INTERNATIONAL STANDARD

ISO 11154

First edition
2023-03

Road vehicles — Roof load carriers

Véhicules routiers — Porte-charges de toit

Reference number
ISO 11154:2023(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 40, *Specific aspects for light and heavy commercial vehicles, busses and trailers*.

This first edition cancels and replaces ISO/PAS 11154:2006, which has been technically revised.

The main changes are as follows:

— update and revision of document structure, which results in renumbering;

— update and revision Clause 2;

— update and revision Clause 6;

— addition of test procedure (6.4);

— addition of lane change test (6.11.3);

— addition of brake test (6.11.4);

— revision of 6.12.2, changing application of force from 10 min to 1 min.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Road vehicles — Roof load carriers

1 Scope

This document applies for roof racks of passenger cars and light commercial vehicles up to a permissible total weight of 3,5 t according to ISO 1176 and specifies requirements and test methods for these. It is also valid for roof racks mounted on trailers.

So-called magnetic or suction foot racks, i.e. roof racks whose attachment on the vehicle is only via magnetic forces or vacuum, are excluded from this document.

This document provides safety-related requirements under consideration of the weight, centre of gravity, air resistance and other safety-relevant properties for structures of roof racks for which no other technical or statutory regulations otherwise apply and which are not listed in 4.2. In individual cases, test requirements can extend beyond these requirements.

2 Normative references

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

ISO 179-1, *Plastics — Determination of Charpy-impact properties — Part 1: Non-instrumented impact test*

ISO 3888-2, *Passenger cars — Test track for a severe lane-change manoeuvre — Part 2: Obstacle avoidance*

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

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

EN 15194, *Cycles — Electrically power assisted cycles — EPAC Bicycles*

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
roof rack
device, which is attached directly or indirectly via other roof rack forms on the roof of passenger cars or vehicles derived from this and which are suitable for the transportation of *loads* (3.2)

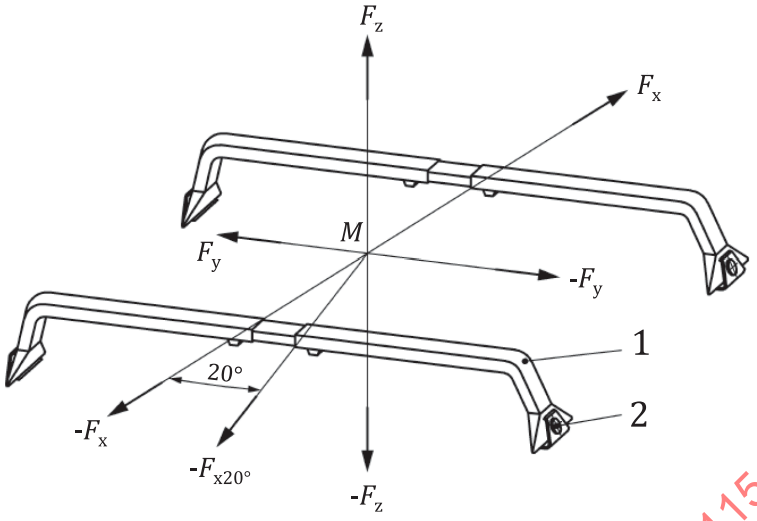
3.2
load
transport goods which can be transported with the *roof racks* (3.1) provided for this

4 Symbols, types and designation

4.1 Symbols

$-F_Z$	direction of the normal force of the load
F_z	direction of the vertical force, acting vertically to the direction of travel
F_Y	direction of the lateral force, acting laterally to the direction of travel
$-F_x$	direction of the longitudinal force, acting longitudinally to the direction of travel
F_x	direction of the opposing longitudinal force, acting against the direction of travel
$-F_{x20°}$	direction of the force in the horizontal plane, 20° to the vehicle longitudinal axis through the centre point *M*
m_D	permissible roof load in kilograms
m_N	permissible load bearing capacity of the roof rack in kilograms
m_E	dead weight of the roof racks and possibly the roof structural system in kilograms
s	stroke path from deformation and displacement in millimetres
x-direction	vehicle longitudinal axis
y-direction	transverse to the vehicle longitudinal axis (horizontal)
z-direction	transverse to the vehicle longitudinal axis (vertical)
M	force application point
F_{Vr}	front wheel contact force
F_g	gravity force
F_{Hr}	force transmitted to the ground by the rear wheel
S_m	centre of gravity of test bicycle
RS	wheelbase
h_{Sm}	height of centre of gravity

The directions of action by the individual forces are shown correspondingly in Figure 1.



Key

1 cross member

2 support foot

Figure 1 — Presentation with the example of a base carrier, consisting of two carrying brackets and four support feet for clamping attachment to a vehicle roof

4.2 Types

The following types of roof racks are differentiated:

Type A Base carrier

Type B Luggage carrier

Type C Ski carrier, snowboard carrier

Type D Windsurf carrier

Type E Bicycle carrier

Type F Boat carrier

Type G Roof box

Type H Air deflector device, advertising carriers and signal lights

Type I Luggage basket

Type J Front wheel/Rear wheel holder (bicycle)

Type K Cross-country ski carrier

Type L Surf mast carrier

NOTE Only types A and B can be mounted directly on the vehicle. Type A contains a base carrier, which is mounted directly on the vehicle or on special devices on the vehicle. Type B (luggage carrier) is a luggage basket with integrated carrier function. Types C to L can only be mounted on the base carrier (Type A). Special versions are possible insofar as these correspond to the safety requirements of this document (see Introduction and Clause 1).

The following essential elements characterize the base carrier:

— carrying bracket or cross member for holding and attaching roof rack types C to L;

— device (for example, supporting foot with retaining claws) for positive and non-positive attachment of the carrying bracket or cross member to the vehicle or to special devices on the vehicle (screwed or clamped connection or railing or similar).

4.3 Designation

Roof racks according to this document can be marked via the designation of the document and the designation of the type.

EXAMPLE Designation of a roof rack type A:

Roof rack ISO 11154 – A

5 Attachment to the vehicle

The attachment of the roof racks to be tested according to this document with the vehicle shall be realized by a mechanical non-positive locking. Combinations of non-positive with positive locking are thus not excluded.

If a manufacturer brings a special roof rack into circulation, which only requires a carrying bracket or cross member of type A (e.g. single wheel carrier or wind deflector) for attachment to the vehicle, the manufacturer shall test this special roof rack completely with the entire intended structure and the intended vehicle according to this document.

6 Safety requirements, tests

6.1 Measurement uncertainties

Unless otherwise stated, the measurement uncertainties based on the Newton values shall correspond to the following:

Forces and torques	±5 %
Masses and weights	±2 %
Dimensions	±2 %
Angles	±2°
Time (e.g. test duration)	±5 s
Temperatures	±5 %
Pressure	±5 %
Speed	±5 %

6.2 General

The test requirements described in the following clauses are minimum requirements. Tests with increased requirements are permissible.

The following requirements and associated tests apply for components whose failure would also entail a failure of the overall system or detachment/loss of the load or which would render safe driving of the vehicle impossible.

6.3 Resistance of the materials

The roof rack including accessories shall fulfil requirements 6.11 to 6.13 in the temperature range from –20 °C to +60 °C.

This is to be demonstrated for plastic parts in the force flow by one of the following methods:

— material test certificates and test reports[1)] show the suitability of the design for the intended purpose;

— performing tests under the above extreme conditions;

— reference to corresponding material standards.

6.4 Test procedure

Five test samples shall be used for the tests. The sequence of the tests shall follow Figure 2.

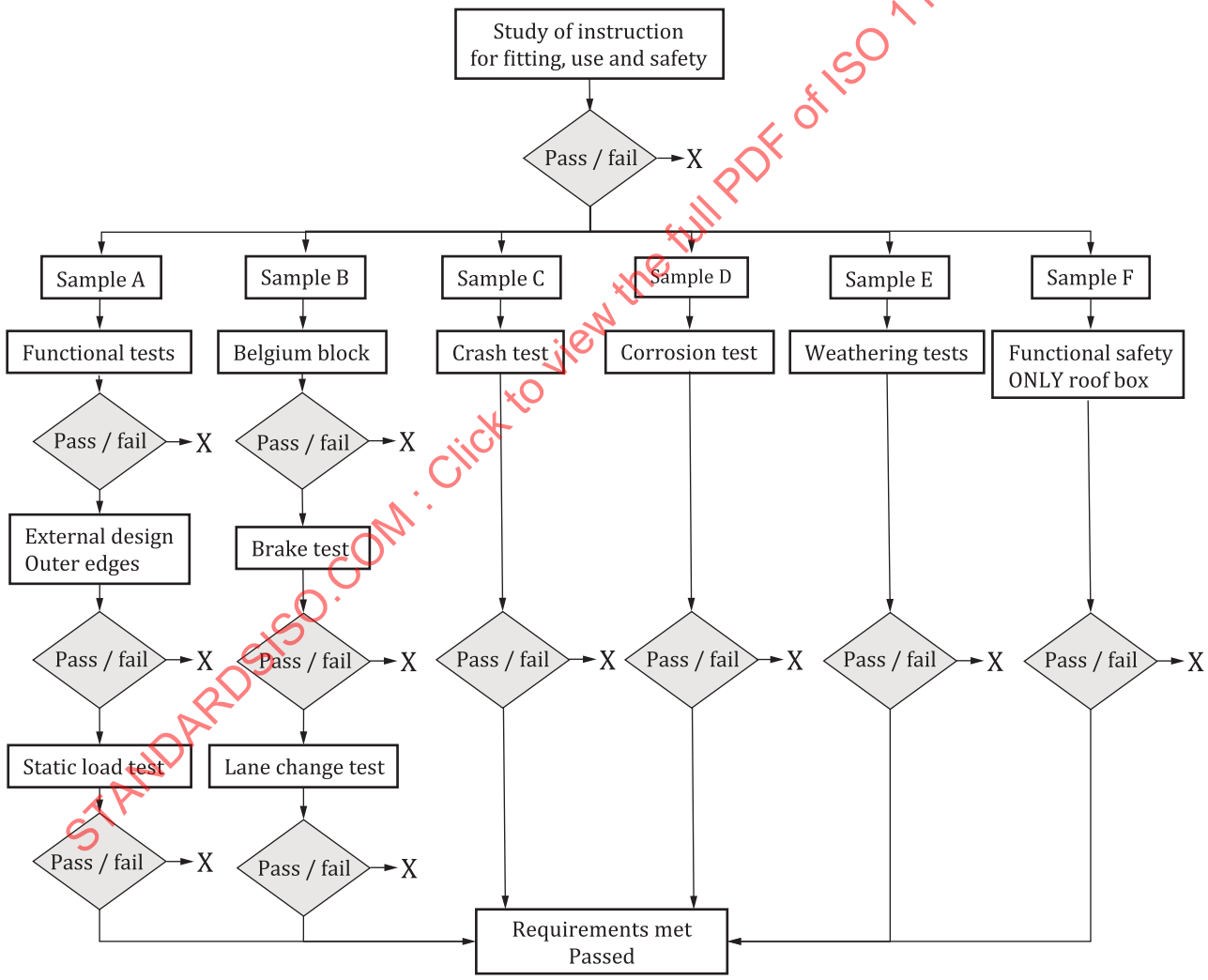


Figure 2 — Test sequence

1) For example, technical specifications for the material or test sample of the manufacturer or manufacturer certificate.

6.5 Test conditions

The strength and functional safety are determined both by dynamic test bench tests as well as in drive tests and static-load tests.

The screws are tightened with the torques indicated in the instructions for use.

The roof racks shall be tested in the installation situation approved as least favourable for the user (e.g. height-adjustable roof racks are tested in the highest position).

For types A to L, the distance in the x-direction of the middle plane of the base carrier, which the roof racks to be tested assume, shall be (700 ± 2) mm. Roof racks for which the distance is already specified by regulations or design, shall be tested with the specified distance. In case of roof racks that are fastened to rain gutters, the following rain gutter distances shall serve as a basis: during drive test ≥ 1 250 mm; during the tests for the static load bearing capacity = 1 250 mm. If the intended use is limited by the manufacturer of the roof rack, the maximum permissible distance of rain gutters shall be applied.

The detailed mounting conditions that shall be followed for the test are oriented to the specifications of the manufacturers of the roof racks or vehicle manufacturers. These specifications shall be included in the user information.

6.6 Test specimens

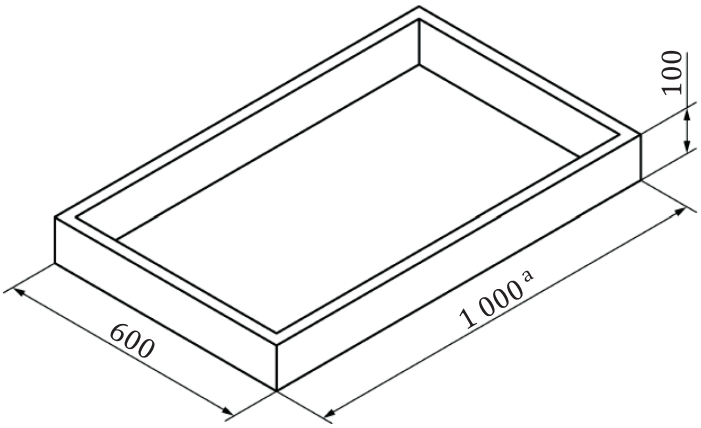
Roof racks which correspond to the series state shall be presented as test specimens for the operational safety (see 6.11), the brake test (see 6.11.4), the static-load bearing capacity (see 6.12) and the crash simulation stress (see 6.13). A new test specimen can be used, if required, for testing the operational safety. If one of these tests is negative, this test may only be repeated to pass these requirements if an improvement has been made to the roof rack or the attachment to the vehicle. The other tests shall be repeated with this new technical status if their result is affected by the modification.

6.7 Test instruments

6.7.1 Roof-box dummy for load simulation

The test crate shall be designed according to Figure 3 and shall not be deformed by the load. The mass of the test crate shall correspond to Table 1. The mass of the load weights shall be evenly distributed. The centre of gravity height of the laden roof-box dummy shall be between 50 mm and 80 mm above the roof rack, roof rails or roof panel.

Dimensions in millimetres



[a] If the distance between the outer roof rails is more than 900 mm, the length of the test crate shall correspond to this distance plus 100 mm.

Figure 3 — Test crate

6.7.2 Test wheel

The test bicycle shall correspond to Annex A.

The test wheel shall exhibit a diameter of 700 mm and the mass shall correspond to Table 1.

6.7.3 Test skis

The test skis shall exhibit a mass according to Table 1.

6.7.4 Test snowboards

The snowboard shall exhibit a mass according to Table 1.

6.7.5 Test surfboard

The test surfboard shall exhibit a mass according to Table 1. The dimensions of the test surfboard shall correspond to Figure 4.

Dimensions in millimetres

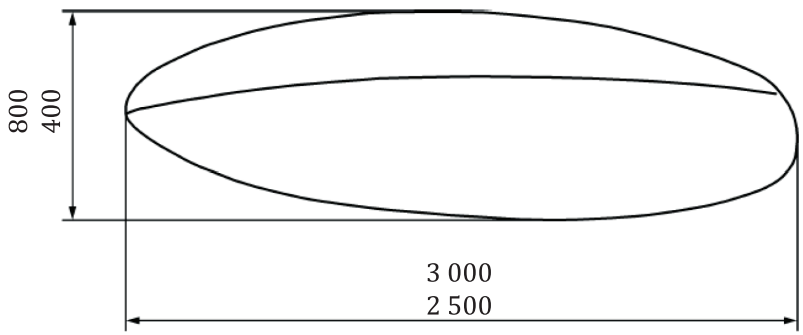


Figure 4 — (Wind) surfboard

6.7.6 Test surf mast

The test surf mast shall exhibit a mass according to Table 1 and a minimum length of 4 500 mm.

6.7.7 Test boat

The test boat shall exhibit a mass according to Table 1. The dimensions of the test boat shall correspond to Figure 5.

Dimensions in millimetres

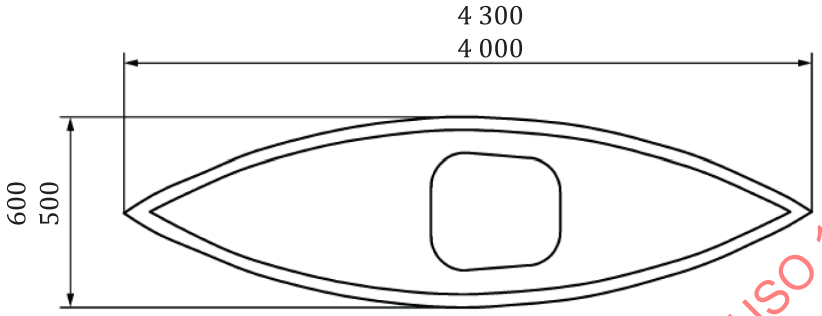


Figure 5 — Boat

6.7.8 Test ladder

The test ladder shall exhibit a length of 4 m, with a mass of 9,5 kg.

6.7.9 Test roof box

The test roof box is not the roof-box dummy [see (6.7.1)] but the roof box itself.

This shall be loaded with the masses from Table 1.

6.7.10 Test air deflector device

The test air deflector device is the air deflector device itself.

6.7.11 Test basket

The test basket is the luggage basket itself. Test baskets shall be differentiated into two types: with gallery on all sides (see Figure 6), with side gallery (see Figure 7).

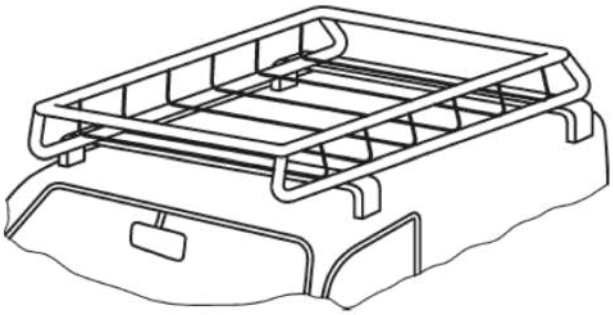


Figure 6 — Test basket with gallery on all sides

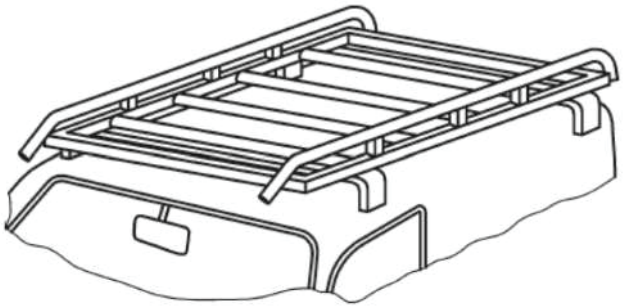


Figure 7 — Test basket with side gallery

6.8 External design

In order to avoid injuries to other road users in the event of accidents, roof racks shall conform to the requirements (see ECE-R 26, outer edges and protrusions) applicable at the time of testing.

See national statutory regulations regarding external limitation and lighting. An unintentional detachment the cross member out of the means of attachment of the base carrier shall be prevented by design (e.g. end stop).

6.9 Functional design

Safety-relevant locking mechanisms shall be secured against automatic and unintentional opening.

The testing of the locking mechanisms shall be performed by a manual test.

6.10 Attachment and type of load during the test

The attachment of the roof racks and their load during the tests according to 6.11 to 6.13 shall be carried out as specified by the manufacturer.

Table 1 — Test weights

Roof rack	Basis of the calculated test force for the test according to 6.12 and 6.13	Test weights for tests according to 6.11	Type of attachment of the load/test weights	Location of the centre of gravity of the additional weight
Base carrier Type A	Permissible load bearing capacity specified by the manufacturer	1,5 times the permissible load bearing capacity	**A.** In case of base carriers with special cross member profile and special assembly regulations for the use of this profile for attachment of the further roof rack components or loads: Additional load attached rigidly on a sufficiently stable device (e.g. plate), this is connected firmly twice with the two carrying bracket or cross member profiles (device length 700 mm, device width 600 mm, y-position of the attachment points aligned centrally, distance of the base carriers in x-direction as specified by the manufacturer or 700 mm in the absence of specifications).	**A.** Centre symmetrical to the attachment points plate to carrier The additional weights shall be dimensioned so that a centre of gravity of approximately 50 mm to 80 mm above the cross-member profile results.
			B. Base carriers where the attachment of the further roof rack components or loads are not specified in more detail, are fastened with a test crate fastened with straps and provided with stoppers on each cross member, tested as specified in Figure 8. (Distance of the base carriers in x-direction as specified by the manufacturer or 700 mm in the absence of specifications.)	**B.** See Figure 8.
The additional weights shall be attached at the points described in such way that they are resistant to movement and vibration. The attachment of the additional load shall not lead to strengthening of the roof rack to be tested.				

Table 1 *(continued)*

Roof rack	Basis of the calculated test force for the test according to 6.12 and 6.13	Test weights for tests according to 6.11	Type of attachment of the load/test weights	Location of the centre of gravity of the additional weight
Luggage carrier Type B/ luggage basket Type I/ roof box Type G	Permissible load bearing capacity specified by the manufacturer		Additional loads shall be attached with support from existing or supplied means of attachment as specified by the manufacturer on the base of the luggage carrier/luggage basket/roof box. Sand bags shall be used as additional loads.	Additional weight distributed as specified by the manufacturer
Ski snowboard carrier Type C	For each pair of skis and snowboard as specified by the manufacturer, but min. 7 kg		See Figure 10, in case of load with skis or snowboards these shall be mounted with the tip to the rear.	At the centre of gravity of the "test skis", with mounted skis/ snowboards, the additional weight (if necessary) is mounted in the area of the bindings.
Cross-country ski carrier Type K	For each pair of skis as specified by the manufacturer, but min. 3 kg		See Figure 10, in case of load with skis these shall be mounted with the tip to the rear.	At the centre of gravity of the "test skis", with mounted skis, the additional weight (if necessary) is mounted in the area of the bindings.
(Wind) surf carrier Type D	For (wind) surfboard as specified by the manufacturer, but min. 15 kg		The roof rack is loaded with a wind surfboard as specified by the manufacturer, the front tip shall point downward in the direction of travel.	The centre of gravity of the additional weight is located at the approximate centre of gravity of the wind surfboard.
Surf mast carrier Type L	For each mast as specified by the manufacturer, but min. 3 kg		The roof rack is loaded with a surf mast or a similar test object with the same dimensions, as specified by the manufacturer.	The centre of gravity of the additional weight is located at the approximate centre of gravity of the wind surf mast.
Bicycle carrier Type E	For each bicycle as specified by the manufacturer, but min. 15 kg or 25 kg for EPAC (see Annex A)		The roof rack is loaded with a bicycle as specified by the manufacturer.	The centre of gravity of the additional weights is located at a height of 500 mm ± 25 mm above the cross-member support approximately at the bicycle centre.
The additional weights shall be attached at the points described in such way that they are resistant to movement and vibration. The attachment of the additional load shall not lead to strengthening of the roof rack to be tested.				

Table 1 *(continued)*

Roof rack	Basis of the calculated test force for the test according to 6.12 and 6.13	Test weights for tests according to 6.11	Type of attachment of the load/test weights	Location of the centre of gravity of the additional weight
Boat carrier Type F	As specified by the manufacturer, but min. 25 kg		The roof rack is loaded with a boat as specified by the manufacturer.	The centre of gravity of the additional weight is located at the approximate centre of gravity of the boat.
Air deflector device or similar Type H	Test loads according to Tables 3 and 4	1,5 times the roof rack weight	Attachment as specified by the manufacturer. See also Clause 5.	The centre of gravity of the additional weight is located centre symmetrically in relation to the roof rack height and width.
Front wheel/rear wheel holder (bicycle) Type J	2 kg	1,5 times the permissible load bearing capacity	The roof rack is loaded with a front wheel as specified by the manufacturer.	Centre of wheel axle (see Figure 9)
The additional weights shall be attached at the points described in such way that they are resistant to movement and vibration. The attachment of the additional load shall not lead to strengthening of the roof rack to be tested.				

6.11 Operational safety

6.11.1 General

The test for the operational safety has the aim of validating the damage-free functional capability under operating conditions. To increase the safety of the validation, this test is carried out with increased test weight according to Table 1.

The tests for the roof racks of Types A and B to be tested are carried out with the vehicle specially provided for these types. The roof racks of Types C to L to be tested are mounted on a sufficiently stable roof rack of Type A not subject to the test requirements, which is mounted on the test vehicle defined in 6.11.2.3.

The tests in real operation according to 6.11.2.2 and 6.11.2.3 can be replaced by adequate tests in the laboratory. In order to reproduce a Belgian block test with laboratory equipment, the devices used shall be able to reproduce six degrees of freedom and be suitable for frequencies of 0,5 Hz to 60 Hz. The equipment shall also be able to measure and record the accelerations actually occurring, in order to confirm that the current test results correspond to the target data. For the testing of the roof racks Types A and B, the vehicle provided can be replaced by its roof section.

6.11.2 Vibration resistance

6.11.2.1 Requirements

The components of the roof rack and vehicle provided for the roof rack loaded during the tests shall not exhibit any permanent deformation nor become non-functional. Signs of settling are not regarded as permanent deformation.

Tightening torques (prevailing torque) of bolted joints shall not decrease by more than 30 %. The load shall remain adequately secured on the roof rack after the test.

After all three test speeds, the maximum permissible displacement of the roof rack to be tested shall be 5 mm at the contact points to the vehicle.

The testing of Type A and B is conducted according to 6.11.2.2.

The testing of Type C to L is conducted according to 6.11.2.3.

6.11.2.2 Testing of Type A and B

The specially provided vehicle with roof rack to be tested and test weights travels on a Belgian block test track for a test distance of minimum 2 000 m at each test speed.

Annex B gives the instructions for the construction of the Belgian block test track.

The test distance can be attained by travelling over the test track several times. The minimum length of the test track is 50 m.

Speed: v = 15 km/h, 25 km/h and 35 km/h

Slope of the test track: 0 %

6.11.2.3 Testing of Type C to L

The test vehicle with roof rack to be tested and test weights travels on a Belgian block test track for a test distance of minimum 2 000 m at each test speed.

Annex B gives the instructions for the construction of the Belgian block test track.

The test distance can be attained by travelling over the test track several times. The minimum length of the test track is 50 m.

A suitable vehicle of medium class from current mass production with sufficient payload is used as a test vehicle, which is characterized by a wheelbase of 2 450 mm to 2 750 mm and a vehicle height in K1 location of 1 400 mm to 1 650 mm. The vehicle does not have air suspension. The vehicle corresponds to its approved state. Loading with additional weights not belonging to the vehicle is not permitted. Vehicle-specific roof racks shall be tested with a suitable vehicle from the intended usage range.

Speed: v = 15 km/h, 25 km/h and 35 km/h

Slope of the test track: 0 %

6.11.3 Lane change test

6.11.3.1 Requirements

After the lane change test, it shall be determined by a visual inspection whether attachments or parts of the carriers have loosened or whether damage to the vehicle or to the load has occurred.

Testing is carried out according to 6.11.3.2. However, the test shall not be carried out for roof racks on trailers.

6.11.3.2 Test method

The lane change test shall be carried out according to ISO 3888-2 and is driven by a vehicle (see 6.11.2.3) at the following speeds in succession:

— 50 km/h;

— 55 km/h;

— 60 km/h.

6.11.4 Brake test

6.11.4.1 Requirements during braking

After full braking, it shall be determined by a visual inspection whether attachments or parts of the roof load carrier have loosened and/or whether damage to the vehicle or to the load has occurred.

6.11.4.2 Carrying out the brake test

When testing each roof rack, braking is performed with maximum attainable deceleration (with ABS) on a flat, dry road with the relevant test vehicle at an initial speed for each of the three instances of braking of 80 km/h, 30 km/h and 15 km/h until standstill. The coefficient of friction of the road surface shall be 0,7 at a minimum. The following requirements for the mean fully developed deceleration (measured with disconnected engine) shall be fulfilled:

— for passenger cars: 6,4 m/s^2 with a maximum actuating force of 50 daN;

— for light commercial vehicles until 3,5 t: 5 m/s^2 with a maximum actuating force of 70 daN.

The loading with additional weights is performed in accordance with Table 1.

6.11.5 Requirements and test criteria for lane change test (6.11.3) and brake test (6.11.4)

— The product shall remain safely fixed to the vehicle/roof, railing or roof load carrier device during the complete test.

— The load shall remain safely fixed to the roof load carrier device.

— The load shall not be damaged during the test.

— The main function of the product shall remain after the competed test.

— No visual plastic deformations or cracks are allowed on structural parts. A deformation can be accepted, as far as it does not have any negative influence on function or safety of the device

— During the test, the load and the device of the roof load carrier shall not come into contact with the vehicle or damage it.

— There shall be no chafe marks on the car finish.

— The remaining torque shall be more than 70 % of the initial torque.

— Displacements (d) of maximum 20 mm between product and roof or railing / fixing point shall occur, following the specification listed in Annex F, Figure F.1.

— Displacements (d) of maximum 10 mm between carrier feet and cross bar shall occur, following the specification listed in Annex F, Figures F.2 to F.8.

6.12 Static load bearing capacity

6.12.1 General requirements

6.12.1.1 Types A to L

For Types A to L, the requirements according to Table 2 apply.

Table 2 — Minimum traction force F_x or $F_{x20°}$ for Types A to L in relation to the permissible load bearing capacity

m_N [kg]	F_x or $F_{x20°}$ [N]	F_x or $F_{x20°}$ [N]
Permissible load bearing force	At $F_x = F_{x20°} = 20 \times m_N$ the deformation in the vehicle longitudinal direction (see also Figure 8) shall be maximum 10 mm.	At $F_x = F_{x20°} = 40 \times m_N$ no failure may occur and the sum, *s*, from displacement and plastic deformation in the vehicle longitudinal direction (see also Figure 8) shall not exceed 50 mm.
30	600	1 200
40	800	1 600
50	1 000	2 000
60	1 200	2 400
70	1 400	2 800
80	1 600	3 200
90	1 800	3 600
100	2 000	4 000

6.12.1.2 Type H, air deflector devices

For Type H the requirements according to Table 3 apply.

The worst-case position shall be tested in case of adjustable air deflector devices.

Table 3 — Minimum traction force in relation to the air resistance area of a roof rack of Type H, air deflector devices

A [m^2]	F_x or $F_{x20°}$ [N]	F_x or $F_{x20°}$ [N]
Air deflector area A	At $F_x = F_{x20°} = 1\,200 \times A$ the deformation in the vehicle longitudinal direction (see also Figure 8) shall be maximum 10 mm.	At $F_x = F_{x20°} = 2\,400 \times A$ no failure may occur and the sum, *s*, from displacement and plastic deformation in the vehicle longitudinal direction (see also Figure 8) shall not exceed 50 mm. Apparent plastic deformations are permitted.
0,2	240	480
0,3	360	720
0,4	480	960
0,5	600	1 200

6.12.1.3 Type H, advertising carriers and signal lights

For Type H for advertising carriers and signal lights, the requirements according to Table 4 apply.

Table 4 — Minimum traction force in relation to the air resistance area of a roof rack of Type H, advertising carriers and signal lights

A [m^2]	F_x or $F_{x20°}$ [N]	F_x or $F_{x20°}$ [N]
Air deflector area A	At $F_x = F_{x20°} = 2\,400 \times A$ the deformation in the vehicle longitudinal direction (see also Figure 8) shall be maximum 10 mm.	At $F_x = F_{x20°} = 4\,800 \times A$ no failure may occur and the sum, *s*, from displacement and plastic deformation in the vehicle longitudinal direction (see also Figure 8) shall not exceed 50 mm. Apparent plastic deformations are permitted.
0,1	240	480
0,2	480	960
0,3	720	1 140
0,4	960	1 920
0,5	1 200	2 400
NOTE The test forces are derived from the air resistance at about 80 km/h relative speed between the vehicle and wind flow.		

6.12.2 General test

The test forces according to 6.12.1 shall correspond at a minimum to the permissible load-bearing capacity indicated by the manufacturer (see Tables 1 and 2) or to the test forces resulting from the available air resistance area (Tables 3 and 4). After reaching the half and full maximum load, the force is promptly removed and the path s measured.

Types A and B:

All static pull-off tests at categories A and B shall be performed with the intended vehicle itself or its roof section. Instead of the roof section, a device shall be used as a substitute, which offers the same clamping and stress conditions. The fixed anchoring of the vehicle section or the device shall not act as additional reinforcement.

Types C to L:

The base carrier that is to hold the roof rack to be tested (base carrier with the relevant clamping conditions for Types C to L) is fixed mounted. The roof racks of Types C to L are fixed mounted on the base carrier as specified by the manufacturer. In the absence of specifications, the distance of the base carriers in the x-direction is 700 mm.

Roof racks with special attachment shall be tested on vehicles with this means of attachment or on corresponding test structures with the same clamping and stress conditions.

6.12.3 Testing the forces in the direction of travel; height of the force application point

The roof rack is mounted with the tightening torque as specified by the manufacturer in the highest position.

The force F_x is applied corresponding to Table 2 to Table 4 in the direction of travel.

The tensile tests are carried out in the longitudinal direction in a horizontal plane.

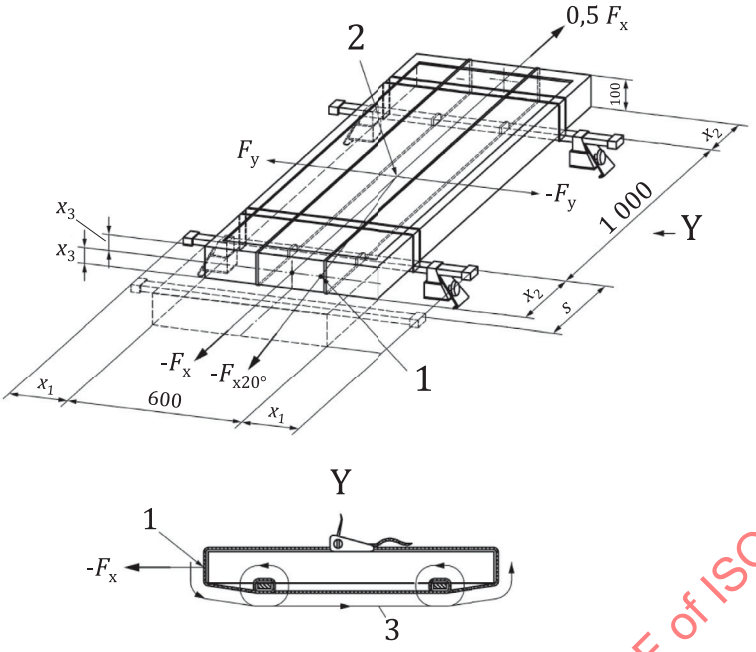
The measurement of the maximum permissible displacement of the roof rack to be tested is carried out at the contact points to the vehicle or to the carrying system.

Table 5 — Force application points

Roof rack	The force application occurs	Position of centre of gravity
Base carrier	at the balance point of the load.	See Table 1.
Luggage carrier Luggage basket	distributed evenly 50 mm to 80 mm above the roof rack base, over the width of the galleries on all sides in the direction of force (see Figure 6); in case of side galleries (see Figure 7) roof racks force application centre symmetrical to the attachment points to the base carrier/vehicle by means of stable aiding device.	
Ski carrier Snowboard carrier	at the centre of gravity of the test skis or snowboards.	See Figure 10.
Windsurf carrier	at the centre of gravity of the boards provided.	See Table 1.
Bicycle carrier	at the centre of gravity of the bicycles.	See Table 1.
Boat carrier	at the centre of gravity of the boats provided.	See Table 1.
Air deflector devices, advertising carriers, signal lights	at the centre of gravity of the device provided.	See Table 1.
Roof box	when a strap is looped around the roof box in the direction of force application, the vector of the tensile force on the strap is at a height of 50 mm to 80 mm over the roof rack base through the centre of gravity of the load or at the height of the front attachment to the base carrier.	
Front wheel/rear wheel holder (bicycles)	at the centre of the wheel hub.	See Figure 9.

For more information on the force application, see Annex E – Figures E.1 to E.6.

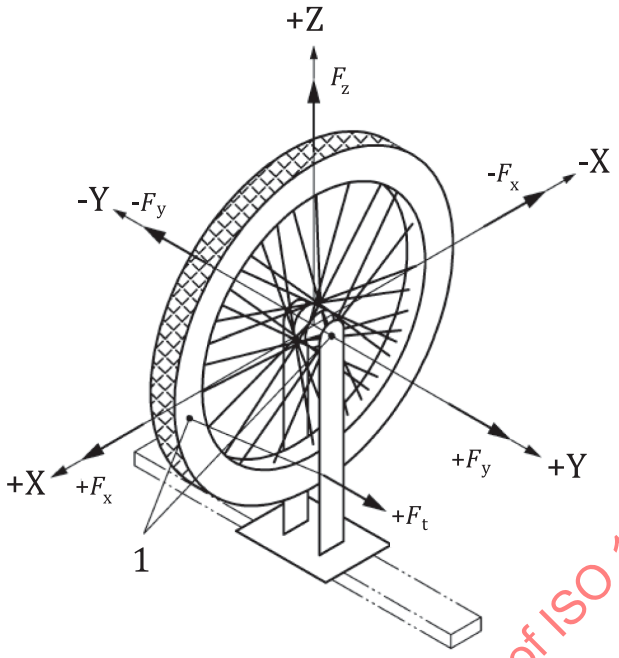
Dimensions in millimetres



Key

x_1 symmetrical alignment in y-direction
x_2 symmetrical alignment in x-direction
x_3 symmetrical alignment in z-direction
1 force application
2 centre of gravity
3 wrapping direction around the roof rack and test device (e.g. test crate)
s displacement

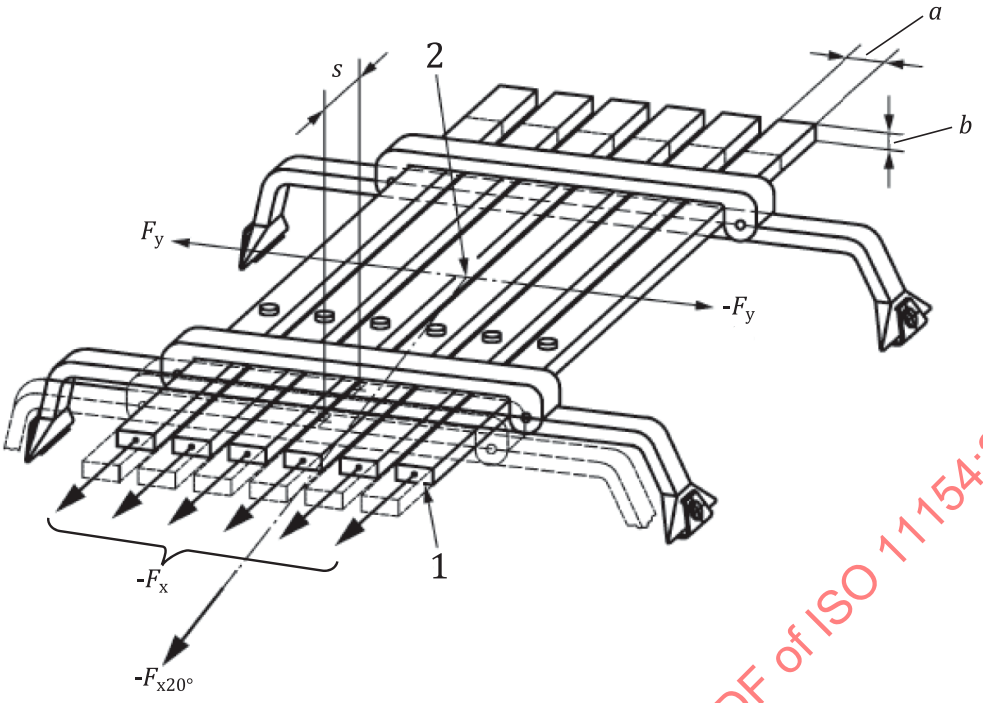
Figure 8 — Roof rack with test crate



Key

x-direction	vehicle longitudinal axis
y-direction	transverse to the vehicle longitudinal axis (horizontal)
z-direction	transverse to the vehicle longitudinal axis (vertical)
1	force application
F_z	direction of the vertical force
$-Fy$	direction of the opposing lateral force, acting laterally to the direction of travel
F_y	direction of the lateral force, acting laterally to the direction of travel
$-F_x$	direction of the longitudinal force, acting in the direction of travel
F_x	direction of the opposing longitudinal force, acting against the direction of travel
F_t	direction of the torsional force

Figure 9 — Front /rear wheel holders with force application points



Key

1	force application
2	centre of gravity
a	70 mm for downhill ski and 40 mm for cross-country ski
b	27 mm for downhill ski and 24 mm for cross-country ski
$-F_x$	force in x-direction
$-F_{x20°}$	force 20° inclined to x-axis
s	displacement

Figure 10 — Roof ski carrier with test ski from planed boards

As a substitute for skis or snowboards, planed boards, as shown in Figure 10, are used for testing of Type C. The displacement of the planed boards is prevented by and end stop on the ski carrier located on each of the boards.

6.12.4 Requirements for forces in the direction of travel $-F_x$

The forces indicated in 6.12.1 shall be attained for the permissible load bearing capacities of the roof rack indicated in Table 1.

6.12.5 Requirements for forces opposing the direction of travel $+F_x$

The test forces ≥ 0,5 F_x according to 6.12.1 shall be complied with.

6.12.6 Testing the forces opposing the direction of travel $+F_x$

The test shall be carried out similarly to 6.12.4 (testing the wind resistance and impact from the rear).

6.12.7 Requirements for forces 20° horizontal to the direction of travel (only for Types A and B)

The forces indicated in 6.12.1 shall be attained for the permissible load bearing capacities of the roof rack indicated in Table 1.

6.12.8 Testing the forces 20° horizontal to the direction of travel (only for Types A and B)

Testing is done as in the test according to 6.12.4, but the tensile tests with the force $F_{x20°}$ (see 6.12.1) are carried out in a horizontal plane 20° to the vehicle longitudinal axis. The force application point shall correspond to Table 2.

6.12.9 Requirements for the stress due to vertical forces

Roof racks shall be able to absorb the vertical forces (buoyancy forces) to be expected during intended use.

During testing, neither the roof rack nor the load (e.g. bicycle) shall become detached. No part of the roof rack shall deform in such way that the intended function becomes impaired.

The test is carried out on the rear attachment points at half the value of the force indicated in Table 3. The testing of the attachment points can be omitted if the attachment conditions are the same at the front and rear.

6.12.10 Testing the stress due to vertical forces

Testing is done as in the test according to 6.12.4, but the tensile tests with the force F_z (buoyancy) (see Table 6) are carried according to Figure 11. The force is applied in the plane that passes through the front or rear attachment points of the roof rack to the carrying system for Types C to L or the front or rear carrying bracket for Types A and B. The force is applied two sided with the shortest possible distance to the means of attachment to the carrying system on the roof rack to be tested for Types C to L or at a centre symmetrical distance of 800 mm for Types A and B.

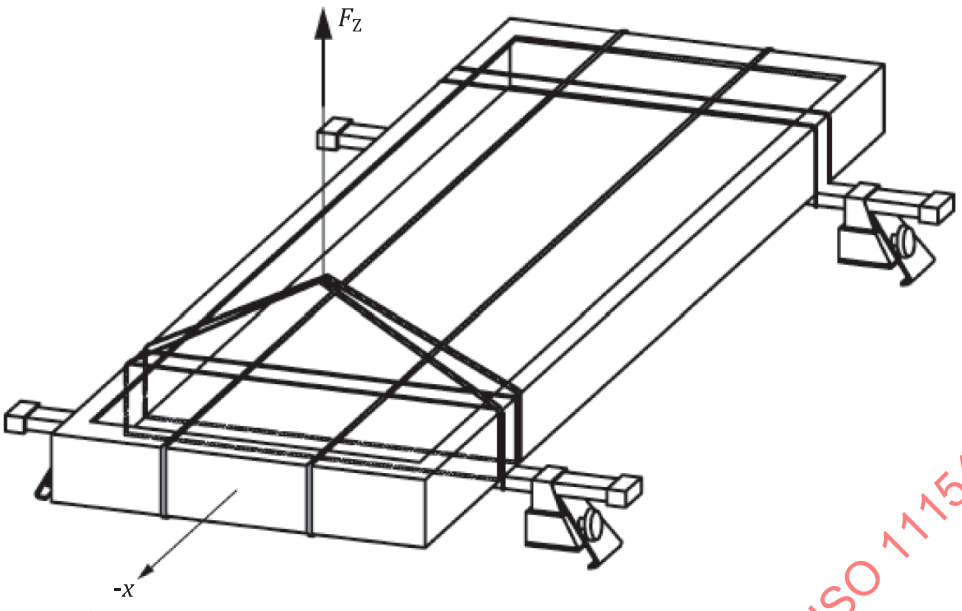
Duration of the load: 10 min.

The force F_z (buoyancy) according to Table 6 shall be applied as a tensile force so that the means of attachment to be tested are loaded evenly.

Table 6 — Vertical force F_z (buoyancy) on the roof rack

Design	Vertical force F_z (buoyancy) at the front carrying bracket [N]	Multiple
Base carrier Luggage carrier Luggage basket	3 000	1
Ski carrier	240	multiplied by the number of skis (next to each other)
Snowboard carrier	720	multiplied by the number of snowboards (next to each other)
Windsurf carrier	1 500	1
Bicycle carrier	600	1
Boat carrier	1 500	1
Roof box	2 000	1

For more information on the force application, see Annex E – Figures E.1 to E.6.



Key

−x direction of travel

F_z direction of vertical force

Figure 11 — Testing the buoyancy force

6.12.11 Requirements for the stress due to lateral forces

During testing, neither the roof rack nor the load (e.g. bicycle) shall become detached. No part of the roof rack shall deform in such way that the intended function becomes impaired.

For the roof racks, the sum from the plastic deformation and displacement at the contact points to the vehicle shall not exceed 10 mm.

Testing in both directions can be omitted if the attachment conditions right and left are the same.

6.12.12 Testing the stress due to lateral forces

The strain due to lateral forces is tested according to 6.12.4, but the tensile tests with the force F_y (see Figure 1 and Table 7) are carried out in a vertical plane to the vehicle longitudinal axis.

Duration of the load: 1 min.

The lateral forces resulting due to centrifugal forces or side wind are tested on the roof racks according to Table 7 by a static load test. The force is applied according to Table 5.

After reaching the full maximum load, the force is promptly removed.

The path s of displacement is measured directly at the contact points to the roof or base carrier.

Table 7 — Lateral forces F_y on roof racks

Design	Lateral force F_y [N]	Multiple
Base carrier	20	multiplied by the maximum permissible load in kg
Ski carrier	240	multiplied by the number of ski pairs

Table 7 *(continued)*

Design	Lateral force F_y [N]	Multiple
Snowboard carrier	720	multiplied by the number of snowboards next to each other
Windsurf carrier	375	multiplied by the number of surfboards next to each other
Bicycle carrier	40	multiplied by the maximum permissible load in kg alternating three times (see Figure E.4)
Boat carrier	375	multiplied by the number of boats next to each other
Roof box/luggage basket	20	multiplied by the maximum permissible load in kg
Front wheel/rear wheel holder	80	—

For more information on the force application, see Annex E – Figures E.1 to E.6.

6.13 Crash simulation stress

6.13.1 Requirement for the crash simulation stress

The roof racks to be tested shall remain on the vehicle during the crash simulation (typical collision accident in the city).

No part that has a mass greater than 10 g may become detached. The components of the roof racks and vehicle loaded during the tests may exhibit permanent deformation and/or damage or become non-functional.

The progression of the acceleration shall not be below the acceleration curve specified in Figure 12.

The speed of the carriage directly before applying the test load is 16^{+2}_{0} km/h. The end speed is 0 km/h.

In case of a test with positive acceleration of the carriage, the end speed is 16^{+2}_{0} km/h, after a start speed of 0 km/h.

If tests are carried out with increased requirements, these are only permissible as a substitute if these requirements comprise higher acceleration, lower limits or more demanding time regimes with the aim of attaining a higher dynamic load. In this case, an adequate increase in the carriage speed is permissible.

The tests can be carried out with a roof rack of Types A to L or alternatively with a combination of Types C to L, mounted on Type A. Upon fulfilling the requirements, Types C to L and the roof rack involved in the test shall pass the test within the framework of the implemented test conditions. Type A can only pass the test alone or if similar to the test setup, only in conjunction with Types G and I.

6.13.2 Testing the crash simulation stress

Types A and B:

All crash simulations on Types A and B shall be performed with the vehicle itself or its roof section. Instead of the roof section, a device shall be used as a substitute, which offers the same clamping and stress conditions. The fixed anchoring of the roof section or the device on a moving test carriage shall not act as reinforcement.

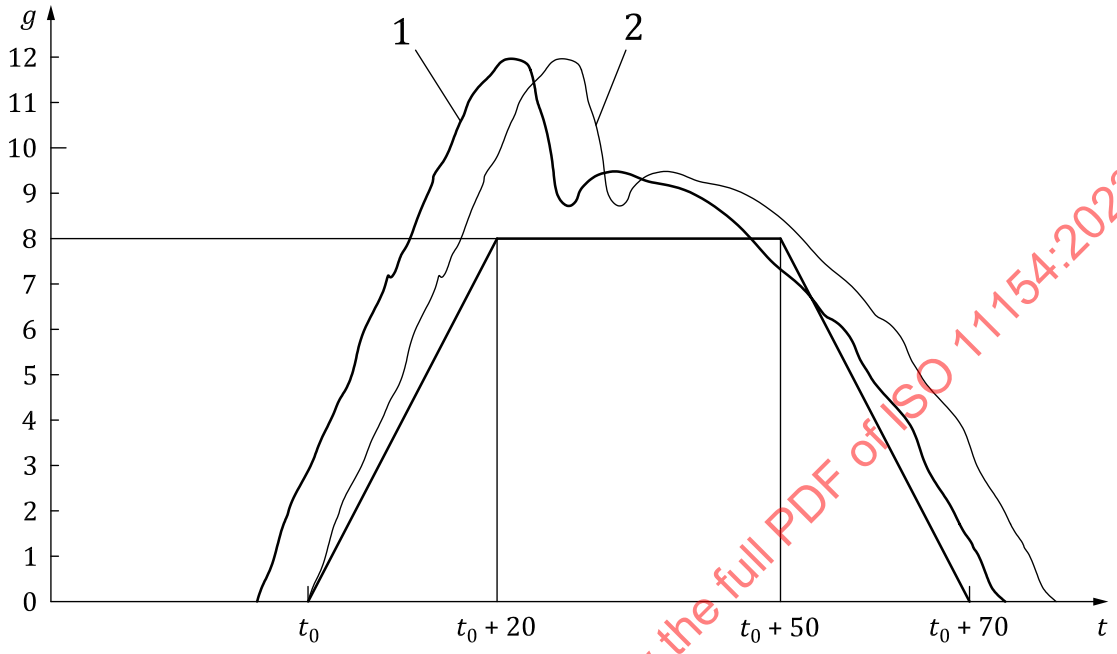
Types C to L:

The carrying system that is to hold the roof rack to be tested (carrying system with the relevant clamping conditions for Types C to L) is firmly anchored on a moving test carriage. This fixed anchoring shall not act as reinforcement.

The roof racks of Types C to L are fixed mounted on the carrying system.

Roof racks with special attachment shall be tested on vehicles with this means of attachment or on corresponding devices with the same clamping and stress conditions.

After loading with the permissible loading bearing capacity of the roof rack, a horizontal acceleration according to Figure 12 acting against the direction of travel is applied onto the test carriage on which the carrying system is anchored.



Key

1 measuring curve recorded during the test

2 option of shifting the curve

NOTE The example shows the measuring record of a passed test.

Figure 12 — Braking the test carriage at initial speed 16^{+2}_{0} km/h

6.14 Corrosion resistance

6.14.1 Requirements for the corrosion resistance of components with galvanic surface protection

After the test, no corrosion shall be present inside and outside, which would impair the function and strength of the roof rack.

Upon loosening the connections, no parts shall break nor shall visible damage occur.

Carrying rods that are covered with plastic sleeves shall be coated with a galvanic surface protection inside and outside.

6.14.2 Testing the corrosion resistance of components with galvanic surface protection

The roof rack or a partial extent representative for the strength shall be mounted as specified by the manufacturer with the intended material pairings of the contact points. Any cut edges can be protected according to ISO 9227:2022, 8.3.

All bolted joints shall be tightened as specified by the manufacturer.

The degreased roof rack is subject to a salt spray test according to ISO 9227.

Duration of test: 168 h.

Tightening torques (further torque) of bolted joints shall not decrease by more than 30 %.

6.15 Weather resistance

6.15.1 Requirements for the weather resistance of plastic straps parts and attachment elements exposed to UV

The impact strength determined shall not drop by more than 20 % in comparison to the non-aged samples, whereby a corresponding service life of 5 years is presupposed.

6.15.2 Testing the weather resistance of plastic parts and means of attachment

Plastic parts exposed to UV shall be tested according to ISO 4892-2. The test duration in the synchronisation is 250 h. The black standard temperature is (65 ± 3) °C. The test cycle is performed with a rain time of (18 ± 0,5) min and a subsequent drying time of (102 ± 0,5) min. The relative air humidity in the dry phase is 65 %. The irradiance is (0,51 ± 0,02) W/(m^2 · nm). Following the test according to ISO 4892-2, impact bending tests (according to ISO 179-1) shall be carried out in accordance with ISO 179-1/1fU or ISO 179-1/1n on aged and non-aged samples for material composites.

The impact bending tests are carried out with an impact on the non-weathered side. The decrease in the impact strengths due to weathering shall be determined on samples that exhibit the same orientation in respect to the manufacturing method.

The results are evaluated as follows:

To determine the impact strength value on non-aged and aged samples, 7 samples of the tested 10 items of samples shall exhibit a fracture, in order to attain a true (or actual) impact strength value or the resultant mean value (in accordance with ISO 179-1). If 0 % fracture is present at the non-aged samples when determining the impact strength (there is no fracture and the test specimen is only bent and/or drawn through, possible in conjunction with a white fracture), the impact strength value displayed on the test device shall be included as an initial value for drawn-through non-fractured samples (with fracture types).

6.15.3 Cold resistance of plastic parts and attachment elements

6.15.3.1 General requirements (except for outer skin of roof boxes Type G)

No obvious damage (fracture) or deformation shall occur on the component after the cold resistance test. The tests shall be carried out after storage at −20 °C. The storage duration is 2 h per 1 mm wall thickness.

At least one storage of the part at room temperature (23 ± 5) °C shall occur between both thermal storages for min. 2 h respectively per 1 mm wall thickness.

6.15.3.2 General test (except for outer skin of roof boxes Type G)

Ball drop test with steel ball:

Energy: 2,0 J

Ball weight: 250 g

Fall height: 0,815 m

Component temperature: −20 °C

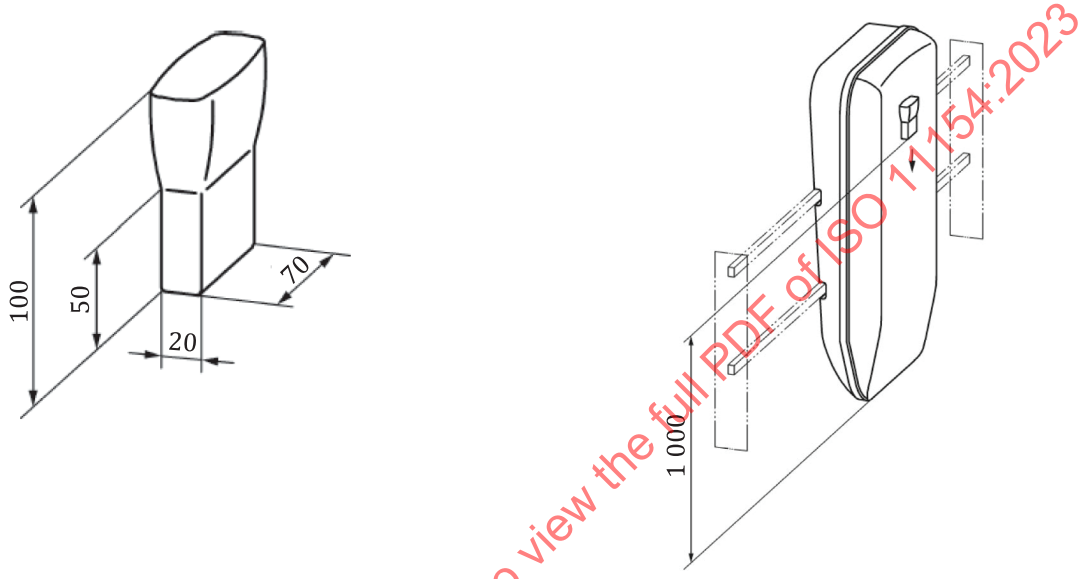
6.15.3.3 Requirement for the cold resistance of the outer skin of roof boxes (Type G)

At a drop height of 1,00 m, the outer skin shall not break into separate parts by the falling body and shall not be pierced through. Cracks and stress whitening are permitted.

6.15.3.4 Testing the cold resistance of roof boxes (Type G)

The strength of the roof box is tested by a drop test at −20 °C (see Figure 13). The test shall be carried out so that the falling body with a mass of 2,5 kg impacts the non-supported front end of the roof box with the pointed end in free fall.

Dimensions in millimetres



a) Falling body (radii R5 circumferential) **b) Test setup**

Figure 13 — Drop test

6.15.4 Heat resistance of plastic parts (apart from Type G)

6.15.4.1 Requirements for the heat resistance of plastic parts (apart from Type G)

The component shall not exhibit any visible permanent deformation after the test. The function shall be ensured.

6.15.4.2 Testing the heat resistance of plastic parts (apart from Type G)

Carriers, whose carrying elements comprise plastic parts, are loaded with 1,5 times the permissible load capacity, weights and distribution similar to Table 1.

The test duration is 6 h at a temperature of 80 °C.

6.16 Functional safety of roof boxes Type G

6.16.1 Requirements

The maximum form deviation at −20 °C and +60 °C shall not impair the functional safety. The roof box shall open and close safely corresponding to the instructions for use at −20 °C and +60 °C. Visible

permanent deformations are not permitted. The function test is carried out with 1,5 times the permissible load capacity, weights and distribution similar to Table 1.

6.16.2 Test

The roof box is fastened in the usage position (horizontal orientation) on two carrying brackets which have a distance of 700 mm between them.

The test is carried out continuous component temperatures of –20 °C and +60 °C. The cold and hot storage time of the test parts is 2 h per 1 mm wall thickness.

At least one storage of the part at room temperature (23 ± 5) °C shall occur between both thermal storages for min. 2 h respectively per 1 mm wall thickness.

6.17 Lock and hinge test on the roof box

6.17.1 Requirements

After a 10-minute load, no apparent damage or deformations may occur at the hinges and locks and other attachment points.

6.17.2 Test

The cover is loaded evenly with sandbags in the reversed state of the roof box according to Figure 14. The test weight is 750 N. The roof box is located in a holding device evenly on the cover in the reversed state. The lock and hinge loading occurs evenly by uniform lifting of the base of the roof box so that the cover is fully raised from the holder.

The test shall be carried out at (23 ± 5) °C.

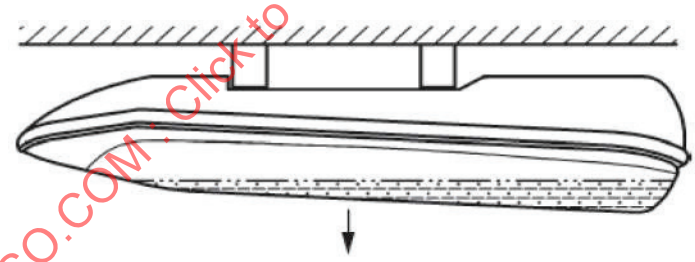


Figure 14 — Lock and hinge test

7 Marking

7.1 Requirement

To fulfil this document, the following markings, clearly visible during assembly and loading, are necessary on the roof racks:

— name and contact address of the manufacturer or, insofar as the latter is not domiciled in the European Economic Area, the name and contact address of the authorized representative or the importer shall be indicated;

— unique marking for identification of the consumer product;

— dead weight of the roof rack in kilograms;

— permissible load bearing capacity in kilograms or maximum number of skis, surfboards, bicycles, boats, etc.;

— warning note “Read manufacturer's information” or a graphic symbol (e.g. Figure 15);

— corresponding additional markings and warning notes shall be added if required.

ISO 7000-1641

Figure 15 — Read manufacturer's information

7.2 Test

A visual inspection in respect to clear legibility shall first be performed. The focus here is on adequate font size and contrast amongst other factors.

Contact with commercially available operating fluids (e.g. gasoline, diesel, oil) and cleaning agents shall not lead to any visible surface changes (deformation, discoloration, etc.) on the component.

This is tested with 10 times rubbing of the inscriptions by hand with a cotton cloth soaked in water, and then one soaked in windscreen washer fluid and another one in insect remover.

The inscriptions shall be clear legible after the tests. It shall not be possible to remove marking (e.g. labels, signs) and these shall not exhibit any crimping.

Other operating fluids which may be tested:

— cold cleaner;

— tar remover;

— rim cleaner;

— cleaner (isopropanol);

— door lock de-icer;

— ethanol;

— benzine;

NOTE The benzine used for the tests can be an aliphatic hexane solution with a maximum aroma content of 0,1 (volume fraction in percent), a Kauri butanol value of 29, an initial boiling point of about 65 °C, a drying point of about 69 °C and a specific mass of about 0,689 kg/l.

— diesel.

8 Instructions for use

8.1 General

a) The instructions for use shall have a logical structure into the area:

— safety notes,

— initial assembly,

— instructions for use and

— care notes;

b) technical terms, symbols, stylised depictions and pictograms shall be explained with the first use in the text;

c) the assignment of the images to the text, also for the language versions, shall be unmistakable;

d) the instructions for use shall be enclosed with the product in printed form.

For the notes on the layout of the instructions for use, see IEC/IEEE 82079-1.

8.2 Examples of safety notes in instructions for use

See Annex D for examples of safety notes in instructions for use.

8.3 Initial assembly

The requirements for the assembly instructions are listed below.

a) to c) in 8.1 do not apply if the roof racks are fully preassembled Ex works.

The initial assembly of the roof rack shall be described in the necessary individual steps starting from the parts kit illustrated with reference numbers and number of individual parts. If not contained in the parts kit, the required tool for the initial assembly shall be indicated precisely to the user.

The individual steps of the initial assembly shall be described and supplemented by illustrative pictures. The ready mounted roof rack shall be illustrated.

At the end of the description of the initial assembly, a reference to the instructions for use shall be provided.

8.4 Content

The instructions for use describe:

— the possible preassembly or preparation of the roof rack and vehicle;

— the proper assembly of the fully preassembled roof rack on the vehicle or on the base carrier;

— the proper loading of the roof rack (see Annex C); and

— the tightening torques of all attachment parts.

The notes according to Table 8 shall be included.

Table 8 — Notes on the content of the instructions for use

Types	Notes
A B C D E F G H I J K L	If the roof racks can be disassembled, adequate and easy-to-follow assembly instructions shall be provided (e.g. sufficient overlapping of the components).
	Instructions for setting up the complete roof rack including possible additional equipment on the vehicle.
	Note concerning which vehicle types or vehicle characteristics the roof rack is suitable for.
	Note that it is important to check the bolted joints, in particular the roof rack attachments after a short distance for the first time and again at given time intervals, depending on the road.
	Note on the changed driving performance of the vehicle (side wind sensitivity, curving and braking behaviour) when roof racks are mounted and especially loaded.
	The manufacturing company or the importer with name and address and type designation of the roof rack.
	Note that the ends of the carrying brackets or cross members shall not protrude over the rain gutter or, in case of vehicles without grain gutters, over the roof outer edges (see road-traffic regulations).
	Note that these roof racks are to be removed from the vehicle when not in use for reasons of safety, for other road users and energy saving.
	Note that the distance should be minimum 700 mm for roof racks where the distance from the front carrying bracket to the rear carrying bracket is not specified owing to their design.
A B D E F G I J K L	Indication of the roof rack dead weight.
A B I J K L	Indication of the permissible load bearing capacity of the roof rack in kilograms.
	Note on an evenly distributed load with as low centre of gravity as possible.
	Note that the transported goods shall not protrude significantly over the loading area (see road-traffic regulations).
	The transported goods shall be secured against shifting out of place using suitable tensioning straps (no elastic straps with hooks).
C K	Note that short skis that can slip out of the carriers shall be secured against sliding out of the carriers or transported in the luggage compartment.
	Note that the skis shall be loaded with the tips to the rear.
	Indication of the maximum permissible number of ski pairs.
D G	Windsurfer boards and roof boxes shall be mounted without adjustment angle in the direction of travel, to avoid increased buoyancy forces.
D	Note that the front tip shall point downward in the direction of travel when transporting windsurfer boards.
	Note that the insertion fins shall be removed during transport.
	Note on fastening the accessory parts of the windsurfer boards.
H	Note that the air deflector devices on the vehicle roof change the outer contour and may only be operated in conjunction with trailers.
G	Indication of the permissible load bearing capacity.
	Note that the load shall be secured against shifting out of place.
	Note that for safety reasons the roof box shall be mounted in such way that loading and unloading can be done from the side that is not facing the road.
	Note on leakproof functions (possible leaks when cleaning with water jets and with steam pressure, leakproof performance during driving).
E	Indication of the permissible bicycle weight.
	Note that parts of the bicycles, for example, handlebars or pedals, shall not protrude over the contour of the vehicle and that child seats, panniers, cover plates, etc. shall be removed.

Annex A
(normative)

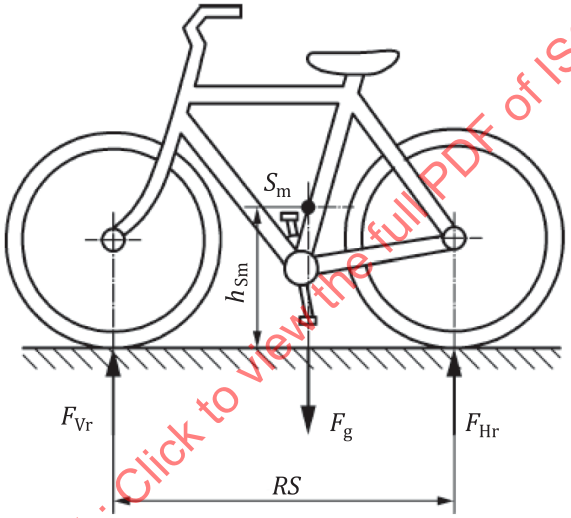
Test bicycle

A.1 Test bicycle properties

The test bicycle has the following properties:

a) wheel load distribution front/rear of 40 % (F_{Vr})/60 % (F_{Hr});

b) centre of gravity height (HS) of (500 ± 25) mm above standing point (see Figure A.1);



Key

F_{Vr}	front wheel contact force
F_g	weight force
F_{Hr}	rear wheel contact force
S_m	centre of gravity of test bicycle
RS	wheelbase
h_{Sm}	height of centre of gravity

Figure A.1 — Test bicycle

c) handlebar height/Saddle height: (1 000 ± 100) mm;

d) handlebar width: (700 ± 50) mm;

e) tyre width: 55 mm;

f) maximum tyre pressure corresponding to manufacturer's specifications;

g) luggage carrier width: (150 ± 10) mm.

A.2 Test bicycle A (conventional bicycle)

Test bicycle A shall be a city and trekking bike (bicycle) according to ISO 4210-2 with the following properties:

— total weight minimum: 15 kg;

— if an additional load on the bicycle is necessary, this shall be attached so that the wheel load distribution and centre of gravity height are retained;

— wheelbase (*RS*): (1 200 ± 100) mm.

A.3 Test bicycle B (E-bike/pedelec)

Test bicycle B shall be an EPAC according to EN 15194 with the following properties:

— total weight of minimum: 25 kg;

— if an additional load on the bicycle is necessary, this shall be attached so that the wheel load distribution and centre of gravity height are retained;

— wheelbase (*RS*): (1 250 ± 150) mm.

Annex B
(informative)

Requirements for a Belgian block test track[2)]

B.1 Road width

The road width shall be ≥ 3,70 m.

B.2 Surface

The surface of the track shall be deliberately uneven so as to correspond to a paved road in a poor state.

In the longitudinal direction of the road, there are elevations and recesses at distances changing between 600 mm and 1 500 mm with a depth of maximum 75 mm also changing. The recesses shall be pan-shaped with elliptical contour whose longitudinal axis is transverse to the road.

The height of the individual blocks shall be as high as possible and vary randomly with a deviation of ± 25 mm from the mean height.

B.3 Durability

Although the surface of the road is deliberately poor, it shall be constructed strong enough so that it does not deteriorate increasingly during operation.

B.4 Dimension of the blocks

Width: (130 ± 10) mm

Length: 150 mm to 230 mm

Height: 100 mm to 150 mm

B.5 Material of the blocks

The material of the blocks shall be granite stone.

B.6 Base

The base shall be concrete, prepared in such way that the surface can be used as a base for the undulation described in the B.2.

B.7 Paving

The bed serving to hold the blocks comprises a mixture of dry cement and sand. The blocks shall be placed on this so that resultant elevations and recesses are purely random. It shall be ensured that this design is suitable to receive an unchanging paving and hence deviate from the normal type of paving. In this way, the blocks shall remain in the position in which they were originally.

2) According to M.I.R.A. Bulletin III/49; Motor Industry Research Association (MIRA), Watling Street, Nuneaton, Warwickshire CV 10, OTU, England.

B.8 Spaces between blocks

The spaces between the blocks shall be (25 ± 5) mm, into which chippings mixed with mortar are swept down to about 10 mm below the lowest blocks. The remaining 10 mm can be filled with clay or loam in order to increase the skidding hazard in the wet.

B.9 Edge strips and ramps

Slanting rigid edge trips limit the test track at the sides and a ramp each with a slope of 1:20 at the beginning and end.

B.10 Road curvature

No normal curvature shall be envisaged owing to the uneven track surface.

Annex C
(informative)

Determination of the payload

For the determination of the payload and calculation examples, see Table C.1.

Table C.1 — Determination of the payload

Values in kilograms

Reference	To be considered	Example 1	Example 2	Example 3
a	Maximum permissible roof load of the vehicle as specified by the manufacturer	60	75	100
b	Payload of the vehicle as specified by the manufacturer	350	500	650
c	Maximum load bearing capacity of the roof rack	75	50	100
d	Assumed load (75 kg/person + luggage)	300	380	450
e	Dead weight of the roof rack	10	5	20
f	Actual supporting load of the trailer coupling	0	50	75
g	Maximum mass that can be loaded additionally on a roof rack – the lowest of the following calculated values:			
	g = a − e	50	70	80
	g = c	75	50	100
	g = b − (d + e + f)	40	65	105
	The following may be loaded additionally:	40	50	80

Annex D
(informative)

Example of safety notes in instructions for use

The work steps and safety notes indicated in these instructions for use for the initial assembly, mounting, remounting and handling of the roof rack shall be strictly complied with.

These instructions for use shall be handed over to other users if handing over the roof rack.

The roof rack is designed so that no damage to the vehicle can result after proper assembly and use.

Safety notes

The permissible roof load (indicate applicable value) kg shall not be exceeded. For the determination of the payload see Annex C.

The assembly shall be carried out according to the instructions for use.

All bolted joints and connections between the base carriers and mounted parts shall be checked for firm fit before each journey and retightened, if necessary.

After driving breaks, in which the vehicle with roof rack has been left unattended, all freely accessible attachments of the roof rack and the load should be checked for strength and functionality (inspection for damaging external influence).

Each time roof racks are reassembled on the vehicle roof and after each new load on the roof rack, the roof rack and load shall be checked for firm attachment for the first time after a short travel time (maximum 30 min on rough road or 50 km on normal road) and retightened, if necessary. In particular during longer drives, the bolted joints between the roof rack and vehicle roof shall be checked for firm attachment at regular intervals – but no later than 500 km – and retightened, if necessary. On rough roads, an inspection of the bolted connection shall be repeated after 2 h travel respectively.

Distribute the luggage items evenly, keep the centre of gravity as low as possible and secure the transport strap against moving out of place with suitable tensioning straps (no elastic straps).

Note that the driving performance changes depending on the load transported.

Sudden braking, abrupt starting off and rapid cornering shall be avoided where possible.

The speed shall be adapted to the objective conditions such as road state, road surfacing, side wind conditions, general traffic levels, etc. when transporting items on the roof. A guide speed is recommended.

When transporting items on the roof, please be aware of the road-traffic regulations or the country-specific regulations.

For reasons of fuel economy and the safety of other road users, roof racks should be removed from the vehicle when not in use.

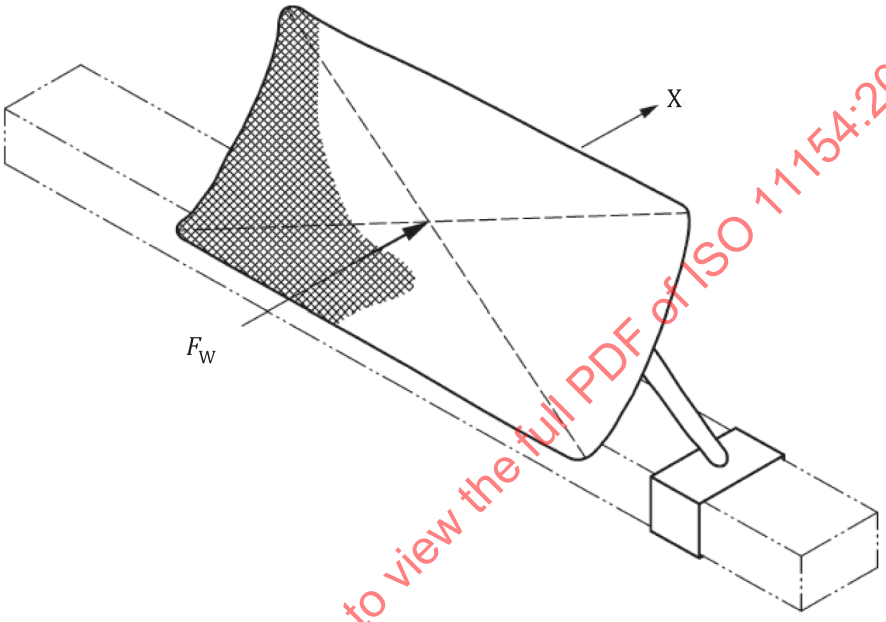
Do not drive into car washes with mounted roof racks.

When driving with roof racks with and without load into garages, multi-story car parks etc., it is imperative to observe the significantly increased vehicle height. Failure to comply may result in a collision and can lead to major material damage and personal injury.

Annex E
(informative)

Presentation of the force application

The Figures E.1 to E.6 show the application of the forces.

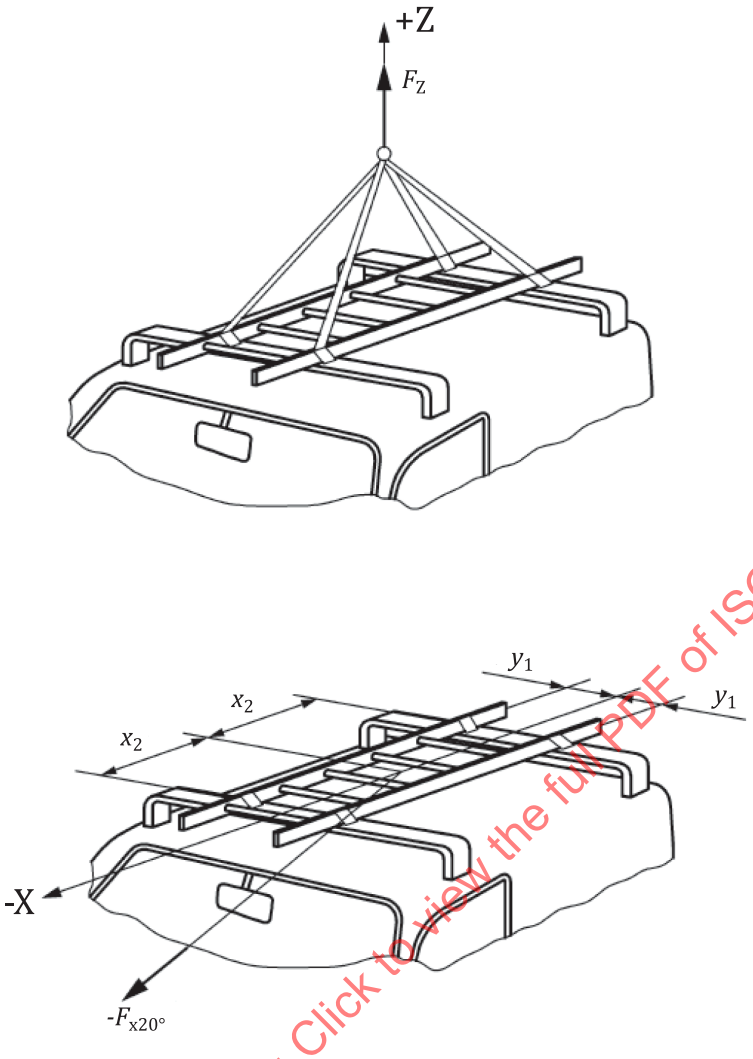


Key

X vehicle longitudinal axis

F_w wind force

Figure E.1 — Wind deflector device



Key

-X	vehicle longitudinal axis
x_2	symmetrical alignment in x-direction
y_1	symmetrical alignment in y-direction
$+Z$	vertical direction to the direction of travel
$-F_x$	direction of the longitudinal force, acting longitudinally to the direction of travel
F_z	direction of the normal force of the load
$-F_{x20°}$	direction of the force in the horizontal plane, 20° to the vehicle longitudinal axis through the centre point *M*

Figure E.2 — Ladder holder