ESSA White Paper

Classification concepts in Burglary Standardization

Background information on the classification concepts used in burglary resistance standards around the world
(Issue 0.2, 27 May 2020)

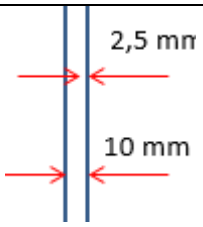
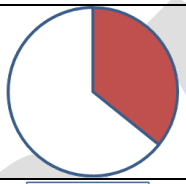
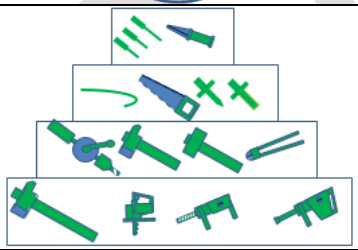
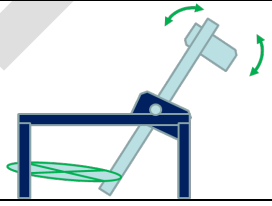
Content

1. Introduction

Since nearly 100 years the industry standardizes burglary tests. The classification in burglary standards can be assessed according to different methods. From simple construction standards to standards which rely on attack times in minutes or on a risk based system, which need an assessment or type test by a qualified laboratory.

Every classification system is different and has its advantages and disadvantages, which will be shown in this White Paper.

The following concepts are evaluated:

Classification concept	Simplified	Principle	Clause
Design concept		Product is constructed according to specific rules, for instance wall thicknesses. Test laboratories are not needed. From class to class more construction requirements are added.	2
Time concept		Product is tested for a certain time without taking into account, which tool is attacking the product. From class to class the attack time rises.	3
Tool concept		Product is tested with a certain tool category. From class to class more tools are added in the concept.	4
Risk concept		It is assessed how likely a specific burglar would use a certain tool based on noise, risk, knowledge etc. The overall result is calculated in units. From class to class the amount of units rise.	5
Machine concept		The product is tested with a machine. From class to class for instance the amount of hits rises.	6

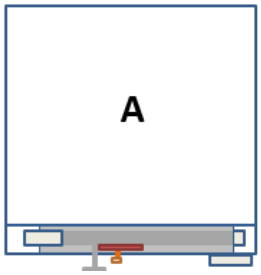
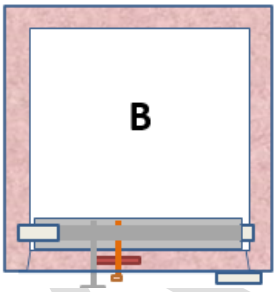
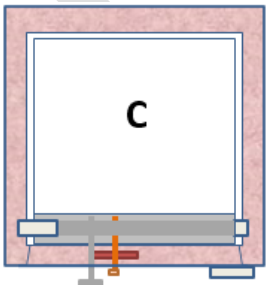
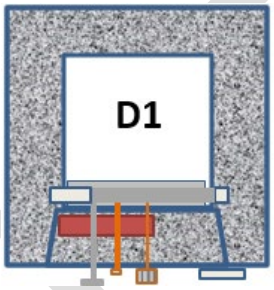
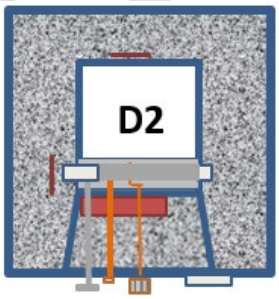
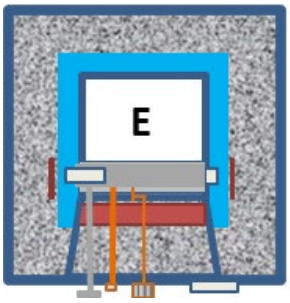
The basis for this White Paper are more than 50 burglary standards (see clause 7). All standards have the aim to raise the security of a product. Sometimes the scope of the different classification concepts overlaps and more than one concept is used in a standard.

2. Design concept

2.1. Explanation

The design concept does not test the burglary resistance of a product. Based on technical experience different construction requirements are set, this may include wall thicknesses, bolt thickness or thickness and type of other material.

For instance, from the 1960ies to the 1980ies in Germany "VDMA/RAL safe standards" were published. Depending on the standard and the class in the standard, a safe had to be constructed according to the guidelines:

A VDMA 24992	**B** VDMA 24992	**C** VDMA 24990:1972, 1.3
		
D1 RAL-RG 626/1	**D2** RAL-RG 621	**E** RAL-RG 621
		

VDMA/RAL design concept in Germany in the 1960ies to the 1980ies (simplified)

2.2. Advantages and disadvantages of the concept

The advantage of the concept is that every manufacturer regardless of his knowledge of safe construction can theoretically produce the product. Furthermore, customers know exactly how their product is made and could sometimes even produce the product themselves. As the product is not tested in a laboratory the development phase of such a product is short.

However, in case a design concept is used, burglars know the basic concept of the products and if they know how to open one product of one manufacturer, they can open every single product in a similar way.

The walls of such a product can be described precisely, but for the doors this is not possible without leaving out certain important points. Due to this, standards like the VDMA 24992 were renewed regularly to eliminate different flaws of construction and at the end the VDMA 24992 was withdrawn altogether.

For the market as such, construction rules prevent innovation. If every manufacturer produces exactly the same product, there is no need to invest in new burglary prevention technologies. Furthermore, the competitiveness in a market is not high. Customers cannot differentiate between products of different manufacturers.

2.3. Standards using the concept

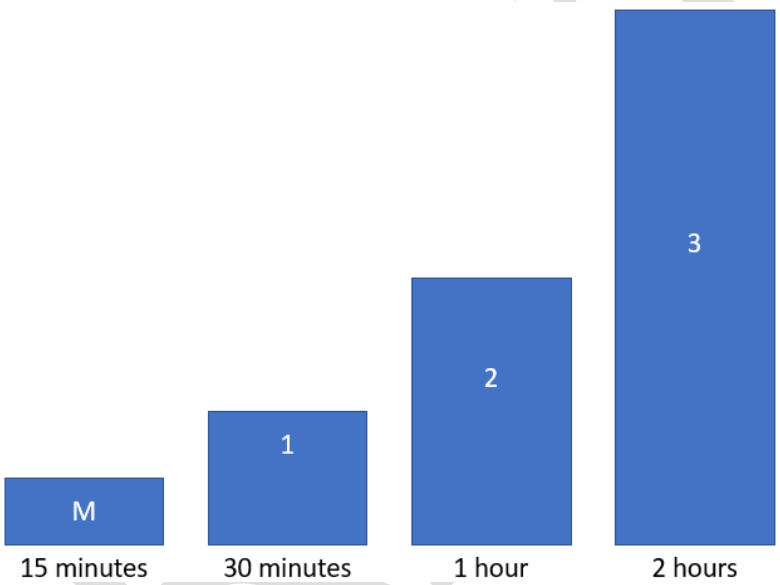
Based entirely on the concept	**Certain criteria are based on the concept**
Older German Cabinet Standard VDMA 24992	American Safe Standard UL 687
Older German Safe Standard RAL-RG 621	Indian Safe Standard IS-550-2
Older German Safe Standard RAL-RG 626	Chinese Cabinet Standard GA166
Older Austrian Safe “VSÖ” standards	American ATM standard UL 291
	European Key Lock Requirements in EN 1300

3. Time concept

3.1. Explanation

The time concept is purely based on how long a product resists to a certain burglary attack. Per grade the attack time is exactly given. The concept relies on the thought, that a product is part of a complete security system with an alarm system. The costumer choses his product based on the “intervention time” of the alarm system.

A good example of this concept is the UL 608. This American Vault standard has only four classes. Each class indicates a certain time, which the vault door resists to. For instance, products of the class M resist 15 min, products of class 3 resist 2 hours. All classes are attacked with the same tools.



Classes and burglary time in UL 608

3.2. Advantages and disadvantages of the concept

The concept is easy to understand by everyone. A customer wishing to have 1 hour of burglary protection, can easily find a product, which fits to their needs. It is easily possible, to compare one class to another.

However, a concept based entirely on time is usually not ideal for following reasons:

- The time a laboratory uses is usually multiple times faster than a burglar needs in reality. As a laboratory:
  - tests very regularly;
  - can study the product based of the drawings and
  - has several tries to attack the product.

  The time stated in the standard is usually lower than the burglary resistance of the product.

- Generally, such concepts only assess the most effective tool. In case a standard uses a thermal lance, laboratories would mainly use the thermal lance, as it is usually the most effective with the lowest attack time. The concept does not differentiate, if a product is attacked 1 minute with a screwdriver or 1 minute with a heavy tool, which may set the alarm.

- The concept assumes that a tool is always available. For instance, when attacking with a grinder, in some attacks burglars may only need a single disc. Other products may force the burglar to change discs several times. The time concept does not differentiate how many discs, saws blades, drill bits or chisels are needed.

- In case a customer only needs a product which withstands to a crowbar attack for 15 minutes, the customer would pay a lot more than needed, as the product would additionally be tested to all the other tools.

- The ATM standard UL 291 has above all the two classes: “level 1” and “level 2”. Both state that the testing time is 15 minutes. However, due to a different tool list (see tool concept in clause 4) the security of a “level 2” ATM is at least four times as high than a “level 1” ATM. When only depending on the time of a product, these differences cannot be noticed.

Therefore, in reality the time concept is only rarely used for burglary standards. When it is used, it is mostly combined with the tool concept.

3.3. Standards using the concept

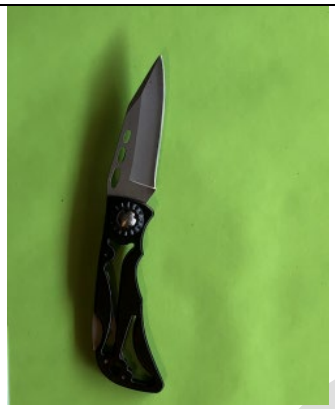
Based (nearly) entirely on the concept	**Based to a big extent on the concept**
American Vault Standard UL 608	American Safe Standard UL 687
	European Secure Safe Cabinet Standard EN 14450
	Chinese Safe Standard GB10409
	Chinese Strongbox Standard GA166
	South African Safe Standard SANS 751

4. Tool concept

4.1. Explanation

The tool concept is based on the type of tools a product is attacked with for a certain time. Usually different tool categories for instance "small tools", "large tools" and "electric tools" are defined. In every class the product is attacked with a different tool category.

A good example of this concept is the EN 1630. For each resistance class in the EN 1630 new tools can be used to attack the product

RC 1	RC 2	RC 3
 Knife with 120 mm blade	 Compass saw with 310 mm blade  Hacksaw with 330 mm blade	No additional cutting tools
RC 4	**RC 5**	**RC 6**
 Axe 800 g in weight	 Ø125 mm disc grinder	 Ø230 mm disc grinder

Burglary tools used in EN 1630 to cut the products per class (the tools of RC 1 can also be used in RC 2, RC 3 etc, the tools of RC 2 can also be used in RC 3, RC 4 etc.)

4.2. Advantages and disadvantages of the concept

Customers specifically wishing to have a product withstanding to one certain type of tool, can choose the class which they need. The concept is easy to understand by everyone.

However, in the tool concept there is no direct correlation between the classes, as every class is totally different. Manufacturers cannot "upgrade" their product to a higher class by simple calculation (simplified: double the thickness, double the time). For every new class a completely new test is usually needed in a laboratory, which creates higher testing and development costs.

Sometimes it is not easy to understand, why a certain tool is available for one class but not for the other class.

Furthermore, the concept does not differentiate on how many tools are used. For instance, the class RC 3 of EN 1627/EN 1630 allows the use of approx. 30 tools. If the product can be opened only by

- using an Allen Key to demount the door
- or by using a hammer, several wedges, a crowbar, a hacksaw and a drilling machine

does not make a difference in the tool concept.

4.3. Standards using the concept

Based (nearly) entirely on the concept	**Based to a big extent on the concept**
European Door/Window Standard EN 1630 (in combination with EN 1627)	American Safe Standard UL 687
American ATM Standard UL 291	British Intruder Resistant Building Component Standard LPS 1175
	South African Safe Standard SANS 751
	Chinese Safe Standard GB10409

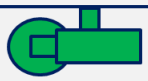
5. Risk concept

5.1. Explanation

In the risk concept the standard wants to reflect the reality as much as possible. It tries to assess every tool and every attack which could be performed and tries to evaluate the risk and the knowledge which the burglar may need to attack a safe in a certain way.

One example of the concept is the European safe, ATM safe and vault standard EN 1143-1. For every tool the standard allocates

- a risk factor (c) and
- a basic value (BV), which allocates the tool on how much effort is needed to use the tool and carry it to the burglary site (see BV example figure below).

Tool	Acquisition	Transport	Usage	Size	BV
 Screw driver	Openly available everywhere	Can be concealed on the body	No knowledge needed	Small	0
 1,5 kg axe	Openly available everywhere	Cannot be easily concealed on body	Burglar needs strength	Approx. 500 mm 1,5 kg	5
 125 mm grinder	Available in do it your self shops	Needs at least a bag	protective glasses, power connection	Approx. 400 mm Approx. 3 kg	14
 230 mm grinder	Available in do it your self shops	Needs a bigger bag and is heavy to carry	Risk of being hurt, protective glasses power connection	Approx. 600 mm Approx. 6 kg	25
 Mini-Lance	Only available in specific shops	Too long to carry in a bag, needs gas bottles	Needs protective closing, high risk of being hurt	Approx. 1200 mm + gas bottles	42
 Lance	Only available in specific shops	Too long to carry in a bag, needs gas bottles	Needs protective closing, high risk of being hurt	3000 mm + gas bottles	70

Examples on how the basic value is chosen for a specific tool in EN 1143-1

Based on the different factors and the time the product is classified into different resistance grades.

5.2. Advantages and disadvantages of the concept

From all concepts, the risk concept is closest to reality. It tries to simulate a real burglary and evaluates every tool on how it could be used. Furthermore, products tested according to the risk concept are always attacked in a variety of ways. Customers receive an "all-rounder" product.

It is differentiated on how many tools are needed to attack a product.

In addition, the classes used in these standards can be sorted according to their security and calculations based on different tests can be made to a series of products and classes. The risk concept is usually the concept leading to the least amount of weak points in a product.

The disadvantage of such a concept is that the customer needs an explanation to understand how secure his product is. Furthermore, the testers of such a product need a lot of testing experience and several test specimens are usually needed.

If a risk based standard is created, every tool needs to be assessed and certain basic values, coefficients etc. have to be allocated to the tool. This allocation is subjective, through which compromises must be found and updates of "risk based standards" often take a longer time to publish as other standards. Furthermore, as risk factors change over time, it is important to recheck the standard every few years.

5.3. Standards using the concept

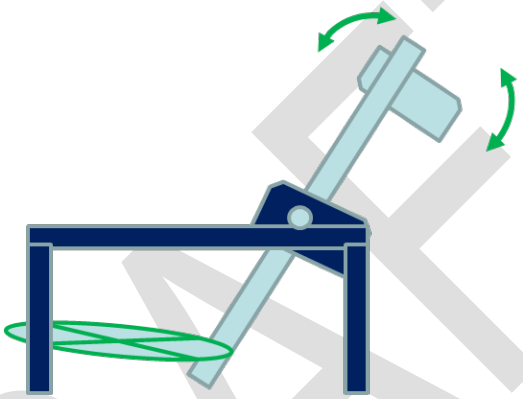
Based (nearly) entirely on the concept	**Based to a big extent on the concept**
European Safe, Vault and ATM Safe Standard EN 1143-1	European Secure Safe Cabinet Standard EN 14450
Australian Safe and Vault Standard AS/NZS 3809	
Older German Safe Standard RAL-RG 621/10	
Older Scandinavian Safe Standard INSTA 610	

6. Machine testing concept

6.1. Explanation

The machine testing concept is usually based on an attack with only one tool. The concept is not based on a certain time limit, but on other tool specific criteria, for instance number of hits with a axe (EN 356) or a specific load which is applied on a specific location of the product (EN 1628).

Example:
The EN 356 uses a simple “axe machine”. Depending on the class a different amount of hits is applied. For class P6B the amount of hits is 30, for P7B it is 50 etc.



6.2. Advantages and disadvantages of the concept

The machine concept is used to have reproducible testing results. Testing done by one laboratory have usually the same result as tests done by another laboratory.

However, machine tests always have the disadvantage, that these do not reflect a burglary attack in reality. For instance, the EN 1303 has an automated drilling test. If the cylinder passes this test, it does not mean that in reality the product cannot be drilled. Skilled burglars are able to drill in certain ways, a machine can’t by reacting to the product.

This has led to the fact, that on top of “machine tested” standards, a lot of local requirements are added by different testing laboratories.

The more complex a product is constructed, the less a machine test can be used. Often machine tests are therefore only used as an addition. The EN 1628 and EN 1629 are machine tests, but are always used together with the EN 1627/EN 1630, which are based on the tool concept.

6.3. Standards using the concept

Based (nearly) entirely on the concept	Only partly based on the concept
European Security Glazing Standard EN 356	Swedish CabinetStandard SSF3492
European Door/Window Testing Standards EN 1628 and EN 1629	Older Italian Cabinet Ctandard UNI 10868
European Cylinder Lock Standard EN 1303	

7. Overview of different standards using different concepts

For writing this White Paper more than 50 burglary standards were used. These are summarized in the below table. Without pointing out the advantages and disadvantages of each concept, the following can be said based on the history:

- Until the 1970ies standards in the middle of Europe (for example in Austria, Belgium, Switzerland, Germany) were mainly based on the **design** concept. This concept seems to be outdated. No current standard is entirely based on the concept.
- In parallel in the 1930ies (USA), the 1950ies (India) and the 1960ies (South Africa) Standards were published which were based on a mixture of the **design**, **time** and the **tool** concept.
- In the last 40 years countries creating completely new standards usually chose the **risk** concept.
- Until now the machine concept has not received support as a burglary standard for a complete product.

Standard	Type of product	Country	Version checked	Concept mainly used				
				Design	Time	Tool	Risk	Machine
AP H54	*Safes*	*France*	*1985*		*X*	*X*		
AS/NZS 3809	Safes	Australia New Zealand	1998				X	
DIN 18104-1	Building products	Germany	2017		X			
DIN 18104-2	Building products	Germany	2013		X			
DS 2121	*Safes, Vaults*	*Denmark*	*1981*				*X*	
EN 356	Building products	Europe	1999					X
EN 1300	Locks	Europe	2018	X			X	
EN 1303	Locks	Europe	2015					X
EN 1143-1	Safes, ATM safes, vaults	Europe	2019				X	
EN 1143-2	Deposit systems	Europe	2014				X	
EN 1628	Building products	Europe	2015					X
EN 1629	Building products	Europe	2015					X
EN 1630	Building products	Europe	2015			X		
EN 14450	Cabinets	Europe	2017		X		X	
INSTA 610	*Safes, vaults*	*Scandinavia*	*1987*				*X*	
IS 550-2	Safes and Deposit Safes	India	2005	X	X	X		
GA166	Cabinets	China	2006	X	X			X
GB10409	Safes	China	2001		X	X		

ГОСТ Р 50862	Safes, vaults, ATM safes	Russia	2017				X	
ГОСТ Р 51053	Locks	Russia	2014				X	
Konstruktionsmerkmale Panzerschränke	*Safes*	*Switzerland*	*1971*	*X*				
Klassierte Tresorräume	*Vaults*	*Switzerland*	*1988*				*X*	
LPS 1228	Cabinets	Great Britain	2014			X		
LPS 1175	Building products	Great Britain	2010			X		
MS EN 1143-1	Safes	Malaysia	2014				X	
Notation des coffres-forts blindes anti-chalumeau	*Safes*	*France*	*1967*				*X*	
NS 5089	*Safes, Vaults*	*Norway*	*1981*				*X*	
PTZ 7201.10	*Safes*	*Germany*	*1956*	*X*				
PTZ 7201.11	*Safes*	*Germany*	*1956*	*X*				
RAL-RG 621	*Safes*	*Germany*	*1969*	*X*				
RAL-RG 621/10	*Safes*	*Germany*	*1989*	*X*			*X*	
RAL-RG 621/20	*Safes*	*Germany*	*1989*	*X*			*X*	
RAL-RG 622	*Vaults*	*Germany*	*1970*	*X*				
RAL-RG 622/1	*Vaults*	*Germany*	*1987*				*X*	
RAL-RG 623	*Vaults*	*Germany*	*1970*	*X*				
RAL-RG 623/10	*Vaults*	*Germany*	*1987*				*X*	
RAL-RG 624	*Vaults*	*Germany*	*1970*	*X*				
RAL-RG 624/20	*Vaults*	*Germany*	*1987*				*X*	
RAL-RG 625/1	*Vaults*	*Germany*	*1970*	*X*				
RAL-RG 625/4	*Vaults*	*Germany*	*1989*				*X*	
RAL-RG 625/5	*Vaults*	*Germany*	*1987*				*X*	
RAL-RG 626/1	*Safes*	*Germany*	*1970*	*X*				
RAL-RG 626/2	*Safes*	*Germany*	*1989*				*X*	
RAL-RG 626/3	*ATM safes*	*Germany*	*1989*				*X*	
RAL-RG 626/5	*Cabinets*	*Germany*	*1980*	*X*				
RAL-RG 626/6	*Cabinets*	*Germany*	*1980*	*X*				
RAL-RG 626/10	*Safes*	*Germany*	*1989*	*X*			*X*	
RAL-RG 627	*Safes, ATM safes*	*Germany*	*1998*				*X*	
SANS 751	Safes	South Africa	2008		X	X		
SANS 10052	Vaults	South Africa	2007	X				
SI 5421	Cabinets	Israel	2009		X		X	
SIS 83 75 01	*Safes*	*Sweden*	*1965*		*X*	*X*		
SFS 3529	*Safes, Vaults*	*Finland*	*1981*				*X*	
SS 3000	*Safes, Vaults*	*Sweden*	*1981*				*X*	
SSF 3492	Cabinets	Sweden	2015	X	X			X
UL 291	ATM safes	USA	2012	X		X		

UL 687	Safes	USA	2011	X	X	X		
UL 608	Vaults	USA	2004		X			
UNI 10868	*Cabinets*	*Italy*	*2000*				*X*	*X*
VDMA 24990 1.3	*Cabinets*	*Germany*	*1972*	*X*				
VDMA 24992	*Cabinets*	*Germany*	*1995*	*X*				
VSÖ Qualitäts-bestimmungen	*Safes, vaults*	*Austria*	*1978*	*X*				
Sum total				**24**	**13**	**10**	**28**	**7**

Standards in italics have been withdrawn.

8. Summary

Several burglary standardization concepts exist. There is no concept, which has only advantages. Depending on the aim of a standard or certain concept may be better than a different concept.

The risk concept is the most modern, but also needs the most explanation. The design concept is the concept with the highest reproducability, however it often leaves out certain burglary risks.

About the author
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White Paper of the European Security Systems Association (ESSA) e. V.

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This White Paper only gives an overall comparison.