Reference material

Advanced train control Migration System (AMS) Specifications – AMS Identification of High Risk Turnouts

This document is published as reference material to support the implementation of Automatic Train Protection as part of the roll out of the Advanced Train Control Migration System project.

The content described might be of assistance to individuals and organisations performing work on Transport for NSW Rail Assets.

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AMS PROJECT SPECIFICATIONS: AMS IDENTIFICATION OF HIGH RISK TURNOUTS

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Authored by: Graeme Cutler Senior Technical Manager		27/9/2016 **Date:**
Reviewed by: Coppel Lai Design Manager		**Date:** 27/09/2016
Reviewed by: Michael Little Manager Safety Assurance		**Date:** 6·10·2016
Reviewed by: * Roy Ale Senior Manager Operational Integration		11/10/16 **Date:**
Reviewed and Accepted by: Frederic Tricoche Principal Engineering Manager Systems		10/10/16 - **Date:**
Approved for Release by: Craig Southward ATP Project Director		12/10/16 **Date:**

* DOCUMENT MUST REFLECT CORRECT PROJECT NAME & DIVISION

Document History

Version	Date of Issue	Author	Summary of change
0.1	06/04/2016	G. Cutler	Initial draft
0.2	11/04/2016	G. Cutler	Updates based on review comments and feedback from Malcolm Kerr
0.3	13/04/2016	G. Cutler	Updates based on review comments and feedback from Graeme Shephard
0.4	22/04/2016	G. Cutler	Updates based on the review workshop
0.5	29/04/2016	G. Cutler	Ready for internal review
0.6	29/05/2016	G. Cutler	Updates following internal review
1.0	09/05/2016	G. Cutler	Updated following stakeholder review Issued for approval
1.1	18/05/2016	G. Cutler	Updated following internal approval comments
1.2	23/05/2016	G. Cutler	Updated following further internal comments
2.0	11/08/2016	G. Cutler	Release Version: Updated as a result of the following discussions: - reduction of the allowable overspeed allowance to take into account the speed at which the EBD would be in effect through the turnout - need to consider exit line infrastructure beyond the exit of the turnout when determining if a TSM is required to protect a train travelling across the turnout
3.0	23/09/2016	G. Cutler	Changes to avoid naming a turnout as a high risk due to hazards on exiting the turnout

Foreword

This guideline forms a part of the AMS Project Specifications which detail the requirements for the implementation of ATP / AMS on the TfNSW heavy rail network. This principle specifically covers the ETCS Level 1 System using Limited Supervision.

This guideline specifically covers the identification of high risk turnouts.

To gain a complete overview of ATP / AMS signalling design requirements, this document should be read in conjunction with the AMS suite of signalling design principle and guideline modules.

Note

The following guideline is to be used by AEO's engaged by the ATP program for the ATP / AMS concept design implementation. This is to ensure that a consistent methodology is applied.

It has been produced during the development of the AMS Project Specifications and subsequent further development of the principle may be required as the specifications evolve.

It is an interim document until the ASA standard is published.

Table of contents

1. Introduction

This design guideline defines rules that are to be applied to all the turnouts installed within the TfNSW infrastructure to determine if the turnout is a high risk due to whether or not the difference between the approach speed to the turnout and the permitted maximum speed through the turnout is likely to lead to a derailment, or whether a movement authority across the turnout needs to be protected due to the existence of a hazard on the exit line that will need to be protected by AMS.

If a derailment, due to the approach speed/turnout speed differential, is likely to occur, or there is a potential for an unmanaged hazard on the exit line, then the turnout needs to be protected by the AMS system.

The guidelines have been developed as a result of the Review of *High Speed Transit Through Turnouts* report and internal workshops within TfNSW. These have:

1. Determined the likely increase of a risk that is typically associated with a derailment due to speed through a turnout;
2. Recommended a permitted overspeed through any particular turnout configuration provided the defined constraints do not first apply;
3. Defined constraints (such as the impact of related infrastructure) that revise the overspeed allowance;
4. Identified circumstances where high risk rail infrastructure beyond the turnout requires the supervision of movements across the turnout.

2. Purpose

This document forms part of the AMS project specification that details the AMS design requirements used on the NSW rail network.

This design guideline defines the rules to be used to identify turnouts that need to be supervised and hence protected by the AMS project.

Once a high risk turnout has been identified, the AMS Project Specifications: AMS Signal Design Principles must be used to determine the placement of the AMS ETCS Level 1 LS Mode infrastructure.

2.1. Scope

This document defines the guidelines associated with the identification of high risk turnouts on the existing electrified NSW rail network that need to be protected by the AMS project.

The identification of the area of infrastructure on which to apply the AMS project is outside the scope of this document.

2.2. Application

This document applies to AEOs engaged to carry out the design for AMS works.

This design guideline has been written to facilitate the application of ETCS Level 1 LS on the Advanced Train Control Migration System (AMS) project. This design guideline will need to be reapplied as a result of new signalling works within the AMS area.

3. Reference documents

To gain a complete overview of the signalling design requirements, the following documents should be read in conjunction with this AMS guideline.

European Rail Agency (ERA) Specifications, Baseline 3 Maintenance Release 1

Transport for NSW standards

TN 046:2015 ESC-250 Turnouts and Special Trackwork

TN 028:2015 ESC-210 Track Geometry and Stability

AMS Requirements:

AMS System Requirements

AMS Trackside Subsystem Requirements

AMS Project Specifications: AMS Signal Design Principles

AMS Guidelines:

AMS Identification of High Risk Speed Sign Reductions

Balise Arrangement for High Risk Location Design Guideline

4. Terms and definitions

The following terms and definitions apply in this document:

APOA Actual Permitted Overspeed Allowance (above the design speed) for a turnout to be used in the speed difference calculation

AEO Authorised Engineering Organisation; means a legal entity (which may include a Transport Agency as applicable) to whom the ASA has issued an ASA Authorisation

Approach BG aims to provide the on-board equipment with aspect information for the signal as the train is approaching, having passed the controlled balise group announcing the start of the TSM. This enables the train to take early advantage of a clearing signal by being relieved of restrictions associated with the more restrictive aspect which was previously displayed

ASA Asset Standards Authority

AMS Advanced train control Migration System

ATCS Automatic Train Control System

ATP Automatic Train Protection; a system which supervises train speed and target speed, alerts the driver of the braking requirement, and enforces braking when necessary. The system may be intermittent, semi-continuous or continuous according to its track-to-train transmission updating characteristics

BG Balise Group; a set of 1 to 3 balises

BG used for initiating TSM A balise group (e.g. controlled balise group, etc.) whose primary function is to initiate TSM when required for the protection of a high risk hazard. It excludes balise groups containing the target speed in order to provide redundancy and negate the need to have braking as linking reaction at the balise group used for initiating TSM. A balise group providing redundancy shall be referred to as balise group containing redundant TSM

BMM Big Metal Mass

Cascading Functions More than one AMS function in the same vicinity where one function affects another

Combined Functions More than one AMS function that can be implemented by using a single balise group

Contact Sensing Arrangement LEU monitors the actual current drawn by spare contacts of the signal aspect control relays in series with a load resistor

Controlled Balise Group consists of minimum one controlled balise and one fixed balise

Conventional Trainstop refers to physical contact type trainstop

CPOA Constrained Permitted Overspeed Allowance (above the design speed) for a turnout following the review the surrounding track infrastructure

CSM Ceiling Speed Monitoring; the speed supervision in the area where the train can run with the speed as defined by the Most Restrictive Speed Profile without the need to brake to a target

Current Sensing Arrangement LEU monitors the actual current drawn by the individual signal operating lamps (i.e. lamp monitoring)

Design Speed is the turnout or crossover design speed as defined in either ESC-250 or this guideline

DMI Drivers Machine Interface

DPU Data Pickup Unit

DTRS Digital Train Radio System

EoA End of Authority

ERA European Rail Agency

ERA Braking Curve Tool customised for AMS and is used to calculate the braking curves of an ETCS fitted train

ETCS European Train Control System; a three level, unified, modular automatic train protection specification to enhance interoperability across Europe

Fixed Balise Group consists of fixed balises only

GE52 / GE52A/ GE76 / GE2M Braking curve for different type of trains, referenced in T HR RS 00830 ST RSU and ESG 100.3 Appendix A

High Risk Turnout refers to turnout or crossover where there is a risk of derailment due to high speed differential between the line speed and the turnout speed. Other contributing factors include running line geometry, configuration of the turnout and surrounding infrastructure

HR Signal Caution Relay

HDR Signal Medium Relay

In advance of signal Past the signal in the direction of travel

In rear of signal On approach to the signal in the direction of travel

JRU Juridical Recording Unit

L0 Level 0; an ETCS application level

L1 Level 1; an ETCS application level

LEU Lineside Electronic Unit; equipment that controls the balise output based on the state of the signalling inputs

Level Crossing refers to road and pedestrian crossing

Low Risk Turnout refers to turnout or crossover where there is no risk of derailment should a train traverses through the turnout or crossover at line speed

LS Limited Supervision; an operation mode in ETCS Level 1

LSSMA Lowest Supervised Speed within the Movement Authority

MA Movement Authority

MLAS Main Line Approach Speed

Non-Risk Turnout refers to turnout that is neither low risk nor high risk, and has been excluded from AMS protection

Overlap Deficiency refers to high risk deficient overlaps, high risk catch points within an overlap and high risk level crossings within an overlap

PMAS refers to Permitted Maximum AMS Speed which is the sum of the turnout Design Speed and the Actual Permitted Overspeed Allowance. It is the speed which is compared with the Approach Speed as part of the assessment process to identify high risk turnouts

Repositioning is used to manage linking of balise groups at facing turnouts/crossovers when specific route information is not given

Rolling stock refers to Electric Multiple Train (EMU) train. The ETCS on-board equipment will be fitted on A-Sets, C-Sets, H-Sets, K-Sets, M-Sets, T-Sets, V-Sets and S-Sets

RSM Release Speed Monitoring; the speed and distance supervision in the area close to the EOA where the train is allowed to run with release speed to approach the EOA

SH Shunting; an operation mode in ETCS Level 1

SoM Start of Mission

SPA Special Proceed Authority

SPAD Signal Passed At Danger

SR Staff Responsible; an operation mode in ETCS Level 1

SSI Solid State Interlocking or later equivalents, such as Smartlock, Westrace and Westlock

SSP Static Speed Profile

TCO Traction Cut Off

TFM Trackside Functional Module; controls individual trackside equipment e.g. signal, point etc.

TfNSW Transport for New South Wales

TOC Train Operating Conditions manual

TSM Target Speed Monitoring; the speed supervision in the area within which the train brakes to a target

TSR Temporary Speed Restriction

TSW Temporary Speed Warning

UPOA Unconstrained Permitted Overspeed Allowance (above the design speed) for a turnout before review the surrounding track infrastructure

5. Background

5.1. Overview of the rationale behind identification of High Risk Turnouts

AMS is based on the European Train Control System (ETCS) Level 1 Limited Supervision (LS) mode.

A design feature of AMS includes a Turnout Protection function. Turnout protection is used to ensure that the train speed through the turnout is within a defined tolerance of the turnout design speed; otherwise there is a risk that the train may travel too fast through the turnout which may result in a train derailment, or the train may be travelling too fast than can be safely tolerated by the exit line rail infrastructure.

With AMS, the turnout protection will be fitted to turnouts identified as **High Risk or those turnouts where there is a hazard on exiting from the turnout** based on the guidelines defined within this document. These turnouts will be fitted with infrastructure that provides Target Speed Monitoring (TSM), i.e. the onboard will supervise the approach speed to the turnout and will apply the brakes if necessary.

5.2. Safety Target

The design guidelines to determine whether a tangential or conventional turnout is a *High Risk Turnout* and needs to be protected by AMS consist of:

1. Identifying whether the turnout can be classified directly as a non-risk turnout within an AMS context (see section 6). In case which no further assessment, in accordance with this guideline, needs to be undertaken;

If the turnout cannot be categorised as an AMS non-risk turnout then the following steps need to be undertaken:

2. Determine the turnout or crossover design speed;
3. Identify the main line approach speed to be used in the assessment;
4. Determine the Actual Permitted Overspeed Allowance (APOA) according to the turnout or crossover configuration;
5. Determine the Permitted Maximum AMS Speed (PMAS) through the turnout;
6. Determine whether the turnout is a high risk turnout because the turnout PMAS is less than the approach speed;
7. Determine whether there is a High Risk Speed Sign Reduction across the turnout (based on the approach line speed and the exit line speed);
8. Determine whether there is a hazard on the exit line that needs to be considered; and
9. Identify whether a speed sign in the rear of the turnout and in advance of the 1st warning signal for the turnout was used as the main line approach speed in the speed difference calculation.

5.3. Overview of identifying AMS Non-Risk turnouts

There are a number of situations where a turnout will immediately be assessed, within an AMS context, as a non-risk risk turnout and hence not require AMS protection. These are:

1. Where there are specific processes in place that safeguard the speed through the turnout in accordance with the posted speed, such as those associated with emergency working turnouts; or
2. Where there can only ever be a shunt only movement(s) over the turnout, i.e. no main line passenger movements, unless the turnout (facing points only) is situated within an overlap and the points could lie in either direction with the route set.

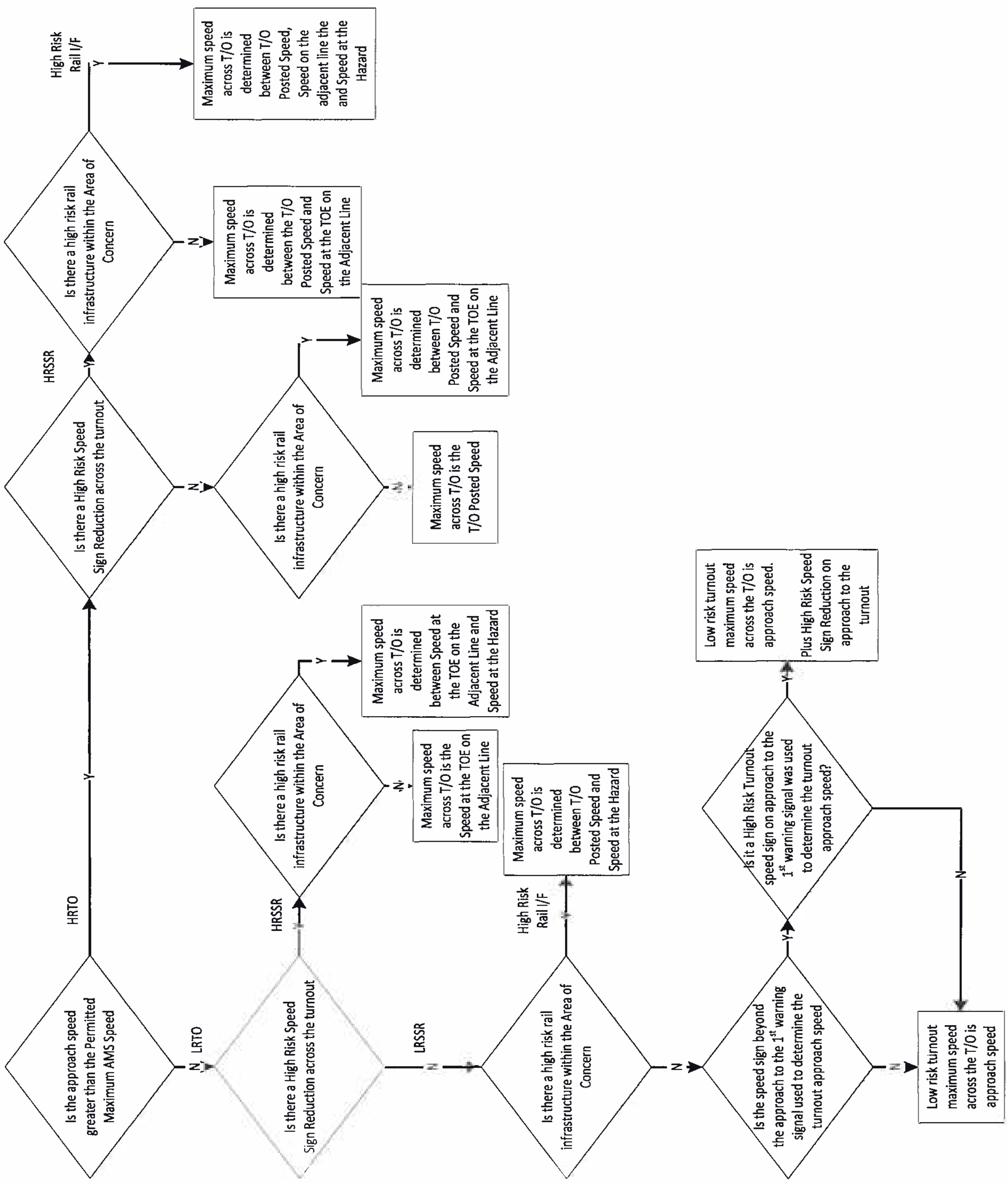
Should any one of these situations be true then the turnout will not be identified as a low risk or high risk turnout and no further high risk turnout assessment is required.

5.4. Overview of the process to identify a high risk turnout

If, following the application of section 5.3, the turnout is not immediately determined as non-risk turnout, then it is necessary to undertake a process to determine whether the turnout itself or surrounding rail infrastructure will cause the turnout to be identified as a high risk turnout.

Figure 1 depicts the process for determining whether the turnout itself or related track infrastructure will cause the turnout to be supervised.

Figure 1 – Flow chart to determine a high risk turnout and its supervised speed



As can be seen it is not enough to initially conclude whether a turnout in isolation is a high risk turnout or a low risk turnout, it is also necessary to determine if the turnout and related infrastructure satisfies the tests for a High Risk Speed Sign Reduction (HRSSR) and whether there is additional rail infrastructure that also needs to be considered. This fully qualified step by step assessment is necessary to determine if AMS will supervise a turnout.

Lastly once a turnout has been assessed as low risk it is still necessary to determine whether there is a High Risk Speed Sign Reduction risk on approach to the turnout (for more see section 7.5).

5.4.1. Overview of the speed elements for assessing a turnout or crossover

To evaluate the comparison of the approach speed to the Permitted Maximum AMS Speed a number of intermediate values need to be determined:

Turnout Design Speed

The turnout design speed will depend on a number of factors, such as whether:

- it is a standard turnout configuration (main line track is straight);
- it is a non-standard turnout configuration (main line track is curved);
- the turnouts that comprise the crossover are separated by enough straight track to be able to classify the crossover as two independent turnouts.

Note: the posted (or unposted) turnout speed sign is NOT TO BE used in preference to the turnout design speed. For more details on the turnout design speed see section 7.2.

Actual Permitted Overspeed Allowance (APOA)

The Actual Permitted Overspeed Allowance of the turnout or crossover will depend on the specific turnout or crossover configuration and whether there is any associated track infrastructure that will alter the overspeed allowance (for more details see section 7.4).

Permitted Maximum AMS Speed (PMAS)

The Permitted Maximum AMS Speed is the sum of the turnout Design Speed and the Actual Permitted Overspeed Allowance. This represents the maximum speed above the turnout posted speed that the train would, under normal circumstances, be allowed to traverse the turnout.

Main Line Approach Speed (MLAS)

The main line approach speed will either be given by the speed sign in the rear of the first warning signal for the turnout, or the last speed sign in the rear of the turnout providing it is at least 157m (i.e. the maximum length of the shortest train) from the toe of the points. Refer to section 7.3 for determination of the approach speed.

Note: where the speed sign define different speed profiles (e.g. high, medium or general), then the high and the medium speed profiles must be used to determine the speed difference.

5.4.2. High Risk Speed Sign Reduction across the turnout

The AMS High Risk Speed Sign Reduction (HRSSR) guideline defines the rules by which a speed reduction between two successive speed signs is considered high risk. When the HRSSR is identified appropriate AMS protection will be put in place to supervise the train to the target speed of the upcoming speed sign.

It is also necessary to apply the HRSSR guideline across the turnout, using the turnout approach speed and the speed at the toe of the points on exit to the exit line.

5.4.3. High risk rail infrastructure on the exit line

In addition to determining whether the turnout is itself high or low risk and whether there is a HRSSR across the turnout, it is also necessary to determine whether there is any high risk rail infrastructure or another AMS mitigation (i.e. Target Speed Monitoring – TSM) within a defined area, called the Area of Concern (AOC), on exit from the turnout onto the exit line.

Regardless of whether a turnout is itself adjudged to be a low risk turnout, or whether there is no HRSSR across the turnout, it is still necessary to determine whether travelling over the turnout at the lowest of the assessed speeds will circumvent the AMS protection of the high risk rail infrastructure, or TSM, on the exit line with the Area of Concern. (Note this also includes any TSM that may also start to operate within the Area of Concern). Where the previously determined speeds are:

1. turnout posted speed (if the turnout is of itself a high risk turnout);
2. Permitted Maximum AMS Speed (if the turnout is of itself a low risk turnout); or
3. exit line speed (if there is a HRSSR across the turnout).

Such high risk rail infrastructure (or hazards) includes, but is not limited to:

- Level crossing;
- Turnouts;
- Signalling controls dependent on speed (such as level crossing boom gate activations);
- Posted speed reductions;
- Station with a platform with a kinematic infringement;
- A signal with a deficient overlap;
- A signal with a sufficient overlap based on the exit line speed;
- Cascaded functions; or
- TSMs or part of a TSM applied before or after the turnout that would not be in operation for a train traversing the turnout (i.e. not announced to the train taking this route).

For the high risk rail infrastructure or an upcoming TSM to be considered, it must be located within the Area of Concern.

5.4.4. Overview of the Area of Concern on the exit line

The Area of Concern (AOC) is defined as the maximum distance the train could travel on the exit line at the supervised speed across the turnout before it will be arrested to the rated speed the train should be travelling on the exit line. Note that when calculating the maximum distance of the AOC the gradient of the actual trackside needs to be used.

Figure 2 depicts an example of an AOC (the shaded area in advance of the turnout exit). In the example:

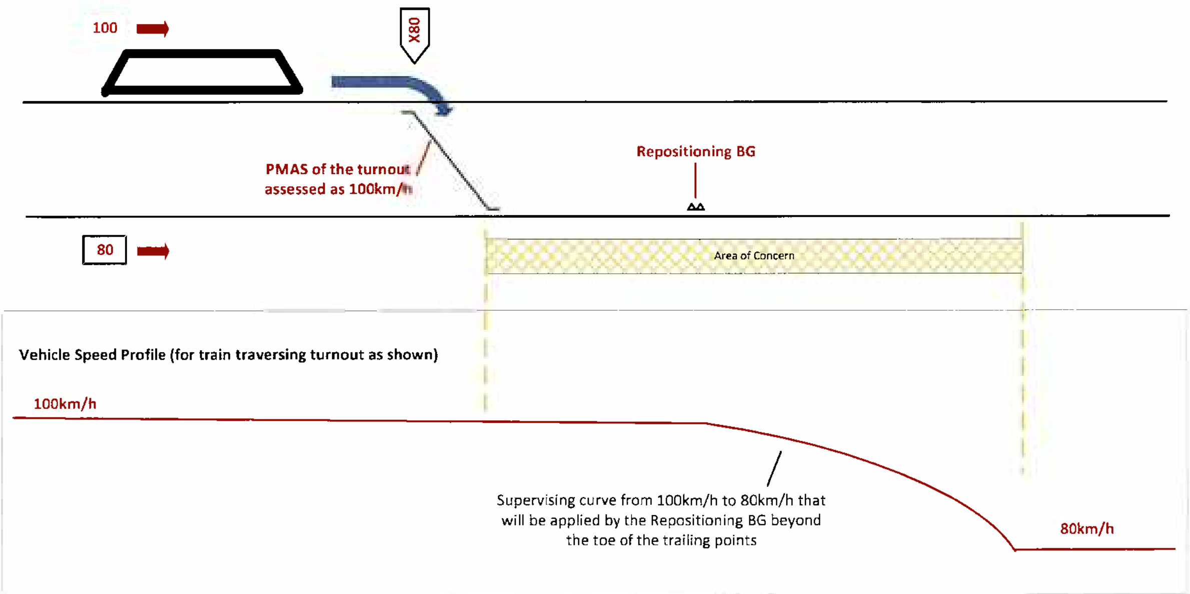
- the PMAS across the turnout equals the approach speed (100kph), hence the turnout is initially considered low risk)
- the speed reduction between the approach speed and the exit line on exit from the turnout is assessed as low risk based on the HRSSR guideline
- on exit from the turnout the speed profile will be updated to the actual exit line speed, via the repositioning balise group, in this case 80kph.

Hence the distance of the AOC will be determined by:

- the distance the train will have travelled, on exit from the turnout, on the exit line at 100kph to the repositioning balise group (which could be up to 200m) plus
- the distance travelled before decelerating from 100kph down to 80kph (which is approx. 300m). Note in this simple example the gradient of the trackside is zero.

In this example the AOC could be between 300m to 500m in length. It is within this distance that a check needs to be made to determine if a high risk rail infrastructure, or active TSM, is present.

Figure 2 – Example Area of Concern prior to determining if further hazards after the turnout require AMS mitigation



5.4.5. If the Area of Concern is not free of a hazard or TSM

If it is determined that within the area of concern there is high risk rail infrastructure or a TSM, then the turnout will be identified as requiring supervision of the movements across the turnout.

5.4.6. AMS speed across a turnout

If it is determined that the turnout requires AMS protection due to one or more of the following:

- the turnout is itself a high risk turnout;
- there is a HRSSR across the turnout; or
- there is a high risk rail infrastructure or TSM within the area of concern

then the AMS supervised speed across the turnout has to be determined. The speed will be the supervised to one of the following:

1. the posted (or unposted) speed of the turnout;
2. the speed at the exit of the turnout; or
3. the supervised speed at the high risk rail infrastructure

6. AMS Non-Risk Risk Turnout assessment

6.1. Overview

Before determining if a turnout needs AMS protection, it is first possible to identify whether a turnout is in fact an AMS non-risk turnout, based on localised characteristics of the turnout or particular operational considerations.

If a turnout meets any one of the AMS non-risk turnout criteria, then it will be deemed an AMS non-risk turnout and it will not be necessary to determine the design speed or the permitted allowable overspeed.

6.1.1. Existing operational processes

If there are in place operational processes that safeguard the speed through the turnout is limited to the posted speed, such as those associated with emergency working turnouts, then the turnout is an AMS non-risk turnout.

These operational processes need to seek to constraint the speed of the train and include:

- safe working processes in place; or
- warnings are provided to the driver.

6.1.2. Non-passenger related train movements

If the only reason a train will traverse a turnout or crossing is as a result of a non-passenger train movement, as per the timetable, and it is not situated within a signal overlap then the turnout is an AMS non-risk turnout.

7. Determining the speeds for turnout assessment

7.1. Overview of approach speed and turnout speed

If a turnout cannot definitely be categorised as an AMS non-risk turnout in accordance with section 6, then it must be reviewed within a process that starts by determining its design speed, the initial permitted overspeed allowance and then whether there are any specific track infrastructure features that may constrain the actual permitted overspeed allowance. This information then leads to:

is the Approach Speed (AS) to the turnout greater than the Permitted Maximum AMS Speed (PMAS)

where the PMAS is equal to the Design Speed (DS) of the turnout plus the Actual Permitted Overspeed Allowance (APOA) of the turnout

i.e. is PMAS ≤ AS, where PMAS = DS + APOA

If the speed differential can be greater than the permitted overspeed then the turnout is a High Risk Turnout and must be protected by the AMS system.

If the main line speed sign has both a Medium and a High speed profile, then the difference in speed calculation must be done using both speed profiles. The turnout will be determined to be a ***High Risk Turnout*** if the difference in speed is **higher** than the permitted overspeed allowance.

7.2. Turnout or crossover design speed

If section 6 determines that the turnout is **not a direct non-risk**, then the remainder of the assessment guideline uses the **design speed** for the turnout or crossover configuration, and not the posted (or unposted) turnout speed in the TOC.

The design turnout speed for a standard single conventional or single tangential turnout configuration and where the main line track is straight is defined in table 3, section 6.1.5.1 of ESC-250 Turnouts and Special Trackwork.

Section 7.2.1 defines the design speed for a standard crossover that comprises two standard turnouts (conventional or tangential) and where the main line track is straight.

Section 7.2.2 defines the design speed for a turnout or crossover where the main line track is not straight.

Note:

1. The design speed or calculated speed is often the same as the trackside posted speed, or X speed sign. However, this is not always the case and it is possible that the posted turnout speed sign will be lower than the design or calculated speed.

7.2.1. Standard crossover design speed

The design speed of a standard crossover is defined in Table 1 **provided** the following are all true:

1. Both the diverging and converging main line track is straight; and
2. The crossover comprises two standard turnouts as defined in table 3 of ESC-250; and
3. There is less than (<) 13m of straight track between the end of the first turnout and the start of the second turnout.

The design speed for the crossover will be the turnout with the lowest design speed.

If the crossover is not comprised of two standard turnouts listed in table 3 in ESC-250 then refer to section 7.2.2 to calculate the design speed for the crossover.

If there is greater than or equal to (≥) 13m of straight track between the two standard turnouts, then the crossover is to be treated as two individual and separate turnouts. In this situation refer to table 3 of ESC-250 to obtain the design speed for each individual turnout. Again, the design speed for the crossover will be the turnout with the lowest design speed.

Table 1 – Design speed for a single crossover comprising tangential turnouts

Radius (m): Turnout Rate	Crossing is Straight/ Curved	Calculated Design Speed (kph)
160:6	Curved	30
190:7	Curved	35
250:8.25	Curved	40
300:9	Curved	40
500:12	Curved	50
800:15	Curved	60
1200:18.5	Curved	Rare Configuration – to be calculated
160:8.25	Straight	30
190:9	Straight	35
250:10.5	Straight	40
300:12	Straight	45
500:15	Straight	60
800:18.5	Straight	75
1200:24	Straight	Rare Configuration – to be calculated

Table 2 – Design speed for a single crossover comprising conventional turnouts

Turnout Rate	Crossing is Straight/ Curved	Switch Length (m)	Calculated Design Speed (kph)
1 in 8.25	Curved	6.10	15
1 in 9	Straight	6.10	20
1 in 10.5	Straight	6.10	25
1 in 10.5	Straight	9.15	To be calculated
1 in 15	Straight	9.15	To be calculated

7.2.2. Calculated design speeds of a non-standard turnout or non-standard crossover

If the main line is not straight, i.e. it is bent or curved, the design speed for the non-standard turnout or non-standard crossover configuration needs to be calculated. The ASA standards ESC-250 Turnouts and Special Trackwork and ESC-210 Track Geometry and Stability provide the guidance, define the equations and constants that are to be used to calculate the turnout or crossover design speed.

Once the calculated design speed has been determined the actual design speed must be rounded down to the lowest permanent speed band, which is in multiples of 5kph. So a calculated design speed of 79kph will become an actual design speed of 75kph, and a calculated design speed of 74kph will become an actual design speed of 70kph.

7.3. Determining the main line approach speed

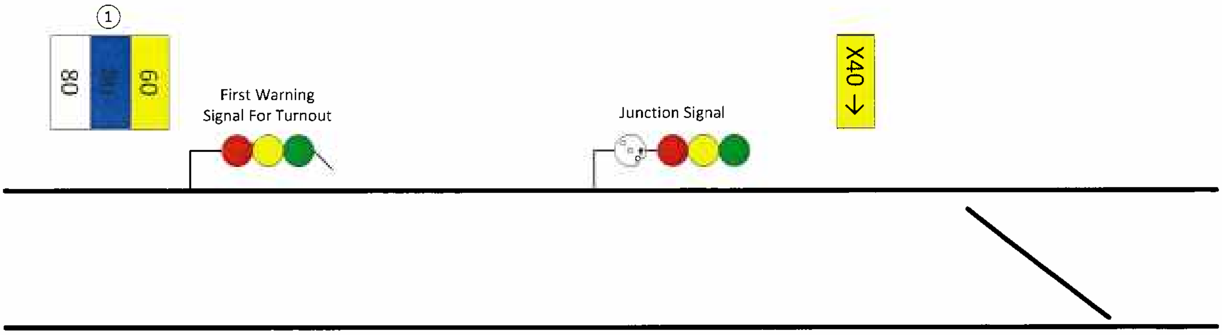
7.3.1. When to use the speed sign in the rear of the 1st warning signal

The main line approach speed is most often going to be given by the speed sign in the rear of the first warning signal before the turnout.

Figure 3 describes a situation where a speed sign, No.1, with different speed profiles is positioned prior to the 1st warning signal for the turnout, and where there are no other qualifying speed signs between this speed sign and the speed sign for the turnout. In this situation the main line approach speed is defined by speed sign, No.1, in the rear of the 1st warning signal for the turnout.

The main line approach speed is most often going to be given by the speed sign in the rear of the first warning signal before the turnout.

Figure 3 – Use of speed sign, No.1, in the rear of the 1st warning signal

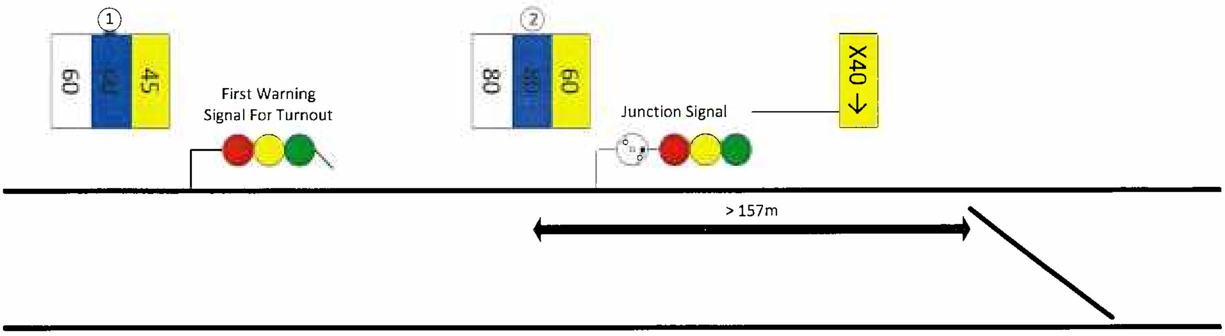


7.3.2. When to use the speed sign in the advance of the 1st warning signal

However, it may be the case that there is a further main line speed sign which is at least 157m from the toe of the points of the turnout and in advance of the first warning signal for the turnout.

Figure 4 describes a situation where a speed sign, No.2, is in advance of the 1st warning signal for the turnout and 157m before the turnout. In this situation the speed profiles given on this speed sign, No.2, are to be used instead of the speed profiles given on the speed sign, No.1, before the 1st warning signal for the turnout.

Figure 4 – Use of speed sign, No.2, in the advance of the 1st warning signal and at least 157m from the toe of the points

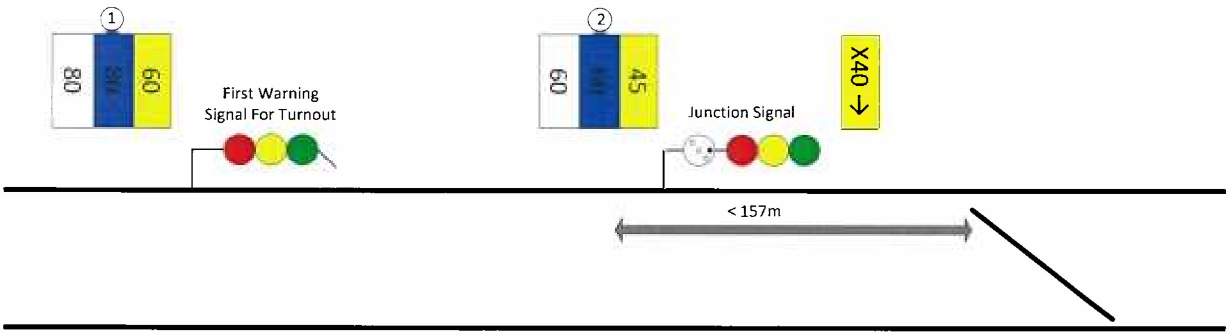


As the speed sign, No.2 will be used to determine the main line approach speed, it may also be necessary to identify this speed sign as requiring AMS protection if the turnout is later identified as being a low risk turnout following the speed difference calculation. See section 7.5 for further details.

7.3.3. When not to use the speed sign in the advance of the 1st warning signal

Figure 5 describes a situation where a speed sign, No.2, is in advance of the 1st warning signal for the turnout **but less than 157m** before the turnout. In this situation speed sign, No.2, is **not to be used**, and the speed profiles given on the speed sign, No.1, before the 1st warning signal for the turnout are to be used.

Figure 5 – Use of speed sign, No.1, in the rear of the 1st warning signal since the next speed sign, No.2, is disqualified as it is **within** 157m from the toe of the points



7.4. Turnout actual permitted overspeed allowance

7.4.1. Overview

This section defines the *Actual Permitted Overspeed Allowance* (APOA) for the different types of turnout configuration.

The APOA is the overspeed allowance that is added to the turnout or crossover design speed (which is discussed in section 7.2), and will be used to determine if the turnout is of itself high risk.

For the various turnout configurations listed in table 3 of ESC-250, an Unconstrained Permitted Overspeed Allowance (UPOA) has been defined, refer to Table 3,Table 4, Table 5 and Table 6.

However, depending on the surrounding track infrastructure, the unconstrained permitted overspeed allowance may not be used, and instead a revised Constrained Permitted Overspeed Allowance (CPOA) is to be used. Table 4, Table 5 and Table 6 define the CPOA that is to be added to the design speed depending on the result of applying a constraining rule.

If none of the constraining rules apply, then the Actual Permitted Overspeed Allowance is defined by the Unconstrained Permitted Overspeed Allowance.

If any of the constraining rules apply, then the Actual Permitted Overspeed Allowance is defined by the lowest Constrained Permitted Overspeed Allowance.

7.4.2. Constraining rule 1 – straight diamond after the turnout

If there is a straight diamond less than or equal to (≤) 10m from the turnout, then the CPOA will be 0kph.

If there is a straight diamond more than (>) 10m from the turnout then the UPOA is not constrained.

7.4.3. Constraining rule 2 - curved diamond after the turnout

If there is a curved diamond with a radius of less than or equal to (≤) 1000m and less than or equal to (≤) 10m from the turnout, then the CPOA will be 0kph.

7.4.4. Constraining rule 3 – slip within the turnout

If there is a slip within the turnout configuration, then the CPOA will be 0kph.

7.4.5. Constraining rule 4 – consecutive turnouts

If there are more than two consecutive turnouts, where each turnout is separated from the other by less than or equal to (≤) 13m of the straight track, then the CPOA will be 0kph.

7.4.6. Unconstrained and constrained permitted overspeed allowance for a single tangential turnout

Table 3 defines the unconstrained and the constrained permitted overspeed allowances (UPOA/CPOA) for a single tangential turnout.

Table 3 – Unconstrained and constrained permitted overspeed allowance for a single tangential turnout

Radius (m): Turnout Rate	Crossing is Straight/ Curved	Unconstrained permitted overspeed allowance	Constrained permitted overspeed allowance due to following track infrastructure			
			Constraining rule 1 (section 7.4.2)	Constraining rule 2 (section 7.4.3)	Constraining rule 3 (section 7.4.4)	Constraining rule 4 (section 7.4.5)
160:6	Curved	10	0	0	0	0
160:8.25	Straight	10	0	0	0	0
190:7	Curved	10	0	0	0	0
190:9	Straight	10	0	0	0	0
250:8.25	Curved	10	0	0	0	0
250:10.5	Straight	10	0	0	0	0
300:9	Curved	10	0	0	0	0
300:12	Straight	10	0	0	0	0
500:12	Curved	10	0	0	0	0
500:15	Straight	10	0	0	0	0
800:15	Curved	5	0	0	0	0
800:18.5	Straight	5	0	0	0	0
1200:18.5	Curved	5	0	0	0	0
1200:24	Straight	5	0	0	0	0

7.4.7. Unconstrained and constrained permitted overspeed allowance for a single tangential crossover

Table 4 defines the unconstrained and the constrained permitted overspeed allowances (UPOA/CPOA) for a single crossover comprising two tangential turnouts, where there is less than (<) 13m of straight track separating the two turnouts.

If the crossover is comprised of two different types of tangential turnout, then the turnout with the lowest UPOA or CPOA is to be used.

If the crossover is comprised of at least one conventional turnout, then section 7.4.9 applies.

If the straight track separating the two turnouts is greater than or equal to (≥) 13m then the crossover can be treated as two separate and independent turnouts and the lowest design speed from either Table 3 or Table 5, as applicable, is to be used.

Table 4 – Unconstrained and constrained permitted overspeed allowance for a single tangential crossover

Radius (m): Turnout Rate	Crossing is Straight/ Curved	Unconstrained permitted overspeed allowance	Constrained permitted overspeed allowance due to following track infrastructure			
			Constraining rule 1 (section 7.4.2)	Constraining rule 2 (section 7.4.3)	Constraining rule 3 (section 7.4.4)	Constraining rule 4 (section 7.4.5)
160:6	Curved	0	0	0	0	0
160:8.25	Straight	0	0	0	0	0
190:7	Curved	0	0	0	0	0
190:9	Straight	0	0	0	0	0
250:8.25	Curved	0	0	0	0	0
250:10.5	Straight	0	0	0	0	0
300:9	Curved	0	0	0	0	0
300:12	Straight	0	0	0	0	0
500:12	Curved	0	0	0	0	0
500:15	Straight	0	0	0	0	0
800:15	Curved	5	0	0	0	0
800:18.5	Straight	5	0	0	0	0
1200:18.5	Curved	5	0	0	0	0
1200:24	Straight	5	0	0	0	0

7.4.8. Unconstrained and constrained permitted overspeed allowance for a single conventional turnout

Table 5 defines the unconstrained and the constrained permitted overspeed allowances (UPOA/CPOA) for a single conventional turnout.

Table 5 – Unconstrained and constrained permitted overspeed allowance for a single conventional turnout

Radius (m): Turnout Rate	Crossing is Straight/ Curved	Switch Length (m)	Unconstrained permitted overspeed allowance	Constrained permitted overspeed allowance due to following track infrastructure			
				Constraining rule 1 (section 7.4.2)	Constraining rule 2 (section 7.4.3)	Constraining rule 3 (section 7.4.4)	Constraining rule 4 (section 7.4.5)
1 in 8.25	Curved	6.10	5	0	0	0	0
1 in 9	Straight	6.10	5	0	0	0	0
1 in 10.5	Straight	6.10	0	0	0	0	0
1 in 10.5	Straight	9.15	0	0	0	0	0
1 in 15	Straight	9.15	0	0	0	0	0

7.4.9. Unconstrained and constrained permitted overspeed allowance for a single conventional crossover

Table 6 defines the unconstrained and the constrained permitted overspeed allowances (UPOA/CPOA) for a single crossover comprising two conventional turnouts and both their turnout rate is 1 in 9 or tighter, and where the there is less then (<) 13 of straight track separating the two turnouts.

If the crossover comprises two conventional turnout with turnout rate of 1 in 10.5 or greater, then the two turnouts are to be treated as though there is at least 13m of straight track separating the turnouts. In this case the lowest UPOA or CPOA from Table 5, as applicable, is to be used.

Table 6 – Unconstrained and constrained permitted overspeed allowance for a single conventional crossover

Radius (m): Turnout Rate	Crossing is Straight/ Curved	Switch Length (m)	Unconstrained permitted overspeed allowance	Constrained permitted overspeed allowance due to following track infrastructure			
				Constraining rule 1 (section 7.4.2)	Constraining rule 2 (section 7.4.3)	Constraining rule 3 (section 7.4.4)	Constraining rule 4 (section 7.4.5)
1 in 8.25	Curved	6.10	0	0	0	0	0
1 in 9	Straight	6.10	0	0	0	0	0

If the crossover is comprised of two different types of turnout (conventional or tangential), then the turnout with the lowest UPOA or CPOA from Table 4 or Table 6 is to be used.

If straight track separating the two turnouts is greater than or equal to (≥) 13m then the crossover can be treated as two separate and independent turnouts and the lowest UPOA from either Table 3 or Table 5, as applicable, is to be used.

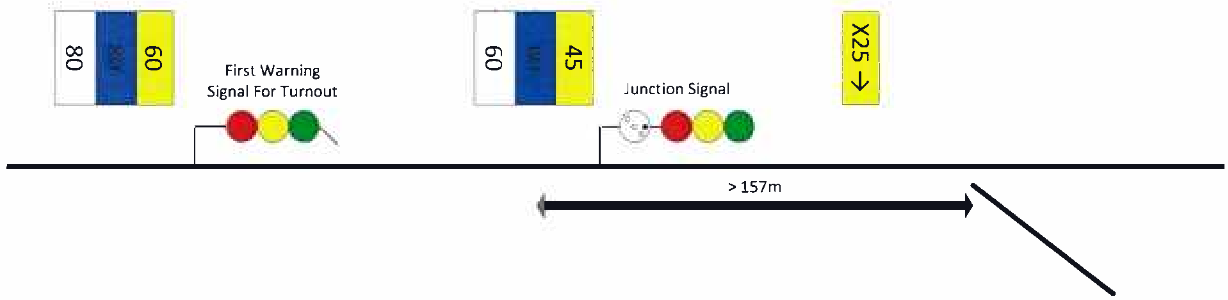
7.5. Turnout determined to be a low risk turnout

If, following the speed difference calculation, the turnout is identified as a low risk turnout it is then necessary to determine if the speed sign used for the main line approach speed needs to be considered as an AMS high risk speed sign.

If the speed sign used for the main line approach speed was the speed sign in the rear of the 1st warning signal for the turnout move, then **no AMS high risk speed sign protection** is required either for the speed sign or the determined low risk turnout.

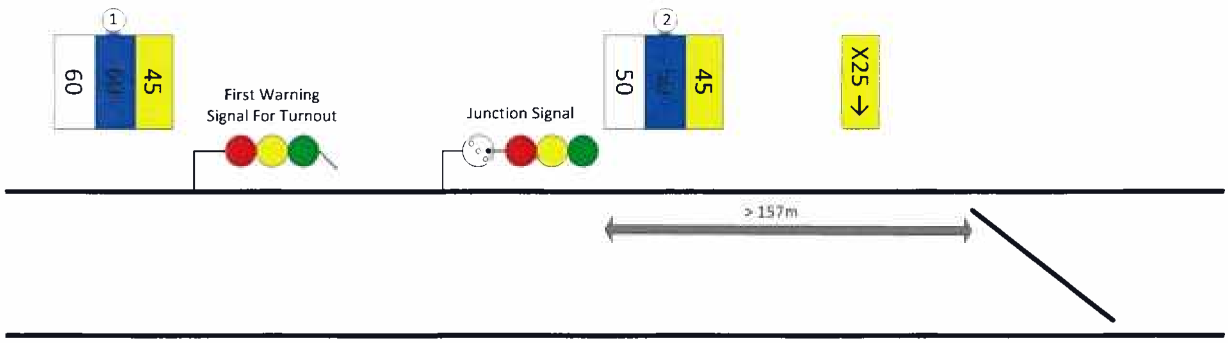
However, if as Figure 6, a speed sign, No. 2, there is a speed sign in advance of the first warning signal for the turnout, then it is necessary to determine if this speed sign, No. 2, needs to be considered as an AMS high risk speed sign. To determine this it is necessary to use the speed profiles from the speed sign, No. 1, in the rear of the 1st warning signal for the turnout and recalculate the speed difference equation. If using the speed sign, No. 1, the result concludes the turnout would have been a high risk turnout, **then the speed sign, No.2, needs to be considered as an AMS high risk speed sign**.

Figure 6 – Speed sign in advance of 1st warning sign used to determine low risk turnout requiring AMS high risk speed sign protection



But, if as in Figure 7, the speed difference recalculation using the speed sign, No. 1, the result already concludes the turnout would have been a low risk turnout, **then the speed sign, No.2, does not need to be considered as an AMS high risk speed sign.**

Figure 7 – Speed sign in advance of 1st warning sign used to determine low risk turnout not requiring AMS high risk speed sign protection



8. Example identification of low risk and high risk turnouts

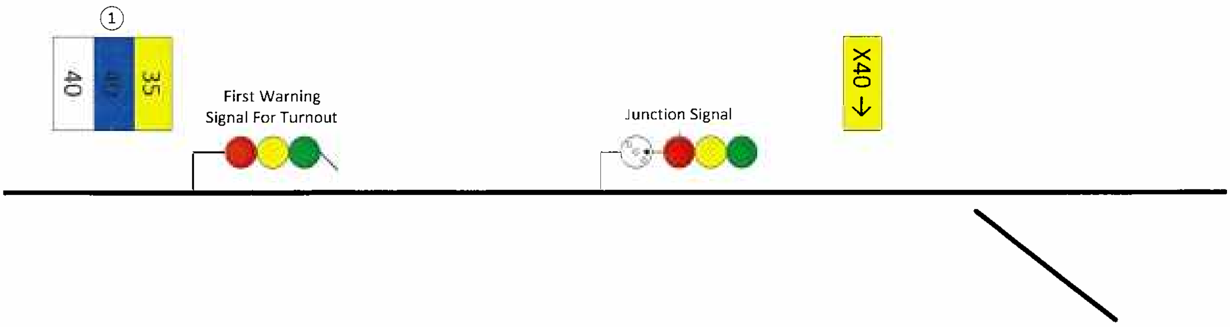
8.1. Example Low Risk Turnouts

8.1.1. Example 1 - low risk single standard tangential turnout with single speed board

Key Information

- Straight main line track
- Single turnout, tangential 500: 12, curved crossing
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 8 – Logical track layout for example 1 – low risk turnout



Assessment

1. Consider if it is a default *low risk* turnout.
2. The speed difference between the high and the medium speed profile and the posted speed is **0kph**. This is a *low risk turnout*.

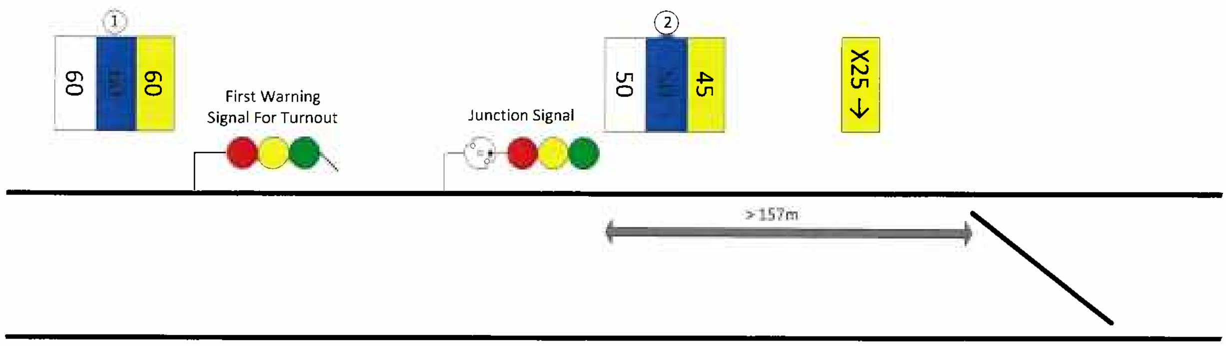
8.1.2. Example 2 - low risk single standard tangential turnout with intermediate speed board and low risk speed sign reduction

Key Information

- Straight main line track
- Single turnout, tangential 500: 12, curved crossing

- After the turnout there is a straight diamond within 10m
- There is no constraining hazard, or TSM in operation after the turnout

Figure 9 – Logical track layout for example 2 – low risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.
2. Identify the design speed of the turnout.
   a. Straight track, standard tangential configuration
   b. Table 3 ESC-250 states the **turnout design speed is 60kph**
   c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used**.
3. Identify the *Actual Permitted Overspeed Allowance* (APOA)
   a. Turnout is a single tangential so use Table 3
   b. There is constraining infrastructure after the turnout, rule 1 applies
   c. The *Actual Permitted Overspeed Allowance* is given by the *Constrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 0kph**.
4. Identify the main line approach speed

a. There is a speed sign, No.2, in advance of the 1st warning signal for the turnout, therefore use this speed sign **and not** the speed sign, No.1, in the rear of the 1st warning signal for the turnout

b. Speed sign has three speed profiles, in the assessment use the high (50kph) and medium (50kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

a. High speed profile

50kph (**AS**) – (60kph (**DS**) + 0kph (**APOA**) = -10kph. This is less than **0kph**

b. Medium speed profile

50kph (**AS**) – (60kph (**DS**) + 0kph (**APOA**) = -10kph. This is less than **0kph**

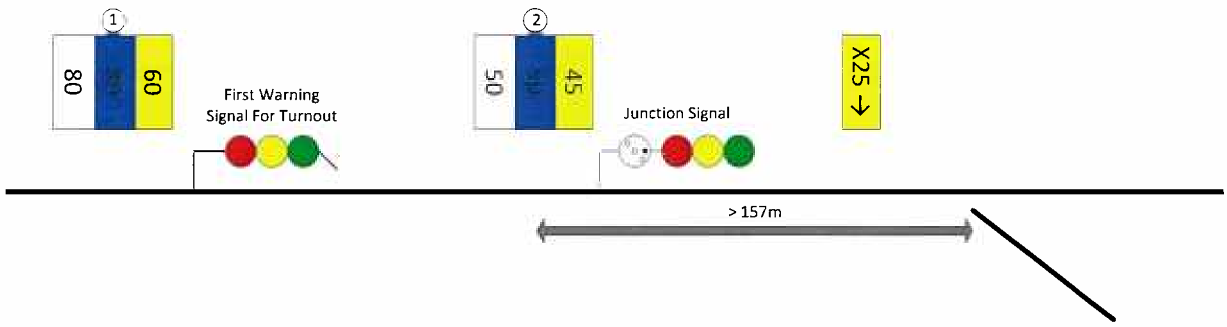
c. When considering both the high and medium speed profiles, the turnout is considered to be ***low risk***.

8.1.3. Example 3 - low risk single standard tangential turnout with intermediate speed board and high risk speed sign reduction

Key Information

- Straight main line track
- Single turnout, tangential 500: 12, curved crossing
- After the turnout there is a straight diamond within 10m
- There is no constraining hazard, or TSM in operation after the turnout

Figure 10 – Logical track layout for example 3 – low risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.

2. Identify the design speed of the turnout.

   a. Straight track, standard tangential configuration

   b. Table 3 ESC-250 states the **turnout design speed is 60kph**

   c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used**.

3. Identify the *Actual Permitted Overspeed Allowance* (APOA)

   a. Turnout is a single tangential so use Table 3

   b. There is constraining infrastructure after the turnout, rule 1 applies

   c. The *Actual Permitted Overspeed Allowance* is given by the *Constrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 0kph**.

4. Identify the main line approach speed

   a. There is a speed sign, No.2, in advance of the 1st warning signal for the turnout, therefore use this speed sign and not the speed sign, No.1, in the rear of the 1st warning signal for the turnout

   b. Speed sign has three speed profiles, in the assessment use the high (50kph) and medium (50kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      50kph (**AS**) – (60kph (**DS**) + 0kph (**APOA**) = -10kph. This is less than **0kph**

   b. Medium speed profile

      50kph (**AS**) – (60kph (**DS**) + 0kph (**APOA**) = -10kph. This is less than **0kph**

   c. When considering both the high and medium speed profiles, the turnout is considered to be *low risk*.

   d. The protection for the risk will be High Risk Speed Sign Protection at No.2 speed sign, as the Turnout is High Risk if the speed indicated by No.1 speed sign is used, the lower speed indicated at No.2 speed sign has reduced the risk level of the turnout and therefore the speed sign has to be fitted with High Risk Speed Sign protection due to its protective nature.

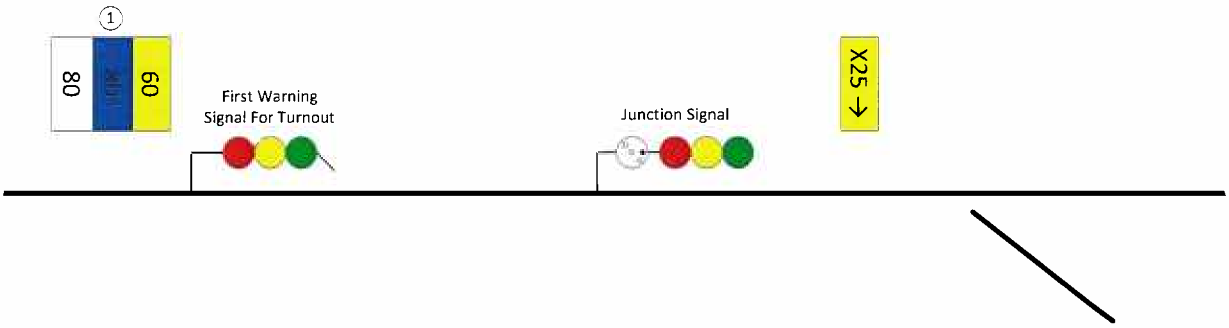
8.2. Examples of a Turnout requiring Protection

8.2.1. Example 1 - high risk single standard tangential turnout with one speed board

Key Information

- Straight main line track
- Single turnout, tangential 160: 6, curved crossing
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 11 – Logical track layout for example 1 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.
2. Identify the design speed of the turnout.
    a. Straight track, standard tangential configuration
    b. Table 3 ESC-250 states the **turnout design speed is 30kph**
    c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used.**
3. Identify the Actual Permitted Overspeed Allowance (APOA)
    a. Turnout is a single tangential so use Table 3
    b. No constraining infrastructure after the turnout, i.e. rules 1 through 4 do not apply
    c. The *Actual Permitted Overspeed Allowance* is given by the *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 10kph**.
4. Identify the main line approach speed
    a. No speed sign in advance of the 1st warning signal for the turnout, therefore use the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

b. Speed sign has three speed profiles, in the assessment use the high (80kph) and medium (80kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      80kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 40kph. This is greater than **0kph**

   b. Medium speed profile

      80kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 40kph. This is greater than **0kph**

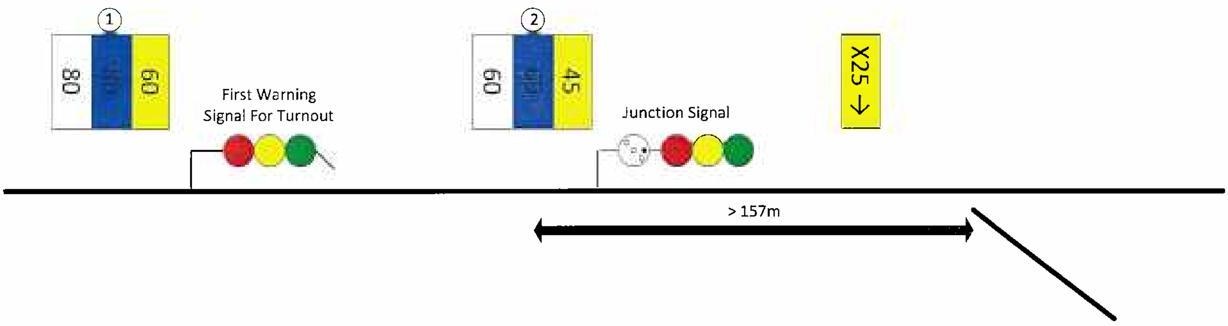
   c. When considering both the high and medium speed profiles, the turnout is considered to be *high risk*.

8.2.2. Example 2 - high risk single standard tangential turnout with intermediate speed board greater than 157m

Key Information

- Straight main line track
- Single turnout, tangential 160: 6, curved crossing
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 12 – Logical track layout for example 2 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.

2. Identify the design speed of the turnout.

    a. Straight track, standard tangential configuration

    b. Table 3 ESC-250 states the **turnout design speed is 30kph**

    c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used.**

3. Identify the Actual Permitted Overspeed Allowance (APOA)

    a. Turnout is a single tangential so use Table 3

    b. No constraining infrastructure after the turnout, i.e. rules 1 through 4 do not apply

    c. The *Actual Permitted Overspeed Allowance* is given by the *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 10kph**.

4. Identify the main line approach speed

    a. There is a speed sign, No. 2, in advance of the 1st warning signal for the turnout, therefore use this speed sign **and not** the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

    b. Speed sign has three speed profiles, in the assessment use the high (60kph) and medium (60kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

    a. High speed profile

       60kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 20kph. This is greater than **0kph**

    b. Medium speed profile

       60kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 20kph. This is greater than **0kph**

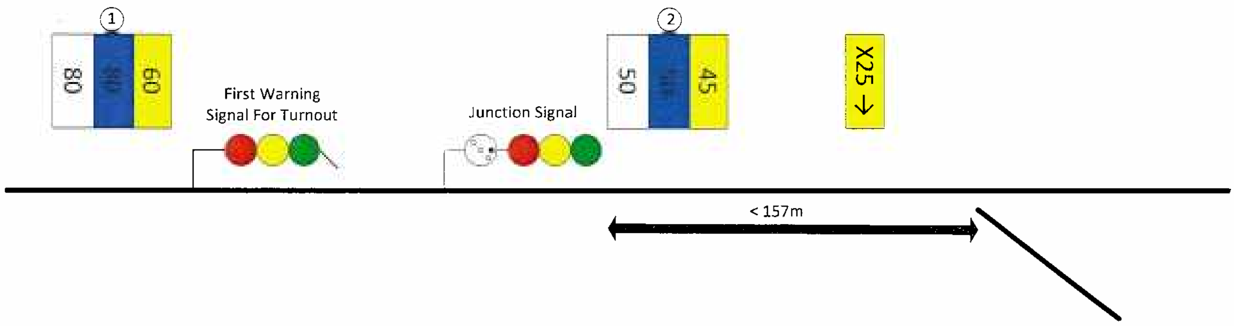
    c. When considering both the high and medium speed profiles, the turnout is considered to be *high risk*.

8.2.3. Example 3 - high risk single standard tangential turnout with intermediate speed board greater less than 157m

Key Information

- Straight main line track
- Single turnout, tangential 160: 6, curved crossing
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 13 – Logical track layout for example 3 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.
2. Identify the design speed of the turnout.
    a. Straight track, standard tangential configuration
    b. Table 3 ESC-250 states the **turnout design speed is 30kph**
    c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used**.
3. Identify the *Actual Permitted Overspeed Allowance* (APOA)
    a. Turnout is a single tangential so use Table 3

b. No constraining infrastructure after the turnout, i.e. rules 1 through 4 do not apply

c. The *Actual Permitted Overspeed Allowance* is given by *the Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 10kph**.

4. Identify the *main line* approach speed

   a. There is a speed sign, No. 2, in advance of the 1st warning signal for the turnout. However, this speed sign is within 157m of the toe of the points of the turnout and as a result it cannot be used in the speed difference calculation

   b. Therefore use the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

   c. Speed sign has three speed profiles, in the assessment use the high (80kph) and medium (80kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      80kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 40kph. This is greater than 0kph

   b. Medium speed profile

      80kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 40kph. This is greater than 0kph

   c. When considering both the high and medium speed profiles, the turnout is considered to be *high risk*.

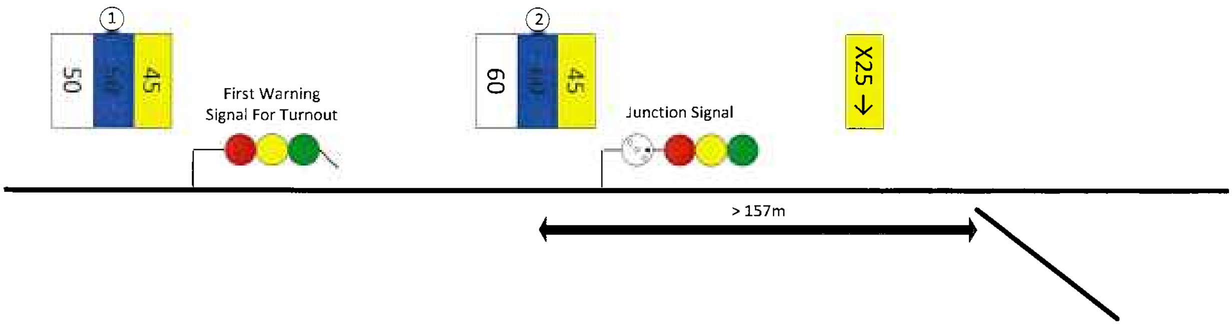
8.2.4. Example 4 - high risk single standard tangential turnout with speed increase in advance of 1st warning signal for the turnout

Key Information

- Straight main line track

- Single turnout, tangential 160: 6, curved crossing
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 14 – Logical track layout for example 4 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.
2. Identify the design speed of the turnout.
   a. Straight track, standard tangential configuration
   b. Table 3 ESC-250 states the **turnout design speed is 30kph**
   c. Note: the posted turnout speed is 25kph, **but this is not used. The turnout design speed is used.**
3. Identify the Actual Permitted Overspeed Allowance (APOA)
   a. Turnout is a single tangential so use Table 3
   b. No constraining infrastructure after the turnout, i.e. rules 1 through 4 do not apply
   c. The *Actual Permitted Overspeed Allowance* is given by the *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 10kph.**
4. Identify the main line approach speed

a. There is a speed sign, No. 2, in advance of the 1st warning signal for the turnout, therefore use this speed **sign and not** the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

b. **Note**: the speeds on this speed sign are faster than those on the speed sign in the rear of the 1st warning signal for the turnout

c. Speed sign has three speed profiles, in the assessment use the high (60kph) and medium (60kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      60kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 20kph. This is greater than **0kph**

   b. Medium speed profile

      60kph (**AS**) – (30kph (**DS**) + 10kph (**APOA**) = 20kph. This is greater than **0kph**

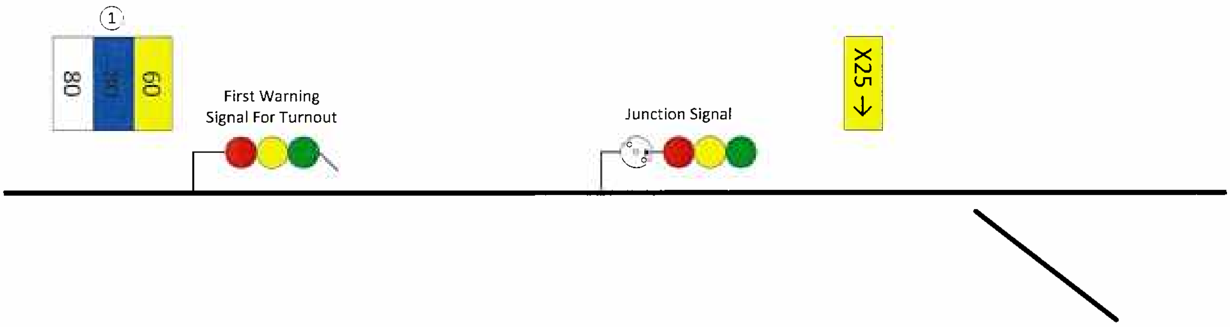
   c. When considering both the high and medium speed profiles, the turnout is considered to be high risk.

8.2.5. Example 5 - high risk single standard tangential turnout with one speed board and constraining infrastructure

Key Information

- Straight main line track
- Single turnout, tangential 500: 12, curved crossing
- After the turnout there is a straight diamond within 10m
- There is no constraining hazard, or TSM in operation after the turnout

Figure 15 – Logical track layout for example 5 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.
2. Identify the design speed of the turnout.
   a. Straight track, standard tangential configuration
   b. Table 3 ESC-250 states the **turnout design speed is 60kph**
   c. **Note: the posted turnout speed is 25kph, but this is not used. The turnout design speed is used.**
3. Identify the Actual Permitted Overspeed Allowance (APOA)
4. Turnout is a single tangential so use Table 3
5. There is constraining infrastructure after the turnout, rule 1 applies
6. The *Actual Permitted Overspeed Allowance* is given by the *Constrained Permitted Overspeed Allowance* (UPOA) from Table 3. **APOA is 0kph**.
7. Identify the main line approach speed
   a. No speed sign in advance of the 1st warning signal for the turnout, therefore use the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

   b. Speed sign has three speed profiles, in the assessment use the high (80kph) and medium (80kph) profiles

8. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      80kph (**AS**) – (60kph (**DS**) + 0kph (**APOA**) = 10kph. This is greater than **0kph**

   b. Medium speed profile

      80kph (**AS**) – (60kph (**DS**) +0kph (**APOA**) = 10kph. This is greater than **0kph**

   c. When considering both the high and medium speed profiles, the turnout is considered to be *high risk*.

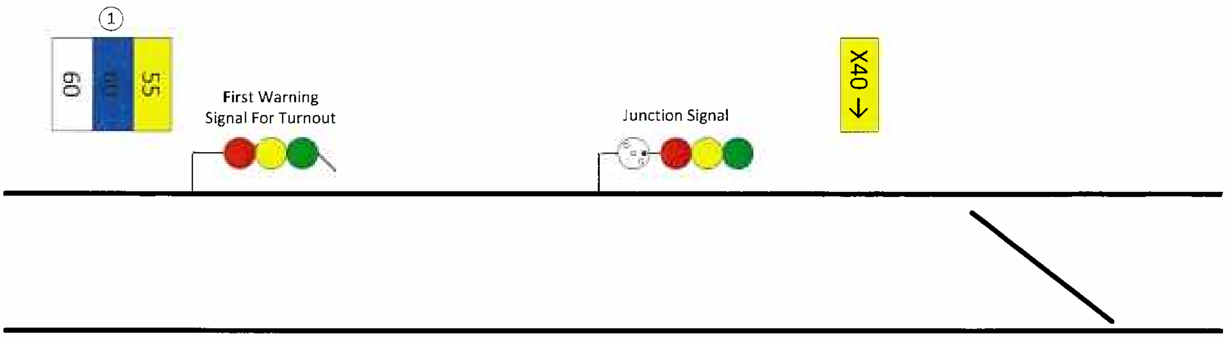
9. **Note**: In this example, if there was no constraining track infrastructure then the APOA would have been 20kph. In this situation the speed difference would have been 0kph and in this situation the turnout would be marked as a *low risk* turnout.

8.2.6. Example 6 - high risk single standard tangential crossover with single speed board

Key Information

- Straight main line track
- Single crossover, comprising tangential 800: 15, curved crossing, and tangential 250:10.5, straight crossing. Less than 13m of straight track separates the two turnouts
- There is no constraining infrastructure, hazard, or TSM in operation after the turnout

Figure 16 – Logical track layout for example 6 – high risk turnout



Assessment

1. Consider if it is a default *low risk* turnout. No operational processes apply to this turnout.

2. Identify the design speed of the crossover.

   a. Straight track, standard tangential configurations

   b. For 800:15, curved, states the **turnout design speed is 60kph**

   c. For 250:10.5, straight

   d. Table 1 states **design speed is 45kph**

   e. The crossover design speed is the lower of the two, and is 45kph

   f. Note: the posted turnout speed is 40kph, but this is not used. The turnout design speed is used.

3. Identify the *Actual Permitted Overspeed Allowance* (APOA)

   a. Turnout is a single tangential crossover so use Table 4

   b. No constraining infrastructure after the turnout, i.e. rules 1 through 4 do not apply

   c. The *Actual Permitted Overspeed Allowance* is given by the *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 4

d. The *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 4 for the 250:10.5 tangential turnout is **0kph**

e. The *Unconstrained Permitted Overspeed Allowance* (UPOA) from Table 4 for the 800:15 turnout is **5kph**

f. **The APOA is the lower of the two UPOA and is 0kph**

4. Identify the main line approach speed

   a. No speed sign in advance of the 1st warning signal for the turnout, therefore use the speed sign, No. 1, in the rear of the 1st warning signal for the turnout

   b. Speed sign has three speed profiles, in the assessment use the high (60kph) and medium (60kph) profiles

5. Calculate the speed difference for both the high and the medium speed profiles

   a. High speed profile

      60kph (**AS**) – (45kph (**DS**) + 0kph (**APOA**) = 15kph. This is greater than **0kph**

   b. Medium speed profile

      60kph (**AS**) – (45kph (**DS**) + 0kph (**APOA**) = 15kph. This is greater than **0kph**

   c. When considering both the high and medium speed profiles, the turnout is considered to be high risk.

8.3. Examples of a High Risk Rail Infrastructure causing a High Risk Location through a Turnout

8.3.1. Example 1 – Deficient Overlap on exit from the turnout

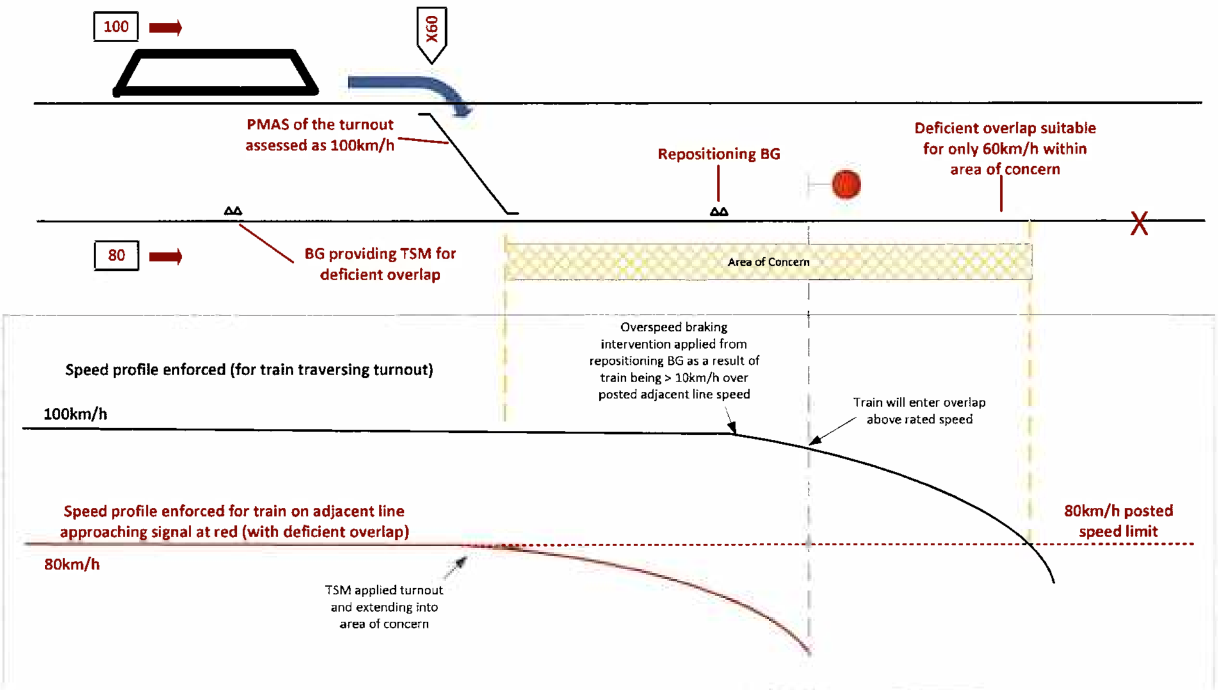
Key Information for Figure 17

It has been determined that:

- the turnout of itself is low risk (PMAS equals approach speed)
- there is no high risk speed sign reduction across the turnout

- there is a signal with a deficient overlap rated to 60kph in advance of the turnout, which requires a balise group announcing the TSM in the rear of the turnout
- the deficient overlap is within the calculated Area of Concern (based on the train potentially being able to travel at 100kph)

Figure 17 – Logical track layout for example 1 – TSM in place in rear of the turnout



Potential purple coloured speed profile based on initial turnout assessment

Without any prior concern for the impact of the deficient overlap, the train could exit the turnout at up to 100kph and continue to travel at 100kph until the repositioning balise. At this point the train will be supervised down to 80kph. However, should the signal be at stop and the train continue through the signal and be subsequently tripped by the train stop, then the train will be travelling up to 20kph too fast for the signal overlap.

Adjacent line AMS protection Red coloured speed profile

On the exit line the posted speed board is 80kph and ahead is a signal with an overlap rated for 60kph. To protect the train from approaching the signal too fast a balise group announcing the TSM is put in place to start in the rear of the exit of the turnout. In this example overspeed intervention will operate before the toe of the points and supervise the train speed down to 60kph if required.

Remedial action

Since there is a TSM in place on the exit line it is necessary to supervise the movements across the turnout. The permitted speed across the turnout is then determined such that the train is travelling at the expected speed at the start of the hazard (in this case the signal with the deficient overlap).

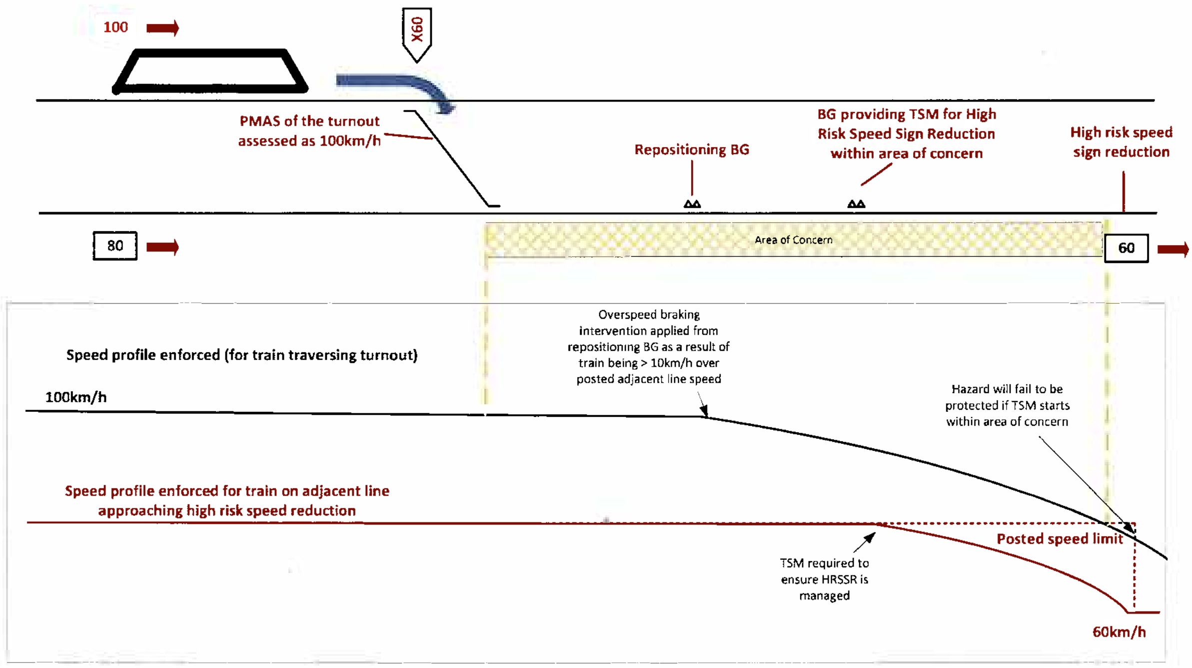
8.3.2. Example 2 – High Risk Speed Sign Reduction on exit from the turnout

Key Information for Figure 18

It has been determined that:

- the turnout of itself is low risk (PMAS equals approach speed)
- there is no high risk speed sign reduction across the turnout
- there is a high risk speed sign reduction on the exit line, between the speed sign in the rear of the exit of the turnout and the speed sign in advance of the turnout
- the HRSSR balise group announcing the TSM is within the area of concern, although the supervised ceiling speed begins outside the area of concern

Figure 18 – Logical track layout for example 2 – TSM in place in the area of concern



Potential purple coloured speed profile based on initial turnout assessment

Without any prior concern for the impact of the HRSSR on the exit line, the train could exit the turnout at up to 100kph and continue to travel at 100kph until the repositioning balise. At this point the train will be supervised down to 80kph. Although the train will then travel over the HRSSR TSM, it could be travelling too fast (up to 20kph) and a consequence be unable to be arrested to 60kph before the upcoming speed sign.

Adjacent Line AMS protection Red coloured speed profile

On the exit line the posted speed board is 80kph and ahead is a speed sign of 60kph, and this has been assessed as a high risk speed sign reduction (HRSSR). To protect the train from approaching the 60kph speed sign too fast a balise group announcing the TSM is put in place within the area of concern, designed for a train approaching the balise group at 80kph or below. In this example the associated TSM starts beyond the repositioning balises.

Remedial action

Since there is a TSM in place on the exit train it is necessary to supervise the movements across the turnout. The permitted speed across the turnout is then determined such that the train is travelling at the expected speed at the start of the hazard (in this case the 60kph speed sign).