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Interested committees:

Title: BS EN 62290-2 Railway applications. Urban guided transport management and command/control systems
Functional requirements specification

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:

IEC 62290-2 ED3

DATE OF CIRCULATION:

2023-04-28

CLOSING DATE FOR VOTING:

2023-07-21

SUPERSEDES DOCUMENTS:

9/2944/RR

IEC TC 9 : ELECTRICAL EQUIPMENT AND SYSTEMS FOR RAILWAYS

SECRETARIAT:

France

SECRETARY:

Mr Denis MIGLIANICO

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:

☐

Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☐ SAFETY

☒ SUBMITTED FOR CENELEC PARALLEL VOTING

☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

Attention IEC-CENELEC parallel voting

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of

- any relevant patent rights of which they are aware and to provide supporting documentation,
- any relevant "in some countries" clauses to be included should this proposal proceed. Recipients are reminded that the enquiry stage is the final stage for submitting "in some countries" clauses. See AC/22/2007.

TITLE:

Railway applications – Urban guided transport management and command/control systems – Part 2: Functional requirements specification

PROPOSED STABILITY DATE: 2029

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2: Functional requirements specification

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 62290-2 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

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

The main technical changes with regard to the previous edition are as follows:

- the functions 5.1.4.5 Stopping a train en route, 5.1.5.4 Monitor speed at discrete location, 5.5.5 Manage UGTMS transfer tracks, 5.6.4.1 Monitor passenger emergency calls and 6.2.4 Ensure commuting services of the second edition have been deleted,
- the functions 5.5.11 Manage train washing, 5.5.12 Manage non-stopping area and 6.3.4 Perform progressive shutdown have been added in this third edition

- many of the requirements of the second edition have been reworded: changes in their wording could be only minor and editorial, or it could have technical consequences,
- some requirements of the second edition have been moved from one subclause to another,
- some requirements of the second edition have been deleted,
- some new requirements have been added in the existing functions,
- an informative annex giving the reader some user's recommendations about Part 2 has been added,
- another informative annex giving some typical performance-related criteria has been also added

It has to be noted that in order to avoid any disturbance in the use of the document, when functions or requirements of the second edition have been deleted, their numberings have been kept on purpose in this third edition. 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 this third edition is limited as much as possible.

The text of this standard is based on the following documents:

FDIS	Report on voting
9/XXXX/FDIS	9/XXXX/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62290 series, 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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 62290 standard 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. This series does not apply to lines that are operated under specific railway regulations, unless otherwise specified by the authority having jurisdiction.

These systems are designated here 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.

This 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 objective of this series is to achieve interoperability, interchangeability and compatibility.

This series is a recommendation for those transport authorities wishing to introduce interoperable, interchangeable and compatible equipment.

It is the responsibility of the transport authority concerned in accordance with the authority having jurisdiction to decide on how to apply this series and to take into account their particular needs.

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.

This 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 to be 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 this series.

According to IEC 62278, it is the responsibility of the transport authority, in agreement with the authority having jurisdiction, 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 have to be determined by a specific risk analysis.

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

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

- Part 1 “System principles and fundamental concepts” provides an introduction to the standard and deals with the main concepts, the system definition, the principles and the basic functions of UGTMS (Urban Guided Transport Management and Command/Control Systems).

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

- Part 2 “Functional requirements specification” specifies the functional requirements associated to the basic functions provided by Part 1, within the system boundaries and interfaces as defined in Figure 3 of Part 1.

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.

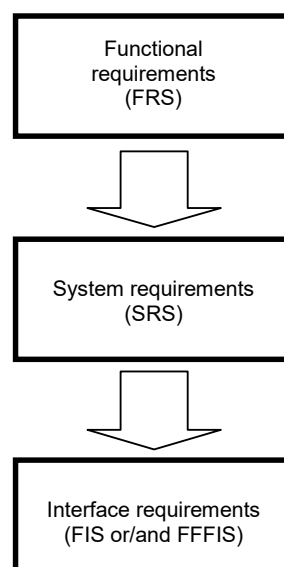
- Part 3 “System requirements specifications” deals with the architecture of the system and the allocation of the requirements and functions identified in Part 2 to UGTMS equipment.

The SRS (System Requirement Specification) specifies the architecture of a UGTMS system, with mandatory and optional UGTMS equipment.

- Part 4 (under consideration) “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 Part 3.

For interfaces between UGTMS equipment, the logical interface or FIS (Functional Interface Specification) and/or the physical and logical interface or FFFIS (Form Fit Functional Interface Specification) will be considered.

NOTE The specific structure of Part 4 will be established to accommodate optional and mandatory UGTMS equipment, and to reflect local conditions. In principle, only one FIS or/and 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 891/11

Figure 1 – The three-step process followed by the UGTMS standard

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

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

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

84

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

Part 2: Functional requirements specification

1 Scope

This document 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 standard 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
- localisation of trains by onboard UGTMS equipment (reporting trains), and optionally by external wayside (and optionally onboard) device.

In this standard, the functional requirements set the framework to which detailed functions should be 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 may be added for a generic or specific application.

Note: the functional breakdown in this document is consistent with Basic functions in Table 1 of Part 1. These Basic functions have been refined into a more complete and detailed tree, and the “Mandatory/Optional” attributes of their subfunctions may be different with those given in Table 1. The functional breakdown which follows this clause is the reference one for IEC 62290 series.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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, *Railway applications – Urban guided transport management and command/control systems – Part 1: System principles and fundamental concepts*

3 Terms, definitions and abbreviations

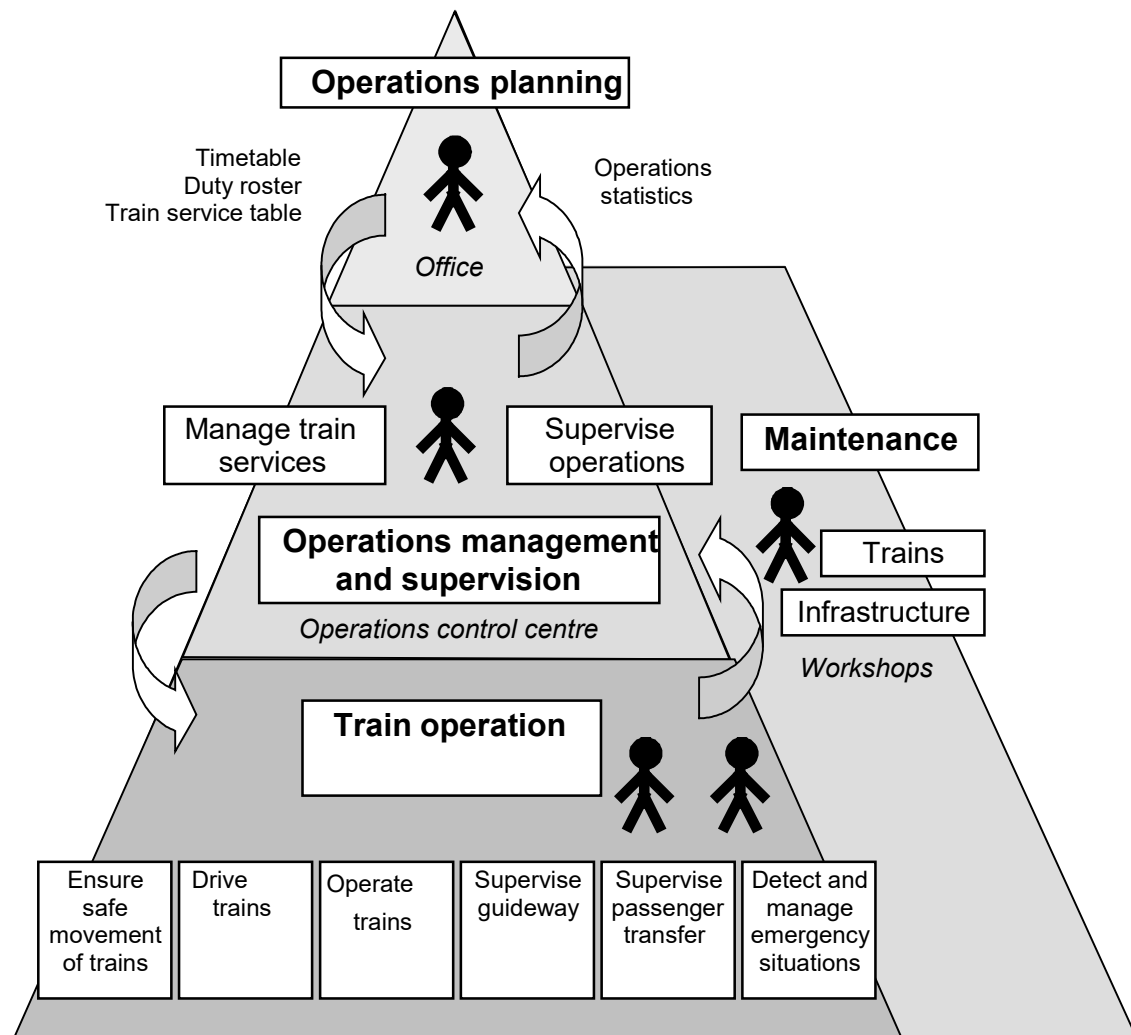
For the purposes of this document, the terms, definitions and abbreviations given in IEC 62290-1 apply.

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 standard,
- 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 standard, but UGTMS supports maintenance as described in 6.9.



IEC 892/11

Figure 2 – Organisation of operation

This operations organisation hierarchy provides an overview of UGTMS functions of this functional requirements specification. 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.

Operation planning provides the operation management and supervision level with all necessary information to execute train operation and is provided with information from

management and supervision 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/or 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 protection of either a separate fall-back wayside signal system or operating procedures, or a combination of both, as specified by the transport authority (see also 4.6 below).

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.

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 and/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.

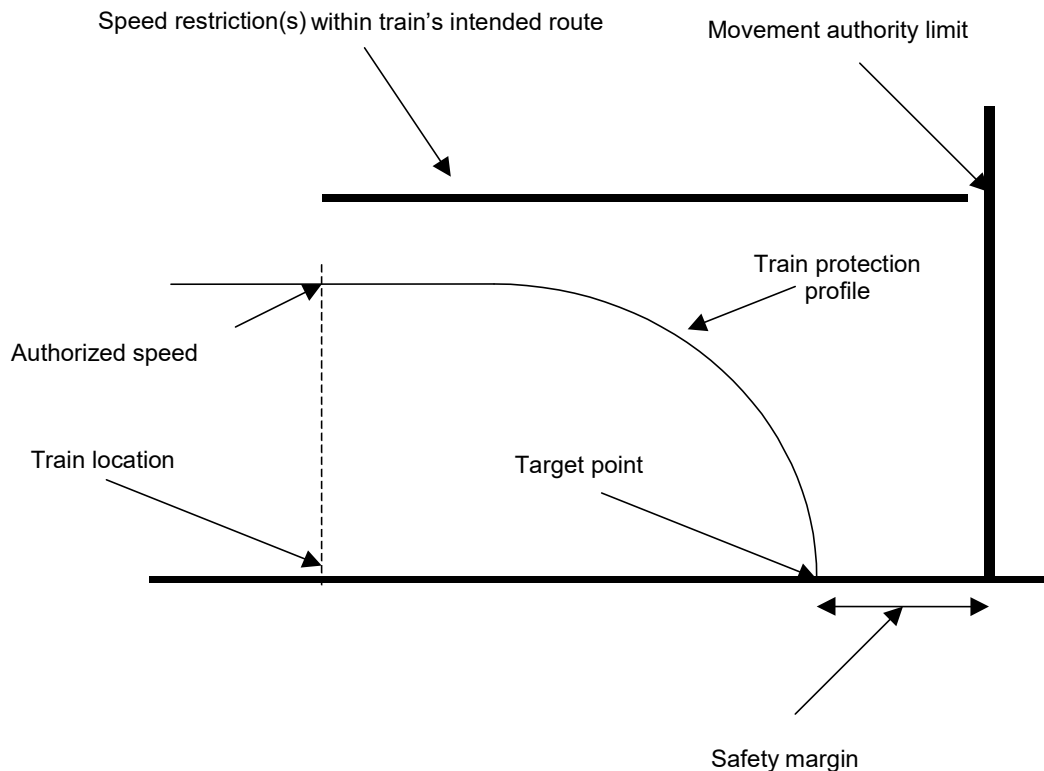
UGTMS provides safe train separation assurance in all grades of automation based on the principle of an instantaneous stop of a preceding train. Safe train separation may be achieved using either fixed block or moving block principles.

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 margin inaccuracy of 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.



IEC 893/11

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 being beyond 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 and/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 any or all of the above.

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

This clause 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 [...]".

5.1 Ensure safe movement of trains

Ensuring safe movement of trains is achieved by:

- Ensuring a safe route for each train; this 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 a movement authority limit and train protection profile (addressed in 5.1.4)
- Supervising train movement in accordance with this movement authority limit and train protection profile (addressed in 5.1.5)

5.1.1 Ensure safe route

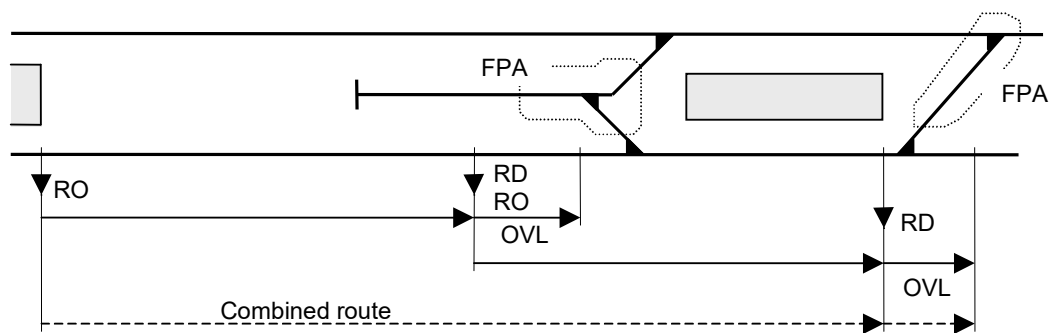
Mandatory: all GOAs if "Ensure safe route" functions are provided by UGTMS

This subclause 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).



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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).

Locking a route element consists in maintaining a route element as it is set.

Releasing a route element consists in unlocking a locked route element.

Locking a route consists in locking all route elements of the route.

Releasing a route consists in 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#

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

316 #REQ_5.1.1.1.1-2#

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

321 #REQ_5.1.1.1.1-3#

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

323 #REQ_5.1.1.1.1-4#

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

326 #REQ_5.1.1.1.1-5#

327 Deleted.

328 #REQ-5.1.1.1.1-6#

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

332 #REQ_5.1.1.1.1-7#

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

335 #REQ_5.1.1.1.1-8#

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

338 #REQ_5.1.1.1.1-9#

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

341 #REQ_5.1.1.1.1-10#

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

344 **5.1.1.1.2 Supervise route**

345 **Mandatory: all GOAs**

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

347 #REQ_5.1.1.1.2-1#

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

350 #REQ_5.1.1.1.2-2#

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

353 #REQ_5.1.1.1.2-3#

354 Deleted.

355 #REQ_5.1.1.1.2-4#

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

358 **5.1.1.1.3 Lock route by train**

359 **Mandatory: all GOAs**

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

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

363 #REQ_5.1.1.1.3-1#

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

366 #REQ_5.1.1.1.3-2#

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

369 #REQ_5.1.1.1.3-3#

370 The route shall be maintained locked as soon as the train has entered it.

371 **5.1.1.2 Release route**

372 **Mandatory: all GOAs**

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

374 #REQ_5.1.1.2-1#

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

378 #REQ_5.1.1.2-2#

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

381 #REQ_5.1.1.2-3#

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

384 #REQ_5.1.1.2-4#

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

388 #REQ_5.1.1.2-5#

389 Deleted.

390 #REQ_5.1.1.2-6#

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

392 **5.1.2 Ensure safe separation of trains**

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

395 **5.1.2.1 Locate UGTMS reporting trains**

396 This function is intended to locate reporting trains.

397 **5.1.2.1.1 Initialise UGTMS reporting trains location**

398 **Mandatory: all GOAs**

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

- 400 • awakened inside UGTMS territory,
- 401 • entering UGTMS territory,
- 402 • recovering from localisation failures.

403 #REQ_5.1.2.1.1-1#

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

406 #REQ_5.1.2.1.1-2#

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

408 #REQ_5.1.2.1.1-3#

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

411 #REQ_5.1.2.1.1-4#

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

414 #REQ_5.1.2.1.1-5#

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

417 #REQ_5.1.2.1.1-6#

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

420 **5.1.2.1.2 Determine train orientation**

421 **Mandatory: all GOAs**

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

424 #REQ_5.1.2.1.2-1#

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

427 **5.1.2.1.3 Determine actual train travel direction**

428 **Mandatory: all GOAs**

429 This function determines the actual travel direction of reporting trains.

430 #REQ_5.1.2.1.3-1#

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

432 #REQ_5.1.2.1.3-2#

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

435 **5.1.2.1.4 Determine train location**

436 **Mandatory: all GOAs**

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

439 #REQ_5.1.2.1.4-1#

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

441 #REQ_5.1.2.1.4-2#

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

443 #REQ_5.1.2.1.4-3#

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

446 #REQ_5.1.2.1.4-4#

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

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

451 #REQ_5.1.2.1.4-5#

452 Deleted.

453 #REQ_5.1.2.1.4-6#

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

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

459 #REQ_5.1.2.1.4-7#

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

461 #REQ_5.1.2.1.4-8#

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

464 #REQ_5.1.2.1.4-9#

465 Deleted.

466 **5.1.2.2 Locate non-reporting trains**

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

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

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

472 #REQ_5.1.2.2-1#

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

475 #REQ_5.1.2.2-2#

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

479 **5.1.3 Determine permitted speed**

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

482 **5.1.3.1 Determine static speed profile**

483 **Mandatory: all GOAs**

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

487 #REQ_5.1.3.1-1#

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

489 #REQ_5.1.3.1-2#

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

492 **5.1.3.2 Determine temporary infrastructure speed restrictions**

493 **Optional: all GOAs**

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

496 #REQ_5.1.3.2-1#

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

500 #REQ_5.1.3.2-2#

501 Deleted.

502 #REQ_5.1.3.2-3#

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

505 #REQ_5.1.3.2-4#

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

508 #REQ_5.1.3.2-5#

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

511 #REQ_5.1.3.2-6#

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

514 #REQ_5.1.3.2-7#

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

518 #REQ_5.1.3.2-8#

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

522 **5.1.3.3 Determine maximum speed by train type**

523 **Optional: all GOAs**

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

525 #REQ_5.1.3.3-1#

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

527 **5.1.3.4 Determine temporary train speed restrictions**

528 **Optional: all GOAs**

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

531 #REQ_5.1.3.4-1#

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

534 #REQ_5.1.3.4-2#

535 UGTMS shall determine speed restrictions based on the driving mode.

536 **5.1.4 Authorize train movement**

537 This function deals with the:

- 538 • determination of movement authority limit by assignment of limits of safe route, limits
539 of safe train separation and other limits (such as zone of protection),
- 540 • determination of train protection profile by assignment of the movement authority limit
541 and authorized speed,
- 542 • 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 the movement authority, corresponding to the first danger point ahead of the train.

#REQ_5.1.4.1-1#

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

- Limit of safe route
- Limit based on safe train separation
- Limit based on the guideway (e.g. end of track)
- Zones of protection.

#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.

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 (shunting in depot, stabling areas, etc.) and at a speed sufficiently slow to reduce the consequences of a collision. (O)

#REQ_5.1.4.2-3#

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

582 #REQ_5.1.4.2-4#

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

584 #REQ_5.1.4.2-5#

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

587 **5.1.4.3 Authorize train movement by wayside signals**

588 **Mandatory: all GOAs if wayside signals are used by UGTMS**

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

591 #REQ_5.1.4.3-1#

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

594 #REQ_5.1.4.3-2#

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

597 #REQ_5.1.4.3-3#

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

601 **5.1.4.4 Determine a zone of protection**

602 **Mandatory: all GOAs**

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

605 #REQ_5.1.4.4-1#

606 UGTMS shall automatically set a zone of protection based on commands provided by external
607 devices (e.g. emergency stop switch on platform), if such external devices are used by
608 UGMTS.

609 #REQ_5.1.4.4-2#

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

612 #REQ_5.1.4.4-3#