highways england

The Delivery Hub health, safety and environment Raising the bar 4

Temporary Vehicle Restraint Systems (TVRS)

Issued July 2012 Revised October 2016

Note: For design of TVRS the following advice should only be used in conjunction with design standards referenced in Section 6 of this document

Contents

Objective

To identify good practice in the implementation of Temporary Vehicle Restraint Systems (TVRS) to protect the Workforce and Travelling Public.

1.1 Background

Consolidate location of all relevant standards relating to TVRS and best practice adopted across Highways England Projects.

1.2 Scope

This document gives guidance and sets minimum requirements as well as examples of good practice and references key areas when planning the installation of Temporary Vehicle Restraint System (TVRS)
Once it is established that temporary traffic cones are not appropriate, the possibility of using TVRS shall be assessed. This will be dependent on the individual contract through risk assessment (see section 2).
Also available is the Highways England Interim Advice Note 142/11 Temporary Barrier Decision Tool (2011) to inform and support their decision to use TVRS for works of less than 28 days;
http://www.standardsforhighways.co.uk/ians/pdfs/ian142.pdf

2.0 Safety risk assessment / minimum requirements

A safety risk assessment in accordance with GD04/12 shall be carried out. If works are greater than 28 days it would be expected that temporary barrier would be used unless a risk assessment showed that this disproportionately increased risk.
All TVRS shall be EN1317 Compliant Road Restraint Systems;
http://www.standardsforhighways.co.uk/ha/standards/tech_info/en_1317_compliance.htm

Standards for highways that relate to road restraints and safety barriers;
https://www.gov.uk/guidance/standards-for-highways-online-resources

To support any decision on using TVRS, the Road Restraint Risk Assessment Process (RRRAP) shall be applied.
http://www.standardsforhighways.co.uk/ha/standards/tech_info/rrrap.htm

2.1 Suitability assessment

A site specific assessment of the suitability of TVRS shall be carried out. Designers will need to take account of restrictions in working width and containment levels for the type of work in the assessment, and include, as a minimum.

a) The protection of bridge supports , scaffolding and vulnerable structures in accordance with TD 19 & RRRAP

b) Imposed Speed Restrictions within the works

c) Layout and geometry of the site including the topography of the road layout /sight lines

d) The duration of the works and the cost benefits of using TVRS

e) Presence or otherwise of existing permanent VRS throughout the project timeline

f) Whether there is a risk to the workforce or road users as a result of vehicles running into works

g) If there is a risk of vehicles entering into the verge and impacting bridge soffit or overhead hazard e.g. overhead cables

h) The effect of the vehicle breakdowns within the works

I) Access for Emergency Services or Recovery Operators

j) The effect of a barrier on the drainage of the carriageway

k) The load of the barrier on the road surface and supporting structure

l) Traffic movements on the approach to the barrier.

m) Where permitted, access for pedestrians, cyclists and non motorised users

n) The safe locating of access and egress points

o) The presence and positioning of emergency access/egress points within the works.

p) Installation shall be undertaken by competent personnel in accordance with the manufacturer's requirements and complying with National Highway Sector Scheme 2B.

3.0 Installation of TVRS

3.1 Upgrading TVRS Decreasing the working width of TVRS may be achieved by pinning/anchoring the length of barrier . Note pinning might not be appropriate for underbridges due to the fixing and depth of surfacing above the concrete deck. Please refer to manufacturer's guidance on the options and suitability of pinning for specific products.

Pinning may help if the works area is tight for workspace, or for areas considered high risk for the workforce. This may also be a benefit in buffer zones for contraflow situations. Alternative methods of improving containment / reducing working width include interlinking concrete barriers with H- shaped plates, which should be located between adjoining units.

3.2 TVRS Visibility

TVRS products may have top reflectors - these may be used on roads with no lighting or on roads that are prone to inclement weather such as reduced visibility. This is recognised in TSRGD diagram 560 "Amber reflector in centre and red in verge." Also reference Chapter 8 of The Traffic Signs Manual 2009 **O4.7.7**

3.4 TVRS at works access point (within works area)

TVRS placed and linked together at gaps , access and egress points along edge of excavation.

Above red and white interlinked TVRS with M6 J16-J19 Smart Motorways within works area , adjacent to works access.

Key benefits :

- Workforce operate behind continuous compliant TVRS protecting against errant road users within works
- Edge protection , clear demarcation and segregation of work operations e.g. haul route and passing works vehicles
- Eliminating risk of roaduser crossover incidents
- Removing the need to close up / relocate access and egress points during construction (a) Saving programme time , and also the need for overnight lane closures to fill and open new gaps , this in turn removing road worker exposure (b) Fixed access and egress points for duration of scheme e.g. no confusion to deliveries

3.5 Assessment of soft verges

Where temporary barrier and associated works require moving running lanes closer to soft verges a risk assessment should be conducted to identify the likelihood of vehicles entering the soft verge. The risk assessment should include:

Inspecting the full verge and producing a plan identifying and recording 'high risk' areas i.e. French drains / soft verge

The possibility of temporary verge hardening to mitigate overrun at 'high risk' areas.

Assessing condition of the pavement between hard shoulder line and the verge and the effect of using a raised rib line

A1 Leeming to Temporary Narrow Lane Running A1 Barton example of verge hardening and temporary raised rib line

3.6 Workforce Awareness

Different TVRS have different working widths and containment levels and manufacturer's guidance shall be followed. Any changes in working width / containment shall be identified in inductions and briefed to the workforce.

3.7 Surface condition

The weight of the TVRS on newly laid surfaces may result in depressions in the newly laid surface. The designer shall choose a barrier that will not damage the surface. Rubber protection or pads can be considered.

3.8 Chicanes

TVRS can be used instead of cones in chicanes during narrow lanes (See insert 4) as identified in "key" details (E & F) Part 1 (Design) of Chapter 8 of the TSM. This will reduce the maintenance risk to road workers and obstruction risks to road users.

M1 J39- J42 Smart Motorway

3.9 Barrier End Treatments / Transitions

In some cases transitions eliminate the need for terminals / end treatments. This should be considered in GD04/12 assessment.

4. Installation of transitions – requirements

Installation shall be undertaken by competent personnel in accordance with the manufacturer's requirements and complying with NHSS 2B.

Installation time of the transitions must be considered against the overall duration of the works , i.e. if the works are short term it might not be practical to use a transition due to the risk factors (especially if the time for installation and removal are considered in line with GD04/12 requirements.

Where transitions are to be installed, visibility as defined in TD19 8.17/8.18 shall be included as part of the safety risk assessment.

TD19/06 RRRAP does not consider transitions on TVRS. All installations shall be subject to risk assessment.

5. Use of crash cushions on TVRS

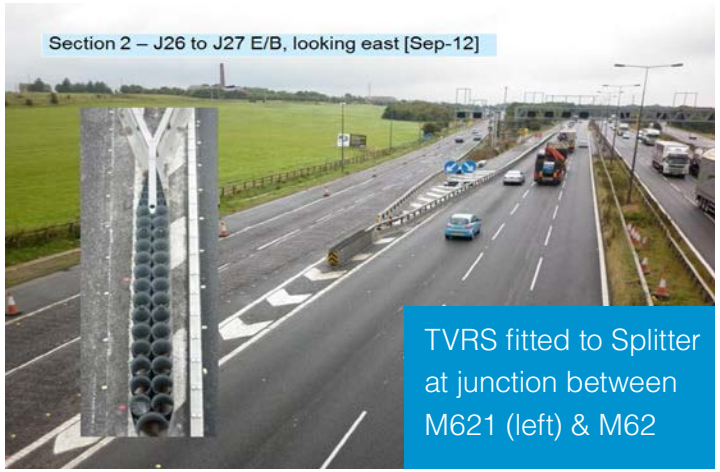
Crash cushions can be one design solution used when traffic passes the side(s) of the barrier:

(a) Road users passing either side of Crash Cushion.

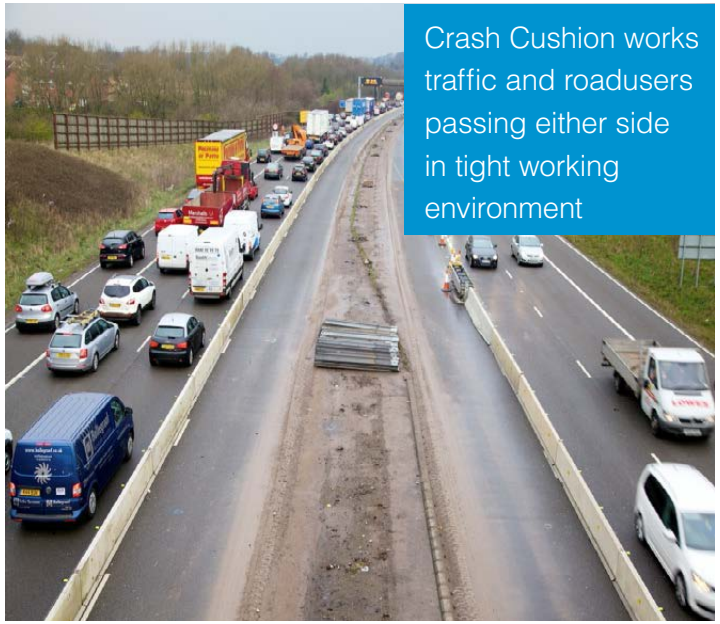
Example shown crash cushion fitted to splitter at the junctions between M621 and M62 eastbound carriageway at junction 27, on the M62 junction 25 to junctiion 30 Smart Motorway scheme

The splitter detail using a Crash Cushion was required as a gantry base was constructed just east of existing nosing.

(b) Works traffic passes on works side, and road users pass on the other (live carriageway side)



TVRS fitted to Splitter at junction between M621 (left) & M62



Crash Cushion works traffic and roadusers passing either side in tight working environment

Technical considerations crash cushions
Crash cushion may also assist in maintaining works area / haul route widths when compared with ramped end and flare.

5.1 Technical requirements - crash cushions
Installation should always be undertaken by competent personnel in line with the manufacturer's requirements and complying with NHSS 2B .

Where the use of crash cushions is proposed for safety reasons, the proposals must be supported by an analysis of the benefits of such deployment.

TD19/06 7.11 Crash cushions may be included in the design proposals for Temporary Traffic Management (TTM)

TD19/06 RRRAP does not consider end treatments on TVRS. All installations shall be subject to risk assessment.

Time and cost benefits - TD 19/06 states "Where each crash cushion installation is intended to be in position for less than 28 days, the overall benefits to the workforce and road users may be outweighed by the time/cost of installation, the risks to the installation team and possible delays to the travelling public."
Industry feedback suggests that there is very little time difference between the installation of a crash cushion and a ramp end terminal, however the cost difference can be significant.

5.2 Temporary barrier decision tool IAN 142/11
The use of a static crash cushion fitted to a steel plate at the start of the working area is a possibility for longer term works. These plated devices shall be installed by suitably qualified personnel in accordance with manufacturer's instructions.

The positioning of the crash cushion shall be in accordance with the manufacturer's instructions and the maximum practical setback.

5.3 Crash cushion behaviour
Unlike terminals, crash cushions are free standing and do not require connection to existing VRS systems

The approach lengths to the crash cushion and terminals must be kept clear, and no works should be undertaken in that exclusion area. This must be made clear at induction. Subject to a site specific risk assessment the minimum exclusion area distances are:

Speed Limit	Exclusion area of no works
40mph	32m
50mph +	40m

This exclusion zone should be made clear at site induction and regular briefings.

If this area is highlighted / indicated with equipment which requires maintaining, the exclusion zone could become a hazard for the workforce.

Breaks (gaps) in TVRS
The number of breaks (gaps) within the Temporary Vehicle Restraint System shall be minimised . Risks associated with breaks shall be balanced against access for emergency responders.

Also see section 3.3 TVRS at works access point (within works area)

5.4 Lateral displacement zones for crash cushions

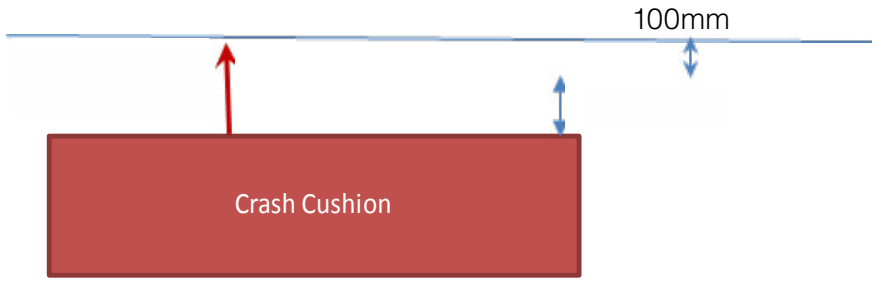
Crash Cushions are listed in Highways England List of EN1317 Compliant Road Restraint Systems (March 2016).
The permanent lateral displacement zone for crash cushions is the 'D' value; the zone on both sides of the cushion that when impacted the cushion may deflect into. For a head-on impacts the cushion may collapse and gain width on both sides due to the nature of controlled collapse.

Crash cushion cannot be mounted against a fixed object, i.e. existing VRS, as it will be unable to collapse on a controlled manner as the fixed object will prevent this. There must be a minimum clearance distance of 'D'.

'D' Zones are specified in EN1317-3:2010 in Table 12 below ; for use in permanent works , the crash cushions must be CE marked , although for temporary works , this is not the case. In the case of temporary works , the crash cushion must still have met the testing requirements of EN1317-3:2010

Table 12 — Permanent lateral displacement zones for crash cushions

Classes of crash cushion D	Displacement	
	Da m	Dd m
D1	0,5	0,5
D2	1,0	1,0
D3	2,0	2,0
D4	3,0	3,0
D5	0,5	≥ 0,5 Test 3, Figure 3
D6	1,0	≥ 1,0 Test 3, Figure 3
D7	2,0	≥ 2,0 Test 3, Figure 3
D8	3,0	≥ 3,0 Test 3, Figure 3



Leaving a minimum 100mm above the Crash Cushion's D Value (collapse area) this would generally be the width of the stud or temporary line.

If the cushion is tapered, the measurement should be made from the widest point of the cushion. For example

#1 The cushion to be used is a parallel (rectangular) D1 crash cushion (as above). Minimum set-back will be 500mm (D1) + 100mm = 600mm measured from the side of the crash cushion to the traffic face of the demarcation line.

#2 The cushion is a tapered D2 crash cushion . minimum set-back will be 1000mm (D2) + 100mm = 1100mm this to be measured from the widest point of the crash cushion (normally the rear) to the traffic face of the demarcation line.

Use of Ramped Ends

Technical considerations: ramp ends for Temporary Vehicle Restraint
Installation should always be undertaken by competent personnel in line with the manufacturer's requirements complying with NHSS 2B.

TD19/06 RRRAP does not consider end terminals for TVRS. All installations should be subject to risk assessment.

Chevron markings / reflectors should be installed on end treatments, on approach and in some cases departure ends to prevent risk of works vehicles not seeing ramp rend during road closures .

Reflectors or lamps should only deployed on straight runs of barriers following the edge of the carriageway line so not to draw roadusers into the works area.

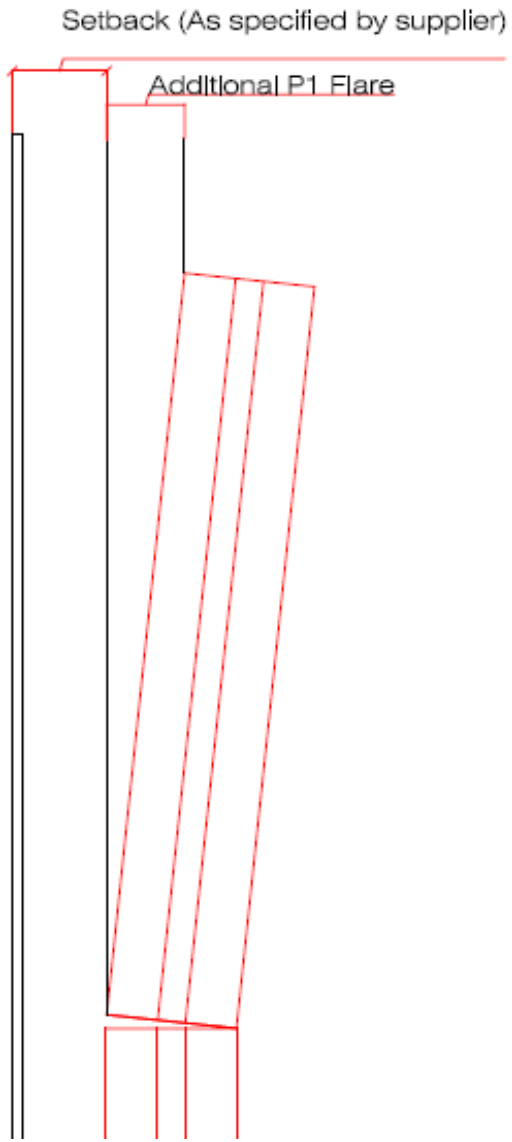
This control will also help highlight end terminals during work operations in hours of darkness during road closures.

Where ramps are to be installed, visibility as defined in TD19/06 8.17/8.18 shall be included as part of the safety risk assessment.

Gaps cannot be introduced into the barrier system that will permit vehicles in opposing flows of traffic to crossover. If emergency access points are required, gated systems shall be used.

When designing for ramped end

Design example:
Set-back = 600mm (TD19 8.19 – 50mph road speed)
Terminal flare = 1500mm (manufacture specified)
Minimum distance for the corner of the P1 Terminal from live traffic = Setback + Terminal flare = 600 + 1500 = 2100mm
It must be noted that this is a minimum value, and a flare should be installed that reaches as far into the workzone as is practicable.



Monitor / maintenance and repair of TVRS

Refer to manufacture/promoter for specific requirements.
TVRS falls under PUWER '98, as it is a piece of work equipment and the following must be noted:

- If in doubt, refer to the tvrs installer/provider.
- See requirements of Maintaining Static Traffic Management detailed in Ch 8 Q3.7
- All works must be undertaken by trained personnel – refer to the provider
- All installations are to be monitored on a regular cycle for deviation from installation – drive by inspections, reviews by workforce in work-area as part of start of shift assessment.
- Inspections are visual assessments only, however logs and records of these inspections should be produced

Note :

Any time the TVRS is pushed out – towards the traffic (this will be seen as a reduction in the set-back), the incident must be treated as a near miss, and rectified as soon as practicable.

TD19 – 7.13 All permanent crash cushion installations must be monitored over a three-year period following deployment.
All temporary crash cushion installations must be monitored over the period of deployment. The performance of the installation, in terms of accident numbers and maintenance/repair costs, are to be reported in an agreed format to the Overseeing Organisation.

6. References

DMRB Volume 2 Section 2 Part 8 Criteria and Guidance for the Provision of Temporary Safety Barriers at Road Works TD 19/06 (2006)
www.standardsforhighways.co.uk/dmrb/vol2/section2/td1906.pdf

Road Restraint Systems Part 3: Performance Classes, impact test acceptance criteria and test methods for crash cushions BS EN 1317 -3: (2010)
http://shop.bsigroup.com/ProductDetail/?pid=000000000030168435

Highways Agency Interim Advice Note 142/11 Temporary Barrier Decision Tool (2011)
http://www.standardsforhighways.co.uk/ians/pdfs/ian142.pdf

Traffic Signs Manual Chapter 8 Traffic Safety Measures and Signs for Road Works and Temporary Situations Part 1 & 2 (2009)
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/203669/traffic-signs-manual-chapter-08-part-01.pdf

Technical Note A1 Dishforth to Leeming ECI Scheme – use of rubber pads on varioguard (temporary restraint) (2012)
http://www.highwayssafetyhub.com/uploads/5/1/2/9/51294565/a1d2l_technical_note_tvrs_pads.pdf

Road Restraints Risk Assessment Process (RRRAP)
http://www.standardsforhighways.co.uk/ha/standards/tech_info/rrrap

Published List of EN1317 Compliant Road Restraint Systems
http://www.standardsforhighways.co.uk/ha/standards/tech_info/en_1317_compliance.htm

Standards for highways online
https://www.gov.uk/guidance/standards-for-highways-online-resources

GD04 /12
http://www.standardsforhighways.co.uk/dmrb/vol0/section2/gd0412.pdf