



JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS T 9291 : 2022

**Wheelchairs — Specifications of test
dummies**

ICS 11.180.10

Reference number : JIS T 9291 : 2022 (E)

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T 9291 : 2022

Date of Establishment: 2022-03-22

Date of Public Notice in Official Gazette: 2022-03-22

Investigated by: Japanese Industrial Standards Committee

Standards Board for ISO area

Technical Committee on Assistive Technology

JIS T 9291 : 2022, First English edition published in 2023-07

Translated and published by: Japanese Standards Association
Mita MT Building, 3-13-12, Mita, Minato-ku, Tokyo, 108-0073 JAPAN

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Printed in Japan

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Foreword

This Japanese Industrial Standard has been established by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Act.

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Wheelchairs — Specifications of test dummies

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 7176-11** : 2012, Edition 2, with some modifications to adapt the technical contents to the actual business practices in Japan.

Annex JA is unique to **JIS** and not given in the corresponding International Standard. The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

1 Scope

This Standard specifies requirements for test dummies of any mass greater than or equal to 25 kg, to be used in the evaluation of wheelchairs. This Standard provides formulae that specify the location of the overall centre of mass of test dummies, the masses of the segments that comprise the test dummies and the locations of pivots that connect the segments. It also specifies the characteristics of loading pads that support the segments.

The specified location for the centre of mass is approximately the same as that of a human being of the corresponding mass when seated in a wheelchair. This Standard does not attempt to represent the mass distribution of a person with limb atrophy or amputation. This Standard is intended to enable the construction of test dummies that will produce comparable results for stability, performance and durability testing of manual wheelchairs and electrically powered wheelchairs, including scooters.

This Standard also includes informative tables of mass and locations of centre of mass, which are derived from the formulae, corresponding to example test dummy masses up to 300 kg in 25 kg increments.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 7176-11 : 2012 *Wheelchairs — Part 11 : Test dummies* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS T 9201 *Manually propelled wheelchairs*

JIS T 9203 *Electric wheelchairs*

ISO 7176-26 *Wheelchairs — Part 26 : Vocabulary*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions, and those given in **JIS T 9201**, **JIS T 9203** and **ISO 7176-26** apply.

3.1

forward location

distance forward from the seat reference point, measured in the horizontal direction

Note 1 to entry For the purposes of this Standard, the back support reference plane is equivalent to the front surface of the test fixture's back support when the test dummy is fitted in the test fixture (see **5.1**).

3.2

height

distance upward from the seat reference point, measured perpendicular to it

Note 1 to entry For the purposes of this Standard, the seat reference plane is equivalent to the upper surface of the test fixture's seat when the test dummy is fitted in the test fixture (see **5.1**).

3.3

loading pad

component, consisting of a loading plate and a foam cushion, intended to transfer the load between a segment of the test dummy and the wheelchair under test

Note 1 to entry The foam cushion is the part of the loading pad intended to make contact with the wheelchair.

3.4

loading plate

rigid flat plate for use in a loading pad

3.5

lower leg segment

segment of the test dummy that represents the lower legs (from knee to ankle) and feet (from ankle below) of a human being

3.6

overall centre of mass

centre of mass of the whole test dummy

3.7

test dummy

device used to represent the mass (weight) and mass distribution of a human being, for the purpose of testing a wheelchair

3.8

thigh segment

segment of the test dummy that represents the upper legs and buttocks of a human being

3.9

torso segment

segment of the test dummy that represents the torso, head and arms of a human being

3.10

seat reference point

point of intersection of the back support reference plane and the seat reference plane projected onto the median plane (see Figures 1, 5 and 6)

Note 1 to entry This is the original point for measurement of the positions specified in Clause 4.

3.11

median plane

symmetrical plane of organisms, etc. that are bilaterally symmetrical

4 Symbols and abbreviated terms

CoM centre of mass

m_{dummy} nominal mass of test dummy

NOTE The nominal mass is not the actual mass but a mass used as a nominal designation.

m_{leg} mass of the lower leg segment

m_{thigh} mass of the thigh segment

m_{torso} mass of the torso segment

l_{thigh} distance from the hip pivot axis to the knee pivot axis

l_{leg} distance from the knee pivot axis to the ankle pivot axis

x_{ankle} forward location of the ankle pivot axis

x_{dummy} forward location of the overall centre of mass

x_{hip} forward location of the hip pivot axis

x_{knee} forward location of the knee pivot axis

x_{leg}	forward location of the CoM of the lower leg segment
x_{thigh}	forward location of the CoM of the thigh segment
x_{torso}	forward location of the CoM of the torso segment
y_{ankle}	height of the ankle pivot axis
y_{dummy}	height of the overall centre of mass
y_{hip}	height of the hip pivot axis
y_{knee}	height of the knee pivot axis
y_{leg}	height of the CoM of the lower leg segment
y_{torso}	height of the CoM of the torso segment
y_{thigh}	height of the CoM of the thigh segment

NOTE In this Standard, all linear dimensions are expressed in millimetres and all masses are expressed in kilograms.

5 Test equipment

5.1 Test fixture

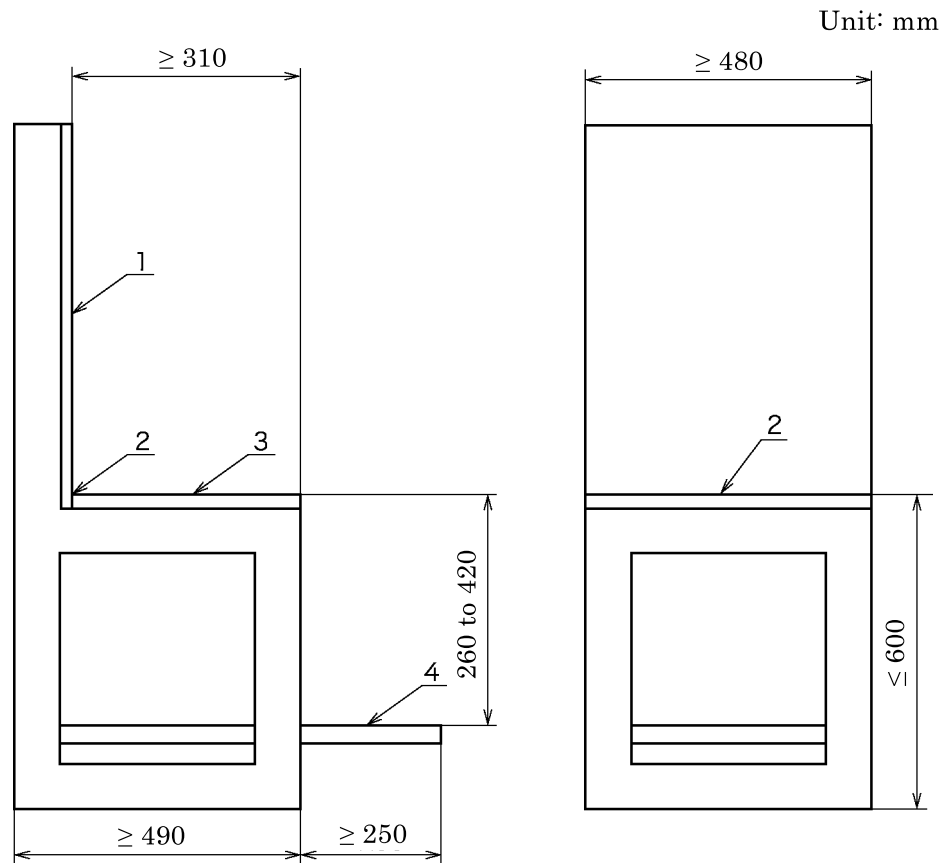
The test fixture is for measuring the location of the overall centre of mass. The test fixture shall :

- conform to the dimensions shown in Figure 1;
- be constructed so that the seat and back support are perpendicular within $\pm 0.5^\circ$;
- be constructed so that the foot support and seat are parallel within $\pm 0.5^\circ$;
- have provision for the height of the foot support to be adjusted within the range shown in Figure 1 or include rigid spacers to be placed on the foot support, such that the upper surface of the uppermost rigid spacer can be located within the range shown in Figure 1 and such that it is parallel to the seat as specified in **b)**;
- include means to secure the torso segment and thigh segment so that the torso loading pad and thigh loading pad are in contact with the back support and seat respectively, with the foam cushions compressed;
- include a means to secure the lower leg segment so that the foot loading pads are in contact with the foot support or uppermost rigid spacer as specified in **d)**;
- ~~have mass not exceeding 28 kg or 15 % of m_{dummy} , whichever is greater;~~
- be constructed with sufficient stiffness that during use no dimensional change exceeds 5 mm;
- if necessary, be fitted with means for manual handling, such as handles.

The recommended seat depth is 310 mm for test dummies 25 kg or over up to and including 50 kg, and 375 mm for test dummies over 50 kg.

Plywood specified for structural use in unprotected exterior conditions, of thickness

19 mm, and solid timber specified for structural use, of thickness 60 mm, is suitable for use in the construction of test fixtures for test dummies of 125 kg or less.



Key

- 1 : back support
- 2 : seat reference point
- 3 : seat
- 4 : foot support

Figure 1 Text fixture (example for mass 25 kg to 50 kg)

5.2 Inclinator or plumb line

The inclinometer or plumb line are used to measure the angle of inclination of the test fixture with an uncertainty of less than 0.2° , when using the balance method specified in Annex A.

5.3 Scales

The scales are used to measure the combined weight of the test fixture and the test dummy with an uncertainty of less than 0.2 kg.

5.4 Test surface

The test surface is constructed of a hard material, such as a concrete or hardwood platform, whose deviation from level is less than 2 mm within the area occupied by the

test fixture when using either of the methods specified in Annex A.

NOTE A surface plate meets this requirement.

6 Materials

6.1 General

The material and construction of the test dummy shall be selected so that the dummy meets the requirements of mass and mass distribution specified in 7.5 and 7.6 and so that it does not distort beyond the specified limits under the stresses it will encounter during use.

NOTE 1 Steel, nominally 6 mm thick, aluminium, nominally 12 mm thick, and plywood specified for structural use in unprotected exterior conditions, nominally 19 mm thick, have all been used successfully for test dummy segments.

NOTE 2 Plywood, nominally 19 mm thick, has been used successfully for loading plates.

6.2 Rigid spacers

Any material used to position the overall centre of mass shall meet the requirements specified in 6.1.

NOTE Lightweight material, such as expanded polystyrene rigid foam insulation for domestic purposes, has been successfully used for rigid spacers.

6.3 Foam cushion

Foam cushions for loading pads shall be made of material that compresses to (15 ± 3) mm when tested as follows.

Conduct the test at an ambient temperature of (20 ± 5) °C.

Prepare a homogeneous test sample (i.e. one with no surface “skinning”, such as from a manufacturing process) of thickness (30 ± 5) mm, cut to an area of $(140\,000 \pm 4\,000)$ mm², with the minimum dimension of its large surface no smaller than 300 mm.

Place the sample with one of its large surfaces on a flat surface. Using a flat plate, apply to the upper surface of the sample a uniformly distributed force of (920 ± 20) N perpendicular to the lower surface of the sample, for (60 ± 10) s.

NOTE 1 The area of the sample corresponds to the area of the thigh loading plate of a 100 kg test dummy. The force applied corresponds to the combined weight of the torso segment and thigh segment of a 100 kg test dummy.

NOTE 2 The test sample may be built up from sheets of foam that are below the required thickness.

NOTE 3 Some closed-cell foam that has an indentation hardness index equal to (750 ± 250) N when measured as specified in JIS K 6400-2, method A (for PVC, polyurethane and latex foams of the open-cell type) is suitable.

7 Specifications

7.1 General

7.1.1 A test dummy consists of three segments: the torso segment, thigh segment and lower leg segment. The segments have associated loading pads and may also have rigid spacers between the segments and loading pads. The lower leg segment may have either one or two leg members. Typically, the torso segment and thigh segment each consists of a frame loaded with weights, which are added, removed or repositioned to adjust the mass and location of CoM of the segment.

The foam cushions of the loading pads should be the only parts of the test dummy that come into contact with the wheelchair under test. The dimensions of the torso, thigh and lower leg segments should be selected so that they do not project beyond the profile of any loading plate that can be used with them in any way that might cause the segments to come into contact with the wheelchair under test.

NOTE 1 The loading plates specified in this Standard are expected to be suitable for testing most wheelchairs, but might be unsuitable for testing some particular wheelchairs. It is anticipated that a future revision of **ISO 7176-22** will deal with these situations by providing instructions for selecting alternative loading plates, from the ones specified in this Standard, that are more appropriate.

NOTE 2 The frames of the torso and thigh segments should be of appropriate size to allow final adjustment of the position of the overall centre of mass by adding or removing rigid spacers between the frame and the associated loading plate.

7.1.2 The torso segment and thigh segment shall be connected by hip pivots. The thigh segment and lower leg segment shall be connected by knee pivots. The lower leg member(s) and the feet shall be connected by ankle pivots. The pivots shall provide a range of rotation that accommodates all postures likely during use.

7.1.3 When determining the mass and location of CoM of each segment, the mass of the associated loading pad(s) and rigid spacer(s) shall be included. The mass of the hip pivots and knee pivots shall be included in the thigh segment and the mass of the ankle pivots shall be included in the lower leg segment.

7.1.4 If the lower leg segment has two separate lower leg members, the knee pivots for the lower leg members shall rotate independently and allow lateral placement of the lower leg members as necessary to place the foot loading pads on the foot support(s) of the wheelchair under test. Regardless of the number of lower leg members, the lower leg segment shall have two feet.

Unless otherwise specified, a lower leg segment with a single leg member may be used when testing a wheelchair with a one-piece foot support.

7.1.5 The feet of the test dummy consist of the foot loading pads, together with all components connecting the foot loading plates to the ankle pivots. The feet are part of the lower leg segment.

7.2 Location of pivots

NOTE These dimensions (see Figure 6) are derived from WHO growth charts, **DIN 33402-2** and **AFNOR X 35-002**.

7.2.1 x_{hip} shall be (78 ± 25) mm.

7.2.2 y_{hip} shall be (78 ± 25) mm.

Where the test dummy is intended to stand, x_{hip} should be equal to y_{hip} .

7.2.3 y_{knee} shall be (78 ± 25) mm.

7.2.4 The nominal value of l_{thigh} shall be as shown in Table 1.

Table 1 Nominal value of l_{thigh} and l_{leg}

Dummy mass range kg	l_{thigh} (nominal) mm	l_{leg} (nominal) mm
$25 \leq m_{\text{dummy}} \leq 50$	$4.2 m_{\text{dummy}} + 205^{\text{a)}}$	$5.2 m_{\text{dummy}} + 160^{\text{a)}}$
$50 < m_{\text{dummy}}$	415	420
Note ^{a)} These formulae relate the numerical value of linear dimensions, expressed in millimetres, to the numerical value of dummy mass, expressed in kilograms.		

The distance between the knee pivots and the hip pivots shall be adjustable. The range of adjustment shall include the nominal value of l_{thigh} and a value 75 mm greater. If the adjustment is incremental, the increments should not be greater than 15 mm. The means for adjustment shall be locked whenever the test dummy is in use, while allowing the hip pivots and knee pivots to rotate freely.

NOTE The requirement for adjustment is to allow the test dummy to be adjusted to fit a particular wheelchair.

7.2.5 The nominal value of l_{leg} shall be as shown in Table 1.

The distance between the knee pivots and the ankle pivots shall be adjustable to allow the foot loading pads to be positioning on the foot supports of a wheelchair. Provision shall be made to allow the test dummy to be used with the means for adjustment locked or unlocked, while allowing the knee and ankle pivots to rotate freely in either condition.

7.2.6 The forward position of the ankle pivots relative to the rear of the foot loading plates shall be (70 ± 15) mm (see Figure JA.1).

7.2.7 The relative height of the ankle pivots above the bottom of the foot loading plates shall be (60 ± 15) mm (see Figure JA.1).

7.3 Loading pads

7.3.1 Loading pads transmit loads between the test dummy and the wheelchair under test. They are components of the test dummy, but they may be removable.

7.3.2 A torso loading pad shall be fitted at the rear of the torso segment. The foam cushion of the torso loading pad shall have the property specified in 6.3 and shall be of unloaded thickness (30 ± 5) mm.