SAFETY BARRIERS
AIMS:

Improved Understanding of current Specification for Roadworks

Implementation of EN1317 part 5

Specification of Terminals to ENV 1317 part 4
Clause 401 General

Safety barriers shall:

a) comply with NRA TD19 – Remains
b) be Type tested to Clause 405 - i.e. EN1317 Parts 1+2

c) be manufactured under ISO 9000 accreditation as further detailed in clause 404

d) have been approved by the NRA

OR Insitu Concrete Barrier to clause 409
Specification Series 400

402 Types – Prefabricated or Insitu – Retained
403 Materials – Limited to Durability
404 Control of Manufacture } Replaced
405 Evaluation of Conformity } by CE Marking
406 Installation } Produced by manufacturer,
407 Site testing } new spec for site works.
408 Anchorages – Extended to cover tensioned beams/ropes
409 Insitu Concrete Barrier – refers to RCD’s
410 Temporary Barriers
411 Terminals and Transitions – new Appendix 4/3
412 Provision of Information, Training, Materials & equipment – new Appendix 4/4
413 Pedestrian Guard Rails – refers to BS7818
**Roles and Responsibilities (D+B)**

**Contractor** has Overall Responsibility for both **Design** and **Construction** in accordance with the **Main Contract**, under self certifying Quality Procedures.

**Client’s Representative:**
- Audits the contractor’s quality procedures
- **Monitors** the works in accordance with their **appointment** from the **Client**

**Designer:**
- Designs the works in accordance with their **appointment** by the **Contractor**, and thereby with the **Main Contract**
- Co-certifys the **Design** and **Construction** in accordance with the **Main Contract**
Roles and Responsibilities (D+B)

Supplier & Installer procures, delivers and installs appropriate barrier systems in accordance with their Sub-Contract, and thereby specified elements of the Main Contract.

Manufacturer is responsible to the Supplier in accordance with their Order, and thereby specified elements of the Sub-Contract and referenced elements of the Main Contract.

Independent Chartered Engineer is required to certify that the proposed site testing regime is appropriate to the particular barrier system and site conditions (Clause 407.8).
Once a supplier has obtained **NRA approval** for a system then the supplier can be **assumed** to be providing a **fully compliant** installation.

**THIS IS NOT SO!**

NRA Approved List gave contractor’s a starting point for procurement options and will be superceded by CE Marking.
Clause 401 General

Safety barriers shall:

a) comply with NRA TD19
b) be CE Marked to EN1317
c) modifications evaluated to Annex A of En 1317 Part 5

OR Insitu Concrete Barrier to clause 409
NRA TD 19/09 – Safety Barriers

Part of the NRA Design Manual for Roads and Bridges

Sets out where to provide safety barriers
States the performance requirements
Principal design document

Intended for roads with design speeds of 85km/h or more unless exceptional hazard

Requires Specification to IS EN 1317
European Standard for Road Restriant Systems
Performance Specification

Sets out performance criteria
- Size of vehicle the barrier is to contain
  and how it contains it

Compliance is by crash testing
- Not by design
  - Computer simulations may be used in future

A set of crash tests costs around €150,000 or so

‘Harmonised Product Standard’

Compliance is compulsory!
NRA TD 19/09 Safety Barriers

Contents

1 Introduction
2 Definitions
3 Hazard Mitigation
4 Clear Zone
5 Permanent Safety Barriers
6 Terminals
7 Transitions
Why install a safety barrier?

The three main reasons are:

1. To minimise injuries to the occupants of vehicles which leave the carriageway;
2. To provide protection to third parties;
3. To protect property or equipment.

However, safety barriers may themselves be a hazard.
Possible mitigative measures are:

- Remove the obstruction
- Relocate
- Reduce impact severity (e.g. use a breakaway feature or set a culvert flush with the existing ground)
- Shield the object (i.e. use a safety barrier or crash cushion)
The **Clear Zone** is a width of land which should be kept clear of hazards if possible.

It is the area where an out of control vehicle might end up.
Clear Zone
Clear Zone
# Clear Zone

<table>
<thead>
<tr>
<th>Horizontal radius (m)</th>
<th>Required Width of Clear Zone (m)</th>
<th>Design Speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside of bend or Straight</td>
<td></td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>900m</td>
<td>120</td>
</tr>
<tr>
<td>Outside of bend ≥1,000m</td>
<td>6.5</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>800m</td>
<td>10.0</td>
</tr>
<tr>
<td></td>
<td>700m</td>
<td>12.4</td>
</tr>
<tr>
<td></td>
<td>600m</td>
<td>14.9</td>
</tr>
<tr>
<td></td>
<td>500m</td>
<td>17.5</td>
</tr>
<tr>
<td></td>
<td>400m</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>300m</td>
<td>22.8</td>
</tr>
</tbody>
</table>
Clear Zone

1:5 or flatter included
1:2 to 1:3 up to 2m may be omitted
Otherwise L1 only

Combinations must be considered individually, plus total height

Nominally parallel Interceptors up to 1.2m deep, offset from embankment and flat bottom to RCD can be ignored
Design of Safety Barriers

Performance Specification

Barriers are defined by:

**Containment:** What vehicle is the barrier intended to stop?

**Impact Severity:** What effect will a collision have on vehicle occupants?

**Working Width:** How far will the barrier deflect?

**Set-back:** How far should the barrier be from the edge of road?
# Containment

<table>
<thead>
<tr>
<th>Type</th>
<th>Mass</th>
<th>Vehicle Type</th>
<th>Speed</th>
<th>Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal:</td>
<td></td>
<td>N1</td>
<td>80km/h</td>
<td>20°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N2</td>
<td>110km/h</td>
<td>20°</td>
</tr>
<tr>
<td>Higher:</td>
<td></td>
<td>H1</td>
<td>70km/h</td>
<td>15°</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H2</td>
<td>70km/h</td>
<td>20°</td>
</tr>
<tr>
<td>Very High:</td>
<td></td>
<td>H4b</td>
<td>65km/h</td>
<td>20°</td>
</tr>
</tbody>
</table>
Design of Safety Barriers

Crash Testing

FORD GRANADA SCORPIO 2.9i
1500kg, 0.44m/s, 2x1 angle 20°
4 Rope system, Post spacings 3.2m
Containment

NRA TD 19 sets out where barriers are required and the minimum Containment to be provided.

In most cases, use N2 (car).

In some areas, use H2 (bus):
- Central Reserve up to 7.5m wide
- Verges adjacent to road or railway

Table 5/4 gives minimum Containment.

Note 8: N1 may be substituted for N2 for design speeds of 85kph or less.
Design of Safety Barriers

Impact Severity

- Measure of accelerations and decelerations inside the vehicle – effect on the occupants
- A is better (softer) than B
- Use A in verges
  B may be used in central reserves
Design of Safety Barriers

Working Width

W = Working Width
(Barrier + Deflection)

- W1 = 0.6m
- W2 = 0.8m
- W3 = 1.0m
- W4 = 1.3m
- W5 = 1.7m
- W6 = 2.1m
- W7 = 2.5m
- W8 = 3.5m
Design of Safety Barriers

Working Width

Verges

The Working Width shall not allow the traffic face of the barrier to extend beyond the back of verge.

The Working Width shall not allow the barrier to strike the obstruction – including toe of cut slope.

Central Reserves

The Working Width shall be such that no part will deflect into the opposing traffic lane.
Design of Safety Barriers

Set-back
Design of Safety Barriers

Set-back

**Set-back** is the dimension between the traffic face of the safety barrier and the edge of the road pavement.

The road pavement includes any hard shoulder or hard strip.

**Verges**

Minimum Set-back = 0.6m where there is a hard strip of 1m or more or hard shoulder

= 0.6m where Design Speed is 85km/h or less

otherwise = 1.2m

**Central Reserves**

Minimum Set-back = 0m (zero) where there is a hard strip of 0.6m

= 0.6m where there is no hardstrip
Design of Safety Barriers

Set-back

For isolated hazards, the safety barrier should be placed as close to the obstruction as possible.

Hence a small Working Width (W2 to W4) (0.8 to 1.3m) should be selected.

For H2 or H4b barriers with small Working Widths, it is preferable to keep the Set-back distance as small as possible.

This will minimise the angle of impact, reducing the severity of impact.
Length of Need

**Length of Need** is the total length over which a full-height, full-strength barrier is required.

This is the length the designer specifies.

The actual length of barrier will be longer.

Actual length  = Length of Need
+ terminals at each end
+ if required, ‘intermediate lengths’ over which the barrier attains full performance
Design of Safety Barriers

Length of Need

Approach and Departure Lengths
TD19 defines minimum approach and departure lengths for particular circumstances, over and above the 1:7 rule.

Minimum total length is defined by the system manufacturer – related to the intermediate length.
Design of Safety Barriers

Terminals are defined by:

**Performance Class:** What range of collision is the terminal intended to protect?

**Impact Severity:** Required to be consistent with barrier

**Permanent Lateral Displacement Class:** Max permissible displacement

- Da in front of barrier, X1 (0.5m), X2 (1.5m) or X3 (3.0m)
- Dd behind barrier, Y1 (1.0m), Y2 (2.0m), Y3 (3.5m) or Y4 (>3.5m)

**Exit Box:** Redirection of the vehicle

- Za in front of barrier, Zd behind barrier
- Classes Z1, Z2, Z3, Z4 permit different combinations of Za and Zd
3.17: Wall thicknesses used to define when sign posts are considered a hazard revised to match standard sections

5.10A: Central reserve barriers on Motorways and Type 1 Duals must be of concrete construction

5.50: Concrete barrier to RCD’s deemed H2 W2 B, but vertical barrier to RCD/400/5 may be assumed to have a working width of Zero
3.17: Wall thicknesses used to define when sign posts are considered a hazard revised to match standard sections.

5.10A: Central reserve barriers on Motorways and Type 1 Duals must be of concrete construction.

5.50: Concrete barrier to RCD’s deemed H2 W2 B, but vertical barrier to RCD/400/5 may be assumed to have a working width of Zero.

6.4 to 6.9: Upstream terminals must be full height, P4 at 100 kph or above, otherwise P1. Downstream may be ramped or P1.
Specification of Safety Barriers

Designer Determines:

- Length of Need (Ch. at start ….. Ch. at end)
- Containment (N2, etc.)
- Impact Severity (A or B)
- Working Width (W4, etc.)
- Minimum Set-Back
- Terminal Performance Class (P4, P1)
- Terminal Permanent Lateral Displacement Class (X2, Y3 etc)
- Terminal Exit box class (Z1 etc)
- Any Special Requirements

Designer does **not** specify the actual barrier
Specification of Safety Barriers

Contractor Determines:

- Particular Barrier to use
- Particular Terminals and Transitions
- ‘Intermediate Length’ to gain full strength
- Site Tests for Ground Conditions
- (Width of Central Reserve or Verge required)

Contractor effectively designs and installs barrier to match performance specification.

In **D+B** the **Designer** must certify the final as installed design to be compliant with the Design Requirements.
Clause 401 General

Safety barriers shall:

a) comply with NRA TD19
b) be CE Marked to EN1317 for criteria in App 4/1
c) modifications evaluated to Annex A of En 1317 Part 5

OR Insitu Concrete Barrier to clause 409
CE MARKING

All product should arrive with CE Labelling

Confirm Performance requirements

Check Certification Body on EU Nando listing to confirm they are authorised to certify to EN1317

OR (until Jan 2011)

Submit everything EN1317-5 required for CE Marking to ER
Clause 401 General

Safety barriers shall:

a) comply with NRA TD19
b) be CE Marked to EN1317 for criteria in App 4/1
c) modifications evaluated to Annex A of EN 1317 Part 5

OR Insitu Concrete Barrier to clause 409
Clause 401 General

Safety barriers shall:

a) comply with NRA TD19
b) be CE Marked to EN1317 for criteria in App 4/1
c) modifications evaluated to Annex A of EN 1317 Part 5

OR Insitu Concrete Barrier to clause 409
**409: Insitu Concrete Barrier**

Barrier must comply with NRA RCD’s listed in Appendix 4/6

Note requirements for
- 60mm embedment
- Continuous pavement under barrier
- Drainage and Mammal slots

Any other concrete barrier must be treated as a proprietary product and CE Marked or equivalent

NRA currently using Departure process to administer this
403: Durability

Manufacturer must assess the durability of his product as part of Initial Type Testing

Specification calls for life of not less than 20 years, or for concrete 50 years
406 : Installation

Manufacturer must provide data sheet defining all installations requirement that ensure that the installed product is the product that was tested and certified.

Specification contains additional requirements for site works

- Handling and Storage requirements
- Final layout arrangements and tolerances
- Excavations, concrete works, damage to coatings etc.
Installation

407 : Site Testing

Site testing regime to be defined as appropriate to the particular barrier system:

- Anchorages
- System assembly
- Ground Conditions in relation to EN1317 test
- Demonstration that post sockets remain serviceable after collapse of post

Regime to be certified by an Independent Chartered Engineer as being appropriate to the particular system in the specific site conditions
**411 : Terminals and Transitions**

Full height terminals shall comply with IS ENV 1317-4 for the performance criteria described in Appendix 4/3.

Transitions shall comply with NRA TD19 and impact assessment test criteria of IS EN 1317-2.
412 : Provision of Information, training, Materials and Equipment

Contractor to supply the information, training, spare materials and equipment required by Appendix 4/4

Employer must complete App 4/4 if he wants these!

Contractor to provide details of supply for further spares
Chronological Summary

**Designer** defines requirements to TD19 in App 4/1 (4/3 & 4/4)

**Contractor** selects barrier system and submits all relevant system data to the **Employer**, with inputs from the **Manufacturer** obtained via the **Supplier & Installer** – or CE Marking

**Contractor** must submit the proposed site testing regime to the **Employer** as required by the **Manufacturer** and certified by an Independent Chartered Engineer

**Employer’s Representative** monitors construction and audits the Contractor’s Quality System, including CE marking details

**Contractor** may propose revisions to the App 4/1 requirements to suit the particular system or site circumstances as advised by the **Supplier & Installer**, but in D+B all such changes must be signed off by the **Designer**.