Standards for bicycle parking systems

Specified by the Board of the Stichting FietsParKeur

Version 2.0

November 10, 2004

Introduction to the third version (November 2004)

This is the third version of the Standards. As envisioned, this document will over time be adapted to the latest developments, both with regard to the bicycle parking systems and to the bicycles positioned therein. The introduction to the first version provides an insight into the genesis of this document and will therefore be reproduced here in full. After minor changes in March 2002, a second revision has resulted in this version.

Introduction to the first version (November 1998)

These standards for bicycle parking systems herald the first quality requirements regarding bicycle parking systems in the Netherlands. This document aims at major improvements in the bicycle parking systems used in the Netherlands. Time will tell whether this document is satisfactory in all respects. Chances are that new types of bicycle parking systems will be developed beyond the range of this document. Moreover, techniques improve over time. This document will therefore need to be updated regularly. These standards are meant to follow social trends and certainly not impede innovation. However, the standards also do not intend to raise the threshold to using a bicycle. The standards therefore assume that bicycle parking systems for public use should be available for free. For the future the use of electronic techniques is not excluded, provided these offer clear advantages.

More development is necessary, particularly in the field of theft prevention. The requirements stated in this document are deemed to be currently attainable within reason and signify a qualitative improvement of the bicycle parking systems currently on the market. In the years to come a study will be conducted in close consultation with the industry and the Stichting ART, in order to decrease the opportunities for bicycle theft in the combination bicycle, lock and bicycle parking system. At present the following areas of improvement have been identified in bicycle parking systems:

- the facility to fasten the frame and one wheel with a single lock;
- a design that prevents the lock from being too taut when fastened (a taut lock is easier to distort);
- the fastening features to be positioned in such a way that smaller locks will suffice;
- heavier requirements for attack resistance.

1 Introduction

A wide range of bicycle parking systems is available in the Netherlands. In order to raise the quality of these systems and tailor them to the needs of the consumer, the FIPAVO, the trade association of the various Dutch manufacturers and suppliers of bicycle parking systems, and the Fietsersbond have decided in 1998 to establish standards. A steering committee was established for the actual content. The concept standards were set by a working group. At the time the steering committee and working group respectively consisted of:

Steering committee

J. Klaver	supplier/manufacturer, member FIPAVO
A. van Klooster	supplier/manufacturer, member FIPAVO
T. Godefrooij	Fietsersbond, policy official
F. Smith	ANWB, policy official
R. de Bruijn	RAI, Stichting Fiets, secretary
R. Freeman	NS Railinfrabeheer, policy official
M. de Bot	ICS Adviseurs, advisor
S. de Kleijn	Architectenbureau van Herk & de Kleijn, architect
W. van Zijl	City of Utrecht, designer/advisor

Working group

H. Bosman	supplier/manufacturer, member FIPAVO
T. Godefrooij	Fietsersbond, policy official
A. Guit	André Guit Organisatie en Adviezen, advisor
J. Kostense	TNO-WT, research scientist

The current version was realized in cooperation with the Council of Experts of the Stichting FietsParKeur, consisting of:

R. Cobelens	Erdi Wegbebakening B.V.
H.J. van der Heu	ProRail
Ir. M.I. de Jong	Verkeersadviesburo Diepens en Okkema BV
J.A. Julius	NS Reizigers
J. Klaver	Klaver Technical Consultancy Group
Ir. C.L.C.M. Spapé	SOAB
R.D. Vos	City of Emmen afd. Verkeer
Th. Zeegers	Fietsersbond

2 Subject and area of application

The standards refer to bicycle parking systems. For all places in the system these systems should meet the requirements with the bicycles included in appendix I.This means that bicycle parking systems meeting these standards may be less suitable for children's bicycles or other types of bicycle. The standards do not apply to sheltered bicycle parking systems and bicycle lockers.

3 Basic principles for standards

When a BPS meets the standards for types of bicycle different from those included in appendix I, for instance children's bicycles, this may be included in the sales information.

A BPS must be equipped with a preventative anti-theft feature. When the BPS is installed in a safe, locked space or guarded shed, a preventative feature is not necessary. In that case the BPS need not meet the requirements concerning theft prevention and crack resistance. The sales information may contain the following statement: 'This BPS solely meets the standards when located in a safe, locked or permanently monitored space.'

These standards assume that a BPS is installed in such a way that bicycles can easily be parked and that the BPS, including the bicycles it contains, does not provide a needless obstacle to other traffic. For the width of aisles etc. we refer to `Plaats maken voor de fiets' (CROW publication 98, 1996).

These standards also assume that the manager of the space containing the BPS will arrange regular inspections and maintenance. At the end of the BPS's life the manager will arrange for disposal in accordance with the environmental regulations valid at that time.

4 Criteria and purchase considerations

4.1 Criteria

In the decision to buy a BPS several considerations play a role. These standards will be limited to the following criteria:

- Ease of use in parking a bicycle;
- Risk of injury to user or passer-by;
- Risk of damage to bicycle;
- Limitations concerning types of bicycles and/or bike components;
- Vandalism resistance;
- Ease of use in fastening a bicycle;
- Crack resistance of the anti-theft feature;
- Durability;
- Information.

Various technical requirements affect several criteria. The relation between the technical requirements as stated in chapter 7 and the criteria is visualized in appendix II

4.2 Purchase considerations

For several reasons in some areas no specific requirements have been formulated. As these considerations may nevertheless carry some weight, they will be discussed below.

Risk of theft

It is important that a BPS has features preventing theft. The standards state several requirements in this respect. For locations at high risk of theft a BPS is recommended to which both frame and front wheel can be fastened.

Use of space

The standards provide several requirements affecting the use of space, but essentially it is the manager who determines the amount of space available for parking bicycles.

Ease of installation

The sales information should state how a BPS is to be installed and which materials should be used. When installed accordingly the BPS should meet the requirements. Further considerations regarding installation are left to the manager.

Maintenance

The standards provide requirements concerning the durability of a BPS, but not concerning the removal of dirt or any other maintenance. It is wise when purchasing a BPS to confer with the department responsible for maintenance as to the importance of this consideration. Chapter 3 assumes that the manager of a BPS will provide the usual maintenance.

Design

Design is ofter a major factor in a purchase decision. As this criterium cannot be objectively considered, no requirements have been formulated in this respect.

Environment

It is assumed that this will be provided by successive laws and regulations for production and materials. Should this not occur, then the BPS and/or the production process should at least meet the environmental demands valid at the time of production (see requirement 7.3.5).

Price per bicycle

This criterium will often be a major factor in the decision to purchase. The standards assume that the buyer is well-qualified to weigh price and quality.

5 Description of definitions

5.1 Terms and definitions

Anti-theft system	Feature on a BPS that allows fastening of a bicycle to the BPS, if necessary by using a lock.
Attack resistance	Indicated by means of the time required for unauthorized opening of a fastening system and/or (integrated) lock of the BPS in order to remove the bicycle.
Bicycle locker	(Almost) completely separate, lockable bicycle shed meant exclusively for parking one or several bicycles.
Bicycle parking arrangement	Bicycle shed, parking system (BPS) or combination thereof.
Bicycle parking system (BPS)	Construction designed to provide sufficient stability to bicycles placed in or against the system.
Bicycle shed	Building designated to park bicycles.
Bicycle stand/rack	BPS meant for more than two bicycles (not to be confused with the stand affixed to a bicycle).
Bolt system	Element on the BPS that can be attached around or through the bicycle and when bolted, blocks and prevents the bicycle from being removed from the BPS. Bolting is effected by an internal or external lock to the BPS.
Clamp	BPS meant for one or two bicycles.
Clasp system	BPS where (part of) a bicycle can be positioned in such a way that the bicycle is supported on both sides (to the left and to the right).
Closed part of bicycle	The closed shape of the bicycle frame that is inextracably linked together and provides enough space to attach the (bicycle) locks from appendix I. (For instance: a fork does not belong to the closed part of a bicycle).
Double-sided (DS)	BPS where bicycles may be positioned side by side as well as facing.
Fastening system	A fastening feature available on the BPS allowing the bicycle to be joined to the BPS by the use of an external lock.
Guarded bicycle shed	Building protected by staff.
Heart to heart (HtH)	Distance between the midpoints of two adjoining bicycle places (measured perpendicular to the heartline of the place).
High/low (H/L)	BPS with alternating high and low bicycle places.
Ideal position	The position in the BPS that the manufacturer has intended as the definitive position of the bicycle, in the perception of the user. When there is no unique ideal position, this requirement should be met for at least one ideal position.
Installation distance	Distance between the midpoints of two bicycle places.
Lift height	Difference between the ground and the height where the effort is reduced thanks to the (partial) support of part of the bicycle by a part of the BPS.
Lockable bicycle shed	Building whose entrance is protected by a (mechanic or electronic) lock.

Multi-story rack	BPS where bicycles may be parked both at or near ground level and at a height of approx. 1.25 m.
Non-rigid system	(Part of) a BPS that is deformed elastically by 10 cm under a load of 250 N or less (when the load is removed the part reverts to its former position).
Oblique arrangement	Arrangement of bicycles in one or more BPS where the bicycles are not perpendicular but oblique to the construction of the BPS (the angle indicates the degree of rotation of the clamp).
Positioning manoeuvres	Manipulating the bicycle and/or movable parts of the BPS (bolts etc.) in order to position the bicycle in the BPS. A deliberate change of direction, tilting, lifting or changing hands are separate manoeuvres. (For instance: driving the bicycle forward is a separate manoeuvre. Therefore: driving the bicycle forward (1), tilting it (2), passing a frame clasp (3), righting it (4) and backing up into the clasp (5) are five separate manoeuvres).
Railing system	BPS where a bicycle can be positioned in such a way that support is provided mainly on one side of the bicycle.
Roll	Horizontal displacement over wheels or ball bearings without any effort.
Shelter	Roof over a BPS to protect bicycles against precipitation.
Simple manoeuvres	Manoeuvres requiring little strength (< 100 N.) and no tools, for instance shifting, pushing, pulling and tilting.
Single-sided (SS)	BPS where bicycles may only be positioned side by side.
Straight arrangement	Arrangement of bicycles in one or more BPS where the bicycles are perpendicular to the construction of the BPS (angle 0?).
Suspension system	BPS from which (part of) a bicycle is suspended.
Threshold height	Difference between the ground and the highest level in the BPS that the front wheel of a bicycle has to clear in order to be positioned in the BPS.
Two-sided (TS)	BPS where bicycles can be positioned on either side of the system.

5.2 Classification diagram bicycle parking arrangements

5.2.1 Bicycle shed

unprotected bicycle shed	**protected bicycle shed**
	• lockable bicycle shed • guarded bicycle shed

5.2.2 Bicycle parking systems

stability	**anti-theft**	**installation**
• clasp system – wheel – fork – frame – handlebars – seat	• fastening system – frame – front wheel – back wheel – handlebars – seat	• none • wall mounted • floor mounted • dug

• suspension system – handlebars – seat – wheel	• bolt system – frame – front wheel – rear wheal – handlebars – seat	
• railing system – frame – fork		

6 Catalogue of standards

The standards listed below contain regulations that serve as regulations for the standards contained in this document as well, assuming references occur in this document. At the time of publication of this document the editions mentioned were valid, but all standards are subject to change. Parties entering into agreements on the basis of the standards under consideration are advised to investigate whether it is possible to use the latest edition of the standards listed below .

ISO 8090:1990	Cycles – Terminology
NEN-EN-ISO 2409:1994	Paint and lacquer - Square test
ASTM 3359:1992	Standard test methods for measuring adhesions (of Coatings) by tape test. Test methode A = X-cut, test methode B = conform ISO 2409 (cross-cut).
ISO 9227:1990	Corrosion tests in artificial atmospheres - Salt spray tests
NEN-EN-ISO 4628-3:2003	Paint and lacquer - Assessment of qualitative deterioration of paint layers - Specification of intensity, quantity and size of common flaws - Part 3: Assessment of the degree of corrosion.
NEN-EN-ISO 1461:1999	Thermal galvanizing of top coats on iron and steel objects
Stichting ART	Test requirement MBT-03
TMS-01:1992	TNO test module for carrying out tests on locks

7 Technical requirements

7.1 Construction demands

7.1.1 Finish

7.1.1.1 Protruding parts and sharp edges

The BPS should not possess sharp edges and/or protruding parts that might injure users, catch them or their clothing and/or damage the bicycle.

- Parts protruding between a height of 0.8 and 2 m should be blunted and have a (final) width of at least 3.6 cm (flat part of the extremity) with a projected surface of at least 4 cm2 (flat part + radius of curvature).
- Parts protruding below 0.8 m and/or above 2 m should be blunted and have a (final) surface of at least 0.8 cm2 (corresponding to Ø 10 mm).
- Corners and edges of protruding parts should be cut (at least 2 x 2 mm) or possess a radius of curvature of 2 mm or more.
- The remaining edges of the BPS should have a radius of curvature of 0.5 mm or more.

7.1.1.2 Surface roughness

The surface of the BPS should be smooth enough not to cause injury and damage to the bicycle (for instance no wire edges, welding spatters and/or zinc droplets).
To be judged by the naked eye and by touch (hand smooth).

7.1.1.3 Jamming

Holes in the BPS with an insertion depth exceeding 8 mm should have a diameter <8 mm or > 25 mm.

7.1.2 Functional dimensions

7.1.2.1 Dimensions in relation to bicycle

The dimensions of the BPS should accommodate all bicycles mentioned in appendix I either in or against the BPS.
Test method: empirical trials.

7.1.2.2 Dimensions in relation to bicycle parts

The dimensions of the BPS should prevent bicycle parts like spokes, headlights and dynamo that are vulnerable during positioning, from coming into contact with the BPS. Cables should also not become ensnared and/or caught.
Test method: empirical trials with the bicycles and components from appendix I.

7.1.2.3 Stability

The BPS should provide a sufficient degree of stability for the bicycles from appendix I to be clasped/held or leant against the system in such a way that these remain upright in or against the arrangement without damage. When the BPS is intended for two-sided use, the bicycles on either side should in addition not hinder each other's stability.
Test method see par. 8.1.

7.1.2.4 Heart to heart-distance same level

The HtH-distance between two places in a clasp or suspension system at the same level and with a straight or oblique arrangement1 of the BPS should be at least 65 cm.

NB When the bicycle cannot enter in line with the parking place (when for instance a sideways maneuvre is required to guide the bicycle past a part of the BPS) the HtH-distance should be increased by the distance necessary to swerve.

7.1.2.5 Heart to heart-distance high/low systems

The HtH-distance between two places in a H/L-BPS and in a straight or oblique arrangement [1] of the BPS should be at least 37.5 cm.

NB When the bicycle cannot enter in line with the parking place (when for instance a sideways manoeuvre is required to guide the bicycle past a part of the BPS) the HtH-distance should be increased by the distance necessary to swerve.

7.1.2.6 Space between railing systems

The space between two railing systems at the same level and with a straight or oblique arrangement1 of the BPS should be:

- at least 65 cm when bicycles can only be positioned on one side of the system;
- at least 90 cm when bicycles can be positioned on either side of the system.

7.1.2.7 Difference in height

In high-low systems taking the front wheel the difference in height between the wheels of two bicycles positioned side by side should always be at least 30 cm.
Test method: empirical trials using 26" wheels.

In other high-low systems the difference in height between two bicycles positioned side by side should be at least 17 cm at the level of the handlebars, for each pair of bicycles listed in appendix I and in all possible configurations.
Test method: empirical trials, height of handlebars to be measured at the highest point of the (basic) handlebars.

7.1.2.8 Threshold and lift heights

In systems taking the front wheel the threshold height of the BPS should not exceed 42 cm.
In other systems the lift height of the bicycle to be positioned in the BPS should not exceed 30 cm.

7.1.3 Theft prevention

7.1.3.1 Construction anti-theft feature

- The BPS should be equipped with a feature to allow the bicycle to be fastened to the BPS with an integrated or external lock in a closed part of the bicycle frame - or any other part of the bicycle, provided the feature is designed to prevent removal of that part;
- in case of an external lock the feature should be suitable for the locks listed in appendix I;
- the aperture taking the external lock should have a diameter of at least 6 cm;
- in case the BPS is equipped with an integrated lock, improper use by a third party should be impossible;
- the anti-theft feature should be available to anyone possessing a bicycle and lock, including key, only (should not operate exclusively with the aid of money, a chip card or any other specific item).

In case of a fastening feature the locks mentioned in appendix I will all remain at least 25 cm above the ground. It is also impossible to easily move the bicycle positioned in the BPS in such a way as to bring the lock within 25 cm of the ground. In case of more than one fastening feature, this requirement goes for at least one of these.

[1] The installation distance between two clamps of a BPS increases in an oblique arrangement and is calculated according to the formula L^{instal} = HtH / cos á, (65 / cos 30° = 75 or 65 / cos 45° = 92 mm)

7.2 User requirements

7.2.1 Comprehensibility

The manner of positioning and/or fastening/bolting should be clear and comprehensible and/or clearly stated by way of signs (e.g. drawing).
Test method: assessment by panel (for procedure and composition of the panel see par. 8.2).

7.2.2 Maximum number of positioning manoeuvres

No more than five (5) positioning manoeuvres should be necessary to place the bicycle in/against the BPS.

7.2.3 Manoeuvres

All manoeuvres required to place a bicycle in a BPS should be possible with both hands on the handlebars (performing positioning manoeuvres).

7.2.4 Effort positioning

No excessive effort should be required to place and/or remove a bicycle.
Any effort required to push the bicycle upwards and/or lift/pull/push the bicycle into a clamp should not exceed 150 N.
Test method see par. 8.3

7.2.5 Accessibility anti-theft feature

In case an anti-theft feature is required, this should be within easy reach (to be ascertained at full occupancy of the BPS); in addition no complex manoeuvre should be required to operate the anti-theft feature and/or fastening the bicycle to the BPS.

- Operating procedures for bolts or clasps should not coincide with positioning of the bicycle.
- In case positioning or operation of an anti-theft feature occurs at the front of the bicycle, the distance between the ground and the scene of the action should be at least 60 cm.
- In case positioning or operation of an anti-theft feature occurs at the site of the seat tube of the bicycle, the distance between the ground and the scene of the action should be at least 50 cm.

7.2.6 Effort anti-theft feature

No excessive effort should be required to operate the anti-theft feature.
Any effort required to operate an anti-theft feature present on the BPS (bolts, clasps etc.) should not exceed 100 N.
Test method see par. 8.4.

7.2.7 Drainage

Wheel grooves and/or moving parts of the BPS should not retain water. Drainage holes, if used, should have a surface area of at least 50 mm2 (for instance a round hole equivalent to Ø 8 mm).

7.2.8 Temperature isolation

Contact surfaces of the BPS (for instance bolts etc.) that for correct operation must inevitably be touched by the user should not be composed of metal (synthetic or powder coating etc. are allowed).

7.2.9 Damage prevention

With correct use of the BPS no damage should occur to the bicycle, adjoining bicycles, the cyclist or third parties.

7.3 Strength and durability

7.3.1 Strength

7.3.1.1 Impact

The BPS should be vandalism-proof.
In tests conforming to par. 8.5 no breaks and/or visible cracks should appear in the BPS and the BPS should continue to function properly.

7.3.1.2 Fatigue

In case of non-rigidity of the BPS or parts thereof (10 cm displacement at a force not exceeding 250 N), these should be able to withstand alternating stress.
In tests conforming to par. 8.6 no breaks and/or visible cracks should appear in the BPS and the BPS should continue to function properly.

7.3.1.3 Removability protective parts

Parts fitted onto the BPS and meant as (protective) contact surfaces between the BPS and the bicycle and/or hands of the user should withstand for at least three minutes attempts to remove these parts by:

- exerting a pushing or pulling force of 150 N on the part involved and/or
- manipulation with pointed leverage tools like screwdrivers, knives etc. with a maximum length of 20 cm, with the force exerted on the tool not to exceed 150 N.

7.3.1.4 Durability moving parts

In case the BPS contains parts that are to be moved for the proper operation of the BPS (bolts etc), these should last at least 10.000 movements. After tests conforming to
par. 8.7 the moving part should still function properly, the effort needed should meet the requirements of par. 7.2.6 and no excessive slack should occur.

7.3.2 Crack resistance

7.3.2.1 Fastening and bolt systems

In case of attack of the fastening feature and/or boltsystem according to par. 8.8, these should resist for at least 1.5 minutes against wrongful opening and consequent removal of the bicycle.
In case part of the BPS remains attached to the bicycle lock after attack, the resistance time may be reduced to at least 1 minute.

7.3.2.2 Integrated lock

In case the BPS is equipped with an anti-theft feature with a lock, this lock should resist for at least 3 minutes against wrongful opening and consequent removal of the bicycle, when attacked according to par. 8.8.

7.3.3 Paint bonding

The paint bonding should be equal to or less than class 1.
Bonding is determined in accordance with NEN-EN-ISO 2409.
In case the paint layer exceeds 250 mm in thickness, the bonding may also be determined in accordance with ASTM 3359, testmethod A (X-cut). The bonding should in that case be equal to or less than class 4A (equivalent to class 1 in NEN-EN-ISO 2409).

7.3.4 Resistance to weather influences

7.3.4.1 Corrosion resistance

The entire BPS (including attachments) should be free of rust after 6 months of exposal to wind and weather or after 48 hours of salt-spray test ISO 9227 (to be judged by the naked eye). In case the BPS is completely galvanized, the galvanization should comply with NEN-EN-1461.

7.3.4.2 Synthetic parts

Synthetic materials used should be weather-resistant (temperature, moisture, UV, ozon) to such a degree that the mechanical properties still conform to at least 80% of the initial value after 15 years of use in all weathers.
Test method: Statement of the manufacturer of the synthetic parts or research into mechanical properties of new and artificially aged material.

7.3.4.3 Embrittlement point synthetics

In case the synthetics used possess an embrittlement point at low temperatures, that point should be at or below minus 25 ?C .
Test method: Statement of the manufacturer of the synthetic parts or research into mechanical properties of new and artificially aged material.

7.3.5 Environment

In constructing the BPS the manufacturer is to meet all environmental requirements in force at that time.

8 Test methods

8.1 Stability

The stability of the BPS is tested with the aid of the bicycles mentioned in appendix I. After positioning in the BPS the following loads are placed on one side of the bicycle:

- 10 kg in a bag to the side of the carrier of the bicycle, with the centre of gravity over the rear axle, 20 ± 2 cm below the top of the carrier and 5 ± 2 cm to the side of the carrier.
  And
- 7.5 kg hanging from the handlebars, at approx. 5 cm from the end of the handlebars.

The BPS should provide stability on both sides without the use of fastening or bolt systems, if present. The bicycle loaded in this way should also remain upright when another bicycle is dropped from a distance of 20 centimetres against the BPS or the bicyce itself.
With the load described above, a bicycle positioned in the BPs should not tilt more than 15 degrees sideways in relation to the resting position. The bicycle should also tilt less than 15 degrees sideways when a bicycle is moved into or out of the BPS next to it.
In case it is possible to roll the bicycle positioned in the BPS lengthways, the loaded bicycle should not fall over or damage a neighbouring bicycle when shifted 10 centimetres to the front or back of the ideal position.

8.2 Comprehensibility to the user

The comprehensibility of the BPS is judged subjectively by a panel of 12 people working independently. The panel is to be chosen at random, but should be composed of frequent cyclists. The panel should consist of:

- 4 people (2 male/female) aged 12 to 20;
- 4 people (2 male/female) aged 20 to 55;
- 4 people (2 male/female) aged 55 to 70.

Each member of the panel should reach within three (3) minutes the conviction that the proper use of the BPS and the particulars for using the anti-theft feature, if present, as described in par. 7.2.1 are clear and comprehensible.
A comparable panel is also used to determine the ideal position of the BPS.

8.3 Effort positioning

The effort needed to move a bicycle into or out of the BPS is determined empirically with the aid of a weighing device and the bicycles mentioned in appendix I.
Measuring method: the weighing device (push or pull steelyard) is attached against/to the seat pin immediately over the seat tube of the bicycle. The weighing device exerts a slowly increasing power on the bicycle. The direction of the effort should be parallel to the direction of motion of the bicycle. Determine the maximum effort needed to move the bicycle into or out of the BPS. Repeat 5 times. The lowest value of the 5 repeats is the measurement to be tested against the requirements.
Measuring equipment: push-pull steelyard, measuring range 0 - max. 250 N, measuring accuracy ± 5%.

8.4 Effort anti-theft feature

The effort needed to operate the anti-theft feature is determined empirically with the aid of a weighing device.
Measuring method: the weighing device (push or pull steelyard) is attached against/to the feature concerned. The point of action is determined empirically and in accordance with established practice (the steelyard is positioned at a place with the largest possible leverage, up to a maximum of 2.5 cm

from the end of a lever). The weighing device exerts a slowly increasing power on the anti-theft feature. The direction of the effort should match the direction of movement of the anti-theft feature. Determine the maximum effort needed to operate the anti-theft feature. Repeat 5 times. The lowest value of the 5 repeats is the measurement to be tested against the requirements.
Measuring equipment: push-pull steelyard, measuring range 0 - max. 250 N, measuring accuracy ± 5%.

8.5 Impact strength

In order to test the impact strength the BPS is treated as in actual practice (kicking against and/or jumping on the BPS). To that purpose a worst-case plan of attack is drawn up, stating at which point and at which angle the attack should occur.

The attack is executed by knocking a lead ball[2] horizontally or vertically, in the situations described below:

- arrangement BPS as in actual practice, without bicycles;
- vandalism is mimicked by a knock with a lead ball; horizontal movement from swinging the ball, vertical movement by dropping it from a height;
- the size of the horizontal movement depends on the height of attack, to wit:
  - attack height below 70 cm: vertical displacement 60 cm;
  - attack height above 70 cm: vertical displacement 50 cm;
- the vertical knock only to be executed when the height of attack is below 30 cm; height of drop
- 50 cm.

8.6 Fatigue strength non-rigid systems

In order to test the fatigue strength the BPS is treated as in actual practice (jiggling the BPS). To that purpose a worst-case plan of attack is drawn up, stating at which point and at which angle the alternating load should occur.
During the load test an alternating push-pull force of 250 N ± 5% with a frequency of approx. 0.5 Hz is exerted on the BPS with the aid of compressed air. The minimum number of load changes is 300.000 (1 pull and 1 push = 1 load change).
Arrangement BPS as in actual practice, without bicycles.

8.7 Durability moving parts

In order to test the durability (wear) of moving parts, these are moved according to actual practice (angular turn and/or axial rotation). To that purpose the part is moved over the entire rotation length with a speed of 0.5 m/s ± 0.1 and a cycle frequency of approx. 0.5 Hz.

8.8 Attack test

In order to test the attack resistance of the fastening feature this is treated according to actual practice (cutting, sawing, distortion, beating, skinning) To that purpose a worse-case plan of attack is drawn up, stating in which way, at which point(s) and at which angle(s) the stress should occur. The execution of this test is in accordance with the ART test for bicycle locks.

- The test is conducted with a single bicycle in the BPS.
- The point(s) where the lock and/or the fastening feature will be violently attacked are to be determined by those carrying out the attack test. To that purpose these will draw up one or more plans of attack.
- The attack occurs with the aid of tools selected from appendix III.

[2] A football filled with lead shot, with a mass of 25 kg.

- The tools selected may be sharpened and used in accordance with private preferences.
- When tools are changed during the attack, the time needed should be included in the attack time.
- Damage to the bicycle as a result of the test, is allowed provided the damage does not compromise the bicycle's performance.

9 Information for users

9.1 Information on the product

Preferably no information is necessary on the product. In case information is provided, the following requirements should be met:

- All information relevant for the end user should be durable and applied in such a way that it is clearly visible and legible in the operating situation of the product
- In case symbols and/or letters are used, these should display marked contrasts (e.g. by the use of black-and-white or primary colours).
- The lettering of the information on the BPS should exceed 4 mm.

9.2 Sales information

The sales information should contain the following data:

- name, address and other relevant information about the manufacturer (e.g. telephone, fax, etc.);
- model name/type BPS;
- does BPS meet requirements with or without anti-theft feature;
- Intended use of the BPS (types of bicycle);
- number of bicycles to be parked in BPS;
- heart to heart-distance (HtH-distance) of the bicycle places in the BPS;
- installation distance between two indivi dual bicycle places;
- overall dimensions of the BPS (after installation);
- assembly/positioning;
- overall dimensions of the BPS after installation and with bicycle(s) (length bicycle, but also (extra) space due to the width of the handlebars of the outermost bicycles);
- overall dimensions of the BPS with the space required to manoeuvre the bicycles (room to move);
- assembly dimensions;
- total weight;
- in case the BPS can be disassembled, weight of the heaviest part;
- materials and surface treatments used;
- maintenance;
- in case warranties are mentioned, conditions for warranty (which, subject of warranty and period) should be stated;
- information concerning availability in colour;
- information concerning sales procedure (delivery times, prices, etc.).

9.3 Installation instructions

The installation instructions should contain the following information:

- assembly/positioning requirements;
- materials and/or tools necessary for assembly/positioning;
- maintenance and cleaning.

Appendix I - Specifications bicycles and locks

Description bicycles and locks

In order to determine the range of use of BPS the following bicycle parts and bicycles are employed:

Wheels

- w1 - 28" tyre width 34 mm (city bike) (drum brakes, gear hub)
- w2 - 28" tyre width 27 mm (racing bike) (rim brakes, derailleur)
- w3 - 26" tyre width 47 mm (ATB) (cantilever brakes, derailleur)

Handlebars

- s1 - city bike handlebars (conventional), width 580 mm ± 15 mm
- s2 - racing handlebars, width 425 mm ± 15 mm
- s3 - ATB handlebars (+ bar ends), width 600 mm ± 15 mm

Bicycles (complete, including brake cables, etc.)

The cables are mounted according to manufacturer's instructions.

- A city bike, frame size 61 cm, wheels w1, handlebars s1, handlebar height 110 cm ± 5, handbrakes with cables, cables mounted decently along frame, dynamo on left of front wheel, headlight (Ø approx. 9 cm) on steering pin.
- B racing hybrid, frame size 60 cm, wheels w2, handlebars s2, handlebar height 100 cm ± 5, handbrakes with cables, cables mounted decently along frame.
- C ATB hybrid, frame size 53 cm, wheels w3 (cantilever brakes), handlebars s3, handlebar height 95 cm ± 5, handbrakes with cables, cables mounted decently along frame.
- D. Ladies' citybike: sit-up-and-beg-type, frame size 56 cm, handlebar height 115 cm ± 5, handbrakes with cables, cables mounted decently along frame, dynamo on left of front wheel, headlight (Ø approx. 9 cm) on steering pin.

To determine the usefulness of the anti-theft feature the following locks (including keys) are employed:

- chainlock (length 90 cm., length and width of links not to exceed 50 x 40 mm.) (e.g.. Konig blue chain 8 mm. x 90; Starry Chainlock double pin blue (8 x 90), Abus Granite CityChain 1060/85)
- U-lock (inside width and length 11 x 23 cm.) (e.g.. ABUS 74/170 HB 260 or Trelock BS 610 108-300D).

As the availability of these bicycles and locks may change quickly in dynamic market circumstances, the Stichting FietsParKeur may update the specifications mentioned in this appendix at the beginning of each calendar year.

Appendix II - Relationship 'technical requirements - criteria'

Presence and status of requirements in relation to particular areas of interest (TNO rap. 1998)

A		B - requirements	C – criteria									D – purchase considerations						
TNO-rapport			ease positioning bicycle in BPS	chances damage to user or passer-by	chances damage bicycle	BPS range of bicycle types etc.	vandalism resistance BPS	ease of fastening bicycle to BPS	crack resistance of anti-theft feature	durability	information	risk of theft	use of space BPS	ease of installation BPS	maintenance BPS	design BPS	environment BPS	price per bicycle
p.			1	2	3	4	5	6	7	8	9							
14	Finish	sharp edges, potruding parts		x	x											*		
14	Functional dimensions	a) range of use bicycles	x	x	x	x										*		
15		b) chances damage to bicycle parts	x		x	x										*		
15		stability	x	x	x	x										*		
15		HtH (level)	x	x	x	x							x			*		
15		HtH (high-Low system)	x	x	x	x							x			*		
16		free space between railings	x	x	x	x							x			*		
16		height difference (H/L systems)	x	x	x	x										*		
16		threshold and lift heights	x	x	x	x										*		
16	Theft prevention	anti-theft feature							x			x				*		
17	Operational particulars	comprehensibility to user	x	x	x	x		x	x			x				*		
17		number of manoeuvres	x	x	x	x		x								*		
17		effort positioning	x	x	x	x		x								*		
17		accessibility anti-theft feature	x	x	x	x										*		
17		effort use anti-theft feature	x	x	x	x		x								*		
18		drainage	x	x	x			x							x	*		
18		isolation contact surfaces	x	x	x			x								*		
18	Strength durability	impact strength (vandalism)					x		x	x		x			x	*		
18		fatigue (vandalism)					x		x	x		x			x	*		
18		removability protective parts			x		x			x						*		
19		durability moving parts					x									*		
19	Crack resistance	fastening feature and bolt systems					x		x	x		x			x	*		
19		integrated lock					x		x	x		x			x	*		
19		paint bonding								x					x	*	x	
19	Resistance to weather	galvanized parts		x	x					x					x	*	x	
19		metal and/or coated parts								x					x	*	x	
20		synthetic parts								x					x	*	x	
20		embrittlement synsthetics													x	*	x	
20	Environment	environment											x	x	x	*	-	x
23	Information for users	information on product	x	x	x	x		x						x		*		
24		sales information				x			x		x	x	x	x	x	*	x	x
24		installation instructions						x					x	x	x	*		
25	Description bicycles, parts and locks		*		*	*		*	*		*							

column A: page in report containing relevant requirement
column B: requirements
columns C and D: x area of interest partly determines requirements. X mainly determines

Appendix III - Tools used in attack test

Tool	Brand, type
Steel bar cutters 60 cm	Bahco 4559-24"
Cable cutters 60 cm	Felco C.16
Side-cutting nippers	Gedore 8316-8/8030-8
Front-cutting nippers	Gedore 8367/8370-8
Pincers	Knipex 50/210
Pipe wrench	Gedore 143-10
Metal saw (a)	Sandvik High speed 12"
Metal saw (b)	Sandvik HSS Bi-metal 12"
Tungsten saw (blade)	Wolfram Grit WS 12"
Tungsten saw (string)	Wolfram Grit HS 12"
Adjustable spanner 10"	Gedore 91-1- 255 mm 10"
Set wrenches	Gedore 7-020 set of 20
Nail extractor 50 cm	Nooitgedagt 55 cm
Set screwdrivers	Gedore 1545-1605-007
Bench hammer 250 gram	Gedore 8601-1/2 L 280
Bench hammer 500 gram	Gedore 8606-500
Chisel	Gedore 246

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