation to transpose the objectives of protection embodied in the relevant directives. Articles 95 and 137 of the EC Treaty each represent a particular basis for this transposition.

A particular feature of the transport sector is that elements which have a direct function of serving carriage on public transport and which are (still) excluded from the scope of German legislation governing trades are also excluded from the scope of certain EC directives. This applies for example to rail vehicles, to which the Machinery Directive or the Workplace Directive do not apply.

Directives pursuant to Article 95 place requirements upon the quality of the products in question which are relevant to occupational health and safety. The safety requirements of such directives are generally defined in detail in European standards.

The study addressed the following issues:

- ☐ What subjects of the directives are of direct relevance as elements or components of rail transport? Directives governing machinery (98/37/EC), low-voltage electrical equipment (73/23/EEC) and construction products (89/106/EEC) were evaluated with regard to their relevance to rail transport.
- ☐ What general subjects of directives are employed in rail transport as elements or processes?

  A range of technical components are in use in rail transport. The objective was to ascertain specific conditions of use by which specific safety requirements could also be substantiated by means of reference to the directives.

  Machinery (98/37/EC), lifting and mechanical handling appliances (84/528/EEC) and pressure vessels (87/404/EEC) are employed in such a manner that the conditions under which they

are used in rail transport place particular requirements upon safety.

Directives pursuant to Article 137 of the EC Treaty contain minimum requirements for occupational health and safety which must be implemented by the EU member states in the form of national legislation. The use of European standards is restricted to specific areas.

Of the directives pursuant to Article 137, a number of individual directives were considered in addition to the Framework Directive (89/391/EEC) the subjects of regulation and objectives of protection of which are applicable to rail transport.

The objectives of **railway directives** are not generally concerned in the first instance with occupational health and safety. A relationship could be established only indirectly, for example where safety requirements are defined in the context of European development of rail transport or combined transport. In this context, directives governing the development of the Community's railways (91/440/EEC, 95/18/EC), the allocation of railway infrastructure capacity and the charging of infrastructure fees (95/19/EC), and interoperability (96/48/EC), were included in the considerations.

In the authors' view, operational safety objectives specific to rail transport have not been accorded particular attention in EU directives governing the development of European railways. Greater attention should be paid to this aspect from the outset in future directive initiatives (interoperability – not only in very high-speed traffic, combined transport).

Safety objectives may be implemented in very different ways from one standard to the next. Assessment of the extent of implementation in existing standards and standardization projects requires comprehensive analysis (the same applies to the other types of regulation studied, such as UIC leaflets, German accident prevention (UVV) regulations, ZH 1 provisions), which was possible within the scope of the present study only for a selection of documents, and in the form of selective conclusions concerning the **level of and deficiencies in regulation** with regard to occupational health and safety in rail transport.

The authors recommend that the technical knowledge of occupational health and safety experts who are familiar with standardization be exploited as a matter of course in order to eliminate deficiencies in standards in the area of occupational health and safety.

Criteria were required and accordingly drawn up for (adequate) consideration of occupational health and safety interests in existing regulations. The following formulations and characteristics served as evidence of such interests:

> Clarity of the state of safety development is enhanced if the relationship to relevant EC directives is defined in the preamble to the EN and the co-operation of occupational health and safety experts during development of the standard is established. Even greater clarity would be provided by a special Appendix to the standard containing a list of the hazards with corresponding references to the content of the standards and to generic standards, in order to document the progress of safety developments and to provide a basis for future revision.

The authors concluded that standards applicable to the rail transport sector address occupational health and safety issues to this extent (in a manner which can be implemented) if the external **ad-hoc OH&S working group in CEN/TC 256** (now the internal OH&S advisory committee) had been involved in their creation. The influence of this group can be seen from the following example:

☐ In order to provide greater protection against the consequences of excessive braking in the event of a fault, either the deceleration under braking must be reduced, or the shunting engine driver on the vehicle must be warned. This situation is governed by VDV document No. 201.

These requirements were incorporated (in the form of a compromise) into draft standard EN 50239 (radio remote control for freight vehicles).

☐ Implementation of design requirements in the form of

- design of steps and grates (non-slip surfaces, dimensions of clearances and areas of steps for safe grip)
- provision and integration of handrails
- provision of facilities for attachment of a safety harness (personal protective equipment)

as governed by accident prevention regulation VBG 74 concerning ladders and steps. These requirements are implemented accordingly in draft standard EN 12561-7 governing platforms and ladders on tank wagons.

☐ The marking of hot lines of heating connections to tank wagons in draft standard EN 12561-8, "Heating connections".

Characteristic/formulation	Example
Provision of a list of (significant) hazards	Machinery standards
Easy access to controls	Tank wagon valves (EN 12561-3)
Clearances for connections	Tank wagons (EN 12561-3)
Design of handles	Tank wagon dome (EN 12561-4, -5)
Specification of objectives of protection	Protection against fire (EN 45545-1, -3): Definition of fire-proofing requirements
Comfort parameters (example of provisions for passengers and personnel)	Coaches (EN 13129-1)
Electric lighting (safety conditions for passengers and personnel)	Rail vehicles (EN 13272)
Door operation (different requirements for passengers and personnel)	EN project on power door systems

Confirmation of the internal OH&S advisory committee in CEN/TC 256 permitted systematic and timely consideration of occupational health and safety requirements.

Cross-sector standards, such as those in the area of machine safety, personal protective equipment, ergonomics and environment, may be of relevance to rail transport. They have a bearing upon rail transport standards, either directly or through normative references. Either case may however also result in rail transport being excluded from the **scope** of certain standards, or in regulations (only) having the status of recommendations for rail transport. The following examples demonstrate the difference in relevance of the subject of standardization to rail transport:

- ☐ The integration of (construction) machinery into railway operations entails special requirements (gauge, clearances to be observed, etc.). Standard project PrNr 256010 governing the transport of guided machines requires for example that gauges and clearances must be observed in the interests of occupational safety.
- ☐ The subjects of standardization are subject to special conditions of use in rail transport which also affect their safety of use.

For industrial trucks, conditions related to freight handling in the railway industry will generally fall within the general conditions of use. This affects, for example, the provisions of EN 1551 (governing powered industrial trucks with a carrying capacity of over 10,000 kg). This does not make clear, however, what specific influence certain applications have upon the range of requirements.

Conversely, the relevance is stated from the outset with regard to the provisions of ISO/DIS 13562-2 (Additional stability tests for trucks handling freight containers of 6 m length and above).

One conclusion with regard to cross-sector standardization projects is that (organizational) conditions must be created on the basis of which occupational safety interests can also be considered systematically in a cross-sector manner.

The German Consensus Statement permits no encroachment by standards upon responsibilities for the health and safety of workers at work. In international rail transport, these requirements must be given specific and appropriate attention:

- Background: Workplaces (and working equipment) are not restricted by national borders, and are used by personnel in other countries, or employees must use workplaces (and working equipment) in another country.
- Task: The requirements of a country regarding the health and safety of workers at work must be met in a different country. In the authors' view, this results in a particular requirement for harmonization of standards pursuant to Article 137 (for example in the design of the workplace and working equipment, with regard to process organization and in some cases exposure limits at the workplace) in the interests of interoperability.

International requirements concerning the health and safety of workers at work lead to the conclusion that (organizational) conditions (e.g. a directive pursuant to Article 137) must be created which can form the basis of harmonized arrangements.

In Germany, a notably high standard of occupational health and safety is assured by a complex body of regulations. All activities in the area of European standardization must have as their objective the preservation of this high stand-

ard. The results of the analysis also address two particular aspects with relevance to rail transport:

- ☐ DIN and VDE standards containing occupational health and safety provisions the scope of regulation of which is not (yet) covered by EN or ISO standards form a basis for standards initiatives.
- ☐ Provisions governing product characteristics in (UVV) accident prevention regulations and in some cases in statutory regulations represent a suitable basis for the launching or support of standards projects.

  This affects for example VBG 1 in general and VBG 11 (section III "governing construction and equipment") contains provisions specific to railway transport.

The **UIC code** imposes conditions for rail transport which must be considered in conjunction with European standards. The task of transposing UIC leaflets over the longer term into EN standards remains on the one hand; on the other, mutual citation is possible in the interests of efficacy.

- ☐ In the course of systematic implementation of normative references in accordance with the Memorandum of Understanding between CEN and UIC [17], duplication and unsubstantiated deviations should be progressively eliminated; examples include design requirements for freight cars and comfort characteristics for coaches.
- ☐ In the course of elimination over the longer term of parallel regulations on different levels, UIC leaflets should be transposed into harmonized EN standards, for example regulations in DIN standards, (UVV) accident prevention regulations and UIC leaflets governing clearances to be provided at vehicle extremities, or steps and handles.
- ☐ Provisions of recommendatory or for that matter informatory character in UIC leaflets could conceivably contribute, in the context of testing and consolidation, towards the realization of binding regulations (ultimately EN standards), for example: recommendatary agreements have been reached on the interaction between passenger rolling stock and fixed installations (UIC leaflet 508-1), and informatory agreements for installations for servicing and stabling passenger rolling stock ready for operation (UIC leaflet 508-2). A process of clarification should lead to corresponding European standardization as requirements upon interoperability increase.

5 Summary and conclusions

Co-operation between UIC and CEN committees should be intensified; the fact that UIC leaflets contain obligatory, recommendatory and informatory provisions can clearly benefit regulations in the interests of consolidation and testing.

Table 9 summarizes the requirement for European regulation contained in Appendix 1. This selection is based upon the key issues presented in the results of the present study for European standard projects in rail transport:

- ☐ International rail transport in Europe requires solutions that are interoperable wherever possible. Such solutions must represent the highest possible standard of occupational safety.
- ☐ New railway technology must also guarantee compliance with the state of the art for occupational health and safety from the outset.
- ☐ New transport technology is often multimodal in character. The occupational safety interests of all parties must be assigned the highest priority and considered in an interdisciplinary fashion.
- ☐ The UIC code, in which occupational safety is addressed primarily indirectly by solutions embodying safety of function, operation and control, should be incorporated systematically and efficiently into the process of European standardization.
- ☐ Relevant German regulations must be introduced into European standardization initiatives in compliance with the dual OH&S system and in the interest of a high level of occupational health and safety.

Table 9: Selected examples of requirement for European standardization

No.	System elements System components	Occupational health and safety requirements	State of regulation	
			EN and international standards	DIN and equivalent regulations
1.0.1	Standard gauge vehicle			
1	Clearance to be provided at vehicle extremities	Matched to specified clearance gauge and distance between centres of lines		27505 E
2	Loading gauge	Clearances to be observed without restrictions		
	Coupling handle	Present, usable		
1.1	Powered stock	General compliance with "machine safety"	[292-1,2]; [414]; [457]	
1	Driver's cab	Dimensions, atmospheric conditions, noise, visibility and pressure conditions	13272; [61310-1,2]	(25647-1); 5566-1 to 5566-3
2	Control panel (control switchgroup, automatic vigilance device, brake lever)	Ergonomic design and positioning		
3	Driver's seat	Vibration damping, adjustable, ergonomic design		
1.4	Coaches	Safety of operation, electrical safety, atmospheric conditions, fire protection	45545-1,-3; 50120	[45638]; 5510-1, -2
1.5	(Standard) wagons	(See also 1.0.1)		(25632-3 to 25623-7)
1	Steps	Provision, stability and imperviousness to slipping, with clearance		1580; 1588;
2	Handles	Dimensions, position and strength		1585; 1588; 25106-10
3	Hand-rail	Dimensions, position and strength		25106-1/2

State of regulation		Requirement for European standardization Remarks
UIC leaflets	National regulations	
505-1; 505-4; 506	EBO, § 22, 25; BOA, § 41; VBG 11, § 6(1)	Interoperability, very high-speed traffic; EN project launched
521	EBO § 25; BOA § 46; VBG 11, §15(2)	EN project based upon UIC leaflets and German regulations
535-2	EBO, § 28(11); VBG 11, § 15(6)	Elimination of the contradiction between EBO and VBG 11: general requirement for provision.
508-1; (534); 552	EBO, §28; VBG 5	Interoperability, new technology. Uniform and unambiguous design of signal-controlled traction units
(553); **617-5/-6/-7**; **642**; 644; **651**	Ordinance on Workplaces	EN project based upon DIN standards and UIC leaflets
541-3; 641		EN project based upon DIN standards and UIC leaflets
		EN project based upon DIN standards and UIC leaflets
508-1; 550; 550-1; 552; 554; 557; 567; 567-1/-3/-5/-7; 584		Obligations to assure preventive measures for passengers; installations and methods of operation should be harmonized in the interests of interoperability
(422); 500; 530; 571-1/-2/-3/-4; 576		New technology; uniform and clear design of innovative freight cars (IGWs)
535-1; 535-2	**EBO, §25(3) and 28(12); VBG 11, § 15(3)**	EN project for implementation of requirements for characteristics in consideration of remote radio control based upon UIC leaflets and German regulations
535-1; 535-3	**EBO, §28(11); VBG 11, § 15(4)**	To German standard, in consideration of the requirements for characteristics specified in VBG 11
	VBG 11, § 15(4)	To German standard, in consideration of the requirements for characteristics specified in VBG 11

Continuation of Table 9: Selected examples of requirement for European standardization

No.	System elements System components	Occupational health and safety requirements	State of regulation	
			EN and international standards	DIN and equivalent regulations
5	End platform, brakeman's control panel	Hand-rail, safe use		1580
1.5.1	Freight cars (standard type)	Safe operation		27150
1.5.2.13	Tank wagon and container-carrying wagon	Safe operation		
1.5.2.14	Wagons for transport of road goods vehicles ("rollende landstrasse")	Safe use and operation		
1.5.2.17	Road semi-trailers running on rail bogies	Safe use and operation		
2.1.1	Tracks and points			
1	Specified clearance gauge	Reliable, uniform		27505
2	Distance between centres of lines	Reliable, adequate		
2.1.2	Marshalling yard/ yard track			
2.2.3.1	Platforms			
1	Height	Safely accessible		
2	Surface	Level, without obstacles		
5.1.5	Trailers			
1	Auxiliary supports	Safe operation		
2	Axle hoist	Safe operation, manually if necessary		
6.7	Earthing unit	No hazards in use		VDE 0681-1
10.2	Air	Reduction in pollutants		33892

State of regulation		Requirement for European standardization Remarks
UIC leaflets	National regulations	
535-3	VBG 11, § 15(3) and (4)	Transposition of UIC leaflets and requirements of VBG 11 for characteristics into EN standards
		DIN standard as basis for EN project
571-4; 596-5		Inclusion in EN project of interoperability, multimodality, requirements for characteristics
571-4; 596-5		Incorporation in EN project of interoperability, bimodality, requirements for characteristics
429; 597;		New technology, bimodal; incorporation into EN project of requirements for characteristics
	EBO, §9	Interoperability and very high-speed traffic require reliability internationally
505-4; 508-2	EBO, § 10; VBG 11, § 5	EN project for the implementation of minimum requirements (cf. 1.0.1-1)
504; 508-1, -2	Ordinance on Workplaces	Interoperability; EN project for the creation of uniform conditions for vehicle maintenance and stabling
508-1; 741	VBG 1, §§ 19 and 22 EBO, § 13(1)	Interoperability; EN project for the creation of uniform conditions. cf. 1.0.1-1
429; 597		Interoperability, bimodality; EN project for the creation of uniform conditions.
792		Interoperability; EN project for the creation of uniform methods of operation.
		No limit values for diesel engines; EN project required

1. Documents

[1] EC Treaty, Official Journal of the European Communities C340, 10.11.1997, pp. 145-172

[2] Eisenbahn-Bau- und Betriebsordnung (EBO), effective from 28 May 1967, Official Federal Gazette 1967, Part II, p. 1563

[3] Verordnung über den Bau und Betrieb von Anschlussbahnen (EBOA/BOA), in the legislation of the German regions

[4] KAN Study 19a, Standardization of occupational safety in the rail transport sector, Part I: freight cars, January 1998 (not published)

[5] DIN 25003, Systematik der Schienenfahrzeuge, Übersicht, Benennung, Definition, December 1990

[6] DIN-Katalog für technische Regeln, 1997

Volume 1: Deutsche Normen und technische Regeln, Part 1: main section, Part 2: Index. Published by: DIN

[7] DB AG, Merkblatt zur Ermittlung der Gefährdungen gemäss Arbeitsschutzgesetz (§5), BUZ 1997 (not published)

[8] Sicherheits-Check, Eisenbahnen - Rangieren, BG BAHNEN, October 1997, Draft

[9] Rangieren bei Eisenbahnen, code of practice, BG BAHNEN, June 1996; Service im Zug - sicher und kompetent, code of practice, BG BAHNEN, December 1997

[10] Gefährdungs- und Belastungskatalog für Arbeitsplätze in Verkehrsunternehmen, BG BAHNEN, August 1997

[11] Nohl, J.: Verfahren zur Sicherheitsanalyse. Eine prospektive Methode zur Analyse und Bewertung von Gefährdungen. Deutscher Universitätsverlag, Wiesbaden 1989

[12] Unfallverhütungsvorschrift "Allgemeine Vorschriften" (VBG 1) mit Durchführungsanweisungen, April 1996. BG BAHNEN

[13] Recherche Arbeitsunfälle, BG BAHNEN, 1998 (not published)

[14] Recherche Rangierunfälle 1995/96 im Bereich Hamburg. EUK (not published)

[15] Jahresbericht Arbeitsschutz 1997 für die Geschäftsbereiche Nahverkehr und Fernverkehr. Deutsche Bahn AG, Geschäftsbereich Fernverkehr, Fachstelle für Umwelt und Arbeitsschutz, Frankfurt, June 1998. (not published)

[16] Europäische Normung im Bereich des betrieblichen Arbeitsschutzes, KAN Report 5, July 1996, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[17] Memorandum of Understanding between CEN and UIC, DOC CEN/TC

256, issued 16 October 1997 (working paper)

[18] Normung im Bereich von Sicherheit und Gesundheitsschutz am Arbeitsplatz, KAN Report 2, November 1995, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[19] Europäische Normen zur Ergonomie - Bestandsaufnahme und Systematisierung, KAN Report 7, August 1996, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[20] KANBRIEF No. 2/98, Kommission Arbeitsschutz und Normung, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[21] Stärkung des Arbeitsschutzes in der Normung, KAN-Bericht 1, September 1995, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[22] DIN-Katalog für technische Regeln 1997

Volume 2: Internationale Normen und technische Regeln, Part 1: main section, Part 2: index; Published by: DIN

[23] Normen und Norm-Entwürfe für Schienenfahrzeuge, Verzeichnis 1995, updated: 1 November 1997, produced by the Normenausschuss Schienenfahrzeuge (FSF) im DIN Deutsches Institut für Normung e. V.

[24] PSA-Normen in der Praxis, KAN Report 17, December 1997, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

[25] Normung im Bereich persönliche Schutzausrüstungen, KAN Report 12, March 1997, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

(cf. Appendices 3 to 7 for further directives, standards and other regulations)

2. Electronic media

[EM1] Rail Lexic, CD-ROM, Union Internationale des Chemins de Fer, 1996 edition

[EM2] Official documents of the EU. http//europa.eu/int/abc/off/index.de.html

[EM3] DIN and ISO standards, VDI guidelines and publications of the Beuth-Verlag. http://www.beuth.de/beuth.html?datenbanken

[EM4] VDE regulations, Katalog der Normen 1998, CD-ROM, January 1998 edition 1998, VDE Verlag

[EM5] UIC code, catalogue of leaflets and list of publications. http://www.uic.asso.fr/de/produits/index.html

3. Further literature

Abt, W.: Gefahr durch das rollende Rad auf der Schiene (+ Fortschreibungen der

Statistik des HVBG). In: Die BG (1991) No. 10, pp. 562-568.

Angerer, M.: Niederfrequente elektrische und magnetische Felder. In: Der Eisenbahningenieur (48) 9/97, pp. 37-40.

BG BAHNEN: Gefährdungs- und Belastungskatalog für Arbeitsplätze in Verkehrsunternehmen. Katalog zur Handlungsanleitung, date of issue: August 1997.

BG BAHNEN: Handlungsanleitung zur Gefährdungsbeurteilung, code of practice, date of issue: August 1997.

BG BAHNEN: Eisenbahnen - Rangieren. Sicherheits-Check, date of issue: October 1997.

BG BAHNEN: Rangieren bei Eisenbahnen, code of practice (ZH1/53), date of issue June 1996

BG BAHNEN: Service im Zug - sicher und kompetent, code of practice, date of issue: December 1997.

Bolten, K.-A.: Der InterCity Triebwagen. In: Der Eisenbahningenieur (48) 4/97, pp. 46-54.

Bongwald, O. et.al.: Leitfaden für die Beurteilung von Hebe- und Tragetätigkeiten. Hauptverband der gewerblichen Berufsgenossenschaften (HVBG), December 1995.

Borgwardt, H.: Sicherheit der elektrischen Bahnanlagen. In: Eisenbahningenieurkalender '94, pp. 267-287.

German Ministry of Transport: Lärmschutz im Verkehr, Schiene, Strasse, Wasser, Luft, 2nd reprint, January 1998

Butz, M. et.al.: Arbeitssicherheit und Gesundheitsschutz: System und Statistik. Hauptverband der gewerblichen Berufsgenossenschaften (HVBG), November 1994.

Christ, E.: Arbeitsschutz und Normung aus der Sicht eines Vorsitzenden/Chairman. In: DIN-Mitteilungen 76. 1997, No. 5, pp. 329-331.

DIN Taschenbuch 76, Verkehrswegebauarbeiten, Oberbauschichten ohne Bindemittel, Oberbauschichten mit hydraulischen Bindemitteln, Oberbauschichten aus Asphalt, Pflasterdecken, Plattenbeläge und Einfassungen. VOB/StLb, VOB Part B: DIN 1961, VOB Part C: ATV DIN 18299, ATV DIN 18381, 1997-03 edition.

Eickemeier, S.; Rommelfanger, H.: Wachstum durch innovative Produktionskonzepte - Chancen des Kombinierten Ladungsverkehrs der DB AG. In: Internationales Verkehrswesen (49) 9/97, pp. 435-439.

Ermittlung gefährdungsbezogener Arbeitsschutzmassnahmen im Betrieb - a guide -. Published by the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, special edition, p. 42, Dortmund/Berlin 1997.

Literature

Europäische Normung im Bereich des betrieblichen Arbeitsschutzes. Ein Leitfaden für die deutschen Mitarbeiter in der Europäischen Normung. Kommission Arbeitsschutz und Normung, KAN Report 5, July 1996.

Fischer, D.; Kirchner, J.-H.: Ein Gerät zur Manipulation von Stückgut in engen Packräumen. In: Jahresdokumentation 1992 der Gesellschaft für Arbeitswissenschaft, Report delivered at the 38th Conference on occupational safety at the Technische Universität, Braunschweig, 1992, p. 25.

Fischer, D.; Mast, G.: Betriebsverfassungsrechtliche Aspekte des betrieblichen Arbeitsschutzes. In: Eisenbahningenieurkalender '96, pp. 367-379.

Freystein, H.: Europäische Normung - Auswirkungen auf den Eisenbahnbau. In: EI-Eisenbahningenieur (48) 10/97, pp. 42-47.

Friedrichs, H.: Zug- und Stosseinrichtungen der Regelbauart. In: Eisenbahningenieurkalender '94, pp. 267-245

Fritze, A.: EG-Recht zu Arbeitsschutz, Gesundheitsschutz und Produktsicherheit. WEKA Fachverlag, Augsburg 1994 (continually updated).

GdED: Wagenmeister im Personenverkehr, a guide. Bildungs- und Förderungswerk der GdED, date of issue: June 1994.

Gerke, H.: Bedeutung der europäischen Normung im kombinierten Ladungsverkehr (KLV). In: Eisenbahningenieurkalender '96, pp. 249-255.

Grass, K.-H.: Normung im Bereich von Sicherheit und Gesundheitsschutz am Arbeitsplatz. Kommission Arbeitsschutz und Normung, KAN Report 2, November 1995.

Gutzmann, Ch. et.al.: Europäische Normen zur Ergonomie - Bestandsaufnahme und Systematisierung. Kommission Arbeitsschutz und Normung, KAN Report 7, August 1996.

Häfner, P.: Die EG-Richtlinie 91/440 und ihre Folgen. In: Der Eisenbahningenieur (46) 5/95, pp. 372-375.

Heimerl, G., Weiger, U.: Europas Eisenbahngrenzen - Chancen und Risiken in einem künftig grenzenlosen Verkehrsmarkt. In: Eisenbahntechnische Rundschau (44) 4/95, pp. 267-275.

Henken, H.-M. et al.: Gefahr beim Abladen: Arbeitssicherheit. In: lastauto omnibus (1987) 7, pp. 44-45.

Heyneck, M.; Jacobs, K.: Einsatz "überbreiter" Fahrzeuge. In: Die Bundesbahn 7-8, 1991.

Informationssysteme zu Arbeitsschutz und Normung. KAN Report 14, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V., May 1997.

Jacobs, K.: Neue Tendenzen bei der Unfallverhütung im Gefahrenbereich von Gleisen. In: Deine Bahn 4/96, pp. 228-231.

Janicki, J.: Der Wagenuntersuchungsdienst. In: Deine Bahn 12/96, pp. 744-747.

Jesberg, K.-H.: Rationeller Eisenbahnbetrieb bei Werks- und Anschlussbahnen. In: Eisenbahningenieurkalender '96, pp. 441-461.

Johannknecht, A.: Anforderungen an Betriebsanleitungen in Europäischen Maschinennormen. Kommission Arbeitsschutz und Normung, KAN Report 18, December 1997.

Kaiser, B.: Arbeitsschutzgesetzgebung. In: Der Eisenbahningenieur (49) 6/98, pp. 54-55.

Kirchberg, S.: Ermittlung gefährdungsbezogener Arbeitsschutzmassnahmen im Betrieb - a guide -. Bundesanstalt für Arbeitsschutz und Arbeitsmedizin, Dortmund/Berlin 1997.

Kirchner, J.-H.: Arbeitsplatzgestaltung in Strassenbahnen. In: Europäische Forschungsansätze zur Gestaltung der Fahrtätigkeit im ÖPNV; Bremerhaven: Wirtschaftsverlag NW, 1993, pp. 135-140.

Kirchner, J.-H.; Weymann, J.: Der ergonomisch gestaltete Fahrerarbeitsplatz in Strassenbahnen: neues Konzept fand positive Aufnahme. In: Der Nahverkehr, 15 (1997), 6, pp. 37-39.

König, D.H. et al: Aspekte kombinierter Belastungen bei Tätigkeiten an Arbeitsplätzen mit modernen Kommunikationstechnologien: eine Problemanalyse. Bremerhaven: Wirtschaftsverlag NW, 1995.

Kuhlmann, A.: Einführung in die Sicherheitswissenschaft. Verlag TÜV Rheinland, 2nd, completely revised edition, 1995.

Kunz, W. (ed.): Eisenbahnrecht. Systematische Sammlung mit Erläuterungen der deutschen, europäischen und internationalen Vorschriften. (loose-leaf edition) Nomos Verlagsgesellschaft, Baden-Baden, date of issue: May 1998

Lage, H.-H.: Aktionsplan der UIC. Aufbruch in eine neue Wettbewerbsposition der Bahn. In: EI-Eisenbahningenieur (49) 1/98, pp. 24-25.

Manson, H.-L.: Normungsvorhaben "Umschlagtechnik im Eisenbahn-Schüttgutverkehr". In: Eisenbahningenieurkalender '93, pp. 289-313.

Molle, P.: Europäische Normung. Neue Initiativen und Strukturen bei den Bahnen. In: Der Eisenbahningenieur (43) 7/92, pp. 378-383.

MTU Motoren- und Turbinen-Union Friedrichshafen GmbH, Abgasgesetzge-

bung für Dieselmotoren, date of issue January 1998 (leaflet)

Munzert, R.: Beladetechnik und Ladungssicherung. In: Deine Bahn 6/98, pp. 345-349.

Noetel, K.H. et al.: Normung im Bereich persönliche Schutzausrüstungen. Kommission Arbeitsschutz und Normung, KAN Report 12, March 1997.

Pergande, H.-G.: Instandhaltung der Schienenfahrzeuge der DB AG im Zeichen der Bahnreform. In: Der Eisenbahningenieur (49) 4/98, pp. 78-80.

Reimers, K.: Die Interoperabilität des Europäischen Hochgeschwindigkeitsbahnnetzes - eine Direktive der Europäischen Union. In: Eisenbahningenieurkalender '95, pp. 341-354.

Reudenbach, R.: Sichere Maschinen in Europa. Verlag Technik&Information, 3rd, revised edition (date of issue: April 1997).

Sasse, F.: Quetschstellen - Arbeitsgrundlagen für die Normung. Kommission Arbeitsschutz und Normung, KAN Report 4, June 1996.

Schlereth, K., Helmer, G.: Schutzmassnahmen bei indirektem Berühren an elektrifizierten Strecken. In: Eisenbahningenieurkalender '96, pp. 381-401.

Seidenstücker; B.: Anforderungen an die Konstruktion und Instandhaltung der Schienenfahrzeuge. Paper presented at the 2nd rail vehicle conference, 17-19 September 1997, HTW Dresden.

Sell, I.: Umsetzung ergonomischer Erkenntnisse in der Produktplanung und

-realisierung. In: Methodik und Hilfsmittel. Düsseldorf: VDI-Verlag 1988.

Stieler, G.: Neuere Güterwagenentwicklungen der Deutschen Bahnen. In: Eisenbahningenieurkalender '94, pp. 289-320.

Stier, G.: Die kinematische Fahrzeug- und Lichtraum-Geometrie. In: ZEV+DET Glas. Ann. 116 (1992), No. 7, pp. 212-225.

Stier, G.: Neue Entwicklungen bei den technisch-betrieblichen "Regelwerken" für die deutschen Eisenbahnen. In: Eisenbahntechnische Rundschau (40) 8/91, pp. 519-524.

Streffer, Ch.: Arbeitsschutz und Normung aus der Sicht des Bundesministeriums für Arbeit und Sozialordnung. In: DIN-Mitteilungen 76. 1997, No. 5, pp. 318-322.

Thomasch, A.: Abnahme von Fahrzeugen. Arbeitsschutz, Brandschutz, Umweltschutz und Gesundheitsschutz bei der Abnahme von Regel- und Nebenfahrzeugen/gleisfahrbaren Maschinen. In: EI-Eisenbahningenieur (47) 10/96, pp. 12-19.

Tietz, S.: Entwicklung eines ergonomiegerechten Hemmschuhs, zur Verbesserung der Handhabung und der Arbeitssicherheit beim Abbremsen von Eisenbahnwagen mit Hemmschuh. Bremerhaven: Wirtschaftsverlag NW, 1982.

Tischendorf, F. et al.: Typische Unfälle von Rangierern, Triebfahrzeugführern und Wagenmeistern der Deutschen Reichsbahn; Ursachen und Beeinflussungsmöglichkeiten. HfV Dresden, Institut für Verkehrssicherheit, 1988 (unpublished study).

Uckermann, R.; Kirchner, J.-H.: Schienenfahrzeuge-Rangierhilfen: Arbeitshilfen beim Rangieren von Schienenfahrzeugen. Dortmund: Bundesanstalt für Arbeitsschutz, 1983.

Uckermann, R.; Kirchner, J.-H.: Möglichkeiten der Verhinderung von Unfällen beim Rangieren von Schienenfahrzeugen, Dortmund 1978

Uckermann, R.; Kirchner, J.-H.: Verhinderung von Unfällen beim Rangieren von Schienenfahrzeugen, unter besonderer Berücksichtigung ergonomischer Gestaltung. Bremerhaven: Wirtschaftsverlag NW, 1978.

VDV-Schrift 201: Bedingungen für die Gestaltung von Funkfernsteueranlagen für Triebfahrzeuge von nichtbundeseigenen Eisenbahnen, Ausgabe 08/1992

Wirsig, K.: ICE-Aussenreinigungsanlage München. In: EI-Eisenbahningenieur (49) 10/98, pp. 69-75

Zieschang, H., Ackers, D.: Informationssysteme zu Arbeitsschutz und Normung. Kommission Arbeitsschutz und Normung, KAN Report 14, May 1997.

Zur Problematik der Normung von Arbeitsschutzmanagementsystemen. Kommission Arbeitsschutz und Normung, KAN Report 11, 2nd, supplemented edition, November 1997, published by: Verein zur Förderung der Arbeitssicherheit in Europa e.V.

Zwingmann, B.: Arbeitsschutz und Normung aus der Sicht der Gewerkschaften. In: DIN-Mitteilungen 76. 1997, No. 5, pp. 324-328.

Abbreviations

AEIF	European Association for Railway Interoperability
BG	Berufsgenossenschaft (institution for statutory accident insurance and prevention)
BOA	Regulation on Construction and Operation of Private Industrial Railroad Systems
CEN	Comitée Européen de Normalisation
DB AG	Deutsche Bahn Aktiengesellschaft (German railways)
DIN	Deutsches Institut für Normung
DKE	Deutsche Elektrotechnische Kommission im DIN und VDE
EBO	Regulation on Construction and Operation of Railroad Systems
EBOA	Regulation on Construction and Operation of Private Industrial Railroad Systems
EC	European Community
EMC	Electromagnetic compatibility
EN	European standard
ERRI	European Rail Research Institute
EUK	Eisenbahn-Unfallkasse, railway accident fund
FSF	Standards committee for rail vehicles (in DIN)
GUV	accident prevention regulation of the German statutory accident insurance institutions for the public sector
ICE	InterCityExpress
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
OSShD	Organization for the Collaboration of Railways
PPE	Personal protective equipment
RAMS	Reliability, availability, maintainability and safety
TC	Technical Committee
TSI	Technical Specification for Interoperability
UIC	International Union of Railways
UVV	Unfallverhütungsvorschrift, German accident prevention regulation (general)
VBG	(Unfallverhütungs-) Vorschrift der gewerblichen Berufsgenossenschaften, accident prevention regulation of the German BGs for the industrial sector
VDE	Verband der Elektrotechnik, Elektronik, Informationstechnik e.V.
VDMA	Verband Deutscher Maschinen- und Anlagenbau e.V.
ZH 1	Collection of publications by the BGs dealing with health and safety at work