BS ISO 13988:2021

BSI Standards Publication

Passenger car and light truck vehicle wheels — Clip and adhesive balance weight and rim flange nomenclature, test procedures and performance requirements

bsi.

National foreword

This British Standard is the UK implementation of ISO 13988:2021. It supersedes BS ISO 13988:2008, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/15, Safety related to vehicles.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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BS ISO 13988:2021

INTERNATIONAL STANDARD

ISO 13988

Second edition
2021-08-27

Passenger car and light truck vehicle wheels — Clip and adhesive balance weight and rim flange nomenclature, test procedures and performance requirements

Roues pour véhicules particuliers et camionnettes — Nomenclature des masselottes d'équilibrage clippées et adhésives ainsi que des rebords de jantes, méthodes d'essai et exigences de performance

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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).

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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 33, *Vehicle dynamics and chassis components*.

This second edition cancels and replaces the first edition (ISO 13988:2008), which has been technically revised. The main changes compared with the previous edition are as follows:

— adhesive balance weights have been added, which covers clip on weights only;

— nomenclature for the balance weight and test procedures and performance requirements for the adhesive weights have been included.

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.

Introduction

This document addresses clip and adhesive balance weights used on passenger car wheels. It provides general features and configurations of the clip balance weights, general features of the adhesive balance weights, and general features and configurations for rim dimensions relevant to clip on weights and defines terms used to describe these features.

This document provides test procedures to evaluate weight retention on the wheel.

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INTERNATIONAL STANDARD ISO 13988:2021

Passenger car and light truck vehicle wheels — Clip and adhesive balance weight and rim flange nomenclature, test procedures and performance requirements

1 Scope

This document specifies procedures and minimum performance requirements for testing without tyres the retention of balance weights for use on wheels for passenger vehicles. It also specifies general features for configurations of clip balance weights, rim flanges for light alloy and steel wheels intended for use on passenger cars and adhesive balance weights. Alternative materials and geometries can be considered in the future.

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 3911, *Wheels and rims for pneumatic tyres — Vocabulary, designation and marking*

ISO 4000-1, *Passenger car tyres and rims — Part 1: Tyres (metric series)*

ISO 4000-2, *Passenger car tyres and rims — Part 2: Rims*

ISO 4223-1, *Definitions of some terms used in the tyre industry — Part 1: Pneumatic tyres*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3911, ISO 4000-1, ISO 4000-2, ISO 4223-1 and the following apply.

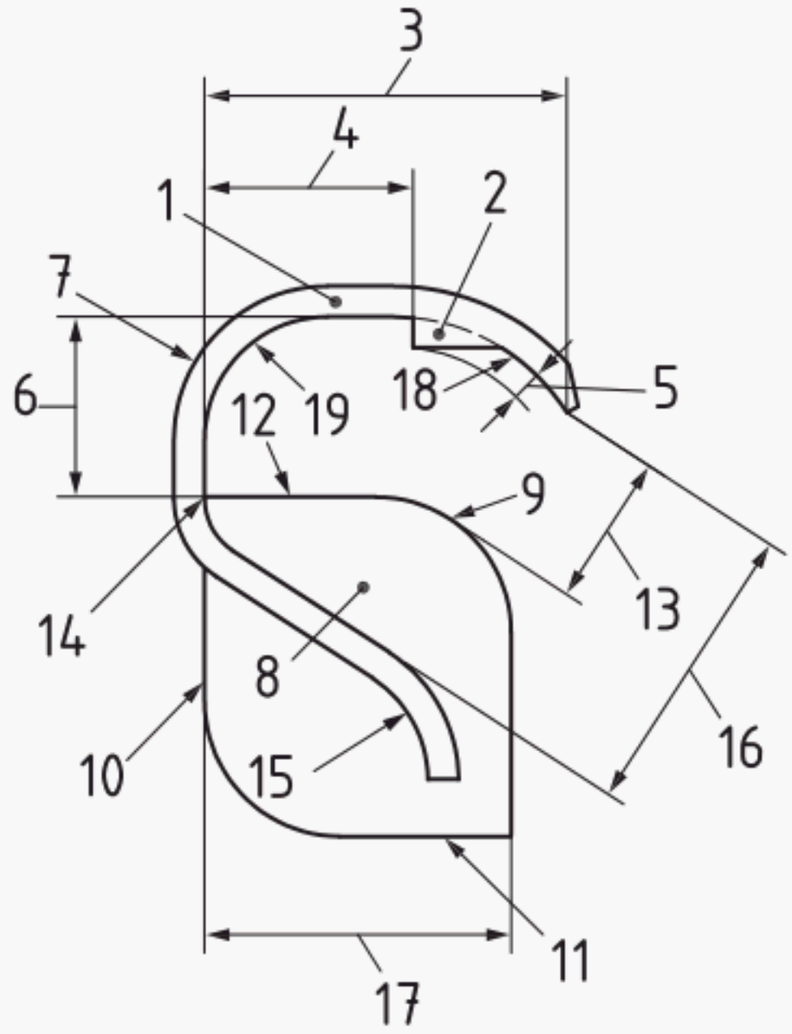
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

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

3.1
clip balance weight assembly
assembly of the *weight* (3.1.1) and the *clip* (3.1.3), which is intended for mounting on the *rim flange* (3.3) to balance the tyre/wheel assembly about its axis of rotation and thus minimize vibrations due to the rotation of the tyre/wheel assembly

Note 1 to entry: Figure 1 gives the terminology and nomenclature of balance weight assembly.



Key

1	clip	7	outer surface of clip	13	weight gap
2	spur	8	balance weight	14	clip insertion point
3	clip depth	9	contact radius	15	back leg of clip
4	spur location	10	front surface	16	clip gap
5	spur depth	11	bottom surface	17	weight depth
6	clip height	12	top surface	18	compound radius
				19	compound radius

Figure 1 — Clip balance weight assembly terminology

3.1.1
weight
material of a specified mass with contours to conform to the surface of the *rim flange* (3.3)

Note 1 to entry: The material is recommended to be free of lead.

3.1.2
clip
specially formed metal affixed to the *weight* (3.1.1) to mount the balance weight on the *rim flange* (3.3)

3.1.3
spur
optional part of a *clip* 3.1.3) that protrudes from its surface interfacing with the *rim flange* 3.3)

3.1.4
balance weight coating
non-corrosive material coating to avoid corrosion

EXAMPLE Polyester, nylon.

3.1.5
balance weight key dimensions
dimensions that are essential for fitting the balance *weight* (3.1.1) on the *rim flange* (3.3)

3.1.6
balance weight size
size determined by the magnitude of the balance *weight* (3.1.1) mass

Note 1 to entry: Balance weight size is expressed in grams.

3.1.7
balance weight retention force
static force required to remove the balance *weight* (3.1.1) from the *rim flange* (3.3)

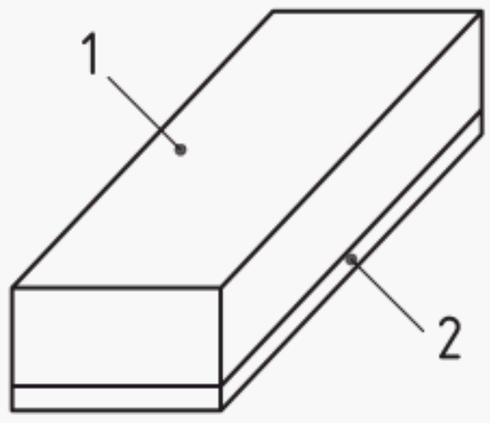
Note 1 to entry: Balance weight retention force is expressed in newtons.

3.1.8
balance weight retention
ability of the balance *weight* (3.1.1) to maintain its secure position on the *rim flange* (3.3) in various service conditions

3.1.9
interference
measure of balance *weight* (3.1.1) press fit computed as the difference between the flange thickness and the weight gap

3.2
adhesive balance weight assembly
assembly of the *weight portion* (3.2.1) and the adhesive portion, which is intended for mounting on the rim to balance the tyre/wheel assembly about its axis of rotation and thus minimize vibrations due to the rotation of the tyre/wheel assembly

Note 1 to entry: Figure 2 gives the terminology and nomenclature of the adhesive balance *weight* (3.1.1) assembly.



Key

1 weight
2 adhesive

Figure 2 — Adhesive balance weight assembly terminology

3.2.1
weight portion
portion of the *weight* (3.1.1) that provide mass for balancing the wheel

Note 1 to entry: The material is recommended to be free of lead.

3.2.2
tape portion
double-sided adhesive tape with three layers: a) adhesive for the *weight portion* (3.2.1), b) a backing material, and c) adhesive for attachment to the wheel surface

3.3
rim flange
part of the rim where the *clip* (3.1.3) balance *weight* (3.1.1) is mounted

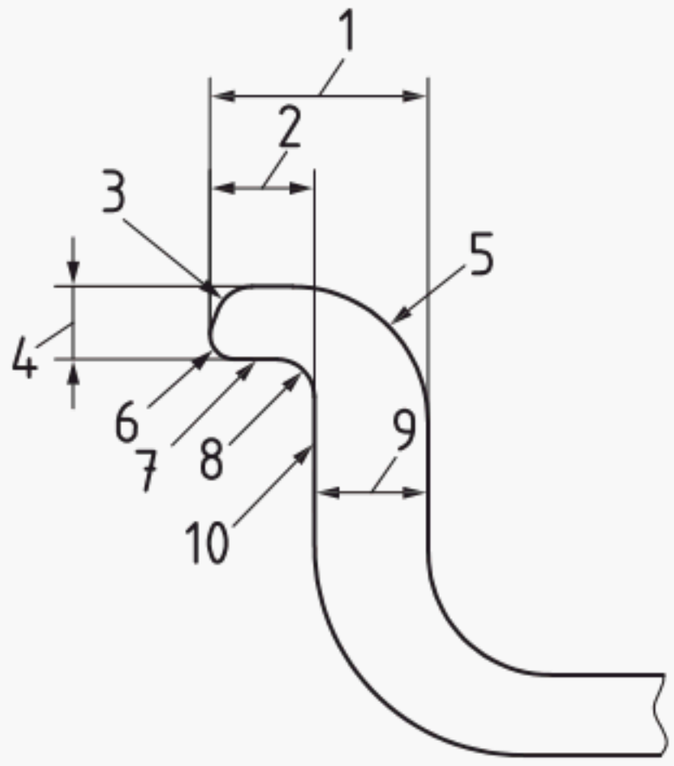
Note 1 to entry: Figure 3 gives the terminology and nomenclature of rim flange features for light alloy wheels.

Note 2 to entry: Figure 4 gives the terminology and nomenclature of rim flange features for wheels with rolled formed rim.

Note 3 to entry: Figure 5 gives the terminology and nomenclature of rim flange features for fullface wheels.

Note 4 to entry: Figure 6 gives the terminology and nomenclature of rim flange features for clad wheels.

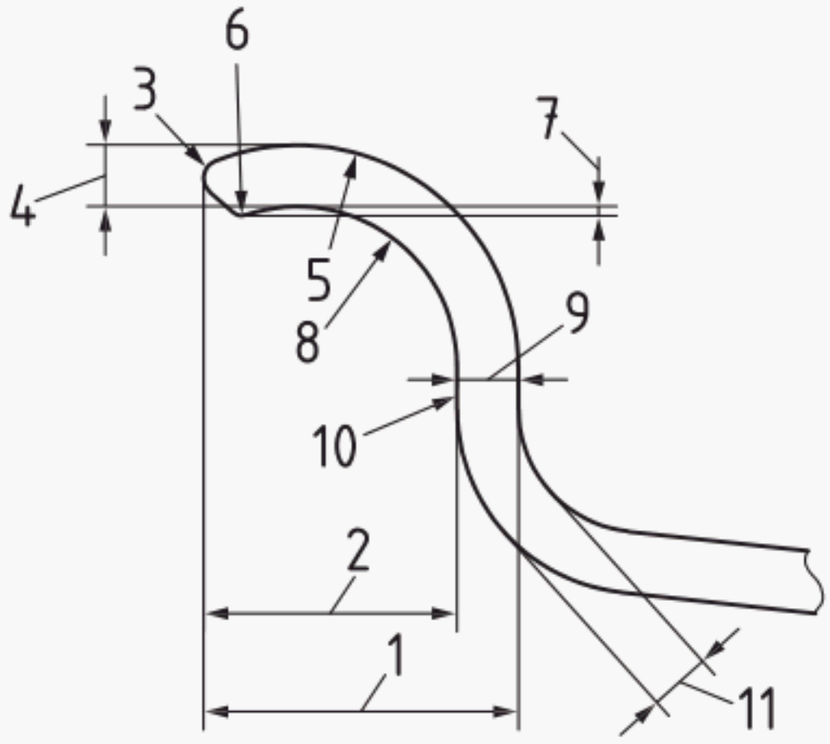
3.3.1
rim flange key dimensions
dimensions that are essential for fitting *clip* (3.1.3) balance *weight* (3.1.1) on the *rim flange* (3.3)



Key

1	flange width	6	break corner radius at balance weight side
2	flange offset	7	balance weight side
3	break corner radius at tyre side	8	rim flange radius at balance weight side
4	flange lip thickness	9	flange wall thickness
5	rim flange radius at tyre side	10	contact surface

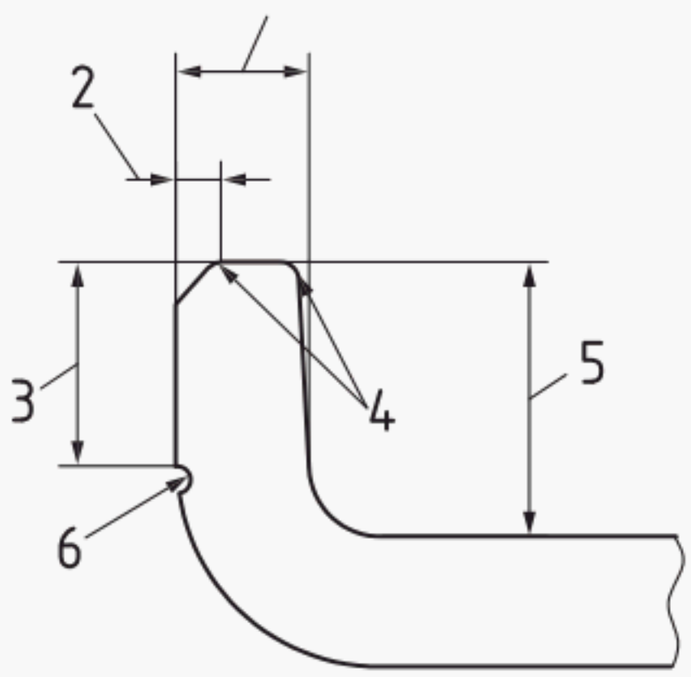
Figure 3 — Light alloy rim flange terminology



Key

1 flange width
2 flange offset
3 break corner radius at tyre side
4 flange lip thickness
5 rim flange radius at tyre side
6 flange compound radius at balance weight side
7 flange curl
8 flange radius at balance weight side
9 flange wall thickness
10 contact surface
11 flange bead seat thickness

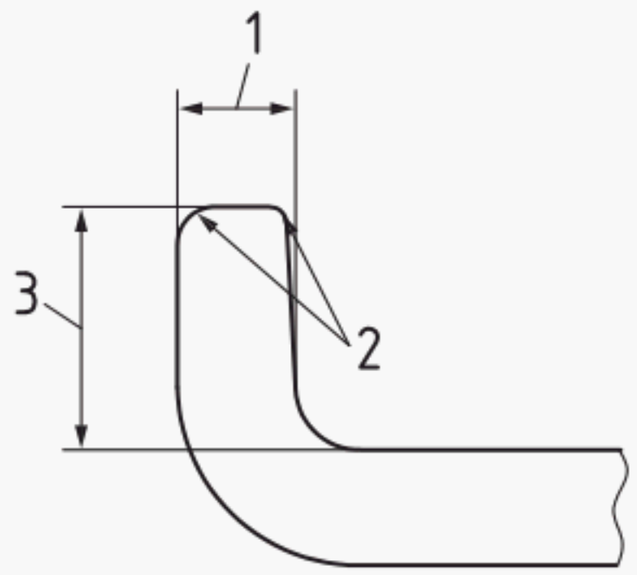
Figure 4 — Rolled formed rim flange terminology



Key

1 flange lip thickness
2 weight lead in
3 groove location
4 break corner
5 flange offset
6 optional groove

Figure 5 — Fullface rim flange terminology



Key

1 flange lip thickness
2 break corner
3 flange offset

Figure 6 — Cladded rim flange terminology

4 Rim flange types

Rim flange types are identified by letter codes. Rim flange types covered by this document are J and B. Configurations of these rim flanges are included in ISO 4000-2.

Dimensions shown in ISO 4000-2 are limited to those pertaining to the rim flange contour on the tyre side and do not include dimensions on the balance weight side.

5 Test procedure for clip on balance weight

5.1 Preparation of clip on balance weight for test

5.1.1 Selection of balance weights

For each test, use a set of new balance weights of different sizes representative of the wheel for which they are intended. The balance weights of each size shall be equally divided into two groups, each containing the same number. For testing purposes, one group shall be mounted on the outboard flange and the other group on the inboard flange.

5.1.2 Measurement of key dimensions of balance weights

For balance weights intended for light alloy wheels, measure the weight gap and, when applicable, the spur depth. For balance weights intended for steel wheels, measure the weight gap only. For fullface wheels, measure the weight gap and the clip depth (see Figure 1).

The measured values shall be within design specifications.

5.1.3 Marking of balance weights

Individual balance weights of different sizes shall be picked at random from the selected group and marked by using sequential numbers. One half of the group is to be tested on the outboard rim flange and the other half on the inboard rim flange.

5.2 Preparation of the wheel for clip on balance weight testing

5.2.1 Cleaning

Clean the surface of the outboard and the inboard rim flanges to remove any dirt or grease by using a suitable product which leaves no residue.

5.2.2 Marking

Make equally spaced marks around the circumference of the outboard and inboard flanges to indicate mounting points for each of the balance weights. The flange surface at each mounting point shall be free of scratches, gouges and welds.

5.2.3 Measurement of rim flange dimensions

Measure and record the following dimensions on the outboard and inboard rim flanges (see Figures 3 to 6):

— for all wheel types: flange lip thickness, flange curl, flange offset and flange width;

— for fullface and clad wheels: weight lead in and optional groove location.

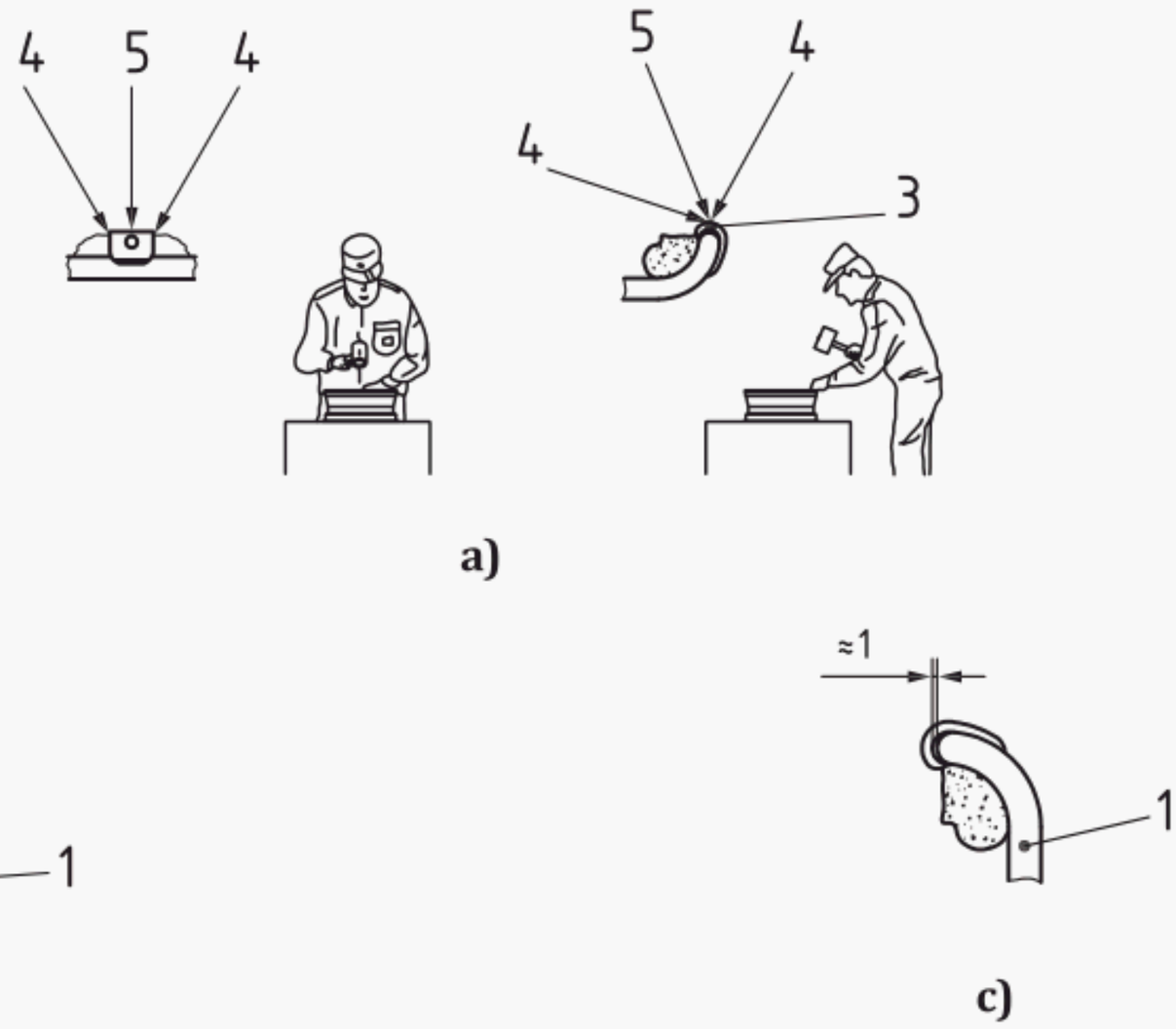
All measured dimensions shall be within design specifications.

5.3 Installation of clip on balance weight

Improper striking can cause drop-out of the balance weight. Follow the proper procedure as described below.

The operator shall do the striking work right in front of the striking position.

Strike the balance weight in such a manner that the striking force is applied parallel with the wheel rim configuration and a maximum of three strikes properly seats it on the rim flange. Care shall be taken that a gap of about 1 mm is left between the balance weight and the wheel for secure bite of the balance weight (see Figure 7).



Key

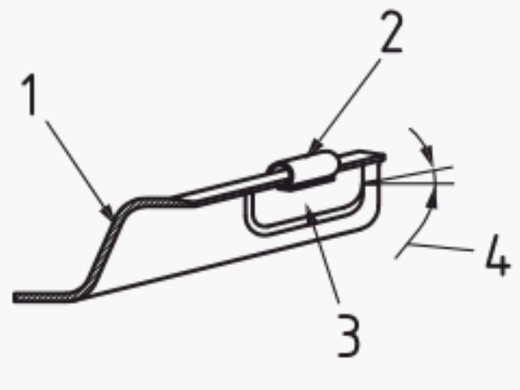
1 wheel
2 repulsion not acceptable
3 clip centre
4 unacceptable
5 acceptable

Figure 7 — Balance weight installation

5.4 Tangential test for clip on balance weight

5.4.1 General

The test shall consist of measuring the minimum tangential force required to initiate the movement (see Figure 8).



Key

1 rim flange
2 clip
3 weight
4 tangential force (from the rim flange)

Figure 8 — Tangential force test

5.4.2 Test equipment

The test equipment shall be capable of removing the balance weight from the rim flange, as well as measuring and reading the minimum tangential force required (0° to 15° angle from the rim flange) to initiate the movement. Calibrate the load cell using increments of 25 N up to 200 N.

5.4.3 Test sequence

5.4.3.1 Using a non-metallic hammer, install the balance weight on the inboard and outboard rim flange as described in 5.3.

5.4.3.2 Set the force indicator (dynamometer) on the test equipment to zero.

5.4.3.3 Gradually increase the tangential force and record the maximum indicated force.

5.4.3.4 Discard the balance weight removed from the rim flange and do not use it in future testing.

5.4.3.5 Reset the wheel for the next position of balance weight removal.

5.4.3.6 Repeat steps 5.4.3.1 to 5.4.3.5 for each balance weight installed on the inboard and outboard rim flange, following the sequential order of balance weight numbers.

5.4.4 Performance requirements tangential force

The minimum value of balance weight retention force determined in accordance with the static test procedure described in 5.4 is shown in Table 1. The minimum values shown in Table 1 only apply to weight installed on wheels without a tyre mounted. Additional testing with a tyre mounted to the wheel may be desirable to evaluate vehicle performance.

NOTE The size and inflation pressure of the tyre can increase or decrease the final force.

Table 1 — Tangential test-force values

Mass, g	5	≥ 10
Force, N	60	100

5.5 Axial removal test for clip on balance weight

5.5.1 Test equipment

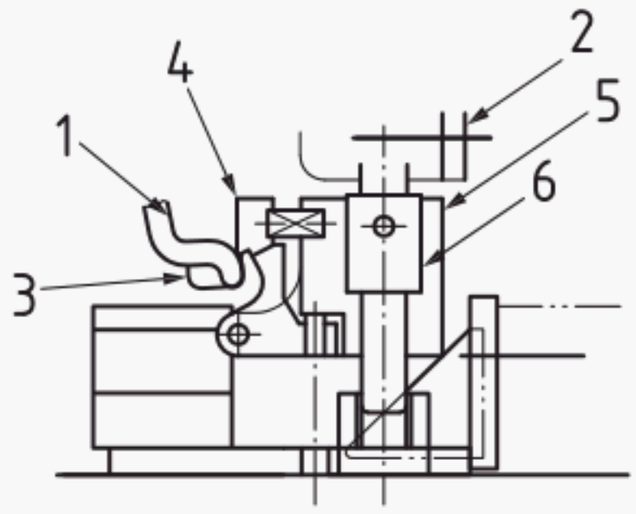
The test equipment shall be capable of removing the balance weight from the rim flange, as well as measuring and reading the minimum force required to initiate movement. Calibrate the load cell using increments of 10 N up to 500 N.

5.5.2 Test sequence

5.5.2.1 There are two distinct methods for evaluating axial weight retention:

— option 1: push-off test (see Figure 9, which illustrates a possible apparatus);

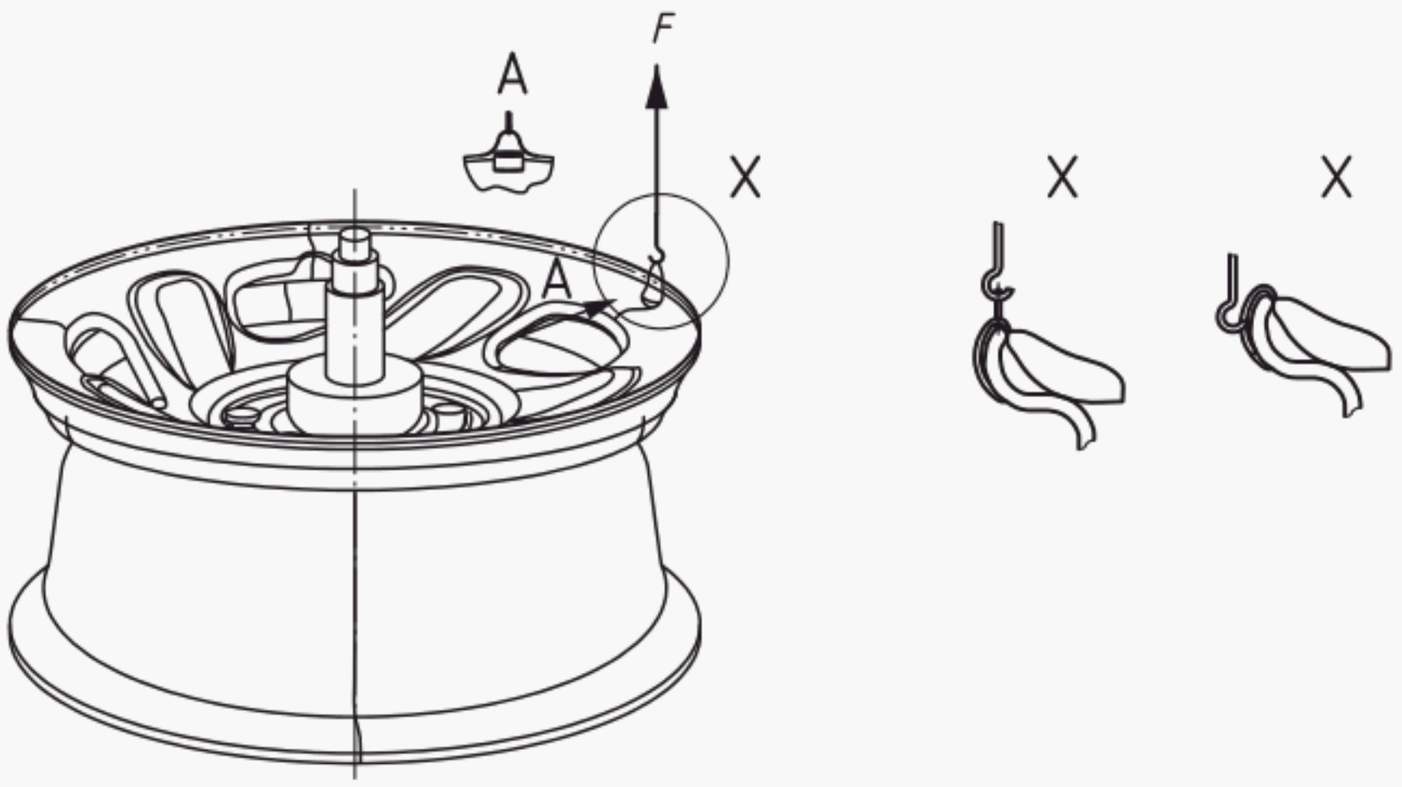
— option 2: pull-off test (see Figure 10).



Key

1 wheel rim flange
2 arbor press force gage
3 weight
4 push-off pivot tool (probe)
5 arbor press pivot block
6 arbor press extension – force gage

Figure 9 — Push-off balance weight test



Key

X acceptable

Figure 10 — Pull-off balance weight test

5.5.2.2 The test shall be conducted in accordance with the sequence described in 5.5.2.3 to 5.5.2.11.

5.5.2.3 For option 1, install the probe for moving the balance weight on the rim flange in the centre hole of the fixture with the flat edge facing up.

5.5.2.4 Install the balance weight on the inboard and outboard rim flange by using a non-metallic hammer, as described in 5.3. For option 2, install a weight with a wire loop under the weight clip; alternatively, for a balance weight with a hole in the clip, set the hook of the force indicator in the clip hole (see Figure 10).

5.5.2.5 Install the wheel in the test fixture and centre it in the base of the fixture.

5.5.2.6 For option 1, set the probe in the centre of the hole or notch located in the clip by adjusting its horizontal, vertical and angular positions, while avoiding contact with the rim flange during the test sequence. For option 2, connect the wire loop (alternatively, the hook, avoiding contact with the rim flange) to the force indicator.

5.5.2.7 Set the force indicator on the test equipment to zero.

5.5.2.8 Gradually increase the force on the lever until the balance weight moves. Record the maximum indicated force.

5.5.2.9 Discard the balance weight removed from the rim flange and do not use it in future testing.

5.5.2.10 Reset the wheel for the next position of the balance weight removal.

5.5.2.11 Repeat steps 5.5.2.3 to 5.5.2.10 for each balance weight installed on the inboard and outboard rim flange, following the sequential order of balance weight numbers.

5.5.3 Performance requirement axial force

The minimum value of balance weight retention force determined in accordance with the static test procedure described in 5.5 is shown in Table 2. The minimum values shown in Table 2 only apply to weight installed on wheels without a tyre mounted. Additional testing with a tyre mounted to the wheel may be desirable to evaluate vehicle performance.

NOTE The size and inflation pressure of the tyre can increase or decrease the final force.

Table 2 — Axial removal test force values

Mass, g	5	10 to 15	20, 25 ,30 ,35	40 to 80	≥ 90
Force, N	50	100		200	300

6 Test procedure for adhesive balance weights for all size weights and wheels

6.1 Test equipment

Adhesive weight removal can use the same test fixture as in Figure 10. For the shear adhesion test, the test fixture is prepared for the appropriate fixture head or jig for the force indicator (see Figures 11 and 12).

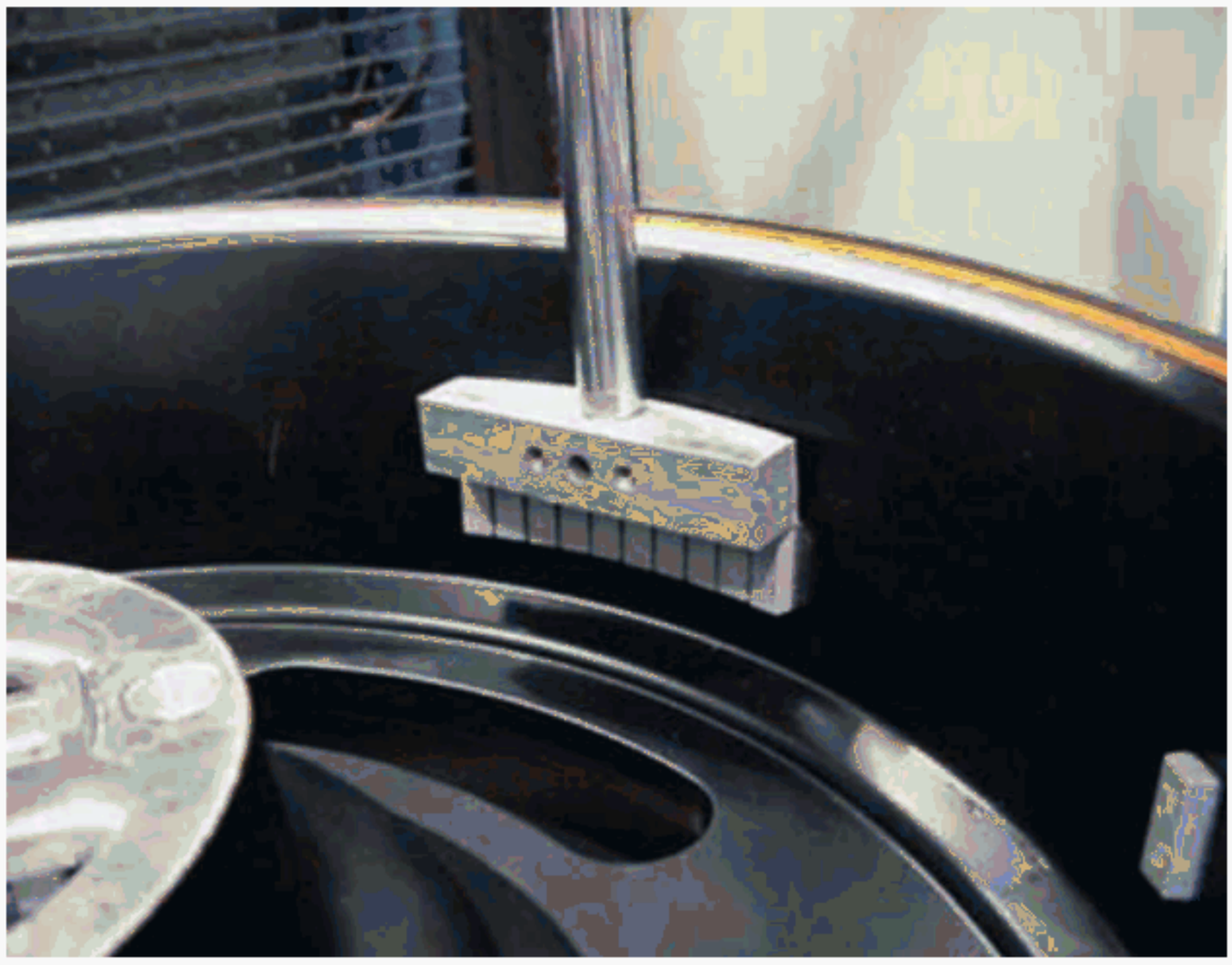
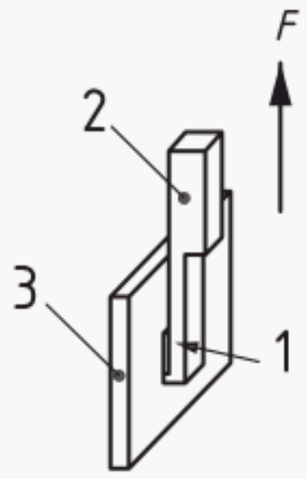


Figure 11 — Shear test method for adhesive weights



Key

1 test specimen (adhesive balance weight)
2 jig
3 aluminium wheel or plate

Figure 12 — Shear test method using a jig for adhesive weights

6.2 Wheel preparation

Prepare the wheel inner rim surface using an appropriate solvent or alcohol for cleaning. Allow the solvent or alcohol to dry prior to test. The wheel shall be prepared as agreed upon between the supplying and receiving parties concerned.

If an aluminium plate is used for this test (see Figure 12), the aluminium plate should be prepared as agreed upon between the supplying and receiving parties concerned. The surface roughness of the aluminium plate shall be 6,3 Ra.

6.3 Balance weight selection and installation

The following items shall be agreed upon by the supplying and receiving parties, prior to test:

— size of the adhesive balance weight;

— identification of the surface on the wheel or plate;

— preparation method (surface cleaning);

— press fitting method for the balance weight.

For each test use a set of new weights of different sizes. Weights need to be alternately selected by mass increments. In the case of cut-to-length weights, the mass increments are defined by the five ranges in Table 2. The test can be performed on weights located behind the spokes or at the inner rim outboard location as per customer requirements. The location should be selected so the weight is not likely to contact brake components.

A normal load force to the weight using a tool to achieve a minimum wet out of 85 % shall be applied.

Remove the protective backing from the weight adhesive and apply the weight to the correct location on the wheel. A specified tool and force to achieve the required wet out shall be agreed upon between the supplying and receiving parties concerned. The unit is to set for one hour prior to test. Figure 11 shows proper alignment of the tool for all size wheels for the shear test. A test data sheet is recommended to record results as required for each customer.

7 Shear adhesion test

7.1 Test procedure

Set up the wheel in the test fixture such that the weight can be put into shear by the probe.

The test temperature is (23 ± °C or as agreed upon between the supplying and receiving parties concerned.

The push-off head or pull-off jig should encompass the entire length of the weight being tested as well as the radii of the wheel. The fixture for the shear test is shown in Figures 11 and 12.

Set up the probe to contact the side of the weight and not on any part of the adhesive.

Move the probe push down or pull up until the weight begins to shear the backing of the adhesive.

The probe loading speed should be 50 mm to 300 mm per minute.

7.2 Performance

When the backing begins to break and the adhesive does not come away from the wheel or the weight, the test is a pass. A testing force value for shear is 200 kPa minimum.

8 Pull-off adhesion test

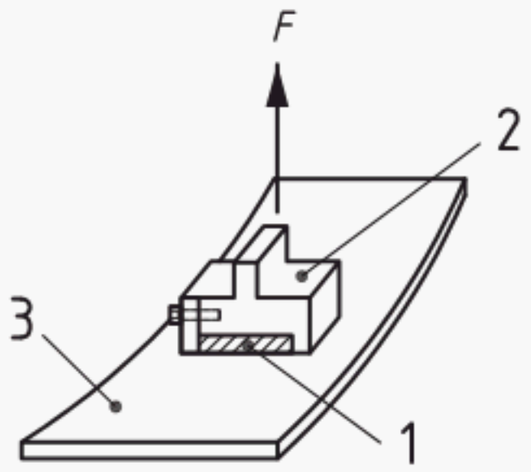
8.1 Test procedure

The pull-off adhesion test is performed by applying the pull-off removing load toward the perpendicular direction against the adhesive surface (see Figure 13).

The speed of the pull-off removing load should be 0,5 mm to 30 mm per minute.

The size of the adhesive balance weight, the using type of wheel type and size, the preparation method of the surface cleaning, and the press fitting method for the balance weight and the wheel shall be agreed upon between the supplying and receiving parties concerned.

The test temperature is (23 ± °C or as agreed upon between the supplying and receiving parties concerned.



Key

1 test specimen (adhesive balance weight)
2 jig
3 aluminium wheel

Figure 13 — Pull-off test method for adhesive weights

8.2 Performance

The pull-off adhesion force shall be 30 kPa minimum.

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