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Review on vehicle barrier protection guidance

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Title Review on vehicle barrier protection guidance

Abstract

A search and review of publicly available documents with guidance on the security of designated spaces against vehicle-ramming attacks has been conducted. The current report provides a list of these sources, which focus on the protection of public spaces, such as pedestrian areas, tourist sites, city squares or other perimeter protected areas. The list aims at bringing to the interested security stakeholders information on measures to prevent potential attacks and/or mitigate their consequences by properly designed and tested barrier systems.

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Executive summary

The current document provides a list of available information sources focusing on the design, testing and installation procedures of vehicle barriers used to protect special security designated areas and the so-called soft targets against terrorist and other types of malicious extremist attacks by the use of vehicles. Soft targets represent vulnerable material or human assets, which in principle should not be specifically protected. However, such assets are often the target of terrorist groups in their effort to maximize casualties, inflict fear to the population and attain media coverage. Of particular interest are public spaces, such as pedestrian areas, fairs, tourist sites, outdoor markets and city squares, as was noticed during the recent attacks in Nice, Barcelona, London, Berlin and Stockholm. The list aims at bringing to the interested security stakeholder existing documents with information and practical guidance on the available methods for testing, selecting and installing vehicle security barriers that can prevent a potential attack and to mitigate the consequences, should such an attack materializes. Special attention is also given on introducing "security by design" concepts in public space design and promoting aesthetically pleasing barrier solutions in order to reach a balance between the open nature of public spaces and their security measures.

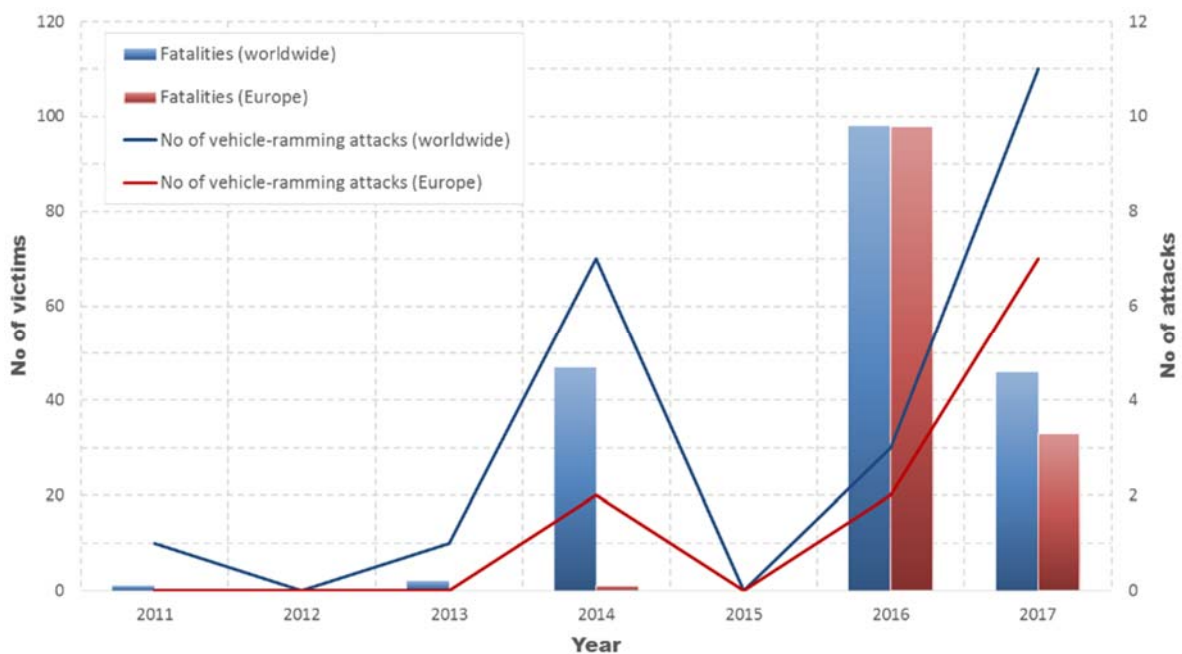
The collected documents mainly address the testing, selection and installation of vehicle barriers for security and not for safety purposes. The documents are grouped according to the following broad domains relating to their contents: testing, selection, design, aesthetics/security by design, application/installation, product availability and cost. Clearly, many of the presented documents fit into more than one domain, but the categorisation is based on the main piece of information that is provided.

The referenced information sources originate from various technical or standardization bodies and countries, such as UK, France, USA, Australia etc. The list is quite comprehensive but it is limited to the publicly available documents and practically to those found in English and French.

1 Introduction

The worldwide rise of terrorism has been accompanied by a series of vehicle-ramming attacks against targets that were characterized by limited protection measures. A tendency has appeared for assaults at unprotected places of people congregation, irrespective of the gathering purpose (recreational, political, religious, commercial etc.). The numerous recent terrorist attacks (Nice 2016, Berlin 2016, Barcelona and London 2017 etc.), has led into the realization that public spaces (pedestrian precincts, open-air festivals, fairs, outdoor markets, city squares etc.) are becoming potential targets of vehicle-ramming attacks performed by terrorist groups or extremists and often carried out by a single individual. Fig.1 shows the number of victims from vehicle-ramming attacks that were performed worldwide and in Europe in the last six years (numbers from [Jane's], internal calculations). From the numbers in this figure it can be concluded that there exists a recurrent targeting of crowded places with the use of vehicles and that over the last years this has resulted in a steady increase in the death toll.

Figure 1. Number of victims in vehicle-ramming attacks in the last six years in Europe and worldwide.



It is a common belief among the public, the security officials and the administrators that more effective protection measures are necessary. This is a considerably difficult task as the public spaces vary widely and their characteristics range from fully open spaces with no protection to areas where basic or more elaborate protection has been introduced. Standardised solutions may not exist or may not be adequate due to the ever changing nature of the hazard, and for this reason any available information on protection guidance or best practice techniques is urgently needed. The European Commission has recently presented an Action Plan that aims at supporting Member States in protecting and reducing the vulnerability of public spaces [COM(2017)612]. As advocated in this communication, technical solutions should be sought that can help to make public spaces more secure while preserving their open and public nature. Further, it is pointed out that "security by design" should become an essential principle from a very early stage in their development.

An effort has been made in the current document to provide a list of the available information sources focusing on the testing, design and installation of vehicle mitigation measures against terrorist and other types of malicious extremist attacks. These documents aim at offering to the interested security stakeholder insight into how physical security measures can be utilized for mitigating the consequences of such types of attacks.

The term “vehicle-ramming” is typically adopted to indicate the use of vehicles (cars, vans, trucks etc.) used as a weapon against human targets by terrorists and other type of extremists in their effort to maximize casualties, gain global attention and inflict fear to the population. The methodology of the attackers during the last years has shifted by placing the citizen as the main target instead of other critical infrastructures for which attacks require better preparation, larger funds and have lower chances of success. The increase in vehicle-ramming attacks is also attributed to the easy planning, the direct accessibility to a wide variety of vehicles and the minimal expertise required. In response to this threat, besides the intelligence and prevention measures for averting such attacks, considerable attention has been directed by many countries to methods and techniques for enhancing the physical security measures of public spaces. This has resulted in a considerable number of guidance and best practice documents, which, by not being in the form of official standards, may not always be known to all security officers, premise owners, building designers, technical experts or other interested professionals.

For the purposes of this document vehicle barriers are devices or other structural obstacles that allow the controlled access of vehicles to an area that is designated as protected. These barriers should be specifically designed and capable of stopping an ill-intentioned vehicle that attempts to breach the barrier. They are placed across roadways and passages and can be active or passive, permanent or temporary, and come under various technical and commercial names as bollards, wedge barriers, beam barriers, concrete Jersey barriers etc., and they can even take the form of concrete sitting benches, flower planters etc.

The material that is collected and presented in the current report focuses on vehicle barriers that are mainly utilized for security and not safety purposes. The distinction between safety and security barriers is a challenging task, as they both share many common characteristics and they can satisfy different protection needs. Safety barriers are utilized for preventing and/or mitigating the results of an accident (errant vehicle) that can result in life loss, injuries or environmental destruction. On the other hand, vehicle security barriers are adopted for creating a physical obstacle against unauthorised entry and other form of relevant attacks, aiming at protecting human life and damage of property.

The list of documents included in the present report can serve as a tool for establishing techniques that could be adopted for enhancing the security of crowded spaces. The referenced information sources originate from a wide variety of technical or standardization bodies and countries (UK, France, USA, Australia etc.). The documents are in their majority recent and, according to their contexts, are presented under the following non-strictly separable categories: testing, selection, design, aesthetics/security by design, application/installation, product availability and cost. As will be noticed, in the European Union the listed guidelines originate mostly from the UK and France, while similar documents were not found publicly available in the other Member States.





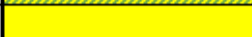









The documents are of public domain and most of them are freely downloadable from the indicated web sites.

Towards enriching this list, the authors would be grateful to receive any additional information regarding missing or newly-produced documents on the subject.

2 Availability of information sources





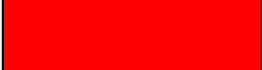
The following tables contain the guidance documents available from the various information sources regarding physical protection measures against vehicle-ramming attacks. A short description and keywords of each document are included. The identified sources originate from several countries and the documents found, at the first phase of this search, are predominantly written in the English, French, or German languages. As a result, in the EU relevant guidance has been found in reports, the majority of which has been produced in the UK. As mentioned above, it would be highly appreciated if informed readers point out to the authors the existence of similar documents in other languages.

The first table below graphically summarises the current state of guidance availability and completeness of coverage per security

Documentation availability on security barriers*		
	Guidance	
	EU member states	International**
Testing		
Selection		
Design		
Aesthetics/Security by design		
Application/Installation		
Cost		
Products list		

*Publicly available in EU working languages

** USA, Australia

Good coverage/availability	
Full availability in the UK, partial availability in the rest EU member states	
Partial coverage/availability	
Partial availability in the UK, no availability in the rest EU member states	
No coverage/availability	

3 Security Barrier Information Sources

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Testing (1/2)	International Organization for Standardization	International Workshop Agreement	ISO/ IWA 14-1	Vehicle Security Barriers- Part 1: Requirement, vehicle impact test method and performance rating	2013	test methodology, parameter definition, test site preparation, test vehicle preparation, impact speed, vehicle category, test report, measurements	https://www.iso.org/obp/ui/#iso:std:iso:iwa:14:-1:ed-1:v2:en
	European Committee for Standardization (EU)	CEN Workshop Agreement	CWA 16221	Vehicle security barriers- Performance requirements, test methods and guidance on application	2010	performance requirements, test conditions, classification, test methods, item preparation, data, design criteria, foundation, site assessment, <u>site design, barrier types</u>	https://shop.bsigroup.com/ProductDetail/?pid=000000000030237303
		Standard	EN1317-1*	Road Restraint Systems- Part 1: Terminology and general criteria for test methods	2010	test site, instrumentation, vehicles, data processing, results, deformation, loading conditions	http://www.extrudakerb.com/pdf/BS%20EN%201317-1%202010.pdf
				Road Restraint Systems- Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers and vehicle parapets	2010	safety barrier, vehicle behaviour, vehicle deformation, barrier deformation, test methods, test site, impact point, impact speed, approaching angle	https://infostore.saiglobal.com/previous/is/en/2010/i.s.en1317-2-2010.pdf?sku=1420452
				Road Restraint Systems- Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions	2010	crash cushion types, impact severity, vehicle behaviour, crash cushion behaviour, test methods, test site, impact point, impact speed, approaching angle	http://www.extrudakerb.com/pdf/BS%20EN%201317-3%202010.pdf
				Road Restraint Systems- Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers	2001	treatment of safety barrier, test criteria, severity class, lateral displacement, vehicle behaviour, transition, impact requirements, impact points, loading conditions	http://www.trafficlab.eu/bandi/doc_download/76-norma-en1317-4.html

*regarding mainly on safety barriers

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Testing (2/2)	British Standards Institution (UK)	Publicly Available Specification	PAS:68	Impact test specifications for vehicle security systems	2013	test methods, vehicle classification, impact assessment, test vehicle, data collection, test preparation, barrier classification	https://shop.bsigroup.com/ProductDetail/?pid=000000000030273707
	American Society for Testing and Materials (USA)	Standard	ASTM F 2656-15	Standard Test Method for Vehicle Crash Testing of Perimeter Barriers	2015	impact speed, vehicle type, test site, design basis, vehicle weight, performance, penetration limits, preparation	http://www.astm.org/cgi-bin/resolver.cgi?F2656F2656M-15
Selection	Whole Building Design Guide- G. Oakes (USA)		-	Bollard: Crash- and Attack- resistance Models	2016	barrier types, running costs, impact resistance, selection procedure	https://www.wbdg.org/resources/bollard-crash-and-attack-resistant-models
	Department of Homeland Security- FEMA (USA)	Guide	FEMA 386-7	Integrating Manmade Hazards into Mitigation Planning	2003	mitigation planning, community support, risk assessment, mitigation priorities, mitigation action, implementation	https://www.fema.gov/media-library-data/20130726-1524-20490-3869/howto7.pdf
	Department of Homeland Security (USA)	Guide	-	Guide to Active Vehicle Barrier (AVB) Specification and Selection Resources	2014	site planning, threat assessment, selection criteria, specifications, recommended practices, planning, operational considerations	https://www.dhs.gov/sites/default/files/publications/Guide-to-Active-Vehicle-Barrier-2014-508.pdf
	Direction générale de l'aviation civile (France)	Informative note	-	État de l'art des systèmes de protection périmétrique des aéroдрomes	2012	fence types, vegetation, gate design, gate types, barrier types, detection technology systems	http://www.stac.aviation-civile.gouv.fr/publications/documents/prot ec_perimetrique.pdf
	American Public Transportation Association (USA)	Informative note	APTA SS-SIS-RP-009-12	Anti-Vehicle Barriers for Public Transit	2012	barrier overview, risk assessment, barrier design, selection procedure, training, maintenance, cost, liability, selection checklist	http://www.apta.com/resources/standards/Documents/APTA-SS-SIS-RP-009-12.pdf
	VdS (Germany)	Manual	VdS 3143	Perimeter security manual	2012	risk, protective measures, risk analysis, site design, physical protection measures, landscape design, fences, walls, barriers, detection system, alarm, personnel	https://vds.de/fileadmin/vds_publicationen/vds_3143en_web.pdf

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Design (1/2)	The National Capital Urban Design and Security Plan (USA)	Guide	-	Designing and Testing of Perimeter Security Elements	2007	element design, contextual design, foundations, barrier types, layout, vehicle approach, testing principles	https://www.ncpc.gov/docs/Designing_and_Testing_of_Perimeter_Security_Elements.pdf
	Department of Defence (USA)	Handbook	MIL-HDBK-1013/1	Design Guidelines for Physical Security of Facilities	1987	planning, aggressor characteristics, penetration performance, detection, threat assessment, fences, barriers, gates, access control, forced entry, ballistic attack, standoff distance, protection level, vehicle impact energy	http://www.countermeasures.com/physical_security_docs/Mil-HDBK-1013.pdf
			FEMA-426/BIPS-06	Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings	2011	vulnerability, risk, site design strategy, barrier examples, building design, glazing, security system design, CCTV	https://www.dhs.gov/xlibrary/assets/st/st-bips-06.pdf
		Manual	FEMA-427	Design of Commercial Buildings to Mitigate Terrorist Attacks	2003	threat characterization, damage prediction, design approach, design guidance, perimeter security measures, protective barriers, occupancy, cost	https://www.fema.gov/media-library-data/20130726-1455-20490-6114/fema427.pdf
			FEMA-428/BIPS-07	Primer to Design Safe School Projects in Case of Terrorist Attacks and School Shootings	2012	risk assessment, site design, perimeter protection, layers of defence, access control, blast protection, risk to CBR agents	https://www.dhs.gov/xlibrary/assets/st/bips07_428_schools.pdf
		Guidance	FM 3-19.30	Physical Security	2001	design strategies, protective measures, site design, perimeter barriers, speed control, detection, protective barriers, gates, fences, security entrances	https://www.wbdg.org/FFC/ARMYCOE/FIELDMAN/fm31930.pdf
			ATTP 3-39.32	Physical Security	2010	security planning, plan development, site design, barrier types, security perimeter, access control, electronic security, resource management	https://fas.org/irp/doddir/army/attp3-39-32.pdf

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Design (2/2)	Department of Veteran Affairs (USA)	Manual	-	Physical Security Design Manual (for VA mission critical facilities)	2015	site design, perimeter barriers, control access, building envelope, column protection, anti-ram resistance, utilities, security systems	https://www.wbdg.org/FCC/VA/VAPHYS/dmp_hysecmc_2015.pdf
	U.S. General Services Administration (USA)	Guide	-	The Site Security Design Guide	2007	risk reduction strategy, site design, perimeter elements, site access	https://www.wbdg.org/FCC/GSA/site_security_dg.pdf
	Australia-New Zealand National Counter-Terrorism Committee (Australia)	Guide	-	Hostile Vehicle Guidelines for Crowded Places	2017	mitigation techniques, safety by design, barrier types, pedestrian area design, safety factors, impact angle	https://www.nationalsecurity.gov.au/Media-and-publications/Publications/Documents/hostile-vehicle-guidelines-crowded-places.pdf
	Department of Homeland Security (USA)	Guide	-	Dams Sector-Active and Passive Vehicle Barriers Guide	2010	security plan, access control, barrier types, operation, selection procedure, certification rating	https://www.dhs.gov/sites/default/files/publications/dams-vehicle-barriers-guide-508.pdf
		Buildings and Infrastructure Protection Series	-	Primer to design Safe School projects in Case of Terrorist Attacks and School Shooting	2012	risk assessment, design recommendations, attack methods, access control, protection levels	https://www.dhs.gov/xlibrary/assets/st/bips07_428_schools.pdf
	Aesthetics /security by design (1/2)	National Cooperative Highway Research Program (USA)	Report	NCHRP 554	Aesthetic Concrete Barrier Design	2006	aesthetics considerations, design techniques, affecting factors, assessment, viewer preference, crash test, design solutions
World Resources Institute (USA)		Guidance	-	Cities Safer by Design	2015	safety, traffic, design elements, traffic calming measures, pedestrian areas, medians, public space, safe access	https://www.wri.org/sites/default/files/CitiesSaferByDesign_final.pdf

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Aesthetics/ security by design (2/2)	Department of Homeland Security-FEMA (USA)	Guidance	FEMA 430	Site and Urban Design for Security (against potential terrorist attacks)	2007	lessons learned, design considerations, blast effects, cost, defence layers, barrier design, barrier types, active/passive barrier overview, access points	https://www.fema.gov/media-library-data/20130726-1624-20490-9648/fema430.pdf
	Jon Coaffee	Book	-	Terrorism, Risk and the Global City (towards urban resilience)	2009	defensive landscape, crime prevention, gates, barriers, landscape management, resilient planning, working example	http://dlx.b-ok.org/genesis/398000/50f7bb31c2100535cf6393c2e7e80bb0/_as/[Jon_Coaffee]_Terrorism,_Risk_and_the_Global_City(b-ok.org).pdf
Application/ Installation (1/2)	International Organization for Standardization	International Workshop Agreement	ISO/IWA 14-2	Vehicle Security Barriers- Part 2 : Application	2013	threat assessment, site characteristics, asset assessment, barrier performance, penetration distance, maintenance	https://www.iso.org/standard/64737.html
	British Standards Institution (UK)	Publicly Available Specification	PAS:69	Guidance for the selection, installation and use of vehicle security barriers	2013	barrier types, selection procedure, installation, threat assessment, asset assessment, site design, requirements, implementation, inspection	https://shop.bsigroup.com/ProductDetail/?pid=000000000030274479
	Service d'Etudes Techniques des Routes et Autoroutes (France)*	Guide	-	Barrières de Sécurité pour la retenue des poids lourds	1999	design, conception, barrier list, aesthetics, adaptation, efficiency, fabrication, application, repair	http://memoar.setra.developpement-durable.gouv.fr/_ftp/Barrieres_PL.pdf
	United States Army Corps of Engineers (USA)	Guide	UFGS-34	Active Vehicle Barriers	2008	failure modes, barrier types, system characteristics, execution advice, training	https://www.wbdg.org/FFC/DOD/UFGS/UFGS%2034%2071%202013.19.pdf
	Department of Defence (USA)	Guide	UFC-4-022-02	Selection and Application of Vehicle Barriers	2010	design parameters, vehicle speed, barrier types, design considerations, aesthetics, reliability, installation requirements, active/passive barriers systems overview, cost analysis, debris	https://www.wbdg.org/FFC/DOD/UFC/ufc_4_022_02_2009_c1.pdf

*regarding mainly on safety barriers

Category	Publisher/ Author	Document type	Code name	Specification	Issue date	Identifiers	Link
Application/ Installation (2/2)	Department of Defence (USA)	Guide	UFC-4-022-03	Security Fences and Gates	2013	requirements, fence types, gate types, foundation types, installation characteristics	https://www.wbdg.org/FFC/DOD/UFC/ufc_4_022_03_2013.pdf
	Department of Defence (USA)	Handbook	MIL-HDBK-1013/10	Design Guidelines for Security Fencing, Gates, Barriers, and Guard Facilities	1993	fence design, erection requirements, maintenance, intrusion detection, penetration, gate design, traffic control, guard facilities	http://www.cdse.edu/documents/cdse/mil-handbook.pdf
		Handbook	-	DoD Antiterrorism Handbook (chapters 22-23)	2004	physical security, threat detection, layers of security, access control, barrier systems, design considerations, penetration, perimeter security,	http://www.esd.whs.mil/DD/
Producer/ product list	United States Air Force (USA)	Guide	-	Installation Force Protection Guide	1997	risk management, threat assessment, vulnerability assessment, protection strategies, site planning, development plan, vehicular access, controlled	https://www.wbdg.org/FFC/AF/AFDG/ARCHIVES/afinstal.pdf
	United States Air Force (USA)	List	-	DoD Anti-Ram Vehicle Barrier List	2017	bollard, gate, net, wedge, cable, beam, impact speed, penetration, maintenance, deployment	https://pdc.usace.army.mil/library/BarrierCertification
	Department of Transportation (USA)	List	-	Aesthetic Barrier	2015	wooden barriers, cable barriers, stone barriers, steel barriers, concrete barriers	https://safety.fhwa.dot.gov/roadway_dept/countermeasures/docs/Aesthetic_Mar2015Saferlogo.pdf
Cost	Department of Defence (USA)	Manual	-	Cost Estimates for Physical Security Enhancements-Physical Security Design Manual for VA Facilities	2007	cost estimate, vehicle barriers, fences, pedestrian screening, lighting, access control, building envelope, column protection, electrical systems	https://www.wbdg.org/FFC/VA/VAPHYS/va_security_costs_dm_2007.pdf

4 Conclusions

In the current document, sources of guidelines and other information material concerning the protection from vehicle-ramming incidents by using barrier systems have been collected and presented. The illustrated sources cover a wide range of areas, including documentation on proper testing, design and selection methodologies for vehicle barriers. The list included herein, is divided in categories based on the scope of each document and contains practical guidance originating from various countries. As noted, in the European Union detailed documentation on installation methodologies, cost and available products is rather limited and there is strong encouragement by the European Commission for the development of such material. As emphasized in several of the documents collected, special care should also be paid on barrier aesthetics and the integration of security by design concepts in the construction of such systems in particular for public spaces, like city centres. The future guides to be produced should aim at providing advice to the security stakeholders for reducing the risk of a vehicle-ramming attack and introducing proper measures for mitigating the consequences, should such an incident occurs.

Finally, it is worth commenting that the CEN member states, UK and the USA have adopted different barrier impact testing procedures, as per CWA 16221, PAS 68 and ASTM F2656-15, respectively. This implies that after testing a barrier according to one of these procedures, some ambiguity exists as to whether it complies with the requirements of the other two documents. In order to avoid costly multiple impact tests, the industry usually resorts to the impact testing prescribed in IWA 14 of ISO, which has been developed from a committee that comprised representatives from several countries and organizations. IWA 14 has encompassed many of the testing recommendations of the previously mentioned standards in an effort to combine acquired knowledge and introduce a document that can be applied internationally and provide security certification.

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