Responsibility for the regulation of health and safety on the railways was transferred from the Health and Safety Commission (HSC) and Health and Safety Executive (HSE) to the Office of Rail Regulation (ORR) on 1 April 2006.

This document was originally produced by HSC/E but responsibility for the subject/work area in the document has now moved to ORR.

If you would like any further information, please contact the ORR’s Correspondence Section - contact.cct@orr.gsi.gov.uk
RAILWAY SAFETY PRINCIPLES and GUIDANCE part 1
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<td>Interiors</td>
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<td>Access and egress</td>
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<td>Compatibility with infrastructure</td>
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<td>Trains</td>
<td>Compatibility with electric traction systems</td>
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FOREWORD

Soon after the Railway Inspectorate was formed in 1840, they issued the first written advice on the standards of construction which were considered to be important for the safety of the railway. The advice was aimed at those who were building the new railways. It outlined good practice and helped to produce consistency between different places and different railways.

Over the years this advice on good practice has been extended to cover most aspects of railway construction. The last full review and updating took place in 1950 and was issued by the Ministry of Transport as *Railway construction and operation requirements for passenger lines and recommendations for goods lines*. It became widely known throughout the industry as ‘The Blue Book’ or simply the ‘Requirements’, although it was always intended to give advice and not set an absolute standard.

Some parts of the Blue Book have since been revised and reissued, notably the sections on level crossings and structural clearances. Other parts are clearly now out of date and the Inspectorate has been working on updating the document for some time. Consultation with the rapidly changing railway industry has recognised a need to provide advice in a different way and in a somewhat different format than the Blue Book.

The guidance is now being published in two distinct ‘parts’. Part 1 sets out the top level safety principles and gives an indication of the factors which need to be taken into account in implementing them. For some sections of the railway industry this level of advice will be sufficient and from it they will develop their own standards. However, the needs of the industry differ as widely as the railways themselves.

Part 2 consists of seven separate publications dealing with specific aspects of railway construction. It provides an expansion of the advice given in Part 1 and also gives examples of good practice acceptable to the Inspectorate, for those who would find such advice of assistance.

With the new format there is also a new name for the documents: *Railway safety principles and guidance*. It is hoped that the railway industry of today will find this new guidance to be as helpful as the Blue Book’s advice was in the past.

During the development of the new format and preparation of the principles and guidance, the Railway Inspectorate has consulted extensively with the railway industry and other organisations who could usefully contribute to the work. Much assistance and many constructive comments have been received and the Inspectorate is most grateful for the time and help it has been given.
INTRODUCTION

Intended readership

1 Railway safety principles and guidance is intended to give guidance and advice to those involved in the design and construction of new and altered works, plant and equipment (which includes trains and other rail mounted vehicles) capable of affecting the safety of railways, tramways or other guided transport systems, which require approval under the Railways and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994.

Objective

2 The document is not intended to set out mandatory standards. It describes the aspects of safety which HM Railway Inspectorate of the Health and Safety Executive would expect to see considered in railway works, plant and equipment to provide an acceptable level of safety for any people affected, ie the public (passengers and others), employees and contractors.

Structure

3 Part 1 sets out the top level safety principles which will need to be considered in the development and implementation of new and altered works, plant and equipment. For some parts of the railway industry, with the appropriate competence and resource, this level of advice will be sufficient for them to develop their own standards.

4 Part 2 provides further advice on how these principles may be implemented, for those who would find such advice of assistance. It consists of eight separate publications dealing with specific aspects of railway construction and also gives examples of acceptable good practice. The publications are:

   A The infrastructure
   B Stations
   C Electric traction system
   D Signalling
   E Level crossings
   F Trains
   G Tramways
   H Minor railways

The RSPG series Parts 1 and 2 can be found on the HSE website at:

Scope

5 The document covers all the types of works, plant and equipment that may be found on all guided transport systems including main-line (heavy) railways, mass transit, light rail and tramway systems. For convenience, works, plant and equipment are grouped into categories such as track, stations, trains etc.
<table>
<thead>
<tr>
<th>OPERATIONAL SAFETY</th>
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<tbody>
<tr>
<td>6 It is not intended to provide any guidance on operational safety, but the design</td>
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<td>should take account of how the works, plant or equipment are to be used and</td>
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<tr>
<td>maintained.</td>
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<tr>
<td>7 The principles apply to the finished works, plant or equipment but not to the</td>
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<tr>
<td>processes of designing or building. Designers and builders need to be aware of</td>
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<tr>
<td>the responsibilities imposed upon them by the Construction (Design and Management)</td>
</tr>
<tr>
<td>Regulations 1994 as amended by the Construction (Design and Management) (Amendment)</td>
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<td>Regulations 2000 made under the Health and Safety at Work etc Act 1974.</td>
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<th>APPLICABILITY</th>
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<td><strong>Application</strong></td>
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<td>8 Not every principle applies to all aspects of all guided transport systems.</td>
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<td>For example, some of the principles do not apply to a non-electrified freight</td>
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<td>only railway.</td>
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<th>EFFECTS ON EXISTING WORKS</th>
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<td>9 Railway safety principles and guidance does not apply retrospectively to</td>
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<td>existing works, plant and equipment. However, new or altered works, plant and</td>
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<td>equipment might introduce incompatibilities or inconsistencies with the existing</td>
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<td>works, plant or equipment. This could have implications for safety. In this</td>
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<td>case, approval may only be given if appropriate arrangements have been made</td>
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<td>to address these safety implications which may include modifications to the</td>
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<td>existing works, plant or equipment.</td>
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<th>TRAMWAYS</th>
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<td>Application to tramways</td>
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<td>10 While the principles are worded for railways, they are usually also</td>
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<td>applicable to tramways, so that in general where the term ‘railway’ is used in</td>
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<tr>
<td>the text, it is intended to include ‘tramway’ and similarly ‘train’ to</td>
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<tr>
<td>include ‘tramcar’. Where there are differences, the extent of the application</td>
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<td>to tramways is indicated under the principle concerned.</td>
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<th>HERITAGE SYSTEMS</th>
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<td>Application to heritage systems</td>
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<td>11 The principles also apply to heritage railways and tramways. The way the</td>
</tr>
<tr>
<td>principles are implemented may differ from main-line railways and tramways</td>
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<tr>
<td>because of restrictions in the way that the heritage systems operate, such as</td>
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<td>lower speeds and the overall intention to preserve the historical appearance of</td>
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<td>the railway or tramway.</td>
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<tr>
<th>FUNICULARS AND OTHER GUIDED TRANSPORT SYSTEMS</th>
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<tr>
<td>Application to funiculars and other guided transport systems</td>
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<tr>
<td>12 The principles are intended to apply to funiculars and other guided transport</td>
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<td>systems only to the extent that is appropriate taking into account the special</td>
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<td>features which the system concerned may possess. In such cases, the principles</td>
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<td>may have to be interpreted with some degree of flexibility.</td>
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<tr>
<th>ALARP</th>
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<tr>
<td>Level of safety to be achieved</td>
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<td>13 The Inspectorate, in judging whether any works, plant or equipment provides</td>
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<td>a sufficient level of safety for approval to be given, will wish to be satisfied</td>
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<tr>
<td>that due consideration has been given to implementing the safety principles in</td>
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<tr>
<td>this document in a way that ensures that all intolerable risks have been</td>
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<tr>
<td>eliminated and that all remaining risks have been reduced to be as low as</td>
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<td>reasonably practicable (known as ALARP).</td>
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</table>
14 In considering how to implement these principles, care should be taken to:
   (a) identify the complete range of foreseeable hazards;
   (b) assess each hazard and establish its importance;
   (c) provide a means of preventing or controlling the hazard, if appropriate;
   (d) provide a means of mitigating the effects of the hazard in appropriate ways; and
   (e) provide a means of recovery from the hazard, if appropriate.

15 It is important to consider hazards that arise from outside the railway system as well as from
within the railway system or adjacent railway systems.

Operating conditions
16 The choice and design of the works, plant and equipment will depend not only on the safety
principles expressed in this document, but also on the operational requirements of the railway.

17 In assessing the suitability of any proposed safety measures or arrangements, it is important to
take into account:
   (a) normal operating conditions;
   (b) degraded conditions where any component or part of the railway system has failed;
   (c) foreseeable abnormal conditions to which the railway system may be subjected; and
   (d) emergency situations.

Environmental conditions
18 It is important to take into account the full range of foreseeable environmental conditions to
which the works, plant and equipment may be subjected. This includes temperature extremes, wind,
rain, hail, snow, ice, flood, reduced visibility etc.

Fire
19 It is also important to take into account the risk and consequences of a fire and the measures
that may be necessary to deal with this situation.

Inspection and maintenance
20 The safe inspection and maintenance of any works, plant and equipment should be allowed for
throughout their lifetime, as well as their decommissioning and disposal. However, approval does
not extend to the inspection and maintenance procedures themselves.

Approval procedures
21 Guidance on the procedures to be adopted, and the format of the documents to be submitted by
those seeking approval of projects, is contained in the HSE publication Guide to the approval of
railway works, plant and equipment (second edition), is published on the HSE website at:
Other regulations and standards

22 Works, plant or equipment may be subject to other specific regulations, for example, the Electricity at Work Regulations 1989. In implementing the principles in Part 1 there must be compliance with such regulations as appropriate. The principles and factors in Part 1 do not make reference to these other regulations, however, the Part 2 documents do provide some of the more significant references.

23 Similarly, any material or article used in the provision of works, plant or equipment may need to comply with a specific standard. The principles and factors in Part 1 do not make reference to these numerous standards, however, the Part 2 documents do indicate where standards may be appropriate.

READING THE PRINCIPLES

24 The principles and their attached factors are presented concisely and are as self-contained as possible. Therefore, in reading the principles it is important to understand the format employed:

(a) principle title - a short title identifying its subject matter;

(b) principle group - the group to which the principle belongs;

(c) the principle itself;

(d) any notes on applicability or exclusions; and

(e) a list of factors for consideration.

25 Many of the safety principles are related. The relationship between principles is evident either in the wording of the principle or in the factors to be considered. The structure and inter-relationships are described below.
Definition of a principle

26 A safety principle is a key objective for the performance of works, plant or equipment in ensuring the safety of the railway system.

27 The principles do not set specific target levels of safety. The risk management process should determine the appropriate levels.

Structure of the principles

28 Principle 1 is the top-level safety principle or safety mission for a railway:

The design and construction of new and altered works, plant and equipment should, in so far as is reasonably practicable, ensure the safety of any people who may be affected.

29 This principle is broken down into a number of further, more specific principles to make its interpretation easier. These principles have been grouped as shown in Figure 1. The structure is based on the major types of works, plant and equipment. ‘Equipment’ includes trains and other rail mounted vehicles.

![Figure 1: Structure of the principles](image-url)
Figure 2: Complete structure of the principles
The main groups of principles can be sub-divided further. The full sub-division of principles is shown in Figure 2. Figure 3 illustrates a specific sub-division for stations. Similar figures are used to ‘sign-post’ the groups of principles in the document.

![Diagram showing sub-division of principles]

**Figure 3: Structure of station and stabling areas principles**

**Explanation:**

(a) The top shaded box sign-posts a grouping of principles;
(b) Principle 10 is the top-level principle for stations. Its factors apply to all aspects of the station;
(c) Principle 11 gives specific advice for station platforms;
(d) Principle 12 gives specific advice where there are terminal tracks at a station which need special consideration; and
(e) Principle 13 gives specific advice on control facilities in station complexes, which is further expanded in the areas of station evacuation (Principle 14) and fire precautions (Principle 15).

Continuing to sub-divide principles will result in detailed guidance which is provided in Part 2.
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<tr>
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<th>CONTROL SYSTEMS AND SIGNALLING</th>
<th>TRAINS</th>
<th>ELECTRIC TRACTION SYSTEMS (ETS)</th>
<th>STATIONS</th>
<th>INFRASTRUCTURE</th>
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<td>Location identification</td>
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<td>Structure integrity</td>
<td>Location identification</td>
<td>Location identification</td>
<td>Protection of the railway</td>
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<td>Level crossings</td>
<td>Level crossings</td>
<td>Interiors</td>
<td>ETS - Safe for people</td>
<td>Stations safe</td>
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<td>Compatibility with ETS</td>
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</table>

Figure 4: Relationships

Explanation:

(a) The intersections contain the principle titles with their numbers that relate to parts of the railway. For example, Principles 4 and 23 concern Level crossings and People.

(b) Where there are no relationships between principles, the intersections are shaded. For example, there are no principles that relate Trains directly with Level crossings.
Relationships between the principles

32 Many of the safety principles are related. The relationship between them is evident either in the wording of the principle or in the factors to be considered.

33 The principles describe the performance required of an item of works, plant or equipment in relationship with people or other items of work, plant or equipment. The principles are either:
(a) directly concerned with the safety of people; or
(b) concerned with the safety of the environment, in so far as it may have a subsequent effect on the safety of people; or
(c) concerned with the safety of the works, plant or equipment, in so far as they may have a subsequent effect on the safety of people.

34 Where a principle is concerned with a related item of works, plant or equipment then there is likely to be a related principle. For example, Principle 6 is concerned with the positioning of track so that there are adequate clearances for trains, while Principle 32 is concerned with the compatibility of trains with the infrastructure.

35 Figure 4 shows how the principles relate to different aspects of the railway and it can be used to work out the relationships between principles.

36 Further relationships exist between the subordinate principles, but these are not shown in Figure 4.

Factors

37 Each principle has attached to it a number of factors which should (where appropriate) be taken into account in implementing the principles. The factors given are not intended to be an exhaustive list nor are they listed in a precise order of priority. They give some of the most critical factors for safety as well as some aspects which the Inspectorate finds are often overlooked.

Applicability of principles and factors

38 Factors which apply to a principle also apply to any subordinate principle. For example, the need for inspection and maintenance throughout the lifetime of works, plant and equipment is a factor attached to Principle 1 which applies to all other principles.

39 Not all principles or all factors apply to all guided transport systems. For example, they do not apply retrospectively, and some of the principles do not apply to the on-street running sections of a tramway where the tramway is not segregated from people and road traffic.

40 A ‘Note’ is provided where there is a need to note exceptions and interpretations.

41 In the document, some words or expressions are used in a particular way which may mean something different to what they mean normally, or they may have a meaning that is different to that accepted by different parts of the Railway Industry. The ‘Common terms’ section gives an explanation of the words and expressions used.
COMMON TERMS

Where possible the document has been written in plain English and the use of technical expressions or jargon has been avoided. However, to keep the document reasonably concise and to avoid the repetition of phrases which only serve to provide an extended definition, some words or expressions are used in a way which has a slightly wider meaning than their natural meaning, or a meaning that is different to that accepted by disparate parts of the Railway Industry.

The following are terms used within the document:

RAILWAY TERMS

Railway terms

‘Railway’ means all guided transport systems to which the Railway and Other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994 apply. It includes main-line (heavy) railways, mass transit, light rail, tramway and heritage systems.

‘Tramway’ means a system of transport used wholly or mainly for the carriage of passengers which:

(a) employs parallel rails which provide support and guidance for vehicles carried on flanged wheels; and

(b) has been designed to have a significant element which operates on line-of-sight on a highway.

Note: In the context of tramways, ‘highway’ is used to mean any, or any combination, of the following: carriageway, bridleway, cycle track, footpath, land on the verge of a carriageway or between two carriageways and any other place to which the public has access (including access only on making a payment).

‘Heritage system’ means a railway or tramway which has retained or has assumed the character and appearance and, where appropriate, operating practices of railways or tramways of former times. For example, it may replicate a railway branch line of former times, or may reflect no particular era but demonstrates a wide variety of motive power and rolling stock at work, irrespective of the company (or country) of origin.

‘Other guided transport system’ means a system, other than a railway or tramway, where the vehicles operating on it are guided by means external to the vehicles (whether or not the vehicles are also capable of being operated in some other way). The term therefore includes monorails and airport transit systems.

Note: Trolleybuses are excluded because they are not in any circumstances guided externally, and funiculars are not included because they fall under the definitions of railway or tramway.
People terms

‘People’ means workers on the railway, passengers, emergency services personnel, people on business, level crossing users and trespassers (those who are on railway property when they have no right to be there) on the railway.

There are four types of ‘people’:

(a) ‘Workers’ means staff and contractors directly employed on the railway (including the train crew, station staff, signalling staff etc) and contractors employed in the supply industries, maintenance facilities and disposal organisations. The workers may be employed at a fixed location or move about the railway.

(b) ‘Passenger’ means any person who is on railway property and is travelling, or intends to travel, or has recently finished travelling on the railway. Consideration should be given to a wide range of passenger characteristics and classifications, for example:

- passengers who are disabled (visually, hearing, or mobility impaired);
- children and unusually short and tall adults;
- passengers with heavy luggage, pushchairs, young children etc.

Passengers may be on the station premises (waiting to purchase a ticket, waiting on the platform etc) or on a train.

(c) ‘People on business’ means people who:

- visit railway premises as non-travelling ‘passengers’ (people meeting or seeing off passengers, train spotters, customers of station retail units etc);
- official visitors to the railway.

(d) ‘Level crossing users’ means people crossing the railway on or at a level crossing. This includes pedestrians, horse-riders and occupants of road and agricultural vehicles.

Infrastructure terms

‘Infrastructure’ means works, plant and equipment used for the operation of a railway including its permanent way, and plant and equipment used for signalling or exclusively for supplying electricity for operational purposes to the railway. It does not include a station. It refers to track, structures supporting it, signalling, and fixed electrical plant such as feeders, switchgear, sub-stations and the like.
### STATION TERMS

**Station terms**

‘Station’ means a railway passenger station or terminal, but does not include any permanent way or plant used for signalling or exclusively for supplying electricity for operational purposes to the railway. For tramways, ‘station’ is used to include a tramstop or platform. A station includes a halt, terminal station and a station complex with or without retail units. ‘Station’ does not include areas associated with station premises, such as car parks, which lie outside those premises.

‘Sub-surface station’ means a station of which more than half of any one platform is within a tunnel or under a building.

### TRAIN TERMS

**Train terms**

‘Train’ means any vehicle or combination of vehicles which run on the railway. Therefore, a train may consist of a single vehicle or a number of vehicles coupled together including any locomotives or power units. A train may be composed of one or more vehicles and vehicle inter-connections. These can be passenger and freight, also maintenance and construction, vehicles. It also includes on-track machines, engineers’ trolleys, cranes and other plant while operating on a railway (commonly referred to as on-track plant or machines). For tramways, ‘train’ means a tramcar, or two or more tramcars coupled together, and includes non-passenger vehicles.

### ELECTRIC TRACTION SYSTEM TERMS

**Electric traction system terms**

‘Electric traction system’ means the electrical equipment and conductors necessary to power trains on the railway. It includes the switchgear and transformers which control the electric current at line voltage, the distribution network and overhead line or conductor rail equipment. It does not include the collection equipment of the train or other on-board equipment.

### SAFETY TERMS

**Safety terms**

‘Hazard’ means a situation with the potential to cause harm including human injury, damage to property, plant or equipment, damage to the environment, or economic loss.

‘Risk’ means the chance of something adverse happening and its severity. It is the combination of the probability, or frequency, of the occurrence of a defined hazard and the magnitude of the consequences of the occurrence.

‘Safety’ means the freedom from unacceptable risks of personal harm, i.e. the avoidance of accidents and incidents.

### OPERATIONAL CONDITIONS OR STATES

**Operational conditions or states**

‘Normal conditions’ means the conditions which a part of the railway is designed to accommodate. This would include the peaks, e.g. rush hours, and troughs in demand experienced during the day.
‘Degraded conditions’ means the state of the part of the railway system when it continues to operate in a restricted manner due to the failure of one or more components.

‘Abnormal conditions’ means extreme loading on a part of the railway system. For example, this may be the result of extended delays on one part of the service impinging on another.

‘Emergency situation’ means a current unforeseen or unplanned event which has life threatening or extreme loss implications and requires immediate attention, eg a fire.
Principle 1: Safety mission

Infrastructure principles

Stations and stabling areas principles

Electric traction system principles

Railway control system principles

Principle 23: Level crossings Safe for users and trains

Train principles
Safety mission

The design and construction of new and altered works, plant and equipment should, in so far as is reasonably practicable, ensure the safety of any people who may be affected.

Note: This is an overriding principle that applies to all fixed works, plant and equipment, and to mobile plant and equipment, including trains, tramcars and any other vehicles, of all guided transport systems.

Factors
The factors for consideration should include the following, which are applicable to all the safety principles:

(a) the interactions between the particular works, plant and equipment and other new, altered or existing works, plant or equipment on the railway;
(b) the interactions between the particular works, plant and equipment and those of other railways and other guided transport systems;
(c) the intended use and the method of operation of the works, plant and equipment, and the safety management system employed;
(d) human factors including the interactions between people and plant and equipment;
(e) trespass, vandalism and wilful acts;
(f) the interactions between the railway and its adjacent environment including physical interfaces, noise, vibration, and electrical and magnetic interference;
(g) the reliability and durability of the works, plant and equipment, and the level of maintenance required;
(h) the arrangements for safe inspection and maintenance throughout the life of the works, plant and equipment, and their decommissioning and disposal;
(i) the implications in respect of the risk posed when degradation occurs;
(j) the integrity of safety critical works, plant and equipment;
(k) the foreseeable climatic conditions;
(l) the limitation of fire load, ignition sources and fire spread; and
(m) the arrangements for the mobility impaired.
Protection of the railway

The railway should be protected against unwanted intrusion and unauthorised access.

*Note: Not all aspects of this principle apply to a tramway.*

Factors
The factors for consideration should include:
(a) the risk of unauthorised access and the provision of suitable barriers and signs;
(b) the need for authorised access by people (workers, emergency services etc) while deterring access to others;
(c) the risks of and special arrangements for any electric traction system;
(d) the arrangements at earthworks and structures supporting, above or adjacent to the railway;
(e) the arrangements at any level crossings;
(f) the activities adjacent to the railway;
(g) the proximity of airports and alignment of runways;
(h) the provision of crash barriers where roads are adjacent to the railway; and
(i) visual distractions such as coloured or beams of light from road vehicles adjacent to the railway.

Clearances for people

There should be adequate clearances, so that where operational procedures permit people onto the infrastructure while trains are operating, they can carry out their duties in safety.

*Note: Except on tramways, it is preferable that people should not be allowed on or about the track while trains are operating.*

Factors
The factors for consideration should include:
(a) the range of people permitted onto the infrastructure including workers, emergency services and those on business with the railway;
(b) the safety clearances on the track side taking into account the aerodynamic effect of passing trains;
(c) the provision of a place of safety or refuge and the time required to reach it by workers on or about the track;
(d) the appropriate marking of structures where clearances do not include allowances for personnel safety;
(e) the safety clearances for all walkways including those to signal posts and in sidings and depots;
(f) the arrangements for emergency disembarkation of people on the train; and
(g) the positioning and securing of any electric traction system equipment.
PRINCIPLE 4
Infrastructure

Location identification

Appropriate means to identify particular locations on the infrastructure should be provided for the safe operation and maintenance of the railway.

Factors
The factors for consideration should include:
(a) the need to identify uniquely the exact location;
(b) the need to identify uniquely the structures;
(c) the method of operating the railway in both normal and abnormal conditions;
(d) the need to respond to foreseeable incidents and attendance by emergency services; and
(e) the need for the identifying mark to be observed from both on and off the railway.

PRINCIPLE 5
Infrastructure

The track

The track should provide for the safe guidance and support of trains.

Factors
The factors for consideration should include:
(a) the static and dynamic forces imposed by the trains on the range of track geometry;
(b) the transfer of loads to the supporting structures;
(c) the arrangements for the transfer of trains from one track to another;
(d) the effect of temperature on the performance of the track;
(e) the requirements of any signalling, train control or electric traction systems;
(f) the provision of adequate containment arrangements where the effects of derailment would be severe;
(g) the resistance of the rails to contamination;
(h) drainage;
(i) in the case of on-street tramways, the effects of road traffic and tramway tracks on each other;
(j) the arrangements at any level crossing;
(k) the means of detecting track failure; and
(l) the noise and vibration that may be generated and their effects.
Clearances for trains

There should be adequate clearances between trains on adjacent tracks and between trains and structures and fixed equipment to ensure safe passage.

Factors
The factors for consideration should include:
(a) the static vehicle profile of trains taking account of the range of track geometry;
(b) the dynamic vehicle profile and behaviour of the trains at all permitted speeds taking account of the range of track geometry;
(c) the aerodynamic effects generated by trains passing through restricted spaces;
(d) the need to place equipment within the confines of the structures without affecting clearances;
(e) the maximum and minimum clearances required at platforms; and
(f) special arrangements to locate and position the track in relation to structures.

Earthworks and structures under the track

Earthworks and structures supporting the track should be capable of carrying and transferring the forces exerted by the trains.

Factors
The factors for consideration should include:
(a) the ground conditions in the locality;
(b) the static and dynamic track loading;
(c) the risk of collision from road, rail or water traffic and the likely impact damage;
(d) the risk of flooding and scour, and their effects;
(e) the risk of derailment and the need to provide for derailment containment;
(f) the positioning and securing of any electric traction system equipment;
(g) the activities adjacent to the railway; and
(h) the risk to earthworks and structures from the failure of pipes or other services under or running alongside the railway.
Earthworks and structures above the track

Earthworks and structures above or adjacent to the railway should be capable of supporting the loads imposed upon them and afford protection to the railway.

Factors
The factors for consideration should include:
(a) the ground conditions in the locality;
(b) the loading on the structures over or adjacent to the railway;
(c) the risk of collision from road, rail or water traffic and the likely impact damage;
(d) the risk of flooding and scour, and their effects;
(e) the risk of derailment and the need to provide for derailment containment;
(f) the positioning and securing of any electric traction system equipment;
(g) the activities adjacent to the railway; and
(h) the risk to the railway from failure of pipes or other services crossing above or running alongside the railway.
Tunnels and similar structures

Tunnels and other enclosed spaces should provide a safe environment for people and for safe evacuation.

*Note: Tunnels are not necessarily sub-surface. Developments over the railway, deep cuttings or other structures may give rise to situations with similar characteristics to tunnels with respect to limited means of access and egress, means and time to escape to a place of safety, and lack of natural ventilation.*

Factors
The factors for consideration should include:
(a) the length of tunnel, single or double track and cross-passages;
(b) the type and frequency of traffic, and type and length of trains relative to the length of the tunnel;
(c) the clearances within the tunnel;
(d) the fire load of the tunnel and equipment within it;
(e) any smoke and fire detection, and fire-fighting and suppression arrangements;
(f) the provision of fresh air and the arrangements to control smoke and other emissions;
(g) the aerodynamic effects generated by trains passing through restricted spaces;
(h) compatibility with rolling stock for emergency evacuation;
(i) a safe means of escape to a place of safety in an acceptable time;
(j) the provision of emergency lighting, communications and route signing;
(k) the provision of safe access for emergency services;
(l) the risks of flooding;
(m) the means of de-energising any electric traction system; and
(n) the fencing and security arrangements at tunnel portals.
Safe for people

Stations should provide for the free and safe movement of people.

Factors
The factors for consideration should include:
(a) the movement of people and their waiting within a station in normal or abnormal operating conditions;
(b) the provisions to control overcrowding;
(c) the behaviour of people in enclosed areas;
(d) the sizing and treatment of surfaces of concourses, passageways, ramps, stairs, escalators and platforms;
(e) the suitability of escalators, lifts and passenger conveyors for the number of people they are to carry;
(f) the number, size and spacing of exits;
(g) the positioning of booking offices and other retail outlets;
(h) the provision of communication equipment and signs;
(i) the provision of lighting;
(j) the provision of emergency lighting in the event of loss of power supplies;
(k) ventilation arrangements;
(l) the integrity of the station structure and its ability to survive emergency situations;
(m) the security of people; and
(n) the special arrangements necessary for sub-surface stations including the additional risks caused by fire and the need to segregate evacuation routes and provide ventilation control systems.
Platforms safe for people

Platforms should allow for the safe waiting of people, their boarding and alighting from trains.

Note: In the case of tramways, the station may form part of and be influenced by the surrounding roads, pavements and other public areas.

Factors

The factors for consideration should include:

(a) the protection arrangements for structural supports against derailment;
(b) the compatibility with the trains;
(c) the surface alignment in relation to the level of the track and the floor height of the trains;
(d) the arrangements to control access to the platforms;
(e) the facilities for train crew to observe boarding and alighting passengers;
(f) provision for people waiting on the platform and the movement of people on and between platforms;
(g) the need to avoid ‘pinch points’ at platform entrances and exits;
(h) the effect of platform edge screen doors on the station and other systems of the railway;
(i) the positioning of vending facilities;
(j) the arrangements to deter trespass from the platform onto unauthorised parts of the railway;
(k) the surface treatment and drainage of platforms to avoid tripping and slipping;
(l) the need for platforms to be easily cleaned and the avoidance of places where debris can collect;
(m) the aerodynamic effects generated by trains passing through restricted spaces; and
(n) ventilation arrangements.
Terminal tracks

Where stations have terminal tracks, arrangements should be provided to arrest a train and protect people and the station from the effects of an overrun.

Factors
The factors for consideration should include:
(a) the positioning of structural and other critical supports;
(b) the positioning of booking offices and retail outlets;
(c) the areas where people are likely to congregate;
(d) the overrun provisions and type of arresting device(s) provided;
(e) the protection that can be gained from automatic train protection or train stop systems;
(f) the effect on braking performance of the elements and the covering or otherwise of the track; and
(g) the balance of risk between damaging the train and injury to its passengers, and damaging the station and the people using the station.

Control

Facilities should be provided for the operational control of the station in co-ordination with the railway and with activities adjacent to the railway.

Factors
The factors for consideration should include:
(a) the means of co-ordinating activities on the railway with those within the station so they do not cause additional risks to each other;
(b) relationships and liaison arrangements with adjacent or connecting railway systems and with activities adjacent to the railway;
(c) the level and diversity of surveillance, communication and information required to control the activities within the station complex;
(d) the means of communication and the provision of information and instructions to workers and other people;
(e) the liaison arrangements at the station for the emergency services; and
(f) the availability of control facilities during emergency situations.
**Evacuation**

The station and its control arrangements should allow for safe evacuation in an emergency.

**Factors**

The factors for consideration should include:

(a) the time taken to complete evacuation of the station;
(b) the protection of evacuation routes;
(c) access for emergency services, especially in sub-surface stations;
(d) information systems for evacuation of the station;
(e) the zoning of public address systems; and
(f) the management of any ventilation system.

**Fire precautions**

Stations should have fire and fume prevention and control measures commensurate with the fire risk and evacuation arrangements.

*Note: This principle is not applicable to tramstops which are not enclosed.*

**Factors**

The factors for consideration should include:

(a) minimising the fire load;
(b) the segregation of public areas of stations from non-public areas and high fire risk areas;
(c) the provision of fire detection and warning systems and fire suppression systems;
(d) ventilation and zoning for fume extraction systems to limit smoke from a fire spreading to other parts of the station;
(e) the aerodynamic effects generated by trains passing through restricted spaces;
(f) the provision and identification of initial fire-fighting equipment;
(g) facilities and systems for fire-fighters;
(h) the location of a suitable ‘rendezvous’ point where station staff will meet emergency services; and
(i) the additional risks caused by fire in a sub-surface station and the need to segregate evacuation routes and provide ventilation control systems.
Safe for people

The railway should provide for the safe stabling, marshalling and maintenance of trains.

Factors
The factors for consideration should include:
(a) the segregation of the stabling, marshalling and maintenance areas from the running lines;
(b) the protection of people in these areas from danger from moving trains;
(c) the position of any electric traction system, its sectioning and its means of isolation to facilitate train maintenance;
(d) protection of the area from activities adjacent to the railway;
(e) the need for adequate clearances and walkways;
(f) the need for identifiable crossing places;
(g) secure stabling of trains;
(h) segregation of road vehicles in the area from trains and people;
(i) the arrangements for the control of train movements within, into and from the area; and
(j) the provision of lighting for operational activities.
railway safety principles and guidance

**SAFETY MISSION**

- Infrastructure principles
- Stations and Stabling Areas Principles
- Electric traction system principles
- Railway control system principles
- Principle 23 Level crossings Safe for users and trains
- Train Principles

**Principle 1**
- Electric traction system principles
  - Electric traction system Safe for people
  - Electric traction system Management
  - Electric traction system Interactions

**Principle 17**
- Electric traction system Safe for people

**Principle 18**
- Electric traction system Management

**Principle 19**
- Electric traction system Interactions
Safe for people

An electric traction system should not present safety hazards to people.

Factors

The factors for consideration should include:

(a) the position and extent of live non-insulated components;
(b) the avoidance of dangerous touch potentials on structures within and adjacent to the railway;
(c) the arrangements at level crossings;
(d) the sectioning and isolation arrangements for normal operations, for maintenance and in emergencies;
(e) in the case of on-street tramways, special arrangements for sectioning and isolating overhead wires suspended over a highway;
(f) the arrangements to deter trespass and wilful acts that might give rise to danger;
(g) the display of warning signs; and
(h) the effects of wind, ice and lightning.
PRINCIPLE 18
Electric traction system

Management

An electric traction system should provide for its safe management and operation.

Factors

The factors for consideration should include:

(a) communications between the electrical control centre, the electricity supplier, the railway control centre, the emergency services and trackside locations;

(b) the sectioning and isolating arrangements for normal operations, including for maintenance and in emergencies;

(c) the continuity of power supply and the effect of its loss;

(d) the power supply and return configuration and its management;

(e) earth fault and short-circuit protection;

(f) the monitoring of the status of the electric traction system equipment;

(g) the marking of electric traction system equipment and structures for location purposes; and

(h) special circumstances for sub-surface railways.
Interactions

An electric traction system should not give rise or be subject to dangerous interactions within the railway or with other systems.

Factors

The factors for consideration should include:

(a) the characteristics of the trains using the electric traction system;
(b) the compatibility and separation of different electric traction systems;
(c) the interfaces with trains or other plant and equipment;
(d) the structures on the railway and the electrical clearances;
(e) the siting of both conductor rails and overhead line equipment to allow sufficient clearance so as not to foul the trains, other road vehicles or mobile plant in the case of an on-street tramway, or interfere with other structures on the railway;
(f) the transfer of electro-magnetic fields which may be generated and their likely effects on other plant and equipment on the railway or adjacent to it; and
(g) the transfer of electrical effects and their likely impact on other plant and equipment in use on the railway or adjacent to it.
Safe routing, spacing and control

The signalling system should provide for the safe routing, spacing and control of trains.

*Note: This principle does not apply to sections of tramways which operate on line-of-sight.*

Factors

The factors for consideration should include:

(a) the prevention of collisions;
(b) protection against human error during operation;
(c) the type of trains permitted to operate on or likely to operate on the railway;
(d) the effects of the electric traction system;
(e) the type of track and track condition;
(f) the interface with communication and other systems;
(g) the protection of the railway from the signalling system failing in an unsafe mode;
(h) the avoidance of the degradation of the signalling system from the use of secondary or other interfacing systems;
(i) the capability of the signalling system to be maintained without endangering the railway;
(j) the marking of signalling equipment for location purposes and identification of lineside signals;
(k) the means of cancelling proceed indications in an emergency;
(l) in the case of tramways, the means of alerting drivers to a change of signalling system or a change from signalled to line-of-sight;
(m) the effects of possible modifications to the signalling system;
(n) the compatibility with level crossing arrangements; and
(o) interference from electrical sources.
PRINCIPLE 21
Signalling

Degraded conditions

The signalling system should continue to provide for safe passage of trains permitted to run under degraded conditions.

Note: This principle does not apply to sections of tramways which operate on line-of-sight.

Factors
The factors for consideration should include:
(a) design for ‘graceful degradation’ so that correctly working parts of the signalling system may continue to be used safely;
(b) protection from failure modes creating unsafe situations;
(c) the loss or restoration of power supplies creating unsafe situations;
(d) the identification of and communication with specific trains or signals;
(e) the making of general broadcasts to trains and signallers;
(f) alternative means of communication between the signaller and the driver of the train and between signallers;
(g) the controlled restoration of the whole signalling system; and
(h) protection against human error during degraded operation.
Safe operation and control

Sufficient facilities should be provided for the safe operation of the railway and for a co-ordinated control between the railway and external organisations in the event of an emergency.

Factors
The factors for consideration should include:
(a) the interfaces between the controls of the infrastructure, trains, stations and the emergency services;
(b) the communication with the controls of the infrastructure, trains, stations, the emergency services and people using the railway;
(c) the effective facilities for normal, abnormal and degraded conditions, and emergency situations; and
(d) the inter-relationships between control systems.
Safe for users and trains

Where a right of way crosses the railway at track level, appropriate arrangements should be provided to warn and protect level crossing users, and safeguard the railway.

Note 1: This principle does not apply to a tramway in the highway.

Note 2: All proposals for level crossings should be examined to determine whether there is such a need.

Note 3: The appropriate local authorities and enforcement agencies should be consulted in the planning of any level crossing.

Factors

The factors for consideration should include:

(a) the types of level crossing users and the frequency and speed of expected rail, road and pedestrian traffic;
(b) the uniform visual appearance of each type of level crossing;
(c) the possibility of slow or abnormal road traffic using the level crossing;
(d) the type of road or path on either side of the level crossing;
(e) the need to deter trespass and straying onto the railway;
(f) the protection of the level crossing by the signalling system;
(g) the effect of equipment failure on the safety of trains and level crossing users;
(h) the arrangements to avoid danger if a level crossing user is trapped;
(i) the need for local operation; and
(j) the interface with any electric traction system.
Structural integrity

The structural integrity of trains should be maintained in normal operations and afford protection to people and goods carried in the event of an accident.

Factors

The factors for consideration should include:
(a) the loads arising in normal operations;
(b) the effects of a collision;
(c) the structural compatibility of all trains using the route unless there are arrangements to reduce further the risk of collision;
(d) the level of containment and containment arrangements of any goods carried;
(e) the protection from and containment of fire;
(f) the integrity of attachment of equipment;
(g) the range and compatibility of coupling devices;
(h) compatibility with buffer stops or similar train arrestor devices;
(i) the arrangements for lifting the vehicle for both normal maintenance and emergency situations; and
(j) the ability of glazing to resist impact damage and withstand aerodynamic effects.
**PRINCIPLE 25**  
**Interiors**

The interiors of trains should provide a safe environment for people and any goods carried.

**Factors**

The factors for consideration should include:

(a) compatibility with the body shell of the vehicle and the access and egress arrangements;
(b) intended passengers and their foreseeable behaviour which can include sitting, standing, sleeping, moving about the train, and the taking of meals or refreshments;
(c) foreseeable events which may lead to injury and the arrangements which may be taken to mitigate against injury;
(d) foreseeable actions by people which may lead to injury to others;
(e) the stowage of luggage, goods and equipment and their retention in normal operation and during an accident;
(f) the integrity of fixtures and fittings;
(g) the limitation of fire load, ignition sources and fire spread;
(h) the conditions and ergonomics to enable the train crew to operate the train safely;
(i) the heating, ventilation and lighting of the vehicle in both normal and degraded operation of the train or railway;
(j) train-borne noise;
(k) the retention of toilet and other waste;
(l) the interaction of security arrangements with safety arrangements; and
(m) the provision and marking of emergency or safety equipment to deal with incidents.

**PRINCIPLE 26**  
**Access and egress**

Trains should have a safe means of access, egress and retention of people and goods carried.

**Factors**

The factors for consideration should include:

(a) acceptable stepping distances to and from the platform;
(b) the size, number and arrangement of doors;
(c) the arrangements for the control of the doors;
(d) the arrangements to prevent the doors being opened when the train is moving;
(e) the arrangements to avoid trains departing with doors open;
(f) the hazards created by the doors moving;
(g) the arrangements to avoid trapping people in doors;
(h) the arrangements for emergency evacuation of the train; and
(i) the arrangements for gaining access into the train in emergency situations.
Communications

There should be effective means of communicating safety messages to, from and within the train.

Factors
The factors for consideration should include:
(a) communications between the train, train crew and control or signalling centres;
(b) communications between the members of the train crew on-board the train;
(c) communications between the train crew and passengers;
(d) passenger emergency alarm facilities; and
(e) availability of communication systems in degraded operations or emergency situations, including fire.

Powered systems

The electrical and other powered systems and equipment on-board trains should not endanger other systems or people.

Note: The systems covered by this principle include on-board electrical, mechanical, air or hydraulic systems or equipment including electric traction current collection, main and auxiliary power systems and all electrical control systems including software.

Factors
The factors for consideration should include:
(a) interference with other powered control systems;
(b) the positioning and protection of equipment and electrical conductors to avoid accidental contact by people;
(c) the effect of the loss of power supply and their effects;
(d) the effect of the loss of safety critical systems;
(e) the limitation of fire load and its protection, ignition sources, fire spread and smoke and fumes;
(f) unauthorised access to, or use of, equipment;
(g) the availability of powered systems in degraded operations or emergency situations;
(h) bonding and short-circuit protection; and
(i) avoidance or control of electro-magnetic fields which are known to be harmful to people.
PRINCIPLE 29

Speed regulation

The speed regulation system of the train should meet the operational requirements of the railway without endangering people and goods carried.

Note: The speed regulation system may include systems other than the braking system.

Factors

The factors for consideration should include:

(a) the requirement for the braking system to be continuous, capable of stopping a divided train, and holding a stabled train indefinitely;
(b) the acceleration and deceleration rates and the rate of change of those rates to avoid endangering the people and goods carried;
(c) the performance of the braking system under all foreseeable conditions of adhesion;
(d) the incapacity of the train driver;
(e) redundancy in the service braking;
(f) the availability of the braking system on demand;
(g) the overall braking performance provided by one or more braking systems;
(h) the transition between different types and combinations of braking systems;
(i) the gradients of the railway;
(j) the compatibility with the track and, in particular, the forces imposed on the track;
(k) the compatibility of the service braking performance with the signalling system;
(l) the compatibility with the electric traction system;
m) minimising the risk of ‘dragging’ brakes;
(n) minimising the release of toxic or other harmful substances from brake pads or blocks; and
(o) the provision of a reliable indication of speed.
Running gear

The running gear should guide the train safely along the track.

Factors
The factors for consideration should include:
(a) the compatibility of the wheel and rail interface;
(b) the range of train operating speeds;
(c) the compatibility with the track geometry;
(d) the foreseeable track maintenance tolerances and the risk of the track being outside the
   normal condition tolerances;
(e) the arrangements for transfer between tracks;
(f) the effects of traction and braking forces;
(g) the effects of permitted forces imparted to the track or train body and within the components
   of the running gear;
(h) the risk and effects of component failure, particularly of wheel-sets and bearings;
(j) the effects of collisions with obstacles;
(k) the risk of derailment due to wheel unloading;
(l) transfer of noise or vibration to the track or the train body;
(m) the integrity of attachment of equipment to the running gear; and
(n) bonding and its effects on an electric railway.

Compatibility with signalling

The train should be compatible with the signalling system.

Factors
The factors for consideration should include:
(a) the service braking performance allowed for by the signalling system;
(b) the acceleration and deceleration rates allowed for by the signalling system;
(c) the effects of electro-magnetic interference and the arrangements to be employed to guard
   against interfering with the signalling system;
(d) the compatibility with train position detection arrangements;
(e) the data transfer arrangements between the train and the signalling system; and
(f) the presentation and availability of signalling information at the driving position.
PRINCIPLE 32
Trains

Compatibility with infrastructure

The train should be dimensionally compatible with the infrastructure.

Factors
The factors for consideration should include:
(a) the allowances for safety clearances under static and dynamic conditions;
(b) the influence of the track geometry on the dynamic performance of the train;
(c) the centre and end throws of the train on curved track;
(d) the clearances between structures and trains;
(e) the clearances between trains on adjacent tracks;
(f) the length of platforms;
(g) the stepping distances at platforms; and
(h) operation in degraded mode with failure of suspension, door or other systems.

PRINCIPLE 33
Trains

Compatibility with electric traction systems

Trains should be compatible with the electric traction system.

Note: These factors also need to be taken into consideration for non-electric trains which operate on electric lines.

Factors
The factors for consideration should include:
(a) the electrical clearances between vehicles and electrical conductors;
(b) the position and geometry of electrical collector systems;
(c) the arrangements for return currents;
(d) the arrangements for regenerative braking;
(e) the effects of electric traction system short-circuits; and
(f) the effects of electro-magnetic interference and the arrangements to be employed to guard against them.
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