



BSI Standards Publication

Carrier Cycles

Part 2: Lightweight single track carrier cycles — Mechanical aspects

National foreword

This British Standard is the UK implementation of EN 17860-2:2024.

The UK participation in its preparation was entrusted to Technical Committee GME/25, Cycles.

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Published by BSI Standards Limited 2024

ISBN 978 0 539 19824 9

ICS 43.150; 43.150

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 September 2024.

Amendments/corrigenda issued since publication

Date	Text affected

English Version

Carrier Cycles - Part 2: Lightweight single track carrier cycles - Mechanical aspects

Cycles utilitaires - Partie 2 : Cycles utilitaires légers à 2 roues - Aspects mécaniques

Lastenfahrräder - Teil 2: Leichte einspurige Lastenfahrräder - Mechanische Aspekte

This European Standard was approved by CEN on 14 July 2024.

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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 17860-2:2024) 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of an identical text or by endorsement, at the latest by March 2025, and conflicting national standards shall be withdrawn at the latest by March 2025.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document is part of standard series consisting of the following parts, users are invited to check which parts are applicable to their situation

- EN 17860-1:2023, Cycles — Carrier Cycles — Part 1: Vocabulary
- FprEN 17860-2:2023, Cycles — Carrier Cycles — Part 2: Lightweight single track carrier cycles – mechanical and functional aspects
- FprEN 17860-3:2023, Cycles — Carrier Cycles — Part 3: Lightweight multi track carrier cycles – mechanical and functional aspects
- prEN 17860-4, Cycles — Carrier Cycles — Heavyweight multi track carrier cycles – mechanical and functional aspects
- prEN 17860-5:2023, Cycles — Carrier Cycles — Electrical aspects
- prEN 17860-6, Cycles — Carrier Cycles — Passenger transport
- prEN 17860-7:2023, Cycles — Carrier Cycles — Trailers

Examples of carrier cycle configurations can be found in Annex A. Annex B provides a reading guide for parts 2,3 and 4 of this standard series.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

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

Introduction

This document gives requirements and test methods for mechanical and functional aspects for single track carrier cycles.

This document has been developed in response to demand throughout Europe. Its aim is to provide a standard for the assessment of mechanical aspects for single track carrier cycles of a type which are excluded from type approval by Regulation (EU) No. 168/2013.

Because of the diversity of geometries and solutions of carrier cycles not all requirements and test methods in this document may apply to every carrier cycle.

- Annex A gives an overview of vehicle configurations.
- Annex B provides a reading guide for the parts of this standard series.
- Annex J contains a rationale explaining the choices made when developing the standard series

This document is based on a risk analysis, the focus is on mechanical aspects for single track carrier cycles. This document is a type C standard as specified in EN ISO 12100. The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

1 Scope

This document is applicable to single track carrier cycles with or without electric assistance and a maximum gross vehicle weight of:

- 300 kg in case the manufacturer defines the carrier cycle to be intended for both private and commercial use; or
- 250 kg in case the manufacturer defines the carrier cycle to be intended for solely private use.

NOTE Requirements for electrical power assisted carrier cycles are covered in part 5 of this standard series.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 17860-1, *Cycles — Carrier Cycles — Part 1: Terms and definitions*

EN ISO 4210-2:2023, *Cycles - Safety requirements for bicycles - Part 2: Requirements for city and trekking, young adult, mountain and racing bicycles (ISO 4210-2:2023)*

EN ISO 4210-3:2023, *Cycles - Safety requirements for bicycles - Part 3: Common test methods (ISO 4210-3:2023)*

EN ISO 4210-4:2023, *Cycles - Safety requirements for bicycles - Part 4: Braking test methods (ISO 4210-4:2023, Corrected version 2023-08)*

EN ISO 4210-6:2023, *Cycles - Safety requirements for bicycles - Part 6: Frame and fork test methods (ISO 4210-6:2023, Corrected version 2023-08)*

EN ISO 4210-7:2023, *Cycles - Safety requirements for bicycles - Part 7: Wheel and rim test methods (ISO 4210-7:2023)*

EN ISO 4210-8:2023, *Cycles - Safety requirements for bicycles - Part 8: Pedal and drive system test methods (ISO 4210-8:2023)*

EN ISO 4210-9:2023, *Cycles - Safety requirements for bicycles - Part 9: Saddles and seat-post test methods (ISO 4210-9:2023)*

ISO 5775-1:2023, *Bicycle tyres and rims — Part 1: Tyre designations and dimensions*

ISO 5775-2:2023, *Bicycle tyres and rims — Part 2: Rims*

EN ISO 11243:2023, *Cycles - Luggage carriers for bicycles - Requirements and test methods (ISO 11243:2023)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

ISO 9633:2001, *Cycle chains — Characteristics and test methods*

ISO 6742-1:2015, *Cycles — Lighting and retro-reflective devices — Part 1: Lighting and light signalling devices*

ISO 6742-2:2015, *Cycles — Lighting and retro-reflective devices — Part 2: Retro-reflective devices*

ISO 6742-3:2015, *Cycles — Lighting and retro-reflective devices — Part 3: Installation and use of lighting and retro-reflective devices*

ISO 14878:2015, *Cycles — Audible warning devices — Technical specification and test methods*

3 Terms and definitions

For the purposes of this document the terms and definitions given in EN 17860-1:2024 and EN ISO 12100:2010 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Use cases: private and commercial/professional use

The requirements in the main part of this standard refer to carrier cycles for private use. In case the manufacturer defines the carrier cycles to be intended for commercial/professional use, higher test values for dynamic tests apply. Annex C gives the higher test values for the relevant tests.

Annex D shows proposals for labels for private use and commercial/professional use. Annex J contains a rationale explaining the choices made when developing the standard series.

5 General vehicle requirements

5.1 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 will 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.

5.2 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 torques	0/+5 %
Masses	± 1 %
Dimensions	± 1 mm
Angles	$\pm 1^\circ$
Time duration	± 5 s
Temperatures	± 2 °C
Pressures	± 5 %

5.3 Protrusions

This requirement is intended to address the hazards associated with the users of carrier cycles falling on projections or rigid components (e.g. handlebars, levers) on a carrier cycle, possibly causing internal injury or skin puncture. Tubes and rigid components in the form of projections which constitute a puncture hazard to the rider should be protected. The size and shape of the end protection has not been stipulated, but an adequate shape shall be given to avoid puncturing of the body. Screw threads which constitute a puncture hazard shall be limited to a protrusion length of one major diameter of the screw beyond the internally threaded mating part. Handlebar ends shall comply with EN ISO 4210-2:2023.

5.4 Sharp edges

Exposed edges that could come into contact with the limbs of rider, passenger or other road users during normal riding or normal handling and normal maintenance shall not be sharp, e.g. deburred, broken, rolled or processed with comparable techniques.

NOTE Attention is drawn to ISO 13715 [3].

5.5 Securing and strength of safety-relevant fasteners

5.5.1 General

Any screws used in the assembly of safety critical parts, e.g. indirect steering parts, to the frame or fork shall be provided with suitable locking devices, e.g. lock- washers, lock-nuts, thread locking compound, or stiff nuts. Fasteners used to assemble hub and disc brakes should have heat-resistant locking devices. The screws used to attach hub-generator are not subject to these requirements.

5.5.2 Minimum failure torque

The minimum failure torque of any bolted joints used in the assembly of safety critical parts, shall be at least 20 % greater than the manufacturer's maximum recommended tightening torque.

NOTE Examples of safety critical parts are indirect steering parts, to the frame or fork, handle bars, handlebar stems, bar ends, saddle and seat-posts

5.5.3 Mechanism for folding carrier cycles

If a carrier cycle is equipped with a folding mechanism, it shall be designed such that the carrier cycle can be locked for use in a simple, stable, safe way, and when folded, no damage shall occur to any cables. No locking mechanism shall contact the wheels or tyres during riding, and it shall be impossible to unintentionally loosen or unlock the folding mechanisms during riding.

5.6 Steering function

5.6.1 General

The steering shall allow manoeuvring up to the minimum turning radius as defined in the stability test and shall exhibit no tight spots, stiffness or slackness in the bearings, ball joint(s) or cable(s) when correctly adjusted.

No free play shall be determined in the steering over the entire steering travel. This shall be tested by moving the handlebar back and forth in different steering positions.

The carrier cycle shall be loaded with the maximum payload. If there are several loading areas, distribution shall be carried out as specified by the manufacturer; if there are no specifications, the most unfavourable case (loading with the lowest possible load on the steered axle) shall be used. At least 25 % of the maximum gross vehicle mass when the rider is holding the handlebar grips and is sitting on the saddle, with the saddle and rider in their most rearward positions is at the steered axle.

For indirect steering systems with linkage, cable or chain, the steering action shall be limited with an end stop to prevent overstretching of the steering system and/or blockage of the front wheel.

5.6.2 Steering — Rigidity and strength test for indirect steering systems

5.6.2.1 Steering rigidity - requirement

No visible slip or deformation shall take place when testing the rigidity between the handlebar and the steered axle.

During the test in accordance with 5.6.2.2, the stiffness between the steerer and the steered axle shall be measured as the rotational angle at the handlebar under the influence of steering torque. The stiffness of the torque transmission shall not be less than 7 Nm/°. No slip or permanent deformation in any of the components transmitting steering torque between the handlebar and the steered vehicle axle shall be ascertained after the test in accordance with 5.6.2.2.

5.6.2.2 Steering rigidity - test method

The fork steerer tube in front fork steering systems or the steering column in the case of other designs shall be correctly installed in the frame and the handlebar/stem combination shall be installed on the fork steerer tube or on the steering axis. All connections shall be tightened according to the manufacturer's specification.

The steering shall be fixed at the axle of the steered wheel by means of a suitable rigid jig.

A torque of 50 Nm shall be applied once in each direction of the possible rotation on a plane perpendicular to the axis of the steerer, in accordance with Figure 1. Each torque shall be maintained for 10 s. During this, the steering angle at the steerer shall be measured with reference to the straight-ahead position.

Force application can vary depending on the shape of the steerer; an example of this is shown in Figure 2, where in this case 100 N shall be used.

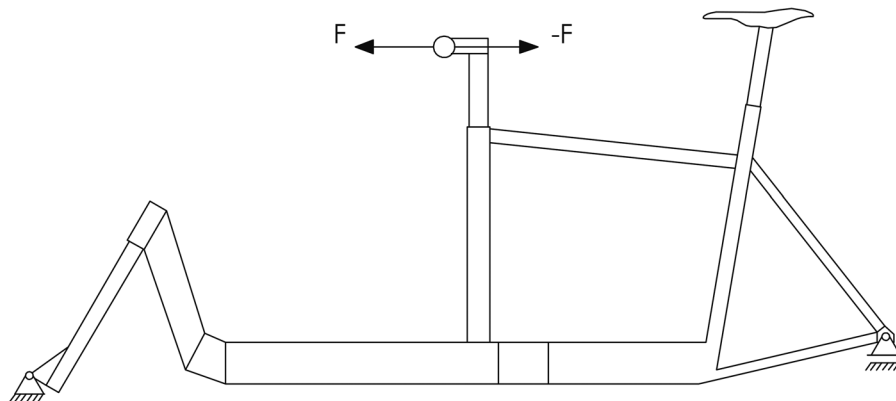


Figure 1 — Handlebar and steering — rigidity and strength test method for indirect steering systems

5.6.2.3 Steering durability – requirement

No visible damage on any cable, hydraulic gasket failure, crack, fracture, or plastic deformation shall occur on the handlebar, stem, front fork or any part that transfers the steering movement during the steering durability test 5.6.2.4.

5.6.2.4 Steering durability – test method

The complete steering assembly shall be correctly installed in the frame and tightened according to the manufacturer's specification.

The axle of the steered wheel shall be fitted to a suitable fixture, which allows rotation of the steering action in either direction against a resistance of 10 Nm (± 5 Nm), e.g. applied through springs, pneumatic cylinders or other suitable means. The steering system shall be actuated repeatedly over a rotational angle of $+10^\circ$ and -10° at the handlebar in both directions for $c1$ 100 000 cycles. The number of test cycles ($c1$) for carrier cycles that have been defined by the manufacturer to be intended for commercial/professional use can be found in Annex C.

5.6.2.5 Steering fatigue – requirement

No visible crack, fracture, visible plastic deformation shall occur on the handlebar, stem, front fork or any part that transfers the steering movement during the steering fatigue test in 5.6.2.6.

5.6.2.6 Steering fatigue – test method

The complete steering assembly shall be correctly installed in the frame and tightened according to the manufacturer's specification.

The steering shall be fixed at the axle of the steered wheel by means of a suitable rigid fixture.

A torque of ± 50 Nm (± 5 Nm) shall be applied repeatedly in each direction of the possible rotation on a plane perpendicular to the axis of the handlebar stem for $c2$ 100 000 cycles. The number of test cycles ($c2$) for carrier cycles that have been defined by the manufacturer to be intended for commercial/professional use can be found in Annex C.

5.6.2.7 Steering strength – requirement

No visible crack, fracture or visible plastic deformation shall occur on the handlebar, stem, front fork or any part that transfers the steering movement during the steering strength test. Displacement or slip of parts connected through friction against one another is permissible if it occurs at a test torque of more than 70 Nm, and if it can be reverted with the same test torque $\pm 20\%$ and, on repetition, the displacement/slip occurs at a minimum of 90 % of the torque determined initially (i.e. the torque at which the slip or displacement is initially noticeable).

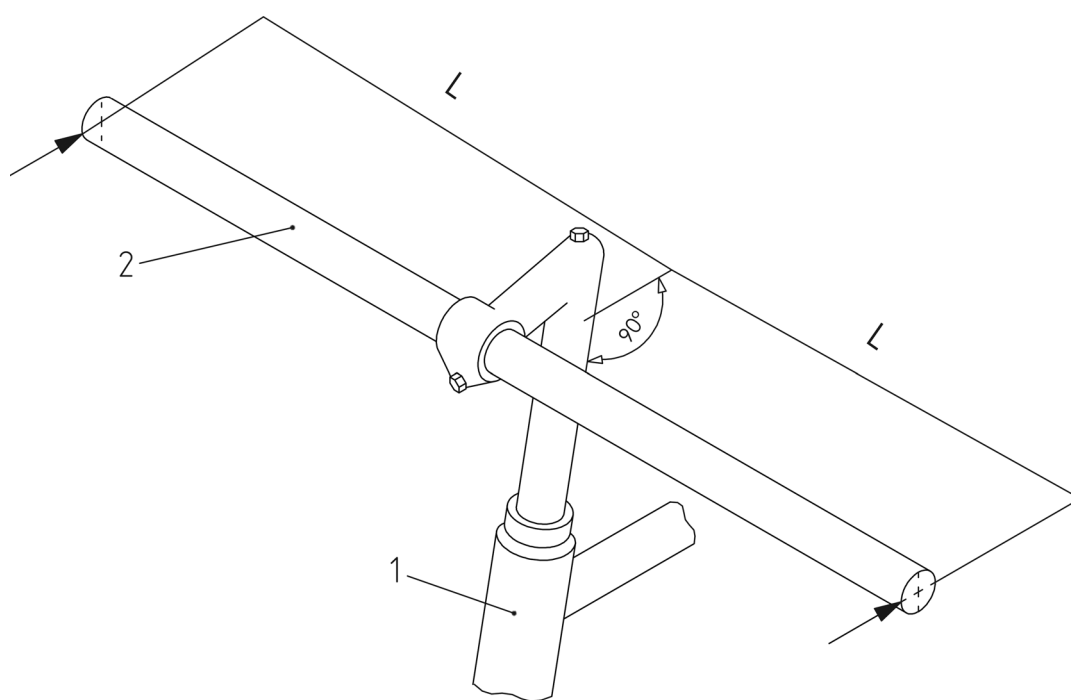
No gearshift, brake or electrical cables or hoses shall be damaged during the test. No permanent deformation shall occur on the end stops.

5.6.2.8 Steering strength – test method

The fork steerer tube in front fork steering systems or the steering column in the case of other designs shall be correctly installed in the frame and the handlebar/stem combination shall be installed on the fork steerer tube or on the steering axis. All connections shall be tightened according to the manufacturer's specification.

A torque of 80 Nm shall be applied once in each direction of the possible rotation on a plane perpendicular to the axis of the handlebar stem, in accordance with Figure 2. The steering shall be positioned against its end stop at the maximum steering angle. Each torque shall be maintained for 10 s.

Dimensions in millimetres



Key

1 frame/front fork unit

2 solid steel bar

F Force (N)

Where F is 160 N for steering strength and 100 N for steering stiffness

Figure 2 — Example of steering system test set up

5.6.3 Dynamic steering fatigue test for indirect steering

5.6.3.1 Requirements

No visible crack, fracture or visible deformation shall occur on any part that transfers the steering movement when testing the fatigue strength of an indirect steering system. It means parts like the handlebar, stem and front fork, steerer or steering wheel, steering column, steering rods, kingpins, steering cables.

After the test in accordance with 5.6.3.2, the displacement between the steerer and the steered axle shall not be less than 70 % of the value measured in the test in accordance with 5.6.2.2.

5.6.3.2 Test method

The fork steerer tube in front fork steering systems or the steering column in the case of other designs shall be correctly installed in the frame and the handlebar/stem combination shall be installed on the fork steerer tube or on the steering axis. All connections shall be tightened according to the manufacturer's specification.

The steering shall be fixed at the axle of the steered wheel(s) by means of a suitable rigid jig.

Apply 100 000 cycles (c3) of dynamic torque of +50 Nm and -50 Nm in each direction of the possible rotation on a plane perpendicular to the axis of the steerer, in accordance with Figure 2 for single-track carrier cycles. The number of test cycles (c3) for carrier cycles that have been defined by the manufacturer to be intended for commercial/professional use can be found in Annex C.

After completion of the 100 000 cycles, a torque of 50 Nm shall be applied once in each direction of the possible rotation on a plane perpendicular to the axis of the steerer. Each torque shall be maintained for 10 s. During this, the steering angle at the steerer shall be measured with reference to the straight-ahead position.

NOTE Force application can vary depending on the shape of the handlebar; an example of this is shown in Figure 2.

5.7 Shimmy

Shimmy is a vibration of the steered wheel(s) around the steering axis, which leads to cyclic turning movements of the handlebar and is therefore also referred to as handlebar flutter.

It is accompanied by lateral oscillation of the head tube and arises from the dynamics of forward motion and the elasticity of the frame, fork, wheels, the saddle position and loading condition.

The frame and its geometry, the inflation of the tire and the gyroscopic effects of the front wheel make it largely speed dependent. Typically, oscillation frequencies in cycles fall in the 4 Hz to 10 Hz range.

Informative Annex E gives information on assessing the shimmy effect. The manufacturer should try to reduce the risk of shimmy.

5.8 Requirements for loading areas/load securing

In the case of several loading areas, attention should be paid to distribute the load proportionally to the maximum permissible loads of each area.

Each individual loading area shall be clearly marked by the manufacturer with the maximum permissible payload mass.

5.9 Parking and stability

5.9.1 Requirement

The carrier cycle shall be equipped with a mechanical parking function. This parking function can be fulfilled, for instance, by a stand and/or a mechanical parking brake and/or a spoke lock or any other mechanical locking device.

With the parking function, it shall be possible to secure the loaded and unladen carrier cycle to prevent it from rolling away on a slope of 10 % in one direction.

Suitable, additional measures (wheel chocks, for instance) are permissible for larger slopes.

5.9.2 Test method

5.9.2.1 Test conditions

The carrier cycle shall be in the following condition:

- the carrier cycle shall be presented in running order according to its mass;
- the fully assembled wheels shall be fitted with the appropriate size tyre and inflated to the lower value of maximum inflation pressure recommended on the rim or on the tyre. This shall be checked before the test;
- the gearbox shall be in neutral or, in the case of an automatic gearbox, in the “park” position if such a position exists;
- if it can be locked, the steering system shall be locked. If the steering system can be locked by being turned either to the left or to the right, the tests shall be conducted for both directions;
- if no lock for the steering system is mounted, the test shall be conducted with the following steering angles:
 - straight-ahead position;
 - tilted to the side of the prop stand (if available).

5.9.2.2 Verification on an inclined surface

5.9.2.2.1 Test equipment

- A suitable test platform with a firm, rectangular surface, on which the carrier cycle can stand without noticeable deformation, shall be used for these tests.
- The surface of the parking plane shall have sufficiently non-slip characteristics so that the carrier cycle does not slide off the supporting surface during the inclination and leaning tests.
- The parking plane shall be designed such that its lateral inclination and longitudinal inclination can be adjusted.

5.9.2.2.2 Test method

The test shall be conducted in both

- laden condition (gross vehicle mass minus rider (100 ± 5) kg); and
- unladen mass condition (without rider and payload).

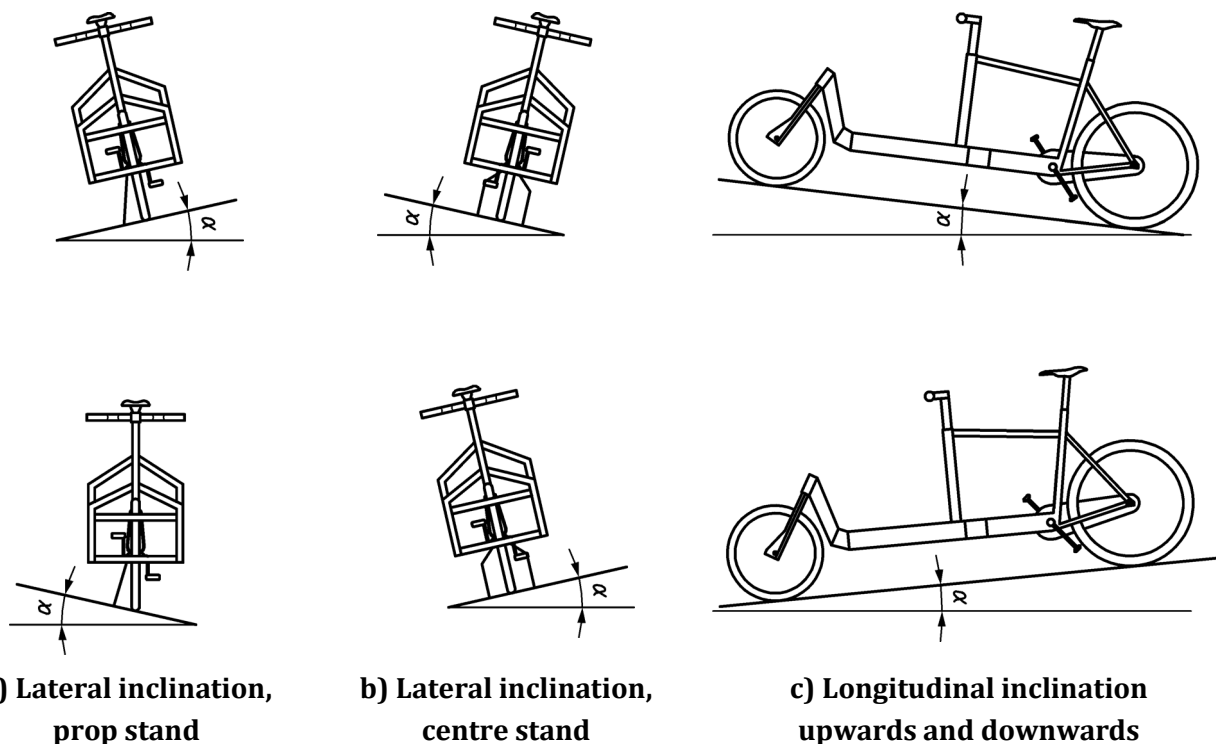
Procedure:

- The carrier cycle is stood on the parking plane with the prop stand and separately with the centre stand folded down or in the park position, and the carrier cycle may lean on the stand.
- The parking plane is set to the lateral inclination and then separately to the longitudinal inclination according to Table 1.

Table 1 — Values for surface inclination angle/surface slope

Inclination	Prop/centre stand	
	Slope	Inclination angle (α)
Lateral inclination (left and right)	8 %	4,6°
Longitudinal inclination downwards	10 %	5,7°
Longitudinal inclination upwards	10 %	5,7°
See Figure 3.		

- If the carrier cycle is stood on the centre stand and only on one wheel on the inclined parking plane, the centre stand shall be tested in this position. If the carrier cycle is stood on the centre stand on an inclined parking plane and either the front wheel or the rear wheel can be in contact with the supporting surface, the tests shall be conducted such that the carrier cycle is stood only on the centre stand and the wheel that is in contact with the surface.
- The carrier cycle shall remain standing stable when the parking plane is inclined according to the angle given in Table 1.
- Alternatively, the parking plane may be inclined to the required extent before the carrier cycle is moved into position.



Key

 α inclination angle

Figure 3 — Parking plane inclination angles (examples for cycle stands)

5.10 Pedal clearance

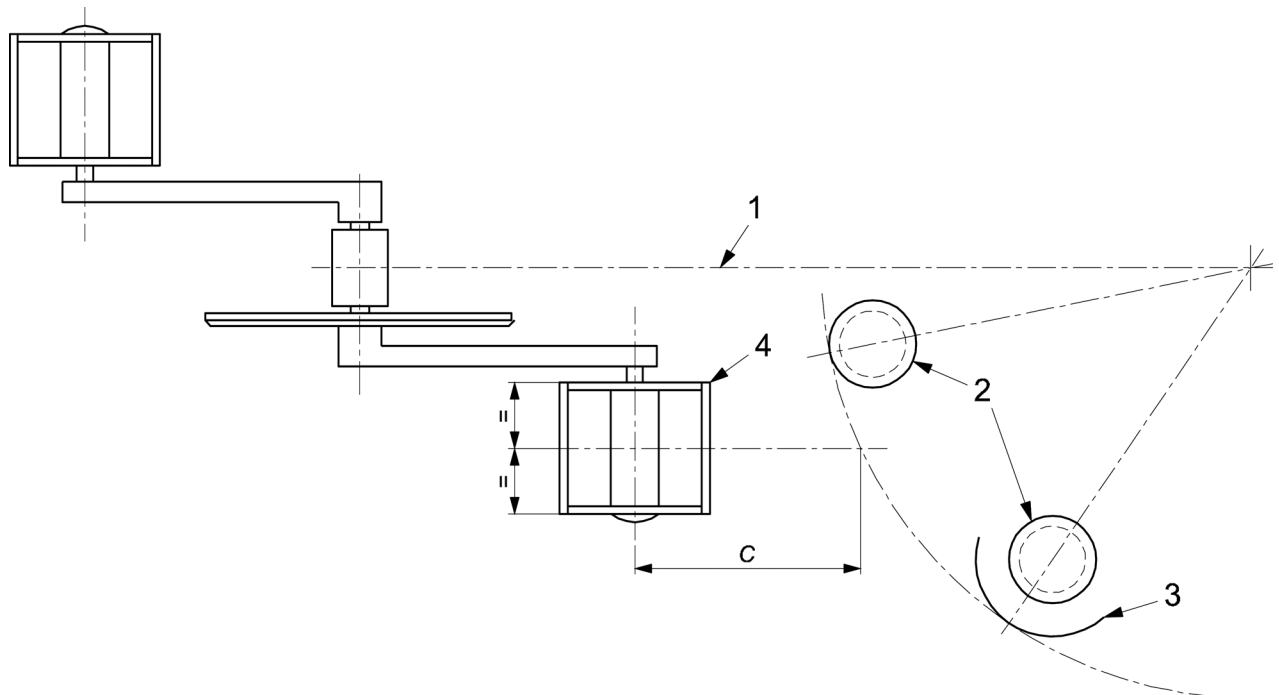
5.10.1 Ground clearance

With the carrier cycle unladen, the pedal at its lowest point and the tread surface of the pedal parallel to the ground and uppermost where it has only one tread surface, carrier cycle shall be capable of being leaned over at an angle of 25° from the vertical before any part of the pedal touches the ground.

When the carrier cycle is equipped with a suspension system, this measurement shall be taken with the suspension dampers (of fork and shock) set to full open positions and with the carrier cycle depressed into a position such as would be caused by a rider weighing (100 ± 5) kg.

5.10.2 Toe clearance

Carrier cycles shall have at least C clearance between the pedal and front tyre or mudguard (when turned to any position) or any bike part. The clearance shall be measured forward and parallel to the longitudinal axis of the carrier cycle from the centre of either pedal-axle to the arc swept by the tyre or mudguard or any bike part, whichever results in the least clearance (see Figure 4). For carrier cycles C is 120 mm. This value is based on 100 mm (1/3 of European Size 46 foot length 300 mm) + 20 mm (shoe thickness)

**Key**

- C Clearance
- 1 longitudinal axis
- 2 front tyre
- 3 Mudguard
- 4 Pedal

Figure 4 — Pedal to wheel/mudguard: toe clearance

5.11 Wheel and tyre assembly – clearance

Alignment of the wheel and tyre assembly in a carrier cycle shall allow not less than 6 mm between the tyre and the frame or fork, or a front mudguard and its attachment bolts. The fully assembled wheel shall be fitted with the appropriate size tyre and inflated to the lower value of maximum inflation pressure recommended on the rim or on the tyre. This shall be checked before the test.

NOTE Where a carrier cycle has a frame or a fork with a suspension system, the value of 6mm applies to the suspension system in its uncompressed state. Clearance requirements for the frame or fork under a load are specified in EN ISO 4210-6:2023, Annex C and 4.9.31.

5.12 Wheel retention

5.12.1 General

Wheel retention safety is related to the combination of wheel, retention device, and dropout design.

Wheels shall be secured to the carrier cycle frame and fork such that when adjusted to the manufacturer's instructions they comply with EN 15194:2017, 4.3.9.4.2, 4.3.9.4.3 and 4.3.9.5.

Where the design of the wheel/fork or frame/fork interface provides positive locking, such as through - axles, the requirements in EN 15194:2017, 4.3.9.4.2, 4.3.9.4.3 do not apply.

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 EN 15194:2017, 4.3.9.5.

5.13 Luggage carriers

If parts or subassemblies of the carrier cycle fall within the scope of EN ISO 11243:2023 are fitted or provided they shall comply with EN ISO 11243:2023.

5.14 Vibrations, ergonomics and design

5.14.1 Vibrations

EN 15194:2017/FprA2:2023¹ gives information on vibration measurement.

5.14.2 Ergonomics

If the carrier cycle is used as work equipment, the relevant rules of ergonomics should be observed.

6 Brakes

6.1 General

A carrier cycle shall be equipped with at least two brake systems that are actuated independently of one another. At least one brake shall act on the front wheel axle and one on the rear wheel axle. The brake systems shall function without jamming. No hand shall need to be taken from the handlebar to operate the brakes.

Two alternative methods are specified to determine brake performance, and experience shows that both methods are suitable and that both can be applied. In the test method on a test track, the minimum braking deceleration is measured directly, where the ascending characteristic curve is clearly visible. In the alternative test method, the braking force is measured on a test device and these measurements are used to calculate the value for the braking effect. The ascending characteristic curve of the brake is determined through linearity measurements. A final, simple test drive is conducted to check that the cycle stops uniformly and safely on a test track.

The heat stability test shall always be conducted. This test on the test bench can be conducted with isolated brake components with reference to the acting axle load.

Requirements on the parking function are described in 5.9 (Parking and stability).

The requirements in accordance with Table 2 or Table 3 shall be met irrespective of the test method.

See EN ISO 4210-4:2015, 4.6.5.7, Point h), Test method — Simple check on the test track.

6.2 Hand-operated brakes

6.2.1 Brake lever position

The brake levers for front and rear brakes shall be positioned according to the legislation or custom and practice of the country in which the carrier cycle is to be sold, and the carrier cycle manufacturer shall state in the manufacturer's instructions which levers operate the front and rear brakes (see also Clause 21).

¹ Under preparation. Stage at time of publication: EN 15194:2017/FprA2:2023.

6.2.2 Brake lever grip dimensions

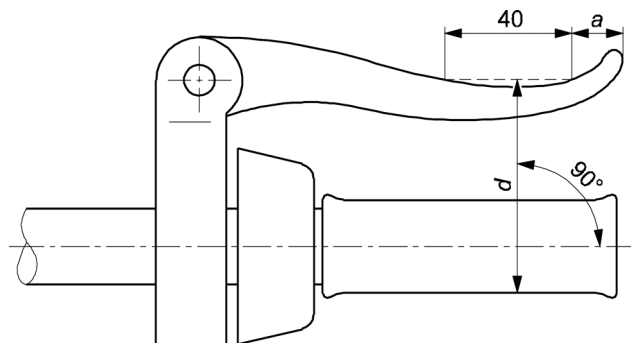
6.2.2.1 Requirement

The dimension, d , measured at the non-activated position of the brake lever between the outer surfaces of the brake lever in the region intended for contact with the rider's fingers and the handlebar or any other covering present shall cover a distance of not less than 40 mm as shown in Figure 5, shall not exceed 90 mm.

Conformity shall be established by the method detailed in 6.2.2.2.

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

Dimensions in millimetres



Key

- a distance between the last part of the lever intended for contact with the rider's fingers and the end of the lever
- d brake lever grip dimension

Figure 5 — Brake lever grip dimensions

6.2.2.2 Brake adjustment

6.2.2.2.1 General

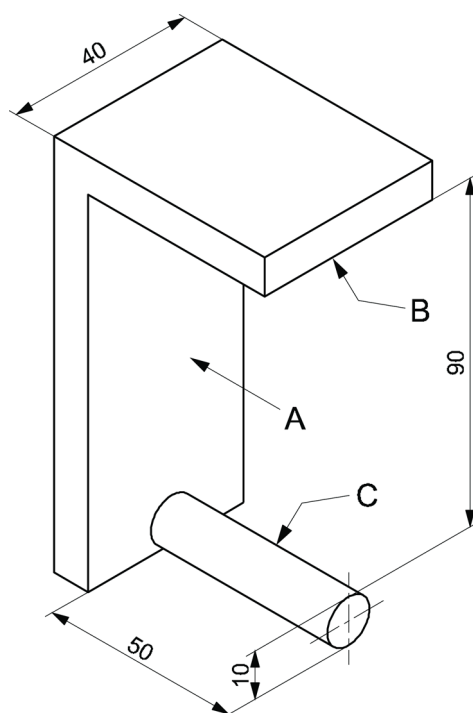
Each brake shall be equipped with an adjustment mechanism, either manual or automatic.

Each brake shall be capable of adjustment with or without 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 manufacturer's instructions. Also, when correctly adjusted, the friction material shall not contact anything other than the intended braking surface.

6.2.2.2.2 Test method for the brake lever

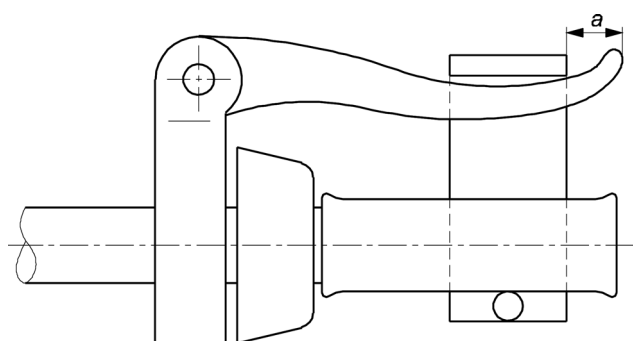
Fit the gauge illustrated in Figure 6 — over the handlebar-grip or the handlebar (when the manufacturer does not fit a grip) and the brake lever as shown in Figure 7 — so that the face A is in contact with the handlebar or grip and the side of the brake lever. Ensure that the face B spans an area of that part of the brake lever which is intended for contact with the rider's fingers without the gauge causing any movement of the brake lever towards the handlebar or grip. Measure the distance a , the distance between the last part of the lever intended for contact with the rider's fingers and the end of the lever.

The measurement ought to be conducted only on a fully-assembled carrier cycle.

**Key**

- A face A
- B face B
- C face C

Figure 6 — Brake lever grip dimension gauge

**Key**

- a distance between the last part of the lever intended for contact with the rider's fingers and the end of the lever

**Figure 7 — Method of fitting the gauge to the brake lever and handlebar
(Minimum grip length is shown)**

6.3 Requirements of the test method on a test track

The general requirements in accordance with 6.1 apply.

The requirements in accordance with a), b) and c) shall be met.

- a) When testing on a test track, the carrier cycle shall meet the requirements listed in Table 2 in both fully laden condition as specified by the manufacturer and in unladen condition. As the maximum braking decelerations do not necessarily have to be achieved with the front wheel brake due to the axle load distribution of carrier cycles, which is dependent on the design and the loading condition, the respectively higher minimum braking decelerations shall apply to the axle that results in the better braking effect.

If there are several loading areas, the payload shall be distributed proportionally according to the maximum individual loads specified by the manufacturer.

Table 2 — Minimum values for the braking deceleration for individual axles on carrier cycles

Cycle type	Conditions	Velocity	Axle concerned	Minimum braking deceleration a_{min}
Carrier cycle	dry	25 km/h	one axle	3,4 m/s ²
			each further axle	2,2 m/s ²
	wet	16 km/h	one axle	2,2 m/s ²
			each further axle	1,4 m/s ²

- b) Under consideration of its intended use and the skills of the anticipated rider, the carrier cycle shall exhibit uniform, safe braking behaviour. When testing on the test track, the characteristics of uniform, safe stopping shall be taken to mean that the following shall not occur when stopping within the required, specified distance:

- 1) increased juddering;
- 2) locking-up of the front wheel;
- 3) loss of control over the carrier cycle due to excessive skidding which causes the rider to place his/her foot on the ground in order to regain control.

With some brake systems, it will not be possible to completely prevent a wheel from skidding during braking; this is regarded as permissible as long as the situation described in b.3) does not occur.

Coaster brakes shall additionally pass the linearity test in accordance with EN ISO 4210-4:2023, 4.6.4.

- c) The following applies to carrier cycles: to ensure safety when braking in both wet and dry conditions, the wet: dry braking effect ratio shall be greater than 4 : 10.

The methods for calculating this ratio are provided in EN ISO 4210-4:2023, 4.6.3.11, Point c for the test track.

6.4 Requirements of the test method on a test bench

The general requirements in accordance with 6.1 apply.

The following requirements in accordance with a) and b) shall be met.

a) Minimum braking force requirement

During the test, the carrier cycle shall meet the requirements listed in Table 3. The minimum braking decelerations from 6.3, Table 2 shall be used to calculate the minimum braking force.

Table 3— Requirements of the minimum braking force of a carrier cycle

Cycle type	Conditions	Axle concerned	Minimum braking force value
			F_{Br} , Formula (1)
Carrier cycle	dry	one axle	$F_{Br} = m_{gvw} \cdot 3,4m/s^2$
		each further axle	$F_{Br} = m_{gvw} \cdot 2,2m/s^2$
	wet	one axle	$F_{Br} = m_{gvw} \cdot 2,2m/s^2$
		each further axle	$F_{Br} = m_{gvw} \cdot 1,4m/s^2$

Where:

m_{Gvw} is the maximum gross vehicle mass of the carrier cycle.

The following applies to carrier cycles: to ensure safety when braking in both wet and dry conditions, the wet: dry braking effect ratio shall be greater than 4 : 10.

The methods for calculating this ratio are provided in EN ISO 4210-4:2023, 4.6.5.7, Point g) for the test on the test bench.

b) Heat stability requirement

The heat stability requirements shall be met by the sum of all brakes per braked axle. If the design of the brakes on an axle is identical, only one brake shall be tested. If only one brake is tested, it shall only meet half of the requirement.

After the brake system has cooled to room temperature, the required, calculated minimum braking force from Table 3, F_{Br} , shall be achieved.

During the test, the residual travel between the brake lever and the handlebar grip shall not be less than 3 mm. The actuating force shall not exceed 180 N.

The parts shall finally be subjected to a visual inspection. Cracks (e.g. on the brake disc), plasticity, other permanent deformations, tyre pressure loss or tyre damage and undershooting defined wear limits are not permissible. The adjustment range of self-adjusting systems shall not be exhausted.

6.5 Tests

6.5.1 Test method on a test track

6.5.1.1 General

The requirements in accordance with 6.3 apply. The braking decelerations in accordance with Table 2 shall be fulfilled in both fully laden and unladen condition.

6.5.1.2 Bedding-in the brakes

Prior to the start of each braking effect test, braking to a stop shall be performed to bed all brakes in.

**Key**

- 1 start of the test run
- 2 start of braking
- 3 stationary zone after braking
- v velocity

Figure 8 — Schematic representation of bedding-in the brake surfaces

Each of the vehicle's braked axes shall be braked individually.

Reasonable vehicle speeds of between 12,5 km/h and 25 km/h shall be selected for the front and rear axes. After reaching the starting line, the braking process is begun (see Figure 8).

Bedding-in procedure shall be done according to the manufacturer's instructions. If there are no manufacturer's instructions available, the actuating hand force is (70 ± 5) N or less if the braked wheel locks up beforehand. Locking up is not permissible during the bedding-in process.

This braking to a stop shall be repeated a maximum of 25 times or until reliable bedding-in of the friction partners is guaranteed. After the bedding-in process, the braking distance shall be as constant as possible. This is regarded as fulfilled if the mean value of the braking distances of the last 5 braking processes varies by no more than $\pm 10\%$.

6.5.1.3 Test runs

The brake test shall be conducted with a max. reasonable starting speed of between 12,5 km/h and 25 km/h; the starting speeds shall be documented.

During the brake test, an actuating force of 180 N for manually actuated brakes and 300 N for foot-actuated brakes shall not be exceeded; this shall be documented using a suitable method.

The minimum braking deceleration shall be documented using a suitable method. A recording system (precise within $\pm 1\%$) shall be selected for this.

The load shall be applied centrally at the loading areas identified by the manufacturer in accordance with 5.8 (Requirement for loading areas/load securing) until the mass stated by the manufacturer is achieved. The maximum mass is defined as follows:

- 300 kg in case the manufacturer defines the carrier cycle to be intended for both private and commercial use; or
- 250 kg in case the manufacturer defines the carrier cycle to be intended for solely private use

The rider is regarded as a load in this case.

The test procedure (wet and dry) is described exhaustively in EN ISO 4210-4:2023, 4.6.1 and shall be applied. Descriptions that are impractical for carrier cycles are described according to this document.

6.5.2 Test method on a test bench

6.5.2.1 Minimum braking force

- a) A test load of 100 kg shall be applied centrally on the seat surface for the rider. A second load shall be applied centrally at the loading areas identified by the manufacturer in accordance with 5.8 (Requirement for loading areas/load securing). The test loads on seat surfaces shall be selected and applied such that a height of 300 mm from the seat surface and the surface of the loading area is not exceeded.

Prior to the tests on the test bench, the load on each vehicle axle shall be determined for the maximum permissible total mass of the carrier cycle. To do this, the carrier cycle can e.g. be positioned with each wheel on a scale to therefore determine the load per axle. All subsequent tests referring to an axle are conducted with the respective axle load instead of the total mass. The applied mass can be removed again when conducting the test.

The test wheel shall be loaded vertically downwards to prevent the wheels from skidding during the test. The force required for this can be applied in any location on the carrier cycle (wheel axle, bottom bracket, seat pillar, etc.) subject to the condition that the force is applied vertically downwards.

- b) The brake system shall be adjusted as specified by the manufacturer and bedded-in in accordance with EN ISO 4210-4:2023.
- c) The test procedure (wet and dry) is described exhaustively in EN ISO 4210-4:2023, 4.6.5 and shall be applied. Descriptions that are impractical for carrier cycles are described according to this standard.

Cooling during the test (dry) is not permissible.

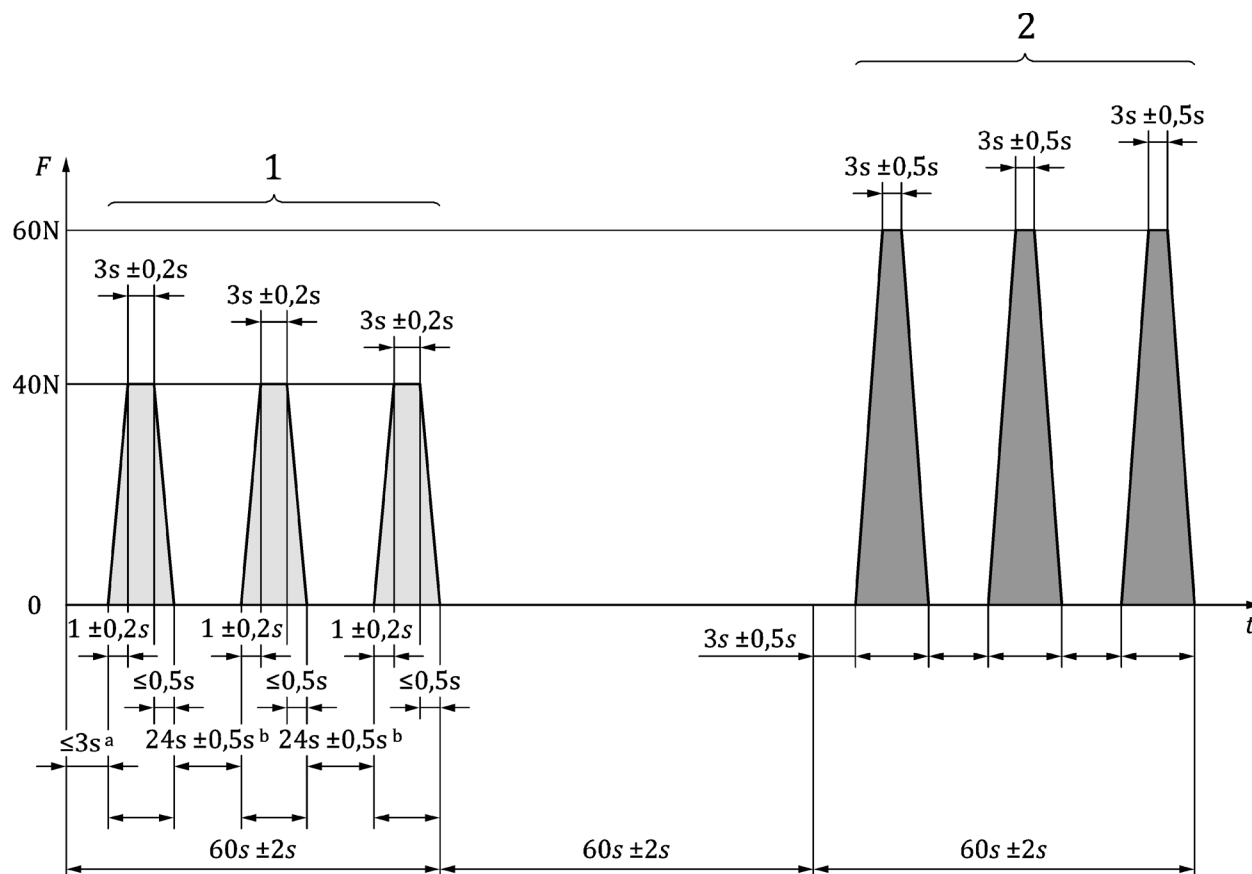
The front and rear axles shall be tested individually.

- d) Dry test

After applying vertical forces on the test wheel which are sufficient to prevent the wheel from skidding during the test, the drive apparatus of a test device is brought to the specified speed for manually actuated brakes. The actuating force is then increased from 40 N to 180 N in steps of 20 N. If the required minimum braking force that has been calculated is already achieved, the test shall be terminated as successful. If the wheel locks up, a brake overload guard is activated or the brake lever comes into contact with the handlebar, the actuating force shall not be increased any further. Three measurements per actuating force shall be conducted within 1 min. The time sequence in accordance with Figure 9 shall be adhered to in this case. Before applying the next highest actuating force, the brake shall cool down for 1 min.

The applied actuating forces shall lie within $\pm 10\%$ of the intended actuating force. Force application shall take place in accordance with EN ISO 4210-4:2023, 4.2.2. The applied actuating forces shall be recorded to an accuracy of $\pm 1\%$ and shall achieve their full effectiveness within 0,5 s after the commencement of braking.

For each actuating force step, the braking force shall be recorded for a duration of $(3 \pm 0,2)$ s. The recorded braking force shall be logged as an average braking value during this measurement period.

**Key**

- F actuating force;
 1 actuating force, F1;
 2 actuating force, F2;
 t time;
 a starting phase;
 b pause.

Figure 9 — Example of a sequence chart for two measurement blocks

e) Wet test

This procedure shall correspond to the method in accordance with 6.5.2 d) with the following addition: wetting of the brake system shall begin no less than 5 s before the commencement of braking and is carried out continuously up to the end of the measurement process.

The wetting nozzles shall be attached in accordance with EN ISO 4210-4:2023.

During the test on a test bench, the characteristics of uniform, safe stopping are defined through meeting the requirements of linearity in accordance with EN ISO 4210-4:2023, 4.6.5.3, and the simple test on the test track in accordance with EN ISO 4210-4:2023, 4.6.5.7, Point h).

6.5.2.2 Heat resistance (HR)

This test is conducted with the braking energy, E of $55\text{Wh} \pm 5\%$ for an axle load of 100 kg. The test unit consisting of the wheel and tyre is driven at a speed, v_{Br2} , of $12,5\text{ km/h} \pm 5\%$ in a test device with the brake applied. A functionally new brake system with new friction partners shall be used for the test. The

brake system shall be adjusted as specified by the manufacturer and bedded-in in accordance with EN ISO 4210-4:2023.

The heat stability is tested on an axle under consideration of the acting axle load, AL. The braking energy is calculated in accordance with the following equation.

The braking force shall be calculated in accordance with the following equation:

$$E \cdot c = F_{Br2} \cdot v_{Br2} \cdot t \quad (2)$$

Where the mass factor, c, expresses the acting axle load:

$$c = \frac{AL}{M} \quad (3)$$

Where:

F_{Br2} is the braking force, in N;

AL is the axle load, in kg;

M is 100 kg (55 Wh corresponds to an axle load of 100 kg);

v_{Br2} is the circumferential speed of the tyre, measured externally, in m/s (i.e. 12,5 km/h = 3,472 m/s);

T is the duration of each test cycle (except for interruptions) (i.e. 15 min = 0,25 h);

C is the mass factor;

E is the total braking energy, in Wh.

A test on the test bench can be conducted with isolated brake components with reference to the acting axle load.

The heat stability test shall be conducted twice in accordance with Figure 10. The cycle is repeated after the brake has cooled to room temperature.

Adjusting the brake is not permissible during the test cycles. Adjusting the brake is permissible during the cooling phase between cycle 1 and cycle 2. Where: non-independently adjusting systems shall be adjusted according to the manufacturer's specifications. Independently adjusting systems shall be actuated accordingly so that adjustment has taken place prior to the start of the test.