

Specification for vehicle security barriers — Fixed bollards

ICS 93.080.30

This Publicly Available
Specification comes into effect
on 10 March 2005

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Amendments issued since publication

Amd.No.	Date	Comments

ISBN 0 580 45450 9

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Foreword

This Publicly Available Specification has been developed for the UK Government's National Security Advice Centre (NSAC) by the Transport Research Laboratory (TRL) in collaboration with the British Standards Institution (BSI). Acknowledgement is given to the following organizations that were consulted in the development of this specification.

ATG Access

BRE

Corus Bi-Steel

D J Goode and Associates

Driveguard

Frontier Pitts Ltd.

HSBC

MFD International Ltd.

NaCTSO

SSG Security

The Police Scientific Development Branch

Townscape Products Ltd.

In particular TRL and BSI are grateful to the BRE for permission to use their draft specification LPS 1246 as a base document for this Publicly Available Specification.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, an inside back cover and a back cover.

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Introduction

PAS 68 has been prepared to address the needs of organizations who wish to have assurance that vehicle security bollards will provide the level of security that they seek.

PAS 68 only addresses fixed security bollards. Other vehicle security barriers such as the following are not covered in this Publicly Available Specification (PAS):

- rising bollards;
- road blockers;
- drop arm barriers;
- security gates.

These types of barriers will be addressed in future Publicly Available Specifications.

Many systems are available that are either promoted for or are being considered suitable for use as vehicle security barriers. As their characteristics differ in both function and form, a comparative means of assessing their performance is required.

The PAS identifies impact test tolerances and vehicle performance criteria that need to be met in order to conform to the PAS. The fixed bollard is taken to include the installation required for the bollard to perform its function. Generic foundations are provided in Annex C. Design guidance is provided in PAS 69.

The performance range of vehicle security barrier systems, designated in this PAS, enables government organizations, national and local authorities, and national and international commercial organizations to recognize and specify the performance class to be deployed.

1 Scope

This Publicly Available Specification (PAS) specifies requirements, test methods and a classification system for the resistance of fixed bollards and their supporting foundations to single horizontal impacts according to the mass and velocity of vehicles.

This PAS is applicable to impact performance only. It does not cover any other aspects of construction, e.g. durability, manual attack resistance.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*.

BS EN 1317-1, *Road restraint systems — Part 1: Terminology and general criteria for test methods*.

BS AU 228-1b, *Impact tests on road vehicles — Specification for measurement and general instrumentation*.

BS AU 246, *Method for determination of the centre of gravity of road vehicles with two axles*.

3 Terms and definitions

For the purposes of this PAS the following terms and definitions apply.

3.1

ballast

mass securely fixed to the vehicle

3.2

cargo

mass representing loose material which is not fixed to the vehicle

3.3

fixed bollard

fixed vertical post permanently embedded into specified foundations designed to prevent forced vehicle access

3.4

impact angle

angle, in the horizontal plane, between the intended direction of traffic flow and the approach path of the test vehicle into the test item

3.5

impact point

initial point of contact between the test vehicle or pendulum impactor and the test item

3.6

impact resistance

resistance of the fixed bollard to vehicle impact

3.7

impact speed, v_i

i) for the vehicle impact test

speed of the vehicle measured along the test vehicle approach path at a point no further than 6 m before the impact point

ii) for the pendulum test

speed of the impactor at the moment of impact

3.8

inertial test mass (vehicle)

mass of the test vehicle including fluids, but not necessarily including the maximum capacity of fluids, and all items rigidly attached to the vehicle's structure, including ballast and instrumentation, but excluding cargo

NOTE The minimum quantity of fuel should be provided to reduce the risk of fire but enough to enable the vehicle to function, for example for the engine to run to provide effective brakes.

3.9

kerb mass

mass of test vehicle, with standard equipment, maximum capacity of engine fuel, oil and coolant

3.10

major debris

any singular item totally detached from the test vehicle or bollard as a consequence of the impact, having a mass of 10 kg or more

3.11

rigid test foundation

foundation that will not move laterally by more than 10 mm, nor rotate by more than 1 degree from the pre-test position

3.12

test item

complete system including the fixed bollard and specified foundations

3.13

test vehicle

commercially available rigid vehicle used in an impact test to evaluate the performance of a test item

3.14

vehicle penetration

distance between the leading edge of the load platform of the commercial vehicle or the base of the "A" pillar of the car and the rear face of the bollard, measured after the impact along a line projected from the line of approach of the vehicle

3.15

vehicle security barrier

system designed and installed to impede the progress of an attacking vehicle

4 Requirements

4.1 Documentation

The organization commissioning the test shall provide the following information and documentation prior to the test:

- a) manufacturer's details (see A.4);
- b) status of bollard — whether the fixed bollard is a prototype or is in series production;
- c) which face of the fixed bollard is designed to resist impact;
- d) an expected performance classification (see Clause 5);
- e) general system arrangement drawings with works assembly descriptions and tolerances;
- f) component drawings and foundation designs with dimensions, tolerances, and all material specifications and finishes;
- g) factory sub-assembly drawings;
- h) parts list;
- i) certification of compliance for component materials;
- j) any other relevant information (e.g. recycling information, details of toxic or dangerous materials in the product);
- k) installation, maintenance and repair instructions.

4.2 Design requirements

4.2.1 In order to minimise injury, all exterior edges on fixed bollards shall be smooth and have a radius of not less than 2 mm.

4.2.2 The bollard shall have a permanent mark visible when the bollard is installed to indicate the plane designed to receive the impact. The relationship between the mark and the plane of impact shall be identified in the test item drawing (see A.5).

NOTE The mark does not need to directly show the installation orientation for the bollard. The mark on the bollard can be at any angle to the installation orientation that the manufacturer decides. This feature may be felt to be useful in order to avoid attackers being able to directly ascertain which is the weakest part of the bollard. The correct alignment of the bollard will need to be detailed in the installation instructions.

4.3 Performance requirements — pendulum impact test

When tested in accordance with Annex B, the bollard shall conform to the requirements specified in 7.5.

4.4 Performance requirements — vehicle impact test

4.4.1 When tested in accordance with Annex D, the bollard shall conform to the requirements specified in 8.6.

4.4.2 Classes are defined to indicate the distances that a test vehicle is allowed to travel beyond the bollard while still classifying the bollard's performance as acceptable.

NOTE The reason for this is that the distance in which a bollard needs to stop a vehicle and remain safe will vary according to the site and the circumstances.

4.4.3 When tested in accordance with Clause 8:

- a) the bollard shall arrest the vehicle without the vehicle penetration exceeding the highest value specified in Table 1;
- b) the bollard shall not fracture in such a manner that any structural element becomes separated during the impact;
- c) the test vehicle shall not penetrate beyond the rear face of the bollard, as measured at pavement level prior to impact, greater than the distance specified in Table 1 for each class of bollard;
- d) major debris shall not be dispersed beyond the rear face of the bollard, as measured at pavement level prior to impact, greater than the distance specified in Table 1 for each class of bollard.

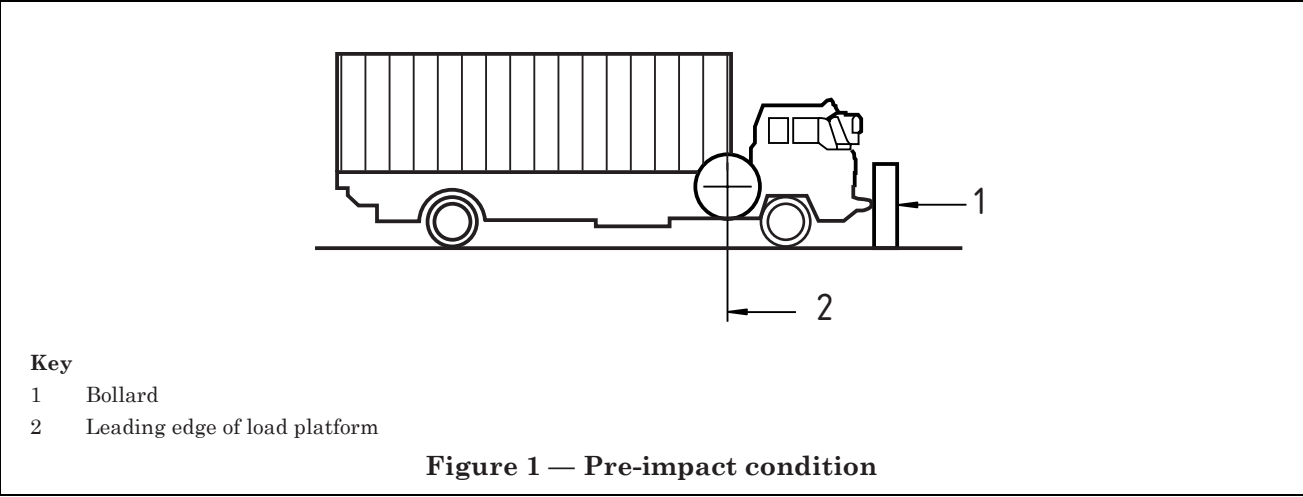
NOTE These requirements exclude fragmented glass unless a single piece having a weight of 10 kg or more is formed (see 3.10).

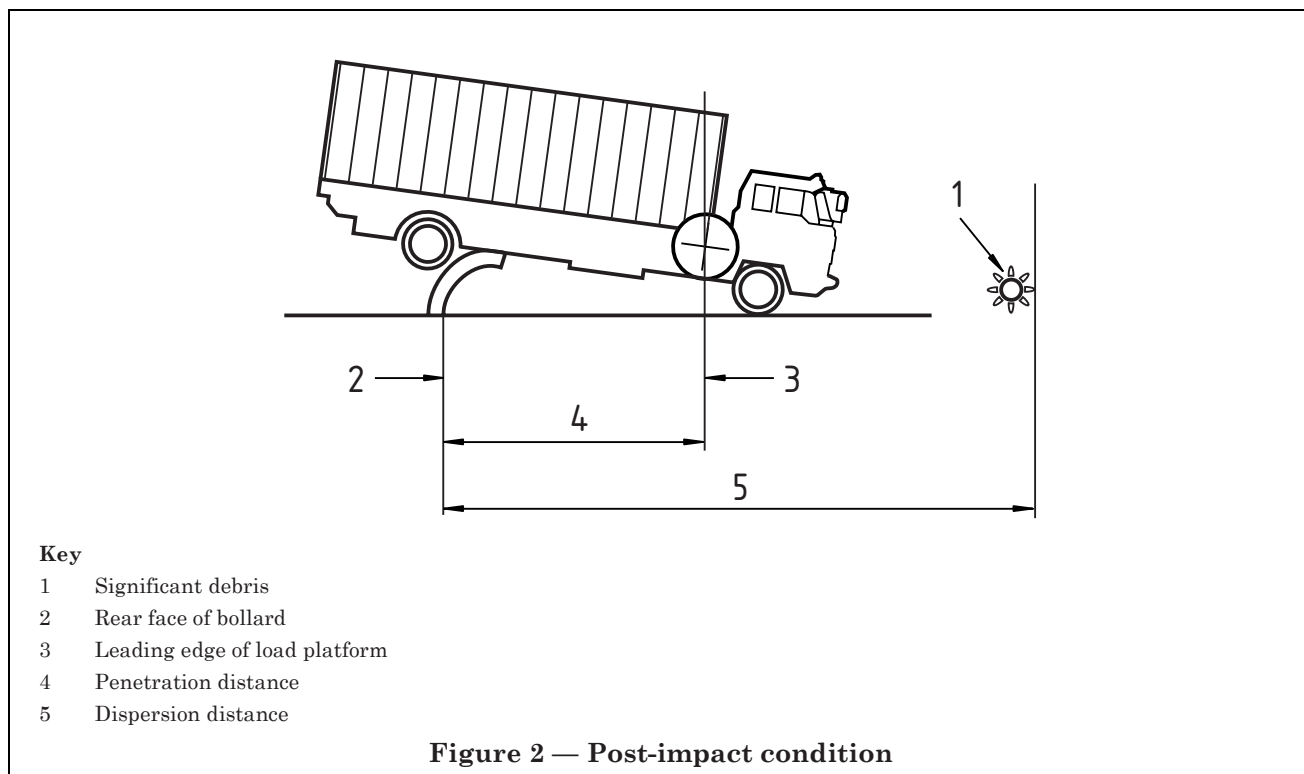
4.4.4 In order to claim conformance with this PAS, a bollard shall achieve as a minimum a classification of at least Class P5.0/D25.

Table 1 — Penetration and dispersion distance

Penetration class and distance for test vehicle		Dispersion class and distance for major debris	
Class	Distance m	Class	Distance m
P0	0	D0	0
P0.5	0.5	D1	1
P1.0	1.0	D2	2
P2.5	2.5	D5	5
P5.0	5.0	D10	10
		D15	15
		D25	25

Figure 1 and Figure 2 show a test vehicle in the pre-impact condition and the post-impact condition respectively, for illustration purposes.





5 Classification system

5.1 Vehicle impact test method

Fixed bollards tested in accordance with Clause 8 shall be classified in accordance with Table 1 and Table 5. The performance shall be expressed in terms of a three-part classification.

Example: **FB 2500-48/P1.0/D5** — in this fixed bollard designation, the classification elements would have the following meaning:

Table 2 — Example of performance classification

Classification elements	FB 2500-48 (from Table 5)	P1.0 (from Table 1)	D5 (from Table 1)
Meaning of classification element	Fixed bollard: kerb mass: 2 500 kg impact speed: 30 mph (48 kph)	Penetration of vehicle: >0.5 m and <1.0 m	Dispersion of major debris: >2.0 m and <5.0 m

5.2 Pendulum test method

Fixed bollards tested in accordance with Clause 7 (maximum input energy 100 kJ) shall be classified as pass or fail.

5.3 Design method

Fixed bollards submitted on the basis of calculation shall be classified in accordance with Table 6.

6 Test preparation

6.1 General

General laboratory procedures, confidential handling of specimens, event record requirements and presentation of the test report shall be in accordance with BS EN ISO/IEC 17025.

The supplier of the product shall identify the class of performance against which the product is to be assessed.

Three alternative methods of determining the performance classification for fixed bollards rating are acceptable: the pendulum impact method (Clause 7), vehicle impact method (Clause 8), and the design method (Clause 9).

6.2 Conformity between specimens and documentation

Prior to testing, the test specimen(s) shall be examined for conformity with the details supplied by the manufacturer (see 4.1). Any lack of conformity identified at this stage or during testing shall be reported immediately to the manufacturer and resolved by the manufacturer through provision of corrected drawings and/or samples prior to continuation of the test programme.

6.3 Prototypes

The implications of any modifications to an assessed system shall be evaluated and declared in respect of the effect on the performance of the fixed bollard. If a prototype product meets the requirements of this PAS, and subsequently an application is made for its formal approval, then the following conditions shall apply.

- a) If there are no changes to the original product or its associated design drawings, then the product can be approved.
- b) If there are any modifications, the manufacturer shall describe them in respect of drawings and specifications used to define the system in the original assessment. The procedure for the assessment of modified products shall be in accordance with Table 3.

Table 3 — Assessment of modified fixed bollards

Category	Change	Description	Action
A	Slight	Modifications requiring no mechanical changes to the fixed bollard.	Nil
B	Moderate	Modifications to one or more components where their effects on the performance of the system can be determined by static or dynamic analysis or other appropriate means.	Component analysis or test
C	Significant	Modifications in excess of A or B.	Re-assess system

6.4 Specimen selection

The specimens for testing shall be examined for dimensional compliance with the design drawings. The specimen selected for testing shall be that which is towards the lower end of the dimensional tolerances such that the specimen likely to be least effective against the requirements for the classification(s) sought shall be selected.