PD CLC/TS 50459-1:2015

BSI Standards Publication

Railway applications — Communication, signalling and processing systems — European Rail Traffic Management System — Driver— Machine Interface

Part 1: General principles for the presentation of ERTMS/ETCS/GSM-R information

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National foreword

This Published Document is the UK implementation of CLC/TS 50459-1:2015. It supersedes DD CLC/TS 50459-1:2005 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/9, Railway Electrotechnical Applications, to Subcommittee GEL/9/1, Railway Electrotechnical Applications - Signalling and communications.

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Railway applications - Communication, signalling and processing systems - European Rail Traffic Management System - Driver-Machine Interface - Part 1: General principles for the presentation of ERTMS/ETCS/GSM-R information

Applications ferroviaires - Systèmes de signalisation, de télécommunications et de traitement - Système européen de gestion du trafic ferroviaire - Interface de conduite - Partie 1: Principes généraux pour la présentation des informations ERTMS/ETCS/GSM-R

Bahnanwendungen - Telekommunikationstechnik, Signaltechnik und Datenverarbeitungssysteme - Europäisches Leitsystem für den Schienenverkehr - Mensch-Maschine Schnittstelle - Teil 1: Ergonomische Grundsätze für die Darstellung von ERTMS/ETCS/GSM-R Informationen

This Technical Specification was approved by CENELEC on 2015-07-20.

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Contents

Page

Figures

Tables

European foreword

This document (CLC/TS 50459-1:2015) has been prepared by CLC/SC 9XA “Communication, signalling and processing systems”, of Technical Committee CENELEC TC 9X “Electrical and electronic applications for railways”.

This document supersedes CLC/TS 50459-1:2005.

CLC/TS 50459-1:2015 includes the following significant technical changes with respect to CLC/TS 50459-1:2005:

— update general principles for the presentation of ERTMS/ETCS/GSM-R information correlated with ERA_ERTMS_015560;

— update ergonomic arrangements with EN 16186 series.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document should be read in conjunction with ERA_ERTMS_015560 “*ETCS Driver Machine Interface”* and EN 16186 series, “*Railway applications — Driver's Cab*”.

CLC/TS 50459 series consists of the following parts under the general title “*Railway applications – Communication, signalling and processing systems – European Rail Traffic Management System – Driver-Machine Interface*”:

— *Part 1: General principles for the presentation of ERTMS/ETCS/GSM-R information*;

— *Part 2: Ergonomic arrangements of GSM-R information*[1)];

— *Part 3: Ergonomic arrangements of non ETCS information*[1)].

1) At final draft stage.

Introduction

CLC/TS 50459 series contains the ergonomic arrangements of information on the ERTMS/DMI Display (CCD and TRD). Most items are illustrated with an example.

The reasons for defining the ergonomics of the DMI are as follows:

— achieving harmonized and coherent presentation for ERTMS/ETCS and NTC information. Given the large number of NTC's requiring the use the ERTMS/ETCS DMI, only a harmonized approach is feasible;

— defining Driver-Machine Interface ergonomics that is compatible with agreed interoperable ERTMS specifications;

— to reduce the risk of incorrect operation by a driver;

— facilitating train operation with a unified ergonomics, hence reducing the cost of driver training;

— better understanding of the tasks to be performed;

— increasing speed and accuracy of driver actions.

1 Scope

This Technical Specification describes from an ergonomic point of view how ERTMS and non-ERTMS information will be arranged and displayed. More specifically, it covers information that is out of the scope of ERA_ERTMS_015560. This Technical Specification describes more ergonomic details than currently provided by the ERTMS/GSM-R specifications.

This Technical Specification defines the ergonomics for the Driver-Machine Interface (DMI) for the following applications:

— stand-alone ERTMS/GSM-R Train Radio Systems;

— non-ERTMS/ETCS Train Control Systems;

— other technical systems currently provided on the rolling stock.

The ergonomics covers

— the general arrangements (dialogue structure, sequences, layout philosophy, colour philosophy),

— the symbols,

— the audible information,

— the data entry arrangements.

This Technical Specification is limited to ergonomic considerations and does not define the technology to be used for the implementation but it does give guidelines about how to implement the requirements using different technology types (soft keys, touch screen device, LCD, electromechanical instruments, indicator lamps, etc.).

This Technical Specification is applicable to all trains fitted with the ERTMS/ETCS and also to trains fitted with train radio (GSM-R) DMI.

The scope of Part 1 of CLC/TS 50459 is to define ergonomic principles for the interface between the driver and the above listed applications.

TDD is out of scope of CLC/TS 50459 series.

For human factor items, such as display of information, display location, viewing angles and organization of the screens, see EN 16186 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.

ERA_ERTMS_015560, *ETCS Driver Machine Interface*, Version 3.4.0, 2014-05-12

EN 16186-1, *Railway applications – Driver's cab – Part 1: Anthropometric data and visibility*

prEN 16186-2:2015, *Railway applications – Driver's cab – Part 2: Integration of displays, controls and indicators* [2)]

prEN 16186-3, *Railway applications – Driver's cab – Part 3: Design of displays* [2)]

2) At draft stage.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
activated
put into a functional state following a validated input

3.1.2
button
operating element for interaction with the cab display (hard key, soft key, sensitive area)

3.1.3
cell
basic unit to define the shape of DMI objects and the proportions of areas

3.1.4
ERTMS/ETCS system
system in which ERTMS/ETCS functional, technical and the related operational specifications are determined

3.1.5
ERTMS/GSM-R system
system in which ERTMS/EIRENE functional and system specifications are determined

3.1.6
hard key
physical key with permanent marking and not part of the screen area

Note 1 to entry: This permanent marking may be alpha and/or numeric and/or a symbol.

3.1.7
indicator
element designed to draw attention to a system status

3.1.8
input field
highlighted screen area for entering data

3.1.9
label
symbol or text indication on or close to an indicator or a button

3.1.10
On-Board system
ERTMS/ETCS system and/or the ERTMS/GSM-R system or sub-system located in rolling stock

3.1.11
sensitive area
enabled area on a touchscreen on which a physical action is possible in order to give input to the cab display

3.1.12
soft key
context-dependent key that consists of a hard key with an associated label on the display area

3.1.13
sound group
set of sounds relating to similar events

3.1.14
symbol
presentation of information in graphical form instead of using text

3.1.15
title
text explaining the purpose of the window or screen

3.1.16
window
separate visual area of the screen that displays information output and may allow input

Note 1 to entry: Usually, it has a rectangular shape.

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

CCD	Command Control Display
DMI	Driver-Machine Interface
EIRENE	European Integrated Railways radio Enhanced Network
ERRI	European Rail Research Institute
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
GSM-R	Global System for Mobile communication – Railways
ISO	International Organization for Standardization
NTC	National Train Control
TDD	Train Diagnostic Display
TRD	Train Radio Display
UIC	Union Internationale des Chemins de Fer
w × h	width by height

4 General ergonomic principles

4.1 Principles for presentation

4.1.1 General

This subclause provides requirements for the graphical presentation and arrangement of the information shown on the CCD and TRD.

The organization of screen information should comply with the requirements of prEN 16186-3.

The displays shall be located within the maximum reach envelope according to prEN 16186-2:2015, Figure A.1.

The displays should be located within the preferred field of vision according to prEN 16186-2:2015, Figure A.2.

4.1.2 Presentation techniques

4.1.2.1 Emphasizing particular information

To emphasize particular information shown on the DMI, it shall be possible to change the appearance of other areas to make these other areas less conspicuous.

This change of appearance shall be achieved by one or more of the following techniques:

— changing colours;

— changing format.

4.1.2.2 Use of colours

The use of colours shall be according to prEN 16186-3.

4.1.2.3 Use of flashing

The use of flashing shall be according to prEN 16186-3.

4.1.2.4 Use of frames

The use of frames shall be according to prEN 16186-3.

4.1.2.5 Use of highlighting

The use of highlighting shall be according to prEN 16186-3.

4.1.2.6 Use of sound

Sound is used to draw attention to the display.

There are five types of sound:

1) feedback sounds;

2) ERTMS/ETCS sounds;

3) ERTMS/GSM-R sounds;

4) NTC sounds;

5) sounds for other train functions.

The format of the sounds (except NTC sounds and sounds for other train functions) is described in 4.10.2.

ERA_ERTMS_015560 describes how and when the sounds will be used for ETCS.

CLC/FprTS 50459-2 describes how and when the sounds will be used for GSM-R.

Speech and other audible indications for NTC and other train functions according to standards and National Rules can be used. These indications shall not conflict with sounds defined in this document or other in-cab indications.

NOTE Additional information can be found in prEN 16186-2:2015 and prEN 16186-3.

4.1.2.7 Display of indicators

An indicator should be visible for at least 2 s.

NOTE The flashing frame is not subject to this rule.

4.1.3 Text output

The output of text on the screen, e.g. words, sentences and questions, shall meet the following requirements to provide usability and comprehensibility:

— the terminology shall be consistent, i.e. each word has one meaning and one word is used to express one meaning;

— the terminology shall be in line with the operational tasks;

— to avoid overloading of the driver, not more than 5 text messages at the same time shall be presented on each basic screen;

— a conditional instruction shall start with the condition, e.g. "if ... then ...";

— an instruction shall only give one condition and only one question shall be asked in one sentence;

— the active form of verbs shall be used;

— short main sentences shall be used; the length of headline messages should not exceed 40 characters;

— double negations and negative questions shall not be used;

— actions that are required of the driver should be at the beginning of the text information (e.g. ACK transition to level 2);

— lower and upper case characters may be used.

4.1.4 Characters

Displays are based on cells. A cell can consist of one or more pixels. To optimize readability, the chosen character font shall be optimized for display use to compensate the relatively low resolution of display screens in comparison with printed material.

The requirements in prEN 16186-3 shall be fulfilled in respect of the following items:

— character type;

— minimum character height;

— typography;

— character spacing;

— numbers.

4.1.5 Redundancy concept

A display system concept for merging the most important driver information in case of display failures (redundancy concept) may be provided.

4.2 Principles for dialogue

4.2.1 General

This subclause deals with software aspects and describes general ergonomic principles for the dialogue between user and system, which are independent of any specific dialogue technique.

The dialogue principles are intended to make the use of the system easier.

The aim is to design a dialogue, which allows the user to plan and perform work under ergonomically favourable conditions, which take the psychological characteristics of the user into consideration.

The dialogue principles are not independent, and it may be necessary to trade off the benefits of one principle against another.

The applicability and the relative importance will vary with the specific field of application, user groups, and the dialogue technique chosen.

4.2.2 Suitability for the task

A dialogue should support the user in the effective and efficient completion of the task.

4.2.3 Self-descriptiveness

A dialogue should be self-descriptive.

NOTE A dialogue is self-descriptive when each dialogue step is immediately comprehensible through feedback from the system or is explained to the user when requesting the relevant information.

4.2.4 Controllability

A dialogue shall be controllable.

NOTE A dialogue is controllable when the user is able to maintain direction over the whole course of the interaction until the point at which the goal has been met.

4.2.5 Conformity with user expectations

A dialogue should conform to user expectations.

NOTE A dialogue conforms with user expectations when it corresponds to the user's task knowledge, education, experience, and to commonly accepted conventions.

4.2.6 Error guidance

An input dialogue shall give error guidance.

NOTE An input dialogue gives error guidance when, despite errors in input, the intended result can be achieved with minimal corrective action having to be taken.

4.3 Physical parameters

Physical parameters (e.g. position, size, brightness, colour, resolution, luminance, contrast, flicker effect) including adjustment shall be in accordance with EN 16186 series.

It shall not be possible to reduce the luminance and contrast of the DMI so that the displayed information becomes invisible.

4.4 Arrangement of information

4.4.1 General

The arrangement of information can improve visual search and facilitate the discrimination between individual DMI objects or groups of DMI objects.

DMI objects shall clearly indicate the meaning and the status of the related information. (Status is defined in prEN 16186-3.)

Information is given to the driver by means of indicators, symbols and text messages. The driver shall have the possibility to initiate activations and to make selections by means of buttons. The action shall be sent to the corresponding train system.

4.4.2 Window title

Each window should have a title.

The text label on the window title should contain an indication regarding location within a sequence of windows.

4.4.3 Buttons

4.4.3.1 Arrangements of buttons

The requirements in prEN 16186-3 shall be fulfilled in respect of the following items:

— type of buttons (up-type, down-type, delay-type);

— size of buttons;

— separation of buttons;

— shape of buttons;

— feedback of the operation of the buttons.

The feedback sounds are described together with their associated functions in CLC/TS 50459 series.

4.4.3.2 Button activation

Only one button shall be handled at any one time by the DMI. This means that while any button is pressed, no other button can be used.

For existing class B cab signalling systems (as defined in the CR CCS TSI), other solutions may apply.

4.5 Symbols

Symbols shall be used for frequent, common and known indications. Symbols can also be used for labels as part of a graphical language. The symbols defined in prEN 16186-3 and in ERA_ERTMS_015560 shall be used where applicable.

NOTE Additional symbols are described together with their associated functions in CLC/TS 50459 series.

If no suitable symbol is defined in prEN 16186-3, ERA_ERTMS_015560 or in CLC/TS 50459 series, a short unambiguous text label or message may be used.

Alternatively, a new symbol may be used. In this case, the proposed symbol shall comply with the requirements of prEN 16186-3. The proposed symbol should be published at least on CEN/CENELEC, “TecRec” and UIC websites in order to facilitate future revisions of the affected standards.

4.6 Navigation buttons

Navigation buttons (for example, scroll up in a list, enter, etc.) shall comply with prEN 16186-3.

4.7 Menu structure

The menu structure for TRD is defined in CLC/FprTS 50459-2.

There is no defined menu structure for NTC within this document. Any chosen structure should comply with the generic requirements of this document regarding ergonomic principles.

4.8 Data input

Input of data should comply with prEN 16186-3 or ERA_ERTMS_015560 as appropriate.

4.9 Languages

The language selection shall comply with ERA_ERTMS_015560.

The offered languages should be limited by a filter to those relevant for the neighbouring networks.

Deactivation of the filter shall be possible and provide all available languages.

English language shall always be offered to the driver.

4.10 Audible information

4.10.1 General

Audible information is used to draw the driver’s attention to the display.

Audible information is classified in several timbres. The timbre allows the driver to identify if the audible information is a feedback, a warning, an incoming call or something else.

Audible information can be generated simultaneously.

Voice output shall only be used optionally as secondary, additional information.

The loudspeakers shall be placed to obtain the best audible perception to suit the architecture of the cab.

The volume adjustment shall comply with prEN 16186-3.

It shall not be possible to reduce the sound so that it becomes inaudible in the driving cab environment.

4.10.2 Sounds

4.10.2.1 General

The files, in a WAV-format, containing the examples for the sounds can be heard by clicking on the corresponding figures. The WAV-format file is only informative. The examples are given only to be

sure that the sounds provided by the real system are sufficiently similar to avoid confusion. The WAV-format files should be used. Other methods may be used if acceptable to approval bodies.

NOTE General sounds are listed in this part of CLC/TS 50459 series. Specific sounds are listed in the relevant parts of CLC/TS 50459 series.

4.10.2.2 S feedback 1 – down

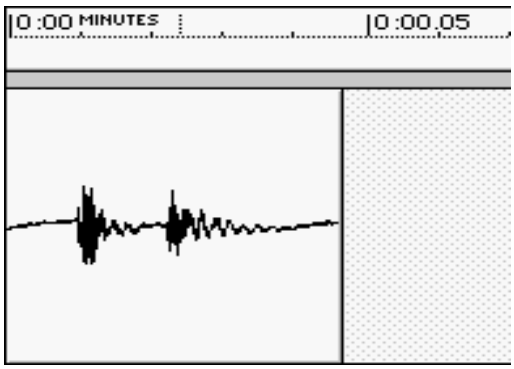
Audible feedback while pressing the finger on a button on the DMI (button down).

Table 1 describes the main characteristics of this audible information.

Table 1 — S feedback 1 – down

Feedback	Sound group:	Feedback
Action required: No	Tone(s)	2
	Duration:	0,05 s
Urgency: information	Frequency sequence:	Not applicable
	Intensity sequence:	Not applicable
	Tempo:	Not applicable
	Presentation:	Once

Figure 1 displays the wave of this audible information.



Reference information:

File: S_feedback1_down.wav

Figure 1 — S feedback 1

4.10.2.3 S feedback 2 – up

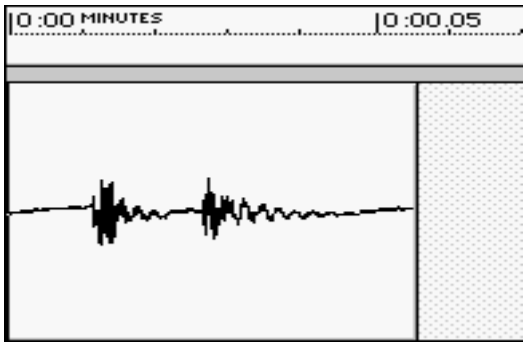
Audible feedback while lifting the finger from a button on the DMI (button up).

Table 2 describes the main characteristics of this audible information.

Table 2 — S feedback 2 – up

Feedback	Sound group:	Feedback
Action required: No	Tone(s)	2
	Duration:	0,06 s
Urgency: information	Frequency sequence:	Not applicable
	Intensity sequence:	Not applicable
	Tempo:	Not applicable
	Presentation:	Once

Figure 2 displays the wave of this audible information.



Reference information:

File: S_feedback2_up.wav

Figure 2 — S feedback 2

4.10.2.4 S feedback 3 – down and up

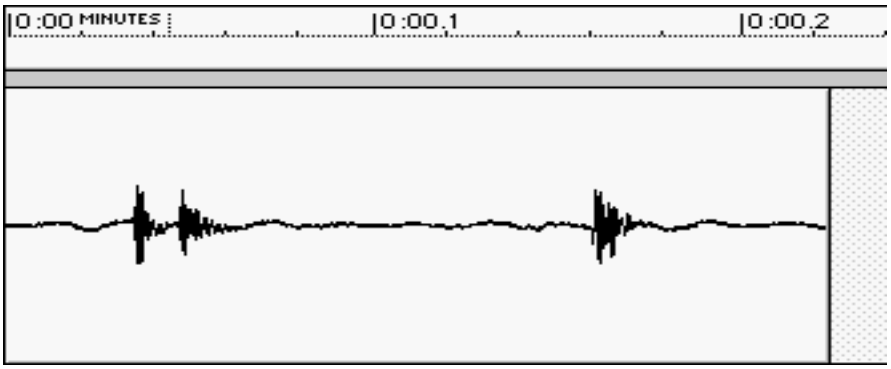
Audible feedback while activating a button on the DMI.

Table 3 describes the main characteristics of this audible information.

Table 3 — S feedback 3 – down and up

Feedback	Sound group:	Feedback
Action required: No	Tone(s)	2
	Duration:	0,16 s + 0,07 s = 0,23 s
Urgency: information	Frequency sequence:	Not applicable
	Intensity sequence:	Not applicable
	Tempo:	Not applicable
	Presentation:	Once

Figure 3 displays the wave of this audible information.



Reference information:

File: S_feedback3_down_up.wav

Figure 3 — S feedback 3

4.10.2.5 S info – Information on DMI

The audible information is given to draw the attention of the driver to new information visually presented on the DMI.

When new information is presented due to the request or an action of the driver, no sound shall be provided.

When new information is presented on the area D (area D is defined in ERA_ERTMS_015560), no sound shall be provided.

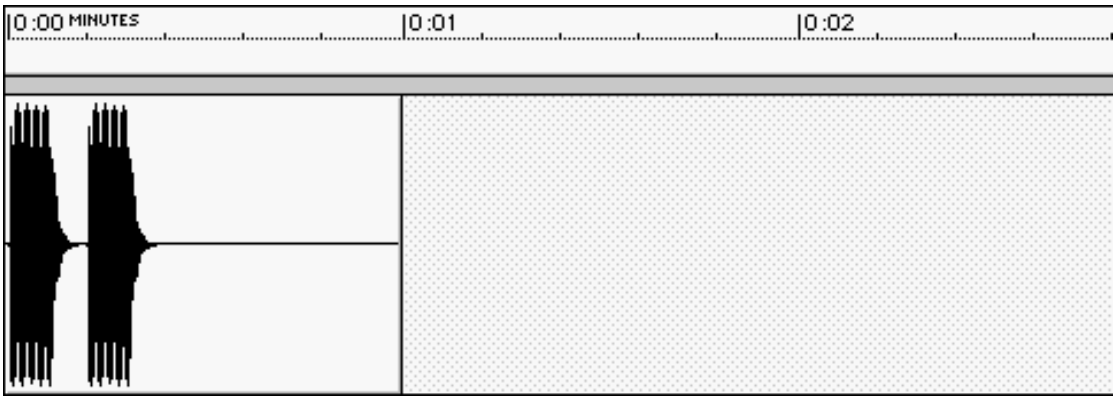
The information may be from the supervision of movement authorities and speed limits (performance critical information) and from the emergency brake (passenger or emergency signal), but also for other information on the DMI.

Table 4 describes the main characteristics of this audible information.

Table 4 — S info – Information on DMI

Information	Sound group:	Information
Action required: look at DMI	Tone(s):	1
	Duration:	2 × 0,2 s = 0,4 s
Urgency: information	Frequency sequence:	Not applicable
	Intensity sequence:	Not applicable
	Tempo:	Not applicable
	Presentation:	Once

Figure 4 displays the wave of this audible information.



Reference information:

File: S_info.wav

Figure 4 — S info

4.10.2.6 S1 – Driving too fast

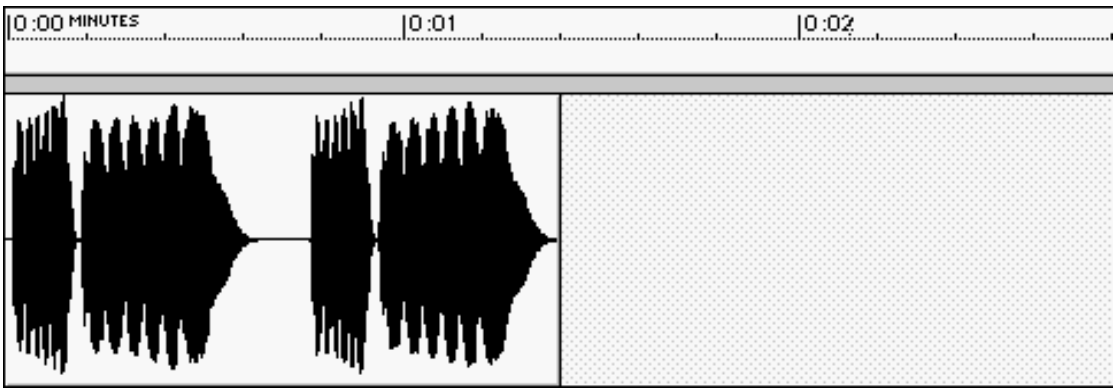
This is an attention signal from the supervision of the speed.

Table 5 describes the main characteristics of this audible information.

Table 5 — Driving too fast

Supervision of movement authorities	Sound group:	Supervision
Action required: operate brake	Tone(s):	2
	Duration:	0,15 s low tone + 0,45 s high tone = 0,6 s
Urgency: attention	Frequency sequence:	Low / high
	Intensity sequence:	Not applicable
	Tempo:	Every 0,8 s (pause 0,2 s)
	Presentation:	Twice

Figure 5 displays the wave of this audible information.



Reference information:

File: S1_toofast.wav

Figure 5 — Driving too fast

4.10.2.7 S2 – Speed warning

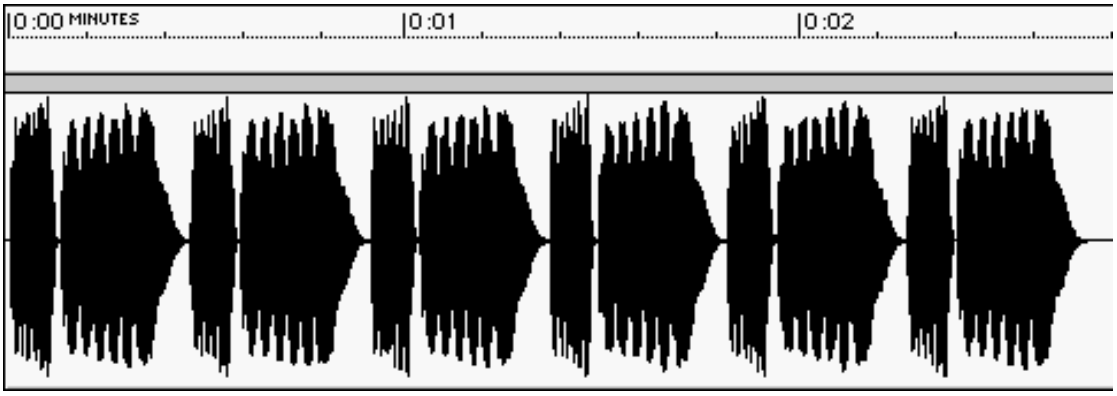
This is a warning signal from the supervision of movement authorities and speed limits.

Table 6 describes the main characteristics of this audible information.

Table 6 — S2 – Speed warning

Supervision of movement authorities	Sound group:	Supervision
Action required – operate brake	Tone(s):	2
	Duration:	0,12 s low tone + 0,36 s high tone = 0,48 s
Urgency – warning	Frequency sequence:	Low / high
	Intensity sequence:	Increasing
	Tempo:	Every 0,48 s (no pause)
	Presentation:	As long as necessary until the driver handles the brake or until the system activates the brake (intervention).

Figure 6 displays the wave of this audible information.



Reference information:

File: S2_warning.wav

Figure 6 — S2 – Speed warning

4.10.2.8 S3 – End of intervention

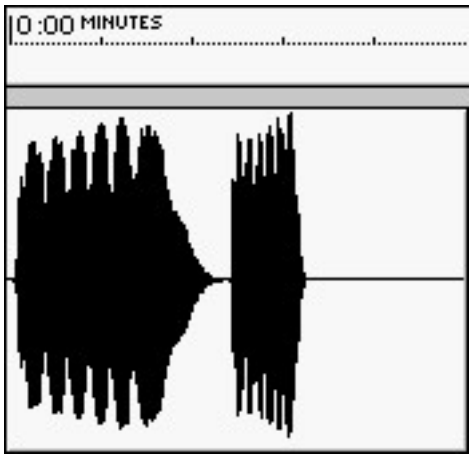
This is an information signal from the supervision of movement authorities and speed limits.

Table 7 describes the main characteristics of this audible information.

Table 7 — S3 – End of intervention

Supervision of movement authorities	Sound group:	Supervision
Action required – operate brake	Tone(s):	2
	Duration:	0,45 s high tone + 0,15 s low tone = 0,6 s
Urgency – information	Frequency sequence:	High / low
	Intensity sequence:	Not applicable
	Tempo:	Not applicable
	Presentation:	Once

Figure 7 displays the wave of this audible information.



Reference information:

File: S3_end_of_intervention.wav

Figure 7 — S3 – End of intervention

4.10.2.9 S4 – Reserved

Reserved

4.10.2.10 S5 – More restrictive target changed

This sound is used to indicate the moment a more restrictive target has changed.

The sound S info (4.10.2.5) shall be used.

4.10.2.11 S6 – Error occurred

This sound is used to indicate the moment an error or failure occurs or a request from the driver is denied.

The sound S info (4.10.2.5) shall be used.

4.10.2.12 S7 – New text message

This sound is used to indicate that a new text message is presented on the DMI.

The sound S info (4.10.2.5) shall be used.

4.10.2.13 S8 – New advisory information

This sound is used to indicate the moment advisory information about movement authorities is presented on the DMI screen.

The sound S info (4.10.2.5) shall be used.

4.10.2.14 S10 – Release the brakes when applied by the driver

S10 may be used to indicate the moment that releasing the brakes applied by the driver would lead to a train speed not exceeding the permitted speed.

The sound S info (4.10.2.5) should be used.

4.10.2.15 S11 – Brakes commanded by a system

This sound is used to indicate the moment the emergency brake or full service brake is commanded by the train system as a reaction to an emergency signal or passenger emergency brake signal.

The sound S info (4.10.2.5) shall be used.

4.10.2.16 S12 – Acknowledgement required

This sound is used to indicate that an acknowledgement is required by the driver.

The sound S info (4.10.2.5) shall be used.

Bibliography

[1] CLC/FprTS 50459-2, *Railways applications – Communication, signalling and processing systems – European Rail Traffic Management System – Driver-Machine Interface – Part 2: Ergonomic arrangements of ERTMS/GSM-R information*

[2] CLC/FprTS 50459-3, *Railways applications – Communication, signalling and processing systems – European Rail Traffic Management System – Driver-Machine Interface – Part 3: Ergonomic arrangements of non ETCS command and control functions*

[3] EN 894-2, *Safety of machinery – Ergonomics requirements for the design of displays and control actuators – Part 2: Displays*

[4] EN ISO 9241-302:2008, *Ergonomics of human-system interaction – Part 302: Terminology for electronic visual displays (ISO 9241-302:2008)*

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