

EU-Directive and Implementation in Germany

Federal Highway Research Institute
Division „Bridges and Structural Engineering“

Seminar

Road Tunnels Operations Management and Safety
Chongqing, China Oct 18.-20., 2006



Structure

- Introduction
- Directive 2004/54 EC
 - Recitals
 - Articles
 - Annexes (I, II, III)
- Implementation
 - Germany
 - other Member States

Federal Highway Research Institute



Federal Highway Research Institute
Bundesanstalt für Straßenwesen, Bergisch Gladbach, Germany

Introduction

Jahr	Name	Land	Länge	Tote / Verletzte
1978	Velsen	Niederlande	770 m	55 Tote, 5 Verletzte
1979	Nihonzaka	Japan	2.000 m	9 Tote
1982	Caldecott	USA	1.000 m	7 Tote, 2 Verletzte
1983	Pecorile	Italien	600 m	8 Tote, 22 Verletzte
1989	Brenner	Österreich	412 m	2 Tote, 5 Verletzte
1995	Pfänder	Österreich	6.800 m	3 Tote
1996	Isola delle Femmine	Italien	148 m	5 Tote, 10 Verletzte
1999	Mont-Blanc	Frankreich-Italien	11.600 m	39 Tote, 25 Verletzte
1999	Tauern	Österreich	6.000 m	12 Tote
2001	Gleinalm	Österreich	8.800 m	5 Tote
2002	St. Gothard	Schweiz	12.600 m	11 Tote
2005	Frejus	Frankreich-Italien	12.900 m	2 Tote, 6 Verletzte

Introduction



Viamala, September 2006, 9 fatalities



EU-Directive

Directive 2004/54/EC of the European Parliament and of the Council on Minimum Safety Requirements for Tunnels in the Trans-European Road Network

- Recitals
- Directive of the European Parliament and of the Council
- Annex I: Safety Measures
- Annex II: Approval of the design, safety documentation, commissioning of a tunnel, modifications and periodic exercises
- Annex III: Signing for Tunnels

Download: www.europa.eu.int

Structure

- Introduction
- Directive 2004/54 EC
 - Recitals
 - Articles
 - Annexes (I, II, III)
- Implementation
 - Germany
 - other Member States

Recitals

- The objective is the achievement of a uniform, constant and high level of protection for all European citizens in road tunnels.
- Safety measures should enable people involved in incidents to rescue themselves, allow road users to act immediately so as to prevent more serious consequences, ensure that emergency services can act effectively and protect the environment as well as limit material damage.
- Member States should be encouraged to implement comparable safety levels for road tunnels located in their territory that do not form part of the Trans-European Road Network and consequently do not fall within the scope of this Directive.

EU-Directive

Article 1 Subject matter and scope
Article 2 Definitions
Article 3 Safety Measures

Article 4: Administrative Authority
Article 5: Tunnel Manager
Article 6: Safety Officer
Article 7: Inspection Entity

Article 10 Tunnels whose design has been approved but which are not yet open
Article 11 Tunnels already in operation
Article 12 Periodic inspections

Article 13: Risk Analysis

Article 14 Derogation for innovative techniques
Article 15 Reporting
Article 16 Adaptation to technical progress
Article 17 Committee procedure
Article 18 Transposition
Article 19 Entry into force

Organisation

Article 5: Tunnel Manager*

- The Administrative Authority shall identify as Tunnel Manager the public or private body responsible for the management of the tunnel,
- Any significant incident or accident occurring in a tunnel shall be the subject of an incident report prepared by the Tunnel Manager,
- The Tunnel manager forwards reports to the Safety Officer, to the Administrative Authority and to the emergency services.

*) Administrative Authority may perceive this task

Organisation

Article 4: Administrative authority

- The Administrative Authority may be set up at national, regional or local level.
- Each tunnel in the Trans-European Road Network located on the territory of a single Member State shall fall under the responsibility of a single Administrative Authority.
- The Administrative Authority shall commission tunnels.
- The Administrative Authority shall have power to suspend or restrict the operation of a tunnel,
- The Administrative Authority shall ensure that tunnels are tested and inspected on a regular basis, organisational and operational schemes (including emergency response plans) for the training and equipping of emergency services are put in place, the procedures for immediate closure of a tunnel in an emergency are defined, the necessary risk reduction measures are implemented.

Organisation

Article 6: Safety Officer

- For each tunnel, the Tunnel Manager shall, with the prior approval of the Administrative Authority, nominate one Safety Officer,
- He shall co-ordinate all preventive and safeguards measures to ensure the safety of users and operational staff,
- The Safety Officer shall perform the following tasks/functions:
 - co-ordination with emergency services,
 - take part in the planning, implementation and evaluation of emergency operations,
 - take part in the definition of safety schemes and the specification of the structure,
 - verify that operational staff and emergency services are trained,
 - take part in the evaluation of any significant incident or accident .

Organisation

Article 7: Inspection Entity*

- Member States shall ensure that inspections, evaluations and tests are carried out by Inspection Entities,
- Any entity performing the inspections, evaluations and tests must have a high level of competence and high quality procedures,
- Must be functionally independent from the Tunnel Manager.

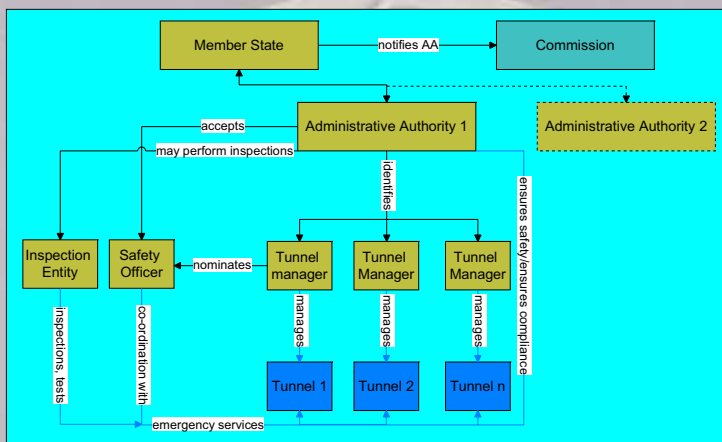
*) Administrative Authority may perceive this task

Risk Analysis

Article 13: Risk Analysis:

A risk analysis is an analysis of risks for a given tunnel, taking into account all design factors and traffic conditions that affect safety, notably traffic characteristics and type, tunnel length and tunnel geometry, as well as the forecast number of heavy goods vehicles per day.

Organisation



Risk Analysis

Risk Analysis according to the EC-Directive

- Alternatives to structural measures (Article 3).
- Special characteristic of a tunnel.
- Longitudinal ventilation in tunnels longer than 1.000 m with bi-directional and/or congested unidirectional traffic.
- Definition of regulations and requirements regarding the transportation of dangerous goods through a tunnel

Risk Analysis

Alternative to structural measures with disproportionate costs (Article 3)

Compensation

Structural requirements ↔ other measures
(evidence for equivalent or improved protection)

Annex I: Safety Measures

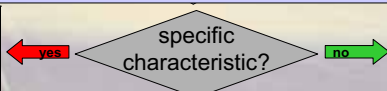
Criteria for equipment

Traffic:	> 2.000 Veh./day and lane < 2.000 Veh./day and lane
Length:	500 - 1000 m 1.000 - 3.000 m > 3.000 m
Tunnel:	new existing

Risk Analysis

Risk Analysis and implementation in Austria
Presentation by Rudolf Hoerhan

Risk Analysis



Measures according to Annex I

Safety Measures

Number of tubes and longitudinal slope

- 2 tubes obligatory, if traffic volume according to a 15-year prognosis is higher than 10.000 Veh./24h
- Longitudinal slope in tunnels less than 5 %, if geographically possible.



Safety Measures

Devices for closing the tunnel

- Barriers in front of tunnels; obligatory for tunnels longer than 1.000 m.
- Traffic signals in tunnels; recommended every 1.000 m in tunnels longer than 3.000 m with a control centre.



Safety Measures

Emergency stations

- Emergency stations consist of a box on the sidewall or preferably a recess in the sidewall.
- They shall be equipped with at least an emergency telephone and two fire extinguishers
- Emergency stations shall be provided near the portals and inside at intervals which for new tunnels shall not exceed 150 m and which in existing tunnels shall not exceed 250 m



Safety Measures

Lay-bys

- Obligatory every 1.000 m for new bi-directional tunnels longer than 1.500 m without emergency lanes.
- In existing bi-directional tunnels without emergency lanes the feasibility and effectiveness shall be evaluated.



Safety Measures

Emergency exits

- In new tunnels, emergency exits shall be provided. The distance between two emergency exits shall not exceed 500 m.
- In existing tunnels longer than 1.000 m, the feasibility and effectiveness of the implementation of new emergency exits shall be evaluated.
- Doors shall be used to prevent smoke and heat from reaching the escape routes behind the emergency exit.



Safety Measures

Emergency walkways

- Obligatory, if emergency lane is not available.
- In existing tunnels, without emergency lane and emergency walkways additional/reinforced measures are to be taken.



Safety Measures

Cross passages for rescue services

- Obligatory in two-tube tunnels, where the two tubes are at the same level or nearly.



Safety Measures

Lighting

- Normal lighting shall be provided.
- Safety lighting shall be provided.
- Evacuation lighting, such as evacuation marker lights, at a height of no more than 1.5 m, shall be provided.
- The two nearest emergency exits shall be signed on the sidewalls at distances of no more than 25 m



Safety Measures

Water supply

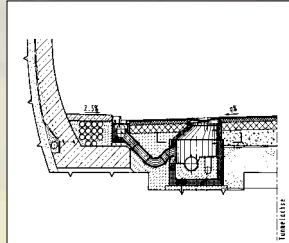
- Obligatory for tunnels longer than 500 m.
- Hydrants at the portals and every 250 m inside the tunnel.



Safety Measures

Drainage

- Obligatory, where the transport of dangerous goods is permitted.
- If in existing tunnels that requirement cannot be met or can be met only at disproportionate cost, this shall be taken into consideration when deciding whether to allow the transport of dangerous goods on the basis of an analysis of relevant risks.



Safety Measures

Ventilation (2)

- For tunnels with bi-directional traffic, with a traffic volume higher than 2.000 vehicles per lane, longer than 3.000 m and with a control centre and transverse and/or semi-transverse ventilation, the following minimum measures shall be taken as regards ventilation:
 - air and smoke extraction dampers shall be installed which can be operated separately or in groups
 - the longitudinal air velocity shall be monitored constantly and the steering process of the ventilation system (dampers, fans, etc.) adjusted accordingly



Safety Measures

Ventilation (1)

- A mechanical ventilation system shall be installed in all tunnels longer than 1.000 m (traffic volume higher than 2.000 vehicles per lane).
- In tunnels with bi-directional and/or congested unidirectional traffic, longitudinal ventilation shall be allowed only if a risk analysis according to Article 13 shows it is acceptable.
- Transverse or semi-transverse ventilation systems shall be used in tunnels where a mechanical ventilation system is necessary and longitudinal ventilation is not allowed.



Safety Measures

Monitoring Systems

- Video monitoring systems and a system able to automatically detect traffic incidents (such as stopping vehicles) and/or fires shall be installed in all tunnels with a control centre.
- Automatic fire detection systems shall be installed in all tunnels which do not have a control centre.



Safety Measures

Communication systems

- Radio re-broadcasting equipment for emergency service use shall be installed in all tunnels longer than 1 000 m with a traffic volume higher than 2 000 vehicles per lane.
- Where there is a control centre, it must be possible to interrupt radio re-broadcasting of channels intended for tunnel users, if available, in order to give emergency messages
- Shelters and other facilities where evacuating tunnel users must wait before they can reach the outside shall be equipped with loudspeakers for the provision of information to users.



Safety Measures

• mandatory for all tunnels ◯ not mandatory
 * mandatory with exceptions ◻ recommended

Structural Measures	Traffic < 2 000 veh. per lane 1 000 m	Traffic < 2 000 veh. per lane > 1 000 m	Traffic = 2 000 vehicles per lane		Additional conditions for implementation to be mandatory, or comments
			1 000 m	> 1 000 m	
2 exits or more	□ 2.1	□	□	□	Mandatory where a 15 year forecast shows that traffic > 10 000 veh./day
Exits > 1 %	□ 2.2	•	•	•	Mandatory unless not geographically possible.
Emergency walkways	□ 2.3.1	•	•	•	Mandatory where there is no emergency lane, unless the condition in §2.3.1 is required.
Emergency exits in both ways	□ 2.3.2	•	•	•	In existing tunnels where there is neither an emergency lane, nor an emergency walkway additional, reinforced concrete shall be taken.
Clearance for emergency vehicles at least every 1 000 m	□ 2.4	□	□	□	Implementation of emergency exits in existing tunnels to be evaluated case by case.
Clearance for emergency vehicles at least every 1 000 m	□ 2.4	□	□	□	Mandatory in two-lane tunnels longer than 1 500 m
Clearance of the central reserve outside each portal	□ 2.4.2	•	•	•	Mandatory outside twice in multi-lane tunnels whenever geographically possible.
Clearance of the central reserve outside each portal	□ 2.4	□	□	□	Mandatory in new bi-directional tunnels < 1 500 m without emergency lanes. In existing bi-directional tunnels > 1 500 m depending on analysis. For both new and existing tunnels, depending on extra safety tunnel width.
Clearance of the central reserve outside each portal	□ 2.4	□	□	□	Mandatory where transport of dangerous goods is allowed.
Structures for fire-fighting and other traffic	□ 2.5	•	•	•	Mandatory where a local collapse can have catastrophic consequences.
Fire resistance of structures	□ 2.7	•	•	•	

Safety Measures

Control Centre

- A control centre shall be provided for all tunnels longer than 3.000 m (2.000 Veh./lane).
- Surveillance of several tunnels may be centralised at a single control centre.



Safety Measures

• mandatory for all tunnels ◯ not mandatory
 * mandatory with exceptions ◻ recommended

Lighting	Traffic < 2 000 veh. per lane 1 000 m	Traffic < 2 000 veh. per lane > 1 000 m	Traffic = 2 000 vehicles per lane		Additional conditions for implementation to be mandatory, or comments
			1 000 m	> 1 000 m	
Normal lighting	□ 2.8.1	•	•	•	
Surface lighting	□ 2.8.2	•	•	•	
Emergency lighting	□ 2.8.3	•	•	•	
Mechanical ventilation	□ 2.9	□	□	□	
Special provisions for parallel or opposite ventilation	□ 2.9.1	□	□	□	Mandatory in bi-directional tunnels where there is a control centre.
Emergency exits	□ 2.10	•	•	•	Equipped with brightness and 2 configurations. A maximum interval of 250 m is allowed in existing tunnels.
Water supply	□ 2.11	•	•	•	If not available, mandatory to provide sufficient water otherwise.
Road signs	□ 2.12	•	•	•	For all safety facilities provided for tunnel users (see Annex 20).
Control centre	□ 2.13	□	□	□	For tunnels of general interest may be centralised into a single control centre.
Monitoring systems	Vision	□ 2.14	□	□	Mandatory where there is a control centre.
Automatic acoustic detection and/or fire detection	□ 2.14	•	•	•	At least one of the two systems is mandatory in tunnels with a control centre.
Equipment to close the tunnel	Traffic signals before the entrance	□ 2.15.1	□	□	
Traffic signals inside the tunnel at least every 1 000 m	□ 2.15.2	□	□	□	Recommended if there is a control centre and the length exceeds 1 000 m

Safety Measures

SUMMARY OF MINIMUM REQUIREMENTS		Traffic < 2 000 vehicles per lane		Traffic > 2 000 vehicles per lane		Additional conditions for implementation to be considered, if necessary
		1 000 m	1 000 m	1 000 m	1 000 m	
Communication systems	Build-in broadcasting for emergency services	02.14.1	Q	Q	Q	•
	Emergency radio-coverage for tunnel users	02.14.2	•	•	•	•
	Landmobile or cellular radio	02.14.3	•	•	•	•
	Emergency power supply	02.17	•	•	•	•
	Provision of equipment	02.18	•	•	•	•

Safety documentation

Commissioning stage

- Safety documentation for the design stage;
 - + a description of the organisation, human and material resources and instructions specified by the Tunnel Manager to ensure operation and maintenance of the tunnel,
 - + an emergency response plan drawn up jointly with the emergency services which also takes into account people with reduced mobility and disabled people,
 - + a description of the system of permanent feedback of experience through which significant incidents and accidents can be recorded and analysed.

Safety documentation

Design stage

- a description of the planned structure and access to it,
- a traffic forecast study specifying and justifying the conditions expected for the transport of dangerous goods, together with the risk analysis,
- a specific hazard investigation describing possible accidents which clearly affect safety of road users in tunnels,
- an opinion on safety from an expert or organisation specialising in this field.

Safety documentation

Operation

- Safety documentation design stage,
- Safety documentation commissioning stage,
 - + a report and analysis on significant incidents and accidents, which have taken place since the entry into force of this Directive,
 - + a list of the safety exercises carried out and an analysis of the lessons learned from them.

Exercises

Periodic exercises

- The Tunnel Manager and the emergency services shall, in co-operation with the Safety Officer, organise joint periodic exercises for tunnel staff and the emergency services.
- full scale exercises under conditions that are as realistic as possible shall be conducted in each tunnel at least every four years.
- the Safety Officer and the emergency services shall evaluate jointly these exercises draw up a report and make appropriate.

Structure

- Introduction
- Directive 2004/54 EC
 - Recitals
 - Articles
 - Annexes (I, II, III)
- Implementation
 - Germany
 - other Member States

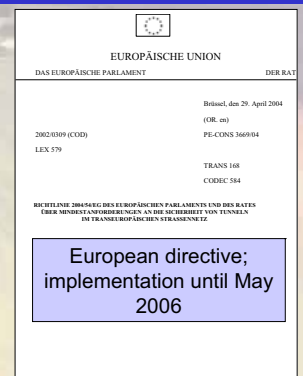
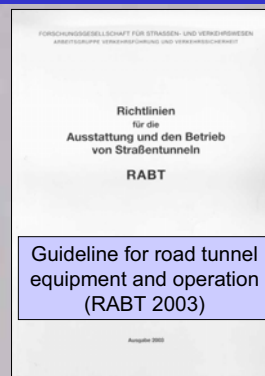
Signing for tunnels

Road signs shall be used to designate the following safety facilities in tunnels:

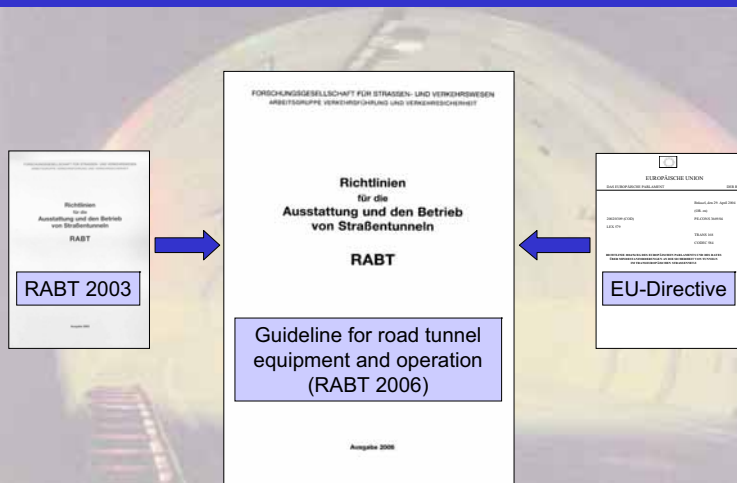
- Lay-bys
- Emergency exits
- Escape routes
- Emergency stations



Implementation



Implementation



Implementation

- Organisation (Articles 4 to 7)
- Risk Analysis (Article 13; prescriptive ↔ performance based)
- Level of equipment (Annex I) is higher than requirements of the Directive
- Signing

Implementation

- Guideline (RABT 2006) given to the 16 „Länder“ (States) by the Federal Ministry of Transport Building and Urban Affairs.
- Introduction by each of the 16 „Länder“.
- Instructions on signing have been implemented by new articles in the traffic regulations (law).

Implementation

- Plan for upgrading of existing tunnels
- Methodology for risk analysis (national research, C3.3-WG2)
- Reporting of incidents on Federal level
-

Implementation

- Austria: Law
- Netherlands: Law
- Check Republic: Law
- Belgium: Law for TERN tunnels

The End

Thanks for your kind attention!