Locks for Bicycles and Motorcycles

Requirements and Test Methods

Publisher and publishing house: VdS Schadenverhütung GmbH

Amsterdamer Str. 172-174
50735 Köln, Germany
Phone: +49 221 77 66 0; Fax: +49 221 77 66 341

Guidelines for Physical Security Devices

Locks for Bicycles and Motorcycles

Requirements and Test Methods

Content

1 General

1.1 Scope

These guidelines describe the minimum requirements and test methods for bicycle and motorcycle locks. Bicycle and motorcycle locks can either be installed by the manufacturer, not being exchangeable by the consumer, or issued as an additional purchase.

VdS-approvals on the basis of these guidelines are exclusively valid for the usage as bicycle or motorcycle locks. Single components of bicycle or motorcycle locks for bicycles such as pad locks or chains shall not, due to the fact they are separate elements, be described as VdS-approved.

Remark: Instead of "bicycle and motorcycle lock" also the term "lock" is used in the following.

1.2 Validity

These guidelines are valid from 2007, October 1st and replace the version VdS 2597: 2001-10 (draft).

Note: This is a translation of the German guidelines; if there are any discrepancies, the German version shall be binding.

2 Normative references

These guidelines contain dated and undated references to other publications. The normative references are cited at the appropriate places in the clauses, the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these guidelines only when announced by a change of these guidelines. For undated references the latest edition of the publication referred will be applied.

- **DIN 338** Kurze Spiralbohrer mit Zylinderschaft (Short spiral drill with cylinder shaft)
- **DIN 1412** Spiralbohrer aus Schnellarbeitsstahl – Anschliffformen (Spiral drill made from HSS – polished forms)
- **DIN 18252 : 2006-12** Profilzylinder für Türschlösser – Begriffe, Maße, Anforderungen, Kennzeichnung (Locking cylinders for doorlocks – terms, dimensions, requirements, marking)
- **DIN VDE 0470-1: 2000-09** Schutzarten durch Gehäuse (IP-Code) (IEC 60529:1989 + A1:1999); Deutsche Fassung EN 60529:1991 + A1:2000 (Type of protection by means of housing (IP-code))
- **ISO 9227 : 1990-12** Korrosionsprüfungen in künstlichen Atmosphären – Salzsprühnebelprüfungen (ISO 9227 : 2006); Deutsche Fassung EN ISO 9227 : 2006 (Corrosion tests in artificial atmospheres – salt spray tests (ISO 9227:2006))
- **VdS 2344** Procedures for Testing, Approval and Evaluation of Conformity of Equipment, Components and Systems for Fire Protection and Security Technologies.

3 Terms and definitions

Main lock element: Element of the lock (e.g. shackle, chain) with which the positive safety of elements of the bicycle or motorcycle with each other or with fixed elements (e.g. lamp post) can be achieved.

Bolt element: Element of the lock producing, in active state, the connection between the main locking device and the other lock elements.

Connection, non-detachable: Connection of elements which cannot, at least not without destruction of one element, be released.

Condition, locked: Condition in which the lock is locked in a way that it cannot, without the necessary key/code or damage be opened. The main lock element (chain, shackle or comparable) is thereby connected to the other lock elements and the bolt element in the lock is activated.

4 Classification

According to their characteristics, VdS-approved locks are assigned to the classes A and B. Locks of the category A have lower, locks of the category B have higher requirements.

Products, suitable to attach a bicycle or motorcycle to a railing or similar are further marked with an additional "+" (e.g. class B+).

For the locking of bicycles and small motorcycles (capacity less than 50 cm^3), at least locks of class A, for motorcycles locks of class B are recommended.

5 Requirements

5.1 General

5.1.1 Operating instructions

Operating instructions in German language have to be issued for locks. These have to include all necessary information in a clear and understandable manner to the consumer.

5.1.2 Mounting Instructions

Mounting instructions in German language have to be issued for locks and all their components. These have to include all necessary information in a clear and understandable manner to the consumer.

5.1.3 Marking

Locks have to be marked with the

- manufacturer label or trademark
- model designation
- approval number as well as
- class of the lock.

The marking has to be durable and visible without having to take the lock apart.

Furthermore, locks have to be marked with the VdS label according to the VdS guidelines VdS 2344.

5.1.4 Conclusion to a key number/code

Locks shall not be marked with a number or combination referring to the code or key number.

5.1.5 Keys

At least two keys shall be delivered with each key lock.

5.1.6 Options

Options shall not adversely affect the characteristics of locks. Options and their characteristics shall be specified by the manufacturer.

5.2 Construction

5.2.1 Function

Locks shall be engineered in a way to make it impossible to use or move the locked vehicle in a normal way.

5.2.2 Self-locking

Locks shall not cause danger for persons. It shall be guaranteed that the locks do not close self-acting during operation of the vehicle and therefore influence its functions.

5.2.3 Forcible closing

Forcible closing has to be given. Locks have to be manufactured in a way that the bolt element is activated before removal of the key (if the main lock element is in its locking position, the lock is inevitably activated). Locking or unlocking cannot occur after removal of the key.

5.2.4 Lock components

The lock components have to be manufactured in a way that a connection between the lock and the vehicle is being created that cannot be circumvented. At least it has to be possible to prevent normal rotation of the wheels or the steering function of the vehicle. A non-destructive dismantling of the activated lock shall not be possible.

Locks such as U-locks, chain or cable locks have to enclose at least one wheel and one fixed part of the frame.

The ”+”-sign will be issued if the product offers the possibility to enclose a body of at least a circumference of 40 cm.

5.2.5 Effective varieties

The minimum amount of effective varieties for mechanical locks are for

- class A 5,000
- class B 30,000

For key locks the difference of the deepest key cuts in a row has to be at least three steps. The connection line of the key cuts shall not be a straight line in the row with the highest number of pin tumblers. Not more than two neighbouring key cuts shall be manufactured in the same depth. The key shall not have more than 60 % of key cuts of the same depth in at least one row of cuts.

The minimum amount of effective varieties for electronic locks is for

- class A 100,000
- class B 1,000,000

The operating instructions of combination locks is required to have a remark that the usage of simple codes such as 1-2-3-4-5 or similar is not allowed.

5.3 Corrosion protection

Locks shall not be influenced in their functions by corrosive impact according to clause 6.5. After the corrosive influence according to clause 6.5 it shall not be possible to open the lock in a simple way without using the appropriate key or code.

5.4 Circumvention security

5.4.1 Opening protection

It shall not be possible to open locks in a simple way without using the appropriate key or code.

5.4.2 Code protection

Locks have to be manufactured in a way that it is impossible to read-out the appropriate code when the product is locked.

5.4.3 Picking protection

Locks have to be manufactured in a way that they cannot be unlocked with picking tools or similar devices within the time frames listed in table 5.01. The picking protection can furthermore be guaranteed by means of verifiable construction characteristics.

5.4.4 Protection against opening with the next closest key

It shall not be possible to open key locks with the next closest key by means of using a torque according to table 5.01.

5.4.5 Attacks to the locking cylinder

5.4.5.1 Tension/pressure

Cylinder locks have to withstand tension or pressure in accordance to table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

5.4.5.2 Torsion strain

Cylinder locks have to withstand torsion strain without providing the opportunity to open the lock according to clause 6.1.8.

5.4.6 Combination locks

5.4.6.1 Changing the code

For the user it has to be possible to change the code.

5.4.6.2 Signs of wear

The identification of the correct code due to signs of wear shall not be possible in a simple way.

5.5 Mechanical influences

5.5.1 Tension

According to table 5.01 locks have to withstand tension lengthways and sideways to the direction of opening without providing the opportunity to open the lock according to clause 6.1.8.

This requirement is not valid for steering column locks.

5.5.2 Torsion strain

5.5.2.1 Shackle

Shackles of U-locks have to withstand torsion strain according to table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

5.5.2.2 Steering column locks

Steering column locks have to withstand torsion strain at the steering column according to table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

5.5.3 Cutting strain

Locks have to withstand cutting stress according to table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

This requirement is not valid for brake disc locks and steering wheel locks.

5.5.4 Dynamic strain

Locks have to withstand impacts according to table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

5.5.5 Sawing

Locks have to withstand sawing attacks within the time listed in table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

This requirement is not valid for brake disc locks and steering wheel locks.

5.5.6 Drilling

Locks have to withstand drilling attacks within the time listed in table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

5.5.7 Attacks with hand tools

Locks have to withstand attacks with hand tools according to table 6.02 within the time listed in table 5.01 without providing the opportunity to open the lock according to clause 6.1.8.

Kind of attack/test characteristics	**class**		**Test methods clause**
	A	**B**	
Picking protection	5 min	10 min	6.6.3
Protection against opening with the next closest key	1.5 Nm	1.5 Nm	6.6.4
Tension/pressure of the locking cylinder	7 kN	7 kN	6.6.5.1
Torsion strain of the locking cylinder	15 Nm	15 Nm	6.6.5.2
Tension in opening direction	25 kN	35 kN	6.7.1
Tension sideways to the opening direction	12 kN	15 kN	6.7.1
Torsion of the shackle	250 Nm	500 Nm	6.7.2.1
Torsion of the steering column lock	250 Nm	500 Nm	6.7.2.2
Cutting strain	30 kN	40 kN	6.7.3
Impact on the lock body (test specimen tempered to -20 °C)	5 impacts à 30 J	5 impacts à 60 J	6.7.4.1
Impacts on the shackle resp. bolt element at chain or wire locks (test specimen tempered to -20 °C)	5 impacts à 30 J	5 impacts à 60 J	6.7.4.2
Sawing	3 min	4 min	6.7.5
Drilling	2 min	5 min	6.7.6
Attacks with hand tools	5 min	5 min	6.7.7

Table 5.01: Requirements for the security for physical influences and manipulation

6 Tests

6.1 Conditions

6.1.1 Environmental conditions

If not stated otherwise, all tests are performed under interior conditions.

6.1.2 Test specimen

The manufacturer has to provide original packed test specimen from the series production including the appropriate accessories for the laboratory technical tests.

Tests of brake disc, steering wheel, chain and cable locks require seven test specimens, test of U-locks require 9 test specimens.

The manufacturer also has to provide accessories which are not necessarily delivered with the locks but are optional and can be, according to the manufacturer's information, used with the lock. Depending on the test procedure, additional test specimens might be necessary and have to be provided by the manufacturer.

If the product is not manufactured in series production, the test can be performed on prototypes. In this case additional testing of the product from the series production is necessary for a final evaluation.

6.1.3 Documentation

The following documents are necessary for the tests:

- operating instructions
- mounting instructions (if necessary)
- figures of the lock with information of tolerances and locking variations
- unit list
- figures of the cylinder with component plans
- specifications and certificates (if necessary; e.g. when using special steels)

6.1.4 Tolerances

The following tolerances are admitted if not otherwise stated:

- power ± 2 %
- torque ± 2 %
- mass/weight ± 2 %
- length ± 2 %
- time ± 5 s
- temperature ± 2 °C

6.1.5 Test preparation

Before each test the lock has to be locked. The keys have to be removed from key locks, the combination of combination locks has to be turned to a different combination.

6.1.6 Studies of construction

The test team – consisting of at least two people – will familiarise itself with the construction of the lock by means of the included Figures, before proceeding with the practical test.

6.1.7 Non-feasible tests

The test laboratory may decide that certain tests – due to construction – are not feasible. Such a decision has to be documented in the test report and the certification body decides if a certification on base of a positive test report still is possible.

6.1.8 Opening

The test specimen is considered opened if a cylinder-shaped gauge with a diameter of 5 mm can be moved through a generated opening. Beforehand the lock may be exposed to mechanical influences for no longer than 5 s. For this purpose the lock shall not be fixed with tools; locks not installed rigidly at a vehicle have to be held by hand. The lock may be treated with a screwdriver or with pliers of a maximum length of 200 mm.

The lock will be considered confirming the requirements if tests prove that in practice the enforced unlocking of the lock affects parts of the vehicle the lock is connected to and therefore prevents normal usage of the vehicle.

Example: The shackle of a U-lock can be rotated by 180° before the bolt element jumps out of the lock case or before the demanded amount of pressure has been reached. In practice such procedure would significantly damage the vehicle. Therefore, the lock is considered confirming the requirements.

6.1.9 Test matrix

The individual tests are performed according to the test matrix of table 6.01. Should a test specimen fail one test, the test team has to decide, after consulting the manufacturer if necessary, if and with which test step the test will be continued.

Test step	**Test**	**Accor-ding to clause**	**Test specimen**								
			1	2	3	4	5	6	7	8	9
1	Completeness	6.2.1	x	x	x	x	x	x	x	x	x
2	Identity	6.2.2	x	x	x	x	x	x	x	x	x
3	Operating instructions	6.3.1	x								
4	Mounting instructions	6.3.2	x								
5	Marking	6.3.3	x								
6	Conclusion to a key number/code	6.3.4	x								
7	Keys	6.3.5	x								
8	Options	6.3.6	x								
9	Function	6.4.1	x								
10	Self-locking	6.4.2	x								
11	Forcible closing	6.4.3	x								
12	Lock components	6.4.4	x								
13	Effective varieties	6.4.5	x								
14	Corrosion protection	6.5	x								
15	Opening protection	6.6.1		x							
16	Code protection	6.6.2		x							
17	Picking protection	6.6.3		x							
18	Protection against opening with the next closest key	6.6.4		x							
19	Tension/pressure	6.6.5.1		x[1)]							
20	Torsion strain	6.6.5.2			x[1)]						
21	Changing the code	6.6.6.1		x[2)]							
22	Signs of wear	6.6.6.2		x[2)]							
23	Tension	6.7.1		x[3)]	x[3)]						
24	Torsion strain, shackle	6.7.2.1				x[4)]					
25	Torsion strain, steering column lock	6.7.2.2				x[4)]					
26	Cutting strain	6.7.3		x							
27	Dynamic strain, lock body	6.7.4.1					x				
28	Dynamic strain, shackle	6.7.4.2						x[5)]			
29	Sawing	6.7.5		x							
30	Drilling	6.7.6							x		
31	Attack with hand tools	6.7.7								x	
32	Further tests	6.8									x[6)]

1) Test only for key locks
2) Test only for combination locks
3) Tension in or sideways to opening direction only takes place if this, according to the construction, is reasonable (for example, for the simulation of an attack with a car jack)
4) Test only for U-locks or steering column locks
5) Not applicable for brake disc, steering column, chain and cable locks
6) Tests can only be determined for individual cases or according to the construction of the lock; further test specimen might have to be provided

The sequence of tests may change for individual cases. Already used test specimen can only be used for further tests if an influence caused by previous tests can be excluded.

Table 6.01: Test matrix

6.2 Receiving inspection

6.2.1 Completeness

A visual test determines if the test specimen are complete and, if necessary, supplied with the appropriate keys and accessories and if all necessary documents are available.

6.2.2 Identity

A visual test and a measurement control determines if the test specimen correspond with the manufacturer's information.

All other tests are performed only if the tests above do not show any discrepancies.

6.3 General tests

6.3.1 Operating instructions

A visual test determines if the operation instructions correspond with the requirements listed in clause 5.1.1.

6.3.2 Mounting instructions

A visual test determines if the installation instructions correspond with the requirements listed in clause 5.1.2.

6.3.3 Marking

A visual test determines if the locks are marked according to the requirements listed in clause 5.1.3.

Furthermore it is tested, whether the markings are sufficiently steady, e.g. by peeling, wiping with a moist cloth.

6.3.4 Conclusions to a key number/code

A visual test determines if the requirements listed in clause 5.1.4 are fulfilled. The key number or code shall not be visible, either by itself or as part of a different number or lettering on the lock, stated on the lock or the key.

6.3.5 Keys

A visual test determines if the requirements for key locks listed in clause 5.1.5 are fulfilled.

6.3.6 Options

A visual test of the locks as well as of the manufacturers documentation and, if necessary, a practical test to be decided for particular cases, determines if the requirements listed in clause 5.1.6 are fulfilled.

6.4 Construction

6.4.1 Function

A visual test of the locks and the construction documents determines if the requirements listed in clause 5.2.1 are fulfilled.

6.4.2 Self-locking

A visual test of the locks and the construction documents and, if necessary, a practical test to be decided for particular cases, determines if the requirements listed in clause 5.2.2 are fulfilled.

6.4.3 Forcible closing

A practical test determines if the requirements listed in clause 5.2.3 are fulfilled.

6.4.4 Lock components

A visual test of the locks and the construction documents as well as, if necessary, a practical test to be decided for particular cases, determines if the requirements listed in clause 5.2.4 are fulfilled.

The “+” recognition will be rewarded if the product offers the possibility to surround a body with a circumference of at least 40 cm (the form of the body to be surrounded is not pre-determined).

6.4.5 Effective varieties

By means of the construction documents, it is determined if the requirements listed in clause 5.2.5 are fulfilled.

6.5 Corrosion protection

A corrosion test in neutral salt-spray corresponding with ISO 9227:1990-12 according to the NSS test is performed.

After a 96-hour spraying process, the test specimen can dry for 30 minutes and is afterwards rinsed off under cold running water ($T \leq 40°$ C). After the lock is dried, it will be lubricated according to the manufacturer’s instructions.

The lock will be opened and locked with the appropriate key/code. The test is considered passed if the lock can be operated in accordance with the regulations and for key locks if a subsequent test of the protection against opening with the next closest key, according to clause 6.6.4, indicates that the lock cannot be opened.

6.6 Circumvention protection

6.6.1 Opening protection

A visual test of the locks and the construction documents and, if necessary, a practical test to be decided for particular cases, determines if the requirements as listed in clause 5.4.1 are fulfilled.

Especially tested is the possibility to unlock the test specimen by means of existing conditions (e.g. the keyhole).

The test is considered passed if the lock cannot be opened non-destructive.

6.6.2 Code protection

A visual test of the locks and the construction documents and, if necessary, a practical test to be decided for particular cases, determines if the requirements as listed in clause 5.4.2 are fulfilled.

Especially tested is the possibility to determine the code by mean of existing conditions.

6.6.3 Picking protection

A visual test and on base of the construction documents it is determined if constructive characteristics guarantee a sufficient unlocking protection as listed in clause 5.4.3 exist. The evaluation of such characteristics is performed in particular cases.

Alternatively, a practical test determines if the requirements are fulfilled. An experienced tester using picking tools or similar tools available in relevant specialist stores or producible with simple equipment (e.g. wire hooks) will try to open the lock. The test specimen might be tested in any fixed position.

The test is considered passed if the existing constructive characteristics are categorised as "appropriately safe" or if the lock cannot be opened in the time frames as listed in table 5.01.

6.6.4 Protection against opening with the next closest key

It is tested if the requirements listed in clause 5.4.4 are fulfilled. For this purpose, the lock is set and the next closest key will be inserted into the keyway. The key will be loaded with a torque according to table 5.01. The pressure is evenly raised by about 10 Nm/min to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if, during the pressure, the cylinder does not rotate and if, after releasing the pressure, an opening according to clause 6.1.8 cannot be achieved.

6.6.5 Attacks to the locking cylinder

6.6.5.1 Tension/pressure

It will be tested if the requirements listed in clause 5.4.5.1 are fulfilled. For this purpose, the lock will be placed on an inflexible surface providing an adequate gap for the locking cylinder. The gap is constructed in a way that the lock is not being supported by the fastening points of the cylinder.

The strain according to table 5.01 may be applied by means of a drilling from the back. The drilling shall not influence the fastening of the locking cylinder. The strain is evenly raised by about 10 kN/min to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if, after releasing the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

6.6.5.2 Torsion strain

It will be tested if the requirements listed in clause 5.4.5.2 are fulfilled. For this purpose, the lock is fixed and a revolving tool such as a steel blade or a key blank is inserted into the keyway. The neighbouring outer layer of the keyway may be deformed. The energy used to install the tool is limited for locks of

- class A to 30 J (kinetic energy of a free falling mass of 2.927 kg from 1.044 m)
- class B to 60 J (kinetic energy of a free falling mass of 4.363 kg from 1.402 m).

The torsion strain is evenly raised by about 10 Nm/min to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if no rotation of the cylinder occurs during the maintained pressure and if, after releasing the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

6.6.6 Combination locks

6.6.6.1 Changing the code

By use of the operating instructions as well as a function control it is determined if the requirements according to clause 6.1.8 are fulfilled.

6.6.6.2 Signs of wear

The lock will be operated 500 times. Afterwards a visual test determines if the requirements listed in clause 5.4.6.2 are fulfilled. Optical aids (e.g. borescope) are not used.

Besides the visual test it is tested if signs of wear can be detected by feeling, making opening of the lock possible.

The test is considered passed if signs of wear cannot be determined by means of the visual test or by feeling them.

6.7 Mechanical influences

6.7.1 Tension

It is tested if the requirements listed in clause 5.5.1 are fulfilled. For this purpose, the lock is set and the lock case is supported and fastened as shown in Figure 6.01. The counter support shall not influence the test results negatively.

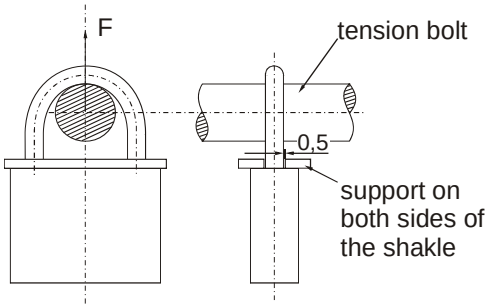

Figure 6.01: Tension stress in opening direction

The diameter of the tension bolt for stress in the direction of the opening has to be at least 80% of the clearance of the shackle. The greatest possible model has to be used if a tension bolt of such size cannot be used.

To determine the tensile strength in opening direction, a tension/compression device produces a force, as illustrated in Figure 6.01. The force is evenly raised by about 10 kN/min to the maximum value indicated in table 5.01 and maintained for 1 min.

To determine the tensile strength crosswise to opening direction a force is produced in a distance of 30 mm from the lock case, as illustrated in Figure 6.02, perpendicular to the opening direction and along the area surrounded by the shackle. The determination of the tensile strength perpendicular to the opening direction is only performed if attacks with a car jack or similar are possible. The lock might be set during the pressure to prevent a slipping of the lock or the pressure device. The strength is evenly raised by about 10 kN/min to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if, after finish of the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

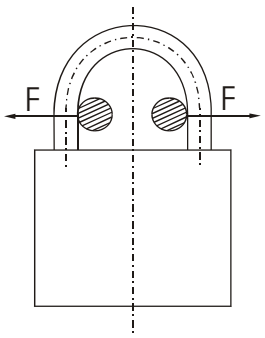

Figure 6.02: Tension across the opening direction

6.7.2 Torsion

6.7.2.1 Shackle

It is tested if the requirements listed in clause 5.5.2 are fulfilled.

For this test a lock case is fixed and the lock shackle is put under pressure as illustrated in Figure 6.03 and table 5.01. The torque is raised evenly by about 200 Nm/min to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if, after finish of the pressure, an opening according to clause 6.1.8 cannot be achieved.

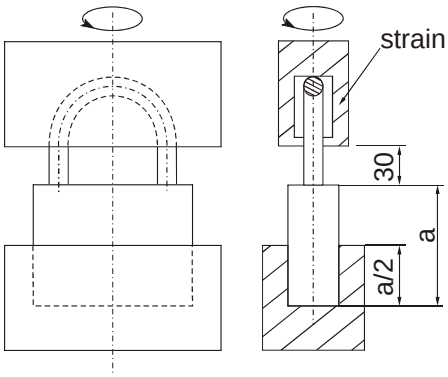

Figure 6.03: Torsion strain

6.7.2.2 Steering column lock

To test steering column locks, the lock will be installed analogously to an installation situation and loading will be put on the steering column as listed in table 5.01. The torque is raised evenly by about 200 Nm/min up to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if during or after finish of the pressure the steering column cannot be freely rotated.

6.7.3 Cutting strain

It is tested if the requirements as listed in clause 5.5.3 are fulfilled. For this purpose, pressure will be applied to the lock at a position determined by the tester as illustrated in figure 6.04. The blade of the pressure device consists of a material whose distortion, compared to the distortion of the shackle, might be neglected. The loading is raised evenly by about 10 kN/min up to the maximum value indicated in table 5.01 and maintained for 1 min.

The test is considered passed if, after the pressure, an opening according to clause 6.1.8 cannot be achieved.

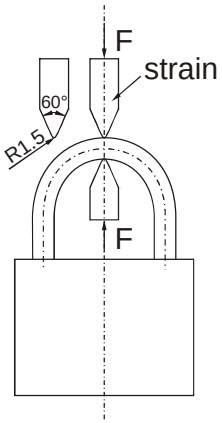

Figure 6.04: Cutting Stress

6.7.4 Dynamic strain

It is tested if for lock cases and shackles the requirements listed in clause 5.5.4 are fulfilled. At steering column wheel, brake disc, chain and cable locks only a test of dynamic pressure to the lock case is performed.

6.7.4.1 Lock body

Dynamic pressure by means of a falling weight is applied to the lock body of the test specimen as indicated in table 5.01. The spike of the falling weight consists of steel and has a diameter of 12 mm. Depending on the construction of the test specimen, the tester will determine the appropriate pressure points individually.

Figure 6.05 illustrates, as an example, the test construction of a U-Lock. The diameter of the suspension device for the locks has to be at least 80 % of the clearance of the shackle. The greatest possible model has to be used if a tension bolt of such size cannot be used.

The test specimen has to be tempered to a temperature of -20° C in a climate chamber and positioned in the test device. The first impact has to be performed not later than 15 s and the fifth impact has to occur no later than 60 s after the test specimen has been removed from the climate chamber.

The test is considered passed if, after finish of the pressure, an unlocking according to clause 6.1.8, cannot be achieved.

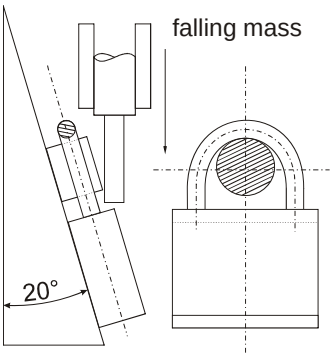

Figure 6.05: Dynamic strain – lock body

6.7.4.2 Shackle

Dynamic pressure is applied to the test specimen by means of a falling weight applied to the shackle as listed in table 5.01. The spike of the falling weight consists of steel and has a diameter of 12 mm. Depending on the construction of the test specimen – for an example, refer to figure 6.06 – the tester will determine the appropriate pressure points individually.

The test specimen has to be brought to a temperature of -20 °C and positioned in the test device. The first impact has to be performed not later than 15 s and the fifth impact has to be performed no later than 60 s after the test specimen has been removed from the climate chamber.

The test is considered passed if, after finish of the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

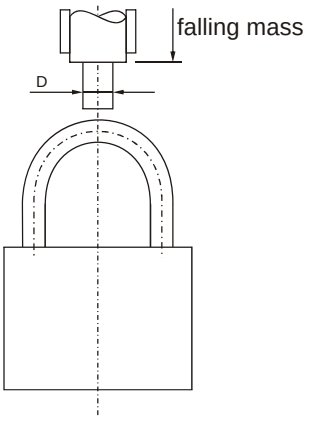

Figure 6.06: Dynamic pressure – shackle

6.7.5 Sawing

It is tested if the requirements listed in clause 5.5.5 are fulfilled. For this purpose according to Figure 6.07, the locks or parts of the lock are installed in a sawing test device. HSS saw blades (24 saw teeth/inch) with an initial load of 1 kN are used. The sawing speed has to be 60 ± 5 cycles per minute, the sawing stroke has to be 165 mm and the pressure of the saw blade against the test specimen has to be 90 ± 10 N. The amount of saw blades to be used is unlimited. Every exchange of the saw blade counts as 60 s of sawing time. Cooling or cutting fluids are not used.

The test is considered passed if, after finish of the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

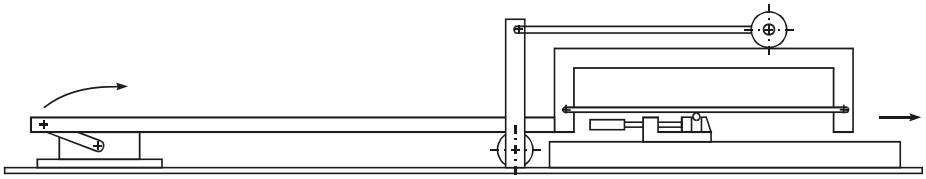

Figure 6.07: Sawing

6.7.6 Drilling

It is tested if the requirements listed in clause 5.5.6 are fulfilled. For this purpose the lock will be installed in a drilling device as illustrated in figure 6.08. A column drilling machine with a rotational speed of 1400 rpm is used. The feeding force of the drill is limited to 200 N.

High-speed steel drills with a diameter of 3 to 12 mm according to DIN 338 Type N are used. The drills are edged meeting DIN 1412, grind A. Cooling or cutting fluids are not used. The amount of drills is unlimited; but the diameter of the drill shall not be changed during the test.

- Calculated drilling periods are: times when the drill touches the test specimen and rotates
- 15 s for each drill exchange
- cleaning periods.

The cleaning of the lock from chips or other material which hinders the drilling can be done with tweezers, watchmaker's screw-drivers, cleaning needles or small pliers.

The test is considered passed if, after finish of the pressure, an unlocking according to clause 6.1.8 cannot be achieved.

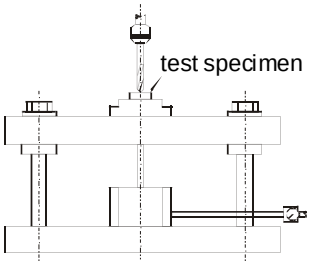

Figure 6.08: Drilling

6.7.7 Attack with hand tools

It is tested if the requirements according to clause 5.5.7 are fulfilled. Therefore, under usage of the tools listed in table 6.02 and within the time limits listed in table 5.01, it is tested if an unlocking can be achieved according to clause 6.1.8.

Tool	**Specification**
Hammer	Mass ≤ 700 g
Screwdriver	Length ≤ 300 mm
Chisel	Length ≤ 300 mm
Spike	Length ≤ 300 mm
Water pump pliers	Length ≤ 300 mm
Gripping pliers	Length ≤ 300 mm
Nipper pliers	Length ≤ 300 mm
Bolt cuter	Length ≤ 300 mm
Metal rope scissors	Length ≤ 300 mm
Coach wrench	Length ≤ 300 mm
Cylinder wrench	Length ≤ 310 mm
Knife	Length ≤ 160 mm
Lighter	Non-returnable product

Table 6.02: Tools

Only tools listed in table 6.02 shall be used, if necessary at the same time or in alternation. If a tool breaks, a new tool can be used.

Only one person is treating the test specimen during the test. A second person may hold the lock in any desired position with a cylinder wrench with a maximum length of 700 mm.

The attack time starts when the tools, except the wrench for fixing the lock, touch the lock for the first time and runs continuously until the lock has been opened or until the determined time as listed in table 5.01 has been reached.

The test is considered passed if an unlocking according to clause 6.1.8, cannot be achieved.

6.8 Further tests

New constructions or manufacturing procedures or new unlocking devices or methods might indicate that further tests are required.

Changes

Compared to the prior version the following changes were made:

- Rephrase the requirements according to the effective varieties (not more than two *neighbouring* key cuts shall be manufactured in the same depth)
- Cancellation of precise test conditions regarding climatic conditions
- Increasing the duration of application with corrosive medium to 96 hours
- Editorial changes