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Racing bicycles - Safety requirements and test methods

Bicyclettes de course - Exigences de sécurité et méthodes d'essai

Rennräder - Sicherheitstechnische Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 7 October 2005.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This European Standard (EN 14781:2005) has been prepared by Technical Committee CEN/TC 333 “Cycles”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2006, and conflicting national standards shall be withdrawn at the latest by November 2006.

This European Standard is completely new and is one of a series being produced to cover all types of bicycle:

EN 14764	*City and trekking bicycles — Safety requirements and test methods*
TC 333 WI 00333002	*Cycles - Vocabulary — Terminology (ISO 8090: 1990 Modified)*
EN 14765	*Bicycles for young children — Safety requirements and test methods*
EN 14781	*Racing bicycles — Safety requirements and test methods*
prEN 15194	*Cycles — Electrically power assisted cycles — EPAC bicycle*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

This European Standard has been developed in response to demand throughout Europe, and the aim has been to ensure that bicycles manufactured in compliance with it will be as safe as is practically possible. The tests have been designed to ensure the strength and durability of individual parts as well as of the bicycle as a whole, demanding high quality throughout and consideration of safety aspects from the design stage onwards.

The scope has been limited to safety considerations, and has specifically avoided standardisation of components.

If the bicycle is used on public roads national regulations apply.

1 Scope

This European Standard specifies safety and performance requirements for the design, assembly and testing of racing bicycles and sub-assemblies, and lays down guidelines for manufacture's instructions on the use and care of such bicycles.

This European Standard applies to racing bicycles intended for high-speed amateur use on public roads, and on which the saddle can be adjusted to provide a maximum saddle height of 635 mm or more.

This European Standard does not apply to mountain bicycles and to specialised types of racing bicycle such as tandems or bicycles designed and equipped for use in sanctioned competitive events.

NOTE For bicycles with a saddle height of ≤ 435 mm see EN 71 and with a maximum saddle height of more than 435 mm and less than 635 mm see EN 14765.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 5775-1, *Bicycle tyres and rims — Part 1: Tyre designations and dimensions*

ISO 5775-2, *Bicycle tyres and rims — Part 2: Rims*

ISO 7636, *Bells for bicycles and mopeds — Technical specifications*

ISO 9633, *Cycle chains — Characteristics and test methods*

3 Terms and definitions

For the purposes of this European Standard, the following terms and definitions apply.

3.1
cycle
any vehicle that has at least two wheels and is propelled solely or mainly by the muscular energy of the person on that vehicle, in particular by means of pedals

3.2
bicycle
two-wheeled cycle

3.3
tandem
bicycle with saddles for two or more riders, one behind the other

3.4
fully-assembled bicycle
bicycle fitted with all components necessary for its intended use

3.5
racing-bicycle
bicycle having a steering assembly with multiple grip positions allowing for an aerodynamic posture, a multi-speed transmission system, tyre width not greater than 28 mm, and a maximum mass of 12 kg for the fully assembled bicycle

3.6
maximum saddle height
vertical distance from the ground to the top of the seat surface, measured with the seat in a horizontal position and with the seat-pillar set to the minimum insertion depth

[EN 71-1:1998]

3.7
suspension fork
front fork incorporating controlled, axial flexibility to reduce the transmission of road-shocks to the rider

3.8
suspension-frame
frame incorporating controlled, vertical flexibility to reduce the transmission of road-shocks to the rider

3.9
braking distance
distance travelled by a bicycle between the commencement of braking (3.10) and the point at which the bicycle comes to rest

3.10
commencement of braking
point on the test track or test machine at which the brake actuating device operated directly by the rider's hand or foot or by a test mechanism starts to move from its rest position, on the test track this point being determined by the first brake actuating device (front or rear) to operate

3.11
braking force F_{Br}
tangential rearward force between the tyre and the ground or the tyre and the drum or belt of the test machine

3.12
rim-brake
brake in which brake-shoes act on the rim of the wheel

3.13
hub-brake
brake which acts directly on the wheel-hub

3.14
disc-brake
brake in which pads are used to grip the lateral face of a thin disc attached to or incorporated in the wheel-hub

3.15
secondary brake levers
any system that enables the rider to operate the brakes with the hands applied away from the main braking grip position

3.16
wheel
assembly or combination of hub, spokes or disc, and rim, but excluding the tyre

3.17
pedal tread-surface
surface of a pedal that is presented to the underside of the foot

3.18
quick-release pedal (quick-release device)
pedal that presents a system for attachment to the shoe that can be released by foot-movement alone

3.19
crank assembly
for fatigue testing it consists of the two cranks, the pedal-spindle adaptors, the bottom-bracket spindle, and the first component of the drive system, e.g. the chain-wheel set

3.20
aerodynamic extensions
extension (or extensions) secured to the handlebar, stem, or other part to improve the rider's aerodynamic posture

3.21
visible crack
crack which results from a test where that crack is visible to the naked eye

3.22
fracture
unintentional separation into two or more parts

3.23
wheel-base
distance between the axes of the front and the rear wheels of an un-laden bicycle

3.24
public road
any designated and adopted road, pavement, path, or track on which a bicycle is legally permitted to travel, and on most though not all of which, bicycles will share use with other forms of transport including motorised traffic

3.25
toe-clip
device attached to the pedal to grip the toe end of the rider's shoe but permitting withdrawal of the shoe

3.26
highest gear
gear ratio which gives the greatest distance travelled for one rotation of the cranks

3.27
lowest gear
gear ratio which gives the shortest distance travelled for one rotation of the cranks

4 Requirements and test methods

4.1 Brake tests and strength tests – special requirements

4.1.1 Definition of brake tests

Brake tests to which accuracy requirements apply, as in 4.1.4, are those specified in 4.6.2.2.3 to 4.6.6.2 inclusive and 4.6.7.5.1.3.

4.1.2 Definition of strength tests

Strength tests to which accuracy requirements apply, as in 4.1.4, are those involving static, impact or fatigue loading as specified in 4.7 to 4.13 inclusive and 14.17.2.

4.1.3 Numbers and condition of specimens for the strength tests

In general, for static, impact and fatigue tests, each test shall be conducted on a new test sample, but if only one sample is available, it is permissible to conduct all of these tests on the same sample with the sequence of testing being fatigue, static and impact.

When more than one test is conducted on the same sample, the test sequence shall be clearly recorded in the test report or record of testing.

NOTE It should be noted that if more than one test is conducted on the same sample, earlier tests can influence the results of subsequent tests. Also, if a sample fails when it has been subjected to more than one test, a direct comparison with single testing is not possible.

In all strength tests, specimens shall be in the fully-finished condition.

4.1.4 Accuracy tolerances of test conditions for brake tests and strength tests

Unless stated otherwise, accuracy tolerances based on the nominal values shall be as follows:

Forces and torgues…………… 0/+5 %
Masses and weights……………± 1 %
Dimensions…………………......± 1 mm
Angles……………………………± 1°
Time duration……………………± 5 s
Temperatures……………………± 2 °C
Pressures………………….........± 5 %

4.2 Sharp edges

Exposed edges that could come into contact with the rider's hands, legs etc., during normal riding or normal handling and normal maintenance shall not be sharp.

4.3 Security and strength of safety-related fasteners

4.3.1 Security of screws

Any screws used in the assembly of suspension systems or screws used to attach generators, brake-mechanisms and mudguards to the frame or fork or handlebar, and the saddle to the seat- pillar shall be provided with suitable locking devices, e.g. lock-washers, lock-nuts, or stiff nuts.

NOTE Fasteners used to assemble hub and disc brakes should have heat-resistant locking devices.

4.3.2 Minimum failure torque

The minimum failure torque of bolted joints for the fastening of handlebars, handlebar-stems, bar-ends, seats and seat-pillars shall be at least 50 % greater than the manufacturer's recommended tightening torque.

4.4 Crack detection methods

Standardised methods may be used to emphasise the presence of cracks where visible cracks are specified as criteria of failure in tests specified in this European Standard. See 3.21.

NOTE For example, suitable dye-penetrant methods are specified in ISO 3452.

4.5 Protrusions

4.5.1 Requirement

4.5.1.1 Exposed protrusions

Any rigid exposed protrusion longer than 8 mm (see *L* in Figure 1) after assembly except:

a) the front gear-change mechanism at the chain wheel;

b) the gear-change mechanism at the rear wheel;

c) the rim-brake mechanism at the front and rear wheels;

d) a lamp-bracket fitted on the head-tube;

e) reflectors;

f) toe-clips and toe-straps;

g) clip-less attachment mechanism;

h) chain wheels and rear sprockets;

i) water bottle cage

shall terminate in a radius, R (see Figure 1), of not less than 6,3 mm. Such protrusions shall have a major end dimension, A, not less than 12,7 mm and a minor dimension, B, not less than 3,2 mm.

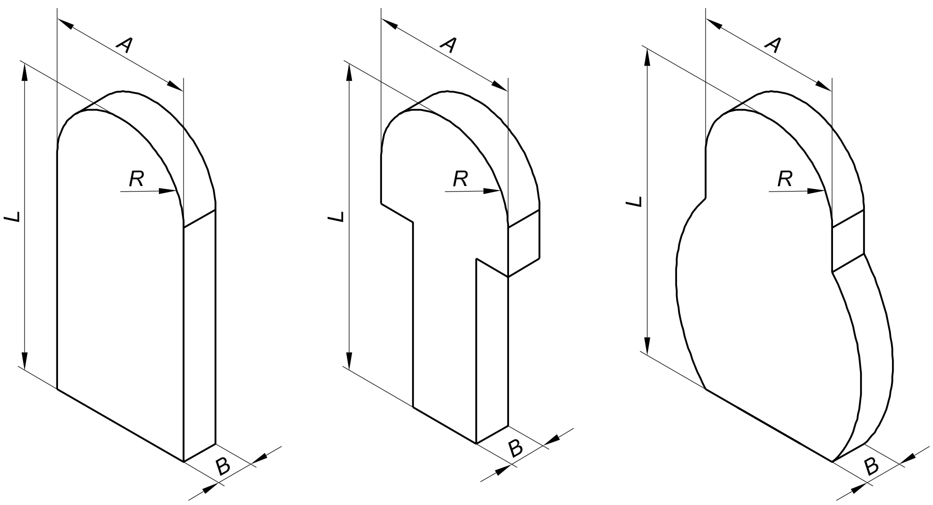
4.5.1.2 Exclusion zone, protective devices and screw threads

There shall be no protrusions on the top tube of a bicycle frame between the saddle and a point 300 mm forward of the saddle, with the exception that control cables no greater than 6,4 mm in diameter and cable clamps made from material not thicker than 4,8 mm may be attached to the top tube.

Foam pads attached to the bicycle frame to act as protective cushions are permitted, provided that the bicycle meets the requirements for protrusions when the pads are removed.

A screw thread that is an exposed protrusion shall be limited to a protrusion length of one major diameter of the screw beyond the internally threaded mating part.

Dimensions in millimetres



Key

$R \geq 6,3$

$A \geq 12,7$

$B \geq 3,2$

Figure 1 — Examples of minimum dimensions of exposed protrusion (these apply when *L* is greater than 8 mm)

Dimensions in millimetres

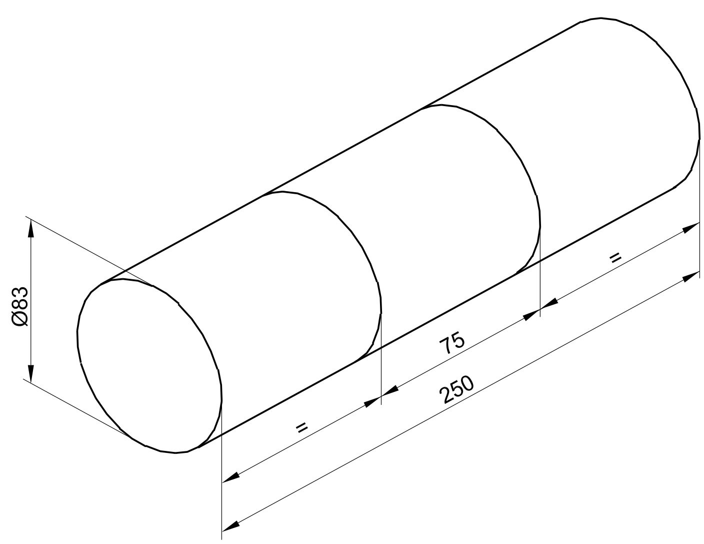
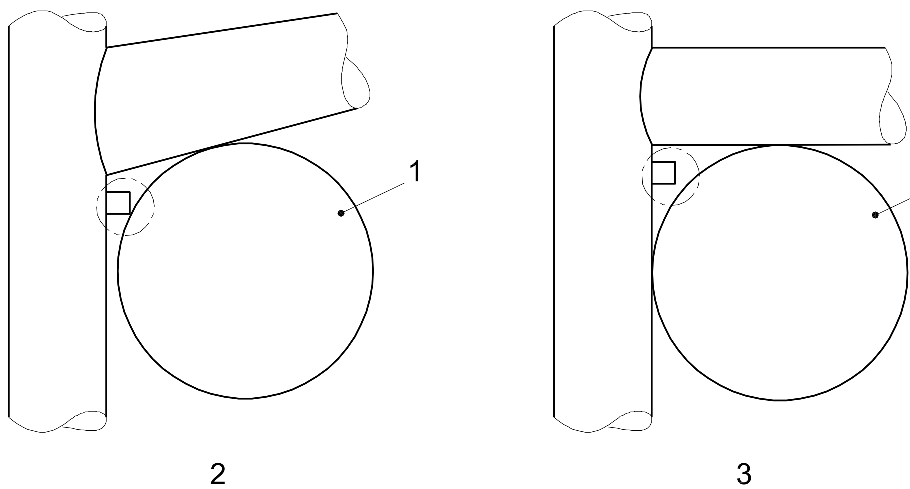


Figure 2 — Exposed protrusion test cylinder



Key

1 Test cylinder

2 Protrusion shall comply

3 Protrusion need not comply

Figure 3 — Examples of protrusions

4.5.2 Test method

Conduct the test with a protrusion test cylinder (which simulates a limb) having the dimensions shown in Figure 2.

Manoeuvre the test cylinder in all possible attitudes towards any rigid protrusion on the bicycle. If the central 75 mm long section of the cylinder contacts the protrusion, that protrusion shall be considered to be an exposed protrusion and it shall comply with 4.5.1.1.

Examples of protrusions that need and do not need to comply with the requirements are shown in Figure 3.

4.6 Brakes

4.6.1 Braking-systems

A bicycle shall be equipped with at least two independent braking-systems. At least one shall operate on the front wheel and one on the real wheel. The braking systems shall operate without binding and shall be capable of meeting the braking-performance requirements of 4.6.7.

Brake-blocks containing asbestos shall not be permitted.

4.6.2 Hand-operated brakes

4.6.2.1 Brake-lever position

The handbrake levers for front and rear brakes shall be positioned according to the legislation or custom and practice of the country in which the bicycle is to be sold, and the bicycle manufacturer shall state in the manufacturer's instructions manual which levers operate the front and rear brakes (see also Clause 5 b)).

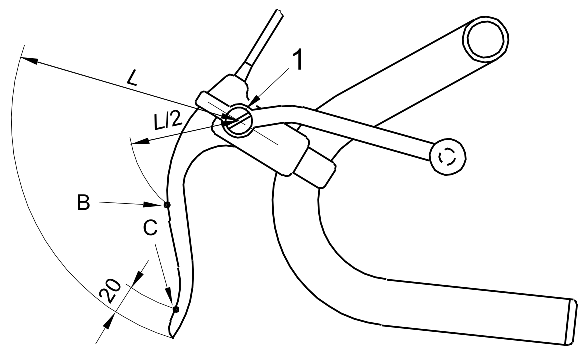
4.6.2.2 Brake-lever grip dimensions

4.6.2.2.1 Requirement

It shall be possible to fit the dimension gauge shown in Figure 5 over the brake-lever (or a secondary brake-lever) and the handlebar grip or any other covering in at least one position between points B and C indicated in Figure 4, without causing any movement of the brake-lever towards the handlebar.

NOTE The range of adjustment on the brake-lever should permit these dimensions to be obtained.

Dimension in millimetres

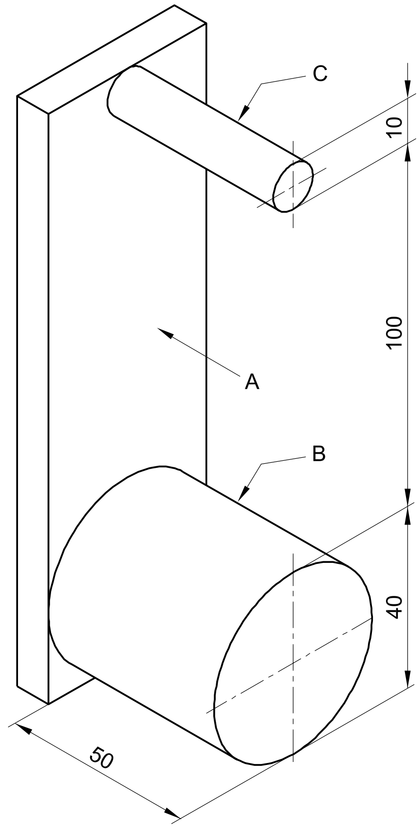


Key

1 Pivot

Figure 4 — Handbrake-lever grip dimensions

Dimensions in millimetres



Key

A = Face A

B = Face of cylinder

C = Rod

Figure 5 — Handbrake-lever grip-dimension gauge

4.6.2.2.2 Test method

Fit the gauge illustrated in Figure 5 over the handlebar and brake lever as shown in Figure 6 so that the face A contacts the handlebar or handlebar-grip and the brake-lever. Put the face of cylinder B in contact with the part of the grip intended for contact with rider's hand and check if the requirements are met.

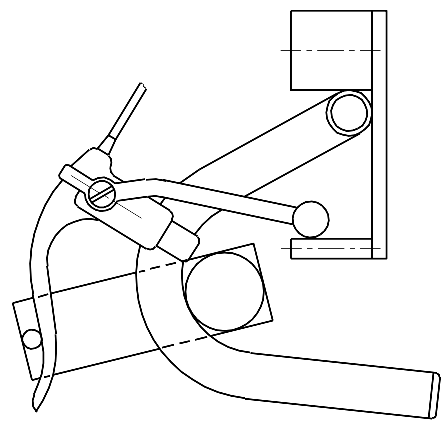


Figure 6 — Method of fitting the gauge to the handbrake-lever and handlebar

Dimensions in millimetres

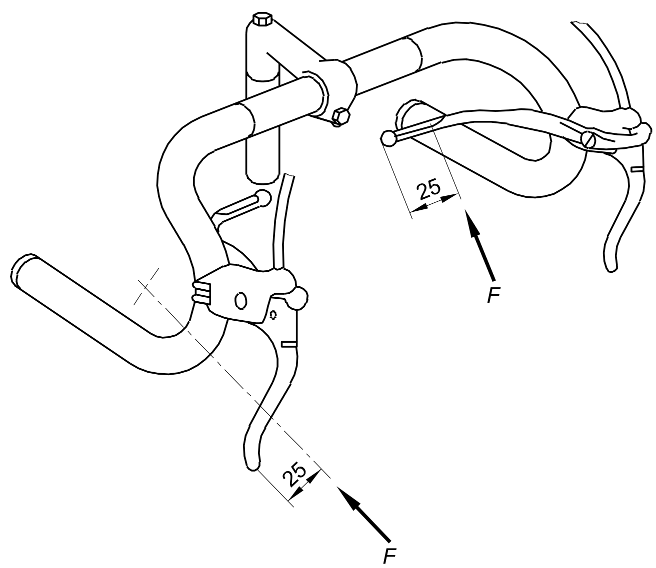


Figure 7 — Position of applied force on the handbrake-lever

4.6.2.3 Position of applied force

For the purposes of all braking tests in this European Standard the test force shall be applied at a distance of 25 mm from the free end of the brake-lever (see Figure 7).

4.6.3 Attachment of brake assembly and cable requirements

NOTE See 4.3 in relation to fasteners.

Cable pinch-bolts shall not sever any of the cable strands when assembled to the manufacturer's instructions. In the event of a cable failing, no part of the brake mechanism shall inadvertently inhibit the rotation of the wheel.

The cable end shall either be protected with a cap that shall withstand a removal force of 20 N or be otherwise treated to prevent unravelling.

The inner cable shall be protected from corrosion, e.g., by a suitable impervious liner to the outer casing. Also, either the inner cable shall have a low-friction coating or the outer casing shall have a low-friction lining.

4.6.4 Brake-block and brake-pad assemblies – security test

4.6.4.1 Requirement

The friction material shall be securely attached to the holder, backing-plate, or shoe and there shall be no failure of the assembly when tested by the method specified in 4.6.4.2. The brake system shall be capable of meeting the strength test specified in 4.6.6 and the braking performance requirements of 4.6.7.4.1 or 4.6.7.5.1, after completion of the test specified in 4.6.4.2.

4.6.4.2 Test method

Conduct the test on a fully assembled bicycle with the brakes adjusted to a correct position with a rider or equivalent mass on the saddle. The combined mass of the bicycle and rider (or equivalent mass) shall be 100 kg.

Actuate each brake-lever with a force of 180 N applied at the point as specified in 4.6.2.3 or a force sufficient to bring the brake-lever into contact with the handlebar grip, whichever is the lesser. Maintain this force while subjecting the bicycle to five forward and five rearward movements, each of which is not less than 75 mm distance.

4.6.5 Brake adjustment

Each brake shall be capable of adjustment with the use of a tool to an efficient operating position until the friction material has worn to the point of requiring replacement as recommended in the literature provided by the manufacturer. Also, when correctly adjusted, the friction material shall not contact anything other than the intended braking surface.

4.6.6 Hand-operated braking-system – strength test

4.6.6.1 Requirement

When tested by the method described in 4.6.6.2, there shall be no failure of the braking-system or of any component thereof.

4.6.6.2 Test method

Conduct the test on a fully assembled bicycle. After it has been ensured that the braking system is adjusted according to the recommendations in the manufacturer's instructions, apply a force to the brake-lever at the point as specified in 4.6.2.3. This force shall be 450 N, or such lesser force as is required to bring:

a) a brake-lever into contact with the handlebar grip or the handlebar where the manufacturer does not fit a grip;

b) a secondary brake lever to the end of its travel.

Repeat the test for a total of 10 times on each hand-brake lever or secondary brake lever.

4.6.7 Braking performance

4.6.7.1 General

Braking performance is determined by the distance to stop (the braking distance). Two test methods are specified and experience has shown that either method is suitable and either can be used.

One test method is the track test in which braking distance is measured directly with the progressive characteristics of the brakes being self-evident.

The alternative test method is the machine test in which braking force is measured and, from which, braking distance is calculated. The progressive characteristics of the brake are determined by linearity measurements. A final, simple track test checks for smooth, safe, stopping characteristics.

Whichever method is used there shall be in compliance with 4.6.7.2 and 4.6.7.3.

4.6.7.2 Test bicycle

Conduct the braking-performance test on a fully assembled bicycle after the brakes have been subjected to the strength test detailed in 4.6.6. Before testing the bicycle by either method, inflate the tyres and adjust the brakes all according to the manufacturer's instructions, but in the case of rim-brakes to the maximum clearance specified by the manufacturer.

4.6.7.3 Secondary brake levers

Where a bicycle is fitted with secondary brake-levers attached to handbrake-levers, bar-ends or aerodynamic extensions, separate tests shall be conducted for the operation of the secondary brake-levers in addition to tests with the normal levers.

4.6.7.4 Requirements

4.6.7.4.1 Braking distance

The bicycle shall fulfil the requirements shown in Table 1.

Table 1 — Brake test velocities and braking distances

Condition	**Velocity** **km/h**	**Brakes in use**	**Braking distance** **m**
Dry	25	Both	6,00
		Rear only	12,00
Wet	16	Both	5,00
		Rear only	10,00

4.6.7.4.2 Smooth, safe stop-characteristics

The bicycle shall show smooth, safe stop-characteristics.

i) For the track test, smooth, safe stop characteristics are defined as stopping within the required distances without occurrence of any of the following:

   a) excessive juddering;

   b) front wheel locking;

   c) bicycle overturning (rear wheel lifting uncontrollably);

   d) rider's loss of control;

   e) excessive side-skid causing the rider to put his foot to the ground to retain control.

With certain types of braking system, it may not be possible to avoid entirely some skidding of the rear wheel during braking; this is considered acceptable provided that d) or e) above do not occur as a result.

ii) For the machine test, smooth, safe stop characteristics are defined by compliance with the linearity requirements specified in 4.6.7.5.2.3 and the simple track test described in 4.6.7.5.2.7 VII).

4.6.7.5 Test methods

4.6.7.5.1 Track test method

4.6.7.5.1.1 Test track

a) Use an indoor test-track if possible. If an outdoor test-track is used, pay special attention to ambient conditions throughout the test;

b) the gradient of the track shall not exceed 0,5 %. If the gradient is less than 0,2 % carry out all runs in the same direction. If the gradient lies between 0,2 % and 0,5 % carry out alternate runs in opposite directions;

c) the surface shall be hard, of concrete or fine asphalt, free from loose dirt or gravel. The minimum coefficient of friction between the dry surface and the bicycle tyre shall be 0,75;

d) the track shall be essentially dry at the commencement of tests. When testing to the method described in 4.5.7.5.1.6, the track shall remain dry throughout the tests;

e) the wind speed on the track shall not exceed 3 m/s during the tests.

4.6.7.5.1.2 Instrumentation

The test bicycle or the test track shall be instrumented to include the following:

a) a calibrated speedometer or tachometer (accurate to within ± 5 %) to indicate to the rider the approximate speed at the commencement of braking (3.10);

b) a velocity recording device (accurate to within ± 2 %) to record the velocity at the commencement of braking (3.11);

c) a distance recording system (accurate to within ± 1 %) to record the braking distance (3.9);

d) a water spray system, to provide wetting of the braking surface, consisting of a water reservoir connected by tubing to pair of nozzles at the front wheel and a pair of nozzles at the rear wheel. A quick-acting on/off valve shall be included for control by the rider. Each nozzle shall provide a flow of water of not less than 4 ml/s. Water at ambient temperature shall be used;

Details of the positions and directions of nozzles for rim-, hub-, band-, and disc-brakes are given in Figures 8 to 12.

NOTE Figures 8 and 9 for rim-brakes show side-pull callipers but the same arrangements apply to centre-pull callipers and cantilever brakes.

e) a brake-actuation indicating system, to record independently when each lever is activated.

4.6.7.5.1.3 Mass of bicycle, rider and instrumentation

The combined mass of the bicycle, the rider, and the instrumentation shall be 100 kg ± 1 %.

When wet-condition braking tests are performed, the combined mass can decrease during the test due to water consumption, but it shall be not less than 99 kg at the end of the valid test runs.

Where a manufacturer specifies that his bicycle can carry a mass such that the total of that mass plus that of the bicycle is in excess of 100 kg, the bicycle shall be tested at that greater total mass ± 1 % and it shall meet the specified braking distances.

Any extra weight shall be positioned above the rear wheel and in front of the rear axle.

4.6.7.5.1.4 Force applied to the handbrake-levers

I) Magnitude and position of force on handbrake-levers

Apply a handgrip force not exceeding 180 N at the point as specified in 4.6.2.3. Check before and after each series of test runs to verify the lever force.

II) Optional brake-force application device

It is permissible to use a test mechanism to operate the handbrake-lever, and when such a device is used, it shall meet the requirements of 4.6.7.5.1.4 I) and shall additionally control the rate of application of the handbrake-lever force such that 63 % of the maximum force is attained in not less than 0,2 s.

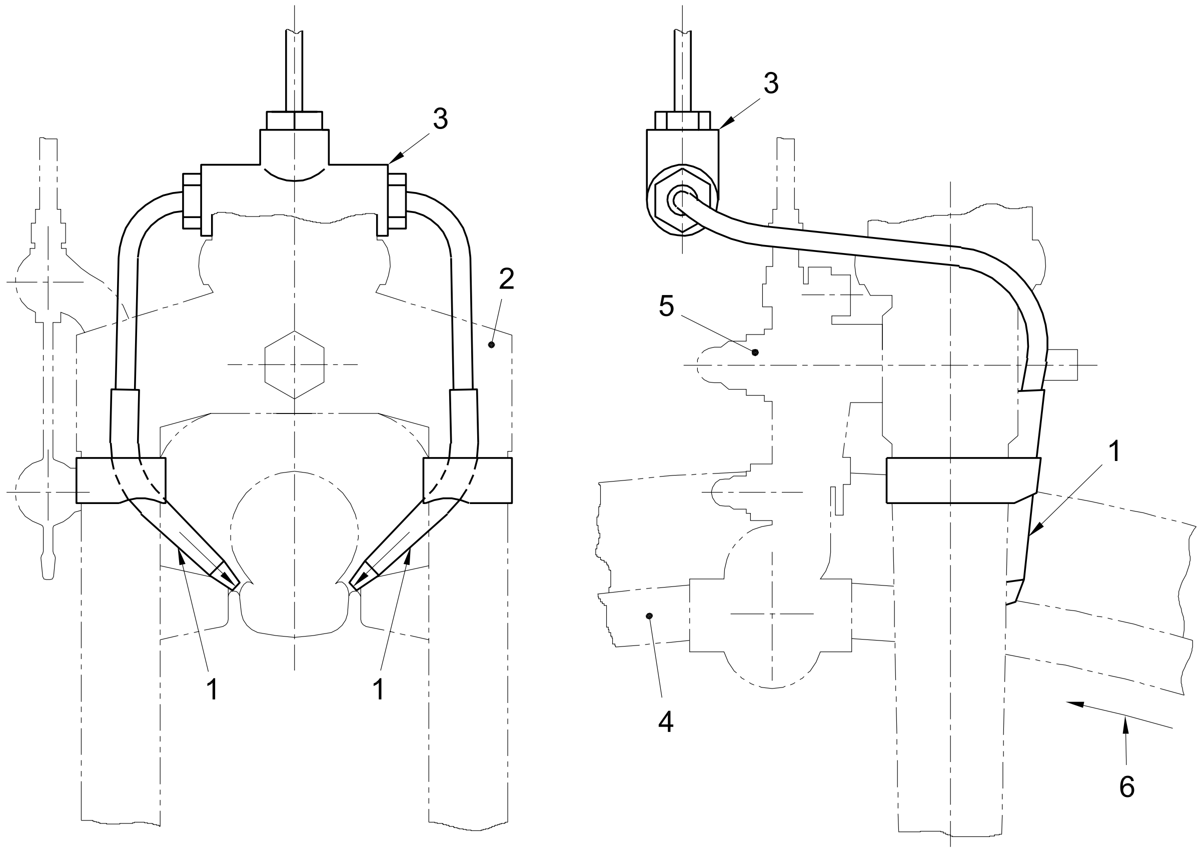
4.6.7.5.1.5 Running-in the braking surfaces

A running-in process shall be conducted on every brake before performance testing is carried out.

Apply the brakes for not less than three seconds to maintain steady deceleration whilst the bicycle is being ridden at a speed of approximately 16 km/h. Repeat this operation 10 times.

4.6.7.5.1.6 Test method – test runs under dry conditions

Pedal the test bicycle until the specified test velocity is attained (see Table 1), then stop pedalling and apply the brakes. The bicycle shall be brought to a smooth, safe stop (see 4.6.7.4.2 i)).



Key

1 Water-nozzles

2 Front crown

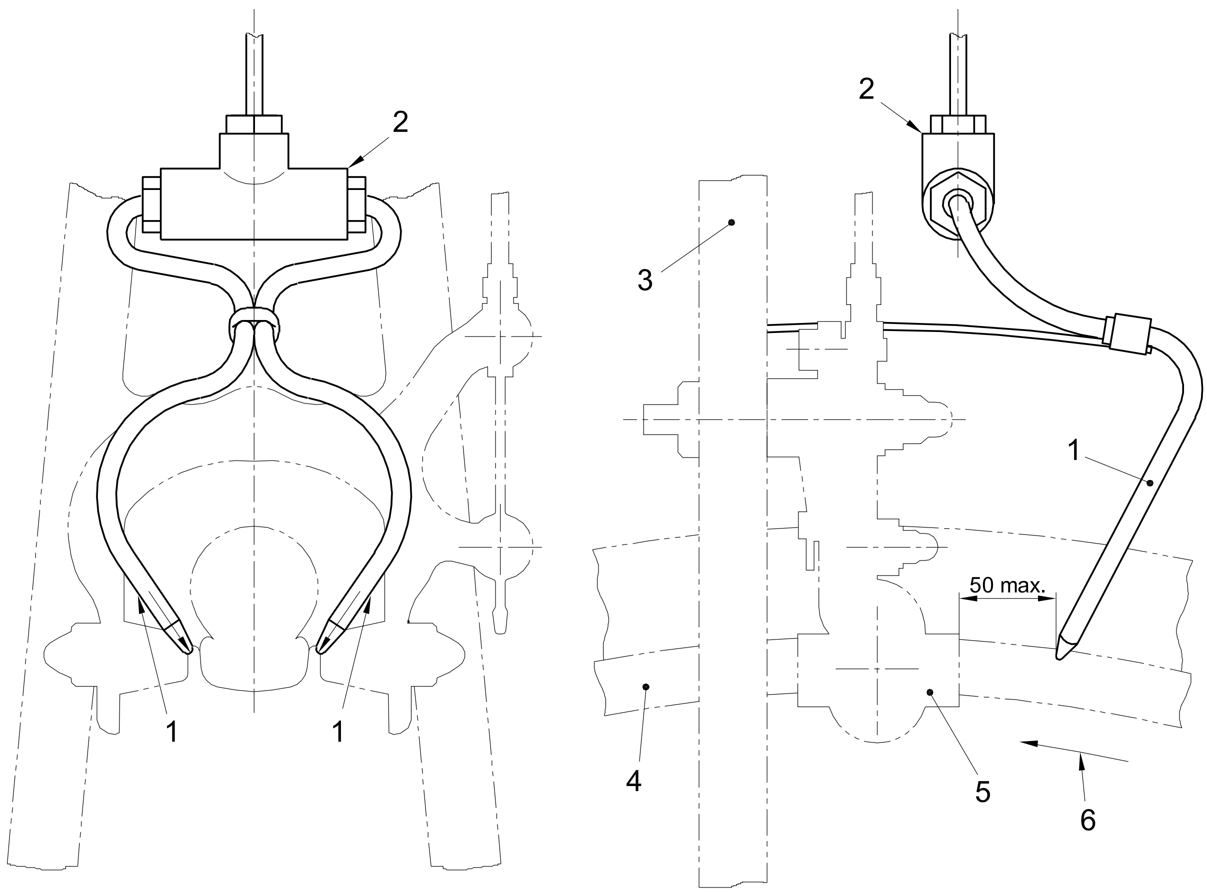
3 Front tee-piece

4 Wheel rim

5 Direction of wheel rotation

Figure 8 — Water-nozzles for rim-brake (front)

Dimension in millimetres



Key

1 Water-nozzles

2 Rear tee-piece

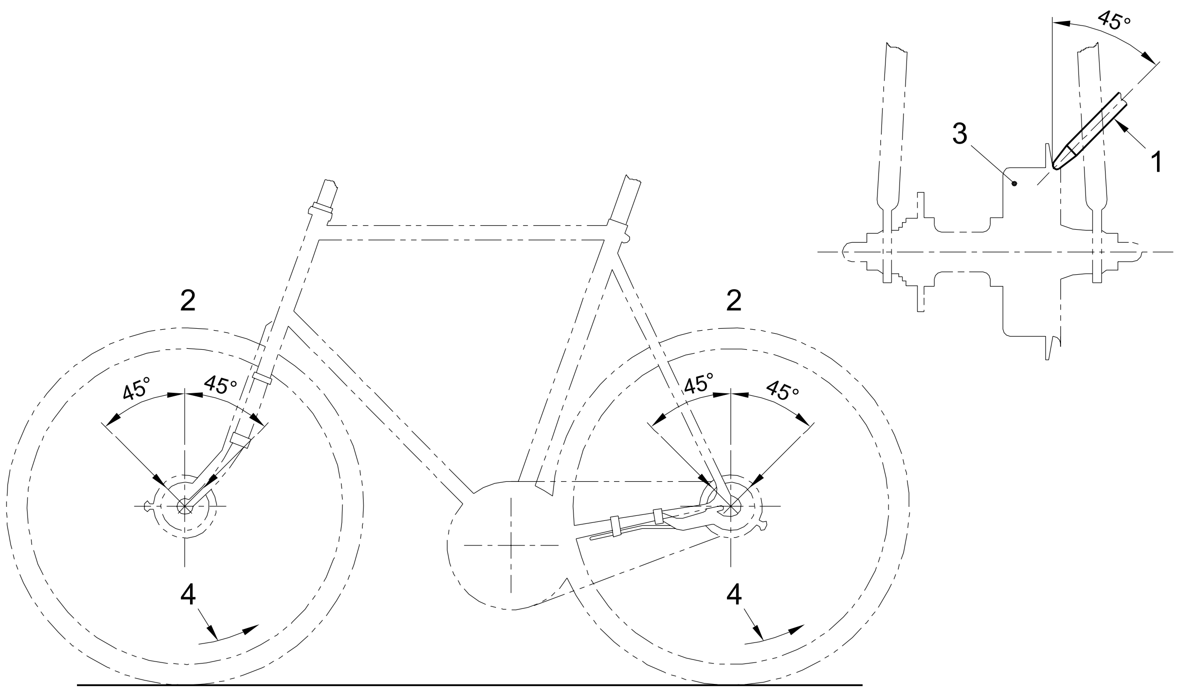
3 Bicycle frame

4 Wheel rim

5 Brake assembly

6 Direction of wheel rotation

Figure 9 — Water-nozzles for rim-brake (rear)



Key

1 Water nozzles

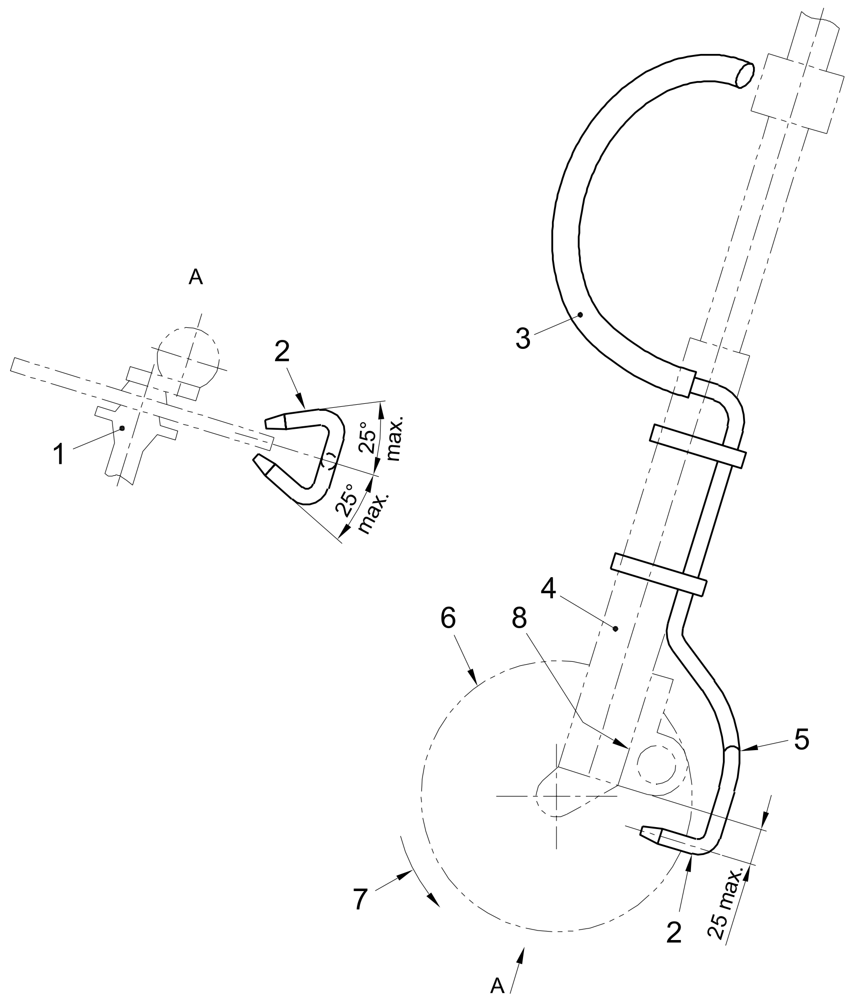
2 Two water-nozzle

3 Hub-brake

4 Direction of wheel rotation

Figure 10 — Water-nozzles for hub-brake (front and rear)

Dimension in millimetres



Key

1 Water nozzles

2 Front hub

3 Flexible pipe

4 Suspension-fork leg

5 Y-joint

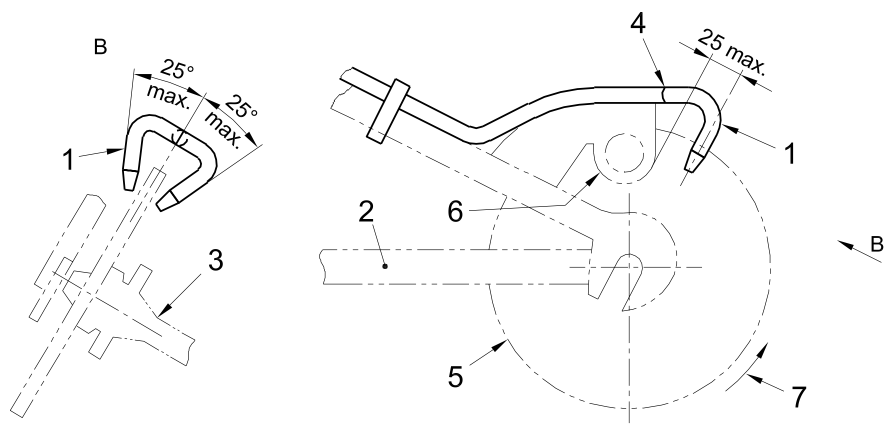
6 Brake disc

7 Disc-brake calliper

8 Direction of wheel rotation

Figure 11 — Water-nozzles for disc-brake (front)

Dimension in millimetres



Key

1 Water-nozzles

2 Rear suspension frame

3 Rear hub

4 Y-joint

5 Brake disc

6 Disc-brake calliper

7 Direction of wheel rotation

Figure 12 — Water-nozzles for disc-brake (rear)

4.6.7.5.1.7 Test method – test runs under wet conditions

The method shall be as given in 4.5.7.5.1.6, with the addition that wetting of the brake system(s) shall commence not less than 25 m prior to the commencement of braking (3.10) and shall continue until the bicycle comes to rest.

NOTE Excessive amounts of water may be swept from the test-track surface between runs.

4.6.7.5.1.8 Number of valid test runs

I) If the gradient of the track is less than 0,2 %, the following runs shall be made:

a) five consecutive valid runs under dry conditions;

b) two acclimatization runs under wet conditions (results not recorded);

c) five consecutive valid runs under wet conditions.

II) If the gradient of the track lies between 0,2 % and 0,5 %, the following runs shall be made:

a) six consecutive valid runs under dry conditions with alternate runs in opposite directions;

b) two acclimatisation runs under wet conditions (results not recorded);

c) six consecutive valid runs under wet conditions with alternate runs in opposite directions.

NOTE A rest period not exceeding 3 min may be taken between successive runs.

4.6.7.5.1.9 Velocity/distance correction factor

A correction factor shall be applied to the measured braking distance if the velocity as checked by the timing device is not precisely that specified in 4.6.7.4.1.

The corrected braking distance shall be determined from the following equation:

$$S_c = \left(\frac{V_s}{V_m}\right)^2 \times S_m$$

where

S_c is the corrected braking distance (m);

S_m is the measured braking distance (m);

V_s is the specified test velocity (m/s);

V_m is the measured test velocity (m/s).

4.6.7.5.1.10 Validity of test runs

I) A test run shall be considered invalid if:

a) excessive side-skid, causing the ride to put his foot to the ground to retain control, or

b) loss of control

occur.

With certain types of braking system, it may not be possible to avoid entirely some skidding of the rear wheel during braking: this is considered acceptable provided that a) or b) above do not occur as a result;

II) If the corrected braking distance exceeds the braking distance specified in Table 1, a test run shall be considered invalid if: the velocity at the commencement of the test exceeds the specified test velocity by more than 1,5 km/h.

III) If the corrected braking distance is less than the braking distance specified in Table 1, a test run shall be considered invalid if: the velocity at the commencement of braking is more than 1,5 km/h below as specified in Table 1.

If the corrected braking distance exceeds the braking distance specified in Table 1, the test run shall be considered valid.

4.6.7.5.1.11 Test results

I) Braking under dry conditions

Depending on the gradient of the test track, the test result shall be the average value of the corrected braking distances (see 4.5.7.5.1.9) of the test results of either 4.6.7.5.1.8 I) a) or 4.6.7.5.1.8 II) a).

For compliance with the requirements of 4.6.7.4.1, the above average values shall not exceed the relevant braking distances specified in Table 1.

II) Braking under wet conditions

Depending on the gradient of the test track, the test result shall be the average value of the corrected braking distances (see 4.6.7.5.1.9) of the test results of either 4.6.7.5.1.8 I) c) or 4.6.7.5.1.8 II) c).

For compliance with the requirements of 4.6.7.4.1, the above average values shall not exceed the relevant braking distances specified in Table 1.

4.6.7.5.2 Machine test method

4.6.7.5.2.1 General

The test machine enables the braking distances for both brakes or the rear brake alone to be calculated from measurements of the individual braking forces of the front and rear brakes on a drum or belt.

4.6.7.5.2.2 Symbols

F_{Op} = Operating force (i.e. force applied on handbrake lever)

$F_{\mathrm{Op\ intend}}$ = Intended operating force (e.g. 20 N, 40 N, 60 N etc.)

$F_{\mathrm{Op\ rec}}$ = Recorded operating force (e.g. 22 N, 38 N, 61 N etc.)

F_{Br} = Braking force

$F_{\mathrm{Br\ rec}}$ = Recorded braking force

$F_{\mathrm{Br\ corr}}$ = Corrected braking force (corrected for difference between $F_{\mathrm{Op\ intend}}$ and $F_{\mathrm{Op\ rec}}$)

$F_{\mathrm{Br\ average}}$ = The arithmetic mean of the three $F_{\mathrm{Br\ corr}}$ at one level of $F_{\mathrm{Op\ intend}}$

$F_{\mathrm{Br\ max}}$ = The maximum $F_{\mathrm{Br\ average}}$

4.6.7.5.2.3 Linearity

When tested by the methods described in 4.6.7.5.2.7 III) a) and b), the braking force $F_{\mathrm{Br\ average}}$ shall be linearly proportional (within $\pm$ 20 %) to the progressively increasing intended operating forces $F_{\mathrm{Op\ intend}}$. The requirement applies to braking forces $F_{\mathrm{Br\ average}}$ equal to and greater than 80 N (see Annex A).

4.6.7.5.2.4 Test machine

The test machine shall incorporate a system that drives the wheel under test by tyre contact and a means of measuring the braking-force, and typical examples of two types of machine are illustrated in Figures 13 and 14.

Figure 13 shows a machine in which a roller drives the individual wheels, and Figure 14 shows a machine in which a driven belt contacts both wheels. Other types of machine are permitted, provided they meet the specific requirements listed below and those specified in 4.6.8.5.2.5 and 4.6.8.5.2.6.

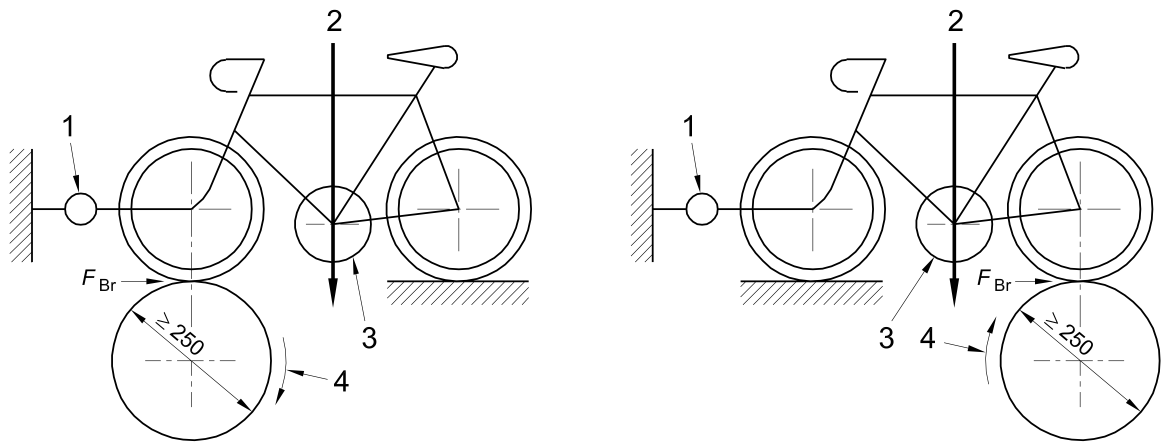
The specific requirements are as follows:

a) the linear surface velocity of the tyre shall be 12,5 km/h and shall be controlled within ± 5 %;

b) a means of laterally restraining the wheel under test shall be provided which does not create any fore/aft restraint;

c) a means of laterally applying forces to the hand-brake levers at the point specified in 4.6.2.3 shall be provided, with the width of the contact on the lever not greater than 5 mm.

Dimensions in millimetres



a) testing the front brake

b) testing the rear brake

Key

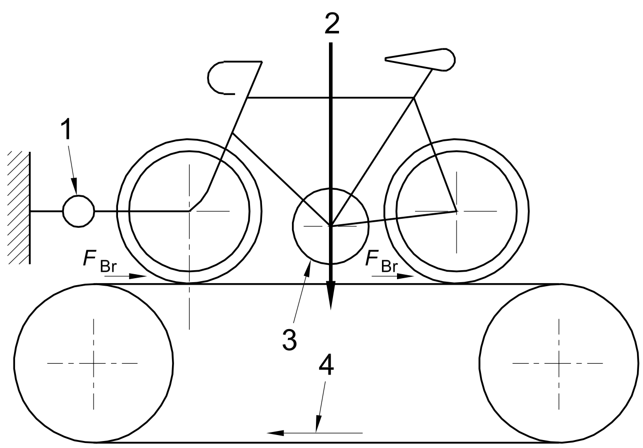
1 Braking-force transducer

2 Applied force or

3 Additional mass

4 Direction of drum rotation

Figure 13 — Braking performance test machine – single drum type



Key

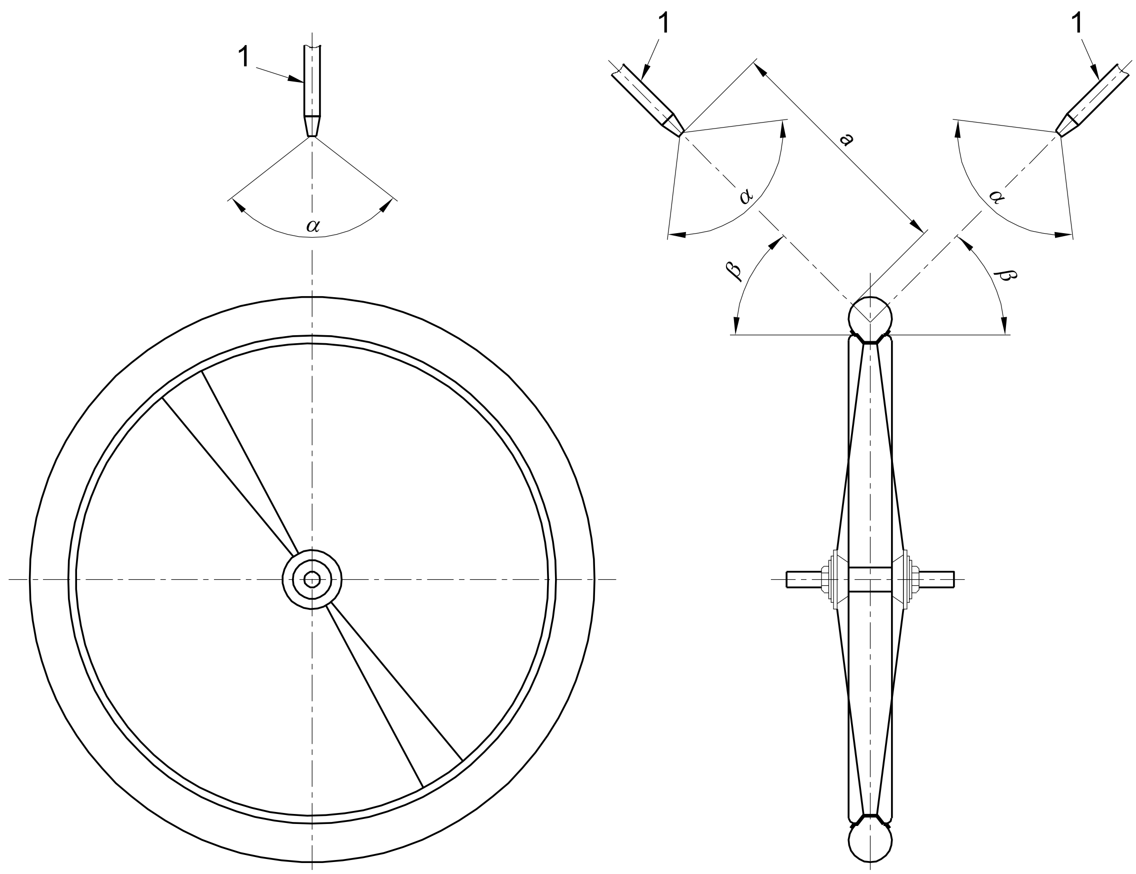
1 Braking-force transducer

2 Applied force or

3 Additional mass

4 Direction of belt travel

Figure 14 — Braking performance test machine – driven-belt type



Key

α = 90° to 120°

β = 30° to 60°

a = 150 mm to 200 mm

1 Water nozzles

Figure 15 — Water nozzle arrangement for the wet braking test (applicable to all types of brake)

4.6.7.5.2.5 Instrumentation

The test machine shall be instrumented to include the following:

a) a device to record the surface velocity of the tyre, accurate to within ± 2 %;

b) a device to record the braking force (see Figures 13 and 14, for example), accurate to within ± 5 %;

c) a device to record the force applied to the hand-lever, accurate to within ± 5 %;

d) a water spray system, to provide wetting of the brakes of the bicycle, consisting of a water reservoir connected by tubing to pair of nozzles arranged as shown in Figure 15. Each nozzle shall provide a flow of water at ambient temperature of not less than 4 ml/s. The wheel shall be suitably enclosed to ensure that, in addition to the rim, any hub- or disc-brake is thoroughly wetted before a test begins;

e) a system for loading the wheels of the bicycle against the driving mechanism (see 4.6.7.5.2.6).

4.6.7.5.2.6 Vertical force on the test wheel

The wheel to be tested shall be forced vertically downwards so that no skidding of the wheel occurs when tested according to 4.6.7.5.2.7 III) a) and b).

NOTE The necessary force may be applied anywhere on the bicycle (wheel-axle, bottom bracket, seat-post, etc) provided that it is exerted vertically downwards.

4.6.7.5.2.7 Test method

I) General

Test the front and rear wheels individually.

II) Running-in the braking surfaces

Conduct a running-in process on every brake before carrying out the performance test.

In order to determine the operating force to be used during the running-in process, mount the loaded bicycle on the test machine with the belt or drum running at the specified speed and apply an operating force to the handbrake lever that is high enough to achieve a braking force of 200 N ± 10 %. Maintain this operating force for at least 2,5 s, and note the value of the applied operating force.

Repeat the procedure (applying the operating force determined as above accurate to within ± 5 %) ten times, or, with more repetitions if necessary, until the mean braking force from anyone of the three latest tests does not deviate by more than ± 10 % from the mean braking force from these same three tests.

III) The performance tests

a) Testing under dry conditions

With a vertical force applied to the bicycle sufficient to prevent skidding of the tyre on the wheel under test, accelerate the driving mechanism to the specified velocity, then apply the operating-force in a series of 20 N increments from 40 N to either 180 N or to the force necessary to achieve a braking force of at least 700 N, whichever is the lesser. However, if the wheel locks, if any possible brake-overload device is actuated, or if the hand-lever comes into contact with the handlebar, do not increase the force further. For each increment of applied operating force, perform three tests within 1 min. Before applying the next level of operating force, allow the brake to cool for 1 min.

The applied operating forces shall lie within ± 10 % of the intended operating forces, shall be applied as specified in 4.6.2.3 and 4.6.7.5.2.4 c), shall be recorded with an accuracy of ± 1 %, and shall be fully applied within 1 s of the commencement of braking.

For each increment of hand-lever force, record the horizontal braking force value, $F_{\mathrm{Br\ rec}}$, for a period of between 2,0 s and 2,5 s, with measurement starting 0,5 s to 1,0 s after the commencement of braking (see 3.11). Record $F_{\mathrm{Br\ rec}}$ as the average braking force during this measurement period.

The time at which the measurement of the braking force is started shall be related to the speed at which the operating force is applied. If the operating force is fully applied in less than 0,5 s after the commencement of braking, start the measurement after 0,5 s. However, if the operating force is fully applied between 0,5 s and 1,0 s after the commencement of braking, start the measurement when the operating force is fully applied.

b) Testing under wet conditions

The method shall be as given in 4.6.7.5.2.8 III) a) with the addition that wetting of the brake system shall commence not less than 5 s before the commencement of braking for each increment of hand-lever force and shall continue until the test run has finished.

IV) Correction of braking force

Each recorded braking force, $F_{Br\ rec}$, shall be corrected for any difference between the recorded operating force and the intended operating force. The corrected braking force shall be calculated by multiplying the recorded braking force, $F_{Br\ rec}$, with a correction factor which is the ratio between the intended operating force, $F_{Op\ intend}$, and the recorded operating force, $F_{Br\ rec}$.

EXAMPLE

Recorded braking force $F_{Br\ rec}$	= 225 N
Intended operating force $F_{Op\ intend}$	= 180 N
Recorded operating force $F_{Op\ rec}$	= 184 N
Correction factor	= 180/184
Corrected braking force $F_{Br\ corr}$	= 225 x (180/184)

V) Test results

Select from the record the maximum output braking force, $F_{Br\ max}$, for each combination of wheel (front or rear) and each test condition (wet or dry).

Calculate from the average braking force, $F_{Br\ average}$, as the arithmetic mean of three corrected brake force measurements, $F_{Br\ corr.}$

Calculate the braking distance, D, for each combination with the following formula:

$$D = (K/F_{Br\ max}) + C$$

where

D is the calculated braking distance (m);

$F_{Br\ max}$ is the maximum $F_{Br\ average}$ (N);

K is the braking specific test constant (Nm);

C is the delay specific test constant (m).

Values for the constants are given in Table 2.

Where a manufacturer specifies that his bicycle can carry a mass such that the sum of that mass plus the mass of the bicycle is in excess of 100 kg to some value M, increase the factors K in the ratio M/100.

Table 2 — Constants for calculation of braking distances, D, from braking forces, F_{Br}

Condition	Brake in use	Constant, K	Constant, C
Dry	Front only	1 955	1,40
	Rear only	2 756	1,40
Wet	Front only	605	2,25
	Rear only	980	3,00

After calculating the braking distances, compare the results for the front brake tests with the requirements for both brakes in Table 1, and compare the results for the rear brake only with the requirements for the rear brake only in Table 1 to determine whether or not the requirements have been met.

VI) Linearity

Plot the calculated $F_{\text{Br average}}$ values (the arithmetic mean of the three corrected braking forces at each level of operating force) against the equivalent operating force values, $F_{\text{Op intend}}$, in order to assess the linearity against the requirement in 4.6.7.5.2.3. Plot the results on a graph, showing the line of best fit and the ± 20 % limit lines obtained by the method of least squares outlined in Annex A.

VII) Simple track test (see 4.19)

After completion of the machine test, conduct a brief, simple track test with progressively increasing operating forces to determine whether or not the brakes bring the bicycle to a smooth, safe stop.

NOTE This test can be combined with the test on the fully assembled bicycle.

4.6.8 Brakes – heat-resistance test

4.6.8.1 General

This test applies to all disc- and hub-brakes but to rim-brakes only where they are known or suspected to be manufactured from or include thermoplastic materials.

Each brake on the bicycle shall be tested individually, but where the front and rear brakes are identical only one brake need be tested.

4.6.8.2 Requirement

Throughout the test described in 4.6.8.3, a gap of at least 10 mm shall remain between the hand-brake lever and the handlebar-grip, the operating force shall not exceed 180 N, and the braking force shall not deviate outside the range 60 N to 115 N.

Immediately after having been subjected to the test described in 4.6.8.3, the brakes shall achieve at least 60 % of the braking performance which was recorded at the highest operating force used during the performance tests 4.6.7.5.2.7 III) a) and b).

4.6.8.3 Test method

Drive the wheel and tyre assembly with the brake applied on a machine such as those described in 4.6.7.5.4 at a velocity of 12,5 km/h ± 5 % with a rearward, cooling air-velocity of 12,5 km/h ± 10 %, so that a total braking energy of 75 Wh ± 5 % is developed for a period of 15 min ± 2 min.

Allow the brake to cool to ambient temperature and then repeat the test cycle.

A maximum of ten interruptions per test cycle is permitted, each with a maximum duration of ten seconds. When the test has been carried out, subject the brakes to the applicable parts of the tests described in 4.6.7.5.2.7 III) a) and b).

The braking energy shall be calculated by means of the following equation:

$$E = F_{Br} \times V_{Br} \times T(Wh)$$

where

F_{Br} is the braking force in N;

V_{Br} is the braking velocity in m/s (i.e. 12,5 km/h = 3,472 m/s);

T is the duration of each test in hours (h) (excluding interruptions) (15 min = 0,25 h)

When the test has been carried out, the brakes shall be subjected to the applicable parts of the test described in 4.5.7.6.12, in order to check that the requirement 4.5.8.1 is fulfilled.

4.7 Steering

4.7.1 Handlebar – dimensions

The handlebar shall have an overall width between 350 mm and 1 000 mm unless national regulations dictate otherwise. The vertical distance upward between the top of the handlebar grips, when assembled to the lowest riding position according to the manufacture's instructions and the seat surface of the saddle at its highest position shall not exceed 400 mm.

4.7.2 Handlebar grip-areas, grips and plugs

4.7.2.1 Requirement

The main handgrip areas of the handlebar shall be covered by a suitable material to ensure a sufficient grip during the cycling action.

When parts of the handlebar are fitted with handgrips or end plugs, and when tested by the method described in 4.7.2.2, these shall have to withstand a removal force of 70 N.

4.7.2.2 Test method

Immerse the handlebar, with one of the handlebar grips or plug fitted, in water at room temperature for one hour and then place the handlebar in a freezing cabinet until the handlebar is at a temperature lower than -5 °C. Remove the handlebar from the freezing cabinet and allow the handlebar to reach -5 °C, then apply a force of 70 N to the grip or plug in the loosening direction. Maintain the force until the temperature of the handlebar has reached +5 °C.

4.7.3 Handlebar-stem – insertion-depth mark or positive stop

The handlebar-stem shall be provided with one of the two following alternative means of ensuring a safe insertion depth into the fork-stem:

a) it shall contain a permanent, transverse mark, of length not less than the external diameter of the stem, that clearly indicates the minimum insertion-depth of the handlebar-stem into the fork-stem. The insertion mark shall be located at a position not less than 2,5 times the external diameter of the handlebar-stem from the bottom of the stem, and there shall be at least one stem diameter's length of contiguous, circumferential stem material below the mark.

b) it shall incorporates a permanent stop to prevent it from being drawn out of the fork-stem such as to leave the insertion less than the amount specified in a) above.

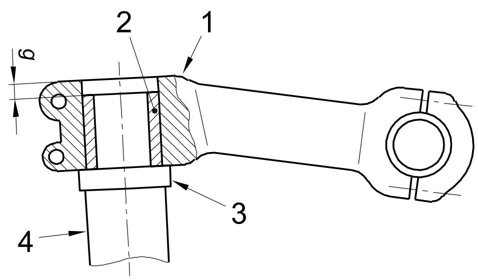
4.7.4 Handlebar stem-extension to fork-stem – clamping requirements

The distance *g,* see Figure 16, between the top of the stem extension clamp and the top of the fork stem to which the stem extension is clamped shall not be greater than 5 mm.

The upper part of the fork-stem to which the stem extension is clamped shall not be threaded.

The dimension *g* shall also ensure that the proper adjustment of the steering system can be achieved.

NOTE For aluminium and carbon-fibre fork stems, the avoidance of any internal device that could damage the internal surface of the fork-stem is recommended.



Key

g Distance between the upper, external part of the handlebar stem clamp and the upper part of the fork-stem

1 Stem-extension

2 Extended fork-stem

3 Spacer-ring

4 Head-tube

Figure 16 — Clamping between handlebar stem-extension and fork-stem

4.7.5 Steering stability

The steering shall be free to turn through at least 60° either side of the straight-ahead position and shall exhibit no tight spots, stiffness or slackness in the bearings when correctly adjusted.

A minimum of 25 % of the total mass of the bicycle and rider shall act on the front wheel when the rider is holding the handlebar grips and sitting on the saddle, with the saddle and rider in their most rearward positions.

NOTE Recommendations for steering geometry are given in Annex B

4.7.6 Steering assembly – static strength and security tests

4.7.6.1 Handlebar-stem – lateral bending test

4.7.6.1.1 General

This test is intended for use when testing handlebar-stems.

4.7.6.1.2 Requirement

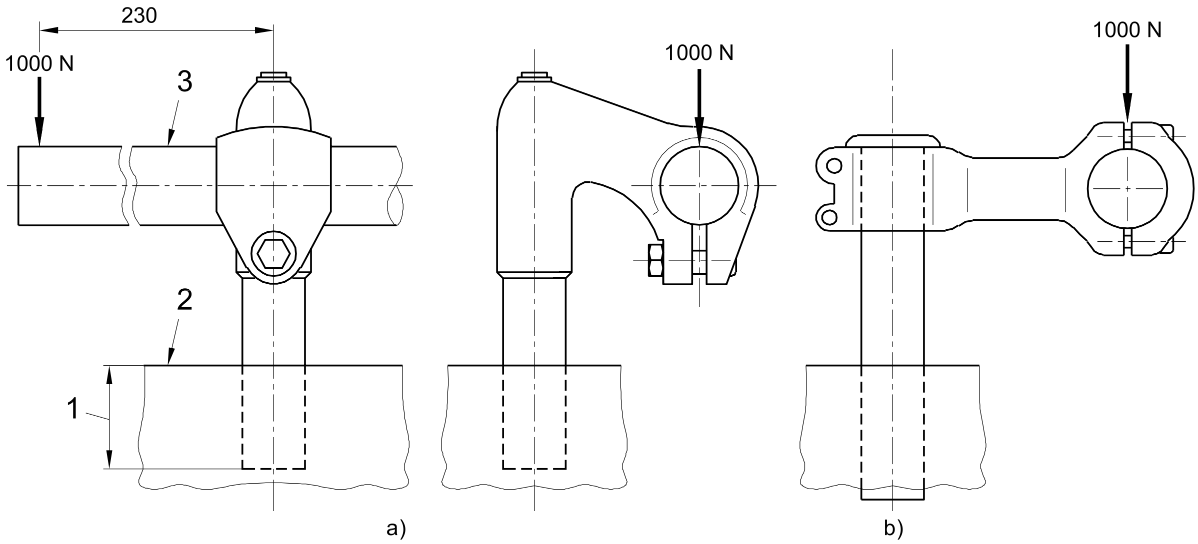
When tested by the method described in 4.7.6.1.3 there shall be no cracking or fracture of the stem and the permanent set measured at the point of application of the test force and in the direction of the test force shall not exceed 10 mm

Handlebar-stems can influence test failures of handlebars but handlebars do not usually influence test failures of stems. For these reasons, a handlebar is always to be tested mounted in a stem but stems can be tested with a solid bar in place of a handlebar.

4.7.6.1.3 Test method

For stems which have a quill for insertion into a fork-stem, clamp the quill securely in a fixture to the minimum insertion depth (see 4.7.3), or, for stem extensions which clamp directly on to an extended fork-stem attach the extension to a fork-stem according to the manufacture’s instructions and clamp this fork-stem securely in a fixture to the appropriate height. Assemble a solid test-bar to the stem, and apply a force of 1 000 N at a distance of 230 mm from the axis of the stem as shown in Figure 17.

Dimensions in millimetres



Key

a) Combined stem and quill

b) Stem extension

1 Minimum insertion depth

2 Clamping block

3 Solid steel bar

Figure 17 — Handlebar-stem: lateral bending test

4.7.6.2 Handlebar and stem assembly – lateral bending test

4.7.6.2.1 General

This test is intended for use when testing handlebars and handlebar-stems.

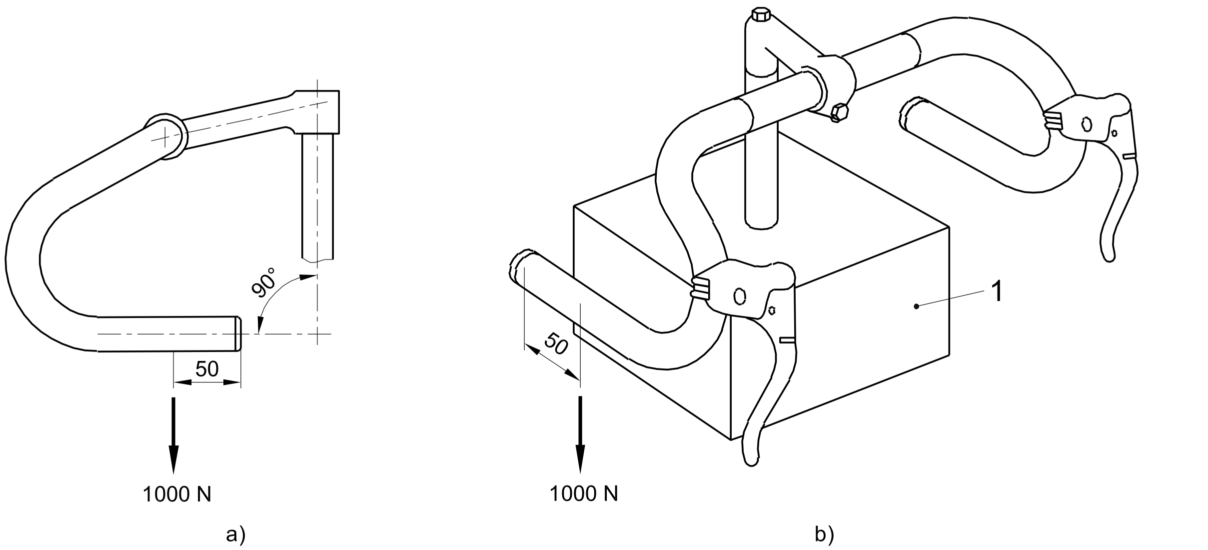
4.7.6.2.2 Requirement

When tested by the method described in 4.7.6.2.3, there shall be no cracking or fracture of the handlebar, stem or clamp-bolt and the permanent set measured at the point of application of the test force shall not exceed 15 mm.

4.7.6.2.3 Test method

Assemble the handlebar and stem in accordance with the manufacturer's instructions and, unless the handlebar and stem are permanently connected, e.g. by welding or brazing, align the grips portion of the handlebar in a plane perpendicular to the steering vertical axis (see Figure 18 a)). For stems which have a quill for insertion into a fork-stem, clamp the quill securely in a fixture to the minimum insertion depth (see 4.7.3), or, for stem extensions which clamp directly on to an extended fork-stem attach the extension to a fork-stem according to the manufacturer's instructions and clamp this fork-stem securely in a fixture to the appropriate height. Apply a vertical force of 1 000 N at a distance of 50 mm in from the free end of the handlebar as shown in Figure 18.

Dimensions in millimetres



Key

a) Orientation of adjustable handlebars

b) Position of applied forces

1 Clamping fixture

Figure 18 — Handlebar and stem assembly – lateral bending test

4.7.6.3 Handlebar-stem – forward bending test

4.7.6.3.1 General

Conduct the test in two stages on the same assembly as follows:

4.7.6.3.2 Requirement for stage 1

When tested by the method described in 4.7.6.3.3, there shall be no visible cracks or fractures and the permanent set measured at the point of application of the test force and in the direction of the test force shall not exceed 10 mm.

4.7.6.3.3 Test method for stage 1

For stems which have a quill for insertion into a fork-stem, clamp the quill securely in a fixture to the minimum insertion dept (see 4.7.3), or, for stem extensions which clamp directly on to an extended fork-stem, clamp the handlebar-stem extension securely on to a suitable, solid-steel bar and clamp the bar in securely in a fixture, the projecting length of the bar not being critical.

Apply a force of 1 600 N through the handlebar attachment point in a forward and downward direction and at 45° to the axis of the quill or steel bar as shown in Figure 19 and maintain this force for 1 min. Release the test force and measure any permanent set (see 4.7.6.3.2).

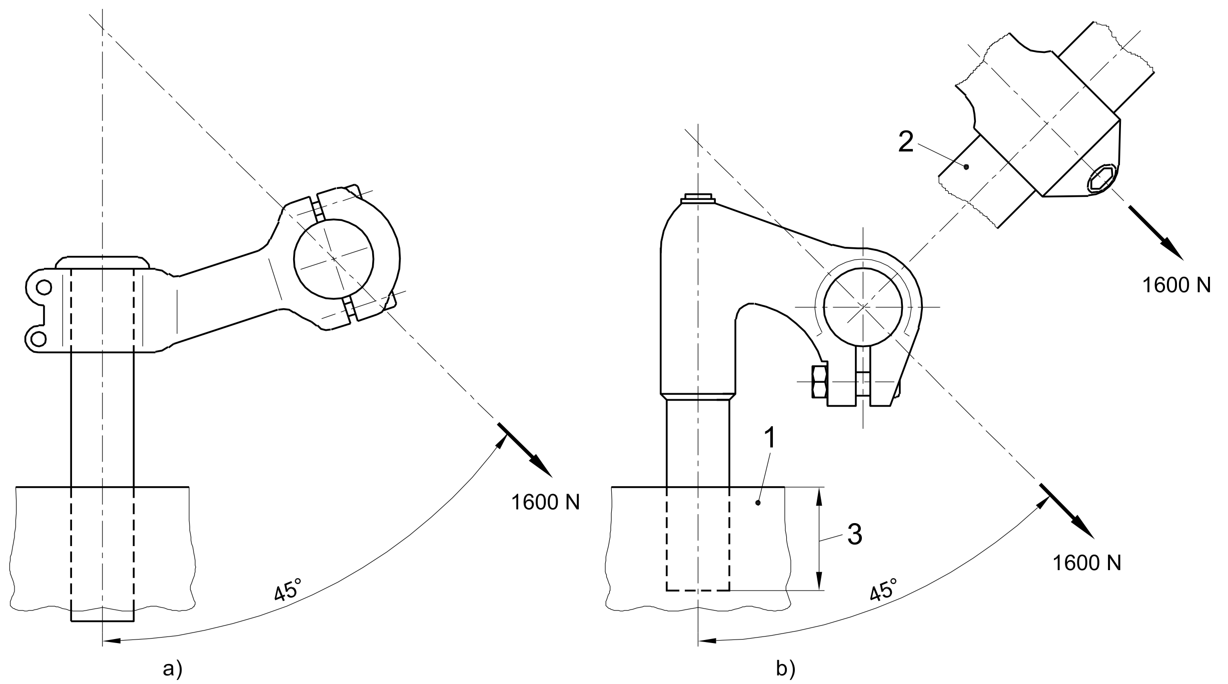
If the handlebar-stem meets the requirement of 4.7.6.3.2, conduct stage 2 of the test.

4.7.6.3.4 Requirement for stage 2

When tested by the method described in 4.7.6.3.5, there shall be no visible cracks or fractures.

4.7.6.3.5 Test method for stage 2

With the handlebar-stem mounted as in stage 1 (4.7.6.3.3), apply a progressively increasing force in the same position and direction as in 4.7.6.3.3 until either the force reaches a maximum of 2 300 N or until the handlebar-stem deflects 50 mm measured at the point of application of the test force and in the direction of the test force. If the stem does not yield or continue to yield, maintain the force for 1 min.



Key

a) Stem extension

b) Combined stem and quill

1 Clamping fixture

2 Solid steel beer

3 Minimum insertion depth

Figure 19 — Handlebar-stem – forward bending test

4.7.6.4 Handlebar to handlebar-stem – torsional security test

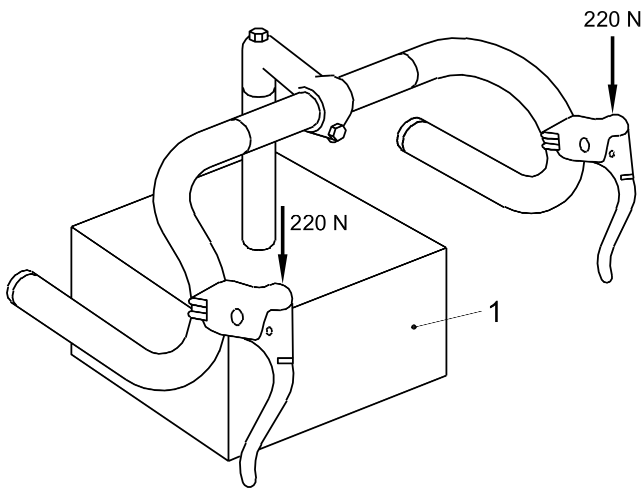
4.7.6.4.1 Requirement

When tested by a method described in 4.7.6.4.2, there shall be no movement of the handlebar relative to the handlebar-stem at the handlebar clamp.

4.7.6.4.2 Test method

Assemble the handlebar correctly in the handlebar-stem with the locking system tightened in accordance with the manufacturer's instructions and attach the handlebar-stem to a fixture at the minimum insertion-depth (see 4.7.3) and with its axis vertical. Apply downward forces of 220 N to both sides of the handlebar at the position giving the maximum torque to the clamp.

NOTE The exact method of applying the torque will vary with the type of handlebar, and an example is shown in Figure 20.



Key

1 Clamping fixture

Figure 20 — Handlebar to handlebar-stem – torsional security test

4.7.6.5 Handlebar-stem to fork-stem – torsional security test

4.7.6.5.1 Requirement

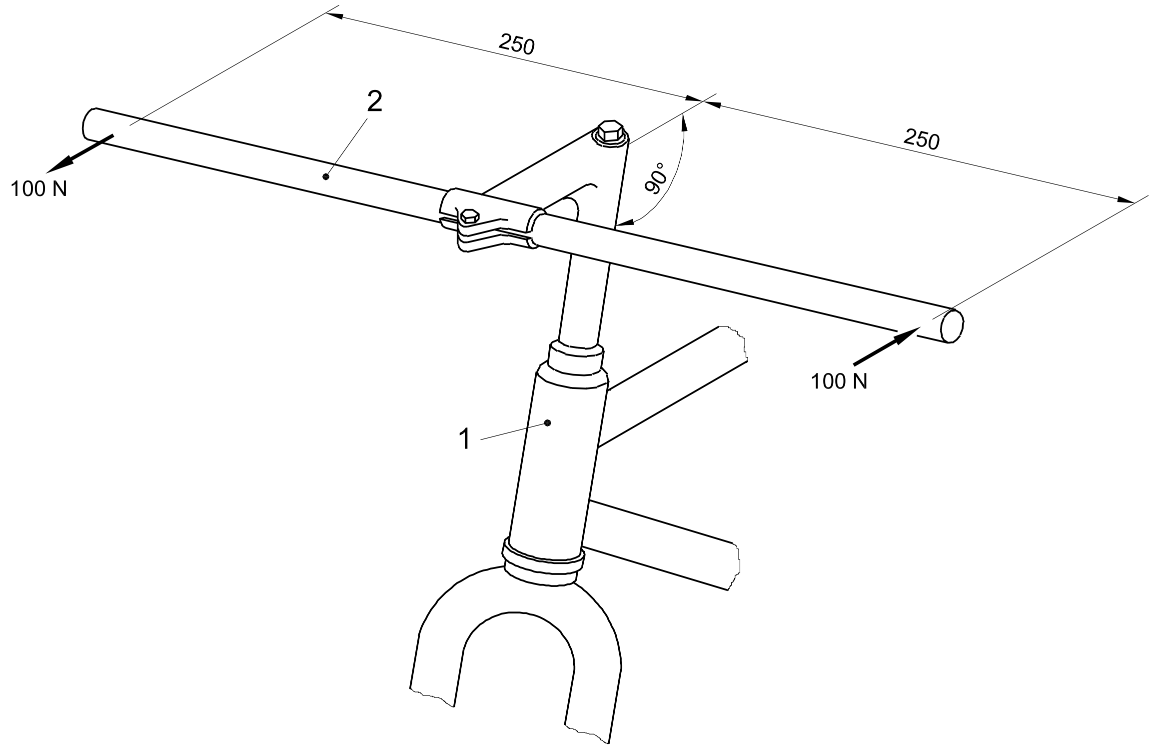
When tested by the method described in 4.7.6.5.2, there shall be no movement of the handlebar-stem relative to the fork-stem at the clamp.

4.7.6.5.2 Test method

Assemble the fork-stem correctly in the frame and attach the handlebar-stem to the fork-stem with the locking system tightened in accordance with the manufacturer's instructions. Apply a torque of 40 Nm once each in each direction of possible rotation by applying a force on the dummy handlebar in a plane perpendicular to the steering axis as shown in Figure 21.

NOTE The exact method of applying the torque may vary with the type of handlebar-stem, and an example is shown in Figure 21.

Dimensions in millimetres



Key

1 Frame and fork assembly

2 Solid steel bar

Figure 21 — Handlebar-stem to fork-stem – torsional security test

4.7.6.6 Aerodynamic extensions to handlebar – security test

4.7.6.6.1 General

When a handlebar is suitable for use with aerodynamic extensions, the extension/handlebar/handlebar-stem assembly shall withstand the following security test.

4.7.6.6.2 Requirement

When tested by the method described in 4.7.6.6.3, there shall be no movement of the extension in relation to the handlebar and of the handlebar in relation to the handlebar-stem.

4.7.6.6.3 Test method

Secure the handlebar in the stem intended for use and assemble the extension on the handlebar tightening all the fixings in accordance with the extension, handlebar and handlebar-stem manufacturer's instructions. The steering axis should be vertical. Apply a vertical force of 300 N to the extension on the position giving the maximum torque to the clamps as shown in Figures 22 a) and 22 b).

NOTE The exact method of applying the force may vary with the type of aerodynamic extension, and an example is shown in Figure 22.

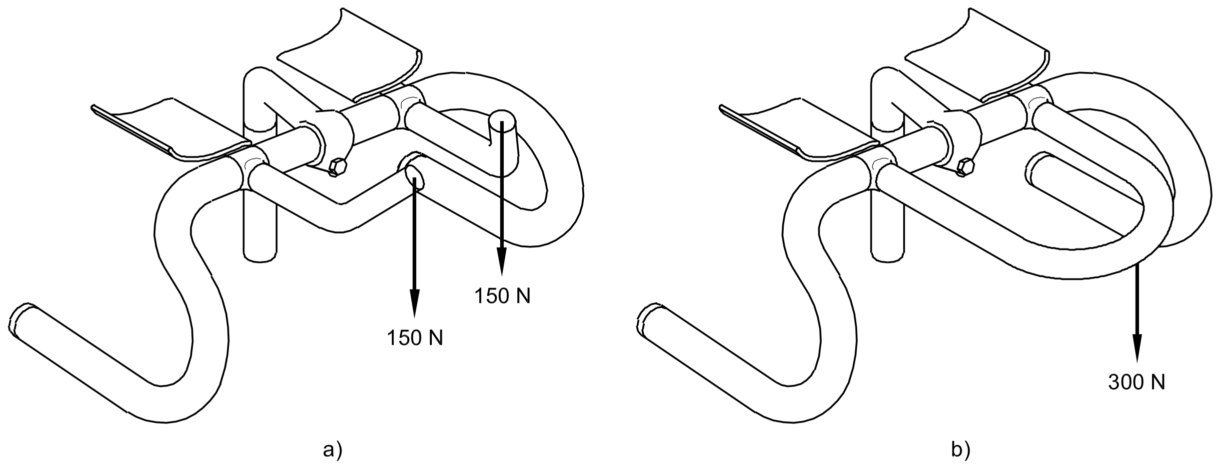


Figure 22 — Aerodynamic extension to handlebar – torsional security test

4.7.7 Handlebar and stem assembly – fatigue test

4.7.7.1 General

Handlebar-stems can influence test failures of handlebars and for this reason, a handlebar and stem is always to be tested as an assembly.

Conduct the test in two stages on the same assembly as follows.

4.7.7.2 Requirement for stage 1

When tested by the method described in 4.7.7.3, there shall be no visible cracks or fractures in the handlebar or stem, or any bolt failure.

4.7.7.3 Test method for stage 1

Unless the handlebar and stem are permanently connected, e.g. by welding or brazing, align the hand-grips or the equivalent parts of the handlebar in a plane perpendicular to the steering axis (see Figure 23), and secure the handlebar to the stem according to the manufacturer's instructions.

Clamp the handlebar stem securely in a fixture to the minimum insertion depth (see 4.7.3) or, in the case of a stem extension which is intended to be clamped to an extended fork-stem, secure the stem-extension using the manufacturer's recommended tightening procedure, to an extended fork-stem which is secured in the fixture with the appropriate length projecting.

Attach to the handlebar two suitable devices that reproduce the brake-lever fixtures without either reducing or increasing the local handlebar strength. Each device shall incorporate a pin for connection to a ball-joint with its axes located 15 mm from the outer surface of the handlebar (or such greater distance which accurately reproduces the position of the appropriate brake lever pivot) - see Figure 23.

Via the ball-joints, apply reversed forces of 280 N to the pin of the device on each side of the handlebar for 100 000 cycles, with the forces at each side of the handle bar being out of phase with each other and parallel to the axis of the handlebar-stem of fork-stem as shown in Figure 24 a). The maximum frequency shall be 25 Hz.

If the assembly meets the requirement of 4.7.7.2, conduct stage 2 of the test on the same assembly in the same mountings.

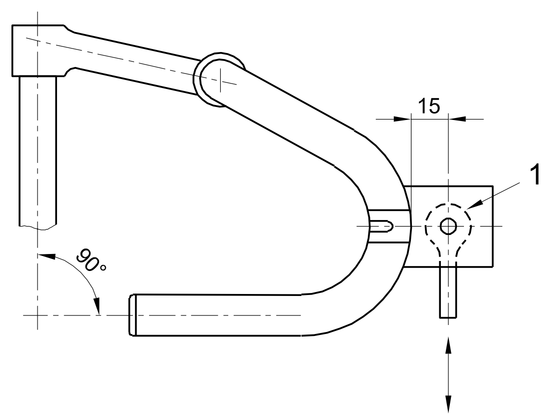
4.7.7.4 Requirement for stage 2

When tested by method described in 4.7.7.5, there shall be no visible cracks or fractures in the handlebar or stem, or any bolt failure.

4.7.7.5 Test method for stage 2

Via the ball-joints, apply reversed forces of 400 N to the pin of the device on each side of the handlebar for 100 000 cycles, with the forces at each side of the handlebar being in phase with each other and parallel to the axis of the handlebar-stem of fork-stem as shown in Figure 24 b). The maximum frequency shall be 25 Hz.

Dimension in millimetres

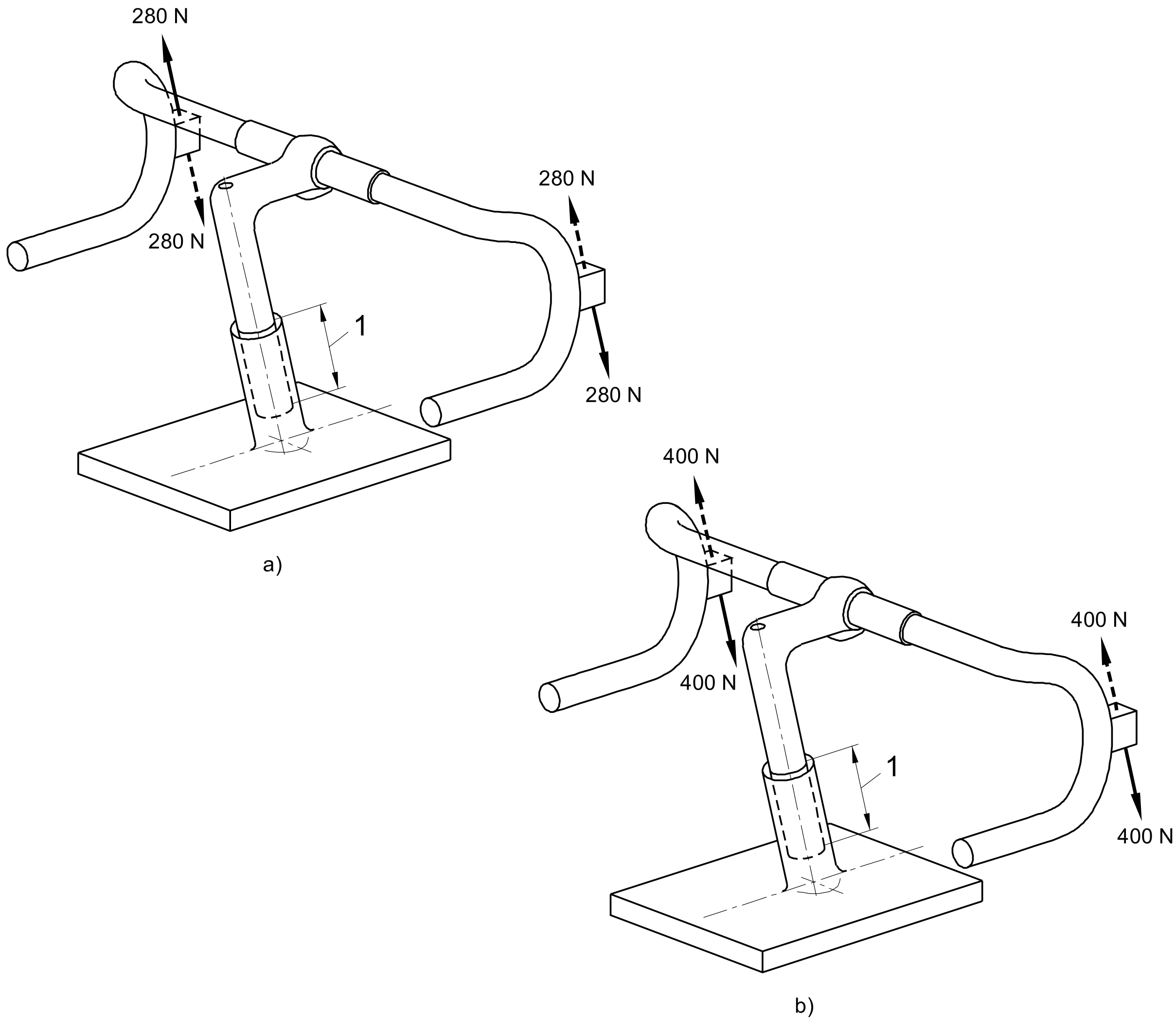


Key

1 Ball-joint

Figure 23 — Device reproducing the brake fixture

Dimensions in millimetres



Key

a) Stage 1 – Out-of-phase loading

b) Stage 2 – In-phase loading

1 Minimum insertion depth

Figure 24 — Handlebar and stem assembly – fatigue test

4.8 Frames

4.8.1 Suspension-frames – special requirements

The design shall be such that if the spring or damper fails, the tyre shall not contact any part of the frame nor shall the assembly carrying the rear wheel become detached from the rest of the frame.

4.8.2 Frame and front fork assembly – impact test (falling mass)

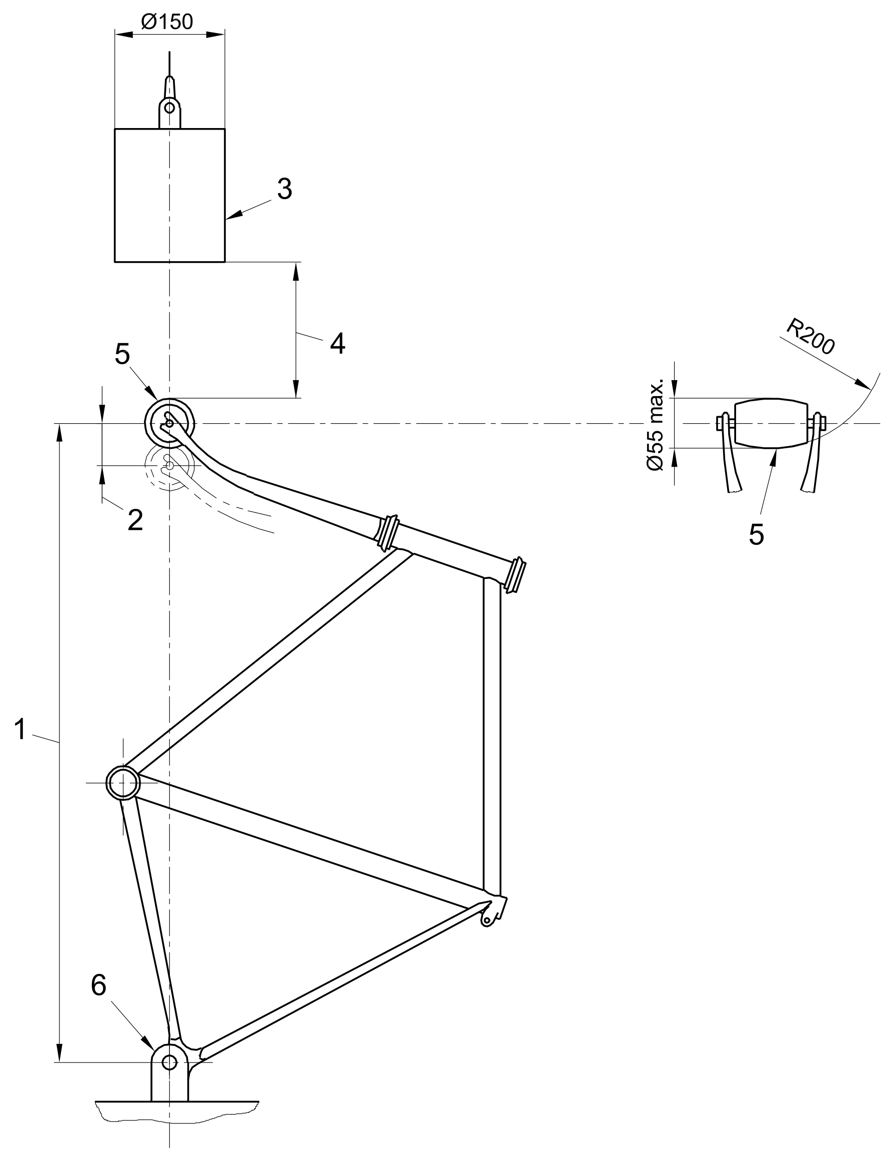
4.8.2.1 General

Manufacturers of complete bicycles shall conduct the test with the frame fitted with the appropriate front fork and, if this is a suspension-fork it shall be at its unloaded length.

Manufacturers of frames are permitted to conduct the test with a solid-steel bar fitted in place of a front fork.

Where a frame is convertible for male and female riders by the removal of a bar, test it with the bar removed. Where a suspension fork is fitted, test the assembly with the fork extended to its unloaded free length. Where a rear suspension system is incorporated in the frame, secure the suspension in a position equivalent to that which would occur with an 80 kg rider seated on the bicycle; if the type of suspension system does not permit it to be locked, then replace the spring/damper unit by a solid link of the appropriate size and with end fittings similar to those of the spring/damper unit.

Dimensions in millimetres



Key

1 Wheelbase
2 Permanent set
3 22,5 kg striker
4 212 mm drop height
5 Low mass roller (1 kg max.)
6 Rigid mounting for rear axle attachment point

Figure 25 — Frame and front fork assembly – impact test (falling mass)

4.8.2.2 Requirement

When tested by the method described in 4.8.2.3, there shall be no visible cracks or fractures in the assembly and there shall be no separation of any parts of any suspension system.

The permanent deformation measured between the axes of the wheel axles (the wheel-base – see 3.23) shall not exceed the following values:

a) 30 mm where a fork is fitted;

b) 15 mm where a solid-steel bar is fitted in place of a fork.

4.8.2.3 Test method

Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 26 in the fork. If a steel bar is used in place of a fork the bar shall have a rounded end equivalent in shape to the roller. Hold frame-fork or frame-bar assembly vertically with clamping to a rigid fixture by the rear-axle attachment points as shown in Figure 25.

Rest a striker of mass 22,5 kg on the roller in the fork drop-outs or on the rounded end of the solid bar and measure the wheel-base. Raise the striker to a height of 212 mm from the rest position of the low-mass roller and release it to strike the roller or the steel bar at a point in line with the wheel centres and against the direction of the fork rake or rake of the bar. The striker will bounce and this is normal. When the striker has come to rest on the roller or solid bar measure the wheel-base again.

4.8.3 Frame and front fork assembly – impact test (falling frame)

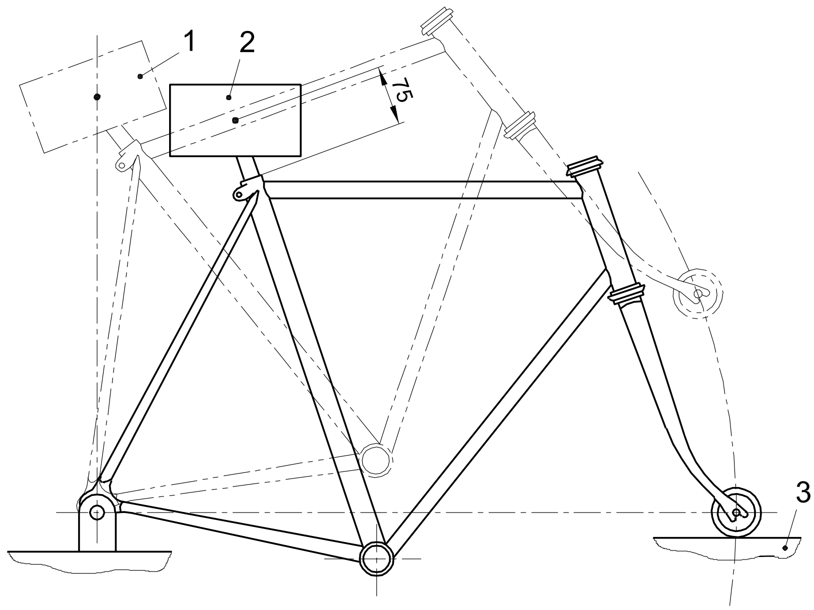
4.8.3.1 General

When testing the complete bicycle the test shall be conducted on the frame fitted with the appropriate front fork.

When testing the frames separately, if the fork intended for the frame is not available, it is permitted for the test to be conducted with the frame fitted with a fork which meets the requirements of the fork impact test as described in 4.9.5.

Where a suspension fork is fitted, the assembly shall be with a fork which meets the requirements of the fork impact test as described in 4.9.5. Where a rear suspension system is incorporated in the frame, the suspension shall be secured in a position equivalent to that which would occur with an 80-kg rider seated on the bicycle; if the type of suspension system does not permit it to be locked, than the suspension system shall be replaced by a solid link of the appropriate size and with the end fittings similar to those of the spring/damper unit.

Dimension in millimetres



Key

1 Mass vertically above rear axle

2 Mass 70 kg

3 Steel anvil

Figure 26 — Frame and front fork assembly – impact test (falling frame)

4.8.3.2 Requirement

When tested by the methods described in 4.8.3.3, there shall be no visible cracks or fractures in the assembly and after the second impact, the permanent deformation measured between the axes of the wheel axles (the wheel-base – see 3.23) shall not exceed 15 mm for a frame-fork assembly and there shall be no separation of any parts of any suspension system.

4.8.3.3 Test method

Conduct the test on an assembly as described in 4.8.3.1.

As shown in Figure 26, mount the frame-fork assembly at its rear axle attachment points so that it is free to rotate about the rear axle in a vertical plane. Support the front fork on a flat steel anvil so that the frame is in its normal position of use. Securely fix a mass of 70 kg, to the seat-post as shown in Figure 26 with the centre of gravity at 75 mm along the seat-post axis from the insertion point.

Measure the wheel-base with the mass in place. Rotate the assembly about the rear axle up to the balance point, then allow the assembly to fall freely to impact on the anvil.

Repeat the test and then measure the wheel-base again with the mass in place and the roller resting on the anvil.

4.8.4 Frame – fatigue test with pedalling forces

4.8.4.1 General

In tests on suspension frames with pivoted joints, adjust the spring, air pressure or damper to provide maximum resistance, or, for a pneumatic damper in which the air-pressure cannot be adjusted, replace the suspension unit with a rigid link, ensuring that its ends fixings and lateral rigidity accurately simulate those of the original unit. For suspension frames in which the chain stays do not have pivots but rely on flexing, ensure that any dampers are set to provide the minimum resistance in order to ensure adequate testing of the frame.

4.8.4.2 Requirement

When tested by the method described in 4.8.4.3, there shall be no visible cracks or fractures in the frame, and there shall be no separation of any parts of any suspension system.

For carbon-fibre frames, the peak deflections during the test at the points where the test forces are applied shall not increase by more than 20 % of the initial values.

4.8.4.3 Test method

Use a new frame/fork assembly fitted with standard head-tube bearings for the test. The front fork may be replaced by a dummy fork of the same length and at least the same stiffness as the original fork.

NOTE If a genuine fork is used, failures of the fork are possible, therefore, it is recommended that for convenience, a dummy fork stiffer and stronger than the genuine fork is used.

Where a frame is convertible for male and female riders by removal of a bar, test it with the bar removed.

Mount the frame assembly on a base as shown in Figure 27 with the fork or dummy fork secured by its axle to a rigid mount of height R_w (the radius of the wheel/tyre assembly ± 30 mm), and with the hub free to swivel on the axle. Secure the rear drop-outs by means of the axle to a stiff, vertical link of the same height as that of the front rigid mount, the upper connection of the link being free to swivel about the axis of the axle but providing rigidity in a lateral plane, and the lower end of the link being fitted with a ball-joint.

Fit a crank and a chain-wheel (or a crank and a chain-wheel set) with a chain assembly or, preferably, a strong, stiff adaptor assembly to the bottom-bracket as shown in Figure 27 and described in a) or b) below.

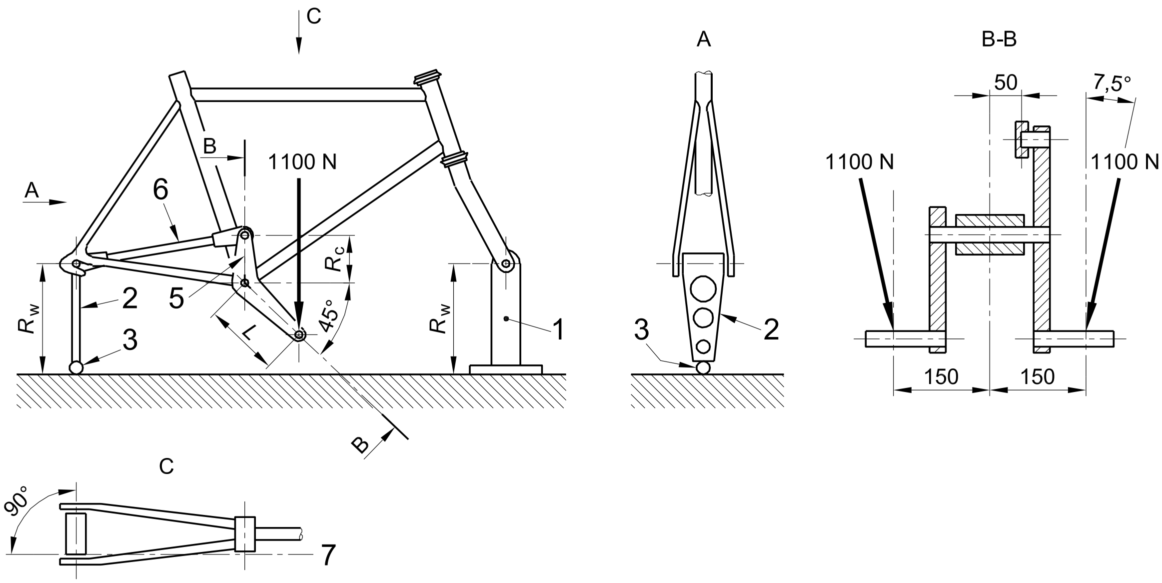
a) If a crank/chain-wheel assembly is used, incline both cranks forwards and downwards at an angle of 45° (accurate to ± 0,5°) to the horizontal and secure the front end of the chain to the middle chain-wheel of three, the smaller chain-wheel of two, or the only chain wheel. Attach the rear end of the chain to the rear axle and perpendicular to the axis of the axle.

b) If an adaptor assembly is used (as shown in Figure 27), ensure that the assembly is free to swivel about the axis of the bottom-bracket and that both replacements arms are 175 mm long (L) and that they are both inclined forwards and downwards at an angle of 45° (accurate to ± 0,5°) to the horizontal. Secure the position of the crank replacement arms by a vertical arm (which replaces the chain-wheel) and a tie-rod which has ball-joints at both ends and which is attached to the rear axle perpendicular to the axis of the rear axle. The length of the vertical arm (R_c) shall be 75 mm, and the axis of the tie-rod shall be parallel to and 50 mm from the vertical plane through the centre-line of the frame.

Subject each pedal spindle (or equivalent adaptor component) to a repeated downward force, of 1 100 N at a position of 150 mm from the centre-line of the frame in a vertical, transverse plane and inclined at 7,5° (accurate to within ± 0,5°) to the fore/aft plane of the frame as shown in Figure 27. During application of these test forces, ensure that the force on a "pedal-spindle" falls to 5 % or less of the peak force before commencing application of the test force to the other "pedal spindle".

Apply the test forces for 100 000 test cycles where one test cycle consists of the application and removal of the two test forces.

Dimensions in millimetres



Key

R_w Height of rigid mount and vertical link

R_c Length of vertical arm (75 mm)

L Length of crank replacement (175 mm)

1 Rigid mount

2 Vertical link

3 Ball-joint

4 Adaptor assembly

5 Vertical arm

6 Tie-rod

7 Centre-line of tie-rod

Figure 27 — Frame – fatigue test with pedalling forces

4.8.5 Frame – fatigue test with horizontal forces

4.8.5.1 General

All types of frame shall be subjected to this test.

It is not necessary for a genuine fork to be fitted, provided that any substitute fork is of the same length as the intended fork and it is correctly installed in the steering-head bearings. For a suspension fork, lock it at a length equivalent to that with an 80-kg rider seated on the bicycle either by adjusting the spring/damper or by external means.

Where a suspension frame has adjustable brackets or linkages to vary the resistance of the bicycle against the ground-contact forces or to vary the attitude of the bicycle, the positions of these adjustable components as used in the fatigue test shall be arranged to ensure maximum forces in the frame.

4.8.5.2 Requirement

When tested by the method described in 4.8.5.3, there shall be no visible cracks or fractures in the frame and there shall be no separation of any parts of any suspension system.

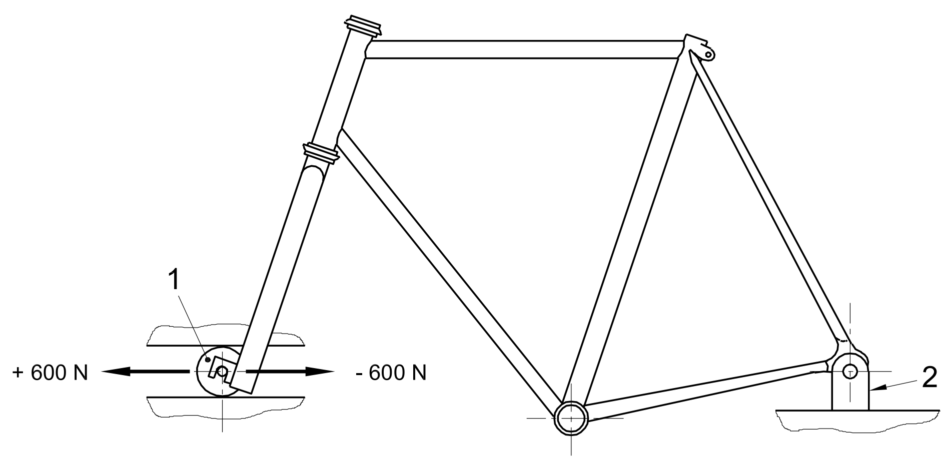
For carbon-fibre frames, the peak deflection during the test in either direction from the mean position shall not increase by more than 20 % of the initial values.

4.8.5.3 Test method

For a rigid frame, mount the frame in its normal attitude and secured at the rear drop-outs so that is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure 28.

For a frame incorporating a rear suspension system, lock the moving part of the frame in to a position as would occur with and 80-kg rider seated on the bicycle. This may be achieved by locking the suspension unit in an appropriate position or, if the type of suspension system does not permit to be locked, then the suspension system may be replaced by a solid link of the appropriate compressed size. Ensure that the axes of the front axle and rear axle are horizontally in line as shown in Figure 28.

Apply cycles of dynamic, horizontal forces of +600 N in a forward direction and -600 N in a rearward direction to the front fork drop-outs on an axis through the front and rear axles for 100 000 cycles as shown in Figure 28, with the front fork constrained in vertical direction but free to move in a fore/aft direction under the applied forces. The maximum frequency shall be 25 Hz.



Key

1 Free-running guided roller

2 Rigid, pivoted mounting for rear axle attachment point

Figure 28 — Frame – fatigue test with horizontal forces

4.9 Front fork

4.9.1 General

4.9.2, 4.9.4, 4.8.5, and 4.9.6 apply to all types of fork.

In the strength tests, 4.9.4, 4.9.5, 4.9.6 and 4.9.7, a suspension-fork shall be tested in its free, uncompressed-length condition.

4.9.2 Means of location of the axle and wheel retention

The slots or other means of location for the wheel-axle within the front fork shall be such that when the axle or cones are firmly abutting the top face of the slots, the front wheel rim remains central within the fork.

The front-fork and wheel shall also fulfil the requirements of 4.10.4 and 4.10.5.

4.9.3 Suspension-forks – special requirements

4.9.3.1 Fail-safe requirement

The design shall be such that if the suspension system fails, the tyre shall not contact the crown of the fork nor shall the components of the fork separate.

4.9.3.2 Tyre-clearance test

4.9.3.2.1 Requirement

When tested by the method described in 4.9.3.2.2, the tyre shall not contact the crown of the fork.

4.9.3.2.2 Test method

With a wheel and tyre assembly fitted to the fork apply a force of 2 800 N to the wheel in a direction towards the fork-crown and parallel to the axis of the fork stem. Maintain this force for 1 min.

NOTE See also 4.10.2.

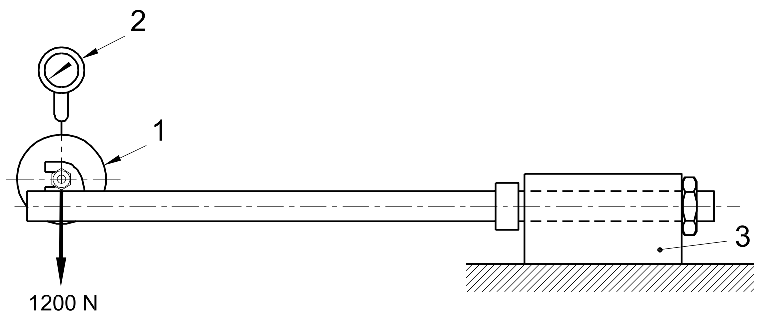
4.9.3.3 Tensile test

4.9.3.3.1 Requirement

When tested by the method described in 4.9.3.3.2, there shall be no detachment or loosening of any parts of the assembly, and the tubular, telescopic components of any fork-leg shall not separate under the test force.

4.9.3.3.2 Test method

Mount the fork-stem securely in a suitable rigid mounts keeping any clamping forces away from the fork-crown, and apply a tensile force of 2 300 N distributed equally between the two drop-outs in a direction parallel to the axis of the fork stem and in a direction away from the fork-crown. Maintain this force for 1 min.



Key

1 Loading attachment to swivel on axle

2 Deflection measuring device

3 Rigid mount incorporating head bearings

Figure 29 — Front fork – static bending test (typical arrangement)

4.9.4 Front fork – static bending test

4.9.4.1 Requirement

When tested by the method described in 4.9.4.2, there shall be no fractures or visible cracks in any part of the fork, and the permanent set, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork-stem, shall not exceed 5 mm for rigid forks and 10 mm permanent set for suspension forks.

4.9.4.2 Test method

Mount the fork in a fixture representative of the head-tube and gripped in the normal head-bearings and fit a loading-attachment and swivel on an axle located in the axle-slots of the blades (see Figure 29). Locate a deflection measuring device on the loading-attachment in order to measure deflection and permanent set of the fork perpendicular to the stem axis and in the plane of the wheel.

Apply a static, pre-loading force of 100 N to the roller perpendicular to the stem axis, against the direction of travel, and in the plane of the wheel. Remove and repeat this loading until a consistent deflection reading is obtained. Adjust the deflection measuring device to zero.

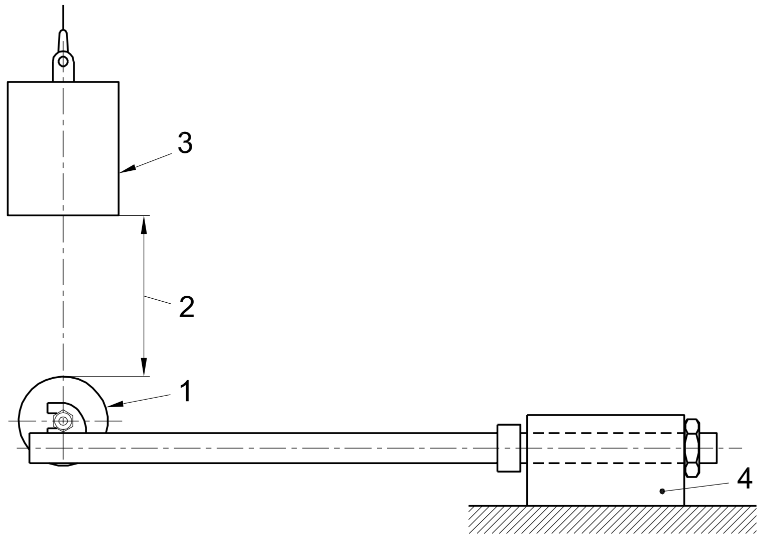
Increase the static force to 1 200 N, maintain the force for 1 min, then reduce the force to 100 N and record any permanent set.

4.9.5 Front fork – rearward impact test

4.9.5.1 Requirement

When tested by the method described in 4.9.5.2, there shall be no fractures in any part of a fork which has fibre-reinforced parts, there shall be no visible cracks or fractures in any part of a fork made entirely of metal, and for either type, the permanent set, measured as the displacement of the axis of the wheel-axle or simulated axle in relation to the axis of the fork-stem, shall not exceed 45 mm.

Dimension in millimetres



Key

1 Low-mass roller

2 Drop height (640 mm for forks which have carbon fibre parts or 360 mm for forks made entirely of metal)

3 Striker 22,5 kg

4 Rigid mount incorporating head bearings

Figure 30 — Front fork – rearward impact test

4.9.5.2 Test method

Mount the fork in a fixture representative of the head-tube and gripped in the normal bearings as shown in Figure 30. Assemble a roller of mass less than 1 kg and with dimensions conforming to those shown in Figure 25 in the fork.

Rest a striker of mass 22,5 kg on the roller in the fork drop-outs such that it is exerting a force against the direction of travel and in the plane of the wheel. Position a deflection measuring device under the roller, record the position of the roller in a direction perpendicular to the axis of the fork-stem and in the plane of the wheel and note the vertical position of the fork.

Remove the deflection device, raise the striker through a height of 640 mm for forks which have fibre-reinforced parts or 360 mm for forks made entirely of metal, and release it to strike the roller against the rake of the fork. The striker will bounce and this is normal. When the striker has come to rest on the roller, measure the permanent set under the roller.

4.9.6 Front fork – bending fatigue test

4.9.6.1 Requirement

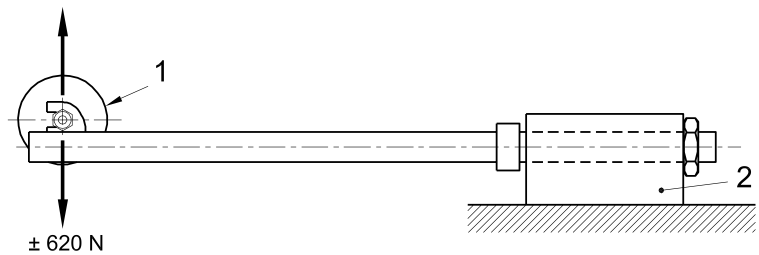
When tested by the method described in 4.9.6.2, there shall be no fractures or visible cracks in any part of the fork.

For carbon-fibre forks, the peak deflections during the test in either direction from the mean position shall not increase by more than 20 % of the initial values.

4.9.6.2 Test method

Mount the fork in a fixture representative of the head-tube and gripped in the normal bearings as shown in Figure 31.

Apply cycles of fully-reversed, dynamic force of ± 620 N in the plane of the wheel and perpendicular to the stem-tube to a loading attachment and swivel on an axle located in the axle-slot of the blades for 100 000 test cycles with a test frequency not exceeding 25 Hz. Check the peak deflections to compare them with the requirements.



Key

1 Pivoted force-attachment

2 Rigid mount incorporating head bearings

Figure 31 — Front fork – bending fatigue test

4.9.7 Forks intended for use with hub- or disc-brakes

4.9.7.1 General

When a fork is intended for use with a hub- or disc-brake and whether supplied as original equipment or as an accessory, the fork manufacturer shall provide an attachment point on the fork-blade for the torque-arm or calliper.

When the use of large discs is approved, the calliper might not be attached directly to the mounting-point on the fork-blade but to an extension, and a realistic assembly shall be used in all of the tests.

In tests conducted by the methods described in 4.9.7.2 and 4.9.7.3 and where more than one mounting-point is provided for a hub- or disc-brake, the following shall apply:

a) where a complete bicycle is supplied, the test adaptor shall be secured to the mounting-point used on the bicycle;

b) where a fork is supplied as an accessory with more than one mounting-point, separate tests shall be conducted on each of the mounting-points on separate forks.

4.9.7.2 Fork for hub/disc-brake – static brake-torque test

4.9.7.2.1 Requirement

When tested by the method described in 4.9.7.2.2, there shall be no fractures or visible cracks in any part of the fork, and the permanent set, measured as the displacement of the axle location of either fork-blade perpendicular to the axis of the fork-stem, shall not exceed 5 mm.

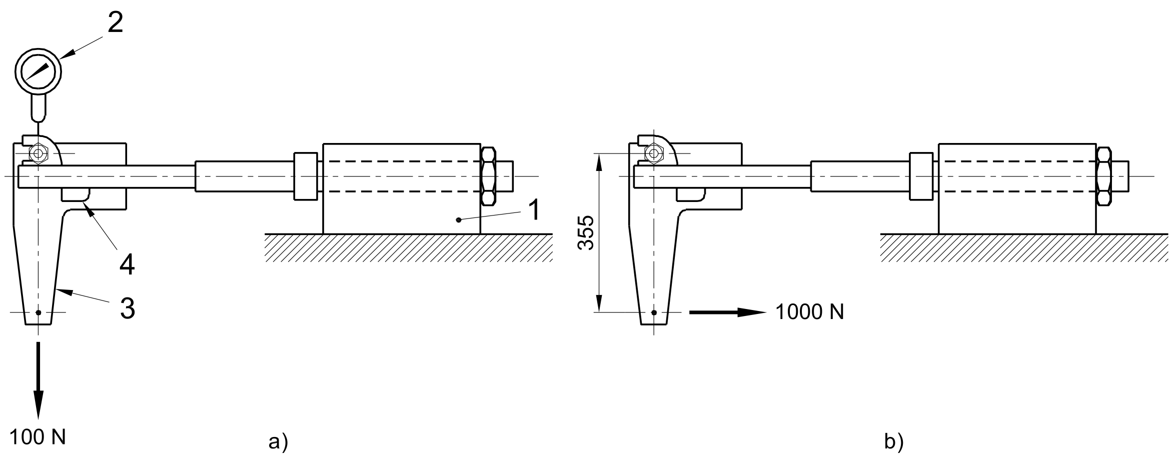
4.9.7.2.2 Test method

Mount the fork in a fixture representative of the head-tube and gripped in the normal head-bearings. Fit an axle to the fork, and mount on the axle a pivoted, L-shaped adaptor as shown in Figure 32 to provide a torque-arm of 355 mm in length and a suitable attachment for the brake mounting-point. Secure the fork against rotation about the stem-axis without constraining it in a bending sense.

Locate suitable measuring devices on both fork-blades at the axle location as shown in Figure 32 a) and apply a force of 100 N to the torque-arm and in a direction against the direction of travel. Remove and re-apply this force until consistent deflection readings are obtained and record the vertical positions of the two blades.

Remove the measuring devices and apply a force of 1 000 N to the torque arm in a direction parallel to the fork-stem axis, towards the fork-crown, and parallel to the plane of the wheel as shown in Figure 32 b), and maintain this force for 1 min. Remove the test force and, if the fork is a suspension-type, allow it to return to its normal length. Replace the deflection devices, re-apply the 100 N force (see Figure 32 a)), and record any permanent set of the two blades.

Dimension in millimetres



Key

a) Setting 'zero' deflection

b) Application of the test force

1 Rigid mount incorporating head bearings

2 Deflection measuring device

3 Brake adaptor

4 Brake mounting-point

Figure 32 — Fork for hub/disc-brake – static brake-torque test

4.9.7.3 Fork for hub/disc-brake – repeated brake-torque test

4.9.7.3.1 Requirement

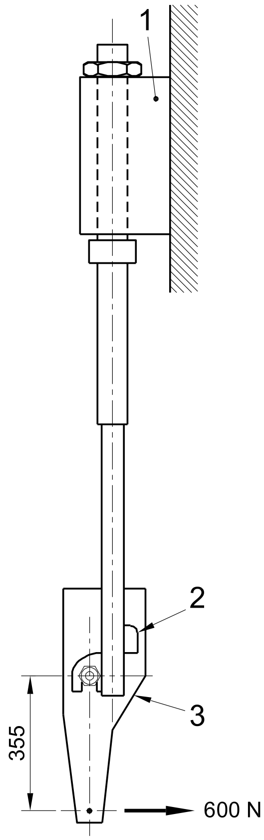
When tested by the method described in 4.9.7.3.2, there shall be no fractures or visible cracks in any part of the fork and, in the case of suspension-forks, there shall be no separation of any parts.

4.9.7.3.2 Test method

Mount the fork in a fixture representative of the head-tube and gripped in the normal head-bearings with the axis of the fork-stem vertical. Fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 33 to provide a torque-arm of 355 mm in length and a suitable attachment for the brake mounting-point.

Apply repeated, horizontal, dynamic forces of 600 N rearward to the end of the torque-arm parallel to the plane of the wheel (as shown in Figure 33) for 20 000 test cycles with a test frequency not exceeding 25 Hz.

Dimension in millimetres



Key

1 Rigid mount incorporating head bearings

2 Brake mounting-point

3 Test adaptor

Figure 33 — Fork for hub/disc-brake – repeated brake-torque test

4.9.8 Tensile test for a non-welded fork

4.9.8.1 General

This test is for forks where the blades and/or the stem are secured in the fork-crown by press-fitting, clamping, adhesives, or any method other than brazing or welding.

NOTE It may be convenient to combine this test with the wheel retention test, 4.10.4.

4.9.8.2 Requirement

When tested by the method described in 4.9.8.3, there shall be no detachment or loosening of any parts of the assembly.

4.9.8.3 Test method

Mount the fork-stem securely in a suitable rigid mount, keeping any clamping forces away from the fork-crown, and apply a tensile force of 5 000 N distributed equally to both drop-outs for 1 min in a direction parallel to the axis of the fork-stem.

4.10 Wheels and wheel/tyre assemblies

4.10.1 Rotational accuracy

4.10.1.1 General

Rotational accuracy shall be as defined in ISO 1101 in terms of circular run-out tolerance (axial). The run-out tolerances given in 4.10.1.2 and 4.10.1.3 represent the maximum variation of position of the rim (i.e. full indicator reading) of a fully assembled and adjusted wheel during one complete revolution about the axle without axial movement.

Since it is impractical to measure concentricity of racing wheels with a tyre fitted, all run-out measurements shall be made without a tyre fitted to the rim.

4.10.1.2 Concentricity tolerance

For all wheels, the run-out shall not exceed 0,5 mm when measured perpendicular to the axle at a suitable point along the rim (see Figure 34).

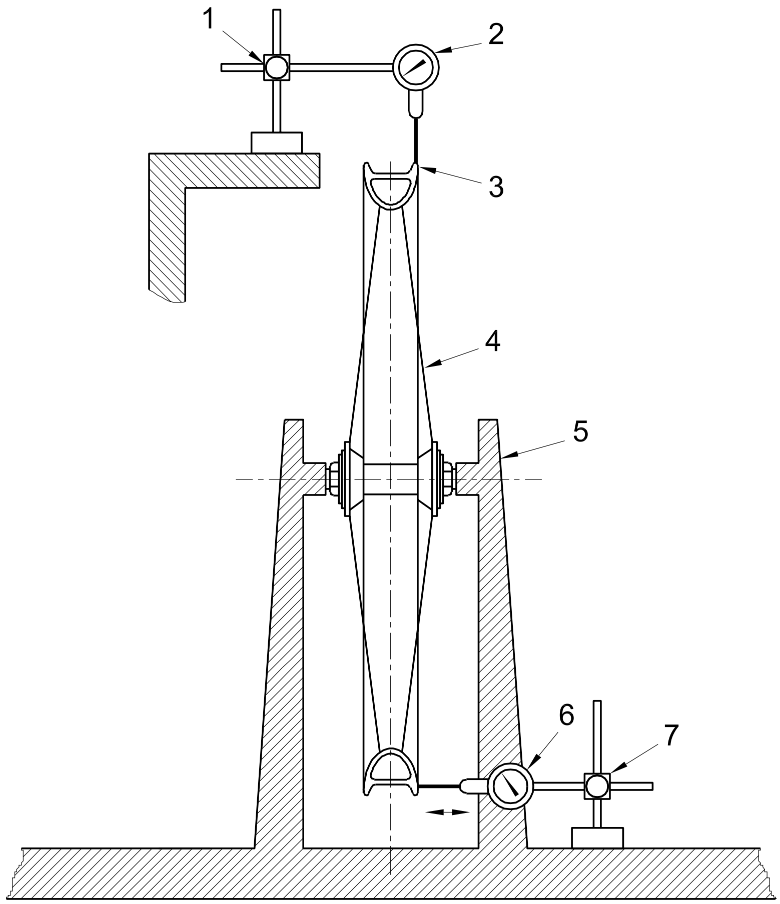
4.10.1.3 Lateral tolerance

For all wheels, the run-out shall not exceed 0,5 mm when measured parallel to the axle at a suitable point along the rim (see Figure 34).

4.10.2 Wheel/tyre assembly – clearance

Alignment of the wheel/tyre assembly in a bicycle shall allow not less than 4 mm clearance between the tyre or the rim and any frame or fork element or a mudguard and its attachment bolts.

Where a racing bicycle has a frame or a fork with a suspension system, the clearances shall be measured with the appropriate suspension system compressed to the limit specified by the manufacturer (see also 4.9.3.2).



Key

1 Instrument stand

2 Dial-gauge (concentricity)

3 Rim

4 Spoke

5 Hub axle support

6 Dial-gauge (lateral run-out)

7 Instrumentation stand

Figure 34 — Wheel – rotational accuracy

4.10.3 Wheel/tyre assembly – static strength test

4.10.3.1 Requirement

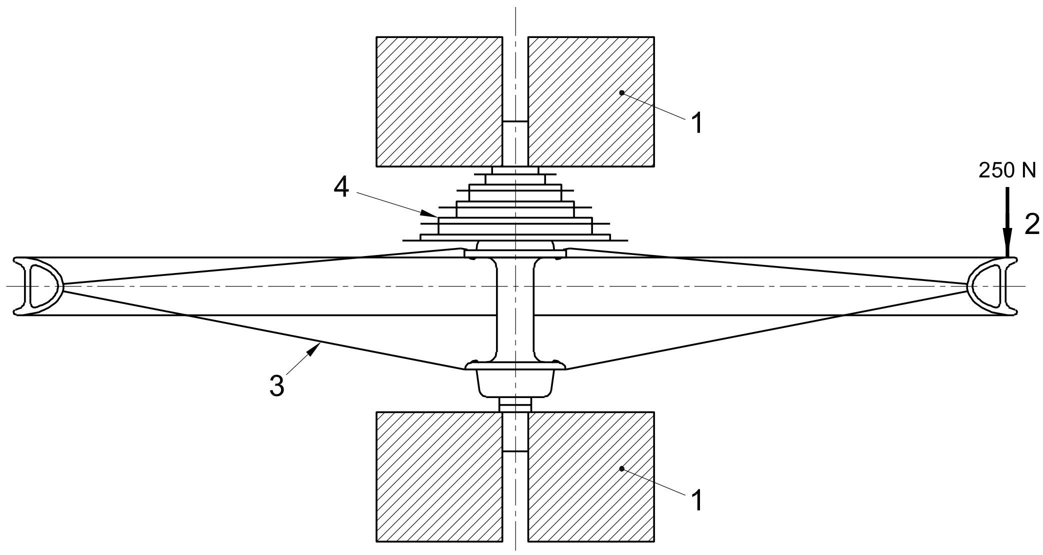
When a fully assembled wheel, fitted with the appropriate size tyre and inflated to the maximum pressure as marked on the tyre, is tested by the method described in 4.10.3.2, there shall be no failure of any of the components of the wheel, and the permanent deformation, measured at the point of application of the force on the rim, shall not exceed 1 mm.

4.10.3.2 Test method

Clamp and support the wheel suitably as shown in Figure 34 and apply a static force of 250 N on the rim once at one spoke and once between two spokes, perpendicular to the plane of the wheel. Apply the force for a duration of 1 min.

In the case of a rear wheel, apply the force from the sprocket side of the wheel as shown in Figure 35.

NOTE In the case when a rim is compatible with different size of tyre width, the test shall be performed with the most severe combination of tyre width and rim.



Key

1 Clamping fixture

2 Test force 250 N

3 Wheel/tyre assembly

4 Drive sprockets

Figure 35 — Wheel/tyre assembly – static strength test

4.10.4 Wheel retention

4.10.4.1 General

Wheel retention safety is related to the combination of wheel, retention device and drop-out design.

Wheels shall be secured to the bicycle frame and fork such that when adjusted to the manufacturer's instructions they comply with 4.10.4.2, 4.10.4.3, 4.10.4.4 and 4.10.5.

Wheel nuts shall have a minimum removal torque of 70 % of the manufacturer's recommended tightening torque.

Where quick-release axle devices are used they shall comply with 4.10.5.

4.10.4.2 Front wheel retention – retention devices secured

4.10.4.2.1 Requirement

When tested by the method described in 4.10.4.2.2, there shall be no relative motion between the axle and the front fork.

4.10.4.2.2 Test method

Apply a force of 2 300 N distributed symmetrically to both ends of the axle for a period of 1 min in the direction of the removal of the wheel.

4.10.4.3 Rear wheel retention – retention devices secured

4.10.4.3.1 Requirement

When tested by the method described in 4.10.4.3.2, there shall be no relative motion between the axle and the frame.

4.10.4.3.2 Test method

Apply a force of 2 300 N distributed symmetrically to both ends of the axle for a period of 1 min in the direction of the removal of the wheel.

4.10.4.4 Front wheel retention – retention devices unsecured

Where threaded axles and nuts are fitted, and the nuts are unscrewed by at least 360° from the finger tight condition open and the brake system disconnected or released, the wheel shall not detach from the fork when a force of 100 N is applied radially outwards and in line with the drop-out slots.

Where quick-release mechanisms are fitted, with the quick-release lever fully open and the brake system disconnected or released, the wheel shall not detach from the front fork when a force of 100 N is applied to the wheel radially outwards and in line with the drop-out slots.

NOTE It is recommended that it be possible to remove and replace the wheel without disturbing the pre-set condition when secondary retention devices are present.

4.10.5 Wheels – quick-release devices – operating features

Any quick-release device shall have the following operating features:

a) it shall be adjustable to allow setting for tightness;

b) its form and marking shall clearly indicate whether the device is in the open or locked position;

c) if adjustable by a lever, the force required to close a properly set lever shall not exceed 200 N and, at this closing force there shall be no permanent deformation of the quick-release mechanism;

d) the releasing force of the clamping device when closed shall not be less than 50 N;

e) if operated by a lever, the quick-release device shall withstand without fracture or permanent deformation a closing force of not less than 250 N applied with the adjustment set to prevent closure at this force;

f) the wheel retention with the quick-release device in the clamped position shall be in accordance with 4.10.4.2 and 4.10.4.3;

g) the front wheel retention with the quick-release device in the open position shall be in accordance with 4.10.4.4.

If applied to a lever, the force specified in c), d), and e) shall be applied 5 mm form the tip end of the lever.

4.11 Rims, tyres and tubes

NOTE Non-pneumatic tyres are excluded form the requirements of 4.11.1 and 4.11.2.

4.11.1 Tyre inflation pressure

The maximum inflation pressure recommended by the manufacturer shall be permanently marked on the side wall of the tyre so as to be readily visible when the latter is assembled on the wheel.

NOTE It is recommended that the minimum inflation pressure specified by the manufacturer also be permanently marked on the sidewall of the tyre.

4.11.2 Tyre and rim compatibility

Tyres that comply with the requirements of ISO 5775-1 and rims that comply with the requirements of ISO 5775-2 are compatible. The tyre, tube and tape shall be compatible with the rim design. When inflated to 110 % of the maximum inflation pressure for a period of not less than 5 min, the tyre shall remain intact on the rim.

NOTE In the absence of suitable information from the above-mentioned International Standards, other publication may be used. See Bibliography.

4.11.3 Tubular tyres and rims

Tubular tyres shall be compatible with the rim design. Instructions for the correct gluing technique shall be given in the bicycle or the wheel assembly instructions (see Clause 5).

4.11.4 Rim wear

In the case where the rim forms part of the braking system and there is a danger of failure due to wear, the manufacturer shall make the rider aware of this danger by a durable and legible marking on the rim in an area not obscured by the tyre (see also Clause 5 s) and 6.1).

4.12 Pedals and pedal/crank drive system

4.12.1 Foot retention

Pedals shall be equipped with devices for securing the shoes to the pedals, such as toe-clips or quick release devices (see also Clause 5 k), 3.18 and 3.25).

4.12.2 Pedal clearance

4.12.2.1 Ground clearance

With the bicycle un-laden, the pedal at its lowest point and the tread surface of the pedal parallel to the ground and uppermost where it has only on tread surface, it shall be possible to lean the bicycle over at an angle of 23° from the vertical before any part of the pedal touches the ground.

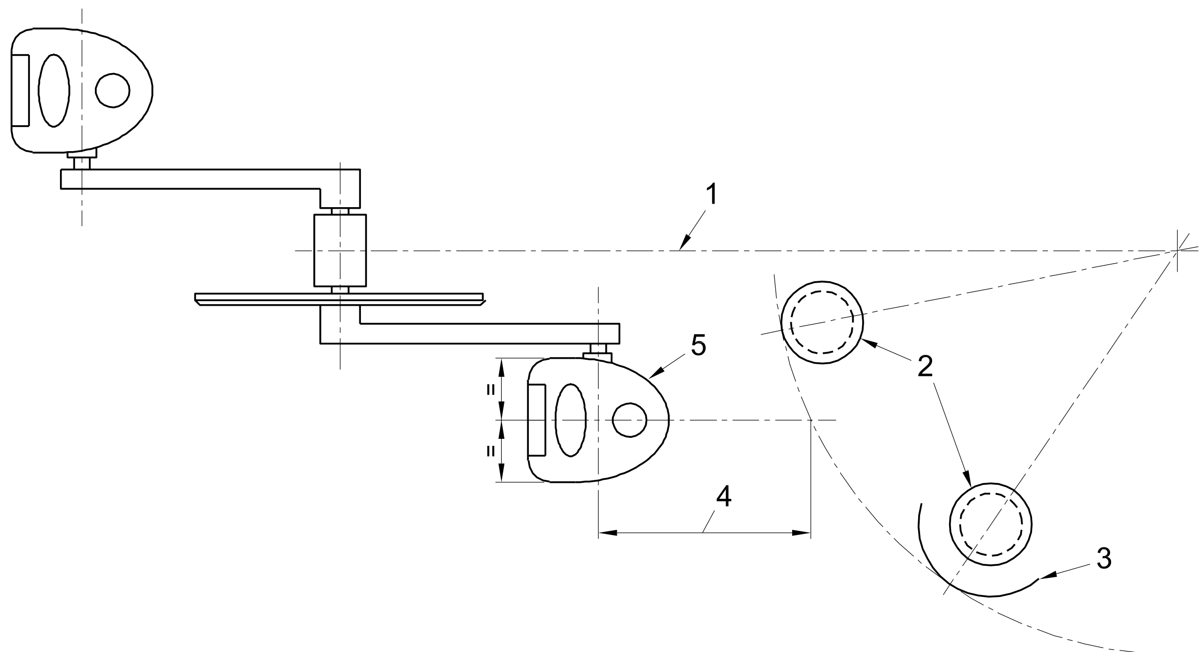
When a racing bicycle is equipped with a suspension system, this measurement shall be taken with the suspension adjusted to its softest condition and with the bicycle depressed into a position such as would be caused by a rider weighing 80 kg.

4.12.2.2 Toe clearance

Bicycles shall have at least 89 mm clearance between the pedal and the front tyre (when turned to any position). The clearance shall be measured forward and parallel to the longitudinal axis of the bicycle from the centre of either pedal to the arc swept by the tyre, whichever results in the least clearance (see Figure 36).

In the case where the front fork has features that are designed to permit the fitting of a front mudguard, the toe-clearance shall be measured with a suitable mudguard so fitted, as shown in Figure 36.

NOTE A racing bicycle will not normally be fitted with mudguards.



Key

1 Longitudinal axis

2 Front tyre

3 Mudguard

4 Clearance

5 Pedal

Figure 36 — Pedal to wheel/mudguard – toe clearance

4.12.3 Pedal/pedal-spindle assembly – static strength test

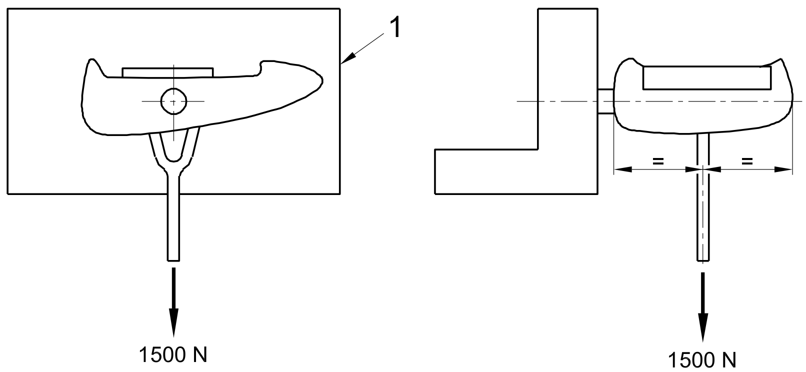
4.12.3.1 Requirement

When tested by the method described in 4.12.3.2, there shall be no fractures, visible cracks, or distortion of the pedal or spindle that could affect the operation of the pedal and pedal-spindle.

4.12.3.2 Test method

Screw the pedal-spindle securely into a suitable rigid fixture with its axis horizontal as shown in Figure 37 and apply to the pedal a vertically-downward force of 1 500 N in line with the pedal spindle and at the centre of the pedal width for 1 min. Remove the force and examine the pedal assembly.

NOTE The exact method of applying the force may vary with the type of pedal, and an example is shown in Figure 37.



Key

1 Rigid mount

Figure 37 — Pedal/pedal-spindle assembly: static strength test

4.12.4 Pedal-spindle – impact test

4.12.4.1 Requirement

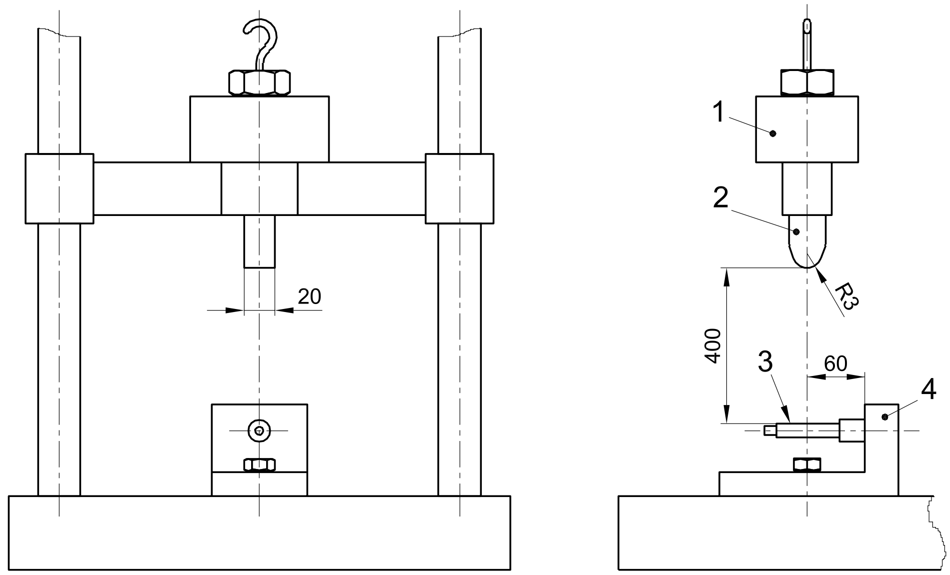
When tested by the method described in 4.12.4.2, the pedal spindle shall not fracture and any permanent set bending at the point of impact shall not exceed 15 mm.

NOTE Visible cracking is permissible because of the hardened surface.

4.12.4.2 Test method

Screw the pedal-spindle securely into a suitable rigid fixture with its axis horizontal as shown in Figure 38 and release a striker of the design shown in Figure 39 and weighing 15 kg from a height of 400 mm to strike the pedal-spindle at point 60 mm from the mounting-face of the rigid fixture or 5 mm from the end of the spindle if the spindle is shorter than 65 mm.

Dimensions in millimetres



Key

1 15 kg mass (whole assembly)

2 Striker

3 Pedal-spindle

4 Rigid fixture

Figure 38 — Pedal-spindle – impact test

4.12.5 Pedal/pedal-spindle – dynamic durability test

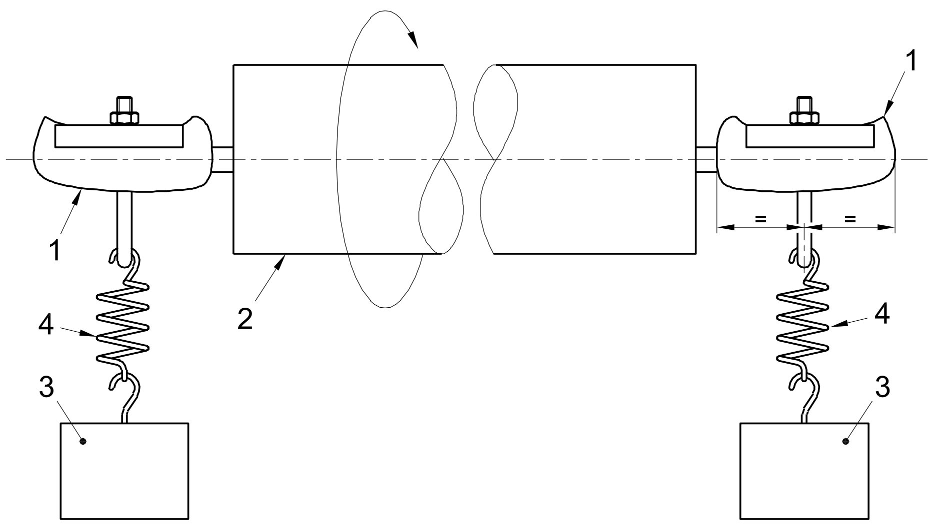
4.12.5.1 Requirement

When tested by the method described in 4.12.5.2, there shall be no fractures or visible cracking of any part of the pedal or the pedal-spindle, nor any failure of the bearing system.

4.12.5.2 Test method

Screw each pedal securely into a threaded hole in a rotable test-shaft as shown in Figure 39 and suspend a mass of 65 kg at the centre of the pedal width by means of a tension-spring to each pedal, the object of the springs being to minimise oscillations of the load.

Drive the shaft at approximately 100 min^{-1} for a total of 100 000 revolutions. If the pedals are provided with two tread surfaces, rotate them through 180° after 50 000 revolutions.



Key

1 Pedal

2 Test shaft

3 65 kg mass

4 Tension-spring

Figure 39 — Pedal/pedal-spindle – dynamic durability test

4.12.6 Drive-system – static strength test

4.12.6.1 Requirement

When tested by the method described in 4.12.6.2, there shall be no fracture of any component of the drive system, and drive capability shall not be lost.

4.12.6.2 Test method

Conduct the test on an assembly comprising the frame, pedals, transmission system, rear wheel assembly, and the gear change mechanism. Support the frame with its longitudinal plane vertical, and with the rear wheel clamped securely at the rim to prevent the wheel rotating.

With the left-hand crank in the forward position, apply a force increasing progressively to 1 500 N vertically downwards to the centre of the left-hand pedal. Maintain this force for 1 min.

Should the system yield or the drive-sprockets tighten such that the crank rotates while under load to a position more than 30° below the horizontal, remove the test force, return the crank to the horizontal position or some appropriate position above the horizontal to take account of yield and repeat the test.

Conduct the tests with the transmission correctly adjusted in its lowest gear ratio.

Conduct the tests with the transmission correctly adjusted in its highest gear ratio.

On completion of the test on the left-hand crank repeat the test with the right-hand crank in the forward position and with the force applied to the right-hand pedal.

4.12.7 Crank assembly – fatigue test

4.12.7.1 Requirement

When tested by the method described in 4.12.7.2, there shall be no fractures or visible cracks in the cranks, the bottom-bracket spindle or any of the attachment features, or loosening or detachment of the chain-wheel from the crank.

4.12.7.2 Test method

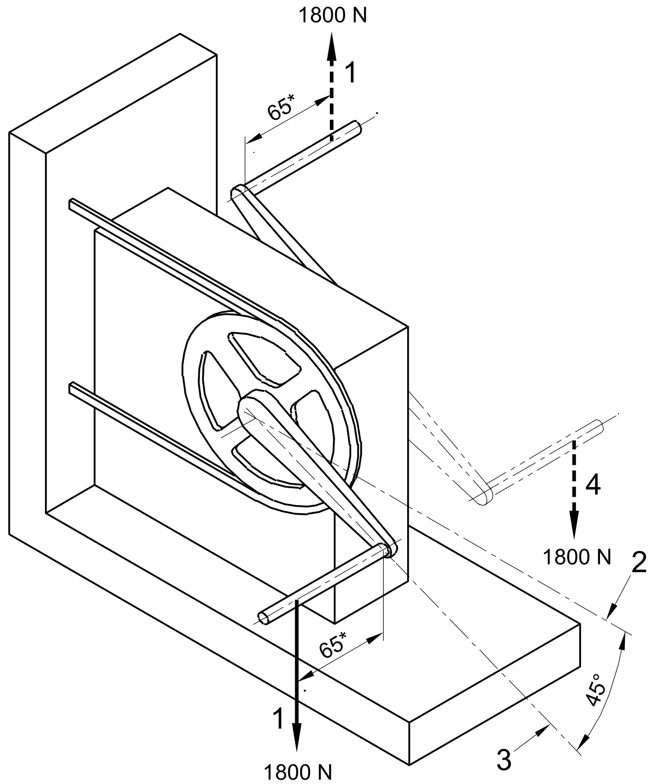
Mount the assembly of the two pedal-spindle adaptors, the two cranks, the chain-wheel set (or other drive component), and the bottom-bracket spindle locate on its normal-production bearings in a fixture with bearing-housings representative of the bottom-bracket, as shown in Figure 40. Incline the cranks at 45° to the horizontal. Prevent rotation of the assembly by locating a suitable length of drive-chain around the largest or only chain wheel and securing it firmly to a suitable support, or, for any other type of transmission (e.g. belt- or shaft-drive) by securing the first stage of the transmission.

NOTE It is permissible to have the left crank in either of the two positions shown in Figure 40, provided the test force is applied in the appropriate direction as specified in the next paragraph.

Apply repeated, vertical, dynamic forces of 1 800 N alternately to the pedal-spindle adaptors of the left- and right-hand cranks at a distance of 65 mm from the outboard face of each crank (as shown in Figure 40) for 100 000 cycles (where one test cycle consists of the application of the two forces). The direction of the force on the right-hand crank shall be downward and that on the left-hand crank shall be upwards for a rearward-pointing crank or downwards for a forward-pointing crank. During application of these test forces, ensure that the force on a pedal-spindle adaptor falls to 5 % or less of the peak force before commencing application of the test force to the other pedal-spindle adaptor.

The maximum test frequency shall be 25 Hz.

Dimensions in millimetres



Key

1 Repeated test force 1 800 N

2 Horizontal axis

3 Axis of crank

4 Alternative left crank arrangement

*From outboard face of crank

Figure 40 — Crank assembly – fatigue test (typical test arrangement)

4.13 Saddles and seat-pillars

4.13.1 General

All strength tests involving the saddle or any plastic materials shall be performed at an ambient temperature in the range 18 °C to 24 °C.

If a suspension seat-pillar is involved, the test may be conducted with the suspension-system either free to operate or locked. If it is locked, the pillar shall be at its maximum length.

4.13.2 Limiting dimensions

No part of the saddle, saddle supports, or accessories to the saddle shall be more than 125 mm above the top saddle surface at the point where the saddle surface is intersected by the seat-pillar axis.

4.13.3 Seat-pillar – insertion depth mark or positive stop

The seat-pillar shall be provided with one of the two following alternative means of ensuring a safe insertion-depth into the frame:

a) it shall contain a permanent, transverse mark of length not less than the external diameter or the major dimension of the cross-section of the seat-pillar that clearly indicates the minimum insertion-depth of the pillar into the frame. For a circular cross-section, the mark shall be located not less than two diameters of the pillar from the bottom of the pillar (i.e. where the diameter is the external diameter). For a non-circular cross-section, the insertion-depth mark shall be located not less than 65 mm from the bottom of the pillar (i.e. where the seat-pillar has its full cross-section).

b) it shall incorporate a permanent stop to prevent it from being drawn out of the frame such as to leave the insertion less than the amount specified in a) above.

4.13.4 Saddle/seat-pillar – security test

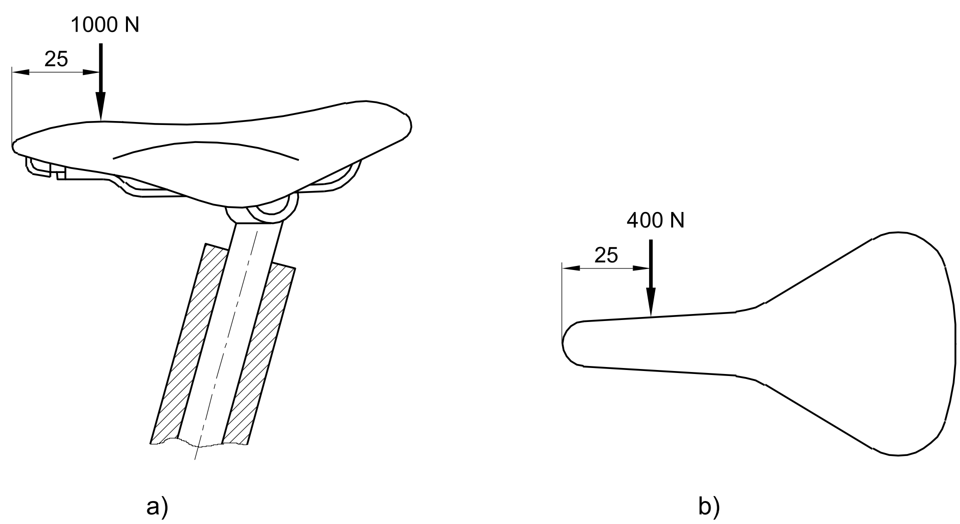
4.13.4.1 Requirement

When tested by the method described in 4.13.4.2, there shall be no movement for the saddle adjustment clamp in any direction with respect to the pillar, or of the pillar with respect to the frame, nor any failure of saddle, adjustment clamp or seat pillar. In the case of saddles with some intended degree of movement, the movement shall fall within the parameters of design.

4.13.4.2 Test method

With the saddle and seat-pillar correctly assembled to the bicycle frame, and the clamps tightened to the torque recommended by the bicycle manufacturer, apply a force of 1 000 N vertically downwards at a point 25 mm from either the front or rear of the saddle, whichever produces the greater torque on the saddle-clamp. Remove this force and apply a lateral force of 400 N horizontally at a point 25 mm from either the front or rear of the saddle, whichever produces the greater torque on the clamp (see Figure 41).

Dimensions in millimetres



Key

a) Vertical force

b) Horizontal force

Figure 41 — Saddle adjustment-clamps security test

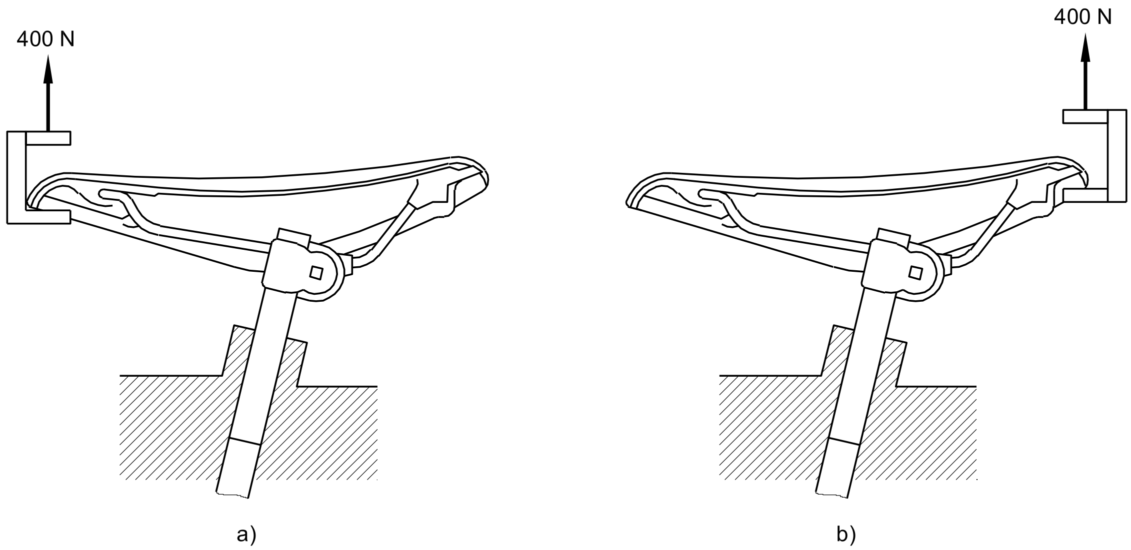
4.13.5 Saddle – static strength test

4.13.5.1 Requirement

When tested by the method described in 4.13.5.2, the saddle cover and/or plastic moulding shall not disengage from the chassis of the saddle, and there shall be no cracking or permanent distortion of the saddle assembly.

4.13.5.2 Test method

With the saddle clamped to a suitable fixture representative of a seat-pillar and the clamps tightened to the torque recommended by the bicycle manufacturer, apply force of 400 N in turn under the rear and the nose of the saddle cover, as shown in Figure 42, ensuring that the force is not applied to any part of the chassis of the saddle.



Key

a) Force under nose

b) Force under rear

Figure 42 — Saddle – static strength test

4.13.6 Saddle and seat-pillar clamp – fatigue test

4.13.6.1 General

Seat-pillars can influence test failures of saddles: for this reason, a saddle shall be tested in combination with a seat pillar as recommended by the saddle manufacturer.

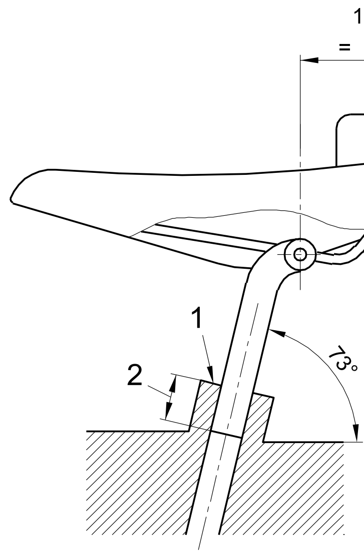
4.13.6.2 Requirement

When tested by method described in 4.13.6.3, there shall be no fractures or visible cracks in the seat-pillar or in the saddle and no loosening of the saddle clamp.

4.13.6.3 Test method

Insert the seat-pillar to its minimum insertion depth (see 4.13.3) in a rigid mount representative of that on the bicycle and with its axis at 73° to the horizontal. Mount the saddle on the seat-pillar, adjust the saddle to have its upper surface in a horizontal plane and to be at its maximum rearward position in the clamp, and tighten the clamp to the torque recommended by the bicycle manufacturer. Apply a repeated, vertically-downward force of 1 000 N for 200 000 cycles, in the position shown in Figure 43 by means of a suitable pad to prevent localised damage of the saddle cover.

The test frequency shall not exceed 4 Hz.



Key

1 Rigid mount

2 Minimum insertion depth

Figure 43 — Saddle and seat-pillar clamp – fatigue test

4.13.7 Seat-pillar – fatigue test

Conduct the test in two stages on the same assembly as follows.

4.13.7.1 Requirement for stage 1

When tested by the method described in 4.13.7.2, there shall be no visible cracks or fractures in the saddle pillar, nor any bolt failure.

If the pillar is a suspension type, the design shall be such that in the event of failure of the suspension system, the two main parts do not separate nor does the upper part (i.e. the part to which the saddle would be attached) become free to swivel in the lower part.

4.13.7.2 Test method for stage 1

Insert the seat-pillar to its minimum insertion depth (see 4.13.3) and securely clamped by means of its usual fastening device in a fixture representative of that on a bicycle, and with its axis inclined to the horizontal at a angle of 73° as shown in Figure 44.

A repeated, vertical downward force of 1 200 N shall be applied alternately at each end of a suitable test adaptor which represents a saddle and which is securely clamped to the seat-pillar (see Figure 44). The adaptor shall be clamped to the top portion where the saddle clamp would fit, and the mid-span of the adaptor shall be located in the middle of the clamp position. The test forces shall be applied 70 mm ahead and 70 mm to the rear, respectively, of the mid-span.

For a saddle with a choice of horizontal position for the clamp, the adaptor shall be located in the rearmost position.

The force shall be applied for 100 000 cycles at a frequency not exceeding 25 Hz, where a cycle represents the application of the two alternating forces.

4.13.7.3 Requirement for stage 2

When tested by the method described in 4.13.7.4, there shall be no visible cracks or fractures in the saddle pillar, nor any bolt failure.

If the pillar is a suspension type, the design shall be such that in the event of failure of the suspension system, the two main parts do not separate nor does the upper part (i.e. the part to which the saddle would be attached) become free to swivel in the lower part.

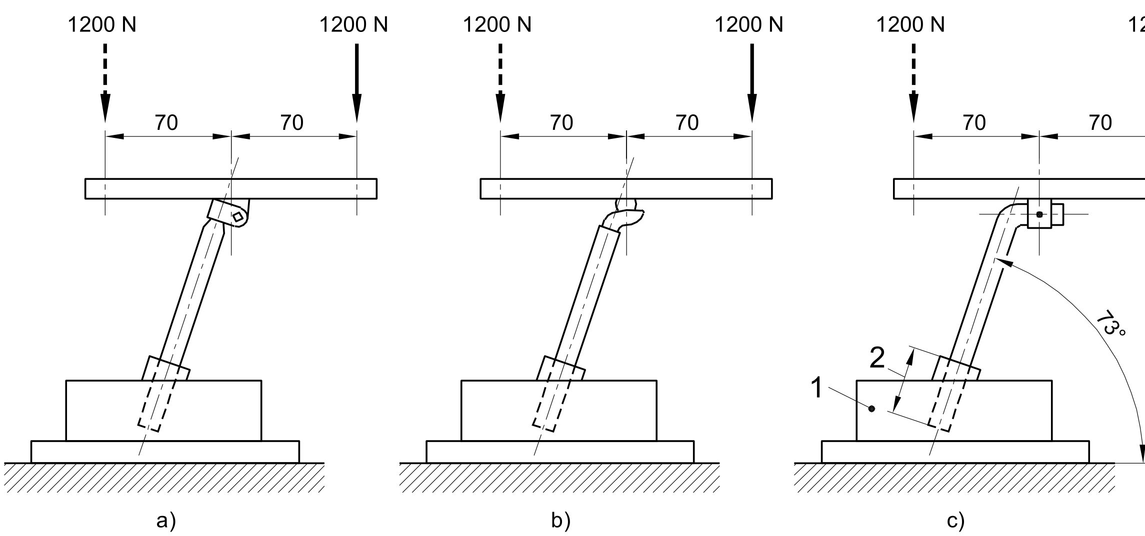
4.13.7.4 Test method for stage 2

Insert the seat-pillar to its minimum insertion depth (see 4.12.3) and securely clamped by means of its usual fastening device in a fixture representative of that on a bicycle, and with its axis inclined to the horizontal at a angle of 73° as shown in Figure 45.

A repeated, rearward force of 900 N shall be applied perpendicular to the main axis of the seat-pillar. For a straight pillar, the force shall be applied through the centre of the saddle-clamp (see Figure 45 a)), and for a pillar with a horizontal extension, the force shall be applied through the intersection of the axes of the main tube and the extension (see Figure 45 b) and c))

The force shall be applied for 100 000 cycles at a frequency not exceeding 25 Hz.

Dimensions in millimetres

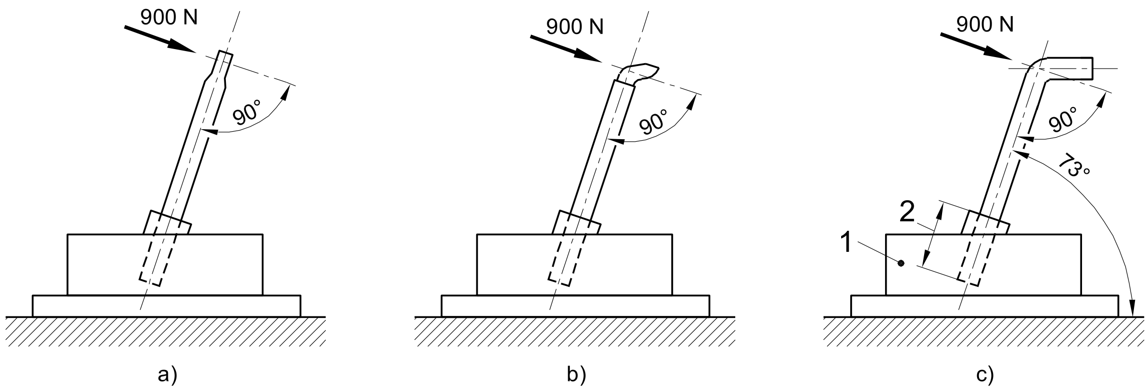


Key

1 Rigid mount

2 Minimum insertion depth

Figure 44 — Seat-pillar – fatigue test (typical arrangements of different types of seat-pillar for stage 1)



Key

1 Rigid mount

2 Minimum insertion depth

Figure 45 — Seat-pillar – fatigue test (typical arrangements of different types of saddle pillar for stage 2)

4.14 Drive-chain

Where a chain-drive is used as a means of transmitting the motive force, the chain shall operate over the front and rear sprockets without binding.

The chain shall conform to the requirements of ISO 9633 and shall have a minimum tensile strength of 9 000 N.

4.15 Chain-guard

4.15.1 General

Chain-guards will not normally be fitted to a racing bicycle: in the case of equipment of the chain-guard, it shall conform to 4.15.2.

4.15.2 Requirement

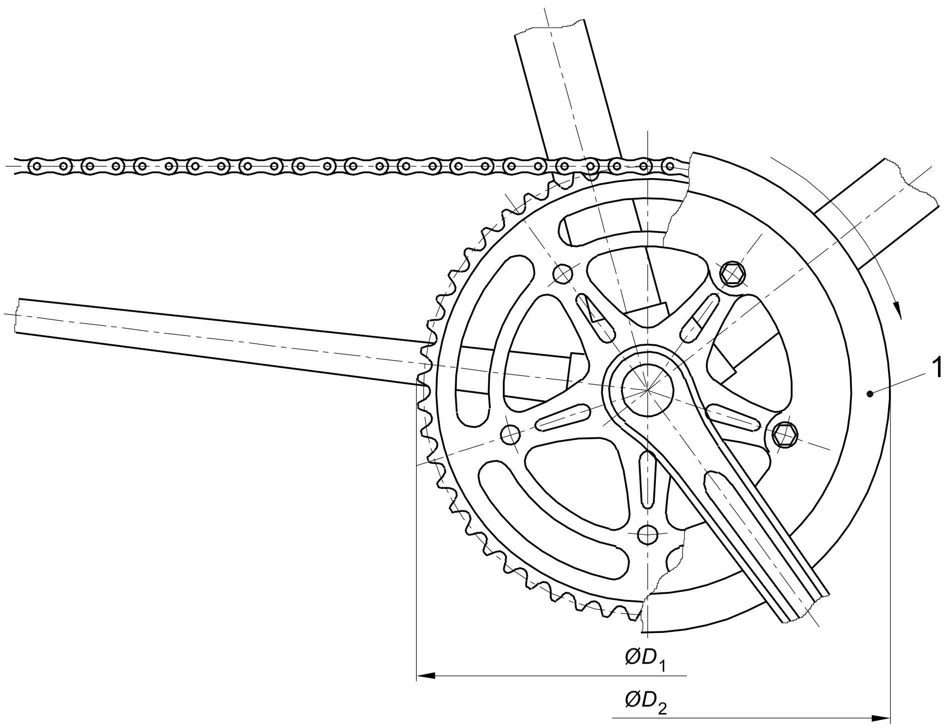
A racing bicycle can be equipped with one of the following:

a) a chain wheel disc which conforms to 4.15.3, or

b) a protective device which conforms to 4.15.4, or

c) where fitted with positive foot-retention devices on the pedals a combined front gear-change guide and a protective device which conforms to 4.15.5.

Dimension in millimetres



$D_2 \geq D_1 + 10$

Key

1 Chain-wheel disc

Figure 46 — Chain-wheel disc

4.15.3 Chain-wheel disc diameter

A chain-wheel disc shall exceed the diameter of the outer chain-wheel, when measured across the tips of the teeth, by not less than 10 mm (see Figure 46).

NOTE Where the design is such that the pedal-crank and chain-wheel are too close together to accommodate a full disc, a partial disc may be fitted which closely abuts the pedal-crank.

4.15.4 Chain protective device

A protective device shall, as a minimum, shield the side-plates and top surface of the chain and the chain-wheel for a distance of at least 25 mm rearwards along the chain from the point where the chain wheel teeth first pass between the side-plates of the chain and forwards round the outer chain-wheel to a horizontal line passing through the bottom-bracket axle centre (see Figure 47).

4.15.5 Combined front gear-change guide

A combined front gear-change guide and protective device shall, as a minimum, shield the outside face of the upper junction of the chain and outer chain-wheel for a distance of at least 25 mm rearwards along the chain from the point where the chain-wheel first passes between the side-plates of the chain (see Figure 47).

Dimension in millimetres

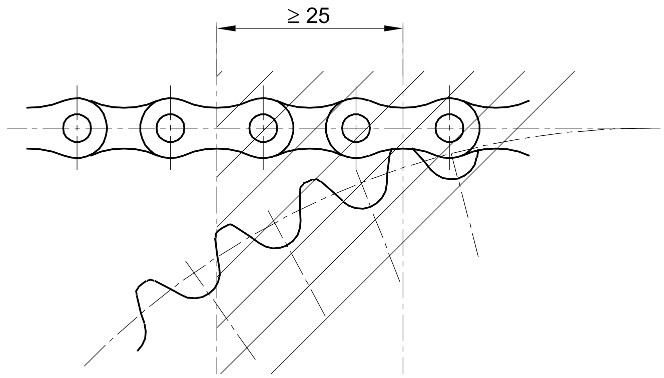


Figure 47 — Chain and chain-wheel junction

4.16 Spoke protector

A bicycle with rear gear-change sprockets can be fitted with a spoke-protector guard to prevent the chain interfering with or stopping rotation of the wheel through improper adjustment or damage.

4.17 Lighting systems and reflectors

4.17.1 Lighting and reflectors

Lighting systems and reflectors will not normally be fitted to a racing bicycle but the manufacturer's instructions shall advise the user to take note of national regulations for the country in which the bicycle is to be used.

4.17.2 Wiring harness

When a wiring harness is fitted, it shall be positioned to avoid any damage by contact with moving parts or sharp edges. All connections shall withstand a tensile force in any direction of 10 N.

4.18 Warning device

Where a bell or other suitable device is fitted, it shall comply with ISO 7636.

4.19 Handling and operation of fully-assembled bicycle

4.19.1 Requirement

When tested by the method described in 4.19.2, the bicycle shall exhibit stable handling in braking, turning and steering and it shall be possible to ride with one hand removed from the handlebar (as when giving hand signals), without difficulty of operation or hazard to the rider.

4.19.2 Test method

First, check and adjust, if necessary, each bicycle selected for the road test to ensure that the steering and wheels rotate freely without slackness, that brakes are correctly adjusted and do not impede wheel rotation. Check and adjust wheel alignment and, if necessary, inflate tyres to the recommended pressure as marked on the side-wall of the tyre. Check and correct, if necessary, transmission-chain adjustment, and check any gear-control fitted for correct and free operation.

Carefully adjust the saddle and handlebar positions to suit the rider.

With a rider of appropriate size, ensure that the bicycle is ridden for at least 1 km.

5 Manufacturer's instructions

Each bicycle shall be provided with a set of instructions in the language of the country to which the bicycle will be supplied, containing information on:

a) the type of use for which the bicycle has been designed (i.e. the type of terrain for which it is suitable) with a warning about the hazards of incorrect use;

b) preparation for riding – how to measure and adjust the saddle height to suit the rider with an explanation of the insertion-depth warning marks on the seat-pillar and handlebar-stem. Clear information on which lever operates the front brake, which lever operates the rear brake, and the presence of any brake-power modulators with an explanation of their function and adjustment;

c) indication of minimum saddle height and the way to measure it;

d) the recommended method for adjusting any adjustable suspension system fitted;

e) recommendations for safe riding – use of a bicycle helmet, regular checks on brakes, tyres, steering, rims, caution concerning possible reduction of toe-clearance due to replacement of cranks or tyres, and caution concerning possible increased braking distances in wet weather;

f) the safe use and adjustment of foot-securing devices (i.e. quick-release pedals and toe-clips);

g) an advisory note to drawn attention to the fact that when using an aerodynamic extension on the handlebar, the rider's response to steering and braking can be adversely affected;

h) the permissible maximum total weight (bicycle + rider);

i) an advisory note to draw attention to the rider concerning possible national legal requirements when the bicycle is to be ridden on public roads (e.g. lighting and reflectors);

j) recommended tightening of fasteners related to the handlebar, handlebar-stem, aerodynamic extension, saddle, seat-pillar, and wheels, with torque values for threaded fasteners;

k) the method for determining the correct adjustment of quick-release devices, such as "the mechanism should emboss the fork-ends when closed to the locked position";

l) the correct method of assembling any parts supplied unassembled;

m) lubrication – where and how often to lubricate, and the recommended lubricants;

n) the correct chain tension and how to adjust it (if appropriate);

o) adjustments of gears and their operation;

p) adjustment of brakes and recommendations for the replacement of the friction components;

q) recommendations on general maintenance;

r) the importance of using only genuine replacement parts for safety-critical components;

s) care of the wheel-rims and a clear explanation of any danger of rim-wear (see also 4.11.4 and 6.1);

t) the correct gluing technique for wheels equipped with tubular tyres (see also 4.11.3);

u) appropriate spares, i.e. tyres, tubes, and brake friction-components;

v) accessories – where these are offered as fitted, details should be included such as operation, maintenance required (if any) and any relevant spares (e.g. light bulbs);

w) an advisory note to draw attention of the rider to possible damage due to intensive use and to recommend periodic inspections of the frame, fork and suspensions joints (if any). The wording of the advice may be as follows:

WARNING: As with all mechanical components, the bicycle is subjected to wear and high stresses. Different materials and components may react to wear or stress fatigue in different ways. If the design life of a component has been exceeded, it may suddenly fail, possibly causing injuries to the rider. Any form of crack, scratches or change of colouring in highly stressed areas indicate that the life of the component has been reached and it should be replaced.

NOTE Any other relevant information may be included at the discretion of the manufacturer.

6 Marking

6.1 Requirements

a) The frame shall be visibly and permanently marked with a successive frame number at a readily visible location such as near the pedal-crank, the seat-pillar, or the handlebar.

b) The frame shall be visibly and durably marked with the name of the manufacturer of the complete bicycle or the manufacturer's representative, and the number of this European Standard, i.e. EN 14781. The method of testing for durability is specified in 6.2.

NOTE 1 In some countries there is a legal requirement concerning marking of bicycles.

NOTE 2 For components, currently there are no specific requirements, but it is recommended that the following safety-critical components be clearly and permanently marked with traceable identification, such as a manufacturer's name and a part number:

a) front fork;
b) handlebar and handlebar-stem;
c) seat-pillar;
d) brake-levers, brake-blocks and/or brake-block holders;
e) outer brake-cable casing;
f) hydraulic-brake tubing;
g) disc-brake callipers, brake-discs, brake-pads;
h) chain;
i) pedals and cranks;
j) bottom-bracket spindle;
k) wheel-rims.

6.2 Durability test

6.2.1 Requirement

When tested by the method described in 6.2.2, the marking shall remain easily legible. It shall not be easily possible to remove any label nor shall any label show any sign of curling.

6.2.2 Test method

Rub the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

Annex A
(informative)

Explanation of the method of least squares for obtaining line of best fit and ± 20 % limit lines for braking performance linearity

The readings taken in the test specified in 4.5.7.5.2.8 can be expected to lie near some straight line that can be drawn through them. Although in practice one might draw a good straight line through the points by eye, the method of least squares given here provides a criterion for minimising the discrepancies, and permits a line to be selected that has a claim to be called the best fit.

The line of best fit is the line that minimises the sum of the squares of the differences between the observed results and the corresponding results predicted by the line.

The relationship between the variables is considered to be of the form:

$y = \mathrm{a} + \mathrm{b}x$

where

- x is the independent variable, and is known precisely (in this case the load applied to the pedal);
- y is the dependent variable, and is observed but with a degree of uncertainty (in this case, the braking force at the wheel);

a and *b* are unknown constants and have to be estimated.

For a series of *n* readings, this relationship can be resolved by taking a minimum of the sum of the squares of the difference to give:

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \sum x \sum x}$$

Taking:

$$\bar{y} = \frac{\sum y}{n} \text{ and } \bar{x} = \frac{\sum x}{n}$$

$$b = \frac{\sum xy - \bar{y}\sum x}{\sum x^2 - \bar{x}\sum x}$$

Then *a* may be found by substitution:

$$a = \bar{y} - b\bar{x}$$

EXAMPLE

The following four values of x and y are noted during a test, from which

$\sum xy$, $\sum x^2$, $\bar{x}$ and $\bar{y}$ are calculated as shown:

No.	x (pedal force) N	y (braking force) N
1 2 3 4	90 150 230 300	90 120 160 220
Sum	$\sum x = 770$	$\sum y = 590$
Mean	$\bar{x} = 192{,}5$	$\bar{y} = 147{,}5$

No.	xy	x^2
1 2 3 4	8 100 18 000 36 800 66 000	8 100 22 500 52 900 90 000
Sum	$\sum xy = 128900$	$\sum x^2 = 173500$

$$b = \frac{\sum xy - \bar{y}\sum x}{\sum x^2 - \bar{x}\sum x}$$

$$= \frac{128900 - (147{,}5 \times 770)}{173500 - (192{,}5 \times 770)}$$

$$= 0{,}606$$

$$a = \bar{y} - b\bar{x}$$

$$= 147{,}5 - (0{,}606 x 192{,}5)$$

$$= 30{,}8$$

The line of best fit is therefore:

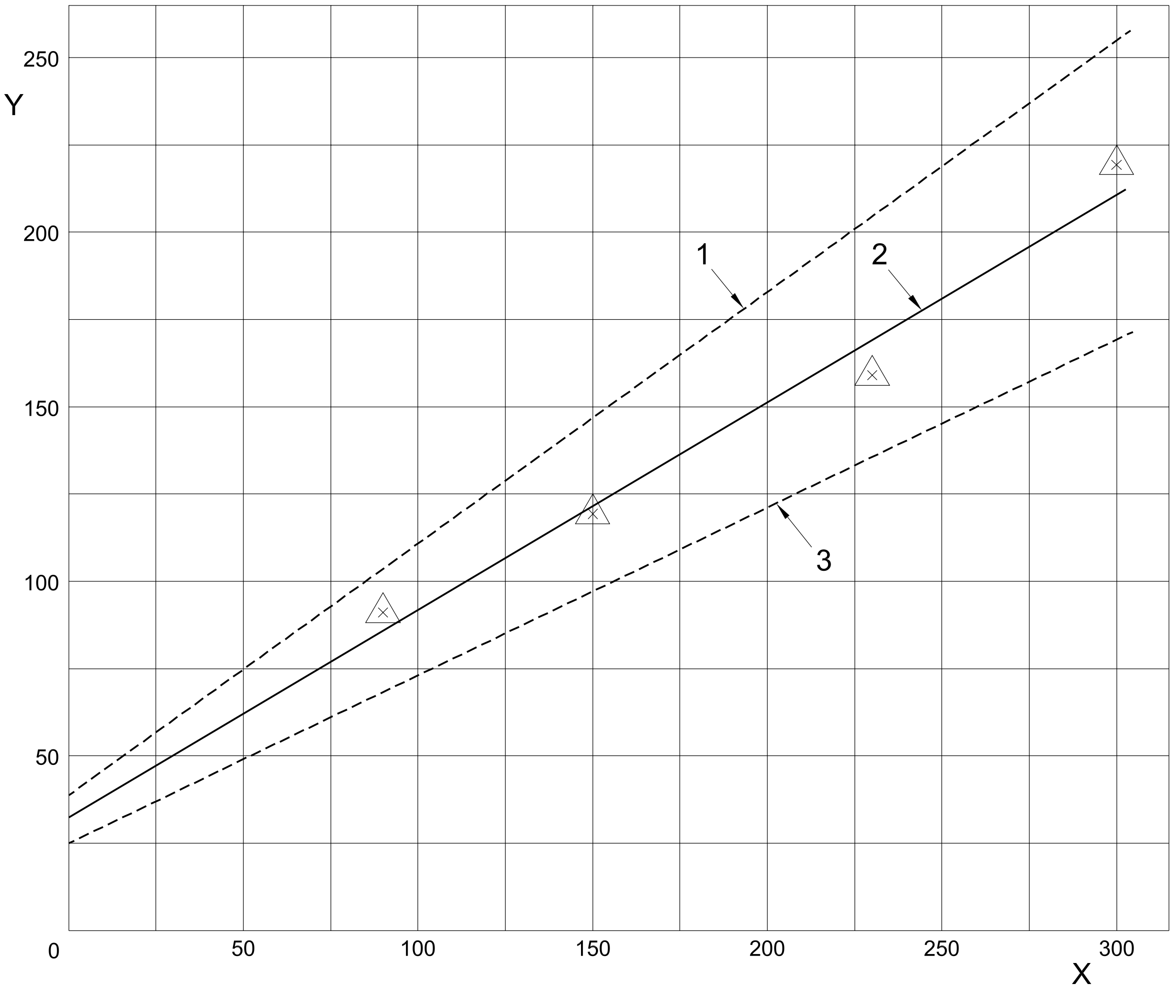
$$y = 30{,}8 + 0{,}606x$$

and the ± 20 % limit lines are:

$$y_{lower} = \frac{80}{100}(30{,}8 + 0{,}606x)$$
$$= 24{,}64 + 0{,}485x$$

$$y_{upper} = \frac{120}{100}(30{,}8 + 0{,}606x)$$
$$= 36{,}96 + 0{,}727x$$

The results are shown graphically in Figure A.1.



Key

Y Braking force, N

X Input force, N

1 + 20 % limit

2 Line of best fit

3 -20 % limit

Figure A.1 — Graph of input force against braking force, showing line of best fit and ± 20 % limit lines

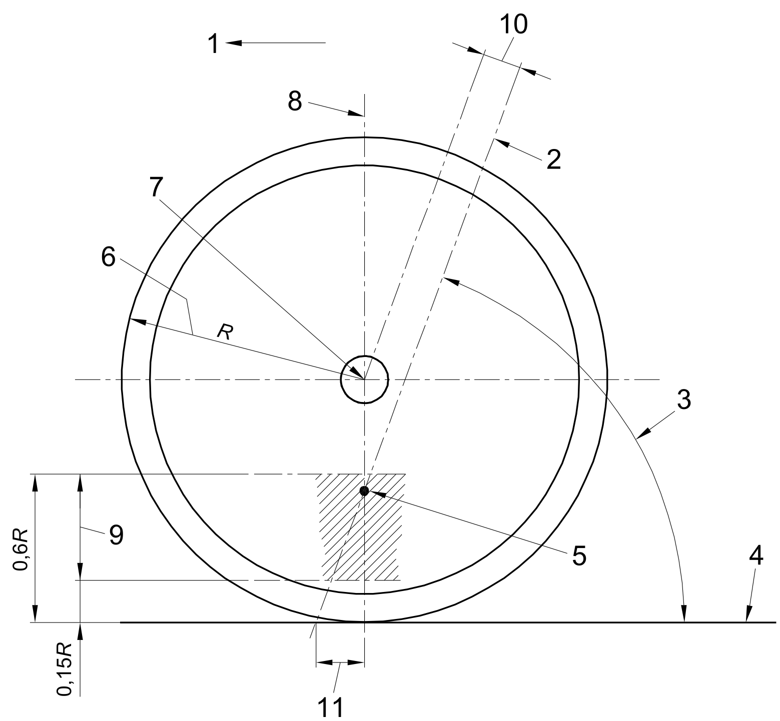
Annex B
(informative)

Steering geometry

The steering geometry employed, as shown in Figure B.1, will generally be dictated by the use for which the bicycle is intended but it is nevertheless recommended that:

a) the steering head angle be not more than 75” and not less than 65° in relation to the ground line; and

b) the steering axis intersects a line perpendicular to the ground line, drawn through the wheel centre, at a point not lower than 15 % and not higher than 60 % of the wheel radius when measured from the ground line.



Key

1 Direction of travel
2 Steering axis
3 Steering head angle
4 Ground line
5 Intersection point
6 Wheel radius
7 Wheel centre
8 Perpendicular to ground line
9 Tolerance
10 Offset
11 Trail

Figure B.1 — Steering geometry

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