# Ambiguities in Subset-026 for Braking curves computations.

## Introduction

This document summarizes the ambiguities encountered while modeling the braking curves computations specified in Chapter 3 of the Subset 026. Each ambiguity is presented using the following structure

* The context : presents the overall context required to understand the ambiguity
* Related paragraphs : Provides the list of paragraphs related to that specific ambiguity
* Argument : presents the description of the ambiguity
* Solution: indicates the solution we followed at ERTMS Solution to alleviate the ambiguity.

## Ambiguities

### Speed restriction to ensure permitted braking distance

#### Context

It shall be possible for trackside to request on-board to calculate a speed restriction which ensures that the train stops within a given permitted braking distance.

#### Related paragraphs

**Paragraph 3.11.11** and followings: “Speed restrictions to ensure permitted braking distance”

#### Argument

The interpretation of the computation of this speed restriction is not clear.

#### Solution

### Level crossing

#### Context

MRSP can be equal 0km/h if the train has to pass a not protected level crossing. The requirements concerning EBD computation state that EBD has to cross the ceiling speed EBI supervision limit for all the targets of MRSP (or LOA) and has to cross 0km/m only for SvL or the maximum permitted distance to run in Staff Responsible.

#### Related paragraphs

**Paragraph 3.12.5.6** “In case the LX is not protected, ERTMS/ETCS on-board equipment shall be informed:

1. at which speed the LX is allowed to be passed
2. whether the stopping of the train in rear of the LX start location is required or not”

**Paragraph 3.13.8.3.1** “ If a target belongs to the MRSP or is an LOA, the on-board shall calculate an EBD curve that crosses the ceiling speed EBI supervision limit at the target location (see 3.13.9.2) and based on the safe deceleration A\_safe(V,d).”

#### Argument

What happens for the case of not protected level crossing? EBD has to cross EBI supervision limit or 0km/h?

#### Solution

EBD crosses 0km/h.

### A\_brake\_service and Magnetic shoe brake

#### Context

Individual speed dependent deceleration models of A\_brake\_emergency(V) and A\_brake\_service(V) have to be defined for each combination of use of regenerative brake, eddy current brake and magnetic shoe brake.

#### Related paragraphs

**Paragraphs 3.13.2.2.3.1.7** “It shall be possible to define individual speed dependent deceleration models of A\_brake\_emergency(V) and A\_brake\_service(V) for each combination of use of regenerative brake, eddy current brake and magnetic shoe brake.” and **3.13.2.2.6.2**, case of magnetic shoe brake.

#### Argument

The paragraph 3.13.2.2.6.2 indicates that the selection of brake parameter for A\_brake\_service(V) is done according to status of regenerative brake and eddy current brake (**but not magnetic brake**), while the paragraph 3.13.2.2.3.1.7 states that it shall be possible to define individual speed dependent deceleration models of A\_brake\_service(V) for each combination of use of regenerative brake, eddy current brake **AND** magnetic shoe brake.

#### Solution

We offer the possibility to define individual models of A\_brake\_emergency(V) for each combination of use of all three brakes, but we consider that the magnetic shoe brake is never used in the case of A\_brake\_emergency(V).

### T\_brake\_service and Conversion model

#### Context

It shall be possible to compute the value of T\_brake\_service by means of the conversion model.

#### Related Paragraphs

**Paragraph 3.13.2.2.6.3** “When the brake percentage is captured as Train Data and the conversion model is applicable, A\_brake\_emergency(V), T\_brake\_emergency and A\_brake\_service(V) shall not be influenced by the status of a special brake. However, the conversion model offers the possibility that T\_brake\_service can be affected by the status of the regenerative brake, eddy current brake or Ep brake (see A.3.9).”

#### Argument

The calculation of the full service brake equivalent time described in 3.A.3.9 does not specify the possibility to create different values of T\_brake\_service for the different combinations of special brakes; it only indicates that the parameters used to calculate T\_brake\_service may change if it is justified by the specific brake system of the train (Paragraph 3.A.3.9.6). However, only one value of T\_brake\_service will be calculated, that is inconsistent with this paragraph.

#### Solution

We compute only one value of T\_brake\_service.

### Validity limits for the conversion model

#### Context

If the brake models are not captured as Train Data, the conversion model shall be used. However, to do so, some validity limits have to be respected.

#### Related Paragraphs

**Paragraph 3.13.3.2.2** “For trains not fitting into at least one of those validity limits, it is still possible to acquire the brake percentage as Train Data, but the conversion models are not applicable, which means that braking models (i.e. pre-programmed deceleration profiles and brake build up times) shall be used by the speed and distance monitoring function.”

#### Argument

What happens if these pre-programmed deceleration profiles and brake build up times are not defined? Looking to the paragraph 3.13.6.2.1.4, I conclude that if it happens, the on-board have to use the conversion model, but what happens if it is not applicable?

#### Solution

If no brake models are defined in train data and the conversion model is not applicable, the system fails.

### Undefined d\_GUI\_FLOI

#### Context

Computation of Permitted speed supervision limit (P) for different cases

#### Related Paragraphs

**Paragraph 3.13.9.3.5.4** “In case the calculation of the Guidance curve is enabled, the on-board shall calculate the location of the Permitted speed supervision limit valid for the estimated speed, as follows:

d\_P (Vest) = min { d\_FLOI (Vest) - Vest \* T\_driver), d\_GUI\_FLOI (V\_est) }”

#### Argument

Where is the definition of d\_GUI\_FLOI?

#### Solution

### Undefined V\_GUI\_EOA

#### Context

Computation of Permitted speed supervision limit (P) for different cases

#### Related Paragraphs

**Paragraph 3.13.9.3.5.6** “In case the calculation of the GUI curve is enabled, for display purpose only, the P speed related to SBD shall be calculated for the estimated train front end as follows:

V\_P\_EOA (d\_estfront) = min { V\_SBD ( d\_estfront + Vest \* ( T\_driver + T\_bs1 ) ), V\_GUI\_EOA ( d\_estfront ) }

V\_P\_EOA (d\_estfront) = 0 if d\_estfront + Vest \* ( T\_driver + T\_bs1 ) >= d\_EOA”

#### Argument

Where is the definition of V\_GUI\_EOA?

#### Solution

### Undefined V\_GUI\_EBD\_Target

#### Context

Computation of Permitted speed supervision limit (P) for different cases

#### Related Paragraphs

**Paragraph 3.13.9.3.5.8** “In case the calculation of the GUI curve is enabled, for display purpose only, the P speed related to EBD, shall be calculated for the max safe front end of the train as follows:

V\_P\_EBD\_Target (d\_maxsafefront) = min { ( V\_EBD ( d\_maxsafefront + Vest \* ( T\_driver + T\_bs2 ) + Dbec ) - ( Vbec - Vest ) ), V\_GUI\_EBD\_Target ( d\_maxsafefront ) }

V\_P\_EBD\_Target ( d\_maxsafefront ) = Vtarget if d\_maxsafefront + Vest \* ( T\_driver + T\_bs2 ) + Dbec >= d\_EBD ( Vtarget ) or if d\_maxsafefront >= d\_GUI ( Vtarget )

With Dbec and Vbec calculated according to 3.13.9.3.2.10”

#### Argument

Where is the definition of V\_GUI\_EBD\_Target?

#### Solution

### Start of mission, degraded situation in level 2 or 3

#### Context

One of the degraded situations should be only applicable for levels 2 and 3.

#### Related Paragraphs

**Paragraph 5.4.5.1** “Nominally, accidental loss of an already open session (that can occur at any step) has not been taken into account for the design of the SoM flowchart. However, should such a fault occur above D11 the nominal procedure applies (refer to D11 in flowchart). On the other hand, if it occurs in any step further than D11, the process shall go to S10.”

#### Argument

If the train is in level 1, it cannot have a session with Euroradio.

#### Solution

Testing the level of the train before taking the transition.

### Computation of A\_ebmax

#### Context

The specification does not precise how is computed A\_brake\_emergency for A\_ebmax.

#### Related Paragraphs

**Paragraph 3.13.6.2.1.8.2** “The maximum EB deceleration A\_ebmax shall be the maximum of A\_brake\_emergency between 0 km/h and the maximum speed of the train. ”

#### Argument

A\_brake\_emergency is computed from the Train Data of from the Conversion Model?

#### Solution

We assume that it is computed from the conversion model.

### computation of P speed related to EBD in the case of inhibition of the GUI

#### Context

Error in computation of d\_EBD for Vtarget.

#### Related Paragraphs

**Paragraph 3.13.9.3.5.7** “In case the calculation of the GUI curve is inhibited, for display purpose only, the P speed related to EBD, shall be calculated for the max safe front end of the train as follows (see Figure 49):

V\_P\_EBD\_Target (d\_maxsafefront) = V\_EBD ( d\_maxsafefront + Vest \* ( T\_driver + T\_bs2 ) + Dbec ) - ( Vbec - Vest )

V\_P\_EBD\_Target (d\_maxsafefront) = Vtarget if d\_maxsafefront + Vest \* ( T\_driver + T\_bs2 ) + Dbec >= d\_EBD (Vtarget)

With D\_bec and V\_bec calculated according to 3.13.9.3.2.10”

#### Argument

d\_EBD is undefined for Vtarget (will always return Infinity), because for each EBD based target (except SvL or SR distance) the EBD curve crosses the ceiling speed EBI supervision limit at the target location (see 3.13.8.3.1). EBI = P + dV\_EBI (see 3.13.9.2.2), so d\_EBD is undefined for Vtarget (= P).

#### Solution

### Display of FLOI speed on DMI

#### Context

DMI has no interface allowing to display the FLOI speed (see Chapter 4.7, DMI depending on modes).

#### Related Paragraphs

**Paragraph 3.13.10.3.2** “When the supervision status is Overspeed, Warning or Intervention, the on-board equipment shall display the SBI speed (i.e. the FLOI speed).”

#### Argument

DMI has no interface allowing to display the FLOI speed (see Chapter 4.7, DMI depending on modes).

#### Solution

We suppose that this information is displayed instead the permitted speed.

### Undefined notationV\_target\_MRDT

#### Context

V\_P\_DMI is computed using V\_P\_MRDT, which is undefined.

#### Related Paragraphs

**Paragraph 3.13.10.4.3** “The on-board equipment shall display the Permitted speed, according to following formula:

V\_P\_DMI = min { max { V\_P\_MRDT, V\_Target\_MRDT }, V\_MRSP }.”

#### Argument

V\_P\_DMI is computed using V\_P\_MRDT, which is undefined.

#### Solution

### Non respected requirement

#### Context

The requirement states that the names of the variables are unique, but is not satisfied by the Chapters 7 and 8.

#### Related Paragraphs

**Paragraph 7.3.2.5** “Names of variables are unique. A variable is used in context with the meaning as described in the variable definition. Variables with different meanings have different names.”

#### Argument

Not respected by the Chapters 7 and 8.

#### Solution