Taiwan Bicycle Industry Standard

TBIS

4210-6

Seventh edition

2026.01.01

Cycles — Safety requirements for bicycles —

Part 6:

Frame and fork test methods

Reference number:
ISO 4210-6:2023

Contents

Page

Foreword

Taiwan Bicycle Industry Standard (TBIS) is approved and announced by Taiwan Bicycle Association (TBA). The preparatory work of "Taiwan Bicycle Industry Standard" is carried out by the technical expert committee from TBIS. When TBA members are interested in the related standard that has been announced, and after they are approved by the 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 in close cooperation to handle all matters applied and established by TBIS.

The structure, establishing process and revising of this standard should 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:

After 2023, The International Organization for Standardization 4210: 2023 (ISO 4210:2023) will be the most commonly used safety standard in global bicycle industry. Although ISO 4210 is not a mandatory inspection standard in various economic markets, they are still requesting their bicycle products suppliers to follow the basis of ISO 4210 safety requirements. However, this phenomenon represents that they are unable to differentiate the quality and grade differences between bicycles and spare parts. 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 General Meeting (rev. NP) Discussion] Total 13 companies and 18 industry experts participate, 2015.06.25.

2nd: [TBIS Working Draft (rev. WD) Discussion] Total 13 companies and 18 industry experts participate, 2015.06.25.

3rd: [TBIS Committee Draft (rev.CD) Discussion] Total 14 companies and 22 industry experts participate, 2015.07.21.

4th: [TBIS Enquiry stage (rev. DTS) Discussion] Total 15 companies and 19 industry experts participate, 2015.09.02.

5th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 17 companies and 19 industry experts participate, 2015.10.28.

6th: [TBIS Subject Meeting] Total 17 companies and 19 industry experts participate, 2015.10.28.

7th: [TBIS Enquiry stage (rev. DTS) Discussion] Total 20 companies and 21 industry experts participate, 2016.04.22.

8th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 18 companies and 18 industry experts participate, 2016.06.24.

9th: [TBIS Subject Meeting] Total 15 companies and 16 industry experts participate, 2016.11.04.

10th: [TBIS Enquiry stage (rev. DTS) Discussion] Total 16 companies and 16 industry experts participate, 2017.04.20.

11th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 13 companies and 13 industry experts participate, 2017.07.28.

12th: [TBIS Enquiry stage (rev. DTS) Discussion] Total 14 companies and 14 industry experts participate, 2018.04.25.

13th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 14 companies and 14 industry experts participate, 2018.09.19.

14th: [TBIS Amendment (rev. FDTS) Discussion] Total 16 companies and 17 industry experts participate, 2019.04.25

15th: [TBIS Amendment (rev. FDTS) Discussion] Total 14 companies and 14 industry experts participate, 2019.07.31.

16th: [TBIS Enquiry stage (rev. DTS) Discussion] Total 16 companies and 16 industry experts participate, 2020.04.24.

17th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 13 companies and 13 industry experts participate, 2020.08.20

18th: [TBIS Approval Stage (rev. DTS) Discussion] Total 9 companies and 10 industry experts participate, 2023.04.28

19th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 5 companies and 6 industry experts participate, 2023.06.30

20th: [TBIS Approval Stage (rev. DTS) Discussion] Total 9 companies and 10 industry experts participate, 2024.04.25

21th: [TBIS Approval Stage (rev. FDTS) Discussion] Total 9 companies and 10 industry experts participate, 2024.06.13

Introduction

The purpose of this TBIS is to build the world's leading bicycle industry standards and norms bicycle manufacturing process to ensure product safety and external benefits effectively (including announcing internationally, producing high-valued products, and leading the R&D of bicycle industry, etc.), highlighting the product inspected by TBIS is in compliance with a higher safety requirement. While riding the bicycle on public roads, the laws and regulations of the country will be applicable.

TBIS 4210：2025 consists of the following parts, under the general title *Cycles — Safety requirements for bicycles*:

— *Part 1: Terms and definitions*

— *Part 2: Requirements for city and trekking, young adult, mountain and racing bicycles*

— *Part 3: Common test methods*

— *Part 4: Braking test methods*

— *Part 5: Steering test methods*

— *Part 6: Frame and fork test methods*

— *Part 7: Wheels and rims test methods*

— *Part 8: Pedals and drive system test methods*

— *Part 9: Saddles and seat-post test methods*

Reference

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‐ 1:2023, *Cycles — Safety requirements for bicycles — Part 1: Terms and definitions*

ISO 4210‐ 2:2023, *Cycles* — Requirements for city and trekking, young adult, mountain and racing bicycles

ISO 4210‐ 3:2023, *Cycles — Safety requirements for bicycles — Part 3: Common test methods*

ISO 4210‐ 4:2023, *Cycles — Safety requirements for bicycles — Part 4: Braking test methods*

ISO 4210‐ 5:2023, *Cycles — Safety requirements for bicycles — Part 5: Steering test methods*

ISO 4210‐ 6:2023, *Cycles — Safety requirements for bicycles — Part 6: Frame and fork test methods*

ISO 4210‐ 7:2023, *Cycles — Safety requirements for bicycles — Part 7: Wheel and rim test methods*

ISO 4210‐ 8:2023, *Cycles — Safety requirements for bicycles — Part 8: Pedal and drive system test methods*

ISO 4210‐ 9:2023, *Cycles — Safety requirements for bicycles — Part 9: Saddle and seat- post test methods*

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

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

Modify TBIS 4210-6:2017 as follows:
Sec. 5.6.2 Fork for hub/disc brake — Static brake-torque test
Apply a rearward force of 1 000 N to the torque arm perpendicular to the fork steerer axis and in the plane of the wheel. Maintain this force for 1 min.
Annex D (normative) Composite frame and composite fork - Disc brake seat endurance test.

Modify TBIS 4210-6:2018 as follows:
Annex E (informative) Stiffness measurement of frame
Annex F (normative) Safety test of folding mechanism of frame

Modify TBIS 4210-6:2019 as follows:
Annex G (normative) Safety test of composite fork stem (fork steerer)

Modify TBIS 4210-6:2020 as follows:
Annex H (normative) Suspension frame- Rear triangle fatigue test
Annex I (normative) Frame for hub/disc brake — Brake mount fatigue test

Modify TBIS 4210-6:2025 as follows:
Sec.4.1.2.1 Stage 1 Frame— Impact test (falling mass)
The hardness of roller shall be not less than 50 HRC at impact surface.

Sec. 4.6 Rear brake mount tests

5.6.3 Fork for hub — Brake mount fatigue test

Sec. 5.6.4 Fork made of composite materials designed for disc brakes

Sec. 5.6.4.1 Forks that do not contain composite structure at the disc brake caliper mount

Sec. 5.6.4.2 Forks that contain composite structure at the disc brake caliper mount

Sec. 5.7 Fork steerer tube and stem assembly — Fatigue test

Cycles — Safety requirements for bicycles —

Part 6:
Frame and fork test methods

1 Scope

This part of TBIS 4210 specifies the frame and fork test methods for TBIS 4210-2.

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.

TBIS 4210-1, *Cycles — Safety requirements for bicycles — Part 1: Terms and definitions*

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

TBIS 4210-3, *Cycles — Safety requirements for bicycles — Part 3: Common test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in TBIS 4210-1 apply.

4 Frame test methods

4.1 Frame — Impact test (falling mass)

4.1.1 General

Manufacturers of frames are permitted to conduct the test with a dummy fork (see Annex A) fitted in place of a front fork.

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

Where a suspension fork is fitted, test the assembly with the fork extended to its unloaded free length. Where a rear suspension system is incorporated in the frame, secure the suspension in a position equivalent to that which would occur with an 80 kg rider seated on the bicycle. For young adult bicycles, secure the suspension in a position equivalent to that which would occur with a 40 kg rider seated on the bicycle; if the type of suspension system does not permit it to be locked, then replace the spring/damper unit by a solid link of the appropriate size and with end fittings similar to those of the spring/damper unit.

4.1.2 Test method

4.1.2.1 Stage 1 Frame— Impact test (falling mass)

Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 1 in the fork. The hardness of roller shall be not less than 50 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 1.

Rest a striker of mass 22,5 kg on the roller in the fork dropouts 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 1. 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 frame meets the requirement as specified in TBIS 4210-2:2025, 4.8.2, and conduct stage 2 of the test with the assembly in the same mountings.

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

NOTE See TBIS 4210-3:2025, Annex B.

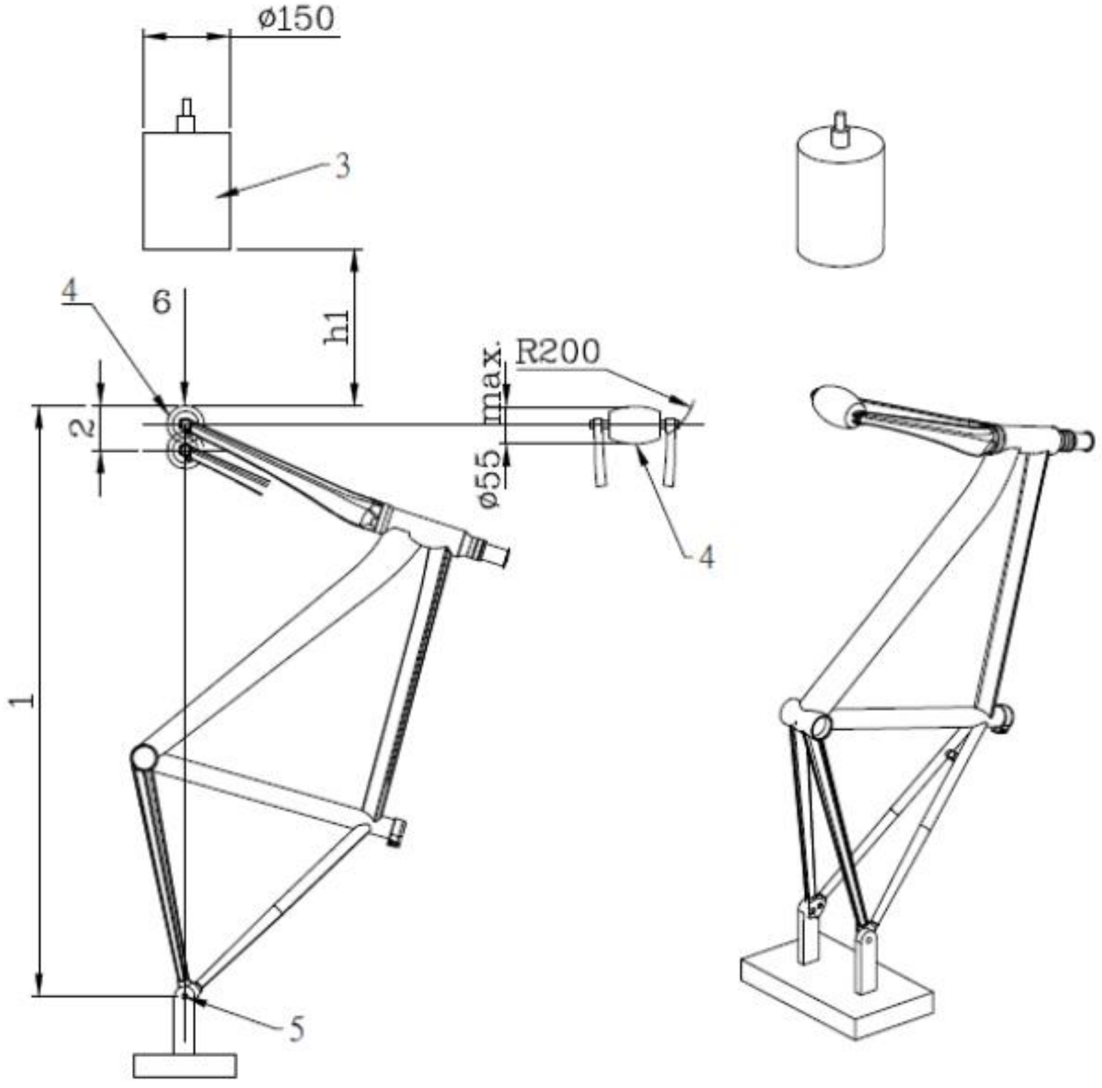
4.1.2.2 Stage 2 Static energy absorption

With the frame and front fork assembly mounted as in 4.1.2.1 apply a progressively increasing force in the same position and direction as in 4.1.2.1, until the energy is given in Table 1. The displacement rate is 15 mm/min

Table 1 — Drop heights and static energy absorption value

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Stage 1: Drop height, h_1 (mm)	180	180	360	212
Stage 2: Static energy absorption ,	47.6	47.6	92.3	56.1

Dimensions in millimetres



Key

h_1 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 1 — Frame and front fork assembly — Impact test (falling mass)

4.2 Frame and front fork assembly — Impact test (falling frame)

4.2.1 General

Manufacturers of complete bicycles shall conduct the test with the frame fitted with the appropriate front fork.

For manufacturers of frames, where the fork intended for the frame is not available, the test can be conducted with the frame fitted with a fork which meets the requirements of the fork impact test as described in TBIS 4210-2:2025, 4.9.5.

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

Where a suspension fork is fitted, it shall be at its unloaded length prior to the impact. If the spring/damper unit can be locked, it shall be locked in its unloaded length position. If the spring/damper cannot be locked, use one of the two following alternative procedures:

— secure the fork at its extended length by an external locking method, or

— replace the fork by a rigid fork which is known to meet the requirements of the impact test described in TBIS 4210-2:2025, 4.9.5 and of a length which is consistent with an 80 kg (in case of young adult bicycles, apply 40 kg) rider seated in a normal riding position on the bicycle when it is equipped with the suspension fork.

Where a rear suspension system is incorporated in the frame, secure the spring/damper unit in a position equivalent to that which would occur with an 80 kg (in case of young adult bicycles, apply 40 kg) rider seated on the bicycle; if the type of suspension system does not permit it to be locked, then replace the spring/damper unit by a solid link of the appropriate size and with end fittings similar to those of the spring/damper unit.

4.2.2 Test method

4.2.2.1 Stage 1

Conduct the test on the assembly used for the test in TBIS 4210-2:2025, 4.8.2 or, in the case of a frame manufacturer who does not make forks, with the same frame with a suitable fork fitted (see 4.2.1).

As shown in Figure 2, mount the frame-fork assembly at its rear axle attachment points so that it is free to rotate about the rear axle in a vertical plane. Support the front fork on a flat steel anvil so that the frame is in its normal position of use. Securely fix mass M_1 to the seat-post as shown in Figure 2 with the centre of gravity at distance D (= 75 mm) along the seat-post axis from the insertion point, and fix masses of M_2 and M_3 (Table 2) to the top of the steering head and the bottom bracket, respectively, as shown in Figure 2.

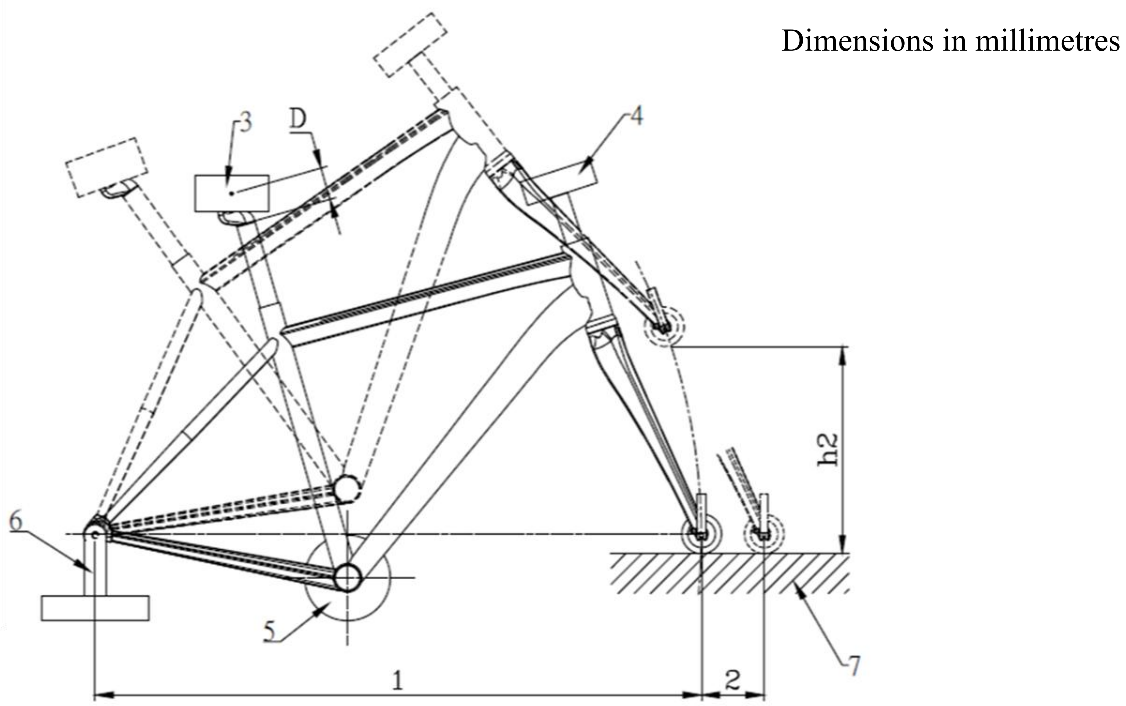
Measure the wheelbase with the three masses in place. Rotate the assembly about the rear axle until the distance between the low-mass roller and the anvil is h_2, then allow the assembly to fall freely to impact on the anvil.

Repeat the test and then measure the wheelbase again with the three masses in place and the roller resting on the anvil.

If the frame meets the requirement as specified in TBIS 4210-2:2025, 4.8.3, and conduct stage 2 of the test with the assembly in the same mountings.

Table 2 — Drop heights and distribution of masses at seat post, steering head, and bottom bracket

Bicycle type		City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Mass 1 Seat-post, M_1 kg		50	40	30	30
Mass 2 Steering head, M_2 kg		10	10	10	10
Mass 3 Bottom bracket, M_3 kg	Stage 1	30	20	50	50
	Stage 2	48	34	68	68
Drop height, h_2 mm		200	200	300	200



Key

1 wheelbase

2 permanent deformation

3 mass 1 (M_1)

4 mass 2 (M_2)

5 mass 3 (M_3)

6 rigid mounting for rear-axle attachment point

7 steel anvil

D distance to the centre of gravity (75 mm)

h_2 drop height

Figure 2 — Frame and front fork assembly — Impact test (falling frame)

4.2.2.2 Stage 2

With the frame and front fork assembly mounted as in 4.2.2.1, increase the 20% of total weight for each kind of bike at mass 3.

Measure the wheelbase with the three masses in place. Rotate the assembly about the rear axle until the distance between the low-mass roller and the anvil is h_2, then allow the assembly to fall freely to impact on the anvil.

Repeat the test and then measure the wheelbase again with the three masses in place and the roller resting on the anvil.

4.3 Frame — Fatigue test with pedalling forces

4.3.1 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.

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.

4.3.2 Test method

4.3.2.1 Stage 1

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

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

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

Mount the frame assembly on a base as shown in Figure 3 with the fork or dummy fork secured by its axle to a rigid mount of height R_W (the radius of the wheel/tyre assembly ±30 mm) and with the hub free to swivel on the axle. Secure the rear dropouts 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 3 and described in item a) or b) below.

a) If a crank/chain-wheel assembly is used, incline both cranks forwards and downwards at an angle of 45° (accurate to within ±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 3), 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 to within ±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 (R_C) shall be 75 mm and the axis of the tie rod shall be parallel to and 50 mm from the vertical plane through the centreline of the frame.

Subject each pedal spindle (or equivalent adaptor component) to a repeated downward force of F_1 at a position 150 mm from the centreline 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 3 and Figure 3. 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 120 000 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 TBIS 4210-3:2014, 4.5.
If the frame meets the requirement as specified in TBIS 4210-2:2025, 4.8.4, and conduct stage 2 of the test with the assembly in the same mountings.

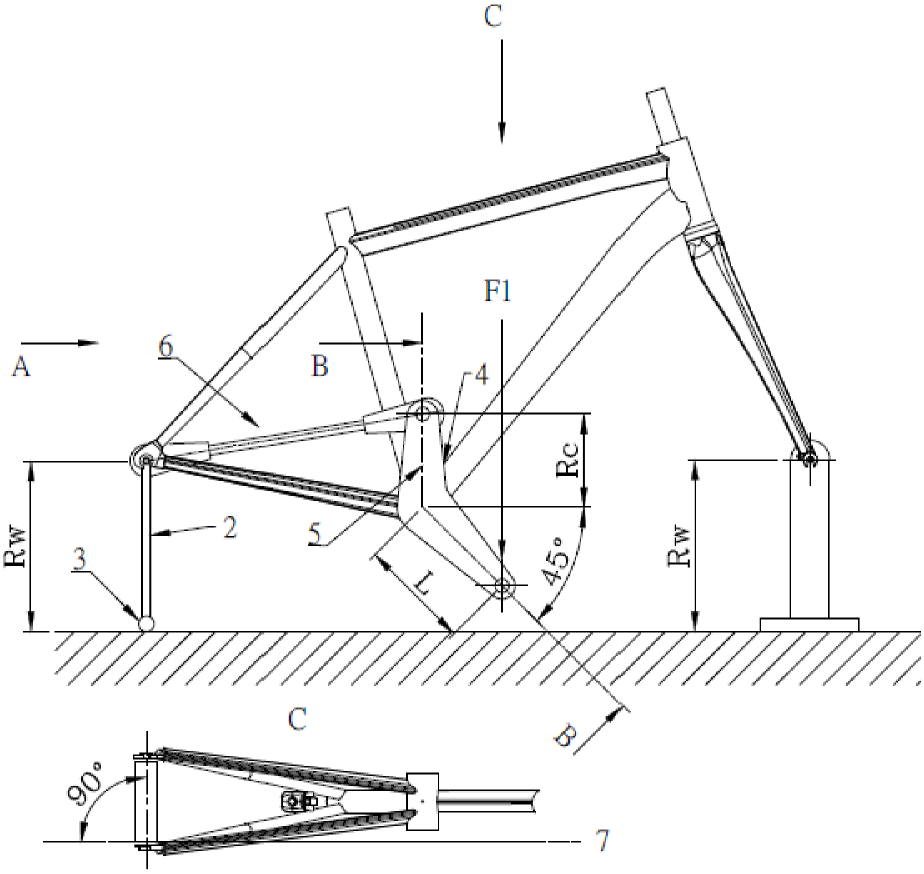
4.3.2.2 Stage 2
With the frame and front fork assembly mounted as in 4.3.2.1. Apply a repeated downward force of Stage 2 F_1 as shown in Tab. 3 for 100 000 test cycles, where one test cycle consists of the application and removal of the two test forces. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

Table 3 — Forces on pedal spindle

Forces in newtons

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Stage 1 F_1	1 000	1 000	1 200	1 100
Stage 2 F_1	1100	1100	1300	1200

Dimensions in millimetres



Key

R_W height of rigid mount and vertical link

R_c length of vertical arm (75 mm)

L length of crank replacement (175 mm)

1 rigid mount

2 vertical link

3 ball joint

4 adaptor assembly

5 vertical arm

6 tie rod

7 centreline of tie rod

Figure 3 — Frame — Fatigue test with pedalling forces

4.4 Frame — Fatigue test with horizontal forces

4.4.1 General

Where a frame is convertible for male and female riders by the removal of a bar, remove the bar.

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 (see Annex A) and it is correctly installed in the steering-head bearings. For a suspension fork, lock it at a length equivalent to that with an 80 kg (in case of young adult bicycles, apply 40 kg) rider seated on the bicycle either by adjusting the spring/damper or by external means.

In tests on suspension frames with pivoted joints, lock the moving part of the frame into a position as would occur with an 80 kg rider seated on the bicycle. This can be achieved by locking the suspension unit in an appropriate position or, if the type of suspension system does not permit it to be locked, then the suspension system can be replaced by a solid link of the appropriate compressed size. Ensure that the axes of the front and rear axles are horizontally in line, as shown in Figure 4. 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.

4.4.2 Test method

4.4.2.1 Stage 1

Mount the frame in its normal attitude and secured at the rear dropouts so that it is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure 4. Ensure that the axis of the front and rear axles are horizontally in line.

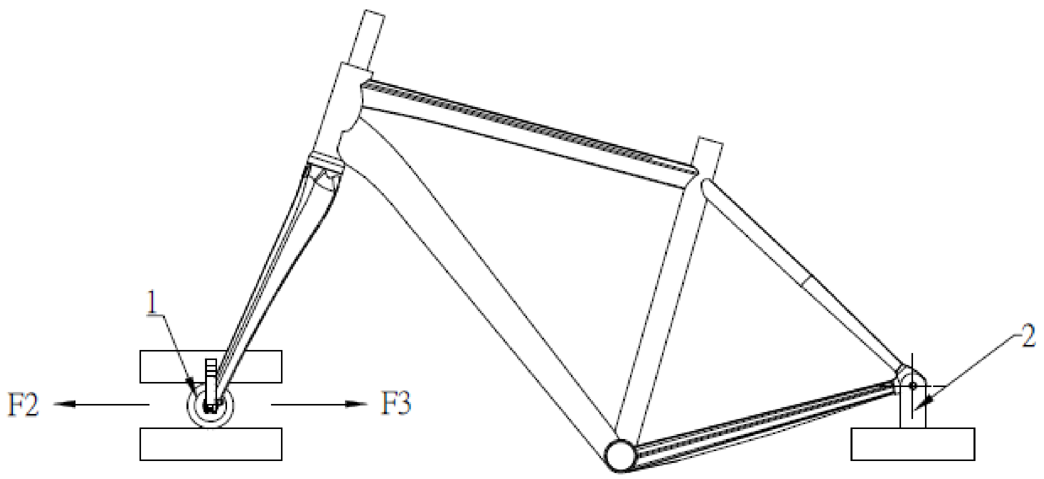
Apply cycles of dynamic, horizontal forces of Stage 1 F_2 in a forward direction and Stage 1 F_3 in a rearward direction to the front fork dropouts for Stage 1 C_1 cycles as shown in Table 4 and Figure 4, with the front fork constrained in vertical direction but free to move in a fore/aft direction under the applied forces. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5. If the frame meets the requirement as specified in TBIS 4210-2:2025, 4.8.5, and conduct stage 2 of the test with the assembly in the same mountings.

4.4.2.2 Stage 2

With the frame and front fork assembly mounted as in 4.4.2.1, Apply cycles of dynamic, horizontal forces of Stage 2 F_2 in a forward direction and Stage 2 F_3 in a rearward direction to the front fork dropouts for Stage 2 C_1 cycles as shown in Table 4 and Figure 4, 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 TBIS 4210-3:2025, 4.5.

Table 4 — Forces and cycles on front fork dropouts

Bicycle type		City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Forward force, F_2 N	Stage 1	450	450	1200	600
	Stage 2	500	500	1250	650
Rearward force, F_3 N	Stage 1	450	450	600	600
	Stage 2	500	500	650	650
Test cycles, C_1	Stage 1	120000	120000	60000	120000
	Stage 2	100000	100000	50000	100000



Key

1 free-running guided roller

2 rigid, pivoted mounting for rear-axle attachment point

Figure 4 — Frame — Fatigue test with horizontal forces

4.5 Frame — Fatigue test with a vertical force

4.5.1 General

Where a frame is convertible for male and female riders by the removal of a bar, remove the bar.

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. Secure the rear suspension as described in 4.3.1.

If a suspension fork is fitted lock it at a length equivalent to that with an 80 kg (in case of young adult bicycles, apply 40 kg) rider seated on the bicycle either by adjusting the spring/damper or by external means.

4.5.2 Test method

4.5.2.1 Stage 1

Mount the frame in its normal attitude and secured at the rear dropouts so that is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure 5. 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 5) to the top of this bar such that its length (dimension h_3 in Figure 5) 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 h_3 shall be 250 mm.

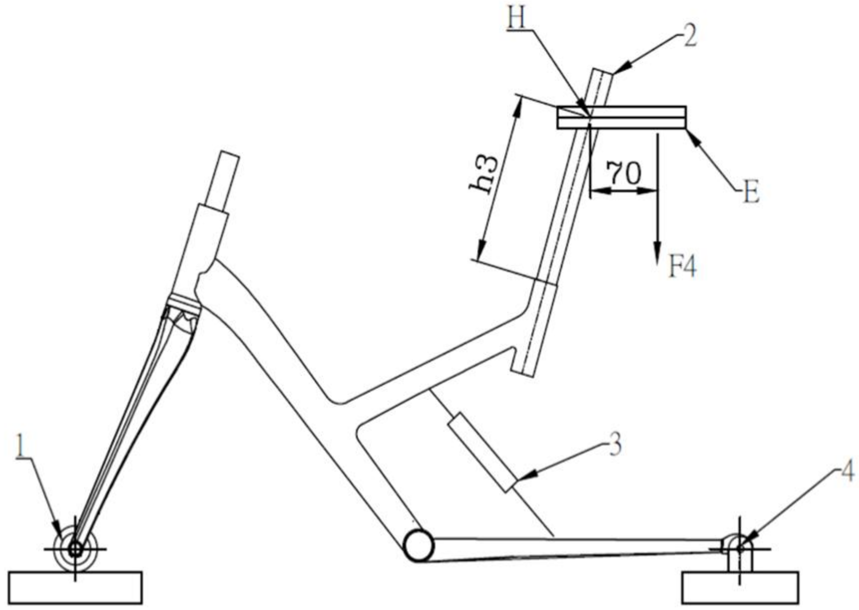
Apply cycles of dynamic, vertically-downward forces of stage 1 F_4 at a point 70 mm behind the intersection of the axes of the solid steel bar and the extension piece, E, as shown in Figure 5 for 60 000 test cycles. The forces are given in Table 5. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.
If the frame meets the requirement as specified in TBIS 4210-2:2025, 4.8.6, and conduct stage 2 of the test with the assembly in the same mountings.

4.5.2.2 Stage 2
With the frame and front fork assembly mounted as in 4.5.2.1. Apply cycles of dynamic, vertically-downward forces of stage 2 F_4 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 5 for 50 000 test cycles. The forces are given in Table 5. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

Table 5 — Forces on seat stem

Forces in newtons

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Stage 1 F_4	1 000	500	1 200	1 200
Stage 2 F_4	1100	600	1300	1300



Key

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 locked suspension unit or solid link for pivoted chain stays

4 rigid, pivoted mounting for rear axle attachment point

Figure 5 — Frame — Fatigue test with a vertical force

4.6 Rear brake mount tests

4.6.1 General

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

4.6.2 Static rear brake torque test

Mount the frame in its normal attitude in a fixture and secured either at the rear wheel axis or at the bottom bracket so that is not restrained in a rotary sense as shown in Figure 6 a) or Figure 6 b). 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. A dummy fork can be fitted in place of the front fork.

Install a stiff, vertical link with an arm length R_w according to the maximum outer radius of the tyre intended for use with the frame or, if this value is not specified by the manufacturer, according to the maximum wheel diameter as given in Table 7. Further install a rigidly mounted brake disc or representative fixture of appropriate diameter at the rear dropouts by means of an axle being free to swivel about the axis of the axle but providing rigidity in a lateral plane.

4.6.3 Rear brake mount fatigue test

Mount the frame in its normal attitude in a fixture in the same manner as for the static rear brake torque test as shown in Figure 6 a) or Figure 6 b).

a) Stage 1

Apply cycles of dynamic, horizontal forces of F5 in a rearward direction and F6 in a forward direction to the link arm for 2 000 test cycles as shown in Table 6 and Figure 6.

NOTE 100 °C is based on the assumption that the temperature of the brake mount rises due to the heat generated during disc brake braking, and does not specify an upper temperature limit for the heat generated by the disc brake. Composite materials change their state when they exceed the glass transition temperature and are therefore tested by heating.

b) Stage 2

After stage 1 test, the heating device shall be turned off and apply repeated apply cycles of dynamic, horizontal forces of F5 in a rearward direction and F6 in a forward direction to the link arm for 20 000 test cycles as shown in Table 6 and Figure 6.

Table 6 — Forces at rear disc brake

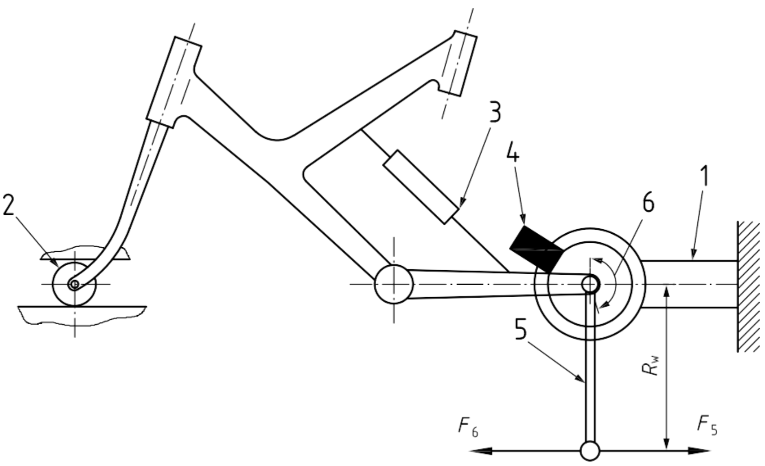
Forces in newtons

Bicycle type	City and trekking bicycle	Young adult bicycle	Mountain bicycle	Racing bicycle
Rearward force, F_5	500	300	500	400
Forward force, F_6	50	50	200	50
Test temperature, Stage 1	100 °C	100 °C	100 °C	100 °C
Test temperature, Stage 2	Ambient temperature	Ambient temperature	Ambient temperature	Ambient temperature

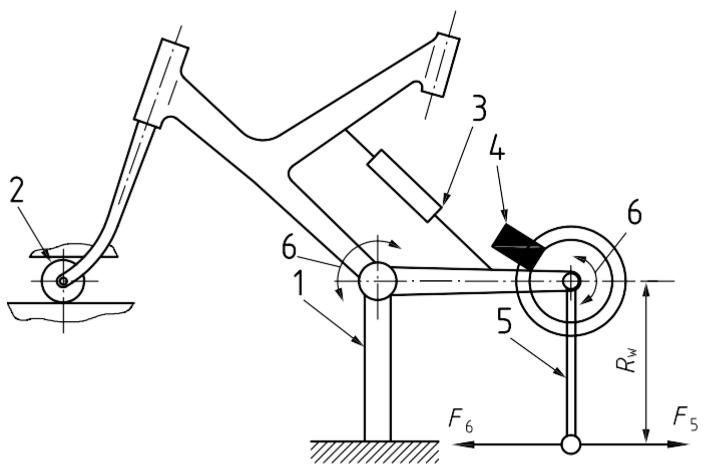
Table 7 — Fixture length

Dimensions in millimetres`

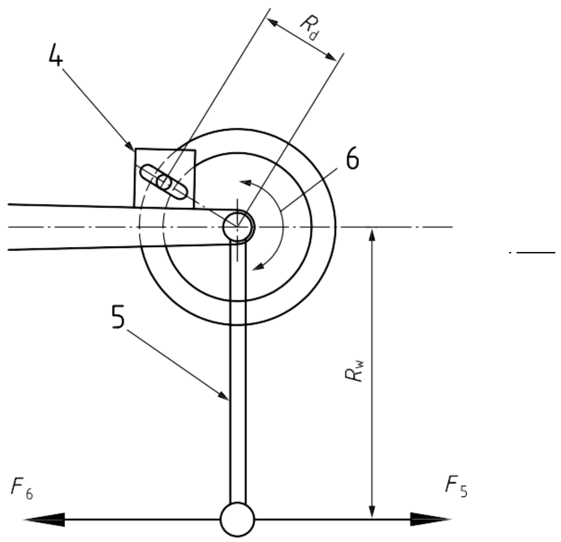
Wheel diameter	20"	24”	26”	650b	29” or 700 c
Arm length, Rw	254	305	330	349	368



a) Fixing the frame to the rear wheel axis



b) Fixing the frame to the bottom bracket



c) Applying of the test force via the link arm

Key

1 rigid, pivoted mounting

2 free-running guided roller or similar movable bearing

3 locked suspension unit or solid link for pivoted chain stays

4 locking device on brake mount/calliper dummy

5 test adapter for force attachment, free to rotate around the axis of rotation of the rear wheel

6 rotational degree of freedom

F_5 dynamic, horizontal force in a rearward direction

F_6 dynamic, horizontal force in a forward direction

R_W wheel radius according to the maximum outer radius of the tyre or according to Table 7

R_d disc brake mean radius

Figure 6 — Frames for disc-brakes — Rear brake mount fatigue test

5 Fork test methods

5.1 Suspension forks — Tyre-clearance test

For the tyre-clearance test, a suspension fork shall first be checked and adjusted if necessary according to the items listed in the following:

a) inflate the tyre to the maximum inflation pressure;

b) place the fork in uncompressed condition to have the highest displacement between suspension stanchion legs and suspension lower legs;

c) if the suspension fork can be locked, place the fork in the open position;

d) if the fork has a spring adjust device, place it in the softest position;

e) if the fork has a pneumatic device, inflate the one or the two chambers at their minimum pressures according the manufacturer's instruction;

f) if the fork has a rebound device, place it on the slowest position.

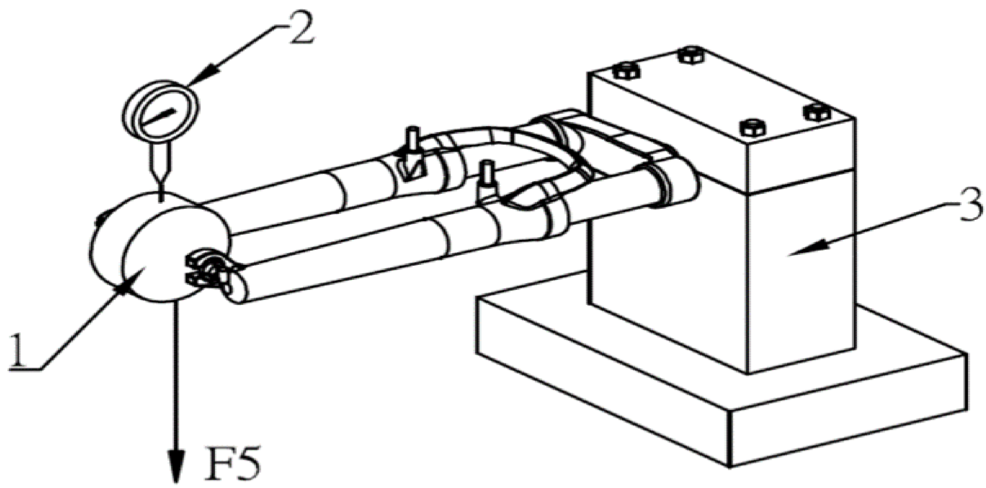
With a wheel and tyre assembly fitted to the fork, apply a force of 2 800 N to the wheel in a direction towards the fork-crown and parallel to the axis of the fork steerer. Maintain this force for 1 min.

5.2 Suspension forks — Tensile test

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

5.3 Front fork — Static bending test

Mount the fork according to Annex B and fit a loading attachment and swivel on an axle located in the axle slots of the blades (see Figure 7). Locate a deflection measuring device over the loading attachment in order to measure deflection and permanent deformation of the fork perpendicular to the steerer axis and in the plane of the wheel.



Key

1 loading attachment swivel on axle

2 deflection measuring device

3 rigid mount incorporating head bearings

Figure 7 — Front fork — Static bending test (typical arrangement)

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

Increase the static force to F_5 and maintain this force for 1 min, then reduce the force to 100 N and record any permanent deformation. The forces are given in Table 8.

Table 8 — Forces on loading attachment

Forces in newtons

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Force, F_5	1 000	1 000	1 500	1 200

5.4 Front fork — Rearward impact test

5.4.1 Test method 1

5.4.1.1 Stage 1 Rearward impact test

Mount the fork according to Annex B as shown in Figure 8. Assemble a roller of mass less than or equal to 1 kg and with dimensions conforming to those shown in Figure 9 in the fork. The hardness of the roller shall be not less than 60 HRC at impact surface.

Rest a striker of mass 22,5 kg ± 0,1 kg on the roller in the fork dropouts such that it is exerting a force against the direction of travel and in the plane of the wheel. Position a deflection measuring device under the roller and record the position of the roller in a direction perpendicular to the axis of the fork steerer and in the plane of the wheel and note the vertical position of the fork.

Remove the deflection measuring device, raise the striker through a height of h_4, and release it to strike the roller against the rake of the fork. The drop heights are given in Table 9. The striker will bounce and this is normal. When the striker has come to rest on the roller, measure the permanent deformation under the roller.
If the fork meets the requirement as specified in TBIS 4210-2:2025, 4.9.2, and conduct stage 2 of the test with the assembly in the same mountings.

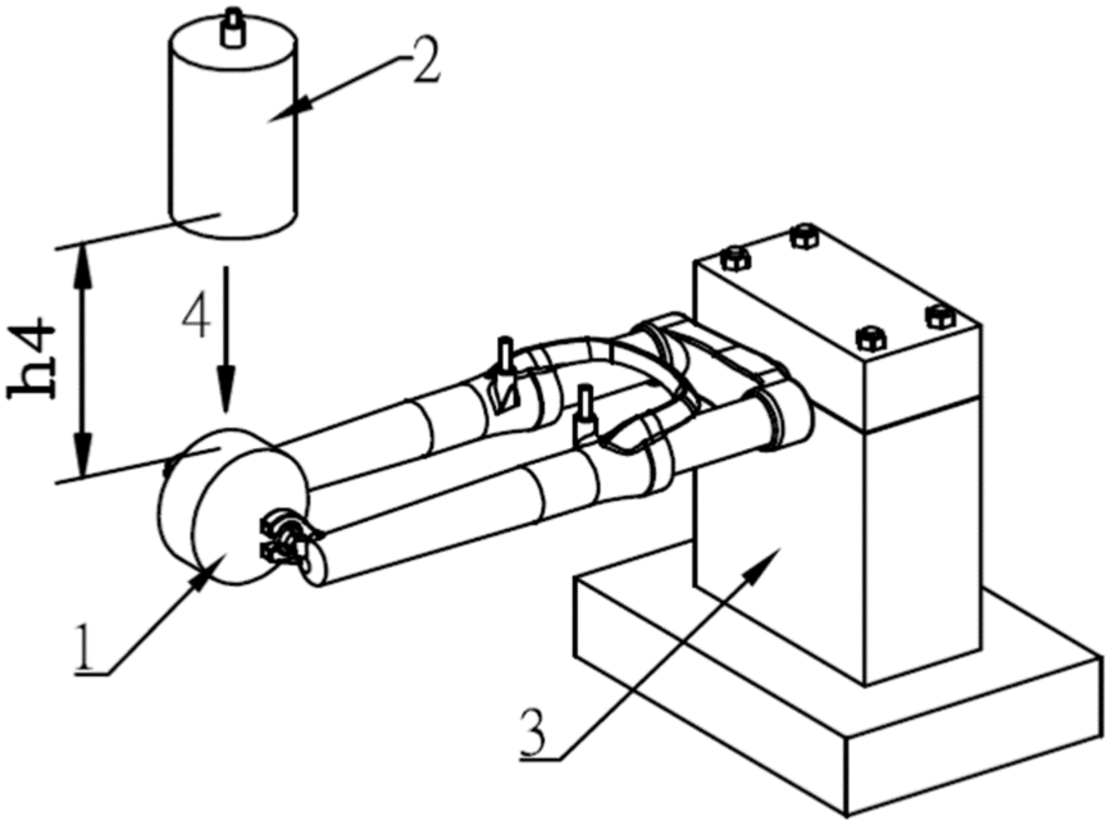
NOTE See TBIS 4210-3:2025, Annex B.

5.4.1.2 Stage 2 Static energy absorption
Mount the fork according as in 5.4.1.1, apply a progressively increasing force in the same position and direction as in 5.4.1.1, until the energy is 1.2 time as 5.4.1.1(Table 9). The displacement rate is 15 mm/min

Table 9 — Drop heights

Dimensions in millimetres

<table>
<tr><th colspan="2">Bicycle type</th><th>City and trekking bicycles</th><th>Young adult bicycles</th><th>Mountain bicycles</th><th>Racing bicycles</th></tr>
<tr><td rowspan="2">Stage 1 Drop height, h_4</td><td>Forks made entirely of metal</td><td>180</td><td>180</td><td>360</td><td>360</td></tr>
<tr><td>Forks which have composite parts</td><td>320</td><td>320</td><td>600</td><td>640</td></tr>
<tr><td rowspan="2">Stage 2 Static energy absorption,</td><td>Forks made entirely of metal</td><td>47.6</td><td>47.6</td><td>95.3</td><td>95.3</td></tr>
<tr><td>Forks which have composite</td><td>84.7</td><td>84.7</td><td>158.8</td><td>169.3</td></tr>
</table>



Key

h_4 drop height

1 low-mass roller (1 kg max.)

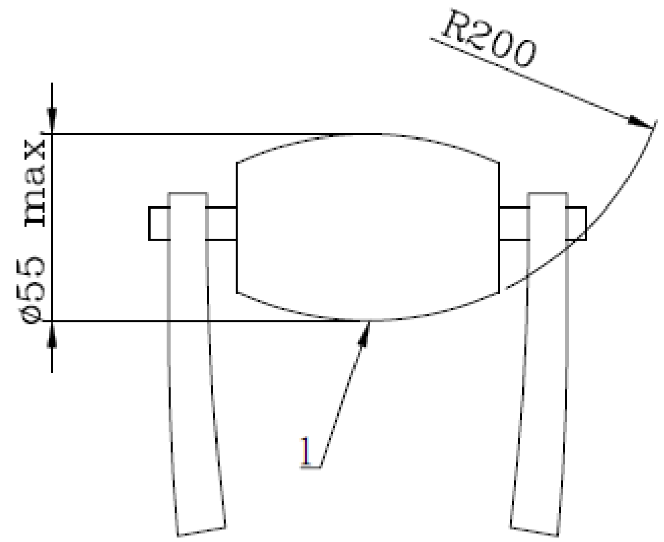
2 22,5 kg striker

3 rigid mount incorporating head bearings

4 direction of rearward impact

Figure 8 — Front fork — Rearward impact test

Dimensions in millimetres



Key

1 low-mass roller (1 kg max.)

Figure 9— Low-mass roller

5.4.2 Test method 2

This test is similar to that described in 5.4.1 except the dropping height.

As shown in Figure 7, mount the fork used for the test in 5.4.1 and assemble a low-mass roller in the fork. Raise the striker to a height of 600 mm above the roller and release it to strike the roller against the rake of the fork. The section applies to forks in TBIS 4210-2:2025, 4.9.5.1.

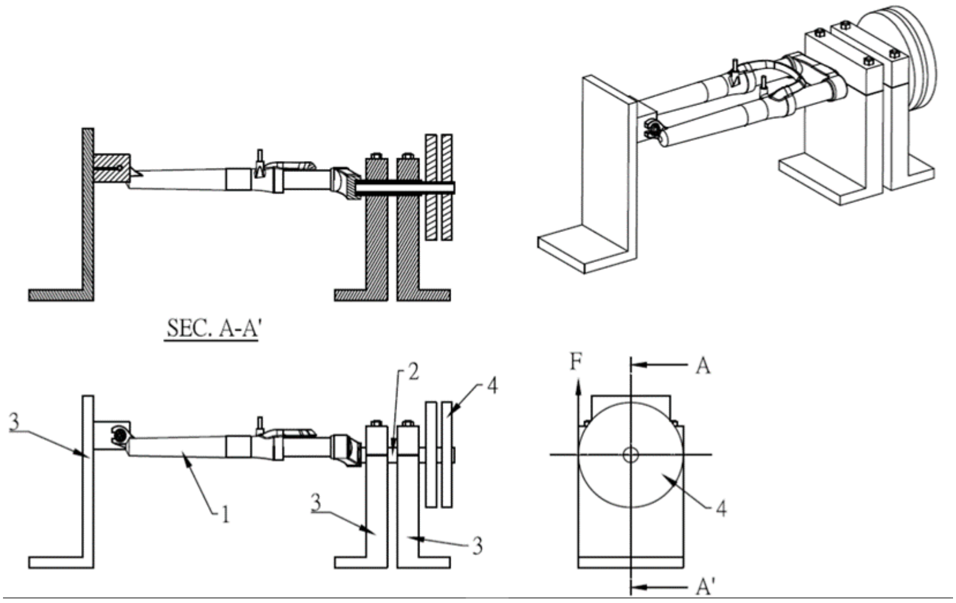
5.4.3 Test method 3

Apply a torque of *T* to the assembly and maintain for 1 min in each direction of possible rotation about the steerer axis. The torque is given in Table 10, and a typical example of test equipment is illustrated in Figure 10.

Table 10 — Torque on fork

Torques in newton metres

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Torque, *T*	50	50	80	80



Key

1 front fork

2 fork mounting fixture (fixture representative of the head tube)

3 rigid mount

4 test adaptor

Figure 10 — Fork steerer torsional test (a typical example)

5.5 Front fork — Bending fatigue test and rearward impact test

Mount the fork according to Annex B as shown in Figure 11.

5.5.1 Stage 1- Bending fatigue test

Apply cycles of fully reversed, dynamic forces of Stage 1 F_6 in the plane of the wheel and perpendicular to the fork steerer tube to a loading attachment and swivel on an axle located in the axle-slots of the blades for 120 000 test cycles. The forces are given in Table 11. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

Conclude the test if the running displacement (peak-to-peak value) at the point where the test forces are applied increases by more than 20 % for rigid forks or more than 40 % for suspension forks from the initial values (see TBIS 4210-3:2025, 4.6).

Stop the test after 120 000 cycles and inspect the sample carefully for fractures. If fractures are found, conclude the test.
If the fork meets the requirement as specified in TBIS 4210-2:2025, 4.9.6, and conduct stage 2 of bending fatigue test with the assembly in the same mountings.

5.5.2 Stage 2- Bending fatigue test

Apply cycles of fully reversed, dynamic forces of Stage 2 F_6 in the plane of the wheel and perpendicular to the fork steerer tube to a loading attachment and swivel on an axle located in the axle-slots of the blades for 100 000 test cycles. The forces are given in Table 11. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5

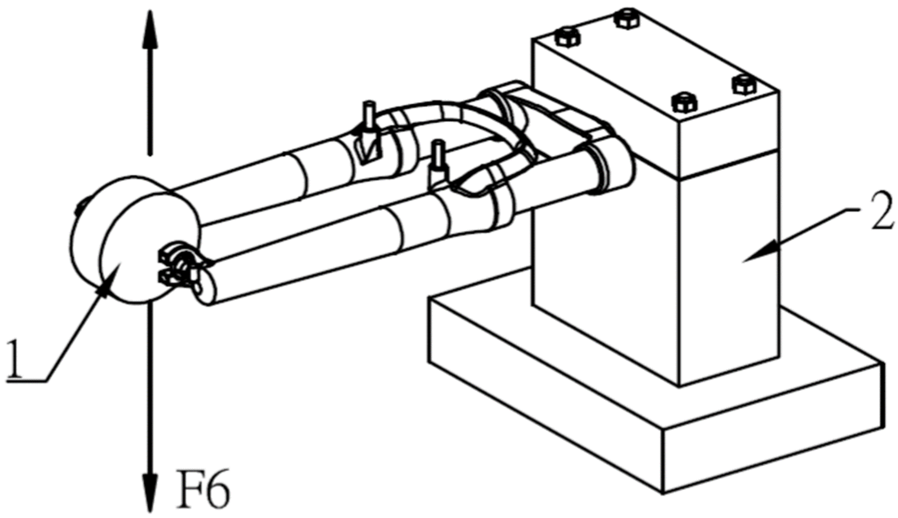
Stop the test after 100 000 cycles and inspect the sample carefully for fractures. If fractures are found, ,conclude the test.

If the sample completes both stage 1 and stage 2 bending fatigue test without exceeding the displacement limits noted above, and if no fractures can be observed, perform the impact resistance test described in 5.4.1 (the drop heights are given in Table 9). When the striker has come to rest on the roller, measure the permanent deformation under the roller and inspect the sample carefully for fractures.

Table 11 — Forces on loading attachment

Forces in newtons

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Stage 1 Force, F_6	±450	±450	±650	±620
Stage 2 Force, F_6	±500	±500	±700	±670



Key

1 pivoted force attachment

2 rigid mount incorporating head bearings

Figure 11 — Front fork — Bending fatigue test

5.6 Forks intended for use with hub or disc brakes

5.6.1 General

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

In tests conducted by the methods described in 5.6.2 and 5.6.3 and where more than one mounting point is provided for a hub or disc brake, the following shall apply:

a) where a complete bicycle is supplied, the test adaptor shall be secured to the mounting point used on the bicycle. If bracket will be supplied, it shall be used to perform the test;

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

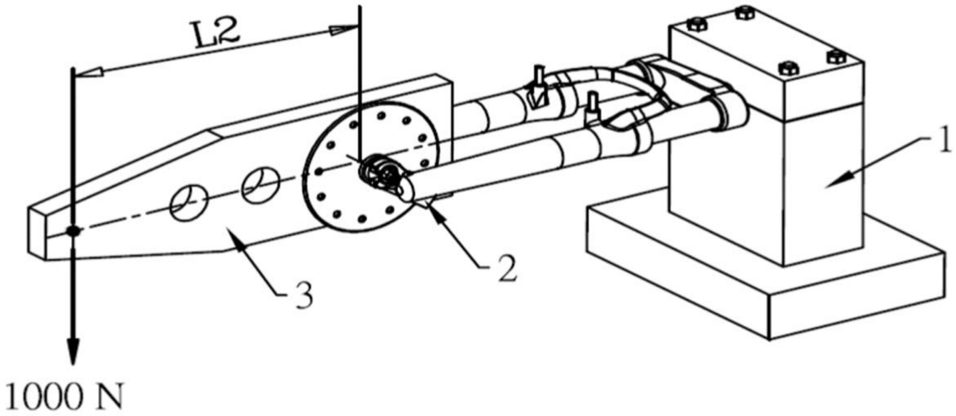
5.6.2 Fork for hub/disc brake — Static brake-torque test

Mount the fork in a fixture representative of the head tube according to Annex B and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 12 to provide a torque arm of L_2 in length (see Table 12) and a suitable attachment for the brake mounting point. If the wheel size is not listed in Table 12, the length L_2 shall be equal to one-half of the wheel diameter.

Apply a rearward force of 1 000 N to the torque arm perpendicular to the fork steerer axis and in the plane of the wheel. Maintain this force for 1 min.

Table 12 — Fixture length

Wheel diameter	**16″**	**18″**	**20″**	**22″**	**24″**	**26″**	**650 b**	**29″ 或 700 c**
Arm length, *L*2 mm	202	228	253	279	305	330	349	368



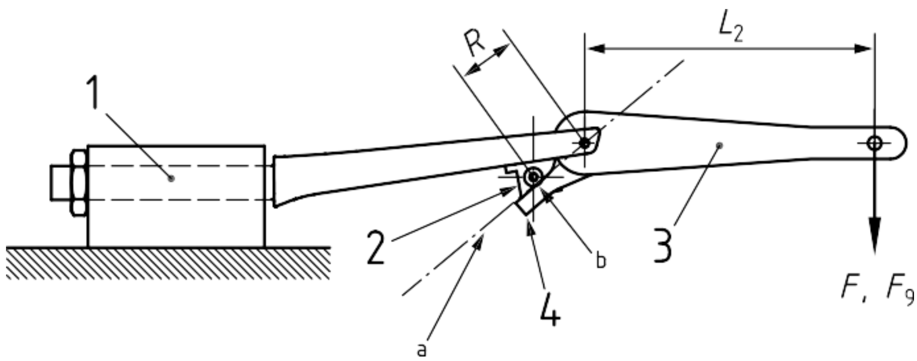
Key

1 rigid mount incorporating head bearings

2 brake mounting point

3 test adaptor

Figure 12 — Fork for hub/disc brake — Static brake-torque test



Key

1 rigid mount incorporating head bearing

2 dummy brake calliper

3 load arm (length depends on wheel size, see Table 12)

4 tang

F rearward force, 1 000 N

F_9 repeated, dynamic forces (see 5.6.4)

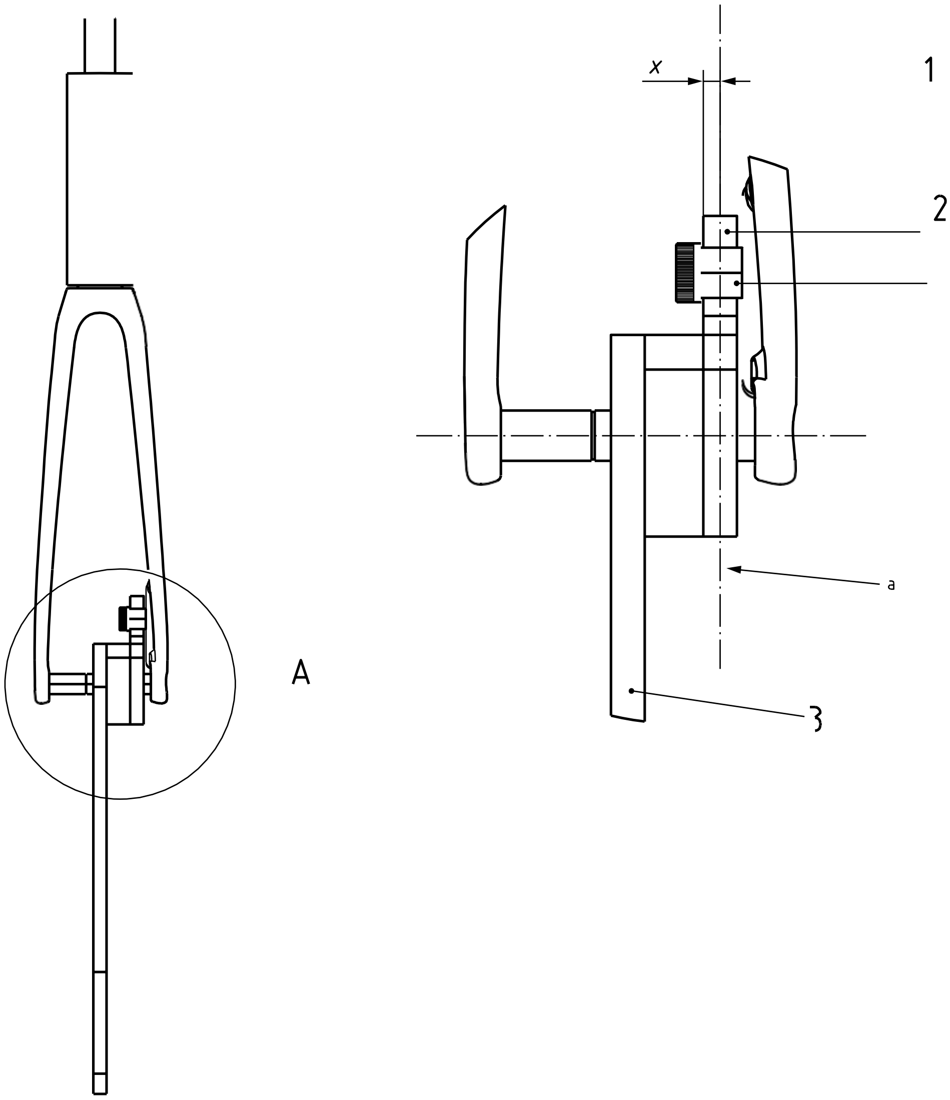
L_2 arm length

R disk brake radius measured at the centre of the brake pad contact

a Tang is radial from hub centreline.

b Point of contact between shoulder bolt and tang corresponding to the centre of the brake pads.

Figure 13 — Fork for disc-brake — Static brake-torque test and brake mount fatigue test — Side view



Key
1 tang
2 shoulder bolt
3 load arm (length depends on wheel size, see Table 12)
x half tang thickness
a Centre line of rotor based on manufacturer hub width.

Figure 14 — Fork for disc brake — Static brake-torque test and brake mount fatigue test — Front view

5.6.3 Fork for hub — Brake mount fatigue test

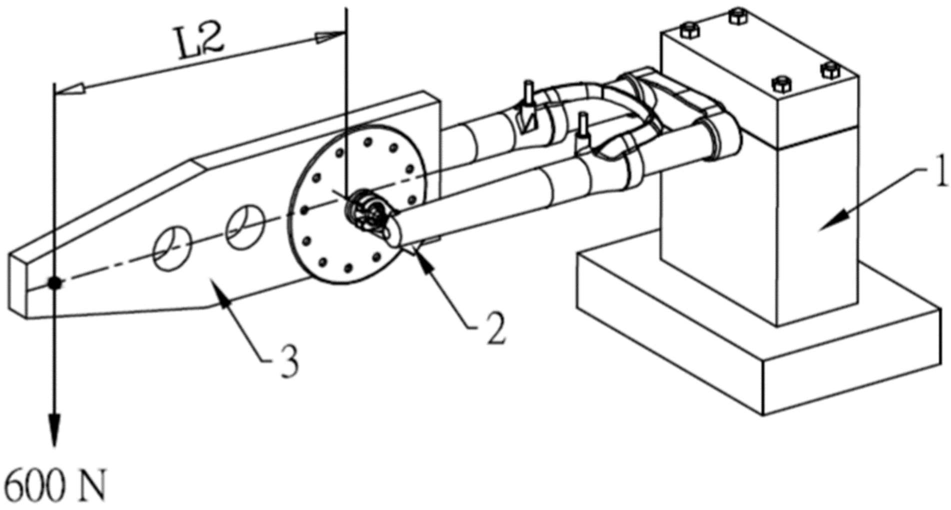
Mount the fork in a fixture representative of the head tube according to Annex B and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 12 to provide a torque arm of L_2 in length (see Table 12) and a suitable attachment for the brake mounting point.

5.6.3.1 Stage 1
Apply repeated, dynamic forces of Stage 1 Force rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 12) for Stage 1 C_2 cycles (see Table 11). The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.
If the fork meets the requirement as specified in TBIS 4210-2:2025, 4.9.7.2, and conduct stage 2 of bending fatigue test with the assembly in the same mountings.

5.6.3.2 Stage 2
Apply repeated, dynamic forces of Stage 2 Force rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 12) for Stage 2 C_2 cycles (see Table 11). The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

Table 13 — Test condition

Bicycle type		City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Force	Stage 1	600	600	600	600
	Stage 2	700	700	700	700
Test cycles, C_2	Stage 1	14400	14400	14400	24000
	Stage 2	12000	12000	12000	20000



Key

1 rigid mount incorporating head bearings

2 brake mounting point

3 test adaptor

Figure 15— Fork for hub/disc-brake — Brake mount fatigue test

5.6.4 Fork made of composite materials designed for disc brakes

5.6.4.1 Forks that do not contain composite structure at the disc brake caliper mount

Mount the fork in a fixture representative of the head tube according to Annex B and gripped in the normal head-bearings, fit an axle to the fork, and mount on the axle a pivoted, straight adaptor as shown in Figure 12 to provide a torque arm of L2 in length (see Table 12) and a suitable attachment for the brake mounting point.

5.6.4.1.1 Stage 1
Apply repeated, dynamic forces of Stage 1 Force rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 12) for Stage 1 C_2 cycles (see Table 11). The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.
If the fork meets the requirement as specified in TBIS 4210-2:2025, 4.9.7.2, and conduct stage 2 of bending fatigue test with the assembly in the same mountings.

5.6.4.1.2 Stage 2
Apply repeated, dynamic forces of Stage 2 Force rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 12) for Stage 2 C_2 cycles (see Table 11). The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

5.6.4.2 Forks that contain composite structure at the disc brake caliper mount

Mount the front fork on the test machine with the same settings as in 5.6.2, Figure 13.

The brake mounting point shall also act as a heat sink capable of applying a constant temperature (Table 14), for phase one of the test (see Table 14). The tolerance for the temperature shall be ±5 °C.

The temperature shall be measured in the middle between the brake mounting points. Washers shall not be used for the thermal sensor at the brake mounting points.

The test is conducted in two stages. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2025, 4.5.

a) Stage 1

Apply repeated, dynamic forces F_9 of 600 N rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 13) for the specified cycles and temperature of stage 1 (see Table 14).

NOTE 100 °C is based on the assumption that the temperature of the brake mount rises due to the heat generated during disc brake braking, and does not specify an upper temperature limit for the heat generated by the disc brake. Composite materials change their state when they exceed the glass transition temperature and are therefore tested by heating.

b) Stage 2

After stage 1 test, the heating device shall be turned off and apply repeated, dynamic forces F_9 of 600 N rearward to the end of the torque arm, perpendicular to the fork steerer axis and in the plane of the wheel (as shown in Figure 13) for the specified cycles and temperature of stage 2 (see Table 14).

Table 14 — Test cycles and test temperature

Bicycle type	City and trekking bicycle	Young adult bicycle	Mountain bicycle	Racing bicycle
Test cycles, Stage 1	1 000	1 000	1 000	1 000
Test cycles, Stage 2	11 000	11 000	11 000	19 000
Test temperature, Stage 1	100 °C	100 °C	100 °C	100 °C
Test temperature, Stage 2	Ambient temperature	Ambient temperature	Ambient temperature	Ambient temperature

5.7 Fork steerer tube and stem assembly — Fatigue test

5.7.1 General

A bicycle fork shall be subjected to in-phase fatigue loading via a stem or a handlebar stem assembly attached at the steerer tube in the direction parallel to the fork steerer tube. The test shall be conducted as far possible using the fork steerer tube and stem assembly as specified by the manufacturer, including the specified stem, expander nut, and headset assembly (top-cap, spacers, bearings etc.).

5.7.2 Test method

For forks intended for use with drop handlebars, the loading conditions shall be the same as TBIS 4210-5：2025, 4.9.2.2 Test method for stage 2.

Mount the fork in a fixture representative of the head tube in accordance with Annex B, and gripped in the normal head-bearings. The fork dropouts shall not be constrained.

If headset spacers are specified by the manufacturer, these shall be fitted for this test. Otherwise, spacers shall be fitted to the maximum height permitted by the manufacturer. If this is not known, no spacers shall be used and the stem shall contact the top cap of the headset.

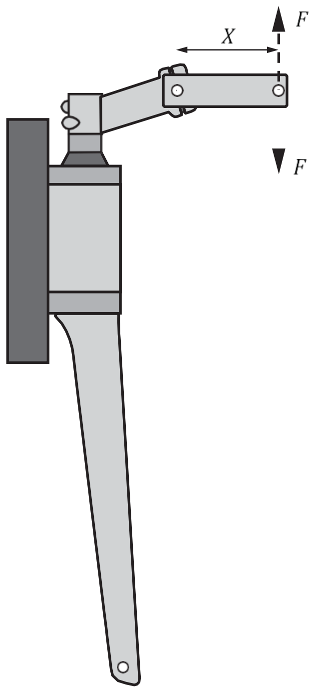
The stem fasteners shall be torqued to the manufacturer's recommended maximum specification.

The maximum length of stem specified by the manufacturer shall be used for this test.

If a handlebar and stem assembly is used for testing, a force of 400 N shall be applied fully reversed to each end of the ball joint attachment. The maximum test frequency shall be maintained as specified in TBIS 4210-3:2023, 4.5.

In the case where the specified stem is known but not the handlebar, a dummy load arm shall be used and adjusted for length based on the manufacturer's specification. If the manufacturer's specification is not known, a value of 110 mm ± 5 mm shall be used for dimension *X* in Figure 16. A force of 800 N shall be applied fully reversed to the dummy clamp (see Figure 16).

Stop the test after 20 000 cycles remove the stem assembly and inspect the fork assembly for cracks or fractures.



Key

X dummy load arm length
F forces, 800 N

Figure 16 — Fork steerer tube and stem assembly — Fatigue test

5.8 Tensile test for a non-welded fork

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

Annex A
(normative)

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 B.1 in Annex B).

a) The deflection ratio, D_r, 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:

$$D_r = \frac{K_1 \times 10\,000 \times \delta}{L^3} \tag{A.1}$$

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 D_r

$$= \frac{1\,417 \times 10\,000 \times 6{,}85}{460^3}$$

$$= 0{,}99721 \leq 1{,}0$$

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:

$$D_r = \frac{K_2 \times 10000 \times \delta}{L^3} \qquad \text{(A.2)}$$

where

D_r is the deflection ratio;

K_2 is 709, a constant;

L is the fork length, expressed in millimetres;

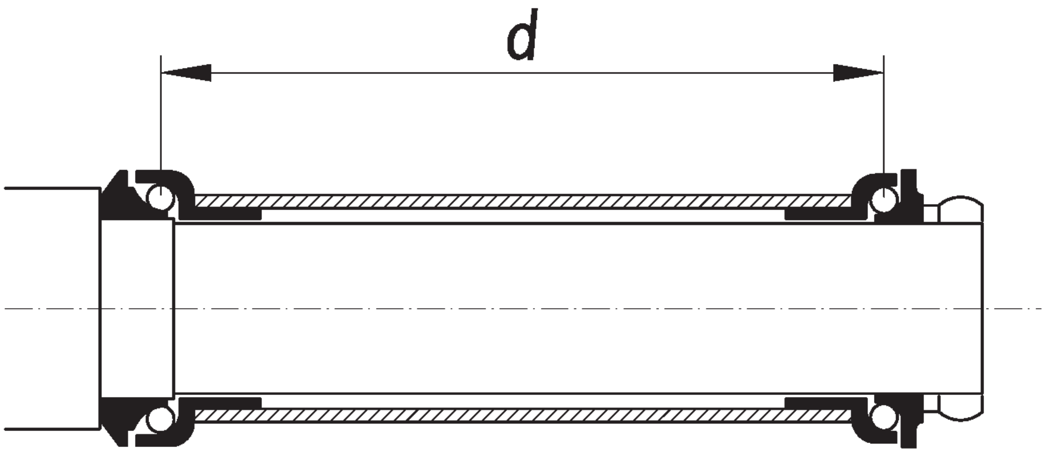
δ is the deflection, expressed in millimetres.

Annex B
(normative)

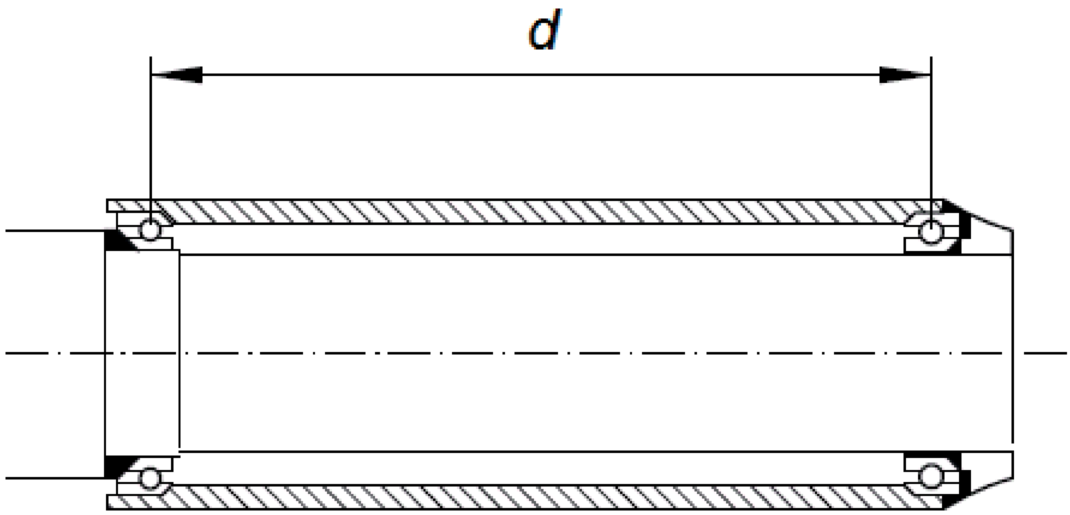
Fork mounting fixture

The fork shall be mounted in a fixture representative of the head tube and gripped in the normal head-bearings. The distance between the bearings can have an influence on the results. Therefore, when known the real mounting distance shall be used with a tolerance of ±5 mm. If no indication about the distance is given, a value of (150 ± 5) mm shall be taken. The measurement points are taken from the middle of the bearings. Examples of distance measurements are given in Figure B.1.

During loading, the fork steerer will bend and can touch the dummy head tube. The design of the dummy tube shall be such that this contact shall not occur.



a) Measurement with external cup bearings



b) Measurement with integrated bearings

Key

d distance between the bearings

Figure B.1 — Examples of distance measurements

Annex C
(informative)

Suspension frames — Tyre-clearance test

C.1 Suspension frames — Tyre-clearance test

C.1.1 Requirements

When tested by the method described in C.1.2, the tyre or any components other than fixing mechanism shall not contact the frame nor shall the components separate.

C.1.2 Test method

For the tyre-clearance test, a suspension frame and wheel shall first be checked and adjusted according to the items listed in the following:

a) inflate the tyre to the maximum inflation pressure;

b) if the frame's suspension element can be locked, place it in the open position;

c) if the frame's suspension element is a pneumatic shock, pressurize the chamber to the minimum pressure according to the manufacturer's instruction.

Secure the frame in an orientation that allows a force to be applied to the wheel from a simulated ground plane. With a wheel and tyre assembly fitted to the frame, apply a force of 2 800 N to the wheel in a direction perpendicular to the simulated ground plane such that the suspension is compressed (see Figure C.1). Maintain the force for 1 min.

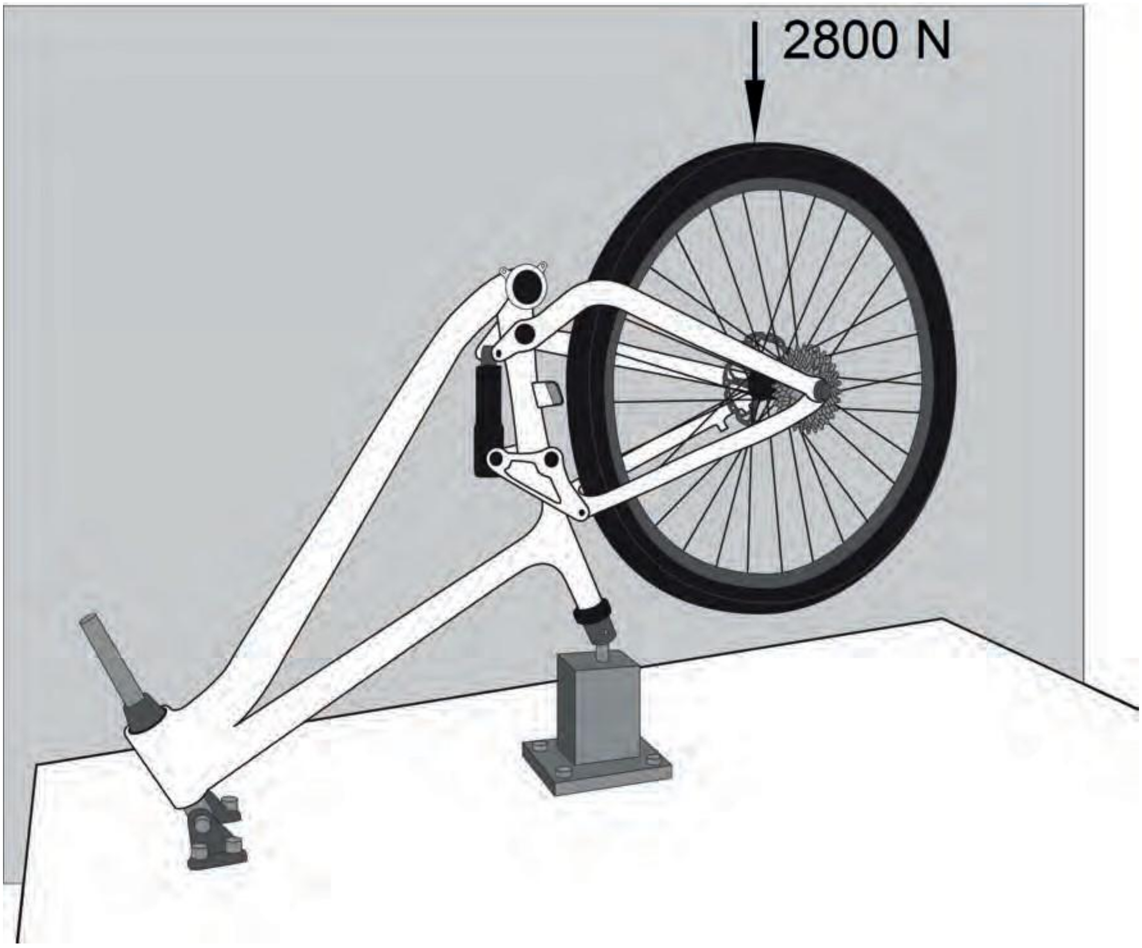


Figure C.1 — Examples of suspension frames — Tyre-clearance test

Annex D
(normative)

Composite frame and composite fork — Disc brake seat endurance test

D1 Composite frame and composite fork — Disc brake seat endurance test

D1.1 Requirement:

When tested by the method described in D.1.2, nor thermal deformation and fractures and cracks at the disc brake seat in any parts of the sample.

D1.2 Test methods:

This test is made with a test speed of 12.5 km/h +/- 5%.

There by the 3,000 cycles (brake 3 sec. and release 3 sec. for 1 cycle) brake delay may not remain under a value of 2.2 m/s^2 +/- 10% whereby for the mass to be slowed down 100 kg.

An adjustment or change the wear parts of the brakes is allowed.

A wind speed of a maximum of 12.5 km/h is allowed.

Annex E
(informative)

Stiffness measurement of frame

E1: General

1. The test method of the item is applicable to the frames defined by TBIS 4210.
2. It is necessary to use a new frame/front fork set, and completely assembling process by the default head set. If only the frame is provided, it is allowed to replace the original front fork by the simulated front fork with the same length (as described in Annex A of TBIS 4210-6:2017); however, it stiffness should not be lower than the original front fork.
3. If the sample to be executed is a shock frame, it is necessary to use the stiffness connection bar to replace the shock component; please note that the gap between the fixation points of two ends of the connection bar and the strength of the lateral stiffness in order to simulate the original configuration of the frame.
4. The force should be slowly increased to reach the setting in order to avoid that the shock influences the deformation of the frame.
5. Before the force is applied, it is necessary to use 20% of the setting value of the force as the preload, and keep applying the force for 1 minute; after the preload is executed for several times, please release the preload, and reset the displacement; then, please use 100% of the force to execute the test.
6. The code for constrain position and types are show as below:

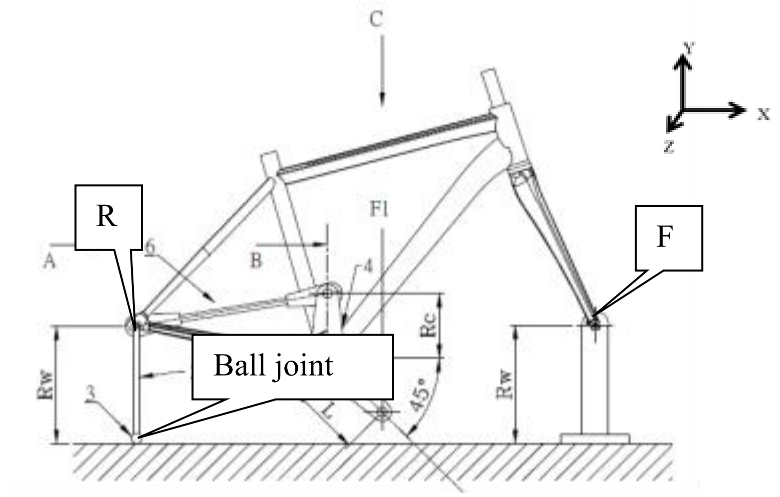


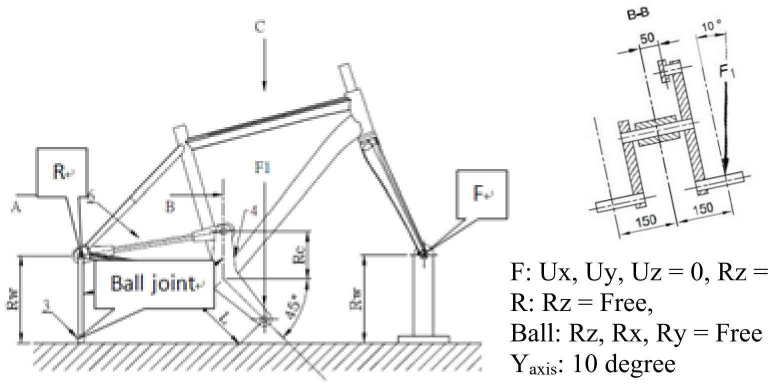
Figure E1 The code for constrain position and type.

Code for constrain position:
F: the shaft of the front fork,
R: the rear shaft,
Ball joing: the link with rear shaft and the base plane
Code for constrain type:
U: move
R: spin
0: constrained
Free: unconstrained

E2: Stiffness measurement of the frame after the bottom brackets (BB) is applied by pedalling force

Test method

The erection condition of the test sample and its force application position are the same with those of TBIS 4210-6 :2017, Sec. 4.3; however, the included angle of the vehicle body and the plumb line of the ground should be 10° during the application of the force (The rear shaft and the base of ball joint shall tilts at the same time, the vehicle body tilts toward the left side when the force is applied to the right side; the vehicle body tilts toward the right side when the force is applied to the left side). Please vertically apply the force 800 N downward for 1 minute; the force should be applied to the drive side first, and then applied to the non-drive side; then, please measure the deformation of the deformations of the shaft fixture of the pedal and the rear fork shaft under the force application condition. The unit for recording the stiffness is N/mm.



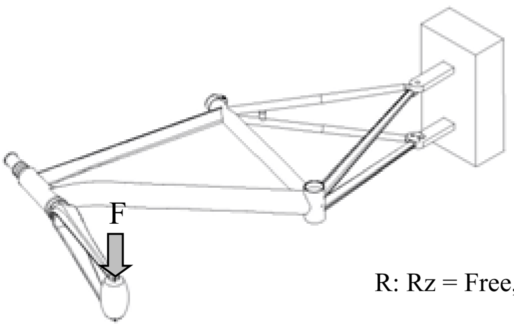
F: Ux, Uy, Uz = 0, Rz = Free, Rx, Ry = 0
R: Rz = Free,
Ball: Rz, Rx, Ry = Free
Y_{axis}: 10 degree

Figure E2- Stiffness measurement of the frame after the bottom brackets (BB) is applied by pedalling force

E3: Stiffness measurement of the frame after the front fork is applied by lateral force.

Test method

The rear shaft should be locked at the bearing base which can freely rotate axial-wise.
Please apply 300 N to the axial direction of the front fork for 1 minute, and measure the deformation of the force application direction. The unit for recording the stiffness is Nm/degree.



R: Rz = Free, Rx, Ry = 0, Ux, Uy, Uz = 0

Figure. E3- Stiffness measurement of the front fork is applied by lateral force.

E4: Stiffness measurement of the frame after the seat tube is applied by down force.

Test method

The erection condition of the test sample and the force application position are the same with those of TBIS 4210-6 : 2017, Sec. 4.3. It is necessary to provide a seat fixture to create a vertical height difference of 750mm between the force application position distance BB center and the seat. The position where the load is hung is sway from the rear side of the center of the base bar by 70mm; please hang 100 kg at the position. The deformation measurement point is away from the rear side of the center of the base bar by 85 mm; please measure the deformation under the force application condition. The unit for recording the stiffness is Nm/degree.

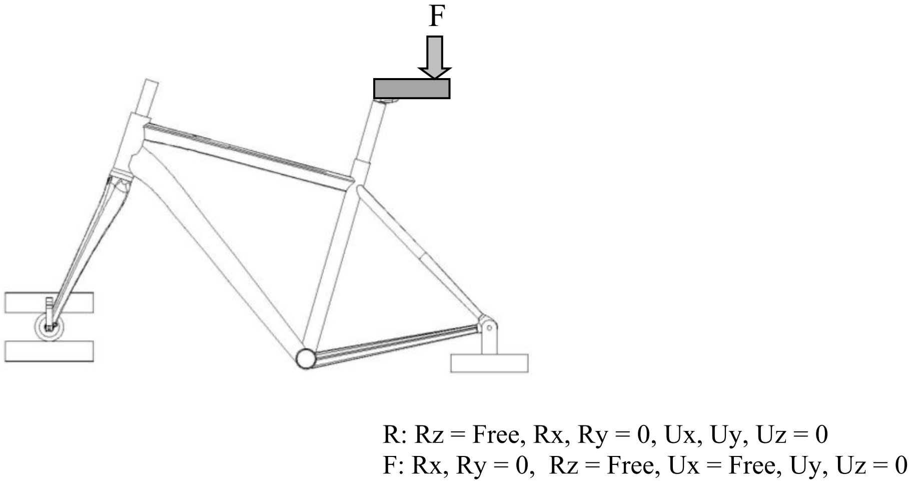


Figure E4- Stiffness measurement of the frame after the seat tube is applied by down force

Annex F
(normative)

Safety test of folding mechanism of frame

F.1 General

1. The test method of the item is applicable to all frames including folding mechanisms defined in TBIS 4210.
2. The tightening conditions of the folding mechanisms should be finished according to the setting values of the manufacturer, and the measurement of the opening force and the closing force should be finished before the test.
3. It is necessary to adopt a new frame to perform the test, and use the simulated front fork (the requirements of the front fork are as shown in Annex A of TBIS 4210-6:2017), the gear set and the handle stems with default sizes.

F.2 Requirements:

After the test is finished according to the method specifically described in F. 2, the folding mechanism should not be broken or have visible cracks; the opening force and the closing force of the folding mechanism should not be lower than 90% of the suggested value of the manufacturer, and should not be stuck; in addition, the rotation shaft of the folding mechanisms should not be loose because a gap appearing in the shaft.

F.3 Test method:

In the test conditions, the requirements of the tangential velocity and time of the wheels, and the jump blocks are the same with Annex A of TBIS 4210-3, the only difference is that it is driven by the ground wheel; the weight of each of the parts of the vehicle body is as shown in the following table:

Unit: kg

Bicycle type	City bike	Teenager bike	Mountain bike	Racing bike
Weight of both free ends of the handlebar	6.75			
Weight of the seat tube of the frame	50	40	30	
Weight of the bottom brackets(BB) of the frame	30	20	50	

Annex G
(normative)

Safety test of composite fork stem (fork steerer)

G.1 General

1. The test method of the item is applicable to all composite fork defined in TBIS 4210.
2. The tightening conditions of the fork stem and handlebar-stem assembly should be finished according to the setting values of the manufacturer.

G1.1 Requirements:

After the test is finished according to the method specifically described in G1.2, there should be no fracture in the fork stem; in the fatigue test, the running displacements (peak-to peak value) at the points where the test forces are applied shall not increase by more than 20% of the initial values.

G1.2 Test method:

1. The tightening conditions of the fork stem and handlebar-stem assembly should be finished according to the setting values of the manufacturer (have to match the head tube angle of the frame). Apply a torque 240 Nm about the centerline of the fork stem and maintain for 1 min

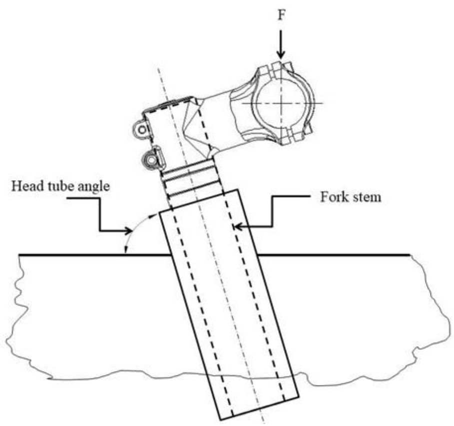


Figure G1 Torque to the fork steerer

2. After the torque to the fork stem, and continue the fatigue test as TBIS 4210-5 Sec. 4.9 with the same assembly of fork stem and handlebar stem assembly.

Annex H
(normative)
Suspension frame- Rear triangle fatigue test

H.1 General

1. The test method of the item is applicable to all frames including folding mechanisms defined in TBIS 4210.
2. It is necessary to adopt a new frame to perform the test, and use the simulated front fork (the requirements of the front fork are as shown in Annex A of TBIS 4210-6:2017).
3. The sample should be a suspension frame, it is able to use the stiffness connection bar to replace the suspension component; the length of the suspension should be provided by applicant or 50% of the suspension stroke, please note that the gap between the fixation points of two ends of the connection bar and the strength of the lateral stiffness in order to simulate the original configuration of the frame.

H1.1 Requirement

After the test is finished according to the method specifically described in H1.2, there should be no fracture or visible cracks in the sample; the composite sample in the fatigue test, the running displacements (peak-to peak value) at the points where the test forces are applied shall not increase by more than 20% of the initial values.

H1.2 Test methods

Mount the frame in its normal attitude and secured at the rear dropouts so that is not restrained in a rotary sense (i.e. preferably by the rear axle) as shown in Figure H1. 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.

Apply cycles of dynamic, vertically-downward forces 3700 N at BB as shown in Figure H1 for 100 000 test cycles. The maximum test frequency shall be maintained as specified in TBIS 4210-3: 4.5.

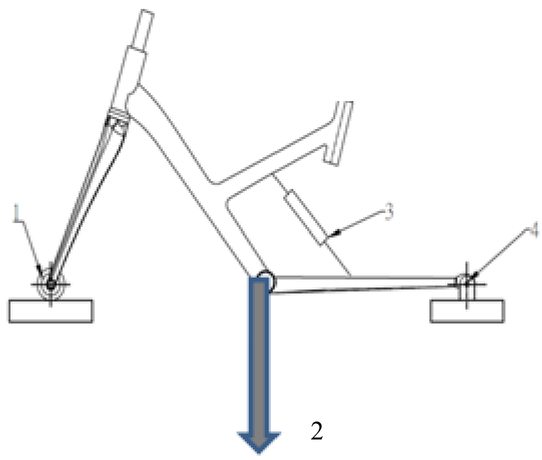


Fig. H1 Suspension frame- Rear triangle fatigue test

Key

1 free-running roller

2 vertically-downward forces at BB

3 locked suspension unit or solid link for pivoted chain stays

4 rigid, pivoted mounting for rear axle attachment point

Annex I
(normative)

Frame for hub/disc brake — Brake mount fatigue test

I.1 General

1. The test method of the item is applicable to all frames including folding mechanisms defined in TBIS 4210 (The frame should be contain the brake mount for hub/disc brake).
2. It is necessary to adopt a new frame to perform the test, and use the simulated front fork (the requirements of the front fork are as shown in Annex A of TBIS 4210-6).

I1.1 Requirement

After the test is finished according to the method specifically described in I1.2, there should be no fracture or visible cracks in the sample; the composite sample in the fatigue test, the running displacements (peak-to peak value) at the points where the test forces are applied shall not increase by more than 20% of the initial values.

I1.2 Test methods

Mount the frame in its normal attitude and secured at BB so that is not restrained in a rotary sense (i.e. preferably by the BB axle) as shown in Figure I1. 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. To fit an axle to the brake mount, and mount on the axle a pivoted, straight adaptor as shown in Figure I1 to provide a torque arm of L2 in length (see Table 10) and a suitable attachment for the brake mounting point.

Apply cycles of dynamic, vertically-upward forces 400 N as shown in Figure I1 , test cycles as shown in Tab I1. The maximum test frequency shall be maintained as specified in TBIS 4210-3: 4.5.

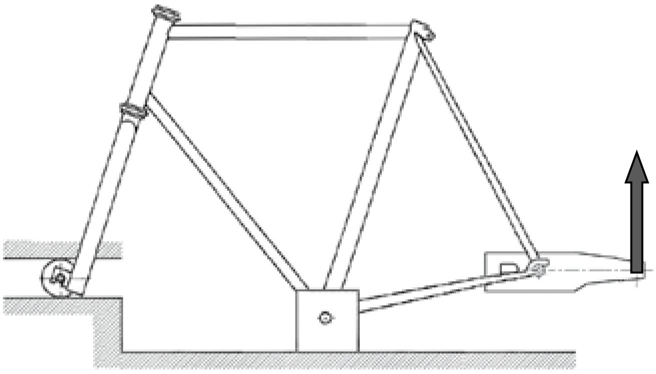


Fig. I1 Frame for hub/disc brake — Brake mount fatigue test

Tab I1 Cycles for the bicycle types

Bicycle type	City and trekking bicycles	Young adult bicycles	Mountain bicycles	Racing bicycles
Test cycles	12000	12000	12000	20000

Annex J
(normative)
Frame stiffness test – Rear Triangle Stiffness

J.1 General
1. This test method applies to frames as defined in TBIS 4210, specifically for evaluating drivetrain system frame performance.
2. This test is specifically designed for frames with belt drive systems. The rear triangle must possess sufficient stiffness to ensure the effectiveness of the belt drive system. Insufficient stiffness may lead to tooth skipping, accelerated wear, drivetrain noise, or even belt derailment.
3. This test is NOT applicable to frames designed for mid-drive motor e-bikes.
4. Testing shall be conducted using a new frame/fork assembly with the headset components as specified by the manufacturer. If only the frame is provided, a substitute fork of equivalent length (as per TBIS 4210-6 Annex A) may be used, provided its stiffness is not less than that of the originally matched fork.
5. For suspension frames, rigid connecting rods shall replace suspension components during testing. Attention shall be paid to the clearance at both ends of the connecting rod and its lateral stiffness to simulate the original frame configuration.
6. Force shall be applied gradually to the set value to avoid impact effects on frame deformation.
7. Before applying the test force, preload at 20% of the set force value for 1 minute. After multiple preloading cycles, release the preload, zero the displacement, and then perform the test at 100% of the preset force.

J.1.1 Requirements
After completing the test according to the method detailed in J.1.2, test results shall adopt a spectrum-based evaluation approach, avoiding absolute good/bad judgments. During testing, the frame shall not exhibit fracture or visible cracks.
Test results shall record stiffness values and reference the stiffness spectrum visualization classification range in Table J.1.
J.1.2 Test methods
J.1.2.1 Rear triangle lateral torsional stiffness test
Test name: Rear triangle lateral torsional stiffness test
Constraint points: Bottom bracket, fork, seat tube
Load application point: Drive-side rear dropout lock center
Test force: 250 N (fixed value)
Number of tests: 3 times, average value
Result unit: N/mm
Mount the frame in its normal configuration with the bottom bracket, fork, and seat tube fixed to the fixture. The bottom bracket and seat tube displacement and rotation shall be fully constrained (Ux, Uy, Uz = 0, Rx, Ry, Rz = 0). Fork end displacement and rotation shall be fully constrained (Ux, Uy, Uz = 0, Rx, Ry = 0), but axial rotation shall be permitted (Rz = Free).
Apply a lateral force of 250 N at the drive-side rear dropout lock center, maintain pressure for 1 minute, and measure the deformation in the direction of force application. Record stiffness in units of N/mm. See Figure J.1 for test setup illustration.

Table J.1 — Rear triangle stiffness spectrum visualization classification range
Stiffness spectrum visualization (Rear triangle stiffness test)
Stiffness value (N/mm)

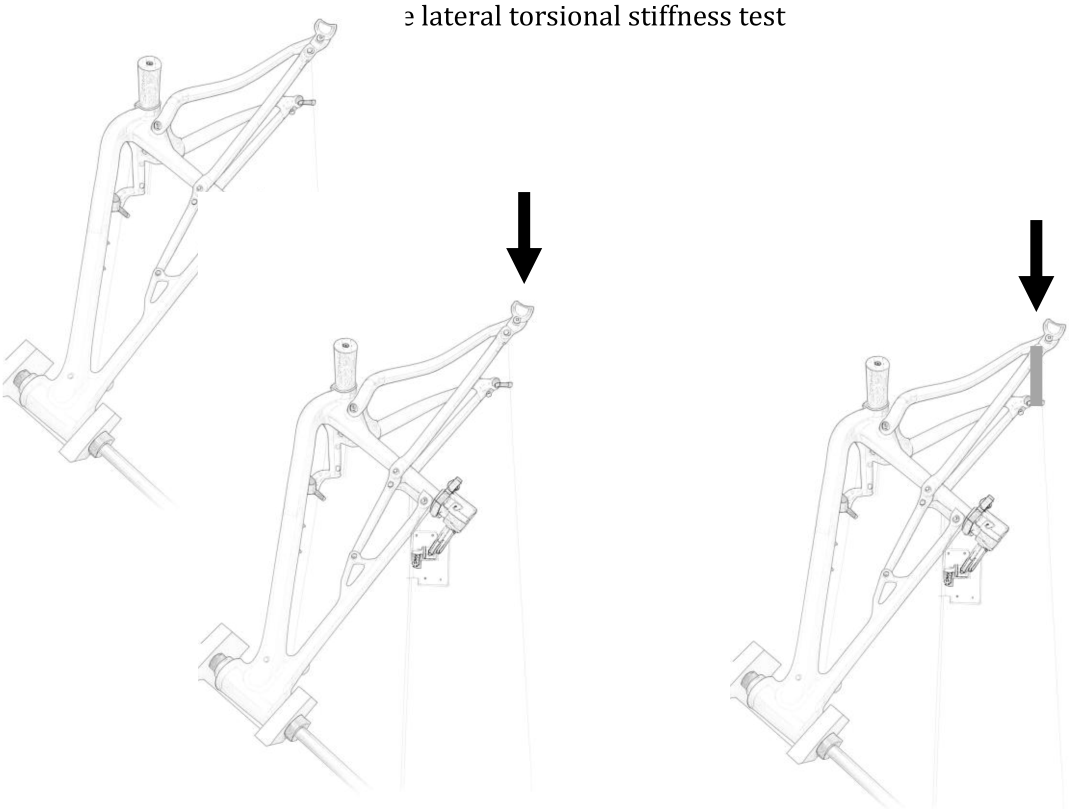
40	50	60	70	80+
Low stiffness	Medium-low stiffness	Balanced stiffness	Medium-high stiffness	High stiffness
<Comfort priority> <Immediate feedback priority>				

Table J.2 — Bicycle category and stiffness classification range

Bicycle category	Stiffness classification range
MTB, trekking bikes, racing bikes, carrier cycles, mid-drive e-bikes	50-80+ N/mm
City bikes, urban bikes, commuter bikes	40-70+ N/mm

Key:
F Force direction (250 N)
1 Bottom bracket constraint point
2 Fork constraint point
3 Seat tube constraint point
4 Drive-side rear dropout (load application and measurement point)
raint

e lateral torsional stiffness test



Annex K
(normative)
Frame and fork assembly stiffness test

K.1 General

1. This test method applies to frame and fork assemblies as defined in TBIS 4210, **limited to non-suspension bicycles**.
2. This test is specifically used to evaluate the structural stability of drivetrain system frames under specific loads and is **NOT applicable** to mid-drive motor e-bike designs.
3. Testing shall be conducted using a new frame/fork assembly with the headset components as specified by the manufacturer.
4. **Fixture requirements:** A rigid handlebar fixture must be used to eliminate shock absorption factors affecting test results (excluding factors such as dual-control levers or handlebar tape shock absorption).
5. Force shall be applied gradually to the set value to avoid impact effects on system deformation.
6. Before applying the test force, preload at 20% of the set force value for 1 minute. After multiple preloading cycles, release the preload, zero the displacement, and then perform the test at 100% of the preset force.

K.1.1 Requirements

After completing the test according to the method detailed in K.1.2, test results shall adopt a spectrum-based evaluation approach, avoiding absolute good/bad judgments. During testing, the frame, fork, and stem assembly shall not exhibit fracture or visible cracks.

Test results shall record stiffness values and reference the stiffness spectrum visualization classification range and design orientation in Table K.1.

K.1.2 Test methods

K.1.2.1 Frame and fork assembly vertical stiffness test

Test name: Frame and fork assembly vertical stiffness test

Applicable bicycle types: Limited to non-suspension bicycles

Fixture requirements: Rigid handlebar fixture, eliminating shock absorption factors

Constraint points: Rear dropouts, fork dropouts (sliding rail installation)

Load application point: 35 mm inward from the outer edge of brake/shifter hoods

Test force: 400 N (fixed value)

Number of tests: 3 times, average value

Result unit: N/mm

Mount the frame in its normal configuration with rear dropouts fixed to the fixture, allowing free rotation (Rz = Free). Rear axle displacement shall be fully constrained (Ux, Uy, Uz = 0), but axial rotation shall be permitted (Rz = Free), with other rotational directions fully constrained (Rx, Ry = 0). Fork dropouts shall be mounted using a sliding rail system, allowing fore-aft movement (Ux = Free), while other displacement and rotational directions are fully constrained (Uy, Uz = 0, Rx, Ry, Rz = 0). Apply a vertical downward force of 200 N simultaneously at each handlebar end, 35 mm inward from the outer edge of brake/shifter hoods (total 400 N), maintain pressure for 1 minute, and measure the vertical deformation at the handlebar endpoints. Record stiffness in units of N/mm. See Figure K.1 for test setup illustration.

Table K.1 — Frame and fork assembly stiffness spectrum visualization classification range

Stiffness spectrum visualization (Frame and fork assembly stiffness test)

Stiffness value (N/mm)

4	6	8	10	12+
Low stiffness	Medium-low stiffness	Balanced stiffness	Medium-high stiffness	High stiffness
<Comfort priority> <Immediate feedback priority>				

Table K.2 Bicycle Type, expected stiffness range and design orientation

Bicycle category	Expected stiffness range	Design orientation
Racing/ competition type	7-12+ N/mm	Stiffness priority
City/ leisure bikes	4-8 N/mm	Comfort priority

Key:

F Force direction (400 N, vertically downward)

1 Rear dropout constraint

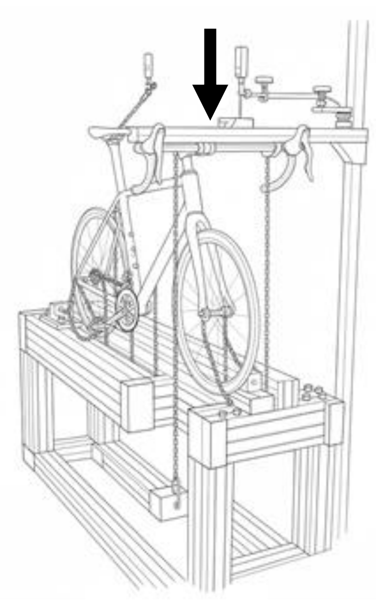
2 Fork dropout (sliding rail mounting)

3 Handlebar endpoint (load point: 35 mm inward from outer edge of brake/shifter hoods)

4 Fork

5 Measurement point

Figure K.1 — Frame and fork assembly vertical stiffness test



Annex L
(normative)
Head tube stiffness test

L.1 General

This test method applies to frames as defined in TBIS 4210.
Applicable bicycle types: Including e-bike frames (including frames with downtube-integrated battery opening design).
Testing shall be conducted using a new frame with the headset components as specified by the manufacturer. Use a substitute fork (as per TBIS 4210-6 Annex A) for testing, with stiffness significantly higher than the frame head tube stiffness.
Battery opening treatment: For frames with downtube-integrated battery opening design, specialized fixtures shall be installed at the opening.
Fixture universality: The stiffness of the downward pressing rigid rod shall be clearly defined; weights may be used to maintain stable force application.
Force shall be applied gradually to the set value to avoid impact effects on frame deformation.
Before applying the test force, preload at 20% of the set force value for 1 minute. After multiple preloading cycles, release the preload, zero the displacement, and then perform the test at 100% of the preset force.

L.1.1 Requirements

After completing the test according to the method detailed in L.1.2, test results shall adopt a spectrum-based evaluation approach, avoiding absolute good/bad judgments. During testing, the frame shall not exhibit fracture or visible cracks.
Test results shall record stiffness values and reference the stiffness spectrum visualization classification range in Table L.1.

L.1.2 Test methods

L.1.2.1 Head tube lateral stiffness test

Test name: Head tube lateral stiffness test
Applicable bicycle types: Including e-bike frames (including downtube-integrated battery)
Constraint points: Bottom bracket, seat tube, head tube
Load application point: 250 mm from head tube center
Test force: 500 N (fixed value)
Number of tests: 3 times, average value
Load application method: Weights may be used to maintain stability
Result unit: N/mm
Mount the frame in its normal configuration with the bottom bracket and seat tube fixed to the fixture. Bottom bracket and seat tube displacement and rotation shall be fully constrained (Ux, Uy, Uz = 0, Rx, Ry, Rz = 0).
Install a substitute fork at the head tube, apply a lateral force of 500 N at 250 mm from the head tube center, maintain pressure for 1 minute, and measure the lateral deformation at the fork end. Record stiffness in units of N/mm. See Figure L.1 for test setup illustration.

Table L.1 — Head tube stiffness spectrum visualization classification range

Stiffness spectrum visualization (Head tube stiffness test)

Stiffness value (N/mm)

50	60	70	80	90+
Low stiffness	Medium-low stiffness	Balanced stiffness	Medium-high stiffness	High stiffness
<Comfort priority> <Immediate feedback priority>				

Table L.2 Material difference reference data

Material type	Reference stiffness value	Characteristic description
Composite/Carbon fiber	63.5 N/mm	Lightweight, adjustable stiffness
Metal materials	85.5 N/mm	High stiffness, excellent durability

Key:

F Force direction (500 N)

1 Bottom bracket constraint point

2 Seat tube constraint point

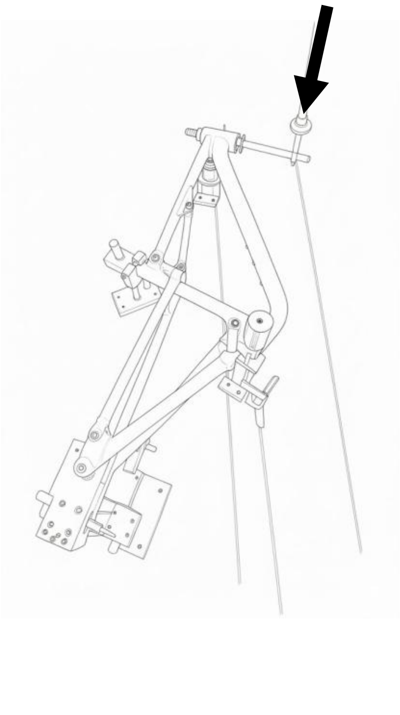
3 Head tube constraint point

4 Rigid fork (Substitute fork)

5 Load application point (250 mm from head tube center)

6 Measurement point

Figure L.1 — Head tube lateral stiffness test



Annex M
(normative)
Bottom bracket vertical stiffness test

M.1 General

1. This test method applies to frames as defined in TBIS 4210.
2. Applicable bicycle types**:** Including e-bike frames (including frames with downtube-integrated battery opening design).
3. Testing shall be conducted using a new frame/fork assembly with the headset components as specified by the manufacturer. If only the frame is provided, a substitute fork of equivalent length (as per TBIS 4210-6 Annex A) may be used, provided its stiffness is not less than that of the originally matched fork.
4. For suspension frames, rigid connecting rods shall replace suspension components during testing. Attention shall be paid to the clearance at both ends of the connecting rod and its lateral stiffness to simulate the original frame configuration.
5. Battery opening design included in test scope: For frames with downtube-integrated battery opening design, specialized fixtures shall be installed at the opening.
6. Force shall be applied gradually to the set value to avoid impact effects on frame deformation.
7. Before applying the test force, preload at 20% of the set force value for 1 minute. After multiple preloading cycles, release the preload, zero the displacement, and then perform the test at 100% of the preset force.

M.1.1 Requirements

After completing the test according to the method detailed in M.1.2, test results shall adopt a spectrum-based evaluation approach, avoiding absolute good/bad judgments. During testing, the frame shall not exhibit fracture or visible cracks.
Test results shall record stiffness values and reference the stiffness spectrum visualization classification range in Table M.1.

M.1.2 Test methods

M.1.2.1 Bottom bracket vertical stiffness test
Test name: Bottom bracket vertical stiffness test
Applicable bicycle types: Including e-bike frames (including downtube-integrated battery)
Constraint points: Front and rear dropouts
Load application point: 250 mm from bottom bracket center
Test force: 800 N (fixed value, vertically downward)
Preload setting: 100 N for zeroing
Number of tests: 3 times, average value
Result unit: N/mm
Mount the frame in its normal configuration with fork end and rear axle separately fixed to the fixture.
Fork end displacement and rotation shall be fully constrained (Ux, Uy, Uz = 0, Rx, Ry = 0), but fork axial rotation shall be permitted (Rz = Free).
Rear axle displacement and rotation shall be fully constrained (Ux, Uy, Uz = 0, Rx, Ry, Rz = 0).
Install a crank fixture at the bottom bracket, apply a vertically downward force of 800 N at 250 mm

from the bottom bracket center. After preloading with 100 N for zeroing, maintain pressure for 1 minute and measure the vertical deformation at the bottom bracket. Record stiffness in units of N/mm. See Figure M.1 for test setup illustration.

Considering industry prevalence, diagonal/angular force application is not added at this time.

Vertically downward force application ensures test condition consistency.

Table M.1 — Bottom bracket stiffness spectrum visualization classification range

Stiffness spectrum visualization (Bottom bracket vertical stiffness test)

Stiffness value (N/mm)

<table>
<tr><td>70</td><td>80</td><td>90</td><td>100</td><td>110+</td></tr>
<tr><td>Low stiffness</td><td>Medium low stiffness</td><td>Balanced stiffness</td><td>中高剛性</td><td>高剛性</td></tr>
<tr><td colspan="5"><舒適性優先> <即時回饋性優先></td></tr>
</table>

Table M.2 Test data reference

Sample type	Test force	Displacement	Stiffness value	Material characteristic analysis
Carbon fiber frame (Sample 1)	600 N	5.42 mm	110.7 N/mm	High stiffness, excellent force transmission
Carbon fiber frame (Sample 2)	352.8 N	3.25 mm	108.6 N/mm	High stiffness, good design adjustability
Metal frame (Sample 3)	350 N	4.37 mm	80.1 N/mm	Medium-high stiffness, excellent durability

Key:

F Force direction (800 N, vertically downward)

1 Fork end constraint

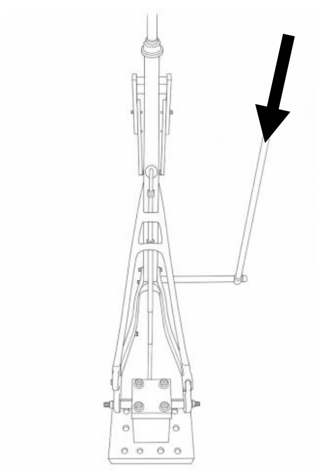
2 Rear dropout constraint

3 Crank fixture

4 Load application point (250 mm from bottom bracket center)

5 Measurement point

Figure M.1 — Bottom bracket vertical stiffness test



Annex N
(informative)
Fixture design proposal — Standard test fixture stiffness consistency specifications

N.1 General

This annex provides design principles and stiffness requirements for standard test fixtures to ensure comparability and consistency of test results between different testing laboratories.

Based on the requirements for test fixtures in the ISO 4210-6:2023 standard, to ensure consistency across different test items, the stiffness of all fixtures is specified.

N.2 Fixture stiffness design specifications

N.2.1 Unified deflection ratio standard

All test fixtures shall comply with the deflection ratio requirements defined in ISO 4210-6 Annex A, ensuring the deflection ratio (Dr) does not exceed 1.0. This applies to all fixtures used for frame and fork testing.

N.2.2 Standardized stiffness verification method

1. All fixtures shall use the same stiffness test method, i.e., applying a test force of 1,200 N at specified test points.
2. Measured deflection shall not exceed the maximum allowable value calculated using the appropriate length and formula.
3. Calculation formula: $Dr = (K \times \delta \times 10000)/L^3$, where K value is selected based on the test type.

N.2.3 Basic principles of fixture stiffness

1. The stiffness of all test fixtures shall be significantly higher than that of the test specimen to ensure that the measured deformation primarily originates from the specimen itself rather than fixture deformation.
2. Fixture stiffness shall be at least 10 times the expected stiffness of the test specimen.
3. Fixture constraint points and load application points shall be manufactured from high-stiffness materials. Steel is recommended, with hardness not less than HRC 45.

N.3 Fixture stiffness verification method

After fixture fabrication, stiffness verification testing shall be conducted:

1. Place the fixture on the test machine and apply force under standard test conditions.
2. Measure the deformation of the fixture itself.
3. Fixture deformation shall not exceed 10% of the expected specimen deformation.

N.4 Design points for fixtures for each test item

N.4.1 Rear triangle stiffness test fixture (Annex J)

1. Bottom bracket constraint fixture shall fully constrain bottom bracket displacement and rotation, with a constraint area not less than 100 mm^2.
2. Fork constraint fixture shall fully constrain fork displacement and rotation (allowing axial rotation), with a constraint area not less than 100 mm^2.
3. Seat tube constraint fixture shall fully constrain seat tube displacement and rotation, with a constraint area not less than 100 mm^2.
4. Rear dropout load application point shall withstand at least 1000 N lateral force, with self-deformation not exceeding 0.1 mm.
5. Base shall have sufficient mass (recommended not less than 50 kg) to ensure test process stability.

N.4.2 Frame and fork assembly stiffness test fixture (Annex K)

1. Rear dropout constraint fixture shall allow free axial rotation but fully constrain displacement and rotation in other directions. Precision bearings are recommended, with friction torque not exceeding 0.5 Nm.
2. Fork dropouts shall be mounted using a sliding rail system, allowing fore-aft movement while fully constraining displacement and rotation in other directions. Sliding rail friction resistance shall not exceed 10 N.
3. Handlebar load application point shall use a rigid handlebar fixture, eliminating shock absorption factors, with uniform clamping force distribution.
4. Fixture stiffness shall withstand at least 1000 N vertical force and 500 N lateral force.

N.4.3 Head tube stiffness test fixture (Annex L)

1. Bottom bracket constraint fixture shall fully constrain displacement and rotation in all directions, with constraint stiffness of at least 1000 N/mm.
2. Seat tube constraint fixture shall fully constrain displacement and rotation in all directions, with constraint stiffness of at least 1000 N/mm.
3. Substitute fork shall be manufactured from high-stiffness materials, with bending stiffness of at least 500 N/mm.
4. Downward pressing rigid rod stiffness shall be clearly defined; weights may be used to maintain stable force application.
5. For frames with downtube-integrated battery opening design, specialized fixtures shall be installed at the opening to prevent opening deformation from affecting test results.

N.4.4 Bottom bracket stiffness test fixture (Annex M)

1. Fork end and rear axle constraint fixtures shall withstand at least 3000 N vertical force.
2. Crank fixture shall be manufactured from steel, with stiffness significantly higher than frame bottom bracket stiffness, recommended stiffness not less than 2000 N/mm.
3. Crank fixture length shall be adjustable to meet standard test length of 250 mm ± 1 mm.
4. Preload device shall accurately apply 100 N preload force, with error not exceeding ± 5 N.

N.5 Fixture calibration and maintenance

N.5.1 Calibration frequency

1. New fixtures shall undergo complete calibration before first use.
2. Fixtures shall undergo regular calibration every 6 months.
3. Fixtures shall undergo immediate calibration after major repairs or abnormal occurrences.

N.5.2 Calibration method

1. Test using standard specimens with known stiffness values.
2. Compare test results with standard values; deviation shall not exceed ± 5%.
3. Record calibration results and establish calibration history.

N.5.3 Maintenance points

1. Regularly inspect fixture mounting bolts to ensure torque compliance.
2. Regularly clean fixture surfaces to prevent contamination from affecting test results.
3. Inspect wear condition of ball joints and bearings; replace when necessary.
4. Store fixtures in dry environment to prevent rust.

N.6 Test report requirements

When conducting stiffness tests, test reports shall include the following information:

1. Fixture identification number and most recent calibration date.

2. Test environment temperature and humidity.
3. Force application rate and hold time.
4. Deformation measurement equipment model and accuracy.
5. Number of preload cycles and preload force value.
6. Complete force-displacement curve diagram.
7. Detailed specifications of test specimen (material, dimensions, model, etc.).

N.7 Inter-laboratory comparison

N.7.1 Comparison purpose

Ensure consistency and comparability of results when different laboratories use different fixtures for testing.

N.7.2 Comparison method

1. Use uniformly provided standard specimens.
2. Each laboratory tests according to methods in TBIS 4210-6 Annexes J, K, L, M.
3. Compare test results from each laboratory.
4. Result deviation shall not exceed ± 8%.

N.7.3 Comparison frequency

Annual inter-laboratory comparison is recommended to ensure test system consistency.

N.8 Deflection ratio calculation examples

N.8.1 Fatigue test fixtures

When conducting vertical fatigue testing on forks, the displacement ratio Dr should not exceed 1, calculated as follows:

$Dr = (K_1 \times 10000 \times \delta) / L^3$

Where:

- Dr: Displacement ratio
- K_1: 1417, a constant
- L: Fork length, mm
- δ: Displacement, mm

Example: Fork length L = 460 mm Displacement δ = 6.85 mm, then

Displacement ratio $Dr = (1417 \times 10000 \times 6.85) / 460^3 = 0.99721 \leq 1.0$

N.8.2 Impact test fixtures

When conducting impact testing, the displacement ratio Dr of test fixtures shall not exceed 1, calculated as follows:

$Dr = (K_2 \times 10000 \times \delta) / L^3$

Where:

- Dr: Displacement ratio
- K_2: 709, a constant
- L: Fork length, mm
- δ: Displacement, mm

The fixture design and verification methods provided in this annex are informative. Laboratories may adjust based on actual conditions but shall ensure accuracy and repeatability of test results.

Fixture design shall consider the prevalence of test conditions in the industry and data consistency. Diagonal/angular force application and other complex conditions are not considered at this time to ensure standardization of test conditions.