



Anti-Ram Vehicle Barriers: Rating Systems

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Summary

To date, the Department of State (DoS), Department of Defense (DoD), US General Administration (GSA)/Interagency Security Committee (ISC) and ASTM have developed rating systems and requirements and/or testing standards. The United Kingdom also has adopted a testing and rating standard which some of the proprietary systems have used for testing. Rating systems are defined by some combination of the size, velocity and angle of approach of the design vehicle (which can be translated into Kinetic Energy) and the allowable penetration distance.

Prior to specifying anti-ram performance requirements the design team should understand the different rating systems and the proof of performance methods that may be required by the specification.

Department of State Ratings and Testing Requirements

The original DoS rating system and test standard was published in SD-STD-02.01 *Certification Standard: Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates*, dated April 1985. This was subsequently revised in SD-STD-02.01, Revision A *Certification Standard: Test Method for Vehicle Crash Testing of Perimeter Barriers and Gates*, dated March 2003. These documents provide “specified levels of vehicle impact resistance” and details of the testing requirements to gain DoS certification. The standard vehicle mass for the current DoS rating system is a medium duty truck with a gross vehicle weight of 6,800 kg (15,000 lb). Impact Condition Designations are shown in the table below.

DoS Impact Conditions

Nominal Impact Speed	Designation
80 kph (50 mph)	K12
65 kph (40 mph)	K8
50 kph (30 mph)	K4

From a rating system perspective, the primary change from the 1985 to the 2003 document was the removal of different allowable penetration distances. The 1985 document utilized “L” ratings to describe the amount of penetration that occurred from the medium duty truck travelling at the nominal impact speed. The 2003 document removed the different penetration distances and now requires that all barriers receiving a DoS certification allow no more than 1 m (3.33 ft) penetration beyond the inside perimeter of the barrier.

The penetration distance is measured based on reference points on both the vehicle and the barrier system. The reference points in the 2003 standard are at the leading edge of the test vehicle’s cargo bed and at the inside face (e.g. non-impact side) of the barrier. Distances are based on the dynamic penetration, that is the maximum penetration distance as opposed to the final penetration distance.

The following table provides the previous penetration rating system used by DoS. This is provided as many of the early proprietary systems were certified using the “L” penetration rating system. While

the tested systems with penetration distances greater than 1 m (3.3ft) no longer meet DoS requirements, they may be correlated with the new ASTM Rating System (described below) which may be useful in DoD projects which have more flexibility as to the requirements of the vehicle barrier systems.

DoS Penetration Ratings*

Designation	Penetration
L 3.0	<=1m (3.3 ft)
L 2.0	<= 6m (20 ft)
L 1.0	<= 15m (50 ft)

* no longer used for DoS projects

US General Services Administration Ratings and Requirements

The General Services Administration first published their blast/security design criteria, *Draft GSA Security Design Criteria*, in 1998. Before this document was finalized, the Interagency Security Committee (ISC) was established and the GSA document was updated and published as the *Interagency Security Committee Security Design Criteria for New Federal Office Buildings and Major Modernization Projects* in May 2001.

The ISC document provides design vehicle weights and velocities but does not prescribe testing requirements, kinetic energy, or certification requirements. ISC vehicle weights and velocities are tied to the level of protection required for the specific facility being protected.

ASTM Ratings and Requirements

ASTM has developed a Standard Test Method for Vehicle Crash Testing of Perimeter Barriers, Standard F-2656-07. This standard builds on the DoS standards and expands if for a wider range of project requirements (i.e. different vehicle sizes, additional velocities, and allowable penetration distances).

The following tables show a summary of Impact Condition Designations and Penetration Ratings.

ASTM Impact Condition Designation

Test Vehicle Weight	Nominal Impact Velocity	Condition Designation*
1,100 kg (2,430 lbm)	65 kph (40 mph)	C40
	80 kph (50 mph)	C50
	100 kph (60 mph)	C60
2,300 kg (5,070 lbm)	65 kph (40 mph)	PU40
	80 kph (50 mph)	PU50
	100 kph (60 mph)	PU60

Test Vehicle Weight	Nominal Impact Velocity	Condition Designation*
6,800 kg (15,000 lbm)	50 kph (30 mph)	M30
	65 kph (40 mph)	M40
	80 kph (50 mph)	M50
29,500 kg (65,000 lbm)	50 kph (30 mph)	H30
	65 kph (40 mph)	H40
	80 kph (50 mph)	H50

* The prefix in the Condition Designator refers to the vehicle type. C = Car, PU = Pick-up M = Medium-duty Truck and H = Heavy Goods Vehicle.

ASTM Penetration Ratings

Designation	Penetration
P1	<= 1m (3.3 ft)
P2	1.01m to 7m (3.3 ft to 23.1 ft)
P3	7.01m to 30m (23.1ft to 98.4ft)
P4	30m (98ft) or greater

The current DoS ratings of K12, K8 and K4 can be described in terms of the ASTM rating system as follows:

- K12 = M50-P1
- K8 = M40-P1
- K4 = M30-P1

Penetration distance measurements in the ASTM document are the same as in the DoS 2003 document (i.e. dynamic penetration as measured from set reference points on the vehicle and the barrier).

Department of Defense

The DoD no longer has a proprietary rating system (the Navy had a rating system, but it is no longer in use). Performance requirements for specific projects are based on either the DoS or the ASTM testing standards and rating systems.

While the DoS and GSA have a limited array of impact conditions and/or penetration ratings which are required for projects, the DoD has the ability to tailor specific project requirements to site, threat, and asset conditions.

United Kingdom

The prevalent anti-ram testing standard in the United Kingdom is the *Publicly Available Specification: PAS 68:2007*. This standard is based on similar premises as the DoS and ASTM documents. The PAS

allows testing by vehicle impact or pendulum impact and allows analysis (Design) for extrapolating test results to alternate ratings or system configurations. The PAS 68 provides 3 classification systems based on the method of classification (i.e. vehicle impact, pendulum impact or analysis).

Vehicle Impact: four-part classification system preceded by a “V”.

- Barrier Type
- Test Weight (kg)/Velocity (km/hr)
- Vehicle Penetration (m)
- Dispersion of Major Debris (m)

Pendulum Impact: three-part classification system preceded by a “P”.

- Barrier Type
- Test Energy (kJ)
- Pendulum Weight (kg)/Release Height (m)

Design Method: two-part classification systems preceded by a “D”.

- Barrier Type
- Design Energy (kJ).

A classification through the vehicle impact test method will be the closest to a DoS or ASTM rating. The vehicle weight categories of the ASTM standards and the PAS 68 can roughly be compared as shown in the following table, with the PAS 68 vehicle weights larger than the corresponding ASTM vehicle weight. There are other differences in the vehicles, based on the vehicle configuration differences between the United States and the United Kingdom.

ASTM vs PAS 68 Vehicle Weights

ASTM Test Vehicle Weight	PAS 68 Vehicle Weights
1,100 kg	1,500 kg
2,300 kg (5,070 lbm)	2,500 kg
	3,500 kg
6,800 kg (15,000 lbm)	7,500 kg
29,500 kg (65,000 lbm)	32,000 kg