Taiwan Bicycle Industry Standard

TBIS 79010:2019

First edition

2019.01.01

Cycles – Safety requirements for Cargo bike

Contents

Page

Foreword ······ iii

Background description ······ iv

1. Scope ······ 01

2. Normative references ······ 02

3. Terms and definitions ······ 03

4. Safety requirements ······ 07

4.1 General ······ 07

4.2 Brakes ······ 09

4.3 Frame and front fork assembly ······ 25

4.4 Parking brakes and parking stability ······ 34

4.5 Structural integrity of the fully assembled CARGO BIKE ······ 36

Annex A (informative) Explanation of the method of least squares for obtaining line of best fitand ± 20 % limit lines for braking performance linearity ·· 38

Annex B (informative) Dummy fork characteristics ······ 41

Foreword

Taiwan Bicycle Industrial Standard (TBIS) is approved and announced by Taiwan Bicycle Association (TBA). The preparatory work of "Taiwan Bicycle Industrial Standard" is carried out by the technical expert committee from TBA. When TBA members are interested in related standard that has been announced, and after they are approved by R&D and patent committee of TBA, they will become the member of the technical expert committee of TBIS. TBA and Cycling & Health Tech Industry R & D Center (CHC) are close cooperation to handle all matters applied and established by TBIS.

The structure, establishing process and revising of this standard shall be proposed to and get determined by the R&D and patent committee of TBA, This standard is implemented after the announcement of TBA. Please be aware, some part of this document may involve patent rights. TBIS has no legal obligation to mark out where all or part of the patent is involved.

Background description:

Cargo bikes have existed in the market for many years, but there are still no relevant specifications for manufacturers and buyers to use as a reference for acceptance. In order to keep up the competitiveness of our bicycle industry in the international market, the technical expert committee of TBIS uses ISO 4210 as their investigation basis and propose a higher level of product safety and standard service, to establish TBIS especially for this purpose. To highlight on the quality, performance and reliability of those components that has passed TBIS inspection, which have already exceeded the international standard. In the meantime, TBIS is developing on the safety standard and testing technology on those bicycle parts that are excluded in ISO 4210, to ensure the product and identify the differences between product performance, which has become an important reference to drive the improvement on Taiwan bicycle industry Research & Design units.

Establishment history:

1st: [TBIS Committee Draft (rev. CD) Discussion]、 [TBIS Enquiry stage (rev. DTS) Discussion] Total 14 companies and 14 industry experts participate, 2018.04.25.

2nd: [TBIS Amendment (rev. FDTS) Discussion] Total 14 companies and 14 industry experts participate, 2018.09.19.

Cycles – Safety requirements for Cargo bike

1. Scope

This industry standard applies to Cargo bike for private and commercial use with exception for hire from unattended station.

	Maximum permissible weight	Maximum width	Electrically power assistance
Single-lane	250 kg	1 m	250 W, 25 km/hr
Multi-lane	300 kg	2 m	

Note: Transport and load bicycles with a maximum permissible weight of more than 300 kg are difficult for the user to handle and reach the limits of physical performance

2. Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4210-1:2014, Cycles — Safety requirements for bicycles — Part 1: Terms and definitions.

ISO 4210-2:2015, Cycles — Safety requirements for bicycles — Part 2: Requirements for city and trekking, young adult, mountain, racing bicycles.

ISO 4210-3:2014, Cycles — Safety requirements for bicycles — Part 3: Common test methods.

ISO 4210-4:2014, Cycles — Safety requirements for bicycles — Part 4: Braking test methods.

ISO 4210-5:2014, Cycles — Safety requirements for bicycles — Part 5: Steering test methods.

ISO 4210-6:2015, Cycles — Safety requirements for bicycles — Part 6: Frame and fork test methods.

ISO 4210-7:2014, Cycles — Safety requirements for bicycles — Part 7: Wheel and rim test methods.

ISO 4210-8:2014, Cycles — Safety requirements for bicycles — Part 8: Pedal and drive system test methods.

ISO 4210-9:2014, Cycles — Safety requirements for bicycles — Part 9: Saddle and seat-post test methods.

3. Terms and definitions

The terms and the definitions given in TBIS 79010 apply.

3.1 cycle

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 city and trekking bicycle

bicycle designed for use on public roads primarily for means of transportation or leisure.

3.3 mountain-bicycle

bicycle designed for use off-road on rough terrain, on public roads and on public pathways equipped with a suitably strengthened frame and other components, and, typically, with wide-section tyres with coarse tread patterns and a wide range of transmission gears.

3.4 fully assembled bicycle

bicycle fitted with all the components necessary for its intended use.

3.5 brake-lever

lever that operates a braking device.

3.6 disc-brake

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

3.7 braking distance

distance travelled by a bicycle between the commencement of braking (3.18) and the point at which the bicycle comes to rest.

3.8 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.

3.9 commencement of braking

point on the test track or test machine at which the brake actuating device operated directly by the riders hand or foot or by a test mechanism starts to move from its rest position.

3.10 composite materials

component that is entirely or partially made of a non-metallic matrix materials which is reinforced by metallic or non-metallic materials such as short or long fibres, fabric or particles.

3.11 crank assembly

assembly for fatigue testing consisting of the drive side and the non-drive side crank arm, the pedal spindle-adaptors, the bottom-bracket spindle, and the first component of the drive system.

3.12 drive belt

seamless ring belt which is used as a means of transmitting motive force.

3.13 dummy fork

test fork manufactured to specific characteristics that can be substituted within a test for either the fork supplied by the manufacturer or where a fork has not been supplied.

3.14 exposed protrusion

protrusion which through its location and rigidity could present a hazard to the rider either through heavy contact with it in normal use or should the rider fall onto it in an accident.

3.15 fork steerer (fork stem)

part of a fork that rotates about the steering axis of a bicycle frame head tube.

Note to entry: It is normally connected to the fork crown or directly to the fork legs, and is normally the point of connection between the fork and the handlebar stem.

3.16 fracture

unintentional separation into two or more parts.

3.17 hub-brake

brake which acts directly on the wheel-hub.

3.18 hub-generator

electric generating device built in the wheel-hub.

3.19 lowest gear

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

3.20 maximum inflation pressure.

maximum tyre pressure recommended by the tyre or rim manufacturer for a safe and efficient performance.

Note to entry: If the rim and tyre both indicate a maximum inflation pressure, the maximum inflation pressure is the lowest of the two pressures indicated.

3.21 maximum saddle height

vertical distance from the ground to the point where the top of the seat surface is intersected by the seat-post axis, measured with the seat in a horizontal position and with the seat-post set to the minimum insertion-depth mark.

3.22 minimum insertion-depth mark

mark indicating the minimum insertion-depth of handlebar stem into fork steerer (fork stem) or seat-post into frame.

3.23 pedal tread-surface

surface of a pedal that is presented to the underside of the foot.

3.24 primary retention system

system that keeps the front/rear wheel securely attached to the frame/fork dropouts whilst riding.

3.25 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 such public roads, bicycles will share use with other forms of transport including motorised traffic.

3.26 pulley

rotating wheel mounted on an axle, that contains around its circumference teeth or groove over which a belt can pass to transmit power.

3.27 quick-release device

lever actuated mechanism that connects, retains, or secures a wheel or any other component.

3.28 quick-release pedal (quick-release device)

pedal that contains a device for the attachment of a rider’s foot/shoe that can be released by foot-movement alone.

3.29 rim-brake

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

3.30 screw thread locking devices

devices attached or applied to the threads of a nut or bolt so that they do not unintentionally become unlocked.

EXAMPLE Lock washers, lock nuts, thread locking compound, or stiff nuts.

3.31 seat-post

component that clamps the saddle (with a bolt or assembly) and connects it with the frame.

3.32 suspension-fork

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

3.33 suspension-frame

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

3.34 toe-clip

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

3.35 visible crack

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

3.36 wheel

assembly or combination of hub, spokes or disc, and rim, but excluding tyre assembly.

3.37 wheelbase

distance between the axes of the front and rear wheels of an unladen bicycle.

3.38 simulated ground plane

plane used to orient a test part or assembly in a way that represents the cycles alignment to the ground in a fully assembled cycle.

3.39 bolted joint

components joined together with threaded fastener.

3.40 maximum permissible total weight

weight of the fully assembled Cargo bike plus rider and luggage as defined by the manufacturer

4. Safety requirements

4.1 General

4.1.1 Structure requirement

4.1.1.1 Definition of brake tests

Brake tests to which accuracy requirements apply, as in 4.1.1.4, are those specified in 4.2.2.3 to 4.2.2.6 inclusive.

4.1.1.2 Definition of strength tests

Strength test to which accuracy requirements apply, as in 4.1.1.4, are those involving static, impact or fatigue loading.

4.1.1.3 Numbers and condition of specimens for the strength tests

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 ought to 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.

4.1.1.4 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 torques	0/+5 %
Masses and weights	±1 %
Dimensions	±1 mm
Angles	±1°
Time duration	±5 s
Temperatures	±2 °C
Pressures	±5 %

4.1.1.5 Fatigue test

The force for fatigue tests is to be applied and released progressively, not to exceed 10 Hz. The tightness of fasteners according to manufacturer's recommended torque can be re-checked not later than 1,000 test cycles to allow for the initial settling of the component assembly. (This is considered applicable to all components, where fasteners are present for clamping). The test bench shall be qualified to meet dynamic requirements of 4.1.1.4.

4.1.1.6 Fatigue test for composite components

For fatigue test for composite components, the initial value of displacement (peak-to-peak value) is taken after 1,000 cycles and before 2,000 cycles.

4.1.1.7 Plastic material test ambient temperature

All strength tests involving any plastic materials shall be pre-conditioned for two hours and tested at an ambient temperature of 23 °C ± 5 °C.

4.1.1.8 Crack detection methods

Standardised methods should be used to emphasize the presence of cracks where visible cracks are specified as criteria of failure in tests specified in this standard.

NOTE For example, suitable dye-penetrant methods are specified in ISO 3452-1, ISO 3452-2, ISO 3452-3 and ISO 3452-4. In addition, white paint or surface treatment can be used to aid in detection for composite materials.

4.1.2 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, e.g. deburred, broken, rolled or processed with comparable techniques.

NOTE Refer to ISO 13715:2000.

4.1.3 Security and strength of safety-related fasteners

4.1.3.1 Security of screws

Any screws used in the assembly of suspension systems or screws used to attach bracket attached electric generators, brake-mechanisms and mud-guards to the frame or fork, and the saddle to the seat-post shall be provided with suitable locking devices, e.g. lock-washers, lock-nuts, thread locking compound or stiff nuts.

NOTE 1 : The screws used to attach hub-generator are not included.

NOTE 2 : mechanical and physical properties of bolts are specified in ISO 898-1.

4.1.3.2 Minimum failure torque

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

4.1.3.3 Folding bicycles mechanism

Folding bicycle mechanism; if provided shall be designed so that CARGO BIKE 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.

4.1.4 Protrusions

These requirements are intended to address the hazards associated with the users of CARGO BIKE falling on projections or rigid components (e.g. handlebars, levers) on CARGO BIKE 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.

NOTE Handlebar-ends are covered by the paragraph in 4.3.6.2.

4.2 Brakes

4.2.1 Braking-systems

CARGO BIKE shall be equipped with at least two independently actuated braking-systems. At least one shall operate on the front wheel and one on the rear wheel. The braking-systems shall operate without binding and shall be capable of meeting the braking-performance requirements of 4.2.2.9.

No hand shall need to be taken from the handlebar to operate the brake levers.

If additional braking-systems are implemented, they shall meet the brake requirements of 4.2.1.

Brake-blocks containing asbestos shall not be permitted.

4.2.2 Hand-operated brakes

4.2.2.1 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 CARGO BIKE is to be sold, and CARGO BIKE manufacturer shall state in the manufacturer's instructions which levers operate the front and rear brakes.

4.2.2.2 Hand-operated brakes

4.2.2.2.1 Requirement

The dimension, *d*, measured 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 over a distance of not less than 40 mm as shown in Figure 1 shall not exceed 90 mm;

Conformance shall be established by the method detailed in 4.2.2.2.2.

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

Dimensions in millimetres

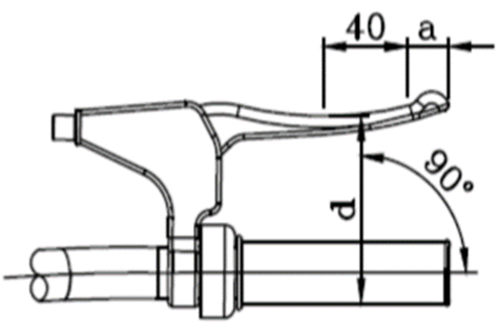


Figure 1 — Brake-lever grip dimensions

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

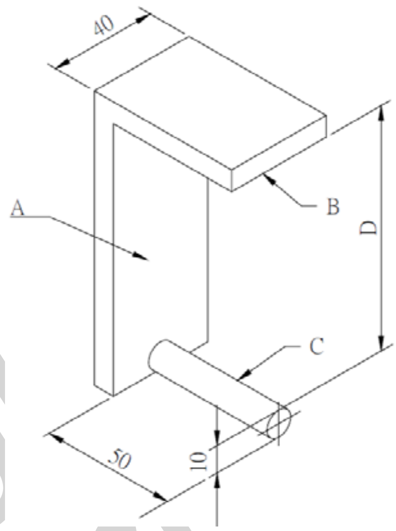
d Brake-lever grip dimension

4.2.2.2.2 Test method for the brake-lever similar

Fit the gauge illustrated in Figure 2 — over the handlebar-grip or the handlebar (when the manufacturer does not fit a grip) and the brake-lever as shown in Figure 3 — 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.

NOTE : The measurement ought to be conducted only on a fully-assembled CARGO BIKE

Dimensions in millimetres



A A Face
B B Face
C Rod

Figure 2 — Brake-lever grip dimension gague

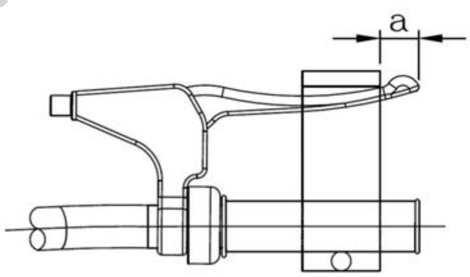


Figure 3 — Method of fitting the gauge to the brake-lever and handlebar (Minimum grip length is shown)

4.2.2.3 Attachment of brake assembly and cable requirements

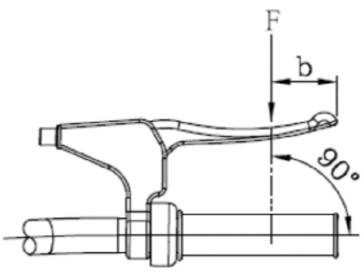
Cable pinch-bolts shall not sever any of the cable strands when assembled to the manufacturer's instructions. In the event of a cable failing, no part of the brake mechanism shall inadvertently inhibit the rotation of the wheel.

The cable end shall either be protected with a cap that shall withstand a removal force of not less than 20 N or be otherwise treated to prevent unravelling.

NOTE See 4.1.3 in relation to fasteners.

4.2.2.4 Brake-levers – Position of applied force

For the purposes of braking tests in this standard, for brake-levers similar to Type A, the test force shall be applied at a distance, b, which is equal to either dimension a as determined in 4.2.2.2.2 or 25 mm from the free end of the brake-lever, whichever is the greater (see Figure 4).



F Applied force
b =25 mm

Figure 4 —Position of applied force on the brake-lever type A

4.2.2.5 Brake-block and brake-pad assemblies – Security test

4.2.2.5.1 Requirement

The friction material shall be securely attached to the holder, backing-plate, or shoe and there shall be no failure of the braking system or any component thereof when tested by the method specified in 4.2.2.5.2.

4.2.2.5.2 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 Figure 4 — 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.

Then conduct the test described in 4.2.2.7 as appropriate depending on the style of brake, and then the test described in 4.2.2.9.

4.2.2.6 Brake adjustment

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.

The brake blocks of a bicycle with rod brakes shall not come into contact with the rim of the wheels when the steering angle of the handlebars is set at 60°, nor shall the rods bend, or be twisted after the handlebars are reset to the central position.

4.2.2.7 Hand-operated braking-system – Strength test

4.2.2.7.1 Requirement

When tested by the method described in 4.2.2.7.2, there shall be no failure of the braking-system or of any component thereof.

4.2.2.7.2 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 Figures 4. 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 brake extension-lever level with the surface of the handlebar or in contact with the handlebar;

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

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

4.2.2.8 Back-pedal braking system – Strength test

4.2.2.8.1 General

If the back-pedal braking system is fitted, the brake shall be actuated by the operator's foot applying force to the pedal in a direction opposite to that of the drive force. The brake mechanism shall function regardless of any drive-gear positions or adjustments. The differential between the drive and brake positions of the crank shall not exceed 60°.

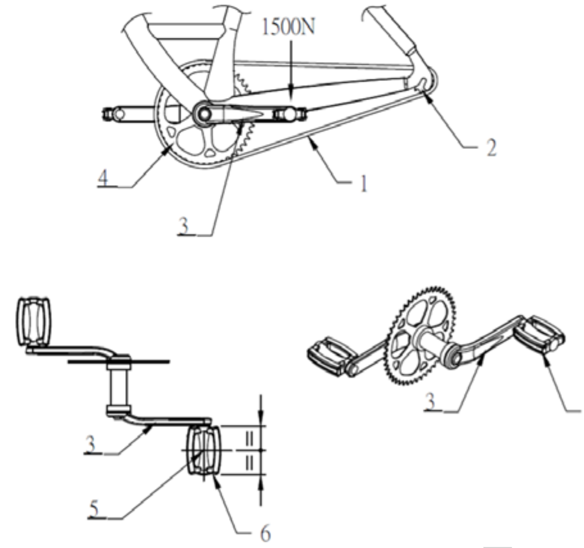
The measurement shall be taken with the crank held against each position with a pedal force of at least 250 N. The force shall be maintained for 1 min in each position.

4.2.2.8.2 Requirement

When tested in accordance with 4.2.2.8.3, there shall be no failure of the brake system or any component thereof.

4.2.2.8.3 Test method

Conduct the test on a fully-assembled bicycle. After it has been ensured that the braking system is correctly adjusted, and with the pedal cranks in a horizontal position, as shown in Figure 5, apply a vertically-downward force to the centre of the left-hand pedal spindle. Increase the force progressively to 1,500 N and maintain fully for 1 min.



1 Chain
2 Hub sprocket
3 Left crank
4 Cycle chain-wheel and pedal crank
5 Point of force application
6 Pedal

Figure 5 — Back-pedal brake test

4.2.2.9 Braking performance

4.2.2.9.1 General

The progressive characteristics of the brake are determined by linearity measurements. A final, simple track test checks for smooth, safe, stopping characteristics.

Conduct the braking-performance test on a fully-assembled bicycle after the brakes have been subjected to the strength test detailed in 4.2.2.7, 4.2.2.8. Before testing the bicycle, 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.

4.2.2.9.2 Requirements

Where CARGO BIKE is fitted with secondary brake-levers attached to brake-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.

When tested in accordance with 4.2.2.9.3, the bicycle shall fulfil the requirements shown in Table 1.

Table 1 — Calculated braking performance value

Condition	Brake in use	Requirement of F_{Br} N
Dry	Front only	425
	Rear only	280
Wet	Front only	220
	Rear only	140

NOTE These values are based on the reference mass ”m“ (100 kg).

4.2.2.9.2.1 Linearity requirements

When tested by the methods described in 4.2.2.9.3.6 c) 1) and 2), the braking force $F_{Br\ average}$ shall be linearly proportional (within ± 20 %) to the progressively increasing intended operating forces $F_{Op\ intend}$. The requirement applies to braking forces $F_{Br\ average}$ equal to and greater than 80 N (see Annex A).

4.2.2.9.2.2 Ratio between wet and dry braking performance requirements

In order to ensure safety for both wet and dry braking, the ratio of braking performance wet:dry shall be greater than 4:10.

The methods for calculating this ratio are given in 4.2.2.9.3.6 g).

4.2.2.9.3 Test method

4.2.2.9.3.1 General

The test machine enables the braking distances or deceleration 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.

4.2.2.9.3.2 Symbols

F_{0p}	Operating force (i.e. force applied on brake-lever or pedal)
$F_{0p\ intend}$	Intended operating force (e.g. 40 N, 60 N, 80 N etc.)
$F_{0p\ rec}$	Recorded operating force (e.g. 38 N, 61 N, 79 N etc.)
F_{Br}	Braking force
$F_{Br\ rec}$	Recorded braking force
$F_{Br\ corr}$	Corrected braking force (Corrected for difference between $F_{Op\ intend}$ and $F_{Op\ rec}$)
$F_{Br\ average}$	The arithmetic mean of the three $F_{Br\ corr}$ at one level of $F_{Op\ intend}$
$F_{Br\ max}$	The maximum $F_{Br\ average}$
F^{D}_{Br}	Dry braking-force
F^{W}_{Br}	Wet braking-force

4.2.2.9.3.3 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 Figure 6.

Figure 6 shows a machine in which a roller drives the individual wheels, Other types of machine are permitted, provided they meet the specific requirements listed below.

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 influence the measurement of braking force;

c) a means of laterally applying forces to the brake-levers at the point specified in Figure 4 — shall be provided, with the width of the contact on the lever not greater than 5 mm. In the case of back-pedal brake, a means of applying forces to a pedal is also required.

4.2.2.9.3.4 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 %;

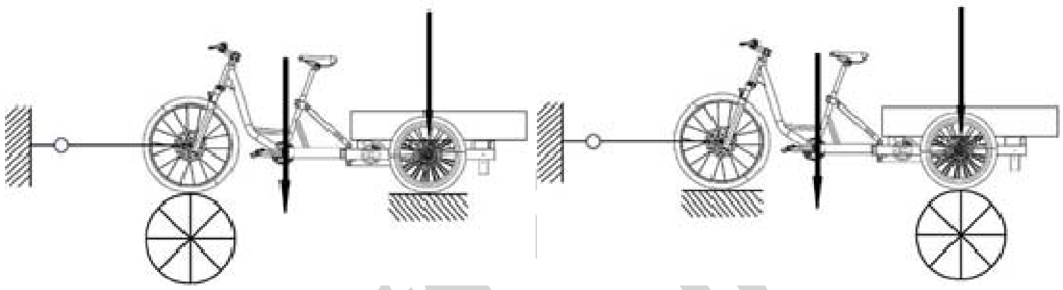
b) a device to record the braking force (see Figures 6, for example), accurate to within ± 5 %;

c) a device to record the operating force applied to the hand-lever or pedal, accurate to within ± 1 %;

d) a water spray system, to provide wetting of the brakes of the bicycle, consisting of a water reservoir connected by tubing to a pair of nozzles arranged as shown in Figure 7. 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 4.2.2.9.3.5).

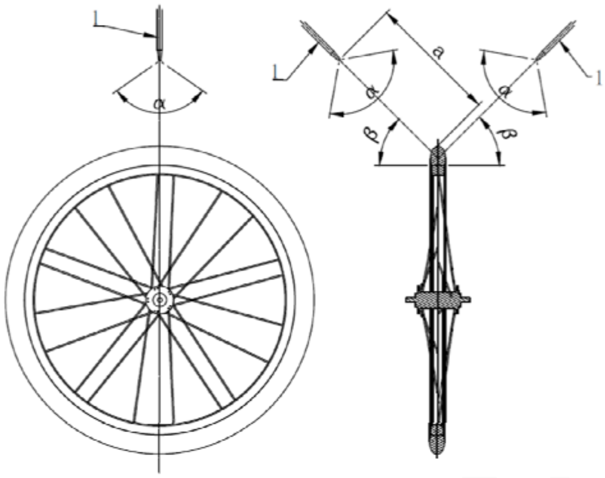
Dimensions in millimetres



a) Testing the front brake   b) Testing the rear brake

1 Braking-force transducer
2 Applied force, or
3 Additional mass
4 Direction of drum rotation

Figure 6 — Braking performance test-machine-Single drum type



α ＝90° 至 120°

β ＝30° 至 60°

a ＝150 mm 至 200 mm

1 Water nozzles

Figure 7 — Water nozzle arrangement for the wet braking test

(Applicable to all types of brake)

4.2.2.9.3.5 Vertical force on the tested wheel

The wheel to be tested shall be forced vertically downwards so that no skidding of the wheel occurs when tested according to 4.2.2.9.3.6 c) 1) and 2).

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

4.2.2.9.3.6 Test method

a) General

Test the front and rear wheels individually.

b) Running-in the braking surfaces

Conduct a running-in process on every brake before the performance test is performed.

In order to determine the operating force to be used during the running-in process, mount and load the bicycle on the test machine with the belt or drum running at the specified speed and apply an operating force to the brake-lever or the pedal 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 %) 10 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.

c) The performance tests

1) Testing under dry conditions

For hand operated brakes, 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.

For back-pedal brakes, 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 50 N increments from 100 N to either 350 N or to the force necessary to achieve a braking force of at least 400 N, whichever is the lesser. However, if the wheel locks, if any possible brake-overload device is actuated, 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 Figures 5 and 6 and 4.2.2.9.3.3 c), shall be recorded with an accuracy of ± 1 %, and shall be fully applied within 1,0 s of the commencement of braking.

For each increment of operating force, record the braking force value, $F_{Br\ rec}$, 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. Record $F_{Br\ rec}$ 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.

2) Testing under wet conditions

The method shall be as given in 4.2.2.9.3.6 c) 1) with the addition that wetting of the brake system shall commence not less than 5,0 s before the commencement of braking and shall continue until the measurement period has ended.

Water nozzles shall be arranged according to Figure 8.

d) 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 $F_{\mathrm{Br\ rec}}$ = 225 N

Intended operating force $F_{\mathrm{Op\ intend}}$ = 180 N

Recorded operating force $F_{\mathrm{Op\ rec}}$ = 184 N

Correction factor = 180/184

Corrected braking force $F_{\mathrm{Br\ corr}}$ = 225 × (180/184)

e) 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).

The braking performance value shall be calculated using the following equation:

$$B_{\mathrm{p}} = F_{\mathrm{Br\,max}} \times \frac{m}{M}$$

where

B_p is the braking performance value（N）;

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

m is the reference mass as 100 kg for adult bicycle;

M is the maximum permissible total mass specified by the manufacturer if in excess of 100 kg

Where a manufacturer specifies that his CARGO BIKE can carry a mass such that the sum of that mass plus the mass of CARGO BIKE is in excess of 100 kg, to some value M, apply M as total weight.

The braking deceleration value shall be calculated using the following equation:
F=ma

F＝ $F_{Br\ max}$ is the maximum $F_{Br\ average}$（N）
m ＝CARGO BIKE＋rider（kg）
a＝ deceleration (m/s^2)

f) Linearity
Plot the calculated $F_{Br\ average}$ values (the arithmetic mean of the three corrected braking forces at each level of operating force) against the equivalent operating force values, $F_{Op\ intend}$, in order to assess the linearity against the requirement in 4.2.2.9.2. 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 F.

g) Ratio between wet and dry braking

Ratio between wet and dry braking For each F_{Op} where $F^{D}_{Br\ average}$ is > 200 N, the ratio of braking performance wet/dry shall be greater than 4:10.determine (using the following formula) whether or not the requirements of have been met:

$$F^{W}_{Br\ average} : F^{D}_{Br\ average}$$

For symbols see 4.2.2.9.3.2.

h) Simple track test

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.

4.2.2.10 Brakes – Heat-resistance test

4.2.2.10.1 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.

4.2.2.10.2 Requirement

Throughout the test described in 4.2.2.10.3, the brake-lever shall not touch 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 4.2.2.10.3, the brakes shall achieve at least 60 % of the braking performance which was recorded at the highest operating force used during the performance tests 4.2.2.9.3.6 c) 1) and 2).

4.2.2.10.3 Test method

Drive the wheel and tyre assembly with the brake applied on a machine such as those described in 4.2.2.9.3.3 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 *E* Wh ± 5 % specified in Table 2 is developed. The duration of the test shall be 15 min ± 2 min.

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

A maximum of 10 interruptions per test cycle is permitted, each with a maximum duration of 10 s.

When the test has been carried out subject the brakes to the applicable parts of the tests described in 4.2.2.9.3.6 c) 1) and 2).

Calculate the braking energy from the following formula:

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

where

F_{Br} is the braking force（N）;

V_{Br} is the linear velocity of the periphery of the tyre(m/s)（12,5 km/h = 3,472 m/s）;

T is the duration of each test cycle (h) (excluding interruptions)（如 15min = 0.25h）

Table 2 — Total braking energy

Total braking energy, *E*	75 Wh

When the test has been carried out, the brakes shall be subjected to the applicable parts of the test described in 4.2.2.9.3, in order to check that the requirement 4.2.2.10.2 is fulfilled.

4.2.2.11 Back-pedal brake linearity test

This test shall be conducted on a fully assembled CARGO BIKE. The output force for a back-pedal brake shall be measured tangentially to the circumference of the rear tyre, when the wheel is rotated in the direction of forward movement, while a force of between 90 N and 300 N is being applied to the pedal at right angles to the crank and in the direction of braking.

The braking force reading shall be taken during a steady pull and after one revolution of the wheel. A minimum of five results, each at a different pedal force level, shall be taken. Each result shall be the average of three individual readings at the same load level.

The results shall be plotted 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.

4.3. Frame and front fork assembly

4.3.1 Suspension-frames – Special requirements

The design shall be such that if the spring or damper fails, neither the tyre shall contact any part of the frame nor the assembly carrying the rear wheel become detached from the rest of the frame.

4.3.2 Frame – Impact test (falling mass)

4.3.2.1 Requirements

When tested by the method described in 4.3.2.2, there shall be no visible cracks or fractures of the frame. The permanent deformation measured between the axes of the wheel axles shall not exceed the following values:

a) 30 mm where a fork is fitted;

b) where a dummy fork is fitted in place of a fork, the values are given in Table 3.

NOTE See Annex B (normative) Dummy fork characteristics.

Table 3 — The values of permanent deformation

Fork type	Real fork	Dummy fork
Permanent deformation	30 mm	10 mm

4.3.2.2 Test method

Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 8 in the fork. The hardness of roller shall be not less than 60 HRC at impact surface. If a dummy fork is used in place of a fork the bar shall have a rounded end equivalent in shape to the roller. Hold the frame-fork or frame-bar assembly vertically with clamping to a rigid fixture by the rear-axle attachment points as shown in Figure 8.

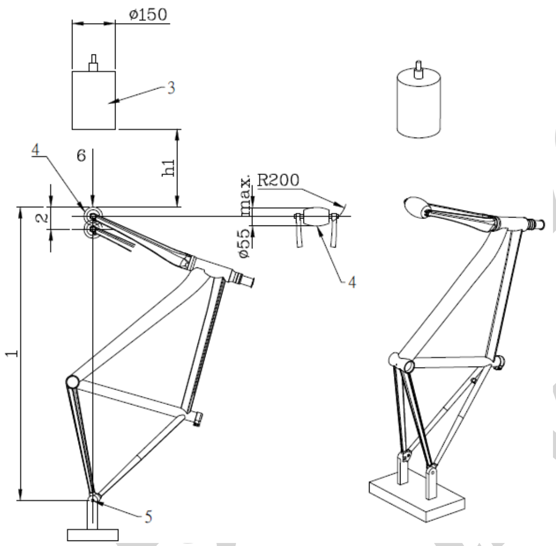
Rest a striker of mass 22,5 kg on the roller in the fork drop-outs or on the rounded end of the dummy fork and measure the wheelbase. Raise the striker to a height of h_1 above the low-mass roller and release it to strike the roller or the steel bar at a point in line with the wheel centres and against the direction of the fork rake or rake of the bar. The drop heights are given in Table 4. The striker will bounce and this is normal. When the striker has come to rest on the roller or dummy fork, measure the wheelbase again.

If the fork fails, the frame shall be tested with a dummy-fork.

Table 4— Drop heights and static energy absorption value

Drop height h_1 (mm)	360

Dimensions in millimetres



h1 Drop height
1 Wheelbase
2 Permanent deformation
3 22,5 kg striker
4 Low mass roller (1 kg max.)
5 Rigid mounting for rear axle attachment point
6 Direction of rearward impact

Figure 8 — Frame and front fork assembly: impact test (falling mass)

4.3.3 Frame and front fork assembly – Fatigue test with pedalling forces

4.3.3.1 General

All types of frame shall be subjected to this test.

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 end 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.

For a suspension frame and front fork, lock it at a length equivalent to that with maximum permissible total weight by adjusting the spring/damper or by external means.

4.3.3.2 Requirement

When tested by the method described in 4.3.3.3, there shall be no visible cracks or fractures in any part of the frame, and there shall be no separation of any parts of the suspension system.

For composite frames, the running displacements (peak-to-peak values) at the points where the test forces are applied shall not increase by more than 20 % of the initial values (see 4.1.1.6).

4.3.3.3 Test method

Use a new frame/fork assembly fitted with standard head-tube bearings for the test.

4.3.3.3.1 single-lane

Mount the frame assembly on a base as shown in Figure 9 with the fork or dummy fork secured by its axle to a rigid mount of height *Rw* (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, chain-wheel and chain assembly or, preferably, a strong, stiff, replacement assembly to the bottom bracket as shown in Figure 9 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 ± 2,0°) 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 9), ensure that the assembly is free to swivel about the axis of the bottom-bracket and that both replacement arms are 175 mm long (L) and that they are both inclined forwards and downwards at an angle of 45° (accurate ± 2,0°) 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 (Rc) 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.

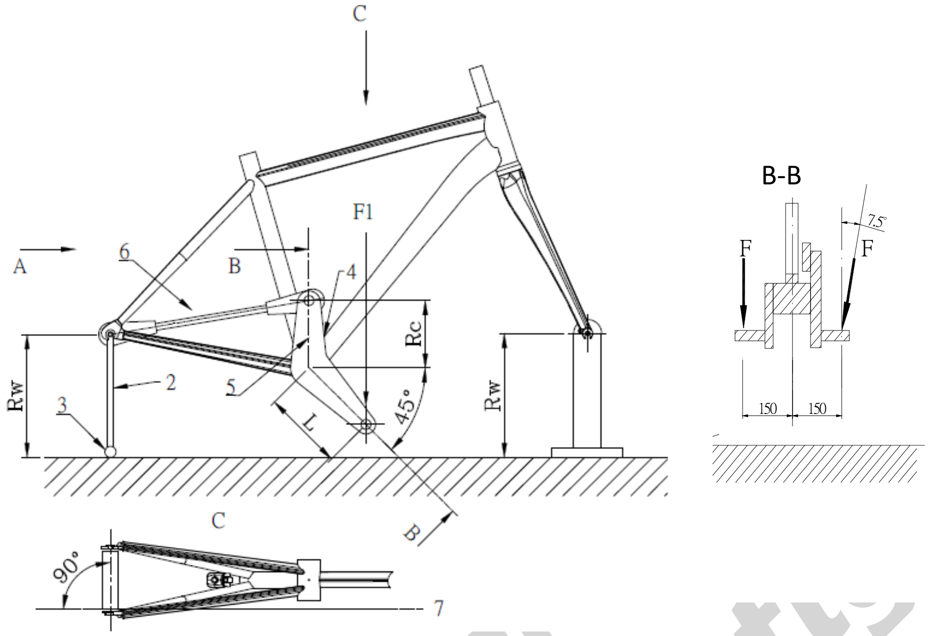
Subject each pedal-spindle (or equivalent adaptor component) to a repeated downward force of *F1* at a position 150 mm from the centre-line of the frame in a vertical, transverse plane and inclined at 7,5° (accurate to within ± 0,5°) to the fore/aft plane of the frame as shown in Table 5 and Figure 9 —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. The maximum test frequency shall be maintained as specified in 4.1.1.5.

Table 5 — Forces on pedal-spindle

Force in N

Force, F_1	1200



Rw Height of rigid mount and vertical link
Rc Length of vertical arm (75 mm)
L Length of crank replacement (175 mm)
1 Rigid mount
2 Vertical link
3 Ball-joint
4 Vertical arm
5 tie-rod
6 Centre-line of tie-rod

Figure 9 — Frame and front fork assembly (single-lane): fatigue test with pedalling forces

4.3.3.3.2 Multi-lane

Mount the frame in its normal attitude and secured at the front and rear drop-outs so that it is not restrained in a rotary sense as shown in Figure 10. Ensure that the axes of the front and rear axles are horizontally in line.

Fit a crank, chain-wheel and chain assembly or, preferably, a strong, stiff, replacement assembly to the bottom bracket as shown in Figure 10 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 ± 2,0°) 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 10), ensure that the assembly is free to swivel about the axis of the bottom-bracket and that both replacement arms are 175 mm long (L) and that they are both inclined forwards and downwards at an angle of 45° (accurate ± 2,0°) 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 (Rc) 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 F_2 at a position 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 Table 6 and Figure 10 —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. The maximum test frequency shall be maintained as specified in 4.1.1.5.

Table 6 — Forces on pedal-spindle

Force in N

Force, F_2	1200

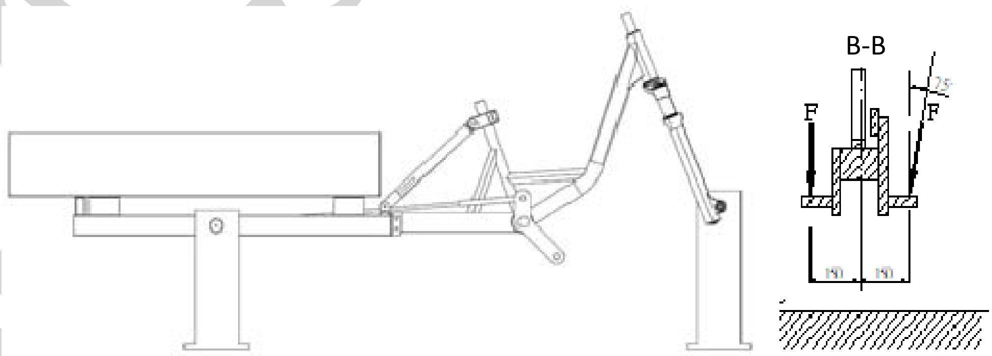


Figure 10 — Frame and front fork assembly (Multi-lane): fatigue test with pedalling forces

4.3.4 Frame and front fork assembly – Fatigue test with horizontal forces

4.3.4.1 General

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.

Ensure that the axes of the front and rear axles are horizontally in line, as shown in Figure 11. 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.

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, arrange the positions of these adjustable components to ensure maximum forces in the frame.

For a suspension frame and front fork, lock it at a length equivalent to that with maximum permissible total weight by adjusting the spring/damper or by external means.

4.3.4.2 Requirement

When tested by the method described in 4.3.4.3, 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 composite frames, the running displacement (peak-to-peak value) at the point where the test forces are applied shall not increase by more than 20 % of the initial values (see 4.3.1.6).

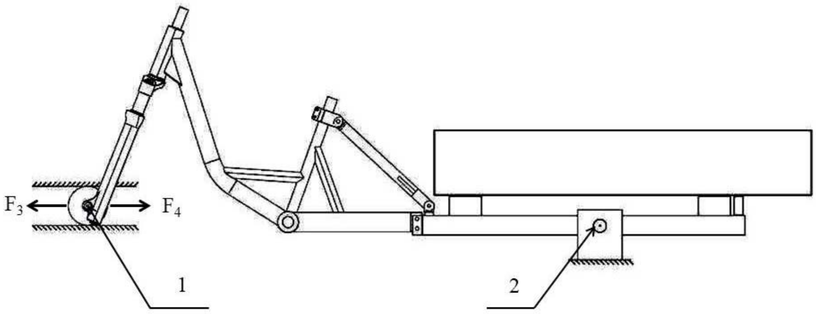
4.3.4.3 Test method

Mount the frame in its normal attitude and secured at the rear drop-outs so that it is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure 11. Ensure that the axes of the front and rear axles are horizontally in line.

Apply cycles of dynamic, horizontal forces of F_3 in a forward direction and F_4 in a rearward direction to the front fork drop-outs for C_1 cycles as shown in Table 7 and Figure 11, with the front fork constrained in vertical direction but free to move in a fore/aft direction under the applied forces. The maximum test frequency shall be maintained as specified in 4.1.1.5.

Table 7 — Forces and cycles on front fork drop-outs

Forward force F_3，N	1200
Rearward force F_4，N	600
Test cycles, C_1	50 000



1 Free-running guided roller

2 Rigid, pivoted mounting for rear axle attachment point

Figure 11 —Frame and front fork assembly: fatigue test with horizontal forces

4.3.5 Frame and front fork assembly – Fatigue test with a vertical force

4.3.5.1 General

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.

Ensure that the axes of the front and rear axles are horizontally in line, as shown in Figure 12. 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.

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, arrange the positions of these adjustable components to ensure maximum forces in the frame.

For a suspension frame and front fork, lock it at a length equivalent to that with maximum permissible total weight by adjusting the spring/damper or by external means.

4.3.5.2 Requirement

When tested by the method described in 4.3.5.3, there shall be no visible cracks or fractures in the frame and there shall be no separation of any parts of the suspension system.

For composite frames, the running displacement (peak-to-peak value) at the point where the test forces are applied shall not increase by more than 20 % of the initial value (see 4.3.1.6).

4.3.5.3 Test method

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 12. Fit a suitable roller to the front axle in order to permit the frame to flex in a fore/aft sense under the test forces.

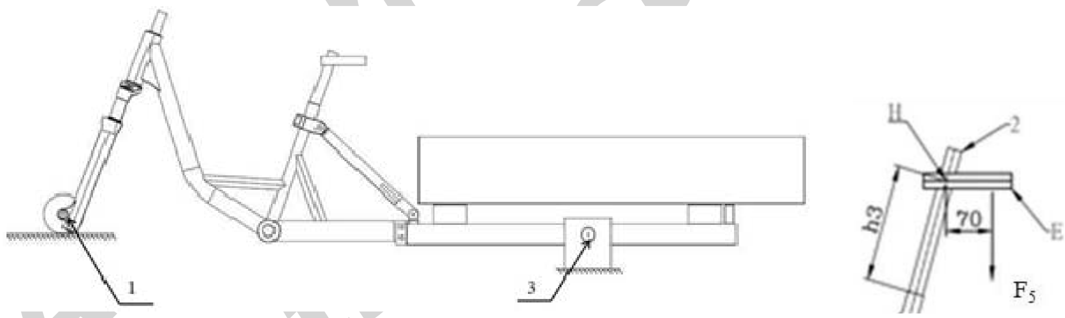
Insert intended seat post at minimum insertion depth or equivalent to a seat-stem to a depth of 75 mm in the top of the seat-tube and secure this to the manufacturer's instructions by the normal clamp. Securely attach a horizontal, rearward extension (*E* in Figure 12) to the top of this bar such that its length (dimension *h3* in Figure 12) places Point H in a position equivalent to that of the centre of the saddle-clamp with the bicycle at its maximum saddle height recommended for the particular frame, or if the maximum saddle height information is not available dimension *h3* shall be 250 mm.

Apply cycles of dynamic, vertically-downward forces of F_5 at a point 70 mm behind the intersection of the axes of the solid steel bar and the extension piece, *E*, as shown in Figure 12 for 50 000 test cycles. The forces are given in Table 8. The maximum test frequency shall be maintained as specified in 4.3.1.5.

Table 8 — Forces on seat-stem

Force in N

Forces,F_5	1200



E Horizontal, rearward extension

H Position equivalent to that of the centre of the saddle-clamp with the bicycle

1 Free-running roller

2 Steel bar

3 Rigid, pivoted mounting for rear axle attachment point

Figure 12 — Frame: fatigue test with a vertical force

4.4 Parking brakes and parking stability

4.4.1 Parking brakes and parking stability for Multi-lane

4.4.1.1 General

For multi-lane design of the CARGO BIKE, during the parking and unloading of the vehicle, the wheel is tightened to stabilize the vehicle body. Therefore, it is necessary to ensure that the slope is stable in the parking state.

4.4.1.2 Requirement

When tested by the method described in 4.4.1.3, No wheel rolling or relative movement of the tire and the ground may cause the vehicle to move in the forward and backward direction. The positive force of any landing support point must not be zero.

4.4.1.3 Test method

Place the test CARGO BIKE on a level and adjustable pitch platform with the wheels in the same direction of travel. Adjust the parking (brake) device to make its parking function work and maximize its effectiveness. The maximum cargo capacity claimed by the operator is placed in the cargo position. Other loading weights: 6.75 kg at each end of the handlebar, 18 kg for each pedal, and 36 kg for the seat post.

Adjust the angle of the front, rear, left and right of the test platform from the horizontal state to 10 degrees (with the ground friction coefficient: 0.75~1), and tilt at an angle of 10 degrees at the front, rear, left and right tilt angles. In the state, observe whether the CARGO BIKE moves in the front-rear direction, and whether the positive force of any ground support point should not be zero.

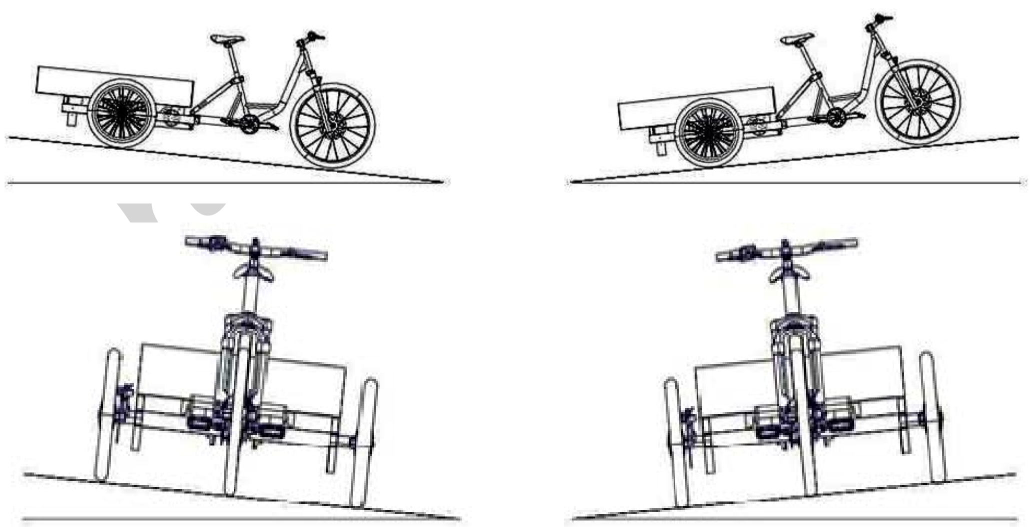


Figure 13 Parking brakes and parking stability for Multi-lane

4.4.2 Parking brakes and parking stability for Single lane

4.4.2.1 General

The single lane design of the CARGO BIKE, during the parking and unloading of the vehicle, the parking device is used to stabilize the body, and the parking device is required to carry the weight of the cargo while maintaining stability, most of CARGO BIKE for single lane were set the two points and one wheel to touch ground, so it is necessary to ensure that the slope is still stable in the parking state.

4.4.2.2 Requirement

When tested by the method described in 4.4.2.3, the positive force of any landing support point must not be zero, to ensure that the slope is still stable in the parking state.

4.4.2.3 Test method

Place the test CARGO BIKE on a level and adjustable pitch platform with the wheels in the same direction of travel. Adjust the parking device to make its parking function work and maximize its effectiveness. The maximum cargo capacity claimed by the operator is placed in the cargo position. Other loading weights: 6.75 kg at each end of the handlebar, 18 kg for each pedal, and 36 kg for the seat post.

Adjust the angle of the front, rear, left and right of the test platform from the horizontal state to 10 degrees (with the ground friction coefficient: 0.75~1), and tilt at an angle of 10 degrees at the front, rear, left and right tilt angles. In the state, the positive force of any ground support point should not be zero.

4.5 Structural integrity of the fully assembled CARGO BIKE

4.5.1 Requirement

When tested by the method described in 4.5.2, there should be no system or component failure and no loosening or misalignment of the saddle, handlebar, controls, lighting equipment, or reflectors, and the function of electric power assisted should be normal.

4.5.2 Test methods

Mount a fully assembled electric power assisted bicycle on a test machine. The following weights should be applied:

—one 36 kg weight with a pin for insertion in the seat-post and divided into two halves to be hung, one on each side;

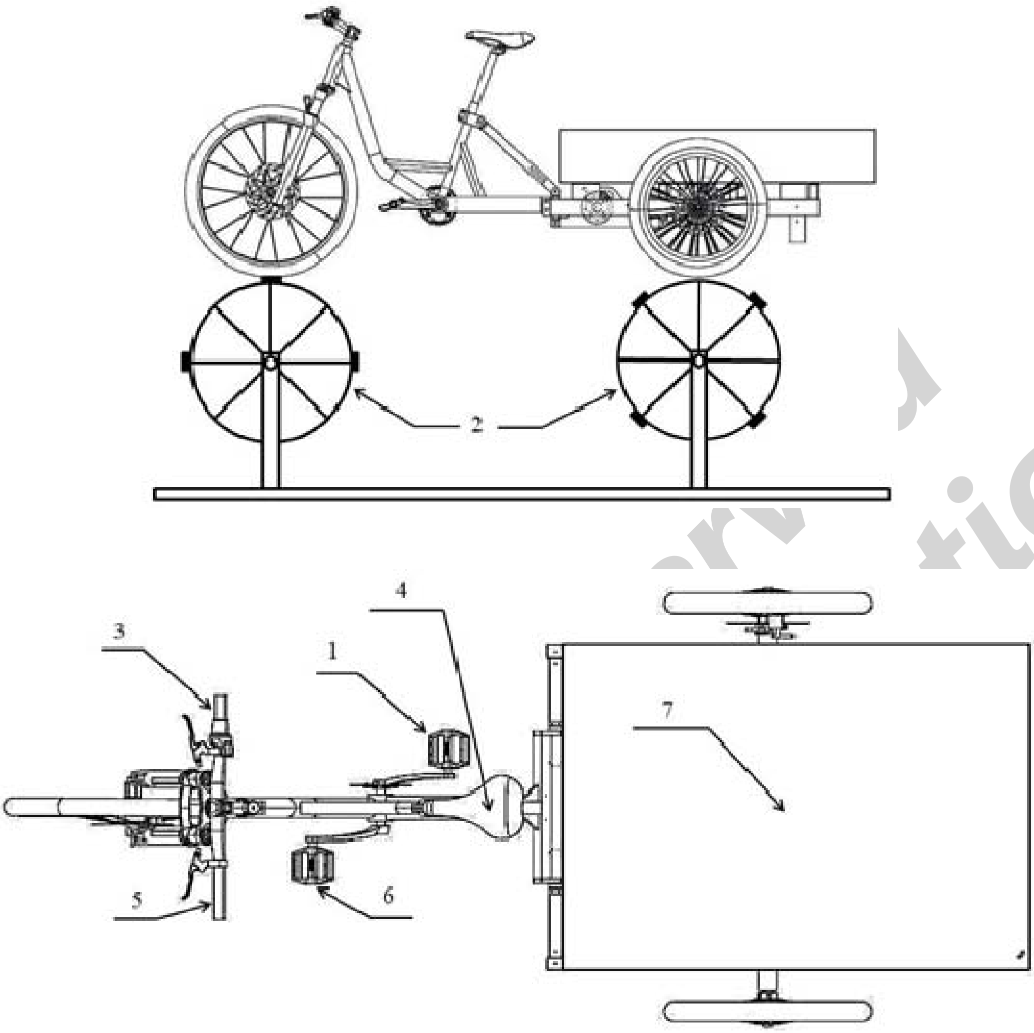
—two 18 kg weights with fixtures for attaching them to the cranks in place of the pedals;

—two 6,75 kg weights with fixtures for attaching them to each side of the handlebar;

—maximum permissible weight on the luggage carrier.

An example of a test arrangement is shown in Figure 14, in which the CARGO BIKE is mounted on two drums. The slots should have a width of 50 mm ± 2,5 mm, a thickness of 10 mm ± 0,25 mm, and 45° chamfered edges of half their thickness. The circumferential spacing between the centrelines of two consecutive slots should be not less than 400 mm.

Rotate the drums to give a linear surface speed of 8 km/h (±10 %) for a period of 6 h. The tyres of the bicycle should be inflated to the maximum inflation pressure.



1. weight, 18 kg
2. drum
3. weight, 6,75 kg
4. weight, 36 kg
5. weight, 6,75 kg
6. weight, 18 kg
7. weight, maximum permissible value

Figure 14—**Structural integrity of the fully assembled CARGO BIKE**

Annex A
(Informative)
Explanation of the method of least squares for obtaining line of best fitand ± 20 % limit lines for braking performance linearity

The readings taken in the test specified in 4.2.2.9.3.6 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:

$$y = a + bx$$

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:

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

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

Then a may be found by substitution:

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

EXAMPLE The following four values of x and y are noted during a test, from which: ，Σxy，Σx^2, x and y are calculated as shown:

No.	X（pedal force，N）	Y（braking force，N）
1	90	90
2	150	120
3	230	160
4	300	220
Sum	Σx=770	Σy=590
Mean	X=192.5	Y=147.5

No.	XY	X^2
1	8100	8100
2	18000	22500
3	36800	52900
4	66000	90000
Sum	Σxy=128900	ΣX^2=173500

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

$$=\frac{128\,900-(147{,}5\times770)}{173\,500-(192{,}5\times770)}$$

$$=0{,}606$$

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

$$=147{,}5-(0{,}606\times192{,}5)$$

$$=30{,}8$$

The line of best fit is therefore:

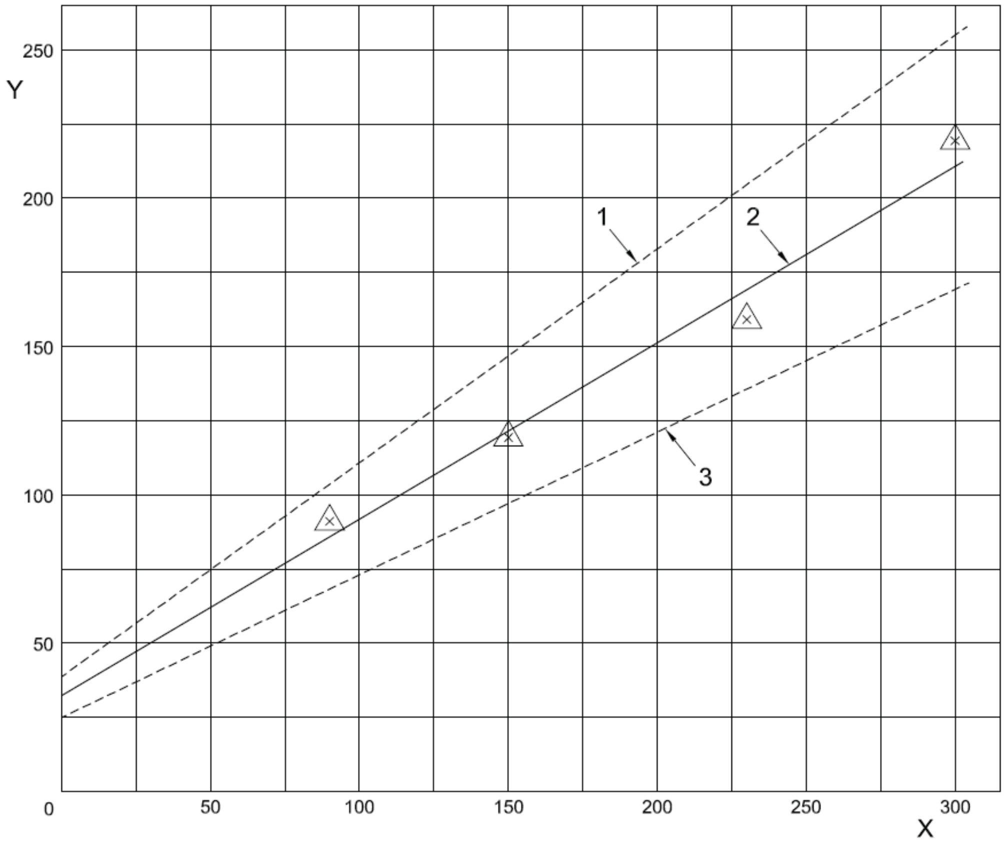
y = 30,8 + 0,60x

and the ±20% limit lines are:

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

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

The results are shown graphically in Figure F.1.



Y   Braking force, N

X   Input force, N

1   +20 % Limit

2   Line of best fit

3   −20 % Limit

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

Annex B
(informative)
Dummy fork characteristics

The test forks shall be designed to mount in a manner similar to the original fork, or in a manner using typical procedures (see Annex B).

The test forks when mounted shall be the same length (axle to race), *L*, as the longest fork designed for use with the frame.

The deflection of the test fork shall be measured in the direction of the force application at the front axle centre, from the resulting application of a vertical force of 1 200 N. The fork shall be secured in a horizontal position by constraining the steerer tube by means of a false head tube (with bearings) equal to 150 mm in length. The steerer tube shall be secured as in a bicycle with the crown race seat adjacent to the false head tube lower bearing assembly. (See Figure G.1 in Annex G).

a) The deflection ratio, *Dr*, for the Test fork for the Horizontal Loading Fatigue test and the Vertical Loading Fatigue test shall not exceed the value of 1,0 when computed as follows:

$$D_r = \frac{K_1 \times 10\,000 \times \delta}{L^3}$$

where

D_r is the deflection ratio;

K_1 is 1 417, a constant;

L is the fork length, expressed in millimetres;

δ is the deflection, expressed in millimetres.

EXAMPLE

Fork length L = 460 mm

Deflection δ = 6,85 mm, from which

Deflection ratio Dr

$$D_r = \frac{K_1 \times 10\,000 \times \delta}{L^3}$$

$$=\frac{1\,417\times10\,000\times6,85}{460^3}$$

$$=0,99721\leq1,0$$

b) The deflection ratio, D_r, for the Test fork for the Impact test shall not exceed the value of 1,0 when computed as follows:

$$D_r=\frac{K_2\times10000\times\delta}{L^3}$$

where

Dr is the deflection ratio;

K_2 709，a constant;

L is the fork length, expressed in millimetres;

δ is the deflection, expressed in millimetres.