



BSI Standards Publication

Railway applications — Urban guided transport management and command/control systems

Part 2: Functional requirements specification

National foreword

This British Standard is the UK implementation of EN IEC 62290-2:2025. It is identical to IEC 62290-2:2025. It supersedes BS EN 62290-2:2014, which will be withdrawn on 31 May 2028.

The UK participation in its preparation was entrusted to Technical Committee GEL/9, Railway Electrotechnical Applications.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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specification
(IEC 62290-2:2025)

Applications ferroviaires - Systèmes de contrôle/commande
et de gestion des transports guidés urbains - Partie 2:
Spécification des exigences fonctionnelles
(IEC 62290-2:2025)

Bahnanwendungen - Betriebsleit- und
Zugsicherungssysteme für den städtischen
schienengebundenen Personennahverkehr - Teil 2:
Funktionale Anforderungsspezifikation
(IEC 62290-2:2025)

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European foreword

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The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-05-31 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-05-31 document have to be withdrawn

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The text of the International Standard IEC 62290-2:2025 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

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MANAGEMENT AND COMMAND/CONTROL SYSTEMS –****Part 2: Functional requirements specification****FOREWORD**

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IEC 62290-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways. It is an International Standard.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the functions 5.1.4.5 Stopping a train en route, 5.1.5.4 Monitor speed limit at discrete location, 5.5.5 Manage UGTMS transfer tracks, 5.6.4.1 Monitor passenger emergency calls and 6.2.4 Ensure connecting services have been deleted;
- b) the functions 5.5.11 Manage train washing, 5.5.12 Manage non-stopping areas and 6.3.4 Perform progressive shutdown have been added;

- c) many of the requirements have been reworded: changes in their wording could be only minor and editorial, or it could have technical consequences;
- d) some requirements of the second edition have been moved from one function/subfunction to another;
- e) some requirements have been deleted;
- f) some new requirements have been added in the existing functions;
- g) an informative annex giving the reader some user's recommendations about this document has been added;
- h) another informative annex giving some typical performance-related criteria has been also added.
- i) an informative annex providing a summary of applicability of functions and subfunctions (mandatory or optional) depending on GOA has been added.

In order to avoid any disturbance in the use of the document, when functions or requirements of IEC 62290-2:2014 have been deleted, their numberings have been kept on purpose in this document. The expression "Deleted" is indicated at the place of the former headlines of the deleted functions, or at the place of the wording of the deleted requirements. Therefore, the impacts on any existing references or traceability matrices defined previously to this third edition is limited as much as possible.

For readability of the text, just below the headline of functions and subfunctions describing requirements, the description of applicability of this function depending on GOAs is given in bold characters.

For the same reason of readability, some elements of Annex A are in italic and bold characters, when some extracts of the main part of the document are considered for providing additional information to the reader, oriented for the proper use of the document.

The text of this International Standard is based on the following documents:

Draft	Report on voting
9/3167/FDIS	9/3198/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62290 series, published under the general title *Railway applications – Urban guided transport management and command/control systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The IEC 62290 series specifies the functional, system and interface requirements for the command, control, and management systems intended to be used on urban, guided passenger transport lines and networks.

These systems are designated herein as urban guided transport management and command/control systems (UGTMS). UGTMS cover a wide range of operations needs from non-automated (GOA1) to unattended (GOA4) operation. A line may be equipped with UGTMS on its full length or only partly equipped.

The IEC 62290 series does not specifically address security issues. However, aspects of safety requirements may apply to ensuring security within the urban guided transit system.

The main objectives of this series are as follows:

- to provide a baseline system description and functional requirements specification for a transport authority to use in a request for proposal,
- to provide recommendations for those transport authorities wishing to acquire an interoperable or interchangeable system.

It is the responsibility of the transport authority concerned to decide on how to apply the IEC 62290 series and to take into account their particular needs.

The IEC 62290 series is also intended to support applications for upgrading existing signalling and command control systems. In this case, interchangeability and compatibility could be ensured only for the additional UGTMS equipment. Checking the possibility for upgrading existing equipment and the level of interoperability is the responsibility of the transport authority concerned.

Application of the series should take into account the differences between the various networks operated in different nations. Those differences include operational and regulatory requirements as well as different safety cultures.

The IEC 62290 series defines a catalogue of UGTMS requirements split into mandatory and optional functions. The functions used are based on the given grade of automation. Most of the functions characterized as mandatory are considered with no condition. Some specific functions have a condition to be mandatory (this condition being generally related to the use of an external equipment by UGTMS). By fulfilling the requirements, a supplier can create one or more generic applications including all mandatory functions and all or a subset of optional functions. A generic application will achieve interoperability within the defined specific application conditions. Customising a generic application will create a specific application taking into account of local conditions such as track layout and headway requirements. It is the choice of supplier and transport authority to add additional functions to a generic or specific application. These additional functions are not described in the IEC 62290 series.

According to IEC 62278, it is the responsibility of the transport authority to decide, taking into account their risk acceptance principles, to conduct specific hazard and risk analysis for each specific application. The safety levels for the functions of each specific application are determined by a specific risk analysis.

Terms like "safety-related command", "safety conditions", "safe station departure" are mentioned without having performed any hazard analysis.

The IEC 62290 series is intended to consist of four parts:

- IEC 62290-1, "System principles and fundamental concepts", provides an introduction to the IEC 62290 series and deals with the main concepts, the system definition, the principles and the main basic functions of UGTMS.

The three other parts correspond to the three steps (see Figure 1) required in the process of specifying UGTMS and are used accordingly.

- IEC 62290-2, "Functional requirements specification", specifies the functional requirements associated to the basic functions provided by IEC 62290-1, within the system boundaries and interfaces as defined in IEC 62290-1:2024, Figure 3.

The FRS (functional requirements specification) identifies and defines the functions that are necessary to operate an urban guided transport system. Two types of functions are distinguished for a given grade of automation: mandatory functions (e.g. train detection) and optional functions (e.g. manage stabling). Requirements of functions have the same allocation, unless they are marked otherwise.

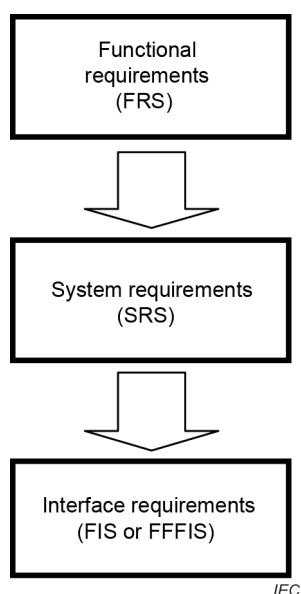
- IEC 62290-3, "System requirements specifications", deals with the architecture of the system and the allocation of the requirements and functions identified in IEC 62290-2 to UGTMS equipment.

The SRS (system requirement specification) specifies the architecture of a UGTMS system, with mandatory and optional UGTMS equipment.

- IEC 62290-4¹, "Interface specifications", deals with the definition of the interfaces, as well as the data exchanged by them (FIS and FFFIS), for the interoperable and interchangeable UGTMS equipment identified in IEC 62290-3.

For interfaces between UGTMS equipment, the logical interface or FIS (functional interface specification) or the physical and logical interface or FFFIS (form fit functional interface specification) will be considered.

NOTE The specific structure of IEC 62290-4 will be established to accommodate optional and mandatory UGTMS equipment, and to reflect local conditions. In principle, only one FIS or FFFIS will be defined for the same interface. However, when justified in some cases, several FISs or several FFFISs will be defined for the same interface.



IEC

Figure 1 – Three-step process followed by the UGTMS series

¹ Under consideration.

Requirements are those necessary to fulfil all operational needs for safe and orderly operation requested by transport authorities without regard to technical solutions.

The chosen level of detail in describing requirements enables customers as well as transport authorities to be assured that generic applications delivered by different suppliers will cover at least the same functionality as specified in this document.

Requirements which are established by the IEC 62290 series are indicated clearly with a requirement identification number related to the function to be covered.

RAILWAY APPLICATIONS – URBAN GUIDED TRANSPORT MANAGEMENT AND COMMAND/CONTROL SYSTEMS –

Part 2: Functional requirements specification

1 Scope

This part of IEC 62290 specifies the functional requirements of UGTMS (urban guided transport management and command/control systems) for use in urban guided passenger transport lines and networks. This document is applicable for new lines or for upgrading existing signalling and command control systems.

This document is applicable to applications using

- continuous data transmission,
- continuous supervision of train movements by train protection profile, and
- localisation of trains by onboard UGTMS equipment (reporting trains), and optionally by external wayside (and optionally onboard) device.

In this document, the functional requirements set the framework to which detailed functions are added to define any generic or specific application.

Because of that, although this document is applicable as a basis to define SRS, FIS and FFFIS, elements can be added for a generic or specific application.

NOTE The functional breakdown in this document is consistent with basic functions in IEC 62290-1:2024, Table 1. These basic functions have been refined in this document into a more complete and detailed tree, and the "mandatory/optional" attributes of their subfunctions can be different with those given in IEC 62290-1:2024, Table 1. The functional breakdown which follows Clause 1 is the reference one for the IEC 62290 series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62290-1:2024, *Railway applications – Urban guided transport management and command/control systems – Part 1: System principles and fundamental concepts*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in IEC 62290-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Operational concept

4.1 Organisation of operation for urban guided transport

Using infrastructure (guideway and its elements) and trains, the organisation of operation for public transport is structured generally into the following tasks (see Figure 2):

- planning operation (offices for planning operation including timetable, train and staff resources), which is out of the scope of this document;
- operations management and supervision (operations control centre) as described in Clause 6;
- executing train operations, as described in Clause 5;
- maintenance for all facilities and equipment of the transport system, especially infrastructure, trains, UGTMS equipment. Maintenance is out of the scope of this document, but UGTMS supports maintenance as described in 6.9.

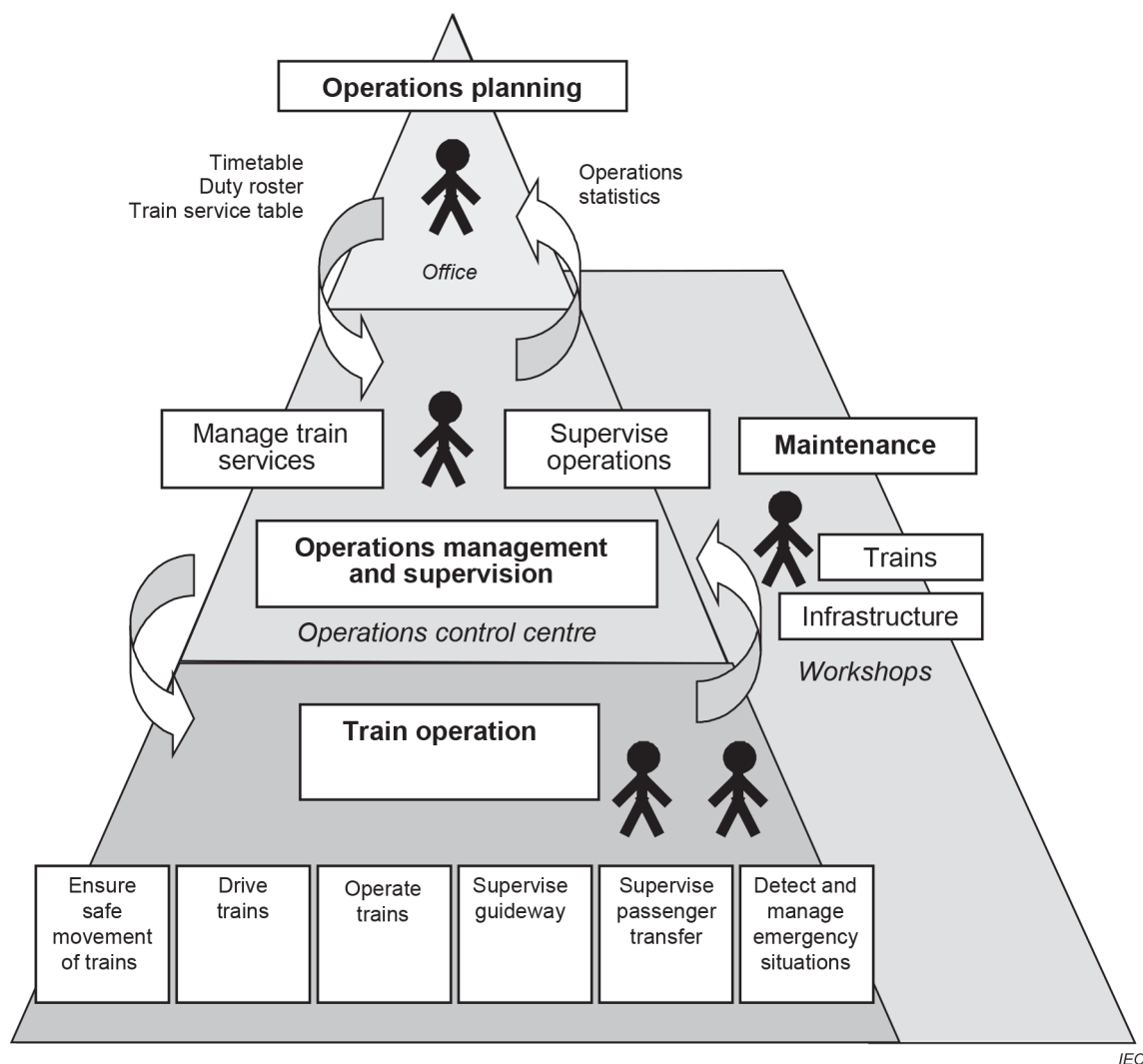


Figure 2 – Organisation of operation

This operations organisation hierarchy provides an overview of UGTMS functions of this document. Train operations are enabled by command-control equipment situated both at the wayside and onboard, which interfaces to the operations control centre (OCC) equipment. Operation management and supervision is carried out from the OCC which provides also the interface to the external operations control HMI to operate and display all functions required by UGTMS.

The task of operations planning contains all necessary measures to prepare operation.

Operations planning provides the operations management and supervision level with all necessary information to execute train operation. Operations management and supervision provides information to operations planning level to enable adjustment of the planning process for operational needs.

Operations management and supervision include all measures which are necessary to ensure operations in normal, perturbed, and failure situations.

The functions to be realised on this level are described in Clause 6.

4.2 Basic operational principles

UGTMS can be applied to a wide range of urban guided transport systems, and the specific UGTMS operational requirements for a given application depend on the required grade of automation. Nevertheless, the following basic operational principles apply for all UGTMS applications.

UGTMS has precise knowledge of the limits of UGTMS territory, which can include both mainline and depot tracks.

UGTMS includes the capability to perform verification checks of the UGTMS onboard equipment prior to entering UGTMS territory. The checks should be performed sufficiently in advance of entry into UGTMS territory to verify the proper operation of the UGTMS onboard equipment, including any UGTMS wayside equipment dependencies.

Under normal circumstances, it should not be necessary for a train to come to a stop when entering or exiting UGTMS territory, unless required for other safety or operational reasons.

UGTMS trains can include passenger trains, non-passenger trains and maintenance trains, and different functional requirements may apply to the different types of train. For example, non-passenger trains and maintenance trains are normally not required to stop at passenger stations on the mainline.

UGTMS trains are capable of operating in various driving modes, depending on the grade of automation and on the operational status of the UGTMS onboard and wayside equipment.

UGTMS ensures a safe route, safe train separation and the safe speed of all UGTMS trains operating in UGTMS territory. Trains can be operated manually by a train operator, or automatically by UGTMS depending on the grade of automation. When operating automatically, some functions (such as door operation) may continue to be the responsibility of the train staff.

Non-operative UGTMS trains that are operating in UGTMS territory operate under the principles described in 4.6.

Commands from staff shall be provided via the interface with the external operations control HMI.

Systems are operated with or without a timetable, for example by using headway regulation only.

The basic system performances of UGTMS can vary, for instance depending on the needs for capacity, headways (see examples of typical system performance criteria in Annex B).

4.3 Principles to ensure safe route

The operational purpose of setting routes is to allow trains to travel to different destinations in the network.

UGTMS permits trains to be manually or automatically routed between any defined origin and destination in accordance with the train service requirements for the line, predefined routing rules, and any UGTMS user-directed service strategy. Where applicable to the specific track configuration, automatic routing supports the proper merging and diverging of trains at junctions, the turnback of trains, the movement of trains from/to depot areas, and the rerouting of trains in response to service disruptions or planned outages.

UGTMS ensures a safe route for all UGTMS trains in all grades of automation.

To prevent train collisions and derailments, train movement is not authorized until the route is set and locked. The route is locked prior to the train entering the route and route locking is maintained while the train is within the route. Routes can be released by manual commands or by movement of trains.

Ensuring a safe route is either a UGTMS function or an external function. In the latter case, an appropriate interface shall be provided.

4.4 Principles to ensure safe separation of trains

The required design and operating headways for the line are as specified by the transport authority. The design headway for a line involves many factors that are outside of UGTMS (e.g. track alignment, gradients, track speed limits, train acceleration and braking rates, station dwell times, terminal track configurations, train operator reaction times, etc.). These factors shall be specified by the transport authority. UGTMS factors contributing to achievable headways include accuracy of train location and train speed determination, resolution of movement authority limits for a given train, frequency at which location reports and movement authorities are updated, data communication delays, and UGTMS equipment reaction times for both UGTMS wayside and UGTMS onboard equipment.

UGTMS provides safe train separation assurance in all grades of automation based on the principle of an instantaneous stop of a preceding train.

To ensure safe train separation, UGTMS establishes an absolute movement authority limit for each train based on the determined location of the train ahead. This absolute movement authority limit represents the limit of movement protection for a following train, with appropriate consideration of the location margin of the preceding train, including location uncertainty and rollback tolerance.

4.5 Principles to ensure safe speed

UGTMS provides overspeed protection in all grades of automation to ensure that the train's actual speed does not exceed its safe speed. The safe speed is derived with consideration of both permanent and temporary speed limits within the train's movement authority as well as any permanent or temporary speed restrictions applicable to the train.

UGTMS ensures that a train does not travel beyond the train protection profile by supervising train movement along the authorized route to a defined target point (see Figure 3). The distance between the target point and movement authority limit is a variable safety distance, as determined by the safe braking model, to ensure that this limit is not exceeded. The safe braking model includes consideration of factors such as location inaccuracy of the following train, train length, allowable overspeed permitted by the UGTMS system, maximum speed measurement error, UGTMS reaction times and latencies, maximum train acceleration rate possible at the time an overspeed condition is detected by UGTMS, worst-case reaction times to disable the propulsion system and apply the emergency brakes following detection of an overspeed condition, and emergency brake rate, etc.

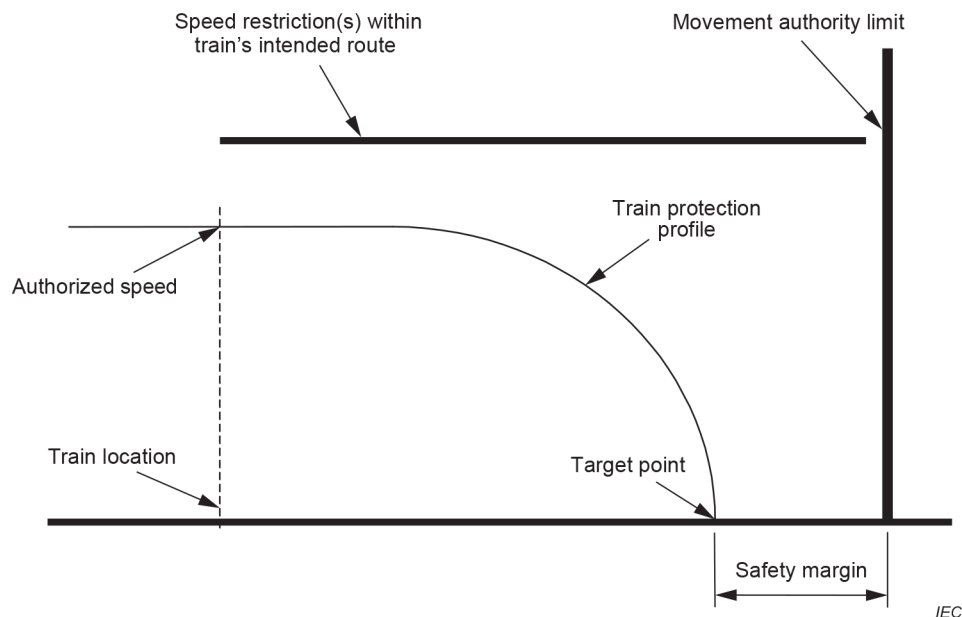


Figure 3 – Train protection profile and speed supervision

According to the safe braking model, any violation of the train protection profile will not result in the train exceeding the movement authority limit.

4.6 Degraded modes of train operation

It is a basic operational principle to continue to move trains with a level of safety potentially degraded in the event of UGTMS equipment failures, possibly at reduced operating speeds or increased operating headways when compared to normal train operations. As a consequence, UGTMS supports degraded modes of operation in the event of failure and continues to provide train protection with reliance on adherence to operating procedures. This is achieved through functional elements of UGTMS itself, through a separate non-UGTMS fall-back wayside signal system (if specified by the transport authority), or through application of the relevant operating procedures, or through a combination of operating procedures with one of the other two methods.

Degraded modes of train operation should take advantage of the functional capabilities of UGTMS in order to eliminate hazards to passengers and staff while continuing to provide passenger train service. Specifically, degraded modes of train operations in UGTMS territory should address those UGTMS equipment failures that affect all trains operating within a particular area of control or a particular train operating within any area of control.

The management of external sensors related to their failures, resetting or overriding is not handled by UGTMS.

For all functions of UGTMS a non-communicating UGTMS train or a train with inoperative UGTMS onboard equipment shall be handled in the same way as a non-equipped train.

5 Functions for train operation

Clause 5 contains all functions which are necessary for train operation to be provided by UGTMS.

Some of the following functions are mandatory, others are optional. A function's classification is indicated at the beginning of each clause/subclause and may be dependent on grade of automation.

Some specific functions have a condition for being mandatory: this is indicated at the beginning of the corresponding clauses/subclauses by using an expression giving the condition, such as "Mandatory: all GOAs if [...]".

Clause A.1 in Annex A can be considered for getting additional information about the way in which to use the document, with its mandatory or optional functions, having mandatory or optional requirements. Annex A gives advice about options in the document (e.g. possible mutual constraints and relationships between requirements).

Annex C provides a table summarizing the applicability of functions and subfunctions, depending on GOAs.

5.1 Ensure safe movement of trains

Ensuring safe movement of trains is achieved by

- ensuring a safe route for each train, which can be done internally (addressed in 5.1.1) or externally with an interface to an external interlocking (addressed in 5.1.6),
- determining the location of all trains and limits of safe train separation (addressed in 5.1.2),
- determining the actual train speed (addressed in 5.1.5.1) and the maximum allowable train speeds (addressed in 5.1.3),
- authorizing train movement in accordance with the movement authority limit and train protection profile (addressed in 5.1.4), and
- supervising train movement in accordance with the movement authority limit and train protection profile (addressed in 5.1.5).

5.1.1 Ensure safe route

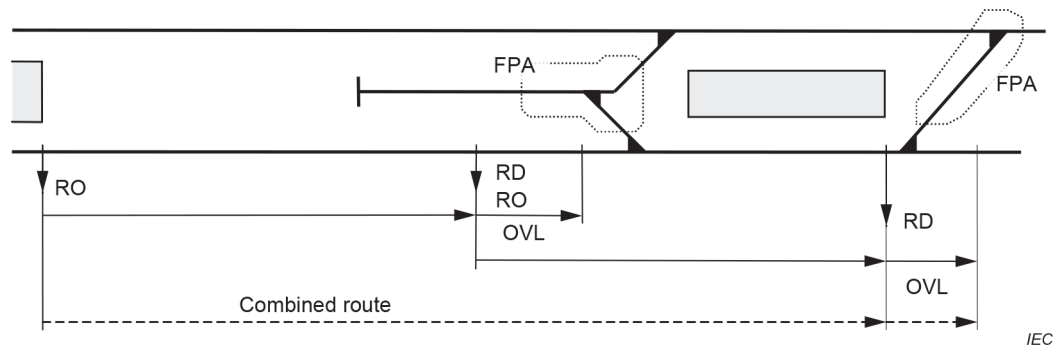
Mandatory: all GOAs if "Ensure safe route" functions are provided by UGTMS

Subclause 5.1.1 contains all functions necessary to command, control and check route elements, set, lock and release routes.

In order to prevent train collision and derailment, a route is to be considered as safe, if all requested elements of the guideway (called "route elements", e.g. points, track sections) are locked in the required position to prevent concurrent use by another train.

A safe route consists of one or more related route elements which are used for

- the area between route origin (RO) to route destination (RD),
- flank protection purposes, and
- the overlap (OVL).

**Key**

RO	route origin
RD	route destination
OVL	overlap
FPA	flank protection area

Figure 4 – Specification of a safe route

A route is seen by UGTMS as a combination of route elements with specified conditions. A route shall be described taking into account the following conditions:

- route origin as a location, where authorization to enter the route shall be given;
- route elements between route origin and route destination, which are to be traversed by the train;
- route elements of the overlap, which are used for safety reasons in case of deviations from an authorized train movement;
- route elements in the flank protection area, which avoid or detect unauthorized flank movement.

An overlap can be replaced by a following safe route building a combined route (see Figure 4).

Lock and release functionality is defined as follows:

Locking a route element means maintaining a route element as it is set.

Releasing a route element means unlocking a locked route element.

Locking a route means locking all route elements of the route.

Releasing a route means releasing all route elements of the route.

5.1.1.1 Set and protect route**5.1.1.1.1 Set route****Mandatory: all GOAs**

This function is intended to set manually a route by command provided via the external operations control HMI or automatically by UGTMS.

#REQ_5.1.1.1.1-1#

UGTMS shall set a route by manual command provided via the interface with the external operations control HMI or automatically.

#REQ_5.1.1.1.1-2#

For the route to be set, UGTMS shall determine the route elements required based on the route origin and destination, including elements required for flank protection, for overlap, and when required, elements related to the protection of the infrastructure (e.g. flood gates, blast doors, rolling shutters).

#REQ_5.1.1.1.1-3#

For the route to be set, the availability of all determined route elements shall be checked.

#REQ_5.1.1.1.1-4#

Availability shall be given if a route element is not blocked against route setting and not used by another route.

#REQ_5.1.1.1.1-5#

Deleted.

#REQ_5.1.1.1.1-6#

In order to set the route, UGTMS shall move all its movable route elements to the desired position if they are not already in that position, not occupied by a train and not blocked against moving.

#REQ_5.1.1.1.1-7#

If a movable route element does not reach the desired position in a predefined time, a failure message shall be provided to the interface with the external operations control HMI. (O)

#REQ_5.1.1.1.1-8#

When all the route elements of the route are confirmed in the required position, the route is set, and UGTMS shall lock it.

#REQ_5.1.1.1.1-9#

UGTMS shall command movable route elements (e.g. a point) from one position to the other by command provided via the interface with the external operations control HMI.

#REQ_5.1.1.1.1-10#

UGTMS shall block a movable route element against switching, or unblock, by command provided via the interface with the external operations control HMI.

5.1.1.1.2 Supervise route

Mandatory: all GOAs

This function is intended to supervise that all conditions for the route are still in place.

#REQ_5.1.1.1.2-1#

UGTMS shall supervise that determined route elements are confirmed in the required position and locked.

#REQ_5.1.1.1.2-2#

The supervision status of a route shall be provided to the interface with the external operations control HMI. (O)

#REQ_5.1.1.1.2-3#

Deleted.

#REQ_5.1.1.1.2-4#

The entrance to a route shall be prohibited by a safety-related command provided via the interface with the external operations control HMI. (O)

5.1.1.1.3 Lock route by train

Mandatory: all GOAs

For a given set route, this function is intended to maintain the lock of the route

- for an approaching train for which the movement authority allows entry into the route, or
- if this train is within the route.

#REQ_5.1.1.1.3-1#

A route approach area longer than the operational braking distance shall be determined in front of a route origin.

#REQ_5.1.1.1.3-2#

The route shall be locked by approach if a train is in the approach area and a movement authority beyond the route origin has been given to the train.

#REQ_5.1.1.1.3-3#

When the train has entered the route, the route shall be maintained as locked until conditions for releasing it are fulfilled (as described in 5.1.1.2).

5.1.1.2 Release route

Mandatory: all GOAs

This function is intended to release a route and its elements.

#REQ_5.1.1.2-1#

For automatic route release, UGTMS shall release a route element by element, by group of elements or as a whole by a train traversing the elements in the sequence corresponding to the authorized direction.

#REQ_5.1.1.2-2#

Route elements in the flank protection area shall be released together with the corresponding route elements.

#REQ_5.1.1.2-3#

UGTMS shall allow route release by operational command provided via the interface with the external operations control HMI if the route is not locked.

#REQ_5.1.1.2-4#

UGTMS shall allow route release by operational command provided via the interface with the external operations control HMI for a route that is locked, if no train is occupying the route and if it can be ensured that a train in the route approach area, if any, will not enter the route.

#REQ_5.1.1.2-5#

Deleted.

#REQ_5.1.1.2-6#

UGTMS shall cancel an overlap when the train has stopped at the route destination. (O)

5.1.2 Ensure safe separation of trains

This function is intended to determine the location of all trains and the limits of safe train separation.

5.1.2.1 Locate UGTMS reporting trains

This function is intended to locate reporting trains.

5.1.2.1.1 Initialise UGTMS reporting trains location

Mandatory: all GOAs

This function is intended to initialise the location of reporting trains which are

- awakened inside UGTMS territory, or
- entering UGTMS territory, or
- recovering from localisation failures.

#REQ_5.1.2.1.1-1#

UGTMS shall initialise the train location for reporting trains stationary in stabling locations after the awakening process. (O)

#REQ_5.1.2.1.1-2#

UGTMS shall initialise the train location for reporting trains entering UGTMS territory.

#REQ_5.1.2.1.1-3#

For reporting trains, UGTMS shall initialise the train location on recovery from UGTMS equipment failures leading to loss of train location.

#REQ_5.1.2.1.1-4#

UGTMS shall determine the train length of reporting trains. (O for GOA1, O for GOA2, O for GOA3, M for GOA4)

#REQ_5.1.2.1.1-5#

UGTMS shall allow manual input of train length data of reporting trains. (O for GOA1, O for GOA2, O for GOA3, not applicable for GOA4)

#REQ_5.1.2.1.1-6#

UGTMS shall allow initialisation of the train location for reporting trains through a movement of train under manual or automatic driving mode.

5.1.2.1.2 Determine train orientation

Mandatory: all GOAs

This function is intended to determine the physical orientation of the train relative to the defined orientation of the track.

#REQ_5.1.2.1.2-1#

UGTMS shall determine the physical orientation of the reporting train relative to the defined orientation of the track.

5.1.2.1.3 Determine actual train travel direction

Mandatory: all GOAs

This function determines the actual travel direction of reporting trains.

#REQ_5.1.2.1.3-1#

UGTMS shall determine the actual travel direction of the reporting train on the track.

#REQ_5.1.2.1.3-2#

Actual train travel direction of reporting trains shall be provided to the interface with the external operations control HMI.

5.1.2.1.4 Determine train location

Mandatory: all GOAs

This function is intended to determine the location of all UGTMS reporting trains according to the train orientation and train length.

#REQ_5.1.2.1.4-1#

UGTMS shall determine the location of the front and rear of all reporting trains.

#REQ_5.1.2.1.4-2#

UGTMS shall take into account inaccuracies in determining location for reporting trains.

#REQ_5.1.2.1.4-3#

UGTMS shall immediately stop the UGTMS train by applying the emergency brake when it has detected a train location failure.

#REQ_5.1.2.1.4-4#

UGTMS shall provide the information about the train location failure of reporting trains to the interface

- with the external operations control HMI, and
- with the external train HMI. (M for GOA1, M for GOA2, O for GOA3, O for GOA4).

#REQ_5.1.2.1.4-5#

Deleted.

#REQ_5.1.2.1.4-6#

Following loss of train localisation, in order to permit re-initialisation of train localisation, UGTMS shall release the emergency brake after receiving a safety-related command via the interface

- with the external train HMI, (M for GOA1, M for GOA2, O for GOA3, O for GOA4), and
- with the external operations control HMI. (O)

NOTE The application of such requirement is not mandatory for GOA3 and GOA4: this allows for the automatic release of the emergency brake, following a check done by UGTMS of conditions for making the release.

#REQ_5.1.2.1.4-7#

UGTMS shall provide train location status to the interface with the external train HMI. (O)

#REQ_5.1.2.1.4-8#

Following the loss of train location status of a reporting train, UGTMS shall determine the area where the concerned train is and optionally set the corresponding zone(s) of protection.

#REQ_5.1.2.1.4-9#

Deleted.

5.1.2.2 Locate non-reporting trains

Mandatory: all GOAs if external train detection devices are used by UGTMS

This function is intended to determine the location of non-reporting trains using external train detection devices.

If this function is not provided, strict adherence to operating procedures is recommended to protect the movement of non-operative UGTMS trains.

#REQ_5.1.2.2-1#

UGTMS shall determine the location of non-reporting trains based on inputs received from external train detection devices.

#REQ_5.1.2.2-2#

A track section shall be determined to be logically non-occupied only if an adjacent track section has been detected occupied before the considered track section has reported unoccupied. (O)

5.1.3 Determine permitted speed

This function is intended to determine the safe speed taking into account permanent and temporary speed restrictions (wayside and train).

5.1.3.1 Determine static speed profile

Mandatory: all GOAs

This function determines the static speed profiles, which are based on infrastructure data such as track geometry and quality, infrastructure constraints (tunnels, bridges, platforms, etc.).

#REQ_5.1.3.1-1#

UGTMS shall determine the maximum permitted speed for all guideway locations.

#REQ_5.1.3.1-2#

UGTMS shall allow the determination of different speed profiles for different types of trains and for different driving modes. (O)

5.1.3.2 Determine temporary infrastructure speed restrictions

Optional: all GOAs

This function is intended to set and remove temporary speed restrictions for selected areas by operational commands or as result of system reactions.

#REQ_5.1.3.2-1#

UGTMS shall set a zone of temporary speed restriction by operational command provided via the interface with the external operations control HMI, including a selected speed limit and the concerned area of the track.

#REQ_5.1.3.2-2#

Deleted.

#REQ_5.1.3.2-3#

In case several speed restrictions can be set at the same location, UGTMS shall enforce the lowest speed restriction.

#REQ_5.1.3.2-4#

Setting a new temporary speed restriction shall not remove existing speed restrictions set at the same location. (O)

#REQ_5.1.3.2-5#

UGTMS shall automatically create speed restrictions based on statuses provided by external devices (e.g. bad weather detectors). (O)

#REQ_5.1.3.2-6#

A temporary speed restriction set manually shall be released by safety-related command provided via the interface with the external operations control HMI.

#REQ_5.1.3.2-7#

A temporary speed restriction set automatically shall be released by safety-related command provided via the interface with the external operations control HMI if the external condition is no longer detected. (O)

#REQ_5.1.3.2-8#

When a temporary speed restriction is established, the status of the speed restriction including as a minimum the selected speed and covered zone shall be provided to the interface with the external operations control HMI. (O)

5.1.3.3 Determine maximum speed by train type

Optional: all GOAs

This function is intended to determine the maximum permitted speed for each type of train.

#REQ_5.1.3.3-1#

UGTMS shall determine the maximum permitted speed for each type of train.

5.1.3.4 Determine temporary train speed restrictions

Optional: all GOAs

This function is intended to determine temporary train speed restrictions due to train failures and to driving modes.

#REQ_5.1.3.4-1#

UGTMS shall determine speed restrictions based on train conditions detected and provided by the train (e.g. failures).

#REQ_5.1.3.4-2#

UGTMS shall determine speed restrictions based on the driving mode.

5.1.4 Authorize train movement

This function deals with

- the determination of movement authority limit by assignment of limits of safe route, limits of safe train separation and other limits (such as zone of protection),
- the determination of train protection profile by assignment of the movement authority limit and authorized speed, and
- the authorization of train movement by wayside signals.

If a train protection profile with permitted speed greater than zero is established, train movement shall be allowed up to next movement authority limit within its restrictions.

5.1.4.1 Determine movement authority limit

Mandatory: all GOAs

To ensure safe train movement, this function determines for each train its limit of movement authority, which corresponds to the position up to where the train can proceed safely.

#REQ_5.1.4.1-1#

UGTMS shall determine for each train the limit of its movement authority based on the most restrictive of the following:

- limit of safe route;
- limit based on safe train separation;
- limit based on the guideway (e.g. end of track);
- limit based on zones of protection;
- limit based on work zones.

#REQ_5.1.4.1-2#

In the event of a loss of safe route once a movement authority has been issued, UGTMS shall pull back the movement authority limit to the new limit of safe route.

#REQ_5.1.4.1-3#

In case a movement authority accepted by the train exceeds its validity period (e.g. due to data communication failure), UGTMS shall either

- pull back the movement authority limit to the first potential danger point ahead of the train, or
- stop the train immediately.

NOTE The characterization of what is a potential danger point is defined by the transport authority.

5.1.4.2 Determine train protection profile**Mandatory: all GOAs**

This function determines the train protection profile for all trains to ensure their limits of movement authority and authorized speeds are never exceeded. The train protection profile terminates at a target point. The train protection profile shall be determined by the applicable safe braking model.

#REQ_5.1.4.2-1#

UGTMS shall determine the train protection profile for each UGTMS-operated train, taking into account the speed profiles, train and infrastructure parameters (e.g. gradients of track, track section lengths, locations of points), and the movement authority limit.

#REQ_5.1.4.2-2#

UGTMS shall allow a train protection profile with reduced or no safety margins in specific areas and at a speed sufficiently slow to reduce the consequences of a collision (shunting in depot, stabling areas, automatic coupling of train units, etc.). (O)

#REQ_5.1.4.2-3#

UGTMS shall calculate the speed limit that results from the most restrictive of all safety-related constraints applied to the UGTMS trains.

#REQ_5.1.4.2-4#

UGTMS shall enforce speed limits for the whole length of the train.

#REQ_5.1.4.2-5#

UGTMS shall authorize train movement for UGTMS-operated trains in accordance with the train protection profile when established.

5.1.4.3 Authorize train movement by wayside signals**Mandatory: all GOAs if wayside signals are used by UGTMS**

This function is intended to authorize train movement by wayside signals if conditions of safe route and safe separation are fulfilled.

#REQ_5.1.4.3-1#

UGTMS shall control wayside signals in consistency with movement authorities and supervised routes.

#REQ_5.1.4.3-2#

UGTMS shall transmit the status information (e.g. "signal at danger", "failure status") received from each specific signal to the interface with the external operations control HMI. (O)

#REQ_5.1.4.3-3#

UGTMS shall ensure that the information given to control the wayside signal and the information provided to the interface with the external train HMI are consistent (M for GOA1, M for GOA2, O for GOA3, O for GOA4).

5.1.4.4 Determine a zone of protection

Mandatory: all GOAs

This function is intended to set and remove zones of protection for selected areas by operational commands or as result of system reactions.

#REQ_5.1.4.4-1#

UGTMS shall automatically set a zone of protection based on input provided by external devices (e.g. emergency stop request from platform), if such external devices are used by UGTMS.

#REQ_5.1.4.4-2#

UGTMS shall apply a zone of protection created by operational command from the interface with the external operations control HMI.

#REQ_5.1.4.4-3#

UGTMS shall provide the zone of protection status, including the covered area and the reason, to the interface with the external operations control HMI.

#REQ_5.1.4.4-4#

UGTMS shall stop by emergency braking all trains present in the zone of protection, except, optionally, for the hazardous situations defined by the transport authority which require trains to leave the zone of protection.

#REQ_5.1.4.4-5#

UGTMS shall prevent trains from entering the zone of protection.

#REQ_5.1.4.4-6#

A zone of protection set manually shall be released by safety-related command provided via the interface with the external operations control HMI.

#REQ_5.1.4.4-7#

A zone of protection set automatically shall be released by safety-related command provided via the interface with the external operations control HMI, if the external condition is no longer detected.

#REQ_5.1.4.4-8#

UGTMS shall provide the zone of protection status, including the covered area and the reason, to the interface with the external train HMI. (O)

5.1.4.5 Deleted

5.1.4.6 Authorize the entry of non-operative UGTMS trains into UGTMS territory

Optional: all GOAs

This function is intended to authorize the entry of non-operative UGTMS trains into the UGTMS territory.

#REQ_5.1.4.6-1#

UGTMS shall authorize the entry through appropriate wayside signals when the conditions (e.g. track section occupancy) defined by the transport authority for entry into UGTMS territory have been fulfilled.

#REQ_5.1.4.6-2#

UGTMS shall detect a non-operative UGTMS train entering a transfer track of the UGTMS territory.

#REQ_5.1.4.6-3#

UGTMS shall report the entrance of a non-operative UGTMS train into a transfer track and into UGTMS territory to the interface with the external operations control HMI.

5.1.5 Supervise train movement

This function is intended to supervise train movement in accordance with train protection profile and other safety-related constraints.

5.1.5.1 Determine actual train speed

Mandatory: all GOAs

This function is intended to determine the actual train speed.

#REQ_5.1.5.1-1#

UGTMS shall detect and determine the actual train speed.

#REQ_5.1.5.1-2#

UGTMS shall take into account the effects of speed measurement inaccuracies.

#REQ_5.1.5.1-3#

UGTMS shall determine the zero-speed status within the predefined tolerances of the speed measurement system.