MERIDIAN
RAPID DEFENSE GROUP

CERTIFIED DEPLOYMENT CONFIGURATIONS

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WHY WE DO WHAT WE DO

Meridian provides not only a security solution but a safety solution for the ever changing needs that arise to protect people, communities and places from hostile vehicles doing damage and harm.

We also provide safety services through our technology and products with fully certified and trained field specialists, standing by our commitment to make the world a safer place.

We care about why we do what we do by providing a lifetime guarantee on our Archer 1200 steel barriers. We believe that we have a lifetime relationship with our customers to remain the leader in mobile barriers and related technology and equipment to continue the work we began nearly two decades ago.

Our company values a set of "Guiding Principles" that last the span of time and are rooted in fairness, authenticity, and collaboration. We do not go it alone; we partner and responsibly engage with communities, people, and places to make the world a safer place.

Meridian is committed to testing using real life testing scenarios which is why all our tests are conducted using asphalt pads because it is important to understand how our barriers will behave when they need to perform.

APPROACH TO ACTION PLANNING

Safety is not achieved in a vacuum. Nor can it be achieved via a top-down implementation unveiled the morning of an event. An effective and refined action plan depends on an iterative process that captures information, involves multiple stake holders, and produces learnings for future events. The following outlines the necessary steps before, during and after a deployment that will ensure customers build toward a safer event strategy that is collaborative and improvement minded.

SCAN ME

Plan
- Identify threat level, footprint, emergency access needs and available equipment
- Create Vehicle Safety Mitigation Plan (VSMP)
- Coordinate details with concerned stakeholders, communicate plans outward

Do
- Conduct training for deployment personnel, event staffing and key stakeholders
- Implement VSMP
- Familiarize emergency agencies on layout and access points

Check
- Evaluate the effectiveness of the deployment layout
- Identify issues of safety, access or community concerns
- Assess permformance of deployment personnel and event staffing

Act
- Capture feedback, field adjustments and reference photos
- Formalize an after Action Action Report (AAR) to capture key learnings
- Communicate lessons learned to stakeholders and future planning groups

This process is vital to creating an effective plan as well as providing a synergy platform for key stakeholders that will minimize event day complaints or non-compliance. It is an especially helpful time saver for repeated events with similar layouts. However, event emergency or one-time deployments will provide important learnings for future events.

IDENTIFYING RISKS AND MITIGATION POTENTIAL

Before developing an effective Vehicle Safety Mitigation Plan (VSMP), it is important to understand the anticipated threats to the area. This can be in the form of known terrorist activity or simply the likelihood of a non-violent errant vehicle encroachment. Local, state, and federal agencies should be consulted for domestic and international terrorist activity.

Terrorists select targets based on maximum impact and maximum consequence. The highest value events or locations combine a high density of people with a high-profile activity. For example, the Super Bowl brings together a very large crowd and includes worldwide exposure for a successful strike. Understand where your activity (or location) stands on that scale. Remember that terrorists can be local, national or international in focus. In that way, a state football game may be a high-value target for a locally focused terrorist.

Apart from aggressive vehicle attacks, there is the potential for accidental incursions manifested by impaired drivers. The causes range from drunk or drug-impacted drivers, or elderly drivers or confused drivers failing to react to unfamiliar traffic patterns. Regardless of the threat origin, the following questions should be considered.

Questions to ask.

- What are your threats and vulnerabilities and what is the likelihood of any given threat to occur?
- What are the consequences if those threats occur?
- What is your community's tolerance for the associated consequences?
- What is your community's attitude toward security practices?
- How close will active traffic come to groups of people?
- Does the area surrounding the event footprint include dangerous runways?
- Will the area need to be secured overnight?
- Will areas need to be closed and reopened on a timetable?
- How do closures effect local businesses or residential access?
- What kind of emergency vehicle access is required?
- Will the closures need to be permeable to walking pedestrians, strollers and wheelchairs, bicyclist?

GUIDANCE ON VSMP PLANNING

Creating an effective VSMP depends on several critical variables. The threat level will inform the overall intensity of the plan. Geography and ingress/egress requirements will help determine closure location.

- Perform a visual site assessment of the area to get a current state view of the general footprint. Look for unmapped access ways, natural barriers, business needs and pedestrian flow (including disability access).

- Use an aerial view map or schematic to delineate the footprint and identify required closures and emergency access points.

• Measure closure points to determine the number of barriers required. Barrier spacing is determined by threat level ranging from bolted together for the highest threats to spaced no more than 4 feet apart for the lowest threats. One or more 4-foot cables can also be used to harden the closure.

• Barriers should be placed with the ramp facing potential on-coming traffic. The optimal impact range is between 70 and 110 degrees.

• Ensure that barriers have wheels in the up position when set for use.

• Vehicle traffic should be slowed in the area surrounding the event. Planners should target reducing speed to slow zones of 15-20 mph mirroring NATCO recommendations for schools, parks, and special zones.

• To address open runways, utilize barriers to construct a serpentine or chicane for speeds mitigation. Ensure that spacing between the barrier sets allows for anticipated traffic including large trucks or buses.

• Plan for emergency access points at the ends and middle of the event footprint. Allow quick access by staging a Hauler or Tow Bar to quickly move a barrier or incorporate a Rapid Gate into the barrier line.

• When planning the closure sequencing, consider staging the barriers curbside prior to the event. Close perimeter streets early leaving main access points open until the time of the event. Following the event, restage the barriers curbside for later pick up.

ADDITIONAL CONSIDERATIONS

• Barriers deployed overnight should incorporate high visibility elements like reflective tape or flashers. Arrestor Cables without reflective coating should have bright flagging tape at the midpoint.

• Haulers stored on the back of barriers should be secured with locked chains or cables.

• When deploying barriers in a hostile environment (e.g., protest), wheels should be left in the down position with the wheel pins removed. Protestors will be unable to move the barriers if the wheels are not pinned in the down position. Additionally, do not deploy barriers with Tow Bars in place as they could be used to move the barriers or as improvised weapons.

• In the event of a vehicle impact with the barriers, gather information about the vehicle, passengers, injuries, and sequence of events including time of day and conditions. Take photos or video as necessary. Contact Meridian as soon as possible to create a collaborative incident report.

• Meridian barriers can be used even after impact.

Meridian Rapid Defense Group Testing Grounds		
Testing Facility	Location	Iso Certification
Calspan Corporation	4455 Genesee Street, Buffalo, NY 14225	ISO/IEC 17025:2017
Applus IDIADA KARCO Engineering	9270 Holly Road, Adelanto, CA 92301	
Safe Roads Engineering	180 Ram Forest Rd, Stouffville, Ontario L4A 2G8	
Tass Internstional B.V.	Automotive Campus 15, 5708 JZ Helmond, Netherlands	

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Calspan LLC

4455 Genesee Street, Buffalo, NY 14225

(Hereinafter called the Organization) and hereby declares that Organization is accredited in accordance with the recognized International Standard:

ISO/IEC 17025:2017

This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system
(as outlined by the joint ISO-ILAC-IAF Communiqué dated April 2017):

Mechanical Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen
President

Perry Johnson Laboratory Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
July 17, 2013	August 13, 2024	November 30, 2026

Accreditation No.:	*Certificate No.:*
76654	L24-616

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

Calspan LLC

4455 Genesee Street, Buffalo, NY 14225
Contact Name: Daryl Wiese Phone: 716-631-6769

Accreditation is granted to the facility to perform the following testing:

FLEX CODE	FIELD OF TEST	ITEMS, MATERIALS, OR PRODUCTS TESTED	COMPONENT, CHARACTERISTIC, PARAMETER TESTED	SPECIFICATION OR STANDARD METHOD	TECHNOLOGY OR TECHNIQUE USED
F1, F2, F3, F4, F5	Mechanical [F]	Perimeter Barrier	Small Passenger (C)	ASTM F2656	Track Guided, Speed Controlled Impacts
F1, F2, F3, F4, F5			Pickup Truck (T)		
F1, F2, F3, F4, F5			Medium-Duty Truck (M)		
F1, F2, F3, F4, F5			Penetration Distance		
F1, F2, F3, F4, F5			Debris Distance		
F1, F2, F3, F4, F5		Roadside Safety Devices	Passenger Car	Manual for Assessing Safety Hardware (MASH)	
F1, F2, F3, F4, F5			Impact Speed		
F1, F2, F3, F4, F5			Pickup Truck		
F1, F2, F3, F4, F5			Single-Unit Truck		
F1, F2, F3, F4, F5			Impact Angle and Location		
F1, F2, F3, F4, F5			Post- Impact Vehicular Response		
F1, F2, F3, F4, F5			Structural Adequacy Occupancy Risk		
F1, F2, F3, F4, F5		Child Restraint Seat Systems	Dynamic Test	ECE/UN R44	1MN & 3MN Sled
F1, F2, F3, F4, F5				FMVSS 213	
F1, F2, F3, F4, F5				CMVSS 213	
F1, F2, F3, F4, F5		Ambulance & Equipment	Dynamic Test	SAE J2917 SAE J2956 SAE J3044 SAE J3043 SAE J3058 SAE J3059 BS EN 1789 SAE J3027 SAE J3026 SAE J3102	

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F1, F2, F3, F4, F5	Mechanical [F]	Anthropomorphic Test Dummy (ATD)	Component Certification Pendulum Test Drop Test Impact Test	CFR 572, Subpart R CFR 572, Subpart P CFR 572, Subpart I CFR 572, Subpart N CFR 572, Subpart M CFR 572, Subpart O SAE J2878, Low Speed Thorax Impact CFR 572, Subpart E SAE J2856, Knee Slider High Speed SAE J2876, Knee Slider Low Speed	1MN & 3MN Sled
F1, F2, F3, F4, F5			Component Certification Pendulum Test Drop Test Impact Test	SAE J2779, Low Speed Thorax Impact NHTSA THOR Qualification Procedures Manual, 2018; 4-14 THOR-50M EuroNCAP SBL-A, 2017 NHTSA THOR-50M Qualification Procedure, Sept-18 EuroNCAP TB026, V1.2 ECE-R 95 CFR 572, Subpart U NHTSA WorldSID 50th Male Qualification Procedure, 2019 Humanetics User Manual WorldSID 50th, rev K CFR 572, Subpart V Humanetics User Manual Q0 Humanetics User Manual Q1 Humanetics User Manual Q1.5 Humanetics User Manual Q3 Humanetics User Manual Q3s Humanetics User Manual Q6 Humanetics User Manual Q10	
F1, F2, F3, F4, F5		Vehicle Crash Testing	Full Frontal Impact Testing	ECE/UN R12 ECE/UN R94 ECE/UN R137 FMVSS 208/212/219 FMVSS 301 FMVSS 305 US NCAP EURO NCAP TNCAP ADR 69	Track Guided, Speed Controlled Impacts

CERTIFICATE OF ACCREDITATION

This is to attest that

APPLUS IDIADA KARCO ENGINEERING, L.L.C.

9270 HOLLY ROAD
ADELANTO, CALIFORNIA 92301, U.S.A.

Testing Laboratory TL-371

has met the requirements of AC89, *IAS Accreditation Criteria for Testing Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories.* This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date November 13, 2024

International Accreditation Service
Issued under the authority of IAS management

Visit www.iasonline.org for current accreditation information.

SCOPE OF ACCREDITATION

International Accreditation Service, Inc.

3060 Saturn Street, Suite 100, Brea, California 92821, U.S.A. | www.iasonline.org

APPLUS IDIADA KARCO ENGINEERING, L.L.C.

www.applusidiada.com

Contact Name Michael Dunlap **Contact Phone** +1-760-246-1672

Accredited to ISO/IEC 17025:2017 *Effective Date November 13, 2024*

Structural	
ASTM F2656/F2656M	Standard test method for crash testing of vehicle security barriers
BS EN 1317-1:2010	Road restraint systems - terminology and general criteria for test methods
BS EN 1317-2:2010	Road restraint systems - performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets
BS EN 1317-3:2010	Road restraint systems - performance classes, impact test acceptance criteria and test methods for crash cushions
DD ENV 1317-4:2002	Road restraint systems - performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers
FMVSS 206	Door locks and door retention components
FMVSS 208	Occupant crash protection: right front passenger test methodologies
FMVSS 214D	Dynamic side impact protection – moving deformable barrier test
FMVSS 214P	Dynamic side impact protection – rigid pole side impact test
FMVSS 216	Roof crush resistance
FMVSS 216A	Roof crush resistance – upgraded standard
FMVSS 223	Rear impact guards
FMVSS 301	Fuel system integrity
FMVSS 305	Electric-powered vehicles: electrolyte spillage and electrical shock protection (including protocols for hybrid and electric vehicles)
IIHS	Side Impact Crashworthiness Evaluation
	Small Overlap Frontal Crashworthiness Evaluation
	Moderate Overlap Frontal Crashworthiness Evaluation
Latin NCAP	Offset Deformable Barrier Frontal Impact Testing Protocol
	Pole Side Impact Testing Protocol

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	Side Impact Testing Protocol
MASH	Manual for Assessing Safety Hardware
National Highway Traffic Safety Administration (NHTSA) for the New Car Assessment Program (NCAP)	Frontal Impact
	Side Impact Moving Deformable Barrier
	Side Impact Rigid Pole
	Dynamic Rollover, Fishhook Maneuver
	Crash Imminent Brake System Performance Evaluation
	Dynamic Brake Support Performance Evaluation Confirmation Test
	Forward Collision Warning System Confirmation Test
	Lane Departure Warning System Confirmation Test and Lane Keeping Support Performance Documentation
	Pedestrian Automatic Emergency Brake System Confirmation Test
	Blind Spot Detection System Confirmation Test
	Blind Spot Intervention System Confirmation Test
	Rear Automatic Braking Feature Confirmation Test
	Lower Beam Headlighting System Visibility Confirmation Test
	Semiautomatic Headlamp Beam Switching Device Confirmation Test
	Amber Rear Turn Signal Lamps Confirmation Test
	Lane Keeping Support System Confirmation Test
NCHRP 350	Recommended procedures for the safety performance evaluation of highway features (including parts A and B)
SD-STD-02.01	Test method for vehicle crash testing of perimeter barriers and gates (revision A)
UN ECE	Regulation 12 - Uniform provisions concerning the approval of vehicles with regard to the protection of the driver against the steering mechanism in the event of impact
	Regulation 34 - Uniform provisions concerning the approval of vehicles with regard to the prevention of fire risks (Inclusion - Part II only)
	Regulation 94 - Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a frontal collision
	Regulation 95 - Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a lateral collision

SCOPE OF ACCREDITATION

International Accreditation Service, Inc.

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	Regulation 135 - Uniform provisions concerning the approval of vehicles with regard to their Pole Side Impact performance (PSI)
	Regulation 137 - Uniform provisions concerning the approval of passenger cars in the event of a frontal collision with focus on the restraint system

FMVSS: Federal Motor Vehicle Safety Standard

IIHS: Insurance Institute for Highway Safety

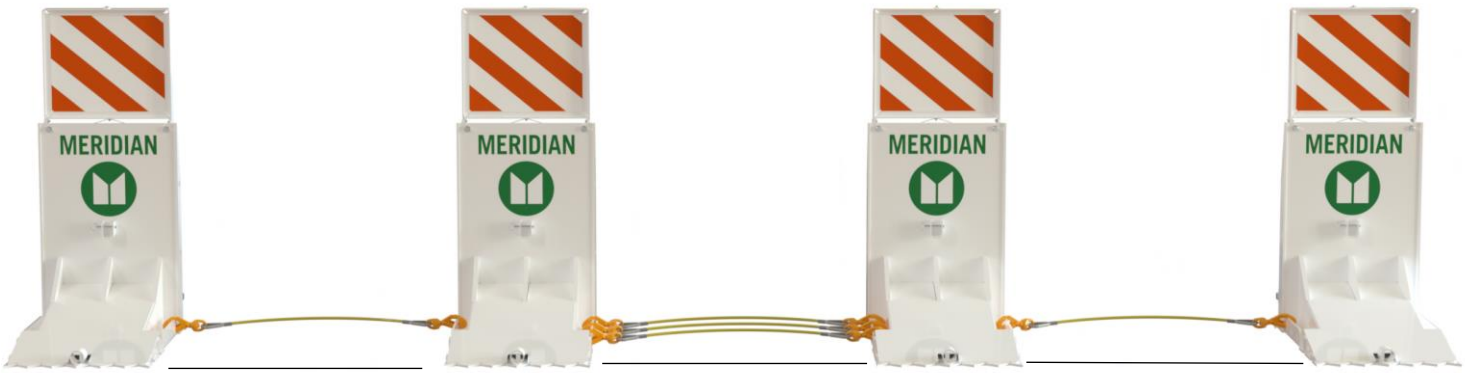
NCHRP: National Cooperative Highway Research Program

UN ECE: United Nations Economic Commission for Europe

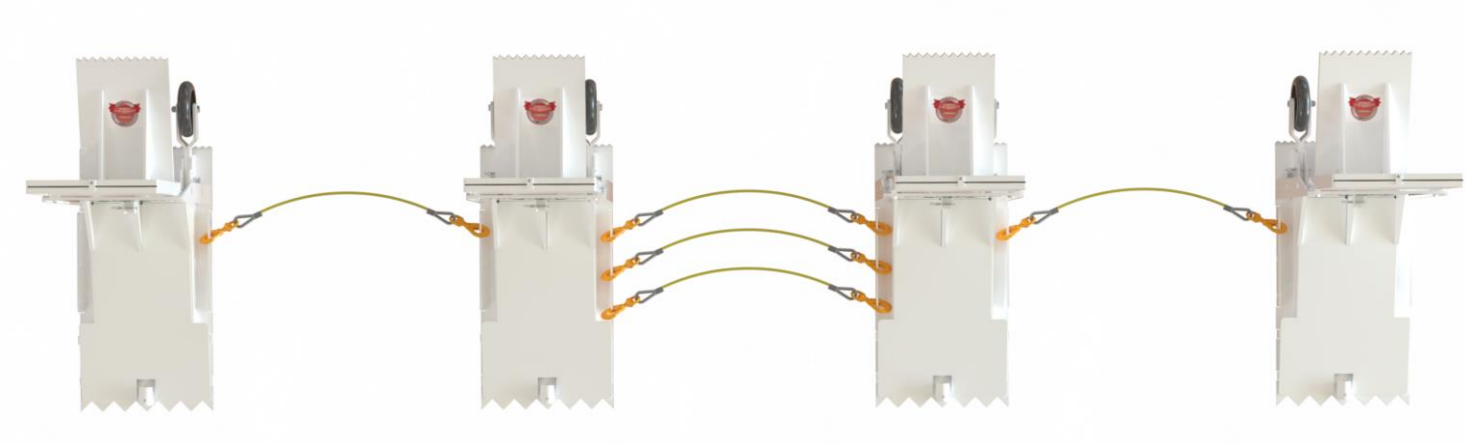
1. Certified Deployment Configuration:

Standard	Vehicle Type	Vehicle Weight	Impact Speed	Penetration Rating
ASTM F2656-20	Full Size Sedan (FS)	4,630 lbs. [2100 kg]	(31.0 mph) [49.9 kph]	P2 < 18 ft [5.4 m]

The following test was conducted at Calspan Corporation on 05-20-2022 Test Report BR0115



Front View



Aerial View

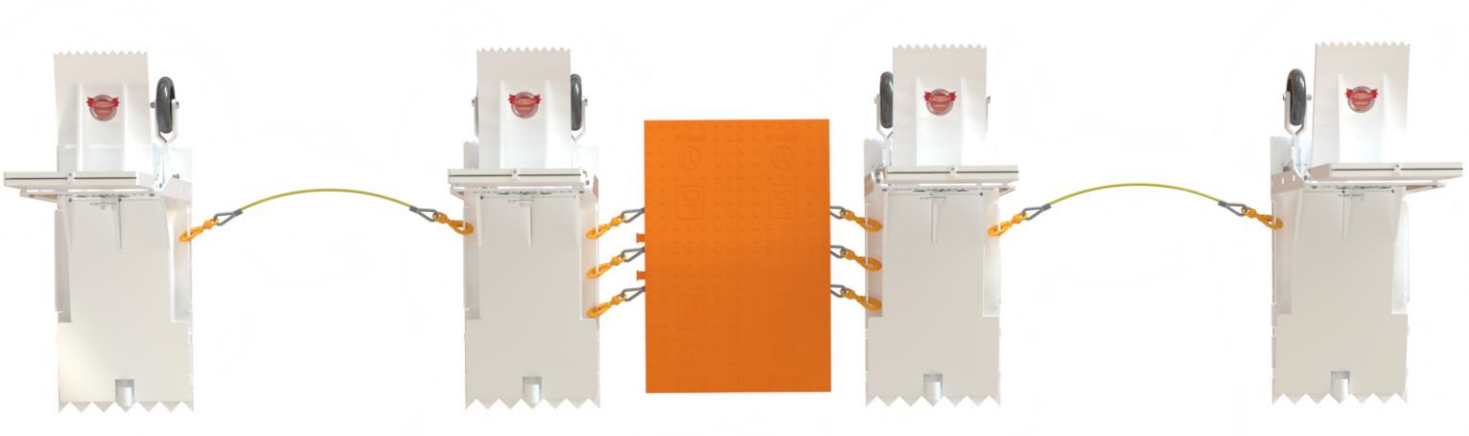
2. Certified Deployment Configuration: ASTM INTERNATIONAL

Standard	Vehicle Type	Vehicle Weight	Impact Speed	Penetration Rating
ASTM F2656-20	Full Size Sedan (FS)	4,630 lbs. [2100 kg]	(31.0 mph) [49.9 kph]	P2 < 18 ft [5.4 m]

The following test was conducted at Calspan Corporation on 05-20-2022 Test Report BR0115

4 ft. [1219 mm] 4 ft. [1219 mm] 4 ft. [1219 mm]

Front View



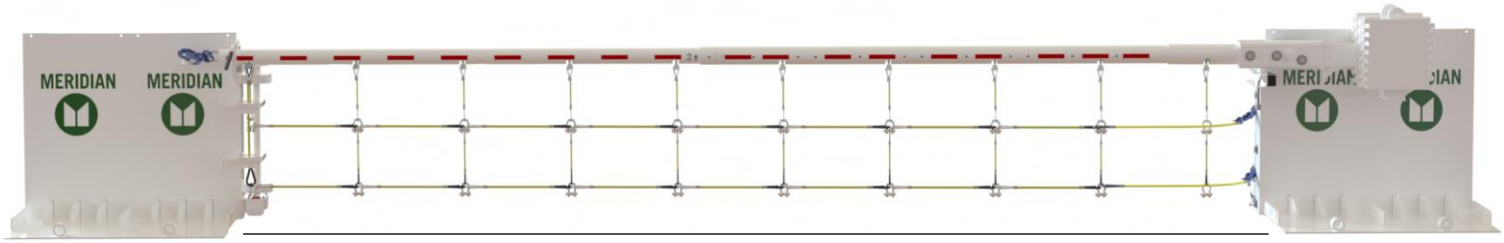
Aerial View

3. Certified Deployment Configuration:

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Pickup Truck (PU)	5032 lbs. [2282 kg]	(46.6mph) [74.9 kph]	P3 < 48 ft [14.6 m]

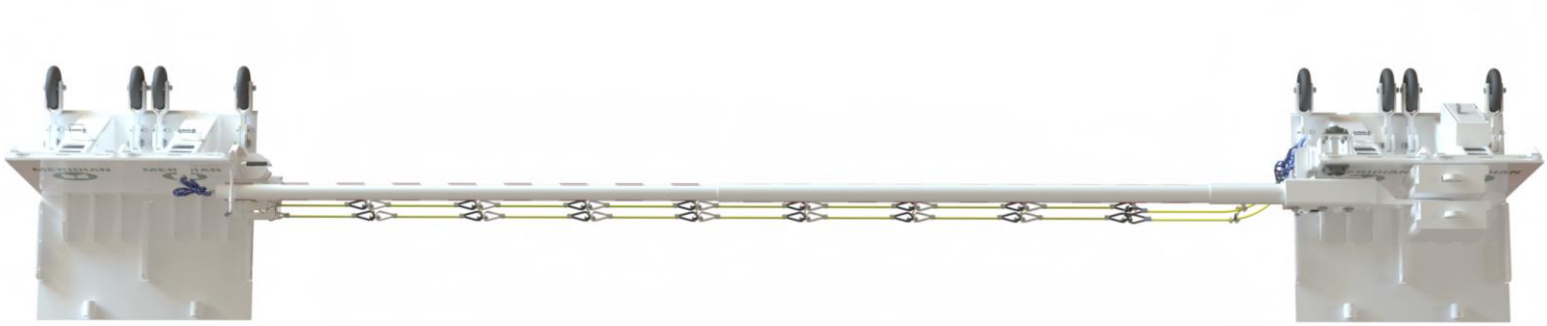
The following test was conducted at Applus IDIADA KARCO Engineering on 03-23-2023 Test Report TR-P43059-01-NC

Archer Beam Gate 2.0



20 ft. [6096 mm]

Front View

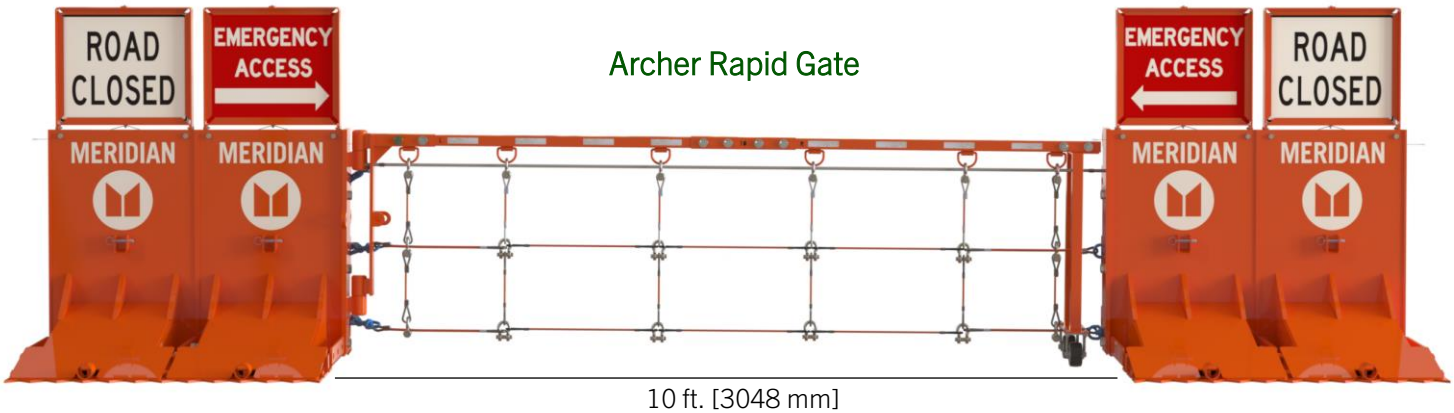


Aerial View

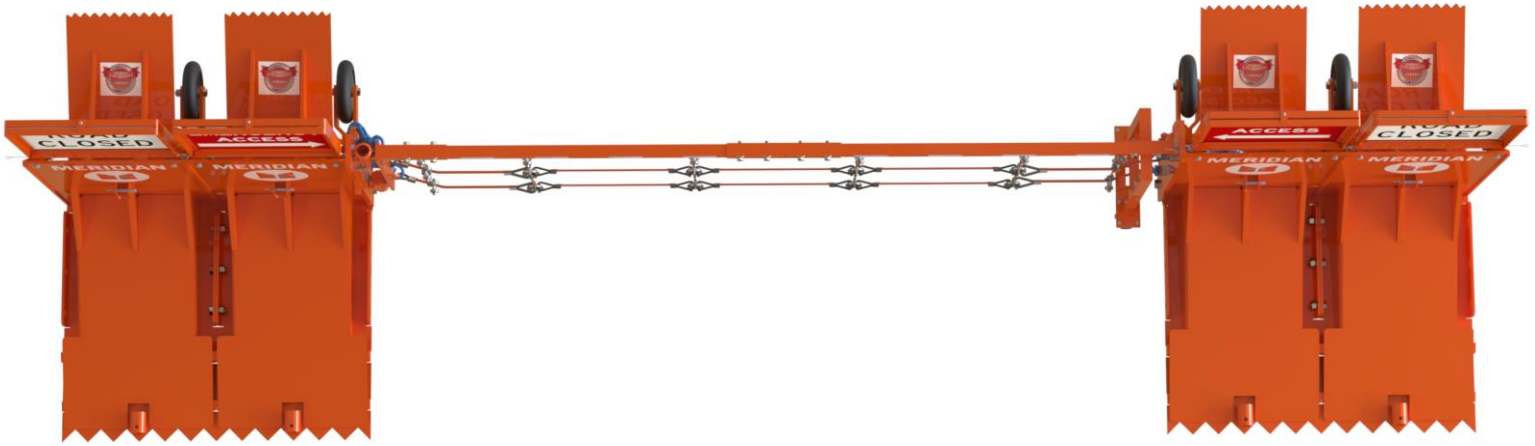
4. Certified Deployment Configuration: ASTM INTERNATIONAL

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Full Size Sedan (FS)	2480 lbs. [1125 kg]	44 mph [70.8 kph]	P2 < 18.0 ft [5.5m]

The following test was conducted at Calspan Corporation on 10-06-2021Test Report MRDG-SC402



Front View



Aerial View

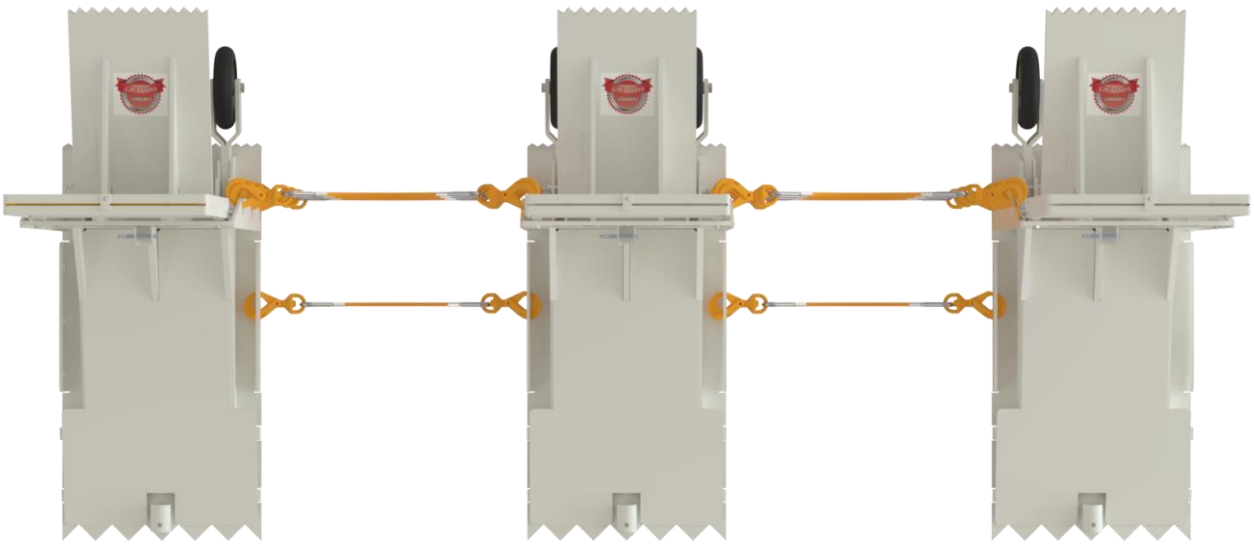
5. Certified Deployment Configuration:

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Pickup Truck	4995 lbs. [2265 kg]	(62 mph) [99.7 kph]	P3 < 88.2 ft [26.6 m]
MASH TL3- 41	Pickup Truck	4967 lbs. [2252 kg]	(61 mph) [98.2 kph]	Pass (114 ft) [34.7 m]

The following tests were conducted at Applus IDIADA KARCO Engineering

Archer-Guard

Front View



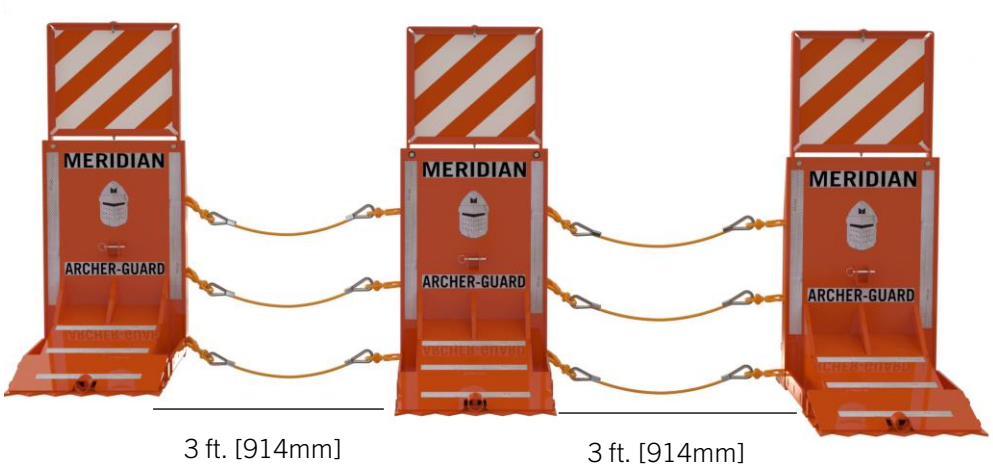
Aerial View

6. ASTM INTERNATIONAL

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Small Car (SC)	2389 lbs. [1084 kg]	(31.2 mph) [50.2 kph]	P3 < 38.2 ft [11.6 m]
ASTM F2656-20	Pickup Truck (PU)	4685 lbs. [2125 kg]	(42.6 mph) [68.6 kph]	P3 < 45.6 ft [13.9 m]
MASH TL1- 40	Small Car	2535 lbs.	(31 mph) [49.8 kph]	Pass (24.7 ft) [7.5 m]
MASH TL2- 40	Small Car	2420 lbs.	(43.6 mph) [70.16 kph]	Pass (38.2 ft) [11.6 m]
MASH TL2- 41	Pickup Truck	4996 lbs.	(42.6 mph) [68.6 kph]	Pass (45.2 ft) [13.8m]

The following tests were conducted at Calspan Corporation and Applus IDIADA KARCO Engineering

Archer-Guard



Front View

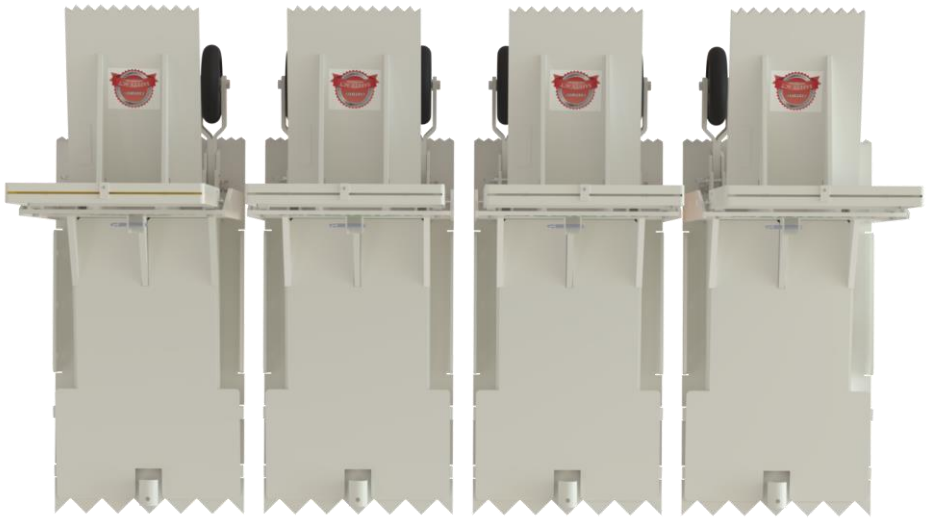
Aerial View

7. Certified Deployment Configuration: ASTM INTERNATIONAL

Standard	Vehicle Type	Vehicle Weight	Impact Speed	Penetration Rating
ASTM F2656-20	Full Size Sedan (FS)	3,762 lbs. [1706 kg]	(29.2 mph) [47.0 kph]	P2 < 7.7 ft [2.3 m]

The following test was conducted at Applus IDIADA KARCO Engineering on 03-27-2003 Test Report TR-P27085-01-NC

Front View



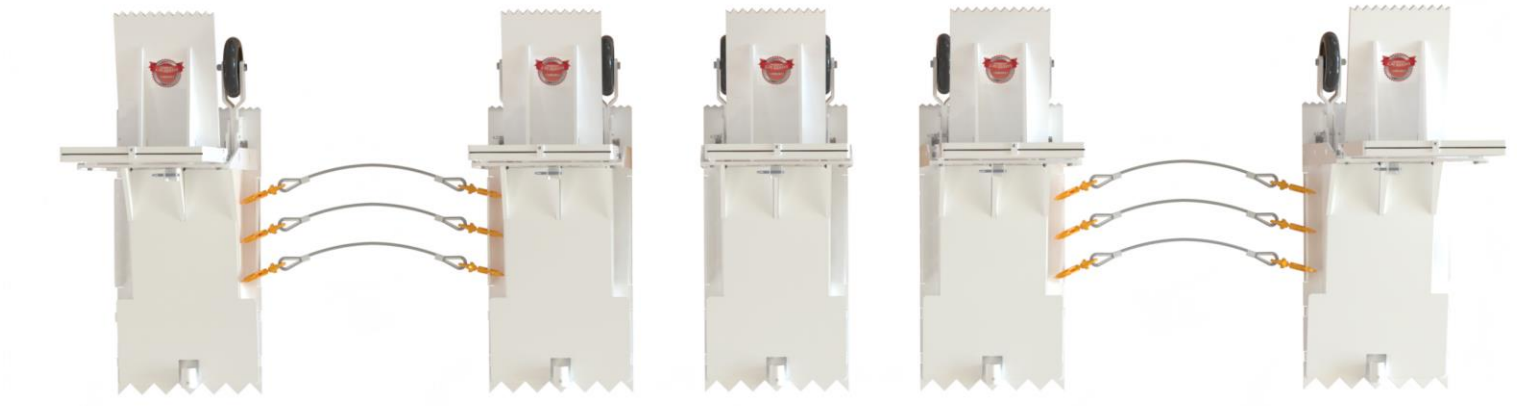
Aerial View

8. Combination of Certified ASTM Crash Test Configurations:

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Full Size Sedan (FS)	3413 lbs. [1548 kg]	(31.2 mph) [50.2 kph]	P2 < 13 ft [3.9 m]

The following test was conducted at Applus IDIADA KARCO Engineering on 03-27-2003 Test Report TR-P27085-01-NC

Front View



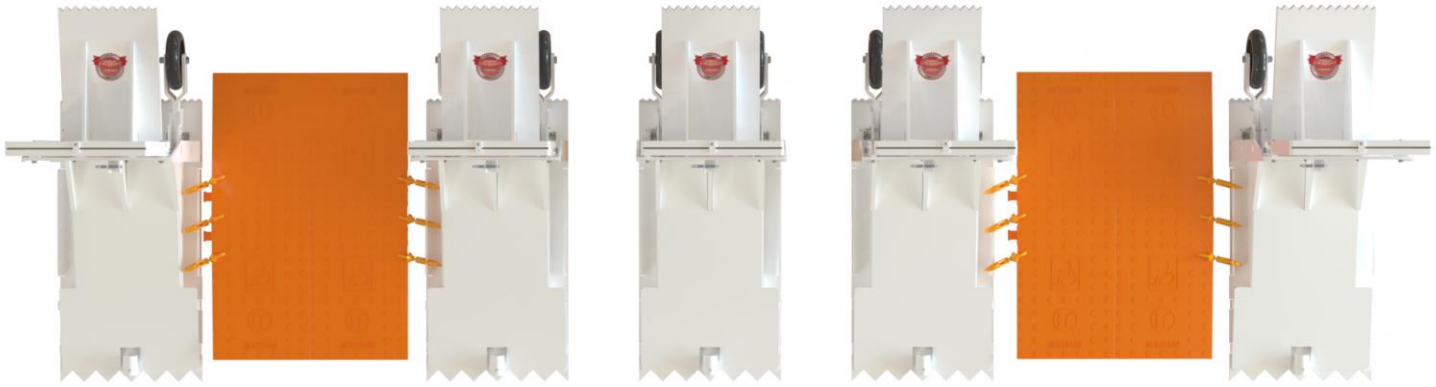
Aerial View

9. Combination of Certified ASTM Crash Test Configurations:

Standard	Vehicle Type	Vehicle Weight	Vehicle Speed	Penetration Distance
ASTM F2656-20	Full Size Sedan (FS)	3413 lbs. [1548 kg]	(31.2 mph) [50.2 kph]	P2 < 13 ft [3.9 m]

The following test was conducted at Applus IDIADA KARCO Engineering on 03-27-2003 Test Report TR-P27085-01-NC

Front View



Aerial View

10. Certified Deployment Configuration:

Standard	Result
PAS 68:2013	V/1,500[M1]/48/90:10.8/12.2

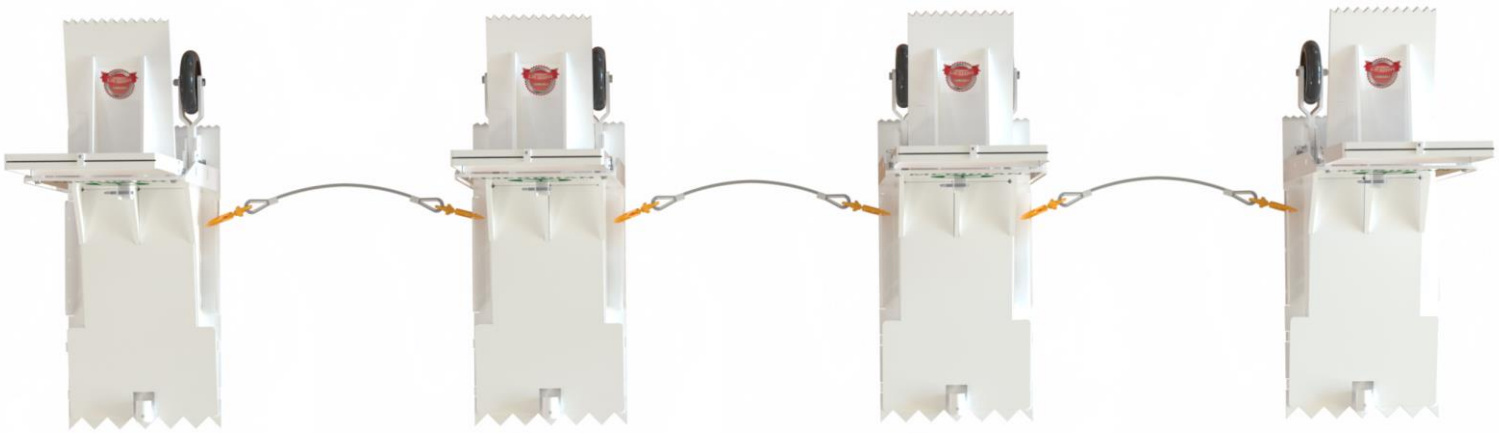
The following test was conducted at Tass International on 04-24-2017

Front View

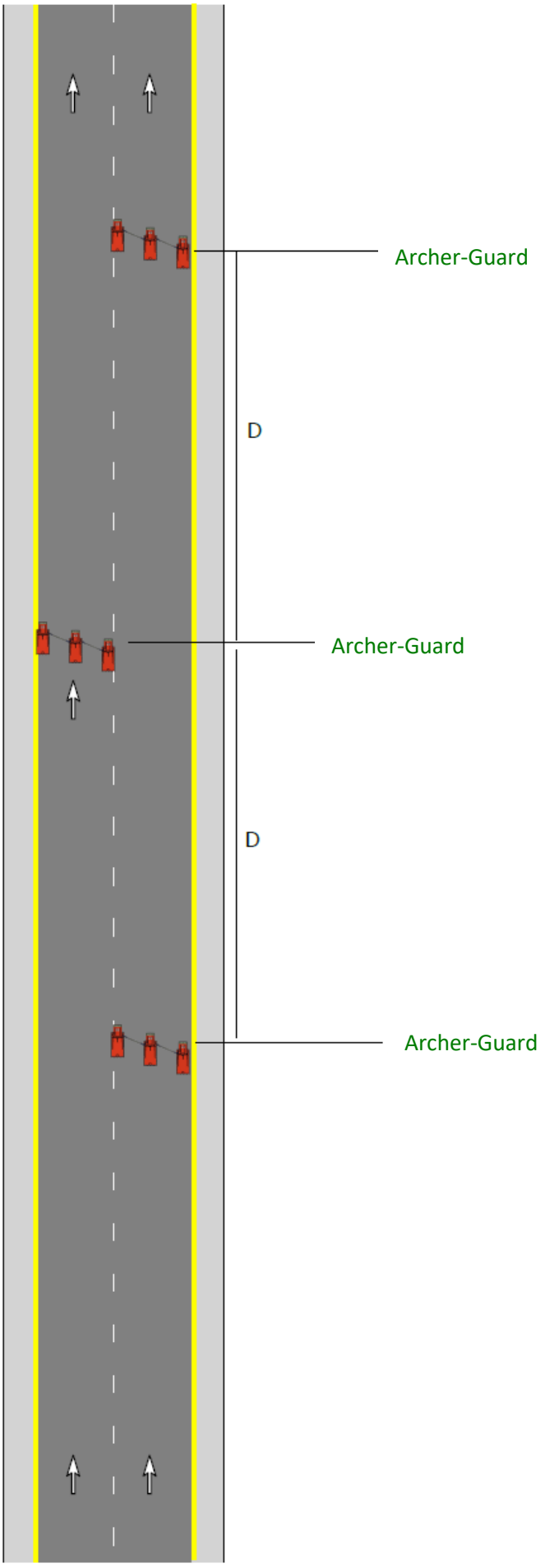
Aerial View

Engineered Rated Configuration -1	Penetration Distance- 15 ft [4.5 m]	Vehicle Speed- 31 mph [50km/h]	Vehicle Weight- 2341 lbs. [1062 kg]

Front View

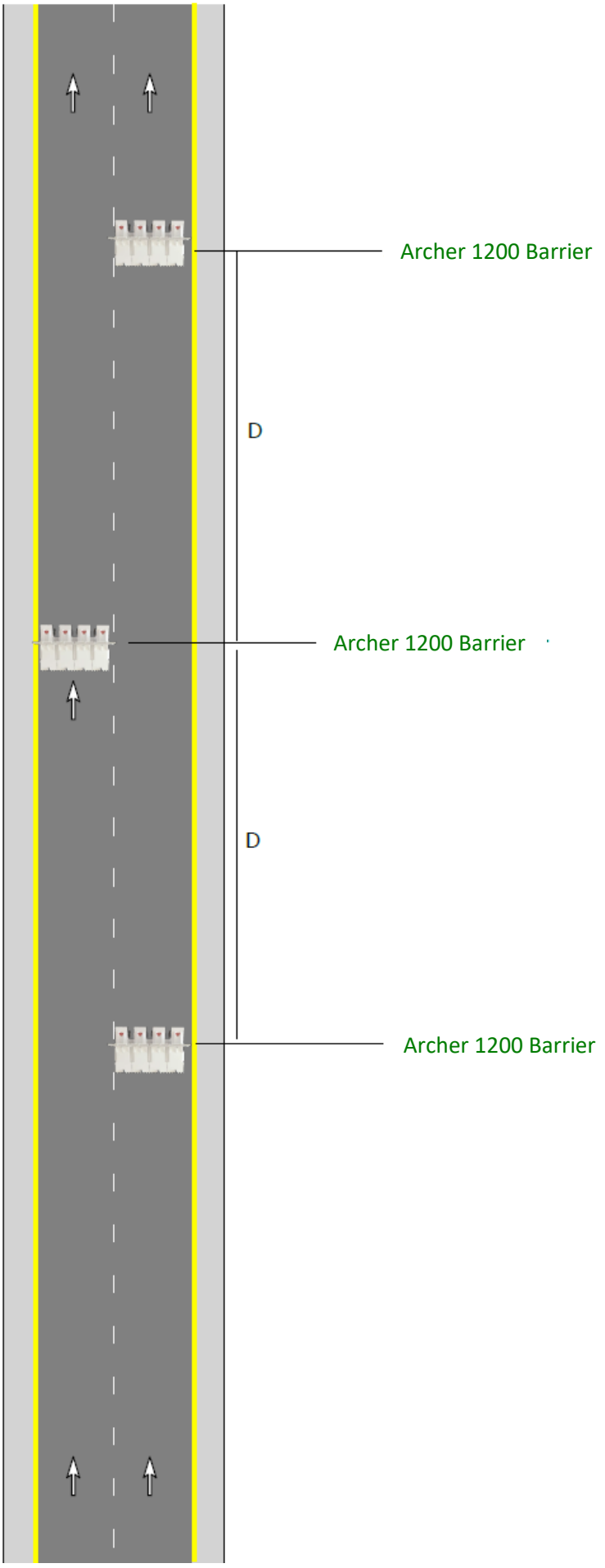


Aerial View



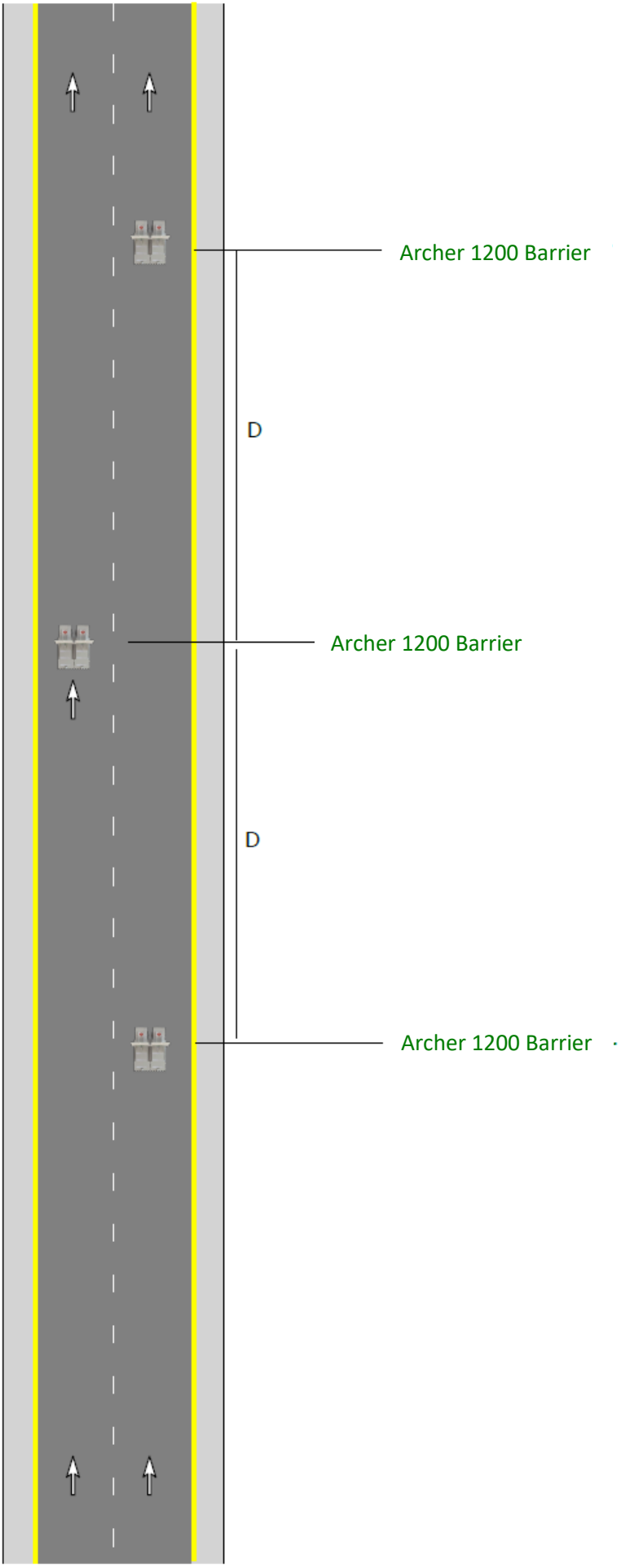
Purpose- Chicanes create a horizontal diversion of traffic and can be gentle or more restrictive depending on the design. Meridian has designed chicanes capable not only slowing vehicles down to a safe speed but also able to stop errant vehicles. The chicane is designed our certified crash test configurations certifications. The first chicane design uses four barriers spaced twelve inches apart spanning a total width of eleven feet. This design uses a certified ASTM design which can stop a vehicle within fourteen feet. It is recommended chicanes are used to control the speed of the vehicles as they approach a beam gate or other critical entry points to an event. The distance between each set of barriers is determined by the type of vehicles that require access. The recommended distances for vehicle access are listed in the table above. This setup is an easy stop and drop with no bolts required. If barriers allow the chicane can be extended as long as necessary, but to maximize the use of the barriers they should be placed within close proximity of an entry point to ensure the speed of the vehicle is approximately 30 mph when it exits the chicane.

Chicane Configuration with Archer-Guards	
Vehicle Access	Distance [D]
Standard vehicle	20 ft., 6.1 m
Box truck	30 ft., 9.14 m
Semi-trailer truck	40 ft., 12.2 m



Purpose- The second chicane design is recommended for roads that have a smaller width as the barrier setup occupies 8 feet. The design is a PAS 68 and IWA-14 certified deployment that can stop an errant vehicle in less than eight feet. The setup will require the barriers to be bolted together. On each barrier there are a total of six holes that can be used to bolt them together. The recommendation is to use at least four bolts between two barriers. The bolts do not require a specific torque rating but should be tighten properly with a wrench and never hand tightened. The distance between each set of bolted barriers is driven by the vehicle that will require access through the chicane.

Chicane Configuration with Archer 1200 Barriers	
Vehicle Access	Distance [D]
Standard vehicle	20 ft., 6.1 m
Box truck	30 ft., 9.14 m
Semi-trailer truck	40 ft., 12.2 m



The serpentine design is an efficient method to utilize the least amount barriers while still controlling the speed of vehicles as they approach an access point. Each section of two barriers is bolted together and the spacing from the first set of barriers to the opposite side of barriers is dependent on the vehicle that will require access. The barriers will need to be placed four feet from the sidewalk. The average vehicle has a width of 5 ft [1.5 m] so the 4 ft [1.2 m] gap between the sidewalk and the barrier would eliminate a vehicle using that space as an access point. Since the three are only two barriers it is recommended that at least 4 bolts are used between each set of barriers.

Serpentine Configuration with Archer 1200 Barriers	
Vehicle Access	Distance [D]
Standard vehicle	20 ft., 6.1 m
Box truck	30 ft., 9.14 m
Semi-trailer truck	40 ft., 12.2 m

TESTING STANDARDS

Standard	Region	Latest Version	Purpose
ISO IWA 14-1:2013	Global	2013	To provide a single international standard for impact testing and performance classification of VSBs. To achieve this, the vehicle categories assessed have UK, European and North American vehicle types present.
BSI PAS 68:2013	UK	2013	Defines a standard method for testing the impact performance and protection rating of a VSB when impacted by different categories of UK vehicles travelling at specified speeds.
ASTM F2656/F2656M – 20	USA	2020	Defines the method for impact testing and assigning performance ratings for a VSB when impacted by different categories of North American vehicles. Now includes a UK/European style vehicle type: C7
DoS SD-STD-02.01	USA	Rev. A, 2003 (Withdrawn)	Forerunner of ASTM F2656, includes only USA vehicles and defines 'K' classifications

ASTM International- ASTM F2656-15

Standard Test Method for Crash Testing of Vehicle Security Barriers

This test method provides a range of vehicle impact conditions, designations, and penetration performance levels. This will allow an agency to select passive perimeter barriers and active entry point barriers appropriate for use at facilities with a defined moving vehicle threat. Agencies may adopt and specify those condition designations and performance levels in this test method that satisfy their specific needs. Agencies may also assign certification ratings for active and passive perimeter barriers based on the tests and test methodologies described herein. Many test parameters are standardized to arrive at a common vehicle type and mass, enhance test realism and replication, and produce uniform rating designations.

Compliance with these test procedures establishes a measure of performance but does not render any vehicle perimeter barrier invulnerable to vehicle penetration. Caution should be exercised in interpreting test findings and in extrapolating results to other than test conditions. While computer simulations are powerful tools that are useful in the development of new and improved barriers or in estimating performance under differing conditions, use of only the results from computer simulation for fielding a product is strongly discouraged. When performing a test, developers and users are encouraged to address specific or unusual site conditions as needed. Often local terrain features, soil conditions, climate, or other items will dictate special needs at specific locations. Therefore, if site conditions are likely to degrade a barrier's performance, the agency in need of a vehicle perimeter barrier should require testing with the specific site conditions replicated for full-scale crash testing.

Product/design certification under this test method only addresses the ability of the barrier to withstand the impact of the test vehicle. It does not represent an endorsement of the product/design or address its operational suitability. The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

Test methods were initially published by the U.S. Department of Defense (DoD) in 1985; however, these methods have been gradually replaced with American Society for Testing and Materials International (ASTM) standards. Therefore, all crash tests will be tested under ASTM standards. The following table shows the DoD crash rating and the original ASTM crash rating which later was expanded to include other vehicles.

Standard	Rating	Vehicle Weight	Vehicle Speed	Penetration Rating
Department of Defense "K-Ratings"	K4	15,000 lbs. [6800 kg]	30 mph [48.3 kph]	L1= 20 – 50 ft [6.1 – 15.2 m] L2= 3 -20ft [1 – 6.1m] L3 = 3ft or less [1 m or less]
	K8	15,000 lbs. [6800 kg]	40 mph [64.4 kph]	L1= 20 – 50 ft [6.1 – 15.2 m] L2= 3 -20ft [1 – 6.1m] L3 = 3ft or less [1 m or less]
	K12	15,000 lbs. [6800 kg]	50 mph [80.5 kph]	L1= 20 – 50 ft [6.1 – 15.2 m] L2= 3 -20ft [1 – 6.1m] L3 = 3ft or less [1 m or less]
ASTM "M-Ratings"	M30	15,000 lbs. [6800 kg]	30 mph [48.3 kph]	P1 = 3ft or less [1 m or less] P2 = 3.31 – 23.0 ft [1.1 – 7 m] P3 = 23.1 to 98.4 ft [7.1 - 30 m]
	M40	15,000 lbs. [6800 kg]	40 mph [64.4 kph]	P1 = 3ft or less [1 m or less] P2 = 3.31 – 23.0 ft [1.1 – 7 m] P3 = 23.1 to 98.4 ft [7.1 - 30 m]
	M50	15,000 lbs [6800 kg]	50 mph [80.5 kph]	P1 = 3ft or less [1 m or less] P2 = 3.31 – 23.0 ft [1.1 – 7 m] P3 = 23.1 to 98.4 ft [7.1 - 30 m]

In addition, ASTM expanded the crash ratings to include the following vehicle weights and speed.

Table 1. ASTM 2656 Vehicle Type, Weight and Penetration Rating

Vehicle Type	Vehicle Weight	Rating/ Vehicle Speed	Penetration Rating
Small Passenger Car (SC)	2,430 lbs. (1102.2 kg)	SC30 (30 mph) (48.2 km/h) SC40 (40 mph) (64.4 km/h) SC50 (50 mph) (80.5 km/h) SC60 (60 mph) (96.5 km/h)	P1 = 3ft or less [1 meter or less] P2 = 3.31 – 23.0 ft [1.1 m – 7 m] P3 = 23.1 ft to 98.4 ft [7.1 m- 30 m]
Full Size Sedan (FS)	4,630 lbs. (2100.1 kg)	FS30 (30 mph) (48.2 km/h) FS40 (40 mph) (64.4 km/h) FS50 (50 mph) (80.5 km/h) FS60 (60 mph) (96.5 km/h)	P1 = 3ft or less [1 meter or less] P2 = 3.31 – 23.0 ft [1.1 m – 7 m] P3 = 23.1 ft to 98.4 ft [7.1 m- 30 m]
Pickup Truck (PU)	5,070 lbs. (2299.71 kg)	PU30 (30 mph) (48.2 km/h) PU40 (40 mph) (64.4 km/h) PU50 (50 mph) (80.5 km/h) PU60 (60 mph) (96.5 km/h)	P1 = 3ft or less [1 meter or less] P2 = 3.31 – 23.0 ft [1.1 m – 7 m] P3 = 23.1 ft to 98.4 ft [7.1 m- 30 m]
Heavy Goods Vehicle (H)	65,000 lbs. (29483 kg)	H30 (30 mph) (48.2 km/h) H40 (40 mph) (64.4 km/h) H50 (50 mph) (80.5 km/h) H60 (60 mph) (96.5 km/h)	P1 = 3ft or less [1 meter or less] P2 = 3.31 – 23.0 ft [1.1 m – 7 m] P3 = 23.1 ft to 98.4 ft [7.1 m- 30 m]

IWA-14-1:2013

International Workshop Agreement-Vehicle security barriers performance requirement, vehicle impact test method and performance rating

IWA-14 (International Workshop Agreement 14) is an internationally recognized and accepted crash (impact) test standard used globally for testing and evaluating vehicles security barriers including bollards, anti-ram barriers, access control barriers, road blockers and more. IWA 14-1:2013 specifies the essential impact performance requirement for a vehicle security barrier (VSB) and a test method for rating its performance when subjected to a single impact by a test vehicle not driven by a human being. The IWA 14-1 specification defines the vehicle type, test mass and impact speed together with the required measurements, vehicle and test item details that should be recorded and reported. Post impact, and if the test is successful - the VSB stopped and immobilized the test vehicle, then the penetration distance is measured. This reading is taken from the front of the vehicle cargo load bed to the position of the original rear face of the VSB. The dispersion distance of major debris is also measured as this may be a consideration at certain sites. These measurements can be used to determine which is the most suitable VSB for each individual site. It must be remembered that the impact testing uses repeatable test criteria and may not replicate the precise dynamics of real-life attacks or vehicle configurations. However, it does provide a common baseline to classify and compare VSB systems. Equipment that has been tested in accordance with the IWA 14-1 specification requires an appropriate installation which is tailored to the individual sites ground and environmental conditions. This ensures the adequate performance if challenged in a hostile vehicle attack.

Table 2. IWA-14 Test Vehicle Type, Designation, Weight, Penetration, and Impact Angle

Test Vehicle Type	Designation	Vehicle Weight	Impact Penetration	Impact Angle
Passenger Vehicle	M1	3,307 lbs. (1,500 kg)	Measured in meters	0-90
4X4 Pickup	N1G	5,512 lbs. (2,500 kg)	Measured in meters	0-90
Day Cab Truck	N1	7,716 lbs. (3,500 kg)	Measured in meters	0-90
Flatbed Day Cab Truck	N2A	15,873 lbs. (7,200 kg)	Measured in meters	0-90
Flatbed Day Cab Truck	N2B	15,873 lbs. (7,200 kg)	Measured in meters	0-90
Flatbed Day Cab Truck	N3C	15,873 lbs. (7,200 kg)	Measured in meters	0-90
Closed Day Cab Truck	N3D	26,455 lbs. (12,000 kg)	Measured in meters	0-90
Closed Day Cab Truck	N3E	52,910 lbs. (24,000 kg)	Measured in meters	0-90
Closed Day Cab Truck	N3F	66,139 lbs. (30,000 kg)	Measured in meters	0-90

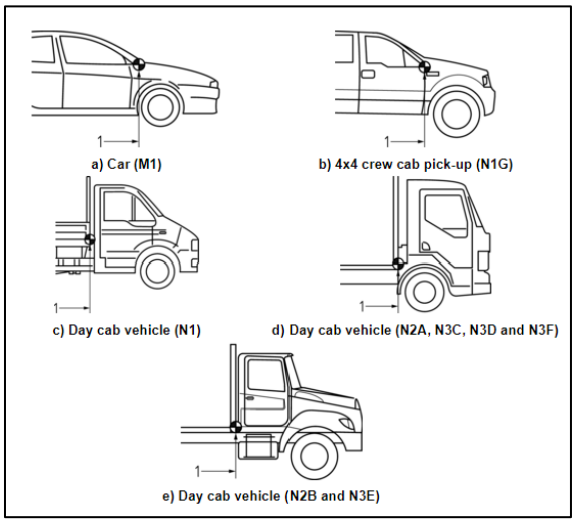


Figure 1. Vehicle datum point- Side View

Table 3. IWA-14 Rating Breakdown

V/7,200[N2A]/80/90:8.4 Rating Breakdown	
Digit	Description
V	Type of test (Vehicle)
7,200	Weight of vehicle used for impact test (in kg)
[N2A]	Vehicle Type
80	Test Speed (km/h) Impact test speeds can vary from 16 to 112 kph. However, the most common test speeds used are 30 kph (20 mph), 48 kph (30 mph), 64 kph (40 mph) and 80 kph (50 mph).
90	Test vehicle's angle of impact. This is generally 90^{0} however other test angles are also used especially when the proposed vehicle barrier system is to be installed in facilities with a shallow attack angle.
8.4	Test vehicle penetration depth in meters. This measures the distance travelled by the test vehicles load carrying bed from the front of the vehicle barrier (datum line – point of impact).

PAS-68

Publicly Available Specification for vehicle security barriers (British Standard)

PAS-68 (Publicly Available Specification) is recognized as one of the premier crash test specifications around the world, PAS 68 has played an integral role in shaping all the impact test standards that have followed. PAS-68 specifies the essential impact performance requirement for a vehicle security barrier (VSB) and a test method for rating its performance when subjected to a single impact by a test vehicle not driven by a human being. The PAS-68 specification defines the vehicle type, test mass and impact speed together with the required measurements, vehicle and test item details that should be recorded and reported. Post impact, and if the test is successful -the VSB stopped and immobilized the test vehicle, then the penetration distance is measured. This reading is taken from the front face of the product being tested and not the back. The dispersion distance of major debris is also measured as this may be a consideration at certain sites. These measurements can be used to determine which is the most suitable VSB for each individual site. It must be remembered that the impact testing uses repeatable test criteria and may not replicate the precise dynamics of real-life attacks or vehicle configurations. However, it does provide a common baseline to classify and compare VSB systems. Equipment that has been tested in accordance with the PAS-68 specification requires an appropriate installation which is tailored to the individual sites ground and environmental conditions. This ensures the adequate performance if challenged in a hostile vehicle attack.

Table 4. PAS-68 Test Vehicle Type, Designation, Weight, Penetration, and Impact Angle

Test Vehicle Type	Designation	Vehicle Weight	Impact Penetration	Impact Angle
Passenger Vehicle	M1	3,307 lbs. (1,500 kg)	Measured in meters	0-90
4X4 Pickup	N1G	5,512 lbs. (2,500 kg)	Measured in meters	0-90
Day Cab Truck	N1	7,716 lbs. (3,500 kg)	Measured in meters	0-90
Flatbed Day Cab Truck	N2	16,534 lbs. (7,500 kg)	Measured in meters	0-90
Flatbed Day Cab Truck	N3	16,534 lbs. (7,500 kg)	Measured in meters	0-90
Closed Day Cab Truck	N3	66,138 lbs. (30,000 kg)	Measured in meters	0-90

Table 5. PAS-68 Rating Breakdown

V/7,500[N2]/48/90:6.8/0 Rating Breakdown	
Digit	Description
V	Type of test (Vehicle)
7,500	Weight of vehicle used for impact test (in kg)
[N2]	Vehicle Type
48	Test Speed (km/h). Impact test speeds can vary from 16 to 112 kph. However, the most common test speeds used are 30 kph (20 mph), 48 kph (30 mph), 64 kph (40 mph) and 80 kph (50 mph).
90	Test vehicle's angle of impact. This is generally 90^0 however other test angles are also used.
6.8	Test vehicle penetration depth in meters. This measures the distance travelled by the test vehicles load carrying bed from the front of the vehicle barrier (datum line – point of impact).
0	This measurement indicates the furthest point that debris weighing over 25 kg traveled during test.

MASH

Manual for Assessing Safety Hardware (MASH) Crash Testing of roadside safety features

The primary parameters that define a full-scale crash test include impact speed, impact angle, test vehicle mass, and impact location. Each of these parameters is selected to represent a "worst practical condition" for a roadside feature crash. For impact speed and angle, the "worst practical condition" has been traditionally set at the 85th percentile level. Test vehicles are normally selected based upon vehicle body style and weight. Weights have generally been selected to approximate the 2nd and 90th percentile levels for passenger vehicles. Impact locations on a safety feature are often selected to represent a critical impact point (CIP) that creates the greatest probability of test failure. Hence, the combination of 85th percentile impact speed, 85th percentile impact angle, 5th and 95th percentile vehicle weights, and critical impact point is believed to represent a worst practical condition. Depending on its intended function, the feature may satisfy structural adequacy by redirecting the vehicle, by stopping the vehicle in a controlled manner, or by permitting the vehicle to break through the device. In order for a test article to be considered MASH approved, not only does it have to stop the vehicle within a specific distance after impact, but it also cannot penetrate into the occupant compartment.

A clear distinction should be made between: (a) penetration, in which a component of the test article penetrates into the occupant compartment; and (b) intrusion or deformation, in which the occupant compartment is deformed and reduced in size, but no actual penetration is observed. No penetration by any element of the test article into the occupant compartment is allowed. As for deformation or intrusion, the extent of deformation varies by area of the vehicle damaged and should be limited as follows:

- Roof ≤ 4.0 in. (102 mm).
- Windshield—no tear of plastic liner and maximum deformation of 3 in. (76 mm).
- Window—no shattering of a side window resulting from direct contact with a structural member of the test article, except for special considerations pertaining to tall, continuous barrier elements discussed below (Note: evaluation of this criteria requires the side windows to be in the up position for testing).
- A- and B-pillars—no complete severing of support member and maximum resultant deformation of 5 in. (127 mm). Lateral deformation should be limited to 3 in. (76 mm).
- Wheel/foot well and toe pan areas ≤ 9 in. (229 mm).
- Side front panel (forward of A-pillar) ≤ 12 in. (305 mm).
- Front side door area (above seat) ≤ 9 in. (229 mm).
- Front side door area (below seat) ≤ 12 in. (305 mm).
- Floor pan and transmission tunnel areas ≤ 12 in. (305 mm).

Table 6. Vehicle Test Inertial Mass Upper and Lower Limits

Test Vehicle Type	Target Vehicle Weight	Impact Penetration	Impact Angle
1100C (Passenger Car)	2,420 lbs. (1,100 kg)	Measured in feet	0-90
1500A (Passenger Car)	3,300 lbs. (1,500 kg)	Measured in feet	0-90
2270P (Pickup Truck)	5,000 lbs. (2,270 kg)	Measured in feet	0-90
10000S (Single-Unit Truck)	22,000 lbs. (10,000 kg)	Measured in feet	0-90
36000V (Tractor-Vani Trailer)	79,300 lbs. (36,000 kg)	Measured in feet	0-90
36000T (Tractor-Tank Trailer)	79,300 lbs. (36,000 kg)	Measured in feet	0-90

Table 7. Safety Evaluation Guideline for Structural Adequacy

Evaluation Factors	Evaluation Criteria	Applicable Tests
	A. Test article should contain and redirect the vehicle or bring the vehicle to a controlled stop; the vehicle should not penetrate, underride, or override the	10,11,12,20,21,22, 30,31,2,33,32,35,3 6,3338,

Structural Adequacy	installation although controlled lateral deflection of the test article is acceptable.	
	B. The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding	60,61,62,70,71,72, 80,80,81,82
	C. Acceptable test article performance may be by redirection-controlled penetration, or controlled stopping of the vehicle.	30,31,32,33,34,37, 38,40,41,42,43, 44,50,51,52,53,90, 91
Occupant Risk	D. Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone.	All
	E. Detached elements, fragments or other debris from the test article, or vehicular damage should not block the driver vision or other cause the driver to lose control of the vehicle.	70,71,71
	F. The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees	All
	G. It is preferable, although not essential, that the vehicle remain upright during and after the collision.	12,22

Table 8. Typical Test Matrix

Test Level	Test No	Vehicle	Impact Speed, mph (km/h)	Impact Angle, b θ, deg.	Impact Tolerances		Impact Point	Evaluation Criteria
					Measured	Acc. Range, kip-ft (kJ)		
1	1-70 1-71 1-72	1100C 1100C 2270P	19 (30.0) 31 (50.0) 31 (50.0)	0-25 0-25 0-25	KE KE KE	≥34 (41) ≥72 (97) ≥148 (202)	(c) (c) (c)	B,D,E,F,H,I, N B,D,E,F,H,I, N B,D,E,F,H,I, N
2	2-70 2-71 2-72	1100C 1100C 2270P	19 (30.0) 44 (70.0) 44 (70.0)	0-25 0-25 0-25	KE KE KE	≥34 (41) ≥141 (191) ≥291 (395)	(c) (c) (c)	B,D,E,F,H,I, N B,D,E,F,H,I, N B,D,E,F,H,I, N

SAFETY ACT CERTIFACATION

Support Anti-Terrorism by Fostering Effective Technologies Act

The SAFETY Act provides important legal liability protections for providers of Qualified Anti-Terrorism Technologies - whether they are products or services. The goal of the SAFETY Act is to encourage the development and deployment of effective anti-terrorism products and services by providing liability protections. A private sector entity must apply for protections for the Department of Homeland Security to determine if their offering is a Qualified Anti-Terrorism Technology. As part of the Homeland Security Act of 2002, Public Law 107-296, Congress enacted the Support Anti-Terrorism by Fostering Effective Technologies Act (SAFETY Act) of 2002. The SAFETY Act provides incentives for the development and deployment of anti-terrorism technologies by creating systems of risk and litigation management. The purpose of the Safety Act Department is to ensure that the threat of liability does not deter potential manufacturers or sellers of effective anti-terrorism technologies from developing and commercializing technologies that could save lives. Meridian has achieved the highest level of certification designated by the Safety Act Department. The Red Seal means Meridian is deemed 'Certified' as a Safety Act product and is provides liability coverage for Meridian products.

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