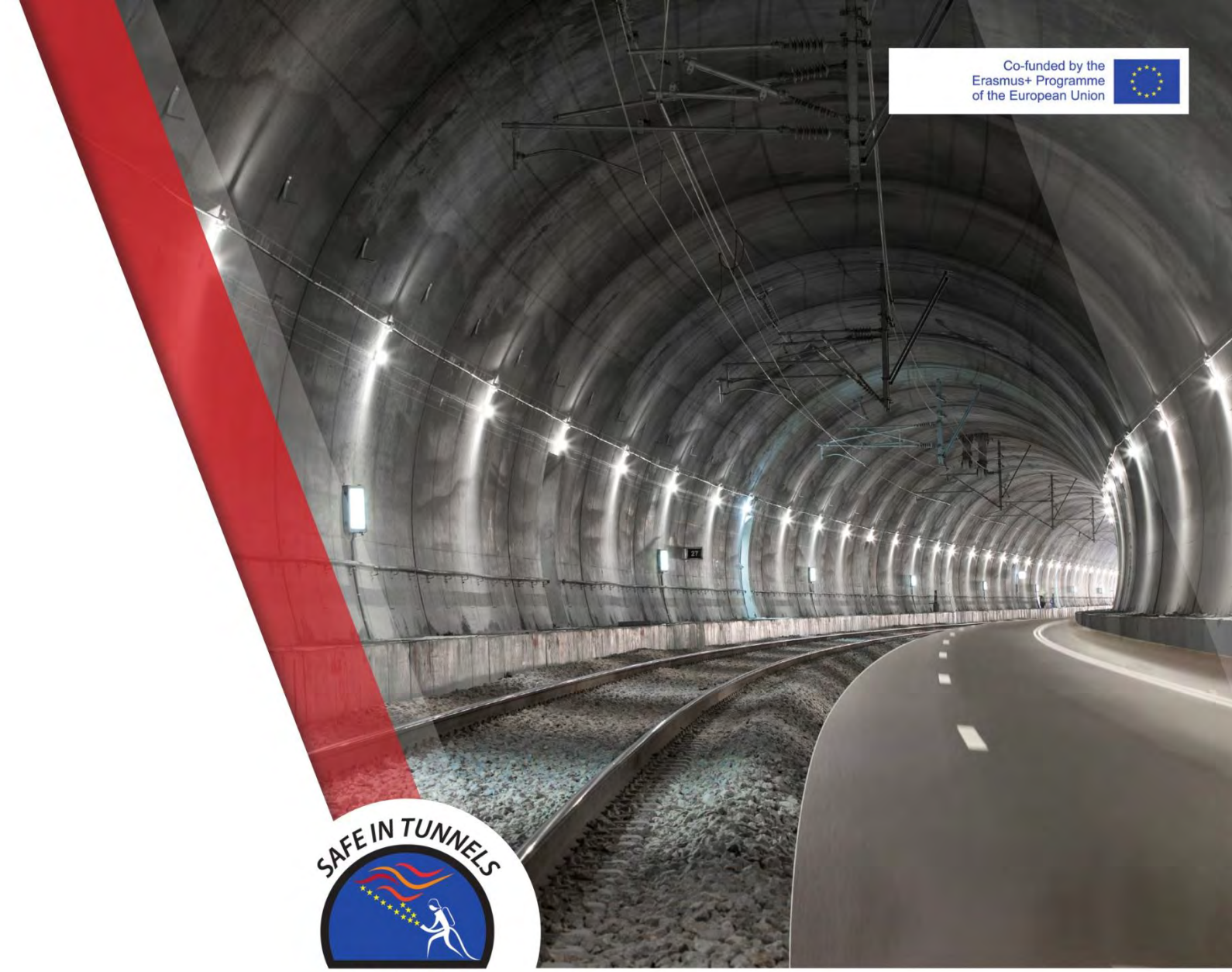
Co-funded by the
Erasmus+ Programme
of the European Union



SAFE IN TUNNELS

SAFEINTUNNELS

Recommendation for the basic training and advanced training of emergency and rescue services in passenger and cargo transport on the transeuropean road and rail

Co-funded by the
Erasmus+ Programme
of the European Union

Introduction

The harmonization of training for tunnel rescue in the fire department on a European level was the aim of the SAFINTUNNELS project. Thanks to the commitment of four partners from three Member States and one associated partner, this "Training Plan for Training and Continuing Education in Tunnel Rescue in the Fire Service" makes it possible to create a European beacon for the safe and operationally appropriate application of technical and strategic elements in the tunnel fire and rescue service. This model training plan is analogous to the recommendation of the Tyrolean Fire Brigade Association and the Norwegian Rogaland Fire Brigades for the training of local and regional firefighters, respectively.

After one year of planning, the Erasmus+ application "Traveling safe through Europe - Training and education for firefighters in tunnel safety" (short: SAFEINTUNNELS) was successfully submitted to the National Agency for Erasmus+ in Austria (OeAD) in March 2019. Four project partners and one associated partner from four European countries were intensively involved in the following three years in proposing a European training format in tunnel rescue: The Tyrol Fire Brigade School in Austria, the Reutlingen Professional Fire Brigade in Germany, the fire departments of the Rogaland region in Norway and Beneke & Prinzhorn GmbH from Germany as well as the associated partner Galleria di Base del Brennero from Italy.

The common goal of the partners was to ensure that training for tunnel rescue operations in the fire department is and can be provided at the harmonized level throughout the European Union. One essential goal got never lost during these three years: a training model that each member state of the European Union can adopt into valid, national training regulations. On August 31, 2022, a manual was completed with the publication of Training Standards for Tunnel Rescue in Europe.

On the one hand, this SAFEINTUNNELS manual is immediately applicable, and, on the other hand, it can be adapted to local or regional conditions for use in tunnel rescue or implemented by the federal states, counties, and municipalities in already existing training structures. There is also no need for a central regulation here. Rather, the manual is structured in such a way that individual learning outcome units can also be used in training.

Furthermore, a comparable training pathway for the transnational transfer of acquired competencies has been set by complying with the ECVET standard for transnational application at the European level – so far unseen in the firefighting scene. Specifically, four training guidelines are now available in German, English, Italian and Norwegian, which can be accessed on RICHTIGE URL EINSETZEN.

Furthermore, blended learning content has been designed to prepare and ensure a consistent level of training. They allow harmonization of what has been learned in several short sessions, while at the same time promoting self-learning skills among users. The motivation for this was that a successful completion is more likely if users do not have to complete the videos and multiple-choice tests in a single long session but can continue at the last level in each of a series of sessions, esp. also on different devices. The content is structured as follows:

Basic module road and rail tunnels

The target group for the basic module is the squad of fire departments in tunnel rescue. It usually consists of up to three squad members. They can be part of a unit with several operational elements that are controlled directly by a leader or centrally from a command vehicle, depending on national circumstances and the hazard situation. The squad members should have completed at least a respiratory protection course and basic firefighter training.

Leadership module for rescue in road and railway tunnels

In addition to the elements of the basic module, managers are required to have a catalog of different competencies depending on national regulations. They must have completed specific training in advance. This course therefore focuses on strategic firefighting approaches in the specific field of tunnel rescue (street and railway).

Trainer module for tunnel rescue (basic and leadership module)

The instructors of these different functional areas need an appropriate application and theoretical knowledge to secure and develop a professional education and training guideline for firefighters. Therefore, high demands are placed on instructors of firefighters because the learners are so-called high-risk teams. Characteristics of these teams are:

Physical and psychological harm can occur, there is responsibility for the lives of others, and rescue operations usually cannot be aborted. Thus, extensive knowledge of technology, operational principles, and operational tactics is required for an instructor of firefighting in tunnel rescue.

Manual „SAFEINTUNNELS“

The manual „SAFEINTUNNELS“ therefore describes a technically sound, systematically structured training path that can be easily implemented in existing training curricula for emergency forces that have to deal with tunnel fire incidents in different roles.

Document links:

Recommendation on the initial and further training of firefighters and other rescue services in passenger and freight transport on the trans-European road and railway network

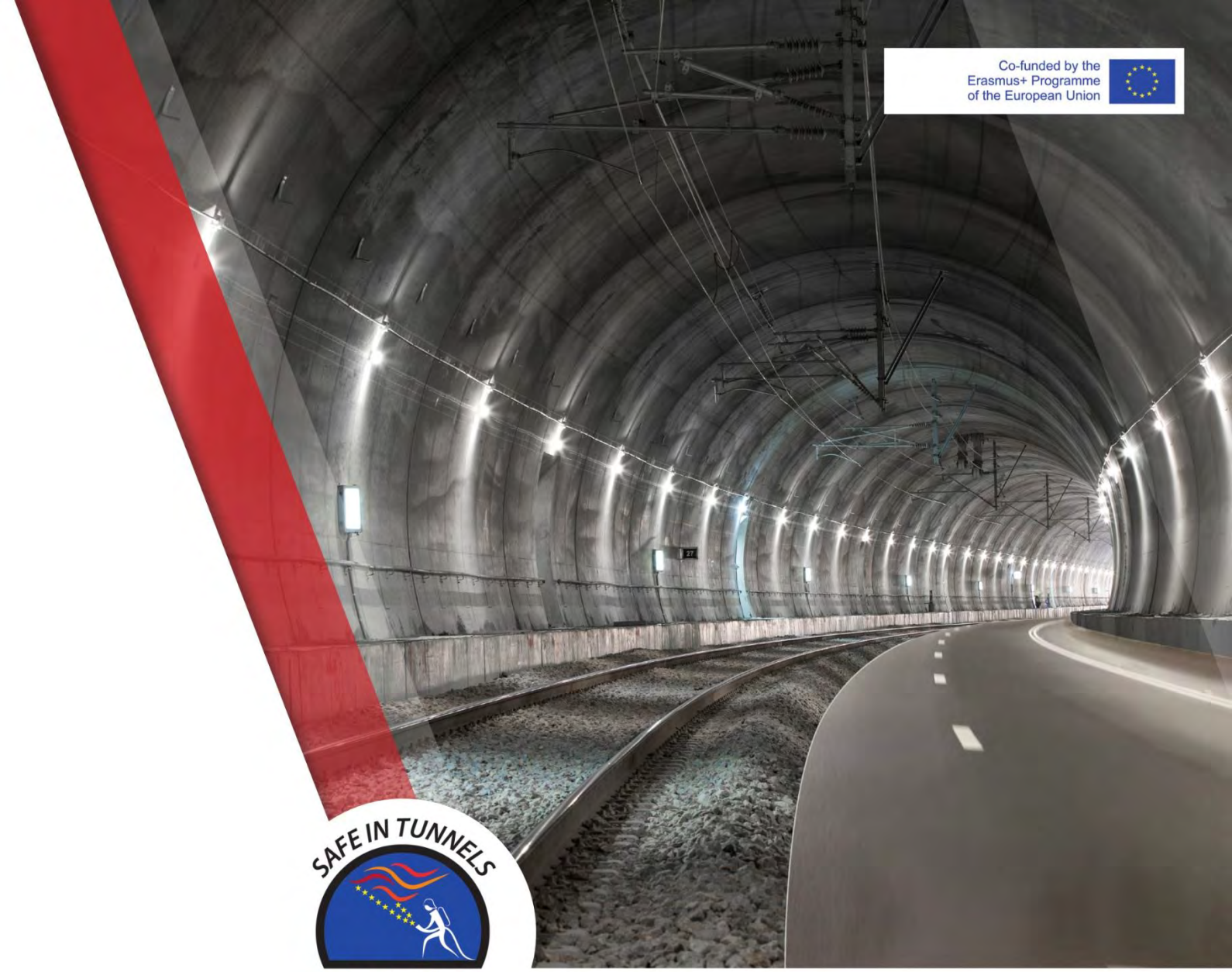
European Vocational Education and Training for Firefighters in Road Tunnels

European Vocational Education and Training for Firefighters in Railway Tunnels

European vocational education and training guideline for operational leaders in road and railway tunnels

European training concept Train the trainer for firefighting instructors at fire incidents in railway and road tunnels

Co-funded by the
Erasmus+ Programme
of the European Union



SAFEINTUNNELS

Recommendation on the initial and further training of firefighters and other rescue services in passenger and freight transport on the trans-European road and railway network

Co-funded by the
Erasmus+ Programme
of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

Table of contents

Co-funded by the
Erasmus+ Programme
of the European Union

Recommendation on the initial and further training of firefighters and other rescue services in passenger and freight transport on the trans-European road and railway network

Executive summary

Road and railway tunnels are a key element in the development of the European transport network. Although the number of accidents in tunnels is low compared to the open roadway, the potential damage caused by a single accident is many times higher in tunnels – in terms of the number of victims, the mass psychological impact on road users and in terms of material damage and the impact on the infrastructure. The behaviour of people and firefighters, in addition to the technical safety systems in the tunnel, therefore has a decisive influence on the safety level in road and railway tunnels. For a structured interaction between victims and firefighters in the tunnel is central for example the level of knowledge of safety processes, the psychology of the people involved as well as the training of firefighters and their supervisors. Having this mind, it surprises that there is no integrated European training concept for "fire and rescue services in tunnel operations". SAFEINTUNNELS – an Erasmus+-funded project from the key action strategic partnerships in the field of vocational training and education – is therefore the content-related and structural push for harmonisation and digitalisation in the training of fire and rescue services in Europe. It focuses on road and railway tunnels as symbolic lifelines of a living European idea. The objectives of this recommendation are therefore:

- To provide a systematic overview of existing European regulations and guidelines in the field of safety in tunnels and for fire and rescue services.
- To provide an overview of the need for harmonisation of the training of "fire brigades and rescue teams in tunnel operations".
- Practical recommendation for regulators and decision-makers, including the basic elements for the training of "fire and rescue services in tunnels".

Background

Modern and safe transport routes are indispensable prerequisites for a dynamic economy – efficient infrastructures are a clear locational advantage for Europe. Of course, one mode of transport alone cannot cope with the predicted growth in European traffic. This is why the European Union's transport policy aims to improve the performance and efficiency of all modes of transport. The European Union, including the Commission's Directorate-General for Mobility and Transport and also the EU Transport Commissioner for 2019-24 Adina Vălean, therefore wants to strengthen passenger and freight transport between the Member States by 2050 by a trans-European expansion of road and railway connections (TEN-T), among other things (EU Regulation No. 1315/2013). TEN-T has two time corridors: an overall network and a core network. The core network is to be completed by 2030, the overall network by 2050. The core network consists of nine corridors, which are intended to strengthen the most important long-distance traffic or routes. They are designed to be multimodal and thus to promote and secure cross-border traffic within the Union.

The TEN-T tunnel plays a central role in traffic management in terms of travel time, speed and environmental protection. Directive 2004/54/EC describes tunnels longer than 500 m as important structures, which link large areas of Europe and play a vital role in the functioning and development of regional economies (recital 2 in 2004L0054-EN-07.08.2009-001.001-2). The Directive further specifies that safety in tunnels requires a number of measures, including those relating to safety equipment, including road signs, traffic management, training of rescue services, incident management, information to users on how to behave in tunnels and improving communication between the competent authorities and rescue services such as police, fire brigade and other emergency teams (recital 9 in 2004L0054-EN-07.08.2009-001.001-2). So-called rescue services are central to a smooth traffic flow. Directive 2004/54/EC therefore defines rescue services in Art. 2, point 2 as all local services – both public and private – or tunnel staff providing assistance in the event of an accident, including police, fire and rescue services.

For the supervision of the rescue services, Directive 2004/54/EC provides for so-called administrative authorities (Art. 4, para. 1), which have the task of establishing organisational and operational procedures for the training and equipping of the rescue services (including plans for intervention in the event of an incident) (Art. 4, para. 6b). As a parameter for the administrative authority to check the effectiveness of the tunnel safety measures, the Directive specifies the access time of the rescue services (Article 3, 1.12), which should be as short as possible (point 3.4, resources for tunnel operation/safety measures section). This objective shall be achieved by periodic exercises, which are as realistic as possible, correspond to the defined incident scenarios and provide clear results (point 5, resources for tunnel operation/safety measures section). In Article 6, Paragraph 2d, the Directive further specifies that it is necessary to organise regular exercises for operating and rescue staff, which requires appropriate basic and continuous training (Point 3.1, Means of tunnel operation in the Safeguards section). It also states that computer simulations may be used for this purpose (point 5, Means of tunnel operation/safety measures section) in order to minimise disruption of tunnel operations. However, large-scale exercises shall be carried out at least every four years under the most realistic conditions possible. In between, partial and/or simulation exercises shall be carried out annually (point 5a, Resources for tunnel operation/safety measures section).

According to the Treaty on the Functioning of the European Union (TFEU), one of the objectives of the EU (Art. 176c) is to support and supplement the activities of the Member States at national, regional and local level with regard to risk prevention, the training of those involved in civil protection in the Member States and intervention in the event of natural or man-made disasters in the European Union. This will make it possible to provide support in firefighting training right down to the lower national, regional and or local levels. For this purpose, a European training framework for transparency and transferability of firefighter and rescue service trainings is needed. The formulation of minimum requirements for firefighters at national, regional and local level will be in accordance with subsidiarity, proportionality and shared responsibility.

Introduction

The sometimes catastrophic consequences of tunnel fires (e.g. Mont Blanc Tunnel 1999, Austrian Kaprun Cableway Tunnel 2000, Swiss St. Gotthard Tunnel 2001 or Simplon Tunnel 2011) not only led to fatalities and serious material damage, but also to a reduced confidence in the European public in road and railway tunnels. The EU Commission reacted with the Directive 2004/54/EC on minimum safety requirements for tunnels in the trans-European road network. There, it gave a prominent position to fire safety in railway and road tunnels due to the specific characteristics of the tunnel environment. This is because the safety of existing and future tunnels requires innovative new safety concepts in view of the increase in road and railway traffic in Europe and the changing vehicle mix, in particular due to the shift towards electric and hydrogen mobility.

Since the publication of the Directive in 2004, almost all Member States have taken up the subject of technical inventory and monitoring of new tunnels. Whether through regular tunnel symposia such as those of the Federal Highway Research Institute (BAST) in the Federal Republic of Germany, partly international research projects such as UPTUN (2007) or SAFE-T (2006) of the European Union, or the formation of specialist groups in European interest groups such as the European Road Assessment Programme (EURORAP), there are numerous efforts being made in this area (Wolf, 2010). Today, there is a strong network at national, European and international level for the development and harmonisation of design guidelines for tunnel safety, which is also receiving international attention, e.g. with the Permanent International Association of Road Congress (PIARC) and the International Union of Railways (UIC). However, a consequent extension of the safety topic up to the fire brigade technical training has only been carried out incoherently on a European level until today. The central role of firefighting technical forces is usually subordinated to the area of operations in presentations and publications (UNECE, 2001). The focus of publications, efforts by interest groups and political decision-makers is on the safety design of existing and new tunnels. However, the life-saving deployment of firefighters in the event of an alarm requires comprehensive technical and tactical training of them. This training for the specific challenges in road and railway tunnels is currently being provided by fire brigades in Europe with varying degrees of intensity. SAFEINTUNNELS has set itself the goal of creating a regulatory recommendation for the standardisation of training in this area in the participating project countries and beyond, and to present it to the regulators in committees and associations. Accordingly, this paper

has two objectives for the Erasmus+ project SAFEINTUNNELS: a framing and an attention-grabbing one. Setting the framework here means realigning the focus and developing a European dimensionally stable framework for the firefighting training of tunnel safety personnel. Attention-grabbing by describing the need for a comprehensive European training approach against the background of the trans-European transport network.

SAFEINTUNNELS – Why standards in the training of firefighters?

A tunnel is one of the most complex structures in construction and maintenance. In general, they serve to facilitate transit and to shorten travel times. In Europe, the available safety concepts for training and further education are divided between firefighters and technical aid organisations according to national conditions. There is no European concept for firefighting in tunnels, and the supranational exchange between the actors and organisations in the Member States has so far only moved into the perception of the public and decision-makers in authorities, associations and institutions on a phased basis (after major accidents) and superficially. Professional exchange should be obligatory.

SAFEINTUNNELS will try to close a gap in knowledge and action: Because despite the fact that firefighting in tunnels requires an individual strategy that takes into account local and/or regional circumstances (location, type and age of the tunnel, applied rescue plan, etc.), there are common nominators that can and should be shared. For example, a harmonised term around the time available in case of an rescue – influenced by the alarm room, fire development and technical equipment of the tunnels (European Commission, 2004) or the common features of technical equipment for fire fighting in tunnels as derivations of other complex equipment for fire fighting is central for a European comparison with impact assessment and recommendations for action. SAFEINTUNNELS is therefore striving for a European training platform that on the one hand makes training content available and on the other hand ensures the dissemination of framework data on all aspects of tunnel rescue. Only in this way can all the forces involved be integrated in consistent and continuous further development – including joint training and exercises. This platform will use the European Qualifications Framework and the European Credit System for Vocational Education and Training as a basis for the creation and safeguarding of comparability of a harmonised European training canon and will call for its application within the Scandinavian-Mediterranean corridor of the trans-European transport network.

The mandated and associated partners of this ERASMUS+ project come along the route of this corridor from Norway (Rogaland Fire Service Network), Germany (Reutlingen Fire Service and Beneke & Prinzhorn GmbH), Austria (Tyrol Fire School) and Italy (Galleria di Base del Brennero SE).

Figure 1 – Scandinavian-Mediterranean corridor of TEN-V

Source: Own graphic, based on EU Commission (2019). Access online on 26.05.2020. https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html.

SAFEINTUNNELS – A European training standard in tunnel rescue

In the past, situations have repeatedly occurred in connection with tunnel accidents, sometimes with fatal results (see previous exemplary list of accidents). These accidents have been caused by technical defects of the tunnel safety systems on the one hand, but also by careless or outdated operational techniques on the other. This is reason enough to structure the training for firefighting vehicle crews, the training of supervisors in this area and the training of the respective instructors more integrated. SAFEINTUNNELS is therefore the necessary content-related and structural push for harmonisation and digitalisation in the training of firefighters in Europe. This is because firefighting in tunnels differs significantly from the situation in buildings (Voeltzel & Dix, 2004).

The firefighters and other rescue services concerned should therefore be prepared for their activities by means of rule-based, multi-stage, comprehensive training. The provisions of Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work require implementation at national level. The objectives are the qualification of the firefighters as well as the documented instruction of resources such as vehicles, equipment and materials for tunnel operations. This should also exclude dangers for the firefighters and other rescue services.

In contrast to commercial companies, however, the fire brigade has a special responsibility towards third parties – the people to be rescued. This responsibility and the existing specifications under building law depending on the tunnel area (e.g. Alps vs. Lower Lake Constance) regarding the assurance of different rescue and firefighting measures therefore requires the fire brigade and rescue workers to be trained in accordance with local requirements, which should go well beyond the requirements of European health and safety at work. Comprehensive technical and tactical training and further training improves the quality in handling with this diverse range of operations and thus not only creates safety for the user and protects the victims, but also legal certainty for those responsible for the fire brigades.

The resources needed to fulfil the contract in tunnel operations are often complex and expensive vehicles, equipment and materials, which make intensive training of the firefighters necessary. Furthermore, firefighting in tunnels requires special tactics, as the sources of danger often require long distances to be covered with breathing apparatus in the dark. However, the special operational principles for tunnel operations do not have the same priority as the technical training on the equipment used but the firefighters require precisely the training of this competence in order to be able to act quickly and correctly in the event of danger. A distinction must therefore be made between the requirements and the actual training:

1. SAFEINTUNNELS – Requirements for tunnel firefighters and their supervisors and their instructors

The fire brigades in tunnel operations consist of different crew members. They might be part of a rescue train, which, depending on the national situation, the danger situation and the type of tunnel (road vs. railway), is led by a supervisor directly on the vehicle or centrally by a command vehicle. The firefighters should have completed at least the "basic course for fire brigades and rescue services in tunnels" and should also have been prepared in a respiratory protection course for the use of the appropriate respiratory protection equipment (such as regenerative or twin-pack respirators) for prolonged, sustained operations in tunnels. Supervisors are required to have a catalogue of the most varied skills depending on national regulations. The instructors of these different functional areas need a corresponding application and theoretical knowledge to ensure the training and further education of the forces.

2. SAFEINTUNNELS – Training of tunnel firefighter and their supervisors

Regular training courses with specific operational tactical content should be provided for the training of firefighters for tunnel operations, their supervisors or the respective instructors. In addition to the sequences of action, the training courses should also provide the firefighters and other rescue services with knowledge of local conditions. Technical aspects relating to the tunnel in the area of operation, such as the functioning of the ventilation system, should also be covered.

SAFEINTUNNELS course approach is a consecutive model:

Prerequisite for the course is a completed training as a firefighter including a breathing protection course, as well as the possession of the necessary driving licence. For supervisors, the corresponding qualification is therefore the SAFEINTUNNELS basic course (road or railway). This course teaches the general basics of tunnel firefighting in road or railway tunnels.

For the training, all course participants should have their own operating instructions for the equipment used for training and comprehensive training documents for squad members or on command guidelines. The contents of this training plan should be conveyed in the form of theoretical principles and practical training.

The following training titles are the basis for a European training standard in tunnel rescue, which applies equally to squad members and supervisors. Further differentiation must be based on compliance with national training principles, taking into account the indication of learning target levels (European Commission, 2009) according to the European Credit System for Vocational Education and Training (ECVET) (see the section SAFEINTUNNELS – transparency in Performance and Knowledge Acquisition for Europe).

Co-funded by the
Erasmus+ Programme
of the European Union

SAFEINTUNNELS – Contents of a "basic course for firefighters and supervisors of fire and rescue services in tunnels"

1. Technical introduction to tunnel constructions
2. Explanation of the technical and local conditions
3. Safety in handling the used resources: Vehicles, equipment and materials for tunnel operations and accident prevention
4. Scientific basis for tunnel operations
5. Tactical use of vehicles, equipment and materials for tunnel operations
6. Types of operations in tunnel rescue
   a) rescue of people
   b) firefighting
7. Special tactics for tunnel operations
8. Training of special tactics in tunnel operations
9. Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties
10. Leadership skills in use – especially in tunnels spanning several countries

SAFEINTUNNELS – Training for instructors for firefighters and their supervisors

High demands are placed on instructors of fire brigade personnel because the trainees are so-called high-risk teams. Characteristics of these teams are: physical and psychological damage can occur, there is responsibility for the lives of others and rescue operations cannot usually be aborted.

As instructors, extensive knowledge of technology, operational principles and tactics is therefore required.

The instructor must have completed the modules for instructors (operational or management) or an equivalent qualification. The instructor should be competent to deal with tunnel operations and have in-depth knowledge of the specific operational principles and the necessary resources.

Comprehensive, specialised, practical and theoretical operational experience, knowledge for firefighting training including knowledge of the framework of knowledge and necessary expertise according to the European Qualifications Framework (EQF) for lifelong learning should be taken into account (European Union 2020).

- The instructor for the module for the basic module on tunnel deployment for firefighters and supervisors should have at least the requirements of the EQF 6 qualification framework.

In addition to the technical content of the various modules, the instructor should also be able to control the effectiveness of the training and adapt the content to the internal and external environment of the fire service:

1. learn and let learn
2. blended learning elements in fire brigade training
3. train-the-trainer-skills

SAFEINTUNNELS – Continuous training of all participants

Operational readiness should be regularly reviewed and continuously improved. In the event of an incident in a tunnel, the time required for the arrival of the rescue services must be kept as short as possible (European Union, 2004). The knowledge gained from the respective training units must therefore be repeatedly refreshed, trained and expanded in order to ensure smooth and safe operations in the long term. The contents of this recommendation are to be consolidated and updated annually through further training events and exercises in accordance with national regulations through practice, theory and simulations. In transnational tunnel projects, joint exercises in the languages of all parties involved should be part of this European harmonised curriculum.

Recommendation for further training in theory and practice:

1. practical exercises for all firefighting services
2. repeated training of the different operational situations on an object and/or by virtual simulation
3. practice with the vehicles, equipment and materials used in the tunnel
4. dealing with technical faults in operation
5. special tactics for tunnel operations
6. updating the content of training in line with technological progress: cars, lorries, railway vehicles
7. regular adjustment of the special tactics of use and object

Where applicable:

1. case studies and decision making training for mission leaders in special operational situations
2. refreshing leadership skills through guideline training
3. additional module instructor training

This is the only way to close across Europe gaps in knowledge, harmonize cooperation and communication between the parties involved, and eliminate deficiencies for targeted deployment and rescue management.

SAFEINTUNNELS – Transparency in performance and knowledge for Europe

In general, the EU has only indirect influence on competences in the areas of fire protection, rescue and civil protection. However, this influence is direct through TEN-T, as the driving of this project includes fire protection. The same applies to the effect of European occupational safety and training standards on fire and rescue services. SAFEINTUNNELS revolves around the effect of the latter point. The freedom of profession and establishment within the EU also means for firefighters that transparency in qualifications and competences, equal opportunities and anti-discrimination are ensured and that international recruitment of young people is possible. The exercise of a profession learnt in an EU Member State must therefore be given the same recognition throughout the EU. SAFEINTUNNELS is one of the few projects in the field of fire and rescue services that pays attention to this issue. It is obvious that sharing the knowledge and practical experience in the fire service available throughout the EU for education and training purposes would promote the level of education and training within the EU in the long term.

SAFEINTUNNELS therefore aims to achieve common standards in Europe with regard to the core competencies of fire brigades using the example of tunnel operations (road and railway). On the basis of the content previously broken down, an adaptation to national, regional and local conditions is carried out – not the other way round. In accordance with the principle of subsidiarity, tunnel operations can of course continue to be carried out with various technical aids. However, this is done on the basis of a comprehensive platform. It has the recognition of the professional qualifications acquired in the respective Member States in the field of fire brigades as its main objective, thus ensuring that Directive 2005/36/EC on the recognition of professional qualifications (European Commission, 2005) also applies to fire and rescue services.

This requires a public database/platform with the necessary requirements for firefighters at three different functional levels (see previous section). At the same time, this platform contains an overview of possible strategies and best practices with regard to the use of tunnels by fire brigades. This European idea needs not only multipliers within the fire brigades, but also and in particular promotion at administrative and decision-maker level within the public administration of the Member States, in the relevant fire brigades associations and in the European structures, whether within the European Commission or with interest groups in the European area.

A key to transferability and recognition of the acquired knowledge will be the development of curricula according to EQF including the integration of the result in ECVET. This learning outcome orientation is the basis for SAFEINTUNNELS and will ensure sustainability beyond the project cycle. In order to achieve this goal, SAFEINTUNNELS focuses on the outcome of the teaching and not on the input (e.g. duration of education, learning location or learning method). The project result will therefore show what operational and management staff and their instructors know, understand and are able to do after completion. Gradually, a common European language could thus be found in the training of fire and rescue services. This regulatory framework is already in place and has a clear legal framework. Nevertheless, this goal needs a maximum multiplication by YOU dear readers and supporters. SAFEINTUNNELS needs YOU: Talk about our project, consolidate our contacts and promote Europeanization in the fire brigades.

Bibliography

Europäische Kommission (2013). Verordnung (EU) Nr. 1315/2013 des Europäischen Parlaments und des Rates vom 11. Dezember 2013 über Leitlinien der Union für den Aufbau eines transeuropäischen Verkehrsnetzes und zur Aufhebung des Beschlusses Nr. 661/2010/EU. Brüssel: Amtsblatt der Europäischen Union.

Europäische Union (2012). Vertrag über die Arbeitsweise der Europäischen Union (AEUV). Brüssel: Amtsblatt der Europäischen Union. Letzter Zugriff online am 05.01.2020: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:12012E/TXT:de:PDF.

Europäische Kommission (2009) Richtlinie 2009/C155/02 des Europäischen Parlaments und des Rates vom 7. Juni 2009 über die Etablierung eines Europäischen Leitungspunktesystem für die Berufsbildung (ECVET). Brüssel: Amtsblatt der Europäischen Union.

Europäische Kommission (2007). Engineering guidance for water based fire fighting systems for the protection of tunnels and subsurfaces facilities (UPTUN – upgrading methods for fire safety in existing tunnels). Letzter Zugriff online am 19.01.2020: https://fogtec-international.com/files/uptun-guideline-08_30.08.07.pdf.

Europäische Kommission (2006). Safety in tunnels thematic network – comprehensive guidelines for pan European decision making on the safety of existing tunnels (primarily road but also railway). Letzter Zugriff online am 19.01.2020: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/pdf/projects/safe-t.pdf.

Europäische Kommission (2005) Richtlinie 2005/36/EG des Europäischen Parlaments und des Rates vom 7. September 2005 über die Anerkennung von Berufsqualifikationen. Brüssel: Amtsblatt der Europäischen Union.

Europäische Kommission (2004). Richtlinie 2004/54/EG des Europäischen Parlaments und des Rates vom 29. April 2004 über Mindestanforderungen an die Sicherheit von Tunneln im transeuropäischen Straßennetz. Brüssel: Amtsblatt der Europäischen Union.

Europäische Kommission (1989). Richtlinie des Rates vom 12. Juni 1989 über die Durchführung von Maßnahmen zur Verbesserung der Sicherheit und des Gesundheitsschutzes der Arbeitnehmer bei der Arbeit. Amtsblatt der Europäischen Union.

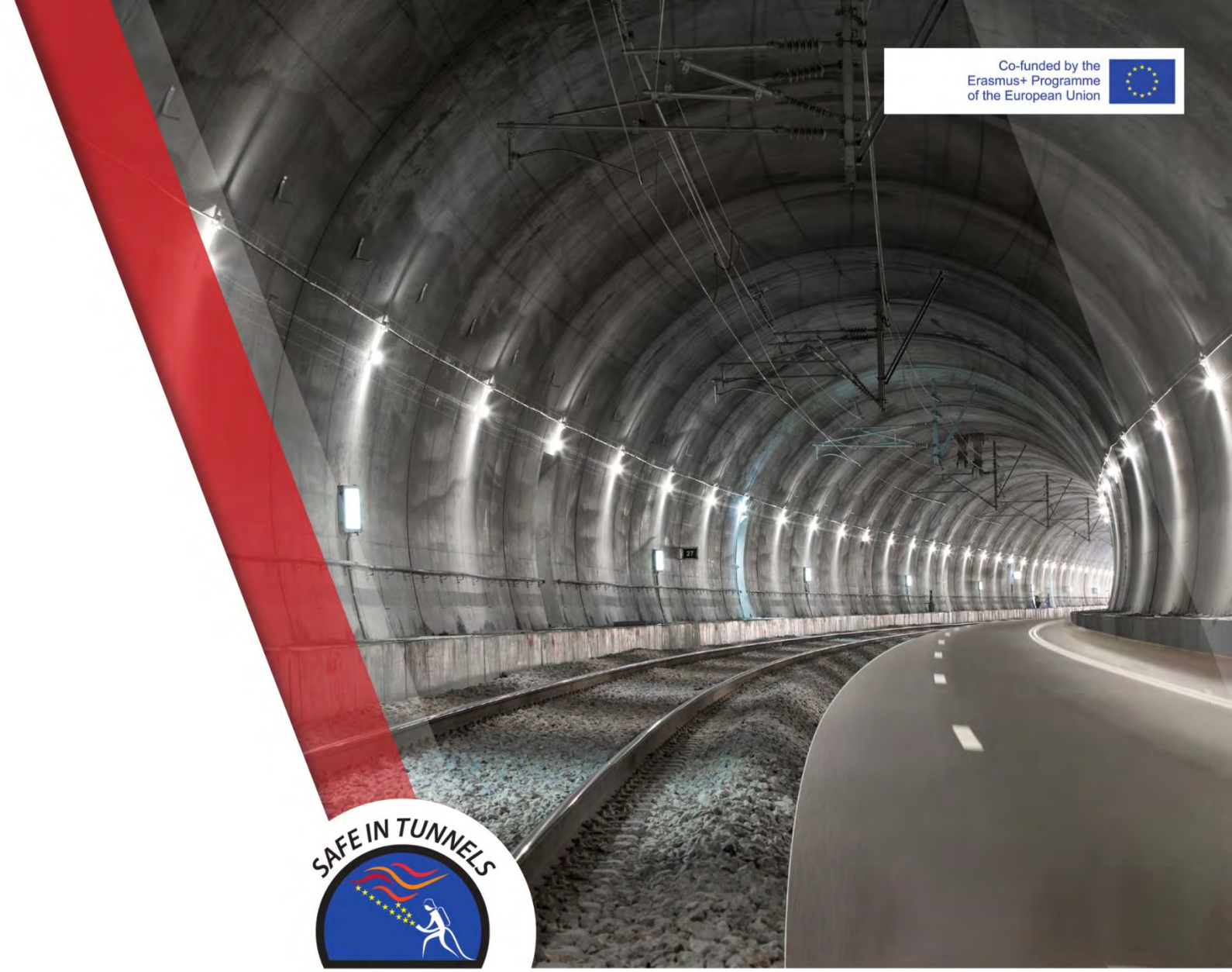
Europäische Union (2020). Descriptors defining levels in the European Qualifications Framework (EQF). Letzter Zugriff online am 19.01.2020: https://ec.europa.eu/ploteus/de/node/1440.

UNECE – United Nations, Economic and Social Council, Economic Commissions for Europe, Inland Transport Committee, Ad hoc Multidisciplinary Group of Experts on Safety in Tunnels (2001). Recommendations of the group of experts on safety in road tunnels – final report. TRANS/AC.7/9, 10 December 2001.

Voeltzel, A. & Dix, A. (2004). A Comparative Analysis of the Mont Blanc, Tauern and Gotthard tunnel fires. In: PIARC (ed.): Roads -N° 324, Seiten: 18-34.

Wolf, Gabrielle (2010). Kosten-Wirksamkeits- und Stakeholder-Analyse von Systemen zur Unfallvermeidung in Straßentunneln. Zugleich Dissertationsschrift an der Technischen Universität Darmstadt. Darmstadt: Technische Universität. Letzter Zugriff online am 05.01.2020: https://www.fzd.tu-darmstadt.de/media/fachgebiet_fzd/previous_design/publikationen_3/2010/2010_wolf_dissertation.pdf.

Co-funded by the
Erasmus+ Programme
of the European Union



SAFE IN TUNNELS

SAFEINTUNNELS

European Vocational Education and Training for Firefighters in Road Tunnels

Co-funded by the
Erasmus+ Programme
of the European Union

Table of content

Co-funded by the
Erasmus+ Programme
of the European Union

European Vocational Education and Training for Firefighters in Road Tunnels

Introduction

This document describes the basic training for tunnel firefighting in road tunnels of firefighters, which was developed within the Erasmus+-project "SAFEINTUNNELS - Traveling safe through Europe - Training and education for firefighters in tunnel safety" funded by the European Commission.

This basic training describes a part of the developed training path for crews of firefighting vehicles performing firefighting in road tunnels.

Tunnel firefighting is considered in firefighting circles to be one of the most complex and dangerous types of operations. The procedure – often over long distances in narrow tunnels with unknowns (temperature level and spread, smoke spread, behavior of escaping persons, type of cargo, etc.) – requires a safe, structured and, above all, standardized approach, which requires a standardized vocational education and training: It was developed by the SAFEINTUNNELS project team for firefighters who have completed their basic firefighting training, including breathing protection training.

Vocational education and training path

A basic vocational education and training for firefighting in tunnels should be possible in every firefighting school. There are several possibilities to simulate situational aspects, e.g. a tunnel section could be erected on the training ground, high fences can be used to simulate the narrow space conditions, poor visibility could be simulated with special respiratory equipments.

The general vocational education and training depends on the area of operation (squad member, incident commander, or instructor).

- **Basic vocational education and training for firefighters**

  Basic vocational education and training requires the completion of basic firefighting training and the authorition of using breathing protection.

- **Basic vocational education and training for firefghting squads – firefighting in road tunnels**

  The aim of this vocational education and training is to enable the participants to apply a standardized procedure for incidents in road tunnels, to implement the necessary measures and to make appropriate situational decisions.

- **Basic vocational education and training for firefighting squads – firefighting in road tunnel**

  The vocational education and training is similar to the programme for firefighting in railway tunnels, but it refers to the conditions in a road tunnel. However, the vocational education and training path is the same.

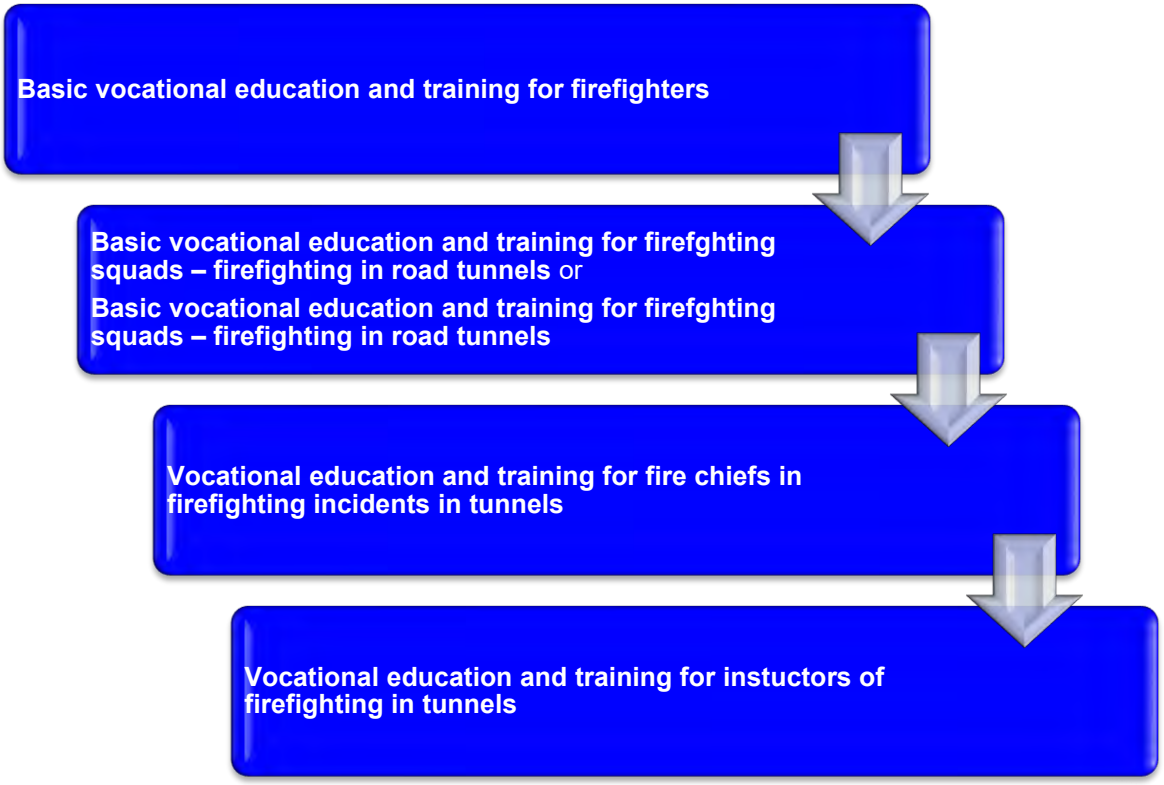
- **Vocational education and training for fire chiefs in firefighting incidents in tunnels**

  The aim of this training is to prepare commanders for firefighting incidents tunnels. The training builds on the basic vocational education and training. However, it focuses on command and control, communication, and the tactical decision-making.

- **Vocational education and training for instuctors of firefighting in tunnel**

  The instructor or trainer has probably the most important role for the dissemination of the standardized learning units. Therefore, it focuses on didactic approachs Each participant will expand his/her pedagogical knowledge and will learn different simulation possibilities. This document describes the basic training for firefighting in road tunnels. It was developed within the Erasmus+-project "SAFEINTUNNELS – Traveling safe through Europe – Training and education for firefighting in tunnels" funded by the European Commission.

The consecutive education path



Basic vocational education and training for firefghting squads – firefighting in road tunnels

Basic vocational education and training requires the completion of basic firefighting training and the authorition of using breathing protection.

The vocational education and training for firefighting in road tunnels starts with a blended learning activity. Each participant must have successfully completed this activity. It is divided into two trainings. Firstly, two videos must be viewed to ensure a standardized knowledge. They focus on the basic measures for tunnel firefighting. Afterwards, a multiple-choice test must be completed. To participate at the practice training, the learner has to answer at least 65% of the questions correctly. Video and test can be repeated as often as desired.

During the vocational education and training at a firefighting school, the following objectives are taught, reviewed, and confirmed to the participant including a representation in ECVET points:

The participant knows:

- the operational tactics for incidents in road tunnels
- general hazards in road tunnel systems
- the usable infrastructure in road tunnel systems
- the advantages and disadvantages of the downstream and upstream of smoke in road tunnels

The participant can - using breathing protection equipment:

- explore a road tunnel
- carry out adequate extinguishing measures
- hose management in a road tunnels
- carry out a systematic search and rescue in a road tunnels
- use the tactical equipment (marker lights, search sticks and thermal imaging cameras)

The participant has mastered:

- recognize and report hazards

Co-funded by the
Erasmus+ Programme
of the European Union

Ten modules for a basic vocational edcuation and training for firefighting

1 Technical introduction to tunnel constructions

2 Explanation of the technical and local conditions

3 Safety in handling the used resources: Vehicles, equipment and materials for tunnel operations and accident prevention

4 Scientific basis for tunnel operations

5 Tactical use of vehicles, equipment and materials for tunnel operations

6 Types of operations in tunnel rescue:
a) rescue of people
b) firefighting

7 Special tactics for tunnel operations

8 Training of special tactics in tunnel operations

9 Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties

10 Leadership skills in use – especially in tunnels spanning several countries

The descriptions of the learning units are structured as follows:

- Course name
- Module (also found on the right sidebar with the corresponding color code)
- Title of learning unit
- Prerequisites for this course
- Duration
- Number of participants
- Number of instructors
- Exam
- EQF-levels:
- Aim of learning unit
- Description of competences
- Further information
- Vocational education and training method
- Type of learning unit
- Teaching methods
- Protective clothing
- Equipment

Note to the vocational education and training methods:

It is just a suggestion, which method will eventually be used is always upon the responsibility of the instructor and/or the firefighting school. Nonetheless, the target of this program is to create a vocational learning and training concept for firefighting in tunnels that is comparable throughout Europe.

Preliminary learning

Participation requires the successful completion of the blended learning activity SAFEINTUNNELS – firefighting in road tunnels. If the single choice test is passed, then the participants receive a certificate confirming the necessary theoretical learning outcomes.

The blended learning activity method prepares and standardizes the learners knowlegde before entering the practice vocational education and training. It creates a common foundation and allows a knowledge consolidation in a timely manner.

The blended learning activity is made up as follow:

1. Read SAFEINTUNNELS Introduction blended-learning-activity
2. Video “SAFEINTUNNELS Explore and extinguish

3. Video „SAFEINTUNNELS Search and rescue

4. SAFEINTUNNELS Multiple-Choice Test

To participate at the practice training, the learner has to answer at least 65% of the questions correctly. Video and test can be repeated as often as desired.

Notes to the questions:

The questions should be asked in a comparable way throughout Europe. Nevertheless, misunderstandings may occur with some technical and pedagogical terms. Therefore, the following instructions should be observed:

Superior, operational leader	=	Fire chief
Team leader, head of operation	=	Commander
Teams / crews	=	Squads
Evacuation	=	Rescue

Scenario 1 Video SAFEINTUNNELS Explore and extinguish road tunnels:

Imagine you are part of squad of six people, which is called to a vehicle fire in a road tunnel. You are the squad arriving on the scene. Other response squads have already been alerted and will arrive shortly.

Quelle: Author

Your tasks, which you have received from the commander, are:

- The basic assignment is: "To carry out firefighting as quickly as possible!"
- To carry out a rapid exploration and send out a situational report.
- If there is a fire, efficient extinguishing measures will be initiated.
- If you find people, appropriate rescue measures will be initiated.

Assignment of your task force:

The task force is divided into 3 teams (squads) of at least 2 persons each.
The engineer remains with the fire engine or takes over orders. This function is not visible in the video.
The squad is divided into 3 teams. The commander leads all teams in the tunnel.

Exploration squad

Commander

Squad member

Fire squad 1

Commander

Squad member

Extinguishing squad 2

Commander

Squad member

Co-funded by the
Erasmus+ Programme
of the European Union

Scenario 2 SAFEINTUNNELS Search and rescue:

Imagine you are part of a squad that goes out to a fire of a vehicle in a road tunnel. You are the first squad of firefighters to arrive on the scene. Other squads have already been alerted and will be arriving shortly.

Source: Author

Your tasks, which you have received from the commander, are:

- Carry out an efficient search and, if necessary, rescue of persons in the assigned tunnel section!
- Give situational reports to the commander.

Assignment of your task force:

The squad is divided into 3 teams. The commander leads all teams in the tunnel.

Exploration squad


Commander


Squad member

Fire squad 1


Commander


Squad member

Extinguishing squad 2


Commander


Squad member

Co-funded by the
Erasmus+ Programme
of the European Union

Schedule for a *Basic vocational education and training for firefighting squads – Firefighting in road tunnels*

First day

*	Time	Topic	Place/Instructor/Lecturer
	8:00 – 8:20	Welcome and introduction	Teaching room Lecturer
	8:20 – 9:10	Basic tactics of firefighting in tunnels	Teaching room Lecturer
	9:10 – 10:00	General communication	Teaching room Lecturer
	10:00 – 10:20	Break	
	10:20 – 11:10	Technical communication	Teaching room Lecturer
	11:10 – 12:00	Tunnel infrastructur	Teaching room Lecturer
	12:00 – 13:00	Lunch break	
	13:00 - 14:00	Exploring road tunnels	Training ground Lecturer
	14:00 – 14:45	Marker lights	Training ground Lecturer
	14:45 - 15:00	Break	
	15:00 – 15:50	Fire extinguishing in road tunnels	Training ground Lecturer
	15:50 – 16:40	Hose managment	Training ground Lecturer
	16:40 – 17:30	Structural cooling	Training ground Lecturer

Second day

*	Time	Topic	Place/Instructor/Lecturer
	08:00 – 09:10	Smoke – down- and upstream	Teaching room Lecturer
	09:10 – 10:00	Tunnel ventilation and ventilation support	Teaching room Lecturer
	10:00 – 10:15	Break	
	10:15 – 12:00	Search and rescue in road tunnels	Training ground Lecturer
		Equipments and tools for firefighting in tunnels	Training ground Lecturer
	12:00 – 13:00	Lunch break	
	13:00 – 15:00	Combined practice training • Fire extinguishing in road tunnels • Search and rescue in road tunnels • Equipments and tools for firefighting in tunnels	Training ground Lecturer
	15:00 – 15:20	Break	
	15:20 – 16:10	Pollutant in the tunnel especially in fires of vehicles with alternative (Li-Ion battery, hydrogen drive) in tunnel systems.	Teaching room / Training ground / Lecturer

Third day

*	Time	Topic	Place/Instructor/Lecturer
	08:00 – 8:50	Water supply	Teaching room / Training ground / Lecturer
	08:50 – 9:40	Safety	Teaching room Lecturer
	09:40 – 10:00	Break	
	10:00 – 12:00	Operational command	Training ground Lecturer
	12:00 – 13:00	Lunch break	
	13:00 – 15:00	Practice exam	Training ground Lecturer
	15:00 – 16:00	Equipment cleaning and inspection	Training ground Lecturer
	16:00 – 17:00	Summary and conclusion	Teaching room Lecturer

***** The color code is chosen according to the category of each module

Co-funded by the
Erasmus+ Programme
of the European Union

Description learning units

Course:	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Basic tactics of firefighting in tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant should have basic knowledge of the fundamental tactics in tunnel operations.
- The participant can use the breathing protection device to implement the assigned tasks in the corresponding area of operation.
- The participant is proficient in leading a squad in firefighting as well as search and rescue operations.

Special tactics for tunnel operations

Knowledge	Skill	Competence
He/She knows: • the basic tasks on exploring, estinguishing, search and rescue in tunnel operations. • basic tactics of firefighting in tunnels.	He/She is able to apply: • all activities according to the assigned role and the command. • the assigned tasks within their squad in the designated area of operation according to the basic tactics of firefighting in tunnels.	He/She masters: • reporting dangers to the commander. • the distinction between the individual tasks of exploration, extinguishing and search and rescue. • leading a squad in a tunnel operation.

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 84 - 91

Vocational education and training method:	The participants are confronted with a tunnel fire event. The participants should assess the corresponding fire in a team effort and work out possible solutions. The instructor reflects on the results with regard to the basic tactics of firefighting in tunnels. The conclusions drawn from this are to be implemented correctly during the practice training.
Type of learning unit:	100% presence
Teaching methods:	90% lecture, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	Documentation firefighting in tunnels	
Created by: Mst. Ing. Gerhard Schöpf		

Course:	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**General communication**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant knows the basic country- and fire brigade-specific radio rules and can apply them during an incident in a tunnel.
- The participant is able to give status reports.
- The participant masters status reports if there is a situational change and in case of danger.

Leadership skills in use – especially in tunnels spanning several countries

Knowledge	Skill	Competence
He/She knows: • the squad's organisation and who actively carries out radio communication. • the requirements for communication in a tunnel (stress, noise, physical activity etc.) and the problems of exaggerated radio communication. • the country-specific radio regulations.	He/She is able to give: • short and precise status reports. • situational adapted status reports and orders in a timely manner.	He/She masters: • status reports in case of changed circumstanes or/and in case of danger. • situational adapted communiation to all hierachial levels.

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 92-93

Vocational education and training method:	The lecture discusses the necessary contents of a concise status report including using breathing protection devices during an incident in a road tunnel. This can be done by situational descriptions, videos, virtual representations, in training or real tunnels or by hologram techniques. The participants actively give status reports. The most important parts of the status report are: • Squad name • Position / location in the tunnel • Smoke including direction of flow • Incident report (including what is burning where and how? Any dangers? or persons found? etc.) • Detected dangers (hazardous material, temperature, ...) • Accessibility (usability of escape routes, ...) Status reports are the basis of good communication. Therefore, they have to be practised intensively so that the transmission becomes intuitively. It is a prerequisite for stressful situations. The practice exercises are to be carried out with all the equipment necessary for a tunnel operation.
Type of learning unit:	100% presence

Teaching methods:	30% lecture, 60% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• Country-specific radio • Corresponding radio equipment • Operating instructions for object radio systems and tunnel emergency telephones
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course:	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**Technical communiation**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant shall have basic knowledge of the radio system, radios and object radio system in use.
- The participant can operate his/her radio and communicate via alternative routes.
- The participant masters his/her complete radio equipment.

Knowledge	Skill	Competence
He/She knows: • the radio channels or groups to be used according to the communication plan. • the technical basics of an object radio system / tunnel radio system (semi-duplex) and its operational limits, radio bridges, loss of signal strength in shadow areas.	He/She is able to: • operate the corresponding radio including its accessories. • communicate with alternative equipment in the tunnel (e.g. emergency telephone). • implement and operate a radio bridge.	He/She masters: • the corresponding radio including its accessories. • communication with alternative equipment in the tunnel (e.g. emergency telephone). • radio bridges and loss of signal in shadow areas.

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 46 – 49

Vocational education and training method:	The instructor explains the country-specific technical regulations regarding radio communication. In a further step, the technical equipment, such as radios and radio accessories, is presented in detail. To ensure safe and error-free operation, the necessary operating steps are practised. Various communication plans of tunnel systems can be used for this purpose. Object radio systems and alternative communication channels, such as emergency telephones (in the tunnel), must be presented and explained.
Type of learning unit:	100% precense
Teaching methods:	90% lecture, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device nach EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• Country-specific radio • Corresponding radio equipment • Operating instructions for object radio systems and tunnel emergency telephones	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Technical introduction to tunnel constructions**		
Title of learning unit:	**Tunnel infrastructur**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the basic structure of a road tunnel, its facilities and their functions.
- can operate simple tunnel infrastructure, recognize escape route doors, etc.
- is able to use the equipments according to the situation and report their possible malfunctions.

Knowledge	Skill	Competence
He/She knows: • the basic facilities of a tunnel, such as entrances and exits, fire extinguishing niches, breakdown bays, emergency niches, cross-passages, escape routes, etc.) • the functioning of the basic installations in a tunnel • the basic structure of a tunnel drainage and retention system	He/She is able to: • operate basic facilities such as fire extinguishing niches, breakdown bays and escape route doors • carry out simple containment measures in the respective drainage system	He/She masters: • reporting malfunctions or defects of infrastructure facilities • depending on the situation, the use of the tunnel infrastructure in the assigned area.

Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 26-59	
Vocational education and training method:	With diagrams, photos and graphics, the tunnel infrastructure is presented. Construction guideline, basic structure of road tunnels, power supply, ventilation systems, water supply, escape routes, emergency call niches and lighting options are explained.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• charts • photos • graphics • cross-sectional designs of the tunnel, if available	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Exploring of road tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	75 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows special tactics for fires in road tunnels.
- can independently assess the damage situation and send qualified situational reports to the commander.
- use the marking system.
- masters the rapid investigation of the assigned damage site in the event of a fire in a road tunnel.
- identify/assess hazards and draw the appropriate safety-related conclusions.

Knowledge	Skill	Competence
He/She knows: • the equipment necessary for the exploration of a road tunnel • the tasks of an exploration team in a road tunnel • the procedure for a quick exploration • various possibilities of the investigation in a road tunnel (situation investigation by observation, questioning of possible witnesses, ...)	He/She is able to: • equip himself/herself as a member of the exploration squad. • set the different markers according to the given instructions. • report the status and carry out the mission according to the assignment. • identify and mark emergency exits, water tapping points, possible dividing breeching points and located people. • brief the squads upon the incident. • record the results of the exploration and communicate a status report. • assess the up- and downstream sides and consequently define the attack side.	He/She masters: • the procedure of an exploration squad. • a quick investigation of the incident (what is burning where and how, recognise special circumstances) while maintaining one's own safety in the assigned tunnel section. • evaluation of the attack measures in the tunnel. • the assessment of the damage including own and third-party situation.
Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 94 – 97		
Vocational education and training method:	During the lecture, the necessary steps for a quick exploration are discussed. The special tactics of the operation are repeated. The focus is on the part "exploring the scene". The main points of the squad are: • operational boundaries (do not walk past the fire) • exploration "what is burning where and how?", air flow direction and special circumstances (persons, accessibility, involvement of dangerous goods etc.) • communication with the commander • necessary equipment	

	• use of the marker system
Type of learning unit:	100% presence
Teaching methods:	50% lecture, 40% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• thermal imaging camera • marker lights
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Tactical use of vehicles, equipments and materials for tunnel operations**		
Title of learning unit:	**Marker lights**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows all matters concerning the marking system
- can correctly apply the marker lights
- can use the marker lights efficiently in complex situations

Knowledge	Skill	Competence
He/She knows: • the three colours of the marking system and the meanings associated with them • the possibilities of using the marking system depending on the incident	He/She is able to: • put into operation the marker lights and position them • according to the order • independently position the marker lights in the assigned area • determine the incident based on the positioned marker lights and take appropriate action	He/She masters: • recognising the correct function of the marking lights and reporting a malfunction or defect, if necessary • assessing the mode of operation of the marker lights and correcting false use, if necessary • positioning of the marker lights in complex operational situations

Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 112-116	
Vocational education and training method:	The uniformed marking system is essential for a smooth operation. This marking system eliminates a considerable part of the verbal communication, therefore, when used correctly, verbal communication errors are reduced. For the three basic measures (exploration, extinguishing, search and rescue) the necessary marking points are discussed in lecture. For better clarification, site plans or sketches depicting operational situations can be used. On these plans, the marking points can be determined in a joint discussion. In order to consolidate the knowledge acquired, real operational situations should be simulated and practised. Care should be taken to ensure that the operational situation is marked precisely and unambiguously.
Type of learning unit:	100% presence
Teaching methods:	10% lecture, 80% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007

	• Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• marker lights – two green • marker lights – three blue • marker lights – four yellow	
Created by: Mst. Ing. Gerhard Schöpf		

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Types of operations in tunnel:** **a. Rescue of people** **b. Firefighting**		
Title of learning unit:	**Firefighting in road tunnel**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	90 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant:

- knows different extinguishing agents and the tasks of the respective firefighting squad.
- can equip himself as a member of the firefighting squad, orientates himself and leads a firefighting squad in case of poor visibility.
- knows the firefighting of vehicles, the definition of operational limits and the reporting of hazards.

Types of operations in tunnel:
a. Rescue of people and b. Firefighting

Knowledge	Skill	Competence
He/She knows: • the equipments and extinguishing agents • the detailed tasks of a firefighting squad focused on extinguishing • extinguishing techniques for road tunnels • the advantages/disadvantages of different extinguishing techniques/agents	He/She is able to: • equip himself as a firefighter carrying out appropiate activities under command • carry out the activities autononomously • report on the incident and the fire • orientate in a tunnel system • lead a fire brigade even under conditions of poor visibility	He/She masters: • equipments (e.g. jet pipe, water cannon) • spatial orientation in a tunnel section • firefighting in a road tunnel and determining its operational limits (e.g. penetration depth, hazardous materials) • application of a surface-active agents • recognition of dangers and spreadings
Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 104-105		

Vocational education and training method:	During the course, the necessary steps for laying the water supply rapidly are discussed. The main principles of fire fighting in a tunnel system are taught. The emphasis is placed on "extinguishing the fire". The main points of the unit are: - Operational limits - Hazard recognition and establishing safety at the incident site - Special extinguishing techniques - Water supply and selection of modes of attack - Communication with the incident commander - Necessary equipment For the practical exercises, conditions should be created as real as possible. This can be done by the presentation at real objects in special training tunnels. Small fire scenes help the participant to put himself in a real operation. A good further possibility is the representation of the damage situation with the help of virtual equipment. For example, smoke and/or fire can be realized using hologram technology. Alternatively, pictures of operations can be used to illustrate the damage situation. The practical exercises are to be carried out with all the equipment necessary for a tunnel operation.
Type of learning unit:	100% presence

Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• teaching material, e.g. flip chart, whiteboard • thermal imaging camera – one per squad • marker lights two green, three blue, and four yellow • radio – one per participant • flashlight – one per participant • branches and hoses • water supply, pump and/or water tender • fire simulation devices • fog machine
Created by: Mst. Ing. Gerhard Schöpf	

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Training of special tactics in tunnel operations**		
Title of learning unit:	**Hose management**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows equipment and ways to effectively establish a fire line, as well as different water tapping points.
- can independently determine attack routes and set up water supply and extinguishing lines.
- masters the equipment for an extinguishing attack and monitors the hose management.

Training of special tactics in tunnel operations

Knowledge	Skill	Competence
He/She knows: • the required equipment for a supply or extinguishing line. • possibilities for the efficient construction of a supply or extinguishing line. • the advantages and disadvantages of the different water tapping points.	He/She is able to: • lay an appropiate supply or extinguishing line. • quickly set up a supply and extinguishing line. • determine attack routes	He/She masters: • the operation of the equipment for the firefighting attack. • the effectiveness in his section. • instruction and supervision the actions of a firefighting squad

Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / p. 103	
Vocational education and training method:	Different variants of laying of fire extinguishing pipelines are implemented in practice. The laying of fire extinguishing pipelines in confined spaces and the drawing of water from different water tapping points (hydrants, vehicles) are to be trained. Special attention must be paid to the correct hose management. The fire hose must be laid in such a way that there are no tripping hazards, the hose does not become knotted or get caught on vehicle tires, and it is possible to move along it quickly and safely.
Type of learning unit:	100% presence
Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: Protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	• various hoses • dividing breeching • branchpipe • thermal imaging camera
Created by: Mst. Ing. Gerhard Schöpf	

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Training of special tactics in tunnel operations**		
Title of learning unit:	**Structural cooling**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the basic principles of physics of construction, which lead to spalling in the concrete material.
- can apply appropriate countermeasures in practice.
- masters the evaluation of the application area and the corresponding derivation of the prevailing situation.

Training of special tactics in tunnel operations

Knowledge	Skill	Competence
He/She knows: • the basics of structural cooling. • the efficient ways of structural cooling. • the physical background in relation to structural cooling.	He/She is able to: • cool certain parts of the tunnel structure independently and under supervision. • govern temperatures of tunnel structures. • recognise the effects (positive or negative) of structural cooling. • estimate the required amount of water.	He/She masters: • operating the required equipment for firefighting and for structural cooling. • evaluating the effectiveness of the applied structural cooling measures • recognising structural cooling measures. • defining the safe and dangerous areas.
Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 104-105		
Vocational education and training method:	The basic principles of construction physics and preconditions responsible for uncontrolled spalling of concrete layers are explained. The countermeasure "structural cooling" is presented to the participants theoretically. In the second step, two extinguishing lines are to be prepared and a targeted structural cooling is to be carried out. The 1/3 - 2/3 extinguishing method can be used as a rough guide. This describes that in extensive fires 1/3 of the extinguishing water should be delivered to the fire and 2/3 to the structure. Care must be taken to ensure that the structure is properly assessed with a thermal imaging camera and subsequently cooled with an appropriately focused spray in front of the deployed squad. The deployed squad must be always in an area of no danger of collapse. As a basic rule, the tunnel structure above the squad must always be wet. Next, the ratio of water delivery toward the structure and fire must be communicated.	
Type of learning unit:	100% presence	
Teaching methods:	20% lecture, 70% practice training, 10% reflection	
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007	

	• Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• various water hoses • dividing breeching • two branches • thermal imaging camera
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Scientific basis for tunnel operations**		
Title of learning unit:	**Smoke – down- and upstream**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	25 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the scientific principles regarding air flows in road tunnels and can explain the terms: up- and downstream sides.
- can recognise the up- and downstream sides and possible hazards.
- knows how to apply, assess, and evaluate the appropiate air flow measures.

Scientific basis for tunnel operations

Knowledge	Skill	Competence
He/She knows: • the scientific principles up- and downstream • the advantages/disadvantages of up- and downstream sides • the hazards associated with the up- and downstream sides	He/She is able to: • recognise hazards • recognise the up- and downstream sides and distinguish between them	He/She masters: • self-protective measures in case of a change of the air flow • assessing the up- and downstream sides and can derive the advantages/disadvantages for the operation in the assigned area
Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 22 – 25, 68 – 73, 97		

Vocational education and training method:	The scientific principles are explained in a lecture or in a discussion. Videos, graphics and/or models of tunnel systems should be used to consolidate this knowledge. For the practical recognition, assessment, and evaluation of air flow conditions, these principles are simulated in real tunnel systems or with hologram techniques. By that, the participants gain experiences and learn to make decisions relevant to the operation. These decisions are discussed between the instructor and the participants.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	• fog machine • adjustable air flow devices (to simulate air flow conditions) • displays such as graphics or pictures • videos of air flow conditions in the tunnel (e.g. from fire tests) • a model of a tunnel system	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**The scientific basis for tunnel operation**		
Title of learning unit:	**Tunnel ventilation and ventilation support**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	25 min		
Number of participants:	5 to. 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the method of mechanical ventilation and ventilation support
- can recognize and distinguish between the upstream and downstream sides
- masters the planning and evaluation of operational ventilation measures

Knowledge	Skill	Competence
He/She knows: • the advantages and disadvantages of the upstream and downstream sides • the dangers for the emergency services in connection with the upstream and downstream sides • the physical background, such as backlayering, etc • The hazards of fire spread and smoke propagation, especially the upstream and downstream sides of a tunnel.	He/She is able to: • recognize and distinguish the upstream and downstream sides • make operational decisions	He/She masters: • recognize and assess the conditions on the upstream and downstream sides • to evaluate the advantages and disadvantages for firefighting • the planning of operational measures based on the advantages and disadvantages of the upstream and downstream sides

Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 38 – 45, 72 – 73, 98 – 101	
Vocational education and training method:	In a teaching talk, the background of the ventilation-supporting measures is explained. Picture and video materials can be used to illustrate the measures and their effect. For example, a model can be used to show a tunnel tube that is ventilated by fans (in the form of small ventilators). The ventilation measures and their effects can thus be visually represented. In this way, the advantages and disadvantages of ventilation support can be shown and discussed.
Type of learning unit:	100% presence
Teaching methods:	30 % lecture, 60% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• Fog machine • Adjustable aeration devices (for simulation of flow conditions) • Display boards (graphics) • Various videos of flow conditions in the tunnel (e.g. from fire tests) • Possibly a model of a tunnel system
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Types of operations in tunnel: a. Rescue of people and b. Firefighting**		
Title of learning unit:	**Rescue of people**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	120 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the equipment and tasks, as well as different mission variants of a search and rescue squad
- is able to carry out a structured search for persons
- masters the targeted search for persons in good visibility conditions, as well as the leadership of a search and rescue team and orientation in the assigned area under poor visibility conditions.

Knowledge	Skill	Competence
He/She knows: • equipments/tasks of search & rescue squads • rescue techniques in a road tunnel • mission variants for a search & rescue squad	He/She is able to: • equip himself as a member of the search & rescue squad • perform search and rescue activities under supervision • systematically search vehicles and assigned areas • apply rescue techniques in a road tunnel • report on searched areas or vehicles • deploy/appoint search & rescue squads (together or split up)	He/She masters: • application of the equipment in use • spatial orientation in an assigned tunnel • systematic search and rescue under conditions of good visibility • leading a search & rescue team under poor visibility conditions • orientate themselves in a tunnel
Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 106-109		
Vocational education and training method:	The systematic search and possible variants are presented to the participants by using diagrams, pictures and graphics. In a further step, operational situations with different levels of difficulty (non-smoky and smoky areas, injury simulation, mannequins or persons [large and small]) are prepared. The participants work themselves through the different tasks. The instructor corrects wrong actions, if necessary. When these actions are understood and persons can be searched and found in a targeted manner, the difficulty levels are to be successively increased until a search and rescue can be performed safely in "zero visibility".	
Type of learning unit:	100% presence	
Teaching methods:	20% lecture, 70% practice training, 10% reflection	
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities.	

	Specific laws and regulations of the member states must be respected.
Equipment:	• marker lights (4 x yellow) • litter • search sticks • thermal imaging camera • flashlight • radios • flashhood
Created by: Mst. Ing. Gerhard Schöpf	

Course:	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Safety in handling the used resources: Vehicles, equipment and materials for tunnel operations and accident prevention**		
Title of learning unit:	**Equipment and tools for firefighting in tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	120 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the appropriate equipment, its designated use and its limitations in a tunnel operation.
- He/She can balance advantages and disadvantages of the equipment and can use it under difficult conditions.
- He/She analyses the incident and is able to apply approbiate equipment.

Knowledge	Skill	Competence
He/She knows: • the necessary devices/equipments and their handling (litter, search and rescue sticks, rolling pallet, marker, flashhood). • the use and mode of the equipment, the safety regulations, if applicable, their cleaning and maintenance requirements.	He/She is able to: • operate equipment in compliance with the relevant safety regulations for tunnel operations. • monitor the efficient use of equipment. • assess the advantages and disadvantages of applied equipment.	He/She masters: • recognising the correct application and reporting a malfunction or defect. • assessing the operation mode and correcting inefficient application. • selecting the required equipment in reference to its application.

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 112-123

Vocational education and training method:	By a brainstorming process, the participants learn about vehicles and equipment and their safe and correct use. During the lecture, the equipment is divided into two groups. First group: all equipment that is used in routine operations. Second group: all devices that are not used regularly in the fire service. These devices are presented, and their use is demonstrated by the instructor with regard to safety and application.
Type of learning unit:	100% presence
Teaching methods:	30% lecture, 60% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11
Created by: Mst. Ing. Gerhard Schöpf	

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Hazardous substances in tunnels, especially in case of fires of vehicles with alternative power units (Li-Ion battery, hydrogen drive) in tunnel systems**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the basic procedures for operations with hazardous substances and is familiar with appropriate reference books.
- applies standardised measures (recognise dangers, set up barriers, rescue people, request forces, distance, stopping time, shielding).
- is able to use the necessary protective clothing and to check the correctness of the labelling of the hazardous substances.

Knowledge	Skill	Competence
He/She knows: • the hazards of a tunnel operation • standardised self-protection and appropriate reference books • basic measures for stabilising the situation (collecting, sealing, etc.)	He/She is able to: • can recognise hazardous substances basesd on their labels • apply standardised measures • use appropiate reference books on labelling of hazardous substances	He/She masters: • the application of basic measures of self-protection (e.g. recognise dangers, set up barriers, rescue people, request special forces) • the classification and meanings of hazardous substances and the respective labels
Further information: • "Gefahrguteinsätze in Straßentunneln" (ISBN 978-3-17-038631-0)		

Vocational education and training method:	The lecture builds on the knowledge firefighters collect during their basic trainings. This is upskilled by information on hazardous materials during incidents in tunnels. Special attention must be directed on recognition of hazardous substances, their labelling and standardized self-protection measures, because: • the substance concentration is lower on the upstream side and correspondingly higher on the downstream side. This fact is particularly important during the exploration phase. • explosions in a tunnel are much more devastating than in open terrain because of the increase in pressure and fire propagation. They can lead to structural changes and fatal injuries. Therefore, ignition factors must be avoided by interrupting power supply and secure appropriate electrical grounding. • The drainage system can be used for the removal of liquid substances. Special attention should be directed to the appropriate absorption of pollutants and their disposal as well as towards flammable liquids and heavy gases because these liquids/gases can cause explosions over huge distances.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007

	• Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• labels of hazardous substances • photos/graphics from previous operations • cross-sectional designs of the tunnel, if available	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**Water supply**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the architecture of water access points and water supply in the tunnel
- can independently put into operation water extraction in the assigned area
- is able to assess the appppropriateness of water access points in the damaged area

Knowledge	Skill	Competence
He/She knows: • the water access points in the respective tunnel • the water supply and the capacity of the water supply in the respective tunnel	He/She is able to: • put into operation the water supply in the respective tunnel • independently locate water access points in the assigned section	He/She masters: • water extraction from the water tender of his own brigade • assessing the appropriateness of a water access point in an assigned tunnel section in relation to the incident

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 50 – 53, 104, 124 – 126

Vocational education and training method:	The instructor defines the available water supply and existing water access points. On this basis, the maximum water withdrawal rate is determined and consequently discussed. Next, the participants evaluate operational situations with regard to the appropriateness of water extraction points and, if necessary, work out solutions. Based on the applied extinguishing attack, he/she is able to calculate how long an attack can be carried out with the available water supply. In addition, the increase of the extinguishing effect through the use of surface-active agents are investigated. The results are discussed among the participants and reflected by the instructor.
Type of learning unit:	100% presence
Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	• description of a tunnel and its safety architecture (e.g. water supply, hydrants, access point) • standard firefighting equipments • information on surface-active agents (e.g. foams) • teaching materials e.g. flip chart/whiteboard	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in road tunnels**		
Module:	**Safety in handling the used resources: Vehicles, equipments and materials for tunnel operations and accident prevention**		
Title of learning unit:	**Safety**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	25 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows how to behave in emergencies as a breathing protection device user.
- knows to recognize escape routes in the tunnel.
- is able to identify hazardous situations and exit the tunnel under conditions of poor visibility as a breathing protection device user, too.
- is able to orientate him/herself under conditions of poor visibility and to operate the emergency vehicles (e.g. rescue fire engine).
- masters safety-relevant circumstances during the operations.
- masters the recognition of his/her own performance limits.

Knowledge	Skill	Competence
He/She knows: • the difficult demands on the breathing protection equipments users in tunnel operations (long approach, physical and mental stress, hazardous substances...) • the importance of the pullback signal • the procedure to be followed in the event of a breathing protection equipment emergency • the measures to be taken when entering the tunnel with a vehicle • the escape and rescue routes in the respective tunnel • the procedure for an orderly pullback of a breathing protection equipment squad	He/She is able to: • recognise dangerous situations and report them to squad leader • find escape and rescue routes even under conditions of poor visibility • lead and handle a breathing protection equipment emergency within a squad • implementing and instructing the necessary measures for entering the tunnel with a vehicle	He/She masters: • recognising the personal performance limits and reporting them to the squad leader • recognising and reporting safety-relevant changes in the operation

Further information: • Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 60 – 83, 110 – 111	
Vocational education and training method:	The instructor discusses the specific dangers during an incident in a road tunnel and simulates them again and again during the practical exercise. The participants must recognise these dangers and react to them accordingly. In particular, breathing protection equipment emergencies and their management are to be trained. Furthermore, the necessary measures (closing windows, setting vehicle ventilation to circulating air, grounding the vehicle on the wagon) are to be carried out on an appropiate vehicle that is brought to the scene of the emergency in the tunnel. Occasional exercises are to be dimensioned in such a way that the participants are pushed to their performance limits. Each participant should gain this experience so that he/she recoginse his/her personal performance limits at an early stage during an incident.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection

Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• material for the simulation of diffent hazards	
Created by: Mst. Ing. Gerhard Schöpf		

Course	**Firefighting in road tunnels**		
Module:	**Leadership skills in use – especially in tunnels spanning several countries**		
Title of learning unit:	**Operational command**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	100 min		
Number of participants:	5 to 9	**Number of instructors:**	5 to 9
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the tasks of the control centre, the responsibilities of the exploration team, how to set up and operate a control centre and how to make use of the different types of information.
- knows the implementation of the breathing protection devices as well as define the handling time according to the situation.
- can report the status and describe the situation appropriately.

Knowledge	Skill	Competence
He/She knows: • tasks/procedures of the exploration team • the tasks of a control centre • how to get there and report appropriately • implementing breathing protection devices and their handling time • the designated areas of operation and set-up areas for the fire brigades (allocation of resources, control centre...)	He/She is able to: • approach the designated areas of operation • report the status correctly (spatial and temporal) • describe the situation appropiately • calculate the time of withdrawal of the squads using breathing protection independently	He/She masters: • implementing a control centre with the appropiate equipments • the organisation (in terms of personnel and equipments) of a control centre • consolidating different information • briefing upon the situation, including passing on information and tasks to the subsequent squads

Further information:

- Firefighting Operations in Road Tunnels (ISBN 978-3-942385-04-6) / pp. 94, 124-131

Vocational education and training method:	General, theoretical, country-specific instructions regarding the organisation of control centre as well as the basic skills for the preparation of a status report and documentation of the situation must be taught. For the simulation of practical activities in a control centre, exercises, or simulation games (including organising the breathing protection squads) are applied. Based on this, the activities of a control centre are carried out and the handling time of the breathing protection equipment is calculated. The instructor coaches the participants and shows them possibilities of reporting the situation and different ways of executing operational command.
Type of learning unit:	100% presence
Teaching methods:	50% lecture, 40% practice training, 10% reflection
Protective clothing:	• Protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities.

	Specific laws and regulations of the member states must be respected.
Equipment:	• analogue or digital equipment to report the status • sketches and descriptions of tunnel systems • plans, documents, and scripts for simulation games • calculation aids for the handling breathing protection equipments • hand-held radios
Created by: Mst. Ing. Gerhard Schöpf	

Examination

The examination *Basic vocational education and training for firefighting squads – Firefighting in road tunnels* consists of a theoretical and a practical examination. Both parts of the examination must be passed. Both parts of the examination are considered positive if at least 65 % of the examination is correctly answered. However, passing the theoretical examination with at least 65 % is a prerequisite for the practical examination.

Theoretical examination

The theoretical examination is carried out as a multiple-choice test. It contains 25 questions. There are three possible answers to each question. The answers marked in green are the correct responses.

Consider that you are a part of the exploration team. What are your first choices of action after entering the tunnel?

- I use the thermographic camera to get a situational overview and place at the entrance a green marker light.
- I ensure the evacuation route with a rope and place at the entrance a green marker light.
- I mark the position of the distributor with a blue marker light.

Consider that you are a part of the exploration team and you find an unconscious person in 30 meters distance to the tunnel entrance. What is your main priority?

- I inform the subsequent squad leader, place a yellow marker light next to the person and continue the operation.
- I start the evacuation immediately.
- I inform the subsequent squad leader and evacuate the unconscious person.

What are the four steps to be followed when rescuing a responsive person from a passenger car?

- Establish contact, send radio message, open door, rescue person.
- Establish contact, prepare escape hood, open door of the vehicle, put on escape hood and rescue.
- Establish contact, open door, put on escape hood, send radio message.

Consider that you are a part of the search and rescue team. A main rule is that the whole squad must be within the range of vision at all time. Is this statement correct?

- No, it is enough if the squad leader knows where everyone is.
- Yes, it is essential because the situation is very dangerous.

- It depends on the situation.

Consider that you are a part of the search and rescue team and you find a casualty/injured person and start the evacuation. The rest of the squad team must wait at the location where the casualty/injured person was found until the squad team is together again. Is this statement correct?

- No, with good communication and positioning of yellow marker lights the rest of the search and rescue team can continue their work.
- Yes, because the risk loosing each other again is too high.
- It depends on the situation.

Once a yellow marker light has been placed, it should not be changed during the operation. Is this statement correct?

- No, this statement is not correct.
- Yes, because the risk of misunderstandings is high.
- It can be changed, but only by the same person who has placed the yellow marker light.

Which assessments will you conduct as a basis to decide the best escape route for the response operation?

- The escape route must be easily accessible to retreat.
- The escape route must be close to the incident scene.
- The escape route must be at a safe distance from the fire and allow access to the rescue work.

Where should the green marker light placed during the response operation?

- On the floor near the tunnel wall (distance approx. 10 cm).
- Above the ground (as high as possible on the tunnel wall).
- Depending on the situation, either on the ground or in height.

Consider that you are a part of the exploration team that has found a possibly injured person outside the vehicle. What is your main priority?

- I produce status report to the subsequent squad leader and start the evacuation.
- I start the evacuation only if the injured person is within 15 meters of the exit area.
- I produce a status report to the subsequent squad leader and ask the search and rescue team to start evacuation.

An injured person is found outside the vehicle. What status report will you convey to the subsequent squad leader?

- Findings from the search operations, conditions of injured persons and applied rescue

measures.
- Personal details, conditions of injured persons and applied rescue measures.
- Personal details, findings from the search operations and conditions of injured persons.

Consider that you are a part of the exploration team. What are your actions after the incident scene has been found?

- I observe the development of the situation until the extinguishing team arrives and continue the exploration.
- I report the findings from the incident scene to the subsequent squad leader and retreat from the tunnel.
- I observe and report the development of the situation to the subsequent squad leader, and depending on the situation, I assist in extinguishing or rescuing.

Consider that you are a part of the extinguishing team. What is your main priority to ensure a satisfactory execution of the extinguishing work?

- I concentrate on extinguishing the fire immediately after the incident scene has been reached.
- I concentrate on the structural cooling immediately after the incident scene has been reached.
- I alter between structural cooling and firefighting depending on the situation.

Consider that you are a part of the exploration team. While approaching the incident scene, you must give a situation report to the squad leader. What will be your message cover?

- Position findings, escape routes, smoke spreadings, fire development, hazards, and risks.
- Position findings, hazards and risks, appropriate firefighting tactics.
- Position findings, hazards and risks, details about the infrastructure.

Consider that you are a part of the search and rescue team and have found an injured person inside a truck. What is your primary task?

- I start life-saving measures in the immediate vicinity.
- I report findings from the search operation to the subsequent squad leader and continue the search and rescue measures.
- I report findings from the search operation to the subsequent squad leader and start evacuation and life-saving measures.

What is the correct use of the yellow marker light?

- The light should be used to mark position of injured persons.
- The light should be used to mark position findings and the maximum immersion/length of the search.
- The light should be used to mark the incident scene, the position of injured persons and the maximum immersion/length of the applied search.

How should communication take place within the search and rescue team?

- Essential information must only be communicated to peers and operation leader
- Essential information must be communicated by mobiles to the whole team.
- Essential information must be communicated to the peer, subsequent squad leader and operation leader.

When will you consider the search and rescue operation completed?

- When the entire tunnel and all vehicles have been cleared.
- When the vicinity to the vehicle has been cleared.
- When all vehicles have been cleared.

Which assessments will you make in order to decide the rescue route?

- I do not make any assessments; the rescue route is chosen by the subsequent squad leader.
- The rescue route is always at the right-hand side of the vehicle.
- I choose the rescue route based on accessibility to exit areas in dialogue with the subsequent squad leader.

What is the correct use of the green marker light?

- The light should be used to mark findings of injured persons.
- The light should serve the escape route to be used.
- The light should be used to mark water supply points and distributor.

What is the correct use of the blue marker light?

- The light should be used to mark findings of injured persons.
- The light should serve the escape route to be used.

- The light should be used to mark water supply points and distributor.

Apart of the standard fire protection equipment, which search and rescue equipment is essential?

- Thermal imagining camera (TIC), escape sets, stretcher
- Marking lights, search sticks and transport aids.
- Thermal imagining camera (TIC), search sticks, marking lights and transport aids.

What do you do when encountering persons in the tunnel?

- I report their position findings to the subsequent squad leader and guide them towards the nearest emergency exit.
- I report their position findings to the subsequent squad leader and point them towards the nearest emergency exit.
- I ask for additional resources to assist in evacuation.

What are special dangers in the tunnel?

- Risk of tripping, noise, slipping, ...
- Falling hazard, explosion hazard, electricity, ...
- Long approach routes, falling debris (fans, etc.), high temperatures, poor visibility, fall hazard, explosion hazard, electricity, …

What is the most important task of the exploration squad?

- Quick and qualified situation report to the incident commander
- Quick rescue of unconscious persons
- Quick rescue of disoriented (responsive) persons

You are part of a search and rescue squad. How is the depth of penetration marked?

- The unit leader stops at the location of the last rescued person
- The squad sets a yellow marker light at the last car/truck
- A yellow marker light is placed on the left and right sides of the tunnel wall at ground level

Practical exam

With passing the practical examination with more than 65 % correct answers, the entire course is concluded. In order to adequately assess the learning outcomes of the practical training, adequate practical tasks have to be set based on the theory. The examination situation can be set up in the form of a simulation. Each participant is assigned to a fixed role in his training squad. The trainers have to pay attention to a fair assessment when conducting the examination and its assessment. For this purpose, two trainers per training squad (5 to 9 participants) must observe and assess the participants.

Parts of the practical examinatio

Topic with number and color code of the module			**Results**		
			not achieved	partly achieved	achieved
	1	Technical introduction to tunnel constructions	1 point	2 points	3 points
	2	Explanation of the technical and local conditions	1 point	2 points	3 points
	3	Safety in handling the used resources: Vehicles, equipments and materials for	1 point	2 points	3 points
	4	Scientific basis for tunnel operations	1 point	2 points	3 points
	5	Tactical use of vehicles, equipments and materials for tunnel operations	1 point	2 points	3 points
	6	Types of operations in tunnel: a) rescue of people b) firefighting	1 point	2 points	3 points
	7	Special tactics for tunnel operations	1 point	2 points	3 points
	8	Training of special tactics in tunnel operations	1 point	2 points	3 points
	9	Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties	1 point	2 points	3 points
	10	Leadership skills in use – especially in tunnels spanning several countries	1 point	2 points	3 points
Sum of achieved points→					
Result • ≥ 20 points passed • < 20 points not passed					

ECVET assessment

ECVET to promote mobility and lifelong learning

The European Credit System for Vocational Education and Training (ECVET) is a technical framework for the crediting, recognition and, where appropriate, accumulation of learning outcomes achieved by an individual towards the acquisition of a qualification.[1] This is achieved in particular through the structured description of qualifications of learning outcomes, which allows greater transparency and better comparability in the field of VET through the use of a "common language", and through the structured processes and agreements between stakeholders, which form the basis for mutual trust.

The application possibilities of ECVET are particularly in the area of cross-border mobility of VET and in the area of lifelong learning:

- On the one hand, ECVET contributes to making the knowledge, skills and competences acquired in the context of cross-border mobility in VET visible and – based on their identification and assessment abroad – facilitating their recognition at home. This should make it easier to integrate learning experiences gained abroad into initial or continuing vocational education and training.
- On the other hand, ECVET can be used to make programmes and training paths leading to the acquisition of a qualification more flexible and to improve the framework conditions for lifelong learning. Thus, ECVET can facilitate the recognition of learning outcomes acquired by learners in different settings such as different countries, institutions or systems (e.g. education or training), in formal, non-formal and/or informal learning contexts.

[1] Recommendation of the European Parliament and of the Council of 18 June 2009 on the establishment of a European Credit system for Vocational Education and Training (ECVET).

Source: https://www.na-bibb.de/fileadmin/user_upload/na-bibb.de/Dokumente/02_Berufsbildung/01_Mobilitaet/08_ECVET/Implementing_ECVET.pdf (last acccessed on 08.02.2021)

Evaluation of the training

1. Blended learning acitvity:

   A period of three teaching units (45 minutes each) is estimated as a preparation for the actual course. This calculation includes the multiple, concentrated viewing of the training films, the detailed reflection on the necessary steps in case of incidents in road tunnels as well as answering the multiple-choice questions.

2. Face-to-face training:

The three-day classroom training includes all mentioned learning units and the practical examination. According to the inserted timetable, all teaching units are required for the passing the examination.

With the positive completion of the practical examination, the course *Basic vocational education and training for firefighting squads – Firefighting in road tunnels* is completed.

This training is assessed with one ECVET point.

Certificate

Each participant will receive a certificate after passing both parts of the examination. The following points must be mentioned on the certificate:

Co-funded by the
Erasmus+ Programme
of the European Union

Certificate of attendance

Course:	Basic vocational education and training for firefighting squads – Firefighting in road tunnels
Place of training:	e.g. Landes-Feuerwehrschule Tirol, Telfs
Date:	e.g. 2nd of April, 2020
Name of participant:	e.g. Gerhard Schöpf
Place of employment:	e.g. Fire brigade Silz
ECVET points:	1

Learning Outcome:

The participant knows:

- the operational tactics for incidents in road tunnels.
- the basics of breathing protection related to incidents in tunnels.
- the hazards during the activity of incidents in road tunnel systems.

The participant will be able to:

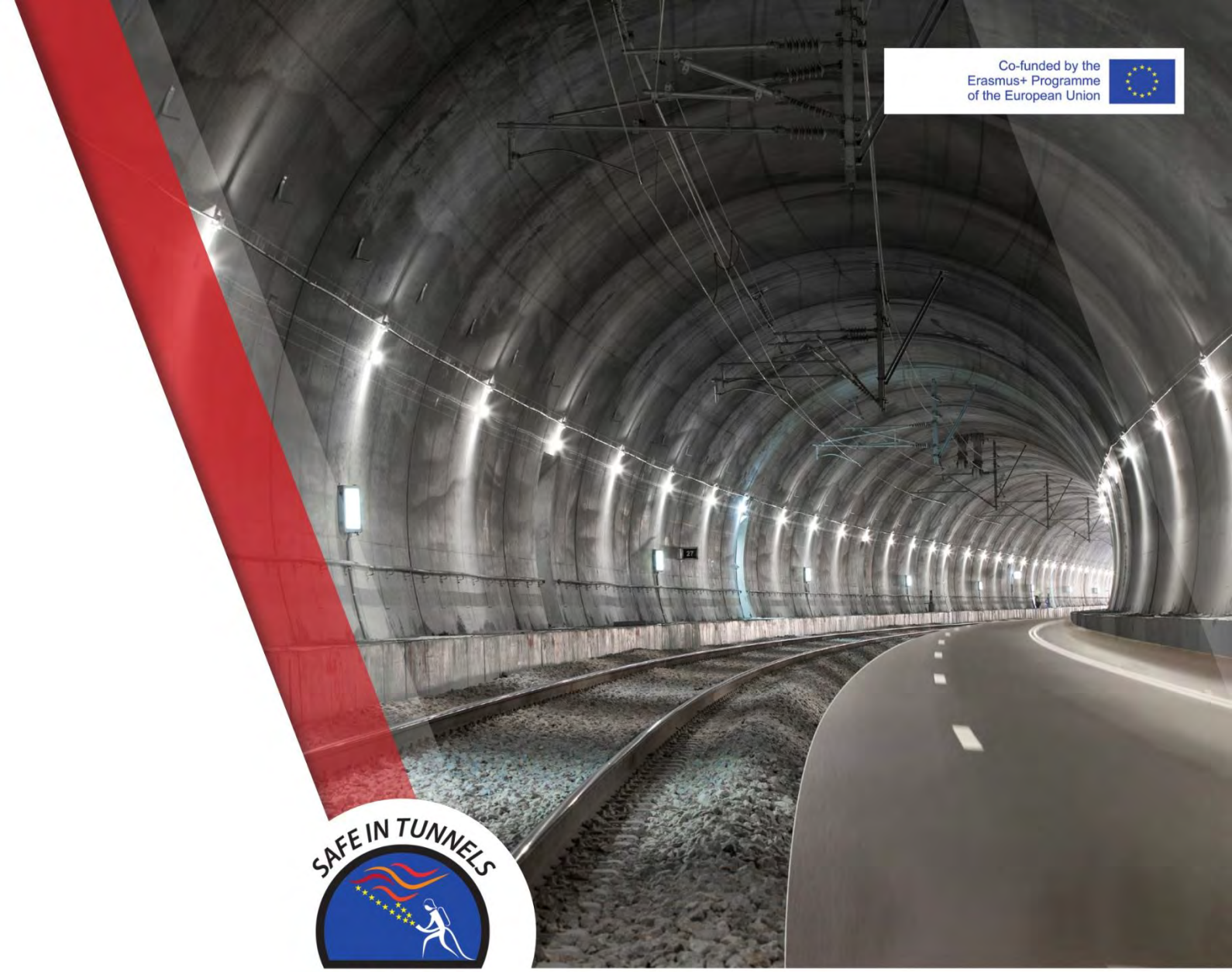
- explore a road tunnel.
- carry out adequate firefighting measures.
- lay hose lines in a road tunnel.
- carry out a systematic search and rescue in a road tunnel.
- use tactical equipment (marker lights, search sticks and thermal imaging cameras).

The participant masters:

- planning emergency measures, taking into account the advantages and disadvantages of the up- and downstream of the air flow.
- assessing emergency measures, of the incident and hazards for him/her/others.
- spatial orientation in a tunnel system.
- the guidance of a search and rescue team under conditions of poor visibility.
- the recognition of hazards.
- the recognition of a possible fire propagation.
- the definition of his/her operational limits (max. penetration depth, fires with hazardous materials, etc.).

Signature: confirmation (stamp, signature) of the educational institute

Co-funded by the
Erasmus+ Programme
of the European Union



SAFE IN TUNNELS

SAFEINTUNNELS

European Vocational Education and Training for Firefighters in Railway Tunnels

Co-funded by the
Erasmus+ Programme
of the European Union

Co-funded by the
Erasmus+ Programme
of the European Union

Table of content

Co-funded by the
Erasmus+ Programme
of the European Union

European vocational education and training for firefighters in railway tunnels

Introduction

This basic vocational education and training describes firefighting for squad members in railway tunnels.

Tunnel firefighting is considered in firefighting circles to be one of the most complex and dangerous types of operations. The procedure – often over long distances in narrow tunnels with unknowns (temperature level and spread, smoke spread, behavior of escaping persons, type of cargo, etc.) – requires a safe, structured and, above all, standardized approach, which requires a standardized vocational education and training: It was developed by the SAFEINTUNNELS project team for firefighters who have completed their basic firefighting training, including breathing protection training.

Vocational education and training path

A basic vocational education and training for firefighting in tunnels should be possible in every firefighting school. There are several possibilities to simulate situational aspects, e.g. a tunnel section could be erected on the training ground, high fences can be used to simulate the narrow space conditions, poor visibility could be simulated with special respiratory equipments.

The general vocational education and training depends on the area of operation (squad member, incident commander, or instructor).

- **Basic vocational education and training for firefighters**

  Basic vocational education and training requires the completion of basic firefighting training and the authorition of using breathing protection.

- **Basic vocational education and training for firefghting squads – firefighting in railway tunnels**

  The aim of this vocational education and training is to enable the participants to apply a standardized procedure for incidents in railway tunnels, to implement the necessary measures and to make appropriate situational decisions.

- **Basic vocational education and training for firefighting squads – firefighting in street tunnels**

  The vocational education and training is similar to the programme for firefighting in railroad tunnels, but it refers to the conditions in a road tunnel. However, the vocational education and training path is the same.

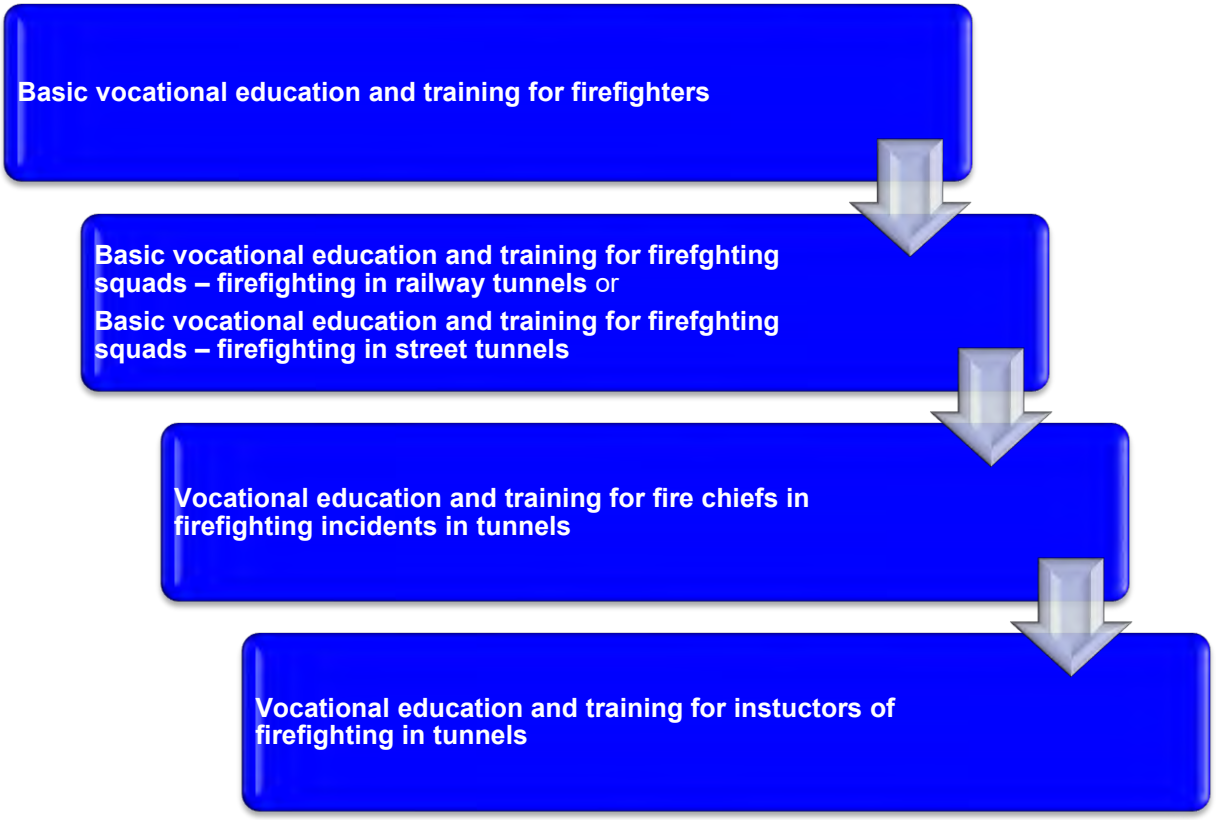
- **Vocational education and training for fire chiefs in firefighting incidents in tunnels**

  The aim of this training is to prepare commanders for firefighting incidents tunnels. The training builds on the basic vocational education and training. However, it focuses on command and control, communication, and the tactical decision-making.

- **Vocational education and training for instuctors of firefighting in tunnels**

  The instructor or trainer has probably the most important role for the dissemination of the standardized learning units. Therefore, it focuses on didactic approachs Each participant will expand his/her pedagogical knowledge and will learn different simulation possibilities. This document describes the basic training for firefighting in railroad tunnels. It was developed within the Erasmus+-project "SAFEINTUNNELS – Traveling safe through Europe – Training and education for firefighting in tunnels" funded by the European Commission.

The consecutive education path



Basic vocational education and training for firefghting squads – firefighting in railway tunnels

Basic vocational education and training requires the completion of basic firefighting training and the authorition of using breathing protection.

The vocational education and training for firefighting in railroad tunnels starts with a blended learning activity. Each participant must have successfully completed this activity. It is divided into two trainings. Firstly, two videos must be viewed to ensure a standardized knowledge. They focus on the basic measures for tunnel firefighting. Afterwards, a multiple-choice test must be completed. To participate at the practice training, the learner has to answer at least 65% of the questions correctly. Video and test can be repeated as often as desired.

During the vocational education and training at a firefighting school, the following objectives are taught, reviewed, and confirmed to the participant including a representation in ECVET points:

The participant knows:

- the operational tactics for incidents in railway tunnels
- the procedures for entering and working in the track area and in the railway tunnel
- the advantages and disadvantages of the downstream and upstream of smoke in railway tunnels

The participant can - using breathing protection equipment:

- explore a railway tunnel
- carry out adequate extinguishing measures
- hose management in a railway tunnels
- carry out a systematic search and rescue in a railway tunnels
- use the tactical equipment (marker lights, search sticks and thermal imaging cameras)

The participant has mastered:

- recognize and report hazards

Ten modules for a basic vocational edcuation and training for firefighting

1. Technical introduction to tunnel constructions
2. Explanation of the technical and local conditions
3. Safety in handling the used resources: Vehicles, equipment and materials for tunnel operations and accident prevention
4. Scientific basis for tunnel operations
5. Tactical use of vehicles, equipment and materials for tunnel operations
6. Types of operations in tunnel rescue:
   a) rescue of people
   b) firefighting
7. Special tactics for tunnel operations
8. Training of special tactics in tunnel operations
9. Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties
10. Leadership skills in use – especially in tunnels spanning several countries

The modules split the aspects in tunnels: Focussed on the teached competences the units were developed and described.

The descriptions of the learning units are structured as follows:

- Course name
- Module (also found on the right sidebar with the corresponding color code)
- Title of learning unit
- Prerequisites for this course
- Duration
- Number of participants
- Number of instructors
- Exam
- EQF-levels:
- Aim of learning unit
- Description of competences
- Further information
- Vocational education and training method
- Type of learning unit
- Teaching methods
- Protective clothing
- Equipment

Note to the vocational education and training methods:

It is just a suggestion. Which method will eventually be used is always upon the responsibility of the instructor and/or the firefighting school. Nonetheless, the target of this program is to create a vocational learning and training concept for firefighting in tunnels that is comparable throughout Europe.

Preliminary learning

Participation requires the successful completion of the blended learning activity SAFEINTUNNELS – firefighting in railway tunnels. If the single choice test is passed, then the participants receive a certificate confirming the necessary theoretical learning outcomes.

The blended learning activity method prepares and standardizes the learners knowlegde before entering the practice vocational education and training. It creates a common foundation and allows a knowledge consolidation in a timely manner.

The blended learning activity is made up as follow:

1. Read SAFEINTUNNELS Introduction blended-learning-activity
2. Video SAFEINTUNNELS Explore and extinguish

3. Video SAFEINTUNNELS Search and rescue

4. SAFEINTUNNELS Multiple-Choice Test

To participate at the practice training, the learner has to answer at least 65% of the questions correctly. Video and test can be repeated as often as desired.

Notes to the questions:

The questions should be asked in a comparable way throughout Europe. Nevertheless, misunderstandings may occur with some technical and pedagogical terms. Therefore, the following instructions should be observed:

Superior, operational leader	=	Fire chief
Team leader, head of operation	=	Commander
Teams / crews	=	Squads
Evacuation	=	Rescue

Co-funded by the
Erasmus+ Programme
of the European Union

Scenario 1 SAFEINTUNNELS Explore and extinguish

Imagine you are part of squad of six people, which is called to a train fire in a railway tunnel. You are the squad arriving on the scene. Other response squads have already been alerted and will arrive shortly.

Source: Author's diagram

Your tasks, which you have received from the commander, are:

- The basic assignment is: "To carry out firefighting as quickly as possible!"
- To carry out a rapid exploration and send out a situational report.
- If there is a fire, efficient extinguishing measures will be initiated.
- If you find people, appropriate rescue measures will be initiated.

Assignment of your task force:

The squad is divided into 3 teams. The commander leads all teams in the tunnel.

Exploration squad


Commander


Squad member

Fire squad 1


Commander


Squad member

Fire squad 2


Commander


Squad member

For subsequent rescue measures a search and resuce team of another response squad is used:

Search and rescue squad 1


Commander


Squad member

Scenario 2 SAFEINTUNNELS Search and rescue:

Imagine you are part of squad of six people, which is called to a train fire in a railway tunnel. You are part of an assitence squad. The first exploration team already arrived and extinguishing measures are applied.

Source: Author's diagram

Your tasks, which you have received from the commander, are:

- Carry out an efficient search and, if necessary, rescue of persons in the assigned tunnel section!
- Give situational reports to the commander.

Assignment of your task force:

The squad is divided into 3 teams of two people. The commander leads all teams in the tunnel.

Exploration squad

Commander

Squad member

Search and rescue squad 1

Commander

Squad member

Search and rescue squad 2

Commander

Squad member

Co-funded by the
Erasmus+ Programme
of the European Union

Schedule for a *Basic vocational education and training for firefighting squads – Firefighting in railway tunnels*

First day

*	Time	Topic	Place / Instructor / Lecturer
	08:00 – 08:20	Welcome and introduction	Teaching room Lecturer
	08:20 – 09:10	Basic tactics of firefighting in tunnels	Teaching room Lecturer
	09:10 – 10:00	General communication	Teaching room Lecturer
	10:00 – 10:20	Break	
	10:20 – 11:10	Technical communication	Teaching room Lecturer
	11:10 – 12:00	Tunnel infrastructur	Teaching room Lecturer
	12:00 – 13:00	Lunch break	
	13:00 – 14:00	Exploring of railway tunnels	Training ground Lecturer
	14:00 – 14:45	Marker lights	Training ground Lecturer
	14:45 – 15:00	Break	
	15:00 – 15:50	Fire extinguishing in railway tunnels	Training ground Lecturer
	15:50 – 16:40	Hose managment	Training ground Lecturer
	16:40 – 17:30	Structural cooling	Training ground Lecturer

Second day

Time	Topic	Place / Instructor / Lecturer
08:00 – 09:10	Hazards in the track area	Teaching room Lecturer
09:10 – 10:00	Smoke – down- and upstream	Teaching room Lecturer
10:00 – 10:15	Break	
10:15 – 12:00	Search and rescue in railway tunnels	Training ground Lecturer
	Equipments and tools for firefighting in tunnels	Training ground Lecturer
12:00 – 13:00	Lunch break	
13:00 – 15:00	Combined practice training • Fire extinguishing in railway tunnels • Search and rescue in railway tunnels • Equipments and tools for firefighting in tunnels	Training ground Lecturer
15:00 – 15:20	Break	
15:20 – 16:10	Hazardous substances in tunnels	Teaching room / Training ground / Lecturer

Third day

Time	Topic	Place / Instructor / Lecturer
08:00 – 08:50	Water supply	Teaching room / Training ground Lecturer
08:50 – 09:40	Safety	Teaching room Lecturer
09:40 – 10:00	Break	
10:00 – 12:00	Operational command	Training ground Lecturer
12:00 – 13:00	Lunch break	
13:00 – 15:00	Practice exam	Training ground Lecturer
15:00 – 16:00	Equipment cleaning and inspection	Training ground Lecturer
16:00 – 17:00	Summary and conclusion	Teaching room Lecturer

* The color code is chosen according to the category of each module

Co-funded by the
Erasmus+ Programme
of the European Union

Description learning units

Course:	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Basic tactics of firefighting in tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant should have basic knowledge of the fundamental tactics in tunnel operations.
- The participant can use the breathing protection device to implement the assigned tasks in the corresponding area of operation.
- The participant is proficient in leading a squad in firefighting as well as search and rescue operations.

Special tactics for tunnel operations

Knowledge	Skill	Competence
He/She knows: • the basic tasks on exploring, estinguishing, search and rescue in tunnel operations. • basic tactics of firefighting in tunnels.	He/She is able to apply: • all activities according to the assigned role and the command. • the assigned tasks within their squad in the designated area of operation according to the basic tactics of firefighting in tunnels.	He/She masters: • reporting dangers to the commander. • the distinction between the individual tasks of exploration, extinguishing and search and rescue. • leading a squad in a tunnel operation.

Further information:

- Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 22 – 23, 108 – 112

Vocational education and training method:	The participants are confronted with a tunnel fire event, sucha as Eurotunnel fire on 17.11.2015. The participants should assess the corresponding fire in a team effort and work out possible solutions. The instructor reflects on the results with regard to the basic tactics of firefighting in tunnels. The conclusions drawn from this are to be implemented correctly during the practice training.
Type of learning unit:	100% presence
Teaching methods:	90% lecture, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	Documentation firefighting in tunnels	
Created by: Mst. Ing. Gerhard Schöpf		

Course:	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**General communication**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant knows the basic country- and fire brigade-specific radio rules and can apply them during an incident in a tunnel.
- The participant is able to give status reports.
- The participant masters status reports if there is a situational change and in case of danger.

Leadership skills in use – especially in tunnels spanning several countries

Knowledge	Skill	Competence
He/She knows: • the squad's organisation and who actively carries out radio communication. • the requirements for communication in a tunnel (stress, noise, physical activity etc.) and the problems of exaggerated radio communication. • the country-specific radio regulations.	He/She is able to give: • short and precise status reports. • situational adapted status reports and orders in a timely manner.	He/She masters: • status reports in case of changed circumstanes or/and in case of danger. • situational adapted communiation to all hierachial levels.

Further information:

- Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 185, 193

Vocational education and training method:	The lecture discusses the necessary contents of a concise status report including using breathing protection devices during an incident in a railway tunnel. This can be done by situational descriptions, videos, virtual representations, in training or real tunnels or by hologram techniques. The participants actively give status reports. The most important parts of the status report are: • Squad name • Position / location in the tunnel • Smoke including direction of flow • Incident report (including what is burning where and how? Any dangers? or persons found? etc.) • Detected dangers (hazardous material, temperature, ...) • Accessibility (usability of escape routes, ...) Status reports are the basis of good communication. Therefore, they have to be practised intensively so that the transmission becomes intuitively. It is a prerequisite for stressful situations. The practice exercises are to be carried out with all the equipment necessary for a tunnel operation.

Type of learning unit:	100% presence
Teaching methods:	30% lecture, 60% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• Country-specific radio • Corresponding radio equipment • Operating instructions for object radio systems and tunnel emergency telephones
Created by: Mst. Ing. Gerhard Schöpf	

Course:	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**Technical communiation**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

- The participant shall have basic knowledge of the radio system, radios and object radio system in use.
- The participant can operate his/her radio and communicate via alternative routes.
- The participant masters his/her complete radio equipment.

Knowledge	Skill	Competence
He/She knows: • the radio channels or groups to be used according to the communication plan. • the technical basics of an object radio system / tunnel radio system (semi-duplex) and its operational limits, radio bridges, loss of signal strength in shadow areas.	He/She is able to: • operate the corresponding radio including its accessories. • communicate with alternative equipment in the tunnel (e.g. emergency telephone). • implement and operate a radio bridge.	He/She masters: • the corresponding radio including its accessories. • communication with alternative equipment in the tunnel (e.g. emergency telephone). • radio bridges and loss of signal in shadow areas.

Further information:

- Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 40, 192 - 193

Vocational education and training method:	The instructor explains the country-specific technical regulations regarding radio communication. In a further step, the technical equipment, such as radios and radio accessories, is presented in detail. To ensure safe and error-free operation, the necessary operating steps are practised. Various communication plans of tunnel systems can be used for this purpose. Object radio systems and alternative communication channels, such as emergency telephones (in the tunnel), must be presented and explained.
Type of learning unit:	100% precense
Teaching methods:	90% lecture, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device nach EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• Country-specific radio • Corresponding radio equipment • Operating instructions for object radio systems and tunnel emergency telephones	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Technical introduction to tunnel constructions**		
Title of learning unit:	**Tunnel infrastructur**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the basic structure of a railway tunnel, its facilities and their functions.
- can operate simple tunnel infrastructure, recognize escape route doors, etc.
- is able to use the equipments according to the situation and report their possible malfunctions.

Technical introduction to tunnel constructions

Knowledge	Skill	Competence
He/She knows: • the basic facilities of a tunnel, such as entrances and exits, fire extinguishing niches, breakdown bays, emergency niches, cross-passages, escape routes, etc.) • the functioning of the basic installations in a tunnel • the basic structure of a tunnel drainage and retention system	He/She is able to: • operate basic facilities such as fire extinguishing niches, breakdown bays and escape route doors • carry out simple containment measures in the respective drainage system	He/She masters: • reporting malfunctions or defects of infrastructure facilities • depending on the situation, the use of the tunnel infrastructure in the assigned area.
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 27 – 45		
Vocational education and training method:	With diagrams, photos and graphics, the tunnel infrastructure is presented. Construction guidelines, the basic structure of rail networks, the power supply, different designs, escape routes, emergency call niches and lighting options are explained. In particular, electrical grounding systems should be presented and explained as well as safety measures with regard to unintentional reclosing.	
Type of learning unit:	100% presence	
Teaching methods:	70% lecture, 20% practice training, 10% reflection	
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	

Equipment:	• charts • photos • graphics • cross-sectional designs of the tunnel, if available	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Exploring of railway tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	75 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

ecvet
European Credit system for Vocational Education & Training

Aim of learning unit:

The participant

- learns to determine the situation quickly and send status reports, so that the commander can make his/her decisions.
- knows the special tactics for fires in railway tunnels.
- can independently assess the incident and send qualified status reports to the commander.
- can use the appropiate markers.
- independently assess the incident and send qualified status reports to the incident commander.
- use the marking system.
- masters a quick assessment of the assigned incident site.
- identifies possible hazards and draws the appropriate safety-relevant conclusions.

Knowledge	Skill	Competence
He/She knows: • the required equipment for the exploration of a railway tunnel. • the tasks of an exploration team in a railway tunnel. • the procedure of a quick exploration. • the differences between the rescue and attack routes. • various possibilities of exploration in a railway tunnel (by observation, by questioning of possible witnesses etc.).	He/She is able to: • equip himself/herself as a member of the exploration squad. • set the different markers according to the given instructions. • report the status according to the assignment. • carry out the mission according to the instructions. • identify and mark emergency exits, water tapping points, possible dividing breeching points and located people. • brief the squads upon the incident. • record the results of the exploration and communicate a status report. • assess the up- and downstream sides and consequently define the attack side. • determine rescue and attack routes.	He/She masters: • the procedure of an exploration squad. • a quick investigation of the incident (what is burning where and how, recognise special circumstances) while maintaining one's own safety in the assigned tunnel section. • evaluation of the attack measures in the tunnel. • the assessment of the damage including own and third-party situation.
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 120 – 121		
Vocational education and training method:	During the lecture, the necessary steps for a quick exploration are discussed. The special tactics of the operation are repeated. The focus is on the part "exploring the scene". The main points of the squad are: • operational boundaries (do not walk past the fire) • exploration "what is burning where and how?", air flow direction and special circumstances (persons, accessibility, involvement of dangerous goods etc.)	

	• communication with the commander • necessary equipment For the practice exercises, conditions should be created that are as real as possible. This can be done by using real objects in special training tunnels or real railway tunnels. Another good possibility is to represent the incident with virtual equipment. For example, smoke and/or fire can be realised using hologram technology. Alternatively, pictures of operations can be used to illustrate the incident. A continuous investigation of the incident has to be incorporated into the exercises. By that, it becomes a routine procedure.
Type of learning unit:	100% presence
Teaching methods:	50% lecture, 40% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• teaching materials, such as flipchart, whiteboard, etc. • one thermal imaging camera • marker lights (two green, tow blue and four yellow) • two radios • hand lamps, one per participant • fog machine
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Tactical use of vehicles, equipments and materials for tunnel operations**		
Title of learning unit:	**Marker lights**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows all matters concerning the marking system
- can correctly apply the marker lights
- can use the marker lights efficiently in complex situations

Knowledge	Skill	Competence
He/She knows: • the three colours of the marking system and the meanings associated with them • the possibilities of using the marking system depending on the incident	He/She is able to: • put into operation the marker lights and position them according to the order • independently position the marker lights in the assigned area • determine the incident based on the positioned marker lights and take appropriate action	He/She masters: • recognising the correct function of the marking lights and reporting a malfunction or defect, if necessary • assessing the mode of operation of the marker lights and correcting false use, if necessary • positioning of the marker lights in complex operational situations

Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 174 – 175	
Vocational education and training method:	The uniformed marking system is essential for a smooth operation. This marking system eliminates a considerable part of the verbal communication, therefore, when used correctly, verbal communication errors are reduced. For the three basic measures (exploration, extinguishing, search and rescue) the necessary marking points are discussed in lecture. For better clarification, site plans or sketches depicting operational situations can be used. On these plans, the marking points can be determined in a joint discussion. In order to consolidate the knowledge acquired, real operational situations should be simulated and practised. Care should be taken to ensure that the operational situation is marked precisely and unambiguously.
Type of learning unit:	100% presence
Teaching methods:	10% lecture, 80% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• marker lights – two green • marker lights – three blue • marker lights – four yellow	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Types of operations in tunnel:** **a. Rescue of people** **b. Firefighting**		
Title of learning unit:	**Fire extinguishing in railway tunnel**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	90 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant:

- can assess a tunnel fire as member of the firefighting squads using breathing protection equipments, identify dangers, set up a water supply and an extinguishing line and carry out appropriate firefighting techniques.

Knowledge	Skill	Competence
He/She knows: • the equipments and extinguishing agents • the detailed tasks of a fire-fighting squad • mode of actions of extinguishing agents • extinguishing techniques for tunnel fires • how extinguishing squads act • the advantages/disadvantages of different extinguishing techniques/agents	He/She is able to: • equip himself as a fire fighter carrying out appropiate activities under command • carry out the activities autononomously • report on the incident and the fire • orientate in a tunnel system • lead a fire brigade even under conditions of poor visibility	He/She masters: • equipments (e.g. jet pipe, water cannon) • spatial orientation in a tunnel section • firefighting in a railway tunnel and determining its operational limits (e.g. penetration depth, hazardous materials) • application of a surface-active agents • recognition of dangers and spreadings
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 132-135		
Vocational education and training method:	The necessary steps for a quick installation of the water supply and the extinguishing line are presented. In addition to these activities, the participant also learns different extinguishing techniques for different types of trains and incidents (locomotives, wagons, axles, etc.). Special attention to the appropriate extinguishing technique must be paid to the location of the fire (inside and/or outside the train). The most important points of the lecture are • operational limits • hazard recognition and establishing safety at the fire scene • special extinguishing techniques • water supply and selection of attack routes • communication with the commander • necessary equipments For the practical exercises, conditions should be as real as possible. This can be done by using real objects in special training tunnels or railway tunnels. Small fire scenes help the participants to imagine themselves in a real operation. Another good possibility is to represent the incident with virtual equipment. For example, smoke and/or fire can be realised using hologram technology. Alternatively, pictures of operations can be used to	

	illustrate the incidents. The practical exercises should be carried out with all the equipment necessary for a tunnel operation.
Type of learning unit:	100% presence
Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• teaching material, e.g. flip chart, whiteboard • thermal imaging camera – one per squad • marker lights two green, three blue, and four yellow • radio – one per participant • flashlight – one per participant • branches and hoses • water supply, pump and/or water tender • fire simulation devices • fog machine
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Training of special tactics in tunnel operations**		
Title of learning unit:	**Hose management**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows equipment and ways to effectively establish a fire line, as well as different water tapping points.
- can independently determine attack routes and set up water supply and extinguishing lines.
- masters the equipment for an extinguishing attack and monitors the hose management.

Training of special tactics in tunnel operations

Knowledge	Skill	Competence
He/She knows: • the required equipment for a supply or extinguishing line. • possibilities for the efficient construction of a supply or extinguishing line. • the advantages and disadvantages of the different water tapping points.	He/She is able to: • lay an appropiate supply or extinguishing line. • quickly set up a supply and extinguishing line. • determine attack routes	He/She masters: • the operation of the equipment for the firefighting attack. • the effectiveness in his section. • instruction and supervision the actions of a firefighting squad

Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 40 – 41, 132 – 135	
Vocational education and training method:	At the beginning of the lecture, the instructor determines the attack or rescue side in the training tunnel (or in tunnel simulation) together with the participants. The attack or rescue side is the area between the tunnel walls and the train. Basically, the side with better access is used as a rescue route and the side with worse access as an attack route. Different variants (e.g. narrow spaces) regarding the laying of extinguishing lines and the use of different sources of water supply are trained in practice (hydrants, vehicles, rescue trains). The extinguishing line must be laid in such a way that they are not stumbling blocks.
Type of learning unit:	100% presence
Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities.

	Specific laws and regulations of the member states must be respected.
Equipment:	• various hoses • dividing breeching • branchpipe • thermal imaging camera
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Training of special tactics in tunnel operations**		
Title of learning unit:	**Structural cooling**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	30 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the physical principles about concrete and spalling.
- can apply appropriate countermeasures
- masters the status evaluation and derives appropiate measures.

Training of special tactics in tunnel operations

Knowledge	Skill	Competence
He/She knows: • the basics of structural cooling. • the efficient ways of structural cooling. • the physical background in relation to structural cooling.	He/She is able to: • cool certain parts of the tunnel structure under supervision. • cool certain parts of the tunnel structure independently. • determine the temperature conditions of the tunnel structure. • recognise the effects (positive or negative) of structural cooling. • estimate the required amount of water.	He/She masters: • operating the required equipment for the firefighting attack and for structural cooling. • verifying the effectiveness of the applied structural cooling measures in his section. • recognising structural cooling measures as needed. • defining the safe and dangerous areas.
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 72 – 73, 132 – 133		
Vocational education and training method:	The instructor explains the physical principles about concrete and uncontrolled spalling. The countermeasure "structural cooling" is presented to the participants theoretically. In the second step, two extinguishing lines are prepared, and a targeted structural cooling is carried out. The 1/3 - 2/3 extinguishing method can be used as a rough guide. It describes that in case of extensive fires 1/3 of the extinguishing water should be discharged on the fire and 2/3 on the structure. Care must be taken to ensure that the structure is properly assessed with a thermal imaging camera and subsequently cooled with an appropriate focused hose before the squad arrives. The squad should be never in an area of danger of collapse. As a basic rule, the tunnel structure above the squad must always be wet. Arriving at the incident, the sqaud has to determine the relation between water used for the concrete structure and the fire. The basic rule here is that as much water as possible should go into the fire and as little as necessary into the structure.	
Type of learning unit:	100% presence	
Teaching methods:	20% lecture, 70% practice training, 10% reflection	

Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• various water hoses • dividing breeching • two branches • thermal imaging camera
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Safety in handling the used resources: Vehicles, equipments and materials for tunnel operations and accident prevention**		
Title of learning unit:	**Hazards in the track area**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

ecvet
European Credit system for Vocational Education & Training

Aim of learning unit:

The participant

- knows the possibilities how to orientate on a track area in a tunnel
- knows possible hazards in the track area and can carry out actions to reduce hazards.
- is proficient in structured procedures with his/her assigned squad and is able to report hazards to the squad leader.

Knowledge	Skill	Competence
He/She knows: • hazards in the track area (e.g. danger of an electric shock...) • the distance marking system of the railway operators • simple measures to secure the assigned area in the tunnel	He/She is able to: • apply hazard reduction measures under guidance (install barriers, place a wheel chock, etc.) • can independently apply or instruct measures to reduce dangers	He/She masters: • reporting dangers to the squad leader • entering and leaving the assigned area safely with its squad

Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 62 – 71, 76 - 89, 128	
Vocational education and training method:	On the basis of real operations, accidents or near-accidents, a lecture is conducted regarding the potential dangers. The instructor teaches the participants how to orientate themselves safely on a railway track. By a brainstorming session, potential hazards such as electricity, long braking distances, large masses, switch stands, danger of falling, etc. In a joint dialogue, protective and countermeasures are discussed for the identified dangers. To consolidate this important knowledge, dangerous situations should be simulated in the ongoing training so that the necessary observations and measures are memoritzed in practice.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities.

	Specific laws and regulations of the member states must be respected.
Equipment:	• pictures of the distance marking system of the railway operators • simulation systems or graphics of electrical system in a tunnel • field reports of accidents or near-accidents
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basisausbildung für Besatzungen von Feuerwehrfahrzeugen – Brandbekämpfung in Eisenbahntunneln**		
Module:	**Scientific basis for tunnel operations**		
Title of learning unit:	**Smoke – down- and upstream**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	25 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the scientific principles regarding air flows in railway tunnels and can explain the terms: up- and downstream sides.
- can recognise the up- and downstream sides and possible hazards.
- knows how to apply, assess, and evaluate the appropiate air flow measures.

Scientific basis for tunnel operations

Knowledge	Skill	Competence
He/She knows: • the scientific principles up- and downstream • the advantages/disadvantages of up- and downstream sides • the hazards associated with the up- and downstream sides	He/She is able to: • recognise hazards • recognise the up- and downstream sides and distinguish between them	He/She masters: • self-protective measures in case of a change of the air flow • assessing the up- and downstream sides and can derive the advantages/disadvantages for the operation in the assigned area

Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 42 – 44, 124 – 127, 141, 162	
Vocational education and training method:	The scientific principles are explained in a lecture or in a discussion. Videos, graphics and/or models of tunnel systems should be used to consolidate this knowledge. For the practical recognition, assessment, and evaluation of air flow conditions, these principles are simulated in real tunnel systems or with hologram techniques. By that, the participants gain experiences and learn to make decisions relevant to the operation. These decisions are discussed between the instructor and the participants.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.

Equipment:	• fog machine • adjustable air flow devices (to simulate air flow conditions) • displays such as graphics or pictures • videos of air flow conditions in the tunnel (e.g. from fire tests) • a model of a tunnel system	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Types of operations in tunnel: a. Rescue of people and b. Firefighting**		
Title of learning unit:	**Search and rescue in railway tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	120 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

ecvet
European Credit system for Vocational Education & Training

Aim of learning unit:

The participant

- knows the equipments and tasks, as well as different missions of a search and rescue squad.
- can independently carry out a systematic exploration and subsequent rescue of persons from a train or the tunnel itself.
- is able to apply appropiate measures to search for persons under good visibility, as well as to lead a search and rescue squad in the assigned area under conditions of poor visibility.

Knowledge	Skill	Competence
He/She knows: • the tasks and equipments of a search and rescue squad • rescue techniques in a railway tunnel • the different types of operations of a search and rescue procedure	He/She is able to: • equip himself for search and rescue • systematically carry out search and rescue activities under supervision • apply rescue techniques in a tunnel • give feedback on searched objects • appoint search and rescure squads (together or split up)	He/She masters: • the application of the equipment in use • spatial orientation in an assigned tunnel section • systematic search and rescue under conditions of good visibility • spatial orientation in a tunnel system • leading a search and rescue team under poor visibility conditions
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 136 - 139		
Vocational education and training method:	The systematic search and the possible alternatives are presented to the participants. Then, operational situations with different levels of difficulty (non-smoked and smoked areas, large and small dummies, simulation of injuries) are prepared and exercised. The instructor corrects actions, if necessary. When these measures are understood and persons can be searched and resuced, the applied levels should be successively increased until a search and rescue can be carried out safely under conditions of poor visibility.	
Type of learning unit:	100% presence	
Teaching methods:	20% lecture, 70% practice training, 10% reflection	
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities.	

	Specific laws and regulations of the member states must be respected.
Equipment:	• marker lights (4 x yellow) • litter • search sticks • thermal imaging camera • flashlight • radios • flashhood
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course:	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**				**Safety in handling the used resources**
Module:	**Safety in handling the used resources: Vehicles, equipment and materials for tunnel operations and accident prevention**				
Title of learning unit:	**Equipment and tools for firefighting in tunnels**				
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training				
Duration:	120 min				
Number of participants:	5 to 9	**Number of instructors:**	1		
Exam:	Part of the overall exam				
EQF-level:	Level 4				

Aim of learning unit:

The participant

- knows the appropriate equipment, its designated use and its limitations in a tunnel operation.
- He/She can balance advantages and disadvantages of the equipment and can use it under difficult conditions.
- He/She analyses the incident and is able to apply approbiate equipment.

Knowledge	Skill	Competence
He/She knows: • the necessary devices/equipments and their handling (litter, search and rescue sticks, rolling pallet, marker, flashhood). • the use and mode of the equipment, the safety regulations, if applicable, their cleaning and maintenance requirements.	He/She is able to: • operate equipment in compliance with the relevant safety regulations for tunnel operations. • monitor the efficient use of equipment. • assess the advantages and disadvantages of applied equipment.	He/She masters: • recognising the correct application and reporting a malfunction or defect. • assessing the operation mode and correcting inefficient application. • selecting the required equipment in reference to its application.

Further information:

- Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 156-177

Vocational education and training method:	By a brainstorming process, the participants learn about vehicles and equipment and their safe and correct use. During the lecture, the equipment is divided into two groups. First group: all equipment that is used in routine operations. Second group: all devices that are not used regularly in the fire service. These devices are presented, and their use is demonstrated by the instructor with regard to safety and application.
Type of learning unit:	100% presence
Teaching methods:	30% lecture, 60% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of learning unit:	**Hazardous substances in tunnels**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the basic procedures for operations with hazardous substances and is familiar with appropriate reference books.
- applies standardised measures (recognise dangers, set up barriers, rescue people, request forces, distance, stopping time, shielding).
- is able to use the necessary protective clothing and to check the correctness of the labelling of the hazardous substances.

Knowledge	Skill	Competence
He/She knows: • the hazards of a tunnel operation • standardised self-protection and appropriate reference books • basic measures for stabilising the situation (collecting, sealing, etc.)	He/She is able to: • can recognise hazardous substances basesd on their labels • apply standardised measures • use appropiate reference books on labelling of hazardous substances	He/She masters: • the application of basic measures of self-protection (e.g. recognise dangers, set up barriers, rescue people, request special forces) • the classification and meanings of hazardous substances and the respective labels

Further information:

- Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 54 – 56, 60 – 61, 106 – 107, 118 – 119

Vocational education and training method:	• The lecture builds on the knowledge firefighters collect during their basic trainings. This is upskilled by information on hazardous materials during incidents in tunnels. Special attention must be directed on recognition of hazardous substances, their labelling and standardized self-protection measures, because: o the substance concentration is lower on the upstream side and correspondingly higher on the downstream side. This fact is particularly important during the exploration phase. o explosions in a tunnel are much more devastating than in open terrain because of the increase in pressure and fire propagation. They can lead to structural changes and fatal injuries. Therefore, ignition factors must be avoided by interrupting power supply and secure appropriate electrical grounding. o The drainage system can be used for the removal of liquid substances. Special attention should be directed to the appropriate absorption of pollutants and their disposal as well as towards flammable liquids and heavy gases because these liquids/gases can cause explosions over huge distances.
Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection

Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.	
Equipment:	• labels of hazardous substances • photos/graphics from previous operations • cross-sectional designs of the tunnel, if available	
Created by: Mst. Ing. Gerhard Schöpf		

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Explanation of the technical and local conditions**		
Title of learning unit:	**Water supply**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	50 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the architecture of water access points and water supply in the tunnel
- can independently put into operation water extraction in the assigned area
- is able to assess the appppropriateness of water access points in the damaged area

Knowledge	Skill	Competence
He/She knows: • the water access points in the respective tunnel • the water supply and the capacity of the water supply in the respective tunnel	He/She is able to: • put into operation the water supply in the respective tunnel • independently locate water access points in the assigned section	He/She masters: • water extraction from the water tender of his own brigade • assessing the appropriateness of a water access point in an assigned tunnel section in relation to the incident
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 40 – 41, 158 – 161, 172		

Vocational education and training method:	The instructor defines the available water supply and existing water access points. On this basis, the maximum water withdrawal rate is determined and consequently discussed. Next, the participants evaluate operational situations with regard to the appropriateness of water extraction points and, if necessary, work out solutions. Based on the applied extinguishing attack, he/she is able to calculate how long an attack can be carried out with the available water supply. In addition, the increase of the extinguishing effect through the use of surface-active agents are investigated. The results are discussed among the participants and reflected by the instructor.
Type of learning unit:	100% presence
Teaching methods:	20% lecture, 70% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11

	Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• description of a tunnel and its safety architecture (e.g. water supply, hydrants, access point) • standard firefighting equipments • information on surface-active agents (e.g. foams) • teaching materials e.g. flip chart/whiteboard
Created by: Mst. Ing. Gerhard Schöpf	

Co-funded by the
Erasmus+ Programme
of the European Union

Course	**Basic vocational education and training for firefighting squads – Firefighting in railway tunnels**		
Module:	**Safety in handling the used resources: Vehicles, equipments and materials for tunnel operations and accident prevention**		
Title of learning unit:	**Safety**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	25 min		
Number of participants:	5 to 9	**Number of instructors:**	1
Exam:	Part of the overall exam		
EQF-level:	Level 4		

ecvet
European Credit system for Vocational Education & Training

Aim of learning unit:

The participant

- knows how to behave in emergencies as a breathing protection device user.
- knows to recognize escape routes in the tunnel.
- is able to identify hazardous situations and exit the tunnel under conditions of poor visibility as a breathing protection device user, too.
- is able to orientate him/herself under conditions of poor visibility and to operate the emergency vehicles (e.g. rescue train/fire engine).
- masters safety-relevant circumstances during the operations.
- masters the recognition of his/her own performance limits.

Safety in handling the used resources: Vehicles, equipments and materials fortunnel operations and accident prevention

Knowledge	Skill	Competence
He/She knows: • the difficult demands on the breathing protection equipments users in tunnel operations (long approach, physical and mental stress, hazardous substances...) • the importance of the pullback signal • the procedure to be followed in the event of a breathing protection equipment emergency • the measures to be taken when entering the tunnel with a vehicle • the escape and rescue routes in the respective tunnel • the procedure for an orderly pullback of a breathing protection equipment squad	He/She is able to: • recognise dangerous situations and report them to squad leader • find escape and rescue routes even under conditions of poor visibility • lead and handle a breathing protection equipment emergency within a squad • implementing and instructing the necessary measures for entering the tunnel with a vehicle	He/She masters: • recognising the personal performance limits and reporting them to the squad leader • recognising and reporting safety-relevant changes in the operation
Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 16 – 18, 62 – 66, 78		
Vocational education and training method:	The instructor discusses the specific dangers during an incident in a railway tunnel and simulates them again and again during the practical exercise. The participants must recognise these dangers and react to them accordingly. In particular, breathing protection equipment emergencies and their management are to be trained. Furthermore, the necessary measures (closing windows, setting vehicle ventilation to circulating air, grounding the vehicle on the wagon) are to be carried out on an appropiate vehicle that is brought to the scene of the emergency in the tunnel, for example, by a rescue train. Occasional exercises are to be dimensioned in such a way that the participants are pushed to their performance limits. Each participant should gain this experience so that he/she recoginse his/her personal performance limits at an early stage during an incident.	

Type of learning unit:	100% presence
Teaching methods:	70% lecture, 20% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007 • Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• material for the simulation of diffent hazards
Created by: Mst. Ing. Gerhard Schöpf	

Course	**Firefighting in railway tunnels**		
Module:	**Leadership skills in use – especially in tunnels spanning several countries**		
Title of learning unit:	**Operational command**		
Prerequisites:	Basic vocational education and training as a firefighter incl. completed breathing protection training		
Duration:	100 min		
Number of participants:	5 to 9	**Number of instructors:**	5 to 9
Exam:	Part of the overall exam		
EQF-level:	Level 4		

Aim of learning unit:

The participant

- knows the tasks of the control centre, the responsibilities of the exploration team, how to set up and operate a control centre and how to make use of the different types of information.
- knows the implementation of the breathing protection devices as well as define the handling time according to the situation.
- can report the status and describe the situation appropriately.

Leadership skills in use – especially in tunnels spanning several countries

Knowledge	Skill	Competence
He/She knows: • tasks/procedures of the exploration team • the tasks of a control centre • how to get there and report appropriately • implementing breathing protection devices and their handling time • the designated areas of operation and set-up areas for the fire brigades (allocation of resources, control centre...)	He/She is able to: • approach the designated areas of operation • report the status correctly (spatial and temporal) • describe the situation appropiately • calculate the time of withdrawal of the squads using breathing protection independently	He/She masters: • implementing a control centre with the appropiate equipments • the organisation (in terms of personnel and equipments) of a control centre • consolidating different information • briefing upon the situation, including passing on information and tasks to the subsequent squads

Further information: • Firefighting Operations in Railway Tunnels (ISBN 978-3-942385-10-7), pp. 110 – 116, 120 – 123, 184 - 193	
Vocational education and training method:	General, theoretical, country-specific instructions regarding the organisation of control centre are lectured. Furthermore, basic skills for the preparation of a status report and documentation of the situation must be taught. For the simulation of practical activities in a control centre, exercises, or simulation games (including organising the breathing protection squads) are applied. Based on this, the activities of a control centre are carried out and the handling time of the breathing protection equipment is calculated. The instructor coaches the participants and shows them possibilities of reporting the situtaion and different ways of executing operational command.
Type of learning unit:	100% presence
Teaching methods:	50% lecture, 40% practice training, 10% reflection
Protective clothing:	• Body protection: protective clothing (level 2) according to EN 469, flame protection hood according to EN 13911:2004 • Hand protection: Protective gloves according to EN 659 • Head protection: Firefighter helmet according to EN 443/2008 • Safety shoes according to EN 15090/2007

	• Breathing protection device according to EN 137:2006-11 Note for the instructor: During practice training, full protective clothing must be worn during the entire exercise, including during dismantling activities. Specific laws and regulations of the member states must be respected.
Equipment:	• analogue or digital equipment to report the status • sketches and descriptions of tunnel systems • plans, documents, and scripts for simulation games • calculation aids for the handling breathing protection equipments • hand-held radios
Created by: Mst. Ing. Gerhard Schöpf	

Examination

The examination *Basic vocational education and training for firefighting squads – Firefighting in railway tunnels* consists of a theoretical and a practical examination. Both parts of the examination must be passed. Both parts of the examination are considered positive if at least 65 % of the examination is correctly answered. However, passing the theoretical examination with at least 65 % is a prerequisite for the practical examination.

Theoretical examination

The theoretical examination is carried out as a multiple-choice test. It contains 25 questions. There are three possible answers to each question. The answers marked in green are the correct responses.

Consider that you are a part of the exploration team. What are your first choices of action after entering the tunnel?

- I use the thermographic camera to get a situational overview and place at the entrance a green marker light.
- I ensure the evacuation route with a rope and place at the entrance a green marker light.
- I mark the position of the distributor with a blue marker light.

Consider that you are a part of the exploration team and you find an unconscious person in 30 meters distance to the tunnel entrance. What is your main priority?

- I inform the subsequent squad leader, place a yellow marker light next to the person and continue the operation.
- I start the evacuation immediately.
- I inform the subsequent squad leader and evacuate the unconscious person.

Consider that you are part of the exploration team. After you have reached the end of the train, you place a blue marker light. On which side of the train will you continue the operation?

- I continue the operation at the same side where the blue marker light has been placed.
- It depends on the situation.
- I continue the operation at the opposite side where the blue marker light has been placed.

Consider that you are part of the extinguishing team and you find a blue marker light on the ground after you have reached the end of the train. At this point, you choose to place a distributor. Is this statement correct?

- No, this statement is not correct, because a distributor has to be placed closer to the incident.
- Yes, this statement is correct, because the blue marker indicates water supply or distributor points.
- It depends on the situation.

Consider that you are a part of the extinguishing team. Your team is preparing two pipes. Where should the preparation of the pipes take place?

- The preparation should take place in front of the fire scene.
- The preparation should take place at the same side of the train.
- The preparation should take place on both sides of the train.

Consider that you are a part of the search and rescue team. A main rule is that the whole squad must be within the range of vision at all time. Is this statement correct?

- No, it is enough if the squad leader knows where everyone is.
- Yes, it is essential because the situation is very dangerous.
- It depends on the situation.

Consider that you are searching for passengers inside the train. Do you close the doors after you have entered the train?

- No, because there is a risk that the doors may not open again.
- Yes, it will keep the smoke out of the train.
- No, because it may hamper the evacuation of the passengers.

Consider that you are a part of the search and rescue team and you find a casualty/injured person and start the evacuation. The rest of the squad team must wait at the location where the casualty/injured person was found until the squad team is together again. Is this statement correct?

- No, with good communication and positioning of yellow marker lights the rest of the search and rescue team can continue their work.
- Yes, because the risk loosing each other again is too high.
- It depends on the situation.

Once a yellow marker light has been placed, it should not be changed during the operation. Is this statement correct?

- No, this statement is not correct.
- Yes, because the risk of misunderstandings is high.
- It can be changed, but only by the same person who has placed the yellow marker light.

Which assessments will you conduct as a basis to decide the best escape route for the response operation?

- The escape route must be easily accessible to retreat.
- The escape route must be close to the incident scene.
- The escape route must be at a safe distance from the fire and allow access to the rescue work.

Where marker lights should be placed during the response operation?

- On the floor near the tunnel wall (distance approx. 10 cm).
- Above the ground (as high as possible on the tunnel wall).
- Depending on the situation, either on the ground or in height.

Consider that you are a part of the exploration team that has found a possibly injured person outside the train. What is your main priority?

- I produce status report to the subsequent squad leader and start the evacuation.
- I start the evacuation only if the injured person is within 15 meters of the exit area.
- I produce a status report to the subsequent squad leader and ask the search and rescue team to start evacuation.

An injured person is found outside the train. What status report will you convey to the subsequent squad leader?

- Findings from the search operations, conditions of injured persons and applied rescue measures.
- Personal details, conditions of injured persons and applied rescue measures.
- Personal details, findings from the search operations and conditions of injured persons.

Consider that you are a part of the exploration team. What are your actions after the incident scene has been found?

- I observe the development of the situation until the extinguishing team arrives and continue the exploration.
- I report the findings from the incident scene to the subsequent squad leader and retreat from the tunnel.
- I observe and report the development of the situation to the subsequent squad leader, and depending on the situation, I assist in extinguishing or rescuing.

Consider that you are a part of the extinguishing team. What is your main priority to ensure a satisfactory execution of the extinguishing work?

- I concentrate on extinguishing the fire immediately after the incident scene has been reached.
- I concentrate on the structural cooling immediately after the incident scene has been reached.
- I alter between structural cooling and extinguishing of the fire depending on the situation.

Consider that you are a part of the exploration team. While approaching the incident scene, you must give a situation report to the squad leader. What will be your message cover?

- Position findings, escape routes, smoke spreadings, fire development, hazards, and risks.
- Position findings, hazards and risks, appropriate firefighting tactics.
- Position findings, hazards and risks, details about the infrastructure.

Consider that you are a part of the search and rescue team and have found an injured person on the train. What is your primary task?

- I start life-saving measures in the immediate vicinity.
- I report findings from the search operation to the subsequent squad leader and continue the search and rescue measures.
- I report findings from the search operation to the subsequent squad leader and start evacuation and life-saving measures.

What is the correct use of the yellow marker light?

- The light should be used to mark position of injured persons.
- The light should be used to mark position findings and the maximum immersion/length of the search.
- The light should be used to mark the incident scene, the position of injured persons and the maximum immersion/length of the applied search.

How should communication take place within the search and rescue team?

- Essential information must only be communicated to peers and operation leader
- Essential information must be communicated by mobiles to the whole team.
- Essential information must be communicated to the peer, subsequent squad leader and operation leader.

When will you consider the search and rescue operation completed?

- When the entire tunnel and train have been cleared.
- When the vicinity to the train has been cleared.

- When all wagons have been cleared.

Which assessments will you make in order to decide the rescue route?

- I do not make any assessments; the rescue route is chosen by the subsequent squad leader.
- The rescue route is always at the right-hand side of the train in the direction of travel.
- I choose the rescue route based on accessibility to exit areas in dialogue with the subsequent squad leader.

What is the correct use of the green marker light?

- The light should be used to mark findings of injured persons.
- The light should serve the escape route to be used.
- The light should be used to mark water supply points and distributor.

What is the correct use of the blue marker light?

- The light should be used to mark findings of injured persons.
- The light should serve the escape route to be used.
- The light should be used to mark water supply points and distributor.

Apart of the standard fire protection equipment, which search and rescue equipment is essential?

- Thermal imagining camera (TIC), escape sets, stretcher
- Marking lights, search sticks and transport aids.
- Thermal imagining camera (TIC), search sticks, marking lights and transport aids.

What do you do when encountering persons in the tunnel?

- I report their position findings to the subsequent squad leader and guide them towards the nearest emergency exit.
- I report their position findings to the subsequent squad leader and point them towards the nearest emergency exit.
- I ask for additional resources to assist in evacuation.

Practical exam

With passing the practical examination with more than 65 % correct answers, the entire course is concluded. In order to adequately assess the learning outcomes of the practical training, adequate practical tasks have to be set based on the theory. The examination situation can be set up in the form of a simulation. Each participant is assigned to a fixed role in his training squad. The trainers have to pay attention to a fair assessment when conducting the examination and its assessment. For this purpose, two trainers per training squad (5 to 9 participants) must observe and assess the participants.

Parts of the practical examinatio

Topic with number and color code of the module			**Results**		
			not achieved	partly achieved	achieved
	1	Technical introduction to tunnel constructions	1 point	2 points	3 points
	2	Explanation of the technical and local conditions	1 point	2 points	3 points
	3	Safety in handling the used resources: Vehicles, equipments, and materials for tunnel operations and accident prevention	1 point	2 points	3 points
	4	Scientific basis for tunnel operations	1 point	2 points	3 points
	5	Tactical use of vehicles, equipments and materials for tunnel operations	1 point	2 points	3 points
	6	Types of operations in tunnel: a) rescue of people b) firefighting	1 point	2 points	3 points
	7	Special tactics for tunnel operations	1 point	2 points	3 points
	8	Training of special tactics in tunnel operations	1 point	2 points	3 points
	9	Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties	1 point	2 points	3 points
	10	Leadership skills in use – especially in tunnels spanning several countries	1 point	2 points	3 points
Sum of achieved points→					
Result • ≥ 20 points passed • < 20 points not passed					

ECVET assessment

ECVET to promote mobility and lifelong learning

The European Credit System for Vocational Education and Training (ECVET) is a technical framework for the crediting, recognition and, where appropriate, accumulation of learning outcomes achieved by an individual towards the acquisition of a qualification.[1] This is achieved in particular through the structured description of qualifications of learning outcomes, which allows greater transparency and better comparability in the field of VET through the use of a "common language", and through the structured processes and agreements between stakeholders, which form the basis for mutual trust.

The application possibilities of ECVET are particularly in the area of cross-border mobility of VET and in the area of lifelong learning:

- On the one hand, ECVET contributes to making the knowledge, skills and competences acquired in the context of cross-border mobility in VET visible and – based on their identification and assessment abroad – facilitating their recognition at home. This should make it easier to integrate learning experiences gained abroad into initial or continuing vocational education and training.
- On the other hand, ECVET can be used to make programmes and training paths leading to the acquisition of a qualification more flexible and to improve the framework conditions for lifelong learning. Thus, ECVET can facilitate the recognition of learning outcomes acquired by learners in different settings such as different countries, institutions or systems (e.g. education or training), in formal, non-formal and/or informal learning contexts.

[1] Recommendation of the European Parliament and of the Council of 18 June 2009 on the establishment of a European Credit system for Vocational Education and Training (ECVET).

Source: https://www.na-bibb.de/fileadmin/user_upload/na-bibb.de/Dokumente/02_Berufsbildung/01_Mobilitaet/08_ECVET/Implementing_ECVET.pdf (last acccessed on 08.02.2021)

Evaluation of the training

1. Blended learning acitvity:

   A period of three teaching units (45 minutes each) is estimated as a preparation for the actual course. This calculation includes the multiple, concentrated viewing of the training films, the detailed reflection on the necessary steps in case of incidents in railway tunnels as well as answering the multiple-choice questions.

2. Face-to-face training:

The three-day classroom training includes all mentioned learning units and the practical examination. According to the inserted timetable, all teaching units are required for the passing the examination.

With the positive completion of the practical examination, the course *Basic vocational education and training for firefighting squads – Firefighting in railway tunnels* is completed.

This training is assessed with one ECVET point.

Certificate

Each participant will receive a certificate after passing both parts of the examination. The following points must be mentioned on the certificate:

Co-funded by the
Erasmus+ Programme
of the European Union

Certificate of attendance

Course:	Basic vocational education and training for firefighting squads – Firefighting in railway tunnels
Place of training:	e.g. Landes-Feuerwehrschule Tirol, Telfs
Date:	e.g. 2nd of April, 2020
Name of participant:	e.g. Gerhard Schöpf
Place of employment:	e.g. Fire brigade Silz
ECVET points:	1

Learning Outcome:

The participant knows:

- the operational tactics for incidents in railway tunnels.
- the basics of breathing protection related to incidents in tunnels.
- the procedure for entering and working in a track area and in railway tunnel, generally.

The participant will be able to:

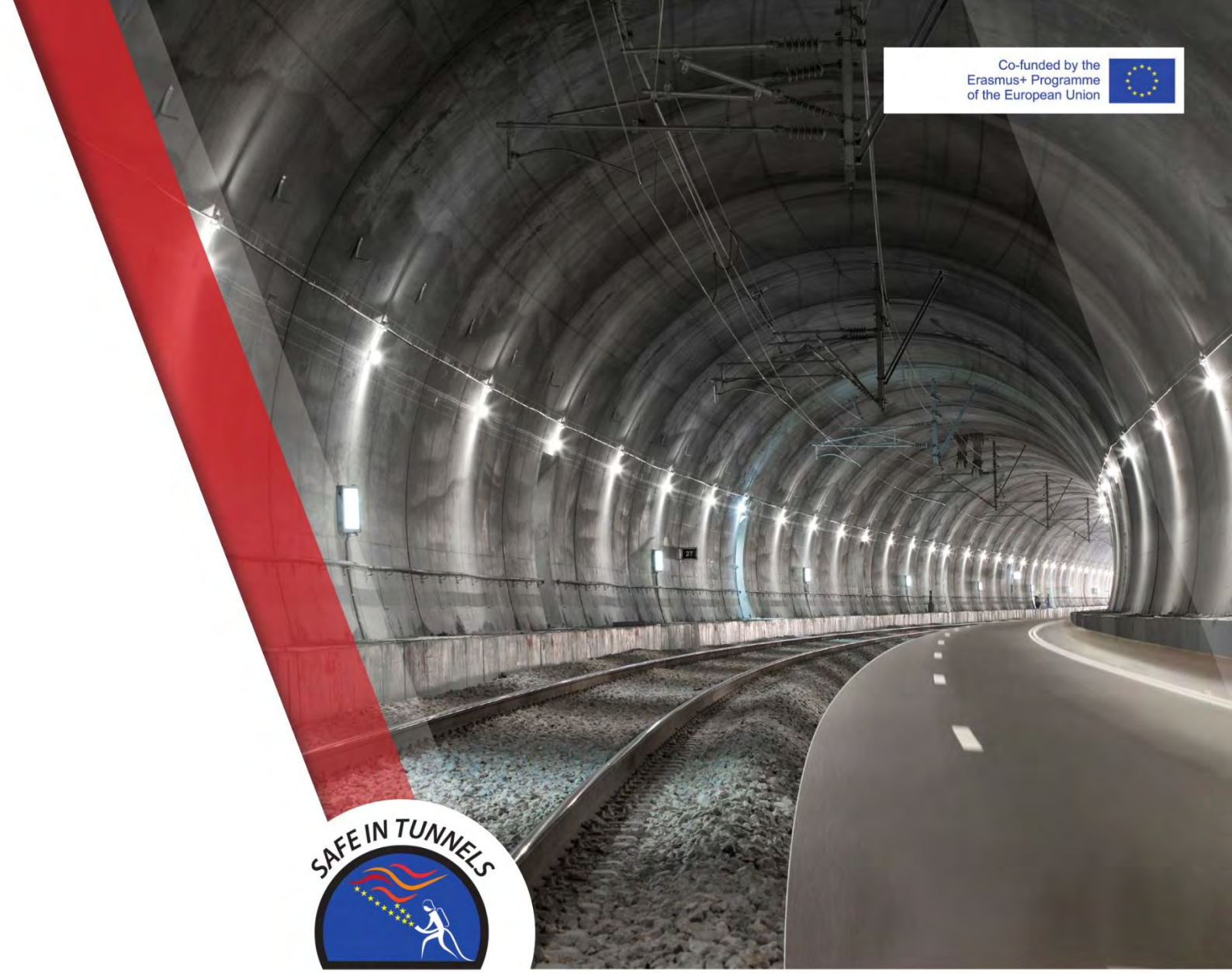
- explore a railway tunnel.
- carry out adequate firefighting measures.
- lay hose lines in a railway tunnel.
- carry out a systematic search and rescue in a railway tunnel.
- use tactical equipment (marker lights, search sticks and thermal imaging cameras).

The participant masters:

- planning emergency measures, taking into account the advantages and disadvantages of the up- and downstream of the air flow.
- assessing emergency measures, of the incident and hazards for him/her/others.
- spatial orientation in a tunnel system.
- the guidance of a search and rescue team under conditions of poor visibility.
- the recognition of hazards.
- the recognition of a possible fire propagation.
- the definition of his/her operational limits (max. penetration depth, fires with hazardous materials, etc.).

Signature: confirmation (stamp, signature) of the educational institute

Co-funded by the
Erasmus+ Programme
of the European Union



SAFEINTUNNELS

European vocational education and training guideline for operational leaders in road and railway tunnels

Table of content

Co-funded by the
Erasmus+ Programme
of the European Union

European vocational education and training for firefighters in railway tunnels

Introduction

Fires in road and rail tunnels are among the most demanding and complex tasks faced by fire and rescue services. Long single-tube two-way tunnels with large gradients and no emergency exits other than the tunnel portals place high demands on the emergency services. Although fires in tunnels are not a common phenomenon, fire and rescue services have to deal with such incidents when they occur. It is important to stress that a fire in tunnels can have serious consequences, often more serious than would have been the case in an open road fire.

The safety level of tunnels is determined, among other things, by the tunnel construction, the safety equipment and the capabilities of the emergency services. Changes in the road network, heavy traffic, traffic behaviour and traffic patterns pose new challenges for fire and rescue services. In order to respond satisfactorily to incidents in tunnels, emergency services must be equipped with sufficient knowledge and skills.

Emergency situations in tunnels require managers who are able to analyse the situation and make critical decisions under time pressure, preferably based on a set of rules. In general, personnel in a managerial position should act quickly and use their accumulated experience and knowledge to interpret the current situation. Interpretation is crucial to the decisions made to act and the outcome of the situation. Lack of knowledge can increase the likelihood of perceiving danger signals too late, misinterpreting available information and consequently taking inappropriate action decisions. High competencies in the form of experience, training and education are important factors that influence human behaviour and decisions in situations that have to be taken due to time pressure. The targeted enhancement of competences can increase the intervention in case of fire incidents in tunnels.

SAFEINTUNNELS is an Erasmus+ funded programme that aims to support the development of a standardised training programme for first responders involved in rescue and firefighting units in road and railway tunnels. The Recommendation for the Framework of European Professional Education and Training for Operational Leaders in Road and Rail Tunnels aims to enable personnel in leading positions to adequately manage emergency situations in tunnels. The training programme is tailored to emergency managers in fire and rescue services involved in emergency management.

Vocational education and training path

A basic vocational education and training for firefighting in tunnels should be possible in every firefighting school. There are several possibilities to simulate situational aspects, e.g. a tunnel section could be erected on the training ground, high fences can be used to simulate the narrow space conditions, poor visibility could be simulated with special respiratory equipments.

The general vocational education and training depends on the area of operation (squad member, incident commander, or instructor).

- **Basic vocational education and training for firefighters**

  Basic vocational education and training requires the completion of basic firefighting training and the authorition of using breathing protection.

- **Basic vocational education and training for firefghting squads – firefighting in railway tunnels**

  The aim of this vocational education and training is to enable the participants to apply a standardized procedure for incidents in railway tunnels, to implement the necessary measures and to make appropriate situational decisions.

- **Basic vocational education and training for firefighting squads – firefighting in street tunnels**

  The vocational education and training is similar to the programme for firefighting in railroad tunnels, but it refers to the conditions in a road tunnel. However, the vocational education and training path is the same.

- **Vocational education and training for fire chiefs in firefighting incidents in tunnels**

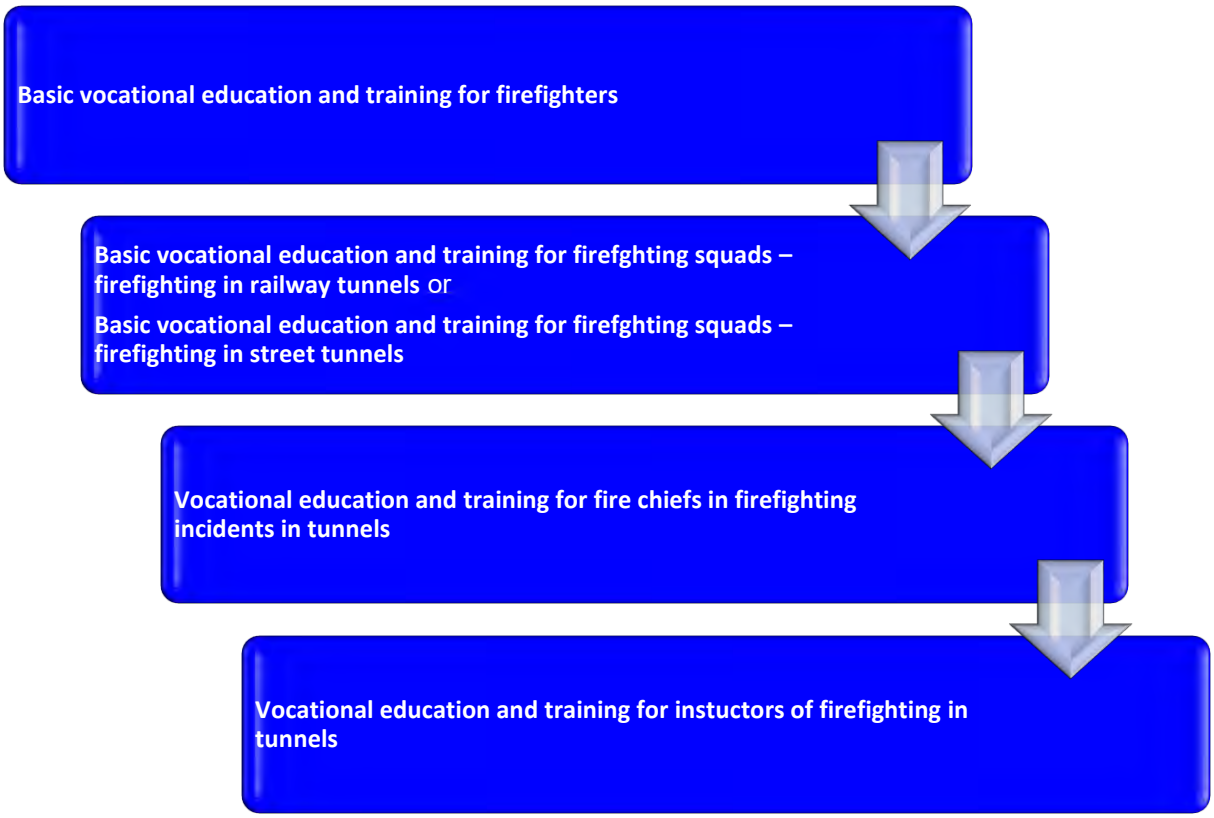
  The aim of this training is to prepare commanders for firefighting incidents tunnels. The training builds on the basic vocational education and training. However, it focuses on command and control, communication, and the tactical decision-making.

- **Vocational education and training for instuctors of firefighting in tunnels**

- The instructor or trainer has probably the most important role for the dissemination of the standardized learning units. Therefore, it focuses on didactic approachs Each

participant will expand his/her pedagogical knowledge and will learn different simulation possibilities. This document describes the basic training for firefighting in railroad tunnels. It was developed within the Erasmus+-project "SAFEINTUNNELS – Traveling safe through Europe – Training and education for firefighting in tunnels" funded by the European Commission.

The consecutive education path



European vocational education and training for operational leaders in road and railway tunnels

The programme is a step-by-step, module-based training concept that sets requirements to the participants' prior knowledge in terms of completed basic vocational education and training for firefighters in road or/and railway tunnels.

The European vocational education and training for operational leaders in road and railway tunnels is a three-day training programme consisting of theoretical lectures and practical

exercises. Prior to initiation of the training programme, the participants shall receive the program and the literature list. It is recommended that the participants have knowledge of the suggested literature. Additionally, the participants shall be physically present during all three days of training and actively participate in the practical exercises and group discussions during theoretical lectures and table-top exercises.

Day 1 starts with registration of the participants and presentation of the project. Prior to the initiation of the training programme, the participants shall evaluate their knowledge and competence in tunnel fire safety based on an evaluation form (see document "Self-evaluation form prior to the course"). Afterwards, the day continues with theoretical lectures. Further, the second part of the day continues with practical exercises arranged under conditions that are as realistic as possible. How the practical exercises shall be arranged, is up to the individual fire department and its access to resources and training facilities. The instructors shall use two evaluation forms (see documents "Evaluation form for operational leader in tunnel operations" and "Evaluation form for incident commander in tunnel operations"). In order to pass the practical exercises, the participants must achieve respectively ≥ 35 points for operational leaders and ≥ 37.5 for incident commanders.

Day 2 starts with registration of the participants and reflections from day 1. Further, similar to the first day, the training programme continues with theoretical lectures. The second part of the day consists of table-top exercises presenting traffic accident and smoke development in single and dual-tube tunnel and fire in vehicle in single and dual-tube tunnel. The table-top exercises are arranged in classrooms and the participants shall be divided in two groups consisting of 6 participants each. Two instructors shall follow-up each group and stimulate the participants through guidance that provides progress and new challenges. After each exercise, the instructors shall set aside time so that the participants present their experiences in plenary – a first impression evaluation. This will provide a basis for a more comprehensive evaluation. Finally, the participants shall be evaluated using two evaluation forms (see document "Evaluation form for operational leaders in tunnel operations" and Evaluation form for incident commanders in tunnel operations"). In the context of table-top exercises, the instructors shall not register points. The evaluation forms shall be used as didactical tools to ensure systematic guidance and feedback.

Day 3 starts as the second day with registration of the participants and reflections from day 2. Further, the training programme continues with theoretical lectures. The second part of the day consist of table-top exercises presenting fire in lorry in single and dual-tube tunnel and fire in

lorry loaded with dangerous goods in single and dual-tube tunnel. The table-top exercises shall be arranged and evaluated as previously described in this chapter. Finally, the participants shall evaluate their knowledge and competence in tunnel fire safety based on an evaluation form (see document "Self-evaluation form after the course"). Submitted answers shall be compared to answers reported in the self-evaluation form prior to the course. The purpose is to map the participants' opinions, as well as the extent to which the training programme makes a concrete contribution to competence development.

Training modules

Based on the roles and responsibilities of first responders involved in emergency response management in tunnels, as well as completed basic vocational education and training for firefighters in road or/and railway tunnels, the following modules are emphasized with the corresponding European Qualification Framework Level (EQF):

Module 1: Technical introduction to tunnels construction – Tunnel infrastructure – EQF5

Module 2: Explanation of technical and local conditions – EQF5

Module 3: Safety in handling the use of resources: Vehicles, equipment and materials for tunnel operation and accident prevention – Safety – EQF5

Module 4: Scientific basis for tunnel operations – Airflow direction and Tunnel fire ventilation – EQF5

Module 7: Special tactics for tunnel operations – Explore road tunnels (railway tunnels) – EQF5

Module 9: Leadership skills in use – Basic communication and Operational commando – EQF5

All modules are further described in learning units structured as follows:

- Course name
- Module
- Title of learning unit
- Prerequisites
- Duration
- Number of participants
- Number of instructors
- Evaluation
- EQF-level

- Learning goals
- Learning outcomes
- Didactical tools
- Requirements
- Teaching method
- Protective equipment
- Equipment

In this context, it is essential to emphasize that the teaching method used is the responsibility of the instructors and/or the educational institution. The aim of this programme is to contribute to the establishment of a vocational training concept with validated and recognized learning goals and outcomes for operational leaders in street and railway tunnels that are transferable across national borders.

Co-funded by the
Erasmus+ Programme
of the European Union

Course program and curricula for European vocational education and training for operational leaders in road and railway tunnels

Day 1

*	Uhrzeit	Thema	Location / Instructor
	08:00 – 08:15	Registration and presentation of the project	Classroom Instructor
	08:15 – 08:30	Self-evaluation prior to the course	Classroom Instructor
	08:30 - 09:15	Systematic fire safety prevention work in tunnels	Classroom Instructor
	09:15 - 10:00	Tunnels' construction and technical installations	Classroom Instructor
	10:00 – 10:15	Break	
	10:15 - 11:00	Tunnels' construction and technical installations	Classroom Instructor
	11:00 - 11:30	Lunch	
	11:30 - 12:00	Transport to training facility	
	12:00 – 14:00	Presentation of scenario 1 and clarification of roles and activities	Training ground Instructor
	14:15 - 14:15	Break	
	14:15 – 16:15	Presentation of scenario 2 and clarification of roles and activities	Training ground Instructor

Day 2

*	Uhrzeit	Thema	Location / Instructor
	08:00 – 08:45	Tunnel fire response operations and safety	Classroom Instructor
	08:45 – 09:00	Break	
	09:00 - 09:45	Tunnel fire response operations and safety	Classroom Instructor
	09:45 - 10:00	Break	
	10:00 – 10:45	Tunnel fire ventilation	Classroom Instructor
	10:45 - 11:00	Break	
	11:00 – 11:45	Tunnel fire ventilation	Classroom Instructor
	11:45 - 12:15	Lunch	
	12:15 - 13:00	Table-top exercise – Traffic accident and smoke development in single tube tunnel	Training ground Instructor
	13:00 - 13:15	Break	
	13:15 - 14:00	Table-top exercise – Fire in vehicle in single tube tunnel	Training ground Instructor
	14:00 - 14:15	Break	
	14:15 – 15:00	Table-top exercise – Traffic accident and smoke development in dual tube tunnel	Training ground Instructor
	15:00 - 15:15	Break	
	15:15 – 16:00	Table-top exercise – Fire in vehicle in dual tube tunnel	Training ground Instructor

Day 3

*	Uhrzeit	Thema	Location / Instructor
	08:00 – 08:45	Reflections from yesterday	Classroom Instructor
	08:45 – 09:00	Break	
	09:00 - 09:45	Operational management in tunnels	Classroom Instructor
	09:45 - 10:00	Break	
	10:00 – 10:45	Human behaviour in crisis	Classroom Instructor
	10:45 - 11:00	Break	
	11:00 – 11:45	Table-top exercise – Fire in lorry in single tube tunnel	Classroom Instructor
	11:45 - 12:15	Lunch	
	12:15 - 13:00	Table-top exercise – Fire in lorry loaded with dangerous goods in single tube tunnel	Training ground Instructor
	13:00 - 13:15	Break	
	13:15 - 14:00	Table-top exercise – Fire in lorry in dual tube tunnel	Training ground Instructor
	14:00 - 14:15	Break	
	14:15 – 15:00	Table-top exercise – Fire in lorry loaded with dangerous goods in dual tube tunnel	Training ground Instructor
	15:00 - 15:30	Self-evaluation after the course	Training ground Instructor
	15:30 – 16:00	Evaluation of the course	Training ground Instructor

Recommended literature:

- Directive 2004/54/EC of the European Parliament and of the Council on minimum safety requirements for tunnels in the Trans-European Road Network (s. 59-91).
- National regulations for safety management in tunnels (e.g. laws, regulations, handbooks, etc. – must be adapted to national conditions).
- Firefighting strategies and tactics - must be adapted to national manuals.
- Contingency plans for tunnels (e.g. specific high-risk tunnels located in the fire department's area of responsibility – must be adapted to local conditions).
- Object plans for tunnels (e.g. specific high-risk tunnels located in the fire department's area of responsibility – must be adapted to local conditions).
- Kim, H.K., Lönnermark, A. & Ingason, H. (2010). Effective Firefighting Operations in Road Tunnels. SP Technical Research Institute of Sweden.
- Bergqvist, A. (2003). What can the fire brigade do about catastrophic tunnel fires? (s.161-175). Proceedings of the International Symposium on Catastrophic Tunnel Fires.
- Flin, R., O'Connor, P., Crichton, M. (2008). Situation awareness (s.17-40). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Flin, R., O'Connor, P., Crichton, M. (2008). Decison-making (s.41-68). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Flin, R., O'Connor, P., Crichton, M. (2008). Communication. (s.69-92). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Martens, M.H, Jenssen, G.D. (2012). Human behaviour in tunnels. What are further steps to take? (s.69-85). Proceedings from the Fifth International Symposium on Tunnel Safety and Security. New York, USA.
- Kinateder, M., Pauli, P., Müler, M., Krieger, J., Heimbecher, F., Rönnau, I., Bergerhausen, U., Vollmann, G., Vogt, P. & Mühlberger, A. (2013). Human behaviour in severe tunnel accidents: Effects of information and behavioural training. (s.20-32). Transportation Research Part F.

Course structure

Day 1

Module 1 and 2:

- Technical introduction to the tunnel's construction: Tunnel infrastructure
- Explanation of the technical and local conditions: Basics – Communication technical and Water supply

Literature:

- Directive 2004/54/EC of the European Parliament and of the Council on Minimum Safety Requirements for Tunnels in the Trans-European Road Network (pp. 59-91).
- National regulations for safety management in tunnels (e.g., laws, regulations, handbooks, etc. – must be adapted to national conditions).
- Contingency plans for tunnels (e.g., specific high-risk tunnels located in the fire department's area of responsibility – must be adapted to local conditions).
- Object plans for tunnels (e.g., specific high-risk tunnels located in the fire department's area of responsibility – must be adapted to local conditions).

Theoretical lectures – Part I

Topic: Systematic fire safety prevention work in tunnels (45 min)

- Laws and regulations
- Planning, construction, operation and maintenance phase
- Inspection – a tool to prevent tunnel fire and its consequences
- Tunnel – special fire object
- Regulations related to fire prevention – risk related to tunnel fires

Topic: Tunnels' construction and technical installations (90 min)

- The tunnel's safety measures
- Planning and construction phase
- Know your tunnel (object plans and contingency plans)
- Limitations and opportunities for road-users

Role-play exercises - Part II

Instructors: 3

What is a role-play exercise?

A role-play exercise consists of two main elements: the practicing group and an opposing group. The practicing group enter roles that are as close as possible to their responsibilities and professional tasks. A role-play exercise implies that the participants can be located at their regular posts and act in roles, as they would have done in real situations. The participants are often located in their traditional contexts, with aids they normally have available in real situations. The counterplay is located in other rooms, and controls the exercise based on a list of inputs. One may say that an input is a message or a scenario that is conveyed from someone (instructor) to the practicing group. The inputs are communicated to the participants through channels used in emergency situations. After receiving the inputs, the participants must react and make decisions as he/she would have done in a real situation. For instance, if a decision requires clarification with another actor in real life settings, the participants must act similar in the exercise.

The participants in role-play exercises are typically personnel in leading roles at the incident scene. The participants shall be divided in two groups with different roles and responsibilities: one group representing operational leader and smoke divers carrying out tasks inside the tunnel and the other group representing incident commander and leader support carrying out tasks outside the tunnel.

The purpose of such an exercise form is to:

- Increase the participants' ability to handle incidents in tunnels, focusing on coordinated information.
- Highlight the complexity related to decision-making and responsibilities in case of incident in tunnels.
- Test contingency plans and procedures and create a basis for further development.
- Test and develop collaboration within the organisation, as well as with other emergency actors.

The overall learning goal must be extensive, concrete and possible to evaluate. The main goal must relate to improving emergency response management in tunnels and developing the quality of services offered by the fire department. The overall learning goal should be divided into concrete sub-goals which are possible to evaluate. The participants should be evaluated based on two evaluation forms (see attached documents: "Evaluation form for operational leader in tunnel operations" and "Evaluation form for incident commander in tunnel

operations").

The main goal of the exercise:

Leaders at the incident scene must be able to tackle their tasks - focusing on collaboration and communication between the emergency response actors (health, police, emergency centrals and road traffic operators) in the various emergency response phases (alarm, en-route, size-up and response) of tunnel fire response operations.
The sub-goals should specify the main goal of the exercise. The sub-goals must be concrete and possible to evaluate.

Sub-goals of the exercise:

- Incident scene leaders must handle information gathering → obtain relevant information and communicate situation report.
- Incident scene leaders must process available information → interpret acquired information and conduct risk assessments.
- Incident scene leaders must identify possible measures → resource needs and determine the goal for the response operation.
- Incident scene leaders must implement measures → make tactical choices, allocate resources and organize the incident scene.
- Incident scene leaders must communicate and collaborate → communicate status report and collaborate.
- Incident scene leaders must create resilience → plan resources and identify critical factors.
- Incident scene leaders must follow-up implemented measures → evaluate and eventually adjust measures.

The scenario

The selected scenario must facilitate the achievement of the main and sub-goals of the exercise. The scenario must be realistic and facilitate learning and competence development. It is essential that the participants possess knowledge of the curriculum and the necessary skills to fulfil their role in the exercise.
The structure of the scenarios should emphasize:

- From normal situation to the incident
- Coping with the incident

The layout for the exercises:

Scenario 1: Vehicle fire in single tube tunnel (2 hours)

- Part 1: Presentation of the scenario
- Part 2: Carrying out the exercise
- Part 3: Debrief and evaluation of the exercise

Scenario 2: Vehicle fire in dual-tube tunnel (2 hours)

- Part 1: Presentation of the scenario
- Part 2: Carrying out the exercise
- Part 3: Debrief and evaluation of the exercise
- Part 4: Organizing the equipment

Preparation of equipment:

- Communication radios
- Smoke machine
- Fire vehicles (2 pcs.)
- The incident commander does not need a car
- Markers (5 pcs.)
- Protective equipment, respiratory protection and breathing air

Both scenarios are based on one type of incident – Vehicle fire in tunnel. The first scenario unfolds in single tube tunnel and the second in a dual-tube tunnel. After the participants are notified about the incident, two crew vehicles and an incident commander shall be mobilized and be on their way to the incident scene. In this phase, it is essential that the leaders seek to create a common understanding of the situation and that the acquired information is communicated clearly to the first responders. To construct a correct picture of the situation, it is expected that leaders continuously strive to obtain key information. Although the scenarios have similar layouts, different approaches are required. Among other things, differences related to the tunnel's design, technical installations and traffic volume should be considered. The purpose is to confront the participants with challenges related to communication and

interaction in both single- and dual-tube tunnels. In order to create challenges related to logistics and communication between emergency operators and incident commander, several markers should be involved.

One instructor should play the role of the emergency operator and traffic operator. During the exercises, each leader should be followed-up by an instructor. In order to provide a thorough and systematic feedback and identify potential weaknesses, the instructors should take notes during the exercises in two separate evaluation forms (see attached documents – "Evaluation form for operational leader in tunnel operations" and "Evaluation form for incident commander in tunnel operations"). The forms should be the starting point for the feedback to the participants in a joint evaluation. The evaluation should emphasise operational management and constructive feedback. In order to pass the exercises, the participants must respectively achieve ≤ 35 points for operational leaders and ≥ 37.5 for incident commanders.

General clarifications:

- The participants shall wait 5 minutes after receiving the incident notification
- The incident commander shall hold distance from the tunnel portal so that he/she will lack overview of the situation outside the tunnel
- The incident commander shall organize the commando scene
- The participants shall only use the areas introduced by the instructors
- The light in the training facility shall be switched off
- To create poor visibility, the training facility shall be filled with smoke
- Markers and vehicles shall be placed in the roadway with a good distance between each other
- The participants shall use the equipment available in the fire vehicles
- The participants shall use protective equipment and respiratory protection with breathing air
- Markers shall be rescued to open area (remember to use correct lifting technique)

Scenario 1: Vehicle fire in single tube tunnel

Notification of fire in vehicle in a single tube tunnel. Two vehicles have collided with each other and one of the vehicles has started to burn. At this time, several vehicles are located downstream from the fire scene. Further, several road-users have been observed sitting in

their vehicles. For this scenario, both fire vehicles shall use the same tunnel portal as the attack route. Both vehicles arrive at the tunnel portal simultaneously, and the leader organize the personnel and the resources. The incident commander arrives 2 minutes after the personnel and is not in physical contact with the operational leader. The commando scene shall be organized with necessary distance from the tunnel portal, so that the situational overview at the tunnel portal is lacking. The communication takes place on radio in a common voice channel.

The alarm en-route phase: Call-out at 16:00

- Notification of vehicle collision in singe tube tunnel, one person is trapped in the vehicle - direction XXX
- Triple notification to all emergency centrals is made and a common communication channel is established
- Fire vehicles XXX are sent to the incident scene
- Fire vehicles report arrival

The size up phase: Key information (incident scene factors) expected to be requested from the operational leader at the incident scene.

- The incident occurs approximately XXX meters inside the tunnel
- The driver notifies the emergency center
- Situational report from the emergency center is given
- The fire ventilation is activated – direction XXX
- The tunnel is closed according to the procedure
- The trapped person is not in the burning vehicle
- High risk of fire escalation
- The tunnel does not have surveillance camera
- Several road-users are sitting in their vehicles downstream from the fire scene
- Operational leader seeks to create a common understanding of the situation on the way to the incident site

The response phase: Arrival at the incident site

- Situational report upon the arrival in common communication channel is provided
- Immediate measures are implemented

- Overview over the situation is provided (contacts the vehicle driver)
- Operational goal and tactical plan are established
- Risk factors for first responders are assessed
- Operational leader reports to incident commander
- Incident commander reports to operational leader
- Incident commander establishes the commando scene and organizes the incident scene
- Incident commander requests additional resources and leader support
- Incident commander makes sector division and draws sketch
- Incident commander is responsible for logistics and clarifies gathering place for potential victims and requests additional resources

Scenario 2: Vehicle fire in dual tube tunnel

Notification of fire in a dual tube tunnel. Two vehicles have collided with each other and one of the vehicles has started to burn. At this time, several vehicles are located downstream from the fire scene. Further, several road-users have been observed sitting in their vehicles.
For this scenario, the first vehicle shall use the tunnel portal upstream as the attack route. Personnel in the second vehicle start search and rescue through cross section after the fire has been extinguished/under control. The commando scene shall be organized by the incident commander without having an overview of the tunnel portal. The communication takes place on radio in a common voice channel.

The alarm en-route phase: Call-out at 08:00

- Notification of vehicle collision in dual tube tunnel, one person is trapped in the vehicle - direction XXX
- Triple notification to all emergency alarm centrals is made and a common voice channel is established
- Fire vehicles XXX are sent to the incident scene
- Fire vehicles report with a message

The size up phase: Key information (incident scene factors) expected to be requested from the operational leader at the incident scene.

- The incident occurs approximately XXX meters inside the tunnel
- The RTC (Road Traffic Center) has been notified through emergency call station inside the tunnel
- The tunnel is closed according to the procedure for fire in vehicle
- Situational report from the RTC is given
- The fire ventilation is activated – direction XXX
- The trapped person is not in the burning vehicle
- High risk of fire escalation
- Cross section number to approach the incident site
- The RTC and the emergency center report poor visibility from the cameras
- RTC has broadcasted information on radio
- Several road-users are sitting in their vehicles downstream from the fire scene
- Operational leader seeks to create a common understanding of the situation on the way to the incident site

The response phase: Arrival at the incident scene

- Situational report upon the arrival in common communication channel is given
- Immediate measures are implemented
- Overview over the situation is provided (contact the vehicle driver)
- Operational goal and tactical plan are established
- Risk factors for first responders are assessed
- Operational leader reports to incident commander
- Incident commander reports to operational leader
- Incident commander establishes the commando scene and organizes the incident scene
- Incident commander requests additional resources and leader support
- Incident commander makes sector division and draws sketch
- Incident commander is responsible for logistics and clarifies gathering place for potential victims and requests additional resources

Evaluation form for operational leader in tunnel operations

Operational leader:	Points
Ensured common understanding of the "callout" in the vehicle	
Ensured confirmation of procedures from the Road Traffic Centre	
Gathered information through emergency/traffic operator	
Sent situational report in common communication channel upon the arrival	
Gathered information through the vehicle driver	
Immediate measures implemented? If yes… efficient and safe?	
Made 360; read the incident, assessed risks and drew correct conclusions	
Ordered according to: operational goal (OG) - tactical plan (TP) • We must rescue • First… Then …	
Is it likely that the OG and the TP created a common mental model among first responders?	
Sent situational report to emergency center	
Used available information (orientation plan, object plan, etc.)	
Adaptability (Does the measures work – offensive/defensive)	
Conveyed information clearly and concisely to incident commander	
Overall impression	
Maximum score 70	

Numerical grades are set from 1 to 5 for each item, where 1 is the lowest and 5 the highest.

Comments:

Passed:		Failed:	

Date:	Time:
Sensor 1:	Sensor 2:

Passed: ≤ 35 points
Failed: ≥ 35 points

Evaluation form for incident commander in tunnel operations

Incident commander:	Points
Ensured common understanding of the "callout" in the vehicle	
Ensured confirmation of procedures from the Road Traffic Centre	
Established and organized the commando scene upon the arrival	
Read the incident, assessed risks and drew correct conclusions	
Gathered information through operational leader	
Communicated and collaborated	
Sector division	
Logistics – assessed resources, mobilized resources	
Assessed the effect of measures based on: operational goal (OG) - tactical plan (TP) • Are we handling the situation correctly? • Are the needs covered?	
Assessed corrective measures	
Sent situational report to emergency center	
Used available information (orientation plan, object plan, etc.)	
Dynamic thinking and the likelihood of potential scenarios	
Conveyed information clearly and concisely to operational leader	
Overall impression	
Maximum score 75	

Numerical grades are set from 1 to 5 for each item, where 1 is the lowest and 5 the highest.

Comments:

Passed:		Failed:	

Date:	Time:
Sensor 1:	Sensor 2:

Passed: ≤ 37.5 points
Failed: ≥ 37.5 points

Day 2

Module 3 and 4:

- Safety in handling the resources used: vehicles, equipment and materials for tunnel use and the accident prevention: Safety
- The scientific basis for tunnel operations: Airflow direction and Tunnel fire ventilation

Literature:

- Firefighting strategies and tactics - must be adapted to national manuals.
- Kim, H.K., Lönnermark, A. & Ingason, H. (2010). Effective Firefighting Operations in Road Tunnels. SP Technical Research Institute of Sweden.
- Bergqvist, A. (2003). What can the fire brigade do about catastrophic tunnel fires? (s.161-175). Proceedings of the International Symposium on Catastrophic Tunnel Fires.

Theoretical lectures – Part I

Topic: Tunnel fire response operations and safety (90 min)

- Opportunities and limitations for response operations
- How to be best prepared?
- HSE and risk for first responders

Topic: Tunnel fire ventilation (90 min)

- Purpose of the ventilation
- Smoke development and ventilation in different types of tunnels
- Risk of fire ventilation
- Changing the ventilation direction during response operations

Table-top exercises – Part II

Instructors: 3

What is a tabletop exercise?

A tablet-top exercise is a form of exercise where the participants are gathered in a room, where all communication takes place. The inputs are given orally or on paper/screen. No measures

shall be physically implemented, and no contact shall be made outside the room. The participants shall not play/simulate roles in crisis management but discuss specific and generic issues related to the presented scenarios. The purpose of such method is to allow the participants to arrive, through discussions and dialogue, at the best practice to solve a particular problem, and thus, gain a better understanding of their own and other roles.

The purpose with this form of exercise is to:

- Increase knowledge of plans and procedures
- Identify potentially different understandings and use of plans and procedures
- Identify responsibilities and role understandings

The focus is not to identify failures made by participants or make them acquainted with a fix answer solution. Instead, the focus is on what had been done and why. The aim is simply to understand the judgements and assessments made during responses and to scrutinize the rationale behind the decisions made. To increase the learning potential from the experiences, the instructors shall introduce new challenges and unexpected moments challenging the participants to think "what if…". This way of sharing experiences and discussing responses has proved to be highly valuable to achieve learning.

The development of scenarios shall incorporate risk and uncertainty management as core issues. Uncertainty shall be conceptualized, and the participants shall be challenged on how to respond to situations that are abnormal to them. By emphasizing the participants approaches to assess risks, it may reveal strength and weaknesses and their approaches to responding to incidents may be improved. Further, this may contribute to develop the participants' capability to cope with abnormal, complex and highly uncertain situations.

Evaluating responses and common practices is necessary if one is to challenge the rationale behind of the current approaches to incidents. By critically analysing responses and questioning the established knowledge and practice, the participants will be able to evaluate if they are performing at the highest standard. Reflective practitioners are better to evaluate the rationale of common practices and to maintain a higher level of competence. The participants shall be evaluated based on two evaluation forms (see previously attached documents: "Evaluation form for operational leader in tunnel operations" and "Evaluation form for incident commander in tunnel operations"). In this context, the instructors shall not calculate points. The evaluation forms shall rather be used as didactic tools to ensure a systematic guidance and feedback.

In table-top exercises, one does not need to formulate goals, but shall rather focus on

formulating the purpose of the exercise. Table-top exercises can have several purposes which may be combined. The main reason why one does not need to formulate exercise goals for table-tops is that such an exercise form is not particularly suitable for practicing abilities. The participants are not always staffed or organized as they would normally have been in a real situation. The scenarios are not written with the purpose to engage the participants in actions, but to encourage discussions related to various issues.

The purpose of the exercises:

- Identify potential ambiguities related to roles in case of incidents in tunnel
- Identify potential ambiguities related to allocation of responsibility in case of incidents in tunnel
- Discuss possible issues related to coping with incidents in tunnels
- Discuss possible issues related to the current practices to cope with incidents in tunnels
- Discuss challenges related to communication and collaboration in case of incidents in tunnel

The exercises shall focus on personnel with operational management tasks at the incident scene. The purpose with the table-top exercises is to cover key issues and contribute to competent practitioners that are able to succeed in their work tasks. The participants shall be divided in two groups with different roles and responsibilities: one group representing the operational leaders carrying out tasks inside the tunnel and the other group representing incident commanders carrying out tasks outside the tunnel.

The participants

Table-top exercises do not get better than the participants' involvement and their reflections. The discussions between participants are the most important part of the exercises. Participants may contribute to good discussions through:

- Being well prepared
- Showing respect to other participants
- Engaging actively in discussions

The layout of the exercises:

Scenario 1: Traffic accident and smoke development in single-tube tunnel (45 min)

- Part 1: Introduction to table-top exercises

- Part 2: Presentation of the purpose of the exercise
- Part 3: Presentation of scenario and input
- Part 4: Discussion in groups and guidance
- Part 5: Evaluation

Scenario 2: Vehicle fire in single-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

Scenario 3: Traffic accident and smoke development in dual-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

Scenario 4: Vehicle fire in dual-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

Preparation of teaching material:

- Review of teaching method
- Preparation of scenario's theme and background
- Pictures and illustrations
- Maps and object plans
- Evaluation form for operational leader and incident commander in tunnel operations

General clarifications:

- The participants shall be divided in two groups with different roles and responsibilities in emergency situations
- The instructors introduce new moments
- The instructors correct potential errors or deviations

- The instructors assess the value of the discussions, and which of these shall be continued or interrupted
- The instructors ensure that all participants are involved in discussions
- The evaluation forms serve as a checklist for the various phases of the exercise

Scenario 1: Traffic accident and smoke development in single tube tunnel

Notification of traffic accident and smoke development in vehicle in XXX, direction XXX. Two vehicles have collided with each other approximately XXX km inside the tunnel, direction XXX. One person is trapped in the vehicle. The situation is unclear.

The alarm phase: Call-out at 16:00

- Traffic accident and smoke development in XXX
- RTC reports that two cars have collided with each other and smoke development in XXX. One person is trapped in the vehicle.
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- The incident occurs approximately XXX meters inside the tunnel, direction XXX
- Type of vehicle involved: diesel and electric
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- The emergency central reports that the person which is trapped is not in the burning vehicle
- The emergency central reports dense smoke development from the vehicle
- RTC reports that no vehicles are located downstream from the fire
- Health and police units are on their way to the incident scene
- RTC has broadcasted information on common radio channel

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.

The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 2: Vehicle fire in single tube tunnel

Notification of vehicle fire in XXX, direction XXX. The vehicle has stopped approximately XXX km from the tunnel portal, direction XXX. No vehicles are observed downstream from the fire.

The alarm phase: Call-out at 11:00

- Vehicle fire in XXX
- RTC reports smoke development in a van heading towards XXX, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- The van has stopped approximately XXX km inside the tunnel, direction XXX
- Type of vehicle involved: diesel
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- The driver has implemented necessary measures but was not able to extinguish the fire
- RTC reports that no vehicles are located downstream from the fire
- Health and police units are on their way to the incident scene
- RTC has broadcasted information on common radio channel

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.

The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader

- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 3: Traffic accident and smoke development in dual-tube tunnel

Notification of traffic accident and smoke development in vehicle in XXX, direction XXX. Two vehicles have collided with each other near cross section no. XXX. Several people are observed sitting in their vehicles and potentially trapped in smoke. At this point, several vehicles are inside the tunnel, downstream from the incident scene. RTC reports potential danger of the fire spreading. The situation is unclear.

The alarm phase: Call-out at 08:00

- Traffic accident and smoke development in XXX, direction XXX
- RTC reports that two cars have collided with each other and smoke development in XXX, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- Attack route: use portal XXX and arrive at the incident scene through cross section no. XXX
- Type of vehicle involved: diesel and electric
- The incident occurs near cross section no. XXX, direction XXX
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- RTC has broadcasted information on common radio channel
- RTC reports traffic jam inside the tunnel and that the fire has spread to other vehicles
- RTC reports that several people are sitting in the vehicles and are potentially trapped in smoke
- Health and police units are on their way to the incident scene

The en-route phase: it is expected that the leader seeks to create a common situational

understanding among first responders on the way to the incident scene. The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Clarifies distribution of resources with regards to road-users potentially trapped in smoke and the risk related to spreading of the fire
- Lifesaving work has first priority

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 4: Vehicle fire in dual-tube tunnel

Notification of vehicle fire in XXX, direction XXX. The vehicle has stopped near cross section no. XXX. Owner and passengers of the burning vehicle have evacuated the tunnel. No vehicles are observed downstream from the fire.

The alarm phase: Call-out at 08:00

- Vehicle fire in XXX
- RTC reports smoke development from vehicle in XXX, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- Attack route: use portal XXX and arrive at the incident scene through cross section no. XXX
- Type of vehicle involved: diesel
- The incident occurs near cross section no. XXX, direction XXX
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- RTC has broadcasted information on common radio channel
- RTC reports that no vehicles are located downstream from the fire
- RTC reports that owner and passengers of the vehicle have evacuated the tunnel
- Health and police units are on their way to the incident scene

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene. The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Day 3

Module 7 and 9:

- Special tactics for tunnel operations: Explore – Road tunnels
- Leadership in operations: Basic communication and Operational command

Literature:

- Flin, R., O'Connor, P., Crichton, M. (2008). Situation awareness (s.17-40). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Flin, R., O'Connor, P., Crichton, M. (2008). Decison-making (s.41-68). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Flin, R., O'Connor, P., Crichton, M. (2008). Communication. (s.69-92). In Safety at the sharp end – a guide to non-technical skills. CRC Press.
- Martens, M.H, Jenssen, G.D. (2012). Human behaviour in tunnels. What are further steps to take? (s.69-85). Proceedings from the Fifth International Symposium on Tunnel Safety and Security. New York, USA.
- Kinateder, M., Pauli, P., Müler, M., Krieger, J., Heimbecher, F., Rönnau, I., Bergerhausen, U., Vollmann, G., Vogt, P. & Mühlberger, A. (2013). Human behaviour in severe tunnel accidents: Effects of information and behavioural training. (s.20-32). Transportation Research Part F.

Theoretical lectures – Part I

Topic: Operational management in tunnels (45 min)

- Strategic decision-making models and processes
- Operational management of incident in tunnels vs. other objects
- Information basis and decision-making
- Establishing effective operational management

Topic: Human behaviour in tunnels (45 min)

- Human behaviour in crisis
- Different types of human behaviour in tunnels (normal situation and fire)
- Implications of human behaviour for response operations

Tabletop exercise – Part II

Discussion-based exercises which gather the participants in a room (around a table) and encourage to reflect around relevant tunnel fire safety issues. The exercises shall focus on personnel with operational management tasks at the incident scene. The purpose with table-top exercises is to cover key issues and contribute to development of competent practitioners that are able to succeed in their work tasks. The participants shall be divided in two groups with different roles and responsibilities: one group representing the operational leaders carrying out tasks inside the tunnel and the other group representing incident commanders carrying out tasks outside the tunnel. As a last part of the training programme, the table-top exercises shall consist of complex tunnel fire scenarios confronting the participants with multiple dilemmas and uncertainties. The main purpose is to create discussions and reflection among the participants.

The overall learning goal must be extensive, concrete and possible to evaluate. The main goal should relate to improving emergency response management in tunnels and developing the quality of services offered by the fire department.

The main goal of the exercises: incident scene leaders must be able to plan and implement appropriate strategy adapted to the object's distinctiveness, with special focus on collaboration and communication to ensure safety of the road-users and the first response personnel.

The sub-goals shall specify the main goal of the exercises. The sub-goals must be concrete and possible to evaluate.

Sub-goals of the exercises:

- Incident scene leaders must handle information gathering → obtain relevant information and communicate situation report
- Incident scene leaders must process available information → interpret acquired information and conduct risk assessments
- Incident scene leaders must identify possible measures → resource needs and determine the goal for the response operation
- Incident scene leaders must implement measures → make tactical choices, allocate resources and organize the incident scene
- Incident scene leaders must communicate and collaborate → communicate status report and collaborate
- Incident scene leaders must create resilience → plan resources and identify critical factors
- Incident scene leaders must follow-up implemented measures → evaluate and eventually adjust the measures

The selected scenario shall facilitate the achievement of the main and sub-goals of the exercise. The scenario must be realistic and facilitate learning and competence development. In order for the participants to master the imagined event/scenario, an assessment of their level of competence must be conducted. The individual must possess knowledge of the curriculum and the necessary skills to fulfil their role in the exercise.

The scenarios:

Scenario 5: Fire in lorry in single-tube tunnel (45 min)

- Part 1: Presentation of the purpose of the exercises
- Part 2: Presentation of scenario and input
- Part 3: Discussion in groups and guidance
- Part 4: Evaluation

Scenario 6: Fire in lorry in dual-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

Scenario 7: Fire involving dangerous goods in single-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

Scenario 8: Fire involving dangerous goods in dual-tube tunnel (45 min)

- Part 1: Presentation of the scenario and input
- Part 2: Discussion in groups and guidance
- Part 3: Evaluation

General clarifications:

- The participants are divided in two groups with different roles and responsibilities in emergency situations
- The instructors introduce new moments
- The instructors correct eventual errors or deviations
- The instructors assess the value of discussions and which of these shall be continued or interrupted
- The instructors ensure that all participants are involved in discussions
- The evaluation forms serve as a checklist for the various phases of the exercise

Scenario 5: Fire in lorry in single tube tunnel

Notification of fire and dense smoke development in lorry in XXX, direction XXX. The lorry has stopped approximately XXX km inside the tunnel, direction XXX. A vehicle is observed parked near the fire, downstream from the incident scene. It is unclear how many people are inside the tunnel.

The alarm phase: Call-out at 16:00

- Fire in lorry in XXX
- RTC reports fire in lorry in XXX. The lorry has stopped approximately XXX km, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- The lorry has stopped approximately XXX km inside the tunnel, direction XXX

- Type of vehicle involved: lorry loaded with construction machines
- Potential risk of fire spreading
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- The driver has implemented necessary measures but was not able to extinguish the fire
- The emergency central reports dense smoke development inside the tunnel
- RTC observes a vehicle parked approximately 300 m downstream from the incident scene. It is unknown if there are people in the vehicle.
- RTC has lost visibility in the area where the lorry is located and has limited visibility downstream from the fire
- Health and police units are on their way to the incident scene
- RTC has broadcasted information on common radio channel

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.
The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority
- Focus on facilitating self-rescue, extinguish the fire, cool the construction, assess the danger of rockslide, ensure safe retreat
- Clarify when the firefighting crew shall be sent to start search and rescue

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 6: Fire in lorry in dual-tube tunnel

Notification of fire and dense smoke development in lorry in XXX, direction XXX. The lorry has stopped near cross section no. XXX. The driver has evacuated the tunnel. No vehicles are observed downstream from the fire.

The alarm phase: Call-out at 16:00

- Fire in lorry in XXX
- RTC reports fire in lorry and smoke development in XXX, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- Attack route: use portal XXX and arrive at the incident scene through cross section no. XXX
- Type of vehicle involved: diesel
- The incident occurs near cross section no. XXX, direction XXX
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- RTC has broadcasted information on common radio channel

- The driver has implemented necessary measures but was not able to extinguish the fire
- The driver has evacuated the tunnel
- RTC reports that no vehicles are located downstream from the fire
- Health and police units are on their way to the incident scene
- RTC reports dense smoke development

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.

The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority
- Focus on facilitating self-recue, extinguish the fire, cool the construction, assess the danger of rockslide, ensure safe retreat, heat release

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.

- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 7: Fire involving dangerous goods in single-tube tunnel

Notification of fire and dense smoke development in lorry in XXX, direction XXX. The lorry has stopped approximately XXX km inside the tunnel, direction XXX. The lorry belongs to XXX Transport Company. 4 vehicles are observed parked approximately 200 m downstream from the incident scene.

The alarm phase: Call-out at 16:00

- Fire in lorry loaded with dangerous goods in XXX
- RTC reports fire in lorry in XXX. The lorry has stopped approximately XXX km, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- The lorry has stopped approximately XXX km inside the tunnel, direction XXX
- Type of vehicle involved: lorry loaded with XXX
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- The driver has implemented necessary measures but was not able to extinguish the fire
- RTC reports that the tank is loaded with oil
- RTC observes 4 vehicles parked approximately 200 m downstream from the incident scene.
- Potential danger of fire spreading
- RTC has lost visibility in the area where the lorry is located and has limited visibility downstream from the fire
- Health and police units are on their way to the incident scene
- RTC has broadcasted information on common radio channel

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.

The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority
- Focus on facilitating self-rescue, extinguish the fire, cool the construction, assess the danger of rockslide, ensure safe retreat, assess heat release
- Clarify when the firefighting crew shall be sent to start search and rescue

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Scenario 8: Fire involving dangerous goods in dual-tube tunnel

Notification of fire and dense smoke development in lorry in XXX, direction XXX. The lorry has stopped near cross section no. XXX. The driver has evacuated the tunnel. The lorry is marked

with dangerous goods signs. The person reporting the fire does not have knowledge of the lorry's load. Due to traffic jam, several vehicles are observed inside the tunnel, direction XXX.

The alarm phase: Call-out at 16:00

- Fire in lorry loaded with dangerous goods in XXX
- RTC reports fire in lorry and smoke development in XXX, direction XXX
- Fire vehicles: XXX are sent to the incident scene

Information gathering: Key information (incident scene factors) expected to be requested on the way to the incident scene/can be given by instructors if needed.

- Attack route: use portal XXX and arrive at the incident scene through cross section no. XXX
- Type of vehicle involved: diesel
- The incident occurs near cross section no. XXX, direction XXX
- RTC has closed the tunnel according to the procedure, direction XXX
- The fire ventilation is activated according to the procedure – direction XXX
- Common communication channel: XXX is assigned
- RTC has broadcasted information on common radio channel
- The driver has implemented necessary measures but was not able to extinguish the fire
- The driver has evacuated the tunnel
- RTC reports that several vehicles and traffic jam inside the tunnel, direction XXX
- RTC reports that the lorry is marked with dangerous goods signs
- The person calling and reporting the incident does not have knowledge of the lorry's load
- Health and police units are on their way to the incident scene
- RTC reports dense smoke development

The en-route phase: it is expected that the leader seeks to create a common situational understanding among first responders on the way to the incident scene.

The arrival phase at the tunnel portal and the incident scene: the instructors first show a picture of the tunnel portal, then a picture of the incident scene.

The response phase: Actions expected to be carried out by operational leaders.

- Give window report in common communication channel
- Implement immediate measures, i.e., extinguish the fire, lifesaving work, evacuation
- Approach the driver of the vehicle to obtain relevant information (provide an overview of the situation)
- Establish operational goal, i.e., extinguish the fire/limit damages
- Establish tactical plan, i.e., type of extinguishing agent
- Assess risk factors for first responders, i.e., smoke diving, evacuation, etc.
- Lifesaving work has first priority
- Focus on facilitating self-rescue, extinguish the fire, cool the construction, assess the danger of rockslide, ensure safe retreat, heat release

The response phase: Actions expected to be carried out by incident commanders.

- Establish the commando scene and organize the incident scene
- Assess the need for leader support
- Make sector division
- Establish gathering place for potential victims
- Clarify when health units may enter the tunnel
- Communicate and collaborate with other emergency response services
- Communicate with operational leader
- Communicate situational report to the emergency central
- Assess the need for notifying the public, i.e., broadcasted radio information, etc.
- Create resilience during the entire response by continuously assessing available resources
- Logistics, i.e., long distances, air consumption, additional resources

Description of the learning units

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Module:	**Technical introduction to tunnel construction**		
Title of the learning unit:	**Tunnel infrastructure**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	45 min		
Number of participants:	6 to 12	**Number of trainers:**	1
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning goals:

The participant

- knows the infrastructure of the relevant tunnel facility and how it may affect the response operation
- can assess and plan response operations adapted to the tunnels' infrastructure
- masters assessments of risk for road-users and first responders based on the tunnels' infrastructure

Technical introduction to tunnel constructions

Knowledge	Skills	Competence
He/she knows: • the tunnels infrastructure (e.g., number of tubes, length, gradient, escape routes, emergency exits, ventilation system, emergency stations, water supply, communication system, power supply, monitoring systems)	He/she can: • understand basic preventive work with tunnel safety and how it may affect the tunnels' safety level • plan response operations adapted to the tunnels' infrastructure (e.g., response route, assessments of resources, ventilation direction, communication challenges)	He/she masters: • limitations and possibilities for response operations based on the tunnels' infrastructure (e.g., lengthy response routes, breathing capacity, extinguishing water capacity, communication, ventilation direction, retreat) • limitations and opportunities for road-users based on the tunnels' infrastructure (e.g., information gathering, detection, variable signs, emergency exits)

Didactical method:	The instructor shall present the current laws, regulations and standards and explains the implications for the tunnel fire safety work during various phases (planning, construction, operation and maintenance). Further, the instructor shall explain what supervision is and the purpose of conducting supervisions. The current object plans for risk tunnels in the fire department's area of responsibility shall be presented and described. The participants shall reflect through joint discussions about how emergency response operations may be facilitated to ensure and safeguard the safety of road-users and first responders.
Requirements:	100% presence
Teaching method:	80% theoretical lecture, 20% reflection
Protective equipment:	• Teaching materials, e.g., power point presentation

	• Description of regulations and standards • Object plans of the relevant tunnel facility	
Equipment:		
Created by: Phd-candidate Gabriela Bjørnsen		

Co-funded by the
Erasmus+ Programme
of the European Union

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Modules:	**Explanation of the technical and local conditions**		
Title of the learning unit:	**Basic communication technical**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	45 min		
Number of participants:	6 to 12	**Number of trainers:**	**1**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning goal:

The participant

- knows the tunnels' contingency plans and object plans
- can basic communication equipment
- masters selecting appropriate communication channel

Explanation of the technical and local conditions

Knowledge	Skills	Competence
He/she knows: • the tunnels' contingency plans and object plans • the tunnels' communication system	He/she can: • use available communication equipment according to the communication plan (e.g., emergency services channel, gateway)	He/she masters: • communication equipment challenges related to operational management (e.g., fan noise, gateway, repeater) • select the appropriate communication channel with other emergency services • select alternative communication methods in case of failure in the communication system

Didactical method:	The instructor shall give a thorough review of the current contingency plans and object plans of the risk tunnels in the fire department's area of responsibility. The participants shall reflect through joint discussions about opportunities and limitations related to basic technical communication in local tunnels. Discussions concerning selecting alternative communication methods in case of failure in communication systems should be emphasized.
Requirements:	100% presence
Teaching method:	80% theoretical lecture, 20% reflection
Protective clothing:	
Equipment:	• Teaching materials, e.g., power point presentation • Description of the risk tunnels in the fire department's area of responsibility • Contingency plans and object plans of the relevant tunnel facility

Co-funded by the
Erasmus+ Programme
of the European Union

				Explanation of the technical and local conditions
Created by: Phd- candidate Gabriela Bjørnsen				
Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**			
Modules:	**Explanation of the technical and local conditions**			
Title of the learning unit:	**Water supply**			
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard			
Duration:	45 min			
Number of participants:	6 to 12	**Number of trainers:**	**1**	
Evaluation:	Part of the overall evaluation			
EQF-level:	Level 5			

Learning goal:

The participant

- knows the tunnels' contingency plans and object plans
- can use basic water supply options
- masters assessments of water resources

Knowledge	Skills	Competence
He/she knows: • the tunnels' contingency plans and object plans • the tunnels' possibilities of water supply	He/she can: • use available water supply options • estimate the available water supply considering the damage situation	He/she masters: • assessments of water resources to extinguish the fire considering the damage situation • assessments of water supply and drainage system regarding accumulation of the water used to extinguish the fire and environmental pollution

Didactical method:	The instructor shall give a thorough review of the current contingency plans and object plans of the risk tunnels in the fire department's area of responsibility. The participants shall reflect through joint discussions about opportunities and limitations related to water supply in local tunnels. Discussions concerning challenges related to the tunnel's water supply and drainage system shall be discussed. The discussions shall emphasize issues related to accumulation of water used to extinguish the fire and environmental pollution.
Requirements:	100% presence
Teaching method:	80% theoretical lecture, 20% reflection
Protective clothing:	
Equipment:	• Teaching materials, e.g., power point presentation • Description of the risk tunnels in the fire department's area of responsibility • Contingency plans and object plans of the relevant tunnel facility
Created by: Phd- candidate Gabriela Bjørnsen	

Co-funded by the
Erasmus+ Programme
of the European Union

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Module:	**Special tactics for tunnel operations**		
Title of the learning unit:	**Explore road tunnels**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	240 min		
Number of participants:	6 to 12	**Number of trainers:**	**3**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning goal:

The participant

- knows basic methods to acquire situational awareness
- can use various methods to make sense of the situation and identify critical factors
- masters assessments related to decision-making and allocation of responsibilities, focusing on coordinated information

Special tactics for tunnel operations

Knowledge	Skills	Competence
He/she knows: • various methods to acquire situational awareness (e.g., interpreting signals, situation investigation by observation, questioning road-users and/or traffic operators) • challenges to acquire situational awareness in tunnel incidents (e.g., information access, smoke, time pressure, ambiguous signals)	He/she can: • interpret the situation, conduct risk assessments and identify various choices of action • communicate a common picture of the situation to first responders and other cooperating actors in a clear and concise manner	He/she masters: • gather information, sort information, interpret information and anticipate the likely development of the situation • assessments of various choices of action, safety measures and identification of risk factors • implementation of measures and assessments of their effectiveness • collaboration with other emergency services

Didactical method:	The participants shall be confronted with a tunnel fire incident: "Fire in vehicle in road tunnel". The participants shall gather key information, assess the situation and create a common understanding of the situation within the firefighting crew and with other emergency response services. One instructor shall play the role of the emergency operator and traffic operator. The participants shall be divided in two groups: one group representing the operational leader and smoke divers inside the tunnel and another group representing the incident commander and leader support outside the tunnel. Through the scenarios the participants shall rotate on roles. During the exercises, each leader should be followed-up by an instructor. The instructors evaluate the decisions and choices of actions based on the evaluation forms. Lastly, the instructors shall conduct a joint evaluation and debriefing emphasizing key findings revealed during the exercise.
Requirements:	100% presence
Teaching method:	80% practical training, 20% reflection

Protective equipment:	• Body protection: protective clothing in accordance with EN 469:2005 / A1:2006 • Hand protection: protective gloves in accordance with EN 659:2003 / A1:2008 • Head protection: firefighter helmet in accordance with EN 443/2008 • Head protection: firefighter hood in accordance with EN 13911:2004 • Safety shoes in accordance with EN 15090/2007 • Breathing apparatus in accordance with EN 137:2006-11 • Member states shall comply with their specific laws and regulations
Equipment:	• Communication radios • Smoke machine • Fire vehicles • Markers • Marking lights and search sticks • Whiteboard
Created by: Phd-candidate Gabriela Bjørnsen	

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Modules:	**Special tactics for tunnel operations – Explore railway tunnels (use for the training of railway tunnels)**		
Title of the learning unit:	**Roleplay exercise: Fire in railway tunnel**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration of teaching unit:	240 min		
Number of participants:	6 to 12	**Number of trainers:**	**3**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning goal:

The participant

- knows basic methods to acquire situational awareness
- can use various methods to make sense of the situation and identify critical factors
- masters assessments related to decision-making and allocation of responsibilities, focusing on coordinated information

Special tactics for tunnel operations

Knowledge	Skills	Competence
He/she knows: • various methods to acquire situational awareness (e.g., interpreting signals, situation investigation by observation, questioning road-users and/or train operators) • challenges to acquire situational awareness in railway tunnel incidents (e.g., information access, smoke, time pressure, ambiguous signals)	He/she can: • interpret the situation, conduct risk assessments and identify various choices of action • communicate a common picture of the situation to first responders and other cooperating actors in a clear and concise manner	He/she masters: • gather information, sort information, interpret information and anticipate the likely development of the situation • assessments of various choices of action, safety measures and identification of risk factors • implementation of measures and assessments of their effectiveness • collaboration with other emergency services

Didactical method:	The participants shall be confronted with several fire incidents in railway tunnel. The participants shall gather key information, assess the situation and create a common understanding of the situation within the firefighting crew and with other emergency services. One instructor shall play the role of the emergency operator and railway personnel. The participants shall be divided in two groups: one group representing the operational leader and smoke divers inside the tunnel and another group representing the incident commander and leader support outside the tunnel. Through the scenarios the participants shall rotate on roles. During the exercises, each leader should be followed-up by an instructor. The instructors evaluate the decisions and choices of actions based on the evaluation forms. Lastly, the instructors shall conduct a joint evaluation and debriefing emphasizing key findings revealed during the exercise.
Requirements:	100% presence
Teaching method:	80% practical training, 20% reflection

Protective equipment:	• Body protection: protective clothing in accordance with EN 469:2005 / A1:2006 • Hand protection: protective gloves in accordance with EN 659:2003 / A1:2008 • Head protection: firefighter helmet in accordance with EN 443/2008 • Head protection: firefighter hood in accordance with EN 13911:2004 • Safety shoes in accordance with EN 15090/2007 • Breathing apparatus in accordance with EN 137:2006-11 • Member states shall comply with their specific laws and regulations
Equipment:	• Communication radios • Smoke machine • Fire vehicles • Markers • Marking lights and search sticks • Whiteboard
Created by: Phd-candidate Gabriela Bjørnsen	

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Modules:	**Safety in handling the resources**		
Title of the learning unit:	**Safety**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	90 min		
Number of participants:	6 to 12	**Number of trainers:**	**1**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning goal:

The participant

- knows possibilities and limitations related to response operations in tunnels
- can plan a safe response operation based on situational factors
- masters assessments of risk for road-users and first responders based on situational factors

Knowledge	Skills	Competence
He/she knows: • situational factors affecting response operations in tunnels (e.g., long distance, fan noise, rockslide, PE-foam, smoke and gases, dangerous goods, access route, ventilation)	He/she can: • assess challenges, dangers and limitations for the response operation based on situational factors (e.g., access to the incident site, traffic volume and proportion of HGV, road-users behaviour, mental and physical requirements, dangerous goods, ventilation, evacuation possibilities) • plan a safe response operation based on situational factors	He/she masters: • decisions concerning safe implementation and execution of the response operation • decisions concerning risk reduction measures (e.g., new rescue team, tolerance of first responders, alternative communication means)

Didactical method:	The instructor shall give a thorough review of special conditions and challenges related to response operations in tunnels and discuss possibilities and challenges when responding to incidents. Local risk tunnels within the fire department's area of responsibility shall be emphasized. The participants shall reflect through joint discussions about situational factors affecting the response operation. Further, essential factors to ensure a safe and satisfactory response shall be stressed. Lastly, the instructor shall highlight key issues to ensure safety of first responders and present available equipment and resources and limitations of the equipment.
Requirements:	100% presence
Teaching method:	80% theoretical lecture, 20% reflection
Protective equipment:	
Equipment:	• Teaching materials, e.g., power point presentation

	• Review of necessary equipment for safe response operations in tunnels • Contingency plans and object plans of the relevant tunnel facility	
Created by: Phd-candidate Gabriela Bjørnsen		

Co-funded by the
Erasmus+ Programme
of the European Union

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Module:	**The scientific basis for tunnel operations**		
Title of the learning unit:	**Airflow direction and Tunnel ventilation**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	90 min		
Number of participants:	6 to 12	**Number of trainers:**	**1**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning outcome:

The participant

- knows physical background of fire phenomena and associated responses
- can facilitate measures to safeguard the self-rescue principle based on the upstream and downstream side of the fire
- masters choices of action that does not expose first responders and/or road-users to risks

The scientific basic for tunnel operations

Knowledge	Skills	Competence
He/she knows: • various methods to control ventilation during tunnel fires and the impact it may have for the response operation and road-users' possibilities to evacuate • the tunnels' ventilation direction • implications of smoke exposure for road-users evacuation possibilities	He/she can: • advantages and disadvantages of using fire ventilation • evaluate the ventilation strategy based on situational factors (e.g., predefined direction, change direction, full fire ventilation) • evaluate the ventilation capacity considering situational factors • assess tactical decisions based on the upstream and downstream side of the fire	He/she masters: • decisions of ventilation strategy to facilitate self-rescue principle • decisions of ventilation strategy to facilitate safe response operations • selection of measures that do not expose road-users and first responders to risks

Didactical methods:	The instructor shall give a thorough review of various ventilation principles and how it may affect the response operation. Further, the purpose of fire ventilation, as well as key issues and facts related to fire ventilation shall be discussed. Among other things, the participants shall reflect about various risks associated with fire ventilation and necessary conditions that must be ensured to change the ventilation direction during tunnel fires. It is recommended that instructors show videos from full-scale fire tests. Subsequently, the videos should be further discussed in plenary and linked to assessments of fire loads, ventilation capacity and the endurance of the tunnel infrastructure.
Requirements:	100% presence
Teaching method:	80% theoretical lecture, 20% reflection
Protective equipment:	
Equipment:	• Teaching materials, e.g., power point presentations • Review of ventilation principles

	• Videos capturing fire dynamics and smoke development in tunnels	
Created by: Phd-candidate Gabriela Bjørnsen		

Co-funded by the
Erasmus+ Programme
of the European Union

Course name:	**European vocational education and training guideline for operational leaders in road and railway tunnels**		
Module:	**Leadership in operations**		
Title of the learning unit:	**Basic communication and Operational command**		
Prerequisites:	Completed basic vocational education and training for fire fighters in road and/or railway tunnels according to SAFEINTUNNELS standard		
Duration:	450 min		
Number of participants:	6 to 12	**Number of trainers:**	**3**
Evaluation:	Part of the overall evaluation		
EQF-level:	Level 5		

Learning outcome:
The participant

- knows opportunities to acquire situational awareness and the significance of sharing information among the cooperation actors
- can use and understand common terminologies and assessments of scenario uncertainties based on available information
- masters decisions of resources and response tactics adapted to the development of the situation

Knowledge	Skills	Competence
He/she knows: • special conditions/challenges related to communication in tunnels (e.g., visibility, fan noise, radio channel, terminologies) • the significance of common situational awareness among first responders and other cooperating actors • the contingency plan and object plan of the relevant tunnel facility	He/she can: • use information provided through video surveillance or other detection means to facilitate safe and satisfactory response operations • develop and implement tactical plans based on available information	He/she masters: • possibilities and limitations of the available resources • organisation of the operational command area in collaboration with the other emergency services • convey key information and tactical instructions to the firefighting team rapid and clearly • share key information with cooperating actors

Didactical methods:	The instructor shall give a thorough review of a strategic decision-making model and process - focusing on emergency response management in tunnels. Further, the instructor shall discuss possibilities and challenges related to emergency response management during incidents in tunnels. Among other things, the participants shall reflect about essential factors necessary to make appropriate decisions. In the second part of the theoretical lecture, the instructor shall give a thorough review of human behaviour during tunnel fires. Further, various challenges related to evacuation shall be discussed. Participants shall reflect about the prerequisites necessary to safeguard the self-rescue principle. During the table-top exercises, the participants shall be confronted with various scenarios in tunnels (e.g., fire with smoke development, traffic accident, fire in heavy goods vehicle). In the initiating phase, the information presented shall be ambiguous and limited. Participants shall seek to obtain key information, assess the situation and develop a common situational awareness within the group. Further, the participants shall discuss in plenary both specific and generic problems related to the presented scenarios. One instructor shall play the role of the emergency operator and traffic operator and supplement with information when necessary. To increase the learning potential from the experiences, the instructors shall try to challenge and introduce unexpected moments that challenges the participants to think "what if…". Through the scenarios the participants shall rotate on roles. The instructors shall evaluate the decisions and choices of actions based on

	the evaluation forms. Lastly, the instructors shall conduct a joint evaluation and debriefing emphasizing key findings focusing on judgements and assessments revealed during the exercise.
Requirements:	100% presence
Teaching method:	90% discussion, 10% reflection
Protective equipment:	
Equipment:	• Teaching materials, e.g., power point presentation • Review of various type of scenarios (e.g., traffic accident with smoke development, fire in lorry, fire involving dangerous goods) • Object plans of the relevant tunnel facility • Map of the relevant tunnel facility • Pictures and illustrations associated with the presented scenarios • Whiteboard
Created by: Phd-candidate Gabriela Bjørnsen	

European credit system for vocational education and training – a tool to approve competence

The European credit system for vocational education and training (ECVET) is a tool helping individuals in transfer, recognition and accumulation of their assessed competencies. The tool may be used to validate individuals' competencies regardless of where the competence has been acquired. The main goal with the EU's mobility tool is to make it easier to assess individuals' competencies without it being necessary to know everything about other countries' curricula and assessments' arrangements. This can be achieved through a structured description of qualifications for the expected learning outcomes (EQF). Learning outcomes are defined in terms of knowledge, skills and competencies.

Employing ECVET as a tool to validate competencies involves, among other things, developing a method to assess the qualifications that the participants have acquired and the extent to which the qualifications are in accordance with the competence requirements for the specific occupation (e.g., firefighter, operational leader, etc.). A first step in this process is to describe the expected learning outcomes of the targeted group. A second step is to assess the learning outcomes against the occupational requirements, document the learning outcomes and develop evaluation processes so that the targeted group receives validation of the acquired competence.

In order to describe the learning outcomes expected to be achieved, the EU-Commission recommends using as a starting point:

1. key activities and/or areas of expertise within the specific occupational domain or
2. products and services provided by the occupation.

In this way, it is possible to acquire a picture of individuals experiences and a starting point to assess their competence against occupational requirements. The occupational requirements are an expression of the competence that an individual is expected to possess when she/he is employed in a specific role. Competence is defined as the ability to solve tasks and master complex problems. The European qualification framework defines competence in terms of knowledge, skills and competence. In order to describe the expected learning outcomes, we have used key activities of first responders with leading roles during incidents in road and railway tunnels.

This training concept is assessed with one ECVET-point.

Evaluation of the participants

In order to evaluate the learning outcomes, the following five questions are relevant and shall be considered:

- What shall be evaluated? Participants' knowledge and competence related to tunnel fire safety.
- How should we evaluate? Continuous evaluation during learning activities based on feedback and guidance and physical participation.
- Who should evaluate? Instructors.
- Why do evaluation? Map the level of knowledge and competence among the participants and increase the learning outcomes.
- Who should have access to the results? Participants, instructors and management within the organisation.

Teaching, learning and evaluation are closely linked. The purpose of the evaluation is to enhance the learning outcomes among the participants. Subsequently, we look upon the evaluation as an integrated part of the learning process.

The evaluation has the following purpose:

- Motivate participants in the learning process. This implies that participants shall receive necessary feedback and guidance that provides inspiration and direction for learning both during the course and after the completion of the course.

A *formative assessment* shall be employed, which is a form of evaluation aimed to enhance learning. This means that all evaluation shall be given during the learning process. The evaluation shall mainly take place during the practical exercises, and it shall comprise feedback and guidance to enhance learning among the participants. The evaluation shall be closely linked and integrated into the teaching activities.

Key principles for the evaluation:

1. Participants shall understand the content of what is being learned. Additionally, it is expected active participation in classroom discussions and debriefings after practical exercises.
2. Participants shall receive feedback regarding the quality of the chosen tactics and strategies.
3. Participants shall be offered recommendation concerning areas of improvement.
4. Participants shall also be involved in the learning process through evaluating their own knowledge and competence.

In this context, measurement and control shall not be the focus of instructors/evaluators. However, the attention shall be directed towards **physical participation during the three days and involvement in discussions and debriefings.** For the practical exercises, the participants shall be evaluated based on two evaluation forms (see previously attached documents: "Evaluation form for operational leader in tunnel operations" and "Evaluation form for incident commander in tunnel operations").

The final overall evaluation shall be: **passed/failed** and shall be based on physical participation and involvement in practical exercises (role-play exercises and table-top exercises).

In addition to the continuous evaluation, the participants shall answer two questionnaires (one before and one after the course) where they will self-evaluate their knowledge and competence. The main goal is to outline whether the course makes a concrete contribution to their competence development. The questionnaires aim also to contribute to reflection and awareness related to their own learning and the tasks they may be confronted with in the work with tunnel fire safety. **The learning goals are the starting point of the evaluation work.**

Co-funded by the
Erasmus+ Programme
of the European Union

Course certificate

Course name: European vocational education and training for operational leaders in road and/or railway tunnels

Place: e.g., Center for Societal Safety in Rogaland (SASIRO)

Date: e.g., 17th of September

Participant's name:

Employment place: Rogaland Fire and Rescue

ECVET-points: 1

Learning outcomes:

The participant knows:

- The tunnel's infrastructure and situational factors (e.g. length, gradient, emergency exits, ventilation, dangerous goods, etc.)
- The implication of smoke exposure for road-users' possibilities of evacuation
- Various methods to acquire situational awareness (e.g., interpreting signals, investigation by observation, questioning road-users and/or traffic operators, etc.)
- Special conditions/challenges related to communication (e.g., visibility, fan noise, etc.)

The participant can:

- Plan the response operation, taking into account the tunnel's infrastructure (e.g., lengthy response routes, traffic, road-users behaviour, dangerous goods, etc.)
- Implement measures that safeguard the self-rescue principle
- Read the incident, sort information, interpret information and anticipate the likely development of the situation
- Use the available information to facilitate a safe response operation

The participant masters:

- Limitations and opportunities related to response operations based on the tunnel's infrastructure and characteristics of the situation (e.g., assessments of first responders' physical capacity, assessments of extinguishing capacity, communication, etc.)
- Decisions related to safe implementation of measures (e.g., assessments and coordination of resources, assessments of first responders' capacities, etc.)

- Communicate key information and tactical instructions to first responders in a clear and concise manner

Signature and stamp:

Co-funded by the
Erasmus+ Programme
of the European Union

Self-evaluation questionnaire prior to the course

The evaluation shall be ranked on a five-point scale where 1 is very small degree, 2 small degree, 3 moderate degree, 4 high degree and 5 very high degree.
We want you to self-evaluate your knowledge and competence related to tunnel fire safety.

The participant's name:

1. To what extent do you have knowledge of fire safety preventive work in tunnels?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

2. To what extent do you have knowledge of the tunnel's emergency response plans and object plans?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

3. To what extent can you assess possibilities for response operations based on the tunnel's infrastructure?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

4. To what extent can you assess challenges, dangers and limitations for the response operation based on situational factors at the incident site?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

5. To what extent can you implement and execute safe response operations in tunnels?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

6. To what extent can you assess various choices of actions that does not expose first responders and/or the road-users to risks based on the downstream and upstream side of the fire?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

7. To what extent do you have knowledge of advantages and disadvantages of using fire ventilation in tunnels?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

8. To what extent can you gather, sort and interpret information, and anticipate the likely development of an incident?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

9. To what extent can you assess various choices of action, safety measures and identify risk factors?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

10. To what extent can you implement measures and assess their effectiveness?

    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

11. To what extent can you assess limitations and possibilities related to tactics and techniques for response operations in tunnels?

    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

12. To what extent can you fast and clearly communicate key information and tactical instructions?

    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

13. To what extent can you assess resources and response tactics based on accumulated information?

    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

14. To what extent can you assess measures and adapt those to the development of the situation?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

15. Imagine that you are called-out and must respond to a major tunnel fire. To what extent are you competent to cope with the situation?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

Co-funded by the
Erasmus+ Programme
of the European Union

Self-evaluation questionnaire after the course

The evaluation shall be ranked on a five-point scale where 1 is very small degree, 2 small degree, 3 moderate degree, 4 high degree and 5 very high degree.

We want you to self-evaluate your knowledge and competence related to tunnel fire safety.

The participant's name:

1. To what extent do you have knowledge of fire safety preventive work in tunnels?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

2. To what extent do you have knowledge of the tunnel's emergency response plans and object plans?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

3. To what extent can you assess possibilities for response operations based on the tunnel's infrastructure?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

4. To what extent can you assess challenges, dangers and limitations for the response operation based on situational factors at the incident site?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

5. To what extent can you implement and execute safe response operations in tunnels?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

6. To what extent can you assess various choices of actions that does not expose first responders and/or the road-users to risks based on the downstream and upstream side of the fire?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

7. To what extent do you have knowledge of advantages and disadvantages of using fire ventilation in tunnels?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

8. To what extent can you gather, sort and interpret information, and anticipate the likely development of an incident?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

9. To what extent can you assess various choices of action, safety measures and identify risk factors?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

10. To what extent can you implement measures and assess their effectiveness?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

11. To what extent can you assess limitations and possibilities related to tactics and techniques for response operations in tunnels?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

12. To what extent can you fast and clearly communicate key information and tactical instructions?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

13. To what extent can you assess resources and response tactics based on accumulated information?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

14. To what extent can you assess measures and adapt those to the development of the situation?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

15. Imagine that you are called-out and must respond to a major tunnel fire. To what extent are you competent to cope with the situation?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

Open question:

Which areas do you wish to emphasise in order to further develop your competence in tunnel fire safety?

Co-funded by the
Erasmus+ Programme
of the European Union

Evaluation feedback

Information from the evaluation feedback will be used as an active tool for the future design of the course.

The evaluation is ranked on a five-point scale, where 1 represents very small degree, 2 small degree, 3 some degree, 4 high degree and 5 very high degree.

1. To what extent has the course contributed to increasing your understanding for decision-making and responsibility related to real incidents in tunnels?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

2. To what extent has the course provided insight into communication challenges related to real incidents in tunnels?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

3. To what extent has the course prepared you for challenges that can be met in real incidents in tunnels?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

4. To what extent has the course challenged your own competence?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

5. To what extent did you experience coherence between the learning goals and your capability to learn during the time allocated to the course?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

6. To what extent did you experience the content and the working methods appropriate for learning?

   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

7. To what extent did the instructors have necessary competence related to the taught topics?

(1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

8. To what extent did you experience the instructors to give concrete and constructive feedback?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

9. To what extent did you experience the content of the course as relevant for your working tasks with tunnel fire safety?
   (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

10. To what extent will the course contribute to changes in the way you perform your working tasks with tunnel fire safety?
    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

11. To what extent has the course confirmed your knowledge, skills and practices related to tunnel fire safety?
    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

12. To what extent has the course given you a deeper understanding of important issues related to tunnel fire safety?
    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

13. To what extent would you recommend this course to others?
    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

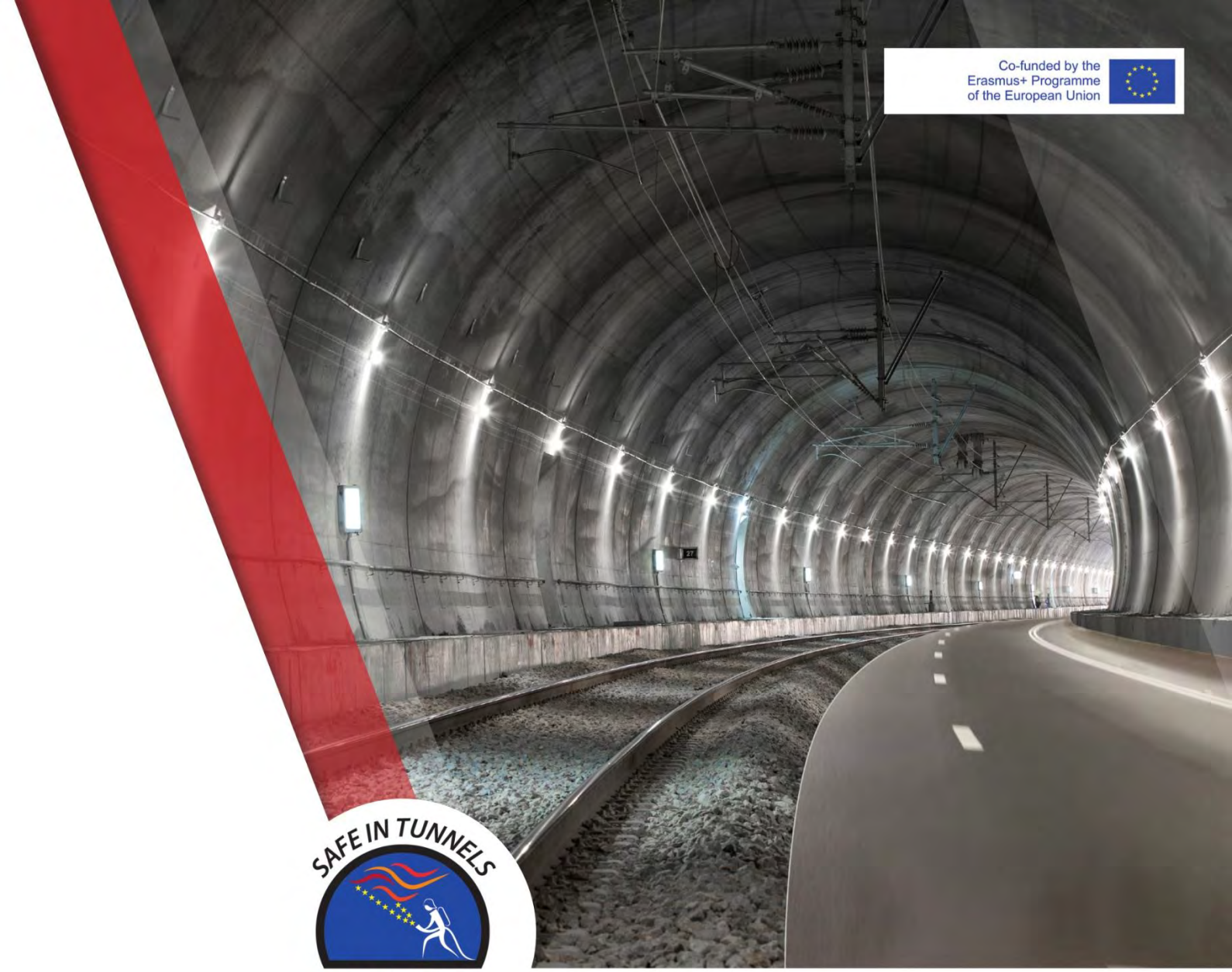
14. To what extent has the course contributed to increasing your competence in tunnel fire safety?
    (1) ❑ (2) ❑ (3) ❑ (4) ❑ (5) ❑

Open questions:

Did you experience the course to meet your expectations? If not, do you have any suggestions about ways in which the course can be improved?

During the course, did you experience to be challenged on something in particular?

Co-funded by the
Erasmus+ Programme
of the European Union



SAFEINTUNNELS

European training concept
Train the trainer for firefighting instructors at fire incidents in railway and road tunnels

Co-funded by the
Erasmus+ Programme
of the European Union

Table of content

Co-funded by the
Erasmus+ Programme
of the European Union

European training concept
Train the Trainer for Firefighting Operations in Tunnels

Introduction

This document describes the training of firefighter trainers for firefighting operations in railway and road tunnels, which has been prepared within the framework of the Erasmus + project "SAFEINTUNNELS - Traveling safe through Europe - Training and education for firefighters in tunnel safety" funded by the European Commission.

The training of trainers for tunnel firefighting requires, in addition to the technical competences, further competences in the area of methodology-didactics in order to be able to sustainably train the complex topic of operations in tunnel fires. To this end, this module emphasises the teaching of training skills. The trainees can reflect on and optimise their personal competence as trainers and instructors in the form of individual coaching with personal feedback.

Training path of trainers and instructors of tunnel operations

Training to become a tunnel operations trainer is the final stage of tunnel training. This means that all previous levels of tunnel training must be completed:

- **Basic training to become a firefighter**

  The tunnel base training requires a completed basic training as a firefighter and the training entitling to wear breathing apparatus.

- **Basic training for fire engine crews - Firefighting in railway tunnels**

  The aim of this basic training is for the participants to learn the uniform procedure for fire incidents in railway tunnels, to be able to implement the necessary measures in practice and to make appropriate situational decisions.

- **Basic training for fire engine crews - Firefighting in road tunnels**

  The training is analogous to the basic training "Fire fighting in railway tunnels". It

refers specifically to the conditions in a road tunnel. The objectives of this training can be found in the document of the same name. The training level is the same as that of the basic training "Fire fighting in railway tunnels".

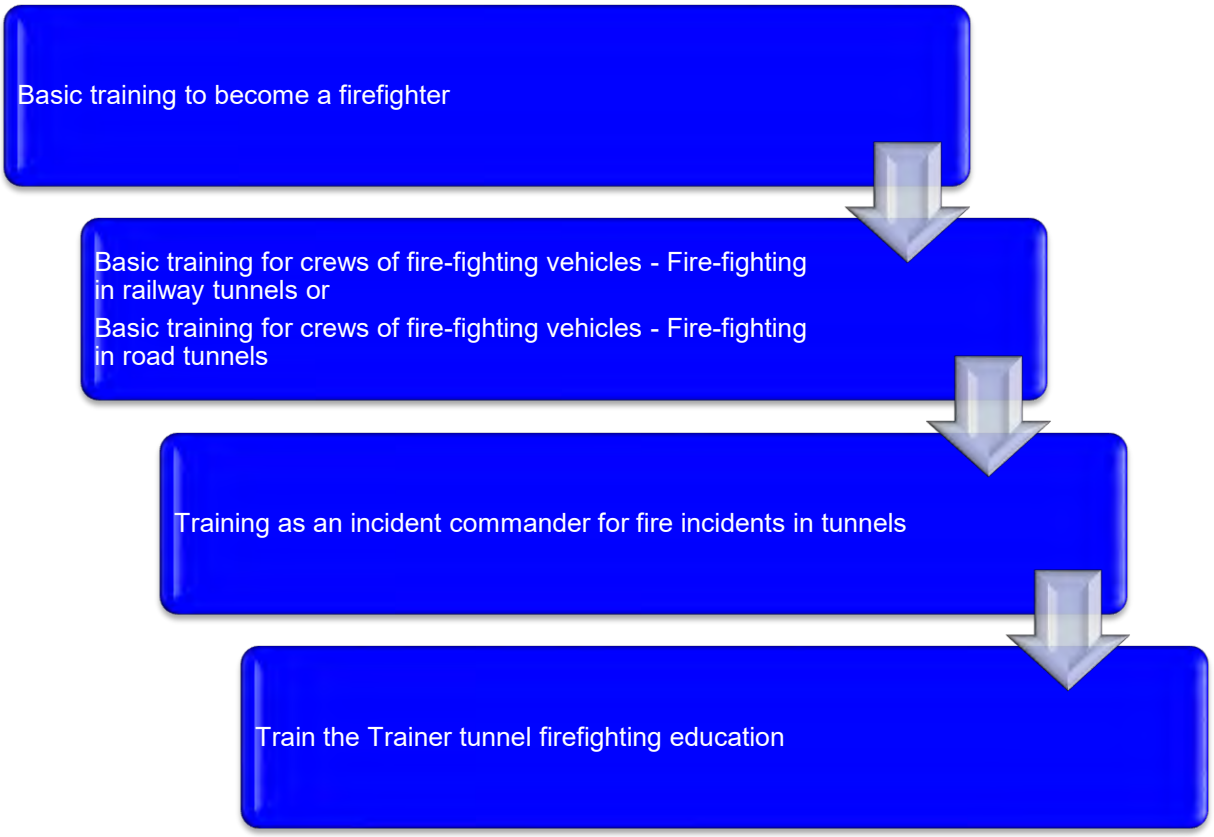
- **Training to become an incident commander for "fire incidents in tunnels".**

  The aim of this training is to prepare incident commanders for tunnel fire incidents in terms of incident command. The training builds on the basic training. In particular, command and control, communication and the making of tactical decisions are trained. A detailed description of this training can be found in the corresponding document.

- **Train the Trainer tunnel deployment training**

  The final stage of the training path is the "train the trainer tunnel operation training". The instructor or trainer probably has the most important role in disseminating the uniform training matrix. In this final training, the upstream trainings are professionally complemented and the didactic approach is imparted. Each participant will expand his/her pedagogical training methods and learn different simulation possibilities.

Graphical representation of the consecutive education pathway



The trainer has a decisive role in this in order to train the topic of the procedure during tunnel operations as uniformly as possible according to the specifications in the "competence catalogue". Therefore, this module is no longer so much about the technical training - this can be taken for granted due to the previous training steps; the upstream training is supplemented technically and the focus is on the methodological-didactic teaching of the contents.

In addition to the subject-specific modules of the tunnel training, the following training is also required:

- **Training as a fire brigade instructor**

Working as a trainer and instructor requires additional competences beyond technical knowledge. This training is designed to promote and consolidate these competences.

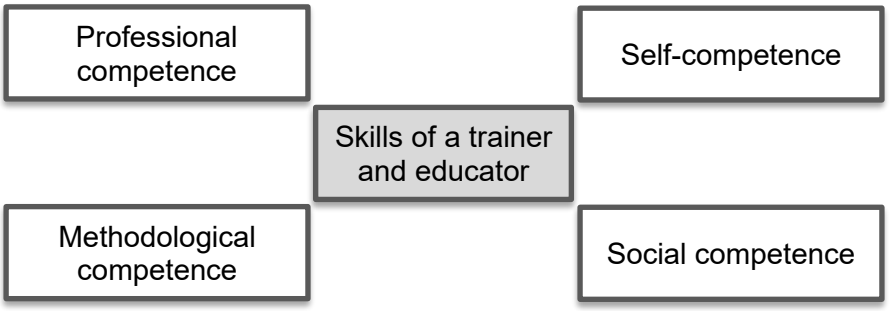
In the following, some basic prerequisites regarding the role of trainers and instructors are described and some methodological-didactic approaches are given in more detail.

Basic requirements of a trainer and educator

Professional competence as a trainer and educator is an important prerequisite for this role. Therefore, the trainer must have successfully completed at least the equivalent level of training. However, it takes more to be able to pass on the existing knowledge to trainees well and sustainably. Therefore, the trainer must also have successfully completed the Train the Trainer training.

Example: A trainer for basic training for fire engine crews - fire fighting in road tunnels must have completed this training and additionally the Train the Trainer tunnel operations training.

The following competences can be regarded as basic characteristics of a trainer and educator:



Expertise:

This is understood to mean the specialist knowledge on the subject area covered on the part of the trainer and instructor. This presupposes that the trainer and instructor has acquired the relevant expertise through previous training and further education and has gained additional competence through experience in operations and exercises, but also through networking and exchange with other institutions, emergency services and experts.

A "good" trainer has a certain amount of expert knowledge that needs to be continuously expanded and deepened.

Self-competence:

Self-competence is often also referred to as personality, individual or personal competence. This mainly refers to those topics that concern one's own person (in our case the trainer). In general, self-competence describes the competence a person has with regard to his or her own knowledge and actions. Through self-critical reflection, a trainer can adequately assess his or her skills and derive appropriate actions, which in turn have an impact on personal development, planning and achieving goals.

Some important elements of self-competence can be:

Self-reflection to reflect on the situation at hand.

Self-criticism to be able to analyse one's own strengths and weaknesses.

Motivational ability to get an envisaged process going.

Ambition to be able to assess what is involved in changes to the current situation.

Impulse control in order not to endanger oneself and the process.

Perseverance to get through lean periods.

Frustration tolerance to be able to deal with possible setbacks and still stay on the ball.

Especially for the role of trainers and coaches, there are other important elements of self-competence:

Openness, self-awareness and self-confidence

Ability to make decisions and take action, willingness to take responsibility and conscientiousness

Analytical ability, recognising correlations

Ability to put oneself in other people's shoes (e.g. trainees), ability to reflect on one's own feelings and the feelings of others

Social competence:

Social competence essentially describes a person's ability to act independently in his or her social environment and - related to the role of trainer - the ability to deal well with other people. Especially for an instructor and trainer, the tension between assertiveness and adaptability is always present. Due to the fact that there is always a colourful variety of different personalities among the participants of teaching events, a good interaction of the trainer and instructor towards the participants is of particular importance. This has a significant influence on the success of learning. Since people tick differently and the learning behaviour of the participants is also different, it is important to be able to put oneself in other people's shoes. Not everyone thinks and acts the way a trainer and instructor might be used to from his or her point of view; not everyone has the same approaches and approaches to a topic. It is therefore important to respond appropriately to these differences, and above all not to devalue another person's sometimes different behaviour or reaction. Ideally, a different approach or way of thinking can enrich the whole group and promote a learning process.

Instead of social competence, terms such as empathy, empathy and knowledge of human nature can also be found.

Some important elements of self-competence can be:

- Ability to lead teams and groups
- Critical faculties and problem-solving skills
- Appreciation, communication and conflict skills
- Recognise and adhere to rules and structures
- Develop a sense of belonging, teamwork skills
- Setting boundaries and asserting oneself, respecting the boundaries of others
- Stress resistance, resilience

Methodological competence:

Methodological competence essentially means being able to convey technical content in an appropriate, situation-related and goal-oriented manner.

A good instructor and trainer is therefore able to convey the learning material in a participant-oriented way using appropriate techniques and methods that promote learning success. This also includes the competence to obtain information, to structure content and to prepare it accordingly.

Since a trainer always has a leadership role, leadership competences must also be considered as an essential part of methodological competence.

Leadership skills include, for example:

- Decision-making ability
- Self-management (ability to plan ahead)
- Delegate
- Presentation skills / media competence
- Communication skills

Competence- and learning outcome-oriented learning

Education and qualification systems in Europe are increasingly based on a shift towards competences and learning outcomes. In all areas of education, competence-oriented descriptions of learning outcomes are increasingly replacing classical descriptions of objectives and DeepL. Therefore, the present training module for "trainers and instructors of operations in tunnels" is also oriented towards descriptions of competences and learning outcomes.

Learning outcomes are statements of what learners know, understand and are able to do after a learning process is completed. Learning outcomes are defined as *knowledge*, *skills* and *competences* .[1]

[1] 1 Recommendation of the European Parliament and of the Council on the establishment of the European Qualifications Framework for lifelong learning, 2008

A unit of learning outcomes should be designed in such a way that as closed and structured a learning process as possible can be derived from it, with defined coherent learning outcomes and clear assessment criteria.

The professional competences of a trainer and educator are largely covered by the preceding training path.

In this training, the participant independently develops the didactic possibilities and methods for the implementation and practical realisation of the teaching unit on the basis of a teaching unit description of a teaching unit assigned to him/her.

The instructor and trainer is therefore fully responsible for the achievement of the learning outcomes and the safety of the participants under his/her supervision.

To achieve this training objective, the following **competences** are defined for this training:

The participant knows

- Didactic principles for imparting knowledge
- Different training methods specifically for tunnel firefighting

The participant can

- Plan, prepare, implement and debrief a teaching unit based on a described teaching unit.
- adapt the knowledge to the needs of the target group accordingly.
- Guide participants through a teaching unit

The participant masters

- the independent and responsible leadership of a training group
- solve subject-related problems and ensure and further develop the participants' subject-methodical development.
- prepare, conduct and reflect on the teaching unit according to specifications
- Select the appropriate teaching method according to the participant's level and design the learning process independently and sustainably

Methodical approach and structure of the training

In order to be able to convey the subject matter as sustainably as possible, it makes sense to use methods that support the self-learning competence of the participants. Therefore, the focus is on a *participant-oriented* and *participant-centred* design of the training.

Participant-oriented training has the following goals:

> Exchange of experience, increase of communication skills and presentation skills, joint development and presentation of contents, exchange of experience

Participant-centred training has the following goals:

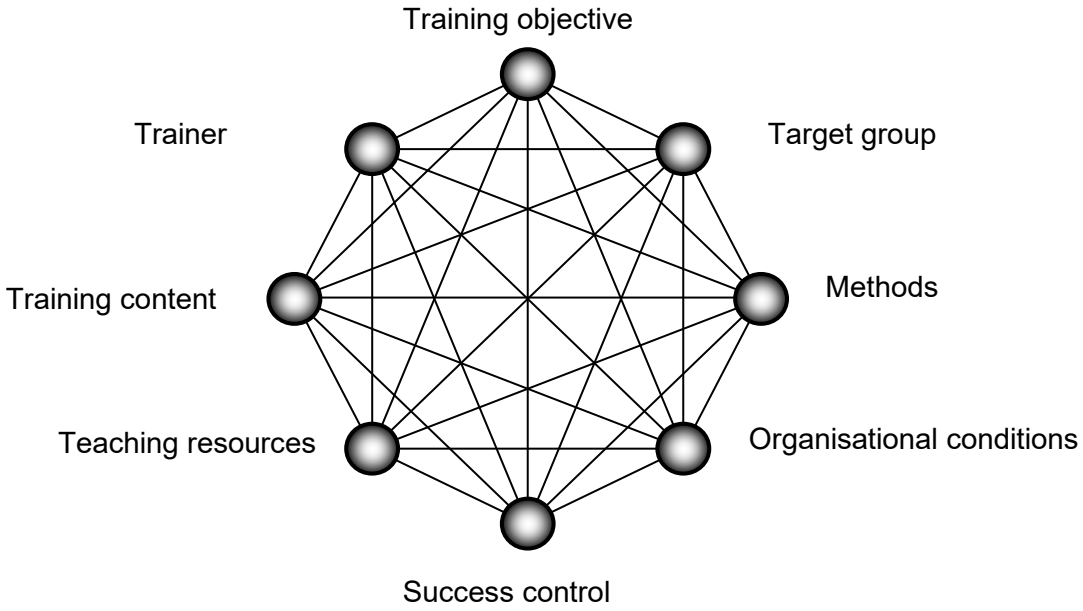
> Fostering the ability to be creative and innovative, teamwork, connecting existing experiences with new tasks, learning by trial and error, learning by doing, coming up with solutions, making decisions, justifying decisions

These goals are supported by the **principle of a guiding and controlling role of the trainer and the self-activity of the trainees. The** more actively the trainees participate in the lessons, the greater the learning success. The learner must be taken out of his passive receiving role and led towards independent thinking and learning. The trainer slips into the role of a "coach" and gives the trainees appropriate feedback.

The intensive, above all practical, engagement with the (future) role of trainer and trainer and learning through feedback results in a very personal and individual gain in learning experience.

Structure and design of a teaching unit - planning elements for trainers and instructors

For planning and designing a teaching unit, the "didactic octagon" serves as a good orientation guide for a trainer and instructor:



The training objective:

The objective sets the direction, defines what should be achieved at the end of the training. It defines the direction of the participants' competence growth.

The target group

Considerations regarding the target group are guided by the following questions:

What is the overall size of the target group? What are the characteristics of the learners in the target group? What (previous) experiences do the participants have in relation to the content? What are common characteristics and what differences exist within the target group?

What about the learning behaviour and habits of the target group?

The contents:

The amount and level of content should be adapted to the respective training project.

What information and content is important to achieve the training objective? What should be the scope of the training unit? Less is more!

The principle applies: less is more. Since not all participants learn equally quickly and equally well, it makes sense to approach the participants individually - and only in this way can sustainable learning success be achieved.

The methods (teaching form):

In order to ensure the best possible learning success and to be able to prepare the content for the target group, considerations regarding the delivery of the learning material are important.

The following questions should be considered:

How can the target group best be addressed and what types of methods are the participants amenable to?

Which method and form of teaching can achieve sustainable learning success?

Which methods are suitable for the given equipment, resources, possibilities and infrastructure?

Does the method suit the teacher? How familiar is it to him? How much does he identify with the method? How creative can he be with the method?

Teaching resources

This involves suitable teaching aids (media) and tools to make training more "comprehensible" and to convey the content in an appealing form. The right teaching aids adapted to the target group can significantly support learning success.

Examples: Pictures, videos, flipchart, worksheets, various materials etc.

Organisational conditions (setting)

The framework conditions for the implementation of a course or teaching unit are also important considerations that need to be taken into account during planning. This includes, for example, the location, infrastructure, equipment, protective equipment, etc. But also the time planning and the sequence of events are important, generally the entire structure of the teaching unit (introduction - main part - conclusion).

Finally, a suitable social setting must be found - i.e. an appropriate group structure or interaction structure and a social form suitable for the target group.

The success control

Whether the defined training objective has been achieved and what the participants take with them from the learning situation into everyday life is to be checked in the form of a performance review.

Success checks can take the form of tests, debriefings or feedback or reflection sessions with the participants.

The trainer:

The trainer is the centre of attention, he sets an example and is also a motivator. He leads the participants, thus has the role of a leader. Appearance and behaviour in front of the group, self-confidence, eloquence, creativity and above all professional, methodological and social competence are important characteristics of a trainer.

In order to support the trainees professionally with regard to the training, the teaching unit "*Didactics and Methods for Tunnel Training*" is upstream at the beginning of the training.

Co-funded by the
Erasmus+ Programme
of the European Union

Description of the teaching unit "Didactics and Methods for Tunnel Education":

Course	**Train the trainer for fire brigade instructors at fire incidents in railway and road tunnels**		
Title of the teaching unit:	**Didactics and methods for tunnel education**		
Duration of the teaching unit:	120 min		
Number of participants:	min. 5 to max. 9	**Number of trainers:**	1
Examination:	Part of the overall examination The theoretical input is implemented and assessed in practical training		
EQF level:	Level 4		

Aim of the teaching unit:

Suitable didactic possibilities and methods for tunnel training are taught. The participants master the independent application of the teaching unit description.

Knowledge	Skills	Competences
He/She knows: • the basics of didactics and the different planning elements ("didactic 8-corner") • Various training methods for theoretical and practical training	He/she can: • plan and develop a training (course, training course) according to the teaching unit description • Analyse the existing knowledge of the target group and adapt the didactic approach to the needs of the target group accordingly.	He/she is proficient: • the application of training methods and selects the method appropriate for the participants • monitoring and assessing the training situation with regard to

	• Guide the participants through a teaching unit • Conduct and reflect on a training unit according to the unit description.	possible hazards and for the participants during training • Evaluation of the training area and conditions with regard to safety
Methods of training:	• Lecture on the basics of methodology and didactics • Lecture on the various methods (lecture, group & team work, teaching discussion, self-study etc.) • Elements of planning a lesson) • Appearance and behaviour of a trainer in front of the group • Use of media such as flipchart, moderation board, etc. • Discussion of the teaching unit description	
Type of teaching unit:	100% presence	
Teaching form:	100 % Teaching talk	
Protective clothing:	Service clothing	
Equipment:	Various teaching aids such as flipchart, moderation board, beamer etc.	

Special methodological-didactic approaches of the "Train the Trainer for Tunnel Operations".

In addition to the various training methods such as lecture, brainstorming, group work, teaching talk, etc., the following special didactic approaches are emphasised in the present training, which are explained in a little more detail here:

Learning through independent development and presentation of teaching units with subsequent feedback

The methodological concept of the present "Train the Trainer" training is that the trainees work out teaching units from the previous curricula of the basic training independently and present them afterwards. This means that one or two trainees slip into the role of a trainer and present and lead a teaching unit for the other trainees; the other trainees are in the role of "participants". The trainer as a coach observes the process on a meta-level and gives personal feedback on the respective lesson afterwards. The other trainees also pass on their experiences as participants in the form of personal feedback.

Focal points that are discussed in the feedback are:

> Appearance as a trainer, leading the participants, correct choice of methodology, creativity, safety

Business game:

A simulation game is a simulation and serves as preparation for a complex practical situation in an operation. If they are designed realistically, simulation games offer the advantage that they enable different ways of acting, and that different decisions can be made and their effects tried out. Through this trial action, a lasting change in the evaluation of contents and behaviour can be achieved. Simulation games offer space for constructions and experimental action. They can be used to experience subject-specific as well as methodological and social competences in an experiential, time-dense and discussion-intensive manner. Simulation games also encourage dialogue and reflection. Moreover, simulation games require the personal participation of several (ideally all) trainees. The simulation game is also a good method to enable learning on many levels.

By imparting knowledge in a playful way, the learning situation is multi-layered and multi-dimensional and thus appeals to the participants affectively and intellectually. In addition, the process orientation enables and promotes a creative approach to the subject knowledge. And creative handling always means active engagement with the subject matter. In addition, the social component of learning is also taken into account in a simulation game, since learning takes place in social units and in a group.

The experiences gained are then analysed and prepared for transfer to everyday work with the trainees in the sense of knowledge transfer.

In this Train the Trainer training, the participants have to independently prepare for the implementation of a business game, adapt it to the level of the trainees and then guide and work through the business game. The results are then analysed and evaluated together with the trainers.

Augmented Reality - Learning in the "Learning Space

A learning method in the form of "virtual reality" or "augmented reality" creates experiential spaces that promote the learning process individually and enable learning spaces in which reflection and feedback can take place. Different scenarios can be reproduced again and again in a standardised way and can be changed depending on the target group and the teaching objective. In addition, a wide variety of scenarios can be played out without putting the participants in danger or having to take elaborate safety precautions or prepare exercises.

In a virtual learning situation, roles and perspectives can be changed in relation to a situation; participants are fully immersed in a scenario in the respective role or perspective. Their own perception is determined by the virtual learning world and enables them to act in the role or to experience the situation through the eyes of another role.

VR learning worlds thus promote the experience on an individual level. They enable interactive engagement with a defined scenario and get participants to get involved in doing and acting themselves. Personalised feedback complements individual learning.

The focus is therefore on independent active doing and experiencing and thus on acquiring action and problem-solving skills. By immersing themselves in a learning situation, participants are themselves part of a virtual learning world, their perception is focused on the respective scenario; for them, the perceived world appears as the "real" one, even if they are aware that they are in a virtual world. Through these experiences, the learning success can be significantly increased.

In this train the trainer course, the virtual learning world is taught using **HoloLens technology.** Specifically, the HoloLens from Microsoft is used with the software application **HoloPackage from the company REALSIM.** Various conditions such as fire, smoke, people, different effects, etc. are superimposed on the real environment via holograms. This puts the trainee in an environment that comes very close to a real operation. This makes it possible to create a safe, but real-looking operational situation. On the one hand, each participant sees the real environment with all influencing factors (vehicles, tunnel wall, road, vehicles), on the other hand, he feels the draught and hears the ambient noises that are really present. In addition, the participant sees and hears the superimposed holograms, which above all represent the dangerous situations. With the possibility that a multiple choice test can also be shown as a hologram, the participant can be asked a wide variety of questions. An ongoing decision-making process is thus available.

Figure 1: Representation of a scenario using HoloPackage from the company REALSIM (LFS Tyrol).

By means of the **"Mixed Reality" method,** the scenarios can be directly adapted to the actions or decisions of the trainees at any time. This provides the possibility of direct feedback on the actions and decisions made. The scenario can become more complex or simpler depending on the tactical decisions made. This direct feedback loop changes the prevailing exercise situation and requires the trainee to re-evaluate the situation and thus make new decisions.

Another great advantage is the production and reproduction of a real operational situation. If an operational situation is not handled as desired, it can be restarted with exactly the same conditions and the mistakes made can be improved in a timely manner. This increases learning success and motivation considerably.

The advantages of augmented reality" summarised once again:

- Safe training environment
- All dangerous situations are virtual
- Scenario can be adapted to the respective learning objective
- Reproducibility and standardisability
- Direct feedback to the participants via the application

eLearning and blended learning

A specific form of eLearning is blended learning. This refers to a form of learning that consists of a mixture of attendance phases and - usually supervised - individual phases/distance learning phases in which parts of the learning process and communication are conducted, for example, via a digital learning platform or a learning management system (LMS).

Today, e-learning is seen as a supplement and extension of traditional forms of learning. The advantages lie in a reduction of dependence on place and time, in an expanded knowledge space, in the use of additional media and communicative levels. The disadvantages lie in the effort required to set up the infrastructure and to supervise virtual groups.

Participation in this training requires completion of the blended learning activity SAFEINTUNNELS - Fire Fighting in Railway Tunnels. If the participants pass a subsequent single choice test, they will receive a certificate confirming the necessary theoretical learning outcomes.

The blended learning activity method is regarded here as upstream independent learning and serves to convey learning content in advance in theory. The aim is to adequately prepare the participants for the classroom course and thus create a good foundation for the practical training. The advantage is that what has been learned in theory can be put into practice immediately and thus an initial consolidation of the contents is achieved in a timely manner.

Ten modules of the Train the Trainer training

The training "Train the Trainer for Tunnel Operations" is divided into 10 modules:

1. Technical introduction to tunnel structures
2. Explanation of the technical and local conditions
3. Safety in handling the resources used: Vehicles, equipment and materials for tunnel operations and accident prevention
4. Natural science basics for tunnel operations
5. Tactical use of vehicles, equipment and materials for tunnel operations
6. Types of operation in tunnel rescue:
   a) Human rescue
   b) Firefighting
7. Special tactics for tunnel operations
8. Training of special tactics in tunnel operations
9. Develop and implement management guidelines for the implementation of tunnel operations and cooperation with external parties.
10. Leadership competence in the field - especially in cross-border tunnels

The individual modules divide up the tunnel topic. For this purpose, teaching units were developed and described, including a short workshop on "*Didactics and Methods"* for the trainers. The aim of this workshop is to update already trained trainers for teaching the specific competences on the tunnel topic.

Timetable of the practical training

Training "Train the Trainer for Tunnel Operations":

Day 1

Time	Topic	Place / Instructor / Speaker
08:00 - 08:30	Welcome and introduction	Teaching room Trainer
08:30 - 10:50	Didactics and methods for tunnel education - Short workshop	Teaching room Trainer
11:00 - 11:50	Training topic: "Safety	* Participant
11:50 - 13:00	Lunch break	
13:00 - 13:50	Training topic: "Upstream and downstream sides	* Participant
14:00 - 14:50	Training topic: "Communication technical	* Participant
14.00 - 14.50	Training topic: "Dangers in the track area".	* Participant
15.00 - 15:50	Training topic: "Equipment and aids for tunnel operations".	* Participant
16.00 - 16:50	Training topic: "Hose management	* Participant
17.00 - 17:50	Training topic: "Structural cooling	* Participant
17.50 - 18:00	Conclusion 1st day	Teaching room Trainer

* The teaching unit is designed and carried out by the participants. The participants receive feedback from the trainers afterwards.

Day 2

Time	Topic	Place / Instructor / Speaker
08:00 - 08:50	Training topic: "Extinguishing - in the road tunnel".	* Participant
09:00 - 09:50	Training topic: "Extinguishing - in the railway tunnel".	* Participant
10:00 - 10:50	Training topic: "Exploring - railway tunnel".	* Participant
11:00 - 11:50	Training topic: "Exploring - Road tunnel"	* Participant
11:50 - 13:00	Lunch break	
13:00 - 13:50	Training topic: "Search and rescue - in the road tunnel".	* Participant
14:00 - 14:50	Training topic: "Search and rescue - in the railway tunnel".	* Participant
15.00 - 15.50	Training topic: "Marking luminaires / identification luminaires	* Participant
16.00 - 16.50	Training topic: "Tunnel infrastructure	* Participant
16.50 - 17.00	Conclusion 2nd day	Teaching room

* The teaching unit is designed and carried out by the participants. The participants receive feedback from the trainers afterwards.

Day 3

Time	Topic	Place / Instructor / Speaker
08:00 - 08:50	Simulation game: thematic focus "Basic tactics for tunnel operations	* Participant
09:00 - 09:50	Business game: thematic focus "water supply	* Participant
10:00 - 10:50	Simulation game: Focus on "Pollutants in the tunnel	* Participant
11:00 - 11:50	Simulation game: Thematic focus "Tunnel ventilation and ventilation support	* Participant
11:50 - 13:00	Lunch break	
13:00 - 13:50	Simulation game: thematic focus "operational command	* Participant
14:00 - 14:50	Business game: thematic focus "Communication	* Participant
15.00 - 16:00	Summary and conclusion	Teaching room

Learning outcomes assessment

Practical exam

The examination is based on the **basic training for crews of fire engines fire fighting in railway tunnels**, the **basic training for crews of fire engines fire fighting in road tunnels** as well as the **training for emergency managers in road and railway tunnels**. The participants are assigned training topics which have to be prepared, carried out and discussed in the role of the instructor. The descriptions of the teaching units from the previous training parts are used as the basis for the content. The trainer responsible for the module observes the participants in the role of the trainer and carries out the assessment. It is also to be checked whether the learning contents and learning objectives have been conveyed according to the description of the corresponding teaching units.

Trainers shall ensure consistency and fairness in assessment and evaluation.

The examination is considered positive if at least 65% of the total number of points has been achieved.

Sub-areas of the practical examination

Practical training competences		**Learning Outcome**		
		Not reached	Partially achieved	reached
Skills The participant can...	• plan and develop a training (course, training course) according to the teaching unit description	1 point	2 points	3 points
	• Analyse the existing knowledge of the target group and adapt the didactic approach to the needs of the target group accordingly.	1 point	2 points	3 points
	• Guide the participants through a teaching unit	1 point	2 points	3 points
	• Conduct and reflect on a training unit according to the unit description.	1 point	2 points	3 points
Competences The participant masters...	• the application of training methods and selects the method appropriate for the participants	1 point	2 points	3 points
	• monitoring and assessing the training situation with regard to possible hazards and for the participants during training	1 point	2 points	3 points
	• Evaluation of the training area and conditions with regard to safety	1 point	2 points	3 points
Sum of the individual evaluations →				
Total points Number • ≥ 14 points passed • < 14 points failed				

ECVET assessment

ECVET to promote mobility and lifelong learning

The European Credit System for Vocational Education and Training (ECVET) is a technical framework for the crediting, recognition and, where appropriate, accumulation of learning outcomes achieved by an individual towards the acquisition of a qualification.[1] This is to be done in particular through the structured description of qualifications in units of learning outcomes, which allows for greater transparency and better comparability in VET through the use of a "common language", and through the structured processes and agreements between stakeholders, which form the basis for mutual trust.

The application possibilities of ECVET are seen above all in the area of cross-border mobility and in the area of lifelong learning:

- On the one hand, ECVET contributes to making the knowledge, skills and competences acquired in the context of cross-border mobility in VET visible and - based on their identification and assessment abroad - to facilitating their recognition at home. This should make it easier to integrate learning experiences gained abroad into initial or continuing vocational education and training.
- On the other hand, ECVET can be used to make programmes and pathways leading to a qualification more flexible and to improve the framework conditions for lifelong learning. ECVET can thus facilitate the recognition of learning outcomes acquired by learners in different settings: be it in different countries, institutions or systems (e.g. education or training) or also within formal, non-formal or informal learning contexts.

[1] Recommendation of the European Parliament and of the Council of 18 June 2009 on the establishment of a European Credit System for Vocational Education and Training (ECVET)

Source: https://www.na-bibb.de/fileadmin/user_upload/na-bibb.de/Dokumente/02_Berufsbildung/01_Mobilitaet/08_ECVET/Implementing_ECVET.pdf (accessed 08.02.2021)

Evaluation of the training

Classroom training at a fire brigade training centre:

The three-day classroom training includes all described learning units and the practical examination. This requires 24 teaching units according to the inserted timetable for the entire implementation.

With the positive completion of the practical examination, the course "Train the Trainer for Fire Service Instructors in Fire Incidents in Railway and Road Tunnels" is completed.

This training is assessed 1. ECVET point.

Certificate

Each participant receives a certificate after passing the practical examination. The following points must be listed on the certificate:

Certificate of attendance

Event: Train the Trainer for firefighting instructors at fire incidents in railway and road tunnels.

Location of the training centre:	e.g. Tyrol Regional Fire Brigade School, Telfs
Date:	e.g. 02.-04.09.2022
Name of the participant:	e.g. Mst. Ing. Gerhard Schöpf
Place of employment:	e.g. Silz fire brigade
ECVET points:	1

He/She knows:

- the basics of didactics and the different planning elements
- Various training methods for theoretical and practical training

The participant can:

- plan and develop a training (course, training course) according to the teaching unit description
- Analyse the existing knowledge of the target group and adapt the didactic approach to the needs of the target group accordingly.
- Guide the participants through a teaching unit
- Conduct and reflect on a training unit according to the unit description.

The participant masters:

- the application of training methods and selects the method appropriate for the participants
- monitoring and assessing the training situation with regard to possible hazards and for the participants during training
- Evaluation of the training area and conditions with regard to safety

Signature: Confirmation (stamp, signature) of the training institution